

Using the TPS24700EVM-001, TPS24701EVM-002, TPS24710EVM-003 and the TPS24711EVM-004

User's Guide



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TPS24700/01/10/11 Evaluation Module (TPS24700EVM-001, TPS24701EVM-002, TPS24710EVM-003 and the TPS24711EVM-004)

This User's Guide describes the setup and operation of the TPS24700EVM-001, TPS24701EVM-002, TPS24710EVM-003 and the TPS24711EVM-004 system test boards.

1 Introduction

This User's Guide describes the features of the TPS24700/01/10/11EVM. Also provided are the schematic, layout and list of materials.

2 Description

The EVM is a 3-V to 20-V module using the TPS24700/01/10/11 hot-swap controller with external MOSFET. At power on, the output is power limited to control inrush current and protect the MOSFET. On an over-current condition, the controller interrupts power to the load at high speed and signals load status. Operating current, fault current and fault timer settings are hardware programmable.

2.1 Applications

- Server
 - Plug-In Circuit Boards
 - RAID/Disk Drive
- Telecom
 - ATCA
 - Micro-ATCA
- General Hot Plug

2.2 Features

- Board design covers input/output from 3-V to 20-V but is factory set for 12-V operation. The customer can change components to operate at other voltages and currents.
- Board design for 50-A steady state max output. The EVM will be set up for a 12-V, 25-A nominal application. The datasheet design examples show how to select components for other operating set points.
- Latch-off or re-try controller by part number.
- Input/output out of operating range transient voltage protections.
- Support components to be 0603 size where permitted by power dissipation or component ratings.
- 2-oz copper, 4 layer.
- On-board ENABLE input (slide switch).

3 Schematic

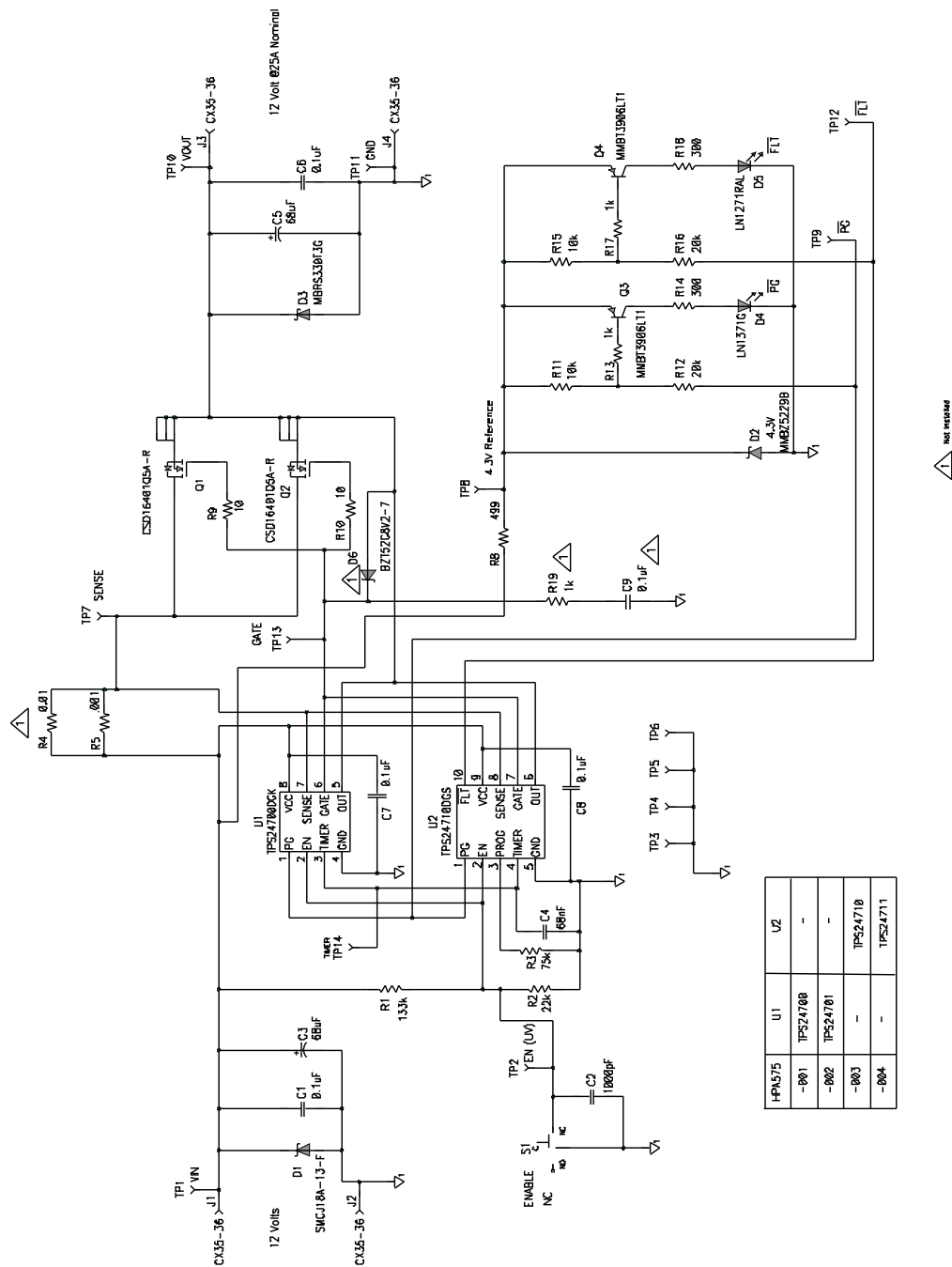


Figure 1.

4 Overvoltage Protection

Input protection for the TPS24700A and MOSFET consists of a 15-V TVS and 0.1- μ F and 47- μ F capacitors located close to the V_{IN} pins. The TVS is active at 16.5 V minimum. TVS is Vishay SMAJ15A, 400 W, SMA package.

Output protection is a fixed 47- μ F capacitor and a parallel 0.1- μ F capacitor located at the output terminals. A schottky diode on the output clamps negative going transitions. Diode MBRS3100T3, 3 A, 100 V.

5 $\overline{\text{ENABLE}}$ Signal

Slide switch to operate $\overline{\text{ENABLE}}$ signal. The Enable signal is externally pulled to V_{IN} through a resistor divider to set the UV to 10-V. A 0.1- μ F capacitor will be used to help de-bounce the Enable switch.

6 Test Points

Test points are located on the board edge.

Table 1. Test Points

NAME	DESCRIPTION
ENUV	Enable Signal
4.3-V REF	4.3 V
$\overline{\text{PG}}$	Power Good, Signal, Low True
$\overline{\text{FLT}}$	Fault, Signal, Low True
SENSE	Sense Resistor Voltage Low
GND	Scope Ground Test Point
GND	Scope Ground Test Point
GND	Scope Ground Test Point
GND	Scope Ground Test Point
VOUT	Output Voltage
CT	Fault Timer Capacitor
PROG	Program Voltage
SET	Current Limit Set Point
GATE	Gate Signal
VIN	Input Voltage Power Supply

7 Jumpers

None

8 Indicator LEDs

A 4.3-V Zener is used to control the voltage applied to the EN signal. It is also used to limit the voltage range on the LEDs. A bipolar signal transistor is used to turn on the LED while keeping the $\overline{\text{PG}}$ and $\overline{\text{FLT}}$ signals less than 0.3-V active.

Table 2. Indicator LED Colors

SIGNAL	LED COLOR
$\overline{\text{PG}}$	Green
$\overline{\text{FLT}}$	Red

9 Disable Power Limiting

Power limiting can be disabled by leaving the PROG pin open (no programming resistor). The soft-start time can be controlled by a gate capacitor and series 1-k Ω resistor. See Not Installed.

10 Not Installed

- D6 is installed if the VGS needs to be limited. The zener voltage rating set VGS max.
- R19, C9 installed if the soft start is not controlled by power limiting but by gate current and the selected C9 Where $C = I \times T / V$. Example, for 10-ms start on a 12-V board, $C = 30 \mu A \times 10 \text{ ms} / 25 \text{ V}$, $C = 12 \text{ nF}$.

NOTE: The provision provided for dual current sense resistor packages (R4 and R5) can lead to current sensing and power limit accuracy reduction. A simple PCB modification can be made to improve this accuracy as shown in [Figure 2](#).

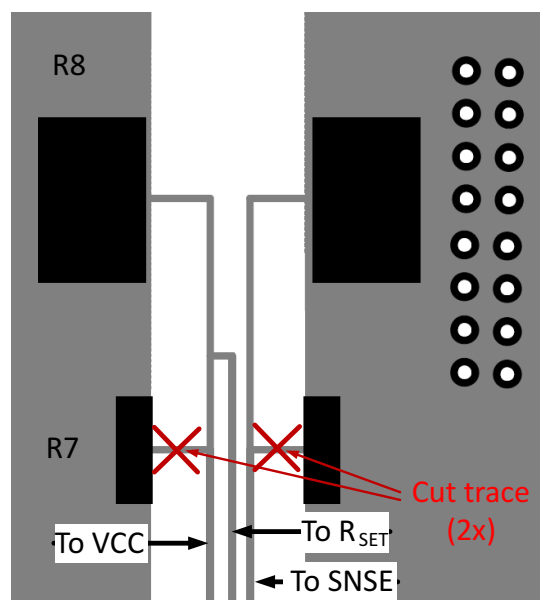


Figure 2. PCB Modification

11 EVM Assembly Drawings and Layout

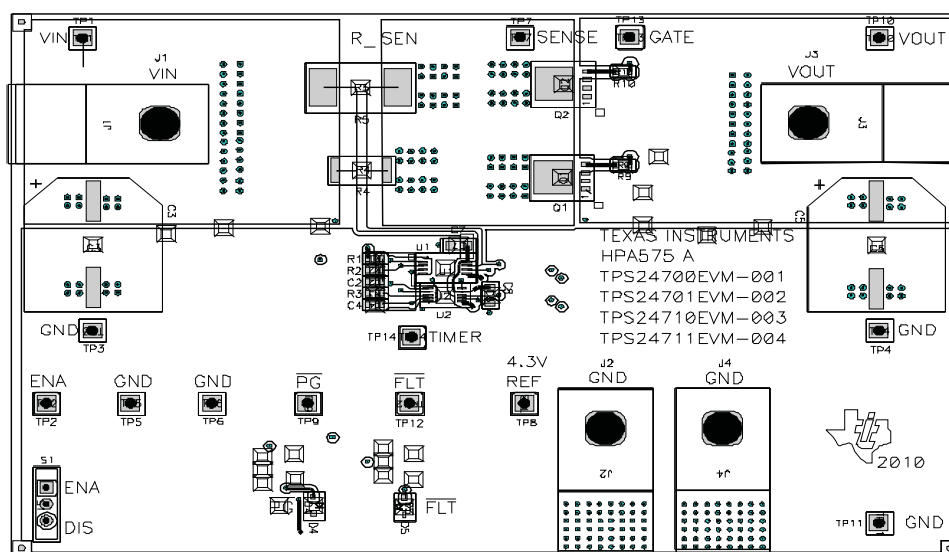


Figure 3. Board Top

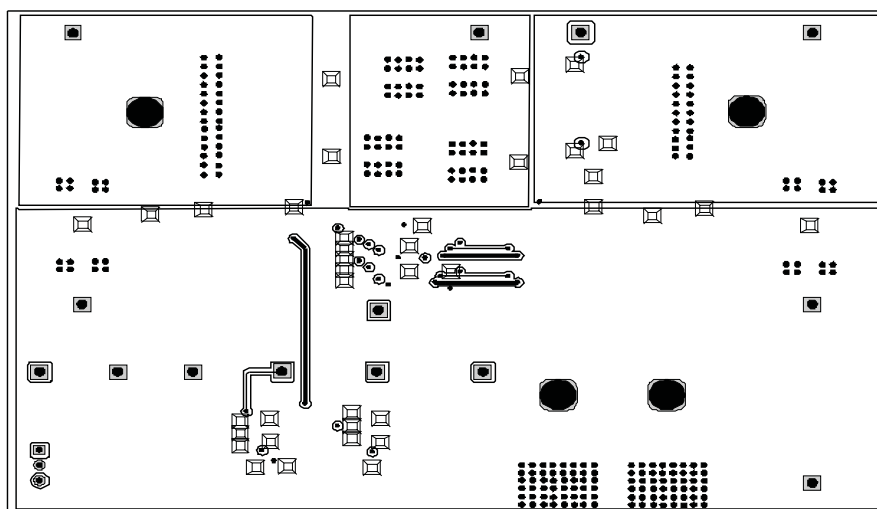


Figure 4. Layer 1

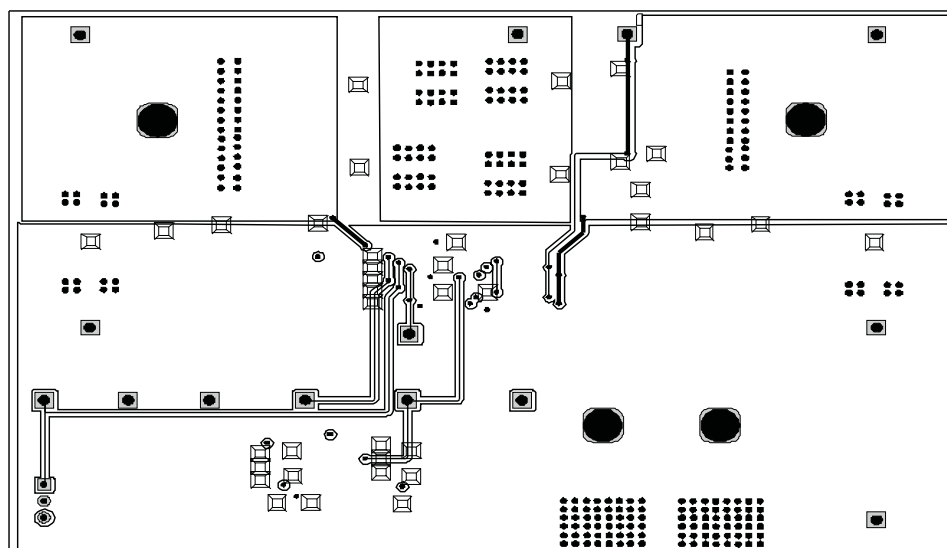


Figure 5. Layer 2

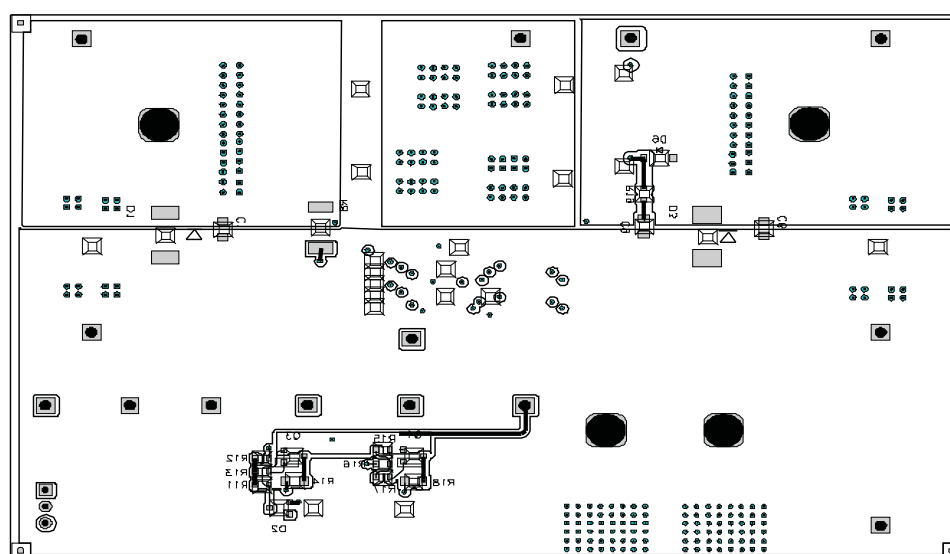


Figure 6. Board Bottom

12 List of Materials

Table 3. List of Materials⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾

-004	-003	-002	-001	REF DES	DESCRIPTION	PART NUMBER	MFR
4	4	4	4	C1, C6, C7, C8	Capacitor, ceramic, 100 V, X7R, 10%, 0.1 μ F, 0805	STD	STD
0	0	0	0	C9	Capacitor, ceramic, 100 V, X7R, 10%, 0.1 μ F, 0805	STD	STD
1	1	1	1	C2	Capacitor, ceramic, 100 V, X7R, 10%, 1000 pF, 0603	STD	STD
2	2	2	2	C3, C5	Capacitor, aluminum, 80 VDC, $\pm$ 20%, 68 μ F, 0.670 inch x 0.750 inch	EEVFK1K680Q	Panasonic
1	1	1	1	C4	Capacitor, ceramic, 16 V, X7R, 10%, 68 nF, 0603	STD	STD
1	1	1	1	D1	Diode, [uni-]directional TVS, 1500 W, SMC	SMCJ18A-13-F	Diodes
1	1	1	1	D2	Diode, Zener, 4.3 V, SOT23	MMBZ5229B	Motorola
1	1	1	1	D3	Diode, Schottky, 3 A, 40 V, SMC	MBRS330T3G	On Semi
1	1	1	1	D4	Diode, LED, green, 0.114 inch x 0.049 inch	LN1371G	Panasonic
1	1	1	1	D5	Diode, LED, ultra bright red, 0.114 inch x 0.049 inch	LN1271RAL	Panasonic
0	0	0	0	D6	Diode, Zener, planar power, 500 mW, 8.2 V, SOD-123	BZT52C8V2-7	Vishay
4	4	4	4	J1, J2, J3, J4	Lug, copper, 35 A, 0.380 inch x 1.020 inch	CX35-36	Panduit
2	2	2	2	Q1, Q2	MOSFET, N-channel, 25 V, 37 A, 1.3 m Ω , QFN 5 x 6 mm	CSD16401Q5A-R	Ciclon
2	2	2	2	Q3, Q4	Bipolar, PNP, 40 V, 200 mA, SOT23	MMBT3906LT1	On Semi
1	1	1	1	R1	Resistor, chip, 1/16 W, 1%, 133 k Ω , 0603	STD	STD
2	2	2	2	R11, R15	Resistor, chip, 1/16 W, 5%, 10 k Ω , 0603	STD	STD
2	2	2	2	R12, R16	Resistor, chip, 1/16 W, 5%, 20 k Ω , 0603	STD	STD
2	2	2	2	R13, R17	Resistor, chip, 1/16 W, 1%, 1 k Ω , 0603	STD	STD
0	0	0	0	R19	Resistor, chip, 1/16 W, 1%, 1 k Ω , 0603	STD	STD
2	2	2	2	R14, R18	Resistor, chip, 1/10 W, 5%, 300 Ω , 0805	STD	STD
1	1	1	1	R2	Resistor, chip, 1/16 W, 1%, 22 k Ω , 0603	STD	STD
1	1	0	0	R3	Resistor, chip, 1/16 W, 1%, 75 k Ω , 0603	STD	STD
0	0	0	0	R4	Resistor, metal strip, 0.01 Ohms, 2 W, 1%, 0.01 Ω , 2512	LCR-LRF2512-01-R010-F	IRC
1	1	1	1	R5	Resistor, power metal strip, 3 W, $\pm$ 1%, 0.001 Ω , 4527	WSR-3	Vishay Dale
1	1	1	1	R8	Resistor, chip, 0.5 W, 1%, 499 Ω , 2512	STD	STD
2	2	2	2	R9, R10	Resistor, chip, 1/16 W, 1%, 10 Ω , 0603	Std	Std

⁽¹⁾ These assemblies are ESD sensitive, ESD precautions shall be observed.

⁽²⁾ These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.

⁽³⁾ These assemblies must comply with workmanship standards IPC-A-610 Class 2.

⁽⁴⁾ Ref designators marked with an asterisk ("**") cannot be substituted. All other components can be substituted with equivalent MFG's components.

Table 3. List of Materials ⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾ (continued)

-004	-003	-002	-001	REF DES	DESCRIPTION	PART NUMBER	MFR
1	1	1	1	S1	Switch, SPDT, slide, PC mount, 500 mA, 0.400 inch x 0.100 inch	09.03201.02	EAO
14	14	14	14	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14	Test point, white, thru hole, 0.125 inch x 0.125 inch	5012	Keystone
0	0	0	1	U1	2.5 V to 20 V Positive Voltage Power-Limiting Hotswap Controller, VSSOP-8	TPS24700DGK	TI
0	0	1	0	U1	2.5 V to 20 V Positive Voltage Power-Limiting Hotswap Controller, VSSOP-8	TPS24701DGK	TI
0	1	0	0	U2	2.5 V to 20 V Positive Voltage Power-Limiting Hotswap Controller, VSSOP-10	TPS24710DGS	TI
1	0	0	0	U2	2.5 to 20 V Positive Voltage Power-Limiting Hotswap Controller, VSSOP-10	TPS24711DGS	TI
1	1	1	1	--	PCB, 4.82 inch x 3.3 inch x 0.062 inch	PCB	Any
4	4	4	4		Bumpers, cylindrical, black	SJ5514-0	3M
4	4	4	4		Screw, panhead	#10-32	0.500 inch
4	4	4	4		Washer, flat	#10	
4	4	4	4		Washer, split	M5	
4	4	4	4		Nut, hex	#10-32	

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CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

Concerning EVMs Including Radio Transmitters:

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2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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