

CL-709 Product Family Specification

PFS-CL709-A1

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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.

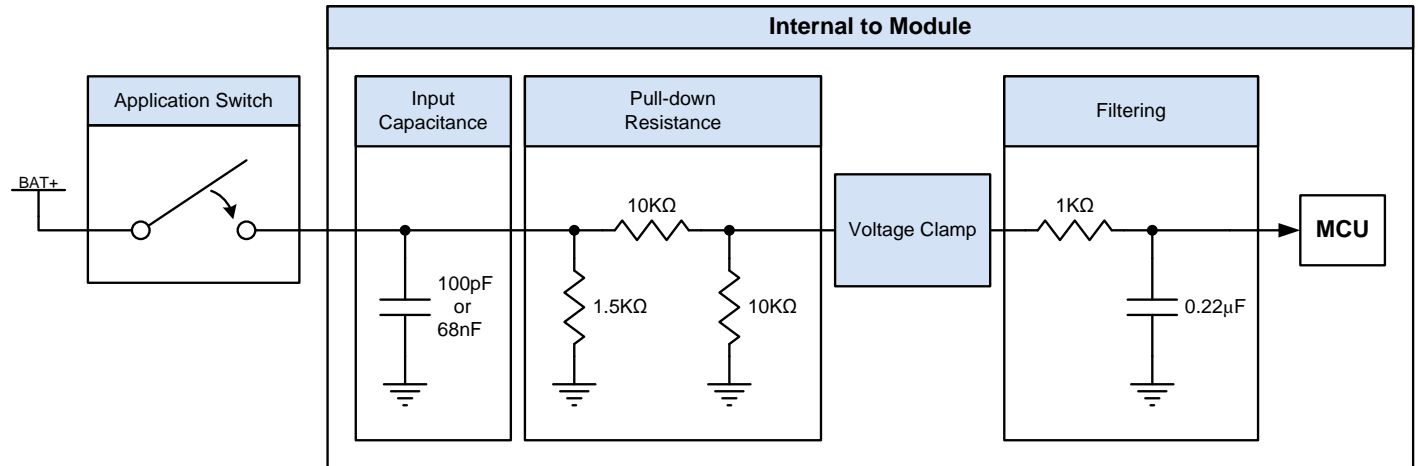
The products described herein, including without limitation, product features, specifications, designs, availability and pricing, are subject to change by HED® at any time without notice.

INPUT STG (DEUTSCH PIN 10)¹
INPUT STB/STG (DEUTSCH PIN 12)¹

INPUT STB/STG/VTD/FREQ/PWM/ENCODER/RTD (DEUTSCH PINS 15 - 18)¹

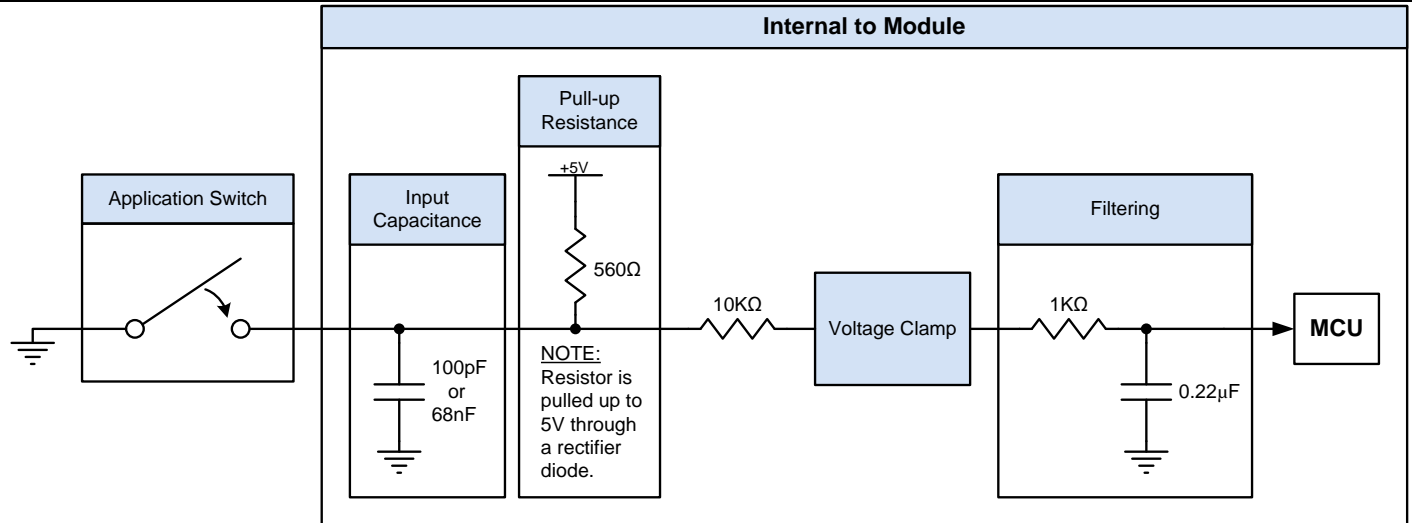
Switch-to-Battery (STB) Mode

- Input Resistance
- 1.4K Ω (typical)
- Input Current
- 5.7mA at 8V (typical)
 - 24.0mA at 32V (typical)
- Positive Going Threshold
- > 6.5V
- Negative Going Threshold
- < 3.5V
- Parallel Resistance
- 2K Ω at 8V (minimum)
 - 12K Ω at 32V (minimum)
- Series Resistance
- 220 Ω (maximum)



Switch-to-Ground (STG) Mode

- Pull-up Resistance
- 560 Ω (typical)
- Input Current
- 7.6mA at 0V (typical)
- Positive Going Threshold
- > 3.25V
- Negative Going Threshold
- < 1.75V
- Parallel Resistance
- 2K Ω at 0V (minimum)
- Series Resistance
- 220 Ω (maximum)



¹ Pins 15, 16, 17, and 18 have input capacitance of 100pF. Pins 10 and 12 have input capacitance of 68nF.

INPUT STG (DEUTSCH PIN 10)¹
INPUT STB/STG (DEUTSCH PIN 12)¹

INPUT STB/STG/VTD/FREQ/PWM/ENCODER/RTD (DEUTSCH PINS 15 - 18)¹

Voltage-to-Digital (VTD) Mode
(0 – 5.65VDC)

Input Voltage Range

- 0V to 5.51V (minimum)
- 0V to 5.65V (typical)

Input Resistance

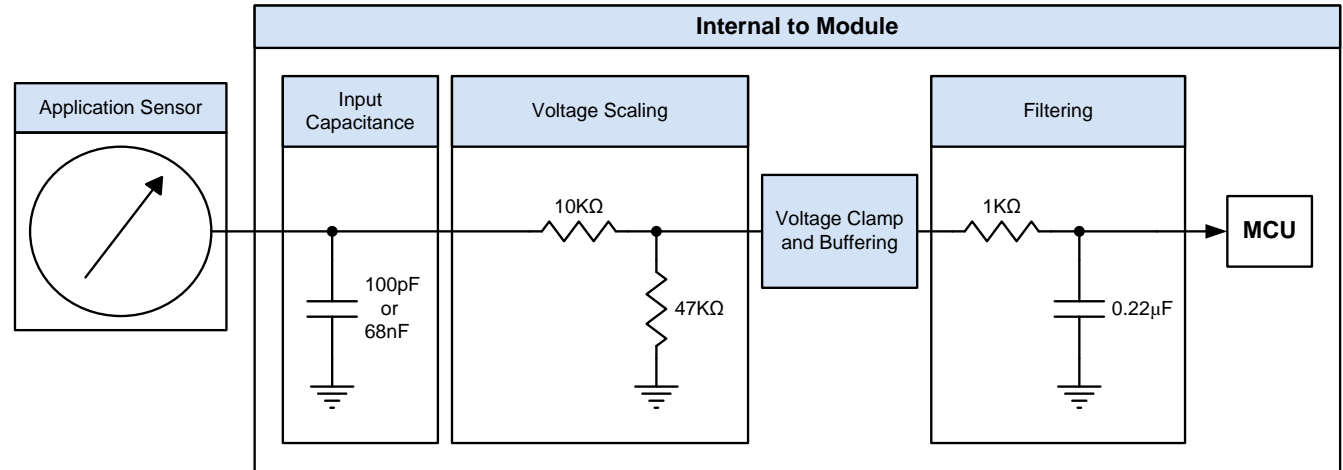
- 57K Ω (typical)

Resolution

- 10 Bits
- 5.52mV / count (typical)

Accuracy²

- $\pm 1.0\%$ and $\pm 18\text{mV}$ ($T_A = 25^\circ\text{C}$)
- $\pm 2.5\%$ and $\pm 25\text{mV}$ ($T_A = \text{Full}$)



Frequency / PWM / Encoder Mode

Pull-up Resistance

- 4.7K Ω (typical)

Positive Going Threshold

- $> 2.6\text{V}$

Negative Going Threshold

- $< 0.5\text{V}$

Frequency Range

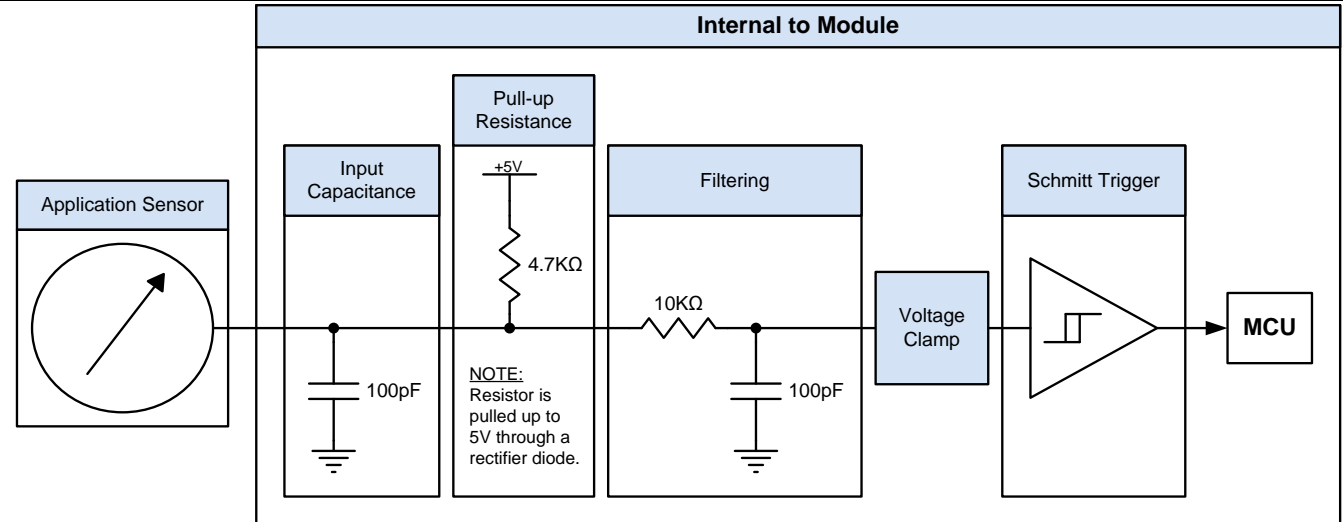
- 10KHz (maximum)³

Resolution

- $< 5\text{ Hz}$

Accuracy

- $\pm 2.0\%$ ($T_A = \text{Full}$)



¹ Pins 15, 16, 17, and 18 have input capacitance of 100pF. Pins 10 and 12 have input capacitance of 68nF.

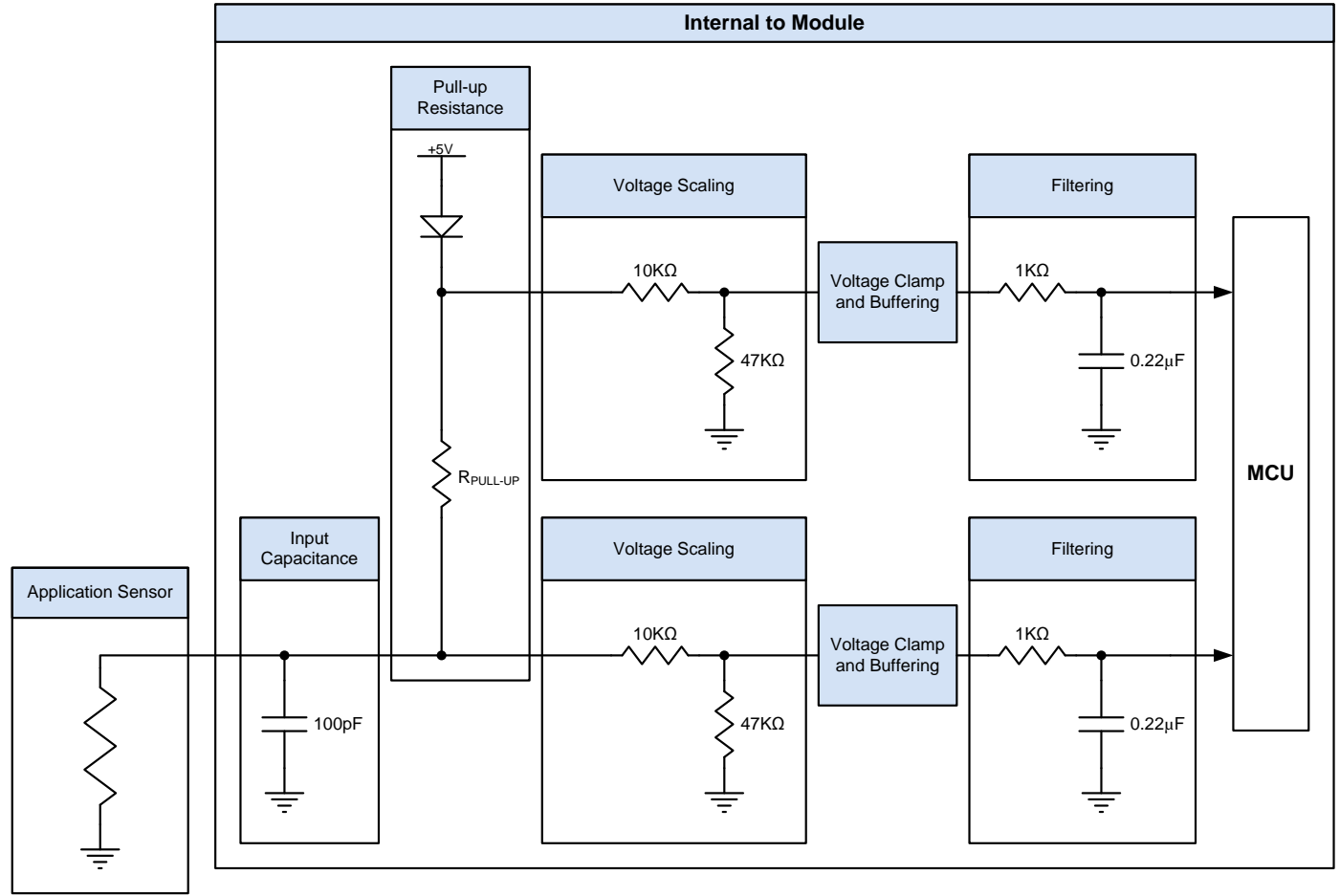
² VTD accuracy is estimated using datasheet maximums and a weighted average of worst-case and root-sum-square (RSS) methods. It is considered as a percentage of the input voltage combined with an additional offset.

³ Frequency range maximum assumes square wave, open-drain, sinking sensor at 50% duty cycle.

INPUT STG (DEUTSCH PIN 10)¹
INPUT STB/STG (DEUTSCH PIN 12)¹

INPUT STB/STG/VTD/FREQ/PWM/ENCODER/RTD (DEUTSCH PINS 15 – 18)¹

Resistance-to-Digital (RTD) Mode (0 – 500Ω)
Pull-up Resistance ($R_{PULL-UP}$) <ul style="list-style-type: none"> • 499Ω (typical) Accuracy ² <ul style="list-style-type: none"> • ±1.0% and ±5.0Ω ($T_A = 25^\circ\text{C}$) • ±2.5% and ±7.0Ω ($T_A = \text{Full}$)
Resistance-to-Digital (RTD) Mode (0 – 2KΩ)
Pull-up Resistance ($R_{PULL-UP}$) <ul style="list-style-type: none"> • 2KΩ (typical) Accuracy ² <ul style="list-style-type: none"> • ±1.0% and ±21.0Ω ($T_A = 25^\circ\text{C}$) • ±2.5% and ±27.5Ω ($T_A = \text{Full}$)



¹ Pins 15, 16, 17, and 18 have input capacitance of 100pF. Pins 10 and 12 have input capacitance of 68nF.

² RTD 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 application sensor resistance combined with an additional offset. Offset is estimated at an application sensor resistance of $\frac{1}{2}(R_{PULL-UP})$.

INPUT STB WAKE-UP (DEUTSCH PIN 11)

Switch-to-Battery (STB) Mode

See input section for Deutsch pin 11 (STB mode)

Wake-Up Mode

Wake-Up Source

- Uses STB for active-high wake

Wake-Up / Shutdown

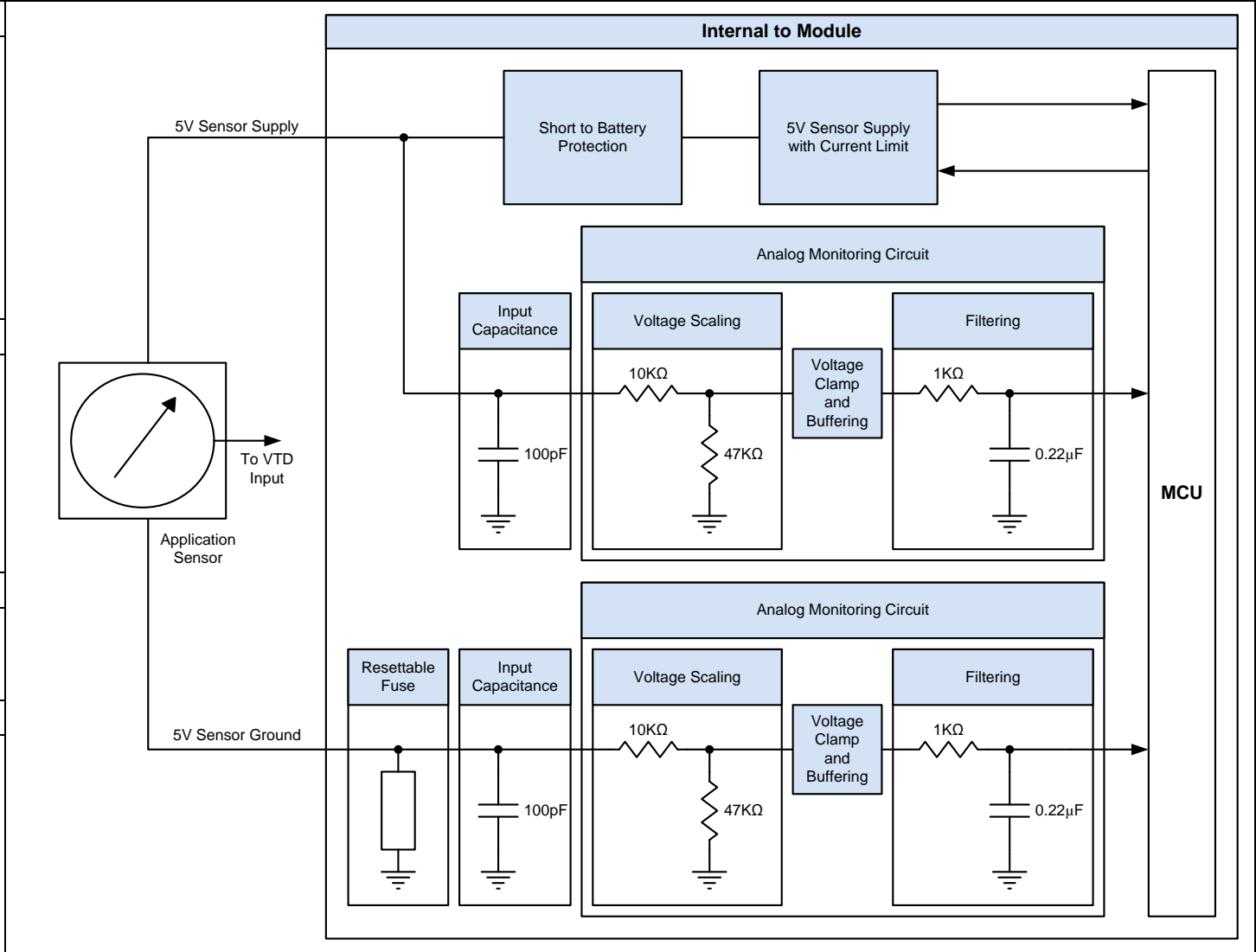
- Input transition from inactive to active will wake module from low power / sleep mode
- Input transition from active to inactive will begin controlled shutdown sequence and place module in low power / sleep mode

See input section (STB mode) for Deutsch pin 11

Input capacitance is 68nF

5VDC SENSOR SUPPLY (DEUTSCH PIN 10) AND SENSOR GROUND (DEUTSCH PIN 9)

5VDC Sensor Supply Mode
Voltage Range <ul style="list-style-type: none"> • 5V ± 5% Current Rating <ul style="list-style-type: none"> • 250mA Current Limit <ul style="list-style-type: none"> • 255mA (minimum) • 292mA (typical) • 355mA (maximum)
Analog Monitoring Circuit
Resolution <ul style="list-style-type: none"> • 10 Bits • 5.52mV / count (typical) Accuracy <ul style="list-style-type: none"> • See Section Input – VTD Mode (0-5.65V Range)
5VDC Sensor Ground Mode
Current Rating <ul style="list-style-type: none"> • 250mA
Analog Monitoring Circuit
Resolution <ul style="list-style-type: none"> • 10 Bits • 5.52mV / count (typical) Accuracy <ul style="list-style-type: none"> • See Section Input – VTD Mode (0-5.65V Range)



CAN COMMUNICATION (DEUTSCH PINS 7/8, 13/14)

Baud Rate

- 40kbps to 500kbps

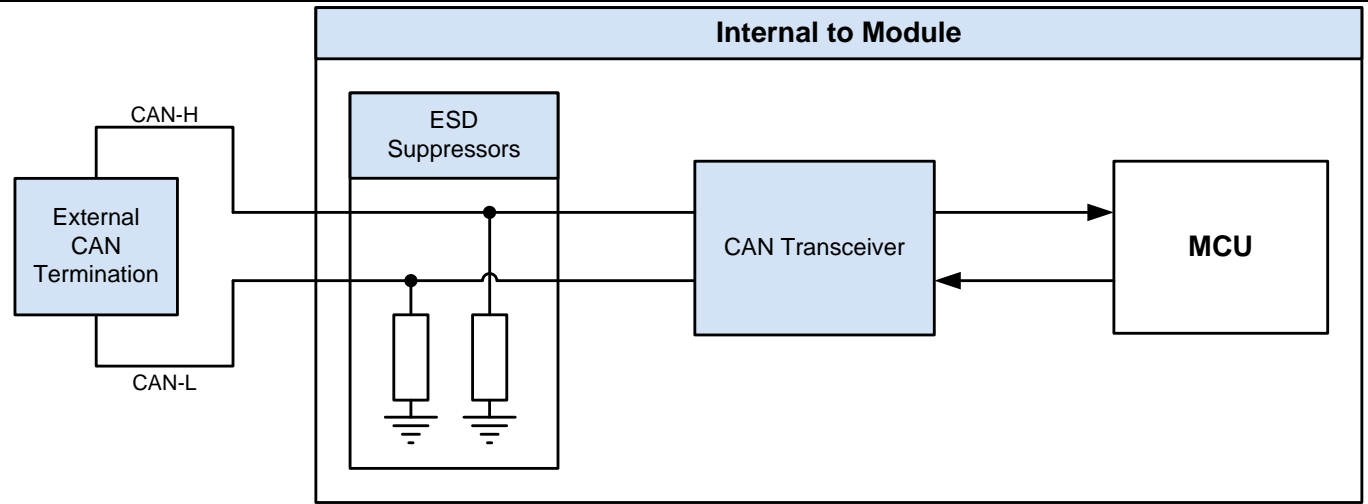
Maximum Allowable Voltage¹

- -27V to +40V

Input Capacitance (max)

- 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 HOST / CLIENT (CONNECTOR M8 PINS 1 - 4)¹

USB Standard

- USB 2.0

V_{BUS} Output Voltage Range

- 5V ± 5%

V_{BUS} Input Capacitance (typical)

- 137.7μF (Host)
- 5.7μF (Client)

V_{BUS} Output Current Rating

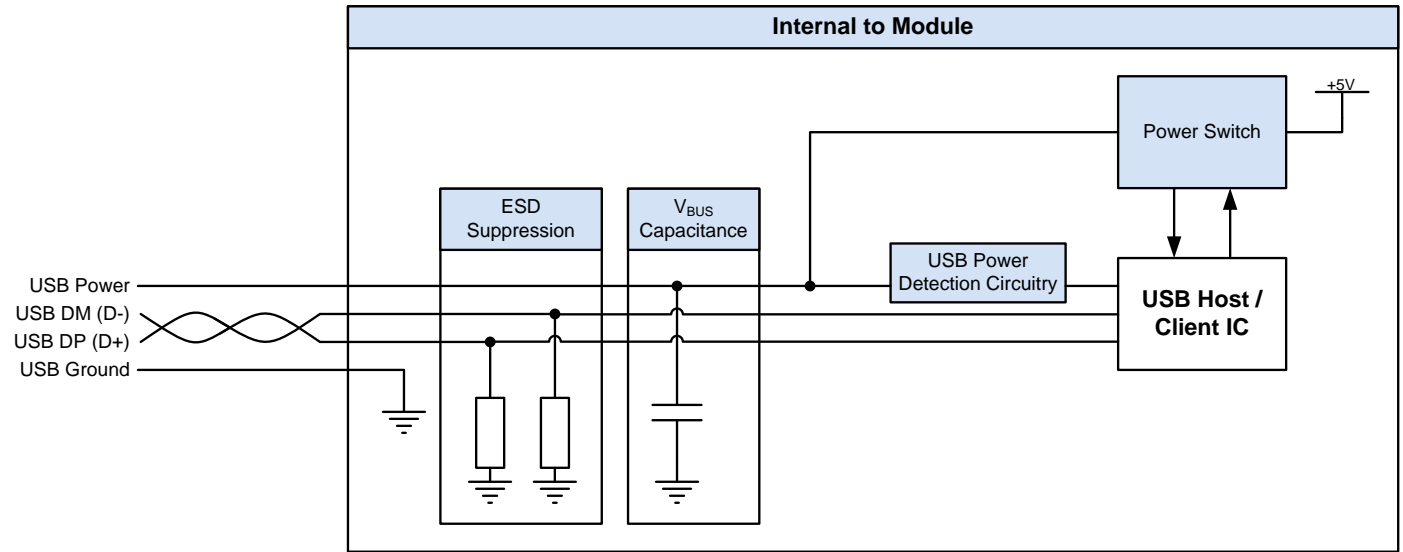
- Approx. 100mA

V_{BUS} Output Current Limit

- 98mA (minimum)
- 117mA (typical)
- 139mA (maximum)

ESD Suppression Capacitance (typ)

- 12.0pF



¹ USB power and signal pins are not protected against shorts to vehicle battery or other signals above USB V_{BUS} voltage levels. Care must be taken to ensure wiring errors and shorts to higher voltage levels do not occur in the application.

INPUT STB/STG (DEUTSCH PINS 1 - 4)

Switch-to-Battery (STB) Mode

Input Resistance

- 1.4K Ω (typical)

Input Current

- 5.7mA at 8V (typical)
- 24.5mA at 32V (typical)

Positive Going Threshold

- > 6.5V

Negative Going Threshold

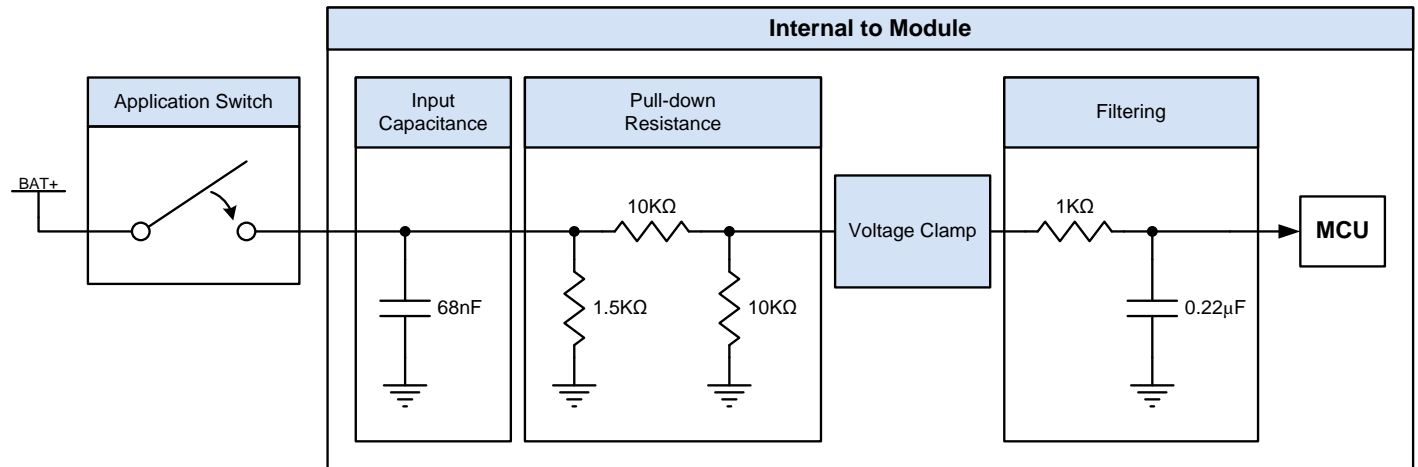
- < 3.5V

Parallel Resistance

- 2K Ω at 8V (minimum)
- 12K Ω at 32V (minimum)

Series Resistance

- 220 Ω (maximum)



Switch-to-Ground (STG) Mode

Pull-up Resistance

- 560 Ω (typical)

Input Current

- 7.6mA at 0V (typical)

Positive Going Threshold

- > 3.25V

Negative Going Threshold

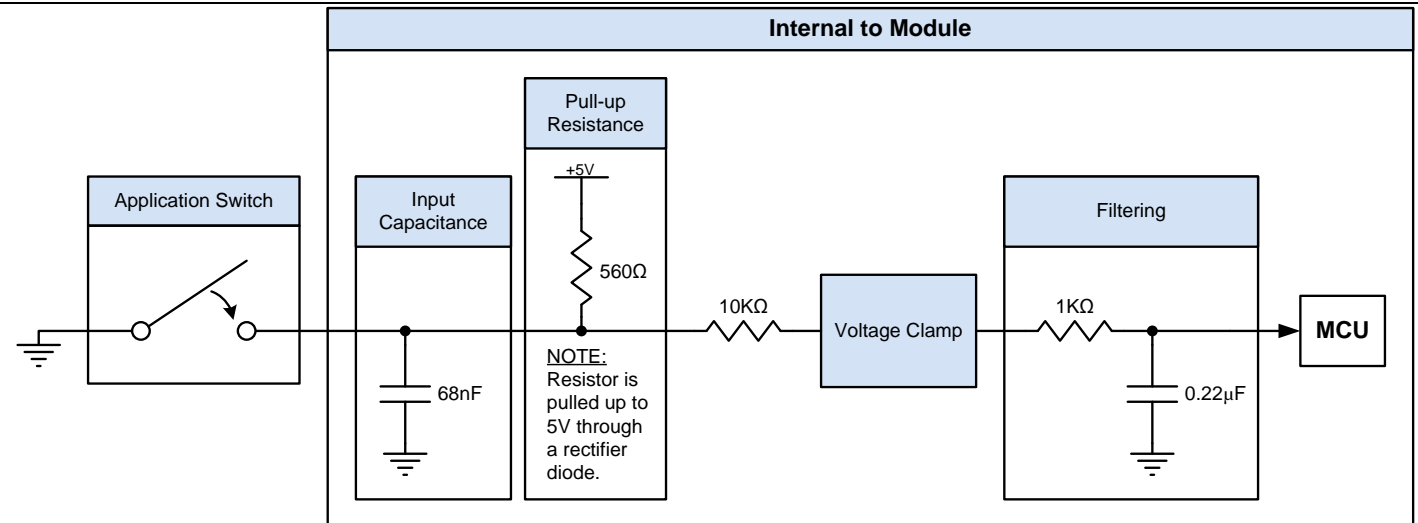
- < 1.75V

Parallel Resistance

- 2K Ω at 0V (minimum)

Series Resistance

- 220 Ω (maximum)



IMPORTANT NOTE: On modules where Input STB/STG and Output modes are software configurable and Input STB mode is chosen, the input voltage must remain at or below the main battery voltage on Pin 6 of the module. Otherwise, the input voltage can back feed through the output FET and may source current to the outputs from the STB input instead of Pin 6, potentially causing damage to the application switch and/or module.

OUTPUT DOUT(+)/PWM(+)/ECC(+) (DEUTSCH PINS 1 - 4)

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 4.1A (minimum)
- Up to 5.0A (typical)

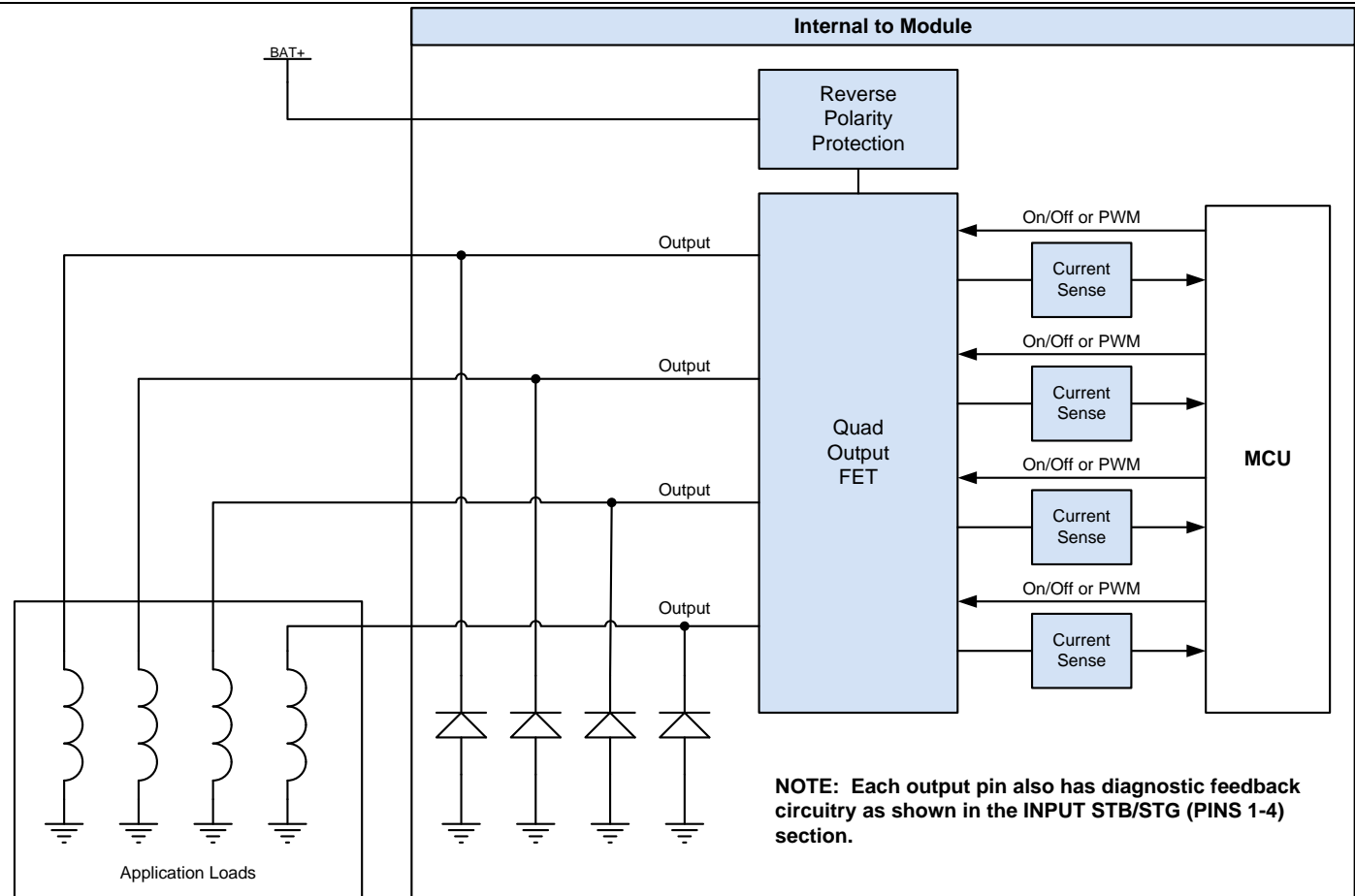
Current Sense Resolution

- 10 bits
- 4.9mA / count (typical)

Current Sense Accuracy (typical)

- < 50mA at 2A, T_A = 25°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 1-4 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 mode circuit diagram and parameters).

BATTERY (+) MODULE AND OUTPUTS (DEUTSCH PIN 6)

Battery (+)

Operating Voltage Range

- 8VDC – 32VDC

Maximum Continuous Voltage¹

- 36VDC

Module Current Draw – Running²

- 251mA at 8.0V (typical)
- 155mA at 13.8V (typical)
- 99mA at 28.0V (typical)
- 73mA at 32.0V (typical)

Module Current Draw – Low Power³

- 440 μ A at 8.0V (typical)
- 343 μ A at 13.8V (typical)
- 378 μ A at 28.0V (typical)
- 437 μ A at 32.0V (typical)

Maximum Total Output Current

- See Output Section

Analog Monitoring Circuit

Input Voltage Range

- 0V to 34.98V (minimum)
- 0V to 36.33V (typical)

Input Resistance

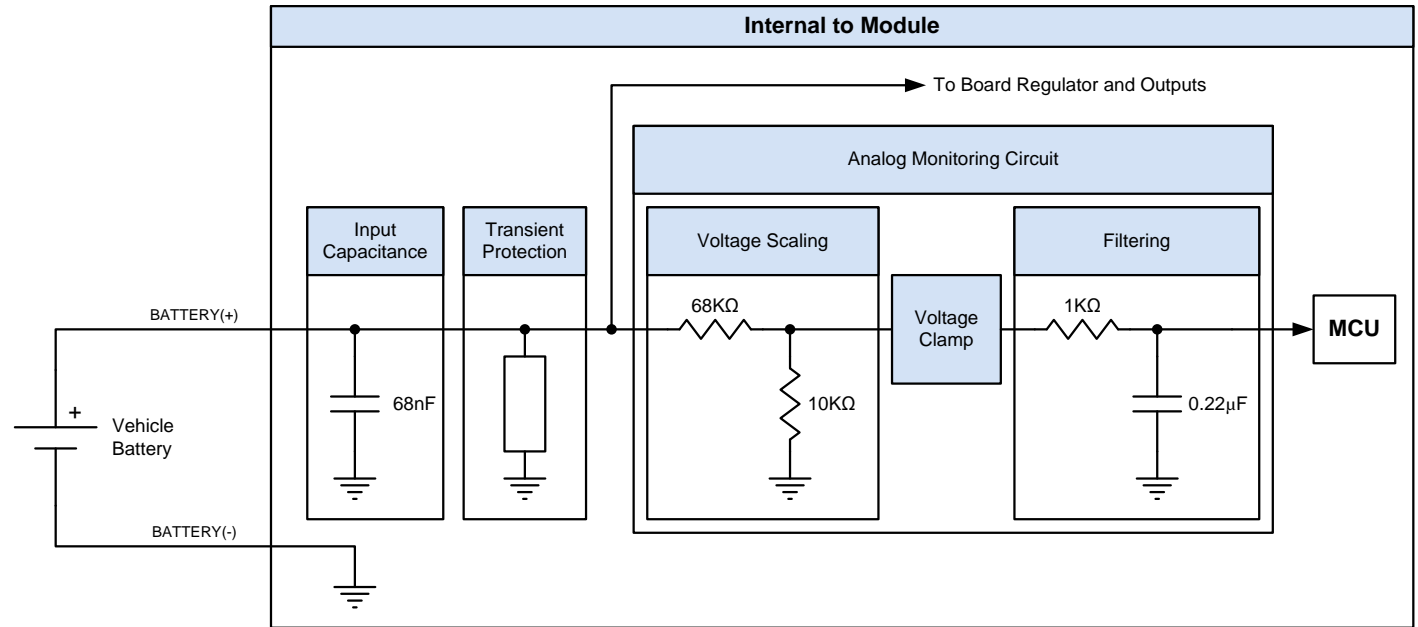
- 78K Ω (typical)

Resolution

- 10 Bits
- 35.48mV / count (typical)

Accuracy⁴

- $\pm 1.5\%$ and $\pm 73\text{mV}$ ($T_A = 25^\circ\text{C}$)
- $\pm 3.5\%$ and $\pm 482\text{mV}$ ($T_A = \text{Full}$)



¹ Exposure to maximum voltages for extended periods may affect device reliability.

² Module current draw is measured with I/O inactive, no CAN communication, 5V sensor supply disabled, wake-up active, LCD backlight 100%, and test application drawing.

³ Module current draw is measured with input inactive and wake-up inactive.

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.

Please refer to the module-specific technical datasheet for information regarding internal peripherals such as flash memory, RAM memory, real-time clock, LCD, and touchscreen.

REVISION HISTORY

Revision	Date	EC #	Changes
A1	2/8/16	316-003	Initial Release