Technical Article

Is PMBus Still Useful without Telemetry?

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PMBus is an Inter-Integrated Circuit (I^2C)-based communication standard/interface for power-supply management. Many point-of-load (POL) converters on the market today are built with the PMBus interface, which enables digital communication between converters and their hosts. The host can be any microcontroller, microprocessor, computer, board-management controller, automatic test equipment or application-specific integrated circuit/field-programmable gate array. There are four general types of communication between the converter and host: command, control, sequence and monitor. A PMBus device can support any combinations of the above communication types.

To know which PMBus device to choose for a particular application depends on the application environment and price point. Generally, PMBus devices designed to provide monitoring functions such as input voltage, input current, output voltage, output current and die temperature have significantly higher silicon and design costs because of the addition of a precision analog-to-digital converter circuit design.

The monitoring capability through PMBus is generally referred to as "telemetry." Figure 1 shows a graphical user interface (GUI) generated by TI's Fusion Digital Power™ designer software. The GUI displays three telemetries: output voltage, output current and temperature.

Telemetry is also very useful in systems where data analysis and system characterization are essential. In high-reliability systems where live performance monitoring and failure analysis are absolute musts, the right kind of telemetry can provide great value.

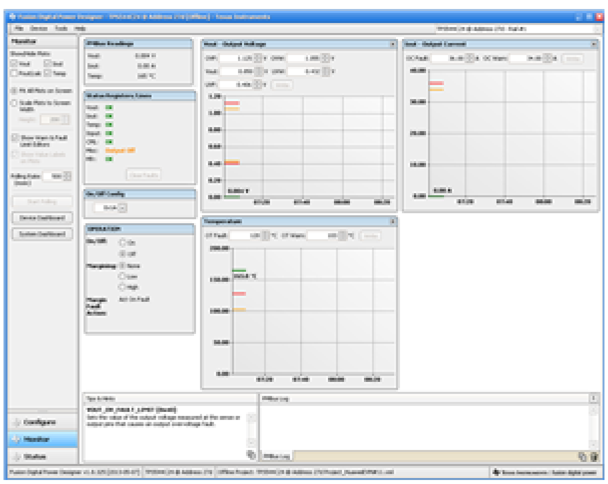

Figure 1. TI Fusion Digital Power GUI for Live Telemetry Reading

Even though telemetry is a very useful feature in a PMBus device, not every system or application has the right environment or the need to take advantage of the feature, especially since PMBus devices with telemetry normally cost more than devices without telemetry. But the value and benefit of PMBus is so compelling that even without telemetry, it is still worth your consideration.

One of the major benefits of PMBus is the cost savings that it brings to the overall system bill of materials (BOM). Integrating the PMBus interface into the POL converter eliminates external pin-strapping components that analog designs need to program converter configurations such as switching frequency, current limit, under voltage lockout, soft-start time, power good delay and voltage margining/tracking components.

Figure 2 shows the waveform of adaptive voltage scaling behavior by using the TPS549D22, a 40A PMBus synchronous step-down converter. A voltage identification digital (VID) chip like the TI LM10011 – with several resistors to support the identical voltage scaling functionalities – is necessary to support the series of digital events shown in Figure 2. The PMBus benefit includes not only BOM cost optimization, but also the printed circuit board area reduction achieved by fewer components and routing traces.

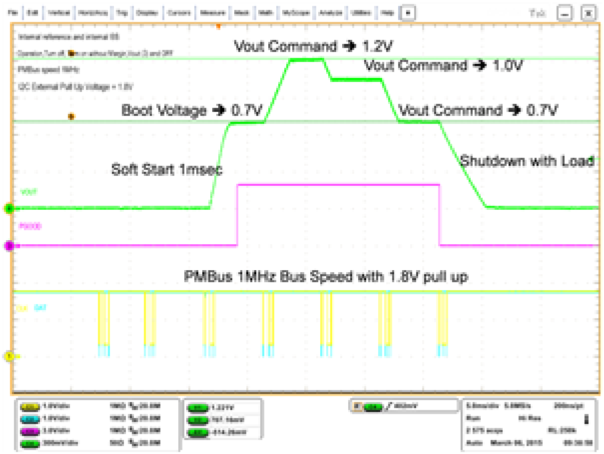

Figure 2. TPS549D22 Digital Events Driven by a 1MHz PMBus Device

TI offers several unique high performance and high current converter families. Figure 3 summarizes TI's PMBus and multi-chip module (MCM) converter products, including the TPS549D22, which is the highest current rated (40A) synchronous buck converter with PMBus, albeit without telemetry. Figure 4 shows the detailed PMBus command sets for the TPS549D22.

Device	12A	15A	40A	20A	30A	35A	20A	30A
P/N	TPS53915	TPS549A20 (ptp with TPS53915)	TPS549D22	TPS544B25	TPS544C25 (ptp to B25)	TPS546C20/23	TPS544B20	TPS544C20
Control Mode	DCAP3			Fixed Frequency Voltage Mode with Input Feed-forward			DCAP2	
Vin Range	1.5V to 18V	1.5V to 20V	1.5V to 16V	4.5V to 18V			4.5V to 18V	
Vout Range	0.6V to 5.5V			0.5V to 5.5V			0.6V to 5.5V	
PMBus capability	Programming/ Configuration/ Margining			Programming/ Configuration/ Margining + Telemetry RESET to VOUT_COMMAND back to the initial boot voltage set @ startup w/o power cycling			Programming/ Configuration/ Margining + Telemetry	
Special Features	0.5% 0.6V Vref accuracy, Eco Mode, No external compensation, up to 1MHz Fsw		0.5% 0.9V Vref accuracy from -40°C to +125°C Tj, Remote Differential Voltage Sensing, up to 1MHz Fsw	1% 0.6V Vref accuracy from -40°C to +125°C, Remote Differential Voltage Sensing, up to 1MHz Fsw		Stackable x 2 for 70A Output Current 0.5% 0.6V Vref accuracy from -40°C to +85°C, Remote Differential Voltage Sensing, up to 1MHz Fsw	1% 0.6V Feedback Pin accuracy (includes loop comparator input offset errors) from -40°C to +125°C Tj, Remote Differential Voltage Sensing, up to 1MHz Fsw	
HS/LS FET Rds_ON	13.8/5.9m Ohm	9.9/4.3mOhm	2.9/1.2mOhm	5.5/2mOhm		3.2/1.4mOhm	4.5/2.1mOhm	
FSYNC	No			Yes, 200KHz to 1MHz			No	
AVS	VREF_TRIM (MFGR_SPECIFIC_04), D4h		VOUT_COMMAND (21h)	VOUT_COMMAND (21h) and VOUT_SCALE_LOOP			VREF_TRIM (MFGR_SPECIFIC_04), D4h	
Package	3.5x4.5 QFN single GND Pad Powerstack™		5x7 QFN single GND Pad Powerstack™					

Figure 3. PMBus Converter Selection at a Glance

CMD CODE (HEX)	COMMAND NAME (PMBus 1.2 spec)
0	PAGE
1	OPERATION
2	ON_OFF_CONFIG
3	CLEAR_FAULTS
10	WRITE_PROTECT
11	STORE_DEFAULT_ALL
12	RESTORE_DEFAULT_ALL
15	STORE_USER_ALL
16	RESTORE_USER_ALL
19	CAPABILITY
1B	SMBALERT_MASK
20	VOUT_MODE (2 bytes)
21	VOUT_COMMAND
24	VOUT_MAX
25	VOUT_MARGIN_HIGH
26	VOUT_MARGIN_LOW
27	VOUT_TRANSITION_RATE
29	VOUT_SCALE_LOOP
35	VIN_ON
36	VIN_OFF
39	IOUT_CAL_OFFSET
40	VOUT_OV_FAULT_LIMIT
41	VOUT_OV_FAULT_RESPONSE
42	VOUT_OV_WARN_LIMIT
43	VOUT_UV_WARN_LIMIT
44	VOUT_UV_FAULT_LIMIT
45	VOUT_UV_FAULT_RESPONSE
46	IOUT_OC_FAULT_LIMIT
47	IOUT_OC_FAULT_RESPONSE
4A	IOUT_OC_WARN_LIMIT
4F	OT_FAULT_LIMIT

CMD CODE (HEX)	COMMAND NAME (PMBus 1.2 Spec)
50	OT_FAULT_RESPONSE
51	OT_WARN_LIMIT
60	TON_DELAY
61	TON_RISE
62	TON_MAX_FAULT_LIMIT
63	TON_MAX_FAULT_RESPONSE
64	TOFF_DELAY
65	TOFF_FALL
78	STATUS_BYTE
79	STATUS_WORD
7A	STATUS_VOUT
7B	STATUS_IOUT
7C	STATUS_INPUT
7D	STATUS_TEMPERATURE
7E	STATUS_CML
80	STATUS_MFR_SPECIFIC
8B	READ_VOUT
8C	READ_IOUT
8E	READ_TEMPERATURE_2
98	PMBUS_REVISION
A4	MFR_VOUT_MIN
AD	IC_DEVICE_ID
AE	IC_DEVICE_REV
D0	MFR_SPECIFIC_00, SCRATCH PAD
D1	MFR_SPECIFIC_01, DELAY_CONTROL
D2	MFR_SPECIFIC_02, SOFT START & MODE
D3	MFR_SPECIFIC_03, FREQUENCY SETTING
D4	MFR_SPECIFIC_04, VOUT ADJ +/-0.75%
D5	MFR_SPECIFIC_05, VOUT_MARGIN
D6	MFR_SPECIFIC_06, UVLO THRESHOLD
D7	MFR_SPECIFIC_07 TRK THRESHOLD
FC	Read GUI device ID and IC rev

Figure 4. Total PMBus Command Sets Supported by the TPS549D22

Today, PMBus is widely adopted as an effective communication means between the load and its power supply source during design, production test and every day in-system usage. Choosing the right PMBus feature for the power supply application becomes increasingly critical due to multiple considerations contributing to the success of the overall design, including functionality, performance and cost. PMBus without telemetry is still useful when it comes to configuring and controlling all the power sources, and the high integration simplifies design.

For more information on designing with PMBus, read the Power House blogs "PMBus benefits in multi-rail systems," and "Save PCB space and overcome point-of-load design complexity with PMBus modules."