

Evaluation Board EPC9032 Quick Start Guide

40 V Half-Bridge with Gate Drive using EPC2024

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Version 2.0



DESCRIPTION

The EPC9032 evaluation board is a 40 V maximum device voltage, 40 A maximum output current, half bridge with onboard gate drives, featuring the EPC2024 enhancement mode (eGaN®) field effect transistor (FET). The purpose of this evaluation board is to simplify the evaluation process of the EPC2024 eGaN FET by including all the critical components on a single board that can be easily connected into the majority of existing converter topologies.

The EPC9032 evaluation board measures 2" x 2" and contains two EPC2024 eGaN FETs in a half bridge configuration using the Texas Instruments LMG1205 gate driver. The board also contains all critical components and the layout supports optimal switching performance. 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 the EPC2024 please refer to the datasheet available from EPC at www.epc-co.com. The datasheet should be read in conjunction with this quick start guide.

QUICK START PROCEDURE

The half bridge evaluation board EPC9032 is easy to set up as buck or boost converter. Refer to figure 2 for buck converter configuration and measurement setup, and figure 3 for boost converter setup, and follow the procedure below:

Buck converter configuration

1. With power off, connect the input power supply bus to V_{IN} (J5, J6) 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 (L_1) and output capacitors (C_{out}), as shown in figure 2 with a DC load connected across V_{OUT} and GND.
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 (J2, Pin-1) 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 switching 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.

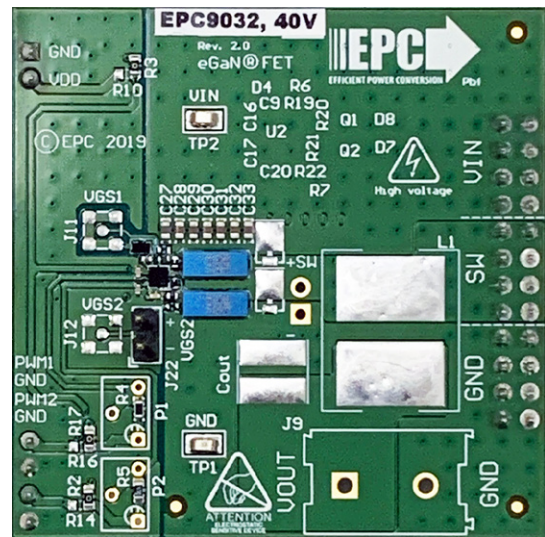
Table 1: Performance Summary ($T_A = 25^\circ\text{C}$) EPC9032

Symbol	Parameter	Conditions	Min	Max	Units
V_{DD}	Gate Drive Input Supply Range		7	12	V
V_{IN}	Bus Input Voltage Range ⁽¹⁾			32 ⁽¹⁾	V
I_{OUT}	Switch Node Output Current ⁽²⁾			40 ⁽²⁾	A
V_{PWM}	PWM Logic Input Voltage Threshold	Input 'High' Input 'Low'	3.5 0	6 1.5	V V
V_{SW}	Switch-node Voltage			32 ⁽¹⁾	
	Minimum 'High' State Input Pulse Width	V_{PWM} rise and fall time < 10ns	50		ns
	Minimum 'Low' State Input Pulse Width ⁽³⁾	V_{PWM} rise and fall time < 10ns	100 ⁽³⁾		ns

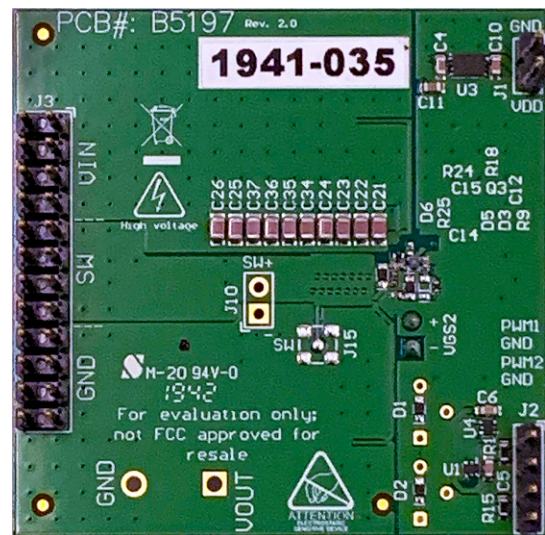
(1) Maximum input voltage depends on inductive loading, maximum switch node ringing must be kept under 40 V for EPC2024.

(2) Maximum current depends on die temperature – actual maximum current will be subject to switching frequency, bus voltage and thermal cooling.

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



Front view



Back view

EPC9032 evaluation board

Boost Converter configuration

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

1. The inductor (L_1) and input capacitors (labeled as C_{out}) can either be soldered onto the board, as shown in figure 3, or provided off board. Anti-parallel diodes can also be installed using the additional pads on the right side of the EPC2024 FETs.
2. With power off, connect the input power supply bus to V_{OUT} (J9, Pin-1) and ground / return to GND (J9, Pin-2), or externally across the capacitor if the inductor L_1 and C_{out} are provided externally. Connect the output voltage (labeled as V_{IN} , J5, J6) 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 (J2, Pin-1) and ground return to any of GND J2 pins indicated on the bottom side of the board. Note that the bottom FET gate drive signal is inverted with regard to PWM1. It is also possible to use separate input PWM signals by removing R2 and R17 and installing 0 Ω jumpers for R14 and R16.
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 switching 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.

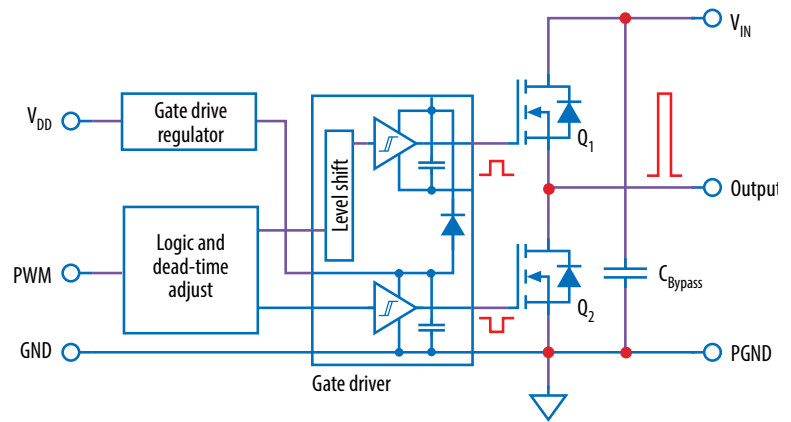


Figure 1: Block diagram of EPC9032 evaluation board

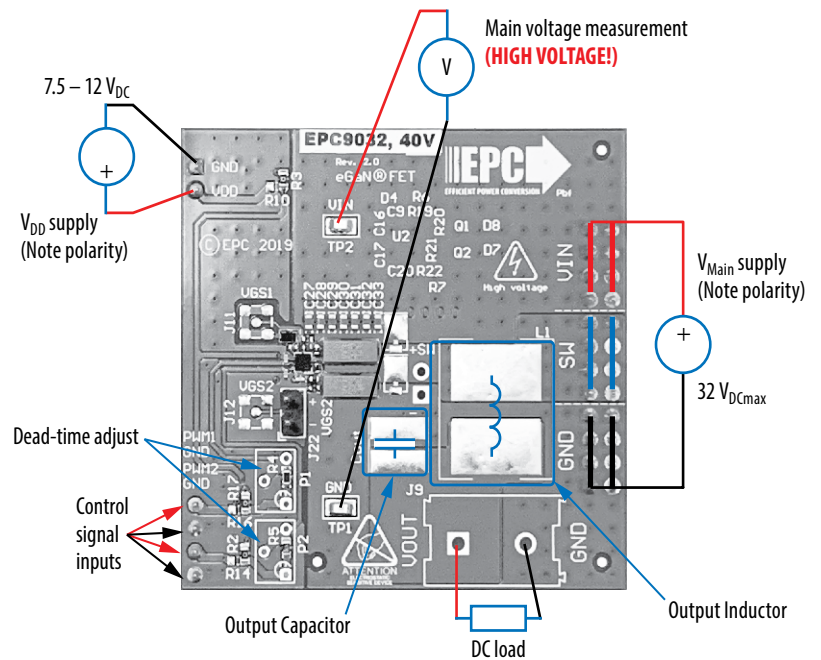


Figure 2: Buck configuration

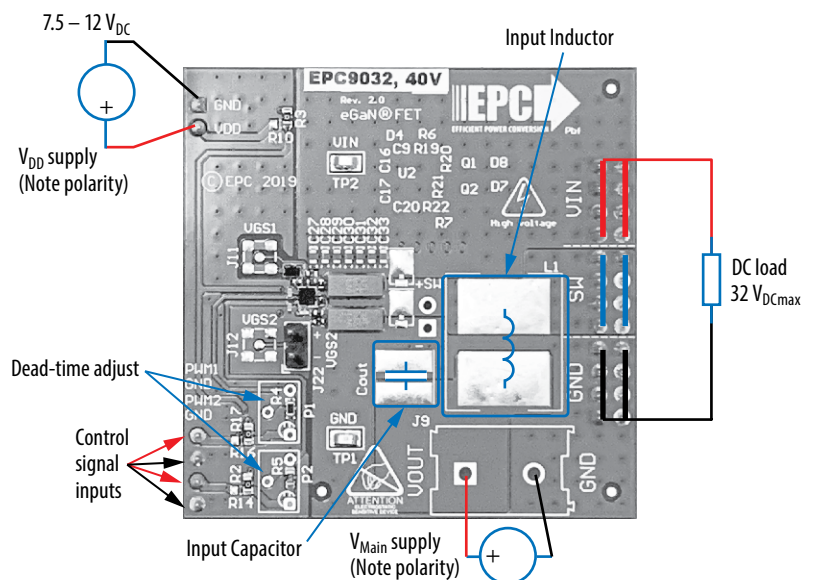


Figure 3: Boost configuration

THERMAL CONSIDERATIONS

The EPC9032 evaluation board showcases the EPC2024 eGaN FET. The EPC9032 is intended for bench evaluation with low ambient temperature and convection cooling. The addition of heat-sinking and forced air cooling can significantly increase the current rating of these devices, but care must be taken to not exceed the absolute maximum die temperature of 150° C.

NOTE. The EPC9032 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.

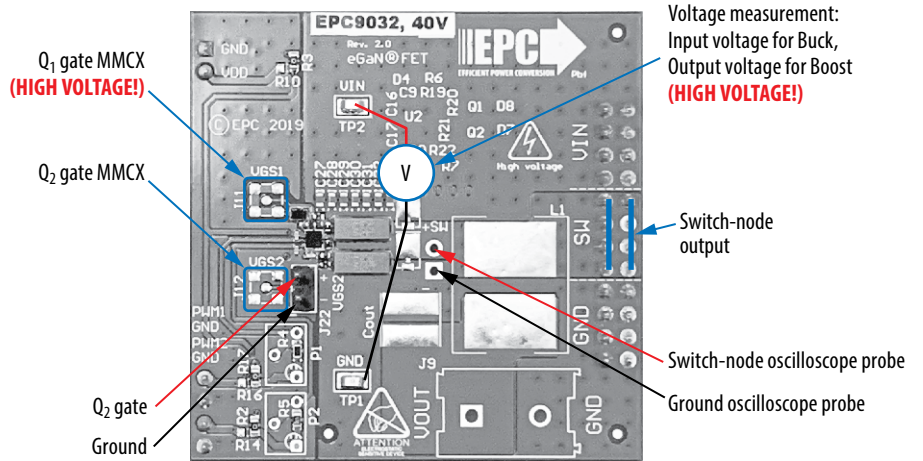


Figure 4: Measurement top side

MEASUREMENT CONSIDERATIONS

When measuring the high frequency content switch node, care must be taken to provide an accurate high speed measurement. An optional two pin header (J10) is included for switch node measurement. MMCX connector footprint is also provided (J15 in figure 5) to measure switch node.

Low-side gate voltage (V_{GS2}) can be measured at the two pin header (J22) or the MMCX (J12). Please refer to figure 4. R7 (0 Ω resistor) will need to be installed.

High-side gate voltage (V_{GS1}) can only be measured using the MMCX connector (J11). Please refer to figure 4. R6 (0 Ω resistor) will need to be installed.

Differential probe is recommended for measuring high-side gate. IsoVu probes from Tektronix has mating MMCX connector.

For regulator passive voltage probes (e.g. TPP1000) measuring low-side gate or switch node using MMCX connector, probe adaptor is available. PN: 206-0663-xx.

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

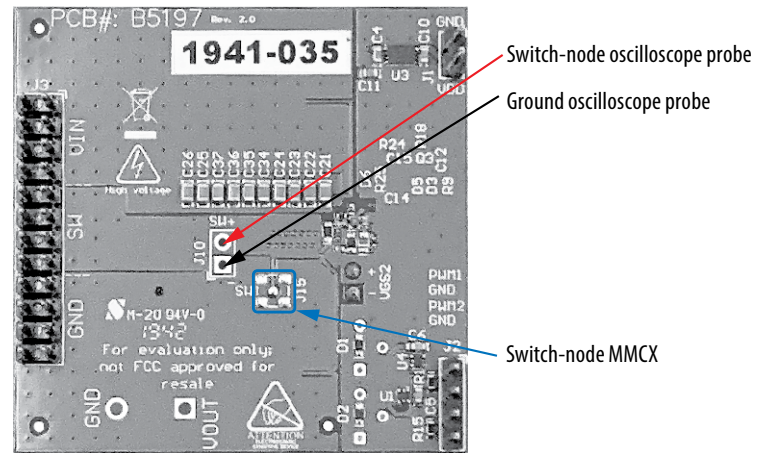


Figure 5: Measurement bottom side.

For support files including schematic, Bill of Materials (BOM), and gerber files please visit the EPC9032 landing page at: <https://epc-co.com/epc/products/demo-boards/epc9032>

For More Information:

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Evaluation Board Notification

The EPC9032 board is intended for product evaluation purposes only. It is not intended for commercial use nor is it FCC approved for resale. Replace components on the Evaluation Board only with those parts shown on the parts list (or Bill of Materials) in the Quick Start Guide. Contact an authorized EPC representative with any questions. This board is intended to be used by certified professionals, in a lab environment, following proper safety procedures. Use at your own risk.

As an evaluation tool, this board is not designed for compliance with the European Union directive on electromagnetic compatibility or any other such directives or regulations. As board builds are at times subject to product availability, it is possible that boards may contain components or assembly materials that are not RoHS compliant. Efficient Power Conversion Corporation (EPC) makes no guarantee that the purchased board is 100% RoHS compliant.

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