Absolute / Permissive Block Simulator

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IMPORTANT NOTE

This circuit board does not provide any isolation between the user and the electrical circuits. It must be connected to a supply which is safe to touch, through being limited in both voltage and power.

DO NOT connect it to the mains.

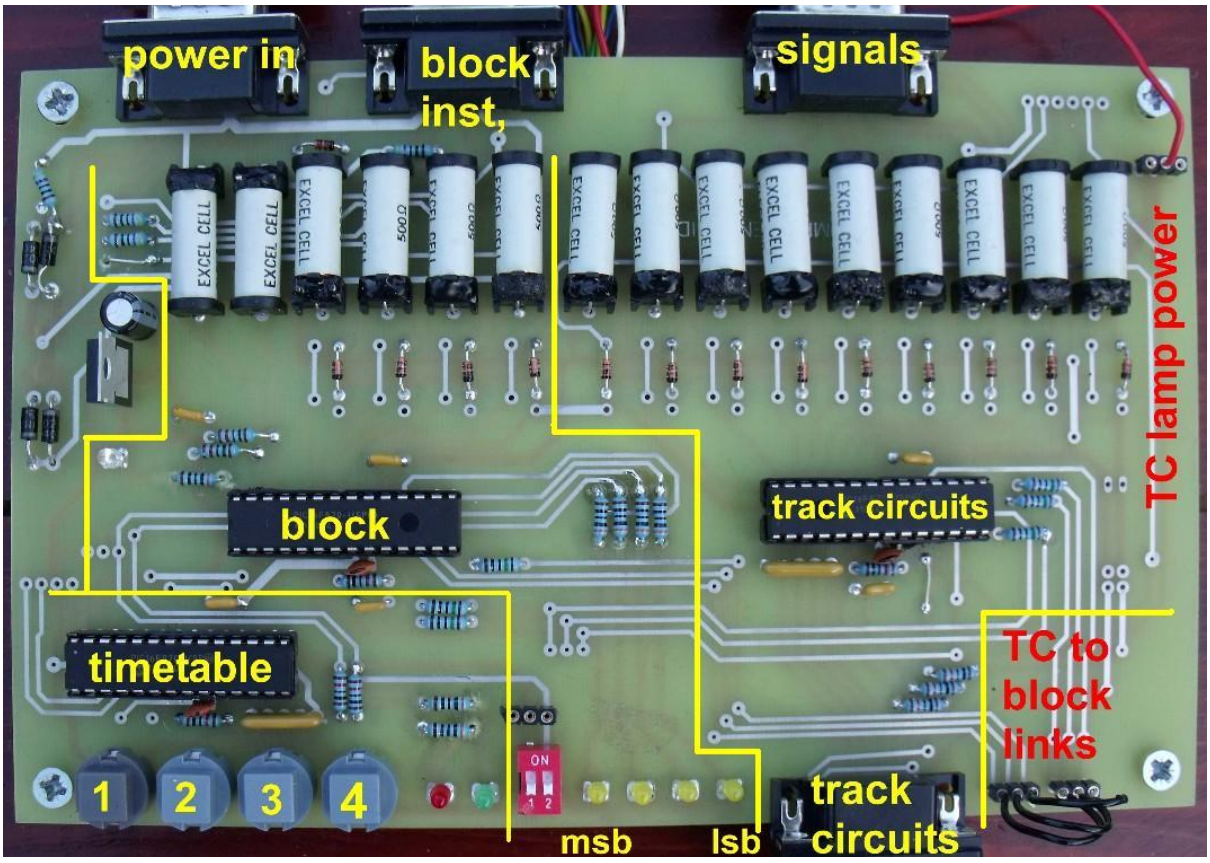
DO NOT operate it on a conducting (e.g. metal) surface.

DO mount it so that the board is held clear of any surface.

DO make sure the input voltages have the correct polarity.

DO make sure you connect the input power to the correct socket (if you don't you'll destroy the TC chip).

General layout of board



The circuit is built around 3 PICs:

Timetable PIC – this holds the timetable (or section of train register). It is associated with 4 buttons (1 to 4) and two LEDS (one red, one green on the above board).

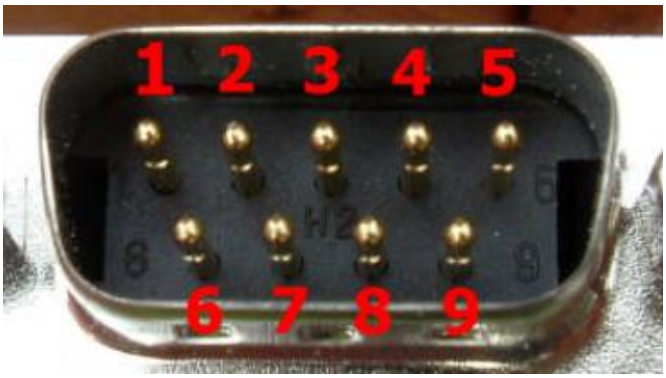
From the timetable chip, trains are 'sent' to the **block PIC** which takes care of block signalling between us and the adjacent signal box. . This block chip is associated with: two switches, four yellow LEDs (for setup and error reporting; in the diagram above msb and lsb denote most and least significant bit, repectively), one orange LED, and six reed relays.

From the block chip, trains are sent to the **Track Circuit PIC**, which looks after the operation of the track indicators. This chip is associated with 9 reed relays.

Finally, the train is sent from the Track Circuit PIC back to a block chip, which may or may not be on the same circuit board. In the above example, the track circuit chip is connected back to the original block chip, so this is a one block instrument setup (i.e. a terminus).

Electrical Connections

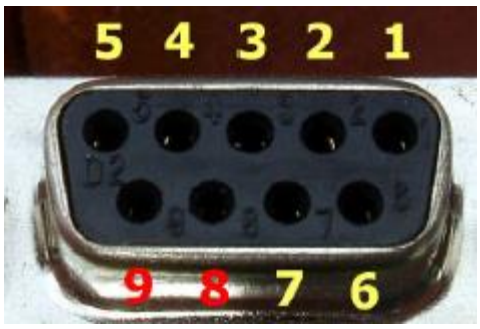
Input Power



D pin 1	**–ve (block)**
D pin 2	**0V (block)**
D pin 3	**+ve (block)**
D pin 4	**0V digital**
D pin 5	**+ve digital (9 to 15V)**

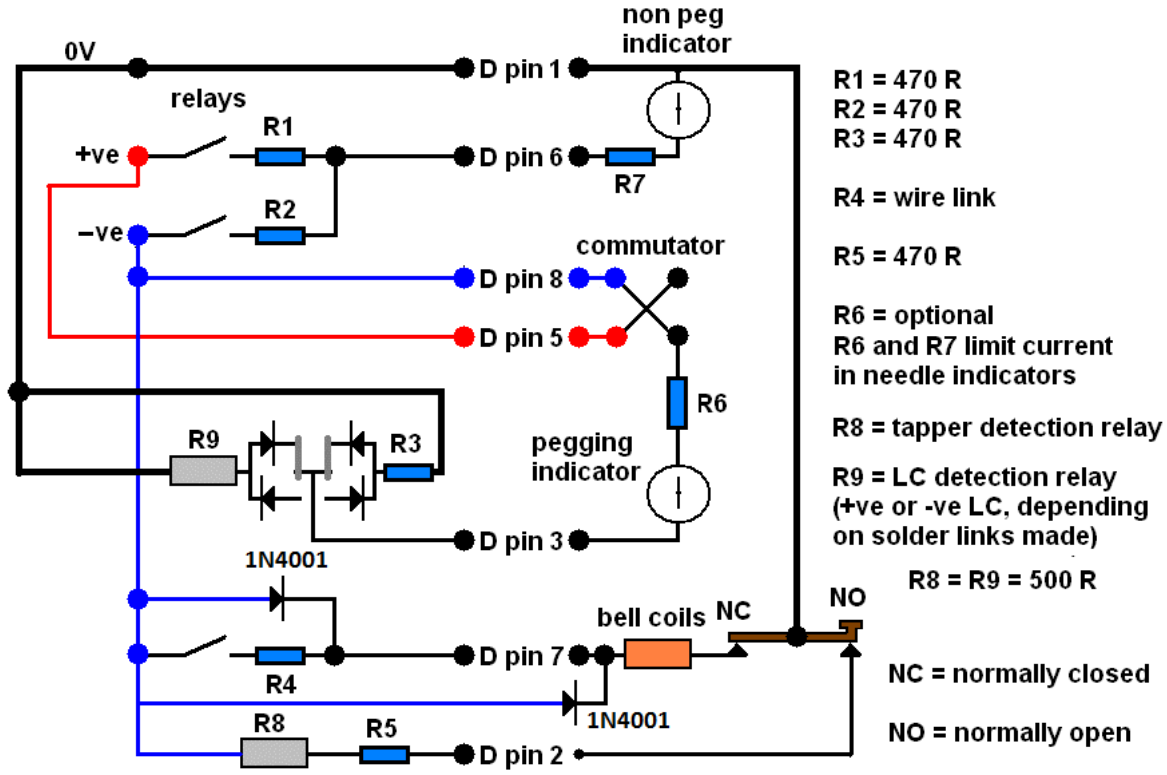
The PICs operate from a 5V DC supply, for which a 7805 voltage regulator is provided on the board. This regulator requires a 9 to 15 V input. You can use an external 5V supply if you wish, but this will require shorting two tracks on the board.

Block Instrument Connections

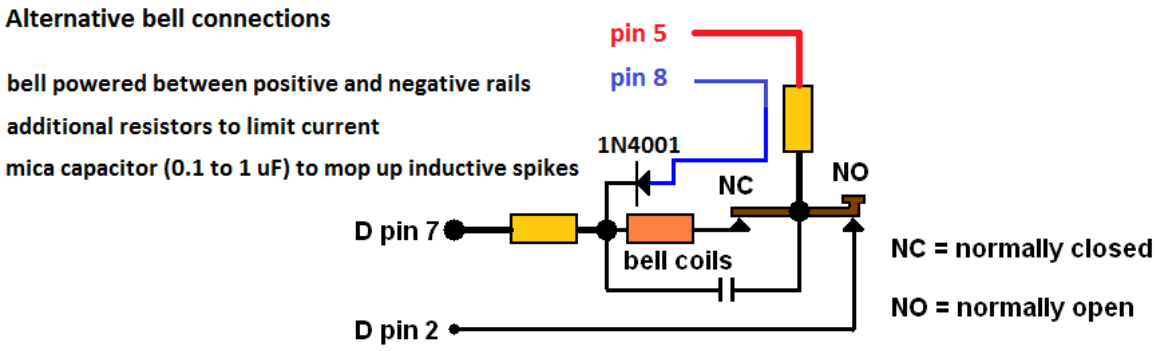


D pin 1	**0V**	
D pin 2	**bell tapper**	input to PCB, line grounded when tapper pressed
D pin 3	**pegging block**	input to PCB*
D pin 4		
D pin 5	**+ve power**	
D pin 6	**non-pegging block**	output from PCB
D pin 7	**ring bell**	output from PCB
D pin 8	**–ve power**	
D pin 9		

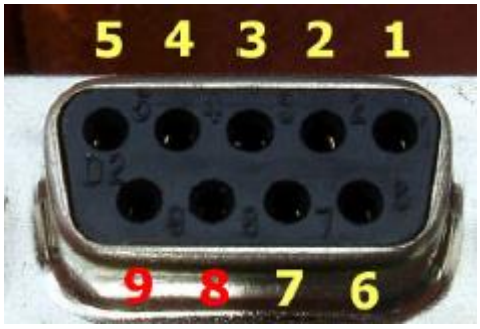
Circuit allows detection of line clear (can be positive or negative, depending on solder links on board). This feature not used in present version of software. **Note the block bell connections – they are different to a conventional block bell. All diodes are 1N4001** (or higher voltage versions thereof).



This circuit was found to be unreliable with some block bells (which required higher voltage) and for these a slightly different circuit was used. The bell is powered between positive and negative rails, additional resistors are fitted to limit the current (and volume!) and a capacitor (mica, around 0.1 uF, but not critical) is used to help mop up inductive spikes.

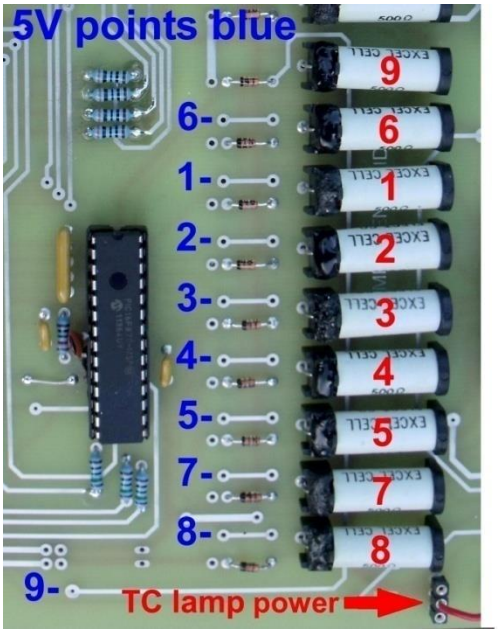


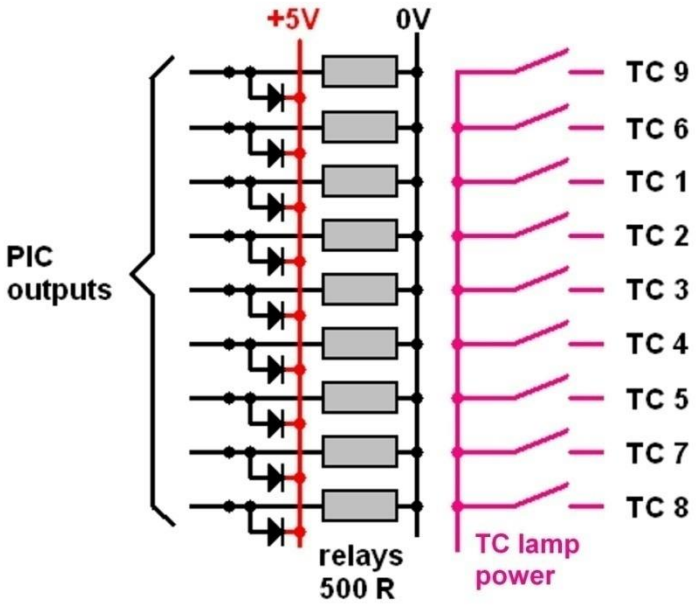
Track Circuit Indicator Connections



D pin 1	**track circuit 1**
D pin 2	**track circuit 2**
D pin 3	**track circuit 3**
D pin 4	**track circuit 4**
D pin 5	**track circuit 5**
D pin 6	**track circuit 6**
D pin 7	**track circuit 7**
D pin 8	**track circuit 8**
D pin 9	**track circuit 9**

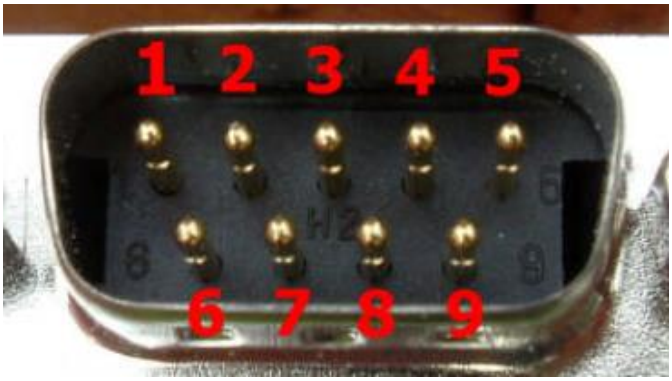
The next image shows the positioning of the TC relays. Relay for TC8 is nearest corner of the board. The 5V (digital) drives to the relays are also accessible on the board (although it will then be necessary to solder a single pin socket into the appropriate hole – see image).





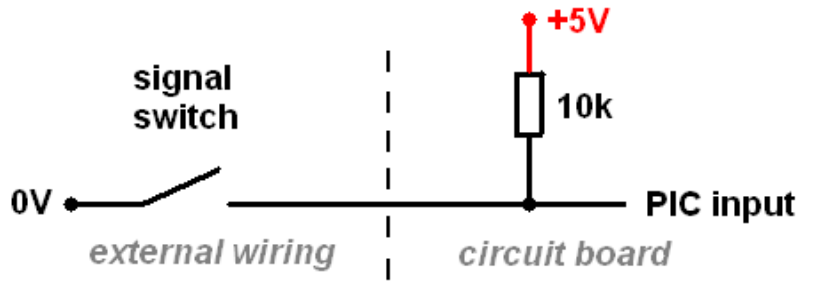
Signal Connections (7 inputs)

This is the simpler configuration, but only allows 7 inputs.



D pin 1	**signal 1**
D pin 2	**signal 2**
D pin 3	**signal 3**
D pin 4	**signal 4**
D pin 5	**signal 5**
D pin 6	**signal 6**
D pin 7	**signal 7**
D pin 9	**digital ground**

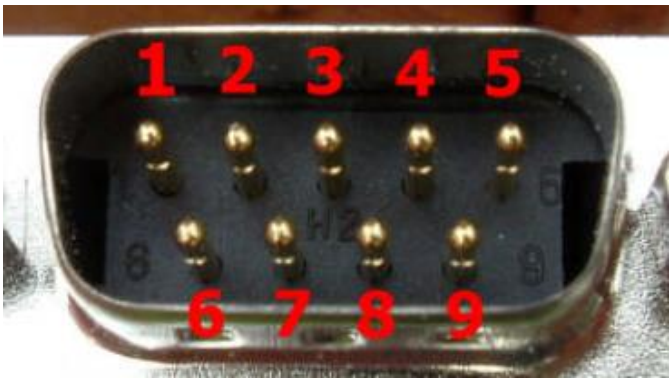
Each of the 7 signal inputs is arranged as follows:



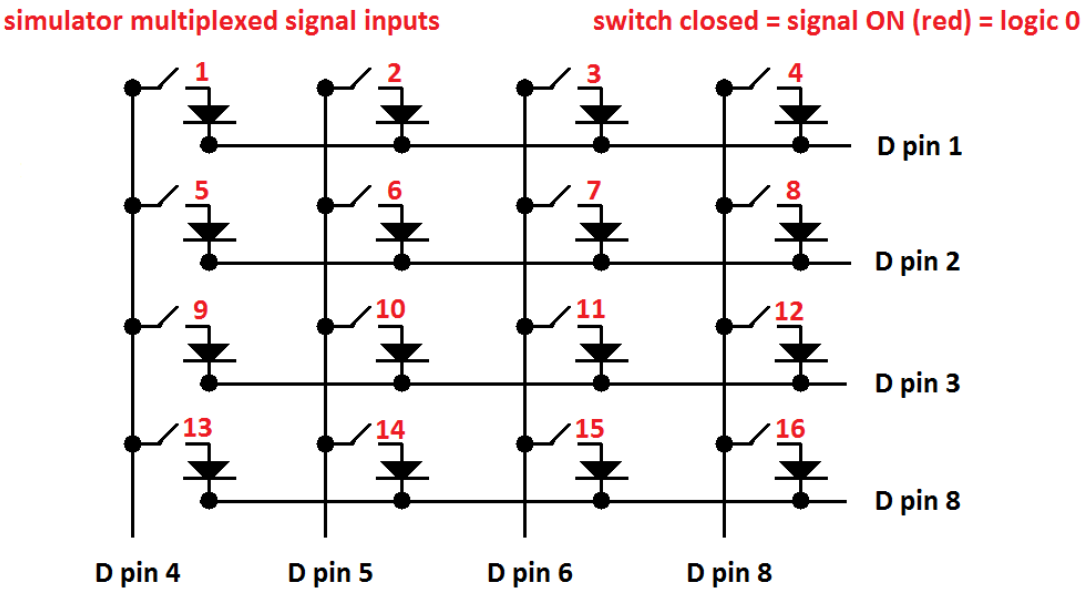
switch open = input 5V = logic high = signal OFF
switch closed = input 0V = logic low = signal ON

Signal Connections (16 inputs)

This configuration allows 16 inputs, but is slightly more complex and uses diode multiplexing. The diodes are not critical; either 1N4148 or 1N4001 are suitable.

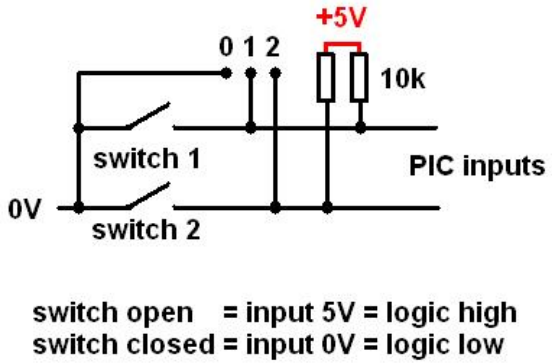


D pin 1	**Ground group A**
D pin 2	**Ground group B**
D pin 3	**Ground group C**
D pin 4	**Signals 1, 5, 9, 13**
D pin 5	**Signals 2, 6, 10, 14**
D pin 6	**Signals 3, 7, 11, 15**
D pin 7	**Signals 4, 8, 12, 16**
D pin 8	**Ground group D**



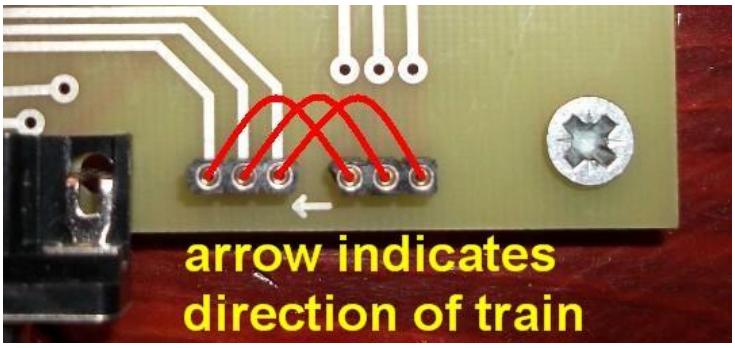
Other stuff

Switches 1 and 2 are used to set the configuration of the Block chip. You can use the switches on the board, or leave this switches open and connect external switches via the terminals shown. Use of these switches to set the configuration is described later.



inter-board connections

Configuration for a terminal station (train goes back to the block post from which it came)



Operation

On power up ...

The orange LED should flash.

Timetable Chip

This has four buttons and two LEDs.

On power up, the chip is in setup mode, where you can set the start time, relative to the start time for the train register. For example, you can start at the beginning of the register, or fast forward a certain amount. Button functions are as follows:

	button 1	**button 2**	**button 3**	**button 4**
setup mode	advance 1 hour	advance 5 mins	reset to start	go to **run mode**
run mode				*fast forward to next train

*press and hold button 4 until the LEDs flash

Block Chip

This has two switches, a group of 4 yellow LEDs and another (orange LED).

The chip has three modes: **set configuration**, **run**, and **set index**.

set configuration mode can only be entered at power up. To enter this mode, both switch 1 and switch 2 should be ON at power up. Then use the bell tapper to set the four configuration bits:

	msb			**lsb**
clear (LED off)	not used	AB advance section	AB rear section	3 wire block
set (LED on)	not used	PB advance section	PB rear section	1 wire block

The default configuration is all configuration bits clear, i.e. absolute block (AB) on both rear and advance sections, and 3 wire block.

If you select permissive block (PB) on rear section, permissive working will apply to *all* trains (i.e. you can't have PB for some types of trains and AB for others).

(The software can also be configured for 1 wire block. This basically switches polarity *before* ringing, and has a slightly longer bell pulse. It also requires extra external circuitry. This is not yet 100% reliable, so is not described further here).

Having set the configuration, set switch 1 only to OFF. This will allow us to set the index (see below). After doing this, set switch 2 to OFF, to enter **run** mode.

set index mode – the index can be set immediately after setting the configuration, or at any time thereafter, by setting switch 2 on.

run mode

In this mode, the system can be used for block signalling of trains. The four LEDs will display the selected variable (see below). The variables are in pairs, you can select either one of the pair – whilst staying in run mode –using switch 2.

The variable pairs are selected according to the index (see below). Perhaps the most useful pair is **error count** and **last error**. This reports signalling errors by the user.... The other variables are mainly for my use: for checking the operation of the program, and finding bugs.

	switch 1	**switch 2**	
at power on only	ON	ON	set configuration ; ***then switch 1 to OFF – this saves configuration***
	OFF	ON	set index
from run mode	ON	ON	set index
	OFF	OFF	run – display column1 below
	ON	OFF	run – display column 2 below

Block Chip - Index

index	**1 OFF**	**1 ON**
1	error count	error code for last error (see below)
2	rsnbx – trains in rear section, according to bells	rsnbx – trains in rear section (strictly, on block chip), according to Track Circuits
3	trs1 – minutes left before train in rear section reaches block chip	
4	tas00 – minutes left before train in advance section clears section	
5	rsntd	rsntd
6	asntd	asntd
7	spare	spare

Block Chip - Error Codes

error code	LEDs	section	description
1	`---X`	rear	trying to accept train when one has not been offered, ***or*** tried to block back when not allowed to (needle at LC or TOL)
2	`--X-`	rear	acceptance with home signal off
3	`--XX`	rear	acceptance by repetition, but wrong total number of beats
4	`-X--`	rear	user rang 2-4-2 or 4-3, when should have accepted by repetition
5	`-X-X`	rear	user should have accepted with 2-4-2 or 4-3, but did not
6	`-XX-`	rear	error acknowledging Train Entering Section, or Banking Engines
7	`-XXX`	rear	user sent 2-1, but train has not yet reached track circuits ***or*** sent 2-1 when should have sent 3-3-4
8	`X---`		
9	`X--X`	advance	user offered train *either* with needle already at Line Clear, *or* at TOL with permissive block not allowed
10	`X-X-`	advance	user sent Train Entering Section with needle at Line Blocked
11	`X-XX`	advance	error in acknowledging 2-4-2 (wrong number of beats, i.e. not 8)
12	`XX--`	advance	train left Track Circuit chip before user sent Train Entering Section
13	`XX-X`	advance	error in acknowledging Train Out of Section (wrong number of beats)
14	`XXX-`	advance	train reached next box, but was not signalled on bell (Train Entering Section not sent, also send 6 bells!)

TRB file format

This is a simple text file which can be created with Notepad. The format is similar to that of a train register book.

The filename should end in **_trb.txt**, for example, **woodhead_060480_trb.txt**

The first 3 lines are ignored; the data start on line 4. Here is an example:

```
first line of file
 bell
 code          ToffR TappR TesR nbank TosR     ToffA  TesA  TosA
  42   0 0 0 0  810     0    810    1    811 0 0   810   811   812
  31   0 0 0 0  815     0    816    0    817 0 0   816   817   818
  312  0 0 0 0  817     0    818    0    818 0 0   818   818   819
```

etc...

Note that the file must contain the zeroes, even although they are not used at present.
The number of spaces between items does not matter (a comma is also acceptable).

ToffR = time of offering of train from box in rear
TappR = time train approaching (1-2-1) sent from box in rear; leave at 0 if not used
TesR = time train entering section is sent from box in rear
nbank = number of banking engines
TosR = time train out of section is sent to box in rear

ToffA = time of offering train to box in advance
TesA = time train entering section is sent to box in advance
TosA = time train out of section is received from box in advance

These times are used to calculate the following:

Rear Section

when to offer train (i.e. minutes since last train)
time from offering to train approaching = **TappR – ToffR**
time from offering to train entering section = **TesR – ToffR**
time from offering to train reaching station limits (i.e. being sent to TC chip) = ***x*** **–ToffR**, where is ***x*** earlier of **TosR** and **TesA**

Advance Section

time from train leaving TC chip to getting train out of section from box in advance = **TosA – TesA**
(this is appropriate if station limits are fairly short; it might not be quite right if there is IB section).