HEX TRAIN SENSORS

This kit is available from:

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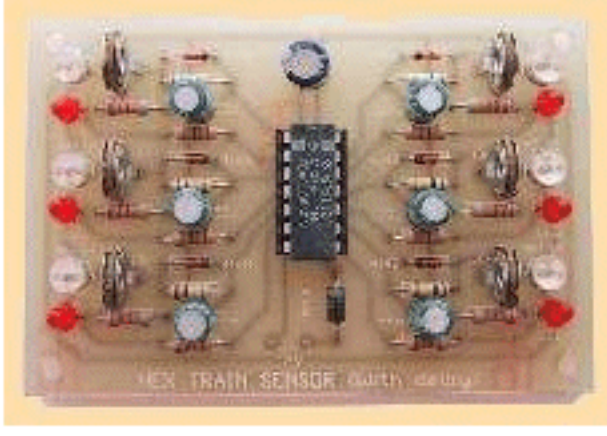
for pricing and postage.



TRAIN DETECTORS

Two simple light activated train detectors that can be used to trigger other circuits or to drive LEDs on a remote panel.

On a large model railway with numerous tunnels and stretches of track that are hidden from the operators view, knowing exactly where a train is can be a problem. This is why train detectors were invented.

Train detectors have been used for years on real railways for the same reason.

There are two train detectors presented in this article. One is simple and cheap. The other offers better operation but at a higher price.

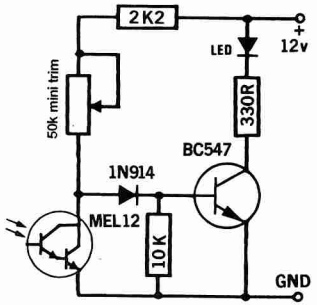
The first train detector PC board has provision for five of the simpler sensors. The board can be cut up and the sensors separated if required. Each sensor consists of three resistors, a trim pot, a diode, a transistor, a LED and a darlington photo-transistor. This photo-transistor is an MEL-12.

How each detector works

Normally the MEL-12 will be placed between the sleepers of the track in a position where light falls on it. The trimpot should be adjusted to a value where this amount of light is enough to switch the MEL-12 on hard enough to pull LOW the voltage at the juntion of its collector and the trim pot. This voltage is fed through a signal diode to a transistor.

The purpose of the signal diode is to drop the voltage from the junction of the MEL-12 and the trim pot by .6 volts to make sure the transistor switches off when the MEL-12 is conducting. When darkness covers the MEL-12 (a train is blocking the light) it switches off, allowing the trimpot to pull the base of the transistor HIGH. This turns the transistor on which in turn drives the LED. A relay could be driven if connected across the LED and resistor. A protection diode would be needed to stop the back EMF from the relay coil damaging the transistor.

Usually neither the LED or the MEL-12 will be mounted on the PC board. The MEL-12 will be between the tracks as mentioned previously, and the LED will be on a display panel remote from the layout. For this reason the LEDs are wired as a common anode display. Only the cathode of the LED need be taken back to the Train Detector PC board. All the anodes can be connected to positive.



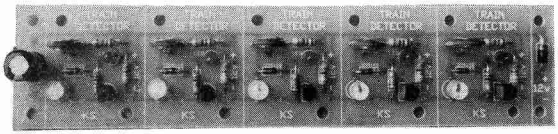
This is the circuit diagram of the simple sensor. There are five of these units on the Train Detector PC board. If the detectors are to be used in a poorly lit area, the sensitivity can be increased by replacing the 10K pot with a 50K pot, or by increasing the value of the 2K2 stop-resistor.

Construction

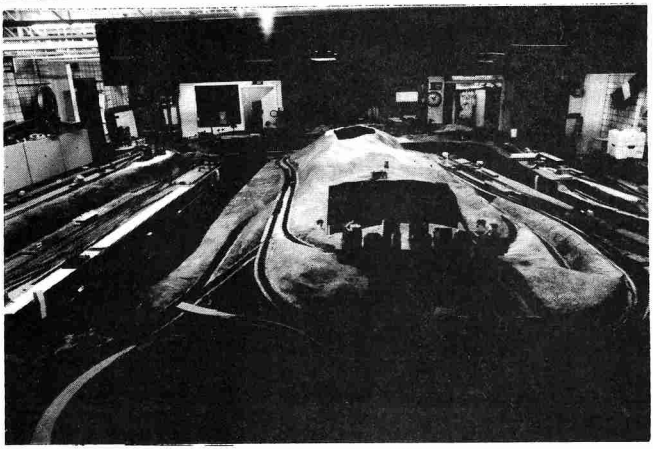
Check that the holes for the five trimpots are large enough. If not, enlarge them a little with a drill. Solder in all the resistors and diodes first, followed by the electrolytic, the trimpots and the transistors.

The LEDs and MEL-12s may be tacked into position for testing purposes but it is not necessary, as the circuit can easily be aligned when installed into the layout.

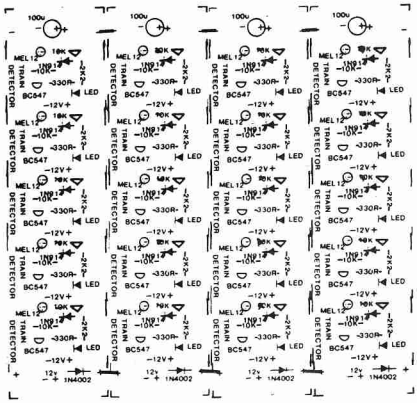
The board has been designed in such a way that several of them can be mounted side by side. The power rails between boards can then simply be connected using very short links, making



There are five detector circuits on the simpler Train Detector unit. They may be separated if necessary.



On a large layout with tunnels and hidden stretches of tracks, it is difficult to know the location of one train, let alone several. Signals, point positions and train locations are all indicated on the track plan above the layout at the Victorian branch of AMRA.



Train Detector Parts List

5 - 330R
5 - 2K2
5 - 10K

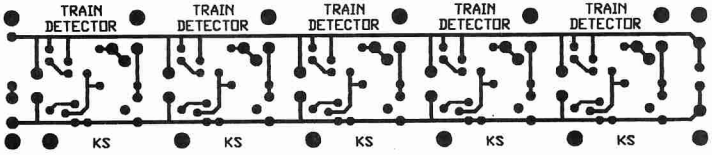
5 - 50k mini trim pot

1 - 1N4002 diode
5 - 1N914 diode
5 - 5mm LEDs
5 - BC547 transistors
5 - MEL-12 photo-tran.

1 - 100 mfd electro

1 - Train Detector PCB

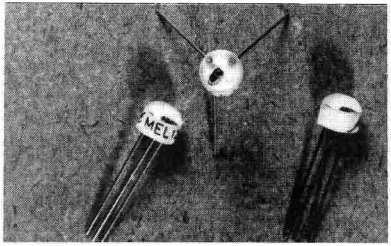
LEFT: The Train Detector boards can be mounted side by side with the power rails connected by short links. This makes centralized mounting very neat.



centralised mounting neat. Of course the LEDs and MEL-12s would have to be connected via long leads.

The LEDs can be mounted on a panel displaying the track plan of your layout, to give an indication of the location of your trains.

The MEL-12s should be mounted between the tracks about a train length apart, so that there is always a LED lit on the panel.



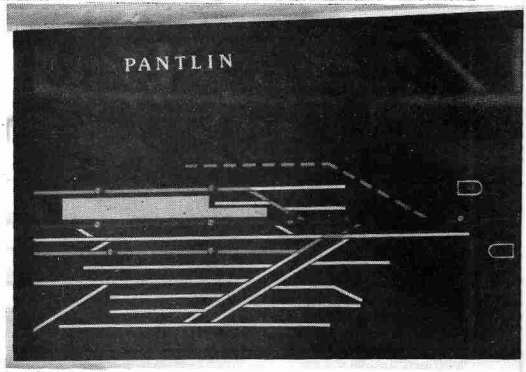
Three MEL-12 photo-transistors. The darlington transistor can be seen inside the top of the device. The collector is the lead with the transistors mounted on it. Fine wires join the other leads to the transistors.

The Train Sensor with Delay

Although this is the more complex of the two sensors, it is still very simple. It is based on the 74C14 hex Schmitt inverter. As each sensor only needs one inverter, there are six sensor circuits on the PC board, thus the name 'Hex Train Sensor (with delay).'

How it works

When light is falling on the MEL-12, it switches on, pulling the input to the delay circuit LOW. The capacitor will be charged slowly via the 100K



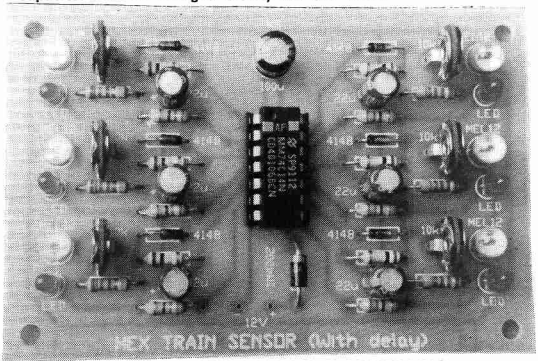
A close up of the track plan, showing the LEDs.

resistor. When the voltage on the capacitor reaches the lower threshold of the Schmitt inverter, its output will go high and switch off the LED. This indicates that there is no train above the sensor.

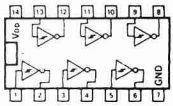
When a train does pass over the MEL-12, its shaddow switches off the MEL-12. The 22mfd capacitor then rapidly discharges through the 1N914 diode, and the trim-pot and its stop-resistor. This pulls the input of the Schmitt inverter HIGH. The output of the Schmitt inverter then falls LOW and switches on the LED.

When the train has passed and light falls on the MEL-12 again, it switches on and slowly recharges the 22 mfd capacitor.

The result is that the LED will switch on as soon as a train covers the MEL-12, but will remain on for a short while after it has passed. This is so the gaps



The LEDs and MEL-12 photo-transistors were mounted on the PC board to test the Train Sensors. The 10K pots can be placed with 50K pots if more sensitivity is needed.



Pinout of the 74C14

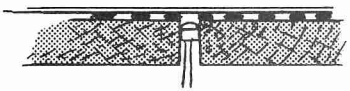
between the wagons or coaches on a train will not cause the LED to flicker as occurs on the first sensor described.

It is important to note that this circuit can not drive a relay directly. This is where the Remote Relay Unit would be ideal.

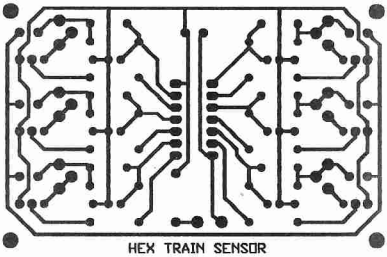
Construction

The Hex Train Sensor is a repetitive circuit. Excluding the 74C14, the power diode and the 100 mfd electrolytic, every other component is present six times on the PC board.

The first component to install is the IC socket. Then solder in all of the low components. The trim-pots are next, followed by the electrolytics. The LEDs and MEL-12s need not be installed unless you want to test the unit before wiring it into your layout. Quick connect terminals would help greatly in both the wiring and testing of the unit, as one LED and one MEL-12 could be tried on each Sensor in turn. The base lead of the MEL-12 is not needed, so it can be trimmed short.



To mount the MEL-12 photo-transistors, 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 MEL-12. If light falls on the MEL-12 from too low an angle, the train will not have enough shaddow to trigger the unit. It is important to remember that it is darkness that triggers the train sensors. Disconnecting the delay capacitors while aligning the unit will make the job a lot easier.



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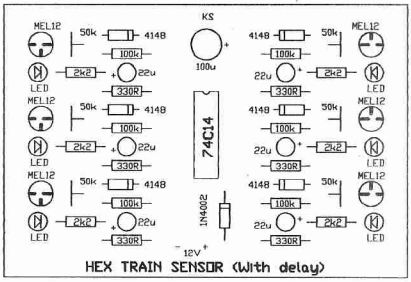


HEX TRAIN SENSOR (With delay)

Hex Train Sensor (with delay)

Parts List

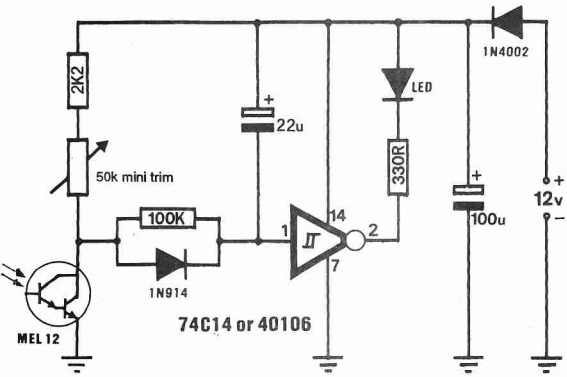
6 - 330R
6 - 2K2
6 - 100K

6 - 50k mini trim pot

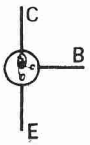
6 - 22mfd electro's
1 - 100mfd electro

6 - 1N914 diodes
1 - 1N4002 diode
6 - 5mm LEDs
6 - MEL-12 photo-trans.
1 - 74C14 chip

1 - 14 pin IC socket
1 - Hex Train Detector (with delay) PCB



The 100 mfd electrolytic and the 1N4002 power diode are common to all of the sensors on the PC board, as are the chip's power rails. Look at the pinout of the 74C14 for the connections to the other schmitt inverters.



Pinout of the MEL-12