

TPS65320-Q1 and TPS65320C-Q1 Design Checklist

Frank Dehmelt

ABSTRACT

This application note for TPS65320-Q1 and TPS65320C-Q1, which are single high-voltage switch-mode asynchronous buck power supplies with an LDO regulator (see the corresponding device data sheet), lists the connection details for each pin. The pin details include a brief explanation of the function of each pin or signal and whether the signal is analog or digital. Use this information to check the connectivity for each pin on a system schematic.

In the event of any inconsistency between the official specification and any user's guide, application report, or other referenced material, the data sheet specification will be the definitive source. For the TPS65320-Q1 data sheet, see *TPS65320-Q1 40-V Step-Down Converter With Eco-mode™ and LDO Regulator*, [SLVSAY9](#). For the TPS65320C-Q1 data sheet, see *TPS65320C-Q1 36-V Step-Down Converter With Eco-mode™ and LDO Regulator*, [SLVSD50](#).

Table 1. TPS65320-Q1 and TPS65320C-Q1 Design Checklist

NAME	PIN NO.	TYPE	I/O ⁽¹⁾	DESCRIPTION	RECOMMENDED CONNECTION	UNUSED FEATURES
BOOT	1	Analog	O	A capacitor on this pin acts as the voltage supply for the high-side N-channel MOSFET gate-drive circuitry in the buck converter.	Connect a capacitor on the order of 100 nF between BOOT and SW; use low impedance, low inductance, and a small loop. Avoid using vias in the signal path.	N/A
COMP	12	Analog	O	Error amplifier output of buck and compensation node for voltage-loop stability. The voltage at this node sets the target for the peak current through the inductor.	Connect Type2 compensation network, designed for a bandwidth of one-sixth to one-tenth of f_{SW} . Calculate using the Component Selection Tool .	N/A
EN1	8	Digital	I	Enable input for Buck (with an internal pulldown resistor). An input voltage higher than 2.5 V enables the converter, whereas an input voltage lower than 0.7 V disables the converter. Note: if disabled, the LDO uses VIN as supply.	Pull high for activation, low to de-activate. Hard-wired or μ C-controlled	Buck is off if left open.
EN2	7	Digital	I	Enable input for LDO (with an internal pulldown resistor). An input voltage higher than 2.5 V enables the LDO, whereas an input voltage lower than 0.7 V disables the LDO.	Pull high for activation, low to de-activate. Hard-wired or μ C-controlled	LDO is off if left open.
FB1	11	Analog	I	Feedback-voltage pin for the buck. The buck converter regulates the feedback voltage to the internal reference of 0.8 V. A suitable resistor divider network between the buck output and the feedback pin sets the desired output voltage.	Choose resistor network to set FB1 voltage to 0.8 V, allow for $>10 \mu$ A current. For noise cancellation, a capacitor on the order of 47 pF to 100 pF in parallel with the lower resistor can help.	N/A

⁽¹⁾ I = Input; O = Output

Eco-mode is a trademark of Texas Instruments.

Table 1. TPS65320-Q1 and TPS65320C-Q1 Design Checklist (continued)

NAME	PIN NO.	TYPE	I/O ⁽¹⁾	DESCRIPTION	RECOMMENDED CONNECTION	UNUSED FEATURES
FB2	5	Analog	I	Feedback voltage pin for LDO. The buck controller regulates the feedback voltage to the internal reference of 0.8 V. A suitable resistor divider network between the buck output and the feedback pin sets the desired output voltage.	Choose resistor network to set FB2 voltage to 0.8 V; allow for >10 μ A current. For noise-cancellation, a capacitor on the order of 47 pF to 100 pF in parallel with the lower resistor can help.	N/A
GND	13	—	O	Ground reference	Provide a low-impedance, low-resistance path to GND, ideally to the GND plane. For lowest noise on the LDO, connect LDO to GND only underneath the IC.	N/A
LDO_OUT	4	Power	O	Linear regulator output. Decouple with a low-ESR ceramic output capacitor in the range of 1 μ F to 47 μ F connected from this terminal to ground.	Decouple with a low-ESR ceramic output capacitor in the range of 1 μ F to 47 μ F connected from this terminal to ground.	N/A
nRST	6	Digital	O	Active low, push-pull reset output, asserted high (at the actual LDO output voltage) after the LDO of the device starts regulating. Note, the pin does not indicate if the Buck is in regulation.	Connect to the interrupt input of the processor or leave open. An additional pullup of, for example, 10 k Ω can strengthen the output.	Leave open
RT/CLK	9	Analog	I	External resistor connected ground to program the internal oscillator. An alternative option is to feed an external clock to provide a reference for the switching frequency.	Connect a resistor to GND for appropriate frequency, for example, 300 k Ω for 400 kHz, 50 k Ω for 2.1 MHz.	N/A (Device does not switch if unconnected.)
SS	10	Analog	I	Soft-start input for buck converter. The buck controller regulates the FB1 voltage to the lower of 0.8 V or the SS pin voltage. An internal pullup current source of typically 2 μ A is present at the pin, and use of an appropriate capacitor connected here can set the soft-start ramp duration.	Connect a capacitor to GND for soft-start; calculate the capacitor value using the Component Selection Tool .	N/A
SW	14	Power	O	Source node of internal switching FET	Keep the trace to the inductor short and low impedance.	N/A
VIN	2	Power	I	Input for internal supply, and drain-node input for internal high-side MOSFET. Connect a bypass capacitor between this pin and ground to filter noise.	Decouple with a total capacitance on the order of 100 μ F, consisting of several smaller, different values in parallel (for example, 82 μ F, 10 μ F, and 2.2 μ F). Keep close to the IC with a low-impedance, low-inductance path. Avoid using vias in the signal path.	N/A
VIN_LDO	3	Power	I	The output of the buck is the LDO input when Buck and LDO are both ON. If Buck is disabled or out of regulation, VIN becomes the input. Alternately, another supply can power VIN_LDO. This supply must not exceed 20 V maximum and must be lower or equal to VIN-voltage. Indifferent if available, in case the Buck is disabled, VIN will still be the source for the LDO. Do not leave this pin un supplied.	This input shares the output capacitor of the buck. If the output capacitor of the buck is far away, decouple close to the pin with approximately 100 nF. If an alternative voltage source is used as LDO-supply, decouple locally with approximately 4.7 μ F plus approximately 100 nF.	N/A

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from A Revision (January 2015) to B Revision	Page
• Added part number TPS65320C-Q1.....	1
• Added data sheet reference SLVSD50 for TPS65320C-Q1.....	1
• Added alternate power supply information.....	2

Changes from Original (April 2013) to A Revision	Page
• Changed the description, recommended connection, and unused features for EN1 and EN2	1

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com