Evaluation System EPC9157 Quick Start Guide

18–60 V Input, 12 V, 25 A Output
300 W $^{1}/_{16}^{th}$ Brick Evaluation Module

December 29, 2020

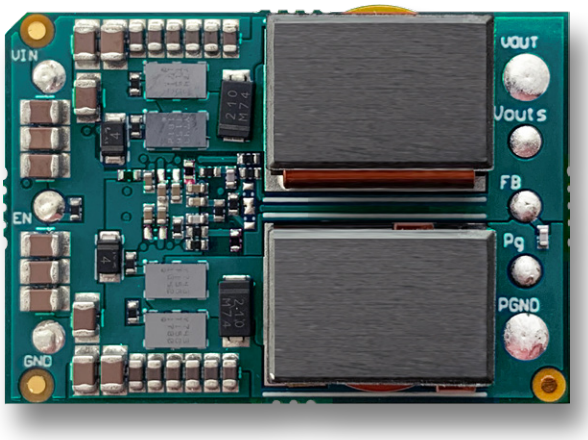
Version 1.0

EFFICIENT POWER CONVERSION

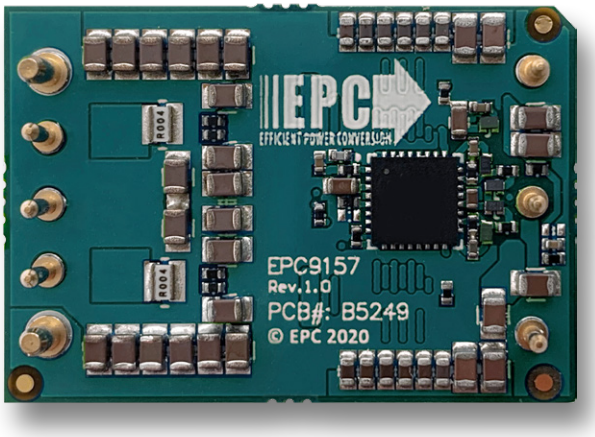
DESCRIPTION

The EPC9157 $^{1}/_{16}^{th}$ brick evaluation power module is designed for 48 V to 12 V DC-DC applications. It features the EPC2218 eGaN® FETGaN, and enhancement mode field effect transistors, as well as the Renesas ISL81806 80 V Dual Synchronous Buck Controller. Other features include:

- High efficiency: > 95% @ 12 V/25 A output
- Dimension: 33 mm x 22.9 mm x 9 mm (1.30 in. x 0.90 in. x 0.35 in.)
- Industry standard footprint and pinout
- Positive logic on/off
- Power good output
- Constant switching frequency: 500 kHz
- Remote output voltage sense
- Fault protection:
  - o Output over-current/ over-voltage
  - o Over temperature protection



EPC9157 top view



EPC9157 bottom view

REGULATORY INFORMATION

This power module is for evaluation purposes only. It is not a full-featured power module and cannot be used in final products. No EMI test was conducted. It is not FCC approved.

Table 1: Maximum Ratings

Symbol	Parameter	Conditions	Min	Max	Units
V_{IN}	Input voltage			65	V
I_{OUT}	Output current	With Sufficient Cooling		25	A
T_C	Operating temperature	Measured at FET case as indicated in thermal measurement figure, airflow 1700 LFM		100	°C

Table 2: Electrical Characteristics (T_A = 25°C unless specified otherwise)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{IN}	Input Voltage		18	48	60	V
$V_{IN,on}$	Input UVLO turn on voltage			18.5		
$V_{IN,off}$	Input UVLO turn off voltage			17		
V_{OUT}	Output voltage		11.8	12	12.1	
C_{OUT}	External capacitance load		200			µF
$t_{OUT,rise}$	Output Voltage Rise Time			12		ms
ΔV_{OUT}	Output Voltage Ripple	I_{OUT} = 25 A, mounted in EPC9534 test fixture		40		mV
I_{OUT}	Output Current	1700 LFM airflow	0		25	A
$I_{OUT,limit}$	Overcurrent Limit Threshold	Each phase		20	26	
f_s	Switching Frequency			500		kHz
On/off control input logic						
V_{on}	Logic low (Module Off)				0.9	V
V_{off}	Logic high (Module On)		1.83		5.25	
I_{off}	Current sink for disable				0.15	mA
Power good output logic						
P_{good}	Logic high (in regulation)	Internal 100 kΩ pull-up resistor		5	5.25	V
P_{good}	Logic low (not regulated)		0		0.35	
I_{Pgood}	Sink current capability of P_{good}				2	mA

ELECTRICAL PERFORMANCE

Typical efficiency and power loss

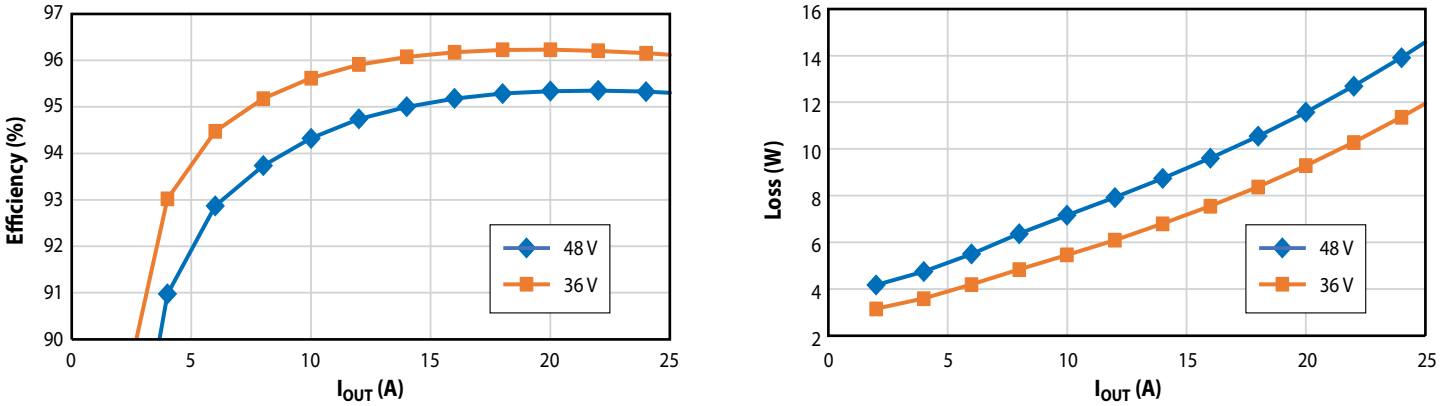


Figure 1. 12 V output, various input voltages

Typical output voltage ripple

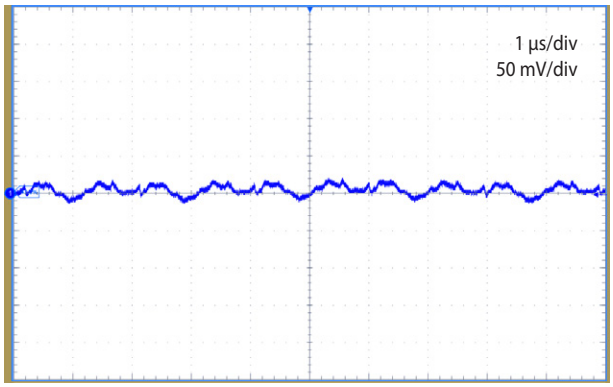


Figure 2. 48 V input, 12 V 25 A output

Typical transient response

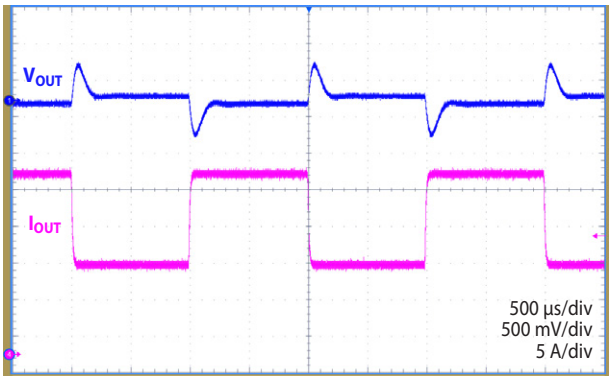


Figure 3. V_{IN} = 48 V, V_{OUT} = 12 V, 50% (12.5 A) to 100% (25 A) at 500 Hz repetition rate output current transitions

Startup

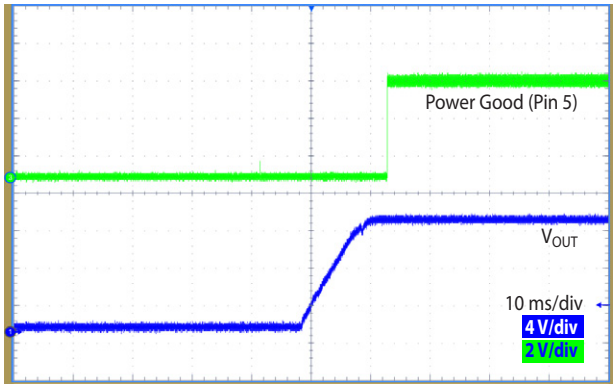


Figure 4. 48 V input, EN floating

ELECTRICAL PERFORMANCE *(continued)*

Typical load regulation

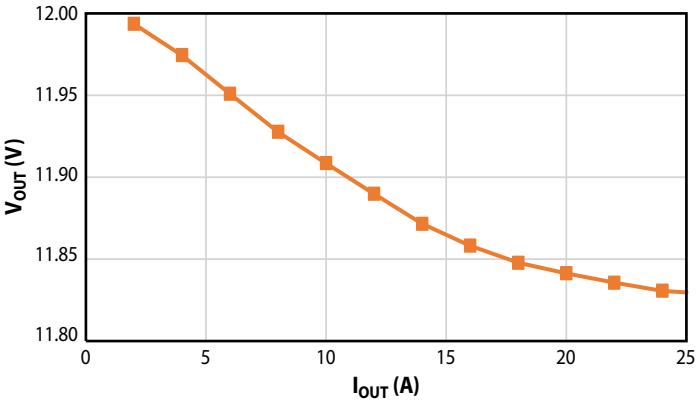


Figure 5. V_{IN} = 48 V, V_{OUT} = 12 V

Temperature vs. output current

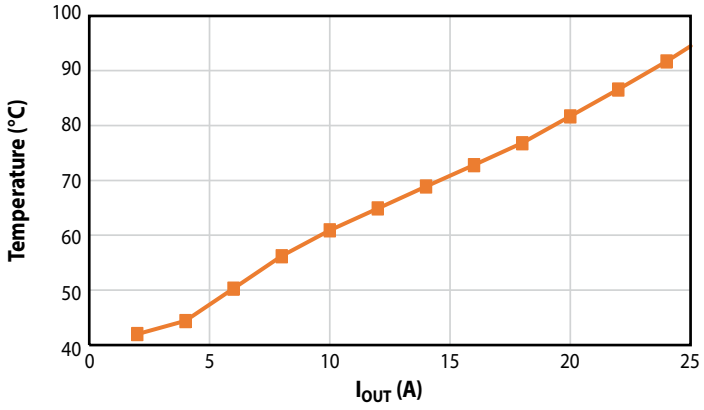


Figure 6. V_{IN} = 48 V, V_{OUT} = 12 V, 1700 LFM forced air cooling

OPERATING CONSIDERATIONS

Output capacitance

Minimum external output capacitance of 200 µF is recommended for stability. The EPC9534 16th brick motherboard includes this extra capacitance and is used for testing. The measured voltage loop phase and gain margin with EPC9534 are 80° and 19 dB, respectively.

Input capacitance

To minimize the impact from the input voltage feeding line, low ESR capacitors should be located at the input to the module. It is recommended that a 33 µF - 100 µF input capacitor be placed near the module.

Over-current protection

As described in "Output Average Current Monitoring and Regulation Loops" section in the ISL81806 datasheet, the over-current protection can be set to either constant current output when triggered, or hiccup type of protection. In this module, the protection is set to hiccup type--after the average current is higher than the set point for 32 consecutive switching cycles, the converter turns off for 50 ms before a restart is issued.

Remote On/Off

This module has positive on/off logic: the module is turned on during a logic high and off during a logic low. Remote on/off can be controlled by an external switch between the on/off pin and the Vin- (GND) pin as shown in figure 7. The switch can be an open collector or open drain. If the remote on/ off feature is not used, leave the on/ off pin floating.

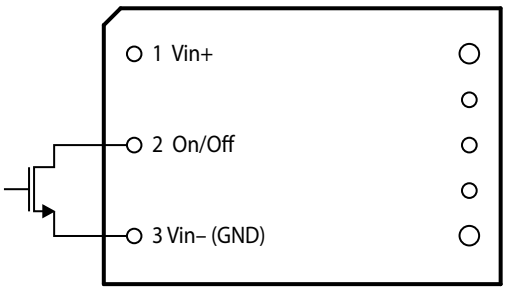


Figure 7. Adding an external MOSFET for remote enable/disable

Remote output voltage sense

Remote sense can compensate for output voltage distribution drop by sensing the actual output voltage at the point of load. The maximum voltage allowed between the output and sense pins is 5% of the output voltage (0.6 V for 12 V output). If the remote sense feature is not used, the pin can be either left floating or connected to Vout+.

Power good

This module features a power good signal with 5 V logic. The output is open-drain with an onboard 100 kΩ pull-up resistor. This signal will be logic high when the output voltage is regulated to +/- 11% of the setpoint, and logic low for all other conditions. If the power good feature is not used, the pin should be left floating.

Output voltage trim (adjustment)

The output voltage of this module can be trimmed (adjusted) by connecting an external resistor between the Trim pin and Vout- (GND) pin as shown in figure 8.

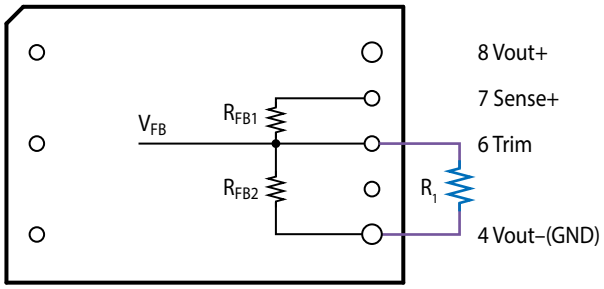


Figure 8. External resistor connection for output voltage trim adjust

The new output voltage can be calculated as follows:

$$V_{OUT} = V_{FB} R_{FB1} \left(\frac{1}{R_{FB2}} + \frac{1}{R_1} \right) + V_{FB}$$

For this design, V_{FB} is 0.8 V, R_{FB1} is 48.7 kΩ, R_{FB2} is 3.48 kΩ, therefore

$$V_{OUT} = 12 + \frac{39}{R_1\,[k\Omega]}$$

The maximum trim voltage is 1 V using this method.

QUICK START PROCEDURE

The EPC9157 1/16th brick module is best tested plugged into EPC9534 motherboard. The EPC9534 QSG provides detailed operating procedure instructions. See **EPC9534 QSG**.

MECHNICAL SPECIFICATIONS

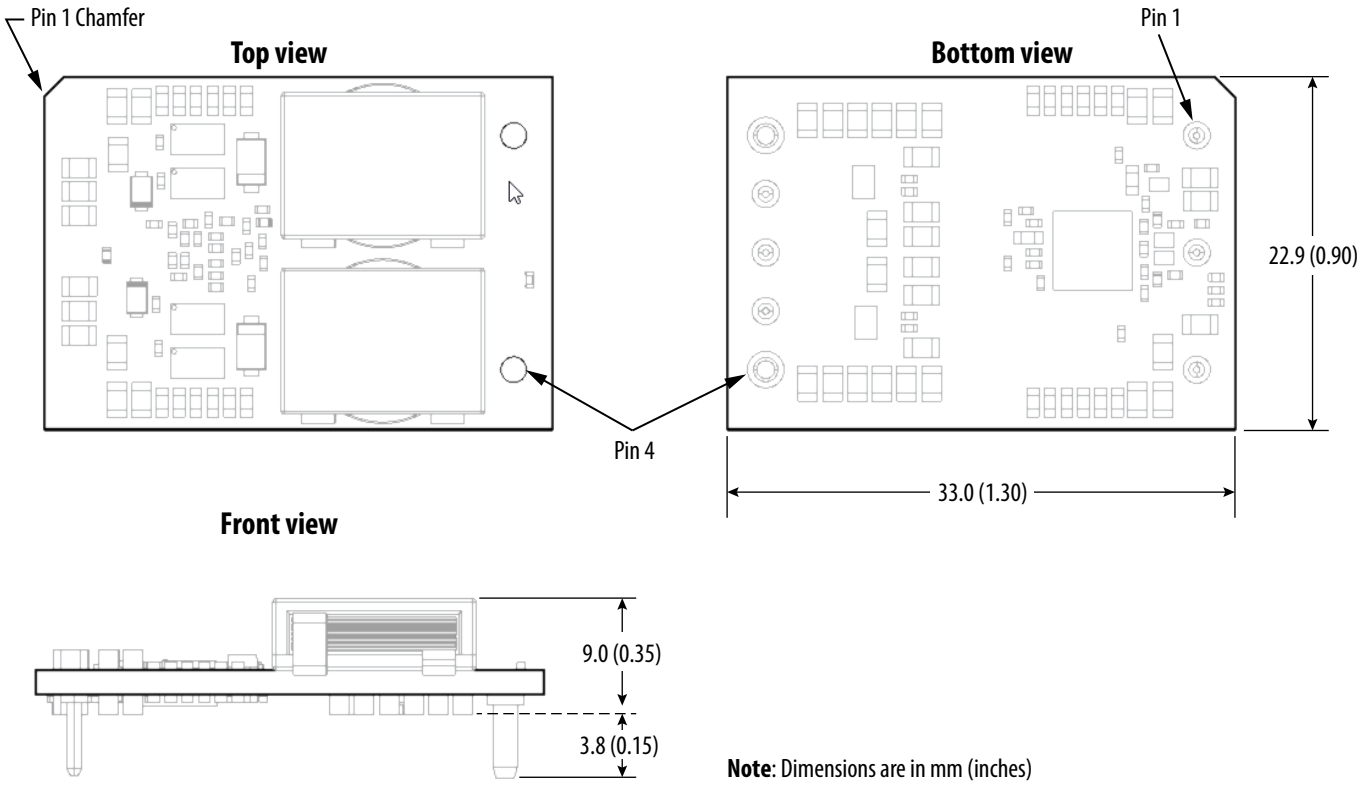


Figure 9. EPC9157 mechanical dimensions

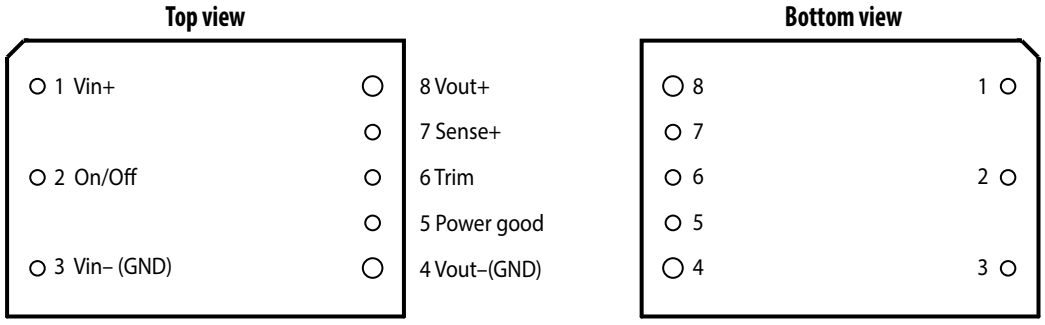


Figure 10. Pin assignment

THERMAL MANAGEMENT

Thermal management is very important to ensure proper and reliable operation. Sufficient cooling is required for this module to operate in the full specified output current range. Forced air of 1700 LFM is used for specification testing. Heatsink or heat spreader can also be used. The hot spots are the control FETs of the buck converter (Q1 and Q3) as shown in figure 11.

Thermal derating

Without sufficient cooling, the output current capability is reduced. The module temperature should be monitored to ensure the maximum temperature does not exceed the rating. Especially when the input voltage is higher than 48 V, the maximum output current is reduced.

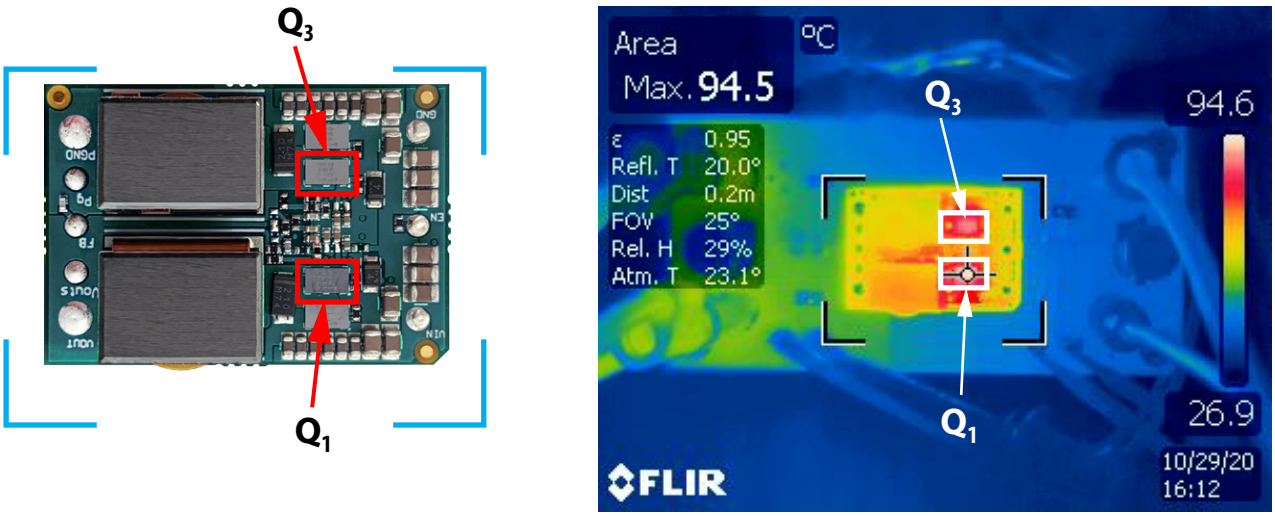


Figure 11. V_{IN} = 48 V, V_{OUT} = 12 V, 1700 LFM forced air cooling

For support files including schematic, Bill of Materials (BOM), and gerber files please visit the EPC9157 landing page at: https://epc-co.com/epc/products/demo-boards/epc9157

EPC would like to acknowledge Renesas Electronics Corporation (**www.renesas.com**) for their support of this project.

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The EPC9157 system features the Renesas ISL81806 80 V Dual Synchronous Buck Controller.

Learn more at **www.renesas.com**.

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Evaluation Board Notification

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