Development Board EPC9013 Quick Start Guide

100 V Parallel Evaluation for High Current Applications Using EPC2001C

Revision 2.0

EFFICIENT POWER CONVERSION

DESCRIPTION

The EPC9013 development board features the 100 V EPC2001C enhancement mode (eGaN®) field effect transistor (FET) operating up to a 35 A maximum output current with four half bridges in parallel and a single onboard gate drive. The purpose of this development board is to simplify the evaluation process of the EPC2001C eGaN FET for high current operation by including all the critical components on a single board that can be easily connected into any existing converter.

The EPC9013 development board is 2” x 2” and features eight EPC2001C eGaN FETs using the uPI Semiconductor uP1966A gate driver. The development board configuration is recommended for high current applications. The board contains all critical components and the printed circuit board (PCB) layout is designed for optimal switching performance. There are also various probe points to facilitate simple waveform measurement and evaluate eGaN FET efficiency. A complete block diagram of the circuit is given in Figure 1.

For more information on the EPC2001C 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

Development board EPC9013 is easy to set up to evaluate the performance of the EPC2001C 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 of 100 V on V_{OUT}).
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 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.

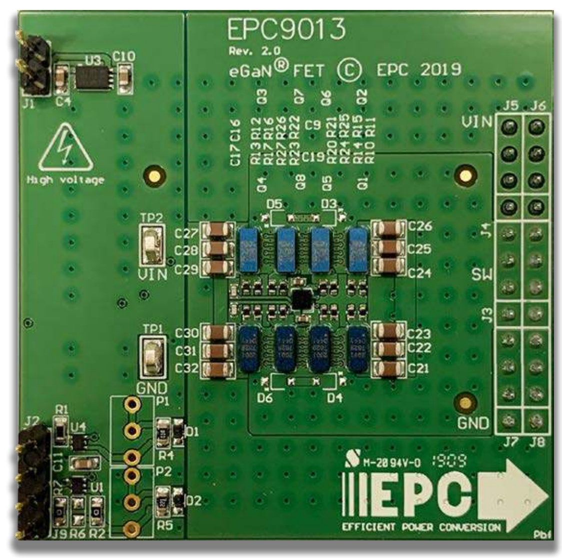
For information about measurement techniques, please review the how to GaN series: HTG09- Measurement

http://epc-co.com/epc/DesignSupport/TrainingVideos/HowtoGaN/

Table 1: Performance Summary (T_A = 25°C) EPC9013

Symbol	Parameter	Conditions	Min	Max	Units
V_{DD}	Gate Drive Input Supply Range		7	12	V
V_{IN}	Bus Input Voltage Range(1)			70	V
V_{OUT}	Switch Node Output Voltage			100	V
I_{OUT}	Switch Node Output Current (2)	200 LFM		35	A
V_{PWM}	PWM Logic Input Voltage Threshold	Input ‘High’ Input ‘Low’	3.5 0	6 1.5	V V
	Minimum ‘High’ State Input Pulse Width	V_{PWM} rise and fall time < 10ns	60		ns
	Minimum ‘Low’ State Input Pulse Width (3)	V_{PWM} rise and fall time < 10ns	100		ns

(1) Assumes inductive load, maximum current depends on die temperature – actual maximum current will be subject to switching frequency, bus voltage and thermals.
(2) Maximum current depends on die temperature – actual maximum current with be subject to switching frequency, bus voltage and thermal cooling.
(3) Limited by time needed to ‘refresh’ high side bootstrap supply voltage.



EPC9013 development board

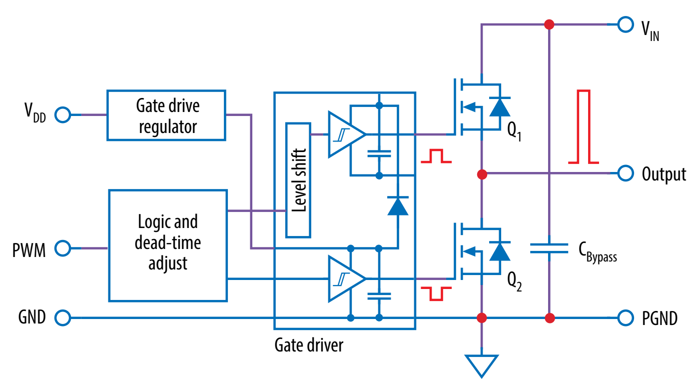


Figure 1: Block diagram of EPC9013 development board

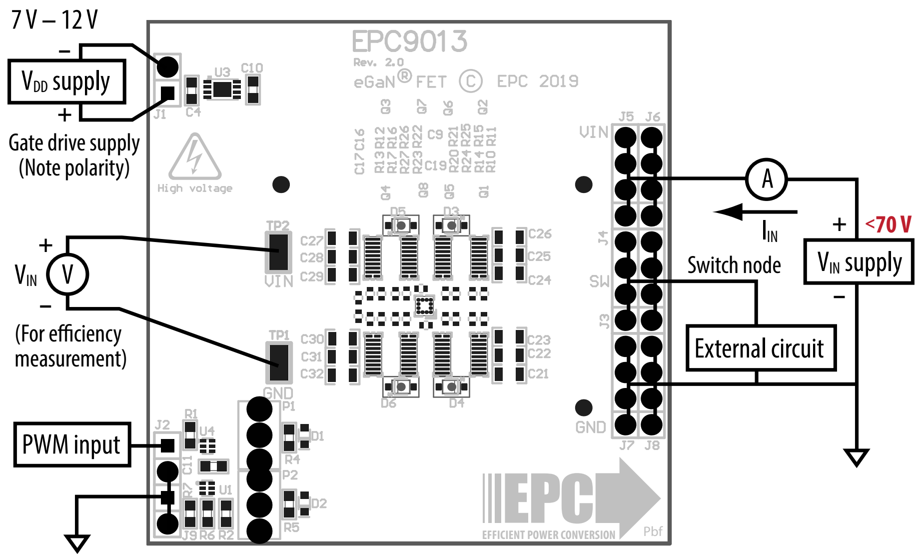


Figure 2: Proper connection and measurement setup

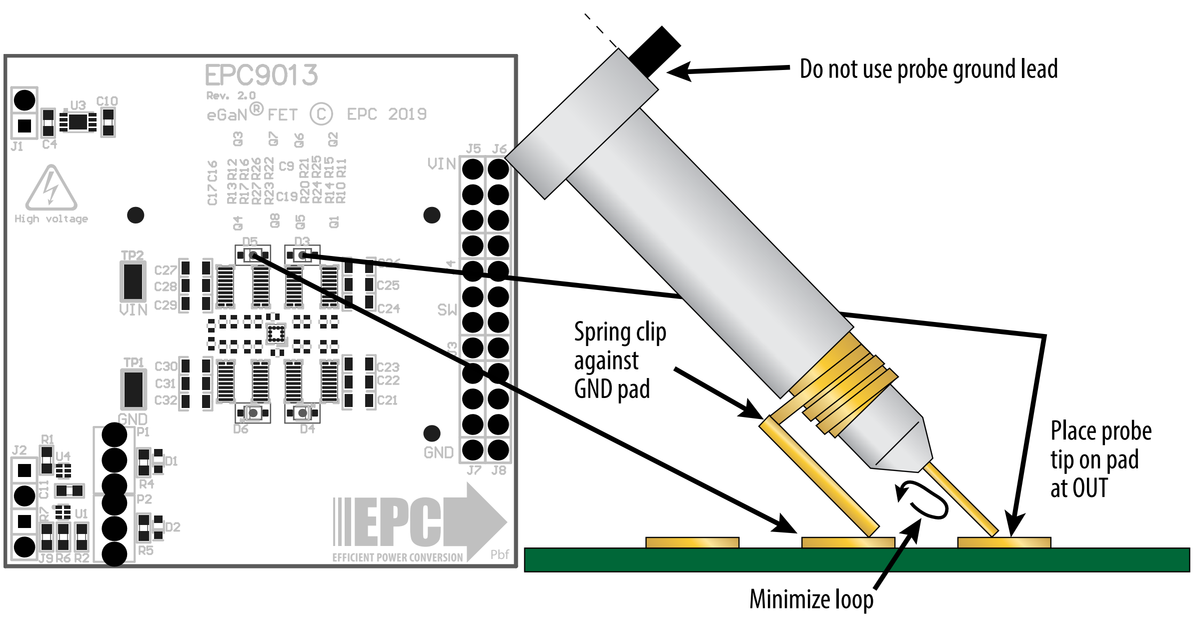


Figure 3: Proper Measurement of Switch Node – V_{SW}

THERMAL CONSIDERATIONS

The EPC9013 development board showcases the EPC2001C eGaN FET. Although the electrical performance surpasses that for traditional silicon devices, their relatively smaller size does magnify the thermal management requirements. The EPC9013 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 EPC9013 development 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.

Table 2: Bill of Materials

Item	Qty	Reference	Part Description	Manufacturer	Part Number
1	3	C4, C10, C11	Capacitor, 1 µF, 10%, 25 V, X5R	Murata	GRM188R61E105KA12D
2	2	C16, C17	Capacitor, 100 pF, 5%, 50 V, NP0	Kemet	C0402C101K5GACTU
3	2	C9, C19	Capacitor, 100 nF, 10%, 25 V, X5R	TDK	C1005X5R1E104K
4	12	C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32	Capacitor, 1 µF, 10%, 100 V, X7R	TDK	CGA4J3X7S2A105K125AE
5	2	D1, D2	Schottky Diode, 30 V	Diodes Inc.	SDM03U40-7
6	3	J1, J2, J9	Connector	FCI	68001-236HLF
7	6	J3, J4, J5, J6, J7, J8	Connector	FCI	68602-224HLF
8	8	Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8	eGaN® FET	EPC	EPC2001C
9	1	R1	Resistor, 10.0 k, 5%, 1/8 W	Stackpole	RMCF0603FT10K0
10	2	R2, R7	Resistor, 0 Ω, 1/10 W	Panasonic	ERJ-3GEY0R00V
11	1	R4	Resistor, 100 Ω, 1%, 1/10 W	Stackpole	RMCF0603FT100R
12	8	R10, R11, R12, R13, R20, R21, R22, R23	Resistor, 4.7 Ω, 1%, 1/16 W	Yageo	RC0402FR-074R7L
13	8	R14, R15, R16, R17, R24, R25, R26, R27	Resistor, 2.0 Ω, 1%, 1/16 W	Vishay Dale	CRCW04022R00FKED
14	1	R5	Resistor, 220 Ω, 1%, 1/10 W	Stackpole	RMCF0603FT220R
15	2	TP1, TP2	Test Point	Keystone	5015
16	1	U1	I.C., Logic	Fairchild	NC7SZ00L6X
17	1	U2	I.C., Gate driver	upi Semiconductor	uP1966A
18	1	U3	I.C., Regulator	Microchip	MCP1703T-5002E/MC
19	1	U4	I.C., Logic	Fairchild	NC7SZ08L6X
20	1	R6	Optional Resistor		
21	4	D3, D4, D5, D6	Optional Diode		
22	2	P1, P2	Optional Potentiometer		

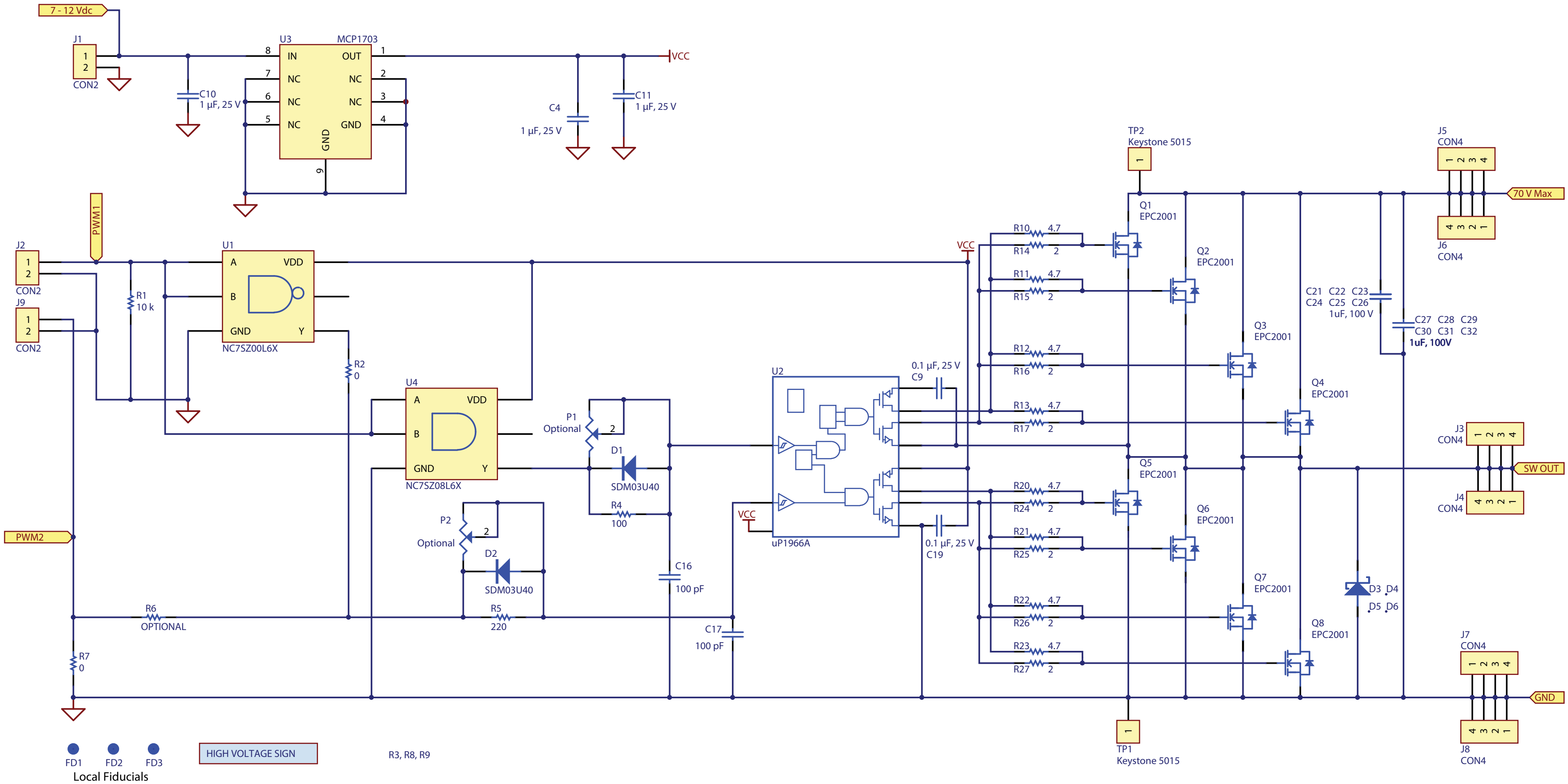


Figure 4: EPC9013 - Schematic

For More Information:

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Demonstration Board Notification

The EPC9013 board is intended for product evaluation purposes only and is not intended for commercial use. 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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