

Development Board EPC9031/32/33/34/35 Quick Start Guide

Half-bridge with Gate Drive
for EPC2020/21/22/23/24

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DESCRIPTION

These development boards are in a half-bridge topology with onboard gate drives, featuring the EPC2020/21/22/23/24 eGaN® field effect transistors (FETs). The purpose of these development boards is to simplify the evaluation process of these eGaN FETs by including all the critical components on a single board that can be easily connected into any existing converter.

The development board is 2" x 1.5" and contains two eGaN FETs in a half-bridge configuration using the Texas Instruments LM5113 gate driver, supply and bypass capacitors. The board contains all critical components and layout for optimal switching performance. There are also various probe points to facilitate simple waveform measurement and efficiency calculation. A complete block diagram of the circuit is given in Figure 1.

For more information on the EPC2020/21/22/23/24 eGaN FETs, please refer to the 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 °C)

| Symbol | Parameter | Conditions | Min | Max | Units |
|------------------|--|--|------------------|-----|-------|
| V _{DD} | Gate Drive Input Supply Range | | 7 | 12 | V |
| V _{IN} | Bus Input Voltage Range | When using 30 V devices, EPC9031 | | 24* | V |
| | | When using 40 V devices, EPC9032 | | 32* | V |
| | | When using 60 V devices, EPC9033 | | 48* | V |
| | | When using 80 V devices, EPC9034 | | 64* | V |
| | | When using 100 V devices, EPC9035 | | 80* | V |
| V _{OUT} | Switch Node Output Voltage | When using 30 V devices, EPC9031 | | 30 | V |
| | | When using 40 V devices, EPC9032 | | 40 | V |
| | | When using 60 V devices, EPC9033 | | 60 | V |
| | | When using 80 V devices, EPC9034 | | 80 | V |
| | | When using 100 V devices, EPC9035 | | 100 | V |
| I _{OUT} | Switch Node Output Current | When using 30 V devices, EPC9031 | | 40* | A |
| | | When using 40 V devices, EPC9032 | | 35* | A |
| | | When using 60 V devices, EPC9033 | | 30* | A |
| | | When using 80 V devices, EPC9034 | | 27* | A |
| | | When using 100 V devices, EPC9035 | | 25* | A |
| V _{PWM} | PWM Logic Input Voltage Threshold | Input 'Low' | 3.5 | 6 | V |
| | | Input 'High' | 0 | 1.5 | V |
| | Minimum "High" State Input Pulse Width | V _{PWM} rise and fall time < 10ns | 50 | | ns |
| | Minimum "Low" State Input Pulse Width | V _{PWM} rise and fall time < 10ns | 100 [#] | | ns |

*Assumes inductive load, maximum current depends on die temperature – actual maximum current will be subject to switching frequency, bus voltage and thermal cooling.
Limited by time needed to 'refresh' high side bootstrap supply voltage.

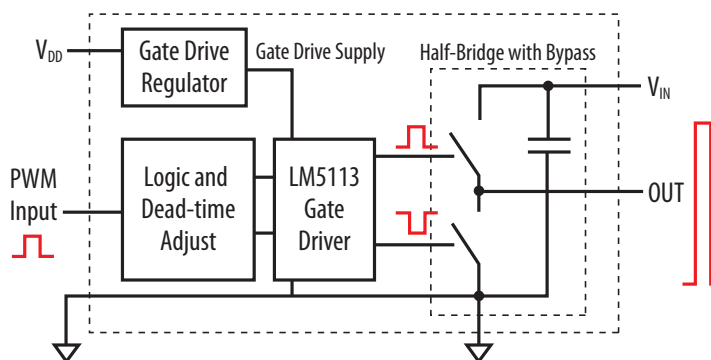


Figure 1: Block Diagram of Development Board

Demonstration Board Notification

EPC9031/32/33/34/35 boards are intended for product evaluation purposes only and are not intended for commercial use. As evaluation tools, they are 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. No Licenses are implied or granted under any patent right or other intellectual property whatsoever. EPC assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind.

EPC reserves the right at any time, without notice, to change said circuitry and specifications.

QUICK START PROCEDURE

The development boards are easy to set up to evaluate the performance of the eGaN FET. Refer to Figure 2 for proper connect and measurement setup and follow the procedure below:

1. With power off, connect the input power supply bus to $+V_{IN}$ (J5, J6) and ground / return to $-V_{IN}$ (J7, J8).
2. With power off, connect the switch node of the half-bridge OUT (J3, J4) to your circuit as required.
3. With power off, connect the gate drive input to $+V_{DD}$ (J1, Pin-1) and ground return to $-V_{DD}$ (J1, Pin-2).
4. With power off, connect the input PWM control signal to PWM (J2, Pin-1) and ground return to any of the remaining J2 pins.
5. Turn on the gate drive supply – make sure the supply is between 7 V and 12 V range.
6. Turn on the bus voltage to the required value (do not exceed the absolute maximum voltage on V_{OUT} as indicated in the table below:
 - a. EPC9031, 30 V
 - b. EPC9032, 40 V
 - c. EPC9033, 60 V
 - d. EPC9034, 80 V
 - e. EPC9035, 100 V
7. Turn on the controller / PWM input source and probe switching node to see switching operation.
8. Once operational, adjust the bus voltage and load PWM control within the operating range and observe the output switching behavior, efficiency and other parameters.
9. For shutdown, please follow steps in reverse.

NOTE. When measuring the high frequency content switch node (OUT), care must be taken to avoid long ground leads. Measure the switch node (OUT) by placing the oscilloscope probe tip through the large via on the switch node (designed for this purpose) and grounding the probe directly across the GND terminals provided. See Figure 3 for proper scope probe technique.

THERMAL CONSIDERATIONS

The EPC9031/32/33/34/35 development boards showcase the EPC2020/21/22/23/24 eGaN FETs. Although the electrical performance surpasses that for traditional Si devices, their relatively smaller size does magnify the thermal management requirements. These development boards are 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 EPC9031/32/33/34/35 development boards do not have any current or thermal protection on board.

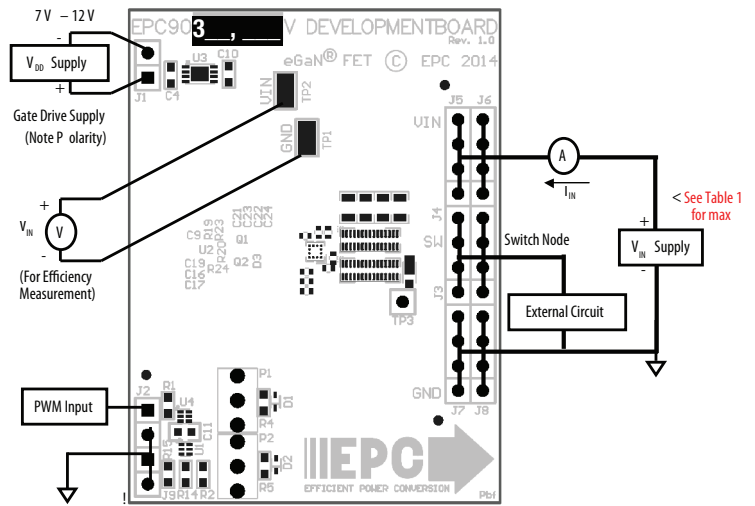


Figure 2: Proper Connection and Measurement Setup

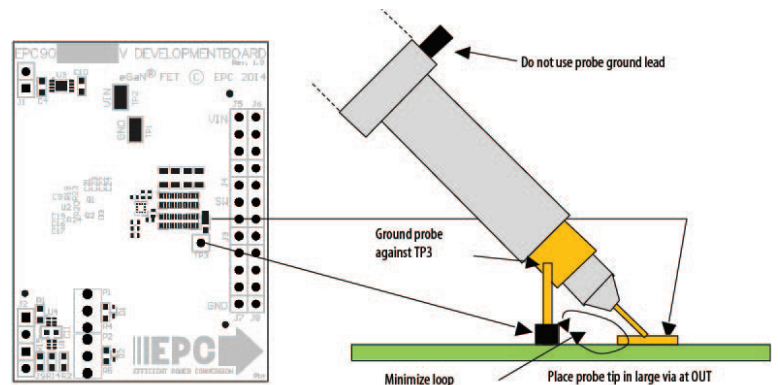


Figure 3: Proper Measurement of Switch Node – OUT

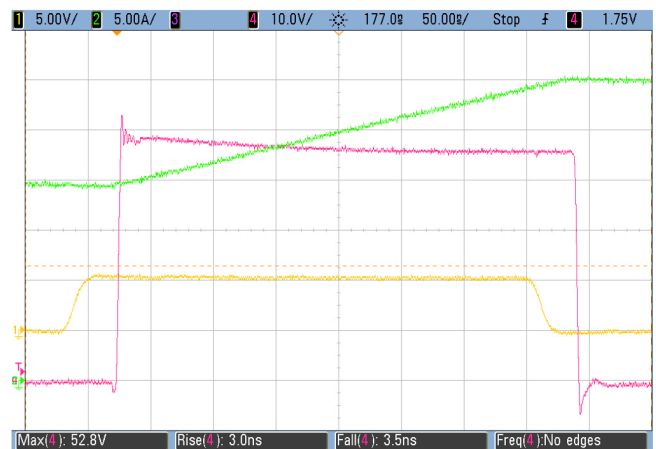


Figure 4: Typical Waveforms for $V_{IN} = 48 V$ to $5 V/25 A$ (300 kHz) Buck converter
 CH1: (V_{PWM}) Input logic signal – CH2: (I_{OUT}) Output inductor current –
 CH3: (V_{DD}) Gate drive supply voltage – CH4: (V_{OUT}) Switch node voltage

Table 2 : Bill of Material

| Item | Qty | Reference | Part Description | Manufacturer / Part # |
|------|-----|------------------------|---------------------------------|------------------------------|
| 1 | 3 | C4, C10, C11, | Capacitor, 1µF, 10%, 25V, X5R | Murata, GRM188R61E105KA12D |
| 2 | 2 | C16, C17 | Capacitor, 100pF, 5%, 50V, NP0 | Kemet, C0402C101K5GACTU |
| 3 | 2 | C9, C19 | Capacitor, 0.1µF, 10%, 25V, X5R | TDK, C1005X5R1E104K |
| 4 | 4 | C21, C22, C23, C24 | Capacitor, - see Table 3 | See Table 3 |
| 5 | 2 | D1, D2 | Schottky Diode, 30V | Diodes Inc., SDM03U40-7 |
| 6 | 3 | J1, J2, J9 | Connector | 2 pins of Tyco, 4-103185-0 |
| 7 | 1 | J3, J4, J5, J6, J7, J8 | Connector | FCI, 68602-224HLF |
| 8 | 2 | Q1, Q2 | eGaN® FET, - see Table 3 | See Table 3 |
| 9 | 1 | R1 | Resistor, 10.0K, 5%, 1/8W | Stackpole, RMCF0603FT10K0 |
| 10 | 2 | R2, R15 | Resistor, 0 Ohm, 1/8W | Stackpole, RMCF0603ZT0R00 |
| 11 | 1 | R4 | Resistor, 10 Ohm, 1%, 1/8W | Stackpole, RMCF0603FT10R0 |
| 12 | 1 | R5 | Resistor, - see Table 3 | See Table 3 |
| 13 | 2 | R19, R20 | Resistor, 0 Ohm, 1/16W | Stackpole, RMCF0402ZT0R00 |
| 14 | 2 | R23, R24 | Resistor, 0 Ohm, 1/16W | Stackpole, RMCF0402ZT0R00 |
| 15 | 2 | TP1, TP2 | Test Point | Keystone Elect, 5015 |
| 16 | 1 | TP3 | Connector | 1/40th of Tyco, 4-103185-0 |
| 17 | 1 | U1 | I.C., Logic | Fairchild, NC7SZ00L6X |
| 18 | 1 | U2 | I.C., Gate driver | Texas Instruments, LM5113 |
| 19 | 1 | U3 | I.C., Regulator | Microchip, MCP1703T-5002E/MC |
| 20 | 1 | U4 | I.C., Logic | Fairchild, NC7SZ08L6X |
| 21 | 0 | R14 | Optional Resistor | |
| 22 | 0 | D3 | Optional Diode | |
| 23 | 0 | P1, P2 | Optional Potentiometer | |

Table 3 : Variable BOM Components

| Board Number | Item | Qty | Reference | Part Description | Manufacturer / Part # |
|--------------|------|-----|--------------------|---------------------------------|---------------------------|
| EPC9031 | 4 | 4 | C21, C22, C23, C24 | Capacitor, 4.7µF, 10%, 50V, X5R | TDK, C2012X5R1H475K125AB |
| | 8 | 2 | Q1, Q2 | eGaN® FET | EPC2023 |
| | 12 | 1 | R5 | Resistor, 47 Ω, 1%, 1/8W | Stackpole, RMCF0603FT47R0 |
| EPC9032 | 4 | 4 | C21, C22, C23, C24 | Capacitor, 4.7µF, 10%, 50V, X5R | TDK, C2012X5R1H475K125AB |
| | 8 | 2 | Q1, Q2 | eGaN® FET | EPC2024 |
| | 12 | 1 | R5 | Resistor, 47 Ω, 1%, 1/8W | Stackpole, RMCF0603FT47R0 |
| EPC9033 | 4 | 4 | C21, C22, C23, C24 | Capacitor, 1µF, 10%, 100V, X7R | TDK, CGA4J3X7S2A105K125AE |
| | 8 | 2 | Q1, Q2 | eGaN® FET | EPC2020 |
| | 12 | 1 | R5 | Resistor, 75 Ω, 1%, 1/8W | Stackpole, RMCF0603FT75R0 |
| EPC9034 | 4 | 4 | C21, C22, C23, C24 | Capacitor, 1µF, 10%, 100V, X7R | TDK, CGA4J3X7S2A105K125AE |
| | 8 | 2 | Q1, Q2 | eGaN® FET | EPC2021 |
| | 12 | 1 | R5 | Resistor, 100 Ω, 1%, 1/8W | Stackpole, RMCF0603FT100R |
| EPC9035 | 4 | 4 | C21, C22, C23, C24 | Capacitor, 1µF, 10%, 100V, X7R | TDK, CGA4J3X7S2A105K125AE |
| | 8 | 2 | Q1, Q2 | eGaN® FET | EPC2022 |
| | 12 | 1 | R5 | Resistor, 100 Ω, 1%, 1/8W | Stackpole, RMCF0603FT100R |

