

DATE 20 June, 2013No. V-70033

Messrs. _____

SPECIFICATION

Model: AP4, AG4 Pressure Sensor

Project: _____

Distributor: _____

Reference: _____

Preliminary Edition**rev. 1.00****This document has a possibility to
be revised without notice.**

Yoshiyuki Uchiumi, Application Engineer
Sensor Department Fujikura Ltd.

Fujikura Ltd.

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1. General

This document describes the specifications of Fujikura Pressure Sensors, AP4 and AG4 series.

2. Principle

Fujikura Pressure Sensor is composed of a silicon piezoresistive pressure sensing chip and a signal conditioning integrated circuit. The low-level signal from the sensing chip is amplified, temperature compensated, calibrated, and finally converted to digital data that is proportional to the applied pressure.

3. Device Lineup

This device has the following lineup.

Model	Pressure Type	Supply Voltage	Accuracy	Pressure Range (kPa)					
				-100	0	25	50	100	200
AP4 or AG4	Gauge	5.0Vdc	±1.5%FS	[Bar chart showing pressure ranges for 5.0Vdc: 0 to 25, 0 to 50, 0 to 100, 0 to 200]					
		3.3Vdc		[Bar chart showing pressure ranges for 3.3Vdc: 0 to 100, 0 to 200]					
		3.0Vdc		[Bar chart showing pressure ranges for 3.0Vdc: 0 to 1000]					
				[Bar chart showing pressure ranges for -100 to 0, -100 to 100]					

Features

- Digital Output
- High Accuracy

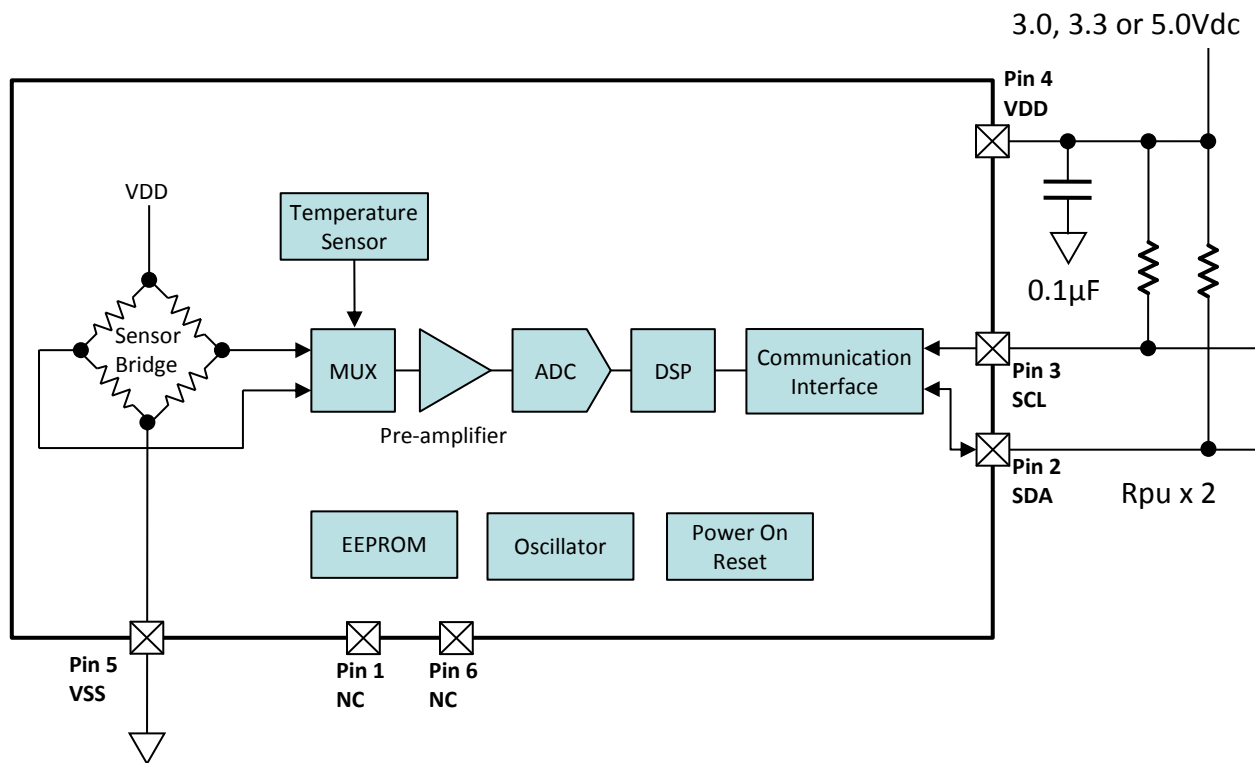
4. RoHS

This device is compliant with the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).

Table shown below is revision records of this specification

Rev.				
Est.				
	Date	Name	Comment	Mark

5. Block Diagram and Pin Connections



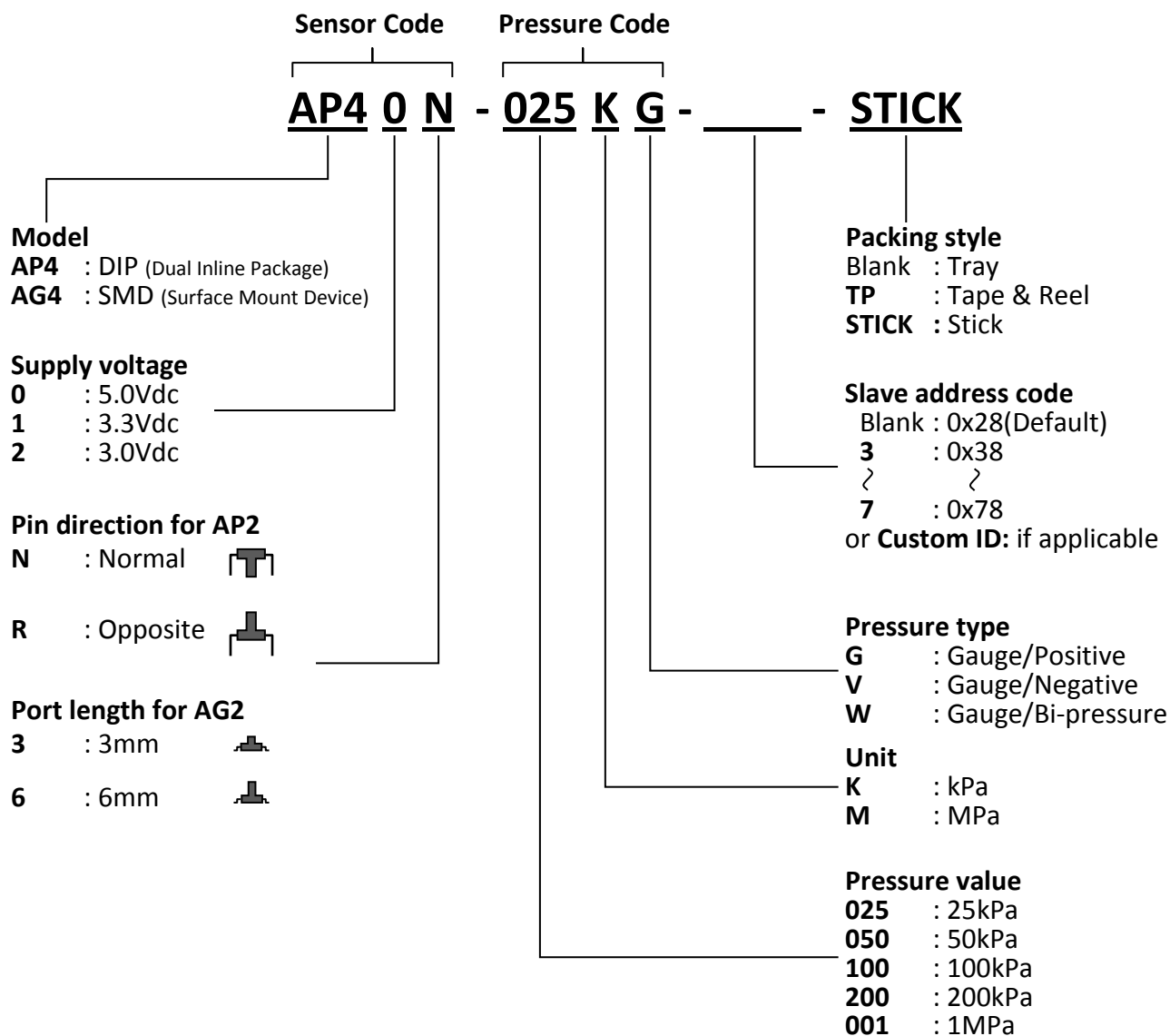
Pin Assignment		Pin No.	Pin Name	I/O	Type	Function	
AP4	AG4						
		1	NC	-	-	-	
		2	SDA	I/O	Digital	Serial bidirectional data	*1
		3	SCL	I	Digital	Serial clock input	*2
		4	VDD	-	-	Power supply connection	*1
		5	VSS	-	-	Common voltage connection	
		6	NC	-	-	-	-

Notes:

- *1) Put a 0.1µF capacitor between VDD Pin 4 and VSS Pin 5.
- *2) Pin 1 and 6 must be open.

6. Device Name Code

The device name code is consisted of Sensor code, Pressure code, Slave address code and Packing style. For the exact ordering device number, please refer to Chapter 19 Ordering Information.



7. Absolute Maximum Ratings

Item		Symbol	Rating			Unit	
			Min.	Typ.	Max.		
Load Pressure	Pressure Code	025KG	Pmax+	-	-	+50	kPa
		050KG		-	-	+100	kPa
		100KG		-	-	+200	kPa
		200KG		-	-	+400	kPa
		001MG		-	-	+1.5	MPa
		100KV		-	-	+200	kPa
		100KW		-	-	+200	kPa
Supply Voltage		VDDmax	-0.3	-	6	Vdc	
Voltage at Digital I/O pins		Vdiomax	-0.3	-	VDD+0.3	Vdc	
Operating Temperature		Topt	-40	-	+125	deg. C	
Storage Temperature		Tstg	-40	-	+125	deg. C	

Note:

*1) Absolute maximum ratings are the limits that the device will withstand without damage.

8. General Specifications

Item	Sensor Code		AP40x AG40x	AP41x AG41x	AP42x AG42x	Unit
	Symbol					
Supply Voltage	VDD		5.0±0.25	3.3±0.165	3.0±0.15	Vdc *1
Type of Pressure	-		Gauge pressure			*2
Pressure Media	-		Non-corrosive gases			*3
Pressure Range	Popt		Refer to Chapter 9			
Compensated Temperature	-		0 ~ +85			deg. C *4
Operating Humidity	Hopt		30~85 (non-condensing)			%RH *5
Storage Humidity	Hstg		30~85 (non-condensing)			%RH *5
Dielectric Strength			Leakage current 1mA maximum, AC500V, 1minute			*6
Insulation Resistance			100MΩ minimum (DC500V)			*7

Notes:

*1) Supply (VDD) should be constant.

*2) Gauge pressure is defined as the difference between the pressure applied to the pressure port and an atmospheric pressure of the device.

*3) Ensure the pressure media contains no particulates. The device is not compatible with liquids.

*4) Please also refer to Chapter 14 Transfer Function.

*5) Do not wet the device with dew.

*6) Dielectric strength is defined as the leakage current between all pins and the package with AC500, 1 minute.

*7) Insulation resistance is defined as the resistance value between all pins and the package with DC500V.

9. Pressure Range

Pressure Code	Symbol	Pressure Range *1			Unit
		Min.	Typ.	Max.	
025KG	Popt	0	-	+25	kPa
050KG		0	-	+50	kPa
100KG		0	-	+100	kPa
200KG		0	-	+200	kPa
001MG		0	-	+1	MPa
100KV		-100	-	0	kPa
100KW		-100	-	+100	kPa

Note:

*1) Pressure range is defined as the measurable pressure range of the device. Do not expose intentionally beyond minimum Popt and maximum Popt.

10. Electrical Characteristics

Ambient temperature Ta=25deg. C

Item	Condition	Symbol	Rating			Unit
			Min.	Typ.	Max.	
Offset Pressure Data	Min. Popt, 100KV: Max. Popt	Doff	598	819	1040	Count *1, 2
Full Scale Pressure Data	Max. Popt, 100KV: Min. Popt	Dfs	15344	15565	15786	Count *3
Span Pressure Data	Min. to max. Popt	SD	-	14746	-	Count *4
Accuracy	0 to 85 deg. C	Error	-1.5	-	+1.5	%FS *5, 6
Consumption Current		Ic	-	-	3	mAdc
Response Time	for reference	tr	-	-	2	msec. *7

Notes;

- *1) Offset pressure data (Doff) is defined as the pressure data at minimum Popt. In case of 100KV, Offset pressure data (Doff) is defined as the pressure data of maximum Popt.
- *2) Offset error is calibration error of Offset pressure data (Doff) at production. It does not include Long term offset drift. It would be suggested that applications have Auto-zeroing function.
- *3) Full scale pressure data (Dfs) is defined as the pressure data at maximum Popt. In case of 100KV, Full scale pressure data (Dfs) is defined as the pressure data of minimum Popt.
- *4) Span pressure data (SD) is defined as the pressure data difference between Offset pressure data (Doff) and Full scale pressure data (Dfs).
- *5) Accuracy consists of the following:
 - Non-linearity
 - Temperature errors over the temperature range 0 to 85 degree C
 - Pressure hysteresis
 - Calibration errors of sensitivity and offset
- *6) The unit of Accuracy “%FS” is defined as a percent error by Span pressure data (SD).
- *7) Response time is defined as the time of 1 cycle measurement sequence.

11. Communication Interface

Ambient temperature Ta=25deg. C

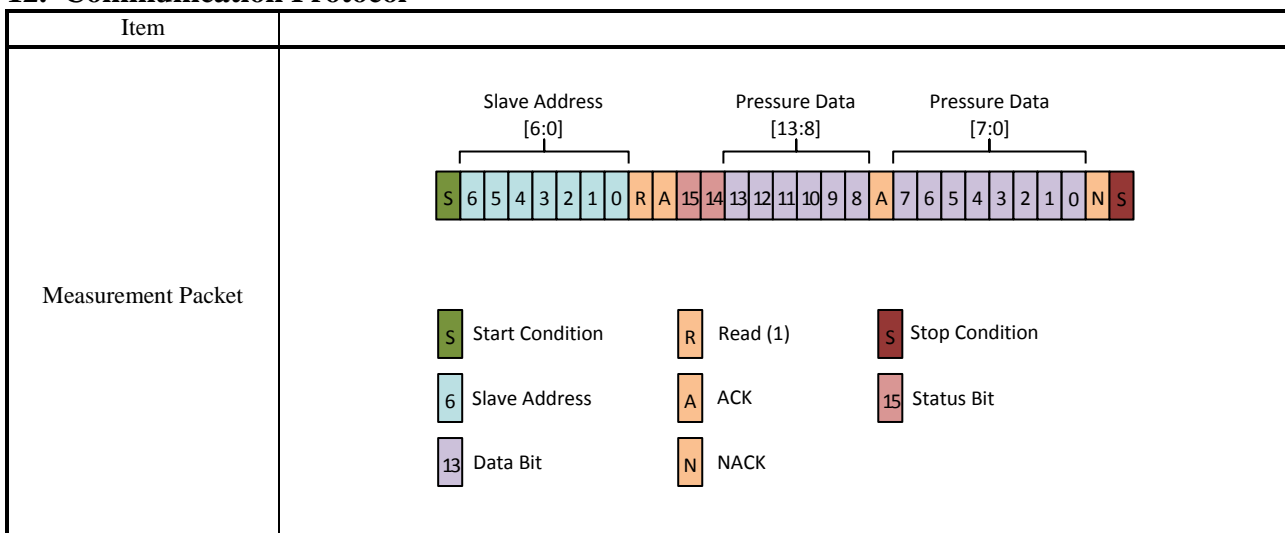
Item	Condition	Symbol	Rating			Unit
			Min.	Typ.	Max.	
Interface			I ² C TM			
Input Low Voltage		VIL	0	-	0.2	V
Input High Voltage		VIH	0.8	-	1	V
Output Low Voltage		VOL	-	-	0.1	V
Load Capacitance	Pin2 SDA, 400kHz	Cmax	-	-	200	pF
Pull-up Resistor	Pin2 SDA, Pin3 SCL	Rpu	1	-	-	kΩ
Slave address	7 bit		0x28			

Notes:

*1) I²CTM is a trademark of NXP.

*2) Slave address is available from 0x38 to 0x78 as optional. Please designate the slave address in the device name code.

12. Communication Protocol



13. Output versus Input Pressure

Pressure Code	Output vs. Input pressure
025KG, 050KG, 100KG, 200KG, 001MG	<p>Temp. = 0 to 85 °C</p> <p>Count</p> <p>Dfs: 15565</p> <p>Error: $\pm 1.5\%FS$</p> <p>Doff: 819</p> <p>SD: 14746</p> <p>Min. Popt: 0kPa Max. Popt: 25, 50, 100, 200kPa</p> <p>Input Pressure</p>
100KV	<p>Temp. = 0 to 85 °C</p> <p>Count</p> <p>Dfs: 15565</p> <p>Error: $\pm 1.5\%FS$</p> <p>Doff: 819</p> <p>SD: 14746</p> <p>Min. Popt: -100kPa Max. Popt: 0kPa</p> <p>Input Pressure</p>
100KW	<p>Temp. = 0 to 85 °C</p> <p>Count</p> <p>Dfs: 15565</p> <p>Error: $\pm 1.5\%FS$</p> <p>8192</p> <p>Doff: 819</p> <p>SD: 14746</p> <p>Min. Popt: -100kPa 0kPa Max. Popt: +100kPa</p> <p>Input Pressure</p>

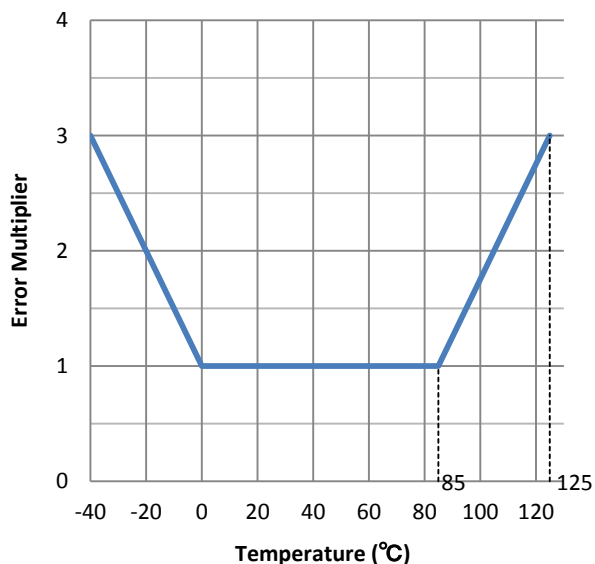
14. Transfer Function

$$\text{Pressure Data (Count)} = P \times \alpha + \beta \pm (\text{Pressure Error} \times \text{Temperature Error Multiplier})$$

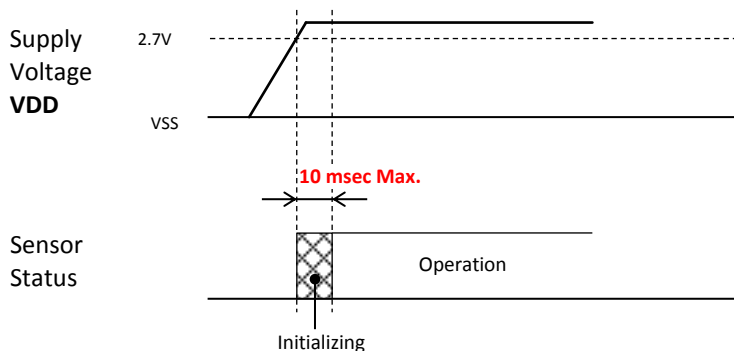
Parameters

Parameter Pressure Code	P (kPa)	α	β	Pressure Error (Count)
025KG	0 ~ +25	14746/25	819	221
050KG	0 ~ +50	7373/25	819	221
100KG	0 ~ +100	7373/50	819	221
200KG	0 ~ +200	7373/100	819	221
001MG	0 ~ +1000	7373/500	819	221
100KV	-100 ~ 0	-7373/50	819	221
100KW	-100 ~ +100	7373/100	8192	221

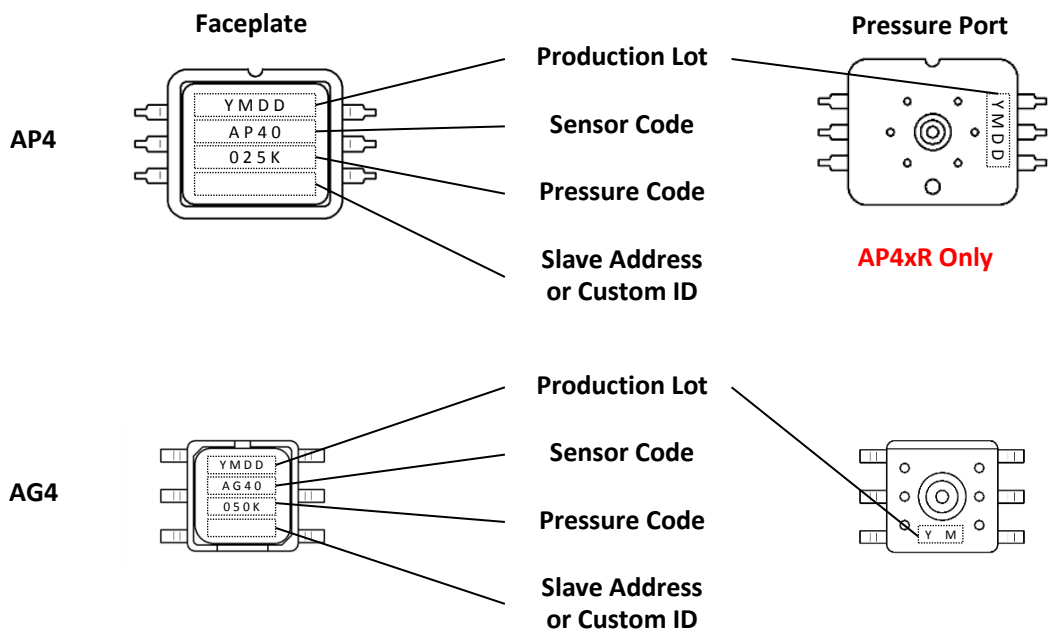
Temperature Error Multiplier



15. Operating Sequence



16. Device Marking



Items		Marking
Production Lot		
Y	Last digit of Production year	0~9
M	Production month	1, 2, 3 ~ 8, 9, X=Oct., Y=Nov., Z=Dec.
DD	Production date	01~31
Sensor Code		
	AP40x	AP40
	AP41x	AP41
	AP42x	AP42
	AG40x	AG40
	AG41x	AG41
	AG42x	AG42
Pressure Code		
	025KG	025K
	050KG	050K
	100KG	100K
	200KG	200K
	001MG	001M
	100KV	100V
	100KW	100W
Slave Address Code		
	Blank	Blank
	3	3
	4	4
	5	5
	6	6
	7	7
Custom ID		If applicable

*1

*2

Notes:

- *1) Pin direction for AP4 or Port length for AG4 is not marked on the face plate.
- *2) Custom ID will be added when a product is customized for a customer.

17. Soldering

Process	Sensor code	Condition															
Hand Soldering	AP4xx	Soldering iron temperature: 350 deg. C max. Soldering time: 3 seconds max.															
Wave Soldering	AP4xR	Soldering bath temperature: 260 deg. C max. Soldering time: 5 seconds max.															
Reflow Soldering	AG4xx	<div style="text-align: center;"> <p>Soldering Profile</p> <p style="text-align: center;">Temperature (°C)</p> <p style="text-align: center;">Time</p> </div> <table border="1" style="width: 100%; margin-top: 10px; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;">A</th> <th style="width: 20%;">Ramp up</th> <th style="width: 75%;">2 to 4 deg. C / sec.</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>Pre-heating</td> <td>150 to 180 deg. C 60 to 120 sec.</td> </tr> <tr> <td>C</td> <td>Ramp up</td> <td>2 to 4 deg. C / sec.</td> </tr> <tr> <td>D</td> <td>Heating</td> <td>Above 230 deg. C, 45 sec. max. 245 deg. C max., 10 sec. max.</td> </tr> <tr> <td>E</td> <td>Ramp down</td> <td>2 to 4 deg. C / sec.</td> </tr> </tbody> </table>	A	Ramp up	2 to 4 deg. C / sec.	B	Pre-heating	150 to 180 deg. C 60 to 120 sec.	C	Ramp up	2 to 4 deg. C / sec.	D	Heating	Above 230 deg. C, 45 sec. max. 245 deg. C max., 10 sec. max.	E	Ramp down	2 to 4 deg. C / sec.
A	Ramp up	2 to 4 deg. C / sec.															
B	Pre-heating	150 to 180 deg. C 60 to 120 sec.															
C	Ramp up	2 to 4 deg. C / sec.															
D	Heating	Above 230 deg. C, 45 sec. max. 245 deg. C max., 10 sec. max.															
E	Ramp down	2 to 4 deg. C / sec.															

*1, 2
*1, 2
*1, 2, 3, 4

Notes:

- *1) NEVER wash the device with any washing liquid. NEVER wash the device with any ultrasonic washing machine.
- *2) Do not put the solder and flux on the device's package.
- *3) Temperature means Surface temperature of the device's package.
- *4) Reflow soldering is within two times.

18. Dimensions and Weights

Refer to the following drawing as attached.

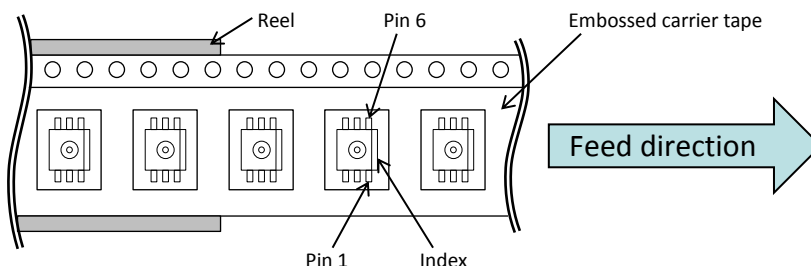
Sensor Code	Dimension Drawing	Weight
AP4xN	9-772-001	approx. 1.4 grams
AP4xR	9-772-002	
AG4x3	9-772-003	approx. 0.3 grams
AG4x6	9-772-004	approx. 0.4 grams

19. Ordering Information

Model	Package	Supply Voltage	Pin Direction	Packing	Ordering Device Number	Qty./Packing	
AP4	DIP	5.0 Vdc	Normal	Tray	AP40N- [Pressure Code] -[Slave]	150 Pcs/Tray	
				Stick	AP40N- [Pressure Code] -[Slave] -STICK	40 Pcs/Stick	
			Opposite	Tray	AP40R- [Pressure Code] -[Slave]	150 Pcs/Tray	
				Stick	AP40R- [Pressure Code] -[Slave] -STICK	40 Pcs/Stick	
			3.3 Vdc	Normal	Tray	AP41N- [Pressure Code] -[Slave]	150 Pcs/Tray
					Stick	AP41N- [Pressure Code] -[Slave] -STICK	40 Pcs/Stick
		Opposite	Tray	AP41R- [Pressure Code] -[Slave]	150 Pcs/Tray		
			Stick	AP41R- [Pressure Code] -[Slave] -STICK	40 Pcs/Stick		
		3.0 Vdc	Normal	Tray	AP42N- [Pressure Code] -[Slave]	150 Pcs/Tray	
				Stick	AP42N- [Pressure Code] -[Slave] -STICK	40 Pcs/Stick	
			Opposite	Tray	AP42R- [Pressure Code] -[Slave]	150 Pcs/Tray	
				Stick	AP42R- [Pressure Code] -[Slave] -STICK	40 Pcs/Stick	
Port Length							
AG4	SMD		5.0 Vdc	3mm	Tray	AG403- [Pressure Code] -[Slave]	300 Pcs/Tray
		Tape & Reel			AG403- [Pressure Code] -[Slave] -TP	500 Pcs/Reel	
		6mm		Tray	AG406- [Pressure Code] -[Slave]	300 Pcs/Tray	
				Tape & Reel	AG406- [Pressure Code] -[Slave] -TP	500 Pcs/Reel	
		3.3 Vdc		3mm	Tray	AG413- [Pressure Code] -[Slave]	300 Pcs/Tray
					Tape & Reel	AG413- [Pressure Code] -[Slave] -TP	500 Pcs/Reel
		6mm	Tray	AG416- [Pressure Code] -[Slave]	300 Pcs/Tray		
			Tape & Reel	AG416- [Pressure Code] -[Slave] -TP	500 Pcs/Reel		
		3.0 Vdc	3mm	Tray	AG423- [Pressure Code] -[Slave]	300 Pcs/Tray	
				Tape & Reel	AG423- [Pressure Code] -[Slave] -TP	500 Pcs/Reel	
			6mm	Tray	AG426- [Pressure Code] -[Slave]	300 Pcs/Tray	
				Tape & Reel	AG426- [Pressure Code] -[Slave] -TP	500 Pcs/Reel	

Pressure Range	Pressure Code	Slave Address	Slave Address Code
0 ~ +25kPa	025KG	0x28	Blank
0 ~ +50kPa	050KG	0x38	3
0 ~ +100kPa	100KG	0x48	4
0 ~ +200kPa	200KG	0x58	5
0 ~ +1MPa	001MG	0x68	6
0 ~ -100kPa	100KV	0x78	7
-100 ~ +100kPa	100KW	Custom ID	If applicable

20. Tape & Reel Information

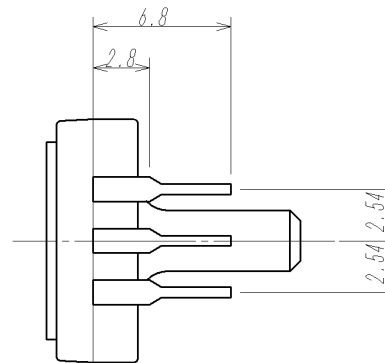
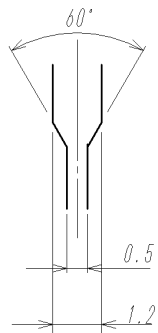
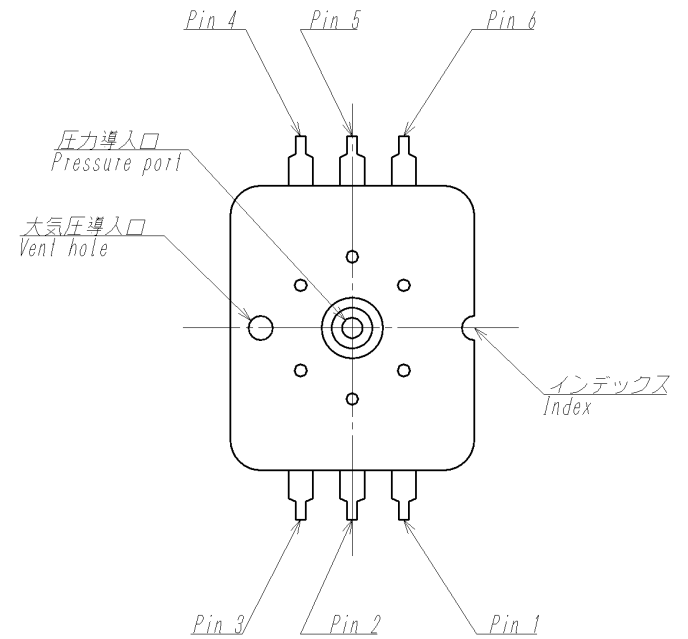
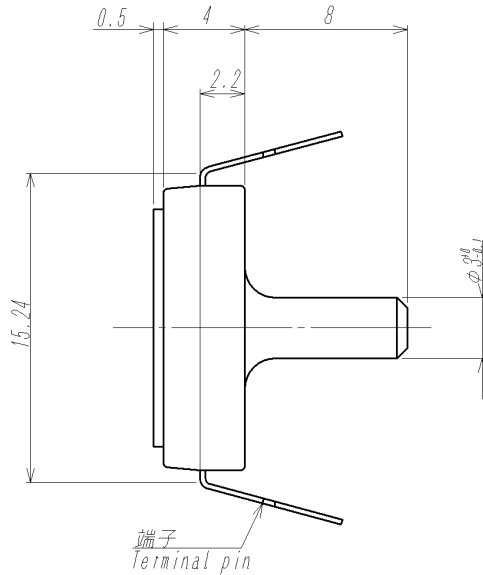
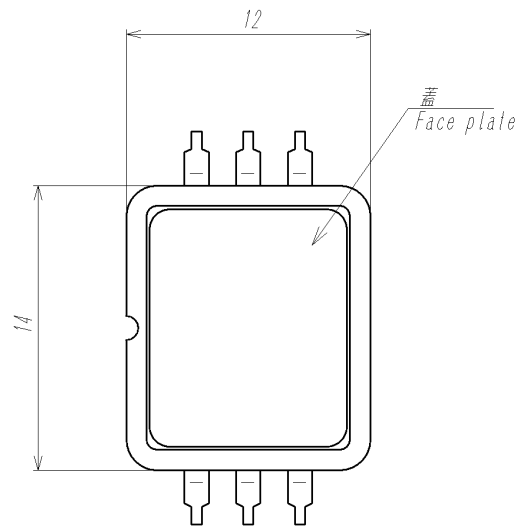


21. Footprint for PCB (for Reference)

Sensor Code	Footprint
AP4xN	
AP4xR	
AG4x3	
AG4x6	

Notes:

- *1) These footprints are for reference. Please evaluate well these footprints, before your mass production.
- *2) When designing your PCB, please also refer to the outline diagrams.

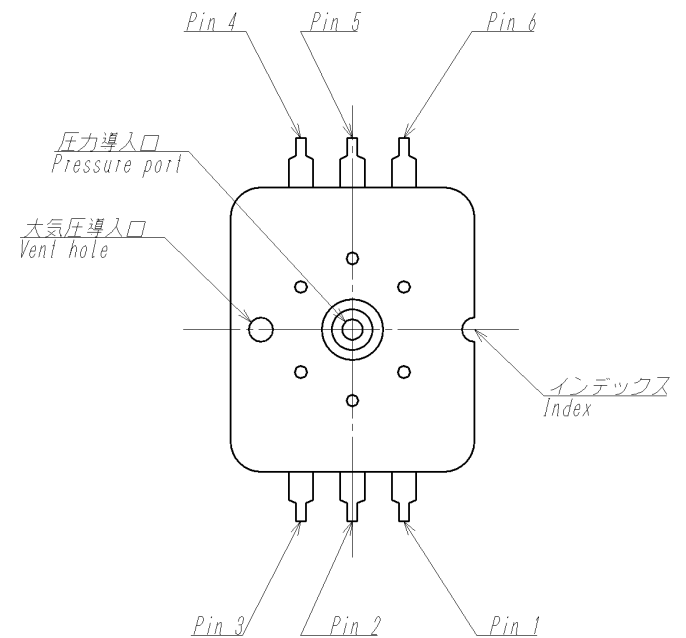
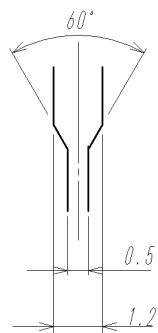
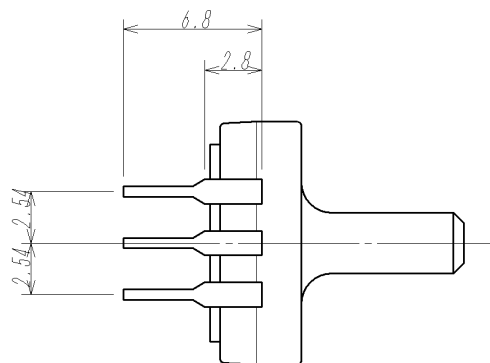
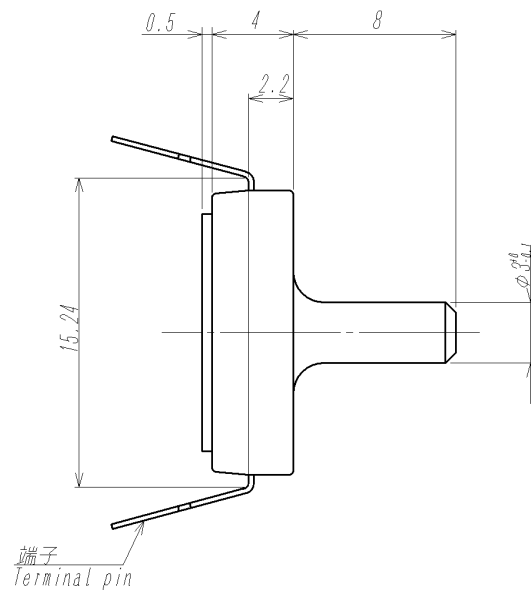
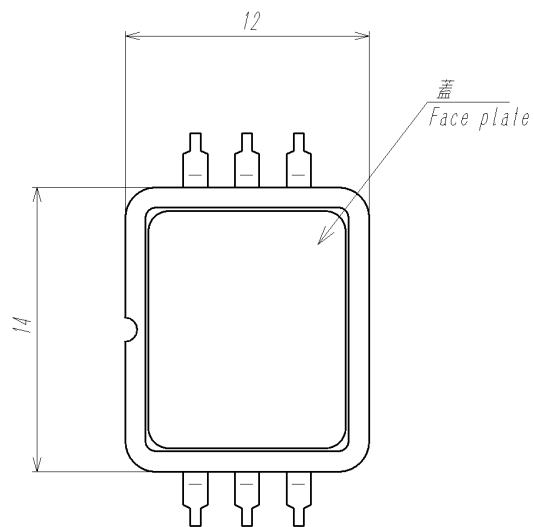


Unless otherwise specified, tolerance: +/-0.1mm

PART NO.	部品名 NAME OF PART	材質 MAT'L	個数 QTY	摘要 REMARKS
PROJECT NAME :				
第3角法 3RD ANGLE PROJECTION	名称TITLE			
単位UNITS mm	APxxN series			
尺度SCALE Free	Outline diagram			
DATE OF ISSUE Oct/4/2012	図面番号DRAWING NO.			REV. MARK
	-9-772-001-----			◇

MARK	変更 REVISIONS	年月日 DATE
◇		



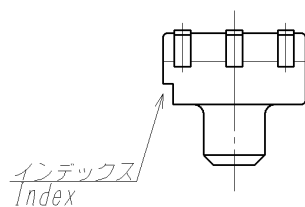
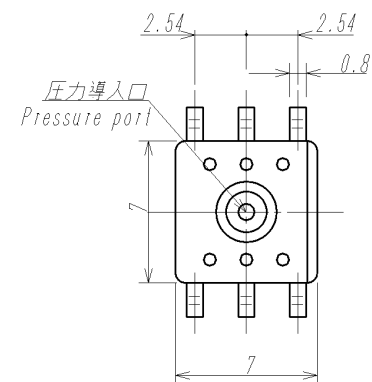
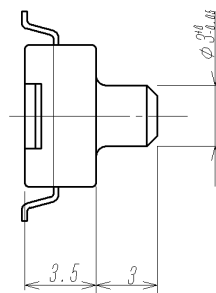
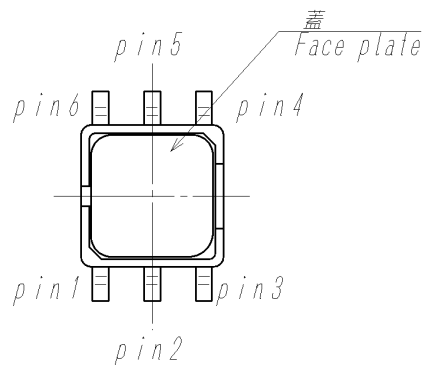
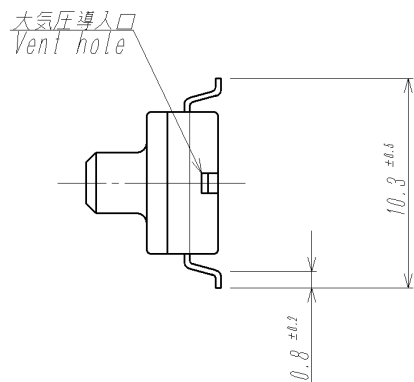


Unless otherwise specified, tolerance: +/-0.1mm

PART NO.	部品名 NAME OF PART	材質 MAT'L	個数 QTY	摘要 REMARKS
PROJECT NAME :				
第3角法 ISO: ANGLE PROJECTION	名称TITLE			
単位UNITS mm	APxxR series			
尺度SCALE Free	図面番号DRAWING NO.			
DATE OF ISSUE Oct/4/2012	9-772-002			REV. MARK

MARK	変更 REVISIONS	年月日 DATE
◇		



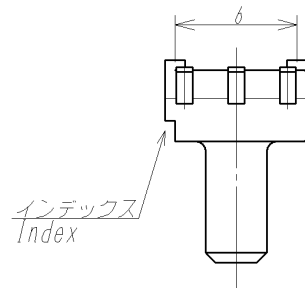
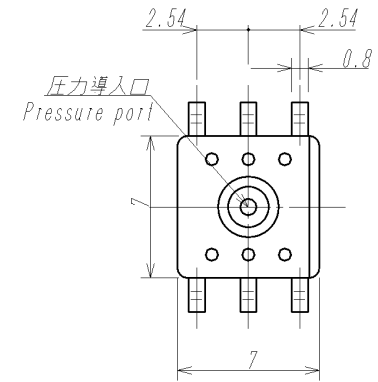
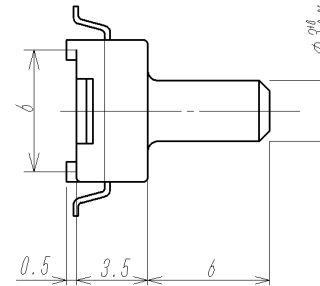
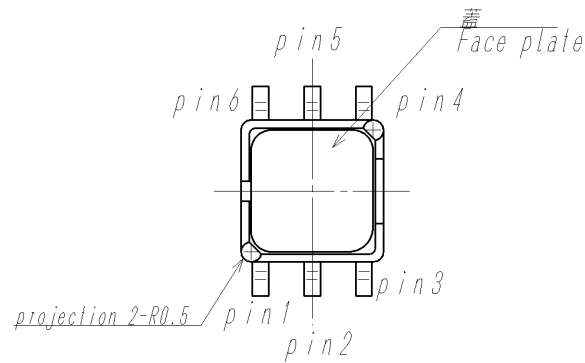
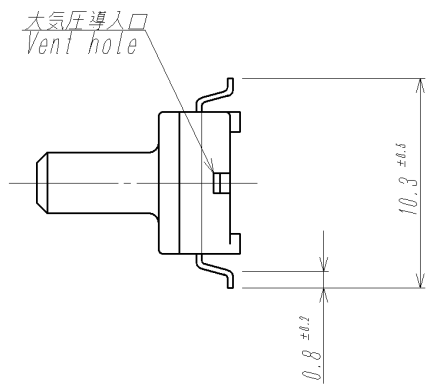


Unless otherwise specified, tolerance: +/-0.1mm

PART NO.	部品名 NAME OF PART	材質 MAT'L	個数 QTY	摘要 REMARKS
PROJECT NAME :				
第3角法 3RD ANGLE PROJECTION	名称TITLE			
単位UNITS mm	AGxx3 series			
尺度SCALE Free	図面番号DRAWING NO.			
DATE OF ISSUE Oct/4/2012	9-772-003			REV. MARK

◇	変更 REVISIONS	年月日 DATE
MARK		





Unless otherwise specified, tolerance: +/-0.1mm

PART NO.	部品名 NAME OF PART	材質 MAT'L	個数 QTY	摘要 REMARKS
PROJECT NAME :				
第3角法 3RD ANGLE PROJECTION	名称TITLE			
単位UNITS mm	AGxx6 series			
尺度SCALE Free	Outline diagram			
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