ACAN-93 describes PMBus™ digital communications protocol adapted by the **D1U74T-W-1600-12-HB4C** series power supplies.

Standard PMBus™ characteristics

- Complies with PMBus™ Power Systems Management Protocol Part 1 – General Requirements Rev 1.2 including use of PEC (Packet Error Checking).
- Linear data format is used for all supported 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.

Internal PSU 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**A1** and PS**A0** as follows:

Slave Device Address Selection			
Slave Address (hex)	Slave Address (bin)	**A1** Pin Status	**A0** Pin Status
0xB0/B1	1011 0000	Low	Low
0xB2/B3	1011 0010	Low	High
0xB4/B5	1011 0100	High	Low
0xB6/B7	1011 0110	High	High

PMBus™ Command List

Cmd Code	Command Name	Read / Write	# Bytes	Byte Name	Bit #	Bit Name	Definition	Support	Comments
03	CLEAR_FAULTS	Write	0				Write only command clears all faults that have been set in all the STATUS_XXXX registers simultaneously.	YES	If PSU output is shut down due to a fault, this command can re-start the output.
10	WRITE_PROTECT	R/W	1				Data byte value = 1000 0000b => Disable all writes except to the WRITE_PROTECT command. Data byte value = 0000 0000b => Enable writes to all commands. Default value: 00000000b	YES	PMBus Spec - Part II - Revision 1.2 - Sections 11.1
19	CAPABILITY	Read	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
20	VOUT_MODE	Read	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
3A	FAN_CONFIG_1_2	Read	1				Show the config of fan. Always read C0h. Fan is installed in position 1. Fan is commanded in RPM.	YES	PMBus Spec - Part II - Revision 1.2 - Sections 14.10
3B	FAN_COMMAND_1	R/W	2				Manual fan override command fan speed value in RPM (0 - 32736, default = 0). In linear data format (N = 5)	YES	Actual fan speed (RPM) is limited by fan maximum speed specified in fan spec
4A	IOUT_OC_WARN_LIMIT	R/W	2				Sets the value of the output current, in Amperes, that causes an output overcurrent warning. In Linear Data format . (Allowable range: 0 - 151.8A, default value: 150A)	YES	
4F	OT_FAULT_LIMIT (Hot Spot)	R/W	2				Set the temperature, in degrees Celsius, of the unit at which main output shutdown due to OTP. In the Linear Data format . (Allowable range: 0 - 130 °C, default value: 117 °C)	YES	

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Cmd Code	Command Name	Read / Write	# Bytes	Byte Name	Bit #	Bit Name	Definition	Support	Comments
51	OT_WARN_LIMIT (Hot Spot)	R/W	2				Set the temperature, in degrees Celsius, of the unit at which it should indicate an Overtemperature Warning alarm. In Linear Data format . (Allowable range: 0 - 130 °C, default value: 112 °C)	YES	
5D	IIN_OC_WARN_LIMIT	R/W	2				Sets the value of the input current, in amperes, that causes a warning that the input current is high. In Linear Data format . (Allowable range: 0 - 18 A, default value: 15A)	YES	
6A	POUT_OP_WARN_LIMIT	R/W	2				Sets the value of the output power (not include 12Vsb), in watts, that causes a warning that the output power is high. In Linear Data format . (Allowable range: 0 - 2018W, default value: 1818W)	YES	
6B	PIN_OP_WARN_LIMIT	R/W	2				Sets the value of the input power, in watts, that causes a warning that the input power is high. In Linear Data format . (Allowable range: 0 - 4160W, default value: 3960W)	YES	
79	STATUS_WORD	Read	2	STATUS_BYTE (Lower byte of STATUS_WORD)	7	BUSY_F	Not used	NO	
					6	UNIT_OFF	Asserted when unit not providing power to the output for whatever reason	YES	Report PSU state at real time
					5	VOUT_OV_F	Asserted when main output shutdown due to overvoltage fault has occurred	YES	same as bit 7 of STATUS_VOUT
					4	IOUT_OC_F	Asserted when main output shutdown due to overcurrent fault has occurred	YES	same as bit 7 of STATUS_IOUT
					3	VIN_UV_F	Asserted when main output shutdown due to input undervoltage fault has occurred. This bit will not be set before main output is normally startup	YES	same as bit 4 of STATUS_INPUT
					2	TEMPERATURE_F_W	Asserted when an overtemperature fault or warning has occurred	YES	
					1	CML_F	Asserted when a communications, memory, or logic fault has occurred	YES	
					0	HIGH_BYTE	Asserted when a fault in STATUS_WORD upper byte has occurred	YES	
				STATUS_WORD (Upper byte of STATUS_WORD)	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	YES	
					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	Not used	NO	
					0	UNKNOWN_F_W	Asserted when a fault not listed in [15:1] has occurred	YES	
7A	STATUS_VOUT	R/W	1		7	VOUT_OV_F	Asserted when main output shutdown due to overvoltage fault has occurred. Protection threshold refer to data sheet.	YES	Main o/p off, SMB_ALERT# goes low
					6	VOUT_OV_W	Not used	NO	
					5	VOUT_UV_W	Not used	NO	
					4	VOUT_UV_F	Asserted when main output shutdown due to undervoltage fault has occurred. Protection threshold refer to data sheet.	YES	Main o/p off, SMB_ALERT# goes low
					3	VOUT_MAX_F	Not used	NO	
					2	TON_MAX_F	Not used	NO	
					1	TON_MAX_W	Not used	NO	
					0	VOUT_TRACKING_E	Not used	NO	

Cmd Code	Command Name	Read / Write	# Bytes	Byte Name	Bit #	Bit Name	Definition	Support	Comments
7B	STATUS_IOUT	R/W	1		7	IOUT_OC_F	Asserted when an output overcurrent fault has occurred. Protection threshold refer to data sheet.	YES	Main o/p off, SMB_ALERT# goes low
					6	IOUT_OC_SHUTDOWN	Not used	NO	
					5	IOUT_OC_W	Asserted when an output overcurrent warning has occurred. Warning threshold = IOUT_OC_WARN_LIMIT, recovery threshold = warning threshold – 2A	YES	SMB_ALERT# goes low, Auto recovery
					4	IOUT_UC_W	Not used	NO	
					3	CURRENT_SHARE_F	Not used	NO	
					2	POWER_LIMIT_MODE	Not used	NO	
					1	POUT_OP_F	Not used	NO	
					0	POUT_OP_W	Asserted when an output overpower warning has occurred. Warning threshold = IOUT_OP_WARN_LIMIT, recovery threshold = warning threshold – 100W	YES	SMB_ALERT# goes low, Auto recovery
7C	STATUS_INPUT	R/W	1		7	VIN_OV_F	Not used	NO	
					6	VIN_OV_W	Asserted when an input overvoltage warning has occurred. Warning threshold = 290V, recovery threshold = 280V	YES	Auto recovery
					5	VIN_UV_W	Not used	NO	
					4	VIN_UV_F	Asserted when main output shutdown due to input undervoltage fault has occurred. Startup threshold (bit clear when Vin > 178V), shutdown threshold (bit set when Vin < 168V) This bit will not be set before main output is normally startup	YES	Main o/p off, SMB_ALERT# goes low, Auto recovery
					3	VIN_UV_OFF (PSU_OFF)	Asserted when main output is OFF because of insufficient input voltage	YES	Main o/p off, Auto recovery
					2	IIN_OC_F	Not used	NO	
					1	IIN_OC_W	Asserted when an input overcurrent warning has occurred. Warning threshold = IIN_OC_WARN_LIMIT, recovery threshold = warning threshold – 1A	YES	SMB_ALERT# goes low, Auto recovery
					0	PIN_OP_W	Asserted when an input overpower warning has occurred. Warning threshold =PIN_OP_WARN_LIMIT, recovery threshold = warning threshold – 100W	YES	SMB_ALERT# goes low, Auto recovery
7D	STATUS_TEMPERATURE	R/W	1		7	TEMPERATURE_OT_F	Asserted when an overtemperature fault has occurred. Hot spot protection threshold = OT_FAULT_LIMIT Ambient protection threshold refer to data sheet.	YES	Main o/p off, SMB_ALERT# goes low
					6	TEMPERATURE_OT_W	Asserted when an overtemperature warning has occurred. Warning threshold = OT_WARN_LIMIT, recovery threshold = warning threshold – 20°C	YES	SMB_ALERT# goes low, Auto recovery
					5	TEMPERATURE_UT_W	Not used	NO	
					4	TEMPERATURE_UT_F	Not used	NO	
					3	RESERVED	Reserved	NO	
					2	RESERVED	Reserved	NO	
					1	RESERVED	Reserved	NO	
					0	RESERVED	Reserved	NO	
7E	STATUS_CML	R/W	1		7	CML_COMMAND_E	Asserted when an invalid or unsupported command is received	YES	
					6	CML_DATA_E	Asserted when invalid or unsupported data is received	YES	
					5	CML_PEC_E	Asserted when a packet error checking (PEC) failed has occurred	YES	
					4	CML_MEMORY_F	Not used	NO	
					3	CML_PROCESSOR_F	Not used	NO	
					2	RESERVED	Reserved	NO	
					1	CML_COMM_F	Not used	NO	
					0	CML_OTHER_F	Asserted when another memory or logic fault has occurred (Primary/Secondary MCU communication error)	Yes	

| Cmd Code	Command Name	Read / Write	# Bytes	Byte Name	Bit #	Bit Name	Definition	Support	Comments
80	STATUS_MFR_SPECIFIC	R/W	1		7	RESERVED		NO	
					6	RESERVED		NO	
					5	RESERVED		NO	
					4	I_SENSE_FAIL	Current sensor reading error	YES	Main o/p off, SMB_ALERT# goes low
					3	TEMP_SENSE_FAIL	Temperature sensor reading error	YES	Main o/p off, SMB_ALERT# goes low
					2	WRONG_PID	Primary product ID incorrect	YES	Main o/p off, SMB_ALERT# goes low
					1	STBY_FAULT	Standby output fault	YES	Main o/p off, SMB_ALERT# goes low
					0	ORING_FAULT	Main output Oring FET fault	YES	Main o/p off, SMB_ALERT# goes low
81	STATUS_FANS_1_2	R/W	1		7	FAN_1_F	Fan 1 fault (This bit is set when fan speed < 3000 rpm)	YES	Main o/p off, SMB_ALERT# goes low
					6	FAN_2_F	Not used	NO	
					5	FAN_1_W	Not used	NO	
					4	FAN_2_W	Not used	NO	
					3	FAN_1_OVERRIDE	Fan 1 speed overridden (Fan speed is following the speed set by FAN_COMMAND_1)	YES	
					2	FAN_2_OVERRIDE	Not used	NO	
					1	FAN_AIRFLOW_F	Not used	NO	
					0	FAN_AIRFLOW_W	Not used	NO	
88	READ_VIN	Read	2				Input Voltage Sensor Reading in Vrms In linear data format Accuracy: +/-5%	YES	
89	READ_IIN	Read	2				Input Current Sensor Reading in Arms In linear data format Accuracy: +/-5% or less than +/-0.15A (in ambient temperature 20 - 30°C)	YES	
8B	READ_VOUT	Read	2				Output Voltage Sensor Reading in Vdc Voltage = data bytes value * 2^N with N supplied by command VOUT_MODE (N = -9) Accuracy: +/-5%	YES	Main output voltage
8C	READ_IOUT	Read	2				Output Current Sensor Reading in Adc In linear data format Accuracy: +/-5% or less than +/-3A (in ambient temperature 20 - 30°C)	YES	Main output current
8D	READ_TEMPERATURE_1	Read	2				Inlet air temperature reading in °C In linear data format (N = -3) Accuracy: +/-2 ☐C	YES	Inlet air temperature
8E	READ_TEMPERATURE_2	Read	2				Hot spot temperature reading in °C In linear data format (N = -3) Accuracy: +/-2 ☐C	YES	Hot spot temperature (Primary Heatsink Temperature)
90	READ_FAN_SPEED_1	Read	2				Fan Speed Sensor reading in RPM In linear data format Accuracy: +/-3% of full-speed	YES	
96	READ_POUT	Read	2				Output Power (does not include 12Vsb) reading in watts In linear data format Accuracy: +/-5% or less than +/-30W (in ambient temperature 20 - 30°C)	YES	Main output power
97	READ_PIN	Read	2				PSU input Power reading in watts In linear data format Accuracy: +/-5% or less than +/-30W (in ambient temperature 20 - 30°C)	YES	PSU input power
98	PMBUS_REVISION	Read	1				Reading of the PMBus revision to which the power supply is compliant Always returns 22h	YES	PMBus Spec - Part II - Revision 1.2 - Section 22.1
99	MFR_ID	Block Read	1+6				Manufacture's ID (ASCII code): "MURATA"	YES	

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Cmd Code	Command Name	Read / Write	# Bytes	Byte Name	Bit #	Bit Name	Definition	Support	Comments
9A	MFR_MODEL	Block Read	1+21				Manufacture's Model Number (ASCII code) : "D1U74T-W-1600-12-HB4C"	YES	
A0	MFR_VIN_MIN	Read	2				Minimum rated value of the input voltage = 180V. Always returns 00B4h in linear data format.	YES	
A1	MFR_VIN_MAX	Read	2				Maximum rated value of the input voltage =264V. Always returns 0108h in linear data format.	YES	
A2	MFR_IIN_MAX	Read	2				Maximum rated value of the input current = 10 Amps. Always returns D280h in linear data format.	YES	
A3	MFR_PIN_MAX	Read	2				Maximum rated value of the input power = 1800W. Always returns 0B84h in linear data format.	YES	
A4	MFR_VOUT_MIN	Read	2				Minimum rated value of the main output voltage = 11.514V. Voltage = data bytes value * 2^N with N supplied by command VOUT_MODE (N = -9) . Always returns 1707h.	YES	
A5	MFR_VOUT_MAX	Read	2				Maximum rated value of the main output voltage = 12.727V. Voltage = data bytes value * 2^N with N supplied by command VOUT_MODE (N = -9) . Always returns 1974h.	YES	
A6	MFR_IOUT_MAX	Read	2				Maximum rated value of the main output current = 132A. Always returns 0084h in linear data format.	YES	
A7	MFR_POUT_MAX	Read	2				Maximum rated value of the main output power = 1624W. Always returns 0B2Ch in linear data format.	YES	
A8	MFR_TAMBIENT_MAX	Read	2				Maximum ambient temperature: 40°C. Always returns 0028h in linear data format.	YES	
AB	MFR_EFFICIENCY_HL	Block Read	1+14				Retrieves the minimum efficiency performance at specified conditions: 1) high line input (Vin =230V), low power output = 320W, 2) Leff = 94%, MP = 800W, Meff = 96%, HP = 1600W, 3) Heff = 91%. Always returns 98h, F3h, 80h, FAh, F0h, EAh, 20h, 03h, 00h, EBh, 20h, 0Bh, D8h, EAh	YES	
D0	READ_VOUT_SB	Read	2				Output Voltage Sensor Reading in Vdc Voltage = data bytes value * 2^N with N supplied by command VOUT_MODE (N = -9) Accuracy: +/-5%	YES	Standby output voltage
D1	READ_IOUT_SB	Read	2				Output Current Sensor Reading in Adc In linear data format Accuracy: +/-5% for 20-100% load	YES	Standby output current

Linear Data Format

[(return to front page; return to Manual Fan Control)](#)

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

					Data Bit High									Data Bit Low		
7	6	5	4	3		2	1	0	7	6	5	4	3	2	1	0

N
MSB

Y
MSB
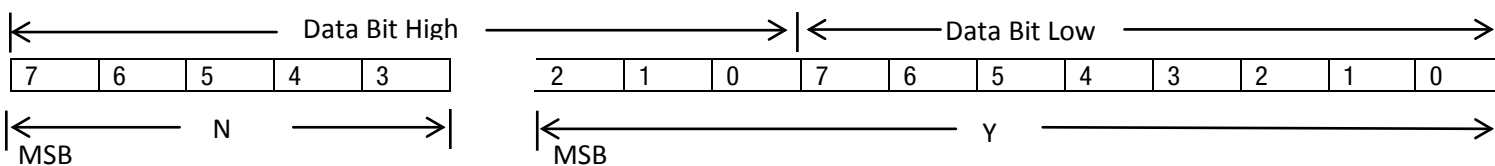
The Relationship between Y, N and the "real world" value is:

X = Y · 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.

[**Link back to command list**](#)

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VOUT_MODE:

Output Voltage returned readings and parameters are expressed in Linear VOUT_MODE format described below.

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:
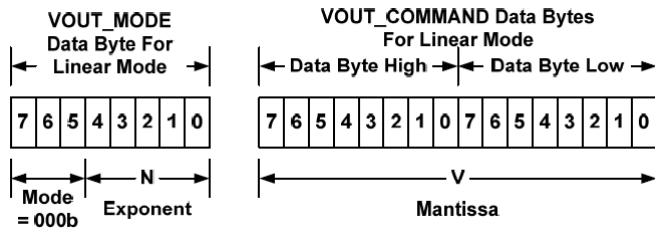
Figure 6. Linear Format Data Bytes

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.

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