Ultrafast, Contactless Current Sensor DS 10. 2s

Tell-i Technologies

Tell-i Technologies' ultrafast current sensor offers very high frequency current sensing through contactless, lossless magnetic point-field detection using magnetoresistor technology. The sensor is optimized for power electronics applications on printed circuit boards where the sensor is placed above the trace carrying the current to be measured. Through patented circuitry[1,2], the Tell-i sensor responds to current at frequencies up to 10 MHz with 15 ns response time and 85 ns rise time, while its contactless design gives circuit designers flexibility. The contactless design allows for measurement without altering the current trace which can introduce inductance and other parasitic effects harming circuit performance at high switching frequencies.

Mounted directly above the current trace to be measured, the sensor is linear up to ±10A, with ±20A full range with some nonlinearity. The sensor experiences very little hysteresis (0.8%) and low temperature drift (-0.3 %/°C) when compared with Hall sensors, and it includes offset and reset pins for calibration and resetting due to oversaturation. The sensor accepts up to 5V supply and outputs a differential voltage proportional to the measured magnetic field with offset 2.5V.

Features

- DC – 10 MHz Bandwidth
- Contactless
- Low Hysteresis
- Linear ±10A, Full ±20A
- High Sensitivity
- Low Temperature Drift
- Compact (1.165x0.446x0.415) (in)

Applications

- Wide-Bandgap Enabled Converters
- Power Supplies
- Control and Prognostics
- Automotive
- Datacenters
- Renewables
- Protection Equipment

Contactless current sensor is placed on top of current carrying trace on printed circuit board.

Figure 1 - Placement of contactless sensor above current trace

1. US Provisional Patent, number 62432327, filed Dec. 9,2016.
2. Patent Application: PCT/US17/32415, May 12, 2017.

Specifications

Characteristic	Condition	Typical	Unit
Bandwidth	-3dB	10	MHz
Rise Time	Step response from 0 to 90% for 10A current	100 (Max: 400)	ns
Response Time	Sensor response delay	15	ns
Linear Current Range	Sensor mounted directly above current trace	±10	A
Full Current Range	Sensor mounted directly above current trace	±20	A
V_{dd} – Supply Voltage		5	V
Output Offset Voltage	Output with no current	~2.5	V
Sensitivity (mV/A)	Sensor mounted directly above current trace	85	mV/A
Output Sensitivity (mV/V/mT)	Independent of mounting	10	mV/V/mT
Hysteresis Error	Percent of full scale	0.08	% FS
Operating Temperature		-40-125	°C
Temperature Drift		-0.3	%/°C

Current Sensing Reset

The DS10.2s current sensor may need to be “reset”. The reset is needed when the output signal looks distorted, inverted, etc. This can simply be resolved by applying a short 5V contact to the Set/Reset pin on the sensor. It is recommended to design a circuit to apply 5V periodically to the Set/Reset pin, but as on the Evaluation Board, you can place a Single-Pole Single-Throw (SPST) switch to apply 5V when clicked. For more information, contact Tell-i for information on the Set/Reset function.

Recommended PCB Trace Width

With the current sensor being contactless, the user must design the current trace that corresponds to the sensor’s necessities. The designer must include a 0.140” current trace right below the sensor. The sensor is then needed to be placed directly on the PCB. Any misalignment may cause the sensing of the sensor to be altered. For exact measurements, the Pinout and Package section will contain the orientation and dimensions needed.

Performance

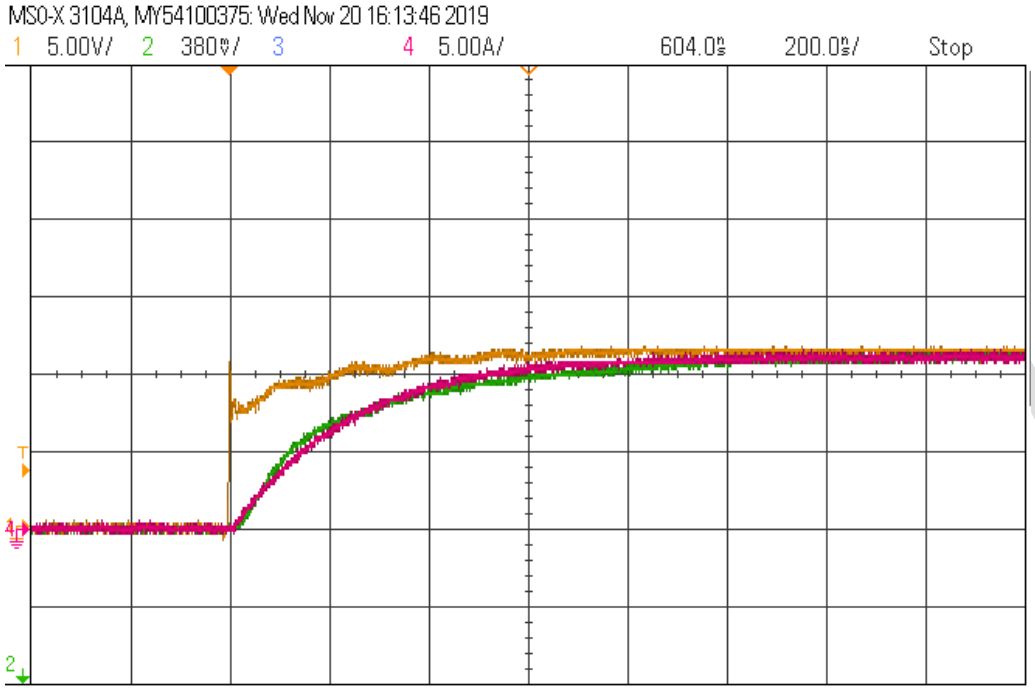

Figure 2 – Sensor response to step change in current (close view) with response and rise times shown. Green trace is the Tell-i sensor response; Red trace is the TEKTRONIX TCP305A current probe with 50 Mhz bandwidth; Orange is the reference current.

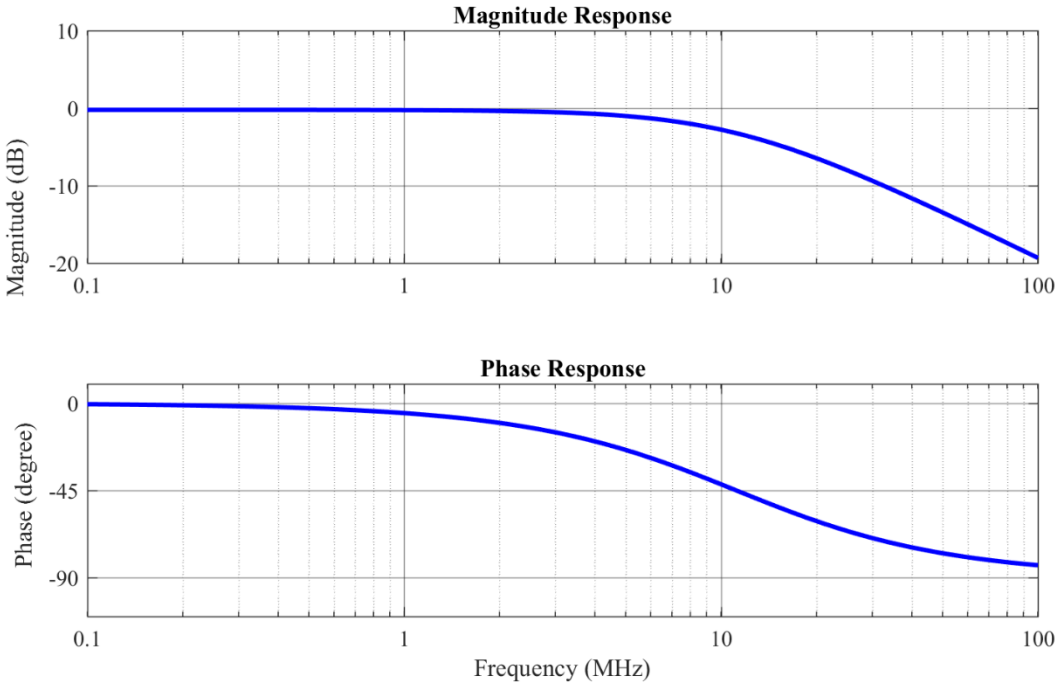

Figure 3. Frequency Response of Sensor (10MHz -3dB bandwidth)

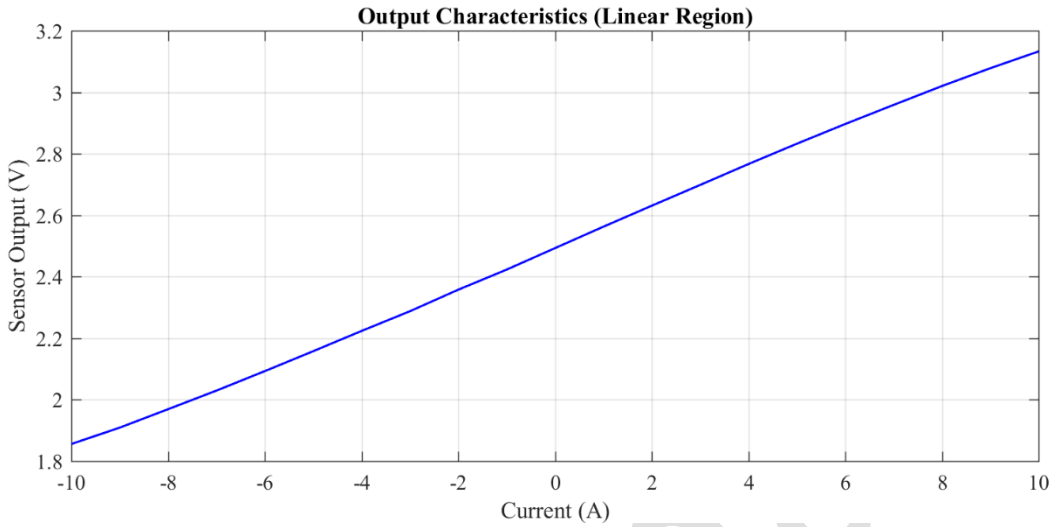

Figure 4 - Steady state (DC) sensor output through linear range of operation

Converter Operation

Tell-i DS10.2s current sensor (green) follows the reference current (blue) closely in 1MHz converter with minimal filtering. Limited bandwidth current sensors (TEKTRONIX TCP305A current probe) experience delay in capturing the current dynamics. The differential probe (yellow) fails to accurately measure current due to its limited bandwidth. Noted, the Tell-i sensor can capture on and off switching containing a small delay; while, the TEKTRONIX Probe filters the signal, hiding the actual current.

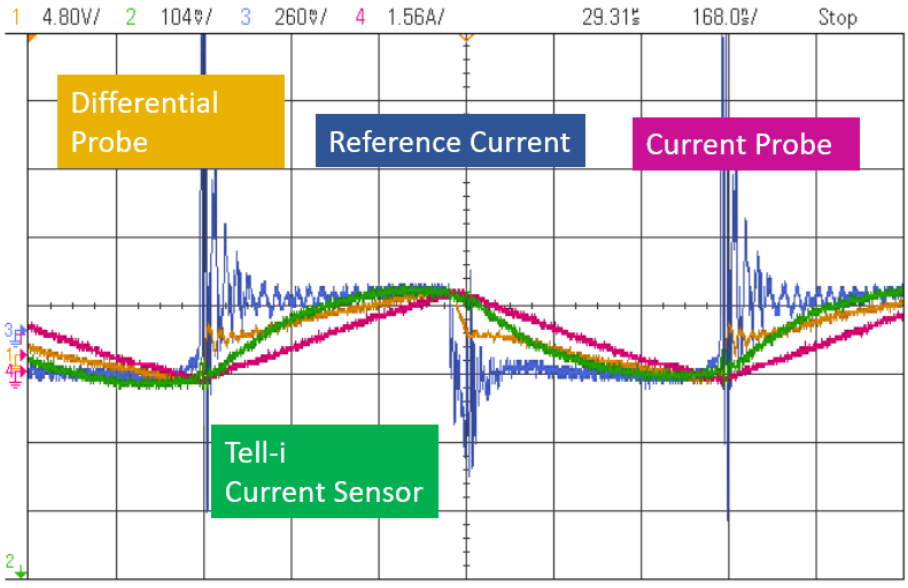

Figure 5 - Sensor operation in 1MHz switching converter with minimal inductor

With enough filtering, the current should be a trangular form shown in Figure 6.

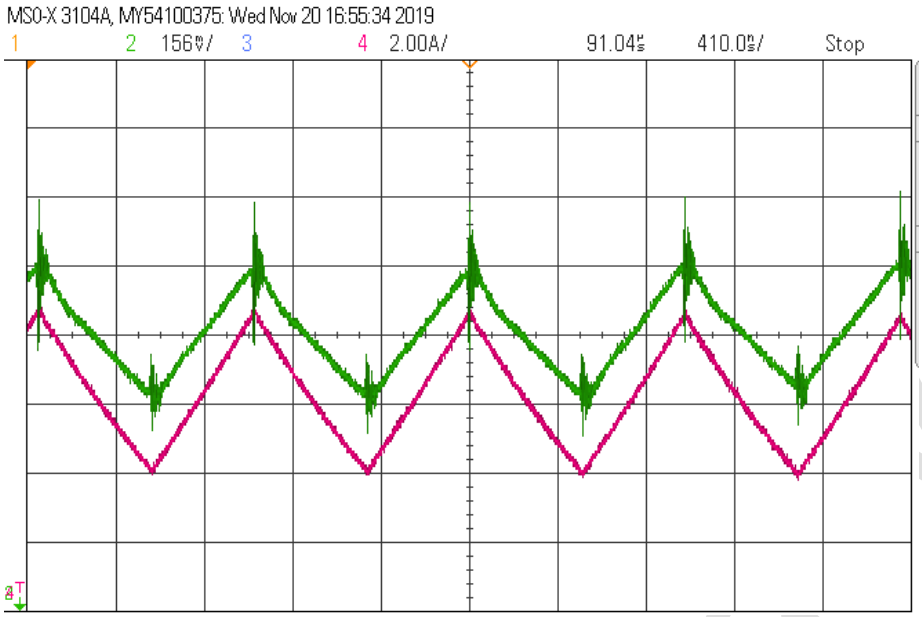

Figure 6. 1 MHz converter response. Green Trace: DS.10.2S with no output filtering. Red trace: TEKTRONIX TCP305A current probe response.

Pinout and Package

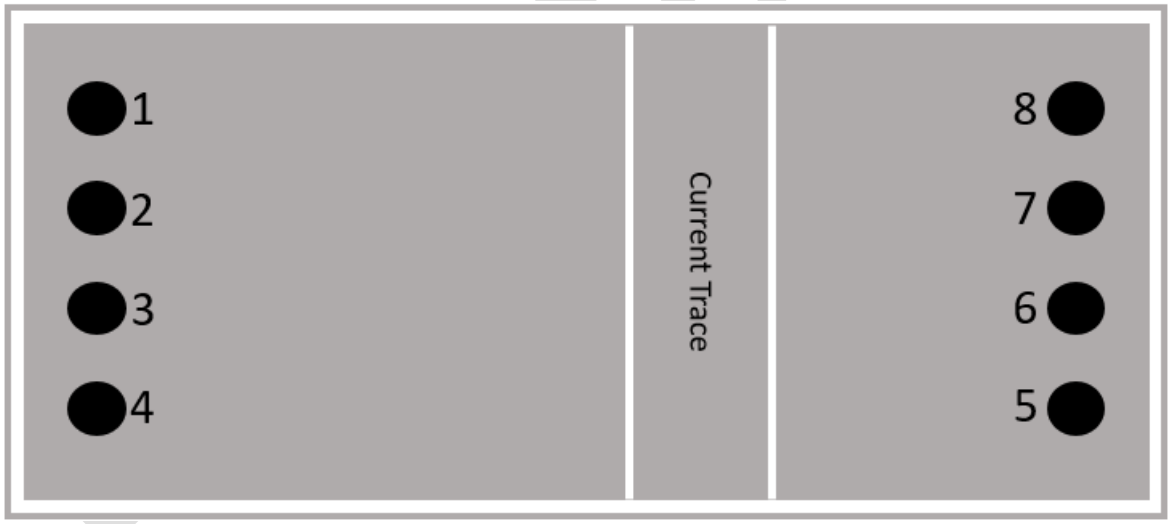

Figure 7 - Pinout Diagram (Bottom View)

Pin		Pin	
1 (circle side)	5V	5	Internal
2	GND	6	Internal
3	Sensor Output	7	Internal
4	Set/Reset	8	Internal

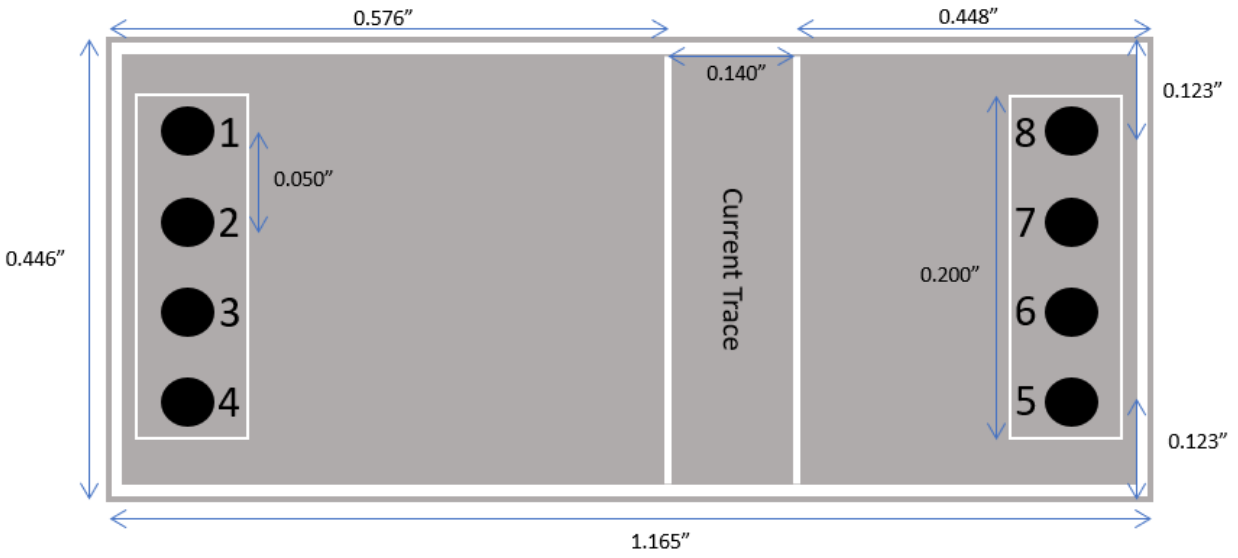

Figure 8 – Sensor Package Dimensions (Bottom View)

Figure 8 -Height Dimensions and Pin Hole Size

