



DATE November 12, 2019

No. V-70177A-E

Messrs.

SPECIFICATION

Semiconductor Pressure Sensor
Drop-in Replacement for the XFHM Pressure Sensors

Model: AH3xR-xxxxx-X1

Project:

Distributor:

Reference:

A handwritten signature in black ink, reading 'Y. Uchiumi'.

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Fujikura Ltd.

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9-772-012 AHxxR	12

Table shown below is revision records of this specification

Rev. 1	November 12, 2019	Y. Uchiumi	Added following specs: Supply voltage: 3.0 Vdc and 3.3 Vdc Pressure range: 500 kPa, 700 kPa and -50kPa Accuracy: $\pm 1.5\%FS$ for 3.3 Vdc and 5.0 Vdc, $\pm 2.0\%FS$ for 3.0 Vdc	
Est.	February 28, 2019	Y. Uchiumi	Issued	
	Date	Name	Comment	Mark

1. General

This document describes the specifications of Fujikura AH3xR-xxxxG-X1 Pressure Sensors. This product has drop-in replacement compatibility with the XFHM pressure sensor.

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	-50	0	25	50	100	200	500	700	1000	kPa
				(-15)	(-7)		(3)	(7)	(15)	(30)	(70)	(100)	(150)	psi
AH3	Gauge	5.0 Vdc	±1.5 %FS			025KG								
						050KG								
						100KG								
						200KG								
		3.3 Vdc	±1.5 %FS			500KG								
						700KG								
						001MG								
		3.0 Vdc	±2.0 %FS			050KV								
						100KV								
						100KW								

Features

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

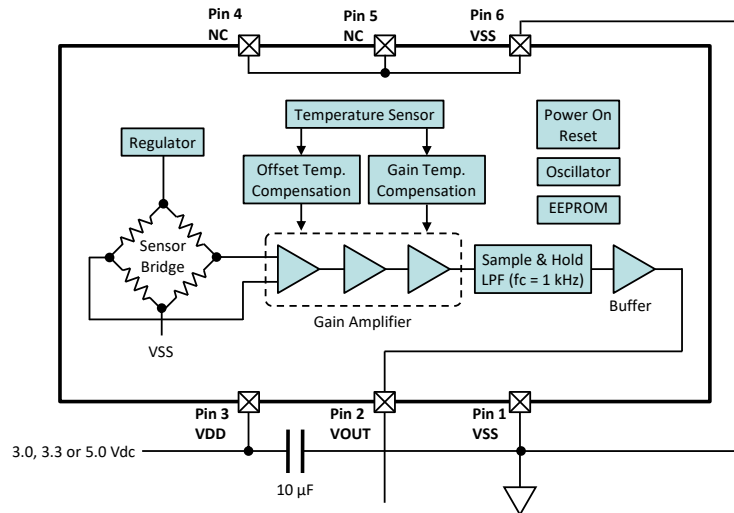
Applications

- ✓ 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

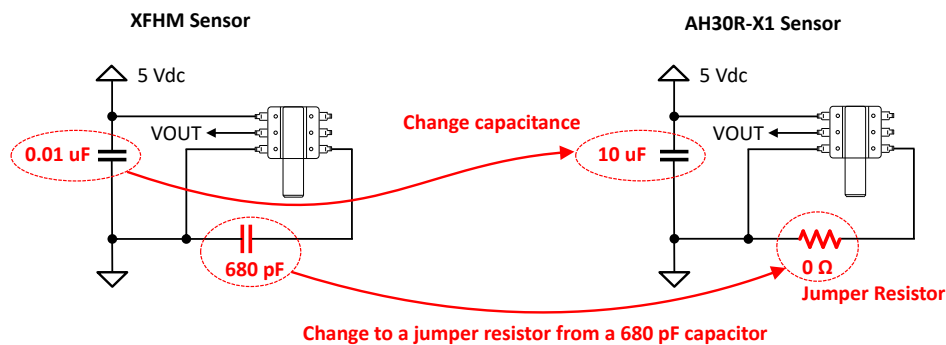


Pin Assignment	Pin No.	Pin Name	I/O	Type	Function	
	1	VSS	-	-	Common voltage connection	*1
	2	VOUT	O	Analog	Analog output	
	3	VDD	-	-	Power supply connection	*2
	4	NC	-	-	Non connection	*3
	5	NC	-	-	Non connection	*3
	6	VSS	-	-	Common voltage connection	*1

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



7. Device Name Code

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

Sensor Code				
AH3	0	R	-	025K G - X1
			Custom ID	X1: Replacement for XFHM sensor, Ver. 1
			025KG:	0 kPa to 25 kPa
			050KG:	0 kPa to 50 kPa
			100KG:	0 kPa to 100 kPa
			200KG:	0 kPa to 200 kPa
			500KG:	0 kPa to 500 kPa
			700KG:	0 kPa to 700 kPa
			001MG:	0 kPa to 1 MPa
			050KV:	-50 kPa to 0 kPa
			100KV:	-100 kPa to 0 kPa
			100KW:	-100 kPa to 100 kPa
			Pressure code	
			Pin direction	R: Opposite 
			Supply voltage	0: 5.0 Vdc 1: 3.3 Vdc 2: 3.0 Vdc
			Model	AH3: DIP Horizontal Port Smooth Analog Output

8. Absolute Maximum Ratings

Item	Condition		Symbol	Rating			Unit
				Min.	Typ.	Max.	
Load Pressure	Pressure Range	025KG	P _{max+}	-	-	+50	kPa
		050KG		-	-	+100	kPa
		100KG		-	-	+200	kPa
		200KG		-	-	+400	kPa
		500KG		-	-	+1	MPa
		700KG		-	-	+1.4	MPa
		001MG		-	-	+1.5	MPa
		050KV		-	-	+100	kPa
		100KV		-	-	+200	kPa
		100KW		-	-	+200	kPa
Supply Voltage			VDD _{max}	-	-	6	Vdc
Input Voltage			VIN	VSS-0.3	-	VDD+0.3	V
Operating Temperature			T _{opt}	-40	-	+105	°C
Storage Temperature			T _{stg}	-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	AH30R	VDD	4.75	5	5.25	Vdc	*1
		AH31R		3.135	3.3	3.465		
		AH32R		2.85	3.0	3.15		
Type of Pressure			-	Gauge pressure				*2
Pressure Media			-	Non-corrosive gases				*3
Pressure Range	Pressure Code	025KG	P _{opt}	0	-	+25	kPa	*4
		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	*5
Operating Humidity	Non-condensing		H _{opt}	30	-	85	%RH	*6
Storage Humidity	Non-condensing		H _{stg}	30	-	85	%RH	*6
Dielectric Strength			-	-	-	1	mA	*7
Insulation Resistance			-	100	-	-	MΩ	*8

Notes:

- *1) Output voltage (V_{out}) 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 P_{opt} and maximum P_{opt}.
- *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

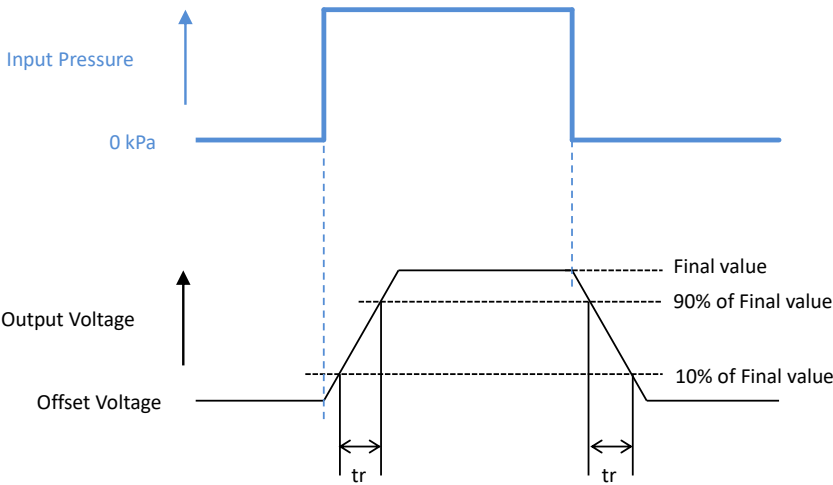
Load resistor $R_L = \infty$, Ambient temperature $T_a = 25^\circ\text{C}$

Item	Condition	Symbol	Rating			Unit	
			Min.	Typ.	Max.		
Sensor Code: AH30R (VDD = 5.0 Vdc)							
Offset Voltage	Pressure type	G, W: Min. P _{opt}	V _{off}	0.1325	0.2	0.2675	V
		V: Max. P _{opt}					
Full Scale Voltage	Pressure type	G, W: Max. P _{opt}	V _{fs}	4.6325	4.7	4.7675	V
		V: Min. P _{opt}					
Span Voltage	Min. to max. P _{opt}		SV	-	4.5	-	V
Accuracy	0 to 60°C	Error	-1.5	-	+1.5	%FS	
			-0.0675	-	+0.0675	V	
Supply Current		I _c	-	-	6	mAdc	
Sensor Code: AH31R (VDD = 3.3 Vdc)							
Offset Voltage	Pressure type	G, W: Min. P _{opt}	V _{off}	0.2595	0.3	0.3405	V
		V: Max. P _{opt}					
Full Scale Voltage	Pressure type	G, W: Max. P _{opt}	V _{fs}	2.9595	3.0	3.0405	V
		V: Min. P _{opt}					
Span Voltage	Min. to max. P _{opt}		SV	-	2.7	-	V
Accuracy	0 to 60°C	Error	-1.5	-	+1.5	%FS	
			-0.0405	-	+0.0405	V	
Supply Current		I _c	-	-	5	mAdc	
Sensor Code: AH32R (VDD = 3.0 Vdc)							
Offset Voltage	Pressure type	G, W: Min. P _{opt}	V _{off}	0.096	0.15	0.204	V
		V: Max. P _{opt}					
Full Scale Voltage	Pressure type	G, W: Max. P _{opt}	V _{fs}	2.796	2.85	2.904	V
		V: Min. P _{opt}					
Span Voltage	Min. to max. P _{opt}		SV	-	2.7	-	V
Accuracy	0 to 60°C	Error	-2.0	-	+2.0	%FS	
			-0.054	-	+0.054	V	
Supply Current		I _c	-	-	5	mAdc	
Response Time	for reference		t _r	-	1	-	msec.
Load Resistor	VOUT - VSS or VDD - VOUT		R _L	9.5	-	-	kΩ
Load Capacitance	VOUT - VSS		C _L	-	-	50	pF

Notes:

- *1) Offset voltage (V_{off}) is defined as the output voltage at minimum P_{opt} . In case of pressure type V, Offset voltage (V_{off}) is defined as the output voltage at maximum P_{opt} .
- *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 (V_{fs}) is defined as the output voltage at maximum P_{opt} . In case of the pressure type V, Full scale voltage (V_{fs}) is defined as the output voltage at minimum P_{opt} .
- *4) Output span voltage (SV) is defined as the voltage difference between Offset voltage (V_{off}) and Full scale voltage (V_{fs}).
- *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 (I_c) is increased depending on the value of Load resistor (R_L).

- *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							
Parameters	Sensor Code	VDD	V _{off}	V _{fs}	SV	V ₀ kPa (Pressure type: W)	Error
	AH30R	5.0 V	0.2 V	4.7 V	4.5 V	2.45 V	±1.5 %FS
	AH31R	3.3 V	0.3 V	3.0 V	2.7 V	1.65 V	±1.5 %FS
	AH32R	3.0 V	0.15 V	2.85 V	2.7 V	1.5 V	±2.0 %FS

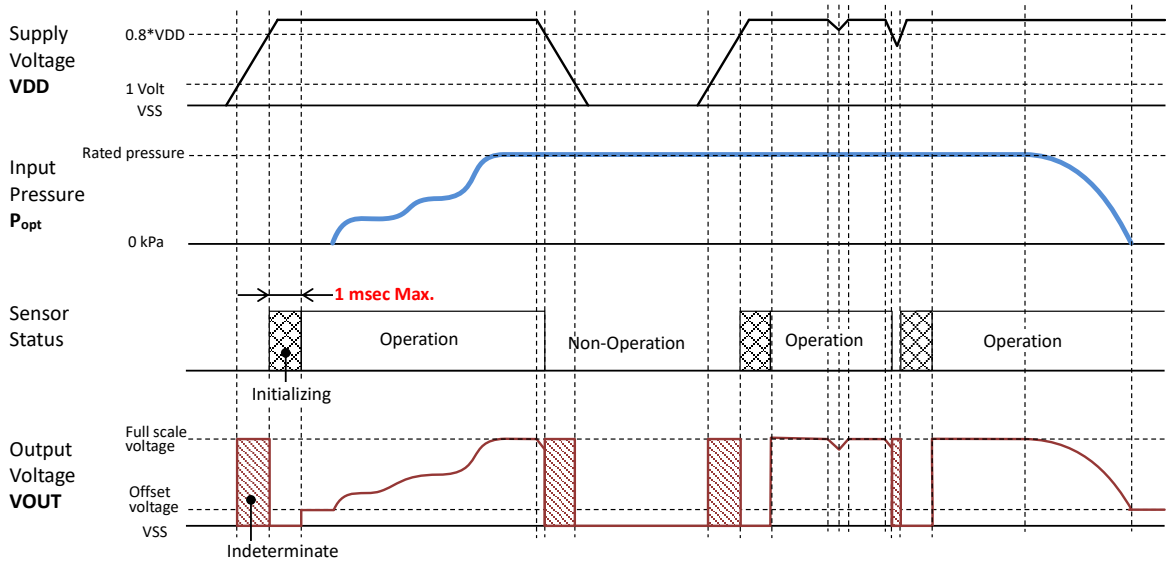
12. Transfer Function

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)												
	AH30R	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												
	AH31R	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												
	AH32R	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	Error Multiplier Temperature (°C) <table><tr><th>Temperature (°C)</th><th>Error Multiplier</th></tr><tr><td>-40</td><td>4.273</td></tr><tr><td>-20</td><td>3.91</td></tr><tr><td>0</td><td>1</td></tr><tr><td>60</td><td>1</td></tr><tr><td>100</td><td>4</td></tr></table>							Temperature (°C)	Error Multiplier	-40	4.273	-20	3.91	0	1	60	1	100	4
Temperature (°C)	Error Multiplier																		
-40	4.273																		
-20	3.91																		
0	1																		
60	1																		
100	4																		

Note:

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

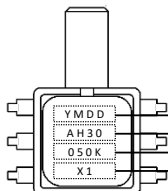
13. Operating Sequence



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	0 to 9						
	M	Production month	Jan	Feb	Mar	Apr	May	Jun	
			1	2	3	4	5	6	
			Jul	Aug	Sep	Oct	Nov	Dec	
			7	8	9	X	Y	Z	
	DD	Production date	01 to 31						
	Sensor Code								
			AH30R						
			AH31R						
			AH32R						
	Pressure Code								
			025KG						
		050KG							
		100KG							
		200KG							
		500KG							
		700KG							
		001MG							
		050KV							
		100KV							
		100KW							
Custom ID		X1							

*1

Notes:

- *1) Pin direction is not marked on the face plate.

15. Soldering

Process	Condition	
Hand soldering	Soldering iron temperature: 350°C max. Soldering time: 3 seconds max. / each pin	*1, 2
Wave soldering	Soldering bath temperature: 260°C max. Soldering time: 5 seconds max. Package surface temperature: 100°C max.	*1, 2

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.

16. Dimensions and Weights

Refer to the following drawing as attached.

Sensor Code	Dimension Drawing	Weights
AHxxR	9-772-012	approx. 0.6 grams

17. Ordering Information

Model	Package	Supply Voltage	Packing	Ordering Device Number	Qty./Packing
AH3	DIP / Horizontal Port	5.0 Vdc	Tray	AH30R- [Pressure Code] -X1	100 Pcs/Tray
		3.3 Vdc		AH31R- [Pressure Code] -X1	100 Pcs/Tray
		3.0 Vdc		AH32R- [Pressure Code] -X1	100 Pcs/Tray

↑

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

Replacement Device Number

Pressure Range	XFHM series	Ordering Device Number (Replacement Device Number)	Qty./Packing
0 to +25 kPa	XFHM-025KPGR	AH30R-025KG-X1	100 pcs/Tray
0 to +50 kPa	XFHM-050KPGR	AH30R-050KG-X1	100 pcs/Tray
0 to +100 kPa	XFHM-100KPGR	AH30R-100KG-X1	100 pcs/Tray
0 to +200 kPa	XFHM-200KPGR	AH30R-200KG-X1	100 pcs/Tray
0 to +1 MPa	XFHM-001MPGR	AH30R-001MG-X1	100 pcs/Tray
-100 to 0 kPa	XFHM-100KPGVR	AH30R-100KV-X1	100 pcs/Tray
-100 to +100 kPa	XFHM-100KPGWR	AH30R-100KW-X1	100 pcs/Tray

18. Handling Notes

The finish plating of pins is silver (Ag). Silver tarnishes in air to form the black silver sulfide, because silver has a chemistry to react with sulfur and its compounds. There are notes for handling as below:

- To prevent tarnish 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.

19. 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.

