Fujikura

DATE 1 October, 2013

No. V-70001

Messrs.

SPECIFICATION

Model: AP2, AG2 Pressure Sensor

Project:

Distributor:

Reference:

Yoshiyuki Uchiumi, Application Engineer
Sensor Department Fujikura Ltd.

Fujikura Ltd.

Table of Contents

1. General

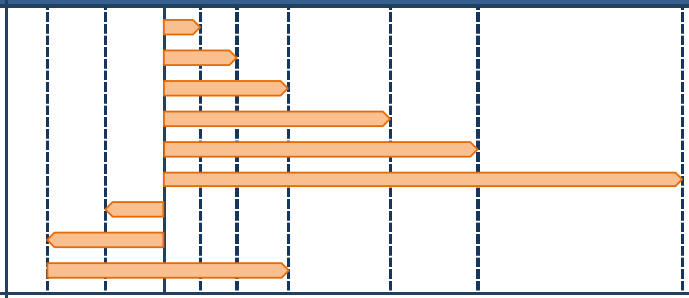
This document describes the specifications of Fujikura Pressure Sensors, AP2 and AG2 series.

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 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 (kPa) -100 -50 0 25 50 100 200 500 1000
AP2 or AG2	Gauge	5.0 Vdc or 3.3 Vdc	±1.5 %FS	
		3.0 Vdc	±2.0 %FS	Same as the above

Features

- ✓ Low power consumption
- ✓ High accuracy
- ✓ Pins & Package compatible with XFPM & XFGM integrated pressure sensor
- ✓ Customization available

Applications

- ✓ Battery-operated devices
- ✓ Medical devices
- ✓ Industrial pneumatic devices
- ✓ Consumer devices

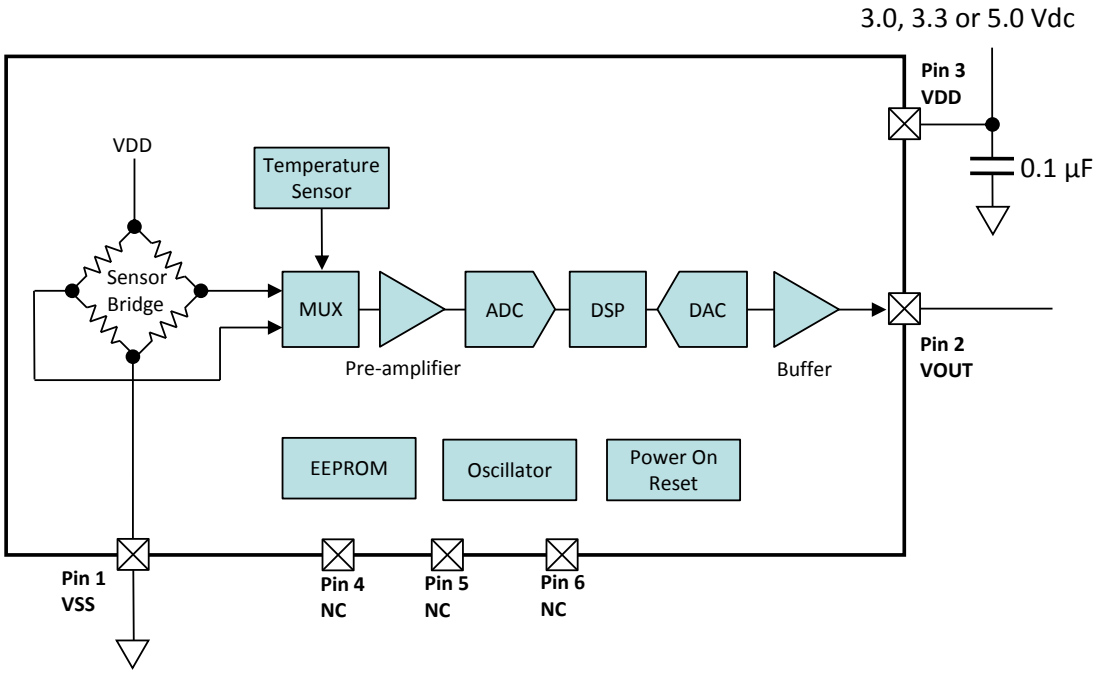
4. RoHS

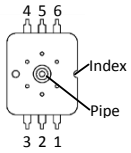
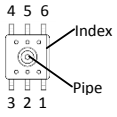
This device is compliant with the Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment (RoHS).

Table shown below is revision records of this specification

Rev.				
Est.	1 Oct., 2013	Y.Uchiumi		
	Date	Name	Comment	Mark

5. Block Diagram and Pin Connections

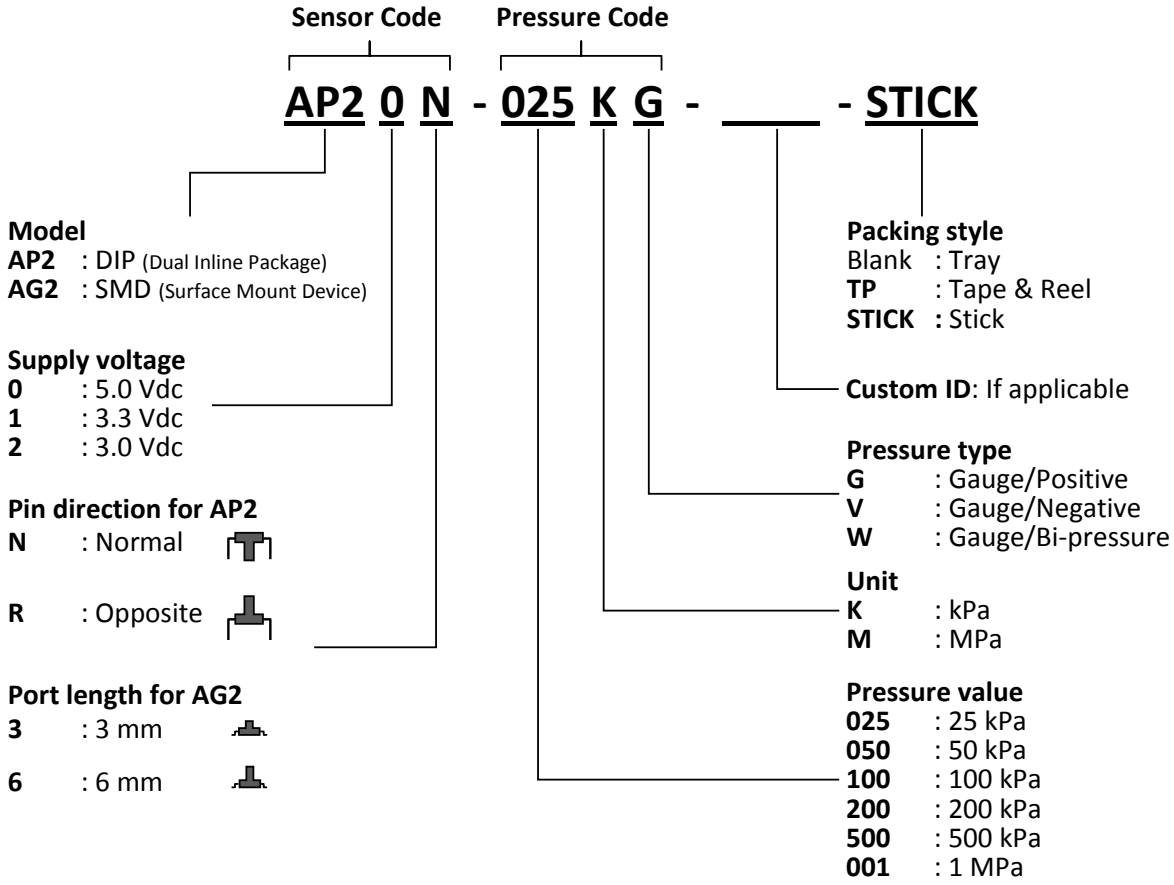


Pin Assignment		Pin No.	Pin Name	I/O	Type	Function	
AP2	AG2						
		1	VSS	-	-	Common voltage connection	
		2	VOUT	O	Analog	Analog output	
		3	VDD	-	-	Power supply connection	*1
		4	NC	-	-	-	*2
		5	NC	-	-	-	*2
		6	NC	-	-	-	*2

Notes:
*1) Put a 0.1 µF capacitor between VDD Pin 3 and VSS Pin 1.
*2) Pin 4, 5 and 6 must be open.

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 16 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		+1	MPa
		001MG		+1.5	MPa
		50KV		+100	kPa
		100KV		+200	kPa
		100KW		+200	kPa
Supply Voltage			VDDmax	6	Vdc
Operating Temperature			Topt	-40 to +125	deg. C
Storage Temperature			Tstg	-40 to +125	deg. C

Note:

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

8. General Specifications

Item \ Sensor Code / Symbol	Symbol	AP20x AG20x	AP21x AG21x	AP22x AG22x	Unit	
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 to +85			deg. C	*4
Operating Humidity	Hopt	30 to 85 (non-condensing)			%RH	*5
Storage Humidity	Hstg	30 to 85 (non-condensing)			%RH	*5
Dielectric Strength		Leakage current 1mA maximum, AC 500 V, 1 minute				*6
Insulation Resistance		100 MΩ minimum (DC 500 V)				*7

Notes:

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

*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 12 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 AC 500 V, 1 minute.

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

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
500KG		0	-	+500	kPa
001MG		0	-	+1	MPa
050KV		-50	-	0	kPa
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

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

Item	Condition	Symbol	Rating			Unit	
			Min.	Typ.	Max.		
Sensor Code: AP20x, AG20x (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 85 deg. C	Error	-1.5	-	+1.5	%FS	*5, 6
			-0.0675	-	+0.0675	V	
Output Resolution		Vrso	-	2.5	-	mV	*7
Supply Current		Ic	-	-	3	mAdc	*8
Sensor Code: AP21x, AG21x (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 85 deg. C	Error	-1.5	-	+1.5	%FS	*5, 6
			-0.0405	-	+0.0405	V	
Output Resolution		Vrso	-	1.7	-	mV	*7
Supply Current		Ic	-	-	2	mAdc	*8
Sensor Code: AP22x, AG22x (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 85 deg. C	Error	-2.0	-	+2.0	%FS	*5, 6
			-0.054	-	+0.054	V	
Output Resolution		Vrso	-	1.5	-	mV	*7
Supply Current		Ic	-	-	2	mAdc	*8
Response Time	for reference	tr	-	1	-	msec.	*9
Sampling Frequency		fs	-	1	-	kHz	*10
Load Resistor	VOUT - VSS or VDD - VOUT	RL	2.5	-	-	kΩ	*8
Load Capacitance	VOUT - VSS	CL	-	-	15	nF	*11

Notes;

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

*2) Offset error is calibration error of Offset voltage (Voff) 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 100KV, Full scale voltage (Vfs) is defined as the output voltage of 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 85 degree C
Pressure hysteresis
Calibration errors of sensitivity and offset

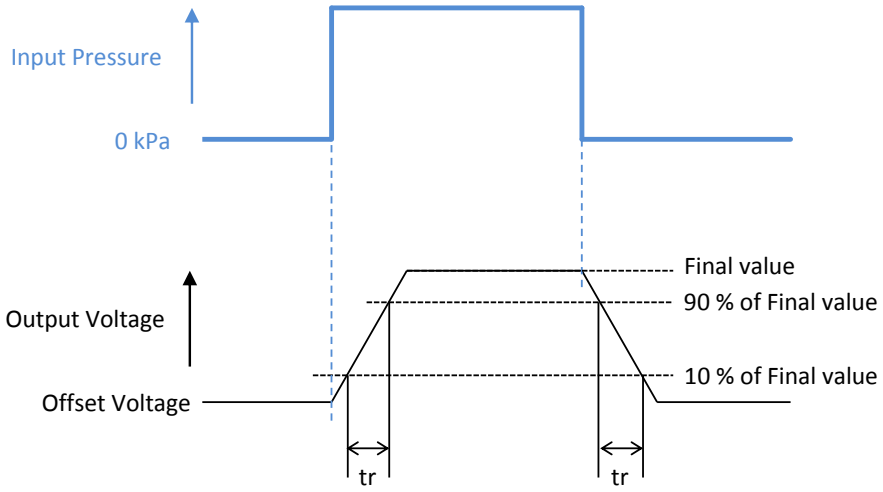
*6) The unit of Accuracy "%FS" is defined as a percent error by Span voltage (SV).

*7) Output voltage (Vout) is generated by the internal digital to analog converter. Therefore the output voltage has Output resolution (Vrso). Resolution in pressure is calculated as below:

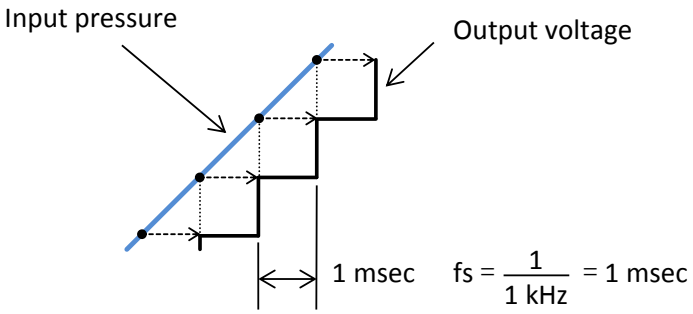
$$\text{Pressure resolution} = \frac{\text{Vrso}}{\text{SV}} \times \text{Pressure range (Min. to Max.)}$$

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

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

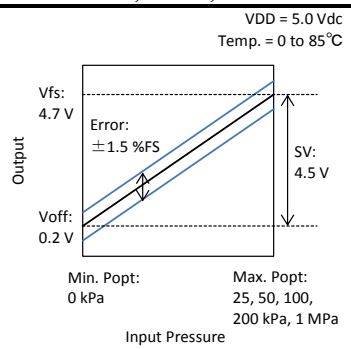
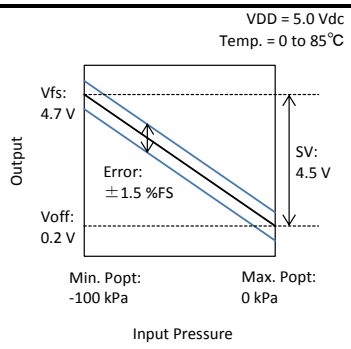
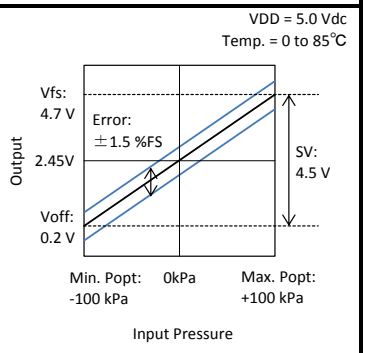
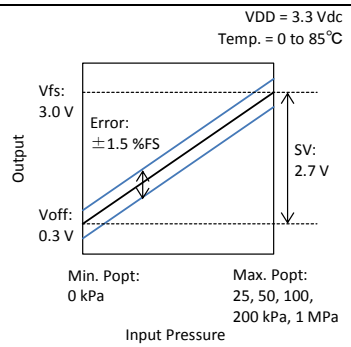
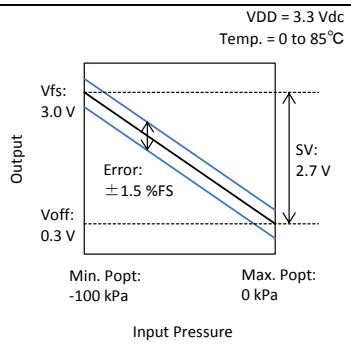
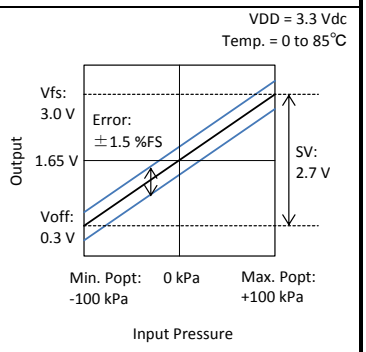
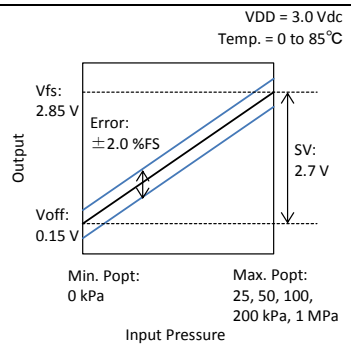
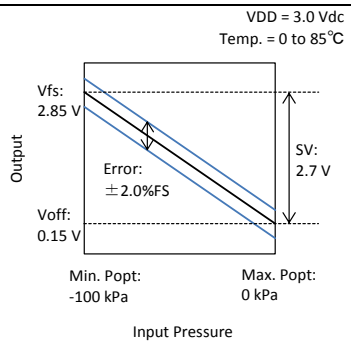
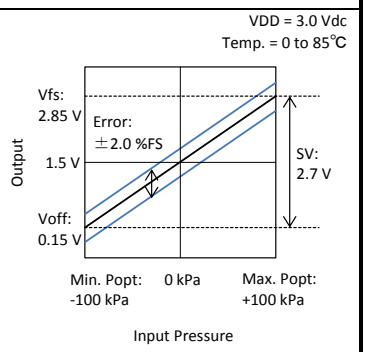


*10) Output voltage (Vout) is sampled and held by the internal sampling / hold block. Sampling frequency (fs) is 1 kHz. The output voltage is changed stepwise every approximately 1millisecond.



*11) Do not directly connect Load capacitance (CL) that is over 15 nF to VOUT.

11. Output versus Input Pressure

Sensor Code	Pressure Code		
	025KG, 050KG, 100KG, 200KG, 500KG, 001MG	050KV, 100KV	100KW
AP20x AG20x			
AP21x AG21x			
AP22x AG22x			

12. Transfer Function

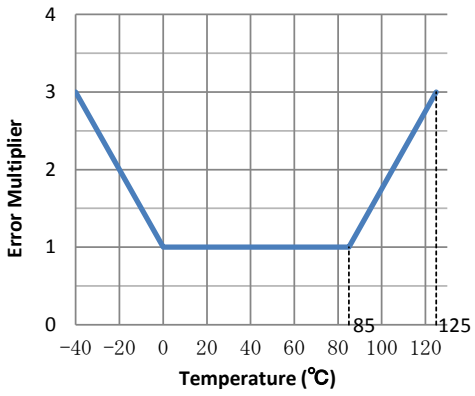
Vout = VDD × ((P × α) + β) ± (Pressure Error × Temperature Error Multiplier × α × VDD)

Parameters

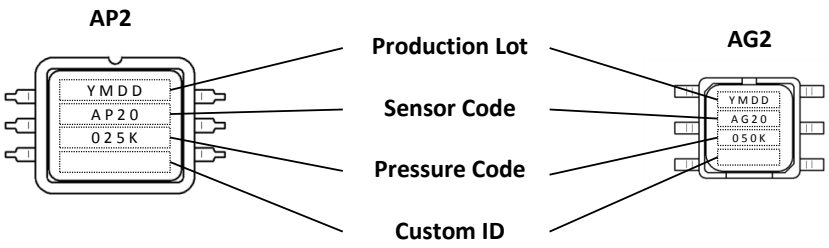
Sensor Code \ Parameter / Pressure Code		VDD (*1)	P (kPa)	α	β	Pressure Error (kPa)
AP20x AG20x	025KG	5.0±0.25 V	0 ~ +25	9/250	1/25	0.375
	050KG		0 ~ +50	9/500	1/25	0.75
	100KG		0 ~ +100	9/1000	1/25	1.5
	200KG		0 ~ +200	9/2000	1/25	3.0
	500KG		0 ~ +500	9/5000	1/25	7.5
	001MG		0 ~ +1000	9/10000	1/25	15
	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
AP21x AG21x	025KG	3.3±0.165 V	0 ~ +25	297/9075	1/11	0.375
	050KG		0 ~ +50	297/18150	1/11	0.75
	100KG		0 ~ +100	297/36300	1/11	1.5
	200KG		0 ~ +200	297/72600	1/11	3.0
	500KG		0 ~ +500	297/181500	1/11	7.5
	001MG		0 ~ +1000	297/363000	1/11	15
	050KV		-50 ~ 0	-297/18150	1/11	0.75
	100KV		-100 ~ 0	-297/3630	1/11	1.5
	100KW		-100 ~ +100	27/6600	1/2	3.0
AP22x AG22x	025KG	3.0±0.15 V	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
	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

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

Temperature Error Multiplier



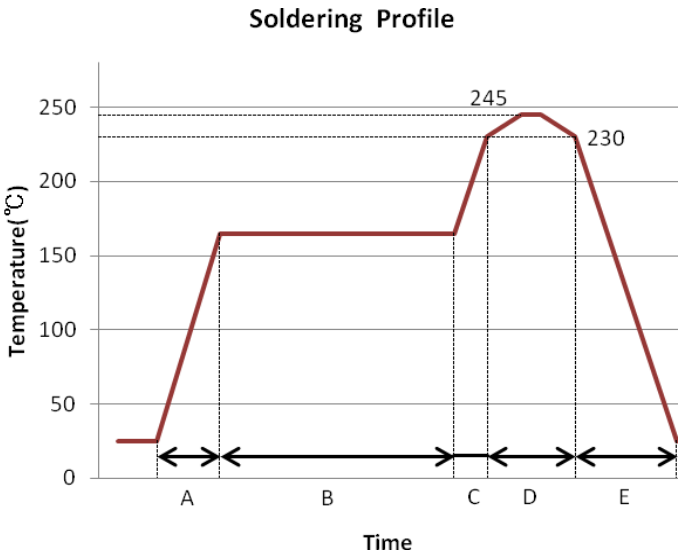
13. Device Marking



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
	AP20x		AP20	
	AP21x		AP21	
	AP22x		AP22	
	AG20x		AG20	
	AG21x		AG21	
	AG22x		AG22	
Pressure Code				
	025KG		025K	
	050KG		050K	
	100KG		100K	
	200KG		200K	
	500KG		500K	
	001MG		001M	
	050KV		050V	
	100KV		100V	
	100KW		100W	
Custom ID			If applicable	*2

Notes:
*1) Pin direction for AP2 or Port length for AG2 is not marked on the face plate.
*2) Custom ID will be added when a product is customized for a customer.

14. Soldering

Process	Sensor code	Condition	
Hand Soldering	AP2xx	Soldering iron temperature: 350 deg. C max. Soldering time: 3 seconds max.	*1, 2
Wave Soldering	AP2xR	Soldering bath temperature: 260 deg. C max. Soldering time: 5 seconds max.	*1, 2
Reflow Soldering	AG2xx		*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) Reflow soldering is within two times.

15. Dimensions and Weights

Refer to the following drawing as attached.

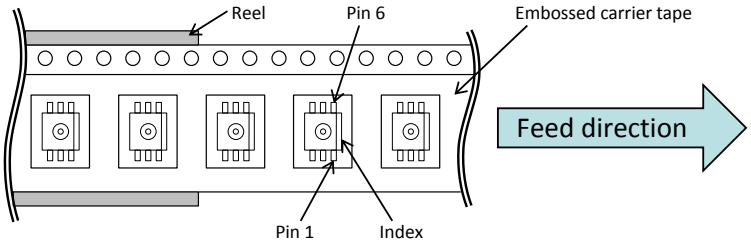
Sensor Code	Dimension Drawing	Weight
AP2xN	9-772-001	approx. 1.4 grams
AP2xR	9-772-002	
AG2x3	9-772-003	approx. 0.3 grams
AG2x6	9-772-004	approx. 0.4 grams

16. Ordering Information

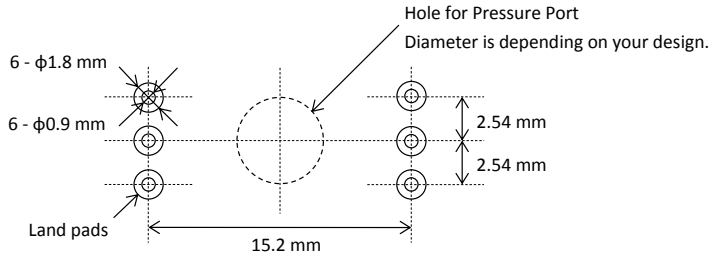
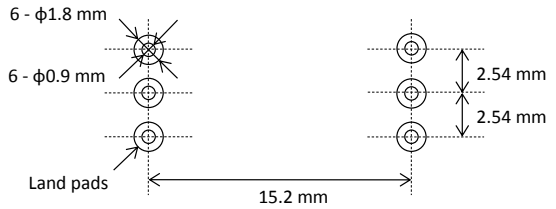
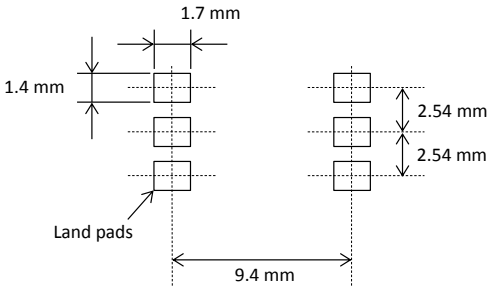
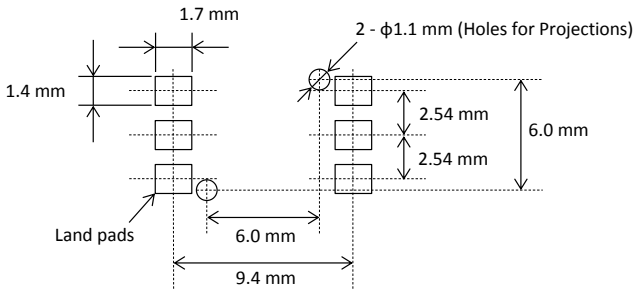
Model	Package	Supply Voltage	Pin Direction	Packing	Ordering Device Number	Qty./Packing
AP2	DIP	5.0 Vdc	Normal	Tray	AP20N- [Pressure Code]	150 Pcs/Tray
				Stick	AP20N- [Pressure Code] -STICK	40 Pcs/Stick
			Opposite	Tray	AP20R- [Pressure Code]	150 Pcs/Tray
				Stick	AP20R- [Pressure Code] -STICK	40 Pcs/Stick
		3.3 Vdc	Normal	Tray	AP21N- [Pressure Code]	150 Pcs/Tray
				Stick	AP21N- [Pressure Code] -STICK	40 Pcs/Stick
			Opposite	Tray	AP21R- [Pressure Code]	150 Pcs/Tray
				Stick	AP21R- [Pressure Code] -STICK	40 Pcs/Stick
		3.0 Vdc	Normal	Tray	AP22N- [Pressure Code]	150 Pcs/Tray
				Stick	AP22N- [Pressure Code] -STICK	40 Pcs/Stick
			Opposite	Tray	AP22R- [Pressure Code]	150 Pcs/Tray
				Stick	AP22R- [Pressure Code] -STICK	40 Pcs/Stick
			Port Length			
AG2	SMD	5.0 Vdc	3 mm	Tray	AG203- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG203- [Pressure Code] -TP	500 Pcs/Reel
			6 mm	Tray	AG206- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG206- [Pressure Code] -TP	500 Pcs/Reel
		3.3 Vdc	3 mm	Tray	AG213- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG213- [Pressure Code] -TP	500 Pcs/Reel
			6 mm	Tray	AG216- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG216- [Pressure Code] -TP	500 Pcs/Reel
		3.0 Vdc	3 mm	Tray	AG223- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG223- [Pressure Code] -TP	500 Pcs/Reel
			6 mm	Tray	AG226- [Pressure Code]	300 Pcs/Tray
				Tape & Reel	AG226- [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 ~ +1 MPa	001MG
-50 ~ 0 kPa	050KV
-100 ~ 0 kPa	100KV
-100 ~ +100 kPa	100KW

17. Tape & Reel Information



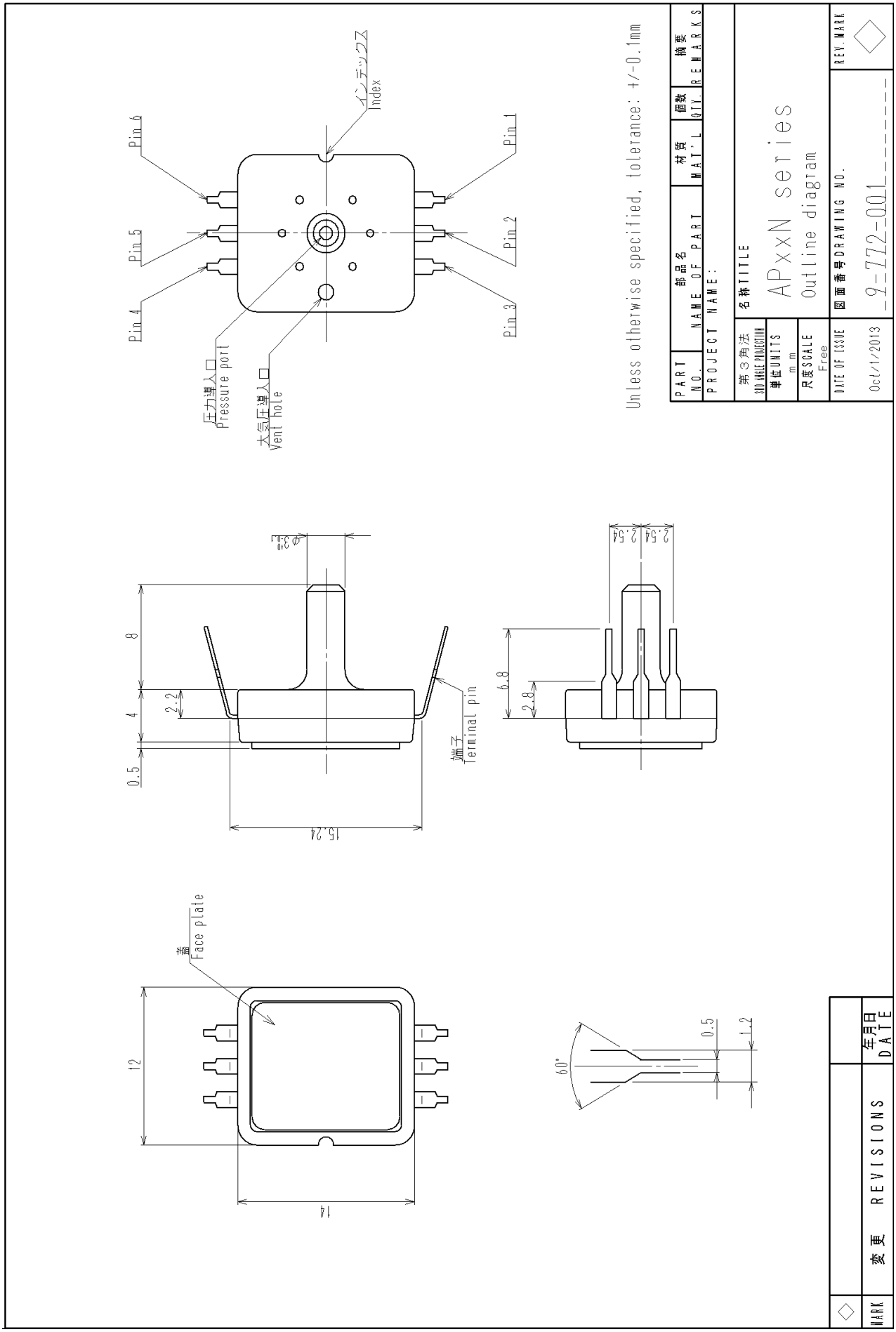
18. Footprint for PCB (for Reference)

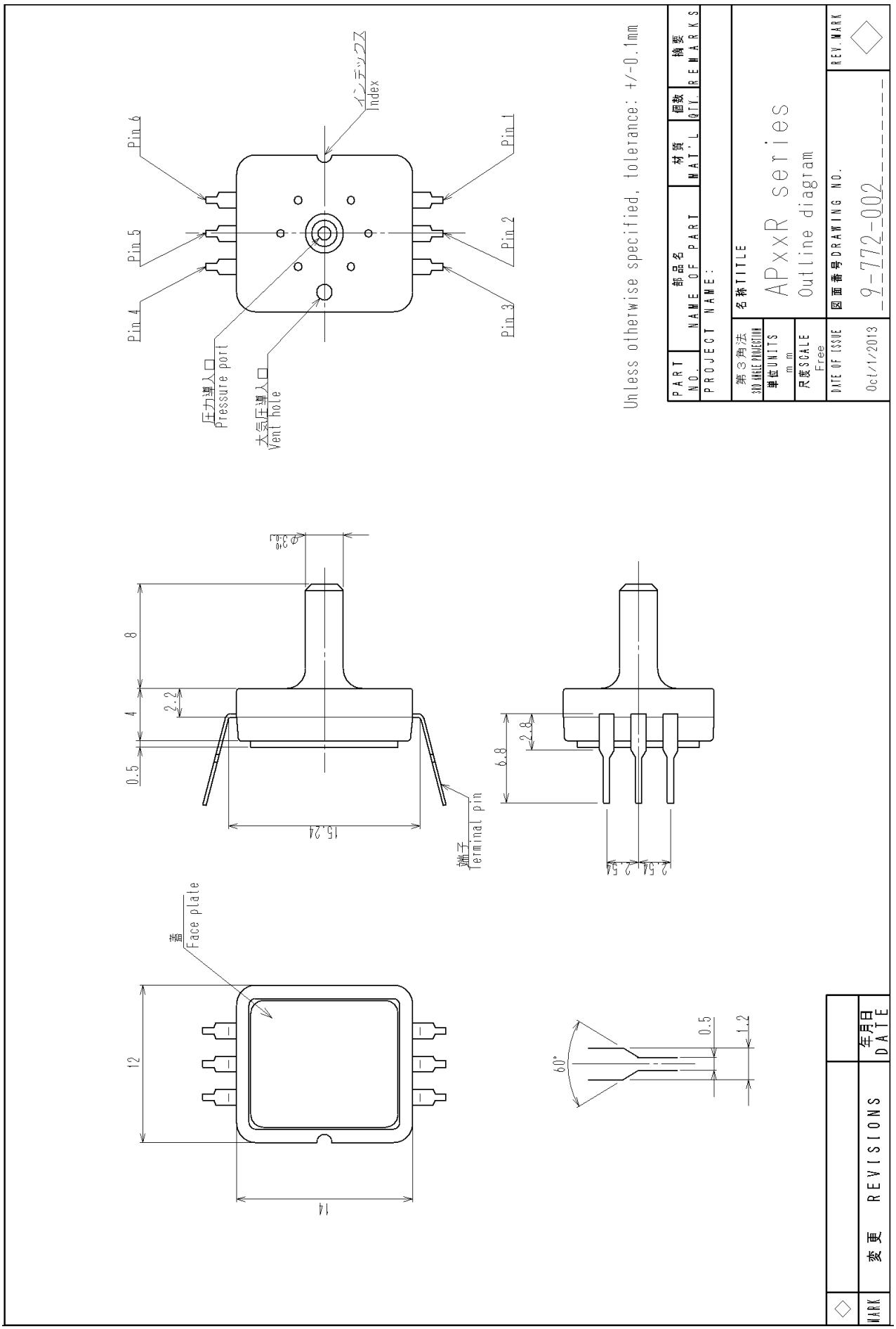
Sensor Code	Footprint
AP2xN	
AP2xR	
AG2x3	
AG2x6	

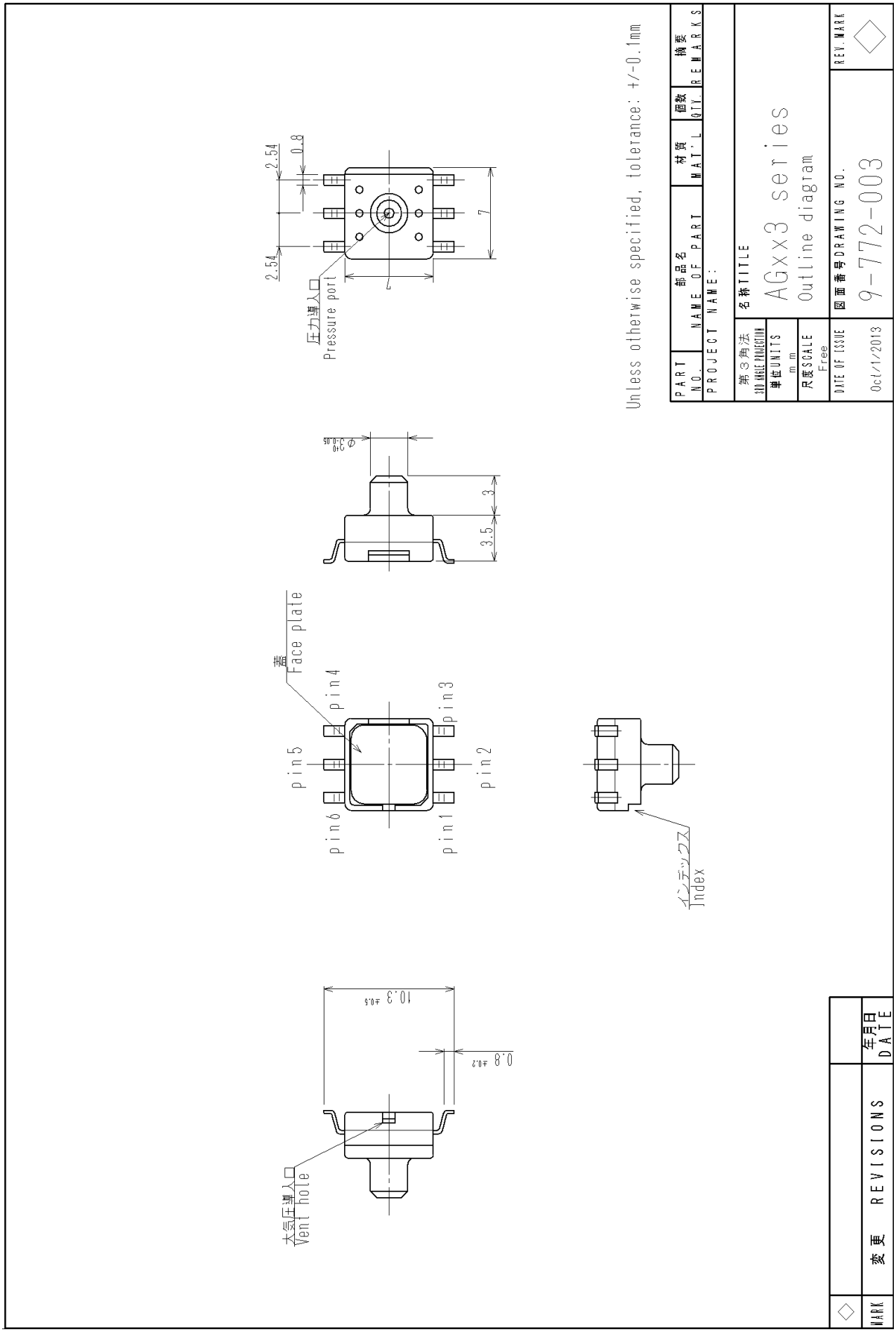
Notes:
*1) These footprints are for reference. Please evaluate well these footprints, before your mass production.
*2) When designing your PCB, please also refer to the outline diagrams.

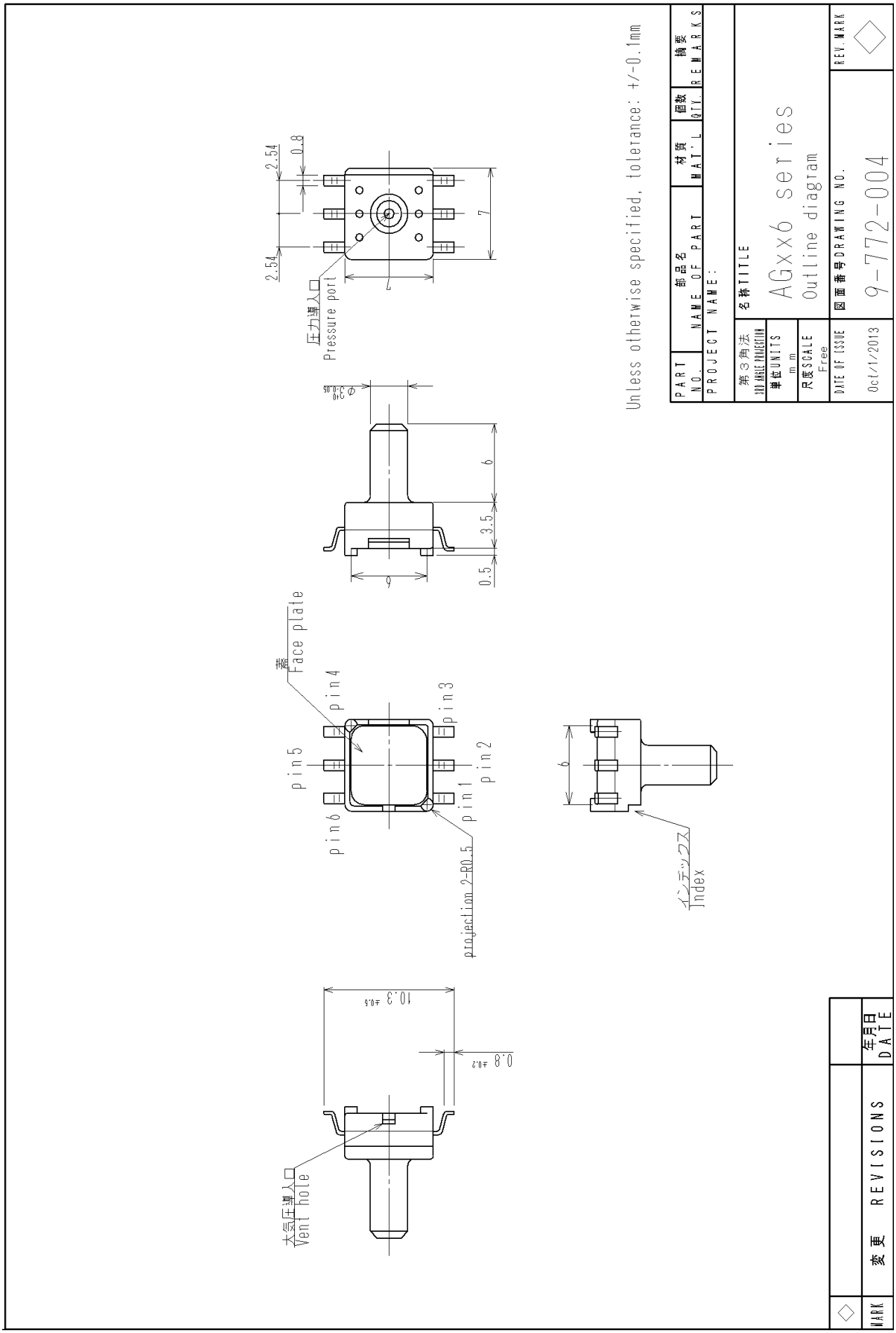
19. Notes

- 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.









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