KEYENCE

96M1191

96M1191-6

Ultra-compact Digital Pressure Sensor

AP-C30 (P) Series

Instruction Manual

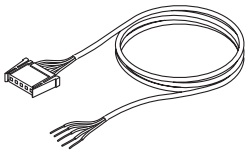
1. Safety Precautions

⚠ WARNING

- *Do not use this product in safety circuits such as those designed to protect human workers.*
- *This product does not employ an explosion-proof construction. Do not use it in the presence of flammable gasses, liquids, or powders.*
- *This is a direct current power supply type sensor. Application of an alternating current may result in explosion or fire.*

■ Accessories

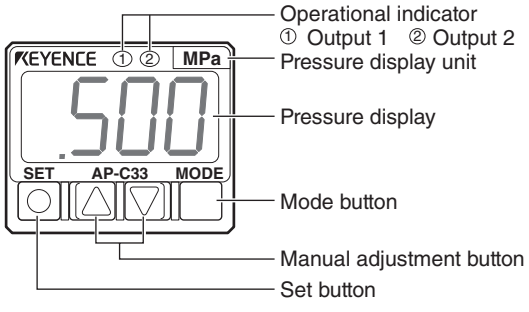
- 1 connector cable (2 m)

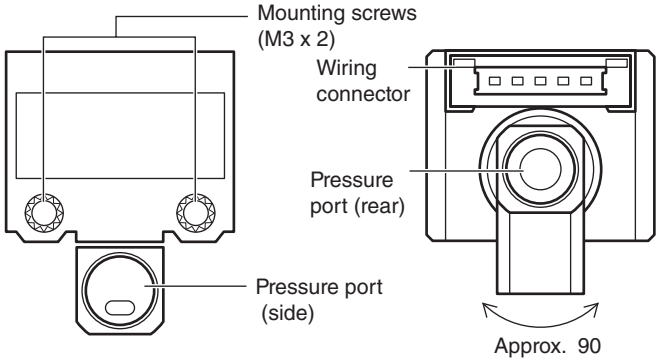


- 1 unit scale label (AP-C33 only)
- 1 valve plug with hexagonal hole

- 1 instruction manual

2. Part Names

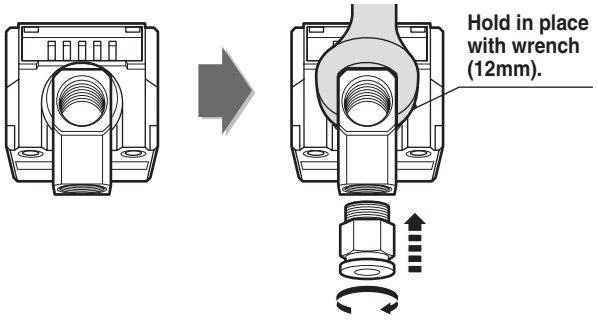




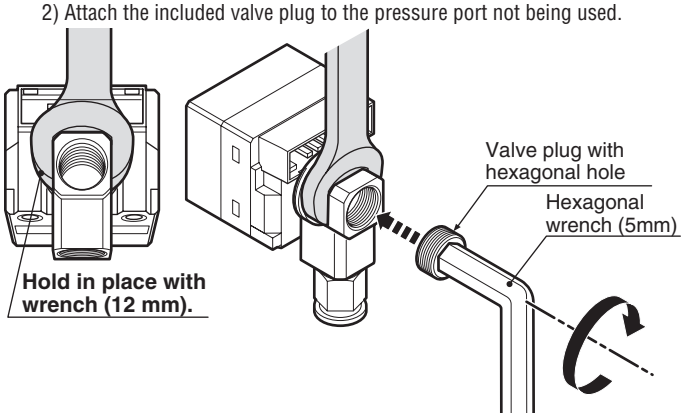
3. Pipe Connections

You can select from one of two pressure ports: one on the back of the sensor that can accommodate a pipe leading directly away from the back of the sensor, and one on the side of the sensor to accommodate a pipe leading away from the sensor at a right angle.

1) The pressure port is 1/8 of Rc (PT). Commercially available air pressure joints and nipples can be used with the port.
When attaching the joint, use a wrench to hold the pressure port in place as illustrated below.



2) Attach the included valve plug to the pressure port not being used.

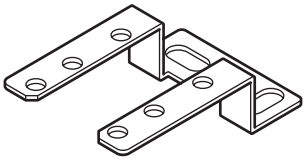


⚠ CAUTION

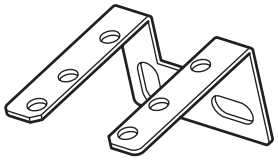
- *Do not use a torque in excess of 10 Nm when tightening the joint. Doing so may damage the joint.*
- *Apply sealing tape when attaching the joint in order to prevent air leaks.*

4. Mounting Brackets (option)

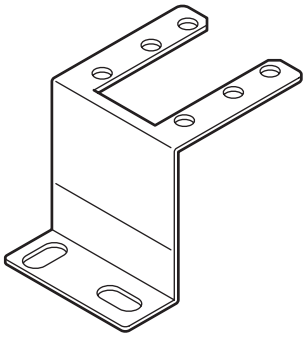
Dedicated mounting hardware is available for the sensor, allowing it to be installed in a range of locations.



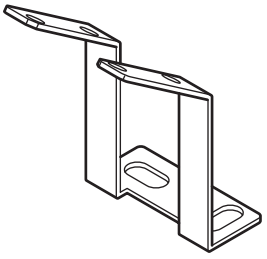
Horizontal mounting bracket
(AP-B01)



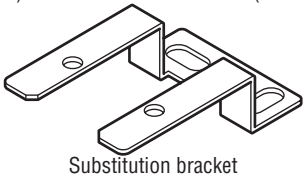
Wall mounting bracket
(AP-B02)



Faceplate/ceiling mounting bracket
(AP-B03)

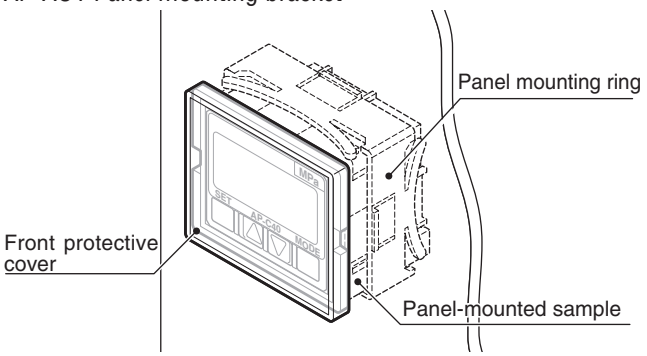


Tilted mounting bracket
(AP-B04)



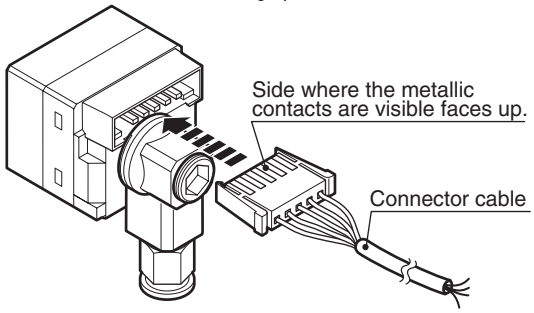
Substitution bracket
(AP-B05)

AP-A01 Panel mounting bracket

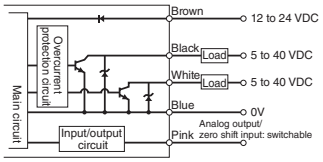


5. Connection Method and Diagrams

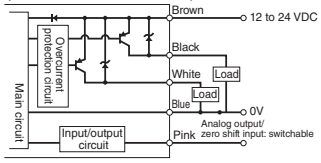
Insert the included connector-tipped cable into the sensor's connector. Position the connector so that the side of the connector where the metallic contacts are visible is facing up.



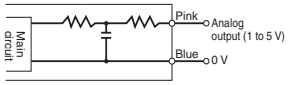
Input/output circuit
(AP-C30/C31/C33)



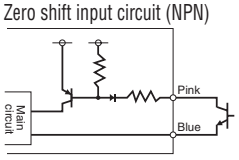
(AP-C30P/C31P/C33P)



Analog output circuit

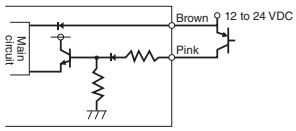


Zero shift input circuit (NPN)



(Short-circuit current 5 mA max.)

Zero shift input circuit (PNP)



(Short-circuit current 5 mA max.)

Use non-contact input device such as open-collector.

6. Precautions for Safe Use

Follow these guidelines. Failure to do so may result in product damage.

⚠ CAUTION

■ *Connections*

Input/output circuit

- *Always ground the frame ground terminal when using an off-the-shelf switching regulator.*
- *Use separate conduits for power line and high voltage lines, since use of a common conduit may result in device malfunction.*
- *Improper wiring may result in the device becoming excessively hot or in device damage.*

■ *Other*

- *Do not use this sensor with corrosive gasses or liquids.*
- *Do not insert objects such as wire into the pressure insertion area. Doing so may result in the device failing to operate properly due to damage to the pressure-sensitive elements.*
- *Do not use sharp-tipped objects to press the setting keys.*

7. Detection Mode Operation

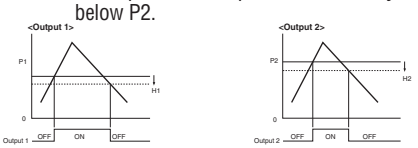
■ **General-purpose mode (F-1)**

This mode allows the user to configure 2 detection points.
Control output 1: Turns ON when pressure exceeds setting P1.
Control output 2: Turns ON when pressure exceeds setting P2.

* Hysteresis is a standard 0.5% of F.S. when operating in general-purpose mode and application modes 1 and 2. During focus mode operation, it is 0.2% of F.S.

■ **Variable hysteresis mode (F-2)**

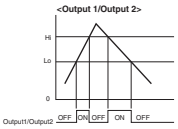
Two detection points may be user-configured, and hysteresis for both may also be set.
Control output 1: Turns ON when pressure exceeds setting P1. Turns OFF when pressure drops the selected hysteresis amount below P1.
Control output 2: Turns ON when pressure exceeds setting P2. Turns OFF when pressure drops the selected hysteresis amount below P2.



■ **Window mode (F-3)**

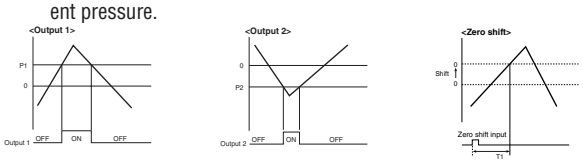
The user may select a pair of upper (Hi) and lower (Lo) thresholds, and the sensor turns OFF when the pressure falls outside of the resulting range.

* Control output 1 is a standard 0.5% of F.S. During focus mode operation, it has a hysteresis of 0.2% of F.S., and control output 2 has a hysteresis of 0.



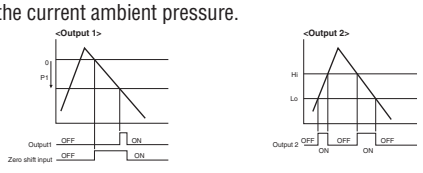
■ **Application mode 1 (A-1)**

This detection mode is optimum for use in suction detection applications.
Recommended sensor heads: AP-C30/C30P/C31/C31P
Control output 1: Suction pressure detection.
Turns ON when pressure exceeds setting P1.
Control output 2: Detection and confirmation of vacuum burst pressure detection (or vacuum ultimate pressure).
Turns ON when the pressure falls below setting P2.
* Cannot be used to detect vacuum burst pressure with the AP-C31/C31P when operating in focus mode. Standard mode operation only.
Zero shift: The zero point is shifted immediately after the zero shift timer is set following the activation of zero shift input.
P1: Pressure setting for control output 1.
T1: Zero shift timer setting (ms) < Variable between 0 and 1,999 ms
P2: Pressure setting for control output 2.
* P2 is unrelated to zero shift and is always based on the current ambient pressure.



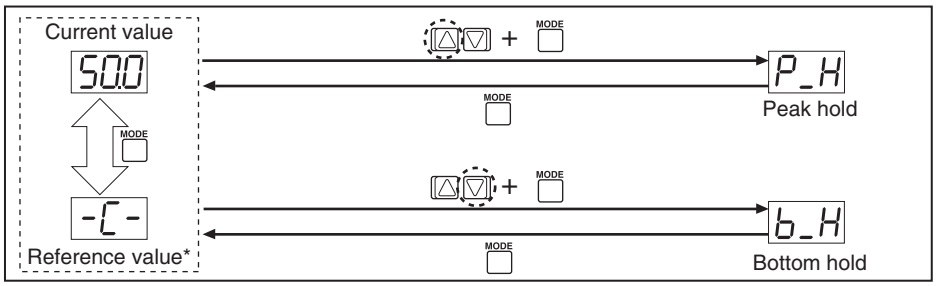
■ **Application mode 2 (A-2)**

This mode is optimum for use in leak test applications.
Recommended sensor head: AP-C33/C33P
Control output 1: Leak pressure detection.
Turns ON when pressure falls below setting P1.
* Output only when receiving zero shift input.
Control output 2: Window comparator output for detection of fill pressure.
Turns OFF when pressure falls outside the range determined by upper (Hi) and lower (Lo) thresholds.
* Fill pressure values are displayed with the center pressure as 0 during focus mode operation.
P1: Pressure setting for control output 1.
Hi: Upper threshold setting for control output 2.
Lo: Lower threshold setting for control output 2.
* The Hi and Lo values are unrelated to zero shift and are always based on the current ambient pressure.



8. Sensor Configuration

■ Toggling the display



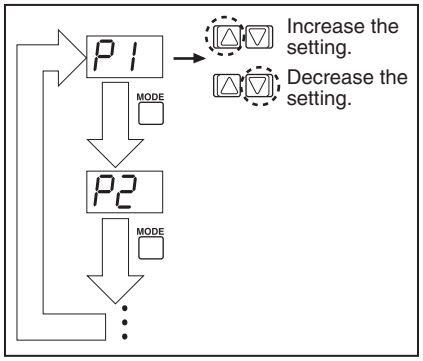
* The reference value is the pressure value when zero shift input is received and is replaced only when zero shift input is selected.

■ Manual configuration

Settings are manually configured. The display changes for each mode.

* Toggling the display of settings (see the diagram below).

* Manual configuration only during F-3/A-2 mode operation.

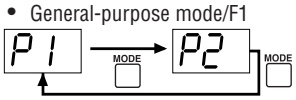


- Two-point tuning
- Active tuning

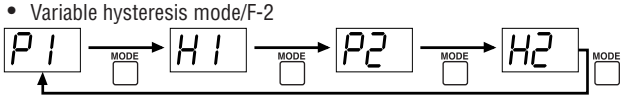
MPa
Pressure display

■ Toggling the display of settings

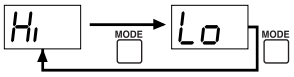
- General-purpose mode/F1



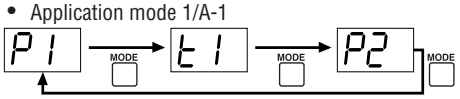
- Variable hysteresis mode/F-2



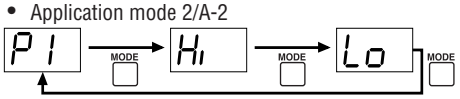
- Window mode/F-3



- Application mode 1/A-1



- Application mode 2/A-2

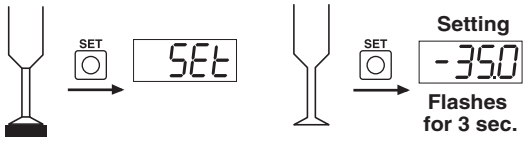


■ Two-point tuning (F-1/F-2)

The sensor is made to detect the pressures when the target object is present and then absent for confirmation of target suction pick-up, and the intermediate value is used.

Control output 1 configuration: When P1 (H1) is selected on the settings display.

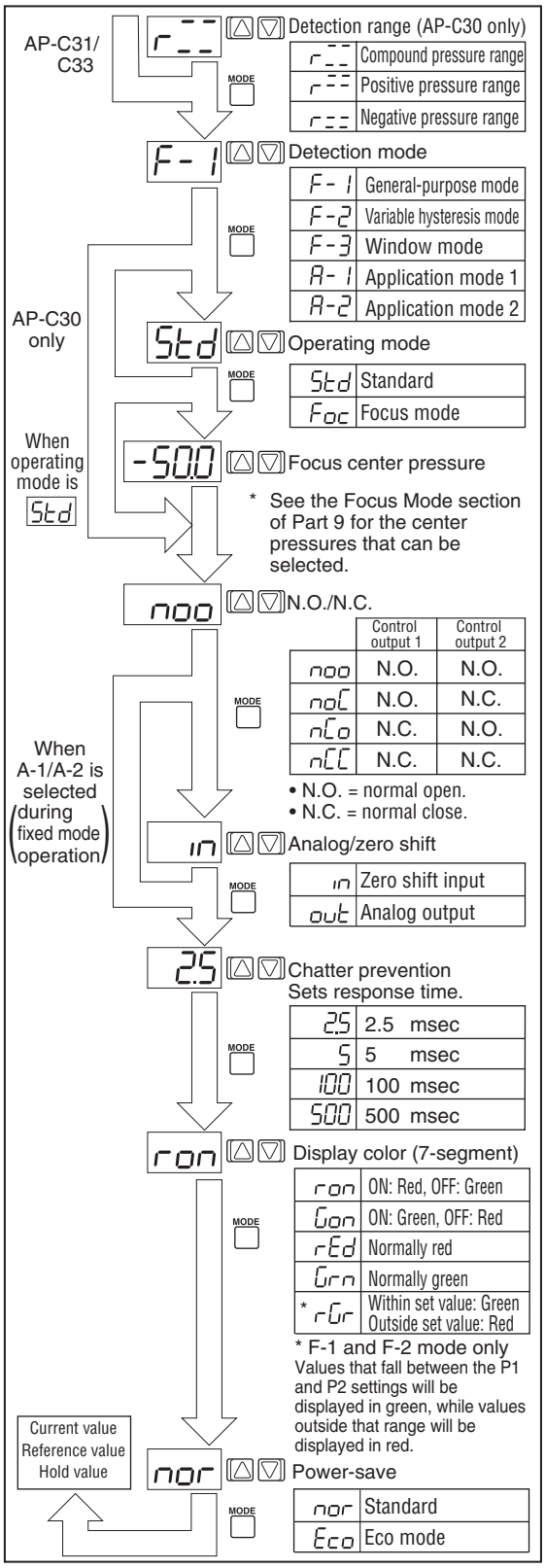
Control output 2 configuration: When P2 (H2) is selected on the settings display.



■ Active tuning (A-1)

See Section 10.

■ Mode configuration



Note:
- Press and hold the MODE button (MODE) for at least 3 seconds to return to the current value/reference value/hold value display from each of the mode setting screens.
- Press the left side (△▽) on the manual adjustment button (△▽) while holding down the mode button (MODE) to return to the previous display.
- The current value will be displayed based on the ambient pressure conditions prevalent at that time without regard to zero shift input when the P2 setting display is selected for A-1 mode or when the Hi and Lo setting displays are selected for A-2 mode.
- The sensor must be configured manually when operating in the F-3/A-2 modes. The SET button (SET) will not function.

9. Explanation of Features

■ Switching the detection range (AP-C30/C30P only)

The AP-C30/C30P allows you to select a detection range.

Pressure type	Display	Range
Negative pressure	r - -	0 to -101.3 kPa
Positive pressure	r - -	0 to 100.0 kPa
Compound pressure	r - -	101.3 to -101.3 kPa

■ Focus mode (AP-C31/C31P/C33/C33P)

Focus mode increases all display resolutions by a factor of 10.

Normal mode Focus mode

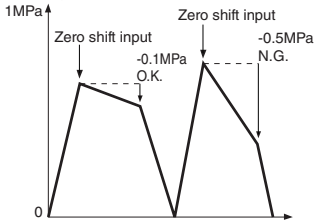
The following focus center pressures can be selected for the models noted in the table below. (Unit: kPa)

AP-C31/C31P	-20.0 / -30.0 / -40.0 / -50.0 / -60.0 / -70.0 / -80.0
AP-C33/C33P	200 / 300 / 400 / 500 / 600 / 700 / 800

The current value is displayed as ±20% of the F.S. range with the focus center pressure as the reference value (0).

■ Zero shift

Zero shift input forces the pressure at that time to be defined as zero. This feature is useful in applications that require the detection of a certain amount of pressure fluctuation without being influenced by changes in the original pressure.



(Example: leak testing)

Zero shift input received when a container is filled with air will allow the amount of leak after a certain time to be displayed as negative pressure. This approach eliminates the influence of small variations in the final fill pressure of the container.

The pressure value (reference value) when zero shift input is received can be verified from the current value display by pressing the MODE button to switch to the reference value display.

(-C- ⇔ 200)

Press the MODE button once more to return to the current value display.

■ Analog output

A voltage corresponding to the pressure value is output.

Model			1 to 5V
AP-C30/C30P	AP-C31/C31P	AP-C33/C33P	
Negative pressure range	——	——	-101.3 to 0 kPa
Positive pressure range	——	——	0 to 100.0 kPa
Compound pressure range	——	——	-101.3 to 101.3 kPa
——	Normal mode	——	0 to -101.3 kPa
——	Focus mode	——	20.0 to -20.0 kPa
——	——	Normal mode	0 to 1.000 MPa
——	——	Focus mode	-200 to 200 kPa

* The pressure value of the focus mode is based on the selected center pressure.

■ Peak/bottom hold display

The maximum (minimum) values are displayed continuously after power to the sensor is turned on.

The active hold display indicated below is used when the A-1 mode is selected.

How to display hold values/

From current value/reference value display

MODE + △▽/ Activates peak hold display.

MODE + △▽/Activates bottom hold display.

The minimum value during zero shift input is displayed for the bottom hold during A-2 mode operation.

Resetting the peak/bottom hold values/

Pressing △▽ for 3 seconds or more while the peak and bottom hold values are being displayed will reset the values.

* The values will also be reset when power to the sensor is turned off, and when the device's detection mode or operating mode is changed.

- **During A-1 mode operation (active hold display)**

The hold values are reset each time the pressure value exceeds (or falls below) the setting, and the peak hold (bottom hold) will then vary from this point.

Peak hold value: The peak hold value will be reset once a value is encountered that exceeds setting P1, and new peak values will be held from that point.

Bottom hold value: The bottom hold value will be reset once a value is encountered that falls below setting P2, and new bottom values will be held from that point.

■ Power-save

The value display will be turned off during power-save operation to reduce the amount of power consumed.

- Use of any keys during eco mode operation will revert the sensor to its normal display. The sensor will return to the eco display when there is no key input for a period of 3 minutes.

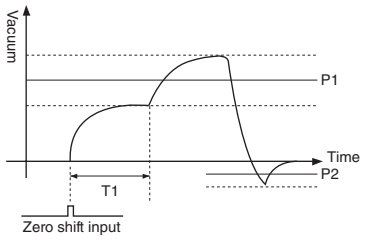
■ Switching the display color

Corresponds to either output 1 or output 2 based on which setting display has been selected.

* rGr can only be set when either the F-1 or F-2 mode is selected. Values that fall between the P1 and P2 settings will be displayed in green, while values outside that range will be displayed in red.

10. Active Tuning

Type	Application	P1	P2	T1
Active 2 point tuning	Suction	Automatic configuration	—	Manual configuration
Active 1 point tuning	Vacuum burst	—	Automatic configuration	—

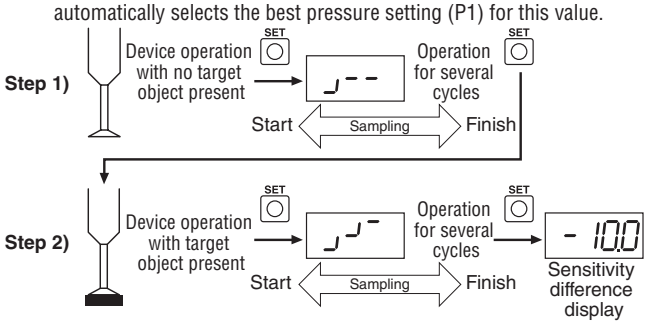


■ Perform these steps first

- Select the setting display as indicated below before performing the tuning procedures.
  Active 2 point tuning: Select either P1 or T1 for the setting display.
  Active 1 point tuning: Select P2 from the settings display.
- Connect the external signal to the zero shift input.

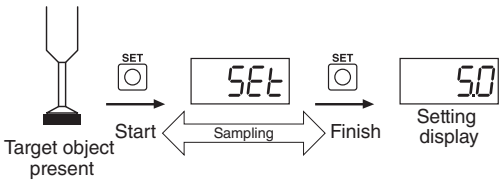
■ Active 2 point tuning / a tuning method suited for automatically configuring suction pick-up detection pressures

The zero shift timer setting is manually configured, and the sensor automatically selects the best pressure setting (P1) for this value.



■ Active 1 point tuning / tuning optimized for vacuum burst detection

The sensor automatically selects the best pressure setting (P2) for vacuum burst detection.



* Cannot be used to detect vacuum burst pressure when operating in focus mode (AP-C31/C31P).

11. Ambient Pressure Compensation

Open the applied pressure to the surrounding air so that it equals the ambient pressure and press the △▽ button for 3 seconds or more while the current value or reference value is being displayed.
The ambient pressure point will be corrected.

*1 Ambient pressure can be corrected within a range of ±5 % of F.S. When atmospheric pressure compensation has been performed, the settings will be saved even when power to the sensor is turned off.

*2 AP-C31/C31P/C33/C33P: Can be used during focus mode operation as well. Values will be compensated based on the center pressure.

12. Key Lock

Disables operations that would modify the sensor's configuration. Display content can be toggled.
Pressing and holding either △ or ▽ for at least 3 seconds while pressing MODE button will lock the keypad and cause the Loc display to flash.
*The same key combination will deactivate the key lock feature.

13. Default Mode Settings (Initialization)

The sensor ships with the following configuration.

	AP-C30/C30P	AP-C31/C31P/C33/C33P
Detection range	r--	—
Detection mode	F-1	F-1
Operating mode	—	Std
N.O./N.C. switching	noo	noo
Analog/zero shift*	in	in
Chatter prevention	2.5	2.5
Display color	ron	ron
Power-save	nor	nor

*Press SET button 5 times while holding down the MODE button to return the sensor to its default configuration.

14. Specifications

Type		Multi-range		Negative pressure	Positive pressure
Model		AP-C30/C30P		AP-C31/C31P	AP-C33/C33P
Rated pressure range		Negative pressure	0 to -101.3 kPa	0 to -101.3 kPa	0 to 1.000 MPa
		Positive pressure	0 to 100.0 kPa		
		Compound pressure	101.3 to -101.3 kPa		
Pressure resistance		500 kPa		500 kPa	1.5 MPa
Adaptive fluids		Air, non-corrosive gasses			
Pressure type		Gauge pressure			
Rating	**Power supply voltage**	12 to 24 VDC10% Ripple (P-P) 10% max.			
	Current consumption		12 V operation(NPN/PNP)	24 V operation(NPN/PNP)	
		Normal	720 mW(60 mA)/900 mW(75 mA) max.	960 mW(40 mA)/1320 mW(55 mA) max.	
		Eco mode	480 mW(40 mA)/600 mW(50 mA) max.	720 mW(30 mA)/960 mW(40 mA) max.	
Display method		3.5 digit two-color 7 segment LED (11 mm character height) Display cycle: 10 times/second			
Configuration/ display range *1		-10 to +110% of F.S.		-15 to +110% of F.S.	
Operating status indicators		Red LED x 2 (supports control output 1 / control output 2)			
Resolution	**Multi-range**	Negative pressure	Positive pressure	Compound pressure	
		0.1 kPa	0.1 kPa	0.2 kPa	
	Standard mode			0.1 kPa	0.001 MPa
	Focus mode			0.01 kPa	0.1 kPa
Hysteresis *2		Variable (standard 0.5% of F.S.)			
Display temperature characteristics		1% of F.S. max.			
Response (chatter prevention feature)		Selectable from 2.5, 5, 100, 500 ms			
Zero shift input		No-voltage input (without contacts) Input time 2 ms or greater(Switchable with analog output.)			
Control output		NPN open collector max. 100 mA (40 V max.) residual voltage 1 V max., 2 outputs (NO/NC switchable) *3 PNP open collector Max. 100 mA (30 V max.) residual voltage 1 V max., 2 outputs (NO/NC switchable)			
Analog output		1 to 5 V Output impedance 1 kΩ max. (Switchable with zero shift input.)			
Environmental resistance	**Ambient temperature**	0 to +50 C (No freezing)			
	Relative humidity	35 to 85 % RH (No condensation)			
	Vibration	10 to 55 Hz, compound amplitude 1.5 mm, 2 hours for each of XYZ axes			
Pressure port		Rc(PT)1/8 Bidirectional rotating type			
Housing material		Front case: polysarfun; Rear case: PBT; Front sheet: polycarbonate; Pressure port: die-cast zinc			
Weight		Approx. 30 g (not including cables) / Approx. 85 g (including 2-m cable)			
Accessories		Power cord (2-m, connector type), Units sticker *4			

*1 During focus mode operation, restricted to focus range.
*2 During focus mode operation, standard 0.2% of F.S.
*3 AP-C30P/C31P/C33P are PNP output types.
*4 AP-C33/C33P only.

15. Error Displays and Corrective Actions

■ **Error displays during normal operation**

Display	Cause	Solution
----	• No difference in sensitivity (during 2 point tuning/active tuning).	Adjust the air pressure device so that there will be a difference in sensitivity.
	• There is an applied pressure of 5 % of F.S. during ambient pressure compensation.	(Return to atmospheric pressure.) Repeat atmospheric compensation.
ErC	• An excess current is flowing to the control output.	Check the load and return it to the rated range.
-FFF	• Reading is falling below (exceeding) configuration/display pressure range.	Return the pressure to the rated pressure range.
FFF	• Reading is exceeding (falling below) configuration/display pressure range.	Return the pressure to the rated pressure range.
Er1	• When there were not at least 2 shift inputs during active 2 point tuning.	Repeat the active tuning procedure so that there are at least 2 shift inputs.

* Contact KEYENCE for information about error displays other than those described above.

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