NEO Interface Developers Guide

NEO v1.00

80139403-001 Rev.86

ID TECH. 10721 Walker St., Cypress, CA 90630
Email: support@idtechproducts.com URL: http://www.idtechproducts.com

Copyright

ID TECH
10721 Walker St.
Cypress, CA 90630

Table of Contents

1.0 INTRODUCTION 1

HISTORICAL BACKGROUND 1

MasterCard Contactless (PayPass) Capability 1
Protocol 1 Deprecated 1
ORGANIZATION OF THIS GUIDE 1
NOTATIONAL CONVENTIONS 2
READER INTERFACE CAPABILITIES 2

2.0 QUICK REFERENCE 4

COMMAND TABLES 4
Commands Sorted by Command Name 4
Commands Sorted by Command Number 6
Pass-Through Command Table 9
EMV Key Manager Command Tables 10
STATUS CODES 11
Status Codes for Protocol 1 11
Status Codes for Protocol 2 11
ERROR CODES 13
RF STATE CODES 16

3.0 SERIAL COMMUNICATION INTERFACES 18

RS232 SERIAL INTERFACE 18
Port Settings 18
Basic Communication 18
Timeouts 19
USB HID INTERFACE 19
HID Report Format 19
Sample Single Report Command and Response 20
Data Frames 21
Sample Single Report Command with Multiple Report Response 21
Error Handling at Report Level 22
Error Handling at Command Level 23

4.0 VIVOPAY COMMUNICATION PROTOCOLS 24

PROTOCOL 1 (DEPRECATED) 24
Command Frames 24
ACK Frames 25
NACK Frames 25
Special Frames 25
PROTOCOL 2 25
Command Frames 26
Response Frames 26
PASS-THROUGH MODE (PROTOCOL 2) 26
Basic Pass-Through Operation 26
Pass-Through Command Frame 27

Pass-Through Response Frame *28*
Suggested Sequence for Pass-Through Commands *28*
Auto-Switch to Pass-Through Mode *29*
RF On/Off States for Pass-through Commands *31*
BURST MODE 31
ViVOpay Burst Mode Frames *32*
CRC CALCULATION 40

5.0 TAG AND DATA SET CONFIGURATION 43

CONFIGURABLE AIDS AND GROUPS 44
System AIDs *46*
User AIDs *46*
Reader Default TLV Group *46*
PayPass Default Group *47*
User-defined TLV Groups *47*
Configurable AID Reader Memory Requirement *48*
ViVOpay Proprietary TLVs *49*
CARD APPLICATION PROPRIETARY TAG LIST (FF69) 49
CONFIGURATION TAG TABLES 50
Global Configuration Tags *50*
Group Configuration Tags *53*
PayPass Group Configuration TLVs *60*
PayPass Group Configuration TLVs with Hard-Coded Values in Kernel *67*
American Express Group Configuration TLVs *71*
AID Configuration Tags *74*

6.0 CARD APPLICATION SELECTION 80

COMBINED SELECTION 80
Selection Features (FFE3) *80*
PARTIAL SELECTION (FFE1) 81
AID PARTICIPATION IN SELECTION PROCESSES (FFE8) 81
TERMINAL AID LIST (DFEF2C) 82

7.0 CARD APPLICATION SPECIFIC BEHAVIOR 83

MASTERCARD PAYPASS M/CHIP 83
PayPass Default Group *83*
Balance Read Function *83*
Torn Transaction Recovery *84*
EMV Certificate Revocation List *84*
Stop Transaction Command *84*
Proprietary Tag List *84*
PayPass Personalization Limits *84*

8.0 PROTOCOL COMMAND REFERENCE: PROTOCOL 1 86

TRANSACTION RELATED COMMANDS 86
Flush Track Data (17-02) *86*
Get Full Track Data (17-CD) *86*
Get ViVOpay Firmware Version (29-00) *89*
KEY MANAGER COMMANDS PROTOCOL 1 90
Set CA Public Key (24-01) Protocol 1 ..... *91*
Delete CA Public Key (24-02) Protocol 1 ..... *95*
Delete All CA Public Keys (24-03) Protocol 1 ..... *97*
MISCELLANEOUS PROTOCOL 1 COMMANDS 98

Set RF Error Reporting (17-03) *98*
RTC (REAL TIME CLOCK) SET UP COMMANDS 99
RTC Set Time (25-01) *99*
RTC Get Time (25-02) *100*
RTC Set Date (25-03) *101*
RTC Get Date (25-04) *102*

9.0 PROTOCOL COMMAND REFERENCE: PROTOCOL 2 104

GENERAL COMMANDS 104
Ping (18-01) *104*
Set Poll Mode (01-01) *104*
Control User Interface (01-02) *105*
Set/Get Source for RTC/LCD/Buzzer/LED (01-05) *107*
Set Configuration Defaults Command (04-09) *109*
Set Configuration Defaults and Keep Encrypt Key Command (04-0A) *111*
Set Configuration (04-00) *112*
Get Configuration (03-02) *112*
Get Version Protocol 2 (29-00) *113*
Get USB Boot Loader Version (29-04) *114*
Set Baud Rate (30-01) *114*
Set Temporary Baud Rate (30-02) *115*
Set Serial Number (12-02) *116*
Get Serial Number (12-01) *117*
Bootup Notification Command (14-01) *118*
CONFIGURABLE AID AND GROUP COMMANDS 118
Set Configurable AID (04-02) *119*
Set Configurable Group (04-03) *120*
Get Configurable AID (03-04) *121*
Get Configurable Group (03-06) *122*
Delete Configurable AID (04-04) *123*
Delete Configurable Group (04-05) *124*
Get All AIDs (03-05) *125*
Get All Groups (03-07) *126*
TRANSACTION RELATED COMMANDS 126
Activate Transaction Command (02-01) *126*
Get Transaction Result (03-00) *148*
Update Balance Command (03-03) *151*
Cancel Transaction Command (05-01) *153*
MASTERCARD M/CHIP 3.0 TRANSACTION COMMANDS 154
Stop Transaction (05-02) *154*
Reset Torn Transaction Log (84-0E) *155*
Clean Torn Transaction Log (84-0F) Command *155*
VISA VCPS TRANSACTION COMMANDS 156
Set Cash Transaction Reader Risk Parameters (04-0C) *156*
Get Cash Transaction Reader Risk Parameters (03-0C) *158*
Set Cashback Transaction Reader Risk Parameters (04-0D) *159*
Get Cashback Transaction Reader Risk Parameters (03-0D) *160*
Set DRL Reader Risk Parameters (04-0E) *161*
Get DRL Reader Risk Parameters (03-0E) *162*
KEY MANAGEMENT COMMANDS 163
Get CA Public Key (D0-01) *164*
Get CA Public Key Hash (D0-02) *165*
Set CA Public Key (D0-03) *166*

Delete CA Public Key (D0-04) *166*
Delete All CA Public Keys (D0-05) *167*
Get All CA Public RIDs (D0-06) *167*
List CA Public Key IDs or RID (D0-07) *168*
MODULE VERSIONING 169
Get Product Type (09-01) *170*
Get Processor Type (09-02) *171*
Get Main Firmware Version (09-03) *172*
Get Hardware Information (09-14) *173*
Get Module Version Information (09-20) *174*
INTERNATIONAL LANGUAGE SUPPORT 175
Other Language *176*
Bitmap Conversion Completed by POS *176*
ILM Header Format *176*
Language Version Information *177*
EMV CERTIFICATE REVOCATION LIST COMMANDS 178
Get EMV Revocation Log Status (84-03) *179*
Add Entry to EMV Revocation List (84-04) *179*
Delete All Entries for Single Index in EMV Revocation List (84-05) *180*
Delete All Entries from EMV Revocation List (84-06) *180*
Get EMV Revocation List (84-07) *181*
Delete an Entry from EMV Revocation List (84-0D) *182*
EMV EXCEPTION LOG LIST COMMANDS 183
Get EMV Exception Log Status (84-08) *183*
Add Entry to EMV Exception List (84-09) *183*
Delete Entry from EMV Exception List (84-0A) *184*
Delete All Entries from EMV Exception List (84-0B) *185*
Get EMV Exception List (84-0C) *185*
GENERIC PASS-THROUGH COMMANDS 186
Pass-Through Mode Start/Stop (2C-01) *186*
Get PCD and PICC Parameters (2C-05) *187*
Poll for Token (2C-02) *188*
Enhanced Poll for Token (2C-0C) *190*
Get ATR (2C-12) *193*
Antenna Control (28-01) *194*
PASS-THROUGH UI CONTROL 194
LED Control (0A-02) *194*
Buzzer Control (0B-xx) *195*
PASS-THROUGH DATA EXCHANGE 196
Exchange Contactless Data (2C-03) *196*
PCD Single Command Exchange (2C-04) Protocol 2 ..... *197*
High Level Halt Command (2C-09) *201*
Enhanced Pass-Through Command (2C-0B) *202*
Single Shot Commands *205*
Exchange APDU Data (2C-13) *209*
HIGH LEVEL PASS-THROUGH COMMANDS FOR MIFARE CARDS 210
Mifare Authenticate Block (2C-06) *210*
Mifare Read Blocks (2C-07) *211*
Mifare Write Blocks (2C-08) *213*
Mifare ePurse Command (2C-0A) *215*
HIGH LEVEL PASS-THROUGH COMMANDS FOR NFC CARDS 220
NFC Commands (2C-40) *220*
SECURE PASS-THROUGH FUNCTION 223

10.0 SECURE COMMUNICATION 227

Burst mode 227
Data Output 227
Encryption Algorithms 227
Secure Data Exchange 228
Padding of Data Fields 228
Set DUKPT Key Encryption Type (C7-32) 229
Get DUKPT Key Encryption Type (C7-33) 229
Set Data Encryption Enable Flag (C7-36) 230
Get Data Encryption Enable Flag (C7-37) 231
Set MSR Secure Parameters (C7-38) 232
Get MSR Secure Parameters (C7-39) 232
KEY INJECTION AND RELATED COMMANDS 233
Set Remote Key Injection Timeout (C7-2D) 233
Get Remote Key Injection Timeout (C7-2E) 233
Check DUKPT Keys (81-02) 234
Check DUKPT Key (81-04) 235
Get DUKPT Key Serial Number (KSN) (81-0A) 236

11.0 IMPROVED COLLISION DETECTION 238

Issues with Standard Collision Detection 238
Collision Detection Modes 239

12.0 KIOSK III BOOT LOADER 242

DESCRIPTION 242
BOOT PROCEDURE 242
COMMUNICATION PROTOCOL 243
FIRMWARE DOWNLOADER FILE NAME FORMAT 243
FIRMWARE DOWNLOADER DATA FORMAT 244
DOWNLOAD FIRMWARE STEPS 245
FIRMWARE DOWNLOADER COMMANDS 245
Enter Boot Loader Process from Main Application (C7-41) 245
Get Boot Loader Version (C7-10) 245
Start Update Process (C7-11) 246
Erase Boot/Application Space(C7-12) 246
Send Encrypted Firmware Check Value(C7-13) 247
Send Firmware Data (C7-14) 248
End Update Process (C7-15) 248
Start Application (C7-16) 249
Firmware Downloader Command Processing Flow 249

13.0 VIVOPAY VENDI READER COMMANDS 251

Configure Buttons (F0-F4) 251
Get Button Configuration (F0-F5) 252
Disable Blue LED Sequence (F0-F6) 252
Enable Blue LED Sequence (F0-F7) 253
LCD Display Clear (F0-F9) 254
Turn Off Yellow LED (F0-FA) 254
Turn On Yellow LED (F0-FB) 255
Buzzer On/Off (F0-FE) 255
LCD Display Line 1 Message (F0-FC) 256
LCD Display Line 2 Message (F0-FD) 257

14.0 OTHER SPECIAL FUNCTIONS 258

PEER TO PEER FUNCTION 258
Peer To Peer Send A Message (C7-9A) 258
Peer To Peer Receive A Message (C7-9B) 258
APPLEPAY FUNCTION 259
Set Merchant Record (04-11) 262
Get Merchant Record (03-11) 262

15.0 SAMPLE SCENARIOS AND FRAME FLOW 264

CONTACTLESS MAGSTRIPE TRANSACTIONS IN AUTO POLL MODE 264
CONTACTLESS MAGSTRIPE TRANSACTIONS IN POLL ON DEMAND MODE 266
EMV (M/CHIP) TRANSACTION IN POLL ON DEMAND MODE 268

APPENDIX A.1: USER EXPERIENCE ILLUSTRATION 271

APPENDIX A.2: AUDIBLE USER INTERFACE 273

APPENDIX A.3: CONFIGURABLE AID USE EXAMPLES 274

APPENDIX A.4: DEMO UTILITIES AND SAMPLE CODE 278

APPENDIX A.5: FIRMWARE FAQ 279

APPENDIX A.6: TDES DATA ENCRYPTION EXAMPLES 283

APPENDIX A.7: AES DATA ENCRYPTION EXAMPLES 294

APPENDIX A.8: TRANSACTION RESULTS FOR MSD2.0.2 AC3.0 CRYPTOGRAM17 306

APPENDIX A.9: PREPARING BITMAPS FOR USE WITH ILM 307

APPENDIX A.10: DEFAULT CONFIGURATION 313

APPENDIX A.11: ENHANCED ENCRYPTED MSR DATA OUTPUT FORMAT 321

APPENDIX A.12: ENCRYPTED DATA FORMAT, TLV-BASED 325

Using Length Byte to Flag Mask and Encryption (IDTech Enhanced TLV): 325
ENCRYPTED/MASKED TAG NOTE 326
TRACK 1 (TAG 56) & 2 (TAG 9F6B) MASK CONFIGURATION NOTE 328
OTHER TAG VALUE MASK CONFIGURATION NOTE 328
DETAILED – TLV ENCRYPTED RESPONSE FORMAT 329
Example of Encrypting a TLV 329
Command Format 331
Response Formats 332

APPENDIX A.13: ENHANCED ENCRYPTED MSR DATA OUTPUT WHEN ENCRYPTION IS TURNED ON WITH C7-38 COMMAND 333

APPENDIX A.14: GLOSSARY 334

APPENDIX A.15: REVISION HISTORY 336

List of Tables

Table 1: Hardware Cross Reference 3
Table 2: Commands Sorted by Command Name 4
Table 3: Commands Sorted by Command Number 7
Table 4: Pass-Through Command Table 9
Table 5: EMV Key Management – Protocol 2 10
Table 6: EMV Key Management - Protocol 1 10
Table 7: Protocol 1 Status Codes 11
Table 8: Protocol 2 Status Codes 11
Table 9: Error Codes 13
Table 10: RF State Codes 17
Table 11: Serial Port Settings 18
Table 12: Burst Mode Frames 32
Table 13: Payload Frame with Cryptogram Data Format and Content When Status OK 33
Table 14: Asynchronous UI Message Event 38
Table 15: Asynchronous UI Message Event Status 39
Table 16: Asynchronous UI message Event Application Type 39
Table 17: System AIDs 46
Table 18: Global Configuration TLVs 50
Table 19: Group Configuration TLVs 54
Table 20: PayPass Default Group Configuration TLVs 61
Table 21: PayPass Group Configuration TLVs with Hard-Coded Default Values in Kernel 68
Table 22: Phone Message Table – Hard-Coded Default Value in Kernel 71
Table 23: American Express Default Group 2 Configuration TLVs 72
Table 24: AID Configuration TLVs 74
Table 25: System AID Default Configuration TLVs 77
Table 26: Get Full Track Data Error Codes 87
Table 27: EMV Key Management Commands Error Codes – Protocol 1 91
Table 28: Set CA Public Key Data Field 94
Table 29: Error Codes for RTC Management Commands 99
Table 30: Control User Interface Data 106
Table 31: Activate Transaction Command Frame Data Format 127
Table 32: Activate Command TLVs 128
Table 33: Activate Transaction Response Frame Data Format 130
Table 34: Activate Response TLVs 130
Table 35: Activate Transaction Clearing Record TLVs 134
Table 36: Activate Transaction Cause of Failure When Not Request Online Authorization 136
Table 37: Activate Transaction Cause of Failure When Request Online Authorization 136
Table 38: Activate Transaction Response Frame Format, Failed Transaction 136
Activate Transaction Response Frame Encrypted Data Format 144

Table 39: Get Transaction Result Format and Content 149
Table 40: Update Balance Format and Contents 152
Table 41: Update Balance Format and Contents When Status OK 152
Table 42: Update Balance Format and Contents When Status Not OK 153
Table 43: Cash Transaction TLVs 157
Table 44: DRL TLVs 161
Table 45: EMV Key Manager Status Codes – Protocol 2 164
Table 46: Language Version Information 177
Table 47: Exception List Record Format 186
Table 48: Get PCD and PICC Parameters Data Field 187
Table 49: Poll for Token Data Field for Command Frame 188
Table 50: Poll for Token Timeout 189
Table 51: Poll for Token Data Field for Response Frame (Status Code is OK) 189
Table 52: Enhanced Poll for Token Data Field for Command Frame 191
Table 53: Enhanced Poll for Token Timeout 191
Table 54: Enhanced Poll for Token Data Field for Response Frame 192
Table 55: LED Control Data Field 195
Table 56: Buzzer Control Data Field 196
Table 57: PCD Single Command Exchange Data Field Protocol 2 197
Table 58: PCD Commands Protocol 2 198
Table 59: PCD Channel Redundancy Register Protocol 2 199
Table 60: PCD Single Command Exchange Data Field for Response 200
Table 61: Halt a Command Exchange Between Terminal/PC and Reader 201
Table 62: Enhanced Pass-Through Data Field 203
Table 63: Mifare Authentication Block Data Field 211
Table 64: Mifare Read Block Data Field 212
Table 65: Mifare Write Block Data Field 214
Table 66: ePurse Value Block Format 215
Table 67: Mifare ePurse Command Data Field 216
Table 68: Mifare ePurse Data Field for Debit/Credit Function Block 217
Table 69: Mifare ePurse Data Field for Backup Function Block 218
Table 70: NFC Command Set List 221
Table 71: NFC Command Set Response Data List 222
Table 72: Summary of LCD Messages 271

1.0 Introduction

This document is intended to provide application developers and integrators with the detailed information necessary to integrate ViVOpay readers with point of sale terminals (POS). It specifies the interfaces that terminals can use to communicate with a ViVOpay reader to carry out contactless EMV transactions.

Historical Background

Before the introduction of the contactless EMV, the ViVOpay reader usually worked in standalone mode, which did not require a terminal to initiate a transaction. In this mode, the reader reads cards and sends transaction data independently. This mode is commonly referred to as “Auto Poll Mode”.

ViVOpay readers can also function in an intelligent mode to provide EMV functionality and fast processing of contactless EMV cards. This approach minimizes the time a cardholder needs to hold a contactless EMV card in front of a reader. However, support for contactless EMV cards requires that terminals set certain parameters and perform intelligent processing to complete a transaction.

While contactless EMV transactions require control commands from a terminal, it is sometimes desirable for the ViVOpay reader to function in standalone mode. This is especially useful for test environments where a terminal may not be available or where all transactions are going to be with contactless MagStripe cards. The EMV serial interface specified in this document addresses the requirements of contactless EMV support, while maintaining backward compatibility to standalone operation.

MasterCard Contactless (PayPass) Capability

ViVOpay readers support MasterCard Contactless technology (PayPass 3.02). You will see numerous references to “PayPass” throughout this guide. *MasterCard has officially deprecated the name “PayPass”* (although not the technology). This version of the guide continues to use “PayPass” to refer to MasterCard Contactless technology. Future versions of this guide will likely drop the name “PayPass” altogether.

Protocol 1 Deprecated

Historically, ID TECH readers have used two serial protocols (Protocol 1 and Protocol 2). Protocol 1 is no longer supported. For historical reasons, you may see references to Protocol 1 in this guide. They will eventually be removed.

Organization of this Guide

This document provides the details of how to communicate with ViVOpay readers, including the physical connections, the ViVOpay command protocols, and the actual serial commands. The document is organized into major sections that contain increasing levels of detail:

- The Quick Reference section includes tables of commands, error and status codes. It is intended to be a quick index into the Protocol Command Reference sections (Protocol 1 and Protocol 2), or a quick reference for decoding serial commands and responses.

- The Serial Communication Interfaces section discusses the serial interfaces available.
- The ViVOpay Communication Protocols section provides information on the various protocols and modes of communication. It describes the frame formats used by each of the protocols.
- The Tag and Data Set Configuration discusses the method for configuring AIDs and groups (parameter/data sets).
- The Card Application Selection section discusses the method for selecting a particular card application and how selection of a particular AID may be controlled.
- The section on Card Application Specific Behavior discusses information specific to particular card applications and the ViVOpay implementation.
- The Protocol Command Reference sections (Protocol 1 and Protocol 2) describe each of the commands available, their frame formats, and the response formats
- The Special Reader Features section discusses additional features that may optionally be used in conjunction with ViVOpay readers. Some of these are specific to a particular ViVOpay reader hardware platform.
- Many useful examples of serial communication flows can be found in the various Appendices at the back of this guide. Also, the Appendices contain examples of how to parse data payloads received during transactions. In future editions of this guide, we will continue to add examples.

Notational Conventions

Many of the tables used in this document describe data objects as TLV (tag, length, value) elements. The details of how TLVs are encoded and explained in the BER-TLV rules. These rules may be found in EMV 4.2 Book 3, Annex B (available from https://www.emvco.com/specifications.aspx?id=223).

The format of the value fields are described in EMV 4.2, Book 3, “Data Element Format Conventions”.

Hexadecimal numbers are expressed in one of two ways:

- With an “h” after the number, e.g. 2Ah
- With a “0x” preceding the number, e.g. 0x2A

Reader Interface Capabilities

ViVOpay readers can be generally categorized by their capabilities to interact with the host terminal. ViVOpay readers fall into one of the following categories according to the available transaction interfaces:

- Contactless Only

- Contactless and MSR
- Contactless and LCD Display
- Contactless, MSR, and LCD Display
- Contactless, MSR and Line Display

The following table categorizes ViVOpay readers by available interfaces.

Table 1: Hardware Cross Reference

Reader	Contactless	MSR	LCD Display	Line Display
Kiosk III	●			
Vendi	●	●		●

Generally, the commands and parameters related to the LCD display only work on the ViVOpay readers with a display. However, there is an option to use an external display. Refer to the Set/Get Source for RTC/LCD/Buzzer/LED command.

2.0 Quick Reference

This section contains tables for looking up commands, status codes and error codes.

Command Tables

The tables in this section organize the commands by their names and by their command number.

Commands Sorted by Command Name

Table 2: Commands Sorted by Command Name

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	CMD	SUB CMD	Notes
Activate Transaction Command	∫	∫	∫	∫	∫	2	02	01	
Add Entry to EMV Exception List	∫	∫	∫	∫	∫	2	84	09	
Add Entry to EMV Revocation List	∫	∫	∫	∫	∫	2	84	04	
Antenna Control	∫	∫	∫	∫	∫	2	28	01	
Boot up Notification	∫	∫	∫	∫	∫	2	14	01	
Buzzer Control Long	∫	∫	∫	∫	∫	2	0B	02	
Buzzer Control Short	∫	∫	∫	∫	∫	2	0B	01	
Buzzer On/Off Command			∫	n/a	∫	2	F0	FE	a
Cancel Transaction Command	∫	∫	∫	∫	∫	2	05	01	
Check DUKPT Key	∫	∫	∫	∫	∫	2	81	04	
Check DUKPT Keys	∫	∫	∫	∫	∫	2	81	02	
Clean Torn Transaction Log	∫	∫	∫	∫	∫	2	84	0F	
Configure Buttons Command			∫	∫	∫	2	F0	F4	a
Control User Interface		∫		∫	∫	2	01	02	
Delete All CA Public Keys Protocol 1	∫	∫	∫		∫	1	24	03	
Delete All CA Public Keys Protocol 2	∫	∫	∫		∫	2	D0	05	
Delete All Entries for Single Index in EMV Revocation List	∫	∫	∫		∫	2	84	05	
Delete All Entries from EMV Exception List	∫	∫	∫		∫	2	84	0B	
Delete All Entries from EMV Revocation List	∫	∫	∫		∫	2	84	06	
Delete CA Public Key Protocol 1	∫	∫	∫		∫	1	24	02	
Delete CA Public Key Protocol 2	∫	∫	∫		∫	2	D0	04	
Delete Configurable AID	∫	∫	∫	∫	∫	2	04	04	c
Delete Configurable Group (DCG)	∫	∫	∫	∫	∫	2	04	05	c
Delete Entry from EMV Exception List	∫	∫	∫	∫	∫	2	84	0A	
Disable Blue LED Sequence		∫	∫	∫	∫	2	F0	F6	
Enable Blue LED Sequence Command			∫	∫	∫	2	F0	F7	a
Enhanced Pass-Through Command	∫	∫	∫	∫	∫	2	2C	0B	
Enhanced Poll for Token	∫	∫	∫	∫	∫	2	2C	0C	

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	CMD	SUB CMD	Notes
Exchange APDU Data	√						2C	13	
Exchange Contactless Data	√	√	√	√	√	2	2C	03	
Flush Track Data	√	√	√	√	√	1	17	02	
Get Account DUKPT Key Encryption Type	√	√	√	√	√	2	C7	33	
Get All AIDs	√	√	√	√	√	2	03	05	c
Get All CA Public RIDs Protocol 2	√	√	√	√	√	2	D0	06	
Get All Groups (GAG)	√	√	√	√	√	2	03	07	c
Get ALL Reader Variables	√	√	√	√	√	2	09	00	
Get ATR	√						2C	12	
Get Button Configuration Command			√	√	√	2	F0	F5	c
Get CA Public Key Hash Protocol 2	√	√	√	√	√	2	D0	02	
Get CA Public Key Protocol 2	√	√	√	√	√	2	D0	01	
Get Cash Transaction Reader Risk Parameters	√	√	√	√	√	2	03	0C	
Get Cashback Transaction Reader Risk Parameters	√	√	√	√	√	2	03	0D	
Get Configurable AID	√	√	√	√	√	2	03	04	c
Get Configurable Group	√	√	√	√	√	2	03	06	c
Get Configuration	√	√	√	√	√	2	03	02	
Get DRL Reader Risk Parameters	√	√	√	√	√	2	03	0E	
Get EMV Exception List	√	√	√	√	√	2	84	0C	
Get EMV Exception Log Status	√	√	√	√	√	2	84	08	
Get EMV Revocation List	√	√	√	√	√	2	84	07	
Get EMV Revocation Log Status	√	√	√	√	√	2	84	03	
Get Firmware Full Version	√	√	√	√	√	1	29	00	
Get Full Track Data	√	√	√	√	√	1	17	CD	
Get Hardware Information	√	√	√	√	√	2	09	14	
Get Data Encryption Enable Flag		√	√	√	√	2	C7	37	
Get DUKPT Key Serial Number (KSN)	√	√	√	√	√	2	81	0A	
Get Merchant Record	√	√	√	√	√	2	03	11	
Get Module Version Information	√	√	√	√	√	2	09	20	
Get Main Firmware Version	√	√	√	√	√	2	09	03	a
Get MSR Secure Parameters	√					2	C7	39	a
Get PCD and PICC Parameters	√	√	√	√	√	2	2C	05	
Get Processor Type	√	√	√	√	√	2	09	02	
Get Product Type	√	√	√	√	√	2	09	01	a
Get Remote Key Injection Timeout	√	√	√	√	√	2	C7	2E	
Get Serial Number	√	√	√			2	12	01	
Get Transaction Result	√	√	√	√	√	2	03	00	
Get USB Boot Loader Version	√	√	√	√	√	2	29	04	e
High Level Halt Command	√	√	√	√	√	2	2C	09	
LCD Display Clear Command			√	n/a	√	2	F0	F9	a
LCD Display Line 1 Message Command			√	n/a	√	2	F0	FC	a
LCD Display Line 2 Message Command			√	n/a	√	2	F0	FD	a
LED Control	√	√	√	√	√	2	0A	02	
List CA Public Key IDs or RID Protocol 2	√	√	√	√	√	2	D0	07	
Mifare Authenticate Block	√	√	√	√	√	2	2C	06	
Mifare ePurse Command	√	√	√	√	√	2	2C	0A	
Mifare Read Blocks	√	√	√	√	√	2	2C	07	
Mifare Write Blocks	√	√	√	√	√	2	2C	08	
NFC Commands	√	√	√	√	√	2	2C	40	

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	CMD	SUB CMD	Notes
Pass-through Mode Start/Stop	√	√	√	√	√	2	2C	01	
PCD Single Command Exchange	√	√	√	√	√	2	2C	04	
Peer To Peer Send A Message	√	√	√	√	√	2	C7	9A	
Peer To Peer Receive A Message	√	√	√	√	√	2	C7	9B	
Reset Torn Transaction Log	√	√	√	√	√	2	84	0E	
RTC Get Date	√	√	√		√	1	25	04	d
RTC Get Time	√	√	√		√	1	25	02	d
RTC Set Date	√	√	√		√	1	25	03	d
RTC Set Time	√	√	√		√	1	25	01	d
Set Account DUKPT Key Encryption Type	√	√	√	√	√	2	C7	32	
Set Baud Rate	√	√	√	√	√	2	30	01	
Set CA Public Key Protocol 1	√	√	√		√	1	24	01	
Set CA Public key Protocol 2	√	√	√		√	2	D0	03	
Set Cash Transaction Reader Risk Parameters	√	√	√	√	√	2	04	0C	
Set Cashback Transaction Reader Risk Parameters	√	√	√	√	√	2	04	0D	
Set Configurable AID	√	√	√	√	√	2	04	02	c
Set Configurable Group	√	√	√	√	√	2	04	03	c
Set Configuration	√	√	√	√	√	2	04	00	
Set DRL Reader Risk Parameters	√	√	√	√	√	2	04	0E	
Set Data Encryption Enable Flag	√	√	√	√	√	2	C7	36	
Set Merchant Record	√	√	√	√	√	2	04	11	
Set MSR Secure Parameters	√					2	C7	38	a
Set Parameter Defaults						2	04	09	
Set Poll Mode	√	√	√	√	√	2	01	01	
Set Remote Key Injection Timeout	√	√	√	√	√	2	C7	2D	
Set RF Error Reporting	√	√	√	√	√	1	17	03	
Set Serial Number	√	√	√			2	12	02	
Set/Get Source for RTC/LCD/Buzzer/LED	√	√	√	√	√	2	01	05	
Set Temporary Baud Rate	√	√	√	√	√	2	30	02	
Stop Transaction	√	√	√	√	√	2	05	02	
Turn Off Yellow LED Command			√	n/a	√	2	F0	FA	a
Turn On Yellow LED Command			√	n/a	√	2	F0	FB	a
Update Balance Command	√	√	√		√	2	03	03	

a ViVOpay Vendi reader only
c Not in Global Reader Lite (GRL)
d Real Time Clock only
e Only applies to devices with USB

Commands Sorted by Command Number

All commands in the following table use Protocol 2 formats (see Protocol 2 Formats) except for **Get Full Track Data**, **Set RF Error Reporting**, and **Get ViVOpay Firmware Version.**

Table 3: Commands Sorted by Command Number

CMD	SUB CMD	Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	Notes
01	01	Set Poll Mode	√	√	√	√	√	2	
01	02	Control User Interface		√		√	√	2	
01	05	Set/Get Source for RTC/LCD/Buzzer/LED	√	√	√	√	√	2	
02	01	Activate Transaction Command	√	√	√	√	√	2	
03	00	Get Transaction Result	√	√	√	√	√	2	
03	02	Get Configuration	√	√	√	√	√	2	
03	03	Update Balance Command	√	√	√		√	2	
03	04	Get Configurable AID	√	√	√	√	√	2	c
03	05	Get All AIDs	√	√	√	√	√	2	c
03	06	Get Configurable Group	√	√	√	√	√	2	c
03	07	Get All Groups	√	√	√	√	√	2	c
03	0C	Get Cash Transaction Reader Risk Parameters	√	√	√	√	√	2	
03	0D	Get Cashback Transaction Reader Risk Parameters	√	√	√	√	√	2	
03	0E	Get DRL Reader Risk Parameters	√	√	√	√	√	2	
03	11	Get Merchant Record	√	√	√	√	√	2	
04	00	Set Configuration	√	√	√	√	√	2	
04	02	Set Configurable AID	√	√	√	√	√	2	c
04	03	Set Configurable Group	√	√	√	√	√	2	c
04	04	Delete Configurable AID	√	√	√	√	√	2	c
04	05	Delete Configurable Group	√	√	√	√	√	2	c
04	09	Set Parameter Defaults						2	
04	0C	Set Cash Transaction Reader Risk Parameters	√	√	√	√	√	2	
04	0D	Set Cashback Transaction Reader Risk Parameters	√	√	√	√	√	2	
04	0E	Set DRL Reader Risk Parameters	√	√	√	√	√	2	
04	11	Set Merchant Record	√	√	√	√	√	2	
05	01	Cancel Transaction Command	√	√	√	√	√	2	
05	02	Stop Transaction	√	√	√	√	√	2	
09	00	Get ALL Reader Variables	√	√	√	√	√	2	
09	01	Get Product Type	√	√	√	√	√	2	
09	02	Get Processor Type	√	√	√	√	√	2	
09	03	Get Main Firmware Version	√	√	√	√	√	2	
09	14	Get Hardware Information	√	√	√	√	√	2	
09	20	Get Module Version Information	√	√	√	√	√	2	
0A	02	LED Control	√	√	√	√	√	2	
0B	01	Buzzer Control Short	√	√	√	√	√	2	
0B	02	Buzzer Control Long	√	√	√	√	√	2	
12	01	Get Serial Number	√	√	√	√	√	2	
12	02	Set Serial Number	√	√	√	√	√	2	
14	01	Boot up Notification	√	√	√	√	√	2	
17	02	Flush Track Data	√	√	√	√	√	1	
17	03	Set RF Error Reporting	√	√	√	√	√	1	
17	CD	Get Full Track Data	√	√	√	√	√	1	
18	01	Ping	√	√	√	√	√	2	
24	01	Set CA Public Key	√	√	√		√	1	
24	02	Delete CA Public Key	√	√	√		√	1	
24	03	Delete All CA Public Keys	√	√	√		√	1	

CMD	SUB CMD	Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	Notes
25	01	RTC Set Time	✓	✓	✓		✓	1	d
25	02	RTC Get Time	✓	✓	✓		✓	1	d
25	03	RTC Set Date	✓	✓	✓		✓	1	d
25	04	RTC Get Date	✓	✓	✓		✓	1	d
28	01	Antenna Control	✓	✓	✓	✓	✓	2	
29	00	Get Version Protocol 2	✓	✓	✓	✓	✓	2	
29	00	Get Firmware Full Version	✓	✓	✓	✓	✓	1	
29	04	Get USB Boot Loader Version	✓	✓	✓	✓	✓	2	e
2C	01	Pass-Through Mode Start/Stop	✓	✓	✓	✓	✓	2	
2C	02	Poll for Token	✓	✓	✓	✓	✓	2	
2C	03	Exchange Contactless Data	✓	✓	✓	✓	✓	2	
2C	04	PCD Single Command Exchange	✓	✓	✓	✓	✓	2	
2C	05	Get PCD and PICC Parameters	✓	✓	✓	✓	✓	2	
2C	06	Mifare Authenticate Block	✓	✓	✓	✓	✓	2	
2C	07	Mifare Read Blocks	✓	✓	✓	✓	✓	2	
2C	08	Mifare Write Blocks	✓	✓	✓	✓	✓	2	
2C	09	High Level Halt Command	✓	✓	✓	✓	✓	2	
2C	0A	Mifare ePurse Command	✓	✓	✓	✓	✓	2	
2C	0B	Enhanced Pass-Through Command	✓	✓	✓	✓	✓	2	
2C	0C	Enhanced Poll for Token	✓	✓	✓	✓	✓	2	
2C	12	Get ATR	✓					2	
2C	13	Exchange APDU Data	✓					2	
2C	40	NFC Commands	✓					2	
30	01	Set Baud Rate	✓	✓	✓	✓	✓	2	
30	02	Set Temporary Baud Rate	✓	✓	✓	✓	✓	2	
81	02	Check DUKPT Keys	✓	✓	✓	✓	✓	2	
81	04	Check DUKPT Key	✓	✓	✓	✓	✓	2	
81	0A	Get DUKPT Key Serial Number (KSN)	✓	✓	✓	✓	✓	2	
84	03	Get EMV Revocation Log Status	✓	✓	✓	✓	✓	2	
84	04	Add Entry to EMV Revocation List	✓	✓	✓	✓	✓	2	
84	05	Delete All Entries for Single Index in EMV Revocation List	✓	✓	✓	✓	✓	2	
84	06	Delete All Entries from EMV Revocation List	✓	✓	✓	✓	✓	2	
84	07	Get EMV Revocation List	✓	✓	✓	✓	✓	2	
84	08	Get EMV Exception Log Status	✓	✓	✓	✓	✓	2	
84	09	Add Entry to EMV Exception List	✓	✓	✓	✓	✓	2	
84	0A	Delete Entry from EMV Exception List	✓	✓	✓	✓	✓	2	
84	0B	Delete All Entries from EMV Exception List	✓	✓	✓	✓	✓	2	
84	0C	Get EMV Exception List	✓	✓	✓	✓	✓	2	
84	0D	Delete an Entry from EMV Revocation List	✓	✓	✓	✓	✓	2	
84	0E	Reset Torn Transaction Log	✓	✓	✓	✓	✓	2	
84	0F	Clean Torn Transaction Log	✓	✓	✓	✓	✓	2	
C7	2D	Set Remote Key Injection Timeout	✓	✓	✓	✓	✓	2	
C7	2E	Get Remote Key Injection Timeout	✓	✓	✓	✓	✓	2	
C7	32	Set Account DUKPT Key Encryption Type	✓	✓	✓	✓	✓	2	
C7	33	Get Account DUKPT Key Encryption Type	✓	✓	✓	✓	✓	2	
C7	36	Set Data Encryption Enable Flag	✓	✓	✓	✓	✓	2	

CMD	SUB CMD	Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	Notes
C7	37	Get Data Encryption Enable Flag	√	√	√	√	√	2	
C7	38	Set MSR Secure Parameters	√					2	
C7	39	Get MSR Secure Parameters	√					2	
C7	9A	Peer To Peer Send A Message	√	√	√	√	√	2	
C7	9B	Peer To Peer Receive A Message	√	√	√	√	√	2	
D0	03	Set CA Public Key Protocol 2	√	√	√	√	√	2	
D0	04	Delete CA Public Key Protocol 2	√	√	√	√	√	2	
D0	05	Delete All CA Public Keys Protocol 2	√	√	√	√	√	2	
D0	06	Get All CA Public RIDs Protocol 2	√	√	√	√	√	2	
D0	07	List CA Public Key IDs or RID Protocol 2	√	√	√	√	√	2	
F0	F4	Configure Buttons Command			√	√	√	2	a
F0	F5	Get Button Configuration Command			√	√	√	2	a
F0	F6	Disable Blue LED Sequence			√	n/a	√	2	a
F0	F7	Enable Blue LED Sequence Command			√	n/a	√	2	a
F0	F9	LCD Display Clear Command			√	n/a	√	2	a
F0	FA	Turn Off Yellow LED Command			√	n/a	√	2	a
F0	FB	Turn On Yellow LED Command			√	n/a	√	2	a
F0	FC	LCD Display Line 1 Message Command			√	n/a	√	2	a
F0	FD	LCD Display Line 2 Message Command			√	n/a	√	2	a
F0	FE	Buzzer On/Off Command			√	n/a	√	2	a

a ViVOpay Vendi reader only
c Not in Global Reader Lite (GRL)
d Real Time Clock only
e Only applies to devices with USB

Pass-Through Command Table

All commands in the following table use Protocol 2 formats (see Protocol 2 Formats).

Table 4: Pass-Through Command Table

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	CMD	SUB CMD
Antenna Control	√	√	√	√	√	2	28	01
Buzzer Control Long	√	√	√	√	√	2	0B	02
Buzzer Control Short	√	√	√	√	√	2	0B	01
Enhanced Pass-Through Command	√	√	√	√	√	2	2C	0B
Enhanced Poll for Token	√	√	√	√	√	2	2C	0C
Exchange Contactless Data	√	√	√	√	√	2	2C	03
Get PCD and PICC Parameters	√	√	√	√	√	2	2C	05
High Level Halt Command	√	√	√	√	√	2	2C	09
LED Control	√	√	√	√	√	2	0A	02
Mifare Authenticate Block	√	√	√	√	√	2	2C	06
Mifare ePurse Command	√	√	√	√	√	2	2C	0A

Mifare Read Blocks	√	√	√	√	√	2	2C	07
Mifare Write Blocks	√	√	√	√	√	2	2C	08
Pass-Through Mode Start/Stop	√	√	√	√	√	2	2C	01
PCD Single Command Exchange	√	√	√	√	√	2	2C	04
Poll for Token	√	√	√	√	√	2	2C	02
Set White List	√	√	√	√	√	2	2C	50
Get White List	√	√	√	√	√	2	2C	51
Clear White List	√	√	√	√	√	2	2C	52

EMV Key Manager Command Tables

The preferred method of accessing the Certificate Authority public keys is to use the following commands in the Protocol 2 format: (see Protocol 2)

Table 5: EMV Key Management - Protocol 2

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	CMD	SUB CMD	Notes
Get CA Public Key	√	√	√		√	2	D0	01	
Get CA Public Key Hash	√	√	√		√	2	D0	02	
Set CA Public Key	√	√	√		√	2	D0	03	
Delete CA Public Key	√	√	√		√	2	D0	04	
Delete All CA Public Keys	√	√	√		√	2	D0	05	
Get All CA Public RIDs	√	√	√		√	2	D0	06	
List CA Public Key IDs for RID	√	√	√		√	2	D0	07	

All commands in the following table use Protocol 1 formats (see Protocol 1). These commands are included for backward compatibility. New development should use Protocol 2 commands listed above.

Table 6: EMV Key Management - Protocol 1

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	CMD	SUB CMD	Notes
Delete All CA Public Keys	√	√	√		√	1	24	03	
Delete CA Public Key	√	√	√		√	1	24	02	
Set CA Public Key	√	√	√		√	1	24	01	

Status Codes

The tables in this section define status codes for Protocol 1 and Protocol 2. Note that Protocol 1 is deprecated.

Status Codes for Protocol 1

Table 7: Protocol 1 Status Codes

Status Code	Status
00h	OK
01h	Incorrect Frame Tag
02h	Incorrect Frame Type
03h	Unknown Frame Type
04h	Unknown Command
05h	Unknown Sub-Command
06h	CRC Error
07h	Failed
08h	Timeout
0Ah	Incorrect Parameter
0Bh	Command Not Supported
0Ch	Sub-Command Not Supported
0Dh	Parameter Not Supported / Status Abort Command
0Eh	Command not Allowed
0Fh	Sub-Command Not Allowed

Status Codes for Protocol 2

Table 8: Protocol 2 Status Codes

Status Code	Status
00h	OK
01h	Incorrect Header Tag
02h	Unknown Command
03h	Unknown Sub-Command
04h	CRC Error in Frame
05h	Incorrect Parameter
06h	Parameter Not Supported
07h	Mal-formatted Data
08h	Timeout
0Ah	Failed / NACK

Status Code	Status
0Bh	Command not Allowed
0Ch	Sub-Command not Allowed
0Dh	Buffer Overflow (Data Length too large for reader buffer)
0Eh	User Interface Event
10h	Need clear firmware(apply in boot loader only)
11h	Communication type not supported, VT-1, burst, etc.
	Need encrypted firmware (apply in boot loader only)
12h	Secure interface is not functional or is in an intermediate state.
13h	Data field is not mod 8
14h	Pad 0x80 not found where expected
15h	Specified key type is invalid
16h	Could not retrieve key from the SAM (InitSecureComm)
17h	Hash code problem
18h	Could not store the key into the SAM (InstallKey)
19h	Frame is too large
1Ah	Unit powered up in authentication state but POS must resend the InitSecureComm command
1Bh	The EEPROM may not be initialized because SecCommInterface does not make sense
1CH	Problem encoding APDU
Module-Specific Status Codes[1]	
20h	Unsupported Index (ILM) SAM Transceiver error – problem communicating with the SAM (Key Mgr)
21h	Unexpected Sequence Counter in multiple frames for single bitmap (ILM) Length error in data returned from the SAM (Key Mgr)
22h	Improper bit map (ILM)
23h	Request Online Authorization
24h	ViVOCard3 raw data read successful
25h	Message index not available (ILM) ViVOcomm activate transaction card type (ViVOcomm)
26h	Version Information Mismatch (ILM)
27h	Not sending commands in correct index message index (ILM)
28h	Time out or next expected message not received (ILM)
29h	ILM languages not available for viewing (ILM)
2Ah	Other language not supported (ILM)
41h – 4Fh	Module-specific errors for Key Manager
50h	Auto-Switch OK
51h	Auto-Switch failed
70h	Antenna Error Note for Kiosk III: If antenna is disconnected when Activate Transaction(02-01)

[1] Status codes in this range are "module-specific" so that their values can be re-used by different modules. The meaning of these codes may depend on which command is being issued. An exception is 23h, which is used generally.

Status Code	Status
	command is not received, reader will keep beeping until the antenna is connected correctly. If Activate Transaction(02-01) command is received, and during the polling time, antenna is disconnected, reader will waiting to the end of polling time, and return status code 08h(Time Out), then keep beeping until the antenna is connected correctly. Reader will response 70h as status code once Activate Transaction(02-01) command is received when antenna is disconnected.
80h	Use another card
81h	Insert or swipe card
90h	Account DUKPT Key does not exist
91h	Account DUKPT Key KSN exhausted

Error Codes

Table 9: Error Codes

Error Code	Description	Reason for Error and Suggested Error Handling
00h	No Error	None.
01h	Out of Sequence Command	Reader did not receive commands in the correct order. Correct the Terminal application to send serial commands in the correct sequence.
02h	Go to Contact Interface	The contactless transaction failed. *If the reader supports a contact interface*, advise the user to complete the transaction on the contact interface. Previously, this error code was used if the reader supported another interface (beside the contact interface). Integrators should use error code 04h Go to Other Interface instead. The previous use has been deprecated.
03h	Transaction Amount is Zero	If the transaction amount is zero and the terminal is "an offline only terminal" then reader needs to terminate the transaction.
04h	Go To Other Interface	The transaction has failed. *If the reader supports another interface*, advise the user to complete the transaction on the other interface.
05h	Go To Nearby Interface	The transaction has failed. *If there is another nearby contact interface*, advise the user to complete the transaction on the nearby contact interface. This situation might be a case where there are multiple pay stations, but only one of them has a contact interface.

Error Code	Description	Reason for Error and Suggested Error Handling
06h	Go To MagStripe Interface	The transaction has failed. *If the reader has a MagStripe interface*, advise the user to complete the transaction using the MagStripe interface.
20h	Card returned Error Status	Card returned SW1SW2 not equal to 9000 hex. Value of the SW1SW2 bytes from the Card is returned in the Data portion of the Response Frame. Details of what the SW1SW2 codes mean for each RF State are Card dependent and are out of the scope of this document. How the terminal handles this error depends on when the error occurs in the transaction flow. The RF State Code (see section on RF State Codes) indicates the transaction state when the error occurred. Suggested error handling for individual RF State Codes is given below: ***RF State Code = PPSE:*** ***If RF State Code = SELECT:*** ***If RF State Code = GPO:*** ***If RF State Code = READ RECORD:*** ***If RF State Code = GET DATA (Ticket):*** ***If RF State Code = GET DATA (Ticketing Profile):*** ***If RF State Code = GET DATA (Balance):*** ***If RF State Code = PUT DATA (Ticket):*** The terminal can retry the transaction or abandon it. ***If RF State Code = GEN AC:*** For Credit transactions: The terminal can retry the transaction or abandon it.
21h	Collision Error	There was more than one contactless card in the reader's range.
22h	Amount Over Maximum Limit	The Transaction Amount is greater than Terminal Contactless Transaction Limit (FFF1).
23h	Request Online Authorization	If the Transaction Amount is greater than the Balance on the card but is less than the Terminal Contactless Transaction Limit (FFF1), the reader sends this error code back to the terminal along with other information needed by the acquirer to format an online authorization request.
24h	Card Communication Error	A communication error occurred while interacting with the card. An example might be the card was removed from the field.
25h	Card Blocked	If the card is not supported by the reader according to the value of parameter Application Capability (FFF3) this error code is sent to the terminal.
26h	Card Expired	This error code is sent to the terminal if the current date of the reader is greater than the expiration date of the card. This status code is only valid for qVSDC cards.
27h	Unsupported Card	Card presented to the reader is of a type that is not supported by the reader. This could be due to presenting a card with an AID that is not recognized by the reader.

Error Code	Description	Reason for Error and Suggested Error Handling
30h	Card did not respond	Card was removed from the field or there was a Communication Error preventing the card response from reaching the reader. How the terminal handles this error depends on when in the transaction the error occurred. The RF State Code (see section on RF State Codes) indicates the transaction state when the error occurred. Suggested error handling for each RF State Code is given below: ***RF State Code = PPSE:*** The terminal can retry the transaction or abandon it. ***If RF State Code = SELECT:*** The terminal can retry the transaction or abandon it. ***If RF State Code = GPO:*** The terminal can retry the transaction or abandon it. ***If RF State Code = READ RECORD:*** The terminal can retry the transaction or abandon it. ***If RF State Code = GEN AC:*** For Credit transactions: The terminal can retry the transaction or abandon it. ***If RF State Code = GET DATA (Ticket):*** ***If RF State Code = GET DATA (Ticketing Profile):*** ***If RF State Code = GET DATA (Balance):*** ***If RF State Code = PUT DATA (Ticket):***
41h	Data Element Missing	A mandatory/required data element was missing from the card.
42h	Card Generated AAC	The card declined the transaction by sending an AAC instead of a TC. Why the card declined, the transaction is not known to the reader.
43h	Card Generated ARQC	This error code would be returned if the card generated an ARQC and the terminal/reader was configured as “Offline Only”; therefore the card was DECLINED.
44h	SDA/DDA Failed (Not Supported by Card)	Card did not indicate support for the correct authentication method and date authentication failed. For Visa, when DDA is required, the card must indicate support for DDA in AIP. If this support is not indicated then the transaction fails and this error code is returned.
50h	SDA/DDA/CDDA Failed (CA Public Key)	Data Authentication failed due to missing CA Public Key. Retrying the transaction does not correct the error until the missing CA Public Key problem is corrected via Key Management commands.
51h	SDA/DDA/CDDA Failed (Issuer Public Key)	Data Authentication failed due to a problem in recovering the Issuer Public Key from the card data. Data on the card may be incorrect or the reader has the wrong CA Public Key. The transaction continues to fail until the Issuer Public Key and the CA Public Key are correct.
52h	SDA Failed (SSAD)	Data Authentication failed during SSAD. Retrying the transaction does not correct the error.
53h	DDA/CDDA Failed (ICC Public Key)	Data Authentication failed during attempted recovery of ICC Public Key. Retrying the transaction does not correct the error.
54h	DDA/CDDA Failed (Dynamic Signature Verification)	Data Authentication failed during Dynamic Signature Verification. Retrying the transaction does not correct the error: At this point, the amount has been deducted from the Card Balance.
55h	Processing Restrictions Failed	The Processing Restrictions step as defined in EMV Specifications failed. This could be due to incorrectly set configuration. Retrying the transaction does not correct the error until the EMV configuration is corrected.

Error Code	Description	Reason for Error and Suggested Error Handling
56h	Terminal Risk Management (TRM) Failed	The Terminal Risk Management step as defined in EMV Specifications failed. This could be due to incorrectly set configuration. Retrying the transaction does not correct the error until the EMV configuration is corrected.
57h	Cardholder Verification Failed	The Cardholder Verification step as defined in EMV Specifications failed. This could be due to incorrectly set configuration. Retrying the transaction does not correct the error until the EMV configuration is corrected.
58h	Terminal Action Analysis (TAA) Failed	The Terminal Action Analysis step as defined in EMV Specifications failed. This could be due to incorrectly set configuration. Retrying the transaction does not correct the error until the EMV configuration is corrected.
61h	SD Memory Error	This error is reported only when trying to retrieve Transaction Logs. This error is never reported during a transaction.
62h	Generic Error	This is a generic / general error that is reported when a more specific reason for the error is not known.
73h	Torn Transaction Log Error	An error occurred while attempting to clean the torn transaction log. This might occur if the reader could not read the time and date from the real time clock.
80h	No Merchants have been configured	This error usually occurred while MerchantID is empty.
81h	TLV Parse Failure	This error usually occurred while fail to TLV parsing card response data.
82h	Merchant Data Error	This error usually occurred while no merchant data returned from card.
83h	System Memory Error	This error usually occurred while fail to read or write system memory.
84h	Application Skip Error	This error usually occurred while configuration isn't consistent on whether or not to skip payment application
85h	Application Version Error	This error usually occurred while application version number is incorrect.

If an error occurs during a transaction and the terminal determines that the reader must perform exception processing, then the terminal must retry the transaction until the transaction has been completed successfully or the terminal decides to abort it. The retries must be continued even if successive transactions fail with conditions that do not require exception processing. This must be done to allow the reader to complete exception processing (even if there are failures during exception processing).

Under certain conditions, such as when a customer walks away or there is a problem with the card, the terminal may want to abort the retries even if the reader has not been able to complete exception processing. How and when the terminal stops retrying is out of the scope of this document.

RF State Codes

For some Error Codes, the RF State Code indicates the exact Reader-Card command that failed. This helps determine the exact place where the failure occurred.

Table 10: RF State Codes

State Code	RF State	Description
00h	None	RF State Code not available
01h	PPSE	Error occurred during PPSE command
02h	SELECT	Error occurred during SELECT command
03h	GPO	Error occurred during GET PROCESSING OPTIONS command
04h	READ RECORD	Error occurred during READ RECORD command
05h	GEN AC	Error occurred during GEN AC command
06h	CCC	Error occurred during CCC command
07h	IA	Error occurred during IA command
08h	SDA	Error occurred during SDA processing
09h	DDA	Error occurred during DDA processing
0ah	CDA	Error occurred during CDA processing
0bh	TAA	Error occurred during TAA processing
0ch	UPDATE RECORD	Error occurred during UPDATE RECORD command
10h	GET DATA (Ticket)	Error occurred during GET DATA command to retrieve the Ticket
11h	GET DATA (Ticketing Prof)	Error occurred during GET DATA command to retrieve the Ticketing Profile
12h	GET DATA (Balance)	Error occurred during GET DATA command to retrieve the Balance
13h	GET DATA (All)	Error occurred during GET DATA command to retrieve all data
20h	PUT DATA (Ticket)	Error occurred during PUT DATA command to retrieve the Ticket

3.0 Serial Communication Interfaces

This section discusses the physical interfaces through which the terminal communicates with the ViVOpay reader. All of the readers have an RS232/ USB Serial Interface.

Note: Please don't plug in/out serial communication interfaces during the device power on, that might cause unstable behavior, The reader is not certified to work properly.

RS232 Serial Interface

Port Settings

To communicate with the ViVOpay reader, set the terminal's serial communication parameters to the values listed below.

Table 11: Serial Port Settings

Parameter	Value
Baud Rate	19200 bps (default value for all but Vendi) 9600 bps (default value for Vendi)
Data Bits	8
Stop Bits	1
Parity	None
Out CTS Flow	Disabled
Out DSR Flow	Disabled
DTR Control	Disabled
RTS Control	Disabled
XON/XOFF	Disabled
Flow Control	None

Basic Communication

The ViVOpay reader and the POS terminal communicate by exchanging Command-Response Frames. The terminal always initiates communication by sending a Command Frame and ViVOpay responds by sending a Response Frame. What frames are exchanged depends on the command and the protocol used. There are two command/response protocols. Protocol 1 uses separate Data Frames and ACK/NACK responses. Protocol 2 is simplified by including data within the Command/Response Frames.

Timeouts

The ViVOpay reader does not timeout while trying to receive a command. There is no maximum inter-character delay. As a result, command frames with length errors may appear to "hang". A subsequent command that does not contain a length error can be received successfully.

Once the ViVOpay reader has received a command, the time required to respond to the terminal varies from command to command, depending on what processing is required.

During a transaction, the Activate (02-01) command may specify a timeout value. The reader will continue to poll until it starts to process a transaction, or the specified timeout period has elapsed. The transaction may not complete within the timeout period.

USB HID Interface

ViVOpay readers can communicate with the terminal using a RS232 Serial link and/or a USB HID link.

All ViVOpay commands sent over the USB HID interface are encapsulated in the following protocol.

Note: The maximum length for any command or response is 1500 bytes since this is the size of the command FIFO.

HID Report Format

All HID reports sent to or received from the ViVOpay are 64 bytes long. The first byte of the frame is a single byte Report ID number. The remaining 63 bytes carry the report payload. Any reports with less than 63 bytes of command or response data are padded with NULL bytes (00h) to make them 63 bytes long.

ViVOpay commands and responses are sent over the USB bus in 63-byte frames. Byte ordering in the USB frame is the same as if the command were sent over the serial port. In other words, the "ViVOtech2" command tag always starts in the second byte of the first report containing the command, just after the Report ID.

There are four defined report IDs used in this protocol: 1, 2, 3, and 4. Undefined report IDs are silently ignored.

3.1.1.1 Report ID 1

ID 1 frames are used when a complete command or response is 63 bytes or less. As soon as the host or device receives a Report ID 1 frame, it should parse the report data to extract the command or response.

3.1.1.2 Report ID 2

ID 2 frames are used when a complete command or response is more than 63 bytes long and cannot fit in a single report. The Report ID 2 frame contains the first 63 bytes of the command. So the “ViVOtech2” command tag is only present in Report IDs 1 or 2. The Report ID 2 frames always contain 63 bytes of valid data with no padding bytes since the command is more than 63 bytes long.

3.1.1.3 Report ID 3

ID 3 frames are continuation frames. For any command or response that is more than 126 bytes long, the middle frames of the response are sent with a report ID of 3. Any frame received with a report ID 3 is ignored unless it is preceded by a report with an ID of 2 or 3. The Report ID 3 frames should always contain 63 bytes of valid data with no padding bytes.

3.1.1.4 Report ID 4

ID 4 frames mark the end of multi-report commands. Any padding needed to make the command a multiple of 63 bytes should be placed in this report. Any frame received with a report ID 4 is ignored unless it is preceded by a report with an ID of 2 or 3. As soon as the host or device receives a valid Report ID 4 frame, it should parse the report data to extract the command or response.

The exception to the rule of only adding pad bytes to reports with ID of 1 or 4 is debug test frames. Surrounding a command with pad bytes to make the command span multiple reports is valid for testing the multi-report handling of the host and device software. This must be avoided in deployed code since it slows command processing times.

Sample Single Report Command and Response

Ping Command Report

01	“V”	“i”	“V”	“O”	“t”	“e”	“c”	“h”	“2”	00	18	01	00	00	B3
CD	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

The pad bytes are marked with blue text in this example.

Ping Response Report

01	“V”	“i”	“V”	“O”	“t”	“e”	“c”	“h”	“2”	00	18	00	00	00	FA
83	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

The pad bytes are marked with blue text in this example.

The serial port version of this command and response would be: (Data bytes in Hex format)

Command: `56 69 56 4F 74 65 63 68 32 00 18 01 00 00 B3 CD`

Response: `56 69 56 4F 74 65 63 68 32 00 18 00 00 00 FA 83`

Data Frames

Byte 0-8	Byte 9	Byte 10	Byte 11	…	Byte n+10	Byte n+11	Byte n+12
Frame Tag	Frame Type	Data 0	Data 1	…	Data n	CRC MSB if from ViVOpay. LSB if from Terminal.	CRC LSB if from ViVOpay. MSB if from Terminal.
ViVOtech\0	'D'			…			

Direction: Both Ways (depending on Command). Variable Length (n = 1 … 244).

Sample Single Report Command with Multiple Report Response

Get Configuration Command Report

01	"V"	"i"	"V"	"O"	"t"	"e"	"c"	"h"	"2"	00	03	02	00	00	5B
91	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

The pad bytes are marked with blue text in this example.

Get Configuration response reports

1st Response Report

02	"V"	"i"	"V"	"O"	"t"	"e"	"c"	"h"	"2"	00	03	00	00	C2	FF
E4	01	00	9F	02	06	00	00	00	00	00	01	9F	03	06	00
00	00	00	00	00	DF	63	01	00	DF	64	01	01	DF	65	01
00	DF	66	01	00	FF	F0	03	00	00	00	FF	F2	08	30	30

2nd Response Report

03	30	30	30	30	30	30	FF	F3	02	03	FF	FF	F7	01	02
FF	F9	01	03	FF	FA	02	03	E8	9A	03	00	01	04	9F	21
03	05	13	54	9C	01	00	5F	2A	02	08	40	9F	09	02	00
02	9F	1A	02	08	40	9F	1B	04	00	00	17	70	9F	33	03

3rd Response Report

03	00	08	E8	9F	35	01	22	9F	40	05	60	00	00	30	00
9F	66	04	A0	00	00	00	FF	F1	06	00	00	00	01	00	00
FF	F4	03	01	00	01	FF	F5	06	00	00	00	00	80	00	FF
F8	01	00	FF	FB	01	00	FF	FC	01	00	FF	FD	05	F8	50

4th and Final Response Report

04	AC	F8	00	FF	FE	05	F8	50	AC	A0	00	FF	FF	05	00
00	00	00	00	72	56	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

The pad bytes are marked with blue text in this example.

Note: The response to this command changes each time the command is sent since it includes the current time and date.

The serial port version of this command and response would be: (Data bytes in Hex format)

Command: `56 69 56 4F 74 65 63 68 32 00 03 02 00 00 5B 91`

Response:
```
56 69 56 4F 74 65 63 68 32 00 03 00 00 C2 FF E4 01 00 9F 02
06 00 00 00 00 00 01 9F 03 06 00

00 00 00 00 00 DF 63 01 00 DF 64 01 01 DF 65 01
00 DF 66 01 00 FF F0 03 00 00 00 FF F2 08 30 30
   30 30 30 30 30 30 FF F3 02 03 FF FF F7 01 02
FF F9 01 03 FF FA 02 03 E8 9A 03 00 01 04 9F 21
03 05 13 54 9C 01 00 5F 2A 02 08 40 9F 09 02 00
02 9F 1A 02 08 40 9F 1B 04 00 00 17 70 9F 33 03
   00 08 E8 9F 35 01 22 9F 40 05 60 00 00 30 00
9F 66 04 A0 00 00 00 FF F1 06 00 00 00 01 00 00
FF F4 03 01 00 01 FF F5 06 00 00 00 00 80 00 FF
F8 01 00 FF FB 01 00 FF FC 01 00 FF FD 05 F8 50
   AC F8 00 FF FE 05 F8 50 AC A0 00 FF FF 05 00
00 00 00 00 72 56
```

Error Handling at Report Level

1. Any report with ID of 1 is processed as soon as it is received. All other unprocessed reports are discarded.
2. Any report with an ID of 2 causes all other unprocessed reports to be discarded.
3. Any report with an ID of 3 is discarded unless the previous report had an ID of 2 or 3. If the previous report ID 3 was discarded then this report also is discarded.
4. Any report with an ID of 4 is discarded unless the previous report had an ID of 2 or 3. If the previous report had an ID of 3 and was discarded then this report also is discarded. If the report ID 4 frame is retained, then all retained reports are processed.

Processing of reports means passing the concatenated Data Frames contained in the reports to the command handler. The report ID bytes must be discarded when concatenating the report Data Frames.

An alternate way to handle the rules for report IDs 3 and 4 is to set a flag when a report with an ID of 2 is received and reset the flag when a report with an ID of 1 is received or an ID of 4 is finished processing. Reports with IDs of 3 or 4 are only kept when the flag is set.

Error Handling at Command Level

The error handling at the command level remains as it is currently implemented for serial port commands.

Incomplete commands are silently ignored when the reception times out. This does not occur for commands received over the USB HID interface unless a complete report is dropped, resulting in missing data for the command. The normal USB handshaking is expected to prevent this.

A bad CRC value for the encapsulated command returns a bad CRC response to the command.

An unknown command or subcommand code results in an unknown command or unknown subcommand Response Frame.

If the host does not receive any response to a command it should retry the command.

If the host receives a bad CRC response to a command it should retry the command. This is not expected to occur when using USB since it includes a layer of error handling.

4.0 ViVOpay Communication Protocols

There are two main types of protocols: Protocol 1 and Protocol 2. Protocol 2 is the preferred method of communicating between the terminal/POS and a ViVOpay reader. Protocol 1 is retained for backward compatibility with older terminal/POS applications.

In addition to the two main protocols, there are modes of communication that are extensions of the protocols. These modes provide flexibility in the control of the ViVOpay reader:

- Pass-through mode allows the terminal/POS application to interact directly with the contactless ISO 7816 cards.
- Burst Mode is a legacy mode intended for use with MagStripe cards.

Protocol 1 (Deprecated)

Protocol 1 is retained for backwards compatibility with existing terminal applications. Whenever possible, Protocol 2 should be used.

Protocol 1 is not supported by Kiosk III/ Vendi.

Communication between ViVOpay and the terminal uses command-response pairs. The terminal sends one or more Command Frames to the reader and waits for one or more response frames. A simple command requires a single Command Frame with a single Response Frame. More complex commands may involve a number of Command/Response Frames being exchanged. This sub-section defines the different types of frames and their format.

Details of specific commands and the order in which different frames are exchanged are documented in a later sub-section.

There are five types of frames – Command, Data, ACK, NACK and Special Frames. The format of each type of frame is given below.

Command Frames

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	See Individual Commands	See Individual Commands	See Individual Commands	See Individual Commands		

Direction: From terminal to ViVOpay

ACK Frames

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	See Individual Commands	See Status Code	See Individual Commands	See Individual Commands		

Direction: ViVOpay to terminal

NACK Frames

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	See Individual Commands	See Status Code	See Individual Commands	See Individual Commands		

Direction: ViVOpay to terminal.

A NACK Frame has the same fields as an ACK Frame unless specified differently for a specific command. The only difference between a NACK and ACK Frame is that the NACK Frame always contains an Error Status. When ViVOpay returns a NACK Frame, the terminal must consider the command terminated. The Data1 and Data2 fields are not used with a NACK, unless specified differently by a command.

Special Frames

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Data1	Data2	Data3	Data4	CRC MSB if from ViVOpay. LSB if from Terminal.	CRC LSB if from ViVOpay. MSB if from Terminal.
ViVOtech\0	'S'	See Individual Commands	See Individual Commands	See Individual Commands	See Individual Commands		

Direction: Both ways (depending on command).

Protocol 2

There are two types of frames for Protocol 2: Command Frames and Response Frames. The general format of these frames is given below.

Command Frames

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0							

Response Frames

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0							

Pass-Through Mode (Protocol 2)

Some versions of ViVOpay firmware provide a Pass-Through mode which can be used by a terminal to communicate directly with an RF card. This feature allows a terminal to add support for RF cards that are not directly supported by the ViVOpay firmware. Pass-through is actually a special mode of the ViVOPay Protocol 2.

This section describes the Pass-Through protocol and frames for the ViVOpay Serial Interface Protocol.

Note: Pass-Through commands could only be executed in Pass-Through Mode. Other commands (non-pass-through) will return an error in Pass-Through Mode with the exception of Ping, Get Version, and Get Serial Number commands, which will work in both modes.

Basic Pass-Through Operation

Pass-Through mode allows a terminal to communicate directly with an ISO 14443 Type A or Type B Proximity Integrated Circuit Card (PICC) without the ViVOpay firmware knowing the specifics of the application or data present on the PICC. The Pass-Through mode supports a set of basic commands that allow polling and selection of a PICC and sending/receiving low level information to/from the PICC. This allows a terminal to communicate with (and support) cards with applications and data that are not supported by a System AID. Individual Pass-Through commands are described in the sections that follow.

The Pass-Through Mode subcommands are grouped into three categories

- **General Pass-Through Set Up Commands**

These commands have to be used whether you are using high level communication with the PICC or low level communication. These commands include:

- Pass-Through Mode Start/Stop
- Poll for Token

- **High Level PICC Communication Commands**
  If a PICC supports ISO 14443-4 Protocol, then these high level commands can be used to send application level APDUs to the PICC and receive the PICC responses. The Send / Receive commands must always be used in pairs, unless the send command returns an error. The high level commands include: Exchange Contactless Data and commands to interact with Mifare cards.

- **Low Level PICC Communication Commands**
  These low level commands can be used to send raw ISO 14443-3 data to the PICC and receive the PICC responses. The Send/Receive commands must always be used in pairs, unless the send command returns an error. In addition to this, these commands can also be used to get and set some PCD and PICC parameters. The low level commands include.
  - PCD Single Command Exchange
  - Get PCD and PICC Parameters

The terminal must periodically instruct the ViVOpay reader to poll for cards. Whenever the ViVOpay reader detects a card in the RF field, it tries to carry out ISO 14443 Layer 3 and Layer 4 negotiations and report the card type found. In the Pass-Through mode, ViVOpay does not attempt to check whether the card application is one that it supports.

Once a card is detected, the terminal may use one of the Pass-Through commands to communicate with the card at the application level and read the data.

Additional Pass-Through commands allow a terminal to use low-level features provided by the ViVOpay reader, such as controlling the RF antenna (field).

Pass-Through Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	See Individual Commands	See Individual Commands	See Individual Commands	See Individual Commands	See Individual Commands		

Note: The Byte 14+n and Byte 15+n CRCs are the reverse of standard Protocol 1 Format and Protocol 2 Format Command Frames. Within each Pass-Through Frame Type, the CRC is stored as big-endian number i.e. higher byte (MSB) first.

Pass-Through Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	See Individual Commands	See Individual Commands	See Individual Commands	See Individual Commands	See Individual Commands		

Suggested Sequence for Pass-Through Commands

Put the ViVOpay reader in Pass-Through Mode by sending a Start Pass-Through Mode command.

Periodically request ViVOpay to poll for cards by sending the **Poll for Token** command. If no card is found within the time specified, the reader ViVOpay indicates this with a timeout error. If a card is found, it returns the card type and serial number.

At this point ViVOpay already has gone through the anti-collision, selection and activation (if required) sequence as per ISO 14443 A/B, and the card is ready for communication. Depending on the Card Type, use the appropriate Pass-Through commands to communicate with the card. Card Types and the applicable commands are given below.

For ISO 14443-4 Compliant Type A or Type B Cards

Use the Exchange Contactless Data command to communicate with the Card at the application level.

For ISO I4443 Type A or Type B Cards that are not ISO 14443-4 Compliant (i.e. ISO 14443-3 Compliant Cards), Mifare Type A, and Mifare Ultralight Type A

Low Level Commands: Use the PCD Single Command Exchange command to communicate with the Card. If required, use the Get PCD and PICC Parameters command for greater control.

High Level Commands (For Mifare Cards Only): Or use the Mifare Authenticate Block, Mifare Read Blocks, and Mifare Write Blocks commands to communicate with a Mifare Standard (1K) or Mifare Ultralight Card.

For Card Type None

The Card has either been removed from the Field, or there was an error in trying to connect to the card, or the card is not ISO 14443-3 or 14443-4 compliant. No need to communicate with the card.

When done communicating with the card, the terminal is responsible for handling the termination sequence. The terminal may use the Antenna Disable/Antenna Enable commands to turn the RF field off and then on again.

The terminal can instruct the ViVOpay reader to terminate the Pass-Through Mode and start normal polling for cards by sending a Stop Pass-Through Mode command.

Note: If the terminal communicates with the card in the Pass-Through mode and finds that it does not support the card, then the terminal is responsible for handling the termination sequence with the card. The terminal may keep sending Poll for Token commands to the ViVOpay reader until the card has been removed from the field, replaced by another card (different serial number), or a timeout has occurred before it terminates the Pass-Through mode. The terminal may choose to terminate the Pass-Through mode as soon as it is reading is complete.

Care should be taken to ensure that the ViVOpay reader is operating in the correct mode (Auto-Poll or Poll on Demand) when returning from Pass-Through mode. If the card is not removed from the field fast enough, and the reader is in Auto Poll mode, the terminal may end up doing multiple reads of the same card.

Auto-Switch to Pass-Through Mode

The reader can be set to switch automatically out of polling (either Poll on Demand or Auto-Poll) and enter Pass-Through Mode. This allows the POS application to send Pass-Through Mode commands directly to the card APDU without explicitly setting the reader in Pass-Through Mode. Auto-Switch can be enabled globally and for configurable User AIDs. This feature is not supported for System AIDs.

If the Auto-Switch feature is enabled, the reader switches to Pass-Through Mode under the following conditions:

- Card application is not recognized – Global Auto-Switch is enabled
- Card AID is not recognized – Global Auto-Switch is enabled
- Mifare card is recognized but fails – Global Auto-Switch is enabled
- DesFire card is recognized but fails – Global Auto-Switch is enabled
- Card AID is recognized – User AID Auto-Switch is enabled

There are two ways to use the auto-switch feature: Global Auto-Switch or User AID Auto-Switch. The DF7C TLV sets the feature globally using the Set Configuration command (Global Auto-Switch) and the Set Configurable AID sets the feature for user AIDs (User AID Auto-Switch). You can use both at the same time if you wish, but they do different things so do not confuse the two. In general, one is used for MiFare, DesFire or unrecognized cards. The second is ONLY used for a specific User AID. The Auto-Switch setting in a User AID overrides the Global Auto-Switch setting.

Once the Auto-Switch feature is activated, the POS application must handle error recovery and exit Pass-Through Mode with the Pass-Through Mode Start/Stop command (2C-01) when done. The reader returns to previous polling mode or idle state. For example, if you were exiting Pass-Through mode and resuming Auto Poll mode, the POS must make sure the PICC has left the field before terminating Pass-Through mode. Otherwise Auto Poll will start and the PICC will be read by the reader again as a brand new transaction!

4.1.1.1 Global Auto-Switch

You can use Global Auto-Switch to process:

- an unrecognized MiFare PICC
- an unrecognized DesFire PICC
- a completely unrecognized PICC (failed MiFare, DesFire, PPSE, Trial & Error)

Auto-Switch is invoked if Global Auto-Switch is enabled AND one of the above cards is tapped on the reader during a transaction.

If successful, the reader returns a Response Frame containing some of the following items:

- Error or Status condition
- UID
- PICC card type detected

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	50h or 51h	See Status Code Table					

Table 12: Poll for Token Data Field for Response Frame (Status Code is OK)

Data Field	Length (bytes)	Description
Card	1	Type of Card Found (or No Card Found). 00h None (Card Not Detected or Could not Activate) 01h ISO 14443 Type A (Supports ISO 14443-4 Protocol) 02h ISO 14443 Type B (Supports ISO 14443-4 Protocol) 03h Mifare Type A (Standard) 04h Mifare Type A (Ultralight) 05h ISO 14443 Type A (Does not support ISO 14443-4 Protocol) 06h ISO 14443 Type B (Does not support ISO 14443-4 Protocol) 07h ISO 14443 Type A and Mifare (NFC phone)
Serial Number	0 or Variable	Serial Number (or the UID) of the PICC. Length depends on the Card Detected. If no card was detected, then a Serial Number is not returned.

The Response Frame is returned asynchronously if the reader is in Auto Poll.

Once Auto-Switch is invoked the reader remains in Pass-Through Mode with the RF antenna on. The POS application must handle error recovery and exit Pass-Through Mode when done with the Pass-Through Mode Start/Stop command (2C-01). The reader returns to previous polling mode or idle state.

To enable Global Auto-Switch, send the Set Configuration command (04-00) with a 01h value for the DF7C TLV.

4.1.1.2 User AID Auto-Switch

You can use User AID Auto-Switch to process:

- a recognized User AID that is selected during PPSE
- a recognized User AID that is selected during Trial & Error

Auto-Switch is invoked if User AID Auto Switch is enabled for an AID and a PICC is initiating a transaction with this AID selected.

If successful, the reader returns a response frame containing some of the following items:

- Error or Status condition
- AID
- PICC card type detected

The response frame is returned asynchronously if the reader is in Auto Poll.

Once Auto-Switch is invoked the reader remains in Pass-Through Mode with the RF antenna on. The POS application must handle error recovery and exit Pass-Through Mode when done with the Pass-Through Mode Start/Stop command (2C-01). The reader returns to previous polling mode or idle state.

To enable Global Auto-Switch, send the Set Configurable AID command (04-02) with a 01h value for the DF7C TLV.

RF On/Off States for Pass-through Commands

Sending a Stop Pass-through command will turn off the RF Antenna. Otherwise, the antenna is under the direct control of the POS/Terminal in Pass-through mode.

Burst Mode

In Burst Mode, a Data Frame is sent from the ViVOpay reader to the terminal each time a card is read successfully. The ViVOpay keeps polling for the supported RF Cards. Whenever the ViVOpay reader detects a card in the RF Field, it tries to read the card data. If the read operation is successful, the ViVOpay reader sends a "Card Payload" frame that contains the Status, Application Type, Card Data and CRC to the terminal through its serial port. Detailed information on the frame format is given in the sections ahead. The terminal does not have to send any command or data to the ViVOpay reader.

Note: The reader must be in Auto Poll mode for Burst Mode to be used successfully. Setting Burst Mode on for other configurations can lead to unexpected results.

Burst mode is **intended to be used with magnetic stripe card data only.**

Burst Mode is enabled using the Set Configuration command and the FFF7 tag. There are two options for Burst Mode: Always On (FFF7 = 01) and Auto Exit (FFF7 = 02). When the reader is in Burst Mode Always On, it ignores Activate Transaction and Get Full Track Data commands and remains in Burst Mode. When Burst Mode Auto Exit is enabled, the reader ends Burst Mode (FFF7

= 00) and processes these command. Burst Mode then remains off until it is reactivated with a new Set Configuration command with tag FFF7 set to 01 or 02.

When the Burst Mode is enabled, the standard ViVOpay Serial Interface is not disabled entirely. Commands not related to transactions, such as Ping, can still be sent to the ViVOpay reader. In the Command-Response Mode, the terminal sends a command to the ViVOpay reader and the ViVOpay reader responds in a pre-defined manner. These commands allow a terminal to use features provided by the ViVOpay reader, such as checking for the presence of the ViVOpay reader by pinging it, retrieving the firmware version number, etc.

Burst mode is not allowed when encryption is enable.

when encryption is enabled, burst mode is always OFF. When encryption is enabled, reader will turn the burst mode to be OFF automatically. When encryption is enabled, if user wants to make burst mode to be ON/AUTO EXIT through “Set Configuration (04-00)” command, reader will response error.

Note: Burst mode is disabled for SRED devices.

ViVOpay Burst Mode Frames

The table below describes the Burst Mode frame types. The frame type appears in Byte 0 of a Burst Mode packet.

Table 13: Burst Mode Frames

Frame type	Description
01h	Payload Frame
02h	Status Frame
03h	Payload Frame for VISA MSD 202 CVN17 type transaction
55h	NACK
0Eh	Asynchronous Event Frame

4.1.1.3 Payload Frame (On Successful Read)

On successful read ViVOpay sends a Card Payload frame to the terminal that always contains Frame Type, Status and Application Type. The Status always shows Success (=00). The Application Type can have any of the values defined in the “Data Definitions” section. This is followed by the track data. Only those tracks the reader was able to read from the Card are sent. Each Track begins and ends with its Start and End Sentinel. After the Track Data, the reader sends two CRC bytes. The details of the CRC algorithm used are given in the “CRC Calculation” section.

Byte 0	Byte 1	Byte 2			Byte n-1	Byte n
Frame Type =01h	Status =00h	Application Type	Track 1 Field (if found)	Track 2 Field (if found)	CRC (MSB)	CRC (LSB)

Example 1: Payload, Card Read Successfully, Application Type Visa, Both Track 1 and Track 2 Present

[01] [00] [02] %B123456789^ABCDEF^12345678?;123456=12345?<CRC1><CRC2>

Example 2: Payload, Card Read Successfully, Application Type MasterCard, Only Track 2 Present

[01] [00] [01] ;123456=12345?<CRC1><CRC2>

Example 3: Payload, Card Read Successfully, Application Type AmEx, Only Track 1 Present

[01] [00] [03] %B1234567^ABCDEF^12345678? <CRC1><CRC2>

Example 4: Payload, Card Read Successfully, Application Type Unknown, Both Track 1 and Track 2 Present

[01] [00] [00] %B123456789^ABCDEF^12345678?;123456=12345? <CRC1><CRC2>

4.1.1.4 Payload Frame for CVN17 Enabled Readers

For MSD-only readers that require an online cryptogram (i.e. TTQ = '80 80 00 00') MSD v1.4.2 and v2.0.2 transactions return the burst mode payload frame is described as follows (please refer to Visa Contactless Payment V. 2.0.2 Including Additions and Clarifications 3.0 – August 2007):

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte5 … Byte 5+n-1	Byte 5+n	Byte6+n
Frame Type	Status Code	Application Type	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
03h	See table below	See Application Type			See Data Tables		

If Status Code is OK then the format and contents of the data field in the Response Frame are given in the following table. All TLV lengths in the TLV include the Tag and Length bytes.

Table 14: Payload Frame with Cryptogram Data Format and Content When Status OK

Data Item	Length (bytes)	Description
Track 1 Length	1	If Track 1 is available, then this field gives the length of the Track 1 data that follows. If Track 1 is not available, then a Length of 00h is returned. Format: Binary
Track 1 Data (MagStripe card)	Variable	Track 1 Data (if available). Format: ASCII (no null terminator)

Data Item	Length (bytes)	Description
Track 2 Length	1	If Track 2 is available, then this field gives the length of the Track 2 data that follows. If Track 2 is not available, then a Length of 00h is returned. Format: Binary
Track 2 Data (MagStripe card)	Variable	Track 2 Data (if available). Format: ASCII (no null terminator)
DE055 (Clearing Record) Present	1	If a Clearing Record (DE 055) field is available, then this field is 01h. If there is no Clearing Record (DE 055) field, then this field is 00h.
TLV DE 055 (Clearing Record)	Variable up to 128	DE 055 data (if available) as a TLV data object encoded with Tag 'E1'. The DE 055 data is the same data as is included in the Clearing Record. Tag: E1 Format: b1...126 variable.
TLV App PAN	Variable, up to 12	Application Primary Account Number (PAN) as a TLV object. This field is present only if the DE 055 object is present. Tag: 5A Format: cn variable length up to 19 (10 bytes)
TLV PAN Seq Number	4	PAN Sequence Number as a TLV object. This field is present only if the DE 055 object is present. Tag: Format: n2, BCD encoded on 1 bytes
TLV Application Expiration Date	6	Application Expiration Date as a TLV object. This field is present only if the DE 055 object is present. Tag: 5F24 Format: n6, BCD encoded on 3 bytes (YYMMDD)
TLV Application Label	Variable, up to 18	Application Label as a TLV object. This field is present only if the DE 055 object is present. Tag: 50 Format: an variable length up to 16 bytes
TLV CVM Results	6	Cardholder Verification Method (CVM) Results as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F34 Format: b3
TLV Data Authentication Code	5	Data Authentication Code as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F45 Format: b2
TLV ICC Dynamic Number	11	ICC Dynamic Number as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F4C Format: b8
TLV Track 1 Equivalent Data (M/Chip card)	81	Track 1 Equivalent Data as a TLV object. This field is present only if the DE 055 object is present. Tag: 56 Format: b79
TLV Transaction Status Information	4	Transaction Status Information as a TLV object. This field is present only if the DE 055 object is present. Tag: 9B Format: b2
Cardholder Name	29	Cardholder Name as a TLV object. This field is present only if the DE 055 object is present. Tag: 5F20 Format: b26
Application Usage Control	5	Application Usage Control as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F07 Format: b2
Issuer Action Code(Default)	8	Issuer Action Code (Online) as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F0D Format: b5
Issuer Action Code(Denial)	8	Issuer Action Code (Denial) as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F0E Format: b5

Data Item	Length (bytes)	Description
Issuer Action Code(Online)	8	Issuer Action Code (Default) as a TLV object. This field is present only if the DE 055 object is present. Tag: 9F0F Format: b5
TLV Auth Code	9	Authorization Code as a TLV object Tag: E300 Format: b8
TLV Track 2 Equivalent Data	21	Track 2 Equivalent Data as a TLV object. This field is present only if the DE 055 object is present or Authorization Code is present. Tag: 57 Format: b19
VLP Issuer Auth Code	9	VLP Issuer Authorization Code as a TLV object Tag: 9F74 Format: b6
Application Identifier	Variable up to 19	AID as a TLV object Tag: 9F06 Format: variable b5...16
Available Offline Spending Amount (Balance)	9	Available Offline Spending Amount as a TLV object Tag: 9F5D Format: variable b6
TLV Application Effective Date	6	Application Effective Date as a TLV object. Tag: 5F25 Format: n6, BCD encoded on 3 bytes (YYMMDD)
Form Factor Indicator	F: b 32 T: '9F6E' L: 4-bytes	Indicates the form factor of the consumer payment device and the type of contactless interface over which the transaction was conducted. The Form Factor Indicator is both an implementation and Issuer option. Inclusion of the Form Factor Indicator in online messages (and clearing records for offline capable readers) is an option for qVSDC and MSD readers.
PayPass Third Party Data	F: b T '9F6E' L: 5-32 bytes	Priority information from a third party in the following format: Country Code according to ISO 3166-1 n3, 2 bytes Unique ID assigned by MasterCard b, 2 bytes Proprietary Data b 1 to 28 bytes
Customer Exclusive Data (CED)	F: b T: '9F7C' L: Var. up to 32-bytes	Contains data for transmission to the Issuer in MSD transactions with a cryptogram. Customer Exclusive Data is both an implementation and Issuer option. Inclusion of the Customer Exclusive Data in online messages is an option for MSD readers compliant to this specification. Customer Exclusive Data shall be updateable via an Issuer script command.

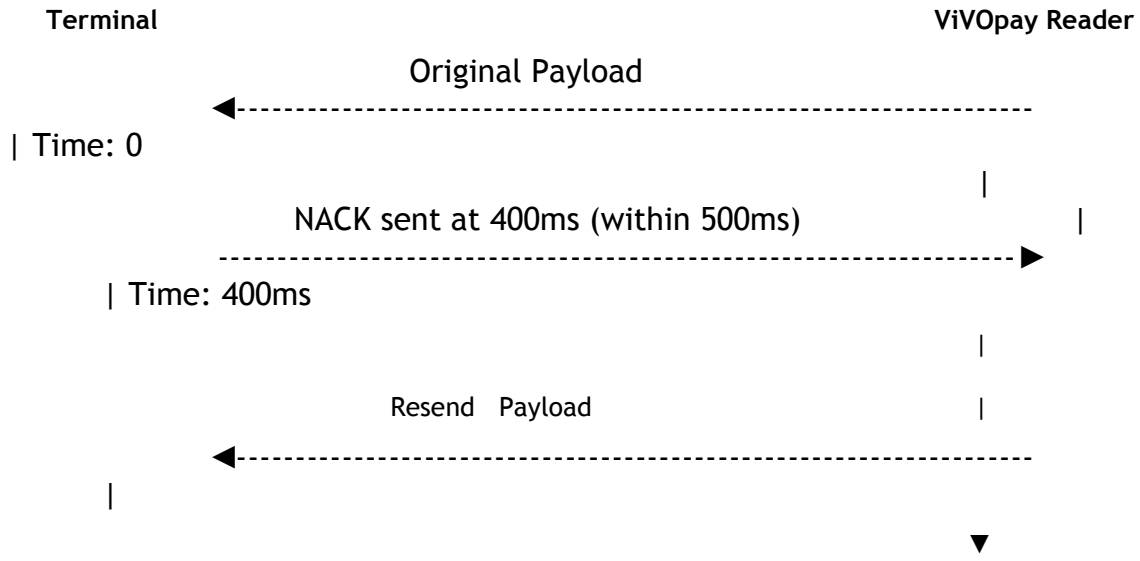
4.1.1.5 NACK Frame

If the terminal fails to receive the card payload data, it can send a NACK frame and request the ViVOpay reader to resend the card payload data. To ensure that the reader resends the card payload data, the NACK frame must be received by the reader within 500ms after it sends the original card payload. If the reader receives the NACK frame within this time period, it resends the card payload data to the terminal. If the reader receives the NACK Frame after 500ms of sending the original card payload, or if a new card has been detected, the reader ignores the NACK frame and does not resend the payload data. Each payload data is only resent once.

The NACK frame is a 1-Byte code with value of 0x55.

Byte 0
Frame Type =0x55h

Example 1: ViVOpay receives NACK frame from terminal within 500ms after sending the original payload data, ViVOpay resends the card payload data.



Original Payload:

Payload, Card Read Successfully, Application Type Master Card, Both Track 1 and Track 2 Present

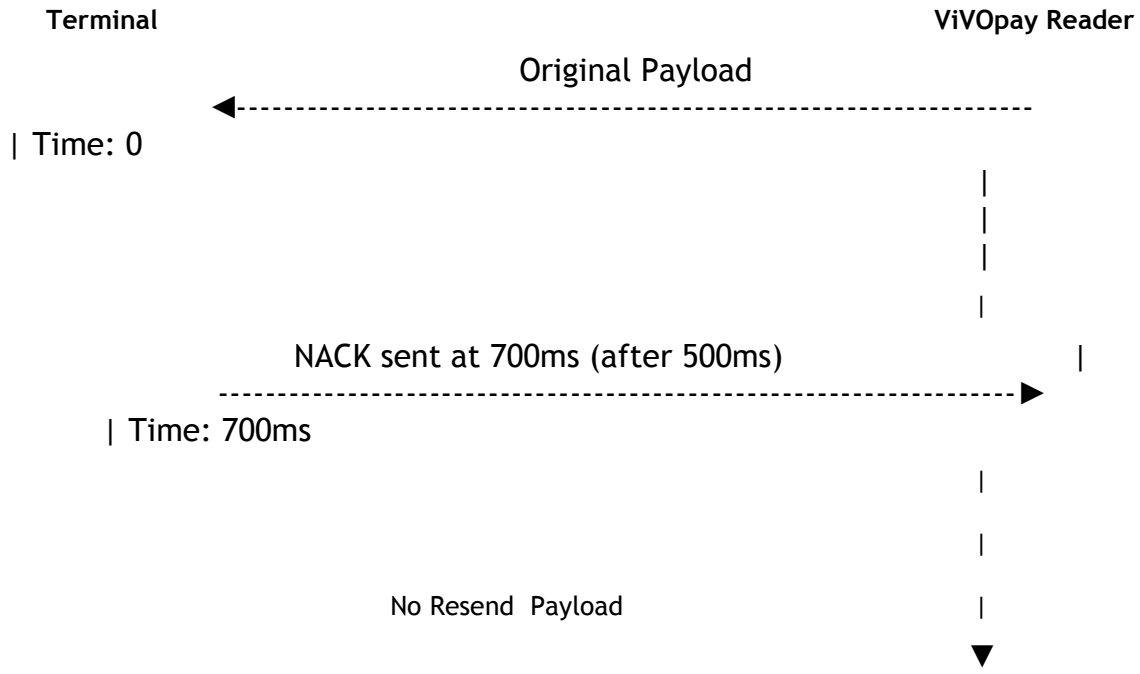
[01][00][01]%B5325350000623567^840SMITH/JOHN^05085011492563892473?;5325350000623567=05081019492993892483? <CRC1><CRC2>

Resent payload:

Payload, Card Read Successfully, Application Type Master Card, Both Track 1 and Track 2 Present

[01][00][01]%B5325350000623567^840SMITH/JOHN^05085011492563892473?;5325350000623567=05081019492993892483? <CRC1><CRC2>

Example 2: Reader receives NACK frame from terminal after 500ms of sending the original payload data, the reader does not resend the card payload data.



Original card payload data (no resent payload data):

Payload, Card Read Successfully, Application Type American Express, Both Track 1 and Track 2 Present

[01][00][03]%B379013539021002^TEST/CARD001^0604718000877840?;379013539021002=0604718 00087784000102? <CRC1><CRC2>

4.1.1.6 Asynchronous UI Message Event

Asynchronous message event is used by the reader to indicate specific events to the terminal. These frames are only sent when LCD and LED are sent to external source.

In synchronizing with the transaction, the reader can send asynchronous user interface (UI) message event to the terminal to specify the required user experience on the terminal.

Following is the format definition of Asynchronous UI Message Event:

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5 & 6	…	Bn-3	Bn-2	Bn-1	Bn
Frame Type 45h, E	Status =00h	Event Type 55h,	UI Scheme, defined on tag ‘FF F8’	Length Byte	2 Byte UI Event	Additional 2 Byte UI Events	Null Character	Null Character	CRC (MSB)	CRC (LSB)

Byte 3 is the UI Scheme # that allows the user to have different user interfaces (LCD display message table, and buzzer/LED profiles).

Byte 4 is the length of the remainder of the frame, less CRC.

Bytes 5 & 6 are the UI Event consisting of component (LCD, LED, or Buzzer) and acts as defined below.

Table 15: Asynchronous UI Message Event

Component	UI Type	UI Status Definition
LED	01h	Higher nibble: LED # 00: LED0 01: LED1 02: LED2 03: LED3 FF: all Lower nibble: 00: Off 01: On 11: No change
Buzzer	02h	Higher nibble: 1: short beeps 2: long beeps Lower nibble, short beep: 0: No change 1: Single beep 2: Double beep 3: Triple beep Lower nibble, long beep: 0: 200ms 1: 400ms 2: 600ms
LCD	03h	LCD message index

List of messages and the message flow for one user experience are given in Appendix 2. More user experience shall be listed later.

4.1.1.7 Data Definitions

4.1.1.7.1 Status

The Status is a 1-Byte code that indicates the Success or contains an Error Code. This can have any value from 0 – 255. A list of valid Status codes is given below.

Table 16: Asynchronous UI Message Event Status

Status	Value	Description
STATUS_OK	00h	Card Read completed successfully.
STATUS_EC_CARD_REMOVED	01h	A timeout occurred, card no longer present
STATUS_EC_COMM_ERROR	02h	Some communication error occurred
STATUS_EC_PROTOCOL_ERROR	03h	Protocol not respected
STATUS_EC_MULTIPLE_CARDS	04h	Collisions were detected
STATUS_EC_CARD_NOT_ACCEPTED	05h	Errors found in card information
STATUS_EC_BAD_DATA	06h	Errors found in card information format
STATUS_EC_UNKNOWN_ERROR	FFh	Internal error

The Status never has a value that matches the Track 1 and Track 2 Start/End Sentinels.

4.1.1.7.2 Application Type

The Application Type is a 1 byte code that indicates the Application Type detected. This can have any value from 0 – 255. A list of currently defined Application Types is given below.

Table 17: Asynchronous UI message Event Application Type

Application Type	Value
Unknown	00h
MasterCard	01h
Visa	02h
American Express	03h
Discover	04h
SpeedPass	05h
Gift Card	06h
Diners Club	07h
EnRoute	08h
JCB	09h
ViVOcard Diagnostic	0Ah
HID card	0Bh
MSR – Physical MSR, Application type unknown	0Ch
Reserved for future use	0Dh
DesFire (ViVOCard3) Track Data	0Eh
DesFire (ViVOCard3) Raw Data	0Fh
RBS	11h
ViVOcomm	14h

The Application Type never has a value that matches the Track 1 and Track 2 Start/End Sentinels.

4.1.1.7.3 Track 1 Field

This is a variable length field consisting of Track 1 data as ASCII characters. This field starts with the Track 1 Start Sentinel '%' and ends with the Track 1 End Sentinel '?'. If any Track 1 data is available, it is present between the Start and End Sentinel. For example

%B123456789^ABCDEF^12345678?

4.1.1.7.4 Track 2 Field

This is a variable length field consisting of Track 2 data as ASCII characters. This field starts with the Track 2 Start Sentinel ';' and ends with the Track 2 End Sentinel '?'. If any Track 2 data is available, it is present between the Start and End Sentinel. For example

;12345678=12345?

4.1.1.7.5 Sample Output

45 00 55 00 04 03 03 00 00 E8 DD <-- LCD Event
45 00 55 00 04 01 11 00 00 28 B6 <-- LED Event
45 00 55 00 04 01 10 00 00 1F 86 <-- LED Event
45 00 55 00 04 02 20 00 00 41 FF <-- Buzzer Event
45 00 55 00 04 01 11 00 00 28 B6 <-- LED Event
45 00 55 00 04 01 21 00 00 ED 13 <-- LED Event
45 00 55 00 04 01 31 00 00 AE 70 <-- LED Event

01 00 0A 25 42 36 32 37 39 32 35 37 37 34 39 31
33 32 33 34 33 5E 54 45 53 54 20 43 41 52 44 2F
56 49 56 4F 54 45 43 48 5E 31 30 31 32 38 31 33
30 30 37 32 31 30 34 33 35 30 30 30 30 3F 3B 36
32 37 39 32 35 37 37 34 39 31 33 32 33 34 33 3D
31 30 31 32 38 31 33 30 30 37 32 31 30 34 33 35
30 30 30 30 3F B5 DC <-- Burst Mode Payload Frame

45 00 55 00 04 03 04 00 00 6D 4D <-- LCD Event
45 00 55 00 0C 01 30 00 00 01 20
00 00 01 10 00 00 53 78 <-- Three LED Events
45 00 55 00 04 03 01 00 00 86 BD <-- LCD Event

CRC Calculation

The 16-bit CRC value is based on CRC-16/CCITT and calculated based on the following parameter set.

Width:	16-bits
Polynomial:	x16 + x12 + x5 + 1
Truncated Polynomial:	1021 hex
Initial Value:	FFFF hex
Input Data:	Not Reflected
Output CRC:	Not Reflected
XOR of Output CRC:	Not Done

The CRC-16 is calculated for the entire frame inclusive of Frame Tags, unused bytes, etc.

For Protocol 1 and Protocol 2: The CRC of the *Command Frames* is little-endian, i.e. lower byte first (LSB). The CRC of the Response Frames is big-endian i.e. higher byte first (MSB).

For Pass-through Frames, both Command and response frames have the CRC stored in big-endian order (MSB first).

For Pass-through frames, the CRC is stored as big-endian number i.e. higher byte first.

Some test values that can be used to test an implementation of this algorithm are given below.

Data String (ASCII Text): 123456789

CRC: 29B1h

Data (Hex): [01h] [02h] [03h] [04h] [05h]

CRC: 9304h

Data (Hex): [56] [69] [56] [4F] [74] [65] [63] [68] [00] [43] [18] [00] [00] [00]

CRC: A1F5h

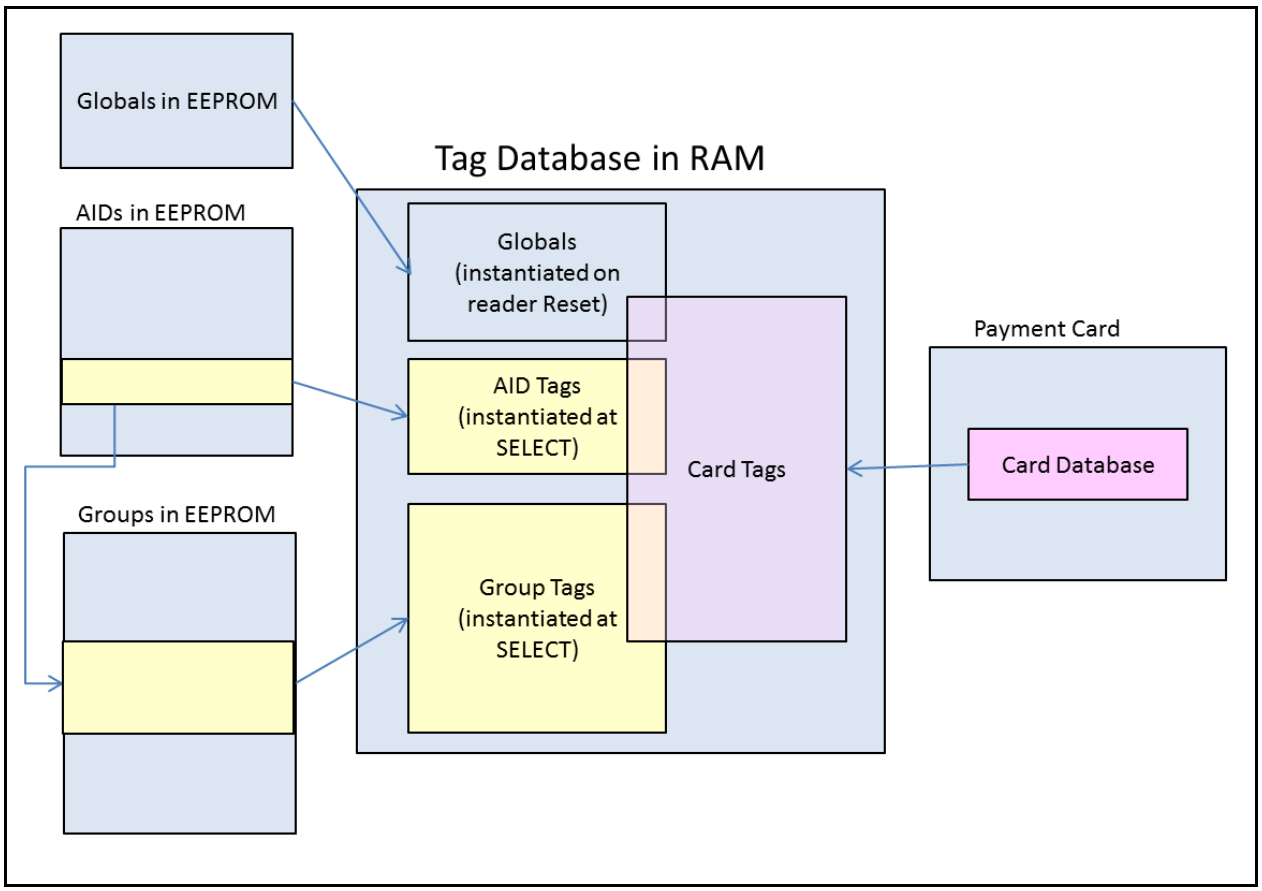
The following code snippet is an example of the CRC Calculation. The returned CRC would be stored in big-endian or little-endian form, depending on whether the Protocol 1, Protocol 2 or Pass-through Mode was being used. This code has been written in Microsoft Visual C++ 6.0.

```
// ------------------------------------------------------------------------------------------
// ID TECH
// ID TECH reserves the right to make changes without notice at any time. ID TECH makes no
// warranty, expressed, implied or statutory, including but not limited to any implied
// warranty of merchantability or fitness for any particular purpose, or that the use will
// not infringe any third party patent, copyright or trademark. ID TECH must not be liable
// for any loss or damage arising from its use.
// ------------------------------------------------------------------------------------------

static const unsigned short CrcTable[ 256 ] = {
0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50A5, 0x60C6, 0x70E7, 0x8108, 0x9129,
0xA14A, 0xB16B, 0xC18C, 0xD1AD, 0xE1CE, 0xF1EF, 0x1231, 0x0210, 0x3273, 0x2252,
0x52B5, 0x4294, 0x72F7, 0x62D6, 0x9339, 0x8318, 0xB37B, 0xA35A, 0xD3BD, 0xC39C,
0xF3FF, 0xE3DE, 0x2462, 0x3443, 0x0420, 0x1401, 0x64E6, 0x74C7, 0x44A4, 0x5485,
0xA56A, 0xB54B, 0x8528, 0x9509, 0xE5EE, 0xF5CF, 0xC5AC, 0xD58D, 0x3653, 0x2672,
0x1611, 0x0630, 0x76D7, 0x66F6, 0x5695, 0x46B4, 0xB75B, 0xA77A, 0x9719, 0x8738,
0xF7DF, 0xE7FE, 0xD79D, 0xC7BC, 0x48C4, 0x58E5, 0x6886, 0x78A7, 0x0840, 0x1861,
0x2802, 0x3823, 0xC9CC, 0xD9ED, 0xE98E, 0xF9AF, 0x8948, 0x9969, 0xA90A, 0xB92B,
0x5AF5, 0x4AD4, 0x7AB7, 0x6A96, 0x1A71, 0x0A50, 0x3A33, 0x2A12, 0xDBFD, 0xCBDC,
0xFBBF, 0xEB9E, 0x9B79, 0x8B58, 0xBB3B, 0xAB1A, 0x6CA6, 0x7C87, 0x4CE4, 0x5CC5,
0x2C22, 0x3C03, 0x0C60, 0x1C41, 0xEDAE, 0xFD8F, 0xCDEC, 0xDDCD, 0xAD2A, 0xBD0B,
0x8D68, 0x9D49, 0x7E97, 0x6EB6, 0x5ED5, 0x4EF4, 0x3E13, 0x2E32, 0x1E51, 0x0E70,
0xFF9F, 0xEFBE, 0xDFDD, 0xCFFC, 0xBF1B, 0xAF3A, 0x9F59, 0x8F78, 0x9188, 0x81A9,
0xB1CA, 0xA1EB, 0xD10C, 0xC12D, 0xF14E, 0xE16F, 0x1080, 0x00A1, 0x30C2, 0x20E3,
0x5004, 0x4025, 0x7046, 0x6067, 0x83B9, 0x9398, 0xA3FB, 0xB3DA, 0xC33D, 0xD31C,
0xE37F, 0xF35E, 0x02B1, 0x1290, 0x22F3, 0x32D2, 0x4235, 0x5214, 0x6277, 0x7256,
0xB5EA, 0xA5CB, 0x95A8, 0x8589, 0xF56E, 0xE54F, 0xD52C, 0xC50D, 0x34E2, 0x24C3,
0x14A0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405, 0xA7DB, 0xB7FA, 0x8799, 0x97B8,
0xE75F, 0xF77E, 0xC71D, 0xD73C, 0x26D3, 0x36F2, 0x0691, 0x16B0, 0x6657, 0x7676,
0x4615, 0x5634, 0xD94C, 0xC96D, 0xF90E, 0xE92F, 0x99C8, 0x89E9, 0xB98A, 0xA9AB,
0x5844, 0x4865, 0x7806, 0x6827, 0x18C0, 0x08E1, 0x3882, 0x28A3, 0xCB7D, 0xDB5C,
0xEB3F, 0xFB1E, 0x8BF9, 0x9BD8, 0xABBB, 0xBB9A, 0x4A75, 0x5A54, 0x6A37, 0x7A16,
0x0AF1, 0x1AD0, 0x2AB3, 0x3A92, 0xFD2E, 0xED0F, 0xDD6C, 0xCD4D, 0xBDAA, 0xAD8B,
0x9DE8, 0x8DC9, 0x7C26, 0x6C07, 0x5C64, 0x4C45, 0x3CA2, 0x2C83, 0x1CE0, 0x0CC1,
0xEF1F, 0xFF3E, 0xCF5D, 0xDF7C, 0xAF9B, 0xBFBA, 0x8FD9, 0x9FF8, 0x6E17, 0x7E36,
0x4E55, 0x5E74, 0x2E93, 0x3EB2, 0x0ED1, 0x1EF0
};


unsigned short CalculateCRC ( unsigned char *Buffer, unsigned int Len )
{
        unsigned short Crc = 0xffff;
        while (Len--)
        {       Crc = CrcTable[ ((Crc >> 8) ^ *Buffer++) ] ^ (Crc << 8);
        }
        return(Crc);
}
```

5.0 Tag and Data Set Configuration

Tags are configured in the ViVOpay reader ahead of time so that when a card is selected, a “data set” (group) may be instantiated for use in a transaction.

The following illustration shows the basic approach to instantiating the tag database for a transaction. Global variables (configured through the Set Configuration command) are instantiated when the reader is reset or powered up. When a card is in the field, an AID is selected and its tags are added to the database. The selection of the AID will cause a “data set” (group) to be selected and its tags are added to the database. As the transaction proceeds, card tags will be added to the database, possibly overwriting or updating some tags that were already in the database.



The specification of MasterCard PayPass M/Chip 3.0 required some additional features in the Tag Database, including:

- The ability to have tags that were “not present” in the database.
- The ability to handle 3-byte tags.

The specific details of changes for M/Chip 3.0 are covered in the following sections.

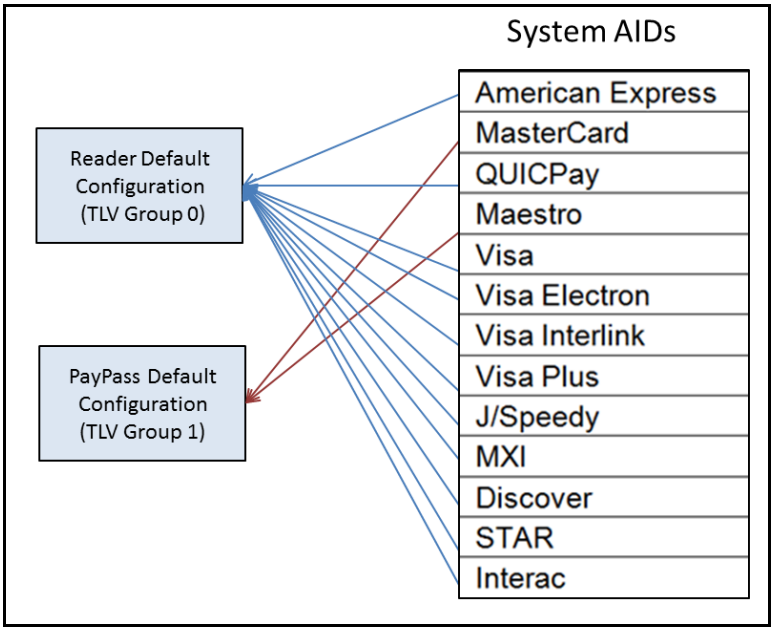
Configurable AIDs and Groups

This section explains how you can create and modify Application Identifiers (AIDs) and associate them with TLV Groups in the reader's memory for specific transaction handling. Detailed descriptions of the Configurable Application Identifier commands are also included.

Each AID uniquely identifies a payment application. The reader has default AIDs that are preconfigured to support common payment applications such as VISA and MasterCard. These AIDs are called the **System AIDs** and they can be modified or disabled but not deleted. The reader also supports up to eight user-defined AIDs called **User AIDs**. Each AID must be associated with a **TLV Group** that defines transaction processing for that payment application. The System AIDs are initially associated with a default TLV Group, which can be modified but not deleted. User AIDs can be associated to the default TLV Group or any of seven other user-defined TLV Groups.

With the implementation of M/Chip 3.0, an additional *default* TLV Group (Group 1) has been added. M/Chip 3.0 *does not* use the Reader Default Group (Group 0).

All AIDs must be unique. The reader's default configuration is System AIDs and two default groups. All of the System AIDs (except PayPass AIDs, as noted above) initially refer to the default TLV Group 0. The diagram below shows the default reader AID configuration.



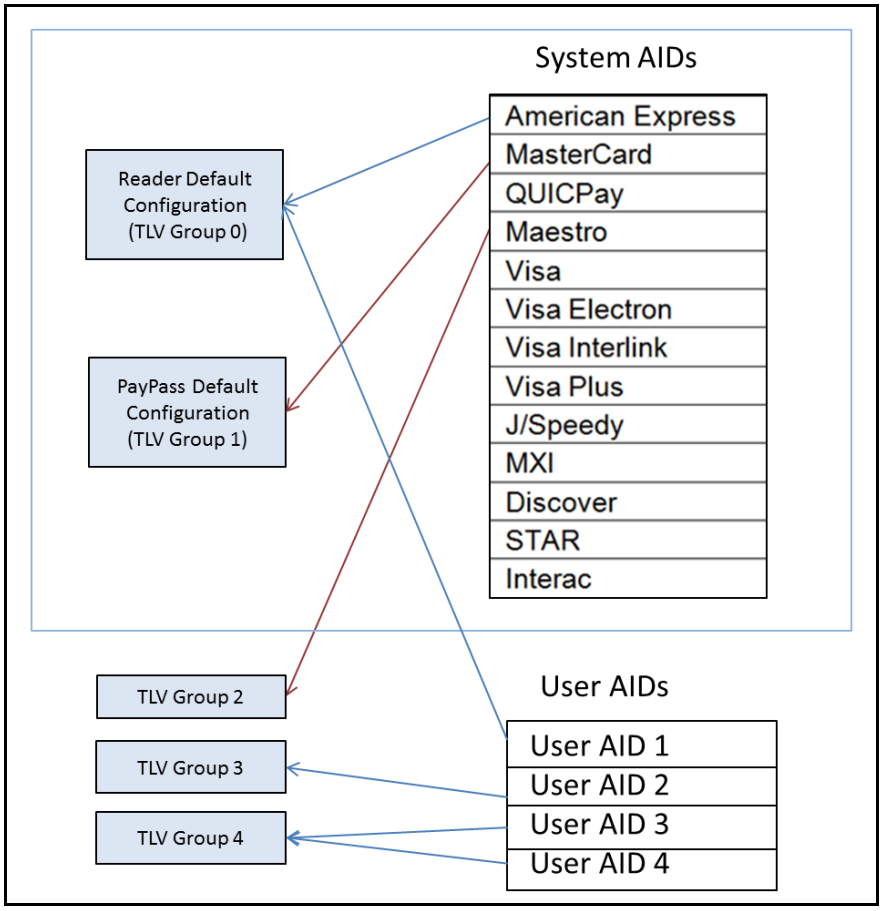
The Configurable Application Identifiers feature of the ViVOpay readers allows you to create and customize AIDs and the TLV Groups associated with them. Each AID may have characteristics that are unique and different from the reader's default System AIDs and TLV Group configuration.

To create a new configurable AID you need to send the AID and the TLV Group you wish to use to the reader. If the AID already exists in the reader's memory, it will modify the AID accordingly. If you send a new AID, the reader creates and saves the new AID. Multiple AIDs can be associated with the same TLV Group or they may refer to unique TLV Groups. You may also redefine the functionality for an existing AID by linking it to a new configuration Group or you

may disable an AID if you do not want the reader to process transactions from that payment application. You may delete an AID by communicating to the reader the AID number with no parameters.

As you add or modify AIDs and TLV Groups, the reader remembers all changes on subsequent boot up.

The diagram below shows an example of a reader's AID configuration after it has been modified with Configurable AID commands.



In this example, ten System AIDs have been disabled and four User AIDs and three new TLV Groups have been configured. The new AID User AID – 1 has been linked to the Reader Default Configuration (TLV Group 0) so that it functions as the other System AID 1 functions. The Maestro AID has been linked to the user-defined TLV Group – 2. User AID – 2 functions as defined in the new TLV Group – 3. Both User AID – 3 and User AID – 4 point to the new TLV Group – 4 and function accordingly. Also notice that the other System AIDs have been disabled by removing their link to a configuration group.

Use the Configurable AID Commands to create new AIDs or change configuration values for an AID. Use the Configurable Group commands to create new groups or configuration values for a group.

System AIDs

A System AID is an AID preloaded for a specific application using a known AID value. Examples include MasterCard, American Express, and Visa. The table below shows all the System AIDs.

Table 18: System AIDs

Application Name	Application Identifier
American Express	A0 00 00 00 25 01
MasterCard	A0 00 00 00 04 10 10
QUICPay	A0 00 00 00 65 90 01
Maestro	A0 00 00 00 04 30 60
Visa	A0 00 00 00 03 10 10
Visa Electron	A0 00 00 00 03 20 10
Visa Interlink	A0 00 00 00 03 30 10
Visa Plus	A0 00 00 00 03 80 10
J/Speedy	A0 00 00 00 65 10 10
MXI	A0 00 00 00 02 30 60 D1 58 00
Discover	A0 00 00 03 24 10 10
Discover	A0 00 00 01 52 30 10
STAR	A0 00 00 04 17 01 01
Interac	A0 00 00 02 77 10 10

The terminal:

- May disable a System AID
- May ONLY modify some of the System AID properties
- May NOT delete a System AID

User AIDs

A User AID is an optional AID that is added and/or configured by the user. These AIDs are used for servicing transactions that are not defined by one of the System AIDs. This determination needs to be made by the integrator.

The terminal:

- May modify ANY User AID property
- May delete a User AID

There is no equivalent to the System AID disable; the User AID either exists, and it is used for its associated transactions, or the User AID is not present.

Reader Default TLV Group

The reader is provided with a default TLV Group (Group 0) that defines all the properties (with TLVs) required for a basic transaction. By default, all of the System AIDs except PayPass System

AIDs (MasterCard and Maestro) use TLV Group 0 to define their transaction processing. By default, MasterCard PayPass System AIDs will use Group 1.

The user:

- MUST ALWAYS include the Group Number TLV as the FIRST TLV in the Set Configurable Group message.
- MUST define AT LEAST ONE TLV in addition to the Group Number TLV (in a Set Configurable Group command)
- May modify ANY TLVs in TLV Group 0
- May NEVER delete TLV Group 0

Unlike all other groups, the TLVs in the Default TLV Group (TLV Group 0) are constant. The reader ALWAYS uses the latest copy of the TLV. If you issue a Set Configurable Group command that only updates some TLVs in TLV Group 0, the reader continues to use older versions of the TLVs that were not updated.

After each transaction, the reader reloads the default values from TLV Group 0, prior to the next transaction. For this reason, TLV Group 0 maintains a copy of ALL TLVs that can be entered into a TLV Group structure[2].

Warning: Changing values in TLV Group 0 should be done with **EXTREME CAUTION**, since this affects the default configuration that most (not PayPass) transactions use.

PayPass Default Group

The PayPass default group is Group 1. PayPass M/Chip 3.0 *does not use Group 0* tag definitions (not even for default values). The process of instantiating a PayPass database is slightly different from other applications:

- *Group 0 tags are not loaded.*
- 28 default tags defined in the *EMV Contactless Book C-2 Kernel 2 Spec v2.3* are initialized with their specified default values. See PayPass Group Configuration TLVs with Hard-Coded Values in Kernel.
- PayPass Group tags are loaded. (Group 1 is the default group for PayPass applications).
- Tags sent in the Activate Command are loaded into the database.

User-defined TLV Groups

There are seven undefined TLV Groups in the reader at startup. These groups can be used for any purpose.

The user:

- MUST ALWAYS include the Group Number TLV as the FIRST TLV in the message.

[2] PayPass specific tags are an exception to this rule. Those are maintained in Group 1.

- MUST include AT LEAST ONE TLV other than the Group Number TLV (in a Set Configurable Group command)
- May modify ANY TLV in the TLV Group
- May ALWAYS delete a TLV Group 1 through 7
- SHOULD NEVER include the TDOL TLV if its length = zero (i.e., only include the TDOL if it has a value)

User-defined TLV Groups differ from the default TLV Group 0 in two important ways. First, these groups only need to contain TLVs that are different than the TLVs in the default TLV Group 0. Thus they are normally a sub-set of the TLVs in the default group.

For American Express Transaction limit(FFF1), CVM limit(FFF5), Floor limit(9F1B):
For Discover Transaction limit(FFF1), CVM limit(FFF5), Floor limit(9F1B), Risk flags(FFF4):
if user-defined TLV Group is used, user should set these above TLVs in the user-defined Group. If not set, these above TLVs will be regard as not exist.

For American Express, Terminal Capabilities (9F33) and Enhanced Expresspay Terminal Capabilities (9F6E) are expected to be set consistently. For example, if Byte 2 bit 7 of '9F6E' is set to 1(b) to indicate 'Online PIN Supported' then '9F33' byte 2 bit 7 should also be set to 1(b).

For American Express, Kiosk III reader is always capable of CVM processing, and CVM items in terminal capabilities are supported (9F33 byte2 bit5-8 =1, 9F6E byte2 bit5-8 =1).

Secondly, the TLVs in TLV Groups 1 through 7 are not permanent. If you configure a TLV Group and then issue a second Set Configurable Group command on the same TLV Group, the second Set Configurable Group command overwrites EVERY change to the TLV Group made by the first command.

Warning: Changing values in TLV Groups 1 through 7 overwrites all content in the TLV Group, including deleting TLVs not in the update.

Except for MasterCard PayPass transactions, when one of these user-defined TLV Groups is selected during a transaction, the reader uses the TLVs included in the group AND any other TLVs required for the transaction are taken from the default Group 0. Once the reader has finished transaction processing, it reloads TLV Group 0 values for all TLVs. It is now ready to commence the next transaction.

There are some guidelines for setting and deleting TLV Groups listed below. Most of these guidelines are intuitive (i.e., you *may not* delete a TLV Group if an AID exists that currently uses it).

Configurable AID Reader Memory Requirement

The Configurable AIDs feature requires memory to store TLV groups and User AIDs. ViVOpay readers use 64K flash memory to support the Configurable AID feature. Refer to the reader's user documentation for more information on reader memory.

ViVOpay Proprietary TLVs

TLVs may be either standard TLVs or proprietary TLVs. *Standard TLVs* are defined by EMV and the Payment Association Requirements and recognized by everyone. *Proprietary TLVs* are created by individual payment associations and reader manufacturers for specific functions. Proprietary TLVs must be handled in a manner that isolates them from other proprietary TLVs.

ViVOpay proprietary TLVs can be present with standard TLVs without encapsulation when the command is processed exclusively by ViVOpay firmware or software. If the TLVs will be processed by other devices, ViVOpay proprietary TLVs must be encapsulated to prevent conflicts with proprietary TLVs from other organizations.

ViVOPay TLV Group Tag FFEE01 is used to encapsulate ViVOpay proprietary TLVs.

EXAMPLE

The following example is for an encapsulated Terminal Capabilities – CVM Required TLV.

The TLV string “FFEE0106DF29030101” is broken down as follows:

FFEE01		ViVOpay TLV Group Tag
06		Length of all encapsulated TLVs
	DF29	Tag Terminal Capabilities – CVM Required – ViVOpay Proprietary
	03	Length of Transaction CVM
	00 01 00	Value: Actual Transaction CVM

Card Application Proprietary Tag List (FF69)

For some applications, there may be a requirement to define a list of proprietary tags that may be returned in Data Object Lists (DOLs). To accomplish this, the reader allows each user-defined group (except Group 0) to define a list of proprietary tags that can be inserted into the tag database. The maximum size of this list is 32 bytes. The new tag that is used for encapsulating the proprietary tag list is FF69.

A tag in this list may be configured in one of two ways:

- Constant Value – the TLV contains a non-zero length and a value. The reader will not modify this value, but it can be provided when requested (as in a DOL).
- Updateable – the TLV contains a length of zero and no value. The tag is then “defined” but has no value, so it may be updated during the

transaction. At the end of a transaction, the reader will send any updated proprietary tags back in the Activate Response frame.

Configuration Tag Tables

Global Configuration Tags

The following table contains TLVs that are configurable using the Set Configuration (04-00) command. These TLVs are global within in the reader.

Table 19: Global Configuration TLVs

Tag	Data Object Name and Description	Format	Length (Bytes)	Default Value
9A	Transaction Date (YYMMDD) This value is used to set the Real Time Clock. Note: The terminal/POS application should perform range checking on this value to ensure it is within acceptable limits.	n6	3	Reader Date
9F21	Transaction Time (HHMMSS) This value is used to set the Real Time Clock. Note: The terminal/POS application should perform range checking on this value to ensure it is within acceptable limits.	n6	3	Reader Time
DF65[1]	Require Heartbeat frame to stay in Idle mode (EMEA User Experience only). If this feature is enabled, then to stay in the Idle mode, a valid frame must be received by the reader every 15 seconds or it returns to Not Working state. 00: Heartbeat frame not required 01: Heartbeat frame required	b	1	00
DF66[1]	Unsupported cards display option (EMEA User Experience only). If an unsupported card is detected, then display a message based on this setting. 00: Display a “Fail” message 01: Display an “Insert/ Swipe” message if the reader is configured to indicate support for Contact cards, otherwise display a “Fail” message.	b	1	00
DF68	Enable/Disable Stop Command processing 0 = Disable (default) 1 = Enable	b	1	00
DF6A	Enable Communication Error Recovery Enables the reader to poll again and return to discovery after a communication error (e.g. tear or “no tag” error) 00: Disabled 01: Enabled (default)	b	1	01

<table>
<tr><th>Tag</th><th>Data Object Name and Description</th><th>Format</th><th>Length (Bytes)</th><th>Default Value</th></tr>
<tr><td>DF75</td><td>Communication Error Delay time
Delay between the time a communication error first occurs and the time when the reader will issue an indication of an error to the reader. If a tear occurs, but the card comes back into the field during this time, then no error indication is issued. Time is expressed in milliseconds (default is 3000ms, or 3 seconds)</td><td>n (BCD)</td><td>3</td><td>00 30 00</td></tr>
<tr><td>DF7C</td><td>Auto-Switch to Pass-Through Mode.
Refer to Auto-Switch to Pass-Through Mode
00: Disable (default)
01: Enable</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>DF7D</td><td>Track 1 and Track 2 Data Format
Sets the format of data returned from Activate Transaction and Get Transaction Results commands.
00: No start/end sentinels or LRC (default)
01: Add start/end sentinel and LRC</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>DF7F</td><td>Improved Collision Detection (see special features Improved Collision Detection.) RF signal locked to a specified card only after a specified number of polling attempts without an EMV collision.
00h = Improved Collision Detection Disabled.
02h-FFh = Number of successful polling attempts required.</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>FFF3[1]</td><td>Application Capability(1:Support,0:Not Support):
Byte 1: (Leftmost)
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td>Normal J/Speedy support</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>ViVOpay Mifare for NFC</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td>Interac support</td></tr>
<tr><td></td><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>X</td><td></td><td></td><td></td><td></td><td>Android Pay support</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td></td><td></td><td></td><td></td><td></td><td>RFU</td></tr>
</table>
Byte 2:
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>MasterCard Credit support</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>American Express support</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>Visa support</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>Mobile J/Speedy support</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>ViVOwallet support</td></tr>
<tr><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>RBS support</td></tr>
<tr><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>MasterCard Cash support</td></tr>
<tr><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Discover support</td></tr>
</table>
Example: 0009 means reader support both MasterCard and Mobile J/Speedy applications</td><td>b</td><td>2</td><td>07 FF</td></tr>
</table>

Tag	Data Object Name and Description	Format	Length (Bytes)	Default Value
FFF7[1]	Enable/Disable Burst Mode: Value = 00: Disable Burst Mode Value = 01: Enable Burst Mode Value = 02: Burst Mode Auto Exit. Burst mode is turned off as soon as a transaction command is received (Sections 6 and 14 of this document)	b	1	02
FFF9[1] [2] [3]	LCD Font Size: Value = 02: Large Value = 03: Extra Large (default)	b	1	03
FFFA[1] [2]	LCD delay time (ms) – default is 1000ms. If the device has no LCD, then the value will be 0.	b	2	03 E8 or 00 00
FFFB[1]	Language Option for LCD display: Value = 00: English only display (default) Value = 01: Chinese only display[2] Value = 02: English & Chinese display[2] Value = 03: French only display Value = 04: Other Language (if ILM present)[2] Value = 05: English & French display [4]	b	1	00
DF891B	Poll Mode Value = 00 : Auto-Poll Value = 01 : Poll on Demand **Note:** Only used for Vendi.	b	1	00
9F15	Merchant Category Code Classifies the type of business being done by the merchant, see ISO 8583:1993.	n4	2	00 00
9F16	Merchant Identifier	ans	15	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
9F1C	Terminal Identification	an	8	00 00 00 00 00 00 00 00
9F40	Additional Terminal Capabilities Indicates the data input and output capabilities of the terminal.	b	5	60 00 00 10 01
9F4E	Merchant Name and Location Allows the reader to be configured with the Merchants Name and Location (VCPS 2.1.1 and M/Chip 3.0)	ASCII	<=30	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
9F7C	Merchant Custom Data	b	<=20	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
FFF2	Interface Device Serial Number This is equivalent to tag 9F1E. They refer to the same parameter.	an	8	30 30 30 30 30 30 30 30

Tag	Data Object Name and Description	Format	Length (Bytes)	Default Value
FFF8	UI Scheme: Value = 00:ViVOpay User Interface (default) Value = 02:Visa Wave User Interface Value = 03:EMEA User Interface Note: LCD Messages need to be configured separately. Warning: EMEA UI is intended for use in the EMV or European environment, where the reader Vend is not allowed to poll continuously (e.g., operate in Auto Poll Mode). The reader Vend does NOT support Auto Poll while in EMEA UI mode. The reader is not certified to work properly in this situation. The reader Vendi supports Auto Poll while in EMEA UI mode.	b	1	00
9F53	Transaction Category Code Indicate type of transaction being performed, defined by MasterCard and Interac.	an	1	00
FFEE1D	Masked Output Data Parameter	b	5	04 04 2A 0C 31
FFEE1E	Group 0 Initialize Flag: Value = 00: not initialized.(If the tag is not found or Value is not 1, reader will initialize group 0 with default setting automatically when the power cycle is on) Value = 01: Initialized Only used for Kiosk III.	b	1	01

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the Reader has returned an OK Response Frame, the Terminal application should dispose of the tags to avoid conflicts with other proprietary TLVs.

[2] These objects only work on the ViVOpay graphic reader.

[3] Only applies to non-index messages. The default size for the LCD Font is 3. The Lookup table for all the messages are hard coded with the Font Size 3. The Font Size = 2 is treated only when the three messages are displayed on the screen. When the user wants to use the LCD Font size = 2, A store LCD message command can be used to configure the string by prefixing the %F2.

[4] These objects only work on the Vendi.

Group Configuration Tags

The following table contains tags that may be configured within a Configurable Group. For Group 0, default values exist. Except for groups associated with a PayPass AID, if a group does not define some of these TLVs, then the values in Group 0 will be used. The Set Configurable Group command should be used to set the TLVs in this section.

The PayPass configuration tags are documented separately. To configure a group that will be associated with a PayPass AID, refer to PayPass Group Configuration TLVs.

Table 20: Group Configuration TLVs

Tag	Description	Format	Length	Default Value in Group 0
9F58	Merchant Type Indicator Provides Merchant Type Indicator used by the card for risk management. Five values are valid: 01, 02, 03, 04 and 05. (Interac)	n1	1	03
9F59	Terminal Transaction Information (TTI) Provides Terminal Transaction Information for the current transaction. (Interac) **Note:** Vendi default values are B4 07 00.	b	3	DC 80 00
9F5D	Terminal Contactless Receipt Required Limit Limit Amount used to compare against Transaction amount to automatically print a transaction record. (Interac)	n12	6	00 00 00 00 50 00
9F5E	Terminal Option Status Options supported by the terminal. (Interac) **Note:** Vendi default values are 00 00.	b	2	E0 00
9F5F	Terminal (Reader) Contactless Floor Limit Floor limit amount used to compare against Transaction amount. (Interac)	n12	6	00 00 00 00 80 00
DF26	Enable/Disable Certificate Revocation list 0 = disable 1 = enable (default) M/Chip 3.02 can make use of the Certificate Revocation list. **Note:** Vendi default value is not present.	b	1	01
DF2A	Threshold Value for Biased Random Selection Value used in terminal risk management for random transaction selection. (Interac)	n12	6	00 00 00 00 50 00
DF2B	Maximum Target Percentage for Biased Random Selection Value used in terminal risk management for random transaction selection. (Interac)	b	1	32
DF2C	Target Percentage for Random Selection Value used in terminal risk management for random transaction selection. (Interac)	b	1	0A
DF51[1]	ExpressPay Terminal Capabilities Used to create the ExpressPay Terminal Capabilities TLV, 9F6D for Amex ExpressPay applications. **Note:** Vendi default value is not present.	b	1	80
DF64[1]	Enable/Disable Visa Wave cards Enables the use of Visa Wave cards (not the Visa Wave protocol). 00: Reject Visa Wave cards 01: Accept Visa Wave cards	b	1	00

Tag	Description	Format	Length	Default Value in Group 0
97	Default Transaction Certificate Data Object List (TDOL) List of TLV data objects to be used by the terminal to generate the TC Hash Value in case the TDOL is not returned by the card. **Note:** Vendi default value is not present. In Group 0, this tag must be encapsulated in another tag, FF67. FF67 encapsulates all "variable length" tags in group 0.	b	<=64	Zero length
9C	Transaction Type Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1987 Processing Code. (default = purchase *goods or services*)	n2	1	00
5F2A	Transaction Currency Code Indicates the currency code of the transaction according to ISO 4217. **Note:** make sure you use the same Transaction Currency Code for all configurable AIDs. (default = US Dollars)	n3	2	08 40
5F36	Transaction Currency Exponent Indicates the implied position of the decimal point from the right of the transaction amount represented according to ISO 4217. (decimal is two places from right of the transaction amount)	n1	1	02
9F01	Acquirer ID	n	6	Not present
9F02	Amount Authorized (Numeric)	n12	6	00 00 00 00 00 01
9F03	Amount Other (Numeric)	n12	6	00 00 00 00 00 00
9F09	Application Version Number PayPass M/Chip (Value = 00 02) D-PAS (Value = 00 02) Interac (Value = 00 02) Amex (Value = 00 01)	b	2	00 02
9F1A	Terminal Country Code Indicates the country code of the terminal, represented according to ISO 3166. Default = US	n3	2	08 40
9F1B	Terminal Floor Limit Indicates the floor limit in the terminal *for the AID(s) associated with this group*. **Note:** The value is the decimal limit amount given in binary represented in Hex in the command/response. (100 limit = 10000 decimal = 2710h). Default = $60.00	b	4	00 00 17 70
9F1C	Terminal Identification **Note:** Vendi default value is not present.	an	8	00 00 00 00 00 00 00 00

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 0</th></tr>
<tr><td>9F33</td><td>Terminal Capabilities
Indicates the card data input, CVM, and security capabilities of the terminal
Default =
▫ No CVM required
▫ SDA supported
▫ DDA supported
▫ Card Capture
▫ CDA supported</td><td>b</td><td>3</td><td>00 08 E8</td></tr>
<tr><td>9F35</td><td>Terminal Type
Indicates the environment of the terminal, its communications capability, and its operational control
Note: Vendi default value is 25.</td><td>n2</td><td>1</td><td>22</td></tr>
<tr><td>9F66</td><td>Terminal Transaction Qualifier (TTQ)
Determine the type of transaction (MSD, qVSDC, and Contactless VSDC) and whether online processing is supported.</td><td>b</td><td>4</td><td>80 00 40 00</td></tr>
<tr><td>9F6D</td><td>Application Version Number (MagStripe)
PayPass MagStripe (Value = 00 01)
Note: Vendi default value is not present.</td><td>b</td><td>2</td><td>00 01</td></tr>
<tr><td>DF28</td><td>Terminal Capabilities – No CVM Required
M/Chip v2.0 element indicating the Terminal Capabilities to be used when Amount, Authorized < CVM Required Limit. Formatted as Terminal Capabilities (tag ‘9F 33’)
Only byte 2 of this tag is actually used. The other terminal capabilities are configured using tag 9F33.
Note: Vendi default value is not present.
<table><tr><th>DF28 Byte</th><th>PayPass Tag Equivalent</th></tr><tr><td>2</td><td>DF8119</td></tr></table></td><td>b</td><td>3</td><td>00 08 E8</td></tr>
<tr><td>DF29</td><td>Terminal Capabilities – CVM Required
M/Chip v2.0 element indicating the Terminal Capabilities to be used when Amount, Authorized >= CVM Required Limit. Formatted as Terminal Capabilities (tag ‘9F 33’)
Only byte 2 of this tag is actually used. The other terminal capabilities are configured using tag 9F33.
Note: Vendi default value is not present.
<table><tr><th>DF29 Byte</th><th>PayPass Tag Equivalent</th></tr><tr><td>2</td><td>DF8118</td></tr></table></td><td>b</td><td>3</td><td>00 68 E8</td></tr>
<tr><td>FFE4[1]</td><td>Group Number
The group number assigned to this group of parameters. AIDs may be associated with the group number.
This tag is mandatory when getting or setting group parameters and it must be the 1st TLV in Data Field. It is used as the “key” for the group parameter set.</td><td>n2</td><td>1</td><td>--</td></tr>
</table>

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 0</th></tr>
<tr><td>FFF1[1]</td><td>Terminal Contactless Transaction Limit
Indicates the terminal limit for this AID for Contactless transactions.</td><td>n12</td><td>6</td><td>00 00 00 01 00 00</td></tr>
<tr><td>FFF4[1]</td><td>Visa Reader Risk Flags
Byte 1
<table>
<tr><th>b 8</th><th>b 7</th><th>b 6</th><th>b 5</th><th>b 4</th><th>b 3</th><th>b 2</th><th>b 1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Status Check</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>-</td><td>RFU</td></tr>
</table>
Byte 2:
<table>
<tr><th>b 8</th><th>b 7</th><th>b 6</th><th>b 5</th><th>b 4</th><th>b 3</th><th>b 2</th><th>b 1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Transaction Limit Check</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>CVM Required Limit Test</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>Terminal Floor Limit Check</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>Cash Transaction Reader Risk (RR)</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Cashback Reader Risk (RR)</td></tr>
<tr><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>DRL (Dynamic Reader Limits) RR</td></tr>
<tr><td>X</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>RFU</td></tr>
</table>
Byte 3
<table>
<tr><th>b 8</th><th>b 7</th><th>b 6</th><th>b 5</th><th>b 4</th><th>b 3</th><th>b 2</th><th>b 1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>1 = online cryptogram required for zero amount (only used with zero amount check enabled)</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>1 = perform zero amount check</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>-</td><td>-</td><td>RFU</td></tr>
</table>
For example:
0x00 = Zero Amount check disabled.
0x01 = Zero Amount check is disabled and online cryptogram required bit will not be checked. (default)
0x02 = Zero Amount check enabled.
0x03 = Zero Amount check enabled and Option 1, online Cryptogram Required
Note: Vendi default values are 01 00 01.</td><td>b</td><td>3</td><td>00 06 01</td></tr>
</table>

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 0</th></tr>
<tr><td></td><td>D-PAS Reader Risk Flags:
Byte 1
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>RFU</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>1=Status Check Support</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>-</td><td>RFU</td></tr>
</table>
Byte 2:
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>RFU</td></tr>
</table>
Byte 3
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>1 = online cryptogram required for zero amount</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>-</td><td>RFU</td></tr>
</table></td><td>b</td><td>3</td><td></td></tr>
<tr><td>FFF5[1]</td><td>CVM Required Limit
Indicates the CVM required limit in the terminal for the associated AIDs.</td><td>n12</td><td>6</td><td>00 00 00 00 80 00</td></tr>
<tr><td>FFFC[1]</td><td>PayPass Profile (also used for Amex)
Information in this tag is equivalent to PayPass tag DF811B, although it is formatted slightly differently:
<table>
<tr><th>87654321</th><th>Bit Meaning</th><th>Value</th></tr>
<tr><td>-------X</td><td>MagStripe Only</td><td>0 = normal transaction
1 = MagStripe only transaction allowed</td></tr>
<tr><td>------X-</td><td>M/Chip Only</td><td>0 = normal transaction
1 = M/Chip only transaction allowed</td></tr>
<tr><td>-----X--</td><td>On Device CVM</td><td>0 = not supported
1 = supported</td></tr>
<tr><td>XXXXX---</td><td>RFU</td><td></td></tr>
</table>
The default value is 0x01 – support MagStripe only.

Note: Vendi default value is not present.</td><td>b</td><td>1</td><td>01</td></tr>
<tr><td>FFFD[1]</td><td>Terminal Action Code (Online)
Reflect the acquirer-selected action to be taken upon analysis of the TVR.</td><td>b</td><td>5</td><td>F8 50 AC F8 00</td></tr>
<tr><td>FFFE[1]</td><td>Terminal Action Code (Default)
Reflect the acquirer-selected action to be taken upon analysis of the TVR.</td><td>b</td><td>5</td><td>F8 50 AC A0 00</td></tr>
<tr><td>FFFF[1]</td><td>Terminal Action Code (Denial)
Reflect the acquirer-selected action to be taken upon analysis of the TVR.</td><td>b</td><td>5</td><td>00 00 00 00 00</td></tr>
</table>

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 0</th></tr>
<tr><td>FFF0[1]</td><td>Specific Feature Switch
Used with Visa VCPS 2.1.1/2.1.2. It controls Visa CVN17 support and Track 1 & 2 data in the transaction response.
Byte 1
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th></th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>RFU (Deprecated)</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>1 = Visa CVN17 supported
0 = Visa CVN17 disabled</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>1 = Remove Track 1 data in Visa response</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>1 = Remove Track 2 data in Visa response</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>RFU</td></tr>
</table>
Byte 2: RFU
Byte 3: RFU</td><td>b</td><td>3</td><td>02 00 00</td></tr>
<tr><td>9F5A</td><td>Terminal Transaction Type (Interac)
• 0x00 = Purchase
• 0x01 = Refund</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>FFEE1D</td><td>Masked Output Data Parameter
When there is a PAN to be output in masked format, this parameter gives the key points of the format.
Byte 1: PrePAN, value scope is [0, 6],
Byte 2: PosPAN, value scope is [0, 4],
Byte 3: MaskAscii, value scope is [20h, 7Eh],
Byte 4: MaskHex, value scope is [0Ah, 0Fh]
Byte 5: Expire date output option,
0x30=Mask, 0x31=NotMask, default 0x31
For detailed rules, please refer to "ID-Tech Encypt Data Format In Command / Response Specification for ICC Communication".</td><td>b</td><td>5</td><td>04 04 2A 0C 31</td></tr>
<tr><td>9F41</td><td>Counter maintained by the terminal that is incremented by one for each transaction

Note: Vendi default value is not present.</td><td>n 4</td><td>4</td><td>Not Present</td></tr>
<tr><td>DF891C</td><td>“Interac Retry Limit”
Configured value for the total number of tap attempts during an Interac Mobile Debit (NFC) application transaction.
Note: Vendi default value is not present.</td><td>n1</td><td>1</td><td>Not Present</td></tr>
</table>

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the Reader has returned an OK Response Frame, the Terminal application should dispose of the tags to avoid conflicts with other proprietary TLVs.

[2] Not used by M/Chip 3.0 because M/Chip 3.0 redefines this as a card tag that passes Application Capability Information.

[3] These objects only work on the Vendi.

[4] These objects only work on the ViVOpay graphic reader.

PayPass Group Configuration TLVs

If a PayPass AID will be assigned to a group, then the table in this section should be used to configure the group. The Set Configurable Group command should be used to set the TLVs in this section.

The following PayPass Group TLVs should not be configured for Group 0. The default PayPass group is Group 1. That is, when the reader is configured from the factory, the PayPass System AIDs will be associated with Group 1.

If there are tags in a PayPass group that should be set, they must all be set explicitly, since the absent values *are not* filled in with Group 0 or Group 1 defaults.

PayPass Group tags are instantiated a little differently than other groups. Group 0 is never used as a default. Refer to the section on PayPass Default Group for an explanation of how the tag database is instantiated for PayPass.

Table 21: PayPass Default Group Configuration TLVs

Tag	Description	Format	Length	Default Value in Group 1
97	Default Transaction Certificate Data Object List (TDOL) List of TLV data objects to be used by the terminal to generate the TC Hash Value in case the TDOL is not returned by the card	b	<=64	Not present
9A	Transaction Date (YYMMDD) Indicates local date that the transaction was authorized. Note: The reader does not perform range checking on this value. The POS application should perform range checking on this value to ensure it is within acceptable limits. Default value = FF FF FF (use the RTC for date and time.) When this value is set in a PayPass group, it should generally be set to FF FF FF (use the RTC). Setting this value to something other than FF FF FF may have unexpected results. The transaction date and time may be overridden by the terminal if the 9A and 9F21 TLVS are supplied in an Activate command.	n6	3	FF FF FF
9C	Transaction Type Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1987 Processing Code (default = purchase *goods or services*)	n2	1	00
5F2A	Transaction Currency Code Indicates the currency code of the transaction according to ISO 4217. **Note:** make sure you use the same Transaction Currency Code for all configurable AIDs. Default = US Dollars(08 40)	n3	2	08 40
5F36	Transaction Currency Exponent Indicates the implied position of the decimal point from the right of the transaction amount represented according to ISO 4217. Default = decimal is two places to the right of the last digit of the transaction amount.	n1	1	02
9F01	Acquirer ID	n	6	Not present
9F02	Amount Authorized (Numeric) **Note:** Vendi default value is not present.	n12	6	00 00 00 00 00 01
9F03	Amount Other (Numeric)	n12	6	00 00 00 00 00 00
9F09	Application Version Number (M/Chip) PayPass M/Chip 3.0(Value = 00 02) Amex (Value = 00 01)	b	2	00 02
9F15	Merchant Category Code Classifies the type of business being done by the merchant, see ISO 8583:1993.	n4	2	11 11
9F16	Merchant Identifier	ans	15	Not present

Tag	Description	Format	Length	Default Value in Group 1
9F1A	Terminal Country Code Indicates the country code of the terminal, represented according to ISO 3166.	n3	2	08 40
9F1B	Terminal Floor Limit Indicates the floor limit in the terminal in conjunction with the AID (hex). This tag is equivalent to MasterCard tag DF8123 Reader Contactless Floor Limit.	b	4	00 00 17 70
9F1C	Terminal Identification **Note:** Vendi default values are 00 00 00 00 00 00 00 00.	an	8	zero length
9F1E	Interface Device Serial Number This is intended to be the serial number *of the terminal/POS*. It is configured by the POS and is unique to the terminal. **Note:** KioskIII/Vendi default value is not present.	an	8	30 30 30 30 30 30 30 30
9F21	Transaction Time (HHMMSS) Indicates local time that the transaction was authorized. Default = use RTC.	n6	3	FF FF FF
9F33	Terminal Capabilities Indicates the card data input, CVM, and security capabilities of the terminal. This tag (9F33) only configures bytes 1 and 3 of the terminal capabilities. Byte 2 of the terminal capabilities actually comes from DF28 or DF29 during the transaction. Refer to tags DF28 and DF29 for details. Note: Byte 1 of 9F33 is the same as DF8117 Card Data Inpput Capability defined in PayPass 3.0.2 and Byte 3 of 9F33 is the same as DF811F Security Capability.	b	3	00 08 E8
9F35	Terminal Type Indicates the environment of the terminal, its communications capability, and its operational control **Note:** Vendi default value is 25.	n2	1	22
9F40	Additional Terminal Capabilities Indicates the data input and output capabilities of the terminal **Note:** Vendi default values are 60 00 00 10 01.	b	5	60 00 00 30 00
9F4E	Merchant Name and Location Allows the reader to be configured with the Merchants Name and Location (VCPS 2.1.1 and M/Chip 3.0)	ASCII	30	Not present

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 1</th></tr>
<tr><td>9F53</td><td>Transaction Category Code
This is a data object defined by MasterCard which indicates the type of transaction being performed, and which may be used in card risk management.
Note: Vendi default value is 00.</td><td>an</td><td>1</td><td>01</td></tr>
<tr><td>9F66</td><td>Terminal Transaction Qualifier (TTQ)
Determine the type of transaction (MSD, qVSDC, and Contactless VSDC) and whether online processing is supported.</td><td>b</td><td>4</td><td>Not present</td></tr>
<tr><td>9F6D</td><td>Application Version Number (MagStripe)
PayPass MagStripe (Value = 00 01)</td><td>b</td><td>2</td><td>00 01</td></tr>
<tr><td>9F6E</td><td>Third Party Data</td><td></td><td></td><td>Not present</td></tr>
<tr><td>9F7C</td><td>Merchant Custom Data</td><td>b</td><td><=20</td><td>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00</td></tr>
<tr><td>9F7E</td><td>Mobile Support Indication. (PayPass only)
Note: Vendi default value is 00.</td><td>b</td><td>1</td><td>Zero length</td></tr>
<tr><td>DF28</td><td>Terminal Capabilities – No CVM Required
M/Chip v2.0 element indicating the Terminal Capabilities to be used when Amount, Authorized < CVM Required Limit. Formatted as Terminal Capabilities (tag ‘9F 33’)
Only byte 2 of this tag is actually used. The other terminal capabilities are configured using tag 9F33.
<table><tr><th>DF28 Byte</th><th>PayPass Tag Equivalent</th></tr><tr><td>2</td><td>DF8119</td></tr></table></td><td>b</td><td>3</td><td>00 08 E8</td></tr>
<tr><td>DF29</td><td>Terminal Capabilities – CVM Required
M/Chip v2.0 element indicating the Terminal Capabilities to be used when Amount, Authorized >= CVM Required Limit. Formatted as Terminal Capabilities (tag ‘9F 33’)
Only byte 2 of this tag is actually used. The other terminal capabilities are configured using tag 9F33.
<table><tr><th>DF29 Byte</th><th>PayPass Tag Equivalent</th></tr><tr><td>2</td><td>DF8118</td></tr></table></td><td>b</td><td>3</td><td>00 68 E8</td></tr>
<tr><td>DF8104</td><td>Pre Gen-AC Balance Read
If this tag is defined, a transaction will read the balance before Gen-AC. This tag may also be sent in the Activate to indicate that the balance should be read prior to Gen-AC.</td><td>n12</td><td>6</td><td>Not present</td></tr>
<tr><td>DF8105</td><td>Post Gen-AC Balance Read
If this tag is defined, a transaction will read the balance after Gen-AC. This tag may also be sent in the Activate to indicate that the balance should be read after Gen-AC.</td><td>n12</td><td>6</td><td>Not present</td></tr>
</table>

Tag	Description	Format	Length	Default Value in Group 1
DF811A	Default UDOL Used for calculating the CCC if no UDOL is present in the card. The default is the tag and length of the "Unpredictable Number".	b	3	9F 6A 04
DF811C	Maximum Lifetime of Torn Transaction Record This is the maximum time a torn record can exist in the log before it expires. It is expressed in seconds. While the transaction log is global to the reader, the MasterCard application is the only application that supports it.	b	2	Not Present
DF811D	Maximum Number of Torn Transaction Records Due to storage limitations, the maximum number of records that may be configured is 2. There may be 0, 1, or 2 torn transaction records configured. If 0 records are configured, the torn transaction recovery facility is effectively disabled. While the transaction log is global to the reader, the MasterCard application is the only application that supports it.	b	1	Not Present
DF811E	MagStripe CVM Required Capability Indicates the CVM capability of the Terminal/Reader in the case of a mag-stripe mode transaction when the *Amount, Authorized (Numeric)* is greater than the *Reader CVM Required Limit*.	b	1	10
DF8124	Reader Contactless Transaction Limit, No On-Device CVM When there is no On-Device CVM available (e.g. with a phone), then this is the transaction limit that will be used. Default = $300.00	n12	6	00 00 00 03 00 00
DF8125	Reader Contactless Transaction Limit, On-Device CVM When On-Device CVM is available (e.g. with a phone) then this is the transaction limit that will be used. **Note:** Vendi default values are 00 00 00 03 00 00. KioskIII default values are 00 00 00 05 00 00.	n12	6	Not Present
DF812C	MagStripe No CVM Required Capability Indicates the CVM capability of the Terminal/Reader in the case of a mag-stripe mode transaction when the *Amount, Authorized (Numeric)* is less than or equal to the *Reader CVM Required Limit*.	b	1	00
DF812D	Message Hold Time Indicates the default delay for the processing of the next MSG signal. The Message Hold Time is an integer in units of 100ms. While this value is configurable, it is not used in practice in the reader. It is a MasterCard requirement.	n6	3	Not Present

Tag	Description	Format	Length	Default Value in Group 1
DF8130	RF Hold Time Value Indicates the time that the field is to be turned off after the transaction is completed if requested to do so by the cardholder device. The Hold Time Value is in units of 100ms. While this value is configurable, it is not used in practice in the reader. It is a MasterCard requirement.	b	1	Not Present
DF8131	Phone Message Table Defines for the selected AID the message and status identifiers as a function of the POS Cardholder Interaction Information. The Phone Message Table is a variable length list with 8-byte entries. Each entry in the Phone Message Table contains the following fields: PCII Mask (3 bytes, binary) PCII Value (3 bytes, binary) Message Identifier (1 byte, binary) Status (1 byte, binary) The last entry in the phone message table must always have the PCII Mask and PCII Value set to '000000'.	B	Var	No Present
FF69	Proprietary Tag List Proprietary tags that are not otherwise configured may be configured by encapsulating them in this tag list.	b	<=32	Not present
FFE4[1]	Group Number The group number that contains the characteristics for this AID This tag is mandatory when getting or setting group parameters and it must be the 1st TLV in Data Field.	n2	1	--
FFF1[1]	Terminal Contactless Transaction Limit Indicates the terminal limit for this AID for Contactless transactions.	n12	6	00 00 00 01 00 00
FFF5[1]	CVM Required Limit Indicates the CVM required limit in the terminal *for the associated AIDs*. Default = $80.00 This is equivalent to MasterCard tag DF8126.	n12	6	00 00 00 00 80 00

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 1</th></tr>
<tr><td>FFF8[1]</td><td>UI Scheme:
Value = 00:ViVOpay User Interface (default)
Value = 02:Visa Wave User Interface
Value = 03:EMEA User Interface
Note: LCD Messages need to be configured separately.
Warning: EMEA UI is intended for use in the EMV or European environment, where the reader is not allowed to poll continuously (e.g., operate in Auto Poll Mode). The reader does NOT support Auto Poll while in EMEA UI mode. The reader is not certified to work properly in this situation.

Note: Vendi default value is not present.

For PayPass M/Chip, this value should be set to 03 (EMEA). It defaults to ViVOpay for backward compatibility with MagStripe applications.</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>FFFB[1]</td><td>Language Option for LCD display:
Value = 00: English only display (default)
Value = 01: Chinese only display[2]
Value = 02: English & Chinese display[2]
Value = 03: French only display
Value = 04: Other Language (if ILM present)[2]
Value = 05: English & French display [3]

Note: Vendi default value is not present.</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>FFFC[1]</td><td>PayPass Profile
Information in this tag is equivalent to PayPass tag DF811B, although it is formatted slightly differently:
<table><tr><th>87654321</th><th>Bit Meaning</th><th>Values</th></tr><tr><td>-------X</td><td>MagStripe Only</td><td>0 = normal transaction
1 = MagStripe only transactions allowed</td></tr><tr><td>------X-</td><td>M/Chip Only</td><td>0 = normal transaction
1 = M/Chip only Transactions allowed</td></tr><tr><td>-----X--</td><td>On Device CVM</td><td>0 = not supported
1 = supported</td></tr><tr><td>XXXXX---</td><td>RFU</td><td></td></tr></table>The default value is 0x01 – support MagStripe only.</td><td>b</td><td>1</td><td>01</td></tr>
<tr><td>FFFD[1]</td><td>Terminal Action Code (Online)
Reflect the acquirer-selected action to be taken upon analysis of the TVR.

This is equivalent to MasterCard tag DF8122.</td><td>b</td><td>5</td><td>F8 50 AC F8 00</td></tr>
<tr><td>FFFE[1]</td><td>Terminal Action Code (Default)
Reflect the acquirer-selected action to be taken upon analysis of the TVR.

This is equivalent to MasterCard tag DF8120.</td><td>b</td><td>5</td><td>F8 50 AC A0 00</td></tr>
</table>

Tag	Description	Format	Length	Default Value in Group 1
FFFF[1]	Terminal Action Code (Denial) Reflect the acquirer-selected action to be taken upon analysis of the TVR. This is equivalent to MasterCard tag DF8121.	b	5	00 00 00 00 00
FFF2	Interface Device Serial Number This is equivalent to tag 9F1E. They refer to the same parameter.	an	8	30 30 30 30 30 30 30 30

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the Reader has returned an OK Response Frame, the Terminal application should dispose of the tags to avoid conflicts with other proprietary TLVs.

[2] These objects only work on the ViVOpay graphic reader.

[3] These objects only work on the Vendi

PayPass Group Configuration TLVs with Hard-Coded Values in Kernel

PayPass transactions do not use Group 0 at all. If a TLV data item has not been defined in a PayPass group (Group 1 or higher), then the default value is not picked up from Group 0 as for other card types.

There is a minimal sub-set of TLV data items that must be present for a PayPass transaction to be performed. If any of the data items from this sub-set are not present, a PayPass transaction cannot be performed.

To allow PayPass transactions to be performed even if these critical data items are missing from the PayPass group, The PayPass Kernel keeps a set of hard-coded default values for these data items. If any of these data items are not present in the PayPass Group then the kernel uses the hard-coded value for the missing data item.

A list of data items that have a hard-coded value and the default value are given in the following table.

If any of these data items is “not present” in the PayPass group, then a Get Group command will not return the values for these data items even though the PayPass kernel will use the hard-coded default values for these data items.

Table 22: PayPass Group Configuration TLVs with Hard-Coded Default Values in Kernel

Tag	Description	Format	Length	Hard-Coded Default Value in PayPass Kernel
9C	Transaction Type Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1987 Processing Code (default = purchase *goods or services*)	n2	1	00
9F09	Application Version Number (Reader) PayPass M/Chip 3.0	b	2	00 02
9F1A	Terminal Country Code Indicates the country code of the terminal, represented according to ISO 3166.	n3	2	00 00
9F1B	Terminal Floor Limit Indicates the floor limit in the terminal in conjunction with the AID (hex). This tag is equivalent to MasterCard tag DF8123 Reader Contactless Floor Limit.	b	4	00 00 17 70
9F33	Terminal Capabilities Indicates the card data input, CVM, and security capabilities of the terminal. This tag (9F33) only configures bytes 1 and 3 of the terminal capabilities. Byte 2 of the terminal capabilities actually comes from DF28 or DF29 during the transaction. Refer to tags DF28 and DF29 for details. Note: Byte 1 of 9F33 is the same as DF8117 Card Data Input Capability defined in PayPass 3.0.2 and Byte 3 of 9F33 is the same as DF811F Security Capability.	b	3	00 00 00
9F35	Terminal Type Indicates the environment of the terminal, its communications capability, and its operational control	n2	1	00
9F40	Additional Terminal Capabilities Indicates the data input and output capabilities of the terminal	b	5	00 00 00 00 00
9F6D	Application Version Number (MagStripe) PayPass MagStripe (Value = 00 01)	b	2	00 01
DF28	Terminal Capabilities – No CVM Required M/Chip v2.0 element indicating the Terminal Capabilities to be used when Amount, Authorized < CVM Required Limit. Formatted as Terminal Capabilities (tag '9F 33') Only byte 2 of this tag is actually used. The other terminal capabilities are configured using tag 9F33. DF28 Byte: 2 — PayPass Tag Equivalent: DF8119	b	3	00 00 E8

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Hard-Coded Default Value in PayPass Kernel</th></tr>
<tr><td>DF29</td><td>Terminal Capabilities – CVM Required
M/Chip v2.0 element indicating the Terminal Capabilities to be used when Amount, Authorized >= CVM Required Limit. Formatted as Terminal Capabilities (tag ‘9F 33’)
Only byte 2 of this tag is actually used. The other terminal capabilities are configured using tag 9F33.
<table><tr><th>DF29 Byte</th><th>PayPass Tag Equivalent</th></tr><tr><td>2</td><td>DF8118</td></tr></table></td><td>b</td><td>3</td><td>00 00 E8</td></tr>
<tr><td>DF811A</td><td>Default UDOL
Used for calculating the CCC if no UDOL is present in the card. The default is the tag and length of the “Unpredictable Number”.</td><td>b</td><td>3</td><td>9F 6A 04</td></tr>
<tr><td>DF811C</td><td>Maximum Lifetime of Torn Transaction Record
This is the maximum time a torn record can exist in the log before it expires. It is expressed in seconds.
While the transaction log is global to the reader, the MasterCard application is the only application that supports it.</td><td>b</td><td>2</td><td>01 2C</td></tr>
<tr><td>DF811D</td><td>Maximum Number of Torn Transaction Records
Due to storage limitations, the maximum number of records that may be configured is 2. There may be 0, 1, or 2 torn transaction records configured. If 0 records are configured, the torn transaction recovery facility is effectively disabled.
While the transaction log is global to the reader, the MasterCard application is the only application that supports it.</td><td>b</td><td>1</td><td>00</td></tr>
<tr><td>DF811E</td><td>MagStripe CVM Required Capability
Indicates the CVM capability of the Terminal/Reader in the case of a mag-stripe mode transaction when the Amount, Authorized (Numeric) is greater than the Reader CVM Required Limit.</td><td>b</td><td>1</td><td>F0</td></tr>
<tr><td>DF8124</td><td>Reader Contactless Transaction Limit, No On-Device CVM
When there is no On-Device CVM available (e.g. with a phone), then this is the transaction limit that will be used.</td><td>n12</td><td>6</td><td>00 00 00 00 00 00</td></tr>
<tr><td>DF8125</td><td>Reader Contactless Transaction Limit, On-Device CVM
When On-Device CVM is available (e.g. with a phone) then this is the transaction limit that will be used.</td><td>n12</td><td>6</td><td>00 00 00 00 00 00</td></tr>
<tr><td>DF812C</td><td>MagStripe No CVM Required Capability
Indicates the CVM capability of the Terminal/Reader in the case of a mag-stripe mode transaction when the Amount, Authorized (Numeric) is less than or equal to the Reader CVM Required Limit.</td><td>b</td><td>1</td><td>F0</td></tr>
</table>

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Hard-Coded Default Value in PayPass Kernel</th></tr>
<tr><td>DF812D</td><td>Message Hold Time
Indicates the default delay for the processing of the next MSG signal. The Message Hold Time is an integer in units of 100ms.
While this value is configurable, it is not used in practice in the reader. It is a MasterCard requirement.</td><td>n6</td><td>3</td><td>00 00 13</td></tr>
<tr><td>DF8130</td><td>RF Hold Time Value
Indicates the time that the field is to be turned off after the transaction is completed if requested to do so by the cardholder device. The Hold Time Value is in units of 100ms.
While this value is configurable, it is not used in practice in the reader. It is a MasterCard requirement.</td><td>b</td><td>1</td><td>0D</td></tr>
<tr><td>DF8131</td><td>Phone Message Table
Defines for the selected AID the message and status identifiers as a function of the POS Cardholder Interaction Information. The Phone Message Table is a variable length list with 8-byte entries. Each entry in the Phone Message Table contains the following fields:
PCII Mask (3 bytes, binary)
PCII Value (3 bytes, binary)
Message Identifier (1 byte, binary)
Status (1 byte, binary)
The last entry in the phone message table must always have the PCII Mask and PCII Value set to ‘000000’.</td><td>b</td><td>Var.</td><td>See next table ‘Phone Message Table Hard-Coded Default Value in Kernel’.</td></tr>
<tr><td>FFF5[1]</td><td>CVM Required Limit
Indicates the CVM required limit in the terminal for the associated AIDs.
This is equivalent to MasterCard tag DF8126.</td><td>n12</td><td>6</td><td>00 00 00 00 00 00</td></tr>
<tr><td>FFFC[1]</td><td>PayPass Profile
Information in this tag is equivalent to PayPass tag DF811B, although it is formatted slightly differently:
<table>
<tr><th>87654321</th><th>Bit Meaning</th><th>Values</th></tr>
<tr><td>-------X</td><td>MagStripe Only</td><td>0 = normal transaction
1 = MagStripe only transactions allowed</td></tr>
<tr><td>------X-</td><td>M/Chip Only</td><td>0 = normal transaction
1 = M/Chip only Transactions allowed</td></tr>
<tr><td>-----X--</td><td>On Device CVM</td><td>0 = not supported
1 = supported</td></tr>
<tr><td>XXXXX---</td><td>RFU</td><td></td></tr>
</table></td><td>b</td><td>1</td><td>00</td></tr>
</table>

Tag	Description	Format	Length	Hard-Coded Default Value in PayPass Kernel
FFFD[1]	Terminal Action Code (Online) Reflect the acquirer-selected action to be taken upon analysis of the TVR. This is equivalent to MasterCard tag DF8122.	b	5	CC 00 00 00 00
FFFE[1]	Terminal Action Code (Default) Reflect the acquirer-selected action to be taken upon analysis of the TVR. This is equivalent to MasterCard tag DF8120.	b	5	CC 00 00 00 00
FFFF[1]	Terminal Action Code (Denial) Reflect the acquirer-selected action to be taken upon analysis of the TVR. This is equivalent to MasterCard tag DF8121.	b	5	00 00 00 00 00

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the Reader has returned an OK Response Frame, the Terminal application should dispose of the tags to avoid conflicts with other proprietary TLVs.

Table 23: Phone Message Table - Hard-Coded Default Value in Kernel

PCI Mask	PCII Value	Message Identifier	Status
000800	000800	20 (SEE PHONE)	00 (NOT READY)
000400	000400	20 (SEE PHONE)	00 (NOT READY)
000100	000100	20 (SEE PHONE)	00 (NOT READY)
000200	000200	20 (SEE PHONE)	00 (NOT READY)
000000	000000	20 (SEE PHONE)	00 (NOT READY)

American Express Group Configuration TLVs

If a American Express AID will be assigned to a group, then the table in this section should be used to configure the group. The Set Configurable Group command should be used to set the TLVs in this section.

The following American Express Group TLVs should not be configured for Group 0. The default American Express group is Group 2. That is, when the reader is configured from the factory, the American Express System AIDs will be associated with Group 2.

If there are tags in a American Express group that should be set, they must all be set explicitly, since the absent values *are not* filled in with Group 0 or Group 1 defaults.

American Express Group tags are instantiated a little differently than other groups. Group 0 is never used as a default. Refer to the section on American Express Default Group for an explanation of how the tag database is instantiated for American Express.

Table 24: American Express Default Group 2 Configuration TLVs

Tag	Description	Format	Length	Default Value in Group 2
5F2A	Transaction Currency Code Indicates the currency code of the transaction according to ISO 4217. **Note:** make sure you use the same Transaction Currency Code for all configurable AIDs. (default = US Dollars)	n3	2	08 40
9A	Transaction Date (YYMMDD) This value is used to set the Real Time Clock. Note: The terminal/POS application should perform range checking on this value to ensure it is within acceptable limits.	n6	3	FF FF FF
9C	Transaction Type Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1987 Processing Code. (default = purchase *goods or services*)	n2	1	00
9F03	Amount Other (Numeric)	n12	6	00 00 00 00 00 00
9F09	Application Version Number PayPass M/Chip (Value = 00 02) Amex (Value = 00 01)	b	2	00 01
9F1A	Terminal Country Code Indicates the country code of the terminal, represented according to ISO 3166. Default = US	n3	2	08 40
9F1B	Terminal Floor Limit ndicates the floor limit in the terminal *for the AID(s) associated with this group.* **Note:** The value is the decimal limit amount given in binary represented in Hex in the command/response. (60 limit = 6000 decimal = 1770h).	b	4	00 00 17 70

<table>
<tr><th>Tag</th><th>Description</th><th>Format</th><th>Length</th><th>Default Value in Group 2</th></tr>
<tr><td>9F21</td><td>Transaction Time (HHMMSS)
This value is used to set the Real Time Clock.
Note: The terminal/POS application should perform range checking on this value to ensure it is within acceptable limits.</td><td>n6</td><td>3</td><td>FF FF FF</td></tr>
<tr><td>9F33</td><td>Terminal Capabilities
Indicates the card data input, CVM, and security capabilities of the terminal
Default =
• No CVM required
• SDA supported
• DDA supported
• Card Capture
• CDA supported</td><td>b</td><td>3</td><td>00 08 E8</td></tr>
<tr><td>9F35</td><td>Terminal Type
Indicates the environment of the terminal, its communications capability, and its operational control
<table><tr><th>Environment</th><th colspan="3">Operational Control Provided By:</th></tr><tr><th></th><th>Financial Institution</th><th>Merchant</th><th>Cardholder</th></tr><tr><td>Attended
Online only
Offline with online capability
Offline only</td><td>
11
12
13</td><td>
21
22
23</td><td></td></tr><tr><td>Unattended
Online only
Offline with online capability
Offline only</td><td>
14
15
16</td><td>
24
25
26</td><td>
34
35
36</td></tr></table></td><td>n2</td><td>1</td><td>25</td></tr>
<tr><td>9F6E</td><td>Terminal Transaction Capabilities</td><td>b</td><td>4</td><td>D8 E0 00 00</td></tr>
<tr><td>DF51</td><td>ExpressPay Terminal Capabilities
Used to create the ExpressPay Terminal Capabilities TLV, 9F6D for Amex ExpressPay applications.</td><td>b</td><td>1</td><td>C0</td></tr>
<tr><td>FFEE1C</td><td>UN range</td><td>b</td><td>4</td><td>00 00 00 3C</td></tr>
<tr><td>FFF1[1]</td><td>Terminal Contactless Transaction Limit
Indicates the terminal limit for this AID for Contactless transactions.</td><td>n12</td><td>6</td><td>00 00 00 01 50 00</td></tr>
<tr><td>FFF5[1]</td><td>CVM Required Limit
Indicates the CVM required limit in the terminal for the associated AIDs.</td><td>n12</td><td>6</td><td>00 00 00 00 50 00</td></tr>
<tr><td>FFFD[1]</td><td>Terminal Action Code (Online)
Reflect the acquirer-selected action to be taken upon analysis of the TVR.</td><td>b</td><td>5</td><td>00 00 00 00 00</td></tr>
</table>

Tag	Description	Format	Length	Default Value in Group 2
FFFE[1]	Terminal Action Code (Default) Reflect the acquirer-selected action to be taken upon analysis of the TVR.	b	5	00 00 00 00 00
FFFF[1]	Terminal Action Code (Denial) Reflect the acquirer-selected action to be taken upon analysis of the TVR.	b	5	00 00 00 00 00

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the Reader has returned an OK Response Frame, the Terminal application should dispose of the tags to avoid conflicts with other proprietary TLVs.

[2] These objects only work on the ViVOpay graphic reader.

[3] These objects only work on the Vendi

AID Configuration Tags

In this table, the "Usage" column indicates when the tag is used. In some cases, the use may depend on whether a system AID or a user AID is being configured. The possible usages are:

- MAND – this is a mandatory tag when configuring an AID
- OPT – this is an optional tag when configuring an AID
- NEVER – this tag should never be used for configuring this type of AID (e.g. "System")
- DEP – this tag is Mandatory depending on how another tag is configured.

For default values of the AID configuration TLVs for each System AID, refer to the System AID Default Configuration TLVs table in the appendix.

Table 25: AID Configuration TLVs

Tag	Data Object Name	Usage	Description	Format	Length
9F06	Application Identifier (AID)	MAND	Identifies the application as described in ISO/IEC 7816-5. This must be the 2nd TLV in the data field.	b	5 – 16
DF7C	Auto-Switch	OPT	Automatically switch to Pass-Through Mode when PICC is unknown. 00h = disabled (default) 01h = enabled	b	1
FFE0[1]	Registered Application Provider Identifier (RID)	Sys = NEVER User = OPT	Identifies the payment system to which the Certification Authority Public Key is associated. If this Tag is not provided the first five bytes from the AID are used.	b	5

<table>
<tr><td>FFE1[1]</td><td>Partial Selection Allowed</td><td>OPT (Visa MAND)</td><td>Tells the reader to allow partial selection during the initial select process. 01 = Allowed, 00 = Disabled
Note: Required for Visa application flow, this value is set to 01 Allowed and cannot be changed.</td><td>b</td><td>1</td></tr>
<tr><td>FFE2[1]</td><td>Application Flow</td><td>Sys = NEVER

User = MAND</td><td>1 (01h) – MasterCard MagStripe Application
2 (02h) – American Express Application
3 (03h) – MasterCard PayPass Application
6 (06h) - Visa Application.
13 (0Dh) - Discover Application
14 (0Eh) – JCB QuicPay Application
15 (0Fh) – STAR Application
21 (15h) –Interac Application
23 (17h) - Android Pay Application</td><td>b</td><td>1</td></tr>
<tr><td>FFE3</td><td>Selection Features</td><td>OPT</td><td>Enables or disables selection features. For M/Chip 3.0, this value will default to 74h. Please refer to the Selection Features section for a detailed description of this tag.

<table><tr><th>87654321</th><th>Selection Feature</th></tr><tr><td>-------x</td><td>Deprecated / RFU</td></tr><tr><td>------x-</td><td>Extended Selection Supported</td></tr><tr><td>-----x--</td><td>Cardholder Confirmation Not Supported</td></tr><tr><td>----x---</td><td>API (application priority indicator) required</td></tr><tr><td>---x----</td><td>Invalid AID Allowed</td></tr><tr><td>--x-----</td><td>Duplicate AID Allowed</td></tr><tr><td>-x------</td><td>Enable Kernel ID</td></tr><tr><td>x-------</td><td>RFU</td></tr></table></td><td>b</td><td>1</td></tr>
<tr><td>FFE4[1]</td><td>TLV Group Number</td><td>MAND</td><td>The TLV Group number that contains the characteristics for this AID
This must be the 1st TLV in Data Field.

For MasterCard PayPass and any applications that use the Combined Selection Feature, this tag represents the fallback group if the TLV FFE9 transaction type list is empty, or the kernel ID is disabled (see tag FFE3).

For MasterCard PayPass, this tag may NOT be Group 0.</td><td>n2</td><td>1</td></tr>
<tr><td>FFE5[1]</td><td>Maximum AID Length</td><td>DEP</td><td>This value must be <= 16.
For Visa application flow, this value is set to 16 and cannot be changed.

Note: This tag must be included if the FFE1 Partial Select TLV is included.</td><td>b</td><td>1</td></tr>
<tr><td>FFE6[1]</td><td>AID Disabled</td><td>OPT</td><td>Used to disable a System AID (has no effect on a User AID). 80h = disabled and 00h = enabled</td><td>b</td><td>1</td></tr>
</table>

<table>
<tr>
<td>FFE8</td>
<td>Exclude from Processing</td>
<td>OPT</td>
<td>This byte is formatted as follows:
<table>
<tr><th>87654321</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-------x</td><td>Exclude from PPSE processing. 1 = This AID will not be added to the candidate list during PPSE.</td></tr>
<tr><td>------x-</td><td>Exclude from Trial and Error processing. 1 = This AID may not be added to the candidate list during Trial and Error (sometime referred to as “List of AIDs” processing.</td></tr>
<tr><td>xxxxxx--</td><td>RFU</td></tr>
</table>
</td>
<td>b</td>
<td>1</td>
</tr>
<tr>
<td>FFE9</td>
<td>Transaction Type List</td>
<td>OPT</td>
<td>This list defines 3-byte triplets, where the Kernel ID and transaction type may be used to identify the group that will be used to instantiate the dataset for the transaction. A maximum of 8 entries may appear in this list. The format of each triplet entry is as follows:
<table>
<tr><th>Byte</th><th>Description</th></tr>
<tr><td>1- Kernel ID</td><td>Kernel ID as defined by EMV first byte only.</td></tr>
<tr><td>2- Transaction Type</td><td>Supported transaction types may be: Payment(00), Cash(01), Cashback(09) or Refund(20)</td></tr>
<tr><td>3- Group Number</td><td>The group that should be used for this transaction and Kernel ID.</td></tr>
</table>
Group 0 may not be used in this list.
</td>
<td>b</td>
<td>Variable <= 24</td>
</tr>
<tr>
<td>FFEA</td>
<td>Configurable Kernel Identifier</td>
<td>OPT</td>
<td>This Kernel Identifier will be used if the card does not supply a valid Kernel ID (9F2A). If this tag is not provided, then default kernel identifiers will be used depending on the application:
<table>
<tr><th>Card Application</th><th>Default KID</th></tr>
<tr><td>MasterCard</td><td>2</td></tr>
<tr><td>Visa</td><td>3</td></tr>
<tr><td>American Express</td><td>4</td></tr>
<tr><td>JCB Quickpay</td><td>5</td></tr>
<tr><td>All others</td><td>0</td></tr>
</table>
This tag is equivalent to MasterCard tag DF810C.
</td>
<td>b</td>
<td>1</td>
</tr>
<tr>
<td>DFEF2C</td>
<td>Terminal AID List</td>
<td>OPT</td>
<td>Tells the reader to allow Terminal AID List support during the initial select process. 01 = Allowed, 00 = Disabled</td>
<td>b</td>
<td>1</td>
</tr>
</table>

Setting the FFE6 tag may disable an AID. However, the preferred method to disable an AID is to issue a “Delete Configurable AID” command (04-04). For a system AID, the command will set the disable bit in FFE6.

The following table lists the System AIDs and the default values for their TLVs

Table 26: System AID Default Configuration TLVs

Name	Tag	Length (Hex)	Value (Hex)	Card Application
Group	FF E4	01	02	
AID	9F 06	06	A0 00 00 00 25 01	
Partial Selection	FF E1	01	01	American Express
Application Flow	FF E2	01	02	
Max AID Length	FF E5	01	10	
Group	FF E4	01	01	
AID	9F 06	07	A0 00 00 00 04 10 10	
Partial Selection	FF E1	01	01	
Application Flow	FF E2	01	03	
Max AID Length	FF E5	01	10	MasterCard PayPass Application
Selection Features	FF E3	01	74	
Transaction Type List	FF E9	0C	02 00 01 02 20 01 02 01 01 02 09 01	
Kernel ID	FF EA	01	02	
Group	FF E4	01	00	
AID	9F 06	07	A0 00 00 00 65 90 01	
Partial Selection	FF E1	01	01	
Application Flow	FF E2	01	0E	
Max AID Length	FF E5	01	08	JCB (QUICPay) Application
Selection Features	FF E3	01	14 **Note:** Vendi default value, FF E6 = 80	
Group	FF E4	01	01	
AID	9F 06	07	A0 00 00 00 04 30 60	
Partial Selection	FF E1	01	01	
Application Flow	FF E2	01	03	
Max AID Length	FF E5	01	10	MasterCard PayPass Application
Selection Features	FF E3	01	74	
Transaction Type List	FF E9	0C	02 00 01 02 20 01 02 01 01 02 09 01	
Kernel ID	FF EA	01	02	

Name	Tag	Length (Hex)	Value (Hex)	Card Application
Group	FF E4	01	00	Visa Application
AID	9F 06	07	A0 00 00 00 03 10 10	
Application Flow	FF E2	01	06	
Partial Selection	FF E1	01	01	
Max AID Length	FF E5	01	10	
Selection Features	FF E3	01	14	
Group	FF E4	01	00	Visa Application (Visa Electron)
AID	9F 06	07	A0 00 00 00 03 20 10	
Application Flow	FF E2	01	06	
Partial Selection	FF E1	01	01	
Max AID Length	FF E5	01	10	
Selection Features	FF E3	01	14	
Group	FF E4	01	00	Visa Application (Visa Interlink)
AID	9F 06	07	A0 00 00 00 03 30 10	
Application Flow	FF E2	01	06	
Partial Selection	FF E1	01	01	
Max AID Length	FF E5	01	10	
Selection Features	FF E3	01	14	
Group	FF E4	01	00	Visa Application (Visa Plus)
AID	9F 06	07	A0 00 00 00 03 80 10	
Application Flow	FF E2	01	06	
Partial Selection	FF E1	01	01	
Max AID Length	FF E5	01	10	
Selection Features	FF E3	01	14	
Group	FF E4	01	00	Visa Application (J/Speedy)
AID	9F 06	07	A0 00 00 00 65 10 10	
Application Flow	FF E2	01	06	
Partial Selection	FF E1	01	01	
Max AID Length	FF E5	01	10	
Selection Features	FF E3	01	14	
			Note: Vendi default value, FF E2 = FF	

Name	Tag	Length (Hex)	Value (Hex)	Card Application
Group AID Application Flow Partial Selection Max AID Length Selection Features	FF E4 9F 06 FF E2 FF E1 FF E5 FF E3	01 0A 01 01 01 01	00 A0 00 00 00 02 30 60 D1 58 00 10 01 10 74 **Note:** Vendi default value, FF E2 = FF	MXI Application
Group AID Application Flow Partial Selection Max AID Length	FF E4 9F 06 FF E2 FF E1 FF E5	01 07 01 01 01	00 A0 00 00 03 24 10 10 0D 01 10	Discover (ZIP)Application
Group AID Application Flow Partial Selection Max AID Length	FF E4 9F 06 FF E2 FF E1 FF E5	01 07 01 01 01	00 A0 00 00 01 52 30 10 0D 01 10	Discover (D-PAS) Application
Group AID Partial selection Application Flow Max AID Length Selection Features	FF E4 9F 06 FF E1 FF E2 FF E5 FF E3	01 07 01 01 01 01	00 A0 00 00 04 17 01 01 01 0F 08 08	STAR Application
Group AID Partial selection Application Flow Max AID Length	FF E4 9F 06 FF E1 FF E2 FF E5	01 07 01 01 01	00 A0 00 00 02 77 10 10 01 15 10 **Note:** Vendi default value, FF E2 = 15	Interac Application

6.0 Card Application Selection

Combined Selection

The selection of a card application may be based on a Kernel ID, transaction type and other requirements. The Selection Features tag directs the flow through the selection logic in the firmware. In addition, the selection of an AID may be based on a list of transaction types that it supports. Depending on the transaction type, the AID may be mapped to a different Configurable Group. This entire process is referred to as “Combined Selection”.

Selection Features (FFE3)

The following table defines each of the bits in the Selection Features tag (FFE3) and describes how they control the logic flow:

87654321	Feature Name	Description
-------x	Deprecated/RFU	Reserved for Future use.
------x-	Extended Selection Supported	Allow the Extended Selection value optionally provided by the card in PPSE to be added to the AID for final selection. The resulting AID must be less than or equal to 16 bytes or the candidate will not be added to the candidate list. 0 = the Extended Selection value, if provided by the card, will not be appended to the AID value for final select. 1 = the Extended Selection value, if provided by the card, will be appended to the AID value, if it fits (AID + ES <= 16), for use in final select.
-----x--	Cardholder Confirmation Not Supported	0 = Cardholder Confirmation is allowed for this AID and if API bit 8 (Cardholder Confirmation) is true, the application will not be added to the candidate list. 1 = Customer Cardholder Confirmation is not allowed for this AID, API bit 8 (Cardholder Confirmation) will be ignored.
----x---	API Required	0 = the API is not required for this AID and the application may be added to the candidate list if the API is missing. 1 = the API is required for this AID; the application will not be added to the candidate list if the API is missing.
---x----	Invalid AID Allowed	0 = any invalid AID will cause this AID to terminate the transaction. 1 = any invalid AID will be ignored as related to this AID.
--x-----	Duplicate AID Allowed	0 = a duplicate AID, whether extended or not, is not allowed and will not be added to the candidate list. 1 = a duplicate AID, whether extended or not, is allowed and may be added to the candidate list.
-x------	Enable Kernel ID	1 = allow the evaluation of the Kernel ID. 0 = if a Kernel ID is provided by the card it is ignored.
x-------	RFU	Reserved for Future Use.

Refer to the System AID Defaults for the configuration of Selection features for each of the AIDs. If no Selection Features tag (FFE3) is specified, then no selection features are specified.

Partial Selection (FFE1)

For some applications, an AID on the card may be longer than an AID configured in the reader. If partial selection is allowed, the AID will be considered a match if all of the AID configured in the reader matches the first portion of an AID in the card.

Table 1: Partial Selection (FFE1)

87654321	Value	Description
-------x	Partial selection is allowed	0 = This AID does not participate in partial selection 1 = This AID will participate in partial selection (default) For M/Chip 3.0, this value should be set to "allowed"
xxxxxxx-	RFU	Reserved for Future Use

Historically, Partial Selection has been a separate tag. However, it is an integral part of the selection process, and may be used in conjunction with combined selection features.

AID Participation in Selection Processes (FFE8)

In some cases, applications/AIDs may not be able to participate in some of the selection processes. For example, some cards/applications do not support PPSE. The following table describes the bits in tag FFE8 that may be used to exclude an AID from selection processes.

Table 2: Exclude from Processing (FFE8)

87654321	Process to be Excluded	Description
-------x	Exclude from PPSE Processing	0 = This AID may be added to the candidate list during PPSE. 1 = This AID will not be added to the candidate list during PPSE.
------x-	Exclude from Trial & Error Processing	0 = This AID may be added to the candidate list during T&E. 1 = This AID will not be added to the candidate list during T&E.
xxxxxx--	RFU	Reserved for Future Use

"Trial & Error" is sometimes referred to as "List of AIDs". It is a process by which the reader will attempt to select an AID by going through its list, hoping for a successful selection.

For M/Chip 3.0, tag FFE8 should be set to 0x00.

Terminal AID List (DFEF2C)

The Terminal AID List Tag DFEF2C is associated with each Terminal AID which set by the 04-02 (Load AID) command. This tag can control which Terminal AID should be sent to the card, if the Select AID Command (with PPSE) get “Select AID Failed”(response SW1/SW2 not 9000 or format error), or the AID list returned by the card cannot matched by any Terminal AID. One by one, the terminal will check each Tag DFEF2C associated with the Terminal AID, if the Tag DFEF2C value is ‘01’, the terminal will send out that Terminal AID data to the card, contactless transaction can be continued if any Terminal AID matched by the card; if the Tag DFEF2C value is ‘00’, that terminal AID data will not be sent.

Table 3: Terminal AID List (DFEF2C)

87654321	Value	Description
-------x	Terminal AID List is allowed	0 = Terminal will not send out terminal AID data 1 = Terminal will send out terminal AID data Note: The Terminal AIDs can be modified by 04-02 Load AID command.
xxxxxxx-	RFU	Reserved for Future Use

7.0 Card Application Specific Behavior

This section contains information specific to a particular card application.

MasterCard PayPass M/Chip

The implementation of MasterCard M/Chip 3.0 is the EMV mode transaction flow. This includes support for Mag Stripe, but does not include Data Exchange functionality.
The M/Chip 3.0 implementation incorporates new functionality for:

- Balance reading before and after GenAC
- Recovery of torn transactions
- Support for Certificate Revocation List functions
- STOP command processing
- Support for defining proprietary tags that are not otherwise handled or defined in the tag database.

PayPass Default Group

The PayPass implementation required a new data model in which data objects could be “not present” or “not defined”. As a result, the historical method of using Group 0 to define default tags could not be used.

Group 0 is no longer used by the PayPass application. The default group for PayPass applications is Group 1.

In addition to the PayPass default group, the PayPass Kernel also keeps hard-coded values for a sub-set of the group parameters that are essential for a transaction. If one of these data items is not available via Activate Transaction or via Get Configurable Group, then the kernel uses its own hard-coded value for the ‘Not Present’ data item.

Balance Read Function

The balance may be read from cards that support balance reading. The balance may be read before or after the Generate AC process. In order to enable balance reading, the tags for balance read must be defined in the tag database. This may be accomplished through the Set Configurable Group command or by including the balance TLVs (DF8104, DF8105) in the Activate command.

For example, if DF8104 is included in the Activate Command, and the card supports balance reading, then the balance read prior to Generate AC will be returned in the DF8104 TLV in the Activate response.

Torn Transaction Recovery

A method exists for saving data from a torn transaction and matching up that transaction with a card that re-appears in the field to complete the transaction. Due to space limitations in the reader, the maximum number of torn transaction records that can be retained is two. New tags (configurable in a PayPass Group) control the size and use of the torn transaction log:

Tag	Name	Description
DF811C	Max Lifetime of Torn Transaction Record	Controls how long a torn transaction record can exist in the log before it expires. It is expressed in seconds.
DF811D	Maximum Number of Torn Transaction Records	The only possible values are 0, 1 or 2. If this tag is set to 0, then the torn transaction recovery is effectively disabled.

These tags are configurable for PayPass groups. It they are configured for other groups, they will not be used.

EMV Certificate Revocation List

The MasterCard application can make use of the EMV Certificate Revocation List features if they are enabled. The DF26 tag is used to enable or disable the Certificate Revocation List function. The default value for this tag is “enabled” (1).

Stop Transaction Command

M/Chip 3.02 includes a Stop Transaction Command that is similar to a Cancel Command. The DF68 tag is used to enable or disable the Stop Command. The default value for this tag is “disabled” (0).

Proprietary Tag List

The proprietary tag list feature is not specific to MasterCard. Please refer to the Card Application Proprietary Tag List feature.

PayPass Personalization Limits

To guarantee the successful completion of PayPass transactions using CDA or SDA, size restrictions noted in this section apply.

7.1.1.1 CDA Transactions

The combined length of the following data objects personalized to the card cannot exceed 2400 bytes. ICC Public Key Certificate

- ICC Public Key Exponent
- ICC Public Key Remainder
- Static data used in data authentication (2048 bytes maximum)

7.1.1.2 SDA Transactions

The combined length of the following data objects personalized to the card cannot be greater than 2400 bytes.

- Signed Static Application Data
- Static data used in data authentication (2048 bytes maximum)

8.0 Protocol Command Reference: Protocol 1

Transaction Related Commands

Flush Track Data (17-02)

This command allows the POS application to instruct ViVOpay to flush any Track Data that was read from a card previously but has not been transferred to the POS yet. On receiving this command ViVOpay clears any pending card data.

Command Frame from PC to ViVOpay

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	17h	02h	00	00		

ACK Frame from ViVOpay (or NACK)

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	17h	Status=OK	Unused	XX		

Get Full Track Data (17-CD)

Use this command to return full track data from the ViVOpay reader. If a card has been swiped at the magnetic stripe reader or presented to a reader in Auto Poll mode, ViVOpay sends back an ACK Frame followed by a Data Frame containing track data. If no card has been swiped or presented, ViVOpay just returns an ACK Frame and no Data Frame. If both Track 1 and Track 2 data is being returned, then the Data Frame contains the Track 1 Data, followed by a NULL character (00h) marking the end of Track 1 Data, followed by Track 2 data.

If a card has been swiped, but an error occurred, then ViVOpay just sends an ACK Frame with Status Failed.

Command Frame from PC to ViVOpay

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	17h	CDh	00	00		

Response Frame (ACK)

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	17h	Status	Tracks/ Error Code	DataLen		

Byte 12 is used for Tracks or Error Code, depending on the value of the Status in Byte 11 (see Status Code Protocol 1). When Status is OK, Byte 12 is used to store Tracks. When Status is Failed, Byte 12 is used to store the Error Codes from ViVOpay.

Note: These Error Codes are valid only when the RF Error Code Reporting is enabled through Set RF Error Reporting command, see Set RF Error Reporting.

Table 27: Get Full Track Data Error Codes

Status	Tracks/Error Code
OK	Examples: Bit 0 = Track 1 — Track = 00h => No Track Data Bit 1 = Track 2 — Track = 01h => Track 1 Data Only Bit 3 = Track 3 — Track = 02h => Track 2 Data Only Track = 03h => Track 1 & Track 2 Data etc. Bit 7 = Card Type — Card Type = 0 => Contactless Card Card Type = 1 => Swiped Magnetic Stripe
Failed	Error Code = 01h Card Removed Error Code = 02h Communication Error Error Code = 03h Protocol Error Error Code = 04h Multiple Cards Detected Error Code = 05h Card Not Accepted Error Code = 06h Bad Data Error Code = FFh Unknown Error
Other (See Status Code)	N/A

DataLen

Number of Data Bytes in the Data Frame to Follow. This does not include the Frame Tag, Frame Type and Checksum bytes.

Data Frame from the Reader to PC (If the Reader sent an ACK and Track Data available)

Byte 0-8	Byte 9	Byte 10	Byte 11	…	Byte n+10	Byte n+11	Byte n+12
Frame Tag	Frame Type	Data 0	Data 1	…	Data n	CRC (MSB)	CRC (LSB)
ViVOtech\0	'D'	Data	Data	…	Data		

If the host fails to receive the track data, it can send a NACK Frame to request the reader to resend the track data. To ensure that the reader resends the track data, the NACK Frame must

be received within 500ms after it sends the original track data. If the reader receives the NACK Frame within that time period, it first resends the ACK Frame followed by the Data Frame to PC. If the reader receives the NACK Frame after 500ms of sending out the original track data, or if a new card has been detected, the reader sends an ACK/NACK Frame to the host and does not resend the track data. Each payload data is only resent once.

Response Frame NACK Frame from PC to the Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	17h	00h	00	00		

ACK Frame from the Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	17h	Status	Tracks	DataLen		

Status

OK (see Status Code Protocol 1)

Tracks

Bit 0 = Track 1
Bit 1 = Track 2
Bit 3 = Track 3

Example

Track = 00h => No Track Data
Track = 01h => Track 1 Data Only
Track = 02h => Track 2 Data Only

Track = 03h => Track 1 & Track 2 Data etc.

DataLen

Number of Data Bytes in the Data Frame to Follow. This does not include the Frame Tag, Frame Type and Checksum bytes.

Data Frame from the Reader to PC (If ViVOpay sent an ACK and Track Data available)

Byte 0-8	Byte 9	Byte 10	Byte 11	…	Byte n+10	Byte n+11	Byte n+12
Frame Tag	Frame Type	Data 0	Data 1	…	Data n	CRC (MSB).	CRC (LSB).
ViVOtech\0	'D'	Data	Data	…	Data		

An example of the Data Frame sent in response to the Get Full Track data command is as follows:.

```
56 69 56 4F 74 65 63 68 00 44 42 35 33 32 35 33
35 30 30 30 30 36 32 33 35 36 37 5E 53 4D 49 54
```

```
48 2F 4A 4F 48 4E 5E 30 35 30 38 35 30 31 31 30
30 36 32 36 30 30 34 34 35 30 30 30 30 30 37 38
36 32 30 39 33 33 00 35 33 32 35 33 35 30 30 30
30 36 32 33 35 36 37 3D 30 35 30 38 31 30 31 39
34 34 35 39 39 37 38 36 30 36 32 33 DF 03
```

Annotated

```
56 69 56 4F 74 65 63 68 00 – FRAME TAG
44 – FRAME TYPE 'D'
TRACK 1 DATA
42 35 33 32 35 33 35 30 30 30 30 36 32 33 35 36
37 5E 53 4D 49 54 48 2F 4A 4F 48 4E 5E 30 35 30
38 35 30 31 31 30 30 36 32 36 30 30 34 34 35 30
30 30 30 30 37 38 36 32 30 39 33 33
00 – END OF TRACK 1 START OF TRACK 2
TRACK 2 DATA
35 33 32 35 33 35 30 30 30 30 36 32 33 35 36 37
3D 30 35 30 38 31 30 31 39 34 34 35 39 39 37 38

36 30 36 32 33
DF 03 – CRC
```

Get ViVOpay Firmware Version (29-00)

Use this command to return the ViVOpay reader's Firmware Version Number. This is the Protocol 1 version of the command given in Get Version Protocol 2 (29-00). The ViVOpay reader returns an ACK Frame containing the length of the Version Data. This is followed by a Data Frame containing the firmware version information.

Command Frame from PC to the Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	29h	00h	00	00		

Response Frame from the Reader (ACK or NACK)

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	29h	Status=OK	Unused	DataLen		

Status = OK (see Status Code Protocol 1)

DataLen = Number of Data Bytes in the Data Frame to Follow. This does not include the Frame Tag, Frame Type and Checksum bytes.

Data Frame from the Reader to PC (If ViVOpay sent an ACK)

Byte 0-8	Byte 9	Byte 10 … Byte n+10	Byte n+11	Byte n+12
Frame Tag	Frame Type	Data 0 … Data n	CRC (MSB)	CRC (LSB)
ViVOtech\0	'D'	ViVOpay Version (Null Terminated ASCII String)		

Key Manager Commands Protocol 1

Note: The following commands use Protocol 1 frame formats. Whenever possible, you should use the Key Manager commands in Protocol 2.

The Key Management Protocol 1 commands are retained for compatibility purposes and are not to be used when doing secure communication.

Some ViVOpay firmware versions that support EMV security features provide an EMV Key Management Interface that can be used by a terminal to Add/Delete CA Public Keys and related data. These firmware versions also provide a Real Time Clock set up interface and an EMV ViVOpay Terminal set up interface.

This document describes the ViVOpay Serial Interface, specifically the EMV Key Management commands, the Real Time Clock set up commands and the EMV ViVOpay Terminal set up commands. It describes the communication parameters, the ViVOpay Serial Interface Protocol and the command-specific details.

Warning: DO NOT mix the two Key Management formats. Manage the keys using Protocol 1 or Protocol 2 but not both.

ViVOpay provides a secure storage environment on its Crypto Chip for storing the Certification Authority Public Keys. It allows for storage of up to a maximum of 30 keys which are uniquely identified as a key index in each payment scheme (RID). The basic Key management functions provided are setting of a new Public Key based on a Unique <RID, Key Index> Pair, and deletion of a key. Once a key has been stored in the Crypto Chip, it does not allow retrieval of the key. All authentication/decryption functions that require the key take place inside the Crypto Chip.

The ViVOpay reader periodically checks for Command Frames. Once it starts receiving a Command Frame, it expects each successive byte to arrive within the inter-byte timeout. If the ViVOpay reader is receiving multiple Data Frames it expects each successive byte to arrive within the inter-frame timeout (see table below). If the data is not received within the timeout period listed, the ViVOpay reader times out and a timeout failure response is sent.

Serial Commands	Inter-Byte	Inter-Frame
Delete CA Public Key	200ms	5 sec
Set CA Public Key	200ms	5 sec

Set RTC Date	200ms	5 sec
Set RTC Time	200ms	5 sec
Pass-Through APDU Exchange (multiple Data Frames)	200ms	5 sec
Pass-Through PCD Single Command (multiple Data Frames)	200ms	5 sec
All other Commands	200ms	200ms

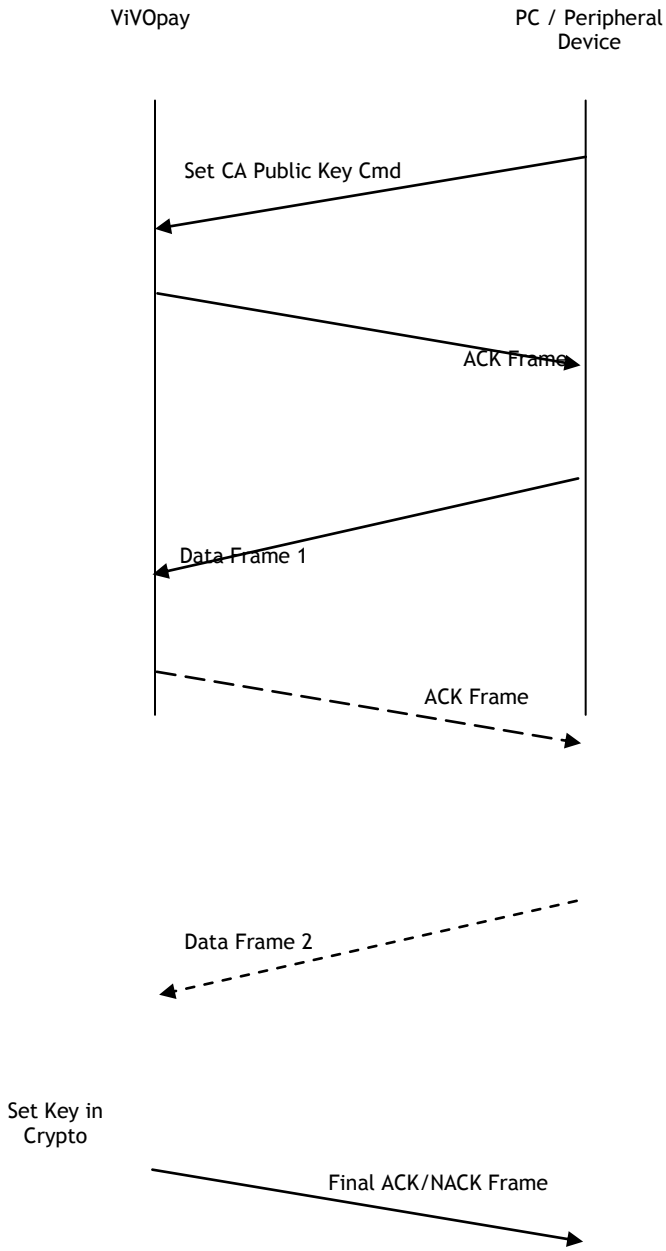
Once the ViVOpay reader has received a command, the time in which it starts sending a response back to the terminal varies from command to command, depending on what kind of processing is required before a response can be sent back to the terminal.

Table 28: EMV Key Management Commands Error Codes – Protocol 1

Error Code	Description
00h	No Error
01h	Unknown Error
02h	Invalid Data
03h	Incomplete Data
04h	Invalid Key Index
05h	Invalid CA Hash Algorithm Indicator
06h	Invalid CA Public Key Algorithm Indicator
07h	Invalid CA Public Key Modulus Length
08h	Invalid CA Public Key Exponent
09h	Key already Exists (Try to Set Key after deleting existing Key)
0Ah	No space for New RID
0Bh	Key not Found
0Ch	Crypto Chip not responding
0Dh	Crypto Chip Communication Error
0Eh	RID Key Slots Full
0Fh	No Free Key Slots Available

Set CA Public Key (24-01) Protocol 1

Use this command to send data related to a CA Public Key to the ViVOpay reader for storing in a secure environment (Crypto Chip Memory). The Public Key is uniquely identified by the <RID, Key Index> pair. If the total length of the key related data being sent is more than 244 bytes, then it can be broken down into two Data Frames.



Flow of Frames between ViVOpay Reader and an External Device

Command Frame from Terminal to ViVOpay

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	24h	01h	DataLen2	DataLen		

DataLen, DataLen2

- If the key data is being sent in a single Data Frame, then DataLen contains the length of the one and only Data Frame to follow and DataLen2 is 0.
- If the key data is being sent in two Data Frames, then DataLen contains the length of the first Data Frame and DataLen2 contain the length of the second Data Frame. The length of either Data Frame must not exceed 244 (0xF4) bytes.
- DataLen > 0, DataLen2 >= 0

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	24h	Status	00	00		

Status: OK (or see Status Code Protocol 1)

NACK from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	24h	FAILED	Error Code	Unused		

Error Code: See EMV Key Management Error Codes Table

If at any time ViVOpay sends back a NACK Frame with Status set to Failed, then the Error code field indicates the reason for failure.

First Data Frame from terminal to Reader (If reader sent an ACK)

Byte 0-8	Byte 9	Byte 10-13	Byte 14	…	Byte 10+(n-1)	Byte 10+n	Byte 10+(n+1)
Frame Tag	Frame Type	Data 0	Data 1	…	Data (n-1)	CRC (LSB)	CRC (MSB)
ViVOtech\0	'D'	Data	Data	…	Data		

Where n = length of the data field.

The data field in the first Data Frame contains the complete or partial CA Public Key related Data. The complete contents and format of the Key Data are given in the following Table. The data portion of Data Frame 1 and Data Frame 2 (if present) when stripped of the Frame overhead and concatenated, provides the data as given in the following table.

Table 29: Set CA Public Key Data Field

Data Byte	Name	Length (bytes)	Format	Notes
0-4	RID	5	Binary	Registered Identifier. Necessary for Unique Identification
5	CaPublicKey Index[1]	1	Binary	Index of the CA Public Key for this RID. Necessary for Unique Identification
6	CaHashAlgoIndicator[1]	1	Binary	CA Hash Algorithm to produce Hash-Result in digital signature scheme. Valid Values: 01h: SHA-1
7	CaPublicKeyAlgoIndicator[1]	1	Binary	Digital Signature Algorithm to be used with CA Public Key. Valid Values: 01h: RSA
8-27	CaPublicKeyChecksum[1]	20	Binary	CA Public Key Checksum
28-31	CaPublicKeyExponent[1]	4 (PICC-based Length may be 1 or 3)	Binary	CA Public Key Exponent. Value can be 3 (Len=1 Byte) or $2^{16}+1=65537=010001h$ (Len=3 Bytes). We consider it as a 32-bit (4-Byte) Big-Endian number for the Serial Interface and Crypto Storage. The PICC may consider it as a 1-Byte or 3-byte number.
32,33	CaPublicKeyModulusLen	2	Binary	CA Public Key (Modulus) Length stored as a Big-Endian number. Aka N_{CA}
34	CaPublicKeyModulus[1]	Variable (max 256)	Binary	CA Public Key (Modulus) with Length=N_{CA}

[1]: Fields specified by EMV that need to be stored in Terminal Memory (See EMV2000, Book 2, Section 11.2.2 Table 23)

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	24h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

NACK from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	24h	FAILED	Error Code	Unused		

Error Code: See EMV Key Management Error Codes Table

Second Data Frame from terminal to ViVOpay (If the reader sent an ACK, and Data remains to be sent).

Byte 0-8	Byte 9	Byte 10-13	Byte 14	…	Byte 10+(p-1)	Byte 10+p	Byte 10+(p+1)
Frame Tag	Frame Type	Data 0	Data 1	…	Data (p-1)	CRC (LSB)	CRC (MSB)
ViVOtech\0	'D'	Data	Data	…	Data		

Where p = DataLen2 > 0

If the second Data Frame is sent, then the data field in this frame contains the remaining CA Public Key related Data.

On receiving valid data, the reader sends it to the Crypto Chip for secure storage. The Crypto Chip checks the data and stores it in its memory. If the CA Public Key is stored successfully in the Crypto Chip memory, the reader returns an ACK frame. If for any reason the CA Public Key is not stored, the reader returns a NACK frame.

Final ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	24h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

Final Nack Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	24h	FAILED	Error Code	Unused		

Error Code: See EMV Key Management Error Codes Table

Delete CA Public Key (24-02) Protocol 1

Use this command to instruct the ViVOpay reader to delete a previously set CA Public Key from within secure storage in the Crypto Chip. The Key is uniquely identified by the <RID, Key Index> pair.

When this command is received, ViVOpay waits for a Data Frame containing the RID and Key Index. It then instructs the Crypto Chip to delete the specified CA Public Key. Depending on the result of this operation, the reader returns an ACK or NACK Frame.

Command Frame from Terminal to Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	24h	02h	00	DataLen=6		

ACK Frame from Reader (or NACK)

ACK Frame

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	24h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

NACK Frame

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	24h	FAILED	Error Code	Unused		

Error Code: See EMV Key Management Error Codes Table

Data Frame from Terminal to Reader (If reader sent an ACK)

Byte 0-8	Byte 9	Byte 10	…	Byte 14	Byte 15	Byte 16	Byte 17
Frame Tag	Frame Type	Data 0	…	Data 4	Data 5	CRC (LSB)	CRC (MSB)
ViVOtech\0	'D'	RID [0]	…	RID [4]	Key Index		

RID: Registered Identifier (5 Bytes)

Key Index: Key Index (1 Byte)

The RID, together with the Key Index specifies a unique Key stored in ViVOpay Secure Memory.

Final ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	24h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

Final NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	24h	FAILED	Error Code	Unused		

Error Code: See EMV Key Management Error Codes

Delete All CA Public Keys (24-03) Protocol 1

Use this command to instruct the ViVOpay reader to delete all previously set CA Public Keys from within secure storage in the Crypto Chip. The Keys is deleted regardless of the <RID, Key Index> pair.

When this command is received, the reader instructs the Crypto Chip to delete all CA Public Keys. Depending on the result of this operation, the reader returns an ACK or NACK Frame.

Command Frame from Terminal to Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	24h	03h	00	00		

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	24h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	24h	FAILED	Error Code	Unused		

Error Code: See EMV Key Management Error Codes Table

Miscellaneous Protocol 1 Commands

Set RF Error Reporting (17-03)

This command allows the POS application to Enable/Disable RF Error Code Reporting for the Get Full Track Data command. When RF Error Code Reporting is enabled, if there is any RF error code, it is reported to the POS application through the ACK Frame for Get Full Track Data command (see Get Full Track Data).

Command Frame from PC to the Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	17h	03h	Operation Code	XX		

Operation Code:

00h: Disable RF Error Code Reporting

01h: Enable RF Error Code Reporting

02h or others: No change

ACK Frame from the Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	17h	Status=OK	RF Error Code Reporting Status	XX		

RF Error Code Reporting Status (only for ACK frame):

00h: RF Error Code Reporting disabled

01h: RF Error Code Reporting enabled

RTC (Real Time Clock) Set Up Commands

On ViVOpay readers that support EMV, the Real Time Clock must be configured with the correct local date and time for the region in which it is used. The RTC commands allow a terminal to check the date and time on a ViVOpay reader and change it if required.

Table 30: Error Codes for RTC Management Commands

Error Code	Description
00h	No Error
01h	Unknown Error
02h	Invalid Data
03h	RTC not found or not responding

RTC Set Time (25-01)

Use this command to instruct the ViVOpay reader to set a specific time in the Real Time Clock.

Command Frame from Terminal to Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	25h	01h	HH	MM		

HH: Hour (2-digit, BCD, Range 00-23)

MM: Minutes (2-digit, BCD, Range 00-59)

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	25h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	25h	FAILED	Error Code	Unused		

Error Code: See RTC Management Error Codes Table

RTC Get Time (25-02)

Use this command to instruct the ViVOpay reader to return the current time from the Real Time Clock.

Command Frame from Terminal to Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	25h	02h	00	00		

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	25h	Status=OK	HH	MM		

Status: OK (or see Status Code Protocol 1)

HH: Hour (2-digit, BCD, Range 00-23)

MM: Minutes (2-digit, BCD, Range 00-59)

NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	25h	FAILED	Error Code	Unused		

Error Code: See RTC Management Error Codes Table

RTC Set Date (25-03)

Use this command to instruct the ViVOpay reader to set a specific Date in the Real Time Clock.

Command Frame from Terminal to Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	25h	03h	00	DataLen=4		

DataLen

- If the key data is being sent in a single Data Frame, then DataLen contains the length of the one and only Data Frame to follow and DataLen2 is 0.
- If the key data is being sent in two Data Frames, then DataLen contains the length of the first Data Frame and DataLen2 contain the length of the second Data Frame. The length of either Data Frame must not exceed 244 (0xF4) bytes.
- DataLen > 0, DataLen2 >= 0

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	25h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	25h	FAILED	Error Code	Unused		

Error Code: See RTC Management Error Codes Table

Data Frame from Terminal to Reader (If the reader sent an ACK)

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Data 0	Data 1	Data 2	Data 3	CRC (LSB)	CRC (MSB)
ViVOtech\0	'D'	YY_1	YY_2	MM	DD		

YY_1: Year (Higher Century Byte) (2-Digit, BCD, Range 00-99)

YY_2: Year (Lower Byte) (2-Digit, BCD, Range 00-99)

MM: Month (2-Digit, BCD, Range 01-12)

DD: Date (2-Digit, BCD, Range 01-31)

Final ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	25h	Status=OK	00	00		

Status: OK (or see Status Code Protocol 1)

Final NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	25h	FAILED	Error Code	Unused		

Error Code: See RTC Management Error Codes Table

RTC Get Date (25-04)

This command returns the reader's the current Date from the Real Time Clock.

Command Frame from Terminal to Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Sub-Command	Data1	Data2	CRC (LSB)	CRC (MSB)
ViVOtech\0	'C'	25h	04h	00	00		

ACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'A'	25h	Status=OK	Unused	DataLen		

Status: OK (or see Status Code Protocol 1)

DataLen

Number of Data Bytes in the Data Frame to Follow. This does not include the Frame Tag, Frame Type and Checksum bytes. This is either 0 (if Date is not being returned) or 4.

NACK Frame from Reader

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Command	Status	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech\0	'N'	25h	FAILED	Error Code	Unused		

Error Code: See RTC Management Error Codes Table

Data Frame from ViVOpay to terminal (If ViVOpay sent an ACK)

Byte 0-8	Byte 9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Frame Tag	Frame Type	Data 0	Data 1	Data 2	Data n	CRC (MSB)	CRC (LSB)
ViVOtech\0	'D'	YY_1	YY_2	MM	DD		

YY_1:	Year (Higher Century Byte)	(2-Digit, BCD, Range 00-99)
YY_2:	Year (Lower Byte)	(2-Digit, BCD, Range 00-99)
MM:	Month	(2-Digit, BCD, Range 01-12)
DD:	Date	(2-Digit, BCD, Range 01-31)

9.0 Protocol Command Reference: Protocol 2

General Commands

Ping (18-01)

Use the Ping command to check if the ViVOpay reader is connected to the terminal. If the ViVOpay reader is connected, it responds with a valid Response Frame, otherwise there is no response.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	18h	01h	00h	00h	B3	CD

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	18h	00h	00h	00h	FA	83

Set Poll Mode (01-01)

The Set Poll Mode command allows the terminal to set the ViVOpay reader polling mode. The ViVOpay reader functions in one of two polling modes: “Auto Poll” or “Poll on Demand”. The value is saved in nonvolatile memory so you only need to send this command when you want to change the mode.

The ViVOpay reader operates in Poll on Demand mode by default. Use the Poll on Demand mode when you want the reader to poll for cards only when requested to by the terminal. In this mode the ViVOpay reader remains in the idle state with the RF field off until it receives an Activate Transaction command. Once the transaction is completed (or the reader times out while polling) the reader returns to the idle state. This mode allows the terminal to send data to the reader before the card data is read, as required for EMV transactions.

Note: KioskIII operates in AutoPoll mode by default.

In Auto Poll mode, the RF field is always active and the reader continuously polls for the presence of a contactless card. There is no requirement for the terminal to initiate a transaction. When a supported contactless MagStripe card is detected, the Track data can be

sent out on the MagStripe interface (if the ViVOpay unit supports it) or retrieved using the Get Transaction Result command. The Auto Poll mode is required in environments where the ViVOpay reader is connected to a POS terminal via the terminal's MagStripe interface.

Warning: EMEA UI is intended for use in the EMV or European environment, where the reader is not allowed to poll continuously (e.g., operate in Auto Poll Mode). The reader does NOT support Auto Poll while in EMEA UI mode and has the potential for aberrant or unstable behavior. The reader is not certified to work properly in this situation.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	01h	01h	00h	01h	Poll Mode		

Poll Mode

00h = Auto Poll

01h = Poll on Demand

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	01h	See Status Code Table	00h	00h		

The Poll Mode has been set to the requested mode only if the Response Frame contains an OK Status Code. No data is returned in the response.

Control User Interface (01-02)

Use the Control User Interface command to instruct the reader to display a message, change LED behavior, and beep. Each action is controlled independently by values in the data field of the command. This allows you to instruct the reader to beep when it displays a message. To display messages, the reader must be in Poll on Demand mode. Readers without a display can use this command to control the buzzer and LEDs.

There are three cases depending on the LCD Message index number:

Indexes 00h to 07h correspond to messages that are automatically displayed by the reader. In most cases, you do not use the terminal to trigger these messages.

Indexes 08h to 0Bh are messages that are triggered by the terminal.

Index FFh indicates that the command is only setting the buzzer and/or LEDs. No message is displayed.

After completion of a successful transaction, the "Thank You" message remains on the LCD until the terminal sends a new Control User Interface command.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	01h	02h	00h	04h	See Data Table		

The format and contents of the data field in the Command Frame are given in the following table.

Table 31: Control User Interface Data

Data Item	Length (bytes)	Description
LCD Message Index	1	Messages 00-07 are normally controlled by the reader. 00: Idle Message (Welcome) 01: Present card (Please Present Card) 02: Time Out or Transaction cancel (No Card) 03: Transaction between reader and card is in the middle (Processing…) 04: Transaction Pass (Thank You) 05: Transaction Fail (Fail) 06: Amount (Amount $ 0.00 Tap Card) 07: Balance or Offline Available funds (Balance $ 0.00) Messages 08-0B are controlled by the terminal 08: Insert or Swipe card (Use Chip & PIN) 09: Try Again(Tap Again) 0A: Tells the customer to present only one card (Present 1 card only) 0B: Tells the customer to wait for authentication/authorization (Wait) FF indicates the command is setting the LED/Buzzer only.
Beep Indicator	1	00h: No beep 01h: Single beep 02h: Double beep 03h: Three short beeps 04h: Four short beeps 05h: One long beep of 200 ms 06h: One long beep of 400 ms 07h: One long beep of 600 ms 08h: One long beep of 800 ms
LED Number	1	00h: LED 0 (Power LED) 01h: LED 1 02h: LED 2 03h: LED 3 FFh: All LEDs Where the LEDs are numbered 0, 1, 2, 3 counting from the left. **Note**: You can attempt to control the Power LED (LED 0) but other UI behavior takes control, so attempting to manipulate the Power LED in

Data Item	Length (bytes)	Description
		non-pass-through mode has no effect.
LED Status	1	00h: LED Off 01h: LED On

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	01h	See Status Code Table	00h	00h		

If the Status Code does not return OK, the command failed.

Set/Get Source for RTC/LCD/Buzzer/LED (01-05)

Use this command to set up or get the source for RTC/LCD/Buzzer/LED on the ViVOpay reader. The reader can be configured to use internal source or external source for RTC/Buzzer/LED control. If necessary, the reader can be configured to use both internal and external source except for the RTC.

Note: ViVOpay reader may not support all these options. Careful attention must be given to these details.

When the data length is 02h, the command is used to set up the source configuration for RTC/LCD/Buzzer/LED; when the data length is 0, the current source configuration shall be returned in the Response Frame.

Command Frame (Set Source)

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16	Byte 17
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data Byte1	Data Byte2	CRC (LSB)	CRC (MSB)
ViVOtech2\0	01h	05h	00h	02h	Bitmap for RTC/LCD/Buzzer/ LED			

Response Frame (Set Source)

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	01h	See Status Code Table	00h	00h		

Command Frame (Get Source)

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	01h	05h	00h	00h		

Response Frame (Get Source)

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16	Byte 17
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data Byte1	Data Byte2	CRC (MSB)	CRC (LSB)
ViVOtech2\0	01h	See Status Code Table	00h	02h	Bitmap for RTC/LCD/Buzzer/LED			

Data Byte1 Definition:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved	Reserved	RTC		LCD		Buzzer	

Bit1 Bit0	Description
00	Don't use Buzzer
01	Use Buzzer from ViVOpay reader
10	Use Buzzer from external source
11	Use Buzzer from both reader and external source

Bit3 Bit2	Description
00	Don't use LCD
01	Use LCD from ViVOpay reader
10	Use LCD from external source
11	Use LCD from both reader and external source

Bit5 Bit4	Description
00	Don't use RTC

01	Use RTC from ViVOpay reader
10	Not allowed
11	Not allowed

Data Byte2 Definition:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Reserved		Reserved		Power LED		Transaction LED	

Bit1 Bit0	Description
00	Don't use transaction LED
01	Use transaction LED from ViVOpay reader
10	Use transaction LED from external source
11	Use transaction LED from both reader and external source

Bit3 Bit2	Description
00	Don't use power LED
01	Use power LED from ViVOpay reader
10	Use power LED from external source
11	Use power LED from both reader and external source

The Date/Time can be configured to use internal or external Date/Time, depending on the reader configuration. When the reader is configured to use internal time, the RTC (Real Time Clock) chip is needed on the ViVOpay reader and the date and time from the RTC chip is used. When the reader is configured to use external time, the terminal needs to set up the RTC inside the ARM processor of the ViVOpay reader (using the Set Configuration command).

If configured to use the internal buzzer, the ViVOpay reader's buzzer is used to indicate the transaction progress. If configured to use external buzzer, an external buzzer is used and the ViVOpay reader's buzzer is not used.

If configured to use internal LEDs, the ViVOpay reader's LEDs are used to indicate the transaction progress. If configured to use external LEDs, the LEDs on the terminal are used, and the reader's LEDs are not used. The source of the three transaction LEDs and the power LED can be configured separately.

Set Configuration Defaults Command (04-09)

This command provides an external method for resetting parameters in non-volatile memory (NVM) to their default values.

When this serial command is received an NVM Initialization function is called and the display is changed to show the message.

Initializing ….
Please Wait

Once initialization is complete the display is returned to the ready state message.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	09h	00h	00h	87h	30h

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04	00h	00h	00h	AEh	16h

This command does not modify the following data objects:

- Merchant Name and Location (tag 9F 4E)
- Transaction Category code (tag 9F 53)
- Terminal IFD Serial Number (tag FF F2)
- Application Capability (tag FF F3)
- Enable/Disable burst mode (tag FF F7)
- LCD font size (tag FF F9)
- LCD delay time (tag FF FA)
- Poll mode (tag DF 89 1B)
- Baud rate (tag FE 02)
- Boot up Message Enable (tag FE 03)
- Serial Number (tag DF 89 1A)
- UI Source Config (tag FE 05)
- Analog parameters (tag FE FE)

Set Configuration Defaults and Keep Encrypt Key Command (04-0A)

This command provides an external method for resetting parameters in non-volatile memory (NVM) to their default values.

When this serial command is received, the reader will erase eeporm and keep encrypt keys.

When reader initialation is completed, the reader is reboot.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	0Ah	00h	00h	F7h	46h

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04	00h	00h	00h	AEh	16h

This command does not modify the following data objects:

- Admin Key
- DUKPT Data Key
- Encrypt type
- Encrypt Status
- Serial Number (tag DF 89 1A)
- UI Source Config (tag FE 05)
- Analog parameters (tag FE FE)

  Baud rate (tag FE 02)

Set Configuration (04-00)

Use this command to set or change the values of the specified Tag Length Value (TLV) data objects in the reader. It can be used to set parameters for Auto Poll as well as Poll on Demand Mode.

When the reader receives this command, it extracts the TLV encoded parameters from the data portion of the command and saves them to the default TLV Group in non-volatile memory. If a TLV data object is incorrectly formatted, the reader stops processing the object. A single command may contain more than one TLV data object.

The Set Configuration command is the only mechanism for setting the values of global configuration parameters.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	00h			TLV Data Objects		

The TLV data objects that can be set using this command are defined in the Global Configuration Tags table.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table	00h	00h		

Get Configuration (03-02)

Use this command to return the values of the TLV global data objects and default group data objects (TLV Group 0) in the reader from the reader's nonvolatile memory.

Note: If your reader supports Configurable Application Identifier (AIDs), the following applies:

1. The Get Configuration command may be used to retrieve global configuration tags and Group 0 configuration tags.

2. The Get Configuration command produces the same result as a Get Configurable Group command for group 0 (default). Get Configuration cannot return TLVs from other TLV Groups.

3. The Get Configuration command cannot return PayPass Group tags (because PayPass does not use group 0).

When the reader receives this command, it returns the current values for all the parameters that can be set using the Set Configuration command. Each parameter is returned as a TLV data object. Floor Limits for different AIDs are preceded by the TLV of the specific AID associated with that object.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	02h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects		

Refer to the Global Configuration Tags and Group Configuration Tags for definitions of tags that can be returned in this command.

Get Version Protocol 2 (29-00)

Get the ViVOpay Firmware Version Number from the ViVOpay reader. The reader returns a Response Frame containing the ViVOpay firmware version information.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	29h	00h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	29h	See Status Code Table	00h	String length	Version string		

Get USB Boot Loader Version (29-04)

Get the version of the USB Boot Loader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	29h	04h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	29h	See Status Code Table	00h	String length	Version string		

Set Baud Rate (30-01)

This command instructs the reader to change its baud rate to the specified value. If the Command Frame is valid and the ViVOpay reader supports the specified baud rate, it returns an OK response and then switches to the specified baud rate. If the Command Frame is not valid, or an invalid baud rate parameter is specified then the reader returns an error Response Frame. The new baud rate is retained over power cycles.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	30h	01h	00h	01h	Baud Rate Code		

Baud Rate Code	Baud Rate
01h	9600 baud
02h	19200 baud
03h	38400 baud
04h	57600 baud
05h	115200 baud

Important: All other values for Baud Rate Code are invalid and should not be accepted by reader.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	30h	See Status Code Table	00h	00h		

The reader switches baud rate only if the Response Frame contains an OK Status Code. No data is returned in the response.

Set Temporary Baud Rate (30-02)

This command instructs the reader to change its baud rate to the specified value temporarily. **After power up, the baud rate will return to the previous value.** If the Command Frame is valid and the ViVOpay reader supports the specified baud rate, it returns an OK response and then switches to the specified baud rate. If the Command Frame is not valid, or an invalid baud rate parameter is specified then the reader returns an error Response Frame.

Note: If the new baud rate is set by sending 30-02 command, then after power up, the baud rate will return to the previous value. If the new baud rate is set by sending 30-01 command, then after power up, the baud rate will still be the new value.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	30h	02h	00h	01h	Baud Rate Code		

Baud Rate Code	Baud Rate
01h	9600 baud
02h	19200 baud
03h	38400 baud
04h	57600 baud
05h	115200 baud

Important: All other values for Baud Rate Code are invalid and should not be accepted by reader.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	30h	See Status Code Table	00h	00h		

The reader switches baud rate only if the Response Frame contains an OK Status Code. No data is returned in the response.

Set Serial Number (12-02)

This command instructs the ViVOpay to store the 15-digit serial number in its non-volatile memory. If a serial number has already been set in the reader then this command fails with a Command Not Allowed error status. If the Command Frame is not valid, or the length is not 15 bytes then ViVOpay returns an error Response Frame.

Note: The reader serial number can only be set once. For Kiosk III, the coding of serial number must follow ID Tech Product Serial Number Requirement. If the input serial number does not satisfied by ID Tech Product Serial Number Requirement, reader will reject this command and respond error. For detailed information, refer to "WI 7.5.1-8 ID TECH Product Serial Number Requirements"

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 14+n	Byte 15+n

Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	12h	02h	00h	0Fh	15 digit Serial Number		

Note: For the 15 digit Serial Number in Kiosk III, only the first 10 bytes are valid.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	12h	See Status Code Table	00h	00h		

Get Serial Number (12-01)

Note: This command can only be used after the reader has received a Set Serial Number command.

This command instructs the ViVOpay to return the 15-digit serial number stored in its non-volatile memory. If a serial number has not been set in the reader then this command fails with a Command Not Allowed error status. If the Command Frame is not valid then ViVOpay returns an error Response Frame.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	12h	01h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	12h	See Status Code Table	00h	0Fh	15-digit Serial Number		

Note: For the 15 digit Serial Number in Kiosk III, only the first 10 bytes are valid.

Bootup Notification Command (14-01)

The ViVOpay firmware has the ability to spontaneously transmit its version information over the serial line during bootup. In this way the reader can notify the POS that it is ready to communicate when the bootup process has finished.

This feature can be toggled on or off using of the Bootup Notification command.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-Byte 18	Byte 19	Byte 20
Header Tag & Protocol	Command	Sub Command	Length MSB	Length LSB	Data 1 Bytes	CRC (LSB)	CRC (MSB)
ViVOtech2/0	14h	01h	00h	01h	See below	Varies	Varies

This command contains a single 1-byte argument.

Byte	Description
00h	Bootup Notification is disabled.
01h	Bootup Notification is enabled.

If Bootup Notification is enabled, the firmware transmits its Firmware Version string one time at the end of bootup.

For example, if a Vendi reader were enabled, it would begin to transmit its string, in this case, "Vendi V1.00" each time it was restarted.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-Byte 14+n-1	Byte 14+n	Byte 14+n+1
Header Tag & Protocol	Command	Status	Length MSB	Length LSB	Data 1 Bytes	CRC (LSB)	CRC (MSB)
ViVOtech2/0	14h	Varies	00h	00h	NA	Varies	Varies

Configurable AID and Group Commands

Set Configurable AID (04-02)

This command creates or selects an AID for configuration or deletion. There are eight TLVs that can be included in this command, some of which are mandatory.

TLV Group Number – This number refers to the group that has been created containing all of the characteristics desired for this AID. Setting and configuring the TLV Group Number is explained below. The TLV Group Number must be configured first. If an AID is communicated referring to a non-existing group, that AID is rejected.

Registered Application Provider Identifier (RID) – The parameter is optional. If it is provided, this number is used to reference the CA Public Key payment system. If it is not provided the first five bytes of the AID are used.

For System AIDs:

- Must always include the TLV Group Number TLV as the FIRST TLV in the message.
- Must always include the AID TLV as the SECOND TLV in the message.
- Must never include the Application Flow TLV in the message
- Must never include the RID TLV in the message
- The FOUR remaining TLVs are all optional.

There are System AIDs in the reader. These can be disabled but cannot be deleted.

For User AIDs:

- Must always include the TLV Group Number TLV as the FIRST TLV in the message.
- Must always include the AID TLV as the SECOND TLV in the message.
- Must always include the Application Flow TLV in the message
- The FIVE remaining TLVs are all optional.
- The DISABLE AID tag is ignored if included in a USER AID.

There are eight User AIDs in the system. These can be added (set) or deleted at the user's discretion.

- No User AID can have the same exact AID as a System AID.

In addition to the above requirements:

- All AIDs must reference a TLV Group (in the TLV Group Number TLV) that already exists
- Any AID with a Partial Select TLV must also include the Max AID Length TLV

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	02h			TLV Data Objects		

The TLV Data Objects that can be set using this command are defined in the AID Configuration Tags.

To set Configurable AID tags, the Application Identifier (9F06) and Group Number (FFE4) are mandatory tags.

Note: At present, the preferred means of disabling a System AID is **NOT** to include the FFE6 TLV. Instead, just issue a Delete AID command to for particular AID. This deletes a User AID OR disables a System AID.

If a Set Configurable AID command is sent without an FFE6 TLV, the reader enables the AID if it is not already enabled.

Finally, a Set AID command used for a User AID can include a FFE6 Disable AID Tag, but it is ignored. This tag is only used to set System AID.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table	00h	00h		

Set Configurable Group (04-03)

This command creates or modifies a TLV Group. You configure a specific TLV Group by passing the TLVs with the desired functionality and a unique TLV Group Number to the reader. The TLVs that can be associated with a TLV Group are listed below. A TLV Group Number and at least one other TLV is required. The reader uses TLVs in the default TLV Group 0 for any TLVs not defined in the user-defined TLV Group.

For M/Chip 3.0, Group 0 is not used. If you are configuring a group for M/Chip PayPass, then you should refer to the PayPass Group Tags. Otherwise, refer to the Group Configuration Tags.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n

Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	03h			TLV Data Objects		

If you are changing TLVs in Group 0 (the Default Group) the reader retains and uses the old values of any TLVs not included in the Set Configurable Group command. If you are changing any other Group, the reader discards existing TLVs not in the current Set Configurable Group command.

The implication of the statement above is that if you are configuring a group for PayPass, you must configure all of the necessary tags, as they will not default to Group 0 tags.

To set the TDOL TLV, simply pass on the desired values in the TLV. To disable the default TDOL, send a TDOL TLV with Length set to zero and no Value field included. This instructs the reader to delete any existing TDOL list for this group.

The TLV Data Objects that can be set using this command are given in the Configurable Group Tags Table (for non- PayPass applications) or the PayPass Group Tags.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table	00h	00h		

Get Configurable AID (03-04)

This command returns the configurable (User) AID parameters. The user MUST send an AID TLV in the command, as the first TLV in the command. The reader then returns all tags associated with that User AID in the response.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	04h			TLV Data Objects		

The command MUST include the TLV below. The command should NOT include any other TLV.

9F06	Application Identifier (AID) – terminal	MANDATORY	Identifies the application as described in ISO/IEC 7816-5. **Note:** This is the ONLY TLV in this command.	b	5 – 16

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects		

The optional Data Objects encoded as TLV that is returned in the data section of the Response Frame are the same as those listed in the AID Configuration Tags. The reader returns ALL TLV associated with this AID in its response.

If an AID is requested and the reader fails to find it in its database, the reader returns the AID TLV itself and NO additional arguments. This indicates that the command was correct with the proper argument, but there was no match in the reader's database. The reader does NOT indicate an error situation.

If the user requests a System AID that is currently disabled, the reader returns the AID TLVs, but appends the FFE6 TLV, showing that the AID is currently disabled.

Get Configurable Group (03-06)

Use this command to return all TLVs associated the specified Configurable Group. A configurable Group Tag must be included as the ONLY TLV in this command. The response should contain all of the Tags associated with this configurable Group.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	06h			TLV Data Objects		

The following TLV MUST be encoded in the command, it is the ONLY tag included in the command.

FFE4[1]	Group Number	MAND	The group that contains the properties for this AID **Note:** This must be the ONLY TLV in Data Field.	n2	1

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the reader has received these values and saved them in memory, it should dispose of the tags (and not keep them associated with these two values).

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects		

The Data Objects encoded as TLV that is returned in the data section of the Response Frame are given in the Group TLV Objects Table.

If the user requests a Group that is illegal, an error response is sent back.

If the user requests a valid Group number but the Group does NOT exist, then the reader returns the regular response but only includes the Group Number TLV (no other TLV is included). This signifies that the user has requested a valid number but no Group has been assigned to it.

Note: For a PayPass group, if a TLV data item is not present in the Group then it will not be present in the data returned by this command. However, this does not mean that there is no value for this particular TLV in order to perform a transaction. It is possible that the PayPass Kernel may have a hard-coded value for this TLV which will be used in a transaction if the TLV is not present in the Group or in Activate Transaction data. The data items for which the PayPass kernel has hard-coded default values are given in in the section on PayPass Group Configuration TLVs with Hard-Coded Values in Kernel.

Delete Configurable AID (04-04)

This command deletes a configurable AID. It is MANDATORY to include the AID TLV of the AID to be removed. No other TLVs should be included.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	04h			TLV Data Objects		

The Data Object encoded as TLV that can be set using this command is below.

9F06	Application Identifier (AID) – terminal	MANDATORY	Identifies the application as described in ISO/IEC 7816-5. **Note:** This is the ONLY TLV in this command.	b	5 – 16

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table	00h	00h		

The user may NOT delete a System AID. If this command is used on a System AID, the reader disables that System AID but does not delete it. That System AID can be restored at any point by using the Set AID command on it. Until that point it does not function (but it continues to reside in the reader's database).

When deleting an AID, the reader returns an OK response if the operation was successful. If it failed to find a matching AID, it returns an invalid parameter error response. If there was a problem with the command, the error response indicates malformed data.

Delete Configurable Group (04-05)

Use this command to delete a configurable Group. This means that this Group can no longer be used to load the parameters for a transaction.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	05h			TLV Data Objects		

It is MANDATORY to include the Group Number TLV of the Group the user wishes to delete. No other TLVs should be included.

FFE4[1]	Group Number	MAND	The group that contains the properties for AID **Note:** This must be the ONLY TLV in Data Field.	n2	1

[1] These objects use proprietary tags. The use of these tags should be restricted to the serial interface. Once the reader has received these values and saved them in memory, the Terminal should dispose of the tags.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table	00h	00h		

Do NOT delete the Default Group 0. The reader does not allow this command, and does NOT disable Group 0; instead it returns an error.

If the Group is not a valid Group Number this returns an error.

Finally, if the reader has ANY AID that references this Group, it does NOT delete the Group. It returns an error. That is, ONLY Groups that are NOT referenced by existing AID can be deleted. In this situation, the user must first delete or modify these AIDs, and then delete the Group.

Get All AIDs (03-05)

Use this command to return all AIDs in the reader. This command may be used to verify configured AIDs or to determine what System AIDs are in the reader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	05h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects		

The only Data Objects that should be returned from the GAA command are AID Tags. The reader sends out ALL TLV associated with each AID.

The reader sends one or more frames with all the AID TLVs in it. Each AID grouping begins with the Group Number TLV that this AID uses. The user can use this fact to parse between the AID groups passed back to the POS.

Get All Groups (03-07)

This command returns all Groups in the reader. This command may be used to verify all configured Groups in the reader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	07h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects		

The only Data Objects that should be returned from the GAG command are Group Tags. These are the same as those itemized in the Group Configuration Tags table.

The reader sends one or more frames with all the Group TLVs in it. Each Group begins with the Group Number TLV for the Group in question. The user can use this fact to parse between the Groups passed back to the POS.

Transaction Related Commands

Activate Transaction Command (02-01)

Use this command when the ViVOpay reader is in “Poll on Demand” mode to begin an EMV or contactless MagStripe Card transaction. When the reader is in “Poll on Demand” mode, the RF is turned on only after receiving an Activate Transaction command. When a valid Activate Transaction command is sent to the ViVOpay reader, it starts polling for cards.

If the ViVOpay reader does not find a supported card (an AID that matches one of the configured AIDs in the reader) for the specified time duration, it times out and ends the transaction. If the ViVOpay reader finds a card within the specified time interval, it attempts to carry out the transaction. The transaction flow between the reader and the card depends on the type of card detected.

If the transaction is successful, the reader returns the data in the response data. If the transaction is not successful, yet it proceeded into the transaction state machine, the reader returns a Failed Transaction Record in the response data. The presence and format of the Clearing Record, Track Data and Failed Transaction record depends on the type of card that was detected.

Note: While an Activate command is in progress, only a Cancel or a Stop command may be sent. Do not send other commands until Activate Transaction has completed, because the reader will interpret these as a Cancel Transaction command.

Note: For Non-SRED version device, response format for Activate Transaction Command is according to "Set Data Encryption Enable Flag (C7-36)" setting and Account DUKPT Key. When Data Encryption is disabled, device responds with plaintext data format. When Data Encryption is enabled: (1) When Account DUKPT Key exists and is valid, device responds with encrypted data format. (2) When Account DUKPT Key exhausts or does not exist, device responds status code 0x91/0x90 and no data.

For SRED version device, response format for Activate Transaction Command is according to Account DUKPT Key. When Account DUKPT Key exists and is valid, device responds with encrypted data format. When Account DUKPT Key exhausts or does not exist, device responds status code 0x91/0x90 and no data.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	02h	01h			See Data Format below		

The format and contents of the data field in the Command Frame are given in the following table. *All length values include the Tag and Length bytes*.

Table 32: Activate Transaction Command Frame Data Format

Data Item	Length (bytes)	Description
Timeout	1	Time in seconds that the reader waits for a card to be presented before timing out and returning an Error response. The reader will continue to poll for this amount of time if no card is found. Note that if a card is found, the transaction may not complete within the timeout period. This field must be present in the Activate Command. Format: Binary
TLV Data	varies	See Activate Command TLVs below.

Table 33: Activate Command TLVs

Tag	Description	Format	Length (in bytes)
9A	Transaction Date. EMV data element. Local date that the transaction was authorized. If TLV 9A and 9F21 are not provided, then the reader's current date and time will be used. Both date (9A) and time (9F21) tags must be present if either one is specified. The terminal/POS is responsible for ensuring that the date is valid: ▫ Year <=99 ▫ Month <=12 ▫ Day <=31 If the date value is set to 0xFF, 0xFF, 0xFF, then the date and time stamp will be taken from the reader's date and time will be used.	n6 (YYMMDD)	3
9C	Transaction Type. Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1993 Processing Code: ▫ 0x00 – Purchase Goods/Services ▫ 0x20 – Refund	n2	1
5F2A	Transaction Currency Code. Indicates the currency code of the transaction, in accordance with ISO 4217.	n3	2
5F36	Transaction Currency Exponent Indicates the implied position of the decimal point from the right of the transaction amount, according to ISO 4217.	n1	1
9F02	Amount, Authorized	n12	6
9F03	Amount Other	n12	6
9F1A	Terminal Country Code. (Typically, this has been configured in the reader – refer to Group Configuration Tags.)	n3	2
9F21	Transaction Time. Local time that the transaction was authorized. If TLV 9A and 9F21 are not provided, then the reader's current date and time will be used. Both date (9A) and time (9F21) tags must be present if either one is specified. The terminal/POS is responsible for ensuring that the time is valid.	n6 (HHMMSS)	3
9F5A	Terminal Transaction Type (Interac) ▫ 0x00 = Purchase ▫ 0x01 = Refund	b	1
FFEE01	ViVOtech TLV Group Tag	b	variable

For EMV transactions, if the terminal has already set up one or more of these data items using the Set Configuration or Set Configurable Group command, then the terminal need not include those data items in the Command Frame. If the terminal includes one or more values in the Command Frame, the reader uses the included values. If it does not, the reader just uses the default or previously set values.

The ViVOpay reader starts polling for cards when it receives this command. If it finds a card, it tries to complete a transaction with the card. If the card is a supported contactless EMV Card the reader uses the TLV fields in the Command Frame for the transactions. If the card is a contactless MagStripe Card, the reader does not use the TLV objects for the transaction.

If the transaction is completed successfully, and the card supported contactless EMV, then the reader returns the Clearing Record in the response data, otherwise, if the card does not support contactless EMV i.e. it is a contactless MagStripe Card, the reader returns Track information in the response data.

If the transaction cannot be completed successfully, the response contains an appropriate status code. The Response Frame contains more error information in the data field, for certain status codes.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	02h	See Status Code Table			See Response Frame Data Format		

Note: Specific TLV data may or may not be returned based on what was recovered from the card. Also, there is no implied sequence for returning the TLVs; the TLVs may or may not be returned in the order listed in the table based on what was recovered from the card.

Note: ViVOcomm and DesFire cards return raw track data only.

Note: Kiosk III/ Vendi don't support ViVOcomm and DesFire cards.

If the Status Code is OK or “Request Online Authorization” then the format and contents of the data field in the Response Frame are given in the following table.

Some data objects may not be present depending on the card involved in the transaction and the presence or absence of a Clearing Record object (DE 055). All TLV lengths include the Tag and Length bytes.

Table 34: Activate Transaction Response Frame Data Format

Data Item	Length (bytes)	Description
Track 1 Length	1	If Track 1 is available, then this field gives the length of the Track 1 data that follows. If Track 1 is not available, then a Length of 00h is returned. Format: Binary For MasterCard transactions, this field is always 0. If track data is present, it is contained in the MasterCard TLVs.
Track 1 Data (MagStripe Card)	Variable	Track 1 Data (if available). Format: ASCII (no null terminator)
Track 2 Length	1	If Track 2 is available, then this field gives the length of the Track 2 data that follows. If Track 2 is not available, then a Length of 00h is returned. Format: Binary For MasterCard transactions, this field is always 0. If track data is present, it is contained in the MasterCard TLVs.
Track 2 Data (MagStripe Card)	Variable	Track 2 Data (if available). Format: ASCII (no null terminator)
DE055 (Clearing Record) Present.)	1	If a Clearing Record (DE 055) field is available, then this field is 01h. If there is no Clearing Record (DE 055) field, then this field is 00h. For MasterCard transactions, this field is always 0.
TLV DE 055 (Clearing Record)	Variable up to 128	DE 055 data (if available) as a TLV data object encoded with Tag 'E1'. The DE 055 data is the same data as is included in the Clearing Record. Refer to the Activate Transaction Clearing Record table. Tag: E1 Format: b1...126 variables.
TLV Data	Variable	See Activate Response TLVs below. Not all of the tags will be present.

MasterCard transactions do not return a Clearing Record or the track data fields. Tags are returned in a format specified by M/Chip 3.0. Track 1 and Track2 data are encapsulated in tags according to the MasterCard specification.

Table 35: Activate Response TLVs

Tag	Description	Format	Length (in bytes)
50	Application Label. Name associated with the AID, in accordance with ISO/IEC 7816-5.	an	<= 16
56	Track 1 Equivalent Data. Contains the data objects of the track 1 according to [ISO/IEC 7813] Structure B, excluding start sentinel, end sentinel and LRC. The *Track 1 Data* may be present in the file read using the READ RECORD command during a mag-stripe mode transaction.	ans	<=79

Tag	Description	Format	Length (in bytes)
57	Track 2 Equivalent Data. Contains the data objects of the track 2, in accordance with ISO/IEC 7813, excluding start sentinel, end sentinel, and LRC.	ans	<=19
5A	Application Primary Account Number (PAN). The cardholder account number.	cn	<=19 (10 bytes)
82	Application Interchange Profile. Indicates the capabilities of the Card to support specific functions in the application.	b	2
84	DF Name. Identifies the name of the DF as described in ISO/IEC 7816-4.	b	5..16
95	Terminal Verification Results. Status of various functions from the terminal perspective.	b	5
9A	Transaction Date. Local date that the transaction was performed.	n6 (YYMMDD)	3
9B	Transaction Status Information.	b	2
9C	Transaction Type. Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1993 Processing Code.	n2	1
5F20	Cardholder Name.	b	<=26
5F24	Application Expiration Date. The date after which the card application has expired.	n6 (YYMMDD)	3
5F25	Application Effective Date. Date from which the card application may be used.	n6 (YYMMDD)	3
5F2A	Transaction Currency Code. Indicates the currency code of the transaction, in accordance with ISO 4217.	n3	2
5F2D	Language Preference. 1-4 languages stored in order of preference, each represented by 2 alphabetical characters according to ISO 639.	an	2..8
5F34	PAN Sequence Number. Identifies and differentiates cards with the same *Application PAN*.	n2 (BCD)	1
9F02	Amount, Authorized	n12	6
9F03	Amount Other	n12	6
9F06	Application Identifier (AID).	b	5..16
9F07	Application Usage Control.	b	2
9F09	Application Version Number (Reader) Version number assigned by the payment system for the Kernel application.	b	2
9F0D	Issuer Action Code (Default).	b	5
9F0E	Issuer Action Code (Denial).	b	5
9F0F	Issuer Action Code (Online).	b	5
9F10	Issuer Application Data. Contains proprietary application data for transmission to the issuer in an online transaction.	b	<=32

Tag	Description	Format	Length (in bytes)
9F11	Issuer Code Table Index. Indicates the code table according to ISO/IEC 8859 for displaying the Application Preferred Name.	n2	1
9F12	Application Preferred Name. The preferred mnemonic associated with the AID.	ans	<=16
9F1A	Terminal Country Code. (Typically, this has been configured in the reader – refer to Group Configuration Tags.)	n3	2
9F1E	Interface Device Serial Number. Unique and permanent serial number assigned to the IFD by the manufacturer. (Typically, this has been configured in the reader – refer to Group Configuration Tags.)	an	8
9F21	Transaction Time. Local time that the transaction was performed.	n6 (HHMMSS)	3
9F26	Application Cryptogram. This is returned in the response to GenAC or RecoverAC.	b	8
9F27	Cryptogram Information Data Indicates the type of cryptogram and the actions to be performed.	b	1
9F33	Terminal Capabilities. Indicates the card data input, CVM, and security capabilities of the Terminal and Reader.	b	3
9F34	Cardholder Verification Method (CVM) Results. Indicates result of last CVM performed.	b	3
9F35	Terminal Type. (Typically, this has been configured in the reader – refer to Group Configuration Tags.)	n2	1
9F36	Application Transaction Counter. Counter maintained by the application in the card.	b	2
9F37	Unpredictable Number. A challenge number used by the card to ensure uniqueness of the generated cryptogram.	b	4
9F39	Point of Service (POS) Entry Mode. Indicates the method by which the PAN was entered. Values: 90h = Magnetic Stripe Reader swipe 91h = Contactless MSD transaction 07h = Contactless EMV	n2	1
9F42	Application Currency Code. Indicates the currency in which the account is managed in accordance with ISO 4217.	n3	2
9F45	Data Authentication Code.	b	2
9F4C	ICC Dynamic Number.	b	8
9F53	Transaction Category Code. Indicates the type of transaction being performed, and which may be used in card risk management.	an	1
9F5A	Membership Scheme - Account Number (Amex) Or Terminal Transaction Type (Interac)	an b	<=5 1
9F5B	Membership Scheme Number of Points (Amex).	an	<=29

Tag	Description	Format	Length (in bytes)
9F5D	Available Offline Spending Amount (Balance).	b	6
9F6B	Track 2 Data. Contains the data objects of the track 2 according to ISO/IEC 7813, excluding start sentinel, end sentinel and LRC.	b	<=19
9F6C	Card Transaction Qualifiers (Visa transactions only). If card does not return this tag then a length of zero is returned.	b	16
9F6D	Mag-Stripe Application Version Number (Reader). Version number assigned by the payment system for the specific mag-stripe mode functionality of the Kernel.	b	2
9F6E	Third Party Data. Contains various information, possibly including information from a third party.	b	5..32
9F74	VLP Issuer Authorization	b	6
E300	Authorization Code.	b	8
DF8104	Balance Read Before GenAC. (MasterCard) Balance read from the card before the GenAC.	n12	6
DF8105	Balance Read After GenAC. (MasterCard) Balance read from the card after the GenAC.	n12	6
DF8115	Error Indication. (MasterCard) Flags defining the error conditions from the transaction. Refer to the M/Chip PayPass specification.	b	6
DF8129	Outcome Parameter Set (MasterCard). Contains the result of the transaction. Refer to the M/Chip PayPass specification.	b	8
FF8105	Data Record (MasterCard, container). Contains the data from the transaction. Refer to the M/Chip PayPass specification.	b	varies
FF8106	Discretionary Data (MasterCard, container). Contains the discretionary data from the transaction. Refer to the M/Chip PayPass specification.	b	varies
FFEE01	ViVOPay Group Tag. (container) This three-byte Group Tag was created to contain ViVOpay proprietary Tags. See tags below.	b	<=76
DF30 (ViVOpay proprietary)	Track Data Source. This tag is embedded in the ViVOpay Group tag. It specifies whether the track data came from a swipe or RFID transaction. 0Ch for swiped MagStripe 00h for a contactless card.	b	1
DF31 (ViVOpay proprietary)	DD Card Track 1 (MagStripe Card) This tag is embedded in the ViVOpay Group tag. If Track 1 Data is present, then DD CARD TRACK1 contains a copy of the discretionary data field of Track 1 Data as returned by the card.	**b**	<= 56
DF32 (ViVOpay proprietary)	DD Card Track 2 (MagStripe Card) This tag is embedded in the ViVOpay Group tag. If Track 2 Data is present, then DD CARD TRACK2 contains a copy of the discretionary data field of Track 2 Data as returned by the card.	b	<=8

Tag	Description	Format	Length (in bytes)
DF33 (ViVOpay proprietary)	Receipt Requirement (Interac) This tag is embedded in the ViVOpay Group tag for Interac transaction responses. 00 = No receipt required 01 = Receipt required	b	1
DF5B (ViVOpay proprietary	Terminal Entry Capability (Visa). For Visa Transactions, defines reader support for VSDC contact chip. Values: 05h = Reader supports VSDC contact chip 08h = Reader does not support VSDC contact chip	n2	1
DFEE26	Encrypt Information Length: 1 bytes Values (same as Attribution): bit0 – Card Type: 0 – Contact Card 1 – Contactless Card bit2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode bit3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR. bit6~4 – Reserved bit7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON.	b	1

If a Clearing Record is returned, its potential TLVs are described in the following table.

Different card applications may have a slightly different format, or different TLVs, for the Clearing Record. MasterCard M/Chip 3.0 does not return a clearing record.

Table 36: Activate Transaction Clearing Record TLVs

Tag		Data Element Name	Format	Origin
E1		DE 055	b1...126 var	
	50	Application Label	ans1…16 var	Card
	82	Application Interchange Profile	b2	Card
	84	DF name	b	Card
	95	Terminal Verification Results: Indicates results of various transaction processes.	b 5	Reader
	9A	Transaction Date	n6	Terminal
	9B	Transaction Status Information	b2	Terminal
	9C	Transaction Type ▫ 0x00 = Purchase Goods/Services ▫ 0x20 = refund	n2	Reader
	5F2A	Transaction Currency Code	n3	Terminal
	5F2D	Language Preference	an2-8 var	Card
	5F34	Application Primary Account Number Sequence Number	n2	Card
	9F02	Amount, Authorized (Numeric)	n12	Terminal
	9F03	Amount, Other (Numeric, Visa only)	n12	Terminal
	9F08	Application Version Number	b2	Card
	9F09	Application Version Number	b2	Card

	Tag	Data Element Name	Format	Origin
	9F10	Issuer Application Data	b1-32 var	Card
	9F11	Issuer Code Table Index	n2	Card
	9F12	Application Preferred Name	ans1-16 var	Card
	9F1A	Terminal Country Code	n3	Terminal
	9F21	Transaction Time	n6	Terminal
	9F26	Application Cryptogram	b8	Card
	9F27	Cryptogram Information Data	b1	Card
	9F33	Terminal Capabilities	b3	Terminal
	9F34	Cardholder Verification Method (CVM) Results	b3	Terminal
	9F35	Terminal Type (Interac)	b1	Terminal
	9F36	Application Transaction Counter	b2	Card
	9F37	Unpredictable Number	b4	Reader
	9F39	POS Entry Mode (Interac)	b1	Reader
	9F45	Data Authentication Code	b2	Card
	9F4C	ICC Dynamic Number	b2-8 var	Card
	9F59	Terminal Transaction Information (Interac)	b3	Terminal
	9F5A	Terminal Transaction Type (Interac)	b1	Terminal
	9F66	Visa TTQ(Visa only)	b4	Reader
	9F6C	Card Transaction Qualifiers (Visa only)	b2	Card
	9F6E	Form Factor Indicator or PayPass Third Party Data	b4 b5-32 var	Reader Reader
	9F74	VLP Issuer Authentication Code	b	Terminal
	9F7C	Customer Exclusive Data	b1-32 var	Reader
	DF30	Track Data Source ▫ 0x0C – swiped mag-stripe card ▫ 0x00 – contactless card	b1	Reader
	DF33	Receipt Required (Interac) – calculated by checking the Interac Terminal Receipt Required Limit (9F5F).	b1	Reader
	DF52	Transaction CVM: ▫ 00 = for No CVM ▫ 01 = for Signature ▫ 02 = for Online PIN ▫ 03 = for Mobile CVM / Consumer Device CVM	b1	Reader
	DF76	TVR Backup – value of TVR prior to GenAC	b5	Reader
	FFEE01	ViVOpay Proprietary Group Tag	b variable	Terminal

If the Status Code being returned in the Response Frame is “Failed” and the Error Code is not “Request Online Authorization”, then the contents of the Data field contains further information on the cause of the failure and does not contain the Track or Clearing Record information. In this case the Data field in the Response Frame has the following format.

Table 37: Activate Transaction Cause of Failure When Not Request Online Authorization

Data Field	Length (bytes)	Description
Error Code	1	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1	Value of SW1 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
SW2	1	Value of SW2 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
RF State Code	1	RF State Code indicating exactly where the error occurred in the Reader-Card transaction flow. See sub-section on RF State Codes.

If the Status Code being returned in the Response Frame is "Failed" and the Error Code is "Request Online Authorization", then the contents of the Data field contains further information on the cause of the failure and does not contain the Track or Clearing Record information. In this case the Data field in the Response Frame has the following format.

Table 38: Activate Transaction Cause of Failure When Request Online Authorization

Data Field	Length (bytes)	Description
Error Code	1	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1	Value of SW1 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
SW2	1	Value of SW2 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
RF State Code	1	RF State Code indicating exactly where the error occurred in the Reader-Card transaction flow. See sub-section on RF State Codes.
TLV Track 2 Equivalent Data	21 (including Tag & Length)	Track 2 Equivalent Data as a TLV object. Tag: 57 Format: b19
Amount Requested	6	Difference between the Terminal Contactless Transaction Limit (FFF1) and Balance. Format: n12

If the Status Code is "User Interface Event" then the format and contents of the data field in the Response Frame are given in the following table:

Data Item	Length (bytes)	Description
Transaction status	1	01: The reader detects the card and initiates the transaction.

For any other Status Code the data field is empty.

If the transaction failed, the Response Frame may have the following format. Invalid or inappropriate cards may result in no Response Frame.

Table 39: Activate Transaction Response Frame Format, Failed

Transaction

Data Item	Length (bytes)	Description
Error Code	1	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1	Value of SW1 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
SW2	1	Value of SW2 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
RF State Code	1	RF State Code indicating exactly where the error occurred in the Reader-Card transaction flow. See RF State Codes.
TLV data	Varies	Refer to the Activate Response TLVs.

Special TLV for Discover D-PAS and Android Pay Application

A new ViVOtech proprietary tag "TLV Special Flow" will be added to the Activate Transaction command data as shown below.

Command Data

Data Item	Length (Bytes)	Description		
:	:	:		
ViVOtech TLV Group Tag FFEE01	Variable	TLV Special Flow	2 Byte Tag + 1 Byte Length + Variable data (max 40 bytes)	This TLV defines one or more special transaction flows for specific non-payment apps that are ISO 14443-4 compliant. Tag: DF50 Format: The TLV value contains one or more 4-byte "Special Flow Record" entries. The format of a Special Flow Record is given in the next table. A Special Flow TLV cannot have more than 10 record entries.
		TLV Read Cmd Data	2 Byte Tag + n-Byte Length + Variable Data	This TLV is for Android Pay only. This TLV contains the data that is to be sent to the card as part of the Request Data command. Format of the TLV value will be as defined by Android Pay/Discover D-PAS and is out of the scope of this document. Tag: DF47 Format: Raw data
		TLV Write Data	2 Byte Tag + n-Byte Length + Variable Data	This TLV is for Android Pay only. This TLV contains the data that is to be written to the card. Format of the TLV value will be as defined by Android Pay/Discover D-PAS and are out of the scope of this document. Length of the Value <= 255. Tag: DF48 Format: Raw data
		TLV Issuer Script	2 Byte Tag + n-Byte Length + Variable Data	This TLV is for Discover D-PAS only. This TLV contains the Issuer Script that is to be sent to the card. The Issuer Script is defined by the Discover D-PAS specification. Tag: DF51 Format: Raw data

Special Flow Record Format

Byte #	Field
1	**Application Flow Code** This is the card application for which this special flow entry is being defined. This can be any of the Application Flows defined for the ViVOtech2 "Set Configurable AID" command as long as it is for a non-Payment application such as ISIS. A special flow entry should not be made explicitly for an ISO Payment application.
2	**Special Transaction Flow Flags** This byte defines the nature of the special flow and indicates whether the Application Flow defined in the previous byte occurs during pre-PPSE or post-PPSE processing. It also indicates whether a standard ISO Transaction will be performed in between pre-PPSE and post-PPSE processing or skipped. The flags within this byte are given below.

B7	B6	B5	B4	B3	B2	B1	B0	Flag Description
0	0	0	0	0				Unused. Set to 0
					1			Perform Post-PPSE Transaction
						1		Perform Pre-PPSE Transaction
							1	Perform ISO Payment Transaction (PPSE+AID)

3	**Special Transaction Type Flags for Pre-PPSE Processing** This byte indicates the type of special (non-payment) transaction that will be performed in the Pre-PPSE transaction processing (if any). The flags within this byte are given below.							

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Flag Description
0	0	0	0	0	0			Unused. Set to 0
						1		Write Transaction
							1	Read Transaction

4	**Special Transaction Type Flags for Post-PPSE Processing** This byte indicates the type of special (non-payment) transaction that will be performed in the Post-PPSE transaction processing (if any). The flags within this byte are given below.							

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	Flag Description
0	0	0	0	0	0			Unused. Set to 0
						1		Write Transaction
							1	Read Transaction

For Discover D-PAS 2nd Presentment of Issuer Update Process, the value in the Special Flow TLV will be:
Pre-PPSE Write D-PAS On-Line Script Processing DF50 04 0D 02 02 00

The 0xFFEE01 TLV format for Discover D-PAS when input Issuer Script for Issuer Update Processing:
FFEE01 <len> DF50 04 0D020200 DF51 <len> <Issuer Script>
<Issuer Script> is defined by D-PAS spec.

Steps to do Issuer Update Processing for Discover D-PAS:
Step1: Set TTQ Byte3 Bit8 "Issuer Update Processing supported" to be 1
Step2: Use "Activate Transaction Command (02-01)" to do normal Discover D-PAS transaction and reader will response transaction result and data.
Step3: After host receives Online Request from reader, host can send "Activate Transaction Command (02-01)" to reader with Issuer Scripts(DF51 TLV) in FFEE01 TLV. Then reader will run Issuer Update Processing and response TVR and TSI

For Android Pay, each of the Transaction flows described below, the value in the Special Flow TLV will be as follows:
(1) Pre-PPSE SA Data Read DF50 04 17 02 01 00

(2) Pre-PPSE SA Data Write DF50 04 17 02 02 00
(3) Pre-PPSE SA Data Read & ISO Payment DF50 04 17 03 01 00
(4) Post-PPSE SA Data Read & ISO Payment DF50 04 17 05 00 01
(5) Post-PPSE SA Data Write & ISO Payment DF50 04 17 05 00 02
(6) Pre-PPSE SA Data Read + ISO Payment + Post-PPSE SA Data Write DF50 04 17 07 01 02
(This is not an Android Pay flow, but the current firmware supports such flows if required)

The 0xFFEE01 TLV format for Android Pay:
FFEE01 <len> DF50 04 <Special Flow> DF47 <len> <Read Cmd Data> DF48 <len> <Write Cmd Data>
DF47 TLV and DF48 TLV are optional according to DF50 TLV setting.

The Activate Transaction response data will contain a new tag that will contain the Android Pay Transaction related data if an Android Pay Transaction was performed, regardless of whether the transaction was successful or failed. See table below.

Data Item	Length (Bytes)	Description
TLV Data	Variable	Transaction Data (if any) as a TLV object. Tag: DF49 Format: binary The value field contains (1) 2 bytes: 0x00 0x00 (2) 1byte: Error Code (3) 1 byte: RF State Code (4) 2 byte: SW1 SW2 (5) Zero or more bytes of data from the card (if available). Format of the card data is out of the scope of this document.

If an Android Pay operation was performed in the Pre-PPSE phase, Activate Transaction response contains the following Transaction Data:
FFEE02 <len><DF49 TLV>
If an Android Pay operation was performed in the Post-PPSE phase, Activate Transaction response contains the following Transaction Data:
FFEE03<len><DF49 TLV>

Steps to do Android Pay Transaction:
Step1: Enable Android Pay by setting FFF3 Byte1 Bit5 "Android Pay Support"to 1.
Step2: Add FFEE01 TLV with Android Pay flow(DF50 TLV), Read Cmd Data (DF47 TLV) or Write Cmd Data (DF48 TLV) in "Activate Command (02-01)" to start transaction.
Step3: FFEE02 or FFEE03 TLV which contains read or write status and data from Android Pay will appear in reader response.

Special TLV for PayPass Application

This design connect the M/Chip signal handling to the existing GR user interface module ("Process D") to support MSG and OUT signals in ViVOpay readers with displays.

Reference files
[1] EMV Contactless Book C-2, Kernel 2 Specification, v2.3
[2] PayPass Test Cases for PayPass v3.0 Level 2 Reader Testing, Aug 2011
[3] EMV Contactless Specifications for Payment Systems, Book A, Architecture and General Requirements, v2.3
[4] PayPass M/Chip Reader Card Application Interface Specification v3.0.2
[5] Engineering Specification, MChip 3.0 on GR, v1.6

(1) MSG Signals

MSG Signals are used by other processes to send the User Interface Request Data to Process D. Process D manages the User Interface Requests as defined in reference [3] and displays a message and/or a status. The User Interface Request Data is defined in reference [1] as tag DF8116 and holds twenty-two bytes of data as shown in the table below:

Data Field	Length
Message Identifier	1
Status	1
Hold Time	3
Language Preference	8
Value Qualifier	1
Value	6
Currency Code	2

(2) OUT Signals

OUT Signals are used by the kernel (Process K) to indicate the outcome of a transaction. According to reference [1] the OUT signal may comprise the following objects.

Data Field	Tag	Length
Outcome Parameter Set	DF8129	8
Data Record (if any)	FF8105	var.
Discretionary Data	FF8106	var.
User Interface Request Data (if any)	DF8116	22

According to reference [1], all objects listed below are to be added to the output buffer if they are present.

The Data Record (FF8105) may contain the following objects for an EMV transaction, with a maximum length of 256 bytes (74 TL, 182 V).

Data Field	Tag	Length
Amount, Authorized (Numeric)	9F02	6
Amount, Other (Numeric)	9F03	6
Application Cryptogram	9F26	8
Application Expiration Date	5F24	3
Application Interchange Profile	82	2
Application Label	50	16
Application PAN	5A	16
Application PAN Sequence Number	5F34	1
Application Preferred Name	9F12	16
Application Transaction Counter	9F36	2
Application Version Number (Reader)	9F08	2
Cryptogram Information Data	9F27	1
CVM Results	9F34	3
DF Name	84	16
Interface Device Serial Number	9F1E	8
Issuer Application Data	9F10	32
Issuer Code Table Index	9F11	1
Terminal Capabilities	9F33	3
Terminal Country Code	9F1A	2
Terminal Type	9F35	1
Terminal Verification Results	95	5
Track 2 Equivalent Data	57	19
Transaction Category Code	9F53	1
Transaction Currency Code	5F2A	2
Transaction Date	9A	3
Transaction Type	9F21	3
Unpredictable Number	9F37	4

The Data Record may contain the following objects for a Mag-Stripe transaction, with a possible maximum length of 182 bytes (20 TL, 162 V).

Data Field	Tag	Length
Application Label	50	16

Application PAN	5A	16
Application Preferred Name	9F12	16
Mag-stripe Application Version Number	9F6D	2
DF Name	84	16
Issuer Code Table Index	9F11	1
Track 1 Data	56	76
Track 2 Data	9F6B	19

Discretionary Data is always included in an OUT signal. Discretionary Data for an EMV transaction may include the following objects, with a possible maximum length of 1009 bytes (61 TL, 948 V), ignoring the Data Storage elements. Without the Torn Record maximum size would only be 80 bytes.

FF8106	var	Discretionary Data		
		9F42	2	Application Currency Code
		DF8105	6	Bal Read After Gen AC
		DF8104	6	Bal Read Before Gen AC
				DS Summary 3
				DS Summary Status
		DF8115	6	Error Indication
		DF810E	1	Post-Gen AC Put Data Status
		DF8105	1	Pre-Gen AC Put Data Status
		9F6E	32	Third Party Data
		FF8101	894	Torn Record

A Torn Record (FF8101) contains the following objects and may have a maximum length of 894 bytes (66 TL, 828 V);

Data Field	Tag	Length
Amount, Authorized (Numeric)	9F02	6
Amount, Other (Numeric)	9F03	6
Application PAN	5A	16
Application PAN Sequence Number	5F34	1
Balance Read Before Gen AC	DF8104	6
CDOL1 Related Data	DF8107	252
CVM Results	9F34	3
DRDOL Related Data	DF8113	252
IDS Status	DF8128	1
Interface Device Serial Number	9F1E	8
PDOL Related Data	DF8111	252
Reference Control Number	DF8114	1
Terminal Capabilities	9F33	3
Terminal Country Code	9F1A	2
Terminal Type	9F35	1
Terminal Verification Results	95	5
Transaction Category Code	9F53	1
Transaction Currency Code	5F2A	2
Transaction Date	9A	3
Transaction Type	9F21	3
Unpredictable Number	9F37	4

Discretionary Data for a Mag-Stripe transaction may include the following objects, with a possible maximum length of 117 bytes (15 TL, 102 V):

FF8106	var	Discretionary Data		
		DF812A	56	DD Card (Track 1)
		DF812B	8	DD Card (Track 2)
		DF8115	6	Error Indication

		9F6E	32	Third Party Data

The most typical Intermediate OUT Signal (for cases such as Error – Other Card and Try Again) are only required to include the Outcome Parameter Set and the Error Indication and the L2 tests usually focus on verifying data within these objects.

Tag	Len	Data Object		
DF8129	8	Outcome Parameter Set		
FF8106	10	Discretionary Data		
		DF8115	6	Error Indication

(3) Signal Data TLV – FFEE04

A new proprietary TLV is defined to hold the intermediate signal data during a transaction. It will be populated with one or more signal objects as the UI_MSG_Signal function in UserInterface.c receives MSG Signals and the UI_OUT_Signal function in UserInterface.c receives OUT Signals.

This tag must be included in the ACT command to enable the signal data capture feature during the transaction. If it is received in the ACT command this feature is enabled and the Signal Data Handler will add signal data to the buffer. If it is not received, the Signal Data Handler will do nothing and the length of this TLV will remain 0 and nothing will be returned.

A second new proprietary tag is defined (FFEE05) which is used to separate and identify each individual signal entry added to the buffer, whether it is a MSG signal or an OUT signal. A new tag (DF8914) which includes Activate Response TLVs (Table 29) may be included in FFEE05.

When the transaction is complete, if tag FFEE04 was received in the ACT command and the Signal Data tag is not empty, it will be added to the ACT response. The signal data buffer (the "contents" of FFEE04) is cleared when an ACT command is received.

Activate Transaction Response Frame Encrypted Data Format

The above description is plaintext response. The encrypted data format is as follows: (Please see "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" for details)

(1) Success Transaction--Plaintext data field format before encryption

Data Item	Length (bytes)	Description
Track 1 Length	1	If Track 1 is available, then this field gives the length of the Track 1 data that follows. If Track 1 is not available, then a Length of 00h is returned. Format: Binary For MasterCard transactions, this field is always 0. If track data is present, it is contained in the MasterCard TLVs.
Track 1 Data (MagStripe Card)	Variable	Track 1 Data (if available). Format: ASCII (no null terminator)
Track 2 Length	1	If Track 2 is available, then this field gives the length of the Track 2 data that follows. If Track 2 is not available, then a Length of 00h is returned. Format: Binary For MasterCard transactions, this field is always 0. If track data is present, it is contained in the MasterCard TLVs.
Track 2 Data (MagStripe Card)	Variable	Track 2 Data (if available). Format: ASCII (no null terminator)
DE055 (Clearing Record) Present.)	1	If a Clearing Record (DE 055) field is available, then this field is 01h. If there is no Clearing Record (DE 055) field, then this field is 00h. For MasterCard transactions, this field is always 0.
TLV DE 055 (Clearing Record)	Variable up to 128	DE 055 data (if available) as a TLV data object encoded with Tag 'E1'. The DE 055 data is the same data as is included in the Clearing Record. Refer to the Activate Transaction Clearing Record table. Tag: E1 Format: b1...126 variables.

Data Item	Length (bytes)	Description
TLV Data	Variable	See Activate Response TLVs Not all of the tags will be present.

Success Transaction--Encrypted data field format for Contactless card

Data Item	Length (bytes)	Description
Attribution	1	bit0 – Card Type: 0 – Contact Card.1 – Contactless Card bit2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode bit3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR. bit6~4 – Reserved bit7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON.
TLV KSN	10	KSN of DUKPT Account Key Tag: FFEE12 Format: Binary
TLV Track 1 (MagStripe Card)	Variable	TDES/AES Encrypted Track 1 Data (if available) with Padding (0x00). If Track 1 is not available, this field is not present. Tag: FFEE13 (Not Paypass), 56 (Paypass) Format: ASCII (no null terminator)
TLV Track 2 (MagStripe Card)	Variable	TDES/AES Encrypted Track 2 Data (if available) with Padding (0x00). If Track 2 is not available, this field is not present Tag: FFEE14 (Not Paypass), 9F6B (Paypass) Format: ASCII (no null terminator)
TLV DE 055 (Clearing Record)	Variable up to 128	DE 055 data (if available) as a TLV data object encoded with Tag 'E1'. The DE 055 data is the same data as is included in the Clearing Record. Refer to the Activate Transaction Clearing Record table. Sensitive TLV will be TDES/AES encrypted with Padding (0x00) Please see "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" for details Tag: E1 Format: b1...126 variables.
TLV Data	Variable	Refer to Activate Response TLVs. Sensitive TLV will be TDES/AES encrypted with Padding (0x00) Please see "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" for details

Success Transaction--Encrypted data field format for MSR card

<table>
<tr><th>Data Item</th><th>Length (bytes)</th><th>Description</th></tr>
<tr><td>Attribution</td><td>1</td><td>bit0 – Card Type: 0 – Contact Card.1 – Contactless Card
bit2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode
bit3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR.
bit6~4 – Reserved
bit7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON.</td></tr>
<tr><td>MSR TLV</td><td>Variable</td><td>MSR TLV
Data length compose of data length indicator (1 byte) and actual data length byte.
<table>
<tr><th colspan="2">MSR FIELD DATA length</th><th>Data length Indicator byte</th><th>Data length byte</th></tr>
<tr><td>Data <128 bytes</td><td>01~7F</td><td>X</td><td>1</td></tr>
<tr><td>128 bytes <= Data <=255 bytes</td><td>80~FF</td><td>81</td><td>1</td></tr>
<tr><td>Data > 255 bytes</td><td>FF~</td><td>82</td><td>2</td></tr>
</table>
Data is follow Enhanced Encrypted MSR FIELD DATA. Refer to Appendix A.11: Enhanced Encrypted MSR Data Output Format

Tag: DFEE23 Format: Binary</td></tr>
<tr><td>TLV Data</td><td>Variable</td><td>See Activate Response TLVs</td></tr>
</table>

(2) Failed Transaction--Plaintext data field format before encryption

Data Item	Length (bytes)	Description
Error Code	1	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1	Value of SW1 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
SW2	1	Value of SW2 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
RF State Code	1	RF State Code indicating exactly where the error occurred in the Reader-Card transaction flow. See RF State Codes.
TLV data	Varies	Refer to the Activate Response TLVs.

Failed Transaction--Encrypted data field format

Data Item	Length (bytes)	Description
Attribution	1	bit0 – Card Type: 1 – Contactless Card bit2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode bit3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR. bit6~4 – Reserved bit7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON.
TLV KSN	10	KSN of DUKPT Account Key. If only TLV Error code is present and no other TLV data, this field is not present. Tag: FFEE12 Format: Binary
TLV Error code	4	<Error Code><SW1><SW2><RF State Code> Tag: FFEE1F

Data Item	Length (bytes)	Description
TLV data	Varies	Refer to the Activate Response TLVs. Sensitive TLV will be TDES/AES encrypted with Padding (0x00) Please see “80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F” for details

Get Transaction Result (03-00)

Use this command when the ViVOpay reader is functioning in "Auto Poll" mode. In this mode the reader does not wait for an Activate Transaction command to start polling for a card. It is always in Auto Poll Mode. When it detects a card, it carries out a transaction with the card. If the card is a supported contactless MagStripe card, the reader does not need any parameters from the terminal. If the card is a supported contactless EMV Card, then the reader uses the default terminal parameters (Group 0 TLVs) in the reader. If some terminal parameters had been set by using the Set Configuration command, then the reader uses the new values for these parameters.

If the transaction is successful, the reader keeps the transaction data (Track or Clearing Record) in its memory. When it receives the Get Transaction Result command, it returns this data to the terminal immediately and reset its data buffer. If the reader has not detected any card since power up or since the last Get Transaction Result command, and this command is received, the reader responds back immediately indicating that it has no data for the terminal.

In Auto Poll Mode the reader can carry out only contactless MagStripe and contactless EMV transactions. It cannot carry out any ticketing or ePurse transactions since these transactions require interaction with the Terminal during the transaction itself.

Note: For Non-SRED version device, response format for Get Transaction Result Command is according to "Set Data Encryption Enable Flag (C7-36)" setting and Account DUKPT Key. When Data Encryption is disabled, device responds with plaintext data format. When Data Encryption is enabled: (1) when Account DUKPT Key exists and is valid, device responds with encrypted data format. (2) When Account DUKPT Key exhausts or does not exist, device responds status code 0x91/0x90 and no data.

For SRED version device, response format for Get Transaction Result Command is according to Account DUKPT Key. When Account DUKPT Key exists and is valid, device responds with encrypted data format. When Account DUKPT Key is invalid or does not exist, device responds status code 0x91/0x90 and no data.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	00h	00h	00h		

On receiving this command, the ViVOpay reader returns one of the following …

- A response containing Track Data (Contactless MagStripe Transaction)
- A response containing a Clearing Record (Contactless EMV Transaction)
- A response containing no Data (No transaction)

If the transaction cannot be completed successfully, the response indicates an OK status and indicates “No Data”.

Note: ViVOcomm and DesFire cards return raw track data only.

If there was an error in the Command Frame received then the response contains an appropriate status code.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			See Data Tables		

If Status Code is OK then the format and contents of the data field in the Response Frame are given in the following table. Some data objects may not be present depending on the card involved in the transaction and the presence or absence of a Clearing Record object (DE 055). All TLV lengths include the Tag and Length bytes.

Table 40: Get Transaction Result Format and Content

Data Item	Length (bytes)	Description
Track 1 Length	1	If Track 1 is available, then this field gives the length of the Track 1 data that follows. If Track 1 is not available, then a Length of 00h is returned. Format: Binary
Track 1 Data (MagStripe card)	Variable	Track 1 Data (if available). Format: ASCII (no null terminator)
Track 2 Length	1	If Track 2 is available, then this field gives the length of the Track 2 data that follows. If Track 2 is not available, then a Length of 00h is returned. Format: Binary
Track 2 Data (MagStripe card)	Variable	Track 2 Data (if available). Format: ASCII (no null terminator)
DE055 (Clearing Record) Present	1	If a Clearing Record (DE 055) field is available, then this field is 01h. If there is no Clearing Record (DE 055) field, then this field is 00h.
TLV DE 055 (Clearing Record) (see Clearing Record Format)	Variable up to 128	DE 055 data (if available) as a TLV data object encoded with Tag ‘E1’. The DE 055 data is the same data as is included in the Activate Transaction Clearing Record. Refer to the Activate Transaction Clearing Record table. Tag: E1 Format: b1...126 variable.
TLV Data	Variable	Refer to Activate Response TLVs.

If the Status Code is OK the response is different depending on the card application:

Card Application	Return Data
PayPass MagStripe	Track1/Track2
PayPass M/Chip	Chip data plus other tags
JCB QuicPay	TLV Auth code and Track2 Equivalent data
VSDC online application	Track1/Trakc2 and VLP Issuer Auth code
VSDC offline and qVSDC	Chip data E1 and some other tags

A Status Code 23 (request online authorization) can be returned for some cards (qVSDC & M/Chip) with a fully populated data field.

This command never returns a status code of "Failed". If any status code other than OK or status code '23' (request online authorization) is returned, the data field is empty.

The above description is plaintext response. The encrypted data format is as follows: (Please see "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" for details)

Get Transaction Result Encrypted data field format for contactless card

Data Item	Length (bytes)	Description
Attribution	1	bit0 – Card Type: 0 – Contact Card.1 – Contactless Card bit2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode bit3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR. bit6–4 – Reserved bit7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON.
TLV KSN	10	KSN of DUKPT Account Key Tag: FFEE12 Format: Binary
TLV Track 1 (MagStripe Card)	Variable	TDES/AES Encrypted Track 1 Data (if available) with Padding (0x00). If Track 1 is not available, this field is not present. Tag: FFEE13 (Not Paypass), 56 (Paypass) Format: ASCII (no null terminator)
TLV Track 2 (MagStripe Card)	Variable	TDES/AES Encrypted Track 2 Data (if available) with Padding (0x00). If Track 2 is not available, this field is not present Tag: FFEE14 (Not Paypass), 9F6B (Paypass) Format: ASCII (no null terminator)
TLV DE 055 (Clearing Record)	Variable up to 128	DE 055 data (if available) as a TLV data object encoded with Tag 'E1'. The DE 055 data is the same data as is included in the Clearing Record. Refer to the Activate Transaction Clearing Record table. Sensitive TLV will be TDES/AES encrypted with Padding (0x00) Please see "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" for details Tag: E1 Format: b1...126 variables.
TLV Data	Variable	Refer to Activate Response TLVs. Sensitive TLV will be TDES/AES encrypted with Padding (0x00) Please see "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" for details

Get Transaction Result Encrypted data field format for MSR card

<table>
<tr><th>Data Item</th><th>Length (bytes)</th><th>Description</th></tr>
<tr><td>Attribution</td><td>1</td><td>bit0 – Card Type: 0 – Contact Card.1 – Contactless Card
bit2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode
bit3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR.
bit6~4 – Reserved
bit7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON.</td></tr>
<tr><td>MSR TLV</td><td>Variable</td><td>MSR TLV
Data length compose of data length indicator (1 byte) and actual data length byte.
<table><tr><th colspan="2">Enhanced encrypted MSR FIELD DATA length</th><th>Data length Indicator byte</th><th>Data length byte</th></tr><tr><td colspan="2">Data <128 bytes</td><td>01~7F</td><td>X</td><td>1</td></tr><tr><td colspan="2">128 bytes <= Data <=255 bytes</td><td>80~FF</td><td>81</td><td>1</td></tr><tr><td colspan="2">Data > 255 bytes</td><td>FF~</td><td>82</td><td>2</td></tr></table>
Data is follow Enhanced Encrypted MSR FIELD DATA. Refer to Appendix A.11: Enhanced Encrypted MSR Data Output Format

Tag: DFEE23 Format: Binary</td></tr>
<tr><td>TLV Data</td><td>Variable</td><td>See Activate Response TLVs</td></tr>
</table>

Update Balance Command (03-03)

Use this command when the ViVOpay reader has been put in “Poll on Demand” mode and after the reader sends an online request to the issuer. This command is the authorization response sent by the issuer to the terminal including the Authorization Status (OK or NOT OK).

This command is also being used in some implementations (i.e. EMEA) to communicate the results of Issuer Authentication to the reader in order to display the correct LCD messages.

With this command, the POS passes the authorization result (OK/NOT OK), and possibly the Authorization Code (Auth_Code)/Date/Time to the terminal.

For a Visa transaction when the card supports Available Offline Spending Amount, the LCD displays the available amount.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	03h			See Data Table		

The format and contents of the data field in the Command Frame are given in the following table. All TLV lengths include the Tag and Length bytes.

Table 41: Update Balance Format and Contents

Data Item	Length (bytes)	Description
Status Code	1	00: OK 01: NOT OK
TLV Auth_Code	9	Authorization Code as a TLV object. Tag: E300 Format: b8
TLV Transaction Date	5	EMV data element "Transaction Date" as a TLV data object. Local date that the transaction was authorized. If this TLV is not provided, the transaction uses the reader's current date. Tag: 9A Format: n6 (YYMMDD) **Note:** The reader does not perform range checking on this value. The POS application should perform range checking on this value to ensure it is within acceptable limits.
TLV Transaction Time	6	EMV data element "Transaction Time" as a TLV data object. Local time that the transaction was authorized. If this TLV is not provided, the transaction uses the reader's current time. Tag: 9F21 Format: n6 (HHMMSS) **Note:** The reader does not perform range checking on this value. The POS application should perform range checking on this value to ensure it is within acceptable limits.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			See Data Tables		

If the Status Code is OK then the format and contents of the data field in the Response Frame are given in the following table. All TLV lengths include the Tag and Length bytes.

Table 42: Update Balance Format and Contents When Status OK

Data Item	Length (Bytes)	Description
TLV Track 2 Equivalent Data	21	Track 2 Equivalent Data as a TLV object. Tag: 57 Format: b19
TLV Auth_Code	9	Authorization Code as a TLV object Tag: E300 Format: b8

If the Status Code being returned in the Response Frame is "Failed", then the contents of the Data field contains further information on the cause of the failure and does not contain the

Authorization Code etc. In this case the Data field in the Response Frame has the following format.

Table 43: Update Balance Format and Contents When Status Not OK

Data Field	Length (bytes)	Description
Error Code	1	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1	Value of SW1 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
SW2	1	Value of SW2 returned by the Card (SW1SW2 is 0000 if SW1 SW2 not available)
RF State Code	1	RF State Code indicating exactly where the error occurred in the Reader-Card transaction flow. See sub-section on RF State Codes.

For any other Status Code the data field is empty.

Cancel Transaction Command (05-01)

Use this command to stop reader/card communication after the Activate Transaction command or Update Balance command has been sent to the reader.

After the terminal has issued the Cancel Transaction command, the terminal should not send any commands until it receives a response from the reader. If the reader receives the Cancel Transaction command before it sends the response to an Activate command, it only sends the Cancel Transaction response. The reader then enters an “idle” state and waits for the next command from the terminal.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	05h	01h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	05h	See Status Code Table	00h	00h		

MasterCard M/Chip 3.0 Transaction Commands

This section describes commands that are specific to MasterCard M/Chip 3.0 transaction behavior.

Stop Transaction (05-02)

The Stop Transaction command is similar to the Cancel command. However, the transaction will exit at whatever phase it was currently in. Depending on timing, the transaction could exit with an Activate Response. In that case, the Stop command was received too late to stop the transaction. Receipt of any response other than the Stop response is proof that the Stop command did not execute.

The Stop command is currently only used by the MasterCard M/Chip 3.0 application.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	05h	02h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	05h	See Status Code Table	00h	30h	See below		

The following information is returned in the data field of a successful Stop command:

Data item	Tag	Tag Len	Notes
Outcome Parameter Set TLV	DF8129h	12	
Discretionary Data TLV	FF8106h	10	Encapsulates the Error TLV
Error Indication TLV	DF8115	6	

Reset Torn Transaction Log (84-0E)

The Reset Torn Transaction Log effectively erases the content of the torn transaction log and sets it back to an “empty” state.

Normally, this function will only be used in certification scenarios where the torn transaction log must be put into a known state before performing a test.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	0Eh	00h	00h	Varies	Varies

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	Refer to standard status values	00h	00h	Varies	Varies

This command, when sent, will restore the Torn Transaction Log back to its original pristine state, as if a power up had just occurred.

Clean Torn Transaction Log (84-0F) Command

This command is used to remove Torn Transaction Log entries that have exceeded the allowed lifetime defined in tag DF811C (Maximum Lifetime of Torn Transaction Log Record).

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	0Fh	00h	00h	Varies	Varies

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-N	Byte N + 1	Byte N + 2
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)

ViVOtech2\0	84h	Refer to standard status values	XX	XX	List of Torn TLV's	Varies	Varies

The response may contain expiring torn entries. These are returned inside a Discretionary Data tag, as shown below:

Byte 0-2	Byte 3	Bytes 4-6	Byte 7	Byte 8-N
Discretionary Data	Tag Length	Torn Transaction	Tag Length	TLV's for Torn Record
FF8106h	Varies	FF8101h	Varies	Varies

NOTE: The terminal should execute the CLEAN command repeatedly, until no more torn records are sent back to it. In other words, the final response will be:

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	00h	00h	00h	Varies	Varies

Refer to the M/Chip PayPass specification for the contents of the Torn Transaction Log Record.

9.1.1.1 Torn Transaction Log Timer

The reader keeps track of how much time has elapsed for each torn transaction record. However, it *does not* take any action when this time has expired. Since the interface between the terminal/POS and the Reader is a command/response interface, cleaning the torn transaction log must be initiated by the terminal/POS.

Periodically, the POS should initiate a cleaning cycle and repeatedly issue the "Clean" command (84-0F) at that point until the reader reports that the Torn Log has been successfully purged.

How the POS accomplishes this is beyond the scope of the interface and this document.

Visa VCPS Transaction Commands

Set Cash Transaction Reader Risk Parameters (04-0C)

This command creates or modifies the TTQ and reader risk parameters associated with VCPS 2.1.1 cash transactions. Visa defines a "cash" transaction as a transaction that results in cash

only being returned, like a bank machine withdrawal. If the transaction is a cash transaction and the Cash Transaction RR enable is set in the default FFF4 Visa Reader Risk Flags tag, then the reader risk parameters provided are used instead of the default TTQ and reader risk parameters. Once the transaction has been completed the TTQ and reader risk parameters are returned to their default settings.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	0Ch	00h	00h	TLV Data Objects (see Cash Transaction TLVs)		

Important: All the TLVs listed in the table below are mandatory. If any are omitted, the command returns an error.

Table 44: Cash Transaction TLVs

Tag	Data Object Name and Description	Format	Length (Bytes)
9F1B	Terminal Floor Limit Indicates the floor limit in the terminal in for a Visa Cash or Cashback Transaction (hex).	b	4
9F66	Visa Terminal Transaction Qualifier (TTQ) Determines the characteristics of the transaction for a Cash transaction.	b	4
FFF1[1]	Terminal Contactless Transaction Limit Indicates the floor limit in the terminal for a Visa Cash transaction.	n12	6

<table>
<tr><th>Tag</th><th>Data Object Name and Description</th><th>Format</th><th>Length (Bytes)</th></tr>
<tr><td>FFF4[1]</td><td>Visa Reader Risk Flags
Byte 1
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Status Check</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>-</td><td>RFU</td></tr>
</table>
Byte 2:
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Transaction Limit Check</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>CVM Required Limit Test</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>Terminal Floor Limit Check</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>Cash Transaction Reader Risk (RR)</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Cashback Reader Risk (RR)</td></tr>
<tr><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>DRL (Dynamic Reader Limits) RR</td></tr>
<tr><td>X</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>RFU</td></tr>
</table>
Byte 3
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Zero Amount Test
0 = If amount is zero, transaction disallowed
1 = If amount is zero, online cryptogram required in the TTQ (9F66)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>Zero Amount Test. If 0, bit 1 is ignored.</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>-</td><td>RFU</td></tr>
</table></td><td>b</td><td>3</td></tr>
<tr><td>FFF5[1]</td><td>CVM Required Limit
Indicates the CVM required floor limit for a Visa Cash transaction.</td><td>n12</td><td>6</td></tr>
</table>

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table				

Get Cash Transaction Reader Risk Parameters (03-0C)

This command returns the TTQ and reader risk parameters that will be used for cash transactions, if enabled.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	0Ch	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects (see Cash Transaction TLVs)		

The only Data Objects that should be returned are the Cash Transaction TLVs sent in the Set Cash Transactions Reader Risk Parameters command (9F66, FFF1, FFF5, and 9F1B).

Set Cashback Transaction Reader Risk Parameters (04-0D)

This command creates or modifies the TTQ and reader risk parameters associated with a VCPS 2.1.1 cashback transaction. Visa defines a “cashback” transaction as a transaction that results in the purchase of merchandise with cash being returned. If the transaction is a cashback transaction and the Cashback Transaction Reader Risk enable is set in the default FFF4 Visa Reader Risk Flags tag, then the reader risk parameters provided are used instead of the default TTQ and reader risk parameters. Once the transaction has been completed the TTQ and reader risk parameters are returned to their default settings.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Data	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	0Dh	00h	00h	TLV Data Objects (see Cash Transaction TLVs)		

Important: All the TLVs listed in the Cash Transactions TLVs table are mandatory. If any are omitted, the command returns an error.

On ViVOpay Readers there are three ways to initiate a Cashback Transaction:

1. If you define an Authorized Amount (9F02) that is greater than the Other Amount (9F03), and the Other Amount is greater than zero, then the transaction will be treated as a Cashback transaction. These parameters may be configured through configuration commands or by including them in the Activate (02-01) command.

2. If you configure the Transaction Type (9C) using serial commands, or if you provide the Transaction Type (9C) in the Activate Transaction command and set its value to 0x09, then the transaction will be treated as a Cashback transaction.

3. If you provide an Other Amount (9F03) with a valid length of 6 bytes in the Activate Transaction Command, the transaction will be treated as a Cashback transaction.

While the concept of cashback transactions may be applied to other card applications, the command to set Reader Risk Parameters (04-0D) only applies to Visa. It allows the creation or modification of the TTQ (Terminal Transaction Qualifiers).

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table	00	00		

Get Cashback Transaction Reader Risk Parameters (03-0D)

This command returns the TTQ and reader risk parameters for all cashback transactions.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	0Dh	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects (see Cash Transaction TLVs)		

The only Data Objects that should be returned are the Cash Transaction TLVs sent in the Set Cash Transactions Reader Risk Parameters command (9F66, FFF1, FFF5, and 9F1B).

Set DRL Reader Risk Parameters (04-0E)

This command creates or modifies the Application Program ID and reader risk parameters for four Dynamic Reader Limit sets. If a Visa card provides an Application Program ID that matches one of the four programmed in the reader DRL sets and the DRL RR enable is set in the default FFF4 Visa Reader Risk Flags tag, the Reader risk parameters for that DRL are used during the transaction. Once the transaction has been completed the Reader risk parameters are returned to their default settings.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	04h	0Eh	00h	01h	DRL Index and TLVs		

Important: All the TLVs listed in the table below are mandatory. If any are omitted, the command returns an error.

Table 45: DRL TLVs

Tag	Data Object Name and Description	Format	Length (Bytes)
None	DRL Index This index refers to which DRL set (1 – 4) this data belongs.	b	1
9F1B	Terminal Floor Limit Changes the Floor Limit for the DRL (hex).	b	4
9F5A	Application Program ID Determine the characteristics of the transaction for the DRL.	b	16
FFF1[1]	Terminal Contactless Transaction Limit Indicates the floor limit in the terminal for the DRL.	n12	6

<table>
<tr><th>Tag</th><th>Data Object Name and Description</th><th>Format</th><th>Length (Bytes)</th></tr>
<tr><td>FFF4[1]</td><td>Visa Reader Risk Flags
Byte 1
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Status Check</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>-</td><td>RFU</td></tr>
</table>
Byte 2:
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning (0 = disable, 1 = enable)</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Transaction Limit Check</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>CVM Required Limit Test</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>Terminal Floor Limit Check</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>Cash Transaction Reader Risk (RR)</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>Cashback Reader Risk (RR)</td></tr>
<tr><td>-</td><td>-</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>DRL (Dynamic Reader Limits) RR</td></tr>
<tr><td>X</td><td>X</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>RFU</td></tr>
</table>
Byte 3
<table>
<tr><th>b8</th><th>b7</th><th>b6</th><th>b5</th><th>b4</th><th>b3</th><th>b2</th><th>b1</th><th>Meaning</th></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>X</td><td>Zero Amount Test
0 = If amount is zero, transaction disallowed
1 = If amount is zero, online cryptogram required in the TTQ (9F66)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td>X</td><td></td><td>Zero Amount Test. If 0, bit 1 is ignored.</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td></td><td>-</td><td>RFU</td></tr>
</table></td><td>b</td><td>3</td></tr>
<tr><td>FFF5[1]</td><td>CVM Required Limit
Indicates the CVM required floor limit for the DRL.</td><td>n12</td><td>6</td></tr>
</table>

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04h	See Status Code Table				

Get DRL Reader Risk Parameters (03-0E)

This command returns the Index, Application Program ID, and reader risk parameters for the DRL settings.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n

Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	03h	0Eh	00h	01h	DRL Index (01-04)		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03h	See Status Code Table			TLV Data Objects (see DRL TLVs)		

The response TLV Data Objects are formatted as shown in the table DRL Transaction TLVs (Index, 9F5A, FFF1, FFF4, FFF5, and 9F1B).

Key Management Commands

Warning: DO NOT mix Protocol 1 and Protocol 2 Key Management commands. The preferred method is to use the Protocol 2 commands.

The Key Management Protocol 2 commands are the preferred method. The Key Management Protocol 2 commands MUST be used when doing secure communication.

The following status codes may be generated in response to the CA Public Key commands.

The following status codes are specific to the Key Manager module. *Their values may have different meanings when used with other commands.*

Table 46: EMV Key Manager Status Codes - Protocol 2

Status Code	Status
00h	Operation was successful
20h	SAM Transceiver error – problem communicating with the SAM (see note below)
21h	Length error in data returned from the SAM
41h	Unknown Error from SAM
42h	Invalid data detected by SAM
43h	Incomplete data detected by SAM
44h	Reserved
45h	Invalid key hash algorithm
46h	Invalid key encryption algorithm
47h	Invalid modulus length
48h	Invalid exponent
49h	Key already exists
4Ah	No space for new RID
4Bh	Key not found
4Ch	Crypto not responding
4Dh	Crypto communication error
4Fh	All key slots are full (maximum number of keys has been installed)

Get CA Public Key (D0-01)

This command retrieves all of the information related to a specific key. It includes the key hash, the algorithms, and so forth. See the data definition below:

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - 18	Byte 19	Byte 20	Byte 21
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	RID	Key Index	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	01h	00h	06h	varies	varies	Varies	Varies

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 19 - n	Byte n+1	Byte n+2
Header Tag & Protocol Version	Cmd	Status	Length (MSB)	Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	varies	varies	Varies	Varies

When the status is successful (00h), the data field contains:

Key Hash Algorithm (1 Byte) - 01h = SHA-1
Key Encryption Algorithm (1 Byte) – 01h = RSA
Checksum – This Checksum is calculated with a concatenation of:
RID & **KeyIndex** & **Modulus** & **Exponent**
where the exponent is either one byte or 3 bytes
Modulus Length (2 bytes)
Modulus (varies in length)

Get CA Public Key Hash (D0-02)

This command returns only the "Checksum" portion of the key.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 – 18	Byte 19	Byte 20	Byte 21
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	RID	Key Index	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	02h	00h	06h	varies	varies	Varies	Varies

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 19 – n	Byte n+1	Byte n+2
Header Tag & Protocol Version	Cmd	status	Length (MSB)	Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	varies	varies	Varies	Varies

Status = 00 if successful. When the status is successful, the data contains:

Key Hash Algorithm (1 byte)

Key Algorithm (1 byte)

Checksum (20 bytes) – calculated over the key information as previously described

Set CA Public Key (D0-03)

This command adds a new key in the reader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - 18	Byte 19	Bytes 19-n	Byte n+1	Byte n+2
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	RID (5 bytes)	Key Index (1 byte)	Key Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	03h	varies	varies	varies	varies	See below	Varies	Varies

Key Data is as follows: (all binary)

Byte	Name	Length (bytes)	Description
0	Hash Algorithm	1	The only algorithm supported is SHA-1. The value is set to 01h
1	Public Key Algorithm	1	The encryption algorithm in which this key is used. Currently support only one type: RSA. The value is set to 01h
3-22	Checksum/Hash	20	Checksum which is calculated using SHA-1 over the following fields: **RID** & **KeyIndex** & **Modulus** & **Exponent** where the exponent is either one byte or 3 bytes (although we store it in a 4 byte field)
23-26	Public Key Exponent	4	Actually, the real length of the exponent is either one byte or 3 bytes. It can have two values: 3, or 65537.
27-28	Modulus Length	2	Indicates the length of the next field.
29-n	Modulus	Variable	This is the modulus field of the public key. Its length is specified in the field above.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Cmd	status	Length (MSB)	Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	00h	Calculated	Calculated

Delete CA Public Key (D0-04)

This command allows the POS to delete a specific key.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - 18	Byte 19	Byte 20	Byte 21

Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	RID (5 bytes)	Key Index (1 byte)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	04h	00h	06h	varies	varies	Varies	Varies

The RID and Key Index for the key being deleted must be specified in the frame.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Cmd	status	Length (MSB)	Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	00h	Calculated	Calculated

Delete All CA Public Keys (D0-05)

This command deletes all of the CA public keys.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	05h	00h	00h	Calculated	Calculated

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Cmd	status	Length (MSB)	Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	00h	Calculated	Calculated

Get All CA Public RIDs (D0-06)

The Get All CA Public RIDs command tells the reader to retrieve a list of all the RIDs.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	06h	00h	00h	Calculated	Calculated

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 13-n	Byte n+1	Byte n+2
Header Tag & Protocol Version	Cmd	status	Length (MSB)	Length (LSB)	RID(s)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	varies	Each RID is 5 bytes.	Calculated	Calculated

Status 00h – RIDs returned with the number of RIDs = Length/5;

Note: If the length returned is 0, then the communication was good, but no RIDs are stored.

List CA Public Key IDs or RID (D0-07)

The following command retrieves a list of key indices that are installed for this RID.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 – 18	Byte 19	Byte 20
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	RID (5 bytes)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	07h	00h	05h	varies	Varies	Varies

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-18	Byte 19 – n	Byte n+1	Byte n+2
Header Tag & Protocol Version	Cmd	status	Length (MSB)	Length (LSB)	RID (5 bytes)	List of Indices	CRC (LSB)	CRC (MSB)
ViVOtech2\0	D0h	See Key Manager status codes	00h	varies	varies	varies	Varies	Varies

Status – 00h = successful index retrieval

Module Versioning

The module versioning feature provides information about the firmware versions, and the specification versions for specific modules, interfaces, and hardware in the reader. The information is returned to the POS or the POS Simulator via the serial interface. Versioning of card applications may also facilitate the tracking of changes for certification purposes.

The implementation of this feature has been simplified for the following reasons:

- To align more closely with the behavior of the Advanced Reader firmware.
- To make the version strings more accessible for human readers.
- To facilitate maintenance of version strings.

The following subcommands are available for the Module Version command:

Sub-command	Description
01h[1]	Get Product Type
02h	Get Processor Type
03h[1]	Get Main Firmware Version
14h	Get Hardware Information
20h	Get Module Version Information[3]

[1] Those sub-commands only work on Vendi.

Note: All other sub-commands for the Module version command have been deprecated. However, a 0x00 in the sub-command field will return the same result as a 20h sub-command. All other commands will return an "unknown sub-command" error.

The table below shows the information that is available and the subcommand that is used to extract that information. The term "module" is used very loosely in the context of the firmware.

Module Type	Sub-Command	Description	Format
FW	20h	The firmware version that is resident in the reader For KioskIII, this verion number shows the firmware version for Lab Verification, it won't change unless new Lab Verification is done for the certain module.	ASCII text
CL AppSel	20h	Refers to the special application selection module and version.	ASCII text
CL AID	20h	Contactless L2 Application specification/version (since L2 applications are identified by the "application ID", this type refers to an AID)	ASCII text

[3] Previously a subcommand "0x00" was supported. It is being deprecated. However, because some of the ViVOpay internal utilities used that command to determine if the reader was alive, a subcommand of 0x00 will behave exactly the same as a subcommand 0x20 and will not give an error.

Module Type	Sub-Command	Description	Format
CL AppSpe	20h	Contactless L2 Special Application specification/version that not identified by the “application ID” (Example: Android Pay and Apple Pay VAS)	ASCII text
CL L1	20h	L1 Interface specification/version	ASCII text
UI	20h	User Interface specification/version	ASCII text
SAM	14h	Secure Access Module version string	ASCII text
HW	14h	Hardware platform identifier	ASCII text
EEPROM	14h	The EEPROM version	ASCII text
N/A	02h	Returns the processor type in TLV format	TLV

The module types described above appear in the response packet for the respective sub-command. Refer to the examples in the response packet section.

Get Product Type (09-01)

This command returns a product type TLV.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	09h	01	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte12	Byte 13	Byte 14 … Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	09h	See Status Code Table			See below		

The Get Product Type sub-command returns a TLV string as follows:
Tag: 0xDF60
Length: 0x03
Value: 3-byte field representing the product type.

The following example shows the command and response.

Command: Get Product Type
56 69 56 4F 74 65 63 68 32 00 09 01 00 00 A0 A0
Response:
56 69 56 4F 74 65 63 68 32 00 09 00 00 06 DF 60 03 43 36 00 DC 60

Product Type (hex values)	Description
43 36 00	Vendi
55 33 00	Unipay III
55 31 00	Unipay 1.5

Get Processor Type (09-02)

This command returns a processor type TLV.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	09h	02	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte12	Byte 13	Byte 14 … Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	09h	See Status Code Table			See below		

The Get Processor Type sub-command returns a TLV string as follows:
Tag: 0xDF61
Length: 0x02
Value: a 1-byte field representing the processor type.

The following types of processors may be identified in the **Value** field:

Processor Type (hex values)	Description
45 00	ARM7/ LPC21xx

Processor Type (hex values)	Description
4D 00	ARM Cortex-M4/ K21 Family
Processor Type (hex values)	Description
45 00	ARM7/ LPC21xx
4D 00	ARM Cortex-M4/ K21 Family

The following example shows the command and response.

Command: Get Processor Type
56 69 56 4F 74 65 63 68 32 00 09 02 00 00 F0 F9
Response:
56 69 56 4F 74 65 63 68 32 00 09 00 00 05 DF 61 02 4D 00 AC 4D

Get Main Firmware Version (09-03)

This command returns main firmware version TLV.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	09h	03	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte12	Byte 13	Byte 14 … Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	09h	See Status Code Table			See below		

The Get Main Firmware Version sub-command returns a TLV string as follows:
Tag: 0xDF62
Length: Varies
Value: Varies field representing the main firmware version.

The following example shows the command and response.

Command: Get Main Firmware Version
56 69 56 4F 74 65 63 68 32 00 09 03 00 00 C0 CE

Response:
56 69 56 4F 74 65 63 68 32 00 09 00 00 14 DF 62 11 43 72 61 6E 65 56 65 6E 64 69 5F 31 2E 30 2E 30 00 E1 5D

Get Hardware Information (09-14)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	09h	14h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte12	Byte 13	Byte 14 … Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	09h	See Status Code Table			See below		

The format for hardware module version information returned is “human readable”, consisting of fields that are separated by commas, and lines separated by carriage return and line feed characters:

<module type>,<module name><CRLF>
<chip version>

The following example shows the hardware version information subcommand and the information being returned (in ASCII format).

Command: Get Hardware Version Information
56 69 56 4F 74 65 63 68 32 00 09 14 00 00 33 08

Response:
56 69 56 4F 74 65 63 68 32 00 09 00 00 15 48 57 2C 56 50 56 65 6E 64 69 0D 0A 4B 32 31 46 20 52 65 76 39

ASCII translation of the data field:
HW,VPVendi<CR><LF>
K21F Rev9

ASCII	Description

ASCII	Description
HW,VPVendi<CR><LF> K21F Rev9	Vendi
HW,VPUnipayIII<CR><LF> K21F Rev9	Unipay III
HW,VPUnipay1.5<CR><LF> K21F Rev2	Unipay 1.5

Get Module Version Information (09-20)

For KioskIII, this verion number shows the modules version for Lab Verification, it won't change unless new Lab Verification is done for the certain module. So it may not be consistent with the result of "Get ViVOpay Firmware Version (29-00)" and "Get Main Firmware Version (09-03)"

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	09h	20h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte12	Byte 13	Byte 14 … Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	09h	See Status Code Table			See below		

If there is an error, the appropriate Status Code will be returned with an empty Data field (Data Length = 0000h).

The format for module version information returned is "human readable", consisting of fields that are separated by commas, and lines separated by carriage return and line feed characters:

<module type>,<module name and spec. version>,[<implementation version>],<CRLF>

The following example shows the module version information subcommand and the information being returned (in ASCII format).

Command: Get Module Version Information
56 69 56 4F 74 65 63 68 32 00 09 20 00 00 56 11

Response:

56 69 56 4F 74 65 63 68 32 00 09 00 01 2A 46 57 2C 56 65 6E 64 69 20 56 31 2E 30 30 2C 2C
0D 0A 20 46 53 26 44 42 20 56 31 2E 30 30 2C 2C 0D 0A 20 43 4C 20 41 70 70 53 65 6C 2C 50
50 53 45 20 4D 6F 64 75 6C 65 2C 20 76 31 2E 30 30 2C 2C 0D 0A 20 43 4C 20 41 49 44 2C 4D
61 73 74 65 72 43 61 72 64 20 50 61 79 50 61 73 73 20 4D 2F 43 68 69 70 20 76 33 2E 30 2E 32
2C 20 56 65 6E 64 69 20 76 31 2E 30 2E 30 2C 2C 0D 0A 20 43 4C 20 41 49 44 2C 56 69 73 61
20 56 43 50 53 20 32 2E 31 2E 33 2C 20 76 30 2E 39 39 2C 2C 0D 0A 20 43 4C 20 41 49 44 2C
41 6D 65 78 20 45 78 70 72 65 73 73 50 61 79 20 33 2E 30 2C 20 76 31 2E 30 30 2C 2C 0D 0A
20 43 4C 20 41 49 44 2C 44 69 73 63 6F 76 65 72 20 44 50 41 53 20 31 2E 30 20 5A 69 70 20 33
2E 31 2E 32 2C 20 76 31 2E 30 30 2C 2C 0D 0A 20 43 4C 20 41 49 44 2C 49 6E 74 65 72 61 63
20 31 2E 35 2C 20 76 31 2E 30 30 2C 2C 0D 0A 20 43 4C 20 4C 31 2C 45 4D 56 20 34 2E 33 20
4C 31 2C 20 76 31 2E 30 30 00 8C 33

ASCII translation of the data field:

FW,Vendi V1.00,,<CR><LF>
FS&DB V1.00,,<CR><LF>
CL AppSel,PPSE Module, v1.00,,<CR><LF>
CL AID,MasterCard PayPass M/Chip v3.0.2, Vendi v1.0.0,,<CR><LF>
CL AID,Visa VCPS 2.1.3, v0.99,,<CR><LF>
CL AID,Amex ExpressPay 3.0, v1.00,,<CR><LF>
CL AID,Discover DPAS 1.0 Zip 3.1.2, v1.00,,<CR><LF>
CL AID,Interac 1.5, v1.00,,<CR><LF>
CL L1,EMV 4.3 L1, v1.00<NUL>

International Language Support

The goal of this feature is to offer support for foreign languages including those based on graphical fonts (i.e. Chinese, Thai, Arabic…).

Four core language options built into it. Some of these are font-based; the others are ideogram-based. The ideogram language options are stored in flash as bitmaps. The other languages use fonts that have been stored in flash.

For example, an English message is composed of multiple small bitmaps that represent different characters (i.e., a “Thank You” message is 8 bitmaps displayed together). The ideogram messages are (usually) a single bitmap (i.e., the Chinese “Thank You” message is a single bitmap displayed on the screen). See Appendix A.7 Preparing Bitmaps for Use by ILM for instruction on working with bitmaps.

Each reader keeps four “core” languages in its firmware. This ensures that the reader can be used in virtually any geographical area “as is”. A core language may NOT be modified or deleted by customer/third party actions. They always exist and are always available for use.

At present, there are four (4) Core Languages available:

- English (U.S., fonts)
- French (fonts)
- Chinese (ideograms)
- English + Chinese (fonts & ideograms)

See Set Configuration (04-00) for information on how to set a language preference.

Other Language

In addition to the Core Languages, a fifth language called “Other Language” is available. This is a ‘slot’ in flash memory that can contain all the message bitmaps for a language.

Since this Other Language is stored in the ideogram bitmap format, it eliminates the need for fonts, etc., for this language. The Other Language only needs a unique record for each distinct message it must display.

At present there are twenty-two (22) predefined message types that can be displayed.

Note: Each time you configure the reader for ILM, you must download messages for all 22 indices in consecutive order. You cannot change individual messages.

Bitmap Conversion Completed by POS

The reader expects to load a simplified version of the monochrome bitmap. While data is the same as in a standard bitmap, it must be converted to a format that the LCD hardware can use.

The standard 40-byte DIB bitmap header is discarded. It is replaced by a simplified ViVOpay header, described in ILM Header Format.

The bitmap data produces an LCD image that is:

- Reversed in color (black is white, and vice versa).
- Upside down.

White space reduction

Large parts of the bitmap are empty background. The LCD does not need to save this white space, since it corresponds to off-pixel values (which are already turned off). This limited form of image compression makes the image much smaller.

ILM Header Format

Each bitmap loaded onto a reader is expected to contain a proprietary header instead of the standard DIB header.

This header format is shown in the following table, prefixed to the actual bitmap data:

Bytes 0-1	Bytes 2-3	Bytes 4-5	Bytes 6-7	Bytes 8-9	Bytes 10-11	Bytes 12…n
Bitmap Length	Row Number	Column Number	Height	Width	Type (truncate, etc.)	Bitmap data

All variables in the header are 2 bytes long.

Byte	Description
Bitmap Length	This data field contains the total number of bytes in the Bitmap Data Field.
Row Number	This data field contains the row offset that this image should start at. Value is in PIXELS.
Column Number	This data field contains the column offset that this image should start at. Value is in BYTES.
Height	This data field contains the number of rows (in pixels) that this image contains.
Width	This data field contains the number of columns (in bytes) that this image contains.
Type	Reserved – must be set to 00h.
Bitmap Data	This is the actual image data.

Language Version Information

This block contains data used for version control of the ILM. It contains variables that identify the particular language module that is currently stored in the system.

The language module specifies both the language name and the Country Code. This is done because there are a number of languages (English, French, Spanish, etc.) that are shared by multiple nations but the reader is intended to be operate in a particular country (such as Canada).

Table 47: Language Version Information

Language Version Information		
Variable	Length (bytes)	Description/Example
Language Name	25	ASCII String, Null Terminated – “Spanish\0”
Abbreviation	4	ASCII String, Null Terminated – “ES\0” (ASCII-2 character Country Code) or “ESP\0” (ASCII-3 character Country Code) or “724\0” (3 digit decimal number Country Code)
Format	1	Unsigned 8-bit Integer
Author	10	ASCII String, Null Terminated – “NCR\0”
Version	6	ASCII String, Null Terminated – “1.3\0”
ID	4	Unsigned 32-bit Integer

Language Name is the name of the ILM language, using ASCII characters.

Abbreviation is the Country Code listed in ISO 3166. The format is either ASCII-2 character, ASCII-3 character or a 3 digit decimal number. Regardless of method, it is stored in ASCII alphanumeric characters.

The **Format** data field specifies the format of the Abbreviation field noted above. All follow the specification from ISO DOC 3166.

Format Data Field	
Value	Description/Example
01 02 03	Alpha2 (2 character) – "ES\0" Alpha3 (3 character) – "ESP\0" Decimal (3 digit) – "724\0"

Author is an ASCII string noting the customer that developed this language module.

Version is an ASCII string, also customer defined. It identifies this language module by version number.

ID is a value that is reserved for future use. It is currently **NOT** used.

All fields are the length indicated. If (as is usually the case) the ASCII string does not occupy the entire data field, the remaining bytes **MUST** be padded with zeroes.

The Language Version Information area is provided to the customer as a way to track which language is currently loaded into the reader. It can be accessed and values are returned to the POS. The intent is to facilitate automated updating through the POS. The POS can examine the existing language module currently stored, and then make appropriate decisions as to its use (i.e., updating the module).

How the Language Version Information is used by the customer cannot be defined or enforced. It is only provided for identification and could be unused.

However, value of 00h in this area is interpreted as indicating that the ILM area of flash memory is empty. Therefore, if the customer does edit the ILM area, they **MUST** update this Version Information area as well, if only to write arbitrary non-zero values to it.

EMV Certificate Revocation List Commands

The Certificate Revocation List (CRL) contains entries that include the RID, Key Index and Certificate Serial Numbers for cards that should be rejected. The kernel checks the CRL for entries matching the index and serial number of the Issuer Public Key Certificate *provided by the card*. If it is found the card is rejected.

The CRL is maintained in non-volatile memory but a copy is kept in RAM to provide faster access during transactions. A tag (DF26h) is defined to enable or disable the entire Revocation feature in the reader.

The M/Chip 3.0 application is the only application capable of using the Certificate Revocation List feature.

The firmware supports a maximum of 30 entries in the certificate revocation list.

Get EMV Revocation Log Status (84-03)

This command returns information about the EMV revocation log. The information returned can be used by the terminal/POS to determine how to read the log.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	03h	00	00		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table			TLV Data Objects		

If the command is successful, the following data is returned. All fields are encoded with MSB first.

Offset	Length (bytes)	Data Description
00h	4	Version number
04h	4	Number of records
08h	4	Size of records

Add Entry to EMV Revocation List (84-04)

This command adds a new entry to the revocation list. The new entry is added at the end of the revocation list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	04h	00	09			

The data field contains the revocation list entry:

Offset	Length (bytes)	Data Description	Example
00h	5	RID (packed hex format)	A0 00 00 00 04
04h	1	Key Index (packed hex format)	F8
08h	3	Certificate serial number (packed hex format)	00 10 00

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00	00		

Delete All Entries for Single Index in EMV Revocation List (84-05)

This command deletes all entries *that match a key index and RID* from the EMV revocation list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	05h	00	06			

The data field contains RID and key index for the records to be deleted.

Offset	Length (bytes)	Data Description	Example
00h	5	RID (packed hex format)	A0 00 00 00 04
05h	1	Key Index (packed hex format)	F8

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00	00		

Delete All Entries from EMV Revocation List (84-06)

This command deletes *all* entries from the EMV revocation list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	06h	00	00		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00	00		

Get EMV Revocation List (84-07)

This command retrieves a sequence of consecutive records from the EMV revocation list. The list may be retrieved in several command exchanges, depending on the size specified in the command and the number of entries in the list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	07h	00	00			

The data field specifies the following information:

Offset	Length (bytes)	Data Description
00h	2	Size - maximum number of bytes to be retrieved (MSB first)
02h	2	Starting record[4] (MSB first)

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	07h	00	00			

[4] For GR, this number must be less than 30. The first record is 0.

The data field will contain the maximum number of records that can fit in the size provided in the command. No partial records are returned. The maximum size of data bytes that can be returned is 282 bytes (12 + 9 * size of a list record).

The data field is formatted as follows:

Offset	Length (bytes)	Data Description
00h	4	Number of records returned
04h	4	Number of records remaining in the file
08h	4	Record size
0Ch	varies	Revocation list records

Each record is formatted as follows:

Offset	Length (bytes)	Data Description	Example
00h	5	RID (packed hex format)	A0 00 00 00 03
05h	1	Key Index (packed hex format)	FE
08h	3	Certificate Serial Number (packed hex format)	00 10 00

Delete an Entry from EMV Revocation List (84-0D)

This command deletes a specific entry from the EMV revocation list. Unlike the commands described previously, this command deletes the specific entry that matches *the RID, the key index, and the certificate serial number*.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	0Dh	00	09			

The data field contains the information to select the EMV revocation list record:

Offset	Length (bytes)	Data Description	Example
00h	5	RID (packed hex format)	A0 00 00 00 04
05h	1	Key Index (packed hex format)	F8
06h	3	Certificate Serial Number (packed hex format)	00 10 01

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00	00		

EMV Exception Log List Commands

Get EMV Exception Log Status (84-08)

This command returns information about the EMV exception log. The version number, record size, and number of records contained in the file are returned.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag &Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	08	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-13+n	Byte 14+n	Byte 15+n
Header Tag &Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00h	00h			

The data returned in a successful command contains the following information:

Offset	Length (bytes)	Description
00h	4	Version number
04h	4	Number of records
08h	4	Size of records

Add Entry to EMV Exception List (84-09)

This command adds an entry to the EMV exception list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-25	Byte 26	Byte 27
Header Tag &Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	09	00h	0Ch	See Below		

The exception list data is as follows:

Offset	Length (bytes)	Description	Example
00h	1	PAN logical length in bytes (packed hex format). Must be <= 0Ah	08h
01h	10	PAN (packed hex format, padded with 'F' if required)	5413339000001596FFFFh
0Bh	1	Sequence number (packed hex format)	00h

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag &Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Codes Table	00h	00h		

Delete Entry from EMV Exception List (84-0A)

This command deletes an entry from the EMV exception list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-25	Byte 26	Byte 27
Header Tag &Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	0A	00h	0Ch	See Below		

The exception list data is as follows:

Offset	Length (bytes)	Description	Example
00h	1	PAN logical length in bytes (packed hex format). Must be <= 0Ah	08h
01h	10	PAN (packed hex format, padded with 'F' if required)	5413339000001596FFFFh
0Bh	1	Sequence number (packed hex format)	00h

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag &Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Codes Table	00h	00h		

Delete All Entries from EMV Exception List (84-0B)

This command deletes all entries from the EMV exception list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag &Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	0B	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag &Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00h	00h		

Get EMV Exception List (84-0C)

This command retrieves consecutive records from the EMV exception list.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Bytes 14-15	Bytes 16-17	Byte 18	Byte 19
Header Tag &Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Max number of bytes	Starting Record	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	0C	00h	00h	N	0-65535		

The maximum number of byte is a 16-bit binary number, MSB first.
The starting record is the first record to be retrieved; expressed as a 16-bit binary number MSB first, value from 0-65535.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Bytes 14-13+n	Byte 14+n	Byte 15+n
Header Tag &Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	84h	See Status Code Table	00h	00h			

The data returned is the maximum number of transaction records that satisfy the command constrains. The nmber of bytes returned always is an integer multiple of the transaction record size(i.e., no partial records are returned) plus 12 decimal bytes. The maximum number of data bytes that can be returned in a single operation is limited to 4080 bytes.

Offset	Size in Bytes MSB First	Description
0	4	Number of records returned
4	4	Number of records remaining in file
8	4	Record size
C	n-C	Exception list records

The format of an exception list record (as returned in the Response Data) is as follows:

Table 48: Exception List Record Format

Offset	Field	Length (bytes)
0	PAN Length (Logical)	1
1	PAN (right-padded with F if required)	10
11	PAN Sequence Number	1

Generic Pass-through Commands

The commands in this section provide the most basic capability to communicate directly with a PICC. They provide control of the polling process, and exchange of application protocol data units (APDU). These commands may be used to "extend" the capabilities of the ViVOpay reader to accept cards using application protocols that are not currently supported in the reader firmware.

If the reader is not in Pass-Through mode, a "Pass-Through Mode Start" command must first be issued. Otherwise, the commands in this section will result in an error.

Pass-Through Mode Start/Stop (2C-01)

The Pass-Through Mode Start/Stop command is used to enter and exit Pass-Through Mode. The ViVOpay reader can only accept Pass-Through commands when it is in Pass-Through Mode.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	01h	00h	01h	Mode		

Mode

0 = Stop Pass-Through
1 = Start Pass-Through

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	00h		

The Pass-Through Mode Start command *must* be used to enter Pass-Through Mode.

The Pass-Through Mode Stop command can only be used in Pass-Through Mode. *If the reader is not in Pass-Through mode when the Pass-Through Mode Stop command is issued, the reader will respond with an error.*

Get PCD and PICC Parameters (2C-05)

This command allows the terminal to retrieve PCD and PICC related parameters from the ViVOpay reader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	05h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	00h or 0Fh	See Table below		

If a valid Command Frame is received from the terminal, the ViVOpay reader retrieves the parameters from the PCD and PICC. If the parameters are retrieved successfully, the reader returns a Response Frame with OK Status and Data containing the parameters given below. For details on the parameters, refer to ISO 14443.

If the Command Frame contains any errors, or an error occurred while retrieving the parameters, then the reader sends a Response Frame with an appropriate Status. No data is returned in this case.

Data Fields for the Response Frame (if Status = OK)

Table 49: Get PCD and PICC Parameters Data Field

Data Byte	Name	Length (bytes)	Format	Notes
0-1	Reader Buffer Size	2	Binary	Reader RF Buffer Size stored as a big-endian number.

2-3	Max PICC Frame Size	2	Binary	Maximum PICC Frame Size stored as a big-endian number.
4	CID	1	Binary	CID
5	Block	1	Binary	Block Number.
6	CID Supported	1	Binary	CID Supported
7-10	FWT	4	Binary	Frame Waiting Time in ETUs. It is stored as a big-endian number.
11-14	D-FWT	4	Binary	Delta FWT in ETUs. It is stored as a big-endian number.

If you need to use these parameters, you should issue this command immediately after issuing a "Poll for Token" command. This command simply reads the last parameters out of the control block used to set parameters in the RF chip.

Poll for Token (2C-02)

Once Pass-Through Mode is started, ViVOpay will not poll for any cards until the "Poll for Token" command is received. This command tells ViVOpay to start polling for a Type A or Type B PICC until a PICC is detected or a timeout occurs.

This command automatically turns the RF Antenna on.

If a PICC is detected within the specified time limit, ViVOpay activates it and responds back to the terminal with card related data such as the Serial Number.

If no PICC is detected within the specified time limit, ViVOpay stops polling and responds back indicating that no card was found. No card related data is returned in this case.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14,15	Byte 16	Byte 17
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	02h	00h	02h	See Below		

Data Fields for the Command Frame

Table 50: Poll for Token Data Field for Command Frame

Data Field	Length (bytes)	Description
Timeout1	1	Time in Seconds Timeout1 cannot be zero seconds if Timeout2 is Zero.

Timeout2	1	Multiplier for Time in multiples of 10 milliseconds. Timeout2 / Time in ms 0 / 0 1 / 10 2 / 20 : / : 255 / 2550

Together Timeout1 and Timeout2 are used by the ViVOpay reader to calculate the Timeout i.e. the time to wait for a PICC. For example:

Table 51: Poll for Token Timeout

Timeout1	Timeout2	Timeout
0	0	Not Allowed
0	20	0 Seconds, 200 ms
0	50	0 Seconds, 500 ms
0	100	1 Second
1	0	1 Second
1	20	1 Second, 200 ms

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	Variable	below		

The Data field contains data only if the Status Code is OK.

Table 52: Poll for Token Data Field for Response Frame (Status Code is OK)

Data Field	Length (bytes)	Description
Card	1	Type of Card Found (or No Card Found). 00h None (Card Not Detected or Could not Activate) 01h ISO 14443 Type A (Supports ISO 14443-4 Protocol) 02h ISO 14443 Type B (Supports ISO 14443-4 Protocol) 03h Mifare Type A (Standard) 04h Mifare Type A (Ultralight) 05h ISO 14443 Type A (Does not support ISO 14443-4 Protocol)

		06h ISO 14443 Type B (Does not support ISO 14443-4 Protocol) 07h ISO 14443 Type A and Mifare (NFC phone)
Serial Number	0 or Variable	Serial Number (or the UID) of the PICC. Length depends on the Card Detected. If no card was detected, then a Serial Number is not returned.

Note: Most cards use a 4-byte UID, so the data field of the response is five (5) bytes long. However, some cards with 7-byte UID's have entered the market (for example, ViVOcard3) and it is expected that cards with 10-byte UID's will soon become available. All of these card types are handled by this command.

Enhanced Poll for Token (2C-0C)

Once Pass-Through Mode is started, ViVOpay waits until the **Poll for Token** command is received. This command tells ViVOpay to start polling for a Type A or Type B PICC until a PICC is detected or a timeout occurs.

This command automatically turns the RF Antenna on.

If a PICC is detected within the specified time limit, ViVOpay activates it and responds back to the terminal with card related data, such as the Card Type and Serial Number (UID).

If no PICC is detected within the specified time limit, ViVOpay stops polling and responds back indicating that no card was found. No card related data is returned in this case.

9.1.1.2 Dual Application Cards

Some cards have more than one type of application stored on them. These are known as Dual Application cards. At present, all these cards have an ISO-APDU compliant application as well as a Mifare application.

To date, the only such supported dual application card is Card Type '07', supporting ISO 14443 Type A, Mifare.

For normal ViVOpay transactions (i.e., not Pass-Through Mode), these cards are automatically handled as ISO 14443 applications.

In Pass-Through Mode, the POS controls the polling mechanism. The POS can use a standard Poll for Token (2C-02), where Card Type '07' establishes a Mifare session.

Alternatively, the POS can issue an **Enhanced Poll for Token** (02-0C), where Card Type '07' can establish an ISO 14443 session.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14,15	Byte 16	Byte 17
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	0Ch	00h	04h	See Table Below		

Table 53: Enhanced Poll for Token Data Field for Command Frame

<table>
<tr><th>Data Field</th><th>Length (bytes)</th><th>Description</th></tr>
<tr><td>Timeout1</td><td>1</td><td>Time in Seconds Timeout1 cannot be zero seconds if Timeout2 is Zero.</td></tr>
<tr><td>Timeout2</td><td>1</td><td>Multiplier for Time in multiples of 10 milliseconds.

<table><tr><th>Timeout2</th><th>Time in ms</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>10</td></tr><tr><td>2</td><td>20</td></tr><tr><td>:</td><td>:</td></tr><tr><td>255</td><td>2550</td></tr></table></td></tr>
<tr><td>Transaction Type</td><td>2</td><td>Initiate a transaction based upon the following masks (more than 1 can be active):

<table><tr><th>Mask (hex)</th><th>Action</th></tr><tr><td>00 01</td><td>Expect Card Type ‘07’
Force polling ISO 14443</td></tr><tr><td>00 02</td><td>PUPI Read deprecated by EMV 2.0</td></tr><tr><td>00 03</td><td>Force ISO 14443 Polling
Set Single PUPI Read</td></tr><tr><td>00 04
…
80 00</td><td>RFU – Reserved for Future Use</td></tr></table></td></tr>
</table>

Together Timeout1 & Timeout2 are used by the ViVOpay reader to calculate the Timeout, i.e., the time to wait for a PICC. For example:

Table 54: Enhanced Poll for Token Timeout

Timeout1	Timeout2	Transaction Type	Timeout
0	0	00 01	Not Allowed Timeout error
0	20	00 01	0 Seconds, 200 ms Force ISO 14443 polling
0	50	00 02	PUPI Read deprecated by EMV 2.0
0	100	00 00	1 Second
1	0	00 04	Not Allowed Transaction Type Error
1	0	00 03	1 second Force ISO 14443 Polling Set Single PUPI Read
1	20	00 01	1 second Force ISO 14443 Polling

Multiple Transaction Types in an **Enhanced Poll for Token** command are supported. That is, it is possible to enable both Single PUPI Read and forced ISO 14443 polling simultaneously.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	00 - OK ?? – Fail	00h	Variable	See Table Below		

The data field contains data only if the Status Code is OK (i.e., = 00h). For more information on the status, please check the Status Code Table.

Table 55: Enhanced Poll for Token Data Field for Response Frame

Data Field	Length (bytes)	Description
Card	1	Type of Card Found (or No Card Found). 00h None (Card not detected or could not activate) 01h ISO 14443 Type A (Supports ISO 14443-4 protocol) 02h ISO 14443 Type B (Supports ISO 14443-4 protocol) 03h Mifare Type A (Standard) 04h Mifare Type A (Ultralight) 05h ISO 14443 Type A (Does not support ISO 14443-4 protocol) 06h ISO 14443 Type B (Does not support ISO 14443-4 protocol) 07h ISO 14443 Type A and Mifare (NFC phone)
Serial Number	0 or Variable	Serial number (or the UID) of the PICC. Length depends on the card detected. If no card was detected, then a serial number is not returned.

Note: Most cards use a 4-byte UID, so the data field of the response is five (5) bytes long. However, some cards with 7-byte UID's have entered the market (for example, ViVOcard3) and it is expected that cards with 10-byte UID's soon becomes available. All of these card types are handled by this command.

9.1.1.3 Enhanced Poll for Token Usage

This command can be substituted for the standard **Poll for Token** in any transaction taking place in Pass-Through Mode. Its differences in operation are noted as above; its other arguments should be identical to those of the standard **Poll for Token** that it replaces.

Note: If you use an **Enhanced Poll for Token** command but have set all values in the Transaction Type field to zero, then the command performs a standard **Poll for Token** instead.

Get ATR (2C-12)

This pass-through command can be used to get the ATR received by the reader from the SAM when a Level 1 session was established. This command applies to the SAM interfaces (SAM1/SAM2).

Before this pass-through command can be used, a Level 1 session must have been established on the contact interface to be used through the Enhanced Pass-through command (Poll for Token single shot command).

Note: SAM interface is only supported in SRED devices. It is not supported in non-SRED versions.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	2Ch	12h	00h	01h	Interface		

Command Data

Data Item	Length (bytes)	Description/Example
Interface	1	Allowed interfaces for which to get the ATR. 00h = retrieve last ATR received from PICC 21h = SAM1 (SRED version only) 22h = SAM2 (SRED version only)

If a 21h or 22h is specified in the Data Field for any ViVOpay reader other than the VP5500, the result will be the same as if a 00h was specified. That is, any GetATR command only returns the last ATR received from the PICC.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	variable	ATR		

Antenna Control (28-01)

This command turns the RF Antenna ON or OFF.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	28h	01h	00h	01h	Mode		

Mode:

0 = Disable RF Antenna
1 = Enable RF Antenna

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	28h	See Status Code Table	00h	00h		

Warnings on use of Antenna Off command:

Turning off the antenna deactivates the RF field and returns the card to a Power Off state, terminating any existing connection. A new "Poll for Token" command would need to be issued to establish a new conversation with a card. Turning the antenna off and then turning it back on is a useful way to reset the card to its Idle State where it will respond to polling commands.

When exiting Pass-Through Mode, if the ViVOpay reader is returning to Auto Poll mode, it is advised to issue an "Antenna Control Enable RF Antenna" command before exiting to ensure the antenna is in the right state.

Pass-through UI Control

LED Control (0A-02)

This command switches the specified ViVOpay LEDs off or on *only* when ViVOpay is in Pass-Through Mode.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14,15	Byte 16	Byte 17
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	0Ah	02h	00h	02h	below		

Table 56: LED Control Data Field

Data Field	Length (bytes)	Description
LED#	1	00h: LED 0 (Power LED) 01h: LED 1 02h: LED 2 03h: LED 3 FFh: All 4 LEDs Where the LEDs are numbered 0, 1, 2, 3 counting from the left. **Note:** If you are using pass-through mode to control the Power LED (LED 0), it is your responsibility to make sure that it behaves correctly.
LED Status	1	00h: LED Off 01h: LED On

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	0Ah	See Status Code Table	00h	00h		

Buzzer Control (0B-xx)

This command can be used to sound the ViVOpay Buzzer.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	0Bh	See Below	00h	01h	Buzzer Parameter		

Sub-Command = 01h N Short Beeps
= 02h Single Long Beep of Specified Duration

Table 57: Buzzer Control Data Field

Data Field	Length (bytes)	Description
Buzzer Parameter	1	If Sub-Command is Short Beeps … Num Beeps = 01h One Short Beep = 02h Two Short Beeps = 03h Three Short Beeps = 04h Four Short Beeps If Sub-Command is Long Beep … Duration = 00h 200 ms = 01h 400 ms = 02h 600 ms = 03h 800 ms

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	0Bh	See Status Code Table	00h	00h		

Pass-through Data Exchange

Exchange Contactless Data (2C-03)

This command allows the terminal to send, via ViVOpay, application-level APDUs to a PICC that supports ISO 14443-4 Protocol. The PICC response is sent back by ViVOpay to the Terminal.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	03h	Variable	Variable	APDU Out		

APDU Out is the complete APDU that is to be sent to the PICC. *The contents of the APDU depend on the application residing on the PICC and are out of the scope of this document.*

If a valid Command Frame is received from the terminal, ViVOpay sends the APDU data to the PICC and receives its response. ViVOpay treats the PICC response as unknown data and does not try to interpret it. If the operation was successful, ViVOpay returns a Response Frame with an OK status and the response received from the PICC (APDU response).

If the Command Frame contains any errors, or an error occurred during communication with the PICC, then ViVOpay sends a Response Frame with an appropriate Status. No Data is returned in this case.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	Variable	Variable	APDU response Or None		

The Data field contains data only if the Status Code is OK. In this case, the data consists of "APDU Response" i.e. the response data that was received from the PICC. The contents of the response depend on the application residing on the PICC and are out of the scope of this document.

For SRED device, the APDU data being received from the card/device by the reader will be checked for sensitive data elements using rule in "Secure Pass-Through Function". If found, the Command will return a Parameter Not Supported error (0x06).

PCD Single Command Exchange (2C-04) Protocol 2

This command allows the terminal to send, via the ViVOpay reader, raw data to an ISO 14443 PICC that does not support ISO 14443-4 Protocol (such as Mifare Standard or Mifare Ultralight). The PICC response is sent back by the reader to the terminal.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	04h	Variable	Variable	See Table below		

Table 58: PCD Single Command Exchange Data Field Protocol 2

Data Field	Length (bytes)	Description
PCD Command	1	This is the command that is sent to the PCD Reader IC on the ViVOpay board. It tells the PCD what to do with the data sent with the command. The PCD commands supported and their values are given in

Data Field	Length (bytes)	Description
		the “PCD Cmd” Table below
PCD Timeout	4	This is the RF communication timeout in ETUs stored as a 4-byte big-endian number, where 1 ETU is 9.44 microseconds. The RF communication timeout guards the communication between the PCD reader IC and the PICC Card. The timeout is measured between the last bit sent to the PICC and the first bit received from the PICC.
PCD Command Flags	1	These flags allow greater control over the way ViVOpay processes the command via the PCD Reader IC. Format of the PCD Command Flags byte is given in the “PCD Command Flags” Table below.
Channel Redundancy Register	1	This value tells the PCD what data integrity checks to perform during communication with the PICC Card. The checks to perform at each stage are defined by the protocol (14443 Type A or B). The format of the PCD Command Flags byte is given in the “Channel Redundancy Register” Table below.
Raw Data Out	Variable	Raw data that is sent to the PICC or to the PCD.

The Command Frame contains some PCD parameters and raw data. The PCD Command Parameter is used by ViVOpay to determine what PCD function is to be carried out. The raw data is sent to the PICC for the Transceive command, or is used for LoadKey/Authentication. The contents of the data depend on the PICC and PCD and are out of the scope of this document.

Table 59: PCD Commands Protocol 2

PCD Command	Value	Description
PCD LOADKEY	19h	Used for Loading Mifare Key into PCD for Authentication
PCD AUTHENTICATE1	0Ch	Used for PCD-based Mifare Authentication. This command results in both Level 1 and Level 2 authentication being performed automatically.
PCD TRANSCEIVE	1Eh	Used to Send/Receive raw Data to/from the PICC

Note: The PCD LOADKEY and PCD AUTHENTICATE1 functions may also be performed by the terminal directly by using the PCD Transceive Command.

PCD Command Flags Table

Bit#	Flag	Value	Meaning
0	Disable DF (DF=Disturbance Filter)	1	When response from PICC Card has been received, end of response is signaled regardless of errors.
		0	When response from PICC Card has been received, if there are errors then the data received is flushed and we continue to receive. If there are no errors then end of response is signaled.
1	Flush FIFO	1	PCD FIFO is flushed before starting this PCD command.
		0	PCD FIFO is not flushed before starting this command.
2-4	TxLastBits	000	Used for transmission of bit oriented frames: TxLastBits

		~111	defines the number of bits of the last byte that shall be transmitted. A 000 indicates that all bits of the last byte shall be transmitted. After transmission, TxLastBits is cleared automatically.
5-7	RFU	00	Reserved for future use.

Table 60: PCD Channel Redundancy Register Protocol 2

Bit#	Flag	Value	Meaning
0	Parity Enable	1	Parity bit inserted in transmitted data and expected in received data.
		0	No parity bit inserted or expected.
1	Parity Odd	1	Odd parity.
		0	Even parity.
2	Tx CRC Enable	1	CRC Bytes appended to transmitted data.
		0	CRC Bytes not appended to transmitted data.
3	Rx CRC Enable	1	Last bytes of received data are interpreted as CRC bytes. **Note**: The CRC is not sent back to the terminal by ViVOpay.
		0	No CRC expected.
4	CRC-8	1	8-Bit CRC calculated.
		0	16-Bit CRC calculated.
5	CRC 3309	1	CRC-Calculation is done according to ISO /IEC3309 (ISO 14443B).
		0	CRC-Calculation is done according to ISO 14443A.
6	RFU	0	Must always be zero.
7	RFU	0	Must always be zero.

If a valid Command Frame is received from the terminal, ViVOpay sends the data to the PICC (or carries out the appropriate action) and receives the PICC response. The ViVOpay reader treats the response as unknown data and does not try to interpret it. If there is no error, the reader returns a Response Frame with OK Status and the Data received from the PICC (if any). The Response Frame also contains the result of the PCD Command (PCD Status). The PCD Status may indicate success or an Error Code.

If the Command Frame contains any errors, or an error occurred during communication with the PICC (such as PICC removed from the field), then the reader sends a Response Frame with an appropriate Status. No Data is returned in this case.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)

ViVOtech2\0	2Ch	See Status Code Table	Variable	Variable	See Table below OR None		

Table 61: PCD Single Command Exchange Data Field for Response

Data Field	Length (bytes)	Description
PCD Status	1	This field contains the result of the PCD Command. Possible values are given in the following table.
RcvdBits	4	Number of bits received (stored as a big-endian number)
Raw Data In	0 or Variable	The response data that is received from the PICC. The contents of the response depend on the application residing on the PICC and are out of the scope of this document.

PCD Status	Description
0	OK
-1	No Tag Error (Card not present)
-2	CRC Error
-3	Empty
-4	Authentication Error
-5	Parity Error
-6	Code Error
-7	Card Type Error
-8	Serial Number Error
-9	Key Error
-10	Authentication not carried out for this Sector
-11	Bit Count Error
-12	Byte Count Error
-13	Idle
-15	Write Error
-18	Read Error
-19	FIFO Overflow Error
-21	Framing Error
-22	Access Error
-23	Unknown Command
-24	Collision Error
-25	Reset Error
-27	Access Timeout
-31	Coding Error
-54	Baud rate not supported by PCD
-112	Receive Buffer Overflow

For SRED device, the Raw Data being received from the card/device by the reader will be checked for sensitive data elements using rule in “Secure Pass-Through Function”. If found, the Command will return a Parameter Not Supported error (0x06).

9.1.1.4 Example: Sending a HALTA Command to a Type A PICC

Assuming that ViVOpay has been put into Pass-Through Mode, a Type A PICC has been detected using the Poll for Token command, and the terminal application has completed the transaction with the card, an ISO 14443 HALTA command can be sent to the PICC using the PCD Single Command Exchange command. Given below is a log of the command and data that the terminal would send to ViVOpay and also the responses that may be received from ViVOpay.

The following serial data may be exchanged between a terminal/PC and a ViVOpay reader:

Table 62: Halt a Command Exchange Between Terminal/PC and Reader

Terminal	ViVOpay
Command Frame ("PCD Single Command Exchange", PcdTransceive, 106 ETUs, [FlushFiFO=0, DisableDF=0], ChanRedReg=07) "ViVOtech2\0" 2Ch 04h 00h 09h 1Eh 00h 00h 00h 6Ah 00h 07h 50h 00h <CRC><CRC>	
	Response Frame (OK, NoTagError, RcvdBits=0) "ViVOtech2\0" 2Ch 00h 00h 05h FFh 00h 00h 00h 00h <CRC><CRC>

High Level Halt Command (2C-09)

This command instructs the ViVOpay reader to send a HALT command to the card and can be used for any Type A or Type B card. This command can only be used once the reader has been put in Pass-Through mode and the "Poll for Token" command has indicated that a Card is present.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	09h	00h	01h	Card Type		

Card Type:

0x01 = Type A

0x02 = Type B

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	00h		

Enhanced Pass-Through Command (2C-0B)

This command instructs the reader to carry out several tasks while in Pass-Through Mode. This command is ONLY enabled in Pass-Through Mode. If the reader is not in Pass-Through Mode, the reader ignores this command.

Note: SAM interface is only supported in SRED devices. It is not supported in non-SRED version.

This command is used in three basic situations:

1. To initiate a pass-through transaction
2. To terminate a “successful” transaction
3. To terminate a “failed” transaction

This command is based in large part on the standard Set Message Led/Buzz command. It differs primarily in that:

- Activation/Deactivation of interface
- Turn On/Off Antenna (PICC)
- Single-shot command processing
- Poll for Token (PICC/ICC/SAM)
- Sound the buzzer in various ways
- Turn on or off any of the LED’s
- Write text and amount messages to the display

If this command is only used to set the Buzzer/LED then it works on the all readers.

There are three cases depending on the LCD Message index number:

Index 00h to 07h messages are directly display by the reader. Normally these messages are not set through this command.

Index 08h to 0Bh messages can be set by the terminal.

Index FFh indicates the terminal is setting LED/Buzzer only.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	2Ch	0Bh	07 + N OR 7 + X + Y		See Data Table		

The format and contents of the data field in the Command Frame are given in the following table.

Table 63: Enhanced Pass-Through Data Field

Data Item	Length (bytes)	Description
Single-Shot Commands	1	This bitmask contains the following commands. If a bit is set (1), the command is issued by the reader in the proper order. If the command mask is cleared (0), the command is NOT executed. 0000 0001 : Activate Interface (mutually exclusive) 0000 0010 : Deactivate Interface (mutually exclusive) 0000 0100 : Issue Poll For Token 0000 1000 : Use Independent LED instead (mutually exclusive) 0001 0000 : Use Independent Buzzer instead (mutually exclusive) 0010 0000 : Use Specified Interface 0100 0000 : Reserved 1000 0000 : Reserved For more information see Single-Shot Commands below.
LCD Message Index (for readers with a display only)	1	00-07 is controlled by the reader and normally not set by this command 00: Idle Message (Welcome) 01: Present card (Please Present Card) 02: Time Out or Transaction Cancel (No Card) 03: Transaction between reader and card is in the middle (Processing…) 04: Transaction Pass (Thank You) 05: Transaction Fail (Fail) 06: Amount (Amount $ 0.00 Tap Card) 07: Balance or Offline Available funds (Balance $ 0.00) 08-0B is controlled by the terminal through this command 08: Insert or Swipe card (Use Chip & PIN) 09: Try Again(Tap Again) 0A: Indicate the custom to present only one card (Present 1 card only) 0B: Indicate the custom to wait for authentication/authorization (Wait) 80 MASK – indicates the User has included a String1 character string to be displayed with the standard message. If 0x80 is present, then the message index (in the lower portion of the byte) is displayed and LCD String1 and LCD String2 are only used for the Amount and Balance messages.

<table>
<tr><th>Data Item</th><th>Length (bytes)</th><th>Description</th></tr>
<tr><td></td><td></td><td>FF indicates not to set the LCD message which allows terminal to set LED/Buzzer only.

EXAMPLE 1: Index = 00h, reader displays standard “Welcome”
EXAMPLE 2: Index = 86h, reader displays standard 06h “Amount” message but also displays String1 (in this case String1 = “$3.95”)</td></tr>
<tr><td>Beep Indicator</td><td>1</td><td>00h: No beep
01h: Single beep
02h: Double beep
03h: Three short beeps
04h: Four short beeps
05h One long beep of 200 ms
06h One long beep of 400 ms
07h One long beep of 600 ms
08h One long beep of 800 ms</td></tr>
<tr><td>LED Number</td><td>1</td><td>00h: LED 0 (Power LED)
01h: LED 1
02h: LED 2
03h: LED 3
FFh: All LEDs
Where the LEDs are numbered 0, 1, 2, 3 counting from the left.
Note: If you are using past-through mode to control the Power LED (LED 0), it is your responsibility to make sure that it behaves correctly.</td></tr>
<tr><td>LED Status</td><td>1</td><td>00h: LED Off
01h: LED On</td></tr>
<tr><td>Timeout1</td><td>1</td><td>Time in Seconds. Timeout1 cannot be zero seconds if Timeout2 is Zero.</td></tr>
<tr><td>Timeout2</td><td>1</td><td>Multiplier for Time in multiples of 10 milliseconds.

<table><tr><th>Timeout2</th><th>Time in ms</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>10</td></tr><tr><td>2</td><td>20</td></tr><tr><td>:</td><td>:</td></tr><tr><td>255</td><td>2550</td></tr></table></td></tr>
<tr><td>LCD String1 Message</td><td>X</td><td>This field is included when LCD Message Index AND 80h = True.
The field is X bytes long and consists of a simple character string. It contains NO formatting information, ONLY text characters. If LCD String1 Message and LCD String2 Message are included, then the reserved field must be included, with LCD String1 Message appearing immediately after it.
Note: The string must be null terminated (00) to indicate the end of the string.</td></tr>
<tr><td>LCD String2 Message</td><td>Y</td><td>The field is Y bytes long and consists of a simple character string. It contains NO formatting information, ONLY text characters.
Note: The string must be null terminated (00) to indicate the end of the string.</td></tr>
<tr><td>Selected Interface</td><td>Z</td><td>This field is present when the Single-Shot Commands Byte, Specified Interface bit = 1:

It is 1 byte long.
Allowed Interface Values are:
00h = Contactless
20h = RFU
21h = SAM1 (SRED version only)
22h = SAM2 (SRED version only)
Note: If this field is not present, the firmware will default to standard</td></tr>
</table>

Data Item	Length (bytes)	Description
		PICC behavior OR generate an error, depending upon which actions are indicated.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	Variable	below		

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	Variable	below		

The message has been set to the requested message only if the Response Frame contains an OK Status Code.

If the interface is SAM, the response is ATR.

If the interface is Contactless Card, the response is as follows: If Poll for Token bit is disabled, no data is returned in the response. It is the same for the beep indicator. If Poll for Token bit is enabled, the response is the same as Poll for Token (2C-02) command..

Single Shot Commands

The first data byte of the command lists several ‘single-shot’ commands. If the associated bit of this field is set, the indicated discrete operation is carried out. If the bit is cleared, the associated command is NOT carried out.

If the Poll for Token bit is enabled, the reader checks the value of the Use Specified Interface bit.

If Use Specified Interface bit = 0, reader polls for a PICC card.

If Use Specified Interface bit = 1, reader attempts a Poll for Token operation on the interface specified in the Selected Interface byte

9.1.1.5 Activate Interface

This bit turns on the RF antenna for the contactless interface by default.

If the “Use Specified Interface” bit in the Single-Shot Command byte is set, the specified interface will be activated:

- Contactless turns on the RF antenna
- SAM1, SAM2 activates the appropriate SAM

9.1.1.6 Deactivate Interface

This turns off the RF antenna for the contactless interface by default.

If the Use Specified Interface bit in the Single-Shot Command byte is set, this bit turns off the indicated interface:

- Contactless turns off the RF antenna
- SAM1, SAM2 deactivates the appropriate SAM

Note: The interface to be deactivated MUST be the one that is currently active.

9.1.1.7 Poll for Token

This bit executes a Poll for Token on the Contactless interface by default.

If the Use Specified Interface bit in the Single-Shot Command byte is set, this bit performs a Poll for Token on the indicated interface:

- Contactless performs a Poll for Token
- SAM1, SAM2 performs a Poll for Token on appropriate SAM slot

9.1.1.8 Use Independent Buzzer

If the Use Independent Buzzer bit is set, the reader checks the Beep Indicator byte and calls the standard Buzzer Command (0B 01).

If the bit is cleared, the reader checks the Buzzer byte and follows the Set Message Buzzer command (01 02).

9.1.1.9 Use Independent LED

If the Use Independent LED bit is set, the reader reads the included LED Number and Status bytes and then call the standard LED Command (0A 02).

If the bit is cleared, the reader reads the included LED bytes and then calls the Set Message LED command (01 02).

9.1.1.10 Mutual Exclusions

This command has several elements that are mutually exclusive; the command fails if both are enabled.

Antenna	You cannot enable both the Switch On and Switch Off options.
Independent LED Enabled	Reader uses the LED Bytes and calls the standard 0A 02 LED command
Independent LED Disabled	Reader uses the LED Bytes and follows the SetMsg 01 02 LED command

Independent Buzzer Enabled	Reader uses the Buzzer Byte and calls the standard 0B 01 Buzzer command
Independent Buzzer Disabled	Reader uses the Buzzer Byte and follows the SetMsg 01 02 Buzzer command

LED, Buzzer and Message operations all occur simultaneously. The order in which processes are executed depends upon the situation:

If SWITCH ANTENNA ON is enabled:

- Switch Antenna On
- Perform any Message, LED, and Buzzer operations
- Poll for Token

If SWITCH ANTENNA OFF is enabled:

- Perform any Message, LED, and Buzzer operations
- Switch Antenna Off

9.1.1.11 Example Using Enhanced Pass-Through Commands

Currently, a typical command order used during a transaction flow:

- Switch Antenna On
- Set Message LED Buzz
- Poll for Token
- Exchange APDU (Select)
- Exchange APDU (PPSE)
- Exchange APDU (Get Processing Option)
- Exchange APDU (Read Record 1.1)
- Exchange APDU (Read Record 2.1)
- Exchange APDU (Read Record 3.1)
- Exchange APDU (Read Record 3.2)
- Exchange APDU (Cryptogram)
- LED On
- Buzzer

- Switch Antenna Off

The Enhanced Pass-Through command order for the *same* transaction flow becomes:

- ***Enhanced Pass-Through Control***
- Exchange APDU (Select)
- Exchange APDU (PPSE)
- Exchange APDU (Get Processing Option)
- Exchange APDU (Read Record 1.1)
- Exchange APDU (Read Record 2.1)
- Exchange APDU (Read Record 3.1)
- Exchange APDU (Read Record 3.2)
- Exchange APDU (Cryptogram)
- ***Enhanced Pass-Through Control***

The first command would be formatted as follows:

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	2Ch	0Bh	00h	07h	See Below		

Byte 0 Single Shot	Byte 1 LCD Index	Byte 2 Beep	Byte 3 LED #	Byte 4 LED Status	Byte 5 Timeout1	Byte 6 Timeout2
05	01	00	00	01	01	01

In this first call of the Enhanced Pass-Through command:

Byte 0 instructs the reader to single-shot the Turn Antenna On and Poll for Token commands

Byte 1 instructs the reader to display message #1 on the display

Byte 2 says that no buzzer is expected

Byte 3 & 4 set the left-most LED on

Byte 5 & 6 set the timeouts (see Timeout1 and Timeout2)

The second command would be formatted as follows:

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	2Ch	0Bh	00h	07h	See Below		

Byte 0 Single Shot	Byte 1 LCD Index	Byte 2 Beep	Byte 3 LED #	Byte 4 LED Status	Byte 5 Timeout1	Byte 6 Timeout2
02	04	01	FF	02	01	01

In this call of the Enhanced Pass-Through command:

Byte 0 instructs the reader to single-shot the Turn Antenna Off command

Byte 1 instructs the reader to display message #4 (Thank You) on the display

Byte 2 says that give one short beep with the buzzer

Bytes 3 & 4 set all 4 LEDs to blink on then off

Bytes 5 & 6 set the timeouts (see Timeout1 and Timeout2)

Exchange APDU Data (2C-13)

Note: SAM interface is only supported in SRED devices. It is not supported in non-SRED version.

This command allows exchange of application level APDU's with the following:

- PICC (contactless card) that is ISO 14443-4 compliant
- SAMs

An application level Command APDU meant for a card or SAM is sent to the reader in the Command Frame, along with the interface. The reader sends the APDU to the card/SAM. The response APDU received from the card/SAM is sent back by the reader in the Response Frame.

Before this pass-through command can be used, a Level 1 session must have been established with a card on the interface to be used i.e., contactless (PICC) or contact (SAM1/SAM2) through the Enhanced Pass-through command (Poll for Token single shot command).

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)

ViVOtech2\0	2Ch	13h	Variable	See Command Data Table		

Command Data

Data Item	Length (bytes)	Description/Example
Interface	1	Allowed interfaces for which to get the ATR. 00h = Contactless 20h = RFU 21h = SAM 1 (SRED version only) 22h = SAM 2 (SRED version only)
Command APDU	Variable	Command APDU data that will be sent to the card via the specified interface. For SAMs, any command/response pair can be passed.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	variable	Response APDU		

For SRED device, if the interface is Contactless, the APDU data being received from the card/device by the reader will be checked for sensitive data elements using rule in “Secure Pass-Through Function”. If found, the Command will return a Parameter Not Supported error (0x06).

High Level Pass-Through Commands for Mifare Cards

This section contains serial commands that implement higher level functionality for the Mifare Cards. These commands can only be used once the reader has been put in Pass-Through mode and the “Poll for Token” command has indicated that a Mifare Card is present. These commands do not work for non-Mifare cards.

Mifare Authenticate Block (2C-06)

This command allows the terminal to instruct the ViVOpay reader to authenticate the Mifare Card sector containing the specified block of data. The Key to be used is also specified by the terminal. This command is applicable only for Mifare Standard/Classic Cards.

This command is not applicable for Mifare Ultralight Cards.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-Byte 21	Byte 22	Byte 23
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	06h	00h	08h	See Table below		

Table 64: Mifare Authentication Block Data Field

Data Field	Length (bytes)	Description
Block	1	Block Number in the Mifare Card for which the relevant sector must be authenticated.
Key Type	1	Specifies which type of key to use for authentication. It can have the following values. 01h: Key A 02h: Key B
Key	6	Value of the Key

For details on these fields, refer to the relevant Mifare Specifications

This command does not actually perform the authentication. It sets the key to be used for the subsequent authentication. The actual authentication will be performed before the next read or write operation. If a sector boundary is crossed, the reader will attempt to authenticate using the key that was established with this command.

After receiving the Command Frame, the ViVOpay reader verifies the data and if the data is valid, it interacts with the Mifare card to authenticate the sector containing the specified block. If this operation is successful, the ViVOpay reader sends a Response Frame with an OK Status. If the operation fails or the data was invalid, then the reader returns a Response Frame with an appropriate Status.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	00h		

If the card in the field is not a Mifare card, a 0Ch (Sub-command not allowed) will be returned in the status code.

Mifare Read Blocks (2C-07)

Use this command to read data from one or more blocks on the Mifare Card. The terminal can instruct the reader to read up to 15 blocks using this command. If more than one block is defined, then the reader automatically reads the starting block and the blocks that follow. For multi-block reads, the sector trailer will be skipped. Sector trailer's may be read (except that the keys will not be visible) using a single block read.

If the card specified is a Mifare Standard card, then the terminal must have successfully sent at least one Mifare Authenticate Block command to the reader for the first block to read. This does not authenticate the block; it stores a key for use by the reader as it performs reads and writes.

If the card specified is a Mifare Standard card and the read command specifies a single block read, then the reader tries to read the data regardless of whether the block is a sector trailer block.

If the card specified is a Mifare Standard card, and the read is a multi-block read, then the reader skips reading the sector trailer blocks that contain the Keys (since the Keys cannot be read). Skipped blocks are not included in the block count. While reading blocks in a Mifare Standard Card, if the read requires access to the next sector, then the ViVOpay reader carries out authentication for this block/sector automatically by using the Key Type and Key Value that were set in the Mifare Authenticate Block command to authenticate the sector for the Starting Block via the Mifare Authenticate Block command.

Block reads and writes that span multiple sectors assume that the keys to authenticate those sectors are the same as the one that was set using the Mifare Authenticate Block command.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14,15	Byte 16	Byte 17
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	07h	00h	02h	See Table below		

Table 65: Mifare Read Block Data Field

Data Field	Length (bytes)	Description
Card & Block Count	1	Card Type: [Bit 7..4] This can only indicate the following cards Mifare Type A (Standard) Mifare Type A (Ultralight) The values for these card types are defined in the "Poll for Token" command (consider only the lower 4 bits). Block Count: [Bit 3..0] This is the number of 16-byte blocks that are read. The Block Count cannot be greater than 15. This count does not include the skipped blocks if the card is a Mifare Standard card.
Start Block	1	This is the card block number from which the reader starts reading.

After receiving the Command Frame the ViVOpay reader verifies the parameters. If the parameters are valid, then it reads the data from the card. If this operation is successful, the ViVOpay reader sends a Response Frame containing a Status of OK and the data that was read. If the operation fails or one or more parameters were invalid, then the reader sends a Response Frame containing an appropriate Status, but no data.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	Variable	Variable	Data Read from Card OR None		

If the Status is OK, then the Data Length depends on the number of blocks read and the card type.
DataLen = Blocks Read * (Bytes per Block for Card).

If there was an error or no data was read, then the Data Length is zero.

For SRED device, the data being received from the card/device by the reader will be checked for sensitive data elements using rule in "Secure Pass-Through Function". If found, the Command will return a Parameter Not Supported error (0x06).

9.1.1.12 Reading Mifare Ultralight Cards

Mifare Ultralight cards differ from Mifare Cards. For Mifare Standard Cards the block size is 16 bytes. However, for Mifare Ultralight Cards the block (page) size is 4 bytes. When reading Mifare Ultralight cards, *Block Count* is taken to mean the number of 16 byte blocks (each consisting of four 4-byte pages). However, for Mifare Ultralight cards, the *Start Block* represents a 4-byte page.

For example, if the card is a Mifare Ultralight card, and a read is requested starting at Block 3 and Block Count is 1 then 16 bytes of data are returned consisting of Page # 3, 4, 5 & 6. And if a read is requested starting at Block 3 and Block Count is 2 then 16*2=32 bytes of data are returned consisting of Page # 3, 4, 5, 6, 7, 8, 9, and 10.

Typically, Mifare Ultralight Cards are read by the ViVOpay reader, but are not written. This is because they are typically used for disposable applications such as ticketing.

Mifare Write Blocks (2C-08)

Use this command to instruct the ViVOpay reader to write data to one or more blocks on the Mifare Card. The terminal can instruct ViVOpay to write up to 15 blocks of data using this command. If more than one block is defined, then the reader automatically writes to the starting block and the blocks that follow.

The block size depends on the type of Mifare card being accessed. For Mifare Standard Cards the block size is 16 bytes. For Mifare Ultralight Cards the block size is 4 bytes.

If the card specified is a Mifare Standard card, then the terminal must have successfully sent at least one Mifare Authenticate Block command to the reader for the first block to write. This does not authenticate the block; it stores a key for use by the reader as it performs reads and writes.

If the card specified is a Mifare Standard card and the write command is a single block write, the reader tries to write the data regardless of whether the block is a sector trailer block or not.

If the card specified is a Mifare Standard card, and the write is a multi-block write, then the reader skips writing to the sector trailer blocks that contain the Keys. Skipped blocks are not included in the block count. While writing blocks to a Mifare Standard Card, if the write requires access to the next sector, then the ViVOpay reader carries out authentication for this block/sector automatically by using the Key Type and Key Value that were used by the terminal to authenticate the sector for the Starting Block via the Mifare Authenticate Block command.

Block reads and writes that span multiple sectors assume that the keys to authenticate those sectors are the same as the one that was set using the Mifare Authenticate Block command.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	08h	Variable	Variable	See Table below		

Table 66: Mifare Write Block Data Field

Data Field	Length (bytes)	Description
Card & Block Count	1	Card Type: [Bit 7..4] This can only indicate the following cards Mifare Type A (Standard) Mifare Type A (Ultralight) The values for these card types are defined in the “Poll for Token” command (consider only the lower 4 bits). Block Count: [Bit 3..0] This is the number of blocks that are written. The Block Count cannot be greater than 15. This count does not include the skipped blocks if the card is a Mifare Standard card.
Start Block	1	This is the card block number from which the reader starts writing.
Data to Write	Variable (multiple of block size)	Data to write to the Card. The length of the data to be written to the card depends on the number of blocks to be written and the card type.

After receiving the Command Frame the ViVOpay reader verifies the parameters. If the parameters are valid, it writes the data to the card. If this operation is successful, the ViVOpay reader sends a Response Frame with a Status of OK.

If the Command Frame is invalid or the write operation fails then the reader sends a Response Frame with an appropriate Status.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	00h		

Mifare ePurse Command (2C-0A)

Use this command to instruct the ViVOpay reader to carry out Debit, Credit and Backup operations on value blocks in a Mifare card. These functions require that the related data blocks be formatted as a value block and that operations and keys used match the defined Access Conditions for that sector.

The following illustration shows the format of a value block:

Table 67: ePurse Value Block Format

Byte Number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Description	Value				Value				Value				Adr	$\overline{\text{Adr}}$	Adr	$\overline{\text{Adr}}$

A Debit function subtracts a given amount from a Mifare value block and stores the result in the same block. A Credit function adds a given amount to a Mifare value block and stores the result in the same block. A Backup function reads a value block and stores a copy of it in another value block in the same authenticated sector.

This command is flexible in that it allows any number of Debit, Credit or Backup function blocks to be embedded within one Command Frame in any order, with or without keys specified, as long as the total number of bytes is within the size capability of one Pass-Through command. Operations are performed in the order they are specified.

For instance, a Purse Command could simply contain one Debit function to debit a value block by a specified amount. If a key and key type is included they are used to authenticate the block and the debit function is performed. If no key information is included the key and key type used in the previous Mifare Authentication command is used.

In another case, the Purse Command could contain a Credit function to credit a value block by a specific amount and a Backup function to backup the resulting balance to another value block somewhere on the card. Each command could include a specific key for the block being addressed, or omit the key information and let the reader use the last known key.

Note: The default key and key type are overwritten each time a key is encountered while processing a Purse Command. The initial default values are those set when the Mifare Authenticate Block command is received. That key type and key are used until another key is encountered, at which point the new key becomes the default key for subsequent transactions. If purse commands are used without key information then the terminal must have successfully sent at least one Mifare Authenticate Block command to the reader for the first block.

Warning: Multiple ePurse command blocks can be included in one command; each command contains a count of the number of command blocks included in the command.

If the count of command blocks specified is not equal to the actual number of command blocks included in the command, an error may or may not be returned to the user.

If the count of command blocks is greater than the actual number of command blocks specified, all command blocks available are acted upon and an error is returned.

If the count of command blocks is less than the actual number of command blocks in the command, only the number of commands specified in the count is acted upon but no error is returned.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	0Ah	Variable	Variable	See Table below		

Table 68: Mifare ePurse Command Data Field

Data Field	Length (bytes)	Description							
Mode, Card Type & Operation Count	1	7	6	5	4	3	2	1	0
		1 = Inc 0 = Dec	Card Type			Operation Count			
		Increment / Decrement Flag: [Bit 7] Set to 1 instructs reader to Add to (Credit) amount. Set to 0 instructs reader to Subtract from (Debit) amount. Card Type: [Bit 6..4] This can only indicate Mifare Type A (Standard) card (3, as defined in the "Poll for Token" command). Operation Count: [Bit 3..0] This is the number of operation command blocks contained within the rest of the Purse Function data area.							
Purse Function Blocks	Variable [1]	Series of any combination of supported Purse Function blocks (Debit/Credit, Backup). Refer to the description of each individual Command Frame below.							

Debit / Credit Function Block (with Key specified)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11	Byte 12
Value Block Number	Command Length	Amount				Key Type	Key					
	0Bh	See Table below				See Table	See Table					

Debit / Credit Function Block (using default Key)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
Value Block Number	Command Length	Amount			
	04h	See Table			

Table 69: Mifare ePurse Data Field for Debit/Credit Function Block

Data Field	Length (bytes)	Description
Amount	4	Amount to be added (Debit) or subtracted (Credit) in Little-Endian format. Mode of operation (+ or -) is specified by most significant bit of first data byte in Purse Command (Mode, Card Type and Operation Count)
Key Type	1	Specifies which type of key to use for authentication. It can have the following values. 01h: Key A 02h: Key B
Key	6	Value of the Key

For details on these fields, refer to the relevant Mifare Specifications.

Backup Function Block (with Key specified)

Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
Backup Block Number	Command Length	Primary Block Number	Key Type	Key					
See Table below	08h	See Table below	See Table below	See Table below					

Backup Function Block (using default Key)

Byte 0	Byte 1	Byte 2
Backup Block Number	Command Length	Primary Block Number
See Table below	01h	See Table below

Mifare ePurse backup commands are distinguished from Debit/Credit operations by the value in the Command Length field.

Table 70: Mifare ePurse Data Field for Backup Function Block

Data Field	Length (bytes)	Description
Backup Block Number	1	Number of destination value block to be used for backup.
Command Length	1	Set to 01h or 08h, depending on whether a key type and key are supplied.
Primary Block Number	1	Number of source value block to be copied.
Key Type	1	Present only if Command Length = 08h Specifies which type of key to use for authentication. It can have the following values. 01h: Key A 02h: Key B
Key	6	Present only if Command Length = 08h Value of the Key

For details on these fields, refer to the relevant Mifare Specifications.

After receiving the Command Frame the ViVOpay reader verifies the parameters. If the parameters are valid, it performs the operations specified in the order in which they appear within the Purse Command Data Frame.

Note: Although it is possible to include multiple value operations (Debit or Credit) in one command, because there is only a single one-bit flag to specify the Debit or Credit mode all value commands within one Purse Command must be either Debit or Credit functions. (However, backup operations may be included because they are distinguished by the command length field).

If all operations are successful, the ViVOpay reader sends a Response Frame with a Status of OK. If the Command Frame is invalid or any of the operations fail then the reader sends a Response Frame with an appropriate Status.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Status Code Table	00h	00h		

Examples

Application: Perform a Debit operation. Subtract 2000 from value block number 20H using last key specified. Blue shaded area shows the Debit function block within the Purse Command Frame.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16

Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Mode, Card Type, Operation Count	Value Block	Debit Cmd Length
ViVOtech2\0	2Ch	0Ah	00h	07h	31h	20h	04h
Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22		
Debit Amount				CRC MSB	CRC LSB		
D0h	07h	00h	00h				

Application: Perform a Credit operation. Add 100 to value block number 20H specifying Key A. Blue shaded area shows the Credit function block within the Purse Command Frame.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Mode, Card Type, Operation Count	Value Block	Credit Cmd Length
ViVOtech2\0	2Ch	0Ah	00h	0Eh	B1h	20h	0Bh
Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22	Byte 23	Byte 24
Credit Amount				Key Type	Key		
64	00	00	00	01	Ka	Kb	Kc
Byte 25	Byte 26	Byte 27	Byte 28	Byte 29			
Key			CRC MSB	CRC LSB			
Kd	Ke	Kf					

Application: Perform a Debit operation with Backup. Subtract 300 from value block number 20H specifying Key A and backup the result to value block number 21H using the same key. Blue shaded area shows the Debit function block and yellow shaded area shows the Backup function block within the Purse Command Frame.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Mode, Card Type, Operation Count	Value Block	Debit Cmd Length
ViVOtech2\0	2Ch	0Ah	00h	11h	32h	20h	0Bh
Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22	Byte 23	Byte 24
Debit Amount				Key Type	Key		
2Ch	01	00	00	01	Ka	Kb	Kc

Byte 25	Byte 26	Byte 27	Byte 28	Byte 29	Byte 30	Byte 31	Byte 32
Key			Backup Block	Backup Cmd Length	Primary Block	CRC MSB	CRC LSB
Kd	Ke	Kf	21h	01h	20h		

Application: Perform a Backup (value copy) operation only. Copy the value amount from block 1CH to block 1DH specifying Key B. Yellow shaded area shows the Backup function block within the Purse Command Frame.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Mode, Card Type, Operation Count	Backup Block	Backup Cmd Length
ViVOtech2\0	2Ch	0Ah	00h	0Bh	31h	1Dh	08h
Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22	Byte 23	Byte 24
Primary Block	Key Type	Key					
1Ch	02h	Ka	Kb	Kc	Kd	Ke	Kf

Byte 25	Byte 26
CRC MSB	CRC LSB

High Level Pass-Through Commands for NFC Cards

This section contains serial commands that implement higher level functionality for the NFC Cards. These commands do not work for non-NFC cards.

NFC Commands (2C-40)

This command uses Data[0] in command data field to implement different functions. This command should be used in Pass-Through mode and command with “Poll for a NFC Tag” data should be used first. Command with other data can only be used once the “Poll for a NFC Tag” command has indicated that a NFC tag is present.

NFC Commands

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 ...Byte 13+n	Byte 14+n	Byte 15+n

Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	Data	CRC(MSB)	CRC(LSB)
ViVOtech2\0	2Ch	40	00	00	See Below		

Individial commands in NFC command set are distingushed as to parameters in Data field.

Table 71: NFC Command Set List

Command	Data length	Command Data Field Description
Poll for a NFC Tag	2	Data[0]: FFh Data[1]: Timeout (in second)
Tag1 Static Get All Data	1	Data[0]: 11h
Tag1 Static Read a Byte	2	Data[0]: 12h Data[1]: Address of the data
Tag1 Static Write a Byte	3	Data[0]: 13h Data[1]: Address of the data Data[2]: Data to be written
Tag1 Static Write a Byte NE	3	Data[0]: 14h Data[1]: Address of the data Data[2]: Data to be written
Tag1 Dynamic Read a Segment	2	Data[0]: 15h Data[1]: Address of the segment
Tag1 Dynamic Read 8 Bytes	2	Data[0]: 16h Data[1]: Address of the data
Tag1 Dynamic Write 8 Bytes	10	Data[0]: 17h Data[1]: Address of the data Data[2]~Data[9]: Data to be written
Tag1 Dynamic Write 8 Bytes NE	10	Data[0]: 18h Data[1]: Address of the data Data[2]~Data[9]: Data to be written
Tag2 Read Data (16 bytes)	2	Data[0]: 21h

		Data[1]: Address of the data
Tag2 Write Data (4 bytes)	6	Data[0]: 22h Data[1]: Address of the data Data[2]~Data[5]: Data to be written
Tag2 Select Sect	2	Data[0]: 23h Data[1]: Sect number
Tag3 Read Data	variable	Data[0]: 41h Data[1]: Number of services, value n. Data[2]~Data[2n+1]: Service code list Data[2n+2]: Number of blocks, value m. Data[2n+3....]: Block list, length is 2m~3m
Tag3 Write Data	variable	Data[0]: 42h Data[1]: Number of services, value n. Data[2]~Data[2n+1]: Service code list Data[2n+2]: Number of blocks, value m. Data[2n+3....]: Block list, length is 2m~3m Data[...]: Block data, length is 16m
Tag4 Command	variable	Data[0]: 0x81 Data[1]~Data[n]: data

NFC Response

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 ...Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	Data	CRC(MSB)	CRC(LSB)
ViVOtech2\0	2Ch	See Status Code Table	00	00	See Below		

Table 72: NFC Command Set Response Data List

Command Response	Data length	Command Response Data Field Description

Poll for a NFC Tag	variable	Data[0]: Card type 00h None (Card Not Detected or Could not Active) 01h ISO 14443 Type A (Supports ISO 14443-4 Protocol) 02h ISO 14443 Type B (Supports ISO 14443-4 Protocol) 03h Mifare Type A (Standard) 04h Mifare Type A (Ultralight) 05h ISO 14443 Type A (Does not support ISO 14443-4 Protocol) 06h ISO 14443 Type B (Does not support ISO 14443-4 Protocol) 07h ISO 14443 Type A and Mifare (NFC phone) 0Ah NFC Tag 1 0Bh NFC Tag 2 0Ch NFC Tag 3 0Dh NFC Tag 4 Data[1...]: Serial Number (or the UID) of the PICC. Length depends on the card detected. If no card was detected, then a Serial Number is not returned.
Others	variable	Returned data from card

For details on these data field, refer to the relevant NFC Specifications.

For SRED device, if the command isn't "Poll for a NFC Tag", the data being received from the card/device by the reader will be checked for sensitive data elements using rule in "Secure Pass-Through Function". If found, the Command will return a Parameter Not Supported error (0x06).

Secure Pass-Through Function

Note: In SRED device, Pass-Through mode is called Secure Pass-Through Mode.

(1) General Introduction

In Secure Pass-Thru mode the reader will not allow the exposure of sensitive financial data. All data returned from the card is parsed and analyzed to detect sensitive financial data before that data is provided in the transaction response. If any sensitive financial data is found only an error is returned and no data from the card is provided for the entire transaction.

(2) Handling Sensitive Financial Data

Any TLV or structure on the SRED list of protected financial data will cause the Pass-Thru command response to return a Parameter Not Supported status (0x06) with no data returned.

SRED List of Protected Financial Data

TLV	Name	Find Method
56	Track 1 Equivalent Data	Match EMV TLV
57	Track 2 Equivalent Data	Match EMV TLV
5A	Application PAN	Match EMV TLV
5F20	Cardholder Name	Match EMV TLV
5F24	Application Expiration Date	Match EMV TLV
5F30	Service Code	Match EMV TLV
9F27	Cryptogram Information Data	Match EMV TLV
9F60	CVC3Track1	Match EMV TLV
9F61	CVC3Track2	Match EMV TLV
9F6B	Track 2 Data	Match EMV TLV
none	Track 1	Matches ISO/IEC 7813 format for Track 1. See details in Track 1 Format Test below.
none	Track 2	Matches ISO/IEC 7813 format for Track 2. See details in Track 2 Format Test below.
none	Track 3	Matches ISO/IEC 4909:2006 format for Track 3. See details in Track 3 Format Test below.

(1) Accessing SAMs in Pass- Thru Mode

In Secure Pass-Thru SAM access is always clear data. The SAM will never contain sensitive financial data.

(2) Pass-Thru Command Need to be parsed for sensitive financial data

Cmd-Sub	Name
2C-03	Exchange APDU
2C-04	PCD Single Command Exchange
2C-07	Read Mifare Block
2C-13	Exchange APDU
2C-40	NFC Commands

(3) Parsing and Analysis of Data provided by Card

This section provides detailed instructions which are the primary methods used to determine if a card contains sensitive financial data. Whether the data received by the reader from the card is raw data, an APDU or Mifare data, all data will be parsed for recognizable sensitive financial data as defined in “SRED List of Protected Financial Data”.

The following steps will be used to parse the data:

Step1 - BER-TLV parsing
First the data is parsed to determine if they follow the standard BER-TLV structure. If the data does follow the BER-TLV structure then each TLV will be evaluated to determine if any match the sensitive financial TLV’s listed in“SRED List of Protected Financial Data”.

Step2 - Data Structures parsing

If the data does not follow the standard BER-TLV format then the data is evaluated to determine if an image similar to Track data can be found.

Track Data Structure Rules

Track 1 ASCII:
- Start Sentinel (STX= "%")
- End Sentinel (ETX = "?")
- Format Code (FC = "B")
- Separator after the PAN (FS = "^")
- Max PAN 19 digits. Minimum Card Brand PAN size is 12.
- Max record length 79 characters

1. If the Start Sentinel is found, followed by the Format Code, with the Separator within 12 to 19 characters after the Format Code, then sensitive data has been found.
2. If no Start Sentinel is found, but the Format Code followed by the Separator within 12 to 19 characters after the Format Code is found, then sensitive data has been found.
3. If no Start Sentinel and no Format code found, but the Separator is found within 12 to 19 characters from the start of data, then sensitive data has been found.

Examples:
Found with Test #1 – PAN length >11 < 20
%B6279257749132343^TEST CARD/VIVOPAY^10128130072?

Found with Test #2 – PAN length >11 < 20
B6279257749132343^TEST CARD/VIVOPAY^10128130072

Found with Test #3 – PAN length >11 < 20
6279257749132343^TEST CARD/VIVOPAY^10128130072

Track 2 ASCII:
- Start Sentinel (STX= ";")
- End Sentinel (ETX = "?")
- Separator after the PAN (FS = "=")
- Max PAN 19 digits. Minimum Card Brand PAN size is 12.
- Max record length 40 characters

1. If the Start Sentinel is found, followed by the Separator within 12 to 19 characters after the Start Sentinel, then sensitive data has been found.
2. If no Start Sentinel, but the Separator is found within 12 to 19 characters from the start of data , then sensitive data has been found.

Examples:
Found with Test #1 – PAN length >11 < 20
;6279257749132340=10128130072104350000?

Found with Test #2 – PAN length >11 < 20
6279257749132340=10128130072104350000

Track 3 ASCII:
- Start Sentinel (STX= ";")
- End Sentinel (ETX = "?")
- Format Code (FC = "0x00 – 0x99")
- Separator after the PAN (FS "=")

- Max PAN 19 digits. Minimum Card Brand PAN size is 12.
- Max record length 107 characters

1. If the Start Sentinel is found, and the Format Code is found, followed by the Separator within 12 to 19 characters from the Format Code, then sensitive data has been found.
2. If no Start Sentinel, but the Format Code is found and the Separator is found within 12 to 19 characters from the Format Code, then sensitive data has been found.
3. If no Start Sentinel, and no Format Code is found, but the Separator is found within 12 to 19 characters from the start, then sensitive data has been found.

Examples:
Found in Test #1 – PAN length >11 < 20
;011234567890123445**=**72472410000000030300XXXX040400099010=******==1=00?

Found In Test #2 - PAN length >11 < 20
011234567890123445**=**72472410000000030300XXXX040400099010=******==1=00

Found In Test #3 - PAN length >11 < 20
1234567890123445**=**72472410000000030300XXXX040400099010=******==1=00

10.0 Secure Communication

Special Considerations for Secure Communications

Take time to familiarize yourself with certain key differences in device usage that come into play when secure communications are required (as described below).

Burst mode

Burst mode is not allowed when encryption is enabled.

When encryption is enabled, burst mode is always OFF. When encryption is enabled, reader will turn the burst mode to be OFF automatically. When encryption is enabled, if user wants to make burst mode to be ON/AUTO EXIT through “Set Configuration (04-00)” command, reader will respond with an error code.

Note: Burst mode is disabled for SRED devices.

Data Output

When secure communications are enabled, all magstripe data output (MSR) will be encoded according to the rules described in ID TECH P/N #80000403-001, *Enhanced Encrypted MSR Data Output Format*. All other encrypted output will conform to ID TECH P/N 80000404-001, *ID Tech Encrypt Data Format in Command/Response Specification for IC Communication*. The former (encrypted MSR) is a fixed-layout data encoding scheme with ID TECH proprietary semantics for flag values, field meanings, etc. The latter (encrypted EMV/ICC) is a TLV-based format using industry standard TLV (tag/length/value) encoding conventions, with a mix of industry-standard EMV tags and ID TECH proprietary tags.

For further information (including actual data in the two output styles), see the appendix called TDES Data Encryption Examples, and/or consult the appendix on Enhanced Encrypted MSR Data Output Format.

Encryption Algorithms

The reader uses TDES encryption by default. During the authentication phase, the reader will use TDES in ECB mode. Once the reader and terminal are authenticated, the data field in the command/response frames is encrypted with Cipher Block Chaining (TDES-CBC).

Only the data fields of the ViVOpay command/response frames are encrypted. The 14-byte preamble consisting of the command header, command, sub-command, and status fields, will not be encrypted.

Secure Data Exchange

Data is encrypted using TDES-CBC. Once a session is established, the initial vector will never be reset to its initial value until a new session is established. Thus, the chaining extends across packets and ensures the order of packets. The result is that a session is encrypted in a unique/per-instance non-repeatable way, to make replay attacks all but impossible.

Padding of Data Fields

Padding is usually required for the CBC algorithm, because TDES will require that data blocks be a multiple of 8 bytes long, for example (whereas AES will require data blocks to be a multiple of 16 bytes). Since the length field in the ViVOpay frame indicates the length of the *encrypted* data field, there must be a way to recognize the actual data (in order to recover the data as it existed *before* padding).

The order of operations for sending frames:

1. Insert pads so that data length is a multiple of 8.
2. Encrypt using CBC.
3. Do DLE insertion.

The order of operations for receiving frames:

1. Do DLE deletion.
2. Do decryption using CBC.
3. Remove pads.

If the data is a multiple of 8, then there will be eight pads of 0x08.

If the data was one less than a multiple of 8, then there is one pad of 0x01.

For all other cases, there are n pads of 0x0n, where n is between 1 and 8. The following examples illustrate padding:

Actual Data Falls on an 8-Byte Boundary

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 + x	Byte 23	Byte 24
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	Encrypted Data (n bytes) Pad: 08h, 08h, 08h, 08h, 08h, 08h, 08h, 08h	CRC (LSB)	CRC (MSB)
ViVOtech2\0			00h	Varies	Varies (always multiple of 8 bytes) + 8 bytes 08h pad	Varies	Varies

Actual Data is One Less than 8-Byte Boundary

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 -n + 1	Byte 23	Byte 24
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	Encrypted Data: Pad: 01h	CRC (LSB)	CRC (MSB)
ViVOtech2\0			00h	Varies	Varies (always	Varies	Varies

					multiple of 8 bytes) Last byte = 01h		

Actual Data is less than 8-Byte Boundary

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 -n	Byte 23	Byte 24
Header Tag & Protocol Version	Cmd	Sub Cmd	Length (MSB)	Length (LSB)	Encrypted Data, Pad: n pads of 0x0n, where n is between 1 and 8	CRC (LSB)	CRC (MSB)
ViVOtech2\0			00h	Varies	Varies (always multiple of 8 bytes) Pad example, 03h, 03h, 03h.	Varies	Varies

Set DUKPT Key Encryption Type (C7-32)

This command exists to specify the encryption type of Account DUKPT Key, and MUST be used before the initial loading of the Account DUKPT Key into the device. The encryption type CANNOT be changed once the Account DUKPT Key is present. It must remain either TDES or AES.

Note: This command is only supported in NSRED device. In SRED device, only TDES algorithm is used to encrypt transaction output sensitive data.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte16
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	32h	00	01	Encryption Type		

Encryption Type	Description
0	TDES
1	AES

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	CRC(MSB)	CRC(LSB)
ViVOtech2\0	C7h	See Status Code Table	00	00		

Get DUKPT Key Encryption Type (C7-33)

Note: This command is only supported in NSRED device. In SRED device, only TDES algorithm is used to encrypt transaction output sensitive data.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte15
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	33h	00	00		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte14	Byte 15	Byte16
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	Data1	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table	00	01	Encryption Type		

Encryption Type	Description
0	TDES
1	AES

Example data (top line: command; bottom line: response)

TDES:

```
56 69 56 4F 74 65 63 68 32 00 C7 33 00 00 1A 9B
56 69 56 4F 74 65 63 68 32 00 C7 00 00 01 00 AC 7F
```

AES:

```
56 69 56 4F 74 65 63 68 32 00 C7 33 00 00 1A 9B
56 69 56 4F 74 65 63 68 32 00 C7 00 00 01 01 BC 5E
```

Set Data Encryption Enable Flag (C7-36)

This command is meant to be used once (only), to turn encryption ON permanently. It elevates the security status of the device. *This is meant to be an irreversible event*.

If user sends “Encryption Enable” command, reader will response OK and turn Encryption ON only when an Account DUKPT Key is present and valid, otherwise reader will response error and the setting doesn’t take effect.

Note: This command is supported only in non-SRED devices. In SRED devices, the reader is *always* encryption-enabled and this command is unsupported.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte16
Header Tag & Protocol	Command	Sub-Command	Data length	Data length	Data	CRC (MSB)	CRC (LSB)

Version			(MSB)	(LSB)			
ViVOtech2\0	C7h	36h	00	01	Encryption Enable Flag		

Encryption Type	Description
0	Data Encryption Disable (default)
1	Data Encryption Enable

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	CRC(MSB)	CRC(LSB)
ViVOtech2\0	C7h	See Status Code Table	00	00		

When Data Encryption is disabled, device will always output plaintext data
When Data Encryption is enabled, device will output data as follows:

(1) When Account DUKPT Key does not exist, the commands below will respond status code 0x90 and no data.
(2) When Account DUKPT Key exists and is valid, the commands below will respond encrypted data.
(3) When Account DUKPT Key exists and exhausted, the commands below will respond status code 0x91 and no data.

Commands:

(1) Activate Transaction Command (02-01)
(2) Get Transaction Result Command (03-00)

Get Data Encryption Enable Flag (C7-37)

Note: This command is only supported in Non-SRED version devices, not supported in SRED version devices.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte15
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	37h	00	00		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte14	Byte 15	Byte16
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	Data1	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table	00	01	Encryption Enable Flag		

Encryption Type	Description
0	Data Encryption Disable (default)
1	Data Encryption Enable

Set MSR Secure Parameters (C7-38)

This command allows setting parameters that determine encrypted output from MSR sessions. Use it to force encryption data output to include various kinds of data per Enhanced Encrypted MSR Data Output When Encryption is Turned On with C7-38 Command. Consult the table in that Appendix (A.13) to see the types of output that can occur.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	38h	00h	05h	MSR Secure Parameters TVL		

MSR Secure Parameters TVL objects

Tag	Data Object Name	Description	Format	Length
DFDE04	MSR Encryption Option	Encryption Option (Forced encryption or not) Bit 0: T1 force encrypt Bit 1: T2 force encrypt Bit 2: T3 force encrypt Bit 3: T3 force encrypt when card type is 80 Default value is 0x08.	b	1

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table					
ViVOtech2\0	C7h	38h	00h	05h	MSR Secure Parameters TVL		

Get MSR Secure Parameters (C7-39)

This command can get parameters from flash setting.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)

ViVOtech2\0	C7h	39h	00h	03h	MSR Secure Parameters TVL		

MSR Secure Parameters TVL objects

Tag	Data Object Name	Description	Format	Length
DFDE04	MSR Encryption Option	Encryption Option (Forced encryption or not) Bit 0: T1 force encrypt Bit 1: T2 force encrypt Bit 2: T3 force encrypt Bit 3: T3 force encrypt when card type is 80 Default value is 0x08.	b	1

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table	00h	05h	TLV		

Key Injection and Related Commands

Set Remote Key Injection Timeout (C7-2D)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte14	Byte 15	Byte 16	Byte17
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	2Dh	00	02	Timeout (MSB)	Timeout (LSB)		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	CRC(MSB)	CRC(LSB)
ViVOtech2\0	C7h	See Status Code Table	00	00		

Timeout is in second, value scope is [120, 3600]. If timeout, remote key injection is canceled.

Get Remote Key Injection Timeout (C7-2E)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte15
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	2Eh	00	00		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte14	Byte 15	Byte 16	Byte17
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	Data1	Data2	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table	00	00	Timeout (MSB)	Timeout (LSB)		

Timeout is in second, value scope is [120, 3600]. If timeout, remote key injection is canceled.

Check DUKPT Keys (81-02)

This command checks and returns the state of the DUKPT key associated with each slot.

Slot 2: Admin DUKPT Key (NSRED and SRED device support, use in Remote Key Injection)

Slot 3: MAC DUKPT Key (SRED device support, for future use)

Slot 5: Account DUKPT Key (NSRED and SRED device support, use to encrypt transaction output sensitive data)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 ~ Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	81h	02h	00h	00h	None		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 ~ 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	81h	See Status Code Table	00h	00h or 0Ch	Nothing or Key States		

If successful, the returned Status Code is 00h and the response data will contain the key states for 12 slots. Most of these slots are reserved for future use. Only the supported slot indexes will contain key states. The format of the data returned on success is given below.

Response Data (When Status is OK)

Data Item	Length (bytes)	Description
Key States	12 (0Ch)	This data item contains the Key States for 12 DUKPT Key slots. Each byte represents the Key State for a single slot. Possible values for each Key State are: 00h: Unused (Slot is supported but no key injected) 01h: Valid (A valid key is available in this slot) 02h: End of Life (The key on this slot has reached end of life) FFh: Not Available (This slot is not supported)

If the command is not successful, then the Status Code will not be 00h and no data is returned.

Check DUKPT Key (81-04)

This command checks whether a valid DUKPT key is stored at the specified slot and if a valid key is found then some basic information related to the type of key is returned. The actual Key data is never returned.

This command can be used to check whether a key is already present before injecting a key in a slot to prevent overwriting an existing DUKPT key.

Slot 2: Admin DUKPT Key (NSRED and SRED device support, use in Remote Key Injection)

Slot 3: MAC DUKPT Key (SRED device support, for future use)

Slot 5: Account DUKPT Key (NSRED and SRED device support, use to encrypt transaction output sensitive data)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	81h	04h	00h	01h	Key Slot		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	81h	See Status Code Table	00h	variable	Nothing or Key States		

If the Command Frame is valid, then the Status Code will be OK and the response data will contain the key state and other key related data as shown in the following table. If the Command Frame is not valid, then the Status Code will not be OK and no data will be returned.

Response Data (When Status is OK)

Byte	Field Name	Description	Encoding
0	Key State	Key State for the DUKPT key associated with the specified slot. Possible values for the Key State are: 00h: Unused (Slot is supported but no key injected) 01h: Valid (A valid key is available in this slot) 02h: End of Life (The key on this slot has reached end of life) FFh: Not Available (This slot is not supported) Mandatory Field.	Binary
1-2	Key Usage	'K0' – Key Encryption or Wrapping 'P0' – PIN Encryption 'D0' – Data Encryption 'M0' – MAC Verification Present only if key state indicates a valid key.	2AN
3	Algorithm	'T', hex 0x54. Triple DES 'D', hex 0x44. Single DES Present only if key state indicates a valid key.	1AN
4	Mode of Use	'N' No special restrictions 'E' Encryption only 'D' Decryption only Present only if key state indicates a valid key.	1AN
5-6	Key Version Number	'00', hex 0x3030. If set to '00' key version number is not used. Key version is not supported in this version of the specifications Present only if key state indicates a valid key.	2AN

Get DUKPT Key Serial Number (KSN) (81-0A)

Host can use this command to retrieve the KSN of the selected DUKPT key.

Slot 2: Admin DUKPT Key (NSRED and SRED device support, use in Remote Key Injection)

Slot 3: MAC DUKPT Key (SRED device support, for future use)

Slot 5: Account DUKPT Key (NSRED and SRED device support, use to encrypt transaction output sensitive data)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte 16
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Key Index	CRC (LSB)	CRC (MSB)
ViVOtech2\0	81h	0Ah	00h	01h	Key slot		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	81h	Status Code	00h	variable	KSN		

If the Command Frame is valid, the slot was supported and the DUKPT Key is valid, the Status Code will be OK and the data portion will have the content described below. If the Command Frame is not valid or the slot is unsupported or DUKPT Key is not valid, then the Status Code will not be OK and no data will be returned.

Get KSN Response Data

Data Item	Length (bytes)	Description
KSN	20	KSN of selected DUKPT key Format: ASCII (no null terminator)

11.0 Improved Collision Detection

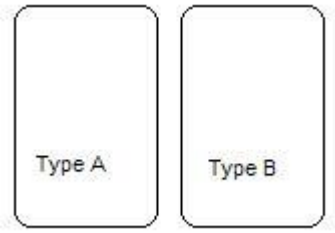
Issues with Standard Collision Detection

This firmware supports the EMV Contactless Communication Protocol Specification. While the EMV specification defines collision detection, there are often physical constraints which prevent collision detection resolving within the timing limits outlined in the specification.

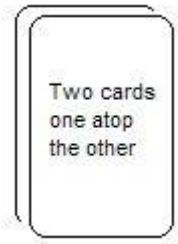
For instance, multiple cards in the field cannot always be detected reliably. If a particular card responds more quickly to RF polling, or if a card has a stronger antenna, then the signal will lock to that card. (This problem is not limited to ID TECH equipment.) Card geometry can also be a major factor in collision detection.

The following bullets explain some of the difficulties associated with multiple card presentation:

- When a single type A and single type B card are presented side-by-side the reader will detect collisions without much difficulty:



- When two cards are stacked on top of one another, the faster card or the card that is closer to the PCD will be activated. This is because the slower card or the card that is further from the PCD suffers insufficient power, interference from the other card, or timing that falls outside the boundaries defined in the EMV specification.



- Presenting two cards of the same type side by side (e.g. A || A) will suffer from the same problems described in the previous bullet, because the RF power draw from one card can negatively impact the communication and/or power of the other card.

The six possible multiple card presentation scenarios are listed in the table below.

Scenario	Card Type	Orientation
1	A / B	Stacked
2	A / B	Fanned
3	A / A	Stacked
4	A / A	Fanned
5	B / B	Stacked
6	B / B	Fanned

Note: Card Type B / B (scenarios 5 & 6) are inherently difficult to detect. When multiple type B cards are presented they should detune one another. If there is minimal detuning then no collision would be detected.

Collision Detection Modes

The firmware features two mutually-exclusive collision detection modes, Standard Collision Detection and Improved Collision Detection, which are described in the subsections below.

11.1.1.1 Standard Collision Detection

Standard Collision Detection, also known as EMEA Anti-Collision Detection, is enabled by default, as it maximizes the chances of completing a transaction. In this mode, if a collision event is detected, the reader will back off and resume polling.

Media removal events are handled as per the EMEA requirements for collision. When detecting a collision a media removal UI event is triggered (all LEDs off, 2 tone alert, and appropriate message for LCD equipped units), a small delay is then introduced before returning to polling.

Note:

It is important to understand that the procedure outlined above will repeat if the collision is not resolved. Also, the media removal event only operates when the EMEA UI is enabled (tag 'FF F8' = '03'). Finally, this procedure occurs automatically without interaction from the integrated system and will operate for the duration of the Timeout period, as set by Activate Transaction.

The reader will then continue to retry the transaction; until either, the collision issue has been resolved (and a transaction takes place), or until the transaction timeout expires. In the latter case, the timeout will contain the timeout status (0x08) and timeout cause in the data field (0x21, collision error).

Note: In this mode, if a collision is detected, the reader will interpret further 'Communication Error' or 'Card Not Present' events as being caused by collision.

11.1.1.2 Improved Collision Detection

Enabling this mode disables Standard Collision Detection mode and changes reader behavior:

1. While polling, the reader will attempt to find the PICC using the standard polling method.
2. If a collision is detected, the reader will abort the transaction and notify the POS.
3. It will report this with an error in the data field of its response (0x21, collision error).

Tag DF7F enables/disables Improved Collision Detection. When this tag is set to zero (default value), Improved Collision mode is disabled. When this tag is set to another value (1-255), Improved Collision mode is enabled.

When Improved Collision mode is enabled, the DF7F tag value defines the number of successful sequential polling attempts required for signal lock. For example, if tag DF7F = 3, then the reader must detect a card successfully three times in a row before the firmware decides this is a successful polling attempt. Given the same conditions, the reader must fail to detect a card three times in a row before the firmware decides this is a 'card not present' polling attempt.

To reiterate, Improved Collision Detection requires a specified number of polling attempts to complete without an EMV collision event before the RF signal is locked to a specific card. If an EMV collision event is reported, the transaction will end and return a collision status code.

The following table summarizes the tag-related information provided above.

Feature	Tag	Length	Value	Notes
Improved Collision Detection	DF7F	1 byte	0 = default	Improved Collision Detection Disabled. (i.e. one successful polling attempt is sufficient for signal lock)
			1 – 255	Improved Collision Detection Enabled. Number of successful sequential polling attempts required for signal lock.

In this new mode, the collision scenarios have been improved in the following manner:

4. Increased sensitivity to improve collision detection generally. Previously, silent card and garbled receive were not identified in the same manner as a standard collision.
5. If the transaction times out due to any of the collision methods described previously, the serial response will reflect this in its error state, with Status Code 0x08 (Time Out) and Error Code 0x21 (Collision Error).

Example

Assume a reader has enabled Improved Collision Detection with tag DF7F = 3. When two cards are placed within view of the reader, the following polling results are obtained.

Polling Attempt	1	2	3
Polling Result	OK	OK	L1C

These results show that the first and second polling attempts are successful; but, the third polling attempt reports an EMV L1 collision (e.g. a slower or weaker signal). This collision detection would result in immediate termination of the transaction and the reader returning a collision status code. In contrast, if Standard Collision Detection mode was enabled instead, then the reader would accept the first attempt and the transaction would proceed with the first card detected.

12.0 Kiosk III Boot Loader

This section only applies to the Kiosk III reader, describes the designation of Kiosk III boot loader version from 'KIOSKIII-BL-V3.00.010' on.

The Boot Loader controls initial operation after reset and also provides the means to program the Flash memory,

Kiosk III has two types of products: Non-SREd and SRED. This boot loader can be used in both types of Kiosk III device.

Description

KIOSK III Boot Loader controls initial operation after reset and also provides the means to program the flash memory which operate over both RS232 and USB interface.

KIOSK III uses a freescale K21 chip with 1M bytes embedded flash. The flash is divided into three zones: boot-loader, configuration and application. As for boot-loader zone, it is divided into three zones: BIM(boot image manager), boot-loader 1 and boot-loader 2. BIM cannot be updated, application can be updated by boot-loader, boot-loader1 can be updated by boot-loader2, and boot-loader2 can be updated by boot-loader1.

Boot loader code is executed every time the reader is powered on or reset.

If a valid user program is not found, the firmware downloader is invoked. If a valid user program is found, then the execution control is transferred to it after 3 seconds waiting, during this waiting time, user can invoke firmware downloader by sending boot load commands.

The firmware data to be updated to device is protected by firmware RSA key, which is RSA key under RSA-2048. Firmware data is encrypted by firmware RSA private key, and must be authenticated by firmware RSA public key when the data are all loaded into device. The updated firmware data won't be valid before authentication succeed. The firmware RSA public key is injected into device during manufacturing.

Boot Procedure

After any reset or power up the Kiosk III boot loader is the first code executed. Boot loader then check whether the main application exists. If the application exists, boot loader waits 3 seconds for user to send boot load commands. If user send boot load commands inside the waiting time, the firmware downloader is invoked and a firmware image is to be downloaded. If user does not send boot loader commands inside the waiting time, then boot loader passes control to the main application. If the main application does not exist then boot loader invoke the firmware downloader and waits for a firmware image to be downloaded.

After power up or reboot, boot-loader gets the control of the chip, and then does the following tasks in order.

a) BIM reads and compares boot-loader1 and boot-loader2 flag, selects the newer and passes the control to it.
b) The selected boot-loader check the reason of reboot. If the reboot reason is that the application did the reboot in favor of entering boot-loader mode, then go to step f).
c) Check whether an application exists in application zone or not. If not, go to step f).
d) Wait boot loader commands from host for 3 seconds, if received boot load command, invoke firmware downloader; if boot load command not received, go to e).

e) Transfer the control of the chip to application.
f) wait for boot-loader commands from host.

Communication Protocol

All Firmware downloader commands are following Protocol 2. .

Firmware Downloader File Name Format

Firmware download file name is formatted as: '[firmware version]_[clear/encrypted]_[port].txt'

- [firmware version]:
  If the file is to update application, then [firmware version] is application main version. For example: 'NEO v1.00.012'.
  If the file is to update boot loader, then [firmware version] is boot loader version. for example: 'KIOSKIII-BL-V3.00.010'.
  If the file is to update both, then [firmware version] is showed as application main version and boot loader version linked with '&'. For example: ' NEO v1.00.012 & KIOSKIII-BL-V3.00.010'

- [clear/encrypted]:
  'ENC' means this download file is encrypted
  'CLR' means this download file is not encrypted
  If file name not marked with 'ENC' or 'CLR', that is encrypted file.
  If firmware key is valuable in device, please use encrypted download file.
  If firmware key is not valuable in device, please use clear download file.

  Note: Encrypted download files are generally used in firmware updating. Clear download files are only prepared for device recovery in special accidents.

- [port]:
  If the file is for RS232 port, then [port] is 'RS232'. If the file is for USBHID port, then [port] is 'USBHID'.

  ' NEO v1.00.016_CLR_RS232.txt'
  ' NEO v1.00.016_CLR_USBHID.txt'
  ' NEO v1.00.016_ENC_RS232.txt '
  'NEO v1.00.016_ENC_ USBHID.txt'

  ' KIOSKIII-BL-V3.00.014_CLR_RS232.txt'
  ' KIOSKIII-BL-V3.00.014_CLR_USBHID.txt'
  ' KIOSKIII-BL-V3.00.014_ENC_RS232.txt'
  'KIOSKIII-BL-V3.00.014_ENC_ USBHID.txt'

  ' NEO v1.00.016 & KIOSKIII-BL-V3.00.014_CLR_RS232.txt'
  ' NEO v1.00.016 & KIOSKIII-BL-V3.00.014_CLR_USBHID.txt'
  ' NEO v1.00.016 & KIOSKIII-BL-V3.00.014_ENC_RS232.txt'
  ' NEO v1.00.016 & KIOSKIII-BL-V3.00.014_ENC_USBHID.txt'

Firmware Downloader Data Format

Firmware download file is coded in ASCII text. Firmware download commands and expected responses are embed in text file one command per line. Host can retrieve each command in order and convert the command from ASCII code to hex data then send them to Kiosk III device, then compare the response from Kiosk III device with expected response next to the command in text file.

Firmware download file data format is as: '[prefix][data]'

Prefix	Data Example	Description
'#'	'XXXXX...'	Data follow '#' is comments only.
'<START:'	None	No data needed, just specify the starting of download.
'TIMEOUT:'	'1000'	Recommended timeout between command and response, unit is ms.
'SLEEP:'	'2000'	Host sleep, unit is ms.
'SEND:'	' 5669564F746563683200C7110000F23D'	Data is the command to be sent to device. Note: Data format is different between RS232 port and USBHID port.
'WAIT:'	' 5669564F746563683200C7000000866E'	Data is the response expected to the command above line. Note: Data format is different between RS232 port and USBHID port.
'END>'	None	No data needed, just specify the ending of download.

Examples:

- NEO v1.00.012_RS232.txt

```
#RS232 version
<START:
TIMEOUT:1000
SEND:5669564F746563683200C7410000ACF3
SLEEP:2000
SEND:5669564F746563683200C7110000F23D
WAIT:5669564F746563683200C7000000866E
SEND:5669564F746563683200C7120001014A91
WAIT:5669564F746563683200C7000000866E
SEND: 5669564F746563683200C71301008A8D92719D9D.......
WAIT:5669564F746563683200C7000000866E
......
......
......
WAIT:5669564F746563683200C7000000866E
SEND:5669564F746563683200C715000832303135303932343 4BE8B
WAIT:5669564F746563683200C7000000866E
SEND:5669564F746563683200C716000077AD
WAIT:5669564F746563683200C7000000866E
END>
```

- NEO v1.00.012_USBHID.txt

```
#USBHID version
<START:
```

```
 TIMEOUT:1000
SEND:015669564F746563683200C7410000ACF300000000000......
 SLEEP:2000
SEND:015669564F746563683200C7110000F23D00000000000......
WAIT:015669564F746563683200C7000000866E00000000000......
 ......
 ......
 ......
 SEND: 015669564F746563683200C7150008323031353039323 4BE8B000000000......
 WAIT:015669564F746563683200C7000000866E000000000000......
 SEND:015669564F746563683200C716000077AD000000000000......
 WAIT:015669564F746563683200C7000000866E000000000000......
 END>
```

Download Firmware Steps

When host wants to update firmware to Kiosk III device, please do as following steps:
step 1: Power on Kiosk III device.
step 2: Configure the communication ports and establish connection between host and Kiosk III device.
step 3: Host selects the right firmware download file, parses data, then finishes the whole commands.
step 4: End

Firmware Downloader Commands

Enter Boot Loader Process from Main Application (C7-41)

Host must use this command to let reader reboot into boot loader mode if reader is running in main application. No response for this command and just reset reader immediately.

If reader is running in boot loader, this command is not needed.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	41h	00h	00h		

Get Boot Loader Version (C7-10)

This command is used to retrieve the boot loader version.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	10h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 ...Byte 13+n	Byte 14+n	Byte 15+n
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table	00h	00h	See Below		

Response data is the version of the boot loader.
For example: ' KIOSKIII-BL-V1.00.001'

Start Update Process (C7-11)

This is the first command sent by host to open a firmware update process.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	11h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	See Status Code Table	00h	00h		

Erase Boot/Application Space(C7-12)

This command is used to erase corresponding zones in the flash.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	12h	00h	01h	See Below		

Data: 0x01 Erase application space
0x02 Erase boot loader space
0x03 Erase application and boot loader space
When this command is received, reader will store a dirty flag in flash.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	See Status Code Table	00h	00h		

Send Encrypted Firmware Check Value(C7-13)

This command is used to send firmware check-value to the device.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - Byte 269	Byte 270	Byte 271
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	13h	01h	00h	See Below		

In this command, data length must be 256 bytes. the 256 bytes data are encrypted firmware check value. It is a SHA256 digest of the plaint firmware encrypted by firmware RSA public key.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	See Status Code Table	00h	00h		

Send Plaint Firmware Check Value(C7-23)This command is used to send firmware check-value to the device.
This command is supported later than KIOSKIII-BL-V3.00.007.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - Byte 269	Byte 270	Byte 271
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	23h	00h	20h	See Below		

In this command, data length must be 32 bytes. the 32 bytes data are plaint firmware check value. It is a SHA256 digest of the plaint firmware.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)

ViVOtech2\0	C7h	See Status Code Table	00h	00h		

Send Firmware Data (C7-14)

This command is sent by host to program specified address in application zone or boot loader zone. One command can send 2048 bytes data block which is 2048 bytes plaint firmware data XOR with the 32 bytes firmware check value.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - Byte 2065	Byte 2066	Byte 2067
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	14h	01h	00h	See Below		

In this command, data length must be 2052 bytes:
The first 4 bytes are the address where the firmware data in this command should be put in reader flash.
The other 2048 bytes are firmware plaint data XOR with the 32 bytes firmware check value and will be XOR with 32 bytes firmware check value by reader, then reader update the plaint firmware data into the right address got from the first 4 bytes.

Item	Start Address	End Address
Main Application	0x00020000	0x000B7FFF
Boot Loader 1	0x00008000	0x00013FFF
Boot Loader 2	0x00014000	0x0001FFFF

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	See Status Code Table	00h	00h		

End Update Process (C7-15)

This is the last command sent by host to close a firmware update process.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - Byte 21	Byte 22	Byte 23
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	15h	00h	08h	See Below		

In this command, data length must be 8 bytes: 'YYYYMMDD', exp: '20150605'.
When this command is received, reader will do the following:
1. Clear the dirty flag.

2. If updated firmware is main application, reader then encrypts the firmware check value by the 32 bytes inherent key using AES256 algorithm(Inherent key is a 32-byte random number that protected by K21 tamper). The 32 bytes encrypted check value is stored in flash. If updated firmware is boot loader, the check value is ignored, will not be store in flash.
3. If updated firmware is boot loader, reader stores boot loader sequence number and time stamp in flash.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	See Status Code Table	00h	00h		

Start Application (C7-16)

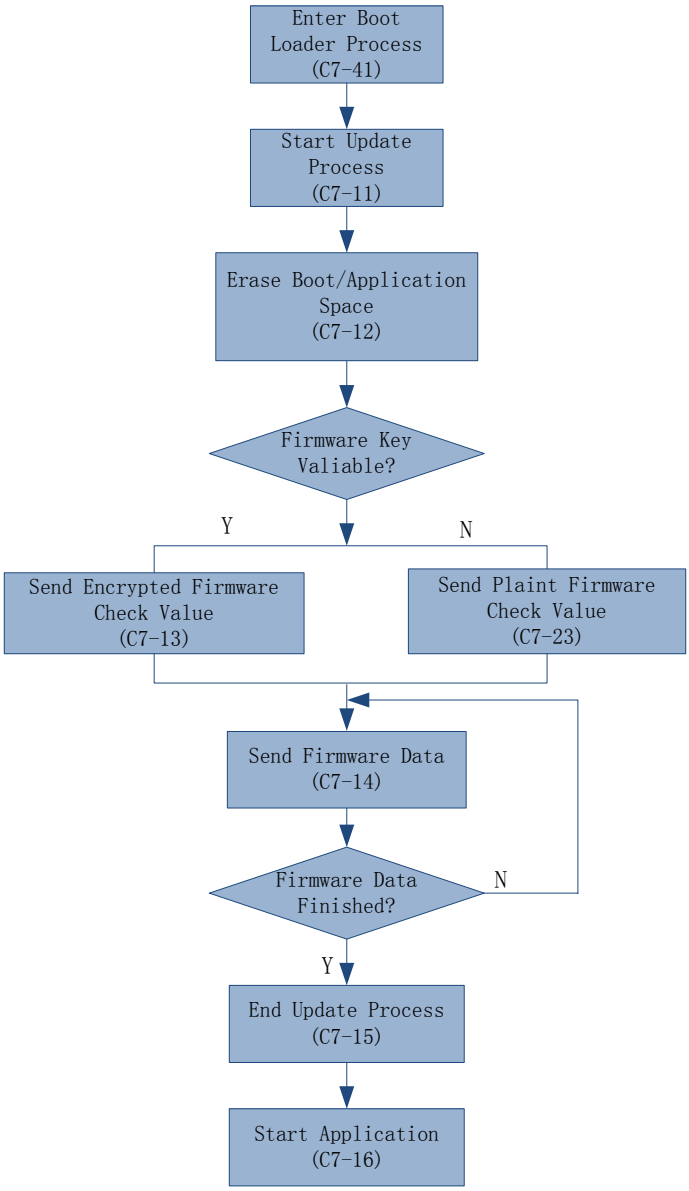
Host can use this command to make boot loader reboot reader, and then enter main application. No response for this command and just reset reader immediately.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	C7h	16h	00h	00h		

Firmware Downloader Command Processing Flow

Firmware downloader commands must be sent to device in sequence as below.


Enter Boot Loader Process (C7-41)
Start Update Process (C7-11)
Erase Boot/Application Space (C7-12)
Firmware Key Valiable?
Y
N
Send Encrypted Firmware Check Value (C7-13)
Send Plaint Firmware Check Value (C7-23)
Send Firmware Data (C7-14)
Firmware Data Finished?
N
Y
End Update Process (C7-15)
Start Application (C7-16)

13.0 ViVOpay Vendi reader Commands

Configure Buttons (F0-F4)

This command configures the buttons on the ViVOpay Vendi reader. Both the **SWIPE** and **DONE** buttons can be independently disabled with this command. This command also sets the TAP disable time for when the **SWIPE** button is pressed. When the **SWIPE** button is enabled, the contactless reader is turned off for the programmed delay time so that a false read does not occur when the user wishes to swipe a dual contactless/MagStripe card.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 to 16			Byte 17	Byte 18
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data			CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	F4h	00h	03h	Done	Swipe	Delay		

If Done (Byte 14) is set to 01h, the Done switch is enabled. If Done (Byte 14) is set to 00h, the DONE switch is disabled. When the DONE button is pressed, the byte string: “02 02 5B 2F” is sent to the serial port (5B 2F are the 2 CRC bytes). Pressing the DONE button also displays “DONE” on the LCD display.

If Swipe (Byte 15) is set to 01h, the Swipe Card switch is enabled. If Swipe (Byte 15) is set to 00h the Swipe Card switch is disabled. The Swipe Card button sends the 4 bytes “02 03 4B 0E” to the serial port (4B 0E are the 2 CRC bytes). The Vendi can be configured to disable the contactless reader for a specified number of seconds. The only visual indication is that the LCD flashes when it writes “Please swipe card” on the LCD and then immediately rewrites the default message.

The Delay is an unsigned delay value in seconds. This should probably not be set to values larger than 30 seconds (Byte 16).

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

The reader switches configuration only if the Response Frame contains an OK Status Code. No data is returned in the response.

Get Button Configuration (F0-F5)

This command reads the button configuration from the ViVOpay Vendi reader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	F5h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 to 16			Byte 17	Byte 18
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data			CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	03h	Done	Swipe	Delay	Swipe	Delay

Done is a Boolean value; if it is set to 0 the DONE switch is disabled.

Swipe is a Boolean value; if it is set to 0 the SWIPE CARD switch is disabled.

Delay is an unsigned 8 bit delay value in seconds.

Disable Blue LED Sequence (F0-F6)

This command stops the blue LEDs on the ViVOpay Vendi reader from flashing in left to right sequence and turns the LEDs off, and contactless function is disable at the same time.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	F6h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)

ViVOtech2\0	F0h	See Status Code Table	00h	00h		

Enable Blue LED Sequence (F0-F7)

Use this command to control the blue LED behavior on the Vendi reader. If you send this command with a Data Length 00h, the reader begins a continuous LED sequence and contactless function is enable. To customize the LED behavior, you can define a sequence of up to eight LED behaviors, but contactless function would keep disable if F0-F6 CMD has been issue. Custom LED behavior can also be set for a continuous cycle. To exit a continuous LED sequence, send a Disable Blue LED Sequence Command to the reader.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14-n	Byte n+1	Byte n+2
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Sequence Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	F7h	00h	00h=continuous sequence 04h to 19h=custom	4 to 25 bytes, if present		

Sequence Data

Byte 0	Byte 1	Byte 2-3	Byte 4	Byte 5-6	Byte 7 – 24
Cycles	LEDs	Duration	LED	Duration	Additional LED/Durations
0 = Cycle once 1 = Repeat	LED State Bitmap	Given in multiples of 10 millisecond	LED State Bitmap	Given in multiples of 10 millisecond	You can define up to 8 LED and duration pairs.

LED State Bitmap

Bit	Description
8	Left blue LED, 0 = off, 1 = on
7	Center Blue LED, 0 = off, 1 = on
6	Right Blue LED0 = off, 1 = on
5	Yellow LED, 0 = off, 1 = on
4	Reserved for future use
3	Reserved for future use
2	Reserved for future use
1	Reserved for future use

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

LCD Display Clear (F0-F9)

This command clears the LCD display.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	F9h	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

Note: Issuing this command disables LCD management by the reader. To resume LCD management by the reader, send a Set Configuration ('04 00') with a UI Scheme (tag 'FF F8') with value chosen at integration. However, firmware control of the LCD does not initiate until after a transaction event. Therefore any UI messaging linked to the initiation of a transaction (i.e. prompt for presentation or amount display) must be written to the LCD before issuing an Activate Transaction. At the same time, to read LCD source and get "Internal " after issuing LCD Display Clear(F0-F9), this feature implemented on the Vendi follows.

Turn Off Yellow LED (F0-FA)

This command turns off the ViVOpay Vendi reader yellow LED. This LED is located below the three blue LEDs.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	FAh	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

Turn On Yellow LED (F0-FB)

This command turns on the ViVOpay Vendi reader yellow LED. This LED is located below the three blue LEDs.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	FBh	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

Buzzer On/Off (F0-FE)

This command causes the buzzer to beep once.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15

Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	FEh	00h	00h		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

LCD Display Line 1 Message (F0-FC)

Use this command to display text on the LCD display. On the Vendi reader the LCD is a 2-line character display. Valid messages for the first line of text are between 1 and 16 printable characters long. If the text message is greater than 16 bytes but not more than 32 bytes, byte 17 and onward are displayed as a second row of text. Messages with more than 32 bytes are rejected with an unknown subcommand status code. All messages are left justified on the LCD display.

Note: Issuing this command disables LCD management by the reader. To resume UI management by the reader, send a Set Configuration ('04 00') with a UI Scheme (tag 'FF F8') with value chosen at integration. However, firmware control of the LCD does not initiate until after a transaction event. Therefore any LCD messaging linked to the initiation of a transaction (i.e. prompt for presentation or amount display) must be written to the LCD before issuing an Activate Transaction. At the same time, to read LCD source and get "Internal " after issuing LCD DisplayLine 1 Message (F0-FC), this feature implemented on the Vend, and Vendi follows.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 - (Byte 14+n-1_	Byte (14+n)	Byte (14+n +1)
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	FCh	00h	Msg len	LCD message		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)

ViVOtech2\0	F0h	See Status Code Table	00h	00h		

LCD Display Line 2 Message (F0-FD)

This command displays the command's message on line 2 of the LCD display. On the Vendi reader the LCD is a 2-line character display. Valid messages are between 1 and 16 printable characters long. Any message that is longer than 16 bytes is rejected with an unknown subcommand status code. All messages are left justified on the LCD display.

Note: Issuing this command disables LCD management by the reader. To resume LCD management by the reader, send a Set Configuration ('04 00') with a UI Scheme (tag 'FF F8') with value chosen at integration. However, firmware control of the LCD does not initiate until after a transaction event. Therefore any UI messaging linked to the initiation of a transaction (i.e. prompt for presentation or amount display) must be written to the LCD before issuing an Activate Transaction. At the same time, to read LCD source and get "Internal " after issuing LCD Display Line 2 Message (F0-FD), this feature implemented on the Vend, and Vendi follows.

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 +n	Byte 14+n+1	Byte 15+n=2
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (LSB)	CRC (MSB)
ViVOtech2\0	F0h	FDh	00h	Msg len	LCD message		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	CRC (MSB)	CRC (LSB)
ViVOtech2\0	F0h	See Status Code Table	00h	00h		

14.0 Other Special Functions

Peer To Peer Function

Peer To Peer function can only be used in Pass-Through mode.

Peer To Peer Send A Message (C7-9A)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte15+n
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	Data	CRC (MSB)	CRC (LSB)
00	02	9Ah	Variable		See Data Format below		

Peer To Peer Send A Message Data Field for Command Frame

Data Field	Length (bytes)	Description
Timeout	1	Time in Seconds.
Message	1	SNDEF message to be sent to the phone

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	CRC(MSB)	CRC(LSB)
ViVOtech2\0	C7h	See Status Code Table	00	00		

Peer To Peer Receive A Message (C7-9B)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte16
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	Data	CRC (MSB)	CRC (LSB)
00	02	9Bh	00h	01h	Timeout (1 byte, time in seconds)		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte 15+n

Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	C7h	See Status Code Table	Variable		See Data description below		

If Status code is OK, Data Field for Response Frame is a message received from the phone. Otherwise, Data Length is zero and no data for Response Frame.

ApplePay Function

The device can store 6 Merchant Records at most. Each record includes an ID and an optional URL.

ACT parameters for ApplePay

The ACT parameters required for the ApplePay VAS function are embedded in the ApplePay VAS Container (FFEE06). The FFEE06 TLV is optional, but must be provided in the ACT if an ApplePay VAS transaction is desired.

TLV	Name	Presence	Description
9F26	ApplePay Terminal Capabilities Information	Rqrd	Determines how the reader handles the VAS and/or Payment flow
9F22	ApplePay Terminal Application Version Number	Rqrd	Hard defined as 01.00 for now.
9F2B	ApplePay VAS Filter	Opt	If not provided filtering will not be performed by the mobile.
DF01	ApplePay VAS Protocol 87654321 -------0 URL VAS Protocol -------1 FULL VAS Protocol ------0- No VAS Beeps ------1- VAS Beeps -----0-- EMEA Comm Error -----1-- Silent Comm Error	Opt	If not provided the following settings are used by default: • Full VAS protocol • No beeps for VAS • EMEA Communications Error Handling If provided the bits define the settings.

ApplePay Terminal Capabilities Information	Card Filter Settings
00	PICC_POLL_TYPE_APPLE_VAS_OR_PAY, PICC_POLL_TYPE_A and PICC_POLL_TYPE_B
01	PICC_POLL_TYPE_APPLE_VAS_AND_PAY, PICC_POLL_TYPE_A and PICC_POLL_TYPE_B
10	PICC_POLL_TYPE_APPLE_VAS_ONLY, PICC_POLL_TYPE_A and PICC_POLL_TYPE_B

11	PICC_POLL_TYPE_APPLE_PAY_ONLY, PICC_POLL_TYPE_A and PICC_POLL_TYPE_B

Activate Command Examples for ApplePay VAS:

VAS or Pay Activate Transaction

56 69 56 4F 74 65 63 68 32 00 02 01 00 29 30 9F 02 06 00 00 00 00 00 01 9C 01 00 FF EE 06 18 9F 22 02 01 00 9F 26 04 00 00 00 00 9F 2B 05 01 00 00 00 00 DF 01 01 01 09 CA

VAS AND Pay Activate Transaction

56 69 56 4F 74 65 63 68 32 00 02 01 00 29 30 9F 02 06 00 00 00 00 00 01 9C 01 00 FF EE 06 18 9F 22 02 01 00 9F 26 04 00 00 00 01 9F 2B 05 01 00 00 00 00 DF 01 01 01 6A 8F

VAS Only Activate Transaction:

56 69 56 4F 74 65 63 68 32 00 02 01 00 29 30 9F 02 06 00 00 00 00 00 01 9C 01 00 FF EE 06 18 9F 22 02 01 00 9F 26 04 00 00 00 02 9F 2B 05 01 00 00 00 00 DF 01 01 01 CF 40

Pay Only Activate Transaction:

56 69 56 4F 74 65 63 68 32 00 02 01 00 29 30 9F 02 06 00 00 00 00 00 01 9C 01 00 FF EE 06 18 9F 22 02 01 00 9F 26 04 00 00 00 03 9F 2B 05 01 00 00 00 00 DF 01 01 01 AC 05

Transaction Responses

Both the ApplePay VAS response and the normal payment transaction response will be provided in a single returned data record. Whether returned in response to a blocking ACT or a non-blocking ACT it will be the same. As described above there are ApplePay VAS scenarios where either the VAS transaction or the payment transaction may not be performed. In those scenarios you will only see the results of the transaction that was actually performed. Only when both VAS and payment transactions are performed will you see both transaction responses in the same returned data record.

The Payment transaction response will not change. The VAS transaction response will be embedded in the proprietary ApplePay VAS Container TLV (0xFFEE06). Each Merchant ID and its associated data will be shown in sequence.

Transaction Response for Combined Payment and VAS

56 69 56 4F 74 65 63 68 32 00 – Serial Command header
02 – Command
23 – Status – for the payment transaction only. In this example it indicates a Request for Online Authorization
nn nn – length of entire response (VAS and Pay)
xx - start of payment response. Payment response format has not changed. See IDG for details.
. . .
xx – End of payment response
FFEE06 nn - ApplePay VAS ContainerViVOpay
9A nn – Date
9F21 nn - Time
9F25 nn – Merchant ID **a**
9F2A nn – Mobile Token
9F27 nn – VAS Data

9F25 nn – Merchant ID **b**
9F2A nn – Mobile Token
9F27 nn – VAS Data
. . .
9F25 nn – Merchant ID **n**
9F2A nn – Mobile Token
9F27 nn – VAS Data
xx xx – CRC for entire response

Transaction Response for VAS Only (No Payment)
56 69 56 4F 74 65 63 68 32 00 – Serial Command header
02 – Command
57 – Status for the payment transaction. 0x57 indicates there was no payment transaction.
nn nn – length of entire response (VAS)
FFEE06 nn - ApplePay VAS ContainerViVOpay
9A nn – Date
9F21 nn - Time
9F25 nn – Merchant ID **a**
9F2A nn – Mobile Token
9F27 nn – VAS Data
9F25 nn – Merchant ID **b**
9F2A nn – Mobile Token
9F27 nn – VAS Data
. . .
9F25 nn – Merchant ID **n**
9F2A nn – Mobile Token
9F27 nn – VAS Data
xx xx – CRC for entire response

Transaction Response for VAS VAS Failure in Select
56 69 56 4F 74 65 63 68 32 00 – Serial Command header
02 – Command
57 – Status for the payment transaction. 0x57 indicates there was no payment transaction.
nn nn – length of entire response (VAS)
FFEE06 nn - ApplePay VAS ContainerViVOpay
9A nn – Date
9F21 nn - Time
DF02 nn – ApplePay VAS Failure Report
xx xx – CRC for entire response

ApplePay VAS Failure Report
DF0204206A8002
DF02 - ApplePay VAS Failure Report Tag
04 – Length of ApplePay VAS Failure Report
20 = Error Code, See IDG for Error Code Encoding
6A80 – SW1-SW2 Status from last APDU received
02 – RF State failure occurred in. 02 = Select

Transaction Response for VAS Failure in Get Data
56 69 56 4F 74 65 63 68 32 00 – Serial Command header
02 – Command
57 – Status for the payment transaction. 0x57 indicates there was no payment transaction.
nn nn – length of entire response (VAS)
FFEE06 nn - ApplePay VAS ContainerViVOpay
9A nn – Date

9F21 nn - Time
9F25 nn – Merchant ID **a**
DF02 nn – ApplePay VAS Failure Report for Merchant ID a
9F25 nn – Merchant ID **b**
9F2A nn – Mobile Token
9F27 nn – VAS Data
. . .
9F25 nn – Merchant ID **n**
9F2A nn – Mobile Token
9F27 nn – VAS Data
xx xx – CRC for entire response

Set Merchant Record (04-11)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte15+n
Header Tag & Protocol Version	Command	Sub-Command	Data length (MSB)	Data length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	04	11h	63h		See Data Format below		

Data Field for Command Frame

Data Field	Length (bytes)	Description
Merchant Record Index	1	The valid value is 1--6.
ID Present	1	1: The Merchant ID is valid, 0: The Merchant ID is not valid.
Merchant ID	32	The tag is 9F25.
Length of Merchant URL	1	
Merchant URL	64	The tag is 9F29.

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	CRC(MSB)	CRC(LSB)
ViVOtech2\0	04h	See Status Code Table	00	00		

Get Merchant Record (03-11)

Command Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14	Byte 15	Byte16
Header Tag & Protocol	Command	Sub-Command	Data length	Data length	Data	CRC (MSB)	CRC (LSB)

Version			(MSB)	(LSB)			
ViVOtech2\0	03	11h	01		Merchant Record Index(1-6)		

Response Frame

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte 14 … Byte 14+n-1	Byte 14+n	Byte15+n
Header Tag & Protocol Version	Command	Status	Data length (MSB)	Data length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	03	See Status Code Table	63h		See Data Format below		

Data Field for Response Frame

Data Field	Length (bytes)	Description
Merchant Record Index	1	The valid value is 1--6.
ID Present	1	1: The Merchant ID is valid, 0: The Merchant ID is not valid.
Merchant ID	32	The tag is 9F25.
Length of Merchant URL	1	
Merchant URL	64	The tag is 9F29.

15.0 Sample Scenarios and Frame Flow

Contactless MagStripe Transactions in Auto Poll Mode

For a contactless MagStripe transaction, the reader does not require any setup data from the terminal.

1. Command: Set Poll Mode (Auto Poll)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	01h	01h	00h	01h	00	F6h	24h
ViVOtech2\0			DLen = 1 decimal		Auto Poll Mode		

Response: OK

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	01h	00	00h	00h		12h	53h
ViVOtech2\0		OK	DLen = 0 decimal		None		

Reader starts polling for cards. The Terminal should keep checking for data from the reader. If a card has been read, data is available, otherwise there is no data. The Get Transaction Result command is for retrieving the data. This command is not required for the reader to poll for cards or to carry out a transaction.

2. Command: Get Transaction Result

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	03h	00h	00h	00h		3Bh	FFh
ViVOtech2\0			DLen = 0 decimal		None		

Response: OK, No Track Data, No Clearing Record i.e. No Transaction

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	03h	00h	00h	03h	00 00 00	8Dh	D0h
ViVOtech2\0		OK	DLen = 3 decimal		T1 Len = 0, T2 Len = 0, Clearing Record Not Present		

Reader continues to poll for cards. No Card has been presented so far.

3. Command: Get Transaction Result

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	03h	00h	00h	00h		3Bh	FFh
ViVOtech2\0			DLen = 0 decimal		None		

Response: OK, No Track Data, No Clearing Record i.e. No Transaction

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	03h	00h	00h	03h	00 00 00	8Dh	D0h
ViVOtech2\0		OK	DLen = 3 decimal		T1 Len = 0, T2 Len = 0, Clearing Record Not Present		

Reader continues to poll for cards. No Card has been presented so far.

Reader continues to poll for cards. Card presented and accepted by the reader.

4. Command: Get Transaction Result

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	03h	00h	00h	00h		3Bh	FFh
ViVOtech2\0			DLen = 0 decimal		None		

Response: OK, Track1, Track2 Data available

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	
56 69 56 4F 74 65 63 68 32 00	03h	00	00h	64h	3Ch	42 35 34 31 33 31 32 33 34 35 36 37
ViVOtech2\0		OK	DLen = 100 dec		T1Len= 60 (dec)	Track 1 Data “B54131234567”

Data
38 34 38 30 38 5E 53 4D 49 54 48 2F 4A 4F 48 4E 5E 30 35 30 38 31 30 31 33 33 35 33 37 33 33 33 36 30 37 32 32 32
Track 1 Data “84808^SMITH/JOHN^05081013353733607222”

Data		
32 32 37 32 34 31 31 31 31 33	25h	35 34 31 33 31 32 33 34 35 36 37 38 34 38 30 38 3D 30 35 30 38 31 30 31
Track1 Data 2272411113	T2Len= 37 (dec)	Track 2 Data “5413123456784808=0508101”

Data		CRC (MSB)	CRC (LSB)
39 36 30 37 39 39 37 32 34 32 31 38 33	00h	F1h	FBh
Track 2 Data 9607997242183	Clearing Record Not Present		

Contactless MagStripe card was presented and accepted by the reader before the Get Transaction Result command. Track 1 and Track 2 data returned in response.

Contactless MagStripe Transactions in Poll on Demand Mode

For a contactless MagStripe transaction, the reader does not require any setup data from the terminal.

1. Command: Set Poll Mode (Poll on Demand)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	01h	01h	00h	01h	01h	D7h	34h
ViVOtech2\0			DLen = 1 decimal		Poll on Demand Mode		

Response: OK

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	01h	00h	00h	00h		12h	53h
ViVOtech2\0		OK	DLen = 0 decimal		None		

Reader stops polling for cards. Terminal has to issue an Activate command to allow the reader to poll for a card and carry out a transaction.

2. Command: Activate (MagStripe/EMV)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	02h	01h	00h	01h	0Ah	6Eh	6Bh
ViVOtech2\0			DLen = 1		Timeout = 10 Seconds		

			decimal	(decimal)		

Reader starts polling for cards. No card is presented. Reader stops polling after 10 seconds and sends back a response indicating timeout.

Response: Error (Timeout) i.e. No Card Detected.

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	02h	08h	00h	00h		20h	2Eh
ViVOtech2\0		Time Out	DLen = 0 decimal		None		

Reader is not polling for cards.

3. Command: Activate (MagStripe/EMV)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	02h	01h	00h	01h	0Ah	6Eh	6Bh
ViVOtech2\0			DLen = 1 decimal		Timeout = 10 Seconds (decimal)		

Reader starts polling for cards. A contactless MagStripe card is presented within 10 seconds. Reader completes transaction, even if more than ten seconds pass since Activate command was received. After completing transaction the reader does not restart polling and just sends back the response containing the Track1 and Track2 data.

Response: OK, Track1, Track2 Data available

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	
56 69 56 4F 74 65 63 68 32 00	02h	00	00h	64h	3Ch	42 35 34 31 33 31 32 33 34 35 36 37
ViVOtech2\0		OK	DLen = 100 dec		T1Len= 60 (dec)	Track 1 Data “B54131234567”

Data
38 34 38 30 38 5E 53 4D 49 54 48 2F 4A 4F 48 4E 5E 30 35 30 38 31 30 31 33 33 35 33 37 33 33 33 36 30 37 32 32 32
Track 1 Data 84808^SMITH/JOHN^050810133537333607222

Data		
32 32 37 32 34 31 31 31 31 33	25h	35 34 31 33 31 32 33 34 35 36 37 38 34 38 30 38 3D 30 35 30 38 31 30 31
Track1 Data 2272411113	T2Len= 37 (dec)	Track 2 Data “5413123456784808=0508101”

Data		CRC (MSB)	CRC (LSB)
39 36 30 37 39 39 37 32 34 32 31 38 33	00h	F6h	7Fh
Track 2 Data “607997242183	Clearing Record Not Present		

EMV (M/Chip) Transaction in Poll on Demand Mode

The correct CA Public Keys required by the Cards that is read have already been set up using the Key Management Commands (refer to Key Management). This operation needs to be done only once for each key. Keys are retained over power cycles by the reader.

1. Command: Set Poll Mode (Poll on Demand)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	01h	01h	00h	01h	01h	D7h	34h
ViVOtech2\0			DLen = 1 decimal		Poll on Demand Mode		

Response: OK

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	01h	00	00h	00h		12h	53h
ViVOtech2\0		OK	DLen = 0 decimal		None		

Reader stops polling for cards. Terminal has to issue an Activate command to allow the reader to poll for a card and carry out a transaction.

2. Command: Set Configuration (Terminal Country Code, Transaction Currency Code)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data		CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	04h	00h	00h	0Ah	9F 1A 02 00 56	5F 2A 02 09 78	69h	03h
ViVOtech2\0			DLen = 10 decimal		TLV Terminal Country Code	TLV Trans Currency Code		

Assuming the current terminal values is used for all other parameters (unless specified otherwise in Activate command).

Response: OK

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data	CRC (MSB)	CRC (LSB)
56 69 56 4F 74 65 63 68 32 00	04h	00	00h	00h		AEh	16h
ViVOtech2\0		OK	DLen = 0 decimal		None		

Reader is still not polling for cards.

Note: These parameter values may not apply to all cards. The terminal has to make sure that correct values have been defined for the parameters based on card requirements otherwise a transaction fails.

3. Command: Activate (MagStripe/EMV)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data		CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	02h	01h	00h	06h	0Ah	9A 03 05 08 18	77h	1Dh
ViVOtech2\0			DLen = 1 decimal		Timeout = 10 Seconds (decimal)	TLV Transaction Date		

Reader starts polling for cards. A contactless EMV (M/Chip) card is presented within 10 seconds. Reader completes transaction, even if more than ten seconds pass since Activate command was received. After completing transaction the reader does not restart polling and just sends back the response containing the Clearing Record data.

Response: OK, Clearing Record and additional Data available

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data		
56 69 56 4F 74 65 63 68 32 00	02h	00	00h	ABh	00h	00h	01h
ViVOtech2\0		OK	DLen = 171 dec		T1Len = 0 (dec)	T2Len = 0 (dec)	Clearing Record Present

Data
E1 56 9F 1A 02 01 58 9F 02 06 00 00 00 00 00 01 5F 2A 02 09 01 9A 03 05 08 02 9C 01 00 95 05 00 00 00 00 00 9F 37
Clearing Record (DE 055)

Data
04 84 77 98 32 82 02 58 80 9F 26 08 02 BB 21 5D D9 06 94 01 9F 27 01 40 9F 10 12 02 10 90 08 01 22 30 00 00 00 00
Clearing Record (DE 055)

Data			
00 00 00 00 15 00 FF 9F 36 02 00 D0	5A 08 54 12 34 00 00 00 00	5F 34 01 00	5F 24 03 10 07

	19		31
Clearing Record (DE 055)	TLV App PAN	TLV PAN Seq Num	TLV App Expiration Date

Data			
50 0A 4D 61 73 74 65 72 43 61 72 64	9F 34 03 00 1F 03	9F 45 02 DA C0	9F 4C 08 00 00 00 00 00 00 00
TLV Application Label	CVM Results	Data Auth Code	ICC Dynamic Number

Data		
57 13 54 12 34 00 00 00 00 19 D1 00 72 01 14 43 14 31 00 00 0F	56 00	9B 02 C8 00
TLV Track 2 Equivalent Data	TLV Track 1 Equivalent Data	Transaction Status Information

Data	CRC (MSB)	CRC (LSB)
5F 20 1A 53 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20 20	27h	60h
Cardholder Name		

Appendix A.1: User Experience Illustration

Following are list of messages and the message flow for one user experience.

Table 73: Summary of LCD Messages

User Interface States	ViVOtech User Experience
Idle	00: Idle Message (Welcome)
Polling	01: Present card (Please Present Card)
Time out or Transaction Cancel	02: Time Out or Transaction cancel (No Card)
Transaction In Progress	03: Transaction between reader and card is in the middle (Processing…)
Transaction Succeed	04: Transaction Pass (Thank You)
Transaction Fail	05: Transaction Fail (Fail)
Configurable messages	06: Amount (Amount $ 0.00 Tap Card)
	07: Balance or Offline Available funds (Balance $ 0.00)
	08: Insert or Swipe card (Use Chip & PIN)
	09: Try Again(Tap Again)
	0A: Indicate the custom to present only one card (Present 1 card only)
	0B: Indicate the custom to wait for authentication/authorization (Wait)

The flow diagram below illustrates how an external UI may be controlled, using asynchronous UI events.

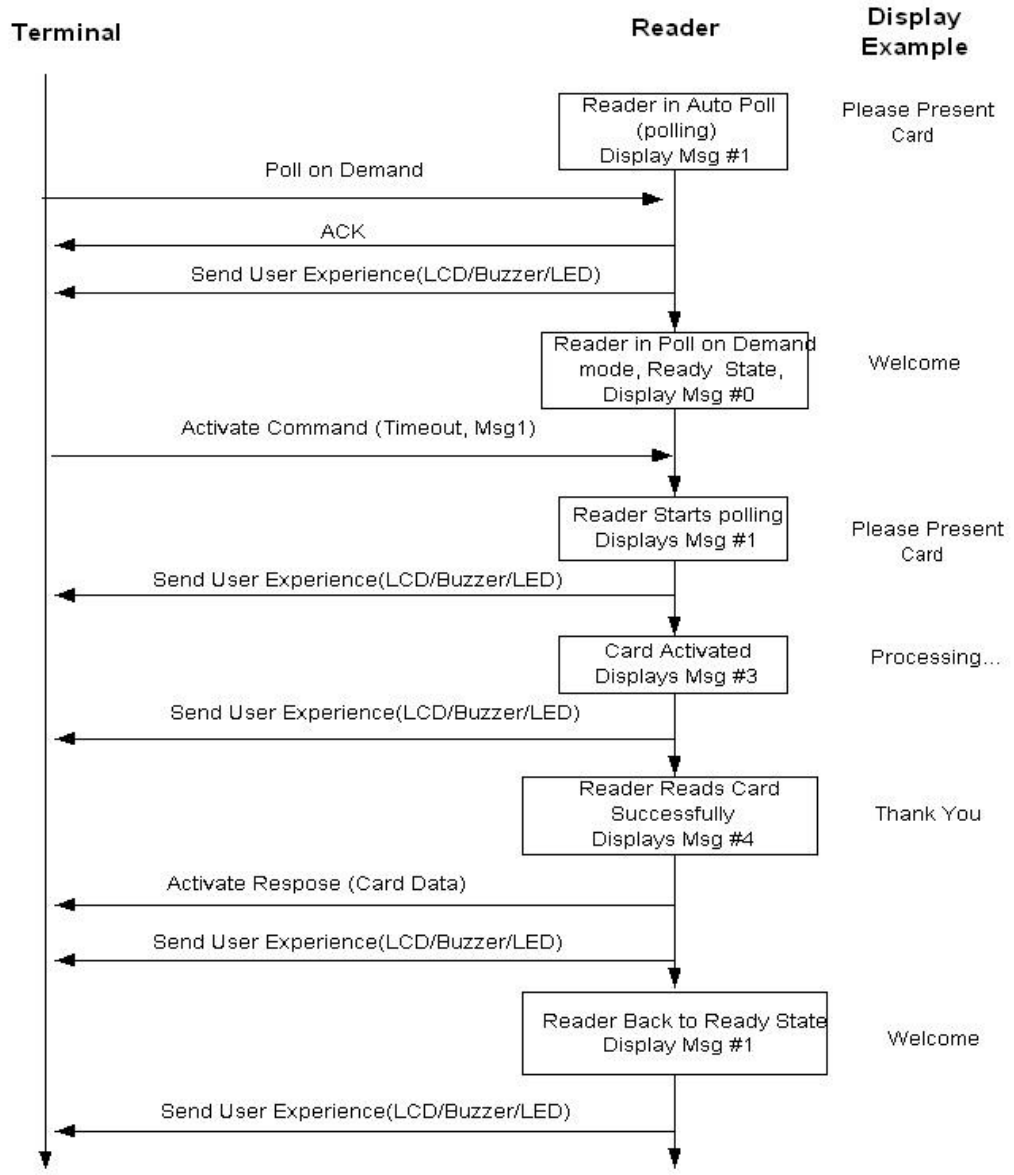


Figure 1a: Poll On Demand: Reader Reads Card Successfully

Appendix A.2: Audible User Interface

Some readers do not have an LCD display. In that case, audible tones and lights indicate the status and when an action must be taken.

The following table describes the audible user interface tones

Table 4: Definition of Audible Tones

Tone Name	Sound
Alert	Two short beeps
Card Read Complete	One long beep
Check Phone	Three short beeps

The Alert tone is an indication to the card user that something unusual has occurred and some action must be taken (for example, insert a card, swipe a card, check your mobile phone, use one card at a time, etc.).

The following table describes the audible tones emitted by the reader for each of the interfaces under various conditions:

Table 5 : Meaning of Audible Tones by Interface

Card/ Interface Type	Tone	Reason for Tone
Contactless	Check Phone	▫ Consumer interaction required (user needs to do something on the phone, such as enter a PIN)
	Alert	▫ Card Read Error ▫ Collision Detected ▫ Unsupported Card ▫ Application Error ▫ No Response after Restart (only for VCPS2.1.1 and ExpressPay 3.0)
	Card Read Complete + Alert	▫ Card Read Complete and Card Error ▫ Card Read Complete & switch to another interface
	Card Read Complete	▫ Transaction Approved, Offline ▫ Transaction Declined Offline (see status and error codes) ▫ Transaction Approved Online ▫ Transaction Declined Online
Contact	Alert	▫ Card Removed ▫ Transaction terminated with Error ▫ Switch from Contact to MagStripe Interface
	Card Read Complete	▫ Transaction Approved, Offline ▫ Transaction Declined, Offline ▫ Transaction Approved, Online ▫ Transaction Declined, Online
MagStripe	Alert	▫ Card Swipe Error
	Card Read Complete	▫ Card Swiped Successfully

Appendix A.3: Configurable AID Use Examples

This is the communications between a Configurable AID capable reader and an attached PC simulating a POS.

Disable System AID

From POS →

56 69 56 4F 74 65 63 68 32 00 04 04 00 0A 9F 06 07 A0 00 00 00 04 10 10 25 59

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the DCA Command (Delete Configurable AID - Cmd 4, Sub Cmd 4)

9F06 07 A0 00 00 00 04 10 10 – Selects the AID Number

Enable System AID

From POS →

56 69 56 4F 74 65 63 68 32 00 04 02 00 0E FF E4 01 00 9F 06 07 A0 00 00 00 04 10 10 D2 A8

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 07 00 00 2B 86

Uses the SCA Command (Set Configurable AID - Cmd 4, Sub Cmd 2)

FFE4 01 00 - Selects Group 0

9F06 07 A0 00 00 00 04 10 10 – Selects the AID Number

Add a New Configurable AID

From POS →

56 69 56 4F 74 65 63 68 32 00 04 02 00 18 FF E4 01 00 9F 06 05 B0 12 34 56 78 FF E2 01 03 FF E1 01 01 FF E5 01 0A 09 AB

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the SCA Command (Set Configurable AID - Cmd 4, Sub Cmd 2)

FFE4 01 00 - Selects Group 0

9F06 05 B0 12 34 56 78 – Selects the AID Number

FFE2 01 03 – Selects Application Flow

FFE1 01 01 – Enables Partial Selection

FFE5 01 0A – Specify Maximum Partial Selection Length

Delete a Configurable AID

From POS →

56 69 56 4F 74 65 63 68 32 00 04 04 00 08 9F 06 05 B0 12 34 56 78 DF 97

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the DCA Command (Delete Configurable AID - Cmd 4, Sub Cmd 4)

9F06 05 B0 12 34 56 78 – Specifies the AID to delete.

Create a New Group

From POS →

56 69 56 4F 74 65 63 68 32 00 04 03 00 0D FF E4 01 01 FF F1 06 00 00 00 01 00 00 64 03

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the SCG Command (Set Configurable Group - Cmd 4, Sub Cmd 3)

FFE4 01 01 – Specify the NEW group number 1.

FFF1 06 00 00 00 01 00 00 - Terminal Transaction Limit.

Connect Existing AID to a Different Group

From POS →

56 69 56 4F 74 65 63 68 32 00 04 02 00 18 FF E4 01 01 9F 06 05 B0 12 34 56 78 FF E2 01 03 FF E1 01 01 FF E5 01 0A FF 7E

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the SCA Command (Set Configurable AID - Cmd 4, Sub Cmd 2)

FFE4 01 01 – Specify the NEW group number 1.

9F06 05 B0 12 34 56 78 - Specifies the AID.

FFE2 01 03 – Selects Application Flow

FFE1 01 01 – Enables Partial Selection

FFE5 01 0A – Specify Maximum Partial Selection Length

Return Existing AID to Group 0

From POS →

56 69 56 4F 74 65 63 68 32 00 04 02 00 18 FF E4 01 00 9F 06 05 B0 12 34 56 78 FF E2 01 03 FF E1 01 01 FF E5 01 0A 09 AB

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the SCA Command (Set Configurable AID - Cmd 4, Sub Cmd 2)

FFE4 01 00 – Specify Group number 0.

9F06 05 B0 12 34 56 78 - Specifies the AID.

FFE2 01 03 – Selects Application Flow

FFE1 01 01 – Enables Partial Selection

FFE5 01 0A – Specify Maximum Partial Selection Length

Delete a Group

From POS →

56 69 56 4F 74 65 63 68 32 00 04 05 00 04 FF E4 01 01 0C 5D

From Reader ←

56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16

Uses the DCG Command (Delete Configurable Group - Cmd 4, Sub Cmd 5)

FF E4 01 01 - Specify Group number to delete.

Appendix A.4: Demo Utilities and Sample Code

The following PC-based demo utilities and sample code are available from IDTECH on request.

Item	Description
ViVOPing.zip	Visual C++ Project and C files containing the sample code given in Appendix A.1 in this document.
ViVOPing.exe	Executable File for the sample code given in this Document.
RFIDRead.exe	Demo Utility that polls ViVOpay for Track Data.
Sample_RFIDRead.zip	Source Code for the RFIDRead Utility (demonstrates use of Ping as well as Get Track Data Commands).

Appendix A.5: Firmware FAQ

The following FAQs attempt to answer common issues:

Q1. How do I identify the reader type from my application?

A. You can identify the reader type by checking the firmware:

Q2. Can you tell me which Terminal Types the reader supports?

A. The Vendi reader supports terminal type 24 – unattended, online only.

Q3. How many keys can I load onto the reader?

A. For CA public key, there is no limitation till the flash is full.

The Kiosk III reader allows for storage of up to a maximum of 60 keys which are uniquely identified as a key index in each payment scheme(RID).

Q4. How can I guarantee that all settings are erased in my reader when I load a new release of firmware?

A. Use the Set Configuration Defaults Command (04-09) to re-initialize the setting to default values.

Q5. Why does my MasterCard application ignore the Terminal Contactless Transaction Limit (FFF1) and the CVM Required Limit (FFF5) Tags?

A. The Terminal Contactless Transaction Limit (FFF1) and the CVM Required Limit (FFF5) Tags are used by Visa and not by MasterCard. MasterCard uses the Floor Limit and the CVM List structure described in the MasterCard specifications.

Q6. How do I enable Maestro cards in reader?

A. To enable Maestro cards, apply the following script.

```
---------CUT---------
AID SET
FFE4 01 00                  ; Group 0
9F06 07 A0 00 00 00 04 30 60  ; AID Number
```

```
;FFE6 01 00              ; AID Disabled OFF
END
---------CUT---------
```

Q7. What applications are supported?

A. The following applications are supported and certified.

EMVCo

- CCPS 2.3.1

MasterCard

- M/Chip v3.02
- M/Stripe v3.3

Visa

- VCPS (qVSDC & MSD) 2.1.3
- Reader Implementation Notes 1.1 Licensed (IRWIN-compliant)

Amex

- ExpressPay 3.0

Discover

- Discover DPAS 1.0 Zip 3.1.2, v1.00

Interac

- Flash 1.5

Q8. Whenever I try to load a key into the device it fails, with the error EMV_KM_EC_NO_FREE_KEY_SLOTS. Why is that?

A. You must first delete a key from a slot before you can load a new one.

Q9. How do I manage the FAIL message on the reader?

A. The way that we expect it to work is when a transaction error occurs; the reader sends error codes back to the host. The host can use the error code to determine the appropriate message to display on the reader using Control User Interface command. You may wish to replace the message FAIL (05) with a more user friendly message or a blank message and manage it yourself.

Q10. Why am I receiving timeouts when I try to load CAP keys into my reader using the key loading API?

A. A possible reason for the time out is because the 'Data Length' in the Command Frame is greater than the actual data length of the data field being sent, therefore the ViVOpay reader waits for more data and times out. Please ensure that the data length matches the actual size of the data field being sent.

Q11. On certain Visa cards the PAN (tag 5A) and Application Expiration Date (tag 5F24) are returned as zero length. Shouldn't the reader provide both PAN and expiry date because the Visa Contactless Payment Specification, Protocol 2.0.2 says: "Note that the PAN and the Expiration Date are obtained by the reader from the Track 2 Equivalent Data"?

A. The reader will only return those tags if they are present in the card, they will then be provided in the transaction results.

Note: The reader will not provide the tags if the card does not send then in the Response Frame.

Q12. I am using the Configurable AID features and my application is not able to correctly identify all Visa Cards.

A. Visa requires partial selection of the AIDs to be set in all PayWave applications. Please ensure that partial selection is enabled as shown below.

```
---------CUT---------
AID SET
FFE4 01 02                  ; Group
9F06 07 A0 00 00 00 03 10 10   ; Visa
FFE5 01 10                  ; include both of these tags Max AID length and
FFE1 01 01                  ; allow partial selection
END
---------CUT---------
```

Note: Partial selection is enabled by default for specific System AIDs (including Visa) but when you reprogram the AID you have to specifically enable partial selection.

Appendix A.6: TDES Data Encryption Examples

Examples are given for MSR data as well as ICC data. Note that data for the former will be in a different format than data for the latter. The former uses the Enhanced Encrypted MSR Data Output Format (see later appendix, or see ID TECH document P/N 80000403-001). By contrast, ICC data comes back as TLV data, preceded by a ViVOtech2 header with command and response bytes and two length bytes, and followed by a 16-bit CRC.

Step 1: Data encryption Enable

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 C7 36 00 01 01 B7 2E
[RX] - 56 69 56 4F 74 65 63 68 32 00 C7 00 00 00 86 6E
```

Step 2: Do a transaction

Example: Burst Mode OFF and Poll on Demand mode

Burst off

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 04 FF F7 01 00 B9 2E
[RX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16
```

Poll on demand

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 01 01 00 01 01 D7 34
[RX] - 56 69 56 4F 74 65 63 68 32 00 01 00 00 00 12 53
```

Activate transaction and then Swipe card or Tap card

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 02 01 00 0A 0A 9F 02 06 00 00 00 00
10 00 AB 6C
```

[RX] - MSR and contactless Card DATA As below

--MSR card data

The data will come back in the Enhanced Encrypted MSR Data Output Format, framed as follows:

<Preamble> <Attribution> < MSR TLV> <CRC>

See Appendix A.11 for format details.

Raw data:

Raw data:

56 69 56 4F 74 65 63 68 32 00	Protocol Header (ViVOtech2\0)
02	Command
00	Status Code
01 3D	Data Length MSB & LSB

88	Attribution
DF EE 23	MSR Tag
82	MSR Data length indicator
01 25	MSR Data length
02 1F 01 80 1F 44 28 00 83 9B 25 2A 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 30 30 32 36 5E 43 41 52 44 2F 49 4D 41 47 45 20 30 33 20 20 20 20 20 20 20 20 20 20 20 20 5E 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 3F 2A 3B 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 30 30 32 36 3D 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 3F 2A C7 27 B0 60 AB FC 2B 62 4C 4D 6E 59 96 E2 2D 84 8D 87 D6 E3 82 0D 57 37 4F 6D 3F B3 1F 75 06 1A DC 17 89 FB C3 C7 50 C7 5D 06 65 00 04 08 CA B4 CA 0C 62 47 62 EE 86 0F BD 54 17 E0 FD D5 7E 1D A9 C9 FA 98 FB DF 49 CA CE 1B DC 33 AA 1A DD A5 D6 52 C6 FC CF C5 DC A9 46 A8 07 1F 1C 13 1B 7F E6 5F 75 06 01 CE C6 1E 8A 64 0E 1C 2B EC 80 D4 51 48 AB 78 7E 8B 8D 05 DC 8A C9 07 9E FC 98 53 27 0B ED B9 10 02 52 D6 AA D8 46 CB 85 69 24 FE 7C 93 52 0B 36 DA D9 25 00 00 00 00 00 00 00 00 00 00 62 99 49 01 2C 00 04 60 00 01 C1 0B 03	Enhanced Encrypted MSR Field Data (see Appendix A.11 for format)
9F 39 01 90	Point of Service (POS) Entry Mode
FF EE 01 04	ViVOPay Group Tag
DF 30 01 0C	Track Data Source
DF EE 26 01 88	Encrypt Information
76 EA	CRC (MSB & LSB)

-- MasterCard Contactless (PayPass) card example:

The data will come back in the encrypted ICC format:

```
<PREAMBLE><Attribution Byte><KSN TLV><Track1 TLV(optional)><Track2
TLV(optional)><Clear Record TLV(optional)><Other TLVs><CRC>
```

The preamble is 14 bytes, as before (see example immediately above). The Attribution Byte will have a value of 0x81 or 0x83 for contactless TDES or AES, respectively. (The lowest bit is a Contactless flag. The second bit is a TDES/AES flag. The highest bit is a Encryption State flag. See Chapter 9.) The TLV data section consists of tag, length, value triplets. The CRC is a 16-bit cyclic redundancy check of the entire data packet, including the preamble.

Raw data:

```
56 69 56 4F 74 65 63 68 32 00 02 23 01 98 81 FF EE 12 0A 62 99 49 01 2C
00 04 60 00 02 82 02 00 00 95 05 00 00 00 00 00 9A 03 14 08 10 9C 01 00
5F 2A 02 08 40 9F 02 06 00 00 00 00 10 00 9F 03 06 00 00 00 00 00 00 9F
06 07 A0 00 00 00 04 10 10 9F 09 02 00 02 9F 1A 02 08 40 9F 1E 08 30 30
30 30 30 30 30 30 9F 21 03 12 02 37 9F 33 03 00 00 E8 9F 34 03 00 00 00
9F 35 01 25 9F 36 02 05 AB 9F 37 04 0F 0A 1A E5 9F 39 01 91 9F 53 01 00
DF 81 29 08 30 F0 F0 00 30 F0 FF 00 FF 81 06 44 DF 81 2A C1 20 10 18 E2
2A 40 63 49 89 C9 4B B1 01 3A D7 4A F6 1D 64 CF 42 5F 33 83 0A 9B BB 63
46 20 7A 72 76 DF 81 2B C1 10 16 DA F4 11 79 F9 0B A4 DC D0 64 31 65 31
CA B0 DF 81 15 06 00 00 00 00 00 FF FF 81 05 79 50 0A 4D 61 73 74 65 72
43 61 72 64 84 07 A0 00 00 00 04 10 10 9F 6D 02 00 01 56 C1 40 A5 14 AD
F8 E6 42 DA 3B 13 17 F5 D3 E6 65 B8 2B 4B E4 DE 13 C3 9F 98 2D D2 18 48
5E 2B 45 9E 3C B1 23 A5 A3 0B B8 08 2C DF B8 BF 07 8C D3 63 EA 19 00 4A
B7 5F A6 61 B6 D2 06 6B 0A AA BC F9 B7 9F 6B C1 18 79 95 EB 5E 9A F6 6A
B9 F6 2F 23 74 13 EE 51 75 1A A1 A9 84 75 68 95 D6 FF EE 01 3C DF 30 01
00 DF 31 C1 20 68 0B 25 F6 29 04 FA 8B D6 F8 BB 6C 64 A5 CD C6 10 A0 A7
60 B1 B4 80 AA 67 9B D5 27 CD 39 F5 BA DF 32 C1 10 38 32 34 F5 6A D7 99
CF 9C 4C 46 06 06 BC BC F9 DF EE 26 01 81 F8 99
```

Parsed data:

Head : 56 69 56 4F 74 65 63 68 32 00 02 23
Data : 01 98 81

Tag : FF EE 12
Length : 0A
Value : 62 99 49 01 2C 00 04 60 00 02

Tag : 82
Length : 02
Value : 00 00

Tag : 95
Length : 05
Value : 00 00 00 00 00

Tag : 9A
Length : 03
Value : 14 08 10

Tag : 9C

Length : 01
Value : 00

Tag : 5F 2A
Length : 02
Value : 08 40

Tag : 9F 02
Length : 06
Value : 00 00 00 00 10 00

Tag : 9F 03
Length : 06
Value : 00 00 00 00 00 00

Tag : 9F 06
Length : 07
Value : A0 00 00 00 04 10 10

Tag : 9F 09
Length : 02
Value : 00 02

Tag : 9F 1A
Length : 02
Value : 08 40

Tag : 9F 1E
Length : 08
Value : 30 30 30 30 30 30 30 30

Tag : 9F 21
Length : 03
Value : 12 02 37

Tag : 9F 33
Length : 03
Value : 00 00 E8

Tag : 9F 34
Length : 03
Value : 00 00 00

Tag : 9F 35
Length : 01
Value : 25

Tag : 9F 36
Length : 02
Value : 05 AB

Tag : 9F 37
Length : 04
Value : 0F 0A 1A E5

```
Tag      : 9F 39
Length  : 01
Value    : 91

Tag      : 9F 53
Length  : 01
Value    : 00

Tag      : DF 81 29
Length  : 08
Value    : 30 F0 F0 00 30 F0 FF 00

*****Embedded TLV Begin (FF 81 06 )*****
Tag      : FF 81 06
Length  : 44

Tag      : DF 81 2A
Length  : C1 20
Value(Encryption Data):
10 18 E2 2A 40 63 49 89 C9 4B B1 01 3A D7 4A F6 1D 64 CF 42 5F 33 83 0A 9B BB 63 46 20 7A 72
76
Value(Decryption Data):
DF 81 2A 18 30 30 30 31 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00

Tag      : DF 81 2B
Length  : C1 10
Value(Encryption Data):
        16 DA F4 11 79 F9 0B A4 DC D0 64 31 65 31 CA B0
Value(Decryption Data):
        DF 81 2B 07 00 01 00 00 01 00 2F 00 00 00 00 00

Tag      : DF 81 15
Length  : 06
Value    : 00 00 00 00 00 FF

*****Embedded TLV End (FF 81 06 )*****
*****Embedded TLV Begin (FF 81 05 )*****
Tag      : FF 81 05
Length  : 79

Tag      : 50
Length  : 0A
Value    : 4D 61 73 74 65 72 43 61 72 64

Tag      : 84
Length  : 07
Value    : A0 00 00 00 04 10 10

Tag      : 9F 6D
Length  : 02
Value    : 00 01

Tag      : 56
Length  : C1 40
Value(Encryption Data):
```

A5 14 AD F8 E6 42 DA 3B 13 17 F5 D3 E6 65 B8 2B 4B E4 DE 13 C3 9F 98 2D D2 18 48 5E 2B 45 9E 3C
B1 23 A5 A3 0B B8 08 2C DF B8 BF 07 8C D3 63 EA 19 00 4A B7 5F A6 61 B6 D2 06 6B 0A AA BC F9 B7
Value(Decryption Data):
56 3E 42 35 32 35 36 38 33 32 30 33 30 30 30 30 30 30 30 5E 53 75 70 70 6C 69 65 64 2F 4E 6F 74 5E 31 32 31 32 35 30 32 38 38 33 31 30 31 34 35 31 31 35 32 31 31 31 31 31 31 31 31 31 31 32

Tag : 9F 6B
Length : C1 18
Value(Encryption Data):
79 95 EB 5E 9A F6 6A B9 F6 2F 23 74 13 EE 51 75 1A A1 A9 84 75 68 95 D6
Value(Decryption Data):
9F 6B 13 52 56 83 20 30 00 00 00 D1 21 25 02 32 21 01 45 11 52 2F 00 00

*****Embedded TLV End (FF 81 05)*****
*****Embedded TLV Begin (FF EE 01)*****
Tag : FF EE 01
Length : 3C

Tag : DF 30
Length : 01
Value : 00

Tag : DF 31
Length : C1 20
Value(Encryption Data):
68 0B 25 F6 29 04 FA 8B D6 F8 BB 6C 64 A5 CD C6 10 A0 A7 60 B1 B4 80 AA 67 9B D5 27 CD 39 F5 BA
Value(Decryption Data):
DF 31 18 30 30 30 31 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00 00

Tag : DF 32
Length : C1 10
Value(Encryption Data):
38 32 34 F5 6A D7 99 CF 9C 4C 46 06 06 BC BC F9
Value(Decryption Data):
DF 32 0D 30 30 30 31 30 30 30 30 30 31 30 30 32

*****Embedded TLV End (FF EE 01)*****
Tag : DF EE 26
Length : 01
Value : 81

Tail : F8 99

Burst Mode OFF and Auto Poll Mode

Burst mode OFF

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 04 FF F7 01 00 B9 2E
[RX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16
```

Auto poll

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 01 01 00 01 00 F6 24
[RX] - 56 69 56 4F 74 65 63 68 32 00 01 00 00 00 12 53
```

Swipe card or Tap card

Get transaction result

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 03 00 00 00 3B FF
```

[RX] –MSR and contactless Card DATA As below

--MSR card data

56 69 56 4F 74 65 63 68 32 00	Protocol Header (ViVOtech2\0)
03	Command
00	Status Code
01 3D	Data Length MSB & LSB
88	Attribution
DF EE 23	MSR Tag
82	MSR Data length indicator
01 25	MSR Data length
02 1F 01 80 1F 44 28 00 83 9B 25 2A 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 30 30 32 36 5E 43 41 52 44 2F 49 4D 41 47 45 20 30 33 20 20 20 20 20 20 20 20 20 20 20 20 5E 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 3F 2A 3B 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 30 30 32 36 3D 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 3F 2A C7 27 B0 60 AB FC 2B 62 4C 4D 6E 59 96 E2 2D 84 8D 87 D6 E3 82 0D 57 37 4F 6D 3F B3 1F 75 06 1A DC 17 89 FB C3 C7 50 C7 5D 06 65 00 04 08 CA B4 CA 0C 62 47 62 EE 86 0F BD 54 17 E0 FD D5 7E 1D A9 C9 FA 98 FB DF 49 CA CE 1B DC 33 AA 1A DD A5 D6 52 C6 FC CF C5 DC A9 46 A8 07 1F 1C 13 1B 7F E6 5F	Enhanced Encrypted Field Data (see Appendix A.11 for format)

75 06 01 CE C6 1E 8A 64 0E 1C 2B EC
80 D4 51 48 AB 78 7E 8B 8D 05 DC 8A
C9 07 9E FC 98 53 27 0B ED B9 10 02
52 D6 AA D8 46 CB 85 69 24 FE 7C 93
52 0B 36 DA D9 25 00 00 00 00 00 00
00 00 00 00 62 99 49 01 2C 00 04 60
00 01 C1 0B 03

9F 39 01 90	Point of Service (POS) Entry Mode
FF EE 01 04	ViVOPay Group Tag
DF 30 01 0C	Track Data Source
DF EE 26 01 88	Encrypt Information
FD 71	CRC (MSB & LSB)

-- MasterCard Contactless (PayPass) card data

Raw data:

```
56 69 56 4F 74 65 63 68 32 00 03 23 01 98 81 FF EE 12 0A 62 99 49 01 2C
00 04 60 00 04 82 02 00 00 95 05 00 00 00 00 00 9A 03 14 08 10 9C 01 00
5F 2A 02 08 40 9F 02 06 00 00 00 00 00 01 9F 03 06 00 00 00 00 00 00 9F
06 07 A0 00 00 00 04 10 10 9F 09 02 00 02 9F 1A 02 08 40 9F 1E 08 30 30
30 30 30 30 30 30 9F 21 03 12 02 53 9F 33 03 00 00 E8 9F 34 03 00 00 00
9F 35 01 25 9F 36 02 05 AC 9F 37 04 3E CE 50 B9 9F 39 01 91 9F 53 01 00
DF 81 29 08 30 F0 F0 00 30 F0 FF 00 FF 81 06 44 DF 81 2A C1 20 C6 9A 82
5D 19 7A 9E AE FC CF 50 39 66 88 21 C2 C9 EF 3B A9 B6 30 32 0E 7F 19 C0
4A A0 77 C0 EC DF 81 2B C1 10 92 95 3B 08 DF EA 80 31 E5 7F BB D2 91 55
3A 38 DF 81 15 06 00 00 00 00 00 FF FF 81 05 79 50 0A 4D 61 73 74 65 72
43 61 72 64 84 07 A0 00 00 00 04 10 10 9F 6D 02 00 01 56 C1 40 AA 67 C3
F5 0A 86 04 3B A9 B3 86 09 C8 88 D5 20 69 24 2D 63 AC 2B 8F 05 83 67 F3
66 44 EB 61 D2 70 F9 61 A4 7B 91 60 4C 7C A5 C9 AA 09 9E 2C 53 FA 7E 6E
C9 C7 8D EC AF C0 91 D9 37 ED 30 F6 26 9F 6B C1 18 0E 0C 92 E0 FC 96 1A
19 EC EB E1 E8 40 E4 8B D1 37 7F B0 9C DF 6D EB D6 FF EE 01 3C DF 30 01
00 DF 31 C1 20 FC 47 AC 22 D0 C7 AE 1B E9 A4 AD F2 7F 8E 60 B1 4E F0 92
73 5D EF CE 9B BA 3D CA BF B1 48 40 BB DF 32 C1 10 A3 1C EC AE 13 AF 03
7C 3A DE EC 45 7B BC DA 8A DF EE 26 01 81 28 F9
```

Parsed data:

Head : 56 69 56 4F 74 65 63 68 32 00 03 23
Data : 01 98 81

Tag : FF EE 12
Length : 0A
Value : 62 99 49 01 2C 00 04 60 00 04

Tag : 82
Length : 02
Value : 00 00

Tag : 95
Length : 05
Value : 00 00 00 00 00

Tag : 9A
Length : 03
Value : 14 08 10

Tag : 9C
Length : 01
Value : 00

Tag : 5F 2A
Length : 02
Value : 08 40

Tag : 9F 02
Length : 06
Value : 00 00 00 00 00 01

Tag : 9F 03
Length : 06
Value : 00 00 00 00 00 00

Tag : 9F 06
Length : 07
Value : A0 00 00 00 04 10 10

Tag : 9F 09
Length : 02
Value : 00 02

Tag : 9F 1A
Length : 02
Value : 08 40

Tag : 9F 1E
Length : 08
Value : 30 30 30 30 30 30 30 30

Tag : 9F 21
Length : 03
Value : 12 02 53

Tag : 9F 33
Length : 03
Value : 00 00 E8

Tag : 9F 34
Length : 03
Value : 00 00 00

Tag : 9F 35
Length : 01
Value : 25

Tag : 9F 36
Length : 02
Value : 05 AC

Tag : 9F 37
Length : 04
Value : 3E CE 50 B9

Tag : 9F 39
Length : 01
Value : 91

Tag : 9F 53
Length : 01
Value : 00

Tag : DF 81 29
Length : 08
Value : 30 F0 F0 00 30 F0 FF 00

*****Embedded TLV Begin (FF 81 06)*****
Tag : FF 81 06
Length : 44

Tag : DF 81 2A
Length : C1 20
Value(Encryption Data):
C6 9A 82 5D 19 7A 9E AE FC CF 50 39 66 88 21 C2 C9 EF 3B A9 B6 30 32 0E 7F 19 C0 4A A0 77 C0 EC
Value(Decryption Data):
DF 81 2A 18 30 30 30 31 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00

Tag : DF 81 2B
Length : C1 10
Value(Encryption Data):
92 95 3B 08 DF EA 80 31 E5 7F BB D2 91 55 3A 38
Value(Decryption Data):
DF 81 2B 07 00 01 00 00 01 00 2F 00 00 00 00 00

Tag : DF 81 15
Length : 06
Value : 00 00 00 00 00 FF

*****Embedded TLV End (FF 81 06)*****
*****Embedded TLV Begin (FF 81 05)*****
Tag : FF 81 05
Length : 79

Tag : 50
Length : 0A
Value : 4D 61 73 74 65 72 43 61 72 64

Tag : 84
Length : 07

Value : A0 00 00 00 04 10 10

Tag : 9F 6D
Length : 02
Value : 00 01

Tag : 56
Length : C1 40
Value(Encryption Data):
AA 67 C3 F5 0A 86 04 3B A9 B3 86 09 C8 88 D5 20 69 24 2D 63 AC 2B 8F 05 83 67 F3 66 44 EB 61 D2
70 F9 61 A4 7B 91 60 4C 7C A5 C9 AA 09 9E 2C 53 FA 7E 6E C9 C7 8D EC AF C0 91 D9 37 ED 30 F6 26
Value(Decryption Data):
56 3E 42 35 32 35 36 38 33 32 30 33 30 30 30 30 30 30 30 5E 53 75 70 70 6C 69 65 64 2F 4E 6F 74
5E 31 32 31 32 35 30 32 30 35 39 31 30 31 34 35 32 31 35 33 31 31 31 31 31 31 31 31 31 31 31 32

Tag : 9F 6B
Length : C1 18
Value(Encryption Data):
0E 0C 92 E0 FC 96 1A 19 EC EB E1 E8 40 E4 8B D1 37 7F B0 9C DF 6D EB D6
Value(Decryption Data):
9F 6B 13 52 56 83 20 30 00 00 00 D1 21 25 02 51 71 01 45 21 53 2F 00 00

*****Embedded TLV End (FF 81 05)*****
*****Embedded TLV Begin (FF EE 01)*****
Tag : FF EE 01
Length : 3C

Tag : DF 30
Length : 01
Value : 00

Tag : DF 31
Length : C1 20
Value(Encryption Data):
FC 47 AC 22 D0 C7 AE 1B E9 A4 AD F2 7F 8E 60 B1 4E F0 92 73 5D EF CE 9B BA 3D CA BF B1 48 40 BB
Value(Decryption Data):
DF 31 18 30 30 30 31 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00 00

Tag : DF 32
Length : C1 10
Value(Encryption Data):
A3 1C EC AE 13 AF 03 7C 3A DE EC 45 7B BC DA 8A
Value(Decryption Data):
DF 32 0D 30 30 30 31 30 30 30 30 30 31 30 30 32

*****Embedded TLV End (FF EE 01)*****
Tag : DF EE 26
Length : 01
Value : 81

Tail : 28 F9

Appendix A.7: AES Data Encryption Examples

Examples are given for MSR data as well as ICC data. Note that data for the former will be in a different format than data for the latter. The former uses the Enhanced Encrypted MSR Data Output Format (see later appendix, or see ID TECH document P/N 80000403-001). By contrast, ICC data comes back as TLV data, preceded by a ViVOtech2 header with command and response bytes and two length bytes, and followed by a 16-bit CRC.

Step 1 Data encryption Enable

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 C7 36 00 01 01 B7 2E
[RX] - 56 69 56 4F 74 65 63 68 32 00 C7 00 00 00 86 6E
```

Step 2 Do a transaction

Burst Mode OFF and Poll on Demand Mode

Burst off

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 04 FF F7 01 00 B9 2E
[RX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16
```

Poll on demand

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 01 01 00 01 01 D7 34
[RX] - 56 69 56 4F 74 65 63 68 32 00 01 00 00 00 12 53
```

Activate transaction and then Swipe card or Tap card

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 02 01 00 0A 0A 9F 02 06 00 00 00 00
10 00 AB 6C
[RX] - MSR and contactless Card DATA As below
```

--MSR card data

56 69 56 4F 74 65 63 68 32 00	Protocol Header (ViVOtech2\0)
02	Command
00	Status Code
01 4D	Data Length MSB & LSB
8A	Attribution
DF EE 23	MSR Tag
82	MSR Data length indicator
01 35	MSR Data length
02 2F 01 80 1F 44 28 00 93 9B 25 2A 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 2A	Enhanced Encrypted MSR Field Data (see Appendix A.11 for format)

30 30 32 36 5E 43 41 52 44 2F 49 4D
41 47 45 20 30 33 20 20 20 20 20 20
20 20 20 20 20 20 5E 2A 2A 2A 2A
2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A
2A 2A 2A 2A 3F 2A 3B 36 35 31 30 2A
2A 2A 2A 2A 2A 2A 30 30 32 36 3D
2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A
2A 2A 2A 2A 2A 2A 2A 2A 3F 2A EB AB
97 04 89 00 E7 C6 5D BC FB BC F9 B3
B5 CA FC 1F 2C A0 AF 39 EC D2 C0 84
15 E4 E9 B9 9D 06 A3 BB B0 91 70 E1
76 B2 C2 17 90 88 84 22 A8 3C D7 12
EA B5 DC A4 A7 0B 5D A0 65 9B C1 73
09 31 92 1F 7B 23 2E F6 FA 1D A4 0A
65 19 BB E1 39 4D 80 EC E5 50 73 BB
BD 82 99 65 D2 EF E2 91 26 97 BA 56
C4 62 C8 18 70 F2 DE 1C AC 97 95 6C
0E 48 5E 8C 9F BB 62 EE 55 E7 47 B1
43 94 B2 D7 F4 31 51 48 AB 78 7E 8B
8D 05 DC 8A C9 07 9E FC 98 53 27 0B
ED B9 10 02 52 D6 AA D8 46 CB 85 69
24 FE 7C 93 52 0B 36 DA D9 25 00 00
00 00 00 00 00 00 00 00 62 99 49 01
2C 00 04 60 00 01 59 23 03

9F 39 01 90	Point of Service (POS) Entry Mode
FF EE 01 04	ViVOPay Group Tag
DF 30 01 0C	Track Data Source
DF EE 26 01 8A	Encrypt Information
B4 A2	CRC (MSB & LSB)

-- MasterCard Contactless (PayPass) card data

The data will come back in the encrypted ICC format:

```
<PREAMBLE><Attribution Byte><KSN TLV><Track1 TLV(optional)><Track2
TLV(optional)><Clear Record TLV(optional)><Other TLVs><CRC>
```

The preamble is 14 bytes, as before (see example immediately above). The Attribution Byte will have a value of 0x81 or 0x83 for contactless TDES or AES, respectively. (The lowest bit is a Contactless flag. The second bit is a TDES/AES flag. The highest bit is a Encryption State flag. See Chapter 9.) The TLV data section consists of tag, length, value triplets.The CRC is a 16-bit cyclic redundancy check of the entire data packet, including the preamble.

Raw data:

```
56 69 56 4F 74 65 63 68 32 00 02 23 01 A1 83 FF EE 12 0A 62 99 49 01 2C
00 04 60 00 02 82 02 00 00 95 05 00 00 00 00 00 9A 03 14 08 10 9C 01 00
5F 2A 02 08 40 9F 02 06 00 00 00 00 10 00 9F 03 06 00 00 00 00 00 00 9F
```

```
06 07 A0 00 00 00 04 10 10 9F 09 02 00 02 9F 1A 02 08 40 9F 1E 08 30 30
30 30 30 30 30 30 9F 21 03 12 03 12 9F 33 03 00 00 E8 9F 34 03 00 00 00
9F 35 01 25 9F 36 02 05 AD 9F 37 04 12 1A 26 E5 9F 39 01 91 9F 53 01 00
DF 81 29 08 30 F0 F0 00 30 F0 FF 00 FF 81 06 44 DF 81 2A C1 20 41 9C 87
3B C8 E8 0E 5A 20 3D 75 E4 36 55 44 BA 2A EA BE 84 A5 9D F5 CE 68 60 FA
85 B6 A6 C8 81 DF 81 2B C1 10 D2 0A FE 17 44 FC 6D 4E 7D 57 33 94 31 6F
5F A9 DF 81 15 06 00 00 00 00 00 FF FF 81 05 81 81 50 0A 4D 61 73 74 65
72 43 61 72 64 84 07 A0 00 00 00 04 10 10 9F 6D 02 00 01 56 C1 40 32 16
A8 D7 1F 47 35 4B 66 69 F7 33 05 C7 4F 74 0B C3 1C 52 13 C5 D9 53 04 CD
BB DF 56 10 D1 AE DE 51 5D 08 D6 CB C6 EA 55 74 89 48 FB 78 25 55 B0 EF
50 66 4B 5A 71 BD 29 C0 0E 25 C2 E1 0B 86 9F 6B C1 20 4F 23 3E 0D CE 3E
D4 E2 84 A8 D8 91 29 DE 84 FE D3 C6 67 A4 8F F6 13 97 6B D4 0D 68 C3 DF
62 4A FF EE 01 3C DF 30 01 00 DF 31 C1 20 F5 C5 F0 6A 13 8A 8F 5E B6 51
5B 72 6C 2F 0B 78 8F E4 38 6C A2 1E 05 7F D8 C5 B4 DF 75 E9 CC 1A DF 32
C1 10 5F 6E DE AA 68 C6 DE FD 61 8C 5C 54 51 95 07 6D DF EE 26 01 83 B8
33
```

Parsed data:
Head : 56 69 56 4F 74 65 63 68 32 00 02 23
Data : 01 A1 83

Tag : FF EE 12
Length : 0A
Value : 62 99 49 01 2C 00 04 60 00 02

Tag : 82
Length : 02
Value : 00 00

Tag : 95
Length : 05
Value : 00 00 00 00 00

Tag : 9A
Length : 03
Value : 14 08 10

Tag : 9C
Length : 01
Value : 00

Tag : 5F 2A
Length : 02
Value : 08 40

Tag : 9F 02
Length : 06
Value : 00 00 00 00 10 00

Tag : 9F 03
Length : 06
Value : 00 00 00 00 00 00

Tag : 9F 06
Length : 07

Value : A0 00 00 00 04 10 10

Tag : 9F 09
Length : 02
Value : 00 02

Tag : 9F 1A
Length : 02
Value : 08 40

Tag : 9F 1E
Length : 08
Value : 30 30 30 30 30 30 30 30

Tag : 9F 21
Length : 03
Value : 12 03 12

Tag : 9F 33
Length : 03
Value : 00 00 E8

Tag : 9F 34
Length : 03
Value : 00 00 00

Tag : 9F 35
Length : 01
Value : 25

Tag : 9F 36
Length : 02
Value : 05 AD

Tag : 9F 37
Length : 04
Value : 12 1A 26 E5

Tag : 9F 39
Length : 01
Value : 91

Tag : 9F 53
Length : 01
Value : 00

Tag : DF 81 29
Length : 08
Value : 30 F0 F0 00 30 F0 FF 00

*****Embedded TLV Begin (FF 81 06)*****
Tag : FF 81 06
Length : 44

Tag : DF 81 2A

Length : C1 20
Value(Encryption Data):
41 9C 87 3B C8 E8 0E 5A 20 3D 75 E4 36 55 44 BA 2A EA BE 84 A5 9D F5 CE 68 60 FA 85 B6 A6 C8 81
Value(Decryption Data):
DF 81 2A 18 30 30 30 31 30 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00

Tag : DF 81 2B
Length : C1 10
Value(Encryption Data):
D2 0A FE 17 44 FC 6D 4E 7D 57 33 94 31 6F 5F A9
Value(Decryption Data):
DF 81 2B 07 00 01 00 00 01 00 2F 00 00 00 00 00

Tag : DF 81 15
Length : 06
Value : 00 00 00 00 00 FF

*****Embedded TLV End (FF 81 06)*****
*****Embedded TLV Begin (FF 81 05)*****
Tag : FF 81 05
Length : 81 81

Tag : 50
Length : 0A
Value : 4D 61 73 74 65 72 43 61 72 64

Tag : 84
Length : 07
Value : A0 00 00 00 04 10 10

Tag : 9F 6D
Length : 02
Value : 00 01

Tag : 56
Length : C1 40
Value(Encryption Data):
32 16 A8 D7 1F 47 35 4B 66 69 F7 33 05 C7 4F 74 0B C3 1C 52 13 C5 D9 53 04 CD BB DF 56 10 D1 AE
DE 51 5D 08 D6 CB C6 EA 55 74 89 48 FB 78 25 55 B0 EF 50 66 4B 5A 71 BD 29 C0 0E 25 C2 E1 0B 86
Value(Decryption Data):
56 3E 42 35 32 35 36 38 33 32 30 33 30 30 30 30 30 30 30 5E 53 75 70 70 6C 69 65 64 2F 4E 6F 74
5E 31 32 31 32 35 30 32 35 37 38 31 30 31 34 35 33 31 30 33 31 31 31 31 31 31 31 31 31 31 31 32

Tag : 9F 6B
Length : C1 20
Value(Encryption Data):
4F 23 3E 0D CE 3E D4 E2 84 A8 D8 91 29 DE 84 FE D3 C6 67 A4 8F F6 13 97 6B D4 0D 68 C3 DF 62 4A
Value(Decryption Data):
9F 6B 13 52 56 83 20 30 00 00 00 D1 21 25 02 55 91 01 45 31 03 2F 00 00 00 00 00 00 00 00 00 00

*****Embedded TLV End (FF 81 05)*****
*****Embedded TLV Begin (FF EE 01)*****
Tag : FF EE 01
Length : 3C

Tag : DF 30
Length : 01
Value : 00

Tag : DF 31
Length : C1 20
Value(Encryption Data):
F5 C5 F0 6A 13 8A 8F 5E B6 51 5B 72 6C 2F 0B 78 8F E4 38 6C A2 1E 05 7F D8 C5 B4 DF 75 E9 CC 1A
Value(Decryption Data):
DF 31 18 30 30 30 31 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00 00

Tag : DF 32
Length : C1 10
Value(Encryption Data):
5F 6E DE AA 68 C6 DE FD 61 8C 5C 54 51 95 07 6D
Value(Decryption Data):
DF 32 0D 30 30 30 31 30 30 30 30 30 31 30 30 32

*****Embedded TLV End (FF EE 01)*****
Tag : DF EE 26
Length : 01
Value : 83

Tail : B8 33

Burst Mode OFF and Auto Poll Mode

Burst mode OFF

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 04 FF F7 01 00 B9 2E
[RX] - 56 69 56 4F 74 65 63 68 32 00 04 00 00 00 AE 16
```

Auto poll

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 01 01 00 01 00 F6 24
[RX] - 56 69 56 4F 74 65 63 68 32 00 01 00 00 00 12 53
```

Swipe card or Tap card

Get transaction result

```
[TX] - 56 69 56 4F 74 65 63 68 32 00 03 00 00 00 3B FF
```

[RX] MSR and contactless Card DATA As below

--MSR card data

56 69 56 4F 74 65 63 68 32 00	Protocol Header (ViVOtech2\0)
03	Command
00	Status Code
01 4D	Data Length MSB & LSB
8A	Attribution
DF EE 23	MSR Tag
82	MSR Data length indicator
01 35	MSR Data length
02 2F 01 80 1F 44 28 00 93 9B 25 2A 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 2A 30 30 32 36 5E 43 41 52 44 2F 49 4D 41 47 45 20 30 33 20 20 20 20 20 20 20 20 20 20 20 20 20 5E 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 3F 2A 3B 36 35 31 30 2A 2A 2A 2A 2A 2A 2A 2A 30 30 32 36 3D 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 2A 3F 2A EB AB 97 04 89 00 E7 C6 5D BC FB BC F9 B3 B5 CA FC 1F 2C A0 AF 39 EC D2 C0 84 15 E4 E9 B9 9D 06 A3 BB B0 91 70 E1 76 B2 C2 17 90 88 84 22 A8 3C D7 12 EA B5 DC A4 A7 0B 5D A0 65 9B C1 73 09 31 92 1F 7B 23 2E F6 FA 1D A4 0A	Enhanced Encrypted MSR Field Data (see Appendix A.11 for format)

65 19 BB E1 39 4D 80 EC E5 50 73 BB
BD 82 99 65 D2 EF E2 91 26 97 BA 56
C4 62 C8 18 70 F2 DE 1C AC 97 95 6C
0E 48 5E 8C 9F BB 62 EE 55 E7 47 B1
43 94 B2 D7 F4 31 51 48 AB 78 7E 8B
8D 05 DC 8A C9 07 9E FC 98 53 27 0B
ED B9 10 02 52 D6 AA D8 46 CB 85 69
24 FE 7C 93 52 0B 36 DA D9 25 00 00
00 00 00 00 00 00 00 00 62 99 49 01
2C 00 04 60 00 01 59 23 03

9F 39 01 90	Point of Service (POS) Entry Mode
FF EE 01 04	ViVOPay Group Tag
DF 30 01 0C	Track Data Source
DF EE 26 01 8A	Encrypt Information
BB 8C	CRC (MSB & LSB)

-- MasterCard Contactless (PayPass) card data

Raw data:

```
56 69 56 4F 74 65 63 68 32 00 03 23 01 91 83 FF EE 12 0A 62 99 49 01 2C
00 04 60 00 03 82 02 00 00 95 05 00 00 00 00 00 9A 03 14 08 10 9C 01 00
5F 2A 02 08 40 9F 02 06 00 00 00 00 00 01 9F 03 06 00 00 00 00 00 00 9F
06 07 A0 00 00 00 04 10 10 9F 09 02 00 02 9F 1A 02 08 40 9F 1E 08 30 30
30 30 30 30 30 30 9F 21 03 12 09 12 9F 33 03 00 00 E8 9F 34 03 00 00 00
9F 35 01 25 9F 36 02 14 97 9F 37 04 71 33 B7 9A 9F 39 01 91 9F 53 01 00
DF 81 29 08 30 F0 F0 00 30 F0 FF 00 FF 81 06 44 DF 81 2A C1 20 7E 75 B6
C3 C9 56 2F F0 9F 96 0B 3D D7 6D 14 05 88 88 46 66 BB 7C 77 E9 EA 08 BB
E7 4B 64 67 3E DF 81 2B C1 10 25 7D 55 0C 4B 98 A3 58 37 BA C9 4D EC 49
4C 32 DF 81 15 06 00 00 00 00 00 FF FF 81 05 81 81 50 0A 4D 61 73 74 65
72 43 61 72 64 84 07 A0 00 00 00 04 10 10 9F 6D 02 00 01 56 C1 40 E0 A0
6E E3 6D B6 D0 DA E7 AE C5 5B 62 6E 1E 6E A7 A0 BD 32 4B B6 F9 56 4A 42
62 D5 B1 BB 27 14 B6 6E 69 EF 72 61 AD 9F 48 52 38 12 23 E9 8B C6 86 8F
7A B8 7B FA A1 04 18 7C 67 D0 13 21 F5 67 9F 6B C1 20 F0 30 4E EB A0 63
0A E1 6E EA D6 F6 2A 0A CC 46 04 D6 17 68 AA 4D 06 5D 62 87 B0 76 EB FE
D6 B4 FF EE 01 2C DF 30 01 00 DF 31 C1 10 96 82 E1 B2 47 DC 01 59 98 D0
FF A6 00 C3 37 C3 DF 32 C1 10 00 2C 77 11 34 E8 1D 52 52 84 54 42 27 71
00 27 DF EE 26 01 83 E6 31
```

Parsed data:

Head : 56 69 56 4F 74 65 63 68 32 00 03 23
Data : 01 A1 83

Tag : FF EE 12
Length : 0A
Value : 62 99 49 01 2C 00 04 60 00 03

Tag : 82
Length : 02
Value : 00 00

Tag : 95
Length : 05
Value : 00 00 00 00 00

Tag : 9A
Length : 03
Value : 14 08 10

Tag : 9C
Length : 01
Value : 00

Tag : 5F 2A
Length : 02
Value : 08 40

Tag : 9F 02
Length : 06
Value : 00 00 00 00 00 01

Tag : 9F 03
Length : 06
Value : 00 00 00 00 00 00

Tag : 9F 06
Length : 07
Value : A0 00 00 00 04 10 10

Tag : 9F 09
Length : 02
Value : 00 02

Tag : 9F 1A
Length : 02
Value : 08 40

Tag : 9F 1E
Length : 08
Value : 30 30 30 30 30 30 30 30

Tag : 9F 21
Length : 03
Value : 12 03 18

Tag : 9F 33
Length : 03
Value : 00 00 E8

Tag : 9F 34
Length : 03
Value : 00 00 00

Tag : 9F 35
Length : 01
Value : 25

Tag : 9F 36
Length : 02
Value : 05 AE

Tag : 9F 37
Length : 04
Value : F8 BF B4 C4

Tag : 9F 39
Length : 01
Value : 91

Tag : 9F 53
Length : 01
Value : 00

Tag : DF 81 29

Length : 08
Value : 30 F0 F0 00 30 F0 FF 00

*****Embedded TLV Begin (FF 81 06)*****
Tag : FF 81 06
Length : 44

Tag : DF 81 2A
Length : C1 20
Value(Encryption Data):
8A 25 46 F5 06 C6 62 6A 6E 9F CD E4 9D 3D 87 0F 4B 39 95 83 6C 0E 69 A6 A5 B2 36 CA 2B 6F EB E0
Value(Decryption Data):
DF 81 2A 18 30 30 30 31 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00

Tag : DF 81 2B
Length : C1 10
Value(Encryption Data):
CB CF 47 87 FE 98 8E CA C7 75 18 61 3E E0 49 D2
Value(Decryption Data):
DF 81 2B 07 00 01 00 00 01 00 2F 00 00 00 00 00

Tag : DF 81 15
Length : 06
Value : 00 00 00 00 00 FF

*****Embedded TLV End (FF 81 06)*****
*****Embedded TLV Begin (FF 81 05)*****
Tag : FF 81 05
Length : 81 81

Tag : 50
Length : 0A
Value : 4D 61 73 74 65 72 43 61 72 64

Tag : 84
Length : 07
Value : A0 00 00 00 04 10 10

Tag : 9F 6D
Length : 02
Value : 00 01

Tag : 56
Length : C1 40
Value(Encryption Data):
6A 85 B3 98 02 AC D6 6A B7 5D AB 39 17 AD F1 DE 35 78 57 46 D8 AA E3 0D 0A 3B 5B E7 67 AD C1 BF
FE CD 7D 9A 53 F1 F1 F3 77 55 35 4E C1 60 0C 0D 3F B8 28 BA 67 8F 73 8C 70 2E 8B 23 54 1F DC F5
Value(Decryption Data):

56 3E 42 35 32 35 36 38 33 32 30 33 30 30 30 30 30 30 5E 53 75 70 70 6C 69 65 64 2F 4E 6F 74
5E 31 32 31 32 35 30 32 32 32 32 31 30 31 34 35 34 31 37 33 31 31 31 31 31 31 31 31 31 31 31 32

Tag : 9F 6B
Length : C1 20
Value(Encryption Data):
1F 3D 43 55 15 93 7A A3 F9 4D 67 D5 56 78 DB 44 89 D7 EE A7 D5 2D 67 0D B6 E6 F7 16 83 21 E5 39
Value(Decryption Data):
9F 6B 13 52 56 83 20 30 00 00 00 D1 21 25 02 05 51 01 45 41 73 2F 00 00 00 00 00 00 00 00 00 00

*****Embedded TLV End (FF 81 05)*****
*****Embedded TLV Begin (FF EE 01)*****
Tag : FF EE 01
Length : 3C

Tag : DF 30
Length : 01
Value : 00

Tag : DF 31
Length : C1 20
Value(Encryption Data):
D0 11 1B C1 20 27 BA 4A B5 8D 84 BE B0 D1 FF 73 FC 4A 80 94 C8 F0 35 D2 91 F4 FD CF 02 B3 3B 96
Value(Decryption Data):
DF 31 18 30 30 30 31 30 30 30 30 30 30 31 30 30 31 31 31 31 31 31 31 31 31 31 31 32 00 00 00 00 00

Tag : DF 32
Length : C1 10
Value(Encryption Data):
09 57 32 31 63 68 79 8F EF 6C C9 D9 0F 27 AC 82
Value(Decryption Data):
DF 32 0D 30 30 30 31 30 30 30 30 30 30 31 30 30 32

*****Embedded TLV End (FF EE 01)*****
Tag : DF EE 26
Length : 01
Value : 83

Tail : 91 CC

Appendix A.8: Transaction Results for MSD2.0.2 AC3.0 Cryptogram17

The following provides information on the transaction results returned for MSD2.0.2 AC3.0 Cryptogram17 transaction.

```
[Header]       56 69 56 4F 74 65 63 68 32 00
[Command byte] 02
[Status Code]  23
[Length]       01 66
[T1]  4C
      42 34 30 30 35 35 37 38 30 30 30 30 33 38 36 36 33 5E 43 41 52 44
      48 4F 4C 44 45 52 2F 56 49 53 41 5E 31 30 31 32 32 30 31 30 31 32
      33 34 30 31 32 33 34 30 30 30 30 30 30 30 30 30 30 30 35 35 36 31 30
      31 31 32 33 36 35 30 30 30 30
[T2]  25
      34 30 30 35 35 37 38 30 30 30 30 33 38 36 36 33 3D 31 30 31 32 32
      30 31 30 31 32 33 34 31 32 33 30 31 36 35 31
[Clearing Record present] 01
[Clearing Record] E1 7C
9F 66 04 80 80 00 00
9F 02 06 00 00 00 00 01 00
9F 37 04 02 45 70 24
5F 2A 02 08 40
9F 26 08 74 13 75 A7 11 47 47 93
9F 10 07 06 01 11 03 A0 00 00
9F 36 02 00 A5
9A 03 01 10 29
9C 01 22
95 05 00 00 00 00 00
82 02 00 80
9F 1A 02 08 40
9F 03 06 00 00 00 00 00 00
9F 6E 04 00 00 00 01
9F 7C 1B 00 06 49 53 53 55 45 52 00 0B 50 52 4F 50 52 49 45 54 41 52 59
00 04 44 41 54 41
[End of clearing record]
9F 6C 00
5A 00
5F 34 01 01
5F 24 00
50 0B 56 49 53 41 20 43 52 45 44 49 54
57 13 40 05 57 80 00 03 86 63 D1 01 22 01 01 23 41 23 01 65 1F
56 00
9B 02 00 00
5F 20 0F 43 41 52 44 48 4F 4C 44 45 52 2F 56 49 53 41
9F 07 00
9F 0D 05 FF FF FF FF FF
9F 0E 05 00 00 00 00 00
9F 0F 05 FF FF FF FF FF
9F 06 07 A0 00 00 00 03 10 10
9F 5D 00
9F 74 00
5F 25 00
[CRC] 4D 0D
```

AC3.0 Additional Tags Definition:

Customer Exclusive Data	**9F7C**	TLV format Fixed length 32 bytes	This field is available for the issuer's discretionary use. If the issuer wishes to put data in this field and have Visa act on it, they will need to contact Visa to have identifiers provided for that purpose. As is the current practice with other fields, Visa will transfer the issuer-selected data without viewing the information contained in the field. Issuer is responsible for ensuring its use of the field complies with all applicable laws and its own privacy policy. **Note**: The length of this field may be expanded to 255 in the future.
Form Factor Indicator	**9F6E**	TLV format Fixed length 4 bytes	This field contains indicators about the attributes of cardholder's device and the technology used for communication between the cardholder's device and the acquiring POS device. For a list of valid values, refer to the *Visa Contactless Payment Specification, Protocol 2.0.2, Including Additions and Clarification 3.0, Personalization Profile—U.S. Region Implementation*.

Appendix A.9: Preparing Bitmaps for Use with ILM

The serial ILM commands for language support require bitmap images to display messages. In place of 22 text string messages, ILM commands use 22 bitmap images to display messages. These bitmaps are downloaded to the reader as described in Download ILM Message Command.

The bit map images used for ILM support must be modified before they can be downloaded to the reader. You need to make the following changes:

- Replace the standard bmp header with a ViVOpay header
- Invert the image orientation (top to bottom)
- Invert the image color (black to white)
- Reduce image size by cropping unused pixels

All processing of regular monochrome bitmaps must be done before attempting to download the images to the reader. You cannot download color or grayscale images.

ViVOpay BMP Header

For each bitmap image, you must replace the standard bitmap header with a simplified ViVOpay header. The ViVOpay bitmap header is 12 bytes of data in the format shown in the following table, prefixed to the actual bitmap data:

Bytes 0-1	Bytes 2-3	Bytes 4-5	Bytes 6-7	Bytes 8-9	Bytes 10-11	Bytes 12…n
Bitmap Length	Row Number	Column Number	Height	Width	Reserved	Bitmap data

All variables in the header are 2 bytes long.

Bitmap Length	This data field contains the total number of bytes in the Bitmap Data Field.
Row Number	This data field contains the row offset that this image should start at. Value is in PIXELS.
Column Number	This data field contains the column offset that this image should start at. Value is in BYTES.
Height	This data field contains the number of rows (in pixels) that this image contains.
Width	This data field contains the number of columns (in bytes) that this image contains.
Reserved	This data field is reserved for future image manipulation options.
Bitmap Data	This is the actual image data.

Inverting the Image

The ViVOpay LCD expects each row of data in the opposite order than is in the bitmap. To invert the image you can employ row swapping. Assuming the bitmap is a 128 x 64 pixel image, each 16 bytes of data constitutes one “row” of 128 pixels (128 pixels / 8 pixels/byte = 16 bytes). Reversing the order of each 16 bytes of data in this case inverts the image.

Inverting the Color

Compared to a regular monochrome bitmap, the image used with ILM commands has inverted color. White areas of the bitmap must be black and black areas white. To invert the color, each bit of a bitmap image must be reversed by performing a NOT operation on each byte of image data.

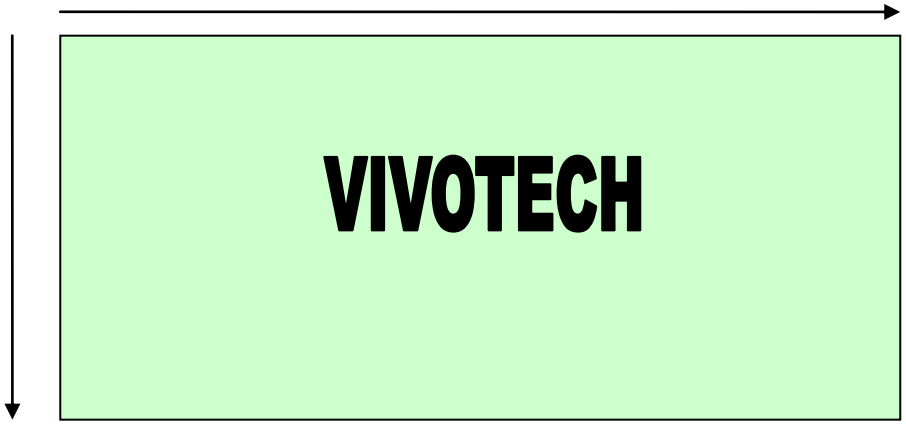
For example, suppose that 8 pixels were stored as 0x43 (0100 0011 in binary). This value must be reversed with the logical NOT to become 0xBC (1011 1100 in binary). Thus, 0xBC on an LCD matches 0x43 displayed on a PC monitor.

Image Cropping

Although message bitmaps can be sent at maximum screen size, cropping the images speeds the download and uses less memory. Cropping MUST be done after all other processing of the bitmap image. Other operations may be done in any order (as long as cropping is done last).

Cropping the image requires that you include the row number, column number, height and width parameters in the ViVOpay header. The Column Number/Row Numbers define where the upper-left corner of the bitmap is positioned. The Height and Width parameters determine the area the bitmap takes up on the LCD screen.

For example, here is a 128x64 pixel bitmap:

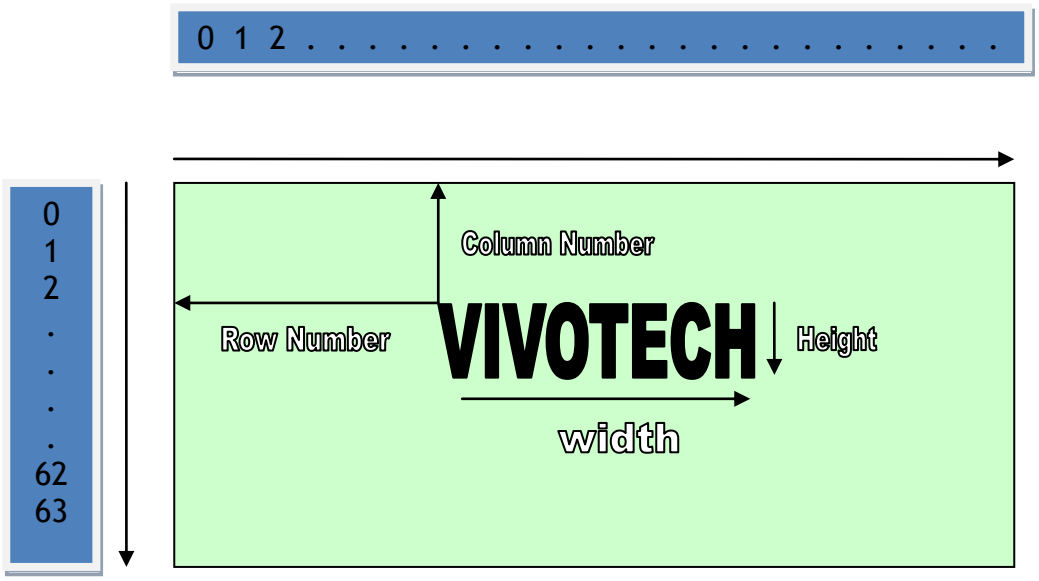


Here is the same image with unnecessary white space cropped out. It is now 50x10 pixels:

Cropping must be expressed in byte boundaries instead of pixels. For example, suppose you want to crop pixels 0 – 11 of a row of 128 pixels. Byte 0 (containing pixels 0-7) can be cropped

but Byte 1 (containing pixels 8-15) cannot be cropped, since it contains bits of non-cropped data. Thus, in this case, the cropping would begin at the Byte 1 (i.e., Column 1 boundary).

The following diagram shows how the header parameters are derived.



The Row Number refers to the number of rows, each of which is a row of pixels. The Column Number refers to a byte location. So Row varies from 0 to 63, and the Column varies from 0 to 15.

Example

The following is a simple example of a bitmap which measures 24x4 pixels (24 pixels per row, 4 rows). All bitmap values shown are arbitrary (and in hexadecimal).

Note: This example does **NOT** include image cropping.

ACTUAL BMP:

[14-byte BMP file header] + [40 byte DIB header] +

[Bitmap Data = (11 00 00 00) (22 00 01 00) (33 00 01 00) (44 00 00 00)]

First remove the headers.

[Bitmap Data = (11 00 00 00) (22 00 01 00) (33 00 01 00) (44 00 00 00)]

Then invert the image by swapping the rows. In this example, each row is 32 bits, i.e., 4 bytes long. Row 1 is swapped with the last row (4), Row 2 is swapped with the next-to-last row (3) and so on.

[Bitmap Data = (44 00 00 00) (33 00 01 00) (22 00 01 00) (11 00 00 00)]

Next reverse the bits.

[Bitmap Data = (BB FF FF FF) (CC FF FE FF) (DD FF FE FF) (EE FF FF FF)]

Analyze the image. If the image needs to be cropped for white space reduction, do it now.

Calculate positioning parameters and generate the ILM header.

[12 byte ILM header] +
[Bitmap Data = [BB FF FF FF] [CC FF FE FF] [DD FF FE FF] [EE FF FF FF]]

This modified image data is now ready to be displayed or stored on the ViVOpay LCD.

Appendix A.10: Default Configuration

ViVOpay readers are set to operate out of the box for many applications. This appendix describes the default operating mode and default TLV data object values that have not been previously covered.

Refer to the Configuration Tag Tables for default TLV values.

Communication Speed

The default baud rate for most units is 19200. The baud rate itself is a configurable parameter that can be set as described in the Interface Developer's Guide. The ViVOpay readers can communicate on any COM port specified by the integrators application. Handshaking is disabled (8 N 1).

Please note, baud rate for the ViVOpay Vendi reader is 9600.

Polling Mode

The default configuration for the firmware is Auto Poll. While operating in Auto Poll, the reader is constantly polling for contactless cards. When a card is presented to the field, reader completes the data exchange. Transaction data is obtained by the POS via GET TRANSACTION RESULT, READ FULL TRACK DATA, or a Burst Mode configuration. This poll mode is best suited for contactless-magstripe data transactions (i.e. PayPass Mag Stripe & payWave MSD).

Auto Poll mode is not compatible with the EMEA User Interface configuration or M/Chip 3.0 applications. If you are using the EMEA UI or M/Chip 3.0, then you should configure the polling mode to be “Poll on Demand”. Refer to the Set Poll Mode (01-01) command.

Burst Mode

While operating in Burst Mode, any time a valid contactless card is presented to the reader and the transaction completes successfully, the Burst Mode Payload Packet is immediately transmitted to the POS. The payload packet primarily consists of Track 1 and Track 2 data.

The default configuration for the firmware is Bust Mode, Auto-Off. When configured in this fashion Burst Mode is fully active until receiving a transaction command (i.e. ACTIVATE TRANSACTION, GET TRANSACTION RESULT, etc.) at which time Burst Mode is disabled until the next power cycle.

Burst Mode is only valid for contactless applications returning magstripe Track 1 and Track 2 data, such as PayPass Magstripe & Visa payWave MSD.

To configure burst mode, refer to the Global Configuration Tags table, tag FFF7h.

The magstripe reader itself always operates in burst mode, regardless of the burst mode settings defined in the EMV parameters, meaning that any swipe at the magstripe reader will result in a payload packet immediately being sent across the serial interface.

Burst mode output from the magstripe reader can be disabled with the Burst mode parameter. Refer to the Global Configuration Tags table, tag FFF7h.

RTC/LCD/Buzzer/LED Source

The ViVOpay readers are designed with flexibility in regards to the source of the Real Time Clock (RTC), Liquid Crystal Display (LCD), Buzzer, and Light Emitting Diodes (LED). Each of these components can be set to use a source internal or external to the ViVOpay unit. These

components can also be disabled by setting the source to "none". As a default the source of each of these components is set as follows:

RTC: Internal for units with an RTC. External for units without an RTC

LCD: Internal

Buzzer: Internal

LED: Internal

To configure the RTC/LCD/Buzzer/LED source, refer to the Set/Get Source for RTC/LCD/Buzzer/LED (01-05) command.

Default Message Index

The LCD message set applied by the ViVOpay unit depends on the User Interface (UI), tag 'FF F8'. As previously defined, the default UI is ViVOpay, and when setting a new UI (Visa Wave or EMEA) the associated message index must be loaded.

The various UI message indexes are structured as follows.

Message Index	Dot Matrix LCD Display Message				
	Indication		ViVOtech UI Scheme = '00'	VisaWave UI Scheme = '02'	EMEA UI Scheme = '03'
	Language	Line			
0x00			WELCOME	WELCOME	WELCOME
	ENG	L1: L2:	" Welcome " " "	" Welcome " " "	" Welcome " " "
	FRA	L1: L2:	" Bienvenue " " "	" Bienvenue " " "	" Bienvenue " " "
	ENG&FRA	L1: L2:	" Welcome " " Bienvenue "	" Welcome " " Bienvenue "	" Welcome " " Bienvenue "
0x01			TAP_OR_SWIPE_CARD	THANK_YOU	TAP_OR_SWIPE_CARD
	ENG	L1: L2:	" Please Tap Or " " Swipe Card "	" Thank You " " "	" Please Tap Or " " Swipe Card "
	FRA	L1: L2:	" Présentez " " carte SVP "	" Merci " " "	" Présentez " " carte SVP "
	ENG&FRA	L1: L2:	" Tap Or Swipe" " Presentez Carte"	" Thank You " " Merci "	"Tap Or Swipe " " Presentez Carte"
0x02			NO_CARD	THANK_YOU	NO_CARD
	ENG	L1: L2:	" No Card " " "	" Thank You " " "	" No Card " " "
	FRA	L1: L2:	" Aucune carte " " "	" Merci " " "	" Aucune carte " " "
	ENG&FRA	L1: L2:	" No Card " " Aucune carte "	" Thank You " " Merci "	" No Card " " Aucune carte "
0x03			PROCESSING	TRANSACTION_COMPLETED	NOT_CONNECTED
	ENG	L1: L2:	" Processing " " "	" Transaction " " Completed "	" Not " " Connected "
	FRA	L1:	" En cours "	" Transaction "	" Pas "

		L2:	" "	" Terminée "	" connecté "
	ENG&FRA	L1: L2:	" Processing " " En Traitement "	"Transaction Done" "Transaction Comp"	" Not Connected " " Pas connecté "
0x04			THANK_YOU	USE_OTHER_VISA_CARD	CARD_READ_OK
	ENG	L1: L2:	" Thank You " " "	" Please Use " "Other VISA Card "	" Card Read OK " " Remove Card "
	FRA	L1: L2:	" Merci " " "	" Utilisez une " "autre carte VISA"	" Lecture Carte OK " "Retirez la carte"
	ENG&FRA	L1: L2:	" Thank You " " Merci "	"Use Other Card " "Autre carte VISA "	" Remove the card" "Retirez la carte"
0x05			CARD_FAIL	SWIPE_CARD	CARD_FAIL
	ENG	L1: L2:	" Fail " " "	"Use Alternative " " Payment Method "	" Fail " " "
	FRA	L1: L2:	" Échec " " "	" Insérez ou " " Passez la carte "	" Échec " " "
	ENG&FRA	L1: L2:	" Card Failure " " Échec Carte "	" Swipe Card " "Passez la carte"	" Card Failure " " Échec Carte "
0x06			AMOUNT	1_CARD	AMOUNT
	ENG	L1: L2:	" Amount: " " "	" Present One " " Card Only "	" Present Card: " " "
	FRA	L1: L2:	" Montant: " " "	" Présentez une " " seule carte "	"Présentez carte:" " "
	ENG&FRA	L1: L2:	"Amount/Montant: " " "	" Present 1 Card " "Présentez 1 Cart"	"Purchase/Achat: " " "
0x07			BALANCE	INTERNATIONAL_CARD	BALANCE
	ENG	L1: L2:	" Balance: " " "	" International " " Card Only "	" Available: " " "
	FRA	L1: L2:	" Solde: " " "	" Internationale " " Carte Seulement"	" Disponible: " " "
	ENG&FRA	L1: L2:	" Balance/Solde: " " "	" Card/Carte " "International(e) "	" Available: " " Disponible: "
0x08			USE_CHIP_N_PIN	TRY_AGAIN	SWIPE_CARD
	ENG	L1: L2:	" Use Chip " " & PIN "	" Please " " Try Again "	"Use Alternative " " Payment Method "
	FRA	L1: L2:	" Utilisez " " la puce "	" Ré-essayez " " "	" Insérez ou " "Passez la carte"
	ENG&FRA	L1: L2:	" Use Chip & PIN " "Utilizer la puce"	"Please Try Again" " Ré-essayez "	" Swipe Card " "Passez la carte"
0x09			TRY_AGAIN	INTERNATIONAL_CARD	TRY_AGAIN
	ENG	L1:	" Please "	" International "	" Try Again "

		L2:	" Try Again "	" Card Only "	" "
	FRA	L1: L2:	" Ré-essayez " " "	" Internationale " " Carte Seulement"	" Ré-essayez " " "
	ENG&FRA	L1: L2:	"Please Try Again" " Ré-essayez "	" Card/Carte " "International(e) "	" Try Again " " Ré-essayez "
0x0A			1_CARD	SIGN_RECEIPT	1_CARD
	ENG	L1: L2:	" Present One " " Card Only "	" Please " " Sign Receipt "	" Present One " " Card Only "
	FRA	L1: L2:	" Présentez une " " seule carte "	" Signez le recu " " "	" Présentez une " " seule carte "
	ENG&FRA	L1: L2:	" Present 1 Card " "Présentez 1 Cart"	" Sign Receipt " " Signez le recu "	"Present 1 Card " "Présentez 1 Cart"
0x0B			WAIT	SIGN_RECEIPT	WAIT
	ENG	L1: L2:	" Please Wait " " "	" Please " " Sign Receipt "	" Please Wait " " "
	FRA	L1: L2:	" Attendez " " "	"" Signez le recu " " "	" Attendez " " "
	ENG&FRA	L1: L2:	" Please Wait " " Attendez "	" Sign Receipt " " Signez le recu "	" Please Wait " " Attendez "
0x0C			REMOVE_CARD	ENTER_PIN	REMOVE_CARD
	ENG	L1: L2:	" Please " " Remove Card "	" Please " " Enter PIN "	" Please " " Remove Card "
	FRA	L1: L2:	" Enlevez " " carte SVP "	"Entrez votre " " code "	" Enlevez " " carte SVP "
	ENG&FRA	L1: L2:	" Remove Card " " Retirez la Carte"	"PIN EntryRequire" "Code exige"	" Remove Card " " Retirez la Carte"
0x0D			APPROVED	AVAIL_OFFLINE_AMOUNT	APPROVED
	ENG	L1: L2:	" Approved " " "	" Offline Amount " " "	" Approved " " "
	FRA	L1: L2:	" Approuvé " " "	" Montant " " hors ligne "	" Approuvé " " "
	ENG&FRA	L1: L2:	" Approved " " Approuvé "	" Offline Amount " " Mt hors ligne "	" Approved " " Approuvé "
0x0E			NOT_AUTHORIZED	ENTER_PIN	DECLINED
	ENG	L1: L2:	" Not " " Authorized "	" Please " " Enter PIN "	" Declined " " "
	FRA	L1: L2:	" Non " " autorisé "	"Entrez votre " " code "	" Refusé " " "
	ENG&FRA	L1: L2:	" Not Authorized " " Non autorisé "	"PIN EntryRequire" "Code exige"	" Declined " " Refusé "

0x0F			DECLINED	SIGNATURE_REQUIRED	Reserved MSG16
	ENG	L1: L2:	" Declined " " "	" Signature " " Required "	" " " "
	FRA	L1: L2:	" Refusé " " "	" Signature " " Requise "	" " " "
	ENG&FRA	L1: L2:	" Declined " " Refusé "	"SignatureRequire" "Signature Requise"[5]	" " " "
0x10			TERMINATED	Reserved MSG17	Reserved MSG17
	ENG	L1: L2:	" Terminated " " "	" " " "	" " " "
	FRA	L1: L2:	" Terminé " " "	" " " "	" " " "
	ENG&FRA	L1: L2:	" Cannot Process " " Ne Peut Procés "	" " " "	" " " "
0x11			TRY_OTHER_INTERFACE	TAP_OR_SWIPE_CARD	TRY_OTHER_INTERFACE
	ENG	L1: L2:	" Try Other " " Interface "	" Present Card " " "	" Try Other " " Interface "
	FRA	L1: L2:	"Autre Interface " " "	" Présentez" "votre carte"	"Autre Interface " " "
	ENG&FRA	L1: L2:	"AnotherInterface" "Autre Interface "	" Purchase/Achat " " "	"AnotherInterface" "Autre Interface "
0x12			USE_OTHER_CARD	REMOVE_CARD	USE_OTHER_CARD
	ENG	L1: L2:	" Use Other Card " " "	" Please " " Remove Card "	" Use Other Card " " "
	FRA	L1: L2:	" Use Other Card " " "	" Enlevez " "votre carte SVP "	" Use Other Card " " "
	ENG&FRA	L1: L2:	" Use Other Card " " "	" Remove Card " "Retirez la Carte"	" Use Other Card " " "
0x13			TIMEOUT	PROCESSING	TIMEOUT
	ENG	L1: L2:	" Time Out " " "	" Processing " " "	" Time Out " " "
	FRA	L1: L2:	" Time Out " " "	" En cours " " "	" Time Out " " "
	ENG&FRA	L1: L2:	" Time Out " " "	" Processing " " En Traitement "	" Time Out " " "
0x14			CANCEL	DECLINED	CANCEL
	ENG	L1:	" Cancel "	" Declined "	" Cancel "

[5] String length over 16 characters, LCD displays first 16 characters only.

		L2:	" "	" "	" "
	FRA	L1: L2:	" Annuler " " "	" Refusé " " "	" Annuler " " "
	ENG&FRA	L1: L2:	" Cancel " " Annuler "	" Declined " " Refusé "	" Cancel " " Annuler "
0x15			ONLINE	TERMINATED	ONLINE
	ENG	L1: L2:	" Authorizing " " "	" Terminated " " "	" Authorizing " " "
	FRA	L1: L2:	" En Traitement " " "	" Terminé " " "	" En Traitement " " "
	ENG&FRA	L1: L2:	" Processing " " En Traitement "	" Cannot Process " " Ne Peut Procés "	" Processing " " En Traitement "
0x16			SEE_PHONE	SEE_PHONE	SEE_PHONE
	ENG	L1: L2:	" See Phone " " "	" See Phone " " "	" See Phone " " "
	FRA	L1: L2:	"Entrée d'un code" " "	"Entrée d'un code" " "	"Entrée d'un code" " "
	ENG&FRA	L1: L2:	" PassCode Entry " "Entrée d'un code"	" PassCode Entry " "Entrée d'un code"	" PassCode Entry " "Entrée d'un code"
0x17			NOT_ACCEPTED	NOT_ACCEPTED	NOT_ACCEPTED
	ENG	L1: L2:	" Not Accepted " " "	" Not Accepted " " "	" Not Accepted " " "
	FRA	L1: L2:	" Pas accepté " " "	" Pas accepté " " "	" Pas accepté " " "
	ENG&FRA	L1: L2:	" Not Accepted " " Pas accepté "	" Not Accepted " " Pas accepté "	" Not Accepted " " Pas accepté "
0x18			INSERT_CARD	INSERT_CARD	INSERT_CARD
	ENG	L1: L2:	" Insert Card " " "	" Insert Card " " "	" Insert Card " " "
	FRA	L1: L2:	"Insérez la carte" " "	"Insérez la carte" " "	"Insérez la carte" " "
	ENG&FRA	L1: L2:	" Insert Card " "Insérez la carte"	" Insert Card " "Insérez la carte"	" Insert Card " "Insérez la carte"
0x19			REFUND	REFUND	REFUND
	ENG	L1: L2:	" Refund " " "	" Refund " " "	" Refund " " "
	FRA	L1: L2:	" Remboursement " " "	" Remboursement " " "	" Remboursement " " "
	ENG&FRA	L1: L2:	"Refund" "Remboursement "	"Refund" " Remboursement "	"Refund" "Remboursement"

0x1A			STOP	STOP	STOP
	ENG	L1: L2:	" STOP " " "	" STOP " " "	" STOP " " "
	FRA	L1: L2:	" Arrêtez " " "	" Arrêtez " " "	" Arrêtez " " "
	ENG&FRA	L1: L2:	" STOP " " Arrêtez "	" STOP " " Arrêtez "	" STOP " " Arrêtez "

Appendix A.11: Enhanced Encrypted MSR Data Output Format

Definitive information on this format can be found in ID TECH document #80000403-001, *Enhanced Encrypted MSR Data Output Format*. Request a copy from your ID TECH representative.

Note that data conforming to this standard will (as with EMV data) be framed within a ViVOtech2 standard header or "preamble" (consisting of 14 bytes: ViVOtech2\0, command byte, response byte, two-byte length), at the beginning, plus a two-byte CRC at the end:

```
<PREAMBLE><Attribution Byte><MSR TLV>< Point of Service (POS) Entry Mode TLV><
ViVOPay Group TLV>< Encrypt Information TLV><CRC>
```

The 24 data fields can be parsed as shown below. Note that the first field is STX (0x02) and the last field is ETX (0x03). It's essential to inspect the flag bits in fields 8 and 9 to determine which of several optional fields are present, and also to determine whether encrypted fields are present (in which case, padding must be taken into account; see detailed description hereunder).

The CRC is calculated using ALL upstream bytes of the data output (that is, using the preamble as well as the 24 fields of data).

MSR DATA OUTPUT FORMAT

Field #	Length in Bytes	Optional	Field Name
1	1		STX
2	2		Data Length
3	1		Card Encode Type
4	1		Track Status
5	1		Track1 data length
6	1		Track2 data length
7	1		Track3 data length
8	1		Clear/mask data sent status
9	1		Encrypted/Hash data sent status
10	Variable	Y	Track1 clear/mask data
11	Variable	Y	Track2 clear/mask data
12	Variable	Y	Track3 clear/mask data
13	Variable	Y	Track1 encrypted data
14	Variable	Y	Track2 encrypted data
15	Variable	Y	Track3 encrypted data
16	8	Y	Session ID (Security level 4 only)
17	20	Y	Track1 hashed (if encrypted)
18	20	Y	Track2 hashed (if encrypted)
19	20	Y	Track3 hashed (if encrypted)
20	10	Y	Reader Serial Number
21	10	Y	KSN
22	1		LRC (XOR of all bytes from Field 3 to 21 inclusive)
23	1		CheckSum (sum of all bytes from Field 3 to 21 inclusive; take the low 8 bits of sum, only)
24	1		ETX

The presence/absence of Optional fields can be determined by inspecting flag bits in fields 8 and 9.

Field 1: STX

Start of Text. 0x02.

Field 2: Data Length
Data Length low byte comes first if it is output format 1, then Data Length high byte.
Data Length high byte comes first if it is output format 2,then Data Length low byte. (Output format 2 applies only to insert readers, not contactless.)

Field 3: Card Encode Type:

Value	Encode Type Description
80	ISO 7813/ISO 4909/ABA format
81	AAMVA format
83	Other
84	Raw; un-decoded format. All tracks are encrypted and no mask data is sent. No track indicator '01', '02' or '03' in front of each track.
85	JIS II Only supported in some products
86	JIS I Only supported in some products
87	JIS II SecureKey and Secure MIR

Field 4: Track Status
MSR sampling and decode status

MSB							LSB
0	0	B5	B4	B3	B2	B1	B0

B0 1: Track 1 decode success (0: Track 1 decode fail)
B1 1: Track 2 decode success (0: Track 2 decode fail)
B2 1: Track 3 decode success (0: Track 3 decode fail)
B3 1: Track 1 sampling data exists (0: Track 1 sampling data does not exist)
B4 1: Track 2 sampling data exists (0: Track 2 sampling data does not exist)
B5 1: Track 3 sampling data exists (0: Track 3 sampling data does not exist)
B6 0—reserved for future
B7 0—reserved for future

Field 5: Track1 data length
Field 6: Track2 data length
Field 7: Track3 data length
These one-byte values are the length of the actual Track data. It indicates the number of bytes in the Track masked data field. It should be used to separate Track 1, Track 2 and Track 3 data after decrypting Track encrypted data field.

For ISO 7813 and ISO 4909 compliant Financial Transaction Cards:
Track 1 maximum length is 79 alphanumeric characters.
Track 2 maximum length is 40 numeric digits.
Track 3 maximum length is 107 numeric digits.

Field 8: Clear/mask data sent status byte and bit 0 is the least significant bit.
Bit 0: 1--- if Track1 clear/mask data present
Bit 1: 1--- if Track2 clear/mask data present
Bit 2: 1--- if Track3 clear/mask data present
Bit 3: 1— if fixed key; 0 DUKPT Key Management
Fixed key is only supported in some products
Bit 4: 0- TDES; 1 - AES
Bit 5: 0- No requirement to use IC (1st digit in Service Code is different from 2 or 6; 1- Use IC where feasible (1st digit in Service Code is 2 or 6)
Bit 6: 1-- Pin Encryption Key; 0 – Data Encryption Key
Refer ANSI X9.24 2009 Page 56 for details.
Bit7: 1 – Serial # present; 0- not present

Field 9: Encrypted data sent status
Bit 0: if 1—track1 encrypted data present
Bit 1: if 1—track2 encrypted data present
Bit 2: if 1—track3 encrypted data present
Bit 3: if 1—track1 hash data present
Bit 4: if 1—track2 hash data present
Bit 5: if 1—track3 hash data present
Bit 6: if 1—session ID present
Bit 7: if 1—KSN present

Fields 13, 14, & 15: These fields are the encrypted Track data, using either TDES-CBC or AES-CBC with initial vector of 0. *If the original data is not a multiple of 8 bytes for TDES or a multiple of 16 bytes for AES, the reader pads the original data with trailing zeros*. Hence, the length of the encrypted data could be greater than the length of the original (unencrypted) data.

The key management scheme is DUKPT. For DUKPT, the key used for encrypting data is called the Data Key. Data Key is generated by first taking the DUKPT Derived Key XOR'd with 0000000000FF00000000000000FF0000 to get the resulting intermediate variant key. The left side of the intermediate variant key is then TDES encrypted with the entire 16-byte variant as the key. After the same steps are preformed for the right side of the key, combine the two key parts to create the Data Key.

Note that Tracks 1, 2 and 3 of card data are encrypted separately. In order to get the number of bytes for each track's *encrypted* data field, the field length is always a multiple of 8 bytes for TDES or multiple of 16 bytes for AES. (This value will be zero if there was no data on a track.) Once the encrypted data has been decrypted, all padding bytes need to be removed. The number of bytes of decoded track 1, 2, or 3 data is indicated by the track 1, 2, or 3 *unencrypted* length field (Fields 5, 6 and 7, respectively).

Field 16: Session ID (Security level 4 only; not applicable to Kiosk II/III nor Vendi)
Field 17: Track1 hashed (if encrypted and hash track1 allowed)
Field 18: Track2 hashed (if encrypted and hash track2 allowed)
Field 19: Track3 hashed (if encrypted and hash track3 allowed)
SHA-1 is used for non-SRED products and 20 zeroes are used for SRED products. Refer to applicable product manual for details.
SHA-1 is used to generate hashed data for track 1 to track 3 unencrypted data. It is 20 bytes long for each track. This is provided with two purposes in mind: One is for the host to ensure data integrity by comparing this field with a SHA-1 hash of the decrypted Track data, as a safeguard against unexpected noise in data transmission. The other purpose is to enable the host to store a token of card data for future use without keeping the sensitive card-holder data itself. This token may be used for comparison with the stored hash data to determine if they are from the same card.

Field 20: Reader Serial Number (optional); always 10 bytes (pad with leading 0x30 if <10 digits)

Field 21: KSN (DUKPT only)

Field 22: CheckLRC
XOR of all data from Card Encode Type to end of KSN for Output Format 1 (contactless); XOR of all data before CheckLRC for Output Format 2 (insert readers).

Field 23: CheckSum Field Omitted if Output Format 2 (insert readers).
Bottom 8 bits of SUM of all bytes values from Card Encode Type to end of KSN.

Field 24: ETX

End of Text (0x03).

Appendix A.12: Encrypted Data Format, TLV-Based

The information below is based, in part, on ID TECH P/N 80000404-001, *ID Tech Encrypt Data Format in Command/Response Specification for IC Communication*. Consult the latest version of that document for more information.

For magstripe data, see ID TECH P/N 80000403-001, *Enhanced Encrypted MSR Data Output Format*. The following TLV-based scheme applies to encrypted EMV (not MSR) transaction data.

For data passed in Tag/Length/Value (TLV) format, the Length value will be used to signal encryption and/or masking of the Value being received. If the bottom 5 bits are ON (that is, if Byte & 0x1F == 0x1F), then the next byte is also part of the tag. Likewise, if the most significant bit is ON (that is, if Byte & 0x80 == 0x80), then the next byte is also part of the tag.

Examples:

8F 02 03 04: Tag = 8F
9F 02 03 04: Tag = 9F02
BF A2 92 82: Tag = BFA292

Length

If the most significant bit (b7) of length is OFF, then that byte is, itself, the data length of the data to follow.

If the most significant bit (b7) is ON, then the lower nibble specifies the number of following bytes that contain the length of the data to follow.

Standard TLV Examples

6F 12 13 14 15 . . .: Tag is 6F, Length is 12, Data starts at 13
9F 20 81 82 83 84 . . .: Tag is 9F20, Length is the 1 byte after 81, which is 0x82, data starts at 83
DF 81 01 82 01 02 03 . . .: Tag is DF8101, Length is the 2 bytes after 82, which is 0x0102, data starts at 03

Using Length Byte to Flag Mask and Encryption (IDTech Enhanced TLV)

The Length bit shall be used when data is masked or encrypted:
Bit 7 will be set to 1
Bit 6 will be set to 1 if there is encryption
Bit 5 will be set to 1 if there is a mask
Bits 0-4 signify the amount of bytes that follow specifying the data length

IDTech Enhanced TLV Examples

6F 12 13 14 15 . . .: Tag is 6F, Length is 12, Data starts at 13, no mask/enc.
9F 20 C1 82 83 84 . . .: Tag is 9F20, Length is the 1 byte after C1, which is 0x82, data is encrypted, data starts at 83
DF 81 01 A2 01 02 03 . . .: Tag is DF8101, Length is the 2 bytes after A2, which is 0x0102, data is masked, data starts at 03

Using Length Byte to Flag Mask and Encryption (IDTech Enhanced TLV):

The Length bit shall be used when data is masked or encrypted:
Bit 7 will be set to 1
Bit 6 will be set to 1 if there is encryption
Bit 5 will be set to 1 if there is a mask

Bits 0-4 signify the amount of bytes that follow specifying the data length

IDTech Enhanced TLV Examples:
6F 12 13 14 15 . . .: Tag is 6F, Length is 12, Data starts at 13, no mask/enc.
9F 20 C1 82 83 84 . . .: Tag is 9F20, Length is the 1 byte after C1, which is 0x82, data is encrypted, data starts at 83
DF 81 01 A2 01 02 03 . . .: Tag is DF8101, Length is the 2 bytes after A2, which is 0x0102, data is masked, data starts at 03

Encrypted/Masked TAG Note

The following table shows the tags that will be encrypted and/or masked:

Tag	Data Object	Note	Plaintext	Mask and format	Encryption and format
5A	Application PAN		None	Mask 5A A1 Len <value> This Value must be Masked according to PreCtlNum and PostCtlNum, then output.	Encryption 5A C1 Len <value>
9F1F	Track 1 Discretionary Data		None	None	Encryption 9F 1F Cx Len <value>
9F20	Track 2 Discretionary Data		None	None	Encryption 9F 20 Cx Len <value>
57	Track 2 Equivalent Data		None	None	Encryption 57 Cx Len <value>
56	Track 1 Data	1. MasterCard-Paypass (MagStripe) defines it 2. DiscoverZip defines it. 3. Visa MSD – Do not Define. 4. Amex – Do not Define. 5. PBOC– Do not Define.	None	None	Encryption 56 Cx Len <value>
5F20	Cardholder Name		Full Plaintext	None	None
5F24	Expire Date		Full Plaintext	None	None
5F30	Service Code		Full	None	None

			Plaintext		
9F6B	Track 2 Data	1. MasterCard-Paypass (MagStripe) defines it 2. DiscoverZip – Do not Define. 3. Visa MSD –Define it for 'Card CVM Limit'. Now Do Not Encrypt it in Visa MSD. 4. Amex – Do not Define. 5. PBOC–Define it for 'Card CVM Limit'. Now Do Not Encrypt it in PBOC. If it is used for Track2 Data. The value need be encrypted, then Output.	None	None	Encryption 9F 6B Cx Len <value>
FFEE13	Track 1 Data	1. DiscoverZip Need Use it. 2. Visa MSD Need Use it. 3. Amex Need Use it. 4. PBOC Need Use it.	None	None	Encryption FF EE 13 Cx Len <value>
FFEE14	Track 2 Data	1. DiscoverZip Need Use it. 2. Visa MSD Need Use it. 3. Amex Need Use it. 4. PBOC Need Use it.	None	None	Encryption FF EE 13 Cx Len <value>

Tag	Data Object	Note	Plaintext	Mask and format	Encryption and format
DF812A	DD Card Track 1		None	None	Encryption DF 81 2A Cx Len <value>
DF812B	DD Card Track 2		None	None	Encryption DF 81 2B Cx Len <value>
DF31	DD Card Track 1		None	None	Encryption DF 31 Cx Len <value>
DF32	DD Card Track 2		None	None	Encryption DF 32 Cx Len <value>

Note:

1. DiscoverZip has 56 Tag (Track 1 Data) and Formal Track1 & 2 Data (No Tags). So DiscoverZip will have 56, FF EE 13, FF EE 14 (3 Tags) later.
2. Visa MSD, Amex, PBOC will have FF EE 13, FF EE 14 (2 Tags for Formal Track 1 & 2 Data) later.

Track 1 (Tag 56) & 2 (Tag 9F6B) Mask Configuration Note

Masked Area

The data format of each masked track is ASCII or Hex. The clear data includes start and end sentinels, separators, first N, last M digits of the PAN, card holder name, expiry date and service code. The rest of the characters should be masked using mask character.

1. Set PrePANClrData (N)
   1 byte parameter, range is 0~6, default value 4

2. Set PostPANClrData (M)
   1 byte parameter, range is 0~4, default value 4

3. Set DisplayExpirationDataID
   1 byte parameter, value is 0x30 (Mask) / 0x31 (Not Mask), default value 0x31

4. Set MaskCharID (Mask Character) for Ascii Code Track Data
   1 byte parameter, range is 0x20~0x7E, default value 0x2A (*)

5. Set MaskCharID (Mask Character) for Hex Code Track Data
   1 nibble parameter sent as byte value, range is 0x0A~0x0F, default value 0x0C

6. Set ExpireDateOutputOpt
   1 byte parameter, value is 0x30 (Output Masked for Tag 57 and Only Output EncryptedValue for Tag 5F24) / 0x31 (Output Plaintext), default value 0x31

Example:

ASCII Pan clear data: “012345678912”
Pre-PAN clear data characters: 5
Post-PAN clear data characters: 3
Mask Character = “*”
Masked Value = “01234****912”

Hex value clear data: 0x012345678912
Pre-PAN clear data characters: 5
Post-PAN clear data characters: 3
Mask Character = 0x0C
Masked Value = 0x01234CCCC912

Other Tag Value Mask Configuration Note

1. Set PrePANClrData (N)
1 byte parameter, range is 0~6, default value 4

2. Set PostPANClrData (M)
1 byte parameter, range is 0~4, default value 4

3. Set MaskCharID (Mask Character) for Ascii Code Value
1 byte parameter, range is 0x20~0x7E, default value 0x2A (*)

4. Set MaskCharID (Mask Character) for Hex Code Value

1 byte parameter, range is 0x0A~0x0F, default value 0x0C

5. In 57 Tag Value, the data before 0xDx is PAN data, it need be Masked as Tag 5A Value.
5. In 57 Tag Value, in the data 0xDy ym ms xz, yy mm is expiry date, and sxz is service code, they Need Not be Masked.

6. In 57 Tag Value, the data after 0xDy ym ms xz are Other data, they need be Masked.

Detailed – TLV Encrypted Response Format

Example of Encrypting a TLV

Example 1

1. Plaintext 5A TLV data (**5A 08 47 61 73 90 01 01 00 10**)

2. Encrypt this TLV data (**5A 08 47 61 73 90 01 01 00 10**) to be 16 bytes Encrypted Data (**XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX**):
- For TDES mode: The Length should be multiple of 8. If it was not multiple of 8, unit should zero padded y bytes data follow automatically (the length +y should be multiple of 8).
- For AES mode: The Length should be multiple of 16. If it was not multiple of 16, unit should zero padded y bytes data follow automatically (the length +y should be multiple of 16).

3. Re-Create New TLV data for Mask:
- TAG is 5A
- Length is A1 08:
  - A1 – Bit 7 is 1 note followed data length bytes. Bit 5 is 1 note data is Masked. Bit 0~4 (1) data note followed n bytes (1 byte) data length.
  - 08 – followed 8 bytes data
- Data is **47 61 CC CC CC CC 00 10** (0x0C is Mask Data)

4. Re-Create New TLV data for Encryption:
- TAG is 5A
- Length is C1 10:
  - C1 – Bit 7 is 1 note followed data length bytes. Bit 6 is 1 note data is Encrypted. Bit 0~4 (1) data note followed n bytes (1 byte) data length.
  - 10 – followed 16 bytes data
- Data is **XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX**

Example 2

1. Plaintext 57 TLV data (**57 11 47 61 73 90 01 01 00 10 D1 51 22 01 17 58 98 93 89**)

2. Encrypt this TLV data (**57 11 47 61 73 90 01 01 00 10 D1 51 22 01 17 58 98 93 89**) to be 24 (TDES mode) or 32 bytes (AES mode) Encrypted Data:
- For TDES mode: The Length should be multiple of 8. If it was not multiple of 8, unit should zero padded y bytes data follow automatically (the length +y should be multiple of 8).

- For AES mode: The Length should be multiple of 16. If it was not multiple of 16, unit should zero padded y bytes data follow automatically (the length +y should be multiple of 16).

3. Re-Create New TLV data for Mask:
- TAG is 57
- Length is A1 11:
  - A1 – Bit 7 is 1 note followed data length bytes. Bit 5 is 1 note data is Masked. Bit 0~4 (1) data note followed n bytes (1 byte) data length.
  - 11 – followed 17 bytes data
- If ExpireDataOutputOpt was set “Output Plaintext”, expiry date and service code all Need Not be Masked. Data is **47 61 CC CC CC CC 00 10 D1 51 22 01 CC CC CC CC CC** (0x0C is Mask Data):
  - **47 61 73 90 01 01 00 10** is PAN, it Need be Masked same as 5A Tag Value
  - In **D1 51 22 01, 1 51 2** is expiry date (2015year, December), **2 01** is service code, they all Need Not be Masked.
  - Followed them all Need be Masked.
- If ExpireDataOutputOpt was set “Output Plaintext”, expiry date and service code all Need Not be Masked. Data is **47 61 CC CC CC CC 00 10 DC CC C2 01 CC CC CC CC CC** (0x0C is Mask Data):
  - **47 61 73 90 01 01 00 10** is PAN, it Need be Masked same as 5A Tag Value
  - In **D1 51 22 01, 1 51 2** is expiry date (2015year, December) and Need be Masked, **2 01** is service code and it Need Not be Masked.
  - Followed them all Need be Masked.

4. Re-Create New TLV data for Encryption (TDES mode):
- TAG is 57
- Length is C1 18:
  - C1 – Bit 7 is 1 note followed data length bytes. Bit 6 is 1 note data is Encrypted. Bit 0~4 (1) data note followed n bytes (1 byte) data length.
  - 18 – followed 24 bytes data
- Data is **XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX**

Example 3

1. Plaintext 9F 20 TLV data (**9F 20 05 01 94 60 02 7F**)

2. Encrypt this TLV data (**9F 20 05 01 94 60 02 7F**) to be 8 (TDES mode) or 16 bytes (AES mode) Encrypted Data:
  - For TDES mode: The Length should be multiple of 8. If it was not multiple of 8, unit should zero padded y bytes data follow automatically (the length +y should be multiple of 8).
  - For AES mode: The Length should be multiple of 16. If it was not multiple of 16, unit should zero padded y bytes data follow automatically (the length +y should be multiple of 16).

3. Need Not Mask:

4. Re-Create New TLV data for Encryption (TDES mode):
- TAG is 9F 20
- Length is C1 08:
  - C1 – Bit 7 is 1 note followed data length bytes. Bit 6 is 1 note data is Encrypted. Bit 0~4 (1) data note followed n bytes (1 byte) data length.
  - 08 – followed 8 bytes data
- Data is **XX XX XX XX XX XX XX XX**

Example 4

- If all TLVs are same level.

Raw data: **57 11 47 61 73 90 01 01 00 10 D1 51 22 01 17 58 98 93 89 5A 08 47 61 73 90 01 01 00 10 84 07 A0 00 00 00 03 10 10 9F 20 05 01 94 60 02 7F**
New data: **57 A1 11 47 61 CC CC CC CC 00 10 D1 51 22 01 CC CC CC CC CC 57 C1 18 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 5A A1 08 47 61 CC CC CC CC 00 10 5A C1 10 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 84 07 A0 00 00 00 03 10 10 9F 20 C1 08 XX XX XX XX XX XX XX XX**

- If all TLVs are not same level (PayPass application list Record).

Raw Data:
<FF 81 06 (Tag00)> <82 01 70 (Len00)> <TLV10> <TLV11>
<FF 81 01 (Tag12)> <7F (Len12)> <TLV20> <TLV21> **57 11 47 61 73 90 01 01 00 10 D1 51 22 01 17 58 98 93 89 5A 08 47 61 73 90 01 01 00 10 84 07 A0 00 00 00 03 10 10 9F 20 05 01 94 60 02 7F** < TLV23 > … <TLV2n>
<FF 81 01 (Tag13)> <7F (Len13)> <TLV20> <TLV21> **57 11 47 61 73 90 01 01 00 10 D1 51 22 01 17 58 98 93 89 5A 08 47 61 73 90 01 01 00 10 84 07 A0 00 00 00 03 10 10 9F 20 05 01 94 60 02 7F** < TLV23 > … <TLV2n>
<TLV14> … <TLV1n>
<FF 81 05 (Tag01)> <60 (Len01)> <TLV10> <TLV11> **57 11 47 61 73 90 01 01 00 10 D1 51 22 01 17 58 98 93 89 5A 08 47 61 73 90 01 01 00 10 84 07 A0 00 00 00 03 10 10 9F 20 05 01 94 60 02 7F** <TLV13> <TLV14> …

New data:
<FF 81 06 (Tag00)> <82 01 **D5** (Len00)> <TLV10> <TLV11>
<FF 81 01 (Tag12)> <**81 B0** (Len12)> <TLV20> <TLV21> **57 A1 11 47 61 CC CC CC CC 00 10 D1 51 22 01 CC CC CC CC CC 57 C1 18 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 5A A1 08 47 61 CC CC CC CC 00 10 5A C1 10 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 84 07 A0 00 00 00 03 10 10 9F 20 C1 08 XX XX XX XX XX XX XX XX** < TLV23 > … <TLV2n>
<FF 81 01 (Tag13)> <**81 B0** (Len13)> <TLV20> <TLV21> **57 A1 11 47 61 CC CC CC CC 00 10 D1 51 22 01 CC CC CC CC CC 57 C1 18 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 5A A1 08 47 61 CC CC CC CC 00 10 5A C1 10 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 84 07 A0 00 00 00 03 10 10 9F 20 C1 08 XX XX XX XX XX XX XX XX** <TLV2**4**> … <TLV2n>
<TLV14> … <TLV1n>
<FF 81 05 (Tag01)> <**91** (Len01)> <TLV10> <TLV11> **57 A1 11 47 61 CC CC CC CC 00 10 D1 51 22 01 CC CC CC CC CC 57 C1 18 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 5A A1 08 47 61 CC CC CC CC 00 10 5A C1 10 XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX XX 84 07 A0 00 00 00 03 10 10 9F 20 C1 08 XX XX XX XX XX XX XX XX** <TLV1**4**> <TLV1**5**> …

Command Format

L2 commands do not carry sensitive data, hence the command can be plaintext.

Response Formats

KSN will be TLV format

1. 3 bytes KSN Tag – DF EE 12 (**FFEE12 is reserved for existing contactless products – it will later be replaced with DFEE12.**)
2. 1 byte Len – 0A
3. 10 bytes KSN

Contact L2 Response Format

06 + <Transaction Result > <Attribution> [<TLV>]

Where:
1. Transaction Result: 2 bytes (Approve, Decline, Other)
2. Attribution: 1 Byte
- BIT0 – Card Type: 0 – Contact Card
- BIT2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode
- BIT3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR. (For ViVOpay IDG)
- BIT6~4 – Reserved
- BIT7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON. (For ViVOpay IDG)

3. <TLV> is optional only if transaction was Approved or Declined
- <TLV> will include KSN as first tag (DFEE12) if new or changed since last KSN value.
- Encryption (bit 6) and Masking (bit5) flags will be utilized as appropriate in the Length component of the TLV element

Contactless L2 Response Format

06 + <Status Code > <Error Code >< Attribution > [<TLV>]

Where:
1. Status Code: 1 Byte. The usage is the same as in KioskII/KioskIII project and are used to specify if transaction was approved or declined.
2. Error Code: 1 Byte. The usage is the same as in KioskII/KioskIII project and are used to specify if transaction was approved or declined.
3. Attribution: 1 Byte
- BIT0 – Card Type: 1 – Contactless Card
- BIT2,1 – Encryption Mode: 00 – TDES Mode, 01 – AES Mode
- BIT3 – Card Type: 0 – Contact/Contactless Card. 1 – MSR. (For ViVOpay IDG)
- BIT6~4 – Reserved
- BIT7 – Encryption Status: 0 – Encryption OFF. 1 – Encryption ON. (For ViVOpay IDG)

4. <TLV> is optional only if transaction was Approved or Declined
- <TLV> will include KSN as first tag (Tag should be DFEE12, **FFEE12 is reserved for existed contactless products – Later it should be replaced with DFEE12.**) if new or changed since last KSN value.
- Encryption (bit 6) and Masking (bit5) flags will be utilized as appropriate in the Length component of the TLV element

Appendix A.13: Enhanced Encrypted MSR Data Output When Encryption is Turned On with C7-38 Command

Enhanced Encrypted MSR Data Output Format for Bank Card

When the C7-38 command is used, the parameter you supply (first column) will determine what kind of output occurs (remaining columns). For example, a parameter value of 0x00 results in masked Track 1 and Track 2 data, cleartext data for Track 3, and encrypted and hashed (E+H) data for Tracks 1 & 2.

C7-38 Parameter Value:		Clear / Mask Data			Encrypted / Hash Data		
		Track 3	Track 2	Track 1	Track 3	Track 2	Track 1
Force Encryption with	0x00(0000)	C	M	M		E+H	E+H
	0x01(0001)	C	M			E+H	E+H
	0x02(0010)	C		M		E+H	E+H
	0x03(0011)	C				E+H	E+H
	0x04(0100)		M	M	E+H	E+H	E+H
	0x05(0101)		M		E+H	E+H	E+H
	0x06(0110)			M	E+H	E+H	E+H
	0x07(0111)				E+H	E+H	E+H
	0x08(1000)		M	M	E+H	E+H	E+H
	0x09(1001)		M		E+H	E+H	E+H
	0x0A(1010)			M	E+H	E+H	E+H
	0x0B(1011)				E+H	E+H	E+H
	0x0C(1100)		M	M	E+H	E+H	E+H
	0x0D(1101)		M		E+H	E+H	E+H
	0x0E(1110)			M	E+H	E+H	E+H
	0x0F(1111)				E+H	E+H	E+H

C:Clear Data. **M**:Mask Data. **E**:Encrypted Data. **H**:Hash Data

Appendix A.14: Glossary

The following terms are relevant to this document:

Term	Definition
AAC	Application Authentication Cryptogram
AEF	Application Elementary File (EMV)
AELx	Evaluation Assurance Level (1 ..7)
AFL	Application File Locator
AID	Application Identifier
AIP	Application Interchange Profile
API	Application Programming Interface or Application Priority Indicator (tag 87)
APDU	Application Protocol Data Unit
ARQC	Authorization Request Cryptogram
ASK	Amplitude Shift Key
ATC	Application Transaction Counter
ATR	Answer To Reset
AUC	Application Usage Control
BER	Basic Encoding Rules (ASN.1)
CAT	Cardholder Activated Terminals
CCC	Compute Cryptographic Checksum
CDA	Combined Dynamic Data Authentication/Application Cryptogram Generation (EMV)
CID	Cryptogram Information Data
CVC	Card Verification Code
CVM	Cardholder Verification Method, EMV Book 3, C3
CVV	Card Verification Value (That's the 3 digit number on the back of cards)
DCVV	Dynamic CVV
DDA	Dynamic Data Authentication (EMV)
DF	Dedicated File (7816-4)
DOL	Data Object List
EF	Elementary File (7816-4)
EMV	Europay MasterCard Visa (EMVCo LLC)
IIN	Issuer Identification Number
IPC	Inter Process Communications
KSI	Key set index
LRC	Longitudinal Redundancy Check
MP	Master File (7816-4)
MSD	Magnetic Stripe Data
NFC	Near Field Communications
PAN	Primary Account Number
PCD	Proximity coupling device
PICC	Proximity card
PN511	FeliCa Chip from Philips
POS	Point of Sale (terminal)
PPSE	Proximity Payment Selection (or System) Environment
PSE	Partial Selection something
PTS	Protocol Type Selection
PUPI	Pseudo Unique PICC Identifier
qVSDC	Quick Visa Smart / Debit Credit
RID	Registered Application Provider Identifier
RN	Random Number
SAK	Select Acknowledge
SAM	Security Access Module, communicated via 7816-3 in T=0.
SDA	Static Data Authentication (EMV)
SFGI	Startup Frame Guard Interval (or time Integer)
SFI	Short File Identifier (EMV)

Term	Definition
SID	SAM ID inside of reader
T=0	Protocol Type, T=0 is the asynchronous half duplex character transmission protocol.
T=1	Protocol Type, T=1 is the asynchronous half duplex block transmission protocol.
TAK	Terminal Authentication Key
TC	Transaction Certificate
TID	Terminal ID
TLV	Tag Length Value
TSI	Transaction Status Information, EMV Book 3, C7
TTQ	Terminal Transaction Qualifier
TVR	Terminal Verification Results, EMV Book 3, C5
UN	Unknown Number
XOR	Exclusive OR

Appendix A.15: Revision History

Version	Date	Change
NEO 1.0.0 Rev. 50	2/28/15	Added EMV Exception Log List Commands (9.10) Added NFC Commands (9.15) Added Key Management Parameter Commands (10.2) Added Status Codes 0x90 (Account DUKPT Key not exist) and 0x91 (Account DUKPT Key KSN exhausted). Added Masked Output Data Parameter (tag FFEE1D).

Version	Date	Change
NEO v1.00 Rev. 51	3/27/2015	Part number changed to NEO 1.0.0 Add note in 10.1, ' Note: This section is not available for Kiosk III/ Vendi.' Title of 10.2 changed to ' DUKPT Key Management Parameter Commands' Marked Output Data Parameter(FFEE1D) format changed Command D0-01 response frame removed RID/ Key Index. Command 02-01 added project name "Vendi" in note "Kiosk III don't support ViVOcomm and DesFire cards". Command 2C-13 removed note "This command only applies to the VP5500 product. It is not supported on other readers". Commands 02-03/ 02-04 were removed. Commands 07-xx series were removed. Commands 13-xx series were removed. Commands 15-01/ 16-01 were removed. Commands 50-01/ 50-03 were removed. Commands 01-03/ 01-04 were removed. Command 14-01 removed VP5000 example, replaced by Vendi. Command 2C-0B removed 01-03/ 01-04 or VP5500 related description. Command 01-02 removed 01-03/ 01-04 related description. Tag FFFB added new values 05. Section 4.1 added project name "Vendi" in note "Protocol 1 is not supported by Kiosk III". Section 9.7 added 01/ 03 sub-command; 9.7.1/ 9.7.3 sections. Section 5.1/ 9.2 removed "thirteen" wording for system AID description. Section 10.2 removed note "Key Management Parameter commands in this section are only used by Kiosk III/ Vendi.". Section 3.0/ 9.1.9/ 10.4 removed "Kiosk II" wording. Section 3.0 added "USB" in description "All of the readers have an RS232 Serial Interface". Section 10.4 (USB Flash Boot Loader) was removed. All sections removed Vend/DTc wording, replaced by "Vendi". All sections removed GR x.x.x or Global Reader related wording. All sections removed SAM related description. All sections removed VP5000 wording, replaced by "graphic reader". All sections removed EEPROM wording, replaced by "flash memory". Appendix A.6 removed Q&A that related to ViVOpay 5000, 07-xx series, 01-03 and 01-04 cmd; corrected some answers to meet current design. Appendix A.8 corrected some description to meet current design. Table 1 (Hardware Cross Reference) removed other readers except Kiosk III; added new reader "Vendi". Table 2 (Commands Sorted by Command Name) removed note "f Requires Firmware Version 1.2.0 or higher". Table 3 (Commands Sorted by Command Number) added 84-0E/ 84-0F commands; 29-00_P2 command removed note "Kiosk II only"; removed note "f Requires Firmware Version 1.2.0 or higher".. Table 12 (System AIDs) added 1 new AID A0 00 00 01 52 30 10 (Discover Application) Table 13 (Global Configuration TLVs)/ 14 (Group Configuration TLVs) some tags added new note: Tag 9F59 added new note "Vendi default values are B4 07 00". Tag 9F5E added new note "Vendi default values are 00 00". Tag DF64 added new note "Vendi default value is 01". Tag FFF7 added new note "Vendi default value is 00". Tag 9F35 added new note "Vendi default value is 24". Tag 9F40 added new note "Vendi default values are 60 00 00 00 01". Tag 9F66 added new note "Vendi default values are A0 00 40 00". Tag 9F7C added new note "Vendi default values are 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00". Tag FFF4 added new note "Vendi default values are 01 00 01". Tag FFF8 added new note "Vendi default value is 03". Tag FFFC added new note "Vendi default value is 04".

Version	Date	Change
		▯ Table 15 (PayPass Default Group Configuration TLVs) some tags added new note: Tag 9F35 added new note "Vendi default value is 24". Tag 9F40 added new note "Vendi default values are 60 00 00 00 01". Tag 9F53 added new note "Vendi default value is 00". Tag 9F7C added new note "Vendi default values are 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01". Tag FFF8 added new note "Vendi default value is 03". Tag FFFC added new note "Vendi default value is 04". ▯ Table 19 (System AID Default Configuration TLVs) added 1 new AID; some AIDs added new note: New AID: A0 00 00 01 52 30 10 (Discover Application) MasterCard: "Vendi default value, FFE3 = 40, FFE9 = 02 00 01" J/Speedy: d"Vendi default value, FFE2 = FF" MXI: "Vendi default value, FFE2 = FF" Interac: "Vendi default value, FFE2 = 15" ▯ Table 46 (Enhanced Poll for Token Data Field for Command Frame) transaction type added value 00 03. Table 56 (Enhanced Pass-Through Data Field) corrected LED 2 as value 02h.
NEO v1.00 Rev. 52	4/1/2015	Appendix A.5, add description for Kiosk III design. ' The Kiosk III reader allows for storage of up to a maximum of 60 keys which are uniquely identified as a key index in each payment scheme(RID).' ▯ Add new tag FFEE1E in Table 13.
NEO v1.00 Rev. 53	4/27/2015	Add Kiosk III Boot Loader (10.5)
NEO v1.00 Rev. 54	4/27/2015	Updated Format
NEO v1.00 Rev. 55	6/19/2015	1. Update Table 2&3: > Delete command Load DUKPT Key Type (C7-30) > Add check DUKPT Key type (81-02) > Add Load Initial DUKPT Key request 2. Update Table 13: > Tag FFF3 byte 1, add SmartTap support flag 3. Update Table 14: > Tag FFF4, add D-PAS reader risk flags definition 4. Update Table 19: > Add default D-PAS AID settings 5. Add 02-01 command response format for D-PAS and SmartTap transaction. 6. Add notes for commands Set Serial Number and Get serial Number (9.1.11 and 9.1.12) 7. Modified 10.2 DUKPT Key Management Parameter Commands 8. Modified 10.4 Kiosk III Boot Loader

Version	Date	Change
NEO v1.00 Rev. 56	6/29/2015	Table 2 (Commands Sorted by Command Name): added 1 cmd 09-00. Table 3 (Commands Sorted by Command Number): added 1 cmd 09-00. Table 13 (Global Configuration TLVs): corrected some notes for Vendi. Table 14 (Group Configuration TLVs): corrected some notes for Vendi; created 1 tag 9F41 Table 15 (PayPass Default Group Configuration TLVs): corrected some notes for Vendi. Table 18 (New): added configuration TLVs of Group 2. Table 20 (System AID Default Configuration TLVs): corrected some notes for Vendi. ---------- CMD 04-09: added 6 data objects that did not be modified, DF891B/ FE02/ FE03/ DF891A/ FE05/ FEFE CMD 09-01: added 1 table to describe the value for Vendi. CMD 09-02: corrected the length of tag DF61, the value for K21 and the example. CMD F0-F6: added descriptions. CMD F0-F7: added descriptions. CMD F0-F9: added descriptions in note. CMD F0-FC: added descriptions in note. CMD F0-FD: added descriptions in note. ---------- Appendix A.8: corrected default message index (ENG/ FRA/ ENG&FRA).
NEO v1.00 Rev.57	7/15/2015	1. Update 5.1.5 User-defined TLV Groups > Add note for American Express and Discover 2. Update 9.3.1 Activate Transaction Command (02-01) > Update special description for Discover D-PAS and SmartTap application 3. Modify 10.2 DUKPT Key Management Parameter Commands > Add 10.2.6 Set Data Encryption Enable Flag (C7-36) > Add 10.2.7 Get Data Encryption Enable Flag (C7-37) 4. Add Encrypted response format in below commands > Activate Transaction Command (02-01) > Get Transaction Result Command (03-00) > Pass Through- Exchange Contactless Data (2C-03) > Pass Through-PCD Single Command Exchange (2C-04) > Pass Through-Get PCD and PICC Parameters(2C-05) > Pass Through-Mifare Read Blocks (2C-07) > Auto-Poll Burst Mode
NEO v1.00 Rev.58	8/4/2015	# Added support for the following SRED items 1. Add Encrypted response format in below commands > Pass Through-Exchange APDU Data (2C-13) > Pass Through-NFC Command (2C-40) 2. Modify Pass Through commands encryption response format: 2C-03, 2C-04, 2C-05, 2C-07, 2C-13,2C-40 Raw data of Encrypted data field is <2 bytes plaintext Data Field Length><whole plaintext Data Field><Padding (0x00)> 3. Add SRED note for response format in commands: > C7-36, C7-37, > 02-01, 03-00, 2C-03, 2C-04, 2C-05, 2C-07, 2C-13,2C-40 > Auto-Poll Burst Mode response 4. Add SAM interface in commands: 2C-0B, 2C-12, 2C-13. SAM interface is only supported by SRED version device # Other changes: 5. Replace SmartTap with Android Pay 6. Modify response format of Enhanced Pass-Through Command (2C-0B) 7. Add special TLV for Paypass application in Activate Command response (02-01)

Version	Date	Change
NEO v1.00 Rev.59	9/25/2015	1. Modify response format of 2C-0B command (add SAM interface description). 2. Update 10.4 Kiosk III Boot Loader
NEO v1.00 Rev.60	10/10/2015	Correct 2C-12 command description
NEO v1.00 Rev.61	10/23/2015	Add peer to peer function commands: 1. Peer To Peer Send A Message (C7-9A) 2. Peer To Peer Receive A Message (C7-9B)
NEO v1.00 Rev. 62	10/21/2015 (KT)	1.1.1 "MasterCard Contactless (PayPass) Capability" added to explain the continued use of the name "PayPass" despite MasterCard's deprecation of that name 1.1.2 Disclaimer added to remind users that Protocol 1 is now deprecated Corrected Protocol 1 to Protocol 2 in a reference to table of Protocol 2 commands. Fixed table numbering. Appendix A.6 "TDES Data Encryption Examples" added. Appendix A.7 "AES Data Encryption Examples" added. Subsequent appendices renumbered. Appendix A.10 modified to remove redundant discussion of Secure Communications. Appendix A.11 added (MSR Data Output Format). Discussion of 80-series commands removed. Private commands relevant to key injection removed. Various Notes involving SRED readers clarified.
NEO v1.00 Rev. 63	10/27/2015	1.LCD Display Table, update string " Echec" to " Échec" 2.Update Vendi response of 09-20, ASCII format "CL AID,MasterCard PayPass M/Chip v3.0.2, v1.00,,<CR><LF> " To CL AID, MasterCard PayPass M/Chip v3.0.2, Vendi v1.0.0,,<CR><LF> and Hex Format 3. Add C7-38 and C7-39 for MSR configuration.
	10/29/2015 (KT)	Fix "Wingding text" issues, fix stray symbols.
Rev. 64	11/9/2015	Added more Notes for MSR parsing table of Appendix A.11, to explain all the fields in detail. Added Appendix for "Encrypted Data Format, TLV-Based"
Rev. 65	11/12/2015	1. Add status code 70h(Antenna Error) and note for protocol 2. 2. Add note for '3.0 Serial Communication Interface' to suggest customer not to plug in/out serial communication interfaces during the device power on.

Version	Date	Change
NEO v1.00 Rev. 66	12/01/2015	1. Fix description error in “Get Admin DUKPT Key Status” (C7-2F) command 2. Add Kiosk III Amex 9F33 and 9F6E configuration description in “User-defined TLV Groups” 3. Add Status code 0x80 (Use another card) and 0x81 (Insert or swipe card)
Rev. 67	12/4/2015 (KT)	Add clarifications to Section 10: Enabling encryption is a one-time-only event (it cannot be disabled), but non-encrypted data will necessarily occur if a DUKPT key is not present. Clarification to Sec. 10 on data output formats and parsing of same. Add enhanced descriptions in Appendix A.6, A.7, A.11 of sample data and parsings.
Rev.68	12/8/2015	Add Appendix A.13 :Enhanced Encrypted MSR Data Output Format for Force Encryption Fixed typo in C7-33 (length byte should be 0x01, not zero).
Rev.69	1/5/2016	1. Add command “Check DUKPT Keys (81-02)” 2. Add command “Check DUKPT Key (81-04)” 3. Add command “Get DUKPT Key Serial Number(KSN) (81-0A)” 4. Add command “Set Temporary Baud Rate (30-02)” 5. Modify “Set Data Encryption Enable Flag (C7-36)” description 6. Add “When encryption is enabled, burst mode is disabled” related description 7. Delete encrypted data format in Burst Mode 8. Modify encryption description in “Activate Transaction(02-01)” and “Get Transaction Result (03-00)” commands 9. Add DFEE26 TLV description in “Activate Response TLVs” table 10. Correct encrypted data format to be `<PREAMBLE><Attribution Byte><KSN TLV><Track1 TLV or 00h><Track2 TLV or 00h><Clear Record Flag Byte><Clear Record TLV(optional)><Other TLVs><CRC>` In Appendix A.5 and A.6 11. Update Encrypted Contactless data example in Appendix A.6 and A.7

Version	Date	Change
Rev.70	1/14/2016	1. Add ApplePay Function 2. Modify encryption output data format to be <Attribution byte><TLV data>
Rev.71	1/18/2016	1. Correcet Set Temporary Baud Rate(30-02) Command Frame Sub-Command value. 2.Correct Table34 Tag DFEE26 Description, Format and Length. 3. Modify Table for Success Transaction--Encrypted data field format for Contactless card. 4. Add Table for Success Transaction--Encrypted data field format for MSR card. 5. Correct Table "Get Transaction Result Encrypted data field format for contactless card". 6. Add Table "Get Transaction Result Encrypted data field format for MSR card. 7. Modify Appendix A.5: Firmware FAQ Q13 Encrypted EMV and Enhanced Encrypted MSR layout. 8. Update Appendix A.6:TDES Data Encrypted Exmaple 9. Update Appendix A.7:AES Data Encrypted Exmaple 10. Modify Appendix A.11: Enhanced Encrypted MSR Data Output Format
Rev.72	1/19/2016	1. Correct description of “NFC Tag Command (2C-40)” 2. Correct description of ApplePay commands Set Merchant Record (04-11) Get Merchant Record (03-11)
Rev. 73	1/19/2016 (KT)	Regenerate TOC and fix format issues. Remove Q13 of FAQ.

Version	Date	Change
Rev. 74	1/2/2016 (Yidong)	1. Add Key Slot Note in 81-02,81-04,81-0A commands 2. Correct description error in “Set Temporary Baud Rate (30-02)” 3. Add description in “Activate Transaction Command (02-01)” Failed Transaction-Encrypted Data Field Format:“KSN of DUKPT Account Key. If only TLV Error code is present and no other TLV data, this field is not present.” 4. Add note in Peer To Peer Function part: “Peer To Peer function can only be used in Pass-Through mode” 5. Correct descryption error in Appendix A.6, A.7 Contactless examples 6. Correct descryption error in “Set DUKPT Key Encryption Type (C7-32)”: “The encryption type CANNOT be changed once the Account DUKPT Key is present” 7. Delete encryption response format tables in Pass-Through related commands (2C-03,2C-04,2C-05,2C-07,2C-13,2C-40)
Rev. 75	2/2/2016 (Erin)	1. Modified Kiosk III Boot Loader descriptions for download file name format. 2. Add Kiosk III boot loader commands and firmware downloader command processing flow. 3. Add 2 boot loader command status codes to protocol 2 status code table.
Rev. 76	2/2/2016 (Richard)	1. Modified product type of Vendi, and add product type of Unipay III and Unipay 1.5, response of CMD 09-01 2. Modified HW Information of Venid, and add product type of Unipay III and Unipay 1.5, response of CMD 09-14
Rev. 77	2/25/2016 (Yidong)	1. Add processing steps for Discover D-PAS Issuer Update and Android Pay in “Activate Transaction Command (02-01)” description 2. Add FFEE01 TLV into “Activate Transaction Command (02-01)” Activate Command TLVs table (Table-32)
Rev. 78	3/3/2016 (Yidong)	1. Add module type “AppSpe” for 09-20 command. 2. Add description for 09-20 command
Rev. 79	3/14/2016 (Ching-Wei)	1. Add Command 04-0A
Rev. 80	4/5/2016 (Yidong)	1. Add Secure Pass-Through Function 2. Add MAC DUKPT Key description in 81-02, 81-04, 81-0A 3. Add description of response in Secure Pass-Through Mode for 2C-03, 2C-04, 2C-07, 2C-13, 2C-40

Version	Date	Change
Rev. 81	4/26/2016 (Yidong)	Add Error Codes 80h-85h that now used in Applepay VAS.
Rev. 82	5/10/2016 (Ching-Wei)	1.Add Tag DF891C. (Interac Retry Limit) 2.Update Tag FFEE1D 4 bytes change to 5 bytes
Rev. 83	5/10/2016 (Yidong)	1. Remove white list function in Secure Pass-Through Function 2. Activate Transaction Response Frame Encrypted Data Format refer to "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F"
Rev. 84	5/16/2016 (StevenChen)	Correct Tag FFE1 Description
Rev. 85	5/18/2016 (Yidong)	1.Return FFE1 Description to Rev.83 2.Remove C7-2F command (use Vivopay Key Loading to load Admin DUKPT Key) 3.Add Slot 2 (Admin DUKPT Key) into 81-02, 81-04, 81-0A 4. Transaction output data encryption refer to "80000404-001 ID-Tech Encrypt Data Format In Command Response Specification v.63F" 5. Add "Activate Command Examples for ApplePay VAS" 6. Add Note in C7-32, C7-33 command "This command is only supported in NSRED device. In SRED device, only TDES algorithm is used to encrypt transaction output sensitive data." 7. Add "Note: KioskIII operates in AutoPoll mode by default" in Set Poll Mode (01-01)
Rev. 86	5/23/2016 (StevenChen)	Add Tag DFEF2C Description