EVM User's Guide: TPS7H5101EVM

TPS7H5101-SEP Evaluation Module

Description

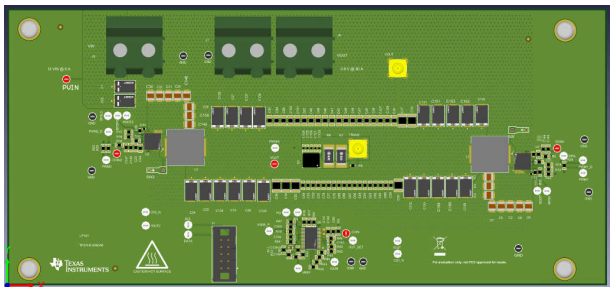
The TPS7H5101-SEP evaluation module (EVM) is a dual-phase D-CAP+™ buck converter meant for high current loads at low output voltages. The controller is optimized for 80A at 0.8V for point-of-load power delivery, using two TPS7H6200-SEP devices to accomplish the power conversion. The EVM uses the advanced control features of the D-CAP+ architecture which support a fast transient response with low output capacitance and high efficiency. The EVM further utilizes DROOP compensation to allow for even lower output capacitance to meet low output voltage tolerances.

Features

- D-CAP+ control for optimal load response
- ±1% reference voltage accuracy
- Differential remote sensing
- Droop regulation for optimized AC response

Applications

- Point-of-load power supplies
- Communications payload
- Radar imaging payload



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1 Evaluation Module Overview

1.1 Introduction

The TPS7H5101EVM is a buck power converter that converters a 12V input to a 0.8V output capable of supporting up to 80A loads utilizing two TPS7H6200-SEP power stages. The D-CAP+ control scheme allows for fast transient response with lower output capacitance than more traditional peak current mode control schemes. The use of GaN power stages allows for high efficiency even when switching at 500kHz, or even higher frequencies to help support frequency shifts during transient performance.

1.2 Kit Contents

- 1 × TPS7H5101EVM board

1.3 Specification

Specification	Value
Input Voltage	12V
Output Voltage	0.8V
Output Current	80A
Nominal Switching Frequency	500kHz
DROOP	30mV
Temperature	25℃

1.4 Device Information

The TPS7H5101 is a dual-phase D-CAP+ buck controller. The controller is optimized for high current, point of load power delivery due to the advanced control features of the D-CAP+ architecture which support a fast transient response with low output capacitance and high efficiency. The output capacitance can further be minimized through both the use of droop regulation and by utilizing the configurable undershoot reduction (USR) feature.

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2 Hardware

2.1 Connector Descriptions

Table 2-1 provides the connector descriptions for the TPS7H5101EVM.

Table 2-1. Connector Descriptions

Reference Designator	Net
TP1	CVIN
TP2	Input to transient circuit
TP3	GND
TP4	PWM1 controller output
TP5	EN controller input
TP6	U1 powerstage VIN input
TP7	PWM2 controller output
TP8	Controller power-good output
TP9	VREF controller output
TP10	OUT_SET controller input
TP11	U2 powerstage VIN input
TP12	CLK controller input
TP13	DATA controller input
TP14	U1 powerstage BP5H
TP15	U1 powerstage BOOT
TP16	U1 powerstage IOUT
TP17	VOUT
TP18	U1 powerstage BP5L
TP19	U2 powerstage BP5H
TP20	U2 powerstage BOOT
TP21	U2 powerstage IOUT
TP22	Controller ISUM
TP23	U2 powerstage BP5L
TP24-30	GND
TP31	U1 powerstage REFIN
TP32	U2 powerstage REFIN
TP33	Controller VSNS_P
TP34	U1 powerstage PWM input
TP35	U2 powerstage PWM input
TP37	U1 SW node
TP38	U2 SW node
TP39	PVIN
J5	Power input to converter
J6	VOUT output of converter
J7	GND output of converter

2.2 Transient Load Circuit

The TPS7H5101EVM provides a transient load circuit using CSD17559Q5 N-Channel Power MOSFET, along with a 20mΩ load resistance created by two 20mΩ chip resistors connected in parallel. While the CSD16408Q5 power MOSFET can conduct 40A of current and 400A pulsed current, the chip resistors are each rated for only 2W. When utilizing the transient circuit on the TPS7H5101EVM, the signal sent to the MOSFET gate through TP2 (TRANS) can be modulated to keep the average power through the load resistors below the 2W rating.

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2.3 Best Practices

The following information is provided to convey best practices while operating this device.

	**WARNING**
	Hot surface! Contact can cause burns. Do not touch!
	Some components can reach high temperatures > 55°C when the board is powered on. Do not touch the board at any point during operation or immediately after operating, as high temperatures can be present.

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3 Implementation Results

3.1 Evaluation Setup

The following tests were performed using the TPS7H5101EVM in the default configuration with detailed settings shown in Table 3-1.

Table 3-1. Default Configuration

Specification	Value
Input Voltage	12V
Output Voltage	0.8V
Output Current	80A
Nominal Switching Frequency	500kHz
DROOP	30mV
Temperature	25℃

3.2 Load Step

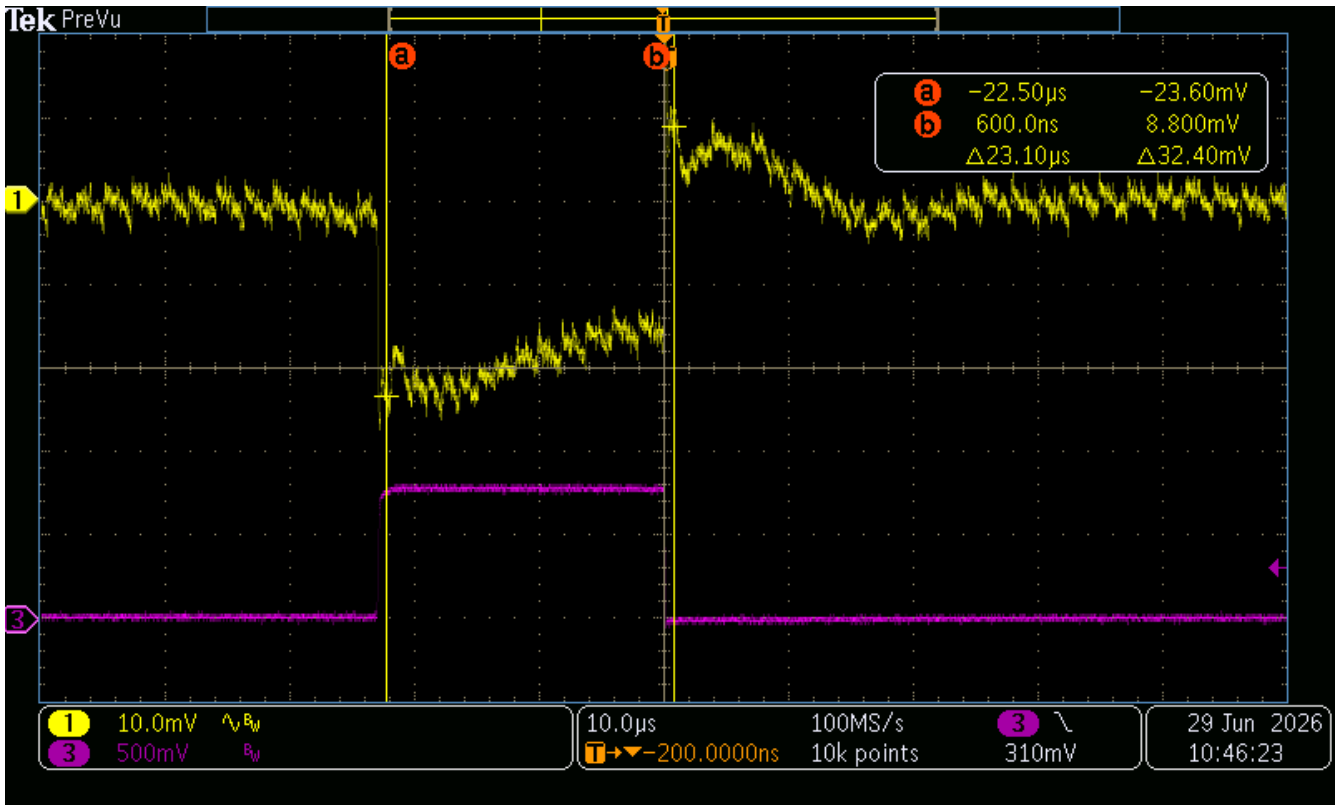


Figure 3-1. Load Step

A load step of 37A delta was taken with a static 20A load on the output of the converter. Ramp rates are 154A/µs increasing and 264A/µs decreasing.

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3.3 Efficiency

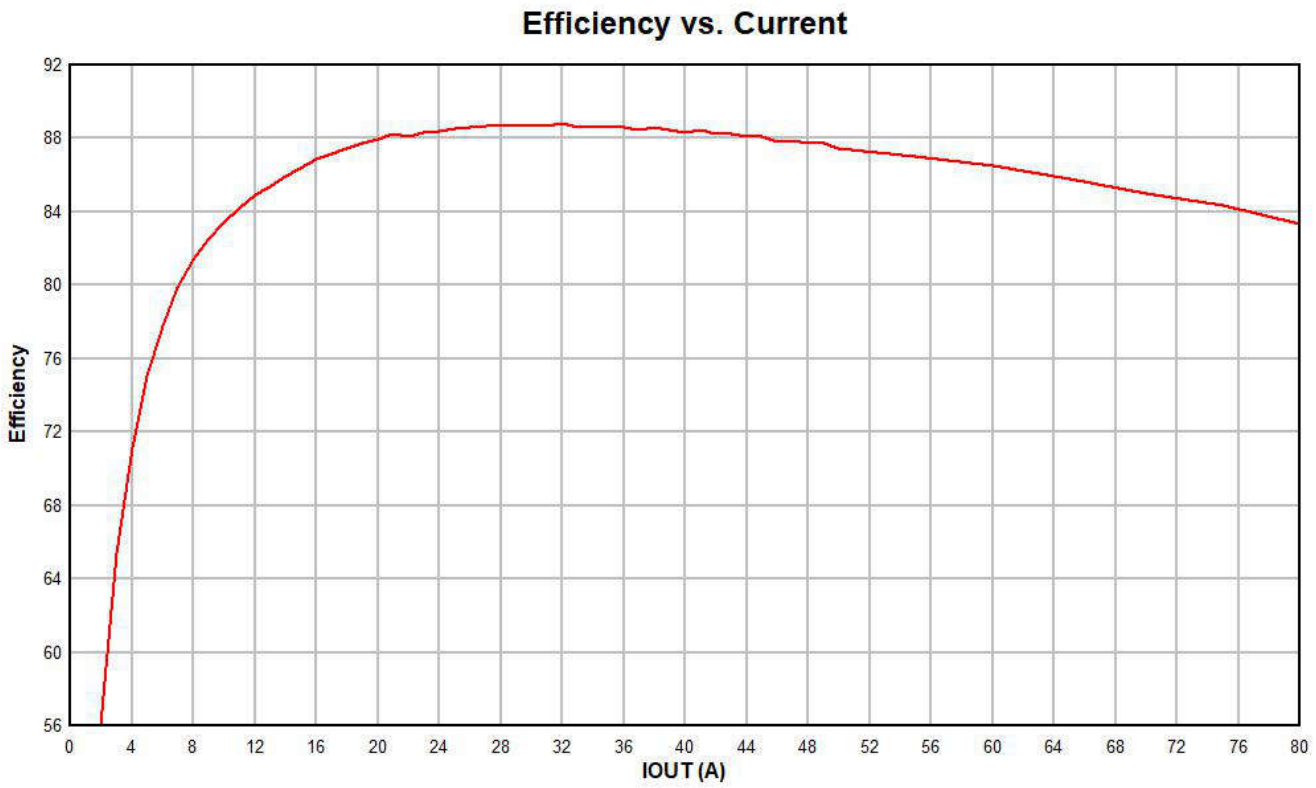


Figure 3-2. Efficiency vs. Current

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3.4 Switch Node

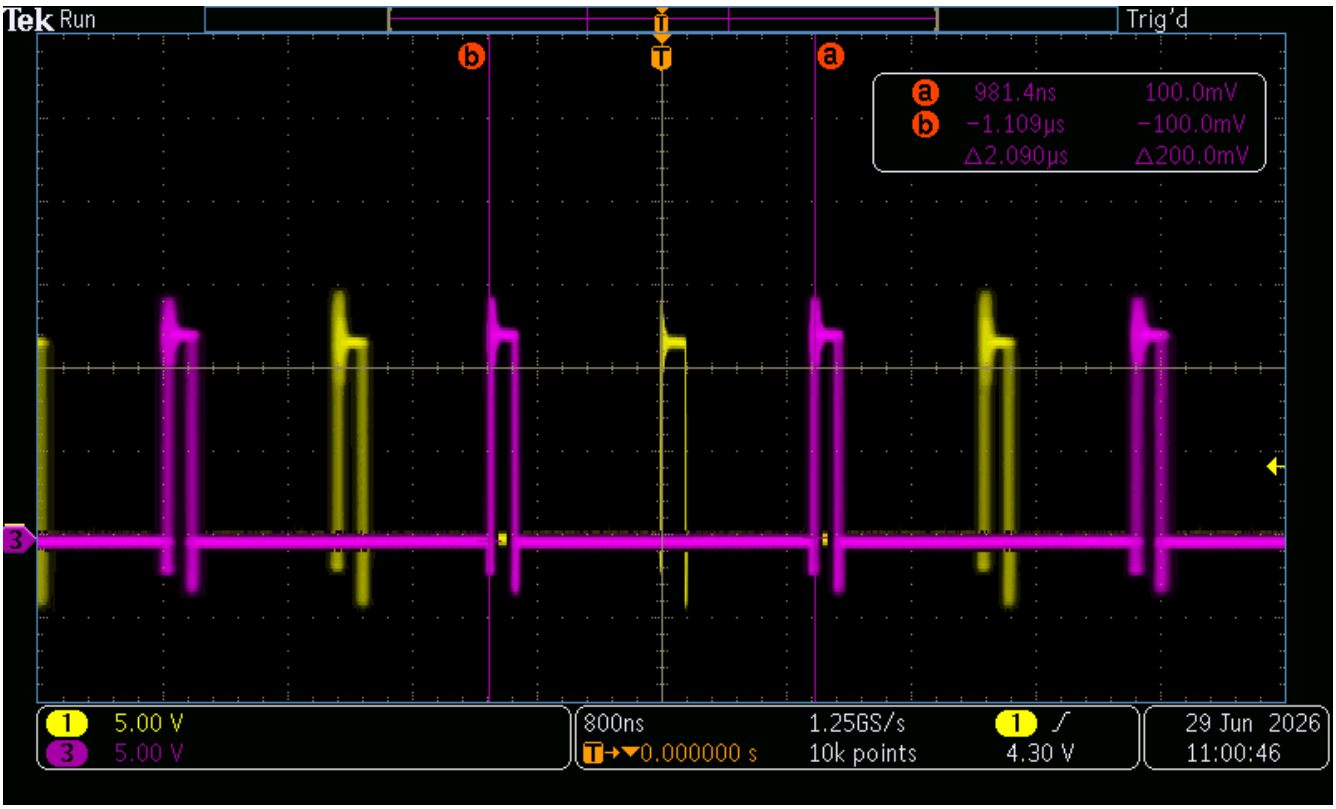


Figure 3-3. Dual Phase Switch Node Waveform

Measured with 80A output. Jitter is within expectations from DCAP+ control.

3.5 Temperature

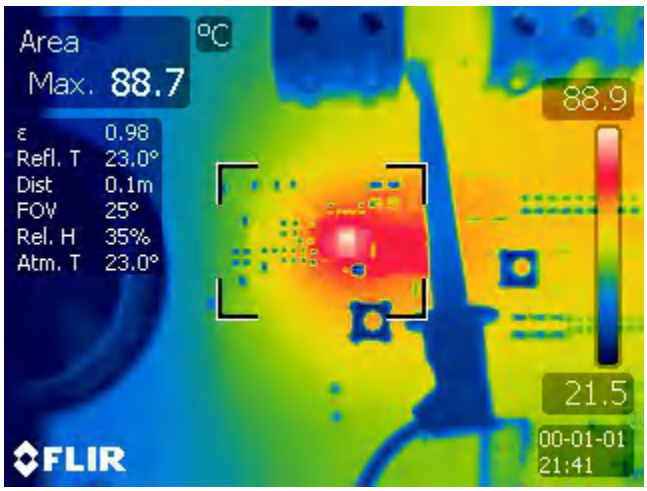


Figure 3-4. No Air-Flow Temperature

The temperature of the power stage was measured with 12V VIN / 80A IOUT after being left to run for five minutes.

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3.6 Non-Invasive Stability Measurement

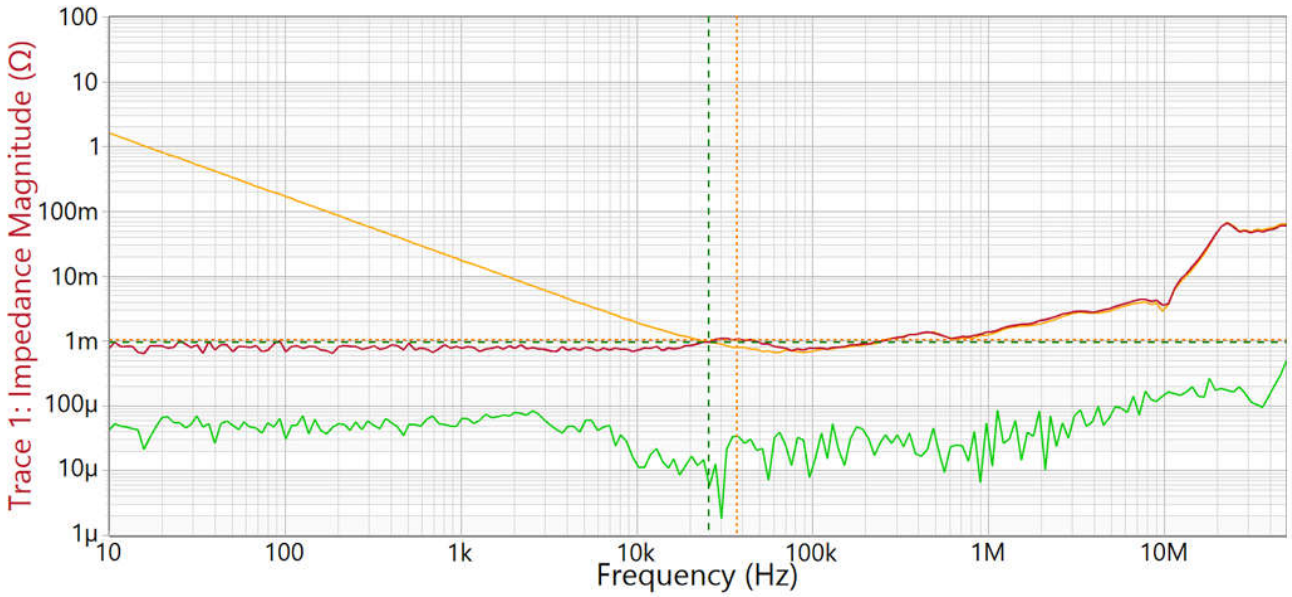


Figure 3-5. Output Impedance Measurement

	Cursor 1	Cursor 2	Delta C2-C1
Frequency	**25.699 kHz**	**37.065 kHz**	**11.366 kHz**
Trace 1 | Magnitude	947.512 µΩ	1.043 mΩ	95.182 µΩ

Figure 3-6. Table of Output Impedance Measurements

Line Color	Description
Orange	Output impedance without converter active
Red	Output impedance with converter active
Green	Measurement noise floor

The figure shows the output impedance of the converter measured with 80A on the output.

3.7 Bode Plot

Bode plots for non-linear measurements are considered to be insufficient for determining stability, however one has been taken.

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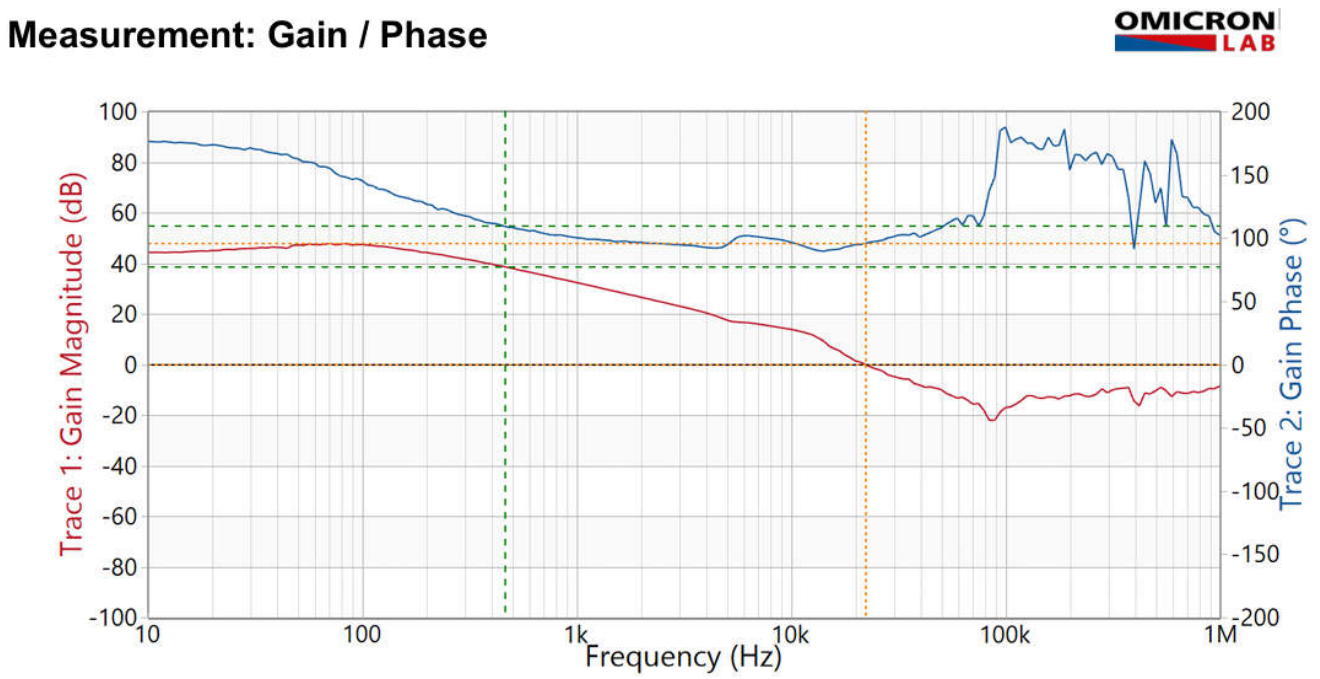


Figure 3-7. Frequency Response

	Cursor 1	Cursor 2	Delta C2-C1
Frequency	**460 Hz**	**22.219 kHz**	**21.759 kHz**
Trace 1 | Magnitude (dB)	38.666 dB	0 dB	-38.666 dB
Trace 2 | Phase (°)	109.262 °	95.8 °	-13.461 °

Figure 3-8. Table of Frequency Response Results

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4 Hardware Design Files

4.1 Schematics

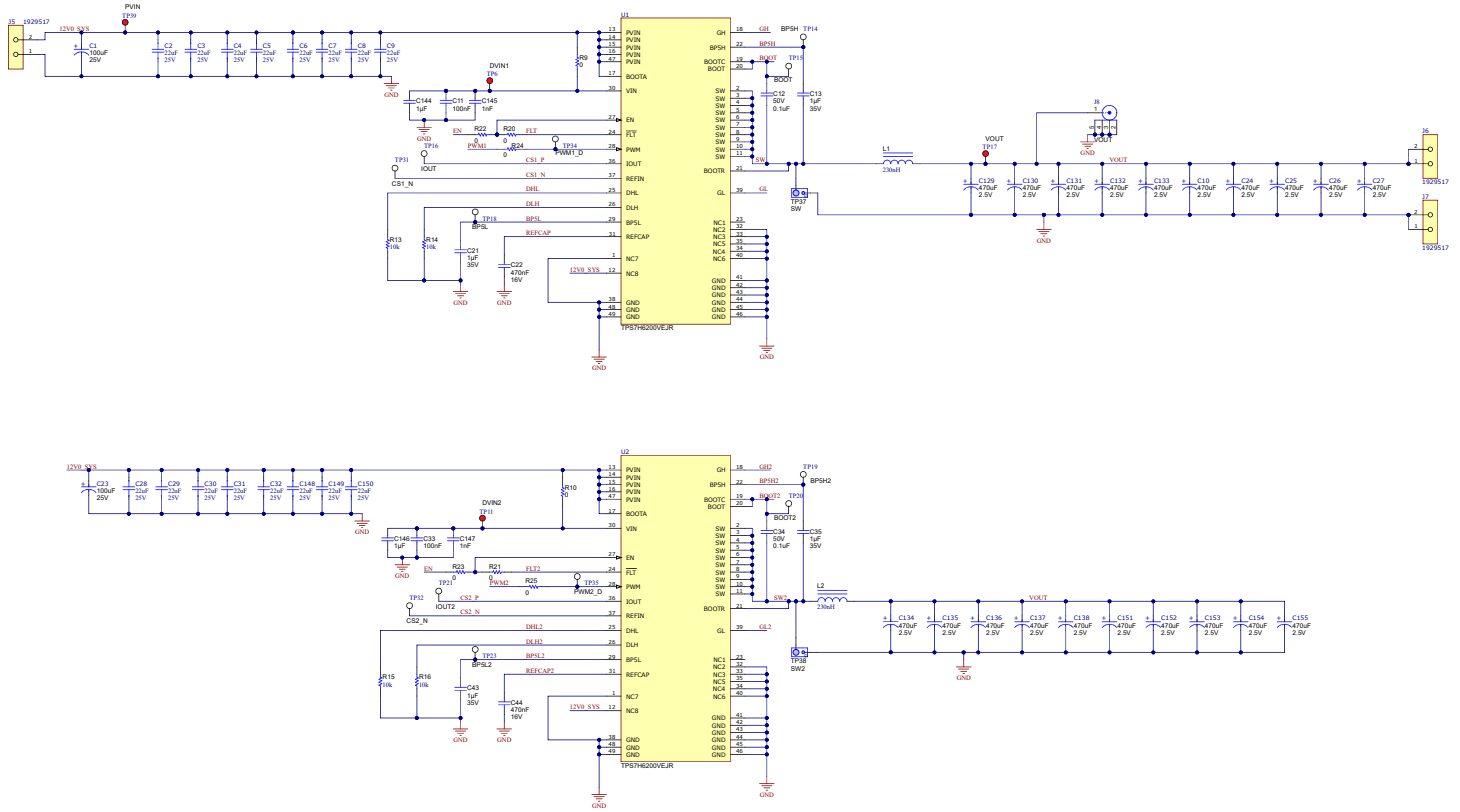


Figure 4-1. Power Stage Schematic

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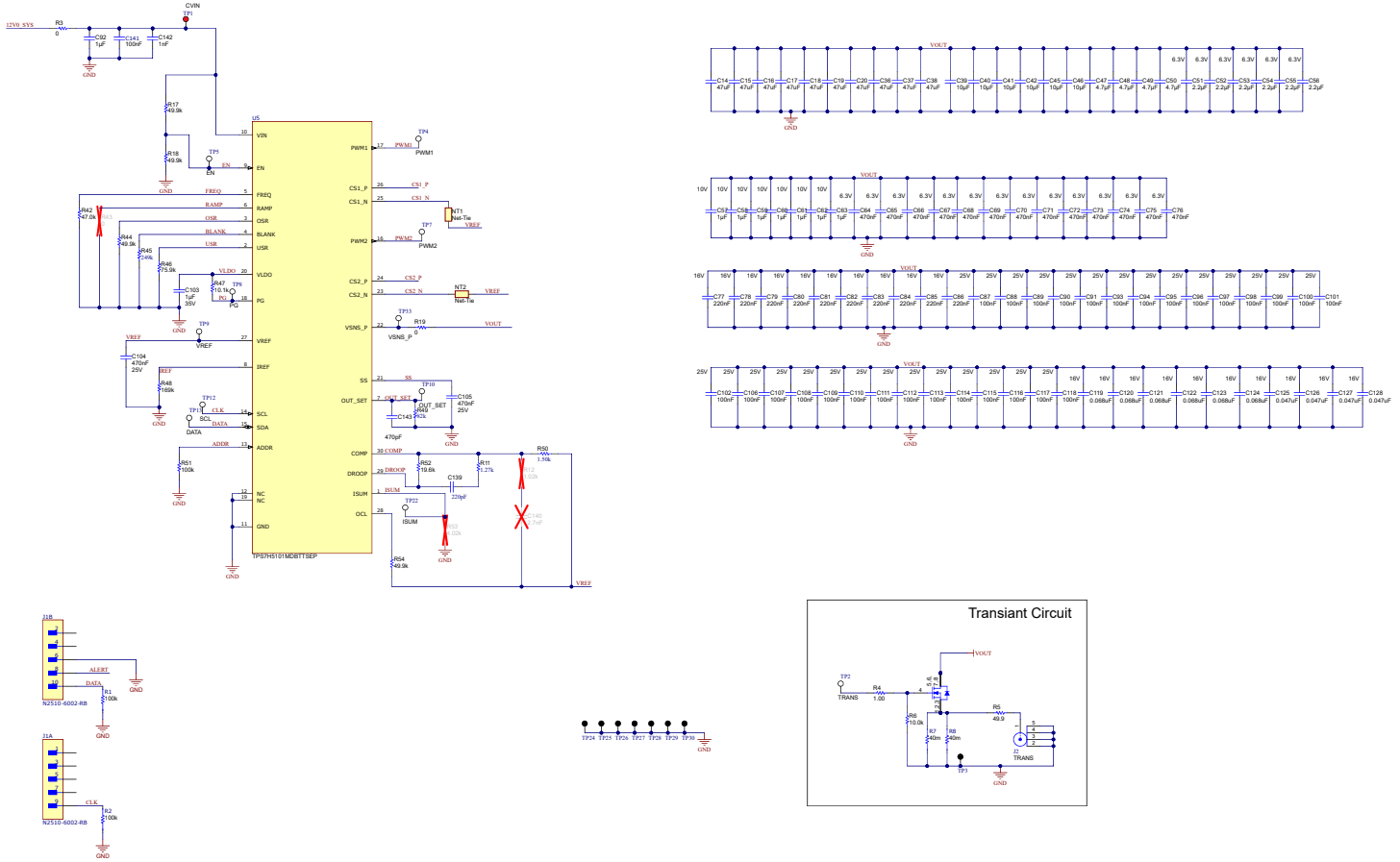


Figure 4-2. Controller Schematic

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4.2 PCB Layouts

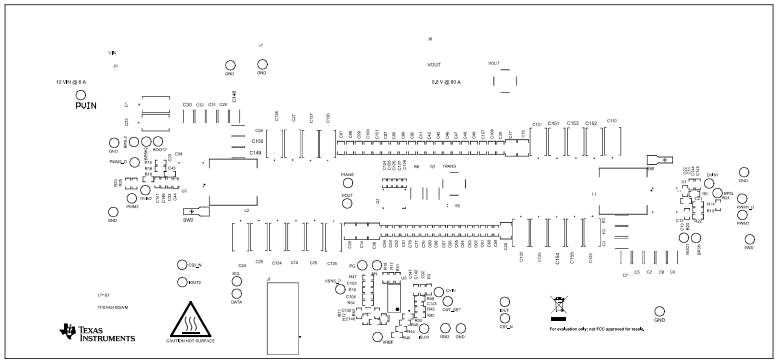


Figure 4-3. Top Overlay

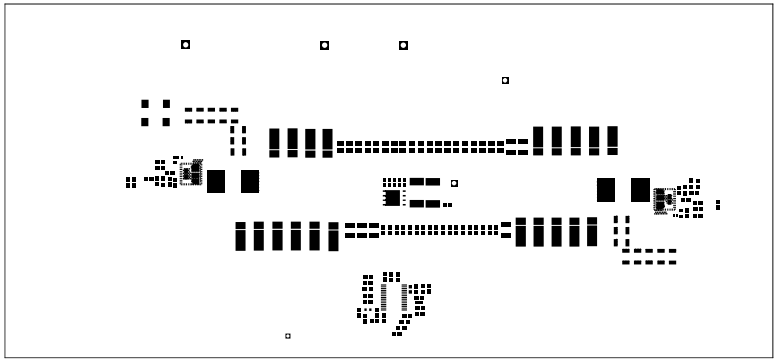


Figure 4-4. Top Solder

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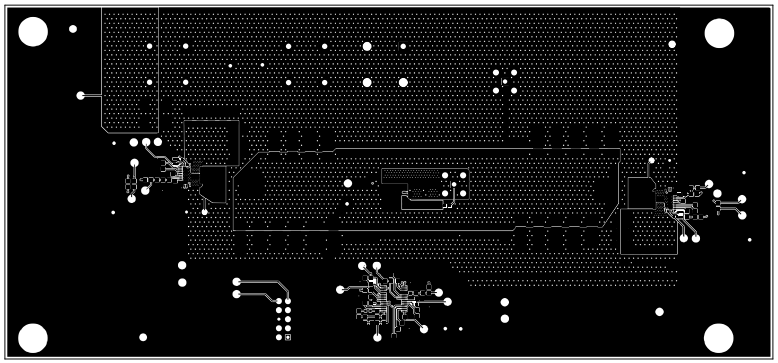


Figure 4-5. Top Layer

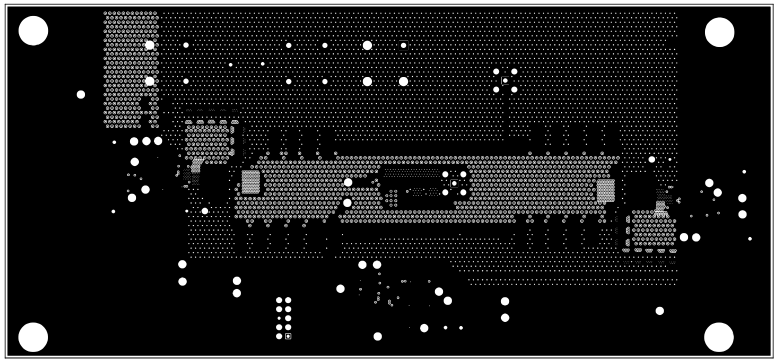


Figure 4-6. Signal Layer 1

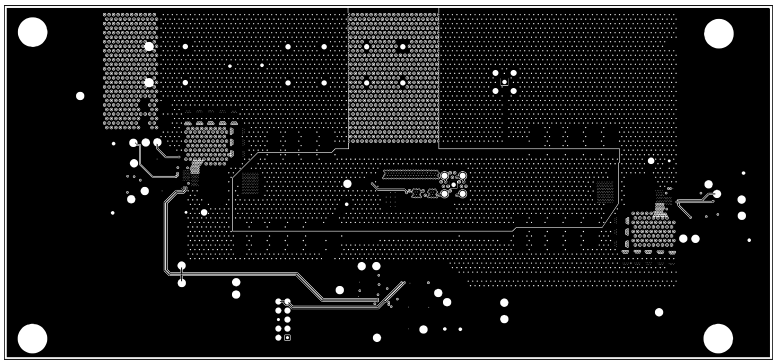


Figure 4-7. Signal Layer 2

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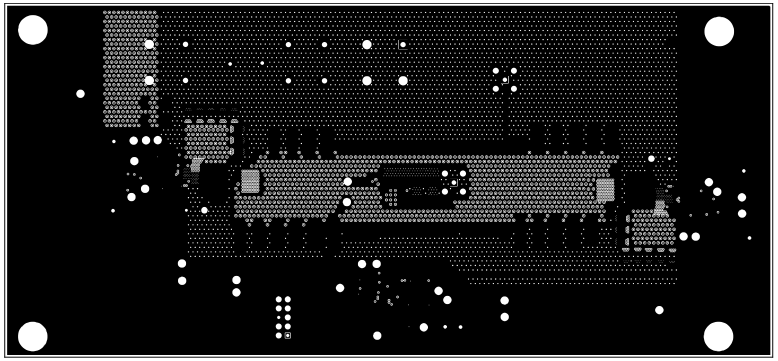


Figure 4-8. Signal Layer 3

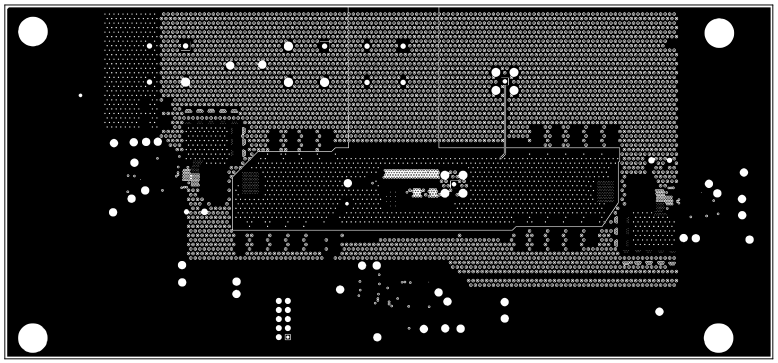


Figure 4-9. Signal Layer 4

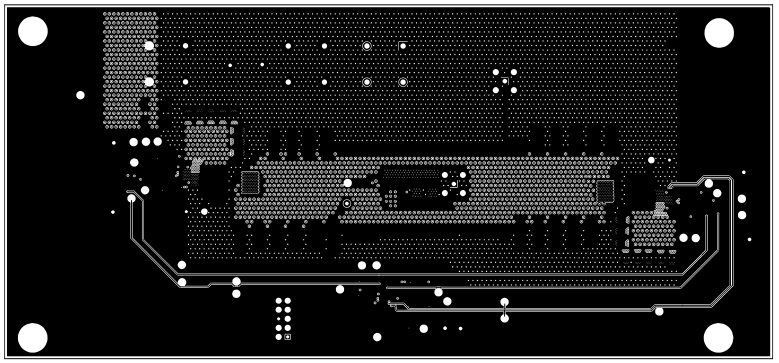


Figure 4-10. Signal Layer 5

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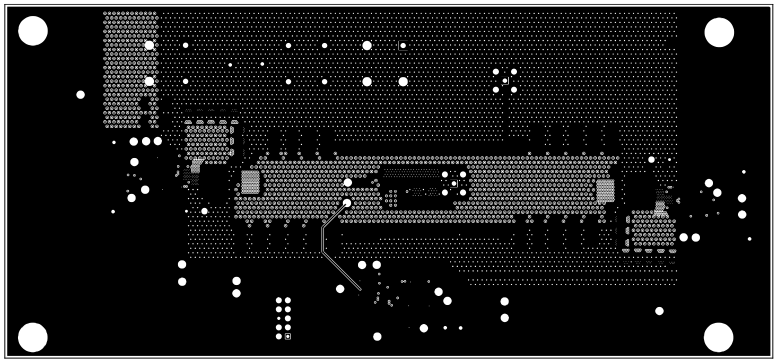


Figure 4-11. Signal Layer 6

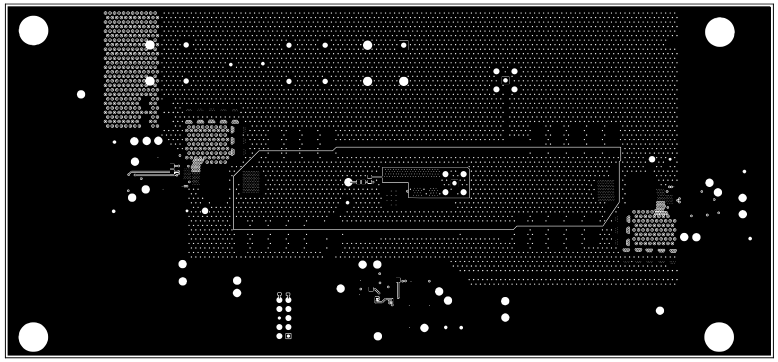


Figure 4-12. Bottom Layer

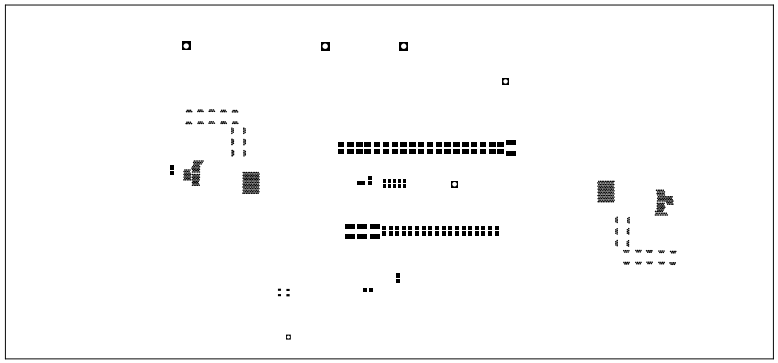


Figure 4-13. Bottom Solder Mask

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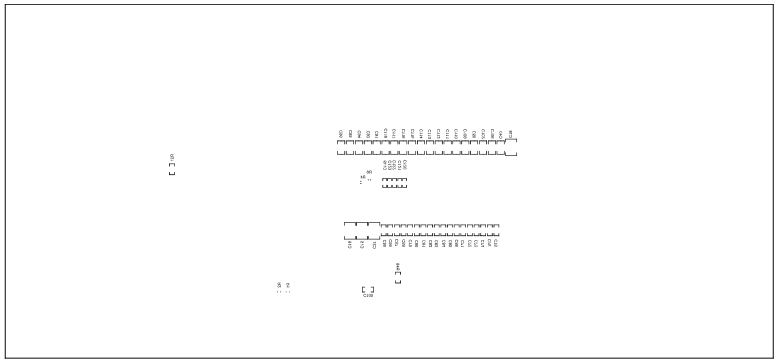


Figure 4-14. Bottom Overlay

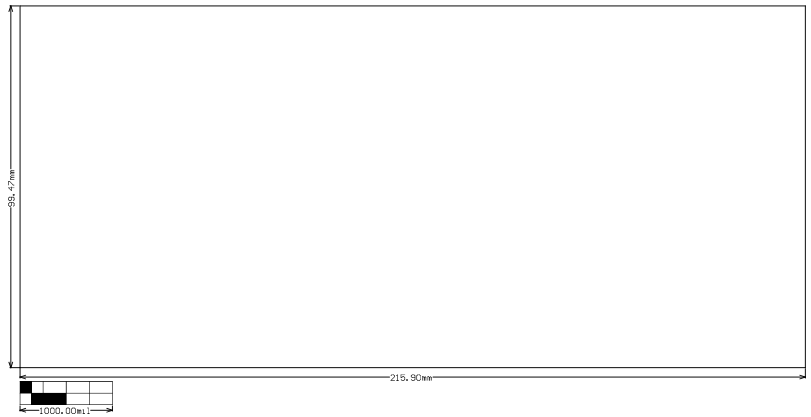


Figure 4-15. Board Dimensions

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4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		LP181	Any		
C1, C23	2	100µF	100µF Molded Tantalum Polymer Capacitor 25V 2917 (7343 Metric) 60mOhm @ 100kHz	2917	T521X107M025ATE060	Kemet		
C2, C3, C4, C5, C6, C7, C8, C9, C28, C29, C30, C31, C32, C148, C149, C150	16	22µF	Ceramic Capacitor for Automotive 22uF ±10% 25VDC X7S 1210 Embossed T/R	1210	GCM32EC71E226KE36L	Murata		
C10, C24, C25, C26, C27, C129, C130, C131, C132, C133, C134, C135, C136, C137, C138, C151, C152, C153, C154, C155	20	470µF	470 µF Molded Tantalum Polymer Capacitor 2.5 V 2917 (7343 Metric) 5mOhm @ 100kHz	2917	T528Z477M2R5ATE005	Kemet		
C11, C33	2	0.1uF	CAP, CERM, 0.1 µF, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C104K5RACAUTO	Kemet		
C12, C34	2	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H104K050BB	TDK		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C13, C21, C35, C43, C92, C103, C144, C146	8	1uF	CAP, CERM, 1 µF, 35 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E1X7R1V105K080AE	TDK		
C14, C15, C16, C17, C18, C19, C20, C36, C37, C38	10	47uF	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X7R, 1210	1210	GRM32ER70J476ME20L	MuRata		
C22, C44	2	0.47uF	CAP, CERM, 0.47 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	GCM188R71C474KA55D	MuRata		
C39, C40, C41, C42, C45, C46	6	10uF	CAP, CERM, 10 µF, 6.3 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0805	0805	JMJ212CB7106KGHT	Taiyo Yuden		
C47, C48, C49, C50	4	4.7uF	CAP, CERM, 4.7 µF, 10 V,+/- 5%, X7R, AEC-Q200 Grade 1, 0805	0805	C0805C475J8RACAUTO	Kemet		
C51, C52, C53, C54, C55, C56	6	2.2uF	CAP, CERM, 2.2 uF, 6.3 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	GCM188R70J225KE22D	MuRata		
C57, C58, C59, C60, C61, C62, C63	7	1uF	CAP, CERM, 1 µF, 10 V,+/- 10%, X7R, 0603	0603	LMK107B7105KA-T	Taiyo Yuden		
C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76	13	0.47uF	CAP, CERM, 0.47 µF, 6.3 V,+/- 10%, X7R, 0603	0603	0603B474K6R3CT	Walsin		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C77, C78, C79, C80, C81, C82, C83, C84, C85, C86	10	0.22uF	CAP, CERM, 0.22 µF, 16 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CL10B224KO8VPNC	Samsung		
C87, C88, C89, C90, C91, C93, C94, C95, C96, C97, C98, C99, C100, C101, C102, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C116, C117, C118	28	0.1uF	CAP, CERM, 0.1 µF, 25 V,+/- 10%, X7R, 0805	0805	SR0805X7R104K1NT95(F)#M123A	Presidio Components		
C104, C105	2	0.47uF	CAP, CERM, 0.47 uF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E474KA12D	MuRata		
C119, C120, C121, C122, C123, C124	6	0.068uF	CAP, CERM, 0.068 uF, 16 V, +/- 10%, X7R, 0402	0402	GRM155R71C683KA88D	MuRata		
C125, C126, C127, C128	4	0.047uF	CAP, CERM, 0.047 uF, 16 V, +/- 10%, X7R, 0402	0402	GRM155R71C473KA01D	MuRata		
C139	1	220pF	CAP, CERM, 220 pF, 50 V, +/- 1%, C0G/NP0, 0603	0603	06035A221FAT2A	AVX		
C141	1		CAP CER 0.1UF 50V X7R 0603	0603	CL10B104KB8NNNC	Samsung		
C142, C145, C147	3	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0603	0603	C0603X102K5RACTU	Kemet		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C143	1	470pF	CAP, CERM, 470 pF, 50 V, +/- 10%, X7R, 0402	0402	GRM155R71H471KA01D	MuRata		
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	1		Connector Header Through Hole 10 position 0.100" (2.54mm)	CONN_HDR10	N2510-6002-RB	3M		
J2, J8	2		JACK, SMB 50 Ohm, TH	JACK, SMB, TH	903-499J-51P2	Amphenol RF		
J5, J6, J7	3		Fixed Terminal Blocks MKDSP 10 HV/ 2-10	HDR2	1929517	Phoenix Contact		
L1, L2	2	230nH	Inductor, Shielded, Ferrite, 230 nH, 55 A, 0.00015 ohm, SMD	SMD 13.46x8.0x12.95mm	SLC1480-231MLB	Coilcraft		
Q1	1	30V	MOSFET, N-CH, 30 V, 100 A, DQH0008A (VSON-CLIP-8)	DQH0008A	CSD17559Q5	Texas Instruments		None
R1, R2	2	100k	100 kOhms ±1% 0.1W, 1/10W Chip Resistor 0603 (1608 Metric) Anti-Sulfur Thick Film	0603	560112116004	Wurth Electronics		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R3, R9, R10, R19, R20, R21, R22, R23, R24, R25	10	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc		
R4	1	1	RES, 1.00, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031R00FKEA	Vishay-Dale		
R5	1	49.9	RES, 49.9, 1%, 0.1 W, 0603	0603	M55342K12B49D9T	TT Electronics/IRC		
R6	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	M55342K12B10E0T	TT Electronics/IRC		
R7, R8	2	40m	40 mOhms ±0.1% 2W Chip Resistor 2512 (6432 Metric) Automotive AEC-Q200, Current Sense, Non-Inductive Metal Film	2512	HoCG25122R040A4	Shenzhen Milliohm Electronic		
R11	1	1.27k	RES, 1.27 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD071K27L	Yageo America		
R13, R14, R15, R16	4	10k	RES, 10 k, 5%, 0.1 W, 0603	0603	RC1608J103CS	Samsung Electro-Mechanics		
R17, R18, R44, R54	4	49.9k	RES, 49.9 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD0749K9L	Yageo America		
R42	1	47.0k	RES, 47.0 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERA-3AEB473V	Panasonic		
R45	1	249k	RES, 249 k, 1%, 0.1 W, 0603	0603	RC0603FR-07249KL	Yageo		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R46	1	75.9k	RES, 75.9 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD0775K9L	Yageo America		
R47	1	10.1k	RES, 10.1 k, 0.1%, 0.1 W, 0603	0603	M55342E12B10B1T	TT Electronics/IRC		
R48	1	169k	RES, 169 k, 1%, 0.1 W, 0603	0603	RC0603FR-07169KL	Yageo		
R49	1	82k	RES, 82 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060382K0JNEA	Vishay-Dale		
R50	1	1.50k	RES, 1.50 k, 1%, 0.1 W, 0603	0603	ERJ-3EKF1501V	Panasonic		
R51	1	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	RC0603FR-07100KL	Yageo		
R52	1	19.6k	RES, 19.6 k, 0.1%, 0.1 W, 0603	0603	M55342E12B19B6T	TT Electronics/IRC		
TP1, TP6, TP11, TP17, TP39	5		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone Electronics		
TP2, TP4, TP5, TP7, TP8, TP9, TP10, TP12, TP13, TP14, TP15, TP16, TP18, TP19, TP20, TP21, TP22, TP23, TP31, TP32, TP33, TP34, TP35	23		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
TP3, TP24, TP25, TP26, TP27, TP28, TP29, TP30	8		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone Electronics		
U1, U2	2		52A GaN Half Bridge Power Stage with Low-Side Current Sense	WQFN-FCRLF49	TPS7H6200VEJR	Texas Instruments		
U5	1		Dual Phase D-CAP+™ Controller	TSSOP30	TPS7H5101MDBTTSEP	Texas Instruments		
C140	0	2700pF	CAP, CERM, 2700 pF, 100 V, +/- 5%, X7R, 0603	0603	06031C272JAT2A	AVX		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
R12	0	1.02k	RES, 1.02 k, 1%, 0.1 W, 0603	0603	RC0603FR-071K02L	Yageo		
R43	0	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc		
R53	0	4.02k	RES, 4.02 k, 0.1%, 0.1 W, 0603	0603	RT0603BRD074K02L	Yageo America		

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5 Additional Information

5.1 Trademarks

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

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6 References

1. Texas Instruments, *TPS7H5101-SEP and TPS7H5101-SP Radiation-Hardened Dual Phase DCAP+ Controller*, datasheet.

7 Revision History

Changes from Revision * (September 2026) to Revision A (November 2026)	Page
• Added table title	3
• Added table title	5
• Added image title	5
• Added image title	6
• Added image title	7
• Added image title	7
• Added image titles to both images	8
• Added image titles to both images	8

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1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

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

FCC NOTICE: 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 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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

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:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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8. *Limitations on Damages and Liability:*

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   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

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