

DATE July 16, 2024No. V-70440Messrs.

SPECIFICATION

Semiconductor Pressure SensorModel: AT7 SeriesProject:Distributor:Reference:

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Fujikura Ltd.

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Table shown below is revision records of this specification

C				
B				
Rev. A				
Est.	Jul. 16, 2024	S. Mitani		
	Date	Name	Comment	Mark

1. General

This document describes the specifications of the AT7 pressure sensors for gauge pressure type.

2. Principle

Fujikura Pressure Sensor is composed of a silicon piezo-resistive 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	Supply Voltage	Pressure Type	Accuracy	Pressure Range									
				-100	-50	0	25	50	100	200	500	700	1000 kPa
				(-15)	(-7)		(3)	(7)	(15)	(30)	(70)	(100)	(150) psi
AT70	5.0 Vdc	Gauge	±1.5 %FS			025KG							
						050KG							
						100KG							
						200KG							
						500KG							
						700KG							
						001MG							
AT71	3.3 Vdc												
AT72	3.0 Vdc					050KV							
						100KV							
						100KW							

Features

- ✓ Tiny mechanical package
- ✓ Digital output
- ✓ Low power consumption
- ✓ High proof pressure
- ✓ High accuracy
- ✓ Modification available

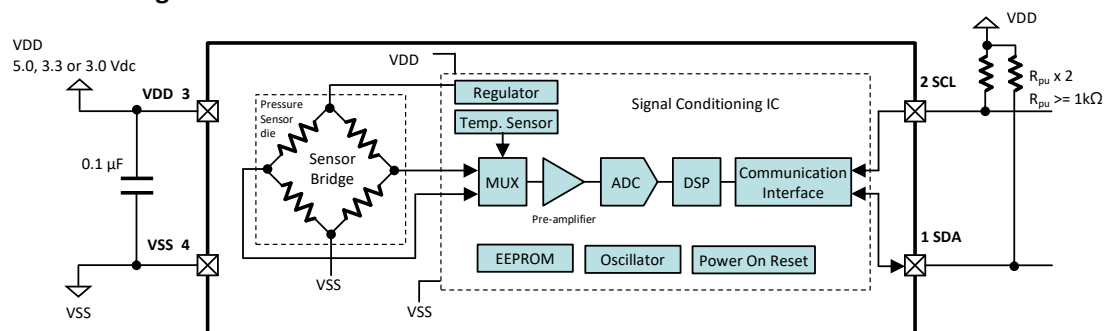
Applications

- ✓ Industrial pneumatic equipment
- ✓ Battery-operated devices
- ✓ Medical 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
	1	SDA	I/O	Digital	Serial bidirectional data
	2	SCL	I	Digital	Serial clock input
	3	VDD	-	-	Power supply connection
	4	VSS	-	-	Common voltage connection

Note:

*1) Put a 0.1 μF capacitor between VDD Pin 3 and VSS.

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 1818 Ordering Information.

Sensor code		Pressure code	
AT7	1	-	025K G - 2 - TP
</			

9. Pressure Specifications

Type of Pressure	Gauge pressure	*1
Pressure Media	Non-corrosive gases for wetted materials	*2, 3

Notes:

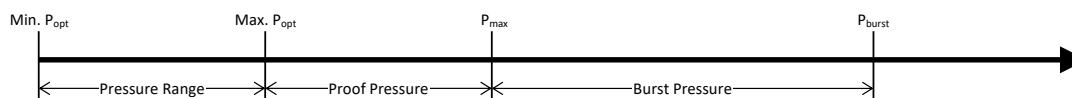
- *1) Gauge pressure is defined as the difference between applied pressure to the pressure port and atmospheric pressure.
- *2) Wetted materials are PPS resin, silicone resin and silicon.
- *3) Ensure the pressure media contains no particulates. The device is not compatible with liquids.

Pressure Table

Pressure Code	Item Symbol	Pressure Range *1		Proof Pressure *2	Burst Pressure *3	Unit
		Min. P_{opt}	Max. P_{opt}	P_{max}	P_{burst}	
025KG		0	+25	+50	+2000	kPa
050KG		0	+50	+100	+2000	kPa
100KG		0	+100	+200	+2000	kPa
200KG		0	+200	+400	+2000	kPa
500KG		0	+500	+1000	+2000	kPa
700KG		0	+700	+1400	+2000	kPa
001MG		0	+1	+1.5	+2	MPa
050KV		-50	0	+100	+2000	kPa
100KV		-100	0	+200	+2000	kPa
100KW		-100	+100	+200	+2000	kPa

Notes:

- *1) In Pressure Range (P_{opt}), the output is proportional to difference between the pressure applied to Port A and atmospheric pressure through the vent hole, meeting the specified accuracy.
- *2) Proof Pressure (P_{max}) is defined as maximum applied pressure to the device without damage.
- *3) The device will be damaged, if applied pressure is beyond Burst Pressure (P_{burst}).



Recommended O-ring (Reference)

The following O-ring is for reference. Please select appropriate tubing considering material, Durometer hardness and maximum pressure. Manifold connection can also be available with O-ring or sealing fixtures.

Type	I.D. (mm)	O.D. (mm)	Width (mm)
S-3	2.5	5.5	1.5
SS-020	2.0	4.0	1.0
1A-SS2.5	2.0	4.0	1.0

10. Electrical Characteristics

Ambient temperature $T_a=25^{\circ}\text{C}$

Item	Condition	Symbol	Rating			Unit	
			Min.	Typ.	Max.		
Supply Voltage	Sensor Code	AT70	4.75	5.0	5.25	Vdc	*1
		AT71	3.135	3.3	3.465		
		AT72	2.85	3.0	3.15		
Offset Pressure Data	Pressure type = G/W: Min. P_{opt} , V: Max. P_{opt}	D_{off}	2393	3277	4161	Counts	*2
Full Scale Pressure Data	Pressure type = G/W: Max. P_{opt} , V: Min. P_{opt}	D_{fs}	61375	62259	63143	Counts	*3
Span Pressure Data	Min. P_{opt} to Max. P_{opt}	SD	-	58982	-	Counts	*4
Accuracy	Compensated temperature	Error	-1.5	-	+1.5	%FS	*5, 6, 7
			-884	-	+884	Counts	
Supply Current		I_c	-	-	3.5	mA	*8
Compensated Temperature		T_c	0	-	85	$^{\circ}\text{C}$	*9
Initializing Time	After VDD reaching 2.7 V	t_{init}	-	-	10	msec.	*10
Sampling Frequency		f_s	-	1.1	-	kHz	*11
Response Time	for reference	t_r	-	1	-	msec.	*12
Temperature Data	for reference	D_{tmp}	-40 $^{\circ}\text{C}$	0	-	Counts	*13
			+25 $^{\circ}\text{C}$	25817	-	Counts	
			+125 $^{\circ}\text{C}$	65535	-	Counts	
Dielectric Strength		-	-	-	1	mA	*14
Insulation Resistance		-	100	-	-	MΩ	*15

Notes:

- *1) Supply Voltage (VDD) should be constant.
- *2) Offset Pressure Data (D_{off}) is defined as the pressure data at Minimum P_{opt} . In case of Pressure type "V", Offset Pressure Data (D_{off}) is defined as the pressure data at Maximum P_{opt} .
- *3) Full Scale Pressure Data (D_{fs}) is defined as the pressure data at Maximum P_{opt} . In case of Pressure type "V", Full Scale Pressure Data (D_{fs}) is defined as the pressure data at Minimum P_{opt} .
- *4) Span Pressure Data (SD) is defined as the pressure difference between Offset Pressure Data (D_{off}) and Full Scale Pressure Data (D_{fs}).
- *5) The unit in Accuracy "%FS" is defined as a percent error by Span Pressure Data (SD).
- *6) Accuracy (Error) is the specs of out-going inspection at Fujikura. It consists of the following:
 - Non-linearity
 - Temperature errors over the temperature range 0 to 85 $^{\circ}\text{C}$
 - Pressure hysteresis
 - Calibration errors of sensitivity and offset
- *7) The following errors are NOT included to Accuracy (Error):
 - Offset change due to port orientation sensitivity, soldering thermal stress and assembling mechanical stress
 - Offset drift over time
- *8) Supply Current (I_c) is changed depending on the value of Load Resistor (R_L).
- *9) Please refer to Chapter13 Transfer Function.
- *10) Initializing process starts when VDD reached 2.7 V. After initializing process, ready to data read. (Figure 1)
- *11) Offset Pressure Data (D_{off}) is processed by the internal sample and hold block. Sampling Frequency (f_s) is 1.1 kHz(Typ.). The output voltage is updated every approximately 0.9 msec. (Figure 2)
- *12) Response time (t_r) is defined as the time for the change in the pressure data from 10 % to 90 % or from 90 % to 10 % of its final value when the input pressure makes a step change. (Figure 3)
- *13) Temperature Data (D_{tmp}) is for reference. Temperature sensor is embedded in the signal conditioning IC for temperature compensation of pressure. Therefore, Temperature Data (D_{tmp}) is NOT for measurement of ambient temperature.
- *14) Dielectric strength is defined as the leakage current between all pins and the package with AC 500 V, 1 minute.
- *15) Insulation resistance is defined as the resistance value between all pins and the package with DC 500 V.

Figure 1

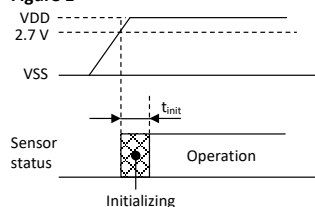


Figure 2

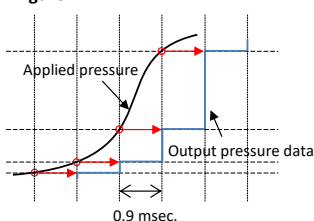
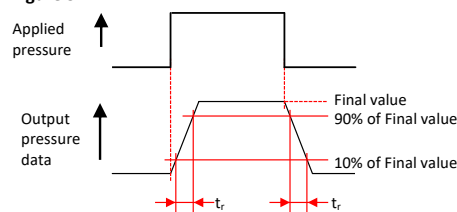
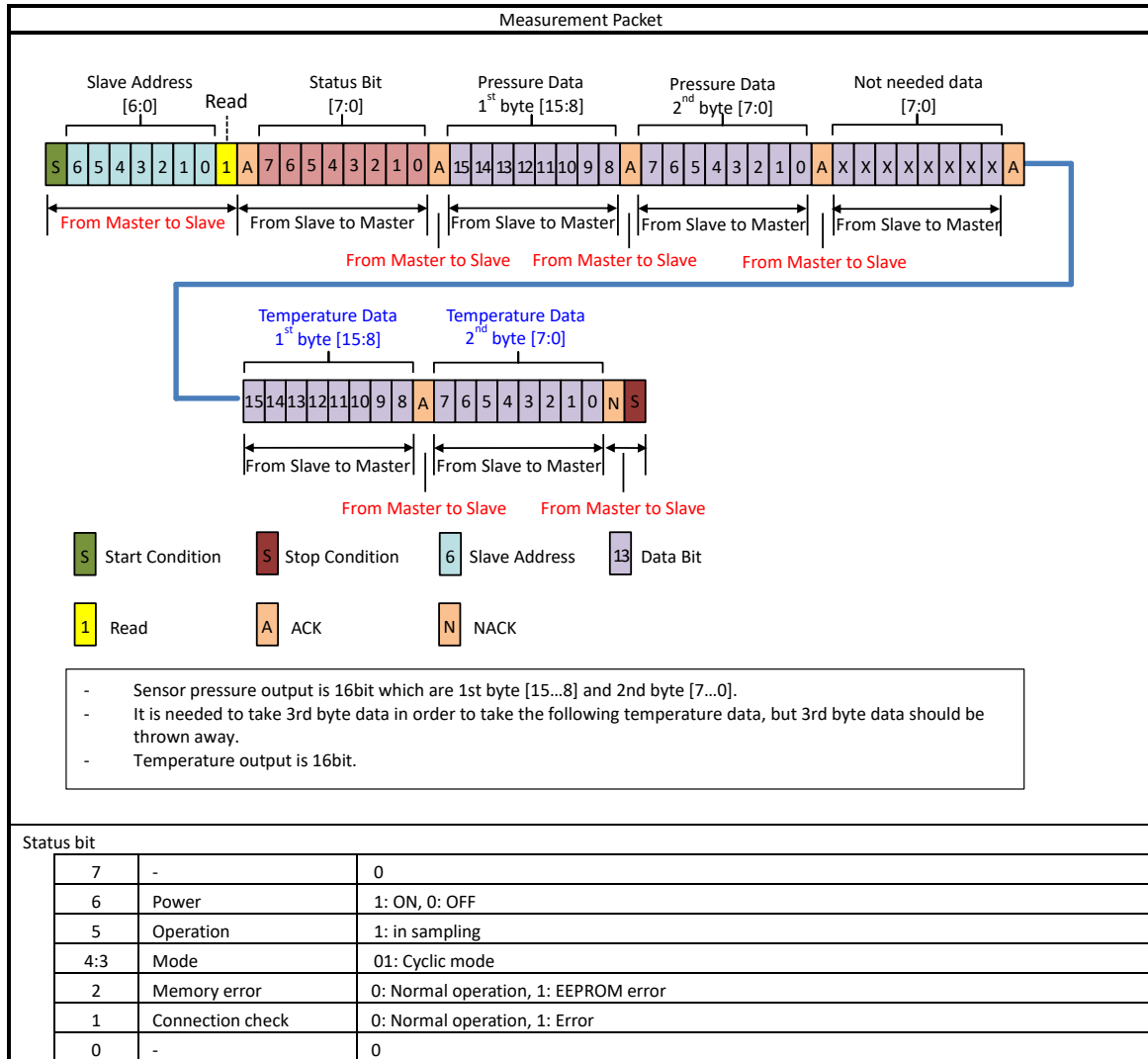


Figure 3

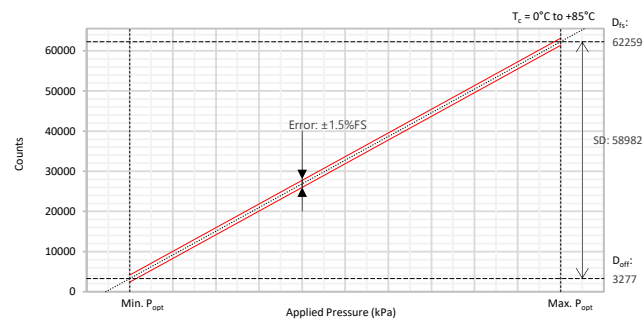


11. Communication Protocol

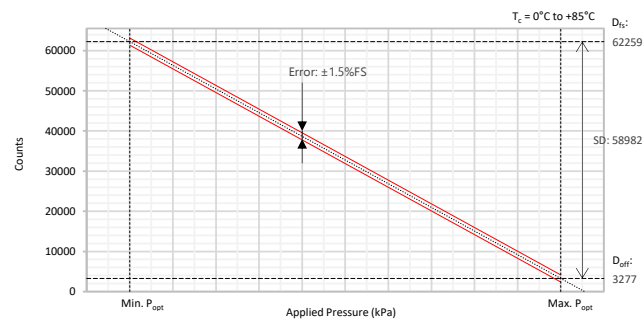


12. Output versus Input Pressure

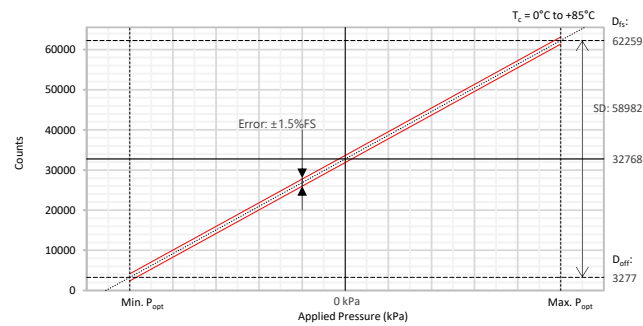
Pressure type: G (Positive pressure)



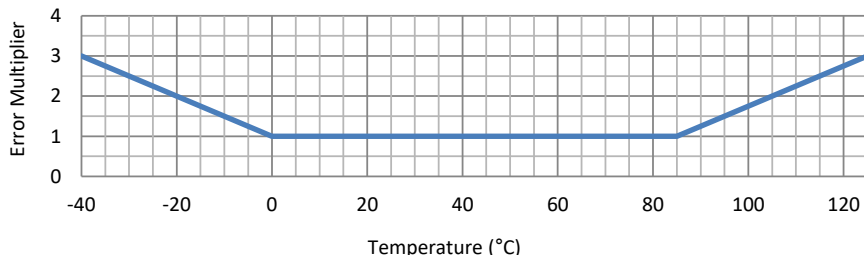
Pressure type: V (vacuum pressure)



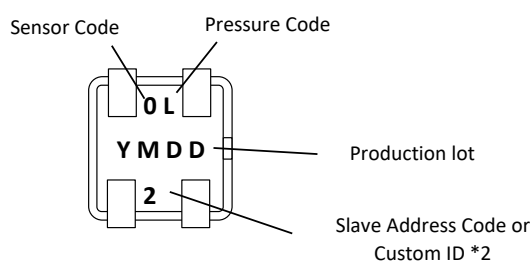
Pressure type: W (Compound pressure)



13. Transfer Function

Item	Transfer Function																																																							
Pressure Data	$\text{Pressure Data (Count)} = P \times \alpha + \beta \pm (\text{Error} \times \text{Temperature Error Multiplier})$ $\updownarrow$ $P \text{ (kPa)} = \frac{\text{Pressure Data} - \beta \pm (\text{Error} \times \text{Temperature Error Multiplier})}{\alpha}$																																																							
	<table><tr><th>Pressure Code</th><th>P (kPa)</th><th>α</th><th>β</th><th>Error</th></tr><tr><td>025KG</td><td>0 to +25</td><td>58982/25</td><td>3277</td><td>884</td></tr><tr><td>050KG</td><td>0 to +50</td><td>29491/25</td><td>3277</td><td>884</td></tr><tr><td>100KG</td><td>0 to +100</td><td>29491/50</td><td>3277</td><td>884</td></tr><tr><td>200KG</td><td>0 to +200</td><td>29491/100</td><td>3277</td><td>884</td></tr><tr><td>500KG</td><td>0 to +500</td><td>29491/250</td><td>3277</td><td>884</td></tr><tr><td>700KG</td><td>0 to +700</td><td>4213/50</td><td>3277</td><td>884</td></tr><tr><td>001MG</td><td>0 to +1000</td><td>29491/500</td><td>3277</td><td>884</td></tr><tr><td>050KV</td><td>-50 to 0</td><td>-29491/25</td><td>3277</td><td>884</td></tr><tr><td>100KV</td><td>-100 to 0</td><td>-29491/50</td><td>3277</td><td>884</td></tr><tr><td>100KW</td><td>-100 to +100</td><td>29491/100</td><td>32768</td><td>884</td></tr></table>	Pressure Code	P (kPa)	α	β	Error	025KG	0 to +25	58982/25	3277	884	050KG	0 to +50	29491/25	3277	884	100KG	0 to +100	29491/50	3277	884	200KG	0 to +200	29491/100	3277	884	500KG	0 to +500	29491/250	3277	884	700KG	0 to +700	4213/50	3277	884	001MG	0 to +1000	29491/500	3277	884	050KV	-50 to 0	-29491/25	3277	884	100KV	-100 to 0	-29491/50	3277	884	100KW	-100 to +100	29491/100	32768	884
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Temperature Data	$D_{\text{tmp}} \text{ (Count)} = \frac{65535}{165} \times (T + 40) \quad \longleftrightarrow \quad T \text{ (}^{\circ}\text{C)} = \frac{165}{65535} \times D_{\text{tmp}} - 40$																																																							

14. Device Marking



Production Lot *1		Sensor Code		Pressure Code		Slave Address Code	
	Marking		Marking		Marking		Marking
Y: Last digit of year	0 to 9	AT70 (VDD = 5 V)	0	025KG	L	2 (0x28)	2
M: Month	1 to 9	AT71 (VDD = 3.3 V)	1	050KG	P	3 (0x38)	3
	October	AT72 (VDD = 3.0 V)	2	100KG	M	4 (0x48)	4
	November			200KG	J	5 (0x58)	5
	December			500KG	Y	6 (0x68)	6
DD: Date	01 to 31			700KG	G	7 (0x78)	7
				001MG	D		
				050KV	S		
				100KV	A		
				100KW	B		

Notes:

- *1) Production Lot is 10-year cycle.
- *2) Custom ID will be added in case that the product is customized for a customer.

15. Soldering

Items	Condition																			
MSL	TBA																			
Reflow Soldering Profile	<table border="1"> <thead> <tr> <th>Segment</th><th>Condition</th><th>Temperature / Time</th></tr> </thead> <tbody> <tr> <td>A</td><td>Ramp up</td><td>2 to 4°C / sec.</td></tr> <tr> <td>B</td><td>Pre-heating</td><td>150 to 180°C, 60 to 120 sec.</td></tr> <tr> <td>C</td><td>Ramp up</td><td>2 to 4°C / sec.</td></tr> <tr> <td>D</td><td>Heating</td><td>Above 230°C, 45 sec. max. 245°C max., 10 sec. max.</td></tr> <tr> <td>E</td><td>Ramp down</td><td>2 to 4°C / sec.</td></tr> </tbody> </table>		Segment	Condition	Temperature / Time	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.	E	Ramp down	2 to 4°C / sec.
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D	Heating	Above 230°C, 45 sec. max. 245°C max., 10 sec. max.																		
E	Ramp down	2 to 4°C / sec.																		

Notes:

- *1) Never wash the device with any washing liquid or ultrasonic washing machine.
- *2) Do not put the solder and flux on the device's package.
- *3) 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.
- *4) Temperature means Surface temperature of the device's package.
- *5) Do not reflow more than twice.

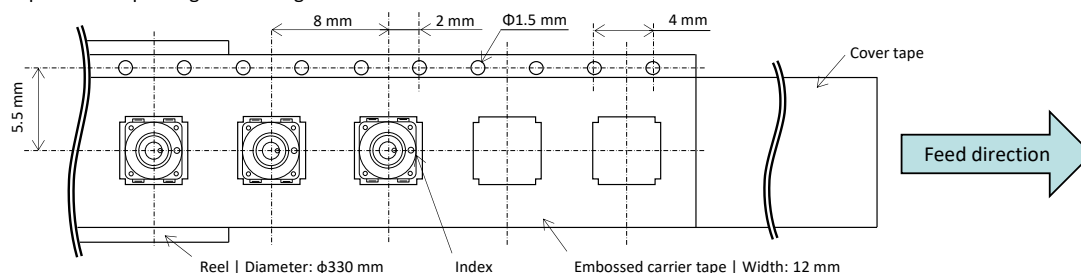
16. Dimensions and Weights

Refer to the following drawing as attached.

Sensor Code	Dimension Drawing	Weight
AT7x	9-772-035	approx. 0.06 grams

17. Tape Information

The tape and reel packing is following JIS C 0806.



18. Ordering Information

Model	VDD	Packing	Ordering Device Number	Qty./Packing
AT7	5.0 Vdc	Tape & Reel	AT70 - [Pressure Code] - [Slave Address] - TP	1500 Pieces/Reel
	3.3 Vdc	Tape & Reel	AT71 - [Pressure Code] - [Slave Address] - TP	1500 Pieces/Reel
	3.0 Vdc	Tape & Reel	AT72 - [Pressure Code] - [Slave Address] - TP	1500 Pieces/Reel

Pressure Code		025KG	050KG	100KG	200KG	500KG	700KG	001MG	050KV	100KV	100KW
Pressure Range	Min P _{opt}	0 kPa	0 kPa	0 kPa	0 kPa	0 kPa	0 kPa	0 MPa	-50 kPa	-100 kPa	-100 kPa
	Max P _{opt}	+25 kPa	+50 kPa	+100 kPa	+200 kPa	+500 kPa	+700 kPa	+1 MPa	0 kPa	0 kPa	+100 kPa

Slave Address		2	3	4	5	6	7
Slave address code		0x28	0x38	0x48	0x58	0x68	0x78

19. 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.

20. Notes

- Fujikura reserves all rights.
- It is regarded that this document was approved by the customer when customer's PO was issued after issue date of this document.
- 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.

