



Global Battery Current Sensor Specifications

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. This specification defines the electrical, mechanical, environmental, reliability and durability performance and validation requirements for battery current sensors used in all GM global common passenger car and light duty truck applications worldwide.

1.2 Applicability. This specification is applicable to all future global common battery current sensors used in GM passenger car and light duty truck vehicles, and is intended to promote uniformity of application across all future GM passenger car and light duty truck vehicles.

1.3 Remarks. Battery current sensors are used in vehicles to measure battery current during battery charging and discharging conditions to help optimize vehicle power utilization.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

AIAG FMEA-4	ASTM STP783	ISO 1043-2	ISO 11469
AIAG PPAP-4	ISO 1043-1	ISO 1629	ISO 18064
ASTM D4804			

2.2 GM Standards/Specifications.

GMW3059	GMW3172	GMW14082 (LU)
GMW3097	GMW3191	

(LU) = This standard is limited to use only with Global A Electrical Architecture applications.

2.3 Additional References.

- Automotive Industry Action Group (AIAG) Production Part Approval Process (PPAP) and Failure Mode and Effects Analysis (FMEA) is available at Uniform Resource Locator (URL) <https://www.aiag.org/>
- GM Part Number 13505369
- GM Part Number 13519047

3 Requirements

3.1 System/Subsystem/Component/Part Definition.

3.1.1 Appearance. The Battery Current Sensor appearance shall reflect quality design and the packaging shall be free of dents, nicks, scratches, blowholes, and any other abnormalities reflecting poor workmanship.

3.1.2 Content. Not applicable.

3.1.2.1 Physical Content. Not applicable.

3.1.2.2 Functional Content. Not applicable.

3.1.3 Ambient Environment. The battery current sensor shall be capable of meeting all performance specifications with air temperatures ranging from -40 °C to 125 °C. The battery current sensor must also be

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capable of withstanding non-operating storage over the temperature range of -40 °C to 125 °C, and non-operating storage temperature of 150 °C for 30 minutes, without impairing its ability to subsequently meet all specifications.

3.1.4 Interfaces. The battery current sensor is linked to the Body Control Module (BCM) with the vehicle harness, Appendix A, Figure A1. The electrical connection is made with an environmental proof connector via 3 pins, Appendix A, Figure A2. The battery current sensor output signal shall be a Pulse Width Modulated (PWM) signal, Appendix B, Figure B1.

3.1.5 Usage Definition. The battery current sensor is an electromagnetic device that measures the total current going to, or from the vehicle battery during battery charging, or discharging conditions.

3.2 Product Characteristics.

3.2.1 Performance Requirements.

3.2.1.1 General Requirements. See Table 1.

Table 1: General Requirements

Requirement	Value
Measuring Current Range	-60 A to +60 A
Absolute Maximum Current	-1000 A to +1000 A
Supply Operating Voltage Range	+5 V $\pm$ 10%
Absolute Maximum Supply Voltage (Over Voltage)	+14 V
Reverse Maximum Supply Voltage (Under Voltage)	-13.5 V
Output Short Circuit Duration Time	Continuous
Maximum Output Sensor Current	+10 mA
Operating Temperature (Accurate Range)	-10 °C to +65 °C
Degraded Performance Operating Temperature	+65 °C to +125 °C -10 °C to -40 °C
Storage Temperature	-40 °C to +150 °C
Sensor Response Time to Step Change	< 25 ms
Allowable Settling Time Following Current Exceeding $\pm$ 1000 A	25 ms (maximum)
Maximum Consumption	10 mA at +5 V
Parasitic Current	0 mA (Key off, V = 0)

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3.2.1.2 Accuracy Requirements. Accuracy requirements in Table 2 include all component errors associated with:

- Maximum Zero Offset
- Circuitry Gain Offset (Maximum)
- Non-Linearity (Maximum)
- Hysteresis (Maximum)
- Temperature Drift

Table 2: Three Sigma (3σ) Accuracy Requirements

Parameter	Typical Value	Maximum Value
Current Measurement Error Accuracy at ± 10 A (-10 °C to $+65$ °C)	$< \pm 350$ mA	$< \pm 500$ mA
Current Measurement Error Resolution at ± 10 A (-10 °C to $+65$ °C)	$< \pm 100$ mA	$< \pm 100$ mA
Current Measurement Error Accuracy at 0 A (-10 °C to $+65$ °C)	$< \pm 200$ mA	$< \pm 300$ mA
Current Measurement Error Accuracy at ± 60 A (-10 °C to $+65$ °C)	$< \pm 1.5$ A	$< \pm 1.8$ A
Degraded Performance at ± 10 A (-40 °C to $+125$ °C)	$< \pm 0.6$ A	$< \pm 0.8$ A
Degraded Performance at ± 60 A (-40 °C to $+125$ °C)	$< \pm 2.5$ A	$< \pm 3$ A
Degraded Performance at ± 0 A (-40 °C to $+125$ °C)	$< \pm 0.6$ A	$< \pm 0.6$ A

3.2.1.3 Operating Voltage Conditions. See Table 3.

Table 3: Operating Voltage and Temperature Conditions

Symbol	Parameter	Value			Unit	Remark
		Minimum	Typical	Maximum		
V _{cc}	Nominal Supply Voltage for +5 V sensor	4.5	5	5.5	V	Normal Parameter
	Continuous Over Voltage +5 V Transient			8.5	V	Normal Parameter
	Over Voltage +5 V			14	V	2 minutes at 25 °C
	Reverse Voltage +5 V	-13.5			V	1 minute at 25 °C
	Nominal Supply Voltage for Accurate Range	4.75	5	5.25	V	
R	Recommended Pull up Load Resistor			4.7	K Ω	Located in BCM
C	Recommended Load Capacitor			10	nF	Located in BCM
T _a	Operating Temperature	-40	25	125	°C	
T _a	Operating Temperature for Accurate Range	-10	25	65	°C	

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3.2.1.4 Operating Characteristics. See Table 4.

Table 4: Operating Characteristics

Symbol	Parameter	Value			Unit	Remark
		Minimum	Typical	Maximum		
I_P	Measuring Current Range	-60		60	A	
I_M	Maximum Current	-1000		1000	A	Crank current only
I_{dd}	Continuous Supply Current at +5 V or Sensor Current Consumption		6	10	mA	
D_o	Duty Cycle @ $I_P = 0$ A		50		%	
	Full Range Duty Cycle at ± 6.0 A	10		90	%	
T_s	Settling Time After Overload			25	ms	Primary overload > 1000 A
T_{pu}	Power-Up Time to Reach Valid Duty Cycle			25	ms	
F	Output PWM Frequency	105	125	145	Hz	
	Sensor Output Resolution	-0.1	0.075	0.1	A	
V	Sensor Output High Voltage			4.8	V	
V	Sensor Output Low Voltage	-0.2	0.0	0.2	V	
T_r	Output PWM Rise Time		60		μ s	Resistance and current dependent
T_f	Output PWM Fall Time		30		μ s	Resistance and current dependent
R_{out}	Sensor Output Resistance		1	10	Ω	Approximate values only

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3.2.1.5 Output Characteristics. See Table 5.

Table 5: Output Characteristics

Symbol	Parameter	Value			Unit	Remark
		Minimum	Typical	Maximum		
$V_{OUT +5V}$	Continuous Voltage			8.5	V	
	Output Over Voltage			14	V	1 minute at 25 °C
I_{OUT}	Continuous Output Current			1	mA	Operating conditions
	Short Circuit Current			10	mA	
t_{sh}	Output Short Circuit Duration			Continuous	hours	

3.2.1.6 Battery Current Sensor Component Protection Requirements. If at any time the battery current sensor connector pins are subject to a condition resulting in power being applied without a ground path being established, the battery current sensor shall be capable of returning to full functionality following restoration of the ground path.

If at any time the battery current sensor is subject to a condition resulting in the grounding of two pins while power is applied to the +5 V connector pin, the battery current sensor shall be capable of returning to full functionality following the restoration of proper connection.

In the event of a condition resulting in the shorting of adjacent connector pins the battery current sensor shall not fail.

If at any time the battery current sensor is subject to a condition resulting in the reversal of the +5 V and Ground (GND) connections (+5 V connected to GND, and GND connected to +5 V) the battery current sensor shall be capable of returning to full functionality following the restoration of proper connection.

3.2.1.7 PWM General Parameters. Table 6 specifies the electrical characteristics of a push-pull driver of variable duty cycle, single wire PWM signal intended to interface with vehicle BCM circuitry.

Table 6: PWM General Parameters

Duty Cycle Band Definitions	Remarks
Data: Acceptable duty cycle	$\geq 10\%$ to $\leq 90\%$
Diagnostic: Failure indication to the BCM	0% to $\leq 4\%$ and $\geq 96\%$ to 100%
Dead Band: Over-current indication	$> 4\%$ to $< 10\%$ and $> 90\%$ to $< 96\%$
Duty Cycle	
Resolution	$\leq 0.05\%$
System Data Transfer Accuracy	
Duty cycle jitter: Cycle to cycle: Appendix B, Figure B2	$\pm 0.05\%$
Examples of Duty Cycle Parameter Errors:	
- Input timer resolution recommendation: BCM input - Vdiff: Transmitter/receiver ground difference - Vpu: Receiver pull-up voltage variation for +5 V	$\leq 2 \mu s$ $< 0.5 V$ $+5 V \pm 0.5 V$

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