

## 60 V, 16-bit, high-precision power monitor with I<sup>2</sup>C and MIPI I3C interface



DFN10 (3x3 mm)

Maturity status link

[TSC1641](#)

### Features

- 16-bit resolution dual-channel sigma-delta ADC
- 2.7 V to 3.6 V power supply voltage
- From 128  $\mu$ s to 32.7 ms total conversion time
- Bidirectional current, high-side, or low-side sensing
- Load voltage sensing from 0 V to 60 V
- Load offset voltage:  $\pm 2$  mV typical
- Shunt and load voltage gain error: 0.3% maximum
- Real-time precise DC power computing
- Internal die temperature monitoring
- MIPI I3C up to 12.5 MHz
- I<sup>2</sup>C bus interface up to 1 MHz
- Default I<sup>2</sup>C address: 1000000(b) to 1000011(b)
- SMBus alert compatible
- Alert signals generated in case of over/undervoltage, over/undercurrent, overpower, or overtemperature
- Extended temperature range: -40 °C to 125 °C
- DFN10 3 x 3 mm<sup>2</sup> package

### Applications

- Industrial battery packs
- Power inverters
- Data centers
- Telecom equipment

### Description

The **TSC1641** is a high precision current, voltage, power, and temperature monitoring analog front-end (AFE). It monitors current into a shunt resistor and load voltage up to 60 V in a synchronized way. The current measurement can be high-side, low-side and bidirectional.

The device integrates high precision 16-bit dual channel ADC with a programmable conversion time from 128  $\mu$ s to 32.7 ms.

The digital bus interface is flexible from an I<sup>2</sup>C/SMBus 1 MHz data rate to an MIPI I3C 12.5 MHz data rate. This allows connectivity to most of the recent STM32 products.

The **TSC1641** allows the assertion of several alerts on the voltage, current, power, temperature signals and thresholds can be set for each parameter in a specific register.

The **TSC1641** comes in a plastic DFN10 package and can operate from -40 °C to 125 °C ambient temperature.

# 1 Block diagram and pin description

Figure 1. Block diagram

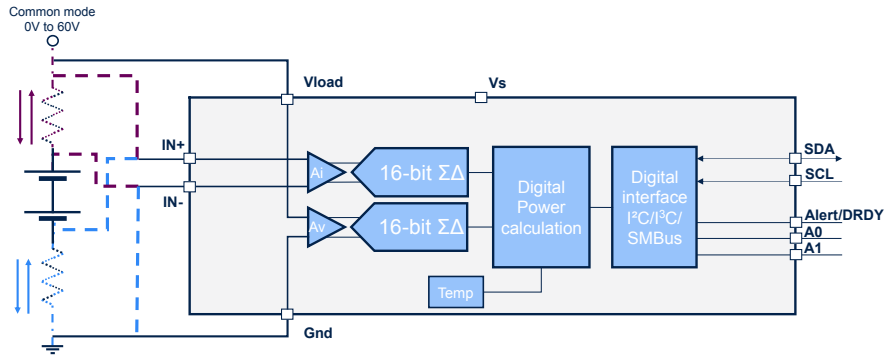


Figure 2. Pin connections (top view – not to scale)

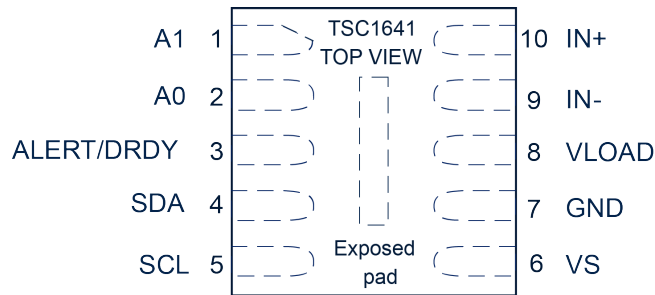
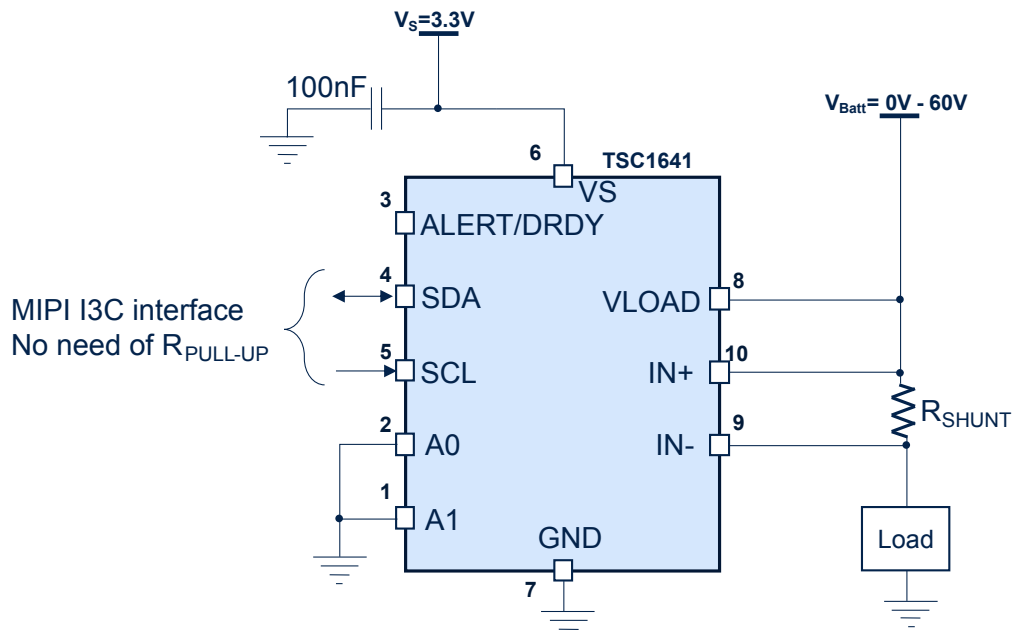


Table 1. Pin description

Pin	Pin name	Type	Description
1	A1	Digital input	I²C mode: A1 is a digital input to select the address of the target. I3C mode: A1 is used to set a static address (priority vs. virtual address)
2	A0	Digital input	I²C mode: A0 is a digital input to select the address of the target. I3C mode: A0 is used to set a static address (priority vs. virtual address)
3	ALERT/DRDY	Digital output	Multi-functional digital alert pin. Open-drain output in I²C. To be connected with a pull-up resistor. Not connected in I3C
4	SDA	Digital input/output	Digital I/O, serial bus data line, open-drain input/output in I²C/SMBus, open-drain or push pull in MIPI I3C mode
5	SCL	Digital input	Digital input, serial bus clock line
6	VS	Power supply	Power supply for the device, range is 2.7 V to 3.6 V
7	GND	Ground	Ground reference point
8	VLOAD	Analog input	Analog input, the load voltage input from 0 V to 60 V
9	IN-	Analog input	Analog input, lower side of the shunt resistor
10	IN+	Analog input	Analog input, upper side of the shunt resistor
-	Exposed pad	-	No electrical connection. Should be left floating

## 2 Typical application circuit

Figure 3. Typical application for high-side sensing and MIPI I3C communication



The TSC1641 is a digital monitoring analog front-end (AFE) for converting parameters such as current, voltage, and temperature. It measures a shunt resistor voltage to determine the current in the load. The shunt resistor is placed outside the device, and can be high-side, low-side, with bidirectional current measurements. The AFE can also monitor the load supply voltage up to 60 V.

For very accurate measurement, the TSC1641 integrates two separated channels for the shunt voltage measurement and the load voltage measurement, thus simultaneous sampling is made possible for an optimum power computation. It enables a wide range of conversion times, from 128  $\mu$ s to 32.7 ms, suitable for many applications.

The input range for the current channel is  $\pm 81.92$  mV and for the load voltage channel it is 0 V to 60 V. Each modulator has the same resolution, rated at 16 bits. The modulator is designed in such a way that only increasing the conversion time allows to improve the noise performance of the device, thus simplifying the device configuration for the user.

A digital interface I<sup>2</sup>C, SMBus or MIPI I3C<sup>SM</sup> version 1.1.1 SDR-only, enables the communication to any system requiring an accurate monitoring of such variables. These protocols are compatible with each other.

The typical application in Figure 3 shows a configuration for I3C communication.

## Revision history

**Table 2. Document revision history**

Date	Revision	Changes
22-Feb-2023	1	Initial release.

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