TPS1H200-Q1 Evaluation Module (EVM)

The TPS1H200-Q1 evaluation module is designed to evaluate the TPS1H200-Q1 integrated circuit. This user's guide provides the connectors and test point description, schematic, bill of materials, and board layout of the EVM.

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1 Introduction

Texas Instruments TPS1H200-Q1 evaluation module contains a TPS1H200-Q1 integrated circuit (IC), supporting 1-channel, high-side driver application. The purpose of this EVM is to facilitate evaluation of the TPS1H200-Q1 for resistive, capacitive, and inductive loads.

1.1 Descriptions

The Texas Instruments TPS1H200-Q1 EVM helps designers evaluate the operation and performance of the TPS1H200-Q1.

The TPS1H200-Q1 is a fully-protected, high-side switch, with integrated NMOS power FET, and charge pump. Full diagnostics and high-accuracy current sense features enable intelligent control of the load. Programmable current-limit function greatly improves the reliability of the whole system.

The TPS1Hxxx-Q1 family is available in different $R_{DS(on)}$ values and output current. The device can switch a wide variety of resistive, inductive, and capacitive loads.

The device diagnostic reporting has two versions to support both digital status output and analog current sense report. The diagnostics can be disabled for multiplexing the sense pin between different devices.

1.2 Applications

The EVM can be used in the following applications:

- High-side relay drivers
- High-voltage power switch for submodule power supply
- Low-wattage lamp driver
- General resistive, inductive, and capacitive loads
- Replace electromechanical relays and fuses

1.3 Features

The EVM supports the following features:

- Single-channel high-side power switch, tested according to AECQ100-12
- Operating voltage 5 V to 40 V, extended operating down to 3.4 V
- Operating junction temperature: –40ºC to 150ºC
- Very-low standby current: < 500 nA
- Microcontroller input control: 3.3-V and 5-V logic compatible
- Protection:
  - Short-circuit protection
  - Overvoltage protection
  - Thermal shutdown and thermal swing with self-recovery
  - Loss of GND, loss of Vs protection
  - ESD protection
- Diagnostic:
  - On/off state output open/short to battery detection
  - Overload and short-to-ground detection and power limiting
  - Thermal shutdown and thermal swing diagnostic
  - Open-drain status output
  - Diagnostic enable function for multiplexing of MCU analog or digital port

2 TPS1H200-Q1 Schematic

Figure 1 illustrates the EVM schematic.

Figure 1.

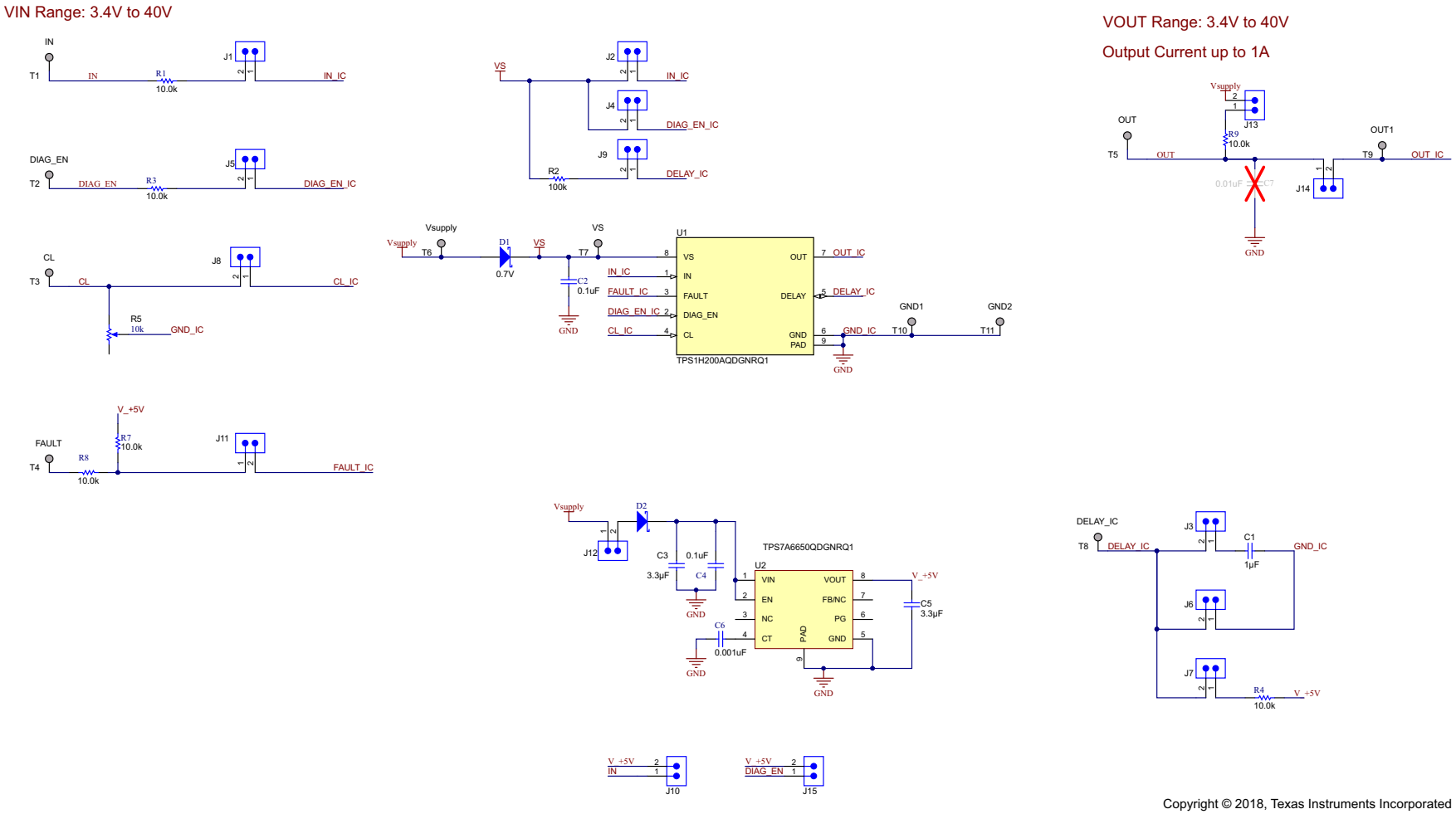

Figure 2. TPS1H200-Q1 EVM Schematic

3 Connections Descriptions

3.1 Connectors and Test Points

Table 1 lists the connector and test point descriptions.

Table 1. Connector and Test Point Descriptions

Connectors and Test Points	Description
GND1 / GND2	Board GND connector, the return connection to the input power supply
IN	Board input connector, 3.3- or 5-V control signal connection pin
OUT	Board output pin connector, the source terminal of DMOS
FAULT	Board fault output connector
CL	Board current limit output connector
DIAG_EN	Board Diag_En input connector, 3.3- or 5-V control signal connection pin
Vsupply	Board positive input supply voltage connector
OUT1	IC output pin test point
VS	IC positive input supply voltage test point
DELAY_IC	IC current limit function configuration; internal pullup

3.2 Jumpers

Table 2 lists the EVM jumper descriptions.

Table 2. Jumper Descriptions

Jumpers	Description
J1	Connects board IN to IN_IC.
J2	Connects VS to IN_IC.
J3	Connects a 1-µF capacitance to the GND pin of the device
J4	Connects the DIAG_EN pin to VS
J5	Connects board DIAG_EN to DIAG_EN_IC
J6	Connects the DELAY_IC pin to GND
J7	Connects a 5-V pullup resistance to DELAY_IC
J8	This jumper is used to connect the CL pin to the potentiometer R5
J9	This jumper adds a pullup resistance to the DELAY_IC pin
J10	Connects IN to +5 V
J11	This jumper is used to set a pull up for the FAULT signal
J12	Connects the input supply to the +5-V LDO
J13	This jumper is used to connect OUT to a 10-kΩ pullup resistance
J14	This jumper is used to connect OUT to OUT1 (IC OUT)
J15	This jumper connects DIAG_EN to +5 V

4 TPS1H200-Q1 EVM Assembly Drawings and Layout

Figure 3 through Figure 5 show the design of the TPS1H200-Q1 PCB. The EVM was designed using FR4 material with four layers (2s2p).

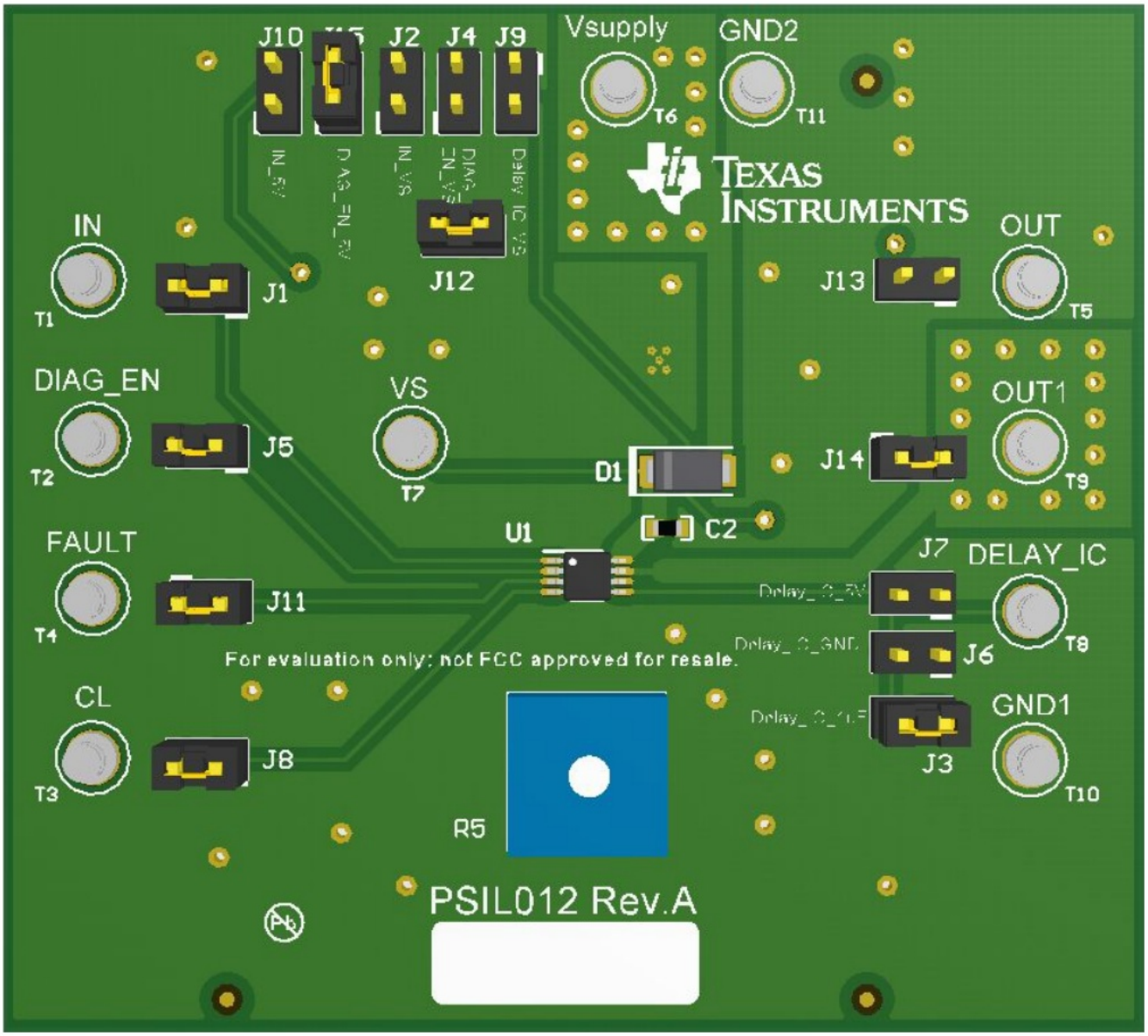

Figure 3. TTPS1H200-Q1 EVM Component Placement (Top View)

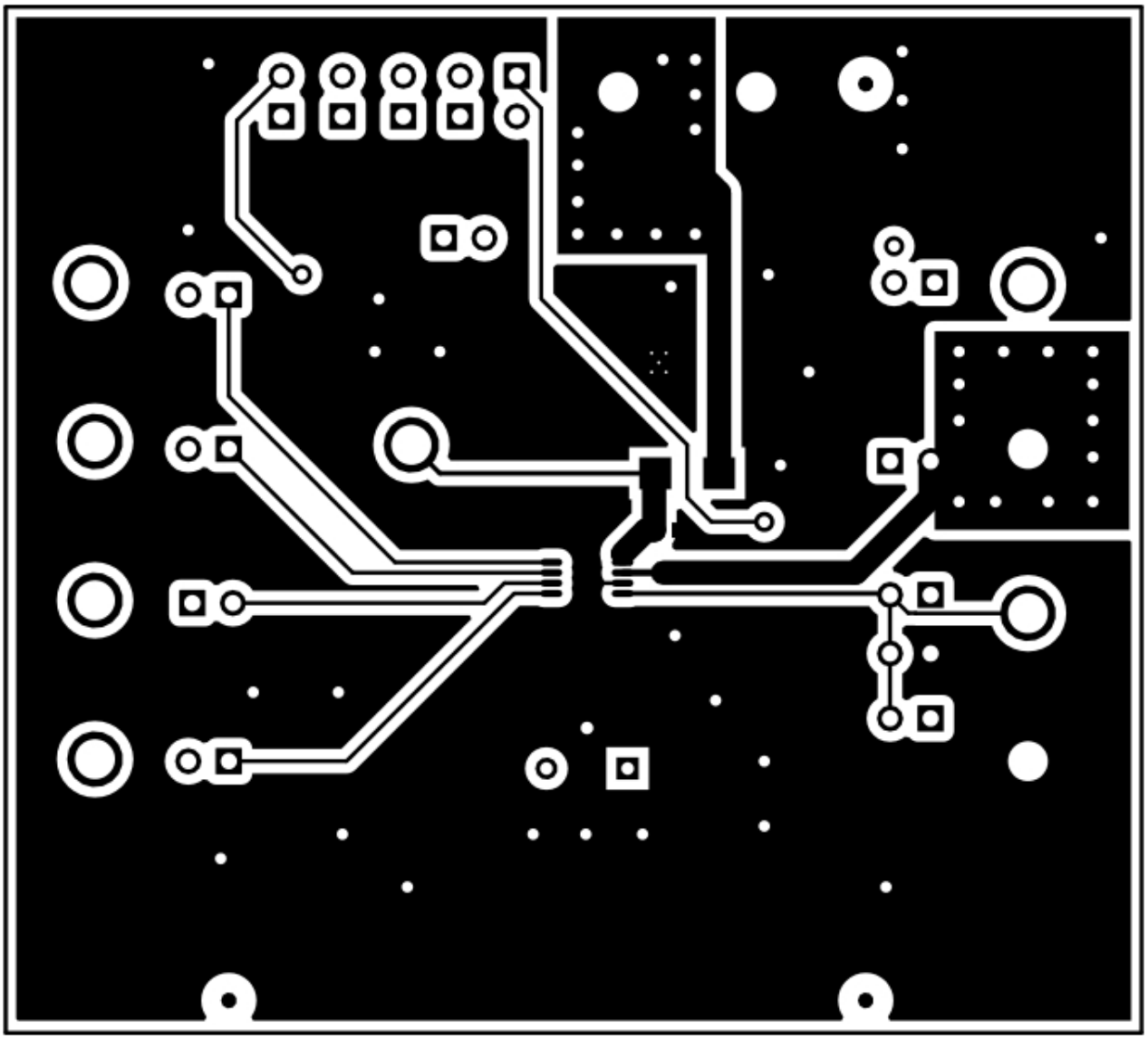

Figure 4. TPS1H200-Q1 EVM Top Layer (Top View)

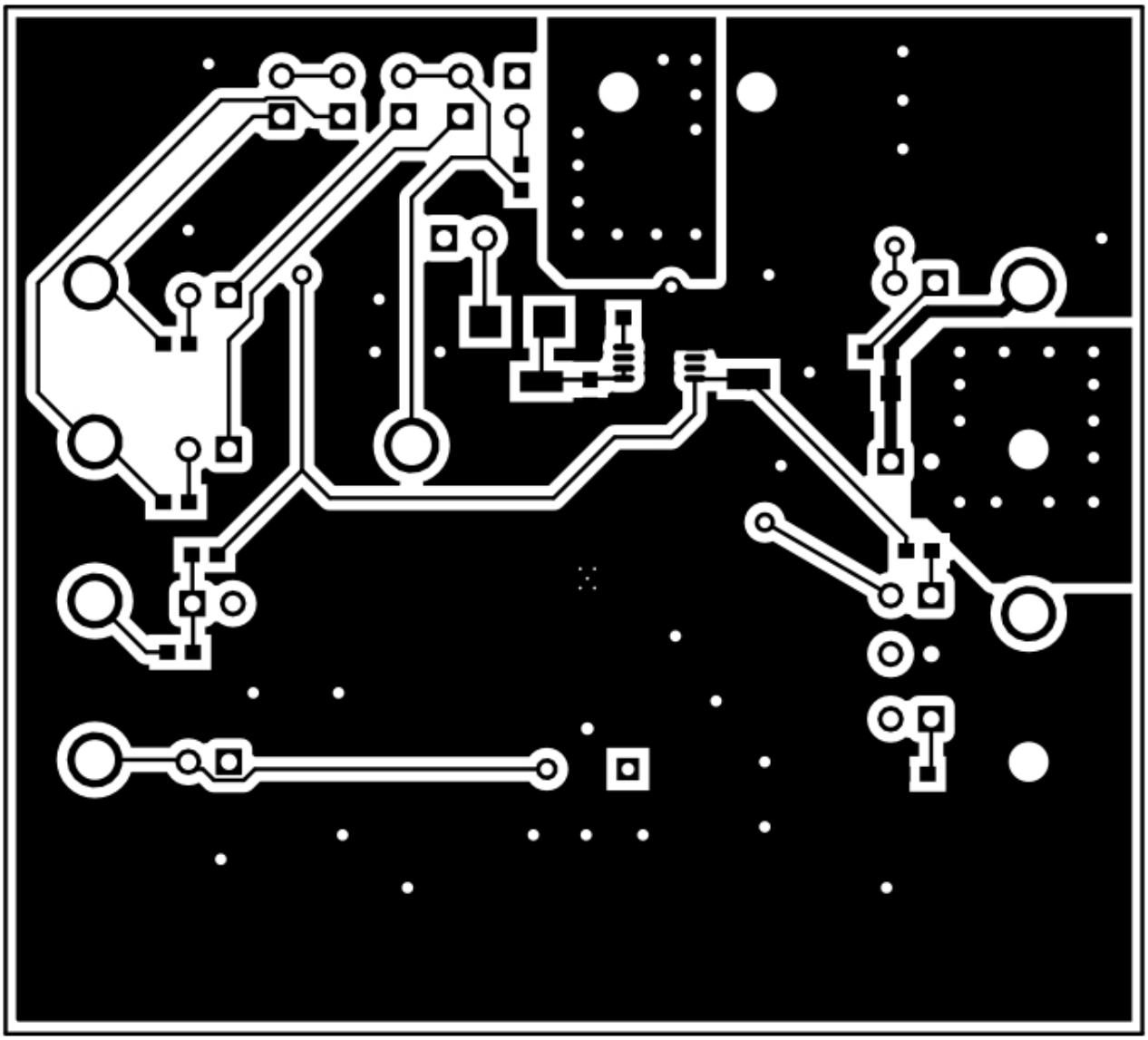

Figure 5. TPS1H200-Q1 EVM Bottom Layer (Bottom View)

5 Variable Resistor for CL

5.1 Current Limit Resistor

An external resistor is used to convert a proportional load current into a voltage, which is compared with an internal reference voltage. When the voltage on the CL pin exceeds the reference voltage, the current is clamped.

The inherent current limit ($I_{lim,nom}$) is still present when using an external current limit. The smaller value of the internal or external set value decides the actual nominal current limit. If the user decides not to use the external programmable current, tie the CL pin to ground.

Equation 1 shows the equation for calculating the current limit resistance.

$$I_{CL} = \frac{V_{CL,th}}{R_{CL}} = \frac{I_{out}}{K_{CL}} \rightarrow R_{CL} = \frac{V_{CL,th} \times K_{CL}}{I_{out}} \quad (1)$$

R5 is a variable resistor, from 0 Ω to 10 kΩ. The CL resistor can be changed through R5. When 0 Ω, there is no external current limit function and the internal current limit is active. When 5 kΩ, the current limit value is around 0.48 A.

6 Bill of Materials

Table 3 details the EVM BOM.

Table 3. TPS1H200-Q1 Bill of Materials

Designator	Quantity	Value	Description	Part Number
C1	1	1uF	CAP, CERM, 1 µF, 25 V, ±10%, X5R, 0603	C1608X5R1E105K080AC
C2, C4	2	0.1uF	CAP, CERM, 0.1uF, 50V, ±10%, X7R, 0603	GRM188R71H104KA93D
C3, C5	2	3.3uF	CAP, CERM, 3.3uF, 50V, ±20%, X7R, 1210	C3225X7R1H335M
C6	1	1000pF	CAP, CERM, 1000pF, 50V, ±10%, C0G/NP0, 0603	06035A102KAT2A
C7	1	0.01uF	NC	08051C103JAT2A
D1, D2	2	0.7V	Diode, Schottky, 50V, 1A, SMA	B150-13-F
H9, H10, H11, H12	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	SJ-5303 (CLEAR)
J1, J2, J3, J4, J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15	15		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10
R1, R3, R4, R7, R8, R9	6	10k	RES, 10.0k ohm, 1%, 0.1W, 0603	CRCW060310K0FKEA
R2	1	100k	RES, 100 k, 0.1%, 0.063 W, 0603	CPF0603B100KE
R5	1	10l	TRIMMER, 10k ohm, 0.5W, TH	3386P-1-103LF
SH-J1, SH-J3, SH-J5, SH-J8, SH-J11, SH-J12, SH-J14, SH-J15	8	1x2	Shunt, 100mil, Gold plated, Black	969102-0000-DA
T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11	11	Double	Terminal, Turret, TH, Double	1502-2
U1	1		40V/1ohm Single Channel Smart High Side Power Switch, DGN0008D	TPS1H200-Q1AQDGNRQ1
U2	1		High-Voltage Ultralow-Iq Low-Dropout Regulator, DGN0008D	TPS7A6650QDGNRQ1
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A

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      3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

      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.

      FCC Interference Statement for Class A EVM devices

      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.

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- *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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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