APPLICATION NOTE

APP-107

MCS MAGNUM RS485 Network Protocol

Revision History

Date	Author	Description
07/31/97	Brian Walterick	Created Application Note.
08/01/97	Brian Walterick	Added new sections for RS232 & RS485 Network Medium, Message Verification. Finished Class Number Descriptions.
08/04/97	Brian Walterick	Added Class Definitions section.
07/09/98	R. Toney	Indicated differences between 4 and 6 board. message structure.
09/08/98	R. Toney	Corrected app #’s, 4 board APP#11 & 6 board APP#12.
11/05/98	BWW	Added new class #44 BMS RAAM
03/23/2023	DEW	Changed to only RS485, changed tables from Chris.

This Application Note describes the network protocol for the MCS-MAGNUM and RS485 communication ports.

Theory

The network is a shared communication channel. To communicate with one another, the interconnected computers(nodes) must follow the rules concerning which nodes can transmit at which time. If the messages transmitted over the network are to be intelligible, their syntax and semantics must conform to a set of rules. These rules constitute the network protocol.

The network is a master-slave protocol. **ONE** node acts as the master and the other nodes function as slaves. Slaves communicate with the master only when the master initiates communication. Slaves cannot talk directly to other slaves.

Network traffic is divided into discrete messages, each of which is a string of bytes. A message is a serial data stream with a predetermined format. Every message starts with a frame open character(17hex) and ends with a frame close character(18hex). Following the frame open character is a fixed header of 16 bytes. This header defines the length of the message, who the message is for, who the message is from, what type of message, what type of data, etc.

Each message also contains a checksum. This is the last byte in the interior of the message, the byte right before the frame close character. The checksum is calculated by adding every byte between the frame open and the frame close characters (excluding the checksum byte). The checksum is used to ensure that the message was received as it was transmitted. After receiving a message, the calculated checksum must equal the transmitted checksum. If not, the message is invalid and should be ignored.

Since the message must contain arbitrary data patterns, a 17 or 18 hex could appear in the message's interior and can be misinterpreted as a frame open or close character. To prevent this problem the interior of the message is stuffed. Any 17, 18 or 10 hex bytes within the framing characters are transmitted as a two-byte sequence. A 17 hex is transmitted as a 10 hex and 07 hex. An 18 hex is transmitted as 10 hex and 08 hex. A 10 hex is transmitted as a 10 hex and 00 hex. The receiving node must then convert these two-byte sequences back to a single byte. The key is a 10-hex byte. Any time a 10 hex appears in the message simply add the next byte to it. This will convert all two-byte sequence back to one byte.

Message Format

The following is the message format. Every message must conform to this format.

Message Fields	Type	Example (Hex)	Range (Hex)	Description
Frame Open	byte	17	17	Start of message indicator.
Length - Low	low byte of word	11	00-FF	Number of bytes in interior (between frame open and frame close) of message before stuffing. Low byte of length word.
Length - HI	hi byte of word	00	0-10	Hi byte of length word.
Receiver Address	byte	01	0-FF	Address of node the message is for.
Transmitter Address	byte	FF	0-FF	Address of node the message is from.
Control Number	byte	5A	0-FF	Number to identify each message.
Status Flag	byte	03	0-FF	Reserved.
Command	byte	01	01 - 05 80-84	Type of message being sent. Request, ACK, etc.
Class Number	byte	1A	00-55	The number of the class data.
Starting Record	byte	01	1-FF	If class number is an array, then this field indicates which record to start at else it must be a 1.
Record Count	byte	04	1-FF	If class number is an array, then this field indicates how many records else it must be a 1.
Reserved	6 bytes	00 00 00 00 00 00	0-FF	Reserved.
Class data	0 to 1024 bytes	No class data in this message (INFO REQUEST) .	0-FF	This field contains that actual class data. It varies in length and structure based on the command field (info request, start cfg transmit, and end of cfg transmit message have no data) and the class number field. This field cannot exceed 1024 bytes. DO NOT send a request or change message with class data that exceeds 1024 bytes. If all the element of the class data being requested or send cannot fit within 1024 bytes, then break the message into multiple messages.
Checksum	byte	8E	0-FF	Use these field to verify that message has been received intact. Simply add all bytes after frame open character (excluding the checksum and frame close) and verify that it equals the value in this field.
Frame Close	byte	18	18	End of message indicator.

Message Commands

Request (Hex)	Type of Request	Respond (Hex)	Type of Respond
01	INFORMATION REQUEST	80	INFORMATION REQUEST ACK
02	CHANGE REQUEST	81	CHANGE ACK
03	RESERVED	82	RESERVED
04	START CFG TRANSMIT REQUEST	83	START CFG TRANSMIT ACK
05	END CFG TRANSMIT REQUEST	84	END CFG TRANSMIT ACK

Class Numbers

Class #	CLASS NAME	#Points	DESCRIPTION
0	BEGIN EEPROM	1	Start of configuration marker.
1	VERSION NUMBER EEPROM	1	Site information for the unit.
2	CHILLER EEPROM	1	Configuration data for the unit.
3	RO EEPROM	90	Configuration data for Relay Outputs.
4	AO EEPROM	36	Configuration data for Analog Outputs.
5	SI EEPROM	144	Configuration data for Sensor Inputs.
6	SETPOINT EEPROM	255	Configuration data for Setpoints.
7	MACHINE EEPROM	1	Configuration data for the hardware.
8	RESERVED	0	
9	AUTH EEPROM	1	Configuration data for auth codes.
10	HISTORY EEPROM	1	Configuration data for history.
11	RTC EEPROM	1	Configuration data for daylight savings and real time clock.
12	HOLIDAY EEPROM	1	Configuration data for holiday schedule.
13	RESERVED	0	
14	RESERVED	0	
15	OPERATING SCHEDULE EEPROM	2	Configuration data for operating schedule.
16	BITMAP EEPROM	1	Configuration data for bitmap data.
17	CIRCUIT EEPROM	20	Configuration data for circuit information.
18	GRAPHIC EEPROM	1	Configuration data for graphic file path.
19	LOOKUP TABLE EEPROM	5	Configuration data for lookup tables.
20	UTILITY EEPROM	1	Configuration data for utility information.
21	END EEPROM	1	End of configuration marker.
22	CHECKSUM EEPROM	23	Configuration data for calculated checksums.
23	CHILLER RAM	1	Ram data for chiller information.
24	RO RAM STATUS	80	Current state for relay outputs.
25	RO RAM INFO	80	Run time information for relay outputs.
26	AO RAM STATUS	28	Current % for analog outputs.
27	AO RAM INFO	28	Min/max/avg for analog outputs.

Class #	CLASS NAME	#Points	DESCRIPTION
28	SI RAM STATUS	122	Current state for sensor inputs.
29	SI RAM INFO	122	Min/max/avg for sensor inputs.
30	MCSIO RAM	1	Diagnostic info for I/O communication.
31	SW STATUS RAM	1	Diagnostic info for software & configuration
32	ALARM RAM	100	
33	ALARM HISTORY RAM	100	Alarm codes, dates and times.
34	MACHINE RAM	1	Diagnostic information on the hardware.
35	RTC RAM	1	Last time read from the RTC chip.
36	SW TIME RAM	1	Time for the software clock.
37	KEYPAD CHANGE RAM	1	
38	HISTORY INDEX RAM	1	Indexes for ALARM and HISTORY RAM.
39	HISTORY RAM	1008	Trending info for all ROs, AOs & SIs
40	RAM BEG MARK	1	Start of ram marker.
41	RAM CFG MARK	1	Start of ram CFG marker.
42	RAM END MARK	1	End of ram marker.
43	RAM AD RAW	1	AD counts being scanned.
44	IP NETWORK INFO	1	Storage class for Ethernet information
45	ALGO FILTERED	112	AD counts formatted.
46	OUTPUT IMAGE	9	Relay output bit information.
47	RS232 RAM	1	Diagnostic information for the RS232 port.
48	RS485 RAM	1	Diagnostic information for the RS485 port.
49	SETPOINT RAM	255	Values for all setpoints.
50	RESERVED	0	
51	RESERVED	0	
52	THERMOSTAT RAM	1	Thermostat information.
53	RO RAM EXTRA	80	Manual % for all pulse outputs.
54	LOCKOUT HISTORY RAM	1	Sensor data at the time of an alarm.
55	CHILLER INFO RAM	1	Chiller unit information.
56	CIRCUIT RAM	20	Information on each Circuit.
57	RESERVED	0	
58	RESERVED	0	
59	RESERVED	0	
60	RESERVED	0	
61	RESERVED	0	
62	RESERVED	0	
63	RESERVED	0	
64	LWC EEROM	1	
65	EXTENDED UNIT ALARM TREND RAM	10	Alarm trending data for the chiller.
66	EXTENDED CIRCUIT LOCKOUT RAM	10	Lockout point info for each circuit.
67	RESERVED	0	
68	RESERVED	0	
69	RESERVED	0	

Class #	CLASS NAME	#Points	DESCRIPTION
70	RESERVED	0	
71	RESERVED	0	
72	RESERVED	0	
73	RESERVED	0	
74	RESERVED	0	
75	RESERVED	0	
76	RESERVED	0	
77	RESERVED	0	
78	RESERVED	0	
79	RESERVED	0	
80	RESERVED	0	
81	RESERVED	0	
82	RESERVED	0	
83	RESERVED	0	
84	RESERVED	0	
85	RESERVED	0	
86	RESERVED	0	
87	RESERVED	0	
88	RESERVED	0	
89	RESERVED	0	
90	RESERVED	0	
91	RESERVED	0	
92	RESERVED	0	
93	RESERVED	0	
94	RESERVED	0	
95	RESERVED	0	
96	RESERVED	0	
97	CPM UNIT RAM	1	Information being passed to the CPM.
98	RESERVED	0	
99	RESERVED	0	
100	RESERVED	0	
101	RESERVED	0	
102	RESERVED	0	
103	RESERVED	0	
104	RESERVED	0	
105	RESERVED	0	
106	RESERVED	0	
107	RESERVED	0	
108	RESERVED	0	
109	RESERVED	0	
110	RESERVED	0	
111	RESERVED	0	
112	RESERVED	0	

Class #	CLASS NAME	#Points	DESCRIPTION
113	RESERVED	0	
114	AO RAM PID STATUS	28	PID information.

Message Verification

When a node receives a message, the node must verify the message is in fact valid. Several fields must be check for the message to be valid. The calculated checksum of message as it is received must equal the checksum field in the message.
The length of the received message after unstuffing must equal the length field in the message. The message must contain a valid command (01-05 or 80-84). The message must contain a valid class number (0-55 hex). The receiver address must match the network address of the node. Once all these conditions are satisfied the message is valid and can be processed.

RS485 Network Medium

The RS485 medium supports a network of up to 60 nodes (one master & up to 19 slaves) using 2 conductor shielded cable. The RS485 network operates at 19,200 baud rate with a maximum cable length of 4000 feet. The character format is 8 data bits, no parity, and 1 stop bit.

Example Message

INFO REQUEST message of CLASS 1C (28 - SI_RAM_STATUS) from MASTER node at address FF (255) to slave node at address 01 (1).

17 11 00 01 FF 5B 03 01 1C 01 20 00 00 00 00 00 00 AD 18

INFO REQUEST ACK message - The response to the above INFO REQUEST message.

17 51 00 FF 01 5B 00 80 1C 01 20 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 03 01 FC 00 00 D6 04 F7 02 8B 08 10 00 03 01 00 01 00 13 03 D0 02 16 03 DF 02 69 0B 10 00 03 01 00 00 00 13 03 4E 02 0E 03 C7 04 0E 05 0B 03 01 00 00 00 0B 03 EC 02 1A 03 CB 18

Class Definitions

- For detailed descriptions of 4 board class structures refer to APP NOTE 11, Four Board Class Definitions.

- For detailed descriptions of 6 board class structures refer to APP NOTE 12, Six Board Class Definitions.