Development Board EPC9018/19 Quick Start Guide

Half-Bridge with Gate Drive for EPC2015/23 AND EPC2001/21

DESCRIPTION

These development boards are in a half-bridge topology with onboard gate drives, featuring the EPC2015/23 and EPC2001/21 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 EPC2015/23 and EPC2001/21 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, EPC9018		24*	V
		When using 80 V devices, EPC9019		64*	V
V_{OUT}	Switch Node Output Voltage	When using 30 V devices, EPC9018		30	V
		When using 80 V devices, EPC9019		80	V
I_{OUT}	Switch Node Output Current	When using 30 V devices, EPC9018		35*	A
		When using 80 V devices, EPC9019		20*	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 with be subject to switching frequency, bus voltage and thermal cooling. Die combination intended for high step-down ratio applications.

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

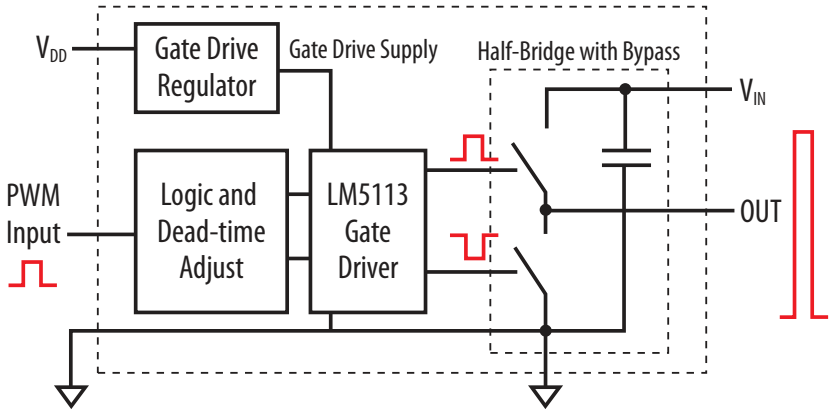

Figure 1: Block Diagram of Development Board

For More Information:

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EFFICIENT POWER CONVERSION

Demonstration Board Notification

EPC9018/19 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. EPC9018, 30 V
   b. EPC9019, 80 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.

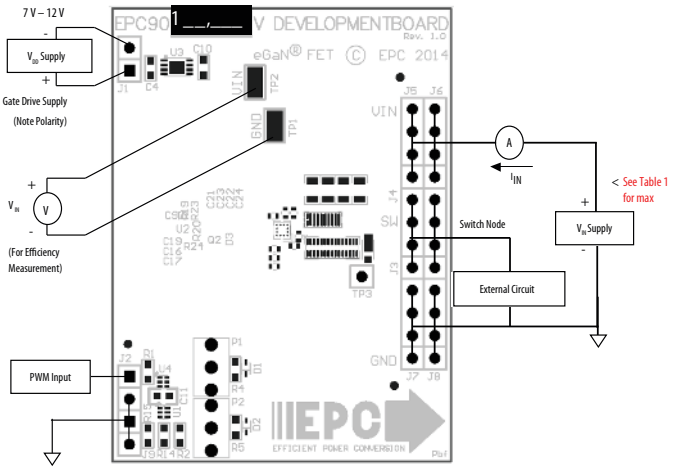

Figure 2: Proper Connection and Measurement Setup

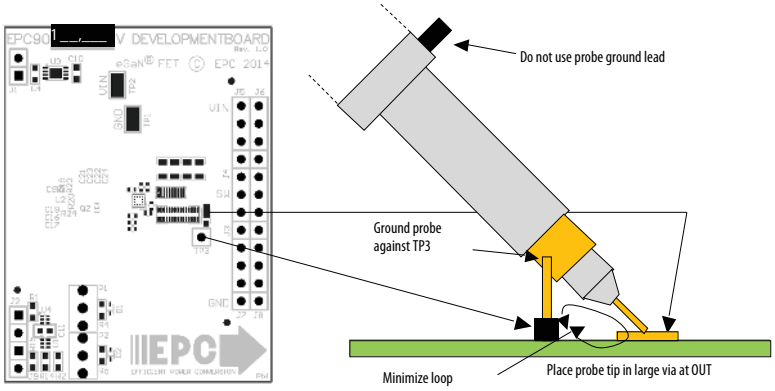

Figure 3: Proper Measurement of Switch Node – OUT

THERMAL CONSIDERATIONS

The EPC9018/19 development boards showcase the EPC2015/23 and EPC2001/21 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 EPC9018/19 development boards do not have any current or thermal protection on board.

Figure 4: Typical Waveforms for V_{IN} = 48 V to 5 V/20 A (300 kHz) Buck converter
CH1: (V_{PWM}) Input logic signal – CH2: (I_{OUT}) Output inductor current –
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	1	Q1	eGaN® FET, - see Table 3	See Table 3
9	1	Q2	eGaN® FET, - see Table 3	See Table 3
10	1	R1	Resistor, 10.0K, 5%, 1/8W	Stackpole, RMCF0603FT10K0
11	2	R2, R15	Resistor, 0 Ω, 1/8W	Stackpole, RMCF0603ZT0R00
12	2	R4, R5	Resistor, 22 Ω, 1%, 1/8W	Stackpole, RMCF0603FT22R0
13	2	R19, R20	Resistor, 0 Ω, 1/16W	Stackpole, RMCF0402ZT0R00
14	2	R23, R24	Resistor, 0 Ω, 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	National, 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 #
EPC9018	4	4	C21, C22, C23, C24	Capacitor, 4.7µF, 10%, 50V, X5R	TDK, C2012X5R1H475K125AB
	8	1	Q1	eGaN® FET	EPC2015
	9	1	Q2	eGaN® FET	EPC2023
EPC9019	4	4	C21, C22, C23, C24	Capacitor, 1µF, 10%, 100V, X7R	TDK, CGA4J3X7S2A105K125AE
	8	1	Q1	eGaN® FET	EPC2001
	9	1	Q2	eGaN® FET	EPC2021

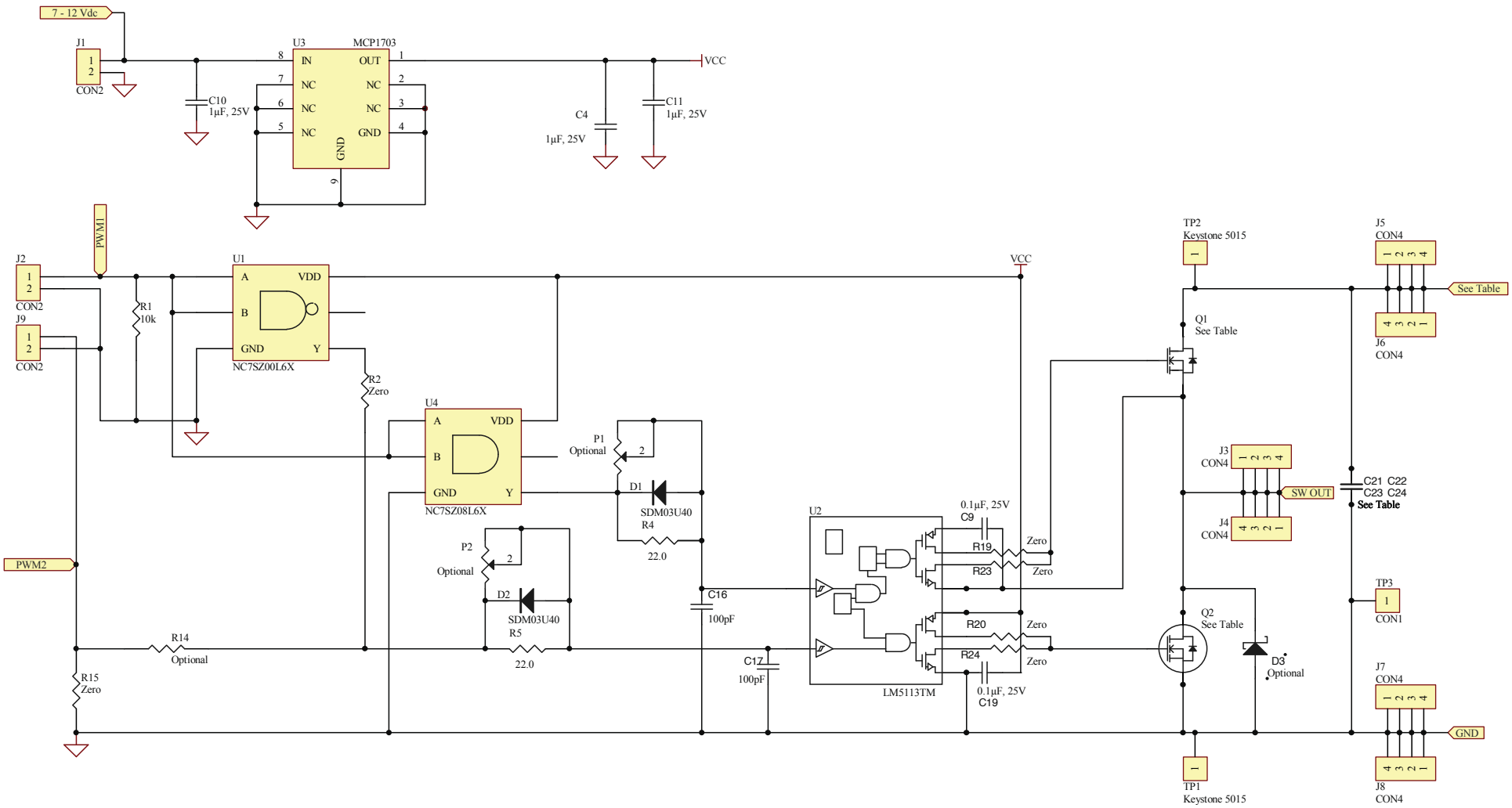

Figure 5: Development Board Schematic