

CL-442 Product Family Specification

PFS-CL442-A2

7/15/2015



INTELLIGENT VEHICLE CONTROLS



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USING THIS DOCUMENT

The specifications contained herein represent all possible configurations for this product family. The actual configurations available on each module may be a subset of this specification. Please refer to the module-specific datasheet for the connector pinout and configurations that are available.

USER LIABILITY

The OEM of a machine or vehicle in which HED® electronic controls are installed is fully responsible for all consequences that might occur. HED®, and any authorized distributor, has no responsibility for any consequences, direct or indirect, caused by failures or malfunctions. Failure or improper selection or improper use of HED® products can cause death, personal injury and property damage.

The OEM must analyze all aspects of their application and review the information concerning product or system in the current product documentation. Due to the variety of operating conditions and applications for these products or systems, the user, through its own analysis and testing, is solely responsible for making the final selection of the products and systems and assuring that all performance, safety and warning requirements of the application are met.

The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by HED® at any time without notice.

INPUT STB or STG (PINS A01-A02, B10-B12)

INPUT STB or STG or VTD (PINS A03-A04, B05-B09)

INPUT STB or STG or VTD or FREQ/PWM/ENCODER (PINS A05-A08)

Switch-to-Battery (STB)

Input Resistance

- 3.21K Ω (typical)

Input Current

- 2.5mA at 8V (typ)
- 11.0mA at 32V (typ)

Positive Going Threshold

- > 6.5V

Negative Going Threshold

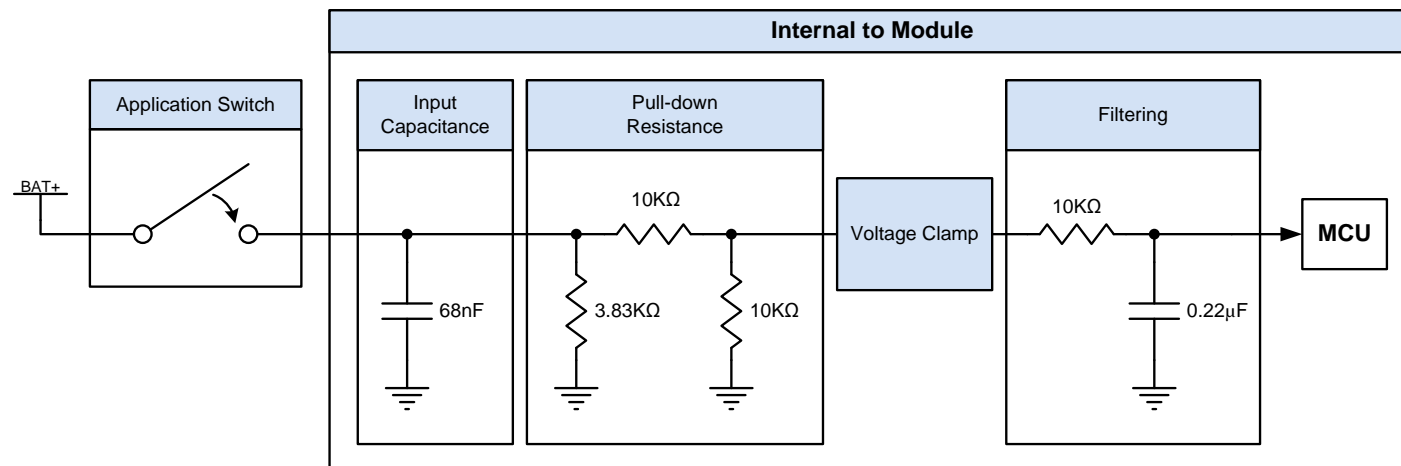
- < 3.5V

Parallel Resistance

- 3K Ω at 8V (minimum)
- 22K Ω at 32V (minimum)

Series Resistance

- 220 Ω (maximum)



Switch-to-Ground (STG)

Pull-up Resistance

- 1.2K Ω (typical)

Input Current

- 3.5mA at 0V (typical)

Positive Going Threshold

- > 3.25V

Negative Going Threshold

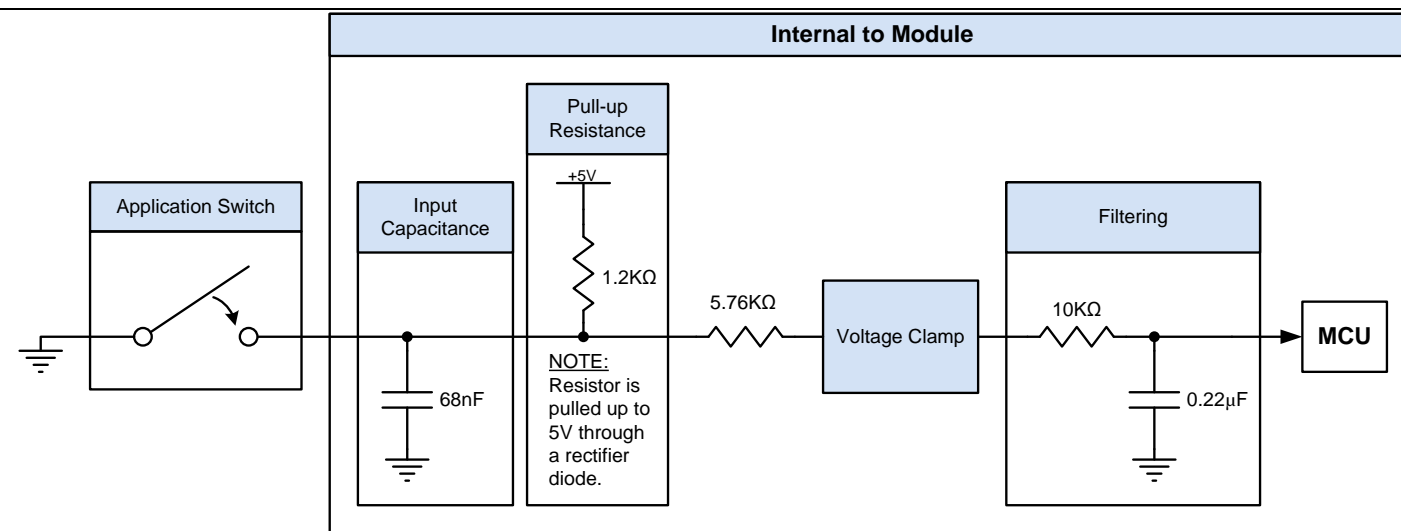
- < 1.75V

Parallel Resistance

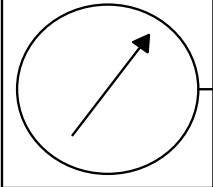
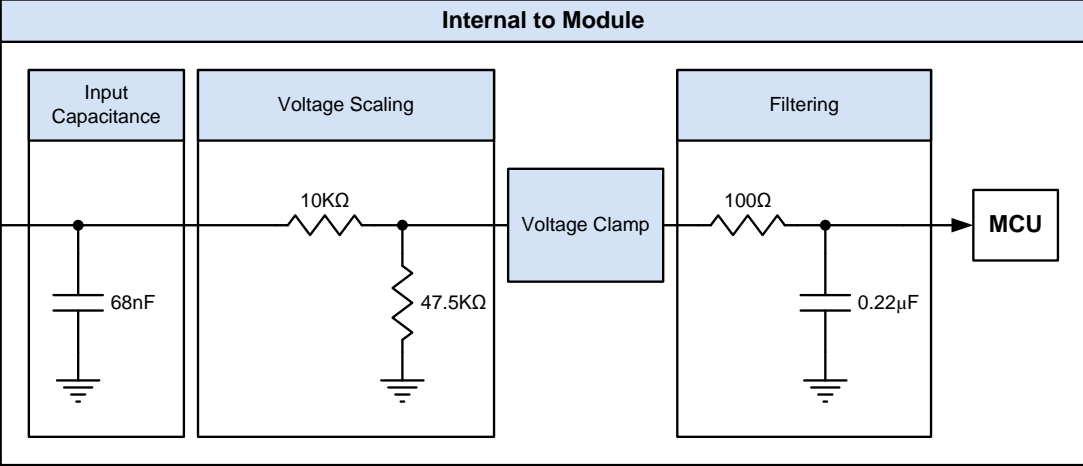
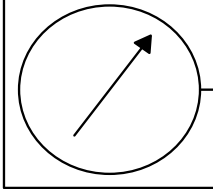
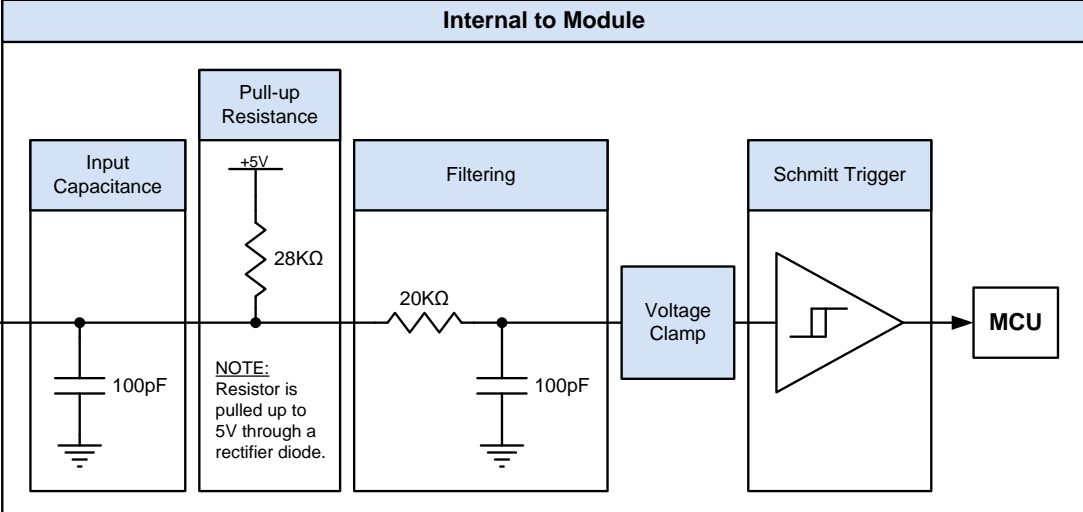
- 3K Ω at 0V (minimum)

Series Resistance

- 220 Ω (maximum)



INPUT STB or STG (PINS A01-A02, B10-B12) INPUT STB or STG or VTD (PINS A03-A04, B05-B09) INPUT STB or STG or VTD or FREQ/PWM/ENCODER (PINS A05-A08)

Voltage-to-Digital (VTD) (0 – 5.64VDC)	<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> Application Sensor  </div> <div style="border: 1px solid black; padding: 5px; flex-grow: 1;"> <p style="text-align: center; background-color: #e6f2ff; margin: -5px -5px 5px -5px;">Internal to Module</p>  </div> </div>
Frequency / PWM / Encoder	<div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin-right: 10px;"> Application Sensor  </div> <div style="border: 1px solid black; padding: 5px; flex-grow: 1;"> <p style="text-align: center; background-color: #e6f2ff; margin: -5px -5px 5px -5px;">Internal to Module</p>  <p style="font-size: small; margin-top: 10px;"> NOTE: Resistor is pulled up to 5V through a rectifier diode. </p> </div> </div>

¹ VTD accuracy is estimated using datasheet maximums and a weighted average of worst-case and root-sum-square (RSS) methods. It is considered as a percentage of the input voltage combined with an additional offset.

² Frequency range maximum assumes square wave, open-drain, sinking sensor at 50% duty cycle. Actual maximum may vary based on application sensor capacitance.

RETURN(-) OUTPUTS (PINS B05, B06)

Current Sense Range

- 0A to 3.43A (minimum)
- 0A to 3.68A (typical)

Resolution

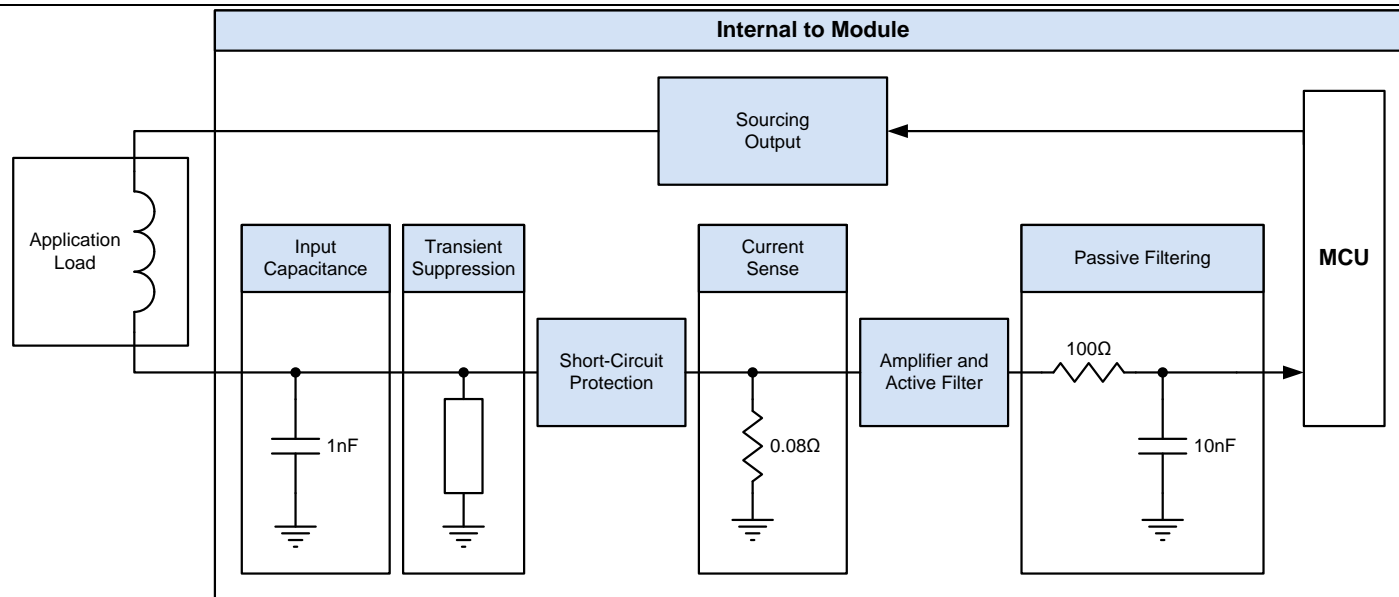
- 10 Bits
- 3.60mA / count (typical)

Hardware Current Limit / Trip Point

- 4.01A (minimum)
- 4.96A (typical)
- 5.44A (maximum)

Accuracy¹

- $\pm 1.0\%$ and $\pm 10\text{mA}$ ($T_A = 25^\circ\text{C}$)
- $\pm 3.0\%$ and $\pm 25\text{mA}$ ($T_A = \text{Full}$)



¹ Return(-) Output accuracy is estimated using datasheet maximums and a weighted average of worst-case and root-sum-square (RSS) methods. It is considered as a percentage of the return current combined with an additional offset. These values assume factory calibration.

5VDC SENSOR SUPPLY (PIN B05, B08) AND SENSOR GROUND (PIN B06, B09)

5VDC Sensor Supply Mode

Voltage Range

- $5V \pm 5\%$

Current Rating

- 500mA

Current Limit

- 600mA (minimum)
- 940mA (typical)

Analog Monitoring Circuit

Resolution

- 10 Bits
- 5.51mV / count (typical)

Accuracy

- See Section Input – VTD Mode (0-5.64V Range)

5VDC Sensor Ground Mode

Current Rating

- 500mA

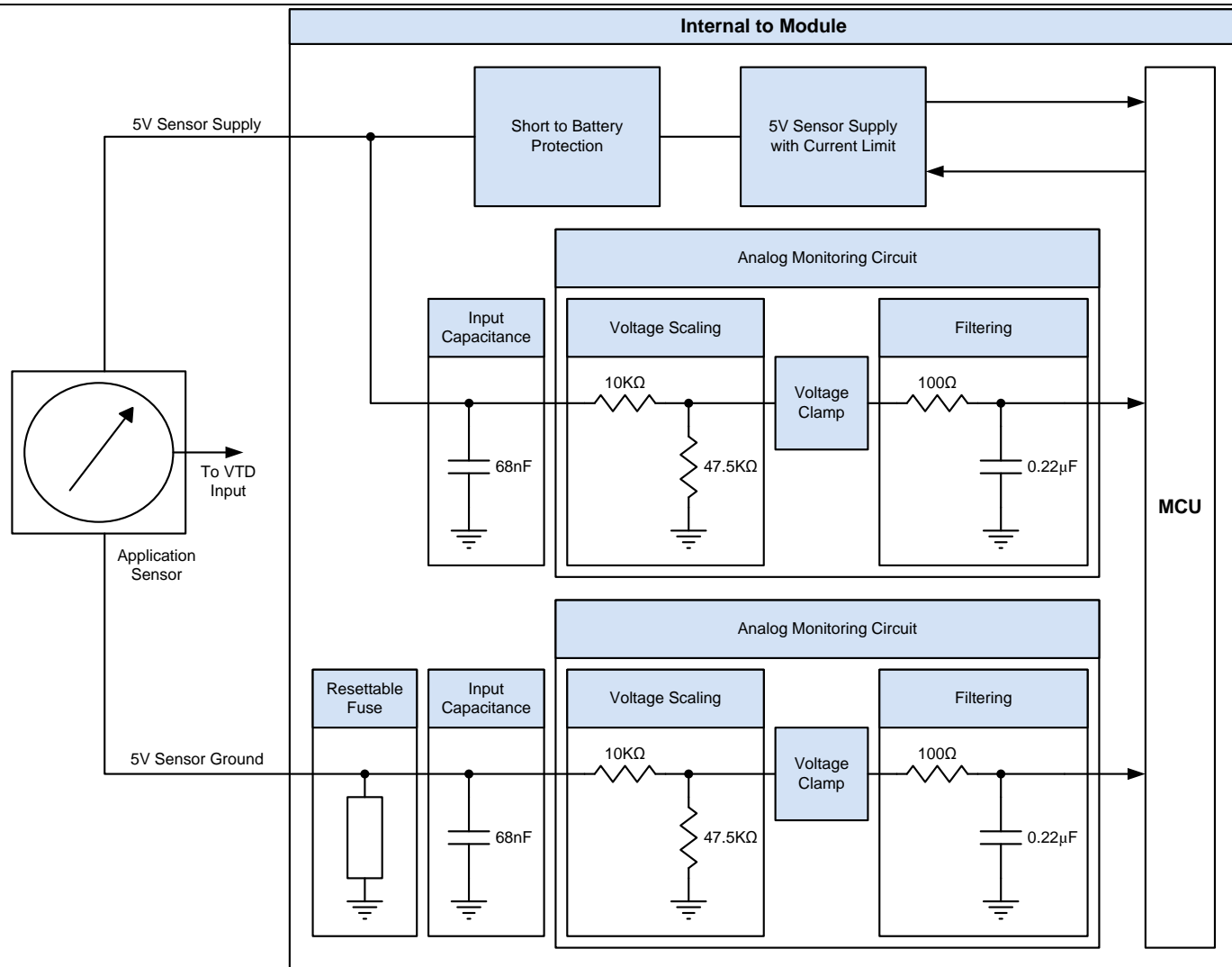
Analog Monitoring Circuit

Resolution

- 10 Bits
- 5.51mV / count (typical)

Accuracy

- See Section Input – VTD Mode (0-5.65V Range)



CAN COMMUNICATION (PINS A01/A02, A9/A10, B05/B06)

Baud Rate

- 40kbps to 500kbps

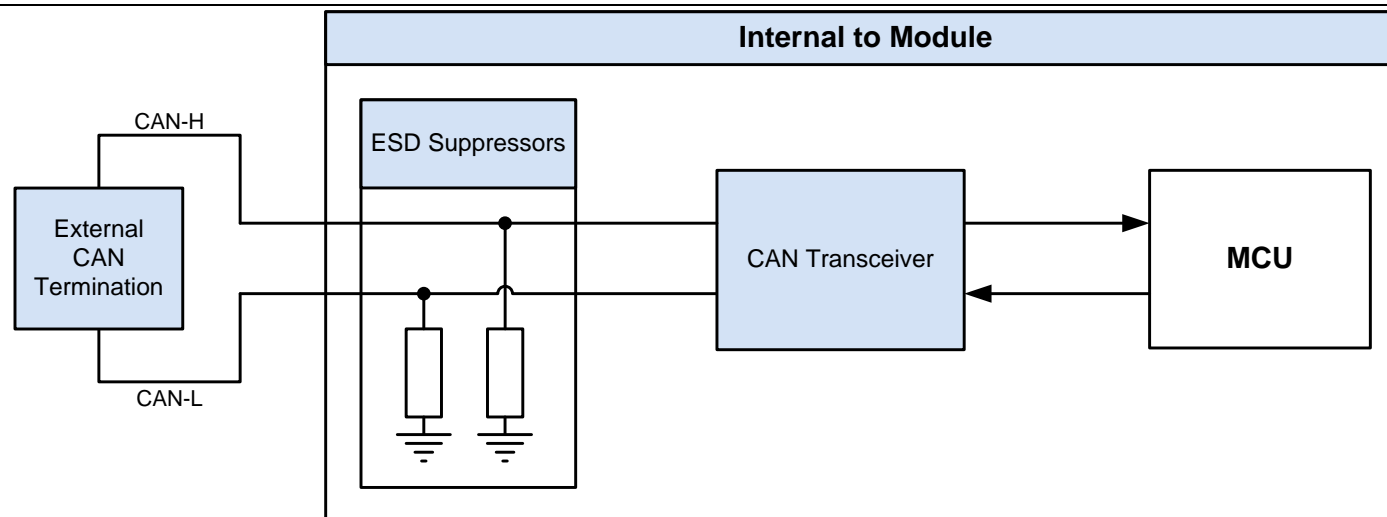
Maximum Allowable Voltage¹

- -27V to +40V

Input Capacitance (maximum)

- 26pF (f = 1MHz)

No Internal Termination



¹ Maximum allowable voltage defines the voltage extremes that the transceiver can tolerate. Exposure to these voltages for extended periods may affect device reliability.

USB-TO-UART SERIAL COMMUNICATION (PINS B10/B11/B12)

USB Standard

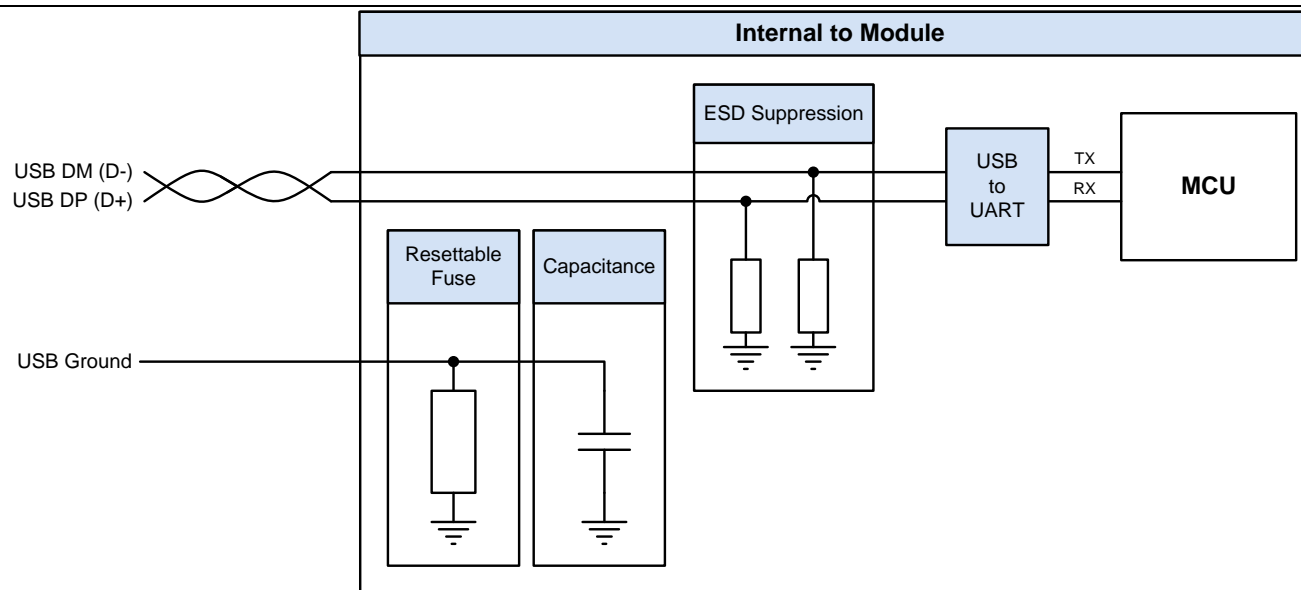
- USB 2.0

Serial Baud Rate

- Up to 115.2 Kbps

ESD Suppression Capacitance (max)

- 33pF



OUTPUT DOUT(+)/PWM(+)/ECC(+) (PINS B01-B04)

Individual Output Current¹

- Digital Mode = 3.0A (maximum)
- PWM Mode = 3.0A (maximum)

Grouped Output Current^{2,3}

- Digital Mode = 2.5A (maximum)
- PWM Mode = 2.0A (maximum)

PWM Frequency⁴

- < 300 Hz (typical)
- < 1 KHz (maximum)

Output Diagnostics

- Short to Battery
- Short to Ground
- Overcurrent
- Open Circuit⁵

Current Sense Range

- Up to 3.6A (minimum)
- Up to 4.5A (typical)

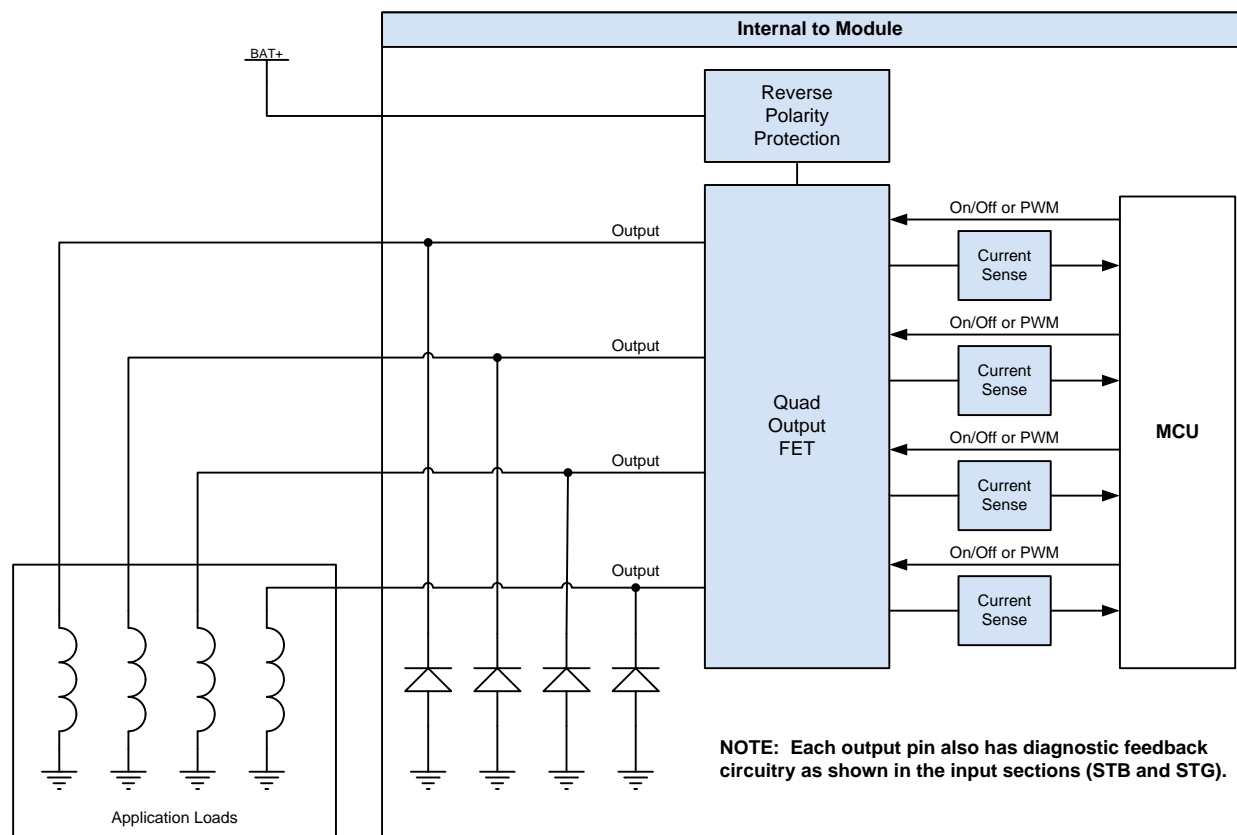
Current Sense Resolution

- 10 bits
- 4.4mA / count (typical)

Current Sense Accuracy (typical)

- $\pm 50\text{mA}$ at 2A, $T_A = 25^\circ\text{C}$

Internal Flyback Diodes



¹ Individual Output Current specifies the maximum current for an individual output channel. Additional restrictions regarding total output current, number of active channels, etc. will apply and are specified in the Grouped Output Current parameter. PWM outputs assume 250Hz frequency.

² Output current maximums assume all four channels are active simultaneously and the module is at maximum ambient temperature. PWM outputs assume 250Hz frequency. Output current may be increased per channel (up to the individual output current maximum) if not all channels are active simultaneously or other channels are at a reduced load current. Please contact HED® for further information.

³ Maximum total output current for Pins B01-B04 is 10 Amps.

⁴ The output driver is best suited for PWM frequencies of 300 Hz or less. PWM frequencies of up to 1 KHz are possible, but at reduced output current and duty cycle range.

⁵ Open circuit can be detected when the output is active using current sense feedback for load currents of at least 250mA and duty cycle of 100%. Open circuit can be detected when the output is inactive using the pull-up resistor for loads that are not influenced by the associated pull-up current (see Input STG circuit diagram and parameters).

BATTERY (+) MODULE (PIN A12), UNSWITCHED BATTERY (+) (PIN A03, B07), AND BATTERY (+) OUTPUTS (PIN B07)¹

Battery (+)

Operating Voltage Range

- 8VDC – 32VDC

Maximum Continuous Voltage²

- 36VDC

Module Current Draw³

- 73mA at 8.0V (typ)
- 45mA at 13.8V (typ)
- 26mA at 28.0V (typ)
- 24mA at 32.0V (typ)

Maximum Total Output Current

- See Output Section for output current constraints

Analog Monitoring Circuit

Input Voltage Range

- 0V to 31.94V (minimum)
- 0V to 32.79V (typical)

Input Resistance

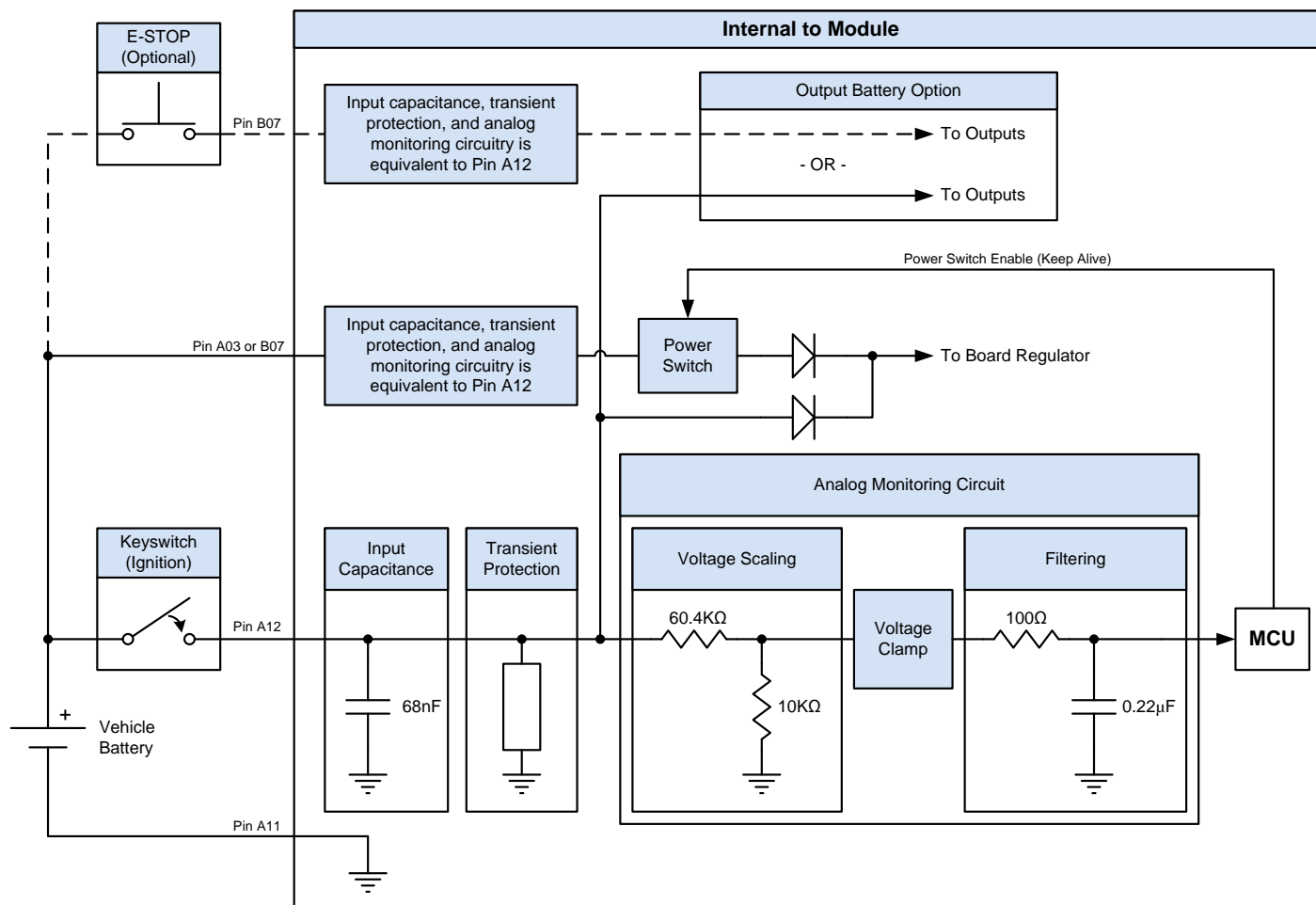
- 70.4K Ω (typical)

Resolution

- 10 Bits
- 32.02mV / count (typical)

Accuracy⁴

- $\pm 2.5\%$ and $\pm 66\text{mV}$ ($T_A = 25^\circ\text{C}$)
- $\pm 4.0\%$ and $\pm 428\text{mV}$ ($T_A = \text{Full}$)



¹ The block diagram shown represents one possible implementation in the system. Other implementations may be used based on system requirements.

² Exposure to maximum voltages for extended periods may affect device reliability.

³ Module current draw is measured with I/O inactive, no CAN communication, and 5V sensor supply disabled.

⁴ VTD accuracy is estimated using datasheet maximums and a weighted average of worst-case and root-sum-square (RSS) methods. It is considered as a percentage of the input voltage combined with an additional offset.

ADDITIONAL NOTES

IMPORTANT: Module configurations that contain sourcing outputs with internal flyback diodes may continue to operate in the event of a loss of module ground. This event can result in a ground shift to the internal board reference (ground). The ground shift is a result of a remaining current path from internal board reference (ground), through internal flyback diode(s), and terminating through an external load to ground (assuming the load is of relatively low resistance). Depending on system configuration and load resistances, analog input accuracy can be affected, especially if the analog sensor is not referenced to the module sensor ground. Be sure to include this condition when conducting a system-level FMEA.

REVISION HISTORY

Revision	Date	EC #	Changes
A1	12/19/14	314-542	Initial Release.
A2	7/15/15	315-246	Added switching thresholds to STB and STG inputs. Added note regarding loss of ground event.