NSPAS5N Series

NOVOSENSE

Automotive Absolute Pressure Sensor

Datasheet (EN) 1.0

Product Overview

NSPAS5N is a calibrated absolute pressure sensor series product launched by NOVOSENSE that can be used in harsh media applications. This series uses an automotive-grade ASIC to calibrate and compensate the MEMS sensor element with noble metal pad, the pressure signal from 10kPa to 400kPa 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 and packaged, reduces the package size greatly. This series provides outstanding performance in terms of initial accuracy and suits applications with harsh automotive temperature and stress conditions needing small drift over lifetime. Reliability test according to AEC-Q100 standard.

Key Features

- High precision pressure sensing
  Better than ±1%F.S. (-20°C to 115°C)
  Better than ±1.5%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
- Directly supplied by high voltage up to 18V (absolute analog output)
- Better than 0.8ms response time
- Ratio-metric/Absolute analog output
- Clamping
- Increased media robustness(1% nitric acid at 25°C)
- RoHS & REACH Compliance
- AEC-Q100 qualified

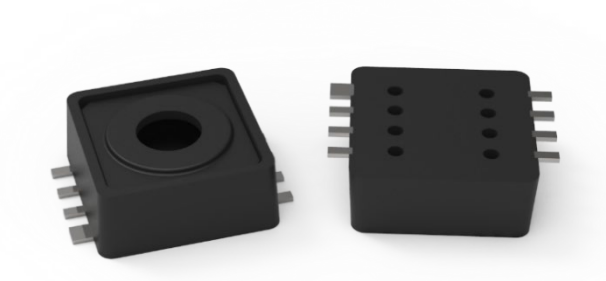
Applications

- Temperature manifold pressure sensor (EGR-TMAP)
- ECU barometric absolute pressure (ECU-BAP)
- Canister desorption pressure detection
- Seat airbag pressure detection
- Industrial control

Device Information

Part Number	*Package*	*Body Size*
NSPAS5N	7070SOP8	7.0mm × 7.0mm

Outline



INDEX

1. Pin Configuration and Functions

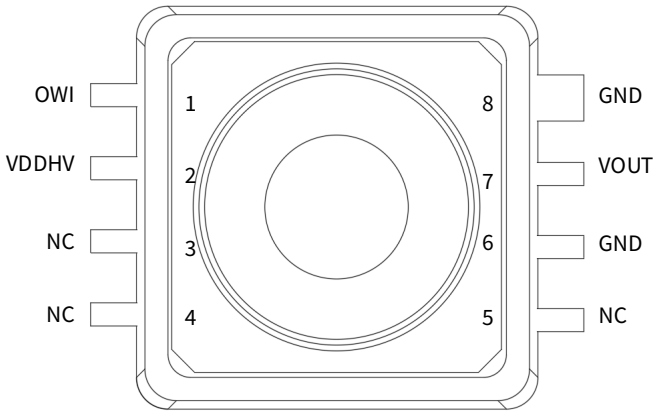


Fig 1.1 Pin Definition (Top view)

Table 1.1 Pin Description

Pin NO.	*Pin Name*	*Description*
1	OWI	One-wire interface (leave floating)
2	VDDHV	Power supply with OVP/RVP
3	NC	No connect
4	NC	No connect
5	NC	No connect
6	GND	Ground
7	VOUT	Analog output
8	GND	Ground

2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply voltage	VDDHV	-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, VDDHV>5V
Analog output current limit				25	mA	
Proof pressure	P_{proof}	1000			kPa	
Burst pressure	P_{burst}	1500			kPa	
Storage temperature	T_{stg}	-40		130	°C	

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	VDDHV	4.5	5	5.5	V	
Operating pressure	P_{amb}	10		400	kPa	
Operating temperature	Topr	-40		130	°C	

5. Specifications

5.1. Electrical Characteristics

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Output voltage range	VOUT	0.05		4.95	V	
Accuracy pressure [1]	Acc_P	-1%		1%	%F.S.	@-20°C~115°C
		-1.5%		1.5%	%F.S.	@-40°C~130°C
Power on reset	$VDDHV_{POR}$		2.5		V	
Operating current [2]	I_{avdd}	2.5	3.1	3.7	mA	
Output load resistance	R_{load}	1			kOhm	
Output load capacitance	C_{load}			150	nF	
Output short current limit	I_{short_lmt}	10		25	mA	Output short to VDDHV or GND
Clamp low level	V_{clampl}	0%		50%	%VDDHV	@VDDHV=5V
Clamp high level	V_{clamph}	50%		100%	%VDDHV	@VDDHV=5V
Clamp level error	ΔV_{clamp}		40		mV	@VDDHV=5V
Power up time [2]	T_{UP}	8	10	12	ms	@25℃
Response time	T_{RESP}		0.8		ms	
Diagnostic response time	T_{diag}			1	ms	
EEPROM data retention	T_{live}	10			years	@150°C

Attention: Unless otherwise specified, characteristics listed in Table 4.1 are tested at room temperature.

1. Pressure accuracy is qualified with part number NSPAS5N115RR01. For pressure accuracy of different part number, please refer to complete part number list at chapter 8.
2. During power up a peak supply current of Typ. 26 mA is possible.

6. Function Description

6.1. Overview

NSPAS5N 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.

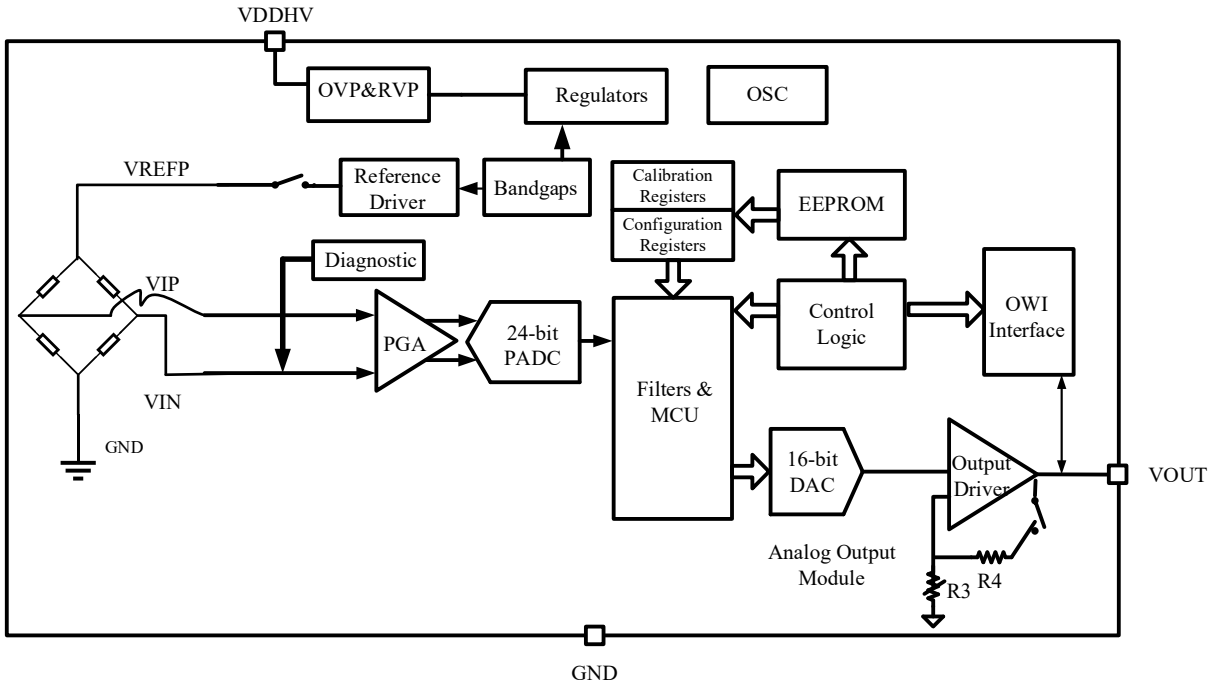


Fig 6.1 Product Function Block Diagram

6.2. Transfer Function

NSPAS5N series device is fully calibrated on delivery. The sensor has a linear transfer function between the applied pressure and the output signal:

Ratiometric: $VOUT = (A \times P + B) \times VDDHV$

Absolute: $VOUT = (A \times P + B) \times 5$

Note: 1) P is the pressure value, absolute pressure, range: 10kPe~400kPa; the transfer function is only established in the pressure range.

2）VDDHV must in the operating voltage range;

Table 6.1 NSPAS5N115RRA1 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}
NSPAS5N115RRA1	10kPa	115kPa	0.4V	4.65V	0.008095	-0.00095	0.3V	4.7V

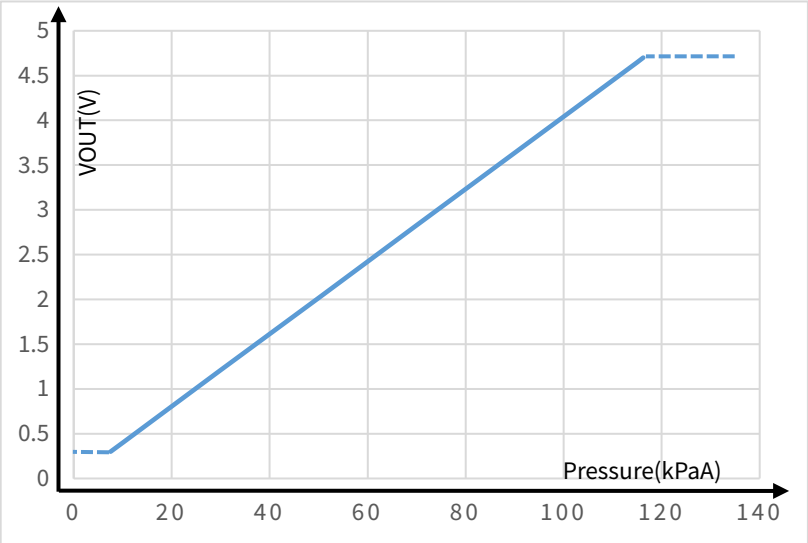


Fig 6.2 NSPAS5N115RRA1 Transfer Function

6.3. Accuracy

Factors affecting the accuracy of NSPAS5N 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. The accuracy in the following analysis is in a typical application circuit.

6.3.1 Ratiometric Error

Ideally the sensor is ratiometric - the output (VOUT) scales by the same ratio that VDDHV increases or decreases. The ratiometric error is defined as the difference between the ratio that VDDHV 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 VDDHV. VDDHV must be in the operating range.

Table 6.2 Ratiometric Output Error

Supply Voltage (V)	*Max. Ratiometric Error E_{RAT}(%) @ $VDDHV_{TYP}$*
$VDDHV_{MIN}$	±0.5%
$VDDHV_{TYP}$	0
$VDDHV_{MAX}$	±0.5%

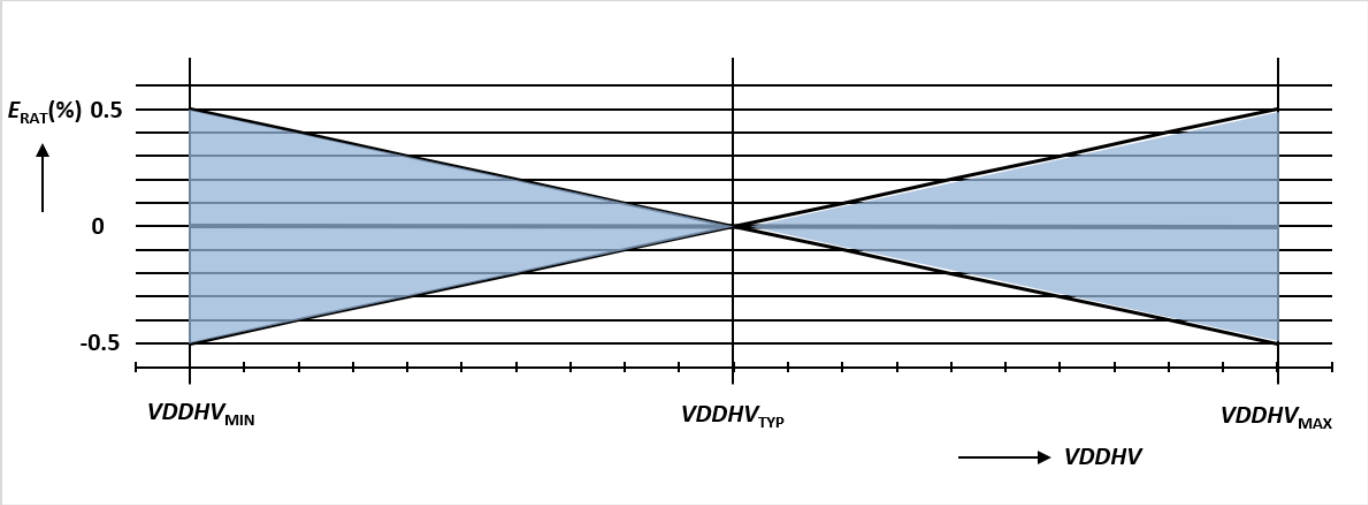


Fig 6.3 Ratiometric Error

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 (VDDHV = 5V).

Table 6.3 Accuracy

Temperature (℃)	*Error(%F.S.)*
-40	1.50
-20	1.00
115	1.00
130	1.50

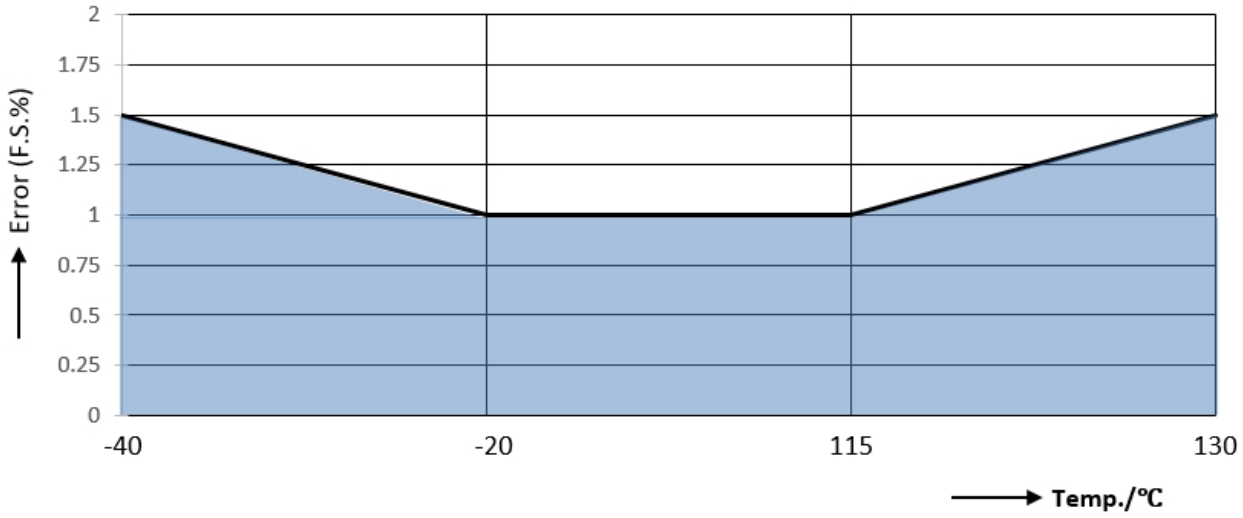


Fig 6.4 Accuracy for Pressure Acquisition

6.4. Alarm

NSPAS5N series have output alarm functions, when MEMS differential signal short to VDDHV/GND, the Vout will be pulled up to high voltage (4.9V@VDDHV=5V). The alarm function is OFF on default in order to optimize the response speed.

7. Typical Application

7.1. Application Circuit

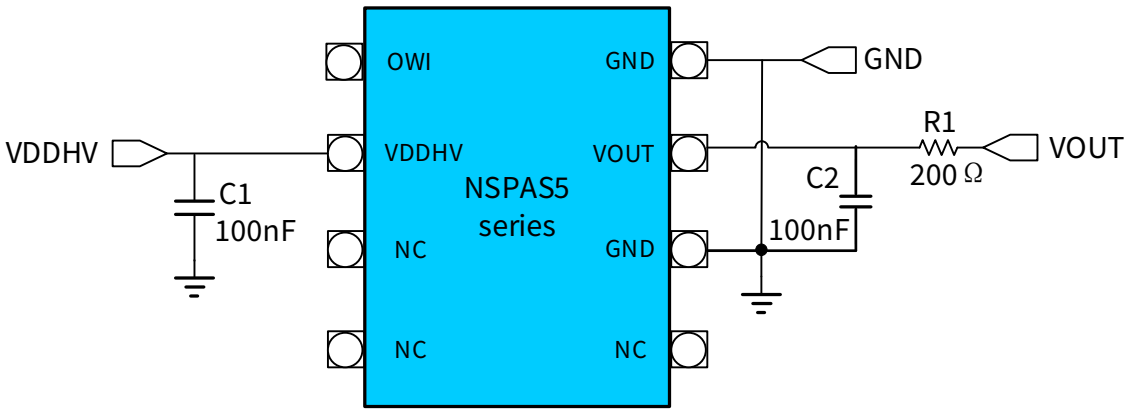


Fig 7.1 Application Circuit

Note:

1)For applications with higher ESD requirements, can add TVS between VOUT and GND and between VDDHV and GND.

2)Please contact NOVOSENSE for detailed peripheral recommended circuit.

7.2. Recommended Footprint

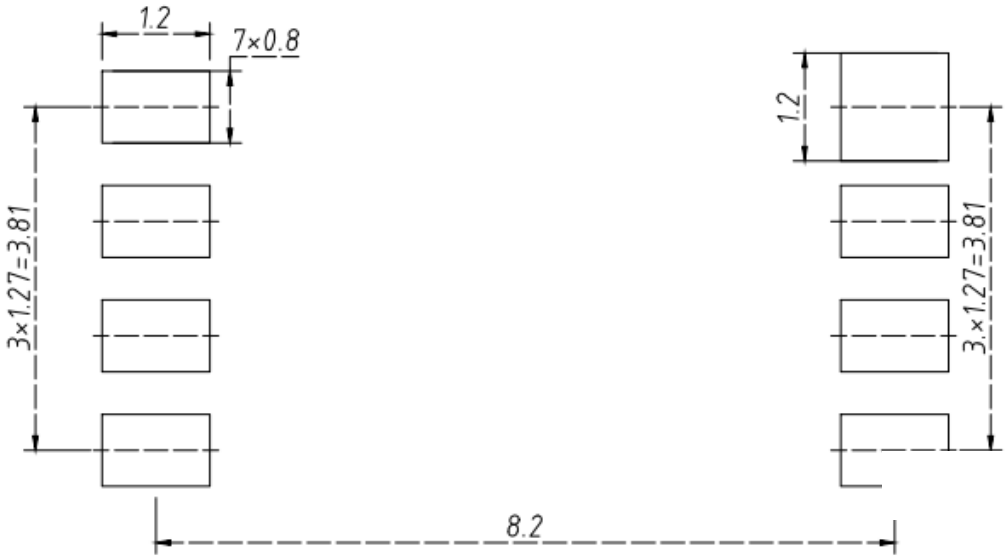


Fig 7.2 Footprint mm

7.3. Soldering Parameters

Table 7.1 Soldering Parameters

Reflow Condition		*Lead–free Assembly*
Pre Heat	Temperature Min ($T_{S(min)}$)	150°C
	Temperature Max ($T_{S(max)}$)	200°C
	Time (min to max) (t_S)	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 (t_p)		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

Note:

1)The environmental cleanliness should be monitored & large particles should be avoided during assembly process.

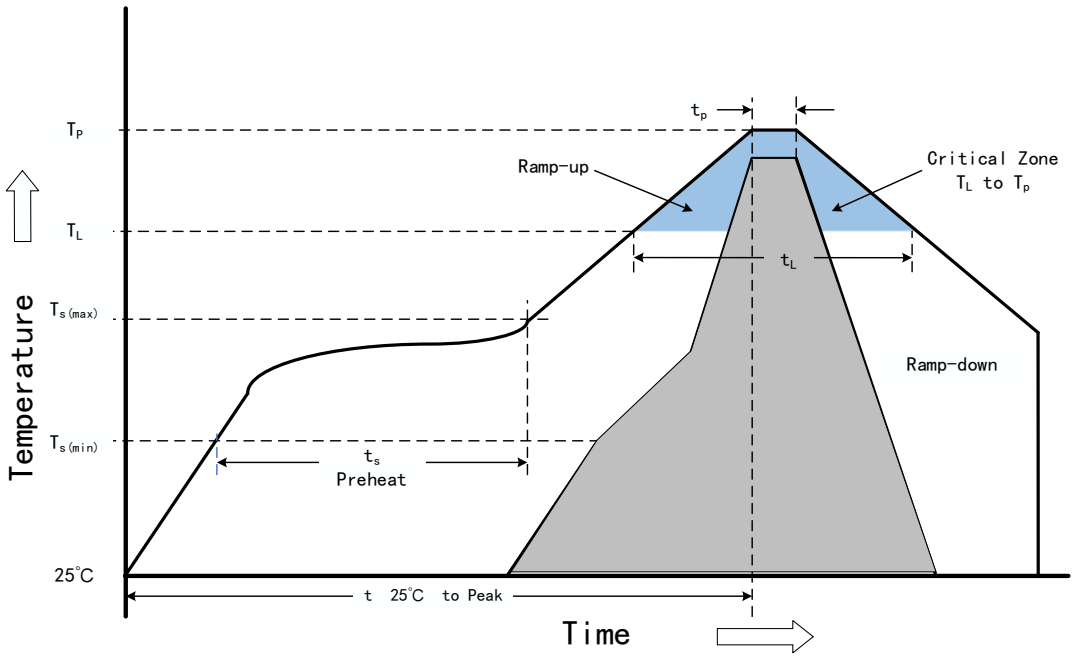
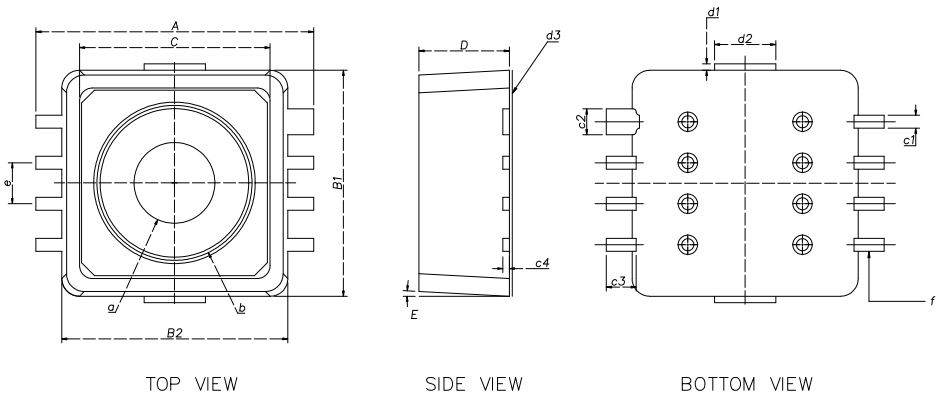


Fig 7.3 Soldering Profile

8. Package Information



CONTROLLING DIMENSION: MM

	MILLMETRE		
SYMBOL	MIN	NOM	MAX
A	8.5	8.6	8.7
B1	6.9	7.0	7.1
B2	6.9	7.0	7.1
C	5.8	5.9	6.0
D	2.7	2.8	2.9
E	1°	3°	5°
a	ø2.4	ø2.5	ø2.6
b	ø4.7	ø4.8	ø4.9
c1	0.35	0.4	0.5
c2	0.75	0.8	0.9
c3	0.9	1.0	1.1
c4	0.15	0.2	0.3
d1	BURR MAX 0.2		
d2	BURR MAX 1.9		
d3	PLASTIC PROTRUSION OF 0.03MAX		
e	1.27 bac		
f	PAD TO PAD FLATNESS 0.1 MAX		

Fig 8.1 Package Outline mm

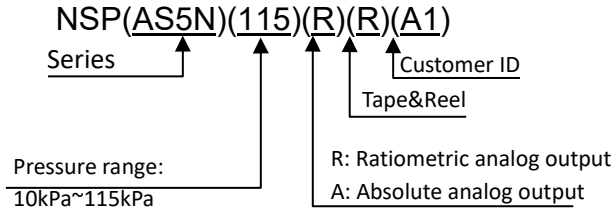
9. Order Information

Product Type	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		-20~115℃	-40~130℃
NSPAS5N115RRA1	Ratiometric	10.00kPa	115.00kPa	0.400V	4.650V	0.30V	4.70V	0.008095	-0.000952	5.0V	±1.0%	±1.5%
NSPAS5N300RRC1	Ratiometric	10.00kPa	300.00kPa	0.400V	4.650V	0.30V	4.70V	0.002931	0.050690	5.0V	±1.0%	±1.5%
NSPAS5N390RRC3	Ratiometric	30.00kPa	390.00kPa	0.500V	4.500V	0.30V	4.70V	0.002222	0.033333	5.0V	±1.0%	±1.5%
NSPAS5N115RRD1	Ratiometric	10.00kPa	115.00kPa	0.400V	4.650V	0.30V	4.80V	0.008095	-0.000952	5.0V	±1.0%	±1.5%
NSPAS5N300RRF2	Ratiometric	20.00kPa	300.00kPa	0.400V	4.650V	0.30V	4.70V	0.003036	0.019286	5.0V	±1.0%	±1.5%
NSPAS5N320RRK9	Ratiometric	20.00kPa	320.00kPa	0.400V	4.650V	0.20V	4.70V	0.002833	0.023333	5.0V	±1.0%	±1.5%
NSPAS5N400RRM9	Ratiometric	10.00kPa	400.00kPa	0.500V	4.500V	0.30V	4.60V	0.002051	0.079487	5.0V	±1.0%	±1.5%
NSPAS5N350RRS8	Ratiometric	20.00kPa	350.00kPa	0.500V	4.500V	0.30V	4.70V	0.002424	0.051515	5.0V	±1.0%	±1.5%
NSPAS5N250RRS9	Ratiometric	20.00kPa	250.00kPa	0.400V	4.650V	0.30V	4.70V	0.003696	0.006087	5.0V	±1.0%	±1.5%
NSPAS5N400RRT3	Ratiometric	20.00kPa	400.00kPa	0.500V	4.500V	0.20V	4.80V	0.002105	0.057895	5.0V	±1.0%	±1.5%
NSPAS5N350RRT5	Ratiometric	30.00kPa	350.00kPa	0.500V	4.500V	0.25V	4.80V	0.002500	0.025000	5.0V	±1.0%	±1.5%
NSPAS5N220RRT9	Ratiometric	50.00kPa	220.00kPa	0.500V	4.500V	0.30V	4.60V	0.004706	-0.135294	5.0V	±1.0%	±1.5%
NSPAS5N300RRU3	Ratiometric	40.00kPa	300.00kPa	0.500V	4.500V	0.25V	4.80V	0.003077	-0.023077	5.0V	±1.0%	±1.5%

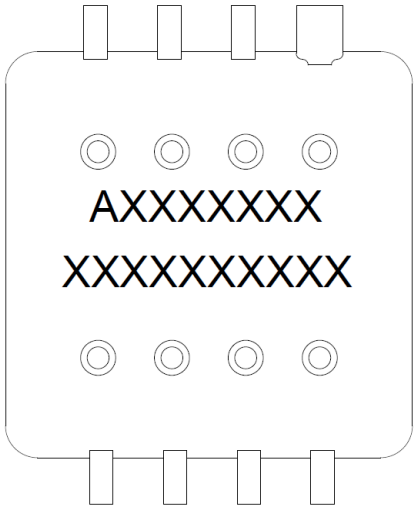
Please scan the following QR code or visit the download link for complete part number list.

https://www.novosns.com/Public/Uploads/uploadfile4/NSPAS5N.pdf

Naming Convention:



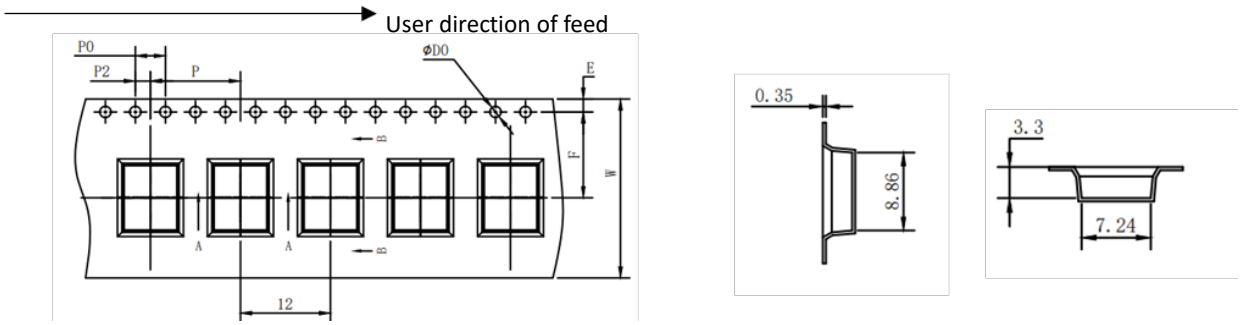
10. Identification Code



AXXXXXXX: Package lot number.

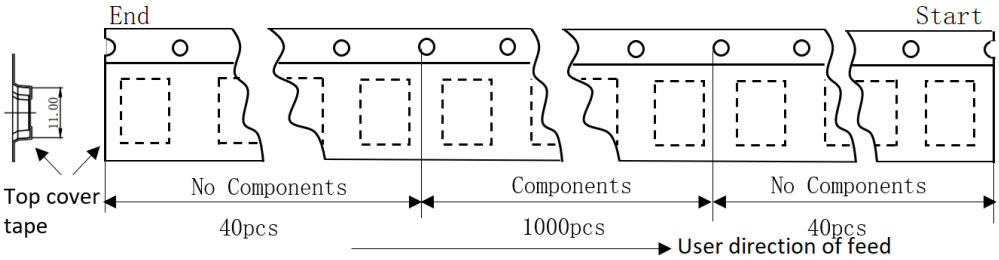
XXXXXXXXXX: Product serial number.

11. Tape/Reel Information

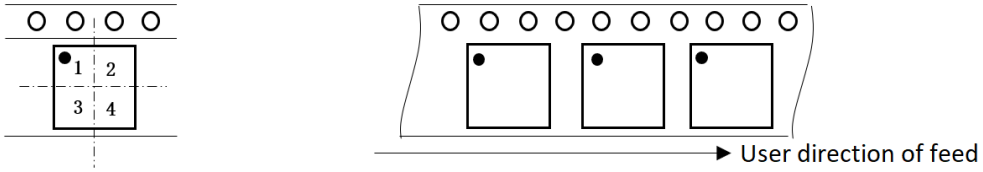


Series	E(mm)	F(mm)	P2(mm)	D0(mm)	P0(mm)	10P0(mm)	W(mm)	P(mm)	A0(mm)	B0(mm)	K0(mm)	T(mm)
NSPAS5N	1.75±0.10	11.5±0.10	2.0±0.10	1.5±0.10	4.0±0.10	40.0±0.20	24.0±0.30	12.0±0.10	7.24±0.10	8.86±0.10	3.30±0.10	0.35±0.05

There is no component at the head and the tail of each tape/reel, where the space is 40pcs, as shown in the following figure.



Pin8 is located at the second 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	2025/4/6

IMPORTANT NOTICE

The information given in this document (the “Document”) shall in no event be regarded as any warranty or authorization of, express or implied, including but not limited to accuracy, completeness, merchantability, fitness for a particular purpose or infringement of any third party’s intellectual property rights.

Users of this Document shall be solely responsible for the use of NOVOSENSE’s products and applications, and for the safety thereof. Users shall comply with all laws, regulations and requirements related to NOVOSENSE’s products and applications, although information or support related to any application may still be provided by NOVOSENSE.

This Document is provided on an “AS IS” basis, and is intended only for skilled developers designing with NOVOSENSE’s products. NOVOSENSE reserves the rights to make corrections, modifications, enhancements, improvements or other changes to the products and services provided without notice. NOVOSENSE authorizes users to use this Document exclusively for the development of relevant applications or systems designed to integrate NOVOSENSE’s products. No license to any intellectual property rights of NOVOSENSE is granted by implication or otherwise. Using this Document for any other purpose, or any unauthorized reproduction or display of this Document is strictly prohibited. In no event shall NOVOSENSE be liable for any claims, damages, costs, losses or liabilities arising out of or in connection with this Document or the use of this Document.

For further information on applications, products and technologies, please contact NOVOSENSE (www.novosns.com).

Suzhou NOVOSENSE Microelectronics Co., Ltd