



# SIM100 MOD™

## Active Insulation Monitoring Device

The 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 device 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, patented and 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 voltage inputs can measure  $\pm 1500$  (max) V in reference to Chassis (0 V). Communications are achieved via an isolated CAN 2.0B interface and the unit operates over a wide temperature range of  $-40$  °C to  $+105$  °C. The SIM100MOD was designed as a component for systems complying with ISO 6469-3:2011-12, UL 2231-1, UL2231-2, IEC 61557-8, CFR 571.305 and other applicable standards.

### Highlights

#### Usability

- Reports battery voltage
- Reports uncertainty for all measured and calculated values
- Provides nonvolatile storage for calibration of the voltage measurements and other parameters; all reported measurements have their respective calibration parameters applied automatically
- 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

#### Performance

- Measures voltage of each battery terminal with reference to chassis
- Reports accurate estimates of the isolation status while the battery is having large voltage variations
- Fast detection of a rapid change in insulation resistance: The SIM100 detects an insulation value change in less than 5 secs
- 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
- Provides high immunity to common-mode noise that can be present on the battery terminals

#### Safety

- 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  $\Omega/V$  per requirements of the safety standards
- The unit continuously monitors both the connections of the voltage sense lines to the battery terminals and its own connection to the chassis, reporting any inadequate connections in either case
- Provides built-in galvanically isolated and intrinsically leakage-safe excitation source
- A single CAN message provides sufficient information for determination of the safety status of the system
- Warning and Fault alerts provided in the STATUS byte for low insulation resistance values

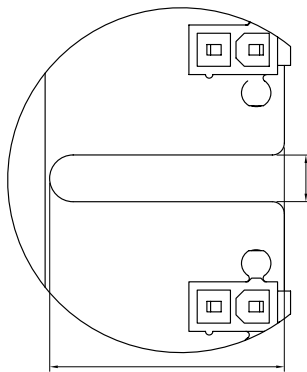
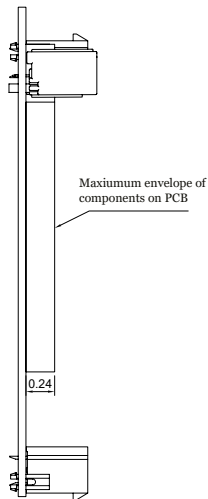
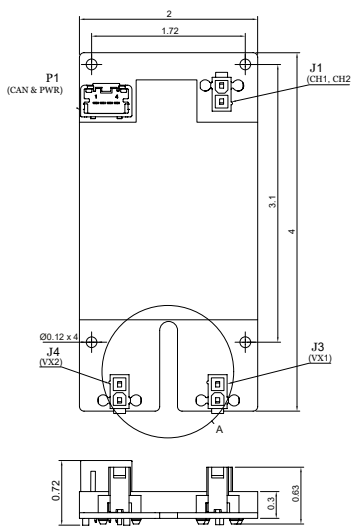
#### Benefits

- Ensures accurate isolation resistance measurements even when the battery voltage drops below 15 V
- Improves overall system safety with continuous monitoring and fault alerts
- Optimizes system performance with rapid initialization and detection capabilities
- Provides robust data storage and automatic calibration for consistent accuracy

#### Applications



# SIM100MOD™ Technical Specifications



## Operating Specifications

| Parameters                         | 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 (optional)              |
| Voltage measurement range          | 2 Channels: ±1500 (max) 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 OC to +125 OC for electronics (-40 OC to +105 OC with connectors) |

| Parameter | Min | Typical | 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  | From application of power and power supply stabilization to availability of initial isolation values |

### Isolation Resistance Measurements

|  |   |       |       |    |  |
|--|---|-------|-------|----|--|
| Reporting range  | 0 |       | 2.727 | MΩ | From each side of the battery to chassis. (includes SIM100 resistances)  |
| Measurement resolution   |   | 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                                 |
| Measurement 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 |
| Measurement update period  |   | 0.5   |       | s  | The SIM100MOD calculates all reportable isolation values every 500 ms  |
| Reporting of short condition* (*Design targets, to be validated on production board) | 0 |       | 5     | kΩ | Reported isolation resistance value will be exactly 0 Ω/V  |

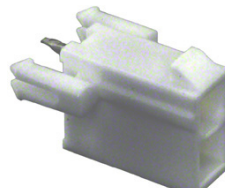
# SIM100MOD™ Technical Specifications

| Parameter   | Min           | Typical       | Max               | Units              | Conditions / Comments   |
|---|---------------|---------------|-------------------|--------------------|---|
| <b>Voltage Measurement</b>  |               |               |                   |                    |   |
| Nominal full-scale voltage range  | ±1520<br>±962 | ±1552<br>±982 |                   | V<br>V             | For SIM100MOD-wNyz<br>For SIM100MOD-wMyz  |
| Voltage offset error  | -1            | ±0.2          | +1                | V                  | VX = 0 V, applies over the full ambient operating temperature range,<br>TA = -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   |               | 200           |                   | m <sub>VRMS</sub>  | 1 Hz reporting rate   |
| Voltage measurement resolution  |               | 1             |                   | V                  | Minimum reportable voltage change   |
| Permitted battery voltage   | 0<br>0        |               | 1500<br>960       | V<br>V             | For SIM100MOD-wNyz<br>For SIM100MOD-xMyz<br>If the battery voltage is under 15 V, only parallel resistance and capacitance will be accurate   |
| <b>Capacitance Measurement</b>  |               |               |                   |                    |   |
| 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                 |   |
| <b>Temperature Measurement</b>  |               |               |                   |                    |   |
| Absolute temperature measurement error  | -5            | ±0.5          | +5                | °C                 | Built-in temperature sensor   |
| Temperature measurement resolution  |               |               | 10                | m°C                | Practical temperature measurement granularity   |
| <b>Noise Immunity of Measurements</b>   |               |               |                   |                    |   |
| Common mode voltage on the battery terminals                                    | 20            |               |                   | V <sub>PK-PK</sub> | 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 <sub>PK-PK</sub> | 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 |
| Test voltage  |               |               | 3                 | kV <sub>DC</sub>   | CAN interface to chassis, 1 min. duration   |
| Overvoltage   |               |               | 6.4 (2s)          |                    | Maximum voltage between VX1/VX2 terminals and Chassis for 2 s.  |
| 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.  |
|   |               |               | ±15 k             | kV                 | Contact discharge to VX1/VX2 terminals, same conditions as above  |
| <b>Communication</b>  |               |               |                   |                    |   |
| <b>Interface</b>  | <b>Spec</b>   |               | <b>Speed</b>      |                    | <b>Termination</b>  |
| CAN   | 2.0B          |               | 500 or 250 kbit/s |                    | 120 Ω termination resistor optional   |

# SIM100MOD™ Technical Specifications

## Connectors

| Interface                   | Manufacturer | Position | 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](#)

## Ordering Information

| Part Number    | Description  |
|----------------|--|
| SIM100MOD-WXYX | SIM100MOD module. See table below for WXYZ options.  |
| SIM100KIT-WXYZ | SIM100MOD module, CAN to USB protocol converter for PC communication, cables, and Windows software |

## Ordering Options (WXYZ)

| SIM100MOD-WXYZ | CAN bus        | Voltage    | Connectors & CAN termination       | Conformal Coat |
|----------------|----------------|------------|------------------------------------|----------------|
|                | A - 500 kbit/s | L - 100 V  | A - All connectors, termination    | N - None       |
|                | B - 250 kbit/s | M - 960 V  | B - All connectors, no termination | C - Yes        |
|                |                | N - 1500 V |                                    |                |

wLyz & wNyx versions with special order

Information for the 100 V version is presented in the "Specifications addendum to SIM100MOD-wLyz document.

## Legacy Parts

| Old Part Number | New Ordering Code |
|-----------------|-------------------|
| SIM100MOD       | SIM100MOD-AMA     |
| SIM100KIT       | SIM100KIT-AMA     |

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