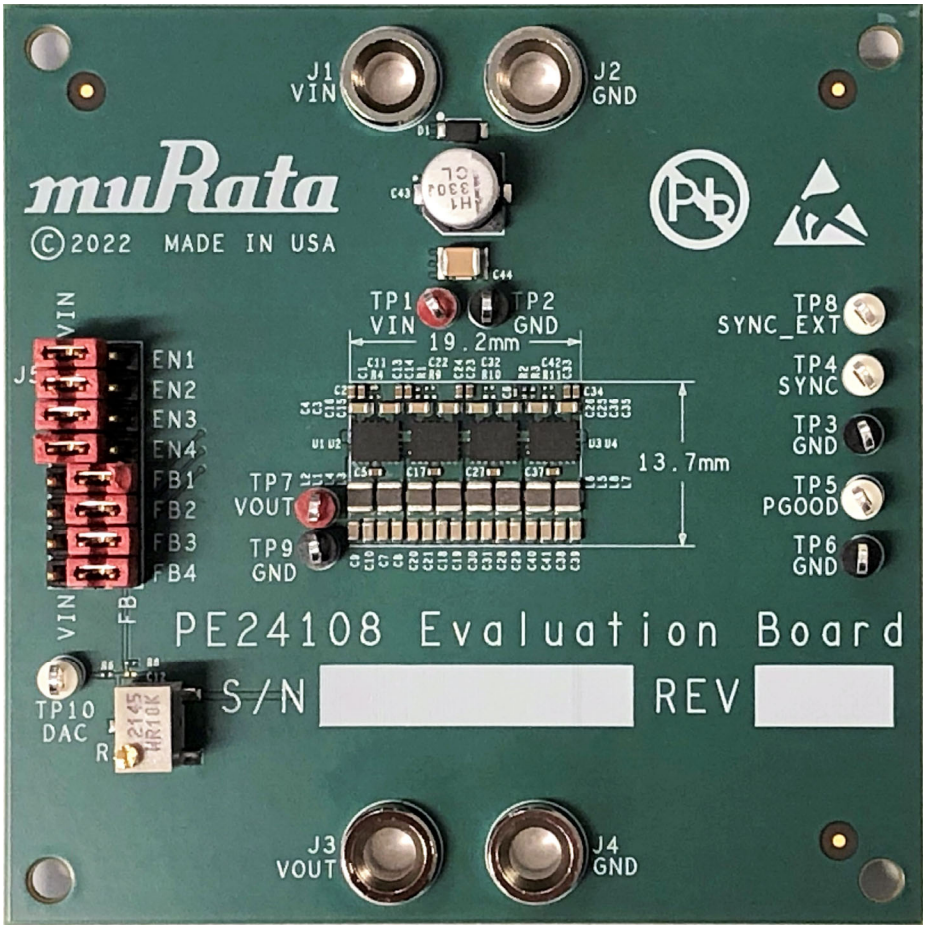
PE24108 Evaluation Kit (EVK) User's Manual

3.3 Vin, 10A, Two-stage Buck Regulator Evaluation Board for Low Output Voltage Applications



Introduction

The **PE24108** is a very small, low-profile, and ultra-high efficiency step-down DC-DC converter solution capable of delivering 10A per stage output current from an input voltage range from 3.0V to 3.6V. The output voltage is selected with external feedback resistors and can be adjusted between 0.40V and 1.00V.

The chip consists of a two-phase interleaved charge pump followed by a two-phase interleaved buck stage. This power system greatly reduces the dependency on inductance for high efficiency solutions in small-footprint and height-constrained applications.

Evaluation Kit Overview

The EK24108-01 evaluation kit (EVK) is a hardware platform that allows customers to easily test the PE24108 step-down DC-DC converter. The buck converter operates at a default switching frequency of 800kHz. The output voltage can be adjusted using the on-board potentiometer. The kit is available in four configurations, which can demonstrate multiple devices connected in parallel as power stages allowing output currents of 10A,18A, 27A or 36A.

Evaluation Kit User's Manual Overview

The PE24108 evaluation kit (EVK) user's manual includes information about the hardware required to control and evaluate the functionality of the DC-DC converter. The manual also includes test results, schematic diagrams, printed-circuit board layouts, and a bill of materials.

Evaluation Kit Contents and Requirements

Kit Contents

The PE24108 EVK includes the following hardware required to evaluate the DC-DC converter.

QUANTITY	DESCRIPTION
1	PE24108 DC-DC converter evaluation board assembly (EK24108-01)

Hardware Requirements

To evaluate the performance of the evaluation board, the following equipment is required:

- Bench supply capable of providing 3.0V to 3.6V at 10A with sense lines
- Three digital multi-meters (for Vin, Vout and test point checking)
- Four-channel oscilloscope with probes (optional to view waveforms)
- Active load capable of 10A (for a single device)

Caution: The PE24108 DC-DC converter EVK contains components that might be damaged by exposure to voltages more than the specified voltage, including voltages produced by electrostatic discharges. Handle the board in accordance with procedures for handling static-sensitive components. Avoid applying excessive voltages to the power supply terminals or signal inputs or outputs. When connecting the EVK to the source power supply, ensure the power supply is off. Connecting the EVK to a live power supply unit may cause failures.

Quick Start Guide

Quick Start Overview

The evaluation board is designed to ease customer evaluation of the PE24108 DC-DC converter. This section guides you through configuring the hardware and the startup procedures.

Evaluation Board Overview

The evaluation board contains:

- Power input/output terminals
- Enable jumpers
- Feedback mode selection jumpers
- DAC input for Vout control
- Sense points and PGOOD signal

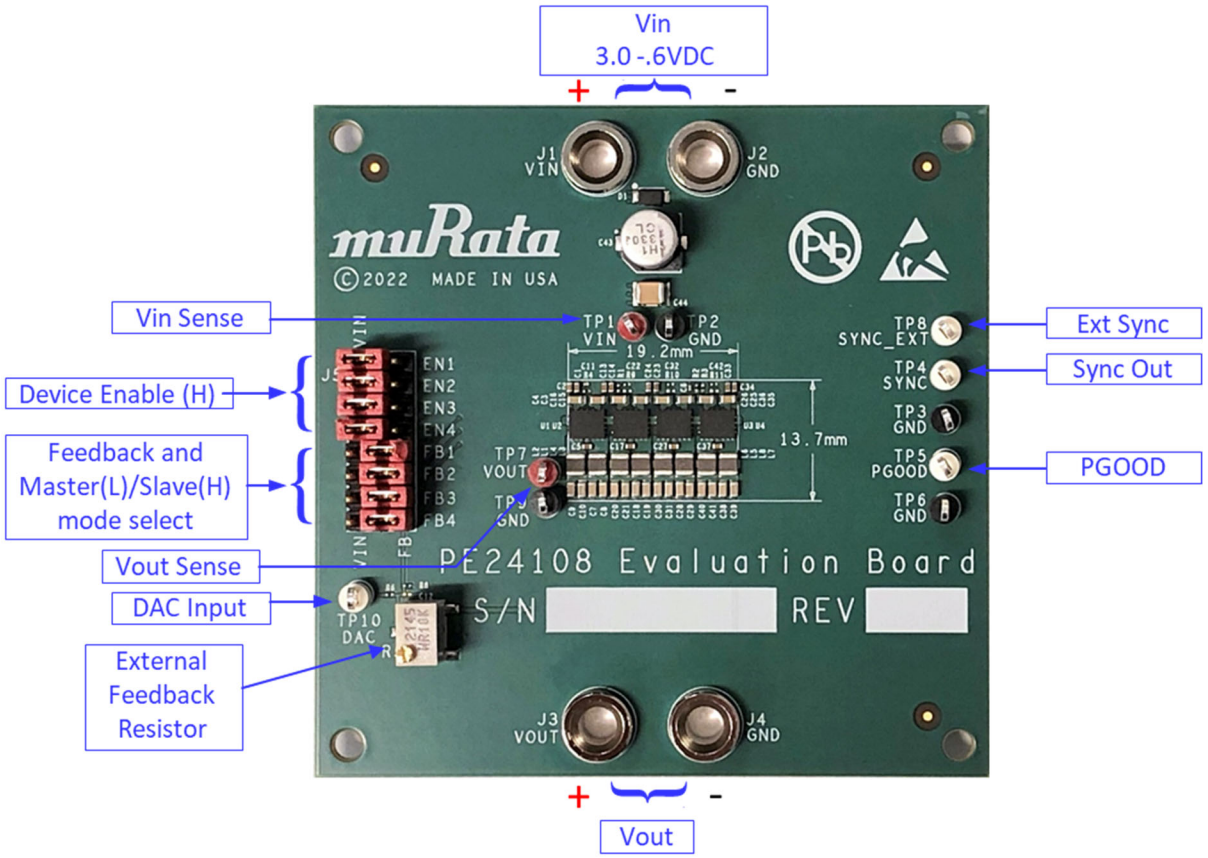


Figure 1. PE24108 Evaluation Board Assembly

EVK Test Connections

Connect the EVK and the lab equipment as shown in Figure 2. The power supply sense lines should be connected to the TP1 and TP2 test points to insure minimal supply droop and accurate voltage regulation at the device input. Due to the high currents present, especially in the x3 and x4 configurations, it is advised to use heavy gauge connection wires for the supply and load.

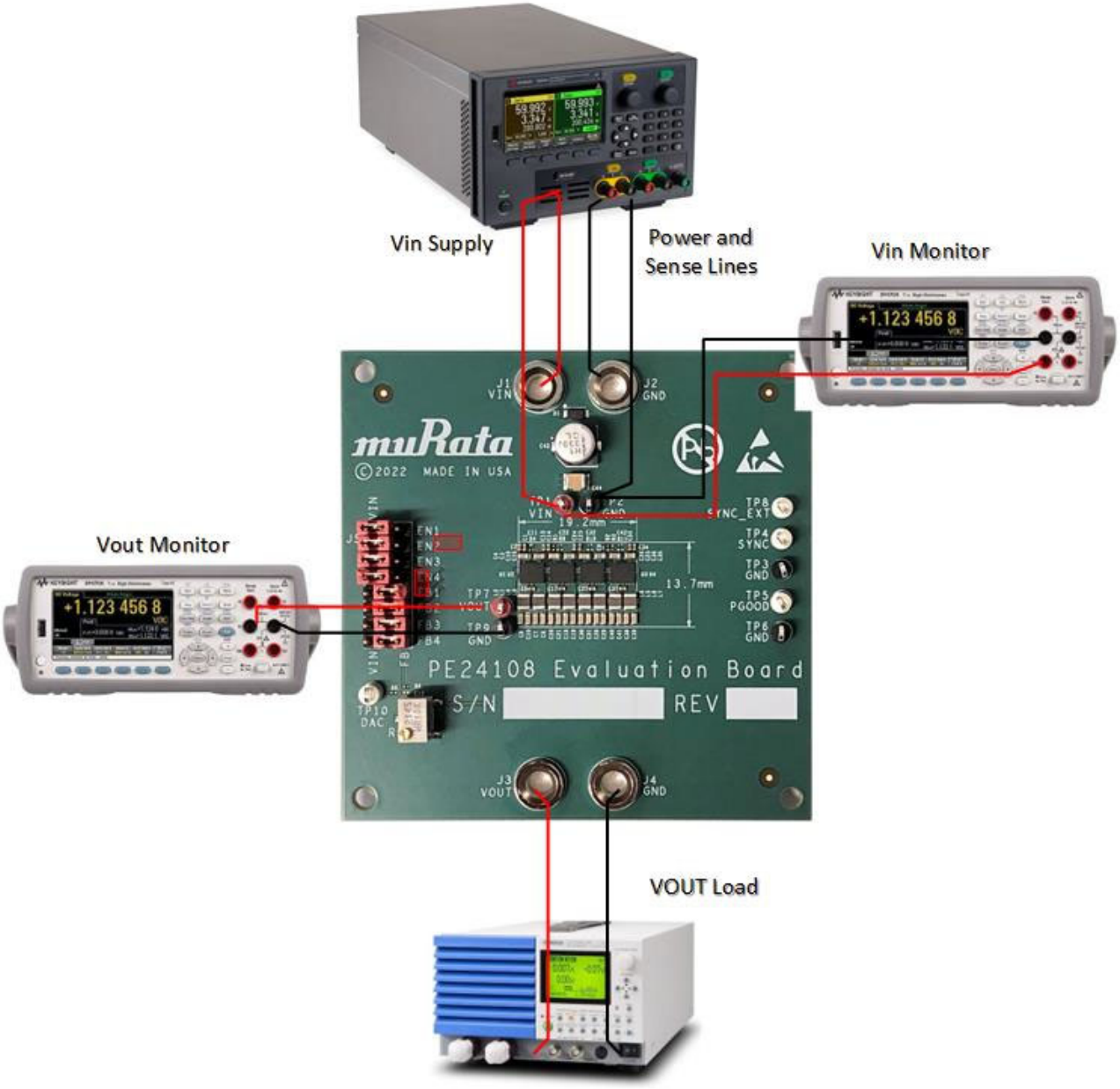


Figure 2. EVK Connection Example

The PE24108-01 EVK can have four different parallel configurations including:

- Single device or x1, up to 10A load current.
- Two devices in parallel or x2, up to 18A load current
- Three devices in parallel or x3, up to 27A load current
- Four devices in parallel or x4, up to 36A load current

Jumpers are provided that connect the enable pins to either VIN or GND, for enabling or disabling each device. Normal operation requires the EN jumpers to be in place and connected to VIN for the given board configuration. There are also jumper positions for the FB pins of each device, which allow connection to VIN or to the other device's FB pins (common FB). Normal operation requires the common FB pin configuration. Figure 3 illustrates the x4 board with four jumpers in place for the EN pins and FB pins.

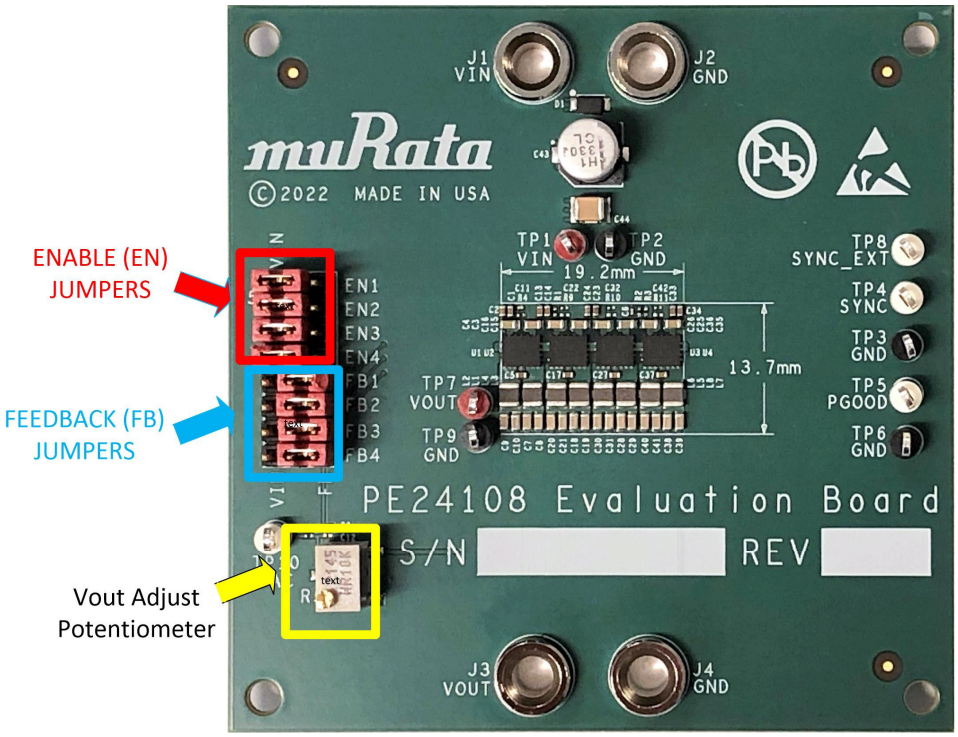


Figure 3. Enable and Feedback Jumper Position, Vout Potentiometer

Changing VOUT

The output voltage is adjustable by varying the potentiometer R5. (See Figure 4.). Adjusting the potentiometer clockwise will decrease VOUT. It is recommended to limit the VOUT range from 0.40V to 1.00V maximum (Although the potentiometer allows a wider VOUT adjustment).

Other Test Points

PG is the test point for the power good signal, asserted high when the output is within 10% of the target value.

SYNC OUT is the internal oscillator signal. The default frequency of 1600 kHz can be monitored on an oscilloscope.

EXT SYNC IN is used to override the internal oscillator by injecting an external clock signal for the DC-DC converter and charge pump. The signal should be a square wave and the frequency should be 1.7 MHz to 2.6 MHz with amplitude of 2.1 Vpp minimum. The clock signal is AC coupled to the SYNC input, so the DC level is not critical.

Parallel Modes of Operation

For two or more devices operating in parallel, the main operating mode is referred to Master-Master mode.

Master-Master Mode provides for each device to be a master with feedback control done individually. Each device will have a common connection to the feedback divider and the compensation R-C network on their COMP pin. The compensation R-C values are identical for all devices. All devices operate from a common FB node and the feedback amplifiers drive the COMP pin, essentially averaging the feedback for all devices.

Compensation

Each regulator device has pads for an R-C network for compensation. The standard values are given in the schematic. A bode plot is shown in Figure 8 for the circuit in Figure 4. Adjusting the R-C values can be done and is governed by the type II compensation circuit with one pole and one zero.

Output Trace Configuration

The EVK board has provisions for connecting the individual outputs together to the VOUT plane, reducing output resistance to the VOUT jacks. The backside of the board has an area where solder bridges will connect the outputs together. For just the x1 configuration, no additional soldering is needed. The x2 configuration solder bridge is shown in Figure 4, with the far-right section (position 1) bridged. For the x3 configuration, the next section would also be bridged, and for x4 all sections will be bridged. If the board received does not have these bridges soldered, they must be added.

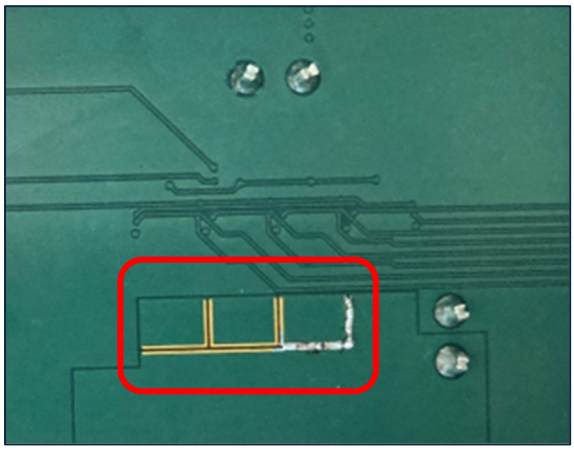


Figure 4. VOUT Trace Solder Bridging

EVK Startup

1. With the power off, ensure the jumpers are in the positions shown in Figure 3 and the backside has correct bridging as shown in Figure 4.
2. Connect the power supply and sense lines, load and meters are in Figure 2.
3. Apply between 3.0V and 3.6V to Vin.
4. Monitor Vout and adjust the load current within the operating range.

Test Results

The following test results show the typical efficiency and Vout waveforms of the PE24108 evaluation board, x1 configuration, VOUT = 0.50V.

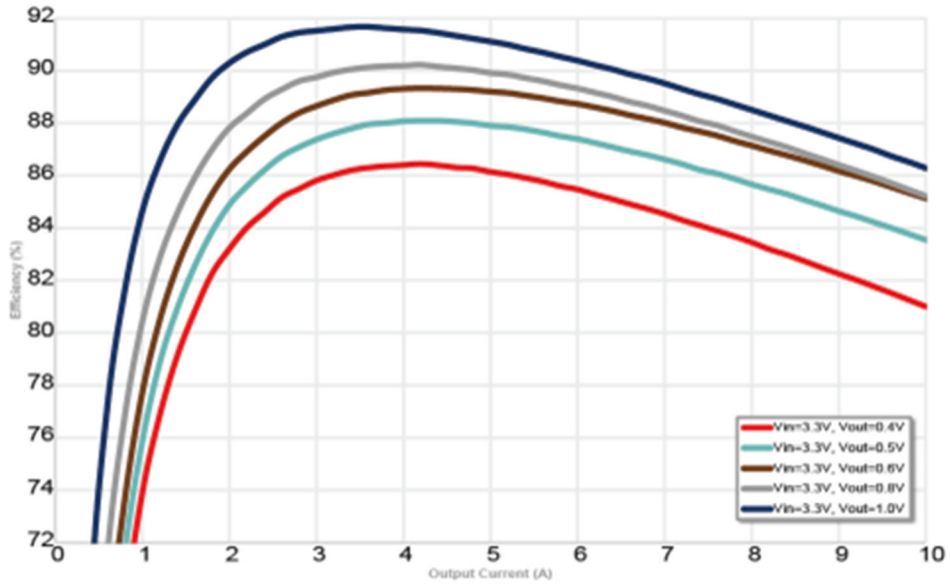


Figure 5. Efficiency vs. Output Current

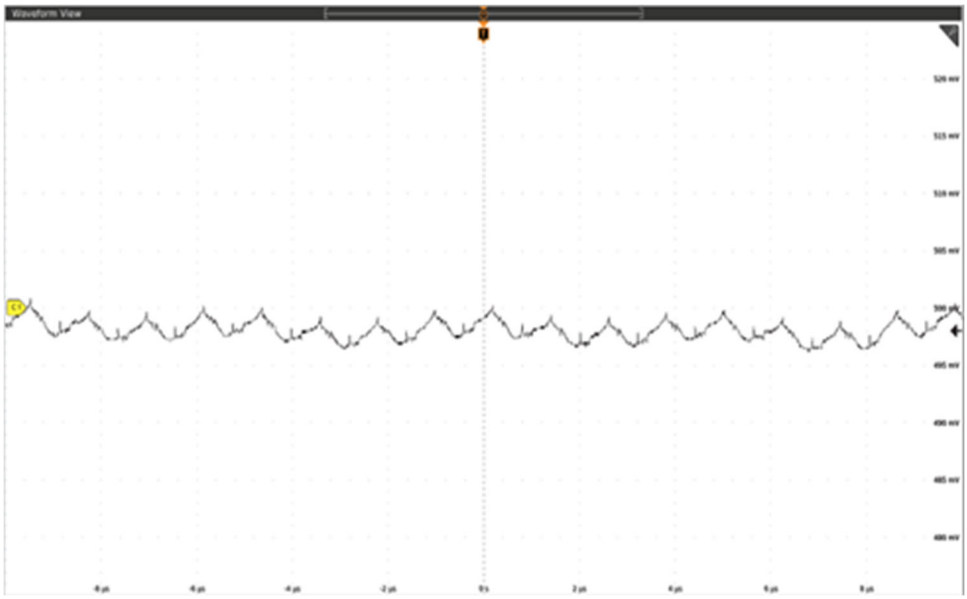


Figure 6. Output Ripple (Vin=3.3V, Iout=9A)

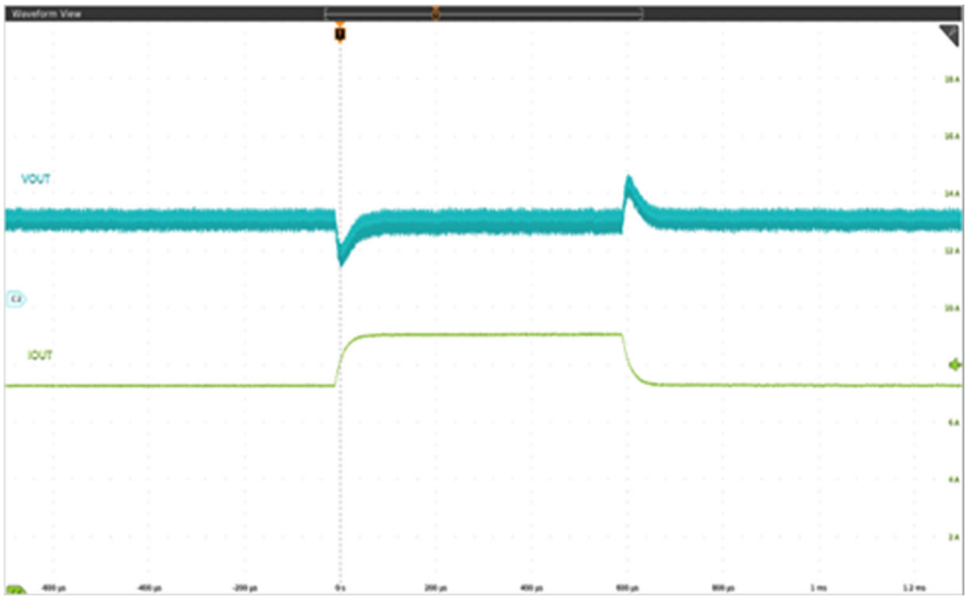


Figure 7. Load Transient Response (Vin=3.3V, 6 – 12A Load Step, 0.5A/µs)

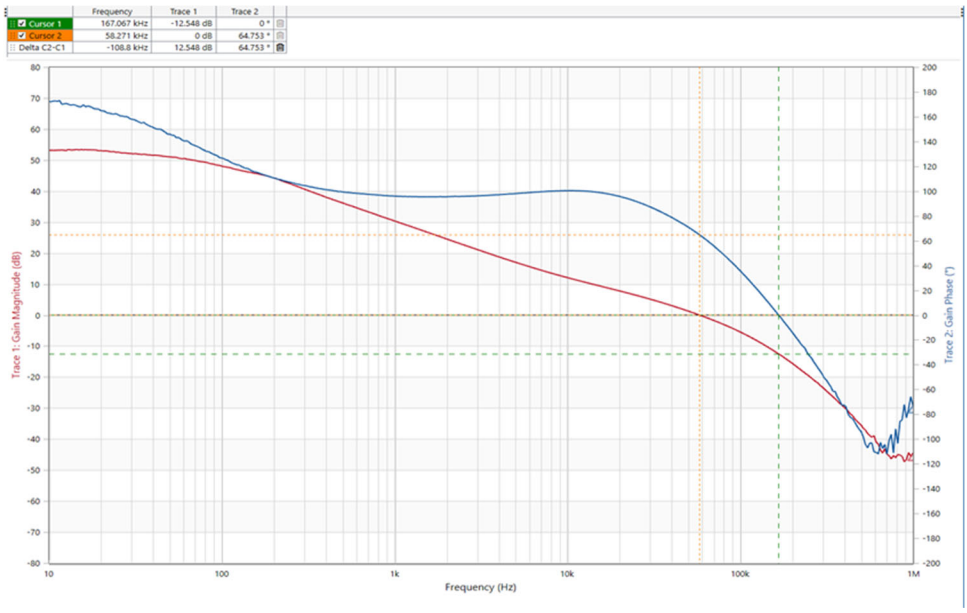


Figure 8. Bode Plot (Vin=3.3V, 10A Load

Information

PE24108 EVK PCB Layout

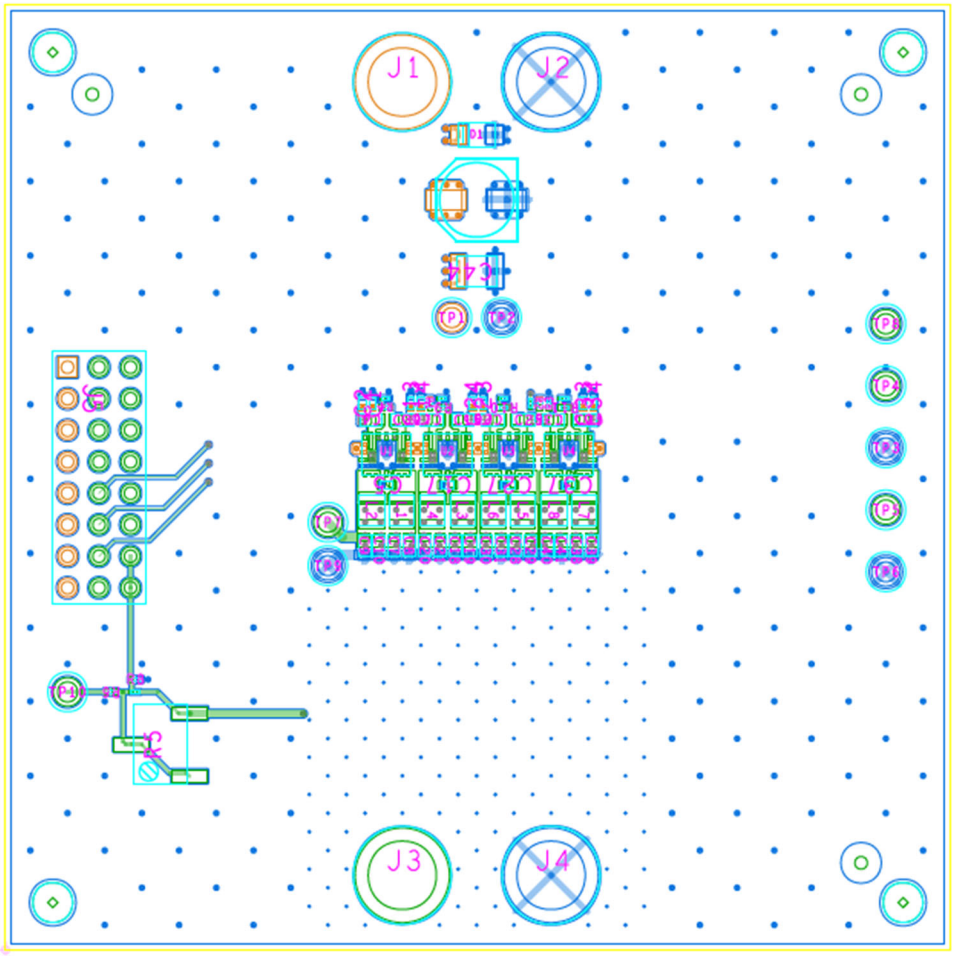


Figure 9. Evaluation Board Layout (Top Silkscreen)

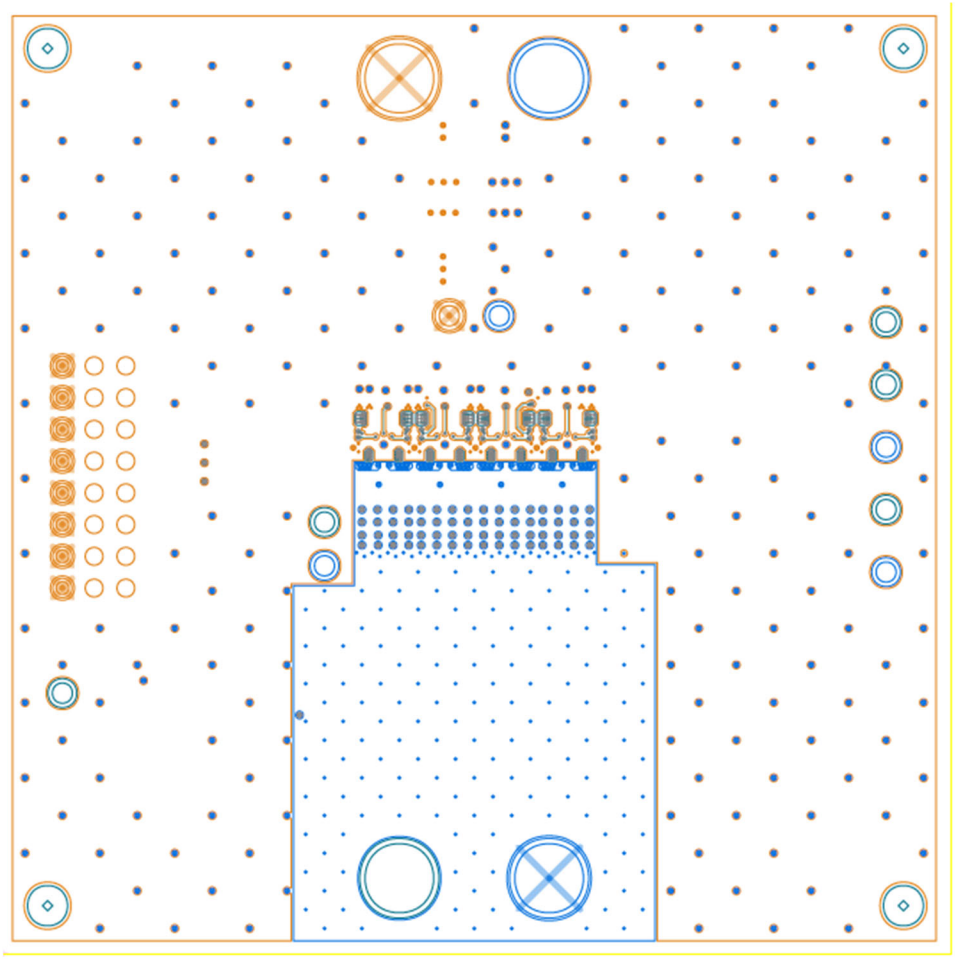


Figure 10. Evaluation Board Layout (Layer 2)

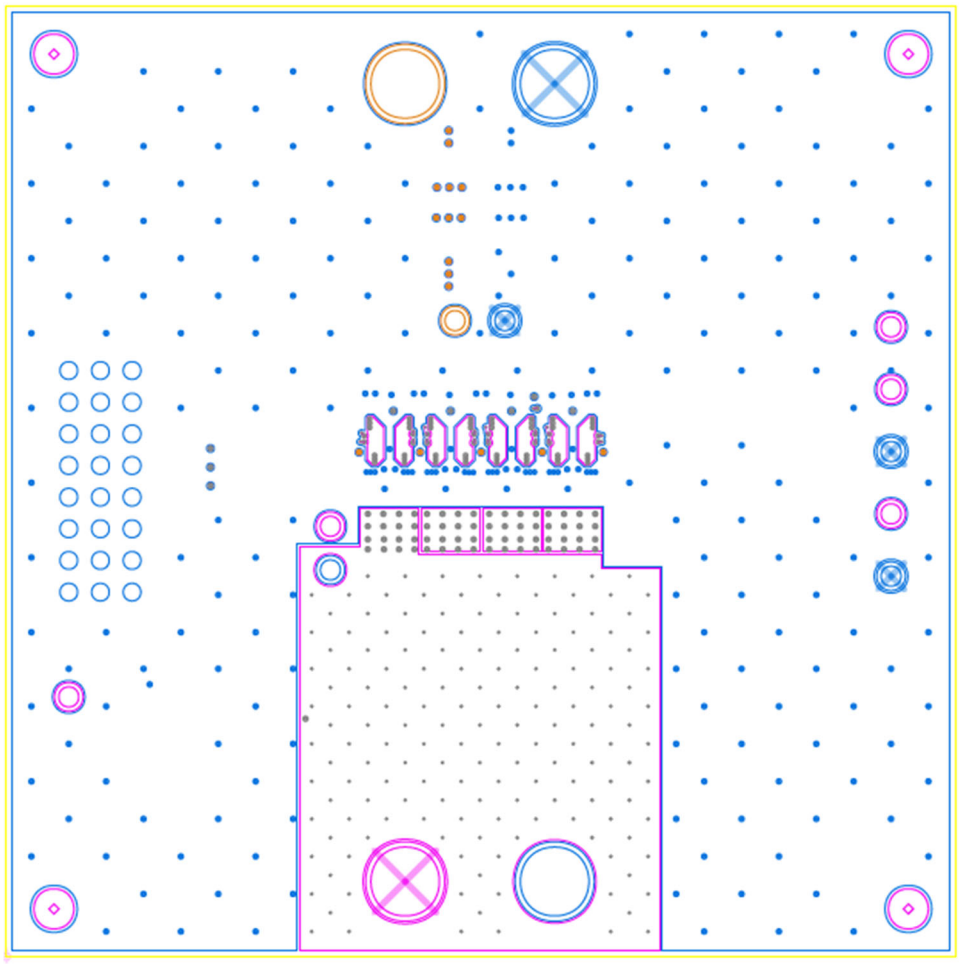


Figure 11. Evaluation Board Layout (Layer 3)

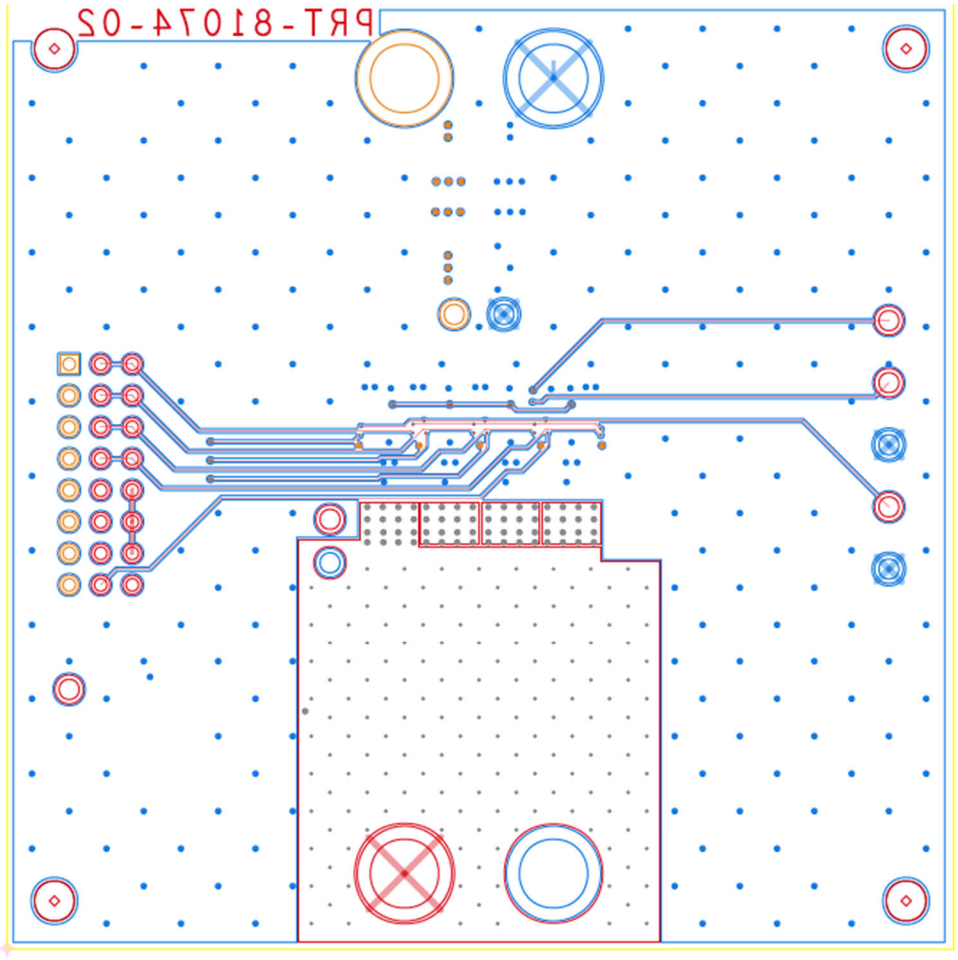


Figure 12. Evaluation Board Layout (Bottom Layer)

PE24108 EVK PCB Schematic

The full schematic for a x4 board is shown below. For other versions with x1, x2, x3 devices populated, start with position 1 for x1, and the successive pages for the other versions (x2 includes position 2, etc.).

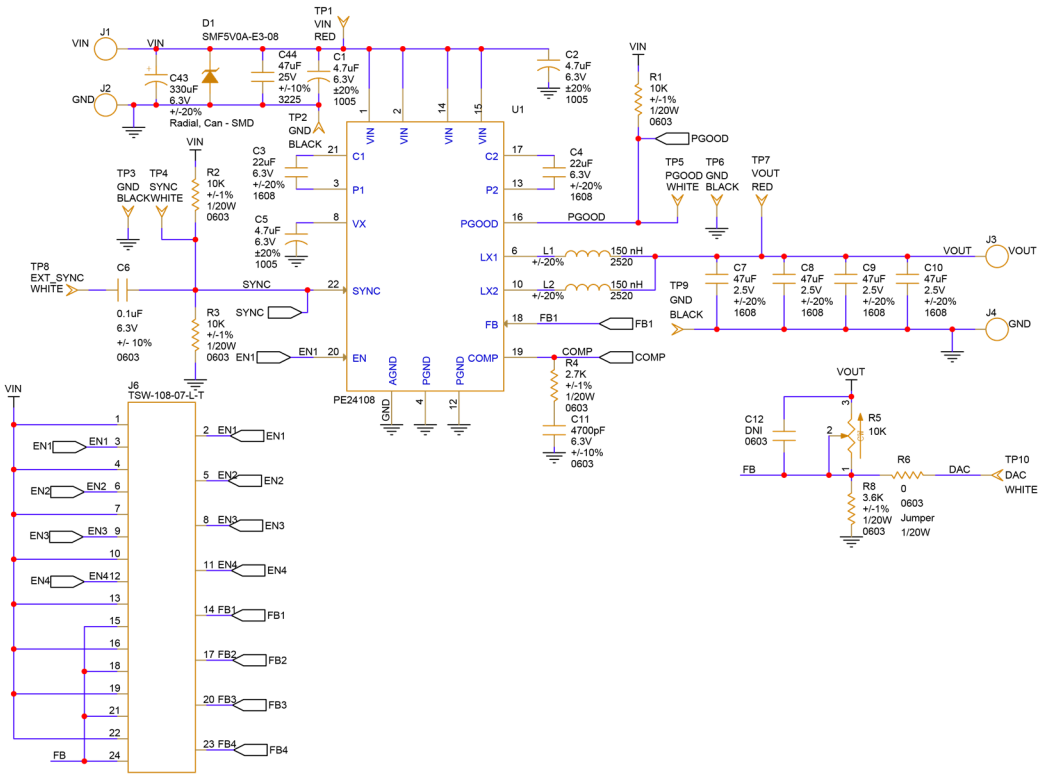


Figure 13. Evaluation Board Schematic, U1 Circuit

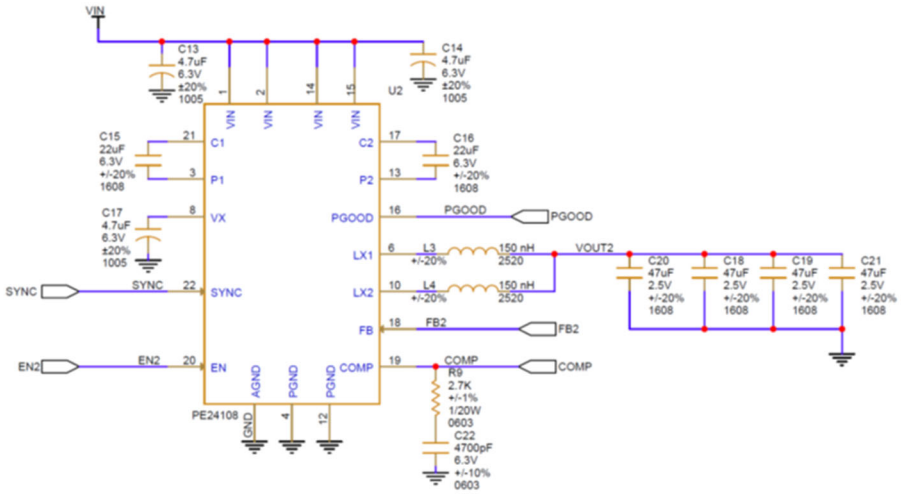


Figure 14. Evaluation Board Schematic, U2 Circuit

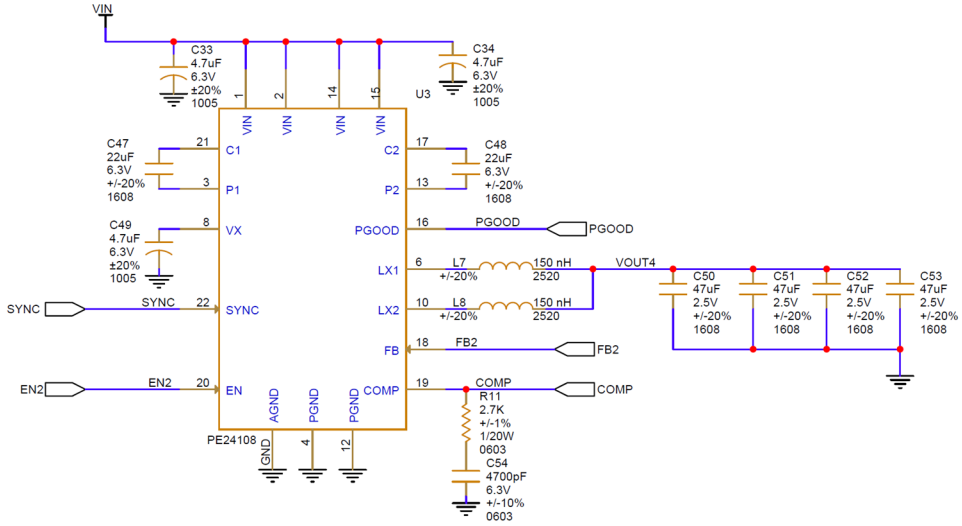


Figure 15. Evaluation Board Schematic, U3 Circuit

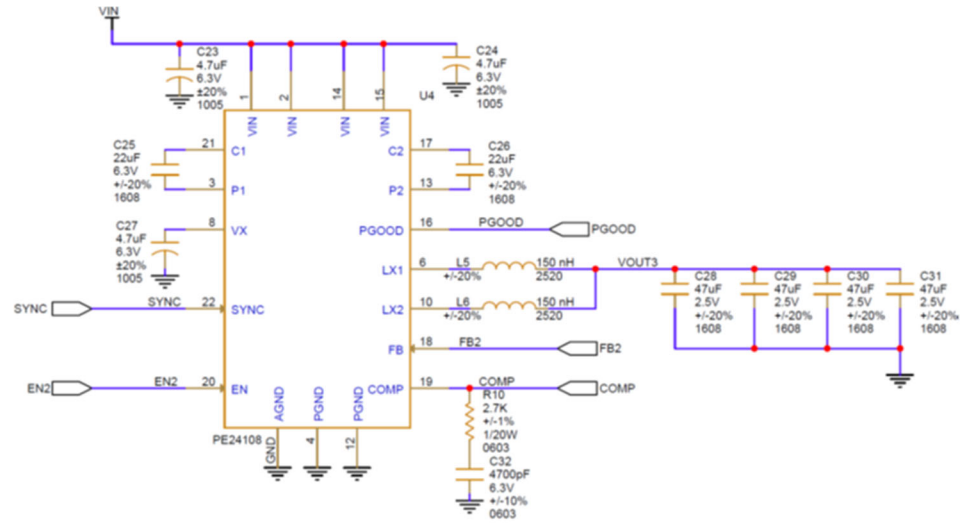


Figure 16. Evaluation Board Schematic, U4 Circuit

PE24108 EVK BOM List, x4 Configuration

REFERENCE	VALUE	DESCRIPTION	PART NUMBER
C1,C2,C5,C13,C14, C17,C23,C24,C27, C33, C34,C37	4.7 µF	CAP, SMD, CER, 4.7µF, 6.3V, ±20%, X6S, 0402, (1005 metric)	GRM155C80J475MEAAD
C3,C4,C15,C16,C25, C26,C35,C36	22 µF	CAP, SMD, CER, 22µF, 6.3V, ±20%, X6S, 0603, (1608 metric)	GRM188C80J226ME15D
C6	0.1 µF	CAP, SMD, CER, 0.1µF, 6.3V, ±10%, X6S, 0201, (0603 metric)	GRM033C80J104KE15D
C7,C8,C9,C10,C18, C19,C20,C21,C28,C29, C30,C31,C38,C39,C40, C41	47 µF	CAP, SMD, CER, 47µF, 2.5V, ±20%, X7T, 0603, (1608 metric)	GRM188D70E476ME01D
C11,C22,C32,C54	4700 pF	CAP, SMD, CER, 4700pF, 6.3V, ±10%, X7R, 0201, (0603 metric)	GRM033R70J472KA01D
C12	470 pF	CAP, SMD, CER, 470pF, 16V, ±10%, X7R, 0201, (0603 metric)	GRM033R71C471KA01D
C43	330 µF	CAP, SMD, ALUM ELEC, RADIAL, 330µF, 6.3V	UCL0J331MCL1GS
C44	47 µF	CAP, SMD, CER, 47µF, 6.3V, ±10%, X7R, 1210, (3225 metric)	GRM32ER70J476KE20L
D1	5V TVS	DIODE, TVS, 5V, SMF, DO-219AB	SMF5V0A
J1,J2,J3,J4	JACK	NON-INSULATED	575-4
J5	Header	Header Connector 24 position, 0.100" (2.54mm) 8x3	TSW-108-07-L-T
L1,L2,L3,L4,L5,L6,L7, L8	150 nH	IND 150nH 11mΩ, 7.3A, 1008 (2520 metric)	TFM252012ALMAR15MTAA
R1,R2,R3	10 kΩ	RES, SMD, Thick Film, 10kohm, ±1%, 0201 (0603 metric)	ERJ-1GNF1002C
R4,R9,R10,R11	2.7 kΩ	RES, SMD, Thick Film, 4.22kohm, ±1%, 0201 (0603 metric)	CRCW02014K22FNED
R5	10 kΩ	POTENTIOMETER, 10kohm, 1/4W, SMD, 12 turn trimmer top adj	84WR10KLFTR
R6	0Ω	RES, SMD, 0 ohms jumper, ±1%, 0201 (0603 metric)	ERJ-1GN0R00C
R8	7.5 kΩ	RES, SMD, Thick Film, 7.5kohm, ±1%, 0201 (0603 metric)	ERJ-1GEF7501C
TP1, TP7	Red	Test Point, TH, Male, Red	5005
TP2,TP3,TP6,TP9	Black	Test Point, TH, Male, Black	5006
TP4, TP5, TP8, TP10	White	Test Point, TH, Male, White	5007
U1,U2,U3,U4	PE21408	Dual Stage Buck Converter IC, 9A	PE24108
PCB1		PE24108 Evaluation Board	PRT-81074-02

Table 1. EVK BOM List

Technical Resources

Additional technical resources are available by contacting Sales at https://www.murata.com/contactform. These include the product specification datasheet, evaluation kit schematic and material declaration form. Trademarks are subject to trademark claims.

Notices

⚠ CAUTION

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Please contact us before using our products for the applications listed below which require especially high reliability for the prevention of defects which might lead to damage to life, body or property.

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- Aerospace equipment
- Undersea equipment
- Power plant control equipment
- Surgical implants
- Transportation equipment (vehicles, trains, ships, etc.)
- Traffic signal equipment
- Disaster prevention / crime prevention equipment
- Application of similar complexity and/or reliability requirements to the applications listed in the above

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2. All the items and parameters in this approval sheet for product specification are based on the premise that our product is used for the purpose, under the condition and in the environment agreed upon between you and us. You are requested not to use our product in a manner deviating from such agreement.
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5. Do not allow our product to be exposed to excess moisture under any circumstances.

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