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CashCode[®] NET

Document 1:

Common Specifications



Document revision history

Revision	Date	Author	Description
2.4.3	Apr. 28, 2006	CashCode Engineering	<ul style="list-style-type: none">- Power recovery commands added to BB section- Options added to BB section- Module identification command added to BB section- Several timeout exceptions described



2.4.2	July 18, 2005	CashCode Engineering	- Escrow cassette functionality description changed.
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2.4.1	June 21, 2005	CashCode Engineering	<ul style="list-style-type: none">- Power recovery states added to section 3.4- EMPTY DISPENSER command added to section 3.4- SET OPTIONS and GET OPTIONS commands added to section 3.4- Description of BB TIME commands added to section 3.4
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2.4	Apr. 11 2005	CashCode engineering	<ul style="list-style-type: none"> - Version numbering revised to reflect internal/external numbering; - Section 7.9 revised to reflect it's irrelevance to Bill Changer operation; - Extended ID command for the Bill Changer – removed data sample from BB Devices software version definition; - For DOWNLOAD command the set of applicable states was extended (p.3.3). - List of states added for SET BARCODE PARAMETERS command for Bill-To-Bill unit - Failure state reporting format for Bill-To-Bill units changed (response 0x47 to the POLL command) - List of states added to Bill Validator command list - CRC32 request (code 0x51) added to Bill-To-Bill command set - MODULE DOWNLOAD command introduced to provide update of internal modules of multi-controller devices - Revision number in the footer corrected - Barcode related commands (0x39, 0x3A) added for Bill-To-Bill devices - The extended identification code changed to 0x3E to avoid conflicts - Identification request (code 0x37) format for Bill-To-Bill has been changed - Extended identification request (code 0x39) for Bill-To-Bill units has been added - Revision format changed to comply with the company versioning standard
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1 General Information

1.1 Introduction

This document defines a serial network interface. The interface is Master-Slave arrangement where all peripherals are Slave to a Master Controller.

1.2 Operational and Application Notes

The serial network interface, or serial bus interface, is configured for Master- Slave operation. There is one Master with the capability of communicating with some peripherals. The Master is defined as Controller and Slave as Peripheral.

Each peripheral is assigned a unique address and command set. The Controller will “poll” the Bus for Peripheral activity. That is, each Peripheral is asked for activity, and responds with either acknowledge, negative acknowledge, invalid command acknowledge, 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.



2 Communication Format.

2.1 Data format

Baud Rate:	9600 bps/19200 bps (no negotiation, hardware selectable)
Start bit:	1
Data bit:	8 (bit 0 = LSB, bit 0 sent first)
Parity:	Parity none
Stop bit:	1

2.2 Message Format

SYNC	ADR	LNG	CMD	DATA	CRC
-------------	------------	------------	------------	-------------	------------

SYNC:	1 byte	Message transmission start code [02H], fixed
ADR :	1 byte	Peripheral address
LNG :	1 byte*	Data length (Total number of bytes including SYNC and CRC)
CMD :	1 byte	Command
DATA	0 to 250 bytes	Data necessary for command (omitted if not required by CMD)
CRC:	2 bytes	Check code by CRC method, LSB first Object section to be from and including SYNC to end of DATA (Initial value = 0)

Error control method: Error detection CRC method
 CRC - CCITT using whole byte shifting into a two-byte frame
 $P(x) = X^{16} + X^{12} + X^5 + 1$

* if a package cannot be fitted into 250-byte frame a wider frame may be used by setting **LNG** to 0; the actual packet length is inserted into **DATA** block bytes 0 and 1 if **CMD** (if present in the frame) **does not require subcommand**, otherwise in **DATA** block bytes 1 and 2; two-byte **LNG** always follows MSB first.

case 1 (CMD present, no subcommand):

SYNC	ADR	0	CMD	LNG HIGH	LNG LOW	DATA	CRC
-------------	------------	----------	------------	-----------------	----------------	-------------	------------

case 2 (CMD present, subcommand present):

SYNC	ADR	0	CMD	SUBCMD	LNG HIGH	LNG LOW	DATA	CRC
-------------	------------	----------	------------	---------------	-----------------	----------------	-------------	------------

case 3 (CMD not present, no subcommand):

SYNC	ADR	0	LNG HIGH	LNG LOW	DATA	CRC
-------------	------------	----------	-----------------	----------------	-------------	------------

This allows accommodation of data packages of up to 65528 bytes; please keep in mind that lengthy exchanges compromise bus bandwidth.



Example of CCNET CRC calculation using C-language source code:

```
#define POLYNOMIAL 0x08408

unsigned int GetCRC16(unsigned char* bufData, unsigned int sizeData)
{
    unsigned int CRC, i;
    unsigned char j;
    CRC = 0;
    for(i=0; i < sizeData; i++)
    {
        CRC ^= bufData[i];
        for(j=0; j < 8; j++)
        {
            if(CRC & 0x0001) {CRC >>= 1; CRC ^= POLYNOMIAL;}
            else CRC >>= 1;
        }
    }
    return CRC;
}
```

Example of CCNET CRC calculation using PASCAL-language source code:

```
const CCNET_CRC_POLY = $08408

function GetCRC16(InData: array of byte; DataLng: word): word;
var i: word;
    j: byte;
begin
    result:=0;
    for i:=0 to (DataLng-1) do
        begin
            result:=result xor InData[i];
            for j:=0 to 7 do
                begin
                    if (result and $0001)<>0 then
                        begin
                            result:= result shr 1;
                            result:= result xor CCNET_CRC_POLY;
                        end
                    else
                        result:= result shr 1;
                end;
            end;
        end;
    end;
end;
```

2.3 Transmission and reception message formats

Transmission and reception message format is divided into the following four types.

- (1) Command transmission **CONTROLLER to PERIPHERAL**

SYNC	ADR	LNG	CMD	DATA	CRC
------	-----	-----	-----	------	-----



SYNC : [02H]
ADR : Peripheral address
LNG : Data length
CMD : Command
DATA : Data necessary for command (omitted if not required by CMD)
CRC : Check code by CRC method

(2) ACK response **PERIPHERAL to CONTROLLER/ CONTROLLER to PERIPHERAL**

SYNC	ADR	LNG	DATA	CRC
------	-----	-----	------	-----

SYNC : [02H]
ADR : Peripheral address
LNG : [06H]
DATA : [00H]
CRC : Check code by CRC method

Sent in PERIPHERAL to CONTROLLER direction to confirm a command correctly received.
 Sent in CONTROLLER to PERIPHERAL direction to confirm a data response correctly received.

(3) NAK response **PERIPHERAL to CONTROLLER**

SYNC	ADR	LNG	DATA	CRC
------	-----	-----	------	-----

SYNC : [02H]
ADR : Peripheral address
LNG : [06H]
DATA : [FFH]
CRC : Check code by CRC method

Sent in PERIPHERAL to CONTROLLER direction if command from controller was not correctly received.

(4) Response message **PERIPHERAL to CONTROLLER**

SYNC	ADR	LNG	DATA	CRC
------	-----	-----	------	-----

SYNC : [02H]
ADR : Peripheral address
LNG : Data length
DATA : Response's Data
CRC : Check code by CRC method

(5) ILLEGAL COMMAND Response message **PERIPHERAL to CONTROLLER**

SYNC	ADR	LNG	DATA	CRC
------	-----	-----	------	-----

SYNC : [02H]
ADR : Peripheral address
LNG : [06]
DATA : [30H]



CRC : Check code by CRC method

Sent by the PERIPHERAL if command from CONTROLLER is not valid in reference to the current peripheral state.

2.4 Peripheral Addresses

The addresses below are defined.

AddressDefinition

00H	<i>Forbidden</i>
01H	<i>Bill-to-Bill unit</i>
02H	<i>Coin Changer</i>
03H	<i>Bill Validator</i>
04H	<i>Card Reader</i>
05H	Reserved for Future Standard Peripherals
.	.
.	.
.	.
0DH	Reserved for Future Standard Peripherals
0EH	<i>Reserved for Future Broadcast Transmissions</i>
0FH	Reserved for Future Standard Peripherals

2.5 Software Operational Rules

- Within multi-byte messages the most significant byte is sent first.
- If the Peripheral has not responded to a poll for its maximum non-response time, the Controller must continue to poll the Peripheral at least every ten seconds with a RESET command.
- All messages, from Controller or Peripheral, must be sent as quickly as possible. There is no minimum t_{response} time. All data block transmissions must be started within 10 mS.
- Any data (bytes or bits) within a command or response that are not specifically defined must be left in a 0 state.
- The Controller may reset Peripheral by sending the signal BUS RESET for a minimum of 100 mS. This informs Peripheral to abort any activity and return to its power-on reset state. It is recommended that the Controller re-initialize each Peripheral after this type of reset. **WARNING:** BUS RESET is device and implementation dependant and may not be present within some devices.

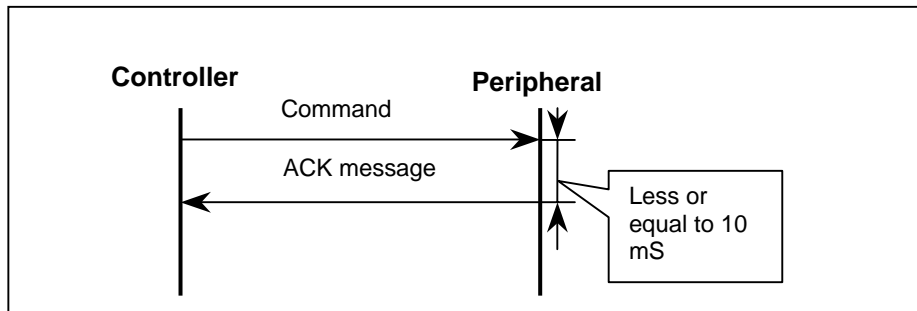
2.6 Typical Session Examples

The Controller must respond to data from a Peripheral with an Acknowledgment (ACK) or Negative Acknowledgment (NAK) message. The 10 mS time-out (t_{response}) described in the Timing section of this document is the equivalent of a NAK message.

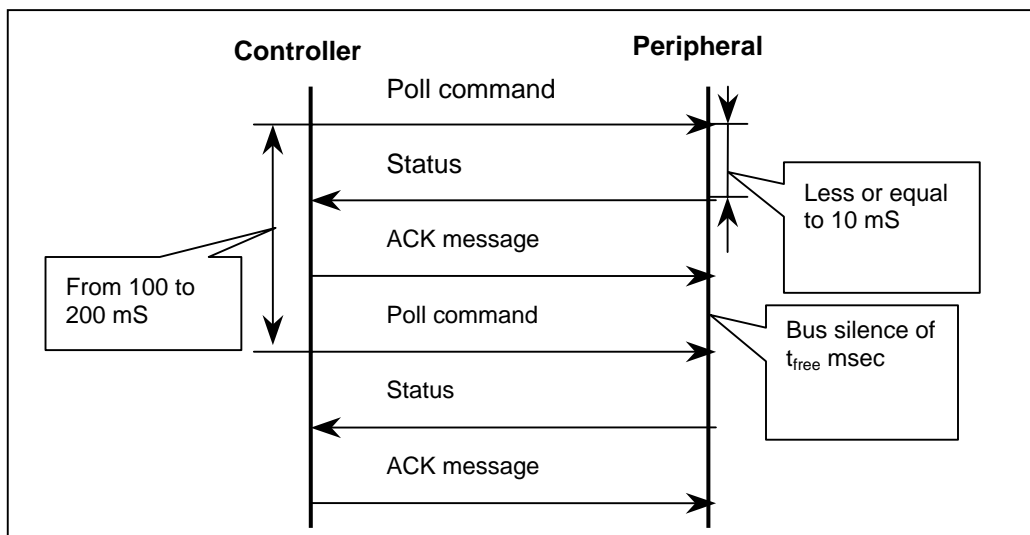
A Peripheral must respond to command from the Controller with response message, or ACK message, or NAK message. The 10 mS time-out (t_{response}) described in the Timing section of this document is the equivalent of a NAK message. **A Bill-to-Bill unit has some exceptions when it responds to IDENTIFICATION and RECYCLING CASSETTE STATUS commands. Refer to section 2.8 for details.**

The t_{free} must be obeyed by the Controller between the end of any ACK or NAK confirmation response and start of the next command transmission. Currently t_{free} is defined as 10 mS of Bus silence, but for reliable operation of future multi-device buses the recommended value of t_{free} is 20mS.

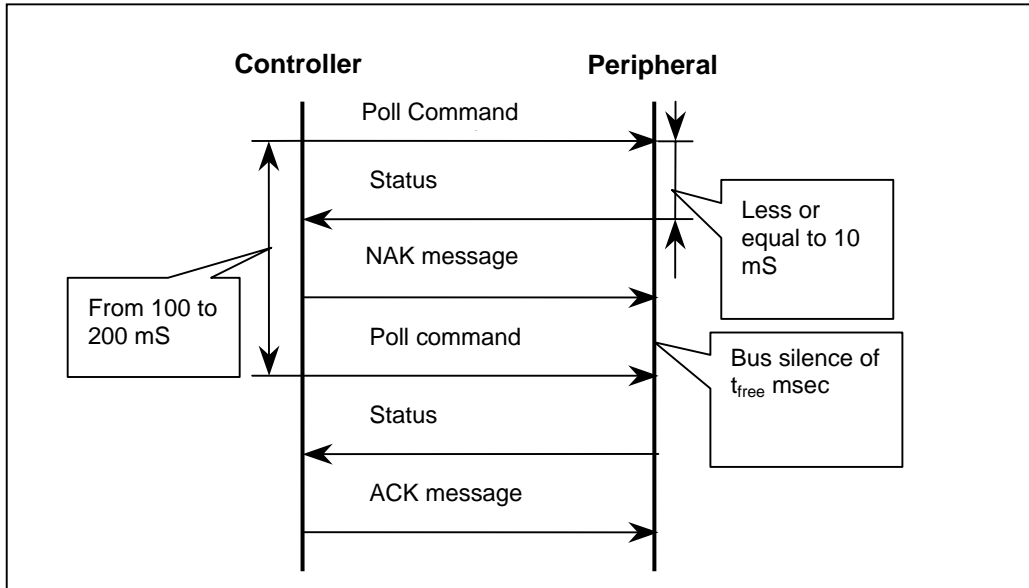
2.6.1 The diagram below represents a typical transmission when PERIPHERAL has no data to return.



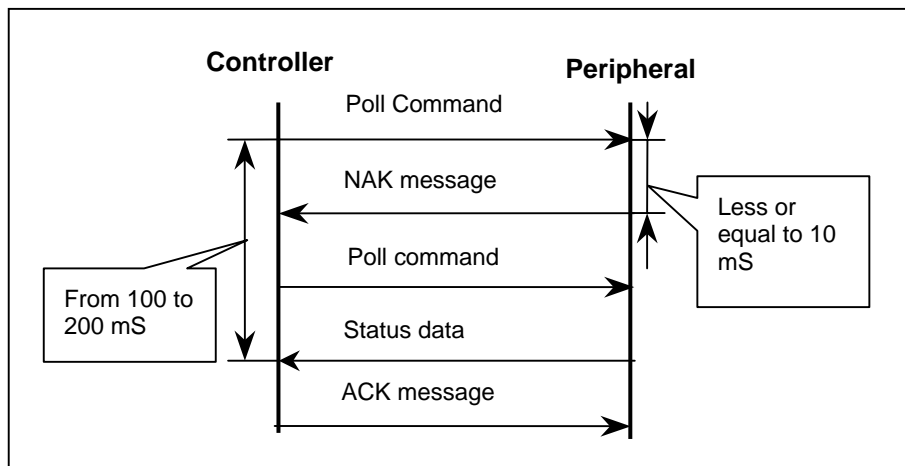
2.6.2 The diagram below represents a typical transmission when PERIPHERAL has data to return.



2.6.3 The diagram below represents a typical transmission when the Controller determines a CRC is not correct.



2.6.4 The diagram below represents a typical transmission when Peripheral determines a CRC is not correct. The Peripheral responds by sending a NAK message to the Controller to indicate that the information was not received correctly.





2.7 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_{response(max.)}	The maximum time Peripheral will take to respond to a valid communication
t_{bus reset(min.)}	The minimum time of sending signal BUS RESET
t_{non-response (max.)}	The maximum non-response time
T_{poll(min.)}	The minimum interval of time between two commands Poll
T_{free(min.)}	The minimum interval of time between confirmation ACK or NAK and next command

2.8 Timing Specifications

Baud Rate	9600/19200 +1%/-2% NRZ (non-return to zero), non-negotiable, hardware selectable
t_{inter-byte(max.)}	5.0 ms
t_{response(max.)} **	10.0 ms
t_{bus reset(min.)}	100 ms
T_{non-response (max.)}	5.0 S
T_{poll(min.)}	100ms (recommended 200 ms or more)
T_{free(min.)}	10 ms (recommended 20 ms or more)

**

Bill-to-Bill may take as much as 200 ms to respond to **IDENTIFICATION** and **RECYCLING CASSETTE STATUS** commands. A 2 s timeout is required for **POWER RECOVERY**, **EXTENDED IDENTIFICATION** and **EXTENDED CASSETTE STATUS** commands.

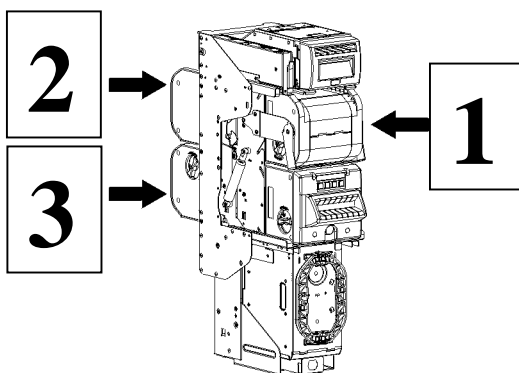
3 CONTROLLER/BILL-TO-BILL UNIT Communication Specification

3.1 Introduction

This section defines the communication bytes sent and received between Bill-to-Bill unit and the Controller. Unless stated otherwise, all information is assumed to be in a hexadecimal format. The Bill-to-Bill unit's address is 01H.

Basic terminology used in the following subsections is as follows:

- "Bill type" – an entry in the bill table; bill types numbering starts with 0 and spans up to 23; not all the bill types may be active for any given Bill-to-Bill configuration (country dependant) and first bill is not mandated to have a bill type 0; bill table is not guaranteed to be continuous, empty entries may be present in between valid bill types;
- Bill type 24 – pseudo bill type for **escrow** cassette; does not represent any real bill type, but used to handle bills in Escrow Cassette instead;
- "Cassette number" – unique number of a recycling cassette; for 3-cassette configuration 1st cassette has number of 1, 2nd has number of 2 and so on; this sequence is not required to be continuous – i.e. if 2nd cassette is missing, there will be only cassettes with numbers 1 and 3 present;



3.2 Command Protocol

If a Controller command is received by the Bill-to-Bill, which is not applicable to its current state, the Bill-to-Bill issues ILLEGAL COMMAND message.

3.3 Controller Commands

<u>Command</u>	<u>HEX Code</u>	<u>Description</u>	<u>Applicable States</u>
RESET	30H	Command for Bill-to-Bill unit to self-reset	ALL
GET STATUS	31H	Request for Bill-to-Bill unit set-up status	IDLING, DISABLED
SET SECURITY	32H	Sets Bill-to-Bill unit Security Mode. Command is followed by set-up data. See command format	INITIALIZE, DISABLED
POLL	33H	Request for Bill-to-Bill unit activity Status	ALL
ENABLE BILL TYPES	34H	Indicates Bill Type enable or disable. Command is followed by set-up data. See command format	IDLING, ACCEPTING, REJECTING, ESCROW, HOLDING, STACKING, RETURNING, DISABLED
STACK	35H	Sent by Controller to stack a bill in escrow to drop cassette or to one of the recycling cassettes	ESCROW, HOLDING
RETURN	36H	Sent by Controller to return a bill in escrow	ESCROW, HOLDING
IDENTIFICATION	37H	Request for Model, Serial Number, Country ISO code, Asset Number	POWER UP, INITIALISE, DISABLED, IDLING
HOLD	38H	Command for holding a bill in Escrow state	ESCROW, HOLDING



SET BARCODE PARAMETERS	39H	Command for settings the barcode format and number of characters	INITIALIZE, DISABLED
EXTRACT BARCODE DATA	3AH	Command for retrieving barcode data if barcode coupon is found. If this command is sent when barcode coupon is not found the Bill Validator returns ILLEGAL COMMAND response.	ESCROW, PACKED, IDLING, DISABLED
RECYCLING CASSETTE STATUS	3BH	Request for Bill-to-Bill unit recycling cassette status	IDLING, DISABLED, ESCROW
DISPENSE	3CH	Command to dispense bill(s)	DISABLED
UNLOAD	3DH	Command to unload bills from recycling cassette(s) to drop cassette	DISABLED
EXTENDED IDENTIFICATION	3EH	Request for Model, Serial Number, Software Version of Bill-to-Bill unit and its subunits, Country ISO code, Asset Number	DISABLED, IDLING
SET RECYCLING CASSETTE TYPE	40H	Assigns recycling cassettes to bill type	DISABLED
GET BILL TABLE	41H	Request for bill type description	IDLING, DISABLED
DOWNLOAD	50H	Command for transition to download mode. Please refer to CCNET Document 2 for details.	DISABLED, FAILURE, DROP CASSETTE REMOVED
GET CRC32 OF THE CODE	51H	Request for Bill Validator's firmware CRC32.	POWER UP, INITIALIZE, DISABLED, FAILURE
MODULE DOWNLOAD	52H	Command to enter an internal module update mode. Please refer to CCNET Document 2 for details.	DISABLED
MODULE IDENTIFICATION REQUEST	53H	Request serial numbers of all intelligent modules	DISABLED, IDLING
REQUEST STATISTICS	60H	Command for retrieving full information about acceptance performance. Please refer to CCNET Document 3 for details.	DISABLED
REAL-TIME CLOCK	62H	Read or initialize internal Real-Time Clock.	DISABLED
POWER RECOVERY	66H	Request whether there was a power cut and perform credit recovery	DISABLED
EMPTY DISPENSER	67H	Dispense all bills remaining in the dispenser after power cut.	POWER CUT WHILE DISPENSING
SET OPTIONS	68H	Set various Bill-To-Bill options	INITIALIZE, DISABLED
GET OPTIONS	69H	Set various Bill-To-Bill options	INITIALIZE, DISABLED
EXTENDED CASSETTE STATUS	70H	Extended recycling cassette status request	DISABLED

3.4 Controller Command Format

RESET

Controller Command	Code	Controller Data
RESET	30H	No data bytes

This command is used to tell the Bill-to-Bill unit that it must return to its default-operating mode. It must abort all communication, reject any bills in the validation process, return any bills in the escrow position, and disable all other activity until otherwise instructed by the Controller.

GET STATUS



Controller Command	Code	Bill-to-Bill unit Response Data
GET STATUS	31H	9 bytes: Z1 – Z9

Z1-Z3	Bill Type, 3 bytes. Indicates the bill enables for bill types 0 to 23.
Z4-Z6	Bill Security Levels, 3 bytes. Indicates the security level for bill types 0 to 23.
Z7-Z9	Bill Type Routing, 3 bytes. Indicates what bill types can be routed to the Bill-to-Bill unit's recycling cassettes. Valid bill types are 0 to 23.

Bill Type

Byte Z1 bits									Byte Z2 bits									Byte Z3 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0			
Bill types enabled if bits set																										
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0		
3	2	1	0	9	8	7	6	5	4	3	2	1	0													

Bill Security Levels

Byte Z4 bits									Byte Z5 bits									Byte Z6 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0			
Bill types set to high security if bits set																										
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0		
3	2	1	0	9	8	7	6	5	4	3	2	1	0													

Bill Type Routing

Byte Z7 bits									Byte Z8 bits									Byte Z9 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0			
Bill types can be routed if bits set																										
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0		
3	2	1	0	9	8	7	6	5	4	3	2	1	0													

SET SECURITY

Controller Command	Code	Controller Data
SET SECURITY	32H	3 Bytes: Y1 – Y3

Byte Y1 bits									Byte Y2 bits									Byte Y3 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0			
Bill types set to high security if bits set																										
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0		
3	2	1	0	9	8	7	6	5	4	3	2	1	0													

A bit is set to indicate the type of bill(s), which are set to a "high" security level. Low security levels provide higher acceptance and vice versa.

POLL

Controller Command	Code	Bill-to-Bill unit Response Data
POLL	33H	<i>n</i> data bytes: Z1- Z <i>n</i>

Indicates state of the Bill-to-Bill unit and its activity. The Bill-to-Bill unit will in most cases send 3 bytes of data (unless stated otherwise), but the package length should be determined according to the length of the frame (refer to the 2.2 for the message format).

The following data can be received from Bill-To-Bill unit in response to the POOL command:



Z1	Z2	Z3 ... Zn	Description
10H	N/A	N/A	POWER UP – The state of a B2B after a power up.
13H	N/A	N/A	INITIALIZE – The state in which Bill-to-Bill unit initializes itself after a RESET command from the Controller.
14H	N/A	N/A	IDLING – The state in which Bill-to-Bill is ready accept bills.
15H	N/A	N/A	ACCEPTING – In this state Bill-to-Bill unit continues to validate a bill and determine its denomination.
17H	N/A	N/A	STACKING – In this state, the Bill-to-Bill unit transports a bill from Escrow position to the recycling cassette or to the drop cassette and remains in this state until the bill is stacked or returned if jammed.
18H	N/A	N/A	RETURNING – In this state Bill-to-Bill unit transports a bill from Escrow position to front bezel and remains in this state until the bill is removed by customer or returned if jammed.
19H	N/A	N/A	DISABLED – The Bill-to-Bill unit has been disabled by the Controller and also the state in which Bill-to-Bill unit is after initialization.
1AH	N/A	N/A	HOLDING – The state, in which the bill is held in Escrow position after the HOLD command from the Controller.
1BH	N/A	N/A	BUSY - The state in which the Bill-to-Bill unit is unable to act on any command.
1CH	60H	N/A	REJECTING - Rejecting due to Insertion. Insertion error
	61H	N/A	REJECTING - Rejecting due to Magnetic. Magnetic error
	62H	N/A	REJECTING - Rejecting due to bill Remaining in the head. Bill remains in the head, and new bill is rejected.
	63H	N/A	REJECTING - Rejecting due to Multiplying. Compensation error/multiplying factor error.
	64H	N/A	REJECTING - Rejecting due to Conveying. Conveying error.
	65H	N/A	REJECTING - Rejecting due to Identification1. Identification error.
	66H	N/A	REJECTING - Rejecting due to Verification. Verification error.
	67H	N/A	REJECTING - Rejecting due to Optic. Optic error.
	68H	N/A	REJECTING - Rejecting due to Inhibit. Returning by inhibit denomination error.
	69H	N/A	REJECTING - Rejecting due to Capacity. Capacitance error.
	6AH	N/A	REJECTING - Rejecting due to Operation. Operation error.
	6CH	N/A	REJECTING - Rejecting due to Length. Length error.
	6DH	N/A	REJECTING - Rejecting due to UV optic. Banknote UV properties do not meet the predefined criteria.
	92H	N/A	REJECTING - Rejecting due to unrecognised barcode. Bill taken was treated as a barcode but no reliable data can be read from it.
	93H	N/A	REJECTING - Rejecting due to incorrect number of characters in barcode. Barcode data was read (at list partially) but is inconsistent.
94H	N/A	REJECTING - Rejecting due to unknown barcode start sequence. Barcode was not read as no synchronization was established.	
95H	N/A	REJECTING - Rejecting due to unknown barcode stop sequence. Barcode was read but trailing data is corrupt.	
1DH	00H	N/A	DISPENSING – B2B moves the bill(s) from recycling cassette to dispenser.
	01H	N/A	DISPENSING – B2B remains in this state until customer take the bill(s) from dispenser.
1EH	00H	N/A	UNLOADING – B2B is moving the bill(s) from recycling cassette to drop cassette.



Z1	Z2	Z3 ... Zn	Description
	01H	N/A	UNLOADING – B2B is moving the bill(s) from recycling cassette to drop cassette. Number of bills requested is more than the number of bills in the cassette.
21H	N/A	N/A	SETTING TYPE CASSETTE – The unloading of the recycling cassette is carried out, and if it is necessary, reprogramming EEPROM.
25H*	N/A	N/A	DISPENSED – Dispensing is completed.
26H*	Number of Bills	N/A	UNLOADED – Unloading is completed.
28H	N/A	N/A	INVALID BILL NUMBER – Required number of bills is incorrect.
29H	N/A	N/A	SET CASSETTE TYPE – Setting recycling cassette type is completed.
30H	N/A	N/A	INVALID COMMAND – Command from the Controller is not valid.
41H	N/A	N/A	DROP CASSETTE FULL – Drop Cassette full condition.
42H	N/A	N/A	DROP CASSETTE REMOVED – The B2B unit has detected the drop cassette to be open or removed.
43H	N/A	N/A	JAM IN ACCEPTOR – A bill has jammed in the bill path.
44H	N/A	N/A	JAM IN STACKER – A bill has jammed in drop cassette.
45H*	N/A	N/A	CHEATED – The Bill-to-Bill unit detected attempts by user to cheat.
47H	Code1	N/A	Generic BB ERROR codes. Followed by failure description bytes.
80H	Bill Type	N/A	ESCROW.
81H*	Bill Type	1 byte destination: 0 – drop cassette 1... 16 – cassette 1...16 correspondingly	PACKED, STACKED.
82H*	Bill Type	N/A	RETURNED.

- **N/A** Not applicable to the current version (always = 00h). Reserved for future use.
- **Bill Type** – 0...24.
- **Code1** see Document 6.

* - State will be reported until it's read by Host controller (a valid ACK received by Bill-To-Bill unit).

ENABLE BILL TYPES

Controller Command	Code	Controller Data
ENABLE BILL TYPES	34H	6 bytes: Y1 – Y6

Byte Y1 bits								Byte Y2 bits								Byte Y3 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types enabled if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											

NOTE: Sending 000000H disables the Bill-to-Bill unit.

Byte Y4 bits								Byte Y5 bits								Byte Y6 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types with escrow enabled if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											



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

STACK

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
STACK	35H	No data bytes

This command causes the Bill-to-Bill unit to send the “bill in escrow” position to drop cassette or one of the recycling cassettes.

NOTE: After a STACK command the Bill-to-Bill unit should respond to a POLL command with the BILL STACKED message within 30 seconds.

RETURN

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
RETURN	36H	No data bytes

This command causes the Bill-to-Bill unit to return the bill in escrow to the customer.

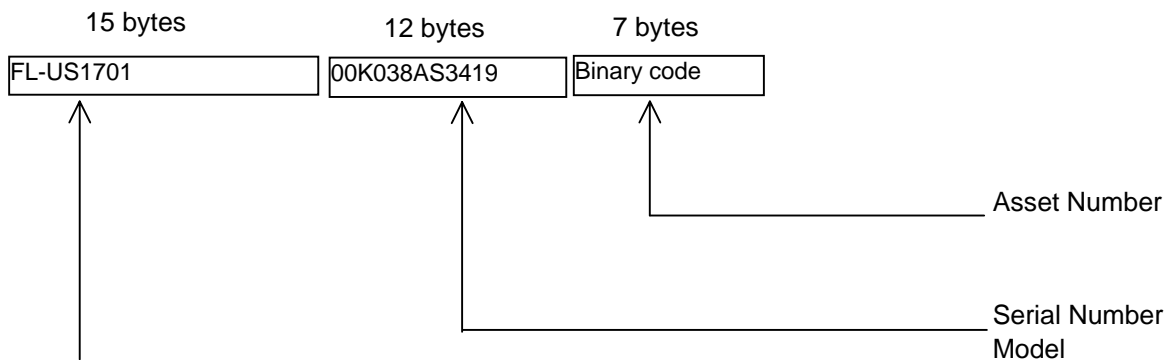
NOTE: After a RETURN command the Bill-to-Bill unit should respond to a POLL command with the BILL RETURNED message within 30 seconds.

IDENTIFICATION

<u>Controller Command</u>	<u>Code</u>	<u>Bill-to-Bill unit Response Data</u>
IDENTIFICATION	37H	34 bytes: Z1 – Z34

<u>Bytes</u>	<u>Description</u>
Z1-Z15	Part Number – 15 bytes, ASCII characters
Z16-Z27	Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z28-Z34	Asset Number – 7 bytes, unique to every Bill Validator, binary data

Bytes Z1-Z27 must be sent as ASCII Characters. Zero (30H) and Blank (20H) are acceptable. Asset Number must be sent as binary code.





SET BARCODE PARAMETERS

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
SET BARCODE PARAMETERS	39H	2 bytes: Y1-Y2

Used to set the barcode format and number of characters.

Y1 - bar code format. 01H = interleaved 2 of 5.

Y2 - number of characters (min 6, max 18).

EXTRACT BARCODE DATA

<u>Controller Command</u>	<u>Code</u>	<u>Bill-To-Bill Response Data</u>
EXTRACT BARCODE DATA	3AH	n bytes: Z1-Zn

Z1-Zn - n bytes ASCII of barcode data, n is equal min 6 bytes, max 18 bytes. Data is sent most significant byte first. Parameter n is assigned by command SET BARCODE PARAMETERS.

This command may be sent at any time after the Bill Validator responds to the Poll command by event 80H, 81H or 82H and the bill type indicates barcode token presence (23). Barcode data of a successful reading is preserved until next bill will be inserted. Otherwise an ILLEGAL COMMAND response will be returned.

EXTENDED IDENTIFICATION

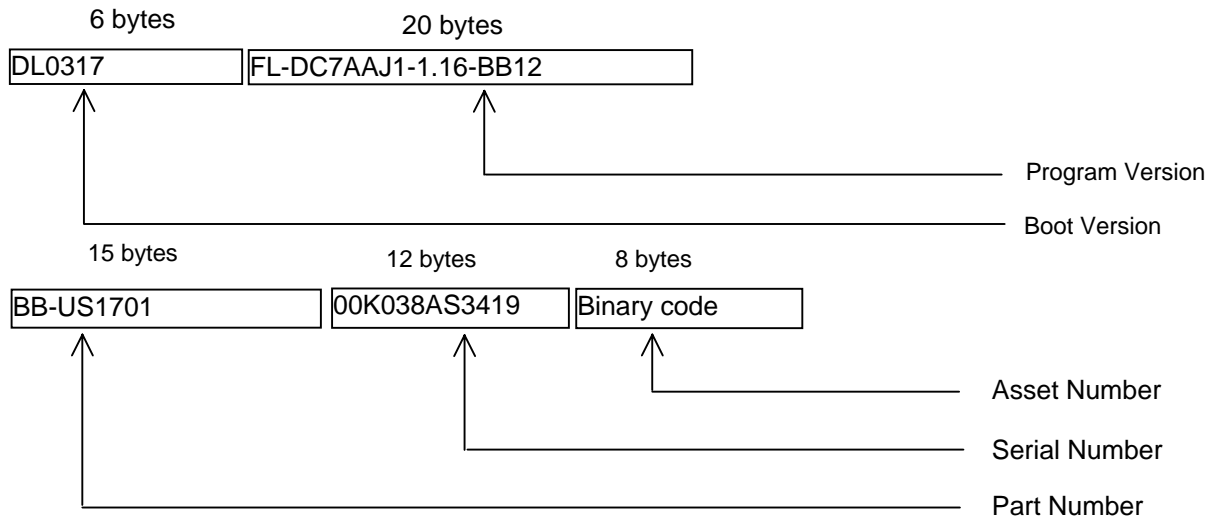
<u>Controller Command</u>	<u>Code</u>	<u>Bill-to-Bill unit Response Data</u>
EXTENDED IDENTIFICATION	3EH	109 bytes: Z1 – Z109

Bytes	Description
Z1-Z15	Part Number – 15 bytes, ASCII characters
Z16-Z27	Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z28-Z35	Asset Number – 8 bytes, unique to every Bill Validator, binary data
Z36-Z41	Boot Version Validator Head – 6 bytes, ASCII characters
Z42-Z61	Program Version Validator Head – 20 bytes, ASCII characters
Z62-Z67	Boot Version CPU Board – 6 bytes, ASCII characters
Z68-Z73	Program Version CPU Board – 6 bytes, ASCII characters
Z74-Z79	Boot Version Packer Board – 6 bytes, ASCII characters
Z80-Z85	Program Version Packer Board – 6 bytes, ASCII characters
Z86-Z91	Boot Version Cassette Processor1 – 6 bytes, ASCII characters
Z92-Z97	Boot Version Cassette Processor2 – 6 bytes, ASCII characters
Z98-Z103	Boot Version Cassette Processor3 – 6 bytes, ASCII characters
Z104-Z109	Program Version Cassette Processor – 6 bytes, ASCII characters

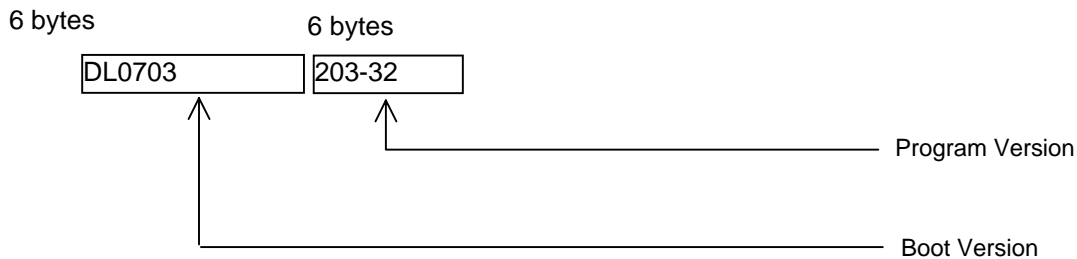
Bytes Z1-Z27 must be sent as ASCII Characters. Zero (30H) and Blank (20H) are acceptable.

Asset Number must be sent as binary code.

Example of Validator Head soft version:



Example of BB Devices software version:



HOLD

Controller Command	Code	Controller Data
HOLD	38H	No data bytes

This command allows the Controller to hold Bill-to-Bill unit in a state Escrow during 10 s. After this time the Controller should send the STACK or RETURN command. For continued holding in an Escrow state it is necessary to resend this command. Otherwise Bill-to-Bill unit will execute return of a bill.

RECYCLING CASSETTE STATUS

Controller Command	Code	Bill-to-Bill unit Response Data
RECYCLING CASSETTE STATUS	3BH	up to 32 bytes: Z1 up to Z32

Z1-Z32 Recycling Cassettes Status – up to 32 bytes.

The data returned in response to this command is a one-dimensional array of word (2-byte) entries. The number of the entries equals number of supported cassettes.

Every entry has the following format:

- **most significant byte:**
 - bit 7 – cassette presence flag, set to 1 if cassette present;



- bit 6 – cassette full flag;
- bit 5 – reserved (not used);
- bits 0 thru 4 – bill type, may take on of the following values:
 - 0 thru 23 – cassette assigned to the bill type **0** thru **23**;
 - 24 – cassette assigned to **escrow**;
 - 1FH – cassette is not assigned;
- **least significant byte** – number of bills in cassette.

If the cassette presence flag is not set all the other information in the entry has no meaning.

NOTE: The Recycling Cassette can be programmed for **ESCROW** operation (bill type **24**). It means that all accepted bills not having a Recycling Cassette assigned to them would be directed from the Validating Head into this Recycling Cassette assigned to Escrow type. The option is useful when one wishes to return the money (in case of transaction cancellation) with exactly the same bills the customer inserted. If the customer cancels the transaction all his bills will be returned through the Dispensing Cassette. If transaction completes successfully all bills from the Escrow Recycling cassette should be reloaded into the Drop Cassette. It is the Host Controller’s responsibility to perform this operation during the pause before next customer. If the next customer enters the bill the reload process should be interrupted and the Bill-to-Bill unit will serve the customer. The reload process should be continued at the next pause. With Escrow cassette present in the Bill-to-Bill the host controller should maintain the log of bill insertions done by the customer. Otherwise in case of transaction cancellation the customer may get the money back with bills different from that one he inserted. This may happen if the customer inserted not an optimal set of bills for the amount given and the Bill-to-Bill has bills to give out an optimal combination for the amount given.

DISPENSE

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
DISPENSE	3CH	32 bytes: Y1-Y32

Y1-Y32 The odd bytes specify bill types and the even bytes contain number of bills to dispense for these types. For example, if bytes Y1-Y6 contain sequence 0, 2, 2, 1, 4, 3 it means that it is necessary to dispense 2 bills of type 0, 1 bill of type 2 and 3 bills of type 4.

NOTE: The total number of bills to dispense must not exceed 20 bills.

UNLOAD

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
UNLOAD	3DH	2 bytes: Y1-Y2

This command unloads the bills from the recycling cassettes to drop cassette.

Y1 The number of recycling cassette.
Y2 The number of bills.

SET RECYCLING CASSETTE TYPE

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
SET RECYCLING CASSETTE TYPE	40H	2 bytes: Y1-Y2

Command for assigning recycling cassette bill type. If the cassette is not empty, the command carries out complete unloading of the cassette.

Y1 Recycling cassette number.



- Y2** Cassette assignment byte:
- Bits 0...4 - Bill type to assign for the cassette (1FH to make cassette “not assigned”, 24 to set cassette to Escrow type);
 - Bits 5, 6, 7 – not used;

NOTE: if a cassette assign operation fails the cassette will be automatically made “not assigned”; some examples of possible fail causes are: cassette is not physically present, cassette is assigned to a bill type not supported by that specific software version (does not have a valid entry in the bill table) etc.

GET CRC32 OF THE CODE

<u>Controller Command</u>	<u>Code</u>	<u>Bill-To-Bill Response Data</u>
GET CRC32 OF THE CODE	51H	4 bytes: Z1-Z4

Z1-Z4 - 4 bytes of CRC, MSB first.

This command is valid in the following states: Power up, Initialize, one of the Failure states (41H-47H) or Unit Disabled.

MODULE IDENTIFICATION REQUEST

<u>Controller Command</u>	<u>Code</u>	<u>Bill-to-Bill unit Response Data</u>
IDENTIFICATION	53H	60 bytes: Z1 – Z60

Bytes	Description
Z1-Z12	Chassis' Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z13-Z24	Dispenser's Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z24-Z36	Cassette 1 Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z37-Z48	Cassette 2 Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z49-Z60	Cassette 3 Serial Number – 12 bytes Factory assigned serial number, ASCII characters

All bytes must be sent as ASCII Characters. Zero (30H) and Blank (20H) are acceptable.



GET BILL TABLE

Controller Command	Code	Bill-to-Bill unit Response Data
GET BILL TABLE	41H	120 bytes: Z1-Z120

Command for request bill type description.

Z1-Z120 The 120 - byte string consists from 24 five-byte words.
 Byte 1 of word – most significant digit(s) of the denomination.
 Bytes 2-4 of word – country code in ASCII characters.
 Byte 5 of word – this byte used to determine decimal placement or proceeding zeros. If bit D7 is 0, the bits D0-D6 indicate the number of proceeding zeros. If bit D7 is 1, the bits D0-D6 indicates the decimal point position starting from the right and moving to the left.
 A five-byte position in the 120-bytes string indicates bill type description for the particular bill type. For example, first five byte correspond bill type=0, second five byte correspond bill type=1 and so on.

Example:

Bill Type	Denomination Code First Byte	Country Code 3 bytes	Denomination Code Second Byte	Denomination	
0	1	USA	0x00	1	Dollar
1	5	USA	0x00	5	Dollar
2	1	USA	0x01	10	Dollar
3	2	USA	0x01	20	Dollar

Unsent bytes are assumed to be zero.

POWER RECOVERY

Controller Command	Code	Bill-To-Bill unit response data
POWER RECOVERY	66H	<i>n</i> data bytes: Z1-Z <i>n</i>

This command is used to request the unit's power up status. In response to this command the Bill-To-Bill unit will report whether power was lost in the middle of a critical operation (such as packing, dispensing or unloading) and provide information for power recovery. The command should be sent by Host controller after power is restored (POWER UP state detected) and the unit finished initialization and is in DISABLED state. The unit's response could be 1 or more bytes long depending on the unit's power up status.

Z1 (Power Up status)	Z2...Zn	Description
00H	N/A	ACK (NO POWER CUT DETECTED) – all critical operations were successfully finished before power was turned OFF.
17H	<u>2 or more bytes*</u> describing just packed bills	POWER CUT WHILE PACKING - a power cut happened during the Accepting process and some bills remained in the channel when the power was restored. All bills have been packed and bytes Z2-Zn of the response contain list of packed bills.
3CH	<u>Up to 80 bytes**</u> describing current dispenser state	POWER CUT WHILE DISPENSING - a power cut happened during the Dispensing process and some bills remained in the dispenser. The last command and list of the bills is reported in data bytes Z2...Zn . EMPTY DISPENSER command should be issued and all bills successfully dispensed before enabling the Bill-To-Bill unit using BILL TYPE command. Otherwise the unit will report a FAILURE state.

Z3 - Number of bytes to unload

Z4-Zn Actual unit state (up to 48 bytes)

The actual unit's state is an array of word (2-byte) entries representing numbers and bill types of the bills successfully unloaded into the drop box. The number of the entries equals the number of different denominations.

Every entry has the following format:

- **most significant byte:**
 - bits 5 ... 7 – reserved (not used);
 - bits 0 ... 4 – bill type, may take on of the following values:
 - **0...23** – the least significant byte contains number of the bill type **0...23** correspondingly;
- **least significant byte** – number of the bills of a bill type specified by the most significant byte.

For example, if power cut happened during unloading 12 bills from the escrow cassette (cassette 2), which contained 7 bills of bill type 5 and 5 bills of bill type 3, and only 10 bills (7 bills of bill type 5 and 3 bills of bill type 3) were successfully unloaded, the Operation Status Data will be:

0CH, 02H, 03H, 03H, 07H, 05H

EMPTY DISPENSER

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
EMPTY DISPENSER	67H	No data bytes

This command is used to recover after power cut during dispensing process and tells the Bill-to-Bill unit to dispense all bills remaining in the dispenser at the moment. The command is valid only in DISABLED state and should be sent before enabling Bill-To-Bill unit using BILL TYPE command in the case if the unit reported POWER CUT WHILE DISPENSING in response to POWER RECOVERY command. Bill-To-Bill unit will react to this command in the same way as to DISPENSE command. Except no additional bills will be transported to the dispenser and dispenser will eject only its current content.

SET OPTIONS

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
SET OPTIONS	68H	4 Bytes: Y1 – Y4

The command turns ON/OFF different options implemented in the Bill-To-Bill device. Each option represents specific feature or optional behaviour supported by the device. The options are set using 4-byte bitmap with bits turning corresponding option ON/OFF.

Byte Y1 bits								Byte Y2 bits								Byte Y3 bits								Byte Y4 bits							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Option is enabled if the corresponding bit is set																															
LED OFF																															
Hold bill																															
Check for tape																															
Turn switch																															
Reserved																															
Reserved																															
Reserved																															
Reserved																															
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Default settings on power up																													
0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The following options are supported by Bill-To-Bill device:

- **LED OFF** – sets the state of the face lights in the DISABLED state:
 0 – Red lights are turned ON;
 1 – Face lights are OFF.
- **Hold bill** – defines whether or not hold bill on the input roller after ejecting:
 0 – Do not hold the bill after ejecting;
 1 – Hold the bill after ejecting until customer takes it out.
- **Check for tape** – defines whether or not apply advanced tape detection algorithm. The advanced algorithm better detects tapes attached to devices, but significantly increases the bill processing time.
- **Turn switch** - defines whether or not to secure bill path after packing the bill. Use this option to prevent cheating by pulling out the bill after stacking. This feature increases time required to stack the bill.

GET OPTIONS

<u>Controller Command</u>	<u>Code</u>	<u>Bill-To-Bill unit response Data</u>
GET OPTIONS	69H	4 Bytes: Y1 – Y4

The command requests currently enabled options implemented in the Bill-To-Bill device. The options are returned in the form of 4-byte bitmap with bits corresponding to specific options. The bitmap format is described in **SET OPTIONS** command description.

REQUEST/SET TIME&DATE

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>	<u>Bill-to-Bill unit Response Data</u>
REQUEST TIME&DATE	62H	-	8 bytes: Z1 – Z8

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>	<u>Bill-to-Bill unit Response Data</u>
SET TIME&DATE	62H	7 bytes:Y1 – Y7	8 bytes: Z1 – Z8

This command is used both for request and for setting time and date. If command contains controller data it is setting command otherwise it is request command. The same format data is used in these variants of a command. It corresponds to the following table. All data is presented in BCD format.

Bit	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Byte									
1.	CH	10 Seconds			Seconds				00-59
2.	0	10 Minutes			Minutes				00-59
3.	0	0	10HR		Hours				00-23
4.	0	0	0	0	0	Day			1-7
5.	0	0	10 date		Date				01-28/29 01-30 01-31
6.	0	0	0	10 month	Month				01-12
7.	10 Year				Year				00-99



CH – enable clock's oscillator. If this bit is cleared the clock is stopped.

EXTENDED CASSETTE STATUS

Controller Command	Code	Controller Data	Bill-To-Bill unit response Data
EXTENDED CASSETTE STATUS	70H	One byte X1	Up to 129 Bytes: Z1 – Z129

The command requests extended information about the contents of the recycling cassette. In response to the command the bill validator will report total number of the bills in the cassette as well as bill type for each bill. This command is useful if one needs to know exactly which bills are stored in the escrow cassette. Note, that Bill-To-Bill unit stores bills in the recycling cassettes according to last-in-first-out principle. Therefore the response will reflect the actual image of the cassette contents (actual denominations and their positions in the cassette).

Controller data:

X1 – Cassette number to report information about

Bill-To-Bill unit response Data:

- Z1** Total number of bills in the cassette. This value determines length of the following cassette contents array.
- Z2-Zn** Cassette Contents Data – Z1 bytes. The cassette contents data is an array containing bill types of the bills in the cassette. If the recycling cassette is assigned to a denomination (not escrow cassette) the array will contain Z1 identical entries equal to the bill type associated with the cassette. In the case of escrow cassette the array will reflect the bills inside of the cassette.



4 CONTROLLER/COIN CHANGER Communication Specification

4.1 Introduction.

This section defines the communication bytes sent and received by a Coin Changer. The Coin Changer's address is 02H. Unless stated otherwise, all information is assumed to be in hexadecimal format.

The coin changer must be compatible with Controller that is designed according to the operational rules defined earlier in this document.

4.2 Command Protocol

The commands IDENTIFICATION, GET COIN TABLE, and DOWNLOAD should be sent by the Controller, when Coin Changer is in the following states: Power up, Initialize or Unit Disabled.

If the Coin Changer, which is not executable in its present state, receives a Controller command Coin Changer issues ILLEGAL COMMAND message.

4.3 Controller Commands

Command	HEX Code	Description
RESET	08H	Command for Coin Changer to self-reset
GET STATUS	09H	Request for Coin Changer set-up status
TUBE STATUS	0AH	Request for Coin Changer tube status.
POLL	0BH	Request for Coin Changer activity Status
ENABLE COIN TYPES	0CH	Indicates Coin Type enable or disable. Command is followed by set-up data. See command format
DISPENSE	0DH	Command to dispense a coin type. Command is followed by set-up data. See command format
IDENTIFICATION	0FH	Request for Model, Serial Number, Software Version of Coin Changer, Country ISO code
GET COIN TABLE	10H	Request for coin type description
DOWNLOAD	50H	Command for transition to download mode

4.4 Controller Command Format

RESET

Controller Command	Code	Controller Data
RESET	08H	No data bytes

This command is used to tell the Coin Changer that it must return to its default-operating mode. It must abort all communication and disable all acceptance until otherwise instructed by the Controller.



GET STATUS

Controller Command	Code	Coin Changer Response Data
GET STATUS	0CH	6 bytes: Z1 – Z6

Z1-Z3	Coin Type, 3 bytes. Indicates the coin enables for coin types 0 to 23.
Z4-Z6	Coin Type Routing, 3 bytes. Indicates what coin types can be routed to the Coin Changer's tubes. Valid coin types are 0 to 23.

Coin Type

Byte Z1 bits								Byte Z2 bits								Byte Z3 bits							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Coin types enabled if bits set																							
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Coin Type Routing

Byte Z4 bits								Byte Z5 bits								Byte Z6 bits							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Coin types can be routed if bits set																							
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

NOTE: Coin type credits sent as FFH are assumed to be Free Vend tokens and their value is assumed to be worth one vend.

TUBE STATUS

Controller Command	Code	Coin Changer Response Data
TUBE STATUS	0AH	18 byte: Z1-Z27

Z1-Z3 Tube Full Status - 3 bytes.

Indicates status of coin tube for coin types 0 to 23.
A bit is set to indicate a full tube.

Byte Z1 bits								Byte Z2 bits								Byte Z3							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Tube for Coin types is full if bits set																							
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Z3-Z27 Tube Status – 24 bytes.

Indicates the greatest number of coins that the changer “knows” reliably can be paid out. A bytes position in the 24-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. Bytes not sent are assumed to be zero.

NOTE: If a Coin 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.



POLL

<u>Controller Command</u>	<u>Code</u>	<u>Bill-to-Bill unit Response Data</u>
POLL	0BH	1 or 2 bytes: Z1 or Z1- Z2

Indicates state of the Coin Changer and its activity. The Coin Changer may send 1 or 2 of the following data bytes:

Response data bytes		Description	
Z1	Z2		
10H		Power Up	The state of Coin Changer after power up
11H		Initialize	The state, in which Coin Changer executes initialization on the RESET command of the Controller.
12H		Idling	In this state Coin Changer waits for an inserting of coin into its front bezel.
13H		Accepting	In this state Coin Changer validates a coin and determines its denomination.
14H		Unit Disable	The Coin Changer has been disabled by the Controller and also the state in which Coin Changer is after initialization
14H		Changer Busy	The Coin Changer is busy and cannot answer a detailed command right now.
16H		Changer Pay Out Busy	The Coin Changer is busy activating Pay Out devices.
17H		Escrow request	An escrow lever activation has been detected.
18H		Double Arrival	Two coins were detected too close together to validate either one.
19H		No Credit	A coin was validated but did not get to the place in the system when credit is given.
13H		Coin Routing Error	A coin has been validated, but did not follow the intended routing.
13H		Generic Acceptor Error	The Coin Changer has detected that the validator has been removed or not responding.
13H		Defective Tube Sensor	The Coin Changer has detected one of the tube sensors behaving abnormally.
13H		Coin Jam	A coin(s) has jammed in the acceptance path.
13H		Tube Jam	A tube Pay Out attempt has resulted in jammed condition.
40 - 4FH (0100xxxx)	Z	Coin accepted to cash box	xxxx = coin type deposited (0 to 15). Z = number of coins in the tube for the coin type accepted.
50 - 5FH (0101xxxx)	Z	Coin accepted to tube	xxxx = coin type deposited (0 to 15). Z = number of coins in the tube for the coin type accepted.
60 - 6FH		Not used	
70 - 7FH (0111xxxx)	Z	Coin was rejected	xxxx = coin type deposited (0 to 15). Z = number of coins in the tube for the coin type accepted.
80 - FFH (1yyyxxxx)	Z	Coin dispensed manually	yyy = number of coins dispensed. xxxx = coin type dispensed (0 to 15) Z = number of coins in the tube for the coin type accepted.



ENABLE COIN TYPES

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
ENABLE COIN TYPES	0CH	4 bytes: Y1 – Y6

Y1 – Y3 Coin enable – 3 bytes

Byte Y1 bits								Byte Y2 bits								Byte Y3 bits							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Coin types enabled if bits set																							
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

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 000000H. All coins are automatically disabled upon reset.

Y6 – Y6 Manual Dispense enable – 3 bytes

Byte Y4 bits								Byte Y5 bits								Byte Y6 bits							
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Dispense enabled if bits set																							
23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

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 must be disabled while in the sales mode.

DISPENSE

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
DISPENSE	0DH	2 bytes: Y1-Y2

Y1 = Indicates coin types 0 to 23 to be dispensed.

Y2 = Indicates number of coins to be dispensed.

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



IDENTIFICATION

<u>Controller Command</u>	<u>Code</u>	<u>Acceptor Response Data</u>
IDENTIFICATION	0FH	19 bytes: Z1 – Z19

Bytes	Description
Z1-Z5	Model No. & Model Code – 5 bytes
Z6-Z12	Serial Number – 7 bytes Factory assigned serial number
Z13-Z16	Version – 4 bytes Current software version
Z17-Z19	Country – 3 bytes ISO code

Bytes Z1-Z19 must be sent as ASCII Characters zero (30H) and blanks (20H) are acceptable.

GET COIN TABLE

<u>Controller Command</u>	<u>Code</u>	<u>Acceptor Response Data</u>
GET COIN TABLE	10H	80 bytes: Z1-Z80

Command for request coin type description.

Z1-Z80 The 80 - byte string consists from 24 five-byte words.
 Byte 1 of word – most significant digit(s) of the denomination.
 Bytes 2-4 of word – country code in ASCII characters.
 Byte 5 of word – this byte used to determine decimal placement or proceeding zeros. If bit D7 is 0, the bits D0-D6 indicate the number of proceeding zeros. If bit D7 is 1, the bits D0-D6 indicates the decimal point position starting from the right and moving to the left.
 A five-byte position in the 80-bytes string indicates coin type description for the particular coin type. For example, first five byte correspond bill type=0, second five byte correspond bill type=1 and so on.
 Example of coin type description for 25-cent USA: 0x19"USD", 0x82;
 Unsent bytes are assumed to be zero.

DOWNLOAD

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
DOWNLOAD	50H	NONE

This command is not implemented in current Coin Changer software releases and will always return an INV response.



5 CONTROLLER/BILL VALIDATOR Communication Specification

5.1 Introduction.

This section defines the communication bytes sent and received between the Bill Validator and the Controller. Unless stated otherwise, all information is assumed to be in a hexadecimal format. The Bill Validator's address is 03H.

5.2 Command Protocol

If a Controller command is received by the Bill Validator, which is not executable in its present state, the Bill Validator issues ILLEGAL COMMAND message.

5.3 Controller Commands

<u>Command</u>	<u>HEX Code</u>	<u>Description</u>	<u>Applicable States</u>
RESET	30H	Command for Bill Validator to self-reset	ALL
GET STATUS	31H	Request for Bill Validator set-up status	ALL
SET SECURITY	32H	Sets Bill Validator Security Mode. Command is followed by set-up data. See command format	ALL
POLL	33H	Request for Bill Validator activity Status	ALL
ENABLE BILL TYPES	34H	Indicates Bill Type enable or disable. Command is followed by set-up data. See command format	ALL
STACK	35H	Sent by Controller to send a bill in escrow to the drop cassette	ESCROW, HOLDING
RETURN	36H	Sent by Controller to return a bill in escrow	ESCROW, HOLDING
IDENTIFICATION	37H	Request for Software Part Number, Serial Number, Asset Number	INITIALIZE, DISABLED, FAILURE
HOLD	38H	Command for holding of Bill Validator in Escrow state	ESCROW, HOLDING
SET BARCODE PARAMETERS	39H	Command for settings the barcode format and number of characters	ALL
EXTRACT BARCODE DATA	3AH	Command for retrieving barcode data if barcode coupon is found. If this command is sent when barcode coupon is not found the Bill Validator returns ILLEGAL COMMAND response.	ESCROW, PACKED, DISABLED, IDLING
GET BILL TABLE	41H	Request for bill type description	INITIALIZE, DISABLED, FAILURE
DOWNLOAD	50H	Command for transition to download mode. Please refer to CCNET Document 2 for details.	INITIALIZE, DISABLED, FAILURE
GET CRC32 OF THE CODE	51H	Request for Bill Validator's firmware CRC32.	INITIALIZE, DISABLED, FAILURE
REQUEST STATISTICS	60H	Command for retrieving full information about acceptance performance. Please refer to CCNET Document 3 for details.	INITIALIZE, DISABLED, FAILURE

The IDENTIFICATION, GET BILL TABLE, DOWNLOAD and REQUEST STATISTICS commands should be sent by the Controller when Bill Validator is in the following states: Power up, Initialize, one of the Failure states (41H-47H) or Unit Disabled. Otherwise an ILLEGAL COMMAND response will be returned.



5.4 Controller Command Format

RESET

Controller Command	Code	Controller Data
RESET	30H	No data bytes

This command is used to tell the Bill Validator that it must return to its default operating mode. It must abort all communication, reject any bills in the validation process, return any bills in the escrow position, and disable all other activity until otherwise instructed by the Controller.

GET STATUS

Controller Command	Code	Validator Response Data
GET STATUS	31H	6 bytes: Z1 – Z6

Z1-Z3	Bill Type, 3 bytes. Indicates the bill enables for bill types 0 to 23.
Z4-Z6	Bill Security Levels, 3 bytes. Indicates the security level for bill types 0 to 23.

Bill Type

Byte Z1 bits								Byte Z2 bits								Byte Z3 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types enabled if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											

Bill Security Levels

Byte Z4 bits								Byte Z5 bits								Byte Z6 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types set to high security if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											

SET SECURITY

Controller Command	Code	Controller Data
SET SECURITY	32H	3 Bytes: Y1 – Y3

Byte Y1 bits								Byte Y2 bits								Byte Y3 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types set to high security if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											

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



POLL

Controller Command	Code	Bill Validator Response Data
POLL	33H	1 or 2 bytes: Z1 or Z1- Z2

Indicates state of the Bill Validator and its activity. The Bill Validator may send 1 or 2 of the following data bytes:

Response data bytes		Description	
Z1	Z2		
10H		Power Up	The state of the Bill Validator after power up
11H		Power Up with Bill in Validator	Power up with bill in the Bill Validator. After a RESET command from the Controller Bill Validator returns the bill and continues initializing.
12H		Power Up with Bill in Stacker	Power up with bill in Stacker (Bill was transported too far to be returned). After the Bill Validator is reset and INITIALIZING is complete, status will immediately change to STACKED (81H) (Credit Recovery feature).
13H		Initialize	Bill Validator executes initialization after the RESET command from Controller.
14H		Idling	Bill Validator waits for an inserting of bill into its bill path.
15H		Accepting	Bill Validator executes scanning of a bill and determines its denomination.
17H		Stacking	Bill Validator transports a bill from Escrow position to drop cassette and remains in this state until the bill is stacked or jammed.
18H		Returning	Bill Validator transports a bill from Escrow position back to customer and remains in this state until customer removes the bill or the bill is jammed.
19H		Unit Disabled	Bill Validator has been disabled by the Controller or just came out of initialization
1AH		Holding	The state, in which the bill is held in Escrow position after the HOLD command of the Controller.
1BH	YH	Device Busy	Bill Validator cannot answer with a full-length message right now. On expiration of time YH, peripheral is accessible to polling. YH is expressed in multiple of 100 milliseconds.
1CH	Generic rejecting code. Always followed by rejection reason byte (see below).		
1CH	60H	Rejecting due to Insertion	Insertion error
1CH	61H	Rejecting due to Magnetic	Dielectric error
1CH	62H	Rejecting due to Remained bill in head	Previously inserted bill remains in head
1CH	63H	Rejecting due to Multiplying	Compensation error/multiplying factor error
1CH	64H	Rejecting due to Conveying	Bill transport error
1CH	65H	Rejecting due to Identification1	Identification error
1CH	66H	Rejecting due to Verification	Verification error
1CH	67H	Rejecting due to Optic	Optic Sensor error
1CH	68H	Rejecting due to Inhibit	Return by "inhibit denomination" error
1CH	69H	Rejecting due to Capacity	Capacitance error
1CH	6AH	Rejecting due to Operation	Operation error
1CH	6CH	Rejecting due to Length	Length error
1CH	92H	Rejecting due to unrecognised barcode	Bill taken was treated as a barcode but no reliable data can be read from it.
1CH	6DH	Rejecting due to UV	Banknote UV properties do not meet the predefined criteria



1CH	93H	Rejecting due to incorrect number of characters in barcode	Barcode data was read (at list partially) but is inconsistent.
1CH	94H	Rejecting due to unknown barcode start sequence	Barcode was not read as no synchronization was established.
1CH	95H	Rejecting due to unknown barcode stop sequence	Barcode was read but trailing data is corrupt.
41H		Drop Cassette Full	Drop Cassette full condition
42H		Drop Cassette out of position	The Bill Validator has detected the drop cassette to be open or removed.
43H		Validator Jammed	A bill(s) has jammed in the acceptance path.
44H		Drop Cassette Jammed	A bill has jammed in drop cassette.
45H		Cheated	Bill Validator sends this event if the intentions of the user to deceive the Bill Validator are detected.
46H		Pause	When the user tries to insert a second bill when the previous bill is in the Bill Validator but has not been stacked. Thus Bill Validator stops motion of the second bill until the second bill is removed.*
47H	Generic Failure codes. Always followed by failure description byte (see below).		
47H	50H	Stack Motor Failure	Drop Cassette Motor failure
47H	51H	Transport Motor Speed Failure	Transport Motor Speed failure
47H	52H	Transport Motor Failure	Transport Motor failure
47H	53H	Aligning Motor Failure	Aligning Motor failure
47H	54H	Initial Cassette Status Failure	Initial Cassette Status failure
47H	55H	Optic Canal Failure	One of the optic sensors has failed to provide its response.
47H	56H	Magnetic Canal Failure	Inductive sensor failed to respond
47H	5FH	Capacitance Canal Failure	Capacitance sensor failed to respond
Events with credit.			
80H	YH	Escrow position	Y = bill type (0 to 23). If bill type is enabled with escrow the Bill Validator waits command from Controller to stack or to return bill. If during 10 sec command will not be sent bill will be returned.
81H	YH	Bill stacked	Y = bill type (0 to 23)
82H	YH	Bill returned	Y = bill type (0 to 23)

* Bill validator is deadlocked in "Pause" state; to resolve deadlock "Reset" command may be issued.
 - YH =17H(23₁₀) corresponds to a barcode coupon.



ENABLE BILL TYPES

Controller Command	Code	Controller Data
ENABLE BILL TYPES	34H	6 bytes: Y1 – Y6

Byte Y1 bits								Byte Y2 bits								Byte Y3 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types enabled if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											

NOTE: Sending 000000H disables the Bill Validator.

Byte Y4 bits								Byte Y5 bits								Byte Y6 bits								
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	
Bill types with escrow enabled if bits set																								
2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	9	8	7	6	5	4	3	2	1	0
3	2	1	0	9	8	7	6	5	4	3	2	1	0											

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

STACK

Controller Command	Code	Controller Data
STACK	35H	No data bytes

This command causes the Bill Validator to send the bill in escrow position to the drop cassette.

NOTE: After a STACK command the Bill Validator should respond to a POLL command with the BILL STACKED message within 30 seconds. If this command is sent when the Bill Validator is not in ESCROW state the ILLEGAL COMMAND message is returned.

RETURN

Controller Command	Code	Controller Data
RETURN	36H	No data bytes

This command causes the Bill Validator to return bill in escrow position to the customer.

NOTE: After a RETURN command the Bill Validator should respond to a POLL command with the BILL RETURNED message within 30 seconds. If this command is sent when the Bill Validator is not in ESCROW state the ILLEGAL COMMAND message is returned.

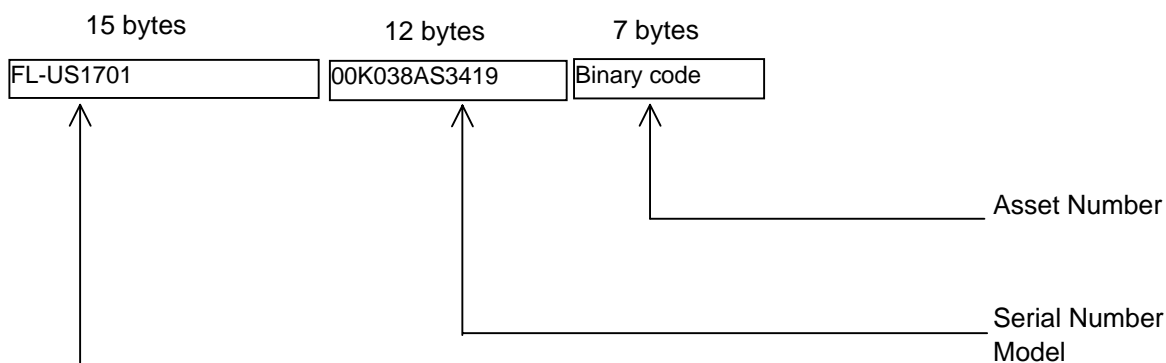


IDENTIFICATION

Controller Command	Code	Bill-to-Bill unit Response Data
IDENTIFICATION	37H	34 bytes: Z1 – Z34

Bytes	Description
Z1-Z15	Part Number – 15 bytes, ASCII characters
Z16-Z27	Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z28-Z34	Asset Number – 7 bytes, unique to every Bill Validator, binary data

Bytes Z1-Z27 must be sent as ASCII Characters. Zero (30H) and Blank (20H) are acceptable. Asset Number must be sent as binary code.



This command is valid in the following states only: Power up, Initialize, one of the Failure states (41H-47H) or Unit Disabled.

HOLD

Controller Command	Code	Controller Data
HOLD	38H	No data bytes

This command allows the controller to hold Bill Validator in Escrow during 10 s. After this time the Controller should send the STACK or RETURN command. For continued holding in an Escrow state it is necessary to resend this command. Otherwise the Bill Validator will execute return of a bill.

SET BARCODE PARAMETERS

Controller Command	Code	Controller Data
SET BARCODE PARAMETERS	39H	2 bytes: Y1-Y2

Used to set the barcode format and number of characters.

Y1 - bar code format. 01H = interleaved 2 of 5.

Y2 - number of characters (min 6, max 18).

EXTRACT BARCODE DATA



<u>Controller Command</u>	<u>Code</u>	<u>Bill Validator Response Data</u>
EXTRACT BARCODE DATA	3AH	n bytes: Z1-Zn

Z1-Zn - n bytes ASCII of barcode data, n is equal min 6 bytes, max 18 bytes. Data is sent most significant byte first. Parameter n is assigned by command SET BARCODE PARAMETERS.

This command may be sent at any time after the Bill Validator responds to the Poll command by event 80H, 81H or 82H and the bill type indicates barcode token presence (23). Barcode data of a successful reading is preserved until next bill will be inserted. Otherwise an ILLEGAL COMMAND response will be returned.

GET BILL TABLE

<u>Controller Command</u>	<u>Code</u>	<u>Bill Validator Response Data</u>
GET BILL TABLE	41H	120 bytes: Z1-Z120

Command for request bill type description.

Z1-Z120 The 120 - byte string consists from 24 five-byte words.
 Byte 1 of word – most significant digit(s) of the denomination.
 Bytes 2-4 of word – country code in ASCII characters.
 Byte 5 of word – this byte used to determine decimal placement or proceeding zeros. If bit D7 is 0, the bits D0-D6 indicate the number of proceeding zeros. If bit D7 is 1, the bits D0-D6 indicate the decimal point position starting from the right and moving left.

A five-byte position in the 120-bytes string indicates bill type description for the particular bill type. For example, first five byte correspond bill type=0, second five byte correspond bill type=1 and so on.

Example:

Bill Type	Denomination Code First Byte	Country Code 3 bytes	Denomination Code Second Byte	Denomination	
0	1	USA	0x00	1	Dollar
1	5	USA	0x00	5	Dollar
2	1	USA	0x01	10	Dollar
3	2	USA	0x01	20	Dollar

Unsent bytes are assumed to be zero.

This command is valid in the following states only: Power up, Initialize, one of the Failure states (41H-47H) or Unit Disabled.

GET CRC32 OF THE CODE

<u>Controller Command</u>	<u>Code</u>	<u>Bill Validator Response Data</u>
GET CRC32 OF THE CODE	51H	4 bytes: Z1-Z4

Z1-Z4 - 4 bytes of CRC, MSB first.

This command is valid in the following states: Power up, Initialize, one of the Failure states (41H-47H) or Unit Disabled.



6 CONTROLLER/ Card Reader Communication Specification

6.1 Introduction

This section defines the communications bytes sent and received between Card Reader and the Controller. The Card Reader 's address is 04H.

Unless stated otherwise, all information is assumed to be in hexadecimal format. The numbers will be sent most significant byte first.

6.2 Card Reader States

Card Readers may be viewed as state machines. These states are as follows:

- 1) Inactive
- 2) Disabled
- 3) Idling
- 4) Ready for Transaction
- 5) Vending
- 6) Busy
- 7) Vend OK/Vend Failed

6.2.1 Inactive

This is the state of the card reader at power up or after a reset. All cards except for stored value cards (for balance inquiry after internal initialization completes) will not be accepted. The card reader cannot leave this state until all SETUP information is received from the Controller.

6.2.2 Disabled

The card reader automatically enters this state from the Inactive state when it has received all SETUP information from the Controller and completes its internal initialization. It will also enter the Disabled state from the Idling state when it receives the READER/DISABLE command. While in the Disabled state, stored value cards will be accepted (for balance inquiries), but no vending requests will be granted.

6.2.3 Idling

In this state, cards may be used for transactions. The card reader will remain in this state until a valid card is read (when it will enter the Ready for Transaction 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).

6.2.4 Ready for Transaction

In the Idling state, when a valid card is processed, the card reader will enter the Ready for Transaction state. This indicates that the card reader is available for vending activities. The only structured exits from the Ready for Transaction state are:

- Through the VEND/SESSION COMPLETE subcommand from the Controller (for a no-value cards, ex. debit and credit cards; for stored value cards this command makes no sense but will not generate an error);
- Through card removal (for stored value cards only).

Other VEND subcommands will cause the card reader to leave the Ready for Transaction state and enter the Vending state when products are purchased.

6.2.5 Vending

This state is entered from the Ready for Transaction state upon reception of a VEND/VEND REQUEST command from the Controller.



6.2.6 Busy

This state is entered when Card Reader starts performing internal operations and exited upon completion of internal operations. Exit is done to the state present before entering Busy, except for error conditions appeared while in Busy.

6.2.7 Vend OK/Vend Failed

This state is entered after processing Vend Request command. When all transactions with card and/or bank are finalized this state is returned to POLL command and cleared upon successful readout or kept until successful readout in case of communication errors.

6.3 Command Protocol

The card reader will provide an informational response immediately with the requested data.

6.4 Controller Commands

COMMAND	HEX CODE	DESCRIPTION
RESET	31H	Command for Card Reader to self-reset.
SETUP	11H	Send/Request Card Reader setup status.
POLL	33H	Request for Card Reader activity status.
VEND	13H	Vend state control.
ENABLE/DISABLE	14H	Disabled/Enabled state control.
IDENTIFICATION	15H	Request for Model, Serial Number, Software Version, Localization ISO code.
DOWNLOAD	50H	Command for transition to download mode.
SPECIAL COMMANDS	61H	Special commands are Get/Set Time, Get Active Payment Systems List, Get Error Log, Get/Change Settings and Get/Modify Language Tables. Please refer to CCNET Document 4 for details.

6.5 Controller Command Format

RESET

Controller Command	Code	Controller Data
RESET	31H	No data bytes

This command is the vehicle that the Controller must use to tell the Card Reader that it must return to the Inactive state. With the exception of the ACK response, it must abort all communication, terminate any ongoing transaction (with a refund, if appropriate), eject the card (if applicable), and go to the Inactive state until otherwise instructed by the Controller.

The Controller must follow the RESET command with the SETUP and ENABLE/DISABLE commands to enable vending transactions. RESET command is not valid for Vending, Busy and Vend OK/Vend Failed states. If received with any of these states active, a COMMAND INVALID response is issued.



SETUP

<u>Controller Command</u>	<u>Code/Subcommand</u>	<u>Controller Data</u>	<u>Response Data</u>
SETUP	11H	Y1-Y4	Z1 – Z2

Y1 = Controller Capabilities Level
Indicates the highest capabilities level the Controller supports. Currently, this byte is set to 01.

Y2-Y4 = Default Currency (3 bytes of ASCII ISO currency code, MSB first)
Indicates the default operating currency of the card reader. If a card is configured to store amounts in different currencies and the default currency in one of them this amount will be shown as card balance. If there is no matching currency in the card the balance to display is left to the discretion of the reader.

SETUP command is valid for Inactive and Disabled states only. If received with any other states active, a COMMAND INVALID response is issued.

RESPONSE - CARD READER CONFIGURATION:

Indicates the Card Reader is responding to a SETUP request from the Controller. This response includes the following data:

Z1 = Card Reader capabilities level
Capabilities level of the Card Reader. Currently the highest capabilities level is 01.

Z2 = Miscellaneous options

- b0 Fund Restoring capable
 - 0 = the card reader is NOT capable of restoring funds to the user's card or account. Do not request refunds.
 - 1 = the card reader is capable of restoring funds to the user's card or account. Refunds may be requested.
- b1 Continuous Payment capable
 - 0 = the card reader is NOT capable of collecting funds from multiple cards for single payment. Money withdraw request will be denied if funds are insufficient in authorized card.
 - 1 = the card reader is capable of collecting funds from multiple cards for single payment. Money withdraw request will be approved even if funds are insufficient in authorized card

Other bits are ignored (under card reader capabilities level 01) and may be set to any value.

POLL

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>	<u>Response Data</u>
POLL	33H	No data	Z1 up to Z2

The POLL command is used by the Controller to obtain information from the Card Reader. This information may include user actions, hardware malfunctions, software malfunctions or information explicitly requested by the controller. Controller may receive the following POLL responses from the Card Reader:

<u>Response data bytes</u>		<u>Description</u>
Z1	Z2	



01H		Inactive	Indicates the Card Reader has been reset/re-powered.
05H		Disabled	Indicates the Card Reader has received all SETUP information from the Controller. Card Reader will also enter the Disabled state from the Enabled state when it receives the ENABLE/DISABLE command.
06H		Idling	In this state cards may be used for transactions. Card Reader will enter the Enabled state from the Disabled state when it receives the ENABLE/DISABLE command.
07H		Ready for Transaction	Indicates the Card Reader is available for vending activity.
08H		Vending	This state is entered from the Idling state upon reception of a VEND REQUEST command from the Controller.
12H		Vend OK	Transaction successfully completed.
13H		Vend Failed	Transaction failed for a reason not relevant to the Controller.
09H	Z2	Malfunction/Error	The Card Reader is reporting a malfunction or error.
10H		Delayed	Indicates that a full response to a command is not available right now. This may occur, for example, while card reader is dialing out to the bank.
11H		Busy	Card Reader is busy with internal operations
14H		Vend cancelled	Vend process successfully cancelled
15H		Vend cancel failed	Vend process may not be cancelled and should be completed
16H	Z2	Level Updated	Indicates the Reader has internally updated its capabilities level. Z2 contains new capabilities level
17H	Z2	Options Updated	Indicates the Reader has internally updated its options. Z2 contains new options byte where format is same as for options byte returned in response to setup command (see blow).

Z1 = 01H INACTIVE:
Indicates the Card Reader has been reset, due to either an external RESET or an internally detected condition.

Z1 = 05H DISABLED:
Indicates the Card Reader has received all SETUP information from the Controller and completed its internal initialization. Card Reader will also enter the Disabled state from the Idling state when it receives the ENABLE/DISABLE command.

Z1 = 06H IDLING:
In this state cards may be used for transactions. Card Reader will enter the Idling state from the Disabled state when it receives the ENABLE/DISABLE command.

Z1 = 07H READY FOR TRANSACTION:
Indicates the Card Reader is available for vending activity.

Z1 = 08H VENDING:
This state is entered from the Idling state upon reception of a VEND REQUEST command from the Controller.

Z1 = 12/13H VEND OK/VEND FAILED:
This state is entered from the Vending state upon completion of a transaction.

Z1 = 09H MALFUNCTION/ERROR:



The Card Reader is reporting a malfunction or error. This response includes the following information:

Z2 = Error Code = xxxxyyyy

xxxx =

0010: Card Error (e.g. stored value card removed while transaction is in progress, or a no-value card read incomplete)¹ or ²

0100: Communications Error (checksum error/data frame inconsistent)²

1000: Reader Failure³

Other values not defined under card reader capabilities level 01.

¹Transient error Reported once.

²Non-transient error reported every POLL until cleared. Card Reader functional after error cleared.

³Non-transient error reported every POLL until cleared. Card Reader not presently functional.

yyyy = Manufacturer defined sub-code

VEND/BEGIN SESSION

Controller Command	Code/Subcommand	Controller Data	Response Data
VEND/BEGIN SESSION Y1 = 10H	13H	Y1	none

VEND BEGIN SESSION - subcommand.

Indicates that VMC is requesting card authentication from the Card Reader. This command may only be issued in Idling state, otherwise a COMMAND INVALID will be returned. If a stored value card is already authenticated, the Ready for Transactions state will be entered immediately. For the no stored value card an invitation is issued for the user to insert/swipe a card, and after completed, Ready for Transactions state is entered. It's at Controllers discretion to terminate this condition if a time-out occurs without a card being authenticated, as this state is never left on Card Reader's initiative for no stored value cards and left on Card Reader's initiative when card is removed for stored-value cards.

VEND/GET FUNDS

Controller Command	Code/Subcommand	Controller Data	Response Data
VEND/GET FUNDS Y1 = 00H	13H	Y1	Z1-Zn

VEND GET FUNDS - subcommand.

Indicates that VMC is requesting a balance from the card. This command may only be issued in Ready for Transactions state, otherwise a COMMAND INVALID will be returned.

Z1 =

Flag indicating that a card contains stored value:
 E0H...E7H – the card is a stored value card;
 E8H...EFH - the card is not a stored value card;

All subsequent data exists for stored value cards only and consists of N 8-byte blocks, one block per each “wallet” with different currency in the card. Wallets are numbered sequentially as they arrive in response to VEND/GET FUNDS, starting from 0.

Z2-Z4 = Currency code, three ASCII characters, following ISO 4217;



Z5-Z8 = Wallet balance in “composite” format, i.e. binary unsigned integer value; Z9 least significant bits compose the fractional part – to obtain the exact value Z5...Z8 should be treated as a 32-bit binary value, then divided by 10^{Z9}; the division result is the integer part of funds value, the remainder stays for the fractional part.

Z9 = Number of decimal places.

VEND/VEND REQUEST

Controller Command	Code/Subcommand	Controller Data	Response Data
VEND/ VEND REQUEST	13H	Y1 – Y10	none
Y1 = 01H	VEND REQUEST - subcommand. Indicates the customer has made a selection. The Controller is requesting vend approval from the Card Reader before dispensing the product. The Card Reader enters state Vending after reception of this command and keeps it until transaction is finalized (state Vend OK is entered) or error occurs (state Vend Fail is entered). The state is preserved until successful read-out.		
Y1 = 02H	VEND REQUEST REFUND - subcommand. Indicates the controller is requesting a refund for the given wallet with amount given. The Card Reader enters state Vending after reception of this command and keeps it until transaction is finalized (state Vend OK is entered) or error occurs (state Vend Fail is entered). The state is preserved until successful read-out.		
	VEND REQUEST and VEND REQUEST REFUND commands are valid only in Ready For Transaction state, otherwise COMMAND INVALID is issued.		
Y2 =	Wallet number. Wallets are numbered serially starting from 0 as returned by VEND/GET FUNDS command. If card is not a stored value card Y2 may be assigned any value.		
Y3 – Y6 =	Amount to draw in “composite” format, same as for VEND/GET FUNDS command.		
Y7 – Y10 =	Accumulated amount in “composite” format, same as for VEND/GET FUNDS command. This field represents amount, accumulated for the given card session (i.e. it is set 0 prior to issuing VEND/BEGIN SESSION and incremented prior to sending every VEND/VEND REQUEST with requested value). This value is used by Card Reader to trace retransmissions of VEND/VEND REQUEST issued by Controller. Separate accumulated amounts are maintained for every wallet reported by the Card Reader.		

VEND/VEND CANCEL

Controller Command	Code/Subcommand	Controller Data	Response Data
VEND/ VEND CANCEL	13H	Y1	none
Y1 = 03H	VEND CANCEL - subcommand. This command can be issued by the Controller to cancel a VEND REQUEST command before the Card Reader has sent a VEND APPROVED/DENIED. The Card Reader will respond to VEND CANCEL with an ACK message and will initiate cancellation sequence. Upon completion the result will be reflected in the reader status (returned in response to only one successful Poll command) and return to the Idling state. This command is valid only in Vending state, otherwise COMMAND INVALID response is issued.		

VEND/SESSION COMPLETE



<u>Controller Command</u>	<u>Code/Subcommand</u>	<u>Controller Data</u>
VEND/ SESSION COMPLETE Y1 = 04H	13H/04H SESSION COMPLETE – subcommand.	Y1

This tells the Card Reader that the session is complete and to return to Idling state.

ENABLE/DISABLE

<u>Controller Command</u>	<u>Code/Subcommand</u>	<u>Controller Data</u>
READER/DISABLE Y1 = 00H	14H DISABLE - subcommand.	Y1

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

Y1 = 00H **DISABLE - subcommand.**
 This informs the Card Reader that it has been disabled, i.e. it must no longer accept a customer's card for the purpose of vending. Vending activities may be re-enabled using the READER ENABLE command. The Card Reader must retain all SETUP information.

Y1 = 01H **ENABLE - subcommand.**
 This informs the Card Reader that it has been enabled, i.e. it must be ready for accepting cards.

Reader may be enabled from Disabled state only and disabled from Idling state only, otherwise a COMMAND INVALID response will be issued.

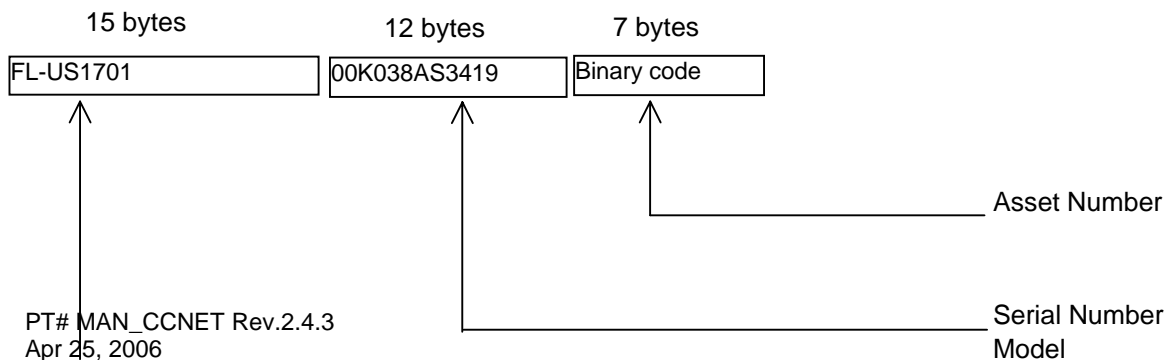
IDENTIFICATION

<u>Controller Command</u>	<u>Code</u>	<u>Card Reader Response Data</u>
IDENTIFICATION Y1 = 01H	15H	Z1 – Z34

Bytes	Description
Z1-Z15	Part Number – 15 bytes, ASCII characters
Z16-Z27	Serial Number – 12 bytes Factory assigned serial number, ASCII characters
Z28-Z34	Asset Number – 7 bytes, unique to every Card Reader, binary data

Bytes Z1-Z27 must be sent as ASCII Characters. Zero (30H) and Blank (20H) are acceptable.

Asset Number must be sent as binary code.





DOWNLOAD

<u>Controller Command</u>	<u>Code</u>	<u>Controller Data</u>
DOWNLOAD	50H	No data bytes

Command for transition Card Reader to download mode. Currently not defined and returns COMMAND INVALID response.

6.6 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 with ACK, NAK or a data message.





7 APPENDIX

CCNET Message Sequences

Examples

(Bill-to- Bill unit)



7.1 Power Up & Reset sequence (No previous power cut)

Controller		Bill-to-Bill unit	Comments
POLL	----->		
	<-----	POWER UP	Power is switched on
ACK	----->		
RESET	----->		Reset peripheral
	<-----	ACK	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
SET OPTIONS*	----->		Enabling/disabling optional features
	<-----	ACK	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	UNIT DISABLED	All bill types are disabled
ACK	----->		
GET STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CONFIG.	
ACK	----->		
GET BILL TABLE	----->		
	<-----	BILL TABLE	
ACK	----->		
SET SECURITY	----->		Update bill security levels
	<-----	ACK	
IDENTIFICATION	----->		Collect Information
	<-----	BILL-TO-BILL UNIT ID	
ACK	----->		
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
		.	
		.	
		.	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	DISABLED	Bill-to-Bill unit completed initialization process and is ready for work
ACK	----->		
POWER RECOVERY**	----->		Report Power Up status
	<-----	NO POWER CUT DETECTED	



ACK	----->		
POLL	----->		
	<-----	DISABLED	Bill-to-Bill unit completed initialization process and is ready for work
ACK	----->		

* - The SET OPTIONS command is optional and should be sent if it is planned to use feature not enabled by default.
 ** - The POWER RECOVERY command is optional and can be skipped.

7.2 Enable sequence

Controller		Bill-to-Bill unit	Comments
ENABLE BILL TYPES	----->		Enable appropriate bill types
	<-----	ACK	
POLL	----->		
	<-----	IDLING	Ready to accept bills
ACK	----->		

7.3 Disable sequence.

Controller		Bill-to-Bill unit	Comments
ENABLE BILL TYPES	----->		Disable all bill types
	<-----	ACK	
POLL	----->		
	<-----	DISABLED	Unit is not ready to accept bills
ACK	----->		



7.4 Bill Accepting sequence (Bill stacked).

Controller		Bill-to-Bill unit	Comments
POLL	----->		
	<-----	ACCEPTING	Accepting bill
ACK	----->		
POLL	----->		
	<-----	ESCROW POSITION	Bill in escrow position
ACK	----->		
	.		
	.		
	.		
POLL	----->		
	<-----	ESCROW POSITION	Bill in escrow position
ACK	----->		
STACK	----->		Send bill to drop cassette or one of the recycling cassettes.
	<-----	ACK	
POLL	----->		
	<-----	STACKING	Stacking bill.
ACK	----->		
	.		
	.		
	.		
POLL	----->		
	<-----	BILL STACKED	Bill has been stacked
ACK	----->		
CASSETTE STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CASSETTE STATUS	
ACK	----->		
POLL	----->		
	<-----	IDLING	Ready to accept bills
ACK	----->		



7.5 Bill Accepting sequence (Bill returned)

Controller		Bill-to-Bill unit	Comments
POLL	----->		
	<-----	ACCEPTING	Accepting bill
POLL	----->		
	<-----	ESCROW POSITION	Bill in escrow position
	.		
	..		
POLL	----->		
	<-----	ESCROW POSITION	Bill in escrow position
ACK	----->		
RETURN	----->		Return bill to user
	<-----	ACK	
POLL	----->		
	<-----	RETURNING	Returning bill
ACK	----->		
	.		
	..		
POLL	----->		
	<-----	BILL RETURNED	Bill has been returned
ACK	----->		
POLL	----->		
	<-----	IDLING	Ready to accept bills
ACK	----->		



7.6 Bill Dispensing sequence.

Controller		Bill-to-Bill unit	Comments
ENABLE BILL TYPES	----->		Disable bill types
	<-----	ACK	
DISPENSE	----->		Dispense bills to customer
	<-----	ACK	
POLL	----->		
	<-----	BILL DISPENSING	Transporting bills to dispenser
ACK	----->		
	.		
POLL	----->		
	<-----	BILL DISPENSED	Dispense is completed. Bills removed from the dispenser.
ACK	----->		
CASSETTE STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CASSETTE STATUS	
ACK	----->		
ENABLE BILL TYPES	----->		Enable bill types
	<-----	ACK	
POLL	----->		
	<-----	IDLING	Ready to accept bills
ACK	----->		



7.7 Bill Unloading sequence.

Controller		Bill-to-Bill unit	Comments
ENABLE BILL TYPES	----->		Disable bill types
	<-----	ACK	
UNLOAD	----->		Unload bills from recycling cassette to drop cassette.
	<-----	ACK	
POLL	----->		
	<-----	BILL UNLOADING	Bill transporting to drop cassette.
ACK	----->		
	.		
	.		
	.		
POLL	----->		
	<-----	BILL UNLOADED	Unloading is completed.
ACK	----->		
CASSETTE STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CASSETTE STATUS	
ACK	----->		
ENABLE BILL TYPES	----->		Enable bill types
	<-----	ACK	
POLL	----->		
	<-----	IDLING	Ready to accept bills
ACK	----->		



7.8 Set cassette type sequence

Controller		Bill-to-Bill unit	Comments
CASSETTE STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CASSETTE STATUS	Cassette to be SET contains bills.
ACK	----->		
SET CASSETTE TYPE	----->		Assigning cassette to bill type
	<-----	ACK	
POLL	----->		
	<-----	SETTING CASSETTE TYPE	Unloading bills.
ACK	----->		
	.		
	.		
	.		
POLL	----->		
	<-----	SET CASSETTE TYPE	Cassette is set to new bill type.
ACK	----->		
CASSETTE STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CASSETTE STATUS	Cassette is assigned new bill type. It contains no bills.
ACK	----->		
POLL	----->		
	<-----	DISABLED	Unit is disabled.
ACK	----->		



7.9 Power Up sequence after power cut during stacking (Power recovery command was sent)

Controller		Bill-to-Bill Unit	Comments
POLL	----->		
	<-----	POWER UP	Power
ACK	----->		
RESET	----->		Reset peripheral
	<-----	ACK	
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing
ACK	----->		
SET OPTIONS*	----->		Enabling miscellaneous options
	<-----	ACK	
GET STATUS	----->		Collect operational parameters
	<-----	BILL VALIDATOR CONFIG.	
ACK	----->		
SET SECURITY	----->		Update bill security levels.
	<-----	ACK	
IDENTIFICATION	----->		Collect asset information.
	<-----	BILL VALIDATOR ID	
ACK	----->		
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
		.	
		.	
		.	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	DISABLED	Bill-to-Bill unit completed initialization process and is ready for work
ACK	----->		
POWER RECOVERY**	----->		Report Power Up status and credit information
	<-----	POWER CUT WHILE PACKING	
ACK	----->		
POLL	----->		
	<-----	UNIT DISABLED	All bill types are disabled.
ACK	----->		

*- The SET OPTIONS command is optional and should be sent if it is planned to use feature not enabled by default.

** - On 'Power up' the validator will check if there was a bill in process just before the power down. A bill is considered to be in process if:

1. It was in the stacking process (bill successfully recognized and verified and decision to stack the bill had been made).
2. It was stacked but the event was not reported or a response to stacked message was not received.



The bill (or several bills), which were in process will be packed and credits will be reported for each bill in the response to POWER RECOVERY command. The POWER RECOVERY command is optional and can be skipped. If the Bill-To-Bill unit is enabled by BILL TYPE command before issuing POWER RECOVERY command the credits will be lost.



7.10 Power Up sequence after power cut during dispensing (Power recovery command was sent)

Controller		Bill-to-Bill Unit	Comments
POLL	----->		
	<-----	POWER UP	Power
ACK	----->		
RESET	----->		Reset peripheral
	<-----	ACK	
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing
ACK	----->		
SET OPTIONS*	----->		Enabling miscellaneous options
	<-----	ACK	
GET STATUS	----->		Collect operational parameters
	<-----	BILL VALIDATOR CONFIG.	
ACK	----->		
SET SECURITY	----->		Update bill security levels.
	<-----	ACK	
IDENTIFICATION	----->		Collect asset information.
	<-----	BILL VALIDATOR ID	
ACK	----->		
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing.
ACK	----->		
		.	
		.	
		.	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	DISABLED	Bill-to-Bill unit completed initialization process and is ready for work
ACK	----->		
POWER RECOVERY**	----->		Report Power Up status and dispenser status
	<-----	POWER CUT WHILE DISPENSING	
ACK	----->		
POLL	----->		
	<-----	DISABLED	All bill types are disabled.
ACK	----->		
EMPTY DISPENSER	----->		
	<-----	ACK	All bills are ejected from dispenser.
POLL	----->		
	<-----	DISPENSING	Transporting bills to dispenser



ACK	----->		
	.		
POLL	----->		
	<-----	DISPENSED	Dispense is completed. Bills removed from the dispenser.
ACK	----->		
POLL	----->		
	<-----	DISABLED	All bill types are disabled.
ACK	----->		

*- The SET OPTIONS command is optional and should be sent if it is planned to use feature not enabled by default.

** - On 'Power up' the validator will check if there were bills in dispensing process just before the power down. A bill is considered to be in dispensing process if:

3. It was in the channel.
4. It was inside of dispenser.

The bill (or several bills), which were in process will be moved either back to the cassette or into dispenser and dispenser state will be reported in the response to POWER RECOVERY command. The POWER RECOVERY command is optional and can be skipped. If the Bill-To-Bill unit is enabled by BILL TYPE command before issuing POWER RECOVERY command it will report a FAILURE state.



7.11 Power Up sequence after power cut during dispensing (Power recovery command was not sent)

Controller		Bill-to-Bill Unit	Comments
POLL	----->		
	<-----	POWER UP	Power
ACK	----->		
RESET	----->		Reset peripheral
	<-----	ACK	
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing
ACK	----->		
SET OPTIONS*	----->		Enabling miscellaneous options
	<-----	ACK	
GET STATUS	----->		Collect operational parameters
	<-----	BILL VALIDATOR CONFIG.	
ACK	----->		
SET SECURITY	----->		Update bill security levels.
	<-----	ACK	
IDENTIFICATION	----->		Collect asset information.
	<-----	BILL VALIDATOR ID	
ACK	----->		
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing.
ACK	----->		
		.	
		.	
		.	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	DISABLED	Bill-to-Bill unit completed initialization process and is ready for work
ACK	----->		
ENABLE BILL TYPES	----->		Enable appropriate bill types
	<-----	ACK	
POLL	----->		
	<-----	FAILURE	Dispenser failure.
ACK	----->		

* - The SET OPTIONS command is optional and should be sent if it is planned to use feature not enabled by default.

** - On 'Power up' the validator will check if there were bills in dispensing process just before the power down. A bill is considered to be in dispensing process if:

5. It was in the channel.
6. It was inside of dispenser.

The bill (or several bills), which were in process will be moved either back to the cassette or into dispenser and dispenser state will be reported in the response to POWER RECOVERY command. The POWER RECOVERY command is optional and can be skipped. If the Bill-To-Bill unit is enabled by BILL TYPE command before issuing POWER RECOVERY command it will report a FAILURE state.



7.12 Power Up sequence after power cut during unloading (Power recovery command was sent)

Controller		Bill-to-Bill Unit	Comments
POLL	----->		
	<-----	POWER UP	Power
ACK	----->		
RESET	----->		Reset peripheral
	<-----	ACK	
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing
ACK	----->		
SET OPTIONS*	----->		Enabling Power Recovery option
	<-----	ACK	
GET STATUS	----->		Collect operational parameters
	<-----	BILL VALIDATOR CONFIG.	
ACK	----->		
SET SECURITY	----->		Update bill security levels.
	<-----	ACK	
IDENTIFICATION	----->		Collect asset information.
	<-----	BILL VALIDATOR ID	
ACK	----->		
POLL	----->		
	<-----	INITIALIZE	Bill Validator is initializing.
ACK	----->		
		.	
		.	
		.	
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	DISABLED	Bill-to-Bill unit completed initialization process and is ready for work
ACK	----->		
POWER RECOVERY**	----->		Report Power Up status
	<-----	POWER CUT WHILE UNLOADING	
ACK	----->		
POLL	----->		
	<-----	DISABLED	All bill types are disabled.
ACK	----->		

*- The SET OPTIONS command is optional and should be sent if it is planned to use feature not enabled by default.

** - On 'Power up' the validator will check if there were bills in unloading process just before the power down. A bill is considered to be in unloading process if:

- 7. It was in the channel.
- 8. It was inside the drop box but was not properly stacked.



9. ACK to the UNLOADED message was not received.

The bill (or several bills), which were in process will be moved into drop box and stacked. The POWER CUT WHILE UNLOADING will be reported in the response to POWER RECOVERY command. The POWER RECOVERY command is optional and can be skipped.

7.13 Drop Cassette Removal and Replacement sequence

Controller		Bill-to-Bill Unit	Comments
POLL	----->		
	<-----	DROP CASSETTE OUT OF POSITION	Drop cassette is removed
ACK	----->		
DROP CASSETTE IS ATTACHED AT THIS POINT			
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill is initializing
ACK	----->		
GET STATUS	----->		Collect operational parameters
	<-----	BILL-TO-BILL UNIT CONFIG.	
ACK	----->		
SET SECURITY	----->		Update bill security levels
	<-----	ACK	
IDENTIFICATION	----->		Collect asset information.
	<-----	BV UNIT ID	
ACK	----->		
POLL	----->		
	<-----	INITIALIZE	Bill-to-Bill unit is initializing
ACK	----->		
POLL	----->		
	<-----	UNIT DISABLE	All bill types are disabled
ACK	----->		