1. Features and Benefits

- Triphibian™ technology
- +/-0.5% full scale lifetime accuracy
- Ratiometric analog output
- Fast response time (min 0.4ms)
- System in a package: MEMS, analog front-end circuitry, 16-bit microcontroller, voltage regulators and analog ratiometric back-end
- Automotive temperature range (-40°C to 150°C)
- Robust in gas and liquid media, compliant with chemical refrigerants
- Qualified according to AEC-Q100 and AEC-Q103-002
- Configurable diagnostic features like internal broken connection, over voltage, under voltage etc.
- Factory calibrated and fully programmable through the connector with the PTC04 programming tool for customized calibration curves
- Extended over (+40V) and reverse (-40V) voltage capabilities (supply & output)
- ASIL compliant developed as an ASIL A SEooC as per ISO 26262

2. Application Examples

- Absolute pressures from 2bar to 70bar with gas and/or liquid media
- Thermal Management of Electric Vehicles
  - Standalone sensors
  - Embedded sensors in expansion valves
  - Embedded sensors in e-compressors
  - Embedded sensors in pumps
- HVAC-R systems

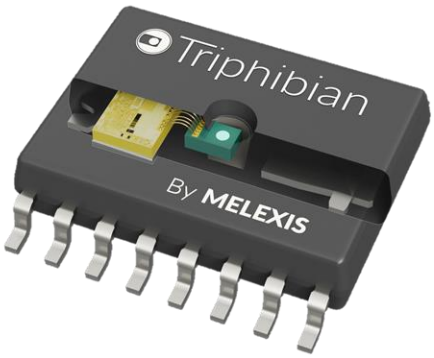


Figure 1: MLX90830

3. Ordering information

Product Code	Temperature Code	Package Code	Option Code	Packing Form Code
MLX90830	L	XG	BAH-001	RE
MLX90830	L	XG	BAF-002	RE

Legend:
Temperature Code: L (-40°C to 150°C)
Package Code: XG = SOIC16 WB cavity package
Option Code: BAH-001 = 0 to 10.342bar (= 150PSI) absolute pressure / 0.5 to 4.5V analog output
BAF-002 = 0 to 34.474bar (= 500PSI) absolute pressure / 0.5 to 4.5V analog output
Packing Form: RE = Reel
Ordering example: MLX90830-LXG-BAH-001-RE

MLX90830LXG-BAH-001-RE

- Packing delivery form
- Option code for variant
- Silicon & firmware version
- Package code
- Temperature code
- Product name

4. Package Diagram

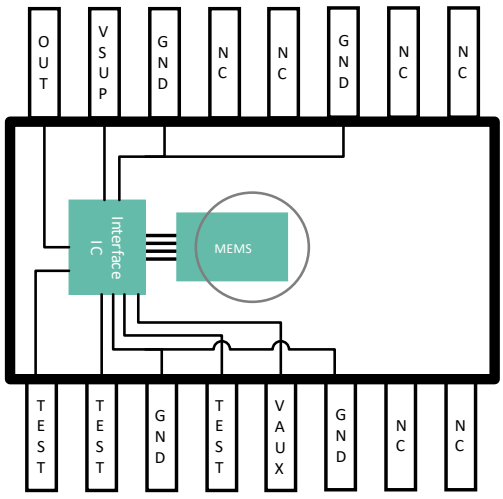


Figure 2: Internal wiring of MLX90830. Top view.

5. General Description

The MLX90830 is a packaged, factory calibrated, absolute pressure sensor measuring spans from 2 to 70 bar. It outputs an analog 'ratiometric' output; the ratio of the output voltage divided by the supply voltage has a linear relationship to the pressure.

The MLX90830 consists of a MEMS pressure sensor element and an interface chip (CMOS technology). This optimized solution exhibits excellent EMC performance. The DSP based signal interface provides outstanding initial accuracy. A smart package and die assembly concept enable high output stability over life, even in stringent automotive temperature and stress conditions.

The MEMS pressure sensor element uses the Triphibian™ technology; a suspended cantilever design that is inherently more robust than rear-side exposed solutions, which still experience a pressure differential between the glass pedestal side and the wire bonding side. The pressure equalization principle is also valid for frozen media.

Contents

6. Glossary of terms

Term	Description
ADC	Analog to Digital Converter
ASIL	Automotive Safety Integrity Level
Bar	Pressure unit (1bar = 100kPa)
DSP	Digital Signal Processor
EMC	Electro Magnetic Compatibility
ESD	Electrostatic discharge
FS	Output Full Scale = O2 – O1
GND	Ground connection
Lower fault band	Output voltage below normal output range to indicate a diagnostic
NC	Not Connected
NVM	Nonvolatile memory
OV	Over Voltage
PCB	Printed Circuit Board
POR	Power-on Reset
PTC04	Melexis Programming Tool, hardware to program the device in lab or production
RV	Reverse Voltage
SEooC	Safety Element out of Context
T_A	Ambient temperature
TEST	Test pin
Upper Fault Band	Output voltage above normal output range to indicate a diagnostic
UV	Under Voltage
Vaux	Pin to connect an auxiliary capacitor
Vsup	Supply pin

Table 1: Glossary of terms

7. Absolute Maximum Ratings

Parameter	Symbol	Value	Units	Comment
Supply Voltage (overvoltage)	OV	40	V	Max 2 hours
Reverse Voltage Protection	RV	-40	V	
Positive output voltage		40	V	
Reverse output voltage (1)		-40	V	
Operating Ambient Temperature Range	T_A	-40 to 150	°C	
Storage Temperature Range		-40 to 150	°C	
Programming Ambient Temperature Range		-40 to 125	°C	
Proof pressure		3x P2	Bar	
Burst pressure		5x P2	Bar	

Table 2: Absolute maximum ratings

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. Maximum duration of over voltage and reverse voltage conditions is 2 hours.

1 Absolute maximum DC negative output at floating supply or supply shorted to output. Maximum DC negative output at operating supply: -5.5V.

8. Pin Definitions and Descriptions

Pin number	Description	Pin number	Description
1	Not connected	16	Not connected
2	Not connected	15	Not connected
3	Ground	14	Ground
4	Not connected	13	VAUX
5	Not connected	12	TEST
6	Ground	11	Ground
7	VSup	10	TEST
8	Analog OUT	9	TEST

Table 3: Pin out definitions and descriptions

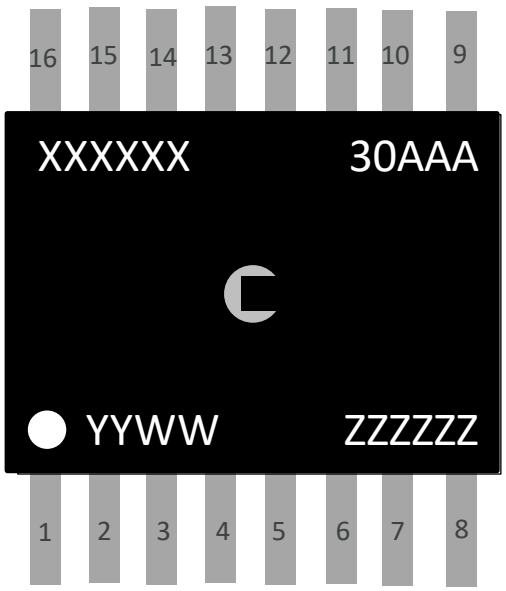


*Figure 3: Package marking (**Top** view)*

Symbol	Function / Description
XXXXXX	ASIC lot number
ZZZZZZ	Sub-lot number
YY	Year of assembly
WW	Calendar week of assembly
AAA	MEMS and ASIC traceability letter

Table 4: Package marking definition

9. General Electrical Specifications

DC Operating Parameters T_A = -40°C to 150°C

Parameter	Symbol	Remarks	Min	Typ[2]	Max	Units
Nominal supply voltage	Vdd		4.5	5	5.5	V
Nominal supply current	Idd	No output load		9.5	12	mA
Current consumption at supply overvoltage	IDD_OV				20	mA
Current consumption at supply reverse voltage	IDD_RV				20	mA
Output short-circuit current	IOUT_SH				20	mA
Capacitive load on output	Cload		47		220	nF
Resistive load on output	Rload	Pull up	3		425	kOhm
		Pull down	3		470	kOhm
Output current	IOUT				2	mA
Under voltage detection range		Programmable. In default configuration set to 4.2V.	4.15		4.8	V
Over voltage detection range		Programmable. In default configuration set to 5.55V.	5.2		5.75	V
Under voltage detection tolerance			-50		50	mV
Over voltage detection tolerance			-50		50	mV
Power up time		Time from reaching minimum allowed supply voltage of 4.5V till having the output within specification			4	ms
Default response time [3]		According to default configuration.			1	ms
Fastest response time [3]					0.4	ms
Refresh rate		Time between two consecutive updates on the output			75	µs
Operating output voltage range		Output range where the linearity is in spec with any resistive load inside the specified range	4		96	%Vdd
Upper Fault Band			97		100	%Vdd
Lower Fault Band			0		3	%Vdd
Pressure output noise		Default configuration			2	mV rms

Table 5: Electrical specifications

2 Typical values are defined at T_A = +25°C and V_{DD} = 5V.

3 Response time is defined as the time elapsed from input pressure step to the output reaching 90% of settled output.

10. Detailed General Description

The MLX90830 consists of a pressure sensor element and a DSP-based interface chip.

The pressure sensor element consists of a diaphragm realized in the silicon chip by wafer bonding on an etched cavity with built in reference vacuum. The diaphragm reacts to a change in absolute pressure. The internal strain increases, in particular at the border of the diaphragm. Here, the piezo-resistive elements have been implanted into the silicon diaphragm forming a Wheatstone bridge, which act as a transducer. The pressure sensor element can operate in gas and liquid media or a mix of both.

The sensor uses Triphibian™ technology: a suspended cantilever design of the sensor provides pressure spike immunity up to 2000 bar/msec and static burst level up to 210 bar. The MLX90830's design is inherently more robust than rear-side exposed solutions, which still experience a pressure differential between the glass pedestal side and the wire bonding side. The pressure equalization principle is also valid for frozen media.

The analog front-end of the interface chip applies filtering and converts the analog signal to a digital value. The DSP performs the compensations over temperature. Furthermore, the digital circuit provides some filtering, the possibility to linearize the pressure signal and also implements the clamping function. This chip has an analog output proportional to the pressure and supply voltage. A broken wire detection block ensures the analog output goes to one of the fault bands in case of a broken supply or ground connection.

Extensive protection of the supply lines and output allows the MLX90830 to handle extreme overvoltage conditions and makes it resistant to severe external disturbances. Several diagnostic functions (over-voltage, under-voltage, overpressure, under pressure detections) have been implemented on the MLX90830 and can be enabled by programming EEPROM settings. Figure 4 shows the MLX90830 block diagram.

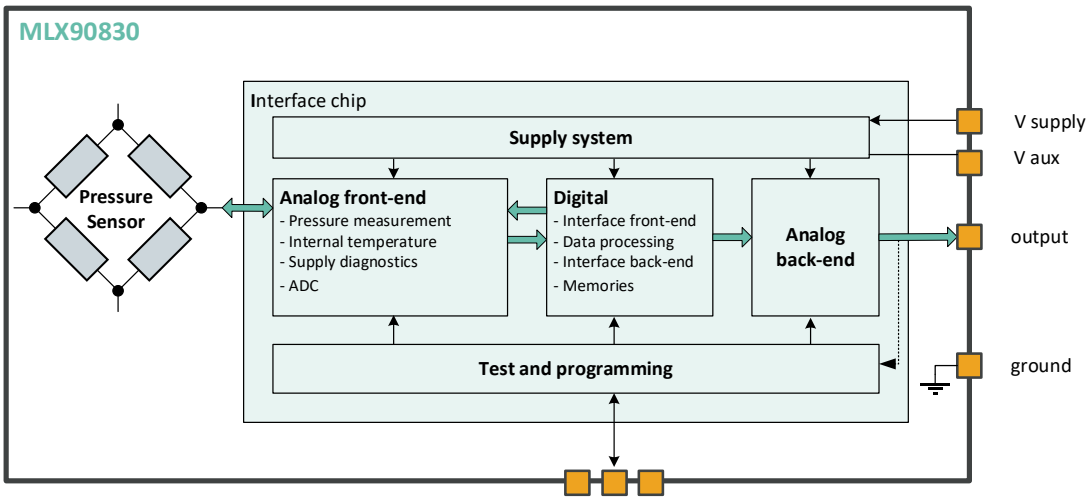


Figure 4: MLX90830 block diagram

11. Default programmed settings

The MLX90830 is calibrated at the final manufacturing test steps. During the calibration, settings are stored in the on-chip EEPROM to define the pressure transfer curve.

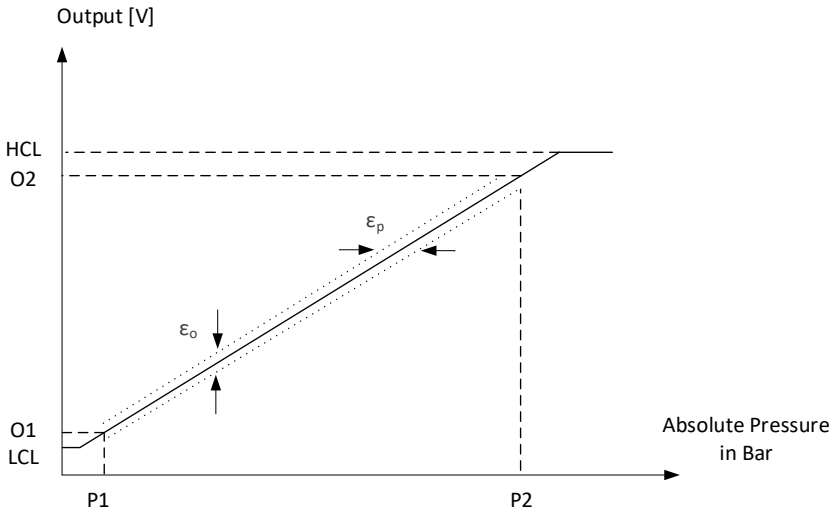


Figure 5: Pressure transfer function and accuracy at room temperature

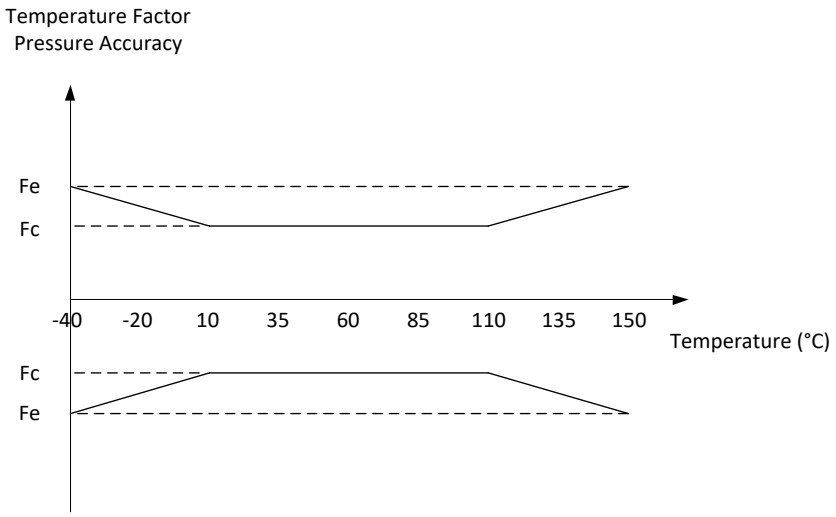


Figure 6: Pressure accuracy temperature factor

11.1. MLX90830-LXG-BAH-001

Transfer Curve Parameter	Symbol	Remarks	Value			Unit
Pressure 1	P1	See Figure 5: Pressure transfer function and accuracy at room temperature	0			Bar
Pressure 2	P2		10.342			Bar
Output 1	O1		0.5			V
Output 2	O2		4.5			V
Low clamping level	LCL		0.3			V
High clamping level	HCL		4.7			V
Pressure Accuracy Parameter	**Symbol**	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Output accuracy	ε_o	Overall accuracy expressed as output value (FS range from 0.5 to 4.5V)	-20 -0.5		20 0.5	mV %FS
Pressure accuracy	ε_p	Overall accuracy expressed as pressure value	-52		52	mBar
Center temperature accuracy factor	Fc	See Figure 6: Pressure accuracy temperature factor			1	
Extended temperature accuracy factor	Fe				1.25	

Table 6: BAH-001 Default configuration

11.2. MLX90830-LXG-BAF-002

Transfer Curve Parameter	Symbol	Remarks	Value			Unit
Pressure 1	P1	See Figure 5: Pressure transfer function and accuracy at room temperature	0			Bar
Pressure 2	P2		34.474			Bar
Output 1	O1		0.5			V
Output 2	O2		4.5			V
Low clamping level	LCL		0.3			V
High clamping level	HCL		4.7			V
Pressure Accuracy Parameter	**Symbol**	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Output accuracy	ε_o	Overall accuracy expressed as output value (FS range from 0.5 to 4.5V)	-20 -0.5		20 0.5	mV %FS
Pressure accuracy	ε_p	Overall accuracy expressed as pressure value	-172		172	mBar
Center temperature accuracy factor	Fc	See Figure 6: Pressure accuracy temperature factor			1	
Extended temperature accuracy factor	Fe				1.25	

Table 7: BAF-002 Default configuration

11.3. Diagnostics

The MLX90830 has built in diagnostics which can flag fault conditions. This is done by having an output set to 0V or 5V, this is beyond the upper and lower clamp levels of a valid output signal. There are two groups. The first is the broken connection diagnostic which triggers when the device is connected incorrectly. The second group consists of the internal diagnostics, these are used to flag abnormal states during operation.

11.4. Broken Connection Diagnostics

Table 8 shows the output behavior of the MLX90830 if a connection is broken or incorrect.

GND	VDD	Analog out	Effect on output	Action after wrong connection
0V	5V	Pull-down or Pull-up	Normal operation	Normal operation
Disconnected	5V	Pull-down or Pull-up	Lower Fault Band for Pull-down Upper Fault Band for Pull-up	Normal operation
0V	Disconnected	Pull-down or Pull-up	Low Fault Band for Pull-down Upper Fault Band for Pull-up	Normal operation
0V	5V	Disconnected	Low Fault Band for Pull-down Upper Fault Band for Pull-up	Normal operation
0V	5V	0V	Low Fault Band	Normal operation
0V	5V	5V	Upper Fault Band	Normal operation

Table 8: Broken connections

11.5. Internal Diagnostics

The MLX90830 has several internal checks which monitor the status of the device. These checks or diagnostic sources can be enabled or disabled based on the sensor module requirements. It's possible to separately define some sources to appear as a Low Fault Band error and others as a High Fault Band. Table 9 shows the available diagnostic sources which can be programmed to result in either a high fault band output or low fault band output.

Bit	Error condition	Default settings
0	Supply voltage too high	Disabled
1	Supply voltage too low	Disabled
2	Internal error	Lower Fault Band
3	Broken pressure membrane	Lower Fault Band
4	Pressure parameter error	Lower Fault Band
5	Pressure output error	Lower Fault Band
6	Internal regulator out of range	Disabled

Table 9: Diagnostic sources

12. Digital

The digital is built around a 16-bit microcontroller. It contains besides the processor also ROM, RAM and EEPROM and a set of user and system IO registers. Temperature compensation of the pressure signal and pressure linearization is handled by the microcontroller. For the pressure compensation there are EEPROM parameters allocated to be able to cover a large variety of calibration approaches.
Both for gain and offset of the pressure signal, there is a separate temperature dependency which is programmable up to a third order compensation. This is reflected in EEPROM parameters for the offset (O0, O1, O2 and O3) and for the gain (G0, G1, G2 and G3).
If required, the linearity of the pressure signal can also be compensated with a first order temperature dependency through EEPROM parameters L0 and L1.

13. Application Information

Below recommendations for external components are providing basic EMC/ESD protection. Depending on the module design and the EMC/ESD requirements, alternative configurations can be necessary.

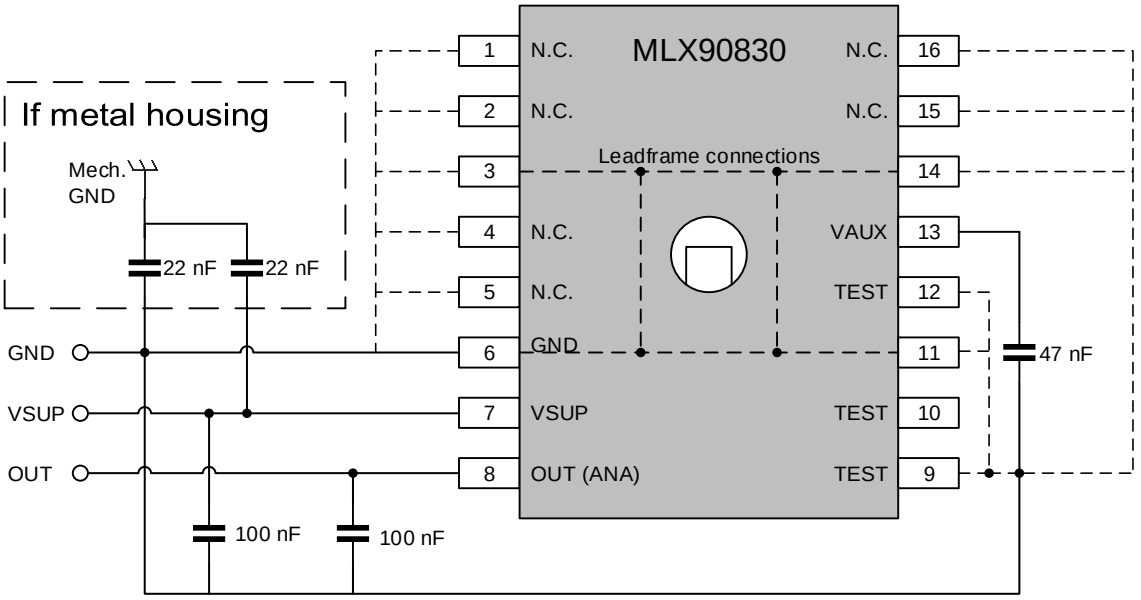
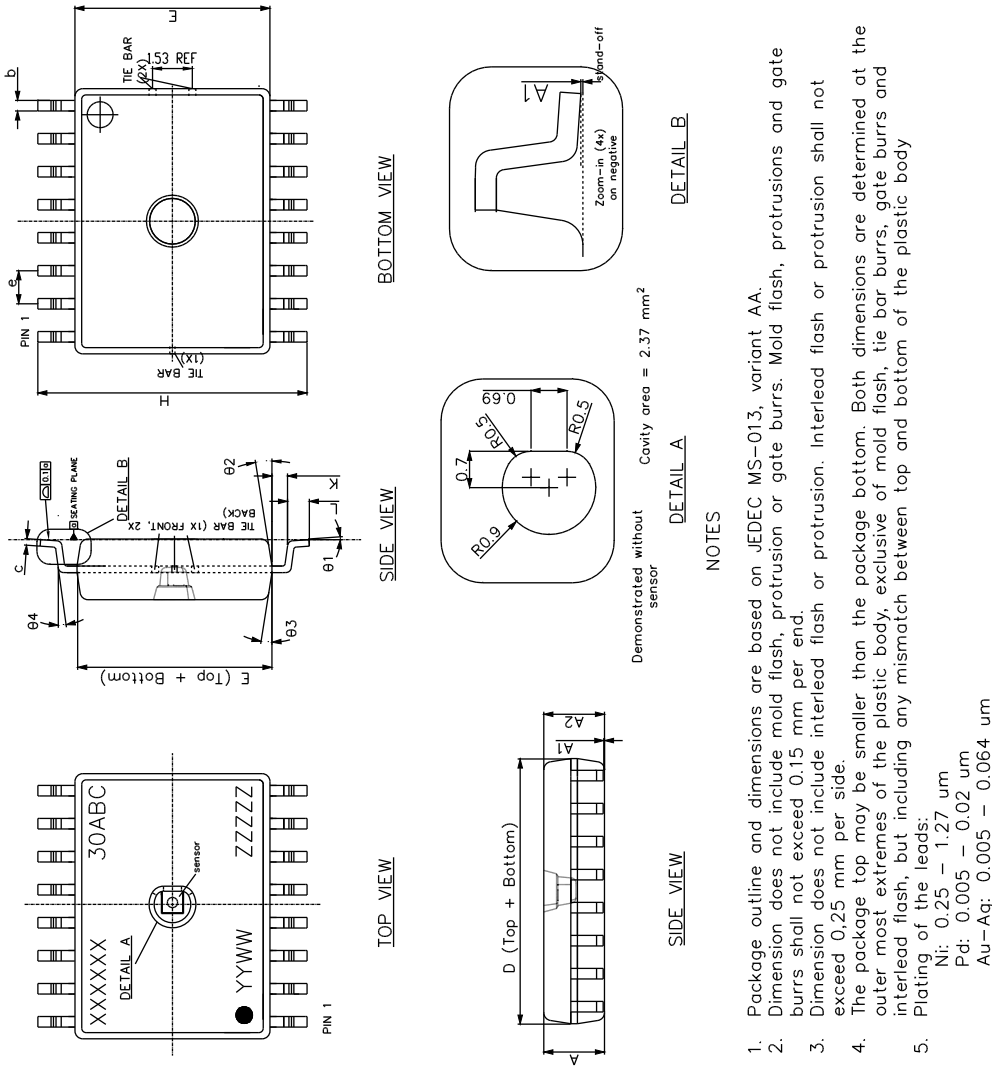


Figure 7: Application schematic (top view). The dark lines are needed connections, the grey lines are recommended connections for better EMC.

14. Package Information, IC handling and assembly

14.1. Package information

SYMBOL	ALL DIMENSION ARE IN MILLIMETERS MINIMUM	NOMINAL	MAXIMUM	NOTES
A	2.23	2.33	2.43	
A1	−0.15	−0.1	−0.05	
A2	2.23	2.33	2.43	
b	0.31	0.41	0.51	
c	0.234	0.254	0.274	
D	10.13	10.2	10.27	2,4
E	7.4	7.5	7.6	3,4
H	10	10.3	10.6	3,4
e		1.27 BSC		
L	0.74	0.84	0.94	
K		0.6 REF		
θ1	0°	–	8°	
θ2	9°	14°	19°	
θ3	9°	14°	19°	
θ4	0°	–	10°	



NOTES

1. Package outline and dimensions are based on JEDEC MS-013, variant AA.
2. Dimension does not include mold flash, protrusion or gate burrs. Mold flash, protrusions and gate burrs shall not exceed 0.15 mm per end.
3. Dimension does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0,25 mm per side.
4. The package top may be smaller than the package bottom. Both dimensions are determined at the outer most extremes of the plastic body, exclusive of mold flash, tie bar burrs, gate burrs and interlead flash, but including any mismatch between top and bottom of the plastic body
5. Plating of the leads:
   Ni: 0.25 – 1.27 um
   Pd: 0.005 – 0.02 um
   Au–Ag: 0.005 – 0.064 um

Figure 8: MLX90830 package drawing

14.2. Storage and handling of plastic encapsulated ICs

Plastic encapsulated ICs shall be stored and handled according to their MSL categorization level (specified in the packing label) as per J-STD-033.

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). The component assembly shall be handled in EPA (Electrostatic Protected Area) as per ANSI S20.20

For more information refer to Melexis *Guidelines for storage and handling of plastic encapsulated ICs* [4]

14.3. Assembly of encapsulated ICs

For Surface Mounted Devices (SMD, as defined according to JEDEC norms), the only applicable soldering method is reflow.

For Through Hole Devices (THD), the applicable soldering methods are reflow, wave, selective wave and robot point-to-point. THD lead pre-forming (cutting and/or bending) is applicable under strict compliance with Melexis *Guidelines for lead forming of SIP Hall Sensors* [4].

Melexis products soldering on PCB should be conducted according to the requirements of IPC/JEDEC and J-STD-001. Solder quality acceptance should follow the requirements of IPC-A-610.

For PCB-less assembly refer to the relevant application notes [4] or contact Melexis.

Electrical resistance welding or laser welding can be applied to Melexis products in THD and specific PCB-less packages following the *Guidelines for welding of PCB-less devices*[4].

Environmental protection of customer assembly with Melexis products for harsh media application, is applicable by means of coating, potting or overmolding considering restrictions listed in the relevant application notes [4]

For other specific process, contact Melexis via www.melexis.com/technical-inquiry

14.4. Environment and sustainability

Melexis is contributing to global environmental conservation by promoting non-hazardous solutions. For more information on our environmental policy and declarations (RoHS, REACH…) visit www.melexis.com/environmental-forms-and-declarations

[4] www.melexis.com/ic-handling-and-assembly

15. Revision history

Revision	Date	Change history
001	17-01-2024	Creation of document

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