

## LM25184-Q1 Single-Output EVM User's Guide

With input voltage range and current capability as specified in [Table 1](#), the PSR flyback DC/DC converter family of parts from TI provides flexibility, scalability, and optimized solution size for a range of applications. Using an 8-pin WSON package with 4-mm × 4-mm footprint and 0.8-mm pin pitch, these converters enable isolated DC/DC solutions with high density and low component count.

**Table 1. PSR Flyback DC/DC Converter Family**

PSR FLYBACK DC/DC CONVERTER	INPUT VOLTAGE RANGE	PEAK SWITCH CURRENT (TYP)	MAXIMUM LOAD CURRENT, $V_{OUT} = 12\text{ V}$ , $N_{PS} = 1$	
			$V_{IN} = 4.5\text{ V}$	$V_{IN} = 13.5\text{ V}$
<a href="#">LM5181-Q1</a>	4.5 V to 65 V	0.75 A	90 mA	180 mA
<a href="#">LM5180-Q1</a>	4.5 V to 65 V	1.5 A	180 mA	360 mA
<a href="#">LM25180-Q1</a>	4.5 V to 42 V	1.5 A	180 mA	360 mA
<a href="#">LM25183-Q1</a>	4.5 V to 42 V	2.5 A	300 mA	600 mA
<a href="#">LM25184-Q1</a>	4.5 V to 42 V	4.1 A	500 mA	1 A

The [LM25184EVM-S12](#) evaluation module (EVM) is a flyback DC/DC converter that employs primary-side regulation (PSR) based on sampling of the primary winding voltage of the transformer to achieve high efficiency in a small footprint. It operates over a wide input voltage range of 6 V to 42 V, providing a regulated 12-V output using a transformer with 1:1 (unity) turns ratio. Operating without an optocoupler or transformer auxiliary winding, the converter delivers an output voltage with  $\pm 1.5\%$  regulation.

The EVM design uses the [LM25184-Q1](#) 42-V PSR flyback converter. An integrated 65-V, 4.1-A power MOSFET provides ample margin for line transients and switch (SW) node voltage spikes related to transformer leakage inductance. Load regulation errors related to transformer secondary winding resistance are avoided by virtue of the quasi-resonant boundary conduction mode (BCM) control scheme. Additional features include peak current-mode control with internal compensation, hiccup-mode fault protection, programmable soft start, and optional output voltage temperature compensation. Input UVLO protects the converter at low input voltage conditions, and the EN/UVLO pin supports adjustable UVLO with user-defined hysteresis for application specific power-up and power-down requirements. Wettable flank pins provide a visual indicator of solderability, which reduces inspection time and manufacturing costs in high-reliability industrial and automotive applications.

Use the LM25184-Q1 with the [WEBENCH® Power Designer](#) to create a custom regulator design. Furthermore, the user can download the [LM25184 Quickstart Calculator](#) to optimize component values and examine predicted efficiency performance across line and load ranges.

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#### Trademarks

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## 1 High Density EVM Description

The LM25184-Q1 single-output EVM is designed to use a regulated or non-regulated high-voltage input rail ranging from 6 V to 42 V to produce a tightly-regulated, isolated output voltage of 12 V at a load current of 1 A (or higher depending on  $V_{IN}$ ). This wide  $V_{IN}$  range isolated DC/DC solution offers outsized voltage rating and operating margin to withstand supply rail voltage transients.

The power-train passive components selected for this EVM, including flyback transformer, flyback rectifying diode, and ceramic input and output capacitors, are available from multiple component vendors. Transformers with functional or basic grade isolation are available with isolation voltages of 1.5 kV and greater.

### 1.1 Typical Applications

- [Automotive powertrain systems](#)
- Sub-AM band [automotive body electronics](#)
- Traction inverter and motor drives: [IGBT and SiC gate drive supplies](#)
- Isolated field transmitters and [field actuators](#)
- Isolated bias power rails

### 1.2 Features and Electrical Performance

- Tightly-regulated, isolated output voltage of 12 V with  $\pm 1.5\%$  load regulation from 1% to 100% load
- Wide  $V_{IN}$  operating range of 6 V to 42 V
  - Operates down to 4 V after startup based on the selected UVLO resistor divider
- Rated full load current of 1 A at  $V_{IN}$  greater than 13.5 V
- Maximum switching frequency of 350 kHz remains below the AM band for automotive applications
- High efficiency across wide load current range
  - Full load efficiency of 88.5% and 90% at  $V_{IN} = 13.5$  V and 24 V, respectively
  - 90.5% efficiency at half-rated load,  $V_{IN} = 24$  V
- 3.3-mA and 2.8-mA no-load supply current at  $V_{IN} = 13.5$  V and 24 V, respectively
- Ultra-low conducted and radiated EMI signatures
  - Optimized for [CISPR 25 Class 5](#) requirements
  - Soft switching avoids diode reverse recovery
  - Input  $\pi$ -stage EMI filter with damping from electrolytic capacitor ESR
- BCM control architecture provides fast line and load transient response
  - Peak current-mode control
  - Quasi-resonant switching for reduced power loss
  - Internal loop compensation
- Integrated 65-V flyback power MOSFET
  - Provides large margin for input voltage transients
- Cycle-by-cycle overcurrent protection (OCP)
- Monotonic prebias output voltage start-up
- User-adjustable soft-start time using capacitor connected between SS/BIAS and GND
  - Option for external bias using auxiliary winding connected to SS/BIAS
- Resistor-programmable input voltage UVLO with customizable hysteresis for applications with wide turnon and turnoff voltage difference
  - Input UVLO set to turn on and off at  $V_{IN}$  of 5.5 V and 4 V, respectively
- Fully assembled, tested, and proven PCB layout with 56-mm  $\times$  36-mm total footprint

## 2 EVM Performance Characteristics

**Table 2. Electrical Performance Characteristics**

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>						
Input voltage range, $V_{IN}$	Operating		6	13.5	42	V
Input voltage turnon, $V_{IN-ON}$	Adjusted using EN/UVLO divider resistors		5.5			
Input voltage turnoff, $V_{IN-OFF}$			4			
Input voltage hysteresis, $V_{IN-HYS}$			1.5			
Input current, no load, $I_{IN-NL}$	$I_{OUT} = 0$ A	$V_{IN} = 12$ V	3.3		mA	
		$V_{IN} = 24$ V	2.8			
		$V_{IN} = 36$ V	2.8			
Input current, disabled, $I_{IN-OFF}$	$V_{EN} = 0$ V	$V_{IN} = 12$ V	10		$\mu$ A	
<b>OUTPUT CHARACTERISTICS</b>						
Output voltage, $V_{OUT}^{(1)}$	$I_{OUT} = 0.5$ A		12.1	12.2	12.3	V
Output current, $I_{OUT}^{(2)}$	$V_{IN} = 12$ V				0.8	A
	$V_{IN} = 24$ V				1.25	
	$V_{IN} = 36$ V				1.45	
Output voltage regulation, $\Delta V_{OUT}$	Load regulation, $V_{IN} = 24$ V	$I_{OUT} = 10$ mA to 1 A	1%			
	Line regulation, $I_{OUT} = 0.5$ A	$V_{IN} = 6$ V to 42 V	1%			
Output voltage ripple, $V_{OUT-AC}$	$V_{IN} = 24$ V, $I_{OUT} = 0.5$ A		50		mVrms	
Output overcurrent protection, $I_{OCP}$	$V_{IN} = 12$ V		0.95		A	
	$V_{IN} = 24$ V		1.25			
Soft-start time, $t_{SS}$	$C_{SS} = 47$ nF		8		ms	
<b>SYSTEM CHARACTERISTICS</b>						
Switching frequency, $F_{SW-NOM}$	$V_{IN} = 24$ V, $I_{OUT} = 0.5$ A		350		kHz	
Half-load efficiency, $\eta_{HALF}^{(1)}$	$I_{OUT} = 0.5$ A		$V_{IN} = 8$ V		89.3%	
			$V_{IN} = 13.5$ V		90.2%	
			$V_{IN} = 24$ V		90.5%	
			$V_{IN} = 36$ V		86.3%	
Full load efficiency, $\eta_{FULL}$	$I_{OUT} = 1$ A		$V_{IN} = 13.5$ V		88.5%	
			$V_{IN} = 24$ V		90%	
			$V_{IN} = 36$ V		89.3%	
Isolation rating <sup>(3)</sup>	Functional insulation		1500		V	
LM25184-Q1 junction temperature, $T_J$			-40	150	$^{\circ}$ C	

<sup>(1)</sup> The default output voltage of this single-output EVM is 12 V. Efficiency and other performance metrics can change based on the operating input voltage, load current, externally-connected output capacitance, and other parameters.

<sup>(2)</sup> The maximum output power delivered by the LM25184-Q1 PSR flyback converter increases with input voltage.

<sup>(3)</sup> The selected flyback transformer provides functional grade isolation to 1500 V DC.

### 3 Application Circuit Diagram

Figure 1 shows the schematic of an LM25184-Q1 PSR flyback converter (EMI filter stage not shown). Soft start (SS), temperature compensation (TC), and UVLO (EN/UVLO) components are shown and are configurable as required for the specific application.

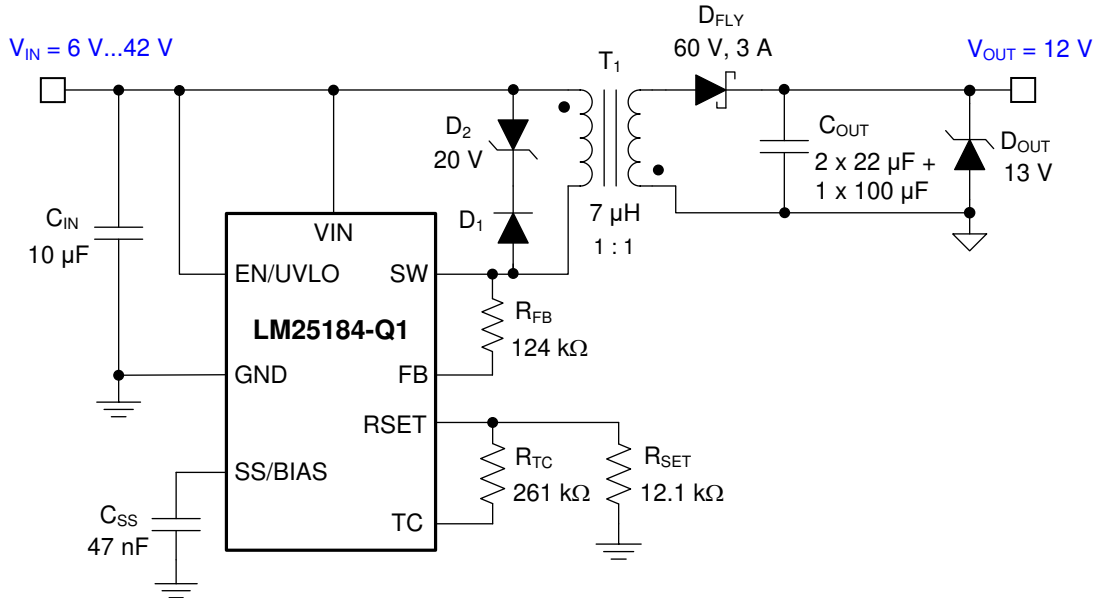


Figure 1. LM25184-Q1 PSR Flyback Converter Schematic

### 4 EVM Photo

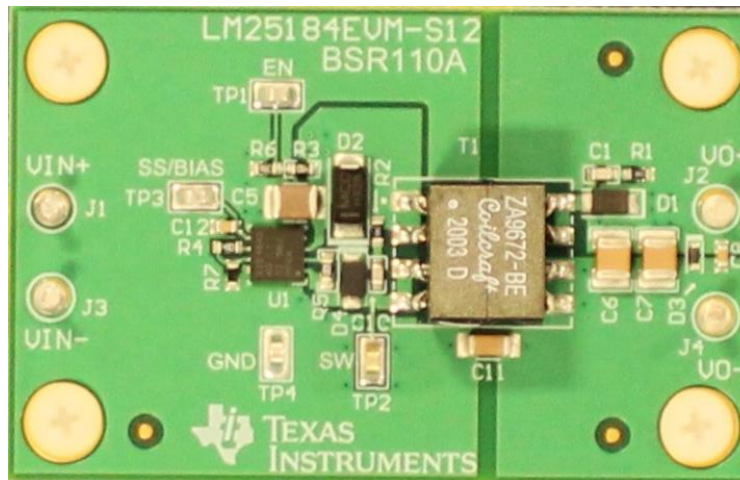



Figure 2. LM25184 EVM (Top Side), 56 mm x 36 mm



**CAUTION**

Caution Hot surface.  
Contact may cause burns.  
Do not touch.

## 5 Test Setup and Procedure

### 5.1 Test Setup

Table 3. EVM Connections

LABEL	DESCRIPTION
VIN+	Positive input voltage power and sense connection
VIN-	Negative input voltage power and sense connection
VO+	Positive output voltage power and sense connection
VO-	Negative output voltage power and sense connection
EN	ENABLE input. Tie to GND to disable converter
SW	Switch-node connection

Referencing the EVM connections described in Table 3, the recommended test setup to evaluate the LM25184EVM-S12 is shown in Figure 3. Working at an ESD-protected workstation, make sure that any wrist straps, bootstraps, or mats are connected and referencing the user to earth ground before power is applied to the EVM.

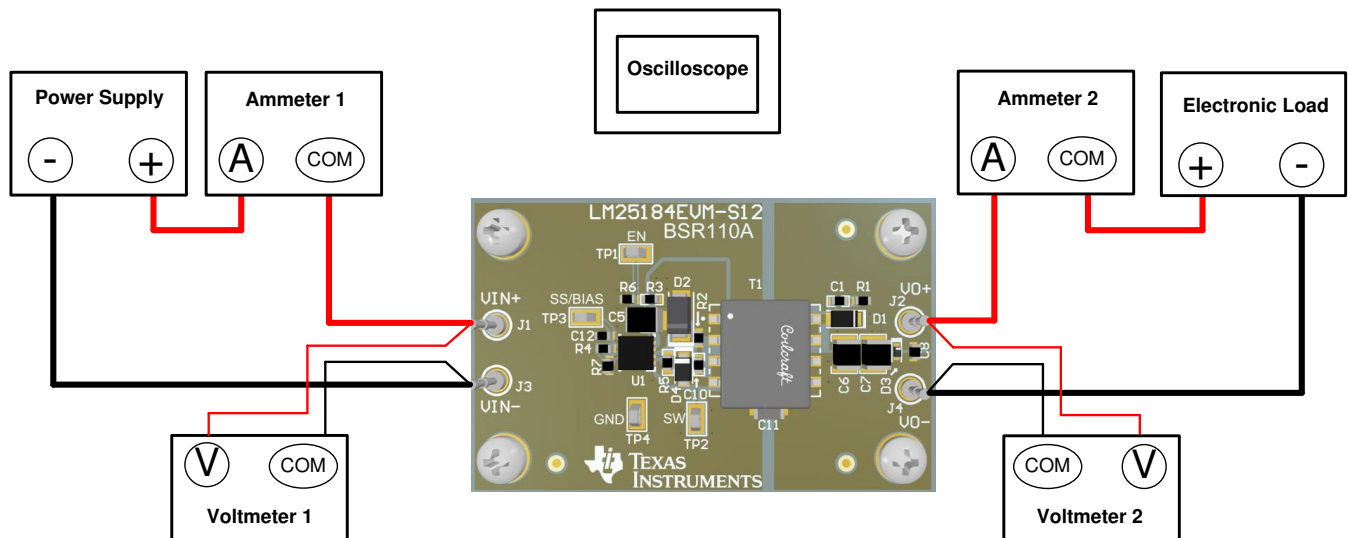


Figure 3. EVM Test Setup

#### CAUTION

Refer to the [LM25184-Q1 42-VIN PSR Flyback DC/DC Converter with 65-V, 4.1-A Integrated MOSFET Data Sheet](#), [LM25183/4 Quickstart Calculator](#), and [WEBENCH® Power Designer](#) for additional guidance pertaining to component selection and converter operation.

## 5.2 Test Equipment

**Voltage Source:** The input voltage source  $V_{IN}$  must be a 0–42-V variable DC source capable of supplying 2 A.

**Multimeters:**

- **Voltmeter 1:** Input voltage at  $V_{IN+}$  to  $V_{IN-}$ . Set the voltmeter to an input impedance of 100 M $\Omega$ .
- **Voltmeter 2:** Output voltage at  $V_{O+}$  to  $V_{O-}$ . Set the voltmeter to an input impedance of 100 M $\Omega$ .
- **Ammeter 1:** Input current. Set the ammeter to 1-second aperture time.
- **Ammeter 2:** Output current. Set the ammeter to 1-second aperture time

**Electronic Load:** The load must be an electronic constant-resistance (CR) or constant-current (CC) mode load capable of 0 Adc to 1 Adc at 12 V. For a no-load input current measurement, disconnect the electronic load as it can draw a small residual current.

**Oscilloscope:** With the scope set to 20-MHz bandwidth and AC coupling, measure the output voltage ripple directly across an output capacitor with a short ground lead normally provided with the scope probe. Place the oscilloscope probe tip on the positive terminal of the output capacitor, holding the ground barrel of the probe through the ground lead to the negative terminal of the capacitor. TI does not recommend using a long-leaded ground connection because this can induce additional noise given a large ground loop. To measure other waveforms, adjust the oscilloscope as needed.

**Safety:** Always use caution when touching any circuits that can be live or energized.

## 5.3 Recommended Test Setup

### 5.3.1 Input Connections

- Prior to connecting the DC input source, set the current limit of the input supply to 0.1 A maximum. Ensure the input source is initially set to 0 V and connected to the  $V_{IN+}$  and  $V_{IN-}$  connection points as shown in [Figure 3](#). An additional input bulk capacitor is recommended to provide damping if long input lines are used.
- Connect voltmeter 1 at  $V_{IN+}$  and  $V_{IN-}$  connection points to measure the input voltage.
- Connect ammeter 1 to measure the input current and set to at least 1-second aperture time.

### 5.3.2 Output Connections

- Connect an electronic load to  $V_{O+}$  and  $V_{O-}$  connections. Set the load to constant-resistance mode or constant-current mode at 0 A before applying input voltage.
- Connect voltmeter 2 at  $V_{O+}$  and  $V_{O-}$  connection points to measure the output voltage.
- Connect ammeter 2 to measure the output current.

## 5.4 Test Procedure

### 5.4.1 Line and Load Regulation, Efficiency

- Set up the EVM as described above.
- Set load to constant resistance or constant current mode and to sink 10 mA.
- Increase input source from 0 V to 24 V; use voltmeter 1 to measure the input voltage.
- Increase the current limit of the input supply to 2 A.
- Using voltmeter 2 to measure the output voltage,  $V_{OUT}$ , vary the load current from 10 mA to 1 A DC;  $V_{OUT}$  should remain within the load regulation specification.
- Set the load current to 0.5 A (50% rated load) and vary the input source voltage from 6 V to 42 V;  $V_{OUT}$  must remain within the line regulation specification.
- Decrease load to 0 A. Decrease input source voltage to 0 V.



## 6 Test Data and Performance Curves

Figure 4 through Figure 6 present typical performance curves for the LM25184EVM-S12. Because actual performance data can be affected by measurement techniques and environmental variables, these curves are presented for reference and can differ from actual field measurements.

### 6.1 Conversion Efficiency

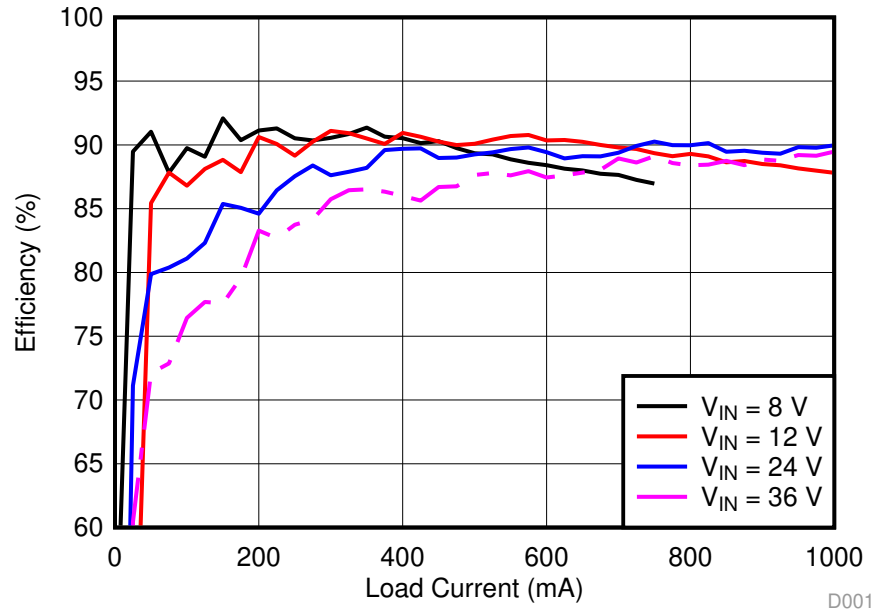


Figure 4. Conversion Efficiency (Linear Scale)

### 6.2 Load Regulation

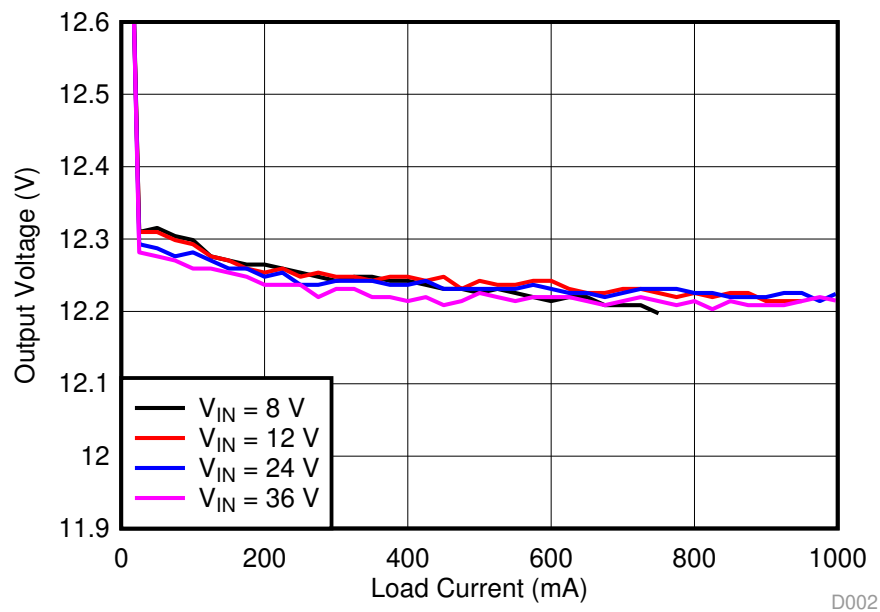


Figure 5. Load Regulation (Linear Scale)

### 6.3 Operating Waveforms

#### 6.3.1 Start-Up

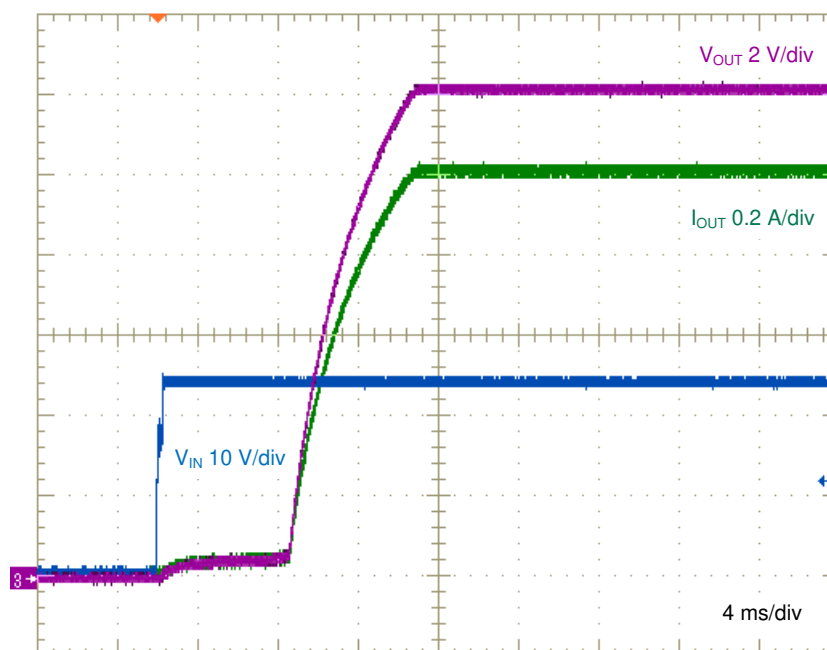


Figure 6. Start-Up,  $V_{IN} = 24\text{ V}$ ,  $I_{OUT} = 1\text{ A}$  Resistive

#### 6.3.2 Enable On And Off

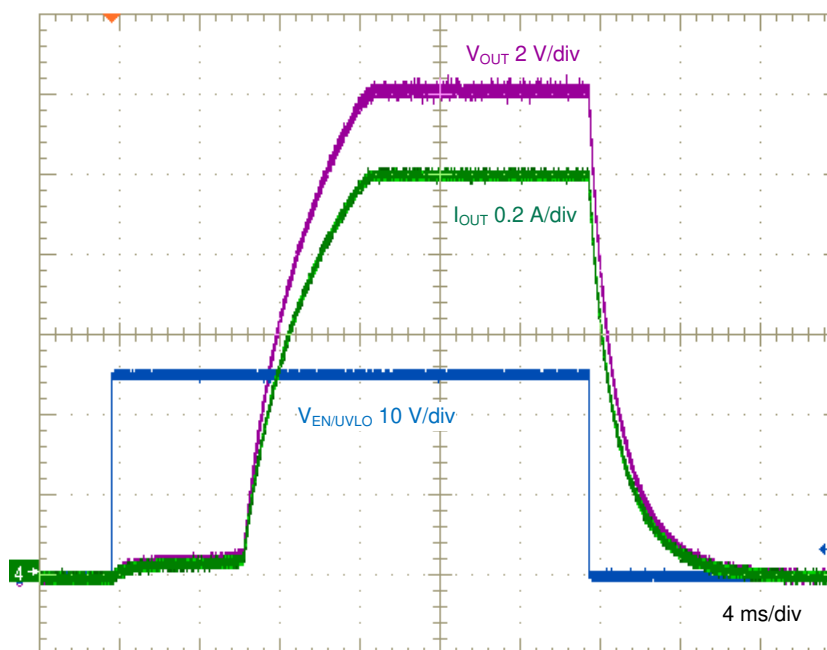


Figure 7. Enable On And Off,  $V_{IN} = 24\text{ V}$ ,  $I_{OUT} = 1\text{ A}$  Resistive

### 6.3.3 Load Transient Response

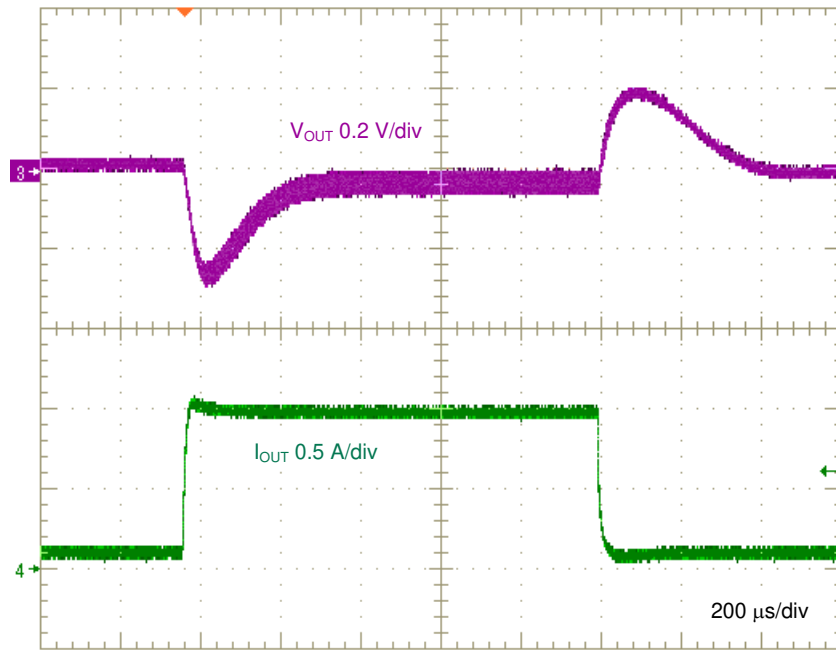


Figure 8. Load Transient Response,  $V_{IN} = 24 \text{ V}$ ,  $0.1 \text{ A}$  to  $1 \text{ A}$  at  $0.1 \text{ A}/\mu\text{s}$

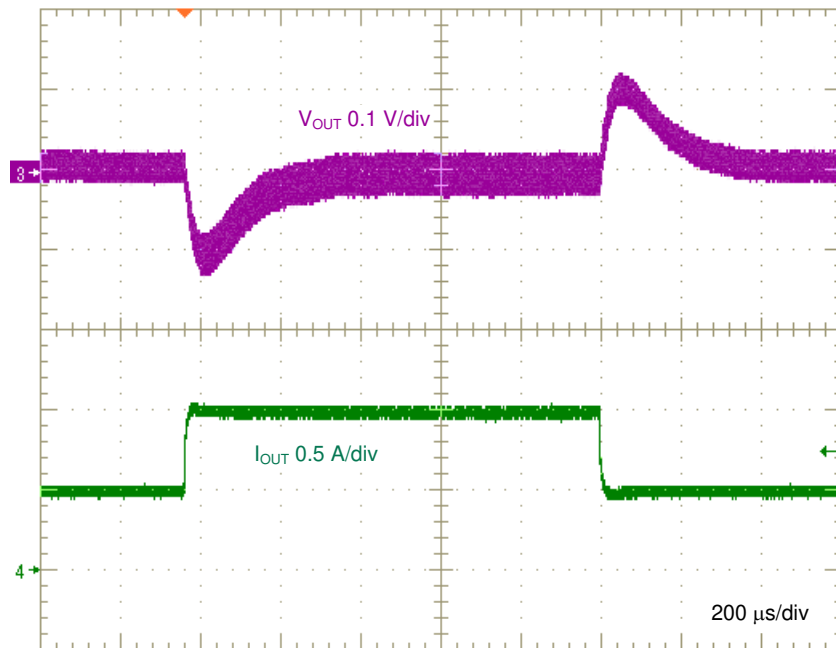


Figure 9. Load Transient Response,  $V_{IN} = 24 \text{ V}$ ,  $0.5 \text{ A}$  to  $1 \text{ A}$  at  $0.1 \text{ A}/\mu\text{s}$

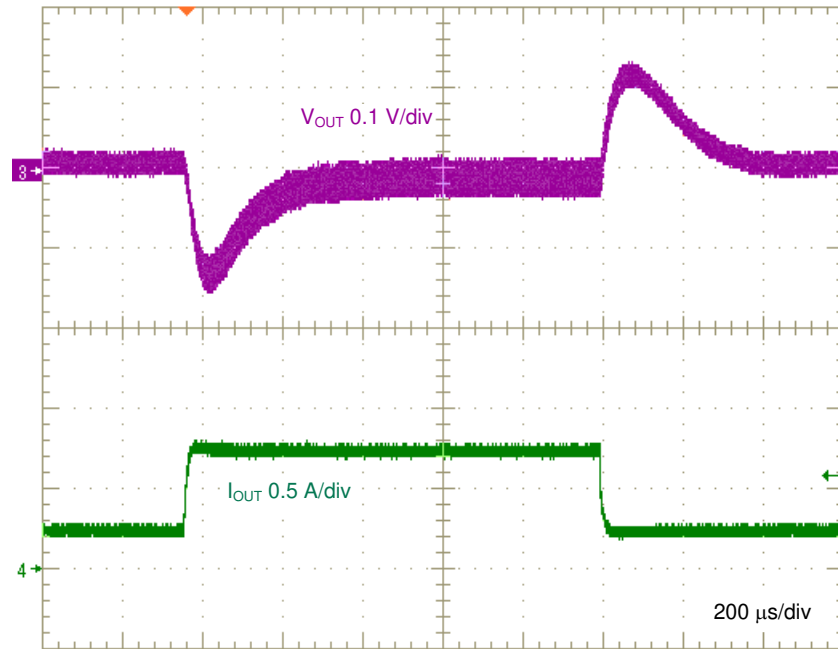


Figure 10. Load Transient Response,  $V_{IN} = 24\text{ V}$ ,  $0.25\text{ A}$  to  $0.75\text{ A}$  at  $0.1\text{ A}/\mu\text{s}$

### 6.3.4 Primary-side Switch Voltage

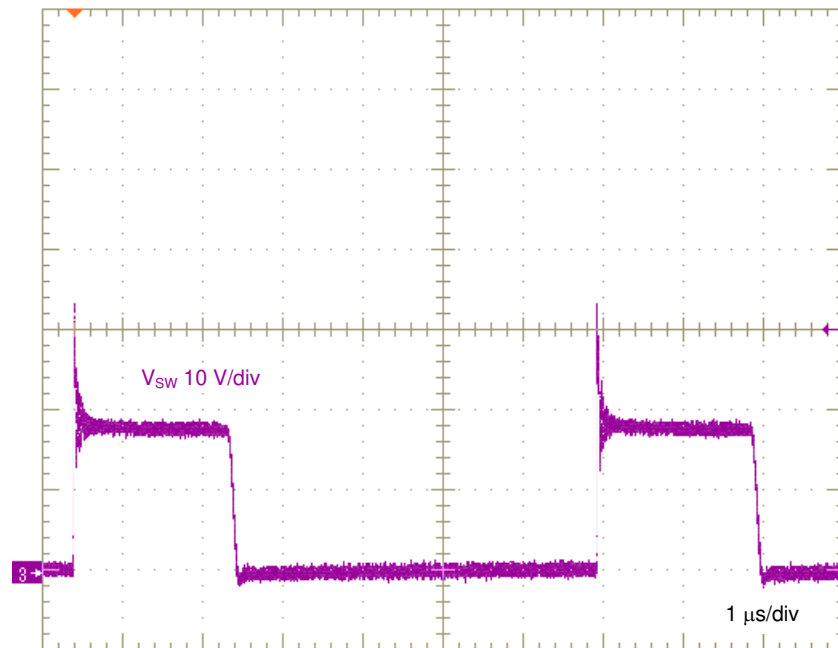
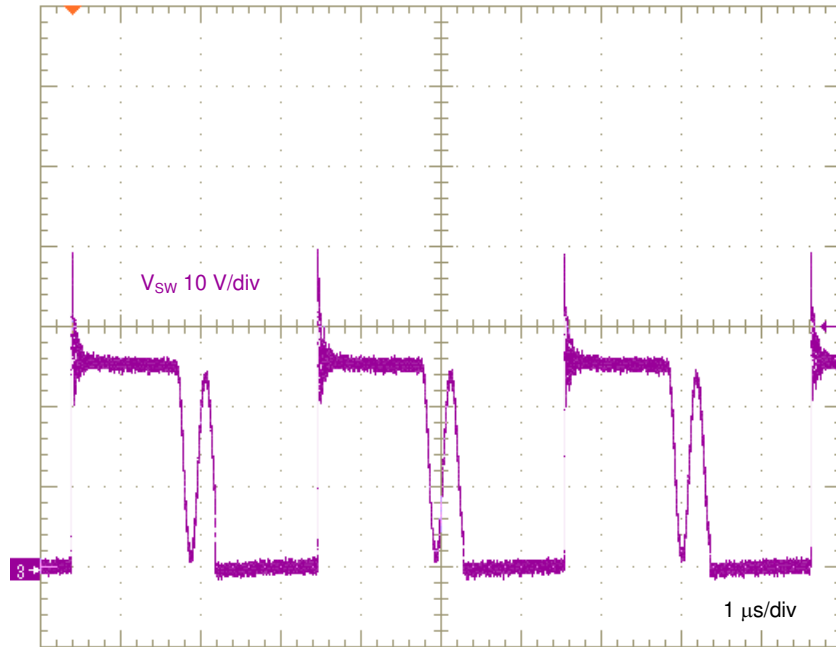
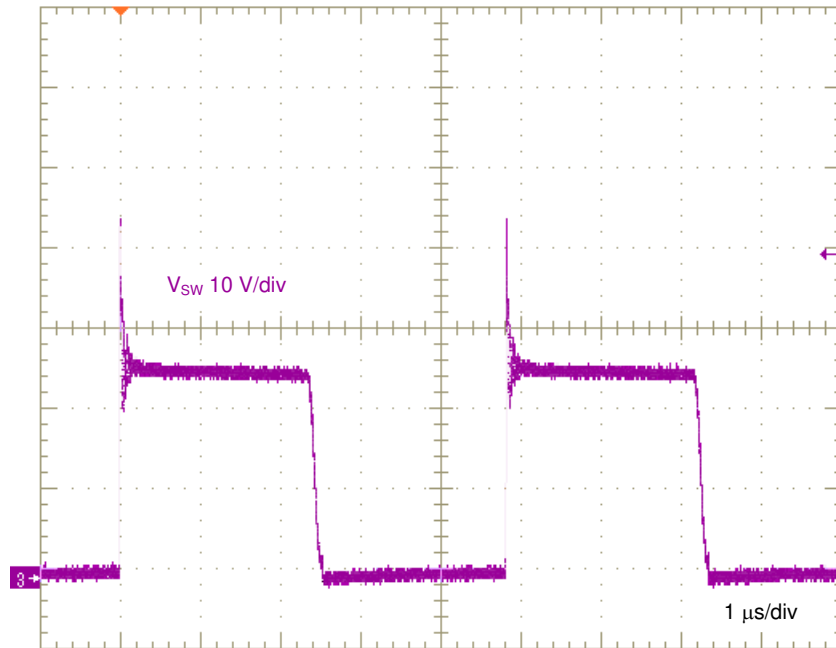


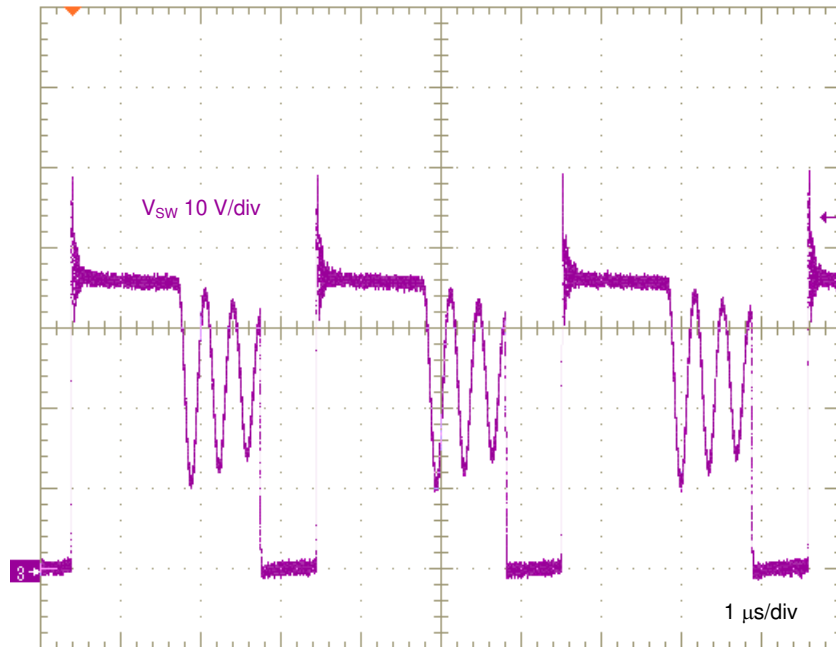
Figure 11. Switch Voltage,  $V_{IN} = 6\text{ V}$ ,  $I_{OUT} = 0.5\text{ A}$



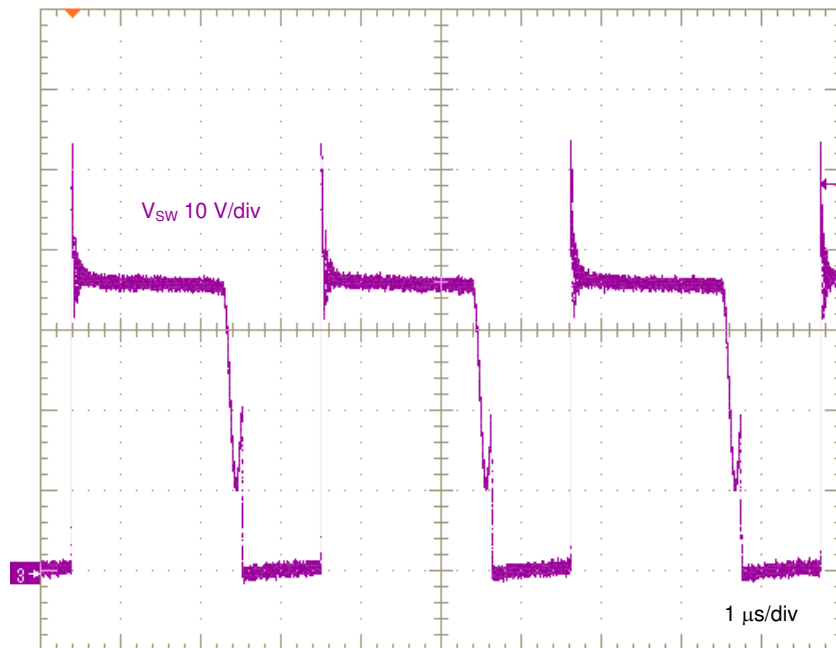
**Figure 12. Switch Voltage,  $V_{IN} = 13.5 \text{ V}$ ,  $I_{OUT} = 0.5 \text{ A}$**



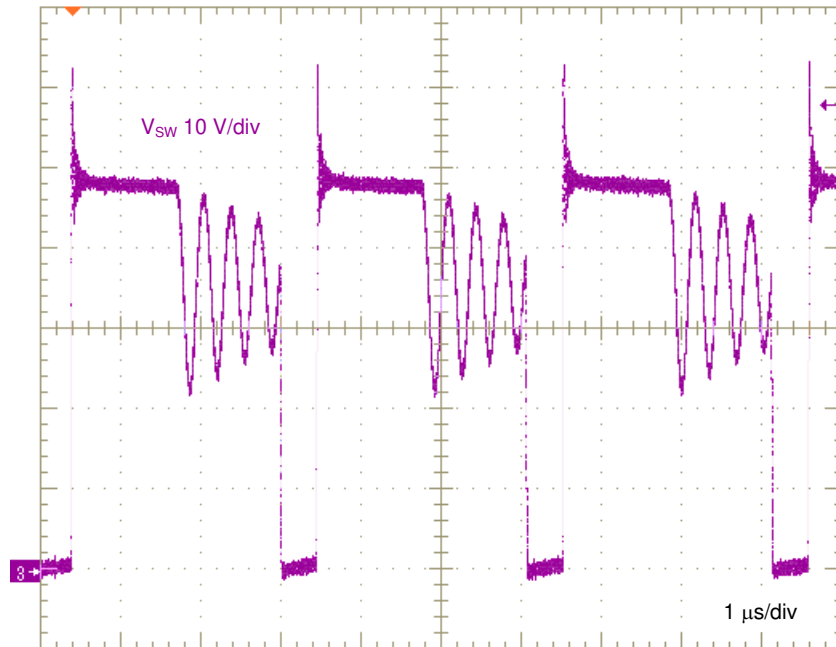
**Figure 13. Switch Voltage,  $V_{IN} = 13.5 \text{ V}$ ,  $I_{OUT} = 1 \text{ A}$**



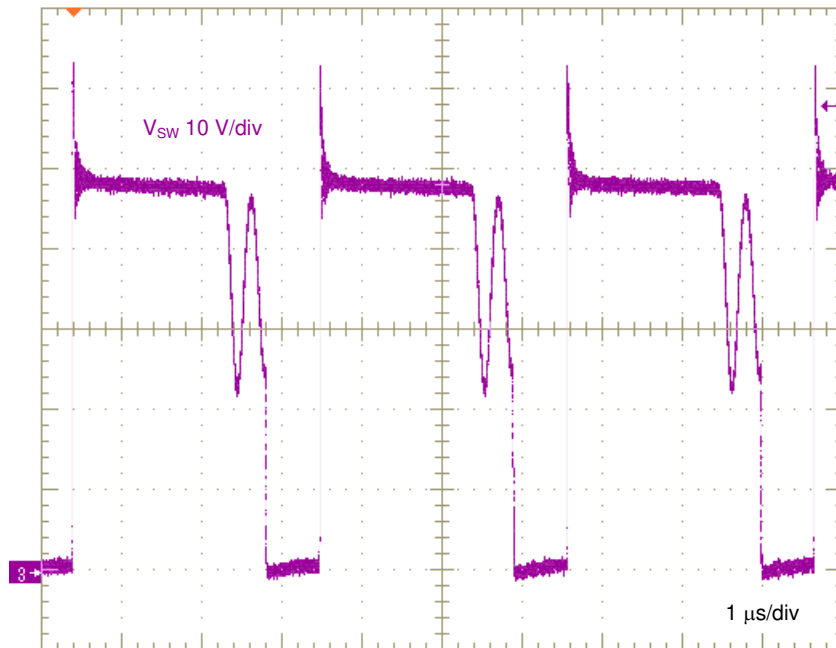
**Figure 14. Switch Voltage,  $V_{IN} = 24\text{ V}$ ,  $I_{OUT} = 0.5\text{ A}$**



**Figure 15. Switch Voltage,  $V_{IN} = 24\text{ V}$ ,  $I_{OUT} = 1\text{ A}$**



**Figure 16. Switch Voltage,  $V_{IN} = 36 \text{ V}$ ,  $I_{OUT} = 0.5 \text{ A}$**



**Figure 17. Switch Voltage,  $V_{IN} = 36 \text{ V}$ ,  $I_{OUT} = 1 \text{ A}$**

### 6.4 Thermal Performance

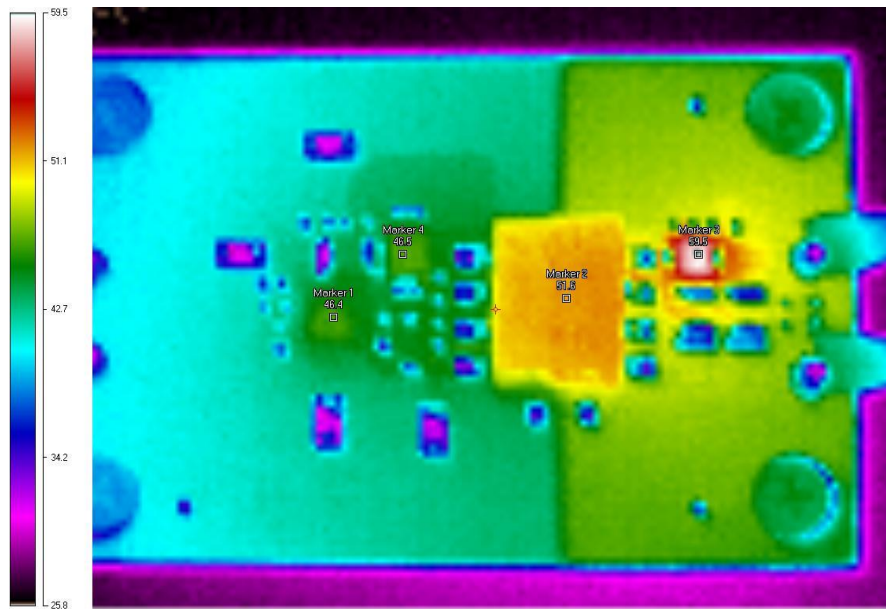


Figure 18. Thermal Performance at  $V_{IN} = 13.5\text{ V}$ ,  $I_{OUT} = 1\text{ A}$ ,  $T_A = 22^\circ\text{C}$ , No Airflow

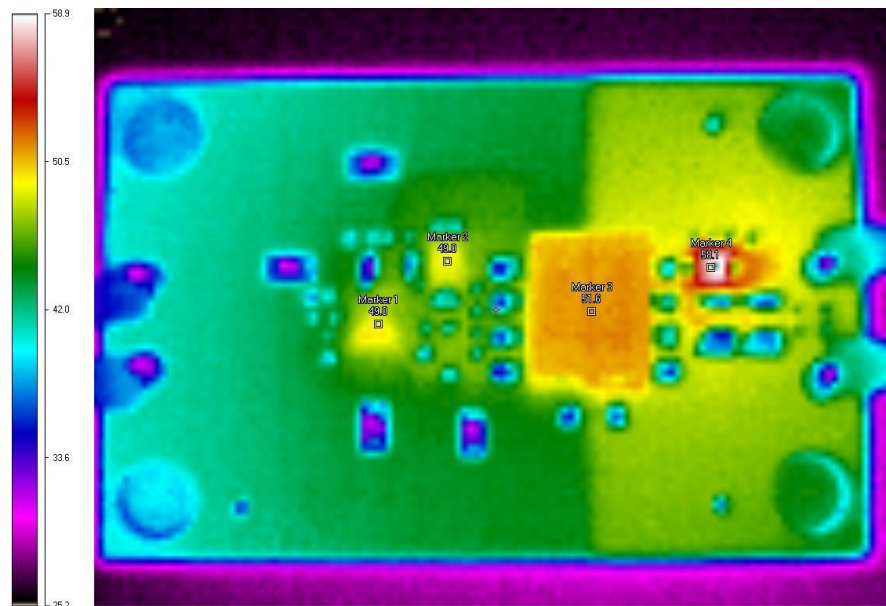


Figure 19. Thermal Performance at  $V_{IN} = 24\text{ V}$ ,  $I_{OUT} = 1\text{ A}$ ,  $T_A = 22^\circ\text{C}$ , No Airflow



### 6.5 CISPR 25 EMI Performance

Figure 20 and Figure 21 present the EMI performance of the LM25184-Q1 EVM at 12-V and 24-V inputs, respectively. Conducted emissions are measured over a frequency range of 150 kHz to 108 MHz using a 5- $\mu$ H LISN according to the CISPR 25 specification. CISPR 25 class 5 peak and average limit lines are denoted in red. The yellow and blue spectra are measured using peak and average detection, respectively.

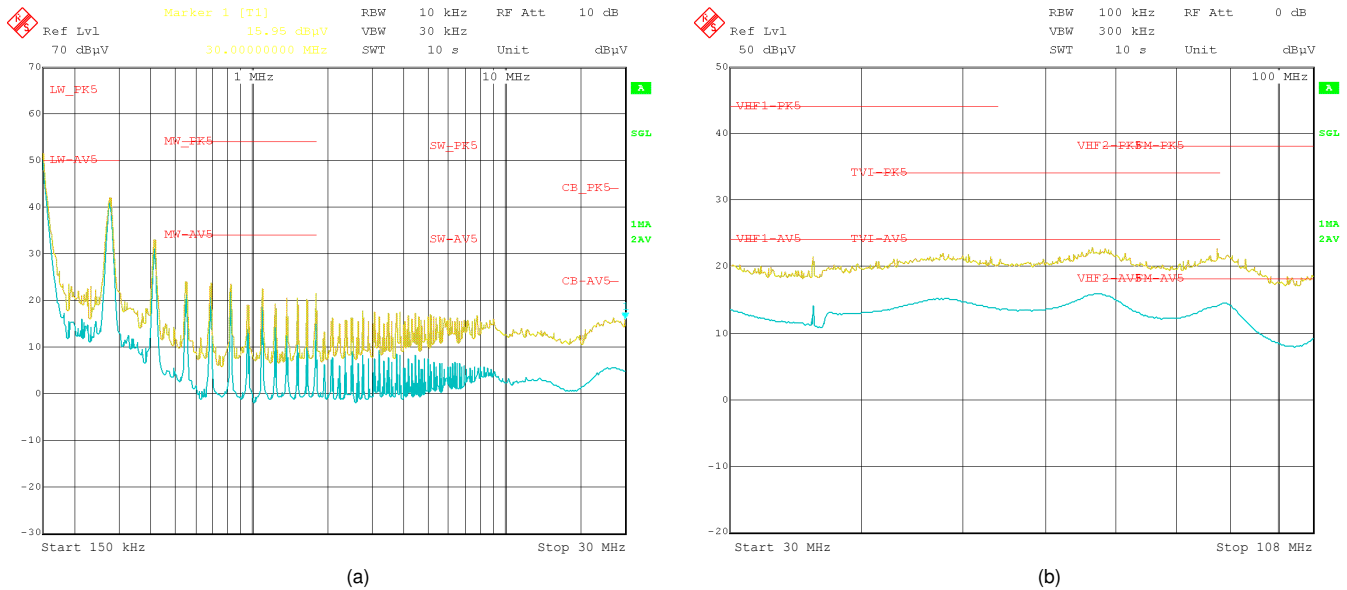


Figure 20. CISPR 25 Class 5 Conducted Emissions Plot,  $V_{IN} = 13.5$  V,  $I_{OUT} = 1$  A, (a) 150 kHz to 30 MHz, (b) 30 MHz to 108 MHz

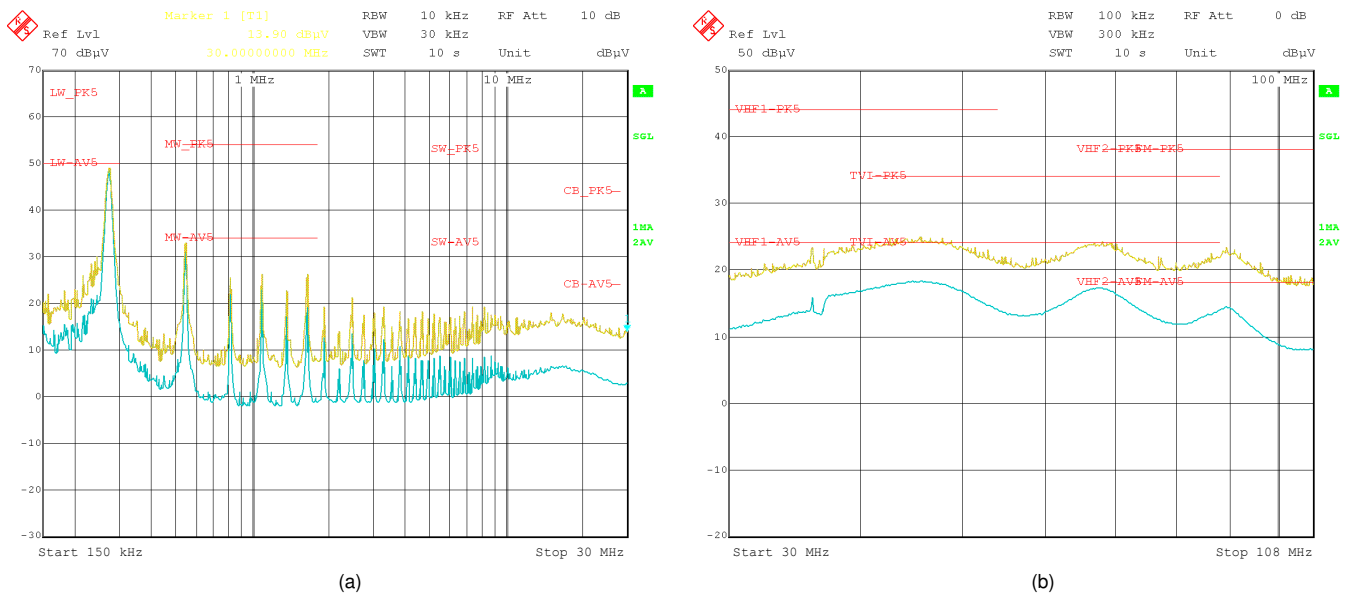


Figure 21. CISPR 25 Class 5 Conducted Emissions Plot,  $V_{IN} = 24$  V,  $I_{OUT} = 1$  A, (a) 150 kHz to 30 MHz, (b) 30 MHz to 108 MHz

Figure 22 presents the radiated emissions from 30 MHz to 1 GHz using a biconical/log antenna with horizontal polarization. CISPR 25 class 5 peak and average limit lines are denoted in purple and red, respectively. The blue and green spectra are measured using peak and average detectors, respectively.

For both conducted and radiated emissions measurements, the transformer core is shielded using a copper strap tied to primary GND.

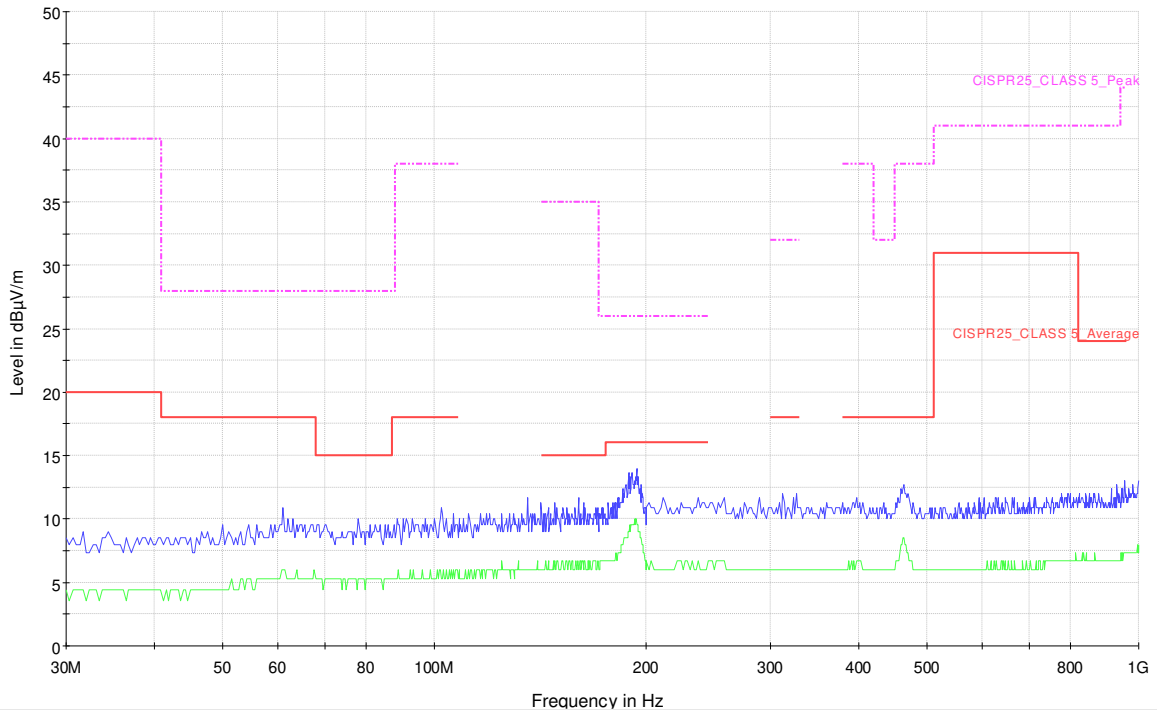
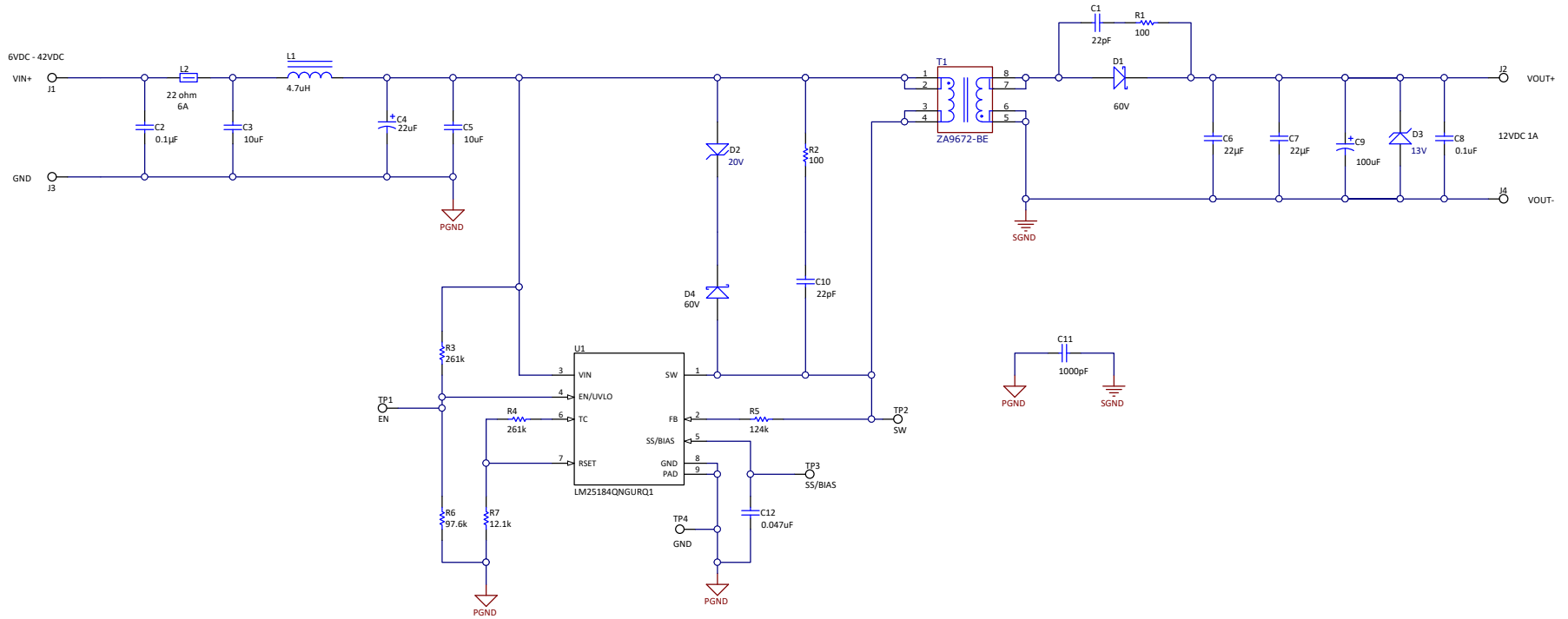


Figure 22. CISPR 25 Class 5 Radiated Emissions Plot,  $V_{IN} = 13.5\text{ V}$ ,  $I_{OUT} = 1\text{ A}$

## 7 EVM Documentation

### 7.1 Schematic



**Figure 23. PSR Flyback EVM Schematic**

## 7.2 Bill of Materials

**Table 4. Bill of Materials**

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
2	C1, C10	Capacitor, Ceramic, 22 pF, 100 V, X7R, 0603	Std	Std
1	C2	Capacitor, Ceramic, 47 nF, 100 V, X7R, 0603	Std	TDK
2	C3, C5	Capacitor, Ceramic, 10 μF, 50 V, X7R, 1210, AEC-Q200	CNA6P1X7R1H106K250AE	TDK
			UMK325AB7106KMHT	Taiyo Yuden
1	C4	Aluminum Electrolytic, 22 μF, 50 V, ±20%, AEC-Q200	EEE-ZC1H220P	Panasonic
2	C6, C7	Capacitor, Ceramic, 22 μF, 25 V, X7R, 1210, AEC-Q200	CGA6P3X7R1E226M250AB	TDK
			TMK325B7226KMHT	Taiyo Yuden
1	C8	Capacitor, Ceramic, 0.1 μF, 25 V, X7R, 0603	Std	Std
1	C9	Tantalum Electrolytic, 100 μF, 16 V, ±20%, AEC-Q200	T598D107M016ATE050	Kemet
1	C11	Capacitor, Ceramic, 1 nF, 2 kV, X7R, 1206	202R18W102KV4E	Johanson Dielectrics Inc.
1	C12	Capacitor, Ceramic, 47 nF, 16 V, X7R, 0603	Std	Std
1	D1	Schottky diode, 60 V, 3 A, SOD-123HE, AEC-Q101	FSV360FP	OnSemi
		Schottky diode, 60 V, 3 A, SOD-123W, AEC-Q101	PMEG60T30	Nexperia
1	D2	Zener diode, 20 V, 3 W, SMA, AEC-Q101	3SMAJ5932B	Micro Commercial
1	D3	Zener diode, 13 V, SOD-523	BZT52C13-7	Diodes Inc.
1	D4	Schottky diode, 60 V, 3 A, SOD-123, AEC-Q101	PMEG60T30	Nexperia
4	H1, H2, H3, H4	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips Panhead	NY PMS 440 0025 PH	B & F Fastener Supply
4	H5, H6, H7, H8	Standoff, Hex, 0.5"L #4-40 Nylon	1902C	Keystone Electronics
1	L1	Ferrite bead, 22 Ω at 100 MHz, 8 mΩ max, 0805	742792021	Würth Elektronik
1	L2	Inductor, 4.7 μH, 25 mΩ, 2 A, 34 MHz, AEC-Q200	XFL4030-472ME	Coilcraft
		Inductor, 4.7 μH, 48.6 mΩ, 3.7 A, AEC-Q200	VCHA042A-4R7MS6	Cyntec
		Inductor, 4.7 μH, 40 mΩ, 3.9 A, 24 MHz, AEC-Q200	74438357047	Würth Elektronik
1	T1	Transformer, 7 μH, 5 A Isat, 1 : 1, 13 mm x 10 mm x 10 mm	YA9672-BE	Coilcraft
			12387-T162	Sumida
		Transformer, 7 μH, 5 A Isat, 1 : 1, 9.8 mm x 9.5 mm x 10.6 mm	750319029	Würth Elektronik
2	R1, R2	Resistor, Chip, 100 Ω, 1/10W, 1%, 0603	Std	Std
1	R3	Resistor, Chip, 261 kΩ, 1/16W, 1%, 0603	Std	Std
1	R4	Resistor, Chip, 261 kΩ, 1/16W, 1%, 0603	Std	Std
1	R5	Resistor, Chip, 124 kΩ, 1/16W, 1%, 0603	Std	Std
1	R6	Resistor, Chip, 97.6 kΩ, 1/16W, 1%, 0603	Std	Std
1	R7	Resistor, Chip, 12.1 kΩ, 1/16W, 1%, 0603	Std	Std
1	U1	IC, LM25184-Q1, wide V <sub>IN</sub> PSR flyback converter, WSON-8	LM25184QNGURQ1	TI
1	PCB1	PCB, FR4, 4 layer, 1 oz, 56 mm x 36 mm	PCB	-
4	J1, J2, J3, J4	Turret, PTH, 4.72 mm, VIN+, VIN-, VO+, VO-	1573-2	Keystone Electronics
4	TP1, TP2, TP3, TP4	Test point for EN, SW, SS/BIAS, GND	5015	Keystone Electronics

### 7.3 PCB Layout

Figure 24 through Figure 29 show the design of a 4-layer PCB with 1-oz copper thickness. The EVM is a two-sided design with post connections for VIN+, VIN-, VO+, and VO-.

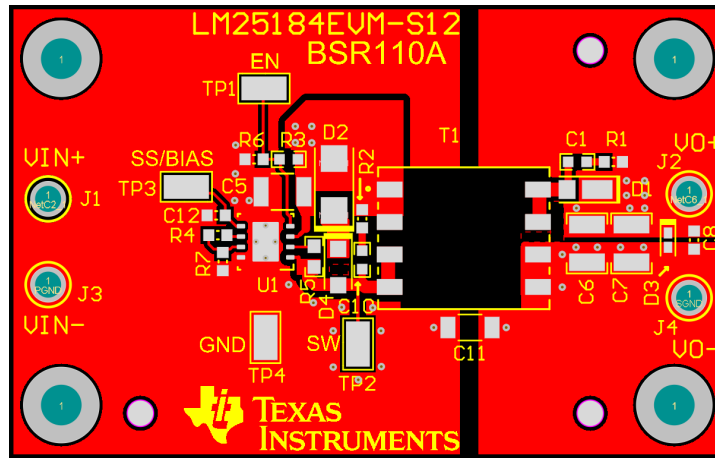


Figure 24. Top Copper (Top View)

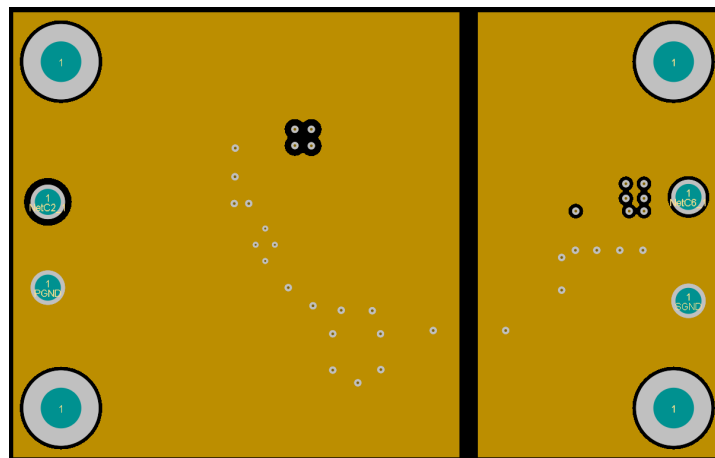


Figure 25. Layer 2 Copper (Top View)

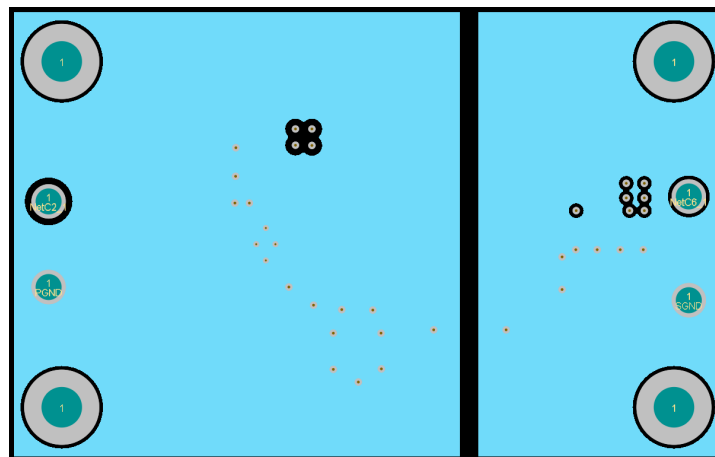


Figure 26. Layer 3 Copper (Top View)

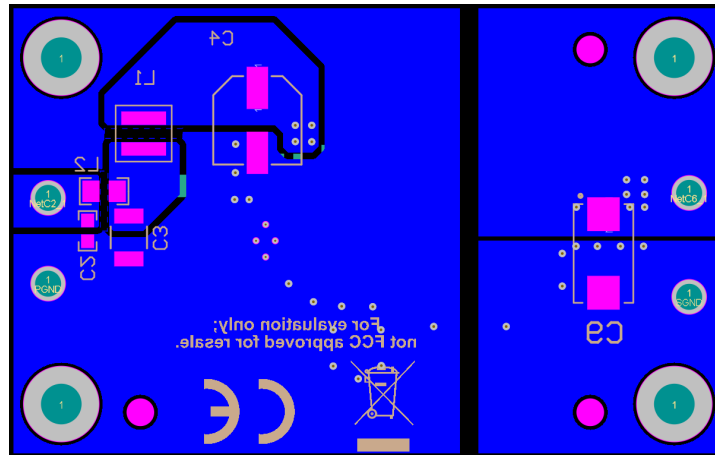


Figure 27. Bottom Copper (Top View)

7.4 Assembly Drawings

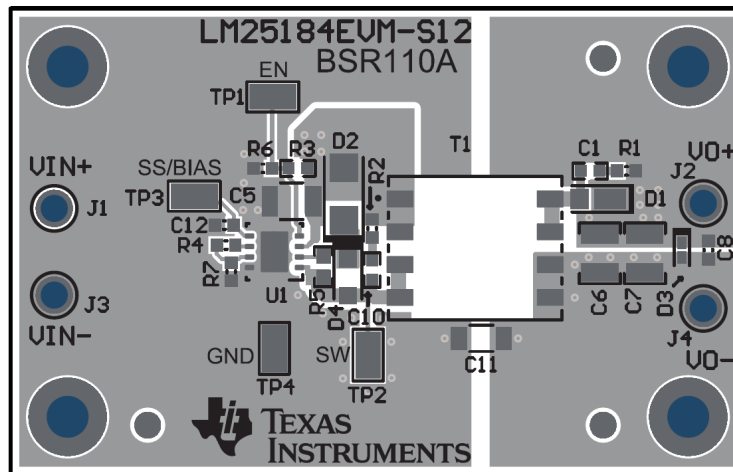


Figure 28. Top Component Drawing

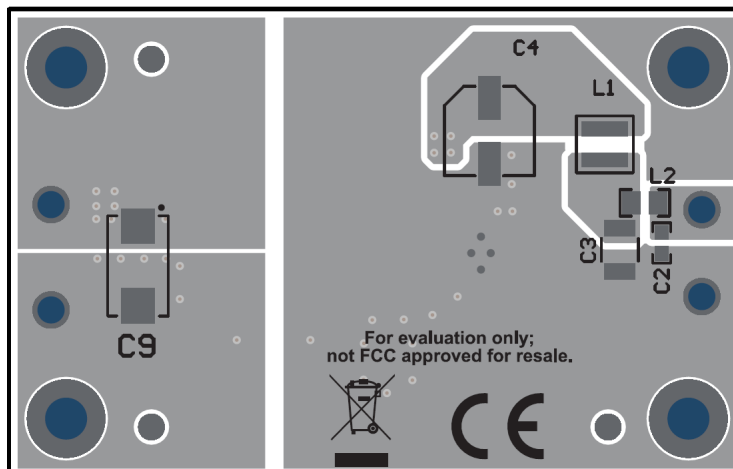


Figure 29. Bottom Component Drawing

## 8 Device and Documentation Support

### 8.1 Device Support

#### 8.1.1 Third-Party Products Disclaimer

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#### 8.1.2 Development Support

For development support see the following:

- For TI's reference design library, visit [TI Designs](#).
- For TI's WEBENCH Design Environments, visit the [WEBENCH® Design Center](#).
- LM25184-Q1 PSR Flyback Converter [Quickstart Calculator](#) and [PSPICE](#) simulation models.

### 8.2 Documentation Support

#### 8.2.1 Related Documentation

For related documentation, see the following:

- [LM5180EVM-S05 Single-Output EVM User's Guide](#) (SNVU592)
- [LM5180EVM-DUAL Dual-Output EVM User's Guide](#) (SNVU609)
- [PSR Flyback Transformer Design for mHEV Applications](#) (SNVA805)
- [How an Auxless PSR Flyback Converter can Increase PLC Reliability and Density](#) (SLYT779)
- TI Designs:
  - [Isolated IGBT Gate-Drive Power Supply Reference Design With Integrated Switch PSR Flyback Controller](#)
  - [Compact, Efficient, 24-V Input Auxiliary Power Supply Reference Design for Servo Drives](#)
  - [Reference Design for Power-Isolated Ultra-Compact Analog Output Module](#)
  - [HEV/EV Traction Inverter Power Stage with 3 Types of IGBT/SiC Bias-Supply Solutions Reference Design](#)
  - [4.5-V to 65-V Input, Compact Bias Supply With Power Stage Reference Design for IGBT/SiC Gate Drivers](#)
  - [Channel-to-Channel Isolated Analog Input Module Reference Design](#)
  - [SiC/IGBT Isolated Gate Driver Reference Design With Thermal Diode and Sensing FET](#)
  - [>95% Efficiency, 1-kW Analog Control AC/DC Reference Design for 5G Telecom Rectifier](#)
- TI Technical Articles:
  - [Flyback Converters: Two Outputs are Better Than One](#)
  - [Common Challenges When Choosing the Auxiliary Power Supply for Your Server PSU](#)
  - [Maximizing PoE PD Efficiency on a Budget](#)
- White Papers:
  - [Valuing Wide  \$V\_{IN}\$ , Low EMI Synchronous Buck Circuits for Cost-driven, Demanding Applications](#) (SLYY104)
  - [An Overview of Conducted EMI Specifications for Power Supplies](#) (SLYY136)
  - [An Overview of Radiated EMI Specifications for Power Supplies](#) (SLYY142)
- [Under the Hood of Flyback SMPS Designs](#) (SLUP261)
- [Flyback Transformer Design Considerations for Efficiency and EMI](#) (SLUP338)

**8.2.1.1 PCB Layout Resources**

- [High-Density PCB Layout of DC-DC Converters Technical Article](#)
- [AN-1149 Layout Guidelines for Switching Power Supplies](#) (SNVA021)
- [AN-1229 Simple Switcher PCB Layout Guidelines](#) (SNVA054)
- [Constructing Your Power Supply – Layout Considerations](#) (SLUP230)
- [Low Radiated EMI Layout Made SIMPLE with LM4360x and LM4600x](#) (SNVA721)

**8.2.1.2 Thermal Design Resources**

- [AN-2020 Thermal Design by Insight, Not Hindsight](#) (SNVA419)
- [AN-1520 A Guide to Board Layout for Best Thermal Resistance for Exposed Pad Packages](#) (SNVA183)
- [Semiconductor and IC Package Thermal Metrics](#) (SPRA953)
- [Thermal Design Made Simple with LM43603 and LM43602](#) (SNVA719)
- [PowerPAD Thermally Enhanced Package](#) (SLMA002)
- [PowerPAD Made Easy](#) (SLMA004)
- [Using New Thermal Metrics](#) (SBVA025)



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