User's Guide TPS5442x5 Step-Down Converter Evaluation Module User's Guide

TEXAS INSTRUMENTS

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1 Introduction

The PWR681EVM evaluation module uses either the TPS544B25 or TPS544C25 devices. The TPS544B25 and TPS544C25 are highly integrated synchronous buck converters that are designed for up to 20-A or 30-A current output, respectively.

2 Description

The PWR681EVM is designed as a single output DC-DC converter that demonstrates either the TPS544B25 or the TPS544C25 in a typical low-voltage application while providing a number of test points to evaluate the performance. It uses a nominal 12-V input bus to produce a regulated 0.95-V output at up to either 20-A or 30-A of load current, depending on the device installed.

2.1 Typical End-User Applications

- High-Density Power Solutions
- Communications Equipment
- Servers and Computing Equipment
- Smart Power Systems

2.2 EVM Features

- Regulated 0.95-V output up to 30-ADC, steady-state output current
- Configuarable features via the PMBus interface include:
 - Programmable Output Voltage via the PMBus Interface
 - Programmable UVLO, Soft Start, and Enable via the PMBus Interface
 - Programmable Overcurrent Warning, Fault Limits and Programmable Response to Faults via the PMBus Interface
 - Programmable Overvoltage, Undervoltage Warning, Fault Limit and Programmable Response to Faults via the PMBus Interface
 - Programmable external Overtemperature Warning, Fault Limit and Programmable Response to Faults via the PMBus Interface
- Convenient Test Points for Probing Critical Waveforms
- Optional External Temperature Sensor

3 EVM Electrical Performance Specifications

Table 3-1. PWR-681EVM Electrical Performance Specifications

	PARAMETER	TEST CONDITIONS	MIN TYP	MAX	UNITS
Input (Characteristics		·		
	Voltage range	V _{IN}	4.5 12	18	V
	Maximum input current	V _{IN} = 8 V, I _O = 30 A		5	А
	No load input current	V _{IN} = 12 V, I _O = 0 A	42		mA
Output	t Characteristics		l.		
V _{OUT}	Output voltage	Output current = 10 A	0.95		V
I _{OUT} Output load current		I _{OUT(min)} to I _{OUT(max)}	0	30	А
	Output voltage regulation	Line regulation: input voltage = 4.5 V to 18 V	0.5%		
		Load regulation: output current = 0 A to I _{OUT(max)}	0.5%		
V _{OUT}	Output voltage ripple	V _{IN} = 12 V, I _{OUT} = 30 A	20		mV _{PP}
V _{OUT}	Output overcurrent		36		А
Syster	ns Characteristics		ŀ		
	Switching frequency	F _{sw}	500		kHz
V _{OUT}	Peak efficiency	V _{IN} = 12 V, I _O = 13 A, F _{SW} = 500 kHz	88%		
	Operating temperature	T _{oper}	0	105	°C

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4 Schematic



Figure 4-1. PWR-681EVM Schematic



5 Test Setup

5.1 Test and Configuration Software

To change any of the default configuration parameters on the EVM, it is necessary to obtain the TI Fusion Digital Power Designer software. This can be downloaded from the TI website.

5.1.1 Description

The Fusion Digital Power Designer is the graphical user interface (GUI) used to configure and monitor the Texas Instruments TPS544B25 or TPS544C25 power converter installed on this evaluation module. The application uses the PMBus protocol to communicate with the controller over serial bus by way of a TI USB adapter. This adapter can be purchased at http://www.ti.com/tool/usb-to-gpio.

Note

The TI USB adapter must be purchased separately. It is not included with this EVM kit.

5.1.2 Features

Some of the tasks performed with the GUI include:

- Turn on or off the power supply output, either through the hardware control line or the PMBus operation command.
- Monitor real-time data. Items such as input voltage, output voltage, output current, temperature, and warnings and faults are continuously monitored and displayed by the GUI.
- Configure common operating characteristics such as VOUT, UVLO, soft-start time, warning and fault thresholds, fault response, and ON/OFF.

This software is available for download at http://www.ti.com/tool/fusion_digital_power_designer

5.2 Test Equipment

Voltage Source: The input voltage source VIN must be a 0-V to 18-V variable dc source capable of supplying at least 8 A_{DC}. Connect VIN to J1 Figure 5-1.

Multimeters: It is recommended to use two separate multimeters Figure 5-1. One meter is used to measure V_{IN} and one to measure V_{OUT} .

Output Load: A variable electronic load is recommended for testing Figure 5-1. It must be capable of 30 A at voltages as low as 0.9 V.

Oscilloscope: An oscilloscope is recommended for measuring output noise and ripple. Output ripple must be measured using a tip-and-barrel method or better as shown in Figure 5-2. The scope must be adjusted to 20-MHz bandwidth, ac coupling at 50 mV/division, and must be set to 1-µs/division.

Fan: During prolonged operation at high loads, it may be necessary to provide forced air cooling with a small fan aimed at the EVM. Temperature of the devices on the EVM must be maintained below 105°C.

USB-to-GPIO Interface Adapter: A communications adapter is required between the EVM and the host computer. This EVM was designed to use the Texas Instruments USB-to-GPIO Adapter. This adapter can be purchased at http://www.ti.com/tool/usb-to-gpio.

Recommended Wire Gauge: The voltage drop in the load wires must be kept as low as possible in order to keep the working voltage at the load within its operating range. See the following table for recommended wire gauge and length to achieve a voltage drop of no more than 0.2 V at the maximum 30-A load.

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AWG GAUGE	OHMS PER FOOT (Ω)	LOAD WIRES COMBINED LENGTH (Ft)	EACH WIRE LENGTH (Ft)
12	1.59E-3	6.30	3.15
14	2.53E-3	3.96	1.98
16	4.02E-3	2.49	1.25
18	6.39E-3	1.57	0.78

Note

If AWG 12 wire is used, no more than 3.15 feet of wire must be used between the EVM and the load.

5.3 The PWR-681EVM



Figure 5-1. PWR-681EVM Overview



Tip and Barrel V_{OUT} Ripple Measurement Figure 5-2. Tip and Barrel Measurement

5.4 List of Test Points, Jumpers ans Switch

ITEM	TYPE	NAME	DESCRIPTION					
TP1	T-H loop	SW	Power supply Switch Node					
TP2	T-H loop	CH-B	Measure loop stability					
TP3	T-H loop	CH-A	Measure loop stability					
TP4	T-H loop	V_sense +	Remote sense +					
TP5	T-H loop	V_sense –	Remote sense –					
TP6	T-H loop	Vout	Use this V _{OUT} for efficiency measurements					
TP7	Т-Н Іоор	SYNC/RST	Input a sync signal from a clock source; or apply logic low signal to RESET V_{OUT} to initial boot-up voltage set by VSET pin. Refer to the Datasheet for details.					
TP8	T-H loop	VDD	Supplies the internal circuitry					
TP9	T-H loop	SMB_Alert	Monitor alerts					
TP10	T-H loop	GND	Common GND					
TP11	T-H loop	Tsns/SS	Monitor the voltage on the TSNS/SS pin					
TP12	T-H loop	PGOOD	PGOOD (also drives LED lamp)					
TP13	T-H loop	V _{OUT}	Use for tip-barrel ripple measurement					
TP14	T-H loop	GND	Use for tip-barrel ripple measurement					
JP1	2-pin jumper	LED Vin	Remove jumper to measure Vin for efficiency. Replace jumper and LED lights with PGOOD.					
JP2	2-pin jumper	CNTL	Shunts control pin to GND (turns off the IC for default configuration of ON_OFF_CONFIG, refer to the Datasheet for details)					
S1	SPDT switch	TSNS and SS Switch	Switch between external temperature sensor and SS resistor to be connected to TSNS/SS pin					

Table 5-1. The Function of Each Test Point

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6 EVM Configuration Using the Fusion GUI

The TPS544B25 or TPS544C25 installed on this EVM leave the factory pre-configured. See Table 6-1 for a short list of key factory configuration parameters as obtained from the configuration file.

ADDRESS HEX	ADDRESS DEC	PART ID					
0x24	36	TPS544x25					
		GENERAL					
CMD Code	CMD CODE HEX	ENCODED HEX	DECODED	COMMENTS			
VIN_OFF	0x36	0xF010	4.0 V	Turn OFF voltage			
VIN_ON	0x35	0xF012	4.5 V	Turn ON voltage			
IOUT_CAL_OFFSET	0x39	0xE000	0.0000 A	Current offset for GUI readout			
	0×46	0xF848 (TPS544C25)	36 A				
	0,40	0xF830 (TPS544B25)	24 A				
IOUT_OC_FAULT_RESPONSE	0x47	0xBF	Restart	Response to OC fault			
IOUT OC WARN LIMIT	0×44	0xF844 (TPS544C25)	34 A				
	0,44	0xF82C (TPS544B25)	22 A				
VOUT_COMMAND	0x21	0x01E6	0.95 V	output voltage			
VOUT_MAX	0x24	0x0300	1.5 V	maximum output voltage			
VOUT_TRANSITION_RATE	0x27	0xD03C	1 mV/us	Vout transition rate			
VOUT_SCALE_LOOP	0x29	0xF004	1	Output sense scaling ratio for main control loop			
VOUT_OV_FAULT_LIMIT	0x40	0x0290	1.281 V	Output overvoltage fault threshold			
VOUT_OV_FAULT_RESPONSE	0x41	0xBF	Restart	Output overvoltage fault response			
VOUT_OV_WARN_LIMIT	0x42	0x0267	1.201 V	Output overvoltage warn threshold			
VOUT_UV_WARN_LIMIT	0x43	0x0143	0.631 V	Output undervoltage warn threshold			
VOUT_UV_FAULT_LIMIT	0x44	0x0130	0.594 V	Output undervoltage fault threshold			
VOUT_UV_FAULT_RESPONSE	0x45	0xBF	Restart	Output undervoltage fault response			
ON_OFF_CONFIG	0x02	0x16	CNTL only, Active High	Control signal and operation command not required			
OPERATION	0x01	0x00	Operation is not used to enable regulation; Unit: immediate off				
OT_FAULT_LIMIT	0x4F	0x007D	125°C	OT fault level			
OT_WARN_LIMIT	0x51	0x0064	100°C	OT warn level			
TON_DELAY	0x60	0x0000	0 ms	Turn-on delay			
TON_RISE	0x61	0x0005	5 ms	Soft-start time			
TON_MAX_FAULT_LIMIT	0x62	0x0064	100 ms	Upper limit for Vout reaching regulation			
TOFF_DELAY	0x64	0x0000	0 ms	Turn-off delay			
TOFF_FALL	0x65	0x0000	1 ms	Soft-stop fall time			
MFR_VOUT_MIN	0xA4	0x0100	0.5 V	minimum output voltage			

Table 6-1. Key Factory Configuration Parameters

If it is desired to configure the EVM to settings other than the factory settings shown in Table 6-1, the TI Fusion Digital Power Designer software can be used for reconfiguration. It is necessary to have input voltage applied to the EVM prior to launching the software so that the TPS544B25 or TPS544C25 installed is active and able to respond to the GUI and the GUI can recognize the device. The default configuration for the EVM is to start converting at an input voltage of 4.5 V; therefore, to avoid any converter activity during configuration, an input voltage less than 4.5 V must be applied. An input voltage of 4 V is recommended.



6.1 Configuration Procedure

- 1. Adjust the input supply to provide 4 V_{DC} , current limited to 1 A_{DC} .
- 2. Apply the input voltage to the EVM. See Figure 5-1 for overview of the EVM and its connections.
- 3. Launch the Fusion GUI software. See the screen shots in Section 9 for more information.
- 4. Configure the EVM operating parameters as desired.
- 5. VSET pin is pulled up to BP3 on the EVM, so the VOUT_COMMAND at boot up is restored from the internal EEPROM. The SYNC/RESET_B pin is configured to SYNC function under this setup. In order to use VSET or RESET_B function, proper resistor of R19 should be populated and resistor R18 should be removed. Please see Datasheet for more details.
- 6. S1 on the EVM provides the option to use the external temperature sensor Q1 on the EVM.

Note

To read the external temprature value on PMBus, the bit 8 (SS_DET_DIS) in (E5h) MFR_SPECIFIC _21 register needs to be set to 1. Otherwise, the READ_TEMPERATURE_2 will always return 25°C.

7. With an input of 4 V_{DC}, the internal configuration circuitry will be powered and active but the device will still be in UVLO and outputs off.

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7 Test Procedure

7.1 Line/Load Regulation Measurement Procedure

- 1. Ensure that the electronic load is set to draw 0 A_{DC}.
- 2. Increase V_{IN} from 0 V to 12 V using the digital multimeter to measure input voltage.
- 3. Use the other digital multimeter to measure output voltage V_{OUT} at TP4 and TP5.

Table 7-1. List of Test Points for Line/Load Measurements

TEST POINT	NODE NAME	DESCRIPTION					
JP1	VIN	Measurement point for VIN +VE (remove the jumper, LED will not light)					
TP10	GND	Measurement point for VIN –VE					
TP4	V_sense +	Measurement point for VOUT +VE					
TP5	V_sense -	Measurement point for VOUT –VE					

- 4. Vary the load from 0 A_{DC} to maximum rated output A_{DC} (TPS544B25 = 20 A, TPS544C25 = 30 A) . V_{OUT} must remain in regulation as defined in Table 3-1.
- 5. Vary V_{IN} from 4.5 V to 18 V. V_{OUT} must remain in regulation as defined in Table 3-1.
- 6. Decrease the load to 0 A.
- 7. Decrease V_{IN} to 0 V or turn off the supply.

7.2 Efficiency

To measure the efficiency of the power train on the EVM, it is important to measure the voltages at the correct location. This is necessary because otherwise the measurements will include losses in efficiency that are not related to the power train itself. Losses incurred by the voltage drop in the copper traces and in the input and output connectors are not related to the efficiency of the power train, and they must not be included in efficiency measurements.

TEST POINT	NODE NAME	DESCRIPTION							
JP1	VIN	Measurement point for VIN +VE (remove the jumper, LED will not light)							
TP10	GND	Measurement point for VIN –VE							
TP6	VOUT	Measurement point for VOUT +VE							
TP10	GND	Measurement point for VOUT –VE							

Table 7-2. List of Test Points for Efficiency Measurements

Input current can be measured at any point in the input wires, and output current can be measured anywhere in the output wires of the output being measured. Using these measurement points result in efficiency measurements that do not include losses due to the connectors and PCB traces.

7.3 Bode Plot Measurement Procedure

- 1. Follow Section 7.1 to set VIN and Load to desired operating condition.
- 2. Connect the AC small signal injection out of isolation transformer to test points TP2 and TP3.
- 3. Connect input signal amplitude measurement probe (Channel A) to TP3.
- 4. Connect output signal amplitude measurement probe (Channel B) to TP2.
- 5. Connect ground lead of Channel A and Channel B to TP10.
- 6. Inject 10 mV or less signal through the isolation transformer.
- 7. Sweep the frequency from 500 Hz to 500 kHz with 10-Hz or lower post filter.
- 8. Control loop gain can be measured by 20 x log (ChannelB/ChannelA).
- 9. Control loop phase can be measured by the phase difference between Channel A and Channel B.
- 10. Follow Section 7.4 to power off the device.

7.4 Equipment Shutdown

- 1. Reduce the load current to 0 A.
- 2. Reduce input voltage to 0 V.
- 3. Shut down the external fan if in use.
- 4. Shut down equipment.



8 Performance Data and Typical Characteristic Curves

Figure 8-1 through Figure 8-13 present typical performance curves for the PWR-681EVM.

8.1 Efficiency



Figure 8-1. Efficiency of 0.95-V Output vs Line and Load

8.2 Load Regulation



Figure 8-2. Load Regulation of 0.95-V Output



8.3 Line Regulation





8.4 Transient Response



Ch1 = V_{IN} at 5 V/division, Ch3 = V_{OUT} at 30 mV/division, Ch4 = I_{OUT} at 10 A/division

Figure 8-4. Transient Response of 0.95-V Output at 12 V_{IN} , Transient is 0 A to 20 A, 2.5 A/ μs



8.5 Output Ripple



Ch1 = SW at 5 V/division, Ch3 = V_{OUT} ripple at 20 mV/division





Ch1 = SW at 5 V/division, Ch3 = V_{OUT} ripple at 20 mV/division

Figure 8-6. Output Ripple and SW Node of 0.95-V Output at 12 V_{IN} , 20-A Output



8.6 Control On



 $Ch1 = V_{IN} \text{ at } 10 \text{ V/division, } Ch2 = CNTL \text{ at } 2 \text{ V/division, } Ch3 = V_{OUT} \text{ at } 500 \text{ mV/division, } Ch4 = PGOOD \text{ at } 5 \text{ V/div} \text{ at } 5 \text{ V/di$

Figure 8-7. Start up from Control, 0.95-V Output at 12 $V_{\text{IN}},$ 20-A Output



Ch1 = V_{IN} at 10 V/division, Ch2 = CNTL at 2 V/division, Ch3 = V_{OUT} at 500 mV/division, Ch4 = PGOOD at 5 V/division

Figure 8-8. 0.5-V Pre-biase start up from Control, 0.95-V Output at 12 V_{IN}, 0-A Output



8.7 Control Off



Ch1 = V_{IN} at 10 V/division, Ch2 = CNTL at 2 V/division, Ch3 = V_{OUT} at 500 mV/division, Ch4 = PGOOD at 5 V/division



8.8 Overcurrent Protection



Ch1 = V_{IN} at 10 V/division, Ch2 = I_{IN} at 2 A/division, Ch3 = V_{OUT} at 500 mV/division, Ch4 = I_{OUT} at 10 A/division

Figure 8-10. Overcurrent Protection, 0.95-V Output at 12 V_{IN}, 36-A Output



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E																	
Ý	N																•
3-1- V(
			-														
Ê																	
	IQUT						+										
	10.0V/div 500mV/di 10.0mV/d	iv 1 liv 1 liv 5	IMΩ ^E W:20.0M IMΩ ^E W:20.0M i0Ω ^E W:20.0M		-2.94V 1.133V 4.073V				A' _ C3	∫ 380n	١V		20.0r Previ 0 acc Auto	ns/div 5 iew ys Marc	500kS/s Single S th 10, 201	2.0µ eq RL:10 5 1	s/pt 0k 3:34:26
ſ		Value	Mean	Min	Max	St Dev	Count	Info									
	Mean	34.54mV	34.541041m	34.54m	34.54m	0.0	1.0										
	Max	3.326V	3.32625	3.326	3.326	0.0	1.0										
		the second se	the second se	1000													
	Freq	11.03KHZ	11.023034k	44.02m	44.02m	0.0	1.0	U									

Ch1 = V_{IN} at 10 V/division, Ch2 = I_{IN} at 2 A/division, Ch3 = V_{OUT} at 500 mV/division, Ch4 = I_{OUT} at 10 A/division

Figure 8-11. Restart from Overcurrent Protection, 0.95-V Output at 12 V_{IN}

8.9 Control Loop Bode Plot



Figure 8-12. Bode Plot at 0.95-V Output at 12 $V_{\text{IN}},$ 20-A Output



8.10 Thermal Image



Figure 8-13. Thermal Image at 0.95-V Output at 12 $V_{\text{IN}},$ 20-A Output



Figure 8-14. Thermal Image at 0.95-V Output at 12 $V_{\text{IN}},$ 30-A Output



9 Fusion GUI

Texas Instruments	
Fusion Digital Power Designer Version 1.8.138 [2011-11-15]	
Restoring user preferences and data	

Figure 9-1. First Window at Fusion Launch

TEX	as Instruments
Fusion Digita Version 1.8.138 [2017	al Power Designer 1-11-15]
Scanning USB Adap 1 device found	Device Found

Figure 9-2. Scan Finds Device Successfully





Version 1.8.138 [2011-11-15]

1 device found; continuing with GUI startup ...





Figure 9-4. Software Launch Continued



Use this next screen to configure (Figure 9-5):

- OV and UV Fault and Warn Limit •
- OC Fault and OC Warn Limit ٠
- OT Fault and OT Warn Limit •
- Fault Response
- UVLO
- On/Off Configuration
- Sequencing
- V_{OUT} Command Voltage

🕀 Fusion Digital Powe	er Designer - TPS544C25 🔘	Address 36d - Texas Instruments				- 2 🛛
File Device Tools	s Debug Help				TPS544C2	5 @ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode	Test Mode Advanced Device Info SMBA	ALERT# Mask All Config			
Write to Hardware	Voltage Limits)	
- Auto write on rail or	Vout Mode:	EXP -9				
device change	Vout Command:	0.949 💭 V				
Discard Changes	Vout OV Warn Limit:	1.201 × V	Vout UV Warn Limit:	0.631 🔿 V		
Store Config to N/M	Vout OV Fault Limit:	1.281 🕆 V	Vout UV Fault Limit:	0.594 💮 V		
	Vout OV Fault Response:	Respo 🗸	Vout UV Fault Response	Bespo Y		
Restore NVM Config	MFR Vout Min:	0.500 🔨 V				
Clear Restore Notices	Vout Max	1.500 📩 V				
]	
	Current Limits		Temperature Limits			
	Iout OC Warn Limit:	34.0 🚔 A	Temp Warn Limit:	100 ⊕ °C		
	Iout OC Fault Limit:	36.0 💮 A	Temp Fault Limit:	125 😴 °C		
	Iout OC Fault Response:	Respo 🗸	OT Fault Response:	Respo V		
	(
	Turn On/Off	4.50	N= 0#	4.00 [] V		
	Vin On:	4.50 V	Vin Off:	4.00 🗸 V		
	Turn On Delay:	0 V ms	Turn Off Delay:			
	Turn On Max Fault Limit:	100 🗸 ms	ian on beau			
	Turn On Max Fault Response:	Respo 🗸				
	On/Off Config:	0x16 🗸				
		Mode: CONTROL Pin Only; Control:				
		TOFF_DELAY/TOFF_FALL				
	<u> </u>				,	
				Dup		
		3]		PMBUS LOG		
Configure	Sets the value of the output voltage warning. This value is typically greater	-, ge at the sense or output pins that causes an ou ater than the output undervoltage fault threshok	tput voltage low			<u>^</u>
Monitor						
- Ctatus				PMPusion		
Status			48	L'HIBUS LUG		
Fusion Digital Power	Designer v2.0.37 [2015-03-	27] TPS544C25 @ Address 36d U	SB Adapter v1.0.11 [PEC; 400 kHz]		TEXAS INSTRUMENTS fusion digital power

Fusion Digital Power Designer v2.0.37 [2015-03-27] TPS544C25 @ Address 36d USB Adapter v1.0.11 [PEC; 400 kHz]

Figure 9-5. First Screen After Successful Launch Configure: Limits and On/Off



Changing the on/off configuration prompts a pop-up window with details of the options Figure 9-6).

• Fusion Digital Powe	er Designer - TPS544C25 @	Address 36d	- Texas Instruments		- • •
File Device Tools	Debug Help				TPS544C25 @ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode	Test Mode Ad	vanced Device Info SMBALERT# Mask All Config		
Configure Write to Hardware ↓ Auto write on rail or device change Uscard Changes Store Config to NM Restore NVM Config Clear Restore Notices	Junis & On/Off Debug Mode Voltage Limits Vout Mode: Vout Mode: Vout Ovalt Minit: Vout OV Fault Response: NFR: Vout Min: Vout V Fault Response: FRR: Vout Min: Vout Max Current Limits Tout OC Fault Limit: Tout OC Fault Limit: Tout OC Fault Response: Turn On Rise: Turn On Rise: Turn On Rise: Turn On Max Fault Limit: Turn O	■Est Mode Ad DP - 9 0.949 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 1.201 ⊕ 94.0 ⊕ A 95.0 ⊕ Y 0 ∀ 1.00 ♥ 9.0 ∀ 5 ∨ 0 ∀ 1.00 ♥ Repon ∀ 0.940 ♥ 100 ∨ Repon ∀ Mode: CONTRA Actre H\$ Actre H\$ NEAHY TOFF_DELAY TOFF_DELAY	Varecel Device Info SHRALERT # Mask All Config On / Off Control On / Off Contr	0.631 ⊕ V 0.594 ⊕ V Respo ↓ 100 ⊕ *C 125 ⊕ *C Respo ↓ 1.00 ↓ V 0 ∨ ms 0 ∨ ms 0 ∨ ms	
 ♦ Configure ♦ Monitor 	Tips & Hints ON_OFF_CONFIG[0x02] Configures the combination of COI and off. This includes how the unit	NTROL pin input ar t responds when p	d serial bus commands needed to turn the unit on wer is applied.	PMBus Log	E ^
Status				PMBus Log	n 9
Fusion Digital Power I	Designer v2.0.37 [2015-03-	-27] TPS5440	25 @ Address 36d USB Adapter v1.0.11 [PEC; 400 kHz]	TEXAS INSTRUMENTS fusion digital power

Figure 9-6. Configure: Limits and On/Off- On/Off Configuration Pop-up

After a change is selected, orange **U** icon is displayed to offer *Undo Change* option. Change is not retained until either *Write to Hardware* or *Store Config to NVM* is selected. When *Write to Hardware* is selected, change is committed to volatile memory and defaults back to previous setting on input power cycle. When *Store Config to NVM* is selected, change is committed to nonvolatile memory and becomes the new default (Figure 9-7).

🔫 Fusion Digital Pow	er Designer - TPS544C25 @ Address 30	id - Texas Instruments		- 🖻 🎽
File Device Tool	s Debug Help			TPS544C25 @ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode Test Mode	Advanced Device Info SMBALERT# Mask All Config	1	
Write to Hardware	Voltage Limits			
Auto write on rail or device change	Vout Mode: DP-9 Vout Command: 0.949 [Vout OV Warn Limit: 1.201 [Vout OV Warn Limit: 1.201 [On / Off Control Aways Converting Unit powers up any time power is present, regardless of state of the CONTROL pin or OPERATION command.	0.631 💭 V	
Store Config to NVM Restore NVM Config Clear Restore Notices	Vout OV Fault Response: Response MFR Vout Min: 0.500 Vout Max 1.500	CONTROL Pin Only The device ignores the on/off portion of the OPERATION command from serial bus. Power is converted when the CONTROL pin is active. OPERATION only The device ignore the CONTROL pin is neuron in	0.594 🐨 V e: Respo v	
	Current Limits	OPERATION command is on. OPERATION command is on. OBoth CONTROL Pin & OPERATION The CONTROL Pin & OPERATION		
	Iout OC Fault Limit: 36.0 w Iout OC Fault Response: Response:	A on/off portion of the OPERATION command on for the device to convert power.	105 v C 125 v ℃ Respo v	
	Turn On/Off	Active high (Pull high to start the unit)		
	Vin On: 4.50 Turn On Rise: 5 Turn On Delay: 0 Turn On Max Fault Limit: 100 Turn On Max Fault Response: Respo	Control Pin Turn Off Configuration Use the tarn off delay configured by TOFF_DELAY and fail time configured by TOFF_DELAY and a tap transferring energy to the output as fast as possible	4.00 ∨ V 0 ∨ ms 0 ∨ ms	
	On/Off Config: U 0x1A Mode: OPE	RATION Only		
	Tips & Hints		PMBus Log	<u>(م)</u>
d) Configuro	MFR_VOUT_MIN [0xA4] Minimum rated value, in volts, to which the output	t voltage may be set.		
A Monitor				
Status			PMBus Log	
Fusion Digital Rowor	Designer v2 0 27 (2015 02 27) TDS5/	AC25 @ Addrorg 26d LISE Adoptory101		Ja Texas Instruments fusion diabila onuor

Figure 9-7. Configure: Limits and On/Off- On/Off Config Pop-Up with Change



Use "Advanced" tag to configure (Figure 9-8) :

- E5h OPTIONS (MFR SPECIFIC 21)
- F0h MISC_CONFIG_OPTIONS options (MFR_SPECIFIC_32)



Figure 9-8. Configure: Advanced



The device information, User Scratch Pad, Write Protection options, the configuration of Vout Scale loop, Vout Transition Rate and lout Offset can be found on "Device Info" tag (Figure 9-9). The I_{OUT} offset can be typed in or scrolled to a new value. The range for I_{OUT} cal offset is -4 A to 3.9375 A and the resolution step is 62.5 mA. If a value is typed in that is between the available discrete steps, the typed-in value does not change but the nearest discrete step is retained. The actual step is displayed on relaunch of the Fusion GUI.

🕀 Fusion Digital Powe	er Designer - TPS544C25 @ Address 36d - Texas Instruments		🚽 🖻 🔽
File Device Tool:	s Debug Help		TPS544C25 @ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode Test Mode Advanced Device Info SMBA	LERT# Mask All Config	
Write to Hardware Underschaft device change Discard Changes Store Config to NVM	Device Constants IC Device ID: 0x2700 (TPS544C25) IC Device REV: 0x0000 Revision: 10,12 - Parti: 1.0, Parti: 1.12 Capability: Maximum Supported Bus Speed: 400 MHz Packet Error Checking (PEC) Supported: Yes Yes	Write Protect Deable all writes except to the WRITE_PROTECT command Deable all writes except to the WRITE_PROTECT, OPERATION and PAGE commands Deable all writes except to the WRITE_PROTECT, OPERATION, PAGE,	
Clear Restore Notices	SHBALERT# Supported: Yes Whether the device has an SHBLERT# pin and supports the SHBUE Alert Response protocol. SHBUE Alert Response protocol. Vout Mode: DP -9	OkuCoPF_CONFIG and VOLT_COMMAND commands ③ Enable writes to all commands Calibration Vout Scale Loop: 1.00 💬 Vout Transition Rate: 1.00 💬	
	MFR_SPECIFIC_00 User Scratch Pad: 15 14 13 12 11 10 9 8 7 6 5 User Scratch Pad: 0	1 out Cal Offset: 0.0000 🔄 A 4 3 2 1 0 0 0 0	
)[
Configure	I Ips & Hints HFR_21 (OPTIONS) [0xE5] Used for setting user selectable options for the Top Avatar controller.	PMBus Log	() ()
Monitor		~	
Status		PMBus Log	
Fusion Digital Dawar	Designer (2.0.27.12015, 02.27) TDEE44625 @ Address 26d U		

Figure 9-9. Configure: Device Info



The sources of SMBALERT which can be masked can be found and configured on the "SMBALERT # Mast" screen (Figure 9-10)

🕀 Fusion Digital Pov	ver Designer - TPS544C25 🖗 A	ddress 36d - Texas Instruments		- 🖻 본
File Device Too	ls Debug Help			TPS544C25 @ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode	Test Mode Advanced Device Info SMBALERT# N	1ask All Config	
	VOUT Mask	MFR_SPECIFIC Mask	INPUT Mask	
Write to Hardware	7 OVF	7 Over temperature fault interr	nal 7 Vin OV Fault	
device change	6 🗌 OVW	6 📄 FSM Illegal ZERO state	6 Vin OV Warning	
Discard Changes	5 🗌 UVW	5 SM Illegal MANY ONES state	5 Vin UV Warning	
	4 UVF	4 Invalid VSET detection	4 Vin UV Fault	
Store Config to NVM	2 TON MAX Fault	2 RESET VOLT	2 ITN OC Fault	
Restore NVM Config	1 0	1 0	1 IN OC Warning	
Clear Restore Notices	0 🗌 0	0 0	0 PIN OP Warning	
Cical Rescore Hoads	WORD Mack			
	6 OCFW	6 IOUT OC Fault	own	
	5 0	5 IOUT OC Warning	5 PEC Fault	
	4 🗌 MFR	4 DUT UC Fault	4 🗌 Memory Fault	
	3 🗹 PGOOD	3 Current Share Fault	3 Processor Fault	=
	2 0	2 Power Limiting Mode	2 Reserved	
		0 POUT OP Warning	Other Commis Fault Other Memory/Logic Fault	
	TEMPERATURE Mask			
	7 OT Fault			
	6 OI Warning			
	4 UT Warning			
1	3 Reserved			
	2 Reserved			
	1 Reserved			
	C Reserved			
	Key: Fault Bit that Contributes to S	MBALERT# Warning Bit that Contributes to SMBALE	ERT# Bit Masked from SMBALERT# Bit Not Supported	
	Tips & Hints		PMBus Log	<u>ج</u>
	SMBALERT_MASK_INPUT [0x18	1		
🚸 Configure	SMBALERT MASK command is us SMBALERT # signal. The bits in the m example if the STATUS_TEMPERATU	sed to prevent a warning or fault condition from assertii ask byte align with the bits in the corresponding status RE command code were sent with the mask byte 01000	register. For 000b, then	
Monitor	an Overtemperature Warning condit command to read/write the SMBALEF	ion would be blocked from asserting SMBALERT#. This is {T# mask for STATUS_INPUT	s the meta	
Status			PMBus Log	
Eucion Digital Rowo	Designer v2.0.27 [2015_02_2	71 TRS544C35 @ Addross 26d USP Add	aptor v1 0 11 (REC: 400 kHz)	A Try as Instruments I fusion digital nonver

Figure 9-10. Configure: SMBALERT # Mask

Use "All Config" tag to configure all of the configurable parameters (Figure 9-11). The screen also shows other details like hexadecimal (hex) encoding.

File Device Too	ls Debug Help								TPS544C25 @ Address 36d - Rail #1	
Configure	Limits & On/Off Debug Mode Test Mode	Advanced	Device Info SMBAL	ERT# Mask A	Il Config					
Write to Hardware	Command	Code	Value/Edit	Hex/Edit	Command	Code	Value/Edit	Hex/Edit		[
Auto write on rail or	▼ Calibration				On/Off Configuration					
device change	IOUT_CAL_OFFSET	0x39	0.0000 🕀 A	0xE000	ON_OFF_CONFIG	0×02	0x16 🗸	0x16		
	VOUT_SCALE_LOOP	0x29	1.00 🗸	0xF004	OPERATION	0×01	0x00 🖂	0x00		
Store Config to NVM	▼ Configuration				TOFF_DELAY	0x64	0 🖂 ms	0x0000		
Restore NVM Config	IC_DEAICE_ID	0×AD	0x2700 🗸	0x2 🗸	TOFF_FALL	0x65	0 🖂 ms	0x0000		
	IC_DEVICE_REV	0×AE	0x0000 🗸	0x0 ~	TON_DELAY	0x60	0 🖂 ms	0x0000		
Liear Restore Notices	MFR_21 (OPTIONS)	0×E5	PMB_V 🗸	0x00C7	TON_MAX_FAULT_LIMIT	0x62	100 🖂 ms	0x0064		
ort Parameters By:	MFR_32 (API_OPTIONS)	0xF0	OV_RE ⊻	0x0001	TON_MAX_FAULT_RESPONSE	0x63	Click 🗸	0xBF		
Command Name Command Code	SMBALERT_MASK_CML	0×1B	000000 🗸	0x00	TON_RISE	0x61	5 🖂 ms	0x0005		
	SMBALERT_MASK_INPUT	0x1B	000000 🖂	0x00	▼ Status					
Group by Category	SMBALERT_MASK_IOUT	0×1B	000000 🗸	0x00	READ_IOUT	0x8C	0.00 A	0xE000		
	SMBALERT_MASK_MFR_SPECIFIC	0×18	000000 🖂	0x00	READ_TEMPERATURE_2	0x8E	25 °C	0x0019		
	SMBALERT_MASK_TEMPERATURE	0×1B	000000 🗸	0x00	READ_VOUT	0x8B	0.010 V	0x0005		
	SMBALERT_MASK_VOUT	0×18	000000 🖂	0x00	STATUS_BYTE	0x78	010000 🖂	0x42		
	SMBALERT_MASK_WORD	0×1B	000010 🗸	0x08	STATUS_CML	0×7E	100000 🖂	0x82		
	VOUT_COMMAND	0x21	0.949 🕀 V	0x01E6	STATUS_INPUT	0x7C	000000 🖂	0x00		
	VOUT_MAX	0x24	1.500 💭 V	0x0300	STATUS_IOUT	0×7B	000000 🗸	0x00		
	VOUT_MODE	0x20			STATUS_MFR_SPECIFIC	0x80	000100 🖂	0x10		
	VOUT_TRANSITION_RATE	0x27	1.000 V mV	0xD03C	STATUS_TEMPERATURE	0x7D	000000 🗸	0x00		
	WRITE_PROTECT	0x10	0x00 🗸	0x00	STATUS_VOUT	0x7A	000000 🖂	0x00		
	▼ Limits				STATUS_WORD	0x79	Click 🗸	0x0842		
	IOUT_OC_FAULT_LIMIT	0x46	36.0 🕀 A	0xF848	▼ User Parameters					
	IOUT_OC_FAULT_RESPONSE	0x47	Click 🗸	0xBF	MFR_00 (FOR USER)	0xD0	0x0052 🗸	0x0052		
	Tips & Hints				PMBus Log					
Configure	ON_OFF_CONFIG [0x02] Configures the combination of CONTROL pin in and off. This includes how the unit responds wi	out and serial b nen power is ap	us commands needed oplied.	to turn the unit	on 🔊					
Monitor					×					
					Fin DMPus Los					5

Fusion Digital Power Designer v2.0.37 [2015-03-27] TPS544C25 @ Address 36d USB Adapter v1.0.11 [PEC; 400 kHz]

Figure 9-11. Configure: All

On/Off configuration can also be configured from the "All Config" screens, and the same process applies (Figure 9-12).

💖 Fusion Digital Pow	ver Designer - TPS544C25 @ Address	36d - Texas	Instruments						- 2 🗳
File Device Too	ls Debug Help							TPS544C25	@ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode Test Mode	Advanced	Device Info SMBA	ERT# Mask	All Config				
Write to Hardware	Command	Code	Value/Edit	Hex/Edit	Command	Code	Value/Edit	Hex/Edit	<u>^</u>
Auto write on rail or	▼ Calibration				▼ On/Off Configuration				
device change	IOUT_CAL_OFFSET	0x39	0.0000 🕀 A	0xE000	ON_OFF_CONFIG	U 0x02	0x1A ~	0x1A	
Discard Changes	VOUT_SCALE_LOOP	0x29	1.00 🗸	0xF004	OPERATION	0x01	0x00 🗸	On / Off Control	
Store Config to NVM	▼ Configuration				TOFF_DELAY	0x64	0 🗸	 Always Converting Unit powers up any time power is present 	nt,
Restore NVM Config	IC_DEVICE_ID	0×AD	0x2700 🗸	0x2 🗸	TOFF_FALL	0×65	0 🗸	regardless of state of the CONTROL pin OPERATION command.	or
	IC_DEVICE_REV	0×AE	0x0000 🗸	0x0 🖂	TON_DELAY	0x60	0 🗸	CONTROL Pin Only	
Clear Restore Notices	MFR_21 (OPTIONS)	0×E5	PMB_V ⊻	0x00C7	TON_MAX_FAULT_LIMIT	0x62	100 🗸	The device ignores the on/off portion of OPERATION command from serial bus. F	bower =
Sort Parameters By:	MFR_32 (API_OPTIONS)	0xF0	0V_RE 🖂	0x0001	TON_MAX_FAULT_RESPONSE	0x63	Click 🗸	is converted when the CONTROL pin is a	active.
Command Name Command Code	SMBALERT_MASK_CML	0×18	000000 🖂	0x00	TON_RISE	0x61	5 ~	The device ignores the CONTROL pin. P	ower is
Command Code	SMBALERT_MASK_INPUT	0×1B	000000 🖂	0x00	▼ Status			converted when the on/off portion of the OPERATION command is on.	ie i i i i i i i i i i i i i i i i i i
Group by Category	SMBALERT_MASK_IOUT	0x1B	000000 🖂	0x00	READ_IOUT	0x8C	0.00	O Both CONTROL Pin & OPERATION	
	SMBALERT_MASK_MFR_SPECIFIC	0×1B	000000 🗸	0x00	READ_TEMPERATURE_2	0×8E	25	on/off portion of the OPERATION comm	and
	SMBALERT_MASK_TEMPERATURE	0×1B	000000 🗸	0x00	READ_VOUT	0x88	0.010	on for the device to convert power.	
	SMBALERT_MASK_VOUT	0×1B	000000 🗸	0x00	STATUS_BYTE	0x78	010000 🗸	Active low (Pull pin low to start the unit)	
	SMBALERT_MASK_WORD	0×1B	000010 ~	0x08	STATUS_CML	0×7E	100000 🗸	 Active high (Pull high to start the unit) 	
	VOUT_COMMAND	0x21	0.949 ⊕ v	0x01E6	STATUS_INPUT	0x7C	000000 🗸	0	
	VOUT_MAX	0x24	1.500 🗘 V	0x0300	STATUS_IOUT	0x78	000000 🗸	Control Pin Turn Off Configuration – Use the turn off delay configured by	
	YOUT_MODE	0×20			STATUS_MFR_SPECIFIC	0x80	000100 🗸	 TOFF_DELAY and fall time configured by TOFF_EAU 	9
	VOUT_TRANSITION_RATE	0x27	1.000 V mV	0xD03C	STATUS_TEMPERATURE	0x7D	000000 🗸	Turn off the output and stop transferring	ng l
	WRITE_PROTECT	0x10	0x00 ~	0x00	STATUS_VOUT	0x7A	000000 🗸	energy to the output as fast as possible	2
	▼ Limits				STATUS_WORD	0x79	Click 🗸		
	IOUT_OC_FAULT_LIMIT	0x46	36.0 🕀 A	0xF848	▼ User Parameters				
	IOUT_OC_FAULT_RESPONSE	0x47	Click 🗸	0xBF	MFR_00 (FOR USER)	0×D0	0x0052 🗸	0x0052	\sim
	Tips & Hints				PMBus Log				
	ON_OFF_CONFIG [0x02]	out and corial h	un commonde peoded	to turo the uni					~
Configure	and off. This includes how the unit responds w	hen power is a	oplied.	to tarr alc an					
Monitor					\sim				
Status					PMBus Log				Fa 😭
Fusion Digital Power	r Designer v2.0.37 [2015-03-27] TPS	544C25 @	Address 36d US	B Adapter	v1.0.11 [PEC; 400 kHz]				TEXAS INSTRUMENTS fusion digital power

Figure 9-12. Configure: All Config- On/Off Config Pop-up



After making changes to one or more configurable parameters, the changes can be committed to nonvolatile memory by selecting *Store Config to NVM*. This action prompts a *confirm selection* pop-up, and if confirmed, the changes are committed to nonvolatile memory (Figure 9-13).

File Device Too	is Debug Help								TPS544C25 @ Address 36d - Rail #1	
Configure	Limits & On/Off Debug Mode Test Mode	Advanced	Device Info SMBA	ALERT# Mask	All Config					
Write to Hardware	Command	Code	¥alue/Edit	Hex/Edit	Command	Code	Value/Edit	Hex/Edit		^
Auto write on rail or	▼ Calibration				On/Off Configuration					
Discard Chapper	IOUT_CAL_OFFSET	0×39	0.0000 🕀 A	0xE000	ON_OFF_CONFIG	0×02	0x16 🗸	0x16		
	VOUT_SCALE_LOOP	0×29	1.00 🗸	0xF004	OPERATION	0×01	0x00 🗸	0x00		
Store Config to NVM	Configuration				TOFF_DELAY	0x64	0 🗸 ms	0x0000		
Restore NVM Config	IC_DEVICE_ID	0×AD	0x2700 🗸	0x2 🗹	TOFF_FALL	0×65	0 🗸 ms	0x0000		
Class Restars Nation	IC_DEVICE_REV	0×AE	0x0000 🗸	0x0 ⊻	TON_DELAY	0×60	0 🛩 ms	0x0000		
	MFR_21 (OPTIONS)	0×E5	PMB_V 🖂	0x00C7	TON_MAX_FAULT_LIMIT	0x62	100 🗸 ms	0x0064		=
Sort Parameters By:	MFR_32 (API_OPTIONS)	0×F0	OV_RE ∨	0x0001	TON_MAX_FAULT_RESPONSE	0×63	Click 🖂	0xBF		
Command Name	SMBALERT_MASK_CML	0×1B	000000 🖂	0x00	TON_RISE	0×61	5 🛩 ms	0x0005		
Creum bu Catagory	SMBALERT_MASK_INPUT	0×1B	000000							
I droup by category	SMBALERT_MASK_IOUT	0×1B	00000 Confir	m Store to F	lash	-	A	0xE000		
	SMBALERT_MASK_MFR_SPECIFIC	0×1B	00000				°C	0x0019		
	SMBALERT_MASK_TEMPERATURE	0×1B	00000	👔 This op	peration will store all configuration	values to fla	sh v	0x0005		
	SMBALERT_MASK_VOUT	0×1B	00000	memo	ry on the TPS544C25 @ Address 360	d. Do you wi	sh to	0x42		
	SMBALERT_MASK_WORD	0×1B	00001	procee	iu i			0x82		
	VOUT_COMMAND	0x21	0.					0x00		
	VOUT_MAX	0x24	1.		Ves		No	0x00		
	VOUT_MODE	0×20	EXP -9		103			0x10		
	VOUT_TRANSITION_RATE	0x27	1.000	0xD03C	STATUS_IEMPERATURE	UX7D	000000 🗹	0x00		
	WRITE_PROTECT	0×10	0x00 ~	0x00	STATUS_VOUT	0x7A	000000 🗸	0x00		
	▼ Limits				STATUS_WORD	0×79	Click 🗸	0x0842		
	IOUT_OC_FAULT_LIMIT	0×46	36.0 💭 A	0xF848	Vuser Parameters					
	IOUT_OC_FAULT_RESPONSE	0×47	Click 🗸	0xBF	MFR_00 (FOR USER)	0xD0	0x0052 🗸	0x0052		~
	Tips & Hints				PMBus Log					Ţ.
Configure	IC_DEVICE_ID [0xAD] IC Device ID.				~					^
Monitor					~					~
Status					PMBus Log					G 😭
Fusion Digital Power	r Designer v2.0.37 [2015-03-271 TPS	544C25 @	Address 36d	ISB Adapter	v1.0.11 [PEC: 400 kHz]				TEVAS INSTRUMENTS fueion diai	ital nower

Figure 9-13. Configure: Store Config to NVM



Fusion GUI

🛯 Fusion Digital Pow	er Designer - TPS544C25 @ A	ddress 36d - Texas Instruments			
File Device Tool	ls Debug Help				TPS544C25 @ Address 36d - Rail #1
Configure	Limits & On/Off Debug Mode	Test Mode Advanced Device Info SME	ALERT# Mask All Config		
Write to Hardware	Voltage Limits				
Write to Hardware ✓ Auto write on air of device change Discard Changes Store Config to NMM Restore NVM Config Clear Restore Notices	Votage Linits Vout Mode: Vout Command: Vout OV Warn Linit: Vout OV Fault Linit: Vout OV Fault Linit: Vout OV Fault Response: MFR Vout Min: Vout Max	0.949 € V 1.201 € V 1.281 € V Respo ∨ 0.500 € V	Vout UV Warn Limit: Vout UV Fault Limit: Vout UV Fault Response	0.631 🚡 V 0.594 🙄 V 51 Respo V	
	Current Limits		Temperature Limits		
	Iout OC Warn Limit: Iout OC Fault Limit:	34.0 ♀ A 36.0 ♀ A	Temp Warn Limit: Temp Fault Limit:	100 ♀ °C 125 ♀ °C	
	Iout OC Fault Response:	Respo 🗸	OT Fault Response:	Respo 🗸	
	Turn On/Off				
	Vin On:	4.50 🗸 V	Vin Off:	4.00 🗸 V	
	Turn On Rise:	5 🗸 ms	Turn Off Fall:	0 🖂 ms	
	Turn On Delay:	0 🖂 ms	Turn Off Delay:	0 🗸 ms	
	Turn On Max Fault Limit:	100 🖂 ms			
	Turn On Max Fault Response:	Respo 🗸			
	On/Off Config:	0x16 🗸			
		Mode: CONTROL Pin Only; Control: Active High, Use			
		TOFF_DELAY/TOFF_FALL			
	Tips & Hints			PMBus Log	₽
	ON_OFF_CONFIG [0x02] Configures the combination of CONT	IROL pin input and serial bus commands need	ed to turn the unit on		^
Configure	and off. This includes how the unit re	esponds when power is applied.	<u></u>		
Monitor			~		\sim
🔄 Status			E.	PMBus Log	fa 🕄
Fusion Digital Power	Designer v2.0.37 [2015-03-2	271 TPS544C25 @ Address 36d 1	JSB Adapter v1.0.11	PEC: 400 kHz1	TEXAS INSTRUMENTS fusion digital power

Figure 9-14. Change View Screen to Monitor Screen



When the Monitor screen is selected (Figure 9-15), the screen changes to display real-time data of the parameters that are measured by the controller. This screen provides access to:

- Graphs of V_{OUT}, I_{OUT}, and Temperature. As shown, Pout display is turned off. •
- Start/Stop polling which turns on or off the real-time display of data.
- Clear Faults to clear any prior fault flags
- Quick access to on/off configuration •
- Control pin activation, and operation command. •
- PMBus log which displays activity on the PMBus. ٠
- Tips and hints which displays additional information when the cursor is hovered over configurable parameters.

At first GUI launch, faults may occur due to communications during power up. These faults can be cleared once the device is enabled.



sion Digital Power Designer v2.0.42 [2015-05-01] TPS544C25 @ Address 36d USB Adapter v1.0.11 [PEC; 400 kHz]

Figure 9-15. Monitor Screen



Selecting *System Dashboard* from mid-left screen adds a new window which displays system-level information (Figure 9-16).

💖 Fusion Digital Pow		er - TPS544C25 @ Addres											2
File Device Too	ls Debug	g Help								TPS544C2	5 @ Addres	s 36d - Rail #1	~
Monitor	PMBus F	Ba											×
Show/Hide Plots:	Vout:	* System Dashboard -	Fusion Digital Po	wer Designe	ř.						34		
🗸 Vout 🗸 Iout	Iout:	Layout Devices											
Pout(calc 🗸 Temp	Temp:	System-Level Actions a	and Settings										
Fit All Plots on Screen	Etature D	On/Off Config		OPERATION			Control Line (USB)) Fault Managem	eni Other				
Scale Plots to Screen Width	Vout	CONTROL Pin Only	Write Setting	Margining 🛛	Turn On Imm	ned Off	High O Low	Clear Faults	Store to Flash				
Height: 200 🕀	lout:			Soft Off						_			
Width: 400 🕀	Temp:												
Show Warn & Fault	Input:												
Show Value Labels	CML:	Rails											
on Plots	Misc:	Device Rail	Vout	Iout Ten	operation		On/Off Config						
Poling Rate: 500 🕀	MIT: SMBAL	TPS544C25 @ 36d 1 Rail;	#1 0.943 V	0.44 A	25 ℃ () On () Im	mediate Off 🛛 So	ft O 0x16 🗸 CONTR	tOL Pin Only					044.4
(msec)	OWDAL											55:40	56:00
Stop Polling												55.40	50.00
Device Dashboard	On/Off (
	0,												
System Dashboard													
	OPERAT												
	On/Off:												
		Status Registers											
		STATUS_WORD	OK										
	Marginii		OK										
		STATUS_1001	OK										
	Margin	STATUS INPUT	OK										
	Fault Action:	STATUS_CML	ок										
		STATUS_MFR_SPECIFIC	ОК										
	Control												
	Tins & F												Ű.
	VOUT_U	Status Registers Log											
Configure	Sets the fault.					14:49:37.177: US	8-SAA #1: CONTROL3 nov	w Low			I		
- Monitor						14:49:37.181:U5 14:49:43.547:TP	8-SAA #1: CONTROL4 nov S544C25 @ 36d: CLEAR F	w Low FAULTS [0x03]: execu	ted SendByte				
Womtor					~								~
Status					E.	PMBus Log							Fa 🗑
Fusion Digital Power	r Designer	v2.0.37 [2015-03-27] TP	S544C25 @ Adv	dress 36d U	B Adapter v1.0.11	[PEC; 400 kHz]					TEXA	S INSTRUMENTS fus	ion digital power

Figure 9-16. System Dashboard





Selecting Status from lower left corner shows the status of the controller (Figure 9-17).



Figure 9-17. Status Screen



Selecting the pull-down menu *File- Import Project* from the upper left menu bar can be used to configure all parameters in the device at once with a desired configuration, or even revert back to a *known-good* configuration. This action results in a browse-type sequence where the desired configuration file can be located and loaded (Figure 9-18).



Figure 9-18. Import Project / Import Configuration File

Selecting *Store User Configuration to Flash Memory* from the device pull-down menu has the same functionality as the *Store Config to NVM* button from the configure screen. It results in committing the current configuration to nonvolatile memory (Figure 9-19).



Figure 9-19. Store Configuration To Memory

Select *Data Logging* (Figure 9-20), from the Tools drop-down menu. This enables logging of common operating values such as V_{OUT} , I_{OUT} , and temperature. The user is prompted to select a location for the file to be stored as well as the type of file. Select the storage location for the file and the type of file. Logging begins when the *Start Data Logging* button is selected, and stops when it is reselected.



Figure 9-20. Data Logging

Common contents of the data log as shown in (Figure 9-21).

X	4 47 + (P +		-	Data-Log-2	015.05.01-15.12	2.27-TPS544C2	5-SAA1-Addr36.tx	kt [Read-Or	nly] - Micro	soft Exce	el			×
File	Home	Insert	Page Layout	Formulas	Data Revie	w View	Add-Ins Acrobat						a 🕜 e	- @ X
Ĉ	K Cali	bri	• 11 • A		≡ 😑 ≫ ·	Gener	al ~				ë•■ Insert →	Σ· Z	A	
Paste	B	IU-	🖽 🔹 🖄 🔹	<u>A</u> - ≡ 1		a	% • 號 🔐	Conditional Formatting	Format as Table *	Cell Styles *	Format •	2 • Sort & Filter •	Find & Select *	
Clipbo	bard G	FC	ont 🖉	-12 	Alignment	-64	Number Fa		Styles		Cells	Editing	3	
-	AI	16	Jx	Timestamp	122	3	1		14/11	1 129		102		v
	A	В	C	D	E	F	G		Н	. <u>I</u>	J	К	L	-
1	imestamp	Adapter	Part_ID	Address	READ_VOUT	READ_IOUT	READ_TEMPER/	ATURE_2						
2	12:27.4	1	TPS544C25	36	0.943	0.5		25						
3	12:27.9	1	TPS544C25	36	0.943	0.4375		25						
4	12:28.4	1	TPS544C25	36	0.943	0.5		25						
5	12:29.1	1	TPS544C25	36	0.943	0.4375		25						
6	12:29.4	1	TPS544C25	36	0.943	0.4375		25						
/	12:29.9	1	TPS544C25	36	0.943	0.4375		25						
8	12:30.4	1	TPS544C25	36	0.943	0.4375		25						
9	12:30.9	1	TPS544C25	36	0.943	0.4375		25						
10	12:31.4	1	TPS544C25	36	0.943	0.4375		25						
11	12:31.8	1	TPS544C25	36	0.943	0.4375		25						
12	12:32.4	1	TPS544C25	36	0.943	0.5		25						
13	12:32.9	1	TPS544C25	36	0.943	0.4375		25						
14	12:33.3	1	TPS544C25	36	0.943	0.4375		25						
15	12:34.0	1	TPS544C25	36	0.943	0.4375		25						
16	12:34.4	1	TPS544C25	36	0.943	0.4375		25						
17	12:34.9	1	TPS544C25	36	0.943	0.4375		25						
18	12:35.2	1	TPS544C25	36	0.943	0.4375		25						
19	12:35.7	1	TPS544C25	36	0.943	0.5		25						
20	12:36.2	1	TPS544C25	36	0.943	0.5		25			1			•
14 4	▶ ► Data	-Log-2015	.05.01-15.1	2.27-IP	Gel /								-	
Read	0.								_		■□□□1	00% 🕒	V	+) _;;

Figure 9-21. Data Log File



Selecting *PMBus Logging* (Figure 9-22) from the Tools drop-down menu enables the logging of all PMBus activity in the same way as the datalogging. This includes communications traffic for each polling loop between the GUI and the device. It also includes common operating values such as V_{OUT} , I_{OUT} , and temperature. The user is prompted to select a location for the file to be stored. See next screen (Figure 9-23).

🔫 Fusion Digital Po	wer Designer - TPS544C25 @ Address 36d - `	Texas Instrum	ients						- 2 🖄
File Device Too	ols Debug Help						TPS544C25 @	⊉ Address 36d - Rail #1	~
Monitor	Device/Project Configuration Compare	Vout - Outpu	ıt Voltage		X	Iout - Output C	urrent		×
Show/Hide Plots:	Debug Console	OVF:	1.281 V OVW:	1.201 🔷 V Vout:	0.949 💭 V	OC Fault:	36.0 🕀 A OC Warn:	34.0 🗭 A 🛛 Write	
Vout Vout	Data Logging	uvw:	0.631 🕀 V UVE:	0.594 ⊕ V MAX:	1.500 🕀 V	40.00			
Fit All Plots on Sci	PMBus Logging	MIN	0.500 @ V						
 Scale Plots to Scr 	SMBus & SAA Tool	1.60-	Write			30.00			
Height: 200	Numeric Encode/Decode Tester	1.40							
Width: 400	Device Read/Write Stress Tester	1.20-				20.00			
Show Warn & Fa	Group Command Protocol Tester	1.00			0.943 V				
Show Value Labe	Configuration Import Tester	0.60-				10.00			
on Plots	ASCII Tool	0.40				10.00			
Poling Rate: 500 (msec)	EEPROM File Tool	0.20							0.50 A
Stop Polling	EEPROM File Compare Tool	0.00	09:40 10	00 10:20	10:40	0.00	09:40 10:00	10:20	10:40
	PEC & SMBus -> I2C Translation Tool	Temperature	e		(N	ງ			
Device Dashboar	Download USB Adapter Firmware	OT Fault:	125 ⊕ °C OT War	m: 100 ⊕ ℃	Write				
System Dashboard		140.00							
	OPERATION	120.00							
	On/Off: On	120.00							
	Immediate Off Set off	100.00 -							
	Margining: None	80.00							
	O Low	60.00 -							
	⊖ High	40.00 -							
	Margin Act On Fault	20.00							
	Action:	20.00			25.0 °C				
	Controlling	0.00	09:40 1	10:00 10:20	10:40				
	Tips & Hints			PMBus Log		_			Į.
	VOUT_MODE [0x20]			15:03:06.649: USB-SAA	#1: CONTROL1 now High				^
Configure	Determines how voltage settings and readings are enc	coded.		15:03:06.734: USB-SAA 15:03:06.738: USB-SAA	#1: CONTROL2 now Low #1: CONTROL3 now Low				
Monitor				15:03:14.549: USB-SAA	#1: CONTROL 1 now Low #1: CONTROL 1 now Low				
do Status				PMBus Log	a control flow high				R 9
Fusion Digital Rows	r Dorignor v2.0.27 (2015.02.27) TBS544C2	25 @ Addross	36d LISB Adapter v1.0.1	1 (DEC: 400 kHz)				Ja Texas berrun gare 1 fue	ion diaital nowar

Figure 9-22. PMBus Logging



Select the storage location for the file and the type of file. As shown (Figure 9-23), the file is a CSV file to be stored in the directory path shown. Logging begins when the *Start Logging* button is selected, and stops when it is reselected (as *Stop Logging*). This file can rapidly grow in size, so caution is advised when using this function.



Figure 9-23. PMBus Log Details



10 EVM Assembly Drawing and PCB Layout

Figure 10-1 through Figure 10-6 show the design of the PWR-681EVM printed-circuit board (PCB).



ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #: PWR681	REV: A	SVN REV	: Not In VersionControl
LAYER NAME = Top Overlay				
PLOT NAME = Top Overlay	GENERATED : 3/30/2	2015 11:10:41	AM	TEXAS INSTRUMENTS

Figure 10-1. PWR-681EVM Top Layer Assembly Drawing (top view)



ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #: PWR681	REV: A	SVN REV	: Not In VersionControl
LAYER NAME = Top Layer				
PLOT NAME = Top Layer	GENERATED : 3/30/2	2015 11:10:42	AM	TEXAS INSTRUMENTS

Figure 10-2. PWR-681EVM Top Layer (top view)



•	
•	
•	
•	
0.	

ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #: PWR681	REV: A	SVN REV	: Not In VersionControl
LAYER NAME = MidLayer1				
PLOT NAME = Inner Layer 1	GENERATED : 3/30/2	2015 11:10:42	AM	TEXAS INSTRUMENTS

Figure 10-3. PWR-681EVM Layer 1 (top view)



ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #: PWR681	REV: A	SVN REV	: Not In VersionControl
LAYER NAME = MidLayer2				
PLOT NAME = Inner Layer 2	GENERATED : 3/30/2	2015 11:10:43	AM	TEXAS INSTRUMENTS

Figure 10-4. PWR-681EVM Layer 2 (top view)





ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #: PWR681	REV: A	SVN REV	: Not In VersionControl
LAYER NAME = Bottom Layer				
PLOT NAME = Bottom Layer	GENERATED : 3/30/2	2015 11:10:43	AM	TEXAS INSTRUMENTS

Figure 10-5. PWR-681EVM Bottom Layer (top view)



ALL ARTWORK VIEWED FROM TOP SIDE	BOARD #: PWR681	REV: A	SVN REV	: Not In VersionControl
LAYER NAME = Bottom Overlay				
PLOT NAME = Bottom Overlay	GENERATED : 3/30/2	2015 11:10:44	AM	TEXAS INSTRUMENTS

Figure 10-6. PWR-681EVM Bottom Layer Assembly Drawing (top view)



11 List of Materials

The EVM components list according to the schematic shown in Table 11-1.

Note

TPS544C25 version used for this example. The TPS544B25 EVM has the same List of Material as the TPS544C25 EVM with the exception of U1.

	Table 11-1. PWR681 List of Materials							
QTY	DES	DESCRIPTION	MANUFACTURER	PART NUMBER				
1	PCB	Printed Circuit Board	Any	PWR681				
1	C1	Capacitor, ceramic, 33 pF, 100 V, ±5%, C0G/NP0, 0603	AVX	06031A330JAT2A				
2	C2, C10	Capacitor, ceramic, 1000 pF, 100 V, ±5%, X7R, 0603	AVX	06031C102JAT2A				
2	C3, C4	Capacitor, ceramic, 1200 pF, 50 V, ±5%, C0G/NP0, 0603	TDK	C1608C0G1H122J				
1	C5	Capacitor, ceramic, 330 pF, 50 V, ±1%, C0G/NP0, 0603	ТДК	C1608C0G1H331F080A A				
1	C6	Capacitor, ceramic, 1 µF, 25 V, ±10%, X7R, 0603	MuRata	GRM188R71E105KA12D				
1	C7	Capacitor, ceramic, 4.7 µF, 10 V, ±10%, X5R, 0603	Kemet	C0603C475K8PACTU				
1	C8	Capacitor, ceramic, 2.2 µF, 6.3 V, ±10%, X6S, 0402	MuRata	GRM155C80J225KE95D				
1	C9	Capacitor, ceramic, 0.1 µF, 25 V, ±5%, X7R, 0603	Kemet	C0603C104J3RACTU				
7	C11, C12, C21, C22, C23, C27, C28	Multi-layer ceramic capacitor, 100 µF, 6.3 V, X5R, 1210	Wurth	885012109004				
4	C13, C14, C15, C16	Multi-layer ceramic capacitor, 22 µF, 25 V, X5R, 1210	Wurth	885012109014				
2	C17, C18	Capacitor, ceramic, 6800 pF, 25 V, ±10%, X7R, 0402	MuRata	GRM155R71E682KA01D				
2	C19, C20	Capacitor, ceramic, 22 µF, 6.3 V, ±20%, X5R, 0805	MuRata	GRM21BR60J226ME39L				
1	C24	Capacitor, TA, 100 μF, 25 V, ±10%, 0.1 Ω, SMD	AVX	TPSV107K025R0100				
1	D1	LED, pink, SMD	Bivar	SMS1105PKD				
4	H1, H2, H3, H4	Bumpon, cylindrical, 0.312 X 0.200, black	3M	SJ61A1				
2	H5, H6	Screw, 6-32 x 3/8" steel	B&F Fastener Supply	PMSSS 632 0038 PH				
1	J1	2-pin terminal block, 0.200" spacing	Wurth	691216510002				
1	J2	10-pin header, 2x5, 0.100" spacing, shrouded	Wurth	61201021621				
2	J3, J4	Swage threaded standoff, brass, swage mount, TH	Keystone	1546				
2	JP1, JP2	2-pin header, 0.100" spacing	Wurth	61300211121				
1	L1	Inductor, shielded drum core, ferrite, 470 nH, 35 A, 0.00032 Ω , SMD	Wurth Elektronik eiSos	744301047				
1	LBL1	Thermal transfer printable labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10				
1	Q1	Transistor, NPN, 40 V, 0.2 A, SOT-23	Fairchild Semiconductor	MMBT3904				
1	Q2	MOSFET, N-Channel, 60 V, 0.24 A, SOT-23	Vishay-Siliconix	2N7002E-T1-E3				
1	R1	Resistor, 100 kΩ, 1%, 0.1 W, 0603	STD	STD				
1	R2	Resistor, 10.5 kΩ, 1%, 0.1 W, 0603	STD	STD				
4	R3, R5, R10, R18	Resistor, 10.0 kΩ, 1%, 0.1 W, 0603	STD	STD				
3	R6, R13, R15	Resistor, 49.9 Ω, 1%, 0.1 W, 0603	STD	STD				
1	R7	Resistor, 40.2 kΩ, 1%, 0.1 W, 0603	STD	STD				
1	R8	Resistor, 300 Ω, 1%, 0.1 W, 0603	STD	STD				
2	R11, R12	Resistor, 51.1 kΩ, 1%, 0.1 W, 0603	STD	STD				
1	R14	Resistor, 0 Ω, 5%, 0.1 W, 0603	STD	STD				
1	R16	Resistor, 1.0 Ω, 5%, 0.25 W, 1206	STD	STD				

QTY	DES	DESCRIPTION	MANUFACTURER	PART NUMBER		
1	R17	Resistor, 0 Ω, 5%, 0.1 W, 0603	STD	STD		
1	R20	Resistor, 21.5, 1%, 0.1 W, 0603	STD	STD		
1	R21	Resistor, 38.3 kΩ, 1%, 0.1 W, 0603	STD	STD		
1	S1	Switch, slide, SPDT 100 mA, SMT	Copal Electronics	CAS-120TA		
2	SH-JP1, SH- JP2	Shunt, 100 mil, gold plated, black	3M	969102-0000-DA		
6	TP1, TP7, TP8, TP9, TP11, TP12	Test point, miniature, white, TH	Keystone	5002		
5	TP2, TP3, TP4, TP6, TP13	Test point, miniature, red, TH	Keystone	5000		
2	TP5, TP14	Test point, miniature, black, TH	Keystone	5001		
1	TP10	Test point, multipurpose, black, TH	Keystone	5011		
1	U1	18 V, 30 A PMBUS Synchronous Buck Converters, RVF0040A	Texas Instruments	TPS544C25RVF		
1	U2	3-Terminal Adjustable Current Source, 8-pin Narrow SOIC, Pb-Free	Texas Instruments	LM334SM/NOPB		
0	C25, C26	Capacitor, TA, 330 μF, 6.3 V, ±20%, 0.025 Ω, SMD	Sanyo	6TPE330ML		
0	FID1, FID2, FID3, FID4, FID5, FID6	Fiducial mark. There is nothing to buy or mount.	N/A	N/A		
0	R4	Resistor, 0 Ω, 5%, 0.1 W, 0603	Panasonic	ERJ-3GEY0R00V		
0	R9, R19	Resistor, 30.1 kΩ, 1%, 0.1 W, 0603	Vishay-Dale	CRCW060330K1FKEA		

Table 11-1. PWR681 List of Materials (continued)

12 Revision History

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

С	Changes from Revision A (September 2015) to Revision B (August 2021)				
•	Updated the numbering format for tables, figures, and cross-references throughout the document	3			
•	Updated the user's guide title	3			
С	hanges from Revision * (May 2015) to Revision A (September 2015)	Page			
•	Added updated EVM Assembly Drawings and PCB Layout drawings	39			
•	Changed C11, C12, C21, C22, C23, C27, C28 description, manufacturer and part number	42			
•	Changed C13, C14, C15, C16 description, manufacturer and part number.	42			
•	Changed J1 description, manufacturer and part number	42			
•	Changed J2 description, manufacturer and part number	42			
•	Changed JP1 and JP2 description, manufacturer and part number	42			
•	Changed L1 part number	42			
•	Changed all resistor manufacturer and part numbers to STD.	42			

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