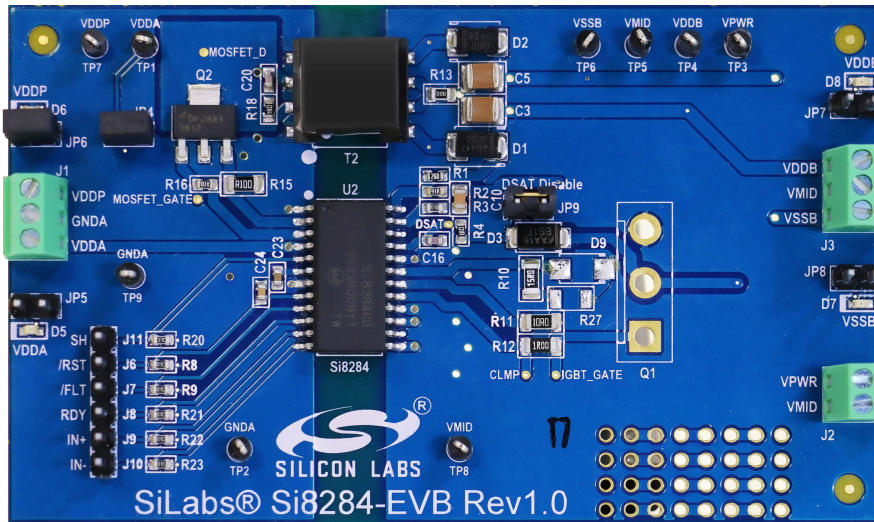


# UG168: Si8284-EVB User's Guide

This document describes the operation of the Si8284-EVB.

The Si8284 Evaluation Kit contains the following items:

- Si8284-EVB
- Si8284CD-IS installed on the evaluation board.



## KEY POINTS

- Discusses hardware overview and setup, including:
  - Si8284 low voltage side connections.
  - DC-DC operation.
  - Si8284 isolated gate drive connections.
- Offers alternative configurations.
- Demonstrates driver functionality.
- Shows Si8284-EVB schematics and silkscreen/copper layout.
- Includes the bill of materials and ordering guide.

## 1. Overview and Setup

### 1.1 Hardware

Si8284-EVB can be used to demonstrate the isolated gate drive capabilities of the installed Si8284CD-IS. The Si8284 includes a DC-DC converter used to supply isolated power to the gate driver.

#### Si8284 Low Voltage Side Connections

Supply power to the input side of Si8284 by applying 12 to 24 VDC to VDDP at terminal block J1. LED D6 above terminal block J1 illuminates to show power applied. For interfacing to the low voltage side of Si8284, VDDA supply must be between 3.0 and 5.5 V<sub>DC</sub>. Either a separate supply can be connected to VDDA terminal on J1 or 5 V<sub>DC</sub> can be derived from VDDP through the regulator circuit and directed to VDDA through a jumper at JP4. LED D5 below terminal block J1 illuminates to show VDDA power applied.

J6-J11 single pin headers provide access to the IN+, IN-, RSTb, and SH inputs and FLTb and RDY outputs of the Si8284. These signals can be brought out to an external microcontroller using a ribbon cable (not supplied). FLTb is an open drain output and has a pull-up resistor to VDDA. The open drain output allows multiple gate drivers FLTb outputs to share the same microcontroller input.

Driver functionality can be exercised without microcontroller by applying a GNDA referenced PWM signal from a function generator to the IN+ and IN- inputs. Maximum input voltage is VDDA.

#### DC-DC Operation

The isolated DC-DC converter is set to generate (with respect to VMID) 15 V for VDDb and -9 V for VSSb. LED D8 and D7 illuminates when VDDb and VSSb are powered respectively. DC-DC operation can be turned off by pulling terminal J11 to VDDA.

#### Si8284 Isolated Gate Drive Connections

There is a provision for a MOSFET or an IGBT in a TO-247 package (not supplied) at Q1.

From top to bottom, the through holes for the transistor leads are Source, Drain, and Gate. Load transistors are biased by applying voltage across VPWR and VMID terminals of J2. This voltage should not exceed the rated V<sub>DS</sub> of the transistor or 300 V, whichever is lower. Supply voltage constraints are summarized in the table below.

**Note:** Si8284 can drive the gate of either high-side or low-side MOSFET or IGBT in a bridge configuration. VMID is the same net as the load when driving the gate of a high side MOSFET or IGBT. For a gate drive for a low side MOSFET or IGBT, VMID is the return for the load.

**Table 1.1. Supply Voltage Constraints**

$3.0\text{ V} \leq \text{VDDA} - \text{GNDA} \leq 5.5\text{ V}$
$12\text{ V} \leq \text{VDDP} \leq 24\text{ V}$
$\text{VSSB} \leq \text{VMID} < \text{VDDb}$
$\text{UVLO} + 1 < \text{VDDb} - \text{VSSB} < 30\text{ V}$
$\text{VPWR} < \text{VDS (Q)}$
$\text{VPWR} < 300\text{ V}$
$ \text{GNDA} - \text{VSSB}  < 5\text{ kV}$
<b>Note:</b> 1. UVLO+ for the Si8284CD-IS is 12.3 V.

## 1.2 Alternative Configurations

### Positive Voltage Gate Drive Only

The standard configuration for the gate driver to apply positive voltage, VDDB-VMID, to the gate during the high drive portion of the PWM cycle and negative voltage, VSSB-VMID, during the low drive portion of the PWM cycle. Alternatively, if only positive drive voltage is desired, remove R13 and install a 0  $\Omega$  resistor at R19.

### Prototyping Area

If additional components are needed to evaluate the gate drive function for a particular load, there is a prototyping area just below Q2 locations.

## 1.3 Demonstrating Driver Functionality

Even with no load present, the basic functionality of the Si8284 can be demonstrated.

1. Apply 24 V to VDDP to power both sides of the Si8284. With jumpers installed at JP4–JP8, D5–D8 will illuminate indicating supplies are biased.
2. Leave VPWR unpowered. Install a jumper at JP9. This disables desaturation detection and allows for normal operation of the Si8284. Since both sides of the Si8284 have been powered on, RDY will output 5 V, which can be observed at J8.
3. Apply 5 V to both J9, IN+ and J10, IN-. VL will turn on and –9 V will be observed across pins 1 and 3 of Q1.
4. Remove 5 V from J10 and allow IN- to be pulled to GNDA. VH will turn on and +15 V will be observed across pins 1 and 3 of Q1.
5. Remove the short between VPWR and VMID at JP9.
6. With no path for DSAT current, the voltage at the DSAT pin rises and the Si8284 will drive the output low and FLTb to 0V which can be observed at J7.
7. Once again, place the short between VPWR and VMID at JP9. Apply 0 V to RSTb input at J6. This clears the fault and normal operation is restored.

## 1.4 Quick Reference Tables

**Table 1.2. Test Point Descriptions**

Test Point	Description	Referenced to:
TP1	VDDA	GNDA
TP3	VPWR	VMID
TP4	VDDB	VMID
TP5	VMID	N/A
TP6	VSSB	VMID
TP7	VDDP	GNDA
TPV8	IGBT_GATE	VMID
TP9	GNDA	N/A
TPV9	DSAT	VMID
TPV10	MOSFET_D	GNDA
TPV11	MOSFET_G	GNDA
TPV12	CLMP	VSSB

## 2. Schematics

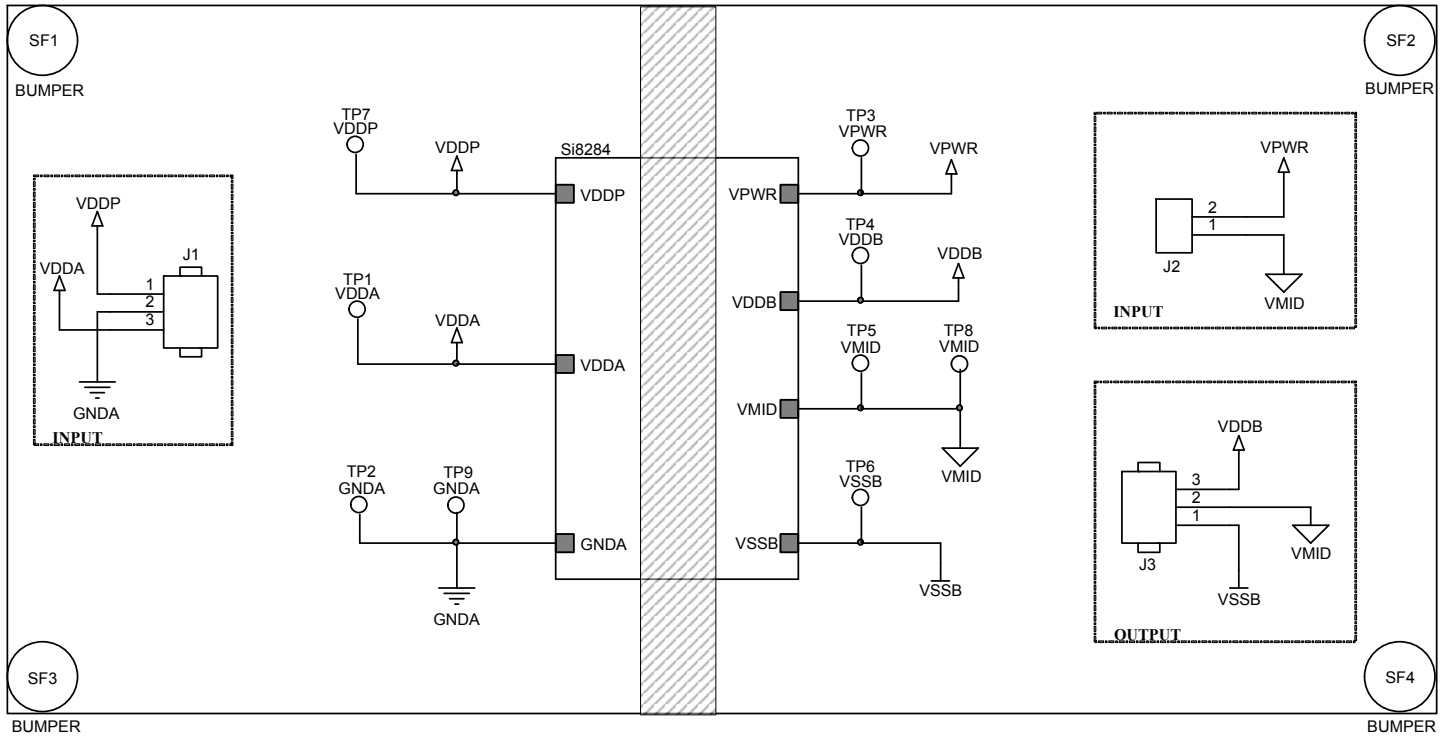


Figure 2.1. Si8284-EVB Top Level Schematic

1. DC/DC is built to drive gate to +15/-9V
2. To operate with positive gate drive only:
  - a. Remove R13
  - b. Install R19 = 0 Ohm
  - c. Change divider  $V_{DDB}-V_{SSB} = (R1/R2 + 1) \times 1.05V$

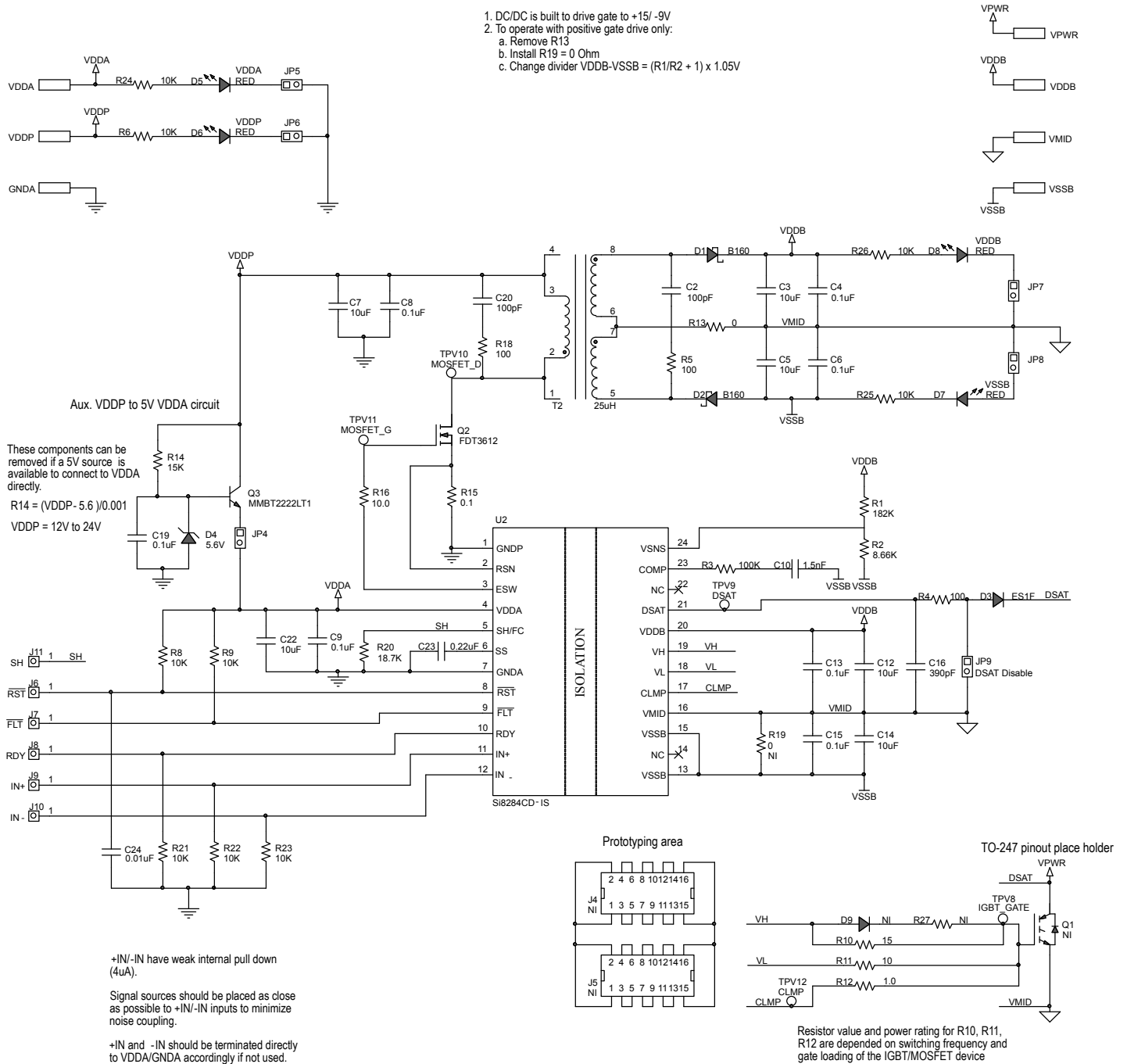


Figure 2.2. Si8284 Circuit Schematic

### 3. Layout

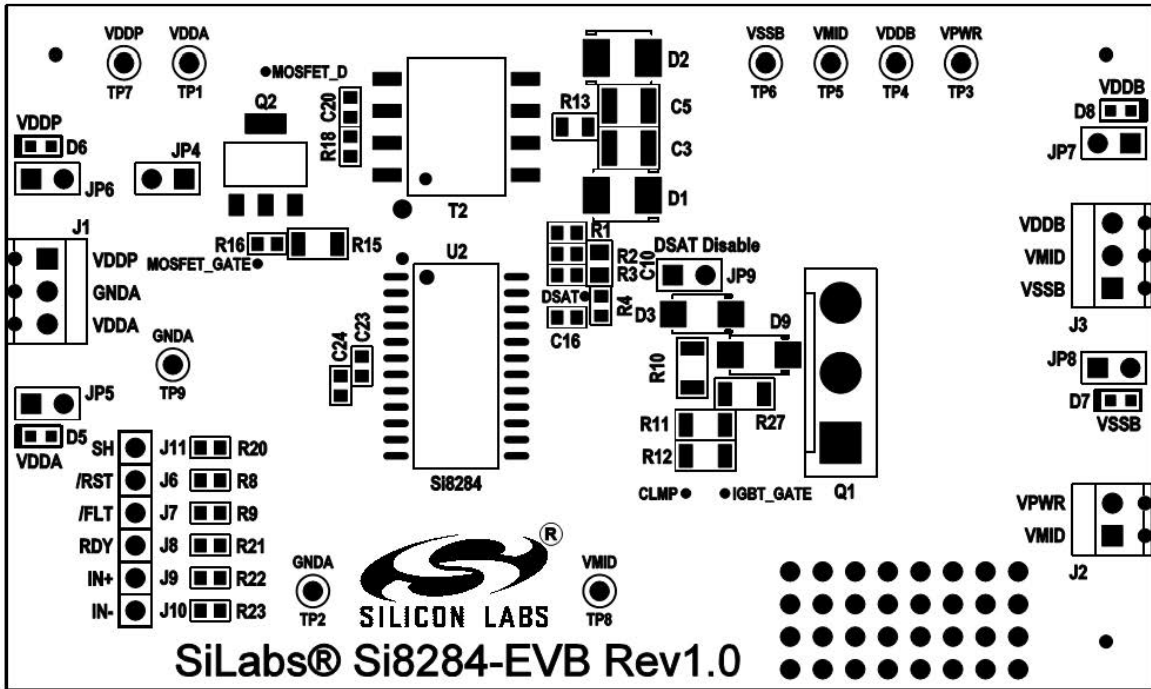


Figure 3.1. Si8284-EVB Top Silkscreen

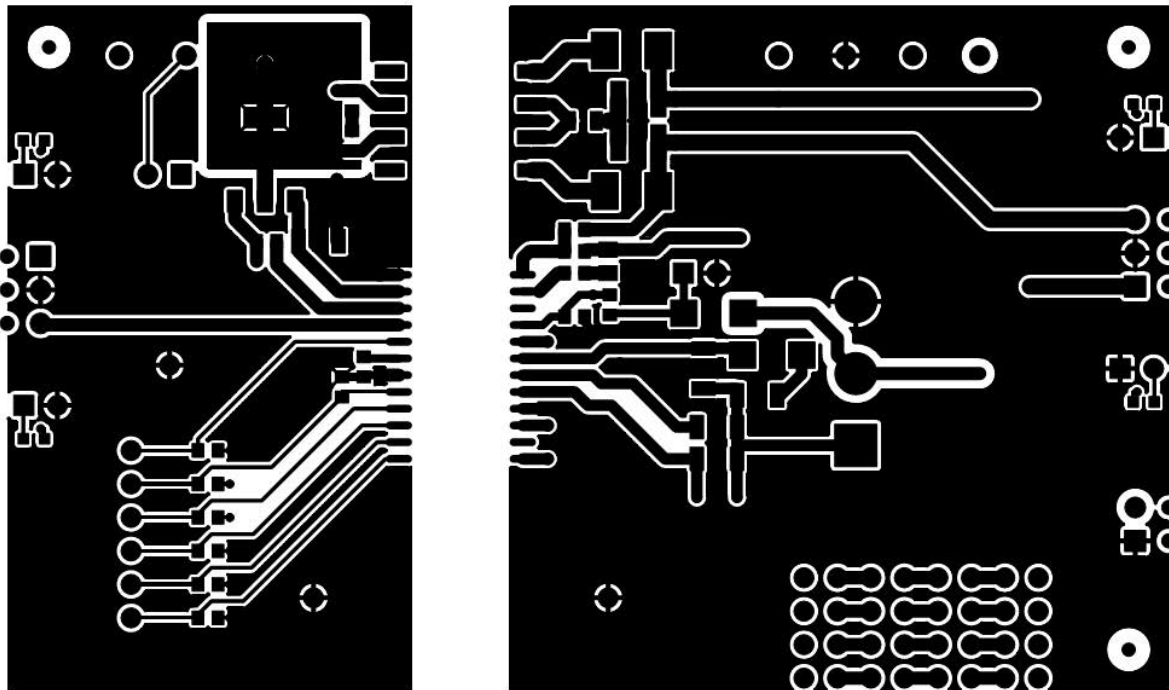


Figure 3.2. Si8284-EVB Top Copper

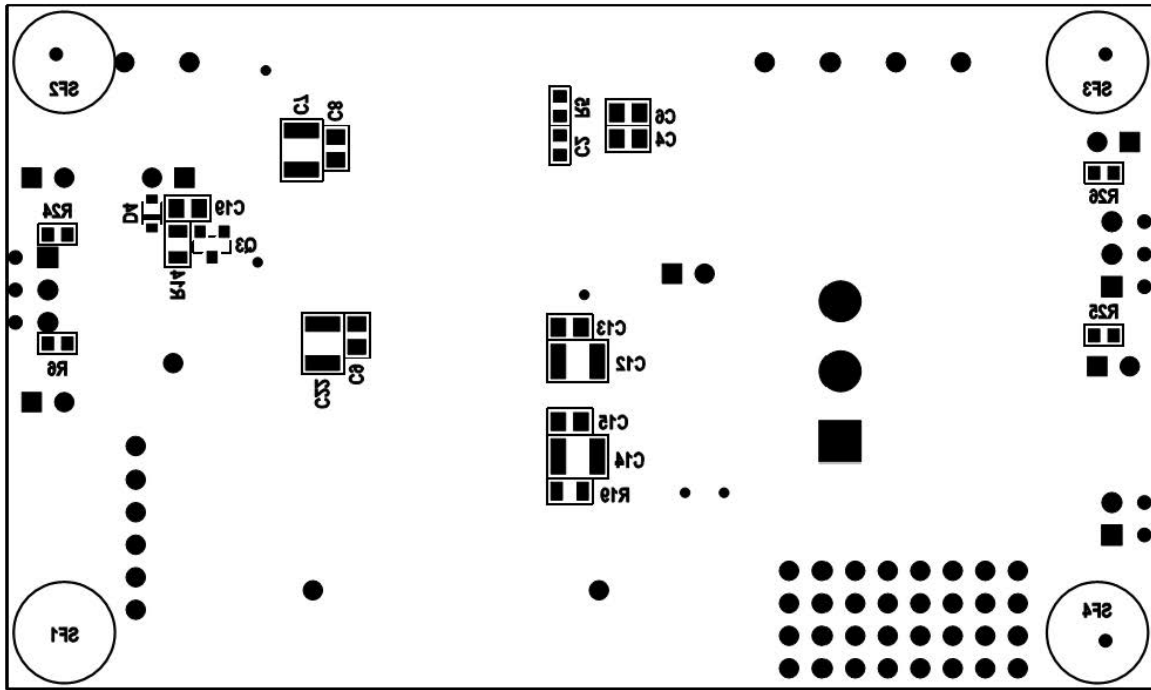


Figure 3.3. Si8284-EVB Bottom Silkscreen

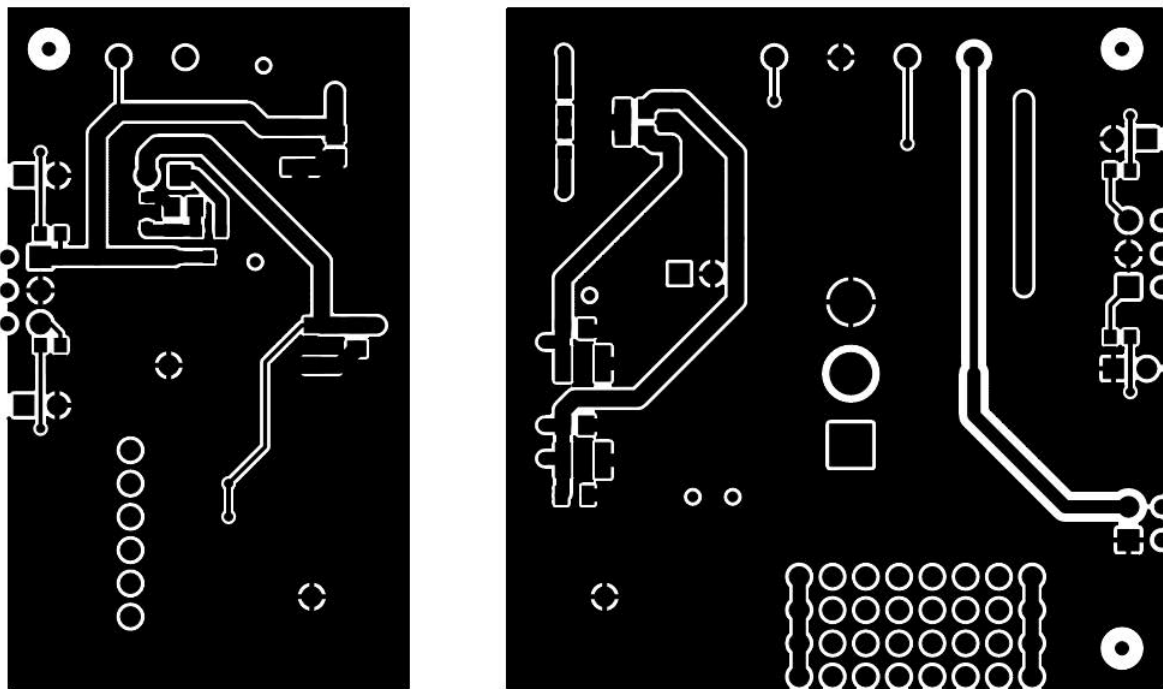


Figure 3.4. Si8284-EVB Bottom Copper



## 4. Bill of Materials

Table 4.1. Si8284-EVB Bill of Materials

Part Reference	Description	Manufacturer	Manufacturer Part Number
C2, C20	CAP, 100 pF, 50 V, $\pm 20\%$ , C0G, 0603	Venkel	C0603C0G500-101M
C3, C5, C7, C12, C14, C22	CAP, 10 $\mu$ F, 50 V, $\pm 20\%$ , X7R, 1210	Venkel	C1210X7R500-106M
C4, C6, C8, C9, C13, C15, C19	CAP, 0.1 $\mu$ F, 50 V, $\pm 10\%$ , X7R, 0805	Venkel	C0805X7R500-104K
C10	CAP, 1.5 nF, 250 V, $\pm 10\%$ , X7R, 0805	Venkel	C0805X7R251-152K
C16	CAP, 390 pF, 50 V, $\pm 10\%$ , C0G, 0603	Venkel	C0603C0G500-391K
C23	CAP, 0.22 $\mu$ F, 25 V, $\pm 10\%$ , X7R, 0603	Venkel	C0603X7R250-224K
C24	CAP, 0.01 $\mu$ F, 10 V, $\pm 20\%$ , X7R, 0603	Venkel	C0603X7R100-103M
D1, D2	DIO, SCHOTTKY, 60 V, 1 A, SMB	Diodes Inc.	B160-13-F
D3	DIO, FAST, 300 V, 1.0 A, SMA	Fairchild	ES1F
D4	DIO, ZENER, 5.6 V, 200 mW, SOD323	DIODES INC	BZT52C5V6S-F-7
D5, D6, D7, D8	LED, RED, 631 nM, 20 mA, 2 V, 54mcd, 0603	LITE-ON TECHNOLOGY CORP	LTST-C190KRKT
D9	DIO, SWITCH, ULTRA FAST, 800 V, 1.0 A, SMA	Diodes Inc.	US1K-13-F
J1, J3	CONN, TERM BLOCK 3POS, 2.54 MM, RT PCB	PHOENIX CONTACT	1725669
J2	CONN, TERM BLOCK 2POS, 2.54MM, RT PCB	PHOENIX CONTACT	1725656
J4, J5	Header, 8x2, 0.1in pitch, Tin Plated	Samtec	TSW-108-07-T-D
J6, J7, J8, J9, J10, J11	Header, Single Pin, Tin Plated	Samtec	TSW-101-07-T-S
JP4, JP5, JP6, JP7, JP8, JP9	Header, 2x1, 0.1in pitch, Tin Plated	Samtec	TSW-102-07-T-S
Q2	TRANSISTOR, MOSFET, N-CHNL, 100 V, 3.7A, 3 W, Switching, SOT223	Fairchild	FDT3612
Q3	TRANSISTOR, NPN, 30 V, 600 mA, SOT23	On Semi	MMBT2222LT1
R1	RES, 182K, 1/10 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-10W-1823F
R2	RES, 8.66K, 1/16 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-16W-8661F
R3	RES, 100K, 1/10 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-10W-1003F
R4, R5, R18	RES, 100 $\Omega$ , 1/10 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-10W-1000F
R6, R8, R9, R21, R22, R23, R24, R25, R26	RES, 10K, 1/16 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-16W-1002F
R10, R27	RES, 15 $\Omega$ , 1/4 W, $\pm 5\%$ , ThickFilm, 1206	Venkel	CR1206-4W-150J
R11	RES, 10 $\Omega$ , 1/4 W, $\pm 1\%$ , ThickFilm, 1206	Venkel	CR1206-4W-10R0F
R12	RES, 1.0 $\Omega$ , 1/4 W, $\pm 5\%$ , ThickFilm, 1206	Venkel	CR1206-4W-1R0J
R13, R19	RES, 0 $\Omega$ , 2A, ThickFilm, 0805	Venkel	CR0805-10W-000
R14	RES, 15K, 1/8 W, $\pm 1\%$ , ThickFilm, 0805	Venkel	CR0805-8W-1502F

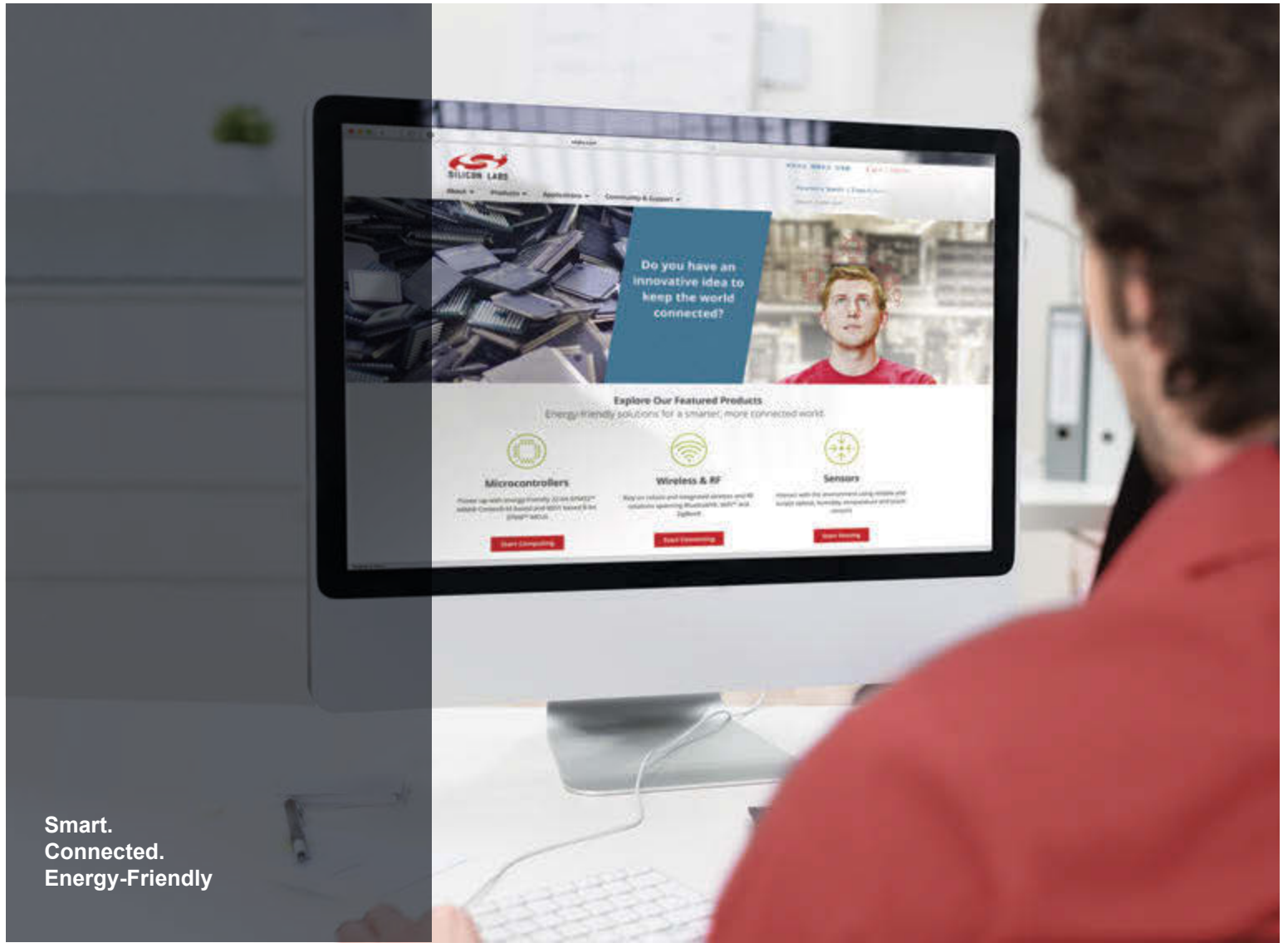


Part Reference	Description	Manufacturer	Manufacturer Part Number
R15	RES, 0.1 $\Omega$ , 1/2 W, $\pm 1\%$ , ThickFilm, 1206	Venkel	LCR1206-R100F
R16	RES, 10.0 $\Omega$ , 1/16 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-16W-10R0F
R20	RES, 18.7K, 1/16 W, $\pm 1\%$ , ThickFilm, 0603	Venkel	CR0603-16W-1872F
SF1, SF2, SF3, SF4	HDW, BUMPON CYLINDRICAL, 0.312 x 0.215, BLK	3M	SJ61A6
T2	TRANSFORMER, POWER, FLYBACK, 5 kV ISOLATED, 25 $\mu$ H PRIMARY, 2 windings N = 1.25, N = 0.75, SMT	Coilcraft	TA7618-AL
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9	TESTPOINT, BLACK, PTH	Kobiconn	151-203-RC
U2	IC, 4 AMP ISODRIVER WITH INTEGRATED DC/DC CONVERTER, 12V UVLO, SO24 WB	SiLabs	Si8284CD-IS

## 5. Ordering Guide

**Table 5.1. Si8284-EVB Ordering Guide**

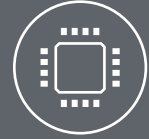
Ordering Part Number (OPN)	Description
Si8284-KIT	Si8284 Isolated gate driver evaluation board kit.



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