Solstice Family: Current Sensor

I²C Pressure Sensor

General Description

The SF-7is a three-chip high side current monitor. The First chip is based on the Texas Instruments INA138 High-Side Measurement Current Shunt Monitor. It has a 0.1-ohm shunt resistor and is designed to measure currents from 50mA to 0.5A.

The output of the current sensor has a transfer ration of 4V/A which is available to sense at TP1. The output is buffered using the LMP7731 Op-Amp. There is a 15.4 KHz low pass filter between the buffer and the ADC. Is a 12-bit Analog-to-Digital Converter with Alert Function based on the Texas Instruments ADC121C027.

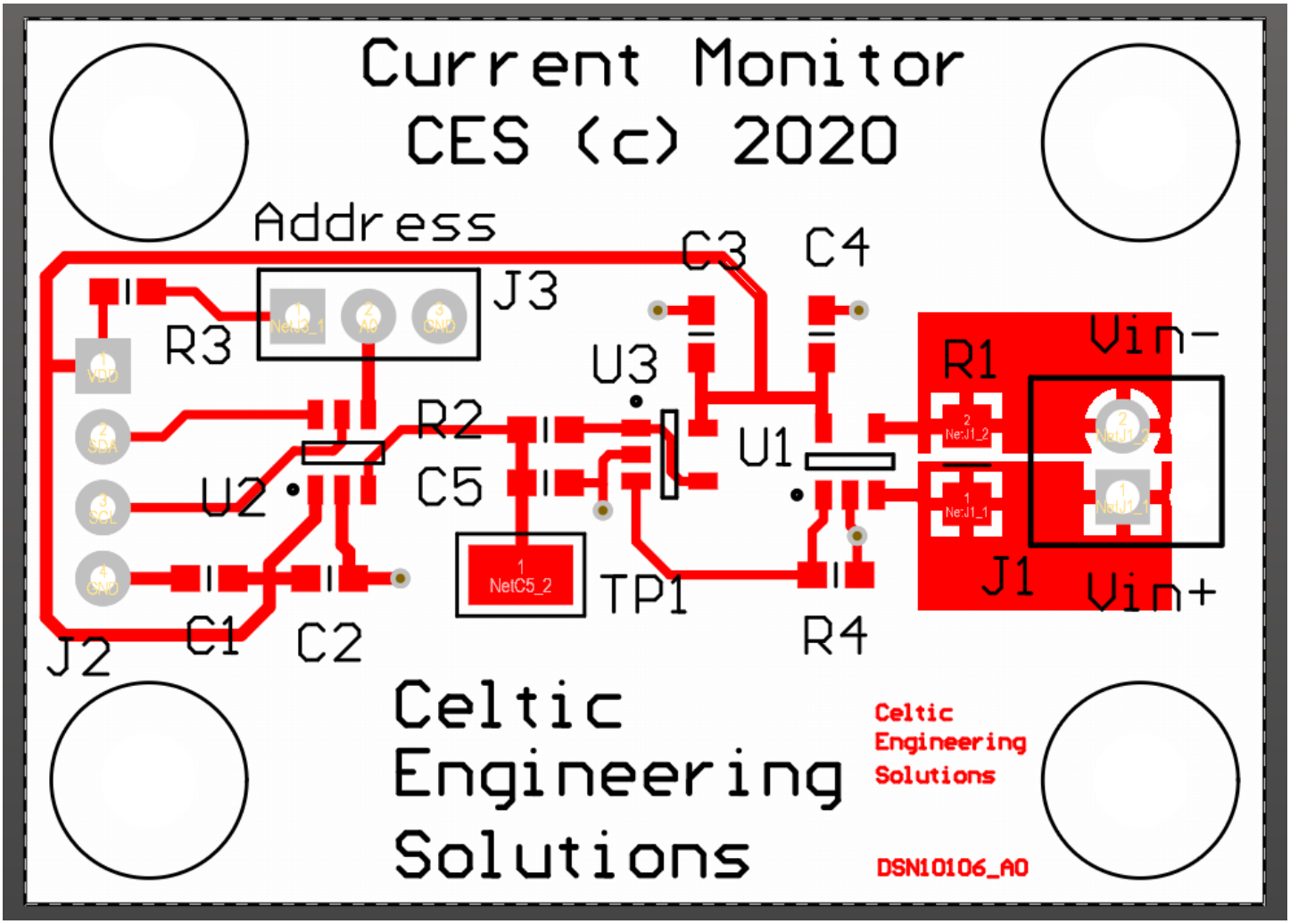
Applications

- System Monitoring
- Peak Detection
- Potable Instruments
- Medical Instruments
- Test Equipment
- Automotive
- Telephones
- Computers
- Portable and battery-Backup Systems
- Battery Chargers
- Power Management
- Cell Phones
- Precision Current Source

Benefits and Features

- Digital output
- Resolution: 12 Bits (No Missing Codes)
- Conversion Time: 1μs (Typ)
- INL & DNL: ±1 LSB (Max) (Up to 22ksps)
- Throughput Rate: 188.9 ksps (Max)
- Complete Unipolar High-Side Current Measurement Circuit
- Power Consumption (at 22 ksps)
    - 3V Supply: 0.26 mW (Typ)
    - 5v Supply: 0.78 mW (Typ)

- Wide Temperature Range: –40°C to +125°C
- Vin+ Pin 2.7 to 36V
- (Vin+ - Vin-) must be less than 2Volts to protect the device (less than 50mV for this board)
- VDD 2.7V to 5.5V
- Single Resistor Gain Set
- Board Size: 1.750” x 1.250”
- Resolution with VDD at 5V is about 305uA/bit.



Pin Configuration (J1)

Pin	Name	Function
1	VDD	Power Supply Input
2	SDA	Bidirectional Serial Data
3	SCL	Serial Clock Input
4	GND	Ground

Absolute Maximum Ratings

VDD, SDA, SCL, Alert/RDY, A0…….. 5.5Vdc
Storage temperature……. -40°C to +125°C

Pin Description

Serial Data Pin (SDA)

SDA is a bidirectional input/output pin, used to serially transmit data to and from the host controller. This pin requires a pull-up resistor to output data.

Serial Clock Pin (SCL)

SCL is a clock input pin. All communications and timing are relative to the signal on this pin. The clock is generated by the host controller on the bus.

Power supply Input (VDD)

VDD is the power pin. The operating voltage is between 2.7Vdc and 5.5Vdc.

Ground (GND)

This is the system ground pin

Address

A0 is the address selection pin for the I2C Address Lines. It allows the user to select from three addresses. Floating = 1010000; GND = 1010001; VDD = 1010010 (default).

Theory of Operation

The current, on the high side of a load, can be measured using this device with voltages up to 36V on Pin 1 of J1. This is marked on the PCB and connecting the load and power source up backwards can damage the device. ***The Vin+ in is on the bottom of J1***, which can be confusing, but was placed there to make the shortest Kelvin connection between the shunt resistor and the current sensing chip. Vin- is connected to the load. It is important to know that the ground of the load must be common with the ground of the board.

The output of the current monitor (U1) is set to 0.25A/V and is good for measuring currents between 10mA and 500mA. The voltage difference between Vin+ and Vin- should not exceed 50mV, which corresponds to 500mA. The op-amp is a high input impedance buffer which then feeds a low pass filter for anti-aliasing and noise suppression. It is set to 15.4MHz which will filter hi frequency noise but may need to be adjusted down to prevent aliasing. The voltage at TP1 will be 2V when the current through the sense resistor is 500mA and 200mV when the current is 50mA.

The ADC is a 12-Bit successive approximation register. It is accessed using the device address selected by placing a jumper on J3 appropriately.

There is an address pointer register to select which register to read/write to and 8 registers to configure the device and access the data. The example Arduino code will be of help in getting started

The ADC (U2), reads the voltage on pin 3 and converts it into counts. There of 4096 counts total. The Voltage Reference is the power supply. The Voltage on TP1 is ADC Counts * VDD / 4096. And the current through

the sense resistor is 0.25 A/V. So, if you have a 5V supply and you are reading 220 counts, then you should be able to measure about 268mV on TP1. That means the current through the sense resistor is 0.25 A/V * 0.268V, which is 67mA. Or, directly, counts/3277 is the current in amps. So, 220/3277 =0.67A or 67mA.

For additional information about the performance of the ADC 121, the INA138 or the LMP7731 please see manufacturers datasheets.

Revision History

NR	New Release
6/21/2021	Added Additional Clarification on current reading