

# **Monitoring Load Current With the TPS2549 and TPS254900 CS Pin**

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## **ABSTRACT**

In many automotive applications, the host controller must monitor load current in real time and take appropriate measures to protect the system when the load current surpasses a safe threshold. This application note presents how to use the TPS2549 and TPS254900 CS pin to monitor load current.

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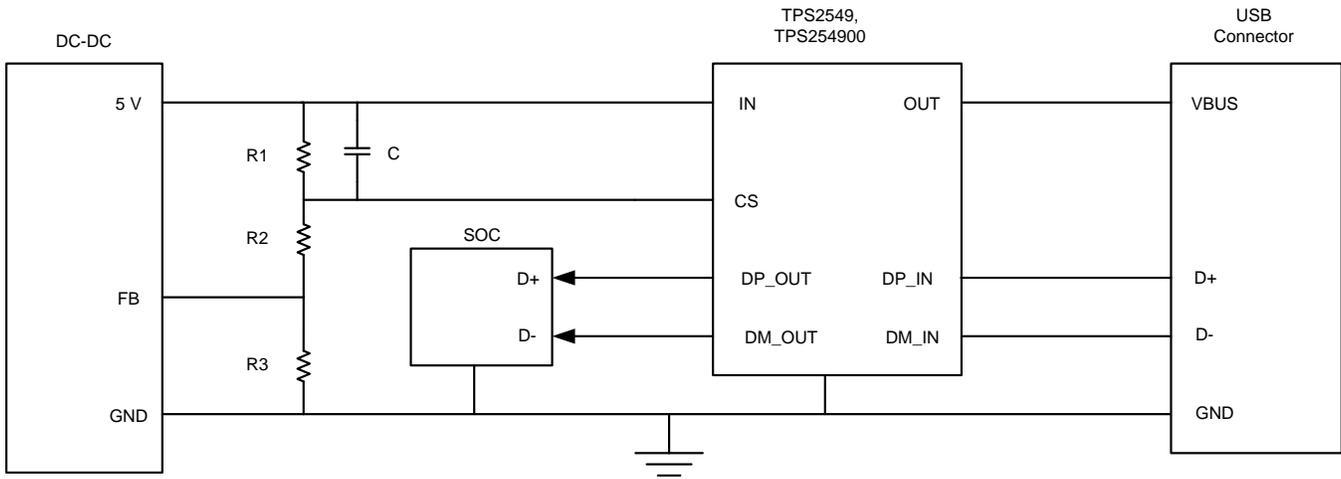
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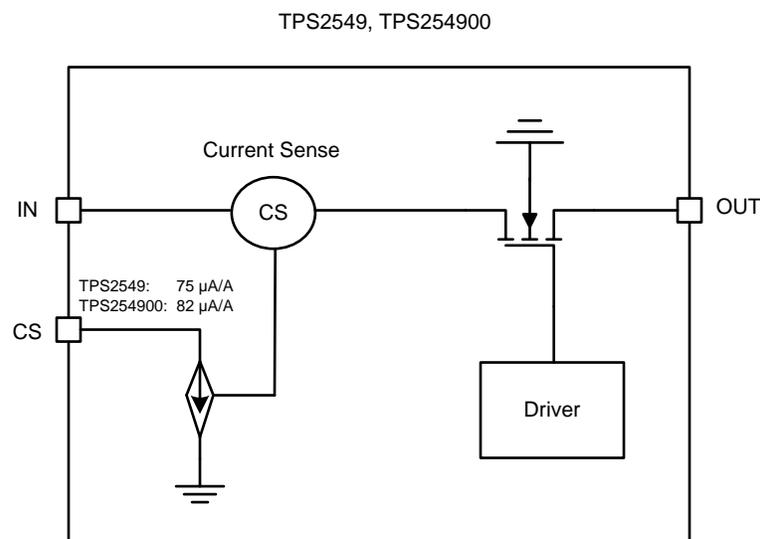
## 1 Introduction

The TPS2549 and TPS254900 devices are USB host-charging controllers with a supply voltage range from 4.5 V to 6.5 V. The TPS2549 and TPS254900 are widely used in automotive applications. Figure 1 shows the typical application circuit. Typically, the CS pin is used to compensate the voltage drop due to the long cable between the USB connector and end-user devices. The TPS2549 and TPS254900 devices sense the load current and generate a proportional sink current through the CS pin, that can be used to adjust the output voltage of the upstream DC-DC regulator. Figure 2 shows the cable compensation block diagram.



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**Figure 1. TPS2549 and TPS254900 Typical Application Circuit**



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**Figure 2. Cable Compensation Block Diagram**

## 2 Device Overview

### 2.1 Using the CS Pin to Monitor Load Current

The CS pin provides a current sink. By connecting a sample resistor in the cable compensation path, we can use the CS pin to monitor load current, which can avoid any impact by connecting a sense resistor in series with the load, to achieve higher efficiency. Figure 3 shows the scheme for monitoring load current with the CS pin. The current sense amplifier converts the current which flows through  $R_s$  to proportional voltage, and this voltage can be sampled by an analog-to-digital converter (ADC).

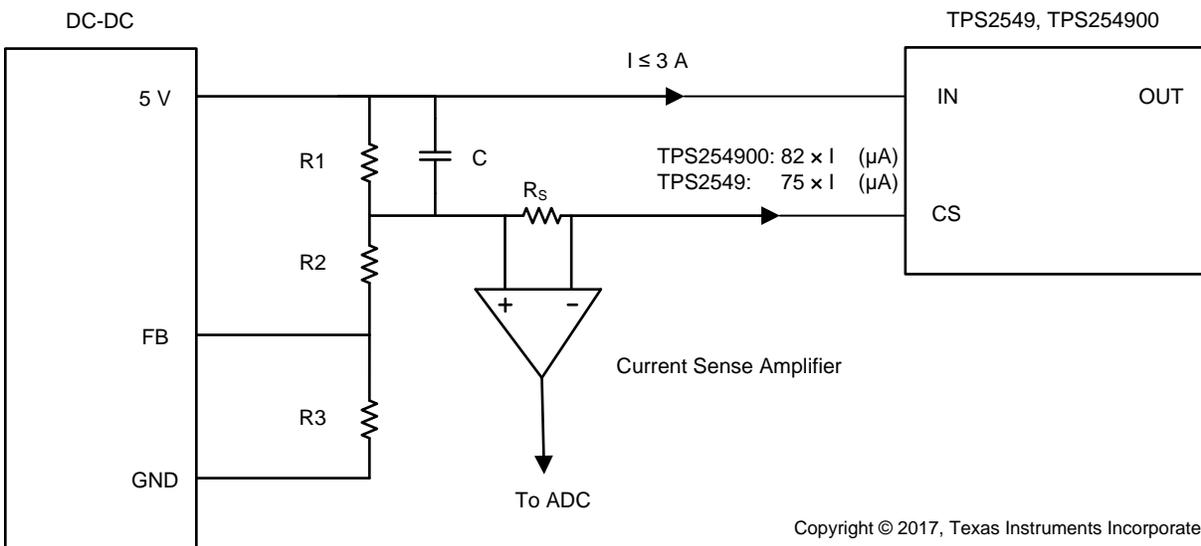


Figure 3. Current-Sensing Scheme With CS Pin

To ensure the cable compensation of the TPS2549 and TPS254900 works normally, TI requires that the voltage at the CS pin is larger than 2.5 V.

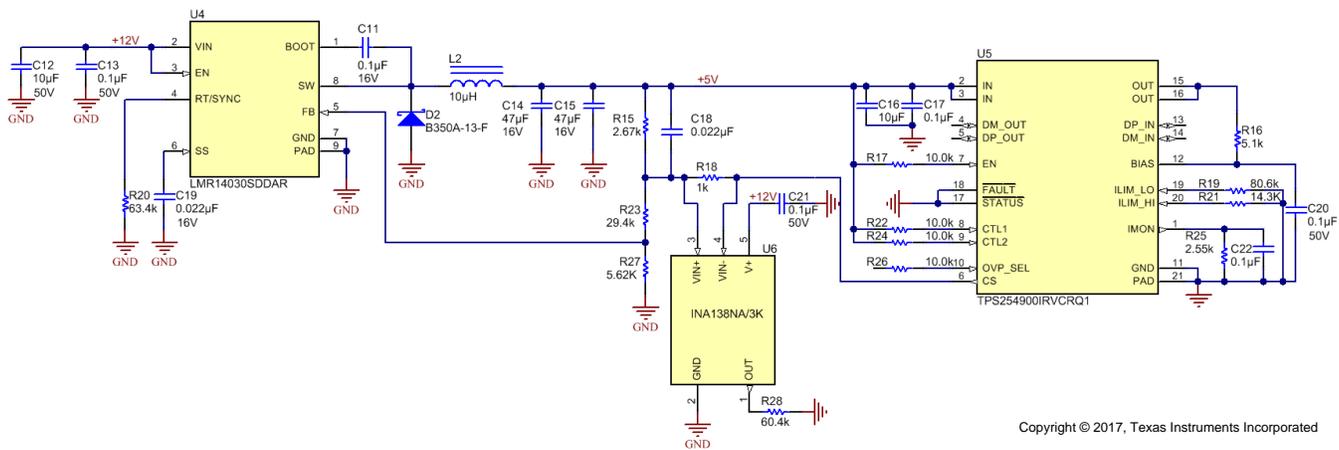
### 3 Device Description

#### 3.1 Example of Monitoring Load Current

Figure 4 shows an example of monitoring the output current of the TPS254900. Using a 1-kΩ sample resistor and an amplifier with a gain of 12.08, the output voltage of the amplifier is described in Equation 1.

$$V = 0.991 \times I \tag{1}$$

Table 1 lists the test results.



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Figure 4. Current Sensing Example

Table 1. Current Sense Test Results

Current (A)	Voltage (V)	Gain
0.5	0.526	1.052
0.8	0.822	1.028
1	1.019	1.019
1.2	1.217	1.014
1.5	1.512	1.008
1.8	1.808	1.004
2	2.005	1.003
2.2	2.202	1.001
2.5	2.498	0.999
2.8	2.795	0.998
3	2.994	0.998

### 4 Conclusion

The guidelines in this application report provide a workable solution for current sensing in USB-charging-based devices. Sensing up to 3-A current is achieved by using proper sample resistors and amplifiers.

## 5 References

- Texas Instruments, [TPS2549 USB Charging Port Controller and Power Switch With Cable Compensation](#), data sheet
- Texas Instruments, [TPS254900-Q1 Automotive USB Host Charger With Short-to-VBATT Protection](#), data sheet
- Texas Instruments, [TPS254900Q1EVM-817](#), user's guide
- Texas Instruments, [TPS2549Q1EVM-729](#), user's guide

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