



CTS-BMS C-1500 / V-1000 Sensor Module

Features

- Input Supply Voltage: 4.5 - 5.5V
- Current Measuring Range: ± 1500 [Apk]
- Redundant measurement: Shunt (16 bits) and Hall (12 bits) sensing
- Voltage Measuring Range (16 bits): ± 1000 V
- Measurement accuracy: 1% (Hall) and 0.5% (Shunt)
- Operating Temperature Range: -40 °C to $+105$ °C
- Galvanic Isolation between High Voltage and Low Voltage
- CAN 2.0B & CAN FD communication interface



Advantages

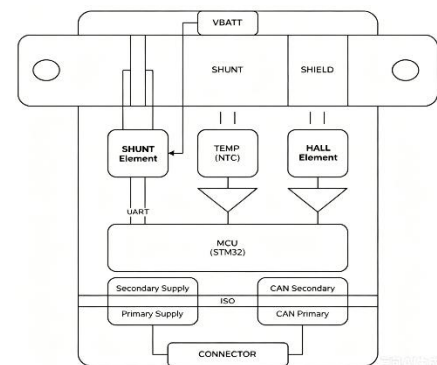
- Functional safety support via heterogeneous redundancy architecture
- High dynamic range with sub-ampere resolution
- Integrated module reduces BOM cost and wiring complexity
- Suitable for high-power EV and ESS applications
- Easy integration via CAN interface
- Designed to support ISO 26262 system architectures (sensor level, ASIL target capability).

Applications

- Electric Vehicle Battery Management System (EV BMS)
- Energy Storage System Battery Management System (ESS BMS), including UPS

Description

- The CTS-BMS sensor module is a galvanically isolated, redundant current and voltage sensing module designed for high-power battery systems up to ± 1000 V and ± 1500 A. By combining precision shunt measurement with Hall-effect sensing, it enables fault-tolerant current measurement for safety-critical BMS architectures in electric vehicles and stationary energy storage systems.
- This module integrates CAN interface for easy installation and use. Thanks to its configurable power supply design, the sensor can be integrated into a wide range of existing systems.





Ordering information

Product	Current Range	Voltage Range
CTS-BMS C-xxx / V-xxx Sensor Module	±500 Apk	±500V
	±1000 Apk	±800V
	±1500 Apk	±1000V

Note: C=Current V=Voltage

Accuracy Definitions

FS: Full Scale

I_{pm} : Peak measurement current

Total error: Includes offset, gain, drift, and noise

Shunt error: Includes temperature drift and factory calibration

Hall error: Includes hysteresis, offset, and thermal drift

Absolute ratings (not operating)

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Supply voltage	V_{DD}	V	4.5		5.5	
RMS current consumption at 0A	I_c	mA	86	100	130	VDD=5V, CAN acknowledge
Ambient storage temperature	T_A	°C	-40		105	
Electrostatic discharge voltage (HBM)	$U_{ESD-HBM}$	KV			8	
RMS voltage for AC insulation test	U_D	KV			4.2	50Hz, 1 min, IEC 60664 Part1
Insulation resistance	R_{INS}	MΩ	500			
Start-up time	I_{start}	ms		520		From power-on to valid output
Max. Data Bit Rate	Bit_data	kbps			1000	$R_L = 120\Omega$
Clearance distance	D_{CL}	mm	≥ 24			For Hall
Creepage distance	D_{CP}	mm	≥ 34			For Hall
Communication Protocol	P_{rot}		CAN 2.0B / CAN FD			

NOTE: exceeding the absolute maximum ratings may cause permanent damage to the sensor module. Exposure to absolute maximum-rated conditions for extended periods of time may affect sensor module reliability.



Operating characteristics in nominal range for Shunt channel

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Resistance value	R	$\mu\Omega$	23.75		26.25	25°C
Operating temperature	T _A	°C	-40		105	
Temperature coefficient	α_R	ppm/°C	-200		200	
Resolution ratio	N _{Rr}	bits		16		
Offset error at 0A	ϵ_{off}	A		±0.05		25°C, factory calibrated
Thermal offset drift	ϵ_{off_dT}	A		±0.1		Full Operating Temperature Range
Total Error (calibrated)	ϵ_{Tol}	%FS		±0.3		25°C, factory calibrated
				±0.5		Full Operating Temperature Range

Note:

1. Calibration Statement: Each unit is 100% factory calibrated at 25°C. Shunt resistance is digitally trimmed per device to minimize initial offset and ensure consistent accuracy.
2. Temperature Compensation: All shunt total error specifications (±0.5% @25°C, ±1% @full temperature range) are valid after internal temperature compensation. Residual drift due to TCR is fully compensated

Operating characteristics in nominal range for Magnetic channel

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Operating temperature	T _A	°C	-40		105	
Response Time	T _{RESP}	μs			2	
Resolution ratio	N _{Rr}	bits		12		
Refresh rate	T _{Rr}	μs		42		
Hysteresis	ϵ_H	mV	-5		5	25°C
Sensitivity	S	mV/mT	20	25	40	
Offset error at 0A	ϵ_{off}	A		±3		25°C, factory calibrated
Thermal offset drift	ϵ_{off_dT}	A		±4		Full Operating Temperature Range
Total Error (calibrated)	ϵ_{Tol}	%FS		±1		25°C, factory calibrated
				±1.5		Full Operating Temperature Range

Note: Hall offset is factory calibrated and optimized for BMS SOC estimation.



Operating characteristics in nominal range for Temperature channel

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Measuring range	T_M	°C	-40		105	
Measurement accuracy	ε_a	%	-1		1	25°C
Resolution ratio	N_{Rr}	bits		12		
Refresh rate	T_{Rr}	μs		42		

Operating characteristics in nominal range for High Voltage channel

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Measuring range	V_M	V	-1000		1000	
Offset error @0V	ε_{off}	V		±0.5		25°C
Bandwidth	BW	kHz			2	
Resolution ratio	N_{Rr}	bits		16		
Refresh rate	T_{Rr}	μs		477		
Total Error	ε_{Tot}	%		±1		25°C
				±1.5		Full Operating Temperature Range

Current Ratings (Continuous vs. Peak)

Parameter	Symbol	Unit	Specification			Conditions
			Min	Typical	Max	
Current measuring range	I_M	A			±1500	Duration ≤ 40s, 25°C ambient, transient overloads only
Max continuous DC current	I_r	A			±300	25°C ambient, continuous operation, full accuracy

CRITICAL THERMAL WARNING: Under high current load, the shunt alloy temperature may exceed 105 °C. Do not operate above the rated maximum operating temperature.

Note:

1. ±1500 A is strictly defined as a short-term overload measurement range, applicable only for transient conditions ≤ 40 s at 25 °C and not intended for continuous operation. The rated continuous current is ±300 A at 25 °C.
2. Derating shall be applied in accordance with the thermal derating curve provided in this datasheet for extended operation at elevated currents or temperatures.



CAN message table

Communication Parameters

- Communication Baud Rate: 1 Mbps
- Frame Type: Standard Data Frame (11-bit ID)
- Data Length: Fixed 8 bytes
- Check Method: CRC8-ITU Check
- Electrical Characteristics: Compliant with ISO 11898-2 standard, differential signal transmission, dominant level 0V, recessive level 5V
- CAN FD Support: used for bit rate improvement only, no payload expansion
- Key Functions: Real-time monitoring (voltage/current/temperature, 20ms cycle) & device diagnostics (fault status, 80ms cycle)
- Fault Detection: Shunt/Hall overcurrent, over/under temperature, overvoltage, sensor IC abnormality

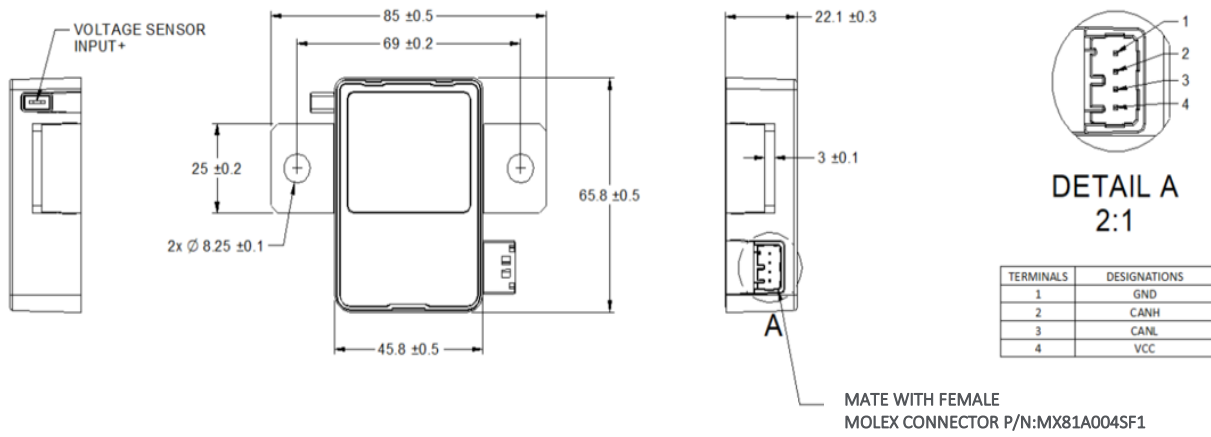
NOTE:

1. Detailed CAN message format, byte resolution, conversion formulas and diagnostics status definition are provided in the separate document ***CAN Communication Protocol Specification_V1.0*** (available on request).
2. This specification is available on request for customers and is also maintained as an internal technical document for product development and quality control.



Dimensions

All the dimensions are expressed in [mm], unless otherwise specified.



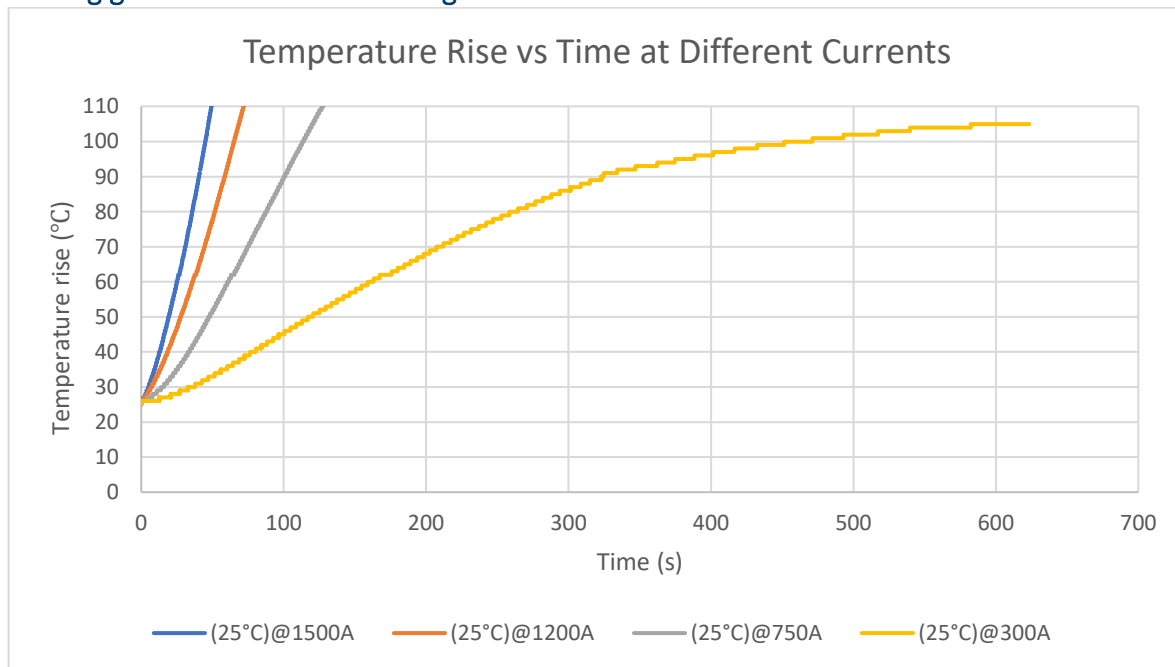
Appendix 1: Derating & Thermal Characteristics

- This section describes the self-heating and temperature rise characteristics of the sensor, which are part of the derating guidelines for reliable operation.
- This Derating & Thermal Characteristics section includes test setup details and temperature rise performance data, all of which form the official derating guidelines for reliable sensor operation.

Setup

- Test environment: Climate chamber, ambient temperature set to 25°C
- Test point: Shunt alloy
- Data collection: NTC thermistor on PCB
- No active cooling in the busbar

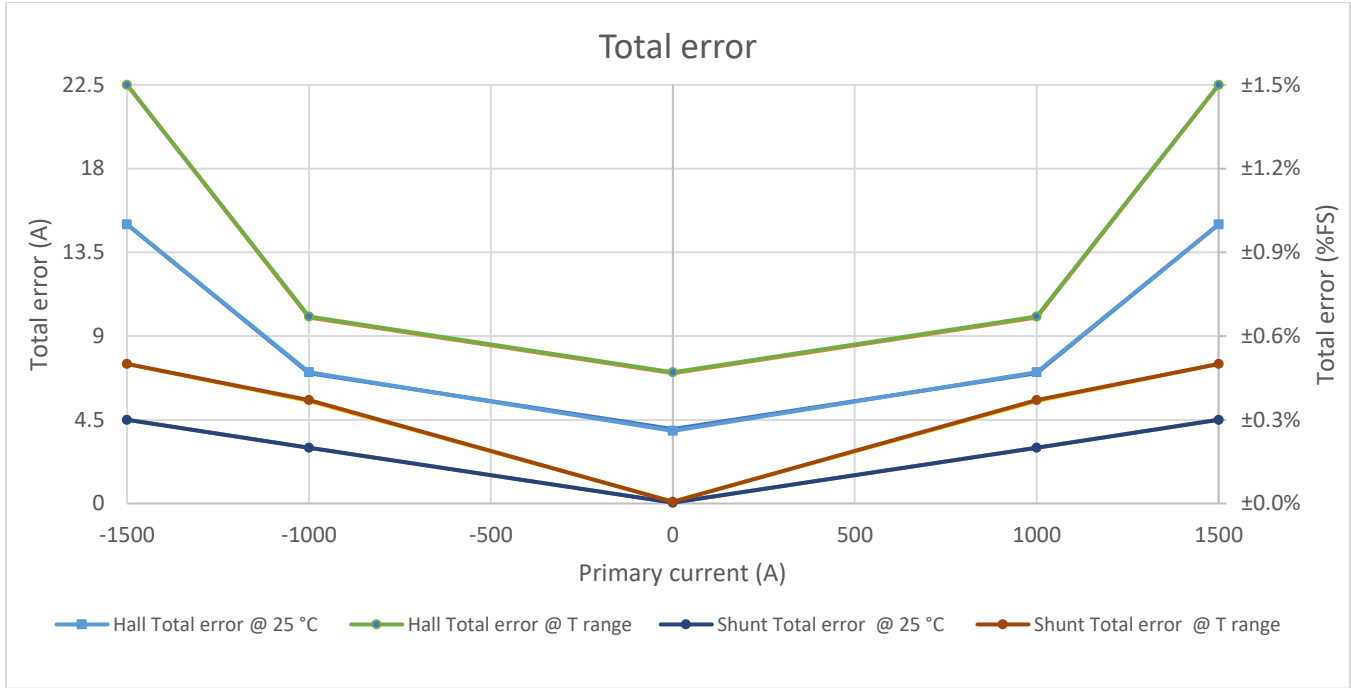
Heating generation chart according to above condition



Note:

- 1.The temperature rise curves are measured under the conditions specified above. Actual temperature rise may vary based on PCB design, ambient temperature, and cooling conditions.
- 2.Depending on the conditions of use, the temperature of the exposed parts of the Shunt alloy may reach or exceed 105°C.
- 3.The sensor must not be operated if the junction temperature exceeds the rated maximum operating temperature. Refer to the derating guidelines for current limits at elevated temperatures.
- 4.This section is part of the derating specification, consistent with industry-standard datasheet practices for current sensors and power components.

Appendix 2: Total error ϵ_{Tot}



Primary current	Total error @ 25 °C				Total error @ T range			
	Hall(A)	Hall(%FS)	Shunt(A)	Shunt(%FS)	Hall(A)	Hall(%FS)	Shunt(A)	Shunt(%FS)
-1500	15	1	4.5	0.3	22.5	1.5	7.5	0.5
-1000	7	0.47	3	0.2	10	0.67	5.5	0.37
0	4	0.26	0.05	0.003	7	0.47	0.1	0.006
1000	7	0.47	3	0.2	10	0.67	5.5	0.37
1500	15	1	4.5	0.3	22.5	1.5	7.5	0.5

Note: Hall channel accuracy calculated by I_{pm} .



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