



DATE May 31, 2019

No. V-70200-E

Messrs. _____

SPECIFICATION

Semiconductor Pressure Sensor

Model: AP3 & AG3-X1 Series

Project: _____

Distributor: _____

Reference: _____

A handwritten signature in black ink that reads 'Y. Uchiyumi'.

Yoshiyuki Uchiyumi, Application Engineer
Sensor Business Unit, Electronics Business Company
Fujikura Ltd.

Fujikura Ltd.

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Table shown below is revision records of this specification

Rev.	Date	Name	Comment	Mark
Est.	May 31, 2019	Y. Uchiumi	Issued	

1. General

This document describes the specifications of Fujikura Pressure Sensor AP3&AG3-X1 series that are drop-in replacement pressure sensors with XFPM & XFGM 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															
				-100 (-15)	-50 (-7)	0	25 (3)	50 (7)	100 (15)	200 (30)	500 (70)	700 (100)	1000 (150) kPa						
AP3 AG3	Gauge	5.0 Vdc 3.3 Vdc	±1.5 %FS																
		3.0 Vdc	±2.0 %FS																

Features

- ✓ Amplified and temperature compensated low noise smooth analog output
- ✓ Single point pressure threshold detection
- ✓ High accuracy
- ✓ Customization or modification available

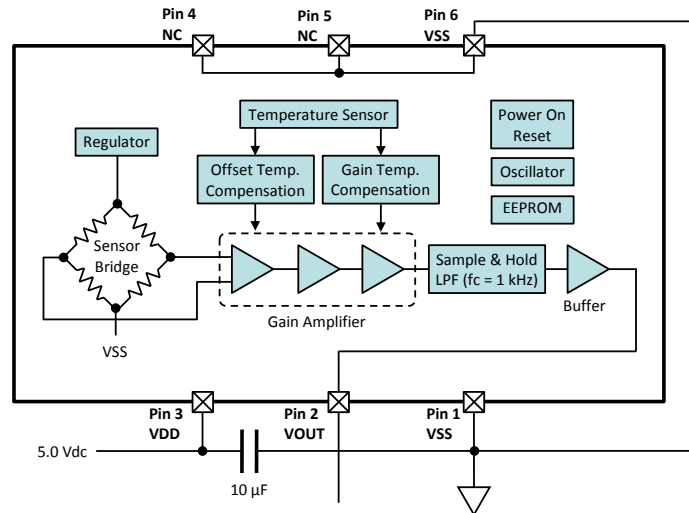
Applications

- ✓ 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	NC	-	-	Non connection	*3
		5	NC	-	-	Non connection	*3
		6	VSS	-	-	Common voltage connection	*1

Notes:

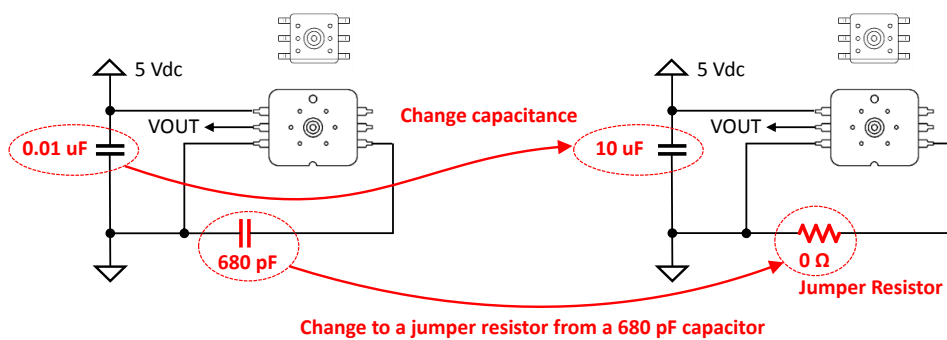
- *1) Both Pin 1 and Pin 4 must be connected to VSS.
- *2) Put a 10 µF capacitor between Pin3 (VDD) and VSS.
- *3) Pin assignment of Pin 4 and 5 is NC (Non connection). But these pins are connected to Pin 6 internally. Pin 4 and 5 are also available to connect to VSS.

6. Drop-in Replacement

Drop-in replacement is available for 5 V products.





XFPM/XFGM Sensor

AP3/AG3-X1 Sensor



7. 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 11 Ordering Information.

Sensor Code			Pressure Code				
AG3	0	6	-	050K	G	-	X1
						Packing	STICK: Stick (AP3) TP: Tape & Reel (AG3) Blank: Tray
						Custom ID	X1: XFPM/XFGM compatible Ver. 1
			Pressure type				G: Gauge Positive pressure V: Gauge Negative pressure W: Gauge Compound pressure
			Pressure value				025K: 25 kPa 050K: 50 kPa 100K: 100 kPa 200K: 200 kPa 500K: 500 kPa 700K: 700 kPa 001M: 1 MPa
			Pin direction for AP3				N: Normal  R: Opposite 
			Port length for AG3				3: 3 mm  6: 6 mm 
			Supply voltage				0: 5.0 Vdc 1: 3.3 Vdc 2: 3.0 Vdc
Model							AP3: DIP Smooth Analog Output AG3: SMD Smooth Analog Output

8. Absolute Maximum Ratings

Item	Condition		Symbol	Rating		Unit
				Min.	Max.	
Load Pressure	Pressure Code	025KG	Pmax+	-	+50	kPa
		050KG		-	+100	kPa
		100KG		-	+200	kPa
		200KG		-	+400	kPa
		500KG		-	+1.0	MPa
		700KG		-	+1.4	MPa
		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	°C
Storage Temperature			Tstg	-40	+105	°C

Note:

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

9. General Specifications

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

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 12 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.

10. Electrical Characteristics

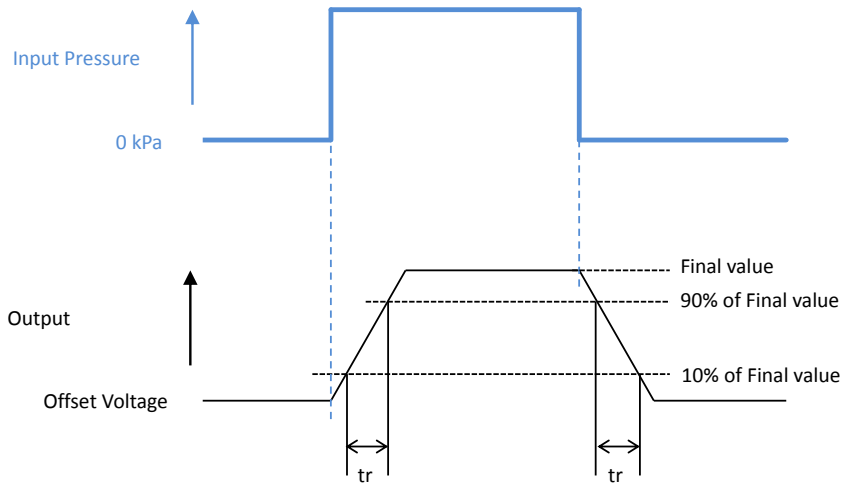
Load resistor $R_L = \infty$, Ambient temperature $T_a = 25^\circ\text{C}$

Item	Condition	Symbol	Rating			Unit		
			Min.	Typ.	Max.			
Sensor Code: AP30x, AG30x (VDD = 5.0 Vdc)								
Offset Voltage	Pressure type	G, W: Min. Popt	Voff	0.1325	0.2	0.2675	V	*1, 2
		V: Max. Popt						
Full Scale Voltage	Pressure type	G, W: Max. Popt	Vfs	4.6325	4.7	4.7675	V	*3
		V: Min. Popt						
Span Voltage	Min. to max. Popt	SV	-	4.5	-	V	*4	
Accuracy	0 to 60°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	Pressure type	G, W: Min. Popt	Voff	0.2595	0.3	0.3405	V	*1, 2
		V: Max. Popt						
Full Scale Voltage	Pressure type	G, W: Max. Popt	Vfs	2.9595	3.0	3.0405	V	*3
		V: Min. Popt						
Span Voltage	Min. to max. Popt	SV	-	2.7	-	V	*4	
Accuracy	0 to 60°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	Pressure type	G, W: Min. Popt	Voff	0.096	0.15	0.204	V	*1, 2
		V: Max. Popt						
Full Scale Voltage	Pressure type	G, W: Max. Popt	Vfs	2.796	2.85	2.904	V	*3
		V: Min. Popt						
Span Voltage	Min. to max. Popt	SV	-	2.7	-	V	*4	
Accuracy	0 to 60°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	-	1	-	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 pressure type V, 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 the pressure type V, 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°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 (t_r) is defined as the time for the change in output voltage from 10% to 90% or from 90% to 10% 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.

11. Output Voltage versus Input Pressure

Temperature = 0 to 60°C

Item	Pressure type					
	G: Positive Pressure		V: Negative Pressure		W: Compound Pressure	
Graph						
Sensor Code	VDD	Voff	Vfs	SV	$V_{0\text{ kPa}}$ (Pressure type: W)	Error
AP30x, AG30x	5.0 V	0.2 V	4.7 V	4.5 V	2.45 V	±1.5 %FS
AP31x, AG31x	3.3 V	0.3 V	3.0 V	2.7 V	1.65 V	±1.5 %FS
AP32x, AG32x	3.0 V	0.15 V	2.85 V	2.7 V	1.5 V	±2.0 %FS

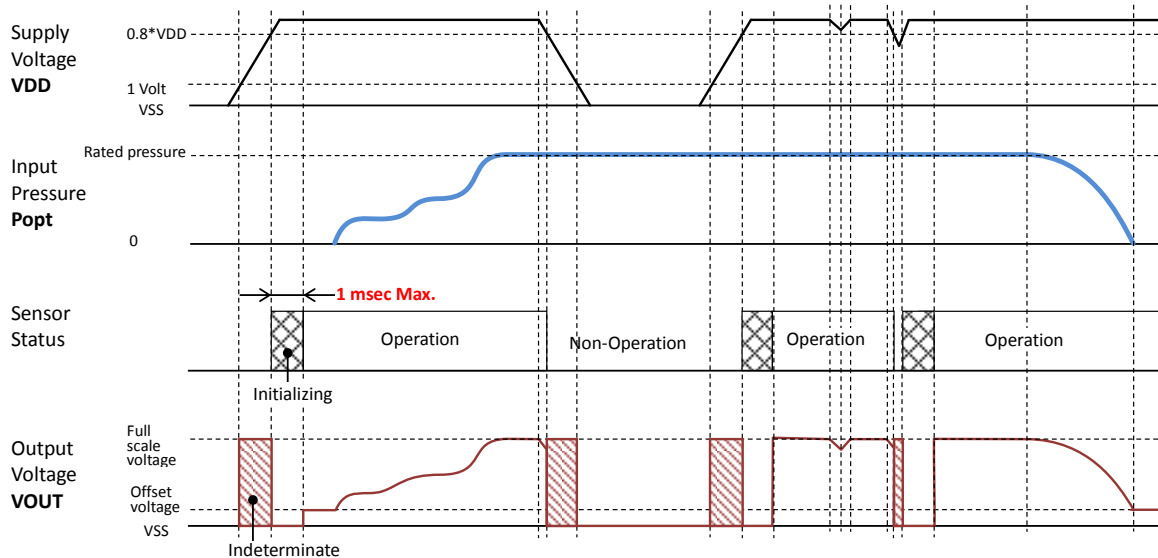
12. Transfer Function

Item	Rating																		
Transfer Function	$V_{out} (V) = VDD \times ((P \times \alpha) + \beta) \pm (\text{Pressure Error} \times \text{Temperature Error Multiplier} \times \alpha \times VDD)$ $P \text{ (kPa)} = \frac{V_{out} \pm (\text{Pressure Error} \times \text{Temperature Error Multiplier} \times \alpha \times VDD) - \beta}{\alpha}$																		
Parameters	Sensor Code	VDD (*1)	Pressure Code	P (kPa)	α	β	Pressure Error (kPa)												
	AP30x AG30x	5.0 ± 0.25V	025KG	0 to +25	9/250	1/25	0.375												
			050KG	0 to +50	9/500	1/25	0.75												
			100KG	0 to +100	9/1000	1/25	1.5												
			200KG	0 to +200	9/2000	1/25	3.0												
			500KG	0 to +500	9/5000	1/25	7.5												
			700KG	0 to +700	9/7000	1/25	10.5												
			001MG	0 to +1000	9/10000	1/25	15												
			050KV	-50 to 0	-9/500	1/25	0.75												
			100KV	-100 to 0	-9/1000	1/25	1.5												
			100KW	-100 to +100	9/2000	49/100	3.0												
	AP31x AG31x	3.3 ± 0.165V	025KG	0 to +25	9/275	1/11	0.375												
			050KG	0 to +50	9/550	1/11	0.75												
			100KG	0 to +100	9/1100	1/11	1.5												
			200KG	0 to +200	9/2200	1/11	3.0												
			500KG	0 to +500	9/5500	1/11	7.5												
			700KG	0 to +700	9/7700	1/11	10.5												
			001MG	0 to +1000	9/11000	1/11	15												
			050KV	-50 to 0	-9/550	1/11	0.75												
			100KV	-100 to 0	-9/1100	1/11	1.5												
			100KW	-100 to +100	9/2200	1/2	3.0												
	AP32x AG32x	3.0 ± 0.15V	025KG	0 to +25	9/250	1/20	0.5												
			050KG	0 to +50	9/500	1/20	1												
			100KG	0 to +100	9/1000	1/20	2												
			200KG	0 to +200	9/2000	1/20	4												
			500KG	0 to +500	9/5000	1/20	10												
			700KG	0 to +700	9/7000	1/20	14												
			001MG	0 to +1000	9/10000	1/20	20												
			050KV	-50 to 0	-9/500	1/20	1												
			100KV	-100 to 0	-9/1000	1/20	2												
			100KW	-100 to +100	9/2000	1/2	4												
Temperature Error Multiplier	<table border="1"> <caption>Temperature Error Multiplier Data</caption> <thead> <tr> <th>Temperature (°C)</th> <th>Error Multiplier</th> </tr> </thead> <tbody> <tr> <td>-40</td> <td>4.273</td> </tr> <tr> <td>-20</td> <td>3.91</td> </tr> <tr> <td>0</td> <td>1.0</td> </tr> <tr> <td>60</td> <td>1.0</td> </tr> <tr> <td>100</td> <td>4.0</td> </tr> </tbody> </table>							Temperature (°C)	Error Multiplier	-40	4.273	-20	3.91	0	1.0	60	1.0	100	4.0
Temperature (°C)	Error Multiplier																		
-40	4.273																		
-20	3.91																		
0	1.0																		
60	1.0																		
100	4.0																		

Note:

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

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					
		M	Production month					0 to 9
			Jan 1	Feb 2	Mar 3	Apr 4	May 5	Jun 6
		Jul 7	Aug 8	Sep 9	Oct X	Nov Y	Dec Z	
	DD	Production date					01 to 31	
Sensor Code		AP30x			AP30			
		AG30x			AG30			
		AP31x			AP31			
		AG31x			AG31			
		AP32x			AP32			
		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							X1	

Note:

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

15. Soldering

Process	Sensor Code	Condition		
Hand soldering	AP3xx	Soldering iron temperature: 350°C max. Soldering time: 3 seconds max. / each pin	*1, 2	
Wave soldering	AP3xR	Soldering bath temperature: 260°C max. Soldering time: 5 seconds max.	*1, 2	
Reflow soldering	AG3xx	Soldering Profile		
		A	Ramp up	2 to 4 °C / sec.
		B	Pre-heating	150 to 180 °C 60 to 120 sec.
		C	Ramp up	2 to 4 °C / sec.
		D	Heating	Above 230 °C, 45 sec. max. 245 °C max., 10 sec. max.
Moisture Sensitivity Level	AG3xx	Level 1	*5	

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 the surface temperature of the device's package.
- *4) Do not reflow more than twice.
- *5) This device is classified as moisture sensitivity level (MSL) 1 that is defined in Jedec standard J-STD-20. Floor life time is unlimited. However, the plating of pins is silver (Ag) that could be discolored to black or brown by sulfur in the environment. Discoloration of pins could impact soldering reliability. The device should be sealed in the embossed carrier tape before soldering.

16. Dimensions and Weights

Refer to the following drawing as attached.

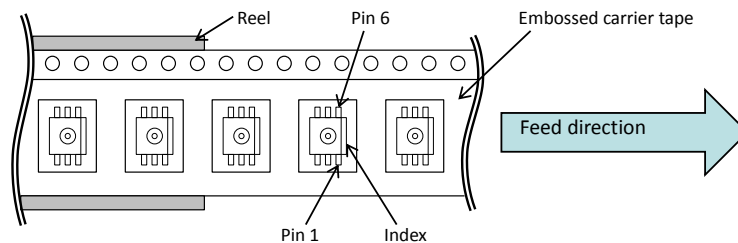
Sensor Code	Dimension Drawing	Weights
AP3xN	9-772-001	approx. 1.4 grams
AP3xR	9-772-002	
AG3x3	9-772-003	approx. 0.3 grams
AG3x6	9-772-004	approx. 0.4 grams

17. Ordering Information

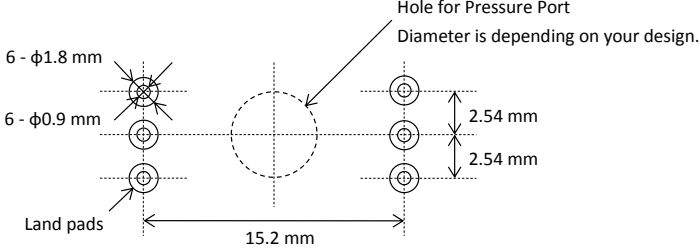
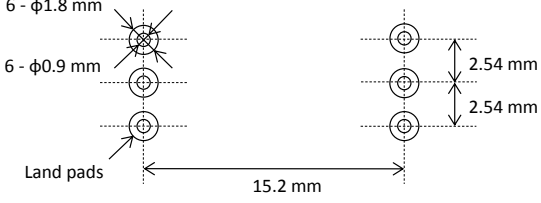
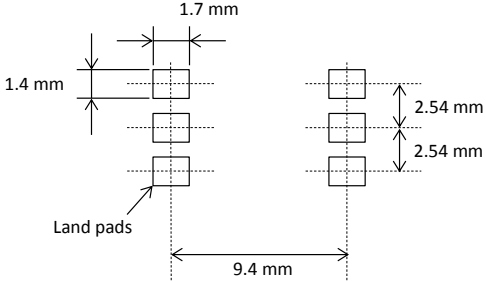
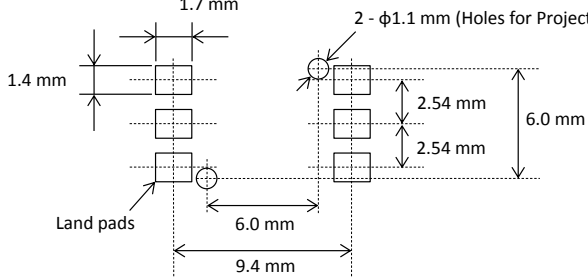
Model	Package	Supply Voltage	Pin Direction	Packing	Ordering Device Number	Qty./Packing
AP3	DIP	5.0 Vdc	Normal	Tray	AP30N- [Pressure Code] -X1	150 Pcs/Tray
				Stick	AP30N- [Pressure Code] -X1-STICK	40 Pcs/Stick
			Opposite	Tray	AP30R- [Pressure Code] -X1	150 Pcs/Tray
				Stick	AP30R- [Pressure Code] -X1-STICK	40 Pcs/Stick
		3.3 Vdc	Normal	Tray	AP31N- [Pressure Code] -X1	150 Pcs/Tray
				Stick	AP31N- [Pressure Code] -X1-STICK	40 Pcs/Stick
			Opposite	Tray	AP31R- [Pressure Code] -X1	150 Pcs/Tray
				Stick	AP31R- [Pressure Code] -X1-STICK	40 Pcs/Stick
		3.0 Vdc	Normal	Tray	AP32N- [Pressure Code] -X1	150 Pcs/Tray
				Stick	AP32N- [Pressure Code] -X1-STICK	40 Pcs/Stick
			Opposite	Tray	AP32R- [Pressure Code] -X1	150 Pcs/Tray
				Stick	AP32R- [Pressure Code] -X1-STICK	40 Pcs/Stick
			Port Length			
AG3	SMD	5.0 Vdc	3 mm	Tray	AG303- [Pressure Code] -X1	300 Pcs/Tray
				Tape & Reel	AG303- [Pressure Code] -X1-TP	500 Pcs/Reel
			6 mm	Tray	AG306- [Pressure Code] -X1	300 Pcs/Tray
				Tape & Reel	AG306- [Pressure Code] -X1-TP	500 Pcs/Reel
		3.3 Vdc	3 mm	Tray	AG313- [Pressure Code] -X1	300 Pcs/Tray
				Tape & Reel	AG313- [Pressure Code] -X1-TP	500 Pcs/Reel
			6 mm	Tray	AG316- [Pressure Code] -X1	300 Pcs/Tray
				Tape & Reel	AG316- [Pressure Code] -X1-TP	500 Pcs/Reel
		3.0 Vdc	3 mm	Tray	AG323- [Pressure Code] -X1	300 Pcs/Tray
				Tape & Reel	AG323- [Pressure Code] -X1-TP	500 Pcs/Reel
			6 mm	Tray	AG326- [Pressure Code] -X1	300 Pcs/Tray
				Tape & Reel	AG326- [Pressure Code] -X1-TP	500 Pcs/Reel

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

18. Tape & Reel Information



19. Footprint for PCB designing (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.

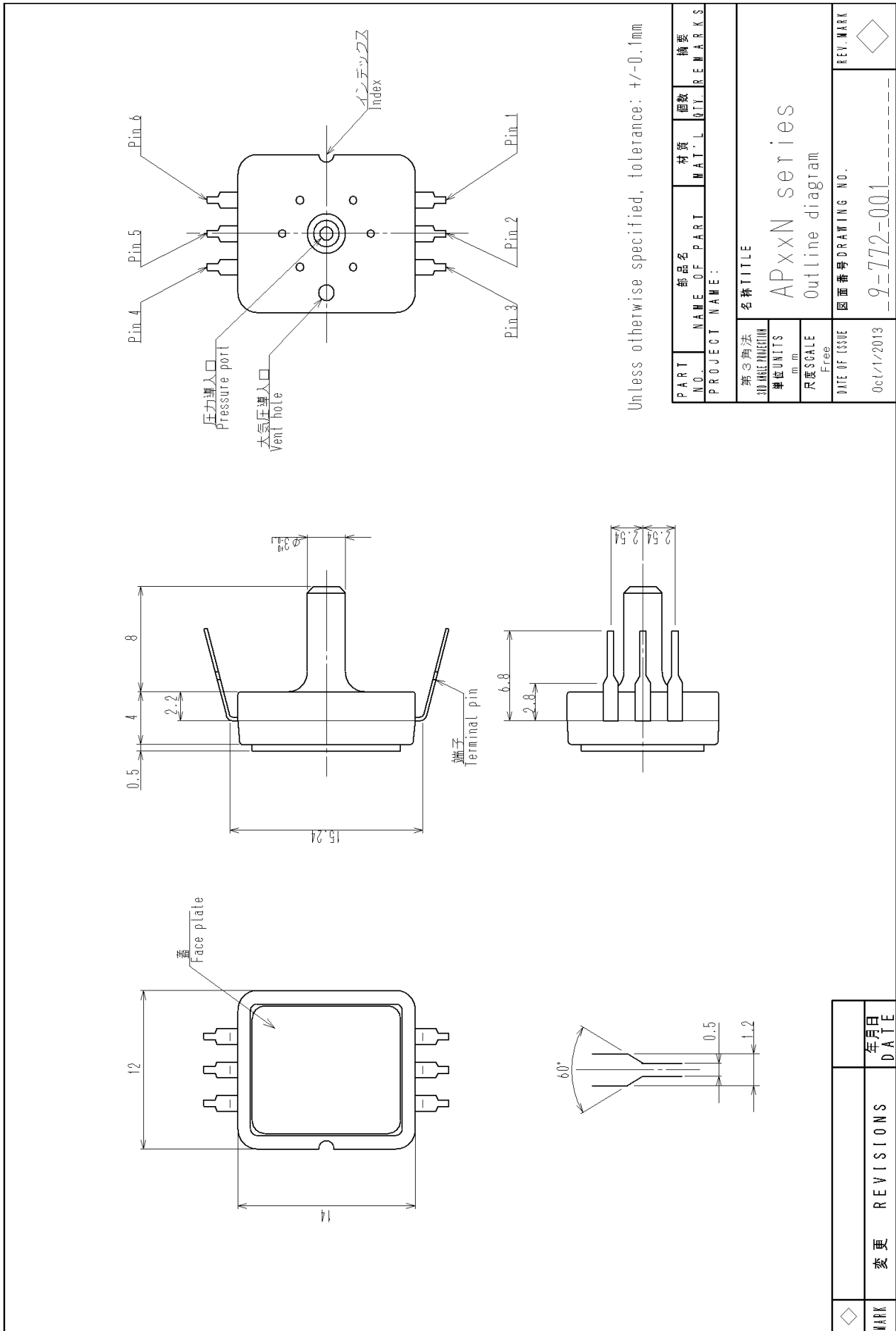
20. Handling Notes

Plating of pins is silver (Ag). Silver has physical property that is discolored to black or brown by sulfur. There are notes for handling as below:

- To prevent discoloration of pins, please keep the devices sealed in static shielding bags before soldering.
- Do not solder the devices that have discolored pins.
- After soldering, pins would be discolored in black or brown in atmosphere. However it does not impact reliability of the device.

21. Notes

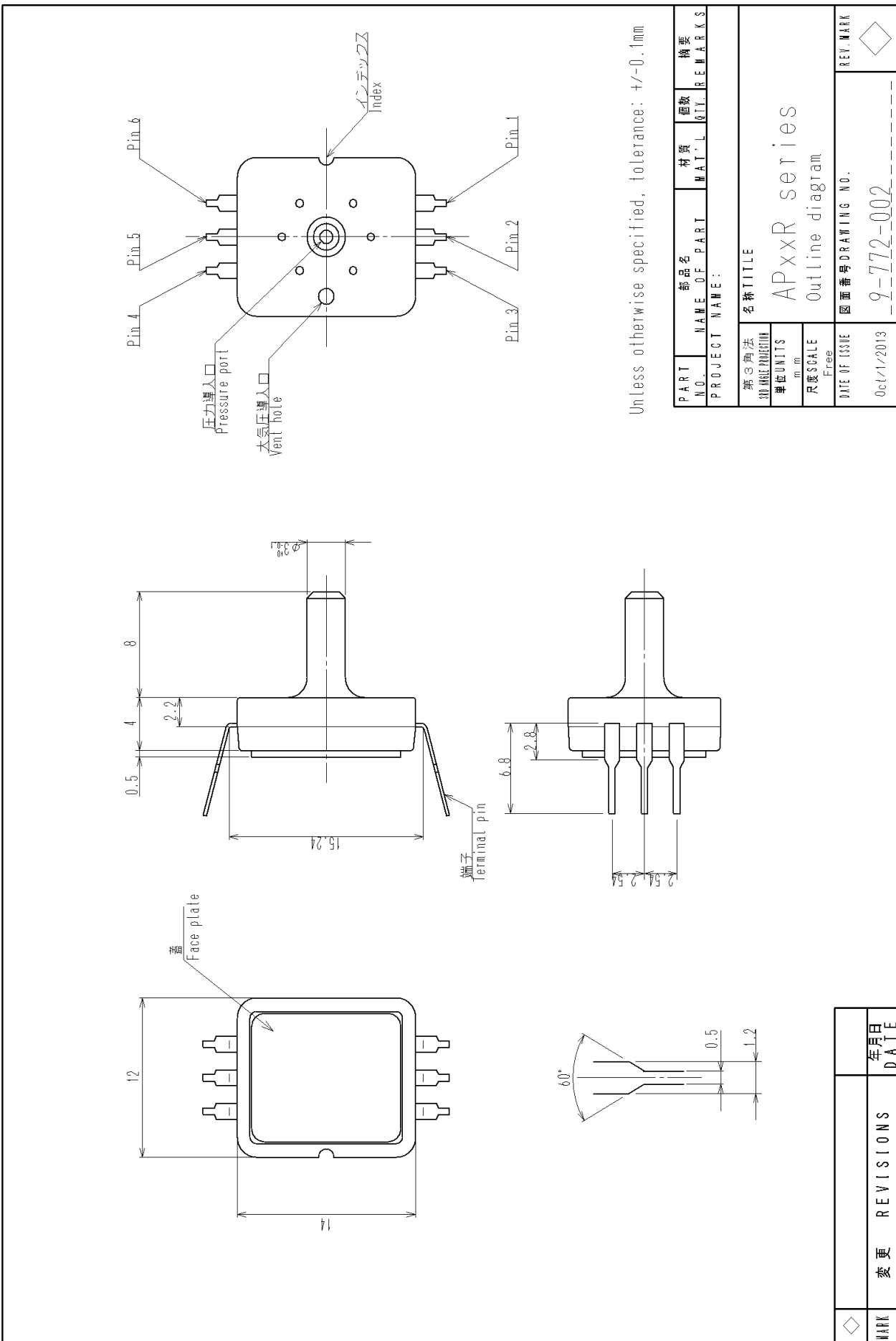
- Fujikura reserves all rights.
- This document is subject to change without notice.
- Limitation, usage, environment, standard warranty and so on are listed on Fujikura web site.
- Please refer to the latest specifications.



Unless otherwise specified, tolerance: $\pm 0.1\text{mm}$

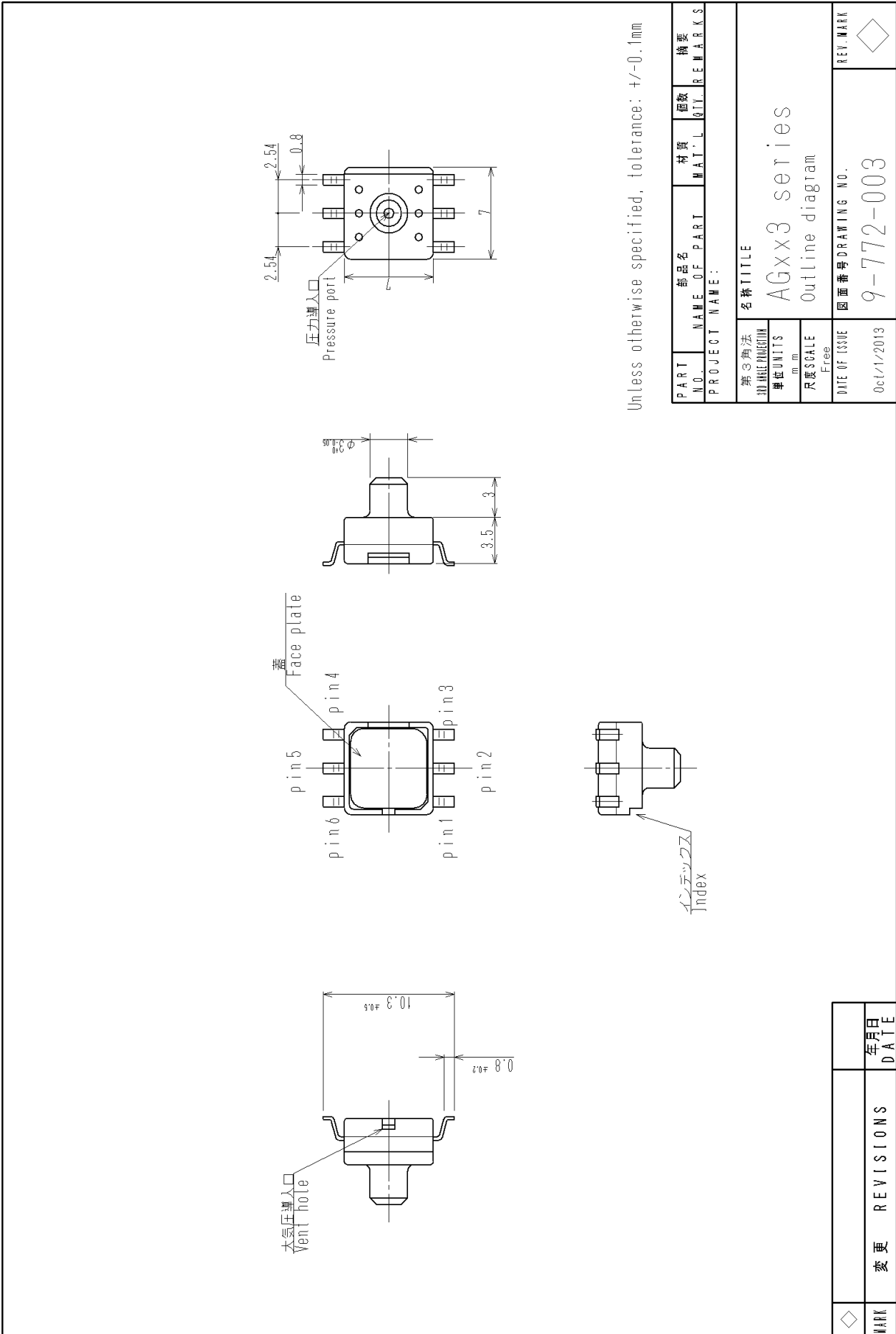
PART NO.	部品名	材質	圖數	構造	REMARKS
PROJECT NAME :					
名稱 TITLE					
APxxN series					
Outline diagram					
第3角法 3rd ANGLE METHOD					
單位 UNITS mm					
尺碼 SCALE Free					
DATE OF ISSUE	圖面番號 DRAWING NO.				REV. MARK
0c1/1/2013	9-772-001				◇

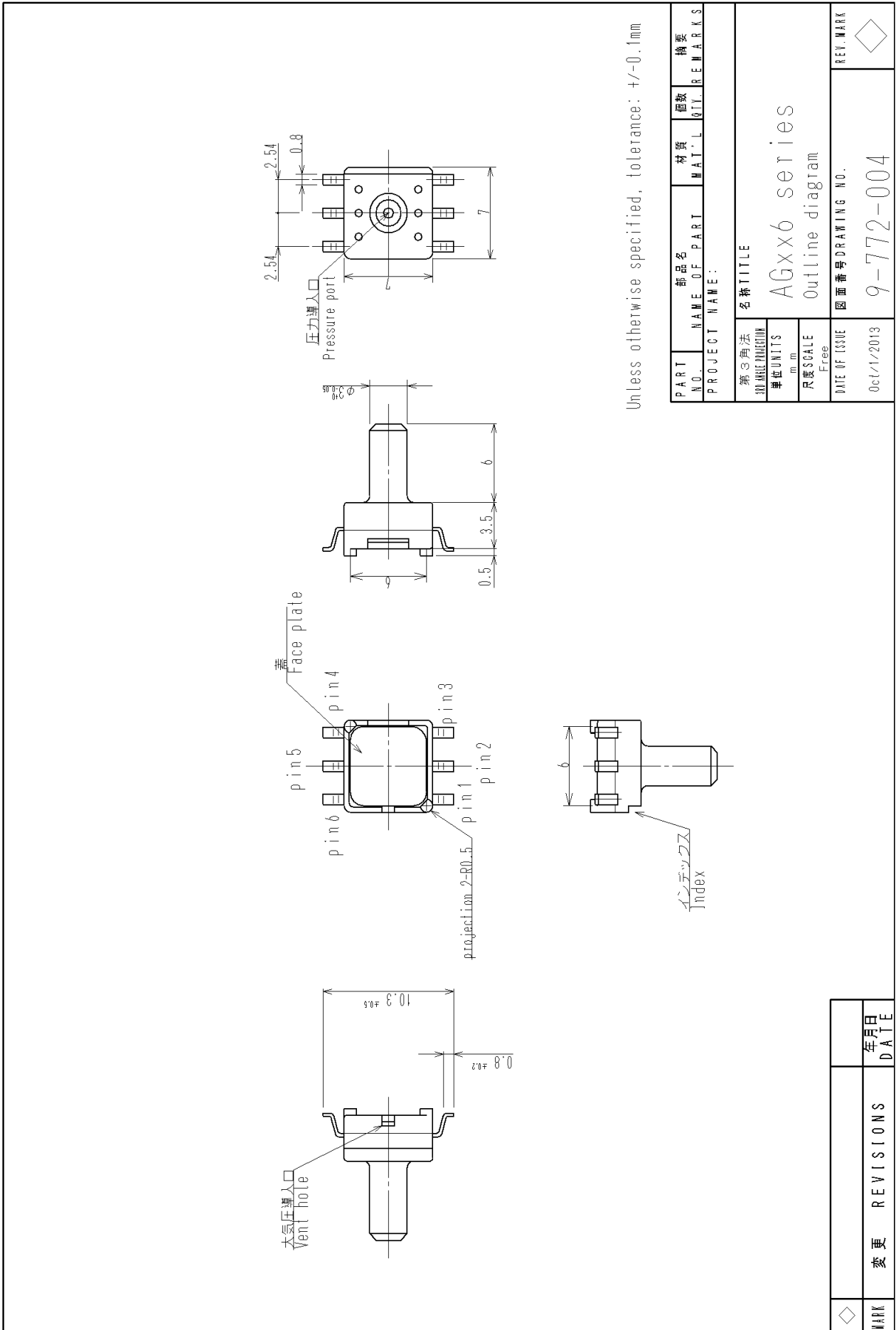
MARK	變更 REVISIONS	年月日 DATE
◇		



Unless otherwise specified, tolerance: +/-0.1mm

PART NO.	部品名	材質	価数	摘要
PROJECT NAME:				
名称TITLE				
APxxR series				
Outline diagram				
第3角法 SYMBOLIZATION	単位UNITS mm	尺度SCALE Free	DATE OF ISSUE Oct/1/2013	図面番号DRAWING NO. 9-772-002
MARK	変更	REVISIONS	年月日 DATE	REMARK





PART NO.	部品名	材質	個数	摘要
PROJECT NAME :	NAME OF PART	MAT'L QTY.	REMARKS	
第3角法 3rd ANGLE METHOD	名称/TITLE			
単位/UNITS mm	AGxx6 series			
尺規/SCALE Free	Outline diagram			
DATE OF ISSUE	図面番号/DRAWING NO.			REV. MARK
Oct/1/2013	9-772-004			◇

◇	MARK	変更	REVISIONS	年月日 DATE
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