

TPS65708EVM

This user's guide describes the characteristics, operation, and use of the TPS65708 evaluation module (EVM). The TPS65708EVM-587 is a fully assembled and tested circuit for evaluating the performance of the [TPS65708](#) four-channel power management unit (PMU). This document includes schematic diagrams, a printed circuit board (PCB) layout, bill of materials, and test data. Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the TPS65708EVM-587 unless otherwise noted.

Contents

| | | |
|-----|---|----|
| 1 | Introduction | 2 |
| 1.1 | Features | 2 |
| 1.2 | Applications | 2 |
| 1.3 | Power-Supply Requirements | 2 |
| 1.4 | Additional Requirements | 2 |
| 2 | TPS65708EVM Output Voltages and Current | 2 |
| 3 | TPS65708EVM Schematic | 3 |
| 4 | Connector and Test Point Descriptions | 4 |
| 4.1 | Enable Jumpers/Switches (RefDes) TPS65708 | 4 |
| 5 | Test Configuration | 7 |
| 5.1 | Hardware Setup | 7 |
| 5.2 | Procedure | 8 |
| 6 | TPS65708EVM Assembly Drawings and Layout | 9 |
| 7 | Bill of Materials | 14 |

List of Figures

| | | |
|---|--|----|
| 1 | TPS65708EVM Schematic | 3 |
| 2 | Hardware Board Connection | 7 |
| 3 | TPS65708EVM Component Placement (Top View)..... | 9 |
| 4 | TPS65708EVM Top-Side Copper (Top View) | 10 |
| 5 | TPS65708EVM Internal Layer 1 (Top View)..... | 11 |
| 6 | TPS65708EVM Internal Layer 2 (Top View)..... | 12 |
| 7 | TPS65708EVM Bottom-Side Copper (Bottom View) | 13 |

1 Introduction

The TPS65708 is a small PMU designed for embedded camera modules or other portable, low-power consumer end equipment. It contains two high-efficiency step-down converters, two low-dropout linear regulators (LDOs), and a 7.5-mA current sink for driving an LED.

The TPS65708EVM-587 is a fully assembled and tested platform for evaluating the operation and performance of the TPS65708 PMU device.

1.1 Features

- Input voltage range: 3.6 V up to 6.0 V
- 2 x 200-mA step-down converter for TPS65708
- 2.25-MHz switching frequency
- Two general-purpose 200-mA LDOs
- PWM dimmable current sink

1.2 Applications

- USB cameras
- Handheld applications

1.3 Power-Supply Requirements

A dc power supply capable of delivering 5 V at 1 A is required to operate this EVM.

1.4 Additional Requirements

In order to operate this EVM, the following components must be connected and properly configured. All components and connectors are shipped with the EVM. If any component is missing, contact your local distributor or Texas Instruments for a replacement.

2 TPS65708EVM Output Voltages and Current

[Table 1](#) summarizes the output voltages and current of the TPS65708EVM.

Table 1. TPS65708EVM Output Voltages and Current

| Orderable EVM Number | Device Part Number | Output Voltage | Output Current | Power-Up Sequence |
|----------------------|--------------------|----------------|--------------------------|---|
| TPS65708EVM-587 | TPS65708 | DCDC1 = 3.3 V | DCDC1 and DCDC2 = 400 mA | DCDC1, then DCDC2, then LDO1, then LDO2 |
| | | DCDC2 = 1.8 V | LDO1 and LDO2 = 200 mA | |
| | | LDO1 = 2.8 V | | |
| | | LDO2 = 1.2 V | | |

3 TPS65708EVM Schematic

Figure 1 illustrates the TPS65708EVM-587 schematic.

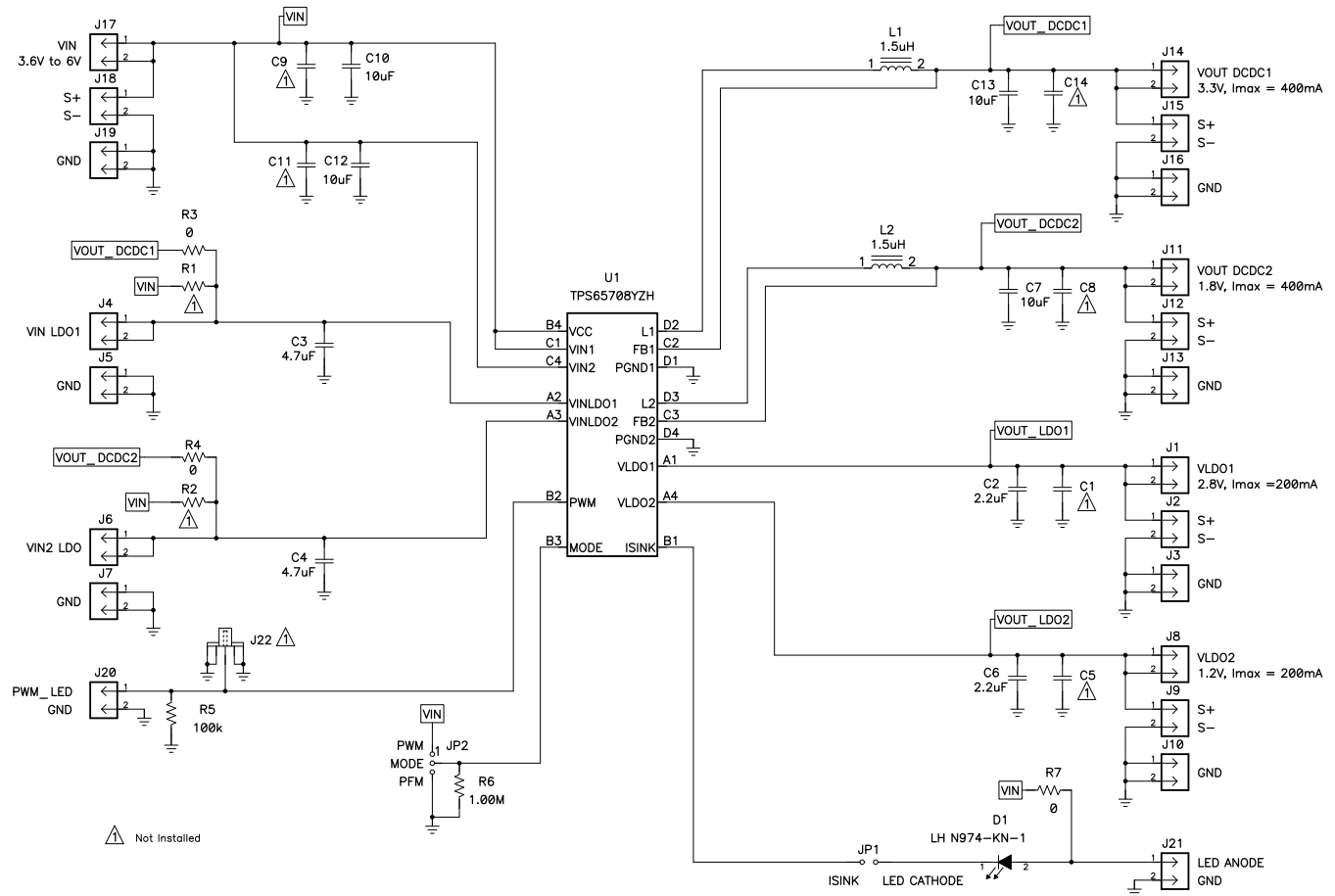


Figure 1. TPS65708EVM Schematic

4 Connector and Test Point Descriptions

4.1 Enable Jumpers/Switches (RefDes) TPS65708

4.1.1 J1 VLDO1

This header is the positive output of the LDO1 linear regulator. The default output voltage of the LDO is 2.8 V. The LDO is capable of sourcing up to 200 mA. A load can be connected between J1 and J3 (GND).

4.1.2 J2 S+/S–

J2 S+/S– are the sense connection for the output of LDO1. Connect a voltmeter, sense connection of an electronic load, or oscilloscope to this header.

4.1.3 J3 GND

This header is the return connection for LDO1. A load can be connected between J3 (GND) and J1 (VLDO1). The LDO is capable of sourcing up to 200 mA.

4.1.4 J4 VINLDO1

This header is the input supply for LDO1 on the EVM. VINLDO1 is directly connected to VOUT_DCDC1 with R3 in the default EVM configuration. Alternatively, LDO1 can be supplied from VIN with resistor R1. Use a 0-Ω resistor for R1. Note that R3 must be removed if R1 is assembled.

An external power supply can be connected between J4 (VINLDO1) and J5 (GND). Note that resistors R1 and R3 must be removed when supplying LDO1 from an external power supply.

4.1.5 J5 GND

J5 is the return connection of VINLDO1. An external power supply can be connected between J5 (GND) and J4 (VINLDO1). Note that resistors R1 and R3 must be removed when supplying LDO1 from an external power supply.

4.1.6 J6 VINLDO2

J6 is the input supply for LDO2 on the EVM. VINLDO2 is directly connected to VOUT_DCDC2 with R4 in the default EVM configuration. Alternatively, LDO2 can be supplied from VIN with resistor R2. Use a 0-Ω resistor for R2. Note that R4 must be removed if R2 is assembled.

An external power supply can be connected between J6 (VINLDO2) and J7 (GND). Note that resistors R2 and R4 must be removed when supplying LDO2 from an external power supply.

4.1.7 J7 GND

This jumper enables/disables the TPS65708 on the EVM. The shorting jumper JP1 between the center pin and ON turns on the unit. Shorting the jumper between the center pin and OFF turns the unit off.

4.1.8 J7 VOUT (SMA)

This header is the return connection of VINLDO2. An external power supply can be connected between J7 (GND) and J6 (VINLDO2). Note that resistors R2 and R4 must be removed when supplying LDO2 from an external power supply.

4.1.9 J8 VLDO2

J8 is the positive output of LDO2. The default output voltage of this LDO is 1.2 V. LDO2 is capable of sourcing up to 200 mA. A load can be connected between J8 and J10 (GND).

4.1.10 J9 S+/S–

J9 S+/S– are the sense connection for the output of VLDO2. Connect a voltmeter, sense connection of an electronic load, or oscilloscope to this header.

4.1.11 J10 GND

J10 is the return connection of LDO2. A load can be connected between J8 (VLDO2) and J10 (GND). The LDO is capable of sourcing up to 200 mA.

4.1.12 J11 VOUTDCDC2

This header is the positive output of the VDCDC2 step-down converter. The output voltage of DCDC2 is fixed to 3.3 V in the TPS65708.

VDCDC2 is capable of sourcing up to 400 mA. A load can be connected between J11 and J13(GND).

4.1.13 J12 S+/S–

J12 S+/S– are the sense connection for the DCDC2 output. Connect a voltmeter, sense connection of an electronic load, or oscilloscope to this header.

4.1.14 J13 GND

J13 is the return connection of VDCDC2. An external power supply can be connected between J13 (GND) and J11 (VDCDC2).

4.1.15 J14 DCDC1

This header is the positive output of the VDCDC1 step-down converter. The output voltage of DCDC1 is fixed to 1.8 V in the TPS65708.

VDCDC1 is capable of sourcing up to 400 mA. A load can be connected between J14 (VDCDC1) and J15(GND).

4.1.16 J15 S+/S–

J15 S+/S– are the sense connection for the output of DCDC1. Connect a voltmeter, sense connection of an electronic load, or oscilloscope to this header.

4.1.17 J16 GND

J16 is the return connection of VDCDC1. An external power supply can be connected between J16 (GND) and J14 (VDCDC1).

4.1.18 J17 VIN

J17 is the positive connection for the input power supply for DCDC1, DCDC2, and VCC. Connect a power supply in the range of 3.6 V to 6.0 V between J17 (VIN) and J19 (GND).

4.1.19 J18 S+/S–

J18 S+/S– are the sense connection for the output of DCDC1, DCDC2, and VCC. Connect a voltmeter or oscilloscope to this header.

4.1.20 J19 GND

J19 is the return connection of the input supply for DCDC1, DCDC2, and VCC. An external power supply can be connected between J19 (GND) and J17 (VIN).

4.1.21 J20 PWM_LED/GND

J20, pin 1 is the PWM input connection for the LED current sink. Use a signal generator, for example, to drive this input. The PWM dimming frequency can be up to 50 kHz, and the duty cycle should be in the range of 5% to 100%. At a 100% duty cycle, the LED current is 7.5 mA. Average LED current decreases with a decreasing duty cycle. In the default EVM configuration, there is a 100-k Ω resistor (R5) assembled between the PWM and GND to terminate the PWM input. SMA connector J22 is also connected to the PWM input. Either J20 or J22 can be used.

4.1.22 J21 LED_ANODE / GND

J21, pin 1 is connected to the anode of LED D1. In the default EVM configuration, the LED anode is supplied from VIN with resistor R7. An external LED power supply can be connected between J22 pin 1 (LED_ANODE) and J22 pin 2 (GND).

Note: R7 must be removed if an external LED power supply is used.

4.1.23 J22 PWM_LED / GND (SMA)

J22 is an SMA connector that is connected to the PWM input connection of the LED current sink. Use a signal generator, for example, to drive this input. The PWM dimming frequency can be up to 50 kHz, and the duty cycle should be in the range of 5% to 100%. At a duty cycle of 100%, the LED current is 7.5 mA. Average LED current decreases with a decreasing duty cycle. In the default EVM configuration, there is a 100-k Ω resistor (R5) assembled between the PWM and GND to terminate the PWM input. J20 is also connected to the PWM input. Either J20 or J22 can be used.

4.1.24 JP1 ISINK / LED CATHODE

JP1 is a jumper that is connected between the LED CATHODE and the input of the LED current sink, ISINK. Placing a shorting bar on JP1 directly connects the the LED cathode to the input of the LED current sink.

JP1 can be opened, and an amp meter or current probe of a scope can be connected between the pins of JP1 to measure the LED current.

4.1.25 JP2 MODE

This jumper enables/disables the power-saving mode under light load conditions. Shorting jumper JP2 between the center pin and the PWM disables power-save mode; if the power-save mode is disabled, the dc-dc converters DCDC1 and DCDC2 operate in forced PWM mode over the entire load current range. Shorting the jumper between the center pin and the PWM enables power-save mode. The device operates in power-save mode under light load conditions. See the [TPS65708 data sheet \(SLVSAE1\)](#) for a detailed description of this configuration.

A 1-M Ω pull-down resistor is connected between GND and MODE. By removing JP2, the converter operates in power-save mode under light load conditions.

5 Test Configuration

5.1 Hardware Setup

Figure 2 illustrates a typical hardware test configuration.

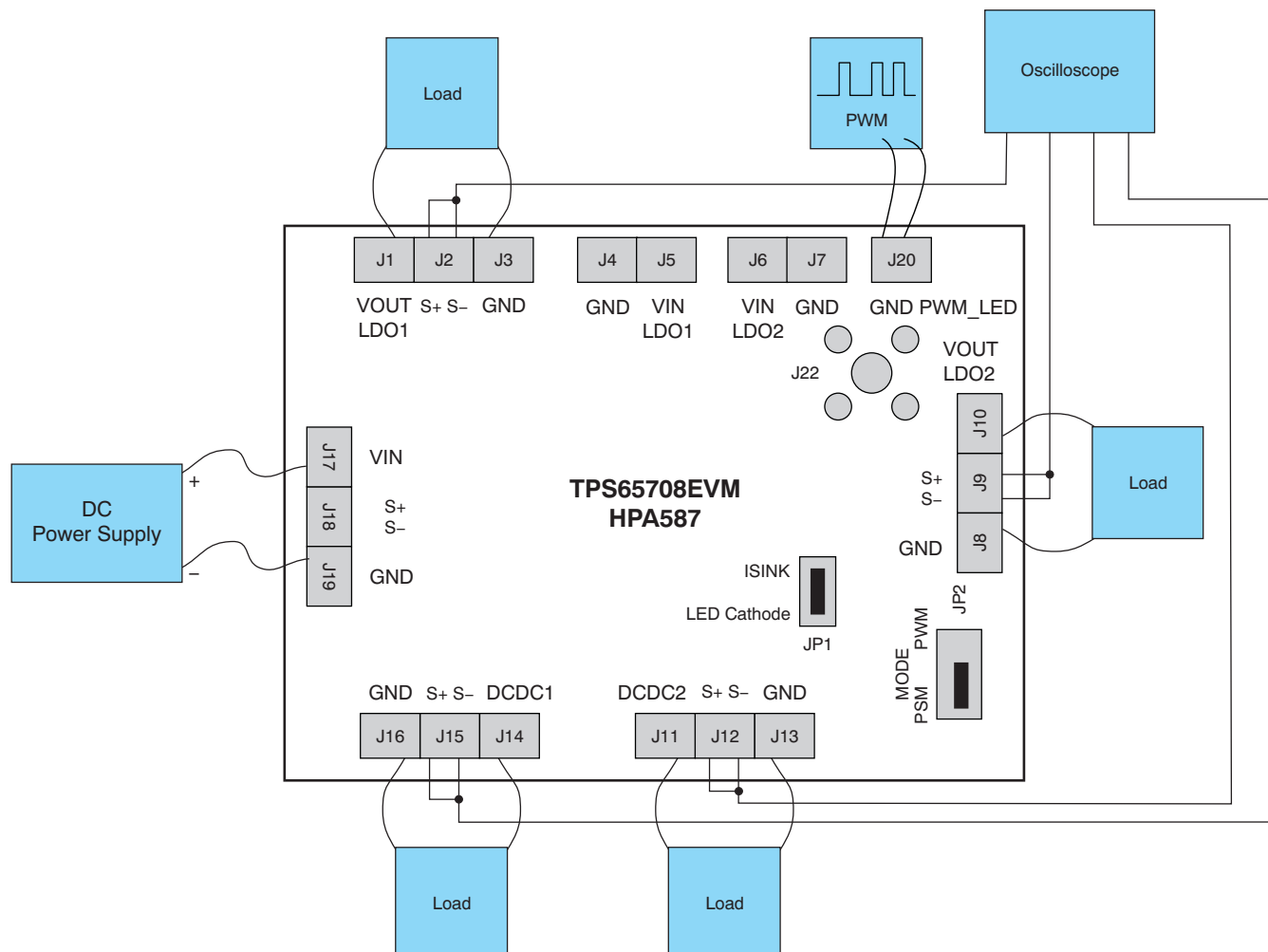


Figure 2. Hardware Board Connection

5.2 Procedure

Follow these procedures when configuring the EVM for testing.

CAUTION

Many of the components on the TPS65708EVM-587 are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap, bootstraps, or mats at an approved ESD workstation. An electrostatic smock and safety glasses should also be worn.

1. Work at an ESD workstation. Make sure that any wrist straps, bootstraps, or mats are connected and reference the user to earth ground before power is applied to the EVM. Electrostatic smock and safety glasses should also be worn.
2. Connect a dc power supply between J17 and J19 on the TPS65708EVM. Note that the input voltage should be in the range of 3.6 V to 6.0 V. Keep the wires from the input power supply to EVM as short as possible and twisted.
3. Connect a dc voltmeter or oscilloscope to the output sense connections of the EVM: J2 for LDO1, J9 for LDO2, J15 for DCDC1, and J12 for DCDC2.
4. A load can be connected between the positive output of the dc-dc converters, LDOs, and GND.
5. To enable the converter, connect the shorting bar on JP10 (JP20) between EN and ON on the TPS65708EVM.
6. The TPS65708EVM has the option to switch between power-save mode under light load conditions and forced PWM mode by using jumper JP2.
7. Connect a signal generator (or any other source that provides a PWM output signal) to header J20 or SMA connector J22. The amplitude of the PWM signal should conform to the low and high level thresholds specified in the [TPS65708 product data sheet](#). The PWM frequency can be up to 50 kHz. The duty cycle of the PWM signal must be in the range of 5% to 100%.

6 TPS65708EVM Assembly Drawings and Layout

Figure 3 through Figure 7 show the design of the show the design of the TPS65708EVM-587 printed circuit board. The EVM has been designed using a four-layer, 1-ounce copper-clad PCB.

NOTE: Board layouts are not to scale. These figures are intended to show how the board is laid out; they are not intended to be used for manufacturing TPS65708EVM-587 PCBs.

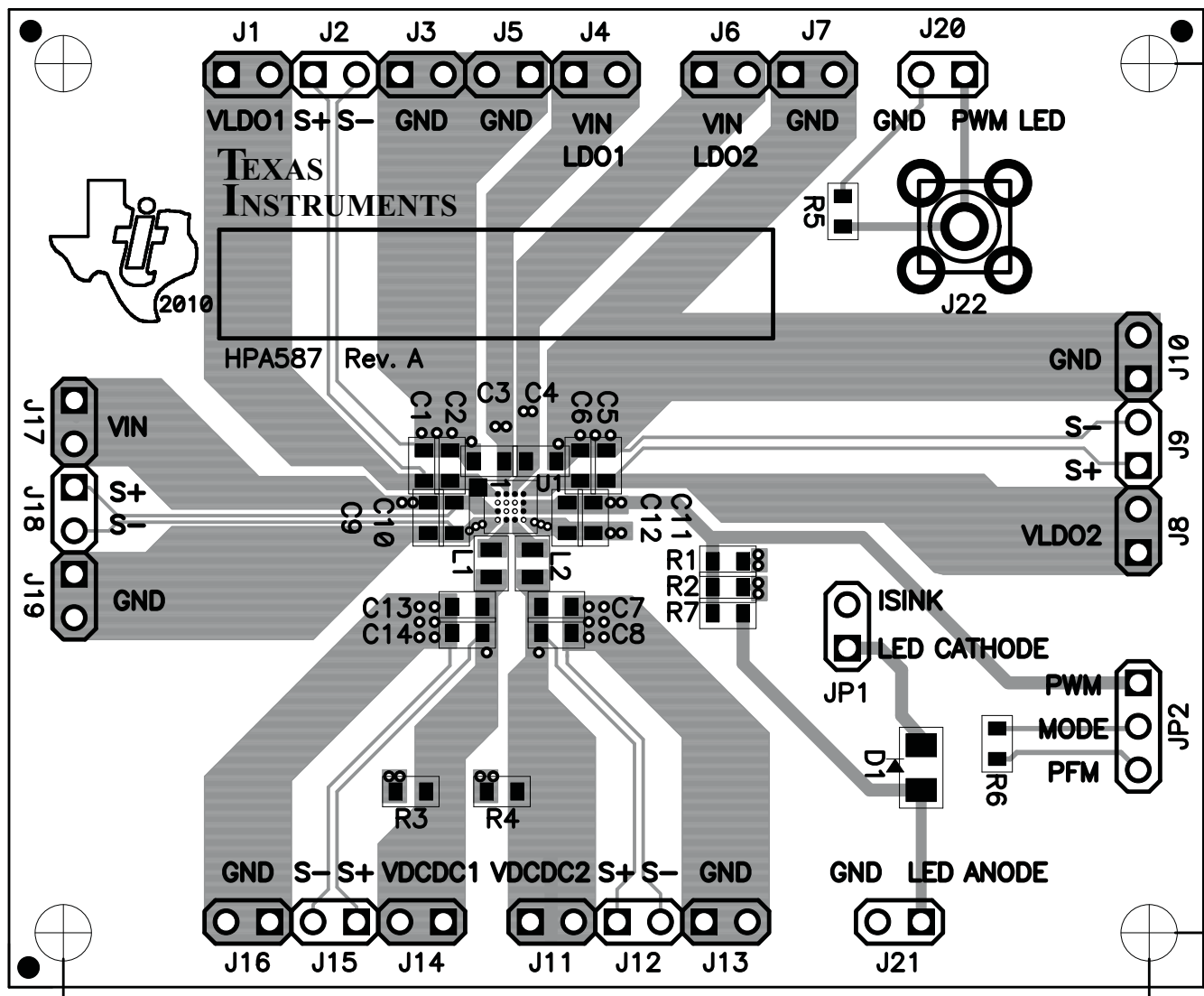


Figure 3. TPS65708EVM Component Placement (Top View)

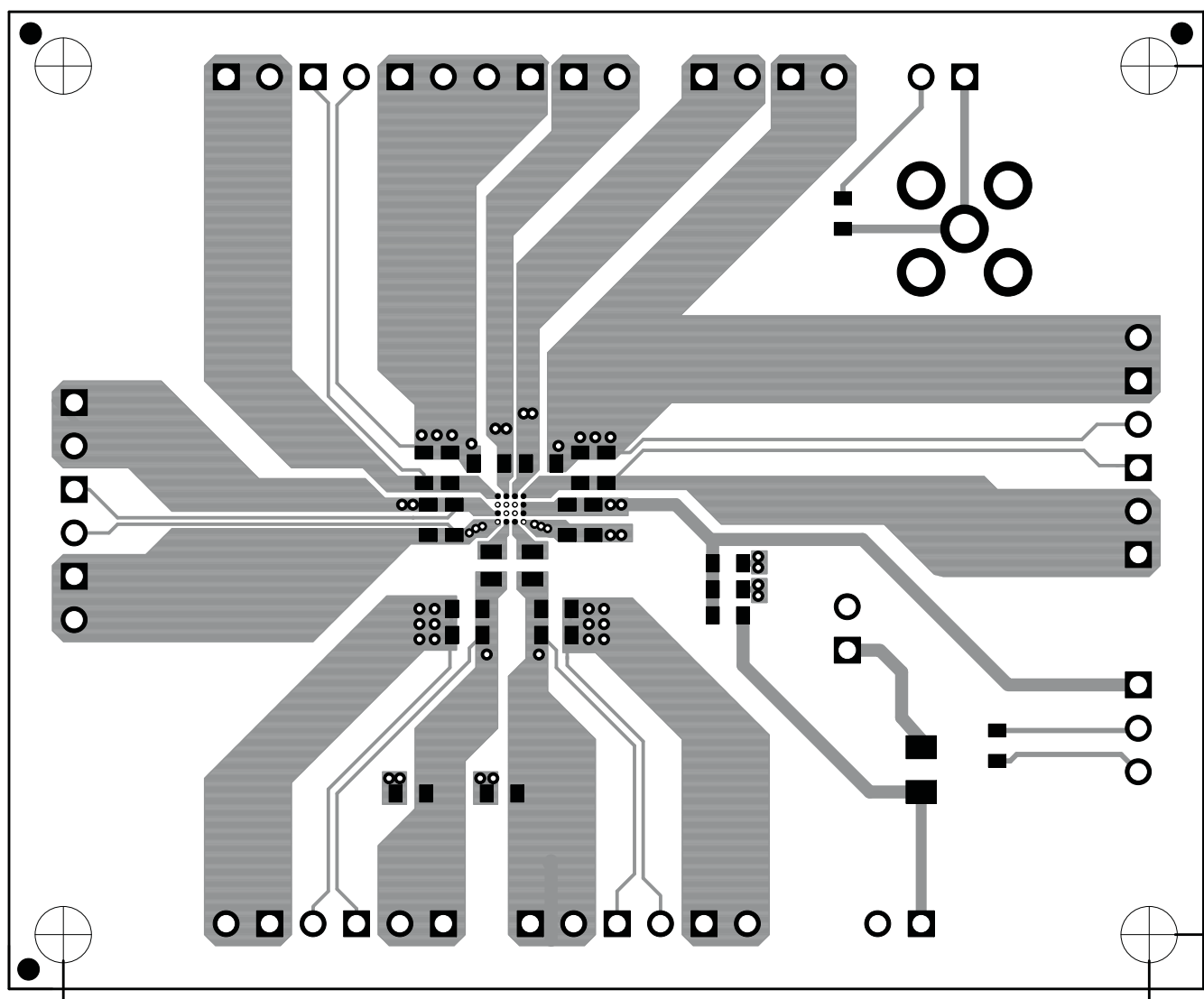


Figure 4. TPS65708EVM Top-Side Copper (Top View)

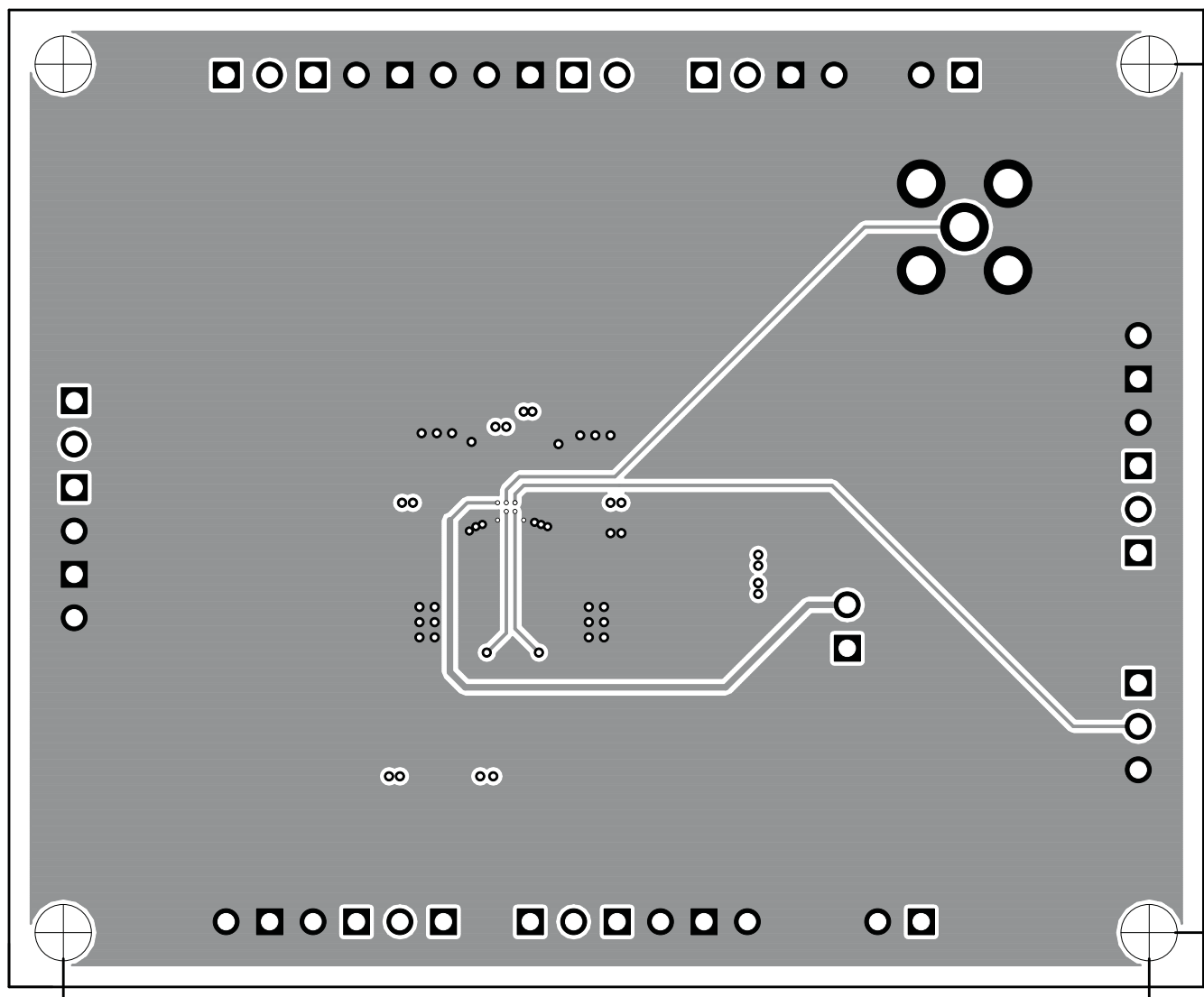


Figure 5. TPS65708EVM Internal Layer 1 (Top View)

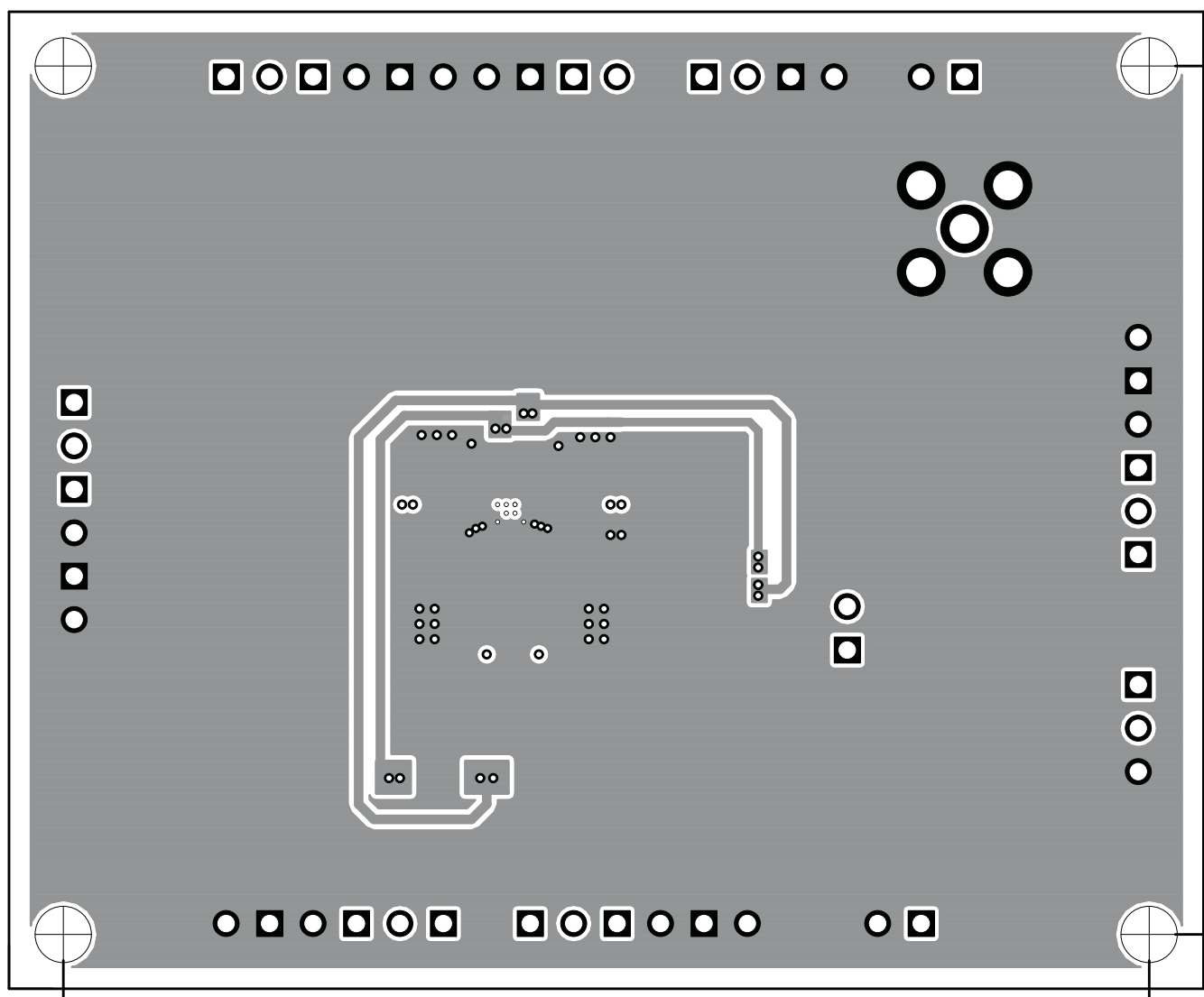


Figure 6. TPS65708EVM Internal Layer 2 (Top View)

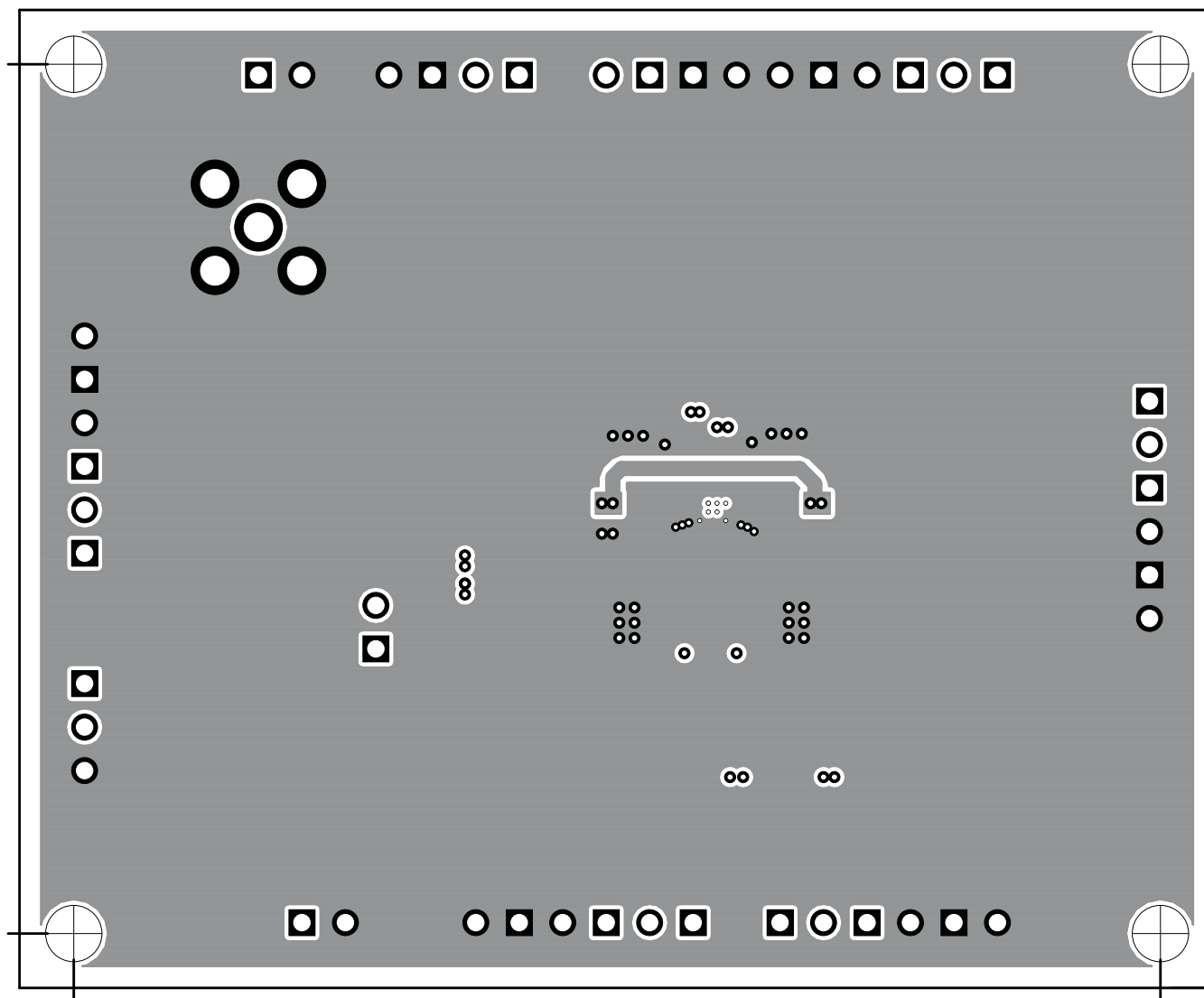


Figure 7. TPS65708EVM Bottom-Side Copper (Bottom View)

7 Bill of Materials

[Table 2](#) lists the bill of materials for the TPS65708EVM.

Table 2. TPS65708EVM-587 Bill of Materials

| Count | RefDes | Value | Description | Size | Part Number | MFR |
|-------|--------------------------|-----------------|-------------------------------------|----------|--------------------|-------------|
| 0 | C1, C5, C8, C9, C11, C14 | Open | Capacitor, Ceramic | 0603 | Std | Std |
| 2 | C2, C6 | 2.2 μ F | Capacitor, Ceramic, 6.3 V, X5R, 10% | 0603 | GRM188R60J225KE19D | muRata |
| 2 | C3, C4 | 4.7 μ F | Capacitor, Ceramic, 6.3 V, X5R, 10 | 0603 | GRM188R60J475KE19D | muRata |
| 4 | C7, C10, C12, C13 | 10 μ F | Capacitor, Ceramic, 6.3 V, X5R, 20% | 0603 | GRM188R60J106ME47D | muRata |
| 1 | D1 | LH N974-KN-1 | Diode, LED, Hyper Red | 1206 | LH N974-KN-1 | Osram |
| 2 | L1, L2 | 1.5 μ H | Inductor, 700 mA, 300 m Ω | 1608 | BRC1608T1R5M | Taiyo Yuden |
| 0 | R1, R2 | Open | Resistor, Chip, 1/16W, 1% | 0603 | Std | Std |
| 3 | R3, R4, R7 | 0 Ω | Resistor, Chip, 1/16W, 1% | 0603 | Std | Std |
| 1 | R5 | 100 k Ω | Resistor, Chip, 1/16W, 1% | 0603 | Std | Std |
| 1 | R6 | 1.00 M Ω | Resistor, Chip, 1/16W, 1% | 0603 | Std | Std |
| 1 | U1 | TPS65708YZH | IC, PMU for Embedded Camera Module | DSBGA-16 | TPS65708YZH | TI |

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 3.6 V to 6 V and the output voltage range of 1.2 V to 3.3 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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During normal operation, some circuit components may have case temperatures greater than +60°C. The EVM is designed to operate properly with certain components above +60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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