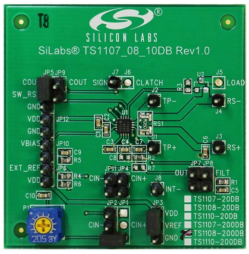

SILICON LABS TS1108 Coulomb Counter User Guide

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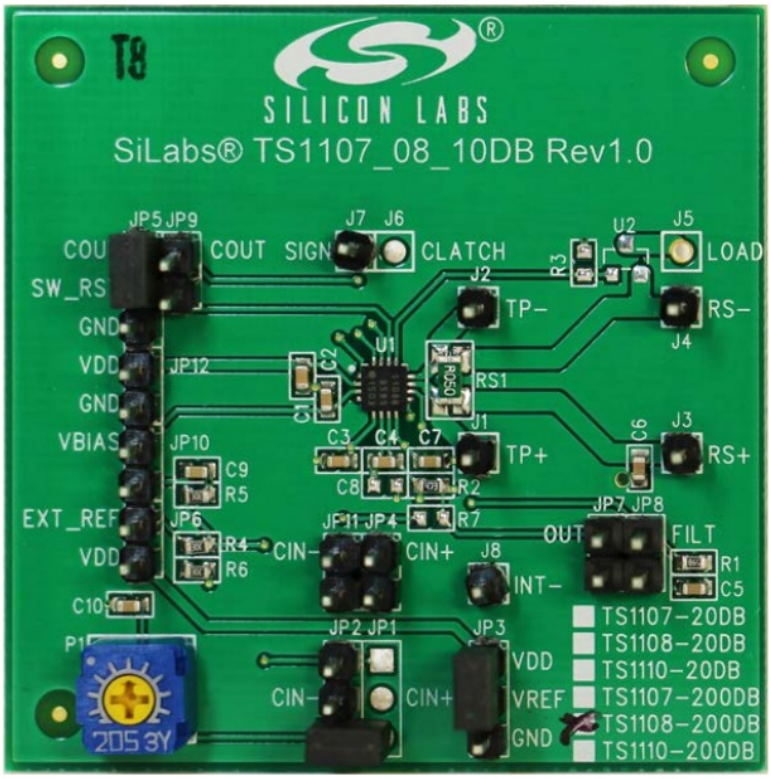

Product Information

- The TS1108 Coulomb Counter is an electronic device that calculates the number of ampere-hours (Ah) of charge that has passed through it. It uses a comparator interrupt pulse to measure the charge passed through it and provides an output waveform with a periodic pulsing pattern. The device has the following key features:
  - Calculates ampere-hours of charge passed through it
  - Uses comparator interrupt pulse to measure charge
  - Provides periodic pulsing waveform output
- The package includes one TS1108 Coulomb Counter, a circuit schematic, a component list, and a quick start procedure. The component list lists all the components included in the package and their quantities. The quick start procedure provides step-by-step instructions on how to start using the device.

Product Usage Instructions

1. Refer to the component list to ensure all components are included in the package.
2. Connect the power supply to VIN and GND as per the circuit schematic provided.
3. Connect a 1 V voltage source to VBIAS.
4. Connect a load to VLOAD and GND.
5. Adjust RSENSE to provide accurate charge measurement for the load connected.
6. Adjust CINT and RINT based on the desired frequency of comparator interrupt pulses.
7. Verify that VOUT equals 1 V.
8. Connect an oscilloscope to COUT to observe the periodic pulsing waveform output.

KEY FEATURES

- RSENSE: 50 mΩ ± 0.5%

- Compatible for Both Gain Options
- 20 V/V
- 200 V/V

ORDERING INFORMATION

- TS1108-20DB
- TS1108-200DB

ABOUT PRODUCT

- The TS1108 coulomb counter accurately measures battery depletion while also indicating the battery charging polarity. The battery discharge current is monitored by a current-sense amplifier through an external sense resistor. Utilizing an Integrator and a Comparator plus a Monoshot, the TS1108 voltage-to-frequency converter provides a series of 90 µs output pulses at COUT, which represents an accumulation of coulombs flowing out of the battery. The charge count frequency is adjustable by the integration resistor and capacitor.
- The TS1108 CSA requires a very low 1.2 µA supply current, while also combining a 150 µV VOS(MAX) with a 0.6% gain error (MAX) for high precision current measurements. The TS1108 provides a buffered CSA output which can be connected with a RC Filter to reduce noise. The VDD supply requires a typical supply current of 1.93 µA when VREF is disabled.
- The TS1108 is fully specified to operate over the –40 °C to +85 °C temperature range and is available in a low-profile thermally-enhanced 16-pin 3 x 3 mm TQFN package with an exposed back-side paddle.

Description

The TS1108 Evaluation Board is intended for evaluating the coulomb counter functionality of the TS1108. The TS1108 Coulomb Counter function utilizes an Integrator and a Comparator plus a 90 µs Monoshot. The CSA's buffered output is applied to the integrator's
input. This signal is integrated by the comparator until it reaches a level which trips the comparator. The comparator's trip level is determined by the voltage applied to the comparator's non-inverting terminal, CIN+. The Monoshot produces a 90 µs output pulse at COUT and the integrator is reset. Therefore, each COUT 90 µs pulse represents an accumulation of coulombs (Please refer to Coulomb
Counter Equations in Applications Information). The TS1108 Integrator works best when the 90 µs Monoshot represents less than 2%
of the total integration period. Therefore, the minimum integration time for a full-scale VSENSE should be limited to 4.7 ms. To guarantee stable operation of the OUT buffer, an integration capacitance of 0.1 µF should be used for integration capacitor, CINT. The TS1108's Coulomb Counting interrupt is provided by the internal comparator with a push-pull output configuration.
The following equation can be used to calculate how many ampere-hours (Ah) each comparator interrupt pulse represents:

$$Comparator\,Pulse = \frac{R_{INT} C_{INT} \left(V_{CIN-} - V_{VBIAS} \right)}{3600 \times GAIN \times R_{SENSE}} Ah$$

Component List

Designation	Quantity	Description
U1	1	TS1108-20, TS1108-200
RS1	1	50 mΩ ±0.5%, 1/2 W (1206)
C1, C6	2	1 µF ± 10%, 10 V (0603)
C2, C4, C7, C9, C10	5	0.1 µF ± 10%, 10 V (0603)
C3	1	1 nF ± 10%, 25 V (0603)
C5	1	0.47 µF ± 10%, 10 V (0603)
R1	1	4.02 kΩ ± 1%, 1/16 W (0603)
R2	1	47 kΩ ± 1%, 1/16 W (0603)
R4, R5, R6	3	2 MΩ ±1%, 1/10 W (0603)
J1, J2, J3, J4, J7, J8	6	Header 1×1
JP2, JP3, JP5	3	Header 1×3
JP4, JP6, JP7, JP8, JP9, JP10, JP 11, JP12	8	Jumper
JS1, JS2, JS3	3	Jumper Shunt

Quick Start Procedure

- **Required Equipment**
  - 3 V Power Supply or 3 V Battery
  - 2 Digital Multimeters
  - 1 Oscilloscope
  - 1 Potentiometer
- To use the TS1108 evaluation board, perform the following steps:
  1. Configure JP3 so that the Jumper Shunt is connecting VDD to VREF.

2. Configure JP5 so that the jumper shunt is connecting COUT and SW_RST.
3. Connect the 3 V power source to RS+ and VDD.
4. Use a voltmeter to measure the VVBIAS and the CIN– voltage. VVBIAS should be 50% of VDD, 1.5 V. CIN– should be 90% of VDD, 2.7 V.
5. Connect a voltmeter to measure VOUT. With no load connected VOUT should be equal to VVBIAS. The expression for the VOUT output voltage is defined by: VOUT = VBIAS í I LOAD × 50mΩ × GAIN
6. Connect an ammeter in series from RS– to a potentiometer. Adjust the POT until the ammeter reads:
   - TS1108-20: 500 mA
   - TS1108-200: 50 mA VOUT should equal 1 V.
7. Connect the oscilloscope to COUT. COUT should produce a periodic pulsing waveform with a period of 11.28 ms, where each monoshot pulse width is 90 µs (typ).

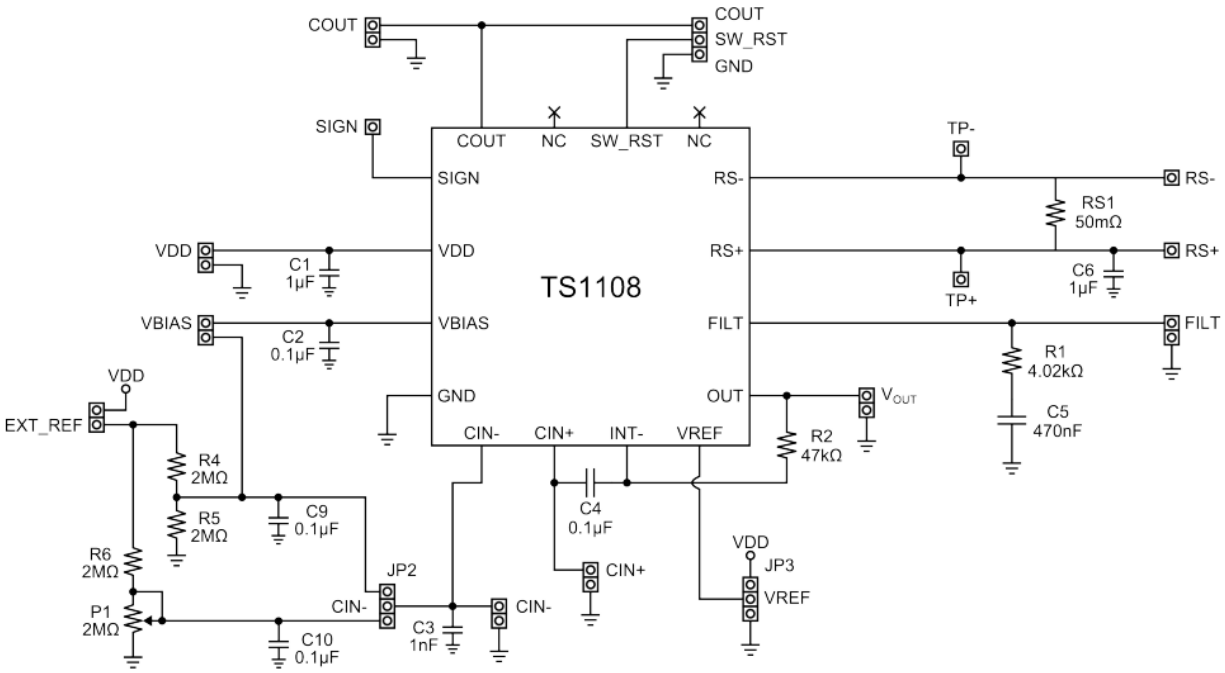

Figure 2.1. TS1108DB Circuit Schematic

Disclaimer

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