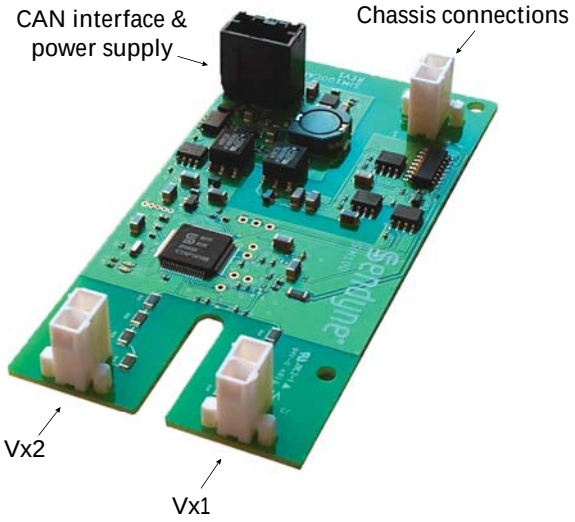
Sendyne® Sensing Products Family

Sendyne Isolation Monitor For Electric and Hybrid Vehicles



Applications

– *Monitoring electric and hybrid vehicle power systems*

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, no variations, or even if the battery is not connected. The SIM100MOD continuously monitors the isolation resistance between a vehicle's IT (Isolated Terra) power system and chassis for deterioration of isolation and potentially dangerous levels of leakage current. The module 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 isolation fault, the unit identifies the position of the fault in relation to the battery's terminals. Battery-connected V_{X1} (Vp) and V_{X2} (Vn) voltage inputs can measure ±962 V in reference to Chassis (0 V). Communications are achieved via an isolated CAN 2.0B interface (500 kbit/s) and a wide temperature range of –40 °C to +105 °C. The Sendyne SIM100MOD was designed as a component for systems compying with ISO 6469-3:2011-12, UL 2231-1, UL2231-2, IEC 61557-A, CFR 571.305 and other applicable standards.

Operating Specifications

Parameter	Value
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: ±962 V/channel continuous, no signal clipping
Rating	Automotive
Power consumption	< 375 mW (+5 V power supply), < 475 mW (+48 V power supply)
Module operating temperature range	-40 °C to +125 °C (-40 °C to +105 °C for connectors)

Features

- *Measures voltage for each battery terminal to chassis*
- *Reports battery voltage*
- *Operates normally while the battery is having large voltage excursions and variations*
- *When the battery is not connected or if the battery voltage drops below 15 V, the parallel combination of the two reported isolation resistances (for the high and low sides) is still accurate, as well as the sum total of the reported high and low capacitances*
- *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*
- *Reports uncertainty for all measured and calculated values*
- *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 safety status of the system*
- *Initializes in under 6 seconds*
- *Fast detection of a rapid change in insulation resistance: The SIM100 detects an insulation value change in less than 5 secs*
- *Warning and Fault alerts provided in the STATUS byte for low insulation resistance values*

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			500	mW	
Start-up time		6		s	After application of power and power supply stabilization to the initial calculation of isolation values
Isolation Resistance Measurement					
Isolation resistance monitoring range	0		2.727	MΩ	From each side of the battery to chassis.
Isolation monitoring lines resistance		2.727		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, battery voltage above 15 V: The total measurement uncertainty includes the contribution by the noise and operations of the target system
Isolation values calculation period		0.5		s	The SIM100MOD calculates all reportable isolation values every 500 ms
Resistance value flagged as a short	0		5	kΩ	Reported isolation resistance value will be exactly 0 Ω/V
Voltage Measurement					
Nominal full-scale voltage range	±962	±982		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

Electrical Specifications

Parameter	Min	Typ	Max	Units	Conditions/Comments
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		V	Minimum reportable voltage change
Permitted battery voltage	0		962	V	If the battery voltage is under 15 V, only parallel resistance and capacitance will be accurate
Capacitance Measurement					
Capacitance monitoring range	0.1	1	2	µF	Capacitance from each terminal of the battery to chassis. A 100 nF capacitance (minimum) is required for normal functioning
Capacitance monitoring uncertainty		±15		%	200 nF to 2 µF, when battery voltage has at least 2 V periodic variations
Capacitance measurement resolution		1		nF	
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
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					

Electrical Specifications

Parameter	Min	Typ	Max	Units	Conditions/Comments
Test voltage			3	kV_{DC}	CAN interface to chassis, 1 min. duration
ESD tolerance			25	kV	Air discharge to VX1/VX2 terminals; CAN connector's signals and/or Chassis connector signals have continuity to reference GND of the ESD tester
			±15k	kV	Contact discharge to VX1/VX2 terminals, same conditions as above

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

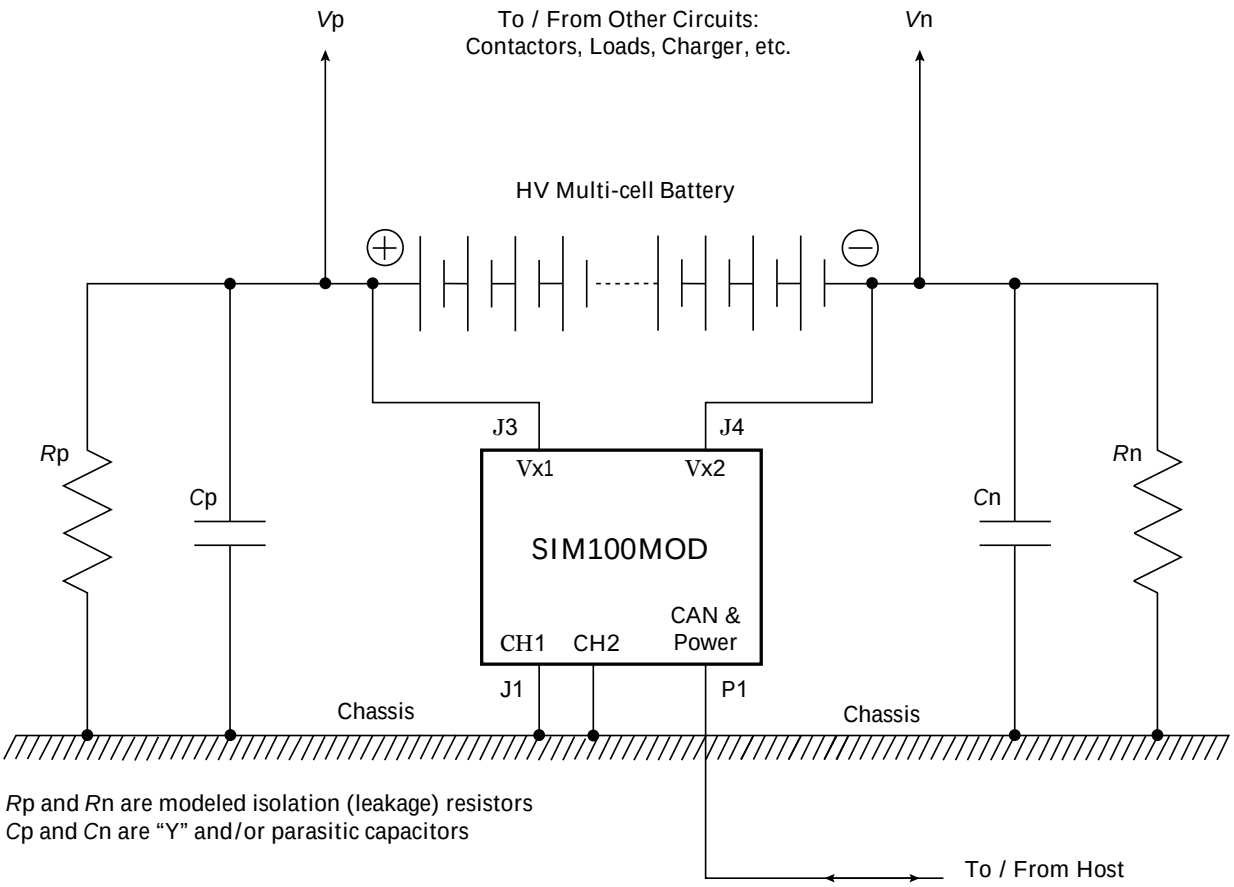
Pin Number	Signal Name	Comments
Connector J1		
1	CH1	Chassis connection 1. One of two independent connections to Chassis.
2	CH2	Chassis connection 2. One of two independent connections to Chassis.

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.

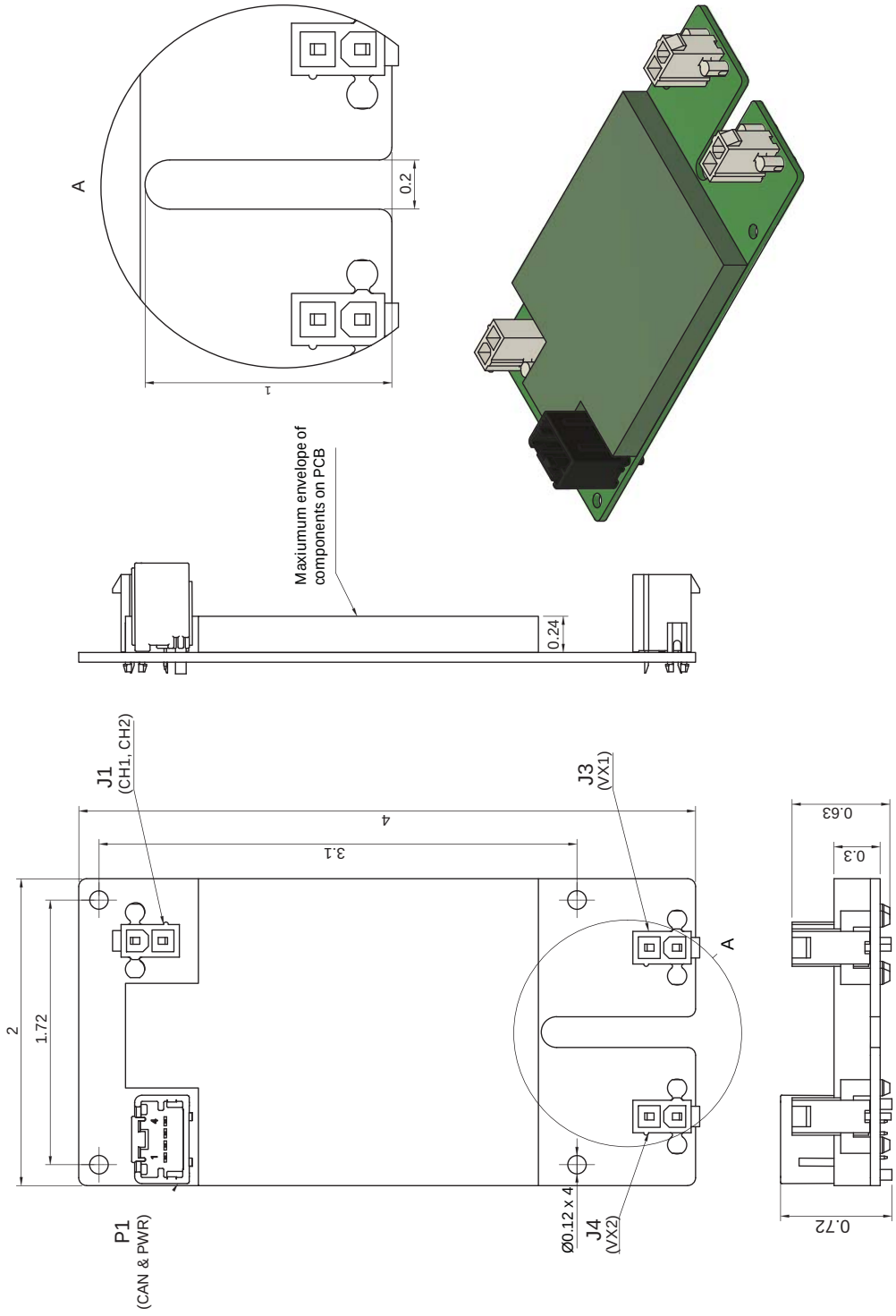
Typical Applications



A 100 nF capacitance (minimum) for *C*p and *C*n is required for normal functioning.
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
SIM100MOD	SIM100MOD module
SIM100MOD-AZ1	SIM100MOD module without connectors
SIM100MOD-AZ2	SIM100MOD module without connectors and CAN termination resistor
SIM100KIT	SIM100MOD module, CAN to USB protocol converter for PC communication, cables, and Windows software

Revision History

Revision Table

Revision Number	Date	Comments
0.13	04/12/2018	Update of electrical specifications and minor corrections of the text. The SIM100 now detects an insulation value change in less than 5 secs instead of 12 secs of the previous version. Warning and Fault alerts now provided in the STATUS byte for low insulation resistance values
0.12	11/22/2017	Part number revisions
0.11	10/04/2017	Additional revision to Operating Specifications
0.10	10/04/2017	Minor correction to Operating Specifications
0.9	08/02/2017	AZ1 and AZ2 implemented in ordering information
0.8	07/19/2017	Minor Corrections
0.7	07/19/2017	Updated UL language, first page
0.6	06/01/2017	Updated voltage measurement, units corrected to V instead of mV
0.5	05/26/2017	Updated capacitance measurement and permitted battery voltage
0.4	04/26/2017	Minor corrections
0.3	03/22/2017	Minor corrections
0.2	03/06/2017	Updated features and electrical specs

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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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