This application note describes PMBus™ Digital Communications Protocol, for the **D1U86T-W-800-12-HBxC-xxx** series power supplies.

Compatible Models				
Murata Model	Address	Main Output	Standby Output	Airflow
D1U86T-W-800-12-HB4C	ADDR_SEL (External resistor)	$12V_{DC}$	$12V_{DC}$	Back to Front

Standard PMBus™ Notes

- All data communicated over the PMBus™ interface uses PEC (Packet Error Checking) as defined by the standard for 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
- 100KHz I^2C communications is supported for the PMBus™ interface.
- "Page" is supported, generally, page "0"and Page "1" contains main output parameters and page "4" contains the standby output parameters.

Device Details

Power Supply Controllers			
Vendor	MFG Part Number	Package	Description
Texas Instruments	UCD3138128PFC	TQFP80	(Secondary) IC Dig SMT Microcontroller UCD3138 TQFP80 31.25MHz
Texas Instruments	UCD3138064RMH	QFN40	(Primary) IC Dig SMT Controller PWM Industrial UCD3138 QFN40 31.25MHz

Device Addressing Methods

Addressing accomplished by configuring pin PS_A0 pin as either high or low corresponding to the LSB of the 8bit PMBus™ address word. The address setting options are listed in table below. Leaving the pin open will result in address setting of "B2"

SLAVE DEVICE ADDRESSES		
Slave Address (hex)	Slave Address (bin)	**A0** Pin Status
0xB0	1011 00**0**0	Low
0xB2	1011 00**1**0	High

Note: Pin **A0** bit shown in bold; note that the address assumes that the R/W bit (LSB of the eight bit word) is assumed to be "**0**" (i.e. configured for "write")

PMBus™ Command List

Cmd Code	Command Name	Read / Write	# Bytes	Pg.	Bit #	Bit Name	Definition	Support	Comments
00	PAGE	R/W	1	All			Command to provide ability to configure, control & monitor multiple outputs Value=01, status & mask points to page1. Value=00,FF,02,03, 10, 11, status & mask points to page0. When value =FF with Clear Fault command, page0 & 1 are cleared.	YES	
01	OPERATION	R/W	1	All	7		Turn the unit on/off in conjunction with digital input from PSON# When bit 7 = 1, PSU 12V main output is ON regardless of the state of PSON# pin When bit 7 = 0, PSU 12V main output is ON if PSON# is LOW, OFF if PSON# is HIGH	YES	ON/OFF control of 12V main output
					0-6	RESERVED			
03	CLEAR_FAULTS	W	0	All			Write only command clears all faults (if page = 0, 2,3, 10, 11, FF) that have been set in all the STATUS_XXXX registers in this page simultaneously	YES	
05	PAGE_PLUS_WRITE	W	Variable	All			Set the page within a device, send a command, and send the data for the command in one packet. Support the following command codes: 01, 3B, 46, 4A, 51, 5D, 6A, 6B, 7A, 7B, 7C, 7D, 7E, 81	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 11.14
06	PAGE_PLUS_READ	R/W	Variable	All			Set the page within a device, send a command, and read the data returned by the command in one packet. Support the following command codes: 01, 19, 20, 3A, 3B, 46, 4A, 51, 5D, 6A, 6B, 78, 79, 7A, 7B, 7C, 7D, 7E, 81, 88, 89, 8B, 8C, 8D, 8E, 8F, 90, 96, 97, 9F, A0, A1, A2, A3, A4, A5, A6, A7, A8, A9, C0, C1, C2, D0,	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 11.15
19	CAPABILITY	R	1	All			This command provides a way for a host system to determine some key capabilities of a PMBus™ device.. Always read 90h	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 11.12
1A	QUERY	R/W	1	All			Used to ask a PMBus™ device if it supports a given command, and if so, what data formats it supports for that command.	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 11.13
					7	CMD_SUPPORTED	Command is supported	YES	
					6	CMD_SUPPORTED_WR	Command is supported for write	YES	
					5	CMD_SUPPORTED_RD	Command is supported for read	YES	
					4:2	CMD_FORMAT	Data format - 0 = Linear data format, 011 = Direct mode format, 111 = Non numeric data	YES	
					1	RESERVED	Reserved	NO	
					0	RESERVED	Reserved	NO	
1B	SMBALERT_MASK	R/W	2 / Variable	All			Used to prevent a warning or fault condition from asserting the SMBALERT# signal. Support the following Status_x command code: 7A - STATUS_VOUT: default mask = FF for page 0 and 1 7B - STATUS_IOUT: default mask = FF for page 0, DF for page 1 7C - STATUS_INPUT: default mask = FF for page 0, EF for page 1 7D - STATUS_TEMPERATURE: default mask = FF for page 0, BF for page 1 7E - STATUS_CML: default mask = FF for page 0 and 1 81 - STATUS_FANS_1_2: default mask = FF for page 0 (not support page 1)	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 15.38
20	VOUT_MODE	R	1	0			Single data byte sets the READ_VOUT sensor to linear mode data format and supplies N = -9 exponent for translation to volts. Always read 17h	YES	For Main Output PMBus™ Spec - Part II - Revision 1.2 - Sections 8.1-8.3

Cmd Code	Command Name	Read / Write	# Bytes	Pg.	Bit #	Bit Name	Definition	Support	Comments
30	COEFFICIENT	R/W	5	All			Used to retrieve the m, b and R coefficients needed by data in the DIRECT format. Support the following command codes: 86, 87 Always read m = 1, b = 0, R= 0	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 14.1
3A	FAN_CONFIG_1_2	R	1	All			Show the config of fan. Always read 90h	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 14.10; Default fan configuration is
					7	FAN_1_INSTALLATION	Asserted when fan is installed in position 1	YES	
					6	FAN_1_SETTING_MODE	Asserted when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	YES	
					5	FAN_1_TACH_PULSES	Fan 1 Tachometer pulses per revolution (upper bit)	YES	
					4	FAN_1_TACH_PULSES	Fan 1 Tachometer pulses per revolution (lower bit)	YES	
					3	FAN_2_INSTALLATION	Asserted when fan is installed in position 2	NO	
					2	FAN_2_SETTING_MODE	Asserted when fan is commanded in RPM (Clear when fan is commanded in Duty Cycle)	NO	
					1	FAN_2_TACH_PULSES	Fan 2 Tachometer pulses per revolution (upper bit)	NO	
					0	FAN_2_TACH_PULSES	Fan 2 Tachometer pulses per revolution (lower bit)	NO	
3B	FAN_COMMAND_1	R/W	2	All			Manual fan override command fan speed value in Duty Cycle (0-100) Command speed formatted in Linear	YES	
46	IOUT_OC_FAULT_LIMIT	R/W	2	0			Sets the value of the output current, in amperes, that causes the overcurrent detector to indicate an overcurrent fault condition and main 12V output shutdown. The value should be within 0 to default value (91A) Data format: Linear	YES	
4A	IOUT_OC_WARN_LIMIT	R/W	2	0			Sets the value of the output current, in amperes, that causes the overcurrent detector to indicate an overcurrent warning. The value should be within 0 to default value (71A) Data format: Linear	YES	
51	OT_WARN_LIMIT (Hot Spot)	R/W	2	All			Set the temperature, in degrees Celsius, of the unit at which it should indicate an Overtemperature Warning alarm. The value should be within 0 to default value (120C) Data format: Linear	YES	
5D	IIN_OC_WARN_LIMIT	R/W	2	All			Sets the value of the input current, in amperes, that causes a warning that the input current is high. The value should be within 0 to default value (13A) Data format: Linear	YES	
6A	POUT_OP_WARN_LIMIT	R/W	2	All			Sets the value of the output power, in watts, that causes a warning that the output power is high. The value should be within 0 to default value (960W) Data format: Linear	YES	
6B	PIN_OP_WARN_LIMIT	R/W	2	All			Sets the value of the input power, in watts, that causes a warning that the input power is high. The value should be within 0 to default value (1040W) Data format: Linear	YES	

Cmd Code	Command Name	Read / Write	# Bytes	Pg.	Bit #	Bit Name	Definition	Support	Comments
78	STATUS_BYTE	R	1	0	7	BUSY_F	Asserted when device busy and unable to respond fault	NO	
					6	UNIT_OFF	Asserted when unit not providing power to the output	YES	Report PSU state at real time
					5	OUTPUT_OV_F	Asserted when an output overvoltage fault has occurred	YES	
					4	OUTPUT_OC_F	Asserted when an output overcurrent fault has occurred	YES	
					3	INPUT_UV_F	Asserted when an input undervoltage fault has occurred	YES	Auto recovery
					2	TEMPERATURE_F_W	Asserted when an overtemperature fault or warning has occurred	YES	Auto recovery
					1	CML_F	Asserted when a communications, memory, or logic fault has occurred	YES	
					0	NONE_F_W	Asserted when a fault not listed in [7:1] occurred	YES	
79	STATUS_WORD	R	2	0	7	BUSY_F	Asserted when device busy and unable to respond fault	NO	
					6	UNIT_OFF	Asserted when unit not providing power to the output	YES	Report PSU state at real time
					5	OUTPUT_OV_F	Asserted when an output overvoltage fault has occurred	YES	
					4	OUTPUT_OC_F	Asserted when an output overcurrent fault has occurred	YES	
					3	INPUT_UV_F	Asserted when an input undervoltage fault has occurred	YES	Auto recovery
					2	TEMPERATURE_F_W	Asserted when an overtemperature fault or warning has occurred	YES	Auto recovery
					1	CML_F	Asserted when a communications, memory, or logic fault has occurred	YES	
					0	NONE_F_W	Asserted when a fault not listed in [7:1] occurred	YES	
					7	VOUT_F_W	Asserted when an output voltage fault or warning has occurred	YES	
					6	IOUT_POUT_F_W	Asserted when an output current / output power fault or warning has occurred	YES	
					5	INPUT_F_W	Asserted when an Input voltage/current/power fault or warning has occurred	YES	
					4	MFG_SPECIFIC_F_W	Manufacturer specific fault or warning has occurred	NO	
					3	POWER_GOOD_L	Asserted when the POWER_GOOD signal is negated	YES	
					2	FANS_F_W	Asserted when a fan fault or warning has occurred	YES	
					1	STATUS_OTHER_F_W	Asserted when a bit in command STATUS_OTHER set	NO	
					0	UNKNOWN_F_W	Asserted when a fault not listed in [15:1] has occurred	NO	
7A	STATUS_VOUT	R/W	1	0	7	VOUT_OV_F	Asserted when an output overvoltage fault has occurred	YES	Main o/p off, Mask alert
					6	VOUT_OV_W	Asserted when an output overvoltage warning has occurred	NO	
					5	VOUT_UV_W	Asserted when an output undervotlage warning has occurred	NO	
					4	VOUT_UV_F	Asserted when an output undervotlage fault has occurred	YES	Main o/p off, Mask alert
					3	VOUT_MAX_F	Asserted when the output is set higher than the commanded VOUT_MAX limit	NO	
					2	TON_MAX_F	Asserted when the output turn-on timing has exceeded the TON_MAX fault timing	NO	
					1	TON_MAX_W	Asserted when the output turn-on timing has exceeded the TON_MAX warning timing	NO	
					0	VOUT_TRACKING_E	Asserted when an error in the output voltage during power-up/down has occurred	NO	

Cmd Code	Command Name	Read / Write	# Bytes	Pg.	Bit #	Bit Name	Definition	Support	Comments
7B	STATUS_IOUT	R/W	1	0	7	IOUT_OC_F	Asserted when an output overcurrent fault has occurred	YES	Main o/p off, Mask alert
					6	IOUT_OC_SHUTDOWN	Asserted when an output overcurrent and low voltage shutdown fault has occurred	NO	
					5	IOUT_OC_W	Asserted when an output overcurrent warning has occurred	YES	Mask alert in page 0, Unmask alert in page 1, Auto recovery
					4	IOUT_UC_W	Asserted when an output undercurrent fault has occurred	NO	
					3	CURRENT_SHARE_F	Asserted when an output current share fault has occurred	NO	
					2	POWER_LIMIT_MODE	Asserted when the unit has entered output power limiting mode	NO	
					1	POUT_OP_F	Asserted when an output overpower fault has occurred	YES	Main o/p off, Mask alert
					0	POUT_OP_W	Asserted when an output overpower warning has occurred	YES	Mask alert, Auto recovery
7C	STATUS_INPUT	R/W	1	All	7	VIN_OV_F	Asserted when an input overvoltage fault has occurred (Vin > 300Vac/310Vdc)	YES	Main o/p off, Mask alert, Auto recovery
					6	VIN_OV_W	Asserted when an input overvoltage warning has occurred	NO	
					5	VIN_UV_W	Asserted when an input undervoltage warning has occurred	YES	Mask alert, Auto recovery
					4	VIN_UV_F	Asserted when an input undervoltage fault has occurred (<150Vdc)	YES	Main o/p off, Mask alert in page 0, Unmask alert in page 1, Auto recovery
					3	VIN_UV_OFF	Asserted when the Unit is OFF for insufficient input voltage	YES	Report at real time, Mask alert
					2	IIN_OC_F	Asserted when an input overcurrent fault has occurred	NO	
					1	IIN_OC_W	Asserted when an input overcurrent warning has occurred	YES	Mask alert
					0	PIN_OP_W	Asserted when an input overpower warning has occurred	YES	Mask alert
7D	STATUS_TEMPERATURE	R/W	1	All	7	TEMPERATURE_OT_F	Asserted when an overtemperature fault has occurred	YES	Main o/p off, Mask alert, Auto recovery
					6	TEMPERATURE_OT_W	Asserted when an overtemperature warning has occurred	YES	Mask alert in page 0, Unmask alert in page 1, Auto recovery
					5	TEMPERATURE_UT_W	Asserted when an undertemperature warning has occurred	NO	
					4	TEMPERATURE_UT_F	Asserted when an undertemperature fault has occurred	NO	
					3	RESERVED	Reserved	NO	
					2	RESERVED	Reserved	NO	
					1	RESERVED	Reserved	NO	
					0	RESERVED	Reserved	NO	
7E	STATUS_CML	R/W	1	All	7	CML_COMMAND_E	Asserted when an invalid or unsupported command is received	YES	Mask alert
					6	CML_DATA_E	Asserted when invalid or unsupported data is received	YES	Mask alert
					5	CML_PEC_E	Asserted when a packet error checking (PEC) failed has occurred	YES	Mask alert
					4	CML_MEMORY_F	Asserted when a memory fault is detected (example: Checksum errors during bootload)	NO	
					3	CML_PROCESSOR_F	Asserted when a processor fault is detected	NO	
					2	RESERVED	Reserved	NO	
					1	CML_NONE_F	Asserted when a communication fault not listed in [7:3] has occurred	NO	
					0	CML_OTHER_F	Asserted when another memory or logic fault has occurred (example: UART error)	NO	

Cmd Code	Command Name	Read / Write	# Bytes	Pg.	Bit #	Bit Name	Definition	Support	Comments
81	STATUS_FANS_1_2	R/W	1	All	7	FAN_1_F	Fan 1 fault	YES	Main o/p off, Mask alert
					6	FAN_2_F	Fan 2 fault	NO	
					5	FAN_1_W	Fan 1 warning	YES	Mask alert
					4	FAN_2_W	Fan 2 warning	NO	
					3	FAN_1_OVERRIDE	Fan 1 speed overridden	YES	Report at real time, Mask alert
					2	FAN_2_OVERRIDE	Fan 2 speed overridden	NO	
					1	FAN_AIRFLOW_F	Airflow fault	NO	
					0	FAN_AIRFLOW_W	Airflow warning	NO	
86	READ_EIN	R	6	All			Input Energy count, Rollover count and Sample count Direct data format, coefficients supplied by command COEFFICIENT Energy count Resolution: 1W	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 18.13
87	READ_EOUT	R	6	All			Output Energy count, Rollover count and Sample count Direct data format, coefficients supplied by command COEFFICIENT Energy count Resolution: 1W	YES	PMBus™ Spec - Part II - Revision 1.2 - Sections 18.13
88	READ_VIN	R	2	All			Input Voltage Sensor Reading in Vdc PMBus™ Sensor Data Format : Linear (N = -1) PMBus™ Sensor Resolution: 0.5Vrdc Full-scale : 511Vdc Accuracy: +/-2%	YES	
89	READ_IIN	R	2	All			Input Current Sensor Reading in Arms PMBus™ Sensor Data Format : Linear (N = -6) PMBus™ Sensor Resolution: 0.015625Adc Full-scale : 16 Arms Accuracy: +/-5% @10-20% load, +/-2% @>20% load	YES	
8B	READ_VOUT	R	2	0			Output Voltage Sensor Reading in Vdc PMBus™ Sensor Data Format : Linear (N = -9) supplied by command VOUT_MODE PMBus™ Sensor Resolution: 0.00195Vdc Full-scale : 16 Vdc Accuracy: +/-2%	YES	Pg .0, 1 for Main output Pg. 4 Standby output
8C	READ_IOUT	R	2	0			Output Current Sensor Reading in Adc PMBus™ Sensor Data Format : Linear (N = -3) PMBus™ Sensor Resolution: 0.125 Adc Full-scale : 128 Adc Accuracy: +/-5% @10-20% load, +/-2% @>20% load	YES	Page0, 1 for Main Output Page 4 for Standby Output
8D	READ_TEMPERATURE_1	R	2	All			Temperature Sensor reading in °C PMBus™ Sensor Data Format : Linear (N = -3) PMBus™ Sensor Resolution: 0.125 °C Range : -128°C to 128°C Accuracy: +/-3°C	YES	Inlet Temperature

Cmd Code	Command Name	Read / Write	# Bytes	Pg.	Bit #	Bit Name	Definition	Support	Comments
8E	READ_TEMPERATURE_2	R	2	All			Temperature Sensor reading in °C PMBus™ Sensor Data Format : Linear (N = -3) PMBus™ Sensor Resolution: 0.125 °C Range : -128°C to 128°C Accuracy: +/-3°C	YES	Secondary Hotspot Sensor
8F	READ_TEMPERATURE_3	R	2	All			Temperature Sensor reading in °C PMBus™ Sensor Data Format : Linear (N = -3) PMBus™ Sensor Resolution: 0.125 °C Range : -128°C to 128°C Accuracy: +/-3°C	YES	Primary Heatsink
90	READ_FAN_SPEED_1	R	2	All			Fan Speed Sensor reading in RPM PMBus™ Sensor Data Format : Linear (N = 5 RPM_MAX <= 32736) PMBus™ Sensor Resolution: 32 RPM (N=5) Full-scale : 32736 RPM Accuracy: +/-500RPM of full-speed	YES	
96	READ_POUT	C	2	All			Output Power Sensor reading in watts PMBus™ Sensor Data Format : Linear (N = 1) PMBus™ Sensor Resolution: 2 Watts Full-scale : 2046W Accuracy: +/-5% @10-20% load, +/-2% @>20% load	YES	
97	READ_PIN	R	2	All			Input Power Sensor reading in watts PMBus™ Sensor Data Format : Linear (N = 2) PMBus™ Sensor Resolution: 4 Watts Full-scale : 4092W Accuracy: +/-5% @10-20% load, +/-2% @>20% load	YES	
98	PMBUS™_REVISION	R	1	All			Reading of the PMBus™ revision to which the power supply is compliant Always read 22h	YES	PMBus™ Spec - Part II - Revision 1.2 - Section 22.1
99	MFR_ID	R	1+6	All			Manufacture's ID (ASCII code): MURATA	YES	
9A	MFR_MODEL	R	1+20	All			Manufacture's Model Number (ASCII code) : D1U86T-W-800-12-HB4C	YES	
9B	MFR_REVISON	R/W	1+2	All			Manufacturer's model revision (ASCII code)	YES	
9C	MFR_LOCATION	R/W	1+3	All			Identify the facility that manufactured the unit (ASCII code) : NNI	YES	
9D	MFR_DATE	R/W	1+4	All			Identify the unit's date of manufacture (ASCII code: YYWW, e.g. 1535, 15-> year, 35 -> week)	YES	
9E	MFR_SERIAL	R/W	1+12	All			Serial Number : TBD	YES	
9F	APP_PROFILE_SUPPORT	R	1	All			Provides a mean for a host to determine which PMBus™ Applications Profiles, and the revision of those profiles, that the device supports. Always read 05h	YES	
A0	MFR_VIN_MIN	R	2	All			Minimum rated value of the input voltage = 90V. Always read 5Ah.	YES	
A1	MFR_VIN_MAX	R	2	All			Maximum rated value of the input voltage = 264V. Always read 108h.	YES	
A2	MFR_IIN_MAX	R	2	All			Maximum rated value of the input current = 13 Amps. Always readD9A0h.	YES	
A3	MFR_PIN_MAX	R	2	All			Maximum rated value of the input power = 900 W. Always read 0384h.	YES	

CMD Code	Command Name	Read / Write	# of Bytes	Page#	Bit Name	Definition	Support	Comments
A5	MFR_VOUT_MAX	R	2	0		Maximum rated value of the output voltage = 12.6V. Linear (N = -9) supplied by command VOUT_MODE. Always read 1933h.	YES	Main Output
A6	MFR_IOUT_MAX	R	2	0		Maximum rated value of the output current = 65A. Always read 41h.	YES	Main Output
A7	MFR_POUT_MAX	R	2	All		Maximum rated value of the output power = 800W. Always read 320h.	YES	
A8	MFR_TAMBIENT_MAX	R	2	All		Maximum ambient temperature: 55degC. Always read 37h	YES	
A9	MFR_TAMBIENT_MIN	R	2	All		Minimum ambient temperature: 0degC. Always read 0	YES	
AA	MFR_EFFICIENCY_LL	R	1+14	All		Retrieves information about the efficiency of the device while operating at a low line condition. V=115, Pow=160W, Eff=92%, Pow=400W, Eff=94%, Pow=800W, Eff=90% Always read 98, EB, 80, F2, E0, EA, 20, FB, F0, EA, 20, 03, D0, EA	YES	
AB	MFR_EFFICIENCY_HL	R	1+14	All		Retrieves information about the efficiency of the device while operating at a high line condition. Always read V=230, Pow=160W, Eff=94%, Pow=400W, Eff=96%, Pow=800W, Eff=91% Always read 98, F3, 80, F2, F0, EA, 20, FB, 00, EB, 20, 03, D8, EA	YES	
C0	MFR_MAX_TEMP1 (Ambient)	R	2	All		Maximum rated temperature (Ambient): 55degC. Always read 37h	YES	
C1	MFR_MAX_TEMP2 (Hot-spot secondary)	R	2	All		Maximum rated temperature (hot-spot secondary): 130degC. Always read 82h	YES	
C2	MFR_MAX_TEMP3 (Hot-spot primary)	R	2	All		Maximum rated temperature (hot-spot primary): 130degC. Always read 82h	YES	
E0	CR_MODE	R/W	1	All	SEE ACAN 100 for Additional details	00h : Normal Mode (Default – conventional load sharing/redundancy) 01h : Active Mode (off line mode) 02h : Standby Mode (off line mode) 03h : Master Mode (CR mode PSU1) 04h : Slave Mode (CR mode PSU2 will set the Von2Voff2 automatically) 05h : Slave Mode (CR PSU3 will set the Von3Voff3 automatically) 06h : Slave Mode (CR PSU4 will set the Von4Voff4 automatically)	YES	Default value 00h (normal redundancy mode)
E1	CR_VonVoff	R/W	1+6	All		System load current to turn on /off PSU main output. Example: 02h -> 2Amp AA,BB,CC,DD,EE,FF AA-->Von2, BB-->Voff2 CC-->Von3, DD-->Voff3 EE-->Von4, FF-->Voff4	YES	Default values AA = 45 BB = 20 CC = 48 DD = 28 EE = 51 FF = 35
E4	MFR_PAGE_X Black box_Details	R/W Byte	1			This command is used to access the black box feature; Click details for additional information	YES	
E5	MFR_POS_TOTAL "Black box" details	Read	4			This returns the "Total Power ON Seconds" (POS) the PSU has been powered on and delivering energy to the main output since it was manufactured. The register increments in seconds during operation of main output. When the main output is not operating the register holds the current value. Time accuracy is +-5%. For example the returned value of 70 73 00 00 represents 29552s. The MFR_POS_TOTAL for the Real Time Data (MFR_PAGE 0xff) should not be cleared prior to PSU manufacturer shipment. All other black box data (MFR_PAGE 0x00 ~0x04) should be cleared prior to PSU manufacturer shipment.	YES	
E6	MFR_POS_LAST "Black box" details	Read	4			This is a read of Total Power ON Seconds (POS) since the PSU has been powered on and delivering energy to the main output since it was last started. This value must be reset to Zero when the main output of the PSU is started. The register must increment in seconds while the main outputs is delivering energy. When the main output is not delivering energy the PSU must hold the current value. Time Accuracy must be within +-5%. The MFR_POS_TOTAL for the Real Time Data (MFR_PAGE 0xFF) should not be cleared PSU manufacturer shipment. All other black box data (MFT_PAGE 0x00~0x04) will be cleared prior to PSU manufactured shipment.	YES	

BLACK BOX Command 0xE4 "MFR_PAGE_X" DETAILS

Back to command list

The "black box" feature of this product automatically saves a complete "snapshot" of the power module's last known operational status immediately after a fault is detected and before the power module shuts down into the power module's non-volatile memory so that it can be recalled at a later time.

Each occurrence is referred to as a "black box event".

Black box event saving process:

- Faults (not warnings) trigger a black box event.
- The faults listed in TABLE 2 trigger a black box event.
- All data listed in TABLE 1 is automatically saved with each black box event
- Five fault history pages are available for black box event, each event uses one fault history page.
- The data listed in TABLE 1 is saved to the most recent of five fault history pages "Fault_History_00" upon fault detection.
- Subsequent black box events shift fault history page content to next most recent page ensuring the five most recent snapshots are retained per TABLE 3.

To read the black box contents:

1. Set the desired Fault History Page (Command **0xE4** + **Fault_History_x**) per Page byte options in TABLE 3
2. Issue the desired individual register command code to return that specific register content saved to the specified fault history page (set in step 1).
3. For real world data, change the fault history page to 0xFF (default setting).

- Contents can be read even if input power is lost as long as the 12VSB bus is powered.
- "MFR_POS_TOTAL" and "MFR_POS_LAST", time data is also included with each event (see command 0xE5 & 0xE6 for details).
- Real Time Data (0xFF) returns the current operating status of the power module as of time the command is issued and therefore varies over time as conditions change.

Clearing faults:

- Issuing "Clear Faults" command / resetting input power clears the Real Time Data page 0xFF but does not clear history pages 0x00 though 0x04.
- Murata factory ensures that this fault history pages 0x00, 0x01, 0x02, 0x03 and 0x04 are cleared prior to shipment.

TABLE 1

Data Saved	
Status Registers saved	**Command Code**
STATUS_VOUT	0x7A
STATUS_IOUT	0x7B
STATUS_INPUT	0x7C
STATUS_TEMPERATURE	0x7D
STATUS_CML	0x7E
STATUS_FANS_1_2	0x81
Readings Saved	
READ_VIN	0x88
READ_IIN	0x89
READ_VOUT	0x8B
READ_IOUT	0x8C
READ_TEMPERATURE_1	0x8D
READ_TEMPERATURE_2	0x8E
READ_TEMPERATURE_3	0x8F
READ_FAN_SPEED_1	0x90
READ_POUT	0x96
READ_PIN	0x97
MFR_POS_TOTAL	0xE5
MFR_POS_LAST	0xE6

TABLE 2

Black box events
Pg. 0/1 (Main output)
VOUT_OV_F
VOUT_UV_F
IOUT_OC_F
POUT_OP_F
Pg. 4 (VSB output)
VOUT_OV_F
VOUT_UV_F
IOUT_OC_F
Others
VIN_OV_F
TEMPERATURE_OT_F
FAN_1_F

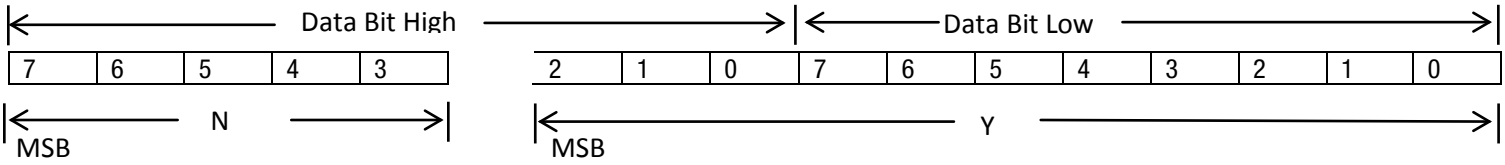
TABLE 3

Command 0xE4 Fault History Page details		
Fault History Page Byte:	**Fault History Page Byte description:**	**History Page Shift Register Chronology**
0x00	Fault_History_1	Most recent
0x01	Fault_History_2	Next most recent
0x02	Fault_History_3	Next most recent
0x03	Fault_History_4	Next most recent
0x04	Fault_History_5	Next most recent
0xFF	Real Time Data	This is the default setting and returns the status_x register's current data as of the time the read command for that register is issued. This data may therefoe diverge from the fault history page data as conditions change. Unlike the five fault history pages, the real time data can be cleared by system/host.

Linear Data Format

(return to front page; return to Manual Fan Control)

Telemetry sensor readings follow Linear format as defined by PMBus Power System Mgmt. Protocol Specification – Part II – Revision 1.2 (summarized below)
Output Voltage readings are also expressed in linear format, VOUT_MODE format



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.

VOUT_MODE:
Output Voltage returned readings and parameters are expressed in Linear VOUT_MODE format described below.
Link back to command list

Step one:

Read VOUT_Mode (CMD_20h) to determine the exponent and format - results are as follows:

Mode definition			Returned results for CMD_20h				
Mode	Bits (7:5)	Bits (4:0) (Parameter)	Command Code (Hex)	Command Name	Value	Bit#	Value
Linear **(Default)**	000b	Five bit two's complement exponent for the mantissa delivered as the data bytes for an output voltage command. Bits 4:0 returned= 10111b = N=-9 **(Default)**	**20**	VOUT_MODE	17h	Bit 7	0
						Bit 6	0
						Bit 5	0
						Bit 4	1
						Bit 3	0
						Bit 2	1
						Bit 1	1
						Bit 0	1

Step Two:

Convert the high and low data bytes known as the Mantissa into real world output voltage:

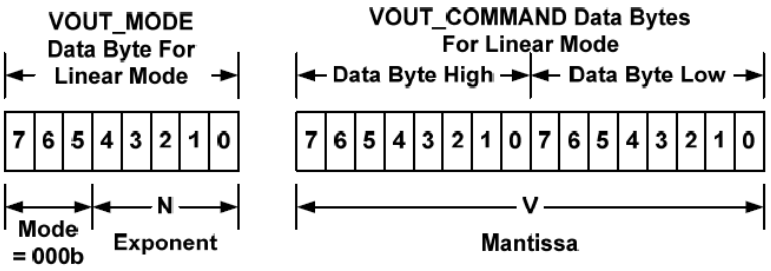


Figure 6. Linear Format Data Bytes

The Mode bits are set to 000b.

The Voltage, in volts, is calculated from the equation:

$$Voltage = V \cdot 2^{N}$$

Where:

Voltage is the parameter of interest in volts;

V is a 16 bit unsigned binary integer; and

N is a 5 bit two's complement binary integer.

Reference Documents		
Murata Model	Description	Link:
ACAN-100	cold redundancy application notes	https://power.murata.com/datasheet?/data/apnotes/acan-100.pdf

Back to command list

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Refer to: https://www.murata-ps.com/requirements/

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