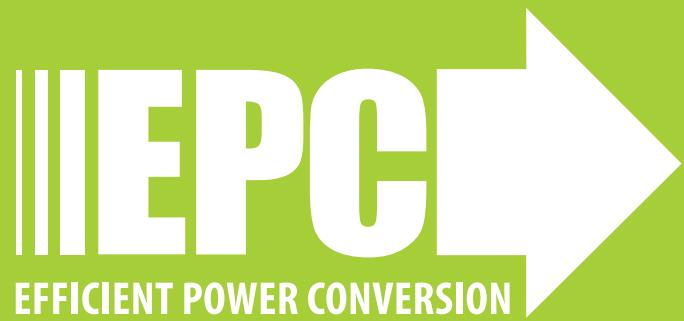


Evaluation Board EPC90167 Quick Start Guide

40 V Half-bridge with Gate Drive using EPC2366

December 9, 2025

Revision 1.0



DESCRIPTION

The EPC90167 is a half bridge evaluation board for the 40 V-rated EPC2366 eGaN® field effect transistor (FET). The purpose of this evaluation board is to simplify the evaluation process of EPC2366 by including all the critical components on a single board that can be easily integrated into most existing converter topologies.

The EPC90167 evaluation board measures 2.5" x 2" and contains two EPC2366 eGaN FETs in a half-bridge configuration paired with the Analog Devices LT8418 half-bridge gate driver. The board also contains all other critical components such as a deadtime generation circuit and input bus capacitors. There are also various probe points to facilitate simple waveform measurement and efficiency calculation. A block diagram of the circuit is given in figure 1.

For more information on **EPC2366** please refer to their datasheets available from EPC at www.epc-co.com. The datasheet should be read in conjunction with this quick start guide.

Table 1: Performance Summary ($T_A = 25^\circ\text{C}$) EPC90167

Symbol	Parameter	Conditions	Min	Nom	Max	Units
V_{DD}	Gate Drive Regulator Supply Range		7.5		12	V
V_{IN}	Bus Input Voltage Range ⁽¹⁾				32 ⁽¹⁾	
I_{OUT}	Switch Node Output Current ⁽²⁾				48 ⁽²⁾	A
V_{PWM}	PWM Logic Input Voltage Threshold ⁽³⁾	Input 'High'	3.5 ⁽³⁾		5.5 ⁽³⁾	V
		Input 'Low'	0		1.5 ⁽³⁾	
	PWM 'High' State Input Pulse Width	V_{PWM} rise and fall time < 10 ns	50			ns
	PWM 'Low' State Input Pulse Width ⁽⁴⁾	V_{PWM} rise and fall time < 10 ns	200 ⁽⁴⁾			

(1) *Maximum input voltage depends on inductive loading, maximum switch node ringing must be kept under 40 V for EPC2366.*

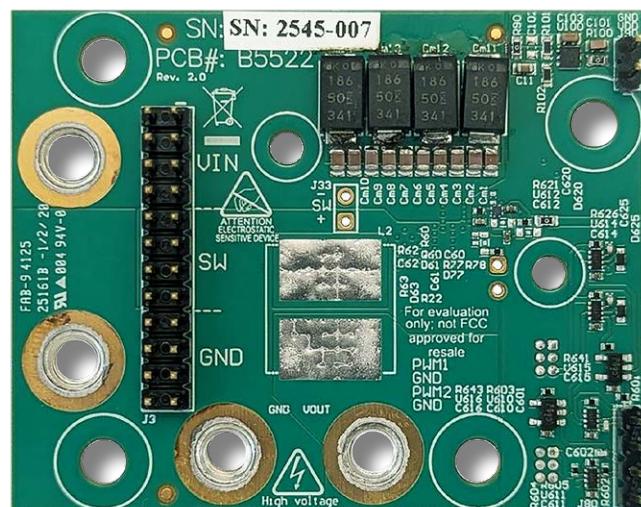
(2) Maximum current depends on die temperature and input bus capacitor temperature – actual maximum current is affected by switching frequency, bus voltage, inductor current ripple and thermal cooling.

(3) Refer to the LT8418 datasheet when bypassing the on-board logic buffers.

(4) Limited by time needed to 'refresh' high side bootstrap supply voltage.



Front view



EPC90167 evaluation board

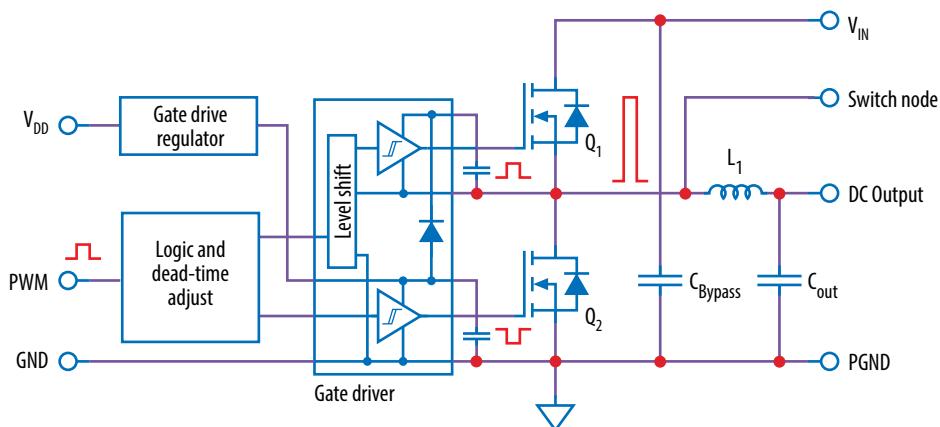


Figure 1: Block diagram of EPC90167 evaluation board default configuration

QUICK START PROCEDURE

The EPC90167 evaluation board is easy to set up as a buck or boost converter to evaluate the performance of the two EPC2366 eGaN FETs. This board includes a dead-time generating circuit that adds a delay from when the gate signal of one FET is commanded to turn off, to when the gate signal of the other FET is commanded to turn on. In the default configuration, this dead time circuit ensures that both the high and low side FETs will not be turned on at the same time thus preventing a shoot-through condition. The dead-time and/or polarity changing circuits can be utilized or bypassed for added versatility.

Single/dual PWM signal input settings

There are two PWM signal input ports on the board, PWM1 and PWM2. Both input ports are used as inputs in dual-input mode where PWM1 connects to the upper FET and PWM2 connects to the lower FET. The PWM1 input port is used as the input in single-input mode where the circuit will generate the required complementary PWM for the FETs. The input mode is set by choosing the appropriate jumper positions for J630 (mode selection) as shown in figure 2(a) for a single-input buck converter (blue jumper across pins 1 & 2 of J630), (b) for a single-input boost converter (blue jumpers across pins 3 & 4 of J630), and (c) for a dual-input operation (blue jumpers across pins 5 & 6 of J630).

Note: In dual mode there is no shoot-through protection as both gate signals can be set high at the same time.

Dead-time settings

Dead-time is defined as the time between when one FET turns off and the other FET turns on, and for this board is referenced to the input of the gate driver. The dead-time can be set to a specific value where resistor R620 delays the turn on of the upper FET and resistor R625 delays the turn on of the lower FET as illustrated in figure 3.

The required resistance for the desired dead-time setting can be read off the graph in figure 4. An example for 10 ns dead-time setting shows that a 120 Ω resistor is needed.

Note: This is the default deadtime and resistor value installed. A minimum dead-time of 5 ns and maximum of 15 ns is recommended.

Bypass settings

Both the polarity changer and the deadtime circuits can be bypassed using the jumper settings on J640 (Bypass), for direct access to the gate driver input. There are three bypass options: 1) No bypass, 2) Dead-time bypass, 3) Full bypass. The jumper positions for J640 for all three bypass options are shown in figure 5.

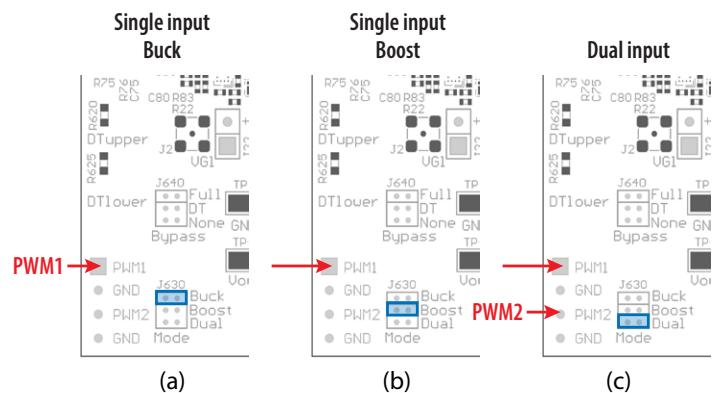


Figure 2: Input mode selection on J630

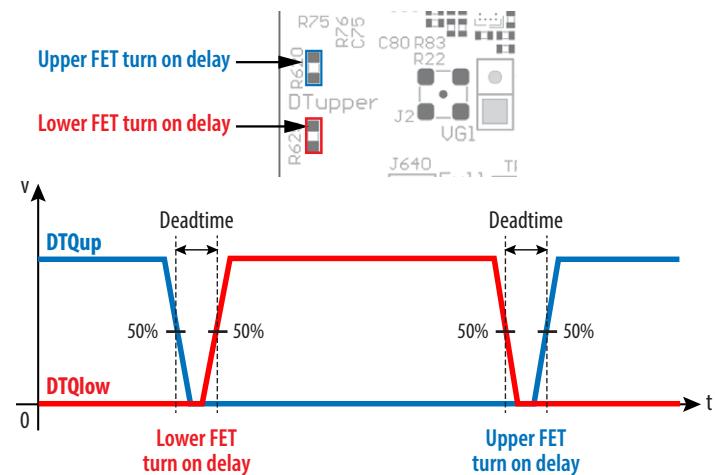


Figure 3: Definition of dead-time between the upper-FET gate signal (DTQup) and the lower-FET gate signal (DTQlow)

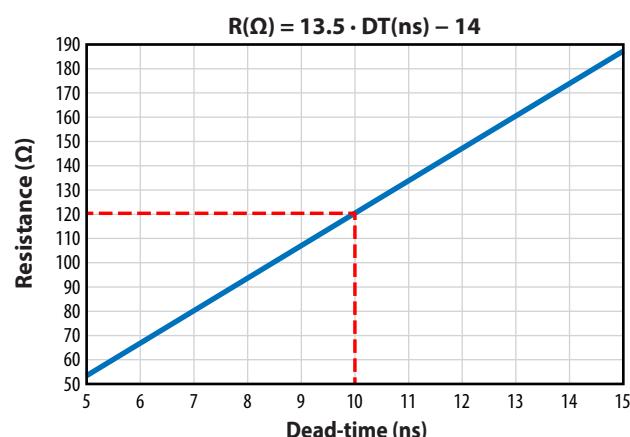


Figure 4: The required resistance values for R620 or R625 as a function of desired dead-time

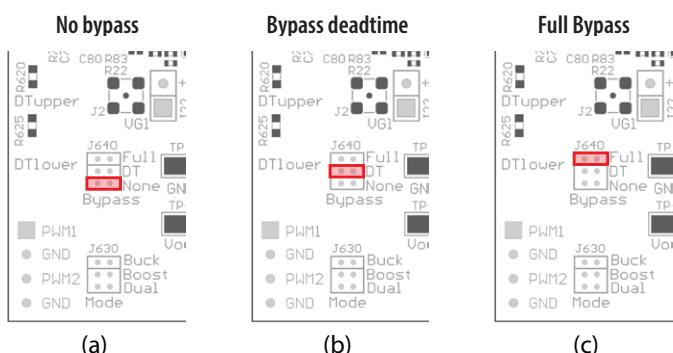


Figure 5: Bypass mode Jumper settings for J640

In **no-bypass mode**, figure 5(a) (red jumper across pins 5 & 6 of J640), both the on-board polarity and dead-time circuits are fully utilized. In **dead-time bypass mode**, figure 5(b) (red jumpers across pins 3 & 4 of J640), only the on-board polarity changer circuit is utilized, effectively bypassing the dead-time circuit. In **full bypass mode**, Figure 5(c) (red jumper across pins 1 & 2 of J640), the inputs to the gate driver are directly connected to the PWM1 and PWM2 pins and the on-board polarity and dead-time circuits are not utilized.

Buck converter configuration

To operate the board as a buck converter, either a single or dual PWM inputs can be chosen using the appropriate jumper settings on J630 (mode).

To select **Single Input Buck Mode**, the bypass jumper J640 **must** be set to the **no-bypass mode**, the **buck mode** J630 **must** be selected as shown in figure 6(a).

To select **Dual Input Buck Mode**, the bypass jumper J640 **may** be configured to any of the valid settings, the dual-input mode J630 **must** be selected as shown in figure 6(b).

Note: In bypass mode the PWM signals must include the deadtimes and desired polarity for either buck or boost operation.

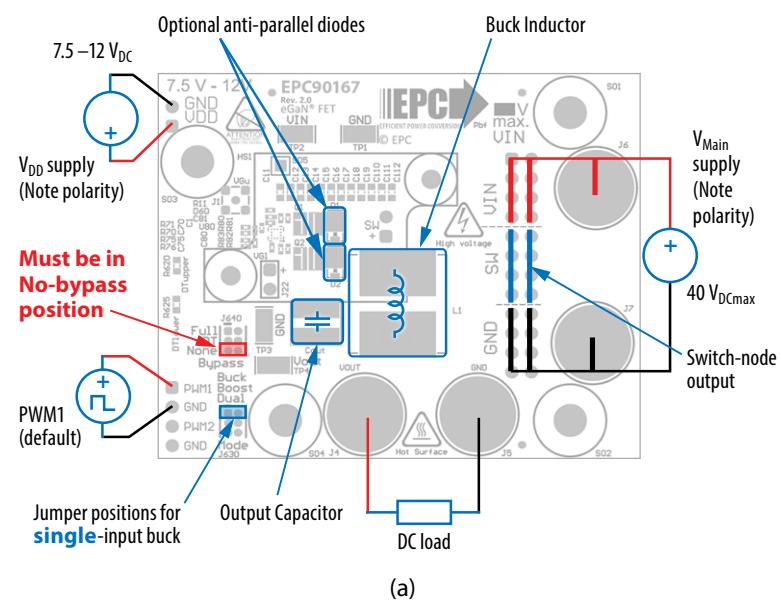
Once the input source, dead-time settings and bypass configurations have been chosen and set, then the boards can be operated.

EPC recommends following these steps:

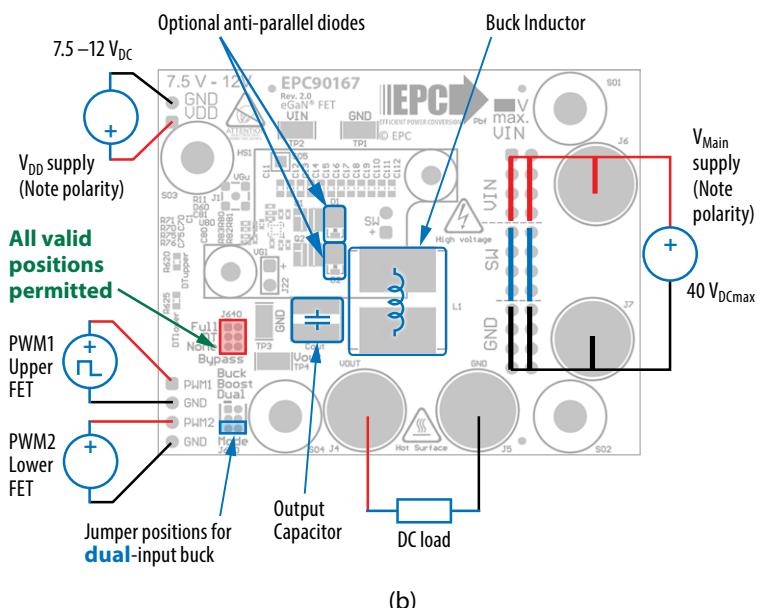
1. With power off, connect the input power supply bus to VIN and ground / return to GND.
2. With power off, connect the switch node (SW) of the half bridge to your circuit as required (half bridge configuration). Or use the provided pads for inductor (L1) and output capacitors (Cout), as shown in figure 6.
3. With power off, connect the gate drive supply to VDD (J1, Pin-1) and ground return to GND (J1, Pin-2 indicated on the bottom side of the board).
4. With power off, connect the input PWM control signal to PWM1 and/or PWM2 according to the input mode setting chosen and ground return to any of GND J2 pins indicated on the bottom side of the board.
5. Turn on the gate drive supply – make sure the supply is between 7.5 V and 12 V.
6. Turn on the controller / PWM input source.
7. Making sure the initial input supply voltage is 0 V, turn on the power and slowly increase the voltage to the required value (**do not exceed the absolute maximum voltage**). Probe switch-node to see switching operation.
8. Once operational, adjust the PWM control, bus voltage, and load within the operating range and observe the output switching behavior, efficiency, and other parameters.
9. For shutdown, please follow steps in reverse.

Bypass mode warnings

- **In bypass mode the PWM signals must include the deadtimes and desired polarity for either buck or boost operation.**
- When operating in **full bypass mode**, the input signal specifications revert to that of the LT8418 gate driver IC. Refer to its datasheet for details.



(a)



(b)

Figure 6: (a) Single-PWM input buck converter (b) Dual-PWM input buck converter configurations showing the supply, anti-parallel diodes, output capacitor, inductor, PWM, and load connections with corresponding jumper positions.

Boost Converter configuration

Warning: Never operate the boost converter mode without a load, as the output voltage can increase beyond the maximum ratings.

To operate the board as a boost converter, either a single or dual PWM inputs can be chosen using the appropriate jumper settings on J630 (mode).

To select **Single Input Boost Mode**, the bypass jumper J640 **must** be set to the **no-bypass mode**, the boost mode J630 **must** be selected as shown in figure 7(a).

To select **Dual Input Boost Mode**, the bypass jumper J640 **may** be configured to any of the valid settings, the **dual-input mode** J630 **must** be selected as shown in figure 7(b).

Note: In bypass mode the PWM signals must include the deadtimes and desired polarity for either buck or boost operation.

Once the input source, dead-time settings and bypass configurations have been chosen and set, then the boards can be operated.

EPC recommends following these steps:

1. The inductor (L1) and input capacitors (labeled as Cout) can either be soldered onto the board, as shown in figure 7, or provided off board. Anti-parallel diodes can also be installed using the additional pads on the right side of the EPC2366 FETs.
2. With power off, connect the input power supply bus to V_{OUT} and ground / return to GND, or externally across the capacitor if the inductor L1 and Cout are provided externally. Connect the output voltage (**labeled as VIN**) to your circuit as required, e.g., resistive load.
3. With power off, connect the gate drive supply to V_{DD} (J1, Pin-1) and ground return to GND (J1, Pin-2 indicated on the bottom side of the board).
4. With power off, connect the input PWM control signal to PWM1 and/or PWM2 according to chosen input mode setting and ground return to any of GND J2 pins indicated on the bottom side of the board.
5. Turn on the gate drive supply – make sure the supply is between 7.5 V and 12 V.
6. Turn on the controller / PWM input source.
7. **Making sure the output is not open circuit**, and the input supply voltage is initially 0 V, turn on the power and slowly increase the voltage to the required value (**do not exceed the absolute maximum voltage**). Probe switch-node to see switching operation.
8. Once operational, adjust the PWM control, bus voltage, and load within the operating range and observe the output switching behavior, efficiency, and other parameters. Observe device temperature for operational limits.
9. For shutdown, please follow steps in reverse.

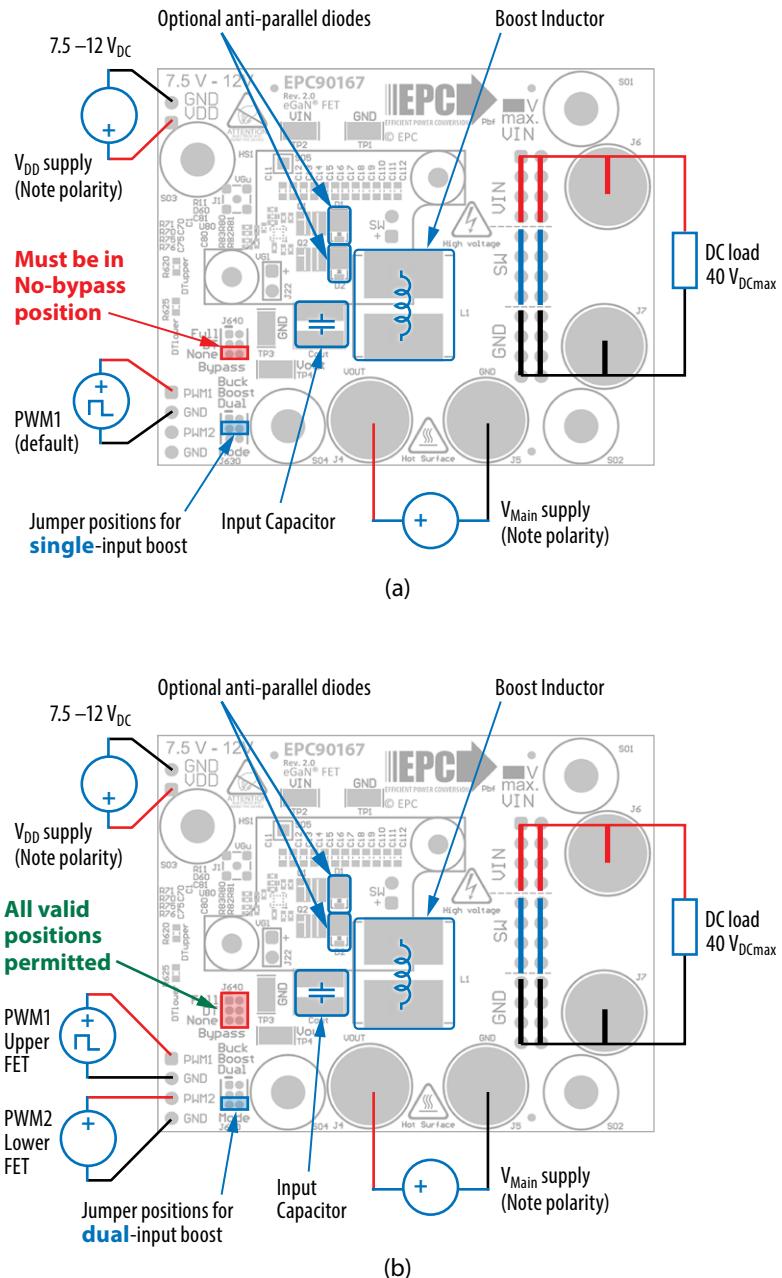


Figure 7: (a) Single-PWM input boost converter (b) Dual-PWM input boost converter configurations showing the supply, inductor, anti-parallel diodes, input capacitor, PWM, and load connections with corresponding jumper settings.

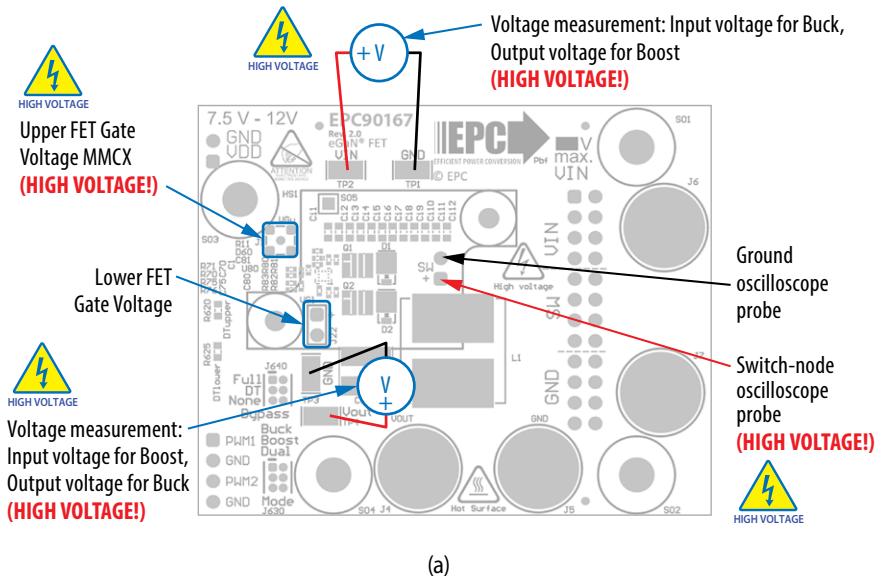
MEASUREMENT CONSIDERATIONS

Measurement connections are shown in figure 8.

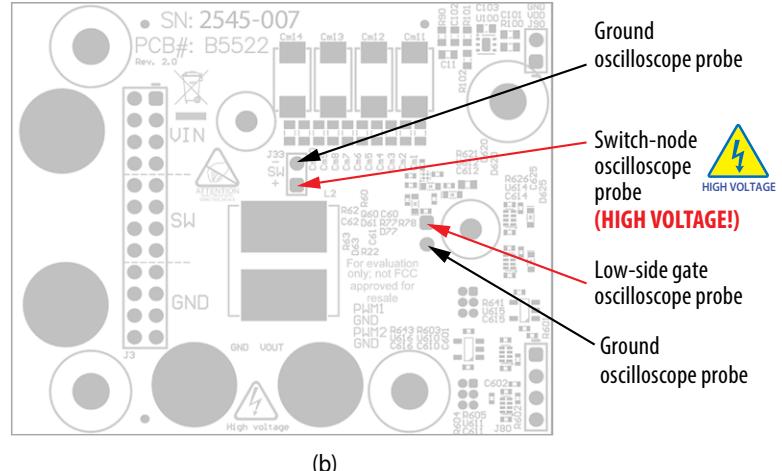
When measuring the switch node voltage containing high-frequency content, care must be taken to provide an accurate high-speed measurement. A two-pin header (J33) is provided for switch-node measurement.

A differential probe is recommended for measuring the high-side gate voltage. IsoVu probes from Tektronix have mating MMCX connector.

NOTE. For information about measurement techniques, the EPC website offers: “[AN023 Accurately Measuring High Speed GaN Transistors](#)” and the How to GaN educational video series, including: [HTG09-Measurement](#)



(a)



(b)

Figure 8: Measurement points (a) top side, (b) bottom side

THERMAL CONSIDERATIONS

The EPC90167 board is equipped with a mechanical spacer and 2 heatsink mechanical mounting holes that can be used to easily attach an off-the-shelf heatsink (P/N: 960-19-21-S-AB-0) as shown in figure 9 (a). The setup only requires a thermal interface material (TIM). Prior to attaching a heatsink, any component exceeding 1 mm in thickness under the heatsink area must be removed from the board as shown in figure 9 (b). Note that the board includes pads for the inductor on top and bottom sides, so if the heatsink is installed, the inductor can be moved to the bottom side of the board.

Note that the heatsink is not electrically connected to the board.

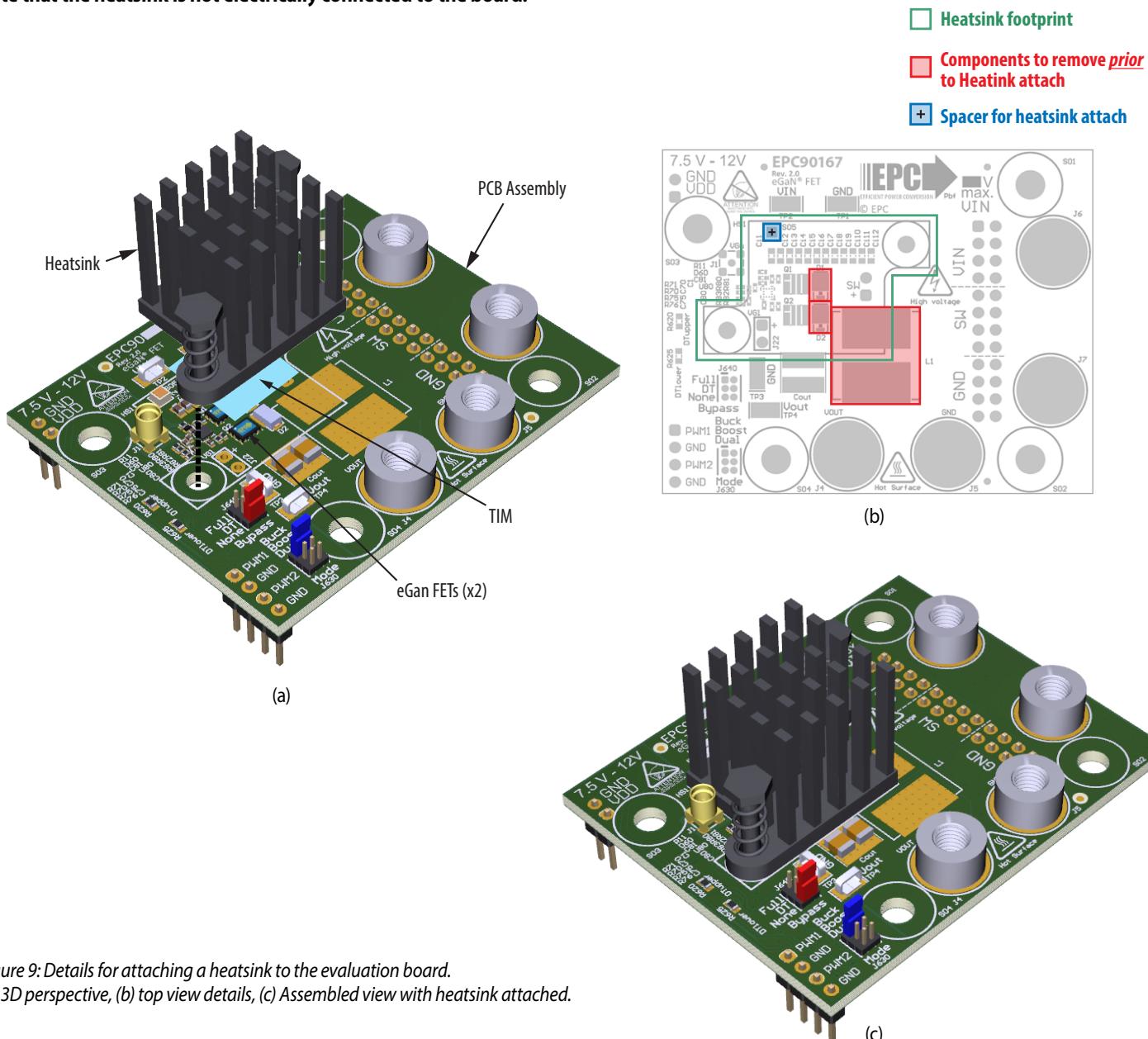


Figure 9: Details for attaching a heatsink to the evaluation board.
(a) 3D perspective, (b) top view details, (c) Assembled view with heatsink attached.

EPC recommends using a high thermal conductivity TIM between the board and the heatsink. The size and location of the TIM are shown in Figure 10. Alternatively, a smaller TIM may be used to cover only the area of the FETs. In that case, adding a thin insulator over the capacitors with a cutout around the FETs, as shown in Figure 11, is recommended.

EPC recommends Laird P/N: A14692-30, Tgard™ K52 with thickness of 0.051 mm the for the insulating material.

The choice of TIM needs to consider the following characteristics:

- **Mechanical compliance** – During the attachment of the heatsink, the TIM underneath is compressed from its original thickness to the vertical gap distance between the spacers and the FETs. This volume compression exerts a force on the FETs. A maximum compression of 2:1 is recommended for maximum thermal performance and to constrain the mechanical force which maximizes thermal mechanical reliability.
- **Electrical insulation** – The backside of the eGaN FET is a silicon substrate that is connected to source and thus the upper FET in a half-bridge configuration is connected to the switch-node. To prevent short-circuiting, the TIM must be of high dielectric strength to provide adequate electrical insulation in addition to its thermal properties.
- **Thermal performance** – The choice of thermal interface material will affect the thermal performance of the thermal solution. Higher thermal conductivity materials is preferred to provide higher thermal conductance at the interface.

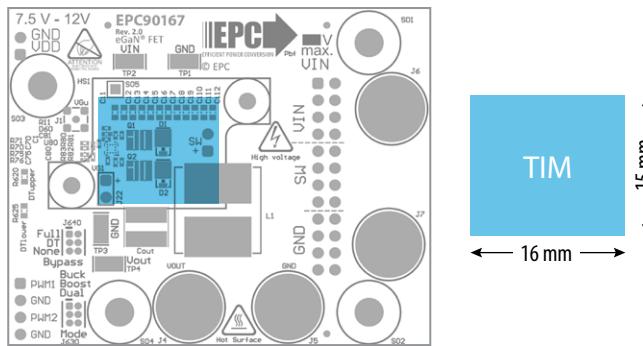


Figure 10: Size and location of the TIM

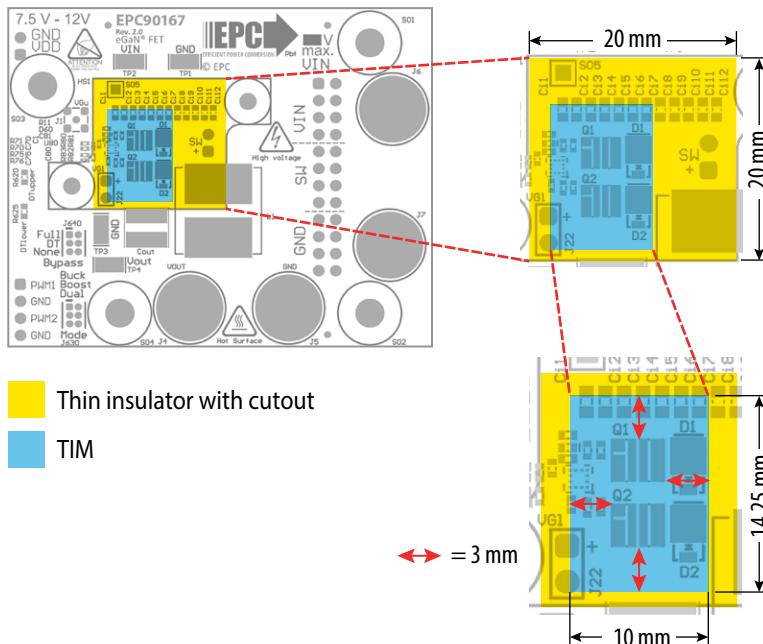


Figure 11: Alternative TIM configuration with insulator sheet with cutout for the TIM

EPC recommends the following thermal interface materials:

- **t-Global** P/N: TG-A1780 X 0.5 mm (highest conductivity of 17.8 W/m.K)
- **t-Global** P/N: TG-A620 X 0.5 mm (moderate conductivity of 6.2 W/m.K)
- **Bergquist** P/N: GP5000-0.02 (~0.5 mm with conductivity of 5 W/m.K)
- **Bergquist** P/N: GPTGP7000ULM-0.020 (conductivity of 7 W/m.K)

NOTE. The EPC90167 evaluation board does not have any current or thermal protection on board. For more information regarding the thermal performance of EPC eGaN FETs, please consult:

D. Reusch and J. Glaser, **DC-DC Converter Handbook, a supplement to GaN Transistors for Efficient Power Conversion**, First Edition, Power Conversion Publications, 2015.

EXPERIMENTAL VALIDATION

The performance of EPC90167 was tested under various input voltages and switching frequencies. Table 2 lists additional details with the inductor, output capacitance, deadtimes and maximum case temperatures.

A heatsink per figures 9 and 10 (P/N: 960-19-21-S-AB-0) using t-Global TG-A1780 thermal interface material (TIM) was added where specified.

Additional input and output capacitance are added to suppress input and output voltage ripple at high output current as shown in Table 2.

Table 2: Test Conditions

Parameter	Value	Units
Inductor (mounted on Board)	1 ⁽¹⁾	µH
Output capacitance	50 ⁽²⁾	µF
Ambient temperature	25	°C
Maximum case temperature	110	°C
Dead time	10	ns

(1) 1 µH inductor from Vishay, P/N IHTH1125KZEB1ROM5A

(2) Capacitors used: 10 µF, 50 V, x5 (P/N: UMK325BJ106MM-T)

ELECTRICAL PERFORMANCE

Measure Waveforms

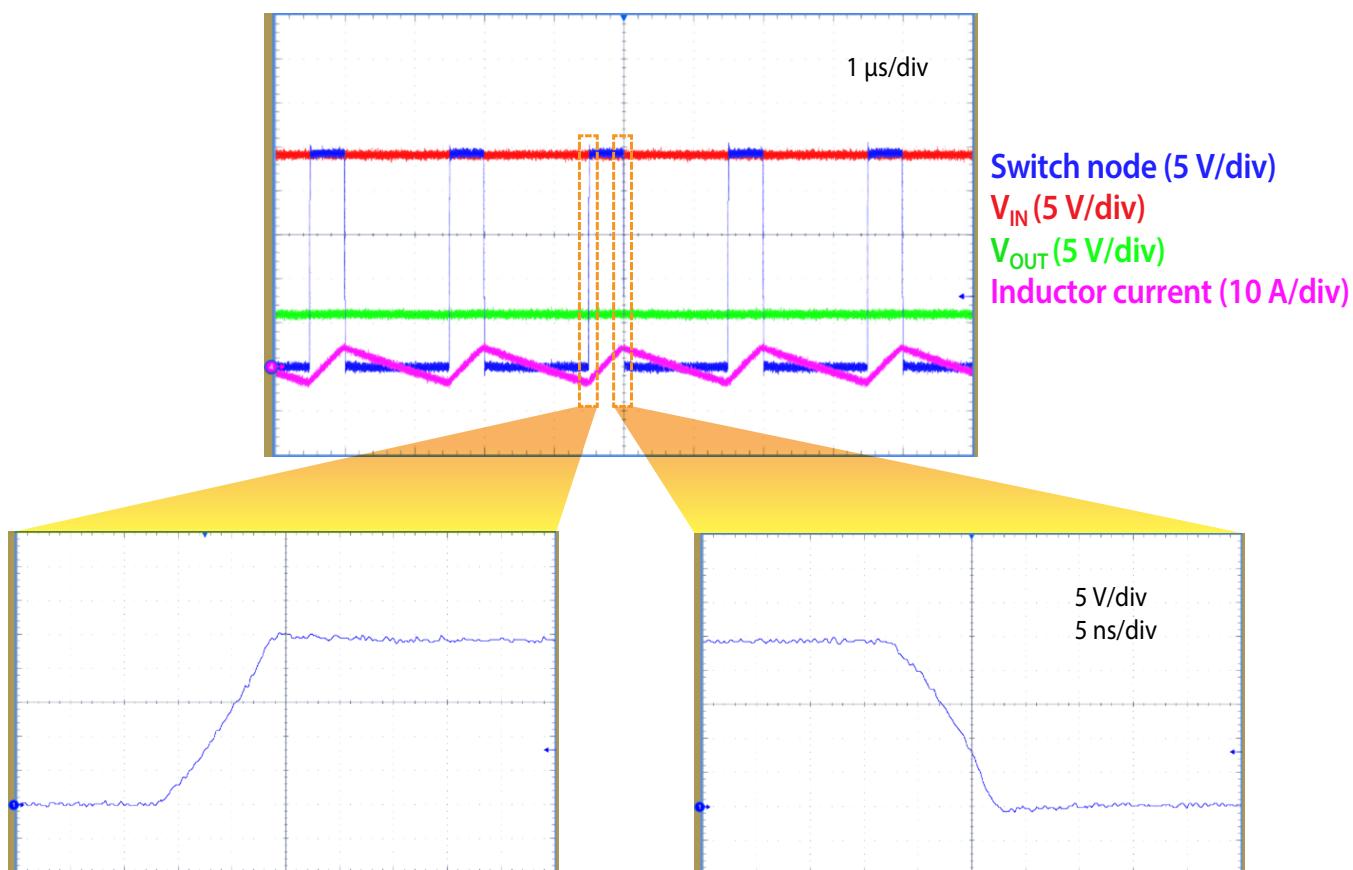


Figure 12: Measured input voltage, output voltage, inductor current, and switch node waveforms when operating from 24 V at 500 kHz and delivering 0 A into a 8 V load

Measure Waveforms (continued)

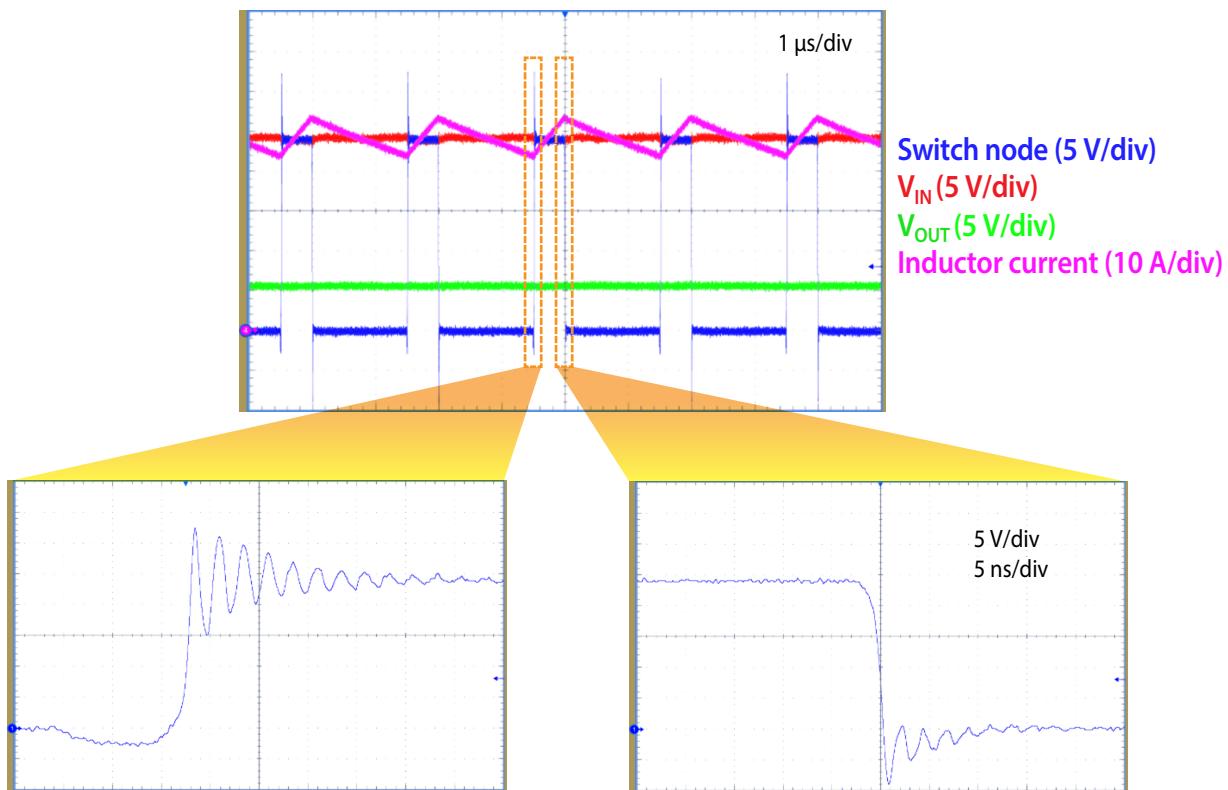


Figure 13: Measured input voltage, output voltage, inductor current, and switch node waveforms when operating from 24 V at 500 kHz and delivering 48 A into a 8 V load

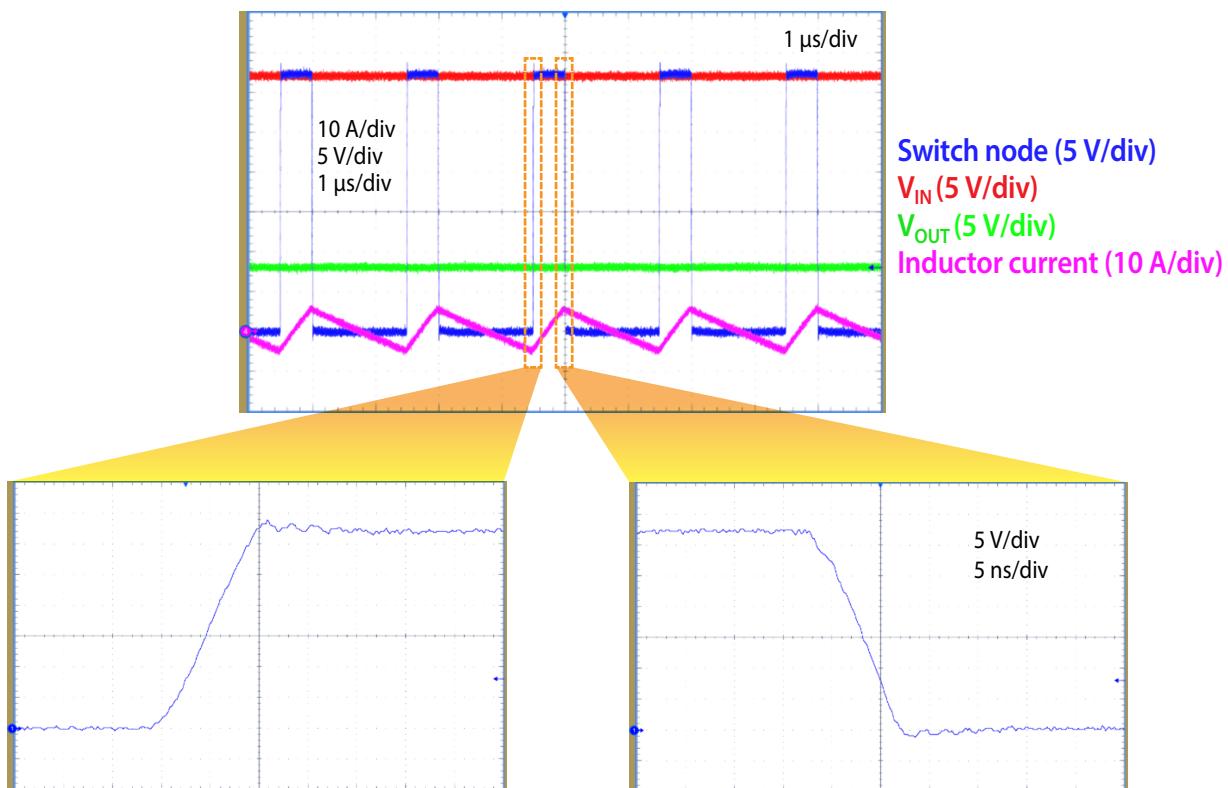


Figure 14: Measured input voltage, output voltage, inductor current, and switch node waveforms when operating from 32 V at 500 kHz and delivering 0 A into a 8 V load

Measure Waveforms (continued)

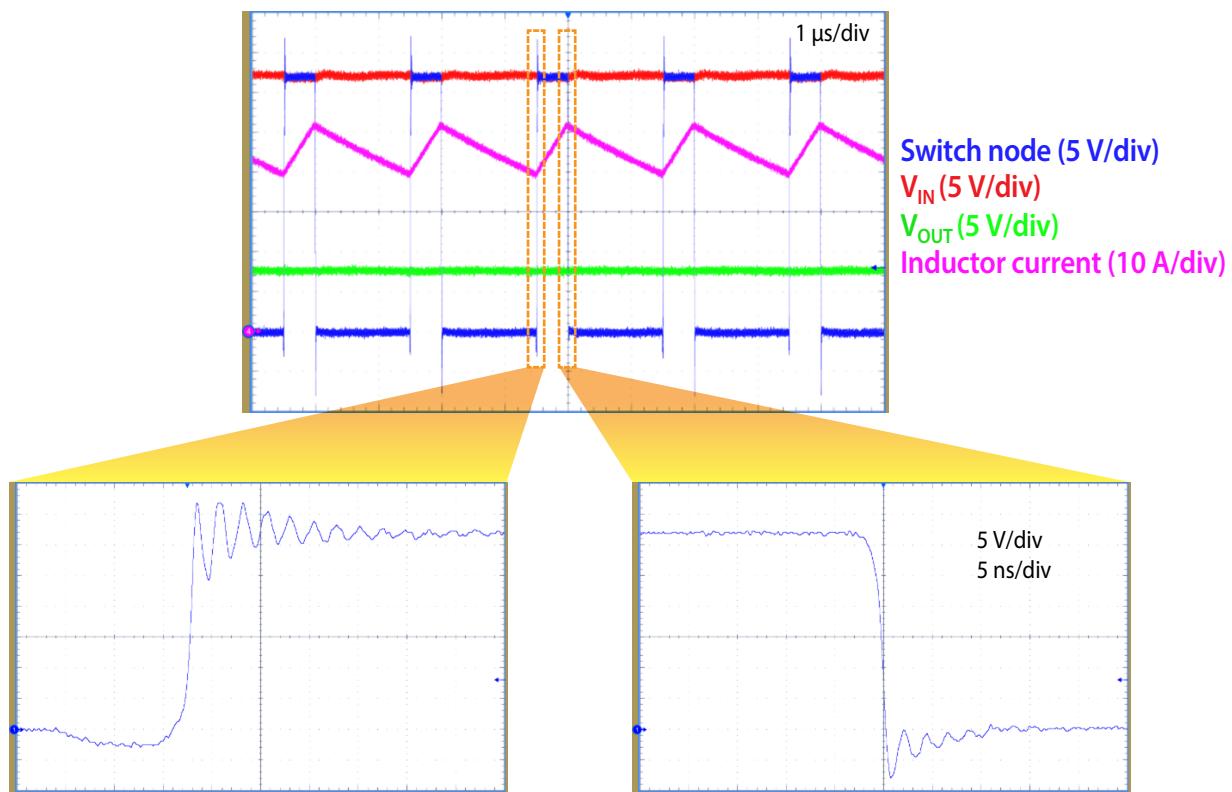


Figure 15: Measured input voltage, output voltage, inductor current, and switch node waveforms when operating from 32 V at 500 kHz and delivering 45 A into a 8 V load

EFFICIENCY and POWER LOSSES

Figure 16 shows the efficiency and power loss results when operating at 500 kHz and various input voltages delivering 8 V into the load, using a 1 μ H inductor and no heatsink installed

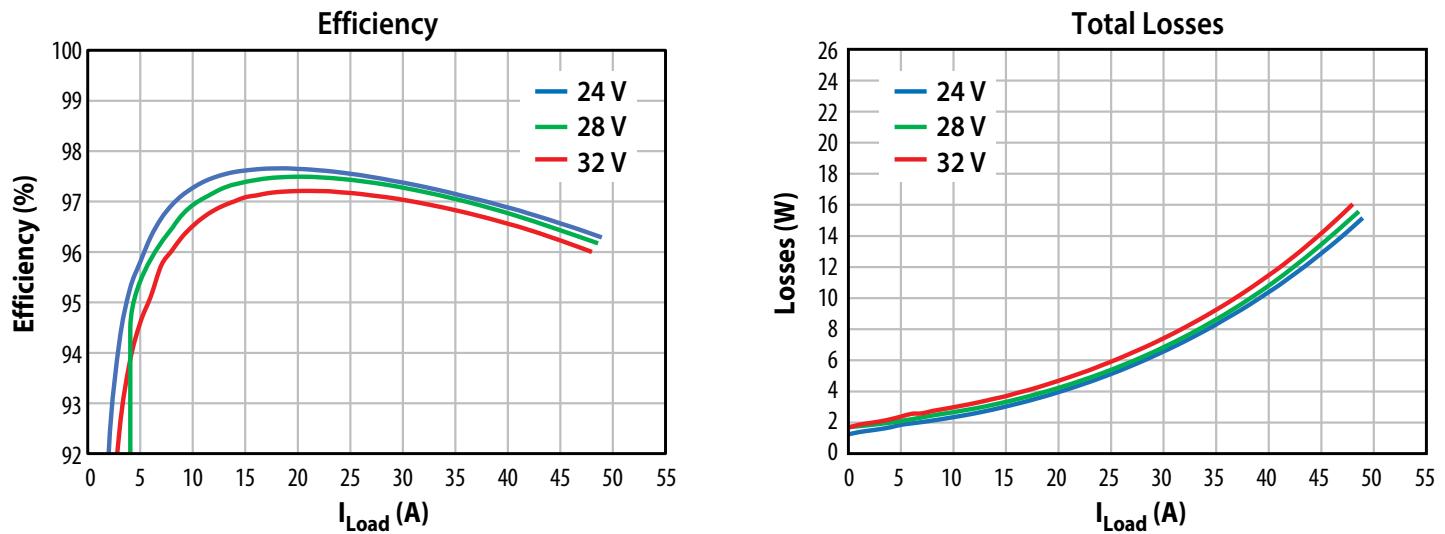


Figure 16: Measured efficiency and power loss when operating at 500 kHz and various input voltages delivering 8 V into the load, using a 1 μ H inductor and no heatsink installed

EFFICIENCY and POWER LOSSES (continued)

Figure 17 shows the efficiency and power loss results when operating at 24 V to 8 V and various switching frequencies using a 1 μ H inductor and no heatsink installed.

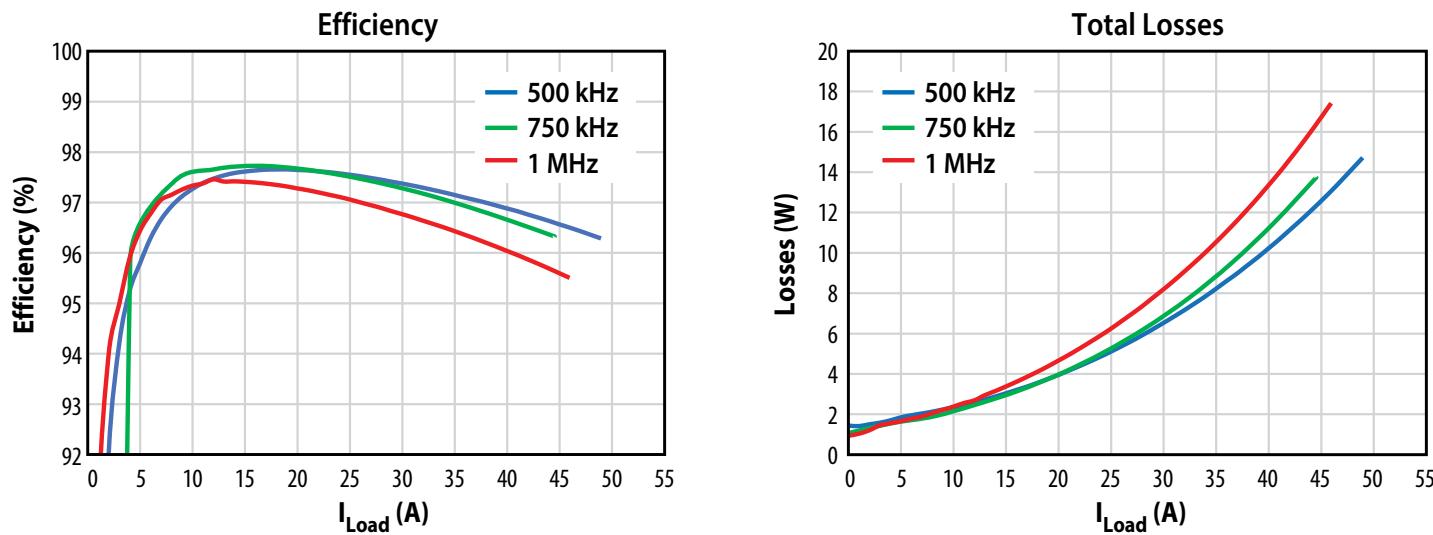


Figure 17: Measured efficiency and power loss when operating at 24 V to 8 V and various switching frequencies using a 1 μ H inductor and no heatsink installed

THERMAL PERFORMANCE

Figure 18 shows the thermal performance of the board when operating at 500 kHz and various input voltages, delivering 8 V into the load with 400 LFM (moderate) airflow.

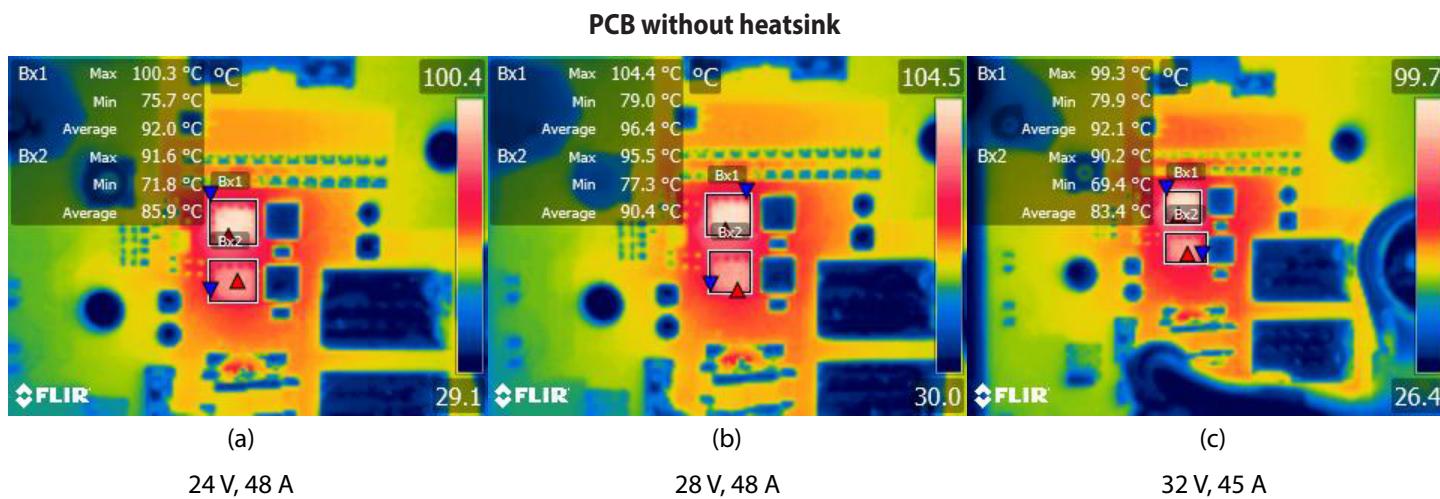


Figure 18: Thermal images of EPC90167 operating at various input voltages with 25C ambient temperature

Thermal Performance (continued)

Figure 19 shows the thermal performance of the board when operating at 24 V input voltage and various switching frequencies, delivering 8 V into the load with 400 LFM (moderate) airflow.

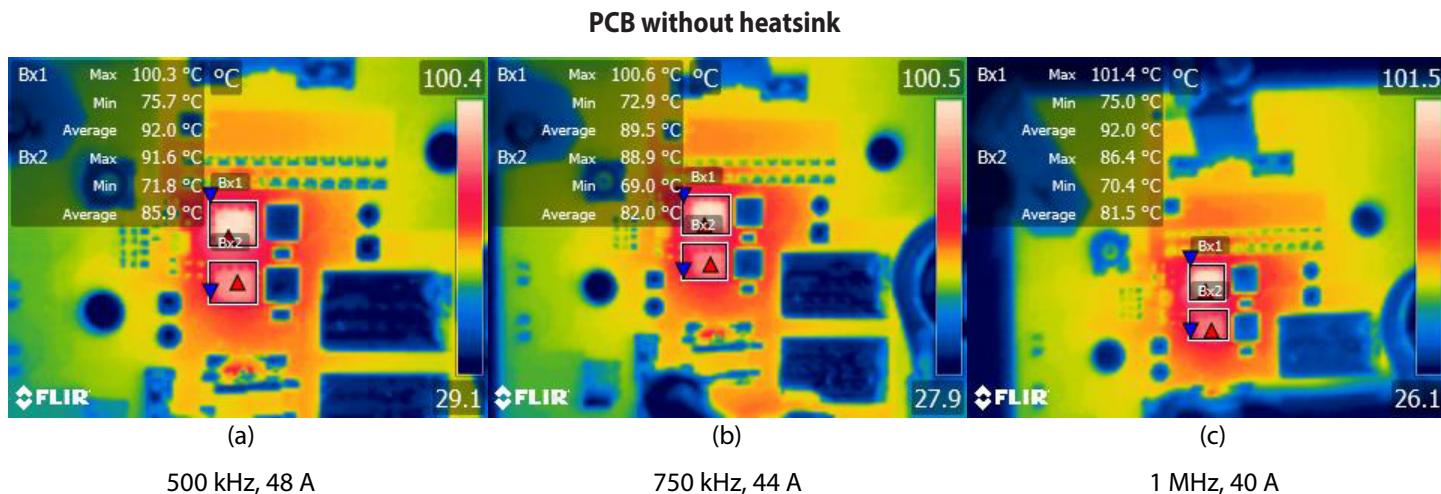


Figure 19: Thermal images of EPC90167 operating at various frequencies with 25C ambient temperature

Thermal Derating

Using the thermal setup for the board shown in Figures 9 and 10, additional testing at 400 LFM and 1000 LFM was conducted to determine the ambient temperature derating for the board with and without a heatsink attached. The temperature rise as function of load current is measured and the derating curves generated for a maximum case temperature of 110°C and shown in figure 20 with the board operating at 24 V to 8 V and various switching frequencies using a 1 μ H inductor.

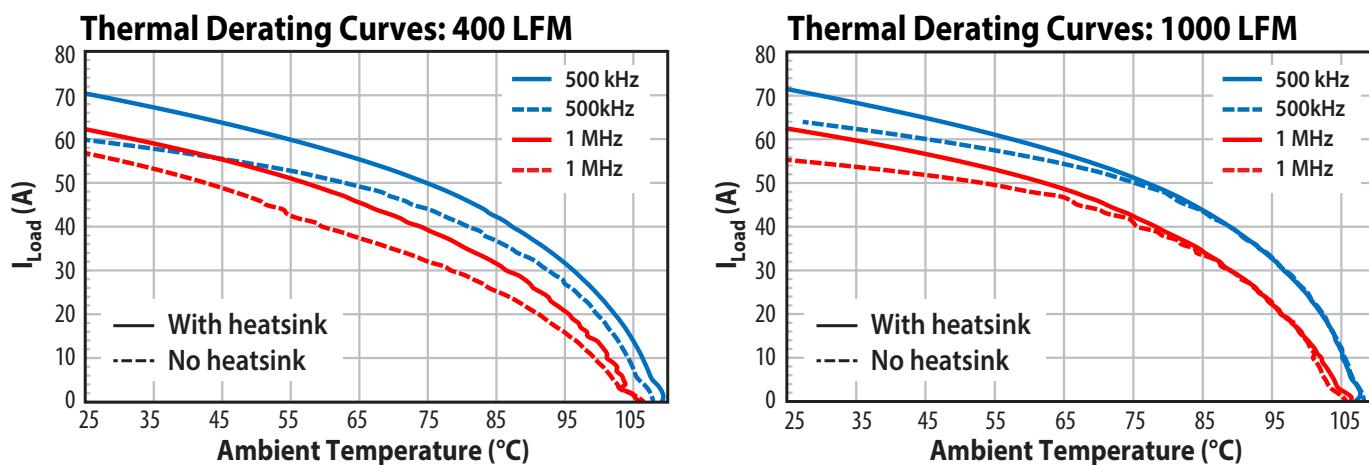


Figure 20: Typical thermal derating curves for two air flow rates, with and without a heatsink attached. Measured with the board operating at 24 V to 8 V and various switching frequencies and using a 1 μ H inductor

For support files including schematic, Bill of Materials (BOM), and gerber files please visit the EPC90167 landing page at: <https://epc-co.com/epc/products/evaluation-boards/EPC90167>

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