

This application note describes PMBus™ Digital Communications Protocol, for the **D1U86T-W-1600-12-HBxC-xxx** series power supplies.

Compatible Models

Murata Model	Address	Main Output	Standby Output	Airflow
D1U86T-W-1600-12-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 required
- 100KHz I²C 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	UCD3138064ARMH	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 0000	Low
0xB2	1011 0010	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 (Page 0 and 1)

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
00	PAGE	R/W Byte	1			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 Byte	1	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		ON/OFF control of 12V main output
				0-6	RESERVED		YES	
03	CLEAR_FAULTS	Send Byte	0			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	Write Block	Variable			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

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
06	PAGE_PLUS_READ	Block Write - Block Read Porcess Call	Variable			Set the page within a device, send a command, and read the data returned by the command in one packet. Suport 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	YES	PMBus Spec - Part II - Revision 1.2 - Sections 11.15
19	CAPABILITY	Read Byte	1			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	Block Write - Block Read Porcess Call	1			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	
1B	SMBALERT_MASK	Write Word/Block Write - Block Read Porcess Call	2 / Variable			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
				0	RESERVED	Reserved	NO	
20	VOUT_MODE	Read Byte	1			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
30	COEFFICIENT	Block Write - Block Read Porcess Call	5			Used to retrieve the m, b and R coefficients needed by data in the DIRECT format. Suport 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	Read Byte	1			Show the config of fan. Always read 90h	YES	PMBus Spec - Part II - Revision 1.2 - Sections 14.10
				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	
3B	FAN_COMMAND_1	R/W Word	2			Manual fan override command fan speed value in Duty Cycle (0-100)	YES	
						Command speed formatted in Linear		

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
46	IOUT_OC_FAULT_LIMIT	R/W Word	2			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 (186A - High line AC or DC input, 116A - Low line AC) Data format: Linear	YES	
4A	IOUT_OC_WARN_LIMIT	R/W Word	2			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 (185A - High line AC or DC input, 115A - Low line AC) Data format: Linear	YES	
51	OT_WARN_LIMIT (Hot Spot)	R/W Word	2			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 (98C) Data format: Linear	YES	
5D	IIN_OC_WARN_LIMIT	R/W Word	2			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 (18A) Data format: Linear	YES	
6A	POUT_OP_WARN_LIMIT	R/W Word	2			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 (2400W - High line AC or DC input, 1500W - Low line AC) Data format: Linear	YES	
6B	PIN_OP_WARN_LIMIT	R/W Word	2			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 (2400W - High line AC or DC input, 1500W - Low line AC) Data format: Linear	YES	
78	STATUS_BYTE	Read Byte	1	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	

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
79	STATUS_WORD	Read Word	2	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 Byte	1	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 undervoltage warning has occurred	NO	
				4	VOUT_UV_F	Asserted when an output undervoltage 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	
7B	STATUS_IOUT	R/W Byte	1	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				

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
7C	STATUS_INPUT	R/W Byte	1	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 Byte	1	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 Byte	1	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	
81	STATUS_FANS_1_2	R/W Byte	1	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	Block Read	6		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	

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
87	READ_EOUT	Block Read	6			Output Energy count, Rollover count and Sample count	YES	PMBus Spec - Part II - Revision 1.2 - Sections 18.13
						Direct data format, coefficients supplied by command COEFFICIENT		
						Energy count Resolution: 1W		
88	READ_VIN	Read Word	2			Input Voltage Sensor Reading in Vdc	YES	
						PMBus Data Format : Linear		
						PMBus Resolution: 0.25Vdc		
						Full-scale : 511Vdc Accuracy: +/-2%		
89	READ_IIN	Read Word	2			Input Current Sensor Reading in Arms	YES	In cal mode, data is presented in direct format with 1mA/unit
						PMBus Data Format : Linear		
						PMBus Resolution: 1mA		
						Full-scale : 28.2A Accuracy: +/-5% @10-20% load, +/-2% @>20% load		
8B	READ_VOUT	Read Word	2			Output Voltage Sensor Reading in Vdc	YES	Page0, 1 for Main Output Page 4 for Standby Output
						PMBus Data Format : Linear (N = -9) supplied by command VOUT_MODE		
						PMBus Resolution: 0.00195Vdc		
						Full-scale : 16 Vdc Accuracy: +/-2%		
8C	READ_IOUT	Read Word	2			Output Current Sensor Reading in Adc	YES	Page0, 1 for Main Output Page 4 for Standby Output
						PMBus Data Format : Linear		
						PMBus Resolution: 0.0625A		
						Full-scale : 226A Accuracy: +/-5% @10-20% load, +/-2% @>20% load		
8D	READ_TEMPERATURE_1	Read Word	2			Temperature Sensor reading in °C	YES	Inlet Temperature (Sec amb)
						PMBus Data Format : Linear (N = -3)		
						PMBus Resolution: 0.125 °C		
						Range : -128°C to 128°C Accuracy: +/-3°C		
8E	READ_TEMPERATURE_2	Read Word	2			Temperature Sensor reading in °C	YES	Secondary Hotspot Sensor (LLC 1)
						PMBus Data Format : Linear (N = -3)		
						PMBus Resolution: 0.125 °C		
						Range : -128°C to 128°C Accuracy: +/-3°C		
8F	READ_TEMPERATURE_3	Read Word	2			Temperature Sensor reading in °C	YES	Primary Heatsink
						PMBus Data Format : Linear (N = -3)		
						PMBus Resolution: 0.125 °C		
						Range : -128°C to 128°C Accuracy: +/-3°C		
90	READ_FAN_SPEED_1	Read Word	2			Fan Speed Sensor reading in RPM	YES	
						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		
96	READ_POUT	Read Word	2			Output Power Sensor reading in watts	YES	
						PMBus Data Format : Linear		
						PMBus Resolution: 0.25 Watts		
						Full-scale :4092W Accuracy: +/-5% @10-20% load, +/-2% @>20% load		

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
97	READ_PIN	Read Word	2			Input Power Sensor reading in watts	YES	In cal mode, data is presented in direct format with 0.1W/unit
						PMBus Data Format : Linear		
						PMBus Resolution: 0.25 Watts		
						Full-scale : 4092W		
						Accuracy: +/-5% @10-20% load, +/-2% @>20% load		
98	PMBUS_REVISION	Read Byte	1			Reading of the PMBus revision to which the power supply is compliant	YES	PMBus Spec - Part II - Revision 1.2 - Section 22.1
						Always read 22h		
99	MFR_ID	Block Read	1+9			Manufacture's ID (ASCII code): MURATA-PS	YES	
9A	MFR_MODEL	Block Read	1+21			Manufacture's Model Number (ASCII code) : D1U86T-W-1600-12-HB4C (Back to front air flow) D1U86T-W-1600-12-HB3C (Front to back air flow)	YES	
9B	MFR_REVISION	Block R/W	1+14			Manufacturer's model revision (ASCII code)	YES	
9C	MFR_LOCATION	Block R/W	1+5			Identify the facility that manufactured the unit (ASCII code) : CHINA	YES	
9D	MFR_DATE	Block R/W	1+4			Identify the unit's date of manufacture (ASCII code: YYWW, e.g. 1535, 15-> year, 35 -> week)	YES	
9E	MFR_SERIAL	Block R/W	1+12			Serial Number : TBD	YES	
9F	APP_PROFILE_SUPP ORT	Read Byte	1			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	Read Word	2			Minimum rated value of the input voltage = 90V (AC input) / 180V (DC input). Always read F8B4h (AC input) / F968h (DC input).	YES	
A1	MFR_VIN_MAX	Read Word	2			Maximum rated value of the input voltage = 264V (AC input) / 300V (DC input). Always read FA10h (AC input) / FA58h (DC input).	YES	
A2	MFR_IIN_MAX	Read Word	2			Maximum rated value of the input current = 13 Amps (High line AC or DC input) / 14 Amps (Low line AC input). Always read D9A0h (High line AC or DC input) / D9C0h (Low line AC input).	YES	
A3	MFR_PIN_MAX	Read Word	2			Maximum rated value of the input power = 1800 W (High line AC or DC input) / 1200 W (Low line AC input). Always read 11C2h (High line AC or DC input) / 112Ch (Low line AC input).	YES	
A4	MFR_VOUT_MIN	Read Word	2			Minimum rated value of the output voltage = 11.59V. Linear (N = -9) supplied by command VOUT_MODE. Always read 172Eh.	YES	
A5	MFR_VOUT_MAX	Read Word	2			Maximum rated value of the output voltage = 12.81V. Linear (N = -9) supplied by command VOUT_MODE. Always read 199Eh.	YES	
A6	MFR_IOUT_MAX	Read Word	2			Maximum rated value of the output current = 133A (High line AC or DC input) / 83A (Low line AC input)/ 3.5A (Standby output). Always read 85h (High line AC or DC input) / 53h (Low line AC input) / D0E0h (Standby output).	YES	Page0, 1 for Main Output Page 4 for Standby Output
A7	MFR_POOUT_MAX	Read Word	2			Maximum rated value of the output power = 1600W (High line AC or DC input) / 1000W (Low line AC input). Always read 1190h (High line AC or DC input) / 10FAh (Low line AC input).	YES	
A8	MFR_TAMBIENT_MAX	Read Word	2			Maximum ambient temperature (D1U86T-W-1600-12-HB4C) 55degC. Always read 37h Maximum ambient temperature (D1U86T-W-1600-12-HB3C) 50degC. Always read 32h	YES	
A9	MFR_TAMBIENT_MIN	Read Word	2			Minimum ambient temperature: 0degC. Always read 0	YES	
AA	MFR_EFFICIENCY_LL	Block Read	1+14			Retrieves information about the efficiency of the device while operating at a low line condition. Vin =115V, LP = 200W, Leff = 92%, MP = 500W, Meff = 94%, HP = 1000W, Heff = 90%. Always read 0x98, 0xEB, 0x90, 0xF9, 0xE0, 0xEA, 0xF4, 0x01, 0xF0, 0xEA, 0xF4, 0x09, 0xD0, 0xEA	YES	

Cmd Code	Command Name	Transaction Type	# Bytes	Bit #	Bit Name	Definition	Support	Comments
AB	MFR_EFFICIENCY_HL	Block Read	1+14			Retrieves information about the efficiency of the device while operating at a high line condition. Vin =230V, LP = 320W, Leff = 94%, MP = 800W, Meff = 96%, HP = 1600W, Heff = 91%. Always read 0x98, 0xF3, 0x80, 0xFA, 0xF0, 0xEA, 0x20, 0x03, 0x00, 0xEB, 0x20, 0x0B, 0xD8, 0xEA	YES	
C0	MFR_MAX_TEMP1 (Ambient)	Read Word	2			Maximum rated temperature (Ambient) (D1U86T-W-1600-12-HB4C): 60degC. Always read 3Ch Maximum rated temperature (Ambient) (D1U86T-W-1600-12-HB3C): 55degC. Always read 37h	YES	
C1	MFR_MAX_TEMP2 (Hot-spot secondary)	Read Word	2			Maximum rated temperature (hot-spot secondary): 98degC. Always read 62h	YES	
C2	MFR_MAX_TEMP3 (Hot-spot primary)	Read Word	2			Maximum rated temperature (hot-spot primary): 93degC. Always read 5Dh	YES	
E0	CR_Mode	R/W Byte	1		See ACAN-100 For details	00h : Normal Mode (Default) 01h : Active Mode (off line) 02h : Standby Mode (off line) 03h : Master Mode (CR PSU1) 04h : Slave Mode (CR 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	
E1	CR_VonVoff	R/W Block	6			AA,BB,CC,DD,EE,FF AA-->Von2, BB-->Voff2 CC-->Von3, DD-->Voff3 ex: 0x02-->2A	YES	
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

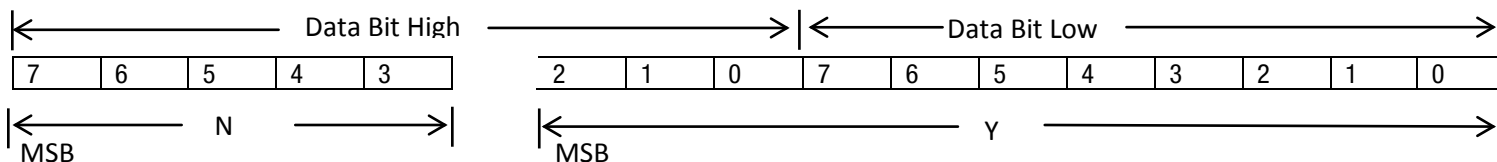
TABLE 3

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 therefore 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 follows 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:

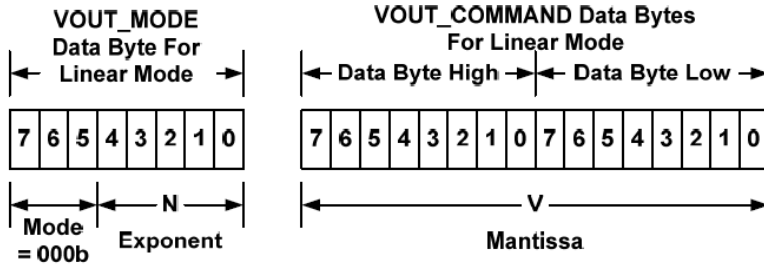


Figure 6. Linear Format Data Bytes

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-100pdf

[Back to command list](#)

Murata Power Solutions, Inc.
129 Flanders Road
Westborough, MA 01581
ISO 9001 and 14001 REGISTERED



This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy.
Refer to: <https://www.murata-ps.com/requirements/>

Murata Power Solutions, Inc. ("Murata") makes no representation that the use of its products in the circuits described herein, or the use of other technical information contained herein, will not infringe upon existing or future patent rights. The descriptions contained herein do not imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards that anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm, and take appropriate remedial actions. Buyer will fully indemnify Murata, its affiliated companies, and its representatives against any damages arising out of the use of any Murata products in safety-critical applications. Specifications are subject to change without notice.

© 2019 Murata Power Solutions, Inc.