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MDB Coin Changer and MDB Bill Validator to RS-232 Interface

Model ARB-C21

DESCRIPTION

This Interface Unit (IU) is designed to convert the MDB Bill Acceptor (BA) and MDB Coin Changer (CC) protocol to RS-232 serial protocol. The IU functions as a slave to a master control system. The master may be any control system that supports RS-232 serial communication, for example a PC.

OPERATION

The master and slave communication is based on master requests and slave replies. The master sends a status request (or command) to the IU and IU answers by sending its current status. The IU's typical response to the Master's request (polling) consists of a header and data bytes. If there is no BA or CC activity, the status is one byte, the header only. When the IU receives data from the BA or CC, it sends a header followed by data bytes in the response to master's status request. The master must always poll (query) the IU. If the IU does not receive a query from the master in the predefined time slot or IU does not recognize master messages 10 times in row, it will inhibit the BA and CC acceptance. At power up, acceptance of the BA and CC is inhibited.

SPECIFICATION

Communication format.

Baud rate	9600 BPS
Start bit	1
Data bits	8
Parity	NO
Stop bit	1

Timing Specification.

Inter-byte (max)	1 ms
Response (max)	50 ms
Master polling times every	150 – 300 ms
Time IU waits for the Master's poll before inhibiting acceptance of the BA and CC (max)	3 second

Hardware Specification.

Power	Min 20 VDC Nominal 24...34 VDC (or 24...30VAC) Max 39 VDC Consumes an idle current < 0.05A 0.5A for 1 sec. when accepting bills
Cable	Standard computer serial cable
Dimensions	approx. 110 x 70 x 80 mm (4.3" x 2.7" x 3.1")
Weight	approx. 100 g (0.2 lb.)

Software specification

- Master Command codes (HEX)

Get Status (Poll)	0x01
Reset BA	0x02
Get BA Set-up Status	0x03
Enable/Disable BA	0x04
Accept Bill	0x05
Return Bill	0x06
Get Stacker Info	0x07
BA Security command	0x08
BA Expansion command	0x09
Reset CC	0x0A
Get CC Set-up Status	0x0B
Enable/Disable CC	0x0C
Get CC Tube Status	0x0D
CC Change command	0x0E
CC Expansion command	0x0F

- IU (slave) status response codes

ACK	0x00
NACK	0xFF

Response to the Get Status command includes one byte long Header with Status information. The Header has the following structure:

A. No BA or CC activity
Bit 7,6
0 1 – no activity
Bit 5,4
0 0 – no MDB attached
0 1 – CC attached
1 0 – BA attached
1 1 – BA & CC attached
Bit 3,2 – reserved
Bit 1
1 – if a BA is attached and is disabled by the IU (see: OPERATION)
Bit 0
1 – if a CC is attached and is disabled by the IU (see: OPERATION)

No data bytes are following

B. Activity from BA and CC
Bit 7
1 - data message
Bit 6,5,4
0 0 1 – data from CC
0 1 0 – data from BA
Bit 3,2,1 – reserved
Bit 0
If data from CC
0 – no BA attached
1 – BA attached
If data from BA
0 – no CC attached
1 – CC attached

The byte after the Header B (activity on the lines from the BA or CC) states the number of data bytes that are following. The last byte is a check sum of all the sent bytes, including the Header.

In response to the master's command that requests for data from the MDB devices, the IU sends:

a. The first byte is the number of data bytes
b. The next byte(s) are the data byte(s)
c. The last byte is the check sum of the data bytes only.

In response to the master's command that sends data to the MDB devices, the IU sends ACK, however, if the IU does not recognize the master's command it sends back NACK. If the IU does not recognize the master's command, 10 times in row, it will inhibit acceptance of the BA and CC.
For data explanation see the Data Specification.

APPLICATION NOTES

The method of communication recommended is as follows:

a. After power up the Master must start sending Get Status (poll) commands to the IU and IU must respond with its status.
b. When communication is established, the Master can send the "Reset" command. The IU should respond with the message ACK.
c. Then the Master sends the "Get Set-up Status" command. The IU responds with the set-up status. See Data Specification.
d. Based on the information received in 'c' the Master builds bytes for the Enable/Disable command and sends it. The IU will respond with the message ACK.
e. If above operation is OK the MDB device is ready to accept money.

DATA SPESIFICATION

BA data specification

Master Command	Code	IU Response Data
Reset BA	0x02h	ACK

Master Command	Code	IU Response Data
Get BA Set-up Status	0x03H	max 28 bytes: B1 – B27

B1 Number of bytes that follow

B2 Bill Validator Feature Level 1 byte
Indicates current feature level of the bill validator. Currently defined level one.

B3 – B4 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

B5 – B6 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.

B7 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

B8 – B9 Stacker Capacity – 2 bytes
Indicates the number of bills that the stacker will hold. For example, a stacker with a 400 bill capacity = 0190H.

B10 – B11 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.

B12 Escrow/No Escrow – 1 byte
Indicates the escrow capacity of the bill validator. If Z11 = 0HH, the bill validator does not have escrow capability. If Z11 = FFH, the bill validator has escrow capability.

B13 – B28 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 OOH. Unsent bill types are assumed to be zero. FFH bills are assumed to be vend tokens.

B29 (or last byte) Check Sum. This byte is a sum of all bytes except first byte.

Master Command	Code	IU Response Data
Enable/Disable BA	0x04	ACK

The Master command is 6 bytes.
B1 command 0x04
B2-B3 Bill enable. Indicates what types of bills are accepted.
b15 b14 b13 b12 b11…b2 b1 b0
B2 B3
Bill types are 0 to 15. A bit is set to indicate acceptance of that bill type.
Sending 0000h disables the Bill Validator
B4-B5 Bill Escrow Enable
b15 b14 b13 b12 b11…b2 b1 b0
B4 B5
Bill types are 0 to 15. A bit is set to indicate enable of escrow for a bill type.
B6 Check sum of the B2..B5

Master Command	Code	IU Response Data
Accept Bill	0x05	ACK

Master Command	Code	IU Response Data
Return Bill	0x06	ACK

Master Command	Code	IU Response Data
Get Stacker Info	0x07	4 bytes

B1 Number of bytes that follow
B2 "Fxxxxxxx" F=1 if the stacker is full, 0 if not
B3 "xxxxxxxx" together with B2 – the number of bills in the stacker
B4 Check Sum (except B1)

Master Command	Code	IU Response Data
BA Security command	0x08	ACK

The Master command are 4 bytes:
B1 – 0x08
B2,B3 – data
B4 – check sum of B1 and B2

b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
B2 B3

A bit is set to indicate the type of bill(s), which are set to a ”high” security level.

Master Command	Code	IU Response Data
BA Expansion command	0x09	31 bytes

The Master command is 3 bytes:
Y1 is the command 0x08
Y2 is 0x0
Y3 is checksum of data byte (only B2) – 0x0
Response bytes:
B1 - number of bytes that follows
B2-B4 – Manufacture Code of a BA
B5-B16 – Serial Number of the BA
B17- B28 – Model and revision of the BA
B29-B30 – Software Version of the BA

Bill Acceptor activity data.

Master Command	Code	IU Response Data
Get Status (Poll)	0x01H	Header and possibly BA data May be up to 16 bytes

If a bill is accepted, the IU will send 4 bytes.
B1 data message header
B2 number of bytes that follow
B3 one of the following:

B3 (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)

B4 check sum

In the case of other BA activity:
The following bytes may exist:

(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 cannot answer a detailed command right now.
(00000100) = ROM Checksum Error [3] – The validator's 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]

NOTES: 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.

CC data specification

Master Command	Code	IU Response Data
Reset CC	0x0A	ACK

Master Command	Code	IU Response Data
Get CC Set-up Status	0x0B	24 bytes: B1 - B24

B1 number of following bytes
B2 Changer Feature Level - 1 byte
Indicates the feature level of the changer. This will distinguish the changer feature level to the VMC.
Current defined levels:
Level 2: Supports "core" command set. These are: RESET, STATUS, and 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.
B3 – B4= 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

B5 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.

B6 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.

B7 – B8 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

B7 B8

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

B9 – B24 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.

Master Command	Code	IU Response Data
Enable/Disable CC	0x0C	ACK

The Master command is 6 bytes.

B1 command 0x0C

B2 – B3 Coin Enable - 2 bytes

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

B2 B3

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 indicated coin type 15, and so on. To disable the changer, disable all coin types by sending a data block containing 000H. All coins are automatically disabled upon reset.

B4 – B5= Manual Dispense Enable - 2 bytes

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

B4 B5

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.

B6 is a check sum of the data byte (B2..B5)

Master Command	Code	IU Response Data
Get CC Tube Status	0x0D	20 bytes

B1 number of following bytes

B2 – B3 Tube Full Status - 2 bytes
Indicates status of coin tube for coin types 0 to 15.
b15 b14 b13 b12 b11 b1- b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
B2 B3
A bit is set to indicate a full tube. For example, bit 7 = set would indicate the tube for coin type 7 is full.
B4 – B19 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 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.

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.
B20 is check sum

Master Command	Code	IU Response Data
CC Change command	0x0E	ACK

The Master command is 3 bytes.
B1 command 0x0E
B2 b7 b6 b5 b4 b3 b2 b1 b0
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 indicated 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.
B3 is a check sum (the same as B2)

Coin Changer activity data.

Master Command	Code	IU Response Data
Get Status (Poll)	0x01H	Header and possibly BA data May be up to 16 bytes

B1 data message header
B2 number of bytes that are following
Then may follow up to 16 CC data bytes. Last byte always is a check sum.

CC data bytes.
Coins Dispensed Manually:

Byte 1 Byte 2
(lyyyxxxx) (zzzzzzzz)

yyy	=	The number of coins dispensed.
xxx	=	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
xxx	=	Coin type deposited (0 to 15).	
zzzzzzzz	=	The number of coins in the tube for the coin type accepted.	

In case of other CC activity, the following bytes may be:

(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

Master Command	Code	Sub-command	IU Response Data
CC Expansion command	0x0F	0x0	35bytes

The Master command is 3 bytes.
Y0 – 0x0E

Y1- 0x0
Y2 – 0x0

IU response:
B1 number of following bytes
B2..B30 the same as for BA
B31..34 Optional features
Each of the 32 bits indicate an optional features. If the bit is set the feature is available.
b0 – Alternative pay-out method. This method allows changer designs that determine change payout.
b1 – Extended diagnostic command supported.
b2 – Controlled manual fill and pay-out commands
b3..b31 for future use.

Master Command	Code	Sub-command	IU Response Data
CC Expansion command	0x0F	0x01	ACK

Features enable. This command is used to enable optional futures defined in B31...B34 above.
The Master command is 6 bytes.
B1 – 0x0E
B2 – 0x01
B3..B6 – data bytes
B7 is check sum of B2...B6

Master Command	Code	Sub-command	IU Response Data
CC Expansion command	0x0F	0x02	ACK

The Master command is 4 bytes.
B1 – 0x0E
B2 – 0x02
B3 – Value of coins to be paid out. This value is expressed as the number of coin scaling factors that would sum to the value.
B4 – is check sum of the B1 and B2

Master Command	Code	Sub-command	IU Response Data
CC Expansion command	0x0F	0x03	18 bytes

The Master command is 3 bytes.
Y1- 0x0E
Y2 – 0x03
Y3 – 0x03
IU response:
B1 the number of following bytes
B2…B17 Number of each coin type paid out
B18 – check sum

The rest of valid for IU expansion command are:

Master Command	Code	Sub-command
CC Expansion command	0x0F	0x04
Master Command	Code	Sub-command

CC Expansion command	0x0F	0x05
Master Command	Code	Sub-command
CC Expansion command	0x0F	0x06
Master Command	Code	Sub-command
CC Expansion command	0x0F	0x07

The detail description of these commands can be found in the document " Multi-Drop Bus Communication protocol" – MDB/ICP. Knowledge of this protocol would be beneficial to developers using this product.

PACKING LIST

1. Interface Unit
2. 24VAC (wall mount adapter)
3. Serial cable to connect IU and RS232 port of PC
4. Coin Changer (Optional)
5. Bill Validator (Optional)
6. Floppy Disk with Operation manual.
7. Floppy Disk with "MDB Tester", which is a PC application, is available (purchased separately). The "MDB Tester" works with Windows 95, 98, ME, 2000, NT. No device driver is required.