

This application note is applicable to the following members of the **D1U54P-W-450-12-HxxC-xxx** Series:

Model Number	MPS #	Address	Standby Output	Airflow
D1U54P-W-450-12- HA3C	M1910	ADDR_SEL (External resistor)	5Vdc	Front to Back
D1U54P-W-450-12- HB3C	M1908		12Vdc	
D1U54P-W-450-12- HA4C	M1909		5Vdc	Back to front
D1U54P-W-450-12- HB4C	M1907		12Vdc	

Standard PMBus™

To Ensure successful interrogation via PMBus™ interface, the host System must be PEC (Packet Error Checking) enabled. For details, refer to PMBus™ Power Systems Management Protocol Part 1 – General Requirements Rev 1.2.

Linear data formatting is used for all passed parameters.

A minimum of 300µs delay between transactions (between the STOP of one command and the START of the next command) is recommended for robust communications.

Note: The PMBus™ slave controller does “clock stretch” on ACK or NAK.

Device Details

Power Supply Controllers

Vendor	MFG Part Number	Package	Description
Microchip Technology Inc.	DSPIC33EP64GS506T-70I/PT	TQFP64	(Secondary) IC Dig SMT Microcontroller dsPIC33 64kB 8kB 70MHz
	DSPIC33EP32GS202T-I/MM	QFN28	(Primary) IC Dig SMT Microcontroller dsPIC33 32kB 2kB 70m

Power Supply External EEPROM

Vendor	MFG Part Number	Package	Description
Microchip Technology Inc.	24AA024T-I/MS	MSOP8	IC Dig SMT EEPROM CMOS Serial I2C AT24CXX 2kB

Device Addressing Methods

There are two methods whereby the three lower order address bits of the seven bit address structure of the internal addressable devices can be assigned (for the secondary microcontroller and the EEPROM device A0, A1 & A2; see the PMBus™ standard). These are as follows:

- Using the ADDR signal pin (Pin# A3) in digital mode by either:
 - Un-terminating (leaving open circuit); this will set a default setting of “111” for the last three addressable bits (A0, A1 & A2) of the seven bit address byte.
 - Terminating the pin to RTN/ground (Pin numbers A2/B2); this method will set a default address of “000” for the last three addressable bits (A0, A1 & A2) of the address byte.
- Using the ADDR signal pin (Pin# A3) in analogue mode by connection of an external resistance to RTN/ground (pin numbers A2/B2). For the possible external resistance values this will result in the following address combinations:

HEX Address Combinations by Analogue Method; ADDR External Resistance Values		
ADDR External Resistance to RTN/Ground (KΩ; ±5% Tolerance)	Power Module Secondary Main Controller (Serial Slave Address)*	Power Module EEPROM (Serial Slave Address)*
0.82	0xB0	0xA0
2.7	0xB2	0xA2
5.6	0xB4	0xA4
8.2	0xB6	0xA6
15	0xB8	0xA8
27	0xBA	0xAA
56	0xBC	0xAC
180	0xBE	0xAE

*The D1U54P-W-450-12- HA4C uses 7-bit left shifted” device addressing; the EEPROM addressing follows a similar convention (commences at base address 0xA0); the lowest order bit of the address is the Read/Write bit. It is assumed that the Read Write bit is set to logic “0” (for addresses shown in the table above).

PMBus™ Commands

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
00	PAGE	R/W	All	1			Command to provide ability to configure, control & monitor multiple outputs	YES
01	OPERATION Link to Returned Results: Operation_CMD	R/W	All	1	5:0		Set output margin high/low voltages	NO
					7:6		Turn the unit on/off in conjunction with digital input from PSON_H	YES
02	ON_OFF_CONFIG Link to Returned Results: ON_OFF_CMD	Send	All	1	0	ON_OFF_DELAY	Set when Turn off immediately (default) / 0 = Use delay @ turn-off	YES
					1	ON_OFF_POLARITY	Set when Power on processing is active high (default)	YES
					2	USE_CONTROL	Set when Use CONTROL pin for on/off power processing (default)	YES
					3	USE_OPERATION	Set when Use OPERATION command for on/off power processing (default)	YES
					4	USE_CNTL_AND_OP	Set when Use both CONTROL pin & OPERATION command (default)	YES
					5	RESERVED		NO
					6	RESERVED		NO
7	RESERVED		NO					
03	CLEAR_FAULTS	W	All	0			Write only command clears all faults that have been set in all the STATUS_XXXX registers simultaneously	YES
04	PHASE	R/W	All	1			Command to provide the ability to configure, control, and monitor multiple phases on one PMBus™ unit.	NO
05	PAGE_PLUS_WRITE	Block Write	All	Variable			Command used to set the page within a device, send a command, and send the data for the command in one packet	YES
06	PAGE_PLUS_READ	Block Write / Block Read Process Call	All	Variable			Command used to set the page within a device, send a command, and read the data returned by the command in one packet	YES
10	WRITE_PROTECT	R/W	All	1			Command to provide ability to configure, control & monitor multiple outputs	YES
11	STORE_DEFAULT_ALL	Send	All	0			Command instructs PMBus™ device to copy contents of Operating Memory to matching NVM	NO
12	RESTORE_DEFAULT_ALL	Send	All	0			Command instructs PMBus™ device to copy contents of NVM to matching Operating Memory	NO
13	STORE_DEFAULT_CODE	W	All	1			Command instructs the PMBus™ device to copy the parameter whose Command Code matches value in the data byte, from Operating Memory to matching NVM	NO
14	RESTORE_DEFAULT_CODE	W	All	1			Command instructs the PMBus™ device to copy the parameter whose Command Code matches value in the data byte, from NVM to matching Operating Memory	NO
15	STORE_USER_ALL	Send	All	0			Command instructs the PMBus™ device to copy the entire contents of Operating Memory to matching NVM	NO
16	RESTORE_USER_ALL	Send	All	0			Command instructs the PMBus™ device to copy the entire contents of NVM to matching Operating Memory	NO
17	STORE_USER_CODE	W	All	1			Command instructs the PMBus™ device to copy the parameter whose Command Code matches value in the data byte from Operating Memory to matching NVM User Store memory	NO
18	RESTORE_USER_CODE	W	All	1			Command instructs the PMBus™ device to copy the parameter whose Command Code matches value in the data byte from NVM to matching Operating Memory Store memory	NO

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
19	CAPABILITY	R	All	1	0:3	RESERVED		NO
					4	SMBALERT_L	Set when device has SMBALERT_L pin which supports the SMBus Alert Response protocol	YES
					6:5	MAX_BUS_SPEED	01 = Max supported bus speed = 400kHz; 00 Max supported bus speed = 100kHz	NO
					7	PEC	Set when packet error checking is supported	YES
1A	QUERY	Block Write / Block Read Process Call	All	1	1:0	RESERVED		NO
					4:2	DATA FORMAT	PMBus™ 1.2 Spec Section 11.13 Table 8.	YES
					5	READ_SUPPORT	1 = Supported ; 0 = Not Supported	YES
					6	WRITE_SUPPORT	1 = Supported ; 0 = Not Supported	YES
				7	COMMAND_SUPPORT	1 = Supported ; 0 = Not Supported	YES	
1B	SMBALERT_MASK	Block Write / Block Read Process Call	All	2			Command may be used to prevent a warning or fault condition from asserting the SMBALERT# signal	YES
20	VOUT_MODE	R	0	1			Single data byte sets the READ_VOUT sensor to linear mode data format and supplies N exponent for translation to volts PMBus™ Spec - Part II - Revision 1.2 - Sections 8.1-8.3	YES
20	VSTBY_MODE	R	1	1			Single data byte sets the READ_VSTBY sensor to linear mode data format and supplies N exponent for translation to volts PMBus™ Spec - Part II - Revision 1.2 - Sections 8.1-8.3	YES
21	VOUT_COMMAND	R/W	0	2			Manual override main output setpoint command - Voltage range setting 11.5V - 12.75V Command speed formatted in Linear as per command 0x8B - VOUT_COMMAND	YES
21	VSTBY_COMMAND	R/W	1	2			Manual override standby output setpoint command - Voltage range setting x. Command speed formatted in Linear as per command 0x8B - VOUT_COMMAND	NO
22	VOUT_TRIM	R/W	0	2			Command used to apply a fixed offset voltage to the output voltage command value	NO
23	VSTBY_TRIM	R/W	1	2			Command used to apply a fixed offset voltage to the output voltage command value	NO
23	VOUT_CAL_OFFSET	R/W	0	2			Command used to apply a fixed offset voltage to the output voltage command value	NO
23	VSTBY_CAL_OFFSET	R/W	1	2			Command used to apply a fixed offset voltage to the output voltage command value	NO
24	VOUT_MAX	R/W	0	2			Command sets upper limit output voltage can be set regardless of other command/combination	NO
24	VSTBY_MAX	R/W	1	2			Command sets upper limit output voltage can be set regardless of other command/combination	NO
25	VOUT_MARGIN_HIGH	R/W	0	2			Load the unit with the voltage to which the output is to be changed when the OPERATION command set to "Margin High"	NO
25	VSTBY_MARGIN_LOW	R/W	1	2			Load the unit with the voltage to which the output is to be changed when the OPERATION command set to "Margin High"	NO
26	VOUT_MARGIN_HIGH	R/W	0	2			Load the unit with the voltage to which the output is to be changed when the OPERATION command set to "Margin Low"	NO
26	VSTBY_MARGIN_LOW	R/W	1	2			Load the unit with the voltage to which the output is to be changed when the OPERATION command set to "Margin Low"	NO
27	VOUT_TRANSITION_RATE	R/W	0	2			Command sets the rate in mV/μs at which the output should change voltage	NO

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
27	VSTBY_TRANSITION_RATE	R/W	1	2			Command sets the rate in mV/μs at which the output should change voltage	NO
28	VOUT_DROOP	R/W	0	2			Command sets the rate (mV/A) which output voltage decreases (or increases) with increasing (or decreasing) output current (in Adaptive Voltage Positioning/passive current sharing)	NO
28	VSTBY_DROOP	R/W	1	2			Command sets the rate (mV/A) which output voltage decreases (or increases) with increasing (or decreasing) output current (in Adaptive Voltage Positioning/passive current sharing)	NO
29	VOUT_SCALE_LOOP	R/W	0	2			PMBus™ Spec - Part II - Revision 1.2 - Section 13.10	NO
29	VSTBY_SCALE_LOOP	R/W	1	2			PMBus™ Spec - Part II - Revision 1.2 - Section 13.10	NO
2A	VOUT_SCALE_MONITOR	R/W	0	2			PMBus™ Spec - Part II - Revision 1.2 - Section 13.11	NO
2A	VSTBY_SCALE_MONITOR	R/W	1	2			PMBus™ Spec - Part II - Revision 1.2 - Section 13.11	NO
30	COEFFICIENTS	Block Write / Block Read Process Call	All	5			Command used to retrieve the m, b and R coefficients needed by data in the DIRECT format	NO
31	POUT_MAX	R/W	All	2			Commands sets output power (watts) which unit starts regulating in constant power mode	NO
32	MAX_DUTY	R/W	All	2			Command sets maximum duty cycle (%) of the unit's power conversion stage	NO
33	FREQUENCY_SWITCH	R/W	All	2			Command sets switching frequency (kHz) of a PMBus™ device	NO
35	VIN_ON	R/W	All	2			Command sets value of input voltage (Vdc/Vrms) at which unit should start power conversion	NO
36	VIN_OFF	R/W	All	2			Command sets value of input voltage (Vdc/Vrms) at which unit should stop power conversion	NO
37	INTERLEAVE	R/W	All	2			PMBus™ Spec - Part II - Revision 1.2 - Section 14.7	NO
38	IOUT_CAL_GAIN	R/W	All	2			Command used to set the ratio of the voltage at the current sense pins to the sensed current	NO
39	IOUT_CAL_OFFSET	R/W	All	2			Command used to null out any offsets in the output current sensing circuit	NO
3A Link Values	FAN_CONFIG_1_2	R	All	1	0	FAN_2_TACH_PULSES	Fan 2 Tachometer pulses per revolution (lower bit)	NO
					1	FAN_2_TACH_PULSES	Fan 2 Tachometer pulses per revolution (upper bit)	NO
					2	FAN_2_SETTING_MODE	Set when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	NO
					3	FAN_2_INSTALLATION	Set when fan is installed in position 2	NO
					4	FAN_1_TACH_PULSES	Fan 1 Tachometer pulses per revolution (lower bit)	YES
					5	FAN_1_TACH_PULSES	Fan 1 Tachometer pulses per revolution (upper bit)	YES
					6	FAN_1_SETTING_MODE	Set when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	YES
					7	FAN_1_INSTALLATION	Set when fan is installed in position 1	YES
3B	FAN_COMMAND_1	R/W	All	2		Manual fan override command fan speed value in Duty Cycle Command speed formatted in Linear as per command 0x90 - READ_FAN_SPEED_1	YES	
3C	FAN_COMMAND_2	R/W	All	2		Manual fan override command fan speed value in Duty Cycle Command speed formatted in Linear as per command 0x91 - READ_FAN_SPEED_2	NO	

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
3D	FAN_CONFIG_3_4	R	All	1	0	FAN_4_TACH_PULSES	Fan 4 Tachometer pulses per revolution (lower bit)	NO
					1	FAN_4_TACH_PULSES	Fan 4 Tachometer pulses per revolution (upper bit)	NO
					2	FAN_4_SETTING_MODE	Set when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	NO
					3	FAN_4_INSTALLATION	Set when fan is installed in position 4	NO
					4	FAN_3_TACH_PULSES	Fan 3 Tachometer pulses per revolution (lower bit)	NO
					5	FAN_3_TACH_PULSES	Fan 3 Tachometer pulses per revolution (upper bit)	NO
					6	FAN_3_SETTING_MODE	Set when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	NO
7	FAN_3_INSTALLATION	Set when fan is installed in position 3	NO					
3E	FAN_COMMAND_3	R/W	All	2		Manual fan override command fan speed value in Duty Cycle Command speed formatted in Linear as per command 0x92 - READ_FAN_SPEED_3	NO	
3F	FAN_COMMAND_4	R/W	All	2		Manual fan override command fan speed value in Duty Cycle Command speed formatted in Linear as per command 0x93 - READ_FAN_SPEED_4	NO	
40	VOUT_OV_FAULT_LIMIT	R	0	2	Link To Readings: Limits, Parameters and Response	Main Output Overvoltage Fault Limit	YES	
40	VSTBY_OV_FAULT_LIMIT	R	1	2		Standby(Auxiliary) Output Overvoltage Fault Limit	YES	
41	VOUT_OV_FAULT_RESPONSE	R	0	1		Main Output Overvoltage Fault Response Actions	YES	
41	VSTBY_OV_FAULT_RESPONSE	R	1	1		Standby(Auxiliary) Output Overvoltage Fault Response Actions	YES	
42	VOUT_OV_WARN_LIMIT	R	0	2		Main Output Overvoltage Warning Limit	YES	
42	VSTBY_OV_WARN_LIMIT	R	1	2		Standby(Auxiliary) Output Overvoltage Warning Limit	YES	
43	VOUT_UV_WARN_LIMIT	R	0	2		Main Output Undervoltage Warning Limit	YES	
43	VSTBY_UV_WARN_LIMIT	R	1	2		Standby(Auxiliary) Output Undervoltage Warning Limit	YES	
44	VOUT_UV_FAULT_LIMIT	R	0	2		Main Output Undervoltage Fault Limit	YES	
44	VSTBY_UV_FAULT_LIMIT	R	1	2		Standby(Auxiliary) Output Undervoltage Fault Limit	YES	
45	VOUT_UV_FAULT_RESPONSE	R	0	1		Main Output Undervoltage Fault Response Actions	YES	
45	VSTBY_UV_FAULT_RESPONSE	R	1	1		Standby(Auxiliary) Output Undervoltage Fault Response Actions	YES	
46	IOUT_OC_FAULT_LIMIT	R	0	2		Main Output Overcurrent Fault Limit	YES	
46	ISTBY_OC_FAULT_LIMIT	R	1	2		Standby(Auxiliary) Output Overcurrent Fault Limit	YES	
47	IOUT_OC_FAULT_RESPONSE	R	0	1		Main Output Overcurrent Fault Response Actions	YES	
47	ISTBY_OC_FAULT_RESPONSE	R	1	1		Standby(Auxiliary) Output Overcurrent Fault Response Actions	YES	
48	IOUT_OC_LV_FAULT_LIMIT	R	0	2		Main Output Overcurrent Foldback Fault Limit	NO	
48	ISTBY_OC_LV_FAULT_LIMIT	R	1	2		Standby(Auxiliary) Output Overcurrent Foldback Fault Limit	NO	
49	IOUT_OC_LV_FAULT_RESPONSE	R	0	1		Main Output Overcurrent Foldback Fault Response Actions	NO	
49	ISTBY_OC_LV_FAULT_RESPONSE	R	1	1		Standby(Auxiliary) Output Overcurrent Foldback Fault Response Actions	NO	
4A	IOUT_OC_WARN_LIMIT	R	0	2		Main Output Overcurrent Warning Limit	YES	
4A	ISTBY_OC_WARN_LIMIT	R	1	2		Standby(Auxiliary) Output Overvoltage Warning Limit	YES	
4B	IOUT_UC_FAULT_LIMIT	R	0	2		Main Output Undercurrent Fault Limit	NO	
4B	ISTBY_UC_FAULT_LIMIT	R	1	2		Standby(Auxiliary) Output Undercurrent Fault Limit	NO	
4C	IOUT_UC_FAULT_RESPONSE	R	0	1		Main Output Undercurrent Fault Response Actions	NO	
4C	ISTBY_UC_FAULT_RESPONSE	R	1	1		Standby(Auxiliary) Output Undercurrent Fault Response Actions	NO	
4F	AIRFLOW_1_OT_FAULT_LIMIT	R	0	2		Airflow 1 Overtemperature Fault Limit	YES	
4F	HOTSPOT_1_OT_FAULT_LIMIT	R	1	2		Hotspot 1 Overtemperature Fault Limit	YES	
4F	AIRFLOW_2_OT_FAULT_LIMIT	R	2	2	Airflow 2 Overtemperature Fault Limit	YES		
4F	HOTSPOT_2_OT_FAULT_LIMIT	R	3	2	Hotspot 2 Overtemperature Fault Limit	YES		

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
50	AIRFLOW_1_OT_FAULT_RESP_ONSE	R	0	1		Link To Readings: Limits, Parameters and Repsonse	Airflow 1 Overtemperature Fault Response Actions	YES
50	HOTSPOT_1_OT_FAULT_RESP_ONSE	R	1	1			Hotspot 1 Overtemperature Fault Response Actions	YES
50	AIRFLOW_2_OT_FAULT_RESP_ONSE	R	2	1			Airflow 2 Overtemperature Fault Response Actions	YES
50	HOTSPOT_2_OT_FAULT_RESP_ONSE	R	3	1			Hotspot 2 Overtemperature Fault Response Actions	YES
51	AIRFLOW_1_OT_WARN_LIMIT	R	0	2			Airflow 1 Overtemperature Warning Limit	YES
51	HOTSPOT_1_OT_WARN_LIMIT	R	1	2			Hotspot 1 Overtemperature Warning Limit	YES
51	AIRFLOW_2_OT_WARN_LIMIT	R	2	2			Airflow 2 Overtemperature Warning Limit	YES
51	HOTSPOT_2_OT_WARN_LIMIT	R	3	2			Hotspot 2 Overtemperature Warning Limit	YES
52	AIRFLOW_1_UT_FAULT_LIMIT	R	0	2			Airflow 1 Undertemperature Fault Limit	NO
52	HOTSPOT_1_UT_FAULT_LIMIT	R	1	2			Hotspot 1 Undertemperature Fault Limit	NO
52	AIRFLOW_2_UT_FAULT_LIMIT	R	2	2			Airflow 2 Undertemperature Fault Limit	NO
52	HOTSPOT_2_UT_FAULT_LIMIT	R	3	2			Hotspot 2 Undertemperature Fault Limit	NO
53	AIRFLOW_1_UT_FAULT_RESP_ONSE	R	0	1			Airflow 1 Undertemperature Fault Response Actions	NO
53	HOTSPOT_1_UT_FAULT_RESP_ONSE	R	1	1			Hotspot 1 Undertemperature Fault Response Actions	NO
53	AIRFLOW_2_UT_FAULT_RESP_ONSE	R	2	1			Airflow 2 Undertemperature Fault Response Actions	NO
53	HOTSPOT_2_UT_FAULT_RESP_ONSE	R	3	1			Hotspot 2 Undertemperature Fault Response Actions	NO
55	VIN_OV_FAULT_LIMIT	R	All	2			Input Overvoltage Fault Limit	YES
56	VIN_OV_FAULT_RESPONSE	R	All	1			Input Overvoltage Fault Response Actions	YES
57	VIN_OV_WARN_LIMIT	R	All	2			Input Overvoltage Warning Limit	YES
58	VIN_UV_WARN_LIMIT	R	All	2			Input Undervoltage Warning Limit	YES
59	VIN_UV_FAULT_LIMIT	R	All	2			Input Undervoltage Fault Limit	YES
5A	VIN_UV_FAULT_RESPONSE	R	All	1			Input Undervoltage Fault Response Actions	YES
5B	IIN_OC_FAULT_LIMIT	R	All	2			Input Overcurrent Fault Limit	YES
5C	IIN_OC_FAULT_RESPONSE	R	All	1			Input Overcurrent Fault Response Actions	YES
5D	IIN_OC_WARN_LIMIT	R	All	2			Input Overcurrent Warning Limit	YES
5E	POWER_GOOD_ON	R	All	2			Power Good On Main Output Voltage Limit	YES
5F	POWER_GOOD_OFF	R	All	2			Power Good Off Main Output Voltage Limit	YES
60	TON_DELAY	R	All	2			Sets the time (mSec) from when a start condition is received (as programmed by the ON_OFF_CONFIG command) until the output voltage starts to rise	NO
61	TON_RISE	R	All	2			Sets the time (mSec) from when the output starts to rise until the voltage has entered the regulation band.	NO
62	TON_MAX_FAULT_LIMIT	R	All	2			Command sets an upper limit (mSec) on how long the unit can attempt to power up the output without reaching the output undervoltage fault limit	NO
63	TON_MAX_FAULT_RESPONSE	R	All	1			Command instructs the device on what action to take in response to a TON_MAX fault	NO
64	TOFF_DELAY	R	All	2			Sets the time (mSec) from a stop condition is received (as programmed by the ON_OFF_CONFIG command) until the unit stops transferring energy to the output	NO
65	TOFF_FALL	R	All	2		Sets the time (mSec) from the end of the turn-off delay time until the voltage is commanded to zero.	NO	
66	TOFF_MAX_WARN_LIMIT	R	All	2		Command sets an upper limit(mSec), on how long unit can attempt to power down output without reaching 12.5% of the output voltage programmed at the time the unit is turned off	NO	
68	POUT_OP_FAULT_LIMIT	R	All	2		Output Overpower Fault Limit	YES	
69	POUT_OP_FAULT_RESPONSE	R	All	1		Output Overpower Fault Response Actions	YES	
6A	POUT_OP_WARN_LIMIT	R	All	2		Output Overpower Warning Limit	YES	

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
6B	PIN_OP_WARN_LIMIT	R	All	2		Link To Readings: Limits, Parameters and Repsonse Input Overpower Warning Limit	YES	
79	STATUS_BYTE	R	All	1	0	NONE_F_W	Set when a fault not listed in [7:1] occurred	NO
					1	CML_F	Set when a communications, memory, or logic fault has occurred	YES
					2	TEMPERATURE_F_W	Set when an overtemperature fault or warning has occurred	YES
					3	INPUT_UV_F	Set when an input undervoltage fault has occurred	YES
					4	OUTPUT_OC_F	Set when an output overcurrent fault has occurred	YES
					5	OUTPUT_OV_F	Set when an output overvoltage fault has occurred	YES
					6	UNIT_OFF	Set when unit not providing power to the output	YES
					7	BUSY_F	Assserted when device busy and unable to respond fault	YES
79	STATUS_WORD	R	All	2	0	NONE_F_W	Set when a fault not listed in [7:1] occurred	NO
					1	CML_F	Set when a communications, memory, or logic fault has occurred	YES
					2	TEMPERATURE_F_W	Set when an overtemperature fault or warning has occurred	YES
					3	INPUT_UV_F	Set when an input undervoltage fault has occurred	YES
					4	OUTPUT_OC_F	Set when an output overcurrent fault has occurred	YES
					5	OUTPUT_OV_F	Set when an output overvoltage fault has occurred	YES
					6	UNIT_OFF	Set when unit not providing power to the output	YES
					7	BUSY_F	Assserted when device busy and unable to respond fault	YES
					8	UNKNOWN_F_W	Set when a fault not listed in [15:1] has occurred	NO
					9	STATUS_OTHER_F_W	Set when a bit in command STATUS_OTHER set	NO
					10	FANS_F_W	Set when a fan fault or warning has occurred	YES
					11	POWER_GOOD_L	Set when the POWER_GOOD signal is negated	YES
					12	MFR_SPECIFIC_F_W	Manufacturer specific fault or warning has occurred	YES
					13	INPUT_F_W	Set when an Input voltage/current/power fault or warning has occurred	YES
					14	IOUT_POOUT_F_W	Set when an output current / output power fault or warning has occurred	YES
					15	VOUT_F_W	Set when an output voltage fault or warning has occurred	YES
7A	STATUS_VOUT	R/W	0	1	0	VOUT_TRACKING_E	Set when an error in the output voltage during power-up/down has occurred	NO
					1	TON_MAX_W	Set when the output turn-on timing has exceeded the TON_MAX warning timing	NO
					2	TON_MAX_F	Set when the output turn-on timing has exceeded the TON_MAX fault timing	NO
					3	VOUT_MAX_F	Set when the output is set higher than the commanded VOUT_MAX limit	NO
					4	VOUT_UV_F	Set when an output undervoltage fault has occurred	YES
					5	VOUT_UV_W	Set when an output undervoltage warning has occurred	YES
					6	VOUT_OV_W	Set when an output overvoltage warning has occurred	YES
					7	VOUT_OV_F	Set when an output overvoltage fault has occurred	YES

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
7A	STATUS_VSTBY	R/W	1	1	0	VOUT_TRACKING_E	Set when an error in the output voltage during power-up/down has occurred	NO
					1	TON_MAX_W	Set when the output turn-on timing has exceeded the TON_MAX warning timing	NO
					2	TON_MAX_F	Set when the output turn-on timing has exceeded the TON_MAX fault timing	NO
					3	VOUT_MAX_F	Set when the output is set higher than the commanded VOUT_MAX limit	NO
					4	VOUT_UV_F	Set when an output undervoltage fault has occurred	NO
					5	VOUT_UV_W	Set when an output undervoltage warning has occurred	YES
					6	VOUT_OV_W	Set when an output overvoltage warning has occurred	YES
					7	VOUT_OV_F	Set when an output overvoltage fault has occurred	YES
7B	STATUS_IOUT	R/W	0	1	0	POUT_OP_W	Set when an output overpower warning has occurred	YES
					1	POUT_OP_F	Set when an output overpower fault has occurred	YES
					2	POWER_LIMIT_MODE	Set when the unit has entered output power limiting mode	NO
					3	CURRENT_SHARE_F	Set when an output current share fault has occurred	NO
					4	IOUT_UC_W	Set when an output undercurrent fault has occurred	NO
					5	IOUT_OC_W	Set when an output overcurrent warning has occurred	YES
					6	IOUT_OC_SHUTDOWN	Set when an output overcurrent and low voltage shutdown fault has occurred	YES
					7	IOUT_OC_F	Set when an output overcurrent fault has occurred	YES
7B	STATUS_ISTBY	R/W	1	1	0	POUT_OP_W	Set when an output overpower warning has occurred	NO
					1	POUT_OP_F	Set when an output overpower fault has occurred	NO
					2	POWER_LIMIT_MODE	Set when the unit has entered output power limiting mode	NO
					3	CURRENT_SHARE_F	Set when an output current share fault has occurred	NO
					4	IOUT_UC_W	Set when an output undercurrent fault has occurred	NO
					5	IOUT_OC_W	Set when an output overcurrent warning has occurred	YES
					6	IOUT_OC_SHUTDOWN	Set when an output overcurrent and low voltage shutdown fault has occurred	YES
					7	IOUT_OC_F	Set when an output overcurrent fault has occurred	YES
7C	STATUS_INPUT	R/W	All	1	0	PIN_OP_W	Set when an input overpower warning has occurred	YES
					1	IIN_OC_W	Set when an input overcurrent warning has occurred	YES
					2	IIN_OC_F	Set when an input overcurrent fault has occurred	YES
					3	VIN_UV_OFF	Set when the Unit is OFF for insufficient input voltage	NO
					4	VIN_UV_F	Set when an input undervoltage fault has occurred	NO
					5	VIN_UV_W	Set when an input undervoltage warning has occurred	YES
					6	VIN_OV_W	Set when an input overvoltage warning has occurred	YES
					7	VIN_OV_F	Set when an input overvoltage fault has occurred	YES
7D	STATUS_TEMPERATURE	R/W	All	1	0	RESERVED	Reserved	NO
					1	RESERVED	Reserved	NO
					2	RESERVED	Reserved	NO
					3	RESERVED	Reserved	NO
					4	TEMPERATURE_UT_F	Set when an undertemperature fault has occurred	NO
					5	TEMPERATURE_UT_W	Set when an undertemperature warning has occurred	NO
					6	TEMPERATURE_OT_W	Set when an overtemperature warning has occurred	YES
					7	TEMPERATURE_OT_F	Set when an overtemperature fault has occurred	YES

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
7E	STATUS_CML	R/W	All	1	0	OTHER_MEMORY_F	Set when another memory or logic fault has occurred	NO
					1	OTHER_COMM_F	Set when a communication fault not listed in [7:3] has occurred (example: UART or SPI)	YES
					2	RESERVED	Reserved	NO
					3	PROCESSOR_F	Set when a processor fault is detected	NO
					4	MEMORY_F	Set when a memory fault is detected (example: Checksum errors during bootload)	NO
					5	PEC_ERROR_F	Set when a packet error checking (PEC) failed has occurred	YES
					6	DATA_ERROR_F	Set when invalid or unsupported data is received	YES
					7	COMMAND_ERROR_F	Set when an invalid or unsupported command is received	YES
7F	STATUS_OTHER	R/W	All	1	0	RESERVED	Reserved	NO
					1	ORING_OUTPUT_F	Set when output ORing device fault occurs	NO
					2	ORING_INPUT_B_F	Set when input B ORing device fault occurs	NO
					3	ORING_INPUT_A_F	Set when input A ORing device fault occurs	NO
					4	FUSE_INPUT_B_F	Set when input B fuse/breaker fault occurs	NO
					5	FUSE_INPUT_A_F	Set when input A fuse/breaker fault occurs	NO
					6	RESERVED	Reserved	NO
					7	RESERVED	Reserved	NO
80	STATUS_MFR_SPECIFIC	R/W	All	1	0	RESERVED	Reserved	NO
					1	VBUS_SOFTSTART_F	Set when the primary boost output bus does not reach regulation in specified time	YES
					2	VINT_RANGE_W	Set when an internal voltage (VCC2, VCC4, or VDD) out-of-range warning has occurred	NO
					3	VINT_RANGE_F	Set when an internal voltage (VCC2, VCC4, or VDD) out-of-range fault has occurred	YES
					4	VBUS_UV_F	Set when the primary boost output bus undervoltage fault has occurred	YES
					5	VBUS_UV_W	Set when the primary boost output bus undervoltage warning has occurred	YES
					6	VBUS_OV_W	Set when the primary boost output bus overvoltage warning has occurred	YES
					7	VBUS_OV_F	Set when the primary boost output bus overvoltage fault has occurred	YES
81	STATUS_FANS_1_2	R/W	All	1	0	FAN_AIRFLOW_W	Airflow warning	NO
					1	FAN_AIRFLOW_F	Airflow fault	NO
					2	FAN_2_OVERRIDE	Fan 2 speed overridden	NO
					3	FAN_1_OVERRIDE	Fan 1 speed overridden	YES
					4	FAN_2_W	Fan 2 warning	NO
					5	FAN_1_W	Fan 1 warning	YES
					6	FAN_2_F	Fan 2 fault	NO
					7	FAN_1_F	Fan 1 fault	YES
82	STATUS_FANS_3_4	R/W	All	1	0	FAN_AIRFLOW_W	Airflow warning	NO
					1	FAN_AIRFLOW_F	Airflow fault	NO
					2	FAN_4_OVERRIDE	Fan 4 speed overridden	NO
					3	FAN_3_OVERRIDE	Fan 3 speed overridden	NO
					4	FAN_4_W	Fan 4 warning	NO
					5	FAN_3_W	Fan 3 warning	NO
					6	FAN_4_F	Fan 4 fault	NO
					7	FAN_3_F	Fan 3 fault	NO
86	READ_EIN	BLOCK READ	All	5		Input Energy Consumption Sensor	YES	
87	READ_EOUT	BLOCK READ	All	5		Output Energy Consumption Sensor	YES	

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
88	READ_VIN	R	All	2		Link to read data: CMD 88 Reads	Input Voltage Sensor Reading	YES
89	READ_IIN	R	All	2			Input Current Sensor Reading	YES
8A	READ_VCAP	R	All	2			PFC Output Voltage Sensor Reading	YES
8B	READ_VOUT	R	0	2			Main Output Voltage Sensor Reading	YES
8B	READ_VSTBY	R	1	2			Standby(Auxiliary) Output Voltage Sensor Reading	YES
8C	READ_IOUT	R	0	2			Main Output Current Sensor Reading	YES
8C	READ_ISTBY	R	1	2			Standby(Auxiliary) Output Current Sensor Reading	YES
8D	READ_TEMPERATURE_1	R	All	2			Airflow 1 Temperature Sensor Reading	YES
8E	READ_TEMPERATURE_2	R	All	2			Airflow 2 Temperature Sensor Reading	YES
8F	READ_TEMPERATURE_3	R	0	2			Hotspot 1 Temperature Sensor Reading	YES
8F	READ_TEMPERATURE_3	R	1	2			Hotspot 2 Temperature Sensor Reading	YES
90	READ_FAN_SPEED_1	R	All	2			Fan 1 Speed Sensor Reading	YES
91	READ_FAN_SPEED_2	R	All	2			Fan 2 Speed Sensor Reading	NO
92	READ_FAN_SPEED_3	R	All	2			Fan 3 Speed Sensor Reading	NO
93	READ_FAN_SPEED_4	R	All	2			Fan 4 Speed Sensor Reading	NO
94	READ_DUTY CYCLE	R	All	2			Command returns the duty of the PMBus™ device's main power converter in percent	NO
95	READ_FREQUENCY	R	All	2			Command returns the switching frequency of PMBus™ device's main power converter in KHz	NO
96	READ_POUT	R	All	2			Output Power Sensor Reading	YES
97	READ_PIN	R	All	2			Input Power Sensor Reading	YES
98	PMBUS™_REVISION	R	All	1		PMBus™ Specification Revision	YES	
99 Link to typical values	MFR_ID	BLOCK READ	All	10		Link to EEPROM Contents Summary	Power Supply Company Name	YES
9A Link to typical values	MFR_MODEL	BLOCK READ / BLOCK WRITE	All	32 Max			Power Supply Model Number	YES
9B Link to typical values	MFR_REVISION	BLOCK READ	0	17			Power Supply Firmware Revision	YES
	MFR_REVISION	BLOCK READ	1	17			Power Supply Firmware Revision	YES
	MFR_REVISION	BLOCK READ	2	17			Power Supply Firmware Revision	NO
9C Link to typical values	MFR_LOCATION	BLOCK READ / BLOCK WRITE	All	16 Max			Power Supply Manufacture Location	YES
9D Link to typical values	MFR_DATE	BLOCK READ / BLOCK WRITE	All	16 Max			Power Supply Manufacture Date	YES
9E Link to typical values	MFR_SERIAL	BLOCK READ / BLOCK WRITE	All	16 Max			Power Supply Serial Number	YES
9F	APP_PROFILE SUPPORT	BLOCK READ	All	Variable		Command provides a mean for a host to determine which PMBus™ Applications Profiles, and the revision of those profiles, that the device supports	YES	

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
A0	MFR_VIN_MIN	R	All	2		Link to Returned Results: Manufacturers Para data	Power Supply Input Voltage Minimum Specification	YES
A1	MFR_VIN_MAX	R	All	2			Power Supply Input Voltage Maximum Specification	YES
A2	MFR_IIN_MAX	R	All	2			Power Supply Input Current Maximum Specification	YES
A3	MFR_PIN_MAX	R	All	2			Power Supply Input Power Maximum Specification	YES
A4	MFR_VOUT_MIN	R	All	2			Power Supply Main Output Voltage Minimum Specification	YES
A5	MFR_VOUT_MAX	R	All	2			Power Supply Main Output Voltage Maximum Specification	YES
A6	MFR_IOUT_MAX	R	All	2			Power Supply Main Output Current Maximum Specification	YES
A7	MFR_POUT_MAX	R	All	2			Power Supply Output Power Maximum Specification	YES
A8	MFR_TAMBIENT_MAX	R	All	2			Power Supply Operating Ambient Temperature Maximum Specification	YES
A9	MFR_TAMBIENT_MIN	R	All	2			Power Supply Operating Ambient Temperature Minimum Specification	YES
AA	MFR_EFFICIENCY_LL	R	All	2			Power Supply Low-Line Input Voltage Specification	YES
				2			Power Supply Low-Line Low Power Specification	YES
				2			Power Supply Low-Line Low Power Efficiency Specification	YES
				2			Power Supply Low-Line Medium Power Specification	YES
				2			Power Supply Low-Line Medium Power Efficiency Specification	YES
				2			Power Supply Low-Line High Power Specification	YES
AB	MFR_EFFICIENCY_HL	R	All	2			Power Supply High-Line Input Voltage Specification	YES
				2			Power Supply High-Line Low Power Specification	YES
				2			Power Supply High-Line Low Power Efficiency Specification	YES
				2		Power Supply High-Line Medium Power Specification	YES	
				2		Power Supply High-Line Medium Power Efficiency Specification	YES	
				2		Power Supply High-Line High Power Specification	YES	
AC	MFR_PIN_ACCURACY	R	All	2		Command returns the accuracy (%) of the value returned by the READ_PIN command	YES	
AD	IC_DEVICE_ID	BLOCK READ	All	32 Max		Command used to set or read the type or part number of IC embedded within a PMBus™ that is used for the PMBus™ interface	YES	
AE	IC_DEVICE_REV	BLOCK READ	All	32 Max		Command is used set or read the revision of the IC whose type or part number is set or read with the IC_DEVICE_ID command	NO	
B0	USER_DATA_00	R/W	All	24		Customer text data block 00	NO	
B1	USER_DATA_01	R/W	All	24		Customer text data block 01	NO	
B2	USER_DATA_02	R/W	All	24		Customer text data block 02	NO	
B3	USER_DATA_03	R/W	All	24		Customer text data block 03	NO	
C0	MFR_MAX_TEMP_1	R	All	2		Maximum temperature (degC) associated with READ_TEMPERATURE_1 - Inlet	YES	
C1	MFR_MAX_TEMP_2	R	All	2		Maximum temperature (degC) associated with READ_TEMPERATURE_2 - Outlet	YES	
C2	MFR_MAX_TEMP_3	R	0	2		Maximum temperature (degC) associated with READ_TEMPERATURE_3 - Hotspot 1	YES	
C2	MFR_MAX_TEMP_3	R	1	2		Maximum temperature (degC) associated with READ_TEMPERATURE_3 - Hotspot 2	YES	

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
E0	PS_STATUS	R	All	2	0	CALIBRATION	Set when the unit is in Calibration mode	YES
					1	VSTBY_SELECT	Set when Vstby set to 5V; de-Set when Vstby set to 3.3V	NO
					2	PS_KILL	Set when the PS_KILL pin is defeated and the unit is properly seated in the chassis	YES
					3	VIN_OK	Set when the input voltage is within operating specification	YES
					4	VIN_RANGE	Set when input voltage range is high; de-Set when input voltage range is low	YES
					5	PFC_BUS	Set when the PFC BUS is within operating specification	YES
					6	PS_ON	Set when the PS_ON logic set to enable the main output	YES
					7	POWER_GOOD	Set when main output power delivered to unit is OK; mirrors the digital output signal	YES
					8	POWER_DOWN	Set when bootloader is taking control and the main output and PFC need to be shutdown	YES
					9	BOOTLOAD_COMPLETED	Set when the bootloader has completed and system reset needs to be Set	YES
					10	UNUSED		NO
					11	UNUSED		NO
					12	UNUSED		NO
					13	UNUSED		NO
					14	WARNING	Set when power supply warning has occurred; tracks 'WARNING' status LED	YES
15	FAULT	Set when power supply fault has occurred; tracks 'FAULT' status LED	YES					
E1 Link To: EEPROM	EEPROM_WP	R/W	All	1			Byte to enable (write 0x9A) or disable (write 0x56) writes to the external EEPROM	YES
E2	READ_HOURS_USED	BLOCK READ	All	3			Power Supply Accumulated Main Output Power-On Hours	YES
EE Link To: CMD EE RTN	PMBUS™_CONFIG	R/W	All	2	0	DATA_FORMAT	0 = Linear data format 1 = Direct data format	NO
					1	SMBALERT_L	0 = SMBALERT_L implemented & supported 1 = SMBALERT not implemented	YES
					2	MAX_BUS_SPEED	0 = 100kHz 1 = 400kHz	NO
					3	PEC	0 = PEC not supported 1 = PEC supported	YES
					4:7	RESERVED		NO
EF Link To: CMD EF RTN	LED_CONTROL	R	All	1	0:2	LED_MODE	LED mode change bits	YES
					3:6	RESERVED		NO
					7	LED_CONTROL	LED manual/auto control toggle bit	NO
F0	READ_RESETS	R	All	2		RCON register status flags for troubleshooting	YES	
				2		RCON2 register status flags for troubleshooting		
F8	BOOTLOAD_RESTART	R/W	All	1			Bootloader completion and application restart request command	YES
FA	BOOTLOAD_REQUEST	R/W	All	6			Bootloader request command	YES

Command Code (Hex)	Command Name	Read / Write	Page	# of Bytes	Bit #	Bit Name	Definition	Supported?
FB	BOOTLOAD_STATUS	R	All	2	0	BOOTLOADING_PRI	Set when primary uC bootloading in process	YES
					1	BOOTLOADING_FLOAT	Set when floating uC bootloading in process	YES
					2	BOOTLOADING_SEC	Set when secondary uC bootloading in process	YES
					3	BOOTLOADED_PRI	Set when primary uC bootloading completed; reset required	YES
					4	BOOTLOADED_FLOAT	Set when floating uC bootloading completed; reset required	YES
					5	BOOTLOADED_SEC	Set when secondary uC bootloading completed; reset required	YES
					6	RESET_PRI	Set when primary uC reset	YES
					7	RESET_FLOAT	Set when floating uC reset	YES
					8	RESET_SEC	Set when secondary uC reset	YES
					9	RESERVED		NO
					10	RESERVED		NO
					11	RESERVED		NO
					12	RESERVED		NO
					13	RESERVED		NO
					14	RESERVED		NO
15	RESERVED		NO					

The following tables represents typical results / responses returned from respective command code entries and is provided as an illustration of what should be expected.

Parameters, limits and response example based on **D1U54P-W-450-12-HA4C**; actual results are variant specific

[Link back to: Commands](#)

Command Code (Hex)	Command Name	Read / Write	Page	Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
40	VOUT_OV_FAULT_LIMIT	R	0	Linear Data Format	2	Vdc	-6					14	
40	VSTBY_OV_FAULT_LIMIT	R	1	Linear Data Format	2	Vdc	-7					6	
41	VOUT_OV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
41	VSTBY_OV_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
42	VOUT_OV_WARN_LIMIT	R	0	Linear Data Format	2	Vdc	-6					13.5	
42	VSTBY_OV_WARN_LIMIT	R	1	Linear Data Format	2	Vdc	-7					5.5	
43	VOUT_UV_WARN_LIMIT	R	0	Linear Data Format	2	Vdc	-6					11.4	
43	VSTBY_UV_WARN_LIMIT	R	1	Linear Data Format	2	Vdc	-7					4.7	
44	VOUT_UV_FAULT_LIMIT	R	0	Linear Data Format	2	Vdc	-6					10.9	
44	VSTBY_UV_FAULT_LIMIT	R	1	Linear Data Format	2	Vdc	-7					4.2	
45	VOUT_UV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
45	VSTBY_UV_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared

Command Code (Hex)	Command Name	Read / Write	Page	Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
46	IOUT_OC_FAULT_LIMIT	R	0	Linear Data Format	2	Adc	-4					47.5	
46	ISTBY_OC_FAULT_LIMIT	R	2	Linear Data Format	2	Adc	-7					2.5	
47	IOUT_OC_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	7	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Continuous restart (self-recovery)
47	ISTBY_OC_FAULT_RESPONSE	R	2	Bit Flags	1						2:0	0	Delay Time - None
											5:3	7	Response - Continuous restart (self-recovery)
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
4A	IOUT_OC_WARN_LIMIT	R	0	Linear Data Format	2	Adc	-4					42.5	
4A	ISTBY_OC_WARN_LIMIT	R	2	Linear Data Format	2	Adc	-7					2.3	
4F	AIRFLOW_1_OT_FAULT_LIMIT	R	0	Linear Data Format	2	°C	0					110	Primary Airflow - Outlet
4F	HOTSPOT_1_OT_FAULT_LIMIT	R	1	Linear Data Format	2	°C	0					120	Primary Hotspot - PFC
4F	AIRFLOW_2_OT_FAULT_LIMIT	R	2	Linear Data Format	2	°C	0					90	Secondary Airflow - Inlet
4F	HOTSPOT_2_OT_FAULT_LIMIT	R	3	Linear Data Format	2	°C	0					130	Secondary Hotspot - Main output hotspot
50	AIRFLOW_1_OT_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_1_OT_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	AIRFLOW_2_OT_FAULT_RESPONSE	R	2	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared

Command Code (Hex)	Command Name	Read / Write	Page	Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
50	HOTSPOT_2_OT_FAULT_RESPONSE	R	3	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
4F	AIRFLOW_1_OT_WARN_LIMIT	R	0	Linear Data Format	2	°C	0					105	Primary Airflow - Outlet
4F	HOTSPOT_1_OT_WARN_LIMIT	R	1	Linear Data Format	2	°C	0					115	Primary Hotspot - PFC
4F	AIRFLOW_2_OT_WARN_LIMIT	R	2	Linear Data Format	2	°C	0					85	Secondary Airflow - Inlet
4F	HOTSPOT_2_OT_WARN_LIMIT	R	3	Linear Data Format	2	°C	0					125	Secondary Hotspot - Main output hotspot
55	VIN_OV_FAULT_LIMIT	R	0	Linear Data Format	2	Vrms	-1					275	Recoverable
56	VIN_OV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
57	VIN_OV_WARN_LIMIT	R	0	Linear Data Format	2	Vrms	-1					270	Recoverable
58	VIN_UV_WARN_LIMIT	R	0	Linear Data Format	2	Vrms	-1					80	Recoverable
59	VIN_UV_FAULT_LIMIT	R	0	Linear Data Format	2	Vrms	-1					73	Recoverable
5A	VIN_UV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
5B	IIN_OC_FAULT_LIMIT	R	0	Linear Data Format	2	Arms	-7					7.8	
5C	IIN_OC_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
5D	IIN_OC_WARN_LIMIT	R	0	Linear Data Format	2	Arms	-7					7	
5E	POWER_GOOD_ON	R	0	Linear Data Format	2	Vdc	-6					10.9	

Command Code (Hex)	Command Name	Read / Write	Page	Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
5F	POWER_GOOD_OFF	R	0	Linear Data Format	2	Vdc	-6					10.9	
68	POUT_OP_FAULT_LIMIT	R	0	Linear Data Format	2	Watts	0					600	
69	POUT_OP_FAULT_RESPONSE	R	0	Bit Flags	1					2:0	0	Delay Time - None	
										5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear	
										7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared	
6A	POUT_OP_WARN_LIMIT	R	0	Linear Data Format	2	Watts	0					540	
6B	PIN_OP_WARN_LIMIT	R	0	Linear Data Format	2	Watts	0					590	POUT_OP_WARN_LIMIT / 0.84

SENSOR DATA AND RESOLUTION example, based on **D1U54P-W-450-12-HA4C**; actual results are variant specific

[Link Back to: CMD 88](#)

Command Code (Hex)	Command Name	Description	Page	Format	Units	Scaling Coefficients				Raw Sensor		PMBus™ Reporting Sensor		
						N	m	R	b	Full-scale / Range	Resolution	Full-scale / Range	Resolution	Accuracy
88	READ_VIN	Input Voltage Sensor Reading	All	Linear Data Format	Vrms	-1				327.93	0.3206	511.5	0.5	+ / - 2% of Reporting Full-Scale
89	READ_IIN	Input Current Sensor Reading	All	Linear Data Format	Arms	-7				17.86	0.0175	7.99	0.0078	+ / - 5% of Reporting Full-Scale
8A	READ_VCAP	PFC Output Voltage Sensor Reading	All	Linear Data Format	Vdc	-1				463	0.4526	511.50	0.5000	+ / - 2% of Reporting Full-Scale
8B	READ_VOUT	Main Output Voltage Sensor Reading	0	Linear Data Format	Vdc	-6				14.79	0.0145	15.98	0.0156	+ / - 2% of Reporting Full-Scale
8B	READ_VSTBY	Standby(Auxiliary) Output Voltage Sensor Reading	1	Linear Data Format	Vdc	-7				6.02	0.0059	7.992	0.00781	+ / - 2% of Reporting Full-Scale
8C	READ_IOUT	Main Output Current Sensor Reading	0	Linear Data Format	Adc	-4				50.58	0.0494	63.94	0.063	+ / - 2% of Reporting Full-Scale
8C	READ_ISTBY	Standby(Auxiliary) Output Current Sensor Reading	1	Linear Data Format	Adc	-7				6.05	0.0059	7.992	0.00781	+ / - 2% of Reporting Full-Scale
8D	READ_TEMPERATURE_1	Temperature Sensor Reading - Inlet (Secondary Side)	All	Linear Data Format	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8E	READ_TEMPERATURE_2	Temperature Sensor Reading - Outlet (Primary Side)	All	Linear Data Format	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - Main Output Hotspot (Secondary Side)	0	Linear Data Format	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - PFC Hotspot (Primary Side)	1	Linear Data Format	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
90	READ_FAN_SPEED_1	Fan 1 Speed Sensor Reading	All	Linear Data Format	RPM	5				16,000		32736	32	+ / - 5% of Reporting Full-Scale
96	READ_POUT	Output Power Sensor Reading	All	Linear Data Format	Watts	0						1023	1	+ / - 5% of Reporting Full-Scale
97	READ_PIN	Input Power Sensor Reading	All	Linear Data Format	Watts	0						1023	1	+ / - 5% of Reporting Full-Scale
E2	READ_POWER_ON_HOURS	Accumulated Main Output Power-On Hours	All	Linear Data Format	Hours	0				~1,900 (Years)		~1,900 (Years)	1	+ / - 3%

MANUFACTURER'S GENERAL PARAMETRIC DATA example, **D1U54P-W-450-12- HA4C**; actual results are variant specific

 Link back to: [CMD A0](#)

Command Code (Hex)	Command Name	Value	Units	N	Value (dec)
A0	MFR_VIN_MIN	90	V	-1	180
A1	MFR_VIN_MAX	264	V	-1	528
A2	MFR_IIN_MAX	6	A	-7	768
A3	MFR_PIN_MAX	550	W	0	550
A4	MFR_VOUT_MIN	11.88	V	-6	760
A4	MFR_VSTBY_MIN	3.14	V	-8	804
A4	MFR_VSTBY_MIN	4.76	V	-7	609
A4	MFR_VSTBY_MIN	11.42	V	-6	731
A5	MFR_VOUT_MAX	12.12	V	-6	776
A5	MFR_VSTBY_MAX	3.46	V	-8	886
A5	MFR_VSTBY_MAX	5.24	V	-7	671
A5	MFR_VSTBY_MAX	12.58	V	-6	805
A6	MFR_IOUT_MAX	37.5	A	-4	600
A6	MFR_ISTBY_MAX	4	A	-7	512
A6	MFR_ISTBY_MAX	4	A	-7	512
A6	MFR_ISTBY_MAX	2	A	-8	512
A7	MFR_POUT_MAX	450	W	0	450
A8	MFR_TAMBIENT_MAX	50	C	0	50
A9	MFR_TAMBIENT_MIN	-5	C	0	2043
AA	MFR_EFFICIENCY_LL_LENGTH	14			
AA	MFR_EFFICIENCY_LL_VIN	115	V	-1	230
AA	MFR_EFFICIENCY_LL_POUT1	90	W	0	90
AA	MFR_EFFICIENCY_LL_EFF1	0.9		-10	922
AA	MFR_EFFICIENCY_LL_POUT2	225	W	0	225
AA	MFR_EFFICIENCY_LL_EFF2	0.92		-10	942
AA	MFR_EFFICIENCY_LL_POUT3	450	W	0	450
AA	MFR_EFFICIENCY_LL_EFF3	0.91		-10	932

OPERATION COMMAND CODE 01 HEX

Link Back to Commands: [CMD_01](#)

Bit # / Bit Description								Valid Values		Power Supply On/Off Mode
7	6	5	4	3	2	1	0	Dec	Hex	
On/off 1	On/off 0	Margin on/off/high/low 1	Margin on/off/high/low 0	Margin fault control 1	Margin fault control 0	not used	not used			
0	0	x	x	x	x	x	x	0 - 63	0 - 3F	Disable power supply when OPERATION command supported
1	0	x	x	x	x	x	x	128 - 191	80 - BF	Enable power supply when OPERATION command supported (Default)

ON/OFF COMMAND CODE 02 HEX

Link Back to Commands: [CMD_02](#)

Bit # / Bit Description								Valid Values		Power Supply On/Off Mode
7	6	5	4	3	2	1	0	Dec	Hex	
reserved	reserved	Reserved	CONTROL pin / OPERATION command PS on/off	OPERATION command on/off	CONTROL pin on/off	CONTROL pin polarity	CONTROL pin action			
0	0	0	1	0	1	0	1	21	15	Control pin only ; active low polarity
0	0	0	1	0	1	1	1	23	17	Control pin only ; active high polarity
0	0	0	1	1	0	x	1	25 or 27	19 or 1B	Operation command only
0	0	0	1	1	1	0	1	29	1D	Operation command and control pin ; active low polarity
0	0	0	1	1	1	1	1	31	1F	Operation command and control pin ; active high polarity

EEPROM WRITE PROTECT SETTINGS: D1U54P-W-450-12- HA4C.

Link back to: [cmd_E1](#)

Bit # / Bit Description								Valid Values		Read / Write	FRU EEPROM Write Protect CONTROL
7	6	5	4	3	2	1	0	Dec	Hex		
WP Control Bit 7	WP Control Bit 6	WP Control Bit 6	WP Control Bit 4	WP Control Bit 3	WP Control Bit 2	WP Control Bit 1	WP Control Bit 0				
1	0	0	1	1	0	1	1	154	9A	Read / Write	EEPROM write protect enabled - write to device not allowed
0	1	0	1	1	1	0	0	86	56	Read / Write	EEPROM write protect disabled - write to device allowed

PMBUS™ Configuration Defaults

Link back to: [CMD_EE](#)

Bit # / Bit Description														Read / Write	PMBus™ Configuration		
15	14	13	12	11	10	9	8	7	6	5	4	3	2			1	0
CMD Key Bit 7	CMD Key Bit 6	CMD Key Bit 5	CMD Key Bit 4	CMD Key Bit 3	CMD Key Bit 2	CMD Key Bit 1	CMD Key Bit 0	R e s.	R e s.	R e s.	R e s.	P E C	Bus Speed	SMBALERT	Data Format		
0	1	0	1	1	0	1	0	X	X	X	X	1	1	0	0	Read	1. PEC supported 2.400kHz 3. SMBALERT supported 4. Linear Data format DEFAULT



Parameter	Bit#	Bit	Function	Notes
Data Format	0	1	Direct Data Format	
		0	Linear Data Format	Default
SMBALERT	1	1	PS Does not have SMBAlert pin or does not support SMBAlert protocol	
		0	PS Does have SMBAlert pin and does support SMBAlert protocol	Default
BUS SPEED	2	1	Max. Supported Bus Speed 400kHz	Default
		0	Max. Supported Bus Speed 100kHz	
PEC CONTROL	3	1	Packet error checking supported	Default
		0	Packet error checking onte supported	

LED CONTROL

Link back to commands: [CMD EF BACK](#)

Bit # / Bit Description								Dec	Hex	Read / Write	LED Status & Control
7	6	5	4	3	2	1	0				
CONTROL Bit	reserved	reserved	reserved	reserved	LED Mode Bit 2	LED Mode Bit 1	LED Mode Bit 0				
Page 0 - INPUT LED											
0	0	0	0	0	0	0	0	0	0	Read	Auto - LED off -Default
0	0	0	0	0	0	0	1	1	1	Read	Auto - LED solid green – Default
0	0	0	0	0	0	1	0	2	2	Read	Auto - LED blinking green – Default
0	X	X	X	X	X	X	X	0 - 127	0 - 7F	Write	Set to Auto LED control
1	0	0	0	0	0	0	0	128	80	Read / Write	Set to Manual - LED off
1	0	0	0	0	0	0	1	129	81	Read / Write	Set to Manual - LED solid green
1	0	0	0	0	0	1	0	130	82	Read / Write	Set to Manual - LED blinking green
Page 1 - OUTPUT LED											
0	0	0	0	0	0	0	0	0	0	Read	Auto - LED off – Default
0	0	0	0	0	0	0	1	1	1	Read	Auto - LED solid green – Default
0	0	0	0	0	0	1	0	2	2	Read	Auto - LED blinking green – Default
0	0	0	0	0	0	1	1	3	3	Read	Auto - LED solid red – Default
0	0	0	0	0	1	0	0	4	4	Read	Auto - LED blinking red – Default
0	0	0	0	0	1	0	1	5	5	Read	Auto - LED solid yellow – Default
0	0	0	0	0	1	1	0	6	6	Read	Auto - LED blinking yellow – Default
0	X	X	X	X	X	X	X	0 - 127	0 - 7F	Write	Set to Auto LED control
1	0	0	0	0	0	0	0	128	80	Read / Write	Set to Manual - LED off
1	0	0	0	0	0	0	1	129	81	Read / Write	Set to Manual - LED solid green
1	0	0	0	0	0	1	0	130	82	Read / Write	Set to Manual - LED blinking green
1	0	0	0	0	0	1	1	131	83	Read / Write	Set to Manual - LED solid red
1	0	0	0	0	1	0	0	132	84	Read / Write	Set to Manual - LED blinking red
1	0	0	0	0	1	0	1	133	85	Read / Write	Set to Manual - LED solid yellow
1	0	0	0	0	1	1	0	134	86	Read / Write	Set to Manual - LED blinking yellow

PMBus™ Manufacturers Vital Data

INVENTORY INFORMATION REGISTERS – shown for illustration purposes; based on model **D1U54P-W-450-12-HA4C**; actual results are unit specific

Link back [CMD 99](#)

PMBus™ Register Name	PMBus™ Register Number	Register Contents	Static or Dynamic Register? (S/D)	Label Markings	Label Part Number
MFR_ID	0x99	Murata-PS	S	MPS Logo	D976xxxxxxx
MFR_MODEL	0x9A	D1U54P-W-450-12-HA4C	D	D1U54P-W-450-12-HA4C	D976xxxxxxx
MFR_REVISION	0x9B (paged)	9151001909-vv-rr (page 0) 9157001909-vv-rr (page 1) 915400xxxx-vv-rr (page 2)	S	n/a	n/a
MFR_LOCATION	0x9C	China / Canada	D	MADE IN xxxxxx	D976xxxxxxx
MFR_DATE	0x9D	YYWW	D	Chars 3-6 of serial number	D976xxxxxxx
MFR_SERIAL	0x9E	SSYYWRRRxxxx	D	SSYYWRRRxxxx	D976xxxxxxx

Command Code 99 HEX (MAN_ID)

[Link back to commands: CMD 99](#)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text		
99	MFR_ID	Murata-PS	MFR_ID_LENGTH:	9	
			MFR_ID_0		'M'
			MFR_ID_1		'U'
			MFR_ID_2		'R'
			MFR_ID_3		'A'
			MFR_ID_4		'T'
			MFR_ID_5		'A'
			MFR_ID_6		'.'
			MFR_ID_7		'P'
			MFR_ID_8		'S'

Command Code 9A HEX (MFR_MODEL), D1U54P-W-450-12-HA4C shown for example purposes:

[Link back to commands: CMD 9A](#)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text		
9A	MFR_MODEL	D1U54P-W-450-12-HA4C	MFR_MODEL_LENGTH	22	
			MFR_MODEL_0		'D'
			MFR_MODEL_1		'1'
			MFR_MODEL_2		'U'
			MFR_MODEL_3		'5'
			MFR_MODEL_4		'4'
			MFR_MODEL_5		'P'
			MFR_MODEL_6		'.'
			MFR_MODEL_7		'W'
			MFR_MODEL_8		'.'
			MFR_MODEL_9		'0'
			MFR_MODEL_10		'4'
			MFR_MODEL_11		'5'
			MFR_MODEL_12		'0'
			MFR_MODEL_13		'.'
			MFR_MODEL_14		'1'
			MFR_MODEL_15		'2'
			MFR_MODEL_16		'.'
			MFR_MODEL_17		'H'
			MFR_MODEL_18		'A'
			MFR_MODEL_19		'4'
			MFR_MODEL_20		C
			MFR_MODEL_21		0
			MFR_MODEL_22		0
			MFR_MODEL_23		0
			MFR_MODEL_24		0
			MFR_MODEL_25		0
			MFR_MODEL_26		0
			MFR_MODEL_27		0
			MFR_MODEL_28		0

Command Code 9B HEX (MFR_REVISION), example only; actual results may vary:

Link Back to Commands: [CMD_9B](#)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text		
9B	MFR_REVISION	0000-0000-0000	MFR_REVISION_LENGTH	14	
			MFR_REVISION_0	'0'	
			MFR_REVISION_1	'0'	
			MFR_REVISION_2	'0'	
			MFR_REVISION_3	'0'	
			MFR_REVISION_4	'-'	
			MFR_REVISION_5	SEC_MAJOR_FW_REV_0	// Secondary FW major rev byte0
			MFR_REVISION_6	SEC_MAJOR_FW_REV_1	// Secondary FW major rev byte1
			MFR_REVISION_7	SEC_MINOR_FW_REV_0	// Secondary FW minor rev byte0
			MFR_REVISION_8	SEC_MINOR_FW_REV_1	// Secondary FW minor rev byte1
			MFR_REVISION_9	'-'	
			MFR_REVISION_10	'0'	
			MFR_REVISION_11	'0'	
			MFR_REVISION_12	'0'	
MFR_REVISION_13	'0'				

Command Code 9C HEX (MFR_LOCATION):

Link Back to Commands List: [CMD_9C](#)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9C	MFR_LOCATION	China	MFR_LOCATION_LENGTH	
			MFR_LOCATION_0	'C'
			MFR_LOCATION_1	'h'
			MFR_LOCATION_2	'i'
			MFR_LOCATION_3	'n'
			MFR_LOCATION_4	'a'

Command Code 9D HEX (MFR_DATE) example only; actual results may vary::

Link Back to Commands List: [COMMAND_9E RTN](#)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9D	MFR_DATE	1400	MFR_LOCATION_LENGTH	4
			MFR_DATE_0	"1"
			MFR_DATE_1	"4"
			MFR_DATE_2	"0"
			MFR_DATE_3	"0"

Command Code 9E HEX (MFR_SERIAL) example only; actual unit results may vary:
 Link Back to Commands List: [Command Back 9E](#)

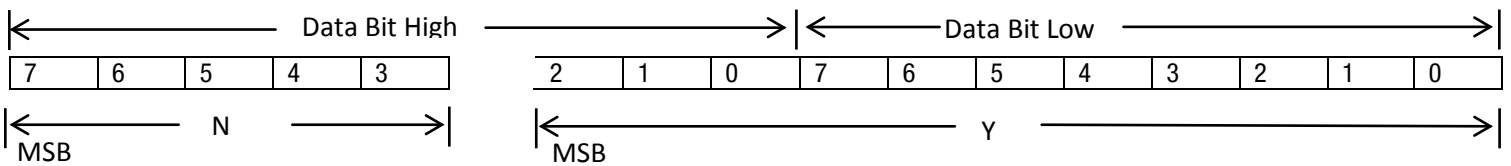
Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9E	MFR_SERIAL	QEyywwR1xxxx	MFR_SERIAL_LENGTH	
			MFR_SERIAL_0	'Q'
			MFR_SERIAL_1	'E'
			MFR_SERIAL_2	'y'
			MFR_SERIAL_3	'y'
			MFR_SERIAL_4	'w'
			MFR_SERIAL_5	'w'
			MFR_SERIAL_6	'R'
			MFR_SERIAL_7	'1'
			MFR_SERIAL_8	'x'
			MFR_SERIAL_9	'x'
			MFR_SERIAL_10	'x'
MFR_SERIAL_11	'x'			

Fan Configuration: CMD 3Ah
 Link back to commands list: [CMD 3A](#)

Bit # / Bit Description/setting							
7	6	5	4	3	2	1	0
Fan 1 installation (set when fan is installed in this position)	Fan 1 setting mode Set when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	Fan 1 tach pulses Upper bit	Fan 1 tach pulses Lower bit	Not used	Not used	Not Used	Not used
1	0 (hard coded, cannot be changed)	1	1	0	0	0	0

Command Code 3Bh (FAN_COMMAND_1) Link Back to Commands List: [COMMAND 3B](#)

Manual fan speed control is a linear mode two byte command, speed expressed as a percentage of the maximum fan duty cycle. The command is expressed in Linear data format, with N=-10:



The Relationship between Y, N and the “real world” value is:

$$X = Y \cdot 2^N$$

Where, as described above:

X is the “real world” value;

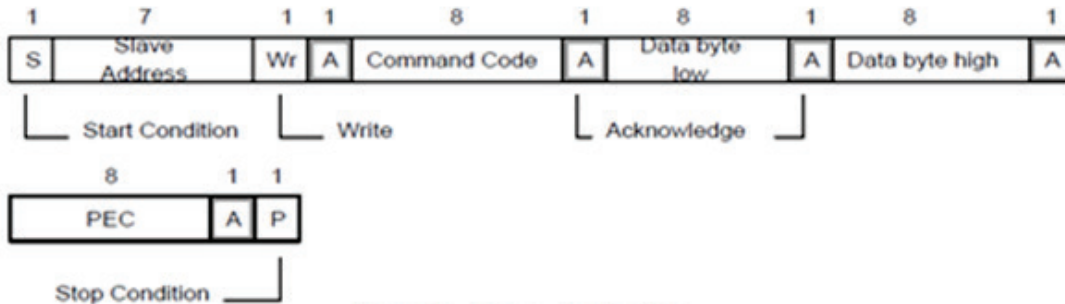
Y is an 11 bit, two’s compliment integer; and

N is a 5 bit, two’s compliment integer.

Tips:

- With duty cycle, N = -10, thus the N bits are 10110b, and the range of Y is 00000000000b to 01111111111b.
- In other words, the valid ranges we can write to command 0x3B are the 1023 settings/valid values from:
- 0xB000 (0% fan speed) to 0xB3FF (~99.9% fan speed)

- Automatic fan speed control (default) can be resumed by writing the command “03h”, (CLEAR_FAULTS).
- You can change the fan from manual fan speed override back to auto fan profile by either:
 - Writing an invalid fan speed to command 0x3B (i.e. any 16-bit value that is not one of the 1023 valid settings)
 - Writing to command 0x03 – CLEAR_FAULTS
- Recall that the power supply has PEC enabled, so the write format for the 0x3B command is:



Write Word Protocol with PEC

MANUAL FAN SPEED OVERRIDE VALUES:

Note: auto fan speed mode resumed by recycling AC line voltage or toggling PS_ON signal, or write “clear_faults” command

CMD 3B(h)	“Fan_COMMAND_1” (2 bytes)			CMD 3B(h)	“Fan_COMMAND_1” (2 bytes)			CMD 3B(h)	“Fan_COMMAND_1” (2 bytes)			CMD 3B(h)	“Fan_COMMAND_1” (2 bytes)		
	% Duty Cycle	MSB(h)	LSB(h)		n(d)	% Duty Cycle	MSB(h)		LSB(h)	n(d)	% Duty Cycle		MSB(h)	LSB(h)	n(d)
0	B0	0	-10	26	B1	A	-10	51	B2	A	-10	76	B2	9	-10
1	B0	A	-10	27	B1	14	-10	52	B2	14	-10	77	B2	14	-10
2	B0	14	-10	28	B1	E1	-10	53	B2	1E	-10	78	B2	1E	-10
3	B0	1F	-10	29	B1	29	-10	54	B2	28	-10	79	B2	28	-10
4	B0	29	-10	30	B1	33	-10	55	B2	33	-10	80	B3	32	-10
5	B0	33	-10	31	B1	3D	-10	56	B2	3D	-10	81	B3	3D	-10
6	B0	3D	-10	32	B1	47	-10	57	B2	47	-10	82	B3	47	-10
7	B0	48	-10	33	B1	52	-10	58	B2	51	-10	83	B3	51	-10
8	B0	52	-10	34	B1	5C	-10	59	B2	5C	-10	84	B3	5B	-10
9	B0	5C	-10	35	B1	66	-10	60	B2	66	-10	85	B3	66	-10
10	B0	66	-10	36	B1	70	-10	61	B2	70	-10	86	B3	70	-10
11	B0	71	-10	37	B1	7B	-10	62	B2	7A	-10	87	B3	7A	-10
12	B0	7B	-10	38	B1	85	-10	63	B2	84	-10	88	B3	84	-10
13	B0	85	-10	39	B1	8F	-10	64	B2	8F	-10	89	B3	8E	-10
14	B0	8F	-10	40	B1	99	-10	65	B2	99	-10	90	B3	99	-10
15	B0	99	-10	41	B1	A3	-10	66	B2	A3	-10	91	B3	A3	-10
16	B0	A4	-10	42	B1	AE	-10	67	B2	AD	-10	92	B3	AD	-10
17	B0	AE	-10	43	B1	B8	-10	68	B2	B8	-10	93	B3	B7	-10
18	B0	B8	-10	44	B1	C2	-10	9	B2	C2	-10	94	B3	C2	-10
19	B0	C2	-10	45	B1	CC	-10	70	B2	CC	-10	95	B3	CC	-10
20	B0	CD	-10	46	B1	D7	-10	71	B2	D6	-10	96	B3	D6	-10
21	B0	D7	-10	47	B1	E1	-10	72	B2	E1	-10	97	B3	E0	-10
22	B0	E1	-10	48	B1	EB	-10	73	B2	EB	-10	98	B3	EB	-10
23	B0	EB	-10	49	B1	F5	-10	74	B2	F5	-10	99	B3	F5	-10
24	B0	F6	-10	50	B2	0	-10	75	B2	FF	-10	100	B3	FF	-10
25	B1	0	-10												

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