PMBus™ Application Profile for Hot Swap Controllers

Revision 1.0

Revision History

Revision	Description	Date
0.5	Initial release	2010-10-05
0.7	Changes addressing recommendation. Changed coefficient for current sense to be in mV. Fixed STATUS_WORD bits. Updated accuracy requirement.	2010-10-02
0.9	Updated READ_PIN requirements. Added different methods to get coefficient values.	2011-03-02
0.91	Better define that devices report values in watts based on data sheet defined coefficients.	2011-03-22
0.92	Modified description of how COEFFICIENT values are reported in section 5.4.	2011-05-17
0.93	Removed rise / fall time requirements Removed high bit 6 from STATUS_WORD Added 400kbps speed as desired bus speed for future use Defined min voltage range at 4.5V & added other voltage/current range options	2011-05-23
1.0	Public release	2012-04-16

TABLE OF CONTENTS

1 Overview

This application profile describes the PMBus™ requirements for a hot swap controller (HSC) to be used in server nodes that accept DC input power. These standard requirements support the ability to monitor power, voltage, and current into the node and status of the hot swap controller via PMBus existing commands.

This specification is based on the PMBus specifications parts I and II, revision 1.2.

2 Related Documents

- PMBus™ Power System Management Protocol Specification Part I – General Requirements, Transport And Electrical Interface; Revision 1.2
- PMBus™ Power System Management Protocol Specification Part II – Command Language; Revision 1.2
- System Management Bus (SMBus) Specification Version 2.0

3 Addressing (recommended addressing)

The device should have the ability to be set to 2 different addresses using a strapping pin. These two 8 bit addresses are reserved for the hot swap controller: 40h and 42h. The LSB is reserved to set the write and read address of the slave device per the SMBus specification.

4 Hardware

The device in the power supply shall be compatible with both SMBus 2.0 'high power' specification for I^2C V_{dd} based power and drive (for Vdd = 3.3V). This bus shall operate at 3.3V.

4.1 Data Speed

The HSC device shall operate at a minimum of 100 kbps and desired maximum operating speed of 400 kbps for future use. The device shall avoid using clock stretching that can slow down the bus. The HSC device shall support SMBus cumulative clock low extend time (Tlow:sext) if < 25msec. This requires the device to extend the clock time no more than 25msec between START and STOP for any given message.

4.2 Bus Errors

The PMBus device shall support SMBus clock-low timeout (Ttimeout). This capability requires the device to abort any transaction and drop off the bus if it detects the clock being held low for >25ms, and be able to respond to new transactions 10ms later.

The device must recognize SMBus START and STOP conditions on ANY clock interval. (These are requirements of the SMBus specifications, but are often missed in first-time hardware designs.) The device must not hang due to 'runt clocks', 'runt data', or other out-of-spec bus timing. This is defined as signals, logic-level glitches, setup, or hold times that are shorter than the minimums specified by the SMBus specification. The device is not required to operate normally, but must return to normal operation once 'in spec' clock and data timing is again received. Note if the device 'misses' a clock from the master due to noise or other bus errors, the device must continue to accept 'in spec' clocks and re-synch with the master on the next START or STOP condition.

4.3 Additional SMBus hardware requirements

The power supply shall not load the SMBus if it has no input power

5 PMBus commands

The follow are the PMBus command required by PMBus enabled hot swap controllers.

5.1 Summary

Name	Code	SMBus transaction(s)	Description
CLEAR_FAULTS	03h	Send Byte w/PEC	Clears all status bits
CAPABILITY	19h	Read Byte w/ PEC	
STATUS_WORD (recommended)	79h	Read Word w/PEC	
low	7		Not used
	6		0 = Hot swap gate drive enabled 1 = Hot swap gate drive disabled
	5		Not used
	4		0 = No OC fault 1 = OC fault
	3		0 = No input under voltage fault detected 1 = input under voltage fault detected
	2		Not used
	1		0 = no communication error 1 = communication error
	0		0 = no other asserted status bits 1 = other status bits are asserted
high	7		0 = no Vout fault 1 = Vout fault
	5		0 = no input fault 1 = input fault
	4		0 = no fault on FET 1 = FET fault
	3		0 = power good is asserted 1 = power good not asserted
	0 – 2		Not used
READ_EIN (desired power monitoring method)	86h	Block Read w/ PEC	See READ_EIN section. Direct format. Coefficients reported by device or defined in data sheet. For devices relying on data sheet to report coefficients these coefficients shall be defined with different sense resistor values.
READ_VIN	88h	Read Word w/PEC	Input voltage reading. Direct format. Units in volts.
READ_PIN (needed only if READ_EIN is not supported)	97h	Read Word w/PEC	See READ_PIN section. Direct format. Coefficients reported by device or defined in data sheet. For devices relying on data sheet to report coefficients these coefficients shall be defined with different sense resistor values.
PMBUS_REVISION	98h	Read Byte w/PEC	
MFR_ID	99h	Block Read w/PEC	
MFR_MODEL	9Ah	Block Read w/PEC	
MFR_REVISION	9Bh	Block Read w/PEC	

5.2 READ_EIN (Block Read with PEC)

This is the preferred command to support input power monitoring. This command provides a more flexible method for power sensing so that the system can get faster or slower power data depending upon how fast it polls the device. Below are more details on the command and reported values.

- Low / High byte power accumulator format: PMBus Direct format. Reports 2's compliment signed value in watts where coefficient values are defined in the data sheet for different sense resistor values.
- Accumulator roll-over counters: 1 byte non-singed value counting the number of times the 2 byte power accumulator value changes from 7FFFh to 0000h.
- 3 byte non-signed value for sample counter

- The sample counter and power accumulator values must be coherent so that any time the system accesses the READ_EIN command the device returns a sample count and power accumulator value that have the same time reference.
- Direct format coefficients: The device data sheet shall define default coefficient values based on different sense resistor values to report units of watts for the power accumulator. If the device supports the COEFFICIENT command there must be a method for the system to set the coefficients to align with different sense resistor values allowing the device to report values in watts.
- Maximum sampling period of about 200msec
- Minimum rollover of the sample counter and power accumulator of about 5 seconds when monitoring 1000W
- Voltage range: 4.5V to 15V (other applications may include device for -36VDC to -75VDC & +48VDC)
- Current sense range: 10A to 100A (current may change depending upon voltage range supported)
- Default of continuous sampling. This means whenever the hot swap controller has input voltage it is sampling the input voltage and current.
- Reset: The READ_EIN power accumulator, roll-over counter, and sample count should keep the latest value when the input voltage is present. The values shall be maintained if the controller has turned off the hot swap FET. The values shall be reset to 00 only if input voltage is lost.

5.3 READ_PIN (Read Word with PEC)

This is the required method to read input power if the READ_EIN command is not supported.

- Direct format
- Direct format coefficients: The device data sheet shall define default coefficient values based on different sense resistor values to report units of watts for the power accumulator. If the device supports the COEFFICIENT command there must be a method for the system to set the coefficients to align with different sense resistor values allowing the device to report values in watts.
- ~200msec averaging
- Voltage range: 4.5V to 15V (other applications may include device for -36VDC to -75VDC; +48VDC
- Current sense range: 10A to 100A (current may change depending upon voltage range supported)
- Default of continuous sampling. This means whenever the hot swap controller has input voltage it is sampling the input voltage and current.

5.4 Translating READ_PIN and READ_EIN to units of Watts

There are two options for the hot swap controller to report values and translate them into units of watts to the system.

1. Automatic unit reporting with devices supporting the COEFFICIENT command: If the device supports the COEFFICIENT command, then the system can read the values in the device directly into units of Watts. In this case the device must support a method for the system to define the sense resistor value to the device either through pin strapping or through software into nonvolatile memory.
2. Manual unit reporting with devices that state coefficient values in their data sheet: If the device does not support the COEFFICIENT command, it must report the coefficients via the data sheet. The data sheet must provide a method to report different coefficient values for any possible current sense resistor value. In this case the system saves the coefficients in non-volatile memory to allow it to translate values from the hotswap control into Watts.

Unit Reporting Method	COEFFICIENT	Location R_{sense} value stored in non-volatile memory	Coefficients reported via …
1) Automatic	Supported	In Hotswap controller	COEFFICIENT command
2) Manual	Not Supported	On motherboard	Data Sheet for any R_{sense} value

5.5 Resetting STATUS_WORD bits

Only the CLEAR_FAULTS command is required to clear individual status bits. The device is not required to clear individual bits in STATUS_WORD.

5.6 Accuracy

The overall accuracy is required to be +/-5% over a current sense voltage range of 8mV to 25mV using a +/-2% sense resistor when tested at 12V +/-5% and 18ºC to 50ºC.