

# UG167: Si8281-EVB User's Guide

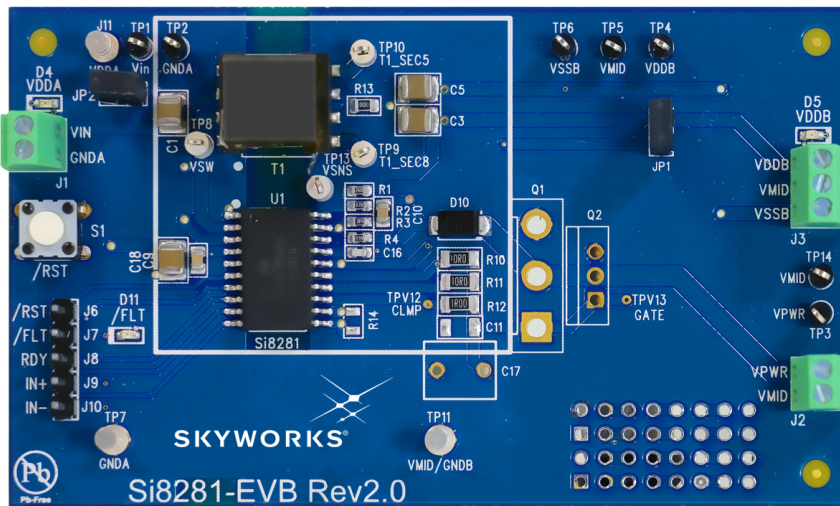
This document describes the operation of the Si8281-EVB.

The Si8281 Evaluation Kit contains the following items:

- Si8281-EVB
- Si8281CD-IS installed on the evaluation board.

## KEY POINTS

- Discusses hardware overview and setup, including:
  - Si8281 low voltage side connections.
  - DC-DC operation.
  - Si8281 isolated gate drive connections.
- Offers alternative configurations.
- Demonstrates driver functionality.
- Shows Si8281-EVB schematics and silkscreen/copper layout.
- Includes the bill of materials and ordering guide.



## 1. Overview and Setup

### 1.1 Hardware

Si8281-EVB can be used to demonstrate the isolated gate drive capabilities of the installed Si8281CD-IS. The Si8281 includes a DC-DC converter used to supply isolated power to the gate driver.

#### Si8281 Low Voltage Side Connections

Supply power to the input side of Si8281 by applying 5.0 V<sub>DC</sub> to VIN at terminal block J1. LED D4 above terminal block J1 illuminates to show power applied. A jumper must be installed at JP2 as VDDA is powered by the same supply as VIN.

J6–J10 single pin headers provide access to the IN+, IN–, RSTb inputs, and FLTb and RDY outputs of the Si8281. 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 weak pull-up resistor and LED D11 in series 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 –11 V for VSSb. LED D5 illuminates when VDDb is powered. A jumper must be installed at JP1 to power VDDb from the DC-DC output.

#### Si8281 Isolated Gate Drive Connections

There are four different load options for Si8281 gate driver:

1. Through holes for a MOSFET or an IGBT in a TO-247 package (not supplied) at Q1.
2. Through holes for a MOSFET or an IGBT in a TO-220 package (not supplied) at Q2.
3. Through holes for a capacitor (not supplied) at C17.
4. Pads for a 1206-size surface mount capacitor (not supplied) at C11.

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:** Si8281 can drive the gate of either high-side or low-side MOSFET or IGBT in a bridge configuration. When used as a high-side gate driver, VMID is connected to the load. When used as a low-side gate driver, VMID is the return for the load.

For capacitive loads, capacitor value should be chosen to match the gate capacitance of the desired transistor. Supply voltage constraints are summarized in the table below.

**Table 1.1. Supply Voltage Constraints**

$3.0\text{ V} \leq \text{VIN} - \text{GNDA} = \text{VDDA} - \text{GNDA} \leq 5.5\text{ V}$
$\text{VSSb} \leq \text{VMID} < \text{VDDb}$
$\text{UVLO+} < \text{VDDb} - \text{VSSb} < 30\text{ V}$
$\text{VPWR} < \text{V}_{\text{DS}}(\text{Q})$
$\text{VPWR} < 300\text{ V}$
$ \text{GNDA} - \text{VSSb}  < 5\text{ kV}$
<b>Note:</b>
1. UVLO+ for the Si8281CD-IS is 12.3 V typically.

## 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 R14.

### 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 Si8281 can be demonstrated.

1. Ensure JP1 and JP2 have jumpers installed.
2. Apply 5 V to VIN to power both sides of the Si8281.
3. Short VPWR to VMID at J2 using a wire between the terminals of J2. This disables DSAT detection and allows for normal operation of the Si8281. Since both sides of Si8281 have been powered on, RDY will output 5 V, which can be observed at J8.
4. Apply 5 V to both J9, IN+ and J10, IN–. The Si8281 will drive low and –11 V can be observed across C17.
5. Apply 5 V to J9, IN+ and 0 V to J10, IN–. The Si8281 will drive high and 15 V can be observed across C17.
6. Remove the short between VPWR and VMID at J2.
7. With no path for DSAT current, the voltage at the DSAT pin rises and the Si8281 will drive the output low and pull FLTb to 0 V which can be observed by D11 illuminating.
8. Once again, place the short between VPWR and VMID at J2. Pull RSTb to 0 V by pushing S1. This clears the fault and D11 will turn off.

## 1.4 Quick Reference Tables

**Table 1.2. Test Point Descriptions**

Test Point	Description	Referenced to:
TP1	VIN	GNDA
TP2	GNDA	N/A
TP3	VPWR	VMID
TP4	VDDB	VMID
TP5	VMID	N/A
TP6	VSSB	VMID
TP7	GNDA	N/A
TP8	VSW	GNDA
TP9	T1_SEC8	VMID
TP10	T1_SEC5	VMID
TP11	VMID/GNDB	N/A
TP13	VSNS	VSSB
TP14	VMID	N/A
TPV12	CLMP	VSSB
TPV13	GATE	VMID

## 2. Schematics

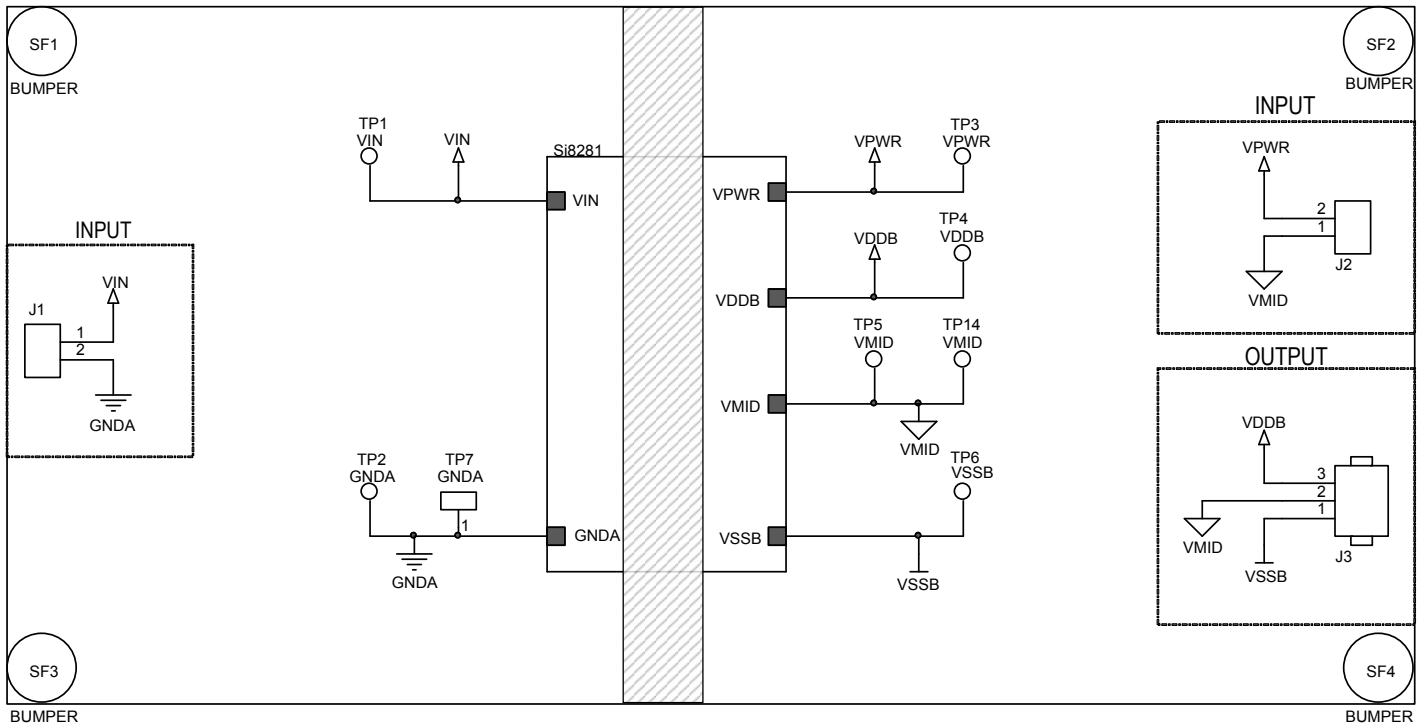
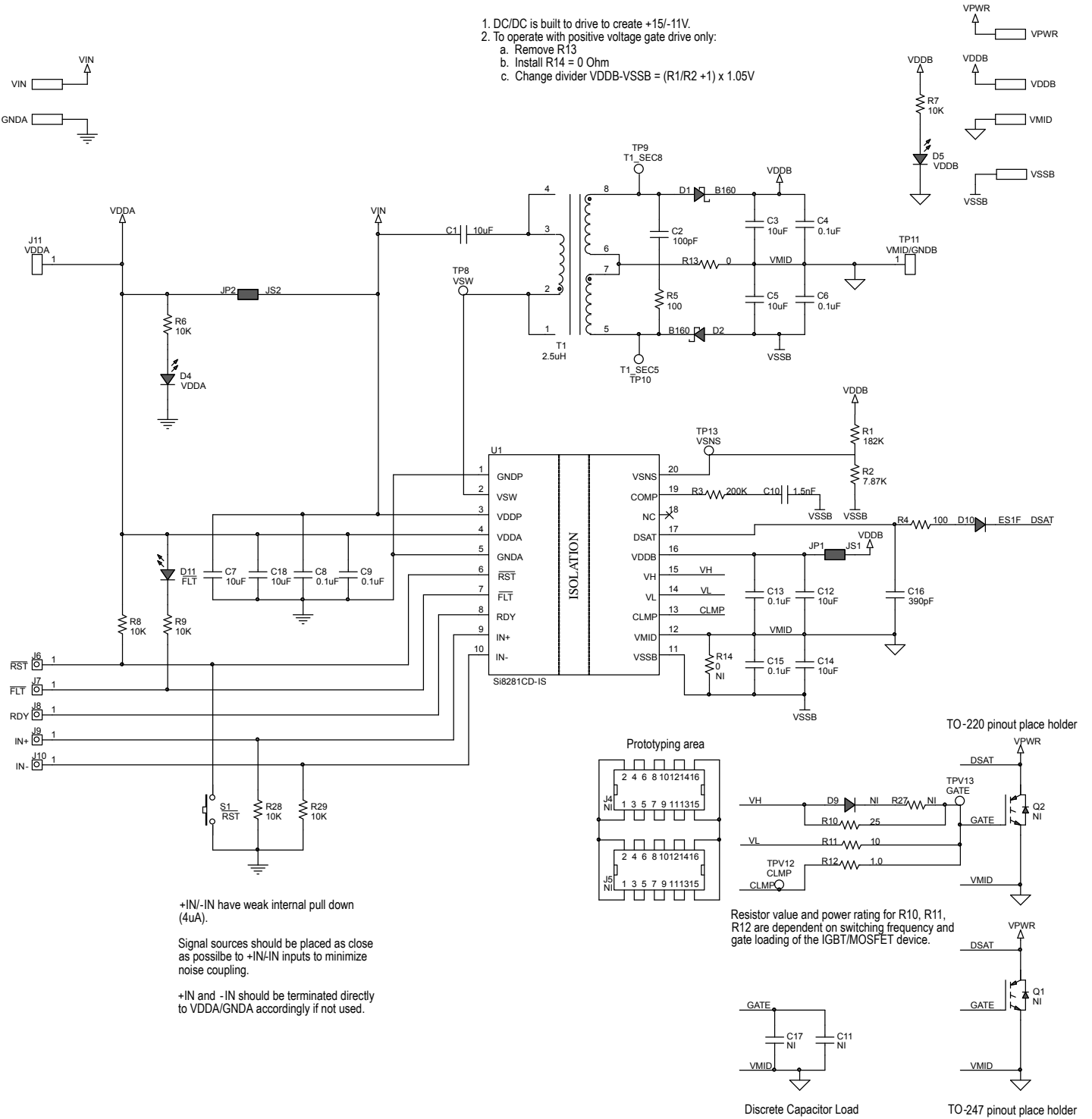


Figure 2.1. Si8281-EVB Top Level Schematic

1. DC/DC is built to drive to create +15/-11V.
2. To operate with positive voltage gate drive only:
  - a. Remove R13
  - b. Install R14 = 0 Ohm
  - c. Change divider VDDB-VSSB =  $(R1/R2 + 1) \times 1.05V$



+IN/-IN have weak internal pull down (4uA).

Signal sources should be placed as close as possible to +IN/-IN inputs to minimize noise coupling.

+IN and -IN should be terminated directly to VDDA/GNDA accordingly if not used.

Resistor value and power rating for R10, R11, R12 are dependent on switching frequency and gate loading of the IGBT/MOSFET device.

Figure 2.2. Si8281 Circuit Schematic

### 3. Layout

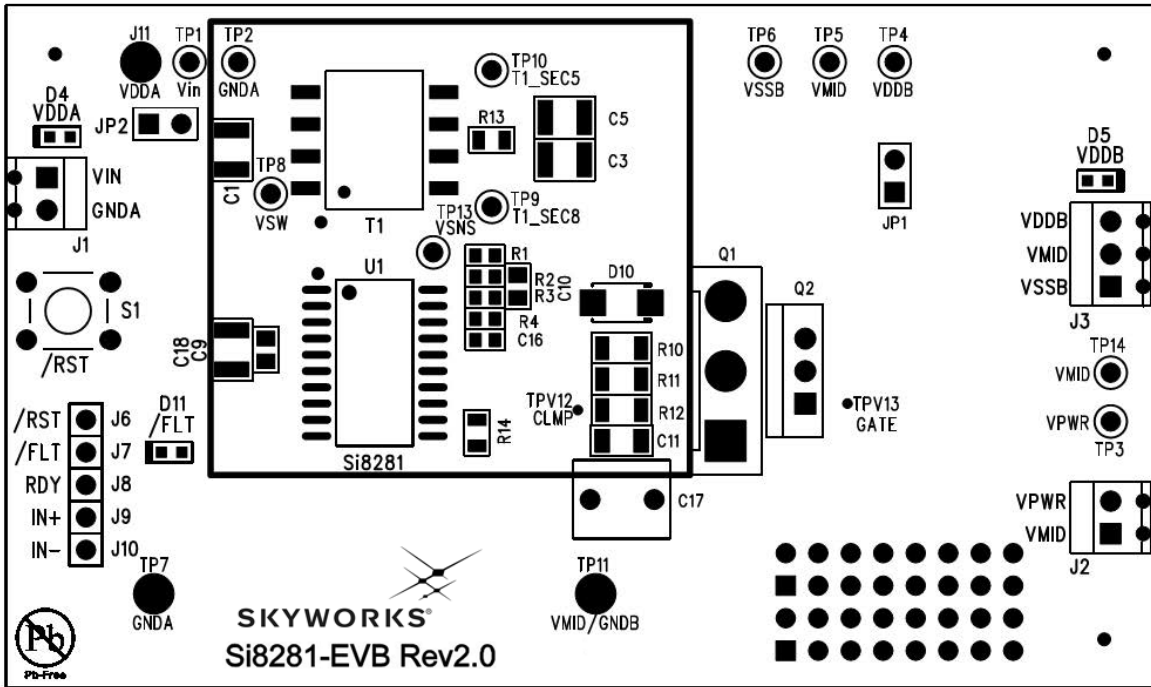


Figure 3.1. Si8281-EVB Top Silkscreen

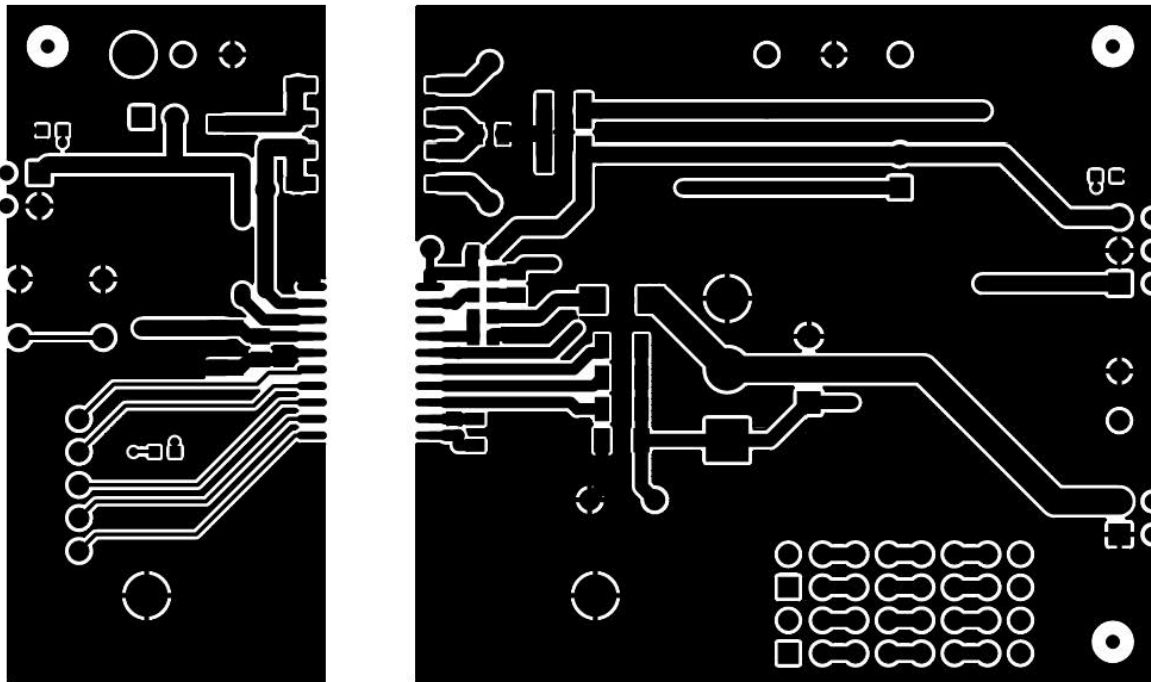


Figure 3.2. Si8281-EVB Top Copper

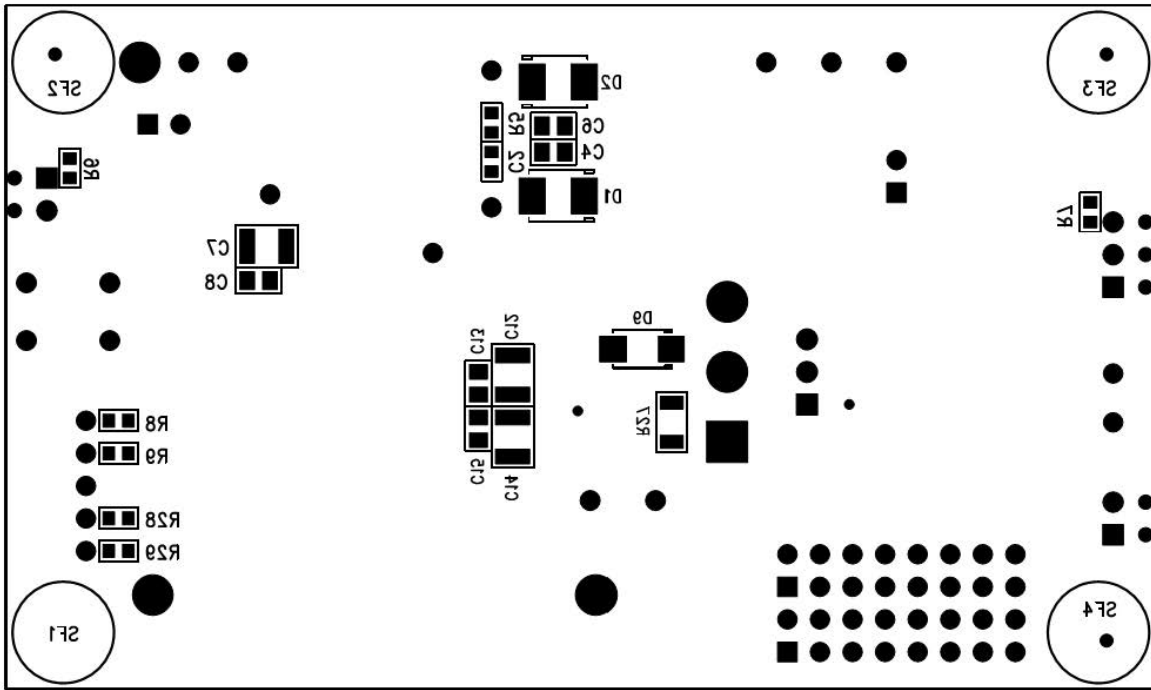


Figure 3.3. Si8281-EVB Bottom Silkscreen

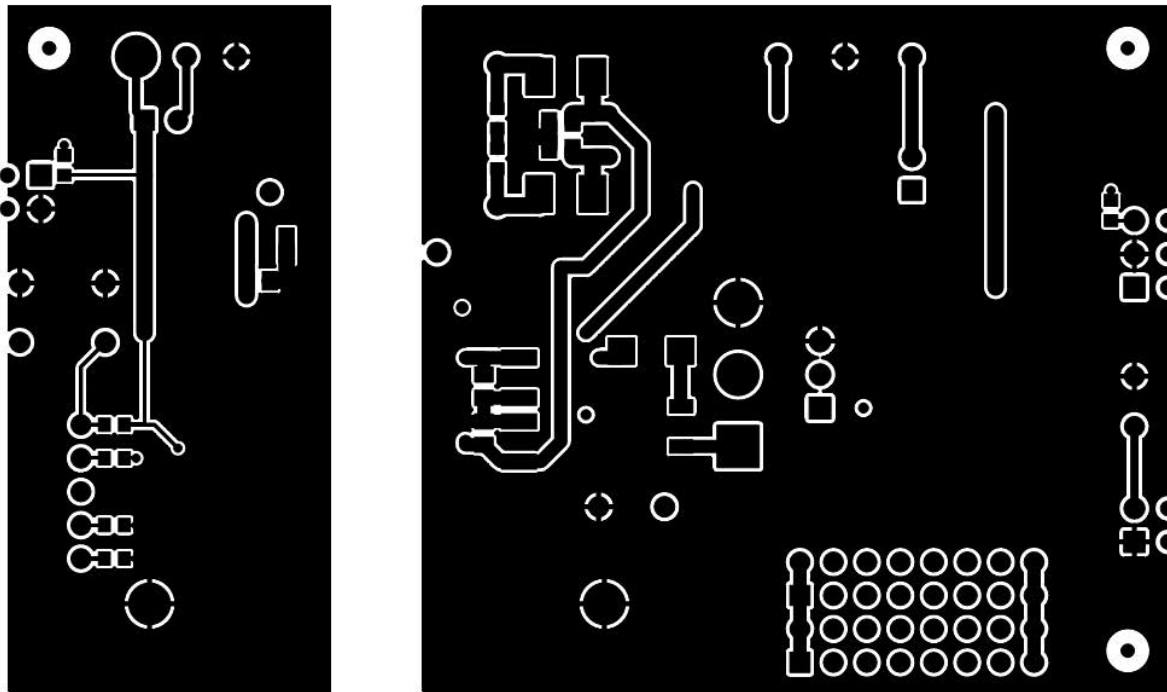


Figure 3.4. Si8281-EVB Bottom Copper

## 4. Bill of Materials

**Table 4.1. Si8281-EVB Bill of Materials**

Part Reference	Description	Manufacturer	Manufacturer Part Number
C1, C3, C5, C7, C12, C14, C18	CAP, 10 $\mu$ F, 50 V, $\pm$ 20%, X7R, 1210	Venkel	C1210X7R500-106M
C2	CAP, 100 pF, 50 V, $\pm$ 20%, C0G, 0603	Venkel	C0603C0G500-101M
C3	CAP, 390 pF, 100 V, $\pm$ 20%, X7R, 0805	Venkel	C0805X7R101-391M
C4, C6, C8, C9, C13, C15	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
D1, D2	DIO, SCHOTTKY, 60 V, 1 A, SMB	Diodes Inc.	B160-13-F
D4, D5, D11	LED, RED, 631 nM, 20 mA, 2 V, 54mcd, 0603	Lite-On Tech.	LTST-C190KRKT
D10	DIO, FAST, 300 V, 1.0 A, SMA	Fairchild	ES1F
J1, J2	CONN, TERM BLOCK 2POS, 2.54 MM, RT PCB	PHOENIX CONTACT	1725656
J3	CONN, TERM BLOCK 3POS, 2.54 MM, RT PCB	PHOENIX CONTACT	1725669
J6, J7, J8, J9, J10	Header, Single Pin, Tin Plated	Samtec	TSW-101-07-T-S
J11, TP7, TP11	SOLDER TURRET, 0.064 inD, 0.105 inL	Mill-Max	2551-2-00-44-00-00-07-0
JP1, JP2	Header, 2x1, 0.1 in pitch, Tin Plated	Samtec	TSW-102-07-T-S
JS1 JS2	Shunt, 1x2, 0.1 in pitch, Tin plating	Samtec	SNT-100-BK-T
R1	RES, 182 K, 1/10 W, $\pm$ 1%, ThickFilm, 0603	Venkel	CR0603-10W-1823F
R2	RES, 7.87 K, 1/16 W, $\pm$ 1%, ThickFilm, 0603	Venkel	CR0603-16W-7871F
R3	RES, 200 K, 1/10 W, $\pm$ 1%, ThickFilm, 0603	Venkel	CR0603-10W-2003F
R4	RES, 100 $\Omega$ , 1/16 W, $\pm$ 1%, ThickFilm, 0603	Venkel	CR0603-16W-1000F
R5	RES, 100 $\Omega$ , 1/10 W, $\pm$ 1%, ThickFilm, 0603	Venkel	CR0603-10W-1000F
R6, R7, R8, R9, R28, R29	RES, 10 K, 1/16 W, $\pm$ 1%, ThickFilm, 0603	Venkel	CR0603-16W-1002F
R10	RES, 25 $\Omega$ , 1/4 W, $\pm$ 5%, ThickFilm, 1206	Venkel	CR1206-4W-250J
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, R14	RES, 0 $\Omega$ , 2 A, ThickFilm, 0805	Venkel	CR0805-10W-000
S1	SWITCH, PB, NO, MOMENTARY, TACTILE, LIGHT TOUCH 130GF, 6MM, PTH	Panasonic	EVQ-PAD04M
SF1, SF2, SF3, SF4	HDW, BUMPON CYLINDRICAL, 0.312 x 0.215, BLK	3M	SJ61A6
T1	TRANSFORMER, POWER, FLYBACK, 5KV ISOLATED, 2.5uH, 100nH LEAKAGE, 7:1, 5:1, SMT	UMEC	UTB02241s
TP1, TP2, TP3, TP4, TP5, TP6, TP14	TESTPOINT, BLACK, PTH	Kobiconn	151-203-RC



Part Reference	Description	Manufacturer	Manufacturer Part Number
TP8, TP9, TP10, TP13	TESTPOINT, WHITE, PTH	Kobiconn	151-201-RC
U1	IC, 4 AMP ISODRIVER WITH DC-DC, SO20 WB	Skyworks	Si8281CD-IS

## 5. Ordering Guide

**Table 5.1. Si8281-EVB Ordering Guide**

Ordering Part Number (OPN)	Description
Si8281-KIT	Si8281 Isolated gate driver evaluation board kit.