

Filename = Magnum Networking Communications Protocol.XLS

7-May-03 Update 10-Oct-03

Update 23-May-05 add 0% charge rate and 250 VAC Dropout for ac disconnect for EMS support

Update 28 March 2006 for new fault codes and new VAC dropout values

Update Oct 06 for sending VACin and VAC output and new fault codes:

RELAY\_FAULT

CHARGER\_FAULT

Update Nov 06 for new battery sizes and new TCO\_FAULT

Update Jan 23-07 added EOF (0xFF) value and third party notes.

Update Apr-23-07 added (0x91) CB3 open fault

Update Aug-13-07 corrected VAC dropout values

Update Oct-15-09 Added new packet information

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#### Software definition of comm system:

This is a definition of the "TCS" (Temp Comm Sys) for the "Charger" part of the Magnum Energy Inverter/Charger/Remote pair.

TCS-C is the "Charger/Inverter" end.

TCS-R is the "Remote" end.

#### OVERVIEW:

This implementation works as:

"Charger/Inverter" is the MASTER of communications, and will transmit its data once every 100ms. During this time

TCS-C will:

1. Enable the RS-485 transmit driver
2. (internally) disable the Receiver (RE)
3. Reset the RECEIVE DATA POINTER
4. Reset the TRANSMIT DATA POINTER, and transmit 16 bytes of data.

At the "end" of the transmission:

1. Disable the RS-485 transmit driver
2. (internally) ENABLE the Receiver (RE)

On reception of bytes (from the Remote):

1. Store data sequentially
2. advance the RECEIVE DATA POINTER
3. after the 16th byte,  
(internally) disable the Receiver (RE).

(repeat)

"Remote" is the SLAVE and responds to messages by transmitting its own message 10ms after the MASTER's message ends.

TCS-R operates in the following manner:

1. Receives bytes of data, storing to ram, advancing the RAM\_POINTER, and RESETTING the Rx\_CLOCK (2ms step) to ZERO.

When Rx\_CLOCK reaches 5 (10ms) do:

1. (internally) disable Receiver (RE),
2. enable the RS-485 transmit driver
3. reset the TRANSMIT DATA POINTER
4. reset the RECEIVE DATA POINTER
5. trigger the TRANSMITTER
6. Every fourth send extends data transmission with AGS or BMK settings

When the transmitter is complete:

1. disable Transmitter
2. disable the RS-485 transmit driver
3. (internally) enable the Receiver (RE)

When AGS clock reaches 10ms, or BMK clock reaches 14ms:

1. "Remote" receives bytes of data, storing to ram

\* Note: AGS and BMK do not communicate on every cycle

\* After sending an AGS a hex A0, or hex A1, the AGS will respond in the next cycle.

(repeat)

#### Hardware definition of comm system:

This is a simple communications systems, where the physical link is RS-485, which is defined as:

true 2 wire only  
5V differential,  
half-duplex,  
multi-drop up to 32 connected transceivers.

RJ-11 wiring on inverter is (from top to bottom) :

1 = "B" RS485 comm

2 = +14

3= GND

4 = "A" RS485 comm

Comm rate = 19.2K BPS  
 Each bit time = about 50usec  
 Each byte = about 500usec  
 All 16 bytes = about 8 msec  
 Time each packet is sent = about every 100 msec

Communications from inverter and remote:

Every 100 msecs, the inverter sends a packet of data, one right after the other, whether remote is connected or not.

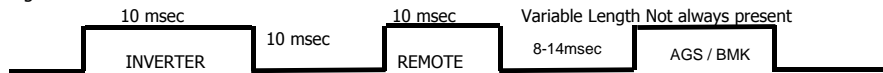
<b>MS rev 3.9 and earlier / All ME, RD, MM, MMS series</b>	Inverter sends <b>16</b> bytes of data
<b>MS rev 4.0 and later</b>	Inverter sends <b>21</b> bytes of data

If remote is connected it will receive the packet and then after a short delay will begin sending a packet back to the inverter.

<b>ME-RC rev 1.4 and earlier / All MM-R, MM-RC, ME-RB, and ME-MR</b>	Remote sends <b>16</b> bytes of data
<b>ME-RC rev 1.5 and later / All ME-ARC</b>	Remote sends <b>21</b> bytes of data

**The definition of remote byte order:**

Scope picture of comm string:



**Inverter sends**

Byte order	Data name	bits	value assignments	Value sent to remote remote (hex)	Comments
0	Inverter status	8	Charger Standby EQMODE FLOATMODE ABSORBMODE BULKMODE BATSAVERMODE CHARGEMODE Off INVERTMODE Inverter Standby SEARCHMODE	0x00 0x01 0x02 0x04 0x08 0x09 0x10 0x20 0x40 0x50 0x80	AC in, charging disabled // unit is eq'ing with ac // unit is float charging w/ac // unit is charging in absorb w/ ac // unit is charging in bulk mode with ac applied // unit is charge mode but no charge current since bat is full // unit is in charge mode, no ac applied // inverter off, charger off waiting for user input (no AC pass through) // inverter on (charger on or off) <b>MS rev 4.0 or later only (PAE)</b> // searching for load (charger on or off)
1	Inverter fault	8	No Fault on inverter STUCKRELAY DC_OVERLOAD AC_OVERLOAD DEAD BAT BACKFEED LOWBAT HIGHBAT HIGHACVOLTS BAD_BRIDGE NTC_FAULT FET_OVERLOAD INTERNAL_FAULT4 STACKER_MODE_FAULT STACKER_CLK_PH_FAULT STACKER_NO_CLK_FAULT STACKER_PH_LOSS_FAULT OVERTEMP RELAY_FAULT CHARGER_FAULT HIBATEMP OPEN_SELCO_TCO CB3 OPEN FAULT	0x00 0x01 0x02 0x03 0x04 0x05 0x08 0x09 0x0A 0x10 0x12 0x13 0x14 0x16 0x18 0x17 0x19 0x20 0x21 0x80 0x81 0x90 0x91	// not used // DC bridge overload fault // AC output overload fault // charging a dead battery AC Backfeed // low bat cutout // high bat cutout // high ac output voltage // Remote displays = Internal Fault 1 = bad fet bridge // Remote displays = Internal Fault 2 = fets too hot (>20C step) // Remote displays = Fet Overload = FETS too hot too fast (6C over 4 sec) // Not used // Stacker fault, both units not in same mode, problem with "other" inverter // Stacker sync clocks are not in phase // Stacker does not detect other stackers sync clock // Stacker AC output voltage is not properly phased // overtemp shutdown // Transfer relay is not closed in chg mode // Bridge fault in chg mode = max PWM, no ac amps, Vbat < FloatV // high battery temp // open transformer TCO temperature cutout // open input 30 amp AC Breaker CB3
2,3	DC volts	16*	0-64K		0-64K = 0 - 6400.0V or 1 count/ 0.1V (real range = 0-100.0V)
4,5	DC amps	16*	0-64K		0-500 amps DC
6,7 (was)	Ac amps NOT IMPLEM	16*	0-64K		NOT Implemented
6 (is)	AC volts output	8			0-150 Volts ac RMS <b>MS Inverter rev 3.0 and later</b>
7 (is)	AC volts input	8			0-255 Volts ac peak <b>MS Inverter rev 3.0 and later</b>
8	Inverter LED	8			IF = 0, then INV LED is off else INV Led on remote ON
9	Charger LED	8			IF = 0, then CHG LED is off else CHG Led on remote ON
10	Inverter Revision	8	0 to 256		i.e. 10 = 1.0 Non-zero is mandatory for remote start up i.e. 11 = 1.1
11	Battery temp	8			0-150 = 0-150 deg C
12	Transformer temp	8			0-150 = 0-150 deg C
13	FET temp	8			0-150 = 0-150 deg C

14 Inverter Model

Model	Dec	Hex
MM612	6	0x06
MM612-AE	7	0x07
MM1212	8	0x08
MMS1012	9	0x09
MM1012E	10	0x0A
MM1512	11	0x0B
ME1512	15	0x0F
ME2012	20	0x14
ME2512	25	0x19
ME3112	30	0x1E
MS2012	35	0x23
MS2012E	40	0x28
MS2812	45	0x2D
MS2712E	47	0x2F
MM1324E	53	0x35
MM1524	54	0x36
RD1824	55	0x37
RD2624E	59	0x3B
MM1x24E	60	0x3C
RD2824	63	0x3F
RD4024E	69	0x45
RD3924	74	0x4A
MS4124E	90	0x5A
MS2024	91	0x5B
MS4024	105	0x69
MS4024AE	106	0x6A
MS4024PAE	107	0x6B
MS4448AE	111	0x6F
MS3748AEJ	112	0x70
MS4448PAE	115	0x73
MS3748PAEJ	116	0x74

Not a currently release model

15 Not used

0

MS rev 3.9 and earlier / All ME's

15 Stack mode	8	Standalone unit Parallel stack - master Parallel stack - slave Series stack - master Series stack - slave	0x00 0x01 0x02 0x04 0x08	MS rev 4.0 and later
16 AC Input Amps	8			1 count = 1 Amp AC
17 AC Output Amps	8			1 count = 1 Amp AC
18,19 AC Hz	16*			1 count = 0.1Hz
20 Not used	8		0	

16\* = NOTE that for all 16 bit variables, they are sent in two bytes, the high byte sent first. So for DC volts, high byte is sent in third position (byte 2) and low byte is sent in fourth position or byte 3.

### Remote sends

Byte order	Data name	bits	value assignments	Value sent to inverter (decimal)	Comments
0	Inverter ON/OFF Charger ON/OFF Future use EQ Mode Future use	4, low order	Bit 0, momentary high Bit 1, momentary high Bit 2 = 0 Bit 1 & 3(0x0A), momentary high Bit 4 - 7 = 0		Toggle inverter on/off Toggle charger on/off (only when AC is in use) Not used Toggle EQ mode (only when AC is in use, only in float mode) Not used
1	Search watts	8	Defeated 5W (default) 5 - 50 Watts	0 5 5 - 50	
2	Battery size	8	400Ah (default) 200Ah (default)	40 20	1 count = 10Amp hours; Inverter accepts increments of 20, from 20-160 ME-RC MM-RC / MM-R 3.6
3	Battery Type	8	Gel Flooded (default) AGM AGM2 Absorption, if set to Custom Custom	2 4 8 10 100+	This becomes Absorption; 144 = 14.4 volts. <b>Inv rev x.x and later</b>
4	Charger Amps	8	0% 10% 20% 30% 40% 50% 60% 70% 80% (default) 90% 100%	0 10 20 30 40 50 60 70 80 90 100	Must be in steps of 10 <b>0% in Inv rev x.x and later</b>  Maximum, inverter will default to 80 if any other value is sent

5 AC shore amps	8 30A	(default)	30	Range is 5 - 60, in steps of 1
6 Remote revision	8	1.0	10	i.e. 10 = 1.0 * MM-R & MM-RC starts at 3.6 ** ME-RB starts at 8.0  *** If using a BMK, the revision must be greater than 1.8, or the BMK will not communicate
7 Ambient temp	8		0-150 = 0-150 deg-C	
7 Parallel threshold / Force Charge	4, low order 4, high order		BIT 0-3 BIT 4 BIT 5 BIT 6 BIT 7	Parallel threshold 1 count = 10% of unit capacity Disable Refloat Force Silent Force Float Force Bulk
8 Auto Genstart	8 Off	(default)	0	
	Enable		1	Allow Auto Gen Start
	Test		2	
	Enable with Quiet Time		4	Don't start during quiet time hours
	On		5	<b>Only in AGS rev 5.0 and later</b>
9 Low Battery Cut Out (LBCO)	8 10.0 volts	(default)	100	Range 9.0 to 16.0 (90 to 160 sent to Inverter)
** 24 volt values	20.0 volts	(default)	200	Range 19.0 to 25.5 (190 to 255 sent to inverter)
*** 48 volt values	40.0 volts	(default)	200	Same range as 24volt, display shows double the value sent.
10 VAC cut out voltage	8 60VAC		110	Range is 0 to 255, but is not linear
	65V		122	Export models (230 VAC/50 Hertz) have the same range, just double the displayed AC voltage
	70V		135	
	75V		145	
	80V	(default)	155	
	85V		165	
	90V		175	
	95V		182	
	100V		190	
	"EMS over-ride- open relay"		255	This will cause inverter to ignore AC input
11 Float Volts	8 13.2 volts	(default)	132	Scaled to 12 volt numbers; 0.1 = 1
12 EQ Volts	8 15.6 volts	(default)	12	Range is 0 - 2.0 volts (0 - 20), this is added to Absorption voltage
13 Absorb Time	8 2.0 hrs	(default)	20	x.x hrs; 0-255, 25 would be two and half hours; 0.1 hr = 6 minutes
14 Hours	8		0 - 23 hours	Remote always sends Hours
15 Minutes	8		0 - 59 minutes	and minutes, unless otherwise noted

**Bytes 16-20 were added for AGS in ME-RC Rev 1.5 and later.**

**Works with AGS revision 3.5 and later**

16 Gen run time	8 2.0 hrs	(default)	20	x.x hrs; 0-255, 25 would be two and half hours; 0.1 hr = 6 minutes
17 Start Temp	8 Off	(default)	0	Range 33 to 104 Fahrenheit (33 - 104); cooling only
18 Start VDC	8 Off		0	Scaled to 12 volt numbers; 0.1 = 1
	11.0 volts	Default	110	Range, 1 to 255
19 Quiet time hours	8 Off	Default	0	** AGS revision 5.0 and later use this byte to enable quiet time
	9pm to 7am		1	
	9pm to 8am		2	
	9pm to 9am		3	
	10pm to 8am		4	
	11pm to 8am		5	
20 Footer	8		0xA0 Hex	Bytes 14 through 19 can be used to communicate to other network devices. Byte 20 is used to address the device.

**Bytes 14-20 were added for AGS in ME-ARC.**

**Works with AGS revision 5.0 and later**

14 AGS Start Time	8 12:00A	Default	0	0 = 12:00 AM one count = 15 minutes
15 AGS Stop Time	8 12:00A	Default	0	* If start/stop are set the equal, function is disabled
16 AGS Vdc Stop	8 14.4v	Default	144	Voltage scaled in 12 numbers
	Float		255	Stop on inverter float mode
17 AGS V Start Delay	8 120 Sec	Default	120	MSB bit controls minute/second selection; Range 0 - 127
	120 Min		248	MSB = 1 = Minute; MSB = 0 = Seconds
18 AGS V Stop Delay	8 120 Sec	Default	120	All "delays" use the above format
19 AGS Max Run Time	8 12.0 hrs	Default	120	x.x hrs; 0-255, 25 would be two and half hours; 0.1 hr = 6 minutes
20 Footer	8		0xA1 Hex	

**Bytes 14-20 were added for AGS in ME-ARC**

**Works with AGS revision 5.0 and later**

14 AGS SOC Start	8 Off	Default	0	1 count = 1%
15 AGS SOC Stop	8 90%	Default	90	1 count = 1%
16 AGS Amps Start	8 Off	Default	0	1 count = 1 Amp
17 AGS Amps Start Delay	8 120 Sec	Default	120	MSB bit controls minute/second selection; Range 0 - 127
	120 Min		248	MSB = 1 = Minute; MSB = 0 = Seconds
18 AGS Amps Stop	8 5 amps	Default	5	1 count = 1 Amp
19 AGS Amps Stop Delay	8 120 Sec	Default	120	MSB bit controls minute/second selection; Range 0 - 127
	120 Min		248	MSB = 1 = Minute; MSB = 0 = Seconds
20 Footer	8		0xA2 Hex	

Bytes 14-20 were added for AGS in ME-ARC			Works with AGS revision 5.0 and later		
14	AGS Quiet Time begin	8 8:00P	Default	80	0 = 12:00 AM one count = 15 minutes
15	AGS Quiet Time end	8 10:00A	Default	40	0 = 12:00 AM one count = 15 minutes
					** Byte 19 in footer A0 must be set to 1 to enable function
					* If begin/end are set equal, function is disabled
16	AGS Exercise Days	8 Off	Default	0	1 Count = 1 Day; Range 0 - 255
17	AGS Exercise Start Time	8 8:00A	Default	32	0 = 12:00 AM one count = 15 minutes
18	AGS Exercise Runtime	8 1.0 hrs		10	x.x hrs; 0-255, 25 would be two and half hours; 0.1 hr = 6 minutes
19	Top off	8 Off	Default	0	1 count = 1 minute; Range 0 - 255
20	Footer	8		0xA3 Hex	

Bytes 14-20 were added for AGS in ME-ARC			Works with AGS revision 5.0 and later		
14	AGS Warm up	8 60 Sec	Default	60	MSB bit controls minute/second selection; Range 0 - 127
15	AGS Cool down	8 60 Sec	Default	60	MSB = 1 = Minute; MSB = 0 = Seconds
					MSB bit controls minute/second selection; Range 0 - 127
					MSB = 1 = Minute; MSB = 0 = Seconds
16	Empty / Not used	8		0	Possible future settings
17	Empty / Not used	8		0	
18	Empty / Not used	8		0	
19	Empty / Not used	8		0	
20	Footer	8		0xA4 Hex	

Bytes 16-20 were added for BMK in ME-RC Rev 1.7 and later.			Works with BMK revision 1.0 and later		
16	Battery efficiency	8 Auto	Default	0	1 count = 1%
17	Resets	8		0	Normal running
				1	Reset minimum volts DC
				2	Reset maximum volts DC
				3	Reset Amp Hour "Trip"
				4	Reset KAmper Hours
18	Battery size	8 400Ah	Default	40	1 count = 10 Amp Hours; 200 amp hour minimum
19	Empty / Not used	8		0	
20	Footer	8		0x80 Hex	

### ME-AGS Sends

AGS transmits every time a remote transmits a footer 0xA0 or 0xA1 hex

** Only revision 3.5 and later communicates on the network					
Byte order	Data name	bits	value assignments	Value sent	Comments
0	Header	8		0xA1 Hex	
1	Status	8	Not valid	0	No Comm on remote
			Off	1	Not enabled
			Ready	2	Enabled
			Manual Run	3	Generator manually started
			AC In	4	Inverter is in charge mode
			In quiet time (hours)	5	
			Start in test mode	6	30 second run, then shutdown
			Start on temperature	7	
			Start on voltage	8	
			Fault start on test	9	
			Fault start on temp	10	
			Fault start on voltage	11	
			Start Time of Day	12	
			Start State of charge	13	SOC comes from BMK
			Start Exercise	14	
			Fault start Time of Day	15	
			Fault start State of charge	16	
			Fault start Exercise	17	
			Start on Amp	18	
			Start on Topoff	19	
			Not used	20	
			Fault start on Amp	21	
			Fault on Topoff	22	
			Not used	23	
			Fault max run	24	Max run time exceeded
			Gen Run Fault	25	
			Gen in Warm up	26	
			Gen in Cool down	27	
2	Revision	8	5.0	50	i.e. 10 = 1.0 Started TX at 3.5
3	Temperature	8	33 to 104		In degrees Fahrenheit (33-104F)
4	Gen Runtime	8	0.0 Hours	0	Gen running for h.m, so 2.5 would be two and half hours
					x.x hrs; 0-255, 25 would be two and half hours; 0.1 hr = 6 minutes
5	AGS vdc	8	12.6	126	xx.x VDC (Scaled to 12V numbers)

** Only revision 3.5 and later communicates on the network					
0	Header	8		0xA2 Hex	
1	Days since last generator run	8	0 days	0	0 - 255 days
2	Empty / Not used				
3	Empty / Not used				
4	Empty / Not used				
5	Empty / Not used				

### ME-RTR Sends

Byte order	Data name	bits	value assignments	Value sent	Comments
0	Header	8		0x91 Hex	
2	Revision	8	1.0	10	i.e. 10 = 1.0 i.e. 11 = 1.1

RTR TX every 0.5 seconds with a deadtime of 18msec after

### ME-BMK Sends

Byte order	Data name	bits	value assignments	Value sent	Comments
0	Header	8		0x81 Hex	8 means ME-BMK
1	State of Charge	8			0-100 - 0 - 100% or 1 count / 1% (255 = Think'n)
2,3	DC volts	16*	12.60 volts	1260	0-64K = 0 - 640.00V or 1 count/ 0.01V (real range = 0-70.00V)
4,5	DC amps	16*	10.1	101	0-64K = -3.2K to 3.2KAmps or 1 count/ 0.1A (real range +-1000A)
6,7	Min Volts	16*	12.61 volts	1261 gVDC	0-64K = 0 - 640.00V or 1 count/ 0.01V (real range = 0-70.00V)
8,9	Max Volts	16*	12.59 volts	1259 gVDC	0-64K = 0 - 640.00V or 1 count/ 0.01V (real range = 0-70.00V)
10,11	AmpH in/out	16*	220 Amp Hr	220	0-64K = -32K to 32KAmpH or 1 count/ 1AmpH (real range = -9999 to 9999 AmpH)
12,13	AmpH Trip	16*	220.2	2202	0-64k = 0 to 6.4kAmpH or 1 count/ 0.1AmpH
14,15	Cumulative AmpH out c	16*			0-64k = 0 to 6.4MAmpH or 1 count/ 100AmpH
16,17	Number of Discharge-C	16*			0-64k, 1 count / Discharge-Cycle
48	Software-Ver	8	0 to 256	Version	
16	Revision	8	0 to 256		i.e. 10 = 1.0
17	Fault	8	Reserved	0	
			Normal	1	
			Fault start	2	

BMK TX every 0.5 seconds with a deadtime of 14msec after a ME-RC revision 2.0 or more

16\* = NOTE that for all 16 bit variables, they are sent in two bytes, the high byte sent first. So for DC volts, high byte is sent in third position (byte 2) and low byte is sent in fourth position or byte 3.

### Third Party Notes

If your company is considering building a product to connect to the Magnum Network:

- 1 Please contact someone in the Engineering Department at Magnum for approval.
- 2 Understand that no power is available for third party devices on the network.
- 3 You should design your product so that it looks like a "wire" to the network. This is so that the timing of the data is not affected adversely and so that the devices on the network will operate properly. Also, when your product is off or not operational, it will not affect existing communication on the network.