

## Application Guide for the EPC7C010/EPC7C011 Evaluation Boards

EPC Space (www.epc.space)

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### ESD Precaution.



Proper ESD precautions should be employed when handling the EPC7C010/011 Eval. Board to prevent damage to the components installed on the board.

### Introduction.

This document describes functionality, options and the recommended connection of the EPC7C010/011 Eval. Board to power supplies, electronic loads and monitoring instruments for proper operation for the evaluation of the switching operation and conversion efficiency performance of the EPC Space discrete eGaN HEMTs (EPC7004B/100V for the EPC7C010 and the EPC7007B/200V for the EPC7C011) and FBS-GAM01P-R-PSE gate driver modules connected as a half-bridge power output stage for a step-down (buck) regulator. The EPC7C010 is rated for a maximum load current of 20A and the EPC7C011 is rated for a maximum load current of 10A.

This document also provides typical switching performance, typical efficiency performance, the schematic of the evaluation board, the bill of materials (BOM) and the PCB layout of the board in the form of layer-by-layer Gerber rendering of the evaluation printed circuit board.

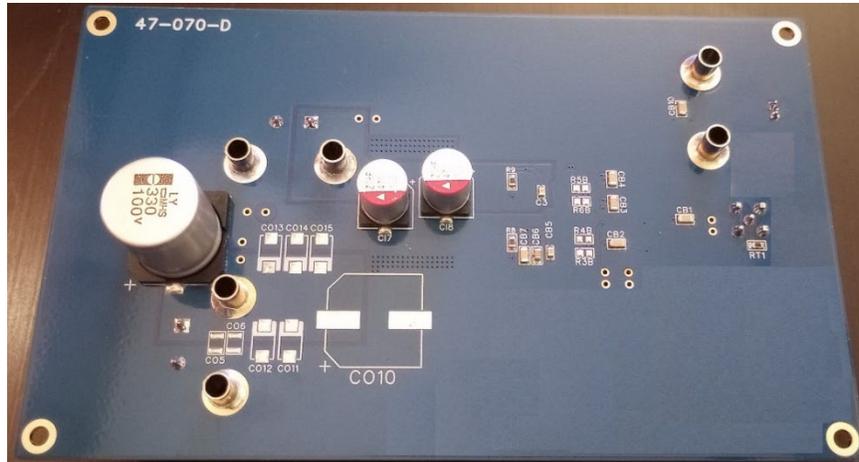
Please consult the EPC7004B, EPC7007B and the FBS-GAM01P-R-PSE for further details regarding their individual specifications and operation.

### Evaluation PCB Photograph.

Figure 1a shows the top view and Figure 1b shows the bottom view of the EPC7C010/011 Eval. Board. These pictures illustrate the component placements, power, load and input signal connections and the numerous test points available for monitoring by the end-user:



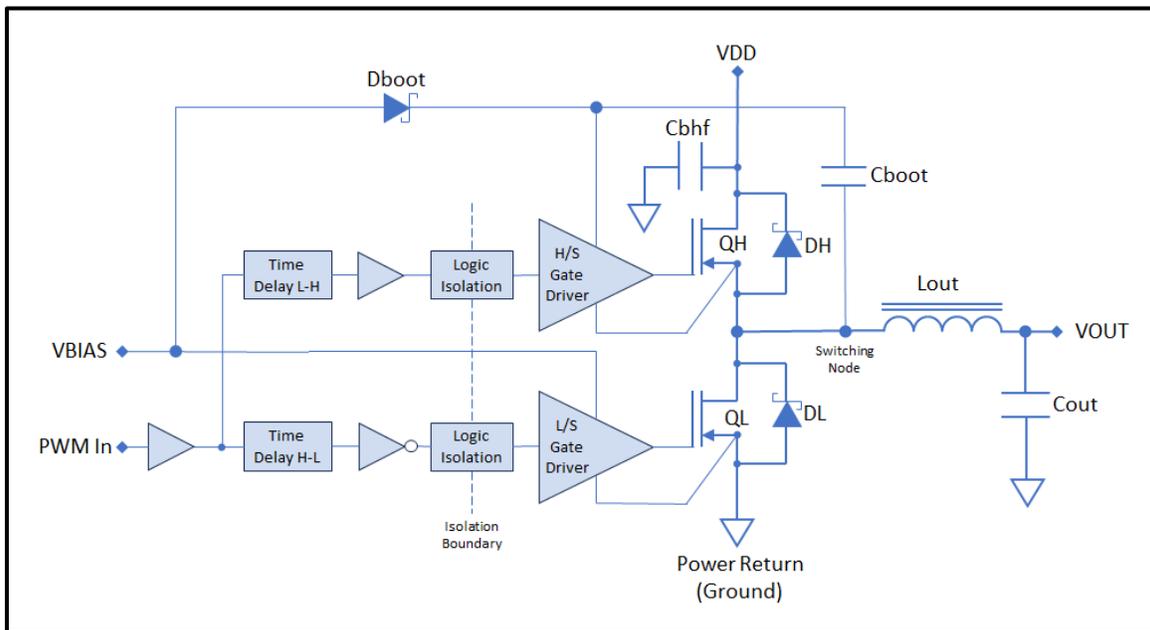
**Figure 1a.** EPC7C010/011 Eval. Board (Top View).



**Figure 1b.** EPC7C010/011 Eval. Board (Bottom View).

**Functional Block Diagram.**

The functional block diagram for the EPC7C010/011 Evaluation Board is Shown in Figure 2.



**Figure 2.** EPC7C010/011 Functional Block Diagram.

In Figure 2, HEMTs QL and QH are EPC7004B (100V) devices for the EPC7C010 board, and EPC7007B (200V) devices for the EPC7C011 board. Diodes DL and DH are 100V breakdown voltage power Schottky rectifiers for the EPC7C010 board and 200V breakdown for the EPC7C011 board. Finally, diode Dboot is a 100V breakdown voltage Schottky diode for the EPC7C010 board and a 200V device for the EPC7C011 board.

**Description of Test Points.**

The description of each test point on the EPC7C010/011 Evaluation Board is found in Table I.

**TABLE I.** EPC7C010/011 Evaluation Board Test Point Identification.

Test Point	+/- Spacing (in.)	Parametric Measurement Location
TP1	0.100	PWM Input Signal Monitor.
TP2	0.100	BIN Logic Signal Monitor.
TP3	0.100	TIN Logic Signal Monitor.
TP4	0.100	Switching Node Signal Monitor.
TP5	0.100	VOUT Signal Monitor.
TP6	0.100	VDD Signal Monitor.

Each set of test points (signal to be measured as indicated by “+”, and ground as indicated by “-”) have the physical spacings shown in Table I so as to facilitate easy oscilloscope probing by the end-user.

**IMPORTANT NOTE:** The “-” side of each test point is connected to the ground potential (i.e. 0Vdc) of the Evaluation Board. ALWAYS make sure that the ground connection to the oscilloscope is connected to this point when power is applied to the board as damage may occur to the oscilloscope, the Eval. Board or BOTH.

**VLOAD AC Signal Monitoring.**

Because the EPC7C010/011 Eval. Board is configured as an “open loop” step-down power stage, there is no test point provision for monitoring the AC signal at the output voltage VLOAD. If it is desired to monitor the ripple voltage at VLOAD, then a dual banana jack-to-BNC adapter, Pomona P/N 1269 “BNC (F) To Double Stacking Banana Plug” may be used as the “LOAD” banana jacks are 0.75” similarly-spaced.

**Description of Connectors.**

There are four (4) two-position connectors and six (6) banana jacks on provided on the EPC7C010/011 Eval. Board. The description of the functionality of each connector is shown in Table II, and the banana jacks, following.

**TABLE II.** EPC7C010/011 Evaluation Board Connector Description and Functionality.

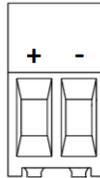
Connector	Description	Description/Functionality
J11		0-5V PWM Logic Input Signal.
JBIAS	Pin 1 – +5Vdc. Pin 2 – 5Vdc Return.	Logic Supply Voltage Input.
JVDD	Pin 1 – VDD. Pin 2 – Ground.	VDD Power Supply Voltage Input.
JVOUT	Pin 1 – VOUT. Pin 2 – Ground.	VOUT Output Voltage/ Load Connection.

**J11 “PWM In” Connector Detail.**

Connector J11 is a standard SMA-style threaded connector.

**JBIAS Connector Detail.**

This connector is a TE 1546215-2 two pin terminal block, screw terminal connector (for VBIAS) as shown in Figure 2:



**Figure 2.** Connector JBIAS (view facing wire access with polarity shown).

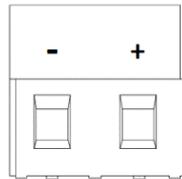
This connector accepts 16-30AWG wire.

**J1 (-) and J2 (+) VBIAS Connector Details.**

Connectors J1 and J2 are standard banana jack receptacles.

**JVDD Connector Detail.**

This connector is a TE 282844-2 two pin terminal block, screw terminal connector (for VDD) as shown in Figure 3:



**Figure 3.** Connector JVDD (view facing wire access with polarity shown).

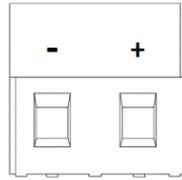
This connector accepts 12-30AWG wire.

**J3 (-) and J4 (+) VDD Connector Details.**

Connectors J3 and J4 are standard banana jack receptacles.

**JOUT Connector Detail.**

This connector is a TE 282844-2 two pin terminal block, screw terminal connector (for VOUT) as shown in Figure 4:



**Figure 4.** Connector JOUT (view facing wire access with polarity shown).

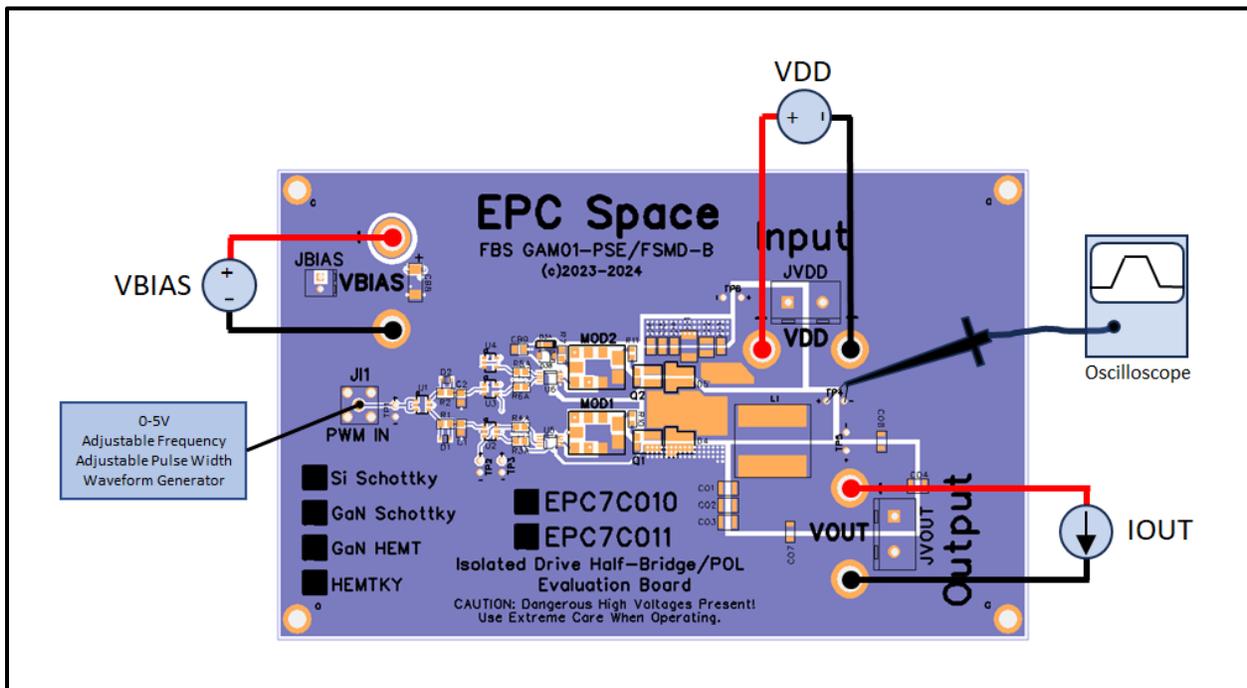
This connector accepts 12-30AWG wire.

**J5 (-) and J6 (+) VOUT Connector Details.**

Connectors J5 and J6 are standard banana jack receptacles.

**Recommended Test Equipment Connections: AC Switching Operation.**

Figure 5 shows the recommended connection to/from the Evaluation Board for switching operation.



**Figure 5.** EPC7C010/011 Evaluation Board Test Equipment Connections: AC Switching Operation.

The dynamic performance of the switching node is monitored using test point TP4. An oscilloscope probe that employs a short as possible ground wire is strongly recommended to obtain the best fidelity signal capture. It is recommended that the connections to the EPC7C010/011 Eval. Board from the VBIAS (5.00V) and VDD power supplies, and the electronic load, be made with banana plug-to-banana plug cables, as short as possible length and twisted to prevent noise pickup. The connection from the

pulse/frequency generator to connector J1 should be made via an SMA (board)-to-BNC (generator) cable.

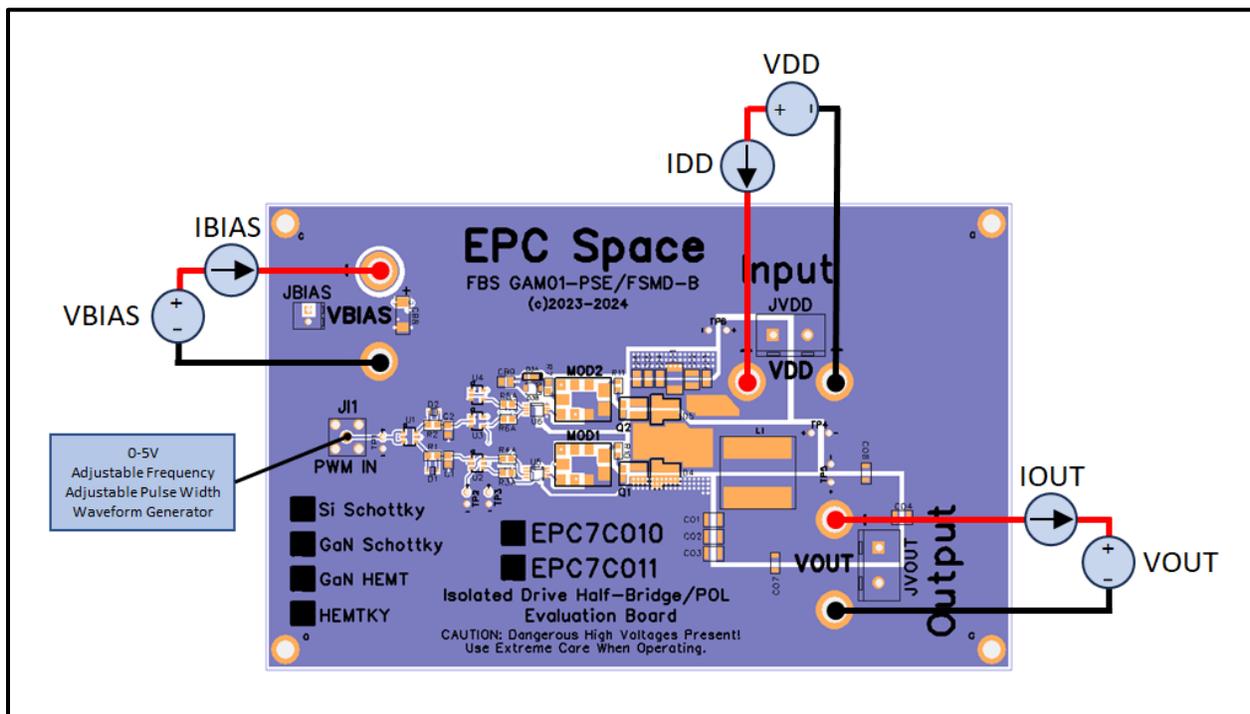
### Recommended Test Equipment: AC Switching Operation.

1.) The following test equipment is recommended to properly evaluate the EPC7C010/011 Eval. Board as shown in Figure 5:

- 0-100V, 20A adjustable DC power supply;
- 0-10V, 100mA adjustable lab power supply set to 5.00Vdc;
- 200V/20A pulsed electronic load;
- 0-1.5MHz, 0-5V, adjustable frequency, adjustable duty cycle signal generator;
- 500MHz/1GHz two channel oscilloscope;
- Two 10:1 passive oscilloscope probes configured with 0.100" spacing between probe tip and ground;
- Quantity 6 – 12" to 18" banana plug-to-banana plug cables.

### Recommended Test Equipment Connections: Conversion Efficiency.

Figure 6 shows the recommended connection to/from the Evaluation Board for switching operation.



**Figure 6.** FBS-GAM02 POL Evaluation Board Test Equipment Connections: Conversion Efficiency.

It is recommended that the connections to the EPC7C010/011 Eval. Board from the VBIAS (5.00V) and VDD power supplies, and the electronic load, be made with banana plug-to-banana plug cables, as short as possible length and twisted to prevent noise pickup. The connection from the pulse/frequency generator to connector J1 should be made via an SMA (board)-to-BNC (generator) cable. Voltages VDD, VBIAS and VLOAD should be monitored/measured at the associated banana jacks on the board.

**Recommended Test Equipment: Conversion Efficiency.**

1.) The following test equipment is recommended to properly evaluate the EPC7C010/011 Eval. Board as shown in Figure 6:

0-100V, 20A adjustable DC power supply;

0-10V, 100mA adjustable lab power supply set to 5.00Vdc;

200V/20A electronic load;

0-1.5MHz, 0-5V, adjustable duty cycle signal generator;

500MHz two channel oscilloscope;

Two 10:1 passive oscilloscope probes configured with 0.100" spacing between probe tip and ground;

Quantity 3 – Precision digital voltmeters (one to monitor VDD, VBIAS and the load voltage, VLOAD);

Quantity 3 – Precision digital ammeters (one to monitor IDD, IBIAS and the load current, ILOAD);

Quantity 15 – 12" to 18" banana plug-to-banana plug cables.

**IMPORTANT WARNING:** Although the EPC7C010/011 evaluation board is a high-performance demonstration vehicle, it has thermal limitations due to its physical size and PCB structure. Care should be taken when operating this board, for either voltage version, so as not to thermally overstress the output HEMTs (QL and QH in Figure 2) at higher operating voltages and currents. To avoid potential thermal issues, it is strongly recommended that adjunct cooling via a small fan blowing across the board and across QL and QH be utilized. It is also advisable that if extended operation of the board is required at higher output currents, output voltages and VDD voltages that a non-contact IR thermometer or a thermocouple attached to the lid of QH (along with the associated thermometer) be used to monitor the case temperature of QH in particular. If the temperature of the lid of QH exceeds 110°C then either increase the airflow provided to the board, decrease the VDD supply voltage and/or the output load current until the lid temperature of QH is less than 110°C.

**EPCS EPC7C010/011 Evaluation Board Minimum and Maximum Ratings.**

The EPC7C010/011 is rated for the following operation:

VDD, EPC7C010: 5Vdc to 100Vdc

VDD, EPC7C011: 5Vdc to 200Vdc

ILOAD: EPC7C010: 0A minimum to 20A maximum.

ILOAD: EPC7C011: 0A minimum to 10A maximum.

VBIAS: 5.0V +/- 10%

PWM IN: 5V maximum/200kHz to 1.5MHz/90% duty cycle maximum.

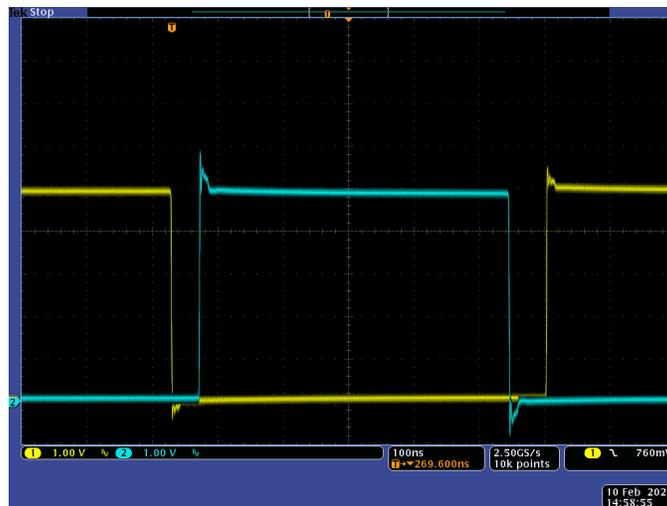
**BIN-TIN and TIN-BIN Logic Input Dead Times.**

The EPC7C010/011 Evaluation Board is shipped with a fixed, approximate 50ns dead time between the BIN and TIN and TIN and BIN logic inputs being asserted to prevent the possibility of cross-conduction/shoot-through occurring during the evaluation board's operation. To improve high-frequency efficiency, the dead time may be decreased to 25ns, minimum, by replacing the 47pF capacitors in reference designations C1 and C1 with 27pF values (27pF, COG, 5%, 0805).

**IMPORTANT NOTE:** The dead time should **NEVER** be reduced below 25ns. It is recommended that prior to the application of VDD for testing the evaluation board that the BIN-TIN and TIN-BIN dead times are verified by applying VBIAS to the circuit and monitoring TP2 and TP3 to ensure that the resultant dead times are either 50ns (default as shipped) or the desired value set by the end-user.

**BIN-TIN and TIN-BIN Dead Time Typical Waveforms.**

The waveform shown in Figure 7 is typical of the BIN-TIN and TIN BIN dead times for C1 = C2 = 47pF. Logic input BIN is the yellow trace and TIN is blue:



**Figure 7.** EPC7C010/011 Evaluation Board BIN-TIN and TIN BIN Logic Input Dead Time.

**AC Switching Operation Test Procedure.**

With the evaluation board connected to the test equipment as shown in Figure 3, the switching node (SN) waveform may be monitored using the following test sequence. Please observe the thermal limitations as described previously:

- 1.) Insert a 0.100" spaced probe/ground into test point TP4, observing the proper polarity for ground;
- 2.) Apply the desired PWM signal;
- 3.) Turn on VBIAS;
- 4.) Adjust the electronic load to the desired output current value and enable the output;
- 5.) Turn on VDD.

When the POL evaluation circuit is ON and running, the load current (ILOAD) and the PWM duty cycle may be adjusted to obtain the desired value of VLOAD/VOUT.

The resultant switching node (SN) waveform may be captured for review/analysis.

**IMPORTANT NOTE: NEVER** adjust the PWM frequency while the EPC7C010/011 POL circuit is ON and running. Damage/destruction of the EPC7C010/011 board may result.

The previous procedure and test sequence are applicable regardless if the power, load and PWM signals are applied via the banana jacks or connectors on the evaluation board.

### **Conversion Efficiency Test Procedure.**

With the evaluation board connected to the test equipment as shown in Figure 6, the conversion efficiency may be determined using the following test sequence. Please observe the thermal limitations as described previously:

- 1.) Apply the desired PWM signal;
- 3.) Turn on VBIAS;
- 4.) Adjust the electronic load to the desired output current value and enable the output;
- 5.) Turn on VDD.

When the POL evaluation circuit is ON and running, the load current (ILOAD) and the PWM duty cycle may be adjusted to obtain the desired value of VLOAD/VOUT at each operating point. A most accurate efficiency is obtained if VDD is adjusted to the same value at each value of load current and then the PWM duty cycle is subsequently adjusted to desired value of VLOAD/VOUT.

The conversion efficiency ( $\eta$ ) at each operating point is defined as:

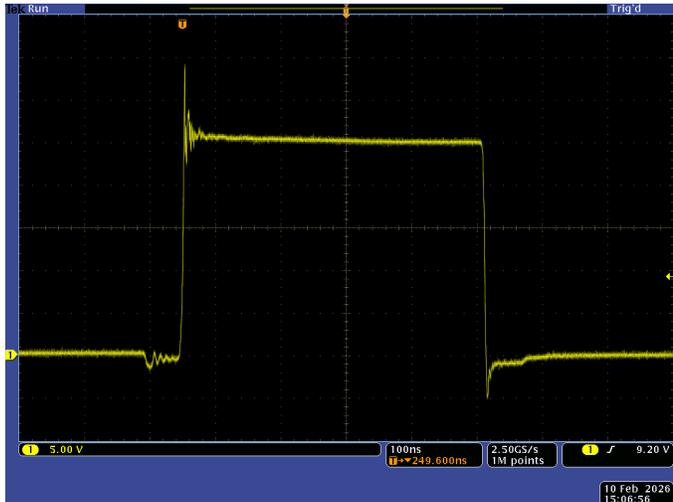
$$\eta = (VOUT * ILOAD) / [(VDD * IDD) + (VBIAS * IBIAS)]$$

**IMPORTANT NOTE: NEVER** adjust the PWM frequency while the EPC7C010/011 POL circuit is ON and running. Damage/destruction of the EPC7C010/01 board may result.

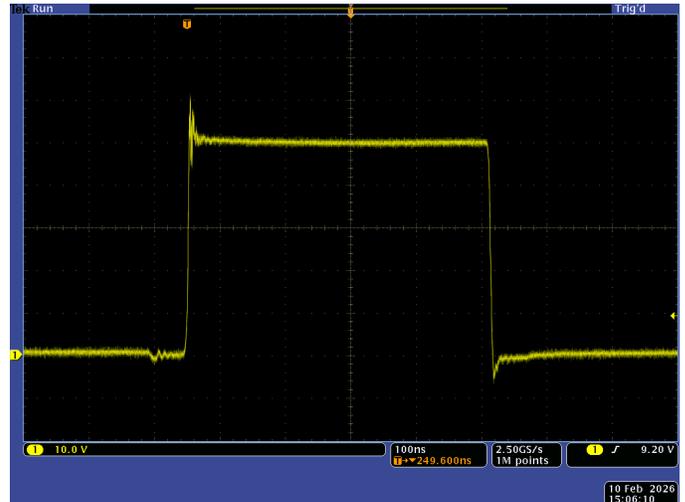
The previous procedure and test sequence are applicable regardless if the power, load and PWM signals are applied via the banana jacks or connectors on the evaluation board.

**Typical Switching Node (SN) Waveform.****a.) EPC7C010 Eval. Board.**

The waveforms shown in Figures 8 and 9 are typical of the switching node for the EPC7C010 Eval. Board operation at a switching frequency = 350kHz and ILOAD = 20A, for the VDD voltage identified:



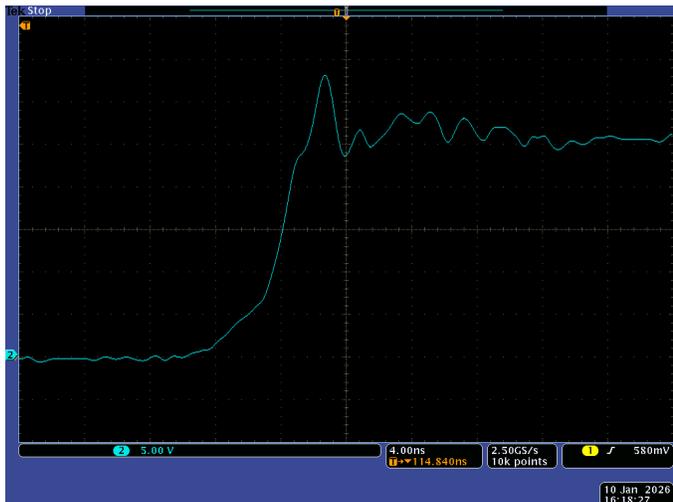
**Figure 8.** EPC7C010 Evaluation Board Typical Switching Node Waveform: VDD = 25Vdc.



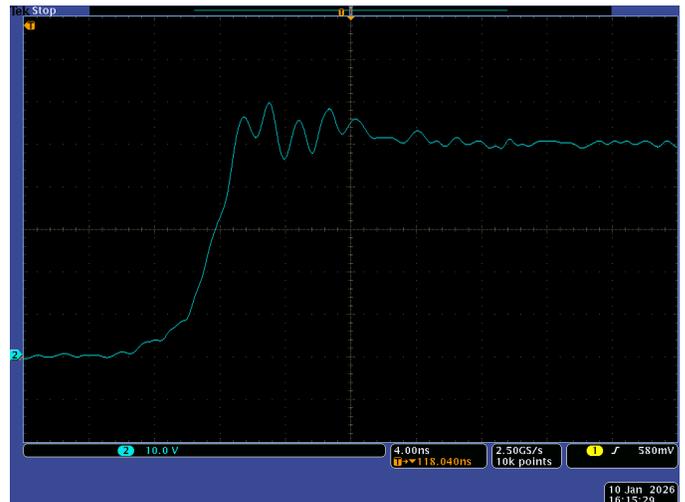
**Figure 9.** EPC7C010 Evaluation Board Typical Switching Node Waveform: VDD = 50Vdc.

The peak leading-edge overshoot voltage for either VDD situation is 10Vpk.

The waveforms shown in Figures 9 and 10 are typical of the switching node rise time for Eval. Board operation at the same conditions as in Figures 8 and 9:



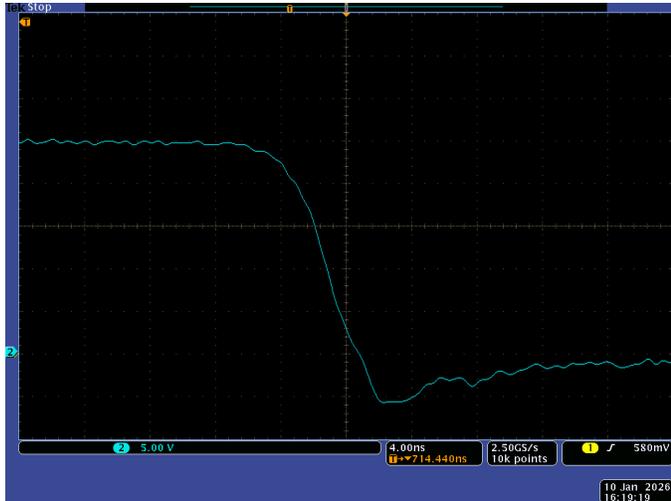
**Figure 10.** EPC7C010 Evaluation Board Typical Rise Time Waveform: VDD = 25Vdc.



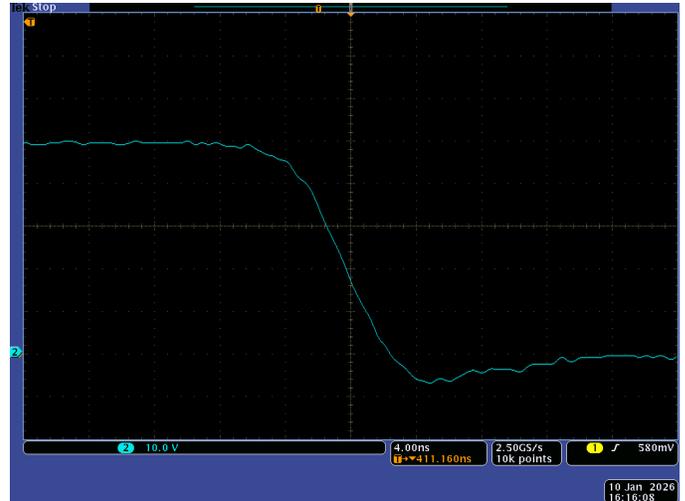
**Figure 11.** EPC7C010 Evaluation Board Typical Rise Time Waveform: VDD = 50Vdc.

The rise time is 4.8ns for VDD = 25Vdc and 5.0ns for VDD = 50Vdc.

The waveform shown in Figures 12 and 13 are typical of the switching node fall time for Eval. Board operation at the same conditions as in Figures 8 and 9:



**Figure 12.** EPC7C010 Evaluation Board  
Typical Rise Time Waveform: VDD = 25Vdc.

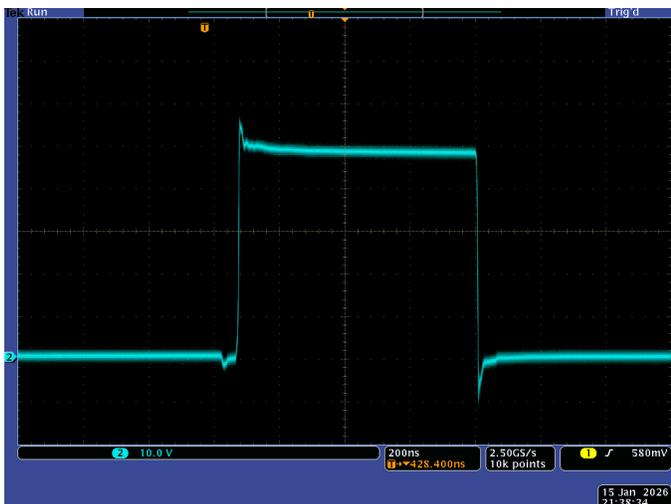


**Figure 13.** EPC7C010 Evaluation Board  
Typical Rise Time Waveform: VDD = 50Vdc.

The fall time is 4.0ns for VDD = 25Vdc and 5.2ns for VDD = 50Vdc.

#### EPC7C011 Eval. Board.

The waveforms shown in Figures 14 and 15 are typical of the switching node for the EPC7C011 Eval. Board operation at a switching frequency = 350kHz and ILOAD = 10A, for the VDD voltage identified:



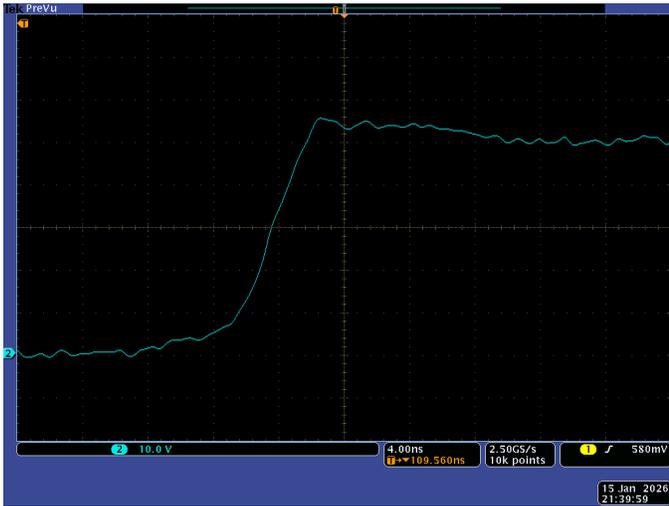
**Figure 14.** EPC7C011 Evaluation Board Typical  
Switching Node Waveform: VDD = 50Vdc.



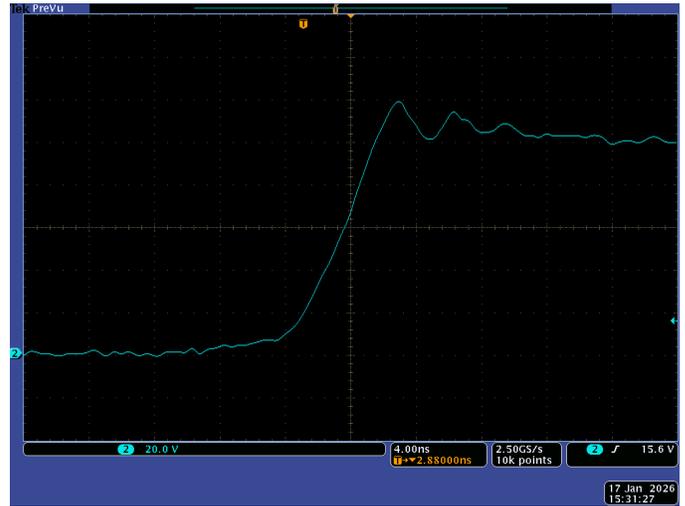
**Figure 15.** EPC7C011 Evaluation Board Typical  
Switching Node Waveform: VDD = 100Vdc.

The peak leading-edge overshoot voltage for either VDD situation is 20Vpk.

The waveforms shown in Figures 16 and 17 are typical of the switching node rise time for Eval. Board operation at the same conditions as in Figures 14 and 15:



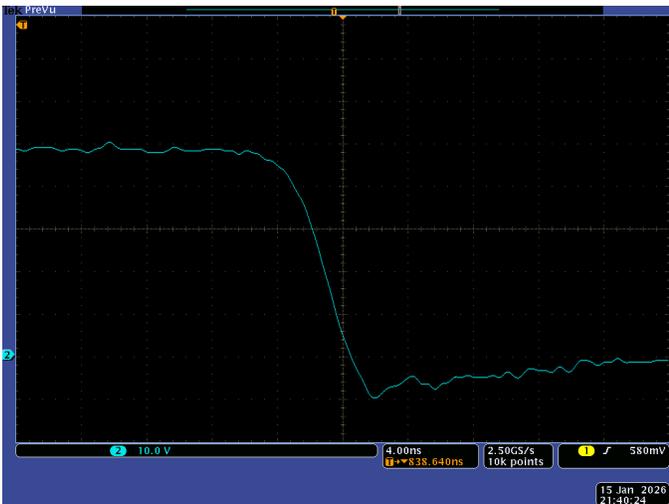
**Figure 16.** EPC7C011 Evaluation Board  
Typical Rise Time Waveform: VDD = 50Vdc.



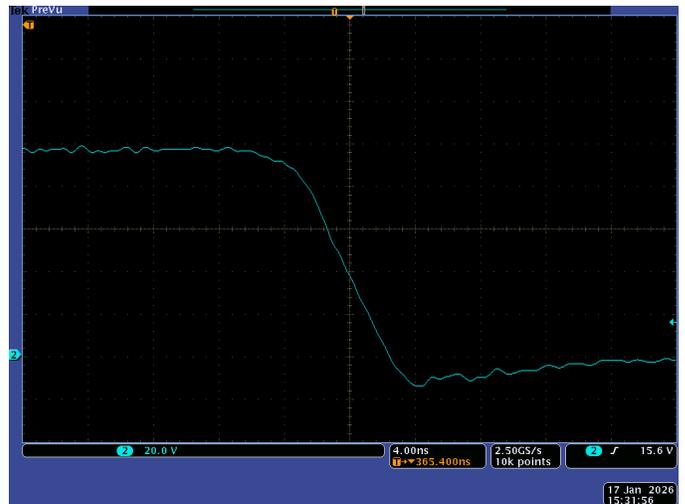
**Figure 17.** EPC7C011 Evaluation Board  
Typical Rise Time Waveform: VDD = 100Vdc.

The rise time is 5.2ns for VDD = 50Vdc and 5.2ns for VDD = 100Vdc.

The waveform shown in Figures 18 and 19 are typical of the switching node fall time for Eval. Board operation at the same conditions as in Figures 14 and 15:



**Figure 18.** EPC7C011 Evaluation Board  
Typical Rise Time Waveform: VDD = 50Vdc.

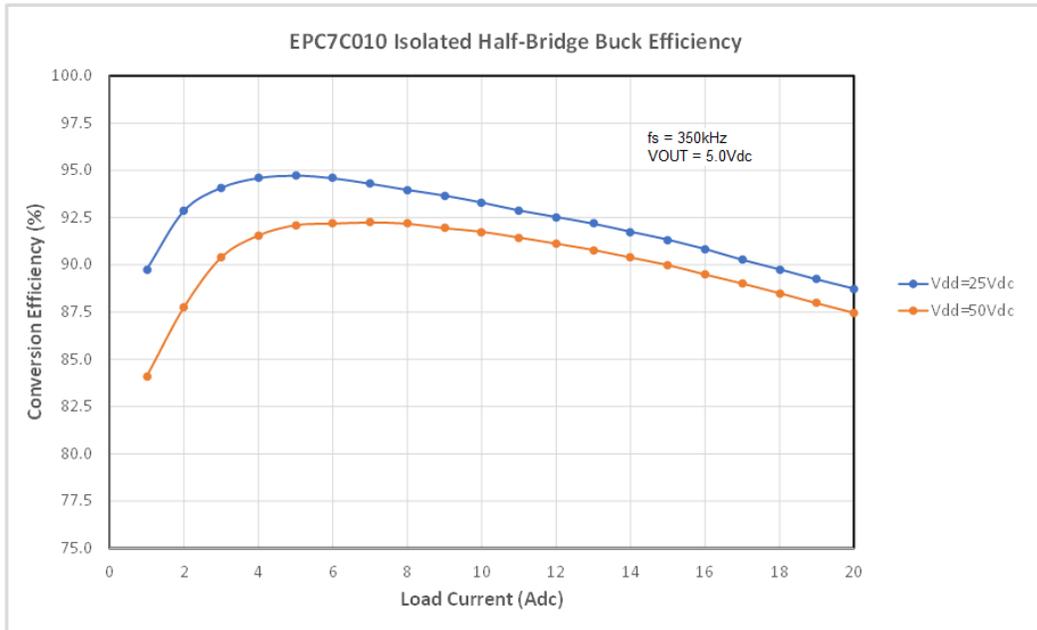


**Figure 19.** EPC7C011 Evaluation Board  
Typical Rise Time Waveform: VDD = 100Vdc.

The fall time is 4.8ns for VDD = 50Vdc and 5.6ns for VDD = 100Vdc.

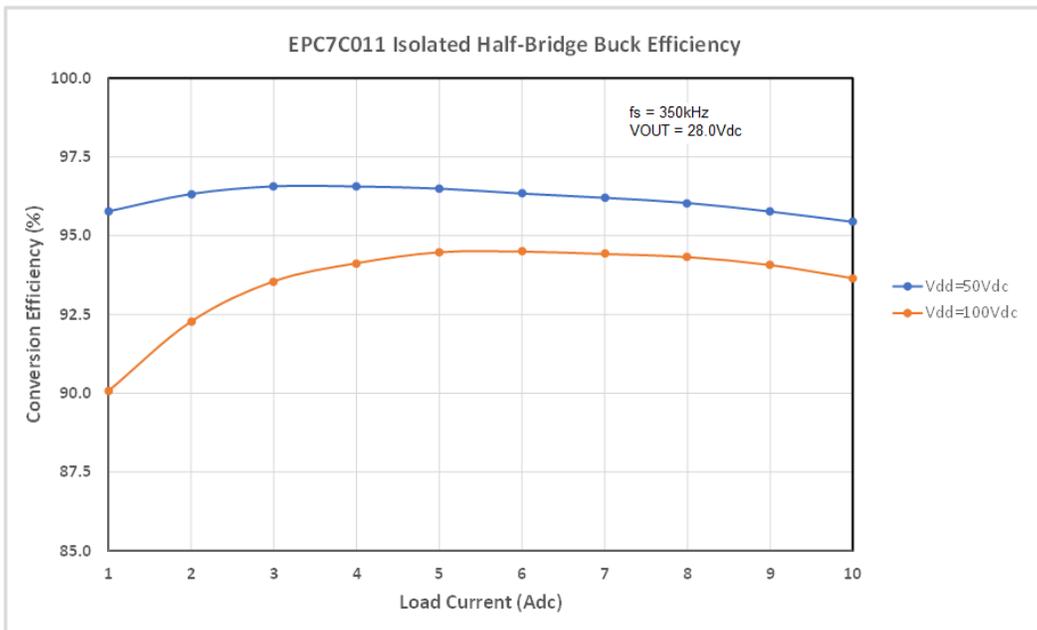
**Typical Conversion Efficiency Graphs.**

The graph shown in Figure 20 is typical of the EPC7C010 evaluation board conversion efficiency with respect to IO<sub>UT</sub> load current for the conditions listed on the graph:



**Figure 20.** EPC7C010 Evaluation Board Typical Conversion Efficiency.

The graph shown in Figure 21 is typical of the EPC7C011 evaluation board conversion efficiency with respect to IO<sub>UT</sub> load current for the conditions listed on the graph:



**Figure 21.** EPC7C011 Evaluation Board Typical Conversion Efficiency.

**Modifications and Optimization of Conversion Efficiency Performance.**

No attempt has been made to optimize the conversion efficiency performance of the EPC7C010/011 evaluation board. The board was, however, optimized for switching performance and to provide the best switching waveforms in terms of minimizing stray inductances in the power loop to prevent transient overshoots at the switching node and VDD.

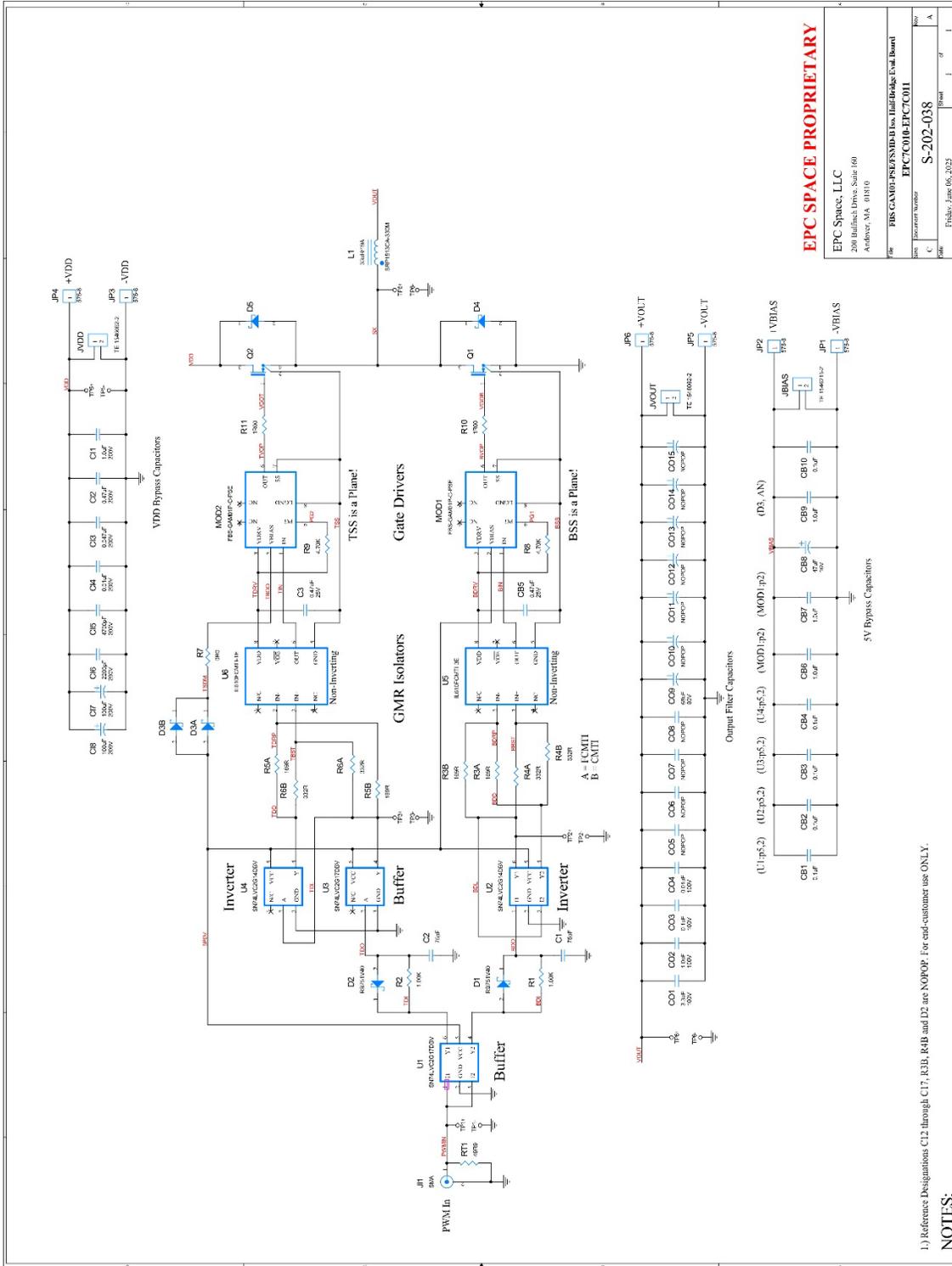
Because the evaluation board was intended to be used over a wide range of input and output voltages (for both the 100V and 200V VDD voltage ranges), load currents and switching frequencies, there could be no “optimized” set of components used for all possible applications to achieve the highest possible conversion efficiency. As such, optimization of the evaluation board for a particular customer end-use application is left to the designer who is evaluating this board. To this end, the output inductor L1 may be changed for a different value in the same package style. The inductor utilized on the evaluation board is in the Bourns SRP1513CA series, so other inductance values (with lower DC resistances and AC core losses) may be chosen for the particular switching frequency desired.

In order to improve performance, other capacitance values and rated voltages may be substituted for the VDD bulk filter capacitors C17 and C18. The capacitors utilized on the evaluation board are in the Kyocera/AVX type APZ 10mm size form factor. The as-shipped rated voltage is 100V to provide adequate de-rating when the evaluation board is operated with a VDD of 50V, but if lower operating voltages are required, the capacitance values of C17 and C18 may be increased substantially. Additionally, because of the pad sizes of the PCB shape for this capacitor, other smaller case styles may be “cut in” to replace the as-shipped components.

In order to reduce the amount of AC ripple at the OUTPUT, there are several unpopulated multilayer ceramic (ref. des. CO5-CO8), an unpopulated aluminum electrolytic capacitor (ref. des. CO10) and several tantalum capacitor shape placeholders (ref. des. CO9-CO14) available to the designer-user. The multilayer ceramic capacitor footprints are EIA 1206 and 1210 sizes. The tantalum footprints provided are intended for an EIA “Y” case capacitor device. And the aluminum electrolytic footprint is in the Chemi-Con MHS style 18mm footprint style.

**EPC7C010/011 Evaluation Board Schematic**

The EPC7C010/011 Evaluation Board schematic is found in Figure 22:



**Figure 22. EPC7C010/011 Evaluation Board Schematic Diagram.**

C EPC7C010/011 Evaluation Board BOMs

The BOM for the EPC7C010 Evaluation Board is shown in Table III, and for the EPC7C011 in Table IV. All active and passive components used are qualified to AEC-QXXX standards where possible.

Table III. EPC7C010 Evaluation Board Bill of Materials.

Item	Quantity	Ref. Des.	Description/Value	Mfrgr.	Mfrgr. P/N	Size/Package
1	6	BULB2,BJ3,BJ4,BJ5,BJ6	Shaking Banana Jack, Uninsulated	Kyocera	575-8	0.208" Dia. Hole C0805
2	2	C1C2	47µF 50V/CG55/0805 Ceramic Capacitor	Murata	GCM188R7E1E4K64D	C0805
3	2	C3,CB5	0.47µF 25V/XT1R102/AEC-01010603 Ceramic Capacitor	Kemet	C0805C47K3RAC-AUTO	C0603
4	1	C11	6.6µF 100V/XT1R102/AEC-01011812 Ceramic Capacitor	Kemet	C1812X666KRLC-AUTO	C1812
5	1	C12	1.0µF 100V/XT1R102/AEC-01011210 Ceramic Capacitor	TDK	GA6M2X1R1A105K200A	C1210
6	1	C13	0.1µF 100V/XT1R102/AEC-01010805 Ceramic Capacitor	TDK	SG44L2X1R1A104K125A4	C0805
7	1	C14	0.047µF 100V/XT1R102/AEC-01010805 Ceramic Capacitor	Kemet	C0805C47K3RAC-AUTO	C0805
8	1	C15	0.01µF 100V/XT1R102/AEC-01010805 Ceramic Capacitor	Kemet	C0805C103K3RAC-AUTO	C0805
9	1	C16	0.001µF 100V/XT1R102/AEC-01010805 Ceramic Capacitor	Kemet	C0805C103K3RAC-AUTO	C0805
10	2	C17,C18	47µF 100V/35A/50 milliohm ESR/18mm/Aluminum Electrolytic SMT Capacitor	Kyocera/AYX	AP210124T0M100R	AP210124T0M100R
11	1	C01	3.3µF 100V/102/XT1R1AEC-01011210 Ceramic Capacitor	Kyocera/AYX	1210C335K4T2A	C1210
12	1	C02	1.0µF 100V/102/XT1R1AEC-01011210 Ceramic Capacitor	Taiyo Yuden	HMK325E1105KNHT	C1210
13	1	C03	1.0µF 100V/102/XT1R1AEC-01011210 Ceramic Capacitor	Kemet	C1210C103K3RAC-AUTO	C1210
14	1	C04	0.1µF 100V/102/XT1R1AEC-01011210 Ceramic Capacitor	Kemet	C1210C103K3RAC-AUTO	C1210
15	15	C05,C06	<b>NOPOP</b> . For customer use ONLY.	N/A	N/A	C1210
16	15	C07,C08	<b>NOPOP</b> . For customer use ONLY.	N/A	N/A	C1206
17	1	C09	330µF 100V/12.30A/15milliohm ESR/18mm/Aluminum Electrolytic SMT Capacitor	Chemicon	EMHS101ARA331MMW03	EMHS101ARA331MMW03
18	1	C010	330µF 100V/12.30A/15milliohm ESR/18mm/Aluminum Electrolytic SMT Capacitor	Chemicon	EMHS101ARA331MMW03	EMHS101ARA331MMW03
19	1	<b>NOPOP</b>	<b>NOPOP</b> . For customer use ONLY.	N/A	N/A	TAMT Y Case
20	1	C011,C012,C013,C014,C015	1.0µF 50V/XT1R102/AEC-01010805 Ceramic Capacitor	Kyocera/AYX	0805C104K4T2A	C0805
21	2	CB1,CB2,CB3,CB4,CB5,CB7,CB10	1.0µF 25V/XT1R102/AEC-01010805 Ceramic Capacitor	Murata	GCMA21B7E105K256K	C0805
22	1	CB6,CB9	47µF 163V/35mm/103µm/103°C Case SMT Capacitor	Kemet	T438C4716K0163ATE500	TAMT C
23	2	D1,D2	0.12A/140V/SOD-323 Schottky Diode	Rectiparts	RB151V40.15	SOD-323-2
24	1	D3A	<b>NOPOP</b>	N/A	N/A	SOD-323
25	1	D3B	0.2A/100V/SOD-323/AEC-01011812 Schottky Diode	OM Semi	MSVR02100HTG	SOD-323
26	2	D4,D5	5A/100V/SOD-123/Schottky Rectifier Diode	ST Micro	STPST5H100AFY	SOD-128
27	1	JB1A3	2 Position/2.54mm/150V/Fixed Terminal Block	TE	154621F-2	154621F-2
28	2	JOUT_AVDD	2 Position/7.5mm/300V/Fixed Terminal Block	TE	282844-2	282844-2
29	1	JP1W1	50 Ohm SMA Connector/FH	TE/Linx	CON5MA001-G	CON5MA001-G
30	1	L1	40A/5 6mH Power Inductor	Bourns	SPR1513CA-596M	SPR1513CA
31	2	MOD1,MOD2	Gain HEMT Gate Driver Modules	EPC Space	FBS GANM01P-C-PSE	GANM01P-SE
32	2	61,62	100V/465A 4.5mH HEFT/TF SMD-B Package	EPC Space	EPC1004B	F3SMD-B
33	1	R11	43k/0.125/0805 Thick Film Chip Resistor	Vishay	CRCW080543R99FKTA	R0805
34	2	R1R2	100k/120/0805/Thick Film Chip Resistor	Vishay	CRCW08051000FKKAC	R0805
35	2	R3A,R5A	165R/120/0805/Thick Film Chip Resistor	Vishay	CRCW0805165RPFKEA	R0805
36	2	R4A,R6A	332R/120/0805/Thick Film Chip Resistor	Vishay	CRCW0805332RPFKEA	R0805
37	<b>NOPOP</b>	R3B,R5B	165R/120/0805/Thick Film Chip Resistor	Vishay	CRCW0805165RPFKEA	R0805
38	<b>NOPOP</b>	R4B,R6B	332R/120/0805/Thick Film Chip Resistor	Vishay	CRCW0805332RPFKEA	R0805
39	1	R7	0R/0Zero Ohm Jumpers Resistor/Thick Film Chip Resistor	Vishay	CRCW0805000020EA	R0805
40	2	R8,R9	4.70k/120/0805/Thick Film Chip Resistor	Panasonic	CRCW0805470FKEA	R0805
41	2	R10,R11	1R00/120/0603/Thick Film Chip Resistor	Vishay	RCS06031R00FKEA	R0603
42	1	U1	Dual Schmitt Trigger Buffer/Little Logic/1.65-5.5V/1VC/SOT-23-6	TI	SN74LVC2G12DBV7TR	SOT-23-6
43	1	U2	Dual Schmitt Trigger Inverter/Little Logic/1.65-5.5V/1VC/SOT-23-6	TI	SN74LVC2G14DBV7TR	SOT-23-6
44	1	U3	Single Schmitt Trigger Buffer/Little Logic/1.65-5.5V/1VC/SOT-23-5	TI	SN74LVC1G12DBV7TR	SOT-23-5
45	1	U4	Single Schmitt Trigger Inverter/Little Logic/1.65-5.5V/1VC/SOT-23-5	TI	SN74LVC1G14DBV7TR	SOT-23-5
46	2	U5,U6	Single/Ultrahigh CMTI/Non-Inverting Output/GMR Isolator/MSOP-8	NVE	IL610FCMTI-IE	MSOP-8
48	<b>NOPOP</b>	U5,U6	Single/Ultrahigh CMTI/Inverting Output/GMR Isolator/MSOP-8	NVE	IL610CMTI-IE	MSOP-8
49	4	Misc. Hardware	Spacer/Hex/M6x0.6-32/10.75" Length	Kyocera	844IE	N/A
50	4	Misc. Hardware	Screw/6-32/Nylon/Round head/Slot/10.5" Length	Ezeentra	010632R050	N/A
50	1	PCB	6.26" x 5.14" x 0.063" 4 Layer FR-4 PCB, Double-Sided	Speed44PCB.com	41-010-D	N/A

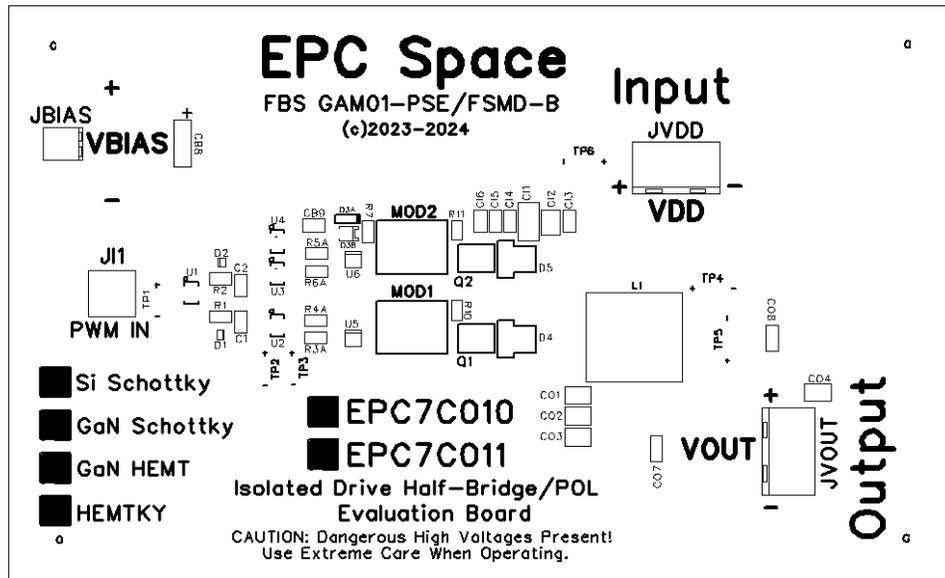
Table IV. EPC7C011 Evaluation Board Bill of Materials.

Item	Quantity	Ref. Des.	Description/Value	Mfgr.	Mfgr. P/N	Size/Package
1	6	BUJ1B12E103BJ4E15J6J6	Stacking Banana Jack, Uninsulated	Koyotone	575-8	0.208" Dia. Hole
2	2	C1,C2	47pF/500VDCGIG50805 Ceramic Capacitor	Kemet	C0805C470J50GACT210	C0805
3	2	C3,CB5	0.47uF/25V/X7R/10%AECC-010106003 Ceramic Capacitor	Kemet	C0805C474K3RAC-AUTO	C0603
4	1	C11	1.0uF/200V/X7R/5%1812 Ceramic Capacitor	Kemet	1812C1005JAT2A	C1812
5	1	C12	0.22uF/200V/X7R/10%1210 Ceramic Capacitor	TDK	D1210F224K3RAC-TU	C1210
6	1	C13	0.056uF/200V/X7R/10%0805 Ceramic Capacitor	TDK	C0805C563K3RAC-TU	C0805
7	1	C14	0.047uF/200V/X7R/10%102/AEC-01010805 Ceramic Capacitor	Kemet	3805C473K28EC-AUTO12	C0805
8	1	C15	0.047uF/200V/X7R/10%102/AEC-01010805 Ceramic Capacitor	Kemet	C0805C473K28EC-AUTO12	C0805
9	1	C16	1000pF/200V/X7R/10%102/AEC-01010805 Ceramic Capacitor	Kemet	C0805C103K28EC-AUTO	C0805
10	2	C17,C18	33uF/100V/10.5V/50 mils/4m ESR/10mm Aluminum Electrolytic SMT Capacitor	Kyocera/VAYX	ULR203303MMLIGS	ULR203303MMLIGS
		C01	3.3uF/100V/10.5V/102/AEC-01011210 Ceramic Capacitor	Kyocera/VAYX	1210C2284KAT2A	C1210
		C02	1.0uF/100V/10.5V/102/AEC-01011210 Ceramic Capacitor	Fajco Tuden	C1210C104M2RFACTU	C1210
		C03	1.0uF/100V/10.5V/102/AEC-01011210 Ceramic Capacitor	Kemet	1210C104M2RFACTU	C1210
		C04	0.01uF/100V/10.5V/102/AEC-01011210 Ceramic Capacitor	Kemet	KGM32RRT2D103KU	C1210
15	NOPOP	C05,C06	NOPOP. For customer use ONLY.			
16	NOPOP	C07,C08	NOPOP. For customer use ONLY.			
17	1	C09	330uF/100V/2.30A/53mOhm ESR/18mm Aluminum Electrolytic SMT Capacitor	Chemicon	EEE-FK2A221AM	EEE-FK2A221AM
		C010				
19	NOPOP	C011,C012,C013,C014,C015	NOPOP. For customer use ONLY.			
20	7	CB1,CB2,CB3,CB4,CB5,CB7,CB10	0.1uF/50V/X7R/10%102/AEC-01010805 Ceramic Capacitor	Kyocera/VAYX	0805C104K4T2A	TAMT Y Case
21	2	CB6,CB9	1.0uF/25V/X7R/10%102/AEC-01010805 Ceramic Capacitor	Murata	GCM32H6R1E05K456K	C0805
22	1	CB8	47uF/16V/Tantalum/10% Case SMT Capacitor	Kemet	T438C4716K0161ATE500	TAMT C
23	2	D1,D2	0.12A/40V/350D-323 Schottky Diode	Mosperis	HBT51740115	SOP-323-2
24	NOPOP	D3A	N/A			N/A
25	1	D3B	0.25A/300V/SOD-123/Silicon Rectifier Diode	Vishay	GSD2004W-HE3-068	SOD-123
26	2	D4,D5	3A/200V/SMA-FL-2/Schottky Rectifier Diode	OM Semi	NRVBAF3200T3G	SMA-FL-2
27	1	JBA3	2 Position/2.54mm/150V/Fixed Terminal Block	TE	1546215-2	1546215-2
28	2	JOUT_VJ00	2 Position/7.5mm/300V/Fixed Terminal Block	TE	282844-2	282844-2
29	1	JPwM	50 Ohm SMA Connector/FH	TE/Lux	CON5MA001-G	CON5MA001-G
30	1	L1	30A/10uH Power Inductor	Bourns	SPR1513CA-100M	SPR1513CA
31	2	M001,M002	GSM HEIMT Gate Driver Module	EPC Space	FES G3AM010-G-PSE	G3AM010-PSE
30	2	0182	200V/18A eSMD HEIMT/F3SMD-B Package	EPC Space	FES G3AM010-G-PSE	G3AM010-PSE
31	1	R11	49R/1%0805 Thick Film Chip Resistor	Vishay	EPC100101B	F3SMD-B
32	2	R1,R2	1.00K/1%0805 Thick Film Chip Resistor	Vishay	CRCW08051K00FKAC	R0805
33	2	R3A,R5A	165R/1%0805 Thick Film Chip Resistor	Vishay	CRCW0805165RFKEA	R0805
34	2	R4A,R6A	332R/1%0805 Thick Film Chip Resistor	Vishay	CRCW0805332RFKEA	R0805
35	NOPOP	R3B,R5B	165R/1%0805 Thick Film Chip Resistor	Vishay	CRCW0805165RFKEA	R0805
36	NOPOP	R4B,R6B	332R/1%0805 Thick Film Chip Resistor	Vishay	CRCW0805332RFKEA	R0805
37	1	R7	0R0/200 Ohm Jumper Resistor/Thick Film Chip Resistor	Vishay	CRCW08050000Z0EA	R0805
38	2	R8,R9	4.70K/1%0805 Thick Film Chip Resistor	Panasonic	CRCW08054K70FKEA	R0805
39	2	R10,R11	1R00/1%0603 Thick Film Chip Resistor	Vishay	RCS06031R00FKEA	R0603
40	1	U1	1R00/1%0603 Thick Film Chip Resistor	Vishay	RCS06031R00FKEA	R0603
41	1	U2	Dual Schmitt Trigger Buffer/Logic Logic/1.65-5.5V/VLC/SOT-23-6	TI	SN74LVC2G10DBVTJR	SOT-23-6
42	1	U3	Dual Schmitt Trigger Inverter/Logic Logic/1.65-5.5V/VLC/SOT-23-6	TI	SN74LVC2G14DBVTJR	SOT-23-6
43	1	U4	Single Schmitt Trigger Buffer/Logic Logic/1.65-5.5V/VLC/SOT-23-5	TI	SN74LVC1G10BVTJR	SOT-23-5
44	2	U5,U6	Single Schmitt Trigger Inverter/Logic Logic/1.65-5.5V/VLC/SOT-23-5	TI	SN74LVC1G14BVTJR	SOT-23-5
44	2	U5,U6	Single/Ultrahigh CMT/Non-Inverting Output/GMR Isolator/MSCOP-8	NVE	IL610FCMT1-E	MSCOP-8
46	NOPOP	U5,U6	Single/Ultrahigh CMT/Inverting Output/GMR Isolator/MSCOP-8	NVE	IL610CMT1-E	MSCOP-8
46	4	Misc. Hardware	Spacer/Hex/Nylon/6-32/0.75" Length	Koyotone	844E	N/A
47	4	Misc. Hardware	Screw/6-32/Nylon/Rounded head/Slotted/0.5" Length	Eccentra	010632R050	N/A
48	1	PCB	6.28" x 3.14 x 0.062" 4 Layer FR-4 PCB, Double-Sided	SpeedtailPCB.com	41-010-D	N/A

**Printed Circuit Board and Layout Details.**

The printed circuit board (PCB) for the EPC7C010/011 Evaluation Board is constructed with four layers. The PCB is 6.41" x 3.89" and is 0.063" thick. The outer layers are 2 oz/in<sup>2</sup> and the inner layers are 1 oz/in<sup>2</sup> copper etch. All electronic components are SMT-packages and all connectors are through-hole.

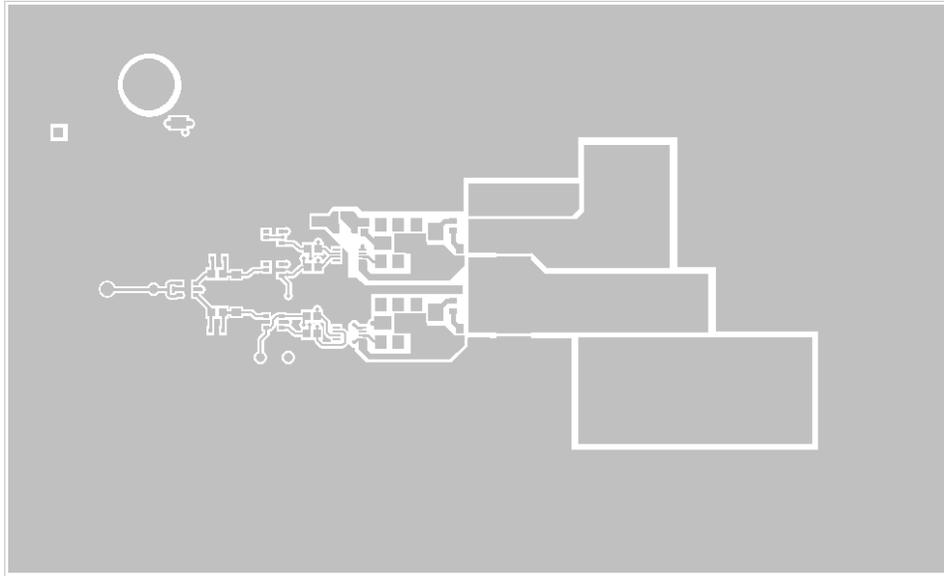
The individual Gerber layers for the PCB are shown in Figures 23 to 32, following:



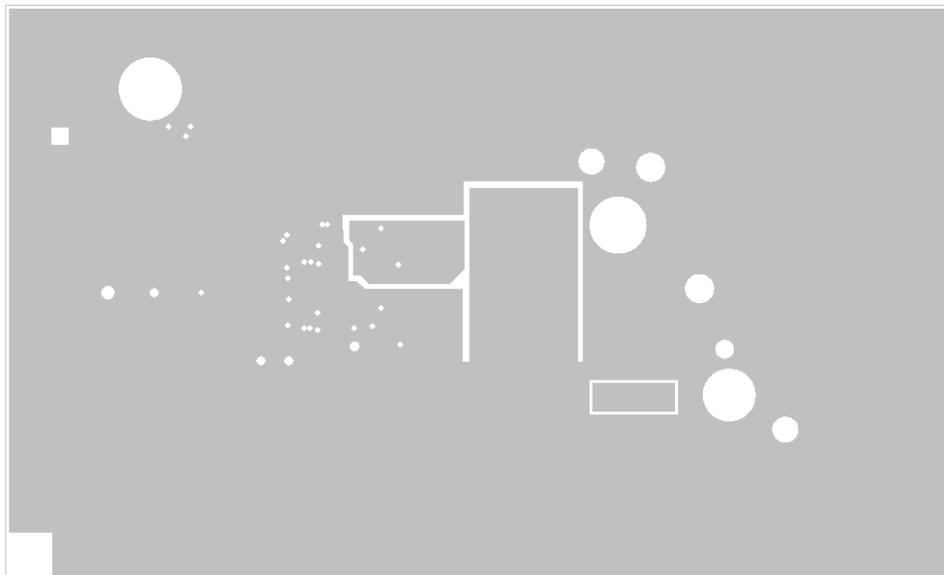
**Figure 23.** EPC7C010/011 Evaluation Board Top Silkscreen.



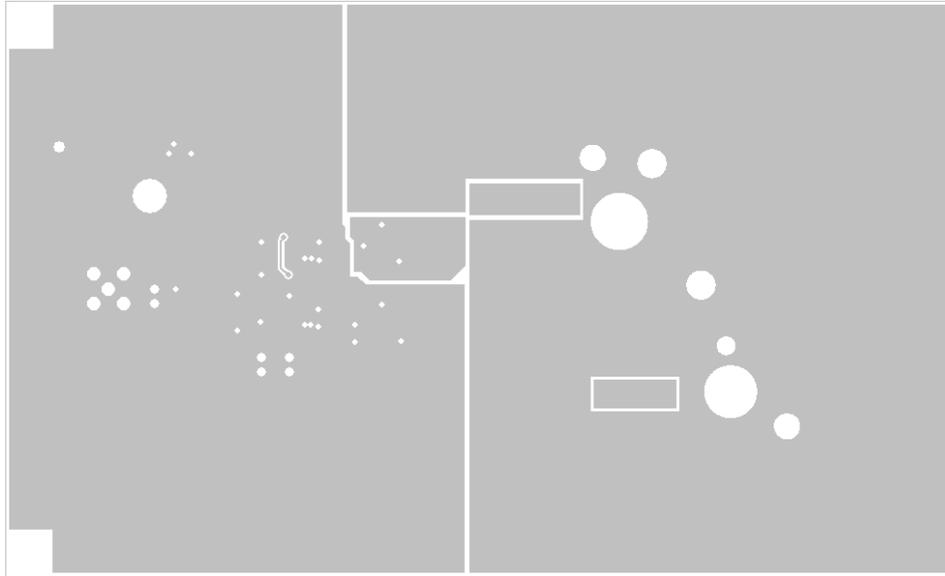
**Figure 24.** EPC7C010/011 Evaluation Board Top Solder Mask.



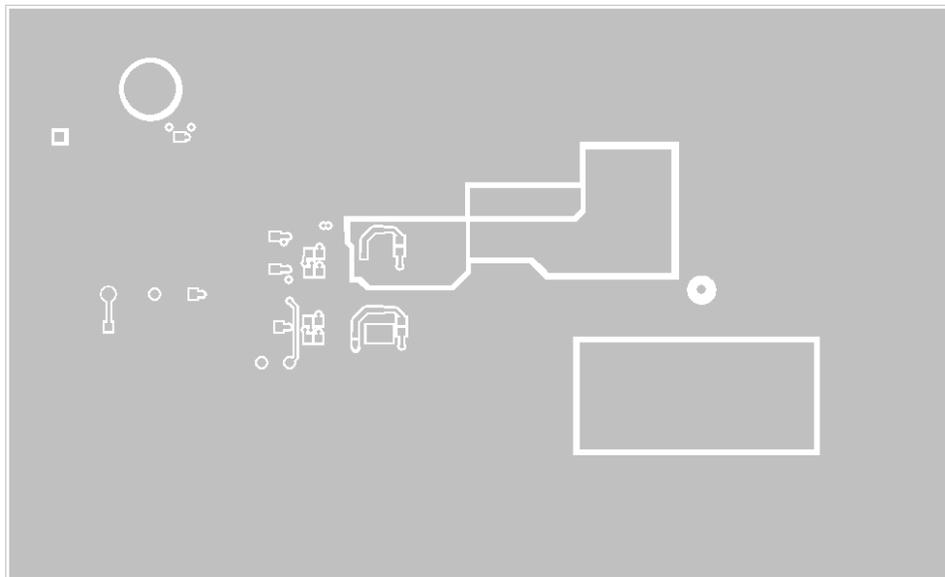
**Figure 25.** *EPC7C010/011 Evaluation Board Top Copper Etch (2 oz).*



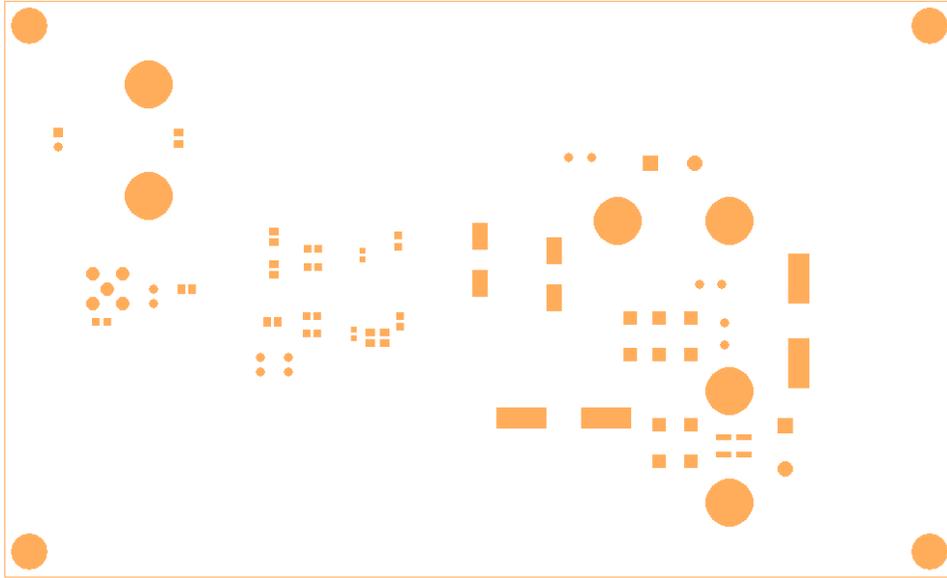
**Figure 26.** *EPC7C010/011 Evaluation Board Inner Layer 1 Copper Etch (1 oz).*



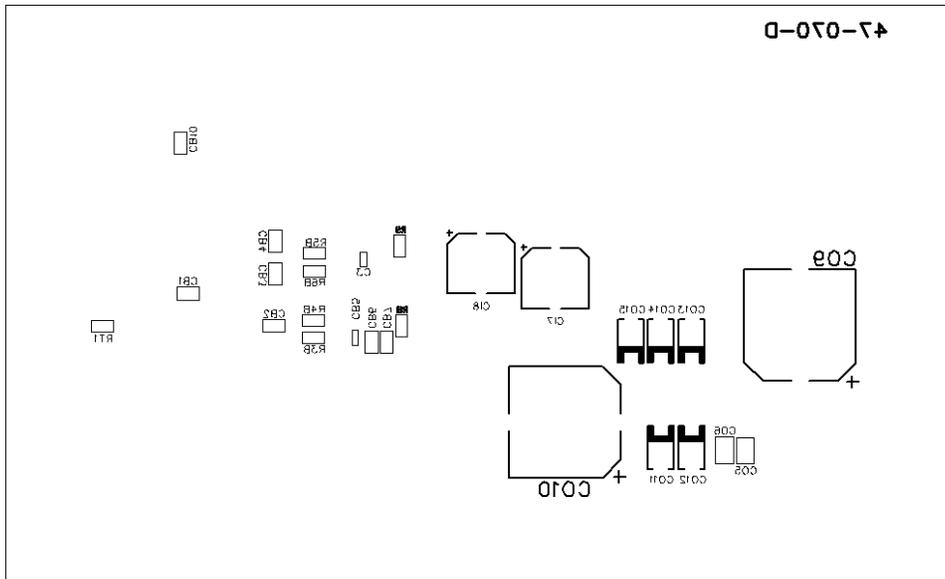
**Figure 27.** *EPC7C010/011 Evaluation Board Inner Layer 2 Copper Etch (1 oz).*



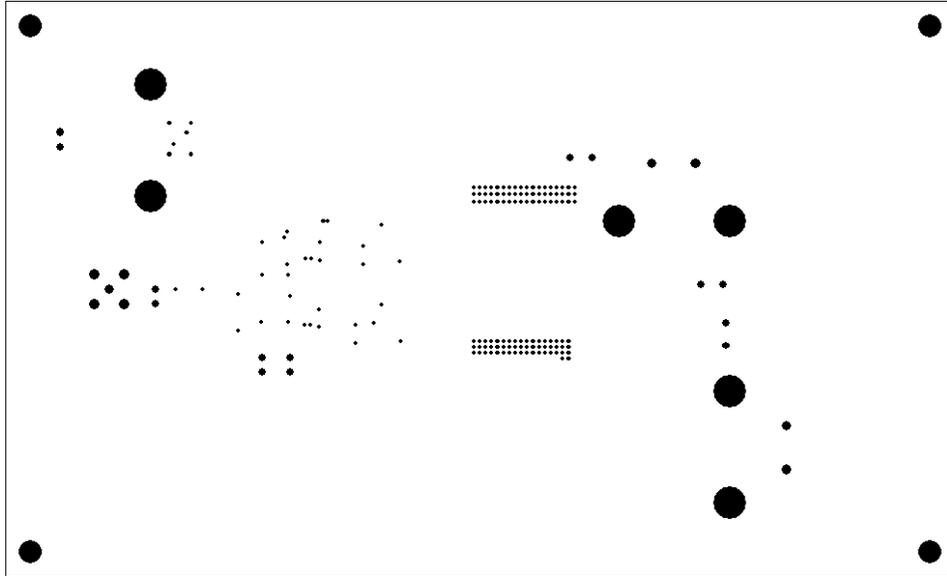
**Figure 28.** *EPC7C010/011 Evaluation Board Bottom Copper Etch (2 oz).*



**Figure 29.** EPC7C010/011/FBS-GAM02 POL Evaluation Board Bottom Solder Mask.



**Figure 30.** EPC7C010/011/FBS-GAM02 POL Evaluation Board Bottom Silkscreen.



**Figure 31.** *EPC7C010/011 Evaluation Board Drill Pattern.*

**NOTES:**

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**Revisions:**

Revision	Date	Status
PR	2/11/2026	Pre-Release
--		Release
A		Revision A



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