TROUBLESHOOTING

The following table gives guidance on resolving some of the problems that you may encounter when becoming familiar with the TT 302. Before using this table, please ensure that:-

- You have followed all the above instructions that are relevant (i.e. for DCC or non-DCC operation).
- The unit is wired exactly as shown in these instructions, as appropriate for your application.
- All electrical connections are sound.
- All wiring is undamaged.

PROBLEM	PROBABLE CAUSE(ES)	SOLUTION(S)
No occupancy detection.	Power supply, or DCC system, faulty or turned off.	Turn on power supply or DCC! Rectify supply fault (consult DCC manual as appropriate).
	Power supply or DCC system shut down due to fault (e.g. short circuit) elsewhere on layout.	Connect and test TT 302 and signal independently from layout. Correct layout fault.
	Insufficient voltage between "PWR" and "RET" terminals.	Check power supply or DCC source – should provide at least 7V. Check wiring – correct if necessary – see page 2.
	Erroneous connection bypassing the "SNS" and "RET" terminals.	Check and correct wiring – see page 2.
Block occupancy does not change the aspect on a signal driven by a TT 301 Digital Signal Decoder.	"In0" on TT 301 incorrectly driven.	See pages 2, 3, 4 & 5 *of this manual* in conjunction with the TT 301 User Guide. Check all connections and ensure that no additional circuitry can interfere with the TT 302/TT 301 inter-connection.
	Problem addressed above.	
Intermittent occupancy detection.	Dirty track or train wheels with occupancy detectors in use.	Check, and clean, all track and wheels.
False occupancy detection.	Strong electrical interference present.	Ensure that any DCC power feed wire-pairs are twisted.
		Try to locate, and eliminate or minimise, the source of interference (e.g. Poorly suppressed electrical tool? Mobile telephone? Nearby radio transmitter?). Ensure that all locomotives have their motor suppression components fitted (as supplied by the manufacturer).

Block Occupancy Detector: Full Instructions
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WARNING

- The human body can generate static electricity which can damage electronic equipment – HANDLE THE TT 302 BY THE CIRCUIT BOARD EDGES ONLY!
- For INDOOR use only.
- The TT 302 is not suitable for use by children under 14 years of age unless supervised by an adult.

Refer to fig. 1

The TT 302 is an electrical *current sensor* designed to detect the presence of a model train within a section of track. It will drive a Traintronics model railway colour-light signal, in order to provide automatic signal "replacement", using either *digital command control* (DCC) or "conventional" (AC or DC) power supplies.

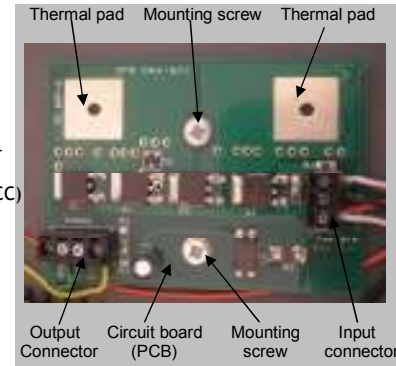

Fig 1: TT 302 General Arrangement

Mounting the unit

We recommend mounting the TT 302 onto a wooden surface (e.g. underside of baseboard) using two 2.5mm diameter wood screws as shown in fig.1.

WARNING

- The unit MUST NOT make contact with any electrically-conductive parts!
- DO NOT OVERTIGHTEN the screws. **Under no circumstances must the pcb be flexed or distorted**

Heatsinking

For scales larger than OO (or HO) the larger currents drawn through the unit **may** cause some of the components to run hot. In this case you may need to mount a heatsink on each of the ***"thermal pads"*** shown in fig. 1. A strip of aluminium about 80mm X 10mm – 1.0 to 1.5mm thick – should be suitable for each heatsink. Each strip should be bent into a "U" shape and mounted onto its respective thermal pad using an M3 nut, bolt and washer.

The TT 302 does not require heatsinks when used with OO/HO, or smaller, scales.

Wiring

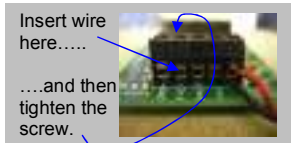

Fig. 2: Making connections

Fig. 2 shows how to make electrical connections to the TT 302. Use stranded insulated wire, of 7/0.2mm size, with about 6mm of insulation stripped from the end. However, for scales larger than OO (or HO) gauge, we recommend using 16/0.2mm wire for the "PWR", "SNS" and "RET"
(input) connections as the wire will need to carry a larger current. Your Traintronics dealer should stock suitable wire. MAKE FIRM CONNECTIONS BUT DO NOT TRAP THE WIRE INSULATION!

Wiring Diagrams

The input terminals are:	"RET"	- Power **return** to power supply or DCC booster
	"SNS"	- Current **sense** from track
	"PWR"	- **Power** from supply or DCC booster (also feed to track)
The output terminals are:	"GND"	- **Ground**, or *common*, for occupancy indicator or signal decoder
	"OUT"	- **Output** to occupancy indicator or signal decoder
	"I-1"	- Intermediate output 1 – (for Traintronics TT 301 decoder)
	"I-2"	- Intermediate output 2 – (for Traintronics TT 301 decoder)

These are labelled with white printing on the circuit board.

Fig. 3 shows the usual configuration for operation under DCC. We recommend using a Traintronics colour-light signal driven by a TT 301 Decoder module. You will then have full control over the signal from your DCC command station BUT the signal will be automatically replaced to "danger" when a train occupies the *block section* between the two *isolation gaps*.

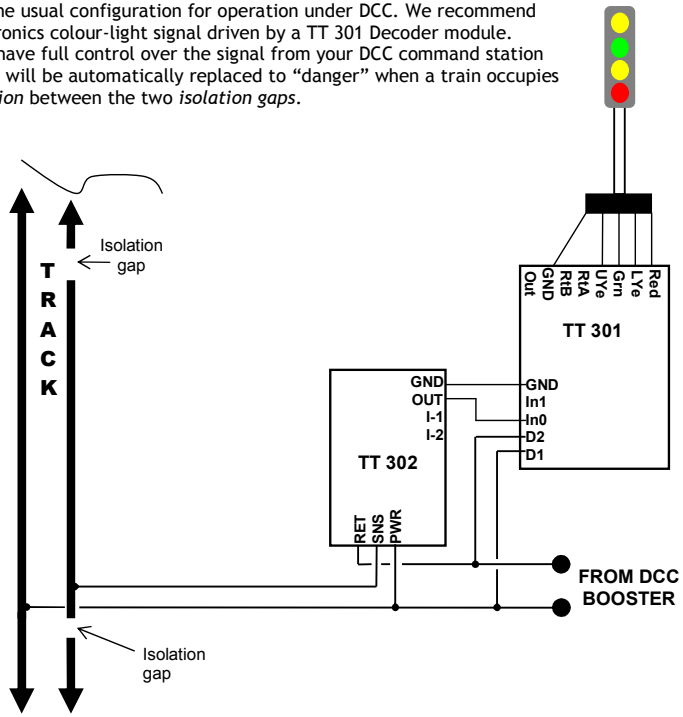

Fig. 3: Connection of the TT 302 to a TT 301 Signal Decoder for DCC use.

NOTE:-

- The *block section* – i.e. the distance between the two isolation gaps – should be at least as long as the longest train running on your layout.

- The TT 302 relies on *current consumption* between the rails in order to detect block occupancy. Therefore – in addition to the locomotive - the rearmost vehicle on the train should draw some current and this is usually achieved by fitting a *resistive wheel-set* to that vehicle. Your Traintronics dealer should be able to help in this respect ("multiple unit" trains will probably have lights in the rear car and the current drawn by these will trigger the occupancy detector without modification to the train).

Block Occupancy Detector: Full Instructions
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Interconnection of Several Multiple-Aspect Signals

The following scheme provides the closest simulation to the track circuiting which is extensively employed on full-size railways. Each signal on your layout can have its own TT 302, along with an associated isolated track section, and the TT 301s on a particular "road" can be "daisy chained" as shown below in fig. 7. Each signal will then display RED, YELLOW, DOUBLE-YELLOW and GREEN in sequence as a train passes the signal and progresses through the block sections in advance of it.
Any number of TT 301s, TT 302s and signals may be interconnected in this manner.
NOTE: It is possible, and indeed advisable, to supply the TT 301 "D1/D2" and TT 302 "PWR/RET" inputs from a separate DCC accessory supply rather than from the actual track. **Signal operation will then be retained in the event of a short circuit on the track.**
SEE THE TT 301 USER GUIDE FOR FURTHER DETAILS.

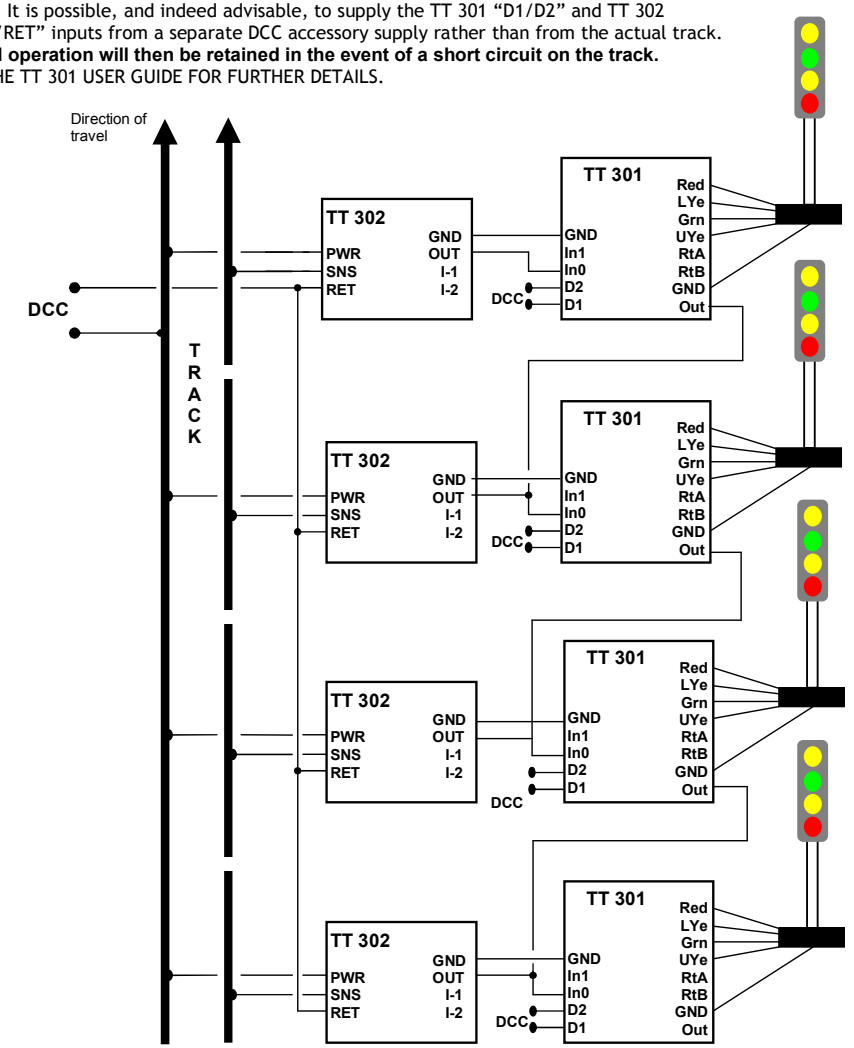

Fig. 7: Four Block Sections with Interconnected TT 302s and TT 301s.

Non-DCC Operation

The TT 302 can be used on "conventional" layouts, **without DCC**, BUT with the following provisos:-

- A continuous source of power must be supplied between the "PWR"/"RET" terminals of the TT 302, and between the "D1"/"D2" terminals of the TT 301.
- When stopping the train, do not turn the speed controller completely off but leave a small amount of power applied to the track. This ensures that a tiny current will flow through the locomotive's motor – sufficient to trigger the TT 302 but not enough to overcome the friction of the motor.

Fig.4 shows the wiring of a TT 302 for operation without DCC.

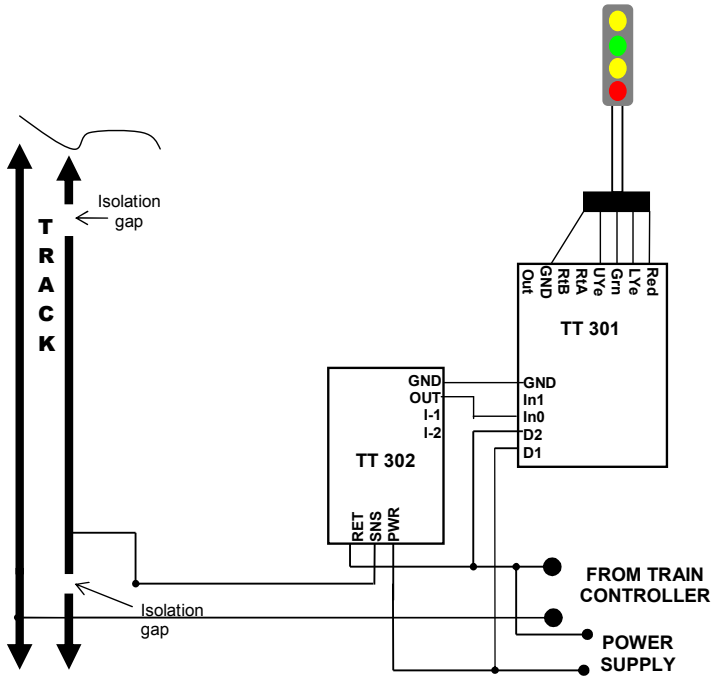

Fig. 4: Connection of the TT 302 to a TT 301 Signal Decoder for use without DCC.

The characteristics of the power supply should be:-

- ALTERNATING CURRENT (AC). This is to ensure that occupancy detection occurs irrespective of the direction in which the train is driven.
- Voltage between 9 volts to 18 volts. DO NOT EXCEED 24V.
- Available current 0.02amp (20mA) for each TT 302 connected to the supply (e.g. 50 TT 302s could be powered from a supply rated at 1 amp).

Many model train power controllers provide an "auxiliary" 16volt AC outlet in addition to the variable DC output used for speed control. This 16V AC supply provides an ideal power source for the "PWR-RET" supply on the TT 302. Alternatively, a separate transformer may be used.

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Driving a Simple Indicator from the TT 302

The Block Occupancy Detector can be used to drive an indicator lamp – for example, on a track diagram – to show the position of a train. To use an indicator, please bear the following points in mind:-

- **The indicator MUST be a *light emitting diode* (LED).** The TT 302 does not supply sufficient current for other types of indicators.
- The LED must be connected correctly as it is *polarity-sensitive*. The photograph in fig.5 below shows how to identify the ANODE and CATHODE leads of a typical LED.
- The LED must have its *anode* connected to the **positive** side of a DC power supply via a current-limiting resistor. The LED *cathode* must be connected to the "OUT" terminal on the TT 302 *output connector*. Fig.5 should make this clear.
- The value of the current-limiting resistor needs to be chosen to suit the power supply voltage. A resistor value of 4.7kohm is suitable for a 12V supply.

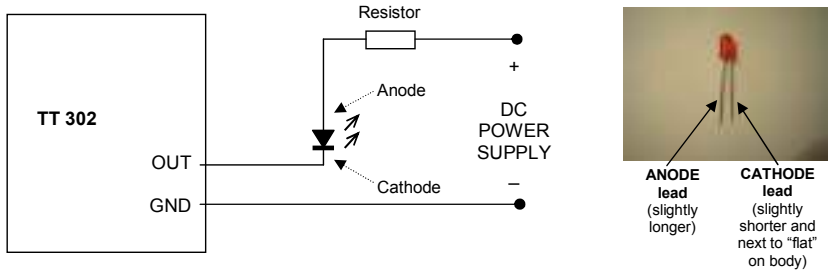

Fig.5: Connection of light emitting diode "occupancy" indicator

Automatic Control of Multiple-Aspect Signals

The "Intermediate" outputs, "I-1" and "I-2", can be used to drive a TT 301 Signal Decoder so as to obtain either a ***caution*** (yellow) or a ***preliminary caution*** (double yellow) aspect on a colour light signal. Fig.6 below shows the use of three TT 302s – each associated with its own block section – driving a single Signal Decoder. Notice, however, that a different output is used from each Occupancy Detector such that the signal aspect will change in the sequence RED, YELLOW, DOUBLE-YELLOW, GREEN as the train progresses through the block sections. The "I-1" output forces a yellow aspect and the "I-2" output forces a double-yellow.

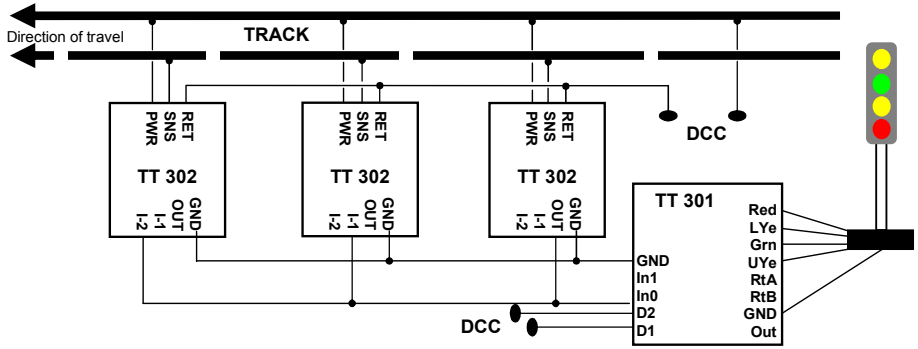

Fig. 6: Multiple Aspect Sequencing using "In0" on the TT 301 Signal Decoder.