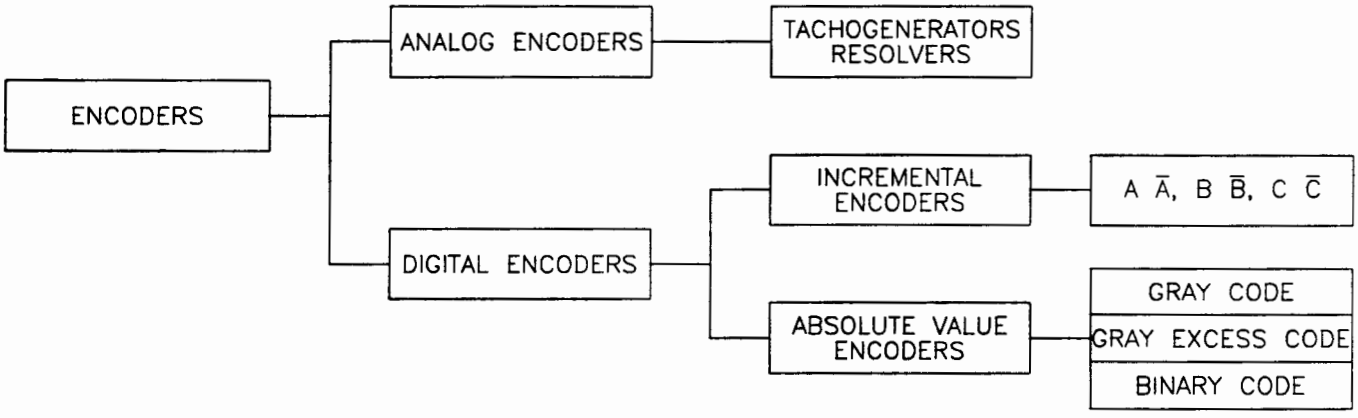
ENCODERS

Encoders are used in a variety of applications to sense both speed and position. The type of encoder chosen for a given application is strictly dependent on the application. Encoders are available in two basic types, analog and digital (see fig. 1), and each have various output configurations.

Fig. 1



Tachgenerators

Tachgenerators were designed primarily to provide speed regulation which in effect widens the speed range for dc motor applications and are still used today. The principle operation of a tachgenerator is that they provide a DC ouput voltage based on speed of their armature. They are low in cost and very reliable.

Resolvers

Resolvers are another type of analog encoder. The principle of operation is based on the rotating transformer. It has a rotor winding with two stator windings placed at 90 degrees to each other. With a given input signal, the output is a two channel sine and cosine signal (see fig. 2). The two signals are then processed and translated into speed and position (see fig. 3). The advantages to resolvers are that they are are tolerant to high temperatures (above what motors can handle), are not sensitive to vibrations and are easy to connect. There is no real selection criteria and they are primarily used in servo motors.

Fig. 2

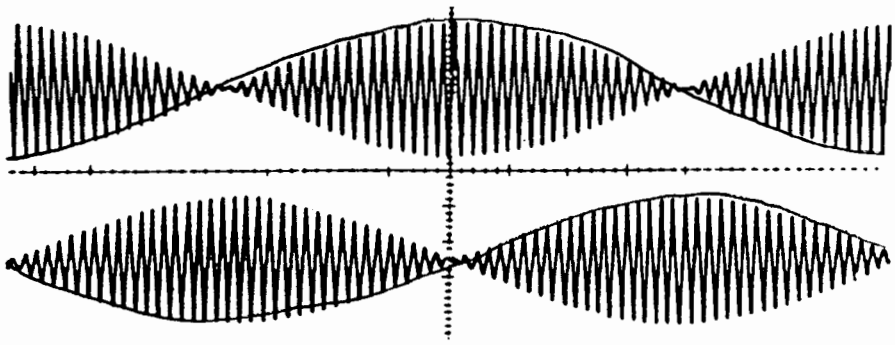
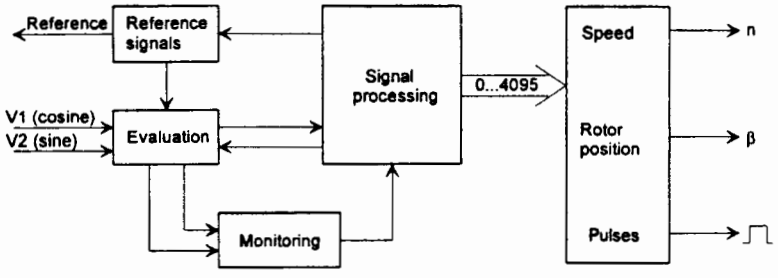


Fig. 3

Evaluation of resolver signals



Incremental Encoders

The most common of encoders, incremental encoders are a digital encoder. Their operation is based on a light emitting diode (LED) passing light through a series of holes in a disc (see fig. 4). This light is detected on the other side and then processed into usable information (see fig. 5) . Incremental encoders are available in a wide variety of output configurations which makes them very flexible and for the most part are reliable. One major disadvantage is if power is lost position information is lost.

Fig. 4

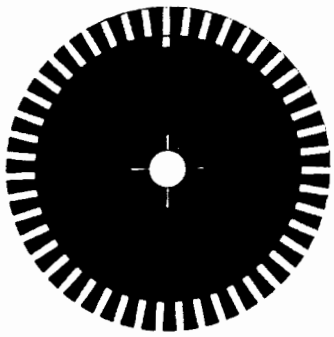
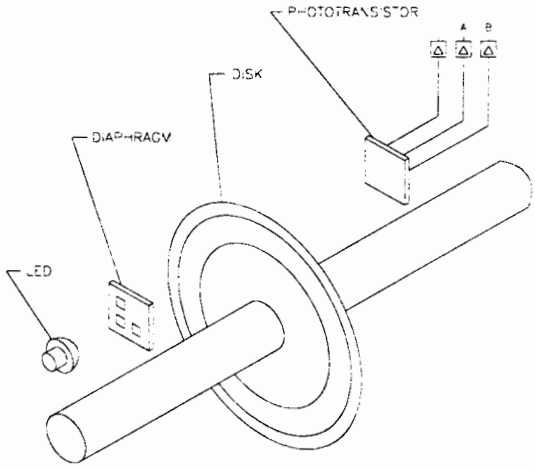


Fig. 5



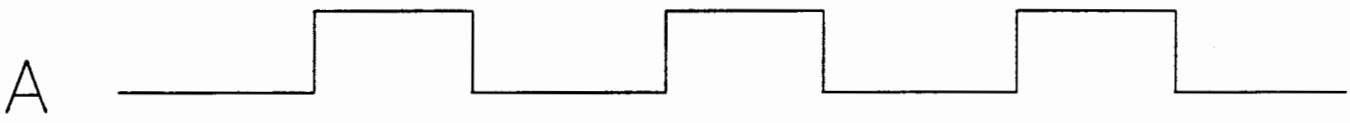
Output Waveforms

The output configuration of an incremental encoder is a series of square wave pulses and is selected based on the application.

Single output: A

This ouput is unidirectional with a mark to space ratio of 1:1. It's complement A (pronounced A-Not) is exactly opposite of A. This is usually used in speed readout and speed regulation type applications.

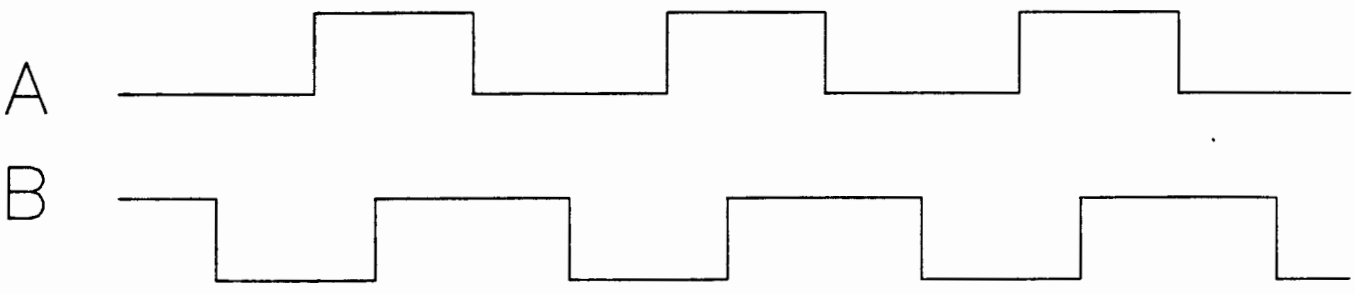
Fig. 6



Quadrature Output: A + B.

The quadrature output has two outputs with a 90 degree phase shift, and has a mark to space ration of 1:1. This type of output with the correct type of extra components can be used to determine direction as well as speed and position.

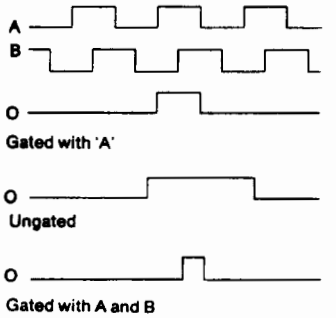
Fig. 7



Marker Output: O

The marker pulse is an ouput of one pulse per revolution and is used in positioning application as a reference point for checking position.

Fig. 8



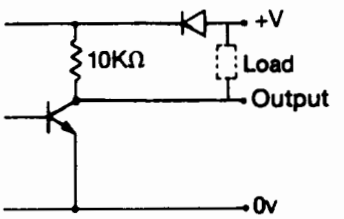
Output Circuits

The incremental encoder has many different possible output circuits to allow them to be connected to various different types of periphial equipment. The most common are as follows:

Current Sink

The current sink circuit can typically sink upto 100 ma depending on the manufacturer, is suitable for cable runs upto approximately 50 feet and upto approximately 100 Khz in output frequency. This circuit is shown with a 10K-Ohm pull up resistor. The resistor is not present in an open-collector version.

Fig. 9

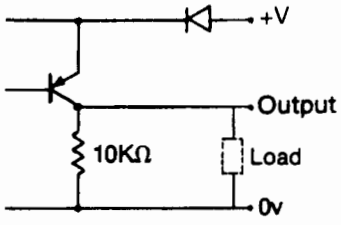


Current Sink (npn)

Current Source

The current source circuit can typically sink upto 100 ma depending on the manufacturer, is suitable for cable runs upto approximately 50 feet and upto approximately 100 Khz in output frequency. This circuit is shown with a 10K-Ohm pull down resistor. The resistor is not present in an open collector version.

Fig.10

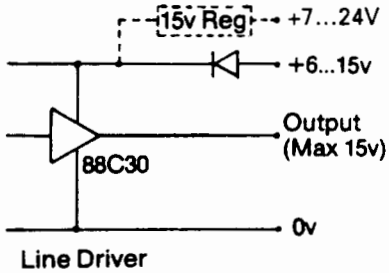


Current Source (pnp)

Differential Line Driver

The differential line driver can sink and source typically upto approximately 50 ma and drive cable runs upto 500 feet at 50 Khz. It is very immune to noise but also requires the device called a differential line receiver.

Fig. 11

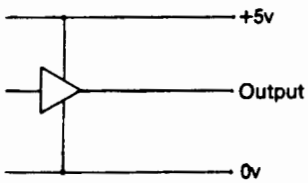


Line Driver

TTL Line Driver

The transistor-transistor line driver (TTL) operates at a maximum voltage level of 5 volt dc and typically only sinks and sources upto 20 ma per channel. Cable runs are short because of voltage drop (30 feet or less) and shielded cable is a must because of low noise immunity, but it is usually lower in cost.

Fig. 12

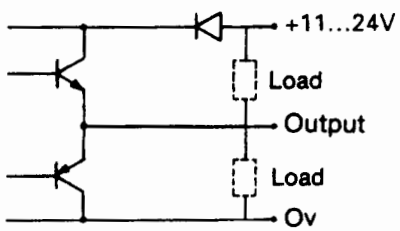


TTL Line Driver

Push-Pull Driver

The push-pull driver output is the least common and typically sinks and sources upto approximately 50 mA at 50 kHz. Maximum cable length is approximately 50 feet.

Fig. 13



Push Pull

Absolute Encoders

Absolute encoders are another type of digital encoder. Like the incremental encoder they use the LED type tranferance of information, but instead of a pulse train the information creats a word of information which is either a binary , binary coded decimal or a grey coded word (see Fig. 14). This word is unique for every rotational position 0 to 360 degrees and the results are that no reading errors can occur. If power is lost the position is not lost. They are also highly accurate. They are more expensive than the incremental encoder and generally as reliable.

Fig. 14