User's Guide

XL750 PMBus Interface

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The N2Power XL750 Series of power supplies optionally supports the industry standard PMBus. This document lists the commands that are currently supported in Version 1.0 of the XL750 PMBus implementation. Refer to the complete XL750 Product Specification (Document 707201) 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. Some 3.3-volt integrated circuits can tolerate the 5-volt I^2C Bus while other 3.3-volt devices will require a bi-directional 3.3V to 5V logic-level translator to interface to the XL750. 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 XL750 I^2C inputs provide weak pullups to 4.6V to keep the clock and data input signals in their high state when not used.

Control Connector J3

The control connector is a Molex™ KK® header with 0.100" centers. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers.

J3	Molex P/N
Connector Circuits (pins)	10
PCB Header (Gold)	22-12-2104
Mating Housing	10-11-2103
Crimp terminal (selective gold)	08-65-0816
Rated Contact Current	2.5 A
Rated Wire Size	AWG 22 thru 30

Table 1 J3 Mating Connector

Address Connector J7 (5 pin connector on the control board)

The address connector is a Molex PicoBlade™ header with 1.25mm centers. The Molex part numbers for the mating housing and crimp-style snap-in terminals are listed below. There may be equivalent connectors available from other manufacturers.

J7	Molex P/N
Connector Circuits (pins)	5
PCB Header (Gold)	53048-0510
Mating Housing	51021-0500
Crimp terminal (selective gold)	50516-8041
Rated Contact Current	1 A
Rated Wire Size	AWG 28 thru 32
Strip Length	1.2-1.7mm

Table 2 J7 Mating Connector

Signal Descriptions and Connector/Pin Assignments

Signal	Description/Remarks
PS_ON	A low-logic level enables the V1 and V2 outputs. Pulled-up by 5K resistor to +4.5V. Factory default is shorted to DC Return with removable jumper.
Power Good	A high-logic level (4.5V) indicates the output power is in regulation for at least the next 2mS.
Power Good LED	Connect to the anode of an LED whose cathode is connected to DC Return. Will illuminate the LED when Power Good is high.
Standby LED	Connect to the anode of an LED whose cathode is connected to DC Return. Will illuminate the LED when PS_ON is open or high.
Fan 2: 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.
Fan 2: Controlled Output	This output can drive a 12V fan and turns on only when the ambient temperature approaches the normal operating limits.
I^2C Serial Data	Optional: Provides PMBus control/status interface. Pulled-up to 4.5V by a 22K resistor.
I^2C Serial Clock	Optional: Provides PMBus control/status interface. Pulled-up to 4.5V by a 22K resistor. Maximum frequency is 100Khz.
Address 0	Low-true address selection input (2 bits: 0,1). Pulled-up to 4.5V by 4.7K resistor.
Address 1	Low-true address selection input (2 bits: 0,1). Pulled-up to 4.5V by 10K resistor.
DC Return	The ground connection for both control signals and power.

Table 3 Signal Descriptions and Remarks

Pin	Signal
J3-1	Fan 2: Tachometer Input
J3-2	I^2C Serial Data
J3-3	I^2C Serial Clock
J3-4	Power Good (output, high-true)
J3-5	Power Good LED (+output)
J3-6	Standby LED (+output)
J3-7	DC Return
J3-8	PS_ON (input, low-true)
J3-9	DC Return
J3-10	Fan 2: Controlled Output (derived from +12Vaux)

Table 4 J3 Pin Assignments

Pin	Signal
J7-1	Address 0 Input (A0, see below)
J7-3	DC Return (ground)
J7-4	Address 1 (A1, see below)

Table 5 J7 Pin Assignments

I^2C Levels	Low State	High State
Input Voltage	<= 1.3VDC	>= 3.0VDC
Output Voltage	<= 0.5VDC @ 8mA	Open with clamp to 4.6V

Table 6 I^2C Signal Levels

Addressing

The XL750 supports one of four physical bus addresses. These are determined by selectively grounding the two low-true address input lines shown in Table 7.

J7-4	J7-1	Address
Open	Open	0 0 1 0 0 1 1
Open	Jumper to J7-3	0 0 1 0 0 1 0
Jumper to J7-3	Open	0 0 1 0 0 0 1
Jumper to J7-3	Jumper to J7-3	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 PSON signal is active 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 PSON signal will override any previous OPERATION command that was issued.

Data of 0x80 will enable the main and 12Vaux outputs (V1 and V2)
Data of 0x00 will disable the main and 12Vaux outputs (V1 and V2)

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 or ambient 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, 28V, 40V, 48V, 54V or 56V.

READ_IOUT 0x8C

The A/D count is linear from zero to 125% of nominal output current resulting in a less-than full scale count of 1023d. Rated output current occurs at a count of 819. Over-current protection occurs at 125% (1023d) and is restored when the current remains below 120%. 100% of rated currents are equal to 750-watts divided by the above output voltages.

READ_TEMPERATURE_1 0x8D

Returns a 10-bit unsigned integer of the main transformer temperature. This is a non-linear sensor with a negative slope. The XL750 will shut down when the count falls to 160d (120°C) and will return to operation when the count rises to 199d (approximately 110°C) or higher. The following table shows temperature codes in 5°C increments:

Hex	°C	Hex	°C	Hex	°C	Hex	°C	Hex	°C
D4	-40	CA	0	A2	40	5B	80	28	120
D3	-35	C7	5	9A	45	53	85	24	125
D3	-30	C4	10	91	50	4B	90	20	130
D2	-25	C0	15	88	55	44	95	1C	135
D1	-20	BC	20	7F	60	3D	100	1A	140
D0	-15	B6	25	76	65	37	105	17	145
CE	-10	B0	30	6D	70	31	110	15	150
CD	-5	A9	35	64	75	2C	115	---	---

Table 9 Transformer Temperature Codes

READ_TEMPERATURE_2 0x8E

Returns a 10-bit unsigned integer of the ambient temperature. This is a linear sensor with a negative slope of approximately 5.6 counts per degree centigrade from 10°C to 150°C. The ambient temperature sensor is located on the Supervisor PCBA (daughter board) on the opposite side of the PCB from J7. The result is unpredictable at temperatures below 10°C. The following table shows some important temperature values:

Ambient Temperature	Decimal Count	Remarks
10°C	1023	Minimum readable temperature
25°C	940	Standard ambient temperature
40°C	857	Fan 2 Output turns off above this count
45°C	829	Fan 2 Output turns on below this count
50°C	801	Power supply's rated maximum operating ambient temperature
70°C	672	Power supply's rated maximum forced air operating temperature with output power derated by 50%
80°C	630	Operation is restored after an Over-Temperature alarm below this count
90°C	573	Power supply shuts down with an Over-Temperature alarm above this count
100°C	514	Beyond the maximum allowed ambient temperature

Table 10 Temperature Coding (Interpolate Linearly)

MFR_SPECIFIC_01 0xD1 – Fan2 Speed Control, Read/Write Byte

Note: Internal thermostat control will override any other mode and turn Fan2 on at 100% duty cycle if the ambient temperature is above 45C or the transformer temperature is above 100C.

Data Byte	Fan2 Speed Control Mode
0x00	Internal thermostat control (power-on default)
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: Ambient Temp — Duty Cycle Above 45°C — 100% duty cycle (on) 43°C-45°C — 75% duty cycle 39°C-42°C — 50% duty cycle 35°C-38°C — 25% duty cycle Below 35°C — 0% duty cycle (off)

Table 11 Fan2 Speed Control Data Byte Usage

MFR_SPECIFIC_02 0xD2 – Fan2 Tachometer Count, Read Word

This command returns a word value (low byte first) of the Fan2 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 Fan2 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.