



Murata Power Solutions

### PMBus™ COMMANDS

This application note is applicable for the following product:

D2U5T-H3-5000-380-HU3C: Three Phase, AC Input 7000W/3500W; Front to Back Airflow; 380VDC; 9.2/13.34A<sub>dc</sub>

### Standard PMBus™ Commands

All data communicated over the PMBus™ interface does NOT use PEC (Packet Error Checking) as defined by the standard for PMBus™ Power Systems Management Protocol Part 1 – General Requirements Rev 1.1.

Linear data formatting is used for all passed parameters. Block reads (where the loose byte received denotes the remaining byte to be clocked out) are not supported on this product series. A minimum of 300µs delay between transactions (between STOP and START bits) is recommended for robust communications.

Note: 400KHz and 100KHz I<sup>2</sup>C communications are supported for the PMBus™ interface.

Note: The PMBus™ slave controller can “clock stretch” on ACK.

### D2U5T-H3-5000-380-HU3C Device Detail

Power Module Internal Devices				
Vendor	Manufacturers Part Number	Package	Description	
Texas Instruments	TMS320F2808PZA	100-pin TQFP	(Primary) 32-bit DSC, 64K flash, 18K SRAM, -40C to 85C	
Microchip Technology Inc.	PIC24FJ64GA306T-I/PT	64-pin TQFP	(Floating) 16-bit PIC, 64K flash, 8K SRAM, -40C to 85C	
Microchip Technology Inc.	PIC24FJ64GA306T-I/PT	64-pin TQFP	(Secondary) 16-bit PIC, 64K flash, 8K SRAM, -40C to 85C	
Microchip Technology Inc.	24AA024T-I/MS	8-pin MSOP	2Kbit, 2.5-5.5V 400kHz, 1.8-2.5V 100kHz, 85C serial EEPROM	

### Device Addressing Details

The D2U5T-H3-5000-380-HU3C supports an address for the module that is variable by use of the address bits A0 and A1 & A2 (accessible via the DC and signal I/O output connector; also see ACAN-61 Application Note for Interface Connector Card) as follows:

DEVICE(S) ADDRESS				
A1 Serial Address Bit 2	A1 Serial Address Bit 1	A0 Serial Address Bit 0	Power Module Secondary Main Controller (Serial 7-Bit Left-Shifted Slave Address)	Power Module EEPROM (Serial 7-Bit Left-Shifted Slave Address)
LOW	LOW	LOW	0xB0	0xA0
LOW	LOW	HIGH	0xB2	0xA2
LOW	HIGH	LOW	0xB4	0xA4
LOW	HIGH	HIGH	0xB6	0xA6
HIGH	LOW	LOW	0xB8	0xA8
HIGH	LOW	HIGH	0xBA	0xAA
HIGH	HIGH	LOW	0xBC	0xAC
HIGH	HIGH	HIGH	0xBE	0xAE

The D2U5T-H3-5000-380-HU3C uses 7-bit Device “left shifted” addressing; the above table assumes that the “Read/Write” bit is logic “0”.

Page Command is supported to allow the ability to control and monitor the dual outputs (the Main output) and the VSTANDBY outputs. Each Command Code is annotated with either "All", "0", "1", "2" or "3" accordingly to identify which "page" is associated with the command.

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
00	PAGE	R/W	All		1			Command to provide ability to configure, control & monitor multiple outputs	YES
01	OPERATION	R/W	All	Bit Flags	1	5:0		Set output margin high/low voltages	NO
						7:6		Turn the unit on/off in conjunction with digital input from PSON_L	NO
02	ON_OFF_CONFIG	R	All	Bit Flags	1	0	ON_OFF_DELAY	1 = Turn off immediately (default) / 0 = Use delay @ turn-off	NO
						1	ON_OFF_POLARITY	1 = Power on processing is active high (default)	NO
						2	USE_CONTROL	1 = Use CONTROL pin for on/off power processing (default)	NO
						3	USE_OPERATION	1 = Use OPERATION command for on/off power processing (default)	NO
						4	USE_CNTL_AND_OP	1 = Use both CONTROL pin & OPERATION command (default)	NO
						5	RESERVED		NO
						6	RESERVED		NO
						7	RESERVED		NO
03	CLEAR_FAULTS	W	All		1		Write only command simultaneously clears all faults that have been set in all the STATUS_XXXX registers	YES	
20	VOUT_MODE	R	0	Bit Flags	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 1.1 - Sections 8.1-8.3	YES	
20	VSTBY_MODE	R	1	Bit Flags	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 1.1 - Sections 8.1-8.3	YES	
25	VOUT_MARGIN_HIGH	R/W	0	Linear Data Format	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_HIGH	R/W	1	Linear Data Format	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_LOW	R/W	0	Linear Data Format	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	Linear Data Format	2		Load the unit with the voltage to which the output is to be changed when the OPERATION command set to "Margin Low"	NO	
3A	FAN_CONFIG_1_2	R	All	Bit Flags	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	R/W	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	R/W	2		Manual fan override command fan speed value in Duty Cycle Command speed formatted in Linear as per command 0x90 - READ_FAN_SPEED_2	NO	

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported		
40	VOUT_OV_FAULT_LIMIT	R	0	Linear Data Format	2		Commands Not Currently Supported	Main Output Overvoltage Fault Limit	NO		
40	VSTBY_OV_FAULT_LIMIT	R	1	Linear Data Format	2			Standby(Auxiliary) Output Overvoltage Fault Limit	NO		
41	VOUT_OV_FAULT_RESPONSE	R	0	Bit Flags	1			Main Output Overvoltage Fault Response Actions	NO		
41	VSTBY_OV_FAULT_RESPONSE	R	1	Bit Flags	1			Standby(Auxiliary) Output Overvoltage Fault Response Actions	NO		
42	VOUT_OV_WARN_LIMIT	R	0	Linear Data Format	2			Main Output Overvoltage Warning Limit	NO		
42	VSTBY_OV_WARN_LIMIT	R	1	Linear Data Format	2			Standby(Auxiliary) Output Overvoltage Warning Limit	NO		
43	VOUT_UV_WARN_LIMIT	R	0	Linear Data Format	2			Main Output Undervoltage Warning Limit	NO		
43	VSTBY_UV_WARN_LIMIT	R	1	Linear Data Format	2			Standby(Auxiliary) Output Undervoltage Warning Limit	NO		
44	VOUT_UV_FAULT_LIMIT	R	0	Linear Data Format	2			Main Output Undervoltage Fault Limit	NO		
44	VSTBY_UV_FAULT_LIMIT	R	1	Linear Data Format	1			Standby(Auxiliary) Output Undervoltage Fault Limit	NO		
45	VOUT_UV_FAULT_RESPONSE	R	0	Bit Flags	1			Main Output Undervoltage Fault Response Actions	NO		
45	VSTBY_UV_FAULT_RESPONSE	R	1	Bit Flags	2			Standby(Auxiliary) Output Undervoltage Fault Response Actions	NO		
46	IOUT_OC_FAULT_LIMIT	R	0	Linear Data Format	2			Main Output Overcurrent Fault Limit - High line	NO		
46	IOUT_OC_FAULT_LIMIT	R	1	Linear Data Format	2			Main Output Overcurrent Fault Limit - Low line	NO		
46	ISTBY_OC_FAULT_LIMIT	R	2	Linear Data Format	1			Standby(Auxiliary) Output Overvoltage Fault Limit	NO		
47	IOUT_OC_FAULT_RESPONSE	R	0	Bit Flags	1			Main Output Overcurrent Warning Limit - High line	NO		
47	IOUT_OC_FAULT_RESPONSE	R	1	Bit Flags	1			Main Output Overcurrent Warning Limit - Low line	NO		
47	ISTBY_OC_FAULT_RESPONSE	R	2	Bit Flags	2			Standby(Auxiliary) Output Overvoltage Warning Limit	NO		
4A	IOUT_OC_WARN_LIMIT	R	0	Linear Data Format	2			Main Output Overcurrent Warning Limit - High line	NO		
4A	IOUT_OC_WARN_LIMIT	R	1	Linear Data Format	2			Main Output Overcurrent Warning Limit - Low line	NO		
4A	ISTBY_OC_WARN_LIMIT	R	2	Linear Data Format	2			Standby(Auxiliary) Output Overvoltage Warning Limit	NO		
4F	AIRFLOW_1_OT_FAULT_LIMIT	R	0	Linear Data Format	2			Airflow 1 Overtemperature Fault Limit	NO		
4F	HOTSPOT_1_OT_FAULT_LIMIT	R	1	Linear Data Format	2			Hotspot 1 Overtemperature Fault Limit	NO		
4F	AIRFLOW_2_OT_FAULT_LIMIT	R	2	Linear Data Format	2			Airflow 2 Overtemperature Fault Limit	NO		
4F	HOTSPOT_2_OT_FAULT_LIMIT	R	3	Linear Data Format	1			Hotspot 2 Overtemperature Fault Limit	NO		
50	AIRFLOW_1_OT_FAULT_RESPONSE	R	0	Bit Flags	1			Airflow 1 Overtemperature Fault Response Actions	NO		
50	HOTSPOT_1_OT_FAULT_RESPONSE	R	1	Bit Flags	1			Hotspot 1 Overtemperature Fault Response Actions	NO		
50	AIRFLOW_2_OT_FAULT_RESPONSE	R	2	Bit Flags	1			Airflow 2 Overtemperature Fault Response Actions	NO		
50	HOTSPOT_2_OT_FAULT_RESPONSE	R	3	Bit Flags	2			Hotspot 2 Overtemperature Fault Response Actions	NO		
51	AIRFLOW_1_OT_WARN_LIMIT	R	0	Linear Data Format	2			Airflow 1 Overtemperature Warning Limit	NO		
51	HOTSPOT_1_OT_WARN_LIMIT	R	1	Linear Data Format	2			Hotspot 1 Overtemperature Warning Limit	NO		
51	AIRFLOW_2_OT_WARN_LIMIT	R	2	Linear Data Format	2			Airflow 2 Overtemperature Warning Limit	NO		
51	HOTSPOT_2_OT_WARN_LIMIT	R	3	Linear Data Format	2			Hotspot 2 Overtemperature Warning Limit	NO		
55	VIN_OV_FAULT_LIMIT	R	0	Linear Data Format	1			Commands Not Currently Supported	Input Overvoltage Fault Limit	NO	
56	VIN_OV_FAULT_RESPONSE	R	0	Bit Flags	2				Input Overvoltage Fault Response Actions	NO	
57	VIN_OV_WARN_LIMIT	R	0	Linear Data Format	2				Input Overvoltage Warning Limit	NO	
58	VIN_UV_WARN_LIMIT	R	0	Linear Data Format	2				Input Undervoltage Warning Limit	NO	
59	VIN_UV_FAULT_LIMIT	R	0	Linear Data Format	1				Input Undervoltage Fault Limit	NO	
5A	VIN_UV_FAULT_RESPONSE	R	0	Bit Flags	2				Input Undervoltage Fault Response Actions	NO	
5B	IIN_OC_FAULT_LIMIT	R	0	Linear Data Format	1				Input Overcurrent Fault Limit - High Line	NO	
5C	IIN_OC_FAULT_LIMIT	R	1	Linear Data Format	2				Input Overcurrent Fault Limit - Low Line	NO	
5D	IIN_OC_FAULT_RESPONSE	R	0	Bit Flags	2				Input Overcurrent Fault Response Actions	NO	
5E	IIN_OC_WARN_LIMIT	R	0	Linear Data Format	2				Input Overcurrent Warning Limit - High Line	NO	
5F	IIN_OC_WARN_LIMIT	R	1	Linear Data Format	2				Input Overcurrent Warning Limit - Low Line	NO	
68	POUT_OP_FAULT_LIMIT	R	0	Linear Data Format	2				Commands Not Currently Supported	Output Overpower Fault Limit - High Line	NO
68	POUT_OP_FAULT_LIMIT	R	1	Linear Data Format	2					Output Overpower Fault Limit - Low Line	NO
69	POUT_OP_FAULT_RESPONSE	R	0	Bit Flags	1		Output Overpower Fault Response Actions	NO			
6A	POUT_OP_WARN_LIMIT	R	0	Linear Data Format	2		Output Overpower Warning Limit - High line	NO			
6A	POUT_OP_WARN_LIMIT	R	1	Linear Data Format	2		Output Overpower Warning Limit - Low line	NO			
6B	PIN_OP_WARN_LIMIT	R	0	Linear Data Format	2		Input Overpower Warning Limit - High line	NO			
6B	PIN_OP_WARN_LIMIT	R	1	Linear Data Format	2		Input Overpower Warning Limit - Low line	NO			

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
74	TEST_OUTPUT_ORING	R/W	1	Bit Flags	1	0	ORING_TEST	Set when a fault not listed in [7:1] occurred	NO
79	STATUS_BYTE NOT SUPPORTED	R	0	Bit Flags	1	0	NONE_F_W	Set when a communications, memory, or logic fault has occurred	NO
						1	CML_F	Set when an overtemperature fault or warning has occurred	NO
						2	TEMPERATURE_F_W	Set when an input undervoltage fault has occurred	NO
						3	INPUT_UV_F	Set when an output overcurrent fault has occurred	NO
						4	OUTPUT_OC_F	Set when an output overvoltage fault has occurred	NO
						5	OUTPUT_OV_F	Set when unit not providing power to the output	NO
						6	UNIT_OFF	Asserted when device busy and unable to respond fault	NO
						7	BUSY_F	Set when a fault not listed in [7:1] occurred	NO
79	STATUS_WORD	R	All	STATUS_BYTE (Lower byte)	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	Asserted 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		MFG_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	0	Bit Flags	1	0	VOUT_TRACKING_E	Asserted when an error in the output voltage during power-up/down has occurred	NO
						1	TON_MAX_W	Asserted when the output turn-on timing has exceeded the TON_MAX warning timing	NO
						2	TON_MAX_F	Asserted when the output turn-on timing has exceeded the TON_MAX fault timing	NO
						3	VOUT_MAX_F	Asserted when the output is set higher than the commanded VOUT_MAX limit	NO
						4	VOUT_UV_F	Asserted when an output undervoltage fault has occurred	YES
						5	VOUT_UV_W	Asserted when an output undervoltage warning has occurred	YES
						6	VOUT_OV_W	Asserted when an output overvoltage warning has occurred	YES
						7	VOUT_OV_F	Asserted when an output overvoltage fault has occurred	YES
7A	STATUS_VSTBY	R	1	Bit Flags	1	0	VOUT_TRACKING_E	Asserted when an error in the output voltage during power-up/down has occurred	NO
						1	TON_MAX_W	Asserted when the output turn-on timing has exceeded the TON_MAX warning timing	NO
						2	TON_MAX_F	Asserted when the output turn-on timing has exceeded the TON_MAX fault timing	NO
						3	VOUT_MAX_F	Asserted when the output is set higher than the commanded VOUT_MAX limit	NO
						4	VOUT_UV_F	Asserted when an output undervoltage fault has occurred	YES
						5	VOUT_UV_W	Asserted when an output undervoltage warning has occurred	YES
						6	VOUT_OV_W	Asserted when an output overvoltage warning has occurred	YES
						7	VOUT_OV_F	Asserted when an output overvoltage fault has occurred	YES

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
7B	STATUS_IOUT	R	0	Bit Flags	1	0	POUT_OP_W	Asserted when an output overpower warning has occurred	YES
						1	POUT_OP_F	Asserted when an output overpower fault has occurred	YES
						2	POWER_LIMIT_MODE	Asserted when the unit has entered output power limiting mode	NO
						3	CURRENT_SHARE_F	Asserted when an output current share fault has occurred	NO
						4	IOUT_UC_W	Asserted when an output undercurrent fault has occurred	NO
						5	IOUT_OC_W	Asserted when an output overcurrent warning has occurred	YES
						6	IOUT_OC_SHUTDOWN	Asserted when an output overcurrent and low voltage shutdown fault has occurred	YES
						7	IOUT_OC_F	Asserted when an output overcurrent fault has occurred	YES
7B	STATUS_ISTBY	R	1	Bit Flags	1	0	POUT_OP_W	Asserted when an output overpower warning has occurred	NO
						1	POUT_OP_F	Asserted when an output overpower fault has occurred	NO
						2	POWER_LIMIT_MODE	Asserted when the unit has entered output power limiting mode	NO
						3	CURRENT_SHARE_F	Asserted when an output current share fault has occurred	NO
						4	IOUT_UC_W	Asserted when an output undercurrent fault has occurred	NO
						5	IOUT_OC_W	Asserted when an output overcurrent warning has occurred	YES
						6	IOUT_OC_SHUTDOWN	Asserted when an output overcurrent and low voltage shutdown fault has occurred	YES
						7	IOUT_OC_F	Asserted when an output overcurrent fault has occurred	YES
7C	STATUS_INPUT (PHASE 1)	R	0	Bit Flags	1	0	PIN_OP_W	Asserted when an input overpower warning has occurred	YES
						1	IIN_OC_W	Asserted when an input overcurrent warning has occurred	YES
						2	IIN_OC_F	Asserted when an input overcurrent fault has occurred	YES
						3	VIN_UV_OFF	Asserted when the Unit is OFF for insufficient input voltage	YES
						4	VIN_UV_F	Asserted when an input undervoltage fault has occurred	NO
						5	VIN_UV_W	Asserted when an input undervoltage warning has occurred	YES
						6	VIN_OV_W	Asserted when an input overvoltage warning has occurred	YES
						7	VIN_OV_F	Asserted when an input overvoltage fault has occurred	YES
7C	STATUS_INPUT (PHASE 2)	R	1	Bit Flags	1	0	PIN_OP_W	Asserted when an input overpower warning has occurred	NO
						1	IIN_OC_W	Asserted when an input overcurrent warning has occurred	YES
						2	IIN_OC_F	Asserted when an input overcurrent fault has occurred	YES
						3	VIN_UV_OFF	Asserted when the Unit is OFF for insufficient input voltage	NO
						4	VIN_UV_F	Asserted when an input undervoltage fault has occurred	NO
						5	VIN_UV_W	Asserted when an input undervoltage warning has occurred	YES
						6	VIN_OV_W	Asserted when an input overvoltage warning has occurred	YES
						7	VIN_OV_F	Asserted when an input overvoltage fault has occurred	NO
7C	STATUS_INPUT (PHASE 3)	R	2	Bit Flags	1	0	PIN_OP_W	Asserted when an input overpower warning has occurred	NO
						1	IIN_OC_W	Asserted when an input overcurrent warning has occurred	YES
						2	IIN_OC_F	Asserted when an input overcurrent fault has occurred	YES
						3	VIN_UV_OFF	Asserted when the Unit is OFF for insufficient input voltage	NO
						4	VIN_UV_F	Asserted when an input undervoltage fault has occurred	NO
						5	VIN_UV_W	Asserted when an input undervoltage warning has occurred	YES
						6	VIN_OV_W	Asserted when an input overvoltage warning has occurred	YES
						7	VIN_OV_F	Asserted when an input overvoltage fault has occurred	NO

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
7C	STATUS_INPUT (PFC)	R	3	Bit Flags	1	0	PIN_OP_W	Asserted when an input overpower warning has occurred	YES
						1	IIN_OC_W	Asserted when an input overcurrent warning has occurred	NO
						2	IIN_OC_F	Asserted when an input overcurrent fault has occurred	YES
						3	VIN_UV_OFF	Asserted when the Unit is OFF for insufficient input voltage	NO
						4	VIN_UV_F	Asserted when an input undervoltage fault has occurred	NO
						5	VIN_UV_W	Asserted when an input undervoltage warning has occurred	NO
						6	VIN_OV_W	Asserted when an input overvoltage warning has occurred	NO
						7	VIN_OV_F	Asserted when an input overvoltage fault has occurred	YES
7D	STATUS_TEMPERATURE	R	ALL	Bit Flags	1	0	RESERVED	Reserved	NO
						1	RESERVED	Reserved	NO
						2	RESERVED	Reserved	NO
						3	RESERVED	Reserved	NO
						4	TEMPERATURE_UT_F	Asserted when an undertemperature fault has occurred	NO
						5	TEMPERATURE_UT_W	Asserted when an undertemperature warning has occurred	NO
						6	TEMPERATURE_OT_W	Asserted when an overtemperature warning has occurred	YES
						7	TEMPERATURE_OT_F	Asserted when an overtemperature fault has occurred	YES
7E	STATUS_CML	R	All	Bit Flags	1	0	CML_OTHER_F	Asserted when another memory or logic fault has occurred (example: UART error)	YES
						1	CML_NONE_F	Asserted when a communication fault not listed in [7:3] has occurred	NO
						2	RESERVED	Reserved	NO
						3	CML_PROCESSOR_F	Asserted when a processor fault is detected	NO
						4	CML_MEMORY_F	Asserted when a memory fault is detected (example: Checksum errors during bootload)	NO
						5	CML_PEC_E	Asserted when a packet error checking (PEC) failed has occurred	NO
						6	CML_DATA_E	Asserted when invalid or unsupported data is received	YES
						7	CML_COMMAND_E	Asserted when an invalid or unsupported command is received	YES
7F	STATUS_OTHER	R	All	Bit Flags	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	All	Bit Flags	1	0	RESERVED	Reserved	NO
						1	RESERVED	Reserved	NO
						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	NO
						4	VBUS_UV_F	Set when the primary boost output bus undervoltage fault has occurred	NO
						5	VBUS_UV_W	Set when the primary boost output bus undervoltage warning has occurred	NO
						6	VBUS_OV_W	Set when the primary boost output bus overvoltage warning has occurred	NO
						7	VBUS_OV_F	Set when the primary boost output bus overvoltage fault has occurred	NO
81	STATUS_FANS_1_2	R	All	Bit Flags	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

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
82	STATUS_FANS_3_4	R	All	Bit Flags	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						
88 #ComCodex88	READ_VIN	R	0	Linear Data Format	2			Input Phase 1 Voltage Sensor Reading	YES
88	READ_VIN	R	1	Linear Data Format	2			Input Phase 2 Voltage Sensor Reading	YES
88	READ_VIN	R	2	Linear Data Format	2			Input Phase 3 Voltage Sensor Reading	YES
89	READ_IIN	R	0	Linear Data Format	2			Input Phase 1 Current Sensor Reading	YES
89	READ_IIN	R	1	Linear Data Format	2			Input Phase 2 Current Sensor Reading	YES
89	READ_IIN	R	2	Linear Data Format	2			Input Phase 3 Current Sensor Reading	YES
8B	READ_VOUT	R	0	Linear Data Format	2			Main Output Voltage Sensor Reading	YES
8B	READ_VSTBY	R	1	Linear Data Format	2			Standby(Auxiliary) Output Voltage Sensor Reading	YES
8B	READ_BUS	R	3	Bit Flags	2			Output Voltage Sensor Reading in Vdc	YES
								PMBus Sensor Data Format : Linear (N = 0) supplied by command VOUT_MODE	YES
								PMBus Sensor Resolution: 1Vdc	YES
								Sensor Full-scale : 1023V	YES
8C	READ_IOUT	R	0	Linear Data Format	2			Accuracy: +/-5% of Sensor Full-scale	YES
8C	READ_IOUT	R	1	Linear Data Format	2			Main Output Current Sensor Reading	YES
8C	READ_IOUT	R	2	Linear Data Format	2			Standby(Auxiliary) Output Current Sensor Reading	YES
8D	READ_TEMPERATURE_1	R	0	Linear Data Format	2			Airflow 1 Temperature Sensor Reading	YES
8D	READ_TEMPERATURE_1	R	1	Linear Data Format	2			Primary DCDC Temperature Sensor Reading	YES
8E	READ_TEMPERATURE_2	R	0	Linear Data Format	2			Floating HS1 Temperature Sensor Reading	YES
8E	READ_TEMPERATURE_2	R	1	Linear Data Format	2			Airflow 2 Temperature Sensor Reading	YES
8F	READ_TEMPERATURE_3	R	0	Linear Data Format	2			Floating HS2 Temperature Sensor Reading	YES
8F	READ_TEMPERATURE_3	R	1	Linear Data Format	2			Primary HS (PFC) Temperature Sensor Reading	YES
90	READ_FAN_SPEED_1	R	0	Linear Data Format	2			Fan 1 Speed Sensor Reading	YES
96	READ_POUT	R	All	Linear Data Format	2			Output Power Sensor Reading	YES
97	READ_PIN	R	All	Linear Data Format	2			Input Power Sensor Reading	YES
98	PMBUS_REVISION	R	All	HEX	1			Reading of the PMBus revision to which the power supply is compliant: PMBus Spec - Part II - Revision 1.1 Section 22.1	YES
99	MFR_ID	R	All	Ascii Text Block	Variable				NO
9A	MFR_MODEL	R	All	Ascii Text Block	21			Power Supply Model Number	NO
9B	MFR_REVISION	R	All	Ascii Text Block	14		See MFR_REVISION at link: #ComCodex9B	Power Supply Firmware Revision	YES
9C	MFR_LOCATION	R/W	All	Ascii Text Block	Variable			Power Supply Manufacture Location	NO
9D	MFR_DATE	R/W	All	Ascii Text Block	4			Power Supply Manufacture Date	NO
9E	MFR_SERIAL	R/W	All	Ascii Text Block	Variable			Power Supply Serial Number	NO
A0	MFR_VIN_MIN	R	All	Linear Data Format	2			Power Supply Input Voltage Minimum Specification	NO
A1	MFR_VIN_MAX	R	All	Linear Data Format	2			Power Supply Input Voltage Maximum Specification	NO
A2	MFR_IIN_MAX	R	All	Linear Data Format	2			Power Supply Input Current Maximum Specification	NO
A3	MFR_PIN_MAX	R	All	Linear Data Format	2			Power Supply Input Power Maximum Specification	NO
A4	MFR_VOUT_MIN	R	All	Linear Data Format	2			Power Supply Main Output Voltage Minimum Specification	NO
A5	MFR_VOUT_MAX	R	All	Linear Data Format	2			Power Supply Main Output Voltage Maximum Specification	NO
A6	MFR_IOUT_MAX	R	All	Linear Data Format	2			Power Supply Main Output Current Maximum Specification	NO
A7	MFR_POUT_MAX	R	All	Linear Data Format	2			Power Supply Output Power Maximum Specification	NO
A8	MFR_TAMBIENT_MAX	R	All	Linear Data Format	2			Power Supply Operating Ambient Temperature Maximum Specification	NO
A9	MFR_VIN_MIN	R	All	Linear Data Format	2			Power Supply Operating Ambient Temperature Minimum Specification	NO

See Sensor Data & Resolution Table

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name/Comment	Description	Supported
AA <a href="#">ComCodexAA</a>	MFR_EFFICIENCY_LL	R	All	Direct Data Format	2		See Manufacturers Data	Power Supply Low-Line Input Voltage Specification	NO
								Power Supply Low-Line Low Power Specification	NO
								Power Supply Low-Line Low Power Efficiency Specification	NO
								Power Supply Low-Line Medium Power Specification	NO
								Power Supply Low-Line Medium Power Efficiency Specification	NO
								Power Supply Low-Line High Power Specification	NO
								Power Supply Low-Line High Power Efficiency Specification	NO
AB <a href="#">ComCodexAB</a>	MFR_EFFICIENCY_HL	R	All	Direct Data Format	2		See Manufacturers Data & Resolution Table	Power Supply High-Line Input Voltage Specification	NO
								Power Supply High-Line Low Power Specification	NO
								Power Supply High-Line Low Power Efficiency Specification	NO
								Power Supply High-Line Medium Power Specification	NO
								Power Supply High-Line Medium Power Efficiency Specification	NO
								Power Supply High-Line High Power Specification	NO
								Power Supply High-Line High Power Efficiency Specification	NO
E0	PS_STATUS	R	All	Bit Flags	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	NO
								9 BOOTLOAD_COMPLETED Set when the bootloader has completed and system reset needs to be Set	NO
								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	EEPROM_WP	R/W	All	Integer	1		See EEPROM FRU Data <a href="#">#ComCodexE1</a>	Byte to enable (write 0x9A) or disable (write 0x56) writes to the external EEPROM	YES
E2	READ_HOURS_USED	R	All	Linear Data Format	3		See Sensor Data Table <a href="#">#ComCodexE2</a>	Power Supply Accumulated Main Output Power-On Hours (Lower Byte)	NO
								Power Supply Accumulated Main Output Power-On Hours (Middle Byte)	NO
								Power Supply Accumulated Main Output Power-On Hours (Upper Byte)	NO



Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name/Comment	Description	Supported
F8	BOOTLOAD_RESTART	R/W	All	HEX	1			Bootloader completion and application restart request command	NO
FA	BOOTLOADER_REQUEST	R/W	All	Ascii Text Block	6			Boot loader request command	NO
FB	BOOTLOADER_STATUS	R	All	Bit Flags	2	0	BOOTLOADING_PRI	Set when primary uC bootloading in process	NO
						1	BOOTLOADING_FLOAT	Set when floating uC bootloading in process	NO
						2	BOOTLOADING_SEC	Set when secondary uC bootloading in process	NO
						3	BOOTLOADED_PRI	Set when primary uC bootloading completed; reset required	NO
						4	BOOTLOADED_FLOAT	Set when floating uC bootloading completed; reset required	NO
						5	BOOTLOADED_SEC	Set when secondary uC bootloading completed; reset required	NO
						6	RESET_PRI	Set when primary uC reset	NO
						7	RESET_FLOAT	Set when floating uC reset	NO
						8	RESET_SEC	Set when secondary uC reset	NO
						9	RESERVED		NO
						10	RESERVED		NO
						11	RESERVED		NO
						12	RESERVED		NO
						13	RESERVED		NO
						14	RESERVED		NO
15	RESERVED		NO						

SENSOR DATA AND RESOLUTION

Command Code (Hex)	Command Name	Description	Page	Format Linear/ Direct	Units	Scaling Coefficients				Raw Sensor		PMBus Reporting Sensor		
						N	m	R	b	Full-scale / Range	Resolution	Full-scale / Range	Resolution	Accuracy
#RetOpCodex88	READ_VIN	Input Voltage Sensor Reading (Phase 1)	0	Linear	Vrms	0				1023	1	1023	1	+ / - 5% of Reporting Full-Scale
88	READ_VIN	Input Voltage Sensor Reading (Phase 2)	1	Linear	Vrms	0				1023	1	1023	1	+ / - 5% of Reporting Full-Scale
88	READ_VIN	Input Voltage Sensor Reading (Phase 3)	2	Linear	Vrms	0				1023	1	1023	1	+ / - 5% of Reporting Full-Scale
89	READ_IIN	Input Current Sensor Reading (Phase 1)	0	Linear	Arms	-5				12.4249488	0.0121456	25	0.03125	+ / - 5% of Reporting Full-Scale
89	READ_IIN	Input Current Sensor Reading (Phase 2)	1	Linear	Arms	-5				12.4249488	0.0121456	25	0.03125	+ / - 5% of Reporting Full-Scale
89	READ_IIN	Input Current Sensor Reading (Phase 3)	2	Linear	Arms	-5				12.4249488	0.0121456	25	0.03125	+ / - 5% of Reporting Full-Scale
8B	READ_VOUT	Main Output Voltage Sensor Reading	0	Linear	Vdc	-4				59.06108611	0.057733222	63.94	0.0625	+ / - 2% of Reporting Full-Scale
8B	READ_VSTBY	Standby(Auxiliary) Output Voltage Sensor Reading	1	Linear	Vdc	-7				5.676619839	0.005548993	7.992	0.00781	+ / - 2% of Reporting Full-Scale
8B	READ_VCURR	Main Output Current Sense Voltage Sensor Reading	2	Linear	Vdc	-7				5.5	0.005376344	7.99	0.0078	+ / - 2% of Reporting Full-Scale
8B	READ_VPFC	PFC Output Voltage Sensor Reading	3	Linear	Vdc	0				451.263801	0.441118085	1023.000	1.00000	+ / - 2% of Reporting Full-Scale
8C	READ_IOUT	Main Output Current Sensor Reading	0	Linear	Adc	-2				163.6016945	0.159923455	255.75	0.250	+ / - 2% of Reporting Full-Scale
8C	READ_ISTBY	Standby(Auxiliary) Output Current Sensor Reading	1	Linear	Adc	-6				7.369455687	0.007203769	15.984	0.01563	+ / - 2% of Reporting Full-Scale
8D	READ_TEMPERATURE_1	Temperature Sensor Reading - Inlet (Secondary Side)	0	Linear	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8D	READ_TEMPERATURE_1	Temperature Sensor Reading - DC/DC (Primary Side)	1	Linear	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8E	READ_TEMPERATURE_2	Temperature Sensor Reading - Main Output Hotspot (Floating Side)	0	Linear	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8E	READ_TEMPERATURE_2	Temperature Sensor Reading - Outlet (Primary Side)	1	Linear	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - Main Output Hotspot (Floating Side)	0	Linear	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - PFC Hotspot (Primary Side)	1	Linear	°C	0				-40 to 150		-40 to 150	1	+ / - 5°C
90	READ_FAN_SPEED_1	Fan 1 Speed Sensor Reading	All	Linear	RPM	4				24,000		16368	16	+ / - 5% of Reporting Full-Scale
96	READ_POUT	Output Power Sensor Reading	All	Linear	Watts	4						16368	16	+ / - 5% of Reporting Full-Scale
97	READ_PIN	Input Power Sensor Reading	All	Linear	Watts	4						16368	16	+ / - 5% of Reporting Full-Scale
E2	READ_POWER_ON_HOURS	Accumulated Main Output Power-On Hours	All	Linear	Hours	0				~1,900 (Years)		~1,900 (Years)	1	+ / - 3%

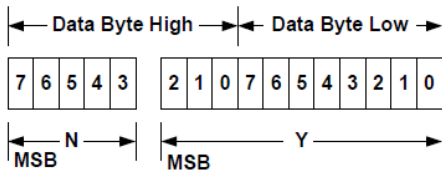
#RetOpCodexE2

Interpreting Received Values:

As defined the PMBus data format for this rectifier is the “Linear” format. The host system receives data that represents the actual value of the measured parameter such as volts, amps degrees Celsius or any other units as appropriate. The rectifier is responsible for necessary processing of the raw data to present these values (thus reducing the onus on the “host system” to perform these calculations).

The linear data format consists of two bytes:

- An 11 bit two’s complement mantissa\*
- A 5 bit , two’s complement exponent (that provides the “scaling factor”)



Only the first 11 bits (mantissa) are used for the “Y” variable while the remaining 5 bits provide the exponent or “N” value; the following formula is used to calculate the “real world” value:

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

Where:

- X is the calculated “real world” value in the appropriate units (V, A, °C etc.)
- Y is a two byte two’s complement integer
- N is a two byte two’s complement integer

\* Note while the READ\_VOUT (Command Code x8B) uses the formula above “Y” is derived from the full 16 bits of the 2 byte returned data, and the exponent “N” is provided by the data returned from VOUT\_MODE (Command Code x20).

**Command Code 9B HEX (MFR-REVISION)**

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9B #RetComCodex9B	MFR_REVISION	0001-0001-0000	MFR_REVISION_LENGTH = 14	
			MFR_REVISION_0	'0' // Primary FW major rev byte0
			MFR_REVISION_1	'0' // Primary FW major rev byte1
			MFR_REVISION_2	'0' // Primary FW minor rev byte0
			MFR_REVISION_3	'1' // Primary FW minor rev byte1
			MFR_REVISION_4	-'
			MFR_REVISION_5	'0' // Secondary FW major rev byte0
			MFR_REVISION_6	'0' // Secondary FW major rev byte1
			MFR_REVISION_7	'0' // Secondary FW minor rev byte0
			MFR_REVISION_8	'1' // Secondary FW minor rev byte1
			MFR_REVISION_9	-'
			MFR_REVISION_10	'0' // Floating FW major rev byte0
			MFR_REVISION_11	'0' // Floating FW major rev byte1
			MFR_REVISION_12	'0' // Floating FW minor rev byte0
MFR_REVISION_13	'0' // Floating FW minor rev byte1			

**EEPROM FRU Data**

Data Length	Register Contents (Hexadecimal Format) Order = Low Address -> High Address Dynamic Data Byte = "xx"	Register Name	Static or Dynamic Register? (S/D)	R/W	Protected? (Y/N)	Data Type	Description	Label Markings
11	01 00 00 00 01 00 00 FE 01 08 19	Header	S		N	HEX		
10	C9 4D 75 72 61 74 61 2D 50 53	Manufacturer Bytes	S		N	TEXT	Reads as "Murata-PS"	Murata Power Solutions
7	C6 52 48 31 37 32 36	Product Name	S		N	TEXT	Reads as "RH1726"	
22	D5 44 32 55 35 54 2D 48 33 2D 37 30 30 2D 35 34 2D 48 55 34 43	Part Number	S		N	TEXT	Reads as "D2U5T-H3-5000-380-HU3C"	D2U5T-H3-5000-380-HU3C
1	C0	Product Version Length	S		N	HEX	Product version, length =0	
13	CC pp pp yy yy ww ww rr rr XX XX XX XX	Product Serial Number	D		N	TEXT	CC = HEX 0xCC length identifier pp = Product Code yy = Serial Number Year ww = Serial Number Week rr = Serial Number Revision Level XX = Serial Number	SN: QEyywwR1xxxx
6	C0 C0 C0 C0 C0 C0	Custom data	S		N	HEX	Asset tag, Custom data, FRU ID	
1	C1	END	S		N	HEX	Signifies end of information	
1	XX	Checksum	D		N	HEX	XX = 2's complement checksum from 0x08 - 0x46	
184	00 00 00 ... 00 00 00	UNUSED EEPROM	S		N	HEX	Fill all unused memory locations with 0x00	

#RetOpCodexE1