OMRON

Multiple-Rotation Absolute Encoder

E6C-M

Compact, Multiple-Rotation Absolute Rotary Encoder Reduces the Size of Required Equipment

- Data is retained and rotational measurement continues even after power is interrupted
- High-resolution 23-bit sensing in a compact package (60 mm long × 50 mm in diameter)
- Drip-proof, oil-proof construction meets IP64F standards
- Wiring is reduced through serial transfer of position signals
- Receiver Unit converts the serial signal to a parallel signal

ISO 9001 Approved
OMRON Corporation, Ayabe Factory, Sensing Components and Systems

Ordering Information

Name	**Part Number**
Multiple-rotation Absolute Encoder	**E6C-MPZ1X2 (see note)**
Receiver Unit	**E63-SR5C**

Note: Order the Encoder and Receiver Unit as a set.

■ ACCESSORIES (ORDER SEPARATELY)

Name	**Part Number**
Coupling	**E69-C06B**

Specifications

■ RATINGS/CHARACTERISTICS

Part number		E6C-MPZ1X2	E63-SR5C
Power supply voltage		---	12 VDC$^{-10\%}$ to 24 VDC$^{+15\%}$
Current consumption		150 mA max. (see note 1)	150 mA max.
Resolution	Absolute	2,048/rotation (11 bits) 4,096 rotations (12 bits)	---
	Incremental	2048/rotation	---
Output code (absolute)		---	Pure binary
Output phases (incremental)		---	A, B, and Z
Phase difference on output (incremental)		---	90°±45° (1/4T±1/8T) between A and B
Output configuration		---	NPN open collector
Output capacity		---	Applied voltage: 30 VDC max. I_{sink}: 20 mA max. Residual voltage: 0.4 V max. (I_{sink}: 20 mA)
Max. response frequency		150 kHz (incremental signal)	---
Max. rotational frequency response		4,500 rpm (1,000 rpm from 1 s after a power interruption) (see note 2)	---
Condenser backup time		20 hrs (typical)	---
Battery backup time		---	5 years min. Internal ER17/33 lithium battery (1500 mAH Hitachi Maxell battery)
Rotational direction		Output code incremented by clockwise rotation	---
Starting torque		100 gf • cm (9.8 mN • m) max.	---
Moment of inertia		15 g • cm^2 (15 x 10^{-7} kg • m^2) max.	---
Shaft loading	Radial	5 kgf (49 N)	---
	Thrust	3 kgf (29.4 N)	---
Ambient temperature	Operating	−10°C to 70°C (14°F to 158°F) with no icing	−10°C to 55°C (14°F to 131°F) with no icing
	Storage	−25°C to 70°C (−13°F to 158°F) with no icing	−25°C to 65°C (−13°F to 149°F) with no icing
Ambient humidity	Operating	35% to 85% (with no condensation)	
Insulation resistance		20 MΩ min. (at 100 VDC) between carry parts and case	
Dielectric strength		1,000 VAC, 50/60 Hz for 1 min between carry parts and case	
Vibration resistance	Destruction	10 to 500 Hz, 1-mm single amplitude (150 m/s^2 (approx. 15G)) for 11 min 3 times each in X, Y, and Z directions	10 to 150 Hz, 0.75-mm single amplitude (100 m/s^2 (approx. 10G)) for 8 min 4 times each in X, Y, and Z directions
Shock resistance	Destruction	1,000 m/s^2 (approx. 100G) 3 times each in X, Y, and Z directions	300 m/s^2 (approx. 30G) 3 times each in X, Y, and Z directions
Enclosure ratings	IEC	IP64 watertight (JEC IP64F oil resistive)	---
Weight		350 g (cable: 2 m, with connector)	350 g

Note: 1. When the Encoder's internal condenser is completely discharged, there will be an inrush current of 300 mA max. for about 2 s. Also, the battery alarm might go ON if the condenser is discharged; in this case, reset the Encoder with the ERS (Encoder Reset Input) before operation.

2. If the main power supply is interrupted, the Encoder's internal condenser and Receiver Unit's internal battery will supply power to retain rotational frequency data and continue rotational measurement. The Encoder can continue to respond to 4,500 rpm rotation for 1 second after the main power is interrupted, but thereafter the maximum rotational frequency response drops to 1,000 rpm. This feature allows the Encoder to keep up with the rotational speed of devices which continue to rotate due to inertia after a power interruption.

Operation

■ E63-SR5C SPECIFICATIONS

Connections

Pin no.	Symbol	Signal		Function
		Single-rotation absolute data	Multiple-rotation absolute data	
1	ABS0	---	2^0	---
2	ABS1	---	2^1	---
3	ABS2	2^0	2^2	---
4	ABS3	2^1	2^3	---
5	ABS4	2^2	2^4	---
6	ABS5	2^3	2^5	---
7	ABS6	2^4	2^6	---
8	ABS7	2^5	2^7	---
9	ABS8	2^6	2^8	---
10	ABS9	2^7	2^9	---
11	ABS10	2^8	2^{10}	---
12	ABS11	2^9	2^{11}	---
13	ABS12	2^{10}	---	---
14	ABS13	---	---	--- (see note 8)
15	ABS14	---	---	--- (see note 8)
16	ABS15	---	---	--- (see note 8)
17	STR0	Strobe 0 output		Strobe output for single-rotation absolute data
18	STR1	Strobe 1 output		Strobe output for multiple-rotation absolute data
19	GND	0 V		0 V for outputs
20	BAL	Battery alarm output		Output when the internal battery's voltage drops (see note 1)
21	OFW	Overflow alarm output		(see note 2)
22	CHK	Open-circuit detection alarm output		Output when a broken circuit is detected in the connection to the Encoder.
23	ERR	Communication error output		Output when a communication error from the Encoder is detected.
24	VCC	Power supply 12 to 24 VDC		---
25	VCC	Power supply 12 to 24 VDC		---
26	GND	Power supply 0 V		---
27	GND	Power supply 0 V		---
28	ERS	Encoder reset input		H: Active (2 s min.) (see note 3)
29	RST	Reset input		L: Active (see note 4) (see note 7)
30	RQ0	Request 0 input		H: Active (see note 5)
31	RQ1	Request 1 input		H: Active (see note 6)
32	GND	0 V		---
33	A	Incremental phase-A output		---
34	GND	0 V		---
35	B	Incremental phase-B output		---
36	GND	0 V		---
37	Z	Incremental phase-Z output		---

Note:
1. This signal is output when the battery voltage drops below 3.0 V.
2. This signal is output if the Encoder's multiple-rotation value exceeds 4,096 during clockwise rotation or falls below 0 during counter-clockwise rotation.
3. The multiple-rotation value and overflow alarm are reset by the BAL (battery alarm output). This is a high-active signal, so input a high signal (12 to 24 V) for 2 s or more.
4. Resets the open-circuit detection alarm and communications error. The RST input signal is the only low-active signal (2 V or less).
5. The single-rotation absolute data is output when this signal is input.
6. The multiple-rotation absolute data is output when this signal is input.
7. When the RST (reset input) is being input, absolute data outputs and alarm outputs cannot be read and input signals cannot be received.
8. The ABS13, ABS14, and ABS15 single-rotation absolute data signals might go ON occasionally, but these signals cannot be used as data.

■ I/O SPECIFICATIONS

Input

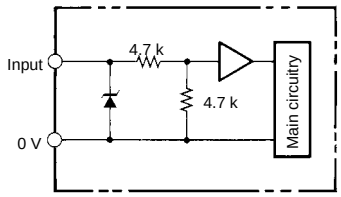
Input voltage	12 to 24 VDC
Input current	1 to 3 mA

Note: When connecting PC outputs to E63-SR5C inputs, use positive-common PC outputs such as those in the C200H-OD217.

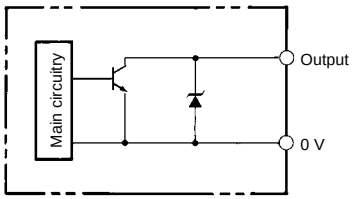
Output

Output configuration	NPN open collector
Output capacity	Applied voltage: 30 VDC max. I_{sink} current: 20 mA max. Residual voltage: 0.4 V max.

Circuits



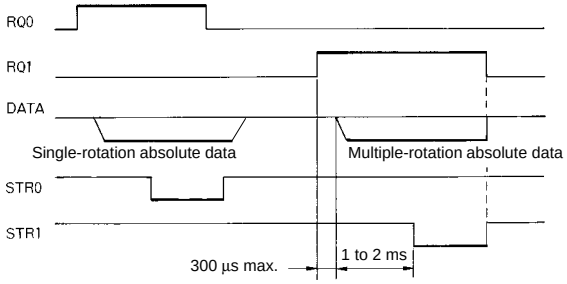
Circuits



■ DATA OUTPUT TIMING

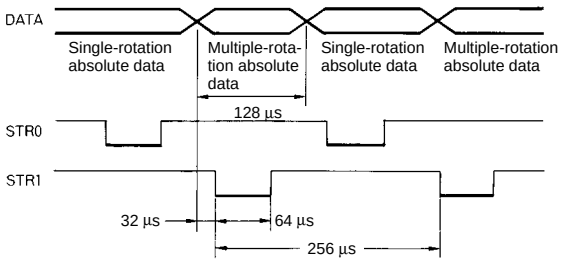
(A) Request Mode

When the request signal is input, data is output along with the strobe signal.



(B) Strobe Mode

Data is output in order along with the strobe signal.



Note:
1. Switch between strobe mode and request mode with the mode switch.
2. In request mode, RQ0 (request input 0) has priority over RQ1 (request input 1), so RQ1 cannot be received while RQ0 is ON. Input RQ0 and RQ1 separately.
3. Since absolute data is transmitted serially between the Encoder and Receiver Unit, there is a 256-µs delay in data transfer. This delay causes real-time data response to be lost at a rotational frequency of more than 100 rpm.

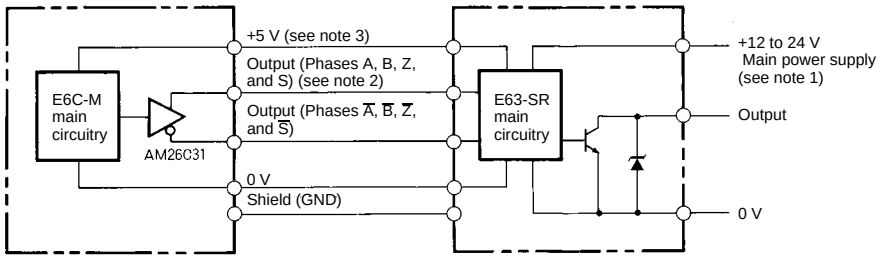
■ DISPLAY

Name	Color	Function
POWER	Green	Lights when the power supply is on
CHK	Red	Lights when there is an open circuit in the signal line
OFW	Red	Lights when there is an overflow error
ERR	Red	Lights when there is a communications error
BAL	Red	Lights when battery voltage drops
Z	Orange	Phase-Z origin indicator

■ DATA OUTPUT MODE SWITCH

Mode	Name	Function
A	Request mode	Data is output when the request signal is input
B	Strobe mode	Data is always output in order

■ OUTPUT CIRCUIT DIAGRAM



Note: 1. The Encoder's data communication will stop when the main power supply goes off, but the Encoder's internal condenser and Receiver Unit's internal battery will supply power to retain multiple-rotation absolute data and measure rotational frequency.

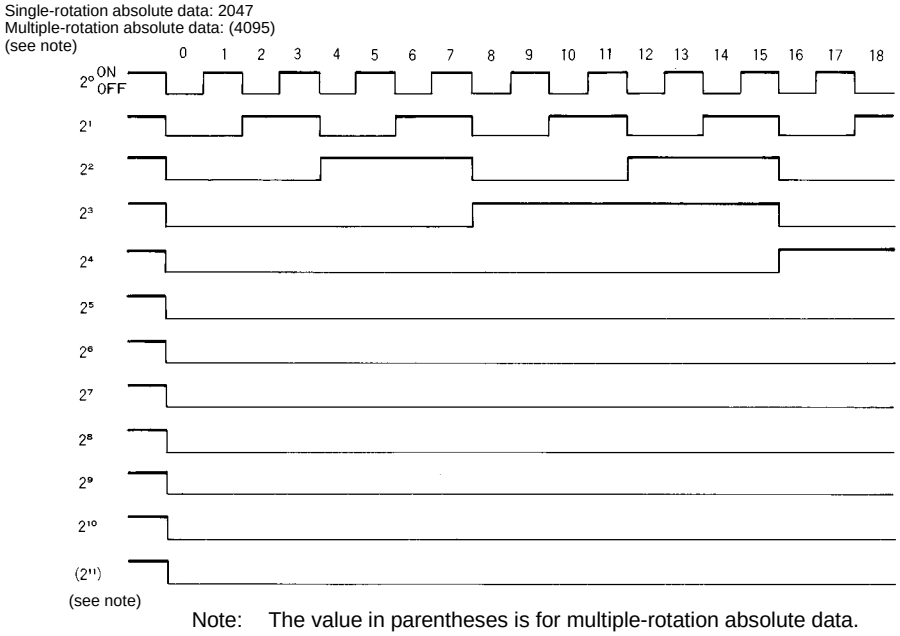
2. Phase S: Absolute serial data output
Phase A: Incremental phase-A output
Phase B: Incremental phase-B output
Phase Z: Incremental phase-Z output
Refer to the separate specifications for each model for details on data transfer formats.

3. There is a voltage feedback function that adjusts for the drops in the voltage supplied to the Encoder due to the length of the encoder cable, which maintains a steady voltage level.

■ TIMING CHARTS

Absolute Signal

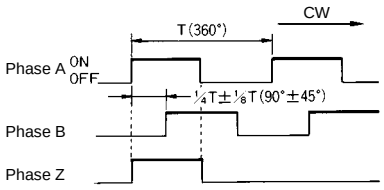
Direction of resolution: CW
(As viewed from the end of the shaft)



Note: The value in parentheses is for multiple-rotation absolute data.

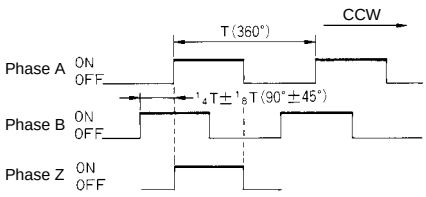
Incremental Signal

Direction of resolution: CW
(As viewed from the end of the shaft)



Note: Phase A is 1/4±1/8T (90°±45°) faster than phase B.

Direction of resolution: CCW
(As viewed from the end of the shaft)



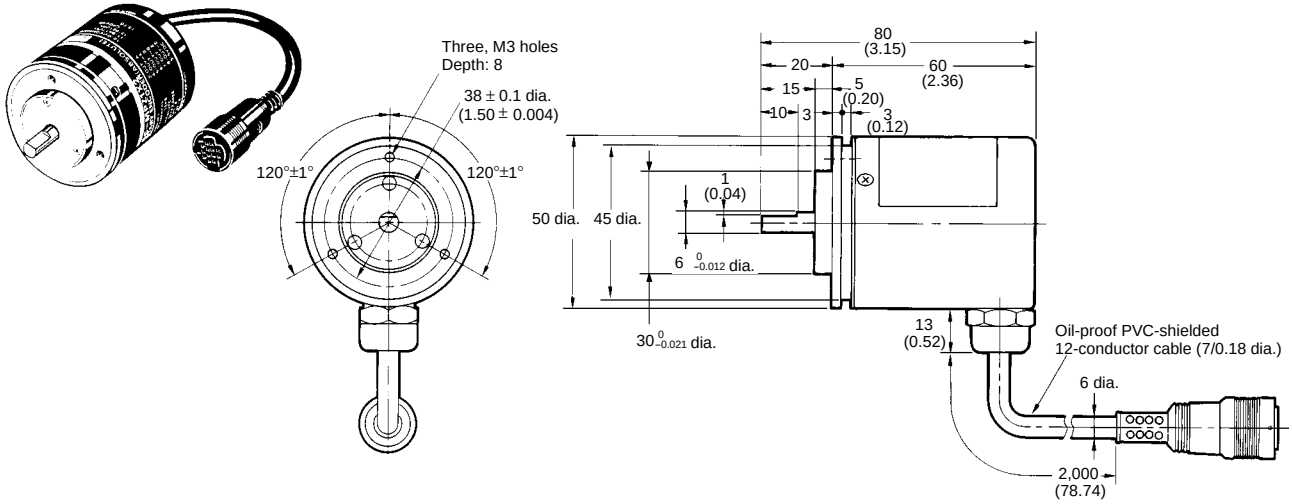
Note: Phase A is 1/4±1/8T (90°±45°) slower than phase B.

Dimensions

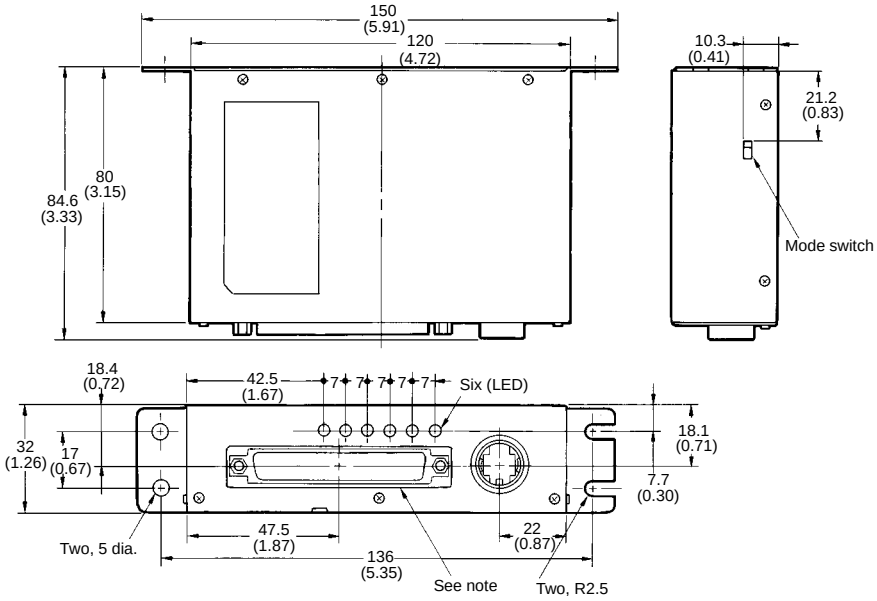
Unit: mm (inch)

■ ENCODERS

E6C-MPZ1X2

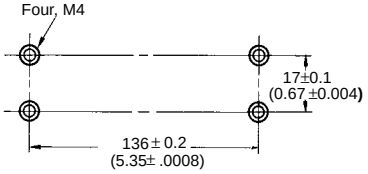


E63-SR5C Receiver Unit



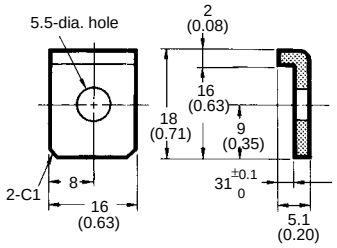
Note: OMRON 37-pin D-sub Connector
XM-2A-3701 (plug)
XM-2A-3712 (hood)

Mounting Holes

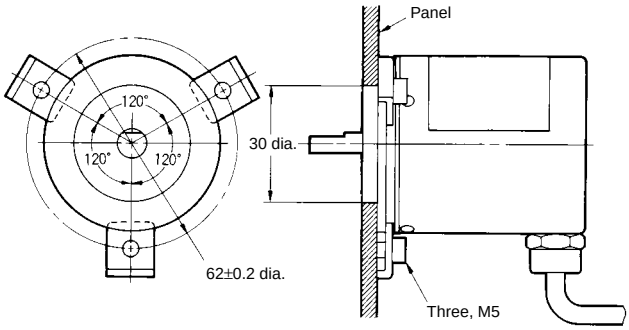


■ ACCESSORIES

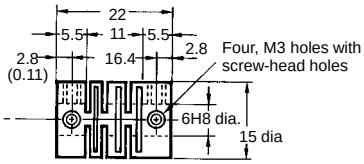
Mounting Bracket (Attached)



Mounting Bracket Installation



E69-C06B Coupling (Order Separately)

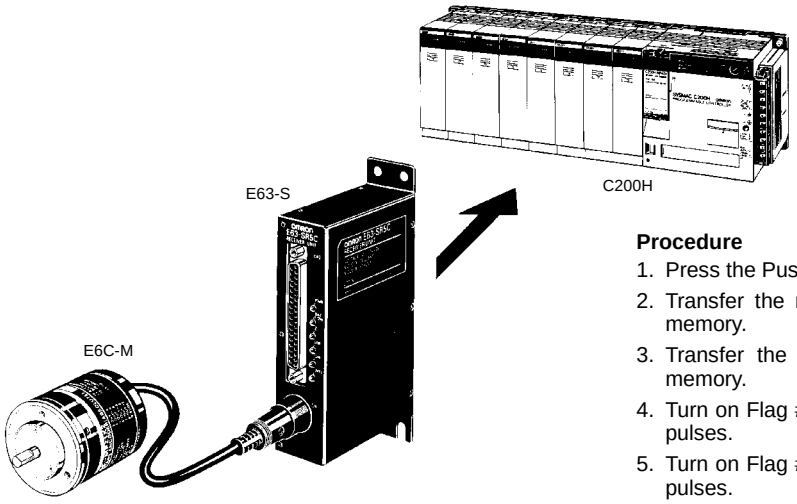


Note: Material: Glass-reinforced PBT

Installation

■ CONNECTION EXAMPLE 1

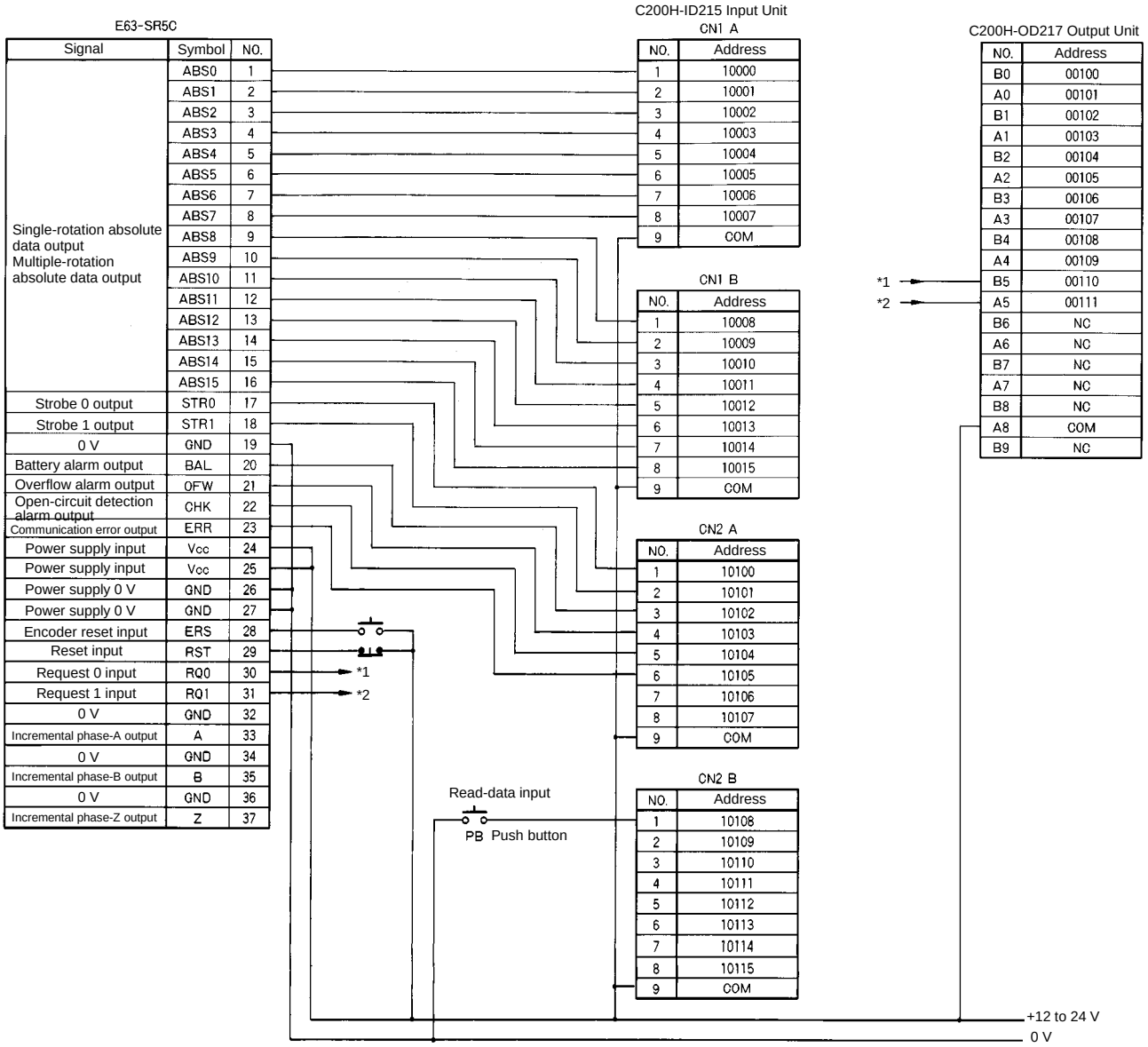
PC Connection (Request Mode)



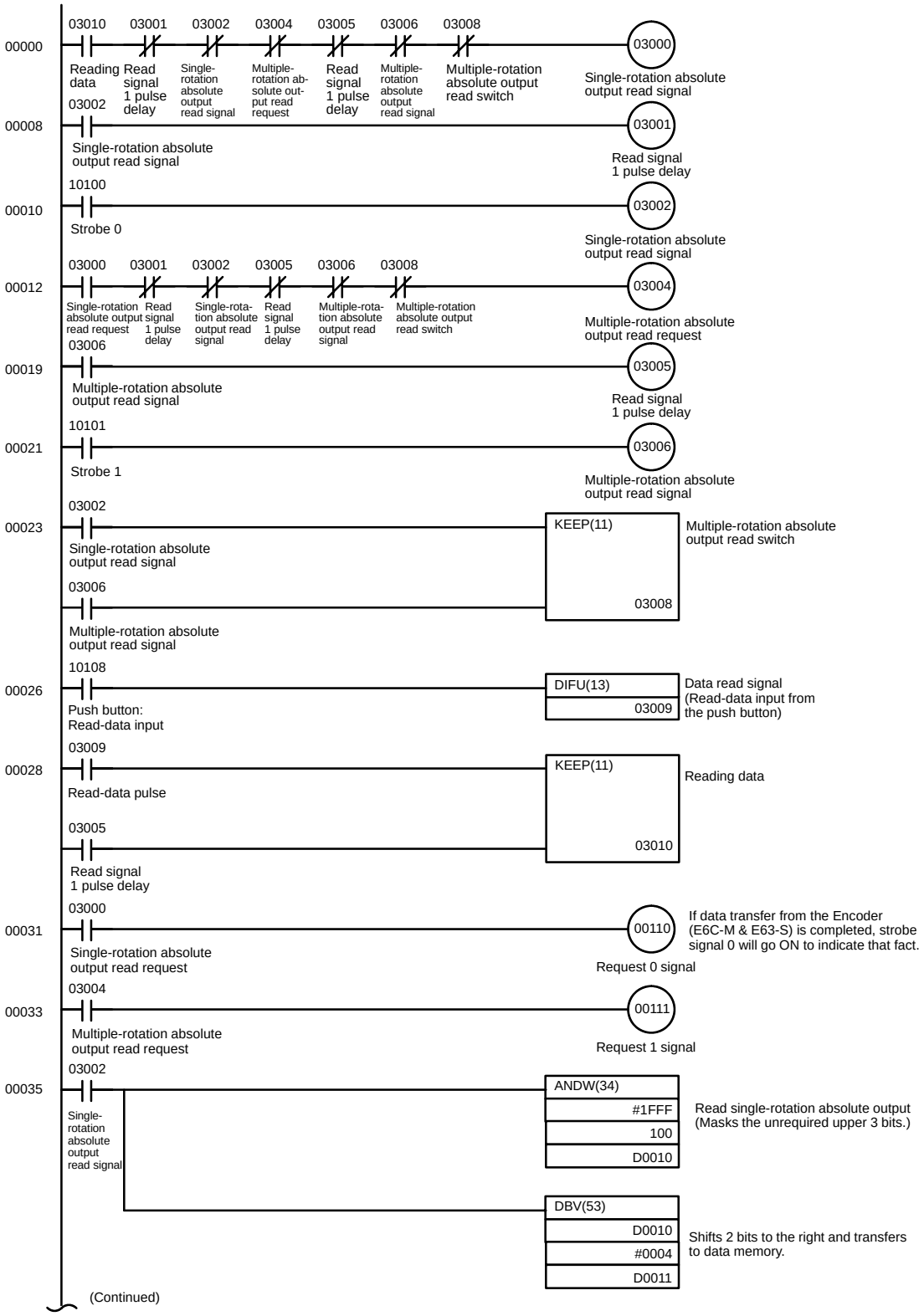
Procedure

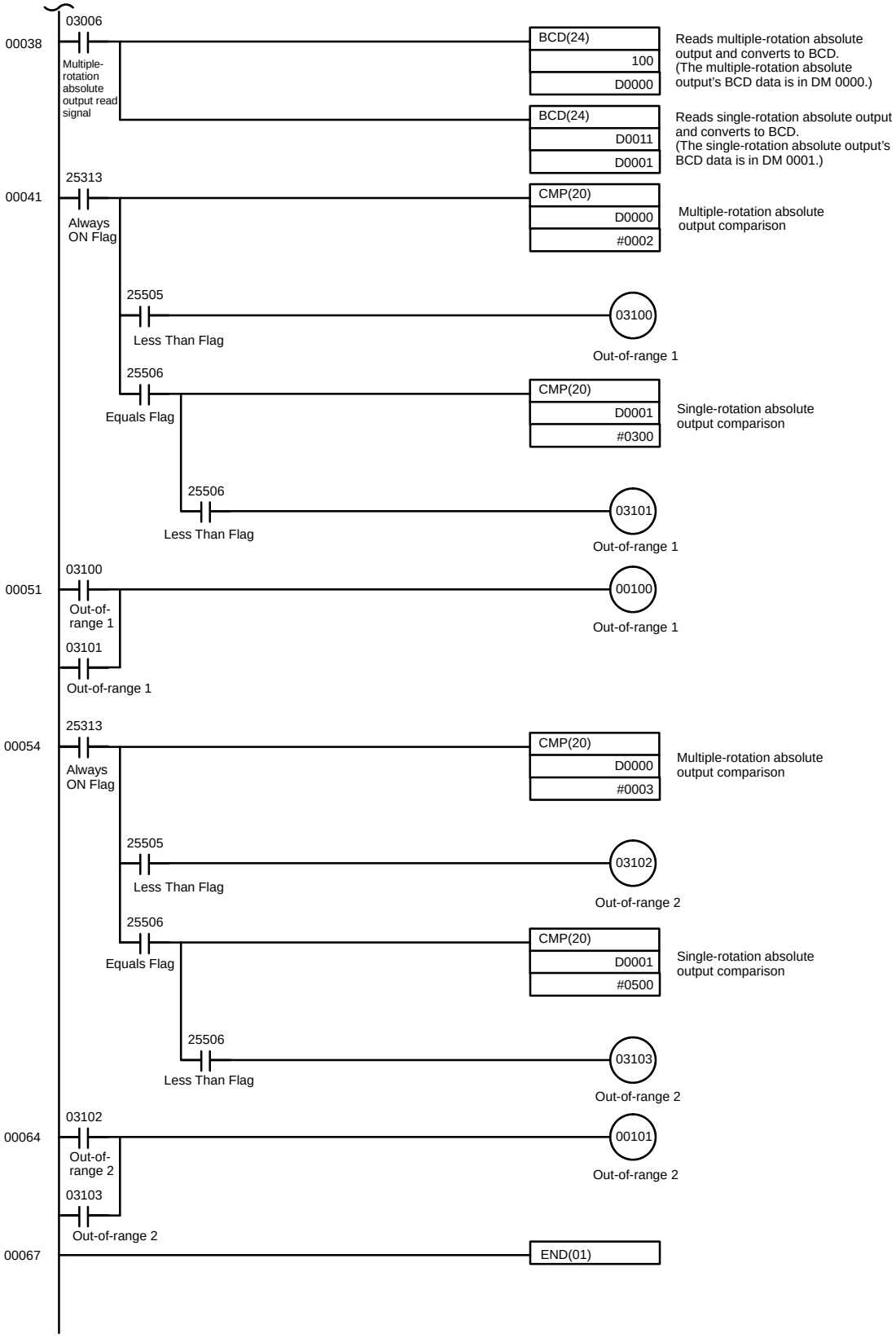
1. Press the Push (PB) Button.
2. Transfer the multiple-rotation absolute data to the PC's data memory.
3. Transfer the single-rotation absolute data to the PC's data memory.
4. Turn on Flag #1 if the above data exceeds 2 rotations and 300 pulses.
5. Turn on Flag #2 if the above data exceeds 3 rotations and 500 pulses.

Connections



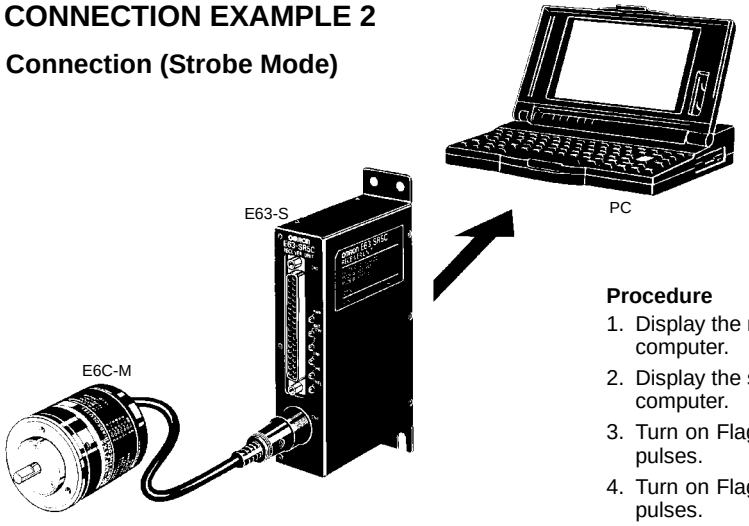
Sample Program




03006
00038
Multiple-rotation absolute output read signal
BCD(24)
100
D0000
Reads multiple-rotation absolute output and converts to BCD. (The multiple-rotation absolute output's BCD data is in DM 0000.)
BCD(24)
D0011
D0001
Reads single-rotation absolute output and converts to BCD. (The single-rotation absolute output's BCD data is in DM 0001.)
25313
00041
Always ON Flag
CMP(20)
D0000
#0002
Multiple-rotation absolute output comparison
25505
Less Than Flag
03100
Out-of-range 1
25506
Equals Flag
CMP(20)
D0001
#0300
Single-rotation absolute output comparison
25506
Less Than Flag
03101
Out-of-range 1
03100
00051
Out-of-range 1
00100
Out-of-range 1
03101
Out-of-range 1
25313
00054
Always ON Flag
CMP(20)
D0000
#0003
Multiple-rotation absolute output comparison
25505
Less Than Flag
03102
Out-of-range 2
25506
Equals Flag
CMP(20)
D0001
#0500
Single-rotation absolute output comparison
25506
Less Than Flag
03103
Out-of-range 2
03102
00064
Out-of-range 2
00101
Out-of-range 2
03103
Out-of-range 2
00067
END(01)

■ CONNECTION EXAMPLE 2

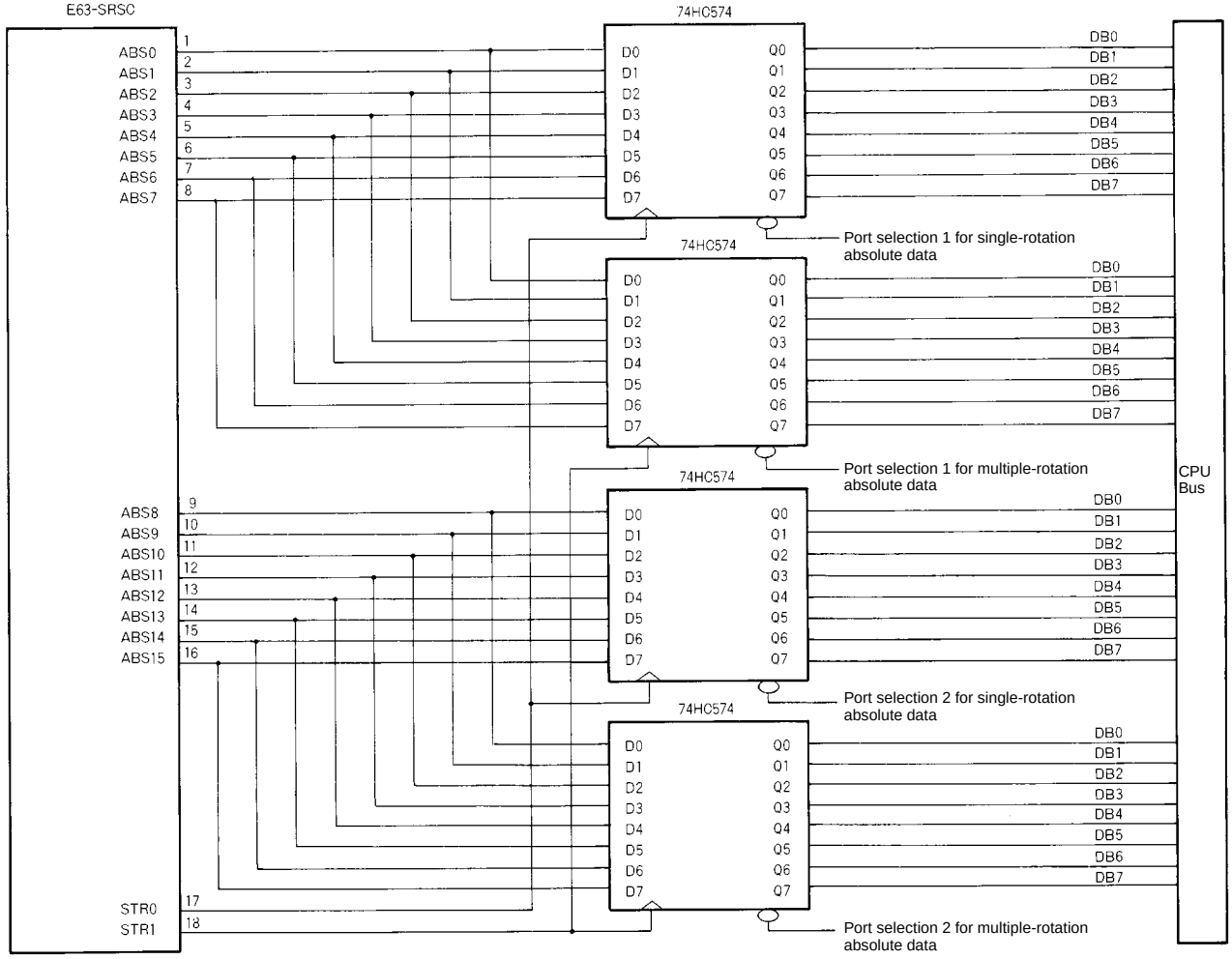
PC Connection (Strobe Mode)



Procedure

1. Display the multiple-rotation absolute data at the personal computer.
2. Display the single-rotation absolute data at the personal computer.
3. Turn on Flag #1 if the above data exceeds 2 rotations and 300 pulses.
4. Turn on Flag #2 if the above data exceeds 3 rotations and 500 pulses.

Connections



Note: The following port selections are used in the sample program on the next page:
Port selection 1 for single-rotation absolute data: ABS_SEL1(&H00D0)
Port selection 2 for single-rotation absolute data: ABS_SEL2(&H00D2)
Port selection 1 for multiple-rotation absolute data: TAKAITEN_SEL1(&H00D4)
Port selection 2 for multiple-rotation absolute data: TAKAITEN_SEL1(&H00D8)

Sample Program

```
100 REM ************************************************
110 REM  Displays the single-rotation absolute data.
120 REM
130 REM ************************************************

200 ABS_SEL1  =&H00D0                          Single-rotation absolute data (lower byte) input latch port address
210 ABS_SEL2  =&H00D2                          Single-rotation absolute data (higher byte) input latch port address

220 KAITENRYO_LOW=INP(ABS_SEL1)                Reads the single-rotation absolute data (lower byte).
230 KAITENRYO_HI =INP(ABS_SEL2)                Reads the single-rotation absolute data (higher byte).
240 KAITENRYO=KAITENRYO_LOW+(KAITENRYO_HI*256) Converts the single-rotation absolute data to 16-bit data.
250 KAITENRYO=KAITENRYO AND &H1FFC             Masks the unneeded bits.
260 KAITENRYO=KAITENRYO /4                     Shifts 2 bits right.
270 PRINT KAITENRYO                            Displays the single-rotation absolute data.
280 END

100 REM ************************************************
110 REM  Displays the multiple-rotation absolute data.
120 REM
130 REM ************************************************

200 TAKAITEN_SEL1=&H00D4                       Multiple-rotation absolute data (lower byte) input latch port address
210 TAKAITEN_SEL2=&H00D6                       Multiple-rotation absolute data (higher byte) input latch port address

220 KAITENSUU_LOW=INP(TAKAITEN_SEL1)           Reads the multiple-rotation absolute data (lower byte).
230 KAITENSUU_HI =INP(TAKAITEN_SEL2)           Reads the multiple-rotation absolute data (higher byte).
240 KAITENSUU=KAITENSUU_LOW+(KAITENSUU*256)    Converts the multiple-rotation absolute data to 16-bit data.
250 KAITENSUU=KAITENSUU AND &HFFF              Masks the unneeded bits.
260 PRINT KAITENSUU                            Displays the multiple-rotation absolute data.
270 END

100 REM ************************************************
110 REM  Turns on flags if the set values are exceeded.
120 REM
130 REM ************************************************

200 ABS_SEL1        =&H00D0                    Single-rotation absolute data (lower byte) input latch port address
210 ABS_SEL2        =&H00D2                    Single-rotation absolute data (higher byte) input latch port address
220 TAKAITEN_SEL1   =&H00D4                    Multiple-rotation absolute data (lower byte) input latch port address
230 TAKAITEN_SEL2   =&H00D6                    Multiple-rotation absolute data (higher byte) input latch port address
240 SETTEI_KAITENRYO1     =300                 Single-rotation absolute data #1 set value (300 pulses)

250 SETTEI_KAITENSUU1 =2                       Multiple-rotation absolute data #1 set value (2 rotations)
260 SETTEI_KAITENRYO2     =500                 Single-rotation absolute data #2 set value (500 pulses)
270 SETTEI_KAITENSUU2 =3                       Multiple-rotation absolute data #2 set value (3 rotations)
280 OVER_FLG1         =0                       Over #1 set value flag
290 OVER_FLG2         =0                       Over #2 set value flag

300 KAITENRYO_LOW=INP(ABS_SEL1)                Reads the single-rotation absolute data (lower byte).
310 KAITENRYO_HI =INP(ABS_SEL2)                Reads the single-rotation absolute data (higher byte).
320 KAITENRYO=KAITENRYO_LOW+(KAITENRYO_HI*256) Converts the single-rotation absolute data to 16-bit data.
330 KAITENRYO=KAITENRYO AND &H1FFC             Masks the unneeded bits.
340 KAITENRYO=KAITENRYO /4                     Shifts 2 bits right.

400 KAITENSUU_LOW=INP(TAKAITEN_SEL1)           Reads the multiple-rotation absolute data (lower byte).
410 KAITENSUU_HI =INP(TAKAITEN_SEL2)           Reads the multiple-rotation absolute data (higher byte).
420 KAITENSUU=KAITENSUU_LOW+(KAITENSUU*256)    Converts the multiple-rotation absolute data to 16-bit data.
430 KAITENSUU=KAITENSUU AND &HFFF              Masks the unneeded bits.

500 *CHECK1
510 IF KAITENSUU=SETTEI_KAITENSUU1 ELSE GOTO*CHECK2     If the multiple-rotation absolute data equals its #1 set value and
520  IF KAITENRYO>=SETTEI_KAITENRYO1 THEN OVER_FLG1=1   the single-rotation absolute data exceeds its #1 set value, the
                                                        "over #1 set value flag" is turned on.
600 *CHECK2
610 IF KAITENSUU>SETTEI_KAITENSUU1 ELSE GOTO *CHECK3    If the multiple-rotation absolute data exceeds its #1 set value,
                                                        the "over #1 set value flag" is turned on.
620 OVER_FLG1=1
```

```
700 *CHECK3
710 IF KAITENSUU=SETTEI_KAITENSUU2 ELSE GOTO *CHECK4
720  IF KAITENRYO>=SETTEI_KAITENRYO2 THEN OVER_FLG2=1

800 *CHECK4
810 IF KAITENSUU>SETTEI_KAITENSUU2 ELSE GOTO *EXIT

820 OVER_FLG2=1

900 *EXIT
910 END
```

If the multiple-rotation absolute data equals its #2 set value and the single-rotation absolute data exceeds its #2 set value, the "over #2 set value flag" is turned on.

If the multiple-rotation absolute data exceeds its #2 set value, the "over #2 set value flag" is turned on.

Note: The KAITENRYO variable is the single-rotation absolute data and the KAITENSUU variable is the multiple-rotation absolute data.

Precautions

■ STORAGE CONDITIONS

Store the E6C-M within the temperature and humidity ranges given in the specifications and observe the following precautions.

- Store the Unit and packaging where they won't be subjected to salt air or corrosive gases such as hydrogen sulfide.
- Store the Unit in a dust-free area where it can be inspected visually.
- Do not store the Unit in direct sunlight.
- Also, never place a load on the Unit that could deform or damage it.

■ OPERATING CONDITIONS

Operate the E6C-M within the temperature and humidity ranges given in the specifications and observe the following precautions.

- Install the Unit in a low-dust location free of corrosive gases.
- Install the Unit in a location free of water and oil where the effects of vibration and shock are insignificant.
- Avoid locations with sudden temperature changes, even if the temperature range is within the recommended limits.
- Also, never place a load on the Unit that could deform or damage it.

■ WIRING

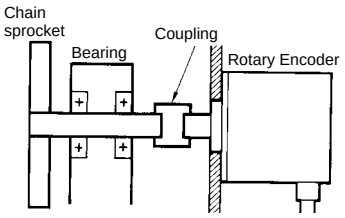
- Insert a surge absorber between the power supply terminals if there is any surge.
- Turn off the Rotary Encoder when wiring. The output circuit may be damaged if the output line contacts with the power source while the Rotary Encoder is turned on.
- Never disconnect or connect the circuit when current is flowing. This might damage the Unit.
- Avoid wiring the E6C-M and E63-SRC's cables parallel to power lines or high-voltage lines. Use a separate conduit.

Spurious pulses might be generated when power is turned on, so wait at least 0.3 s after the last Unit is turned on before using the Units.

■ MOUNTING

The Rotary Encoder consists of high-precision components. Handle with utmost care and do not drop the Rotary Encoder, or malfunctioning may result.

- When installing the Encoder, be sure not to apply excessive force or shock to the rotational shaft.
- Use a coupling on the rotational shaft and be sure to avoid excessive shock or vibration during operation.
- When inserting the shaft in the coupling, do not use excessive force (by striking it with a hammer, for example).
- If the E6C-M is mounted and wired with a cable, do not pull the cable.
- When using a gear linkage, be sure not to apply a large load on the shaft.
- If a significant installation error is made (misalignment), the shaft will be subjected to excessive force which will damage it or shorten the life of the Unit.
- When linking with a chain timing belt or toothed gear, connect a separate bearing before the coupling to the encoder.



NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.

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