NATIONAL
AUTOMATIC
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Serving the Vending / Foodservice management industry

Multi-Drop Bus / Internal Communication Protocol

MDB / ICP

Supported by the

NAMA Vending Technology Standards Committee
EVMMA I.C.P. Working Group
EVA Technical Committee

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Multi-Drop Bus / Internal Communication Protocol

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Revisions

Version 1.0 of this specification is the first release of the international **Multi-Drop Bus / Internal Communication Protocol** (**MDB / ICP**). This specification is the culmination of effort put forth by technical members of NAMA, the EVMMA, and the EVA. The basis for this specification is the **International Multi-Drop Bus Interface Standard** published by NAMA and the **Internal Communication Protocol** published by the EVMMA. The NAMA document was originally introduced on October 19, 1993 and later revised on August 19, 1994, June 20, 1997, and October 15, 1997. The EVMMA document was adopted in 1994 and later revised in 1995.

The following lists the primary revisions to the original two documents which were "combined" to create Version 1.0 of the **MDB / ICP**. In actuality, the NAMA **MDB** was the basis of the **MDB / ICP** with the exception of Section 7 which came from the EVMMA **ICP**. Besides typographical corrections and actual feature changes (below), the entire document was edited to provide a more uniform appearance.

Hardware Specification - Section 4.3

- Added drawings of the MDB male and female connectors.

Coin Acceptor / Changer - Section 5.3

- Added Expansion commands:
  - 0F-05 Send Current Diagnostic Status
  - 0F-06 Send Controlled Manual Fill Report
  - 0F-07 Send Controlled Manual Payout Report

Coin Acceptor / Changer - Section 5.5

- Added coin acceptance and coin payout power requirements for coin changers using motorized payout mechanisms.
- Added note about simultaneously supplying bill validator transport power.

Bill Validator - Section 6.5

- Added note about simultaneously supplying coin mechanism coin acceptance power.

Cashless Payment - Section 7.2.6

- Added Level 02 Revalue capability.

Cashless Payment - Section 7.3

- Added Level 02 REVALUE REQUEST.
- Removed NAK (NCK) response from uninterruptable state and unexecutable command descriptions.
- Eliminated the BUSY response to vend failure sequences.
- Modified Table 1 per above.

Cashless Payment - Section 7.4.1

- Further defined the initializing sequence following a RESET command.

Cashless Payment - Section 7.4.2

- Further defined the Z7 Application Maximum Response Time.
- Added Z8 – b3 for supporting the VEND/CASH SALE subcommand.

Cashless Payment - Section 7.4.4

- Begin Session (03h) - Added Level 02 Reader Z4-Z10 data.
- Malfunction/Error (0Ah) - Added error code 1100 (refund error).
- Command Out of Sequence (0Bh) - Added Z2 data.
- Eliminated Busy (0Ch) response.
- Added Level 02 Reader Revalue Approved (0Dh) response.
- Added Level 02 Reader Revalue Denied (0Eh) response.
- Added Level 02 Reader Revalue Limit Amount (0Fh) response.
- Added Level 02 Reader User File Data (10h) response.
- Added Level 02 Reader Time/Date Request (11h) response.

Cashless Payment - Section 7.4.10

- Added Level 01 Reader CASH SALE (13h/05h) VMC command.

Cashless Payment - Section 7.4.14

- Added Level 02 Reader Revalue - Request (15h/00h) VMC command.

Cashless Payment - Section 7.4.15

- Added Level 02 Reader Revalue – Limit Request (15h/01h) VMC command.

Cashless Payment - Section 7.4.17

- Obsoleted EXPANSION – Read User File (17h/01h) VMC command.

Cashless Payment - Section 7.4.18

- Obsoleted EXPANSION – Write User File (17h/02h) VMC command.

Cashless Payment - Section 7.4.19

- Added Level 02 Reader Write Time/Date File (17h/03h) VMC command.

Cashless Payment - Section 7.5

- Further defined the non-response time with the “Application Maximum Response Time” Z7.

Cashless Payment - Section 7.6 (original ICP Spec)

- Moved this section (ICP Payment Media Return Button) to Section 7.3.2.

Cashless Payment - Section 7.6 (MDB/ICP Spec)

- Previously was the ICP 7.7 with no modifications.

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Introduction

Foreword

This voluntary Standard contains basic requirements for vending machines within the limitations given below and in the General Information section of this Standard. These requirements are based on sound engineering principles, research, field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, and others having specialized experience. These requirements are subject to revision as further experience and investigation may show it necessary or desired.

NAMA, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of NAMA represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the NAMA Standard is processed. NAMA shall not be responsible to anyone for use or reliance upon Standard by anyone. NAMA shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, reliance upon this Standard.

Standard Review

A complete review of this standard shall be conducted at least every five years to keep requirements consistent with technology. These reviews shall be conducted by representatives from industry and user groups on the NAMA Vending Technology Standards Committee at that time.

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Section 1

General Information

1.1 Introduction

This document defines a serial bus interface for electrically controlled vending machines. The interface is a 9600 baud Master-Slave arrangement where all peripherals are Slaves to a Master controller.

The intent of this document is to standardize vending machines that employ electronic control (traditionally known as vending mechanism controller - VMC) so that all vending and peripheral equipment communicates identically.

1.2 Operational and Application Notes

The serial bus, or Multi-Drop Bus (MDB) is configured for Master-Slave operation. There is one Master with capability of communicating with up to thirty-two peripherals. The Master is defined as the Vending Machine Controller (VMC).

Each peripheral is assigned a unique address and command set. The master will “poll” the Bus for peripheral activity. That is, each peripheral is asked for activity, and responds with either an acknowledge, negative acknowledgment, or specific data dependent on its current activity. If a peripheral does not respond within a predefined time, (t-non-response as defined in the peripheral sections) it is assumed that it is not present on the Bus.

Bus interference, or “crashes” are prevented because each peripheral only responds upon being polled. Since there is only one master, and all communication is initiated by the Master, Bus “crashes” are easily precluded.

All peripherals will recognize a disable command, or commands, sent by the Master. This allows for disabling of individual peripherals for various reasons, for example, power management techniques.

Error checking and correction is accomplished by using checksums (CHK) and a retransmit command.

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Section 2

Communication Format

2.1 Byte Format

Baud Rate: 9600 NRZ

Serial Bit Format: 1 Start Bit
8 Data Bits
1 Mode Bit
1 Stop Bit

11 Bits Total

LSB									MSB
Start	0	1	2	3	4	5	6	7	Mode	Stop

Mode Bit: Master-to-Peripheral

The mode bit differentiates between ADDRESS bytes and DATA bytes. ADDRESS bytes must be read by all peripherals, DATA bytes are only read by the peripheral that is active. An active peripheral is defined as a device that has successfully established a communication session with the Master.

The mode bit is set (logic one) to indicate an ADDRESS byte, and not set (logic zero) to indicate a DATA byte.

Mode Bit: Peripheral-to-Master

The mode bit must be set on the last byte sent when data is sent from a Slave to the Master.

2.2 Block Format

Master-to-Peripheral

A Communication Block for Master-to-Slave transmissions is defined as an Address byte, optional data bytes, and a CHK byte. A block is limited to a maximum of thirty-six (36) bytes.

The upper five bits (MSB) of the Address Byte will be used for addressing. That is, bits 7,6,5,4,3 of the previous byte description will be used for addressing.

The lower three bits (i.e. 2,1,0) of the Address Byte will contain peripheral specific commands. This will allow up to eight instructions to be embedded in the first byte of a block.

The VMC Master will respond to data from a peripheral with an Acknowledgment (ACK), Negative Acknowledgment (NAK), or Retransmit (RET) command. These are defined later in the document. The 5 mS time-out (t-response) described in the Bus Timing section of this document is the equivalent of a NAK command.

Peripheral-to-Master

A Communication Block for Slave-to-Master transmissions consists of either a data block and a CHK byte, a acknowledgment (ACK), or a negative acknowledgment (NAK).

The 5 mS time-out (t-response) described in the Bus Timing section of this document is the equivalent of a NAK command. In addition, it is recommended that the peripheral use this time-out as the NAK when a reception error of the ADDRESS byte occurs. This will prevent several peripherals from trying to simultaneously respond with a NAK.

A data block consists of one or more data bytes followed by a CHK byte. The CHK byte is defined later in this document.

The data block and CHK byte are limited to a maximum size of 36 bytes.

A CHK byte is not required when a peripheral responds with NAK or ACK byte. ACK and NAK are defined later in this document.

The peripheral must set the mode bit on the last byte sent to signify end of transmission. This will be either the CHK byte of a block, a NAK byte, or an ACK byte. The mode bit must not be set except for the conditions above.

A peripheral response of ACK or NAK signifies the end of the exchange. When a peripheral responds with a block, the VMC must respond with an ACK, NAK or RET command.

CHK Byte

A CHK byte must be sent at the end of each block of data. The CHK byte is a checksum calculated by adding the ADDRESS byte and all DATA bytes. The CHK byte is not included in the summation. The carry bit for CHK additions is ignored since the CHK byte is limited to eight bits.

The following example shows a CHK byte calculation for a possible response to a STATUS command sent to a USA changer slave. See section 5 for details of byte meanings.

02H	Changer feature level
00H	Country code for USA
01H	Country code for USA
05H	Coin scaling factor
02H	Decimal place
00H	Coin type routing
07H	Coin type routing
01H	Coin type 0 has value of 1 scaling factor
02H	Coin type 1 has value of 2 scaling factor
05H	Coin type 2 has value of 5 scaling factor
14H	Coin type 3 has value of 20 scaling factor
FFH	Coin type 4 is a token
12CH	Therefore the CHK byte would be equal to 2CH

A checksum will be performed on all full blocks of communication. A checksum will not be performed on ACK, NAK, or RET bytes.

The following codes are reserved for the ACK, NAK and RET bytes:

ACK	00H	(acknowledgment/checksum correct)
RET	AAH	(Retransmit. Only the VMC can transmit this byte)
NAK	FFH	(Negative acknowledge)
		The VMC and peripheral must also recognize the 5 mS time-out (t-response) as a NAK.

NOTE: To improve system reliability it is recommended that when receiving ACK, NAK, or RET the receiving device counts the number of bits set in the byte. This method will require at least two bit errors in the byte before the byte can be mis-interpreted.

Bus Reset

The VMC may reset all peripherals by pulling the transmit line “active” for a minimum of 100 mS. This informs all peripherals to abort any activity and return to its power-on reset state. Details of this state for each peripheral are provided in later sections of this document. It is recommended that the VMC re-initialize each peripheral after this type of reset.

2.3 Peripheral Addresses

The addresses below are defined.

Address	Definition
00000B	Reserved for future expansion
00001B	Changer
00010B	Card Reader
00011B	Audit System
00100B	Display
00101B	Energy Management System
00110B	Bill Validator
00111B	Reserved for Future Standard Peripheral
01000B	Universal Satellite Device #1
01001B	Universal Satellite Device #2
01010B	Universal Satellite Device #3
01011B	Reserved for Future Standard Peripherals
.	.
.	.
.	.
11101B	Reserved for Future Standard Peripherals
11110B	Vending Machine Specific Peripheral 1
11111B	Vending Machine Specific Peripheral 2

Vending Machine Specific peripheral addresses (addresses 11110B and 11111B) are reserved for Non-Standard or proprietary applications. These devices are allowed a unique set of commands.

All other peripherals are defined as Standard devices. These peripherals must follow the specifications to ensure compatibility between manufacturers.

2.4 Software Operational Rules

The VMC must regulate the power budget. That is, peripherals must be enabled and disabled dependent on power availability. The power bus is defined later in this document.

During multi-byte messages the most significant byte is sent first.

> Any bytes within a command or response that are not specifically defined should be left in a 0 state. For coin mechanisms, Level III and up, bill validators, Level I and card readers, Level I; this is not a requirement but a suggestion.

The following are recommendations for the methods of VMC to peripheral software operation.

> Each peripheral should be polled every 25-200 milliseconds.
>
> If a peripheral has not responded to a poll for its maximum Non-Response time, the VMC should continue to poll the peripheral at least every ten seconds with a RESET command.

2.5 Typical Session Examples

A. The diagram below represents a typical transmission when a peripheral is idle.

VMC:

ADD* CHK

Peripheral:

ACK*

B. The diagram below represents a typical transmission when a peripheral has data to return.

VMC:

ADD* CHK ACK

Peripheral:

DAT DAT CHK*

C. The diagram below represents a typical transmission when the VMC has data to send.

VMC:

ADD* DAT DAT CHK

Peripheral:

ACK*

*Indicates mode bit set

D. The diagram below represents a typical transmission when the VMC determines a CHK is not correct. The VMC will respond one of two ways:

Send a NAK to the peripheral to indicate that the information was not received correctly then perform other tasks,

OR

The VMC may send a retransmit (RET) command alerting the peripheral to try again.

VMC:

ADD* DAT CHK RET ACK

Peripheral:

DAT DAT CHK* DAT DAT CHK*

*Indicates mode bit set.

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Section 3

Bus Timing

3.1 Timing Definitions

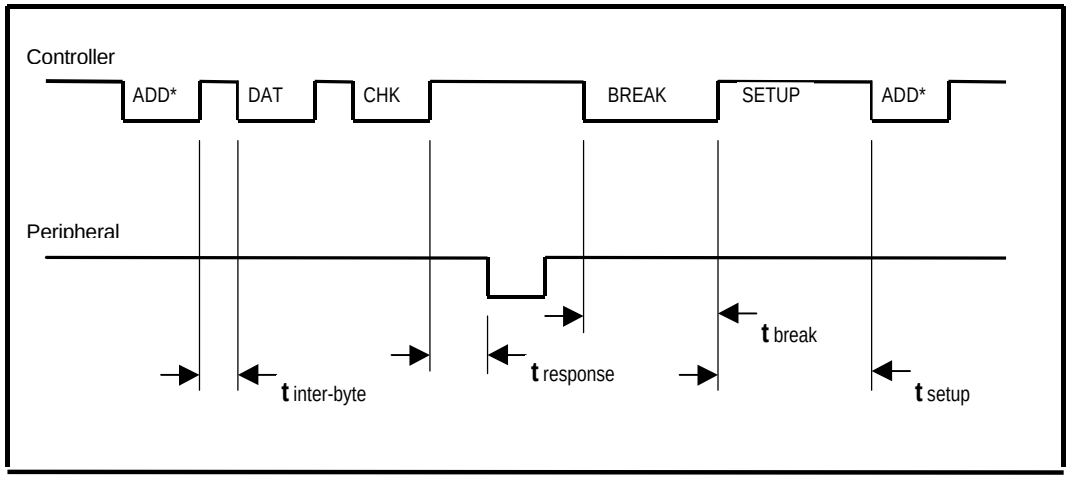
Baud rate	=	The rate of bit transfer per second.
t inter-byte (max.)	=	The maximum time allowed between bytes in a block transmission.
t (max.)	=	The maximum time any device, response master or peripheral, will take to respond to a valid communication.
t break (VMC)	=	The minimum time of the Bus Reset signal sent by the VMC to reset all peripherals.
t setup	=	The minimum set-up time before the VMC attempts to communicate after a reset signal.

3.2 Timing Specifications

Baud Rate	=	9600 +1%/-2% NRZ
t inter-byte (max.)	=	1.0 mS
t response (max.)	=	5.0 mS
t break (min.)	=	100 mS
t setup (min.)	=	200 mS

NOTE: All peripherals have the option of not responding to the VMC. Non-response timing is defined in the peripheral specification.

3.3 Timing Diagram



NOTE: * indicates that the mode bit is set

Section 4

Hardware Specification

4.1 Bus Power Supply Definition

The information below defines the minimum VMC voltage output. The actual current ratings per peripheral will be defined in their respective sections.

Power supply filtering is optional, therefore if a peripheral requires more power, or tighter regulation, they may elect to supply their own power, or filtering, from available sources elsewhere in the machine.

VMC Voltage Output:

Minimum	=	20 VDC rms.(rectified and optionally filtered)
Nominal	=	34 VDC unreg.(rectified and filtered) 24 VDC rms.(rectified only)
Maximum	=	42.5* VDC(ripple voltage upper limit) * High line input may allow 45 VDC peak (max.).

4.2 Bus Transmitter / Receiver Specification

The following section describes the 5V, optically isolated, current loop system between the Master and the Slave.

VMC Master:

Transmit:

Minimum source current (active):	100 mA @ 4V
Maximum leakage current (inactive):	100 uA

NOTES: 1) The transmit line must be able to withstand a short while in the active mode.

2) 15 mA should be added for each peripheral over six.

Receive:

Minimum input current (active):	15 mA @ 1V
Maximum input current (inactive):	1 mA

Peripheral Slave:

Receive:

Maximum input current (active):	15 mA @ 4V
Maximum input current (inactive):	100 uA

Transmit:

Minimum sink current (active):	15 mA @ 1V
Maximum leakage current (inactive):	30 uA

4.3 Connector Specification

Peripheral:

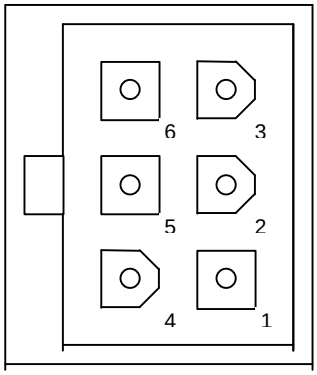
Connector:	Molex 39-01-2060 (6 Circuit receptacle)
Terminals:	Molex 39-00-0065 (sockets)
Strain Relief:	Molex 15-04-0296

Bus Harness:

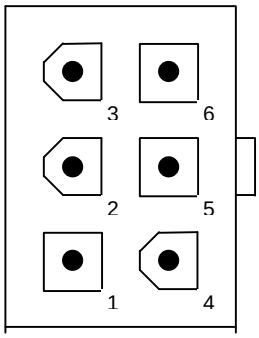
Connector:	Molex 39-01-2061 (6 Circuit plug)
Terminals:	Molex 39-00-0067 (Pins)

Connector Pin-out:

Line 1 - 34 VDC
Line 2 - DC Power Return
Line 3 - N/C
Line 4 - Master Receive
Line 5 - Master Transmit
Line 6 - Communications Common

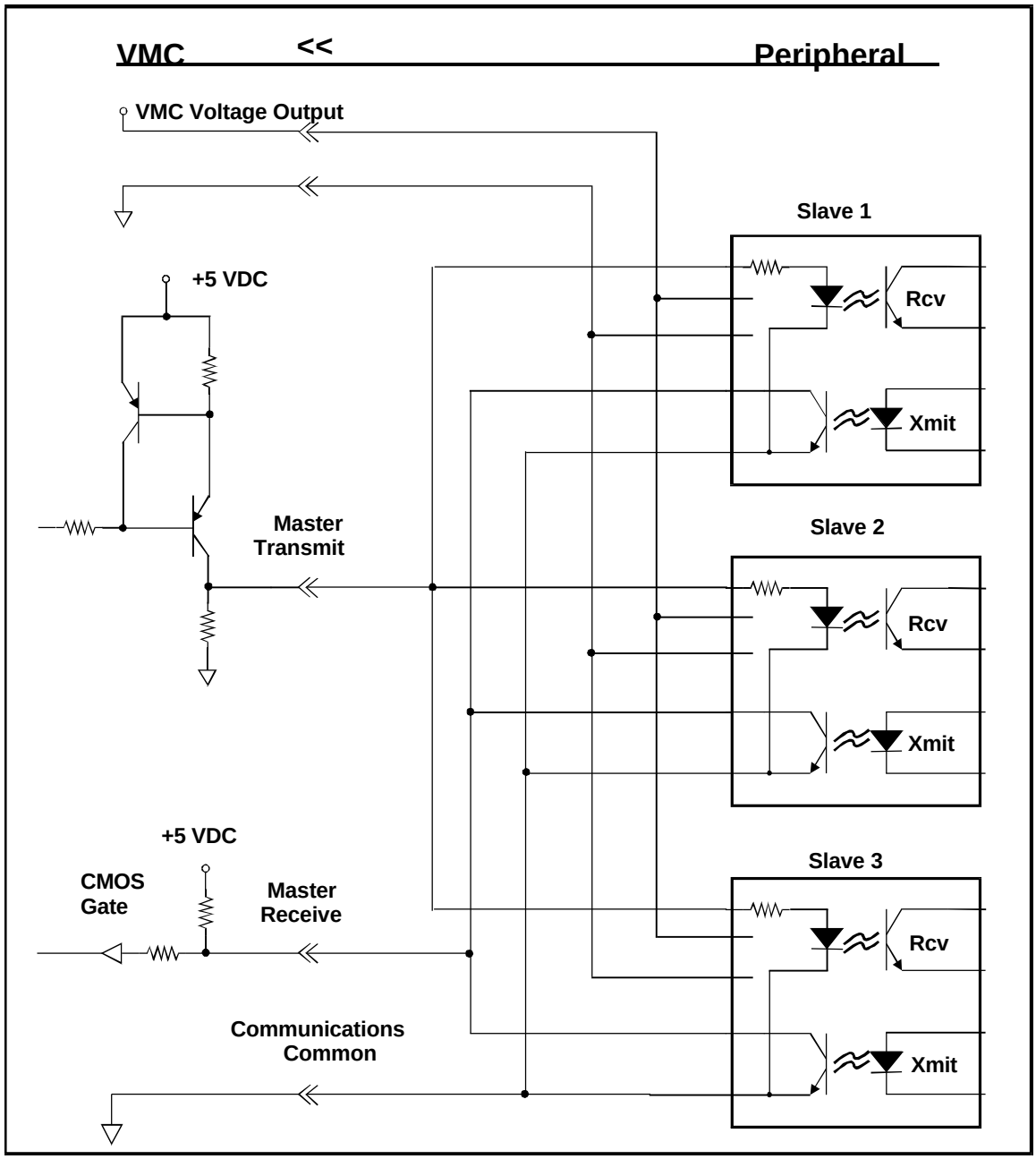


Peripheral Connector
Face View
(Sockets)



VMC / Bus Connector
Face View
(Pins)

4.4 Example Schematic



Section 5

Coin Acceptor/Changer VMC/Peripheral Communication Specifications

5.1 Introduction

This section defines the communication bytes sent and received by a coin accepting device ("Changer"). The changer's address is 00001 binary.

Unless stated otherwise, all information is assumed to be in a binary format.

There are currently two levels of support defined for the coin mechanism interface, Level 2 and Level 3. The level of coin mechanism operation is sent to the VMC in the response to the STATUS command (defined later in this section). The following paragraphs will define how a VMC should differentiate between each level.

Level 2 Changers

For level 2 changers, VMC operation consists of monitoring inputs from the coin mechanism, accumulating credit, issuing a coin acceptance disable command when appropriate, and issuing appropriate payout commands based on the VMC resident payout algorithms and escrow rules.

Level 3 Changers

For level 3 changers, VMC operation is the same as defined above for level 2, with the addition of the EXPANSION command and its implications (defined later in this section). The VMC has the option of sending the EXPANSION command to the coin mechanism to determine the coin mechanism's manufacturer code, serial number, model/tuning revision, software version, and optional features. Based on the optional feature information the VMC will determine the appropriate operating mode (in other words, modes that both the coin mechanism and the VMC can support), enable any appropriate coin mechanism features by sending an appropriate feature enable command back to the coin mechanism, and enter the proper operating mode. This technique allows all VMCs and peripherals to accommodate existing feature capabilities and provides a means for upgrading Level 3 equipment.

5.2 VMC Commands

Command	Hex Code	Description
RESET	08H	Command for changer to self-reset
STATUS	09H	Request for changer status.
TUBE STATUS	0AH	Request for changer tube status.
POLL	0BH	Request for changer activity status.
COIN TYPE	0CH	Signifies coin types accepted and allowable coin dispensing. This command is followed by setup data. See command format section.
DISPENSE	0DH	Command to dispense a coin type. Followed by coin type to dispense. See command format section.
EXPANSION COMMAND	0FH	Command to allow addition of features and future enhancements. Changers at feature level 2 do not support this command.

NOTE: An EXPANSION command is always followed by a “sub-command.” This command allows for feature additions.

5.3 VMC Command Format

VMC Command	Code	VMC Data
RESET	08H	No data bytes

This command is the vehicle that the VMC should use to tell the changer that it should return to its default operating mode. With the exception of the ACK response, it should abort all communication and disable all acceptance until otherwise instructed by the VMC.

VMC Command	Code	Changer Response Data
STATUS	09H	23 bytes: Z1 - Z23

Z1 = Changer Feature Level - 1 byte

Indicates the feature level of the changer. This will distinguish the changers feature level to the VMC. Current defined levels:

Level 2: Supports “core” command set. These are: RESET, STATUS, TUBE STATUS, POLL, COIN TYPE, and DISPENSE.

Level 3: Supports level two and the EXPANSION command addition changer model number, manufacturer code, turning revision, etc. See the details of EXPANSION command later in this document.

Z2 - Z3 = Country Code - 2 bytes

The International Telephone Code for the country that the changer is set-up for, is sent in packed BCD. For example, the USA code is 00 01H

Z4 = Coin Scaling Factor - 1 byte

All accepted coin values must be evenly divisible by this number. For example, this could be set to 05H for the USA nickel.

Z5 = Decimal Places - 1 byte

Indicates the number of decimal places on a credit display. For example, this could be set to 02H in the USA.

Z6 - Z7 = Coin Type Routing - 2 bytes

Indicates what coin types can be routed to the Changer’s tubes.

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Z6								Z7							

Bit is set to indicate a coin type can be routed to the tube. Valid coin types are 0 to 15.

Z8 - Z23 = Coin Type Credit - 16 bytes

Indicates the value of coin types 0 to 15. Values must be sent in ascending order. This number is the coin's monetary value divided by the coin scaling factor. Unused coin types are sent as 00H. Unsent coin types are assumed to be zero. It is not necessary to send all coin types. Coin type credits sent as FFH are assumed to be vend tokens. That is, their value is assumed to worth one vend.

The bytes position in the 16 byte string indicates the coin type(s). For example, the first byte sent would indicate the value of coin type 0, the second byte sent would indicate the value of coin type 1, and so on. For example, the USA coin types may be; Coin type 0 = nickel, Coin type 1 = dime, Coin type 2 = quarter, Coin type 3 = dollar.

VMC Command	**Code**	**Changer Response Data**
TUBE STATUS	0AH	18 bytes: Z1 - Z18

Z1 - Z2 = Tube Full Status - 2 bytes

Indicates status of coin tube for coin types 0 to 15.

b15 b14 b13 b12 b11 b10 b9 b8 | b7 b6 b5 b4 b3 b2 b1 b0

Z1 Z2

A bit is set to indicate a full tube. For example, bit 7 = set would indicate the tube for coin type 7 is full.

Z3 - Z18 = Tube Status - 16 bytes

Indicates the greatest number of coins that the changer “knows” definitely are present in the coin tubes. A bytes position in the 16 byte string indicates the number of coins in a tube for a particular coin type. For example, the first byte sent indicates the number of coins in a tube for coin type 0. Unsent bytes are assumed to be zero. For tube counts greater than 255, counts should remain at 255.

NOTE: If a changer can detect a tube jam, defective tube sensor, or other malfunction, it will indicate the tube is "bad" by sending a tube full status and a count of zero for the malfunctioning coin type.

VMC Command	Code	Changer Response Data
POLL	0BH	16 bytes: Z1 - Z16

Z1 - Z16 = Changer Activity - 16 bytes

Indicates the changer activity. If there is nothing to report, the changer should send only an ACK. Otherwise, the only valid responses are:

Coins Dispensed Manually:

Byte 1	Byte 2
(1yyyxxxx)	(zzzzzzzz)

yyy = The number of coins dispensed.
xxxx = The coin type dispensed (0 to 15)
zzzzzzzz = The number of coins in the tube.

Coins Deposited:

Byte 1	Byte 2
(01yyxxxx)	(zzzzzzzz)

yy = Coin routing. 00: CASH BOX
01: TUBES
10: NOT USED
11: REJECT

xxxx = Coin type deposited (0 to 15).

zzzzzzzz = The number of coins in the tube for the coin type accepted.

Status:

(00000001) = Escrow request[1] - An escrow lever activation has been detected.
(00000010) = Changer Payout Busy[2] - The changer is busy activating payout devices.
(00000011) = No Credit[1] - A coin was validated but did not get to the place in the system when credit is given.
(00000100) = Defective Tube Sensor[1] - The changer has detected one of the tube sensors behaving abnormally.
(00000101) = Double Arrival[1] - Two coins were detected too close together to validate either one.

(00000110) = Acceptor Unplugged[2] - The changer has detected that the acceptor has been removed.
(00000111) = Tube Jam[1] - A tube payout attempt has resulted in jammed condition.
(00001000) = ROM checksum error[1] - The changers internal checksum does not match the calculated checksum.
(00001001) = Coin Routing Error[1] - A coin has been validated, but did not follow the intended routing.
(00001010) = Changer Busy[2] - The changer is busy and can not answer a detailed command right now.
(00001011) = Changer was Reset[1] - The changer has detected an Reset condition and has returned to its power-on idle condition.
(00001100) = Coin Jam[1] - A coin(s) has jammed in the acceptance path.
(00001101) = Not Used
(00001110) = Not Used
(00001111) = Not Used

Slug:

(001xxxxx) = xxxxx is the number of slugs since the last activity.

NOTES: The Changer may send several of one type activity, up to 16 bytes total. This will permit zeroing counters such as slug, inventory, and status.

1 Sent once each occurrence.
2 Sent once each POLL

VMC Command	**Code**	**VMC Data**
COIN TYPE	0CH	4 bytes: Y1 - Y4

Y1 - Y2 = Coin Enable - 2 bytes

```
b15  b14  b13  b12  b11  b10  b9  b8 | b7  b6  b5  b4  b3  b2  b1  b0
Y1                                                          Y2
```

A bit is set to indicate a coin type is accepted. For example, bit 6 is set to indicate coin type 6, bit 15 is set to indicate coin type 15, and so on. To

disable the changer, disable all coin types by sending a data block containing 0000H. All coins are automatically disabled upon reset.

Y3 - Y4 = Manual Dispense Enable - 2 bytes

```
b15  b14  b13  b12  b11  b10  b9  b8 | b7  b6  b5  b4  b3  b2  b1  b0
Y3                                                              Y4
```

A bit is set to indicate dispense enable. For example, bit 2 is set to enable dispensing of coin type 2. This command enables/disables manual dispensing using optional inventory switches. All manual dispensing switches are automatically enabled upon reset.

VMC Command	**Code**	**VMC Data**
DISPENSE	0DH	1 byte: Y1

```
b7  b6  b5  b4  b3  b2  b1  b0
                    Y1
```

Bits b3, b2, b1, b0 indicate coin type to be dispensed. Valid codes are 0H to FH to indicate coin types 0 to 15.

Bits b7, b6, b5, b4 indicate the number of coins to be dispensed.

NOTE: If two coin types have the same value, the highest coin type should be paid out first.

LEVEL THREE CAPABILITIES - EXPANSION COMMAND
The following describes the currently defined expansion commands.

Sub-command 00H is used for a changer that has the capability of reporting model number, serial number, and so on.

VMC Command	**Code**	**Sub-Command**	**Changer Response Data**
EXPANSION COMMAND (Identification)	0FH	00H	33 bytes: Z1 - Z33

Z1 - Z3 = Manufacturer Code - 3 bytes
Identification code for the equipment supplier. Sent as ASCII characters. Currently defined codes are listed in the **EVA** document entitled "***European Vending Association Data Transfer Standard***" (**EVA-DTS**), the Audit Data Lists section, sub-section 2, "Manufacturer Codes".

Z4 - Z15 = Serial Number - 12 bytes

Factory assigned serial number. All bytes must be sent as ASCII characters, zeros (30H) and blanks (20H) are acceptable.

Z16 - Z27 = Model #/Tuning Revision - 12 bytes

Manufacturer assigned model number and tuning number. All bytes must be sent as ASCII characters, zeros (30H) and blanks (20H) are acceptable. Each manufacturer should include information concerning the changer tuning revision.

Z28 - Z29 = Software Version - 2 bytes

Current software version. Must be sent in packed BCD.

Z30 - Z33 = Optional Features - 4 bytes

Each of the 32 bits indicate an optional features availability. If the bit is set the feature is available. Bits should be sent in descending order, i.e. bit 31 is sent first and bit 0 is sent last. Currently defined options are:

b0 - Alternative Payout method. This method allows changer designs that determine change payout. That is, the payout algorithm may reside in the changer instead of the VMC.

b1 - Extended Diagnostic command supported. This command allows the VMC to request diagnostic status of the coin changer.

b2 - Controlled Manual Fill and Payout commands supported. These commands allows the VMC to request the number of coin inserted or dispensed while the changer was in a controlled manual fill or payback mode.

b3 - b31 Available for future use

VMC Command	Code	Sub-Command	VMC Data
EXPANSION COMMAND (Feature enable)	0FH	01H	4 bytes: Y1 - Y4

This command is used to enable each of the optional features defined in Z30-Z33 above. To enable a feature a bit is set to one. All optional features are disabled after reset.

VMC Command	Code	Sub-command	VMC Data	Changer Response
EXPANSION COMMAND (Alternative Payout)	0FH	02H, Payout	Y1	None
	0FH	03H, Payout Status	None	16 bytes: Z1-Z16

Y1 = Value of coins to be paid out - 1 byte

This value is expressed as the number of coin scaling factors that would sum to the value. For example, in a USA system using a scaling factor of 05, if the change to be paid out is 75 cents, then Y1 will equal fifteen. That is, the sum of fifteen nickels equal 75 cents.

Z1 - Z16 = Number of each coin type paid out - 16 bytes

This is the changer's response to the last VMC payout command. Bytes are sent in ascending order of coin types. A bytes position in the string indicates the coin type. That is, byte one is the number of coins for coin type 1, byte two is the number of coins for coin type two, and so on. Unsent bytes are assumed to be zero.

The changer clears payout data after an ACK response for the VMC.

The VMC should compare the value of the coins paid out to Y1.

NOTES: 1) If the changers payout is busy it will respond to the payout status command with an ACK only.

2) If no coins have been paid out, at least one zero valued data byte must be sent.

VMC Command	Code	Sub-command	Changer Response Data
EXPANSION COMMAND	0FH	04H, Payout Value Poll	1 byte: Z1

Z1 = Changer Payout Activity - 1 byte

An interval value (scaled) which indicates the amount of paid out change since the previous Payout Value Poll (or between the initial Payout command (0FH-02H) and the first Payout value Poll).

An 00H response indicates no coins were paid out since the previous Payout Value Poll (or the initial Payout command).

An ACK only indicates that the change payout is finished. This should be followed by the Payout Status command (0FH-03H) to obtain the complete payout data.

NOTE: The initial intent of this command is to determine the amount of change paid out so that the credit display can be decremented as coins are dispensed.

VMC Command	Code	Sub-Command	Changer Response Data
EXPANSION COMMAND	0FH	05H	16 bytes: Z1-Z16

Send Current Diagnostic Status - This command requests the changer to report its current state of operation. The VMC should periodically transmit the command approximately every 1 to 10 seconds.

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Z1-Z2 = Current changer diagnostic information

The changer reports its current state of operation in a 2 byte code. Z1 is the main code and Z2 is the sub-code. The code is reported as long as the condition exists and stops being reported as soon as the condition does not exist. Multiple 2 byte codes may be sent in response to a single command which could result in a maximum of eight 2 byte codes (16 bytes total).

The following identifies the currently defined extended diagnostic codes:

Z1 / Z2	Status	Cause(s) of Status / Error
01 / 00	Powering up	Changer powering up / initialization
02 / 00	Powering down	Changer powering down
03 / 00	OK	Changer fully operational and ready to accept coins
04 / 00	Keypad shifted	MODE key pressed and held so that LED flashes indicating keypad in shifted state. Reverts to normal mode if no key pressed for 15 seconds
05 / 10	Manual Fill / Payout active	Manual Fill or Manual Payout mode of operation in progress (under control of the changer). This response must be reported at least once to allow the VMC to request a manual fill or manual payout report.
05 / 20	New Inventory Information Available	Changer not in Manual inventory mode, but new inventory information available.
06 / 00	Inhibited by VMC	All coin acceptance inhibited at request of VMC, possibly due to product dispenser jams, completely sold out, etc.
10 / Z2	General changer error	Z2 defined as: **00** Non specific error. **01** Check sum error #1. A check sum error over a particular data range of configuration field detected. **02** Check sum error #2. A check sum error over a secondary data range or configuration field detected. **03** Low line voltage detected. The changer has disabled acceptance or payout due to a low voltage condition.

Z1 / Z2	Status	Cause(s) of Status / Error
11 / Z2	Discriminator module error	Z2 defined as: **00** Non specific discriminator error. **10** Flight deck open. **11** Escrow Return stuck open. **30** Coin jam in sensor. **41** Discrimination below specified standard. **50** Validation sensor A out of range. The acceptor detects a problem with sensor A. **51** Validation sensor B out of range. The acceptor detects a problem with sensor B. **52** Validation sensor C out of range. The acceptor detects a problem with sensor C. **53** Operating temperature exceeded. The acceptor detects the ambient temperature has exceeded the changer's operating range, thus possibly affecting the acceptance rate. **54** Sizing optics failure. The acceptor detects an error in the sizing optics.
12 / Z2	Accept gate module error	Z2 defined as: **00** Non specific accept gate error. **30** Coins entered gate, but did not exit. **31** Accept gate alarm active. **40** Accept gate open, but no coin detected. **50** Post gate sensor covered before gate opened.
13 / Z2	Separator module error	Z2 defined as: **00** Non specific separator error **10** Sort sensor error. The acceptor detects an error in the sorting sensor.
14 / Z2	Dispenser module error	Z2 defined as: **00** Non specific dispenser error.
15 / Z2	Coin Cassette / tube module error	Z2 defined as: **00** Non specific cassette error. **02** Cassette removed. **03** Cash box sensor error. The changer detects an error in a cash box sensor. **04** Sunlight on tube sensors. The changer detects too much ambient light on one or more of the tube sensors.

Diagnostic Status EVA-DTS Correlation

The Extended Diagnostic information reported may be used by the vending machine controller as desired (i.e., service mode displays); however, **EVA-DTS** data elements could also be used for reporting to a host system. Examples are:

o Via a translation of the Z1/Z2 code to one of the **Fault Lists** as described in Section 10 of the **EVA-DTS**.

o Via the EA201 Event Identification element with the format **CMxxyy** where xx = Z1 and yy = Z2.

o Via a customer / manufacture specific coding scheme using the **MA5xx** fields.

VMC Command	Code	Sub-Command	Changer Response Data
EXPANSION COMMAND	0FH	06H	16 bytes Z1-Z16

Send Controlled Manual Fill Report - This command requests the changer to report the number of coins inserted during a changer controlled manual fill (controlled bulk fill) mode. While in this mode, the changer must not report coins inserted in response to the **POLL** command.

Z1-Z16 = number of controlled manual mode filled coins (by coin type)

A single byte is reported for each coin type, 0 to 15. For example, Z1 = number of coins of coin type 0 added in a controlled manual fill mode. Any amount above 255 will be reported as 255, i.e. it will reach a maximum limit.

Only coin types *supported* are required to be reported. Counts for unsent coins types will be assumed to be unchanged.

Notes: After power on, changer reset, closing of the machine door, or a change in controlled manual fill status in the changer (changer indicated it was in controlled manual fill mode via CM0510 then changed to any other state) the machine should request the controlled manual coin fill data from the changer using the above command.

See EVA-DTS correlation at end of **SEND CONTROLLED MANUAL PAYOUT REPORT** (0F-07H) command.

VMC Command	Code	Sub-Command	Changer Response Data
EXPANSION COMMAND	**0FH**	**07H**	**16 bytes Z1-Z16**

Send Controlled Manual Payout Report - This command requests the changer to report the number of coins dispensed during a changer controlled manual payout (controlled bulk dispense) mode. Note that this does not include the coins dispensed via the individual dispense switches.

If the new Controlled Manual Fill / Payout command is implemented in the coin mech **and** enabled by the VMC (0Fh, 01h, bit 2 of Y1 to Y4), while in a controlled manual payout (dispense) mode, the changer **must not** report the coins paid out in response to the **POLL** command. Conversely, if the changer does not support the new command or the VMC does not enable it, the changer **should** report the coins paid out in response to the **POLL** command.

Z1-Z16 = number of controlled manual mode dispensed coins (by coin type)

A single byte is reported for each coin type 0 to 15. For example, Z1 = number of coins of coin type 0 dispensed in a controlled manual payout mode. Any amount above 255 will be reported as 255, i.e. it will reach a maximum limit.

Only coin types supported are required to be reported. Counts for unsent coin types will be assumed to be unchanged.

Note: After power on, changer reset, closing of the machine door, or a change in controlled manual payout status in the changer (changer indicated it was in controlled manual payout mode via CM0510 then changed to any other state) the machine should request the controlled manual coin payout data from the changer using the above command.

Controlled Manual Fill / Payout EVA-DTS Correlation

The controlled manual fill and payout coin information may be used by the vending machine controller as desired (i.e., service mode displays); however, **EVA-DTS** data elements could be used for reporting to a host system. Examples are:

	CA3XX	CA4XX	CA1704	CA1705
Controlled Manual Fill	**0F06**	**n/a**	**0F06**	**n/a**
VMC Tube Fill	**VMC**	**n/a**	**VMC**	**n/a**
Controlled Manual Payout	**n/a**	**0F07***	**n/a**	**0F07***
VMC Coin Payout	**n/a**	**VMC**	**n/a**	**VMC**
Manual Dispense Switches	**n/a**	**0B**	**n/a**	**0B**

***If extended **0F06** & **0F07** commands are implemented.
If extended **0F06** & **0F07** commands are not implemented in the coin mech or not enabled by the VMC, the coin mech will respond to the **POLL** command with the controlled manual payout coins.

With the above, the **CA3XX** & **CA4XX** fields can continue to be the primary fields for cash audit and the **CA1704** & **CA1705** fields can be used for indicating controlled manually filled / dispensed coins.

Coin Tube Audit Fields

As a reference, below are the agreed **CA17XX** data elements that provide detailed coin tube count information and controlled-manual coin tube insertion / dispense information. These were approved by the **EVA - DTS** Technical Sub Committee on January 27, 1997.

Block Identifier Reference	Data Contents	Charac-teristic	Length Min	Length Max	Element
CA17	**Coin Type Number (per MDB coin type)**	**N**	**01**	**03**	**CA1701**
	Value of Coin	**N**	**01**	**08**	**CA1702**
	Number of Coins in Tube	**N**	**01**	**08**	**CA1703**
	Number of Coins Inserted during Controlled-Manual Fill	**N**	**01**	**08**	**CA1704**
	Number of Coins Dispensed during Controlled-Manual Payout	**N**	**01**	**08**	**CA1705**

Definitions:

CA1701 The coin type number as referred to in the MDB Interface Specification. If not an MDB system, the number represents the coin's position in the coin set starting with the lowest value coin accepted. Note if two or more vintage of the same coin is accepted, the oldest one is first.

For example, the Canadian coin types may be:

0 Old Nickel	3 Quarter
1 New Nickel	4 $1 Dollar
2 Dime	5 $2 Dollar

CA1702 The cash value of the coin (units base).

For example, the Canadian coin types would be:

Nickel	5	$1 Dollar	100
Dime	10	$2 Dollar	200
Quarter	25		

CA1703 The number of coins in the coin tube (or tubes if multiple tubes per coin) that are reported by the coin mech during normal vending operations. Note that this is the "best known tube count" and may be inaccurate if coins were manually added or removed by hand.

CA1704 The number of coins inserted while the changer was in a Controlled manual fill mode. Controlled manual fill indicates that the coins are being inserted under the control of the coin mech or VMC. Coins are not being loaded by hand through the tops of the tubes.

CA1705 The number of coins dispensed while the changer was in a controlled manual payout mode. Controlled manual payout indicates that the coins are being dispensed under the control of the coin mech or VMC. Coins are not being removed by hand by "dumping" the tubes.

VMC Command	Code	Sub-command	VMC Data	Changer Response
EXPANSION COMMAND (Diagnostics)	0FH	FFH	Y1-Yn	Z1-Zn

Y1 - Yn = Device manufacturer specific instruction for implementing various manufacturing or test modes. Y1 - Yn implies that any number of bytes can be used for the VMC data to the peripheral.

Z1 - Zn = Device manufacturer specific responses after receiving manufacturing or test instructions. Z1 - Zn implies that any number of bytes can be used for the changer response data from the peripheral.

5.4 Changer Non-Response Time

The maximum non-response time for the changer is two seconds.

5.5 Changer Power Requirements

The current draw for any changer must fall within the following limits. All measurements are at the minimum VMC Voltage Output.

Idle mode = 200 mA. (max.) continuous

Coin acceptance = 1.8 A. (max.) for up to 2 seconds
(For coin changers using solenoid based payout mechanisms - typical of 3 tube changers sold in the US market. Vending machines sold into the US market are required to supply this power.)

1.0 A. (max.) for up to 2 seconds
(For coin changers using motorized payout mechanisms - typical of 4 tube changers.)

Coin payout	=	3.6 A. (max.) for 100 mS. with 400 mS. idle current between pulses. (For coin changers using solenoid based payout mechanisms - typical of 3 tube changers sold in the US market. Vending machines sold into the US market are required to supply this power.) 1.8 A. (max.) for 100 mS. with 400 mS. idle current between pulses. (For coin changers using motorized payout mechanisms - typical of 4 tube changers.)

Note: Vending machines should be able to provide sufficient power to simultaneously supply both the above power for the coin changer **Coin Acceptance** and bill validator **Bill Transport** as specified in Section 6.5.

Section 6

Bill Validator
VMC/Peripheral Communication Specifications

6.1 Introduction

This section defines the communication bytes sent and received between a Bill Validator and the VMC. The Bill Validator's address is 00110 binary.

Unless stated otherwise, all information is assumed to be in a binary format.

6.2 VMC Commands

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Command	Hex Code	Description
RESET	30H	Command for bill validator to self-reset.
STATUS	31H	Request for bill validator set-up status
SECURITY	32H	Sets Validator Security Mode
POLL	33H	Request for Bill Validator activity Status.
BILL TYPE	34H	Indicates Bill Type enable or disable. Command is followed by set-up data. See command format.
ESCROW	35H	Sent by VMC to indicate action for a bill in escrow.
STACKER	36H	Indicates stacker full and the number of bills.
EXPANSION COMMAND	37H	Command to allow addition of features and future enhancements. Level 1 bill validators must support this command.

NOTE: The expansion command is always followed by a sub-command.

6.3 VMC Command Format

VMC Command	Code	VMC Data
RESET	30H	No data bytes

This command is the vehicle that the VMC should use to tell the validator that it should return to its default operating mode. It should reject any bills in the validation process, return any bills in the escrow position, and disable all other activity until otherwise instructed by the VMC.

VMC Command	Code	Validator Response Data
STATUS	31H	27 bytes: Z1 - Z27

Z1 = Bill Validator Feature Level - 1 byte
Indicates current feature level of the bill validator. Currently defined level is one.

Z2 - Z3 = Country Code - 2 bytes
The International Telephone Code for the country that the Validator is set-up for. Sent in packed BCD. For example, the code for the USA is 00 01H

Z4 - Z5 = Bill Scaling Factor - 2 bytes
All accepted bill values must be evenly divisible by this number. For example, this could be set to 0064H for the USA.

Z6 = Decimal Places - 1 byte
Indicates the number of decimal places on a credit display. For example, this could be set to 02H for the USA.

Z7 - Z8 = Stacker Capacity - 2 bytes
Indicates the number of bills that the stacker will hold. For example, 400 bill capacity = 0190H

Z9 - Z10 = Bill Security Levels -2 bytes
Indicates the security level for bill types 0 to 15. Since not all validators support multiple security levels, validators that do not have this feature must report a “high” security level.

Z11 = Escrow/No Escrow - 1 byte
Indicates the escrow capability of the bill validator. If Z11 = 00H, the bill validator does not have escrow capability. If Z11 = FFH, the bill validator has escrow capability.

Z12 - Z27 = Bill Type Credit - 16 bytes

Indicates the value of the bill types 0 to 15. Values must be sent in ascending order. This number is the bill's monetary value divided by the bill scaling factor. Unused bill types are sent as 00H. Unsent bill types are assumed to be zero. FFH bills are assumed to be vend tokens.

VMC Command	Code	VMC Data
SECURITY	32H	2 Bytes: Y1 - Y2

Y1 - Y2 = Bill Type(s) - 2 bytes

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Y1								Y2							

A bit is set to indicate the type of bill(s) which are set to a “high” security level. Validators that do not support dual security levels should report a high security level.

VMC Command	Code	Validator Response Data
POLL	33H	16 bytes: Z1 - Z16

Z1 - Z16 = Bill Validator Activity - 16 bytes

Indicates the validator activity, for example, the type and number of bills accepted, and stacker position. If there is nothing to report, the validator should send only an ACK. Otherwise, the only valid responses are:

Bills Accepted:

Indicates the type and number of bills accepted and stacker status.

Byte 1
(1yyyxxxx)

NOTE: These responses should be used to add or subtract credit.

yyy = Bill Routing;
- 000: BILL STACKED
- 001: ESCROW POSITION
- 010: BILL RETURNED
- 011: NOT USED
- 100: DISABLED BILL REJECTED

xxxx = Bill Type (0 to 15)

Status:

(00000001) = Defective Motor[3] - One of the motors has failed to perform its expected assignment.

(00000010) = Sensor Problem[3] - One of the sensors has failed to provide its response.

(00000011) = Validator Busy[2] - The validator is busy and can not answer a detailed command right now.

(00000100) = ROM Checksum Error[3] - The validators internal checksum does not match the calculated checksum.

(00000101) = Validator Jammed[3] - A bill(s) has jammed in the acceptance path.

(00000110) = Validator was reset[1] - The validator has been reset since the last POLL.

(00000111) = Bill Removed[1] - A bill in the escrow position has been removed by an unknown means. A BILL RETURNED message should also be sent.

(00001000) = Cash Box out of position[3] - The validator has detected the cash box to be open or removed.

(00001001) = Unit Disabled[2] - The validator has been disabled, by the VMC or because of internal conditions.

(00001010) = Invalid Escrow request[1] - An ESCROW command was requested for a bill not in the escrow position.

(00001011) = Bill Rejected[1] - A bill was detected, but rejected because it could not be identified.

(010xxxxx) = Number of attempts to input a bill while validator is disabled.[1]

NOTE: The validator may send several of one type activity up to 16 bytes total.

1 Sent once each occurrence.
2 Sent once each POLL
3 Sent once each occurrence. The unit is then disabled until the condition is removed. Validator will respond with unit disabled until repaired or replaced.

VMC Command	Code	VMC Data
BILL TYPE	34H	4 bytes: Y1 - Y4

Y1 - Y2 = Bill Enable - 2 bytes

Indicates what type of bills are accepted.

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Y1															Y2

Bill types are 0 to 15. A bit is set to indicate acceptance of bill type.

NOTE: Sending 0000H disables the bill validator.

Y3 - Y4 = Bill Escrow Enable:

b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Y3															Y4

Bill types are 0 to 15. A bit is set to indicate enable of escrow for a bill type.

NOTE: On power-up or reset all bill acceptance and escrow are disabled.

VMC Command	Code	VMC Data
ESCROW	35H	1 byte: Y1

Y1 = Escrow status - 1 byte

If Y1 = 0;	Return bill in the escrow position.
If Y1 = xxxxxxx1;	Stack the bill (“x” indicates don’t care)

NOTE: After an ESCROW command the bill validator should respond to a POLL command with the BILL STACKED, BILL RETURNED, or INVALID ESCROW message within 30 seconds. If a bill becomes jammed in a position where the customer may be able to retrieve it, the bill validator should send a BILL RETURNED message.

VMC Command	Code	Validator Response Data
STACKER	36H	2 bytes: Z1 - Z2

Indicates stacker full condition and the number of bills in the stacker.

Byte 1 Byte 2

(Fxxxxxxx) (xxxxxxxx)
F = 1 if stacker is full, 0 if not.

xxxxxxxxxxxxxxx = The number of bills in the stacker.

VMC Command	Code	Sub-Command	Validator Response Data
EXPANSION COMMAND (Identification)	37H	00H	29 bytes: Z1 - Z29

Z1 - Z3 = Manufacturer Code - 3 bytes
Identification code for the equipment supplier. Sent as ASCII characters. Currently defined codes are listed in the **EVA** document entitled " ***European Vending Association Data Transfer Standard***" (**EVA-DTS**), the Audit Data Lists section, sub-section 2, "Manufacturer Codes".

Z4 - Z15 = Serial Number - 12 bytes
Factory assigned serial number. All bytes must be sent as ASCII characters, zeros (30H) and blanks (20H) are acceptable.

Z16 - Z27 = Model #/Tuning Revision - 12 bytes
Manufacturer assigned model number. All bytes must be sent as ASCII characters, zeros (30H) and blanks (20H) are acceptable.

Z28 - Z29 = Software Version - 2 bytes
Current software version. Must be sent in packed BCD.

VMC Command	Code	Sub-Command	VMC Data	Val Response
EXPANSION COMMAND (Diagnostics)	37H	FFH	Y1-Yn	Z1 - Zn

Y1 - Yn = Device manufacturer specific instruction for implementing various manufacturing or test modes. Y1 - Yn implies that any number of bytes can be used for the VMC data to the peripheral.

Z1 - Zn = Device manufacturer specific responses after receiving manufacturing or test instructions. Z1 - Zn implies that any number of bytes can be used for the bill validator response data from the peripheral.

6.4 Bill Validator Non-Response Time

The maximum non-response time for the bill validator is five seconds.

6.5 Bill Validator Power Requirements

The current draw for any bill validator must fall within the following limits. All measurements are at the minimum VMC Voltage Output.

Idle mode = 200 mA. (avg.) continuous

Bill transport = 2.5 A. (max.) up to 10 seconds

Note: Vending machines should be able to provide sufficient power to simultaneously supply both the above power for the bill validator **Bill Transport** and coin mechanism **Coin Acceptance** as specified in Section 5.5.

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Section 7

Cashless Payment VMC/Peripheral Communication Specifications

7.1 Introduction

This section defines the communications bytes sent and received between the payment media reader and the Vending Machine Controller (VMC). The payment media reader address is 00010xxxb.

Unless otherwise stated, all monetary values used by the payment media reader and the VMC will be sixteen bit, unsigned binary numbers. The numbers will be sent most significant byte first and scaled using the parameters provided by the payment media reader's READER CONFIGURATION DATA response.

7.2 State Definitions

MDB payment media readers may be viewed as state machines. These states are as follows:

1) Inactive
2) Disabled
3) Enabled
4) Session Idle
5) Vend
6) Revalue (Level 02 readers)

7.2.1 Inactive

This is the state of the reader at power up or after a reset. While in the Inactive state, payment medias will NOT be accepted for vending purposes. The reader cannot leave this state until all SETUP information is received from the VMC.

7.2.2 Disabled

The reader automatically enters this state from the Inactive state when it has received the SETUP CONFIG and SETUP MIN MAX PRICES from the VMC. It will also enter the Disabled state from the Enabled state when it receives the READER DISABLE command. While in the Disabled state, payment medias will NOT be accepted for vending purposes. The reader will remain in this state until either a READER ENABLE command is received (when it will enter the Enabled state) or a RESET is received (when it will enter the Inactive state). For power management purposes, current consumption will not exceed idle mode specification during disabled state.

7.2.3 Enabled

In this state, payment medias may be used for MDB transactions. The reader will remain in this state until a valid payment media is read (when it will enter the Session Idle state), a READER DISABLE command is received (when it will return to the Disabled state) or a RESET is received (when it will enter the Inactive state).

7.2.4 Session Idle

In the Enabled state, when a valid payment media is processed, the reader will issue a BEGIN SESSION response to a VMC POLL and enter the Session Idle state. This indicates that the reader is available for vending activities. The only structured exit from the Session Idle state is through the SESSION COMPLETE message from the VMC. The SESSION COMPLETE command will cause the reader to respond with an END SESSION message and enable/disable itself appropriately. Vend commands will cause the reader to leave the Session Idle state and enter the Vend state when products are selected and purchased.

7.2.5 Vend

This state is entered from the Session Idle state upon reception of a VEND REQUEST message from the VMC. The entire Vend state is an uninterruptable command/response sequence. The reader will return to the Session Idle state upon completion of this sequence.

7.2.6 Revalue (Level 02 Readers)

This state is entered from the Session Idle state upon reception of a REVALUE REQUEST message from the VMC. The entire Revalue state is an uninterruptable command/response sequence. The reader will return to the Session Idle state upon completion of this sequence.

7.3 Command Protocol

After the VMC has issued a command, no new commands may be issued until all data generated in response to that command has been received from the reader. The complete response may be an ACK only (e.g. the READER ENABLE command). Alternatively, it may consist of an informational response (e.g. READER CONFIGURATION DATA).

The reader may provide an informational response in two ways. It may respond immediately with the requested data, or the reader may ACK the VMC command. If ACKed, the VMC must issue POLLs until the reader responds with the requested data, or until the Application Maximum Response Time (defined in READER CONFIGURATION response) has elapsed.

Below are the uninterruptable commands which require an informational response, and their associated responses:

SETUP/CONFIGURATION DATA =>	READER CONFIGURATION DATA	
EXPANSION/REQUEST ID =>	PERIPHERAL ID	
READER CANCEL =>	CANCELLED	
VEND REQUEST... VEND CANCEL =>	VEND DENIED*	
VEND REQUEST =>	VEND DENIED*	
VEND REQUEST =>	VEND APPROVED =>	VEND SUCCESS*
VEND REQUEST =>	VEND APPROVED =>	VEND FAILURE*
REVALUE REQUEST=>	REVALUE APPROVED/DENIED	
SESSION COMPLETE =>	END SESSION	

*These VEND REQUEST / response sequences constitute the Vend state.

Any command may be issued by the VMC at anytime providing the above command protocol is observed. There are four exceptions to this rule:

1) VEND REQUEST/response sequences may only be initiated in the Session Idle state.
2) The VMC may issue a VEND CANCEL command after issuing a VEND REQUEST, but before receiving a VEND APPROVED/DENIED response. In this case the reader will issue a VEND DENIED response to satisfy the original VEND REQUEST response requirement.
3) The reader may issue DISPLAY REQUESTs in response to POLLs at any time, if the VMC's display is available for use.
4) The RESET command is allowed at any time, it is not subject to any restrictions.

If a VMC command is received by the reader while it is in one of the preceding uninterruptable states, the following will occur:

> The reader will ACK the offending command (no data response will be forthcoming). The reader will respond to the next poll with the "COMMAND OUT OF SEQUENCE" response (0BH).

If a VMC command is received by the reader which is unexecutable in its present state, the following occurs:

> The reader will ACK the offending command (no data response will be forthcoming) and the reader will respond to the next poll with the "ACK" response.

Vend failure sequence

In order to ensure that a reader refunds after a Vend Failure command, the VMC must send at least a single Poll command to obtain the reader possible answers:

ACK	Refund Complete
MALFUNCTION ERROR code 1100yyyy	Refund error-internal reader credit lost
SILENCE	Refund in progress. VMC must repoll reader until ACK or Malfunction error answer for maximum NON Response time.

7.3.1 Multi-Message Response Format

The multi-message response format permits the payment media reader to send multiple messages in response to a single command or POLL. Because all messages are of a fixed length, there is no confusion determining where one message ends and the next message begins. (The total message length is subject to the 36 byte limit imposed by Section 2 of this standard.)

For example, if a reader fails to correctly write a payment media after a VEND REQUEST, it may need to report:

1) VEND DENIED
2) MALFUNCTION/ERROR subcode 07h
3) SESSION CANCEL REQUEST

The multi-message response (hex) would look like this:

06	0A 07	04	1B*
1	2	3	4

The first byte above (marked 1) is the VEND DENIED message. The next two bytes (marked 2) are the MALFUNCTION/ERROR message. The third and final message is the CANCEL SESSION REQUEST (marked 3). An eight bit checksum with the mode bit set (marked 4) finishes the message.

It is important to note that the controller must service the messages in the order in which they are received. This is necessary to ensure that command protocol is maintained.

7.3.2 Coin Mechanism Escrow Return Actions

If present, the payment media return button is controlled by the payment media reader and it is the responsibility of the payment media reader to terminate a vend sequence if the payment media return button is pressed during a vend sequence.

The reaction of the VMC to the coin mechanism escrow return will vary depending upon the state of the system at the time it is pressed. If escrow return is allowed then a coin mechanism escrow return should be interpreted as VEND CANCEL or END OF SESSION.

1) In the Enabled state, the VMC should send a READER CANCEL command to the payment media reader. This allows the user to abort a pre-approved on-line authorisation request.
2) In the Session Idle state, the VMC should send a SESSION COMPLETE command to the payment media reader. This will return the reader to the Enabled state. The escrow return may cause the system to enter the revalue state prior to the VMC sending the “SESSION COMPLETE” command.
3) In the Vend state, before the reader has sent a VEND APPROVED or a VEND DENIED, the VMC should send a VEND CANCEL command to the payment media reader. This will cancel the vend and cause the reader to refund the reader if necessary.
4) In all other cases, no message is sent from the VMC to the payment media reader.

TABLE 1: CONTROLLER COMMANDS

Command	Code	Sub-command / Data	Response	Comment
Reset	10h	-	No Data *	
Setup	11h	00H – Config Data	01 H – Reader Config Data	
		01H - Max/Min Prices	No Data *	
Poll	12h	-	00H - Just Reset 01H - Reader Config Data 02H - Display Request 03H - Begin Session 04H - Session Cancel Request 05H - Vend Approved 06H - Vend Denied 07H - End Session 08H - Cancelled 09H - Peripheral ID 0AH - Malfunction / Error 0BH - Cmd Out Of Sequence 0DH - Revalue Approved 0EH - Revalue Denied 0FH - Revalue Limit Amount 10H - User File Data 11H - Time/Data Request E0H-EFH FFH - Diagnostic Response	 (level 02 readers) (level 02 readers) (level 02 readers) (level 02 readers) (level 02 readers) (for future use)
Vend	13h	00H - Vend Request	05H - Vend Approved 06H - Vend Denied	
		01H - Vend Cancel	06H - Vend Denied	
		02H - Vend Success	No Data *	
		03H - Vend Failure	No Data *	
		04H - Session Complete	07H - End Session	
		05H - Cash Sale	No Data *	
Reader	14h	00H - Reader Disable	No Data *	
		01H - Reader Enable	No Data *	
		02H - Reader Cancel	08H - Cancelled	
Revalue	15h	00H - Revalue	0DH - Revalue Approved	(level 02 readers)

		Request	0EH - Revalue Denied	(level 02 readers)
		01H - Revalue Limit Request	0FH - Revalue Limit Amount 0EH Revalue Denied	(level 02 readers)
Expansion	17h	00H - Request ID	09H – Peripheral ID	
		01H - Read User File	10H - User File Data	(level 02 readers)
		02H - Write User File	No Data *	(level 02 readers)
		03H - Write Time/Date	No Data *	(level 02 readers)
		FFH - Diagnostics	FFH - Diagnostic Response	

* No Data response = peripheral just responds with ACK or NAK

NOTE: Reader responses which are part of request / response sequences are listed more than once in the above table since the reader may respond either immediately to the request (within 5 milliseconds) or to a later POLL.

7.4 VMC/Reader Command/Response Formats

7.4.1 Reset and Initialising

RESET
(10H)

Reader response:

No Data response

If this command is received by a payment media reader it should terminate any ongoing transaction (with a refund, if appropriate), eject the payment media (if applicable), and go to the Inactive state.

The VMC must follow the RESET command with the following reader initializing sequence:

POLL (to obtain “JUST RESET” response)
SETUP CONFIGURATION DATA (first)
SETUP MAX/MIN PRICE (second)
EXPANSION REQUEST ID (third - level 2) (optional - level 1)
READER ENABLE (if wanted)

7.4.2 SETUP - Config Data

SETUP (11H)	Config Data (00H) Y1	VMC Feature Level Y2	Columns on Display Y3	Rows On Display Y4	Display Info Y5

Y1 : Configuration data.
VMC is sending its configuration data to reader.

Y2 : VMC Feature Level.
Indicates the feature level of the VMC. The available feature levels are:

01 - The VMC is not capable or will not perform the advanced features as described in bytes Z8, Z9, Z10 of Begin session-level 2 reader. The reader will not provide advanced information to the VMC, but can do the advanced features internally (transparently to the VMC).
02 - The VMC is capable and willing to perform the advanced features. The reader will provide advanced information to the VMC (if possible) and will not do the advanced features internally.

Y3 : Columns on Display. The number of columns on the display. Set to 00H if the display is not available to the reader.

Y4 : Rows on Display.
The number of rows on the display

Y5 : Display Information - xxxxxyyy
xxxxx = Unused
yyy = Display type

000 : Numbers, upper case letters, blank and decimal point.
001 : Full ASCII
010-111: Unassigned

Reader Response:

Reader Config Data (01H) Z1	Reader Feature Level Z2	Country Code High Z3	Country Code Low Z4	Scale Factor Z5	Decimal Places Z6	Application Maximum Response Time Z7	Miscellaneous Options Z8

Z1 : READER - Configuration data.
Indicates the payment media reader is responding to a SETUP – Configuration data request from the VMC.

Z2 : Reader Feature Level.
Indicates the feature level of the reader. Currently feature levels are:
01: The reader has no revaluation capability
02: The reader has revaluation capability

Z3-Z4 : Country Code - packed BCD.
International Telephone Code for the country in which the payment media reader is set-up for. For example the USA code is 0001. Use FFFFh if the country code in unknown.

Z5 : Scale Factor.
The multiplier used to scale all monetary values transferred between the VMC and the reader.

Z6 : Decimal Places.
The number of decimal places used to communicate monetary values between the VMC and the payment media reader.

All pricing information sent between the VMC and the payment media reader is scaled using the scale factor and decimal places. This corresponds to:

$$\text{ActualPrice} = P \cdot X \cdot 10^{-Y}$$

where P is the scaled value send in the price bytes, and X is the scale factor, and Y is the number of decimal places. For example if there are 2 decimal places and the scale factor is 5, then a scaled price of 7 will mean an actual of 0.35.

Z7 : Application Maximum Response Time - seconds.
The maximum length of time a reader will require to provide a response to any command from the VMC. The value reported here supercedes the payment reader's default NON-RESPONSE time defined in section 7.5 if the value reported here is greater.

Z8 : Miscellaneous Options – xxxxyyyy

xxxx:	Unused (must be set to 0)
yyyy:	Option bits
b0=0:	The payment media reader is NOT capable of restoring funds to the user's payment media or account. Do not request refunds.
b0=1:	The payment media reader is capable of restoring funds to the user's payment media or account. Refunds may be requested.
b1=0:	The payment media reader is NOT multivend capable. Terminate session after each vend.
b1=1:	The payment media reader is multivend capable. Multiple items may be purchased within a single session.

b2=0: The payment media reader does NOT have a display.
b2=1: The payment media reader does have its own display.
b3=0: The payment media reader does NOT support the VEND/CASH SALE subcommand.
b3=1: The payment media reader does support the VEND/CASH SALE subcommand.

7.4.3 SETUP – Max / Min Prices

SETUP (11H)	Max / Min Prices (01H) Y1	Maximum Price Y2-Y3	Minimum Price Y4-Y5

Y1 : Max / Min prices

Indicates the VMC is sending the price range to the reader.

Y2 - Y3 : Maximum Price – scaled
This information should be sent as soon as the VMC prices have been established and any time there is a change in the maximum price, If the VMC does not know the maximum price, FFFFh should be sent.

Y4 -Y5 : Minimum Price – scaled
This information should be sent as soon as the VMC prices have been established and any time there is a change in the minimum price. If the VMC does not know the minimum price, 0000h should be sent.

Reader response:

No Data response

7.4.4 POLL

POLL (12H)

The POLL command is used by the VMC to obtain information from the payment media reader. This information may include user actions (CANCEL SESSION REQUEST), hardware malfunctions (MALFUNCTION /ERROR), software malfunctions (COMMAND OUT OF SEQUENCE) or information explicitly requested by the controller (READER CONFIGURATION DATA). An ACK response indicates that no error states exist, and either no information request is pending or pending information is not yet ready for transmission.

In addition to an ACK, the VMC may receive the following POLL responses from the payment media reader.

Reader responses:

Just Reset (00H) Z1

Z1: JUST RESET
Indicates the payment media reader has been reset.
Note: the difference between ACK and JUST RESET responses is:
00H 00H* =JUST RESET
00H* =ACK
*mode bit=1

Reader Config Info (01H) Z1	Reader Feature Level Z2	Country Code High Z3	Country Code Low Z4	Scale Factor Z5	Decimal Places Z6	Application Maximum Response Time Z7	Miscellaneous Options Z8

See paragraph 7.4.2 for a detailed explanation of this response.

Display Request (02H) Z1	Display Time Z2	Display Data Z3-Z34

Z1 : DISPLAY REQUEST
The payment media reader is requesting a message to be displayed on the VMC's display.

Z2 : Display Time - 0.1 second units
The requested display time. Either the VMC or the payment media reader may overwrite the message before the time has expired.

Z3-Z34 : Display Data – ASCII
The message to be displayed. Formatting (leading and/or trailing blanks) is the responsibility of the payment media reader.

The number of bytes must equal the product of Y3 and Y4 up to a maximum of 32 bytes in the setup/configuration command.

Begin Session (03H)	Funds Available
Z1	Z2-Z3

Level 01 Readers

Z1 : BEGIN SESSION (**level 01 readers**)
Allow a patron to make a selection, but do not dispense product until funds are approved.

Z2-Z3 : Funds Available - scaled
a. Lesser of the user's payment media or account balance or FFFEh units.
b. Not yet determined - FFFFh.

Begin Session (03H)	Funds Available	Payment media ID	Payment Type	Payment Data
Z1	Z2-Z3	Z4-Z7	Z8	Z9-Z10

Level 02 Readers

Z1 : BEGIN SESSION (**level 02 readers**)
Allow a patron to make a selection, but do not dispense product until funds are approved.

Z2-Z3 : Funds Available – scaled
a. Lesser of the user's payment media or account balance or FFFEh units.
b. Not yet determined - FFFFh.

Z4-Z7 : Payment media ID.
00000000h-FFFFFFFEh=Payment media identification number.
FFFFFFFFh = unknown payment media ID.

Z8 : Type of payment:
00xxxxxxb = normal vend card
x1xxxxxxb = test media
1xxxxxxxb = free vend card
xx000000b -0 VMC default prices.
xx000001b -1 Price list number. (Z9 = Cost Allocation Code, Z10 = Number)*
xx000010b -2 Discount group index (Z9 = Cost Allocation Code, Z10 = Discount group index)
xx000011b -3 Discount percentage factor (Z9=00, Z10 = 0 to 100**)
xx000100b -4 Surcharge percentage factor (Z9=00, Z10 = 0 to 100**)
xx000101b -5 Use a unit. (Electronic token)
xx000110b -6 Use a different scaling factor specified by Z9 & Z10.

* Cost Allocation Codes are tables of prices or discounts and Number is the index of an item in the chosen table. If the Cost Allocation code is unknown by the VMC, the normal prices are used (Z8 is defaulted to 00h). Minimum value for Z9 and Z10 is 0.

** Percentages are expressed in binary (00 to 64h)

Note:
These functions may NOT be supported by all VMCs.

Z9-Z10 : Payment data as defined above.

Session Cancel Request (04H)
Z1

Z1 : SESSION CANCEL REQUEST
The payment media reader is requesting the VMC to cancel the session. The VMC should initiate an eventual SESSION COMPLETE. This response is sent to the VMC whenever the payment media is removed or a request for removal from the reader is made by the user (e.g. if a return button on the reader is pressed).

Vend Approved (05H) Z1	Vend Amount Z2-Z3

Refer to paragraph 7.4.5 for detailed explanation.

Vend Denied (06H) Z1

Refer to paragraph 7.4.5 for detailed explanation.

End Session (07H) Z1

Refer to paragraph 7.4.9 for detailed explanation.

Cancelled (08H) Z1

Refer to paragraph 7.4.13 for detailed explanation.

Peripheral ID (09H) Z1	Manufacturer Code Z2-Z4	Serial Number Z5-Z16	Model Number Z17-Z28	Software Version Z29-Z30

Z1 : PERIPHERAL ID
Reader is sending peripheral ID information.

Z2 - Z4 : Manufacturer Code - ASCII
Identification code for the equipment supplier. Currently defined codes are listed in the **EVA** document entitled "***European Vending Association Data Transfer Standard***" (**EVA-DTS**), the Audit Data Lists section, sub-section 2, "Manufacturer Codes".

Z5-Z16 : Serial Number – ASCII
Factory assigned serial number.

Z17-Z28 : Model Number - ASCII
Manufacturer assigned model number.

Z29-Z30 : Software Version - packed BCD
Current software version.

Malfunction / Error	Error Code
(0AH) Z1	Z2

Z1 : MALFUNCTION/ERROR
The payment media reader is reporting a malfunction or error.

Z2 : Error Code - xxxxyyyy

xxxx	error types
0000:	Payment media Error1
0001:	Invalid Payment media1
0010:	Tamper Error1
0011:	Manufacturer Defined Error1
0100:	Communications Error2
0101:	Reader Requires Service2
0110:	Unassigned2
0111:	Manufacturer Defined Error2
1000:	Reader Failure3
1001:	Communications Error3
1010:	Payment media Jammed3
1011:	Manufacturer Defined Error
1100:	Refund error – internal reader credit lost
1101-1111:	Unassigned

1 Transient error - Reported once
2 Non-transient error - Reported every POLL until cleared. Reader still functional.
3 Non-transient error - Reported every POLL until cleared. Reader not presently functional.

yyyy = Manufacturer defined subcode

Transient Error Handling

The error will be reported to the VMC until it has been ACKnowledged. The error state will be cleared in the reader, and normal operations will continue.

Non-transient Error Handling
The error will be reported to the VMC at each POLL as long as it exists. If the reader is still functional, multi-message responses will allow normal responses in addition to the error report.

Note: Refund error is sent from the media reader when it is not able to refund money to the payment media following a failed or cancelled vend. The reader internally cancels the credit and the credit is lost.

Command Out of Sequence (0BH) Z1

Level 01 Readers

Z1 : COMMAND OUT OF SEQUENCE (Level 01 readers)
The payment media reader has received a command that is not executable in its current state, or that violates one of the uninterruptable sequences. The offending command should be ACKed but not acted upon the reader. The VMC should send the RESET command to the reader upon reception of this response. Note that the reader will continue with any credit update process prior to resetting.

Command Out of Sequence (0BH) Z1	Status Z2

Level 02 Readers

Z1 : COMMAND OUT OF SEQUENCE. (Level 02 readers)
The payment media reader has received a command that is not executable in its current state.

Z2 : Status
The state of the payment media reader.
01: Inactive state
02: Disabled state
03: Enabled state
04: Session idle state
05: Vend state
06: Revalue state

Revalue Approved (0DH) Z1

Level 02 Readers

Refer to paragraph 7.4.14 for detailed explanation.

Revalue Denied (0EH) Z1

Level 02 Readers

Refer to paragraph 7.4.14 for detailed explanation.

Revalue Limit Amount (0FH) Z1	Revalue Limit Amount Z2-Z3

Level 02 Readers

Refer to paragraph 7.4.15 for detailed explanation.

User File Data (10H) Z1	Number of User File Z2	Length Of User File Z3	User Data Z4-Zn

Level 02 Readers

Refer to paragraph 7.4.17 for detailed explanation.

Time/Date Request (11H) Z1

Level 02 Readers

Z1 : TIME DATE REQUEST
In certain circumstances it will be necessary to synchronize the real time clock of the card reader with real time clock of the VMC. The card reader will respond with TIME/DATE REQUEST to a POLL command of the VMC. The VMC will follow with the EXPANSION-WRITE TIME/DATE FILE to the card reader. Refer to paragraph 7.4.19.

Diagnostics Response (FFH) Z1	User Defined Data Z2-Zn

Refer to paragraph 7.4.20 for detailed explanation.

7.4.5 VEND - Request

Vend (13H)	Vend Request (00H) Y1	Item Price Y2-Y3	Item Number Y4-Y5

Y1 : VEND REQUEST
The patron has made a selection. The VMC is requesting vend approval from the payment media reader before dispensing the product.

Y2-Y3 : Item Price - scaled
The price of the selected product.

Y4-Y5 : Item Number
The item number of the selected product. This number is defined by the manufacturer, and set to FFFFh for undefined or not implemented.

Reader response:

Vend Approved (05H) Z1	Vend Amount Z2-Z3

Z1 : VEND APPROVED
Allow the selected product to be dispensed

Z2-Z3 : Vend Amount - scaled
This is the amount deducted from the user's payment media or account. This may not match the amount specified in the VEND REQUEST command; it may be surcharged or discounted.
FFFFh - an electronic token was used.

Vend Denied (06H) Z1

Z1 : VEND DENIED
Approval denied for the patron's selection. Do not dispense any products.

7.4.6 VEND - Cancel

Vend (13H)	Vend Cancel (01H) Y1

Y1 : VEND CANCEL
This command can be issued by the VMC to cancel a VEND REQUEST command before a VEND APPROVED/DENIED has been sent by the payment media reader. The payment media reader will respond to VEND CANCEL with a VEND DENIED and return to the Session Idle state.

Reader response:

Vend Denied (06H)

Z1

See paragraph 7.4.5 for explanation.

7.4.7 VEND - Success

Vend (13H)	Vend Success (02H) Y1	Item Number Y2-Y3

Y1 : VEND SUCCESS
The selected product has been successfully dispensed.

Y2-Y3 : Item number
The item number of the selected product. This number is defined by the manufacturer, and set to FFFFh for undefined or not implemented.

NOTE A reset between VEND APPROVED and VEND SUCCESS shall be interpreted as a VEND SUCCESS.

Reader response:

No Data response

7.4.8 VEND - Failure

Vend (13H)	Vend Failure (03H) Y1

Y1 : VEND FAILURE
A vend has been attempted at the VMC but a problem has been detected and the vend has failed. The product was not dispensed. Funds should be refunded to user's account.

Reader response:

No Data response

7.4.9 SESSION COMPLETE

Vend	Session Complete

(13H)	(04H) Y1

Y1 : SESSION COMPLETE
This tells the payment media reader that the session is complete and to return to the Enabled state. SESSION COMPLETE is part of a command/response sequence that requires an END SESSION response from the reader.

Reader response:

End Session (07H) Z1

Z1 : END SESSION
This command is issued in response to a SESSION COMPLETE command. The END SESSION response indicates the reader has returned to the Enabled state. If “END SESSION” is not received by the VMC within a the maximum application non-response time, the VMC should issue a “RESET” command.

7.4.10 CASH SALE

Vend (13H)	Cash Sale (05H) Y1	Item Price Y2-Y3	Item Number Y4-Y5

Y1 : CASH SALE
A cash sale (cash only or cash and cashless) has been successfully completed by the VMC.

Y2-Y3 : Item Price – scaled
The price of the selected product or cash portion of the price.

Y4-Y5 : Item Number
The item number of the selected product. This number is defined by the manufacturer, and set to FFFFh for undefined or not implemented.

Note: This command is issued for cash auditing applications and is sent to the payment media reader if the SETUP/CONFIGURATION bit (b3) is enabled anytime a valid cash transaction is completed via a coin mechanism or bill validator.

Reader response:

No Data response

7.4.11 READER - Disable

Reader (14H)	Disable (00H) Y1

Y1 : READER DISABLE
This informs the payment media reader that it has been disabled, i.e. it should no longer accept a patron's payment media for the purpose of vending. Vending activities may be re-enabled using the READER ENABLE command. The payment media reader should retain all SETUP information.

NOTE Any transaction in progress will not be affected and should continue to its normal completion.

Reader response:

No Data response

7.4.12 READER - Enable

Reader (14H)	Enable (01H) Y1

Y1 : READER ENABLE
This informs the payment media reader that is has been enabled, i.e. it should now accept a patron's payment media for vending purposes. This command must be issued to a reader in the Disabled state to enable vending operations.

Reader response:

No Data response

7.4.13 READER - Cancel

Reader (14H)	Cancel (02H) Y1

Y1 : READER CANCEL
This command is issued to abort payment media reader activities which occur in the Enabled state. It is the first part of a command/response sequence which requires a CANCELLED response from the reader.

Reader response:

Cancelled (08H) Z1

Z1 : CANCELLED
This is the reader's response to the READER CANCEL command from the VMC. This command comprises a command/response sequence. Its use is only appropriate in the Enabled state.

7.4.14 REVALUE - Request (Level 02 Readers)

Revalue (15H)	Revalue Request (00H) Y1	Revalue Amount Y2-Y3

Level 02 Readers

Y1 : REVALUE REQUEST (Level 02 Readers)
A balance in the VMC account because coins or bills were accepted or some balance is left after a vend. With this command the VMC tries to transfer the balance to the payment media.

Y2-Y3 : Revalue amount - scaled.
The revalue amount should not exceed the revalue limit value given by the command REVALUE LIMIT REQUEST.

Reader response:

Revalue Approved (0DH) Z1

Level 02 Readers

Z1 : REVALUE APPROVED (Level 02 Readers)
A balance is in the VMC account because coins or bills were accepted or some balance is left after a vend. The VMC has issued a REVALUE REQUEST to the payment media reader to transfer the balance to the payment media. The payment media reader accepted the request and added its value to the payment media balance. The reader then responds with a REVALUE APPROVED, so the VMC may clear the account.

Revalue Denied (0EH) Z1

Level 02 Readers

Z1 : REVALUE DENIED (Level 02 Readers)
A balance is in the VMC account because coins or bills were accepted or some balance is left after a vend. The VMC has issued a REVALUE REQUEST to the payment media reader to transfer the balance to the payment media. The payment media reader does not accept the request and responds with a REVALUE DENIED, so the VMC has to pay out change. It is a quite common situation if there is no payment media inserted at this moment.

7.4.15 REVALUE - Limit Request (Level 02 Readers)

Revalue (15H)	Revalue Limit Request (01H) Y1

Level 02 Readers

Note: If revaluing, follow the BEGIN SESSION with this command.

Y1 : REVALUE LIMIT REQUEST (Level 02 Readers)
In at configuration with a bill and/or coin acceptor and payment media reader connected to a VMC, the VMC must know the maximum amount the payment media reader eventually will accept by a REVALUE REQUEST. Especially if the bill acceptor accepts a wide range of bills. Otherwise the VMC may be confronted by the situation where it accepted

a high value bill and is unable to pay back cash or revalue it to a payment media. (see also below)

Reader response:

Revalue Limit Amount (0FH)	Revalue Limit Amount
Z1	Z2-Z3

Level 02 Readers

Z1 : REVALUE LIMIT AMOUNT (Level 02 Readers)
The patron intends to revalue the payment media with a bill of some value. The VMC must know what kind of bills to accept, so it will issue a REVALUE LIMIT REQUEST to get the amount the payment media reader will accept. The payment media reader will respond will the scaled value, calculated with the maximum allowed payment media balance minus the current balance of the payment media. The payment media reader responds with REVALUE DENIED if there is no payment media available upon this request.

Z2-Z3 : Revalue limit value - scaled.

7.4.16 EXPANSION - Request ID

	Request ID (00H)	Manufacturer Code	Serial Number	Model Number	Software Version
Expansion (17H)	Y1	Y2-Y4	Y5-Y16	Y17-Y28	Y29-Y30

Y1 : REQUEST ID
The VMC is requesting payment media reader identification information. The information included above (Y2-Y30) provides the payment media reader with VMC identification information.

Y2-Y4 : Manufacturer Code - ASCII
Identification code for the equipment supplier. Currently defined codes are listed in the EVA document entitled “The Data Transfer Standard EVA-DTS" document, the Audit Data Dictionary section, chapter 4, "Manufacturer Codes".

Y5-Y16 : Serial Number - ASCII
Factory assigned serial number.

Y17-Y28 : Model Number - ASCII
Manufacturer assigned model number.

Y29-Y30 : Software Version - packed BCD
Current software version.

Reader response:

Peripheral ID (09H) Z1	Manufacture Code Z2-Z4	Serial Number Z5-Z16	Model Number Z17-Z28	Software Version Z29-Z30

See paragraph 7.4.4 for a detailed explanation of this response.

7.4.17 EXPANSION - Read User File (Level 02 Readers)

Obsolete Command – Do not use for new designs!! (Use EXPANSION - Diagnostics)

Expansion (17H)	Read User File (01H) Y1	Number of User File Y2

Level 02 Readers

Y1= READ USER FILE
The VMC request's the user file. The length of the file is variable with a maximum length of 32 bytes. The contents of the data are defined by the VMC manufacturer. If the payment media reader does support this command it will respond with USER FILE DATA.

Y2= Number of User File.
The File identification number. The number and size of the data files are defined by the payment media reader manufacturer. The maximum number of user files are FFh.

Reader response:

User Data File	Number of User File	Length of User File	User Data

(10H) Z1	Z2	Z3	Z4-Zn

Z1 : USER FILE DATA (only level 02 readers)
The VMC requires user data and has issued a EXPANSION - READ USER FILE to the payment media reader.

Z2 : Number of User File.
The File identification number. The number and size of data files are defined by the payment media reader manufacturer. The maximum number of user files are FFh.

Z3 : Length of user file
The length of the user file. The maximum length of the user file is 32 bytes. If the user file don't exists the length will be set to 00h.

Z4-Zn : Data defined by the VMC manufacturer.

7.4.18 EXPANSION - Write User File (Level 02 Readers)

Obsolete Command – Do not use for new designs!! (Use EXPANSION - Diagnostics)

Expansion (17H)	Write User File (02H) Y1	Number of User File Y2	Length of User File Y3	User Data Y4-Yn

Y1 : WRITE USER FILE
The VMC request's to write the user file. The length of the file is variable with a maximum length of 32 bytes. The contents of the data are defined by the VMC manufacturer. If the command is supported but the payment media reader is unable to write the payment media (writing problem or data too long) it will respond with MALFUNCTION/ERROR.

Y2 : Number of User File.
The File identification number. The number and size of data files are defined by the payment media reader manufacturer. The maximum number of user files are FFh.

Y3 : Length of user file
The length of the user file. The maximum length of the user file is 32 bytes.

Y4-Yn : Data defined by the VMC manufacturer.

Reader response:

No Data response

7.4.19 EXPANSION - Write Time/Date File (Level 02 readers)

Expansion (17H)	Write Time/ Date File (03H) Y1	Time Date Y2-Y11

Y1 : WRITE TIME/DATE FILE
The VMC requests to write the Time/Date file.

Y2- Y11: Time/Date to synchronize the card reader real time clock. The date bytes are BCD encoded.

Y2 = Years (Range: 00..99)
Y3 = Months (Range: 01..12)
Y4 = Days (Range: 01..31)
Y5 = Hours (Range: 00..23)
Y6 = Minutes (Range: 00..59)
Y7 = Seconds (Range: 00..59)
Y8 = Day of Week (Range: 01..07, Monday = 1..Sunday = 7)
Y9 = Week Number (Range: 01..53)
Y10 = Summertime (Range: 00..01, Summertime = 1)
Y11 = Holiday (Range: 00..01, Holiday = 1)

If any item of the time/date is not supported use FFH instead.

7.4.20 EXPANSION - Diagnostics

Expansion (17H)	Diagnostics (FFH) Y1	User Defined Data Y2-Yn

Y1 : DIAGNOSTICS.
Device manufacturer specific instruction for implementing various manufacturing or test modes.

Y2-Yn : User Defined Data.
The data portion of this command is defined by the manufacturer and is

not part of this document.

Reader response:

Diagnostics Response (FFH) Z1	User Defined Z2-Zn

Z1 : DIAGNOSTICS RESPONSE

Z2-Zn : User Defined Data.
The data portion of this response is defined by the manufacturer and is not part of this document.

7.5 Non-Response Time

The default maximum non-response time for a payment media reader is 5 seconds. This is the maximum time for which a payment media reader will not respond to a command or a POLL with ACK, NAK or a message. The “Application Maximum Response Time” reported in byte Z7 of the Reader Configuration Data (7.4.2) supersedes this default value if Z7 is greater.

7.6 Payment media Reader Power Requirements

The current draw for any payment media reader must fall within the following limits. All measurements are at the minimum VMC Voltage Output.

Idle mode = 300 mA. (avg.) continuous

Transport or Read/Write cycle = 1.5 A @ 50% maximum duty cycle up to 5 seconds.

7.7 Example Vend Sessions

EXAMPLE VEND SESSION #1
(Valid Single Vend)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
	←	VEND APPROVED	
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #2
(Valid Multiple Vend)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
	←	VEND APPROVED	
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
	←	VEND APPROVED	
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #3
(Session cancelled by user with reader return button)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
	User pushes reader RETURN button		
POLL	→		
	←	SESSION CANCEL	
ACK	→		
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #4a
(Session cancelled by user via coin mechanism escrow return button before product was selected)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
	User pushes coin mech. escrow return		
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #4b
(Session cancelled by user via coin mechanism escrow return button after product was selected)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
User pushes coin mech. escrow return			
CANCEL VEND	→		
	←	ACK	
POLL	→		
	←	VEND DENIED	(Session Idle)
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #5
(VMC Failure/product not dispensed
Refund positive)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
Reader deducts purchase price from payment media			
POLL	→		
	←	VEND APPROVED	
VMC fails to dispense product			
VEND FAILURE	→		
	←	ACK	(Revalue)
POLL	→		
	←	Silence during the refund operation	
POLL	→		
	←	Refund/Revalue Complete	
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #5A
(VMC Failure/product not dispensed
Refund fail)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
Reader deducts purchase price from payment media			
POLL	→		
	←	VEND APPROVED	
VMC fails to dispense product			
VEND FAILURE	→		
	←	ACK	(Revalue)
POLL	→		
	←	Silence during the refund operation	
POLL	→		
	←	MALFUNCTION ERROR code 1100yyyy=refund fail	
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #6
(Vend denied by reader)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)

Insufficient funds or payment media/account error

POLL	→		
	←	VEND DENIED	(Session Idle)

VMC makes no attempt to dispense product

SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #7
(Command Out of Sequence Error)

Controller		Reader	State	
POLL	→			
	←	BEGIN SESSION	(Session Idle)	
ACK	→			
VEND REQUEST	→			
	←	ACK	(Vend)	
EXPANSION ID REQUEST	→			
	←	ACK		
POLL	→			
	←	COMMAND OUT OF SEQUENCE	(Session Idle)	
ACK	→			
POLL	→			**(Level 2)**
	←	ACK	(Inactive)	**(Level 2)**
RESET	→	{**Mandatory**}		**(Level 1)**
	←	ACK	(Inactive)	**(Level 1)**

EXAMPLE VEND SESSION #8a
(Reader busy for longer than max. non response time)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
		[silence…]	(Reader busy)
POLLs (numerous)	→		
	←	[silence…]	(continued POLLs w/ no response)
POLL	→		
	←	ACK	(restart Non-Response timer)
POLLs (numerous)	→		
	←	[silence…]	(continued POLLs w/ no response)
POLL	→		
	←	[silence…]	(Reader almost finished)
POLL	→		
	←	VEND APPROVED	(Reader ready)
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
	←	VEND APPROVED	
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

EXAMPLE VEND SESSION #8b
(Reader busy for shorter than max. non response time)

Controller		Reader	State
POLL	→		
	←	BEGIN SESSION	(Session Idle)
ACK	→		
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
	←	[silence...]	(Reader busy)
POLLs (numerous)	→		
	←	[silence...]	(Continued POLLs w/ no response)
POLL	→		
	←	[silence...]	(Reader almost finished)
POLL	→		
	←	VEND APPROVED	(Reader ready)
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
VEND REQUEST	→		
	←	ACK	(Vend)
POLL	→		
	←	VEND APPROVED	
ACK	→		
VEND SUCCESS	→		
	←	ACK	(Session Idle)
SESSION COMPLETE	→		
	←	ACK	
POLL	→		
	←	END SESSION	(Enabled)

NOTE
If the peripheral omits to respond within the maximum non-response time, it is considered to be off-line.

EXAMPLE VEND SESSION #9

(Pre-approved authorization aborted by coin mechanism escrow return button before BEGIN SESSION)

Controller		Reader	State
	User swipes payment media		
			(Enabled)
POLL	→		
	←	ACK	
READER CANCEL	→		
	←	ACK	
	(If applicable, reader aborts HOST communications, ejects payment media, etc...)		
POLL	→		
	←	CANCELLED	

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Section 8

Audit Device
VMC/Peripheral Communication Specifications

8.1 Introduction

This section defines the communication bytes sent and received by a vending machine auditing device (“Audit Device”). The Audit Device’s address is 00011 binary.

Unless stated otherwise, all information is assumed to be in a binary format.

This specification includes descriptions of two Feature Levels, currently Levels 01 and 02.

Level 01 Audit Devices

The basic operation of the Level 01 Audit Device by the VMC is as follows. The VMC issues a Reset command. On receiving an ACK, it issues a Setup command requesting setup information, and then receives the setup information from the Audit Device. The VMC then sends an Enable command, enabling the Audit Device. The VMC is then expected to transmit one or more blocks of data either periodically or after any change in VMC state that would directly affect audit information, such as the successful vending of a product. This data is transmitted using multiple Transmit commands, each containing one data field which follows the data delimiting standard outlined by the Audit Data Dictionary of the **EVA** document entitled "***European Vending Association Data Transfer Standard***" (**EVA-DTS**). The Level 01 Audit Device is thus responsible for recording and compiling the data sent to it by the VMC. The Level 01 Audit Device then stores the audit information until that data is collected by an external system, such as a Computer or a Portable Collection Device. Two notes:

1. For simplicity, only a small subset of the complete Audit Data Dictionary of the **EVA-DTS** is used in the Level 01 Audit Device.

2. The Disable command indicates that the Audit Device no longer needs to monitor the MDB bus for Transmit Commands.

Level 02 Audit Devices

Level 02 Audit Devices differ in function from the Level 01 Devices as follows. The Reset, Setup, and Enable phases of operation remain the same. From this point on the Audit Device must act as a Level 01 Audit Device, accepting the Level 01 Audit Data and storing just as a Level 01 Audit Device would. This allows the

Level 02 Audit Device to work in a Level 01 compliant VMC without any modification or additional commands. Level 02 Audit Device operation is then expanded through the use of a Poll command in Level 02 Audit Devices.

A Level 02 compliant VMC issues a Poll command to the Level 02 Audit Device. The Level 02 Audit Device replies with one of the following messages:

1. an ACK which implies that the Level 02 Audit Device has no Requests at this time and has no Errors to report.
2. a Request for a Complete Transfer of Audit Data
3. a Request for Transfer of an individual Audit Field
4. a Request to Configure the VMC
5. a Diagnostic Error.
6. a Status Change.
7. an Event Occurred.

The VMC then responds as follows:

1. If the Level 02 Audit Device sends an ACK, no action takes place.

2. If the Level 02 Audit Device does Request a Complete Transfer of Audit Data, the VMC either:
   i) sends a Deny Request command and no action takes place. The Level 02 Audit Device must then request the Audit Data again before the VMC will send it. Or,
   ii) the VMC sends a Grant Request command, then issues a series of Transmit commands. Each Transmit command contains one field of Audit Data, as with the Level 01 Audit Device. Unlike the Level 01 Audit Device, this block of data is delimited by the *complete* Audit Data Dictionary of the **EVA-DTS** instead of a small subset of that Dictionary. After all Audit Data has been Transmitted, the VMC sends a Disable command to indicate an end of data transmissions.

3. If the Level 02 Audit Device does Request an individual Audit Field, then the VMC either:
   i) sends a Deny Request command and no action takes place. The Level 02 Audit Device must then request the Audit Field again before the VMC will send it. Or,
   ii) sends an Unable to Comply command. In this way the VMC will indicate to the Level 02 Audit Device that the requested field is not supported by the VMC. Or,
   iii) the VMC issues one Transmit command. Each Transmit command contains one field of Audit Data specifically requested

by the Level 02 Audit Device. Unlike the Level 01 Audit Device, this block of data is delimited by the *complete* Audit Data Dictionary of the **EVA-DTS** instead of a small subset of that Dictionary. The individual Audit Field Request (02H) can only be sent by itself. Inclusion of the field name in the Transmission from the VMC allows the Level 02 Audit Device to verify that the correct field was sent. In order to streamline this process, the VMC need not issue a Grant Request command before sending fields requested through this command. One exception that must be made is for the PA2-PA5 series of fields. Since these fields have no reference unless preceded by the PA1 field, the request for these records need only include the PA2-PA5 code. The VMC is responsible for automatically sending the PA1 field before any of the PA2-PA5 fields. In this case, two Transmit commands will follow the Audit Field Request instead of only one.

4. If the Level 02 Audit Device Requests to Configure the VMC, the VMC either
   i) sends a Deny Request command and no action takes place, or
   ii) the VMC issues a Receive command to the Level 02 Audit Device. The Level 02 Audit Device then sends one field of Configuration Data, as outlined in the NAMA standard "The Vending Industry Data Transfer Standard".

5. If the Level 02 Audit Device reports an internal Diagnostic Error, the VMC may then issue a Diagnostic/Send Event Log command to get the last sixteen internal Events (including Errors) that occurred in the Audit Device.

6. If the Level 02 Audit Device reports a Status Change, the VMC may then issue a Diagnostic/Status command to determine the current Status of the Audit Device.

7. If the Level 02 Audit Device reports an Event Occurred, the VMC may then issue a Diagnostic/Send Event Log command to get the last sixteen internal Events (including Errors) that occurred in the Audit Device.

Status, Diagnostics and Error Handling

The Level 02 Audit Device keeps track of its internal Status and reports changes in Status to the VMC in response to a Poll. The Status change is only reported by the Audit Device once. When the VMC receives a Status Change response to a Poll, it may then send a Diagnostic/Status command to the Audit Device in order to find out what the new Status of the device is. The Diagnostic/Status command may be issued by the VMC at any time, even if it has not received a Status Change response from the Audit Device.

The Level 02 Audit Device also has some self-diagnostic capability. When one or more errors occur in the Audit Device, the Audit Device records them in order of occurrence in an Event Log which is sixteen entries long. As the Event Log fills with entries, the oldest entries are pushed out of the Event Log and the new entries are added. The Audit Device then reports an internal Diagnostic Error in response to a VMC Poll command. The reporting is handled according to the following Error categories:

1= Transient error- reported once.
2= Non-Transient error- reported every poll until cleared, device still functional.
3= Non-Transient error- reported every poll until cleared, device not functional.

Transient error handling*:* The error will be reported to the VMC until it is ACKed. The error state will be cleared in the device, and normal operation will continue.

Non-Transient error handling*:* The error will be reported to the VMC at each poll as long as the error exists. If the device is still functional, multi-message responses will allow normal responses in addition to the error.

The Event Log may also contain Events which are not errors, such as a change of configuration, which may be useful for Diagnostics. These are recorded in the same way the Diagnostic Errors are, and are logged in order of occurrence in relation to Diagnostic Errors as well as each other. If an Event is logged, the Audit Device will respond to a VMC Poll command with a Event Occurred message.

The VMC may issue a Diagnostic/Send Event Log command at any time to receive the Event Log from the Level 02 Audit Device. The Diagnostic/Send Event Log command should usually be sent only after the VMC has received a Diagnostic Error or Event Occurred response from the Audit Device to a VMC Poll command.

The VMC may also issue at any time a Diagnostic/Reset Event Log command. When it has received this command, the Level 02 Audit Device will then immediately set all Event Log entries to zero. The Event Log should only be reset following a Diagnostic/Reset Event Log command, and the Level 02 Audit Device must never clear the Event Log on its own.

The Alarm Optional Feature

A Level 02 Audit Device which is able to handle alarms from the VMC will have bit b0 set (1) in its Expansion/Optional Features bytes. The VMC indicates to the Level 02 Audit Device it will use this feature by setting the b0 bit in the Expansion/Feature Enable command. Then the VMC may send alarm messages to the Level 02 Audit Device, which may then use that data as needed. See the Expansion/Alarm command description for usage.

The Compact Audit Data Format

The Compact Audit Data Format is a way of compressing the audit data transmitted between the VMC to the Level 02 Audit Device. A Level 02 Audit Device which is able to communicate to the VMC with Compact Audit Data will have bit b1 set (1) in its Expansion/Optional Features bytes **(*Note: This Format must be written and adopted by NAMA in future. This bit is reserved by NAMA until that time)*.** To use this feature, it must be enabled by the VMC through the Expansion/Feature Enable command. Then the VMC may communicate data to and from the Level 02 Audit Device using the Compact Audit Data Format. See the Compact Audit Data Format Specification for usage.

8.2 VMC Commands

Level 01 Audit Device Commands

Level 01 Audit Devices specify the following commands for basic audit functions:

VMC Command	HEX Code	Description
Reset	18H	Command for Audit Device to self-reset.
Setup	19H	Request for Audit Device setup information.
Disable	1B/00H	Command to disable Audit device.
Enable	1B/01H	Command to enable audit device.
Transmit	1CH	Command for sending audit data to the Audit Device

Level 02 Audit Device Commands

Level 02 Audit Devices include the following commands in addition to the basic commands specified for Level 01 Audit Devices, with an addition to the functional description of the Enable and Disable commands.

VMC Command	HEX Code	Description
Reset	18H	Command for Audit Device to self-reset.
Setup	19H	Request for Audit Device setup information.
Poll	1AH	Request for current Audit Device Status.
Disable/Deny Request	1B/00H	Command to disable/deny a request of the Audit Device.
Enable/Grant Request	1B/01H	Command to enable/grant a request of the audit device.
Unable to Comply	1B/02H	Command to indicate to the Audit Device the inability of the VMC to comply with its request.

End Of Transmission (EOT)	1B/03H	Command to mark the end of a transmission of audit data to the Audit Device.
Transmit	1CH	Command for sending audit data to the Audit Device
Receive	1DH	Command for receiving configuration information from the Audit Device.
Diagnostic/Status	1E/00H	Request for current Audit Device status.
Diagnostic/Send Event Log	1E/01H	Request to receive the Event Log from the Audit Device.
Diagnostic/Reset Event Log	1E/02H	Command to reset the Event Log of the Audit Device.
Expansion/Optional Features	1F/00H	Request for Optional Features of the Audit Device.
Expansion/Feature Enable	1F/01H	Command to enable/disable the Optional Features of the Audit Device.
Expansion/Alarm	1F/02H	Command to alert the Audit Device of an alarm condition in the vending machine.
Expansion/Diagnostic	1F/FFH	Command to factory configure and test the Audit Device.

8.3 VMC Command Format

VMC	CODE	AUDIT DEVICE RESPONSE
Reset	18H	ACK

This command is the vehicle the VMC uses to tell the device that it must return to default operating mode. All communications must be aborted with the exception of an ACK. The device must disable until otherwise instructed by the VMC.

VMC	CODE	AUDIT DEVICE RESPONSE
Setup	19H	Z1-Z30

Z1 = Audit device feature level

Indicates the feature level of the device to the VMC.

Current Feature Levels are 01 and 02.

Z2-Z4 = Manufacturer code

Identification code for the equipment supplier. Sent in ASCII characters. Currently defined codes are listed in the **EVA** document entitled "***European Vending Association Data Transfer Standard***" (**EVA-DTS**), the Audit Data Lists section, sub-section 2, "Manufacturer Codes".

Z5-Z16 = Serial Number

Factory assigned serial number. All bytes must be sent as ASCII characters, zeros (30H) and blanks (20H) are acceptable.

Z17-Z28 = Model number

Manufacturer assigned model number. All bytes must be sent as ASCII characters, zeros (30H) and blanks (20H) are acceptable.

Z29-Z30 = Software Version

Current software version. Must be sent in packed BCD.

Z31 = Maximum Non-Response Time in seconds (binary)

Maximum time for which the Level 01 Audit Device will not respond to a command from the VMC with an ACK, NACK, or the appropriate message.

VMC	CODE	AUDIT DEVICE RESPONSE
Poll	1AH	Z1-Zn

This poll command is used by the VMC to obtain information from the audit device. An ACK indicates the device is enabled and no errors exist. More than one Audit Device response may be sent at a time, up to the MDB block limit of 36 bytes. The responses are:

Z1=00H No information requested.

Z1=01H Request complete audit information.

Z1=02H Request individual Audit Field. In this case, Z2-Zn is an individual ASCII formatted Audit Record code listed in the Audit Data Dictionary of the **EVA-DTS**. Only one record may be requested at a time, and the 02H request can only be sent by itself. Inclusion of the field name in the Transmission from the VMC allows the Level 02 Audit Device to verify that the correct field was sent.

One exception that must be made is for the PA2-PA6 series of fields. Since these fields have no reference unless preceded by the PA1 field, the request for these records must be preceded by a request for a PA1 field. This request must include a '*' and the number of the product desired. The VMC is responsible for automatically sending the PA1 field before any of the PA2-PA6 fields, as data verification. The VMC will respond to all requests for PA2-PA6 fields by sending the field belonging to the last set product number. To get fields for a different product number, PA1 must first be requested for that product number. The Level 02 Audit Device may also request all of the PA1-PA6 fields by only requesting PA1.

Example: The Level 02 Audit Device requests the PA5 field for product #4 by responding to a Poll command with:

```
02 50 41 31 2A 34 22     Request to set product number to 4
   P  A  1  *  4
```

The VMC will respond by sending a Transmit command (1CH) followed by the PA1 field for product #4, and then a second Transmit command followed by the PA5 field for product #4. If the Level 02 Audit Device wants to know what product numbers are available, it can request just PA1:

```
02 50 41 31 C4  Request for product numbers and information
   P  A  1
```

and the VMC will respond by sending all of its PA1-PA6 information for all product in the vending machine.

Z1=03H Request to upload vender with configuration data.

Z1=04H Diagnostic Error.

Z1=05H Status Change.

Z1=06H Event Occurred.

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
Disable/ Deny Request	1B/00H	ACK

The Audit Device is disabled and does not accept data transmissions from the VMC, *or*

The VMC is busy and can't service audit device request.

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
Enable/ Grant Request	1B/01H	ACK

The Audit Device is enabled and must be ready to accept data transmissions from the VMC, *or*

The VMC grants the audit device request.

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
Unable to Comply	1B/02H	ACK

The Audit Device has made a request which the VMC cannot Comply with.

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
End Of Trans-mission (EOT)	1B/03H	ACK

It is interpreted as an End Of Transmission command by the Audit Device. It is sent by the VMC only after the following sequence of events takes place:

1. VMC issues a Poll command.
2. Audit Device responds with a Request for Transfer of Audit Data.
3. VMC responds with a Grant Request.

VMC	CODE	VMC AUDIT DATA
Transmit	1C	Z1-Zn

Z1-Zn = The data format to be transmitted by the VMC to the audit device must follow the data delimiting standards as presented in the Audit Data Dictionary of the **EVA-DTS**. The data is to be made up of only one Vending DTS field per issuance of the command.

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
Receive	1DH/Y1	Z1-Z35

Y1 = Packet Number Requested (binary)

The packet number which the VMC is ready to receive. The VMC must start with packet 00H. If the VMC does not correctly receive the transmission, it requests the packet again by packet number.

Z1 = Packet Number Sent (binary)

The packet number which the Level 02 Audit Device is sending. The last packet sent is to be designated FFH.

Z2-Z35 = Data Packet

The data to be received by the VMC from the audit device must meet the **EVA-DTS**. Each set of packets must contain only one field of Configuration Data. If at any time the VMC does not correctly receive the packet, it must request that packet again until correctly received, only then proceeding to the next packet. If the VMC does not receive the last packet (designated FFH), the VMC will request it again using the packet number that the VMC sent when it received the FFH designation.

Example: The Level 02 Audit Device has responded to a Poll command (1AH) with a request to upload configuration data (03H). The VMC then issues a Receive command for the first packet, and the Level 02 Audit Device transmits it:

VMC: 1D 00 1D
L2AD: 00 (data Z2-Z35) (checksum)

The VMC then requests the next packets, until it receives an FFH packet number. If at any time the VMC does not correctly receive a packet, it will request that packet again until properly received, before proceeding to the next packet:

VMC: 1D 01 1E Receive command and checksum
L2AD: 01 (data Z2-Z35) (checksum) Packet 01
VMC: 1D 02 1F Receive command and checksum
L2AD: 02 (data Z2-Z35) (bad checksum) Packet 02
VMC: 1D 02 1F Request retransmit of last packet
L2AD: 02 (data Z2-Z35) (checksum) Packet 02 (correctly received)
VMC: 1D 03 20 Receive command and checksum
L2AD: FF (data Z2-Z35) (checksum) Last Packet

If the VMC did not correctly receive the last packet, the VMC requests it again, using the original packet number:

VMC: 1D 03 20 Receive command and checksum
L2AD: FF (data Z2-Z35) (checksum) Last Packet

VMC	**CODE/SUB-CODE**	**AUDIT DEVICE RESPONSE**
Diagnostic/Status	1E/00H	Z1-Z2

Z1-Z2 = Current Status data.

The device reports its current operational status using a two byte code, with Z1 as the Status Code and Z2 as the Status Subcode. The basic Status Codes and Subcodes must be defined for all devices, with additional codes allowed for individual manufacturer's use.

VMC	**CODE/SUB-CODE**	**AUDIT DEVICE RESPONSE**
Diagnostic/ Send Event Log	1E/01H	Z1-Z32

Z1-Z20 = Event Log data.

The device reports the last sixteen events or errors stored in its Event Log. Each event or error is indicated by two bytes, an Event Code and an Event Subcode. Responses Z1-Z2 are the most recent Events in the Log. Responses Z31-Z32 are the oldest Events in the Log. The basic Event Codes and Subcodes must be defined for all devices, with additional codes allowed for individual manufacturer's use. Unsent events are assumed to be zero (i.e., no error or event).

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
Diagnostic/ Reset Event Log	1E/02H	ACK

This command requests the device to reset its Event Log.

VMC	CODE/SUB-CODE	AUDIT DEVICE RESPONSE
Expansion/ Optional Features	1F/00H	Z1-Z4

Z1-Z4 = Optional Features bytes

The device reports back to the VMC any optional features it may have. The bytes are an array of bits, one bit per feature:

b31 b30 b29 ... b2 b1 b0
Z1 ... Z4

Each bit is set (1) if the feature is present and cleared (0) if the feature is not present. Currently defined optional features are:

b0 - Level 01 Data Requested: The Level 02 Audit Device requires that Level 01 be sent to it. If this bit is cleared (0), the VMC will not automatically transmit the Level 01 status messages to the Level 02 Audit Device as each trigger event occurs.

b1 - Alarm: The Level 02 Audit Device is capable of receiving and acting on Alarm messages sent by the VMC.

b2 - Compact Audit Data: The Level 02 Audit Device is capable of receiving and decoding the Compact Audit Data Format (*Reserved for future use)*.

VMC	CODE/SUB-CODE	VMC TRANSMITTED DATA
Expansion/ Feature Enable	1F/01H	Z1-Z4

Z1-Z4 = Feature Enable bytes

The VMC enables any optional features the Level 02 Audit Device has that the VMC wants to use. The bytes are an array of bits, one bit per feature:

b31 b30 b29 ... b2 b1 b0
Z1 ... Z4

Each bit is set (1) if the feature is to be enabled and cleared (0) if the feature is to be disabled. Currently defined optional features are:

b0 - Level 01 Data Requested: This feature cannot be enabled or disabled, so this bit must always be sent as cleared (0).

b1 - Alarm: The VMC indicates to the Level 02 Audit Device that it will send Alarm messages to that Audit Device.

b2 - Compact Audit Data: The Level 02 Audit Device will decode any data sent to it by the VMC as data in the Compact Audit Data Format (*Reserved for future use)*.

The Level 02 Audit Device must disable all of its Optional Features until enabled by the VMC using this command.

VMC	CODE/SUB-CODE	VMC TRANSMITTED DATA
Expansion/Alarm	1F/02H	Z1-Z16

The VMC Alarm Data is sent a byte codes, with multi-message format allowing for up to 16 Alarm Events to be transmitted in a single message. The message must contain 16 bytes, with unused bytes sent as 00H. The following messages are defined:

Code	Alarm Event
01H	Door Opened
02H	Lock Tampered With
03H	Coin Mechanism No Longer Responding
04H	Bill Validator No Longer Responding
05H	Card Reader No Longer Responding
06H	Cash Box Removed
07H	Machine Received Mechanical Shock
08H	Internal Liquid Present (Rain or Salt Water)
09H-FEH	Currently Undefined
FFH	User-Defined Condition. The “FF” code is followed by one byte which itself contains the User-defined condition code.

Example of Alarm Message: A VMC which detects its Lock Tampered With, the Door Opened, a User-Defined condition defined as code “23”, and then the Cash Box Removed would send the following message to the Level 02 Audit Device:

1F 02 02 01 FF 23 06 00 00 00 00 00 00 00 00 00 00 4C

where the final “4C” is the checksum. Note that the “FF” is followed by *only one* User-Defined condition code. If more than one User-Defined condition is detected, each must be preceded by an “FF”. Also note that a *maximum* of 16 Alarm Events may be sent, with User-Defined Condition messages consuming two Alarm Event spaces.

When the Level 02 Audit Device successfully receives an Alarm Event message from the VMC it must reply with an ACK. If the VMC does not receive an ACK, it must continue to repeat the Alarm Event message until it does.

VMC	CODE/SUB-CODE	VMC TRANSMITTED DATA
Expansion/ Diagnostic	1F/FFH	Z1-Zn

This command is used to allow manufacturer-specific instructions to be sent to the Level 02 Audit Device through the VMC. This command is not to be used outside of the factory. It is for use in factory setup and test only.

Z1-Zn = These bytes are to be used as manufacturer-specific instructions for setup and test of the Level 02 Audit Device in the factory.

8.4 Dictionary of Level 01 EVA-DTS Fields

The following list is the subset of fields (contained in the Audit Data Dictionary of the **EVA-DTS** which are accepted by the Level 01 Audit Device. The list is presented as both the block identifier and the description of the Audit Data which is contained in that field. Two fields are newly proposed here in order to complete the desired Audit Data set. Their definitions follow the Dictionary.

Audit Data	Block Identifier	Description
coin accepted	CA1801	Coin accepted, to tubes or cash box. (New Field)
coin dispensed	CA1201	Coin dispensed by Coin Changer.
bill accepted	CA1401	Bill stacked by Bill Acceptor.
token accepted	TA701	Token accepted by Changer or Bill Val.
debit cash accepted	DA801	Debit Cash used in Vend. (New Field)
product ID	PA101,PA102	Product Key Number, Product Price. These must be sent before any other PA fields so as to identify the product those fields refer to.
product vended	PA601	Product Column Number for Product Vended. (New Field)
event incidence	EA2*DO	Door Opened (New Identifier)
	EA2*DC	Door Closed (New Identifier)
	EA2*COINR	Coin Rejected (New Identifier)

EA2*BILLR	Bill Rejected	(New Identifier)
EA2*CARDR	Card Rejected	(New Identifier)
EA2*ER	General Error	(New Identifier)
EA2*ERxxyy	Peripheral Error	(New Identifier)
EA2*SOxxx	Column Soldout	(New Identifier)
EA2*CJxxx	Column Jammed	(New Identifier)
EA2*INEX	VMC entered exact change state	(New Identifier)
EA2*OUTEX	VMC exited exact change state	(New Identifier)

8.5 Examples of a Level 01 & 02 Audit Device Sessions

Examples of a Level 01 Audit Device Session

The following is an example of the operation of a Level 01 Audit Device. In the narrative, transmissions from the VMC will be preceded by **VMC:** and transmissions from the Level 01 Audit Device will be preceded by **L1AD:**. ASCII equivalents will appear below the messages when appropriate. ASCII blank characters (20H) will be denoted by "_". Blank spaces will be inserted in this example between individual bytes transmitted to improve readability.

Example 1: Initialization and Setup
On power-up, the vender will attempt to reset the Level 01 Audit Device. Since the Level 01 Audit Device responds with an ACK, the VMC requests setup information, and the Level 01 Audit Device responds with a (imaginary) manufacturer code "MDB", a serial number "12345_6789_02", model number "000000000001", and software version "01". Once the VMC has received this information and the VMC is ready to operate, it enables the Level 01 Audit Device.

VMC:	18 18	Reset and checksum
L1AD:	00	ACK
VMC:	19 19	Setup and checksum
L1AD:	01 4D 44 42 31 32 33 34 35 20 36 37 38 39 20 30 32 30 30 30 30 30 30 30 30	
	M D B 1 2 3 4 5 _ 6 7 8 9 _ 0 2 0 0 0 0 0 0 0 0	
	30 30 31 01 95	Setup information and checksum
	0 0 1	
VMC:	00	ACK of setup data
VMC:	1B 01 1C	Enable and checksum
L1AD:	00	ACK

Example 2: Cash Vend and Sellout of Column
Once the Level 01 Audit Device has been enabled, it must be ready to recognize and store any audit data sent by the VMC. In this example, a customer inserts a $0.25 coin and a $1.00 bill and selects button 2 (column 3), which has a $1.05 product price. The VMC vends the product, which sells out the column, returning $0.20 change (two $0.10 coins). The sequence of messages follows (including checksums at the ends of messages):

VMC:	1C 43 41 31 31 2A 30 2A 32 35 ED C A 1 8 * 0 * 2 5	Accepted $0.25 coin to tubes
L1AD:	00	ACK
VMC:	1C 43 41 31 34 2A 31 30 30 C0 C A 1 4 * 1 0 0	Accepted $1.00 bill
L1AD:	00	ACK
VMC:	1C 50 41 31 2A 32 2A 31 30 35 FA P A 1 * 2 * 1 0 5	Vended from button 2 at $1.05 price
L1AD:	00	ACK
VMC:	1C 50 41 36 2A 33 40 P A 6 * 3	Vended from column 3
L1AD:	00	ACK
VMC:	1C 45 41 32 2A 53 4F 30 33 03 E A 2 * S O 0 3	Column 3 sold out
L1AD:	00	ACK
VMC:	1C 43 41 31 32 2A 31 30 8E C A 1 2 * 1 0	Dispensed $0.10 coin
L1AD:	00	ACK
VMC:	1C 43 41 31 32 2A 31 30 8E C A 1 2 * 1 0	Dispensed $0.10 coin
L1AD:	00	ACK

Example 3: Door Cycle and Debit Vend
Following the vend, a route person opens the vending machine, refills it, closes the door, and leaves. Then another customer uses a debit card to make a $1.50 purchase from button 1 (column 1).:

VMC:	1C 45 41 32 2A 44 4F 91 E A 2 * D O	Door opened
L1AD:	00	ACK
VMC:	1C 45 41 32 2A 44 43 85 E A 2 * D C	Door closed
L1AD:	00	ACK
VMC:	1C 44 41 38 2A 31 35 30 99 D A 8 * 1 5 0	Debit cash of $1.50 was used in a vend
L1AD:	00	ACK
VMC:	1C 50 41 31 2A 31 2A 31 35 30 F9 P A 1 * 1 * 1 5 0	Vended from button 1 at $1.50 price
L1AD:	00	ACK
VMC:	1C 50 41 36 2A 31 3E P A 6 * 1	Vended from column 1
L1AD:	00	ACK

Examples of Level 02 Audit Device Sessions
The following are examples of the operation of a number of different Level 02 Audit Devices. The scope of behavior encompassed by Level 02 Audit Devices should become apparent after reading these examples. Note that all the Level 01 Audit Device examples apply to Level 02 Audit Devices. In the narrative, transmissions from the VMC will be preceded by **VMC:** and transmissions from the Level 02 Audit Device will be preceded by **L2AD:**. ASCII equivalents will appear below the messages when appropriate. ASCII blank characters (20H) will be denoted by "_". Blank spaces will be inserted in this example between individual bytes transmitted to improve readability.

Example 1: Initialization and Setup

Initialization and setup for the Level 02 Audit Device is identical to those steps for the Level 01 Audit Device, with the exception of indicated device level. On power-up, the vender will attempt to reset the Level 02 Audit Device. Since the Level 02 Audit Device responds with an ACK, the VMC requests setup information, and the Level 02 Audit Device responds with a (imaginary) manufacturer code “MDB”, a serial number “12345_6789_02”, model number “000000000001”, and software version “01”. The VMC then issues the Expansion/Optional Features command. The Level 02 Audit Device responds with its Optional features bytes, indicating that it Requests Level 01 Data and is capable of receiving Alarm messages (bits b0 and b1 are set). The VMC then enables the Alarm Optional Feature using the Expansion/Feature Enable command. Once the VMC has received this information and the VMC is ready to operate, it enables the Level 02 Audit Device.

VMC:	18 18	Reset and checksum
L2AD:	00	ACK
VMC:	19 19	Setup and checksum
L2AD:	02 4D 44 42 31 32 33 34 35 20 36 37 38 39 20 30 32 30 30 30 30 30 30 30 30 M D B 1 2 3 4 5 _ 6 7 8 9 _ 0 2 0 0 0 0 0 0 0 0 30 30 31 01 96 0 0 1	Setup information and checksum
VMC:	00	ACK of setup data
VMC:	1F 00 1F	Expansion/Optional Features and checksum
L2AD:	00 00 00 03 03	Optional Feature bytes and checksum
VMC:	00	ACK of Optional Feature bytes
VMC:	1F 01 00 00 00 02 22	Expansion/Feature Enable and checksum
L2AD:	00	ACK of Feature Enable
VMC:	1B 01 1C	Enable and checksum
L2AD:	00	ACK

Example 2: Simple Level 02 Audit Device
This device is a Level 02 Audit Device which asks for individual data fields in addition to collecting the Level 01 audit data sent by the VMC. In this example, first the steps indicated in Example 1 take place (initialization as a Level 02 Audit Device. Then the same sequence of events takes place as occurred in Example 2 from the Level 01 Audit Device Examples section. Level 02 Audit Devices must be polled in addition to being sent the Level 01 audit data as necessary. After all the VMC data in the example is sent, the VMC polls the Level 02 Audit Device. The Level 02 Audit Device replies by requesting a system date/time report to time-stamp the transaction. The VMC replies with a date 3/24/97 and time 2:45 PM (14:45):

VMC:	1A 1A	Poll and checksum
L2AD:	02 49 44 35 C4 I D 5	Request field ID5 and checksum
VMC:	1C 49 44 35 2A 39 37 30 33 32 34 2A 31 34 34 35 39 I D 5 * 9 7 0 3 2 4 * 1 4 4 5	ID5 field
L2AD:	00	ACK

As a second scenario, if the VMC is incapable of sending the ID5 field, it will respond with an unable to comply message:

VMC:	1A 1A	Poll and checksum
L2AD:	02 49 44 35 C4 I D 5	Request field ID5 and checksum
VMC:	1B 02 1D	Unable to Comply and checksum
L2AD:	00	ACK

In this way the Level 02 Audit Device can be informed that the VMC does not keep such information and the Level 02 Audit Device has the option of not requesting that field form the VMC again.

Example 3: Gateway Device
This device completely ignores the Level 01 audit data sent to it (except for ACKing) because it has no internal intelligence. Its function is to simply act as a gateway to the Information System (IS). When the IS requests audit data from the Level 02 Audit Device (this step not shown), the Level 02 Audit Device in turn requests a full audit from the VMC. The VMC grants the request and then transmits all of its internal data one field at a time until it is done. When the VMC has completed its transmissions, it sends an End of Transmission (EOT) message to the Level 02 Audit Device:

VMC:	1A 1A	Poll and checksum
L2AD:	01 01	Request for complete audit information and checksum
VMC:	1B 01 1C	Grant request and checksum
L2AD:	00	ACK
VMC:	1C 50 43 31 2A 31 2A 31 30 30 F6 P C 1 * 1 * 1 0 0	First field and checksum
L2AD:	00	ACK
VMC:	1C 50 43 31 2A 32 2A 35 30 CB P C 1 * 2 * 5 0	Second field and checksum
L2AD:	00	ACK
...		

VMC:	1C 50 41 35 2A 39 37 30 32 32 36 2A 30 39 32 34 2A 35 9E	Last field
	P A 5 * 9 7 0 3 2 6 * 0 9 2 4 * 5	
L2AD:	00	ACK
VMC:	1B 00 1B	EOT and checksum
L2AD:	00	ACK

Note that if the Level 02 Audit Device code on the VMC is written correctly, the VMC can continue to poll all other MDB devices in between transmit messages and proceed with normal operation while the full audit is taking place.

8.6 Audit Device Non Response Time

The maximum non-response time the Audit Device is 5 seconds. This is the maximum time the Audit Device will not respond to a command with a ACK, NACK or a data message.

8.7 Audit Device Power Requirements

The current draw for any audit device must meet the following power requirements. All measurements are at the minimum VMC voltage output.

Current Requirements = 200 mA maximum

Section 9

Universal Satellite Device (USD)
VMC/Peripheral Communication Specifications

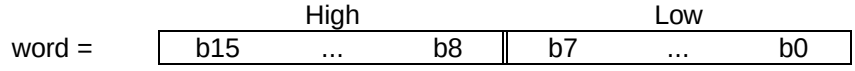
9.1 Introduction

An MDB Universal Satellite Device (USD) is a vending device which lacks customary credit acceptance peripherals. As such, a USD must rely on a host vending machine controller (VMC) to establish credit sufficient to perform a vend. The specification herein describes a protocol by which a USD and a VMC exchange messages and credit via the MDB bus.

9.1.1 Definitions

This section defines the non-response and application response time, base addresses, and the communication bytes sent by the MDB Universal Satellite Device (USD) and a Vending Machine Controller.

- The default maximum non-response time of the USD is 5 seconds.
- The default maximum application response time of the USD is 5 seconds.
- Three consecutive USD base addresses are defined to allow multiple USDs to operate simultaneously from a single VMC
- USD Base addresses are as follows: 01000xxx (40 hex), 01001xxx (48 hex), and 01010xxx (50 hex).
- The specification defined herein assumes a USD base address of 40 hex in all examples. It should be understood that differing USD base addresses will follow the same command format.
- Multi-message responses to a single command are supported. Message length is subject to the 36 byte limit imposed by the MDB standard.
- Unless stated otherwise, all byte information contained herein is assumed to be in a binary format.
- Y_n represents bytes transmitted by the VMC, and Z_n are bytes transmitted by the USD.
- When words are referenced, they consist of two bytes with the higher order byte first.



9.2 USD Summary

This section is a summary of the USD command set and an overview of the modes of operation.

9.2.1 Command Summary

Command	Hex Code	Description
RESET	40	Command for USD to self-reset.
SETUP	41	Command to configure USD to VMC requirements.
POLL	42	Command to request for USD activity status.
VEND	43	Command for vend approve / deny.
FUNDS	44	Command to send funds available or to set prices.
CONTROL	45	Command to enable/disable USD.
EXPANSION	47	Command to allow addition of features and enhancements.

9.2.2 Overview

The USD Command set described herein allows USDs' to be controlled under the following three modes of operation. The USD's mode of operation is determined by the USD's configuration byte[1] and the sequence of commands the VMC uses.

Mode One VMC is used to select items to be vended from the USD and the VMC contains all pricing information. The USD receives vend requests from the VMC and reports vend success or failure.

Mode Two The USD or the VMC may select items to be vended. The USD may have special requirements for price and/or selection ID display. In this case, the USD may issue a **FUNDS** request to retrieve this information. The USD must then issue a **VEND** request to gain approval from the VMC before a vend can take place.

[1] Configuration byte refers to byte Z31 of the sequence Z31 through Z34 of the expansion 07 command. Please refer to page 9.12 for more information on how this byte influences the USD's mode of operation.

Mode Three The USD selects items to be vended and has its own pricing information. The USD must issue an vend request to the VMC and gain approval before a vend can take place.

9.3 Command Protocol

This section contains the complete command set relating to the USD.

9.3.1 RESET

Command	Code	VMC Data	USD Response data
RESET	40	No data bytes.	ACK

The **RESET** command is the vehicle that the VMC should use to instruct the USD to return to its default (power on) operating mode. The USD should respond to a reset command with an ACK to acknowledge receipt of the reset command. The USD must not accept any vend requests until the VMC issued setup command sequence has been completed.

The USD must also respond to the VMC issued “master reset” which resets all MDB peripheral devices. The VMC causes a master reset by transmitting a continuous break condition for a minimum of 100 milliseconds.

To ensure proper initialization, the USD should issue a “just reset” (see **POLL** response **00**) whenever it’s pricing or configuration has changed.

9.3.2 SETUP

Command	Code	VMC Data	USD Response Data
SETUP	41	5 bytes: Y1-Y5	7 bytes: 04 + Z1 - Z6

The **SETUP** command is the vehicle that the VMC should use to configure the USD for feature level, credit scaling factor, display decimal place, and maximum vend approve/deny time. The USD responds to this command by returning it’s feature level, highest vend price (divided by the scaling factor), selection configuration, and maximum application response time.

Alternatively, if the USD is not prepared to render a full response to the **SETUP** command, it may reply with an ACK. If this occurs, the USD must transmit it’s setup data later, in response to a **POLL** command (see **POLL** command, response **04**). Until the **SETUP** command has been received by

the USD, and the USD has correspondingly returned it's own setup data to the VMC, all vend requests will be disallowed.

Data sequence transmitted by the VMC to the USD during SETUP

VMC Data	Meaning or interpretation
Y1 =	VMC Feature level, Indicates current feature level of the VMC. Currently defined level is one.[2]
Y2 - Y3 =	Scaling factor 2 bytes (word). All transactions with the USD must be evenly divisible by this number.
Y4 =	Decimal place (02=US). Indicates the position of the decimal place on the USD's optional credit display
Y5 =	VMC maximum approve / deny time in seconds, FF = 255 seconds.

Data sequence transmitted by the USD to the VMC during SETUP

USD Response	Meaning or interpretation
04 + Z1 =	USD Feature level, indicates current feature level of the USD. Currently defined level is one.[3]
Z2 - Z3 =	Maximum price on USD in 2 bytes (word). Indicates the highest priced item on the USD.[4] USD should return FF FFh if it does not have internal pricing capability.
Z4 - Z5 =	Numeric row (Z4) and column (Z5) configuration (Binary).
Z6 =	USD maximum application response time in seconds, FF = 255 seconds.

[2] Feature level of the VMC is sent to allow the USD to arbitrate command compatibility with the VMC.
[3] Feature level of the USD is sent to allow the VMC to arbitrate command compatibility with the USD. The USD may opt to send this data later in response to a POLL.
[4] The maximum price on the USD is returned to the VMC so this price can be used in the computation of maximum credit acceptance.

9.3.3 POLL

Command	Code	USD response Data	USD Response Description
POLL	42	00	USD has just been reset, or wishes to be reset by the VMC.
		01 **+** 4 bytes Z1- Z4	Vend request, USD requests approval to vend a specified item from VMC.
		02	Vend or home success, requested vend or home was successful.
		03 **+** 4 bytes Z1 - Z4	Vend or home fail, requested vend or home has failed. Reason for failure is returned.
		04 + 6 bytes Z1 - Z6	USD configuration and setup data.
		05 + 2 bytes Z1 - Z2	USD item price request.
		06 + 2 bytes Z1 - Z2	USD Error codes.
		07 + 34 bytes Z1 - Z34	USD Peripheral ID string.
		08 + 4 bytes Z1 - Z4	USD Status response.
		09 + *n* bytes Z1 - Z*n*	USD multiple data block transfer response.
		0A + n bytes Z1 - Zn	USD single data block response
		FF + Z1 - Z*n*	USD Diagnostic response.

The **POLL** command is used by the VMC to obtain status information from the USD. The same command is used by the USD to indicate a reset, request a vend, indicate vend success, indicate the reason for a vend failure, request the price of an item, send configuration and/or error data, return the USD's peripheral identification string, control the transmission and reception of data blocks, return a status and/or diagnostic response.

The USD responds to the **POLL** command with either an ACK, or a multi-byte response if there is more information to convey.

Data sequence transmitted by the USD to the VMC after a *Reset Request*

USD Response	Meaning or interpretation
00	The 00 response indicates that the USD has just been reset or wishes to be reset[5].

Data sequence transmitted by the USD to the VMC for a V*end Request*

USD Response	Meaning or interpretation
01 + Z1- Z2 =	Selection in 2 bytes. Indicates the product to be vended by numeric row (Z1) and column (Z2) as part of a vend request.
Z3 - Z4 =	Scaled product price in 2 bytes (word). Indicates the price of the product to be vended divided by the scaling factor. A price of FFFF is transmitted if the USD does not contain price information.

Data sequence transmitted by the USD to the VMC after a V*end or Home success*

USD Response	Meaning or interpretation
02	Indicates that the requested vend or home was successful.

Data sequence transmitted by the USD to the VMC after a V*end or Home Fail*

USD Response	Meaning or interpretation
03 + Z1 - Z2 =	USD selection in numeric row (Z1) and column (Z2).
Z3 - Z4 =	Bits: b0 = Selection sold out. b1 = Selection motor / actuator jam. b2 = Non-existent motor / actuator. b3 = Invalid selection range[6]. b4 = Health safety error.

[5] The VMC is expected to reconcile whether the USD is transmitting a 00 in confirmation of a VMC issued reset that has just occurred, or as an unsolicited request to be reset. The context of the VMC's prior communication activity should be used in making this assessment.

	b5 - b15 = Not defined.

Data sequence transmitted by the USD to the VMC if *SETUP response delayed*

USD Response	Meaning or interpretation
04 + Z1 =	USD Feature level, Indicates current feature level of the USD. The currently defined level is one.[7]
Z2 - Z3 =	Maximum price on USD 2 bytes (word). Indicates the highest priced item on the USD.[8] USD should return FF FFh if it does not have internal pricing capability.
Z4 - Z5 =	Numeric row (Z4) and column (Z5) configuration.
Z6 =	USD maximum application response time in seconds, FF = 255 seconds.

Data sequence transmitted by the USD if the *USD needs pricing information*

USD Response	Meaning or interpretation
05 + Z1 - Z2 =	USD numeric row (Z1) and column (Z2) item identifier.

Data sequence transmitted by the USD if the *USD has a failure to report to VMC*

USD Response	Meaning or Interpretation
06 + Z1 - Z2 =	Bits: b0 = Health Safety violation. b1 = Home or Chute sensor failure b2 = Keypad or Selection switch failure b3 - b15 = Not defined.

[6] This error code is included to identify actuators that may not be present within the initially defined row and column configuration. See bytes Z4 and Z5 of the USD's setup response. This is typical in a snack machine implementation where some trays may not be populated with a full complement of motors and/or actuators.

[7] Feature level of the USD is sent to allow the VMC to arbitrate command compatibility with the USD. The USD may have elected to transmit this setup data in fulfillment of an earlier **SETUP** command.

[8] The maximum price on the USD is returned to the VMC so this price can be used in the computation of maximum credit acceptance.

Data sequence transmitted by the USD for peripheral ID

USD Response	Meaning or Interpretation
07 + Z1 - Z4 =	Manufacturer ID Code.
Z5 - Z16 =	USD Serial Number.
Z17 - Z28 =	USD Model Number.
Z29 - Z30 =	USD Software Version.
Z31 - Z34 =	Optional feature bits.

Data sequence transmitted by the USD to the VMC after a Status request

USD Response	Meaning or interpretation
08 + Z1 - Z2 =	USD selection by numeric row (Z1) and column (Z2).
Z3 - Z4 =	Bits: b0 = Selection sold out. b1 = Selection motor / actuator jam. b2 = Non-existent motor / actuator. b3 = Invalid selection range. b4 = Health safety error. b5 - b15 = Not defined.

Data sequence transmitted by the USD to the VMC after a USD data transfer command

USD Response	Meaning or interpretation
09 + Z1 =	Z1 = 00 USD requests to receive data block Z2 from VMC Z1 = 01 USD requests to send Z2 data block(s) to VMC Z1 = 02 USD data block response where: Z2 = data block number Z3 - Z*n* = contents of data block
Z2 =	Z2 = Block number USD requests to receive if Z1 = 00 Z2 = Number of blocks the USD requests to send if Z1 = 01 Z2 = Block number the USD is sending if Z1 = 02.
Z3 - Z*n* =	Contents of data block sent by USD to VMC if Z1 = 02

Data sequence transmitted by the USD to the VMC to send a single block of data

USD Response	Meaning or interpretation
0A + Z1 - Z*n*=	Z1 -Z*n* = Arbitrary data to be received by the VMC. The number "*n*" must be less than 35 per MDB standards

Data sequence transmitted by the USD to the VMC after a diagnostic command

USD Response	Meaning or interpretation
FF + Z1 - Z*n* =	Diagnostic response.

9.3.4 VEND

Command	Code	Sub-Cmd	VMC Data	Response Data
VEND	43	00	none	none
	43	01	none	none
	43	02	2 bytes Y1-Y2	none
	43	03	2 bytes Y1-Y2	none
	43	04	2 bytes Y1-Y2	5 bytes: 08 + Z1 - Z4

The **VEND** command is the vehicle that the VMC uses to signal vend approval or disapproval in response to a USD issued vend request (**POLL** response 01). The VEND command can also be used by the VMC to initiate a vend, home a selection, or query the status of a selection on the USD.

Sub Cmd:	Meaning or interpretation
00 =	Requested vend approved.
01 =	Requested vend disapproved.
02 =	Vend specified USD selection numeric row (Y1) and column (Y2).
03 =	Home specified USD selection numeric row (Y1) and column (Y2).
04 =	Request status of specified USD numeric selected row (Y1) and column (Y2).

Data sequence transmitted by the USD to the VMC after a Status request

USD Response	Meaning or interpretation
08 + Z1 - Z2 =	USD selection row (Z1) and column (Z2).
Z3 - Z4 =	Bits: b0 = Selection sold out. b1 = Selection motor / actuator jam. b2 = Non-existent motor / actuator. b3 = Invalid selection range. b4 = Health safety error. b5 - b15 = Not defined.

9.3.5 FUNDS

Command	Code	Sub-Cmd	VMC Data	Response Data
FUNDS	44	00	2 bytes: Y1-Y2	none
	44	01	6 bytes: Y1-Y6	none

The **FUNDS** command is the vehicle the VMC should use to specify the funds available for vending. The **FUNDS** 00 command is issued by the VMC whenever the level of credit changes. Typically, the USD would display the credit information returned by a **FUNDS** 00 command on a credit display. The **FUNDS** 01 is issued by the VMC in response to an item price request (**POLL** response 05) by the USD.

Sub-Cmd	Meaning or interpretation
00 + Y1 - Y2 =	Funds available in 2 bytes (word), scaled by the coin scaling factor.

Sub Cmd	Meaning or interpretation
01 + Y1 - Y2 =	Selection numeric row (Y1) and column (Y2).
Y3 - Y4 =	Selection price in 2 bytes (word) scaled by coin scaling factor.
Y5 - Y6 =	Alphanumeric selection identifier 2 bytes (word), or FFFF if not available.[9]

9.3.6 CONTROL

Command	Code	Sub-Cmd	VMC Data	Response Data
CONTROL	45	00	none	none
	45	01	none	none

This command is the vehicle the VMC should use to enable or disable the USD.

Sub-Cmd	Meaning or interpretation
00	Disable USD.
01	Enable USD.

9.3.7 EXPANSION

Command	Code	Sub-Cmd	VMC Data	Response Data
EXPANSION	47	00	None	07 + Z1 - Z34 Peripheral ID string and feature bits.
	47	01	Y1 – Y4	none
	47	02	Y1	none
	47	03	Y1 - Y*n*	none
	47	04	Y1	09 + Z1 + Z2 - Z*n*
	47	05	Y1 - Y*n*	none
	47	FF	Diagnostics	Diagnostic response.

Data sequence transmitted by the USD to the VMC after an expansion 00 sub-command

[9] Alpha-numeric selection identifier is provided to the USD for display purposes only.

USD Response	Meaning or Interpretation
07 + Z1 - Z4 =	Manufacturer ID Code.
Z4 - Z15 =	USD Serial Number.
Z16 - Z27 =	USD Model Number.
Z28 - Z30 =	USD Software Version.
Z31 - Z34 =	Optional feature bits: b0 = USD is capable of storing and controlling pricing. b1 = USD is capable of selecting items to vend. b2 - b31 = Available for future use.

Sub-Command used by the VMC to enable optional feature bits on the USD

Sub-Cmd	Meaning or interpretation
01 + Y1 - Y4	Enable optional feature bits defined in Z31-Z34 above. Feature is enabled if bit is set to 1, all features are disabled after a reset.

Sub-Command used by the VMC to identify the number of data blocks it wishes to send to the USD

Sub-Cmd	Meaning or interpretation
02 + Y1	Number of data blocks the VMC has to send to the USD (Binary)

Sub-Command used by the VMC to transmit a data block to the USD (Y2-Y*n*) and to identify the current block number being transmitted (Y1)

Sub-Cmd	Meaning or interpretation
03 + Y1	Block number the VMC is transmitting to the USD
Y2 - Y*n*[10]	Data the VMC is transmitting to the USD

[10] The number "*n*" is limited by the MDB maximum message length of 36 bytes.

Sub-Command used by the VMC to request that the USD send or re-send data block number (Y1)

Sub-Cmd	Meaning or interpretation
04 + Y1	VMC requests USD to send block Y1

Sub-Command used by the VMC to send a single block of data to the USD

Sub-Cmd	Meaning or interpretation
05 + Y1 - Y*n*	VMC sends a single block of data consisting of Y1..Y*n*

Data sequence transmitted by the USD to the VMC after a diagnostic command

USD Response	Meaning or interpretation
FF + Z1 - Z*n* =	Diagnostic response.

9.4 USD Power Requirements

This section defines the maximum power requirements for a USD.

USD peripherals may draw power from the MDB bus or from an integral power supply. In such cases where the USD will require power from the MDB bus, the current draw must remain within the following limits:

USD Mode	Current draw
Idle	200 mA (maximum continuous)
Vending/Homing	1.75 A (for up to 10 seconds)

9.5 Examples – Mode 1 / 2 / 3 Sessions

This section contains three examples of USD sessions in which each of the three modes of USD operation are demonstrated operation respectively.

9.5.1 MODE ONE

In this example session the VMC selects the item to vend and knows the vend price. The USD receives the vend command, attempts the vend, and reports if the attempted vend failed or was successful.

VMC	MDB Data	Explanation	USD
⇒	**43+02+01+03**	VMC requests to vend item from row 1**,** column 3 of the USD.	
	<ACK>	USD acks vend request.	⇐
⇒	**42**	VMC polls the USD.	
	<ACK>	USD acks receipt of poll.	⇐
⇒	**42**	VMC polls the USD again .	
	02	USD responds: vend complete	⇐
⇒	**<ACK>**	VMC acks vend outcome.	

9.5.2 MODE TWO

In this example session the USD or the VMC can select items to vend but the USD may not be aware of the vend price of the item selected. If the USD needs the selected item price, it may request the item price from the VMC. The USD must then issue a **VEND** request, and wait for approval from the VMC before a vend is attempted. The VMC then approves or denies the requested vend and polls the USD for vend success or vend fail.

VMC	MDB Data	Explanation	USD
⇒	**42**	VMC polls the USD.	
	05+02+06	USD responds with pricing request for item at row 2, column 6.	⇐
⇒	**<ACK>**	VMC acks the USD price request.	
⇒	**44+01+02+06+00+14 +FF+FF**	Using the Funds command the VMC sends a price of 20 coin factors for item at row 2, column 6.	
	<ACK>	USD acks receipt of VMC price data.	⇐
⇒	**42**	VMC polls the USD.	
	01+02+06+FF+FF	USD responds with a request to vend item at row 2, column 6 at the VMC selected price.	⇐
⇒	**<ACK>**	VMC acks receipt of vend request.	
⇒	**43 + 00** or **01**	VMC approves or denies vend request.	
	<ACK>	USD acks receipt of approval or denial.	⇐
⇒	**42**	VMC polls the USD.	
	03+02+06+00+01	USD responds: vend fail, sold out.	⇐
⇒	**<ACK>**	VMC acks vend outcome.	

- The **FUNDS** command can be used by USD's which do not have internal prices but need pricing information for display purposes or for other reasons that are not required to complete a transaction.

9.5.3 MODE THREE

In this example session the USD selects the item to vend and is aware of the vend price of the item. The USD must issue a vend request and the VMC then approves or denies the requested vend. The VMC then polls the USD for vend success or vend fail.

VMC	MDB Data	Explanation	USD
⇒	**42**	VMC polls the USD.	
	01+03+02+00+1E	USD requests vend for item at row 3, column 2 with price of 30 coin factors.	⇐
⇒	**<ACK>**	VMC acks the USD vend request.	
⇒	**43+ 00** or **01**	VMC approves or denies vend request.	
	<ACK>	USD acks receipt of approval or denial.	⇐
⇒	**42**	VMC polls the USD.	
	02	USD responds: vend complete	⇐
⇒	**<ACK>**	VMC acks vend outcome.	

9.6 Examples - Data Block Transfers

This section contains two examples in which data blocks are transferred between the VMC and the USD and vice versa.

9.6.1 Data Block Transfer from VMC to USD

In this example the VMC wishes to send two data blocks to the USD. To do this, the VMC uses the expansion 02 command to advise the USD of it's request to send data and also to identify the number of data blocks it wishes to send. In response, the USD uses a poll 09 to request the transmission of a data block with the block number enumerated as part of it's poll response. The VMC then uses a different expansion command (03) to send the data to the USD.

VMC	MDB Data	Explanation	USD
⇒	**47+02+02**	VMC issues a request to send two data blocks to the USD	
	<ACK>	USD acks receipt of the request	⇐
⇒	**42**	VMC polls the USD	
	09+00+01	USD responds with a request to receive data block number 01 from the VMC	⇐
⇒	**<ACK>**	VMC acks receipt of block number	
⇒	**47+03+01+21+22+23**	VMC transmits block number 01 containing data: 21, 22, and 23.	
	<ACK>	USD acks receipt of the data block	⇐
⇒	**42**	VMC polls the USD.	
	09+00+02	USD responds with a request to receive data block number 02 from the VMC.	⇐
⇒	**<ACK>**	VMC acks receipt of the block number.	
⇒	**47+03+02+24+25+26**	VMC transmits block number 02 containing data: 24, 25, and 26.	
	<ACK>	USD acks receipt of the data block	⇐

9.6.2 Data Block Transfer from USD to VMC

In this example the USD wishes to send two data blocks to the VMC. To do this, the USD makes use of the Poll 09 command to inform the VMC of it's request to send data and also to identify the number of data blocks it wishes to send. In response, the VMC uses expansion 04 command to request the transmission of a data block by the individual block number. The USD then uses the poll 09 response to send the data blocks to the VMC.

VMC	MDB Data	Explanation	USD
⇒	**42**	VMC polls the USD	
	09+01+02	USD responds with a request to send 2 data blocks to the VMC	⇐
⇒	**<ACK>**	VMC acks request to send data	
⇒	**47+04+01**	VMC responds with a request to receive data block number 01 from the USD	
	<ACK>	USD acks receipt of block number request	⇐
⇒	**42**	VMC polls the USD	
	09+02+01+55+56+57	USD responds by transmitting block number 01 containing data 55, 56, and 57.	⇐
⇒	**<ACK>**	VMC acks receipt of data	
⇒	**47+04+02**	VMC responds with a request to receive data block number 02 from the USD	
	<ACK>	USD acks receipt of block number request	⇐
⇒	**42**	VMC polls the USD	
	09+02+02+58+59+60	USD responds by transmitting block number 02 containing data 58, 59, and 60.	⇐
⇒	**<ACK>**	VMC acks receipt of data	

Document Revision History:

Item:	Editor:	Rev. Date:	Comments:
1	JMC	7/26/97	Revision adopted as NAMA IMDB Spec.
2	JMC	10/7/97	Removed vertical edit bars from right margin. Revised text on page 12 per Bob Ross, MEI. Corrected reference in footer of page 3
3	RDR	10/14/98	Converted document to match new MDB format. **9.5 section title** and description paragraph changed. **9.6 section title** and description paragraph added.