

# Tactical

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## Distance Run Meter and Speed Trip (DRMST)

67TS VICTORIA

## Instruction Manual

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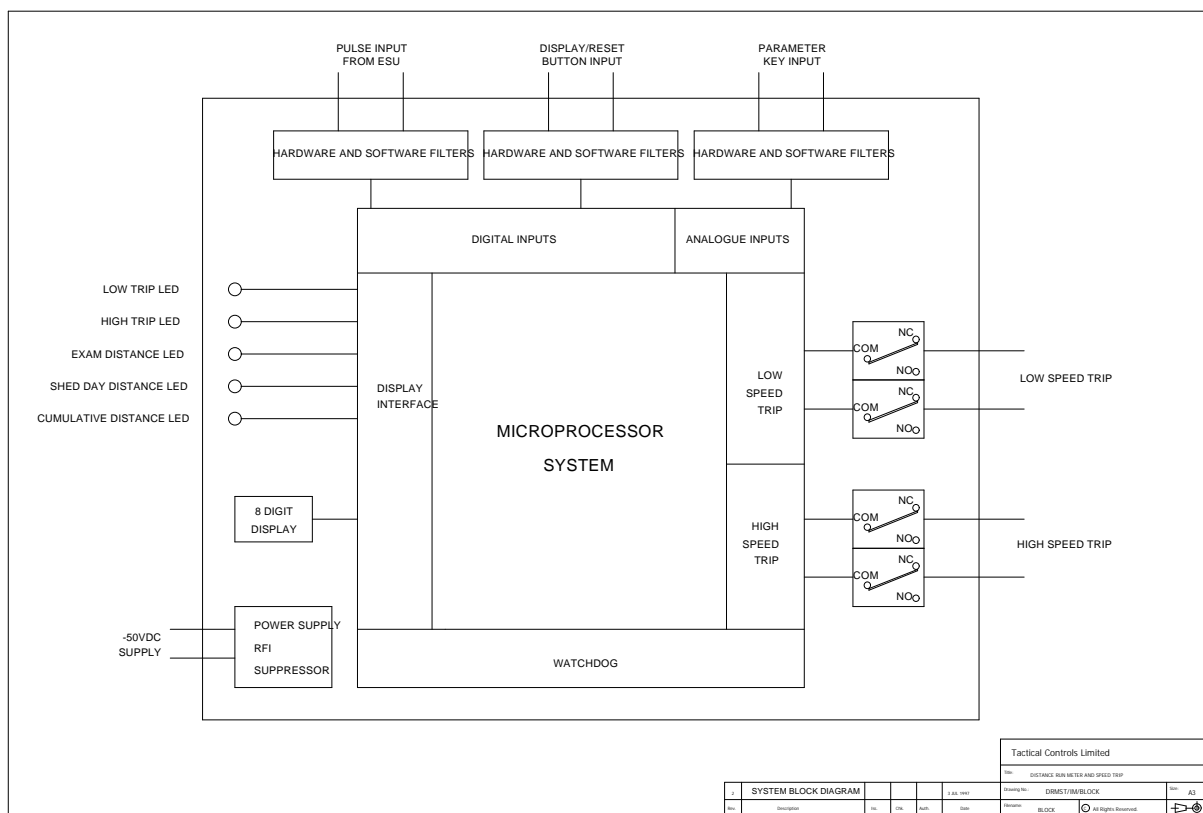
## Introduction

This instruction manual describes a microprocessor-based **Distance Run Meter and Speed Trip (DRMST)** with application to the 67 Tube Stock Victoria Line; contract No: TT293, NPVC No:001.

The DRMST is designed to interface with the Electronic Speedometer (ESU) and stores the distance travelled since the last inspection, up to three distances are to be stored.

There are two relays speed trip outputs; low and high, nominally set at 8KM/H and 40KM/H (5mph and 20mph).

## Block diagram



## Description

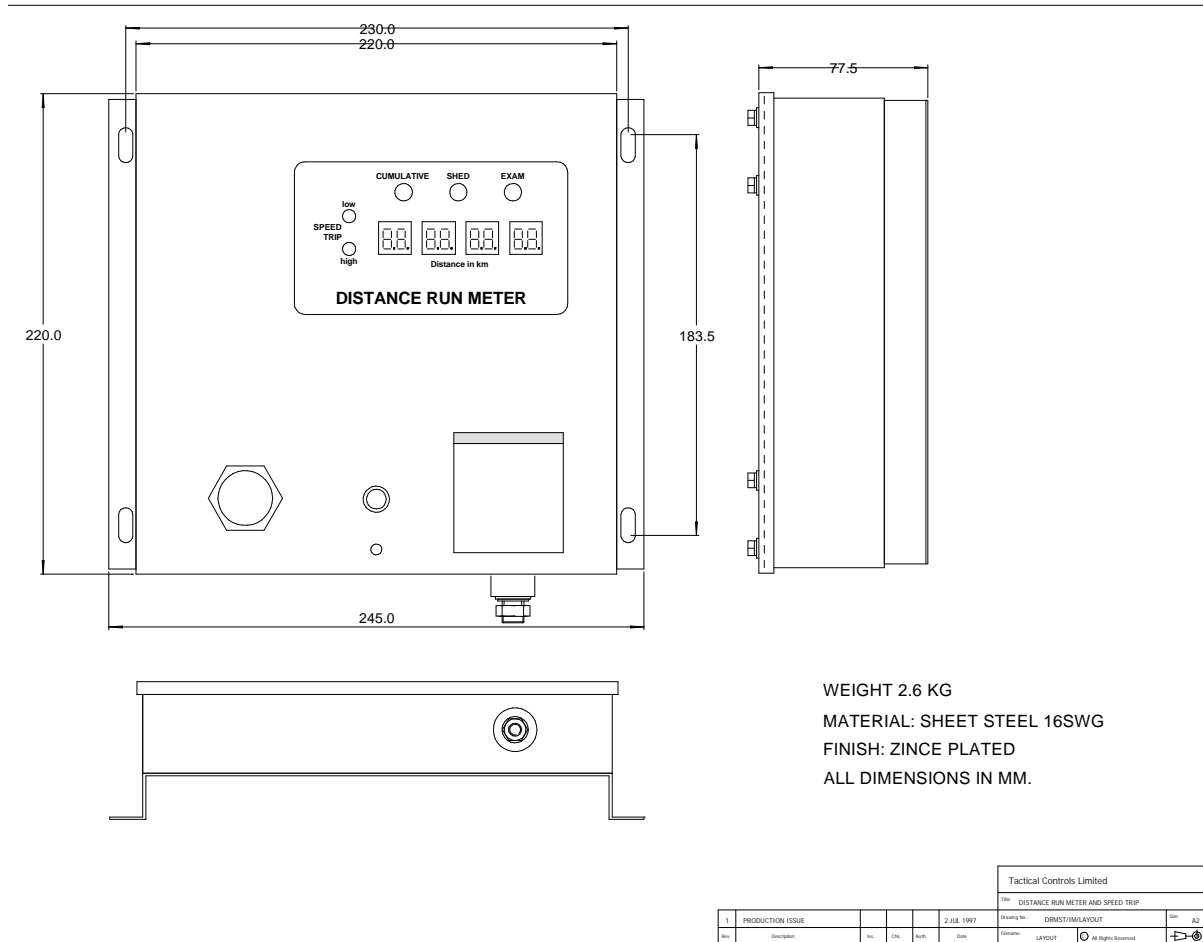
At the heart of the system is the microprocessor which reads the Distance Pulse input signal from the Electronic Speed Unit (ESU), this signal is transient protected, buffered hardware and software filtered before it is connected to the microprocessor input.

The single row of 8-digits display and five LEDs are controlled by the microprocessor using dedicated display integrated circuits.

The speed trip outputs are also controlled by the Microprocessor; their output ports are used to drive transistors which operate the relay coils.

The supply to the microprocessor is derived from the -50Vdc supply via a step-down switch mode power supply. It is surge and transient protected.

### System layout diagram



### Distance measurement

The microprocessor works out the Distance by means of continuously measuring the timing between each cycle of the Distance signals, from which it could calculate the distance travelled.

Unfiltered square pulse signals from the Electronic Speed Unit (ESU) are fed to the input of the DRMST, these pulses undergo hardware and software filters inside the DRMST and the clean signals are then fed to the microprocessor input.

### The Distance Pulse Signal

The distance pulse signal is generated by the ESU, it has a high output impedance and is only capable of driving a high impedance load (greater than 100K-ohm).

The signal amplitude is -12Vdc and -6Vdc with respect to ground (0V); it gives a -12Vdc output when there is no signal.

The maximum signal amplitude is minus -24Vdc with reference to the 0V (system earth). The frequency/speed ratio is 7.344Hz per KM/H.

For detailed circuit diagram of the ESU, please refer to LUL drawing no. 89551, 17 April 1996.

It must be borne in mind that the Distance Pulse signal connections between the ESU and the DRMST unit are un-isolated; both units voltages referred to the system Ground (0V).

It is also important to note the Distance Pulse output signal from the ESU must be within +/- 1.0Vdc of the specified amplitudes - otherwise the DRMST might not response to it.

The maximum train's speed is set at 110KM/H.

## **Operator interface**

The operator interface consists of 7-segment displays, LEDs, front panel push button and 3 PCB mounted push button inside the DRMST.

### **Display**

The DRMST has a single row of 8-digits LED displays, displaying three distances in kilometres these are: the Exam (2 weekly inspection), the Shed Day (36 weekly inspection) and the Cumulative distance. Operating in the auto-scanning mode, these distance parameters have display durations of 3 seconds each.

The display has no-leading zeros.

The displayed parameters are identified by one of three LEDs, which illuminates when the associated parameter is being displayed.

### **Plug/socket as key-switches**

The functions of the Plug/socket key-switches are:-

1. to change the three distance parameters,
2. to change the low or high speed trip settings,
3. and to show the current speed.

The socket is protected by a spring-loaded dust-cover. Note that this spring-loaded dust-cover is protected to IP54 only; that is, protected against dust-limited ingress, no-harmful deposit; also protected against low pressure jets of water from all directions and limited ingress is permitted. However, the socket, mounted behind the spring-loaded cover, is IP65 protected.

The key-switches consist of a receptacle socket mounted on the panel of the DRMST and five key-plugs with different built-in electronic components for use as distance, speed trip setting and speed display "keys".

The five key-plugs are identified by red, yellow, green, blue and brown coloured sleeves or tags (representing: cumulative distance, shed distance, exam distances, speed trip setting and speed display).

Three LEDs: red, yellow and green are used to represent the three distances cumulative, shed and exam respectively. Only one LED would illuminate at any one time.

### **Display button**

The display button is front-panel mounted to IP65. It serves two functions:

1. To turn ON the 8-digit display.
2. To reset the distance parameters.

Under normal operating condition, the DRMST unit is hidden from sight, hence there is no requirement for the 8-digit display and LEDs to be illuminated; however the three distance LEDs remain illuminated in the scanning mode, this serves as an indication that the unit is energised.

The only time when the 8-digit display is required to illuminate is during routine maintenance. For this reason, we have introduced a panel push-button. Once pushed it would cause the display to illuminate for a duration of about two minutes.

This push button also serves as a confirmation to reset a selected distance parameters.

### **Function button and LEDs**

Access to the Function button requires higher authorisation as it involves the opening of the DRMST's lid.

The Function button (together with the UP and DOWN buttons), is mounted on the edge of the PCB. Each button has got "Identification" clearly marked on the PCB.

The "FUNCTION" button enables the selection of three functions:

1. setting of initial distance parameter,
2. setting of low speed trip,
3. and setting of the high speed trip.

Selection of the function is achieved by pressing the "FUNCTION" button.

### **Reset distance parameter**

Any of the three distance parameters can be reset to zero with the combination of the appropriate key-plug and front panel mounted display push button.

For, example, to reset the exam distance, the procedure is as follows:

1. Press display button to energise display.
2. Lift the spring loaded dust-cover.

3. Insert the green key-plug. The green LED (i.e. Exam selected) would stay ON and the 8-digit display would flash. The display would flash continuously until the two-minute time is up, when it automatically turns off.
4. Press front panel push button for 10 seconds to confirm reset exam distance to zero. During this 10 seconds, the display will count down from 10 to 0 as an indication of the count down in progress.

In the event that you have forgotten to remove the key-plug, after a duration of two minutes of inactivity, the display would be switched off. To re-activate, simply re-insert the key-plug.

### Initial distance parameter settings

The DRMST has a facility to initialise the Cumulative, Shed and Exam distances. Access to this facility requires higher authorisation as it requires opening the sealed cover of the unit.

The initial setting facility makes use of three PCB mounted push-buttons switches. Their functions are: "UP", "DOWN" and "FUNCTION".

The setting procedure is as follows:

1. Lift the spring loaded dust cover.
2. Insert a selected key-plug (red, yellow or green).
3. Remove the DRMST's lid.
4. Connect -50Vdc to the DRMST. The LED associated with the distance parameter would stay ON; for example, if a red key-plug is used, the red LED would stay ON. The 8-digit display would flash with the current value.
5. Press the PCB mounted "FUNCTION" button. The 8-digit display would stop flashing.
6. Use the PCB mounted "UP" and "Down" buttons to increment or decrement the selected distance value; the unit has facility for "accelerated" display value.

### Data retention

The DRMST is designed to ensure that the data retention capability of the unit has good RFI immunity. The use of a single-chip microcontroller with special built-in EEPROM offer high reliability for parameter storage. Also the unit's metal enclosure is designed to provide good RFI shield.

### Speed trip outputs

The DRMST has two sets of relay speed outputs for the low and high speed trip outputs.

Table A shows the low trip outputs. Note that the relays are energised at rising speed.

**Table A - low speed trip outputs nominal settings**

| Speed<br>KM/H | Energise at KM/H | De-energise at KM/H |  |
|---------------|------------------|---------------------|--|
| 8             | 9                | 7                   |  |
|               | (rising speed)   | (falling speed)     |  |

Table B shows the high trip outputs. Note that there is a jumper to configure the relays energising at rising or falling speeds. This jumper resides inside the unit.

**Table B - high speed trip outputs nominal settings**

| Speed<br>KM/H | Energise at KM/H      | De-energise at KM/H   | Jumper       |
|---------------|-----------------------|-----------------------|--------------|
| 40            | 41<br>(rising speed)  | 39<br>(falling speed) | energised    |
| 40            | 39<br>(falling speed) | 41<br>(rising speed)  | de-energised |

Each set of relay outputs consists of 2NO and 2NC contacts configured (solder-track on PCB) to form 2 Change-Over relays. The relay outputs PCB track's clearances are designed for the control supply -50Vdc.

## Speed trip adjustment

The DRMST has facility to individually adjust the low and high speed trip levels. Access to this facility requires higher authorisation as it requires opening the sealed cover of the unit and the use of push-buttons inside the unit.

The trip setting procedure is as follows:

1. Lift the spring loaded dust cover.
2. Insert the blue key-plug.
3. Remove the lid.
4. Connect -50Vdc to the DRMST. The display should show "LObbbbSS" where "LO" indicates the display is showing Low Speed trip, "bbbb" represents four blank digits and "SS" is the actual low speed trip setting.
5. Use the PCB mounted "UP" and "Down" buttons to increment or decrement the selected low speed trip value.
6. Press "FUNCTION" button to change the display to "HIbbbbSS" where "HI" indicates the display is showing High Speed trip, "bbbb" represents four blank digits and "SS" is the actual high speed trip setting.
7. Use the PCB mounted "UP" and "Down" buttons to increment or decrement the selected high speed trip value.

## Low speed trip

The speed trips are adjustable from 4 to 11 KM/H, in step of 1KM/H; the factory setting is 8KM/H.

## High speed trip

The speed trips are adjustable from 20 to 51 KM/H, in step of 1KM/H; the factory setting is 40KM/H.

## Power supply

The DRMST is powered by the Train's control supply which is nominally -50Vdc with the positive pole earthed. The design can accommodate a ripple of up to 5V peak to peak, at a nominal frequency of 850Hz and associated harmonics. DRMST's supply input is designed to withstand the RIA12 Surge and Transient tests.

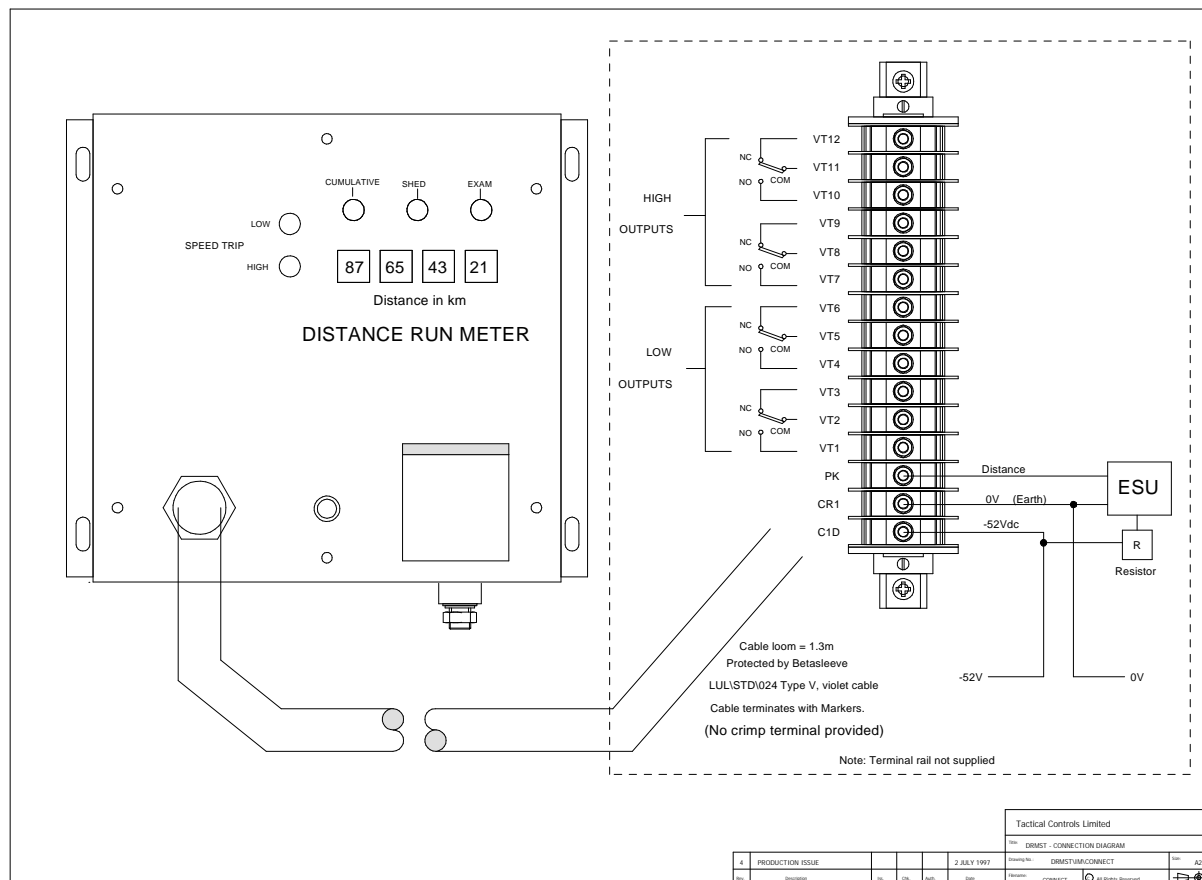
## Installation

The DRMST is designed for back panel mounting through 4 M6 slots on a 230(W) x 184(H) mm matrix. Please see System layout diagram for details.

A cable loom of 15 cables and 1.3M length, terminated with free ends and cable marker, provides all the external connections. Please see System connection diagram and System wiring list for details.

A jumper inside the DRMST changes the output configuration of the high speed trip from normally open to normally closed. The jumper is situated in the middle of the PCB. The factory default is energised - normally open.

## System connection diagram



**System wiring list**

| <b>Cable Marker</b> | <b>Description</b>           |  |
|---------------------|------------------------------|--|
| C1D                 | '-52V supply                 |  |
| CR1                 | 0V earth                     |  |
| PK                  | Distance pulse signal        |  |
| VT1                 | Low speed trip output 1 N/O  |  |
| VT2                 | Low speed trip output 1 COM  |  |
| VT3                 | Low speed trip output 1 N/C  |  |
| VT4                 | Low speed trip output 2 N/O  |  |
| VT5                 | Low speed trip output 2 COM  |  |
| VT6                 | Low speed trip output 2 N/C  |  |
| VT7                 | High speed trip output 1 N/O |  |
| VT8                 | High speed trip output 1 COM |  |
| VT9                 | High speed trip output 1 N/C |  |
| VT10                | High speed trip output 2 N/O |  |
| VT11                | High speed trip output 2 COM |  |
| VT12                | High speed trip output 2 N/C |  |

## Technical Specification

### Supply

|                     |  |
|---------------------|--|
| Voltage             | -32 to -63 Vdc; -50 Vdc nominal.   |
| Ripple              | Unaffected by 5 volt peak to peak.   |
| Input protection    | Reverse polarity protection. Surges and transients to BRB/RIA 12 and RIA18 section 5, burst transient.                           |
| Current consumption | 200mAdc maximum at -50Vdc (when all relays are energised).   |
| Low battery cut-out | Not required as the unit operates on minimum power consumption, as under normal operating condition, the 8-digit display is off. |

### Input

|                |  |
|----------------|--|
| Distance Pulse | Signal square pulse amplitudes are -12Vdc (+/-1) and -6Vdc (+/-0.5) with respect to earth; the frequency/speed ratio is 7.344KM/H.<br>Burst transient tested to RIA18 section 5. |
| Speed accuracy | +/-0.5KM/H.  |

### Indicators

|                 |  |
|-----------------|--|
| Cumulative      | Red 5mm LED; illuminates when displaying Exam distance.                |
| Shed day        | Yellow 5mm LED; illuminates when displaying Shed day distance.         |
| Exam            | Green 5mm LED; illuminates when displaying Cumulative distance.        |
| Speed (8KM/H)   | Red 5mm LED; illuminates when output relays energised.                 |
| Speed (40KM/H)  | Red 5mm LED; illuminates when output relays energised.                 |
| Digital display | One single row of 8-digit display, with no-leading zeros; 4mm minimum. |

### Key switches

|                     |  |
|---------------------|--|
| Number of socket    | One  |
| Socket construction | Panel mounted, 2-way minimum pin contacts.   |
| Plugs               | Five colour plugs; red, yellow, green, blue and brown (not supplied with individual unit). |
| Endurance           | Over 10,000 operations.  |
| IP rating           | IP65, the DRMST's unit.<br>IP54, spring loaded dust-cover for the socket.                  |
| Dielectric strength | Over 1.5 KVac.   |

### Display button

|                     |   |
|---------------------|---|
| Contact             | Normally open; 0.1Adc at 25Vdc minimum. |
| Construction        | Square, panel mounted.                  |
| Endurance           | Over 10,000 operations.                 |
| IP rating           | IP65.                                   |
| Dielectric strength | Over 1.5 KVac.                          |

### Speed relay output

|                   |   |
|-------------------|---|
| Output protection | Surge and transient to BRB/RIA 12 and RIA18, burst transient. |
| Contact rating    | The relays are rated at 4Aac at 250Vac.                       |
| Electrical life   | Greater than 1 million operations at 400mAdc, -50Vdc.         |
| Mechanical life   | Greater than 100 million operations.                          |

**Environment**

Operating temperature -15°C to +55°C.  
Storage temperature -30° to +85°C.  
Relative humidity 0 to 90%.

**Mechanical**

Dimensions 245mm(Width), 220mm(Height) and 65mm(Depth).  
Housing material: sheet steel 16SWG; zinc plated.  
Weight 3Kg approx.  
Mounting 4 M6 mounting slots 230mm x 184mm between centres.

**Standards**

|                             |  |
|-----------------------------|--|
| RSE/STD/031/PART 1: ISSUE B | General requirements for electronic equipment  |
| BRB/LUL/RIA No.13: 1990     | General specification for electronic equipment |
| BRB/LUL/RIA NO.12:1984      | Surge and Transients testings                  |
| BRB/LUL/RIA NO.18:1990      | Interference testings                          |
| BRB/LUL/RIA NO.20:1988      | Vibration and shock testings.                  |

**Warranty** 12 months return to base.

## **Ordering information**

Ordering code: DRMST

You are welcome to order the unit by code or by description - DRMST Distance Run Meter and Speed Trip.

## **Supplier information**

### **Tactical Controls Limited**

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