CL-T27 Product Family Specification

PFS-CLT27-A0

10/20/2023

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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 (PIN 3, 26)

Switch-to-Battery (STB) Mode

Input Voltage
- 5V to 36V

Input Resistance
- 20.0KΩ (typical)

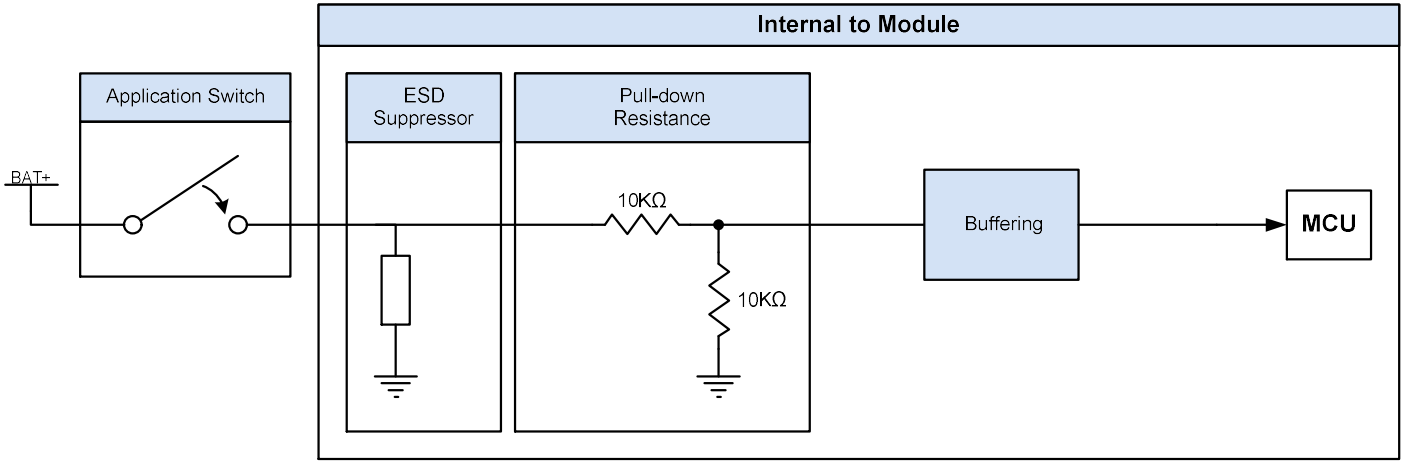
Input Current[1]
- 0.4mA at 8V (typical)
- 1.6mA at 32V (typical)

Positive Going Threshold
- > 3.0V

Negative Going Threshold
- < 1.6V

Parallel Resistance
- 70.0KΩ at 8V (minimum)
- 370.0KΩ at 32V (minimum)

Series Resistance
- 220Ω (maximum)



[1] Verify that the input current is sufficient for the switching device. Some contacts require a minimum “contact clearing” or “wetting” current.

INPUT VTD (PIN 2, 19)

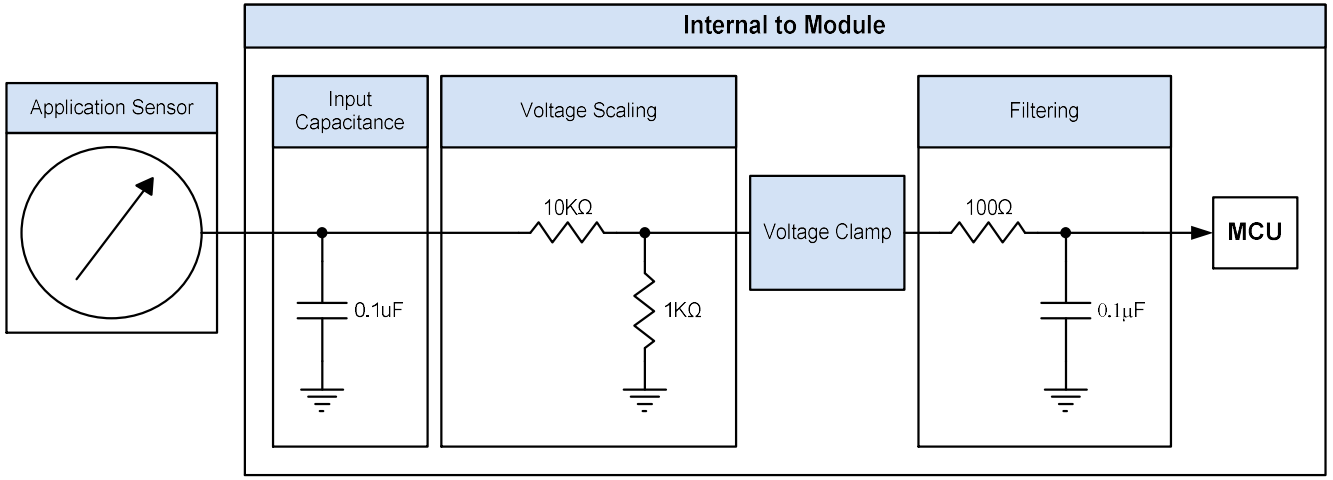
Voltage-to-Digital (VTD) Mode (0 – 36VDC)

Input Voltage Range
- 0V to 36V

Input Resistance
- 11KΩ (typical)

Resolution
- 12 Bits
- 8.79mV / count (typical)

Accuracy
- ±1.0% and ±200mV (T_A = 25°C)
- ±1.6% and ±200mV (T_A = full)



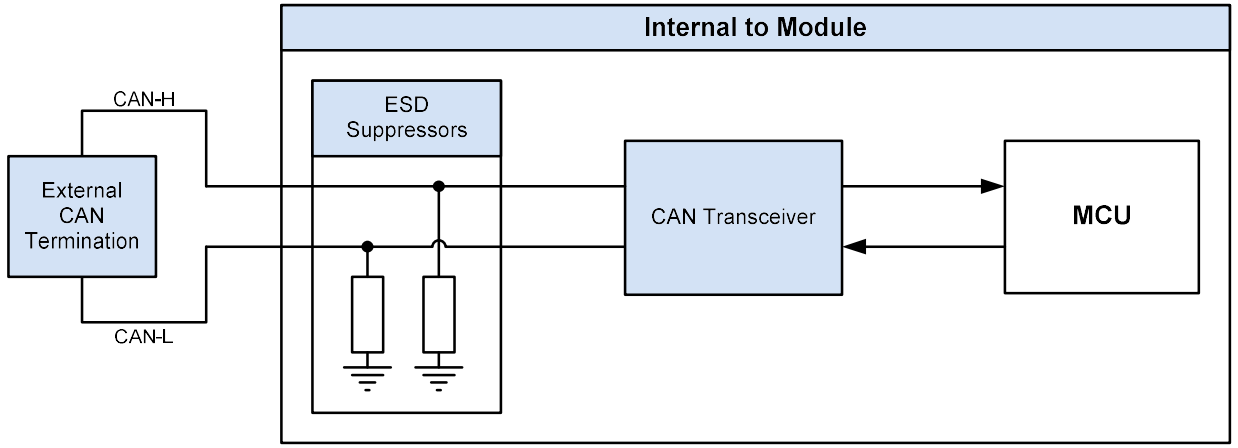
CAN COMMUNICATION (PINS 4/5, [FD=6/7], 17/18)

Baud Rate
- CAN Up to 1Mbps
- CAN FD Up to 5Mbps

Maximum Allowable Voltage[1]
- CAN -42V to +42V
- CAN FD -58 to +58V

Input Capacitance (max)
- CAN 56pF
- CAN FD 56pF

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.

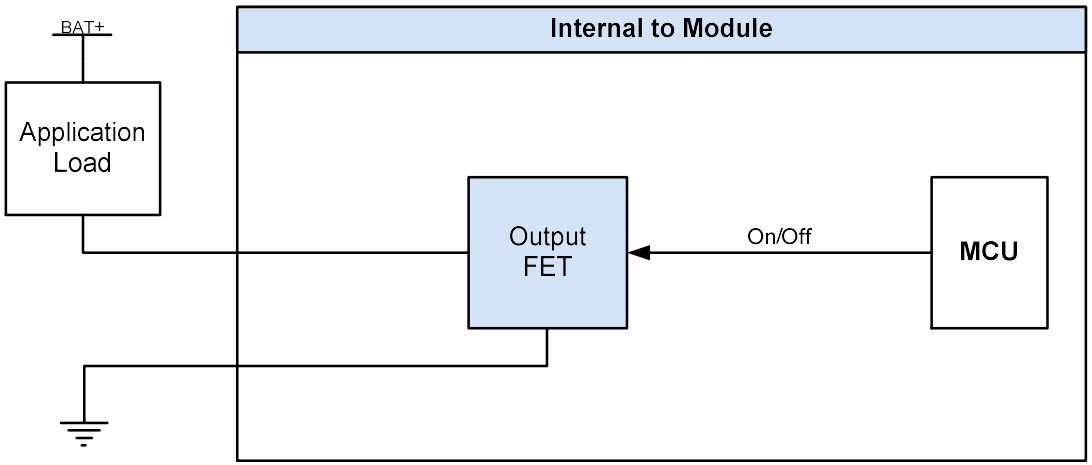
OUTPUT DOUT(-) (PIN 15, 16)

Output Current
- 150mA (maximum)
- Coil = 150mA at 12V

Output Voltage applied
- 12V system compliant
- 24V system not recommended[2]
- 28V (maximum)

Output Protection
- Free-Wheeling Zener diode
- Over current = None

Output Diagnostics
- None



[2] Typical 24V battery system charging alternator runs at +28V and may exceed the rating for this output.

SWITCHED BATTERY (+) / KEYSWITCH (PIN 8)

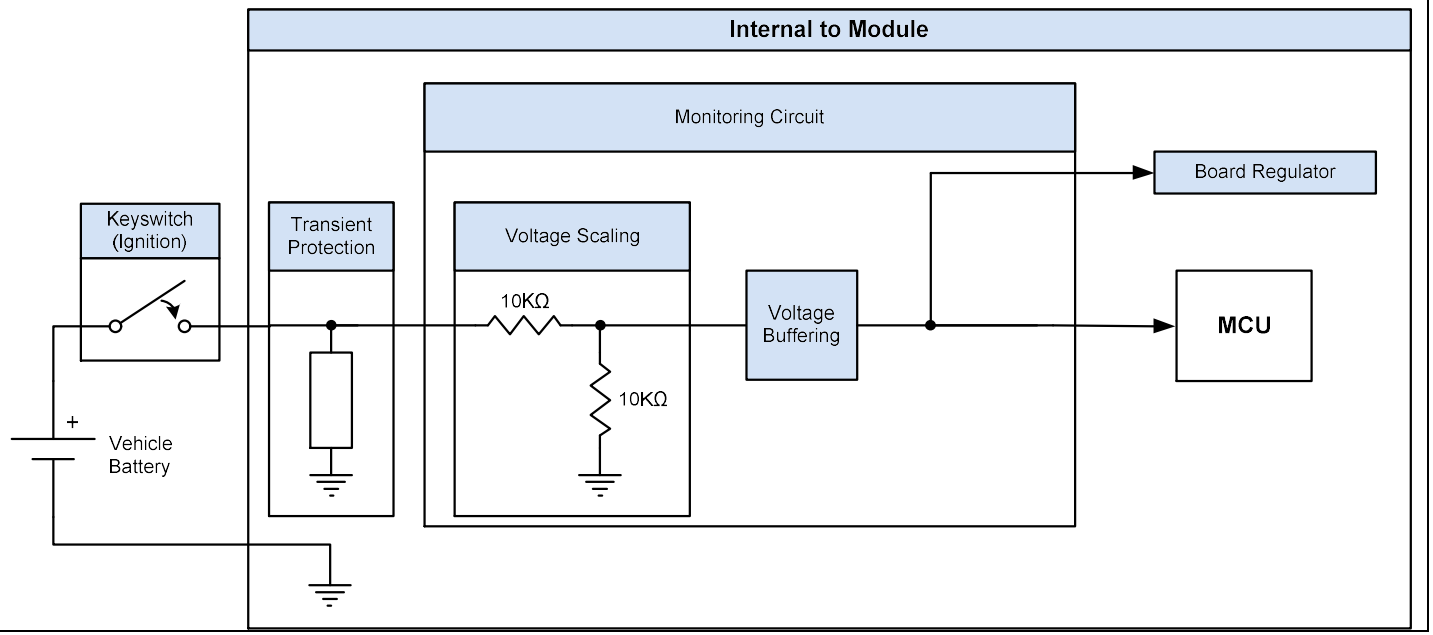
Switched Battery (+)

Operating Voltage Range
- 8VDC – 36VDC

Maximum Continuous Voltage
- 36VDC

Input Current[3]
- 0.4mA at 8V (typical)
- 1.6mA at 32V (typical)

Keyswitch Function
- Input transition from inactive to active will activate module
- Input transition from active to inactive will begin controlled shutdown sequence (if applicable) and de-activate module



[3] Verify that the input current is sufficient for the switching device. Some contacts require a minimum “contact clearing” or “wetting” current.

UNSWITCHED BATTERY (+) MODULE (PIN 24)[1]

Operating Voltage Range
- 9VDC – 32VDC

Maximum Continuous Voltage[2]
- 36VDC

Maximum Transient Voltage
- See test section of datasheet

Module Fusing (Automotive, Fast Acting)
- Can be connected to an existing 10 Amp branch
- Minimum 2 Amps

Module Current Draw
- See table below

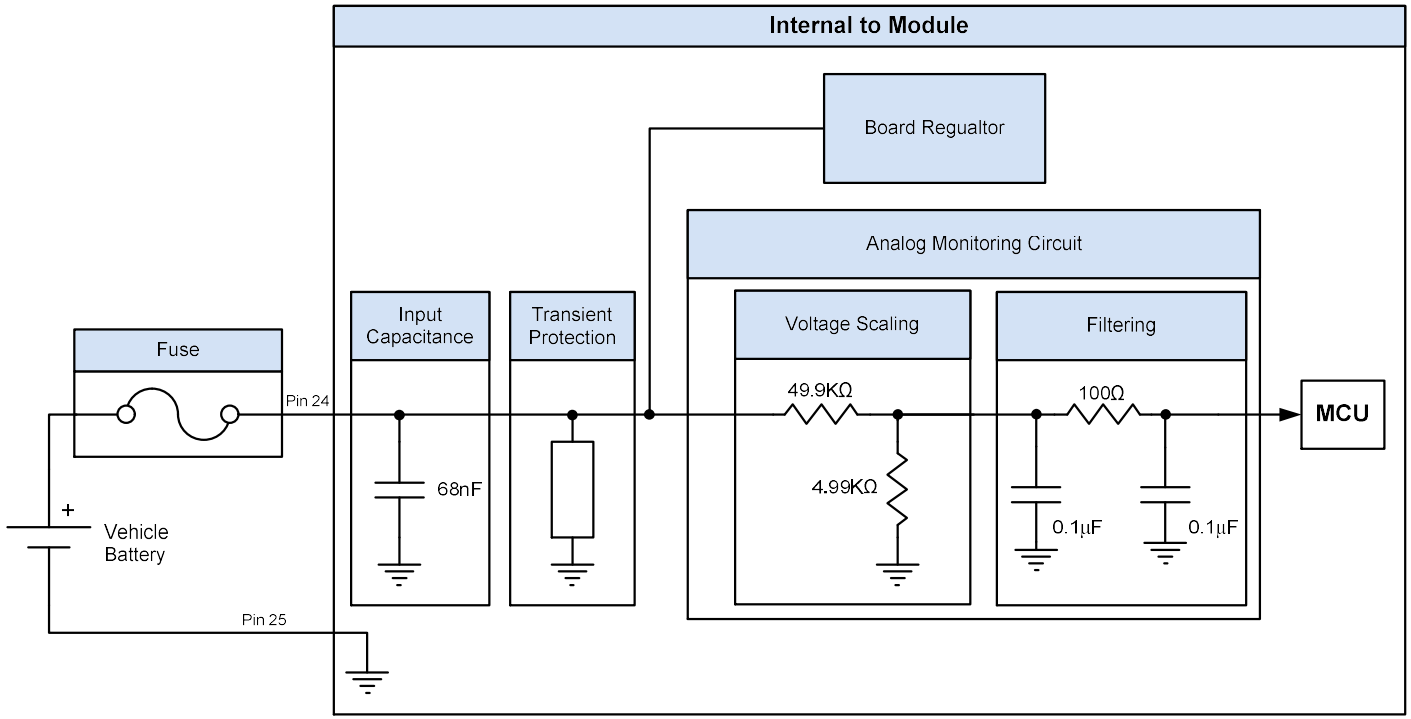
Analog Monitoring Circuit

Input Voltage Range
- 0V to 36.3V (typical)

Input Resistance
- 11KΩ (typical)

Resolution
- 12 Bits
- 8.86mV / count (typical)

Accuracy
- ±1.0% and ±200mV (T_A = 25°C)
- ±1.6% and ±200mV (T_A = full)



[1] It is strongly recommended that Pin 24 of the module be connected directly to the vehicle battery source and to utilize Pin 8 (keyswitch) for activating and deactivating, as well as allowing a safe shut-down sequence of, the module.

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

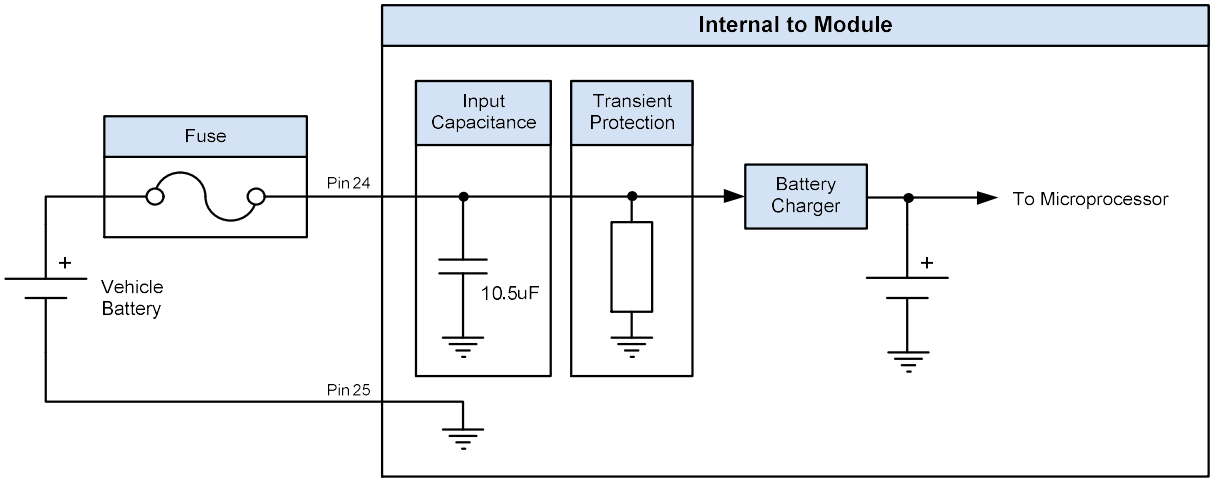
INTERNAL BACKUP BATTERY (+) MODULE (PIN 24)

Battery Nominal Voltage

- 3.85VDC

Battery Capacity

- 1500mAh
- Estimated Battery life at 25C = 17 Days.



MODULE CURRENT DRAW

Configuration	At 9.0VDC	At 13.8VDC	At 28VDC	At 32VDC
Typical Average Current (Keyswtich Enabled)	342 mA	253 mA	141 mA	122 mA
Typical Average Current in Shutdown Mode (Keyswitch Disabled / Module Shutdown)	1.082 mA	1.152 mA	1.587 mA	1.715 mA

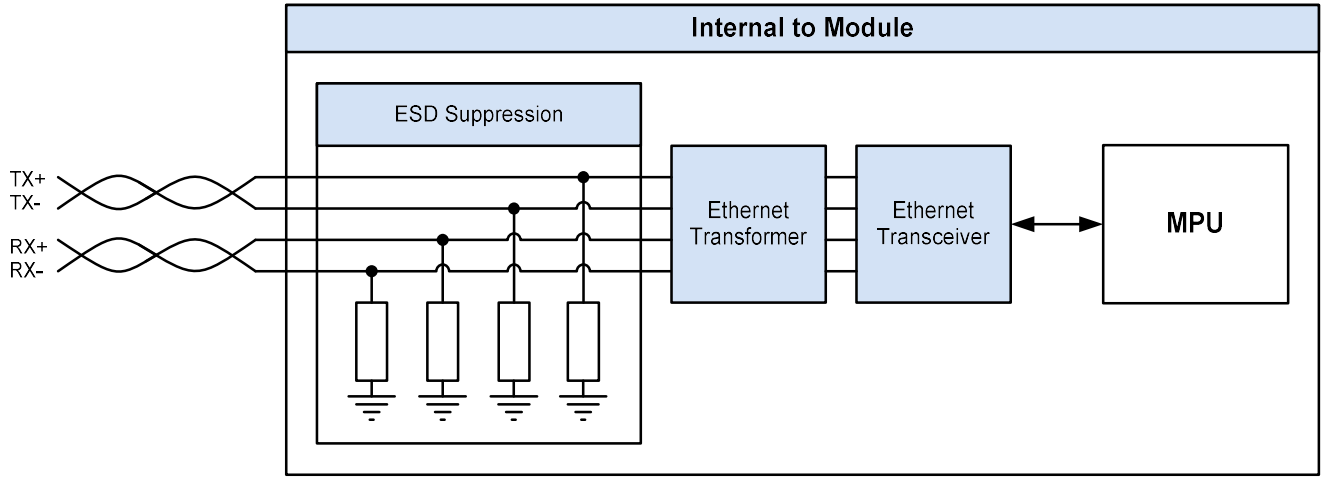
ETHERNET (PINS 11/12, 22/23)

Supported Modes

- 10Base-T
- 100Base-TX

ESD Suppression Capacitance

- 17pF (typ)



USB HOST / CLIENT (PINS 14/32/33/34/35)[1]

USB Standard
- USB 2.0

Connection Speeds
- 480Mbps (maximum)

V_{BUS} Output Voltage Range
- 5V ± 5%

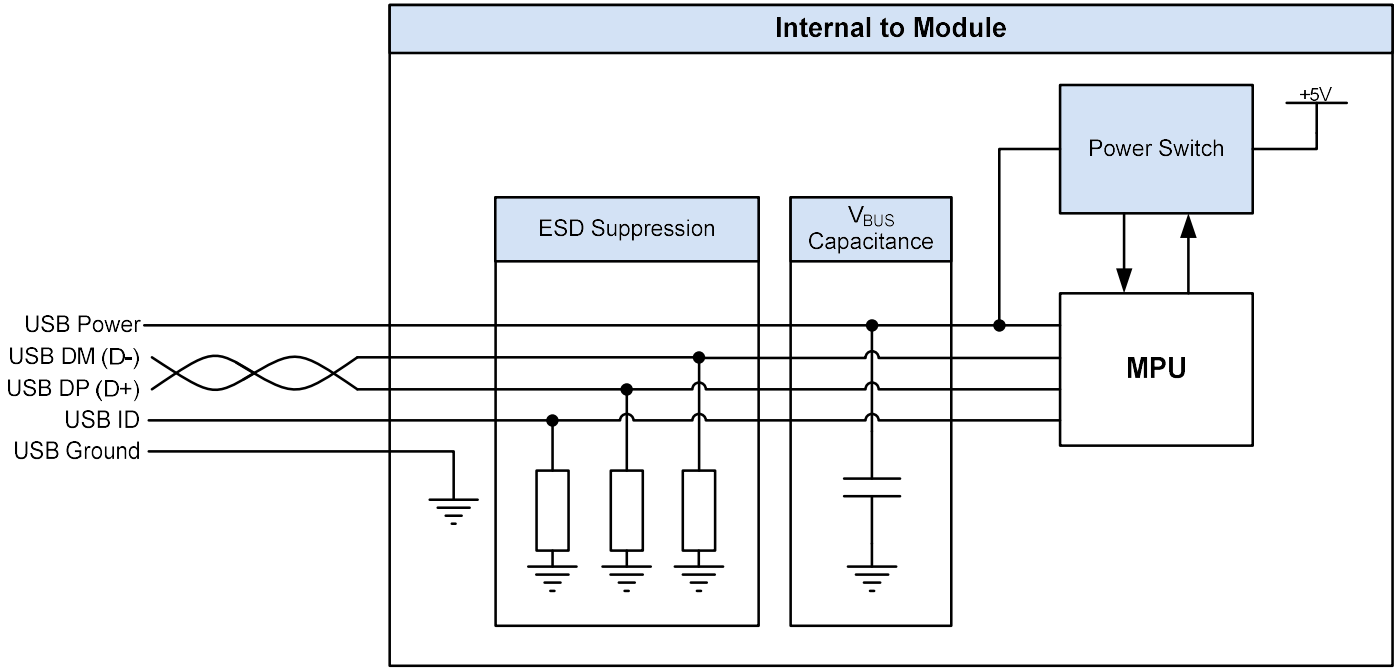
V_{BUS} Input Capacitance (typical)
- 10uF

V_{BUS} Output Current Rating
- 500mA

V_{BUS} Output Current Limit[2]
- 750mA (minimum)
- 1000mA (typical)
- 1250mA (maximum)

ID Pin Connection and Mode
- Connect to USB Ground = Host
- Leave Unconnected = Client

ESD Suppression Capacitance
- USB DP / DM: 17pF (typ)
- USB ID: 17pF (tip)



[1] USB power, ground, and signal pins are not protected against shorts to vehicle battery or other signals above typical USB voltage levels. The USB transceiver, per USB 2.0 standards, is required to withstand continuous short circuit of D+ and/or D- to GND, other data line, or cable shield for 24 hours (does not include shorts to USB power). Care must be taken to ensure wiring errors and shorts to higher voltage levels do not occur in the application.

[2] In host mode, USB bus voltage (VBUS) is used to power an external device as well as the MPU. MPU current draw can be up to 50mA; therefore, output current limit for the external device could reduce by up to 50mA from the values listed.

Warning: When in USB host mode, USB ID (Pin 14) must be connected only to the module USB Ground (Pin 35). Connecting to vehicle ground or other signals may result in damage to the module.

ADDITIONAL NOTES

Please refer to the module-specific technical datasheet for additional parametric data regarding internal peripherals such as flash memory, RAM memory, accelerometer, real-time clock, WiFi, Cellular, and GNSS.

Please refer to the appendix of this document for antenna gain requirements, recommended antennas, and installation guidance to be in compliance applicable regulations.

REVISION HISTORY

Revision	Date	EC #	Changes
A0	10/4/2023	323-226	Initial Release

APPENDIX

FCC COMPLIANCE

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications not expressly approved by HED could void the user's authority to operate the equipment. The device (when using internal antenna version) or external antenna(s) used with this device must provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with multi-transmitter policies.

This device contains the following FCC compliant module(s):

Device	Module(s)
CL-T27-018-10-9N (Cat-M1) CL-T27-028-10-9N (Cat-M1) CL-T27-038-10-9N (Cat-M1)	WiFi FCC ID Contains: VPYLBEE5HY1MW Cellular FCC ID Contains: XMR201707BG96
CL-T27-198-10-9N (Cat-4EU)	WiFi FCC ID Contains: VPYLBEE5HY1MW Cellular FCC ID Contains: XMR2019EG95NAX

ISED (Formally IC) COMPLIANCE

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Any changes or modifications not expressly approved by HED could void the user's authority to operate the equipment. The device (when using internal antenna version) or external antenna(s) used with this device must provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter except in accordance with multi-transmitter policies.

This device contains the following IC compliant module(s):

Device	Module(s)
CL-T27-018-10-9N (Cat-M1) CL-T27-028-10-9N (Cat-M1) CL-T27-038-10-9N (Cat-M1)	WiFi IC ID Contains: 772C-LBEE5HY1MW Cellular IC ID Contains: 10224A-201707BG96
CL-T27-198-10-9N (Cat-4 EU)	WiFi IC ID Contains: 772C-LBEE5HY1MW Cellular IC ID Contains: 10224A-2019EG95NAX

ANTENNA REQUIREMENTS

WiFi Antenna Requirements

Parameter	Specification	Comments
Antenna Type	Dipole or PIFA	Additional testing and regulatory approval may be required for antenna types other than those listed.
Frequency Range	2400~2483.5MHz/4900~5825MHz	
Polarization	Linear	
Gain	≤ 2.1 dBi @ 2442MHz ≤ 3.5dBi @ 5150MHz	Additional testing and regulatory approval may be required for peak gains exceeding this requirement. Peak gain includes cable loss and can be affected by mounting method, location, and cable length.
V.S.W.R	<2.0	
Impedance	50Ω	

GNSS

Parameter	Specification	Comments
Antenna Type	Active	
Gain	<17bB	Active antenna embedded LNA gain
Noise Figure	≤ 3 dB	Lower noise figures can result in better performance and tracking capability
Isolation	≥ 20 dB	Recommended isolation from other active transmitters or antennas
Input Voltage Rating	3.3V	If powered by CL-T27 module
Maximum Input Current	≤ 50 mA	If powered by CL-T27 module

Cellular (CL-T27)

Cellular Antenna Requirements: CAT M1

Parameter	Specification	Comments
Frequency Range	698~960MHz/1710~2700MHz	
Gain	4.0 dBi Typical 7.15 dBi MAX 5.0 dB MAX	Max gain over the entire frequency range of operation dBi = Decibel Isotropic Gain dB = Decibel Gain
Impedance	50Ω	

Cellular Antenna Requirements: CAT 4

Parameter	Specification	Comments
Frequency Range	698~960MHz/1710~2700MHz	
Gain	1.0 dBi Typical 7.15 dBi MAX 5.0 dB MAX	Max gain over the entire frequency range of operation dBi = Decibel Isotropic Gain dB = Decibel Gain
Impedance	50Ω	

NOTE: Higher cellular antenna gains than those listed may be allowed without additional regulatory approval, provided the antenna-to-person distance is increased above 20cm and the ERP / EIRP and/or power density limits are maintained as specified in the associated FCC, ISED, and/ or EN/IEC standards. For further details, contact HED.

ANTENNA REQUIREMENTS (CONTINUED)

Cellular (CL-T27) CAT-M1

Parameter	Specification	Comments
MAX Gain	≤ 10.571 dB in GSM850 band ≤ 10.571 dB in GSM1900 band ≤ 9.000 dB in LTE band 2 ≤ 7.000 dB in LTE band 4 ≤ 10.541 dB in LTE band 5 ≤ 9.798 dB in LTE band 12 ≤ 10.214 dB in LTE band 13 ≤ 9.541 dB in LTE band 26 ≤ 8.000 dB in NB-IOT band 2 ≤ 8.000 dB in NB-IOT band 4 ≤ 8.000 dB in NB-IOT band 5 ≤ 8.000 dB in NB-IOT band 12 ≤ 8.000 dB in NB-IOT band 13	Additional testing and regulatory approval may be required for peak gains exceeding this requirement. Peak gain includes cable loss and can be affected by mounting method, location, and cable length. See note below. For regions that support multiple cellular technologies (i.e. 4G/3G/2G) in similar frequency ranges, the most restrictive gain (i.e. minimum) must be used for that frequency range to ensure compliance.
Receive Diversity	No	Receive diversity is supported on the CL-T27 module and should be used for best performance unless a waiver is approved by the carrier. See CAT 4 table.
Isolation	≥ 20 dB	Recommended isolation between main and diversity antennas for best performance

Cellular (CL-T27) CAT-4

Parameter	Specification	Comments
MAX Gain	≤ 8.000 dB in WCDMA II band ≤ 5.000 dB in WCDMA IV band ≤ 9.416 dB in WCDMA V band ≤ 8.000 dB in LTE band 2 ≤ 5.000 dB in LTE band 4 ≤ 9.416 dB in LTE band 5 ≤ 8.734 dB in LTE band 12 ≤ 9.173 dB in LTE band 13	Additional testing and regulatory approval may be required for peak gains exceeding this requirement. Peak gain includes cable loss and can be affected by mounting method, location, and cable length. See note below. For regions that support multiple cellular technologies (i.e. 4G/3G/2G) in similar frequency ranges, the most restrictive gain (i.e. minimum) must be used for that frequency range to ensure compliance.
Receive Diversity	YES	Receive diversity is supported on the CL-T27 module and should be used for best performance unless a waiver is approved by the carrier.
Isolation	≥ 20 dB	Recommended isolation between main and diversity antennas for best performance

NOTE: Higher cellular antenna gains than those listed may be allowed without additional regulatory approval, provided the antenna-to-person distance is increased above 20cm and the ERP / EIRP and/or power density limits are maintained as specified in the associated FCC, ISED, and/ or EN/IEC standards. For further details, contact HED.

EXAMPLE ANTENNAS (MULTI)*

Manufacturer	Manufacturer P/N or Series	Mounting	Comments	WiFi		GNSS	Cellular	
				2.4G	5G	GPS	CAT-M1	CAT 4
Quectel	CL-A31-104-10	Roof	Custom HED Configuration	X	X	X	X	

*Customer evaluation required