TPS55288EVM-053 Evaluation Module

This user's guide describes the characteristics, operation, and the use of the TPS55288EVM-053 evaluation module (EVM) with 2MHz operation frequency. The EVM contains the TPS55288, which is a high performance, high efficiency synchronous buck-boost converter which integrates two 16-A MOSFETs at the boost leg. 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 TPS55288 EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

PARAMETER	TEST CONDITION	VALUE	UNIT
Input Voltage	N/A	2.7 - 36	V
Output Voltage	N/A	0.8 - 20	V
Maximum Output Current	Vin ≥ 5 V, Vout = 9 V;	3	A
	Vin ≥ 8 V, Vout = 12 V;		
	Vin ≥ 9 V, Vout = 15 V;		
	Vin≥15 V, Vout = 20 V;	2	
Default Switching Frequency	N/A	2	MHz

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 real application.

1.2.1 Modification

This EVM requires an appropriate I2C interface, such as the TI USB2ANY, to configure the TPS55288.

2 Connector, Test Point and Jumper Descriptions

This section describes how to properly connect, set up, and use the TPS55288EVM-053.

2.1 Connector and Test Point Descriptions

This EVM includes I/O connectors and test points as shown in Table 2. The power supply must be connected to input connectors, J1 and J2. The load must be connected to output connectors, J3 and J4.

Table 2. Connectors and Test Points

REFERENCE DESIGNATOR	DESCRIPTION
J1	Input voltage positive connection
J2	Input voltage return connection
J3	Output voltage connection
J4	Output voltage return connection
J7	I²C Connector

2.2 Jumper Configuration

2.2.1 JP1 (ENABLE)

The JP1 jumper enables the device. By default, this jumper is set to the ON position. Put this jumper in the OFF position to disable the output.

2.2.2 JP2 and JP3 (External Feedback and Internal Feedback Selection)

The JP2 jumper is for the external feedback or the internal feedback selection. By default, this jumper is set to the FB_INT position. Place this jumper in the FB_EXT position for the external output voltage feedback.

The JP3 jumper is for the external feedback connection. Placing a jumper across JP3 when uses external feedback. Left JP3 opens when uses internal feedback.

When using external output voltage feedback, the output voltage is determined by the following equation:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_{FB\_UP}}{R_{FB\_BT}}\right) \quad (1)$$

It is recommended to use 100 kΩ for the up resistor RFB_UP. The reference voltage VREF at the FB/INT pin is programmable from 45 mV to 1.2 V by writing a 10-bit data into the register 00H and 01H.

2.2.3 JP4 (SYNC)

The JP4 jumper is for the frequency dithering selection. Placing a jumper across JP4 disables the frequency dithering function. Left JP4 opens when using frequency dithering function.

3 Test Procedure

Step 1: Set the power supply current limit to 10 A. Set the power supply to something around 12V. Turn off the power supply. Connect the positive output of the power supply to J1 and the negative output to J2.

Step 2: Connect the load to J3 for the positive connection and J4 for the negative connection.

Step 3: Turn on the power supply.

Step 4: Enable the IC with GUI. The default output voltage is 5 V.

Step 5: Set the output voltage to the target value on the GUI user interface page.

Step 6: Slowly increase the load while monitoring the output voltage between J3 and J4. It must remain in regulation when the load current is lower than 3 A.

Step 7: Slowly sweep the input voltage from 5 V to 20 V. The output voltage must remain in regulation when the load current is lower than the maximum load current specified in Table 2.

Step 8: Turn off the load, turn off the power supply. Then turn on the load to discharge the output capacitors.

4 Software User Interface

4.1 Install USB2ANY Explorer

Download and install the USB2ANY explorer from: http://www.ti.com/tool/USB2ANY. Upgrade the firmware version to 2.8.2.0.

4.2 GUI Installation

A graphical user interface (GUI) is available from ti.com website (http://www.ti.com/tool/TPS55288-EVM-GUI) which allows simple and convenient programming of the device through the TI USB2ANY device.

- Download the zip file for the desired platform.
- Download GUI Composer Runtime.
- Extract the zip folder and install the GUI.
- Run through the installation steps. The installation wizard might prompt for GUI Composer Runtime. This should be done automatically.
- Open the GUI – TPS55288.

4.3 Interface Hardware Setup

Connect the USB2ANY adapter to your PC using the supplied USB cable. Connect the TPS55288EVM connector J7 to the USB2ANY adapter using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

Figure 1 shows a quick connection overview.

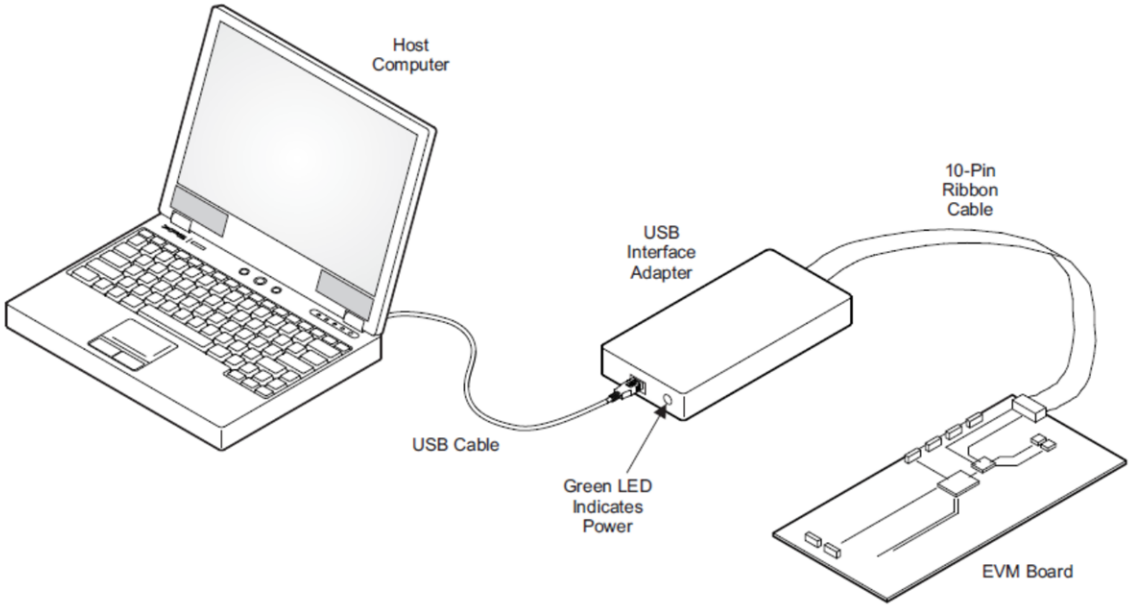

Figure 1. Quick Connection Overview

4.4 User Interface Operation

The TPS55288EVM board can be enabled to work by the following steps:

Step 1: Set JP1 to the ON position. Turn on the power supply.

Step 2: Open the TPS55288EVM GUI.

Step 3: Click the auto connect button on the slave address widget (Figure 2). It will automatically check for slave addresses (0x74, 0x75) and connect the GUI with device. Once after connection, GUI will read all the 8 registers and show a notification (Figure 3).

Figure 2. GUI Auto Connect Button

Figure 3. GUI Auto Connect Notification

Step 4: Click the start button. It will show the GUI user interface of TPS55288EVM-053 (Figure 4).

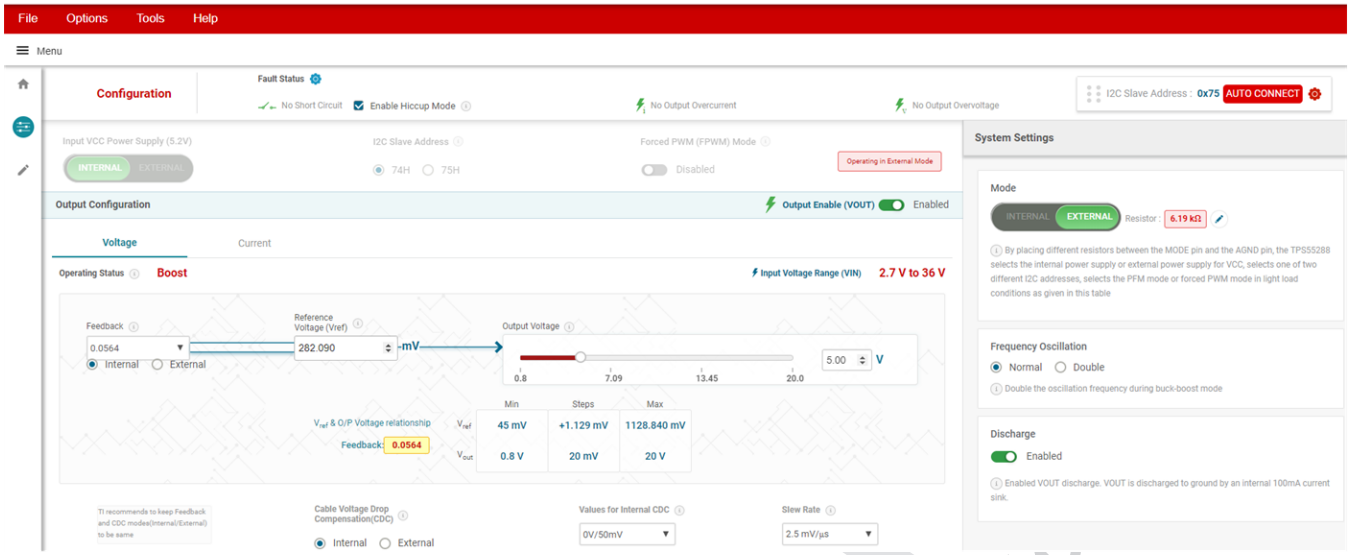

Figure 4. GUI User Interface of TPS55288EVM-053

Step 5: Click the Enable button (Figure 5). The default output voltage is 5 V.

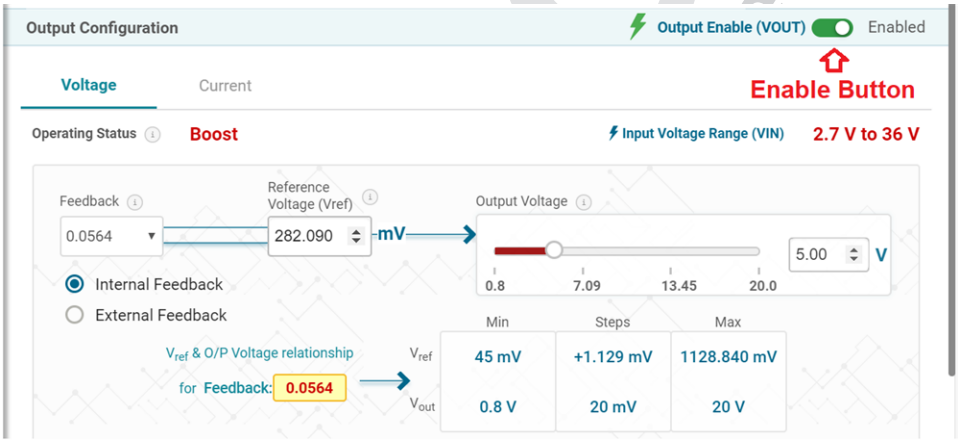

Figure 5. ENABLE Button

Step 6: Set the output voltage, current limit point, etc. according to the design target. If the maximum load current is ≥ 5 A, untick the 'Enable Current Limit' check box or increase the current limit value (Figure 6).

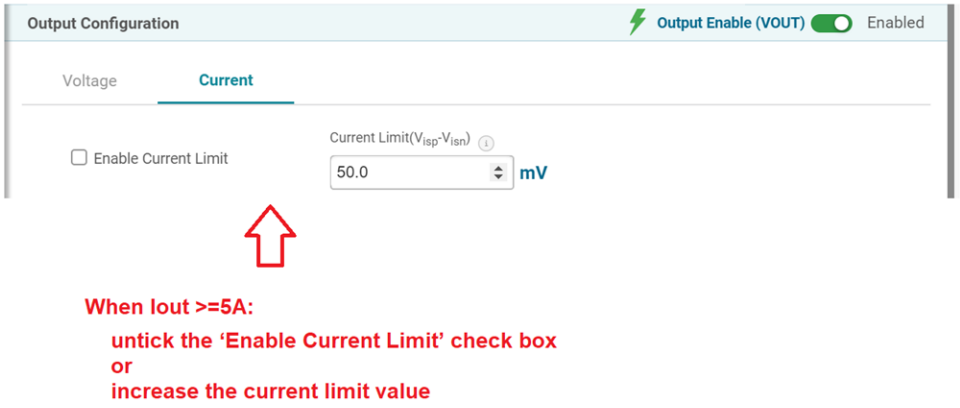

Figure 6. Output Current Limit Point Setting

4.5 Register Map Screen

The Register Map screen shows a register-wise view of all parameters. Here, single registers can be read or written to the device (if applicable). Refer to the TPS55288 data sheet for a detailed description of the TPS55288 registers.

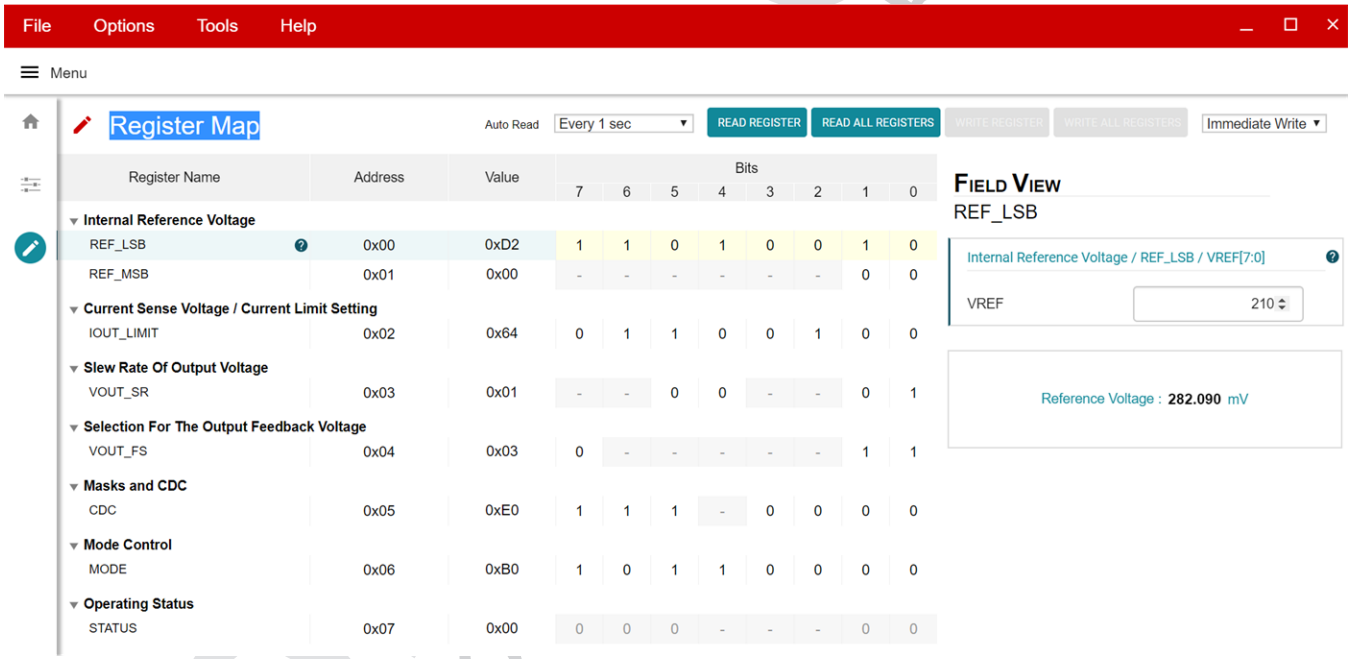

Figure 7. GUI Register Map Screen

5 Schematic, Bill of Materials, and Board Layout

This section provides the TPS55288EVM-053 schematic, bill of materials (BOM), and board layout.

5.1 Schematic

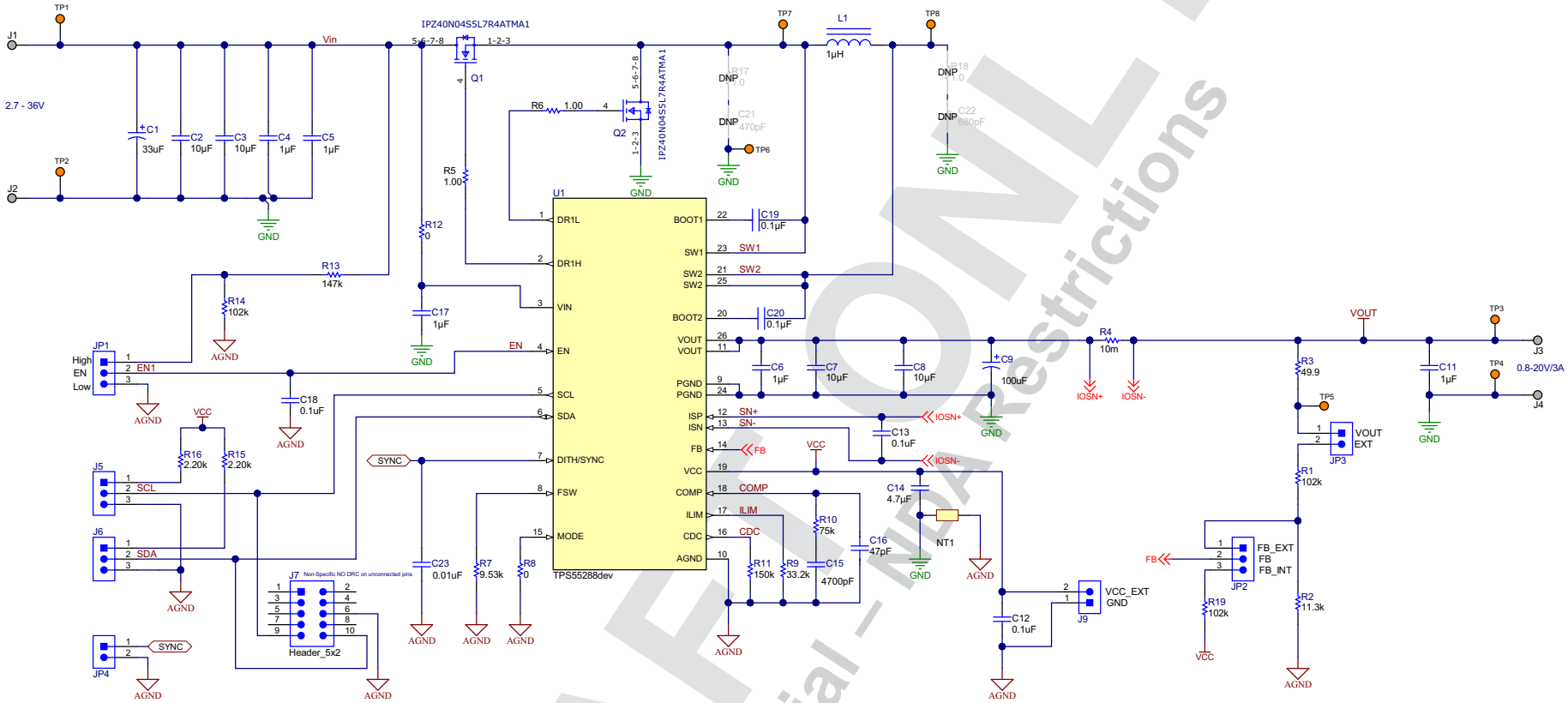

Figure 8. TPS55288EVM-053 Schematic

5.2 Bill of Materials

Table 3. Bill of Materials

Designator	QTY	Value	Description	Package	PartNumber	Manufacturer
C1	1	33uF	CAP, Polymer Hybrid, 33 uF, 50 V, +/- 20%, 40 ohm, 6.3x7.7 SMD	6.3x7.7	EEHZA1H330XP	Panasonic
C2, C3	2	10uF	CAP, CERM, 10 µF, 75 V,+/- 20%, X7R, AEC-Q200 Grade 1, 1210	1210	CGA6P1X7R1N106M250AC	TDK
C4, C5, C6, C11, C17	5	1uF	CAP, CERM, 1 µF, 50 V,+/- 20%, X5R, AEC-Q200 Grade 3, 0603	0603	GRT188R61H105ME13D	MuRata
C7, C8	2	10uF	CAP, CERM, 10 µF, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 1206	1206	CGA5L1X7R1H106K160AC	TDK
C9	1	100uF	CAP, Polymer Hybrid, 100 uF, 25 V, +/- 20%, 30 ohm, 6.3x7.7 SMD	6.3x7.7	EEHZA1E101XP	Panasonic
C12, C13, C18	3	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H104K050BB	TDK
C14	1	4.7uF	CAP, CERM, 4.7 µF, 16 V,+/- 10%, X5R, AEC-Q200 Grade 3, 0603	0603	GRT188R61C475KE13D	MuRata
C15	1	4700pF	CAP, CERM, 4700 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B2X7R1H472K050BA	TDK
C16	1	47pF	CAP 0402 47pF 5% C0G 100V 30ppm	0402	GRT1555C2A470JA02D	Murata
C19, C20	2	0.1µF	0.1µF ±10% 50V Ceramic Capacitor X8L 0603 (1608 Metric)	0603	GCM188L81H104KA57D	Murata Electronics North America
C23	1	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H103K050BB	TDK
J1, J2, J3, J4	4		Terminal, Turret, TH, Double	Keystone1502-2	1502-2	Keystone
J5, J6, JP1, JP2	4		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J7	1		Header (shrouded), 100mil, 5x2, Gold, TH	5x2 Shrouded header	5103308-1	TE Connectivity

Table 3. Bill of Materials (continued)

J9, JP3, JP4	3		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
L1	1	1uH	Inductor, Shielded, Composite, 1 µH, 18 A, 0.00618 ohm, AEC-Q200 Grade 1, SMD	IND_6.4x3.1x6.6	XAL6030-102MEB	Coilcraft
Q1, Q2	2		NPN LO RA 150 MM PGTL M12	TSDSON-8	IPZ40N04S5L7R4ATMA1	Infineon
R1, R14, R19	3	102k	RES, 102 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402102KFKED	Vishay-Dale
R2	1	11.3k	RES, 11.3 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040211K3FKED	Vishay-Dale
R3	1	49.9	RES, 49.9, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040249R9FKED	Vishay-Dale
R4	1		10 mOhms ±1% 1W Chip Resistor 1206 (3216 Metric) Automotive AEC-Q200, Current Sense, Moisture Resistant Metal Element	1206	CRF1206-FZ-R010ELF	Bourns
R5, R6	2	1.00	RES, 1.00, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031R00FKEA	Vishay-Dale
R7	1	9.53k	RES, 9.53 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04029K53FKED	Vishay-Dale
R8, R12	2	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R9	1	33.2k	RES, 33.2 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040233K2FKED	Vishay-Dale
R10	1	75k	RES, 75 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040275K0JNED	Vishay-Dale
R11	1	150k	RES, 150 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402150KFKED	Vishay-Dale
R13	1	147k	RES, 147 k, 1%, 0.1 W, 0603	0603	RC0603FR-07147KL	Yageo

Table 3. Bill of Materials (continued)

R15, R16	2	2.20k	RES, 2.20 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20FKED	Vishay-Dale
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	8	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone
U1	1		36-V, 16-A Buck-Boost Converter, RPM0026A (VQFN-HR-26)	RPM0026A	TPS55288	Texas Instruments
C21	0		Multilayer Ceramic Capacitors MLCC - 470pF 100V 0603	0603	GRT1885C2A471JA02D	Murata
C22	0		680pF ±5% 100V Ceramic Capacitor C0G,0603 (1608 Metric)	0603	GRT1885C2A681JA02D	Murata
R17, R18	0	1.0	RES, 1.0, 5%, 0.5 W, 1206	1206	CRM1206-JW-1R0ELF	Bourns

5.3 Board Layout

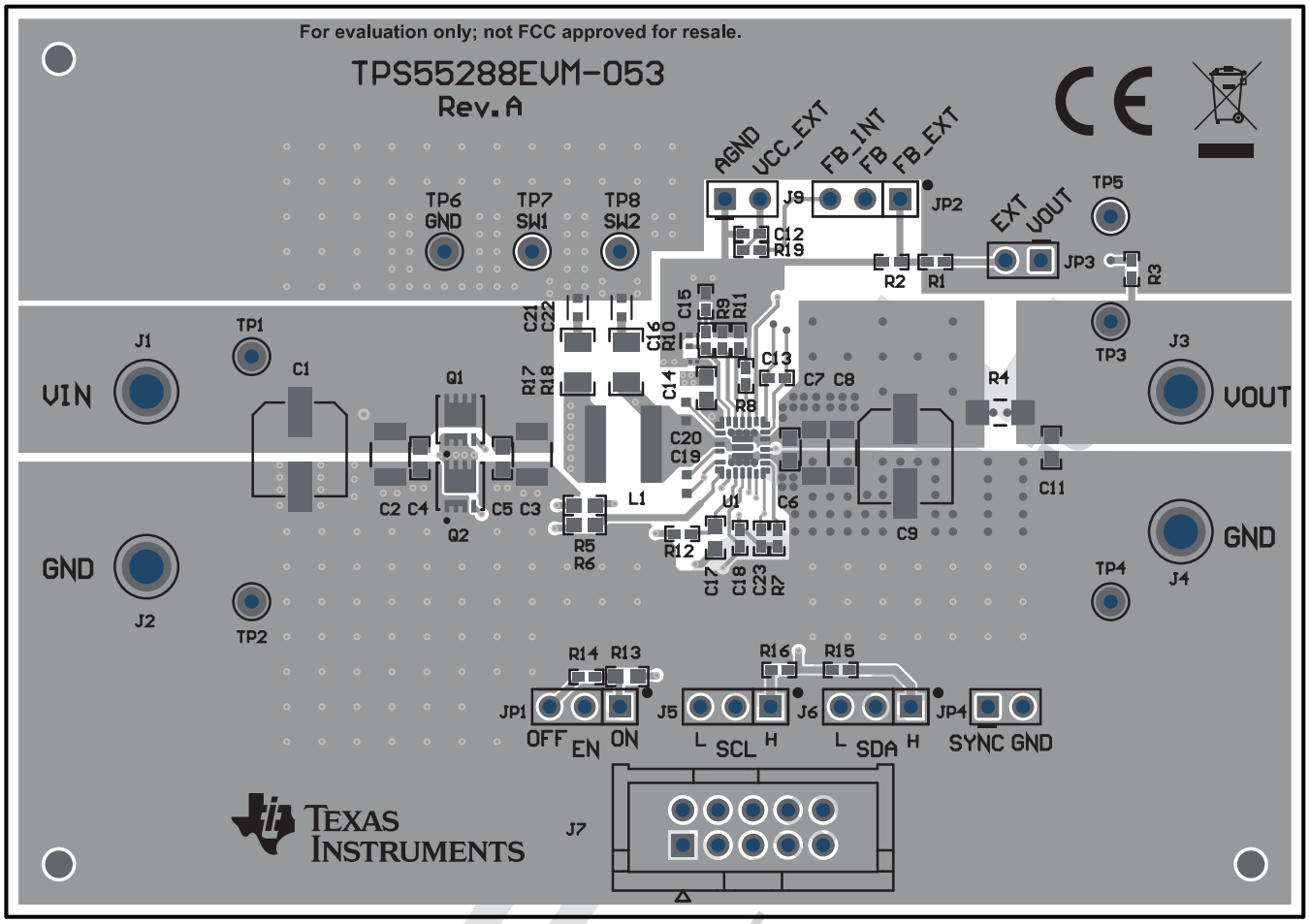

Figure 9. TPS55288EVM-053 Top-Side Layout

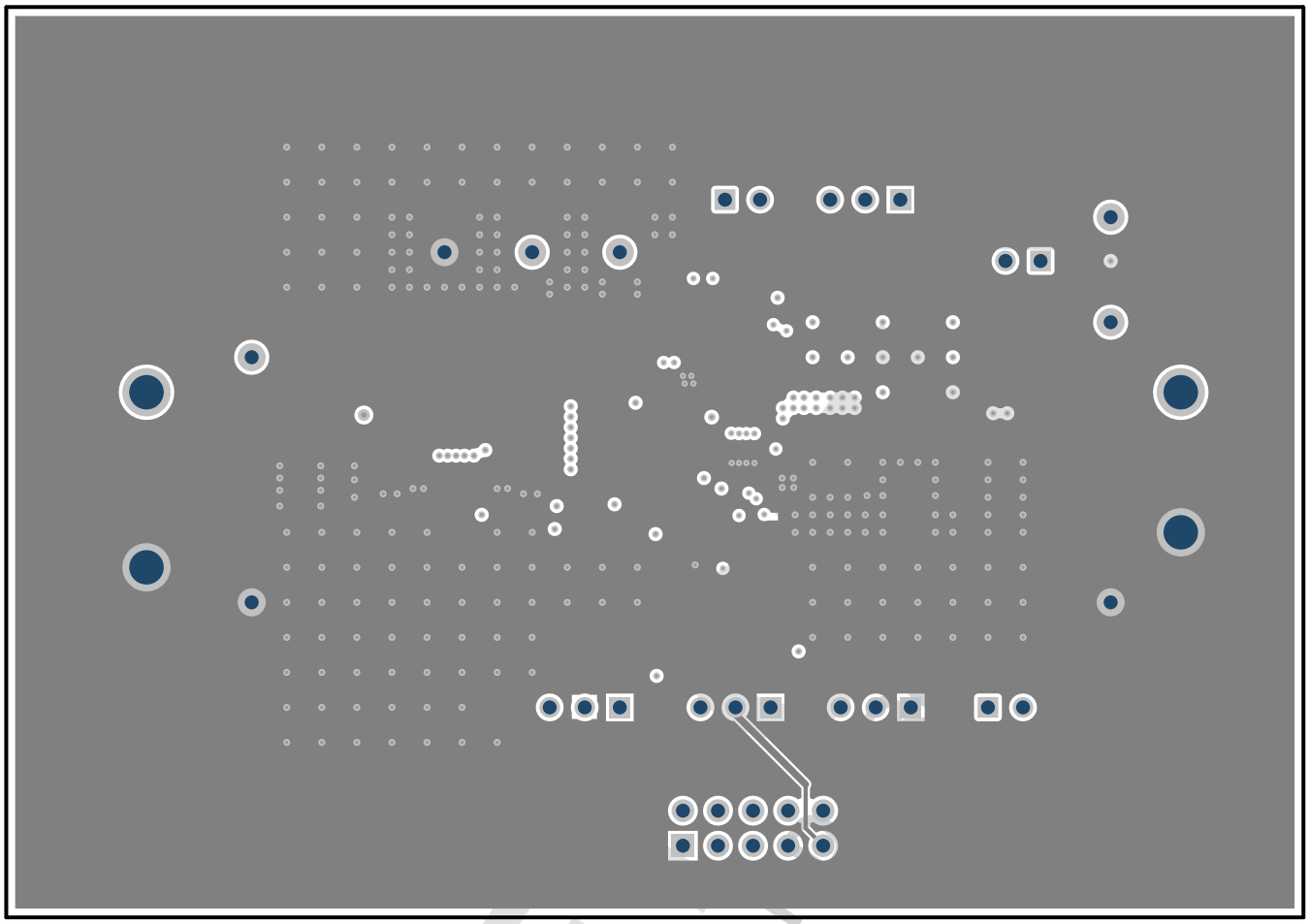

Figure 10. TPS55288EVM-053 Inner Layer1

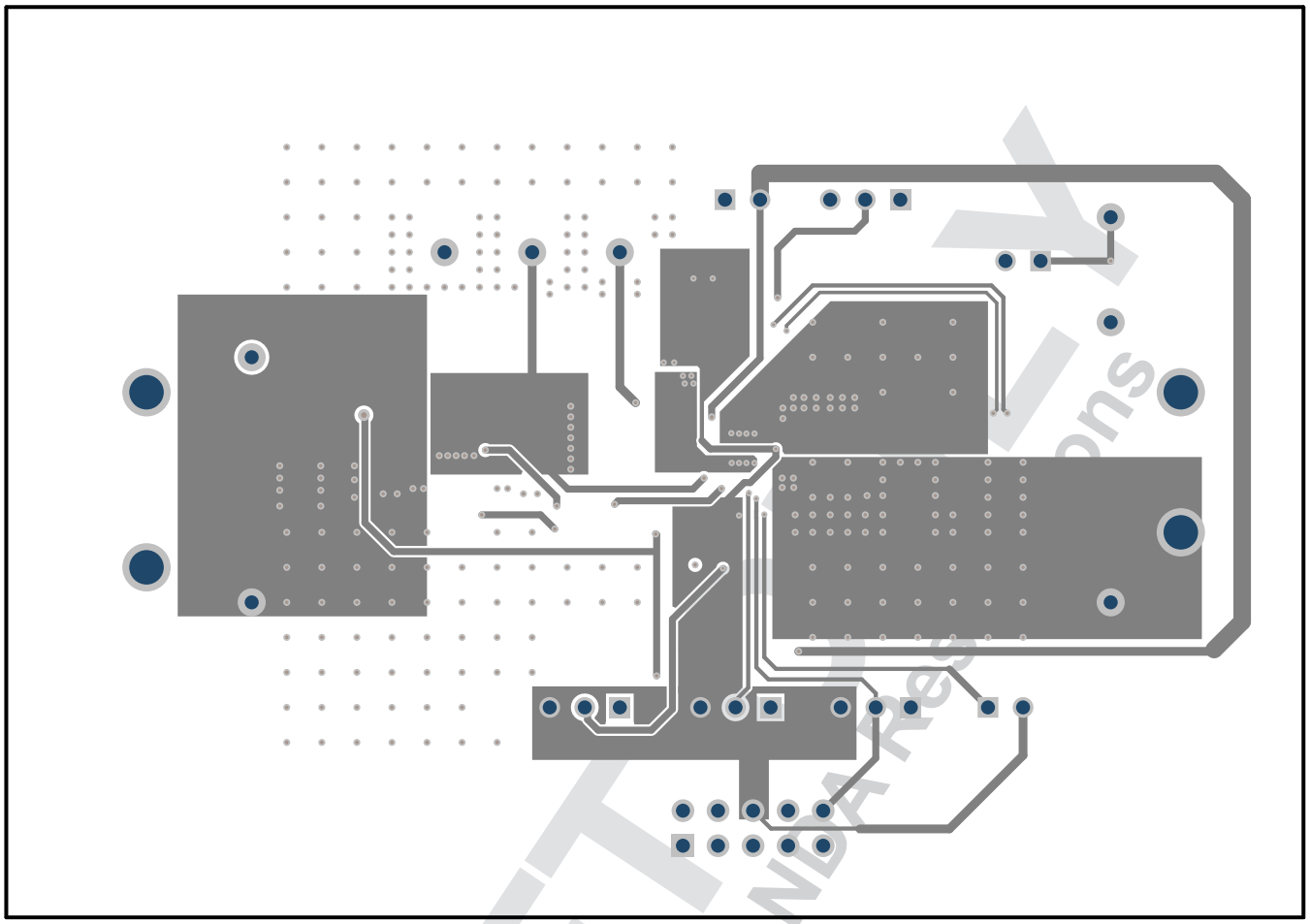

Figure 11. TPS55288EVM-053 Inner Layer2

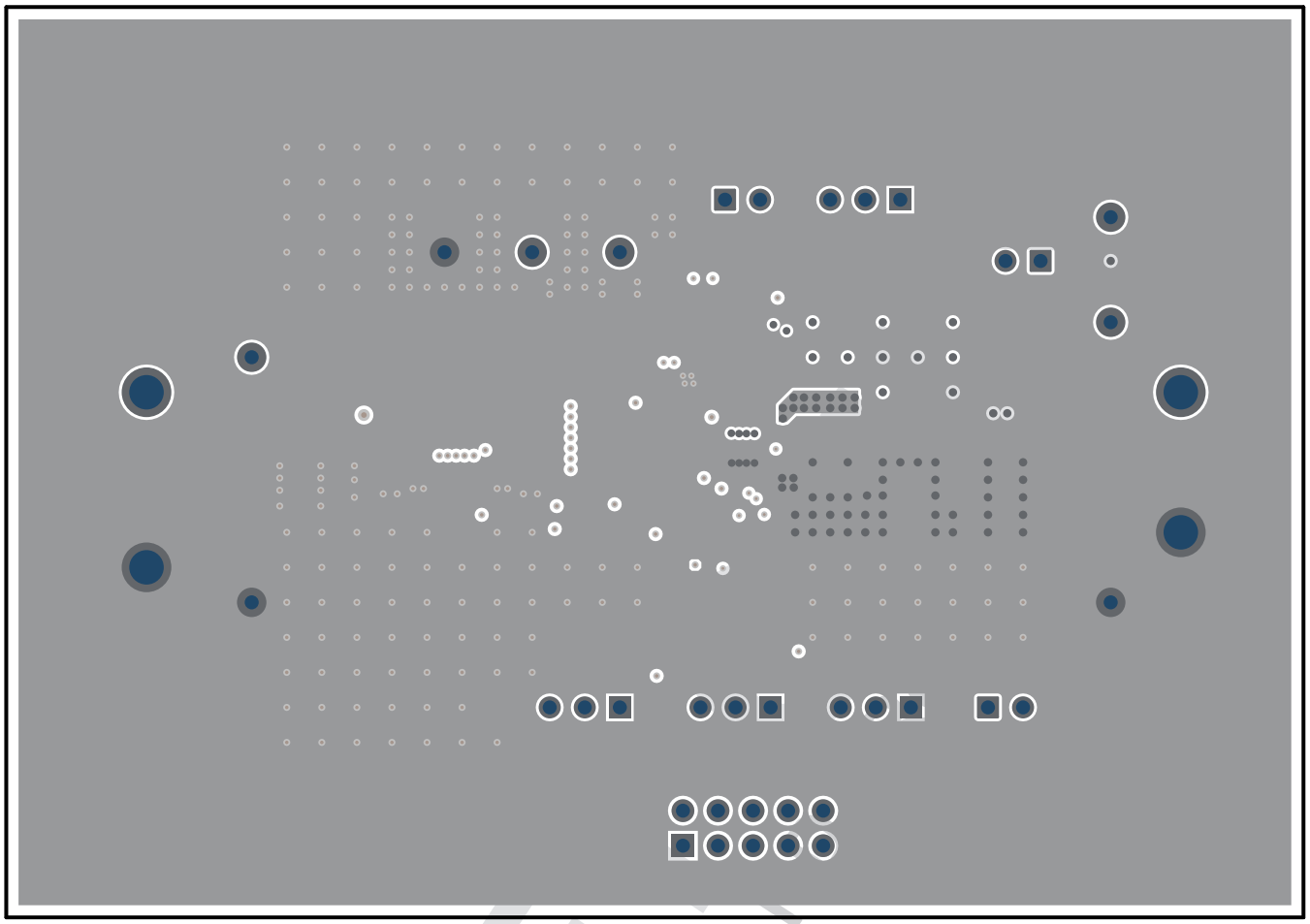

Figure 12. TPS55288EVM-053 Bottom-Side Layout

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