

LM73100 Integrated Ideal Diode Evaluation Module



ABSTRACT

This user's guide describes the evaluation module (EVM) for the LM73100 Integrated Ideal Diode. The LM73100 device is 2.7-V to 23-V, 5.5-A integrated ideal diode with integrated 28-mΩ FET, always ON reverse current blocking with zero DC reverse current, programmable undervoltage and overvoltage, adjustable output slew rate control, overtemperature protection and power good indication with programmable threshold.

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1 Introduction

The LM73100 Integrated Ideal Diode Evaluation Module allows reference circuit evaluation of Texas Instruments (TI) LM73100 Ideal Diode. The LM73100 device is 2.7-V to 23-V, 5.5-A ideal diode power switch with integrated 28-m Ω FET, always ON reverse current blocking, programmable undervoltage and overvoltage, adjustable output slew rate control, overtemperature protection and power good indication with programmable threshold.

1.1 EVM Features

LM73100EVM Integrated Ideal Diode evaluation board features include:

- 2.7 V to 23 V (typ), 5.5 A operation
- Programmable output voltage slew rate control
- Programmable overvoltage lockout threshold
- LED status indication for Power Good output
- Onboard Schottky diode at output prevents negative spike during overcurrent faults
- TVS diode for input transient protection

1.2 EVM Applications

This EVM can be use on the following applications:

- Power MUX and power ORing
- Adapter input protection
- Monitors and docks
- Patient monitors
- Smart speakers
- Headphones
- Building automation

2 Description

The LM73100EVM Integrated Ideal Diode Evaluation Board enables evaluation of LM73100 Integrated Ideal Diode device through two channels. The input power is applied at connectors J5 (for Channel1) and J10 (for Channel2) while J1(for Channel1) and J7 (for Channel2) provides the output connection to the load; refer to the schematic in [Figure 3-1](#), and EVM test setup in [Figure 5-1](#).

S1 and S2 allows U1 and U2 to be RESET or disabled respectively. A power good (PG) indicator is provided by D6 (for Channel1) and D11 (for Channel2). Scaled device current can be monitored at TP15 with a scale factor of 0.22 V/A.

Table 2-1. LM73100EVM Integrated Ideal Diode Evaluation Board Options and Setting

EVM Function	Channel	V _{IN} Range	Vin UVLO	Vin OVLO	Output Slew Rate	Load Current Monitor	Power Good Threshold
2.7 V to 23 V, 5.5-A ideal diode	CH1	2.7 V to 23 V	10.8 V	Programmable	Programmable	0.22 V/A or option to disable	10.87 V
	CH2		10.8 V	13.76 V	0.2 V/ms		

3 Schematic

Figure 3-1 illustrates the EVM schematic.

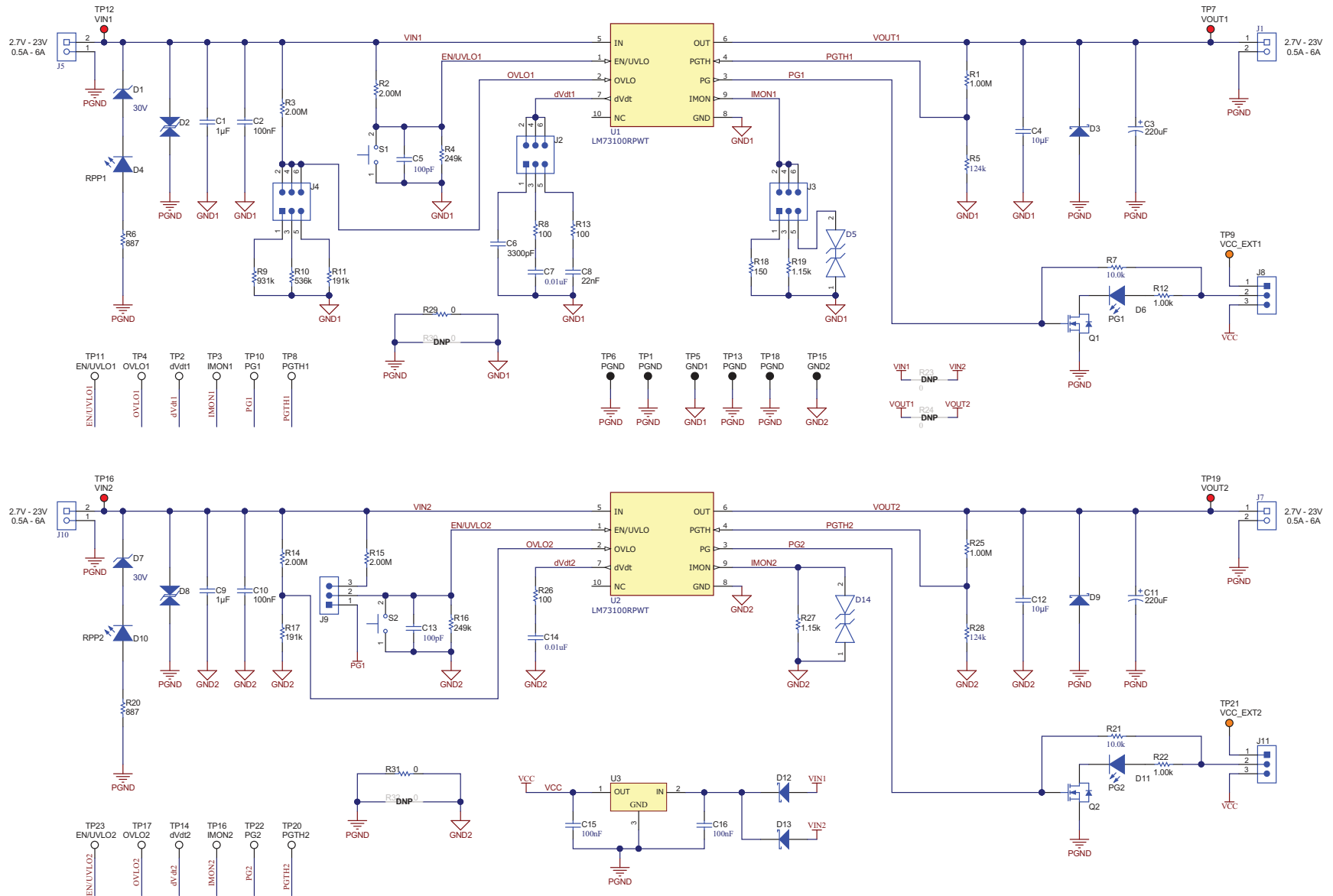


Figure 3-1. LM73100EVM Integrated Ideal Diode Evaluation Board Schematic

4 General Configurations

4.1 Physical Access

Table 4-1 lists the LM73100EVM Ideal Diode Evaluation Board input and output connector functionality. Table 4-2 and Table 4-3 describe the test point availability and the jumper functionality.

Table 4-1. Input and Output Connector Functionality

Channel	Connector	Label	Description
CH1	J5	VIN1(+), GND(-)	Input of CH1
	J1	VOUT1(+), GND(-)	Output of CH1
CH2	J10	VIN2(+), GND(-)	Input of CH2
	J7	VOUT2(+), GND(-)	Output of CH2

Table 4-2. Test Points Description

Channel	Test Points	Label	Description
CH1	TP12	VIN1	CH1 Input voltage
	TP7	VOUT1	CH1 Output voltage
	TP11	EN/UVLO1	CH1 EN/UVLO signal
	TP4	OVLO1	CH1 OVLO signal
	TP2	dVdt1	CH1 Output voltage ramp control
	TP3	IMON1	CH1 Load current monitor
	TP10	PG1	CH1 Power good signal
	TP8	PGTH1	CH1 Power good threshold signal
	TP5	GND1	IC GND of U1
CH2	TP24	VIN2	CH2 Input voltage
	TP19	VOUT2	CH2 Output voltage
	TP23	EN/UVLO2	CH2 EN/UVLO signal
	TP17	OVLO2	CH2 OVLO signal
	TP14	dVdt2	CH2 Output voltage ramp control
	TP16	IMON2	CH2 Load current monitor
	TP22	PG2	CH2 Power good signal
	TP20	PGTH2	CH2 Power good threshold signal
	TP15	GND2	IC GND of U2
	TP6, TP1, TP13, TP18	PGND	Common Power GND for both channels

Table 4-3. Jumpers Description and Default Position

Channel	Jumper	Label	Description	Default Jumper Position
CH1	J2	dVdt1	1-2 Position sets Output Slew Rate to 0.6 mV/us	3-4
			3-4 Position sets Output Slew Rate to 0.2 mV/us	
			5-6 Position sets Output Slew Rate to 0.09 mV/us	
	J3	IMON1	1-2 Position sets $R_{IMON} = 150 \Omega$ (IMON function disabled)	3-4
			3-4 Position sets $R_{IMON} = 1.15 \text{ k}\Omega$	5-6
			5-6 Position connects a low voltage clamping diode	
	J4	OVLO1	1-2 Position sets input OVLO threshold at 3.78 V	5-6
			3-4 Position sets input OVLO threshold at 5.7V	
			5-6 Position sets input OVLO threshold at 13.8V	
	J8	VCC Connection Ch-1	1-2 Position connects external voltage, VCC_EXT1 as reference for PG1	2-3
			2-3 Position connects on board generated voltage , VCC as reference for PG1	
	CH2	J9	EN/UVLO2	1-2 Position connects EN/UVLO2 with PG1. Use this setting for parallel operation of U1 and U2
2-3 Position sets the EN/UVLO2 threshold at 10.8V				
J11		VCC Connection Ch-2	1-2 Position connects external voltage, VCC_EXT2 as reference for PG2	2-3
			2-3 Position connects on board generated voltage , VCC as reference for PG2	

Table 4-4. LED Description

LED	Description
D6	When ON, indicates that PG1 is asserted for Channel-1
D11	When ON, indicates that PG2 is asserted for Channel-2

4.2 Test Equipment and Set up

4.2.1 POWER SUPPLIES

One adjustable power supply 0 V to 30 V output, 0 A to 10 A output current limit.

4.2.2 METERS

One DMM minimum needed.

4.2.3 OSCILLOSCOPE

A DPO2024 or equivalent, three 10x voltage probes, and a DC current probe.

4.2.4 LOADS

One resistive load or equivalent which can tolerate up to 10 A DC load at 24 V and capable of the output short.

5 Test Setup and Procedures

In this section, the test setup and procedure is described for the LM73100EVM. Make sure the evaluation board has default jumper settings as shown in [Table 5-1](#).

Table 5-1. Default Jumper Setting for LM73100 Integrated Ideal Diode Evaluation Board

J2	J3	J4	J8	J9	J11
3-4	3-4 5-6	5-6	2-3	2-3	2-3

Figure 5-1 shows the LM73100EVM setup with test equipment.

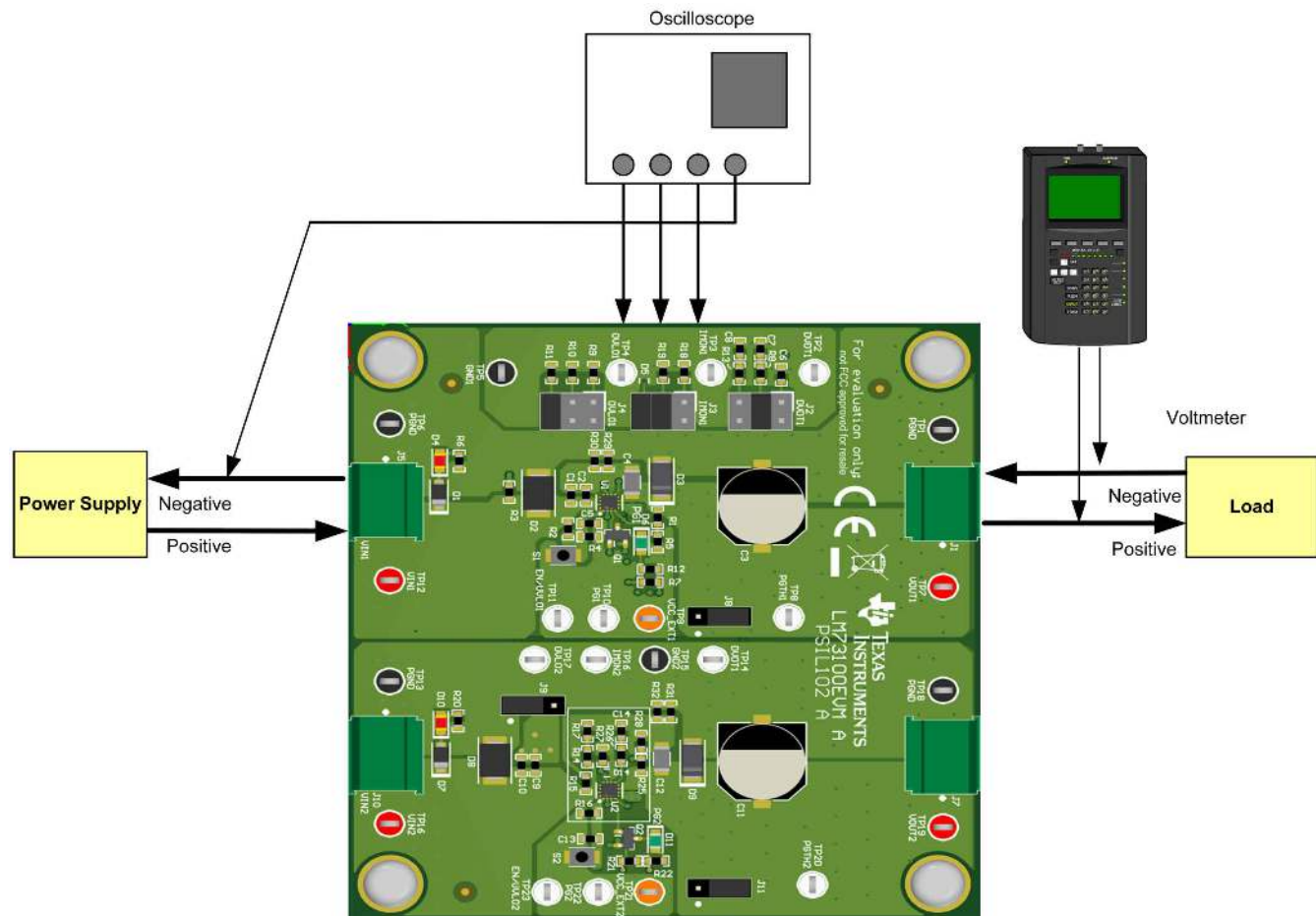


Figure 5-1. LM73100EVM Setup With Test Equipment

Follow these instructions before starting any test and repeat again before moving to next test:

- Set the power supply output (VIN) to zero volts.
- Turn ON the power supply and set the power supply output (VIN) to 12 V, current limit = 10 A.
- Turn OFF the power supply.
- Set the jumper setting on EVM as per required setting as shown in [Table 4-3](#).

5.1 Startup Test

Use the following instructions to measure the inrush current during startup event:

1. Set Jumper J2 position to desired slew rate as mentioned in [Table 4-3](#).
2. Pull EN/UVLO1 to GND to disable the device.
3. Set the input supply voltage VIN to 12 V and current limit of 10 A. Enable the power supply.
4. Release the EN/UVLO1 to GND connection.
5. Observe the waveform at VOUT (TP7) and input current (using current probe) with an oscilloscope to measure the slew rate and rise time of the ideal diode with a given input voltage of 12 V.

Figure 5-2 shows an example of inrush current captured on the LM73100EVM.

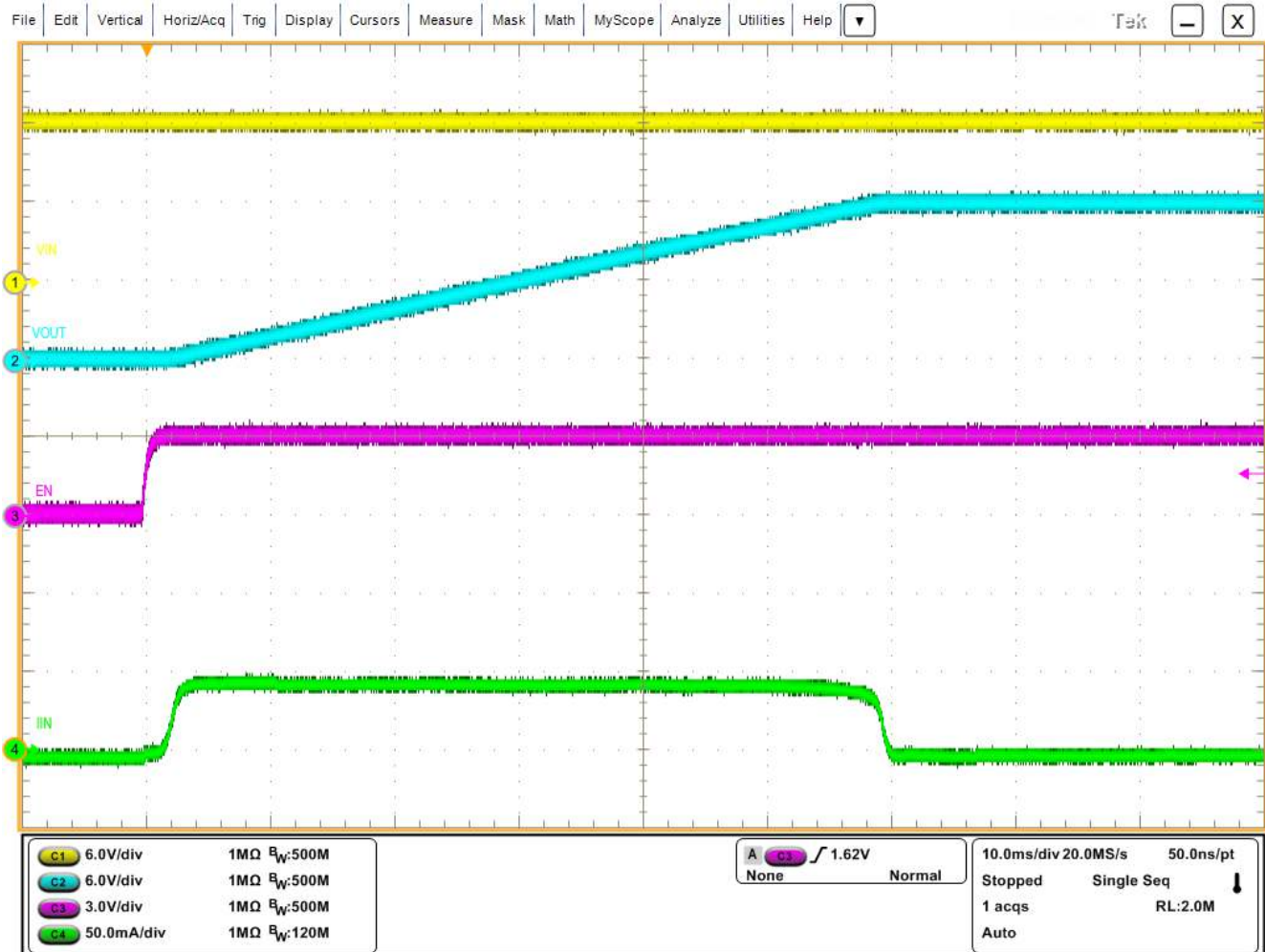


Figure 5-2. LM73100 Output Rise Profile ($V_{IN} = 12\text{ V}$, $C_{dVdT} = 10\text{ nF}$, $C_{OUT} = 220\text{ }\mu\text{F}$, No-Load)

5.2 ORing of Two Power Supplies Test

Use the following instructions to perform Simple ORing test:

1. Use Channel 1 and Channel 2 to test ORing capability of LM73100.
2. Populate R24 with 0Ω resistor to connect VOUT1 and VOUT2.
3. Change the UVLO threshold setting for each channel as per the voltage intended to be applied.
4. Apply voltage on Channel 1 and Channel 2. Different voltages can be applied on Channel 1 and Channel 2.
5. Test various conditions
 - a. Ramp up voltage on the low voltage rail to a value greater than the other rail to see output always follow the highest voltage rail
 - b. Ramp down voltage on the highest voltage rail to a value lower than the other rail to see output always follow the highest voltage rail

Figure 5-3 shows an example of simple ORing on the LM73100EVM Ideal Diode Evaluation Board.

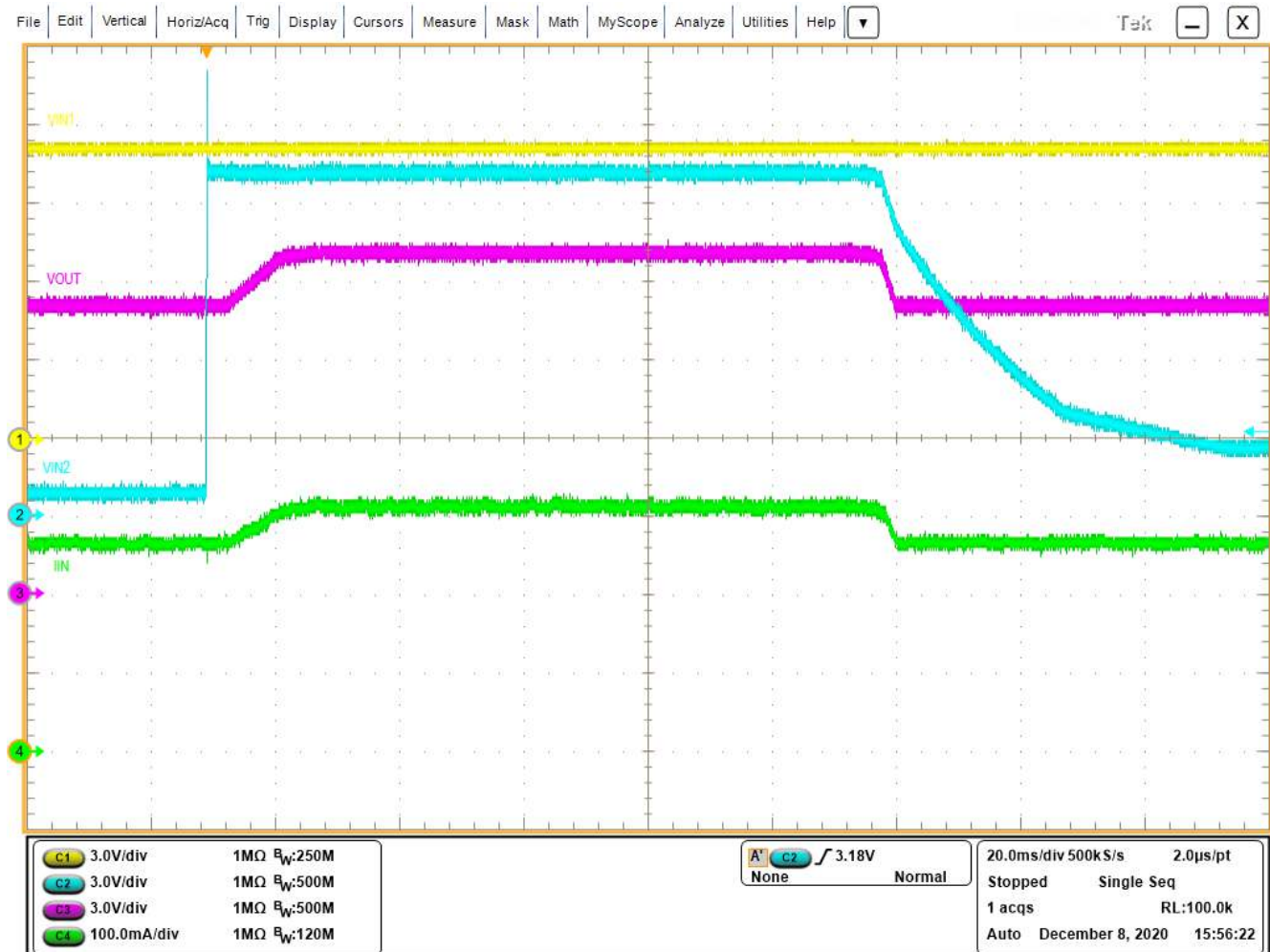


Figure 5-3. ORing Control of LM73100 ($V_{IN1} = 11\text{ V}$, $V_{IN2} = 13\text{ V}$)

5.3 Reverse Current Blocking Test

Use the following instructions to perform reverse current blocking test:

1. Set the input supply voltage V_{IN} to 12 V and current limit of 10 A. Turn ON the power supply.
2. Use a second power supply to apply 20V at the OUT with respect to GND.
3. Observe the PG signal and input current using an oscilloscope. The device turns OFF immediately allowing zero reverse current and deasserts the PG signal.

Figure 5-4 shows test waveform of reverse current blocking on the LM73100EVM Ideal Diode Evaluation Board.

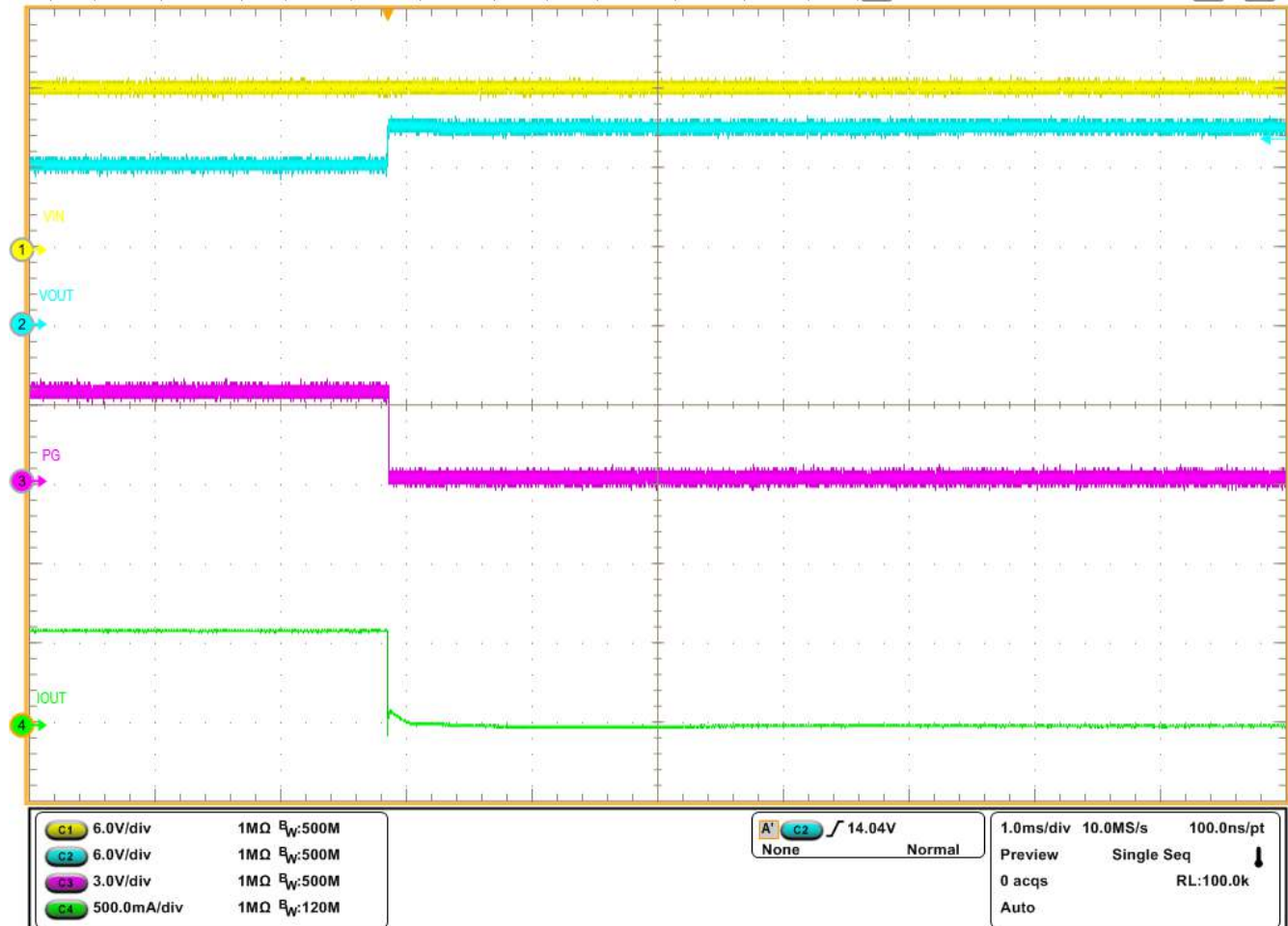


Figure 5-4. Reverse Current Blocking Response of LM73100 Device ($V_{IN} = 12\text{ V}$, $V_{OUT} = 20\text{ V}$)

5.4 Output Short-Circuit Test

Use the following instructions to perform output short-circuit test:

1. Remove the output capacitance. This is to measure the actual current flowing in the device.
2. Add additional capacitance at the input of EVM. This helps to maintain the input voltage during output short circuit condition.
3. Set the input supply voltage V_{IN} to 12 V and current limit of 10 A. Turn ON the power supply.
4. Short the output of the device for example, V_{OUT} to GND with a shorter cable.
5. Observe the output current waveform using an oscilloscope.

Figure 5-5 shows test waveform of output short circuit on the LM73100EVM Ideal Diode Evaluation Board.

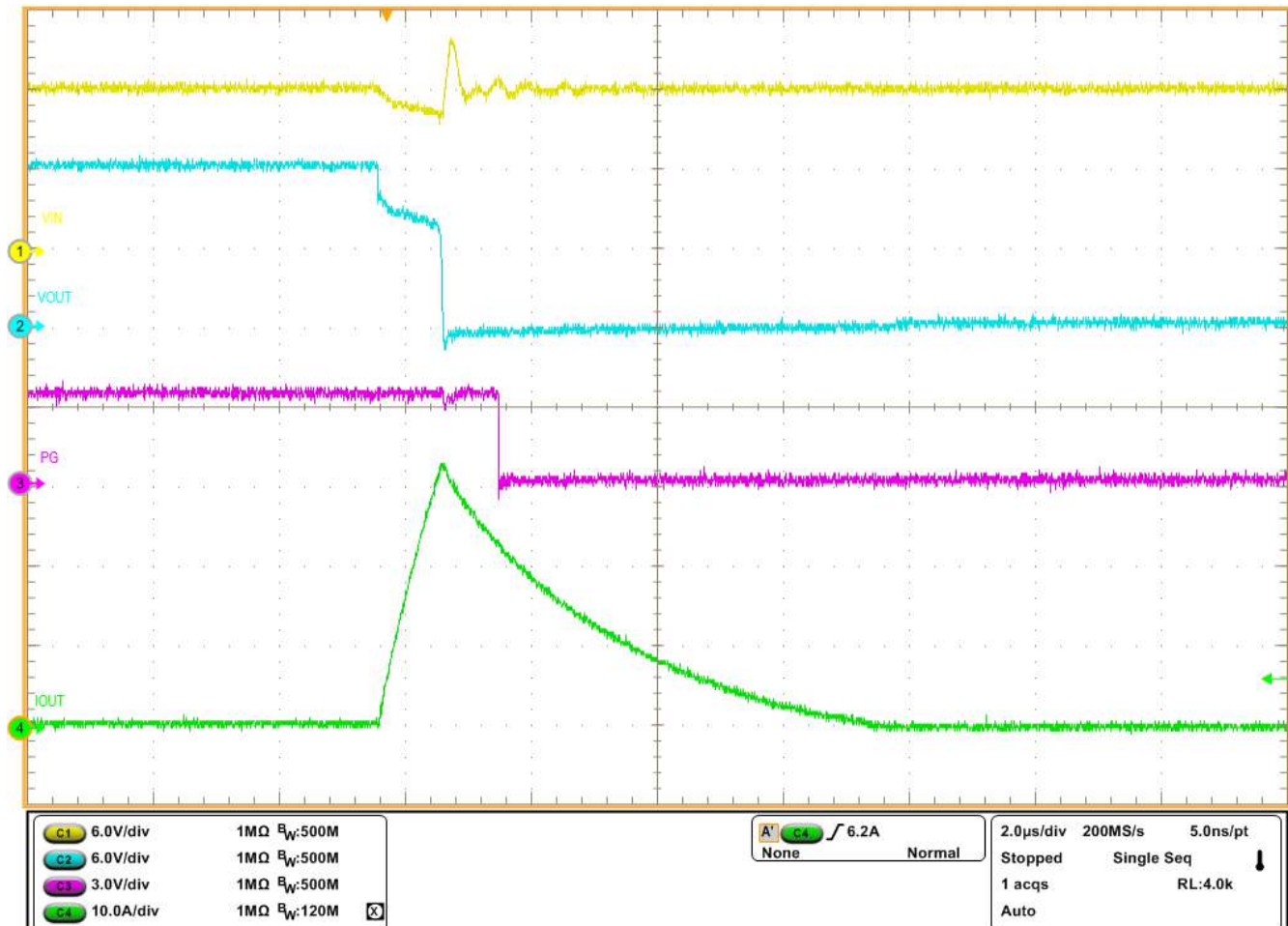


Figure 5-5. Test Waveform of Output Short-Circuit on LM73100 Device

5.5 Input Reverse Polarity Test

Use the following instructions to perform Input Reverse Polarity test:

1. Remove input TVS diode (D2).
2. Set the input supply voltage VIN to 15 V and current limit of 5 A. Apply the supply in reverse polarity at J5 and enable the power supply.
3. Observe VOUT and Input Current waveforms using an oscilloscope.

Figure 5-6 shows input reverse polarity response of LM73100 on LM73100EVM Ideal Diode Evaluation Board.

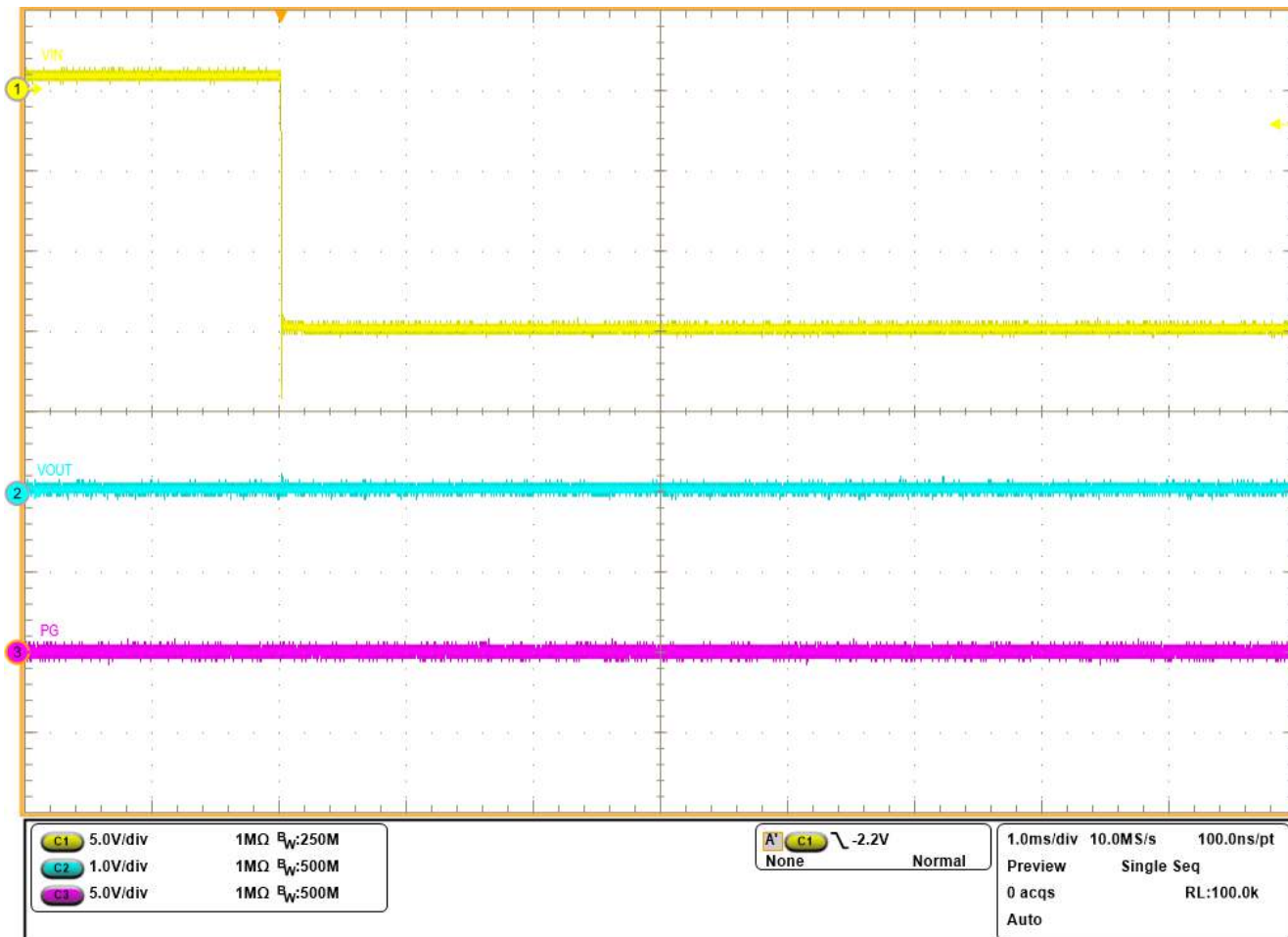


Figure 5-6. Input Reverse Polarity Protection Response of LM73100 Device

6 EVAL Board Assembly Drawings and Layout Guidelines

6.1 PCB Drawings

Figure 6-1 and Figure 6-2 show component placement of the evaluation board. Figure 6-3 and Figure 6-4 show the PCB layout images.

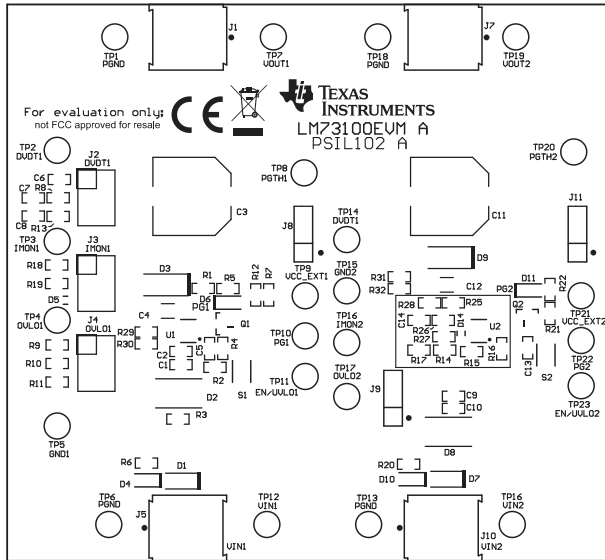


Figure 6-1. LM73100EVM Board Top Assembly

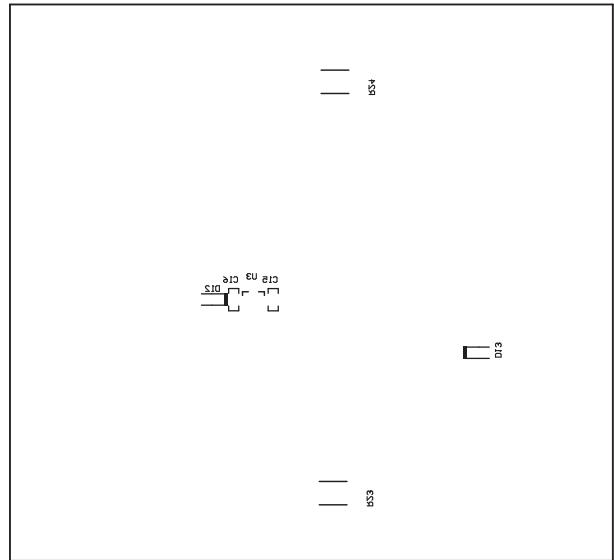


Figure 6-2. LM73100EVM Board Bottom Assembly

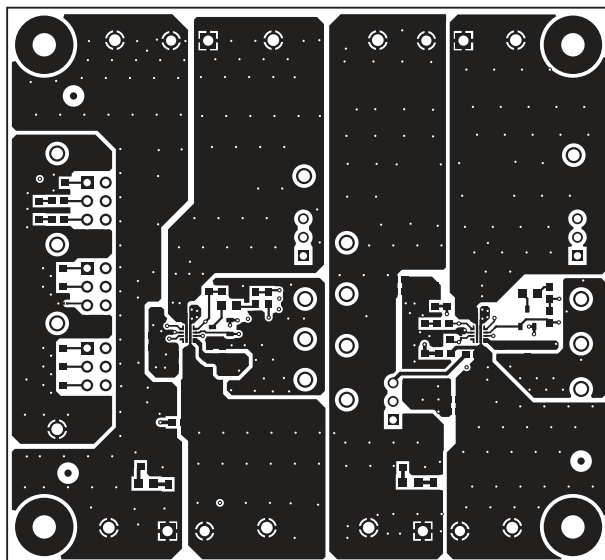


Figure 6-3. LM73100EVM Board Top Layer

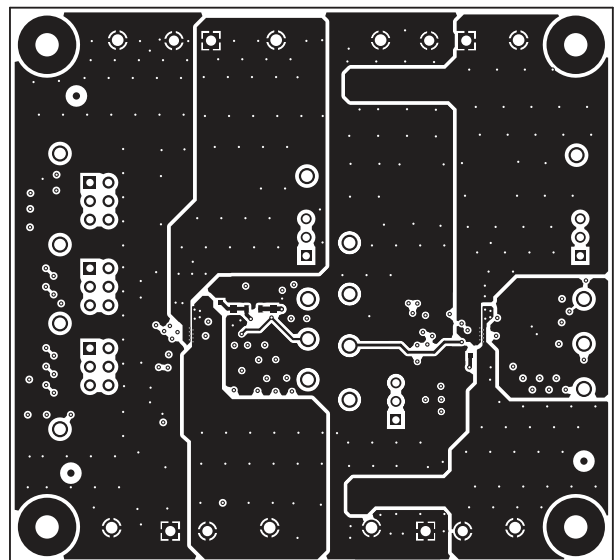


Figure 6-4. LM73100EVM Board Bottom Layer

7 Bill Of Materials (BoM)

Table 7-1 lists the LM73100EVM BOM.

Table 7-1. LM73100EVM BOM

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		PSIL102	Any
C1, C9	2	1uF	CAP, CERM, 1 uF, 35 V, $\pm 10\%$, X7R, 0603	0603	C1608X7R1V105K080AC	TDK
C2, C10	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, $\pm 10\%$, X7R, 0603	0603	GRM188R71H104KA93D	MuRata
C3, C11	2	220uF	CAP, AL, 220 uF, 35 V, $\pm 20\%$, 0.15 ohm, SMD	SMT Radial G	EEE-FC1V221P	Panasonic
C4, C12	2	10uF	CAP, CERM, 10 μ F, 50 V, $\pm 10\%$, X7R, AEC-Q200 Grade 1, 1206	1206	CGA5L1X7R1H106K160AC	TDK
C5, C13	2	100pF	CAP, CERM, 100 pF, 50 V, $\pm 5\%$, C0G/NP0, 0603	0603	885012006057	Wurth Elektronik
C6	1	3300pF	CAP, CERM, 3300 pF, 50 V, $\pm 10\%$, X7R, 0603	0603	C0603X332K5RACTU	Kemet
C7, C14	2	0.01uF	CAP, CERM, 0.01 uF, 50 V, $\pm 5\%$, C0G/NP0, 0603	0603	GRM1885C1H103JA01D	MuRata
C8	1	0.022uF	CAP, CERM, 0.022 uF, 50 V, $\pm 10\%$, X7R, 0603	0603	C0603X223K5RACTU	Kemet
C15, C16	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, $\pm 10\%$, X7R, 0603	0603	06035C104KAT2A	AVX
D1, D7	2	30V	Diode, Zener, 30 V, 500 mW, SOD-123	SOD-123	DDZ30D-7	Diodes Inc.
D2, D8	2	16V	Diode, TVS, Bi, 16 V, SMB	SMB	SMBJ12CA	Littelfuse
D3, D9	2	30V	Diode, Schottky, 30 V, 3 A, SMA	SMA	B330A-13-F	Diodes Inc.
D4	1	RPP1	LED, Red, SMD	Red 0805 LED	LTST-C170KRKT	Lite-On
D5, D14	2		6V Clamp 8A Ipp Tvs Diode Surface Mount 2-DFN (0.6x0.3)	DFN2		ON Semiconductor
D6	1	PG1	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
D10	1	RPP2	LED, Red, SMD	Red 0805 LED	LTST-C170KRKT	Lite-On
D11	1	PG2	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
D12, D13	2	30V	Diode, Schottky, 30 V, 0.2 A, SOD-323	SOD-323	BAT54WS-7-F	Diodes Inc.
FID4, FID5, FID6	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J5, J7, J10	4		Terminal Block, 2x1, 5.08mm, TH	10.16x15.2x9mm	282841-2	TE Connectivity
J2, J3, J4	3		Header, 100mil, 3x2, Tin, TH	3x2 Header	PEC03DAAN	Sullins Connector Solutions
J8, J9, J11	3		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
Q1, Q2	2	60V	MOSFET, N-CH, 60 V, 115 A, SOT-23	SOT-23	2N7002	Fairchild Semiconductor
R1, R25	2	1.00Meg	RES, 1.00 M, 1%, 0.1 W, 0603	0603	RC0603FR-071ML	Yageo
R2, R3, R14, R15	4	2.00Meg	RES, 2.00 M, 1%, 0.1 W, 0603	0603	RC0603FR-072ML	Yageo
R4, R16	2	249k	RES, 249 k, 1%, 0.1 W, 0603	0603	RC0603FR-07249KL	Yageo

Table 7-1. LM73100EVM BOM (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
R5, R28	2	124k	RES, 124 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603124KFKEA	Vishay-Dale
R6, R20	2	887	RES, 887, 1%, 0.1 W, 0603	0603	RC0603FR-07887RL	Yageo
R7, R21	2	10.0k	RES, 10.0 k, 0.1%, 0.1 W, 0603	0603	RG1608P-103-B-T5	Susumu Co Ltd
R8, R13, R26	3	100	RES, 100, 1%, 0.1 W, 0603	0603	RC0603FR-07100RL	Yageo
R9	1	931k	RES, 931 k, 1%, 0.1 W, 0603	0603	RC0603FR-07931KL	Yageo
R10	1	536k	RES, 536 k, 1%, 0.1 W, 0603	0603	RC0603FR-07536KL	Yageo
R11, R17	2	191k	RES, 191 k, 1%, 0.1 W, 0603	0603	RC0603FR-07191KL	Yageo
R12, R22	2	1.00k	RES, 1.00 k, 1%, 0.1 W, 0603	0603	RC0603FR-071KL	Yageo
R18	1	150	RES, 150, 1%, 0.1 W, 0603	0603	RC0603FR-07150RL	Yageo
R19, R27	2	1.15k	RES, 1.15 k, 1%, 0.1 W, 0603	0603	RC0603FR-071K15L	Yageo
R29, R31	2	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic
S1, S2	2		SWITCH TACTILE SPST-NO 0.05A 12V	3x1.6x2.5mm	B3U-1000P	Omron Electronic Components
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7	7	1x2	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt	SPC02SYAN	Sullins Connector Solutions
TP1, TP5, TP6, TP13, TP15, TP18	6		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
TP2, TP3, TP4, TP8, TP10, TP11, TP14, TP16, TP17, TP20, TP22, TP23	12		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone
TP7, TP12, TP16, TP19	4		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP9, TP21	2		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone
U1, U2	2		2.7- 23V, 5.5 A Integrated Ideal Diode Power Switch with Input Reverse Polarity and Overvoltage Protection	VQFN10		Texas Instruments
U3	1		100 mA, Quasi Low-Dropout Linear Voltage Regulator, 3-pin SOT-23, Pb-Free	DBZ0003A	LM3480IM3-3.3/NOPB	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R23, R24	0	0	RES, 0, 5%, 1 W, 2512	2512	RC6432J000CS	Samsung
R30, R32	0	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic

8 Revision History

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

Changes from Revision * (October 2020) to Revision A (December 2020)

Page

-
- Updated user's guide for PSIL102A version..... 1
-

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