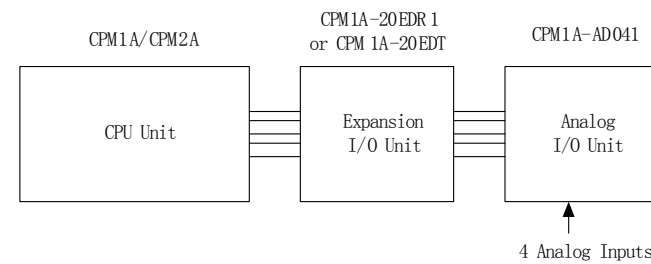# OMRON

CPM1A-AD041 Operating Manual

Thank you for purchasing an OMRON Product. To ensure safe operation, please be sure to read the operating manual first. Keep these operating manuals in a safe location and be sure that they are readily available to the final user of the products.

■ Safety Precaution

Definition of Precautionary Information

⚠ WARNING	Indicates a potentially hazardous situation , which if not avoided, could result in death or serious injury.
⚠ WARNING	Indicates a potentially hazardous situation, which if not avoided, could result in minor or moderate injury, or property damage.

Warnings and Cautions

⚠ WARNING

Dot not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.

⚠ WARNING

Dot not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

⚠ CAUTION

Dot not touch the components in any occation in order to prevent any malfunction due to static electricity.

⚠ CAUTION

Dot not touch the Connecting Cable while the power is being supplied in order to prevent any malfunction due to static electricity.

■ Specification

This product is an Analog Input Unit. CPM1A/CPM2A can connect 1 CPM1A-AD041 Analog Input Unit and 1 other Expansion Unit or Expansion I/O Unit.

```
  CPM1A/CPM2A      CPM1A-20EDR 1        CPM1A-AD041
                  or CPM 1A-20EDT
 ┌──────────┐    ┌──────────┐       ┌──────────┐
 │          │    │          │       │          │
 │ CPU Unit │────│ Expansion│───────│  Analog  │
 │          │    │ I/O Unit │       │ I/O Unit │
 └──────────┘    └──────────┘       └──────────┘
                                          ↑
                                    4 Analog Inputs
```

Note:
1. When CPU Unit is CPM2AH, the connection of CPM1A-AD041 and other Expansion Unit refer to operation manual of CPM2AH.

Items	CPM1A－AD041	
Number of inputs	4 inputs (4 words allocated)	
Input signal range	-10～10V 0～5V 0～10V 0～20mA 1～5V 4～20mA	
Resolution	1/6000(full scale)	
A/D conversion data	16-bit binary （4-digit hexadecimal） Full scale for -10 to 10V: F448 to 0BB8 Hex Full scale for other ranges: 0000 to 1770 Hex	
External input impedance	Voltage input: 1MΩ min	
	Current input: 250Ω	
Max. rated input	Voltage input: ±15V	
	Current input: ±30mA	
Accuracy		Voltage Input	Current Input
	25	±0.3% full scale	±0.4% full scale
	0 to 55	±0.6% full scale	±0.8% full scale
Averaging function	Supported	
Open-circuit detection function	Supported	
Isolation method	Photocoupler isolation between analog Input terminals and internal circuits. No isolation between analog Input signals.	
Conversion time	2 ms/point	
Current consumption	3.0W	
Weight	200g max	
Size	86(W)×50(H)×90(D)mm	

■ Analog Input Signal Ranges

The Analog Input Unit converts analog input data to digital values. The digital values depend on the input signal ranges, as shown in the following diagrams. When the input exceeds the specified range, the AD converted data will be fixed at either the lower limit or upper limit.
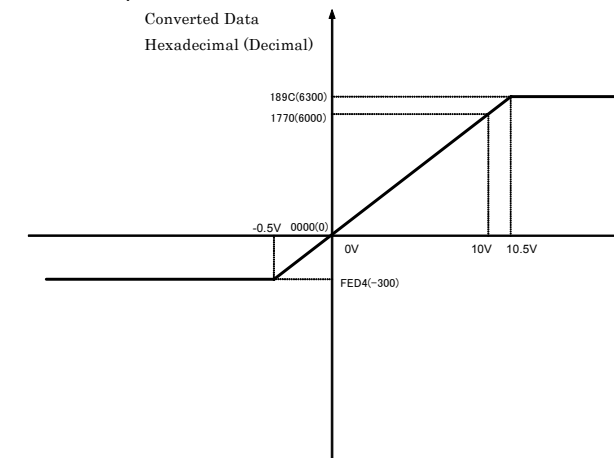
-10 to 10 V

The -10 to 10 V range corresponds to the hexadecimal values F448 to 0BB8(-3000 to 3000). The entire data range is F31C to 0CE4(-3300 to 3300). A negative voltage is expressed as a two's complement.
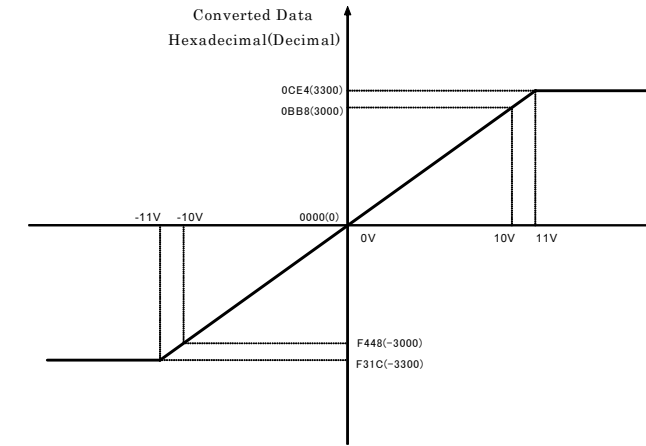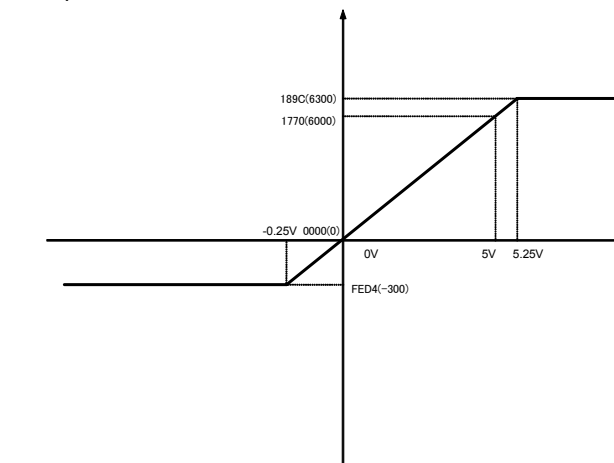

0 to 10 V

The 0 to 10V range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000).The entire data range is FED4 to 189C (-300 to 6300). A negative voltage is expressed as a two's complement.
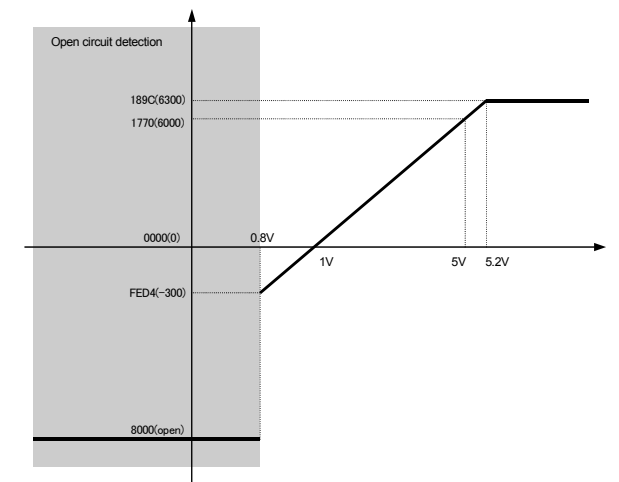

0 to 5V

The 0 to 5V range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (-300 to 6300). A negative voltage is expressed as a two's complement.
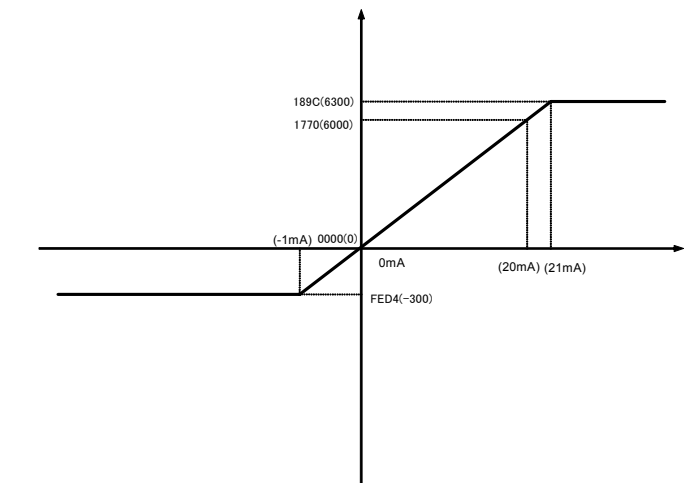

1 to 5V

The 1 to 5V range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C(-300 to 6300). Inputs between 0.8 and 1V are expressed as two's complements. If the input falls bellow 0.8V, open-circuit detection will activate and converted data will be 8000.
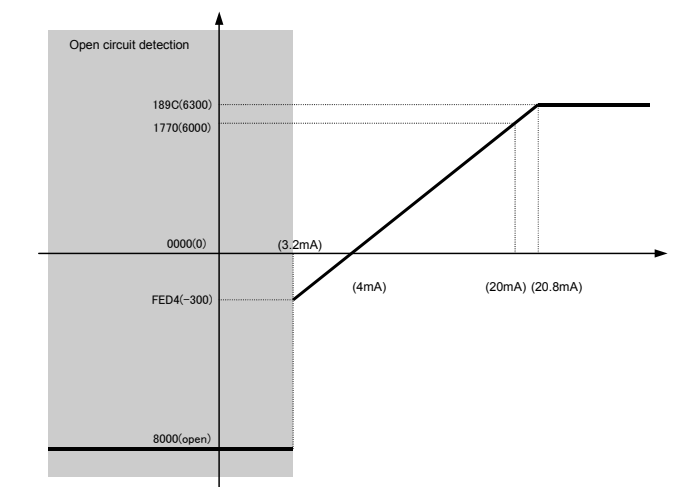

0 to 20mA

The 0 to 20mA range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C(-300 to 6300). A negative voltage is expressed as a two's complement.

4 to 20mA

The 4 to 20mA range corresponds to the hexadecimal values 0000 to 1770 (0 to 6000). The entire data range is FED4 to 189C (-300 to 6300). Inputs between 3.2 and 4mA are expressed as two's complements. If the input falls below 3.2mA, open-circuit detection will activate and converted data will be 8000.
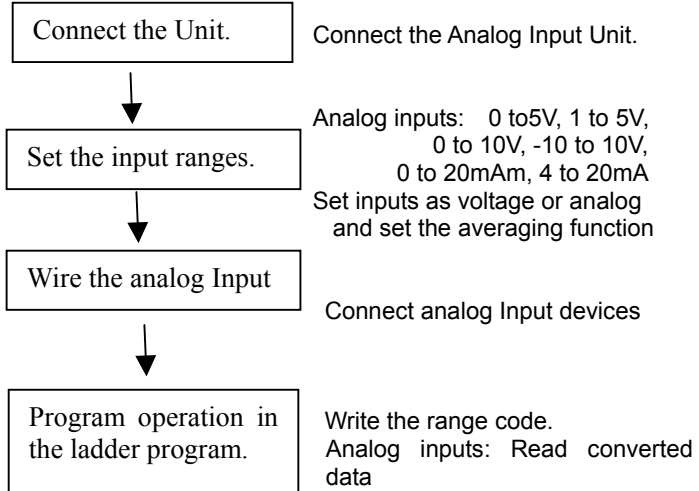
Averaging Function for Analog Inputs

The averaging function can be enabled for inputs with setting the input range. The averaging function stores the average(a moving average) of the last eight input values as the converted value. Use this function to smooth inputs that vary at a short interval.
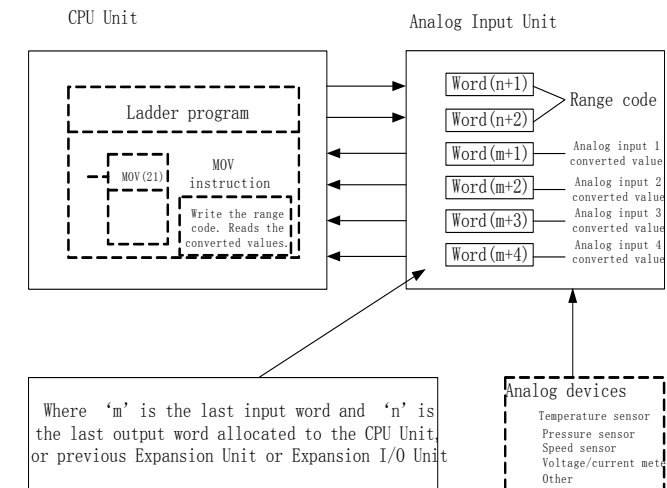
Open-circuit Detection Function for Analog Inputs

The open-circuit detection function is activated when the input range is set to 1to 5V and the voltage drops below 0.8V, or when the input range is set to 4 to 20mA and the current drops below 3.2mA. When the open-circuit detection function is activated, the converted data will be set to 8000.
The open-circuit detection function is enabled or cleared when data is converted. If the input returns to the convertible range, the open-circuit detection is cleared automatically.
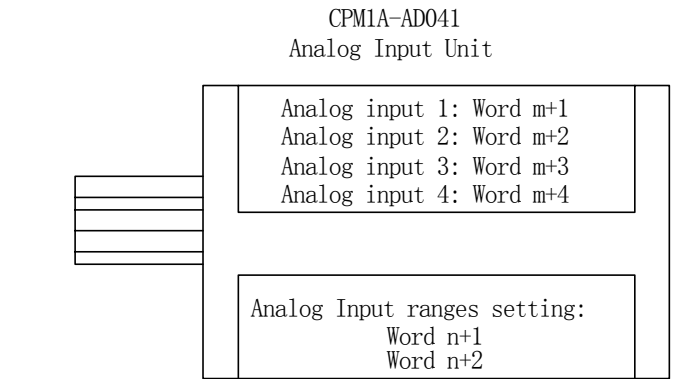
■ Using Analog Input Unit

Connect the Unit.	Connect the Analog Input Unit.
Set the input ranges.	Analog inputs: 0 to5V, 1 to 5V, 0 to 10V, -10 to 10V, 0 to 20mAm, 4 to 20mA. Set inputs as voltage or analog and set the averaging function
Wire the analog Input	Connect analog Input devices
Program operation in the ladder program.	Write the range code. Analog inputs: Read converted data

Analog Inputs

CPU Unit — Analog Input Unit

Ladder program — MOV(21) instruction — Write the range code. Reads the converted values.

Word(n+1), Word(n+2) → Range code
Word(m+1) Analog input 1 converted value
Word(m+2) Analog input 2 converted value
Word(m+3) Analog input 3 converted value
Word(m+4) Analog input 4 converted value

Where 'm' is the last input word and 'n' is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit

Analog devices:
Temperature sensor
Pressure sensor
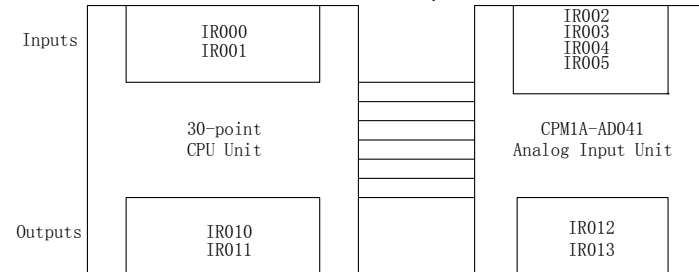Speed sensor
Voltage/current meter
Other

I/O Allocation

I/O is allocated for the Analog Input Unit in the same way as other Expansion Units or Expansion I/O Units starting from the next word following the last allocated word on the CPU Unit or previous Expansion Unit or Expansion I/O Unit. When "m" is the last allocated input word and "n" the last allocated output word on the CPU Unit, or previous Expansion Unit or Expansion I/O Unit, the allocation will be as follows:

CPM1A-AD041
Analog Input Unit

Analog input 1: Word m+1
Analog input 2: Word m+2
Analog input 3: Word m+3
Analog input 4: Word m+4

Analog Input ranges setting:
Word n+1
Word n+2

For example, in the following diagram an Analog Input Unit is connected to a CPU Unit with 30 I/O points.

Inputs: IR000, IR001
30-point CPU Unit
Outputs: IR010, IR011

CPM1A-AD041 Analog Input Unit
IR002, IR003, IR004, IR005
IR012, IR013

Setting Input Signal Range

Input signal ranges are set by writing a range code to the output word of the Analog Input Unit. The range code must be set for the Analog Input Unit to convert data. The range code settings provide the combinations of signal ranges for the analog inputs, as shown in the following table.

Voltage/current selections for the CPM1A-AD041 are made by connecting the appropriate terminals.
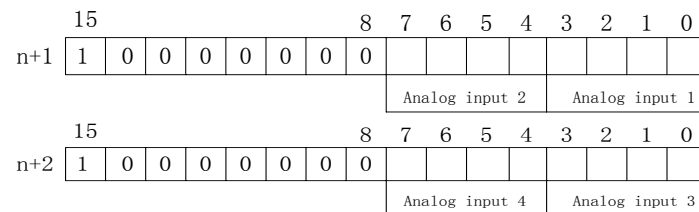
Write the range codes to the Analog Input Unit's output word (n+1, n+2) in the first cycle of program execution.

ch	setting
n+1	AD input 1，input 2 range setting
n+2	AD input 3，input 4 range setting

AD input setting details：

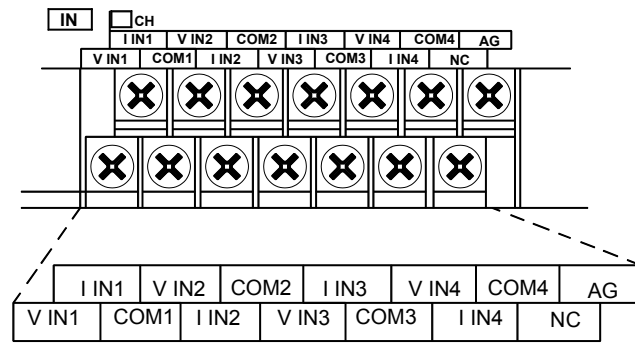|	3	2	1	0
Setting code	AD input allowed 1: open 0: closed	Averaging function 1: used 0: not used	00：-10V～+10V 01：0～10V 10：1～5V(4～20mA) 11：0～5V(0～20mA)	

Note: Be sure to write the correct terminals.
"n" is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit.

n+1:
15							8	7	6	5	4	3	2	1	0
1	0	0	0	0	0	0	0		Analog input 2				Analog input 1		

n+2:
15							8	7	6	5	4	3	2	1	0
1	0	0	0	0	0	0	0		Analog input 4				Analog input 3		

Note:
1. The Analog Input Unit will not start converting analog input values until the range code has been written. Until conversion starts, inputs will be 0000.
2. Once the range code has been set, it is not possible to change the setting while power is being supplied to the CPU Unit. To change the input range, turn the CPU Unit OFF then ON again.
3. When an input is not being used, to set OFF the range code which corresponds the input, and short the V IN and COM terminals.
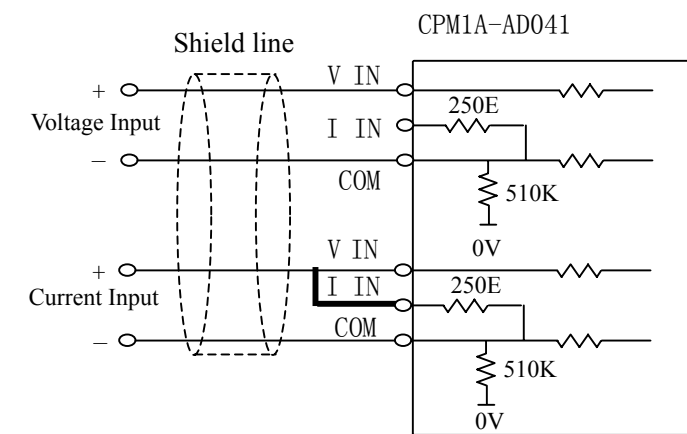

Wiring Analog Input Devices
CPM1A-AD041 Terminal Arrangements

IN □CH
| I IN1 | V IN2 | COM2 | I IN3 | V IN4 | COM4 | AG |
| V IN1 | COM1 | I IN2 | V IN3 | COM3 | I IN4 | NC |

| I IN1 | V IN2 | COM2 | I IN3 | V IN4 | COM4 | AG |
| V IN1 | COM1 | I IN2 | V IN3 | COM3 | I IN4 | NC |

Label	Signal
V IN1	Voltage input 1
I IN1	Current input 1
COM1	Input common 1
V IN2	Voltage input 2
I IN2	Current input 2
COM2	Input common 2
V IN3	Voltage input 3
I IN3	Current input 3
COM3	Input common 3
V IN4	Voltage input 4
I IN4	Current input 4
COM4	Input common 4

Note: For current inputs, short VIN1 to I IN1, VIN2 to I IN2, VIN3to I IN3 and VIN4to I IN4.

Wiring for Analog Inputs

CPM1A-AD041
Shield line

Voltage Input + / − → V IN, I IN, COM, 250E, 510K

Current Input + / − → V IN, I IN, COM, 0V, 250E, 510K, 0V

Note:
1. Use shielded twisted-pair cables, but do not connect the shield.
2. When an input is not being used, short the V IN and COM terminals.
3. Separate wiring from power lines (AC power supply lines, high-voltage lines, etc.)
4. When there is noise in the power supply line, Install a noise filter on the input section and the Power Supply Unit.
5. Turn ON the power supply for the CPU Unit first, and then turn ON the power supply for the load after confirming correct operation.
6. Turn OFF the power supply for the load before turning OFF the power supply for the CPU Unit.

Ladder Program
Specifying the Range Code

Specify the I/O signal range by writing the range code to the Analog Input Unit's output word from the ladder program in the first cycle of program execution. The Analog Input Unit will start to convert analog input values once the range code has been specified. Write the range code to the Analog Input Unit's output word in the first cycle of operation; the Analog Input Unit's output word is "n+1"and "n+2" when "n" is the last word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit in the configuration.
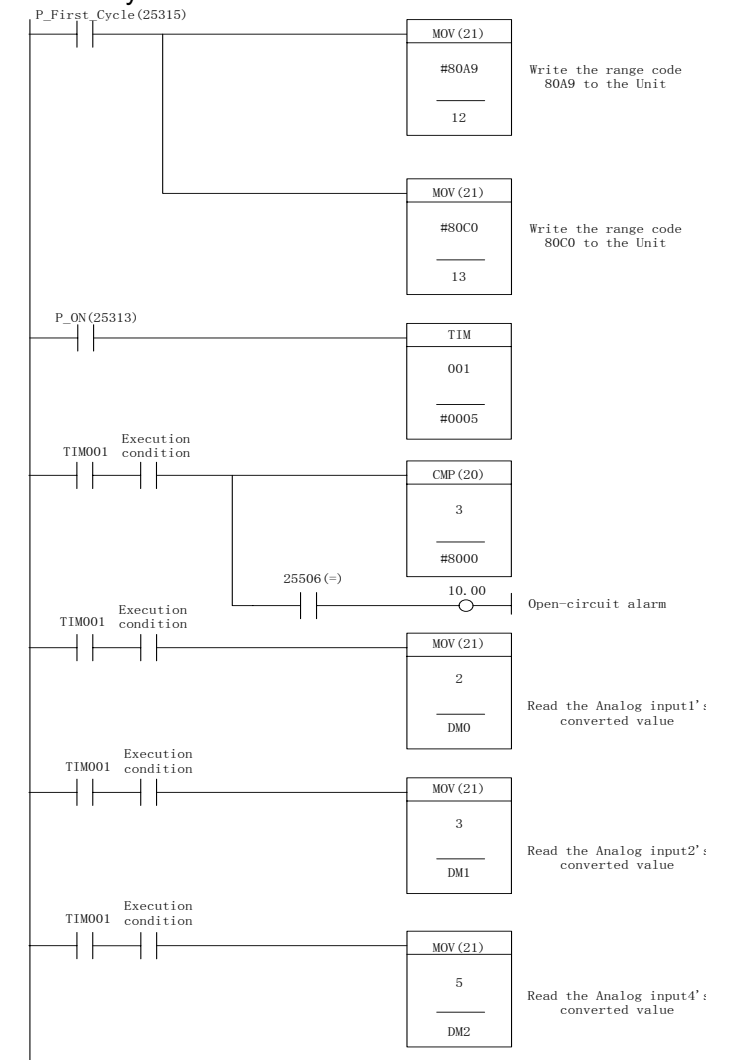
Reading Converted Analog Input Values

The ladder program can be used to read the memory area where the converted values are stored. Values are output to the next four words (m+1, m+2,m+3,m+4) following the last input word (m) allocated to the CPU Unit or previous Expansion Unit or Expansion I/O Unit.
Note: After the range code has been written, if no analog signals input, the output values will be 0000 if the range is 0 to 10 V, −10 to 10 V, 0 to 5 V or 0 to 20 mA, or it will be 8000 if the range is1 to 5 V or 4 to 20 mA.

Programming Example

This programming example uses the following ranges:
Analog Input 1: 0~10V no Averaging function
Analog Input 2: 4~20mA no Averaging function
Analog Input 3: no use
Analog Input 4: -10~10V Averaging function be used

The system is: CPM1A-30CDR-V1+CPM1A-AD041

P_First_Cycle(25315):
MOV(21) #80A9 12 — Write the range code 80A9 to the Unit
MOV(21) #80C0 13 — Write the range code 80C0 to the Unit

P_ON(25313):
TIM 001 #0005

TIM001 Execution condition:
CMP(20) 3 #8000

25506 (=): 10.00 — Open-circuit alarm

TIM001 Execution condition:
MOV(21) 2 DM0 — Read the Analog input1': converted value

TIM001 Execution condition:
MOV(21) 3 DM1 — Read the Analog input2': converted value

TIM001 Execution condition:
MOV(21) 5 DM2 — Read the Analog input4': converted value

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CPM1A-DA041
Operating Manual

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■ Safety Precaution

Definition of Precautionary Information

⚠ WARNING	Indicates a potentially hazardous situation which , if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which , if not avoided, could result in minor or moderate injury, or property damage.

Warnings and Cautions

⚠ WARNING

Dot not attempt to take any Unit apart while the power is being supplied. Doing so may result in electric shock.
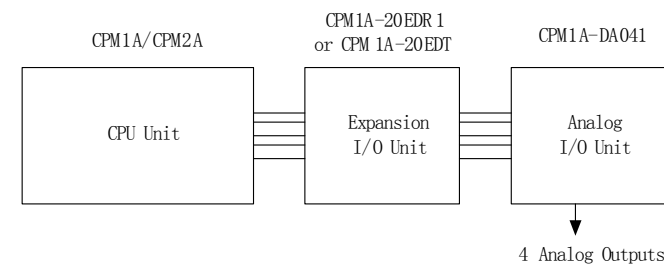
⚠ WARNING

Dot not touch any of the terminals or terminal blocks while the power is being supplied. Doing so may result in electric shock.

⚠ CAUTION

Dot not touch the components in any occasion in order to prevent any malfunction due to static electricity.

⚠ CAUTION

Dot not touch the Connecting Cable while the power is being supplied in order to prevent any malfunction due to static electricity.

■ Specification

This product is an Analog Output Unit. CPM1A/CPM2A can connect 1 CPM1A-DA041 Analog Output Unit and 1 other Expansion I/O Unit.

```
CPM1A/CPM2A      CPM1A-20EDR1        CPM1A-DA041
                 or CPM1A-20EDT

  CPU Unit        Expansion          Analog
                  I/O Unit           I/O Unit

                                  4 Analog Outputs
```

Note:

1. When CPU Unit is CPM2AH, the connection of CPM1A-DA041 and other Expansion Unit refer to operation manual of CPM2AH.

2. If CPM2AH connect 2 or 3 CPM1A-DA041 units, service power 24V can not be used.

| Items	CPM1A－DA041
Number of outputs	4 outputs (4 words allocated)
Output signal range	-10～10V 0～20mA 0～10V 4～20mA 1～5V
Resolution	1/6000(full scale)
D/A conversion data	16-bit binary (4-digit hexadecimal) Full scale for -10 to 10V: F448 to 0BB8 Hex Full scale for other ranges: 0000 to 1770 Hex
Allowable external output resistance load	Voltage output: 2kΩ min
	Current output: 350Ω max
External output impedance	Voltage output: 0.5Ω max
	Current output: －
Accuracy	25	±0.4% full scale
	0 to 55	±0.8% full scale
Isolation method	Photocoupler isolation between analog Output terminals and internal circuits. No isolation between analog Output signals.
Conversion time	2 ms/point
Current consumption	3.3W max
Weight	200g max
Size	86(W)×50(H)×90(D)mm

⚠ CAUTION：

When using the CPM1A-DA041 Analog Output Unit, a voltage (current) may be output momentarily from the output terminal when the power supply to the PC is turned OFF. Approximately 1.5V/6mA will be output for approximately 20mS after the power is turned OFF. If this causes a problem, provide countermeasure so that the power supply or output timing of external devices differs from the OFF timing of the power supply to the PC.

■ Analog Output signal Ranges

The Analog Output Unit converts the digital input data to analog values. The analog values depend on the output signal ranges, as shown in the following diagrams.

−10 to 10 V

The hexadecimal values F448 to 0BB8 (−3000 to 3000) correspond to an analog voltage range of −10 to 10 V. The entire output range is −11 to 11 V. Specify a negative voltage as a two's complement.
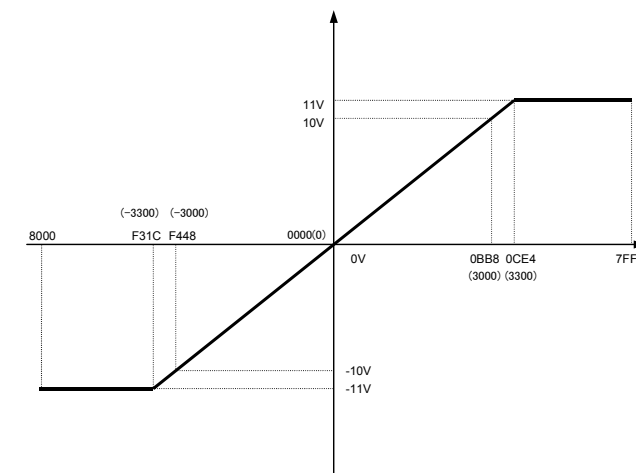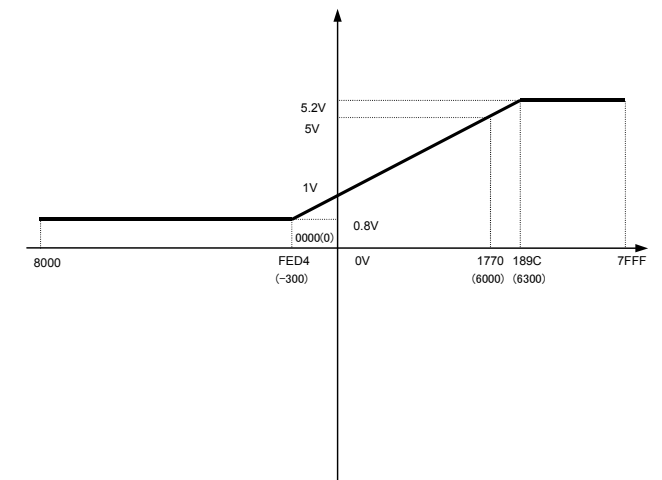

0 to 10 V

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 0 to 10 V. The entire output range is −0.5 to 10.5 V. Specify a negative voltage as a two's complement.
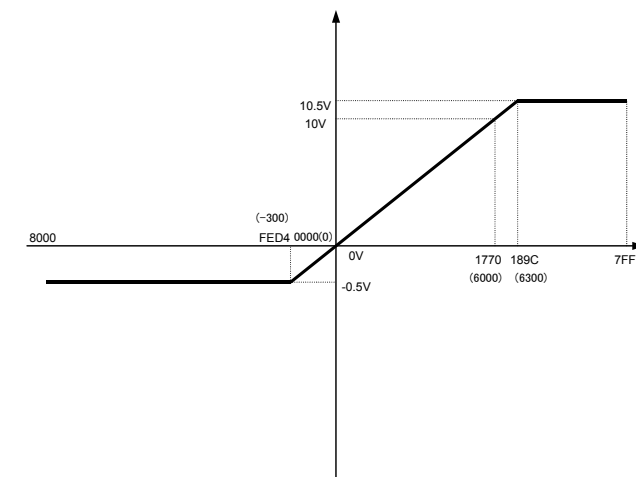
1 to 5 V

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog voltage range of 1 to 5 V. The entire output range is 0.8 to 5.2 V.

0 to 20 mA

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 0 to 20 mA. The entire output range is 0 to 21 mA.

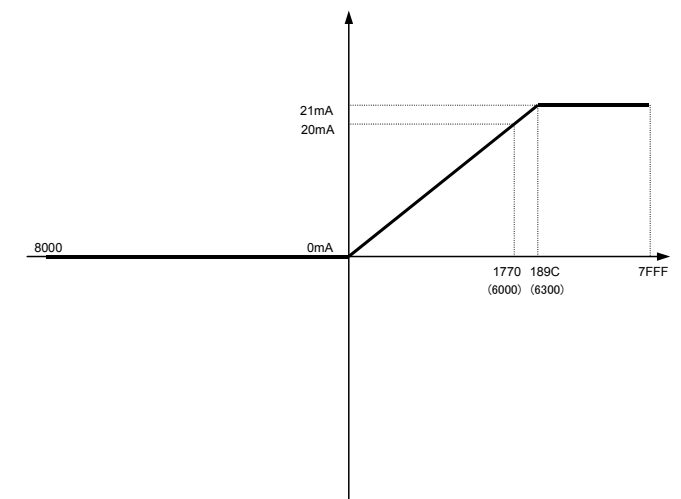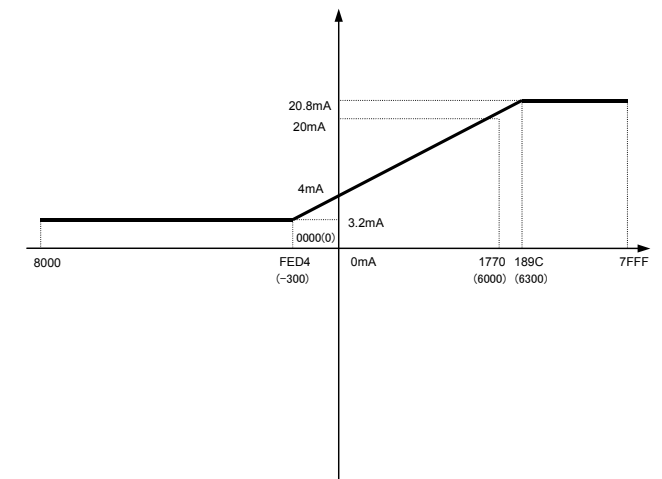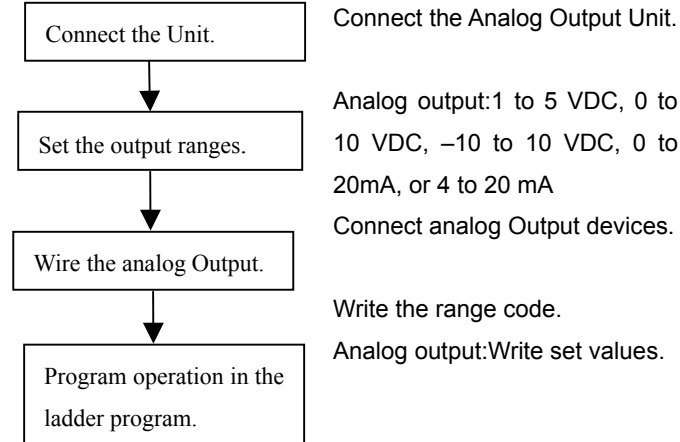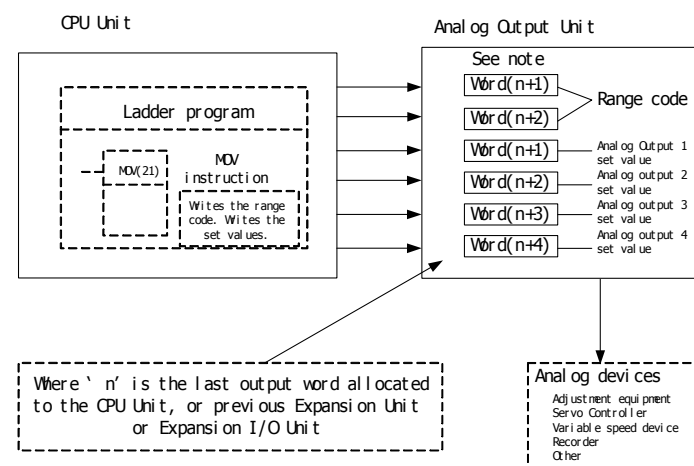### 4 to 20 mA

The hexadecimal values 0000 to 1770 (0 to 6000) correspond to an analog current range of 4 to 20 mA. The entire output range is 3.2 to 20.8 mA.

■ Using Analog Output Unit

Step	Description
Connect the Unit.	Connect the Analog Output Unit.
Set the output ranges.	Analog output:1 to 5 VDC, 0 to 10 VDC, −10 to 10 VDC, 0 to 20mA, or 4 to 20 mA. Connect analog Output devices.
Wire the analog Output.	Write the range code. Analog output:Write set values.
Program operation in the ladder program.	

❖ Analog Outputs

CPU Unit — Analog Output Unit

Ladder program
MOV(21) instruction
Writes the range code. Writes the set values.

Word(n+1) — Range code
Word(n+2)
Word(n+1) — Analog Output 1 set value
Word(n+2) — Analog output 2 set value
Word(n+3) — Analog output 3 set value
Word(n+4) — Analog output 4 set value

Where ' n' is the last output word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit

Analog devices
Adjustment equipment
Servo Controller
Variable speed device
Recorder
Other

Note

Word (n+1) and word(n+2) can be used for either the range code or the analog output set value.
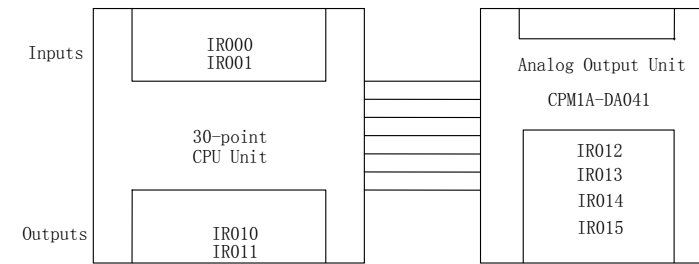
❖ Output Allocation

Output is allocated for the Analog Output Unit in the same way as other Expansion Units or Expansion I/O Units starting from the next word following the last allocated word on the CPU Unit or previous Expansion Unit or Expansion I/O Unit. When "n" is the last allocated output word on the CPU Unit, or previous Expansion Unit or Expansion I/O Unit, the allocation will be as follows:

CPM1A–DA041
Analog Output Unit

Analog Output1:Word n+1
Analog Output2:Word n+2
Analog Output3:Word n+3
Analog Output4:Word n+4
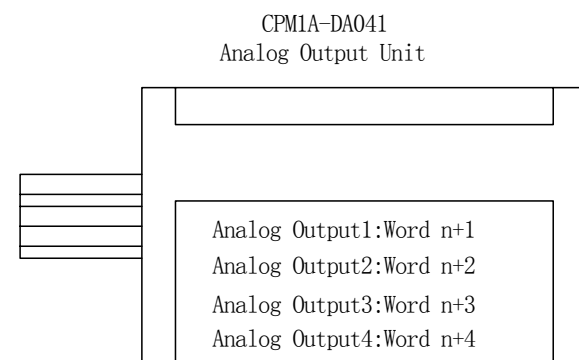
For example, in the following diagram an Analog Output Unit is connected to a CPU Unit with 30 I/O points.

Inputs
IR000
IR001

30-point
CPU Unit

Outputs
IR010
IR011

Analog Output Unit
CPM1A-DA041
IR012
IR013
IR014
IR015

Setting Output Signal Range

Output signal ranges are set by writing a range code to the output word of the Analog Output Unit. The range code must be set for the Analog Output Unit to convert data.

The range code settings provide the combinations of signal ranges for the analog output as shown in the following table.

	3	2	1	0
Setting code	DA output allowed 1: open 0: closed		000：-10V～+10V 001：0～10V 010：1～5V 011：0～20mA 100：4～20mA	

Note Be sure to write the correct terminals.

Write the range codes to the Analog Output Unit's output word (n+1, n+2) in the first cycle of program execution.

ch	setting
n+1	DA Output 1，Output 2 range setting
n+2	DA Output 3，Output 4 range setting

DA Output setting details:.

n+1

15							8	7	6	5	4	3	2	1	0
1	0	0	0	0	0	0	0		Analog Output 2				Analog Output 1		

n+2

15							8	7	6	5	4	3	2	1	0
1	0	0	0	0	0	0	0		Analog Output 4				Analog Output 3		

Note 1.Once the range code has been set, it is not possible to change the setting while power is being supplied to the CPU Unit. To change the Output range, turn the CPU Unit OFF then ON again.

2.The Analog Output Unit will not start converting analog Output values until the range code has been written.Until conversion starts, outputs will be 0 V or 0 mA. After the ranger code has been set ,0V or 0mA will be output for 0 to 10V, -10 to 10V,or 0 to 20mA ranges, and 1V or 4mA will be output for the 1 to 5V,and 4 to 20mA ranges until a convertible value has been written to the output word.

❖ Wiring Analog Output Devices
CPM1A-DA041 Terminal Arrangements

OUT □CH

I OUT1	V OUT2	COM2	I OUT3	V OUT4	COM4	NC
V OUT1	COM1	I OUT2	V OUT3	COM3	I OUT4	NC

IOUT1	V OUT2	COM2	I OUT3	V OUT4	COM4	NC
V OUT1	COM1	I OUT2	V OUT3	COM3	I OUT4	NC
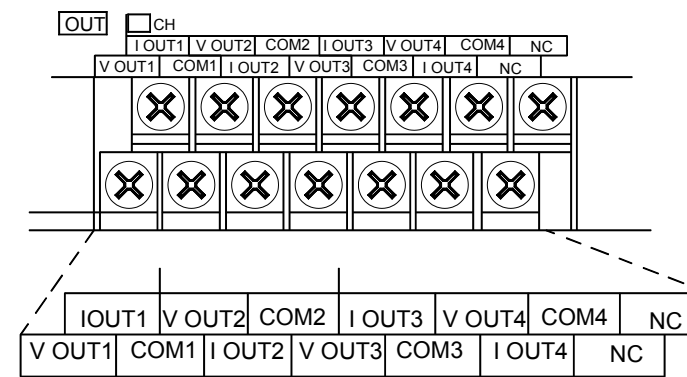
Label	Signal
VOUT1	Voltage output 1
I OUT1	Current output 1
COM1	Output common 1
VOUT2	Voltage output 2
I OUT2	Current output 2
COM2	Output common 2
VOUT3	Voltage output 3
I OUT3	Current output 3
COM3	Output common 3
VOUT4	Voltage output 4
I OUT4	Current output 4
COM4	Output common 4

Wiring for Analog Outputs

CPM1A-DA041

V OUT — Shield line — Voltage Output +
I OUT — Current Output +
COM — −
AG
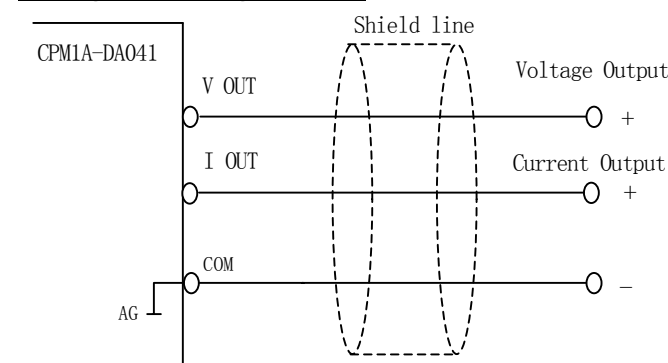
Note: 1. Turn ON the power supply for the CPU Unit first, and then turn ON the power supply for the load after confirming correct operation.

2. Turn OFF the power supply for the load before turning OFF the power supply for CPU Unit.

3. Use shielded twisted-pair cables, but do not connect the shield.

4. Separate wiring from power lines(AC power supply lines, high-voltage lines, etc.)

5. When there is noise in the power supply line, install a noise filter on the input section and the Power Supply Unit.

❖ Ladder Program
Specifying the Range Code

Specify the Output signal range by writing the range code to the Analog Output Unit's output word from the ladder program in the first cycle of program execution. The Analog Output Unit will start to convert analog Output values once the range code has been specified. Write the range code to the Analog Output Unit's output word in the first cycle of operation; the Analog Output Unit's output word is "n+1" and "n+2" when "n" is the last word allocated to the CPU Unit, or previous Expansion Unit or Expansion I/O Unit in the configuration.

Writing Analog Output Set Values

The ladder program can be used to write data to the output word where the set value is stored. The output word will be "n+1", "n+2", "n+3"and"n+4" when "n" is the last output word allocated to the CPU Unit ,or previous Expansion Unit or Expansion Unit.

Programming Example

This programming example uses these ranges:
Analog output1: -10 ~ +10V
Analog output2: 0 ~ 20mA
Analog output3: 4 ~ 20mA
Analog output4: 0 ~ 10V

25315
(First Cycle ON Flag)

MOV
80B8
011 — Write the range code(80B8)to the Unit.

MOV
809C
012 — Write the range code(809C)to the Unit.

25313
(Always ON Flag)

TIM005
#0002

TIM005 — Execution condition
MOV
DM0010
011 — The content of DM0010 is written to the output word as the analog output set value

TIM005 — Execution condition
MOV
DM0011
012 — The content of DM0011 is written to the output word as the analog output set value.

TIM005 — Execution condition
MOV
DM0012
013 — The content of DM0012 is written to the output word as the analog output set value.

TIM005 — Execution condition
MOV
DM0013
014 — The content of DM0013 is written to the output word as the analog output set value.