CPS137

Data Sheet

Digital Barometer

CPS137
Digital Barometer

Consensic

Overview

The CPS137SIP (System-in-a-Package) solution comprises of aresistive bridge type pressure sensor and a 24-bit ADC for high resolution and accurate pressure measurements. The fully calibrated pressure and temperature compensated digital output makes the CPS137 solution simple to use.The CPS137comprises of an internal calibration logic that provides accurate pressure and temperature measurements to the application via I²C interface.There is no need to separately download internal calibration coefficients and have the host micro-controller conduct complicated compensation calculations.

Applications

- Altimeters
- Portable and Stationary Barometers
- Weather Stations
- GPS Applications
- Hard Disk Drives(HDD)
- Industrial Equipment
- Air Control Systems
- Vacuum Systems

Benefits

- Low Power Consumption. Excellent for Battery and Other Low-Power Applications
- External Clock not Required
- High Resistance to Sensing Media

Features

- Factory Calibrated Pressure and Temperature Sensor
- Supply Voltage: 2V to 5.5V(3V @typical)
- Current Consumption: <5uA(One Measurement)
- Sleep State Current: <200nA (25°C)
- Operating Temperature Range: -40°C to +85°C
- Pressure Accuracy: ±0.2kPa (±2.0mbar) @ -20°C to +60°C, ±0.15kPa@25°C
- Temperature Accuracy: ±1.0°C

Interfaces

- I²C^{TM}* Compatible (≤400kHz)

Physical Characteristics

- Small Form Factor, 3.3 x 3.3 x 2.85mm (w x l x h)
- LGA Package, 4 Lead
- Top Side Sensing Port
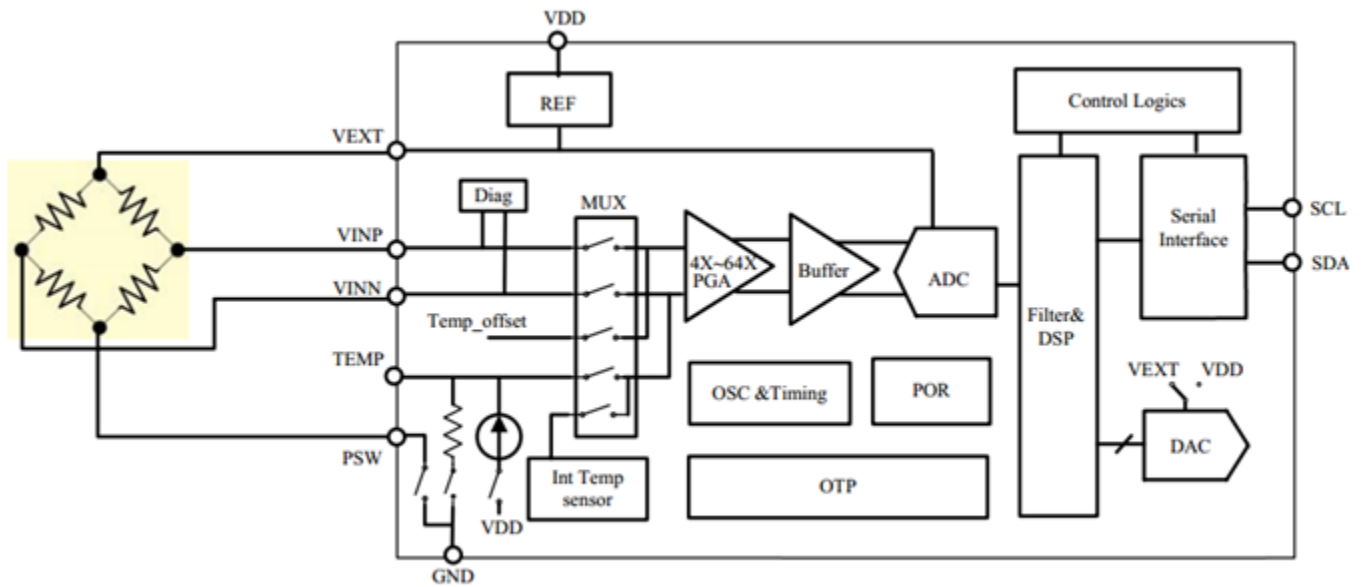
*I²C ^{TM} is a registered trademark of NXP

RoHS Compliant

CPS137 BLOCK DIAGRAM

TABLE1:   ORDERING INFORMATION

PART NUMBER	OUTPUT MODE	OPERATION MODE	PACKAGE
CPS137	I^2C	Sleep	4-Lead LGA
SALES and CONTACT INFORMATION sales@consensic.com			
			www.consensic.com

CPS137
Digital Barometer

United States	China	
Consensic, Inc. 1900 Powell Street,Suite 600 Emeryville California, 94608, USA Ph: +1 510.588.8735	Wuxi Consensic Electronics Co., Ltd. 100 Dicui Road 530 Building B, Suite 704 Wuxi, Jiangsu Province, 214072 Ph: +86 510.85122279 Fax: +86 510.85122259	无锡康森斯克电子科技有限公司 无锡市滨湖区滴翠 路 100 号 530 大厦 B 栋 704 邮编 214072 電話: +86 510.85122279 传真: +86 510.85122259

CONTENTS

CPS137
Digital Barometer

LIST OF TABLES

LIST OF FIGURES

1 OPERATING CHARACTERISTICS

1.1   ABSOLUTE RATINGS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Over Pressure					2X FS	kPa (bar)
Supply Voltage (with respect to GND)	V_{DD}		-0.3		6.5	V
Voltages at Analog and Digital I/O Pins	V_{A_IO} V_{D_IO}		-0.3		V_{DD} +0.3	V
Storage Temperature	T_{STOR}		-60		150	°C

1.2   OPERATING CONDITIONS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
PRESSURE SENSOR						
Range			30 (300)		130 (1300)	kPa (mbar)
Resolution[1]				0.001 (0.01)		kPa (mbar)
Accuracy		70 to 115kPa @25°C	-0.15 (-1.5)	±0.10 (±1.0)	+0.15 (+1.5)	kPa (mbar)
		70 to 115kPa (0°C to 50°C Verified)	-0.2 (-2.0)	±0.15 (±1.5)	+0.2 (+2.0)	kPa (mbar)
Solder Drifts			-0.1		+0.2	kPa
TEMPERATURE SENSOR						
Range			-40		85	°C
Resolution				0.003		°C
Accuracy		-40°C to 85°C	-1	±0.75	+1	°C
OPERATION						
Supply Voltage to GND[2]	V_{SUPPLY}		2	3.0	5.5	V
Operating Temperature Range			-40		85	°C
I[2]C Pull-Up Resistors	R_{PU}		1	2.2		kΩ

[1]Guaranteed by design of 24bits ADC, and calculated according to the range in application.
[2] Factory calibrated for Pressure and Temperature at 3.0V±10%. Output accuracy will be affected if used outside this range. Other ranges available upon request.

1.3 ELECTRICAL PARAMETERS

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY CURRENT						
Supply Current, average(1) during conversion(2) standby(no conversion)	Iavg Isc Iss	VDD=3V		3.95 1.5	 0.2	µA mA uA
ANALOG TO DIGITAL CONVERTER						
Resolution	r_{ADC}				24	Bit
I^{2}C Clock Frequency	$F_{C,I2C}$				400	kHz

<u>Notes</u>

1) Under the assumption of one conversion every second. Conversion means either a pressure or a temperature measurement

2) During conversion, the sensor will be switched on to VDD, and after conversion ended, the sensor will automatically be switched off from VDD.

2   OPERATION MODES

The CPS137 is factory programmed to Sleep Mode. In this mode, the CPS137 remains asleep until the master/host sends a measurement request (MR) before taking sensor measurements. After the CPS137receives an MR command, it wakes up, runs a full measurement cycle, stores the measurement data in internal registers and then returns to sleep mode again.

3   OUTPUT MODES

3.1   I^{2}C Slave

Two-wire I^{2}C is available for reading sensor measurement data from the CPS137.

The factory setting for the I^{2}C slave address is 0x6D and the communication is restricted to this address only.

- I^{2}C Address = 0x6D

I^{2}C COMMANDS

Table 2 details the commands to interface with the device in the I^{2}C mode.

TABLE 2: I^{2}C COMMANDS

TYPE	DESCRIPTION
Get Data (GD)	Retrieves the sensor measurement data from the internal CPS137 registers*.
Measurement Request (MR)	Wakes up the CPS137, performs a sensor measurement, stores the sensor measurement data in internal registers and returns to sleep

*Note: GD does not initiate a new measurement. Repeated GD commands will return the same (or stale) sensor measurement data.

An MR is required to perform a full sensor measurement cycle to refresh the sensor register data.

The Get Data (GD) command is used to read out data from the CPS137. With the start of communication (for I^{2}C after reading the slave address) the entire sensor measurement output packet will be loaded in a serial output register. The register will be updated after the communication is finished. The output is always scaled to 24-bits.

The ordering of the bits is "big-endian".

3.2.1   I^{2}C GET DATA

An I^{2}C Get Data command starts with the 7-bit slave address and the 8th bit = 1 (READ). The device then sends acknowledge (ACK), indicating I^{2}C communication success. The number of data bytes returned by the device is determined by the master, which controls NACK and stop conditions.

Figure 1 displays and example forsending three bytes followed by readingfive bytes. The first byte contains the I^{2}C address followed by internal register address(0x06). Then theI^{2}C address is repeated, followed by the slave sending out three pressure bytes and two temperature bytes.

The GD command is used to retrieve the pressure and temperature sensor data after an MR command has been executed.

FIGURE 1: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE AND TWO TEMPERATURE BYTES

Note that the two temperature byte codes are formatted in 2's complement.

I2C Get Press and Temp

1st Byte	2nd Byte	3rd Byte	4th Byte	5th Byte	6th Byte	7th Byte	8th Byte
S Slave Address = (0x6D<<1) 0 A	Register Address =0x06 A S	Slave Address = (0x6D<<1) 1 A	PressDat <23:16> A	PressDat <15:8> A	PressDat <7:0> A	TempDat <15:8> A	TempDat <7:0> N P

write   read

- [green] from master to slave
- [blue] from slave to master
- S START condition
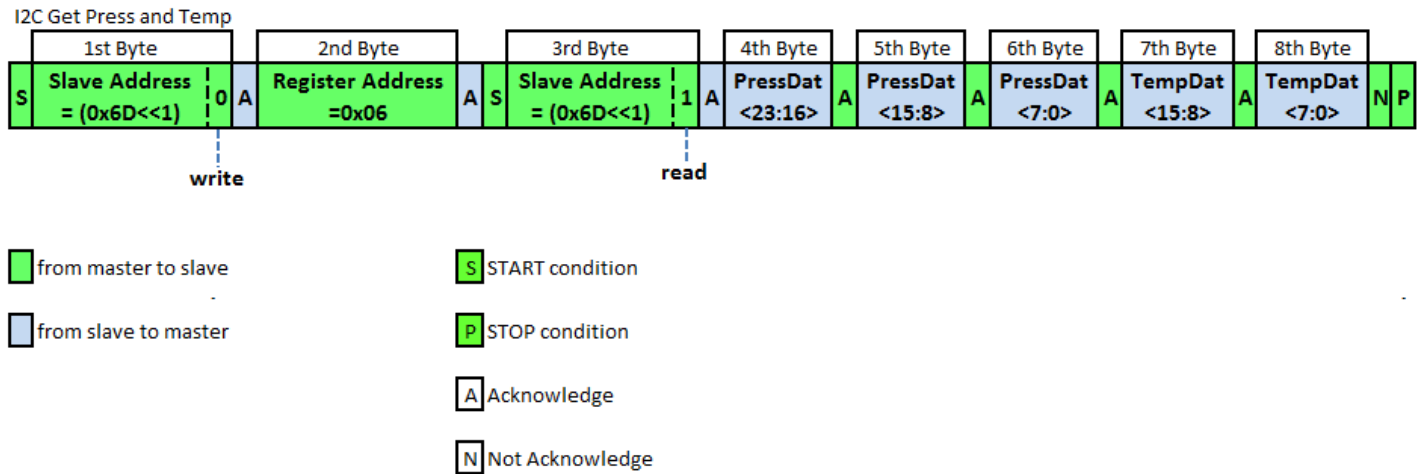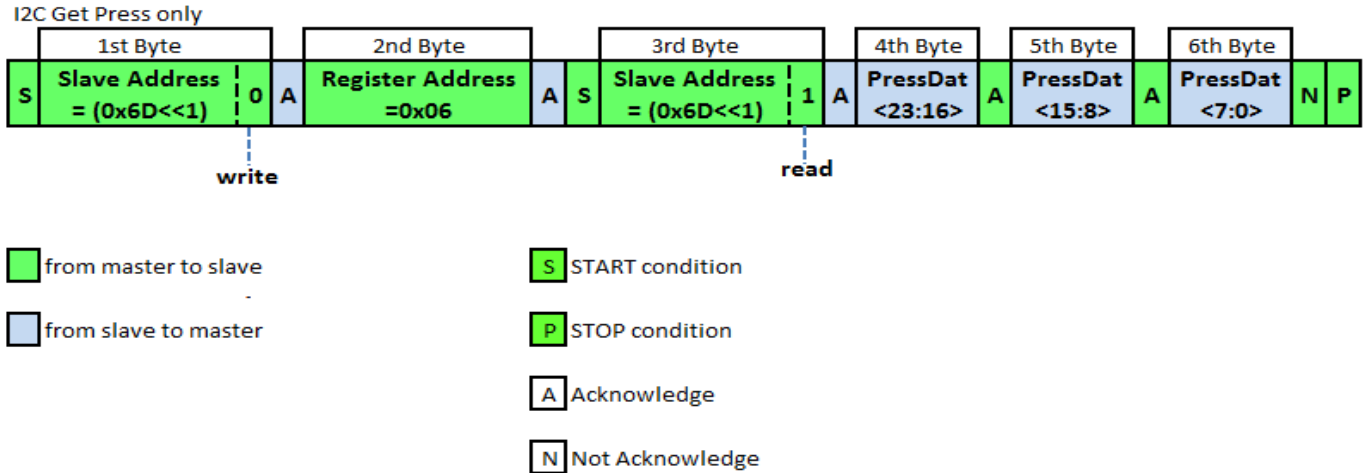- P STOP condition
- A Acknowledge
- N Not Acknowledge

FIGURE 2: 7-BIT SLAVE ADDRESS FOLLOWED BY THREE PRESSURE BYTES

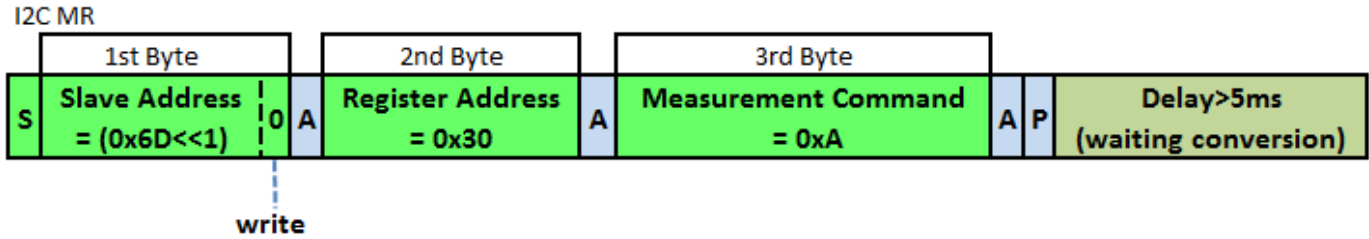For Pressure data only, the data stream can be terminated after thesixthpressure byte. See Figure 2below.

3.2.2 I^{2}C MEASUREMENT REQUEST

The I^{2}C MR is used to wake up the device from Sleep Mode and start a complete sensor measurement cycle, before the device returns to Sleep Mode again. The measurement cycles starts with apressure measurement followed by a temperature measurement. The sensor measurements are digitized and run through an onboard compensation algorithm before the final measurement values are written to the digital output register. As shown in Figure 3, the communication requires the slave address (0x6D) and a WRITE bit (0) to initiate the MR. This is followed by two bytes; register address (0x30) and measurement (0xA). After the CPS137 responds with the slave ACK, the master terminates the communication with a stop condition.

Sensor measurement conversion time takes approximately 5ms, so MRs should not be sent faster than every 5ms.

FIGURE 3: I^{2}C MEASUREMENT REQUEST COMMAND (0xA)

I2C MR

	1st Byte			2nd Byte		3rd Byte			
S	Slave Address = (0x6D<<1)	0	A	Register Address = 0x30	A	Measurement Command = 0xA	A	P	Delay>5ms (waiting conversion)

write

- ▮ from master to slave
- ▯ from slave to master
- ▮ no operation, only delay time

- S START condition
- P STOP condition
- A Acknowledge
- N Not Acknowledge

4   CALCULATING OUTPUT

After retrieving the data, the compensated output can be scaledto real world values by following the equations below.

4.1   PRESSURE OUTPUT

An example of the 24-bit compensated pressure with a full scale range of 30 to 130kPa can be calculated as follows:

Pressure [kPa] = (Pressure 3rd Byte [23:16] x 65536+Pressure 2nd Byte [15:8] x 256 + Pressure1st Byte [7:0]) / 2^6/1000

4.2   TEMPERATURE OUTPUT

The 16-bit compensated temperature can be calculated as follows:

Positive Temperature [°C] = (Temperature High Byte [15:8] x 256 + Temperature Low Byte [7:0]) / 2^8

Negative Temperature [°C] = (Temperature High Byte [15:8] x 256 + Temperature Low Byte [7:0]-65536) / 2^8
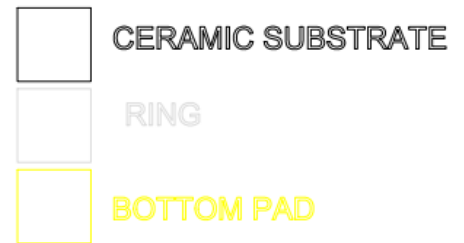
5   PACKAGE AND ASSEMBLY

The CPS137 is available in a 4-pin LGA package.

5.1   PIN ASSEMBLY AND MECHANICAL DRAWING

BOTTOM VIEW   SIDE VIEW   TOP VIEW
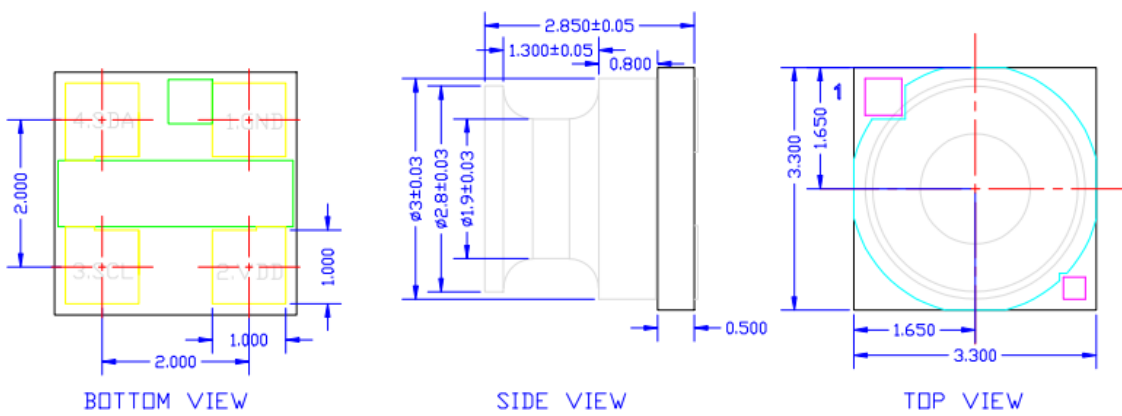
PIN	NAME	FUNCTION
1	GND	GROUND
2	VDD	POSITIVE SUPPLY
3	SCL	I²C CLOCK
4	SDA	I²C DATA

NOTES:(1) Dimensions in mm
(2) General tolerance ±0.1
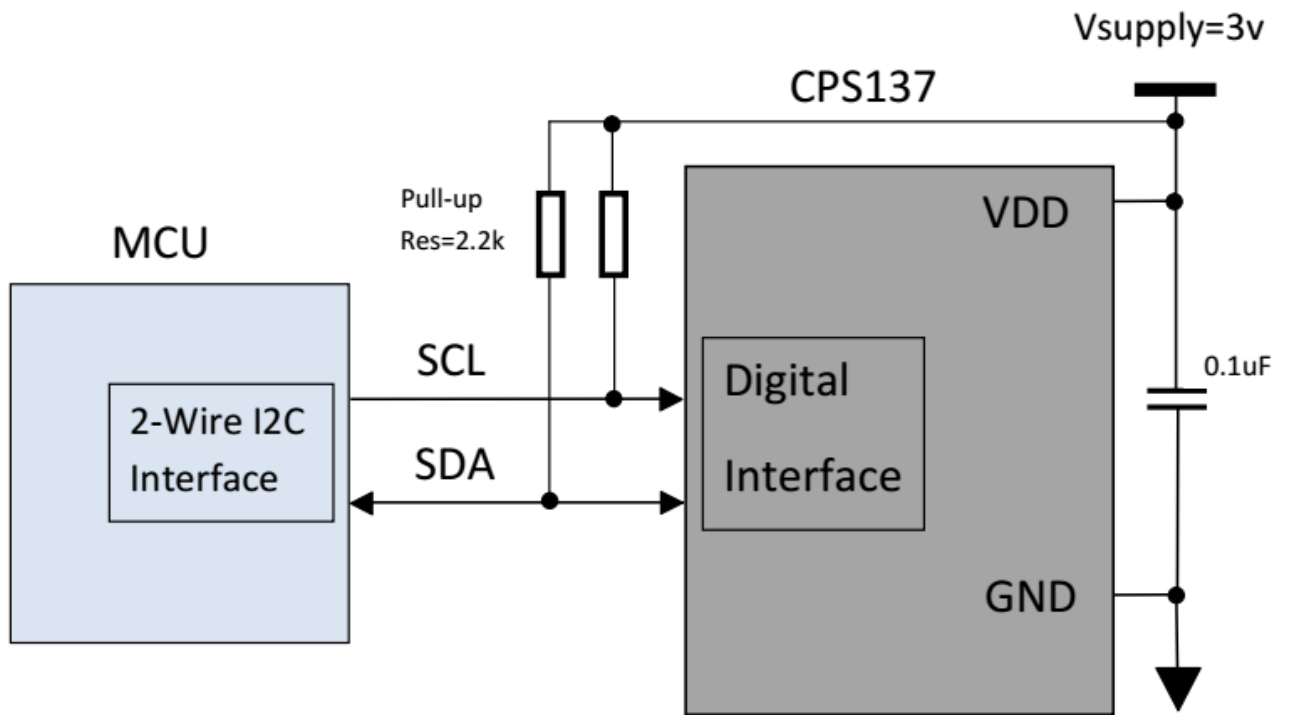(3) Ring centering ±0.1from center of the Ceramic substrate

CERAMIC SUBSTRATE

RING

BOTTOM PAD

5.2   SOLDERING CONDITIONS

TABLE4:   PACKAGE REFLOW TEMPERATURE

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Soldering Peak Temperature	Less than 30 seconds (JEDEC-STD-020 Standard)			260	°C

6   APPLICATION DIAGRAM

7   DOCUMENT HISTORY

REVISION	DATE	DESCRIPTION
0	16-Sep-2015	Preliminary
0.0	07-Mar-2016	Initial Release
1.0	07-Jun-2016	Change limit, package pin define.

8   DISCLAIMER

Information in this datasheet is provided solely to enable implementation and use of Consensic products. The specifications and characteristics are subject to change without notice. Consensic reserves the right to make changes without further notice to any products herein.

"Typical" parameters provided in this datasheet can and do vary in different applications and actual performance may vary over time. Customers must validate all operating parameters for their application.

Consensic is not responsible for direct, indirect, incidental or consequential damages resulting from any defect, error or failure to perform. In no event, regardless of cause, shall Consensic incur any liability for any damages of any kind, including, but not limited to, any direct, indirect, special, incidental, punitive or consequential damages arising out of, resulting from, or any way connected to the use of the product, whether arising under breach of contract, tort (including negligence), strict liability or otherwise, and whether based on this agreement or otherwise, even if advised of the possibility of such damages, and whether or not injury was sustained by persons or property or otherwise; and whether or not loss was sustained from, or arose out of, the results of, the product, or any services that may be provided by Consensic.

The customer assumes all responsibility and liability for proper and safe handling of the goods. It is the customer's responsibility to take any and allappropriate precautions with regard to electrostatic discharge. Also be aware that the products herein may not be regulatory compliant oragency certified (FCC, UL, CE, etc.).

No License is granted under any patent right or other intellectual property whatsoever. Consensic assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other Intellectual property rights of any kind.