LEVEL CROSSINGS

This kit is available from:

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for pricing and postage.

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On almost every model railway there is at least one place where road and rail cross. If prototype practice is to be followed, some way of making the crossing safe is needed.

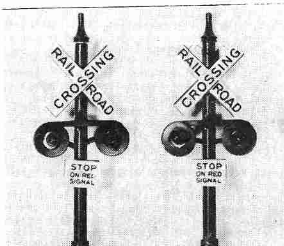
There several ways of doing this, including gates, booms and crossing lights.

Modelling gates is fairly simple, as they are available as plastic kits, but making them operate is quite difficult, as complex gearing is needed.

Operating booms have been approached in several different ways. The simplest uses the weight of the train pressing on a small bar under the track to mechanically hold down the booms. The main problems with this system are that the booms only close when the train is actually on the crossing, and often only the engine is heavy enough to hold them closed.

Booms can also be actuated by solenoids or motors. For the automatic operation of these, sensors will be required to detect the presence of the train.

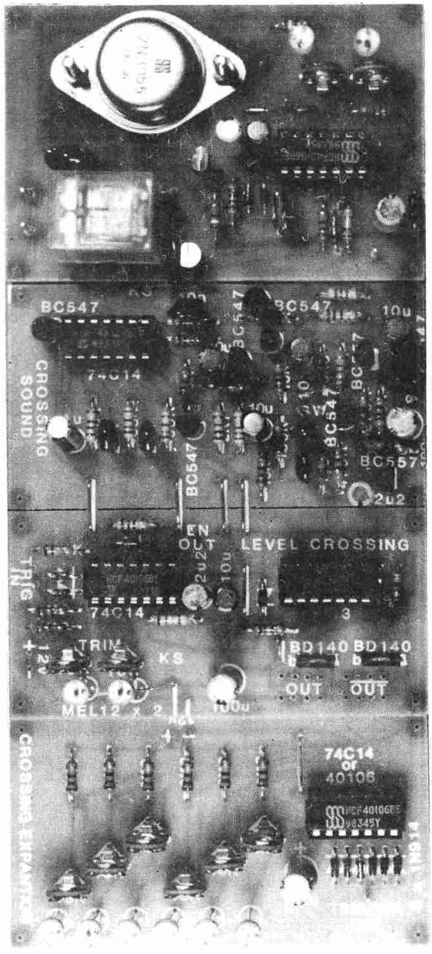
Flashing crossing lights are another option and these require no mechanics, however they are often used in conjunction with booms.



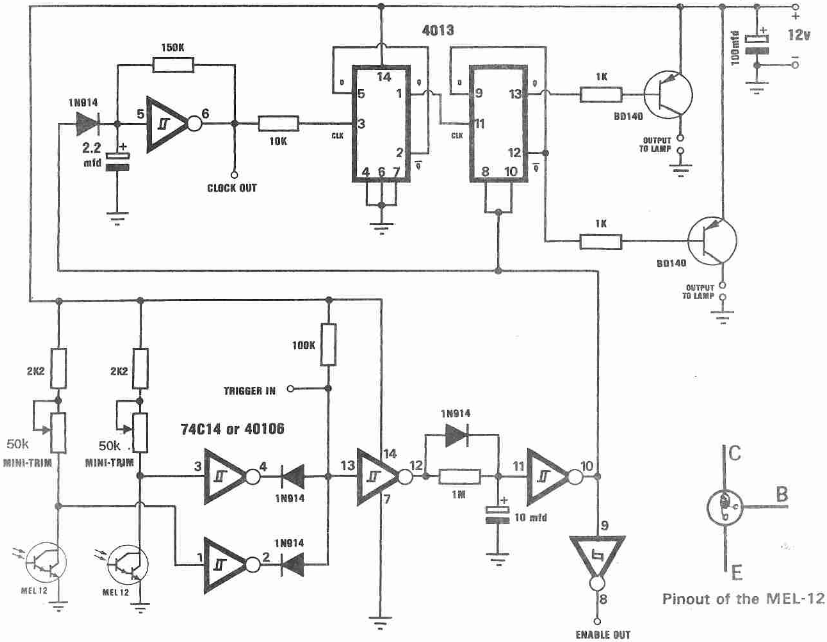
This photograph shows a pair of commercial railway crossing signals. These signals are available at most model railway stores.

The electronics required to alternately flash two lamps is simple. Two-transistor multivibrators are available for around ten dollars. They come in small plastic or epoxy cases and can drive one or two crossing lights but the only way of switching them on and off automatically is to connect them to a spare set of contacts on a relay used in an automatic block signalling circuit.

Presented here is a fully automatic light flashing unit that can detect trains coming from both



Actual size photograph of the four modules of the Level Crossing system.



This is the circuit diagram of the Level Crossing. You may not see the necessity of all the parts. They are used when the unit is expanded.

Pinout of the MEL-12

directions on one track or one direction on each of two tracks. It can be expanded to cover four tracks in both directions.

A crossing bell sound option can be added, as can an operating boom device. The bell sound and boom control do not work well together, as the motor driving the booms creates a lot of electrical noise, especially when driven by a pulse speed controller.

Some people may find a quieter mechanism for driving the booms than the one mentioned in this article. Isolated power supplies and shielding could be used to reduce the noise level.

The circuit will be described in several different stages, as each option is made on a separate PC board. The first stage will be the flashing light unit and automatic control.

How it works.

This unit is based on the 74C14 schmitt inverter and a 4013 dual D flip-flop. The operation is quite complex so it will be described in sections.

The first section is the train detection circuit. The track sensor is placed on the approach to the crossing so that the train will activate it before it arrives at the crossing.

Each sensor is an MEL-12 darlington photo-transistor. The sensitivity can be adjusted using the trimpots that feed the photo-transistors. The output from the junction of these is taken to the input of a schmitt inverter which is part of an OR gate.

When light falls on the MEL-12 it conducts, pulling the input of the schmitt inverter low. If a train covers the MEL-12 making it dark, it turns off and the input of the schmitt inverter is pulled high by the trimpot.

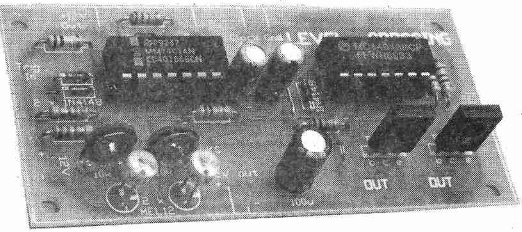
The outputs of the MEL-12 photo-transistors are OR gated together by three schmitt inverters two diodes and a 100K pull-up resistor. This complex type of OR gate was chosen because it had to be easily expandable and have schmitt inputs.

The output of the OR gate is fed into a delay circuit consisting of a diode, a 1M resistor, a 10 mfd electrolytic and a schmitt inverter.

When the output of the OR gate goes high, indicating the presence of a train, the 10 mfd capacitor is charged quickly by the diode. As long as there is a train over either photo-transistor, this capacitor will be held charged through the diode. This will hold the output of the schmitt inverter in the delay circuit low, thus enabling the oscillator and the second D flip-flop of the 4013.

The output frequency of the oscillator is divided by two in each of the flip-flop stages of the 4013 and the complementary outputs of the second stage are fed to the two buffer transistors that drive the lamps.

When the train is no longer over the MEL-12, it switches on and pulls the input of the OR gate low. When both inputs of the OR gate are low the output will also be low, and the 10 mfd electrolytic will discharge through the 1M resistor. After about 15 seconds the output of the schmitt inverter in the delay (pin 10) will rise, disable the oscillator and jam the outputs of the second stage of the 4013 HIGH. This will switch off both output transistors.



Construction

All components of the level crossing project except for the MEL-12 photo-transistors are mounted on a 4cm x 8.5cm PC board. Check that the trimpot leads will fit down the holes on the PC board. If not, enlarge them. Solder in the links first, then the diodes and resistors. Next solder in the IC sockets. The usual care should be taken with the orientation of the electrolytics.

The BD140 transistors are mounted with their metal faces toward the edge of the PC board. Solder in the trimpots and insert the ICs.

You can now test and adjust the unit. Solder in the MEL-12 phototransistors as shown in the photograph. The base leads may be cut short as they are not used. Wire a lamp to each output and connect the unit to 12 volts. This unit has no diode protection so care must be taken with polarity.

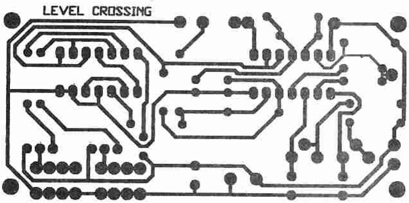
Place the unit in an area that is lit similarly to your model railway. Set both trim-pots to the centre of their travel. Cover one of the photo-transistors. The lights should start flashing. If they don't, adjust the corresponding trimpot until they do. Uncover the photo-transistor. After about fifteen seconds the lights should stop flashing. If they don't, try the adjustment again. The adjustment for the second photo-transistor is the same. To make adjustment easier, the 10 mfd electrolytic can be temporarily removed from the delay circuit. The unit will require a final adjustment when mounted on the layout.

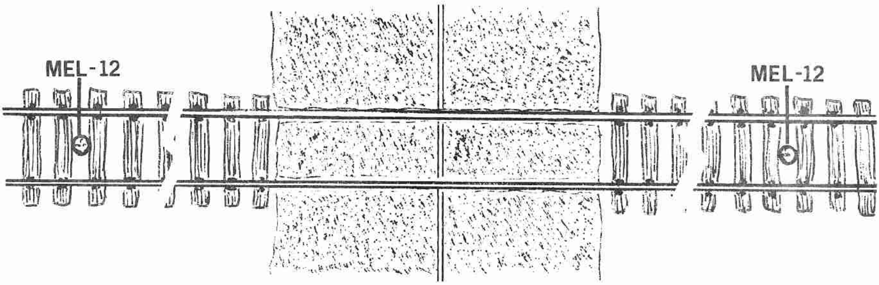
Four lamps can be driven off each output because medium power transistors have been used. They will not be in continuous use so heatsinks are not necessary.

The MEL-12 photo transistors are set between the sleepers of the track. If there is not enough ambient light, mount a street light near the photo-transistor.

A photo-transistor is needed only in the approach to the crossing, as the delay will allow enough time for the train to pass before the lamps stop flashing. If the trains travel along the track in both directions, a photo-transistor will be needed on both sides of the crossing. There should be 15 to 30cm gap between the crossing and the photo-transistor, depending both on scale and the speed at which the trains travel.

The unit is not limited to spanning one bidirectional track or two single direction tracks. The next circuit allows it to span four bidirectional tracks.





The MEL-12 sensors are placed on either side of the level crossing if bidirectional traffic travels along the track. The distance between the sensor and the level crossing should be between 15 and 30cm.

If trains travel along the track in one direction only one sensor is needed because the delay in the circuit will allow enough time for the train to pass.

Level Crossing Parts List

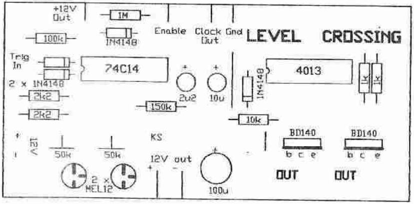
2 - 1K
2 - 2K2
1 - 10K
1 - 100K
1 - 150K
1 - 1M

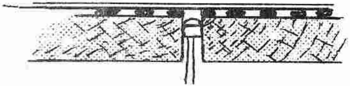
2 - 50k mini trim pot

1 - 2.2 mfd electro
1 - 10 mfd electro
1 - 100 mfd electro

4 - 1N914 diodes
2 - BD140 transistors
2 - MEL12 Darlington phototransistors
1 - CD40106 or 74C14
1 - CD4013

2 - 14 pin IC sockets
1 - Level Crossing PCB





To mount the MEL-12 phototransistors, drill a hole between the sleepers. Push the MEL-12 up the hole from below and secure it with some tape. With it connected to the circuit, adjust its position in the hole so that only light from directly above will fall on the cell. If light falls on the cell from too low an angle, the train will not have enough shaddow to trigger the unit.

It is important to remember that it is not light but shaddow that triggers the unit. When adjusting the unit, make sure all cells you are not adjusting are well lit. If they are not lit they will trigger the unit, making adjustment impossible.