

Electronics Design Guide 6: Measuring devices

A measuring device gives the user information about either the level of a physical signal or a count rate of events or time. This information might be given as an actual value for the signal or count rate (quantitative) or as a relative level (qualitative).

Situations

In each situation decide exactly what it is that your device needs to measure. Then select the physical signal that can be used to represent this measurement.



Sensing input signals

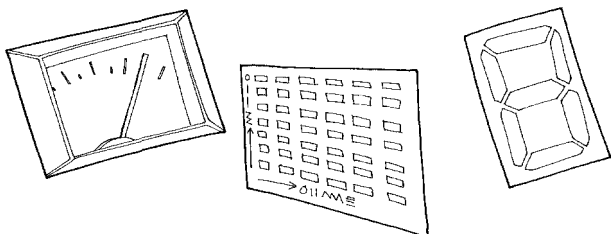
To produce a measurement of a signal level use an analogue sensor. To provide a quantitative output find a sensor with a linear response where the electronic signal is proportional to the physical signal.

For counting events, a digital or cheap analogue sensor will be sufficient.

An effective way to measure time is to produce (and count) regular electronic pulses.

Producing output signals

The measurement display might be qualitative (perhaps a set of lights or LEDs) or quantitative (for example a meter or a 7-segment display).



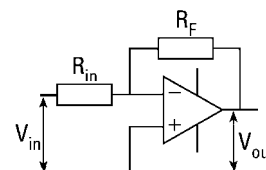
The display will, in all cases, need to provide information to the user about the values that it represents. To get these values, you may need to calibrate the display.

Electronic processing

Your instrument will need some of the following features:

◆ Amplification of the signal size

An op-amp configured as an amplifier will give a linear analogue output. For event counting/ a very small sensor signal change can be amplified with a comparator.



◆ Analogue to digital conversion to provide a digital signal from an analogue signal.

Use a dedicated IC giving the accuracy of conversion that you need.

◆ Counter to count events

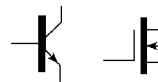
A wide range of counter ICs is available, for example the '4029' is an IC that counts in tens.

◆ Display driver for 7-segment or bar graph display;

To drive 10 LEDs as a bar display use a '3914' IC. Each 7-segment display needs a driver to convert a set of four digital signals into signals for the displayed number. There are also ICs that combine counting and driving.

◆ Current amplification to drive an output device

Use a transistor matched to the power requirements of the output device.

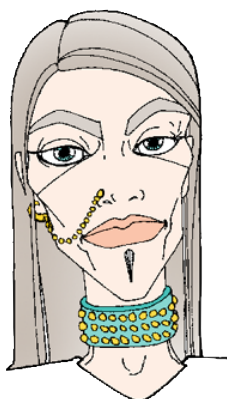


Electronics Design Guide 7: Electronic novelties and toys

A toy or novelty should be fun and amusing. The electronics don't have to be complex. You can use input and output components in unusual ways. Use the special features of electronics – small size, low cost and range of different outputs.

Situations

Use electronics to create something that's a bit different, incorporating electronics into everyday objects.



Sensing input signals

In an electronic musical instrument the inputs to the system will be used to choose the notes or sounds. Think of ways of 'playing' the instrument that are unusual. For other toys the inputs will depend on the purpose of the device. Think of ways of surprising or intriguing young children with inputs. With novelty devices the inputs can be hidden to make the device operate unexpectedly.

Producing output signals

As with other features of a novelty device, look for ways to use outputs in unusual or surprising ways.

Electronic processing

A special feature of many novelty devices is the need to keep the electronics very compact. One way to do this is to use specialist components that contain most of the circuit you need on an IC. For example:

◆ Melody, sound and noise generators

These have one or more tunes (or other sounds) pre-programmed into them. They can often directly drive a piezo transducer or, with a few extra components, a loudspeaker.

◆ Voice record and play back ICs

These can record/playback a few seconds of audio. Some versions allow for a delay or echo to be added to the playback.

◆ Organ IC

Will play a small range of notes (typically 15). Some ICs also have built-in tunes and the ability to record short sequences from the keyboard.

◆ Function generators

Used to create waveforms over a wide range of frequencies. Can be used to generate audio tones.

◆ Display driver for bar graph display

To drive 10 LEDs as a bar display, use a '3914' IC.

◆ Counters

Used with a pulse generator a counter will produce a repeating sequence that can be used to drive LEDs.