NOVOSENSE

NSPGL1 Series
Automotive Gauge Pressure Sensor
Datasheet (EN) 1.0

Product Overview

NSPGL1 series is a calibrated differential pressure sensor product launched by NOVOSENSE for Auto FTPS and vacuum boost market. This series uses an automotive-grade ASIC to calibrate and compensate the MEMS sensor element, the pressure signal from -100kPa to 100kPa can be converted into an analog output signal (0~5V) with a customizable output range. While ensuring the reliability of the product, the two chips are integrated into one ceramic module. This eliminates the need for additional circuitry, such as a compensation network or micro-controller containing a custom correction algorithm. This series provides outstanding performance in terms of initial accuracy and suits applications with high automotive temperature and stress conditions needing excellent stability over lifetime.

Key Features

- High precision pressure sensing
  Better than ±1.5%F.S. (0°C to 85°C)
  Better than ±2.5%F.S. (-40°C to 130°C)
- Large temperature range (-40°C to 130°C)
- Over-voltage and reverse voltage protection between -24V to 28V (70°C, 1H)
- Ratiometric/Absolute analog output
- Pressure range can be customized
- RoHS & REACH Compliance
- AEC-Q100 qualified

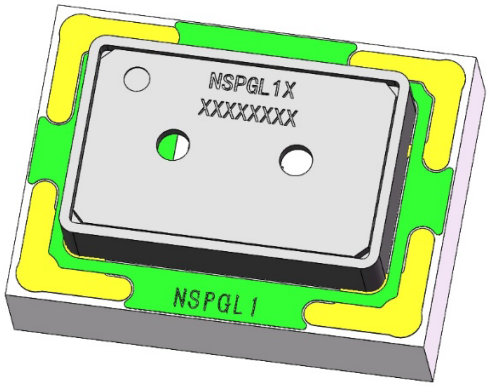
Applications

- FTPS fuel vapor pressure detection
- Pressure sensor for filter monitoring
- Vacuum boost applications
- Crankcase ventilation system
- Industrial vacuum detection

Device Information

Part Number	*Package*	*Body Size*
NSPGL1	LGA(Ceramic module)	7.5mmx10.2mm

Outline



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1. Pin Configuration and Functions

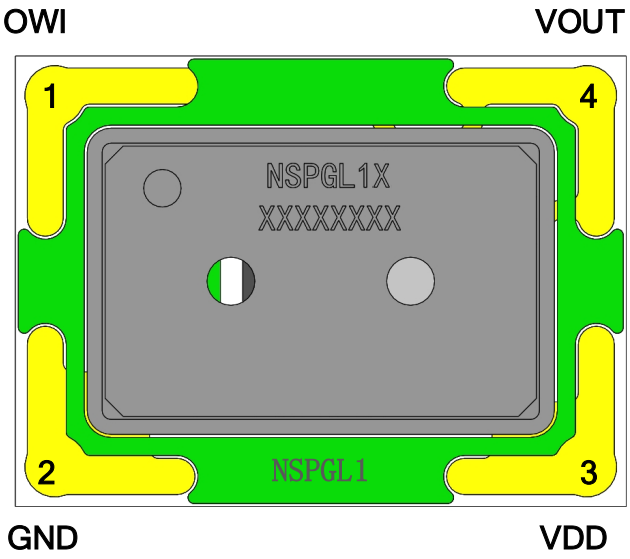


Figure 1.1 Pin Definition (Top view)

Table 1.1 Pin Description

Pin No.	*Symbol*	*Function*
1	OWI	One-wire interface(leave floating)
2	GND	Ground
3	VDD	Power supply
4	VOUT	Analog output

2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply voltage	VDD	-24		28	V	70°C, 1 hour
		-30		36	V	70°C, 1 minute
Analog pin voltage	VOUT	-0.3		5.3	V	25°C， VDD>5V
Analog output current limit				25	mA	
Proof pressure[1]	P_{proof}	(68) 300			kPa	
Burst pressure[2]	P_{burst}	(300) 500			kPa	
Storage temperature	T_{stg}	-40		130	°C	

Note: 1,2 The pressure range is less than 50kPa, and the proof pressure and burst pressure refer to the pressure values in brackets.

3. ESD Ratings

Ratings		Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevE	±2.0	kV
	Charged device model (CDM), per AEC-Q100-011-RevB	±750	V

4. Recommended Operating Conditions

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply voltage	VDD	4.5	5	5.5	V	
Operating pressure	P_{amb}	-100		100	kPa	
Operating temperature	T_{opr}	-40		130	°C	

5. Specifications

5.1. Electrical Characteristics

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Analog output range	VOUT	0.05		4.95	V	
Full life accuracy[1,2]	Acc_{aging}	-1.5		1.5	%F.S.	@0°C~85°C
		-2.5		2.5	%F.S.	@-40°C~130°C
Power on reset	VDD_{POR}		2.5		V	
Operating current[3]	I_{avdd}	2.5	3.1	3.7	mA	
Output load resistance	R_{load}	1			kOhm	
Output load capacitance	C_{load}			150	nF	
Short current limit	I_{short_lmt}	8		23	mA	Output short to VDD or GND
Clamp low level	V_{clampl}	0%		50%	%VDD	@VDD=5V
Clamp high level	V_{clamph}	50%		100%	%VDD	@VDD=5V
Clamp level error	ΔV_{clamp}		40		mV	@VDD=5V
Power up time	T_{UP}		10		ms	
Response Time	T_{RESP}		1		ms	
EEPROM data retention	T_{life}	10			years	@130°C

Attention: Unless otherwise specified, characteristics listed in Table 5.1 are tested at room temperature.

1. Accuracy includes non-linearity, temperature, pressure hysteresis, temperature hysteresis; Unless otherwise specified, it is based on typical operating voltage.
2. For pressure accuracy of different part number, please refer to complete part number list at chapter 9.
3. During power up a peak supply current of Typ. 26 mA is possible.

6. Function Description

6.1. Overview

NSPGL1 uses a MEMS piezoresistive absolute pressure sensor element as a pressure sensitive component that provide an original signal output that is proportional to ambient pressure. The built-in conditioning IC drives the sensitive component and amplifies, temperature compensates, and linearizes the original signal to output a voltage signal that is linear with the applied pressure.

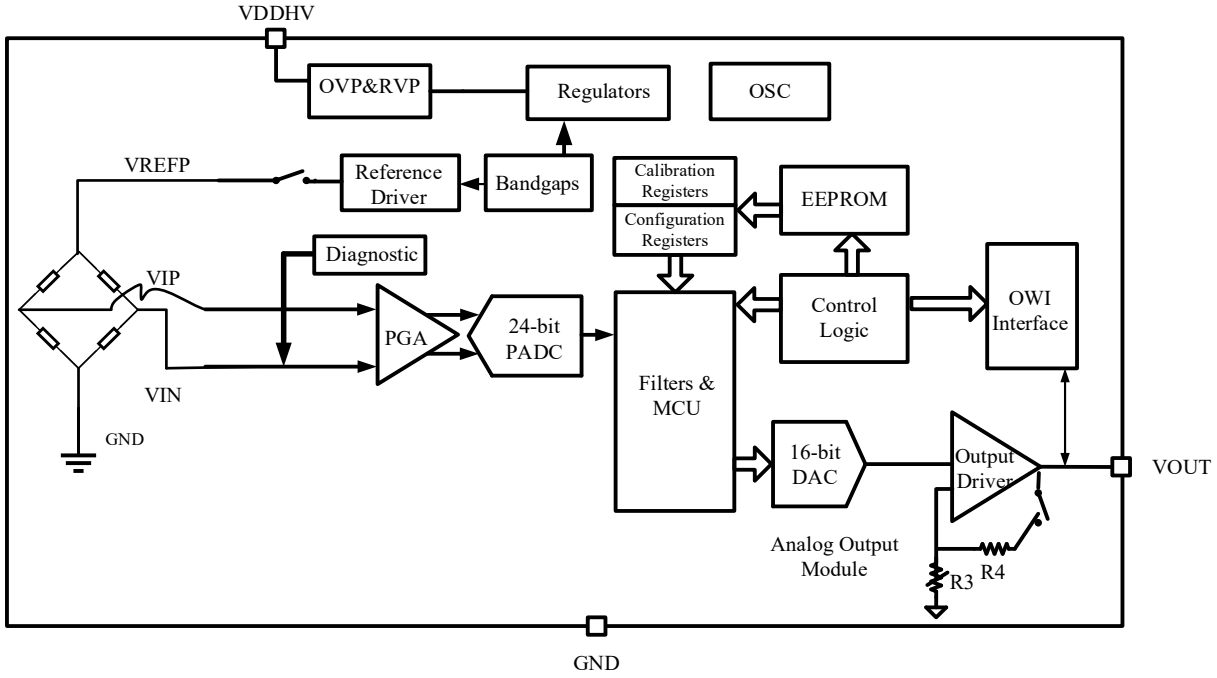


Figure 6.1 NSPGL1 Function Block Diagram

6.2. Transfer Function

NSPGL1 series device is fully calibrated on delivery. The sensor has a linear transfer function between the applied pressure and the output signal:

Ratiometric: VOUT = (A * P + B) * VDD

Absolute: VOUT = (A * P + B) * 5 @VDD=5V

Note:

1) P is the pressure value, differential pressure, range: -100kPa ~100kPa; the transfer function is only established in the pressure range.

2) VDD must in the operating voltage range;

Table 6.1 NSPGL1L032RRA5 Transfer Function Coefficient

Product NO.	*Pressure Range*		*Output Range*		*Gain And Offset*		*Clamp Voltage*	
	P_L	P_H	V_L	V_H	*A*	*B*	V_{CL}	V_{CH}
NSPGL1L032RRA5	-6.00kPa	26.00kPa	0.520V	4.520V	0.025000	0.254000	0.25V	4.75V

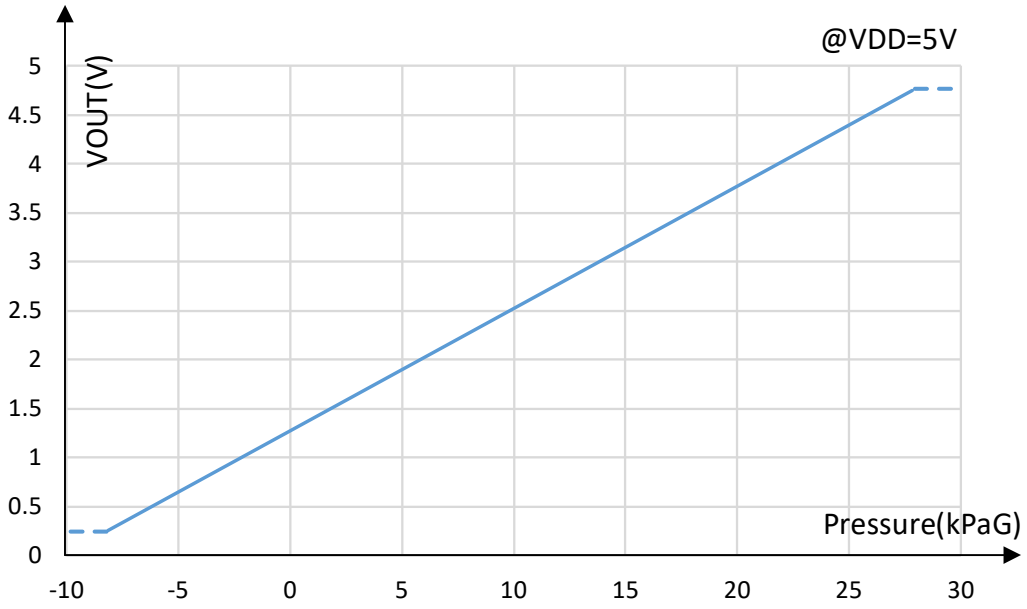


Figure 6.2 NSPGL1L032RRA5 Transfer Function

6.3. Accuracy

Factors affecting the accuracy of NSPGL1 series products include power supply voltage (ratiometric error), pressure, temperature and aging effects. Standard output refers to the theoretical voltage output calculated by the transfer function of the pressure in the range. The error equals the deviation between the measured output voltage value and the specified output voltage value.

6.3.1 Ratiometric Error

Ideally the sensor is ratiometric - the output (VOUT) scales by the same ratio that VDD increases or decreases. The ratiometric error is defined as the difference between the ratio that VDD changed and the ratio that VOUT changed, expressed as a percentage. The calculation formula is as follows:

$$E_{RAT}(\%) = \frac{VOUT(@VDD) - VOUT(@5V) \times \frac{VDD}{5V}}{5V} \times 100\%$$

The output voltage VOUT is ratiometric to VDD. VDD must be in the operating range.

Table 6.2 Ratiometric Output Error

Supply Voltage (V)	***Max. Ratiometric Error ERAT(%) @ VDD, TYP***
$V_{DD,MIN}$	±0.5%
$V_{DD,TYP}$	0
$V_{DD,MAX}$	±0.5%

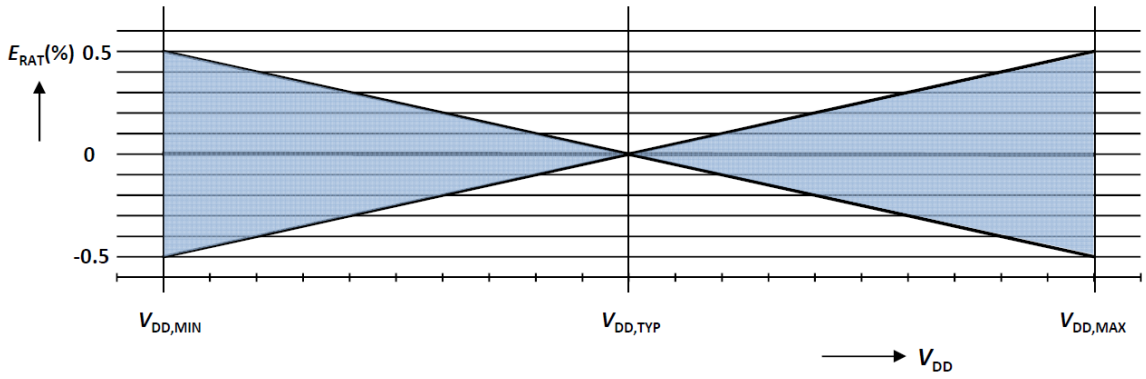


Figure 6.3 Ratiometric Error

6.3.2 Overall Accuracy

The accuracy error includes errors introduced by all influencing factors within the operating range of pressure and temperature, including:

Pressure:

Output deviation from target transfer function over the specified pressure range

Temperature:

Output deviation over the temperature range

Aging:

Parameter drift over life time

Ps: Ratiometric signal error is not included in the overall accuracy. For error measurements, the supply voltage must have the nominal value (VDD = 5V).

Table 6.3 Accuracy

Temperature (°C)	*Error (%F.S.)*
-40	2.5
0	1.5
85	1.5
130	2.5

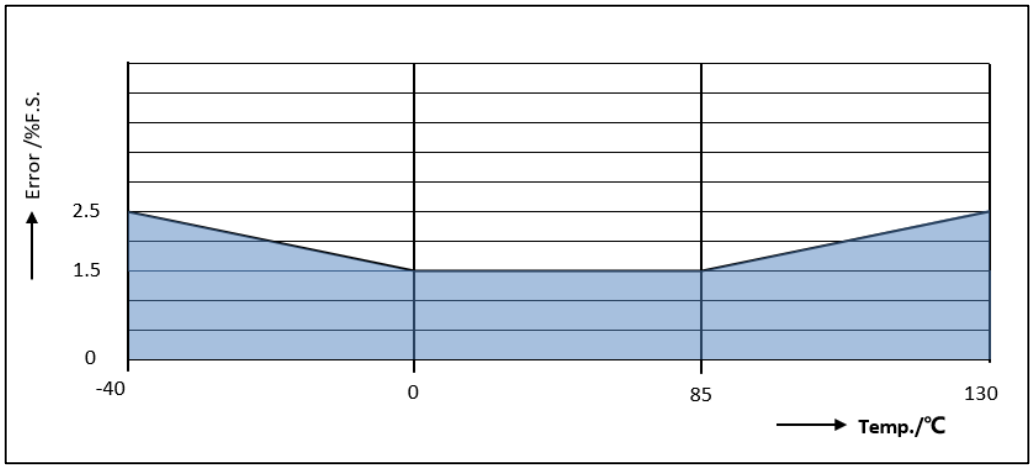


Figure 6.4 Accuracy for Pressure Acquisition

6.4. Alarm

NSPGL1 series have output alarm functions, when MEMS differential signal short to VDD/GND, the Vout will be pulled up to high voltage (4.9V@VDD=5V). The alarm function is OFF on default in order to optimize the response speed.

7. Application Note

7.1. Typical Application Circuit

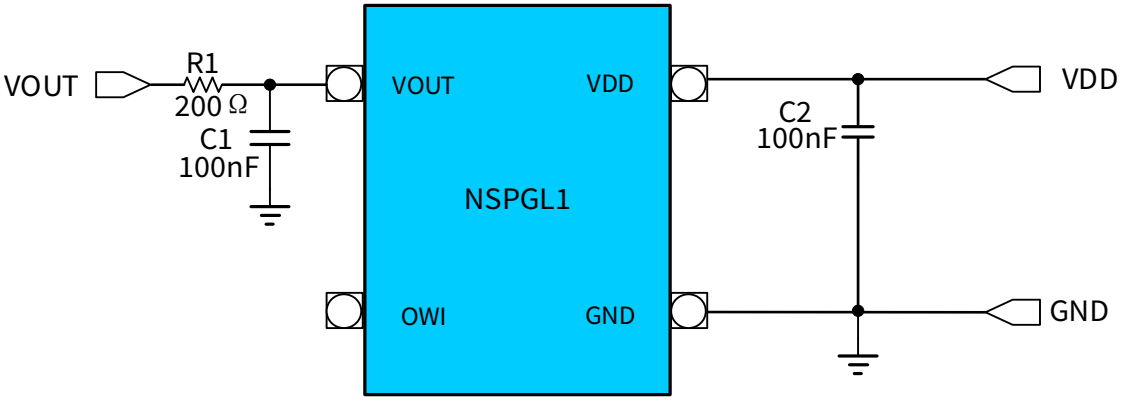


Figure 7.1 Typical Application Circuit

Note:
1)For applications with higher ESD requirements, can add TVS between VOUT and GND and between VDD and GND.
2)For more information on ESD enhanced application circuit of product please contact NOVOSENSE or refer application note AN-12-0044.

7.2. Recommended Footprint

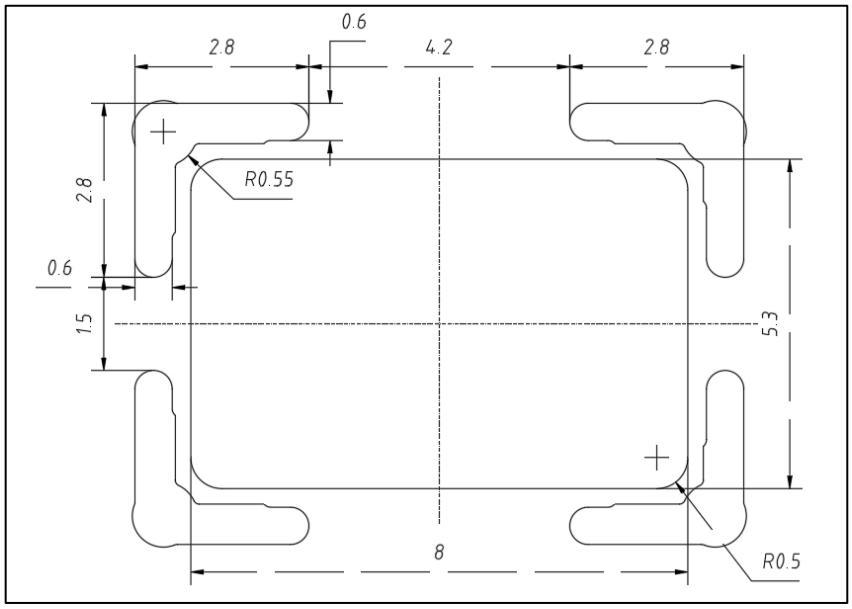


Figure 7.2 Footprint mm

7.3. Typical Application Structure Design

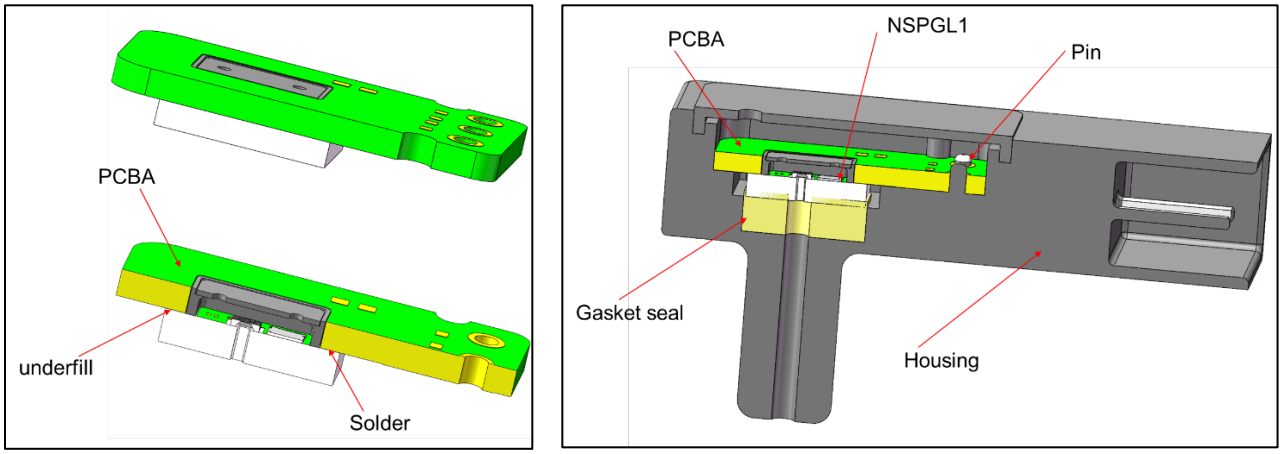


Figure 7.3 PCBA & Sensor Structure Design

The pressure sensor side facing the air shall be exposed only to clean dry air, it should be protected against excessive moisture or any source of corrosion in the application.

For more information on soldering and assembly instructions please refer application note AN-12-0045.

7.4. Soldering Parameters

Table 7.1 Soldering Parameters

Reflow Condition		*Lead-free Assembly*
Pre Heat	Temperature Min (Ts(min))	150°C
	Temperature Max (Ts(max)	200°C
	Time (min to max) (ts)	60 – 180 secs
Average ramp up rate (Liquidus Temp (T_L) to peak		3°C/second max
T_S(max)to T_L - Ramp-up Rate		3°C/second max
Reflow	Temperature (T_L) (Liquidus)	217°C
	Time (min to max) (t_L)	60 – 150 seconds
Peak Temperature (T_P)		260°C
Time within 5°C of actual peak Temperature (tp)		20 – 40 seconds
Ramp-down Rate		6°C/second max
Time 25°C to peak Temperature (T_P)		8 minutes Max.
Do not exceed		260°C

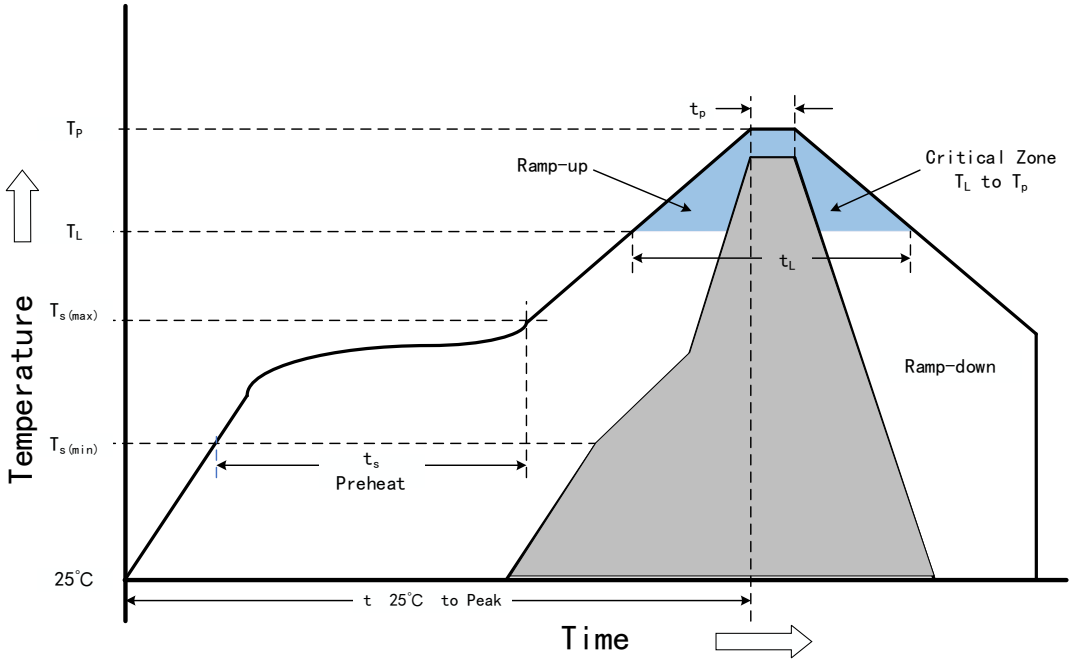
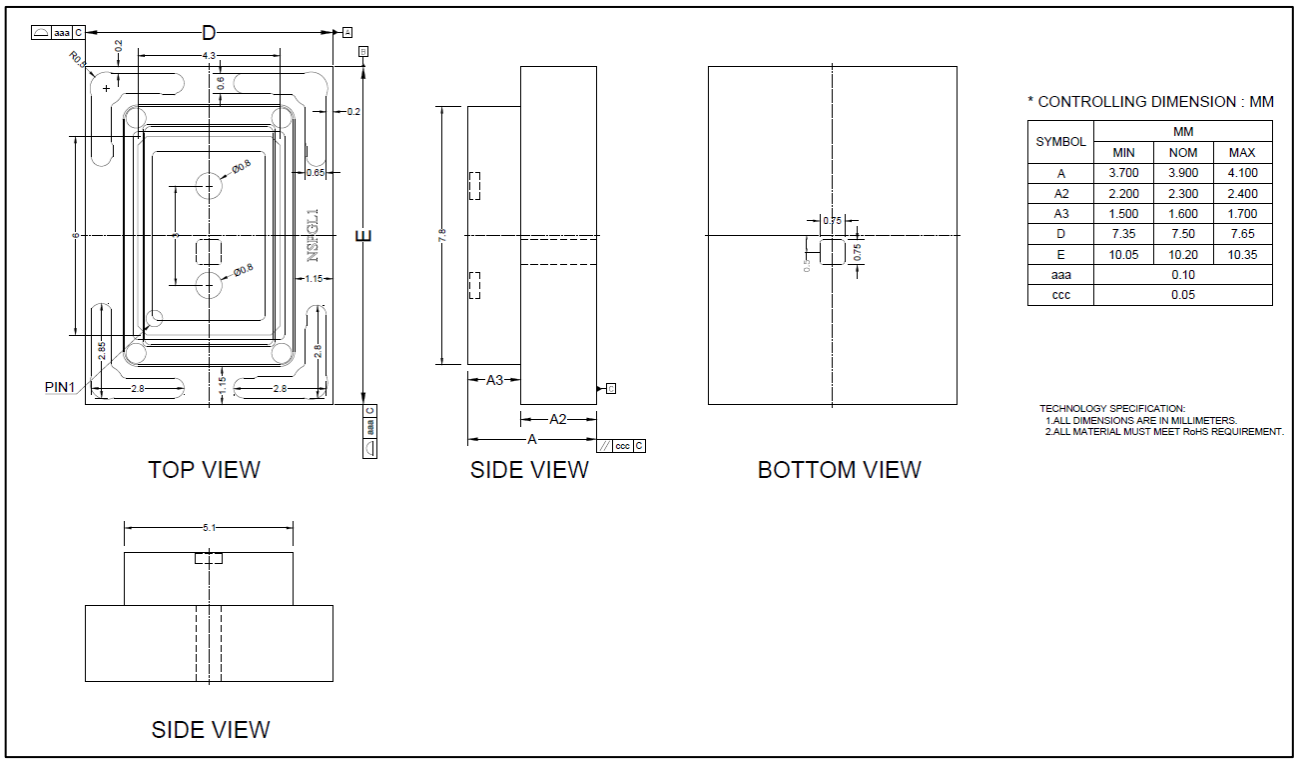


Figure 7.4 Soldering Profile

8. Package Information



SYMBOL	MM		
	MIN	NOM	MAX
A	3.700	3.900	4.100
A2	2.200	2.300	2.400
A3	1.500	1.600	1.700
D	7.35	7.50	7.65
E	10.05	10.20	10.35
aaa	0.10		
ccc	0.05		

Figure 8.1 Package Outline mm

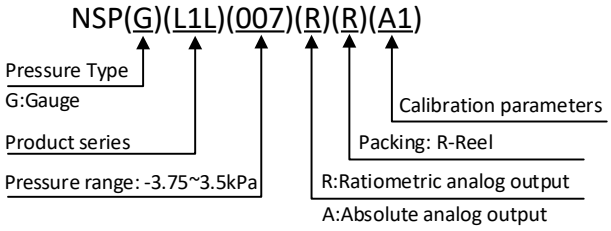
9. Ordering Information

Product NO.	Output Type	Pressure Range		Output Range		Clamp Level		Gain And Offset		Supply Voltage	Accuracy	
		P_L	P_H	O_L	O_H	V_{CL}	V_{CH}	A	B		0-85℃	-40~130℃
NSPGL1L007RRA1	Ratiometric	-3.75kPa	3.50kPa	0.492V	4.615V	0.30V	4.70V	0.113738	0.524917	5.0V	±3.5%	±4.0%
NSPGL1L032RRA5	Ratiometric	-6.00kPa	26.00kPa	0.520V	4.520V	0.25V	4.75V	0.025000	0.254000	5.0V	±1.5%	±2.5%
NSPGL1H120RR01	Ratiometric	-80.00kPa	40.00kPa	0.64V	4.82V	NA	NA	0.006967	0.685333	5.0V	±1.5%	±2.5%
NSPGL1H100RR02	Ratiometric	0.00kPa	-100.00kPa	0.50V	4.50V	0.30V	4.70V	-0.008000	0.100000	5.0V	±1.5%	±2.5%

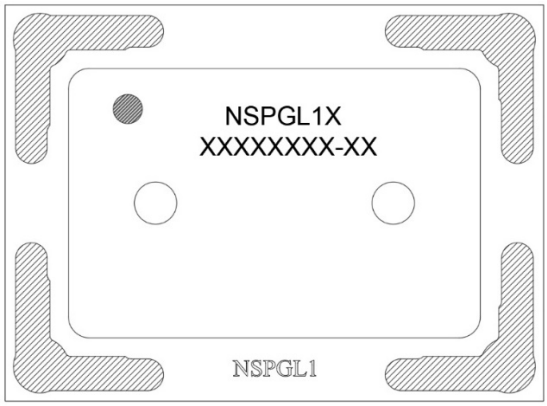
Please scan the following QR code or visit the download link for complete part number list.

https://www.novosns.com//Public/Uploads/uploadfile4/nspgl1.pdf

Naming Convention:



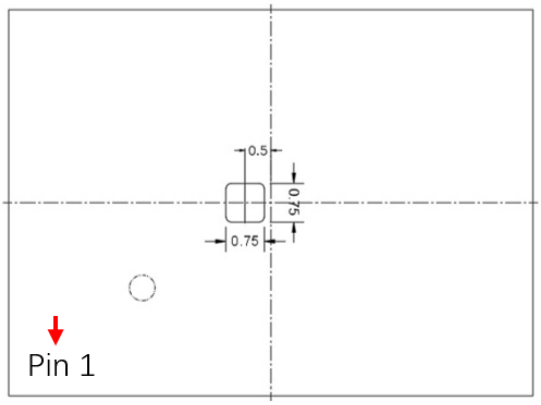
10. Identification Code



(Top View)

NSPGL1X: Product series.

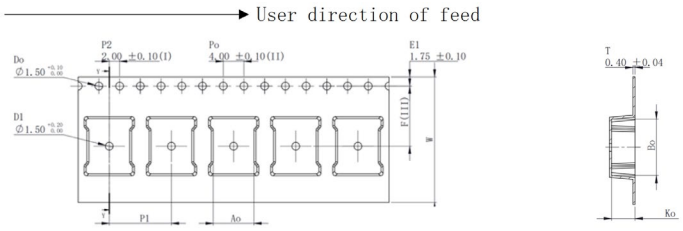
XXXXXXXX-XX: Assembly lot number.



(Bottom View)

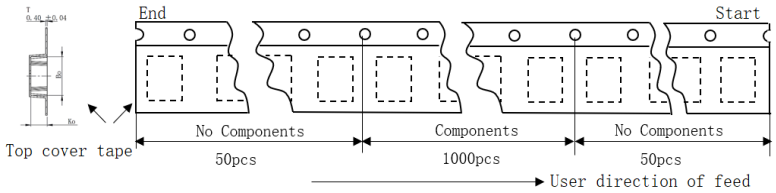
The air hole on the back of the product is off-center by 0.5mm, if the product is placed according to the above picture, then pin1 is on the bottom left corner.

11. Packing Information

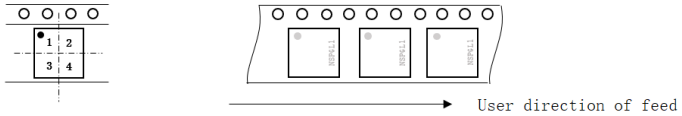


Series	E1(mm)	F(mm)	P2(mm)	D0(mm)	D1(mm)	P0(mm)	10P0(mm)	W(mm)	P1(mm)	A0(mm)	B0(mm)	K0(mm)	T(mm)
NSPGL1	1.75±0.10	11.5±0.10	2.0±0.10	1.5+0.1	1.5+0.2	4.0±0.1	40.0±0.20	24.0+0.30/−0.10	12.0±0.1	7.75±0.1	10.45±0.10	4.40±0.10	0.40±0.05

There is no component at the head and the tail of each tape/reel, where the space is 50pcs, as shown in the following figure.



Pin1 is located at the first quadrant, as shown in the following figure.



Minimum ordering quantity(MOQ):1000EA.
Standard pack quantity(SPQ): 1000EA.

12. Revision History

Revision	Description	Date
1.0	Release Version.	2025/1/9

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