DATE 7 January, 2015

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SPECIFICATION

Semiconductor Pressure Sensor - Standard Product

Model: AP3, AG3 Pressure Sensor

Project:

Distributor:

Reference:

Yoshiyuki Uchiumi, Application Engineer
Sensor Department Fujikura Ltd.

Fujikura Ltd.

Table of Contents

Table shown below is revision records of this specification

Rev. A	7 Jan., 2015	Y. Uchiumi	Added 700kPa(700KG).	A
Est.	7 Mar., 2014	Y. Uchiumi		
	Date	Name	Comment	Mark

1. General

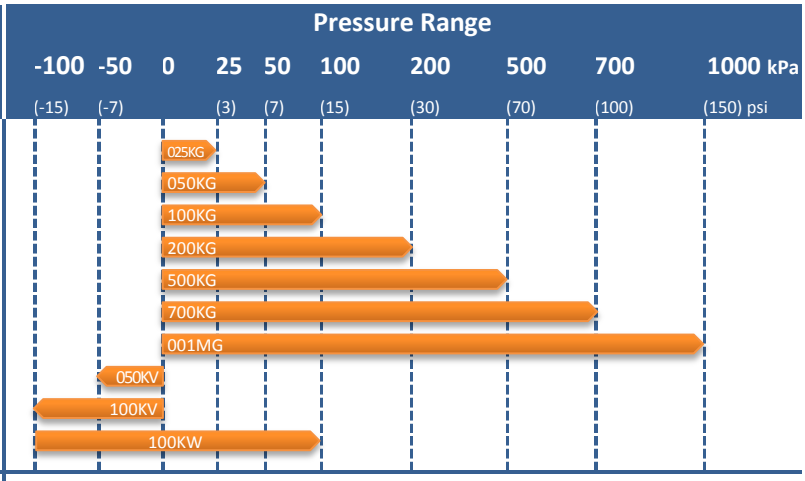
This document describes the specifications of Fujikura Pressure Sensors, Type of AP3 and AG3.

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 a high-level output signal that is proportional to the applied pressure.

3. Device lineup

This device has the following lineup.

Model	Pressure Type	Supply Voltage	Accuracy	Pressure Range
AP3 or AG3	Gauge	5.0 Vdc or 3.3 Vdc	±1.5 %FS	
		3.0 Vdc	±2.0 %FS	Same as the above

Features

- ✓ Amplified and temperature compensated low noise full analog output
- ✓ Single point pressure threshold detection
- ✓ High accuracy
- ✓ Package compatible with XFPM & XFGM integrated pressure sensor
- ✓ Customization or modification available

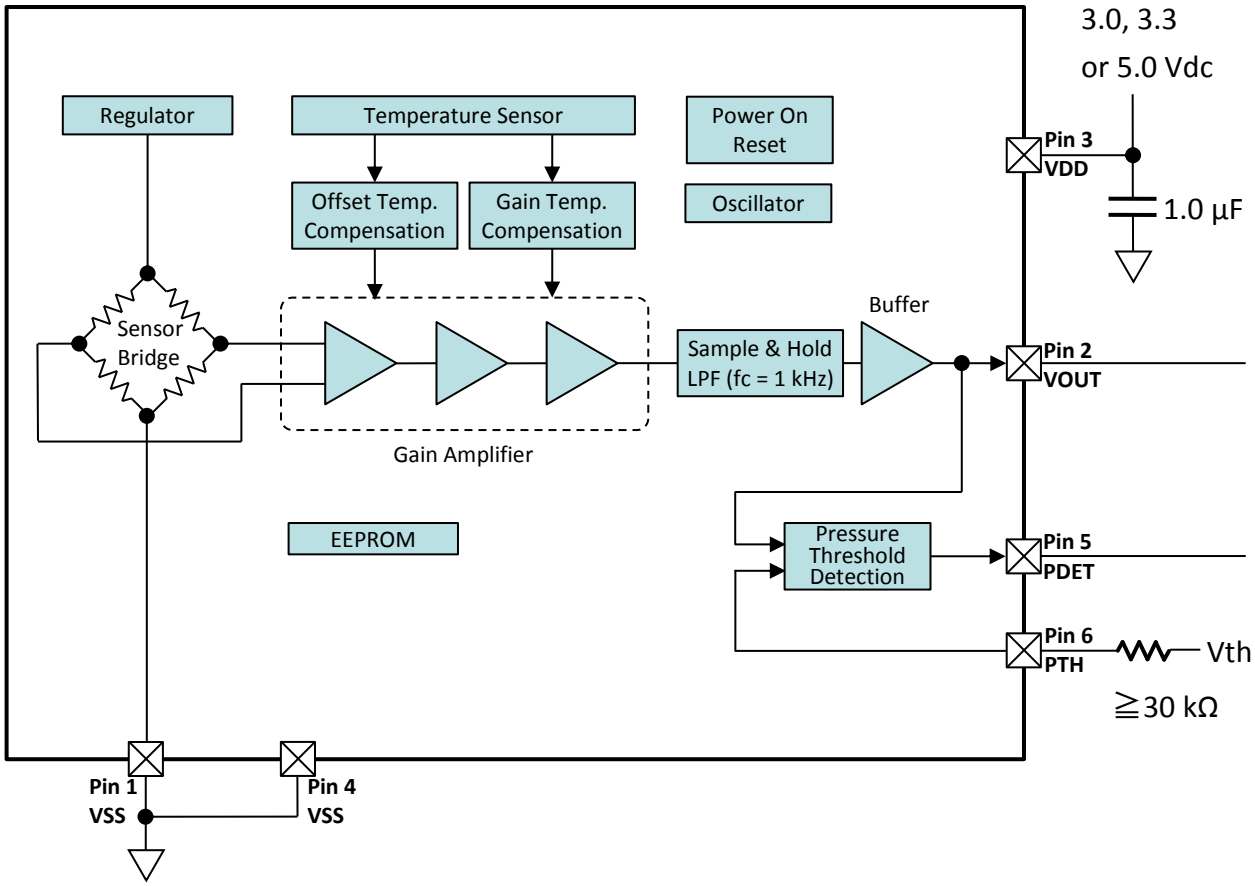
Applications

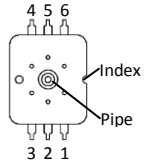
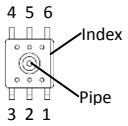
- ✓ Medical devices
- ✓ Industrial pneumatic devices
- ✓ Consumer devices

4. RoHS

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

5. Block Diagram and Pin Connections



Pin Assignment		Pin No.	Pin Name	I/O	Type	Function	
AP3	AG3						
		1	VSS	-	-	Common voltage connection	*1
		2	VOUT	O	Analog	Analog output	
		3	VDD	-	-	Power supply connection	*2
		4	VSS	-	-	Common voltage connection	*1
		5	PDET	O	Digital	Pressure threshold detection	*4
		6	PTH	I	Analog	Pressure threshold input	*3, 4

Notes:

*1) Both Pin 1 and Pin 4 must be connected to VSS.

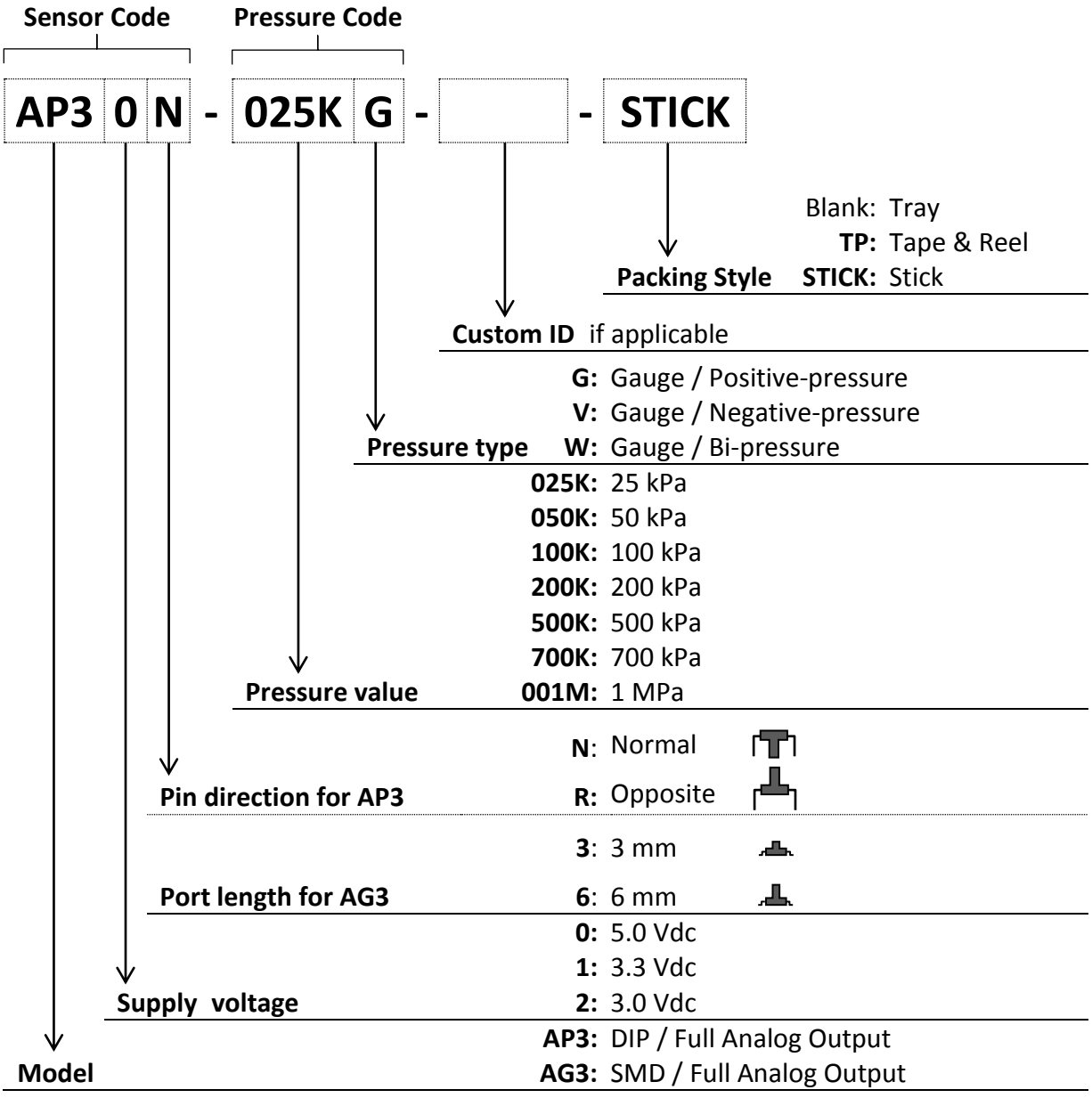
*2) Put a 1.0 µF capacitor between Pin3 (VDD) and VSS.

*3) Put a resistor in series with Pin6 (PTH), when inputting threshold voltage (Vth). The minimum resistance value is 30 kΩ.

*4) When an application does not use Pressure Threshold Detection, put a pull-up resistor between Pin6 (PTH) and VDD, or put a pull-down resistor between Pin6 (PTH) and VSS, and Pin5 (PDET) must be non-connection. The minimum resistance value is 30 kΩ.

6. Device Name Code

The device name code is consisted of Sensor code, Pressure code, Custom ID and Packing style. For the exact ordering device number, please refer to Chapter 17 Ordering Information.



7. Absolute Maximum Ratings

Item			Symbol	Rating	Unit	
Load Pressure	Pressure Code	025KG	Pmax+	+50	kPa	
		050KG		+100	kPa	
		100KG		+200	kPa	
		200KG		+400	kPa	
		500KG		+1000	kPa	
		700KG		+1.4	MPa	(A)
		001MG		+1.5	MPa	
		050KV		+100	kPa	
		100KV		+200	kPa	
		100KW		+200	kPa	
Supply Voltage			VDDmax	6	Vdc	
Input Voltage			VIN	VSS-0.3~VDD+0.3	V	
Operating Temperature			Topt	-40 ~ +105	deg. C	
Storage Temperature			Tstg	-40 ~ +105	deg. C	

Note:

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

8. General Specifications

Item	Condition		Symbol	Rating			Unit	
				Min.	Typ.	Max.		
Supply Voltage	Sensor Code	AP30x, AG30x	VDD	4.75	5	5.25	Vdc	*1
		AP31x, AG31x		3.135	3.3	3.465		
		AP32x, AG32x		2.85	3.0	3.15		
Type of Pressure			-	Gauge pressure				*2
Pressure Media			-	Non-corrosive gases				*3
Pressure Range	Pressure Code	025KG	Popt	0	-	+25	kPa	*4
		050KG		0	-	+50	kPa	
		100KG		0	-	+100	kPa	
		200KG		0	-	+200	kPa	
		500KG		0	-	+500	kPa	
		700KG		0	-	+700	kPa	(A)
		001MG		0	-	+1	MPa	
		050KV		-50	-	0	kPa	
		100KV		-100	-	0	kPa	
		100KW		-100	-	+100	kPa	
Compensated Temperature			-	0	-	+60	deg. C	*5
Operating Humidity	Non-condensing		Hopt	30	-	85	%RH	*6
Storage Humidity	Non-condensing		Hstg	30	-	85	%RH	*6
Dielectric Strength			-	-	-	1	mA	*7
Insulation Resistance			-	100	-	-	MΩ	*8

Notes:

*1) Output voltage (Vout) is not perfectly ratio-metric with the power supply voltage (VDD).

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

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

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

*5) Please also refer to Chapter 11 Transfer Function.

*6) Do not wet the device with dew.

*7) Dielectric strength is defined as the leakage current between all pins and the package with AC 500, 1 minute.

*8) Insulation resistance is defined as the resistance value between all pins and the package with DC 500 V.

9. Electrical Characteristics

Load resistor RL =∞, Ambient temperature Ta = 25 deg. C

Item	Condition	Symbol	Rating			Unit	
			Min.	Typ.	Max.		
Sensor Code: AP30x, AG30x (VDD = 5.0 Vdc)							
Offset Voltage	Min. Popt,050KV & 100KV: Max. Popt	Voff	0.1325	0.2	0.2675	V	*1, 2
Full Scale Voltage	Max. Popt 050KV & 100KV: Min. Popt	Vfs	4.6325	4.7	4.7675	V	*3
Span Voltage	Min. to max. Popt	SV	-	4.5	-	V	*4
Accuracy	0 to 60 deg. C	Error	-1.5	-	+1.5	%FS	*5, 6
			-0.0675	-	+0.0675	V	
Supply Current		Ic	-	-	6	mAdc	*7
Sensor Code: AP31x, AG31x (VDD = 3.3 Vdc)							
Offset Voltage	Min. Popt, 050KV & 100KV: Max. Popt	Voff	0.2595	0.3	0.3405	V	*1, 2
Full Scale Voltage	Max. Popt 050KV & 100KV: Min. Popt	Vfs	2.9595	3.0	3.0405	V	*3
Span Voltage	Min. to max. Popt	SV	-	2.7	-	V	*4
Accuracy	0 to 60 deg. C	Error	-1.5	-	+1.5	%FS	*5, 6
			-0.0405	-	+0.0405	V	
Supply Current		Ic	-	-	5	mAdc	*7
Sensor Code: AP32x, AG32x (VDD = 3.0 Vdc)							
Offset Voltage	Min. Popt, 050KV & 100KV: Max. Popt	Voff	0.096	0.15	0.204	V	*1, 2
Full Scale Voltage	Max. Popt 050KV & 100KV: Min. Popt	Vfs	2.796	2.85	2.904	V	*3
Span Voltage	Min. to max. Popt	SV	-	2.7	-	V	*4
Accuracy	0 to 60 deg. C	Error	-2.0	-	+2.0	%FS	*5, 6
			-0.054	-	+0.054	V	
Supply Current		Ic	-	-	5	mAdc	*7
Response Time	for reference	tr	-	2	-	msec.	*8
Load Resistor	VOUT - VSS or VDD - VOUT	RL	9.5	-	-	kΩ	*7
Load Capacitance	VOUT - VSS	CL	-	-	50	pF	*9

Notes:

*1) Offset voltage (Voff) is defined as the output voltage at minimum Popt. In case of 050KV and 100KV, Offset voltage (Voff) is defined as the output voltage at maximum Popt.

*2) Offset error is calibration error of offset voltage at production. It does not include Long term offset drift. It would be suggested that applications have Auto-zeroing function.

*3) Full scale voltage (Vfs) is defined as the output voltage at maximum Popt. In case of 050KV and 100KV, Full scale voltage (Vfs) is defined as the output voltage at minimum Popt.

*4) Output span voltage (SV) is defined as the voltage difference between Offset voltage (Voff) and Full scale voltage (Vfs).

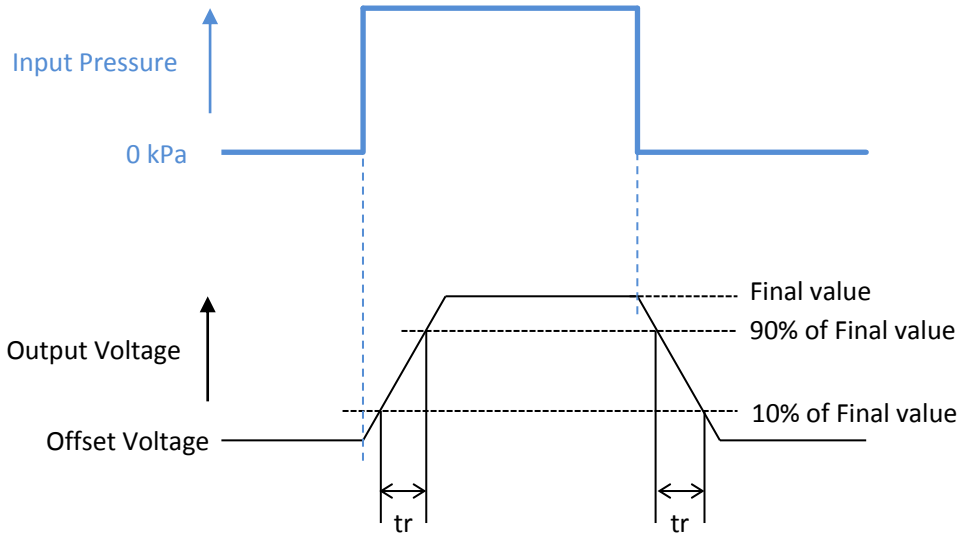
*5) Accuracy consists of the following:

Non-linearity
Temperature errors over the temperature range 0 to 60 degree C
Pressure hysteresis
Calibration errors of sensitivity and offset

*6) The unit of Accuracy “%FS” is defined as a percent error by Span voltage (SV).

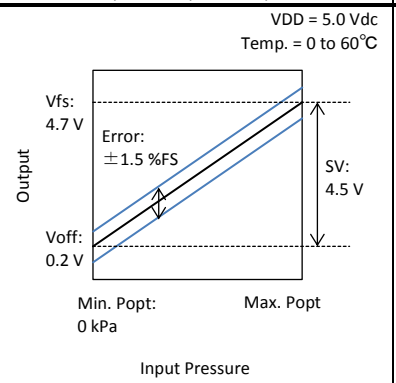
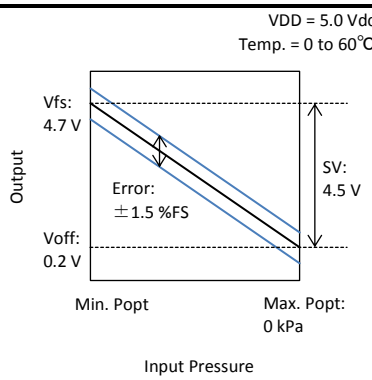
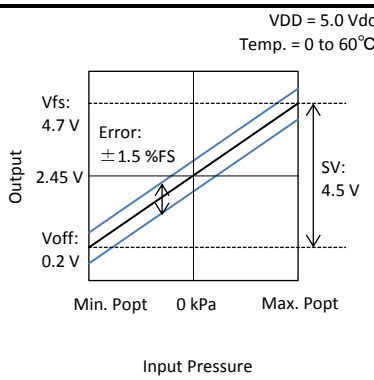
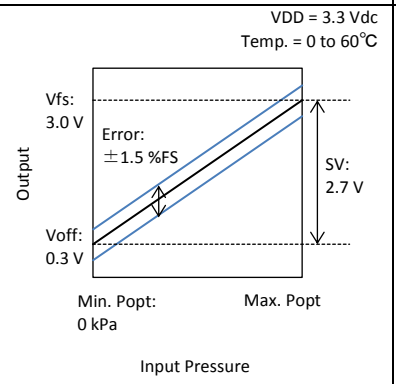
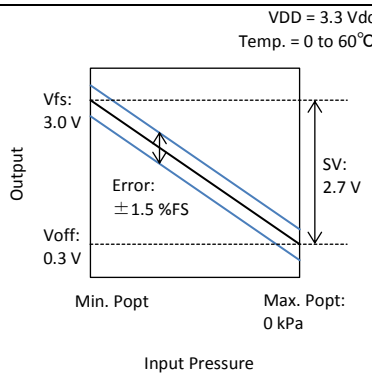
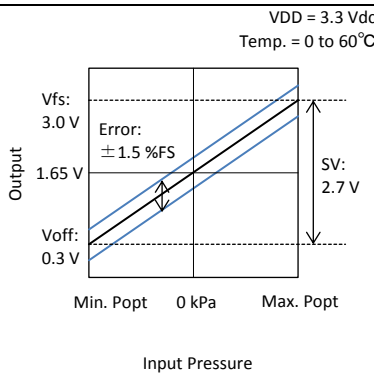
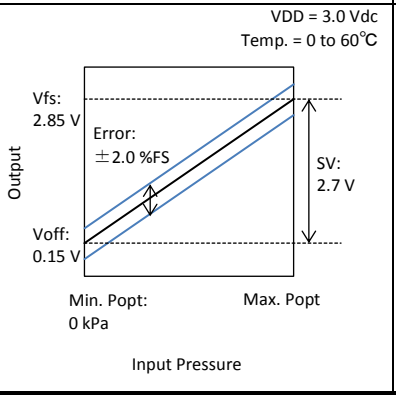
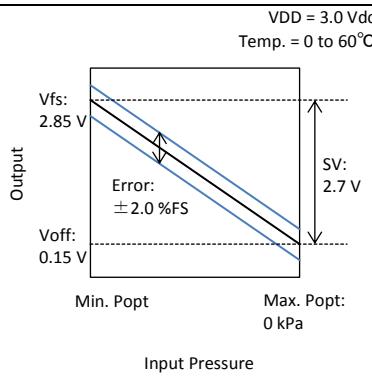
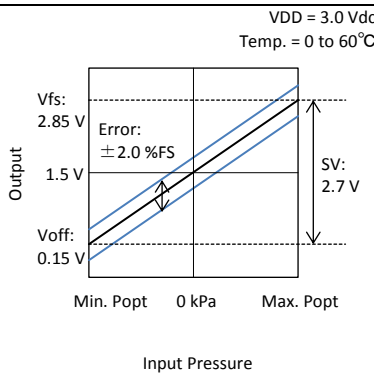
*7) Supply Current (Ic) is increased depending on the value of Load resistor (RL).

*8) Response time (tr) is defined as the time for the change in output voltage from 10% to 90% or from 90% to10% of its final value when the input pressure makes a step change.



*9) Do not put Load capacitance (CL) that is over 50 pF between VOUT and VSS.

10. Output versus Input Pressure

Sensor Code	Pressure Code		
	025KG, 050KG, 100KG, 200KG, 500KG, 700KG, 001MG	050KV, 100KV	100KW
AP30x AG30x			
AP31x AG31x			
AP32x AG32x			

11. Transfer Function

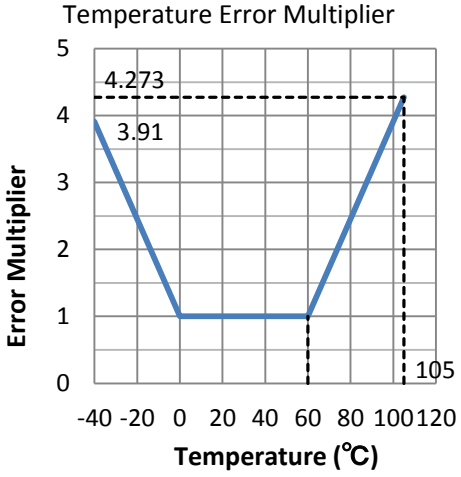
Vout = VDD × ((P × α) + β) ± (Pressure Error × Temperature Error Multiplier × α × VDD)

Parameters:

Sensor Code \ Parameter / Pressure Code		VDD (*1)	P (kPa)	α	β	Pressure Error (kPa)
AP30x AG30x	025KG	5.0±0.25V	0 ~ +25	9/250	1/25	0.375
	050KG		0 ~ +50	9/500	1/25	0.75
	100KG		0 ~ +100	9/1000	1/25	1.5
	200KG		0 ~ +200	9/2000	1/25	3.0
	500KG		0 ~ +500	9/5000	1/25	7.5
	700KG		0 ~ +700	9/7000	1/25	10.5
	001MG		0 ~ +1000	9/10000	1/25	15
	050KV		-50 ~ 0	-9/500	1/25	0.75
	100KV		-100 ~ 0	-9/1000	1/25	1.5
	100KW		-100 ~ +100	9/2000	49/100	3.0
AP31x AG31x	025KG	3.3±0.165V	0 ~ +25	9/275	1/11	0.375
	050KG		0 ~ +50	9/550	1/11	0.75
	100KG		0 ~ +100	9/1100	1/11	1.5
	200KG		0 ~ +200	9/2200	1/11	3.0
	500KG		0 ~ +500	9/5500	1/11	7.5
	700KG		0 ~ +700	9/7700	1/11	10.5
	001MG		0 ~ +1000	9/11000	1/11	15
	050KV		-50 ~ 0	-9/550	1/11	0.75
	100KV		-100 ~ 0	-9/1100	1/11	1.5
	100KW		-100 ~ +100	9/2200	1/2	3.0
AP32x AG32x	025KG	3.0±0.15V	0 ~ +25	9/250	1/20	0.5
	050KG		0 ~ +50	9/500	1/20	1
	100KG		0 ~ +100	9/1000	1/20	2
	200KG		0 ~ +200	9/2000	1/20	4
	500KG		0 ~ +500	9/5000	1/20	10
	700KG		0 ~ +700	9/7000	1/20	14
	001MG		0 ~ +1000	9/10000	1/20	20
	050KV		-50 ~ 0	-9/500	1/20	1
	100KV		-100 ~ 0	-9/1000	1/20	2
	100KW		-100 ~ +100	9/2000	1/2	4

Note:

*1) Output voltage (Vout) is not perfectly ratio-metric with the power supply voltage (VDD).



12. Single Point Pressure Threshold Detection

AP3 and AG3 have a comparator. Output voltage (VOUT) and threshold voltage from PTH are inputted into the comparator. Comparator's output will be changed when VOUT reaches a threshold voltage.

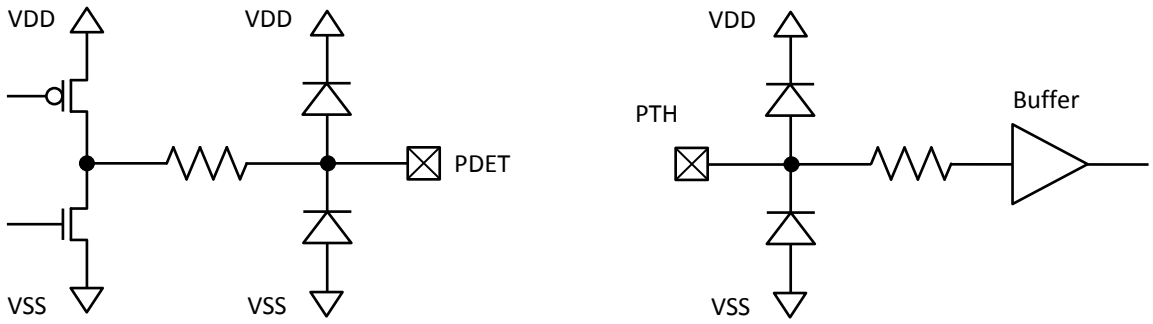
Ambient temperature Ta = 25 deg. C

Item	Condition	Symbol	Rating			Unit	
			Min.	Typ.	Max.		
Type of Output		PDET	CMOS output				*2
Threshold Input voltage	PTH	Vth	0.1*VDD	-	0.9*VDD	V	
Input Impedance	PTH	Zin	1	-	-	MΩ	
Output voltage	VOUT < Vth	V_{OH}	0.9*VDD	-	-	V	
	VOUT ≧ Vth	V_{OL}	-	-	0.1*VDD	V	
Pressure Hysteresis		Phys	-	0.05*VDD	-	V	
Detection Time		Tdetr	-	150	-	µsec	*3
Non Detection Time		Tdetf	-	150	-	µsec	*3

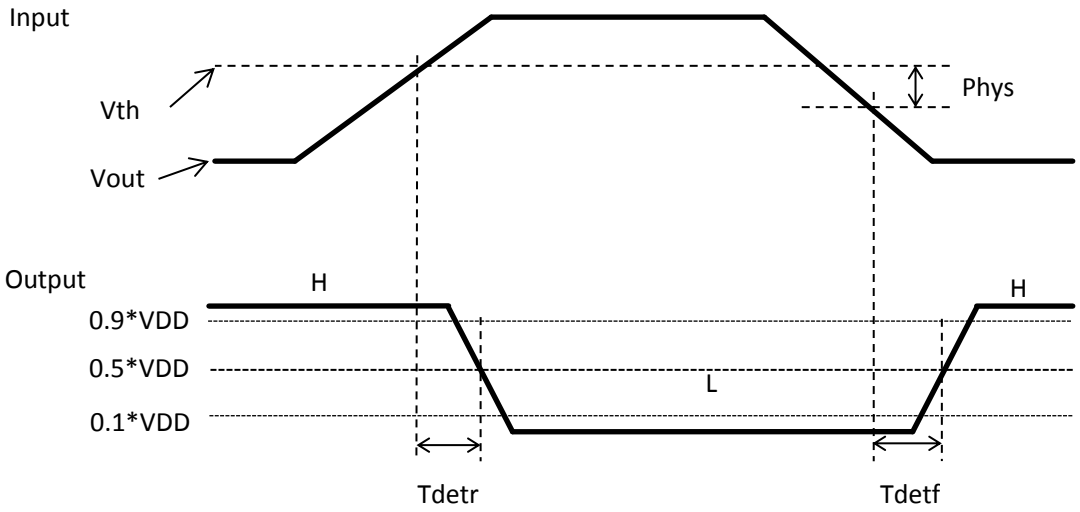
Notes:

*1) Do not control any device directly using this function. Because there is indeterminate status during the supply voltage rises.

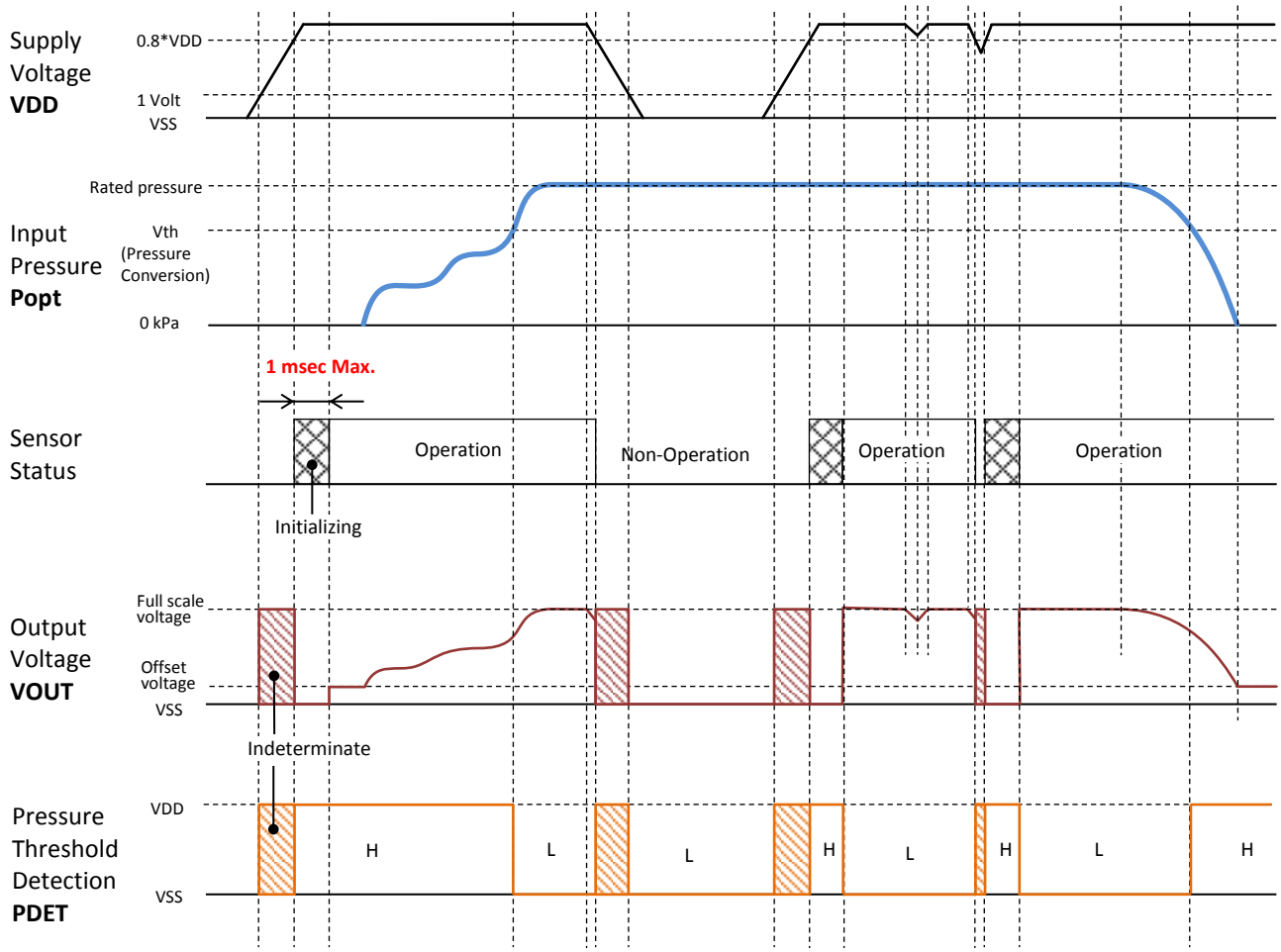
*2) Equivalent circuits of PDET and PDTH are as below:



*3) Please also refer to the following timing chart.



13. Operating Sequence

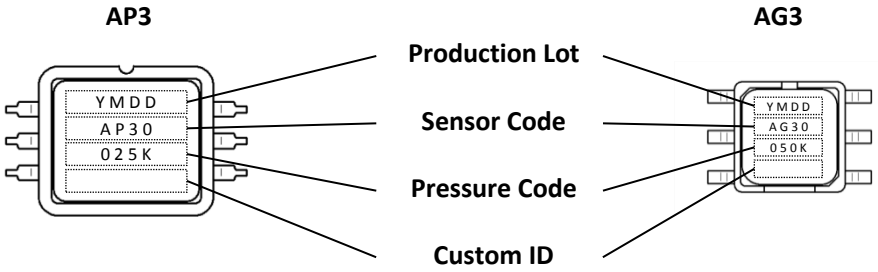


Notes:

*1) The status of VOUT, PDET and PTH are indeterminate when supply voltage is under 0.8*VDD.

*2) Initializing process is started when supply voltage reaches 0.8*VDD,. At initializing process, PDET is fixed 0.9*VDD and over, and VOUT is fixed 0.1*VDD and under.

14. Device Marking



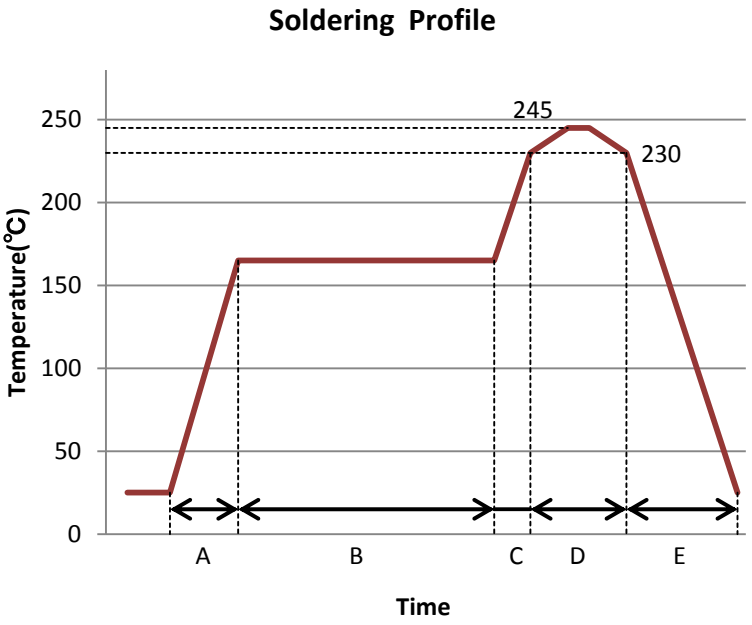
Items			Marking	
Production Lot				
	Y	Last digit of Production year	0~9	
	M	Production month	1, 2, 3 ~ 8, 9, X=Oct., Y=Nov., Z=Dec.	
	DD	Production date	01~31	
Sensor Code				*1
	AP30x		AP30	
	AP31x		AP31	
	AP32x		AP32	
	AG30x		AG30	
	AG31x		AG31	
	AG32x		AG32	
Pressure Code				
	025KG		025K	
	050KG		050K	
	100KG		100K	
	200KG		200K	
	500KG		500K	
	700KG		700K	
	001MG		001M	
	050KV		050V	
	100KV		100V	
	100KW		100W	
Custom ID			If applicable	*2

Notes:

*1) Pin direction for AP3 or Port length for AG3 is not marked on the face plate.

*2) Custom ID will be added when a product is customized for a customer.

15. Soldering

Process	Sensor Code	Condition	
Hand soldering	AP3xx	Soldering iron temperature: 350 deg. C max. Soldering time: 3 seconds max. / each pin	*1, 2
Wave soldering	AP3xR	Soldering bath temperature: 260 deg. C max. Soldering time: 5 seconds max.	*1, 2
Reflow soldering	AG3xx		*1, 2, 3, 4

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.

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) Do not reflow more than twice.

16. Dimensions and Weights

Refer to the following drawing as attached.

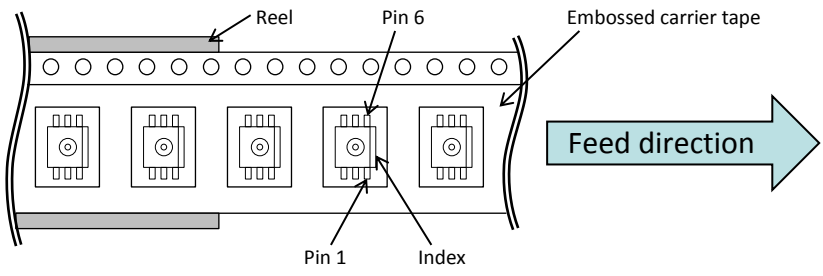
Sensor Code	Dimension Drawing	Weights
AP3xN	9-772-001	approx. 1.4 grams
AP3xR	9-772-002	
AG3x3	9-772-003	approx. 0.3 grams
AG3x6	9-772-004	approx. 0.4 grams

17. Ordering Information

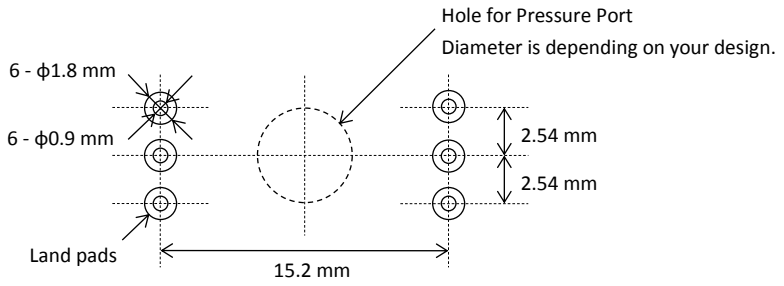
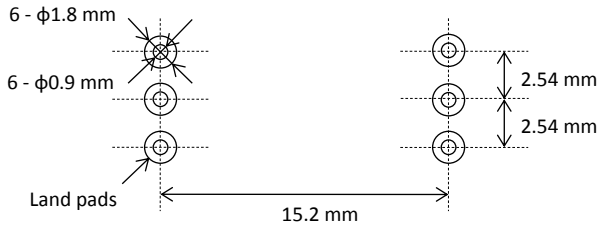
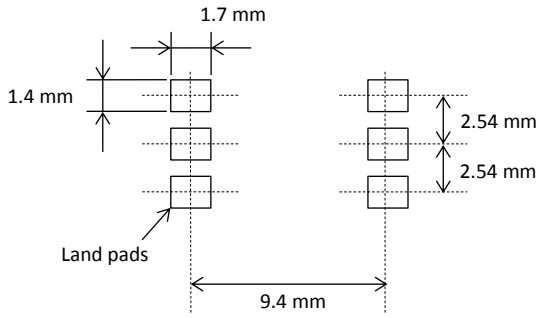
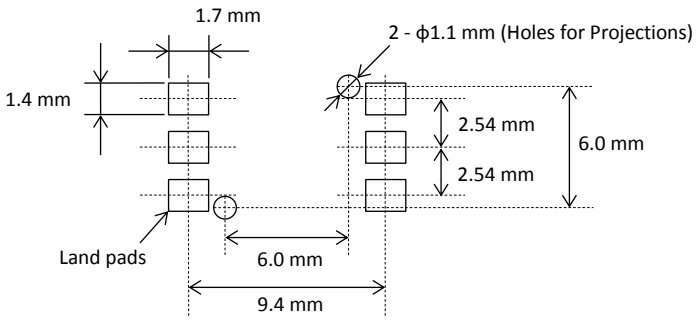
Model	Package	Supply Voltage	Pin Direction	Packing	Ordering Device Number	Qty./Packing
AP3	DIP	5.0 Vdc	Normal	Tray	AP30N- [Pressure Code]	150 Pcs/Tray
				Stick	AP30N- [Pressure Code] -STICK	40 Pcs/Stick
			Opposite	Tray	AP30R- [Pressure Code]	150 Pcs/Tray
				Stick	AP30R- [Pressure Code] -STICK	40 Pcs/Stick
		3.3 Vdc	Normal	Tray	AP31N- [Pressure Code]	150 Pcs/Tray
				Stick	AP31N- [Pressure Code] -STICK	40 Pcs/Stick
			Opposite	Tray	AP31R- [Pressure Code]	150 Pcs/Tray
				Stick	AP31R- [Pressure Code] -STICK	40 Pcs/Stick
		3.0 Vdc	Normal	Tray	AP32N- [Pressure Code]	150 Pcs/Tray
				Stick	AP32N- [Pressure Code] -STICK	40 Pcs/Stick
			Opposite	Tray	AP32R- [Pressure Code]	150 Pcs/Tray
				Stick	AP32R- [Pressure Code] -STICK	40 Pcs/Stick
			Port Length			
AG3	SMD	5.0 Vdc	3 mm	Tray	AG303- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG303- [Pressure Code] -TP	500 Pcs/Reel
			6 mm	Tray	AG306- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG306- [Pressure Code] -TP	500 Pcs/Reel
		3.3 Vdc	3 mm	Tray	AG313- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG313- [Pressure Code] -TP	500 Pcs/Reel
			6 mm	Tray	AG316- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG316- [Pressure Code] -TP	500 Pcs/Reel
		3.0 Vdc	3 mm	Tray	AG323- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG323- [Pressure Code] -TP	500 Pcs/Reel
			6 mm	Tray	AG326- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG326- [Pressure Code] -TP	500 Pcs/Reel

Pressure Range	Pressure Code
0 ~ +25 kPa	025KG
0 ~ +50 kPa	050KG
0 ~ +100 kPa	100KG
0 ~ +200 kPa	200KG
0 ~ +500 kPa	500KG
0 ~ +700 kPa	700KG
0 ~ +1 MPa	001MG
-50 ~ 0 kPa	050KV
-100 ~ 0 kPa	100KV
-100 ~ +100 kPa	100KW

18. Tape & Reel Information



19. Footprint for PCB (for Reference)

Sensor Code	Footprint
AP3xN	
AP3xR	
AG3x3	
AG3x6	

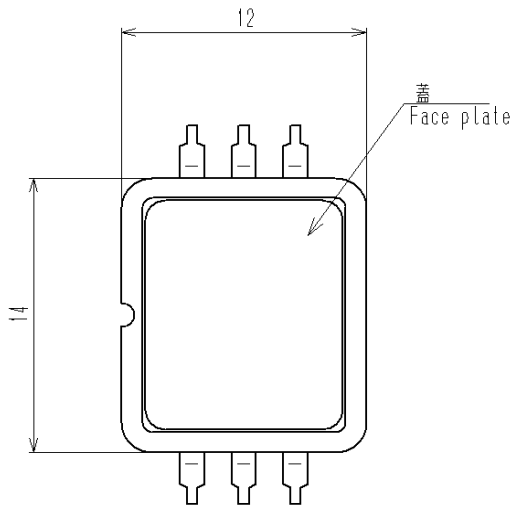
Notes:

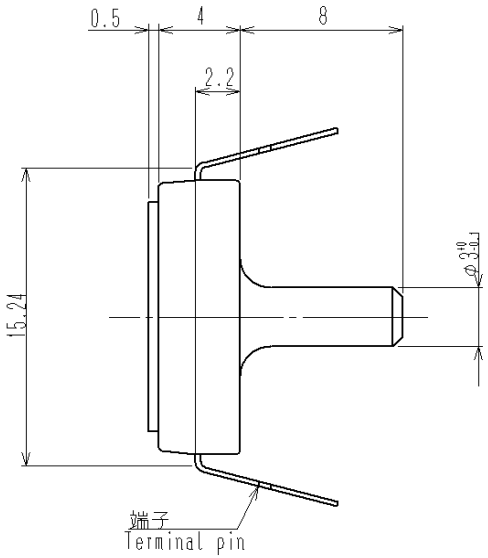
*1) These footprints are for reference. Please evaluate well these footprints, before your mass production.

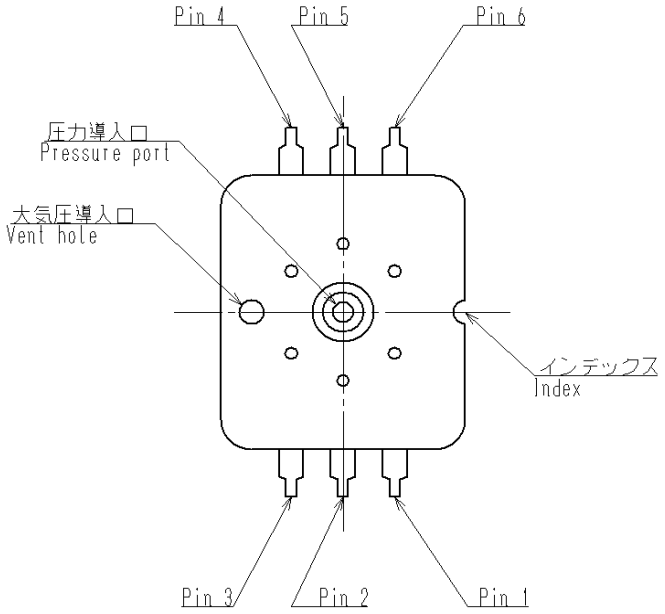
*2) When designing your PCB, please also refer to the outline diagrams.

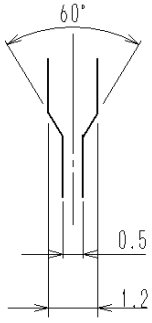
20. Notes

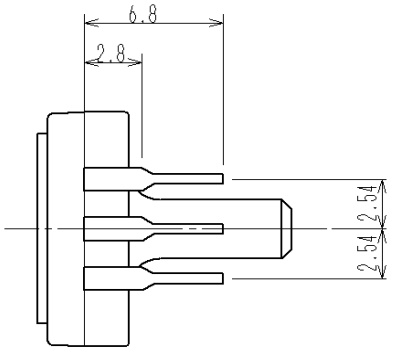
- Fujikura reserves all rights.
- This document has a possibility to be changed without notice.
- Limitation, usage, environment, standard warranty and so on are listed on Fujikura web site.
- Please refer to the latest specifications.









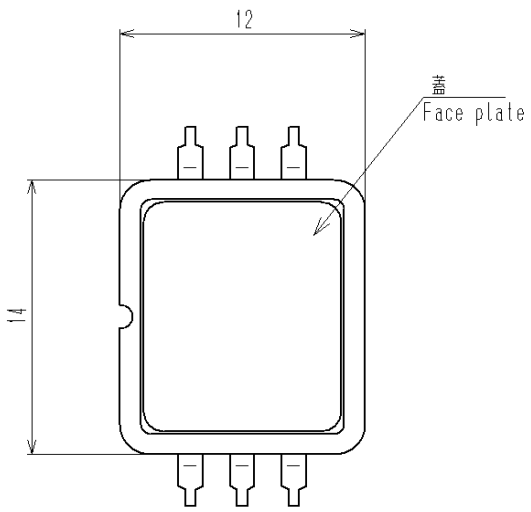


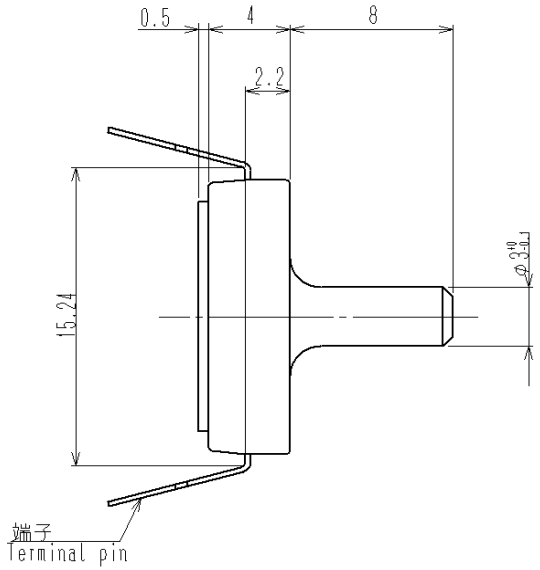
Unless otherwise specified, tolerance: +/-0.1mm

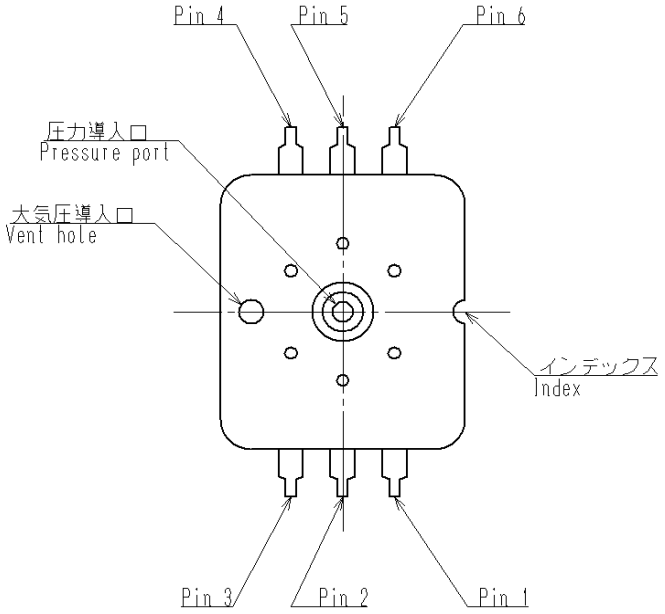
PART NO.	部品名 NAME OF PART	材質 MAT'L	個数 QTY.	摘要 REMARKS
PROJECT NAME:				

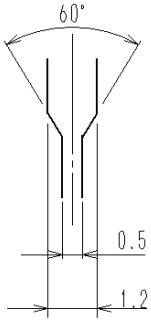
第３角法 3RD ANGLE PROJECTION	名称TITLE
単位UNITS mm	APxxN series
尺度SCALE Free	Outline diagram
DATE OF ISSUE Oct/1/2013	図面番号DRAWING NO. _9-772-001_____
	REV.MARK ◇

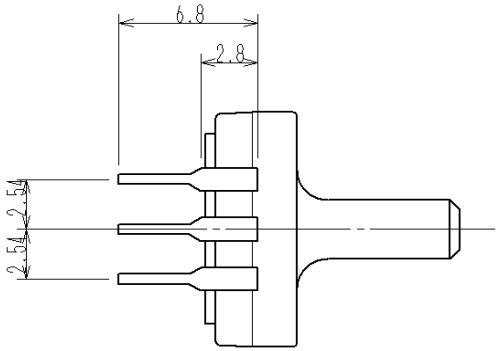
MARK	変更 REVISIONS	年月日 DATE
◇		











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	APxxR series
尺度SCALE Free	Outline diagram
DATE OF ISSUE Oct/1/2013	図面番号DRAWING NO. 9-772-002
	REV.MARK ◇

MARK	変更 REVISIONS	年月日 DATE
◇		