PMBus Interface: User's Guide

XL270 Series

270-Watt AC to DC Power Supplies

706679 Rev 09-26-18

User's Guide

XL270 PMBus Interface

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The N2Power XL270 Series of power supplies optionally supports the industry standard PMBus. This document lists the commands that are currently supported in Version 1.2 of the XL270 PMBus implementation. Refer to the complete XL270 Product Specification (Document 706601) for details about the power supply's operational characteristics.

Refer to the PMBus Power System Management Protocol Specification Parts I and II
- Part I: General Requirements, Transport and Electrical Interface
- Part II: Command Language

The PMBus documents can be downloaded at the following URLs:

- http://pmbus.org/developers.php

- http://pmbus.org/media/PMBus_Specification_Part_I_Rev_1_%200_20050324.pdf

- http://pmbus.org/media/PMBus_Specification_Part_II_Rev_1_0_20050328.pdf

The PMBus is a logical protocol based on the SMBus that was originally conceived by Intel Corporation. They both utilize the 5-volt I^2C hardware bus. The 3.3-volt integrated circuits of XL270 can tolerate the 5-volt I^2C Bus. Electrical and timing requirements must comply with the I^2C Bus specifications. These physical requirements are generally fulfilled by an integrated circuit. External pullup resistors on the I^2C clock and data lines are required. The XL270 I^2C inputs provide weak pullups to 3.3V to keep the clock and data input signals in their high state when not used.

Option Connector (J3)

The J3 connector is a Molex Pico-Blade header (a.k.a. a jack) with 1.25mm pin spacing. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed in Table 1. There may be equivalent connector components available from other manufacturers.

J3	Molex P/N
Number of Circuits (pins)	15
Mating Housing (white)	51021-1500
Crimp Terminal	50212-8100
Rated Contact Current	2 A
Rated Wire Size	AWG 30 thru 24

Table 1   J3 Mating Connectors

Pin numbers

15
14
13
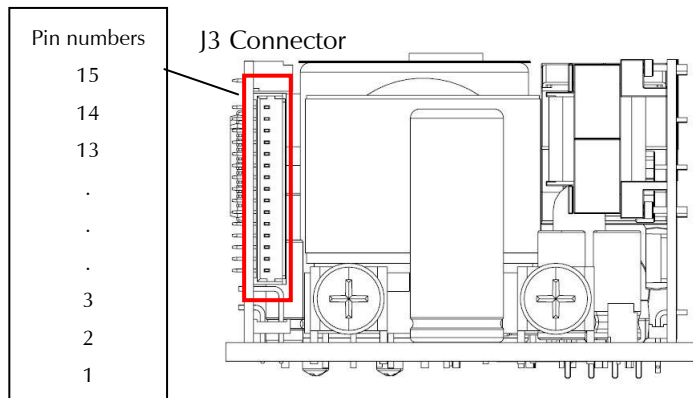.
.
.
3
2
1

J3 Connector

Figure 1   J3 Connector

Tachometer Input, Auxiliary (Fan Controlled Output)/Standby Output Connector (J6)

The J6 connector is a Molex Micro-Latch header (a.k.a. a jack) with 2mm pin spacing. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed in Table 2. There may be equivalent connector components available from other manufacturers.

J6	Molex P/N
Number of Circuits (pins)	5
Mating Housing (white)	51065-0500
Crimp Terminal	50212-8100
Rated Contact Current	2 A
Rated Wire Size	AWG 30 thru 24

Table 2   J6 Mating Connectors
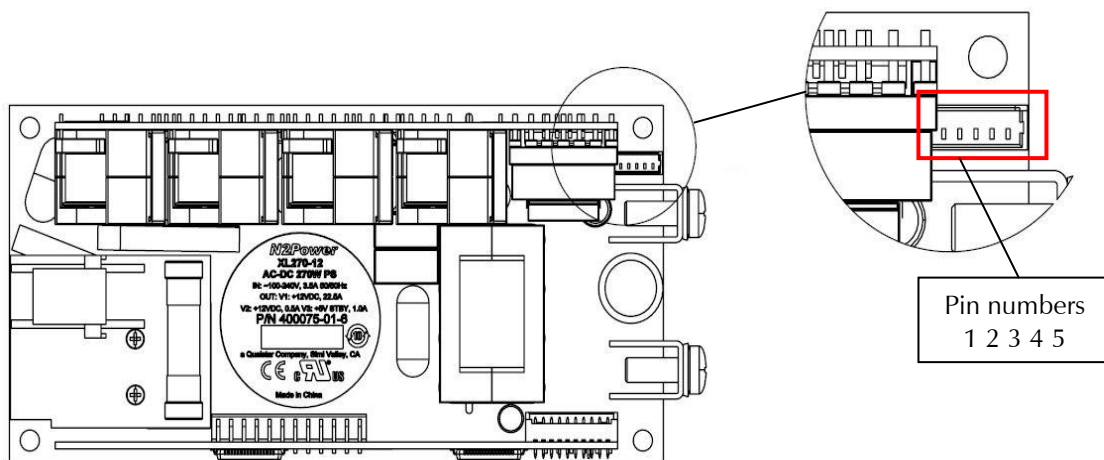

Pin numbers
1 2 3 4 5

Figure 2   J6 Connector

Signal Descriptions and Connector/Pin Assignments

Signal	Description/Remarks
I²C Serial Clock	Provides PMBus control/status interface. Pulled-up to 3.3V by a 4.7K resistor. Maximum frequency is 100Khz.
I²C Serial Data	Provides PMBus control/status interface. Pulled-up to 3.3V by a 4.7K resistor.
Address 1	High-true address selection input (2 bits: 0, 1).
Address 0	High-true address selection input (2 bits: 0, 1).
DC Return (ground)	XL270 circuit return for all outputs and status/control signals. (RTN)
CAN HIGH	HIGH data line for CAN (Controller area Network) communications (for current sharing and service use)
CAN LOW	LOW data line for CAN (Controller area Network) communications (for current sharing and service use)
-RS	Remote sense for RTN
+RS	Remote sense for VOUT (compensates for load-cable drop)
PF/PG	A high-logic level ($\approx$4.5V) indicates the output power is in regulation for at least the next 2ms.
RE	Remote Enable Input
12V Auxiliary (12VAUX) / FAN Controlled Output	Provides 0.5A at 12V. Uses RTN for its return. With the PMBUS command, this output can switch on and off with a preprogrammed duty cycle to control fan speed.
5VSB	Provides 1A at 5V. Uses RTN for its return.
Tachometer Input	The tachometer output of a single fan may be connected to this input. The loss of the tachometer signal is detected and can be reported over the optional serial data interface.

Table 3   Signal Descriptions and Connector/Pin Assignments

Pin	Signal Name
J3-1	I^{2}C Serial Clock
J3-2	I^{2}C Serial Data
J3-3	Address 1 Input (A1, see below)
J3-4	Address 0 Input (A0, see below)
J3-5	DC Return (ground)
J3-6	DC Return (ground)
J3-7	CAN High (CANH) (for Current Sharing)
J3-8	CAN High (CANH) (for Current Sharing)
J3-9	CAN Low (CANL) (for Current Sharing)
J3-10	CAN Low (CANL) (for Current Sharing)
J3-11	Negative Remote Sense (-RS)
J3-12	Positive Remote Sense (+RS)
J3-13	Power Fail/Power Good (PF/PG)
J3-14	Remote Enable (ENABLE)
J3-15	Not used

Table 4   J3 Pin Assignments

Pin	Signal Name
J6-1	Tachometer Input
J6-2	5V Standby (5VSB)
J6-3	DC Return (ground)
J6-4	12V Auxiliary (12VAUX) / FAN Controlled Output
J6-5	DC Return (ground)

Table 5   J6 Pin Assignments

I^{2}C Levels	Low State	High State
Input Voltage	<= 1.3VDC	>= 3.0VDC
Output Voltage	<= 0.5VDC @ 8mA	Open with clamp to 3.3V

Table 6   I^{2}C Signal Levels

Addressing

The XL270 supports one of four physical bus addresses. These are determined by selectively grounding the two high-true address input lines shown in Table 4. Leaving the address pins open will be treated as logic high.

J3-3 (A1)	J3-4 (A0)	Address
Open	Open	0 0 1 0 0 **1 1**
Open	GND	0 0 1 0 0 **1 0**
GND	Open	0 0 1 0 0 **0 1**
GND	GND	0 0 1 0 0 **0 0**

Table 7   Address Selection

Supported Commands

Notes:
1) When applicable, PMBus commands use the direct data format.
2) Packet Error Checking (PEC) is not supported.
3) General Call Address (0x00, Global Broadcast) is not supported.
4) All PMBus reads are a combined data format, where there is no stop condition (stop bit) between the write data portion (PMBus command) and the read data portion. Instead, there is a repeated start condition (start bit) before the change of direction (repeated slave address with read bit) in the transfer.

Refer to the PMBus Specification Part II for detailed descriptions of the following supported commands:

OPERATION 0x01

An OPERATION command will cause the OPERATION byte to be written if the data is valid, but the command will only be processed if the RE (Remote Enable) signal is not at logic low at the time that the OPERATION command is issued. Valid data values that can be written to the OPERATION byte are 0x00 and 0x80. All other values will be discarded. A change in the state of the remote enable (RE) signal will override any previous OPERATION command that was issued.

Data of 0x80 will enable the main and 12Vaux outputs.
Data of 0x00 will disable the main and 12Vaux outputs.

CLEAR_FAULT 0x03

Clears the status byte and status word.

STATUS_BYTE 0x78

Returns the Low byte of the Status Word. See Table 8.

STATUS_WORD 0x79

Byte	Bit Number	Status Bit Name	Description
Low	7	BUSY	Not supported.
	6	OFF	Output off has occurred.
	5	VOUT_OV	Output overvoltage fault has occurred.
	4	IOUT_OC	Output overcurrent fault has occurred.
	3	VIN_UV	Not supported.
	2	TEMPERATURE	Transformer temperature fault has occurred.
	1	CML	PMBus communications fault.
	0	NONE OF THE ABOVE	Not supported.
High	7	VOUT	Output voltage fault or warning has occurred.
	6	IOUT/POUT	Output current fault or warning has occurred.
	5	INPUT	Not supported.
	4	MFR	Not supported.
	3	POWER_GOOD	The POWER_GOOD negation has occurred.
	2	FANS	Not supported.
	1	OTHER	Not supported.
	0	UNKNOWN	Not supported.

Table 8   Status Byte/Word Description

READ_VOUT 0x8B

The A/D count is linear from zero to 120% of nominal output voltage resulting in a full scale count of 1023d (this equates to 0.1173% per count). Nominal output voltage (100% of rated voltage) yields a reading of 852d. Nominal voltages are model dependent but are rated at: 12V, 24V, 30V, 48V or 56V.

The coefficient parameters used to translate the data to the actual percentage value of rated output voltage information are given below.

Parameter	Value
m	8525d
b	0
R	-3d

Table 9   PMBus direct format coefficient parameters for READ_VOUT

READ_IOUT 0x8C

The A/D count is linear from zero to 125% of nominal output current resulting in a full scale count of 1023d. Rated output current occurs at a count of 818d. 100% of rated currents are equal to 270-watts divided by the above output voltages. The coefficient parameters used to translate the data to the actual percentage value of rated output current information are given below.

Parameter	Value
m	8184d
b	0
R	-3d

Table 10   PMBus direct format coefficient parameters for READ_IOUT

READ_TEMPERATURE_1 0x8D

Returns a 10-bit unsigned integer of the temperature near main transformer. The sensor measurement range is from -40 °C to 125 °C. The XL270 will shut down when the temperature reaches around 110 °C (data value of 930d). The parameters used to translate the data to the actual temperature information are given below.

Parameter	Value
m	620d
b	24800d
R	-2d

Table 11   PMBus direct format coefficient parameters for READ_TEMPERATURE_1

MFR_SPECIFIC_01 0xD1 – Fan Speed Control, Read/Write Byte

Note: During non-default mode, internal thermostat control will override other modes and turn the fan on at 100% duty cycle if the transformer temperature is above 85 °C.

Data Byte	Fan Speed Control Mode
0x00	100% duty cycle (power-on default mode)
0x01	Fixed speed at 0% PWM duty cycle (off)
0x02	Fixed speed at 25% PWM duty cycle
0x03	Fixed speed at 50% PWM duty cycle
0x04	Fixed speed at 75% PWM duty cycle
0x05	Fixed speed at 100% PWM duty cycle (on)
0x06	Internal automatic PWM control: transformer Temp Duty Cycle Above 74°C 100% duty cycle (on) 61°C-73°C 75% duty cycle 48°C-60°C 50% duty cycle 35°C-47°C 25% duty cycle Below 35°C 0% duty cycle (off)

Table 12   Fan Speed Control Data Byte Usage

MFR_SPECIFIC_02 0xD2 – Fan Tachometer Count, Read Word

This command returns a word value (low byte first) of the fan tachometer pulse count per second. The user should know what the pulse per revolution specification is for the fan that is installed, in order to translate this value into an actual RPM value.

If the tachometer signal is interrupted by pulse-width modulating the fan power, then the returned tachometer pulse count per second value is only valid when the fan is powered at 100% duty cycle (continuous power). A fan with an open collector tachometer output may still fail to provide a low output when the fan input power is off. A four-terminal fan with a separate power and PWM inputs might provide an accurate tachometer signal at any speed.

The coefficient parameters used to translate the data to the actual pulse count per second information are given below.

Parameter	Value
m	1d
b	0
R	0

Table 13   PMBus direct format coefficient parameters for MFR_SPECIFIC_02