

PMBus COMMUNICATIONS PROTOCOL APPLICATIONS NOTE

FOR PRODUCTS:

D1U86-D-1600-12-HB3DC – DC Input, Front to Back Airflow

D1U86-D-1600-12-HB4DC – DC Input, Back to Front Airflow

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PMBus™ Commands & Features

This application note is applicable for the following members of the D1U86-D-1600-12-HBxDC Product Series:

AC Input Variants	DC Input Variants
-----	D1U86-D-1600-12-HB3DC: 1600W; 12V - Front to Back Airflow
-----	D1U86-D-1600-12-HB4DC: 1600W; 12V - Back to Front Airflow

Standard PMBus™ Commands

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 1.1.

Linear data formatting is used for all passed parameters. It is **strongly** recommended to fully utilize the PEC byte to validate all transactions and to repeat if not validated. 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 current command STOP and next command START) is recommended for robust communications.

Note: These products do support 100KHz and 400KHz I²C communication on the PMBus™ interface.

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

D1U86-D-1600-12-HBxDC Device Detail

Power Module Internal Devices			
Vendor	Manufacturers Part Number	Package	Description
Microchip Technology Inc.	PIC24FJ32GA002T-I/SS	28 Pin	Primary General Purpose uC, 16-bit, 32K flash, 8K SRAM, -40C to +85C
Microchip Technology Inc.	PIC24FJ64GA306T-I/PT	64 Pin	Secondary General Purpose uC, 16-bit, 64K flash, 8K SRAM, -40C to +85C
Microchip Technology Inc.	24AA024T-IMS	8 Pin	2K Bit, 2.5-5.5V, 400KHz, 1.8-2.5V 100KHz, 85C

Device Addressing Methods

(See D1U86P12-CONC Interface Card; Application Note ACAN-50 for Additional Details:

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

1. Using the ADDR signal pin (Pin# 27) in digital mode either by:
 - a. Unterminated (leaving open circuit); this will set a default setting of “111” for the last three addressable bits (A0, A1 & A2) of the seven bit address byte.
 - b. Terminating the pin to RTN/ground (Pin numbers 1-13 and/or 52-64); this method will set a default address of “000” for the last three addressable bits (A0, A1 & A2) of the address byte.
2. Using the ADDR signal pin (Pin# 27) in analogue mode by connection of an external resistance to RTN/ground (pin numbers 1-13 and/or 52-64).

For the possible external resistance values this will result in the following address combinations:

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

NB: The D1U86P-W-1600-12-HBxDC PMBus uses “left shifted” 7-Bit addressing; Bit “0” is the Read/Write bit. The addresses, as shown above, assume that the Read/Write bit is a “0”.



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

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PMBus™ COMMANDS

Command Codes

Page Command is supported to allow the ability to control and monitor the dual outputs (the Main 12V output and the VSTANDBY outputs). Each Command Code is annotated with either "All", "0", "1" or "2" 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 (See Relevant Table at the Rear of Document) #OpCode	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	YES
02	ON_OFF_CONFIG See Relevant Table at the Rear of Document) #OnOffCommand	R	All	Bit Flags	1	0	ON_OFF_DELAY	Set when Turn off immediately (default) / 0 = Use delay @ turn-off	YES
						1	ON_OFF_POLARITY	Set when Power on processing is active high (default)	YES
						2	USE_CONTROL	Set when Use CONTROL pin for on/off power processing (default)	YES
						3	USE_OPERATION	Set when Use OPERATION command for on/off power processing (default)	YES
						4	USE_CNTL_AND_OP	Set when Use both CONTROL pin & OPERATION command (default)	YES
						5	RESERVED		NO
						6	RESERVED		NO
						7	RESERVED		NO
03	CLEAR_FAULTS	W	All		1		Write only command clears all faults that have been set in all the STATUS_XXXX registers simultaneously	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 = -6 exponent for translation to volts	NO	
	VSTBY_MODE	R	1	Bit Flags	1		Single data byte sets the READ_VOUT sensor to linear mode data format and supplies N = -7 exponent for translation to volts	NO	
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	
	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 High"	NO	
26	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 Low"	NO	
	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 RPM Command speed formatted in Linear as per command 0x90 - READ_FAN_SPEED_1	YES	

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		See Returned Data Tables for Individual Models #HB3DCReturnedData #HB4DCReturnedData	Main Output Overvoltage Fault Limit	YES	
40	VSTBY_OV_FAULT_LIMIT	R	1	Linear Data Format	2			Standby(Auxiliary) Output Overvoltage Fault Limit	YES	
41	VOUT_OV_FAULT_RESPONSE	R	0	Bit Flags	1			Main Output Overvoltage Fault Response Actions	YES	
41	VSTBY_OV_FAULT_RESPONSE	R	1	Bit Flags	1			Standby(Auxiliary) Output Overvoltage Fault Response Actions	YES	
42	VOUT_OV_WARN_LIMIT	R	0	Linear Data Format	2			Main Output Overvoltage Warning Limit	YES	
42	VSTBY_OV_WARN_LIMIT	R	1	Linear Data Format	2			Standby(Auxiliary) Output Overvoltage Warning Limit	YES	
43	VOUT_UV_WARN_LIMIT	R	0	Linear Data Format	2			Main Output Undervoltage Warning Limit	YES	
43	VSTBY_UV_WARN_LIMIT	R	1	Linear Data Format	2			Standby(Auxiliary) Output Undervoltage Warning Limit	YES	
44	VOUT_UV_FAULT_LIMIT	R	0	Linear Data Format	2			Main Output Undervoltage Fault Limit	YES	
44	VSTBY_UV_FAULT_LIMIT	R	1	Bit Flags	1			Standby(Auxiliary) Output Undervoltage Fault Limit	YES	
45	VOUT_UV_FAULT_RESPONSE	R	0	Bit Flags	1			Main Output Undervoltage Fault Response Actions	YES	
45	VSTBY_UV_FAULT_RESPONSE	R	1	Linear Data Format	2			Standby(Auxiliary) Output Undervoltage Fault Response Actions	YES	
46	IOUT_OC_FAULT_LIMIT	R	0	Linear Data Format	2			Main Output Overcurrent Fault Limit - High line	YES	
46	IOUT_OC_FAULT_LIMIT	R	1	Linear Data Format	2			Main Output Overcurrent Fault Limit - Low line	YES	
46	ISTBY_OC_FAULT_LIMIT	R	2	Bit Flags	1			Standby(Auxiliary) Output Overvoltage Fault Limit	YES	
47	IOUT_OC_FAULT_RESPONSE	R	0	Bit Flags	1			Main Output Overcurrent Fault Response Actions	YES	
47	IOUT_OC_FAULT_RESPONSE	R	1	Bit Flags	1			Main Output Overcurrent Fault Response Actions	YES	
47	ISTBY_OC_FAULT_RESPONSE	R	2	Linear Data Format	2			Standby(Auxiliary) Output Response Actions	YES	
4A	IOUT_OC_WARN_LIMIT	R	0	Linear Data Format	2			Standby(Auxiliary) Output Overcurrent Fault Response Actions	YES	
4A	IOUT_OC_WARN_LIMIT	R	1	Linear Data Format	2			Main Output Overcurrent Warning Limit - High line	YES	
4A	ISTBY_OC_WARN_LIMIT	R	2	Linear Data Format	2			Main Output Overcurrent Warning Limit - Low line	YES	
								Airflow 1 Overtemperature Fault Limit	YES	
4F	HOTSPOT_1_OT_FAULT_LIMIT	R	1	Linear Data Format	2			Hotspot 1 Overtemperature Fault Limit	YES	
4F	AIRFLOW_2_OT_FAULT_LIMIT	R	2	Linear Data Format	2			Airflow 2 Overtemperature Fault Limit	YES	
4F	HOTSPOT_2_OT_FAULT_LIMIT	R	3	Bit Flags	1			Hotspot 2 Overtemperature Fault Limit	YES	
50	AIRFLOW_1_OT_FAULT_RESPONSE	R	0	Bit Flags	1			Airflow 1 Overtemperature Fault Response Actions	YES	
50	HOTSPOT_1_OT_FAULT_RESPONSE	R	1	Bit Flags	1			Hotspot 1 Overtemperature Fault Response Actions	YES	
50	AIRFLOW_2_OT_FAULT_RESPONSE	R	2	Bit Flags	1			Airflow 2 Overtemperature Fault Response Actions	YES	
50	HOTSPOT_2_OT_FAULT_RESPONSE	R	3	Linear Data Format	2			Hotspot 2 Overtemperature Fault Response Actions	YES	
51	AIRFLOW_1_OT_WARN_LIMIT	R	0	Linear Data Format	2			Airflow 1 Overtemperature Warning Limit	YES	
51	HOTSPOT_1_OT_WARN_LIMIT	R	1	Linear Data Format	2			Hotspot 1 Overtemperature Warning Limit	YES	
51	AIRFLOW_2_OT_WARN_LIMIT	R	2	Linear Data Format	2			Airflow 2 Overtemperature Warning Limit	YES	
51	HOTSPOT_2_OT_WARN_LIMIT	R	3	Linear Data Format	2			Hotspot 2 Overtemperature Warning Limit	YES	
55	VIN_OV_FAULT_LIMIT	R	0	Bit Flags	1			See Returned Data Tables for Individual Models HB3DCOnCodex50 HB4DCOnCodex50	Input Overvoltage Fault Limit	YES
56	VIN_OV_FAULT_RESPONSE	R	0	Linear Data Format	2				Input Overvoltage Fault Response Actions	YES
57	VIN_OV_WARN_LIMIT	R	0	Linear Data Format	2				Input Overvoltage Warning Limit	YES
58	VIN_UV_WARN_LIMIT	R	0	Linear Data Format	2				Input Undervoltage Warning Limit	YES
59	VIN_UV_FAULT_LIMIT	R	0	Bit Flags	1				Input Undervoltage Fault Limit	YES
5A	VIN_UV_FAULT_RESPONSE	R	0	Linear Data Format	2				Input Undervoltage Fault Response Actions	YES
5B	IIN_OC_FAULT_LIMIT	R	0	Bit Flags	1				Input Overcurrent Fault Limit	YES
5C	IIN_OC_FAULT_RESPONSE	R	0	Linear Data Format	2				Input Overcurrent Fault Response Actions	YES
5D	IIN_OC_WARN_LIMIT	R	0	Linear Data Format	2				Input Overcurrent Warning Limit	YES
5E	POWER_GOOD_ON	R	0	Linear Data Format	2				Power Good On Main Output Voltage Limit	YES
5F	POWER_GOOD_OFF	R	0	Linear Data Format	2				Power Good Off Main Output Voltage Limit	YES
68	POUT_OP_FAULT_LIMIT	R	0	Bit Flags	1				Output Overpower Fault Limit	YES
69	POUT_OP_FAULT_RESPONSE	R	0	Linear Data Format	2				Output Overpower Fault Response Actions	YES

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
6A	POUT_OP_WARN_LIMIT	R	0	Linear Data Format	2		See Returned Data Tables for Individual Models HB3DCOpCodex6A HB4DCOpCodex6A	Output Overpower Warning Limit - High line	YES
6A	POUT_OP_WARN_LIMIT	R	1	Linear Data Format	2			Output Overpower Warning Limit - Low line	YES
6B	PIN_OP_WARN_LIMIT	R	0	Linear Data Format	2			Input Overpower Warning Limit - High line	YES
6B	PIN_OP_WARN_LIMIT	R	1	Linear Data Format	2			Input Overpower Warning Limit - Low line	YES
79	STATUS_BYTE	R	All	Bit Flags	1	0	NONE_F_W	Set when a fault not listed in [7:1] occurred	NO
						1	CML_F	Set when a communications, memory, or logic fault has occurred	YES
						2	TEMPERATURE_F_W	Set when an overtemperature fault or warning has occurred	YES
						3	INPUT_UV_F	Set when an input undervoltage fault has occurred	YES
						4	OUTPUT_OC_F	Set when an output overcurrent fault has occurred	YES
						5	OUTPUT_OV_F	Set when an output overvoltage fault has occurred	YES
						6	UNIT_OFF	Set when unit not providing power to the output	YES
						7	BUSY_F	Asserted when device busy and unable to respond fault	YES
79	STATUS_WORD	R	All	Bit Flags	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_POUT_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	Set when an error in the output voltage during power-up/down has occurred	NO
						1	TON_MAX_W	Set when the output turn-on timing has exceeded the TON_MAX warning timing	NO
						2	TON_MAX_F	Set when the output turn-on timing has exceeded the TON_MAX fault timing	NO
						3	VOUT_MAX_F	Set when the output is set higher than the commanded VOUT_MAX limit	NO
						4	VOUT_UV_F	Set when an output undervoltage fault has occurred	YES
						5	VOUT_UV_W	Set when an output undervoltage warning has occurred	YES
						6	VOUT_OV_W	Set when an output overvoltage warning has occurred	YES
						7	VOUT_OV_F	Set when an output overvoltage fault has occurred	YES
7A	STATUS_VSTBY	R	1	Bit Flags	1	0	VOUT_TRACKING_E	Set when an error in the output voltage during power-up/down has occurred	NO
						1	TON_MAX_W	Set when the output turn-on timing has exceeded the TON_MAX warning timing	NO
						2	TON_MAX_F	Set when the output turn-on timing has exceeded the TON_MAX fault timing	NO
						3	VOUT_MAX_F	Set when the output is set higher than the commanded VOUT_MAX limit	NO
						4	VOUT_UV_F	Set when an output undervoltage fault has occurred	YES
						5	VOUT_UV_W	Set when an output under-voltage warning has occurred	YES
						6	VOUT_OV_W	Set when an output overvoltage warning has occurred	YES
						7	VOUT_OV_F	Set when an output overvoltage fault has occurred	YES

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name	Definition	Supported
7B	STATUS_IOUT	R	0	Bit Flags	1	0	POUT_OP_W	Set when an output overpower warning has occurred	YES
						1	POUT_OP_F	Set when an output overpower fault has occurred	YES
						2	POWER_LIMIT_MODE	Set when the unit has entered output power limiting mode	NO
						3	CURRENT_SHARE_F	Set when an output current share fault has occurred	NO
						4	IOUT_UC_W	Set when an output undercurrent fault has occurred	NO
						5	IOUT_OC_W	Set when an output overcurrent warning has occurred	YES
						6	IOUT_OC_SHUTDOWN	Set when an output overcurrent and low voltage shutdown fault has occurred	YES
						7	IOUT_OC_F	Set when an output overcurrent fault has occurred	YES
7B	STATUS_IJBY	R	1	Bit Flags	1	0	POUT_OP_W	Set when an output overpower warning has occurred	YES
						1	POUT_OP_F	Set when an output overpower fault has occurred	YES
						2	POWER_LIMIT_MODE	Set when the unit has entered output power limiting mode	NO
						3	CURRENT_SHARE_F	Set when an output current share fault has occurred	NO
						4	IOUT_UC_W	Set when an output undercurrent fault has occurred	NO
						5	IOUT_OC_W	Set when an output overcurrent warning has occurred	YES
						6	IOUT_OC_SHUTDOWN	Set when an output overcurrent and low voltage shutdown fault has occurred	YES
						7	IOUT_OC_F	Set when an output overcurrent fault has occurred	YES
7C	STATUS_INPUT	R	ALL	Bit Flags	1	0	PIN_OP_W	Set when an input overpower warning has occurred	YES
						1	IIN_OC_W	Set when an input overcurrent warning has occurred	YES
						2	IIN_OC_F	Set when an input overcurrent fault has occurred	YES
						3	VIN_UV_OFF	Set when the Unit is OFF for insufficient input voltage	YES
						4	VIN_UV_F	Set when an input undervoltage fault has occurred	YES
						5	VIN_UV_W	Set when an input undervoltage warning has occurred	YES
						6	VIN_OV_W	Set when an input overvoltage warning has occurred	YES
						7	VIN_OV_F	Set when an input overvoltage fault has occurred	YES
7D	STATUS-TEMPERATURE	R	ALL	Bit Flags	1	0	RESERVED	Reserved	NO
						1	RESERVED	Reserved	NO
						2	RESERVED	Reserved	NO
						3	RESERVED	Reserved	NO
						4	TEMPERATURE_UT_F	Set when an undertemperature fault has occurred	NO
						5	TEMPERATURE_UT_W	Set when an undertemperature warning has occurred	NO
						6	TEMPERATURE_OT_W	Set when an overtemperature warning has occurred	YES
						7	TEMPERATURE_OT_F	Set when an overtemperature fault has occurred	YES
7E	STATUS_CML	R	All	Bit Flags	1	0	CML_OTHER_F	Set when another memory or logic fault has occurred	YES
						1	CML_NONE_F	Set when a communication fault not listed in [7:3] has occurred (example: UART or SPI)	NO
						2	RESERVED	Reserved	NO
						3	CML_PROCESSOR_F	Set when a processor fault is detected	NO
						4	CML_MEMORY_F	Set when a memory fault is detected (example: Checksum errors during bootload)	NO
						5	CML_PEC_E	Set when a packet error checking (PEC) failed has occurred	YES
						6	CML_DATA_E	Set when invalid or unsupported data is received	YES
						7	CML_COMMAND_E	Set when an invalid or unsupported command is received	YES



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

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Command Code (Hex)	Command Name	Read/Wri te	Page	Format	Number of Bytes	Bit(s) Number	Bit Name/Comment	Description	Supported
80	STATUS_MFR_SPECIFIC	R	All	Bit Flags		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	YES
						4	VBUS_UV_F	Set when the primary boost output bus undervoltage fault has occurred	YES
						5	VBUS_UV_W	Set when the primary boost output bus undervoltage warning has occurred	YES
						6	VBUS_OV_W	Set when the primary boost output bus overvoltage warning has occurred	YES
						7	VBUS_OV_F	Set when the primary boost output bus overvoltage fault has occurred	YES
81	STATUS_FANS_1_2	R	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
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_2_OVERRIDE	Fan 2 speed overridden	NO
						3	FAN_1_OVERRIDE	Fan 1 speed overridden	NO
						4	FAN_2_W	Fan 2 warning	NO
						5	FAN_1_W	Fan 1 warning	NO
						6	FAN_2_F	Fan 2 fault	NO
						7	FAN_1_F	Fan 1 fault	NO
88	READ_VIN	R	All	Linear Data Format	2	See Sensor Data Tables for Individual Models #SensorData	Input Voltage Sensor Reading	YES	
89	READ_IIN	R	All	Linear Data Format	2		Input 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	
8C	READ_IOUT	R	0	Linear Data Format	2		Main Output Current Sensor Reading	YES	
8C	READ_ISTBY	R	1	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	
8E	READ_TEMPERATURE_2	R	0	Linear Data Format	2		Airflow 2 Temperature Sensor Reading	YES	
8F	READ_TEMPERATURE_3	R	0	Linear Data Format	2		Hotspot 1 Temperature Sensor Reading	YES	
8F	READ_TEMPERATURE_3	R	1	Linear Data Format	2		Hotspot 2 Temperature Sensor Reading	YES	
90	READ_FAN_SPEED_1	R	0	Linear Data Format	2		Fan 1 Speed Sensor Reading	YES	
91	READ_FAN_SPEED_2	R	0	Linear Data Format	2		Fan 2 Speed Sensor Reading	NO	
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		PMBus Specification Revision	YES	
99	MFR_ID	R	All	Ascii Text Block	Variable		See MFR_ID at link: #ComCodex99	Power Supply Company Name	YES
9A	MFR_MODEL	R	All	Ascii Text Block	10		See MFR_MODEL at link: #ComCodex9AHB3DC #ComCodex9AHB4DC	Power Supply Model Number	YES
9B	MFR_REVISION	R	All	Ascii Text Block	15	See MFR_REVISION at link: #ComCodex9B	Power Supply Firmware Revision	YES	
9C	MFR_LOCATION	R/W	All	Ascii Text Block	Variable	See MFR_LOCATION at link: #ComCodex9C	Power Supply Manufacture Location	YES	
9D	MFR_DATE	R/W	All	Ascii Text Block	5	See MFR_DATE at link: #ComCodex9D	Power Supply Manufacture Date	YES	
9E	MFR_SERIAL	R/W	All	Linear Data Format	2	See MFR_SERIAL at link: #ComCodex9E	Power Supply Serial Number	YES	



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

Murata Power Solutions

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name/Comment	Description	Supported
A0	MFR_VIN_MIN	R	All	Linear Data Format	2		See Manufacturers Data at link: #ComCodexA0	Power Supply Input Voltage Minimum Specification	YES
A1	MFR_VIN_MAX	R	All	Linear Data Format	2			Power Supply Input Voltage Maximum Specification	YES
A2	MFR_IIN_MAX	R	All	Linear Data Format	2			Power Supply Input Current Maximum Specification	YES
A3	MFR_PIN_MAX	R	All	Linear Data Format	2			Power Supply Input Power Maximum Specification	YES
A4	MFR_VOUT_MIN	R	All	Linear Data Format	2			Power Supply Main Output Voltage Minimum Specification	YES
A5	MFR_VOUT_MAX	R	All	Linear Data Format	2			Power Supply Main Output Voltage Maximum Specification	YES
A6	MFR_IOUT_MAX	R	All	Linear Data Format	2			Power Supply Main Output Current Maximum Specification	YES
A7	MFR_POUT_MAX	R	All	Linear Data Format	2			Power Supply Output Power Maximum Specification	YES
A8	MFR_TAMBIENT_MAX	R	All	Linear Data Format	2			Power Supply Operating Ambient Temperature Maximum Specification	YES
A9	MFR_TAMBIENT_MIN	R	All	Linear Data Format	2			Power Supply Operating Ambient Temperature Minimum Specification	YES
AA	MFR_EFFICIENCY_LL	R	All	Linear Data Format	2		See Manufacturers Data at link: #ComCodexAA	Power Supply High-Line Low Power Specification	YES
								Power Supply High-Line Low Power Efficiency Specification	YES
								Power Supply High-Line Medium Power Specification	YES
								Power Supply High-Line Medium Power Efficiency Specification	YES
								Power Supply High-Line High Power Specification	YES
								Power Supply High-Line Low Power Specification	YES
AB	MFR_EFFICIENCY_HL	R	All	Linear Data Format	2		See Manufacturers Data at link: #ComCodexAB	Power Supply High-Line Input Voltage Specification	YES
								Power Supply High-Line Low Power Specification	YES
								Power Supply High-Line Low Power Efficiency Specification	YES
								Power Supply High-Line Medium Power Specification	YES
								Power Supply High-Line Medium Power Efficiency Specification	YES
								Power Supply High-Line High Power Specification	YES
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 by the unit is OK; mirrors the digital output signal	YES
						8	POWER_DOWN	Set when boot loader is taking control and the main output and PFC need to be shutdown	YES
						9	BOOTLOAD_COMPLETED	Set when the boot loader has completed and system reset needs to be Set	YES
						10	UNUSED		NO
						11	UNUSED		NO
						12	UNUSED		NO
						13	UNUSED		NO
						14	WARNING	Set when power supply warning has occurred; tracks 'WARNING' status LED	YES
						15	FAULT	Set when power supply fault has occurred; tracks 'FAULT' status LED	YES



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

Murata Power Solutions

Command Code (Hex)	Command Name	Read/Write	Page	Format	Number of Bytes	Bit(s) Number	Bit Name/Comment	Description	Supported
E1	EEPROM_WP	RW	All	Integer	1			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 Tables for Individual Models #ComCodexE2	Power Supply Accumulated Main Output Power-On Hours	YES
EE	PMBUS_CONFIG	R	All	Bit Flags	2	0	DATA_FORMAT	0 = Linear data format 1 = Direct data format	YES
						1	SMBALERT_L	0 = SMBALERT_L implemented & supported 1 = SMBALERT not implemented	YES
						2	MAX_BUS_SPEED	0 = 100kHz 1 = 400kHz	YES
						3	PEC	0 = PEC not supported 1 = PEC supported	YES
						4:7	RESERVED		NO
						8:15	CMD_KEY	Command activation/verification key = 0x5A	NO
EF	LED_CONTROL #ComCodexEF	R	All	Bit Flags	1	0:2	LED_MODE	LED mode change bits	YES
						3:6	RESERVED		NO
						7	LED_CONTROL	LED manual/auto control toggle bit	NO
F0	READ_RESETS	R	All	Bit Flags	2		RCON register status flags for troubleshooting	YES	
				Bit Flags	2		RCON2 register status flags for troubleshooting	YES	
F8	BOOTLOAD_RESTART	RW	All	HEX	1		Boot loader completion and application restart request command	NO	
FA	BOOTLOADER_REQUEST	RW	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	YES
						1	BOOTLOADING_FLOAT	Set when floating uC bootloading in process	NO
						2	BOOTLOADING_SEC	Set when secondary uC bootloading in process	YES
						3	BOOTLOADED_PRI	Set when primary uC bootloading completed; reset required	YES
						4	BOOTLOADED_FLOAT	Set when floating uC bootloading completed; reset required	NO
						5	BOOTLOADED_SEC	Set when secondary uC bootloading completed; reset required	YES
						6	RESET_PRI	Set when primary uC reset	YES
						7	RESET_FLOAT	Set when floating uC reset	NO
						8	RESET_SEC	Set when secondary uC reset	YES
						9	RESERVED		NO
						10	RESERVED		NO
						11	RESERVED		NO
						12	RESERVED		NO
						13	RESERVED		NO
						14	RESERVED		NO
						15	RESERVED		NO

RETURNED RESULTS VS. COMMAND CODE:

The following table represents typical results/responses returned from respective Command Code entries and is provided as an illustration of what would be expected.

D1U86-D-1600-12-HB3DC – DC Input Variant; Front to Back Airflow:

#RetOpCodex40

Command Code Hex)	Command Name	Read/Write	Page	Data Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
40	VOUT_OV_FAULT_LIMIT	R	0	Linear	2	Vdc	-6					14	
40	VSTBY_OV_FAULT_LIMIT	R	1	Linear	2	Vdc	-6					14.5	
41	VOUT_OV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
41	VSTBY_OV_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
42	VOUT_OV_WARN_LIMIT	R	0	Linear	2	Vdc	-6					13	
42	VSTBY_OV_WARN_LIMIT	R	1	Linear	2	Vdc	-6					13.5	
43	VOUT_UV_WARN_LIMIT	R	0	Linear	2	Vdc	-6					11.5	
43	VSTBY_UV_WARN_LIMIT	R	1	Linear	2	Vdc	-6					11.5	
44	VOUT_UV_FAULT_LIMIT	R	0	Linear	2	Vdc	-6					10.9	
44	VSTBY_UV_FAULT_LIMIT	R	1	Linear	2	Vdc	-6					11.5	
45	VOUT_UV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
45	VSTBY_UV_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
46	IOUT_OC_FAULT_LIMIT	R	0	Linear	2	Adc	-2					145	
46	ISTBY_OC_FAULT_LIMIT	R	2	Linear	2	Adc	-8					2.9	
47	IOUT_OC_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	7	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Continuous restart (self-recovery)
47	ISTBY_OC_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	7	Response - Continuous restart (self-recovery)
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
4A	IOUT_OC_WARN_LIMIT	R	0	Linear	2	Adc	-2					140	
4A	ISTBY_OC_WARN_LIMIT	R	2	Linear	2	Adc	-8					2.8	
4F	AIRFLOW_1_OT_FAULT_LIMIT	R	0	Linear	2	°C	0					80	Inlet – Primary
4F	AIRFLOW_2_OT_FAULT_LIMIT	R	1	Linear	2	°C	0					115	Outlet Secondary
4F	HOTSPOT_1_OT_FAULT_LIMIT	R	2	Linear	2	°C	0					130	Main Output Hot Spot - Secondary
4F	HOTSPOT_2_OT_FAULT_LIMIT	R	3	Linear	2	°C	0					125	PFC Hot Spot - Primary
4F	HOTSPOT_3_OT_FAULT_LIMIT	R	3	Linear	2	°C	0					125	Boost Hot Spot - Primary



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

Murata Power Solutions

D1U86-D-1600-12-HB3DC – DC Input Variant; Front to Back Airflow:

RetOpCodex50

Command Code Hex)	Command Name	Read/Write	Page	Data Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
50	AIRFLOW_1_OT_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	AIRFLOW_2_OT_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_2_OT_FAULT_RESPONSE	R	2	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_2_OT_FAULT_RESPONSE	R	3	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_3_OT_FAULT_RESPONSE	R	4	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
51	AIRFLOW_1_OT_WARN_LIMIT	R	0	Linear Data Format	2	°C	0					70	Inlet – Secondary
51	HOTSPOT_1_OT_WARN_LIMIT	R	1	Linear Data Format	2	°C	0					105	Outlet Primary
51	AIRFLOW_2_OT_WARN_LIMIT	R	2	Linear Data Format	2	°C	0					125	Main Output Hot Spot - Secondary
51	HOTSPOT_2_OT_WARN_LIMIT	R	3	Linear Data Format	2	°C	0					110	PFC Hot Spot - Primary
51	HOTSPOT_3_OT_WARN_LIMIT	R	4	Linear Data Format								110	Boost – Hot Spot Primary
55	VIN_OV_FAULT_LIMIT	R	0	Linear Data Format	2	Vdc	-3					76	
56	VIN_OV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
57	VIN_OV_WARN_LIMIT	R	0	Linear Data Format	2	Vdc	-3					74	
58	VIN_UV_WARN_LIMIT	R	0	Linear Data Format	2	Vdc	-3					41	
59	VIN_UV_FAULT_LIMIT	R	0	Linear Data Format	2	Vdc	-3					39	
5A	VIN_UV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
5B	IIN_OC_FAULT_LIMIT	R	0	Linear Data Format	2	Adc	-4					50	
5C	IIN_OC_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
5D	IIN_OC_WARN_LIMIT	R	0	Linear Data Format	2	Adc	-4					47.3	
5E	POWER_GOOD_ON	R	0	Linear Data Format	2	Vdc	-6					10.9	
5F	POWER_GOOD_OFF	R	0	Linear Data Format	2	Vdc	-6					10.9	
68	POUT_OP_FAULT_LIMIT	R	0	Linear Data Format	2	Watts	1					1770	
69	POUT_OP_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
6A	POUT_OP_WARN_LIMIT	R	0	Linear Data Format	2	Watts	1					1710	
6B	PIN_OP_WARN_LIMIT	R	0	Linear Data Format	2	Watts	1					1920	

RetOpCodex6A



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

Murata Power Solutions

D1U86-D-1600-12-HB4DC – DC Input Variant; Back to Front Airflow:

RetOpCodex40

Command Code Hex)	Command Name	Read/Write	Page	Data Format	# of Bytes	Units	Scaling Coefficients			Bit #		Reading	Comments	
							N	m	R	b				
40	VOUT_OV_FAULT_LIMIT	R	0	Linear	2	Vdc	-6					14		
40	VSTBY_OV_FAULT_LIMIT	R	1	Linear	2	Vdc	-6					14.5		
41	VOUT_OV_FAULT_RESPONSE	R	0	Bit Flags	1							2:0	0	Delay Time - None
												5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
												7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
41	VSTBY_OV_FAULT_RESPONSE	R	1	Bit Flags	1							2:0	0	Delay Time - None
												5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
												7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
42	VOUT_OV_WARN_LIMIT	R	0	Linear	2	Vdc	-6					13		
42	VSTBY_OV_WARN_LIMIT	R	1	Linear	2	Vdc	-6					13.5		
43	VOUT_UV_WARN_LIMIT	R	0	Linear	2	Vdc	-6					11.5		
43	VSTBY_UV_WARN_LIMIT	R	1	Linear	2	Vdc	-6					11.5		
44	VOUT_UV_FAULT_LIMIT	R	0	Linear	2	Vdc	-6					10.9		
44	VSTBY_UV_FAULT_LIMIT	R	1	Linear	2	Vdc	-6					11.5		
45	VOUT_UV_FAULT_RESPONSE	R	0	Bit Flags	1							2:0	0	Delay Time - None
												5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
												7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
45	VSTBY_UV_FAULT_RESPONSE	R	1	Bit Flags	1							2:0	0	Delay Time - None
												5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
												7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
46	IOUT_OC_FAULT_LIMIT	R	0	Linear	2	Adc	-2					145		
46	ISTBY_OC_FAULT_LIMIT	R	2	Linear	2	Adc	-8					2.9		
47	IOUT_OC_FAULT_RESPONSE	R	0	Bit Flags	1							2:0	0	Delay Time - None
												5:3	7	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
												7:6	3	Response - Continuous restart (self-recovery)
47	ISTBY_OC_FAULT_RESPONSE	R	1	Bit Flags	1							2:0	0	Delay Time - None
												5:3	7	Response - Continuous restart (self-recovery)
												7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
4A	IOUT_OC_WARN_LIMIT	R	0	Linear	2	Adc	-2					140		
4A	ISTBY_OC_WARN_LIMIT	R	2	Linear	2	Adc	-8					2.8		
4F	AIRFLOW_1_OT_FAULT_LIMIT	R	0	Linear	2	°C	0					80	Inlet – Primary	
4F	AIRFLOW_2_OT_FAULT_LIMIT	R	1	Linear	2	°C	0					115	Outlet Secondary	
4F	HOTSPOT_1_OT_FAULT_LIMIT	R	0	Linear	2	°C	0					130	Main Output Hot Spot - Secondary	
4F	HOTSPOT_2_OT_FAULT_LIMIT	R	1	Linear	2	°C	0					125	Bridge Hot Spot - Primary	
4F	HOTSPOT_3_OT_FAULT_LIMIT	R	2	Linear	2	°C	0					125	Boost Hot Spot - Primary	



Murata Power Solutions

D1U86-D-1600-12-HB4DC – DC Input Variant; Back to Front Airflow:

RetOpCodex50

Command Code Hex)	Command Name	Read/Write	Page	Data Format	# of Bytes	Units	Scaling Coefficients				Bit #	Reading	Comments
							N	m	R	b			
50	AIRFLOW_1_OT_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	AIRFLOW_2_OT_FAULT_RESPONSE	R	1	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_1_OT_FAULT_RESPONSE	R	2	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_2_OT_FAULT_RESPONSE	R	3	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
50	HOTSPOT_3_OT_FAULT_RESPONSE	R	4	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
51	AIRFLOW_1_OT_WARN_LIMIT	R	0	Linear Data Format	2	°C	0				70	Inlet – Secondary	
51	AIRFLOW_2_OT_WARN_LIMIT	R	1	Linear Data Format	2	°C	0				105	Outlet Primary	
51	HOTSPOT_1_OT_WARN_LIMIT	R	2	Linear Data Format	2	°C	0				125	Main Output Hot Spot - Secondary	
51	HOTSPOT_2_OT_WARN_LIMIT	R	3	Linear Data Format	2	°C	0				110	Bridge Hot Spot - Primary	
51	HOTSPOT_3_OT_WARN_LIMIT	R	4	Linear Data Format							110	Boost – Hot Spot Primary	
55	VIN_OV_FAULT_LIMIT	R	0	Linear Data Format	2	Vdc	-3				76		
56	VIN_OV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
57	VIN_OV_WARN_LIMIT	R	0	Linear Data Format	2	Vdc	-3				74		
58	VIN_UV_WARN_LIMIT	R	0	Linear Data Format	2	Vdc	-3				41		
59	VIN_UV_FAULT_LIMIT	R	0	Linear Data Format	2	Vdc	-3				39		
5A	VIN_UV_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
5B	IIN_OC_FAULT_LIMIT	R	0	Linear Data Format	2	Adc	-4				50		
5C	IIN_OC_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
5D	IIN_OC_WARN_LIMIT	R	0	Linear Data Format	2	Adc	-4				47.3		
5E	POWER_GOOD_ON	R	0	Linear Data Format	2	Vdc	-6				10.9		
5F	POWER_GOOD_OFF	R	0	Linear Data Format	2	Vdc	-6				10.9		
68	POUT_OP_FAULT_LIMIT	R	0	Linear Data Format	2	Watts	1				1770		
69	POUT_OP_FAULT_RESPONSE	R	0	Bit Flags	1						2:0	0	Delay Time - None
											5:3	0	Retry Setting - Unit does not attempt to restart & output remains disabled until fault clear
											7:6	3	Response - Output disabled while fault is present & remains disabled until fault cleared
6A	POUT_OP_WARN_LIMIT	R	0	Linear Data Format	2	Watts	1				1710		
6B	PIN_OP_WARN_LIMIT	R	0	Linear Data Format	2	Watts	1				1920		

[RetOpCodex6A](#)



D1U86-D-1600-12-HBxDC Application Note

ACAN-54; PMBus Communication Protocol

Murata Power Solutions

SENSOR DATA AND RESOLUTION

D1U86-D-1600-12-HB3DC & D1U86-D-1600-12-HB4DC DC Variants

RetOpCodex88

Command Code (Hex)	Command Name	Description	Page	Data Format	Units	Scaling Coefficient	Raw Sensor			PMBus Reporting Sensor		
							N	Full-scale / Range	Resolution	Full-scale / Range	Resolution	Accuracy
88	READ_VIN	Input Voltage Sensor Reading	All	Linear	Vdc	-3	110	0.108	127.875	0.125	+ / - 2% of Reporting Full-Scale	
89	READ_IIN	Input Current Sensor Reading	All	Linear	Adc	-4	66	0.0645	63.94	0.0625	+ / - 5% of Reporting Full-Scale	
8B	READ_VOUT	Main Output Voltage Sensor Reading	0	Linear	Vdc	-6	14.68	0.0143	15.98	0.0156	+ / - 2% of Reporting Full-Scale	
8B	READ_VSTBY	Standby(Auxiliary) Output Voltage Sensor Reading	1	Linear	Vdc	-6	15.91	0.0155	15.984	0.01563	+ / - 2% of Reporting Full-Scale	
8C	READ_IOUT	Main Output Current Sensor Reading	0	Linear	Adc	-2	150.2	0.147	255.75	0.250	+ / - 2% of Reporting Full-Scale	
8C	READ_ISTBY	Standby(Auxiliary) Output Current Sensor Reading	1	Linear	Adc	-8	4	0.004	3.996	0.00391	+ / - 2% of Reporting Full-Scale	
8D	READ_TEMPERATURE_1	Temperature Sensor Reading - Inlet (Primary Side)	0	Linear	°C	0	-40 to 150		-40 to 150	1	+ / - 5°C	
8E	READ_TEMPERATURE_2	Temperature Sensor Reading - Outlet (Secondary Side)	0	Linear	°C	0	-40 to 150		-40 to 150	1	+ / - 5°C	
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - Main Output Hotspot (Secondary Side)	0	Linear	°C	0	-40 to 150		-40 to 150	1	+ / - 5°C	
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - Bridge Hotspot (Primary Side)	1	Linear	°C	0	-40 to 150		-40 to 150	1	+ / - 5°C	
8F	READ_TEMPERATURE_3	Temperature Sensor Reading - Boost 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	5	24,000		32736	1	+ / - 5% of Reporting Full-Scale	
96	READ_POUT	Output Power Sensor Reading	All	Linear	Watts	1			2046	32	+ / - 5% of Reporting Full-Scale	
97	READ_PIN	Input Power Sensor Reading	All	Linear	Watts	1			2046	2	+ / - 5% of Reporting Full-Scale	
E2	READ_POWER_ON_HOURS	Accumulated Main Output Power-On Hours	All	Linear	Hours	0	~1900 (Years)		~1900 (Years)	2	+ / - 3%	

RetOpCodexE2

MANUFACTURERS VITAL PRODUCT DATA

Command Code 99 HEX (MAN_ID)

Command Code (Hex)	Command Name	Value	Units	ID Length/Bit#ID/ASCII Text
99 #RetComCodex99	MFR_ID	Murata-PS	N/A	MFR_ID_LENGTH 9
				MFR_ID_0 'M'
				MFR_ID_1 'u'
				MFR_ID_2 'r'
				MFR_ID_3 'a'
				MFR_ID_4 't'
				MFR_ID_5 'a'
				MFR_ID_6 '.'
				MFR_ID_7 'P'
				MFR_ID_8 'S'

Command Code 9A HEX; (MAN_MODEL) D1U86-D-1600-12-HB3DC DC Input Variant; Front to Back Airflow

Command Code (Hex)	Command Name	Value	Units	ID Length/Bit#ID/ASCII Text
9A #RetOpCodex9A	MFR_MODEL	D1U86-D-1600-12-HB3DC	N/A	MFR_MODEL_LENGTH=5
				MFR_MODEL_0 'D'
				MFR_MODEL_1 '1'
				MFR_MODEL_2 'U'
				MFR_MODEL_3 '8'
				MFR_MODEL_4 '6'
				MFR_MODEL_5 '.'
				MFR_MODEL_6 'D'
				MFR_MODEL_7 '.'
				MFR_MODEL_8 '1'
				MFR_MODEL_9 '6'
				MFR_MODEL_10 '0'
				MFR_MODEL_11 '0'
				MFR_MODEL_12 '.'
				MFR_MODEL_13 '1'
				MFR_MODEL_14 '2'
				MFR_MODEL_15 '.'
				MFR_MODEL_16 'H'
				MFR_MODEL_17 'B'
				MFR_MODEL_18 '3'
				MFR_MODEL_19 'D'
				MFR_MODEL_20 'C'
				MFR_MODEL_21 0
				MFR_MODEL_22 0
				MFR_MODEL_23 0
				MFR_MODEL_24 0
				MFR_MODEL_25 0
MFR_MODEL_26 0				

MFR_MODEL_27	"0"
MFR_MODEL_28	"0"

Command Code 9A HEX; (MAN_MODEL) D1U86-D-1600-12-HB4DC DC Input Variant; Back to Front Airflow

Command Code (Hex)	Command Name	Value	Units	ID Length/Bit#ID/ASCII Text	
9A #RetOpCodex9A	MFR_MODEL	D1U86-D-1600-12-HB4DC	N/A	MFR_MODEL_LENGTH=5	
				MFR_MODEL_0	'D'
				MFR_MODEL_1	'1'
				MFR_MODEL_2	'U'
				MFR_MODEL_3	'8'
				MFR_MODEL_4	'6'
				MFR_MODEL_5	('.')
				MFR_MODEL_6	'D'
				MFR_MODEL_7	('.')
				MFR_MODEL_8	'1'
				MFR_MODEL_9	'6'
				MFR_MODEL_10	'0'
				MFR_MODEL_11	'0'
				MFR_MODEL_12	('.')
				MFR_MODEL_13	'1'
				MFR_MODEL_14	'2'
				MFR_MODEL_15	('.')
				MFR_MODEL_16	'H'
				MFR_MODEL_17	'B'
				MFR_MODEL_18	'4'
				MFR_MODEL_19	'D'
				MFR_MODEL_20	'C'
				MFR_MODEL_21	0
				MFR_MODEL_22	0
				MFR_MODEL_23	0
				MFR_MODEL_24	0
				MFR_MODEL_25	0
				MFR_MODEL_26	0
MFR_MODEL_27	'D'				
MFR_MODEL_28	'1'				

Command Code 9B HEX (MFR-REVISION)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9B #RetOpCodex9B	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			

Command Code 9C HEX (MFR_LOCATION)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9C #RetOpCodex9C	MFR_LOCATION	China	MFR_LOCATION_LENGTH = 5	
			MFR_LOCATION_0	'C'
			MFR_LOCATION_1	'h'
			MFR_LOCATION_2	'i'
			MFR_LOCATION_3	'n'
			MFR_LOCATION_4	'a'
			MFR_LOCATION_5	0
			MFR_LOCATION_6	0
			MFR_LOCATION_7	0
			MFR_LOCATION_8	0
			MFR_LOCATION_9	0
			MFR_LOCATION_10	0
			MFR_LOCATION_11	0
			MFR_LOCATION_12	0
			MFR_LOCATION_13	0
			MFR_LOCATION_14	0
			MFR_LOCATION_15	0
			MFR_LOCATION_16	0
			MFR_LOCATION_17	0
MFR_LOCATION_18	0			

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Command Code 9D HEX (MFR_DATE)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9D #RetOpCodex9D	MFR_DATE	1400	MFR_DATE_LENGTH = 4	
			MFR_DATE_0	'1'
			MFR_DATE_1	'4'
			MFR_DATE_2	'0'
			MFR_DATE_3	'0'
			MFR_DATE_4	0
			MFR_DATE_5	0
			MFR_DATE_6	0
			MFR_DATE_7	0
			MFR_DATE_8	0
			MFR_DATE_9	0
			MFR_DATE_10	0
			MFR_DATE_11	0
			MFR_DATE_12	0
			MFR_DATE_13	0
			MFR_DATE_14	0
			MFR_DATE_15	0
			MFR_DATE_16	0
			MFR_DATE_17	0
MFR_DATE_18	0			

Command Code 9E HEX (MFR_SERIAL)

Command Code (Hex)	Command Name	Value	ID Length/Bit#ID/ASCII Text	
9E #RetOpCodex9E	MFR_SERIAL	QEyywwR1xxxx	MFR_SERIAL_LENGTH = 12	
			MFR_SERIAL_0	'Q'
			MFR_SERIAL_1	'E'
			MFR_SERIAL_2	'Y'
			MFR_SERIAL_3	'Y'
			MFR_SERIAL_4	'W'
			MFR_SERIAL_5	'W'
			MFR_SERIAL_6	'R'
			MFR_SERIAL_7	'1'
			MFR_SERIAL_8	'X'
			MFR_SERIAL_9	'X'
			MFR_SERIAL_10	'X'
			MFR_SERIAL_11	'X'
			MFR_SERIAL_12	0
			MFR_SERIAL_13	0
			MFR_SERIAL_14	0
			MFR_SERIAL_15	0
			MFR_SERIAL_16	0
			MFR_SERIAL_17	0
MFR_SERIAL_18	0			

GENERAL PARAMETRIC DATA

Command Code (Hex)	Command Name	Value	Units	N
A0	MFR_VIN_MIN	40	Vdc	-3
#RetOpCodexA0				
A1	MFR_VIN_MAX	72	Vdc	-3
A2	MFR_IIN_MAX	47	Adc	-4
A3	MFR_PIN_MAX	1800	W	1
A4	MFR_VOUT_MIN	11.40	Vdc	-6
A5	MFR_VOUT_MAX	12.61	Vdc	-6
A6	MFR_IOUT_MAX	133.3	Adc	-2
A7	MFR_POUT_MAX	1600	W	1
A8	MFR_TAMBIENT_MAX	55	C	0
A9	MFR_TAMBIENT_MIN	0	C	0
AA	MFR_EFFICIENCY_LL_VIN	40	Vdc	-3
	MFR_EFFICIENCY_LL_POUT1	320	W	1
	MFR_EFFICIENCY_LL_EFF1	0.90		-10
	MFR_EFFICIENCY_LL_POUT2	800	W	1
	MFR_EFFICIENCY_LL_EFF2	0.90		-10
	MFR_EFFICIENCY_LL_POUT3	1600	W	1
	MFR_EFFICIENCY_LL_EFF3	0.88		-10
AB	MFR_EFFICIENCY_HL_VIN	40	Vdc	-3
	MFR_EFFICIENCY_HL_POUT1	320	W	1
	MFR_EFFICIENCY_HL_EFF1	0.90		-10
	MFR_EFFICIENCY_HL_POUT2	800	W	1
	MFR_EFFICIENCY_HL_EFF2	0.90		-10
	MFR_EFFICIENCY_HL_POUT3	1600	W	1
	MFR_EFFICIENCY_HL_EFF3	0.88		-10

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OPERATION COMMAND CODE 01 HEX

Power Module On/Off Mode: Bit # / Bit Description (Command Code 01 HEX)								Valid Values		Power Module Status
7	6	5	4	3	2	1	0	Dec	Hex	
On/off Bit	On/off Bit	Margin on/off/high/low Bits		Margin Fault Control Bits		Bit	Bit			
1	0	1	0	1	0	Not Used				
0	0	x	x	x	x	x	x	0 - 63	0 - 3F	Disable power supply when OPERATION command supported
1	0	x	x	x	x	x	x	128 - 191	80 - BF	Enable power supply when OPERATION command supported – DEFAULT setting

[RetOpCodex01](#)

ON/OFF COMMAND CODE 02 HEX

Power Module On/Off Configuration: Bit # / Bit Description (Command Code 02 HEX)								Valid Values		Power Supply On/Off Mode
7	6	5	4	3	2	1	0	Dec	Hex	
reserved	reserved	reserved	CONTROL pin / OPERATION command PS on/off	OPERATION command on/off	CONTROL Pin					
					On/Off	Polarity	Action			
0	0	0	1	0	1	0	1	21	15	Control pin only ; active low polarity
0	0	0	1	0	1	1	1	23	17	Control pin only ; active high polarity
0	0	0	1	1	0	x	1	25 or 27	19 or 1B	Operation command only
0	0	0	1	1	1	0	1	29	1D	Operation command and control pin ; active low polarity; DEFAULT setting
0	0	0	1	1	1	1	1	31	1F	Operation command and control pin ; active high polarity

[RetOpCodex02](#)

LED CONTROL COMMAND CODE EF HEX

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

[#RetComCodexEF](#)
DEFAULT SETTING

"X" = Don't Care