Technical Article

Digital Signals and Controls

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Digital signals and controls are in increasing demand in building management, telecommunications and networking applications. One of the main requirements is for intelligent microcontroller-based interfaces to be incorporated into the power supplies which drive the overall system.

An example of such an interface developed by XP Power, and implemented on its EMH250 and 350 high density power supplies enables the control of a number of power supply functions and monitoring of various parameters.

Communication is achieved using the industry standard PMBus protocol over a three wire (SDA, SCL & Gnd) I2C interface. The power supply acts as the slave device and is accessed via a unique 7-bit address allowing up to 30 individual units to communicate over a common bus.

Controls

The digital interface allows the output voltage to be adjusted via the PMBus and the microcontroller also activates the overload protection that can also be programmed over this bus. The microcontroller can be factory programmed to cater for application specific requirements such as high peak loads & timed power boost. As standard, the interface allows voltage adjustment of +/-10% and overload protection adjustment from 0 – 110%.

Signals

The following parameters are measured by the microcontroller and communicated via the PMBus:

- Output Voltage
- Output Current
- Fan Supply Voltage
- Internal Ambient Temperature
- Fan Status (Fan warning alert after 30 seconds. Fan fail alert after 1 minute 30 seconds)

Supported PMBus Commands

Command Code	Command Name	SMBus Transaction Type	Number of Data Bytes
81h	STATUS_FANS_1_2	Read Byte	1
8Ah	READ_VCAP	Read Word	2
8Bh	READ_VOUT	Read Word	2
8Ch	READ_IOUT	Read Word	2
8Dh	READ_TEMPERATURE_1	Read Word	2
98h	PMBUS_REVISION	Read Byte	1
99h	MFR_ID	Block Read	Variable
9Ah	MFR_MODEL	Block Read	Variable
9Bh	MFR_REVISION	Block Read	Variable
9Eh	MFR_SERIAL	Block Read	Variable
D0h	READ_VFAN*	Read Word	2
E4h	VOLTAGE_TRIM*	Write Byte	1
E5h	CURRENT_LIMIT_TRIM*	Write Byte	1

Figure 1 - Supported PMBus Commands

*These are manufacturer specific commands

Data transfer

All data transactions are initiated by a START (S) bit where the data line (SDA) is pulled from low to high while the clock (SCL) is held high. Subsequent to this the 7-bit device address is sent followed by a WR bit (R/W=0) and then an acknowledge (A) bit. Acknowledge bits are sent from the slave to the master and vice versa depending on the transaction type. Following this the 8-bit PMBus command is sent followed by an A bit. This start procedure is standard for all commands and any differences will be found by the second A bit.

All transactions end with a stop (P) bit. The three standard transaction types are shown below in Figure 2 together with a typical timing diagram for the write byte transaction. Grey boxes indicate that the data is being transferred from the slave to the master. For further information refer to the PMBus 1.1 specification.

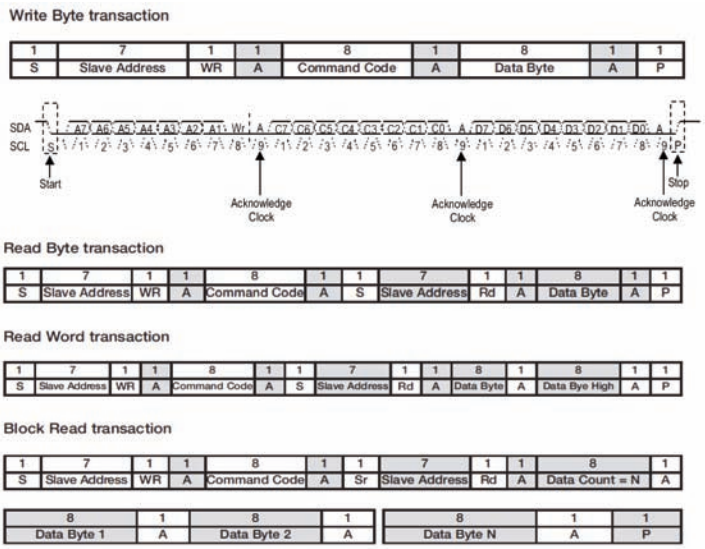

Figure 2 – data byte structure

Custom commands

STATUS_FANS_1_2 bits. These bits change depending on the fault condition generated. After 30 seconds of the fan tacho output measuring a fault condition the Fan 1 warning is flagged, after an additional 30 seconds of the tacho output measuring a fault condition Fan 1 failure is flagged.

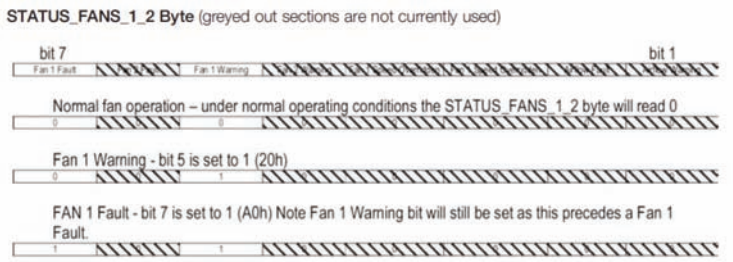

Figure 3 – Status fans fault indication

VOLTAGE_TRIM and CURRENT_TRIM commands

Both of these commands are used to set internal references to trim the output voltage & set the current limit. Should the device power down the last known values for both outputs are restored on power up.

The VOLTAGE_TRIM command accepts a HEX value between 0 and 65; any value greater than 65 is ignored and assumed to be 65. 0 and 65 will set the minimum and maximum trim values as per the power supply specification with the default set at nominal output voltage during manufacture.

The CURRENT_TRIM command also accepts a HEX value between 0 and 65; again any value above 65 is assumed to be 65.0 and 65 will set the current limit between its minimum and maximum values as per the power supply specification.

READ_VFAN

This command operates in the same way as standard PMBus read voltage commands.

Summary

The modular structure adopted for the device code allows for it to be readily adapted facilitating changes to meet customer and application specific requirements. Additional functions include the ability to interrogate serial number, model number and manufacturing date codes.

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09-Feb-11