

EMR³

IB Comm Specifications

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Introduction

This document defines a standard communication protocol for the IB. It will be used between the IB and EMR3. Also it will be used on the IB network, connecting multiple IBs. It includes the command set and communication sequence.

Networks

Each IB will communicate with two EMRs on one RS422 multi-drop channel and to multiple IBs on a second RS422 multi-drop channel. The message formats are the same for both networks. However, the polling techniques will not be the same.

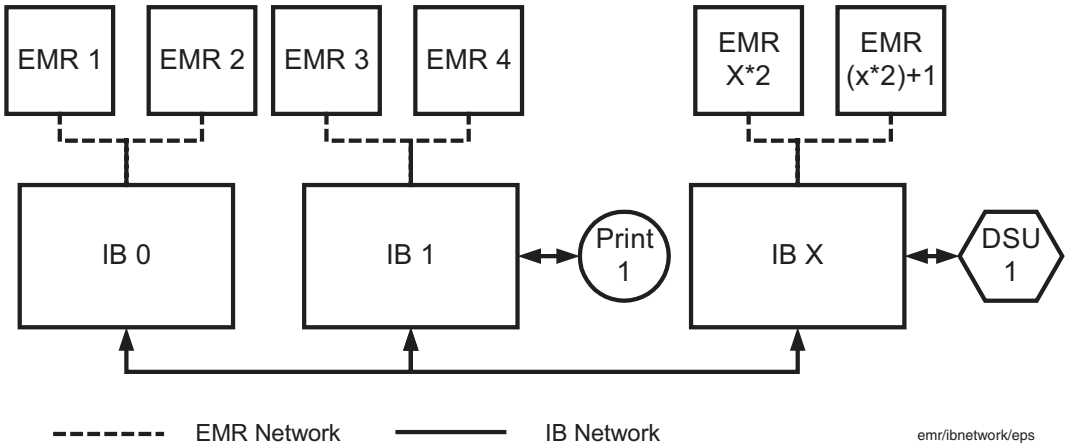


Figure 1. IB Networks

EMRN

This network ties the IB to a maximum of two EMR heads. The IB will poll the EMRs using a simple roll polling technique. The IB starts by transmitting a short poll message to one of the EMRs. If the EMR is ready for transmission, it responds by transmitting its data. The IB then polls the next EMR. The IB has control of the communication line until a response is received, or a timeout has occurred.

IBN

There can be a maximum of 16 IBs connected to the IBN. This limitation is limited by the size of the address field (see Table 3 on page 3). There is a maximum of 32 addresses for each hardware type, and there are two EMRs per IB, therefore 16 IBs utilizes all the EMRs address space. The IBN uses hub polling, which requires the IBs to be numbered sequentially starting from 0. The IB polling network is a modification of the EMR scheme aimed at reducing the polling overhead. The IB with the poll token has control of the network. The IB with the lowest node address starts communication by sending a poll token to the IB with the highest possible address. If this IB has messages to send it begins transmitting its message(s). If it is not ready, it sends the poll token to the next IB (its address -1). If the next address is not found, the IB will send it to the next IB by decrementing the address by one. If there are no responses, it continues to decrement the address until 0 is reached. If there is no response it rolls the address to the highest possible address in the network. Each IB saves the address of the adjacent IB once the token successfully passed. Every 30 seconds every IB searches for new address starting with it's address -1.

When any IB finishes its transmissions it should send the poll token to the next IB. Once the token reaches IB 0 (IBNM), the master IB will complete its transmissions and resume polling by passing the poll token to the IB with the highest address in the network.

Network Protocol

Both networks use the same message packet protocol. This allows EMRs to communicate through IBs to devices on the IBN and vice versa.

HARDWARE CONFIGURATION

Both IBN and EMRN use the same RS422 hardware and communication parameter settings

Table 1.- Communication Settings

Parameter	Default
Baud	19200
Parity	None
Length	8
Stop Bit	1

COMMAND SYNTAX

The command syntax is:

<SOH>[DA][OA][ID][EID]<STX>cmd data<ETX>crc<CR><SOH>[DA][OA][ID][EID]<ETX>crc<CR>

Table 2.- Command Syntax Descriptions

Field	Description
SOH	Start of Header, 0x01 When received, the test tool will mark this as the beginning of the message. It is followed by the command sequence. All incomplete message characters that precede the SOH are discarded. Mandatory
[DA]	Destination Address. One byte field that contains the address of the device the message is intended for.
[OA]	Originator Address. One byte field that contains the address of the device that originated the message.
[ID]	Command ID. One byte that contains the request or response command ID.
[EID]	Extended Command ID. Additional command bytes can be included.
STX	Start of Text, 0x02 Marks the end of the command sequence and the beginning of the optional command data field.Optional. Only need if Command Data is provided.

Table 2.- Command Syntax Descriptions

Field	Description
Cmd data	Variable length Data required for command. Optional.
ETX	End of Text, 0x03 Marks the end of preceding data and the beginning of the checksum. Optional. Only needed if Checksum is provided. If used without checksum, the message will be rejected.
CR	2 byte CCITT CRC-16 checksum. Optional The checksum field is preceded by the <ETX> control byte and terminated by the <CR> control byte. It includes the <SOH> and <ETX> control bytes and all the characters inbetween
CR	Carriage Return, 0x0D. Marks the end of the end of the transmission. Mandatory, always.
DLE	Data Flag, 0x10 When the command data or check sum contains control bytes (SOH, STX,ETX,EOT, DLE) they must be preceded with DLE. Simply stated all characters following a DLE are not control characters, but are valid data for the field where they are found. Example: SOH 0x80 0xE0 0x81 0x80 STX 0x50 0x62 DEL 0x01 0x30 ETX checksum EOT

Communication Addressing

Communication addressing is shown in Table 3:

Table 3.- Addressing Table

	Type			Address				
	7	6	5	4	3	2	1	0
Reserved	0	0	0	32 Possible Addresses				
Tank ID	0	0	1					
Unused	0	1	0					
Unused	0	1	1					
IB	1	0	0					
Printer	1	0	1					
Computer	1	1	0					
EMR	1	1	1					
Type 0 is never used prevent header bytes from forming control characters requiring <DLE> inserts								

The EMR (0) setup menu must provide network setup screens. The IB will only ask reserved type and address 0x1F for the configuration data. Only EMR 0 should respond to this reserved address to avoid conflict with any other EMR programming on the EMRN. The EMR will be set up with the following information:

1. IB Address. This will be the address of the IB on the IBN as well as the EMRN.
2. Port 1 and 2 device types.

IBN ADDRESSING

All IBs power up with the default Address 0. The IB receives its base address from the EMR head at start up. All devices attached to the IB are addressed using relative addressing.

The port base addresses are 0 (Port 1) and 1 (Port 2) on each IB.

Each port's relative address is derived from the port base address using the following formula:

$$\text{Port relative address} = [(\text{IB base address}) \times 2 + \text{Port base address}]$$

EMRN ADDRESSING

EMR base address start at 0 and increment for each EMR on the EMRN.

EMRN relative addressing is derived from the EMR base address using the following formula:

$$\text{EMR relative address} = [(\text{IB base address}) \times 2 + \text{EMR base address}]$$

The host IB will address the local EMR (on the EMRN) using the relative address of the EMR. When initiating commands the EMR uses relative addressing for both source and destination. The only exception is at startup, and when restoring communication. In these cases the IB will poll only for the RESERVED device type with address 0x1F. Only EMR with the base address 0 will respond to this address. EMR 0 will respond with the IB configuration using the same reserved address it was polled with. After the IB acknowledges the response, the EMR will acknowledge the poll, again using the same reserved address the IB started the poll. The IB will resume polling using relative addressing only based on the data received in the configuration.

A network addressing example is shown in Table 4:

Table 4.- IB Network Addressing Example in Hexadecimal

IB	1	2	3	4
IB configuration				
IB Address (1 based at setup, 0 internal)				
Port 1 Type	DSU	Printer	NA	Printer
Port 2 Type	Printer	DSU	NA	NA
IBN Addressing				
IB Address	80	81	82	83
EMR 1 (EMRN 0) Address	E0	E2	E4	E6
EMR 2(EMRN 1) Address	E1	E3	E5	E7
Port 1	C0	A2	--	A6
Port 2	A1	C3	--	--

Command Ids

There are 64 possible command IDs (see Table 5). When a request command is sent, a response returns with the same command ID combined with an ACK or NAK flag. This is used to identify successful receipt of commands on the transport layer. Because it takes time to process the command or is processed by a device not directly tied to the network, a further response is sent later in the form of a new command (or new extended ID) to confirm the execution of the original request. A good example is the print command. The EMR will receive and acknowledge for a print request at the transport layer, but the printer (IB printer driver) will later follow that ACK with a new command to confirm that the printing is complete.

Bits 6 and 7 can not be 0 at the same time, ensuring that all Command Ids outside the control ASCII range and the DLE will not be required in the header fields.

Table 5.- Command IDs

Bit							
7	6	5	4	3	2	1	0
		X	X	X	X	X	X
0	0	Reserved					
0	1	64 Possible Cmd IDs					
1	0	Transport layer ACK					
1	1	Transport layer NAK					

X = don't care

EXTENDED COMMAND IDS

Extended Ids can further define the command IDs (see Table 6). If not used the value will be 0x40. By keeping bit 6 as 1 ensures that all Extended Command Ids are in the printable ASCII range and the DLE will not be required in the header fields.

Table 6.- Extended Command IDs

Bit							
7	6	5	4	3	2	1	0
X	1	X	X	X	X	X	X

X = don't care

Command Tables

Each device type has its own set of commands in the range 0 - 0x3F. Developers can use the command ID range starting from 0 working up to the reserved range. The Global Command Table (GCT) contains the reserved commands.

The device sending commands to another device must support the Global Command Table functions that the receiving device might use when responding. If the device does not send commands to a particular device type, then Global Command Table entry for that device type does not need to be supported.

Global Command Table (GCT)

To allow devices to respond with results, without having to keep a table of commands for each type of device that talks to it, a range of commands are reserved for universal responses (see Table 7).

The GCT must be coordinated and reserved by all device types.

If a new device is added to the system, such as a card reader, and the card reader commands the EMR device - the card reader must support EMR Handler Commands in the GCT as that is where the responses from the EMR originate. Each device must support GCT entries for those devices to which it sends commands.

Table 7.- Global Command Table

Command			
ID ₁₆	EID ₁₆	Data Field	Description
3F			SYSTEM COMMANDS
	00		Wrong Device ID
3E			PRINT HANDLER COMMANDS
	00	N/A	PRINTER_GRANTED
	01	N/A	PRINTER_BUSY
	02	N/A	PRINTER_NEEDS_SERVICE
	03	N/A	PRINT_COMPLETE
	04	N/A	PRINT_DATA_ERROR
	05	N/A	PRINT_COMM_ABORT
	06	N/A	PRINT_ERROR_ABORT
	07	N/A	PRINT_REMOVE_SLIP
	08	N/A	PRINTER_PAPER_OUT
	09	uchar	EGLB_PRINT_REMOTE_END_EID 0 = Not enabled 1 = Enabled
	0A	N/A	EGLB_PRINT_FLUSH_EID

Table 7.- Global Command Table

Command			
ID ₁₆	EID ₁₆	Data Field	Description
3D			IB HANDLER COMMANDS
	00	uchar	1 byte, Relay 1 State Confirmation, Response to IB ID = 01
	01	uchar	1 byte, Relay 2 State Confirmation, Response to IB ID = 01
	02	uchar	1 byte, Relay 3 State Confirmation, Response to IB ID = 01
	03	uchar	1 byte, Relay 4 State Confirmation, Response to IB ID = 01
	04	Relay Pair	4 bytes, Relay Pair State Confirmation, Resp to IB ID = 01
		Pair ID	1 byte, 0 or 1
		Fast	1 byte, Fast Relay State
		Single	1 byte, Single Relay State
		Reserved	Reserved for future enhancements
	05	Version #	15 byte IB version number.2 byte IB Boot version number
	06	ID	1 byte, Unknown ID
	07	EID	1 byte, Unknown EID
	08	TR Record	Transaction Record See Transaction Record Table
	09	long	Unknown TR Ticket #
	0A	integer	Unknown TR index #
	0B		Transaction Record Stored
	0C		Transaction Record Bad CRC
	0D	uinteger	Number of transactions stored
	0E		No NVRAM Installed
0F		Begin IB Download	
10	uchar	IB Sector Status: 0: IDLE, no programming in progress. 1: OK, programming started, no error yet. 2: OK_DONE, erase, program, and verify successful. 3: LOCKED, IB is locked and cannot accept new firmware. 4: BAD_SECTOR, illegal sector number. 5: BAD_LENGTH, number of bytes, or address is either out of range or out of sequence. 6: BAD_DATA, number of received data bytes disagrees with expected number of received data bytes. 7: ERASE_FAIL, failed to erase EEPROM. 8: PROGRAM_FAIL, failed to program. 9: VERIFY_FAIL, failed to verify. 10: NO_START, no start command was sent.	

Table 7.- Global Command Table

Command				
ID ₁₆	EID ₁₆	Data Field	Description	
3C			EMR HANDLER COMMANDS	
	00	Reserved		
	01	Version #	11 byte char field, EMR Version number.2 byte char field, EMR Boot Version number	
	02	ID	1 byte, Unknown ID	
	03	EID	1 byte, Unknown ID	
	04	Float	Preset volume compensated for current product	
	05	Float	Preset volume gross for current product	
	06	Float	Compensated volume of current delivery	
	07	double	Gross volume of current delivery	
	08	Double	Net total quantity of current shift, current product from reset	
	09	Double	Gross total quantity of current shift, current product from reset	
	0A	Double	Net totalizer for current product	
	0B	double	Gross Totalizer for current product	
	0C	uchar	Current (active) product	
	0D	ushort	Timeout for no flow delivery. It will terminate delivery when paused.	
	0E	float	Current product temperature	
	0F			Current Time
		uchar		Hour 00 - 23
		Uchar		Minute 00 - 59
	10	uchar		Second 00 - 59
			Current Date	
uchar			Century 20 - 99	
uchar			Year 01 - 99	
Uchar			Month 01 - 12	
	uchar		Day of the Month 01 - 31	

Table 7.- Global Command Table

Command				
ID ₁₆	EID ₁₆	Data Field	Description	
3C	11	long	Current Sale Ticket number	
	12	20 char	20 character Meter Serial Number	
	13	char	Number of decimal digits for all volume values	
	14			SYSTEM STATUS
		uchar		Bit: 0 1=non-delivery state with no fuel flow 1 1=delivery state with fuel flow 2 1=delivery state with no fuel flow 3 1=non-delivery state with fuel flow 4 1=printer is busy 5 1=User Interface error 6 1=active error condition 7 Set if C&C mode enabled
	15			PRINTER STATUS
		uchar		Bit: 0 1=delivery ticket requested 1 1=Print requested in "pass-thru" mode 2 1=printer is busy 3 1=printer error 4 always zero 5 always zero 6 always zero 7 always zero
	16			DELIVERY STATUS
		uchar		Bit: 0 1=temperature compensation error 1 1=pulser/encoder error 2 1=preset error 3 1=preset stop 4 1=no flow delivery timeout error 5 1=pause delivery request 6 1=delivery end request 7 always zero 8 1=delivery ticket is pending 9 1=product flow is active 10 1=delivery mode 11 1=net preset is active 12 1=gross preset is active 13 1=temperature compensation is active 14 1=delivery completed 15 1=delivery error

Table 7.- Global Command Table

Command				
ID ₁₆	EID ₁₆	Data Field	Description	
3C	17		OBC Command Ack	
	18		OBC Command Error	
	19		OBC Command NAK	
	1A			Register Price Code
		uchar		Price Code Index
		uchar		Tax Code Index
		float		Raw Price
	1B			REGISTER TAX CODE
		Uchar		Tax Code Index
		char		Tax Type: See Tax Discount Type Table
		char		Mask of all tax lines this values applies to. See Tax Mask Table.
		float		Amount of tax for line 1
		char		Tax Type: See Tax Discount Type Table.
		char		Mask of all tax lines this values applies to. See Tax Mask Table.
		float		Amount of tax for line 2
		char		Tax Type: See Tax Discount Type Table.
		char		Mask of all tax lines this values applies to. See Tax Mask Table.
		float		Amount of tax for line 3
		char		Tax Type: See Tax Discount Type Table.
		char		Mask of all tax lines this values applies to. See Tax Mask Table.
		float		Amount of tax for line 4
		char		Tax Type: See Tax Discount Type Table.
		char		Mask of all tax lines this values applies to. See Tax Mask Table.
		float		Amount of tax for line 5
		char		Tax Type: See Tax Discount Type Table.
	char		Mask of all tax lines this values applies to. See Tax Mask Table.	
float		Amount of tax for line 6		

Table 7.- Global Command Table

Command			
ID ₁₆	EID ₁₆	Data Field	Description
3C	1C	TR Record	Transaction Record Data, See Transaction Record Table.
	1D		Transaction Record Unknown Ticket
		long	Ticket number requested
	1E		Transaction Record Unknown Index
		integer	Index requested
	1F	integer	Number of Transaction records stored in head.
	20	integer	Customer Options Bit 0: 1=enable currency mode Bit 1: 1=enable temperature compensation Bit 2: Unused Bit 3: Unused Bit 4: Unused Bit 5: Unused Bit 6: Unused Bit 7: Unused Bit 8: Unused Bit 9: Unused Bit 10: Unused Bit 11: Unused Bit 12: Unused Bit 13: Unused Bit 14: Unused Bit 15: Unused
	21	integer	Sector Status 00 No programming in progress 01 Programming started, no error yet 02 Erase, Program, or Verify Successful!The status values below are error conditions 03 Not in C/C mode 04 Bad sector number in command 05 Bad length in command 06 Bad data (too much data?) in command 07 Erase FAILED! 08 Program FAILED! 09 Verify FAILED! 0A No start was sent! The following status is used only in the IB to indicate that no reply has been received from the EMR yet. 0B Status Unknown

Table 7.- Global Command Table

Command			
ID ₁₆	EID ₁₆	Data Field	Description
3C	22		Delivery Format
			End of Delivery Report (NUL) terminated string of Format Tokens. See table Delivery Report Format Token Table.
	23		Shift Format
			End of Shift Report (NUL) terminated string of Format Tokens. See table Shift Report Format Token Table.
	24		Remote login
	25		Proprietary Feature (MCC command to enable partial/fill and add sale)
		1 byte	CHAR Feature Enable Byte Bit mapped feature enable Bit 0, Tank Fill: 0 = disabled, 1 = enabled Bit 1, Extra Sale: 0 = disabled, 1 = enabled Bit 2 - 7, Reserved for future use
		1 byte	CHAR Data Entry Status (M_RESR only!) (O_SETR has no effect on this byte) Bit mapped data entry Bit 0, Tank Fill: 0 = not entered, 1 = entered Bit 1, Extra Sale: 0 = no entered, 1 = entered Bit 2 - 7, Reserved for future use
	1 byte	CHAR Status O_SETR - Default settings. M_RESR - Data values. Bit mapped feature status Bit 0, Tank Fill: 0 = Full, 1 = Partial Bit 1, Extra Sale: 0 = No, 1 = Yes Bit 2 - 7, Reserved for future use	

Table 7.- Global Command Table

Command			
ID ₁₆	EID ₁₆	Data Field	Description
3C	26	string	Tank ID
	27	String	Delivery volume display, null terminated
	28	String	Totalizer volume display, null terminated
	29	string	Preset countdown display, null terminated
	2A	bool	Pause Printing state 0 = disable, 1 = enabled
	2B	double	Delivery volume display, unrounded
	2C	double	Totalizer volume display, unrounded
	2D	float	Preset countdown display, unrounded
	2E	double	Rate display, unrounded
3B			OBC Global Commands
	00		Unknown ID
	01		Unknown EID

Printer Command Table

Table 8.- Printer Command Table

Command		Data Field	Description	Printer Global Table EID Response
ID ₁₆	EID ₁₆			
00	00		Request printer	0,1,2
01	00		Print Start	None
02	00		Print Data	None
		Binary Data	Subsequent data buffers in the format it is to be sent to the printer.	
03	00		End of Data	3 - 8
		1 byte	Number of packets sent since Print Start was sent.	
04	00		Print directly to the printer, no buffering.	
		Binary Data	Subsequent data buffers in the format it is to be sent to the printer	
05	00		Flush Buffer	3 - 8
		1 byte	Number of packets sent since Print Start was sent	
06	00			

EMR Command Table

Global Response ID out of range is sent in response to commands where the Command ID is not in the table.
 Global Response EID out of range is sent in response to commands where Extended Command ID for the Command ID sent is not in the table.

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response	
ID ₁₆	EID ₁₆				
00	.		POLL (FROM IB CONTROLLER ONLY) IB ROUND ROBINS BETWEEN EID BELOW		
	00		No data follows	None	
	01			Relay & Remote switch state follows in data field	None
		Relay & Switch State	1 Byte Bit 7 = Relay 4, Bit 6 = Relay 3, Bit 5 = Relay 2, Bit 4 = Relay 1, Bit 3 = Start 2, Bit 2 = Stop 2, Bit 1 = Start 1, Bit 0 = Stop1		
	02			Time fields follow in 1 byte data fields	None
		Century	Bit 0 - 3 Centuries, Bit 4 - 5 10 Centuries, Bit 6 - 7 unused. (00 -39)		
		Second	Bit 0 - 3 Seconds, Bit 4 - 6 10 Seconds, Bit 7 unused. (00 - 59)		
		Minute	Bit 0 - 3 Minutes, Bit 4 - 6 10 Minutes, Bit 7 unused. (00 - 59)		
		Hour	Bit 0 - 3 Hours, Bit 4 - 5 10 Hours, Bit 6 - 7 unused. (00 - 23)		
		DayOfWeek	Bit 0 - 2 Days, Bit 3 - 7 Unused (01 - 07)		
		DayOfMonth	Bit 0 - 3 Dates, Bit 4 - 5 10 Dates, Bit 6 - 7 unused. (01 - 31)		
		Month	Bit 0 - 3 Months, Bit 4 10 Months, Bit 5 - 7 unused. (01 - 12)		
	Year	Bit 0 - 3 Years, Bit 4 - 7 10 Years (00 - 99)			
01			FLASH PROM PROGRAM		
	00		Start sector download	None	
		1 byte	Sector 1 - 10. Sector 0 is non-writable (boot)		
		1 byte	Pad		
		4 byte	Total bytes to be sent and programmed		
	01			Sector data	None
		1 byte	Sector 1 - 10. Sector 0 is non-writable (boot)		
		1 byte	Unused		
		4 byte	Start address in sector to program bytes		
		64 bytes max.	Sector data		
	02			Program sector	None
03			Sector status request	21	

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response	
ID ₁₆	EID ₁₆				
02	00		REBOOT EMR	None	
03			CONFIGURATION REQUEST	None	
	00		IB Configuration -Global EMR response to be repaired in Version 2.	None	
	01		Get EMR Configuration	1	
	02		Set EMR Configuration (not implemented)	None	
04			REMOTE SWITCH STATE CHANGE		
	00	Start Switch	1 byte New State (0 = SWITCH_OFF,1 = SWITCH_ON)		
	01	Stop Switch	1 byte New State (0 = SWITCH_OFF,1 = SWITCH_ON)		
05	00		RESET METER	17,18,19	
06			SET PARAMETER		
	00	float	Preset volume 4 bytes	17,18,19	
	01	float	Preset volume gross 4 bytes)		
	08	uchar	Current Product ID		
	09	ushort	Delivery Timeout		
	0B				Current time
		char	Hour		00-23
		char	Minute		00-59
		char	Second		00-59
	12				Current date
		uchar	Century		20-99
		uchar	Year		01 - 99
		Uchar	Month		01-12
		uchar	Day of the Month		01-31
17	bool		Pause Printing 0 = disabled, 1 = enabled		

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response
ID ₁₆	EID ₁₆			
06	18	Char (Key) START = 0 FINISH = 1 MODE = 2 PRESET = 3 NEXT = 4 PLUS = 5 MINUS = 6 CLR = 7 ENTER = 8 Keypad 0 = 9 K1 = 10 K2 = 11 K3 = 12 K4 = 13 K5 = 14 K6 = 15 K7 = 16 K8 = 17 K9 = 18	Key entry. (formally Mode control)	17,18,19
07			Get Parameter	18
	00		Preset volume compensated for current product	04
	01		Preset volume gross for current product	05
	02		Compensated volume of current delivery	06
	03		Gross volume of current delivery	07
	04		Net total quantity of current shift, current product from reset	08
	05		Gross total quantity of current shift, current product from reset	09
	06		Net totalizer for current product	0A
	07		Gross Totalizer for current product	0B
	08		Current (active) product	0C
	09		Timeout for no flow delivery It will terminate delivery when paused	0D
	0A		Current product temperature	0E
	0B		Current Time	0F
	0C		Display Volume string	
	0D		Display Totalizer string	
	0E		Display Preset Countdown string	

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response
ID ₁₆	EID ₁₆			
07	0F		Display Delivery volume (not rounded)	
	10		Display Totalizer (not rounded)	
	11		Display Preset countdown (not rounded)	
	12		Current Date	
	13		Current Sale number	10
	14		Meter Serial Number	11
	15		Display Rate (not rounded)	
	16		Number of decimal digits for all volume values	
	17		Pause Printing	
08			SET DELIVERY	
	00		Start single delivery or Resume	17,18,19
		1 Byte	Optional, product selection (on start only no effect as resume)	
	01		Pause Delivery	
	02		End Delivery	
	03		Print Current Ticket	
	04		Start multiple deliver or Resume multiple delivery	
		1 Byte	Optional, product selection (on start only no effect as resume) 0,1,2	
09			GET EMR STATUS	18
	00		System Status	14
	01		Printer Status	15
	02		Delivery Status	16
0A			PRINT BUFFER	
	00		Print String at assigned printer	17,18,19
		ASCII String	String of varying length	

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response
ID ₁₆	EID ₁₆			
0B			GET REGISTER CONFIGURATION	
	00		Price code	1A
		char	Price Code Index 1 - 15 (max number of price codes)	
	01		Tax Code	1B
		char	Code Index 1 - 15 (max number of tax codes)	
	02		Delivery Report Format	22
	03		Shift Report Format	
	04		Proprietary Features	
	05		Tank IDv	23
0C			SET REGISTER CONFIGURATION	
	00		Price code	17,18,19
		char	Price Code Index 1 - 15 (max number of price codes)	
		char	Tax Code Assigned	
		float	Raw Price	
	01		Tax Code	
		char	Index [1...NUM_TAX_CODES(15)] of tax code of interest	
		char	Tax Type: See Tax Discount Type Table	
		char	Mask of all tax lines this values applies to. See Tax Mask Table.	
		float	Amount of tax for line 1	
		char	Tax Type: See Tax Discount Type Table	
		char	Mask of all tax lines this values applies to. See Tax Mask Table.	
		float	Amount of tax for line 2	
		char	Tax Type: See Tax Discount Type Table	
		char	Mask of all tax lines this values applies to. See Tax Mask Table.	
		float	Amount of tax for line 3	
		char	Tax Type: See Tax Discount Type Table	
	char	Mask of all tax lines this values applies to. See Tax Mask Table.		
	float	Amount of tax for line 4		

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response	
ID ₁₆	EID ₁₆				
0C	01	char	Tax Type: See Tax Discount Type Table	17,18,19	
		char	Mask of all tax lines this values applies to. See Tax Mask Table.		
		float	Amount of tax for line 5		
		char	Tax Type: See Tax Discount Type Table		
		char	Mask of all tax lines this values applies to. See Tax Mask Table.		
		float	Amount of tax for line 6		
	02			Delivery Report Format	
		string		End of Delivery Report (NUL) terminated string of Format Tokens .See table Delivery Report Format Token Table	
	03			Shift Report Format	
		string		End of Shift Report (NUL) terminated string of Format Tokens .See table Shift Report Format Token Table	
	04			Proprietary Features	
		1 byte		CHAR Feature Enable Byte Bit mapped feature enable Bit 0, Tank Fill: 0 = disabled, 1 = enabled Bit 1, Extra Sale: 0 = disabled, 1 = enabled Bit 2 - 7, Reserved for future use	
1 byte			CHAR Status O_SETR - Default settings. M_RESR - Data values. Bit mapped feature status Bit 0, Tank Fill Status: 0 = Full, 1 = Partial Bit 1, Extra Sale: 0 = No, 1 = Yes Bit 2 - 7, Reserved for future use		
0D			TRANSACTION RECORD HISTORY		
	00		Retrieve Transaction Record with this Ticket Number	1C, 1D	
		long	Ticket Number		
	01			Retrieve Nth Transaction Record	1C, 1E
		integer		Index N where N= 0 is most recent record, N+1 is previous record	
02			Return the total records for this head		

Table 9.- EMR Command Table

Command		Data Field	Description	EMR Global Table EID Response
ID ₁₆	EID ₁₆			
0E			CUSTOMER OPTIONS	18
	00		Get Customer Options	20
		6 bytes	Set Customer Options	17,19
		integer	Password	
	02	integer	Customer Options	
0F			RUN DOWNLOAD MANAGER	
	00		Execute the Download Manager	17
10			VERSION NUMBER REQUEST	
	00		Version Number	01,18
11	00		REMOTE DISPLAY LOGIN (Sent by remote display wanabe to potential master)	24
12			DISPLAY UPDATE (Sent by mast to remote display)	None
	00	1 byte	Display State DISP_OFF = 0, DISP_OEM = 1, DISP_DIM = 2, // Backlight off DISP_DIM_OEM = 3 , DISP_ON = 4, DISP_LOCKED = 5, DISP_ALL_SEGS_ON = 6, DISP_ALL_SEGS_OFF = 7	
	01	1 byte	Display state, see above	
		1 byte	Unused	
		64 bytes	Binary Data for display on the EMR head configured for remote display.	
13			KEY UPDATE (sent by remote display to master)	None
	00	ushort	Key selected at the keypad of the remote display.	

Tax discount Types

Table 10.- Tax Discount Types

Type	Value
Tax discount unused	-1
Tax percent	0
Tax per unit volume	1
Tax surcharge	2
Discount percent	3
Discount per unit volume	4
Discount surcharge	5

Tax Mask Table

Table 11.- Tax Mask Table

Mask Definition		Mask bit can be use by Tax Line					
Bit	Tax Applied To	1	2	3	4	5	6
0	Unit Price	Yes	Yes	Yes	Yes	Yes	Yes
1	Line 1	No	Yes	Yes	Yes	Yes	Yes
2	Line 2	No	No	Yes	Yes	Yes	Yes
3	Line 3	No	No	No	Yes	Yes	Yes
4	Line 4	No	No	No	No	Yes	Yes
5	Line 5	No	No	No	No	No	Yes

This table shows what the meaning of each bit in the mask (left of the double line). It also shows the set of bits each tax line can use (right of double line). Tax line 2 can only be applied to Line1 and Unit price (Bit 0 and 1) resulting in a YES in the first two rows. Tax line 2 can not be applied to Tax lines 3 - 6 that follow. Note: none of the Tax lines can be applied to Tax line 6, which is why the mask does not include a bit for Line 6. However, Line 6 can be applied to the Unit price and all lines that precede it.

Delivery Report Format Token Table

Table 12.- Delivery Report Format Token Table

Report Line Description	Code
End of Delivery Report	0
Printer advance (must be first code)	1
Full row of asterisks	2
Blank line	3
Blank line with an asterisk at each end	4
1st line of header	5
2nd line of header	6
3rd line of header	7
4th line of header	8
1st line of header with an asterisk at each end	9
2nd line of header with an asterisk at each end	10
3rd line of header with an asterisk at each end	11
4th line of header with an asterisk at each end	12
1st line of trailer	13
2nd line of trailer	14
3rd line of trailer	15
4th line of trailer	16
Start time	17
End time	18
Start volume	19
Gross end volume	20
Net end volume	21
Delivery temperature (if temperature compensated)	22
Reference temperature (if temperature compensated)	23
Temperature coefficient (if temperature compensated)	24
Ticket number	25
Ticket status (e.g. multiple delivery, summary,..)	26
Meter identification	27
Unused	28

Table 12.- Delivery Report Format Token Table

Report Line Description	Code
Product name	29
Totalizer start volume	30
Totalizer end volume	31
Average flow rate	32
Gross price per unit volume	33
Total price without taxes/discounts	34
Taxes/discounts	35
Net price per unit volume	36
Total of all taxes	37
Total of all taxes	38
Total price with all taxes	39
Total price with all non-taxes	40
Grand total	41
Reserved	42
Encoder Error (required)	43

Shift Report Format Token Table

Table 13.- Shift Report Format Token Table

Report Line Description	Code
End of Shift Report	0
Printer advance (must be first code)	1
Full row of asterisks	2
1st line of header with an asterisk at each end	3
2nd line of header with an asterisk at each end	4
3rd line of header with an asterisk at each end1	5
4th line of header with an asterisk at each end	6
1st line of header	7
2nd line of headerr	8
3rd line of header	9

Table 13.- Shift Report Format Token Table

Report Line Description	Code
4th line of header	10
Blank line	11
Starting date-time of shift	12
Ending date-time of shift	13
Odometer reading at start of shift	14
Odometer reading at end of shift	15
Distance = End odometer - Start odometer	16
Product name	17
Meter identification	18
Totalizer volume at start of shift	19
Loaded volume	20
Totalizer volume at end of shift	21
Total gross volume	22
Number of single deliveries	23
Number of multiple deliveries	24
Total number of deliveries (single + multiple)	25
Total net volume	26
Total unpriced volume	27
Total priced volume	28
Total sales without taxes/discounts	29
Total sales contribution from tax line 1	30
Total sales contribution from tax line 2	31
Total sales contribution from tax line 3	32
Total sales contribution from tax line 4	33
Total sales contribution from tax line 5	34
Total sales contribution from tax line 6	35
Grand total	36
1st line of trailer	37
2nd line of trailer	38
3rd line of trailer	39
4th line of trailer	40

Transaction Record Table

Table 14.- Transaction Record Table

Field Description	Size (bytes)	Type
Ticket #	4	LONG
Transaction Type	2	CHAR
Index: 0 for single, 1-N for multiple, -1 for summary	1	CHAR
# of Summary Records	1	char
# of Records Summarized	1	char
Product ID 0-2 (MAX_PRODUCTS-1)	1	uchar
Tank Id	16	char
Start Time Date	--	--
Minute 00-59	1	uchar
Hour 00-23	1	uchar
Day Of Month 01-31	1	uchar
Second 00-59	1	uchar
Month 01-12 (01=January)	1	uchar
Year 00-255 (2000-2255)	1	uchar
Finish Time Date Same format as Start Time Date	6	--
Odometer Start	4	float
Odometer End	4	float
TotalizerStart	8	double
TotalizerEnd	8	double
GrossVolume This is always the raw, uncompensated volume	8	double
Volume. This is either Gross or TC, depending on fuel	8	double
Average Temp	4	float
Unit Price	4	float
Tax Discount[6]	36	---
Tax Discount type (Percent, Money/Volume, Surcharge)	(1)	char
Assigned Lines Mask	(1)	char
Tax / Discount Value	(4)	float
Number Non Zero Flow; Counts the number of 0.1 second periods with flow > 0 for use in estimating average flow rate.	2	ushort

Table 14.- Transaction Record Table

Field Description	Size (bytes)	Type
Bit field: #number of bits IsVolumeOnly:1 We have 16 bits available (2 bytes) IsTCPProduct:1 IsOdometerUsed:1 IsPresetUsed:1IsStarted:1 Used to control multiple delivery IsStopped:1 Used to control multiple delivery IsFirstPrint:1 Used to denote duplicate ticket print IsBackedUp:1 Used to denote that it was saved to IB NVRAM IsEncoderError:1 Used to indicate encoder sequence error IsOverspeed:1 Used to indicate encoder too fast UnusedBits:6 Unused bits	2	ushort
spare	14	char
CRC of entire transaction data record	2	ushort
Total Bytes	142	

IB Command Table

Global Response ID out of range is sent in response to commands where the Command ID is not in Table 15.
Global Response EID out of range is sent in response to commands where Extended Command ID for the Command ID sent is not in Table 15.

Table 15.- IB Command Table

Command		Data Field	Description	IB Global Table IB Response	
ID ₁₆	EID ₁₆				
00			IB POLL COMMAND		
01			RELAY SET COMMAND	07	
	00	Relay 1 State	1 byte, Head 1 Fast Flow State 0 = OFF, 1 = ON	00	
	01	Relay 2 State	1 byte, Head 1 Single Flow State 0 = OFF, 1 = ON	01	
01	02	Relay 3 State	1 byte, Head 2 Fast Flow State 0 = OFF, 1 = ON	02	
	03	Relay 4 State	1 byte, Head 2 Single Flow State 0 = OFF, 1 = ON	03	
	04			Set two relays simultaneously	04
			Relay id	1 byte, Relay number 1 - 4	
			State	1 byte, 0 = OFF, 1 = ON	
			Relay id	1 byte, Relay number 1 - 4	
	State	1 byte, 0 = OFF, 1 = ON			

Table 15.- IB Command Table

Command		Data Field	Description	IB Global Table IB Response
ID ₁₆	EID ₁₆			
02			CONFIGURATION DATA	07
	00		IB Configuration Update	05
		IB Address	1 byte, Valid address range	
		Port 0 Type	1 byte, Valid Device Type. (See Addressing Table)	
		Port 1 Type	1 byte, Valid Device Type. (See Addressing Table)	
		Spool	1 byte, Bit 0 - Port 0, Bit 1 - Port 1, 0 = Slip Printer, 1 = Roll Printer.	
	01		EMR Configuration for Storage. Not implemented.	07
03		SET TIME	NONE	
	00	Time fields follow in 1 byte data fields		
		Century		Bit 0 - 3 Centuries, Bit 4 - 5 10 Centuries, Bit 6 - 7 Unused (00 - 39)
		Second		Bit 0 - 3 Seconds, Bit 4 - 6 10 Seconds, Bit 7 unused. (00 - 59)
		Minute		Bit 0 - 3 Minutes, Bit 4 - 6 10 Minutes, Bit 7 unused. (00 - 59)
		Hour		Bit 0 - 3 Hours, Bit 4 - 5 10 Hours, Bit 6 - 7 unused. (00 - 23)
		DayOfWeek		Bit 0 - 2 Days, Bit 3 - 7 Unused (01 - 07)
		DayOfMonth		Bit 0 - 3 Dates, Bit 4 - 5 10 Dates, Bit 6 - 7 unused. (01 - 31)
		Month		Bit 0 - 3 Months, Bit 4 10 Months, Bit 5 - 7 unused. (01 - 12)
		Year		Bit 0 - 3 Years, Bit 4 - 7 10 Years (00 - 99)
04			PULSE OUTPUT UPDATE	07
	00	long	4 bytes, long int cumulative. Reset, start.	None
	01	long	4 bytes, long int cumulative. Metering in progress.	

Table 15.- IB Command Table

Command		Data Field	Description	IB Global Table IB Response
ID ₁₆	EID ₁₆			
05			TRANSACTION RECORD	
	00		Store transaction record data	0B,0C
		TR Record	128 bytes, TransactionRecord Structure. See Transaction Record Table	
	01		Retrieve TR with Ticket Number	08,09,0E
		long	Ticket Number	
	02		Retrieve TR with Index and Head	08,0A,0E
		uinteger	Index N where N=0 is most recent record N+1 is previous record	
		uchar	Binary Address of Head where transaction came from (0, 1)	
	03		Retrieve TR with Index	
		uinteger	Index N where N=0 is most recent record N+1 is previous record	0D
	04		Retrieve count of transactions stored for this head	
		uchar	Binary Head address (0 or 1)	
	05		Retrieve count of all transactions stored in IB NVRAM	
06	00		Download EMR	
07			Download	06
	00		Start Download	0F
	01		Status	10
	02		Start	0F
	03		Data	0F
	04		Program ROM	0F
	05		Reboot	0F
	06		Download @ 19200 baud	0F
08			SOFTWARE VERSION REQUEST	05

OBC Command Table

Global Response ID out of range is sent in response to commands where the Command ID is not in Table 16.
 Global Response EID out of range is sent in response to commands where Extended Command ID for the Command ID sent is not in Table 16.

Table 16.- OBC Command Table

Command		Data Field	Description	OBC Global Table EID Response
ID ₁₆	EID ₁₆			
00			TRANSACTION REQUEST * Not fully Implemented *	0,1
	00		Store Record	None
		TR Record	Transaction Record Data, See Transaction Record Table	
	01		Retrieve Transaction Record with this Ticket Numbe	
		long	Ticket Number	
	02		Retrieve Nth Transaction Record	
		integer	Index N where N== 0 is most recent record N+1 is previous record	

Network Polling

Polling example with an EMR print request (see Table 17):

EMR head 2 requests the printer at address 0. In this example the IB is 3 and the printer is on IB 1. The IBN communication to get the print request to the printer via IB1 can be seen in the IBN example following this one. Startup sequence has already taken place and the IB knows its configuration and relative address of the devices attached.

Table 17.- EMRN Example with Print Commands

IB MSG	Description	EMR MSG	Description
<SOH>E4824040<ETX>crc<CR>I	IB 3 Polls EMR 1	<SOH>82E48040<ETX>crc<CR>	Ack Message
<SOH>E5824040<ETX>crc <CR>	Poll EMR 2	<SOH>50E54040<ETX>crc<CR>	Ask For Printer
<SOH>E5508040<ETX>crc <CR>	Ack Message (by IB3)	<SOH>82E58040<ETX>crc<CR>	Poll Ack (no more msgs)
<SOH>E4507F40<ETX>crc <CR>	Printer Granted (from IB1)	<SOH>E550FF40<ETX>crc<CR>	Ack Message
<i>Poll EMR 1 & Ack by EMR 1 not shown</i>			
<SOH>E5824040<ETX>crc <CR>	Poll EMR 2	<SOH>50E54140<ETX>crc<CR>	Beginning of print data
<SOH>E5508140<ETX>crc <CR>	Ack Message (by IB3)	<SOH>50E54240<STX>31014A4F48F E<ETX>crc<CR>	Print JOHN
<SOH>E5508240<ETX>crc <CR>	Ack Message (by IB3)	<SOH>50E54340<STX>01<ETX>crc <CR>	Print Complete 1 buffer sent
<SOH>E5508340<ETX>crc <CR>	Ack Message (by IB3)	<SOH>82E58040<ETX>crc<CR>	Poll Ack (no more msgs)
<SOH>E5507F44<ETX>crc <CR>	Print Complete (from IB1)	<SOH>50E5FF44<ETX>crc<CR>	Msg Ack
<SOH>E48240<ETX>crc <CR>	Poll EMR 1	<SOH>82E480<ETX>crc<CR>	Ack Message nothing to send
<SOH>E58240<ETX>crc <CR>	Poll EMR 2		

Table 18 illustrates an IBN polling example with 3 IBs (1,2,3). IB3 sends the above print command out on the IB network to printer with address 0 (IB 1 port 1).

Table 18.- IBN Communication Example

IB Device A	Description	IB Device B	Description
<SOH>82804040<ETX>crc <CR>	Pass token from IB 1 to 3	<SOH>80828040<ETX>crc<CR>	IB 3 acknowledges receipt of token
		<SOH>50E54040<ETX>crc<CR>	EMR Asks For Printer
<SOH>E5508040<ETX>crc <CR>	Ack Message from IB 1		
		<SOH>81824040<ETX>crc<CR>	Nothing more to send, pass token to IB 2
<SOH>82818040<ETX>crc<CR>	Acknowledge Receipt of Token		
<SOH>81814040<ETX>crc<CR>	Nothing more to send, pass token to IB 1	<SOH>81808040<ETX>crc<CR>	IB 1 acknowledges receipt of Token
		<SOH>E5507F40<ETX>crc<CR>	Printer Granted
<SOH>E550FF40<ETX>crc <CR>	Ack Message		
<SOH>82804040<ETX>crc <CR>	Pass token from IB 1 to 3	<SOH>80828040<ETX>crc<CR>	IB 3 acknowledges receipt of token
		<SOH>50E54140<ETX>crc<CR>	Beginning of print data
<SOH>E5508140<ETX>crc <CR>	Ack Message		
		<SOH>50E54240<STX>31014A4F48FE<ETX>crc<CR>	Print JOHN
SOH>E5508240<ETX>crc <CR>	Ack Message		
		<SOH>50E54340<STX>01<ETX>crc <CR>	Print Complete 1 buffer sent
<SOH>E5508340<ETX>crc <CR>	Ack Message		
		<SOH>81824040<ETX>crc<CR>	Nothing more to send, pass token to IB 2
<SOH>82818040<ETX>crc <CR>	Acknowledge Receipt of Token		
<SOH>80814040<ETX>crc <CR>	Nothing more to send, pass token to IB 1	<SOH>81808040<ETX>crc <CR>	IB 1 acknowledges receipt of token
		<SOH>E5507F44<ETX>crc <CR>	Printer Granted
<SOH>E550FF44<ETX>crc <CR>	Ack Message		
<SOH>82804040<ETX>crc <CR>	Pass token from IB 1 to 3	<SOH>80828040<ETX>crc <CR>	IB 3 acknowledges receipt of token

STARTING (RESTARTING) THE IBN

The IBNM performs the following functions; Starts the token passing, restarts token passing when communication times out, and identifies the highest numbered IB.

There is an EMR setup parameter to program the IB address. There are only 16 possible addresses (0-15). Each IB is listening on the network for communication. They are waiting for commands to their address, or the address of one of their peripheral devices. Each IB has a different network time-out value based on its address (the higher the address, the higher the time-out value). All the IBs will assume responsibility of the token when its network time-out value elapses. It assumes the token and attempts to restart the network by passing the token to the next lower IB address. In principle, the IB with the lowest address should time out first and try to restart communication. Once the IB attempts to pass the token the other IB time-out values will reset, preventing them from assuming the token and restarting network themselves. Once an IB receives the token the network should maintain token passing keeping the network alive.

If the IBNM is not the 0-address device, it will attempt to decrement the token address and pass it to the next lower address. The attempts will continue, decrementing to the next lower address, until the 0 address is attempted and failed. If the 0 address has failed, it will pass the token to the highest known address (unless it is doing the periodic search for additional IBs). The advantage of this scheme is that the lowest addressed IB will take charge of the network if it goes down. Missing addresses are always skipped. The only possibility of network shut down is when any one or two IBs continuously transmit on the network without passing the token.

CONFIGURATION STORAGE

EMR can store its setup values and other operating parameters in the IB. The IB can restore this configuration when requested by the user. This option is only available when the IB has NVRAM.

Startup Sequence

The EMR will not request or send its configuration as a part of normal startup sequence. The IB checks NVRAM for valid EMR configuration. If the IB NVRAM is corrupted or empty, the IB will request the EMR configuration using the EMR Configuration request Command ID and the RESERVED device type with address 0x1F. The EMR configured as device 0 will respond with the current EMR configuration using the Global EMR CMD ID, Configuration Update EID.

Setup Change (EMR)

When the user enters Setup mode and modifies parameters which are stored remotely in the IB, the EMR will upload the latest EMR configuration to the IB using the Global EMR CMD ID, Configuration Update EID.

Setup Menu Restore Option (EMR) Not implemented ver 1B

Setup mode will provide a menu for the user to request a configuration restore from the IB. The user request will generate an IB Command EMR Configuration Restore ID. The IB will respond with the EMR Configuration Restore Command ID that includes the stored data. The EMR must time-out the request in case the IB does not respond. This would force the user to manually enter the operating parameters.

IB Hardware Replacement

Normal startup sequence will successfully identify when the NVRAM requires EMR configuration update. See section 3.9.1.

EMR Hardware Replacement

The operator can restore the EMR configuration from the IB using the Menu Option outlined in section 3.9.3. If this option is not used, the IB will be updated with the latest EMR configuration as outlined in section 3.9.2.

Network Sequence

Figure 2 shows the sequence of communication between devices in the IB. It includes two EMR heads on the EMRN, a printer, DSU, and a second IB on the IBN. The time line is showing event sequence.

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