Sendyne® Sensing Products Family

Sendyne Isolation Monitor For Electric and Hybrid Vehicles

Description

The Sendyne SIM100IC is a low power, pre-programmed automotive rated IC which, in conjunction with the SIM100IC reference design, provides high voltage isolation monitoring for EV/HEVs.

The SIM100IC makes use of a proprietary, patent-pending advanced algorithm developed by Sendyne's modeling and simulation team. This algorithm allows modules based on the IC to continuously monitor 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. SIM100 based modules can detect not only resistive leakages but also capacitively stored energy that could be harmful to human operators and are further 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.

Communications are achieved via an isolated CAN 2.0B interface (500 kbit/s). The IC operates within a wide temperature range of –40 °C to +125 °C. The SIM100MOD is an embodiment of the SIM100IC reference design. The Sendyne SIM100IC and attendant circuit was designed as a component for systems complying with ISO 6469-3:2011-12, UL 2231-1, UL 2231-2, IEC 61557-A, CFR 571.305 and other applicable standards.

Applications

– *Isolation monitoring for electric and hybrid vehicle power systems*

Specifications with Suggested Circuit

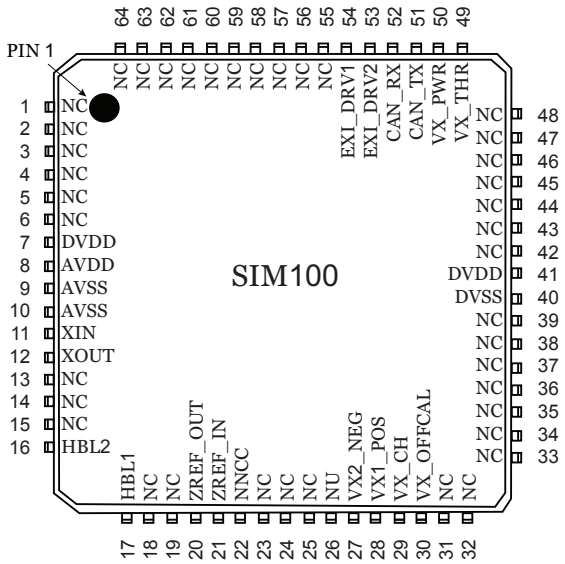
Parameter	Value
IC Power supply	5.0 V 1 % - See suggested schematics
Interface	CAN 2.0B isolated, termination per user's application, 120 Ω suggested
IC Rating	Automotive AEC-Q100
IC Power consumption	< 100 mW
IC operating temperature range	-40 °C to +125 °C

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 voltage is above 15 V*
- *Notifes when the battery is not connected or if the battery voltage drops below 15 V. In this situation the SIM100 reports the parallel combination of isolation resistance and total capacitance between battery terminals and chassis*
- *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 safety status of the system*

SIM100 IC Pin Description

LQFP64



Pin Number	Pin Name	Pin Function
1-6	NC	Not Connected
7	DVDD	Digital Supply
8	AVDD	Analog Supply
9	AVSS	Analog Ground
10	AVSS	Analog Ground
11	Xin	Oscillator input
12	Xout	Oscillator output
13-15	NC	Not Connected
16	HBL2	Heart Beat 2
17	HBL1	Heart Beat 1
18-19	NC	Not Connected
20	ZREF_OUT	Voltage Reference Output
21	ZREF_IN	Voltage Reference Sense
22-26	NC	Not Connected
27	VX2_NEG	Voltage input, negative terminal of battery
28	VX1_POS	Voltage input, positive terminal of battery

Pin Number	Pin Name	Pin Function
29	VX_CH	Voltage input, Chassis Sense
30	VX_OFFCAL	Voltage input, Offset Calibration
31-39	NC	Not Connected
40	DVSS	Digital Ground
41	DVDD	Digital Supply
42-48	NC	Not Connected
49	VX_THR	Voltage input, thermistor reading for termperature
50	VX_PWR	Voltage input, Power supply reading
51	CAN_TX	CAN Transmit pin
52	CAN_RX	CAN Recieve pin
53	EXI_DRV2	Excitation Source Control 2
54	EXI_DRV1	Excitation Source Control 1
55-64	NC	Not Connected

Note: All NC (Not Connected) pins must be left floating; do not connect to any nets, including GND (VSS) or power (VDD).

Absolute Maximum Ratings

T_A = -40 °C to +125 °C

Parameter	Rating
AVSS to DVSS	±0.05 V
AVDD to DVDD	±0.3 V
Input lines	VSS -0.3 V to DVDD +0.3 V
DVDD	-0.3 V to 6.0 V
ESD (human body model) all pins	±6 kV
ESD (charged-device model)	±500 V
Storage temperature	-55 °C to +150 °C
Lead temperature soldering reflow	260 °C Max, per J-STD-020

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges readily accumulate on the human body as well as test equipment, and can discharge without detection. Although this product features protection circuitry, damage may occur in devices subjected to high energy ESD. Proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

Technical Specifications

Electrical Specifications With Suggested Circuit

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 Current			80	mA	At minimum supply voltage of 4.8 V
Start-up time		6		s	After application of power and power supply stabilization to the initial calculation of insulation resistance
Isolation Resistance Measurement, Based on Reference Design					
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 SIM100IC 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 With Suggested Circuit

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	Vx = 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		V	Minimum discernible voltage change
Permitted battery voltage	0		1000	V	If the battery voltage is under 15 V, parallel resistance and capacitance will be reported only
Capacitance Measurement					
Capacitance monitoring range	0.1	1	2	µF	Capacitance from each terminal of the battery to chassis. A minimum of 100 nF capacitance should be present for normal opperations.
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

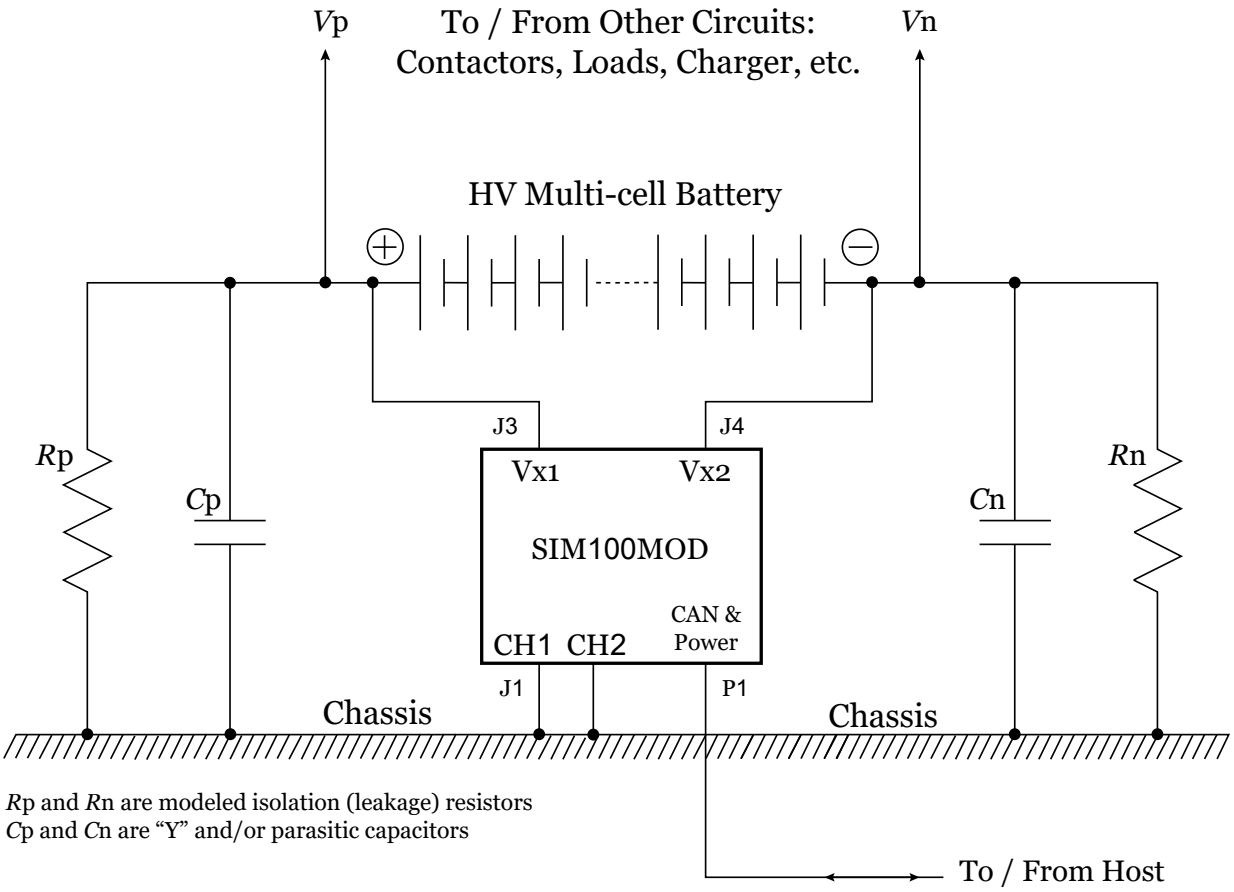
Electrical Specifications With Suggested Circuit

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

Communications

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

Typical Application



A minimum of 100 nF capacitance should be present for normal opperations on *C*p and *C*n

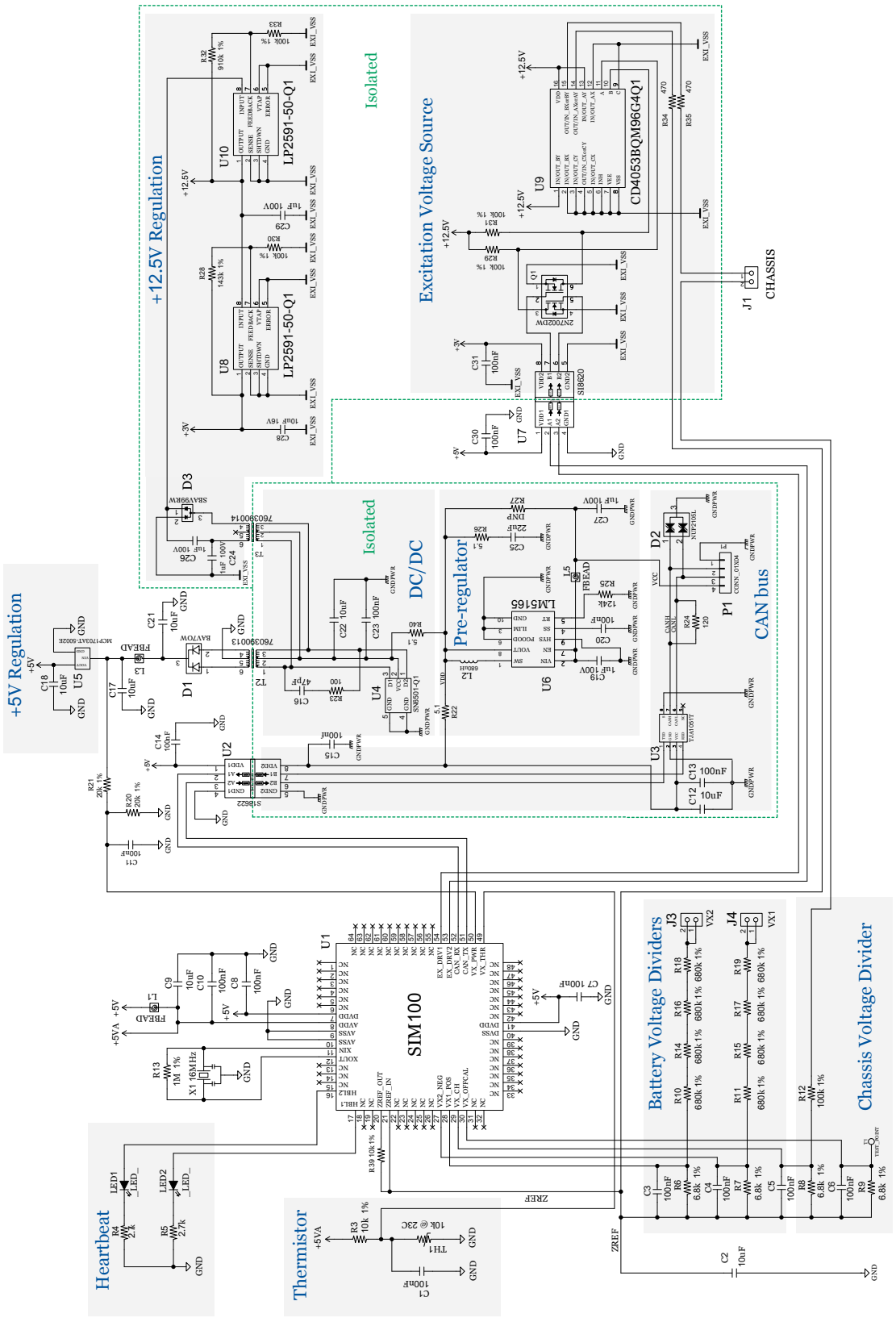
For information on the Host controller interactions with the SIM100, please refer to the separate "SIM100MOD CAN Protocol" document.

Communications

Features

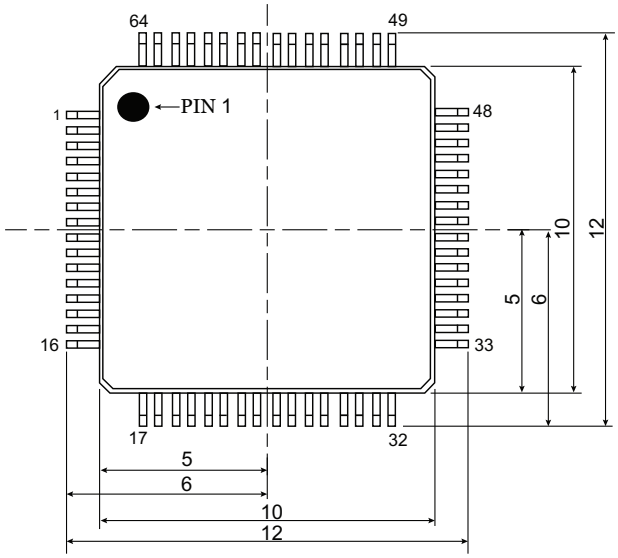
– CAN2.0B extended frame format
– 500 kbit/s
– Polling mechanism allows host to determine the rate of incoming data
– Please see SIM100 CAN Protocol Document for more information

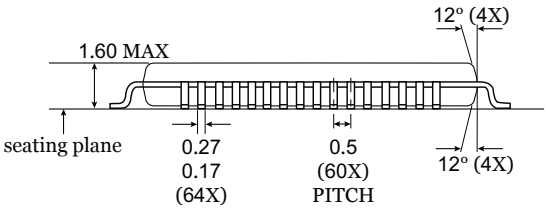
Suggested Schematic



Mechanicals

LQFP64
10 x 10 x 1.4 P 0.5
All dimensions are in millimeters





Additional Documentation

– Sendyne SIM100IC Recommended Schematic and BOM
– Sendyne SIM100 CAN Protocol

Ordering Information

Part Number	Description
SIM100-XX-1ASTZA	SIM1001ASTZA control IC, tray
SIM100-XX-1ASTZAR	Control IC, tape and reel

Revision History

Revision Table

Revision Number	Date	Comments
0.5	5/27/2019	Updated suggested schematic for 2.7 MΩ resistance
0.4	10/02/17	Minor update to technical specifications
0.3	07/19/17	Updated UL Language, first page
0.2	07/13/17	Schematic Modifications
0.1	06/05/17	Preliminary; Initial Release

Information contained in this publication regarding device applications and the like, is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications.

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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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