ViVOpay

Interface Developer's Guide

Version 1.0.1

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1 Introduction

This document specifies a general serial Interface that any terminal can use to communicate with a ViVOpay reader for carrying out contactless EMV transactions. The commands and parameters related to the LCD display only works on the ViVOpay 5000/5000m because the other ViVOpay readers do not have the LCD display module.

Before the introduction of the contactless EMV, the ViVOpay reader usually worked in standalone mode in which it did not require a terminal to initiate a transaction. In this mode the reader could carry out a transaction with a card at any time and then send the data to a terminal.

In order to provide fast processing of contactless EMV cards, the ViVOpay readers function in an intelligent mode and provide EMV functionality. 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 has introduced some dependence on terminals to set certain parameters and also to perform some intelligent processing in order to complete a transaction.

While contactless EMV requires a terminal to carry out a meaningful transaction, it is still desirable for the ViVOpay Reader to be able to function in standalone mode. This is especially useful for test environments where a terminal may not be available. In addition, environments where all transactions are going to be with contactless MagStripe cards, standalone functionality may be desirable.

The EMV serial interface specified in this document attempts to meet the requirements for contactless EMV support, while at the same time being backward compatible to the standalone mode of operation.

This document gives the details of how to communicate with ViVOpay, including the physical connections, the Serial Link Protocol, and the Command API.

1.1 Commands by Hardware

1.1.1 Contactless Only

The following readers are contactless only:

- ViVOpay 3000
- ViVOpay 4000
- ViVOpay 4500
- ViVOpay DT

1.1.2 Contactless + MSR

The following readers are contactless plus Magnetic Stripe (MSR)

- ViVOpay 4500m
- ViVOpay 5000m
- ViVOpay DTm

1.1.3 Contactless + MSR + LCD Display

The following readers are contactless plus Magnetic Stripe (MSR) plus LCD display

- ViVOpay 5000
- ViVOpay 5000m

1.1.4 Contactless + MSR + Line Display

The following readers are contactless plus Magnetic Stripe (MSR) plus line display

- ViVOpay Vend
- ViVOpay DTc

1.1.5 ViVOpay Reader Hardware Cross Reference

Reader	C'less	MSR	LCD Display	Line Display
3000	●			
4000	●			
4500	●			
4500m	●	●		
5000	●		●	
5000m	●	●	●	
DT	●			
DTc	●	●		●
DTm	●	●		●
Vend	●	●		●

1.2 Command Table

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

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	Notes
Ping	√	√	√	√	√	2	
Set Poll Mode	√	√	√	√	√	2	
Set LCD Message		√		√	√	2	
Store LCD Message		√		√	√	2	
Get LCD Message		√		√	√	2	
Set/Get Source for RTC/LCD/Buzzer/LED	√	√	√	√	√	2	
Set EMV Configuration	√	√	√	√	√	2	
Get EMV Configuration	√	√	√	√	√	2	
Cancel Transaction Command	√	√	√	√	√	2	
Set Configurable AID (SCA)	√	√	√	√	√	2	a
Set Configurable Group (SCG)	√	√	√	√	√	2	a
Get Configurable AID (GCA)	√	√	√	√	√	2	a
Get Configurable Group (GCG)	√	√	√	√	√	2	a
Delete Configurable AID (DCA)	√	√	√	√	√	2	a
Delete Configurable Group (DCG)	√	√	√	√	√	2	a
Get All AIDs (GAA)	√	√	√	√	√	2	a
Get All Groups (GAG)	√	√	√	√	√	2	a
Activate Transaction Command	√	√	√	√	√	2	
Get Transaction Result	√	√	√	√	√	2	
Update Balance Command	√	√	√		√	2	
Activate Transaction Command (MXI)	√	√	√		√	2	
Debit Write Command	√	√	√		√	2	
Write Data Command	√	√	√		√	2	

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol	Notes
Reader Download (ISP) Mode	√	√	√	√	√	2	
Set Baudrate	√	√	√	√	√	2	
Configure Buttons Command			√	√	√	2	b
Get Button Configuration Command			√	√	√	2	b
Disable Blue LED Sequence Command			√	n/a	√	2	b
Enable Blue LED Sequence Command			√	n/a	√	2	b
LCD Display Clear Command			√	n/a	√	2	b
Turn Off Yellow LED Command			√	n/a	√	2	b
Turn On Yellow LED Command			√	n/a	√	2	b
Buzzer On/Off Command			√	n/a	√	2	b
LCD Display Line 1 Message Command			√	n/a	√	2	b
LCD Display Line 2 Message Command			√	n/a	√	2	b
Get Full Track Data	√	√	√	√	√	1	
Set RF Error Reporting						1	
Get Version	√	√	√	√	√	1	

a Not in Global Reader Lite (GRL)
b ViVOpay Vend only

1.3 Pass-Through Command Table

Note: All commands in the following table use version 2 formats (see Version 2 Formats).

Command	C'less or C'less + MSR	LCD	Line	US	EMV	Protocol
Antenna Control	√	√	√	√	√	2
LED Control	√	√	√	√	√	2
Buzzer Control	√	√	√	√	√	2
Pass-Through Mode Start/Stop	√	√	√	√	√	2
Poll for Token	√	√	√	√	√	2
ISO APDU Exchange	√	√	√	√	√	2
PDC Single Command Exchange	√	√	√	√	√	2
Get PCD & PICC Parameters	√	√	√	√	√	2
Mifare Authenticate Block	√	√	√	√	√	2
Mifare Read Blocks	√	√	√	√	√	2
Mifare Write Blocks	√	√	√	√	√	2
Mifare ePurse Command	√	√	√	√	√	2
High Level Halt Command	√	√	√	√	√	2

1.4 EMV Key Manager Table

Note: All commands in the following table use version 1 formats (see Version 1 Formats).

Command	C'less or C'less + MSR	C'less + MSR + LCD	C'less + MSR + Line	US	EMV	Protocol	Notes
Set CA Public Key	√	√	√		√	1	a
Delete CA Public Key	√	√	√		√	1	a
Delete All CA Public Keys	√	√	√		√	1	a
RTC Set Time	√	√	√		√	1	b
RTC Get Time	√	√	√		√	1	b
RTC Set Date	√	√	√		√	1	b
RTC Get Date	√	√	√		√	1	b

a If SAM installed, US and EMV; If SAM not installed, US Only
b Real Time Clock only

2 Serial Link Protocol

2.1 Port Settings

In order to communicate with ViVOpay the serial port parameters must be set to specific values. The parameters and the required settings are as follows:

Parameter	Value
Baudrate	19200 bps (or 9600 bps)
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

2.2 Basic Communication

All communication between ViVOpay and the POS Terminal is in the form of command-response packets. The terminal always initiates communication by sending a command packet. And ViVOpay responds by sending a response. Details on packets are given in a later section.

2.3 Timeouts

The timeouts on ViVOpay's end are given below. Timeouts for a sample PC-side application are also given.

The ViVOpay Reader periodically checks for command packets. Once it starts receiving a command packet, it will expect each successive byte to arrive within 200ms. If at least one byte has been received by the ViVOpay reader for the command packet and the next byte is not received within 200ms, the ViVOpay Reader will time out.

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

3 Packet Format

There are 2 types of protocols: Version 1 and Version 2.

3.1 Version 1 Formats

High-level communication between ViVOpay and the terminal is in the form command-response pairs. This command/response mechanism involves the terminal sending information to ViVOpay in the form of one or more frames and the ViVOpay sending one or more frames back to the terminal in a pre-defined order. A simple command will involve a command frame going from the terminal to ViVOpay, and the ViVOpay responding with a single frame. A more complex command may involve a number of 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 three types of Frames – Command Frames, Data Frames and Acknowledgement Frames. The format of each type of frame is given below.

3.1.1 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

3.1.2 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).

3.1.3 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

3.1.4 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 will have 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 will always contain an Error Status and will never contain an "OK" 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.

3.1.5 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).

3.2 Version 2 Formats

There are two types of Packets for Version 2 formats: Command Packets and Response Packets. The formats of these Packets are given below.

3.2.1 Command Packet

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							

3.2.2 Response Packet

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							

3.3 Pass Through Command Packets

There are two types of Packets - Command Packets and Response Packets. This sub-section defines the packet types and their format.

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

3.3.1 Pass-Through Command Packet

Note: The Byte 14+n and Byte 15+n CRCs are the reverse of standard Version 1 Format and Version 2 Format Command packets in that the CRC(MSB) is Byte 14 and the CRC(LSB) is Byte 15 for Pass Through command packets.

Within each Pass-through Packet Type, the CRC will be stored as big-endian number i.e. higher byte first.

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		

Direction: From terminal to ViVOpay

3.3.2 Pass-Through Response Packet

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		

Direction: ViVOpay to terminal

3.4 Status Codes

The Serial Interface supports both Version 1 Protocol and Version 2 Protocol status codes.

3.4.1 Status Codes for Version 1 Protocol

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

3.4.2 Status Codes for Version 2.0 Protocol

Status Code	Status
00h	OK
01h	Incorrect Header Tag
02h	Unknown Command
03h	Unknown Sub-Command
04h	CRC Error in Packet
05h	Incorrect Parameter
06h	Parameter Not Supported
07h	Mal-formatted Data
08h	Timeout
0Ah	Failed / Nak
0Bh	Command not Allowed
0Ch	Sub-Command not Allowed
0Dh	Buffer Overflow (Data Length too large for Reader Buffer)
0Eh	User Interface Event
23h	Request Online Authorization

3.5 Error Codes

Error Code	Description	Reason for Error and Suggested Error Handling
00h	No Error	None.
01h	Out of Sequence Command	Terminal application is sending serial commands in the wrong sequence. Terminal should send commands in the correct sequence in terminal application code.
02h	Go to Contact Interface	If the reader supports contact interface and transaction failed in the contactless interface then can use contact interface to perform the transaction.
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.

Error Code	Description	Reason for Error and Suggested Error Handling
20h	Card returned Error Status	Card returned SW1SW2 not equal to 9000 hex. Value of the SW1SW2 bytes returned by Card will be returned in the Data portion of the response packet. 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 would depend on when in the transaction flow the error occurred. The specific transaction state during which the error occurred is indicated by the RF State Code (see section on RF State Codes) that will be reported in the data section of the response packet. 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 could retry the transaction or abandon it. For MXI (Cash) transactions: The Card amount is not deducted at this point. ***If RF State Code = GEN AC:*** For Credit transactions: The terminal could retry the transaction or abandon it. For MXI (Cash) transactions: At this point the amount may or may not have been deducted from the Card Balance. In this case the terminal MUST ask the customer to represent the card and retry the complete transaction again (from the Activate command). This will allow the Reader to carry out exception processing. If amount was already deducted, it will not be deducted again. If the amount had not been deducted, it will be deducted. If all goes well a Clearing Record will be sent back. If the Reader is not allowed to do exception handling, then the balance on the card may not reflect the balance expected by the customer.
21h	Collision Error	If more than one card in the field will generate this kind of error.
22h	Amount Over Maximum Limit	If the Transaction Amount is greater than Maximum Offline Spending Amount
23h	Request Online Authorization	If the Transaction Amount is greater than the Balance on the card but is less than the Maximum Offline Spending Amount then reader send this error code back to the terminal along with other information needed by the acquirer to format an online authorization request
25h	Card Blocked	If the card is not supported by the reader according to the value of parameter Application Capability (FFF3) this error code will send 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 Comm Error as a result of which the card response did not reach the Reader. How the terminal handles this error would depend on when in the transaction the error occurred. The specific transaction state during which the error occurred is given by the RF State Code. Suggested error handling for each RF State Code is given below: ***RF State Code = PPSE:*** The terminal could retry the transaction or abandon it. For MXI (Cash) transactions: The Card amount is not deducted at this point. ***If RF State Code = SELECT:*** The terminal could retry the transaction or abandon it. For MXI (Cash) transactions: The Card amount is not deducted at this point. ***If RF State Code = GPO:*** The terminal could retry the transaction or abandon it. For MXI (Cash) transactions: The Card amount is not deducted at this point. ***If RF State Code = READ RECORD:*** The terminal could retry the transaction or abandon it. For MXI (Cash) transactions: The Card amount is not deducted at this point. ***If RF State Code = GEN AC:*** For Credit transactions: The terminal could retry the transaction or abandon it. For MXI (Cash) transactions: At this point the amount may or may not have been deducted from the Card Balance. The terminal MUST ask the customer to represent the card and retry the transaction again (from the Activate command). This will allow the Reader to carry out exception processing. If amount was already deducted, it will not be deducted again. If the amount had not been deducted, it will be deducted. On success a Clearing Record will be sent back. If the Reader is not allowed to do exception handling, then the balance on the card may not reflect the balance expected by the customer. ***If RF State Code = GET DATA (Ticket):*** For MXI (Cash) transactions: The terminal could retry the transaction or abandon it. The Card amount is not deducted at this point. ***If RF State Code = GET DATA (Ticketing Profile):*** For MXI (Cash) transactions: The terminal could retry the transaction or abandon it. The Card amount is not deducted at this point. ***If RF State Code = GET DATA (Balance):*** For MXI (Cash) transactions: The terminal could retry the transaction or abandon it. The Card amount is not deducted at this point. ***If RF State Code = PUT DATA (Ticket):*** For MXI (Cash-Ticketing) *Payment at Exit-Exit* transactions Only: In this case the terminal MUST ask the customer to represent the card and retry the complete transaction again (from the Activate command). This will allow the Reader to carry out exception processing.
40h	Unknown Data Element	This Error Code is reserved for future use.

Error Code	Description	Reason for Error and Suggested Error Handling
41h	Required Data Element(s) Missing	This Error Code is reserved for future use.
42h	Card Generated AAC	The card declined the transaction by sending an AAC instead of a TC. The reason why the card declines the transaction is not known to the Reader. For MXI (Cash) transactions: At this point the amount may not have been deducted from the Card Balance. However, in this case too the terminal MUST ask the customer to represent the card and retry the complete transaction again (from the Activate command). This will allow the Reader to carry out exception processing. This is especially important for ticketing applications. If all goes well a Clearing Record will be sent back. If the Reader is not allowed to do exception handling, then the balance on the card may not reflect the balance expected by the customer.
43h	Card Generated ARQC	The card declined the transaction by sending an ARQC instead of a TC. The reason why the card declines the transaction is not known to the Reader. For MXI (Cash) transactions: At this point the amount may not have been deducted from the Card Balance. However, in this case too the terminal MUST ask the customer to represent the card and retry the complete transaction again (from the Activate command). This will allow the Reader to carry out exception processing. This is especially important for ticketing applications. If all goes well a Clearing Record will be sent back. If the Reader is not allowed to do exception handling, then the balance on the card may not reflect the balance expected by the customer.
44h	SDA/ DDA Failed (Not Supported by Card)	Data Authentication failed due to the card not indicating support for the Data Authentication method required. For Visa, when DDA is required, the card must indicate support for DDA in AIP. If this support is not indicated then the transaction will fail and this error code will be returned.
50h	SDA / DDA / CDDA Failed (CA Public Key)	Data Authentication failed due to missing CA Public Key. Retrying the transaction will not help since the transaction will fail at this point each time, unless the missing CA Public Key problem is corrected via Key Management commands. The terminal would have to know the correct key that is to be used before it can set it in the Reader. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.
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. This could be due to incorrect data from the card or due to incorrect CA Public Key data set in the Reader. Retrying the transaction will not help since the transaction will fail at this point each time, unless the problematic data is corrected. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance
52h	SDA Failed (SSAD)	. Data Authentication failed during SSAD. Retrying the transaction will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.
53h	DDA / CDDA Failed (ICC Public Key)	Data Authentication failed during attempted recovery of ICC Public Key. Retrying the transaction will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.

Error Code	Description	Reason for Error and Suggested Error Handling
54h	DDA / CDDA Failed (Dynamic Signature Verification)	Data Authentication failed during Dynamic Signature Verification. Retrying the transaction will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: 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 EMV configuration. Retrying the transaction with the same EMV configuration will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.
56h	Terminal Risk Management (TRM) Failed	The Terminal Risk Management step as defined in EMV Specifications failed. This could be due to incorrectly set EMV configuration. Retrying the transaction with the same EMV configuration will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.
57h	Cardholder Verification Failed	The Cardholder Verification step as defined in EMV Specifications failed. This could be due to incorrectly set EMV configuration. Retrying the transaction with the same EMV configuration will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.
58h	Terminal Action Analysis (TAA) Failed	The Terminal Action Analysis step as defined in EMV Specifications failed. This could be due to incorrectly set EMV configuration. Retrying the transaction with the same EMV configuration will not help since the transaction will fail at this point each time. For MXI (Cash) transactions: At this point the amount has been deducted from the Card Balance.
61h	SD Memory Error	This error will be reported only when trying to retrieve Transaction Logs. This error will never be reported during a transaction.

If an error occurs during a transaction and the terminal determines that exception processing needs to be done by the Reader, then the terminal must keep on retrying 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 the terminal may want to abort the retries even if the Reader has not been able to complete exception processing, for example the customer walks away or there is a problem with the card, etc. How and when the terminal stops retrying is out of the scope of this document.

3.6 RF State Codes

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

For MXI (Cash) transaction, the RF State Codes together with the Error Codes will allow the terminal to determine when exception processing needs to be done by the Reader.

RF 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

3.7 CRC Calculation

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

Width:	16-bits
Polynomial:	$x^{16} + x^{12} + x^5 + 1$
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 will be calculated for the entire packet inclusive of Frame Tags, unused bytes, etc. The CRC of the Command Packets will be little-endian i.e. Lower byte first. The CRC of the Response Packets will be big-endian i.e. higher byte first.

Within each Pass-through Packet Type, the CRC will be 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

See Appendix A.1 for sample source code.

4 General Commands for Transactions

4.1 Ping

Ping command can be used to check if the ViVOpay reader is connected to the terminal or not. If ViVOpay is connected, it will respond back with a valid response packet, otherwise there will be no response.

The Command Packet

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	18h	01h	00h	00h	None		

The Response Packet

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	18h	00	00h	00h	None		

4.2 Set Poll Mode

The ViVOpay reader can function in two polling modes, "Auto Poll" and "Poll on Demand".

When the ViVOpay Reader is powered up, it functions in "Auto Poll" mode by default. In this mode it is not dependent on an external terminal to initiate a transaction. It keeps polling for a card and if a card is found, it carries out a transaction. If a supported contactless MagStripe card is detected, then the transaction can be carried out without the intervention of a terminal and the Track data can be sent out on the MagStripe Interface (if the ViVOpay unit supports it) and also retained until the terminal retrieves it through the "Get Transaction Result" command. The Auto Poll mode is required for environments where the ViVOpay Reader will be connected to a POS terminal via the MagStripe Interface and is required to read only contactless MagStripe Cards.

In some environments it may be desirable that the reader starts to poll for a card only when the terminal requests it to. For such an environment, the terminal may opt for the "Poll on Demand" mode. In this mode the ViVOpay Reader remains in the idle state and does not poll for cards. It only starts polling if the "Activate Transaction" command is received. It continues to poll until a card is found, or it times out. Once the transaction has completed (or the reader times out while polling) the Reader returns to the idle state. This approach is more convenient for situations where the terminal may need to send some data to the reader such as for contactless EMV transactions.

The Set Poll Mode command allows the terminal to set the ViVOpay reader polling mode. And the value will save to the nonvolatile memory so that it will not change after power cycling.

The Command Packet

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	Description
00h	Auto Poll
01h	Poll on Demand

The Response Packet

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	01h	See Table	00h	00h	None		

The Poll Mode has been set to the requested mode only if the response packet contains an OK Status Code. No data will be returned in the response.

4.3 Set LCD Message

This command is a way for the POS terminal to tell the reader to display message number # from the reader message storage. When this command is used to set the LCD message it can only work on the ViVOpay 5000. But if this command is used to set the Buzzer/LED only then it can work on all the modules.

Note: The reader must be in Poll On Demand mode to see the message displayed by the Set LCD Message command.

If the language is English the message can be configured by the "Store LCD Message" command. For all other languages the messages are not configurable.

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

1) Index 0x00 to 0x07 is the messages which directly display by the reader. Normally these messages not set through this command. But the terminal still can use "Store LCD Message" command to disable (set length to zero) or modify it if the language option is English. If using the "Store LCD Message" command to modify message "Amount" and "Balance", the string 1 and string 2 will always refer to the currency sign and value.
2) Index 0x08 to 0x0B is the messages which can set by the terminal. If the language is English the terminal also can use the "Store LCD Message" command to configure it.
3) Index 0xFF indicates to the reader not to set the LCD message which will allow terminal to set LED/Buzzer only.

It also allows the POS terminal to request the beep or flash the LED from the reader when the terminal tells the reader to displays a message.

The Command Packet

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	00	04	See Data Table		

The format and contents of the data field in the command packet are given in the following table.

Set LCD Message Data Table

Data Item	Length in Bytes	Description
LCD Message Index	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) • FF indicates not to set the LCD message which will allow terminal to set LED/Buzzer only

Data Item	Length in Bytes	Description
Beep Indicator	1	00h: No audible 01h: Single audible beep 02h: Double audible 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	00: LED 0 (Left most LED) 01: LED 1 02: LED 2 03: LED 3 FF: All LEDs
LED Status	1	00: LED Off 01: LED On 02: LED Flash at 500ms blink rate

The Response Packet

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	01h	See Table	00h	00h	None		

The LCD message has been set to the requested message only if the response packet contains an OK Status Code. No data will be returned in the response. It is the same for the beep indicator.

4.4 Store LCD Message

This command is a way for the POS terminal to configure the LCD display message in ASCII format and store the configuration data into the EEPROM of the reader. This command only can configure the LCD message in English and only works on the ViVOpay 5000.

The Command Packet

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	03h	00	variable	See Data Table		

If the data field in the command packet is:

- FF: The reader will restore all LCD messages to default set for ViVOtech UI Scheme
- FE: The reader will restore all LCD messages to default set for Visa Wave UI Scheme
- FD: The reader will restore all LCD messages to default set for EMEA UI Scheme

Otherwise the format and contents of the data field in the command packet are given in the following table:

Store LCD Message Table

Data Item	Length in Bytes	Description
LCD Message	Variable	• Message Index ID: one byte • Message Index ID Data length(len1): one byte which is not including the length of string 1,2 and 3 • Message Index ID String 1 length(len2): one byte • Message Index ID String 2 length(len3): one byte • Message Index ID String 3 length(len4): one byte • Message Index ID Data: length is variable and the format of data as follows: --- '%%': '%' --- \n: Indicates the start of a new line. If the \n is not followed by a %Pccrr, the previous %Pccrr is used and the text will overlay previous text. For example, if you enter "Bill/nBlack/n, the word Black will overlay the word Bill. --- %Pccrr: Set the position (column = cc and row = rr) in pixels. If ccrr equals "cccc" the message is centered on the screen. If cc equals "cc" and rr is a valid row number the message is centered to the row. Default value is %P0023. The %Pccrr command is in effect for the entire line, not where it is entered in the command. If multiple %Pccrr values are specified, the last %Pccrr value is used. --- %Ff: Set font to the font number f = 0: small f = 1: medium f = 2: large f = 3: extra large --- %Sn: Insert parameter string n; n is up to 3 The following is optional string data: • String 1: length is variable

		• String 2: length is variable • String 3: length is variable --- %Iii - display image number ii at the current position sent by %P command. This is for displaying Chinese and English together. Example 1: To display message "Welcome" in the center of LCD "%Pcccc%F3Welcome" Example 2: To display message "Transaction Complete" in two lines "%Pcc15%F3Transaction\n%Pcc35Complete" Example 3: To display message "Amount Tap Card" and insert parameter string 1 "$" and parameter string "100.00" So the length is: len1=44, len2 =1, len3=6, len4=0 And the data which including strings is: "%F3%Pcc04Amount\n%Pcc23%S1 %S2\n%F2%Pcc45Tap Card$100.00"

The Response Packet

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	01h	See Table	00h	00h	None		

The LCD message has been stored to the EEPROM only if the response packet contains an OK Status Code.

4.5 Get LCD Message

This command is used to get the messages stored inside EEPROM of the reader. All these messages display in English. This command only works on the ViVOpay 5000.

The Command Packet

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	04h	00	1	Message ID or FF(Request all messages save in the EEPROM)		

The Response Packet

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	01h	See Table	00h	variable	See Data Table		

The format and contents of the data field in the response packet are given in the following table.

Get LCD Message Data Table

Data Item	Length in Bytes	Description
No. of LCD messages	1	Number of LCD messages including in the response packet
LCD Message Data	variable	• Message Index ID: one byte • Message Index ID Data length(len1): one byte which is not including the length of string 1,2 and 3 • Message Index ID String 1 length(len2): one byte • Message Index ID String 2 length(len3): one byte • Message Index ID String 3 length(len4): one byte • Message Index ID Data: length is variable and the format of data as follows: --- '%%': '%' --- \\n: Indicates the start of a new line. If the \n is not followed by a %Pccrr, the previous %Pccrr is used and the text will overlay previous text. For example, if you enter "Bill/nBlack/n, the word Black will overlay the word Bill. --- %Pccrr: Set the position (column = cc and row = rr). In pixels – not characters If ccrr equals "cccc" the message is centered on the screen. If cc equals "cc" and rr is a valid row number the message is centered to the row. Default value is %P0023. The %Pccrr command is in effect for the entire line, not where it is entered in the command. If multiple %Pccrr values are specified in a command, the last

Data Item	Length in Bytes	Description
		%Pccrr value is used. --- %Ff: Set font to the font number f = 0: small f = 1: medium f = 2: large f = 3: extra large --- %Sn: Insert parameter string n; n is up to 3 The following is optional string data: • String 1: length is variable • String 2: length is variable • String 3: length is variable --- %Iii - display image number ii at the current position sent by %P command. This is for displaying Chinese and English together. Example 1: To display message "Welcome" in the center of LCD "%Pcccc%F3Welcome" Example 2: To display message "Transaction Complete" in two lines "%Pcc15%F3Transaction\n%Pcc35Complete" Example 3: To display message "Amount Tap Card" and insert parameter string 1 "$" and parameter string "100.00" So the length is: len1=44, len2 =1, len3=6, len4=0 And the data which including strings is: "%F3%Pcc04Amount\n%Pcc23%S1 %S2\n%F2%Pcc45Tap Card$100.00"

The LCD message data has been taken from the EEPROM correctly only if the response packet contains an OK Status Code.

4.6 Set/Get Source for RTC/LCD/Buzzer/LED

This command is used 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. If necessary, the reader can be configured to use both internal and external source except for RTC.

When the data length is 0x02, 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 packet.

The Command Packet (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			

The Response Packet (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 Table	00h	00h		

The Command Packet (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		

The Response Packet (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 Table	00h	02h	Bitmap for RTC/LCD/Buzzer/LED			

Data Byte1 definition:

Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Rsvd.	Rsvd.	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	use RTC from external source
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, RTC (Real Time Clock) chip is needed on the ViVOpay reader and the date and time from the RTC chip shall be 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 EMV Configuration command).

If configured to use internal buzzer, the buzzer inside the ViVOpay reader shall be used to indicate the transaction progress (same as the standalone VP4500 firmware); if configured to use external buzzer, an external buzzer shall be used, and the buzzer inside the ViVOpay reader shall not be used.

If configured to use internal LED, the LEDs inside the ViVOpay reader shall be used to indicate the transaction progress (same as the standalone firmware); if configured to use external LED, the LEDs on the terminal shall be used, and the internal LEDs shall not be used. The source of three transaction LEDs and one power LED can be configured separately.

4.7 Set EMV Configuration

It is strongly recommended that if you are just making a few changes to the default reader EMV SETTINGS, it is safer to use the Set EMV Configuration command listed below, rather than the Set Configurable Group COMMAND.

Conversely, if you wish to set many default tag values, it is better to use the Set Configurable Group command to modify the default group.

Finally, SET EMV configuration will never affect any configurable group except the default group variables. So, if you need to modify a tag value in a group other than the default, you must use the Set Configurable Group command instead.

Note: The above information only applies if your reader uses configurable Application Identifier (AIDs)

This command can be used to set or change the values of the specified EMV 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 scans the data portion of the command, extracts the TLV encoded EMV parameters from it and saves them to the nonvolatile memory for future use. If the Tag Length Variable (TLV) object is mal-formatted, it stops processing the object. A single command may contain more than one data object.

The Command Packet

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 EMV Data Objects encoded as TLV that can be set using this command are given in the following table.

Tag	Data Element Name	Format	Length in Bytes
9F02	Amount, Authorized (Numeric)	n12	6
9F03	Amount, Other (Numeric)	n12	6
9F33	Terminal Capabilities	b	3
9F40	Additional Terminal Capabilities	b	5
9F1A	Terminal Country Code Indicates the country code of the terminal, represented according to ISO 3166.	n3	2

Tag	Data Element Name	Format	Length in Bytes
9F1B	Terminal Floor Limit Changes the Floor Limit for ALL AIDs. If the Terminal Floor Limit of a specific AID is to be set then this tag should be preceded by a TLV Field for the specific Terminal AID (Tag: 9F06, Format: b5-16). Example 1: To set the Floor Limit for all AIDs to 100: 9F 1B 04 00 00 27 10 Example 2: To set the Floor Limit for PayPass MChip (MasterCard Credit) to 100: 9F 06 07 A0 00 00 00 04 10 10(or 9F 06 07 A0 00 00 00 04 88 26) 9F 1B 04 00 00 27 10 Example 3: To set the Floor Limit for PayPass MXI (MasterCard Cash) to 100: 9F 06 0A A0 00 00 00 02 30 60 D1 58 00 9F 1B 04 00 00 27 10	b	4
9F35	Terminal Type	n2	1
5F2A	Transaction Currency Code Indicates the Currency Code of the Transaction according to ISO 4217.	n3	2
9C	Transaction Type (Value = 00) Indicates the type of financial transaction, represented by the first two digits of ISO 8583, Processing Code.	n2	1
9A	Transaction Date (YYMMDD) Indicates local date that the transaction was authorized.	n6	3
9F21	Transaction Time (HHMMSS) Indicates local time that the transaction was authorized	n6	3
9F66	Visa Terminal Transaction Qualifier(TTQ)	b	4
FFFC[1]	Force MagStripe Transactions on MChip Cards: Value = 00: Normal Transaction Value = 01: Force MagStripe Transaction if MChip Card presented	b	1
FFFD[1]	Terminal Action Code (Other)	b	5
FFFE[1]	Terminal Action Code (Default)	b	5
FFFF[1]	Terminal Action Code (Denial)	b	5
FFFB[1] [2]	Language Option for LCD display: Value = 00: English only display Value = 01: Chinese only display Value = 02: English & Chinese display Value = 03: French only display	b	1
FFFA[1] [2]	LCD delay time(ms)	b	2
FFF9[1] [2]	LCD Font Size: Value = 02: Large Value = 03: Extra Large	b	1
FFF8[1]	UI Scheme: Value = 00:ViVOtech User Interface Value = 02:Visa Wave User Interface Value = 03:EMEA User Interface Note: LCD Messages need to be configured separately.	b	1
FFF7[1]	Enable/Disable Burst Mode: Value = 00: Disable Burst Mode Value = 01: Enable Burst Mode Value = 02: Burst Mode Auto shutoff. Burst mode will be turned off as soon as a transaction command is received (Sections 6 and 7 of this document)	b	1

Tag	Data Element Name	Format	Length in Bytes
FFF5[1]	CVM Required Limit	n12	6
FFF4[1]	Status Check & fDDAV00 & Zero Amount Handling (Online Capable)** for qVSDC Byte0 = 00:Enable Status Check Byte0 > 00:Disable Status Check Byte1 Note: fDDA version 1 is always enabled Byte1 = 00:Disable fDDA version 00 Byte1 > 00:Enable fDDA version 00 Byte2 = 00:Disable Option1** (Option 2) Byte2 > 00:Enable Option1** **See Requirement 5.2.2.3 of Visa Contactless Payment Specifications - v2.0.2.	b	3
FFF3[1]	Application Capability(1:Support,0:Not Support): Value = 0001: Support MasterCard Credit Value = 0002: Support American Express Value = 0004: Support Visa Value = 0008: Support Mobile J/Speedy Value = 0010: Support ViVOWallet1 Value = 0020: Support RBS Value = 0040: Support MasterCard Cash Value = 0080: Support Discover Value = 0100: Support Normal J/Speedy Value = 0200: Support ViVOpay Mifare for NFC Example: 0009 means reader support both MasterCard and Mobile J/Speedy applications	b	2
FFF2[1]	Terminal IFD Serial Number	an	8
FFF1[1]	Terminal Contactless Transaction Limit	n12	6
FFF0[1]	Specific Feature Switch: Byte 1, Bit 1: Value = 0(b): M/Chip Normal Flow Value = 1(b): M/Chip Optimized Flow Byte 1, Bits 2-8: RFU Byte 2: RFU Byte 3: RFU	b	3
DF63[1]	Anti-collision or Collision Detection 00: Anticollision Detection 01: Anticollision Resolution (Visa Wave)	b	1
DF64[1]	Enable/Disable Visa Wave cards 00: Reject Visa Wave cards 01: Accept Visa Wave cards	b	1
DF65[1]	Require Heartbeat packet 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 will go back to Not Working state. 00: Heartbeat packet not required. 01: Heartbeat packet required.	b	1
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

[1] These objects do not have any Tags associated with them. In order to allow setting of these parameters, unused tags have been used. The use of these tags should only be restricted to this 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). This note does not apply to those tags that are not marked as [1]

[2] These objects only work on the ViVOpay 5000.

The Response Packet

Byte 0-9	Byte 0-9	Byte 0-9	Byte 0-	Byte 0-	Byte 0-9	Byte 0-9	Byte 0-9	Byte 10	By
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)		
ViVOtech2\0	04h	See Table			None				

4.7.1 Interaction with Configurable AIDs

The Set EMV command is compatible with existing systems, whether they are Configurable AID-capable or not. This is determined by the amount of EEPROM on the system; those with 64K can use the Configurable AID software, others cannot.

Systems based on the 2124 (those without 64K EEPROM) have the same Set EMV Configuration command capability covered in this document.

Systems with 64K of EEPROM use databases of TLVs, where they have the ability to choose which "Group" of TLV are used in the given transaction. In these systems, there is ALWAYS a Default Group 0, which is used to access most transactions.

In these systems, the Set EMV command actually modifies the TLV found in the Default Group.

In effect, the user can modify the Default Group 0 by either calling Set EMV Configuration or by calling Set Configurable Group. Both commands have access to the variables of the Default Group.

4.8 Get EMV Configuration

It is usually more useful to use GET EMV Configuration rather than the GET GROUP command if you want access to the default group variable settings.

In essence, the Get EMV Configuration command ~ GET GROUP ZERO (default) command. Get EMV configuration cannot obtain any variables from other groups, you must use the GET GROUP command for those.

Note: The above information only applies if your reader uses configurable AIDs.

This command can be used to retrieve the values of the specified EMV data objects in the reader from nonvolatile memory.

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

The Command Packet

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	02h	00h	00h	None		

The Response Packet

Byte 0-9	Byte 0-9	Byte 0-9	Byte 0-	Byte 0-	Byte 0-9	Byte 0-9	Byte 0-9	Byte 10	By
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)		
ViVOtech2\0	03h	See Table			TLV Data Objects				

The EMV Data Objects encoded as TLV that will be returned in the data section of the response packet are given in the following table.

Tag	Data Element Name	Format	Length in Bytes
9F02	Amount, Authorized (Numeric)	n12	6
9F03	Amount, Other (Numeric)	n12	6
9F33	Terminal Capabilities	b	3
9F40	Additional Terminal Capabilities	b	5
9F1A	Terminal Country Code Indicates the country code of the terminal, represented according to ISO 3166.	n3	2

Tag	Data Element Name	Format	Length in Bytes
9F1B	Terminal Floor Limit The response may have multiple occurrences of this Tag, one for the Floor Limit of each AID. The Floor Limit for each AID supported will be preceded by a TLV object representing the Terminal AID. (Tag: 9F06, Format: b5-16). Example: If the terminal supports PayPass MChip (MasterCard Credit) and also PayPass MXI (MasterCard Cash) then the Floor Limits for these two AIDs will be returned as … 9F 06 07 A0 00 00 00 04 10 10 9F 1B 04 00 00 27 10 9F 06 0A A0 00 00 00 02 30 60 D1 58 00 9F 1B 04 00 00 27 10	b	4
9F35	Terminal Type	n2	1
5F2A	Transaction Currency Code Indicates the Currency Code of the Transaction according to ISO 4217.	n3	2
9C	Transaction Type Indicates the type of financial transaction, represented by the first two digits of ISO 8583, Processing Code.	n2	1
9A	Transaction Date (YYMMDD) Indicates local date that the transaction was authorized.	n6	3
9F21	Transaction Time (HHMMSS) Indicates local time that the transaction was authorized	n6	3
9F66	Visa Terminal Transaction Qualifier(TTQ)	b	4
FFFC[1]	Force MagStripe Transactions on MChip Cards: Value = 00: Normal Transaction Value = 01: Force MagStripe Transaction if MChip Card presented	b	1
FFFD[1]	Terminal Action Code (Other)	b	5
FFFE[1]	Terminal Action Code (Default)	b	5
FFFF[1]	Terminal Action Code (Denial)	b	5
FFFB[1] [2]	Language Option for LCD display: Value = 00: English only display Value = 01: Chinese only display Value = 02: English & Chinese display Value = 03: French only display	b	1
FFFA[1] [2]	LCD delay time(ms)	b	2
FFF9[1] [2]	LCD Font Size: Value = 02: Large Value = 03: Extra Large	b	1
FFF8[1]	UI Scheme: Value = 00:ViVOtech User Interface Value = 02:Visa Wave User Interface Value = 03:EMEA User Interface Note: LCD Messages need to be configured separately.	b	1
FFF7[1]	Enable/Disable Burst Mode: Value = 00: Disable Burst Mode Value = 01: Enable Burst Mode Value = 02: Burst Mode Auto shutoff. Burst mode will be turned off as soon as a transaction command is received (Sections 6 and 7 of this document)	b	1
FFF5[1]	CVM Required Limit	n12	6

Tag	Data Element Name	Format	Length in Bytes
FFF4[1]	Status Check & fDDAV00 & Zero Amount Handling (Online Capable)** for qVSDC Byte0 = 00:Enable Status Check Byte0 > 00:Disable Status Check Byte1 Note: fDDA version 1 is always enabled Byte1 = 00:Disable fDDA version 00 Byte1 > 00:Enable fDDA version 00 Byte2 = 00:Disable Option1** (Option 2) Byte2 > 00:Enable Option1** **See Requirement 5.2.2.3 of Visa Contactless Payment Specifications - v2.0.2.	b	3
FFF3[1]	Application Capability(1:Support,0:Not Support): Value = 0001: Support MasterCard Credit Value = 0002: Support American Express Value = 0004: Support Visa Value = 0008: Support Mobile J/Speedy Value = 0010: Support ViVOWallet1 Value = 0020: Support RBS Value = 0040: Support MasterCard Cash Value = 0080: Support Discover Value = 0100: Support Normal J/Speedy Value = 0200: Support ViVOpay Mifare for NFC Example: 0009 means reader support both MasterCard and Mobile J/Speedy applications	b	2
FFF2[1]	Terminal IFD Serial Number	an	8
FFF1[1]	Terminal Contactless Transaction Limit	n12	6
FFF0[1]	Specific Feature Switch: Byte 1, Bit 1: Value = 0(b): M/Chip Normal Flow Value = 1(b): M/Chip Optimized Flow Byte 1, Bits 2-8: RFU Byte 2: RFU Byte 3: RFU	b	3
DF63[1]	Anti-collision or Collision Detection 00: Anticollision Detection 01: Anticollision Resolution (Visa Wave)	b	1
DF64[1]	Enable/Disable Visa Wave cards 00: Reject Visa Wave cards 01: Accept Visa Wave cards	b	1
DF65[1]	Require Heartbeat packet 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 will go back to Not Working state. 00: Heartbeat packet not required. 01: Heartbeat packet required.	b	1
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

[1] These objects do not have any Tags associated with them. In order to allow setting/retrieval of these parameters, unused tags have been used. The use of these tags should only be restricted to this serial interface. Once the Terminal has received these values and saved them in memory, it should dispose of the tags (and not keep them associated with these two values). This note does not apply to those tags that are not marked as [1]

[2] These objects only work on the ViVOpay 5000.

4.8.1 Interaction with Configurable AIDs

The Get EMV command is compatible with existing systems, whether they are Configurable AID-capable or not. This is determined by the amount of EEPROM on the system; those with 64K can use the Configurable AID software, others cannot.

Systems based on the LPC2124 (those without 64K EEPROM) have the same Get EMV Configuration command capability covered in this document.

Systems with 64K of EEPROM use databases of TLVs, where they have the ability to choose which "Group" of TLV are used in the given transaction. In these systems, there is ALWAYS a Default Group 0, which is used to access most transactions.

In these systems, the Get EMV Configuration command actually transmits the TLV found in the Default Group.

In effect, the user can read the Default Group 0 by either calling Get EMV Configuration or by calling Get Group (covered in Get Configuratble Group). Both commands have access to the variables of the Default Group.

4.9 Cancel Transaction Command

This command is to ask the Reader to cancel the polling of any approaching card after the Activate Transaction Command or Update Balance Command has been sent to the reader.

After the terminal has issued the cancel command, the terminal will wait for the response from the reader. There should be no other command issued after the cancel command and before the response from the reader.

If the reader receives the cancel command before it sends the response of Activate command it will only send the response for cancel command. After that the reader will go to "idle" state and wait for the next command from the terminal.

The Command Packet

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	05h	01h	00h	00h	None		

The Response Packet

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 Table			None		

5 Configurable Application Identifiers (AIDs)

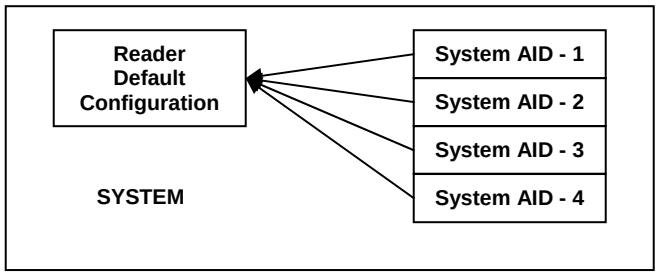
Note: as mentioned in Get EMV Configuration and Set EMV Configuration, a system with configurable AIDs now has multiple methods for accessing its default variables in Group 0.

In general, use the Get EMV Configuration and Set EMV Configuration when changing a few default values in Group 0. Use configurable AID commands when changing a majority of default values in Group 0, any Group 1-7 default values, or setting up new groups for non-default behavior.

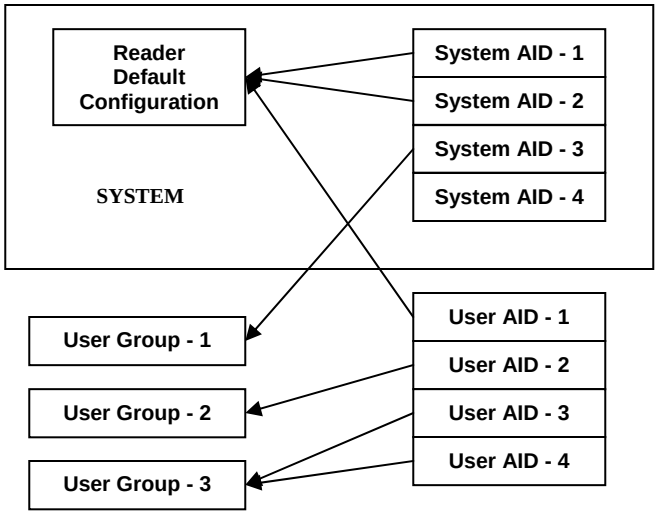
Configurable Application Identifiers allow the creation and customization of AIDs. Each AID may have characteristics that are unique and different from the reader's system configuration (see "Set EMV Configuration" section). The default configuration includes preloaded AIDs with predefined characteristics. These existing AIDs may also be modified or deleted as is required.

To create a new configurable AID you need to declare to the reader the AID you wish to use and you need to specify which function group that AID will use. The function group holds all of the characteristics (features and capabilities) for any AID that refers to it. You may create multiple AIDs and multiple groups. Multiple AIDs may refer to the same group or they may refer to different unique groups.

To modify an existing AID you need only communicate to the reader which AID and refer to the function group that has the characteristics you desire. You may delete an AID by communicating to the reader the AID number with no parameters.



The basic reader system is configured to support multiple AIDs in the reader default mode. The default configuration can be configured using the Get EMV Configuration and Set EMV Configuration commands described above. Each AID specific transaction is defined by the parameters in the Reader Default Configuration.



With configurable AIDs you can create new AIDs and new configuration Groups that define the functionality desired for a specific AID. You may also redefine the functionality for an existing AID by linking them to a new configuration Group or you may disable that AID if you do not desire that application to work.

Notice that 4 new AIDs and 3 new Groups have been created in the example above. The new AID "User AID – 5" has been linked to the Reader Default Configuration so that it will function as the other system AIDs will function. "User AID – 6" is will function as defined in the new "User Group – 2". Both "User AID – 7" and "User AID – 8" both point to the new "User Group – 3" and will function accordingly. "System AID – 3" has been linked to the new Group "User Group – 3" so that an existing AID may function in a new manner. Also notice that "System AID – 4" has been disabled by removing it link to a configuration.

These are the communication tools available to perform these tasks. You will also find example communications sequences in the appendix to help.

Configurable AID Commands:

- Set Configurable AID (SCA) Cmd and Sub Cmd 04 02
- Set Configurable Group (SCG) Cmd and Sub Cmd 04 03
- Get Configurable AID (GCA) Cmd and Sub Cmd 03 04
- Get Configurable Group (GCG) Cmd and Sub Cmd 03 06
- Delete Configurable AID (DCA) Cmd and Sub Cmd 04 04
- Delete Configurable Group (DCG) Cmd and Sub Cmd 04 05
- Get All AIDs (GAA) Cmd and Sub Cmd 03 05
- Get All Groups (GAG) Cmd and Sub Cmd 03 07

5.1 Detailed Explanation of AID and Groups

The reader at present contains ELEVEN System AIDs, NINE User AIDs and EIGHT Groups.

Each AID entry is unique. Only one such AID may be present in the reader at any given time (no duplicate AID values are allowed). No User AID can share the same AID as a System AID.

When a reader is booted up the very first time, it loads its default configuration. In this, the 11 System AIDs are defined along with ONE default group. All of the System AIDs refer to this default Group. There are no other AIDs or Groups present in the reader at this point.

From then on (unless reinitialized), the reader will remember all changes that the user makes. That is, on subsequent bootups, the reader will load the settings saved by the user previously INSTEAD of its default configuration. So for example, if the user has added a User AID to the system, the reader will remember this AID whenever it is power cycled.

5.1.1 System AID

A System AID is an AID preloaded for a specific application, using a known AID value. Examples include MasterCard, American Express, Discover and Visa. These AIDs are the default choice for these applications.

System AIDs Table

Application Name	Application Identifier
Amex	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
Discover	A0 00 00 00 03 24 10 10
MXI	A0 00 00 00 02 30 60 D1 58 00

The user:

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

While a user may not delete a System AID, they can disable it so that the reader does not use it for any transaction processing.

5.1.2 User AID

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 AID (or need to be treated as a special case). This determination needs to be made by the user.

The user:

- 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 is used for its associated transactions) or the User AID is not present.

5.1.3 Default Group

The reader is provided with a default Group. This Group (also known as Group Zero) lists all the properties (contained in EMV Tags) that should be loaded when doing a basic transaction. By default, all of the System AIDs use Group 0 to define their transaction processing. In general, it should suffice for User AIDs as well.

The user:

- MUST ALWAYS include the Group Number TLV as the FIRST TLV in the 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 Group 0
- May NEVER delete Group 0

UNLIKE ALL OTHER GROUPS, the TLVs in the Default Group (Group 0) are constant. The system will ALWAYS use the latest copy of the TLV; if you issue a Set Configurable Group command and only update some TLV, the reader will continue to use older versions of the TLV that were not updated.

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

The lone exception to this is the TDOL TLV. This is an optional field and may be ignored. If the user wishes to set this TLV in Group 0, they simply add a TDOL TLV to the Set Configurable Group command explained below.

If the user has a TDOL TLV present in Group 0 and they wish to delete it, they must include a special TDOL TLV in the Set Configurable Group command. They:

- MUST define a TDOL Tag Length of zero
- MUST NOT include a TDOL Tag Value field

This tag instructs Group 0 to delete the TDOL it may have present in its TLVs. This is the ONLY TLV in Group 0 that can be deleted; all others remain no matter what.

Note: Changing values in Group 0 should be done with EXTREME CAUTION, since this affects the default configuration that most transactions use.

5.1.4 Other Groups

The other 7 Groups on the reader are undefined 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.
- MUST include AT LEAST ONE TLV other than the Group Number TLV (in a Set Configurable Group command)
- May modify ANY Group TLV in the Group
- May ALWAYS delete a Group (as long as its not Group 0, the Default Group)
- SHOULD NEVER include the TDOL TLV if its length = zero (, i.e., only include the TDOL if it has a value)

User Groups differ from the Default Group 0 in a few aspects: first, these groups only need to contain the TLV which differ from the Default Group, so they may not represent a full set of Group TLV, unlike the Default Group which has a copy of all the tags.

Secondly, their tags are not permanent. If you Set a Group and then issue a second Set Configurable Group command on that Group, the 2nd Set Configurable Group command will overwrite EVERY change to the Group made by the first command. THE ORIGINAL SETTINGS WILL BE LOST ENTIRELY.

When one of these Groups is specified during a transaction, the TLV included in it is loaded into the system. If a TLV was not included, then the reader will use the value for this TLV (if necessary) provided by the Default Group 0.

Once the reader has finished transaction processing, it will reload the Group 0 default values for all TLVs. It is now ready to commence the next transaction.

There are some guidelines for setting and deleting Groups listed below, most are intuitive (i.e., you MAY NOT delete a Group IF an AID exists that currently uses it).

The next step is to describe the subcommands themselves in detail.

5.2 Set Configurable AID (SCA)

This sub command allows the user to create or select an AID for configuration or deletion. There are SEVEN TLVs that can be included in this command. Some of them are MANDATORY.

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 Group Number is explained below. The Group number must be configured first. If an AID is communicated referring to a non existing group, that AID will be rejected.

Registered Application Provider Identifier (RID) – The parameter is optional. If it is provided, this number will be 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 AID:

- MUST ALWAYS include the 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 11 SYSTEM AIDs in the system. These can be disabled but may NEVER be deleted.

FOR USER AIDs

- MUST ALWAYS include the 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 will be ignored if included in a USER AID.

There are 9 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:

- ANY AID MUST reference a Group (in the Group Number TLV) that already exists
- ANY AID with a Partial Select TLV MUST also include the Max AID Length TLV

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 EMV Data Objects encoded as TLV that can be set using this command are given in the following table. Some are mandatory, some are optional.

AID TLV OBJECTS TABLE

MAND = Mandatory, OPT = Optional, NEVER = Never Include

Tag	Data Element Name	Status	Description	Format	Length
FFE4[1]	Group Number	MAND	The group number that contains the characteristics for this AID **Note:** This must be the 1st TLV in Data Field.	n2	1
9F06	Application Identifier (AID) – card	MAND	Identifies the application as described in ISO/IEC 7816-5. **Note:** This must be the 2nd TLV in the data field.	b	5 – 16
FFE2	Application Flow	Sys = NEVER User = MAND	1 - MasterCard Application 2 - American Express Application 3 - MasterCard M/Stripe Application 4 - RFU 5 - RFU 6 - Visa application. 7 - RFU 8 - RFU 9 - RFU 10 - RFU 11 - RFU 12 - RFU 13 - Discover application 14 - JCB QuicPay Application	n2	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
FFE1[1]	Partial Selection Allowed	OPT	Tells the reader to allow partial selection during the initial select process.	b	1
FFE3	PPSE Disabled	OPT	01: Disable PPSE	b	1
FFE5	Maximum AID Length	OPT	8 bytes for MasterCard, Discover and QuicPay. 16 bytes for other applications (Visa). **Note:** This is MANDATORY TLV if the FFE1 Partial Select TLV is included.	b	1
FFE6	AID Disabled	OPT	Used to disable a System AID (has no effect on a User AID).	b	1

[1] These objects do not have any Tags associated with them. In order to allow setting of these parameters, unused tags have been used. The use of these tags should only be restricted to this 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). This note does not apply to those tags that are not marked as [1]

Note: At present, the preferred means of disabling a System AID is NOT to include the FFE6 TLV noted above. Instead, just issue a Delete AID command to this particular AID. This will delete a User AID OR disable a System AID.

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

Finally, a Set AID command that is used for a USER AID can include a FFE6 Disable AID Tag, but it will be ignored. This tag is only used to set SYSTEM AID.

The Response Packet

Byte 0-9	Byte 0-9	Byte 0-9	Byte 0-	Byte 0-	Byte 0-9	Byte 0-9	Byte 0-9	Byte 10	By
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)		
ViVOtech2\0	04h	See Table			None				

5.3 Set Configurable Group (SCG)

This sub command allows creating or selecting a group for configuration. You may configure a specific group by communicating the Tags that provide the desired functionality associated with that group to the reader. The possible Tags are listed below. Nearly all of these Tags are optional. The functionality for a Tag not provided will be defaulted to the system configuration (see "Set EMV Configuration" section).

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		

The EMV Data Objects encoded as TLV that can be set using this command are given in the following GROUP TLV OBJECTS TABLE.

In a future release, there may be additional tags defined as mandatory, but for now all tags are optional except for the Group Number tag.

Note 1: When setting a Group, ANY or ALL listed TLV may be included. The requirements are that:
+ The Group Number MUST be included as the FIRST TLV, AND
+ At least ONE OTHER TLV must also be included

Note 2: Remember that when setting Group 0 (the Default Group), if a TLV is not being set in the Set Configurable Group command, then the reader will retain and use the old value for this TLV. If setting ANY other Group, the reader will discard all old values for TLV not mentioned in the current Set Configurable Group command.

Note 3: To set the TDOL TLV, simply pass on the desired values in the TLV. To reset the TDOL list (i.e., to disable it), the user can send a TDOL TLV with Length set to zero and no Value field included. This TLV instructs the reader to delete any existing TDOL list for this group.

GROUP TLV OBJECTS TABLE

MAND = Mandatory, OPT = Optional

Tag	Data Element Name	Status	Description	Format	Length
FFE4[1]	Group Number	MAND	The group number that contains the characteristics for this AID **Note:** This must be the 1st TLV in Data Field.	n2	1
5F2A	Transaction Currency Code	OPT	Indicates the currency code of the transaction according to ISO 4217	n3	2
9C	Transaction Type	OPT	Indicates the type of financial transaction, represented by the first two digits of ISO 8583:1987 Processing Code	n2	1

Tag	Data Element Name	Status	Description	Format	Length
9F1A	Terminal Country Code	OPT	Indicates the country of the terminal, represented according to ISO 3166	n3	2
9F1B	Terminal Floor Limit	OPT	Indicates the floor limit in the terminal in conjunction with the AID	b	4
9F33	Terminal Capabilities	OPT	Indicates the card data input, CVM, and security capabilities of the terminal	b	3
9F35	Terminal Type	OPT	Indicates the environment of the terminal, its communications capability, and its operational control	n2	1
9F40	Additional Terminal Capabilities	OPT	Indicates the data input and output capabilities of the terminal	b	5
9F66	Terminal Transaction Qualifier (TTQ)	OPT	Determine the type of transaction (MSD, Qvsdc, and Contactless VSDC) and whether online processing is supported.	b	4
FFF1[1]	Terminal Contactless Transaction Limit	OPT	Indicates the floor limit in the terminal in conjunction with the AID for Contactless transactions.	n12	6
FFF4[1]	Status Check & fDDAV00 for qVSDC	OPT	Status Check & fDDAV00 & Zero Amount Handling (Online Capable)**** for qVSDC Byte0 = 00:Enable Status Check Byte0 > 00:Disable Status Check Byte1 = 00:Disable fDDA version 00 Byte1 > 00:Enable fDDA version 01 Byte2 = 00:Disable Option1**** (Option 2) Byte2 > 00:Enable Option1**** ****See Requirement 5.2.2.3 of Visa Contactless Payment Specifications v2.0.2	b	3
FFF5[1]	CVM Required Limit	OPT	Indicates the CVM required floor limit in the terminal in conjunction with the AID	n12	6
FFFB[1]	Language Option for LCD Display	OPT	Language Option for LCD display: Value = 00: English only display Value = 01: Chinese only display Value = 02: English & Chinese display Value = 03: French only display	b	1
FFFC[1]	Force MagStripe Transactions on MChip Cards	OPT	Force MagStripe Transactions on MChip Cards: Value = 00: Normal Transaction Value = 01: Force MagStripe Transaction if MChip Card presented	b	1
FFFD[1]	Terminal Action Code (Other)	OPT	Reflect the acquirer-selected action to be taken upon analysis of the TVR	b	5

Tag	Data Element Name	Status	Description	Format	Length
FFFE[1]	Terminal Action Code (Default)	OPT	Reflect the acquirer-selected action to be taken upon analysis of the TVR	b	5
FFFF[1]	Terminal Action Code (Denial)	OPT	Reflect the acquirer-selected action to be taken upon analysis of the TVR	b	5
97	Default Transaction Certificate Data Object List (TDOL)	OPT	List of data objects (tag and length) to be used by the terminal in generating the TC Hash Value in case TDOL is not returned by the card	b	<=64

[1] These objects do not have any Tags associated with them. In order to allow setting of these parameters, unused tags have been used. The use of these tags should only be restricted to this 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). This note does not apply to those tags that are not marked as [1]

The Response Packet

Byte 0-9	Byte 0-9	Byte 0-9	Byte 0-	Byte 0-	Byte 0-9	Byte 0-9	Byte 0-9	Byte 10	By
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)		
ViVOtech2\0	04h	See Table			None				

5.4 Get Configurable AID (GCA)

This sub command allows reading the configurable AID EMV parameters. The user MUST send an AID TLV in the command, as the first TLV in the command. The reader will then return all tags associated with that configurable AID in the response.

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 encode the EMV TLV below. The command should NOT encode 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

The Response Packet

Byte 0-9	Byte 0-9	Byte 0-9	Byte 0-	Byte 0-	Byte 0-9	Byte 0-9	Byte 0-9	Byte 10	By
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)		
ViVOtech2\0	03h	See Table			TLV Data Objects				

The optional EMV Data Objects encoded as TLV that will be returned in the data section of the response packet are the same as those listed in the **AID TLV OBJECTS** TABLE. The reader will return 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 will return 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 will NOT indicate an error situation.

If the user requests a System AID that is currently disabled, the reader will return the AID TLVs, but will append the FFE6 TLV, showing that the AID is currently disabled.

5.5 Get Configurable Group (GCG)

This sub command allows reading the configurable Group EMV Parameters. 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.

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 EMV 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 do not have any Tags associated with them. In order to allow setting of these parameters, unused tags have been used. The use of these tags should only be restricted to this 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). This note does not apply to those tags that are not marked as [1]

The Response Packet

Byte 0-9	Byte 0-9	Byte 0-9	Byte 0-	Byte 0-	Byte 0-9	Byte 0-9	Byte 0-9	Byte 10	By
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)		
ViVOtech2\0	03h	See Table			TLV Data Objects				

The EMV Data Objects encoded as TLV that will be returned in the data section of the response packet are given in the **GROUP TLV OBJECTS TABLE**.

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

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

5.6 Delete Configurable AID (DCA)

This sub command allows the deletion (or disabling) of a configurable AID. It is MANDATORY to include the AID TLV of the AID to be removed. No other TLVs should be included.

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 EMV 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

The Response Packet

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 Table			None		

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

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

5.7 Delete Configurable Group (DCG)

This sub command allows the deletion of a configurable Group. This means that this Group can no longer be used to load the parameters for a transaction.

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 do not have any Tags associated with them. In order to allow setting of these parameters, unused tags have been used. The use of these tags should only be restricted to this 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). This note does not apply to those tags that are not marked as [1]

The Response Packet

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 Table			None		

The user may NOT delete the Default Group 0. The reader will not allow this command, and it will NOT disable Group 0; instead it will return with an error.

If the Group is not a valid Group Number this will likewise return an error.

Finally, if the reader has ANY AID that references this Group, it will NOT delete the Group. It will return 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 AID, and then delete the Group.

5.8 Get All AIDs (GAA)

This sub command allows reading all AIDs in the reader. This sub command may be used to verify configured AIDs or to determine what system AIDs are in the reader.

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	05h			None		

The Response Packet

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 Table			TLV Data Objects		

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

The reader will send one or more packets with all the AID TLVs in it. Each AID grouping will begin with the Group Number TLV that this AID uses. The user can use this fact to parse between the AID grouping passed back to the POS.

5.9 Get All Groups (GAG)

This sub command allows reading all Groups in the reader. This sub command may be used to verify all configured Groups in the reader.

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	07h			None		

The Response Packet

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 Table			TLV Data Objects		

The only EMV Data Objects that should be returned from the GAG command are Group Tags. These are the same as those itemized in the **GROUP TLV OBJECTS TABLE**.

The reader will send one or more packets with all the Group TLVs in it. Each Group will begin 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.

6 Commands for MagStripe & EMV Transactions

6.1 Activate Transaction Command

This command is meant to be used when the ViVOpay Reader has been put in "Poll on Demand" mode, and a transaction needs to be carried out with any supported contactless EMV or contactless MagStripe Card. When a valid Activate Transaction command is sent to the ViVOpay Reader, it will start polling for cards. If it does not find a supported card for the specified time duration, it will time out and end the transaction. If it does find a card within the specified time interval, it will attempt 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 will return the Clearing Record or Track Data in the response data. If the transaction is not successful yet proceeded into the transaction state machine the Reader will return a Failed Transaction Record in the response data. The format of the Clearing Record, Track Data and Failed Transaction record depends on the type of card that was detected.

The Command Packet

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 Table		

The format and contents of the data field in the command packet are given in the following table.

Data Item	Length in Bytes	Description
Timeout	1 Byte	Time in Seconds for which the Reader will wait for a card to be presented before timing out and returning an Error response. Mandatory Format: Binary
TLV Amount Authorized[2]	9 Bytes (including Tag & Length)	EMV data element "Amount Authorized (Numeric)" as a TLV data object. Tag: 9F02 Format: n12, BCD encoded. Not required for MagStripe transactions. Optional for EMV.
TLV Transaction Currency Code[2]	5 (including Tag & Length)	EMV data element "Transaction Currency Code" as a TLV data object. Indicates the Currency Code of the Transaction according to ISO 4217. Tag: 5F2A Format: n3. Not required for MagStripe transactions. Optional for EMV.
TLV Transaction Date	5 (including Tag & Length)	EMV data element "Transaction Date" as a TLV data object. Local date that the transaction was authorized. Tag: 9A Format: n6 (YYMMDD) Not required for MagStripe transactions. Mandatory for EMV.
TLV Transaction Time	6 (including Tag & Length)	EMV data element "Transaction Time" as a TLV data object. Local time that the transaction was authorized. Tag: 9F21 Format: n6 (HHMMSS) Not required for MagStripe transactions. Optional for EMV.
TLV Terminal Country Code[2]	5 (including Tag & Length)	EMV data element "Terminal Country Code" as a TLV data object. Indicates the country code of the terminal, represented according to ISO 3166. Tag: 9F1A Format: n3 Not required for MagStripe transactions. Optional for EMV.

Data Item	Length in Bytes	Description
TLV Transaction Type[2]	3 (including Tag & Length)	EMV data element "Transaction Type" as a TLV data object. Indicates the type of financial transaction, represented by the first two digits of ISO 8583, Processing Code. Tag: 9C Format: n2 Not required for MagStripe transactions. Optional for EMV.

[2] For EMV transactions, if the terminal has already set up one or more of these data items using the Set EMV Configuration command, then the terminal need not include those data items in the command packet. If the terminal includes one or more values in the command packet, the Reader will use the included values. If it does not, the Reader will just use the default or previously set values.

On receiving this command, the ViVOpay reader will start polling for cards. If it finds a card, it will try to carry out a transaction with the card. If the card is a supported contactless EMV Card the reader will use the TLV fields in the command packet for the transactions. If the card is a contactless MagStripe Card, the reader will not use the TLV objects for the transaction.

If the transaction is completed successfully, and the card supported contactless EMV, then the reader will send back 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 will send back Track information in the response data.

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

The Response Packet

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 Table			See Data Tables		

If the Status Code is OK or "Request Online Authorization" then the format and contents of the data field in the response packet are given in the following table.

Data Item	Length in Bytes	Description
Track 1 Length	1	If Track 1 is available, then this field will give the length of the Track 1 data that will follow. If Track 1 is not available, then a Length of 00h will be 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 will give the length of the Track 2 data that will follow. If Track 2 is not available, then a Length of 00h will be returned. Format: Binary
Track 2 Data (MagStripe Card)	Variable	Track 2 Data (if available). Format: ASCII (no null terminator)

Data Item	Length in Bytes	Description
DE055 (Clearing Record) Present	1	If a Clearing Record (DE 055) field is available, then this field will be 01h. If there is no Clearing Record (DE 055) field, then this field will be 00h.
TLV DE 055 (Clearing Record)	Variable up to 128 (including Tag & Length)	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. Details given in next Table Tag: E1 Format: b1..126 variable.
TLV App PAN	Variable, up to 12 (including Tag & Length)	Application Primary Account Number (PAN) as a TLV object. This field will be 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 (including Tag & Length)	PAN Sequence Number as a TLV object. This field will be present only if the DE 055 object is present. Tag: 5F34 Format: n2, BCD encoded on 1 bytes
TLV Application Expiration Date	6 (including Tag & Length)	Application Expiration Date as a TLV object. This field will be 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 (including Tag & Length)	Application Label as a TLV object. This field will be present only if the DE 055 object is present. Tag: 50 Format: an variable length up to 16 bytes
TLV CVM Results	6 (including Tag & Length)	Cardholder Verification Method (CVM) Results as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F34 Format: b3
TLV Data Authentication Code	5 (including Tag & Length)	Data Authentication Code as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F45 Format: b2
TLV ICC Dynamic Number	11 (including Tag & Length)	ICC Dynamic Number as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F4C Format: b8
TLV Track 1 Equivalent Data (MChip card)	81 (including Tag & Length)	Track 1 Equivalent Data as a TLV object. This field will be present only if the DE 055 object is present. Tag: 56 Format: b79
TLV Transaction Status Information	4 (including Tag & Length)	Transaction Status Information as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9B Format: b2
Cardholder Name	29 (including Tag & Length)	Cardholder Name as a TLV object. This field will be present only if the DE 055 object is present. Tag: 5F20 Format: b26
Application Usage Control	5 (including Tag & Length)	Application Usage Control as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F07 Format: b2

Data Item	Length in Bytes	Description
Issuer Action Code(Default)	8 (including Tag & Length)	Issuer Action Code (Default) as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F0D Format: b5
Issuer Action Code(Denial)	8 (including Tag & Length)	Issuer Action Code (Denial) as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F0E Format: b5
Issuer Action Code(Online)	8 (including Tag & Length)	Issuer Action Code (Online) as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F0F Format: b5
TLV Auth_Code	9 (including Tag & Length)	Authorization Code as a TLV object Tag: E300 Format: b6
TLV Track 2 Equivalent Data	21 (including Tag & Length)	Track 2 Equivalent Data as a TLV object. This field will be present only if the DE 055 object is present or Authorization Code is present. Tag: 57 Format: b19
VLP Issuer Auth Code	9 (including Tag & Length)	VLP Issuer Authorization Code as a TLV object Tag: 9F74 Format: b6
Application Identifier	Variable up to 19 (including Tag & Length)	AID as a TLV object Tag: 9F06 Format: variable b5..16
Available Offline Spending Amount (Balance)	9 (including Tag & Length)	Available Offline Spending Amount as a TLV object Tag: 9F5D Format: variable b6
TLV Application Effective Date	6 (including Tag & Length)	Application Effective Date as a TLV object. Tag: 5F25 Format: n6, BCD encoded on 3 bytes (YYMMDD)
Card Transaction Qualifiers	5 (including Tag & Length)	Card Transaction Qualifiers (Visa transactions only) as a TLV object. If card does not return this tag then a length of zero will be returned Tag: 9F6C Format: b16

Format of the Clearing Record is given in the following table.

Tag		Data Element Name	Format	Origin	Value
E1		DE 055	b1..126 var		
	9F1A	Terminal Country Code	n3	Terminal	
	9F02	Amount, Authorized (Numeric)	n12	Terminal	
	5F2A	Transaction Currency Code	n3	Terminal	
	9A	Transaction Date	n6		
	9C	Transaction Type	n2	Reader	'00'
	95	Terminal Verification Results	b5	Reader	All zeroes
	9F37	Unpredictable Number	b4	Reader	
	82	Application Interchange Profile	b2	Card	
	9F26	Application Cryptogram	b8	Card	
	9F27	Cryptogram Information Data	b1	Card	

Tag		Data Element Name	Format	Origin	Value
	9F10	Issuer Application Data	b1..32 var	Card	
	9F36	Application Transaction Counter	b2	Card	
	9F66	Visa TTQ(Visa only)	b4	Reader	
	9F03	Amount, Other (Numeric, Visa only)	n12	Terminal	

If the Status Code is OK the response is different depending on the card application:

--- PayPass MagStripe application the reader returns Track1/Track2
--- PayPass Mchip application the reader returns chip data E1 and plus some other tags
--- JCB QuicPay application the reader only returns TLV Auth code and Track2 Equivalent data
--- VSDC online application the returns Track1/Track2 and VLP Issuer Auth code
--- VSDC offline and qVSDC application the reader returns chip data E1 and some other tags

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

Data Field	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	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 Packet is "Failed" and the Error Code is "Request Online Authorization", then the contents of the Data field will contain further information on the cause of the failure and will not contain the Track or Clearing Record information. In this case the Data field in the Response Packet will have the following format:

Data Field	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	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 Maximum Offline Spending Amount and Balance. Format: n12

If the Status Code is "User Interface Event" then the format and contents of the data field in the response packet are given in the following table.

Data Item	Length in Bytes	Description
Transaction status	1	01: The reader detects the card and initiates the transaction.

For any other Status Code the data field will be empty.

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

Data Item	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	RF State Code indicating exactly where the error occurred in the Reader-Card transaction flow. See sub-section on RF State Codes.
TLV Application Label	Variable, up to 18 (including Tag & Length)	Application Label as a TLV object. Tag: 50 Format: an variable length up to 16 bytes
TLV Track 2 Equivalent Data	21 (including Tag & Length)	Track 2 Equivalent Data as a TLV object. Tag: 57 Format: b19
TLV App PAN	Variable, up to 12 (including Tag & Length)	Application Primary Account Number (PAN) as a TLV object. Tag: 5A Format: cn variable length up to 19 (10 bytes)
Cardholder Name	29 (including Tag & Length)	Cardholder Name as a TLV object. Tag: 5F20 Format: b26
TLV Application Expiration Date	6 (including Tag & Length)	Application Expiration Date as a TLV object. Tag: 5F24 Format: n6, BCD encoded on 3 bytes (YYMMDD)
TLV Application Effective Date	6 (including Tag & Length)	Application Effective Date as a TLV object. Tag: 5F25 Format: n6, BCD encoded on 3 bytes (YYMMDD)
TLV Transaction Currency Code[2]	5 (including Tag & Length)	EMV data element "Transaction Currency Code" as a TLV data object. Indicates the Currency Code of the Transaction according to ISO 4217. Tag: 5F2A Format: n3.
TLV PAN Seq Number	4 (including Tag & Length)	PAN Sequence Number as a TLV object. Tag: 5F34 Format: n2, BCD encoded on 1 bytes
Application Interchange Profile	4 (including Tag & Length)	Indicates the capabilities of the card to support specific functions in the application. Tag: 82 Format b2

Data Item	Length in Bytes	Description
Cardholder Verification Method (CVM) List	Variable, up to 252 (including Tag & Length)	Identifies a method of verification of the cardholder supported by the application. Tag: 8E Format: b
Terminal Verification Results	7 (including Tag & Length)	Status of the different functions as seen from the terminal. Tag: 95 Format: b
TLV Transaction Date	5 (including Tag & Length)	EMV data element "Transaction Date" as a TLV data object. Local date that the transaction was authorized. Tag: 9A Format: n6 (YYMMDD)
TLV Transaction Status Information	4 (including Tag & Length)	Transaction Status Information as a TLV object. Tag: 9B Format: b2
TLV Transaction Type[2]	3 (including Tag & Length)	EMV data element "Transaction Type" as a TLV data object. Indicates the type of financial transaction, represented by the first two digits of ISO 8583, Processing Code. Tag: 9C Format: n2
TLV Amount Authorized[2]	9 Bytes (including Tag & Length)	EMV data element "Amount Authorized (Numeric)" as a TLV data object. Tag: 9F02 Format: n12, BCD encoded.
Application Identifier	Variable up to 19 (including Tag & Length)	AID as a TLV object Tag: 9F06 Format: variable b5..16
Application Usage Control	5 (including Tag & Length)	Application Usage Control as a TLV object. Tag: 9F07 Format: b2
Application Version Number	5 (including Tag & Length)	Version number assigned by the payment system for the application Tag: 9F09 Format: b2
Issuer Action Code(Default)	8 (including Tag & Length)	Issuer Action Code (Default) as a TLV object. Tag: 9F0D Format: b5
Issuer Action Code(Denial)	8 (including Tag & Length)	Issuer Action Code (Denial) as a TLV object. Tag: 9F0E Format: b5
Issuer Action Code(Online)	8 (including Tag & Length)	Issuer Action Code (Online) as a TLV object. Tag: 9F0F Format: b5
Issuer Application Data	Variable up to 35 (including Tag & Length)	Contains proprietary application data for transmission to the issuer in an online transaction Tag: 9F10 Format: b

Data Item	Length in Bytes	Description
TLV Terminal Country Code[2]	5 (including Tag & Length)	EMV data element "Terminal Country Code" as a TLV data object. Indicates the country code of the terminal, represented according to ISO 3166. Tag: 9F1A Format: n3
TLV Transaction Time	6 (including Tag & Length)	EMV data element "Transaction Time" as a TLV data object. Local time that the transaction was authorized. Tag: 9F21 Format: n6 (HHMMSS)
Application Cryptogram	11 (including Tag & Length)	Cryptogram returned by the ICC in response of the GENERATE AC command Tag: 9F26 Format: b
Cryptogram Information Data	4 (including Tag & Length)	Indicates the type of cryptogram and the actions to be performed by the terminal. Tag: 9F27 Format: b
TLV CVM Results	6 (including Tag & Length)	Cardholder Verification Method (CVM) Results as a TLV object. Tag: 9F34 Format: b3
Application Transaction Counter (ATC)	5 (including Tag & Length)	Counter maintained by the application in the ICC (incrementing the ATC is managed by the ICC) Tag: 9F36 Format: b
Unpredictable Number	7 (including Tag & Length)	Value to provide variability and uniqueness to the generation of a cryptogram Tag: 9F37 Format:
TLV Data Authentication Code	5 (including Tag & Length)	Data Authentication Code as a TLV object. Tag: 9F45 Format: b2
TLV ICC Dynamic Number	11 (including Tag & Length)	ICC Dynamic Number as a TLV object. Tag: 9F4C Format: b8
Available Offline Spending Amount (Balance)	9 (including Tag & Length)	Available Offline Spending Amount as a TLV object Tag: 9F5D Format: variable b6

6.2 Get Transaction Result

This command is meant to be used when the ViVOpay Reader is functioning in "Auto Poll" mode. In this mode the reader will not wait for an Activate Transaction command to start polling for a card. It will always be in poll mode. When it detects a card, it will carry out a transaction with the card. If the card is a supported contactless MagStripe card, the reader will not need any parameters from the terminal. If the card is a supported contactless EMV Card, then the reader will use the default Terminal parameters in the Reader. If some Terminal parameters had been set by using the "Set EMV Configuration" command, then the reader will use the new values for these parameters. In either case, the reader will carry out the transaction. If the transaction is successful, the reader will keep the transaction data (Track or Clearing Record) in its memory. When it receives the "Get Transaction Result" command, it will return 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 will respond 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.

The Command Packet

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	00h	00h	00h	None		

On receiving this command, the ViVOpay reader will return 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 will indicate an OK status and indicate "No Data".

If there was an error in the command packet received then the response will contain an appropriate status code.

The Response Packet

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 Table			See Data Tables		

If Status Code is OK then the format and contents of the data field in the response packet are given in the following table.

Data Item	Length in Bytes	Description
Track 1 Length	1	If Track 1 is available, then this field will give the length of the Track 1 data that will follow. If Track 1 is not available, then a Length of 00h will be 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 will give the length of the Track 2 data that will follow. If Track 2 is not available, then a Length of 00h will be 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 will be 01h. If there is no Clearing Record (DE 055) field, then this field will be 00h.
TLV DE 055 (Clearing Record)	Variable up to 128 (including Tag & Length)	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. Details given in next Table Tag: E1 Format: b1..126 variable.
TLV App PAN	Variable, up to 12 (including Tag & Length)	Application Primary Account Number (PAN) as a TLV object. This field will be 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 (including Tag & Length)	PAN Sequence Number as a TLV object. This field will be present only if the DE 055 object is present. Tag: 5F34 Format: n2, BCD encoded on 1 bytes
TLV Application Expiration Date	6 (including Tag & Length)	Application Expiration Date as a TLV object. This field will be 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 (including Tag & Length)	Application Label as a TLV object. This field will be present only if the DE 055 object is present. Tag: 50 Format: an variable length up to 16 bytes
TLV CVM Results	6 (including Tag & Length)	Cardholder Verification Method (CVM) Results as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F34 Format: b3
TLV Data Authentication Code	5 (including Tag & Length)	Data Authentication Code as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F45 Format: b2
TLV ICC Dynamic Number	11 (including Tag & Length)	ICC Dynamic Number as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F4C Format: b8
TLV Track 1 Equivalent Data (MChip card)	81 (including Tag & Length)	Track 1 Equivalent Data as a TLV object. This field will be present only if the DE 055 object is present. Tag: 56 Format: b79

Data Item	Length in Bytes	Description
TLV Transaction Status Information	4 (including Tag & Length)	Transaction Status Information as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9B Format: b2
Cardholder Name	29 (including Tag & Length)	Cardholder Name as a TLV object. This field will be present only if the DE 055 object is present. Tag: 5F20 Format: b26
Application Usage Control	5 (including Tag & Length)	Application Usage Control as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F07 Format: b2
Issuer Action Code(Default)	8 (including Tag & Length)	Issuer Action Code (Online) as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F0D Format: b5
Issuer Action Code(Denial)	8 (including Tag & Length)	Issuer Action Code (Denial) as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F0E Format: b5
Issuer Action Code(Online)	8 (including Tag & Length)	Issuer Action Code (Default) as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F0F Format: b5
TLV Auth_Code	9 (including Tag & Length)	Authorization Code as a TLV object Tag: E300 Format: b6
TLV Track 2 Equivalent Data	21 (including Tag & Length)	Track 2 Equivalent Data as a TLV object. This field will be present only if the DE 055 object is present or Authorization Code is present. Tag: 57 Format: b19
VLP Issuer Auth Code	9 (including Tag & Length)	VLP Issuer Authorization Code as a TLV object Tag: 9F74 Format: b6
Application Identifier	Variable up to 19 (including Tag & Length)	AID as a TLV object Tag: 9F06 Format: variable b5..16
Available Offline Spending Amount (Balance)	9 (including Tag & Length)	Available Offline Spending Amount as a TLV object Tag: 9F5D Format: variable b6
TLV Application Effective Date	6 (including Tag & Length)	Application Effective Date as a TLV object. Tag: 5F25 Format: n6, BCD encoded on 3 bytes (YYMMDD)

Format of the Clearing Record is given in the following table.

Tag		Data Element Name	Format	Origin	Value
E1		DE 055	b1..126 var		
	9F1A	Terminal Country Code	n3	Terminal	
	9F02	Amount, Authorized (Numeric)	n12	Terminal	

	Tag	Data Element Name	Format	Origin	Value
	5F2A	Transaction Currency Code	n3	Terminal	
	9A	Transaction Date	n6	Terminal	
	9C	Transaction Type	n2	Reader	'00'
	95	Terminal Verification Results	b5	Reader	All zeroes
	9F37	Unpredictable Number	b4	Reader	
	82	Application Interchange Profile	b2	Card	
	9F26	Application Cryptogram	b8	Card	
	9F27	Cryptogram Information Data	b1	Card	
	9F10	Issuer Application Data	b1..32 var	Card	
	9F36	Application Transaction Counter	b2	Card	
	9F66	Visa TTQ(Visa only)	b4	Reader	
	9F03	Amount, Other (Numeric, Visa only)	n12	Terminal	

If the Status Code is OK the response is different depending on the card application:

--- PayPass MagStripe application the reader returns Track1/Track2
--- PayPass Mchip application the reader returns chip data E1 and plus some other tags
--- JCB QuicPay application the reader only returns TLV Auth code and Track2 Equivalent data
--- VSDC online application the returns Track1/Track2 and VLP Issuer Auth code
--- VSDC offline and qVSDC application the reader returns chip data E1 and some other tags

This command will never return a status code of "Failed". If any status code other than OK is returned, the data field will be empty.

6.3 Update Balance Command

This command is meant to be used 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).

If the Status Code is OK the issuer will also send Authorization Code (Auth_Code)/Date/Time to the terminal. After that the reader will send a corresponding command to update the balance in the card/phone.

The Command Packet

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 packet are given in the following table.

Data Item	Length in Bytes	Description
Status Code	1	00: OK 01: NOT OK
TLV Auth_Code	9 (including Tag & Length)	Authorization Code as a TLV object. Tag: E300 Format: b6
TLV Transaction Date	5 (including Tag & Length)	EMV data element "Transaction Date" as a TLV data object. Local date that the transaction was authorized. Tag: 9A Format: n6 (YYMMDD)
TLV Transaction Time	6 (including Tag & Length)	EMV data element "Transaction Time" as a TLV data object. Local time that the transaction was authorized. Tag: 9F21 Format: n6 (HHMMSS)

The Response Packet

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 Table			See Data Tables		

If the Status Code is OK then the format and contents of the data field in the response packet are given in the following table.

Data Item	Length in Bytes	Description
TLV Track 2 Equivalent Data	21 (including Tag & Length)	Track 2 Equivalent Data as a TLV object. Tag: 57 Format: b19
TLV Auth_Code	9 (including Tag & Length)	Authorization Code as a TLV object Tag: E300 Format: b6

If the Status Code being returned in the Response Packet is "Failed", then the contents of the Data field will contain further information on the cause of the failure and will not contain the Authorization Code etc. In this case the Data field in the Response Packet will have the following format

Data Field	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	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 will be empty.

7 Commands for MXI (Ticketing/ePurse) Transactions

7.1 Activate Transaction Command (MXI)

This command is meant to be used when the ViVOpay Reader has been put in "Poll on Demand" mode, and an ePurse or Ticketing transaction needs to be carried out with a contactless PayPass MXI Card. When a valid Activate Transaction command is sent to the ViVOpay Reader, it will start polling for cards. If it does not find a supported card during the specified time duration, it will time out and end the transaction. If it does find a card within the specified time interval, it will attempt to carry out the transaction. The transaction flow between the Reader and the card for this command will be as specified in the MasterCard PayPass M/Chip for MXI specs.

This Activate Transaction command for MXI may be given for carrying out the following kinds of transactions

- Transaction on a PayPass MXI Card - Payment at Entry
- Transaction on a PayPass MXI Card - Payment at Exit-Entry
- Transaction on a PayPass MXI Card - Payment at Exit-Exit

The nature of the transaction flow (payment at entry, exit-entry or exit-exit) will depend on the tags that are requested by the terminal. If this leg of the transaction is successful, the Reader will return the requested data objects in the response data.

The Command Packet

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	02h			See Data Table		

The data field will contain the time for which the Reader is supposed to wait for a card to be presented and also a list of Tags indicating to the reader the data items that are to be returned in the response packet. The terminal should request those tags that are required for the specific transaction (payment at entry or exit-exit). The format and contents of the data field in the command packet are given in the following table. All possible tags are listed. The terminal must decide which tags are required.

Data Item	Length in Bytes	Description
Timeout	1 Byte	Time in Seconds for which the Reader will wait for a card to be presented before timing out and returning an Error response. Format: Binary
Ticketing Profile Tag	2	TLV Tag for Ticketing Profile. This can be any valid tag for a ticketing profile. Tag: 9F70 – 9F74
Balance Tag	2	TLV Tag for Balance. The Balance Tag need only be present if the COTR Tag is not. Tag: 9F50
COTR Tag	2	TLV Tag for COTR. The COTR Tag need only be present if the Balance Tag is not present Tag: 9F7A
Application PAN Tag	1	TLV Tag for Application Primary Account Number (PAN). Tag: 5A
PAN Seq Number Tag	2	TLV Tag for PAN Sequence Number. Tag: 5F34
Application Expiration Date Tag	2	TLV Tag for Application Expiration Date. Tag: 5F24
Ticket Tag	2	TLV Tag for Ticket. Tag: 9F75 – 9F79
Application Label Tag	1	TLV Tag for Application Label. Tag: 50

On receiving this command, the ViVOpay reader will start polling for cards. If it finds a PayPass M/Chip MXI card, it will try to carry out the first leg of the transaction with the card.

If the transaction is completed successfully, then the reader will send back the requested TLV Objects in the response. At this point the reader will not terminate the session.

If the transaction cannot be completed successfully, the response will contain an appropriate status code. The response packet will contain more error information in the data field, for certain status codes. At this point the reader will terminate the session.

The Response Packet

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 Table			See Data Tables		

If the Status Code is OK then the data section of the response packet will contain the TLV data objects requested in the command packet. The format and contents of these data objects (if present) in the response packet are given in the following table.

Data Item	Length in Bytes	Description
TLV Ticketing Profile (if requested)	Variable, up to 35 (including Tag & Length)	Ticketing Profile as a TLV object Tag: 9F70 – 9F74 Format: b variable length up to 32 bytes
TLV Balance (if requested)	9 (including Tag & Length)	Balance as a TLV object Tag: 9F50 Format: n12, BCD encoded on 6 bytes
TLV COTR (if requested)	4 (including Tag & Length)	COTR as a TLV object Tag: 9F7A Format: b1
TLV App PAN (if requested)	Variable, up to 12 (including Tag & Length)	Application Primary Account Number (PAN) as a TLV object. Tag: 5A Format: cn variable length up to 19 (10 bytes)
TLV PAN Seq Number (if requested)	4 (including Tag & Length)	PAN Sequence Number as a TLV object. Tag: 5F34 Format: n2, BCD encoded on 1 bytes
TLV Application Expiration Date (if requested)	6 (including Tag & Length)	Application Expiration Date as a TLV object. Tag: 5F24 Format: n6, BCD encoded on 3 bytes (YYMMDD)
TLV Ticket (if requested)	Variable, up to 35 (including Tag & Length)	Ticket as a TLV object. Tag: 9F75 – 9F79 Format: b variable length up to 32 bytes
TLV Application Label (if requested)	Variable, up to 18 (including Tag & Length)	Application Label as a TLV object. Tag: 50 Format: an variable length up to 16 bytes

If any of the optional items is not available, then the Reader may send back a corresponding TLV object with zero length.

If the Status Code being returned in the Response Packet is "Failed", then the contents of the Data field will contain further information on the cause of the failure and will not contain the TLV data objects. In this case the Data field in the Response Packet will have the following format

Data Field	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	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 will be empty.

Note for Terminal Application Developers:

The data items that the terminal must request in the Activate command for specific MXI transaction flows are given in the following table.

MXI Transaction Type	Tags to include in Activate Command
Payment at Entry	Ticketing Profile Balance or COTR
Payment at Exit-Entry	PAN PAN Sequence Number Application Expiry Date
Payment at Exit-Exit	Ticketing Profile Ticket Balance or COTR

7.2 Debit Write Command

This command is used to continue to the second leg of an MXI payment transaction in order to complete the transaction. When a valid Debit Write command is sent to the ViVOpay Reader, it will attempt to carry out the remaining transaction. The transaction flow between the Reader and the card for this command will be as specified in the MasterCard PayPass M/Chip for MXI specs. The type of transaction flow used by Reader (Entry, Exit-Exit) will depend on the data passed by the terminal in the command packet. If this leg of the transaction is successful, the Reader will return the Clearing Record in the response data. Once the transaction has been completed, the reader will terminate the session.

The Command Packet

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	01h			See Data Table		

The data field will contain a list of TLV Data items for the Reader. The terminal should include only those tags that are required for the specific transaction (Payment at Entry, Exit-Exit) as per the PayPass M/Chip for MXI specifications. The format and contents of the TLV data objects in the command packet are given in the following table. All possible data objects are listed. The terminal must decide which TLV objects to include.

Data Item	Length in Bytes	Description
TLV Amount Authorized	9 Bytes (including Tag & Length)	EMV data element "Amount Authorized (Numeric)" as a TLV data object. This is the amount that will be deducted. Tag: 9F02 Format: n12, BCD encoded.
TLV Transaction Date	5 (including Tag & Length)	EMV data element "Transaction Date" as a TLV data object. Local date that the transaction was authorized. Tag: 9A Format: n6 (YYMMDD)
TLV Ticket	Variable Up to 35 (including Tag & Length)	TLV data object "Ticket". Tag: 9F75 – 9F79 Format: b1..32 (variable)
TLV Ticketing Info	Variable Up to 35 (including Tag & Length)	TLV data object for Ticketing information. Tag: DF10 Format: b1..32 (variable)

On receiving this command, the ViVOpay reader will try to carry out the second leg of the payment transaction.

If the transaction is completed successfully the reader will send back the Clearing Record in the response data.

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

In either case the reader will terminate the session.

The Response Packet

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 Table			See Data Tables		

If the Status Code is OK then the format and contents of the data field in the response packet are given in the following table.

Data Item	Length in Bytes	Description
Track 1 Length	1	Always 00h for this command. Format: Binary
Track 2 Length	1	Always 00h for this command. Format: Binary
DE055 (Clearing Record) Present	1	If a Clearing Record (DE 055) field is available, then this field will be 01h. If there is no Clearing Record (DE 055) field, then this field will be 00h.
TLV DE 055 (Clearing Record)	Variable up to 128 (including Tag & Length)	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. Details given in next Table Tag: E1 Format: b1..126 variable.
TLV CVM Results	6 (including Tag & Length)	Cardholder Verification Method (CVM) Results as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F34 Format: b3
TLV Data Authentication Code	5 (including Tag & Length)	Data Authentication Code as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F45 Format: b2
TLV ICC Dynamic Number	11 (including Tag & Length)	ICC Dynamic Number as a TLV object. This field will be present only if the DE 055 object is present. Tag: 9F4C Format: b8

Format of the Clearing Record is given in the following table.

Tag		Data Element Name	Format	Origin	Value
E1		DE 055	b1..126 var		
	9F1A	Terminal Country Code	n3	Terminal	
	9F02	Amount, Authorized (Numeric)	n12	Terminal	
	5F2A	Transaction Currency Code	n3	Terminal	
	9A	Transaction Date	n6	Terminal	
	9C	Transaction Type	n2	Reader	'00'
	95	Terminal Verification Results	b5	Reader	All zeroes
	9F37	Unpredictable Number	b4	Reader	
	82	Application Interchange Profile	b2	Card	
	9F26	Application Cryptogram	b8	Card	
	9F27	Cryptogram Information Data	b1	Card	
	9F10	Issuer Application Data	b1..32 var	Card	
	9F36	Application Transaction Counter	b2	Card	

If the Status Code being returned in the Response Packet is "Failed", then the contents of the Data field will contain further information on the cause of the failure and will not contain the Clearing Record information. In this case the Data field in the Response Packet will have the following format

Data Field	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	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 will be empty.

Note for Terminal Application Developers

The data objects that the terminal must send in the Debit Write command for specific MXI transaction flows are given in the following table.

MXI Transaction Type	Tags to Include in Activate Command
Payment at Entry	Amount Transaction Date Ticketing Info
Payment at Exit-Entry	Command Not Applicable
Payment at Exit-Exit	Amount Transaction Date Ticket Ticketing Info (optional)

7.3 Write Data Command

This command is used to store a ticket on the card. When a valid Write Data command is sent to the ViVOpay Reader, it will attempt to carry out the second leg of the payment at the exit transaction. The transaction flow between the Reader and the card for this command will be as specified in the MasterCard PayPass M/Chip for MXI specs. If this leg of the transaction is successful, the Reader will terminate the session. The response will not contain anything in the data field.

The Command Packet

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	01h			See Data Table		

The format and contents of the data field in the command packet are given in the following table.

Data Item	Length in Bytes	Description
TLV Ticket	Variable, up to 35 (including Tag & Length)	Ticket as a TLV object (including tag and length) Tag: 9F75 – 9F79 Format: b variable length up to 32 bytes

On receiving this command, the ViVOpay reader will try to carry out the second leg of the payment at the exit transaction.

If the transaction is completed successfully the reader will send back a response without any data in the data field.

If the transaction cannot be completed successfully, the response will contain an appropriate status code. The response packet will contain more error information in the data field, for certain status code
s.

In either case the reader will terminate the session.

The Response Packet

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	04h	See Table			None		

If the Status Code being returned in the Response Packet is "Failed", then the contents of the Data field will contain further information on the cause of the failure and will not contain the Clearing Record information. In this case the Data field in the Response Packet will have the following format.

Data Field	Length in Bytes	Description
Error Code	1 Byte	Error Code giving the reason for the failure. See sub-section on Error Codes
SW1	1 Byte	Value of SW1 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
SW2	1 Byte	Value of SW2 returned by the Card (SW1SW2 will be 0000 if SW1 SW2 not available)
RF State Code	1 Byte	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 (including OK) the data field will be empty.

8 Other Commands

8.1 Reader Download (ISP) Mode

This command will instruct the Reader to switch to In System Programming (ISP) mode, also known as Download Mode. When this command is received by the reader, it will respond with an ACK and then put itself in the ISP Mode. Once the Reader is in ISP Mode, the terminal can download firmware (.hex file) to the Reader. For the ViVOpay 5000, 4500, S500 Series of Readers, there are two ways in which firmware can be downloaded to the Reader.

1. By using LPC 2000, a free PC utility available from Philips that will perform the function of downloading the firmware.
2. By programming the Flash Memory by sending specific ISP commands to the Reader. The ISP commands would depend on the processor being used by the Reader. The ViVOpay 5000 and S500 Readers use the Philips LPC 2124. For information on flash memory programming refer to the Philips LPC2124 User Manual, Page 217. This document can be downloaded from the following link
   http://www.standardics.nxp.com/support/documents/microcontrollers/pdf/user.manual.lpc2114.lpc2124.lpc2212.lpc2214.pdf.
   The ViVOpay 4500 Readers use the Philips LPC 2136. For information on flash memory programming refer to the Philips LPC2136 User Manual, Page 237. This document can be downloaded from the following link
   http://www.standardics.nxp.com/support/documents/microcontrollers/pdf/user.manual.lpc2131.lpc2132.lpc2134.lpc2136.lpc2138.pdf
   Details of ISP commands are out of the scope of this document

The Command Packet

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	07h	01h	00h	01h	Max Download Time Code		

The Max Download Time Code specifies the maximum time in multiples of 10 seconds that would be required to download the firmware. This defines the time interval from the time that the Reader switches to ISP mode to the time that the Reader automatically resets to start executing the downloaded firmware. The time interval specified must be large enough to complete the firmware download. If the time interval is shorter than the download time, then the reader will reset itself in the middle of the download.

Max Download Time Code	Actual Timeout Interval
1	10 seconds
2	20 seconds
:	:
6	60 seconds
:	:
10	100 seconds
:	:
255	2550 seconds

If the Reader Download (ISP) Mode command is successful, a response packet is not returned. If the Reader Download (ISP) Mode command is unsuccessful, a NACK packet is returned.

8.2 Set Baudrate

This command instructs ViVOpay to change its baud rate to the specified value. If the command frame is valid and ViVOpay supports the specified baud rate, it will return an OK response and then switch to the specified baud rate. If the command frame is not valid, or an invalid baud rate parameter is specified then ViVOpay will return an error response packet. The new baud rate will be retained over power cycles.

The Command Packet

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	Baudrate Code		

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

Important: All other values for Baudrate Code are invalid and should not be accepted by Reader.

The Response Packet

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	30h	See Table	00h	00h	None		

The Reader will switch baud rate only if the response packet contains an OK Status Code. No data will be returned in the response.

8.3 Get Serial Number

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 14-digit serial number stored in its non-volatile memory. If a serial number has not been set in the reader then this command will fail with a Command not Allowed error status. If the command frame is not valid then ViVOpay will return an error response packet.

The Command Packet

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	01h	00h	00h	none		

The Response Packet

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 Table	00h	0Eh	14 digit Serial Number		

8.4 Set Serial Number

Note: The reader serial number can only be set once.

This command instructs the ViVOpay to store the 14-digit serial number in its non-volatile memory. If a serial number has already been set in the reader then this command will fail with a Command not Allowed error status. If the command frame is not valid, or the length is not 14 bytes then ViVOpay will return an error response packet.

The Command Packet

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	0Eh	14 digit Serial Number		

The Response Packet

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 Table	00h	00h	None		

8.5 Get Full Track Data

Get full Track Data from ViVOpay. If a card has been swiped, ViVOpay sends back an Ack Frame followed by a Data Frame containing track data. If no card has been swiped, 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 will contain the Track 1 Data, followed by a NULL character (0x00) marking the end of Track 1 Data, followed by Track 2 data.

If a card has been swiped, but an error occurred, then ViVOpay will just send 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	Unused	Unused	CRC	
ViVOtech\0	'C'	17h	CDh	XX	XX	CRC	

Acknowledgement 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	
ViVOtech\0	'A'	17h	Status	Tracks/ Error Code	DataLen	CRC	

Byte 12 is used for Tracks or Error Code, depending on the value of the Status in Byte 11 (see Status Codes). 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.

Status	Tracks/Error Code	
OK	Bit 0 = Track 1 Bit 1 = Track 2 Bit 3 = Track 3 Bit 7 = Card Type	Examples: 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. Card Type = 0 => Contactless Card Card Type = 1 => Swiped Magnetic Stripe
Failed	Error Code = 0x01 Error Code = 0x02 Error Code = 0x03 Error Code = 0x04 Error Code = 0x05 Error Code = 0x06 Error Code = 0xFF	Card Removed Communication Error Protocol Error Multiple Cards Detected Card Not Accepted Bad Data Unknown Error
Other (See Status Codes)	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 ViVOpay 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	
ViVOtech\0	'D'	Data	Data	…	Data	CRC	

If PC fails to receive the track data, it can send a Nack Frame to request ViVOpay to resend the track data. To ensure that the ViVOpay resends the track data, the Nack frame must be received by ViVOpay within 500ms after it sends the original track data. If ViVOpay receives the Nack frame within that time period, it will first resend the Ack frame followed by the data frame to PC. If ViVOpay receives the Nack frame after 500ms of sending out the original track data, or if a new card has been detected, ViVOpay will just send an Ack/Nack frame to PC and will not resend the track data to PC. Each payload data will only be resent once.

Nack 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	Status	Data1	Data2	CRC	CRC
ViVOtech\0	'N'	17h	00	00	00	CRC	CRC

Acknowledgement 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	
ViVOtech\0	'A'	17h	Status	Tracks	DataLen	CRC	

Status

OK (see Status Codes)

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 ViVOpay 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	
ViVOtech\0	'D'	Data	Data	…	Data	CRC	

8.6 Set RF Error Reporting

This command allows the PC-side 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 will be reported to the PC-side application through the ACK frame for Get Full Track Data command (see Get Full Track 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	
ViVOtech\0	'C'	17h	03h	Operation Code	XX	CRC	

Operation Code:

0x00: Disable RF Error Code Reporting
0x01: Enable RF Error Code Reporting
0x02 or others: No change

Acknowledgement 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	
ViVOtech\0	'A'	17h	Status=OK	RF Error Code Reporting Status	XX	CRC	

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

0x00: RF Error Code Reporting disabled
0x01: RF Error Code Reporting enabled

8.7 Get ViVOpay Firmware Version

Get the ViVOpay Firmware Version Number from ViVOpay. ViVOpay will send back an Ack Frame containing the length of the Version Data. This will be followed by a Data Frame containing the ViVOpay firmware version information.

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	
ViVOtech\0	'C'	29h	00	XX	XX	CRC	

Acknowledgement 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	
ViVOtech\0	'A'	29h	Status=OK	Unused	DataLen	CRC	

Status

OK (see Status Codes)

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 ViVOpay 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	
ViVOtech\0	'D'	ViVOpay Version (Null Terminated ASCII String)	CRC	

9 ViVOpay Vend/DTc Commands

9.1 Configure Buttons Command

This command configures the buttons on the ViVOpay Vend / DTc reader. Both the SWIPE and DONE buttons can be independently disabled with this command. This command will also set the TAP disable time for when the SWIPE button is pressed. When the SWIPE button is enabled, the contactless reader will be turned off for the programmed delay time so that a false read will not occur when the user wishes to swipe a dual contactless / magstripe card.

The Command Packet

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 is set to 0 the DONE switch is disabled. (Byte 14)
If Swipe is set to 0 the SWIPE CARD switch is disabled. (Byte 15)
The Delay is an unsigned delay value in seconds. This should probably not be set to values larger than 30 seconds. (Byte 16)

The Response Packet

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	F0h	See Table	00h	00h	None		

The Reader will switch configuration only if the response packet contains an OK Status Code. No data will be returned in the response.

9.2 Get Button Configuration Command

This command reads the button configuration from the ViVOpay Vend / DTc reader.

The Command Packet

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		

The Response Packet

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 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.

9.3 Disable Blue LED Sequence Command

This command stops the Blue LEDs on the ViVOpay Vend / DTc from flashing in left to right sequence and turns the LEDs off.

The Command Packet

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		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.4 Enable Blue LED Sequence Command

This command starts the Blue LEDs on the ViVOpay Vend / DTc flashing in left to right sequence to indicate that the reader is active. When the Blue LEDs are enabled the Vend reader will output card data in the vending machine burst mode format.

Swiped card read:
@<ESC>A<STX>CARD-[37 MAX bytes of card data]<ETX><LRC><CR>
RFID Card read:
@<ESC>A<STX>RFID-[37 MAX bytes of Card Data]<ETX><LRC><CR>

The Command Packet

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	F7h	00h	00h		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.5 LCD Display Clear Command

This command clears the LCD display.

The Command Packet

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		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.6 Turn Off Yellow LED Command

This command turns off the ViVOpay Vend / DTc's yellow LED. This LED is located below the 3 blue LEDs.

The Command Packet

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		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.7 Turn On Yellow LED Command

This command turns on the ViVOpay Vend / DTc's yellow LED. This LED is located below the 3 blue LEDs.

The Command Packet

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		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.8 Buzzer On/Off Command

This command causes the buzzer to beep once.

The Command Packet

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		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.9 LCD Display Line 1 Message Command

This command displays the command's message on line 1 of the LCD display. On the Vend / DTc 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 will be rejected with an unknown subcommand status code. All messages are left justified on the LCD display.

The Command Packet

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	F0h	FCh	00h	Msg len	LCD message		

The Response Packet

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	F0h	See Table	00h	00h	None		

9.10 LCD Display Line 2 Message Command

This command displays the command's message on line 2 of the LCD display. On the Vend / DTc 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 will be rejected with an unknown subcommand status code. All messages are left justified on the LCD display.

The Command Packet

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	F0h	FDh	00h	Msg len	LCD message		

The Response Packet

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	F0h	See Table	00h	00h	None		

10 Sample Scenarios and Packet Flow

10.1 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	01	01	00	01	00	F6	24
"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	01	00	00	00		12	53
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader starts polling for cards. Terminal should keep checking for data from Reader. If a card has been read data will be available, otherwise there will be no data. The Get Transaction Results 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	03	00	00	00		3B	FF
"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	03	00	00	03	00 00 00	8D	D0
"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	03	00	00	00		3B	FF
"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	03	00	00	03	00 00 00	8D	D0
"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 Reader.

n. 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	03	00	00	00		3B	FF
"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	03	00	00	64	3C	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^0508101335373336072 22"

Data		
32 32 37 32 34 31 31 31 31 33	25	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	00	F1	FB
Track 2 Data "9607997242183"	Clearing Record Not Present		

Contactless MagStripe card was presented and accepted by Reader before the Get Transaction Results command. Track 1 and Track 2 data returned in response.

10.2 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	01	01	00	01	01	D7	34
"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	01	00	00	00		12	53
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader stops polling for cards. Terminal will have to issue Activate command to allow 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	02	01	00	01	0A	6E	6B
"ViVOtech2\0"			DLen = 1 decimal		Timeout = 10 Seconds (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	02	08	00	00		20	2E
"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	02	01	00	01	0A	6E	6B
"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 Reader does not restart polling and just sends back the response containing the Track1 & 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	02	00	00	64	3C	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	25	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	00	F6	7F
Track 2 Data "9607997242183"	Clearing Record Not Present		

10.3 EMV (MChip) Transaction in Poll on Demand Mode

1. The correct CA Public Keys required by the Cards that will be 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 Reader.

2. 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	01	01	00	01	01	D7	34
"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	01	00	00	00		12	53
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader stops polling for cards. Terminal will have to issue Activate command to allow Reader to poll for a card and carry out a transaction.

3. Command: Set EMV 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	04	00	00	0A	9F 1A 02 00 56	5F 2A 02 09 78	69	03
"ViVOtech2\0"			DLen = 10 decimal		TLV Terminal Country Code	TLV Trans Currency Code		

Assuming the current terminal values will be 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	04	00	00	00		AE	16
"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 will have to make sure that correct values have been defined for the parameters based on card requirements otherwise a transaction will fail.

4. 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	02	01	00	06	0A	9A 03 05 08 18	77	1D
"ViVOtech2\0"			DLen = 1 decimal		Timeout = 10 Seconds (decimal)	TLV Transaction Date		

Reader starts polling for cards. A contactless EMV (MChip) card is presented within 10 seconds. Reader completes transaction, even if more than ten seconds pass since Activate command was received. After completing transaction 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	02	00	00	AB	00	00	01
"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 19	5F 34 01 00	5F 24 03 10 07 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 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	27	**60**
Cardholder Name		

10.4 Ticketing/ePurse (MXI) Transaction (Payment at Entry)

It is assumed that the required CA Public Keys, Date and Time have been set in the Reader at least once in its lifetime.

It is also assumed that the Reader has been put in Poll on Demand mode and the EMV parameters have been set correctly by the terminal (see earlier examples).

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	01	01	00	01	01	D7	34
"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	01	00	00	00		12	53
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader stops polling for cards. Terminal will have to issue Activate command to allow Reader to poll for a card and carry out a transaction.

2. Command: Set EMV Configuration (Terminal Country Code, Transaction Currency Code)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	
56 69 56 4F 74 65 63 68 32 00	04	00	00	1E	9F 33 03 40 08 A0	9F 1A 02 01 58
"ViVOtech2\0"			DLen = 10 decimal		TLV Terminal Capabilities	TLV Terminal Country Code

Data				CRC (MSB)	CRC (LSB)
9F 1B 04 00 00 27 10	9F 35 01 26	5F 2A 02 08 40	9C 01 00	3C	F8
TLV Terminal Floor Limit	TLV Terminal Type	TLV Trans Currency Code	TLV Transaction Type		

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	04	00	00	00		AE	16
"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 will have to make sure that correct values have been defined for the parameters based on card requirements otherwise a transaction will fail.

3. Command: Activate (MXI Payment at Entry)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data			CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	02	02	00	05	0A	9F 50	9F 70	8E	33
"ViVOtech2\0"			DLen = 5 decimal		Timeout = 10s (dec)	Balance Tag	Ticketing Profile Tag		

Reader starts polling for cards. A contactless EMV cash card (MXI) card is presented within 10 seconds. Reader completes first leg of transaction, even if more than ten seconds pass since Activate command was received. After completing this leg of transaction Reader does not close session with card. It sends back the response containing the data items requested and waits for the next command.

Response: OK, Card Detected, Card Data being returned.

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data
56 69 56 4F 74 65 63 68 32 00	02	00	00	2C	9F 50 06 00 00 00 00 19 98
"ViVOtech2\0"		OK	DLen = 44 dec		TLV Balance

Data
9F 70 20 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
TLV Ticketing Profile

CRC (MSB)	CRC (LSB)
38	3C

Reader is not polling for cards. Card is still active.

4. Command: Debit Write

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	
56 69 56 4F 74 65 63 68 32 00	03	01	00	31	9F 02 06 00 00 00 00 00 01	9A 03 05 08 10
"ViVOtech2\0"			DLen = 49 decimal		TLV Amount Authorized	TLV Transaction Date

Data
DF 10 20 31 32 33 34 35 36 37 38 39 30 31 32 33 34 35 36 37 38 39 30 31 32 33 34 35 36 37 38 39 30 31 32
TLV Ticketing Info

CRC (MSB)	CRC (LSB)
BE	57

Response: OK, Clearing Record being returned.

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data		
56 69 56 4F 74 65 63 68 32 00	03	00	00	71	00	00	01
"ViVOtech2\0"		OK	DLen = 113 decimal		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 08 40 9A 03 05 08 10 9C 01 00 95 05 00 00 00 00 00
Clearing Record

Data
9F 37 04 00 00 00 00 82 02 49 80 9F 26 08 EE 57 5B FB D8 33 7D E3 9F 27 01 40 9F 10 12 02 11 90 00 03 22 A0 00
Clearing Record

Data		
00 00 00 00 00 27 96 00 3A FF 9F 36 02 01 FB	9F 34 03 1F 00 02	9F 45 02 12 34
Clearing Record	CVM Results	Data Auth Code

Data	CRC (MSB)	CRC (LSB)
9F 4C 08 01 23 45 67 89 AB CD EF	AA	79
ICC Dynamic Number		

Reader is not polling for cards. Session with card terminated.

10.5 Ticketing/ePurse (MXI) Transaction (Get Balance Only, No Debit)

It is assumed that the required CA Public Keys, Date and Time have been set in the Reader at least once in its lifetime.

The balance will be retrieved by using only the first leg of MXI Payment at Entry and then aborting the transaction without doing a Debit Write.

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	01	01	00	01	01	D7	34
"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	01	00	00	00		12	53
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader stops polling for cards. Terminal will have to issue Activate command to allow Reader to poll for a card and carry out a transaction.

2. Command: Set EMV Configuration (Terminal Country Code, Transaction Currency Code)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	
56 69 56 4F 74 65 63 68 32 00	04	00	00	1E	9F 33 03 40 08 A0	9F 1A 02 01 58
"ViVOtech2\0"			DLen = 10 decimal		TLV Terminal Capabilities	TLV Terminal Country Code

Data				CRC (MSB)	CRC (LSB)
9F 1B 04 00 00 27 10	9F 35 01 26	5F 2A 02 08 40	9C 01 00	3C	F8
TLV Terminal Floor Limit	TLV Terminal Type	TLV Trans Currency Code	TLV Transaction Type		

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	04	00	00	00		AE	16
"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 will have to make sure that correct values have been defined for the parameters based on card requirements otherwise a transaction will fail.

3. Command: Activate (MXI Payment at Entry)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data			CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	02	02	00	05	0A	9F 50	9F 70	8E	33
"ViVOtech2\0"			DLen = 5 decimal		Timeout = 10s (dec)	Balance Tag	Ticketing Profile Tag		

Reader starts polling for cards. A contactless EMV cash card (MXI) card is presented within 10 seconds. Reader completes first leg of transaction, even if more than ten seconds pass since Activate command was received. After completing this leg of transaction Reader does not close session with card. It sends back the response containing the data items requested and waits for the next command.

Response: OK, Card Detected, Card Data being returned.

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data
56 69 56 4F 74 65 63 68 32 00	02	00	00	2C	9F 50 06 00 00 00 00 19 97
"ViVOtech2\0"		OK	DLen = 44 dec		TLV Balance

Data
9F 70 20 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
TLV Ticketing Profile

CRC (MSB)	CRC (LSB)
BC	D2

Reader is not polling for cards. Card is still active.

4. Command: Abort

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	05	01	00	00		92	EF
"ViVOtech2\0"			DLen = 0 decimal		None		

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	05	00	00	00		D8	A2
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader is not polling for cards. Session with card terminated.

3. Command: Activate (MXI Payment at Entry)

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data			CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	02	02	00	05	0A	9F 50	9F 70	8E	33
"ViVOtech2\0"			DLen = 5 decimal		Timeout = 10s (dec)	Balance Tag	Ticketing Profile Tag		

Reader starts polling for cards. A contactless EMV cash card (MXI) card is presented within 10 seconds. Reader completes first leg of transaction, even if more than ten seconds pass since Activate command was received. After completing this leg of transaction Reader does not close session with card. It sends back the response containing the data items requested and waits for the next command.

Response: OK, Card Detected, Card Data being returned.

Header	Cmd	Status Code	DLen (MSB)	DLen (LSB)	Data
56 69 56 4F 74 65 63 68 32 00	02	00	00	2C	9F 50 06 00 00 00 00 19 97
"ViVOtech2\0"		OK	DLen = 44 dec		TLV Balance

Data
9F 70 20 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
TLV Ticketing Profile

CRC (MSB)	CRC (LSB)
BC	D2

Reader is not polling for cards. Card is still active.

4. Command: Abort

Header	Cmd	Sub-Cmd	DLen (MSB)	DLen (LSB)	Data	CRC (LSB)	CRC (MSB)
56 69 56 4F 74 65 63 68 32 00	05	01	00	00		92	EF
"ViVOtech2\0"			DLen = 0 decimal		None		

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	05	00	00	00		D8	A2
"ViVOtech2\0"		OK	DLen = 0 decimal		None		

Reader is not polling for cards. Session with card terminated.

11 Pass-Through Mode

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 supported by ViVOpay.

This document describes the ViVOpay Serial Interface, specifically the Pass-through commands. It describes the communication parameters, the ViVOpay Serial Interface Protocol and the command-specific details.

11.1 Basic Pass-Through Operation

Communication between ViVOpay and the terminal will be through the ViVOpay standard serial interface protocol.

To be able to access the Pass-through commands, the terminal must put the ViVOpay unit into Pass-through mode.

Then the terminal must periodically instruct the ViVOpay unit to poll for RF Cards. Whenever ViVOpay detects a card in the RF Field, it will try to carry out ISO 14443 Layer 3 and Layer 4 negotiation and report the card type found. In the pass-through mode, ViVOpay will not attempt to check whether the card is one of the cards 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.

These commands allow a terminal to use a number of features provided by the ViVOpay, such as checking for the presence of ViVOpay by pinging it, retrieving the firmware version number and controlling the RF antenna (field).

11.2 Pass-Through Commands

Note: The Byte 14+n and Byte 15+n CRCs are the reverse of standard Version 1 Format and Version 2 Format Command packets in that the CRC(MSB) is Byte 14 and the CRC(LSB) is Byte 15 for Pass Through command packets.

Within each Pass-through Packet Type, the CRC will be stored as big-endian number i.e. higher byte first.

11.2.1 Antenna Control

This command will allow the terminal to instruct the ViVOpay to turn the RF Antenna ON or OFF.

The Command Packet

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

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	28h	See Table	00h	00h	None		

Note:

- Antenna should not be disabled while polling for a card or while communicating with a card. If Antenna is disabled, no card will be detected.
- This command should only be used in Pass-through Mode for termination handling once a card transaction is completed (successfully or with an error).

11.2.2 LED Control

This command can be used to switch the specified ViVOpay LEDs off or on.

This command will result in the expected behavior *only* when ViVOpay is in Pass-through Mode. If this command is used to switch on an LED when ViVOpay is in normal operation mode and *not* in Pass-through Mode, the LED will not remain on.

The Command Packet

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	See Table Below		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
LED#	1 Byte	00h: LED 0 (First LED to the Right of Power LED) 01h: LED 1 02h: LED 2 FFh: All three LEDs
LED Status	1 Byte	00h: LEF Off 01h: LED On

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	0Ah	See Table	00h	00h	None		

11.2.3 Buzzer Control

This command can be used to sound the ViVOpay Buzzer.

The Command Packet

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

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
Buzzer Parameter	1 Byte	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

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	0Bh	See Table	00h	00h	None		

11.3 Pass-Through Mode Commands

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

Before enabling the pass-through mode, the terminal must make sure that it has not disabled the RF Field by sending the Antenna Off command. If it has, then it must turn the Antenna On before starting the pass-through mode. Once the pass-through mode has been started, the Antenna should be turned off only after the pass-through mode has been stopped. It should not be turned off during the pass-through mode, unless it is for handling the card removal sequence.

The Pass-through Mode subcommands are grouped into three categories

- **General Pass-through Set Up Sub-Commands**
  These sub-commands will have to be used whether we are using high level communication with the PICC or low level communication. These sub-commands include
    - Pass-through Mode Start/Stop
    - Poll for Token

- **High Level PICC Communication Sub-Commands**
  If a PICC supports ISO 14443-4 Protocol, then these high level sub-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 sub-commands include.
    - ISO APDU Exchange

- **Low Level PICC Communication Sub-Commands**
  These low level sub-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 sub-commands can also be used to get and set some PCD and PICC parameters. The low level sub-commands include.
    - PCD Single Command Exchange
    - Get PCD & PICC Parameters

11.3.1 Pass-Through Mode Start/Stop

Whenever the terminal application wants to use the Pass-through Mode, this sub-command must be issued once at the beginning to instruct ViVOpay to go into Pass-through Mode. It must be issued once at the end to instruct ViVOpay to exit the Pass-through Mode and return to normal operations.

Once Pass-through Mode is started, ViVOpay will stop polling for cards that it recognizes and will only handle Pass-through commands to allow the terminal to communicate directly with a PICC, until it is brought out of Pass-through mode.

ViVOpay will not accept any Pass-through sub-command until it has been put in the Pass-through Mode by issuing this sub-command.

The Command Packet

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

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Table	00h	00h	None		

Note:
- 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.

11.3.2 Poll for Token

Once Pass-through Mode is started, ViVOpay will stop polling for supported cards and sit dormant until the "Poll for Token" command is given. This command tells ViVOpay to start polling for a Type A or Type B PICC until a PICC is detected or a timeout occurs.

If a PICC is detected within the specified time limit, ViVOpay will activate it and respond back to the terminal with card related data such as Serial Number.

If no PICC is detected within the specified time limit, ViVOpay will stop polling and respond back indicating that no card was found. No card related data will be returned in this case.

The Command Packet

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 Table Below		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
Timeout1	1 Byte	Time in Seconds Timeout1 cannot be zero seconds if Timeout2 is Zero.
Timeout2	1 Byte	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:

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

The Response Packet

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 Table	00h	Variable	See Table Below		

The Data field will contain data only if the Status Code is OK.

Data Fields for the Response Packet (if Status = OK)

Data Field	Length in Bytes	Description
Card	1 Byte	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 will depend on the Card Detected. If no card was detected, then a Serial Number will not be sent back.

11.3.3 ISO APDU Exchange

This sub-command will allow 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.

The Command Packet

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 will depend on the application residing on the PICC and are out of the scope of this document.

If a valid Command Packet is received from the terminal, ViVOpay will send the APDU data to the PICC and receive its response. ViVOpay will treat the PICC response as unknown data and will not try to interpret it. If all goes well, ViVOpay will send back a response packet with an OK status and the Data received from the PICC (APDU In).

If the Command Packet contains any errors, or an error occurred during communication with the PICC, then ViVOpay will send a Response Packet with an appropriate Status. No Data will be returned in this case.

The Response Packet

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 Table	Variable	Variable	APDU In Or None		

The Data field will contain data only if the Status Code is OK. In this case, the data will consist of "APDU In" i.e. the response data that was received from the PICC. The contents of the response will depend on the application residing on the PICC and are out of the scope of this document.

11.3.4 PCD Single Command Exchange

This sub-command will allow the terminal to send, via ViVOpay, 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 ViVOpay to the Terminal.

The Command Packet

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		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
PCD Command	1 Byte	This is the command that will be sent to the PCD Reader IC on the ViVOpay board. It will tell the PCD what to do with the data sent with the command. The PCD commands supported and their values are given in the "PCD Cmd" Table below
PCD Timeout	4 Bytes	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 Byte	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 Byte	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 will be sent to the PICC or to the PCD.

The Command Packet 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 will depend on the PICC and PCD and is out of the scope of this document.

PCD Command Table

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 will result 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 Load key, Auth1 and Auth2 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.
2-7	RFU	X	Reserved for future use.

Channel Redundancy Register Table

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 Packet is received from the terminal, ViVOpay will send the data to the PICC (or carry out the appropriate action) and receive its response. ViVOpay will treat the response as unknown data and will not try to interpret it. If all goes well, ViVOpay will send back a Response Packet with OK Status and the Data received from the PICC (if any). The Response Packet will also contain the result of the PCD Command (PCD Status). The PCD Status may indicate success or an Error Code.

If the Command Packet contains any errors, or an error occurred during communication with the PICC (such as PICC removed from the field), then ViVOpay will send a Response Packet with an appropriate Status. No Data will be returned in this case.

The Response Packet

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 Table	Variable	Variable	See Table Below OR None		

Data Fields for the Response Packet (If Status = OK)

Data Field	Length in Bytes	Description
PCD Status	1 Byte	This field contains the result of the PCD Command. Possible values are given in the following table.
RcvdBits	4 Bytes	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 will 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
-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

11.3.5 Get PCD & PICC Parameters

This command will allow the terminal to retrieve PCD and PICC related parameters from the ViVOpay.

The Command Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Sub-Command	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	05h	00h	00h	None		

The Response Packet

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 Table	00h	00h or 0Fh	See Table Below		

If a valid Command Packet is received from the terminal, ViVOpay will retrieve the parameters from the PCD and PICC. If the parameters are retrieved successfully, ViVOpay will send back a Response Packet with OK Status and Data containing the parameters given below. For details on the parameters, refer to ISO 14443

If the Command Packet contains any errors, or an error occurred while retrieving the parameters, then ViVOpay will send a Response Packet with an appropriate Status. No Data will be returned in this case.

Data Fields for the Response Packet (if Status = OK)

Data Byte	Name	Length (Bytes)	Format	Notes
0-1	Reader Buffer Size	2 Bytes	Binary	Reader RF Buffer Size stored as a big-endian number.
2-3	Max Picc Frame Size	2 Byte	Binary	Maximum PICC Frame Size stored as a big-endian number.
4	CID	1 Byte	Binary	CID
5	Block	1 Byte	Binary	Block Number.
6	CID Supported	1 Byte	Binary	CID Supported
7-10	FWT	4 Bytes	Binary	Frame Waiting Time in ETUs. It is stored as a big-endian number.
11-14	D-FWT	4 Bytes	Binary	Delta FWT in ETUs. It is stored as a big-endian number.

11.3.6 High Level Pass-Through Commands for Mifare Cards

This sub 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 will not work for non-Mifare cards.

11.3.6.1 Mifare Authenticate Block

This command will allow the terminal to instruct the ViVOpay Reader to authenticate the Mifare Card sector containing the specified block of data. The Key to be used will also be specified by the terminal. This command is applicable only for Mifare Standard / Classic Cards. It is not applicable for Mifare Ultralight Cards.

The Command Packet

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		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
Block	1 Byte	Block Number in the Mifare Card for which the relevant sector must be authenticated.
Key Type	1 Byte	Specifies which type of key to use for authentication. It can have the following values. 01h: Key A 02h: Key B
Key	6 Bytes	Value of the Key

For details on these fields, refer to the relevant Mifare Specifications

After receiving the Command Packet, the ViVOpay reader will verify the data and if the data is valid, then interact with the Mifare card to authenticate the sector containing the specified block. If this operation is successful, the ViVOpay reader will send a Response Packet with an OK Status. If the operation fails or the data was invalid, then the reader will return a Response Packet with an appropriate Status.

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Table	00h	00h	None		

11.3.6.2 Mifare Read Blocks

This command will allow the terminal to instruct the ViVOpay Reader to read data from one or more blocks on the Mifare Card and return the data to the terminal. The terminal can instruct ViVOpay to read up to 15 blocks using this command. If more than one block is defined, then the reader will automatically read the starting block and the blocks that follow.

The block size will depend on the type of Mifare card being accessed. For Mifare Standard Cards the block size is 16 bytes. For Mifare Ultralight Cards the block (page) size is 4 bytes; however each read operation will read 16 bytes of data. When reading Mifare Ultralight cards, BlockCount will be taken to mean 16 byte blocks (consisting of 4 4-byte pages each).

For example, if the card is a Mifare Ultralight card, and a read is requested starting at Block 3 and BlockCount is 1 then 16 bytes of data will be returned consisting of Page # 3, 4, 5 & 6. And if a read is requested starting at Block 3 and BlockCount is 2 then 16*2=32 bytes of data will be returned consisting of Page # 3, 4, 5, 6, 7, 8, 9, 10.

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.

If the card specified is a Mifare Standard card and the read command specifies a single block read, then the reader will try to read 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 read is a multi block read, then the reader will skip reading the sector trailer blocks that contain the Keys (since the Keys cannot be read). Skipped blocks will not be 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 will carry 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.

The Command Packet

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		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
Card & Block Count	1 Byte	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 will be 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 Byte	This is the card block number from which the reader will start reading.

After receiving the Command Packet the ViVOpay reader will verify the parameters. If the parameters are valid, then it will read the data from the card. If this operation is successful, the ViVOpay reader will send a Response Packet containing a Status of OK and the data read. If the operation fails or one or more parameters were invalid, then the reader will send a Response Packet containing an appropriate Status, but no data.

The Response Packet

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 Table	Variable	Variable	Data Read from Card OR None		

If the Status is OK, then the Data Length will depend 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 will be zero.

11.3.6.3 Mifare Write Blocks

This command will allow the terminal 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 will automatically write to the starting block and the blocks that follow.

The block size will depend 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.

If the card specified is a Mifare Standard card and the write command specifies a single block write, then the reader will try 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 will skip writing to the sector trailer blocks that contain the Keys. Skipped blocks will not be 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 will carry 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.

The Command Packet

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		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description
Card & Block Count	1 Byte	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 will be 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 Byte	This is the card block number from which the reader will start writing.
Data to Write	Variable [1]	Data to write to the Card. The length of the data to be written to the card will depend on the number of blocks to be written and the card type. Length = Blocks to be Written * (Bytes per Block for Card).

After receiving the Command Packet the ViVOpay reader will verify the parameters. If the parameters are valid, it will write the data to the card. If this operation is successful, the ViVOpay reader will send a Response Packet with a Status of OK.

If the Command Packet is invalid or the write operation fails then the reader will send a Response Packet with an appropriate Status.

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Table	00h	00h	None		

11.3.6.4 Mifare ePurse Command

This command allows the terminal 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.

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 packet 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 will be 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 are included they will be used to authenticate the block and the debit function will be performed. If no key information is included the key and key type used in the previous Mifare Authentication command will be 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 key information is encountered while processing a Purse Command. The initial default values are those installed when the Mifare Authentication command is received. Those will be used until another key is encountered at which point that key will become 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 to access.

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 will be acted upon and an error will be returned to the user.
- 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 will be acted upon but no error will be returned.

The Command Packet

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		

Data Fields for the Command Packet

Data Field	Length in Bytes	Description							
Mode, Card Type & Operation Count	1 Byte	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 Command data area.							
Purse Command Blocks	Variable [1]	Series of any combination of supported Purse Command blocks (Debit, Credit, Backup, Write). Refer to the description of each individual command packet 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				A / B Key	Key					
	0Bh	See Table				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			

Data Fields for the Debit / Credit Function Block

Data Field	Length in Bytes	Description
Amount	4 Bytes	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 Byte	Specifies which type of key to use for authentication. It can have the following values. 01h: Key A 02h: Key B
Key	6 Bytes	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	A / B Key	Key					
See Table	08h	See Table	See Table	See Table					

Backup Function Block (using default Key)

Byte 0	Byte 1	Byte 2
Backup Block Number	Command Length	Primary Block Number
See Table	01h	See Table

Data Fields for the Backup Function Block

Data Field	Length in Bytes	Description
Backup Block Number	1 Byte	Number of destination value block to be used for backup.
Primary Block Number	1 Byte	Number of source value block to be copied.
Key Type	1 Byte	Specifies which type of key to use for authentication. It can have the following values. 01h: Key A 02h: Key B
Key	6 Bytes	Value of the Key

For details on these fields, refer to the relevant Mifare Specifications

After receiving the Command Packet the ViVOpay reader will verify the parameters. If the parameters are valid, it will perform the operations specified in the order in which they appear within the Purse Command data packet.

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.

If all operations are successful, the ViVOpay reader will send a Response Packet with a Status of OK. If the Command Packet is invalid or any of the operations fail then the reader will send a Response Packet with an appropriate Status.

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Table	00h	00h	None		

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 packet.

The Command Packet

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	00	07	3**1**H	20H	04H

Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22
Debit Amount				CRC MSB	CRC LSB
D0H	07	00	00		

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 packet.

The Command Packet

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	00	0EH	**B1**H	20H	0BH

Byte 17	Byte 18	Byte 19	Byte 20	Byte 21	Byte 22	Byte 23	Byte 24
Credit Amount				A/B Key	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 packet.

The Command Packet

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	00	11H	32H	20H	0BH
Byte 17	**Byte 18**	**Byte 19**	**Byte 20**	**Byte 21**	**Byte 22**	**Byte 23**	**Byte 24**
Debit Amount				A/B Key	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	01	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 packet.

The Command Packet

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	00	0BH	31H	1DH	08
Byte 17	**Byte 18**	**Byte 19**	**Byte 20**	**Byte 21**	**Byte 22**	**Byte 23**	**Byte 24**
Primary Block	A/B Key	Key					
1CH	**02**	Ka	Kb	Kc	Kd	Ke	Kf
Byte 25	**Byte 26**						
CRC MSB	CRC LSB						

11.3.7 High Level Halt Command

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.

The Command Packet

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	Halt Type		

Halt Type = 01h Send HALT A Command (For Type A Cards)
= 02h Send HALT B Command (For Type B Cards)

The Response Packet

Byte 0-9	Byte 10	Byte 11	Byte 12	Byte 13	Byte --	Byte 14	Byte 15
Header Tag & Protocol Version	Command	Status Code	Data Length (MSB)	Data Length (LSB)	Data	CRC (MSB)	CRC (LSB)
ViVOtech2\0	2Ch	See Table	00h	00h	None		

11.4 Suggested Sequence for Pass-Through Commands

- Put ViVOpay in Pass-through Mode by sending a "Start Pass-through Mode" command to ViVOpay.
- Periodically request ViVOpay to poll for cards by sending the "Poll For Token" command. If no card is found within the time specified, ViVOpay will indicate this. If a card is found, it will return the card type and serial number.
- At this point ViVOpay will already have gone through the anti-collision, selection and activation (if required) sequence as per ISO 14443 A/B, and the card will be 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 "ISO APDU Exchange" 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 & PICC Parameters" command for greater control.

  High Level Commands (For Mifare Cards Only): Or use the "Mifare Authenticate Block", "Mifare Read Blocks", "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 ViVOpay to terminate the Pass-through Mode and start normal polling for cards that ViVOpay supports 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 ViVOpay 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. Or the terminal may opt to not wait and terminate the pass-through mode as soon as it is done reading. However, in this case, if the card is not removed from the field fast enough, the terminal may end up doing multiple reads of the same card.

11.5 Use of "PCD Single Command Exchange" Command

11.5.1 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 by 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 unit:

Terminal	ViVOpay
Command Packet ("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 Packet (OK, NoTagError, RcvdBits=0) "ViVOtech2\0" 2Ch 00h 00h 05h FFh 00h 00h 00h 00h <CRC><CRC>

12 Key Manager Introduction

Note: The Key Manager uses version 1 formats (see Version 1 Formats).

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.

12.1 Key Manager Basic Operation

Communication between ViVOpay and the terminal will be through the ViVOpay standard serial interface protocol described in the following sections.

To be able to carry out key management, terminal parameter set up or real time clock set up, the terminal must use the relevant commands.

12.2 Key Manager Commands

12.2.1 EMV Key Management Commands

These functions allow EMV Key Management.

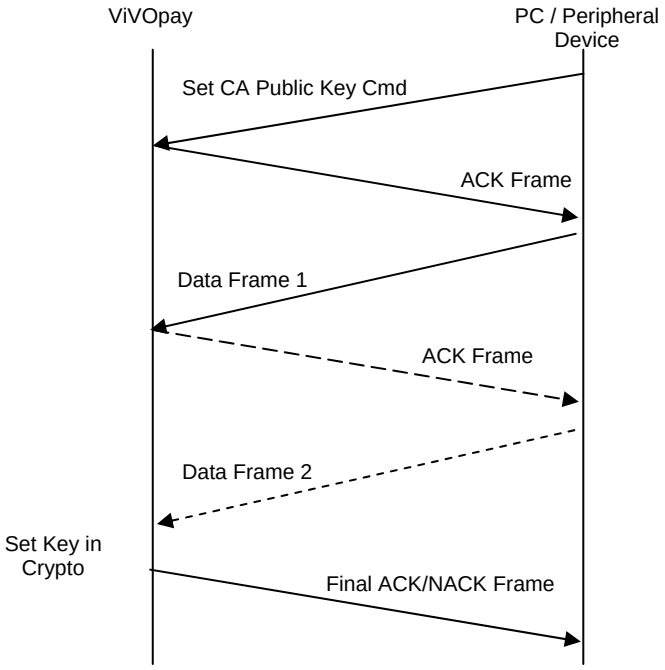
ViVOpay provides a secure storage environment on its Crypto Chip for storing the Certification Authority Public Keys. It allows for storage of up a maximum of 30 keys which are uniquely identified as a key index in each payment scheme (RID). The basic Key management functions provided are setting of 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.

Error Codes for EMV Key Management Commands

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

12.2.1.1 Set CA Public Key

This command will allow the terminal to send the data related to a CA Public Key to ViVOpay for storing in a secure environment (Crypto Chip Memory). The Public Key will be 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 packets.



Flow of Frames between ViVOpay 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 will contain the length of the one and only data frame to follow and DataLen2 will be 0.
If the key data is being sent in two data frames, then DataLen will contain the length of the data frame to follow (first data frame) and DataLen2 contain the length of the second data frame.
DataLen > 0, DataLen2 >= 0

Acknowledgement Frame from ViVOpay (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	Unused	Unused		

Status: OK (or see Status Codes)

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	ErrorCode	Unused		

ErrorCode: 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 will indicate the reason for failure.

First Data Frame from terminal to ViVOpay (If ViVOpay 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 = DataLen.

The data field in the first data frame will contain 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, will provide the data as given in the following table.

Data Byte	Name	Length (Bytes)	Format	Notes
0-4	RID	5 Bytes	Binary	Registered Identifier. Necessary for Unique Identification
5	CaPublicKey Index[1]	1 Byte	Binary	Index of the CA Public Key for this RID. Necessary for Unique Identification
6	CaHashAlgoIndicator[1]	1 Byte	Binary	CA Hash Algo to produce Hash-Result in digital signature scheme. Valid Values: 01h: SHA-1
7	CaPublicKeyAlgoIndicator[1]	1 Byte	Binary	Digital Signature Algo to be used with CA Public Key. Valid Values: 01h: RSA
8-27	CaPublicKeyChecksum[1]	20 Bytes	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 Bytes	Binary	CA Public Key (Modulus) Length stored as a Big-Endian number. Aka N_{CA}
34	CaPublicKeyModulus[1]	Var. (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)

Acknowledgement Frame from ViVOpay (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	Unused	Unused		

Status: OK (or see Status Codes)

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	ErrorCode	Unused		

ErrorCode: See EMV Key Management Error Codes Table

Second Data Frame from terminal to ViVOpay (If ViVOpay 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 will contain the remaining CA Public Key related Data.

On receiving valid data, ViVOpay will send it to the Crypto Chip for secure storage. The Crypto Chip will check the data and store it in its memory. If the CA Public Key is stored successfully in the Crypto Chip memory, ViVOpay will send back an Ack frame. If for any reason the CA Public Key is not stored, ViVOpay will send back a Nack frame.

Final Acknowledgement Frame from ViVOpay (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	Unused	Unused		

Status: OK (or see Status Codes)

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	ErrorCode	Unused		

ErrorCode: See EMV Key Management Error Codes Table

12.2.1.2 Delete CA Public Key

This command will allow the terminal to instruct ViVOpay to delete a previously set CA Public Key from within secure storage in the Crypto Chip. The Key will be uniquely identified by the <RID, Key Index> pair.

When this command is received, ViVOpay will wait for a data frame containing the RID and Key Index. It will then instruct the Crypto Chip to delete the specified CA Public Key. Depending on the result of this operation, ViVOpay will send back an Ack or Nack Frame.

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	02h	Unused	DataLen=6		

Acknowledgement Frame from ViVOpay (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	Unused	Unused		

Status: OK (or see Status Codes)

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	ErrorCode	Unused		

ErrorCode: See EMV Key Management Error Codes Table

Data Frame from terminal to ViVOpay (If ViVOpay 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 Acknowledgement Frame from ViVOpay (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	Unused	Unused		

Status: OK (or see Status Codes)

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	ErrorCode	Unused		

ErrorCode: See EMV Key Management Error Codes

12.2.1.3 Delete All CA Public Keys

This command will allow the terminal to instruct ViVOpay to delete all previously set CA Public Keys from within secure storage in the Crypto Chip. The Keys will be deleted regardless of the <RID, Key Index> pair.

When this command is received, ViVOpay will instruct the Crypto Chip to delete all CA Public Keys. Depending on the result of this operation, ViVOpay will send back an Ack or Nack Frame.

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	03h	Unused	Unused		

Acknowledgement Frame from ViVOpay (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	Unused	Unused		

Status: OK (or see Status Codes)

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	ErrorCode	Unused		

ErrorCode: See EMV Key Management Error Codes Table

12.2.2 RTC (Real Time Clock) Set Up Commands

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

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

12.2.2.1 RTC Set Time

This command will allow the terminal to instruct ViVOpay to set a specific time in the Real Time Clock.

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'	25h	01h	HH	MM		

HH: Hour (2-digit, BCD, Range 00-23)
MM: Minutes (2-digit, BCD, Range 00-59)

Acknowledgement Frame from ViVOpay (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'	25h	Status=OK	Unused	Unused		

Status: OK (or see Status Codes)

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'	25h	FAILED	ErrorCode	Unused		

ErrorCode: See RTC Management Error Codes Table

12.2.2.2 RTC Get Time

This command will allow the terminal to instruct ViVOpay to return the current time from the Real Time Clock.

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'	25h	02h	Unused	Unused		

Acknowledgement Frame from ViVOpay (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'	25h	Status=OK	HH	MM		

Status: OK (or see Status Codes)

HH: Hour (2-digit, BCD, Range 00-23)
MM: Minutes (2-digit, BCD, Range 00-59)

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'	25h	FAILED	ErrorCode	Unused		

ErrorCode: See RTC Management Error Codes Table

12.2.2.3 RTC Set Date

This command will allow the terminal to instruct ViVOpay to set a specific Date in the Real Time Clock.

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'	25h	03h	Unused	DataLen=4		

DataLen

Number of Data Bytes in the Data Frame to Follow. This does not include the Frame Tag, Frame Type and Checksum bytes. This will always be 4.

Acknowledgement Frame from ViVOpay (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'	25h	Status=OK	Unused	Unused		

Status: OK (or see Status Codes)

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'	25h	FAILED	ErrorCode	Unused		

ErrorCode: See RTC Management Error Codes Table

Data Frame from terminal to ViVOpay (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 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 Acknowledgement Frame from ViVOpay (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'	25h	Status=OK	Unused	Unused		

Status: OK (or see Status Codes)

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'	25h	FAILED	ErrorCode	Unused		

ErrorCode: See RTC Management Error Codes Table

12.2.2.4 RTC Get Date

This command will allow the terminal to instruct ViVOpay to return the current Date from the Real Time Clock.

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'	25h	04h	Unused	Unused		

Acknowledgement Frame from ViVOpay (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'	25h	Status=OK	Unused	DataLen		

Status: OK (or see Status Codes)

DataLen

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

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'	25h	FAILED	ErrorCode	Unused		

ErrorCode: 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)

13 Burst Mode

If the ViVOpay Burst Mode Serial Interface is supported on a ViVOpay unit, then the communication between ViVOpay and the terminal will normally be in Burst Mode. In this mode a data packet will be sent from ViVOpay to the terminal, each time a card is read successfully. The terminal does not have to send any command or data to ViVOpay.

The ViVOpay will keep polling for the supported RF Cards. Whenever ViVOpay detects a card in the RF Field, it will try to read the card data. If the read operation is successful, ViVOpay will send a "Card Payload" packet that will contain the Status, Card Type, Card Data and CRC to the VeriFone terminal through its serial port. Detailed information on the packet format is given in the sections ahead.

One thing to note over here is that when the Burst Mode Serial Interface is enabled, the standard ViVOpay Serial Interface is not disabled entirely. Commands such as Ping, etc. can still be sent to the ViVOpay unit by following the protocol specified in the ViVOpay Serial Interface. In the Command-Response Mode, the terminal sends a command to the ViVOpay and the ViVOpay will respond in pre-defined manner. The two devices may exchange a number of packets, depending on the command, in order to complete an operation. Details of this protocol are out of the scope of this document.

These commands will not affect the Burst Mode. However, if at any time the "Get Full Track Data" command is sent to the ViVOpay unit, the ViVOpay Burst Mode Serial Interface will automatically be disabled. It can be re-enabled by sending a specific command to enable it, or by resetting ViVOpay.

These commands allow a terminal to use a number of features provided by the ViVOpay, such as checking for the presence of ViVOpay by pinging it, retrieving the firmware version number, etc.

13.1 ViVOpay Burst Mode Packets

13.1.1 Payload Packet (On Successful Read)

On successful read ViVOpay will send a Card Payload packet to the terminal that will always contain Packet Type, Status and Card Type. The Status will always show Success (=00). The Card Type can have any of the values defined in the "Data Definitions" section. This will be followed by the track data. Only those tracks will be sent which ViVOpay was able to read from the Card. If a track is not present on the card, then it will not be sent to the terminal. Each Track will begin and end with its Start and End Sentinel. After the Track Data, ViVOpay will send two bytes of CRC. 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
Packet Type =01h	Status =00h	Card Type	Track 1 Field (if found)	Track 2 Field (if found)	CRC (MSB)	CRC (LSB)

Example 1: Payload, Card Read Successfully, Card 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, Card Type MasterCard, Only Track 2 Present
[01] [00] [02] ;123456=12345?<CRC1><CRC2>

Example 3: Payload, Card Read Successfully, Card Type AmEx, Only Track 1 Present
[01] [00] [02] %B1234567^ABCDEF^12345678? <CRC1><CRC2>

Example 4: Payload, Card Read Successfully, Card Type Unknown, Both Track 1 and Track 2 Present
[01] [00] [00] %B123456789^ABCDEF^12345678?;123456=12345? <CRC1><CRC2>

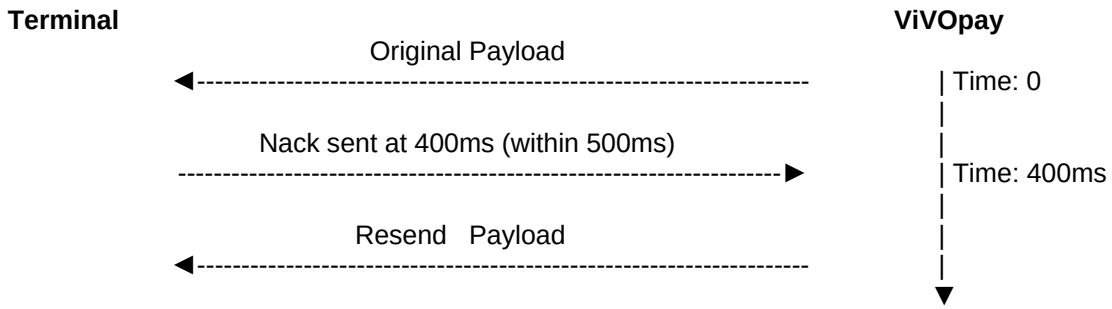
13.1.2 Nack Packet

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

The Nack packet will be a 1-Byte code with value of ox55.

Byte 0
Packet Type =0x55h

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



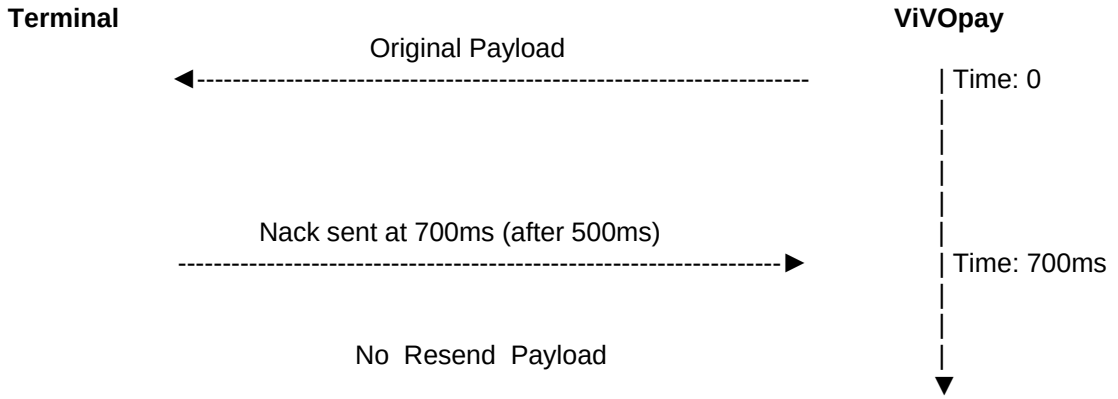
Original Payload:

Payload, Card Read Successfully, Card 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, Card Type Master Card, Both Track 1 and Track 2 Present
[01][00][01]%B5325350000623567^840SMITH/JOHN^05085011492563892473?;5325350000623567=05081019492993892483? <CRC1><CRC2>

Example 2: ViVOpay receives Nack packet from terminal after 500ms of sending the original payload data, ViVOpay does not resend the card payload data.



Original card payload data (no resent payload data):

Payload, Card Read Successfully, Card Type American Express, Both Track 1 and Track 2 Present
[01][00][03]%B379013539021002^TEST/CARD001^0604718000877840?;379013539021002=06047180008778400102? <CRC1><CRC2>

13.1.3 Data Definitions

13.1.3.1 Status

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

Status	Value	Description
Success / No Error	00h	Card Read completed successfully.

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

13.1.3.2 Card Type

The Card Type will be a 1 byte code that will indicate the Card Type detected. This can have any value from 0 – 255. A list of Card Types is given below.

Card 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
ViVOwallet Diagnostic	0Ah
HID card	0Bh
MSR – Physical MSR, Card type unknown	0Ah
Not Used	25h

Card Type	Value
Not Used	3Fh
Not Used	3Bh
Not Used	3Bh
Others	TBD

The Card Type will never have a value that matches the Track 1 and Track 2 Start/End Sentinels.

13.1.3.3 Track 1 Field

This will be a variable length field consisting of Track 1 data as ASCII characters. This field will start with the Track 1 Start Sentinel '%' and end with the Track 1 End Sentinel '?'. If any Track 1 data is available, it will be present between the Start and End Sentinel. For example %B123456789^ABCDEF^12345678?

13.1.3.4 Track 2 Field

This will be a variable length field consisting of Track 2 data as ASCII characters. This field will start with the Track 2 Start Sentinel ';' and end with the Track 2 End Sentinel '?'. If any Track 2 data is available, it will be present between the Start and End Sentinel. For example ;12345678=12345?

Appendix A.1: PC-Side Code for CRC Calculation

Sample PC-side code for CRC Calculation. This code has been written in Microsoft Visual C++ 6.0.

```
// ------------------------------------------------------------------------------------------------------------------
// ViVOtech, Inc.
// ViVOtech reserves the right to make changes without notice at any time. ViVOtech 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. ViVOtech 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);
}
```

Appendix A.2: Examples using Configurable AIDs

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.3: Demo Utilities and Sample Code

The following PC-based demo utilities and sample code are available from ViVOtech 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.4: 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
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

Term	Definition
PICC	Proximity card
PN511	FeliCa Chip from Philips
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	Start up Frame Guard Interval (or time Integer)
SFI	Short File Identifier (EMV)
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

Appendix A.5: Revision History

Interface Developer's Guide

Version	Date	Author	Change
V1.00	10-23-07	AS	Create Document
V1.0.1	01-17-08	JB/AS	Change bauds to baud Valid message length for LCD Line 1 and LCD Line 2 corrected from 15 to 16 characters.
	01-18-08	JB/AS	Response packet byte count definition was incorrect for the following commands: • Set EMV Configuration • Get EMV Configuration • Set Configurable AID • Set Configurable Group • Get Configurable AID • Get Configurable Group • Delete Configurable AID • Delete Configurable Group • Get All AIDs • Get All Groups Change response command for Get/Set Serial Number to 12h

EMV History

Version	Date	Author	Change
V1.00	04-08-2005	SK	First draft of the M/Chip Serial Interface for Retail POS Terminals
V1.01	04-29-2005	SK	Header Tag & Protocol Version in Packets changed to a Null terminated string. Allow setting of new parameters in "Set EMV Configuration" command: Terminal Action Codes (Other, Default & Denial), Additional Terminal Capabilities. Added new commands for Transaction Log Management. Added new error code for SD Memory Error.

Version	Date	Author	Change
V2.00	08-09-2005	SK	Generalized the specs to cover both type of Contactless EMV transactions, i.e., MasterCard (M/Chip, MXI) and Visa VSDC Cards. Changed section of document title from "M/Chip" to "Contactless EMV". Added new Status Codes & Error Codes. Changed CRC byte ordering for Command Packets to little-endian. Added Parameter setting to force the Reader to do MagStripe transactions if an M/Chip card is presented. Added two new commands, Reader Download Mode and Set Baudrate. Made changes to ticketing (MXI) commands: To make specifications conform to latest version of PayPass M/Chip MXI specifications. Two different MXI command sets (Entry, Exit) combined into a single command set. Three different MXI Activate commands (Entry, Exit-Entry & Exit-Exit) combined into a single Activate command for MXI. Two different MXI Debit commands (Entry, Exit-Exit) combined into a single MXI "Debit Write". "Store Ticket" Command renamed to "Write Data" command. Added additional Tags in MXI Activate and Debit Write commands.
V2.01	08-18-2005	SK	Added option of returning Application Label in both Activate commands and Get Transaction Result command. Defined Transaction Date as mandatory in Activate Transaction Command for EMV transactions. Added clarification in Read Next Transaction Log command. Added a new section on sample scenarios to show command flow and sample data.
V2.02	09-09-2005	SK	Error Code "Card Generated AAC or ARQC" split into two separate error codes. New section added for RF State Codes. More details added on how to handle errors reported by the reader (see section on Error Codes). Data field format for response packets indicating "Failed Status" changed to include RF State in addition to SW1 SW2. "Set EMV Configuration" command modified to provide support for setting different Terminal Floor Limits for each AID. Added new command "Get EMV Configuration"
V2.03	09-15-2005	SK	Added some more fields (CVM Results, Data Authentication Code, and ICC Dynamic Number) in the responses to the following commands: Activate Transaction (EMV/MChip) Get Transaction Result Debit Write Updated examples to reflect this change.

Version	Date	Author	Change
V2.04	10-05-2005	JX	Added some more fields(Track 2 Equivalent Data, Track 1 Equivalent Data, Transaction Status Information) in the response to the following commands: Activate Transaction (EMV/MChip) Get Transaction Result
V2.05	11-10-2005	JX	Add Language option parameter to the "Set EMV Configuration" and "Get EMV Configuration" command.
V2.06	11-28-2005	JX	Add Cardholder Name in the response to the following commands: Activate Transaction (EMV/MChip) Get Transaction Result Add collision error in the Error Codes.
V2.07	01-26-2006	JX	Add LCD delay time and LCD font parameters to the "Set EMV Configuration" and "Get EMV Configuration" command.
V2.08	01-30-2006	JX	Add LED color parameters to the "Set EMV Configuration" and "Get EMV Configuration" command.
V2.09	03-24-2006	JX	Add Set Message command. Add IAC and AUC in the response of Activate Transaction (EMV/MChip) and Get Transaction Result commands. Add five more RF State Codes.
V2.10	04-03-2006	JX	Add one more RF State Codes. Modify the IDLE message in Set Message command. Add AID "A0000000048826" in the Set EMV Configuration command for Terminal Floor Limit setting.
V2.11A	04-19-2006	JX	Change Abort Transaction Command to Cancel Transaction Command Add one RF State Codes
V2.12	05-11-2006	JX	Add Update Balance Command Add some changes for the response of the Activate Transaction and Get Transaction Result commands Add one RF State Code for Update Record command Add three parameters to the "Set EMV Configuration" and "Get EMV Configuration" commands: - Enable/Disable Burst Mode - LCD Message Set Number - CVM Required Limit Add three Error Codes: - Amount Over Maximum Limit - Request Online Authorization - Go to Contact Interface Add second set of LCD messages and LED indicator parameter in Set Message command
V2.13	05-17-2006	JX	Add Transaction Time in the Activate Transaction Command Add error response for the Update Balance Command Add "Welcome" message in the Set Message command

Version	Date	Author	Change
V2.14	06-16-2006	JX	Add some comments and "VLP Issuer Auth Code" in the Activate Transaction and Get Transaction Result Command Change the value of Enable/Disable Burst Mode in the "Set EMV Configuration" and "Get EMV Configuration" commands.
V2.15	06-26-2006	JX	Add parameter "Status Check" to the "Set EMV Configuration" and "Get EMV Configuration" commands. Add new value of parameter "LCD Message Set Number" for Visa AP in the "Set EMV Configuration" and "Get EMV Configuration" command.
V2.16	06-27-2006	JX	Add parameter "VisaTTQ" to the "Set EMV Configuration" and "Get EMV Configuration" commands.
V2.17	07-14-2006	JX	Add parameter "Terminal IFD" to the "Set EMV Configuration" and "Get EMV Configuration" commands.
V2.18	07-17-2006	JX	Add parameter "Transaction Limit" to the "Set EMV Configuration" and "Get EMV Configuration" commands. Add "Transaction Amount is Zero" in the Error Codes.
V2.18A	07-31-2006	JX	Add one "LCD Message Set Number" in the Set Message command.
V2.19	08-02-2006	JX	Add parameters 9A, 9F21 and 9F66 to the "Set EMV Configuration" and "Get EMV Configuration" commands and remove FFF3 from those two commands. Allow the terminal cancel the UBC command.
V2.20	08-03-2006	JX	Add parameter Application Capability to the "Set EMV Configuration" and "Get EMV Configuration" commands. Add "Card Not Supported" in the Error Codes.
V2.21	08-04-2006	JX	Add AID in the response of ATC and Get Transaction Result command. Add RBS and MasterCard Cash AID under parameter Application Capability. Modify the Set LCD Message command. Add Store LCD Message command and Get LCD Message command.
V2.22	08-09-2006	JX	Add tag 9F66 and tag 9F03 in the response of ATC and Get Transaction Result command for Visa EMV application. Remove Parameter "LCD Message Number" in the "Set EMV Configuration" and "Get EMV Configuration". Modify the "Set LCD Message", "Store LCD Message" and "Get LCD Message" commands. Add Normal J/Speedy application for parameter "Application Capability" in "Set EMV Configuration" and "Get EMV Configuration" command.

Version	Date	Author	Change
V2.23	09-21-2006	JX	Add parameter "Fddav00" in the "Set EMV Configuration" and "Get EMV Configuration". Add some comments for VP4500 and S500. Add parameter "Available Offline Spending Amount (Balance)" in the Activate Transaction and Get Transaction Result commands.
V2.24	10-11-2006	JX	Change the length of "CVM Required Limit" and "Transaction Limit" to 6.
V2.25	10-27-2006	JX	Add one definition for Store LCD Message command Add one status codes: 23h. Add comments for "Activate Transaction Command" if the status code is 23h.
V2.26	10-30-2006	JX	Add one status codes: 0Eh. Add parameter "Specific Feature Switch" in the "Set EMV Configuration" and "Get EMV Configuration" commands. Add comments for "Activate Transaction Command" if the status code is 0Eh. Add one definition for "Store LCD Message" and "Get LCD Message" command. Add one value for parameter "Application Capability".
V2.27	1-25-2007	AK	Add parameter Zero Amount Handling for Online Capable Readers in the "Set EMV Configuration" and "Get EMV Configuration".
V2.28	2-22-2007	BP	Addition of 5F25 tag to the Activate and Get Transaction commands.
V2.29	04-05-2007	XJ	Added commands for configuring the source for RTC/LCD/Buzzer/LED; added more option for beep parameter in the "Set LCD Message" command
V2.29a	04-17-2007	XJ	Changed the command/sub-command number for configuring the source for RTC/LCD/Buzzer/LED.
V2.29b	04-30-2007	XJ	Modified the command for configuring the source for RTC/LCD/Buzzer/LED to also allow for getting the configuration.
V2.30	05-14-2007	BP	Add new commands required for configurable AIDs
V2.31	07-09-2007	RW	Added Vend /DTc configuration commands.
V2.30a	07-12-2007	AK	Added new status code to indicate card is expired.
V2.32	07-23-2007	BB	Modified Serial CONF AIDs commands. Added Serial GET VERSION command.
V2.33	07-27-2007	RW	Merged AK's 2.30a branch back into main document
V2.34	07-27-2007	BB	Updated Config AID information, added warnings, mandatory tags and optional tag data.
V2.35	07-29-2007	AK	Added Burst Mode Auto-Detect Configuration. Changed LED Color to UI Scheme and added description for new values. Described special values for Store LCD messages. Edited new content throughout the document.

Version	Date	Author	Change
V2.36	08-02-2007	BP/AK	Remove references to AVN from group tags list. Added failed transaction tags to activate transaction and added CONAIDS examples. Added Ping Command. Added Card Transaction Qualifiers in the data returned field. Renamed the current "Card Not Supported" error code to "Card Blocked" and added a new "Unsupported Card" error code. Added configuration to require heart beat for EMEA User Interface. Added configuration to display Insert/Swipe or Fail message for unsupported cards. Added configuration for collision detection/ collision resolution. Added configuration to accept/reject Visa Wave cards. Corrected sub-commands for Get Configurable Group and Get All AIDs commands.
V2.37	09-07-2007	AK	Added Error Code 44(h) and its description.

Pass-Through History

Version	Date	Author	Change Description
V1.0	09-13-2004	SK	Created Document
V1.1	10-05-2004	SK	Added LED and Buzzer Commands
V1.2	01-17-2005	SK	Added example of how the "PCD Single Command Exchange" command can be used to communicate with a PICC (HALTA Command).
V1.3	02-04-2005	SK	The timeout for the "Poll for Token" command can now be specified as a combination of Seconds and MilliSeconds instead of just seconds.
V1.4	04-20-2005	SK	Added high level pass-through commands for Mifare Cards. Added high level Halt command for Type A and Type B cards.
V2.0B	05-06-2005	SK	Changed all commands to version 2 of the ViVOtech protocol which is a simpler command-response protocol. Use default baudrate of 57600 baud.
V2.1B	05-24-2005	SK	Changed some of the Status Codes. Use Default baudrate of 115200 baud.
V2.2	10-5-2007	RW	Added poll-for-token response card type 0x7 for a NFC phone containing both a ISO 14443-4 element and a Mifare card.
V2.3	10-15-2007	RW/RL	Corrected the byte ordering of the CRC bytes for the Ping command. Ping has the same CRC byte order as the rest of the EMV Serial interface commands. This is reversed from the byte ordering of the CRC bytes for Pass-Through commands. Add ePurse command.

EMV Key Management History

Version	Date	Author	Change Description
V1.0	01-17-2005	SK	Created Document
V1.1	09-13-2007	AK	Added Error Codes 0Eh and 0Fh for EMV Key Management Commands