SynQor MPFC-440-3PH-400-LE High Voltage 3-Phase PFC Terminal Commands

The SynQor MPFC-440-3PH-400-LE high voltage 3-Phase PFC contains a serial port to facilitate system monitoring.
Commands are sent to request individual data, and the PFC responds to each command individually.
The PFC's external serial port IO pins are at 3.3V logic levels, not RS232 levels. See datasheet for IO details and polarity.
Commercial data converters are available to translate these levels to RS232 or USB.
The serial port uses 9600 baud, 8 data bits, no parity, and one stop bit. Commands can be sent, and output viewed, with any standard terminal emulator.   The interface is case sensitive. To view user text, set the terminal emulator for local echo.
Some data are writeable; written values are, however, volatile and will revert to default upon power cycling.
A pause of >5 seconds between any two comand characters will timeout/reset the command parser. No response is generated.
This timeout value is user settable, see Hung Parser Timeout below.
The protocol supports single or multi-unit communication via a 'network address'. See Enumeration command (E).
Every command must be terminated by either ascii 13 (cr) OR ascii 10 (lf) OR both (they're all equivalent).
In this document, the symbol ↙ will be used to represent the termination character.

Command Format

Command Syntax

{Net Addr}	{Access Address}	{Action Specifier}	[Value]	{Terminator}
m	0-127	? for read or = for write	"String" or 16-bit numerical	(cr) or (lf) or both, ↙

Net Addr: The network address character presently of default value of 'm' or '@'. 'm' is taken as a single unit's address while '@' is interpreted as all units. To avoid collision, the response to '@' commands is automatically muted.
See the Enumerate command for re-assigning network addresses in a multi-unit application.

Access Addr: The addres to access, see table below.
Addresses can be specified in char, hex, or int formats, see Value Formats below.

Action Specifier: character '?' specifies a data read or '=' specifies a data write.
Only select addresses are writeable.

Value: Values can be supplied in the formats described below;
The supplied format will determine the format of the response datum.
Write commands take an argument of the value to be written.
Read commands take an optional value argument of 0 as a way to specify the response datum format.

Terminator: a carriage return character (cr) = ascii 13, OR a linefeed character (lf) = ascii 10, OR both ↙.

Response Format

Immediately after reception of its terminator, each valid command generates a response.
Invalid commands do not generate a response.

Response Syntax

{Net addr}	{Access Address}	{Is Now}	{Value}	{Terminator}
m	0-127	=	"String" or 16-bit numerical	↙

Net Addr: The PFCs echoes its network address, the character 'm' by default.

Access Address: Echo of the address specifier in the same format as supplied.
Char addresses will be prefixed by the ' character.

Is Now: The character '='

Value: The address's current value.
If responding to a write, the present value is returned in the same format its argument was supplied.
If responding to a read, the value is returned in its natural format, (see Addresses table below) unless the read was supplied an argument (of 0), in which case the response will use that argument's format.
Char format will always contain leading ', hex format will always contain 0x and four ascii hex value characters.

Terminator: ↙ concludes the response

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Value Formats

Data supplied to, and returned from, the PFC can be communicated in several formats, broadly divided into string and numeric formats. While strings are a unique type, numeric data can be divided into serveral interchangeable formats.

Strings	Up to 64 ascii characters, and "enclosed in double quotes". A null string is "". Strings can contain unprintable and control characters which can, of course, affect the appearance of any terminal emulator receiving them.

<table>
<tr><th rowspan="9">Numerical Formats</th><th>Fmt</th><th>Numeric Range</th><th colspan="2">Description</th></tr>
<tr><td>char</td><td>0 - 128</td><td colspan="2">An ascii character, optionally preceeded by single quote character ' to remove ambiguity. Responses using char format will always contain the ' prefix.</td></tr>
<tr><td>hex</td><td>0 - 65536</td><td>0x and then one to four ascii hex characters</td><td rowspan="2">Both hex and int formats have no internal units conversion</td></tr>
<tr><td>int</td><td>-32768 - 32767</td><td>Decimal numeral, optionally preceeded by '-'</td></tr>
<tr><td>mks</td><td>±###.#</td><td colspan="2">Decimal numerals containing a decimal point are interpreted as real MKS values and are internally converted to/from machine units. MKS format is recommended whenever referring to a real-life datum.</td></tr>
</table>

Addresses

Access Address hex,	dec,	or char	Name	Read / Write	Natural Format	Natural Units
0x0	0		ID String	R	string	
0x1	1		Part Number	R	string	
0x2	2		Serial Number	R	string	
0xD	13		Code Revision	R	string	
0x2E	46	.	Code Version	R	hex	Rev<<8 | Subrev
0x21	33	!	Net Address	R	quoted character	
0x22	34	"	Hung Parser Timeout	R/W	##.##	seconds
0x23	35	#	Powered Days	R/W	int	days
0x24	36	$	Powered Hours	R/W	int	hours
0x25	37	%	Powered Minutes	R/W	int	minutes
0x26	38	&	Powered Seconds	R/W	##.##	seconds
0x41	65	A	Auto Command String	R/W	string	
0x61	97	a	Auto Command Interval	R/W	##.##	seconds
0x45	69	E	Enumerate Network Address	R/W	int	
0x46	70	F	AC Input Line Frequency	R	##.##	Hz
0x53	83	S	AC Input Voltage	R	###.##	Volts
0x73	115	s	AC Input Voltage Ripple/Imbalance	R	###.##	Volts
0x72	114	r	Estimated Input Capacitance (per Phase)	R/W	#.###	uF
0x6B	107	k	Angle of PFC Input Current	R	##.#	degrees
0x76	118	v	Midbus (Buck Stage) Output Voltage	R	###.##	Volts
0x69	105	i	Buck Stage Output Current	R	#.###	Amperes
0x70	112	p	Buck Stage Output Power	R	####	Watts
0x49	73	I	Boost Stage Input Current	R	#.###	Amperes
0x50	80	P	Boost Stage Input Power	R	int	Watts
0x56	86	V	Boost Output Voltage	R	###.##	Volts
0x54	84	T	PCB Temperature	R	##.##	°C
0x4D	77	M	Machine State	R	int	
0x4E	78	N	PFC ENA Pin Override	R/W	int	
0x6E	110	n	Battle Short Mode Enable	R/W	int	
0x63	99	c	AC Line Status	R	hex	
0x65	101	e	Shutdown Source	R	hex	
0x77	119	w	BS Warnings	R	hex	

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Address Details

	hex	decimal	char
Address:	0x0	0	
Name:	ID String		
Description:	The unit's ID string "SynQor HV3PH PFC"		
Response units:	string		
Read/Write:	Read Only		

Example Cmd:	Typical Response:
m0x0?↙	m0x0000= "SynQor HV3PH PFC"↙
m0?↙	m0= "SynQor HV3PH PFC"↙

	hex	decimal	char
Address:	0x1	1	
Name:	Part Number		
Description:	The part number "MPFC-440-3PH-400-EP"		
Response units:	string		
Read/Write:	Read Only		

Example Cmd:	Typical Response:
m0x1?↙	m0x0001= "MPFC-115-3PH-270-FP"↙
m1?↙	m1= "MPFC-115-3PH-270-FP"↙

	hex	decimal	char
Address:	0x2	2	
Name:	Serial Number		
Description:	The unit's serial number		
Response units:	String		
Read/Write:	Read Only		

Example Cmd:	Typical Response:
m0x2?↙	m0x0002= "S19095539"↙
m2?↙	m2= "S19095539"↙

	hex	decimal	char
Address:	0xD	13	
Name:	Code Revision		as a string
Description:	The unit's Code Revision		
Response units:	string		
Read/Write:	Read Only		

Example Cmd:	Typical Response:
m0xD?↙	m0x000D= "Rev 4, v4.08"↙
m13?↙	m13= "Rev 4, v4.08"↙

	hex	decimal	char
Address:	0x2E	46	.
Name:	**Code Version**		as a number
Description:	The unit's Code Version
Response units:	hex
Read/Write:	Read Only
Discussion:	Code Version is returned as MainRev<<8	Subrev

Example Cmd:	**Typical Response:**	**Interpretation:**	
m.?↙	m'.= 0x0408↙	0x0408 = 4<<8	8	Code Version is 4.08
m.?u↙	m'.= 1032↙	1032 = 4*256 + 8	Code Version is 4.08
m.?b↙	m'.= b0000010000001000↙		Code Version is 4.08

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	hex	decimal	char
Address:	0x21	33	!
Name:	**Net Address**		
Description:	Returns unit's Network Address as a quoted character
Response units:	quoted character, default is 'm
Read/Write:	Read Only
Discussion:	For single unit operation, the default network address of "m" is adequate
	For multiple unit operation with a shared multi-drop serial bus, it is possible to address each unit individually by assigning each unit a different nework address using the Enumerate command ("E")

Example Cmd:	**Typical Response:**
m0x21?↙	m0x0021= 'm↙
m33?↙	m33= 'm↙
m!?↙	m'!= 'm↙

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	hex	decimal	char
Address:	0x22	34	"
Name:	**Hung Parser Timeout**		
Description:	The Hung Parser Timeout
Response units:	decimal seconds
Read/Write:	Read/Write
Discussion:	A delay of >N.N seconds between any two command characters will reset the command parser.
	This paramter controls the timeout value. It is both readable and writeable.
	Supplied in hex or int format, the units are integer 1/16ths of second.
	Supplied in MKS format, the units are decimal seconds.

Example Cmd:	**Typical Responses:**	**Interpretation:**
m0x22?↙	m0x0022= 5.0↙	Parser timeout is 5.0 seconds (default)
m"=60↙	m'"= 60↙	(Note int units supplied) Parser timeout set to 60/16 = 3.75 secs.
m"=?↙	m'"= 3.75↙	Confirm 3.75 sec timeout in MKS units.
m34=60.↙	m34= 60.0↙	(Note MKS units supplied) Parser timout re-set to one minute

	hex	decimal	char	Response units	
Powered Days	0x23	35	#	int 0-65535	Read/Write
Powered Hours	0x24	36	$	int 0-23	Read/Write
Powered Minutes	0x25	37	%	int 0-59	Read/Write
Powered Seconds	0x26	38	&	decimal 0-59.9	Read/Write

Discussion: Together these contain the number of days, hours, minutes and seconds that power has been applied. They can be written to any value (or cleared) at any time, and will count time thereafter.

Example Cmds:	**Typical Responses:**	**Interpretation:**
m35?✓	m35= 329✓	Unit has been powered for 329 days
m36?✓	m36= 3✓	and 3 hours.
m35=0✓	m35= 0✓	Days variable reset to 0.
m36=0✓	m36= 0✓	hours variable reset to 0.

Address:	hex	decimal	char
	0x41	65	A

Name: **Auto Command String**

Description: The Auto Command String will have the PFC send the same data repeatedly and automatically.

Response units: string

Read/Write: Read/Write

Discussion: The AutoCommandString is written to contain the exact commands to read the desired data. The string's contents are copied directly to the command parser input at an interval given by the Auto Command Interval, see address 'a' below. Using this command is not compatible with a multi-drop serial bus because different units could try to send data at the same time causing a bus collision.

Example Cmd:	**Typical Responses:**	**Interpretation:**
mA?✓	m'A= "m/?✓"✓	The default Auto Command String: Reports a variety of useful real-time data.
mA="mS?✓mF?✓mP?✓"✓	m'A= "mS?✓ms?✓mF?✓mP?✓"✓	Write the Auto Command String with: Read AC Input Voltage, Read AC Line Frequency, Read Boost Stage Power.

Address:	hex	decimal	char
	0x61	97	a

Name: **Auto Command Interval**

Description: Controls how often the Auto Command String is executed.

Response units: decimal seconds

Read/Write: Read/Write

Discussion: A value of 0 (default) turns OFF Auto Command execution
The range of active values is from 1 to 65535 1/16ths of a second, a bit over an hour.
If the value is supplied in hex or int formats, the units are 1/16ths of a second
If the value is supplied in MKS format, the units are decimal seconds.

Example Cmd:	**Typical Responses:**	**Interpretation:**
ma?✓	m'a= 0✓	Auto Command is OFF
ma=0.5✓	m'a= 0.5✓	Execute Auto Command String every half second

Address:	hex	decimal	char
	0x45	69	E
Name:	**Enumerate Network Address**		
Description:	Enumeration automatically sets the network address of each unit in a multi-unit application.		
Write Value Argument:	The value of the **first** adddress to be self assigned.		
Read Response value:	The number of sequential addresses just assigned.		
Read Response units:	int		
Read/Write:	R/W		
Discussion:	At power-up, network address for each unit is 'm'. While that's sufficient for single-unit applications, response collision would occur if multiple units shared 'm'.		
	Upon receiving an Enumerate command, all addressed units will communicate over their interconnected StartSync line and assign themselves unique sequential network addresses.		
	Note that the units must be disabled to communicate over StartSync.		
	Enumerated addresses are volatile; they will revert to default whenever power is cycled.		

Example Cmd:	**Typical Responses:**	**Interpretation:**
@E=A✓	none (response muted for global addr @)	Enumerate network addresses, begin assignments at 'A'
AE?✓	A'E=5✓	Unit A, how many addrs were assigned. Answer=5

Host now knows that there are 5 units on the network; their addresses are A, B, C, D, & E.

Address:	hex	decimal	char
	0x46	70	F
Name:	**AC Input Line Frequency**		
Description:	The AC Line Frequency		
Response units:	decimal Hz		
Read/Write:	Read Only		
Discussion:	The accuracy of this measurement is limited by that of the internal timebase, typically ±2%.		
	Negative values indicate CBA rotation		

Example Cmd:	**Typical Responses:**	**Interpretation:**
m0x46?✓	m0x0046= 59.69✓	60 Hz, ABC rotation
m70?✓	m70= 400.25✓	400 Hz, ABC rotation
mF?✓	m'F= -60.11✓	60 Hz, CBA rotation

Address:	hex	decimal	char
	0x53	83	S
Name:	**AC Input Voltage**		
Description:	The AC Input Voltage (Vsys)		
Response units:	decimal Volts		
Read/Write:	Read Only		
Discussion:	The value is the peak L-N voltage; multiply by √(3/2) to obtain L-L rms.		
	A filter has been applied with a 0.25 second time constant.		
	See datasheet section entitled "Phase Imbalance Shutdown" for more information.		

Example Cmd:	**Typical Response:**	**Interpretation:**
mS?✓	m'S= 359.26✓	The AC input voltage is 359 Vpk L-N = 440 Vrms L-L

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	hex	decimal	char
Address:	0x73	115	s
Name:	**AC Input Voltage Ripple/Imbalance**		
Description:	The AC Input Voltage Ripple/Imbalance (ΔVsys)		
Response units:	decimal pk-pk Volts.		
Read/Write:	Read Only		
Discussion:	Over each line cycle, the instantaneous minimum and maximum AC line voltage is captured, and the reported ripple value ΔVsys is equal to the difference (Max-Min).		
	For perfectly balanced 3-phase line inputs, this value will be zero.		
	A non-zero ripple will be reported for any amplitude imbalance, phase imbalance, or distortion.		
	If the reported value exceeds the datasheet threshold for the specified time, the unit will shut down, unless in battle short mode.		
	See datasheet section entitled "Phase Imbalance Shutdown" for more information.		

Example Cmd:	**Typical Response:**	**Interpretation:**
ms?↙	m's= 2.31↙	There's 2.3V p-p of imbalance.

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	hex	decimal	char
Address:	0x72	114	r
Name:	**Estimated Input Capacitance (per Phase)**		
Description:	The total estimated input capacitance (1.5 uF default at power-up)		
Response units:	decimal uF		
Read/Write:	Read/Write		
Discussion:	This value includes both cap inside the PFC module and in the recommended external EMI filter.		
	This capacitance value is specified in uF per phase assuming lumped WYE connected capacitors.		
	The PFC uses this value to calculate a desired phase angle for input current, relative to input voltage.		
	This phase angle may be accessed via the serial port at address 0x6B / 107 / "k".		
	At higher load levels (and therefore input current amplitudes), the leading current drawn by EMI capacitors can be cancelled out by a lagging current drawn by the active PFC, yielding net unity PF.		
	Note that the desired capacitance value should be entered as a floating point value, so for 2.0 uF, the value should be sent as "2.0" or "2." The internal digital representation is made in multiples of 1/1024 uF, so the text "2" (without the radix point) indicates a (wrong) value of only 0.002 uF.		
	See datasheet section entitled "Reactive Power at Fundamental" for further information.		

Example Cmd:	**Typical Response:**	**Interpretation:**
mr?↙	m'r= 1.500↙	The estimated input capacitance is 1.5 uF per phase

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	hex	decimal	char
Address:	0x6B	107	k
Name:	**Angle of PFC Input Current**		
Description:	The angle of input current drawn by the PFC relative to the applied input voltage angle		
Response units:	decimal degrees of angle		
Read/Write:	Read Only		
Discussion:	The PFC will attempt to achieve unity PF by cancelling leading currents drawn by input capacitors with lagging currents drawn by the PFC. This angle value represents the phase angle of the current drawn only by the power stage of the PFC. It does not include currents drawn by input capacitors inside the PFC module or by capacitors in any external EMI filter.		
	Negative values indicate leading current.		
	This reported angle includes an offset such that at 400 Hz, there is a -8.2 degree offset.		
	This offset will be a function of frequency; at 60 Hz, the offset is -1.2 degrees.		
	The purpose of the offset is to compensate for a fixed delay on acquisition of the input voltage readings.		
	The offset can be measured by setting the "r" parameter above to zero, and then reading the angle "k".		
	The maximum correction angle is limited to approximately 20-25 degrees (lagging).		

Example Cmd:	Typical Response:	Interpretation:
mk?↙	m'k= 14.3↙	The PFC input currents are lagging by 14.3 degrees

	hex	decimal	char	
Address:	0x76	118	v	
Name:	**Midbus (Buck Stage) Output Voltage**			
Description:	The +Midbus output voltage			
Response units:	decimal Volts DC			
Read/Write:	Read Only			

Example Cmd:	**Typical Response:**	**Interpretation:**
mv?↙	m'v= 205.1↙	The Mibdus output voltage is 205.1 VDC

	hex	decimal	char	mc
Address:	0x69	105	i	
Name:	**Buck Stage Output Current**			
Description:	The Buck-Stage output current			
Response units:	decimal Amperes DC			
Read/Write:	Read Only			

Example Cmd:	**Typical Response:**	**Interpretation:**
mi?↙	m'i= 3.21↙	The buck stage is delivering 3.21 Adc (out)

	hex	decimal	char	
Address:	0x70	112	p	
Name:	**Buck Stage Output Power**			
Description:	Returns the Buck-Stage output power			
Response units:	Watts			
Read/Write:	Read Only			

Example Cmd:	**Typical Response:**	**Interpretation:**
mp?↙	m'p= 658↙	The buck stage is processing 658 W.

	hex	decimal	char	
Address:	0x49	73	I	
Name:	**Boost Stage Input Current**			
Description:	The Boost-Stage input current			
Response units:	decimal Amperes DC			
Read/Write:	Read Only			

Example Cmd:	**Typical Response:**	**Interpretation:**
mI?↙	m'I= 3.265↙	The boost stage is also handling 3.2 A (input current).

	hex	decimal	char
Address:	0x50	80	P
Name:	**Boost Stage Input Power**		
Description:	The Boost-Stage input power		
Response units:	Watts		
Read/Write:	Read Only		

Example Cmd:	**Typical Response:**	**Interpretation:**
mP?↙	m'P= 650↙	The boost stage is drawing 650 W in.

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	hex	decimal	char
Address:	0x56	86	V
Name:	**Boost Output Voltage**		
Description:	The Boost-Stage output voltage		
Response units:	decimal Volts DC		
Read/Write:	Read Only		

Example Cmd:	**Typical Response:**	**Interpretation:**
mV?↙	m'V= 403.75↙	The boost stage is producing 404 Vdc.

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	hex	decimal	char
Address:	0x54	84	T
Name:	**PCB Temperature**		
Description:	The unit's internal temperature		
Response units:	units are signed decimal °C		
Read/Write:	Read Only		
Discussion:			

Example Cmd:	**Typical Response:**	**Interpretation:**
mT?↙	m'T= 63.08↙	The PFC is at about 63 °C internally.

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	hex	decimal	char
Address:	0x4D	77	M
Name:	**Machine State**		
Description:	The present operational state number of the PFC		
Responses:	1	Waiting for all conditions to be ready to start	
	2	Starting	
	3	Running	
	4	Stopping	
	5	Waiting auto-restart timeout	
Read/Write:	Read Only		

Example Cmd:	**Typical Response:**	**Interpretation:**
mM?↙	m'M= 3↙	The PFC is Running

Address:	hex	decimal	char
	0x4E	78	N
Name:	**PFC ENA Pin Override**		
Description:	Allows overriding the PFC ENA pin via serial interface		
Response units:	int		
Read/Write:	Read / Write		
Discussion:	value of 10 (0xA) allows unit operation to follow PFC ENA pin [default]		
	writing value of 11 (0xB) overrides PFC ENA pin and forces the unit ON		
	writing a value of 12 (0xC) overrides PFC ENA pin and forces the unit OFF		

Example Cmd:	**Typical Response:**	**Interpretation:**
mN?↙	m'n= 0x000A↙	value = 10; obey PFC ENA pin
mN=11↙	m'N= 11↙	set value to 11, Unit Forced On
mN=10↙	m'N= 10↙	set value back to 10; obey PFC ENA pin again

Address:	hex	decimal	char
	0x6E	110	n
Name:	**Battle Short Mode Enable**		
Description:	Allows engaging Battle Short mode via serial interface		
Response units:	hex		
Read/Write:	Read/Write		
Discussion:	value of 10 (0xA) allows Battle Short mode to follow BS Pin [default]		
	writing value of 11 (0xB) turns on Battle short mode regardless of BS Pin value		

Example Cmd:	**Typical Response:**	**Interpretation:**
mn?↙	m'n= 0x000A↙	value = 10; obey BS pin
mn=11↙	m'n= 11↙	set value to 11, Battle Short Mode = On
mn=10↙	m'n= 10↙	set value back to 10; obey BS pin again

Address:	hex	decimal	char
	0x63	99	c
Name:	**AC Line Status**		
Description:	Status flags relating to the AC Line		
Responses:	bit 0	AC Line Voltage has excessive imbalance / distortion past time limit (see AC GOOD specs)	
	bit 1	AC Line Frequency is outside normal range (see datasheet for lower and upper thresholds)	
	bit 2	AC Line Voltage is below Low Threshold (see datasheet for value, hysteresis, and tolerance)	
	bit 3	AC Line Voltage is above High Threshold (see datasheet for value, hysteresis, and tolerance)	
Read/Write:	Read Only		
Discussion:	Any bit set indicates an out-of-range condition for the AC Line -> AC GOOD will be set low.		
	Bit 0 (imbalance / distortion) will shut down the unit after a timeout unless in battle short mode.		
	Bits 1-3 (freq / voltage) will prevent startup but will not shut down the unit if it is already running.		

Example Cmd:	**Typical Response:**	**Interpretation:**
mc?↙	m'c= 0x0004↙	AC Line voltage is low

Address:	hex	decimal	char
	0x65	101	e
Name:	**Shutdown Source**		
Description:	Status bits that indicate a no-operate condition. See also above AC Line Status command.		
Responses:	bits 0-2	NA	
	bit 3	Low bias suppply input voltage	
	bit 4	Over-Temperature Protection	
	bit 5	+MIDBUS below threshold & past time limit	
	bit 6	Low bias suppply output voltage	
	bit 7	NA	
	bit 8	Unit disabled by user	
	bit 9	NA	
	bit 10	Short circuit detected	
	bits 11-15	NA	
Read/Write:	Read Only		
Discussion:	Any bit set here will shut down the unit. See also above AC Line Status command.		

Example Cmd:	**Typical Response:**	**Interpretation:**
me?↙	m'e= 0x0100↙	PFC ENA set to OFF

Address:	hex	decimal	char
	0x77	119	w
Name:	**BS Warnings**		
Description:	Status bits associated with Battle Short pin (warnings)		
Responses:	bit 0	NA	
	bit 1	Warn Over Temperature	
	bits 2-3	NA	
	bit 4	Warn AC Line Imbalance.	
	bits 5-15	NA	
Read/Write:	Read Only		
Discussion:	These flags indicate the reason the Battle Short pin has been let float		

Example Cmd:	**Typical Response:**	**Interpretation:**
mw?↙	m'w= 0x0002↙	Battle Short Warnings due to temperature