TPS61390EVM-020 Evaluation Module User's Guide

This user's guide describes the characteristics, operation, and the use of the TPS61390EVM-020 evaluation module (EVM). The EVM contains the TPS61390, a step-up converter with integrated current mirror and sample-and-hold circuitry. This design furnishes biasing and monitoring of the avalanche photodiodes (APD) in the optical receivers. The user's guide includes EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

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1 Introduction

1.1 Performance specification

Table 1 provides a summary of the TPS61390 EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

SPECIFICATION	TEST CONDITIONS	MIN TYP MAX	UNIT
VIN		3.3	V
VOUT	TPS61390EVM, VIN = 3.3 V, Io ≤ 10mA	60	V

1.2 Modification

The printed-circuit board (PCB) for this EVM is designed to accommodate some modifications by the user. The external component can be changed according to the user's application.

1.3 Input capacitor

A 100-μF tantalum capacitor C1 is added as the input capacitor in the EVM. The ESR of the tantalum capacitor is 0.1 Ω which helps to damp the ringing of the input voltage when the EVM is powered by a power supply with a long cable. The capacitor is not required for proper operation and can be removed in a user's application.

1.4 Output Capacitor Selection

Two 0.1-μF ceramic capacitors C3 and C4 are added as the output capacitors. These capacitors help ensure the low output ripple at heavy load.

1.5 VSP Voltage Measurement

In the low APD current application, something like in the range of 0μA–50μA, the VSP voltage deviation is affected by the type of the APD load resistor (R11, R12, R13 and R14 in Figure 1). The VSP noise level can be around 30mV with low cost thick-film resistor, while it is less than 10mV with thin-film or wire-wound resistor.

1.6 APD Dynamic Load Test

A MOSFET Q1 is added onto the EVM board to simulate the characteristics of the real APD current. Q1 is turned on and off at a target frequency. Under the default 60-V output, a 1-mA current flows through Q1 when setting the gate voltage at around 1.15V. The exact drain current can be calculated from the voltage drop across the R15 resistor.

1.7 APD Decoupling Capacitor Selection

The default APD decoupling capacitor is 220pF (C10) on the EVM board. In the user's application, if there is already a decoupling capacitor on the optical module, then the decoupling capacitor C10 must be deleted from the EVM board. Too much decoupling capacitance results in poor optical detection sensitivity.

2 Setup

This section describes how to properly connect, set up, and use the TPS61390EVM-020.

2.1 Input/Output Connector Descriptions

J1-VIN: Positive input connection from the input supply for the EVM

J2-GND: Return connection from the input supply for the EVM

J3-VOUT: Positive connection for the output voltage

J4-GND: Return connection for the output voltage

JP1-APD: Power supply for the APD pin

JP2-Vo_ADJ: Adjust the output voltage

JP3-EN: EN pin input jumper. Place a jumper across EN and pin3 to turn on the IC, place a jumper across EN and pin1 to turn off the IC

JP4-SAMPLE: Sample enable pin

JP5-VSP: Sample/Hold output pin

JP6-GAIN: Gain of the current mirror selection

3 Schematic, Bill of Materials, and Board Layout

This section provides the TPS61390EVM-020 schematic, bill of materials (BOM), and board layout.

3.1 Schematic

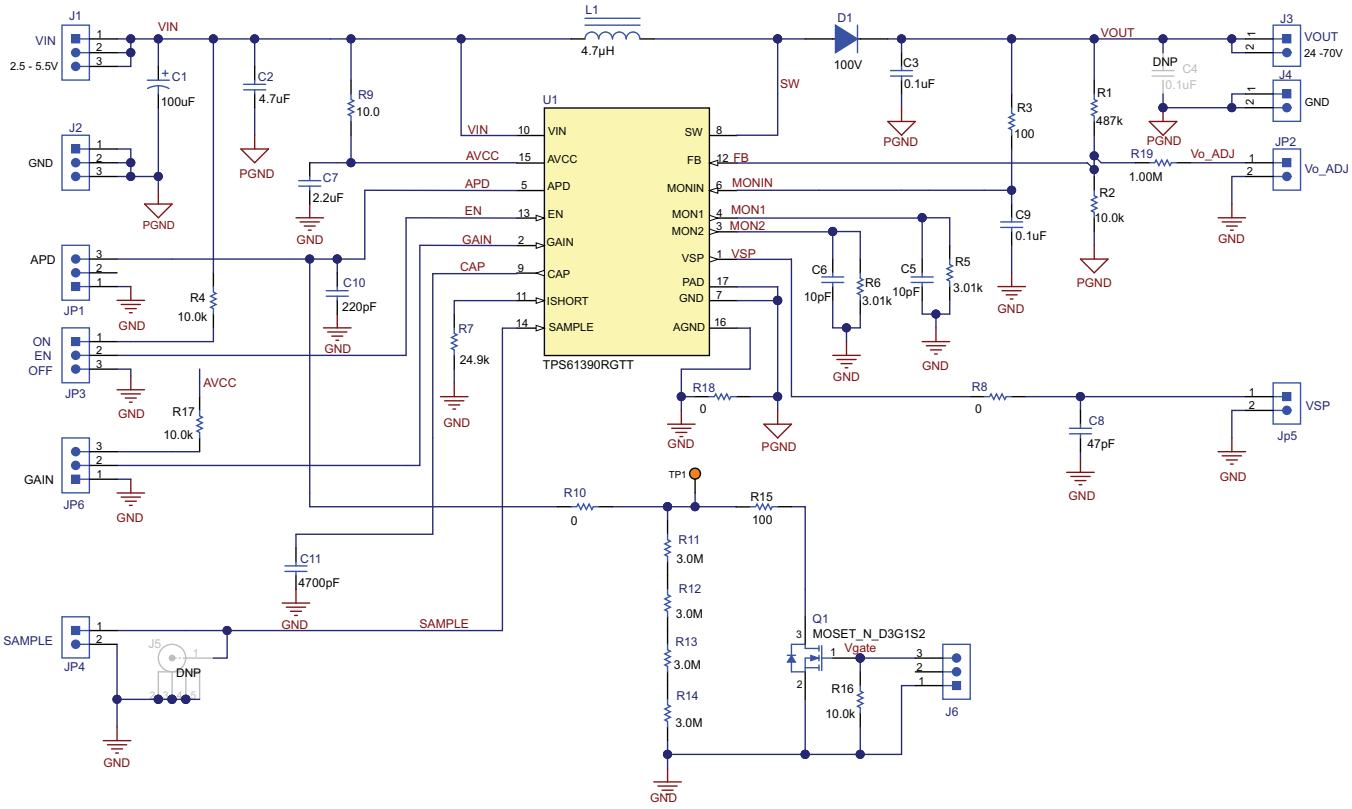

Figure 1. TPS61390EVM-020 Schematic

3.2 Bill of Materials

Table 2. TPS61390EVM-020 Bill of Materials

Designator	QTY	Value	Description	Package	PartNumber	MFG
C1	1	100uF	CAP, TA, 100 µF, 16 V, +/- 10%, 0.1 ohm, SMD	7343-43	T495X107K016ATE100	Kemet
C2	1	4.7uF	CAP, CERM, 4.7 µF, 10 V, +/- 10%, X5R, 0603	0603	0603ZD475KAT2A	AVX
C3, C9	2	0.1uF	CAP, CERM, 0.1 µF, 100 V, +/- 10%, X7R, 0603	0603	GRM188R72A104KA35D	MuRata
C5, C6	2	10pF	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H100JA01D	MuRata
C7	1	2.2uF	CAP, CERM, 2.2 µF, 16 V, +/- 10%, X5R, 0603	0603	GRM188R61C225KE15D	MuRata
C8	2	47pF	CAP, CERM, 47 pF, 50 V, +/- 1%, C0G/NP0, 0603	0603	GRM1885C1H470FA01J	MuRata
C10	1	220pF	CAP, CERM, 220 pF, 100 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C2A221JA01D	MuRata
C11	1	4700pF	CAP, CERM, 4700 pF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E2X7R2A472K080AA	TDK
D1	1	100V	Diode, Switching, 100 V, 0.25 A, AEC-Q101, SOD-123	SOD-123	BAS16D-E3-08	Vishay-Semiconductor
J1, J2, J6, JP1, JP3, JP6	6		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J3, J4, JP2, JP4, JP5	5		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
L1	1	4.7uH	Inductor, Shielded, Metal Composite, 4.7 µH, 1.2 A, 0.252 ohm, SMD	2x1.6mm	DFE201612E-4R7M=P2	MuRata
Q1	1	100V	MOSFET, N-CH, 100 V, 0.17 A, SOT-23	SOT-23	BSS123	Fairchild Semiconductor
R1	1	487k	RES, 487 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603487KFKEA	Vishay-Dale
R2, R4, R16, R17	4	10.0k	RES, 10.0 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R3, R15	2	100	RES, 100, 0.5%, 0.1 W, 0603	0603	RT0603DRE07100RL	Yageo America
R5, R6	2	3.01k	RES, 3.01 k, 0.5%, 0.1 W, 0603	0603	RT0603DRE073K01L	Yageo America
R7	1	24.9k	RES, 24.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060324K9FKEA	Vishay-Dale
R8, R10, R18	3	0	RES, 0, 5%, 0.125 W, 0603	0603	MCT06030Z0000ZP500	Vishay/Beyschlag
R9	1	10.0	RES, 10.0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060310R0FKEA	Vishay-Dale
R11, R12, R13, R14	4	3.0Meg	RES, 3.0 M, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06033M00JNEA	Vishay-Dale
R19	1	1.00Meg	RES, 1.00 M, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031M00FKEA	Vishay-Dale
SH-JP1	1	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1	1		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone
U1	1		85-Vout Boost Converter with Current Mirror and Sample / Hold, RGT0016C (VQFN-16)	RGT0016C	TPS61390RGTT	Texas Instruments
C4	0	0.1uF	CAP, CERM, 0.1 uF, 100 V, +/- 10%, X7R, 0603	0603	GRM188R72A104KA35D	MuRata
J5	0		SMA Straight Jack, Gold, 50 Ohm, TH	SMA Straight Jack, TH	901-144-8RFX	Amphenol RF

3.3 Board Layout

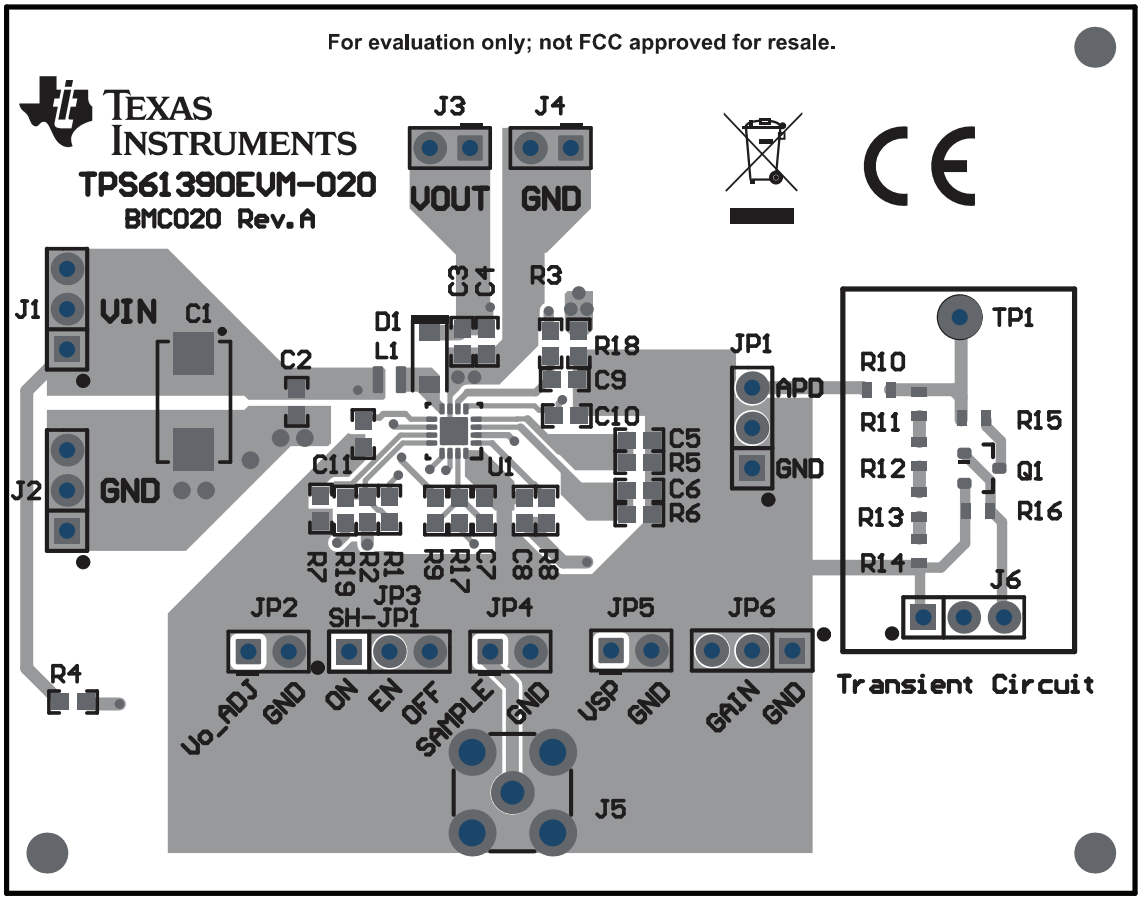

Figure 2. TPS61390EVM-020 Top-Side Layout

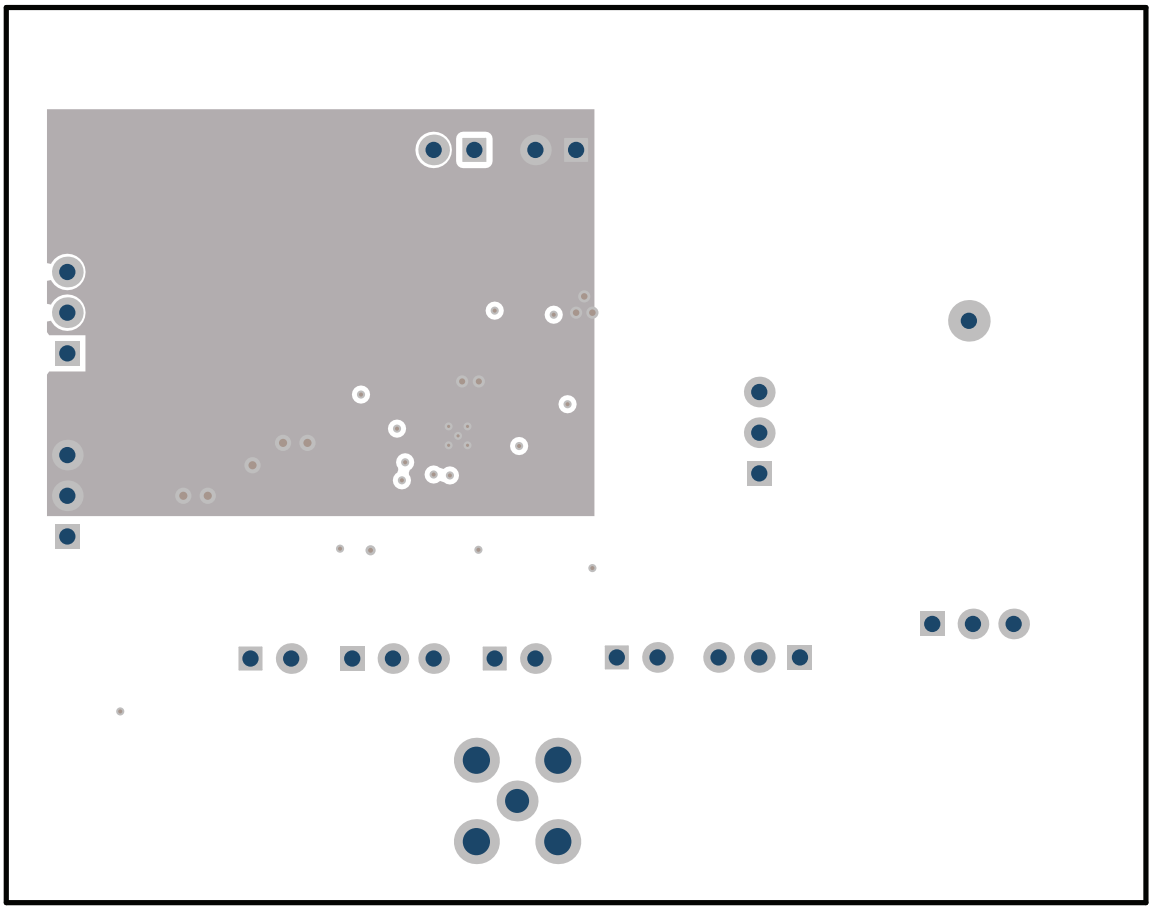

Figure 3. TPS61390EVM-020 Inner-Layer1

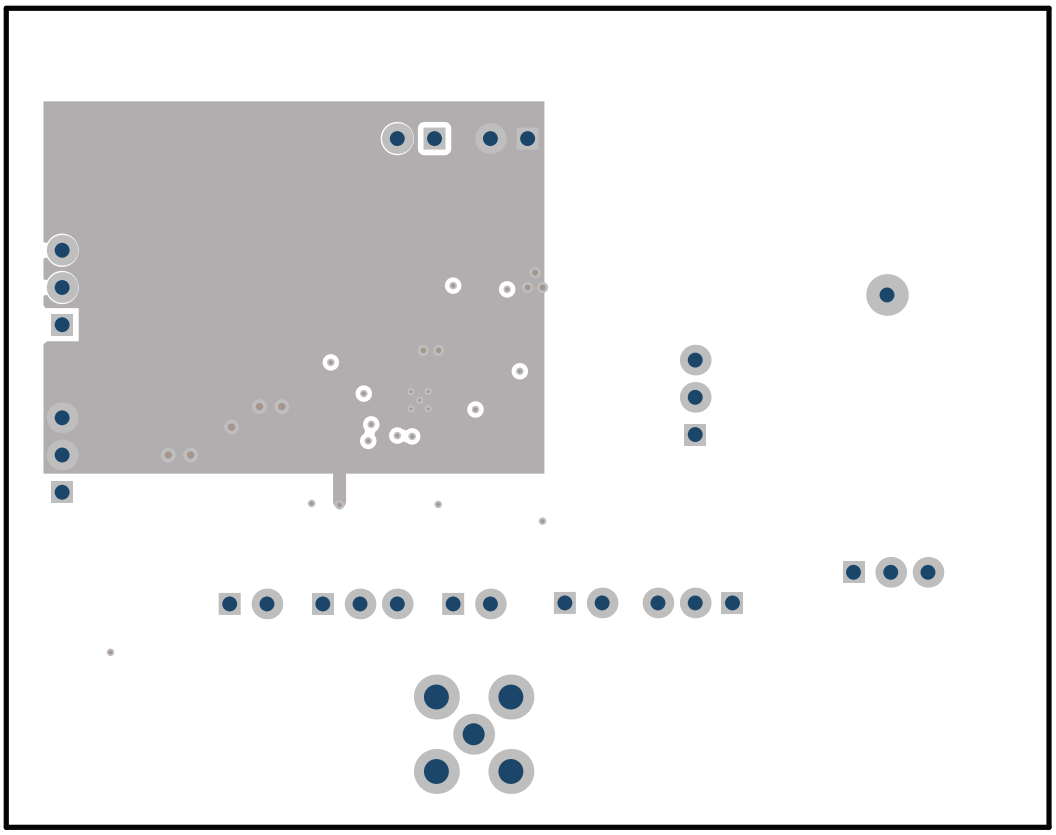

Figure 4. TPS61390EVM-020 Inner-Layer2

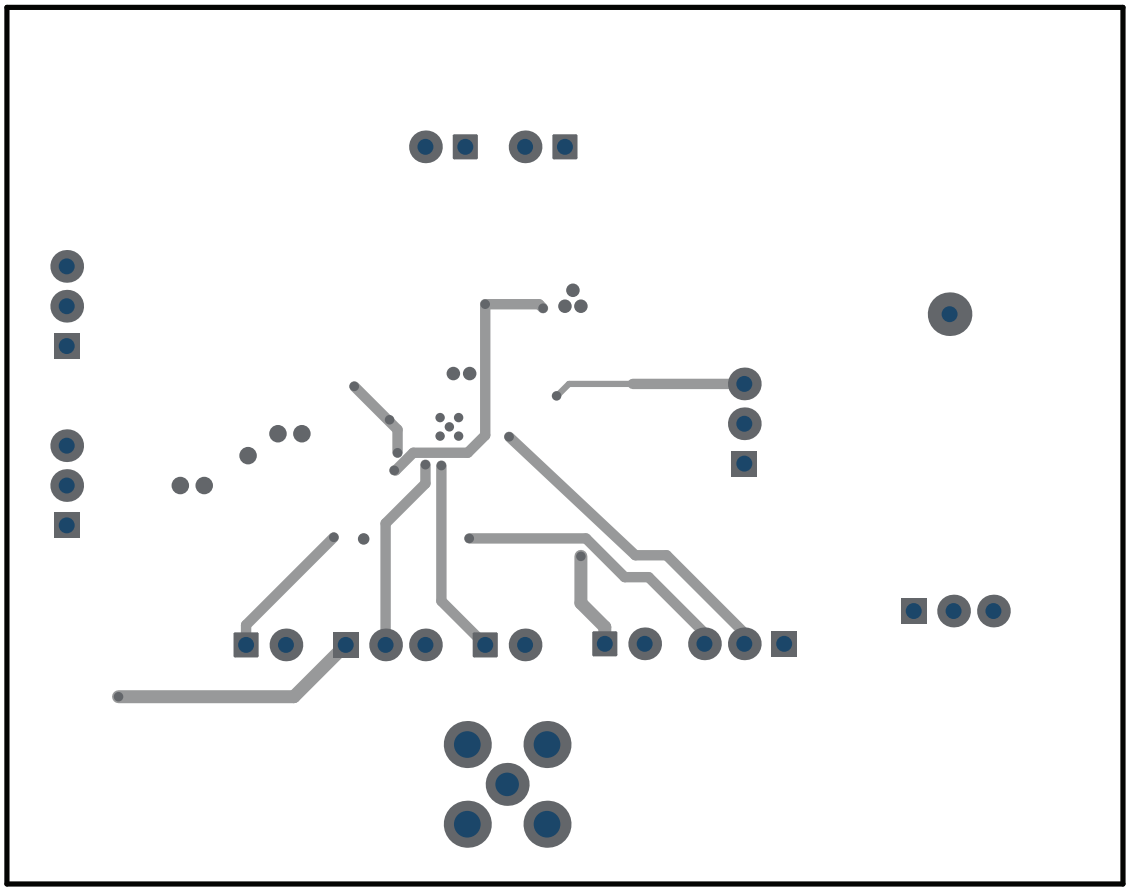

Figure 5. TPS61390EVM-020 Bottom-Side Layout

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265