## OMRON

Ultrasonic Sensor with Separated Digital Amplifier Amplifier Unit

## E4C-UDA\_

## **Instruction Manual**

### Thank you for purchasing this Amplifier Unit.

When using this Amplifier Unit, be sure to observe the following:

- The Amplifier Unit must be operated by personnel knowledgeable in electrical engineering.
- To ensure correct use, please read this manual thoroughly to deepen your understanding of the product.
- Please keep this manual in a safe place so that it can be referred to whenever necessary.

#### **Omron Corporation**

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## READ AND UNDERSTAND THIS DOCUMENT

Please read and understand this document before using the products. Please consult your OMRON representative if you have any questions or comments.

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The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical
  equipment, amusement machines, vehicles, safety equipment, and installations subject to separate
  industry or government regulations.
- · Systems, machines, and equipment that could present a risk to life or property.

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NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

#### Precautions for Safe Use

Please observe the following precautions for safe use of the product:

- 1) Do not use the product in environments where it can be exposed to inflammable/explosive gas.
- 2) Do not use this product in locations where it will be sprayed by water, oil or chemical fumes, or in steamy locations.
- 3) Do not attempt to dismantle, repair, or modify the product.
- 4) The supply voltage and current must be within the rated ranges.
- 5) Do not wire the product incorrectly (e.g. mistake the polarity of the power supply, or mistake wiring terminals).
- 6) Correctly connect the load to both control and analog outputs.
- 7) Both ends of the load on control outputs and analog outputs should not be short-circuited.
- 8) Do not use the product with the case damaged.
- 9) Dispose of this product as industrial waste.

#### Precautions for Correct Use

- Electrical lines and power lines must be wired separately from this product. Wiring them together or placing them in the same duct may cause induction, resulting in malfunction or damage.
- 2) Limit cable extensions to 10 m. Use extension cable of 0.3 mm<sup>2</sup> in diameter or thicker.
- Sensing is possible 200 ms after the product is turned on.
   When the load and product are powered by different power supplies, be sure.
- When the load and product are powered by different power supplies, be sure to turn the product on before the load.
- Be sure to use the product with its protective cover attached.
- 5) When a write error occurs (ERR/EEP flashes) due to power being cut off, or static electricity or other noise, initialize the product settings by its setting keys.
- 6) After the product is turned on, it sometimes takes time for the displayed distance value to stabilize in some operating environments.
- An output pulse is sometimes generated when the product power is cut. For this reason, cut the power of the load or load line before turning the product off.
- 8) Do not use paint thinner, benzene, acetone, or kerosene for cleaning.
- 9) Before connecting or disconnecting connectors to the Sensor Head, be sure to turn the product off.
- Only the E4C Sensor Head can be used. Other Sensor Heads cannot be used. Use of a different model of Sensor Head may damage the product.
- 10)The distance value displayed in the amplifier's display is different from the value measured using a tape measure or other apparatuses. When the value must be adjusted for use, adjust the value using the scaling function.

## 1. Part Names and Functions



- (1) This indicator lights when the output turns ON.
- In the case of the twin output model, this indicator lights when the output of 1CH turns ON.
- (2) This display shows the distance to the workpiece and function name.
- (3) In the case of the twin output model, this indicator lights when the output of 2CH turns ON.
- (4) This sub-display shows additional information and function settings for sensing.
- (5) This switch selects the operating mode.
- (6) In the case of the twin output model, this switch selects the channel to be displayed and set. In the case of the analog output model, this switch selects whether to turn output ON when the workpiece is in the near
- distance or the workpiece is in the far distance.
- (7) These keys switch the display and set functions.

## 2. List of Functions

Function Name	Overview	Page for Description of Operation
Operating mode setting	This function sets the operating mode.	P.7
Threshold setting	This function sets the threshold values.	P.8
Bank setting/call	This function saves and reads settings.	P.10
Scaling setting	This function changes the display values for specific measurement values to the desired values. (twin output model only)	P.11
Judgment output setting	This function selects the output method.	P.12
Analog output range setting	This function sets the range and display ratio of the analog output with respect to the display value. (analog output model only)	P.13
Zero reset/offset	This function sets the current distance to 0 (zero) or to any value.	P.15, P.15
Display inversion	This function inverts how the display for the distance to the workpiece is incremented/decremented.	P.15
Keylock	This function disables key operation.	P.16
Initialization	This function returns the amplifier settings to their factory settings.	P.16

## 3. Installation & Connection

#### Connecting the Sensor Head

- 1. Open the protective cover.
- Orient the Amplifier Unit so that the lock lever of the Sensor Head connector is facing up, and push the Sensor Head into the connector insertion slot as far as it can go.

To remove the Sensor Head, press down on the lock lever and draw the Sensor Head out.



#### Installing the Amplifier Unit

#### Installation procedure

Hook the Sensor Head connector end of the Amplifier Unit on the DIN Track and press in at the bottom until the Amplifier Unit locks into place.

Be sure to mount the Amplifier Unit by hooking the Sensor Head connector end of the Amplifier Unit on the DIN Track.

Hooking the other end may impair the mounting strength of the DIN Track attachment.

#### Removal procedure

Push the Amplifier Unit in direction 1 and pull out the Sensor Head connector end in direction 2.



Hook on sensor head connector



#### 4. Basic Knowledge for Operation

#### Switching Modes

To switch the operating mode, use the SET/RUN Switch. Switch to the desired mode before operating the Amplifier Unit.

Mode	Details		
SET	Select this mode to set the sensing conditions or threshold value by teaching.		
RUN	Select this mode to perform actual sensing or to set the following: Manual adjustment of the threshold value, power adjustment, zero reset, key lock		

#### Key Operations

Use the Control Keys to change the display and set sensing conditions. The currently selected mode determines the key functions.

Kov	Function		
Rey	RUN Mode	SET Mode	
UP key	Increases the threshold value.	<ul> <li>The function changes depending on the settings.</li> <li>Executes teaching.</li> <li>Changes the setting value in the forward direction.</li> </ul>	
DOWN key	Decreases the threshold value.	<ul> <li>The function changes depending on the settings.</li> <li>Executes teaching.</li> <li>Changes the setting value in the reverse direction.</li> </ul>	
MODE key	The function changes depending on the "MODE key setting". • Executes a zero reset • Teaching with and without a workpiece	Changes the display to the function to be set.	

About key pressing time

Unless otherwise mentioned in text descriptions, press keys for about one second.

Example: Press the UP key.

This means that you hold down the key for about one second and then release the key.

#### Reading Displays

The data displayed on the main and sub-displays depends on the currently selected mode. When the power is first turned ON after shipment, RUN mode data is displayed.

Mode	Main Display (Red Display)	Sub-Display (Green Display)		
SET	Displays distance values and function names in order when the Control Keys are pressed.	Displays the threshold values and setting values of functions currently displayed on the main display in order when the Control Keys are pressed.		
RUN*	Displays the current distance value. (default)	Displays the current threshold value. (default)		

\* Display details can be changed by the display switch function. Refer to "Function Transition Charts" in "5. Function Overview."

### 5. Function Overview

#### **Function Transition Charts**

#### SET mode

The following function can be set in SET mode.

The following explanation is for the SET mode on both the twin output model and analog output model.





## 6. Basic Settings

#### 1. Setting the Head Type

#### Initial setting of the head type

Set the head type when the power is first turned ON after the Amplifier Unit is purchased.

#### Setting procedure

When the power is first turned ON, the following is displayed.



Note: The head type does not need to be set from the second time that the power is turned ON.

#### Changing the head type

This feature is used to display the type of head to connect the Amplifier Unit to.

Switch the SET/RUN switch to SET and change the head type by following the procedure below.



Change procedure



This completes setting, and the display returns to regular measurement.

#### 2. Setting the Operating Mode

Select whether to turn output ON when the distance between workpiece and the Sensor Head is shorter than the threshold value (near distance) or when it is longer than the threshold value (far distance).

Selection	Details
NON (near ON) (default)	Output turns ON when the distance between the workpiece and the Sensor Head is shorter than the threshold value.
FON (far ON)	Output turns ON when the distance between the workpiece and the Sensor Head is longer than the threshold value.

#### The setting method varies depending on the Amplifier Unit model.

Model	Method
Twin output model	The setting method is set by the "operating mode" in the SET mode. Refer to "Function Transition Charts" in "5. Function Overview."
Analog output model	Select this method by the operating mode switch.

#### 3. Setting Threshold Values

#### 1) Teaching settings

(1) Teaching with and without a workpiece

Set two points one with a workpiece and another without a workpiece to be respectively sensed, and set the point between these two points as the threshold value. This setting can be made in both of the RUN and SET modes.

When this setting is made in the RUN mode, make sure that the "MODE key setting" function is set to [2PNT]. The default setting is [2PNT]. Refer to "Function Transition Charts" in "5. Function Overview."



(2) Teaching without a workpiece (background teaching)

Set the threshold value referenced to a state in which a workpiece is not present (background).

Set the threshold value 10% in front the sensing range width referenced to the distance in a workpiece absent state. Example: In the case of a 50 to 300 mm type, set the threshold value about 25 mm in front.



(3) Automatic-teaching (set by a moving workpiece)

Measure the sensing distance while the key is held down, and set the value between the minimum and maximum distance values as the threshold value.

Before making this setting, make sure that the MODE key setting is set to [AUTO]. The default setting is [2PNT]. Refer to "Function Transition Charts" in "5. Function Overview."



(4) Position teaching

Set the sensing distance of the workpiece as the threshold value.

Before making this setting, make sure that the MODE key setting is set to [PPT]. The default setting is [2PNT]. Refer to "Function Transition Charts" in "5. Function Overview."



#### Teaching error display

An error occurs if the following is displayed on the sub-display after teaching is executed. Execute teaching again.

Flashes twice.	<b>OVER error</b> The taught distance is outside the sensing range. Check the position of the workpiece, and then execute teaching again.
Flashes twice.	<b>NEAR error</b> The difference between the maximum taught distance and the minimum taught distance is too small. Check the teaching position, and then execute teaching again. (This error occurs with teaching with and without a workpiece, and automatic-teaching.)

#### Manual setting

Manually set the threshold value.

Operation	Set the threshold the UP or DOWN Switch to the RUN mode.	↓ value by key.
		threshold value.
Display	Sensing distance T	After about 3 seconds, the display return to the display set in the display setup.

#### 4. Setting Banks



Selection is completed, and the display moves to [6-BR]. (Refer to "Function Transition Charts in "5. Function Overview.")

Press the MODE key.

Registration is completed, and the display returns to regular measurement.

RUN

(In this example, bank 2 is selected.)

SET

Select the desired bank No. (0 to 3) by the UP or DOWN key.

Switch the SET/RUN switch to RUN.

2

5-65

#### 5. Setting Scaling

#### Setting procedure



The display moves to the next setting.

Note: The scalable width is 1/2 to 2 times the current distance value.

Note: When the values of the first and second points are the same, "NEAR" flashes twice on the error display, and the points must be set again.

Note: "OVER" is sometimes displayed and the setting cannot be made depending on the setting value. In this case, change and then set the setting value again.



#### 6. Output Settings

#### Setting the output method (twin output model)

The output method can be selected.

This function is mounted only on the twin output model.

Switch the SET/RUN switch to MODE, and select from [100T]. (Refer to "Function Transition Charts" in "5. Function Overview" for detailed settings.)



Output method details

Display	Output method	Overview	Timing Chart (Near ON mode)	
20UT	Output on each channel	Independent control signals are output in response to the threshold values of each of channels 1CH and 2CH.	1ch threshold value (a) 2ch threshold value (b) (1ch) (ON) (2ch) (ON) (2ch) (OFF)	
AREA	Output during threshold value	Control signals are output in response during the threshold values of each of channels 1CH and 2CH. The regular independent control signal is output for channel 1CH.	1ch threshold value (a)         2ch threshold value (b)           (1ch)         (ON)           (2ch)         (ON)           (2ch)         (ON)	
2BIT	2-bit output	The distance is divided into four areas by the threshold values of each of channels 1CH and 2CH and the three mid-points between each of these threshold values. Four states are judged according to the relationship between the outputs of channels 1CH and 2CH.	1ch threshold value (a) 2ch threshold value (b) (1ch) (ON) (OFF) (2ch) (ON) (OFF) (a+b)/2	

#### Setting the output range (analog output model)

#### Function

- This function sets the range and display ratio of linear output with respect to the display value.
- · This function is mounted only on the analog output model.
- Note: The preset output range is canceled by initializing the product settings.

Note: When the output range is set, zero reset and offset are automatically cleared.

2-point setting

Setting procedure

- Determine the 1 V and 5 V ranges at the workpiece position.
- · The output ramp is as follows according to the positional relationship between the first and second points.



This completes setting, and the display returns to regular measurement.

SET

The display moves to the next setting.

Note: When the values of the first and second points are the same, "NEAR" flashes twice on the error display, and the points must be set again.

2Ech

#### Background setting

to RUN.

Set the analog output referenced to the background distance (5 V).





Note: When the values of the first and second points are the same, "NEAR" flashes twice on the error display, and the points must be set again.

## 7. Handy Ways of Setting Functions

#### Setting the Display to Zero (zero reset)

Before making this setting, make sure that the "MODE key setting" is set to [0RST] (zero reset).

The default setting is [2PNT] (teaching with and without a workpiece). (Refer to "Function Transition Charts" in "5. Function Overview.")



#### Setting the Display to Any Value (offset)

Before making this setting, make sure that the "MODE key setting" is set to [oFST] (offset). The default setting is [2PNT] (teaching with and without a workpiece). (Refer to "Function Transition Charts" in "5. Function Overview.")



Inverting the Increment/decrement Direction of the Main Display (display inversion)

When display inversion is executed, how the display to the reference distance is indicated is inverted. Before making this setting, make sure that the MODE key setting is set to [0RST] (zero reset) or [0FST] (offset).



#### Keylock Setting method Cancel method Switch to the RUN mode. Switch to the RUN mode. SET RUN SET RUN Hold down the UP key for more Hold down the UP key for more than 3 seconds with the MODE than 3 seconds with the MODE key pressed. key pressed. $\square$ Press the MODE key and then Press the MODE key and then immediately press the UP key. immediately press the UP key. OFF The sub-display flashes twice, The sub-display flashes twice, പ്പ Loc Loc and key entry is disabled. and key entry is enabled. ON LOC LOC

Initializing all Setting Data (initialization processing)
Setting method



The head type setting is not cleared even if all setting data is initialized. Refer to "1. Setting the Head Type" in "6. Basic Settings."

## 8. Ratings

#### **Ratings and Specifications**

Туре		Twin output model		Analog output model	
Model		E4C-UDA11	E4C-UDA41	E4C-UDA11AN	E4C-UDA41AN
		NPNoutput	PNPoutput	NPNoutput	PNPoutput
Connection method			Prewired		
Supply voltage		12 to 24 VDC ± 10%, ripple 10% max.			
Current consi	umption	80 mA max.			
Control output		NPN open collector (26.4 VDC max.) Load current: 50 mA max., Residual voltage: 1 V max.			
Hysteresis			2.0% F	.S.max.	
Timer			OFF/OFF-delay/0	DN-delay/one-shot	
Timer time		1 ms to 5 s			
Analog	Output form		-	Voltage output (DC 1 to 5 V)	
output	Connected load		-	10 kΩ min.	
	Temperature characteristics		-	0.3% F.S./°C	
	Resolution		-	2.0% F.S.max. *	
	Linearity		-	2.0% F.S.max.	
Operating ten	emperature Operating: -25 to +55°C Storage: -30 to +70°C (with no icing)		cing)		
Operating humidity Operating and storage: 35% to 85% (with no condensation)		on)			
Insulation res	istance	50 MΩ min. (by 500 VDC)			
Dialectic stree	ngth	1,000 VAC, 50/60 Hz for 1 min			
Vibration resi	stance	10 to 150 Hz, 0.75 mm double amplitude, 80 min each in X, Y, and Z directions			
Shock resistance		500 mm/s <sup>2</sup> , 3 times each in X, Y and Z directions			
Materials		Case: PBT (polybutylene terephthalate), Cover: Polycarbonate			
Weight		Approx. 150 g			
Accessories			Instruction Manual		

\* Value one hour after the product is turned on. Note, however, that external disturbance sometimes causes minute output.

#### I/O Circuit Diagrams



#### **External Dimensions**

#### E4C-UDA11/-UDA41



36.7

24.7

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