NATIONAL AUTOMATIC MERCHANDISING ASSOCIATION

INTERNATIONAL MULTI-DROP BUS INTERFACE STANDARD

As Prepared by the
NAMA Vending Technology Standards Committee

American Edition

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International Multi-Drop Bus Interface Standard

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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 desirable.

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, or 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.

Section 1

General Information

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.

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 predefine 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.

Section 2

Communication Format

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	O	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. 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
OOH	Country code for USA
01 H	Country code for USA
05H	Coin scaling factor
02H	Decimal place
OOH	Coin type routing
07H	Coin type routing
01 H	Coin type O 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	OOH (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.

3. Peripheral Addresses

The addresses below are defined.

Address	Definition
OOOOOB	Reserved for future expansion
00001B	Changer
OOO1OB	Card Reader
00011B	Audit System
OO1OOB	Display
00101B	Energy Management System
00110B	Bill Validator
00111 B	Reserved for Future Standard Peripherals
.	
.	
11101B	Reserved for Future Standard Peripherals
1111OB	Vending Machine Specific Peripheral 1
11111B	Vending Machine Specific Peripheral 2

Vending Machine Specific peripheral addresses (addresses 1111OB and 1llllB) 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.

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.

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.

5. Typical Session Examples

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

VMC:

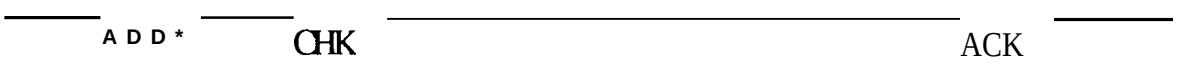
ADD* CHK

Peripheral:

ACK*

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

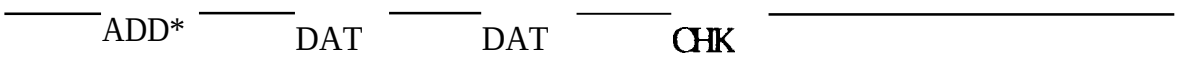
VMC:



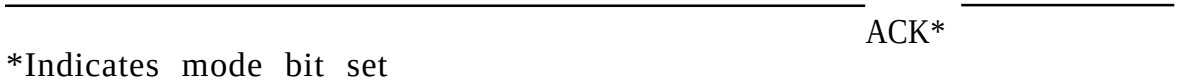
Peripheral:

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

VMC:



Peripheral:



*Indicates mode bit set

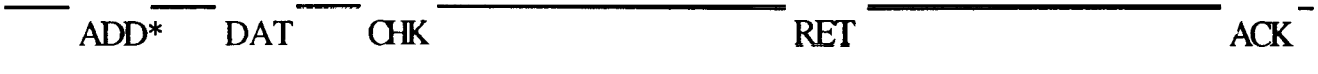
D. The diagram below represents a typical transmission when the VMC determines a CHK is not correct. The VMC will respond one of two ways:

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

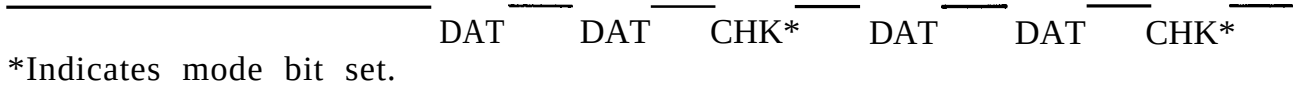
OR

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

VMC:



Peripheral:



*Indicates mode bit set.

Section 3

Bus Timing

1. Timing Definitions

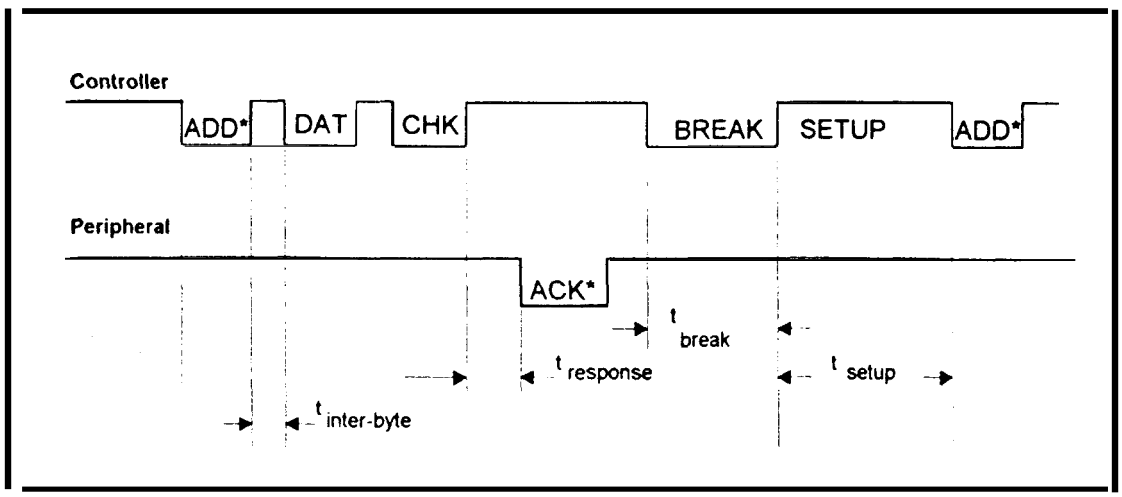
Baud rate =	The rate of bit transfer per second.
$t_{inter\text{-}byte\ (max.)}$ =	The maximum time allowed between bytes in a block transmission.
$t_{response\ (max.)}$ =	The maximum time any device, master or peripheral, will take to respond to a valid communication.
$t_{break\ (VMC)}$	The minimum 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.

2. Timing Specifications

Baud Rate	**= 9600 +1%/-2% NRZ**
$t_{inter\text{-}byte\ (max.)}$	= 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. Timing Diagram



NOTE: * **indicates** that the mode bit is set

Section 4

Hardware Specification

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.).

2. Bus Transmitter/Receive r 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 µA

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 @ IV
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 @ IV
Maximum leakage current (inactive): 30 µA

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)

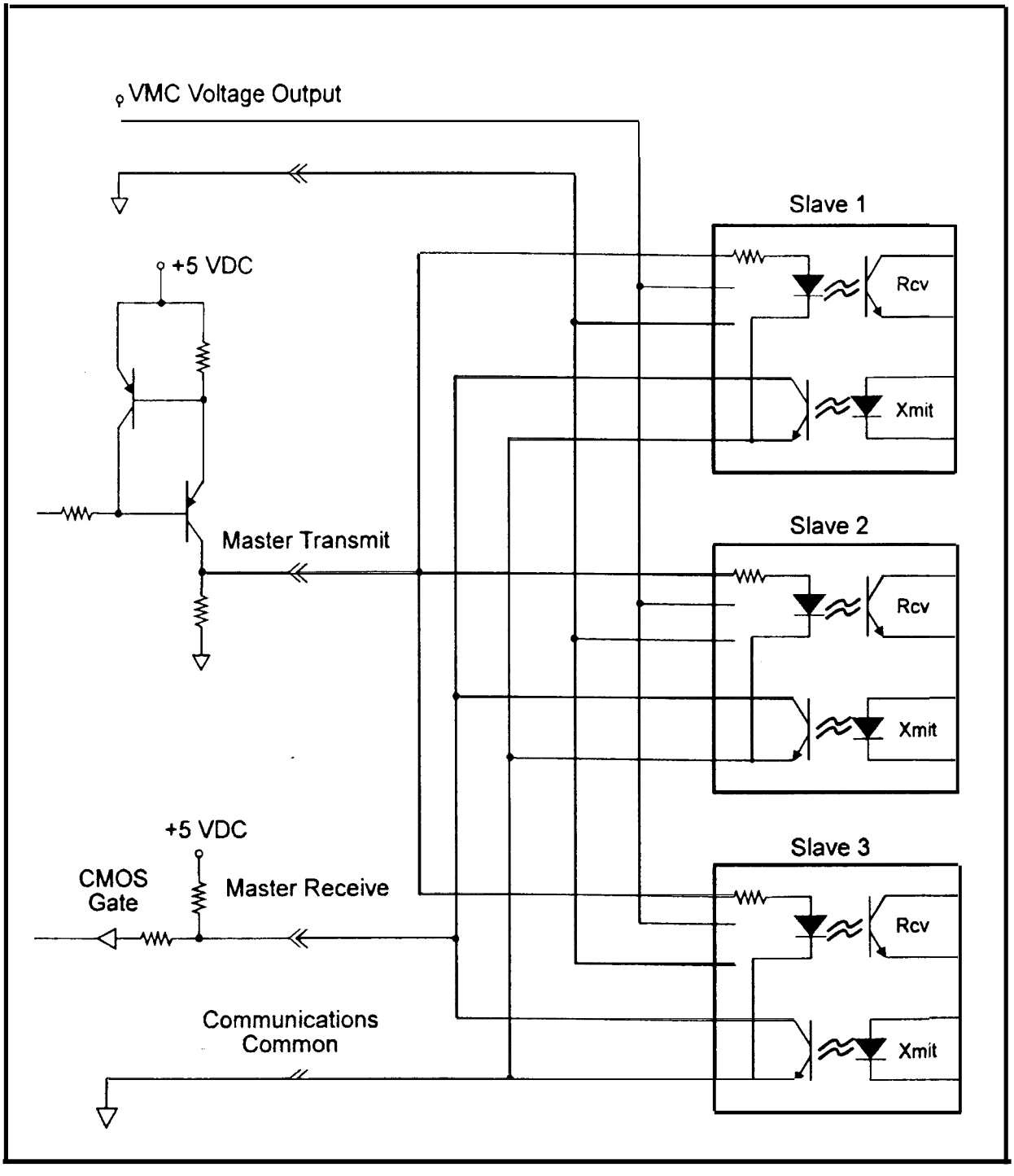
Terminals: Molex 39-00-0067 (Pins)

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

4 Example Schematic



Section 5

Changer
VMC/Peripheral Communication Specifications

1. Introduction

This section defines the communication bytes sent and received by a coin accepting device ("Changer"). The changers 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 w i 11 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 pay out 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 opera ting mode. This technique allows all VMCs and

peripherals to accommodate existing feature capabilities and provides a means for upgrading Level 3 equipment.

2. VMC **Commands**

Command	Hex Code	Description
RESET	08H	Command for changer to self-reset
STATUS	09H	Request for changer status.
TUBE STATUS	OAH	Request for changer tube status.
POLL	OBH	Request for changer activity status.
COIN TYPE	OCH	Signifies coin types accepted and allowable coin dispensing. This command is followed by setup data. See command format section.
DISPENSE	ODH	Command to dispense a coin type. Followed by coin type to dispense. See command format section.
EXPANSION COMMAND	OFH	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.

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 O1H

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 bll bl0 b9 b8 I b7 b6 b5 b4 b3 b2 bl bO
Z6 Z7

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

Z8-Z23= Coin Type Credit - 16 bytes

Indicates the value of coin types O 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 OOH. 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 O, 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 O = nickel, Coin type 1 = dime, Coin type 2 = quarter, Coin type 3 = dollar.

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

Z1 - Z2 = Tube Full Status - 2 bytes

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

b15 b14 b13 b12 bll b10 b9 b8 I b7 b6 b5 b4 b3 b2 bl bO
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 O. Unsent bytes are assumed to be zero.

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	OBH	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 (O 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 (O 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.

(000001 10) = Acceptor Unplugged[2] - The changer has detected that the acceptor has been removed.

(000001 11) = 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.

(00001 100) = Coin Jam[1] - A coin(s) has jammed in the acceptance path.

(00001 101) = Not Used

(000011 10) = Not Used

(0000111 1) = Not Used

Slug :

(00lxxxxx) = 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	OCH	4 bytes: Y1 - Y4

Yl - Y2 = Coin Enable - 2 bytes

b15	b14	b13	b12	bl1	b10	b9	b8	I	b7	b6	b5	b4	b3	b2	b1	bO
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 OOOOH. All coins are automatically disabled upon reset.

Y3 - Y4 = Manual Dispense Enable - 2 bytes

b15	b14	b13	b12	bll	b10	b9	b8	I	b7	b6	b5	b4	b3	b2	bl	bO
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	ODH	1 byte: Y1

b7	b6	b5	b4	b3	b2	bl	bO
				Y1			

Bits b3, b2, bl, bO indicate coin type to be dispensed. Valid codes are OH to FH to indicate coin types O 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 OOH 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)	OFH	OOH	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 NAMA document entitled "The Vending Industry Data Transfer Standard", the Audit Data Dictionary section, sub-section 5, "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 O is sent last. Currently defined options are:

bO - 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.

bl - b31: Available for future use.

VMC coremand	Code	Sub-Command	VMC Data
EXPANSION COMMAND (Feature enable)	OFH	OIH	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 Data
EXPANSION COMMAND (Alternative Payout)	OFH	02H, Payout 03H, Payout Status	Y1 Non e	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 - 15 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.

Controller Command	Code	Sub-command	Data	Device Data
EXPANSION COMMAND	OFH	04H, Payout value poll	none	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 (OFH-02H) and the first Payout value Poll).

An OOH 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 (OFH-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	VMC Data	Changer Response Data
EXPANSION COMMAND (Diagnostics)	OFH	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. Al - Zn implies that any number of bytes can be used for the changer response data from the peripheral.

4. **Changer Non-Response Time**

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

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

Coin payout = 3.6 A. (max.) for 100 mS. with 400 mS. idle current between pulses.

Section 6

Bill Validator
VMC/Peripheral Communication Specifications

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.

2. VMC Commands

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.

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 OIH

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 O064H 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 - Zl0 = Bill Security Levels -2 bytes
Indicates the security level for bill types O to 15. Since not all Validators support multiple security levels, Validators that do not have this feature must report a “high” security level.

Zll = Escrow/No Escrow - 1 byte
Indicates the escrow capability of the bill validator. If Z11 = OOH, 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 O 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 OOH. 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	bll	b10	b9	b8	I	b7	b6	b5	b4	b3	b2	bl	bO
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)

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

xxxx = Bill Type (O to 15)

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

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.

(Ol0xxxxxx) = 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	bll	b10	b9	b8	I	b7	b6	b5	b4	b3	b2	bl	bO
Y1																Y2

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

NOTE : Sending OOOOH disables the bill validator.

Y3 - Y4 = Bill Escrow Enable:

b15	b14	b13	b12	bll	b10	b9	b8	I	b7	b6	b5	b4	b3	b2	bl	bO
Y3																Y4

Bill types are O 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 = O;	Return bill in the escrow position.
If Y1 = xxxxxxxl ;	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, O if not.

xxxxxxxxxxxxxxx = The number of bills in the stacker.

VMC Command	Code	Sub-Command	Validator	Response Data
EXPANSION COMMAND (Identification)	37H	OOH	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 NAMA document entitled "The Vending Industry Data Transfer Standard", the Audit Data Dictionary section, sub-section 5, "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	Changer Response Data
EXPANSION COMMAND (Diagnostics)	OFH	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. Al - Zn implies that any number of bytes can be used for the changer response data from the peripheral.

4. **Bill Validator Non-Response Time**
The maximum non-response time for the bill validator is five seconds.

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

Section 7

Card Reader
VMC/Peripheral Communication Specifications

1. Introduction

This section defines the communications bytes sent and received between the card reader and the Vending Machine Controller (VMC). The card reader address is OOO1Ob.

Unless otherwise stated, all monetary values used by the card 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 card reader's READER CONFIGURATION DATA response.

2. State Definitions

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

1) Inactive
2) Disabled
3) Enabled
4) Session Idle
5) Vend

Inactive

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

Disabled

The reader automatically enters this state from the Inactive state when it has received all SETUP information 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, cards 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 the idle mode specification during the disabled state.

Enabled

In this state, cards may be used for MDB transactions. The reader will remain in this state until a valid card 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).

Session Idle

In the Enabled state, when a valid card 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.

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 uninterruptible command/response sequence. The reader will return to the Session Idle state upon completion of this sequence.

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 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 uninterpritble 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*

SESSION COMPLETE ==> END SESSION

*These VEND COMMAND/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 COMMAND/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 which is unexecutable in its present state or while the reader is in one of the preceding uninterruptible sequences, the following will occur:

1) 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 (OBh).

2) Alternatively, the reader may respond with a NAK or not respond in response to an out of sequence command.

Multi-Message Response Format

The multi-message response format permits the card reader to send multiple messages in response to a single command. 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 card after a VEND

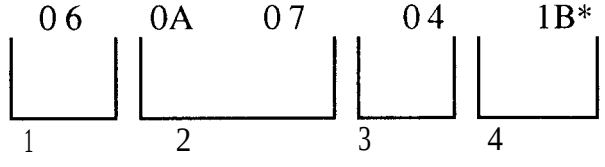
REQUEST, it may need to report:

1) VEND DENIED

2) MALFUNCTION/ERROR subcode 07h

3) SESSION CANCEL REQUEST

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



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 insure that command protocol is maintained.

Coin Mechanism Escrow Return Actions

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.

1) In the Enabled state, the VMC should send a READER CANCEL command to the card reader. This allows the user to abort a pre-approved on-line authorization request.

2) In the Session Idle state, the VMC should send a SESSION COMPLETE command to the card reader. This will return the reader to the Enabled state.

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 card 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 card reader.

TABLE 1 : CONTROLLER COMMANDS

VMC COMMANDS	CODE	CONTROLLER DATA	PAGE	CARD READER RESPONSE	PAGE
RESET	10h	No Data	7.7	No Data	.....
SETUP	11h	OOh - Config. Data	7.7	Olh - Reader Config. Data	7*8
		Olh - Max/Min Prices	7.9	No Data	
POLL	12h	No Data	7.10	00h - Just Reset	7•10
				01h - Reader Config Data	7•10
				02h - Display Request	7•11
				03h - Begin Session	7•11
				04h - Session Cancel Rqst	7"12
				05h - Vend Approved	7*12
				06h - Vend Denied	7*12
				07h - End Session	7•13
				08h - Cancelled	7•13
				09h - Peripheral ID	7•13
				0Ah - Malfunction/Error	7•14
				OBh - Cmd Out of Seq	7.15
				FFh - Diagnostic Response	7.15
VEND	13h	OOh - Vend Request	7.16	05h - Vend Approved	7.16
				06h - Vend Denied	7.16
		Olh - Vend Cancel	7.17	06h - Vend Denied	7.17
		02h - Vend Success	7.17	No Data	.....
		03h - Vend Failure	7.18	No Data	.....
		04h - Session Complete	7.18	07h - End Session	7.18
READER	14 h	Oh - Disable	7.18	No Data	
		01h - Enable	7.19	No Data	
		02h - Cancel	7.19	08h - Cancel led	7.19
EXPANSION	17h	OOh - Request ID	7.2O	09h - Peripheral ID	7.2O
		FEh - Diagnostics	7.21	FFh - Diagnostic Response	7.2 1

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.

4. Card Reader Command/Response Formats

VMC Command	Code	VMC Data
RESET	**10h**	**No data bytes**

Reset (10h)

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

The VMC must follow the RESET command with all SETUP commands and a READER ENABLE command to enable vending transactions.

VMC Command	Code/Sub-Command	VMC Data
SETUP/ CONFIGURATION DATA	**11 h/O O h**	**5 bytes: Y1 - Y5**

Setup (11h)	Con fig Data (OOh) Y1	VMC Feature Level Y2	Cols On Disp Y3	Rows On Disp Y4	Disp Info Y5

Y1 = CONFIGURATION DATA.

VMC is sending its configuration data to reader.

Y2 = VMC Feature Level.
Indicates the feature level of the VMC. Currently the highest feature level is 01.

Y3 = Columns on Display.
The number of columns on the display. Set to OOh if the display is not available to the card reader.

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

Y5 = Display Information
OOh: Numbers, upper case letters, blank and decimal point.
01h-001: Full ASCII.
02h-FFh: Unassigned.

Card Reader Respose	Code	Card Reader Data
READER CONFIGURATION DATA	01 h	8 bytes: Z1 - Z8

Reader Config Data (Olh) Z1	Card Feature Level **Z2**	Country Code High **Z3**	Country Code Low Z4	Scale Factor Z5	Decimal Places Z6	Appl Max Resp Time **Z7**	Misc Optior Z8

Z1 = READER CONFIGURATION DATA.

Indicates the card reader is responding to a SETUP/ CONFIGURATION DATA request from the VMC.

Z2 = Card Reader Feature Level.

The feature level of the card reader. Currently the highest feature level is 01.

Z3 - Z4 = Country Code - packed BCD.

International Telephone Code for the country in which the card reader is set-up for. For example, the USA code is 0001. Use FFFFh if the country code is unknown.

Z5 = Scale Factor.

The multiplier used to scale all monetary values transferred between the VMC and the card reader.

Z6 = Decimal Places.

The number of decimal places used to communicate monetary values between the VMC and the reader.

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

Actual Price = P*X*10^-Y

where P is the scaled value sent 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 price of 0.35.

Z7 = Application Maximum Response Time - seconds.

The maximum length of time that a reader will require to provide a response to any command from the VMC.

Z8 = Miscellaneous Options - xxxxxyyy.

xxxxx = unused

yyy = option bits

bO=O: The card reader is NOT capable of restoring funds to the user's card or account. Do not request refunds.

bO= 1: The card reader is capable of restoring funds to the user's card or account. Refunds may be requested.

bl =0: The card reader is NOT multivend capable. Terminate session after each vend.

bl=l: The card reader is multivend capable. Multiple items may be purchased within a single session.

b2=O: The card reader does NOT have a display.

b2=l: The card reader does have its own display.

VMC Command	C ode/Sub - Command	VMC Data
SETUP/ MAX/MIN PRICES	**11 h/O 1 h**	**5 bytes: Y1 - Y5**

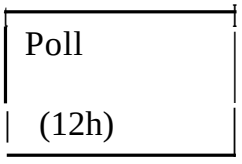
Setup (1lh)	Max/Min Prices (01 h) Y1	Max Price Y2-Y3	Min Price Y4-Y5

Y1 = MAX/MIN PRICES.
Indicates the VMC is sending the price range to the read e r.

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, OOOOh should be sent.

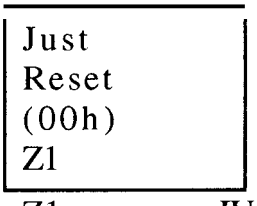
VMC Command	Code	VMC Data
POLL	**12h**	**No data bytes**



The POLL command is used by the VMC to obtain information from the card 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 card reader.

Card Reader Response	Code	Card Reader Data
JUST RESET	OOh	1 byte: Z1



Z1 = JUST RESET.

Indicates the card reader has been reset.

Card Reader Response	Code	Card Reader Data
READER CONFIGURATION DATA	O1h	8 bytes: Z1 - Z8

Reader Con fig Info (Olh)	Card Feature Level	Country Code High	Country Code Low	Scale Factor	Decimal Places	Appl Max Resp Time	Misc Options
Z1	Z2	Z3	Z4	Z5	Z6	Z7	Z8

See full explanation under SET UP/CONFIGURATION Command.

Card Reader Response	Code	Card Reader Data
DISPLAY REQUEST	02h	Up to 34 bytes: Z1-Z34

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

Z1 = DISPLAY REQUEST.

The card 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 card 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 card reader.

The number of bytes must equal the product of Y3 and Y4 in the SETUP/CONFIGURATION command, up to a maximum of **32** bytes

Card Reader	Response Code	Card Reader Data
BEGIN SESSION	03 h	3 bytes: Z1 - Z3

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

Z1 = BEGIN SESSION.

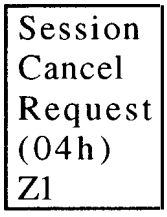
Allow a patron to make a selection, but do not dispense product until funds are approved.

Z2 - Z3 = Funds Available - scaled.

a. Lesser of the user's card or account balance or FFFEh units.

b. Not yet determined - FFFFh.

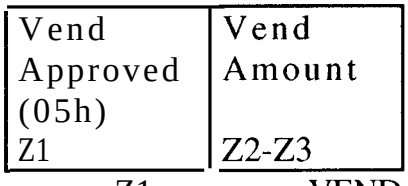
Card Reader Response	Code	Card Reader Data
SESSION CANCEL REQUEST	04 h	1 byte: Z1



Z1 = SESSION CANCEL REQUEST.

The card reader is requesting the VMC to cancel the session. The VMC should initiate an eventual SESSION COMPLETE.

Card Reader Response	Code	Card Reader Data
VEND APPROVED	05 h	3 bytes: Z1 - Z3



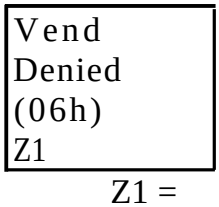
Z1 = VEND APPROVED.

Allow the selected product to be dispensed.

Z2 - Z3 = Vend Amount - scaled.

This is the amount deducted from the user's card or account. This may not match the amount specified in the VEND REQUEST command; it may be surcharged or discounted.

Card Reader Response	Code	Card Reader Data
VEND DENIED	06h	1 byte: Z1



Z1 = VEND DENIED.

Approval denied for the patron's selection. Do not dispense any products.

Card Reader Response	Code	Card Reader Data
END SESSION	**07** h	1 byte: Z1

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 or Disabled state, whichever is appropriate.

Card Reader Response	Code	Card Reader Data
CANCELLED	08h	1 byte: Z1

Cancelled (08h) Z1

Z1 = CANCELLED.

This is the reader's response to the READER CANCEL command from the VMC. These two commands comprise a command/response sequence. Its use is only appropriate in the Enabled state.

Card Reader Response	Code	Card Reader Data
PERIPHERAL ID	09h	30 bytes: Z1 - **Z30**

Peripheral ID (09h) Z1	Manufacture 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 NAMA document entitled "The Vending Industry Data Transfer Standard," the Audit Data Dictionary section, sub-section 5, "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.

Card Reader Response Code		Card Reader Data
MALFUNCTION/ ERROR	OAh	2 bytes: Z1 - Z2

Malfunction/ Error (OAh) Z1	Error Code Z2

Z1 = MALFUNCTION/ERROR.

The card reader is reporting a malfunction or error.

Z2 = Error Code - xxxxyyyy.

xxxx = 0000: Card Error[1]
0001 : Invalid Card[1]
0010: Tamper Error[1]
001 1: Manufacturer Defined Error[1]
0100: Communications Error[2]
0101: Reader Requires Service[2]
01 10: Unassigned[2]
011 1: Manufacturer Defined Error[2]
1000: Reader Failure[3]
1001 : Communications Error[3]
1010: Card Jammed[3]
1011 : Manufacturer Defined Error[3]

1100-1111 : 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.

Card Reader Response	Code	Card Reader Data
COMMAND OUT OF SEQUENCE	OBh	1 byte: Z1

Command out of Sequence (OBh) Z1

Z1 = COMMAND OUT OF SEQUENCE.

The card reader has received a command that is not executable in its current state or which violates one of the uninterruptible sequences. The offending command may be ACKnowledged, but not acted upon by the reader.

Card Reader Response Code	Card Reader Data
DIAGNOSTICS RESPONSE	**FFh** up to **35 bytes: Z2 - Zn**

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.

VMC Command	Code/Sub-Command	VMC Data
VEND REQUEST	**13h/00h**	**5 bytes: Y1 - Y5**

Vend (13h)	Vend Request (OOh) 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 card 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.**

Card Reader Response Code	Card Reader Data
VEND APPROVED 05h	3 bytes: Z1 - Z3

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

See full explanation under POLL Command.

Card Reader Response Code	Card Reader Data
VEND DENIED 06h	1 byte: Z1

Vend Denied (06h) Z1

See full explanation under POLL Command.

VMC Command	Code/Sub-Command	VMC Data
VEND CANCEL	**13 h/O 1 h**	**1 byte: Y1**

Vend (13h)	Vend Cancel (01h) Y1

YI = 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 card reader. The card reader will respond to VEND CANCEL with a VEND DENIED and return to the Session Idle state.

Card Reader Response Code	Card Reader Data
VEND DENIED 06h	1 byte: Z1

Vend Denied (06h) Z1

See full explanation under POLL Command.

VMC Command	Code/Sub-Command	VMC Data
VEND SUCCESS	**13 h/O 2 h**	**3 byte: Y1-Y3**

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.

VMC Command	Code/S u b - Command	VMC Data
VEND FAILURE	**13 h/O 3 h**	**1 byte: Y1**

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.

VMC Command	Code/S u b- Command	VMC Data
SESSION COMPLETE	**13 h/O 4 h**	**1 byte: Y1**

Vend (13h)	Session Complete (04h) Y1

Y1 = SESSION COMPLETE.

This tells the card reader that the session is complete and to return to the appropriate Enabled or Disabled state. SESSION COMPLETE is part of a command/response sequence that requires an END SESSION response from the reader.

End Session (07h) Z1

Z1 = END SESSION.

See full explanation under POLL Command.

VMC Command	Cod e/S u b - Command	VMC Data
READER DISABLE	**14 h/O Oh**	**1 byte: Y1**

Reader (14h)	Disable (OOh) Y1

Y1 = READER DISABLE.

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

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

VMC Command	C ode/Sub - Command	VMC Data
READER ENABLE	**14 h/O 1 h**	**1 byte: Y1**

Reader (14h)	Enable (01h) Y1

Y1 = READER ENABLE.

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

VMC Command	Code/Sub - Command	VMC Data
READER CANCEL	**14 h/O 2 h**	**1 byte: Y1**

Y1 = READER CANCEL.

This command is issued to abort card 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.

Card Reader Response	Code	Card Reader Data
CANCELLED	**08h**	**1 byte: Z1**

Cancelled (08h) Z1

See full explanation under POLL Command.

VMC Command	Code/Sub-Command	VMC Data
EXPANSION/ REQUEST ID	**17 h /00 h**	**30 bytes: Y1-Y30**

Expansion (17h)	Request ID (OOh) Y1	Manufacture Code Y2-Y4	Serial Number Y5-Y16	Model Number Y17-Y28	Software Version Y29-Y30

Y1 = REQUEST ID.

The VMC is requesting card reader identification information. The information included above (Y2-Y30) provides the card reader with VMC identification information.

Y2 - Y4 = Manufacturer Code - ASCII.

Identification code for the equipment supplier. Currently defined codes are listed in the NAMA document entitled "The Vending Industry Data Transfer Standard," the Audit Data Dictionary section, sub-section 5, "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.

Card Reader Response Code	Card Reader Data
PERIPHERAL ID 09h	30 bytes: Z1 - Z30

Peripheral ID (09h) Z1	Manufacture Code Z2-Z4	Serial Numb e r Z5-Z16	Model Numb e r Z17-Z28	Software Version Z29-Z30

See full explanation under POLL Command.

VMC Command	Code/Sub-Command	VMC Data
EXPANSION/ DIAGNOSTICS	**17h/FFh**	**up to** 34 bytes: Y1-Yn

Expansion (17h)	Diagnostics (FFh) Y1	User Defined 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.

Card Reader	Response Code	Card Reader Data
DIAGNOSTICS RESPONSE	**FFh**	**up to 35 bytes: Z2 - Zn**

Diagnostics Response (FFh) Z1	User Defined Z2-Zn

See full explanation under POLL Command.

5. Non-Response Time

The maximum non-response time for a card reader is 5 seconds. This is the maximum time for which a card reader will not respond to a command or a POLL with ACK, NAK or a message.

6. Card Reader **Power Requirements**

The current draw for any card 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