Green TPS53355EVM-864 Evaluation Module

The TPS53355EVM-864 evaluation module (EVM) allows users to evaluate the TPS53355. The TPS53355 is a D-CAP™ mode, 30-A synchronous buck converter with integrated MOSFETs. It provides a fixed 1.5-V output at up to 30 A from a 12-V input bus.

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Trademarks

D-CAP is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

1 Introduction

1.1 Before You Begin

The following warnings and cautions are noted for the safety of anyone using or working close to the TPS53355VQPEVM-864. Observe all safety precautions.

Warning The TPS53355VQPEVM-864 circuit module may become hot during operation due to dissipation of heat. Avoid contact with the board. Follow all applicable safety procedures applicable to your laboratory.

Caution Do not leave the EVM powered when unattended.

WARNING

The circuit module has signal traces, components, and component leads on the bottom of the board. This may result in exposed voltages, hot surfaces or sharp edges. Do not reach under the board during operation.

CAUTION

The circuit module may be damaged by over temperature. To avoid damage, monitor the temperature during evaluation and provide cooling, as needed, for your system environment.

CAUTION

Some power supplies can be damaged by application of external voltages. If using more than 1 power supply, check your equipment requirements and use blocking diodes or other isolation techniques, as needed, to prevent damage to your equipment.

CAUTION

The communication interface is not isolated on the EVM. Be sure no ground potential exists between the computer and the EVM. Also be aware that the computer is referenced to the Battery- potential of the EVM.

2 Description

The TPS53355EVM-864 is designed to use a regulated 12-V bus to produce a regulated 1.5-V output at up to 30 A of load current. The TPS53355EVM-864 is designed to demonstrate the TPS53355 in a typical, low-voltage application while providing a number of test points to evaluate the performance of the TPS53355.

2.1 Typical Applications

- Server/storage
- Workstations and desktops
- Telecommunication infrastructure

2.2 Features

The TPS53355EVM-864 features:

- 30-Adc, steady-state output current
- Supports prebias output voltage start-up
- J5 for selectable switching frequency setting
- J4 for selectable soft-start time
- J2 for enable function
- J6 for auto-skip and forced CCM selection
- Convenient test points for probing critical waveforms

3 Electrical Performance Specifications

Table 1. TPS53355EVM-864 Electrical Performance Specifications

Parameters	Test Conditions	Min	Typ	Max	Units
Input Characteristics					
Voltage range	V_{IN}	8	12	14	V
Maximum input current	V_{IN} = 8 V, I_O = 30 A		6.3		A
No load input current	V_{IN} = 14 V, I_O = 0 A with auto-skip mode		1		mA
Output Characteristics					
Output voltage VOUT			1.5		V
Output voltage regulation	Line regulation (V_{IN} = 8 V – 14 V)		0.1		%
	Load regulation (V_{IN} = 12 V, I_O = 0 A – 30 A)		1		%
Output voltage ripple	V_{IN} = 12 V, I_O = 30 A		20		mVpp
Output load current		0		30	A
Output overcurrent			34		A
Systems Characteristics					
Switching frequency			500		kHz
Peak efficiency	V_{IN} = 12 V, 1.5 V/10 A		91.87		%
Ful-load efficiency	V_{IN} = 12 V, 1.5V/30 A		89.46		%
Operating temperature			25		°C

NOTE: Jumpers are set to default locations; see Section 6 of this user's guide

4 Schematic

Figure 1 illustrates the EVM schematic.

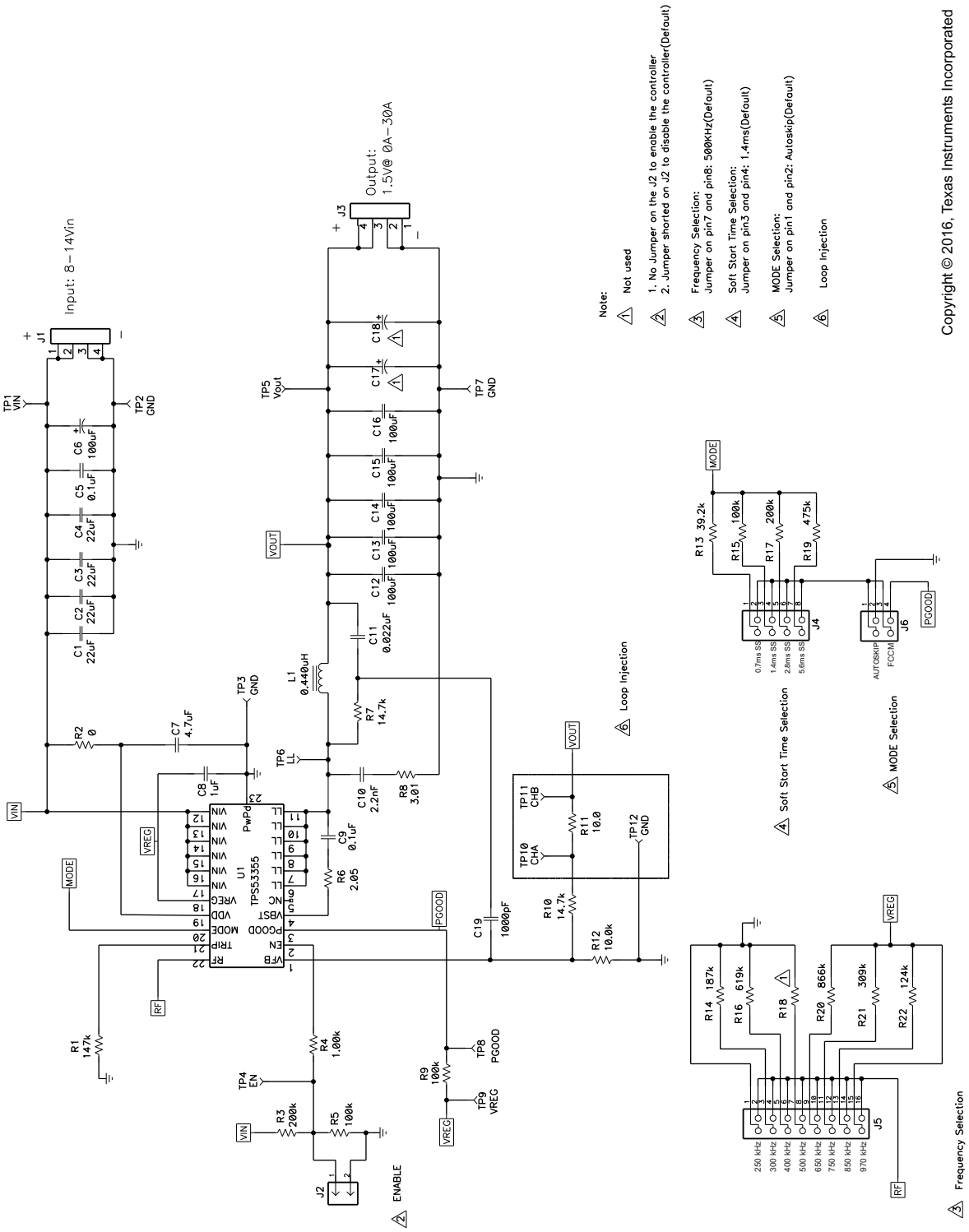

Figure 1. TPS53355EVM-864 Schematic

5 Test Setup

5.1 Test Equipment

Voltage Source: The input voltage source V_{IN} must be a 0-V to 14-V variable dc source capable of supplying 10 Adc. Connect V_{IN} to J1 as shown in Figure 3.

Multimeters:

- V1: V_{IN} at TP1 (V_{IN}) and TP2 (GND).
- V2: VOUT at TP5 (VOUT) and TP7 (GND).
- A1: V_{IN} input current

Output Load: The output load must be an electronic constant resistance mode load capable of 0 Adc to 30 Adc at 1.5 V.

Oscilloscope: A digital or analog oscilloscope can be used to measure the output ripple. The oscilloscope must be set for 1-MΩ impedance, 20-MHz bandwidth, ac coupling, 2-µs/division horizontal resolution, 50-mV/division vertical resolution. Test points TP5 and TP7 can be used to measure the output ripple voltage by placing the oscilloscope probe tip through TP5 and holding the ground barrel on TP7 as shown in Figure 2. Using a leaded ground connection may induce additional noise due to the large ground loop.

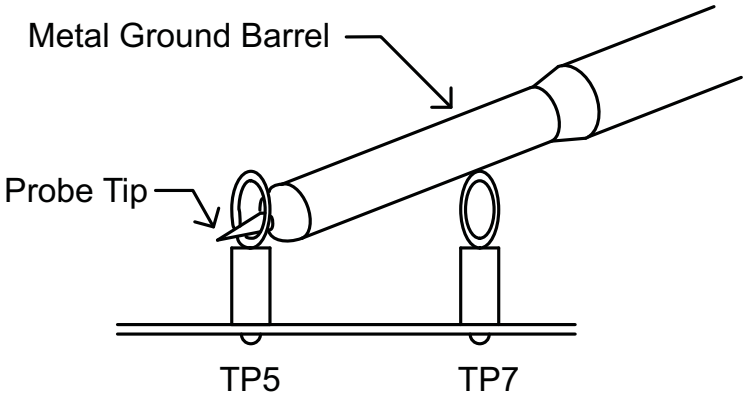

Figure 2. Tip and Barrel Measurement for VOUT Ripple

Fan: Some of the components in this EVM may approach temperatures of 60°C during operation. A small fan capable of 200–400 LFM is recommended to reduce component temperatures while the EVM is operating. Only probe the EVM when the fan is running.

Recommended Wire Gauge:

1. VIN to J1 (12-V input):

   The recommended wire size is 1x AWG 14 per input connection, with the total length of wire less than 4 feet (2-foot input, 2-foot return).

2. J3 to LOAD:

   The minimum recommended wire size is 2x AWG 14, with the total length of wire less than 4 feet (2-foot output, 2-foot return)

5.2 Recommended Test Setup

Figure 3 is the recommended test setup to evaluate the TPS53355EVM-864. Working at an ESD workstation, ensure that any wrist straps, bootstraps, or mats are connected referencing the user to earth ground before power is applied to the EVM.

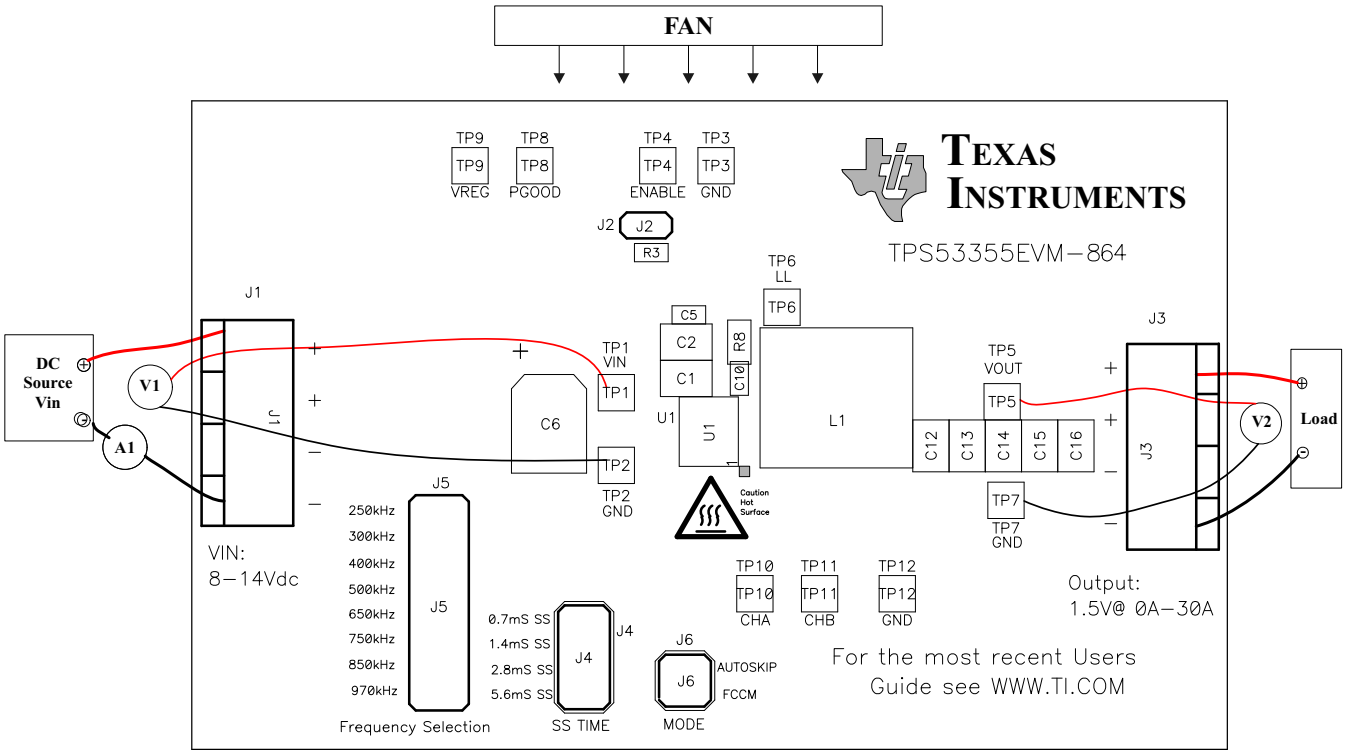

Figure 3. TPS53355EVM-864 Recommended Test Setup

Input Connections:

1. Prior to connecting the dc input source Vin, it is advisable to limit the source current from V_{IN} to 10 A maximum. Ensure that V_{IN} is initially set to 0 V and connected as shown in Figure 3.
2. Connect a voltmeter V1 at TP1 (V_{IN}) and TP2 (GND) to measure the input voltage.
3. Connect a current meter A1 to measure the input current.

Output Connections:

1. Connect Load to J3, and set Load to constant resistance mode to sink 0 Adc before V_{IN} is applied.
2. Connect a voltmeter V2 at TP5 (VOUT) and TP7 (GND) to measure the output voltage.

Other Connections:

Place a fan as shown in Figure 3, and turn it on, making sure that air is flowing across the EVM.

6 Configurations

All jumper selections must be made prior to applying power to the EVM. Users can configure this EVM per the following configurations.

6.1 Switching Frequency Selection

The switching frequency can be set by J5.

Default setting: 500 kHz

Table 2. Switching Frequency Selection

Jumper Set to	Resistor (RF) Connections (kΩ)	Switching Frequency (kHz)
Top (1–2 pin shorted)	0	250
Second (3–4 pin shorted)	187	300
Third (5–6 pin shorted)	619	400
Fourth (7–8 pin shorted)	**Open**	**500**
Fifth (9–10 pin shorted)	866	650
Sixth (11–12 pin shorted)	309	750
Seventh (13–14 pin shorted)	124	850
Bottom (15–16 pin shorted)	0	970

6.2 Soft-Start Selection

The soft-start time can be set by J4.

Default setting: 1.4 ms

Table 3. Soft-Start Time Selection

Jumper Set to	R_{MODE} Connections (kΩ)	Soft-Start Time (ms)
Top (1–2 pin shorted)	39.2	0.7
Second (3–4 pin shorted)	**100**	**1.4**
Third (5–6 pin shorted)	200	2.8
Bottom (7–8 pin shorted)	475	5.6

6.3 Mode Selection

The MODE can be set by J6.

Default setting: Auto Skip

Table 4. MODE Selection

Jumper Set to	MODE Selection
Top (1–2 pin shorted)	**Auto Skip**
Bottom (7–8 pin shorted)	Forced CCM

6.4 Enable Selection

The controller can be enabled and disabled by J2.

Default setting: Jumper shorts on J2 to disable the controller

Table 5. Enable Selection

Jumper Set to	Enable Selection
Jumper shorts on J2	**Disable the controller**
No jumper shorts on J2	Enable the controller

7 Test Procedure

7.1 Line/Load Regulation and Efficiency Measurement Procedure

1. Set up EVM as described in Section 5 and Figure 3.
2. Ensure Load is set to constant resistance mode and to sink 0 Adc.
3. Ensure that all jumpers configuration settings are per Section 6.
4. Ensure that the jumper provided in the EVM shorts on J2 before Vin is applied.
5. Increase V_{IN} from 0 V to 12 V. Use V1 to measure input voltage.
6. Remove the jumper on J2 to enable the controller.
7. Use V2 to measure VOUT voltage
8. Vary Load from 0 Adc to 30 Adc; Vout must remain in load regulation.
9. Vary V_{IN} from 8 V to 14 V; Vout must remain in line regulation.
10. Put the jumper on J2 to disable the controller.
11. Decrease Load to 0 A
12. Decrease V_{IN} to 0 V.

7.2 Control Loop Gain and Phase Measurement Procedure

TPS53355EVM-864 contains a 10-Ω series resistor in the feedback loop for loop response analysis.

1. Set up the EVM as described in Section 5 and Figure 3.
2. Connect isolation transformer to test points marked TP10 and TP11.
3. Connect input signal amplitude measurement probe (channel A) to TP10. Connect output signal amplitude measurement probe (channel B) to TP11.
4. Connect ground lead of channel A and channel B to TP12.
5. Inject an approximate 40-mV or less signal through the isolation transformer.
6. Sweep the frequency from 100 Hz to 1 MHz with 10-Hz or lower post filter. The control loop gain and phase margin can be measured.
7. Disconnect isolation transformer from bode-plot test points before making other measurements. (Signal injection into feedback may interfere with accuracy of other measurements.)

7.3 Test Point List

Table 6. Test Point Functions

Test Points	Name	Description
TP1	VIN	Controller input
TP2	GND	Ground
TP3	GND	Ground
TP4	EN	Enable
TP5	VOUT	Output voltage
TP6	LL	Switching node
TP7	GND	Ground
TP8	PGOOD	Power Good
TP9	VREG	5-V LDO output
TP10	CHA	Input A for loop injection
TP11	CHB	Input B for loop injection
TP12	GND	GND

7.4 Equipment Shutdown

1. Shut down Load.
2. Shut down fan.

8 Performance Data and Typical Characteristic Curves

Figure 4 through Figure 18 present typical performance curves for TPS53355EVM-864.

8.1 Efficiency

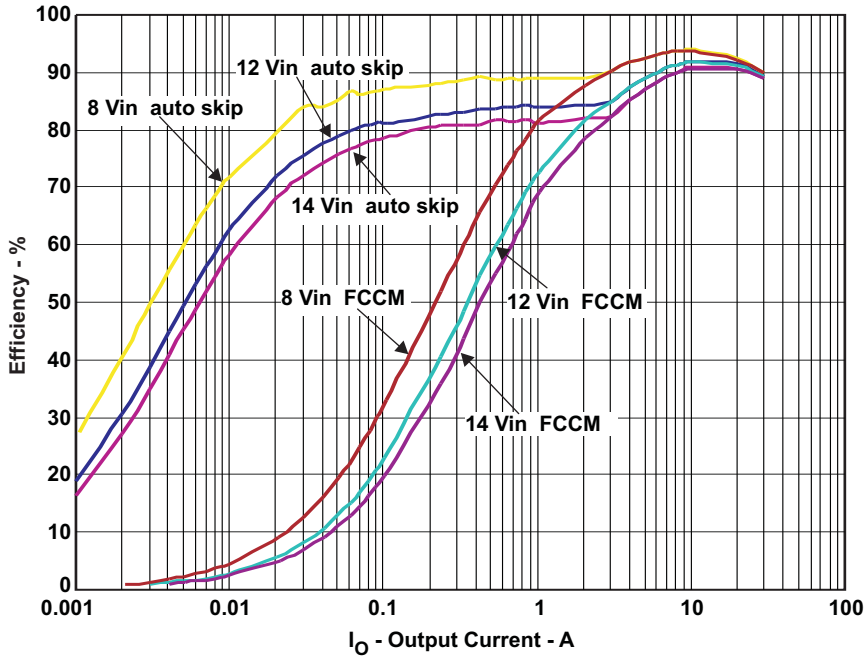

Figure 4. Efficiency

8.2 Load Regulation

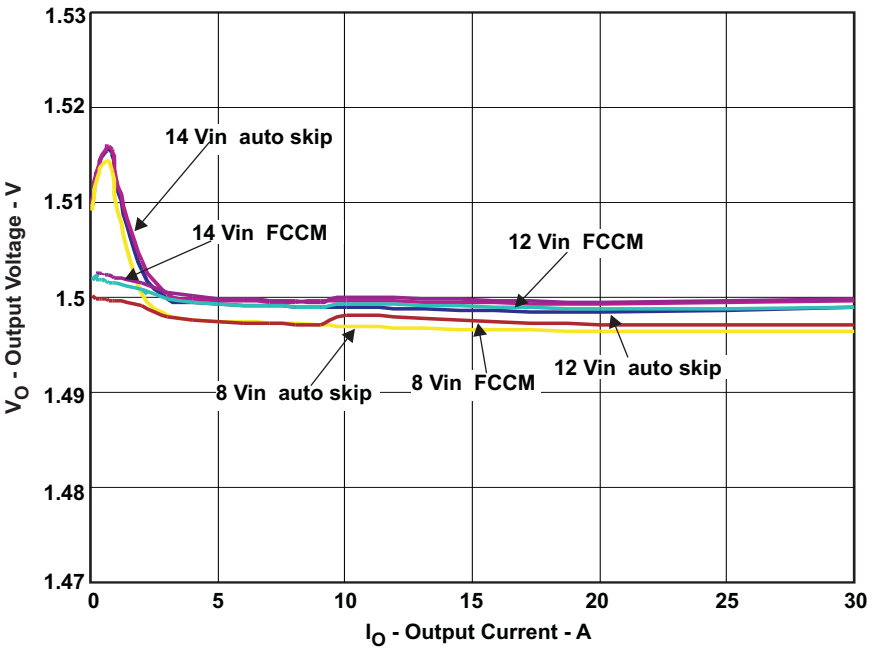

Figure 5. Load Regulation

8.3 Line Regulation

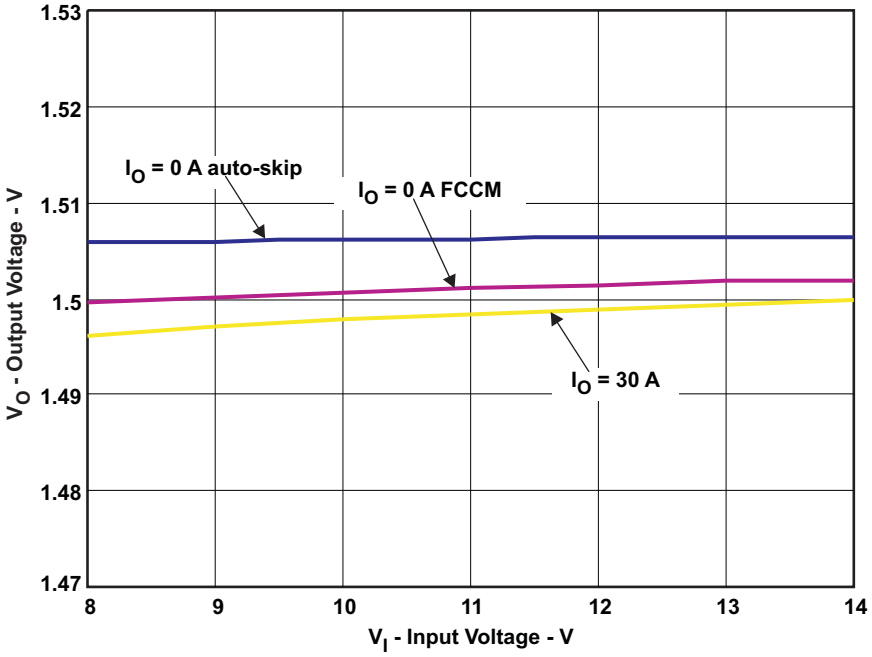

Figure 6. Line Regulation

8.4 Enable Turnon/Turnoff

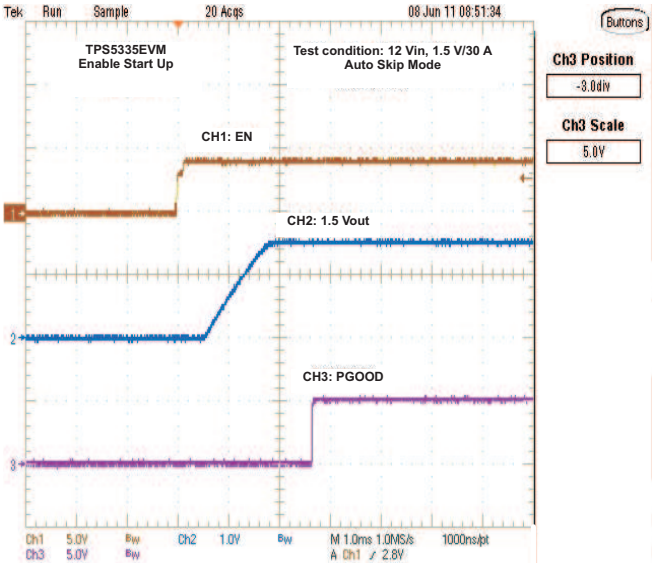

Figure 7. Enable Turnon

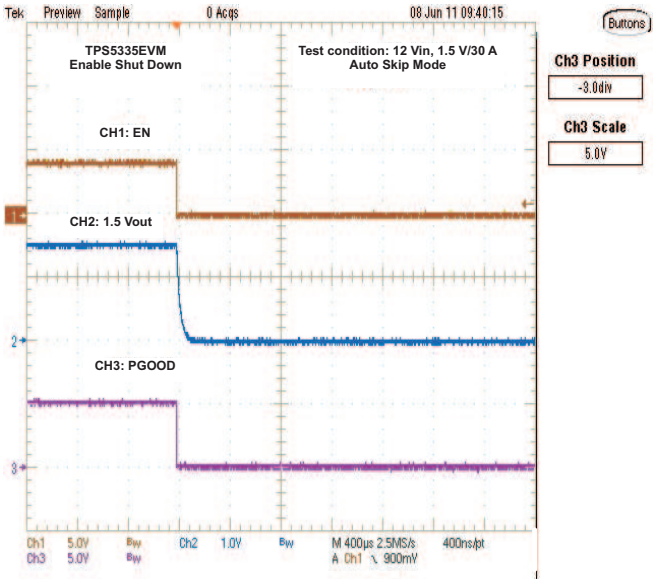

Figure 8. Enable Turnoff

8.5 Output Ripple

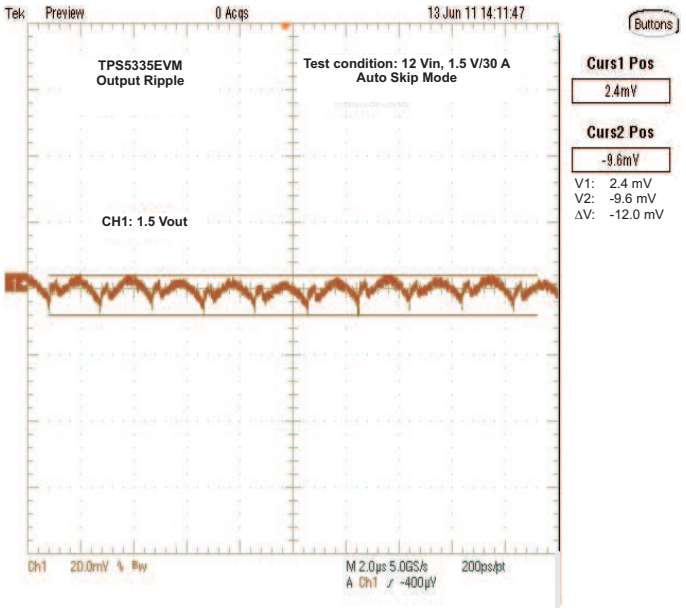

Figure 9. Output Ripple

8.6 Switching Node

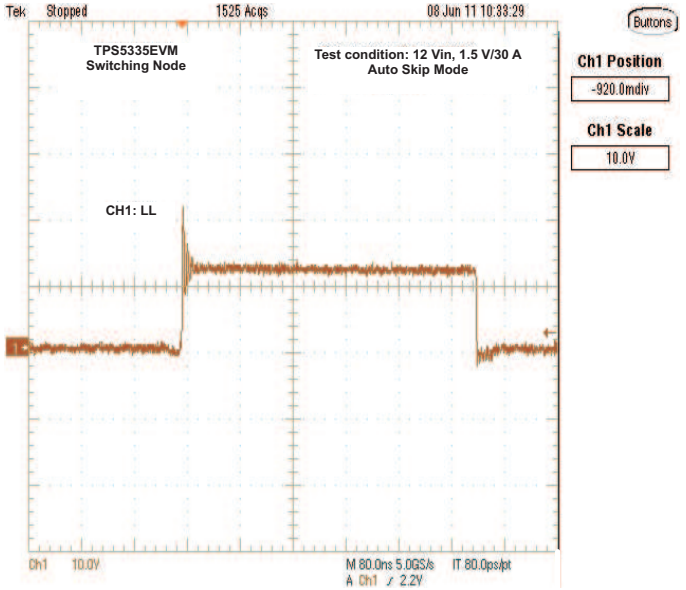

Figure 10. Switching Node

8.7 Output Transient With Auto-Skip Mode

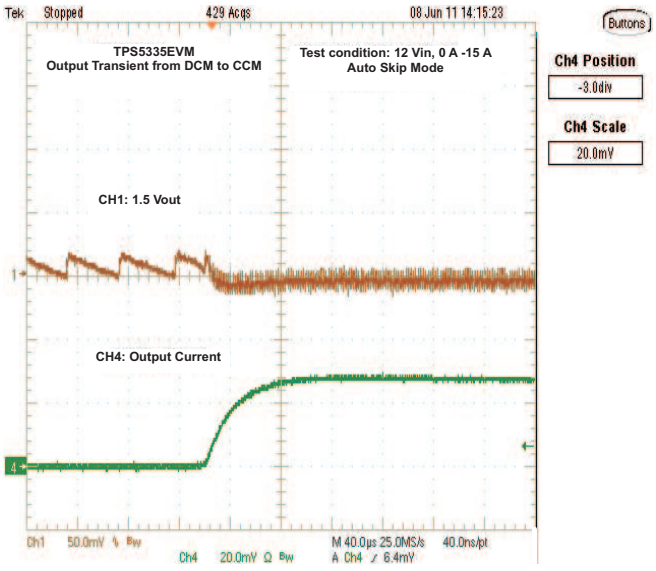

Figure 11. Output Transient From DCM to CCM

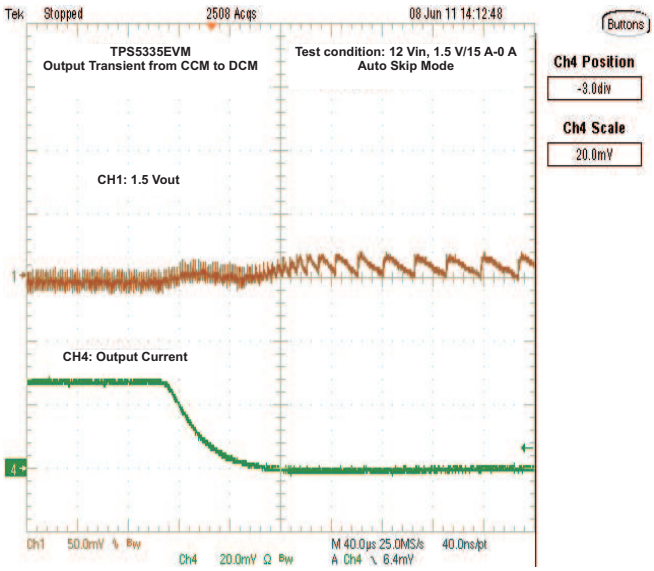

Figure 12. Output Transient From CCM to DCM

8.8 Output Transient With FCCM Mode

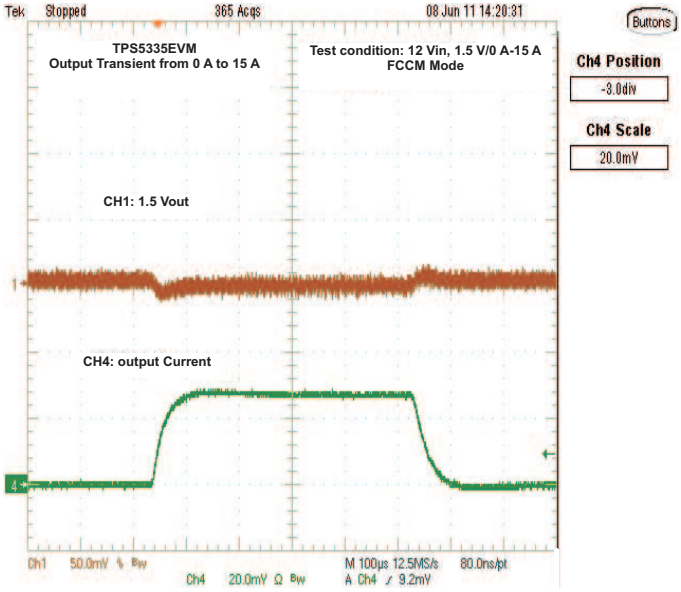

Figure 13. Output Transient With FCCM Mode

8.9 Output 0.75-V Prebias Turnon

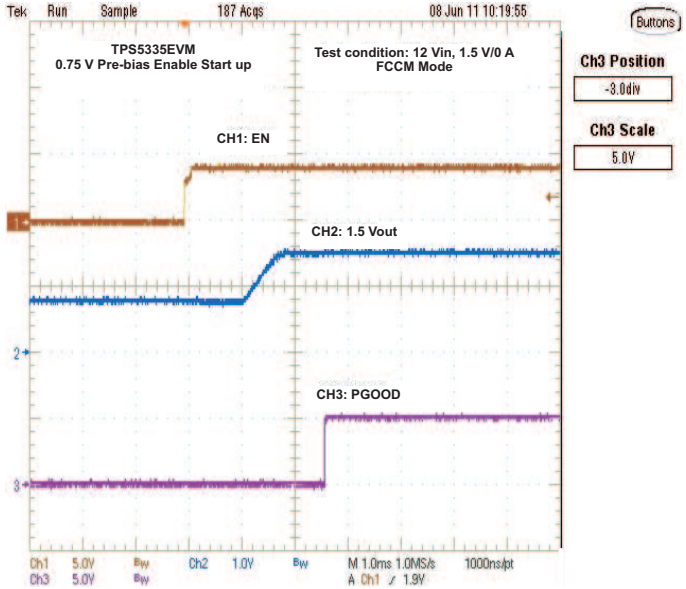

Figure 14. Output 0.75-V Prebias Turnon

8.10 Output Overcurrent and Short-Circuit Protection

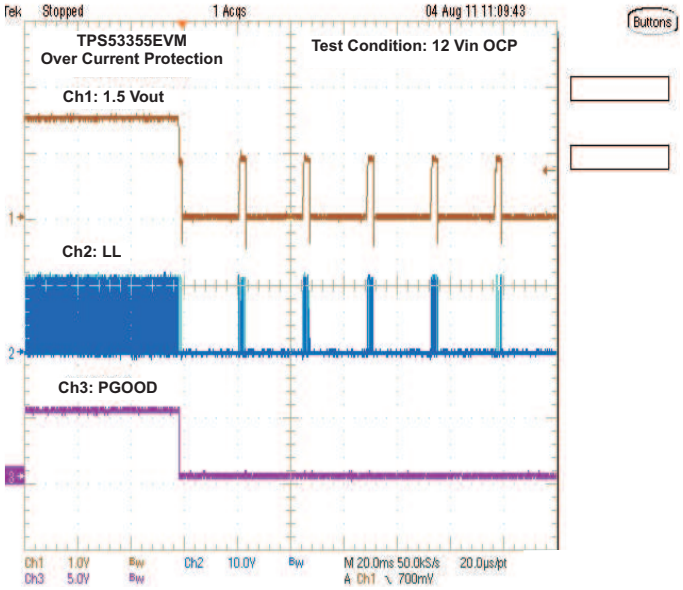

Figure 15. Output Overcurrent Protection

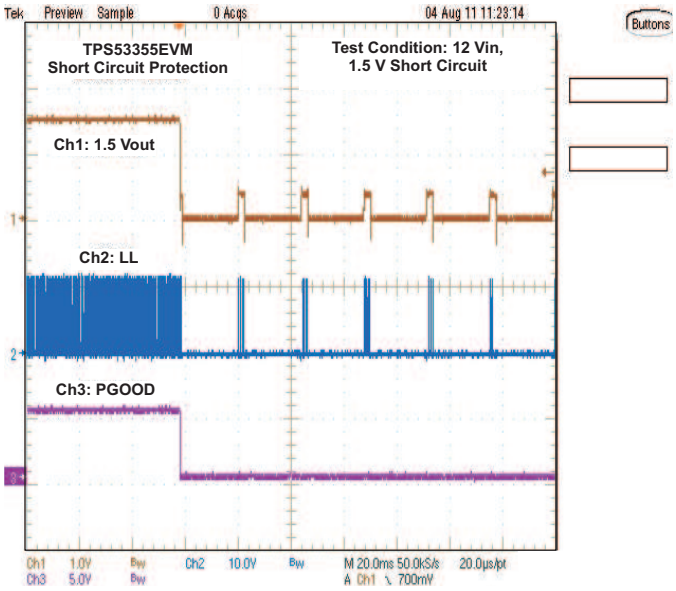

Figure 16. Output Short Circuit

8.11 Bode Plot

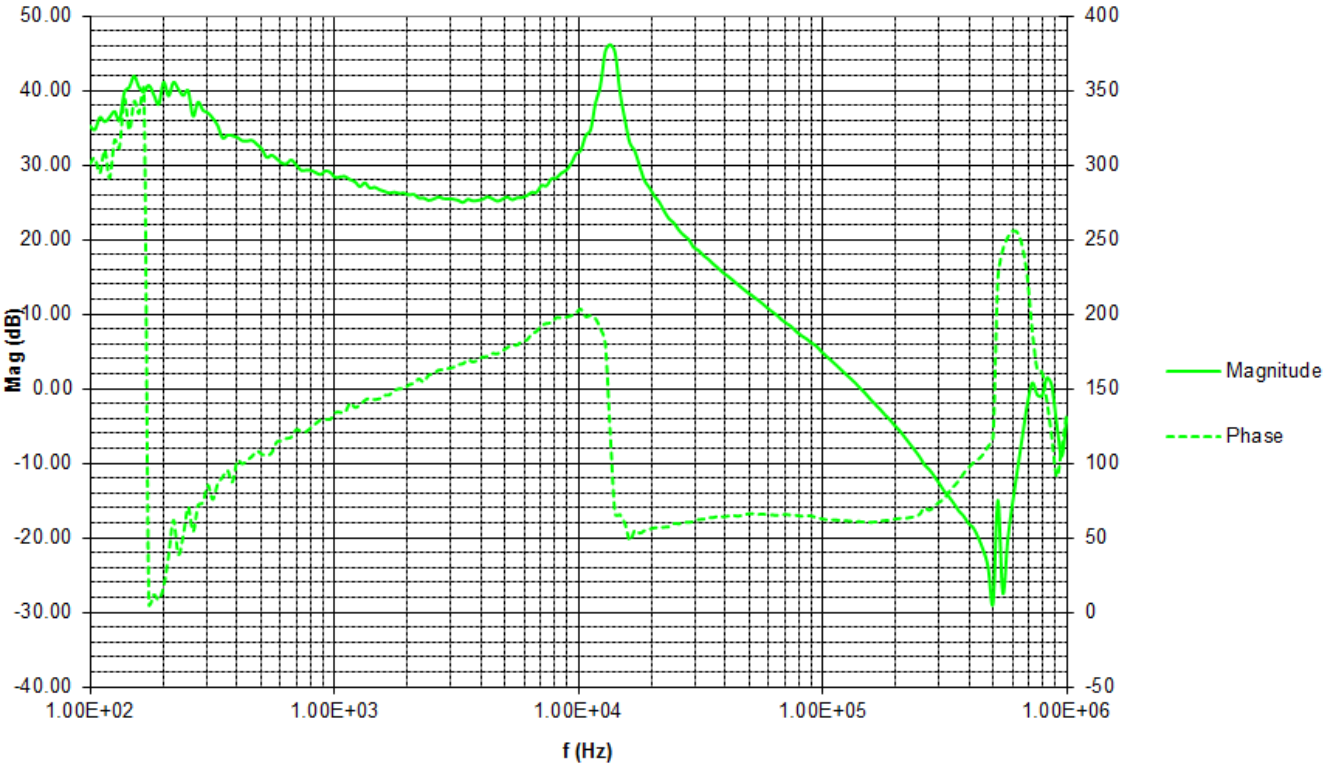

Figure 17. Bode Plot, V_{IN} = 12 V, V_{OUT} = 1.5 V, I_{OUT} = 6 A, Frequency = 500 kHz

8.12 Thermal Image

Figure 18 shows a thermal image of the board.

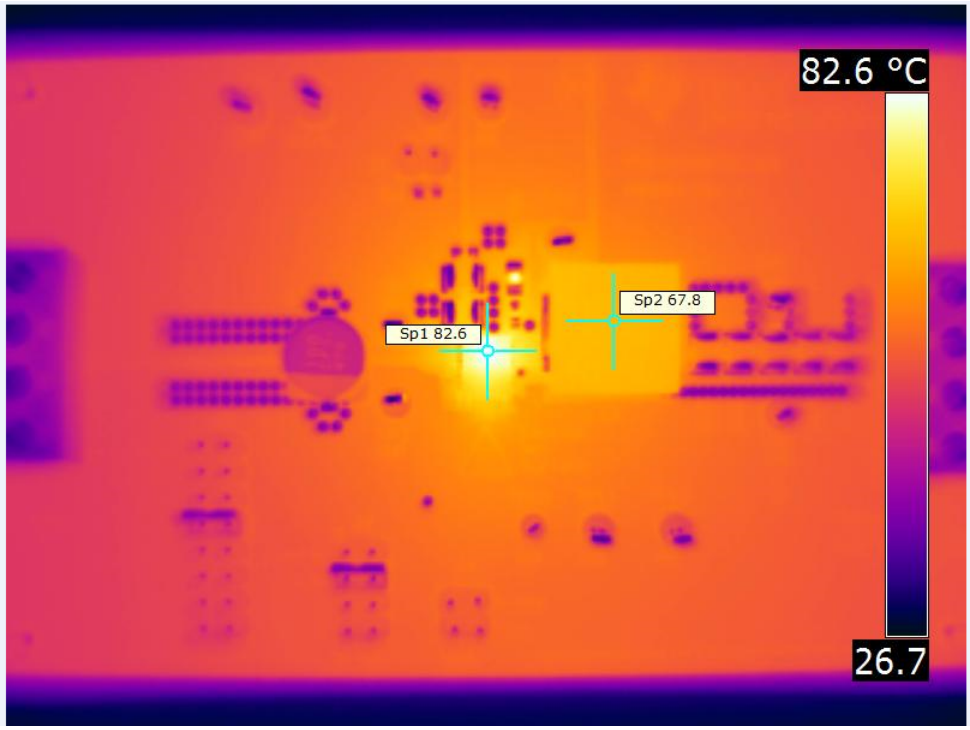

Figure 18. Top Board at 12 V_{IN}, 1.5 V/30 A, 25°C Ambient Temperature Without Airflow

9 EVM Assembly Drawing and PCB Layout

The following illustrations (Figure 19 through Figure 26) show the design of the TPS53355EVM-864 printed-circuit board. The EVM was designed using a 6-layer, 2-oz copper circuit board.

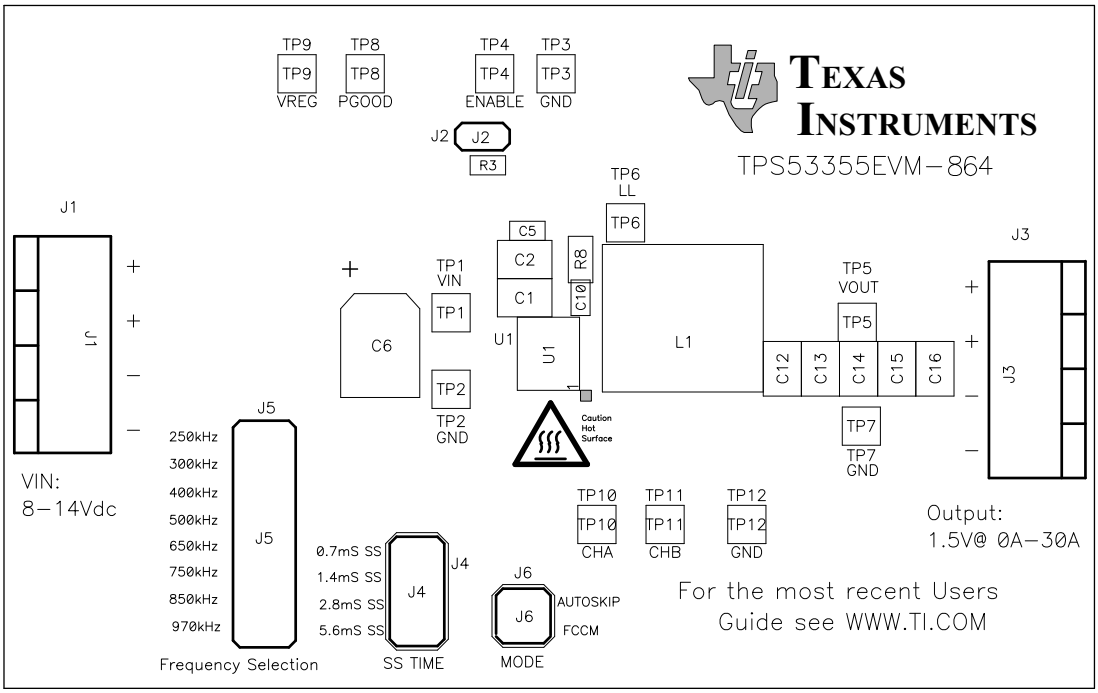

Figure 19. TPS53355EVM-864 Top Layer Assembly Drawing

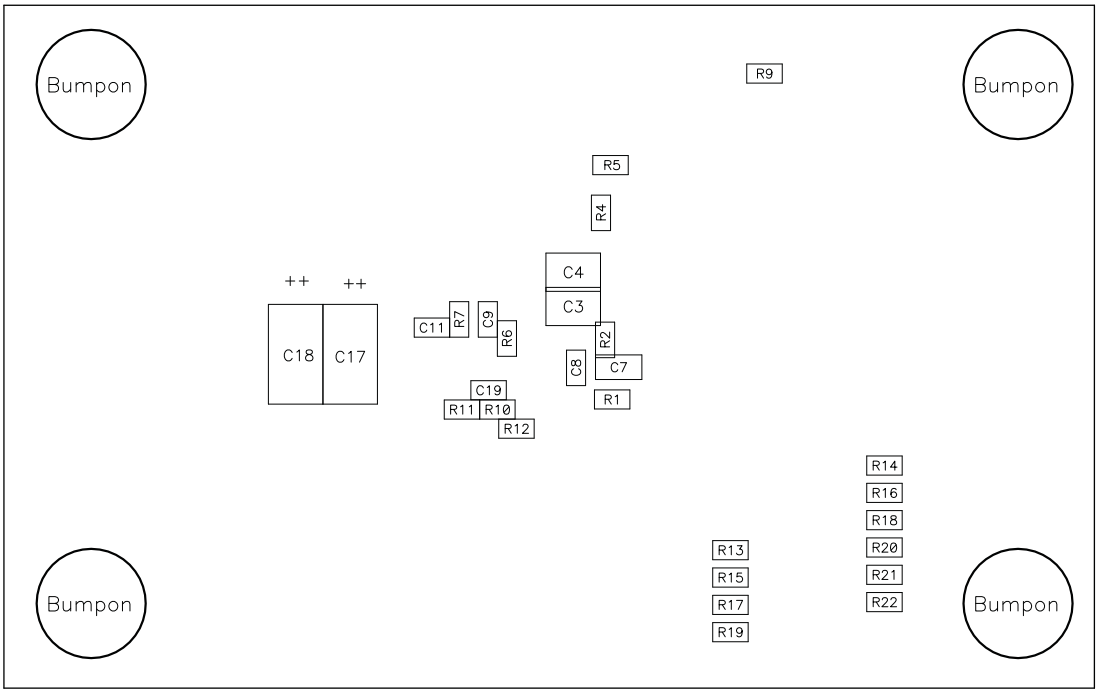

Figure 20. TPS53355EVM-864 Bottom Assembly Drawing

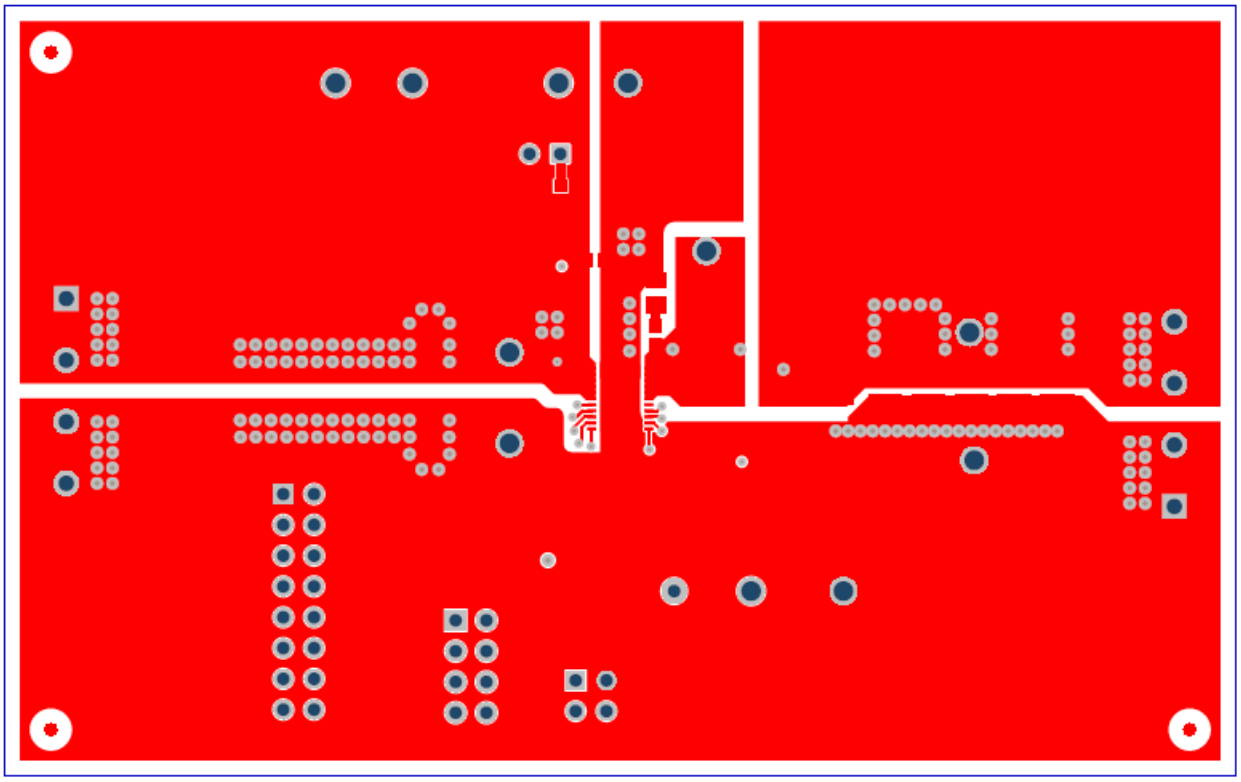

Figure 21. TPS53355EVM-864 Top Copper

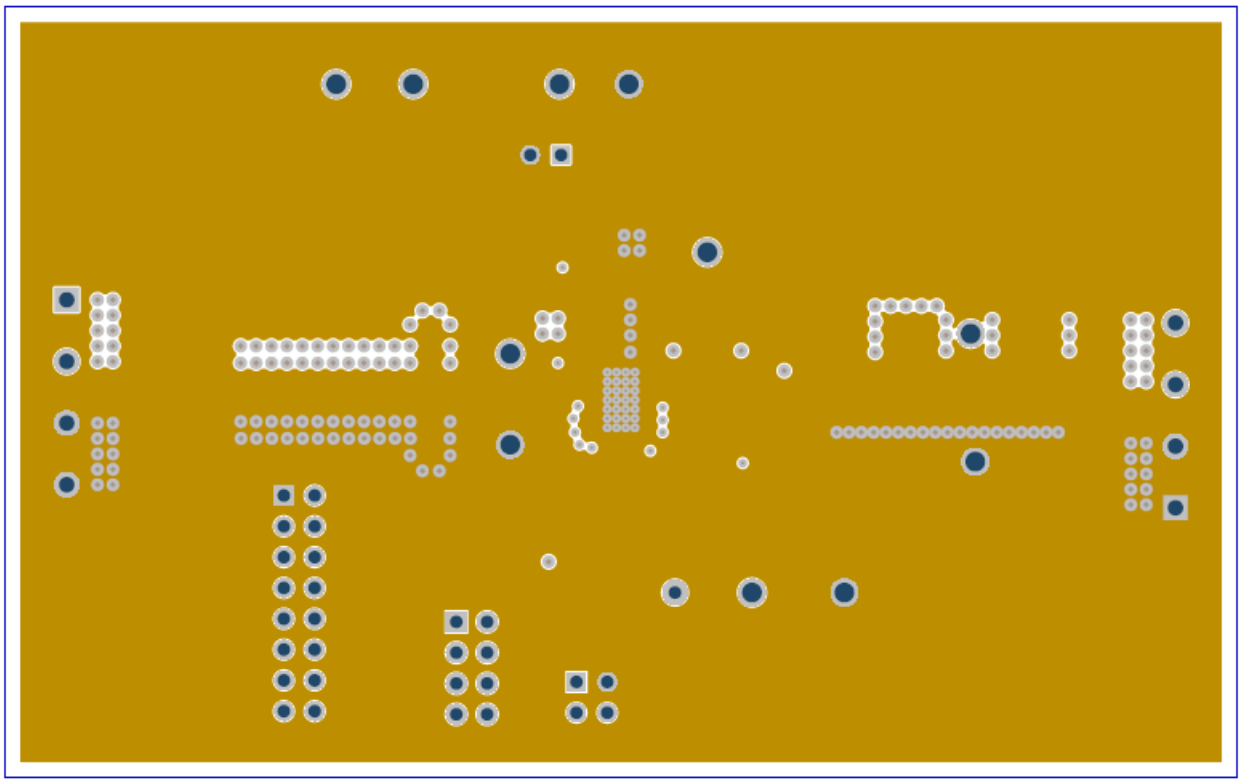

Figure 22. TPS53355EVM-864 Layer-2 Copper

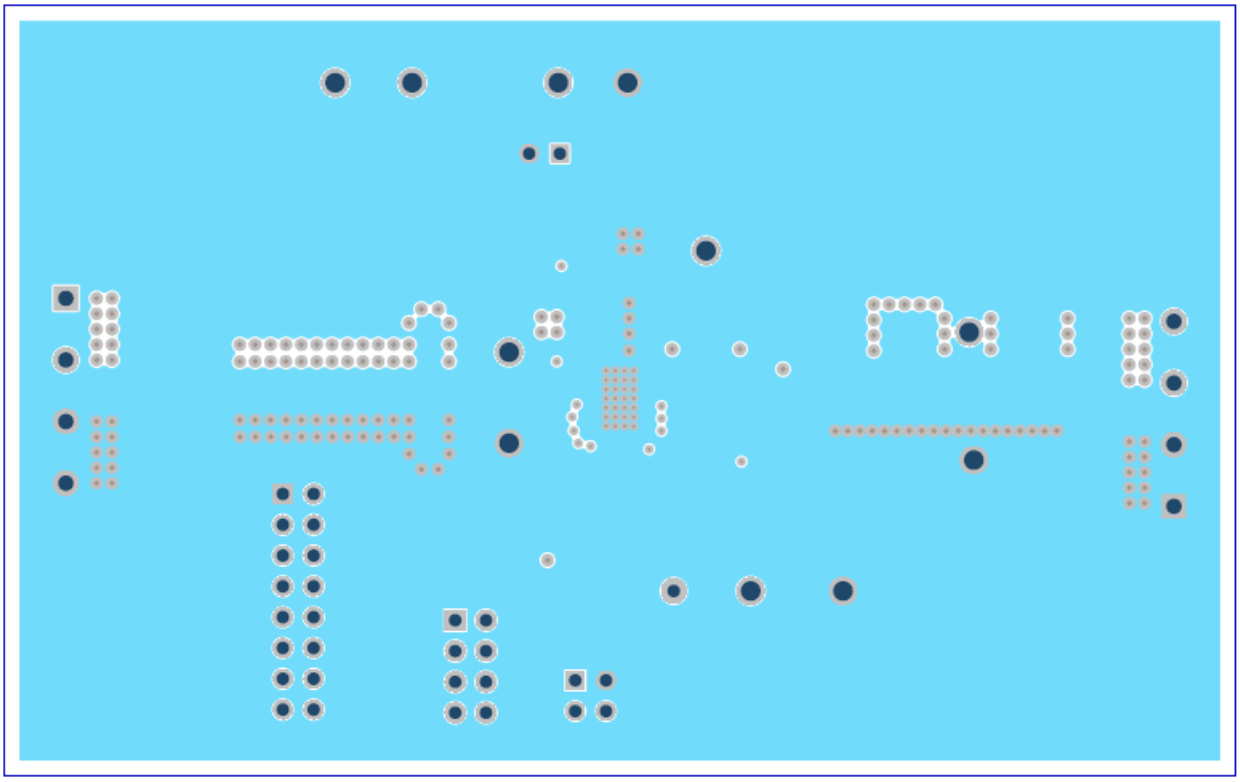

Figure 23. TPS53355EVM-864 Layer-3 Copper

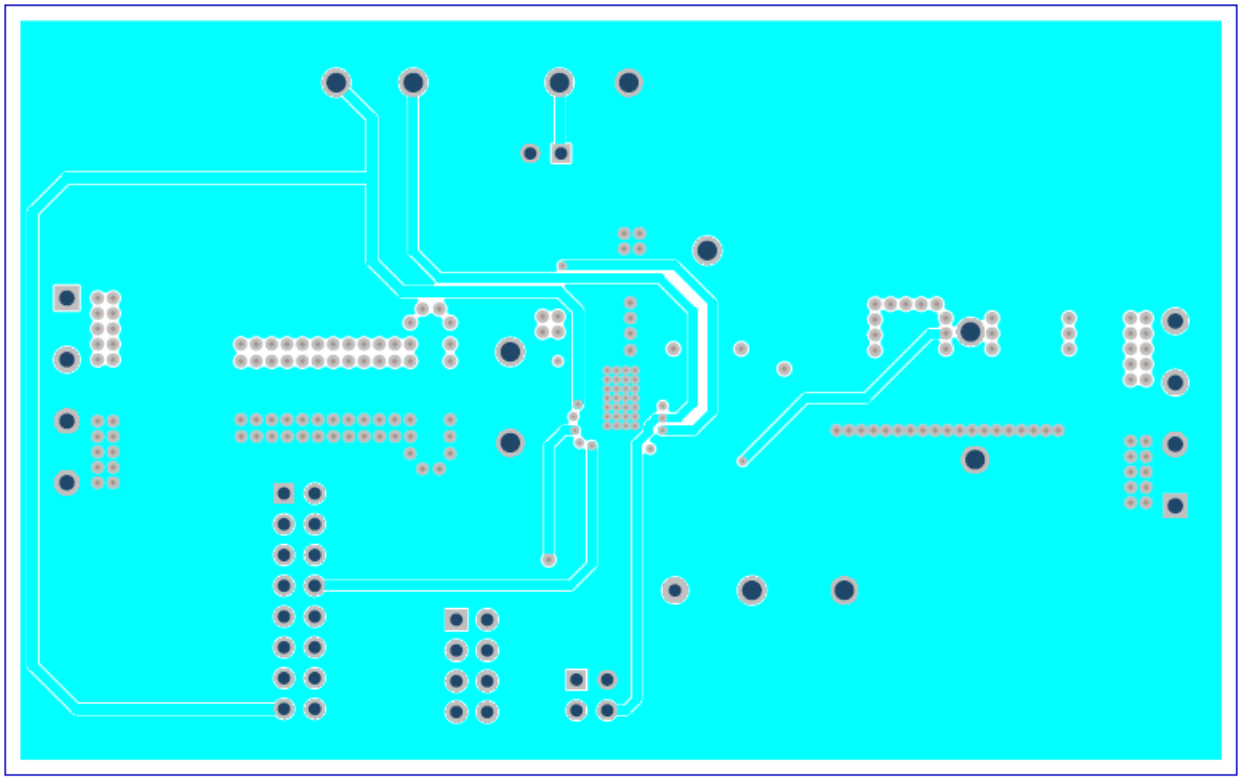

Figure 24. TPS53355EVM-864 Layer-4 Copper

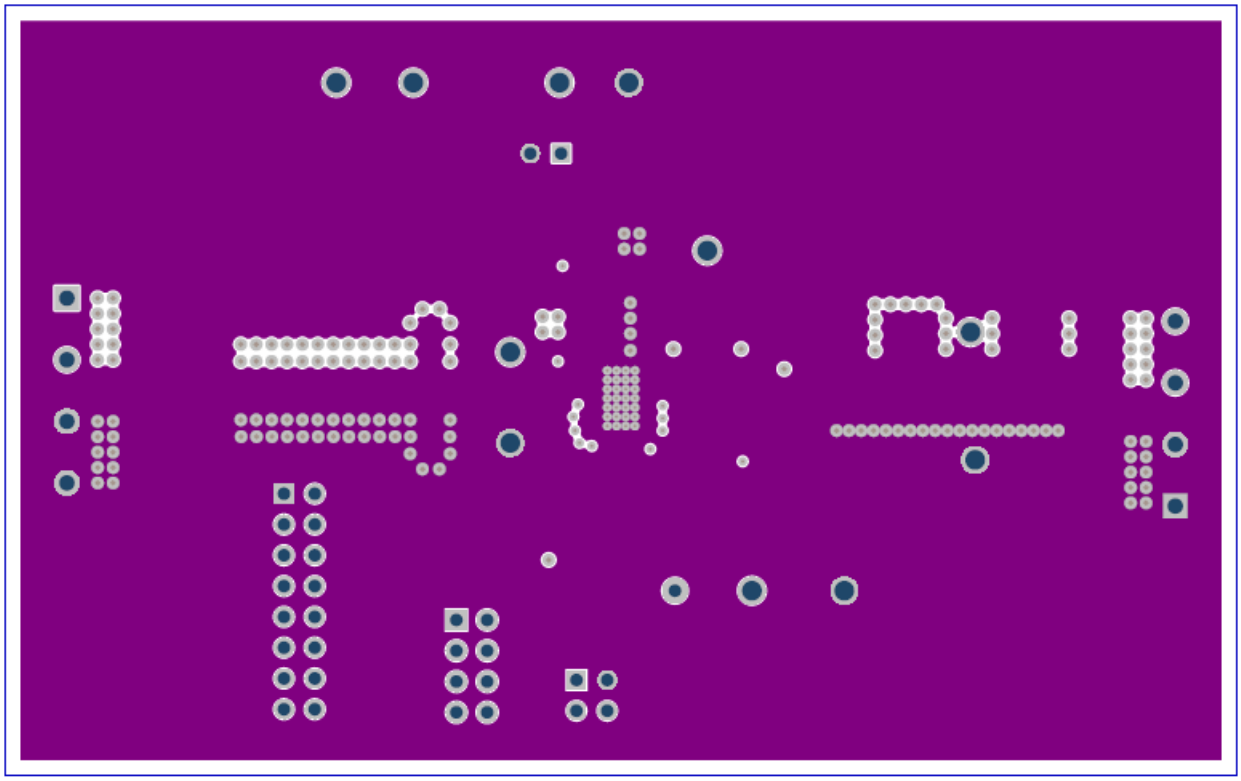

Figure 25. TPS53355EVM-864 Layer-5 Copper

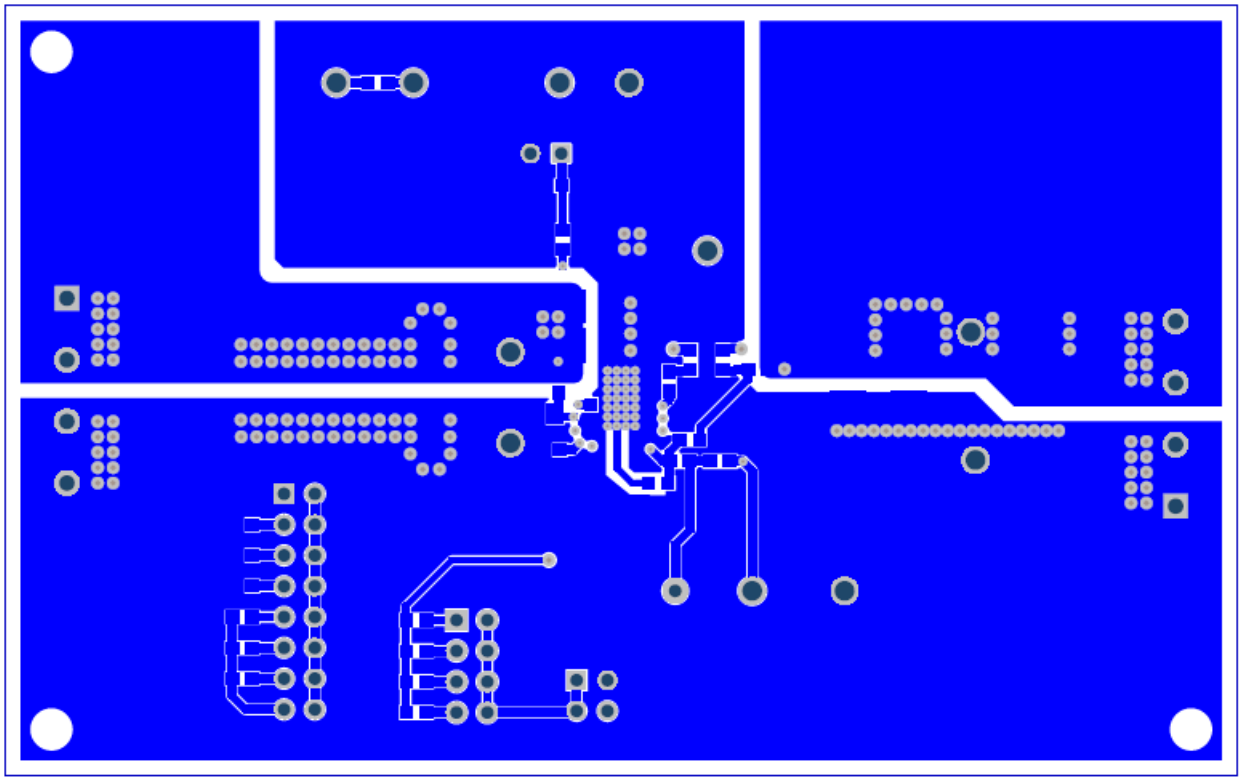

Figure 26. TPS53355EVM-864 Bottom Layer Copper

10 Bill of Materials

Table 7 lists the EVM bill of materials.

Table 7. EVM Components List (see Schematic Figure 1)

Item #	Designator	Qty	Value	Part Number	Manufacturer	Description	Package Reference
1	!PCB1	1		PWR864	Any	Printed Circuit Board	
2	C1, C2, C3, C4	4	22uF	GRM32ER61C226ME20L	Murata	CAP, CERM, 22 µF, 16 V, +/- 20%, X5R, 1210	1210
3	C5	1	0.1uF	885012206095	Wurth Elektronik	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603
4	C6	1	100uF	EEE-FC1C101P	Panasonic	CAP, AL, 100 µF, 16 V, +/- 20%, 0.4 ohm, SMD	SMT Radial E
5	C7	1	4.7uF	C2012X5R1E475K125AB	TDK	CAP, CERM, 4.7 µF, 25 V, +/- 10%, X5R, 0805	0805
6	C8	1	1uF	C0603C105K3RACTU	Kemet	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0603	0603
7	C9	1	0.1uF	C1608X7R1H104K080AA	TDK	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0603	0603
8	C10	1	2200pF	C0603C222K5RAC	Kemet	CAP, CERM, 2200 pF, 50 V, +/- 10%, X7R, 0603	0603
9	C11	1	0.022uF	885012206091	Wurth Elektronik	CAP, CERM, 0.022 µF, 50 V, +/- 10%, X7R, 0603	0603
10	C12, C13, C14, C15, C16	5	100uF	GRM32EC80J107ME20L	Murata	CAP, CERM, 100 µF, 6.3 V, +/- 20%, X6S, 1210	1210
11	C17, C18	2	330uF	6TPE330MAL	Panasonic	CAP, Tantalum Polymer, 330 µF, 6.3 V, +/- 20%, 0.025 ohm, 7.3x2.8x4.3mm SMD	7.3x2.8x4.3mm
12	C19	1	1000pF	06035A102KAT2A	AVX	CAP, CERM, 1000 pF, 50 V, +/- 10%, C0G/NP0, 0603	0603
13	H9, H10, H11, H12	4		SJ-5303 (CLEAR)	3M	Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon
14	J1, J3	2		ED120/4DS	On-Shore Technology	Terminal Block, 5.08 mm, 4x1, Brass, TH	4x1 5.08 mm Terminal Block
15	J2	1		PEC02SAAN	Sullins Connector Solutions	Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin
16	J4	1		PEC04DAAN	Sullins Connector Solutions	Header, 100mil, 4x2, Tin, TH	Header, 4x2, 100mil, Tin
17	J5	1		PEC08DAAN	Sullins Connector Solutions	Header, 2.54 mm, 8x2, Tin, Vertical, TH	Header, 2.54 mm, 8x2, TH
18	J6	1		PEC02DAAN	Sullins Connector Solutions	Header, 100mil, 2x2, Tin, TH	Header, 2x2, 2.54mm, TH
19	L1	1	440nH	PA0513.441NLT	Pulse Engineering	Inductor, Ferrite, 440 nH, 35 A, 0.00032 ohm, SMD	13.46x8.0x12.93mm
20	R1	1	147k	RC0603FR-07147KL	Yageo America	RES, 147 k, 1%, 0.1 W, 0603	0603
21	R2, R18	2	0	CRCW06030000Z0EA	Vishay-Dale	RES, 0, 5%, 0.1 W, 0603	0603
22	R3	1	200k	RC0603FR-07200KL	Yageo America	RES, 200 k, 1%, 0.1 W, 0603	0603
23	R4	1	1.00k	CRCW06031K00FKEA	Vishay-Dale	RES, 1.00 k, 1%, 0.1 W, 0603	0603
24	R5, R9, R15	3	100k	CRCW0603100KFKEA	Vishay-Dale	RES, 100 k, 1%, 0.1 W, 0603	0603
25	R6	1	2.05	CRCW06032R05FKEA	Vishay-Dale	RES, 2.05, 1%, 0.1 W, 0603	0603
26	R7	1	14.7k	CRCW060314K7FKEA	Vishay-Dale	RES, 14.7 k, 1%, 0.1 W, 0603	0603
27	R8	1	3.01	CRCW08053R01FKEA	Vishay-Dale	RES, 3.01, 1%, 0.125 W, 0805	0805
28	R10	1	14.7k	RC0603FR-0714K7L	Yageo America	RES, 14.7 k, 1%, 0.1 W, 0603	0603
29	R11	1	10.0	CRCW060310R0FKEAHP	Vishay-Dale	RES, 10.0, 1%, 0.25 W, 0603	0603
30	R12	1	10.0k	CRCW060310K0FKEA	Vishay-Dale	RES, 10.0 k, 1%, 0.1 W, 0603	0603
31	R13	1	39.2k	CRCW060339K2FKEA	Vishay-Dale	RES, 39.2 k, 1%, 0.1 W, 0603	0603
32	R14	1	187k	CRCW0603187KFKEA	Vishay-Dale	RES, 187 k, 1%, 0.1 W, 0603	0603
33	R16	1	619k	CRCW0603619KFKEA	Vishay-Dale	RES, 619 k, 1%, 0.1 W, 0603	0603
34	R17	1	200k	CRCW0603200KFKEA	Vishay-Dale	RES, 200 k, 1%, 0.1 W, 0603	0603

Table 7. EVM Components List (see Schematic Figure 1) (continued)

Item #	Designator	Qty	Value	Part Number	Manufacturer	Description	Package Reference
35	R19	1	475k	CRCW0603475KFKEA	Vishay-Dale	RES, 475 k, 1%, 0.1 W, 0603	0603
36	R20	1	866k	CRCW0603866KFKEA	Vishay-Dale	RES, 866 k, 1%, 0.1 W, 0603	0603
37	R21	1	309k	RC0603FR-07309KL	Yageo America	RES, 309 k, 1%, 0.1 W, 0603	0603
38	R22	1	124k	CRCW0603124KFKEA	Vishay-Dale	RES, 124 k, 1%, 0.1 W, 0603	0603
39	TP1, TP4, TP5, TP6, TP8, TP9, TP11	7		5010	Keystone	Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint
40	TP2, TP3, TP7, TP12	4		5011	Keystone	Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint
41	TP10	1		5002	Keystone	Test Point, Miniature, White, TH	White Miniature Testpoint
42	U1	1		TPS53355VQP	Texas Instruments	High-Efficiency 30 A Synchronous Buck Converter with Eco-mode, VQP0022A (LSON-CLIP-22)	VQP0022A
43	FID1, FID2, FID3, FID4, FID5, FID6	0		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	N/A

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2 *Limited Warranty and Related Remedies/Disclaimers*:

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3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      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.

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:

This device complies with Industry Canada license-exempt RSS standard(s). 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

3.3 *Japan*

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
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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4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

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4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

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