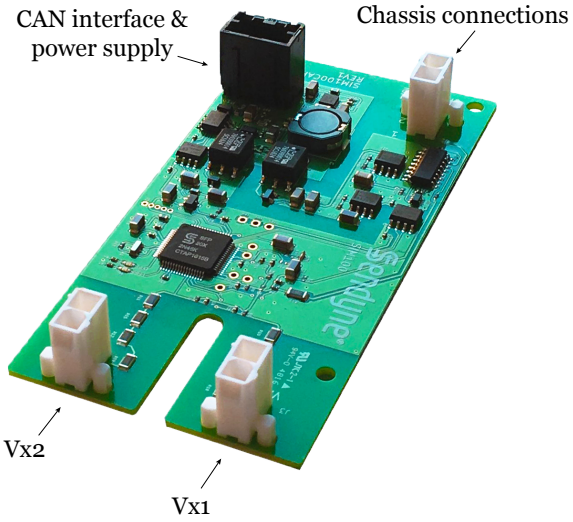
Sendyne® Sensing Products Family

Sendyne Isolation Monitor For Electric and Hybrid Vehicles



Description

The Sendyne SIM100MOD is the first high voltage isolation monitoring device for EV/HEVs capable of operating correctly even when the battery is active, and experiencing large voltage variations.

The SIM100MOD continuously monitors the isolation resistance between a vehicle's IT (Isolated Terra) power system and chassis for deterioration of insulation and potentially dangerous levels of leakage current. The SIM100MOD detects not only resistive leakages but also capacitively stored energy that could be harmful to human operators.

Due to a proprietary, patent-pending advanced algorithm, the module is capable of detecting all sources of leakage, including multiple, simultaneous symmetrical and asymmetrical faults, as well as resistive paths between the chassis and points in the battery with the same potential as the chassis. In the case of an insulation fault, the unit identifies the relative position of the fault in relation to the battery's terminals.

Applications

– *Monitoring electric and hybrid vehicle power systems*

Battery-connected V_{X1} (Vp) and V_{X2} (Vn) voltage inputs can measure ±1000 V in reference to Chassis (0 V). Communications are achieved via an isolated CAN 2.0B interface (500 kbit/s), with an input voltage range of 5 V to 53 V, and a wide temperature range of –40 °C to +105 °C. The module was designed to ISO 6469-3:2011-12 / FMVSS 305.

Operating Specifications

Parameter	Value
Insulation monitoring range	0 to 2.0 MΩ (each of the two measurement lines to chassis)
Power supply	+4.8 to +53 V (Variable, accommodating +5 V to +48 V power supplies)
Interface	CAN 2.0B isolated, 120 Ω termination resistor
Voltage measurement range	2 Channels: ±1000 V/channel continuous, no signal clipping
Rating	Automotive
Power consumption	< 400 mW
Module operating temperature range	-40 °C to +105 °C (due to connector temperature ratings)

Features

– *Measures voltage for each battery terminal to chassis*
– *Reports battery voltage*
– *Operates normally while the battery is having large voltage excursions and variations*
– *Measures and reports modeled leakage resistances per model adapted by the safety standards ISO6469-1, FMVSS §571.305 and others*
– *Reports calculated isolation resistance in Ω/V per requirements of the safety standards*
– *Measures and reports the value of capacitance from each battery terminal to chassis*
– *Calculates and reports the energy stored by the total capacitance between the battery and chassis*
– *Continuously monitors connections of the voltage sense lines to the battery terminals; reports inadequate connections*
– *Continuously monitors connection of the unit to chassis; reports inadequate connection*
– *Provides high immunity to common-mode noise that can be present on the battery terminals*
– *Provides nonvolatile storage for the value of the maximum (design) voltage of the battery (used in calculations of the isolation resistance and stored energy). If the actual observed battery voltage is higher than the set maximum voltage, the higher value is used in the calculations of the isolation resistance and stored energy*
– *Provides nonvolatile storage for calibration of the voltage measurements and other parameters; all reported measurements have their respective calibration parameters applied automatically*
– *Provides built-in galvanically isolated and intrinsically leakage-safe excitation source*
– *A single CAN-interface transaction (packet) provides sufficient information for determination of the safe status of the system*
– *Provides measurement of the internal isolated power supply voltage for system diagnostics*
– *Provides measurement of the module's temperature for system diagnostics*

Technical Specifications

Electrical Specifications

Parameter	Min	Typ	Max	Units	Conditions/Comments
Power and General					
Electronics operating temperature range	-40		+125	°C	
Connector temperature ratings	-40		+105	°C	
Supply Voltage	4.8		53	V	
Supply Power			400	mW	
Start-up time		6		s	After application of power and power supply stabilization to the initial calculation of insulation resistance
Isolation Resistance Measurement					
Isolation resistance monitoring range	0		2.0	MΩ	From each side of the battery to chassis.
Isolation monitoring lines resistance		2.0		MΩ	This is the impedance imposed on the IT system by each of the two battery voltage monitoring lines and the maximum isolation resistance that can be measured.
Isolation monitoring uncertainty		±5		%	For isolation resistance range of 100 kΩ to 500 kΩ. The total measurement uncertainty includes the contribution by the noise and operations of the target system. If externally-induced noise prevents resolution of the values with sufficiently-low uncertainty, then the unit holds the last value until the noise subsides.
Isolation resistance calculation period		0.5		s	The SIM100MOD calculates isolation resistance value every 500 ms. If uncertainty is higher than 5 %, the unit reports the previously calculated value.
Resistance value flagged as a short	0		5	kΩ	Reported isolation resistance value will be exactly 0 Ω/V

Electrical Specifications

Parameter	Min	Typ	Max	Units	Conditions/Comments
Voltage Measurement					
Nominal full-scale voltage range		±1000		V	Continuous operations, referenced to Chassis. No signal clipping.
Voltage offset error	-1	±0.2	+1	V	V_X = 0 V, applies over the full ambient operating temperature range, T_A = -40 °C to +125 °C
Voltage gain error	-1	±0.1	+1	%	Over the full ambient operating temperature range. Calibration and typical value at room temperature.
Voltage noise error		100		mV_{RMS}	1 Hz reporting rate
Voltage measurement resolution		1		mV	Minimum discernible voltage change; corresponds to one count of ADC, voltage report rate of 10 Hz or lower
Permitted battery voltage	15		1000	V	For normal operations of the unit; if battery voltage is below 15 V, an error flag will be activated and resistance measurements will pause
Capacitance Measurement					
Capacitance monitoring range	0.1	1	>10	µF	Capacitance from each terminal of the battery to chassis
Capacitance monitoring uncertainty		±15		%	200 nF to 2 µF
Capacitance measurement resolution		1		nF	200 nF to 2 µF
Temperature Measurement					
Absolute temperature measurement error	-5	±0.5	+5	°C	Built-in temperature sensor
Temperature measurement resolution			10	m°C	Practical temperature measurement granularity
Noise Immunity of Measurements					
Common mode voltage on the battery terminals	20			V_{PK-PK}	No observable effect on isolation resistance value; measured with square and triangular wave test signals at 1 kHz, 10 kHz and 30 kHz

Electrical Specifications

Parameter	Min	Typ	Max	Units	Conditions/Comments
Differential mode voltage on the battery terminals (battery voltage variations)		100		V_{PK-PK}	No observable effect on isolation resistance value; tested with a battery-voltage driving profile that has multiple instantaneous voltage changes up to ±100 V and overall slow battery voltage fluctuation from 330 V to 125 V and back to 330 V
Isolation					
Test voltage		3		kV_{DC}	CAN interface to chassis, 1 min. duration
ESD tolerance			25	kV	Air discharge

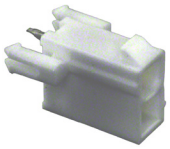
Communications

Interface	Spec	Speed	Termination
CAN	2.0B	500 kbit/s	120 Ω termination resistor

Connectors

Interface	Manufacturer	Positions	Part number	Description
CAN & power on board	Molex	4	347920040	P1: 4 pos. header, shrouded connector (2.00 mm), through hole tin
Can & power mating con.	Molex	4	347910040	Use appropriate crimp contacts (available for AWG 22, 24 and 26)
Voltage sensing on board	Molex	2	39299029	J1, J3, J4: MINIFIT JR HDR 02P 94V-0 30AU
Voltage sensing mating con.	Molex	2	39013028	MINIFIT JR RCPT DR SIDETABS 2 CKT 94V-0. Crimp contacts available for AWG 18 to 28

CAN and Power header & mating connectors



Voltage sensing header & mating connectors

The SIM100MOD uses Molex connectors, part numbers: 347920040 and 39299029.
For more details please see the Molex datasheets:
www.molex.com/pdm_docs/sd/347920040_sd.pdf and www.molex.com/pdm_docs/sd/039299029_sd.pdf

Connectors

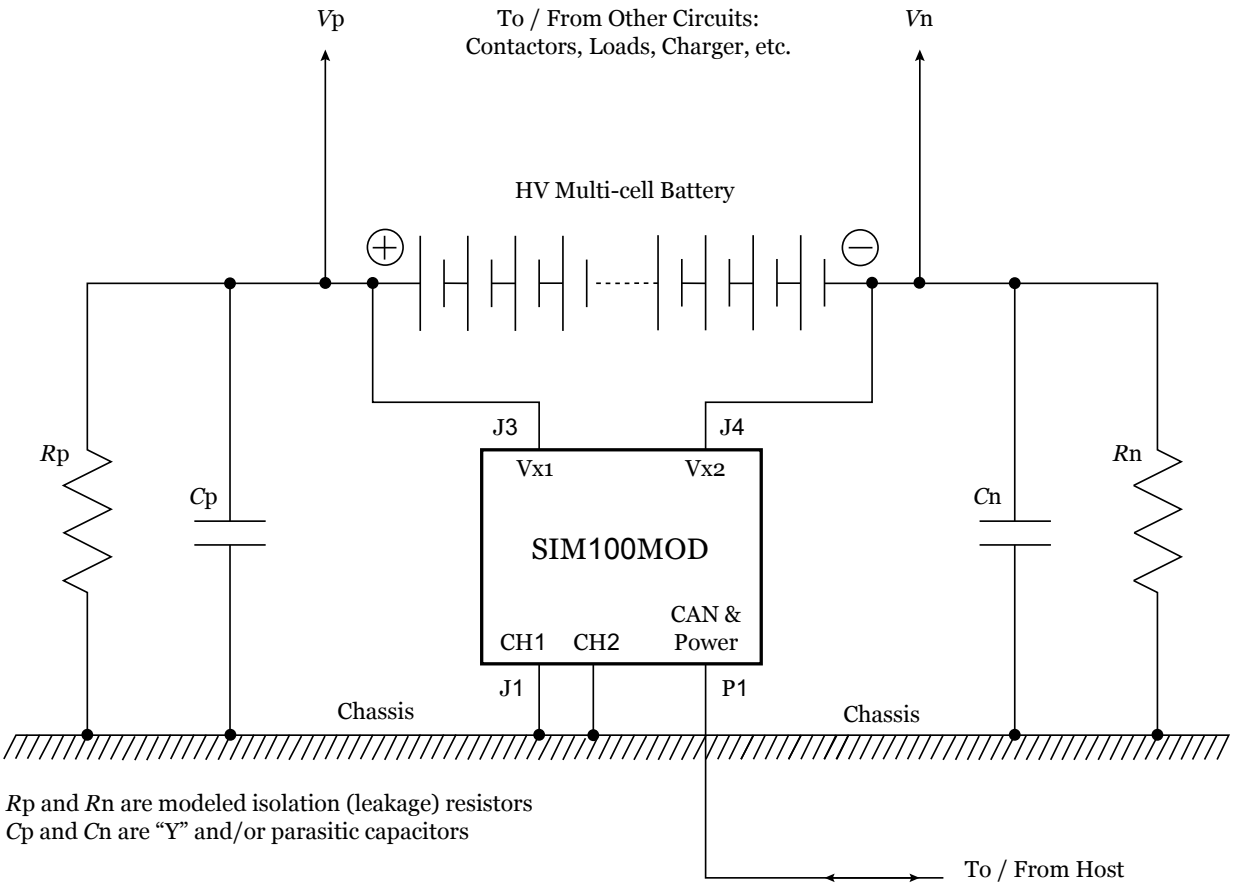
Pin Number	Signal Name	Comments
Connector J1		
1	CH1	Chassis connection 1. One of two independent connections to Chassis.
2	CH2	Chassis connection 2. One of two independent connections to Chassis.

Note: Signals CH1 and CH2 should have independent connections to Chassis. The SIM100 module continuously monitors continuity between these two signals. This information is used for examination of the assured connection of the SIM100 module to Chassis. Absence of solid Chassis connections is reported as a Fault; at that time the results of the Isolation Measurements are not valid.

Connector J3		
1	V_{X1}	To be connected to positive terminal of the Battery. The two pins in this connector are shorted on the PCB; either one or both (redundant) pins can be used for the electrical connection.
2	V_{X1}	Same as above.
Connector J4		
1	V_{X2}	To be connected to negative terminal of the Battery. The two pins in this connector are shorted on the PCB; either one or both (redundant) pins can be used for the electrical connection.
2	V_{X2}	Same as above.
Connector P1		
1	VCC	Positive power supply, can be any voltage within +4.8 V to +53 V.
2	CAN_L	One of two CAN communications lines. Termination resistor of 120 Ω is installed between these two lines on the SIM100 module.
3	CAN_H	One of two CAN communications lines. Termination resistor of 120 Ω is installed between these two lines on the SIM100 module.
4	GND	Common / GND connection, negative return for the power supply.

Note: Signal names for pins of connector P1 are labeled on the PCB. Signal GND is galvanically isolated from Chassis.

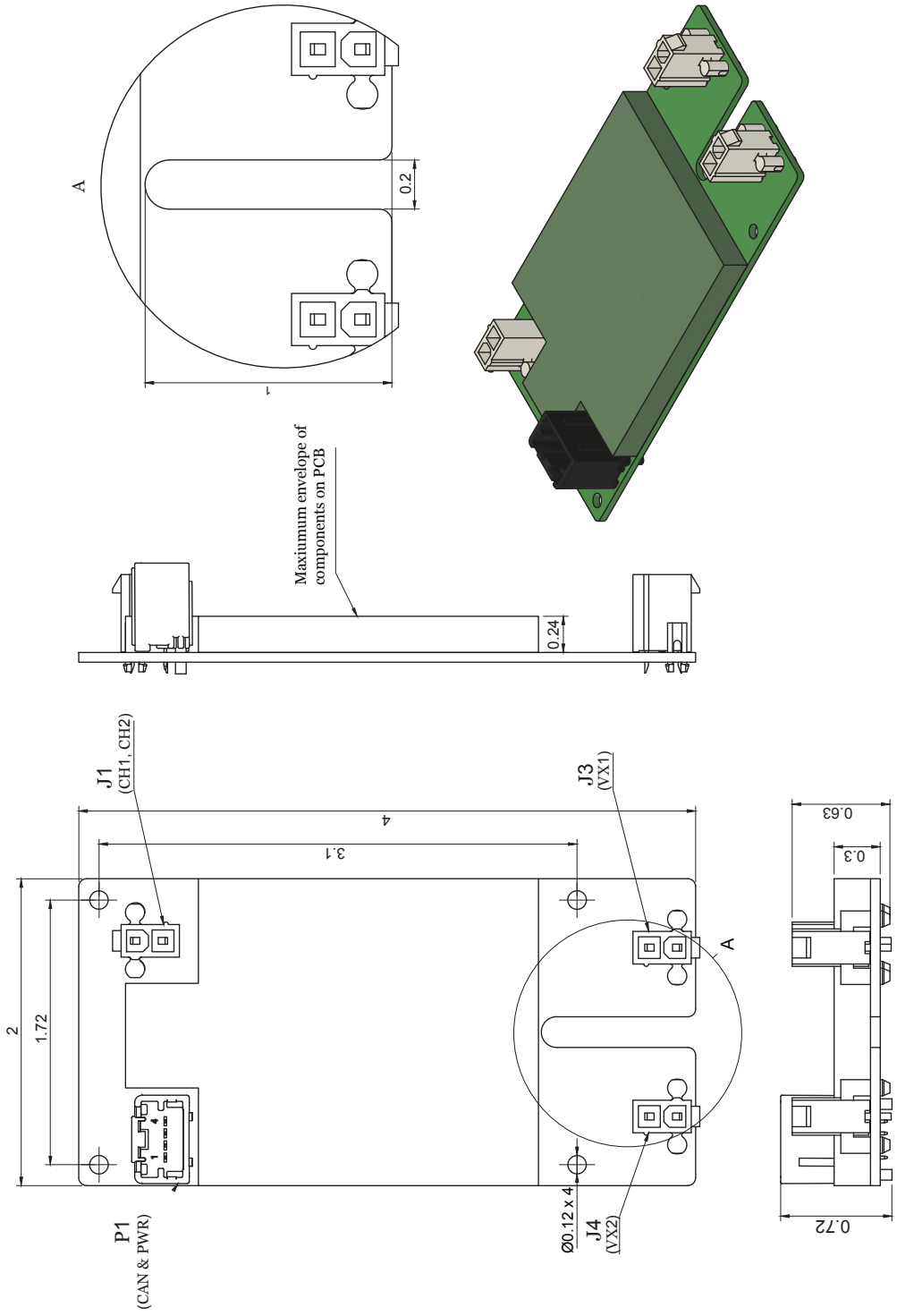
Typical Applications



For information on the Host controller interactions with the SIM100 module, and readout of the results of the module's measurements, please refer to the separate "SIM100MOD CAN Protocol" document.

Mechanicals

SIM100MOD general dimensions [inches]



Ordering Information

Part Number	Description
SIM100CA-MOD	SIM100MOD module
SIM100KIT	SIM100MOD module, CAN to USB protocol converter for PC communication, cables, and Windows software

Revision History

Revision Table

Revision Number	Date	Comments
0.4	04/26/2017	Minor corrections
0.3	03/22/2017	Minor corrections
0.2	03/06/2017	Updated features and electrical specs
0.1	02/28/2017	Preliminary; initial release

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Patents

US Pat. 8,373,408
US Pat. 8,350,552
US Pat. 8,289,030
Other patents pending

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