Eltra® sensing technology

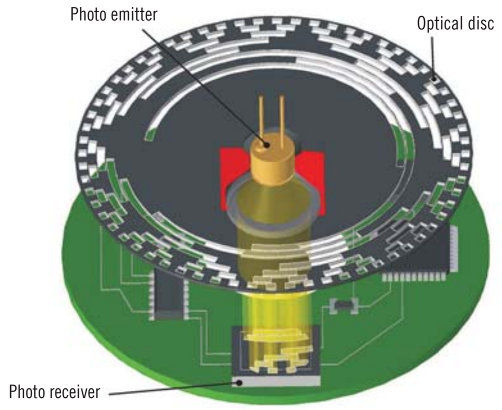
ABSOLUTE ENCODER

GENERAL DESCRIPTION

ISO 9001:2000

WORKING PRINCIPLE

The working principle of an absolute encoder is very similar to incremental one: a rotating disk, with transparent and opaque windows, interrupts a light beam acquired by photo receivers. Consequently, light pulses are converted into electric ones and then they are processed and transmitted by the output electronic.

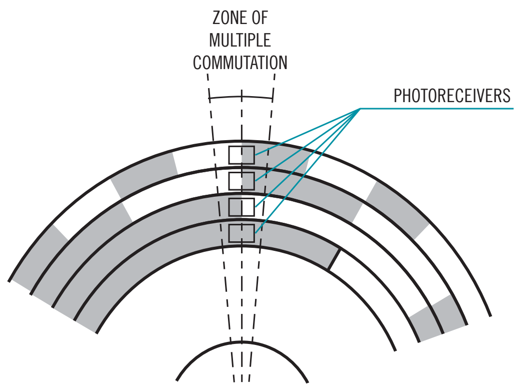


ABSOLUTE CODING

The main difference between incremental and absolute is how the position is given: on incremental the position is given from the zero index while the absolute bases its position on the output code, which is unique for each position inside the revolution. Consequently, an absolute encoder never looses the real position neither if the power goes out nor in case of shaft movement.
Nonetheless, with an absolute encoder as soon as the power is re-stored the position is updated and immediately available instead, with an incremental encoder, the zero set would be required.

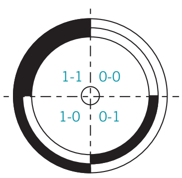
The output code is used to specify the absolute position. The first natural choice would be the binary code because it can be easily processed by external devices but the issue is that it is extracted directly from the rotating disc: acquiring the position synchronized with the output data can be difficult due to the simultaneous change of more than one bit.
For example, if two consecutive binary codes as 7 (0111) and 8 (1000) are considered, it can be noticed that the status of all bits changes. So, if the attempt to read the code in a specific time is made, it could be difficult to assure the correctness of the read data because there is more than one bit change in the same time.
Therefore, a Gray code is used where only the status of one bit changes during two consecutive codes (even from the last to the first).

The Gray code can be easily converted to the binary by using a simple combinatory circuit (see tables above).

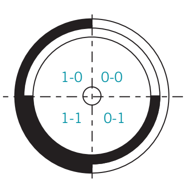


DECIMAL	BINARY	GRAY
0	0000	0000
1	0001	0001
2	0010	0011
3	0011	0010
4	0100	0110
5	0101	0111
6	0110	0101
7	0111	0100
8	1000	1100
9	1001	1101
10	1010	1111
11	1011	1110
12	1100	1010
13	1101	1011
14	1110	1001
15	1111	1000

2 Bit optical disc with binary code



2 Bit optical disc with grey code



THE GRAY EXCESS CODE

However, when the number of defined position is not a power of 2, even with the Gray code more than one bit can change simultaneously between the last and the first code value.
For instance, in a hypothetical 12 ppr absolute encoder, the code should be as the one shown in the aside. It is clear that between the positions 11 and 0 a 3 bit status simultaneous change may involve reading errors so that's not acceptable. The Gray excess code is used to maintain the typical one-bit variation specificity by making the 0 position corresponding to the N value. The N is a number that subtracted from the Gray code converted into binary provides the exact position value.

The formula to calculate the N value is:

$$N = \frac{2^n - IMP}{2}$$

Where : *IMP* is the number of PPR
2^n is the power of 2 multiple immediately higher than *IMP*

In our example *N* will be:

$$N = \frac{2^4 - 12}{2} = \frac{16-12}{2} = 2$$

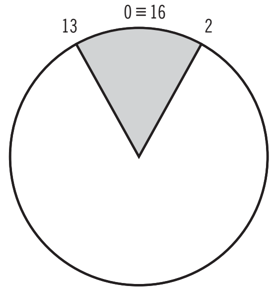
POSITION	GRAY
0	0000
1	0001
2	0011
3	0010
4	0110
5	0111
6	0101
7	0100
8	1100
9	1101
10	1111
11	1110
0	0000

Error

POSITION	GRAY
0	0000
1	0001
2	0011
3	0010
4	0110
5	0111
6	0101
7	0100
8	1100
9	1101
10	1111
11	1110
0	0000

Example: conversion of the position number 5

The Gray code of the position number 5 is 0100 which converted into binary is 0111 (7 in decimal).
Subtracting from 7 the N value the real position value which is 7-2=5) will be obtained.



SINGLETURN ABSOLUTE ENCODER

A singleturn absolute encoder allows a precise acquisition of the angular position of the shaft to which the encoder is coupled to even if power goes out. Therefore, each single degree position is converted into a specific code (gray or binary) proportionally to the bit position.

MULTITURN ABSOLUTE ENCODER

The multiturn absolute encoder series is identified by the EAM prefix. This device allows a higher number of application representing such an interesting extension of the single turn encoder.
This type of encoder represent a significant linear extension maintaining flexibility according to customer specifications.
The encoder uses a main shaft to which one or more mechanical reducers are mounted in 'cascade' allowing a precise code reading even after a mechanical movement when the device is not powered.
Safety and performances are among the highest in the market. Eltra's multiturn encoders are available with several electronic and mechanical output.