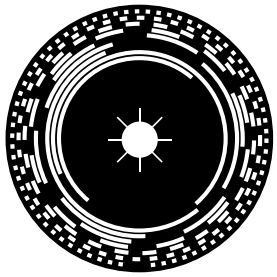
Explanatory Material

Explanation of Absolute Type

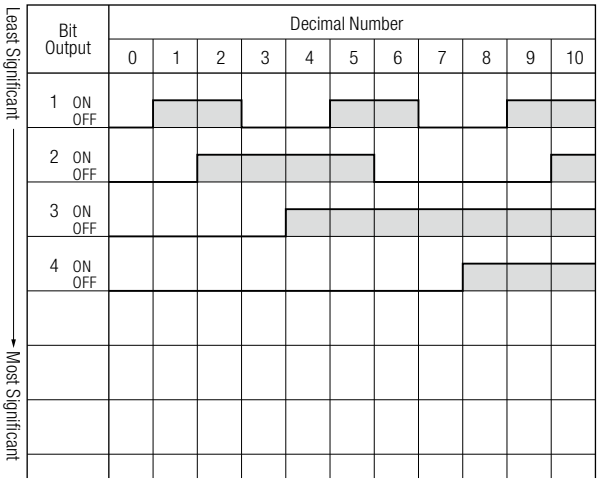
Features of Absolute Type

The signal for the absolute position as determined by the rotation angle is output as a code (gray code) in parallel.
Therefore, a counter is not necessary and the signal is always output according to the angle of the input rotational axis when the power is turned on.
Since a counter is not necessary, the absolute encoder is always stable against chatering cased by electric noise and vibrations.
Moreover, even if the power is turned on again after powering off, an accurate rotation angle can be read and the system can be quickly started because origin return is not necessary.

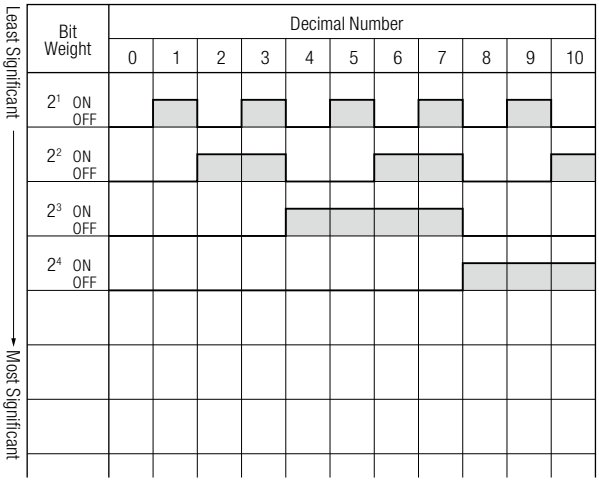


What is the Gray code?

Gray code



Binary code



As shown in the figure above, in the case of a binary code, several bits change simultaneously between neighboring codes.
Since the input response speed of devices connected to the encoder has some variation, errors occur in that codes that were not actually output are read in the case of binary code.
In contrast, since only 1 bit between neighboring codes changes in the case of gray codes, reading errors such as those in binary code do not occur.

* "ON" in the figure indicates the state that the output transistor turns on and the current flows in.

Output Code Table

Decimal system	bit 10	9	8	7	6	5	4	3	2	1
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	1	1
31	0	0	0	0	0	1	0	0	0	0
32	0	0	0	0	1	1	0	0	0	0
37	0	0	0	0	1	1	0	1	1	1
38	0	0	0	0	1	1	0	1	0	1
63	0	0	0	0	1	0	0	0	0	0
64	0	0	0	1	1	0	0	0	0	0
75	0	0	0	1	1	0	1	1	1	0
76	0	0	0	1	1	0	1	0	1	0
127	0	0	0	1	0	0	0	0	0	0
128	0	0	1	1	0	0	0	0	0	0
151	0	0	1	1	0	1	1	1	0	0
152	0	0	1	1	0	1	0	1	0	0
217	0	0	1	0	1	1	0	1	0	1
218	0	0	1	0	1	1	0	1	1	1
255	0	0	1	0	0	0	0	0	0	0
256	0	1	1	0	0	0	0	0	0	0
435	0	1	0	1	1	0	1	0	1	0
436	0	1	0	1	1	0	1	1	1	0
511	0	1	0	0	0	0	0	0	0	0
512	1	1	0	0	0	0	0	0	0	0
871	1	0	1	1	0	1	0	1	0	0
872	1	0	1	1	0	1	1	1	0	0
1022	1	0	0	0	0	0	0	0	0	1
1023	1	0	0	0	0	0	0	0	0	0

Resolution 1,024
Resolution 512
Resolution 256
Resolution 128
Resolution 64
Resolution 32
Resolution 180
Resolution 360
Resolution 720

*Output transistor
"1"=ON "0"=OFF

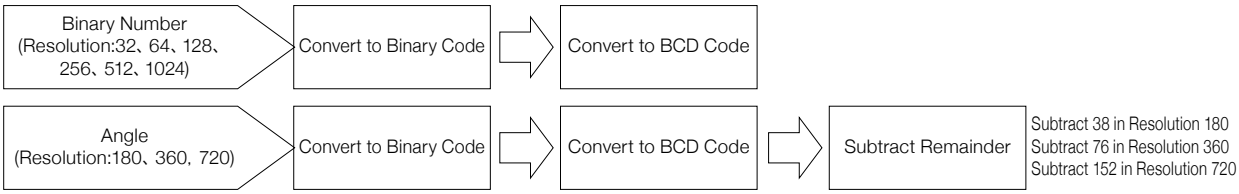
5-bit (Resolution 32)
6-bit (Resolution 64)
7-bit (Resolution 128)
8-bit (Resolution 180·256)
9-bit (Resolution 360·512)
10-bit (Resolution 720·1,024)

Explanatory Material

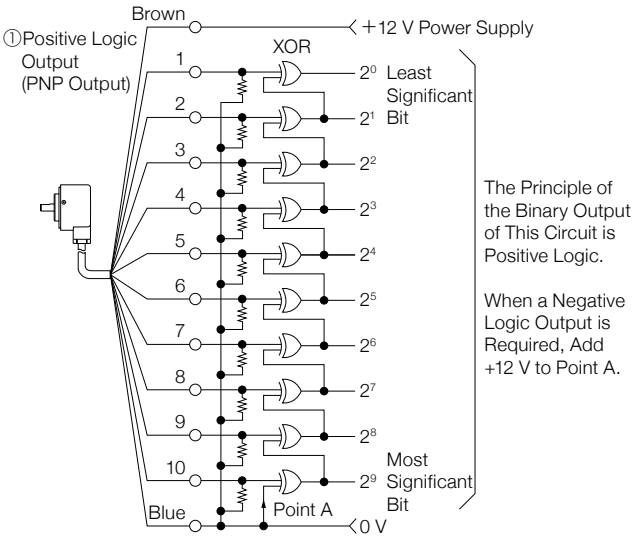
Explanation of Absolute Type

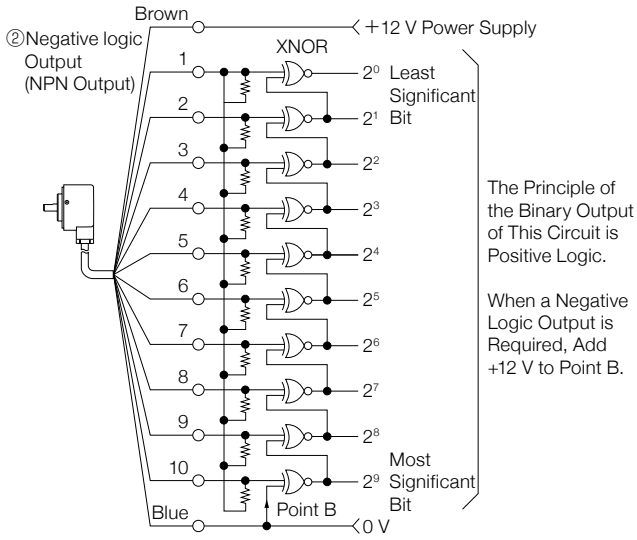
■Conversion of Output Code

Since gray code is used, take the following procedures when converting output code into binary code or BCD code.



Example of a Circuit that Converts Gray Code Into Binary Code (When the resolution is 1,024)





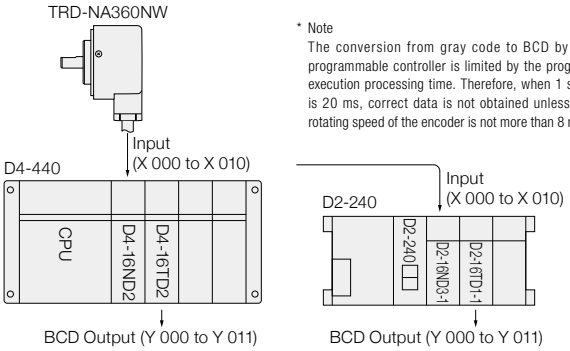
Explanatory Material

Explanation of Absolute Type

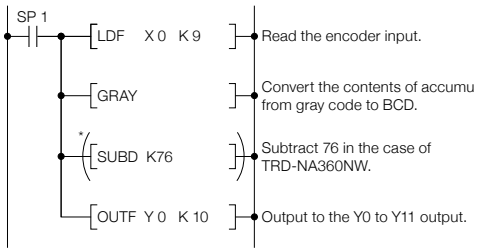
■Conversion From [Gray Code] → [BCD Code] Based on the PLC Program

Example of TRD-NA and D4-440 • D2-240

TRD-NA360NW Output Connection	D4-440・D2-240 Input No.
Red Least significant bit	X 000
Orange	X 001
Yellow	X 002
Green	X 003
Purple	X 004
Gray	X 005
White	X 006
Black / White	X 007
Red / White Most significant bit	X 010



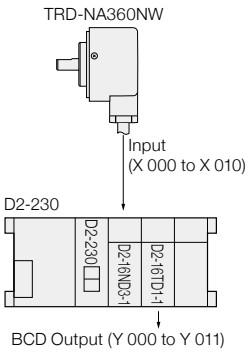
* Note
The conversion from gray code to BCD by the programmable controller is limited by the program execution processing time. Therefore, when 1 scan is 20 ms, correct data is not obtained unless the rotating speed of the encoder is not more than 8 rpm.



* Because the TRD-NA360□ of 360 resolution uses an excess of 76 gray codes, 76 should be subtracted to make the BCD output code of 0° to 360°.
In the TRD-NA512□ of 512 resolution and TRD-NA1024□ of 1024 resolution, this SUBC instruction should be eliminated.

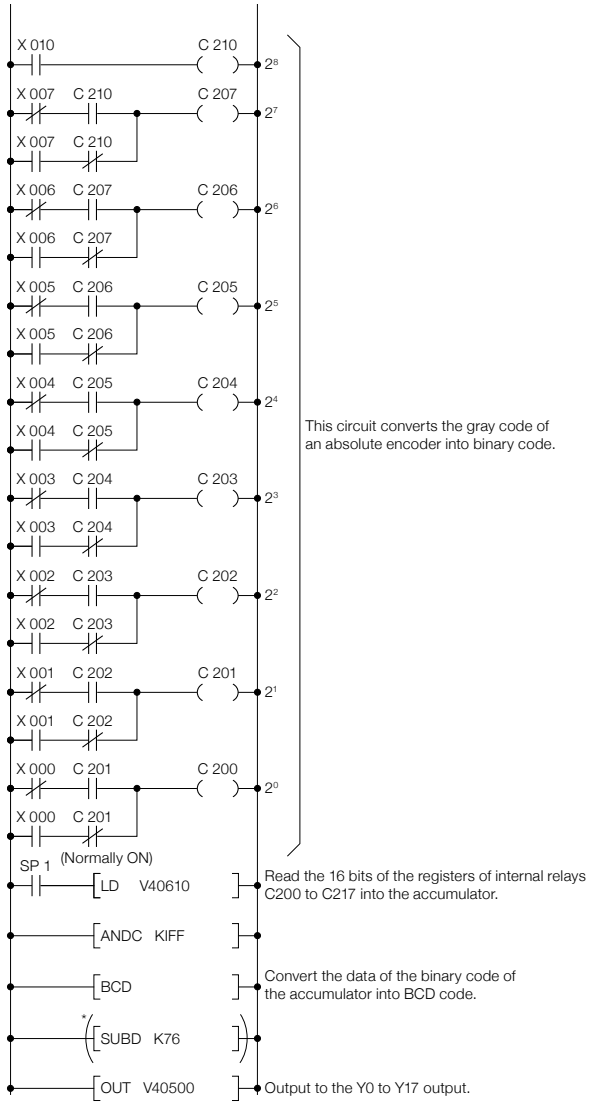
Example of TRD-NA and D2-230

TRD-NA360NW Output Connection	D2-230 Input No.
Red Least significant bit	X 000
Orange	X 001
Yellow	X 002
Green	X 003
Purple	X 004
Gray	X 005
White	X 006
Black / White	X 007
Red / White Most significant bit	X 010



* Note
The conversion from gray code to BCD by the programmable controller is limited by the program execution processing time. Therefore, when 1 scan is 20 ms, correct data is not obtained unless the rotating speed of the encoder is not more than 8 rpm.

In the program below, 6 points from Y 012 to Y 017 cannot be used among the output of the D2-16TD1-1 (points always are OFF).
To use these 6 output points, a superposition program is necessary.



* Because the TRD-NA360□ of 360 resolution uses an excess of 76 gray codes, 76 should be subtracted to make the BCD output code of 0° to 360°.

Explanatory Material
Connection of Incremental Type

Connection with Koyo Electronics' Electronic Counters, etc.

When connecting to a counter, etc., select a model after checking (1) sensor power source (voltage / current) of the counter and (2) the logic of the origin signal, using the table below.

(1) Sensor power source

The voltage and current correlation to the sensor power source and each model of the rotary encoder is shown in the table below.

Connected Devices		Rotary Encoder						
Series Model Number	Sensor Power Source	TRD-N		TRD-J			TRD-GK	
		S	RZ/RZL	S	RZ/RZL	RZV	R/RZ/RZL	BZ
KCV	24 V DC/60 mA	●	●	●	●	×	▲	▲
KCX	12 V DC/50 mA	●	▲	●	●	×	●	▲
KCX-B	24 V DC/80 mA	●	●	●	●	×	●	▲
TC-V	24 V DC/60 mA	●	●	●	●	×	▲	▲
TC-4L	12 V DC/30 mA	▲	▲	●	▲	×	▲	▲
TC-4□*	12 V DC/50 mA	●	▲	●	●	×	●	▲

● mark: Conforming (Usable) ▲ mark: A power supply is separately required.
× mark: Nonconforming (Unusable) *TC-4/TC-4B/TC-4S/TC-4W

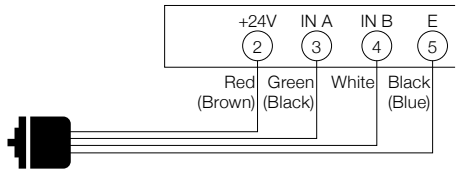
(2) Origin logic

When connecting the origin output (OUTZ) of the rotary encoder to the reset and preset input of a counter, etc., it is necessary to select the origin logic that conforms to the input format, as this differs according to counter. Check the model numbers of conforming electronic counters by referring the table below.

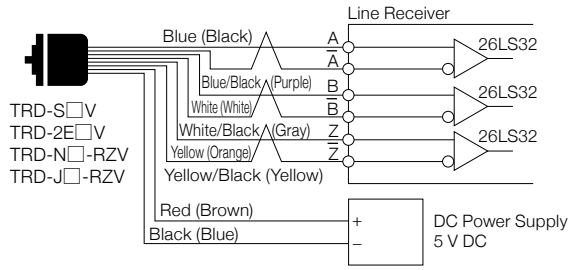
Connected Devices	Rotary Encoder			
Series Model Number	TRD-N/J/GK		TRD-J	TRD-GK
	RZ	RZL	RZV	BZ
KCV	●	●	×	●
KCX	●	×	×	●
KCX-B	●	●	×	●
TC-V	●	●	×	●
TC-4L	×	●	×	×
TC-41	●	●	×	●
TC-4/4B/4S/4W	×	●	×	×

● mark: Conforming (Usable) × mark: Nonconforming (Unusable)

KCV Series

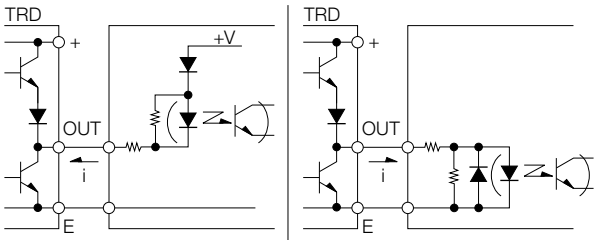


Connection of Line Driver Output Type



Connection to a Photocoupler

A photocoupler can be directly driven by the output of the rotary encoder. Example of connection: The totem-pole output of the TRD series can be used in either case shown in the figure below.



Note) Connect the resistance and diode to the photocoupler side. Use a photocoupler of fast response speed.

Connection to a Stabilized DC Power Supply

When connecting the rotary encoder, if there is a shortage in the capacity of the built-in power source of connected devices such as counters (power source for sensor, etc.), use a commercial stabilized DC power supply.