PMBus Power Solution Guide
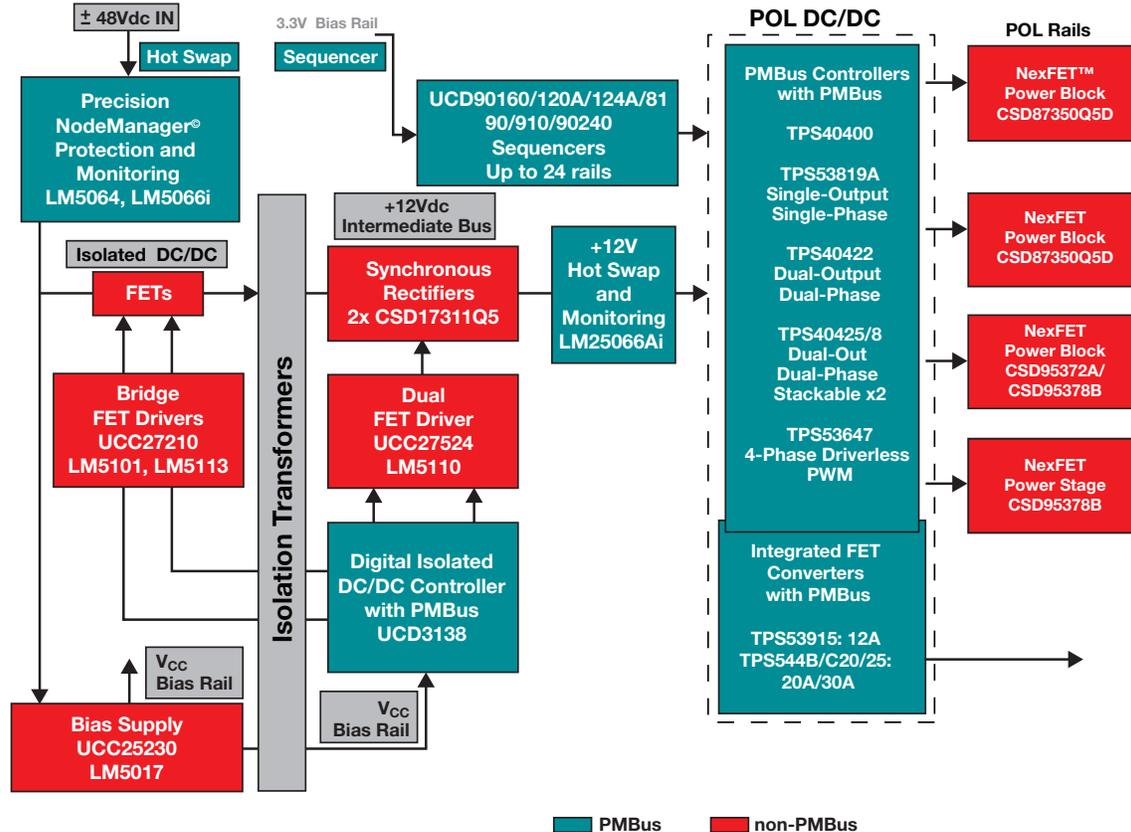
For Power Supply Configuration, Control and Monitoring

PMBus
Power Management.
Defined.

Texas Instruments

Overview

The industry-standard PMBus protocol facilitates communication with power converters and other devices in a power system. Using PMBus can increase power density and reliability of power supplies and optimize component performance and efficiency with reduced design time, risk and cost. TI enables complete industry-standard PMBus power supply designs with a broad portfolio of power protection/monitors, isolated PWM controllers, point-of-load single-/multi-output and single-/multi-phase PWM controllers, and DC/DC converters.

PMBus Power Chain

± 48Vdc IN

Hot Swap

3.3V Bias Rail

Sequencer

Precision NodeManager© Protection and Monitoring LM5064, LM5066i

UCD90160/120A/124A/8190/910/90240 Sequencers Up to 24 rails

POL DC/DC

POL Rails

PMBus Controllers with PMBus

TPS40400

TPS53819A Single-Output Single-Phase

TPS40422 Dual-Output Dual-Phase

TPS40425/8 Dual-Out Dual-Phase Stackable x2

TPS53647 4-Phase Driverless PWM

NexFET™ Power Block CSD87350Q5D

NexFET Power Block CSD87350Q5D

NexFET Power Block CSD95372A/ CSD95378B

NexFET Power Stage CSD95378B

Isolated DC/DC

FETs

+12Vdc Intermediate Bus

Synchronous Rectifiers 2x CSD17311Q5

+12V Hot Swap and Monitoring LM25066Ai

Isolation Transformers

Bridge FET Drivers UCC27210 LM5101, LM5113

Dual FET Driver UCC27524 LM5110

Integrated FET Converters with PMBus

TPS53915: 12A TPS544B/C20/25: 20A/30A

Digital Isolated DC/DC Controller with PMBus UCD3138

V$_{CC}$ Bias Rail

V$_{CC}$ Bias Rail

Bias Supply UCC25230 LM5017

■ **PMBus**   ■ **non-PMBus**

TI PMBus Solution Benefits:

- Optimize power density by reading back actual current draw and re-adjusting power stage components.
- Increase overall reliability and reduce total solution cost by integrating components and optimizing the power stage design based on actual power draw.

- Reduce design time by margining, programming, and verifying the new design values with the PMBus GUI to dramatically reduce development and validation phase for new designs.
- Minimize risk by optimizing future designs through field power consumption data collection and making appropriate value adjustments via the PMBus GUI.

PMBus Power Solution Guide

Streamline your complete power system with TI's extensive portfolio of PMBus product solutions, design tools and technical resources.

PMBus SWIFT™ Buck Converters

Device	Description	VIN (V)	VOUT (V)	IOUT (A)	Integrated MOSFETs	PMBus Telemetry	Frequency Synch.
TPS53915	4.5V to 25V bias, 12A synchronous buck converter	1.5 to 18	0.6 to 5.5	12	Yes	No	No
TPS544B20	4.5V to 18V, 20A synchronous buck converter	4.5 to 18	0.6 to 5.5	20	Yes	Yes	No
TPS544C20	4.5V to 18V, 30A synchronous buck converter	4.5 to 18	0.6 to 5.5	30	Yes	Yes	No
TPS544B25	4.5V to 18V, 20A synchronous buck converter	4.5 to 18	0.5 to 5.5	20	Yes	Yes	Yes
TPS544C25	4.5V to 18V, 30A synchronous buck converter	4.5 to 18	0.5 to 5.5	30	Yes	Yes	Yes

PMBus Buck Controllers

Device	Description	VIN (V)	VOUT (V)	IOUT (A)	Integrated MOSFETs	PMBus Telemetry
TPS40400	3.0V to 20V synchronous buck controller	3 to 20	0.6 to 5.6	30	No	Yes
TPS40422	4.5V to 20V dual-output or multi-phase synchronous buck controller	4.5 to 20	0.6 to 5.6	60	No	Yes
TPS40425	4.5V to 20V dual-output, dual-phase stackable driverless controller	4.5 to 20	0.6 to 3.6	160	No	Yes
TPS40428	4.5V to 20V dual-output, dual-phase stackable driverless controller for use with smart Power Stage	4.5 to 20	0.6 to 3.6	160	No	Yes
TPS53631	4.5V to 17V, 3-phase, D-CAP+™ mode controller with smart Power Stage	4.5 to 17	0.5 to 2.5	120	No	Yes
TPS53641	4.5V to 17V, 4-phase, D-CAP+ mode controller with smart Power Stage	4.5 to 17	0.5 to 2.5	160	No	Yes
TPS53661	4.5V to 17V, 6-phase, D-CAP+ mode controller with smart Power Stage	4.5 to 17	0.5 to 2.5	240	No	Yes
TPS53640	4.5V to 17V, 3-phase, D-CAP+ mode controller with Inductor DCR	4.5 to 17	0.5 to 2.5	120	No	Yes
TPS53640A	4.5V to 17V, 4-phase, D-CAP+ mode controller with Inductor DCR	4.5 to 17	0.5 to 2.5	160	No	Yes
TPS53647	4-Phase, D-CAP+, step-down, buck controller with NVM and PMBus interface	4.5 to 17	0.5 to 2.5	160	No	Yes
TPS53819A	3.0V to 28V single synchronous buck controller	3 to 28	0.6 to 5.5	30	No	No

PMBus System Protection and Monitoring Solutions

Device	Description	VIN (V)	Hotswap Protection	Voltage Telemetry Accuracy (VIN/VOUT)	Current Telemetry Accuracy	Power Telemetry Accuracy	Node Manager Compliant
LM25056/A	3V to 17V system power measurement	3 to 17	No	± 1%	± 0.5%	± 3%	No
LM25066	2V hot swap system power management and protection	3 to 17	Yes	± 1.4%	± 2.4%	± 3%	No
LM25066A	Hot swap system power management and protection	3 to 17	Yes	± 1%	± 1%	± 2%	No
LM25066I	Intel Node Manager-compliant hot swap system power management and protection	3 to 17	Yes	± 1.4%	± 2.4%	± 3%	Yes
LM25066IA	Intel Node Manager-compliant hot swap system power management and protection	3 to 17	Yes	± 1%	± 1%	± 2%	Yes
LM5066	High-voltage hot swap system power management and protection	10 to 80	Yes	± 2.7%	± 3%	± 4.5%	No
LM5066i	Intel Node Manager-compliant high-voltage hot swap system power management and protection	10 to 80	Yes	± 1.25%	± 1.75%	± 4.5%	Yes
LM5056/A	10V to 80V system power measurement	10 to 80	No	± 1%	± 1.25%	± 1.75%	No
LM5064	Negative high-voltage hot swap system power management and protection	10 to 80	Yes	± 2.7%	± 3%	± 4.5%	No

Digital PMBus Point-of-Load PWM Controllers

Device	Description	Rails	Phases (per rail)	Monitoring pins	VID Support	Switching Frequency (MHz)	PMBus Programming and Telemetry
UCD9248	Negative high-voltage hot swap system power management and protection	4	8/8	13	No	2	Yes
UCD9246	Quad-output, six-phase digital PWM system controller	4	6/6	9	No	2	Yes
UCD9224	Dual-output, quad-phase digital PWM system controller	2	4/4	7	No	2	Yes
UCD9244	Quad-output, quad-phase digital PWM system controller	4	4/1	9	Yes 4, 6, 8-bit	2	Yes
UCD9222	Dual-output, dual-phase digital PWM system controller	2	2/1	7	Yes 4, 6, 8-bit	2	Yes

Digital PMBus PWM Controllers for AC/DC and Isolated DC/DC Topologies

Device	Description	Program Memory	Package	Frequency (Max)	A/D Channels	Analog Comparators	Processor
UCD3138	Integrated digital controller for isolated power	32kB	QFN-40, VQFN-64	2MHz	7 or 14	6 or 7	31.25MHz 32-bit ARM®
UCD3138064	Integrated digital controller for isolated power with 64kB memory	64kB	QFN-40, VQFN-48, VQFN-64	2MHz	7, 9, or 14	6 or 7	31.25MHz 32-bit ARM
UCD3138128	Highly integrated digital controller for isolated power with 128kB memory	128kB	TQFP-80	2MHz	14	7	31.25MHz 32-bit ARM7

PMBus Power Solution Guide

Digital Power Sequencers, Health Monitors and Fan Controllers

Device	# of Rails Sequenced	# of Monitor Inputs	# of Voltage Margining Outputs	FAN Control	NV Fault Logs	Max GPI/GPO	PMBus Telemetry Control	PMBus Programming	PMBus Control
UCD90240	24	24	24	N/A	Yes	24/36*	Yes	Yes	Yes
UCD90160	16	16	10	N/A	Yes	8/16	Yes	Yes	Yes
UCD90120A	12	13	10	N/A	Yes	8/12	Yes	Yes	Yes
UCD9090	10	11	10	N/A	Yes	8/10	Yes	Yes	Yes
UCD90124A	12	13	10	4	Yes	8/12	Yes	Yes	Yes
UCD90910	10	13	10	10	Yes	8/10	Yes	Yes	Yes

* Max GPI/GPO counts do not include dedicated 24 rail enable pins and 24 margin pins. The max 36 GPO count includes 24 Command GPO pins and 12 Logic GPO pins.

PMBus Design Resources

Identifying a good product is just one of many steps when designing a complete power system. With that in mind TI offers several design resources, including WEBENCH® Designer, Fusion Digital Power™ Designer, TI Reference Designs, Technical Support Forums and much more to effectively assist customers throughout the complete design process.

WEBENCH® Designer

WEBENCH Designer enables customers to generate, optimize and simulate designs that conform to their unique specifications.
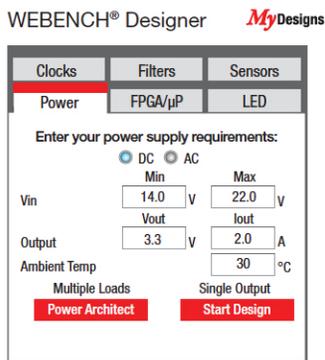
Fusion Digital Software

Fusion Digital Power™ Designer is the Graphical User Interface (GUI) used to configure and monitor select TI digital power controllers and monitors. The application uses the PMBus protocol to communicate with the device over serial bus via a TI USB adapter.
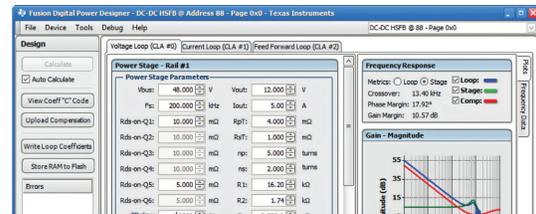
Digital Power Community Forums

TI's E2E™ design support community, Power House blog and instructional videos can be instrumental in streamlining your project.

PMP10896

System power solution with hot-swap, POLs and sequencer/supervisor

Features

- 12V/300W system power solution with eight point-of-load buck converters for three ASIC/FPGA cores, DDR3 core memory and auxiliary voltages found on high-performance Ethernet switches.
- PMBus communication configures hot-swap, SWIFT™ buck converters, multiphase PWM controllers and sequencer/supervisor.
- High-density power conversion utilizing inductor-over-IC layout.
- Voltage margining through PWM, PMBus and AVS bus.
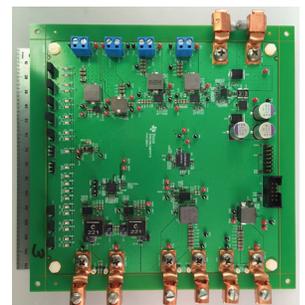
PMP10364

High density 30W DC/DC buck converter with the inductor mounted over the converter to save space

Key Features

- SWIFT™ TPS544C20 converter with PowerStack™ stacked FETs
- D-CAP™/D-CAP2™ control mode control for excellent step load response
- PMBus programmability and telemetry
- Fully synchronous controller for lowest losses

PMP9475

Xilinx® Ultrascale® Kintex® FPGA power solution with TPS40428 controller and TI iFET DC/DC converters

Key Features
- Provides all the supply rails needed to power a Xilinx Virtex® UltraScale™ FPGA
- Design optimized to support a 12V input
- PMBUS interface with output voltage and current reporting
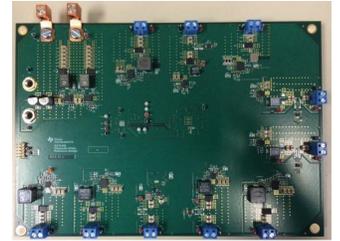
PMP9407

Xilinx® Ultrascale™ Virtex® FPGA Multi-Gigabit Transceiver (MGT) Power Solution with TPS544B20 converters and TPS40400 controller

Key Features
- Provides all the power rails needed to power MGT rails in a Xilinx Virtex Ultrascale FPGA
- Design optimized to support a 5V input
- On board power up and power down sequencing
- PMBUS interface with output voltage and current reporting

PMBus Reference Designs

TI's lab-tested PMBus reference designs come complete with circuit schematics, test results, PCB layouts, BOMs, and gerber files.

Reference Design	Description
PMP5098	Xilinx Virtex-6 FPGA power management solution
PMP6577	Xilinx 7 series multi-gigabit transceivers with 5V input voltage power management solution
PMP6594	Core voltage at 1V at up to 15A for Nyquist microprocessor; four per UCD9244 plus test load for one output
PMP6997	5V to 12V input, 0.9V to 3.3V, 20A output synchronous buck with PMBus
PMP7328	9V to 15V input, 1V at 60A, using TPS40422 multiphase buck PMBus controller
PMP7977	Xilinx Artix-7 FPGA power management solution
PMP7978	Xilinx Kintex-7 FPGA power management solution
PMP8342	12V input, 1V/45A compact point-of-load module with dual output option
PMP8411	12V input, 0.9V/90A power management solution with two stacked 45A modules
PMP8999	12V input, 1V/60A output using TPS40422 and Power Block II CSD87384, two phases with PMBus
PMP9008	12V input, 1V/30A output using TPS544C20 SWIFT™ converter with PMBus, optimized for small size
PMP9131	High density 160A (210A peak) 4-phase DC/DC buck converter with PMBus
PMP9407	Xilinx Ultrascale® Virtex FPGA multi-gigabit transceiver power management solution with SWIFT DC/DC converters
PMP9408	Xilinx Ultrascale Virtex FPGA multi-gigabit transceiver power management solution with PWM controllers
PMP9444	Xilinx Ultrascale Kintex FPGA power management solution
PMP9463	Xilinix Ultrascale Kintex FPGA multi-gigabit transceiver power management solution
PMP9475	Xilinx Virtex UltraScale FPGA power management solution
PMP9703	PMBus controlled voltage regulator for enterprise storage ASIC controller
PMP10000	60A 2-phase PMBus synchronous buck converter
PMP10364	High-density 30W DC/DC buck converter with inductor mounted over converter to save space
PMP10555	Xilinx Ultrascale 16nm FPGA/SoC power management solution for mobile radio basestation
PMP10778	20A ASIC adaptive voltage scaling power management solution for communication or enterprise storage

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TEXAS INSTRUMENTS

IMPORTANT NOTICE

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Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
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Applications

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Energy and Lighting	www.ti.com/energy
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