

A large, light blue, stylized circular graphic that is open at the top, with a small circle at the top center of the opening.

TLF4277 Demoboard

Application Note

Rev. 1.1, 2012-04-25

Automotive Power

1 Introduction

The TLF4277 Demoboard is a demonstration of the Infineon low drop out linear voltage regulator with integrated current monitor. The TLF4277 is the ideal companion IC to supply active antennas for car infotainment applications. The adjustable output voltage makes the TLF4277 capable of supplying the majority of standard active antennas.

This application note contains the main information for the TLF4277 Demoboard.

1.1 General Description

The TLF4277 is a monolithic integrated low drop out voltage regulator capable of supplying loads up to 200 mA. For an input voltage up to 40 V the TLF4277 provides an adjustable output voltage in a range from 5 V up to 12 V. The integrated current monitor function is a unique feature that provides diagnosis and system protection functionality. Fault conditions such as overtemperature and output overvoltage are monitored and indicated at the current sense output. The maximum output current limit of the device is adjustable to provide additional protection to the connected load.

The IC can be disabled via the Enable function to lower the power consumption. The PG-SSOP14 EP package provides an enhanced thermal performance within a SO8 body size.

1.2 TLF4277 Feature List

- Integrated Current Monitor
- Adjustable Current Limitation
- Adjustable Output Voltage
- Overvoltage Detection
- Output Current up to 200 mA
- Very Low Current Consumption
- Very Low Dropout Voltage
- Wide Input Voltage Range up to 40 V
- Reverse Polarity Protection
- Short Circuit Protected
- Overtemperature Shutdown
- Green Product (RoHS and WEEE compliant)
- AEC Qualified

1.3 Block Diagram

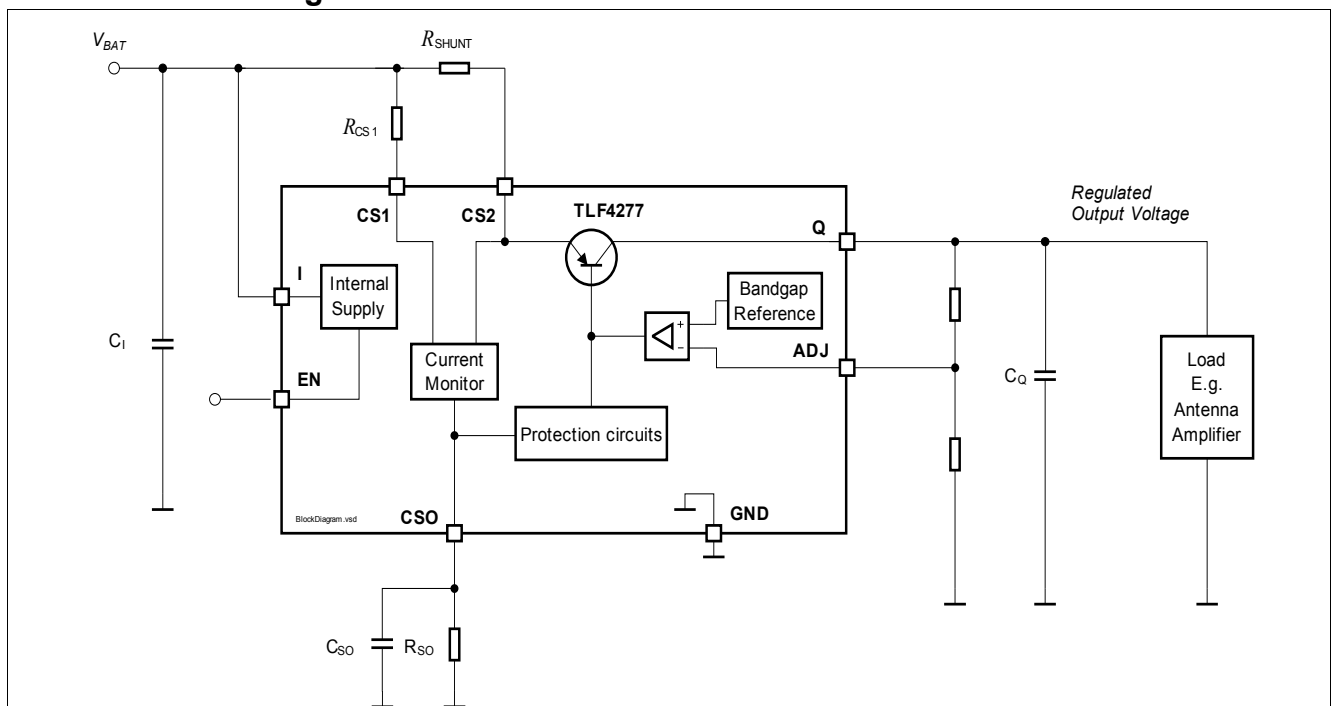


Figure 1 Block and simplified application diagram of TLF4277

2 Technical Specification

The chapter provides a brief technical description of TLF4277.

2.1 Adjustable Output Voltage

The output voltage of the TLF4277 can be adjusted between 5 V and 12 V by an external output voltage divider, closing the control loop to the voltage adjust pin ADJ.

The voltage at pin ADJ is compared to the internal reference of typical 1.22 V through an error amplifier. The error amplifier controls the output voltage.

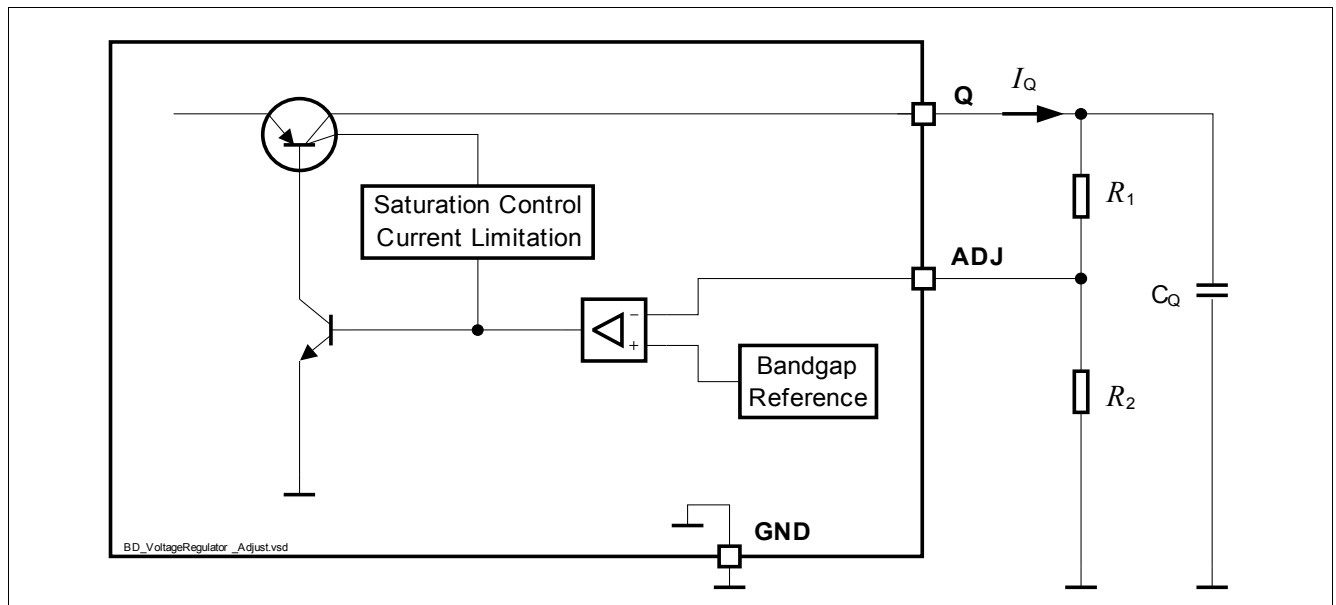


Figure 2 Application detail external components at output for variable voltage regulator

The output voltage is calculated according to [Equation \(1\)](#):

$$V_Q = (R_1 + R_2)/R_2 \times V_{REF,int}, \text{ neglecting } I_{ADJ} \quad (1)$$

$V_{REF,int}$ is typically 1.22 V.

To avoid errors caused by leakage current I_{ADJ} , we recommend to choose the resistor value for $R_2 < 27 \text{ k}\Omega$.

For example, for 8V output voltage the following resistors can be selected:

$$R_1 = 56.2 \text{ k}\Omega$$

$$R_2 = 10 \text{ k}\Omega$$

$$V_Q = (R_1 + R_2)/R_2 \times V_{REF,int} = (56.2 + 10)/10 \times 1.22 = 8.076 \text{ V}$$

The accuracy of the resistors for the external voltage divider can lead to a higher tolerance of the output voltage. To achieve a reasonable accuracy resistors with a tolerance of 1% or lower are recommended for the feedback divider.

2.2 Current and Protection Monitor Functions

The TLF4277 Demoboard provides a set of advanced monitor functionality. The current flowing into the power stage can be monitored at the CSO output. In addition the current limitation can be adjusted via external resistors. Events of the implemented protection functions are reported through dedicated voltage levels at the CSO output. This information can be processed by an external μC for system analysis and failure identification. The monitored events are over-current, overvoltage, and temperature shutdown.

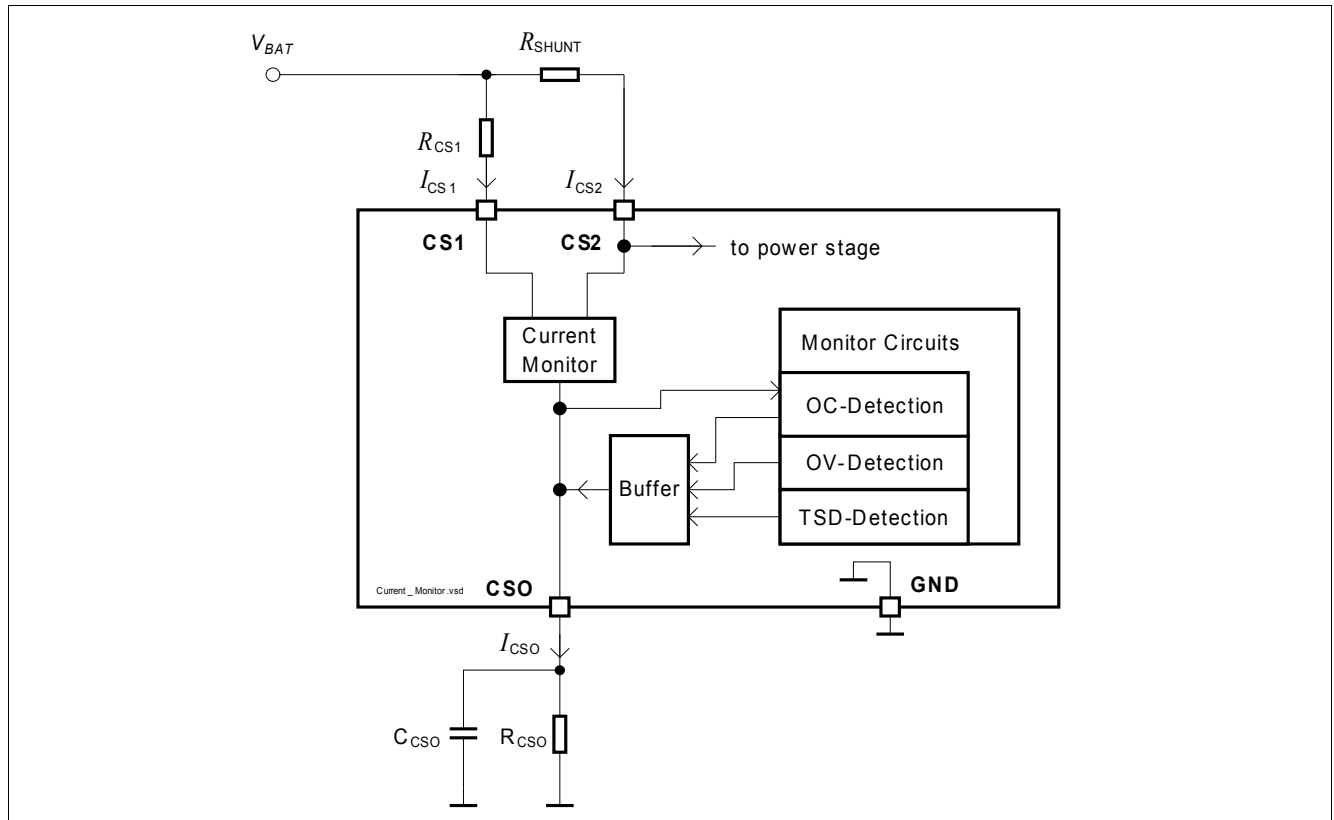


Figure 3 Block diagram current and protection monitor

To reduce possible effects from the supply voltage V_{BAT} additional filtering of the supply voltage is recommended. A combination of a 100 nF capacitor and an additional buffer capacitor of 10 μF or higher should be placed as close as possible to the IC terminal, which are connected to V_{BAT} .

Figure 4 shows the output level at the CSO pin versus the operation or fault condition. The graph is valid for the following set up of external components:

$$\begin{aligned} R_{\text{SHUNT}} &= 1\Omega \\ R_{\text{CS1}} &= 100\Omega \\ C_{\text{CSO}} &= 2.2\mu\text{F} \\ R_{\text{CSO}} &= 1.5\text{k}\Omega \end{aligned}$$

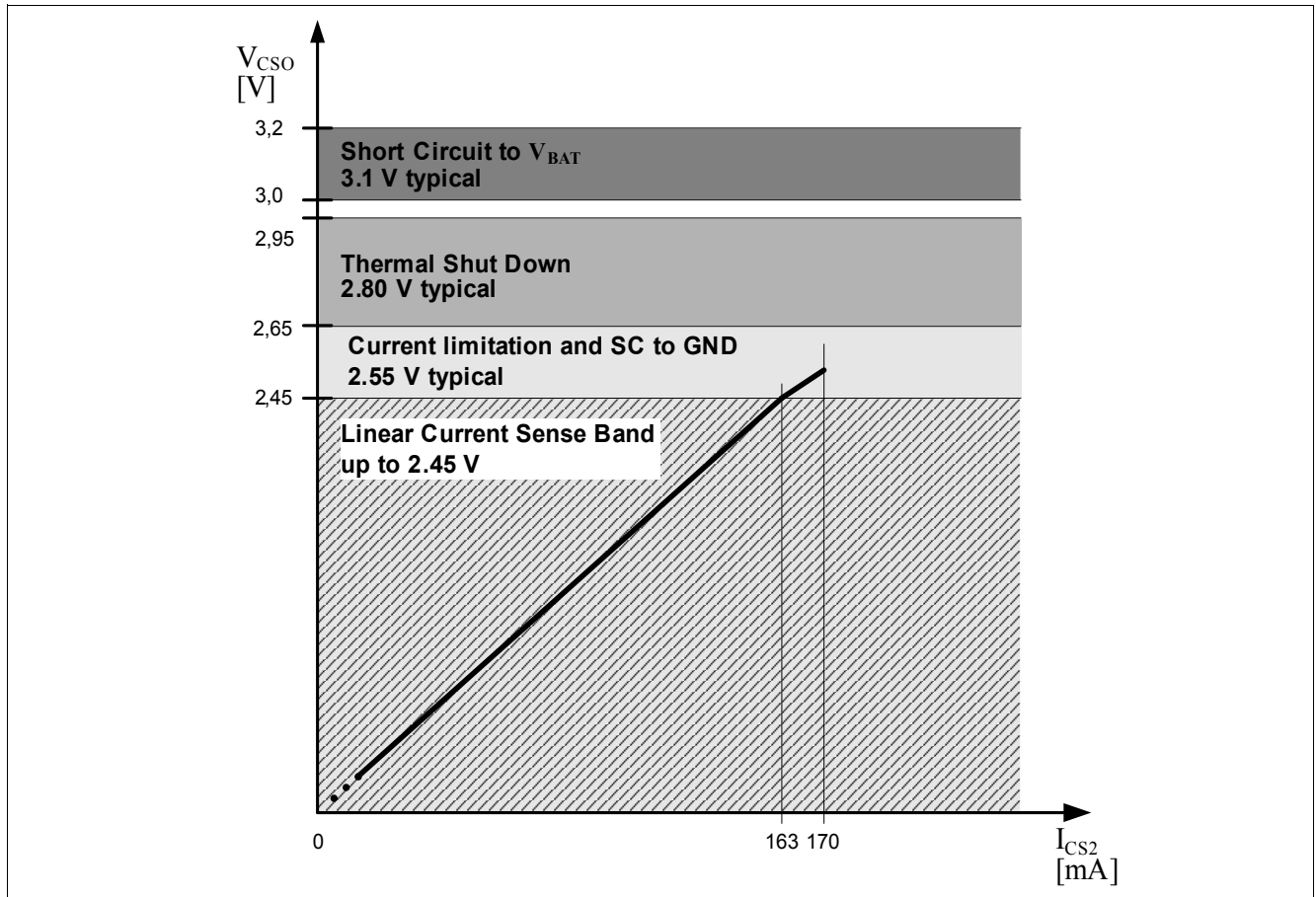


Figure 4 Output levels and functionality of the CSO output¹⁾

2.2.1 Linear Current Monitor

Inside the linear current monitor area the current driven out of the CSO pin is proportional to the voltage which is measured between pin CS1 and CS2.

The level of the current I_{CSO} can be adjusted according to [Equation \(2\)](#):

$$I_{CSO} = \frac{V_{BAT} - V_{CS2}}{R_{CS1}} = I_{CS2} \times \frac{R_{SHUNT}}{R_{CS1}}$$

Adjustment I_{CSO} (2)

$$V_{CSO} = \frac{(V_{BAT} - V_{CS2}) \times R_{CSO}}{R_{CS1}} = V_{SHUNT} \times \frac{R_{CSO}}{R_{CS1}}$$

Adjustment of the voltage level for V_{CSO} (3)

1) The graph is just an example and only valid for an certain configuration of the external components

2.2.2 Adjustable Output Current Limitation

The TLF4277 has an adjustable current limitation for the current flowing into the power stage (pin CS2). If the level of the voltage drop across the sense resistor R_{SHUNT} is higher than the desired linear monitor range the output current of the TLF4277 will be limited.

$$I_{CS2,lim} = \frac{2.55V \times R_{CS1}}{R_{SHUNT} \times R_{CSO}}$$

Setting of the adjustable current limitation (4)

A voltage level of 2.55 V typical, as shown in [Figure 4](#), will be applied at the CSO pin.

To achieve a current limitation of 170mA the following configuration can be used:

$$I_{CS2,lim} = \frac{2.55V \times 100\Omega}{1\Omega \times 1.5k\Omega} = 170mA$$

$$R_{SHUNT} = 1\Omega$$

$$R_{CS1} = 100\Omega$$

$$R_{CSO} = 1.5k\Omega$$

2.2.3 Overvoltage Detection

To detect a possible short circuit of the output to a higher supply rail the TLF4277 has an overvoltage detection implemented. An overvoltage will be detected, if the voltage level at the ADJ pin is 20% higher than the internal reference voltage $V_{REF,int}$, which is typically 1.22 V.

Under this condition the CSO pin will be driven through an internal voltage buffer with the voltage level of 3.10 V typical as shown in [Figure 4](#).

2.2.4 Thermal Shutdown Detection

If the junction temperature exceeds the overtemperature shutdown threshold defined in [\[1\]](#), the TLF4277 will disable the output voltage. In such a case the voltage level of 2.80 V typical will be applied at the CSO pin, as shown in [Figure 4](#).

2.3 Enable Function

The TLF4277 can be turned on or turned off via the EN Input. When voltage levels higher than $V_{EN,high}$ are applied to the EN Input the device will be completely turned on. A voltage level lower than $V_{EN,low}$ sets the device to low quiescent current mode. In this condition the device is turned off and is not functional. The Enable Input has a build-in hysteresis to avoid toggling between ON/OFF states, if signals with slow slope are applied to the input.

3 Demoboard

The TLF4277 Demoboard is equipped with TLF4277 and the necessary external components.

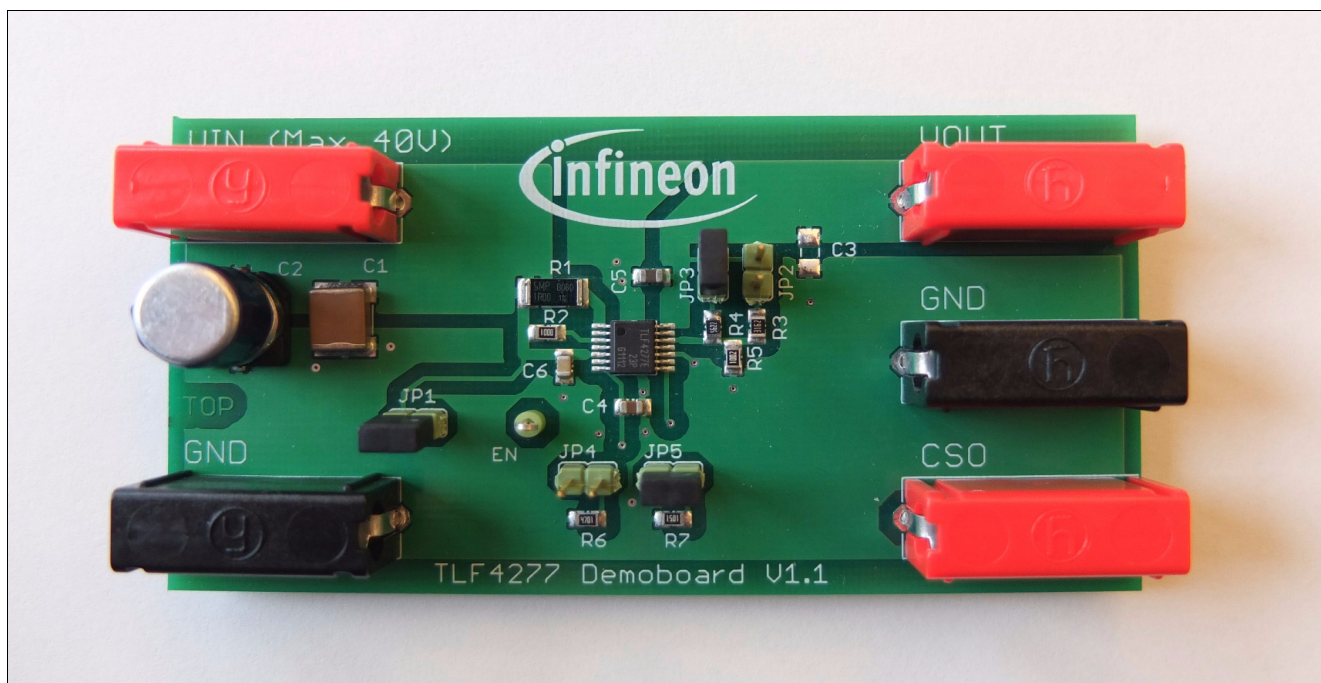


Figure 5 TLF4277 Demoboard V1.1

3.1 Operating Conditions

To avoid damage of the Demoboard, the maximum of the operating range defined in [Table 1](#) must be followed.

Table 1 Input / output operating range ¹⁾

Parameter	Symbol	Limit Values		Unit
		Min.	Max.	
Board Supply	VIN	9	40 ²⁾	V
Regulator Output	VOUT	5	12 ²⁾	V
Current Monitor Out	CSO	0	5	V
Enable Input LOW	EN _{low}	0	0.8	V
Enable Input HIGH	EN _{high}	2.0	40	V

1) The demo board is operating at ambient temperature of 25°C.

2) The max. value depends on the max. rating of external components on the board.

3.2 Quick Start Procedure

1. Set the jumpers on the board to select the desired test setup (refer to [Chapter 3.3](#)).
2. With power off, connect the input power supply to VIN and GND.
3. Connect the load between VOUT and GND. Preset the load current at 10 mA.
4. Turn on the input power supply. Make sure that the input voltage does not exceed 40 V.
5. Slowly increase or decrease the load current while monitoring the voltage at VOUT and CSO.

3.3 Board Configuration

The TLF4277 Demoboard can be easily configured with the jumpers on the board. The board provides the following configuration options:

- Output voltage: 5 V or 8 V.
- Current limitation: 54 mA or 170 mA.
- Enable function.

3.3.1 Output Voltage Setting

The TLF4277 Demoboard provides two output voltage options 5 V and 8 V, which can be configured by setting the jumpers JP2 and JP3 (see [Figure 9](#)).

Table 2 Jumper setting for output voltage

JP2	JP3	Output Voltage
close	open	5.075 V ¹⁾
open	close	8.076 V ¹⁾

1) Nominal value.

3.3.2 Current Limitation Setting

The TLF4277 Demoboard provides two output voltage options 54 mA and 170 mA, which can be configured by setting the jumpers JP4 and JP5 (see [Figure 9](#)).

Table 3 Jumper setting for current limitation

JP4	JP5	Current Limitation
close	open	54.25 mA ¹⁾
open	close	170.00 mA ¹⁾

1) Nominal value.

3.3.3 Enable Function

The jumper JP1 on the TLF4277 Demoboard can be used to deactivate the Enable function by connecting the EN pin to the input pin, then the linear regulator is always on while it is supplied. When J1 is open, the Enable signal can be supplied from the EN test point on the board.

Table 4 Jumper setting for enable function

JP1	Enable Function
close	EN is connected to input, the Enable function is deactivated.
open	EN can be supplied externally, the Enable function can be used.

3.4 Typical Performance

In this chapter, the typical performance of the current and protection monitor functions are shown with lab measurement results. All measurements are done on TLF4277 Demoboard under the following condition:

- $T_{\text{ambient}} = 25^{\circ}\text{C}$
- $V_{\text{in}} = 13.5\text{ V}$

3.4.1 Current Monitor Performance

Setup 1:

8 V output voltage (JP2 open, JP3 close)

170 mA current limitation (JP4 open, JP5 close)

The typical current monitor performance is shown in [Figure 6](#). The current sense accuracy is specified in section 7.2 on page 17 of the TLF4277 data sheet [\[1\]](#).

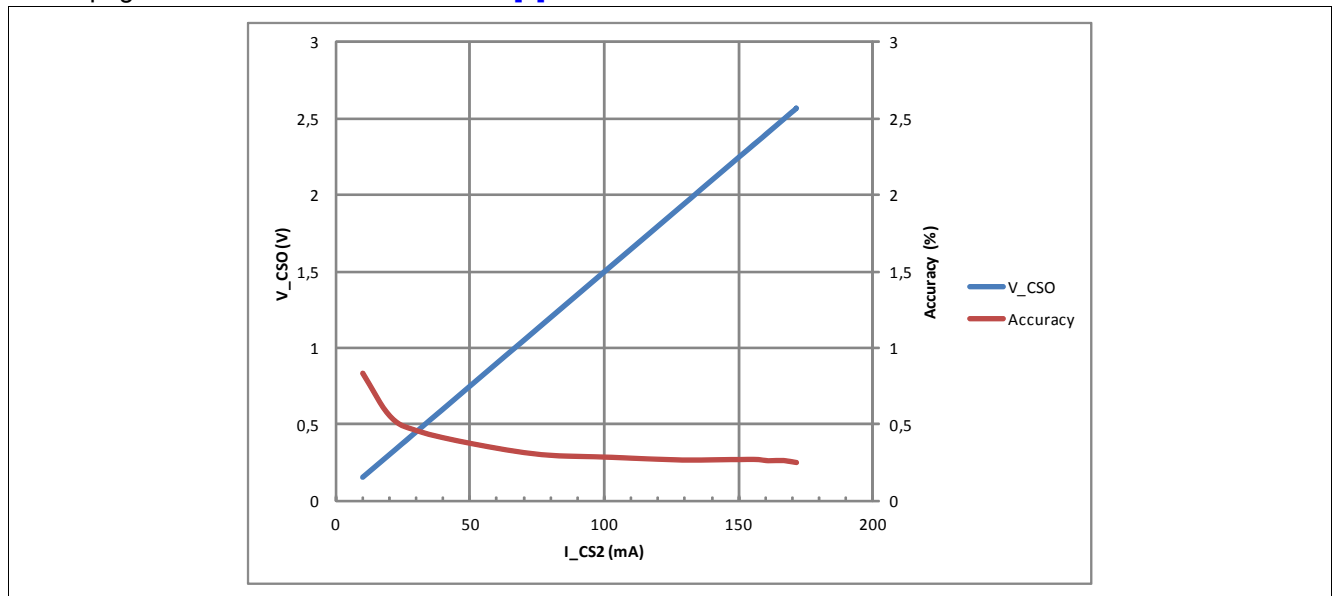


Figure 6 Current monitor performance with setup 1

Setup 2:

5 V output voltage (JP2 close, JP3 open)

54 mA current limitation (JP4 close, JP5 open)

The typical current monitor performance is shown in [Figure 7](#). The current sense accuracy is specified in section 7.2 on page 17 of the TLF4277 data sheet [\[1\]](#).

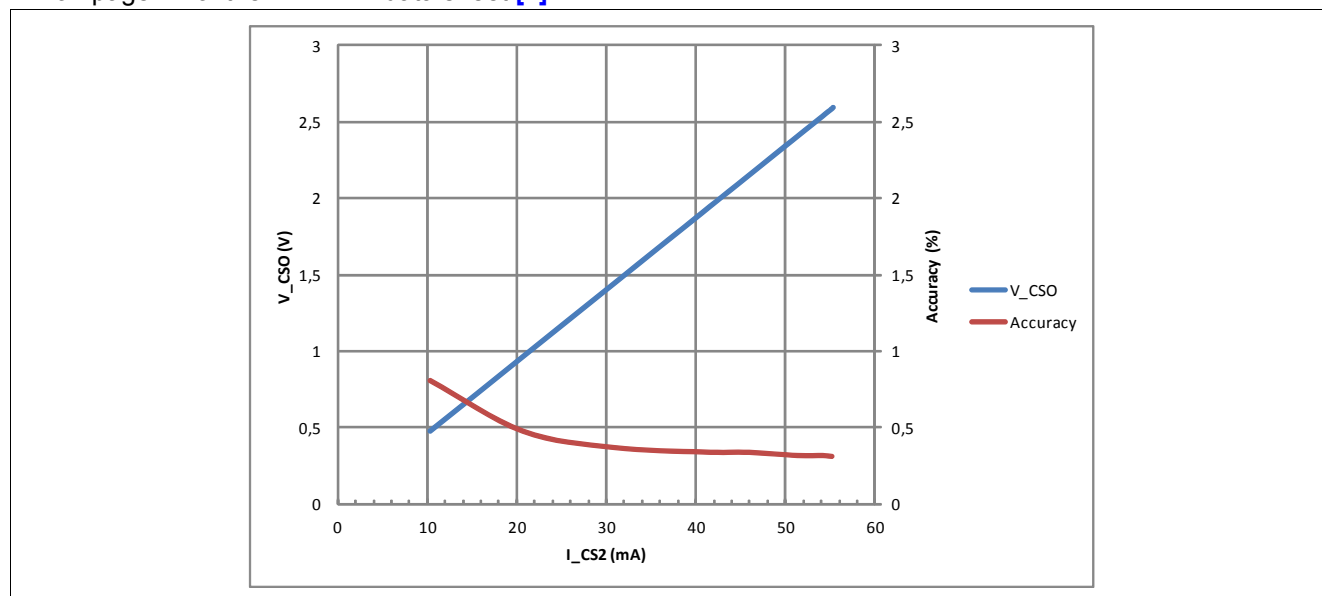


Figure 7 Current monitor performance with setup 2

3.4.2 Current Limitation Performance

Setup 1:

8 V output voltage (JP2 open, JP3 close)

170 mA current limitation (JP4 open, JP5 close)

The typical current limitation performance is shown in [Table 5](#) in comparison with the nominal value. The current limitation accuracy is specified in section 7.2 on page 17 of the TLF4277 data sheet [\[1\]](#).

Table 5 Current limitation value with setup 1

Nominal value	Measured typical value
170.00 mA	171.65 mA

Setup 2:

5 V output voltage (JP2 open, JP3 close)

54 mA current limitation (JP4 open, JP5 close)

The typical current limitation value is shown in [Table 6](#) in comparison with the nominal value. The current limitation accuracy is specified in section 7.2 on page 17 of the TLF4277 data sheet [\[1\]](#).

Table 6 Current limitation value with setup 2

Nominal value	Measured typical value
54.25 mA	55.32 mA

3.6 Bill of Material

Table 9 Bill of material

Part	Value	Package
B1	Banana jack	BABU4MM
B3	Banana jack	BABU4MM
B4	Banana jack	BABU4MM
B5	Banana jack	BABU4MM
B6	Banana jack	BABU4MM
C1	10u/50V	C2220K
C2	100u/50V	CPOL-EUE
C3	10u/16V not mounted	C1206
C4	2u2/10V	C0805
C5	10u/16V	C0805
C6	100n	C0805
EN	LSP10	LSP10
IC1	TLF4277	SSOP-14
JP1	Jumper	JP1E
JP2	Jumper	JP1E
JP3	Jumper	JP1E
JP4	Jumper	JP1E
JP5	Jumper	JP1E
R1	1R/1%/1W	R2010
R2	100R	R0805
R3	31.6k/0.1%	R0805
R4	56.2k/0.1%	R0805
R5	10k/1%	R0805
R6	4k7/1%	R0805
R7	1k5/1%	R0805

3.7 Board Layout

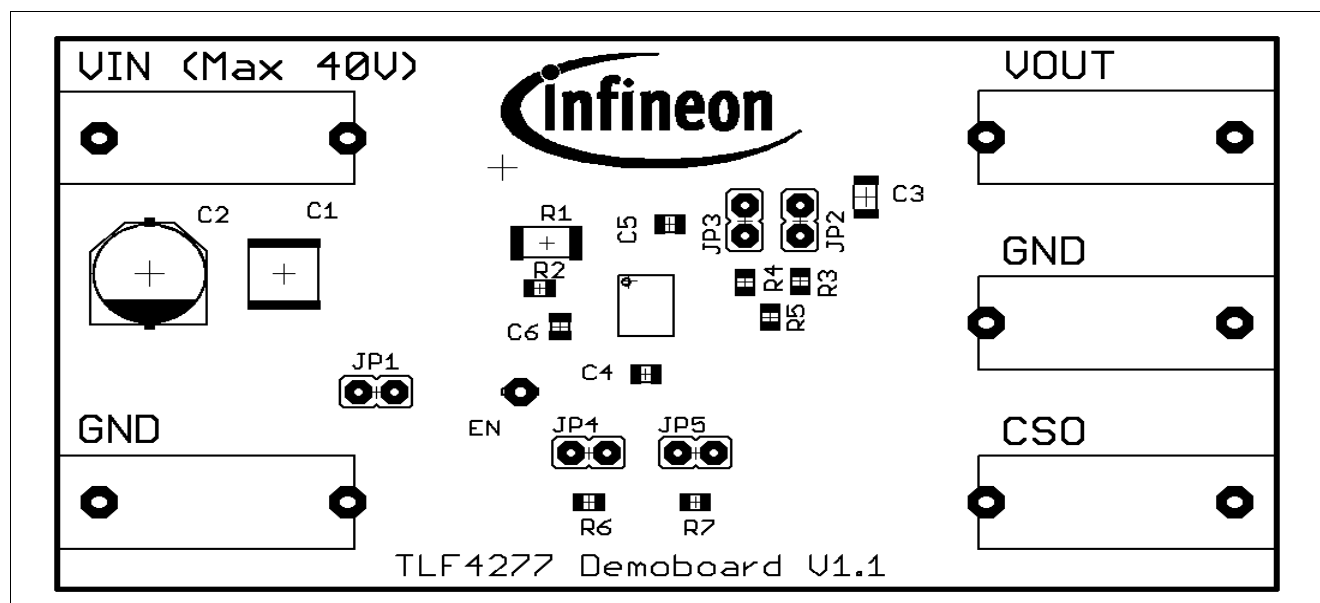


Figure 9 TLF4277 Demoboard V1.1 top layer component placement

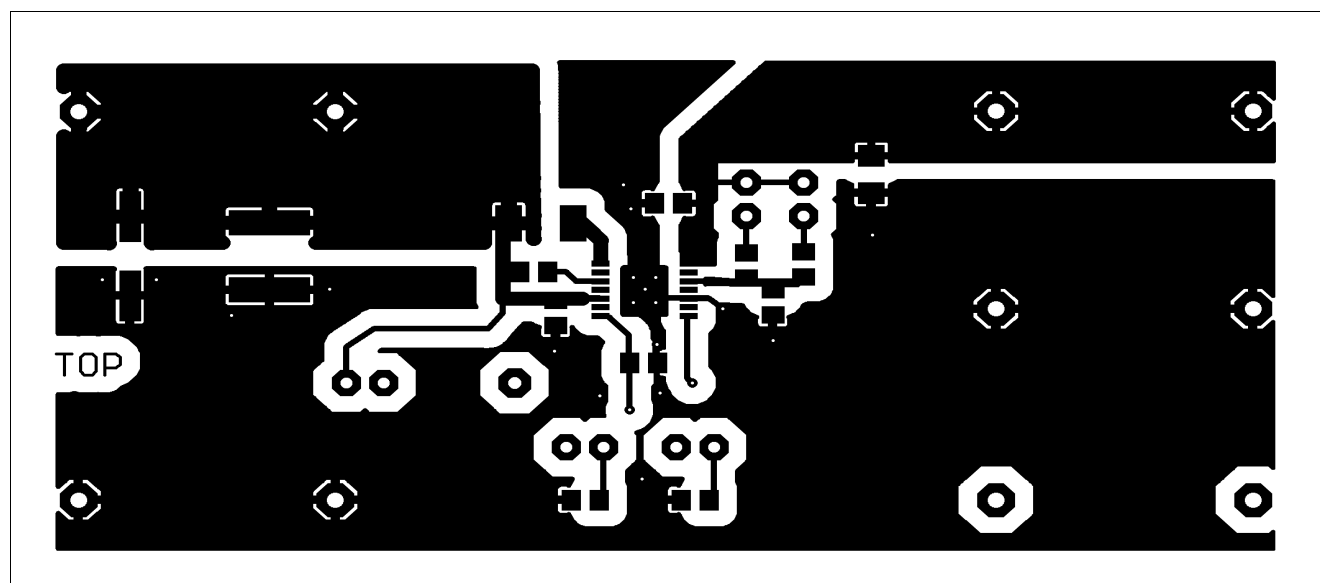


Figure 10 TLF4277 Demoboard V1.1 top layer

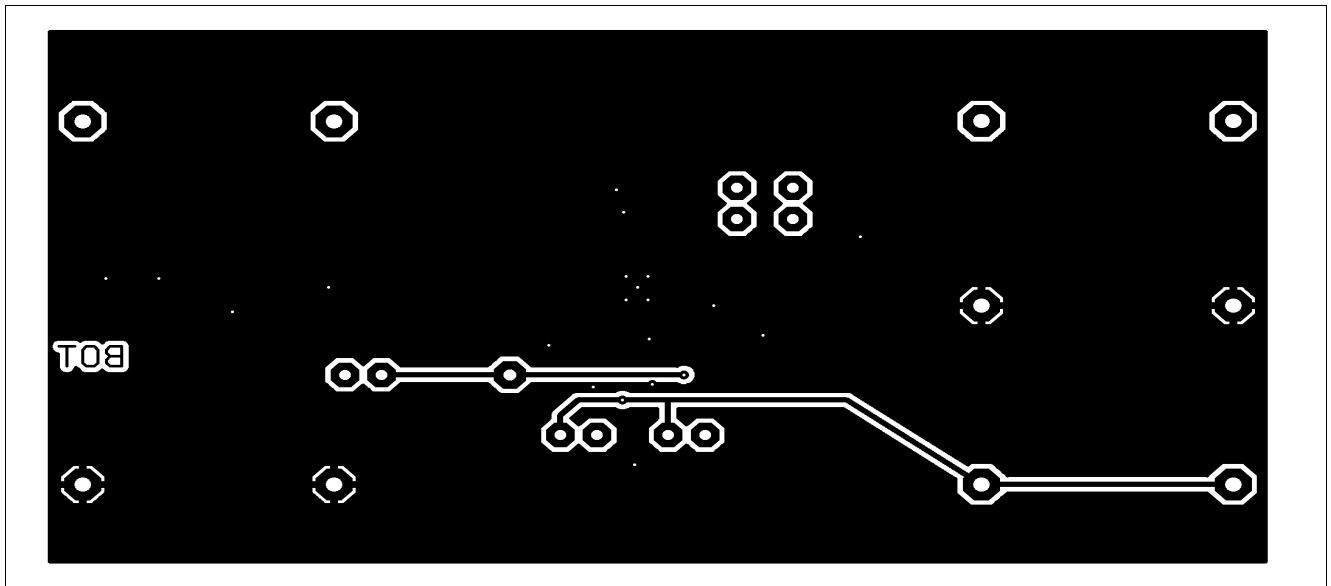


Figure 11 TLF4277 Demoboard V1.1 bottom layer

4 Restrictions

This Demoboard is offering limited features allowing you only to evaluate and test the Infineon products. The Demoboard is not an end product (or finished appliance), nor is it intended or authorized by Infineon to be integrated into end products. You are not authorized to use the Demoboard in any production system.

5 Reference

[1] TLF4277 Data Sheet

6 Revision History

TLF4277 Demoboard

Revision History: Rev. 1.1, 2012-04-25

Previous Version(s): Rev. 1.0, 2012-03-12

Page	Subjects (major changes since last revision)
15	Restrictions disclaimer added.

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