# Development Board EPC9054 Quick Start Guide

*EPC2010C*

*Class-E Wireless Power Amplifier*

EFFICIENT POWER CONVERSION

## DESCRIPTION

The EPC9054 is a high efficiency, differential mode Class-E amplifier development board that can operate up to 15 MHz. Higher frequency operation may be possible but is currently under evaluation. The purpose of this development board is to simplify the evaluation process of class-E amplifier technology using eGaN® FETs by allowing engineers to easily mount all the critical class-E components on a single board that can be easily connected into an existing system.

This board may also be used for applications where a low side switch is utilized. Examples include, and are not limited to, push-pull converters, current-mode Class D amplifiers, common source bi-directional switch, and generic high voltage narrow pulse width applications such as LiDAR.

The amplifier board features the 200 V rated EPC2010C eGaN FET. The amplifier is set to operate in differential mode and can be re-configured to operate in single-ended mode and includes the gate driver and logic supply regulator.

For more information on the EPC2010C eGaN FETs 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.

## DETAILED DESCRIPTION

**The Amplifier Board (EPC9054)**

Figure 1 shows the schematic of a single-ended, Class-E amplifier with ideal operation waveforms where the amplifier is connected to a tuned load such as a highly resonant wireless power coil. The amplifier has not been configure due to the specific design requirements such as load resistance

Given these two extremes of the operating load resistance ($R_{Load}$), the optimal point between them must be determined. In this case, the optimal point yields the same device losses for each of the extreme load resistance points and is shown in the lower center graph of figure 3. This optimal design point can be found through trial and error, or by using circuit simulation.

**Class-E amplifier design**

For this amplifier only three components need to be specifically designed; 1) the extra inductor ($L_e$), 2) the shunt capacitor ($C_{sh}$) and, 3) the selection of a suitable switching device. The RF choke ($L_{RFck}$) value is less critical and hence can be chosen or designed.

The design equations for the Class-E amplifier have been derived by N. Sokal [1]. To simplify these equations, the value of $Q_L$ in [1] is set to infinity, which is a reasonable approximation in most applications within the frequency capability of this development board. The design needs to have a specific load resistance ($R_{Load}$) value and desired load power ($P_{Load}$) that is used to begin the design, which then drives the values of the other components, including the magnitude of the supply voltage.

The Class-E amplifier passive component design starts with the load impedance value ($Z_{Load}$) shown in figure 1. The reactive component of $Z_{Load}$ is tuned out using a series capacitor C MC/Span .0 02n-sho40.025 Tw 5.247 0the 4i4 (562m(L)14 (oad)]TJMC n t27 2/MCID 0 TSn MCI Tc 0 Tw a.4 a ser)-0 Tc e v0 22S89.9408

**NOTE**. When measuring the high frequency content switch-node, care must be taken to avoid long ground leads. An oscilloscope probe connection (preferred method) has been built into the board to simplify the measurement of the Drain-Source Voltage (shown in figure 5). The choice of oscilloscope probe needs to consider tip capacitance where this will appear in parallel with the shunt capacitance thereby altering the operating point of the amplifier.

## Pre-Cautions

The EPC9054 demonstration system showcases the EPC2010C eGaN FETs in a class-E amplifier application. Although the electrical performance surpasses that of traditional silicon devices, their relatively smaller size does require attention paid to thermal management techniques.

Figure 1: Single-ended, Class-E ampli er with ideal operation waveforms.

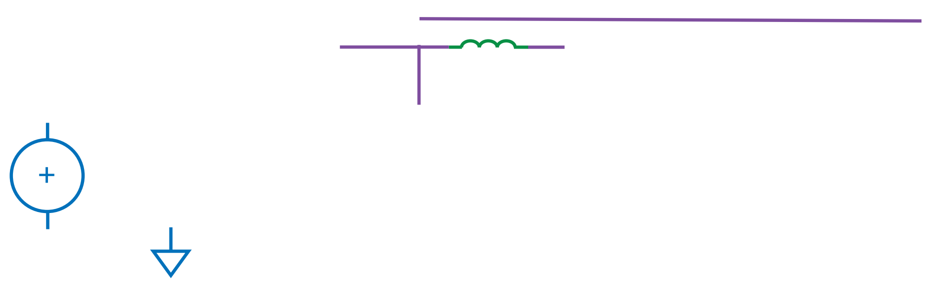



Figure 2: EPC9054 power circuit schematic.

Figure 3: Class-E operation under various load conditions that can be used to determine the optimal design load resistance ($R_{load}$).

Figure 4: Class-E ampli er design process with equations.

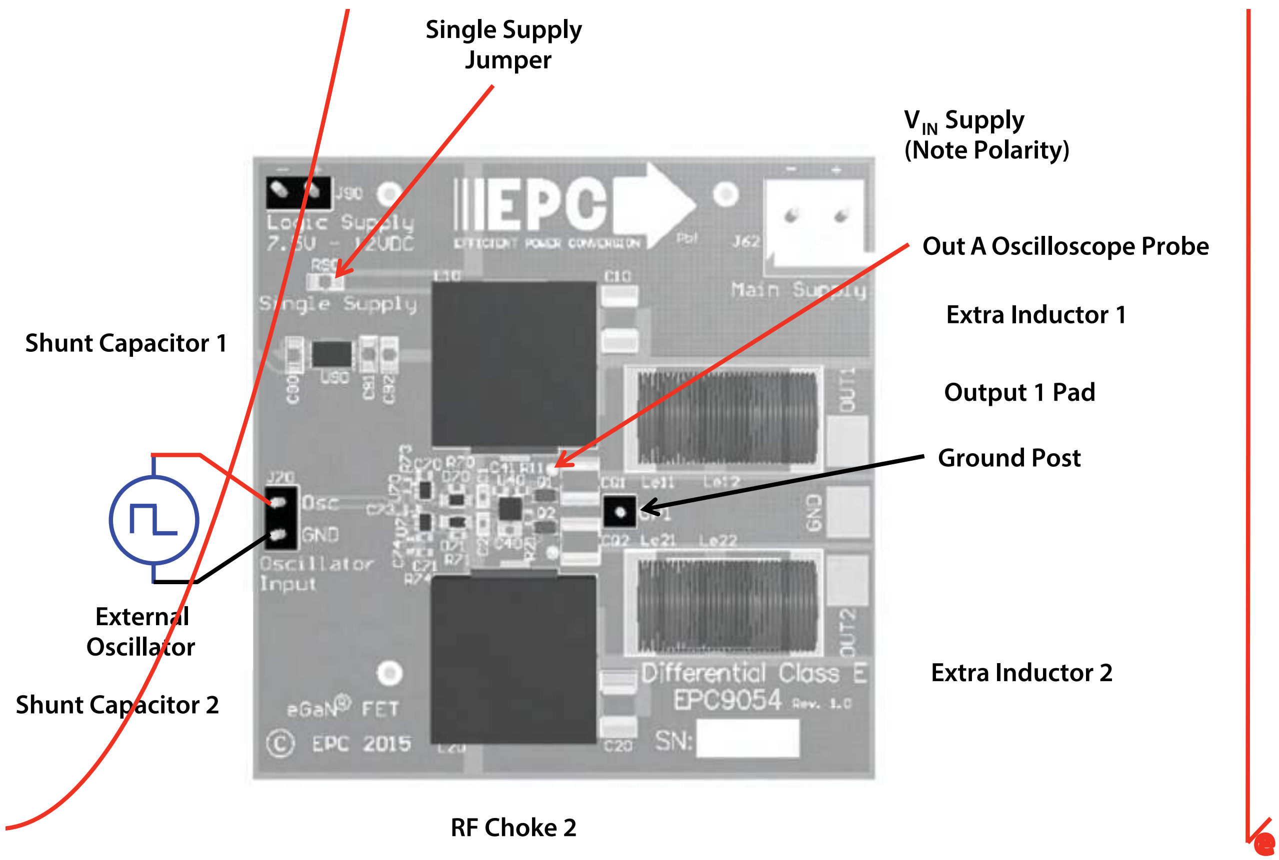
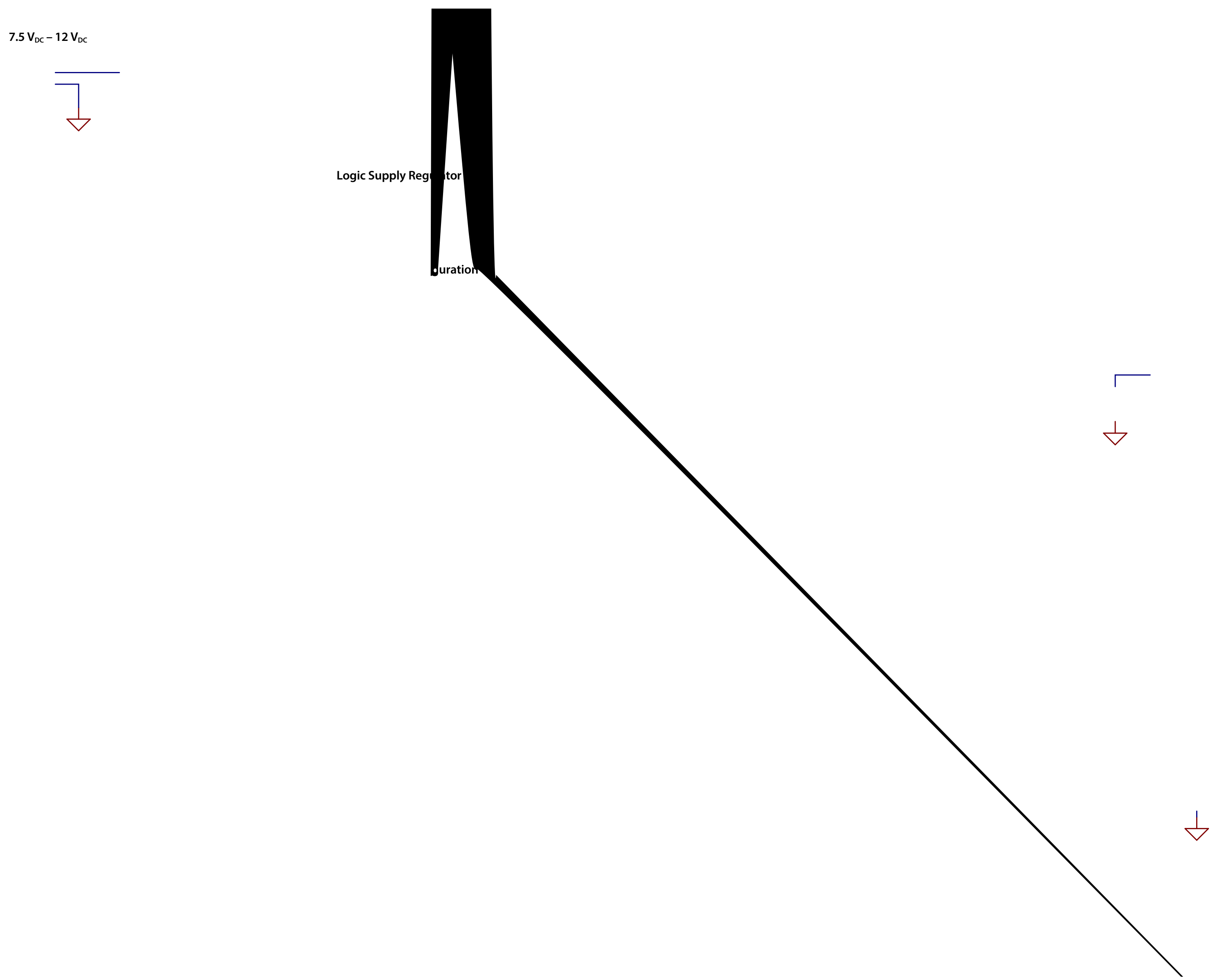



Figure 5: Proper connection and measurement setup for the ampli er board.

Figure 6: Proper measurement of the drain voltage using the hole and ground post.


7.5 $V_{DC}$ – 12 $V_{DC}$
Logic Supply Reg
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**Demonstration Board Notification**

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