SIEMENS

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SYSTEM/PROJECT/PRODUCT: VMS SIGN

Motorway VMS Sign Installation, Commissioning and Maintenance Handbook

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This Document is Electronically Held and Approved

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7	ANL01948/311735/TS000346	22/02/2001
8	TS002819	22/11/2005

SAFETY WARNINGS

In the interests of health and safety, when using or servicing this equipment the following instructions must be noted and adhered to:

(i)   Only skilled or instructed personnel with relevant technical knowledge and experience, who are also familiar with the safety procedures required when dealing with modern electrical/electronic equipment are to be allowed to use and/or work on the equipment. All work shall be performed in accordance with the Electricity at Work Regulations 1989 and the relevant Highways Agency procedures of test and maintenance.

(ii)   Such personnel must take heed of all relevant notes, cautions and warnings in this handbook, and any other document or handbook associated with the equipment including, but not restricted to, the following:

(a)   The equipment must be correctly connected to the specified incoming power supply.

(b)   The equipment must be disconnected/isolated from the incoming power supply before removing protective covers or working on any part from which protective covers have been removed.

(c)   ELECTRIC SHOCK RISK – Hazardous voltages of mains potential are present within the equipment. Observe any warning labels and do not remove any protective covers unless absolutely necessary. Equipment must not be operated with covers removed unless at least two persons are present.

(d)   Any power tools must be regularly inspected and tested.

(e)   Any personnel working on site must wear the appropriate protective clothing, e.g. reflective vests, etc.

(iii)   When using paints and solvents to repaint or touch up the finish on any part of the equipment, follow the safety instructions given in the relevant sections of this handbook.

(iv)   Batteries are used in this equipment and should be treated with respect. When a battery is replaced for any reason, do not dispose of the old one in normal waste as it may contain toxic chemicals.

- DO NOT puncture
- DO NOT dispose of in any fire
- DO NOT attempt to recharge batteries except where specifically permitted.
- Refer to Company Code of Practice CP 526 for handling lithium batteries.

(v)   All normal precautions as laid down by Company Safety Policy are applicable particularly with regard to safe working at the heights at which these signs are mounted. Ladder supports are provided behind the access doors on all the sign types. Ladders, when used, should be lashed to these supports.

(a) Any ladders used must be inspected before use to ensure they are sound and not damaged.

(b) When using a ladder, before climbing it, ensure that it is erected properly and is not liable to collapse or move. If using a ladder near a carriageway ensure that the area is properly coned and signed.

Statutory Approval Maintenance Provision (SAMP)

<div align="right">22/04/99</div>

1. Product Reference

    Variable Message Sign (420 & 320 LED or Flip Dot character signs)

2. Specifications

    The Variable Message Sign is designed to meet the following Highways Agency specification:

    TR2136

3. Installation and Commissioning

    Methods of Installation and Commissioning are detailed in the Siemens Traffic Control document:

    667/HE/24612/ETC   Motorway VMS Sign Installation, Commissioning and Maintenance Handbook.

4. Spares and Maintenance

    All Maintenance and Repairs should be carried out in accordance with the Maintenance sections of this handbook, using only the listed Spare parts or spares kits.

5. Modifications

    There are no approved modifications, with the exception of those listed in the following Siemens Traffic Controls document:

    667/HE/24612/ETC   Motorway VMS Sign Installation, Commissioning and Maintenance Handbook.

6. **Warning**

    Use of components other than those permitted above or modifications or enhancements that have not been authorised by Siemens Traffic Controls Limited may invalidate Statutory Approval of this product.

CONTENTS

TABLE OF FIGURES

1. **INTRODUCTION**

1.1 **What is covered**

The handbook contains the necessary information required to install, commission and maintain the STCL Motorway VMS Sign.

The main body of the document covers the installation, commissioning and maintenance of Motorway VMS. Appendix A describes the use of the Maintenance Terminal. Appendix B describes how to calculate a sample current draw of a VMS Sign. Appendix C shows the maintenance kit required, including part numbers.

1.2 **How to find your way around**

The handbook is split into several major sections each covering a complete topic. The table of contents at the front of the handbook lists topics in the order that they appear, together with their page number. A subject and keyword index is provided at the end of this handbook allowing quick location of information as required.

If you do not know where to find the information you need on a particular subject, use the table of contents if you are interested in a major subject area, or the index for specific references to a particular topic (say fuses).

1.3 **Related Documents**

667/HB/24612/000	VMS General Handbook
667/HB/28279/ETC	VMS Structure Handbook

1.4 **Reference Documents**

a)	667/HE/20664/000	Installation & Commissioning Handbook No.4 Installation Testing (General)
b)	667/HF/24612/ETC	Operational Installation Method Statement and Conditions of Working
c)	4/CC/1010/420	Method Statement

d)	MCH1043	Motorway safety
e)	TR1173	Multipair Communications Cable, Polyethylene Insulated, Polyethylene sheathed and Armoured
f)	MCG1022	Testing for Newly Installed Motorway Communications and Power Cables
g)	TRH1239A	Installation drawings for NMCS
h)	MCX0590	Installation Drawings NMCSII. Motorway Signal Mk2 Cantilever Site - Typical Layout
i)	BS7671	16th Edition IEE Regulations
j)		HSE guidance note Storage of Packaged Dangerous Substances
k)		Control of Pollution Act
l)		Environmental Protection (Duty of Care) Regulations 1992
m)		Control of Substances Hazardous to Health Regulations 1988.

1.5 Abbreviations

ADC	Analogue to Digital Converter
EMI	Enhanced Matrix Indicator
EMK	ethyl methyl ketone (a solvent)
EMS	Enhanced Message Sign
EPROM	Erasable Programmable Read Only Memory
ESD	ElectroStatic Discharge
IEE	Institute of Electrical Engineers
LED	Light Emitting Diode
LSB	Least Significant Bit
MSB	Most Significant Bit
MS2	A VMS consisting of an EMS and an EMI mounted on a cantilever
PCB	Printed Circuit Board
PLD	Programmable Logic Devices
PROM	Programmable Read Only Memory
PSU	Power Supply Unit
QB	Quick Blow
RS232	EIA Data Communications Interface
RS485	EIA Differential Data Communications Interface

SAMP   Statutory Approval Maintenance Provision
SB   Slow Blow
STCL   Siemens Traffic Controls Limited
VMS   Variable Message Sign

1.6 Safety Precautions

When installing, testing, commissioning or maintaining the sign on site, care should be taken to comply with the safety aspects of MCH1043.

Refer to the Safety Instructions and the Statutory Approval and Maintenance Provision which can be found on pages 2 to 4 of this handbook.

1.7 Issue History

1.00		06/06/95	Formal Issue
2.00	83/18371	13/09/95	Maintenance Terminal section updated. SAMP added.
3.00	83/18473	30/11/95	Urban VMS section added, SAMP updated. Minor typographical changes.
4.00		17/08/98	Urban VMS section updated, to include the intelligent character. HA (Yate) stock code numbers added for Motorway consumables and spares. Maintenance and test instructions for LED variant signs. Paint touch up details included for the sign. Part numbers expanded and updated. Minor typographical changes.
5.00		11/09/98	Remaining HA (Yate) stock code numbers added. Details of Structure (Cantilever Gantry and Winch) removed to separate Handbook (667/HB/28279/ETC). Minor typographical changes.
6.00		23/02/99	Replacement procedure for water damaged character modules added. Minor clarification added.

8	TS000346/ ANL01948/ 311735	06/02/01	Urban VMS removed to separate handbook (667/HB/27770/000) and name of this handbook changed. Maintenance routine added to check all LEDs on signs. HA Configuration PROM settings added. Test equipment described. Faults table improved. Current Draw calculations for signs added. Recommended equipment list added. Part numbers checked and amended. Minor typographical changes.
8	TS002819	22/11/05	Add installation information for kit for fitting a firmware PROM giving control of the sign via a Paknet interface and label to indicate fitting. (667/1/31798/000)

1.8 Issue State

Pages	Current Issue	Type	Part ID
1 to 76	8	Meridian	667/HE/24612/ETC

2. EQUIPMENT DESCRIPTION

This handbook describes the installation, commissioning and maintenance of the EMS and MS2 VMS types of sign, either of which may use flip disc or LED characters. Except where indicated otherwise all instructions relate to both types of sign, whether flip disc or LED.

An EMS displays free text and is typically two rows of twelve characters but this is configurable up to 96 characters.

The MS2 sign consists of an EMS and an EMI. An EMI displays symbols such as speed restrictions and lane closures. The EMS and EMI can be considered to be functionally separate signs although they share the same mechanics. An EMS may also be based on the smaller 320mm characters.

The signs can be built with the following options:

- 420mm or 320mm high characters
- Amber or Red or no Lanterns
- Up to 96 characters
- Mains/Data cable entry left or right

The following diagrams (Figure 1 and Figure 2) show the layout of both EMS and MS2 signs, paying particular attention to the location of major modules.

Note: The equipment layout of an EMS sign is slightly different from that of an MS2 sign.

2.1 MS2 Sign Layout
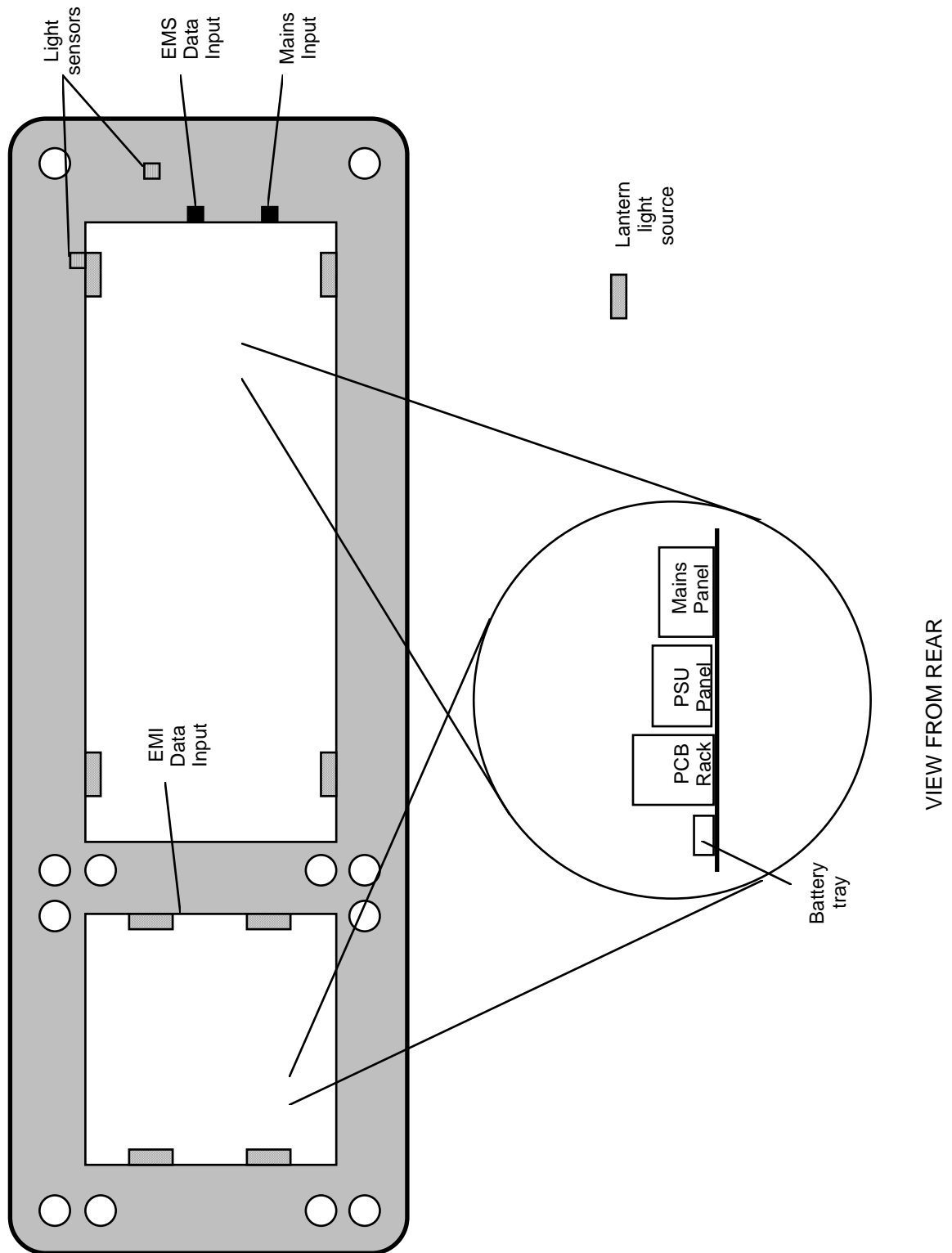
Figure 1 - MS2 Sign Layout

2.2 EMS Sign Layout
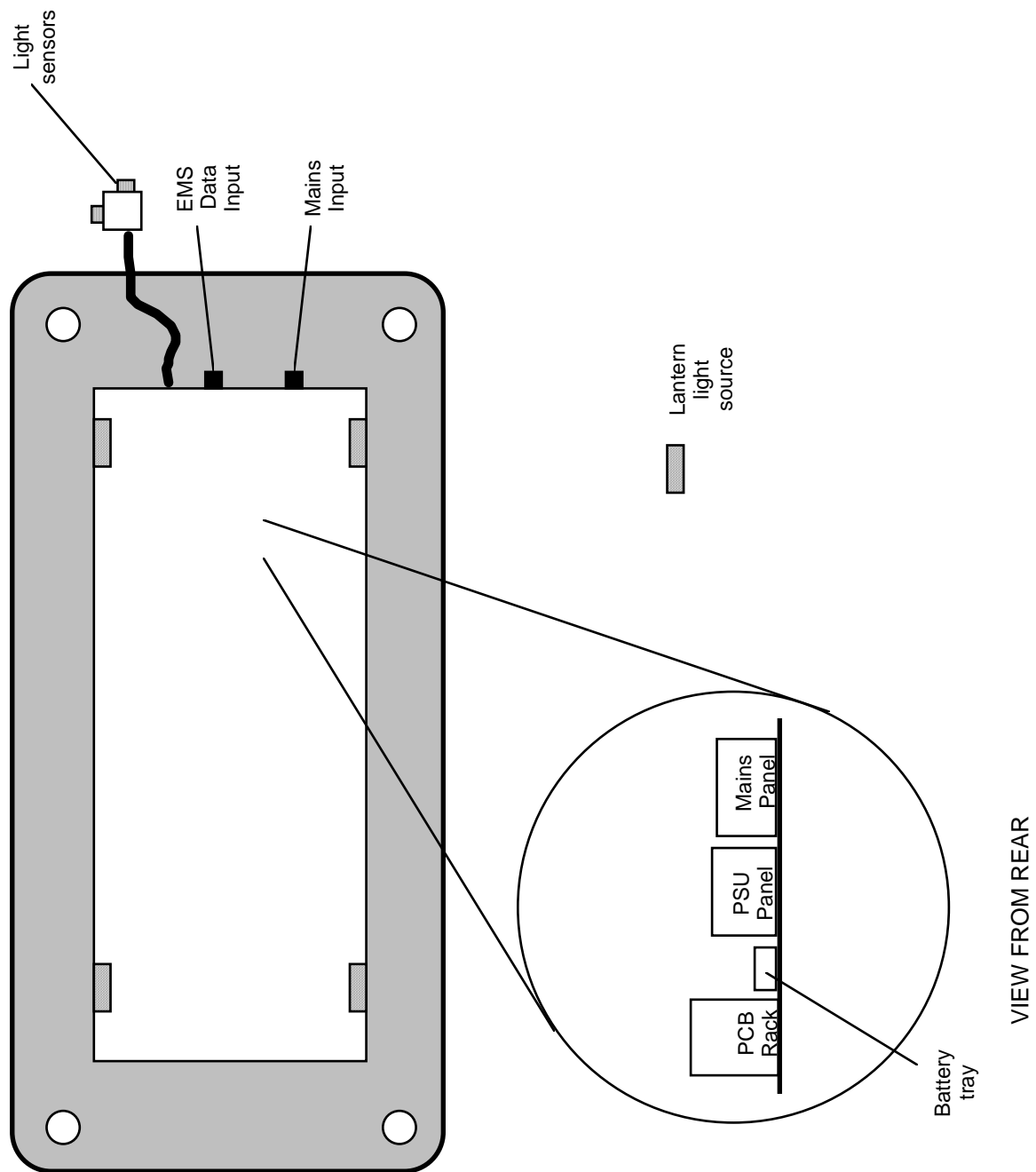
Figure 2 - EMS Sign Layout

2.3 Control Electronics

All the functions of the sign are controlled from the PCB rack which is mounted inside the sign behind the display characters. The basic sign PCB rack contains four printed circuit boards; a processor PCB, a column driver PCB, a row driver PCB and a power distribution PCB, all of which are Double Extended Eurocard size. The sign also contains a mains distribution panel, power supplies and batteries.
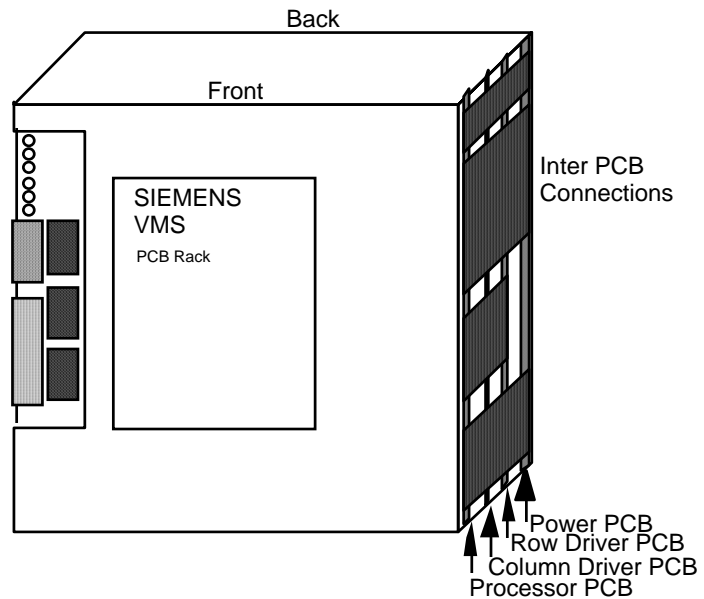
Figure 3 - PCB Rack

A sign configuration of less than 24 characters would require one processor PCB, one row driver, one column driver and one power distribution PCB. For larger signs sub-equipped PCB racks and PSU modules are fitted with extra PCBs and PSUs as below:

No of Chars	Proc PCBs	Row PCBs	Col PCBs	PD PCBs	48V PSUs	12&24V PSUs
1-16	1	1	1	1	1	1
17-24	1	1	1	1	1	2
25-32	1	2	1	1	1	2
33-48	1	2	1	2	1	3
49-64	1	2	2	2	1	4
65-80	1	2	2	3	1	5
65-96	1	2	2	3	1	6

2.3.1 Processor PCB Facilities

- Handles all Comms
- ADC circuit monitors LED, lantern and heater current and light sensors
- Drives other PCBs
- Handles fault monitoring

2.3.2 Row and Column Driver PCB Facilities

- Switches disk pulse to individual pixel

2.3.3 Power Distribution PCB Facilities

- Converts 48V to logic 5V & PCB 12V
- Produces disk pulses
- Drives LEDs and Lanterns
- Monitors LED and Lantern current

3. INSTALLATION

3.1 Installation of the Sign Driver

Install the sign driver into the equipment case as specified in TRH1239A. Ensure that the power switch is off and terminate the power cables to their appropriate fuse connection.

TYPE 600 CABINET

EMS Sign Driver

EMI Sign Driver

Modem Shelf

Type 600 Mains Panel
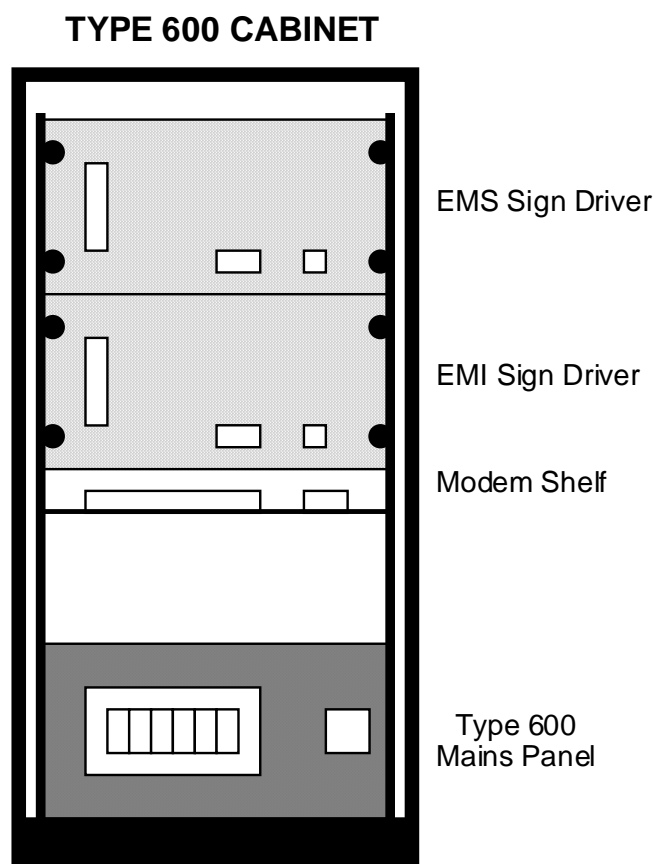
Figure 4 - Type 600 Layout

Wire the sign driver to TBC7 or TBE7 in the rear of the Type 600 as follows:

Colour	From	To (EMS)	To (EMI)	Colour
Pink	Sign Driver TB1.11	Type 600 TBC7.1	Type 600 TBE7.1	Black
Slate	Sign Driver TB1.12	Type 600 TBC7.2	Type 600 TBE7.2	Blue
Yellow	Sign Driver TB1.5	Type 600 TBC7.3	Type 600 TBE7.3	Black
Orange	Sign Driver TB1.6	Type 600 TBC7.4	Type 600 TBE7.4	Orange

3.2 Sign Installation

Warning: Do not wipe the front screen as this will scratch the surface, which will affect the sign's optical performance.

For all 320 signs, refer to the Installation Method Statement 4/CC/1010/420 (see Section 1.4c).

For all 420 and MS2 signs, refer to the Installation Method Statement 667/HF/24612/ETC (see Section 1.4b).

3.3 Paknet Firmware PROM

This is an option to control EMS signs, that are remote from the Motorway network, from a Paknet radio data link.   The kit, comprising a changed firmware PROM (667/1/12618/000) and label, is available by ordering Part Number 667/1/31798/000.

The PROM should be installed in the Sign driver processor board replacing the standard PROM fitted. The label should be attached to the front of the sign driver to indicate that the firmware is fitted.

4. COMMISSIONING

4.1 Safety Precautions

See Section 1.6 for details of safety precautions to be taken when working on the Sign and its associated electronics.

4.2 Pre-Commissioning Checks

This section first describes the function of each VMS PCB switch and LED and describes which should be set in each situation. The sign contains at least one of each PCB and the sign driver contains one processor PCB.

4.2.1 Processor PCB LEDs and Switches

LEDs:
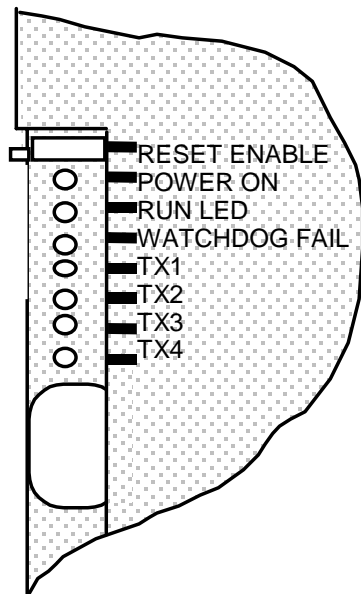
- "Power On" LED indicates that both the logic 5V and PCB 12V are present on the processor PCB.
- "RUN" LED pulses when the processor has successfully initialised.
- "Watchdog fail" LED is lit if the software fails to trigger the watchdog circuit.
- The "Tx" LEDs light when data is being transmitted from the Processor PCB on that link. The links are used as follows:

Figure 5 - Processor PCB LEDs

LED	At Sign with NO Sign Driver	At Sign with Sign Driver	At Sign Driver
TX1	Sign is transmitting to Instation on RS485 link	Sign is transmitting to Sign Driver on RS485 link	Sign Driver is transmitting to Instation on RS485 link
TX2	Sign is transmitting to Instation on V24 link	Not Used	Sign Driver is transmitting to Instation on V24 link
TX3	Sign is transmitting to Diagnostics Terminal on V24 Link	Sign is transmitting to Diagnostics Terminal on V24 Link	Not Used
TX4	Sign is transmitting to Diagnostics Terminal on RS485 Link	Sign is transmitting to Diagnostics Terminal on RS485 Link	Sign Driver is transmitting to Sign on RS485 link
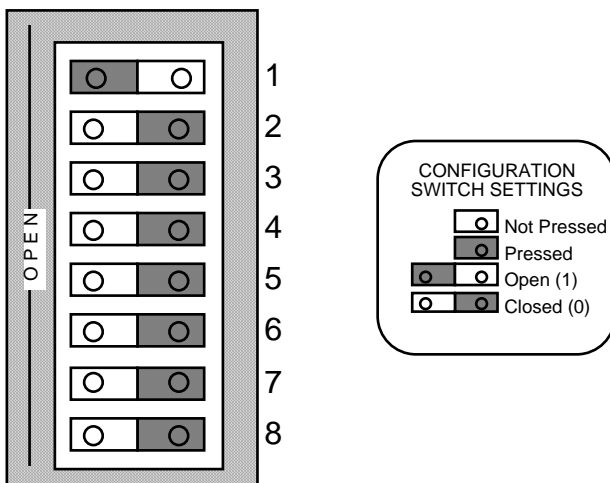
Figure 6 - Processor PCB Switches

Switches:

• Address switches (S2) are set as follows:

1..No two signs on the same RS485 link may have the same address.

2..Switch 1 is the least significant bit.

3..Switch 8 is the most significant bit.

4..Address 00 Hex is invalid (all switches closed).

5..Address FF Hex is invalid (all switches open).

• Luminance level switches (S3) allow adjustment of the lantern and character LED light outputs. The ambient light level sensors determine the luminance level. Level 1 corresponds to low light levels and level 4 to high light levels. For each light level one of four sub levels may be set. The light output for both LEDs and lanterns defined by the sub levels is determined by the configuration EPROM and can be changed.

For HA VMS signs with a Configuration PROM labelled DT999_002, DT999_102 or DT999_103 set the luminance switch S3 to all 8 bits being closed.

For HA VMS signs with a Configuration PROM labelled DT999_000, DT999_001, DT999_100, DT999_101, DT999_200 to DT999_223, DT999_300 to DT999_324, DT999_500 to DT999_503 or DT999_700 set the luminance switch S3 to the following:

1	Closed
2	Closed
3	Closed
4	Open
5	Open
6	Closed
7	Open
8	Open

If the VMS sign is connected to a Sign Driver, the switch settings should be set at the Sign Driver and NOT at the sign.

Note: The diagnostic terminal can be used to determine which luminance level the sign is operating in by selecting the Monitor Light Sensors option (See Appendix A4.4.4).

- Mode switches (S4) set the mode in which the sign is initialised:

Switch 1	Closed	-Diagnostics RS485
	Open	-Diagnostics RS232
	Should be left closed.	
Switch 2	Closed	-Instation link on V24
	Open	-Instation link on RS485
Switch 3	Closed	-Sign is an EMS
	Open	-Sign is an EMI
Switch 4	Closed	-Luminance Override is OFF
	Open	-Luminance Override is ON
Switches 5-8	Sets EMI type. See Figure 7.	

- Reset Enable and Reset switches reset the sign when pressed simultaneously.

Ensure that the battery switch on the processor PCB is switched to the 'on' position.

4.2.2 Row/Column Driver PCB LEDs and Switches

LEDs:

- "POWER LED" indicates the presence of logic 5V on the driver PCB.

Switches:

- Address switch (S1) is a 16 position rotary switch and should be set to 0 for signs with only one of each driver PCB (24 characters or less). If more than one of that particular type of driver PCB is fitted to the sign then the switches must be set sequentially from 0. See section 2.3 for details of how many PCBs will be fitted to the sign.

4.2.3 Power Distribution PCB LEDs and Switches

LEDs:
- "PCB 12V" LED indicates the presence of the PCB 12V power on the power distribution PCB. This supply is generated from the 48V by the DC-DC converter on the power distribution PCB.
- "LOGIC 5V" LED indicates the presence of the Logic 5V supply. This supply is generated from the 48V by the DC-DC converter on the power distribution PCB.
- "LED 24V" LED indicates the presence of the 24V supply for the first 16 characters' LEDs.
- "LANTERN 12V" LED indicates the presence of the 12V supply for the lanterns.
- "PCB 48V" LED indicates the presence of the PCB 48V supply.

Switches:

• Address switch (S1) is a 16 position rotary switch and should be set to 0 for signs with only one Power Distribution PCB (32 characters or less). If more than one PCB is fitted to the sign then the switches must be set sequentially from 0. See section 2.3 for details of how many PCBs will be fitted to the sign.

4.2.4 Sign

Where the sign is used with a sign driver, the only switches on the sign processor PCB that need to be set are S4 switches 1, 2 and 3.

Where the sign is used without a sign driver, set the switches as described in sections 4.2.1, 4.2.2 and 4.2.3.
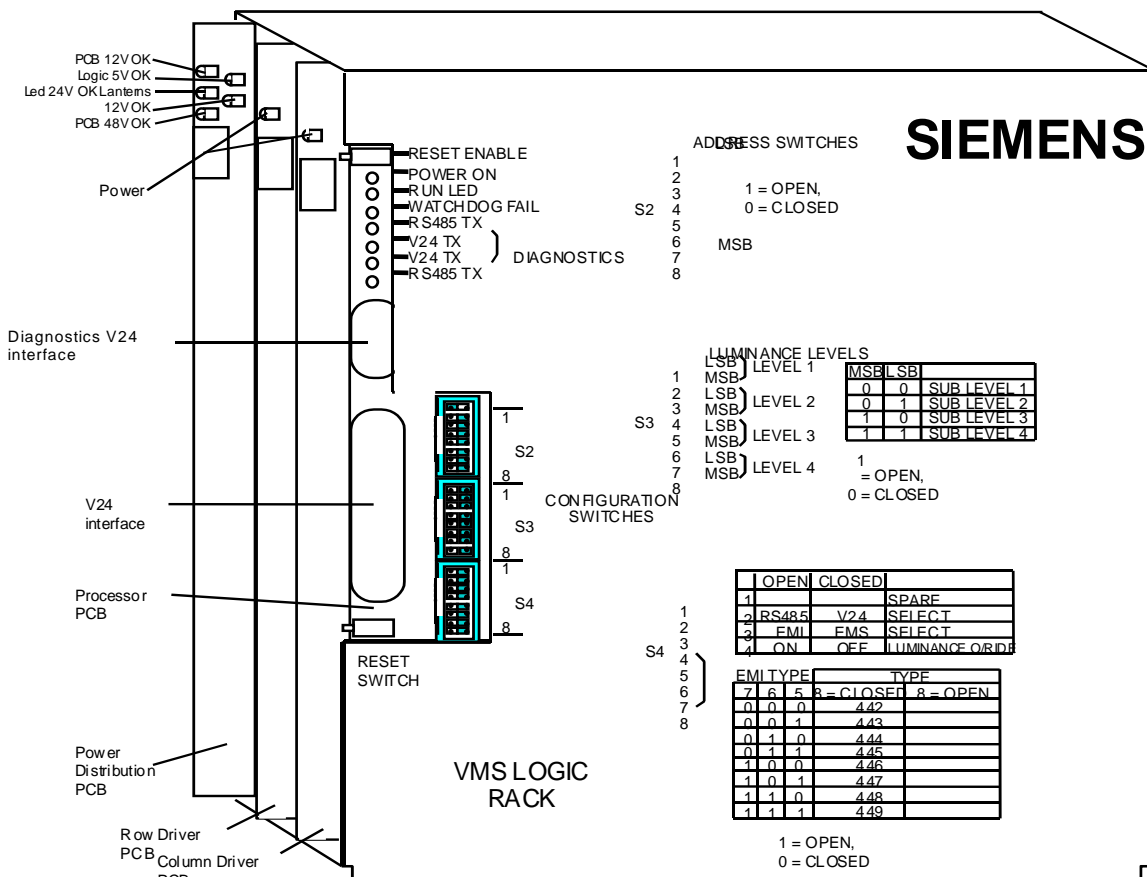
Figure 7 - Sign Enclosure PCB Rack

4.2.5 Sign Driver

Set the switches on the sign driver PCB as described in section 4.2.1. Remove the plastic film strip from the elapsed time meter.

To reset the sign driver press both the reset enable push switch and the reset switch at the same time. This also causes the sign to reset.
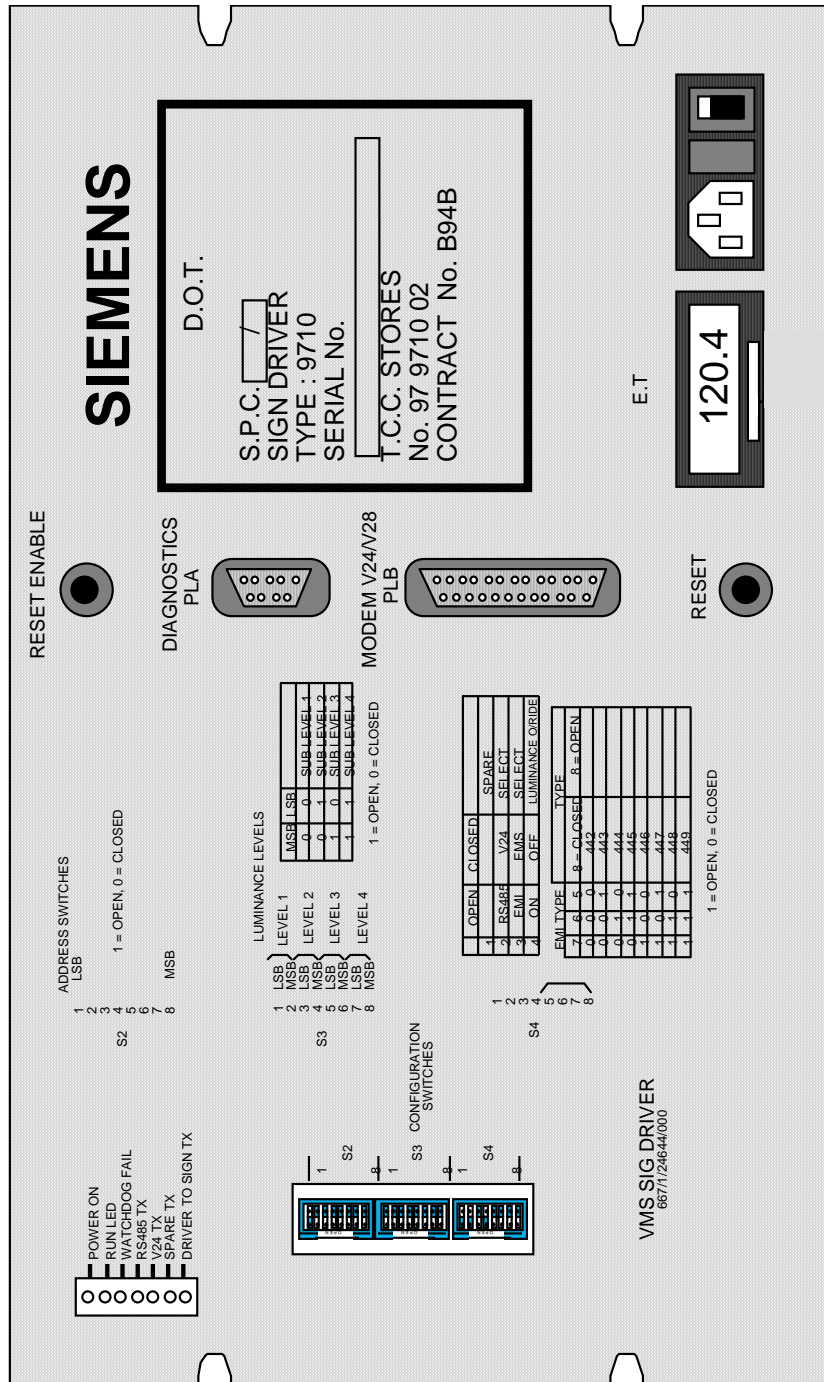
Figure 8 - Sign Driver Front Panel

4.3 Installation Testing

Refer to section 1.3 for installation testing details for the following tests:
- Continuity and Insulation (cables)
- Visual Inspection
- Earth Testing of Installation
- Inspection Certificate
- Installation Test Report
- Insulation Test
- Earth Loop Impedance Test
- RCD Test

The functional test method for the installation varies for each site and should be specified in the contract. It is not covered here.

5. MAINTENANCE

5.1 Safety Precautions

See section 1.6 for details of safety precautions to be taken when working on the Sign and its associated electronics.

5.2 Routine Maintenance Procedure

The timetable below is the recommended maintenance interval. The actual timetable must be agreed with the regional maintenance controller.

5.2.1 Every 800 Hours (Approx.) of Lantern/Message Operation

• Replace all lantern bulbs.

5.2.2 Annual

5.2.2.1 Sign

• In areas of high pollution and dirty conditions the period between cleaning may have to be reviewed depending on site conditions. Clean using a jet of water only.

Warning: Do not wipe the front screen as this will scratch the surface, which will affect the sign's optical performance.

• Visually inspect for any paint work damage.
  Repair as required.
• Re-tighten all fixing screws and nuts as required.
• Re-tighten the clamping connection bolts as required (see Method Statement 4/CC/1010/420 for the correct torques).
• Re-tighten all fixing screws and nuts as required.
• Check and grease the locks.
• Check the sealing strips for wear.
  Repair as required.
• Check the sign for water ingress where this may affect operation.

Repair as required.

- Check the water drainage vents.

  Clean as required.

- Remove, clean and replace air filters.
- Check connections between EMS & EMI (where applicable).
- Check incoming mains cable connector for wear.
- Check and clear debris from door switches as required.
- Check the condition of the PCBs (i.e. scorching, corrosion etc.), batteries and fuses. Replace as necessary.

Note: When replacing a battery, the battery label must also be replaced or updated.

- Examine the diagnostic current fault log.

  Note and rectify any faults reported.

- Check that the outputs of the power supplies are within the following limits:

48v	+/-2.4v
24v	+/-1.2v
12v	+/-0.6v

  If any are outside these limits then the relevant power supply should be changed.

- Check all cable ties for deterioration.

  Replace as necessary with Top Line Black UV resistant Cable Ties 4.8mm x 300mm Cat no. TL134 0192-770.

- Check all UV Bolt Caps where fitted to stud ends on old mounting brackets.

  Replace as necessary.

5.2.2.2 Sign Driver

- Inspect the 600 cabinet for any signs of water penetration.

  Repair as required.

- Check that the power and modem connectors (where fitted) are seated correctly.
- Check that the RESET switches operate correctly.
- Check that the outputs of the power supply are within the following limits:

12v	+/-1.5v

5v   +/-0.25v

If any are outside these limits then the relevant power supply should be changed.

5.3 Using Diagnostics for Maintenance Purposes

The use and operation of the Diagnostic Terminal is explained in detail in Appendix A.

5.4 Fault Finding

On arrival at site the first action is to examine the "Diagnostic Current Fault Log" (See Appendix A4.4.3 for details). Any faults found here should be cleared by the appropriate action. Where communications between the sign and the diagnostic terminal cannot be established or the fault cannot be cleared simply, refer to the following tables.

5.4.1 Sign Driver

Symptom	Diagnosis	Action
Sign not talking to Central Office.	Incorrect address set at Sign Driver	Set correct address on front panel of Sign Driver
	RS485/232 Switch in the incorrect position (switch 4 switch 2).	Set switch to correct position.
	Fault in line between sign and central office.	Find and repair fault.
Sign will not set but will communicate with Central Office.	EMS/EMI switch in the incorrect position (switch 4 switch 3).	Set switch to correct position.
Sign Run LED not flashing and watchdog LED is on.	EPROMs may be fitted incorrectly.	Check EPROMs.
	Processor PCB faulty.	Replace Processor PCB
Sign Run LED not flashing and watchdog LED is off.	Wiring between Sign Driver and sign faulty.	Find and repair fault.

5.4.2 Sign Characters

Symptom	Diagnosis	Action
Discs do not flip positively and rest in half flipped position.	Ribbon connectors on rear of characters are not pushed home.	Push connectors home.
	40 way ribbon connectors on driver PCBs are not pushed home.	Push connectors home.
	Ribbon connectors on rear of characters incorrectly aligned.	Reconnect connector.
Disc(s)/LED(s) on one character do not change state at all. state a.	Fault on character PCB.	Replace character. (See note below re: water damage)
	Heater tape has expanded and fouled the disc.	Contact STCL immediately (on 01202 782064 - Brian Cherry, Project Manager). An Engineer will repair or replace the tape and repair or replace the flip disc free of charge within 48 hours.
Discs/LEDs on a group of characters do not flip at all.	Fault on character PCB.	Disconnect one of the faulty characters at a time and test. If symptom disappears, replace disconnected character.
	Fault on Driver PCB.	Replace relevant driver PCB(s).

Note: Any 320mm or 420mm Character Module that has failed and shows signs of water damage is to be returned to Yate stores using the Return Stock Voucher (RSV) procedure. All such units are to be labelled, stating that they are "returned for free replacement due to water damage" and detailing the sign serial number and motorway location from which it was removed, together with its position within the sign. Yate Stores will provide replacement units by return.

5.4.3 Lanterns

Symptom	Diagnosis	Action
Lantern(s) do not come on when tested.	Blown lamp.	Replace lamp.
	Lantern wiring faulty.	Inspect and correct.
	Fault on power distribution PCB.	Replace Power Distribution PCB.
Lantern stuck on	Lantern wiring faulty.	Inspect and correct.
	Fault on power distribution PCB.	Replace Power Distribution PCB.

5.4.4 Power

Symptom	Diagnosis	Action
PCB 12V LED is OFF.	Fault on power distribution PCB.	Replace Power Distribution PCB.
Logic 5V LED is OFF.	Fault on power distribution PCB.	Replace Power Distribution PCB.
LED 24V LED is OFF or LED supply fault in current fault log.	Faulty 12/24V PSU.	Check 24V output voltage of all 12/24V PSUs. Replace any faulty units.
	Fuse blown and **no** short on power distribution PCB.	Replace fuse.
	Fuse blown and short on power distribution PCB.	Replace fuse and power distribution PCB.
Lantern 12V LED is OFF or Lantern supply fault in current fault log.	Faulty 12/24V PSU.	Check 12V output voltage of all 12/24V PSUs. Replace any faulty units.
	Fuse blown and **no** short on power distribution PCB.	Replace fuse.
	Fuse blown and short on power distribution PCB.	Replace fuse and power distribution PCB.
PCB 48V LED is OFF.	Faulty 48V PSU.	Check 48V output voltage of all 48V PSUs. Replace any faulty units.

	Fuse blown and **no** short on power distribution PCB.	Replace fuse.
	Fuse blown and short on power distribution PCB.	Replace fuse and power distribution PCB.

5.4.5 Miscellaneous

Symptom	Diagnosis	Action
Sign Run LED not flashing and watchdog LED is ON.	EPROMs may be fitted incorrectly.	Check EPROMs.
	Fault on Processor PCB.	Change Processor PCB
Sign Run LED not flashing but watchdog LED is OFF.	Faulty battery.	Connect diagnostic terminal and request current fault log. If battery fault then replace battery.
	Blown battery fuse.	Check for shorts in wiring and on Power Distribution PCB and rectify. Replace fuse. If it blows again replace the Power Distribution PCB.
	Address switch set to 00H or FFH	Set correct address.

5.5 Replacement of Component Parts

Before replacement of any components takes place, the sign should be completely switched off and isolated from the mains supply. The mains isolation should be made external to the sign enclosure, prior to working on / replacing components inside the sign enclosure.

5.5.1 Replacement of PCBs

In the event of a PCB requiring replacement it must be replaced by a part of the same type and the same or higher issue state. Before removing the PCB note all switch settings and configure the replacement PCB in a similar

manner. Swap the EPROMs and PLD on the faulty PCB with those from the replacement PCB.

In order to replace a PCB, all the connections to that PCB should be removed. The PCB can then be slid out of the PCB rack. This is achieved by pressing down on the retaining spring and sliding the PCB out.

During replacement where a PCB has connections in from the front /rear edges, then these must be made prior to completely sliding the PCB into the PCB rack.

When handling PCBs or electronic components, all reasonable precautions must be taken to prevent the damage of components by ESD.

5.5.2   Replacement of Power Supplies

The Power Supply Units are mounted on a metal panel whose location is shown in Figures 1 and 2. After ensuring that the mains supply is completely isolated the procedure for replacement is as follows:

- Remove low voltage connections from the power supply
- Remove mains voltage connections from the power supply

The power supply panel can now be unscrewed and lifted out from the sign enclosure. The PSUs are screwed to the panel from the rear using tapped inserts in the PSU. The rubber feet on the defective PSU should be removed and attached to the replacement PSU.

The PSU panel can now be replaced and all the wiring reconnected.

5.5.3 Replacement of Items on the Mains Distribution

All units on the Mains Distribution Panel are fastened using studs/nuts/washers or rivnuts. In order to remove any item, the necessary fixing must first be unfastened.

Warning: Before removing any protective covers on the mains

distribution panel, ensure that the mains supply to the sign is isolated externally to the sign enclosure.

Any item that is removed should be replaced by an identical item, identified by its STCL part number. If the humidistat or thermostat is replaced, then the new unit should be set to the same value as the unit being replaced.

5.5.4 Replacement of Characters (EMS)

The characters are mounted on metal backing plates which are removed for replacement of the character. The replacement sequence for an individual character is detailed below:

- Remove Row and Column Cables (Ribbon Cables) See Note 1.
- Remove LED Cables (Red/White Twisted Pair) See Note 1.
- Remove Earth Strap.
- Lift the plate upwards until it stops and move the lower edge of the plate out of the guide rail backwards.
- Hold the top of the plate with the other hand and remove the plate completely from the upper guide rail.

The character can now be replaced. The procedure for replacing the character into the sign is the reverse of the removal procedure.

When replacing a flip disc character take care not to knock the disc spindle support brackets. This is necessary because the spindle support brackets can bend sufficiently to pinch the disc causing it to jam. If any characters do get knocked in handling, the brackets must be straightened so that all discs can be moved freely.

Note 1: Use a rocking motion to reduce strain on the cable. When replacing ensure they are pushed fully home.

Note 2: If the character is located behind the PCB rack, this must be tilted out of the sign to allow replacement of the character to take place. This is achieved by unfastening the rear locking nuts and pivoting on the front supports. See Figure 9:
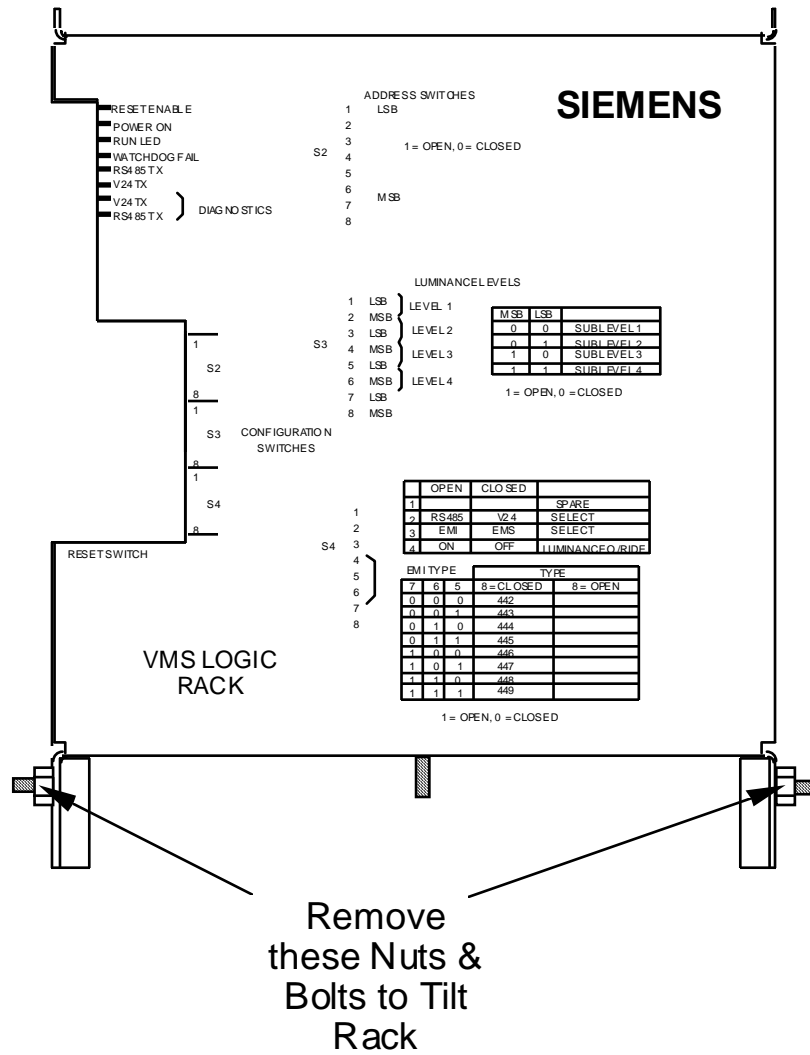
Figure 9 - Tilting the PCB Rack

5.5.5 Replacement of Characters (EMI)

The replacement of characters in an EMI is similar to that used in the EMS (See section 5.5.4) and is detailed below. One difference is the use of 3 stand-offs located between the joins in the backing plates. These must be unbolted before removal and replacement of characters can take place.

- Remove the earth braids from the doors, leaving the plastic braid securely attached to the doors.
- Lift the rearmost door from its channel, pull the base rearwards and place the door on the walkway.

- Lift the other door from its channel, pull the base rearwards and place the door on the walkway.
- Unbolt Stand-offs to front screen. See Figure 10.
- Remove Row and Column Cables (Ribbon Cables). See Note 1.
- Remove LED Cables (Red/White Twisted Pair). See Note 1.
- Lift the plate upwards out of the lower guide rail until it stops.
- Move the lower edge of the backing plate approximately 1 - 2 inches rearwards.
- Carefully lower the backing plate down until it rests on the base of the sign housing and the upper edge is release from its guide.
- Lift the character out of the EMI by tilting the upper edge backwards whilst simultaneously raising the lower edge to clear any electronics in the sign enclosure.

The character can now be replaced. The procedure for replacing the character into the sign is the reverse of the removal procedure.

Note 1: Use a rocking motion to reduce strain on the cable. When replacing ensure they are pushed fully home.

Note 2: If the character is located behind the PCB rack, this must be tilted out of the sign to allow replacement of the character to take place. This is achieved by unfastening the rear locking nuts and pivoting on the front supports. See Figure 9.

Tie
Wrap

VIEW FROM REAR
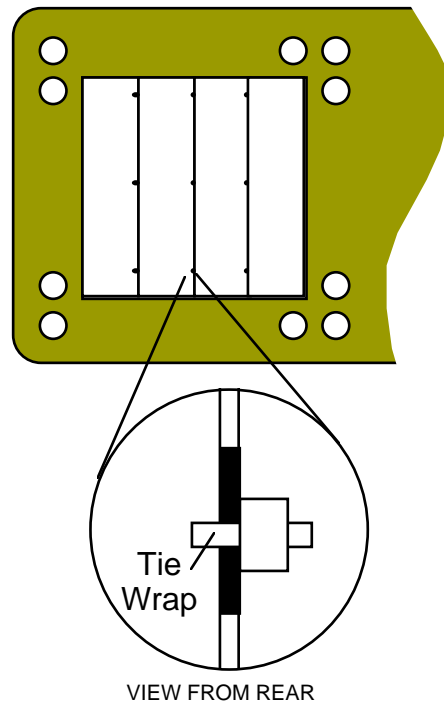
Figure 10 - EMI Screen Stand-Off Detail

5.5.6 Replacement of Heaters

The replacement of any one heater element requires the removal of all character units immediately above that heater element. Follow the procedure in section 5.5.4 or 5.5.5 to do this. When this is complete the heater element can be removed from its retaining clips.

The supply cable to the heater must then be disconnected to complete removal of the heater element.

The new heater element can then be installed and connected to the heater power supply.

When this is complete use the diagnostics heater test function to check satisfactory operation. The character units can then be replaced.

5.5.7   Replacement of Light Sensors

There are two methods of mounting light sensors on the sign.

- One fitted to the top of the sign enclosure and one mounted in a box attached to the sign target board
- Both fitted to a remotely mounted box.

The removal sequence for a faulty light sensor is as follows:

- If the faulty unit is box mounted, remove the box from the target board
- Disconnect the red and white wires to the light sensor
- Unscrew the light sensor nut
- Remove the light sensor.

The light sensor can now be replaced. The procedure for replacing the light sensor into the sign is the reverse of the removal procedure.

Once the faulty light sensor has been replaced it should be checked for correct working as follows:

- Connect the Diagnostic Terminal
- Display the 'Monitor Light Sensors screen' and check that the replaced light sensor is giving sensible readings.
- Display the 'Complete Fault Log' and check that an entry has been placed in the fault log showing clearance of the light sensor failure.
- Cover up the light sensor so that the readings are very low.
- Display the 'Monitor Light Sensors screen' again and check that the light sensor is giving very low readings.
- Uncover the light sensor.

For firmware issue 6:
Display the 'Complete Fault Log' and check that an entry has been placed in the log that the light sensor variation failure has cleared.
For firmware issue 5:
Display the 'Complete Fault Log' and check when the light sensor variation failure was detected. This check is performed approximately every 24 hours, so note when the failure should be cleared. After that time, either return to

the sign and check the fault log, or check that the light sensor failure bit is not set when the instation requests the status of the sign.

5.5.8 Replacement of Lantern Lamp

The lantern lamps are a bulb and reflector integrated into one part. To replace the lantern lamp, pull it from the lamp holder and push in a new one. Care must be taken not to allow fingers to touch the bulb or the inside of the reflector.

5.6 Repainting

Observe all the Safety Precautions regarding the use, storage and disposal of the paint products described in the following sections.

5.6.1 Repainting of Sign

The sign casing should have its paint finish repaired as soon as it starts to show signs of deterioration, e.g. small scratches, chips, abrasions, etc. It is not necessary to recoat the entire sign, but retouch only those areas that have been damaged.

The touch in paint has two components; powder paint and ethyl methyl ketone (EMK) solvent. It must be mixed in the ratio 2 parts powder to 1 part solvent by volume using the spatula and plastic container supplied. See the Safety Precautions below. Apply in small quantities only where absolutely necessary using a fine pointed brush and avoid covering the surrounding areas.

The paint is touch dry in approximately 15 minutes at 20 degrees C, requiring longer at lower temperatures.

The solution should be applied within half an hour of mixing, otherwise it becomes thick and unusable. If this occurs, the made-up paint may be thinned by addition of small quantities of EMK. The mixed paint may be stored for up to one week in a suitably sized closed container. After this time any unused mixed paint must be disposed of. Do not thin down the solution with more EMK solvent.

Surplus paint should be cleaned off the existing paintwork using a weak industrial solvent, e.g. Inhibisol. Brushes and equipment may be cleaned using EMK solvent.

If any large areas of damage occur to the paintwork, the product should be returned for re-working.

The shelf life of the powder paint is six months, if stored in cool dry conditions away from bright light. After this period, water vapour from the air permeates the package making the powder lumpy and mixing difficult. EMK Solvent may be stored indefinitely.

Safety Precautions - Solvent

Avoid inhaling EMK vapour and contact with eyes. EMK solvent is highly inflammable and explosive in vapour/air mixtures. Do not drink.

First Aid:	Inhalation	Remove from exposure. Rest and keep warm.
	Eyes	In the event of EMK solvent entering the eyes, flush with copious supplies of cold water and obtain medical advice.
	Skin	Wash thoroughly with soap and water.
	Mouth	Wash with copious supplies of cold water and obtain medical advice. If accidentally swallowed, obtain immediate medical attention. Keep at rest. **DO NOT** induce vomiting.

Safety Precautions - Powder Coating

The following applies to all products labelled MSDS 3.

The product is classified as Harmful and Irritant.

First Aid:	Inhalation	Remove to fresh air. Rest and keep warm. Give nothing by mouth. If unconscious,

	place in the recovery position and seek medical advice.
Eyes	Contact lenses should be removed. Irrigate with copious supplies of clean, fresh water for at least 10 minutes, holding the eyelids apart, and obtain medical advice.
Skin	Remove contaminated clothing. Wash thoroughly with plenty of water, or use a proprietary skin cleanser. **DO NOT** use solvent or thinners.
Mouth	Wash with copious supplies of cold water and obtain medical advice. If accidentally swallowed, obtain immediate medical attention. Keep at rest. **DO NOT** induce vomiting.

Handling and Storage

Persons with a history of respiratory problems or allergic responses should only be exposed to, or handle this product, under appropriate medical supervision.

Precautions should be taken to prevent the formation of dusts in concentrations above explosive or occupational exposure limits. Electrical equipment and lighting should be protected to appropriate standards and to prevent dust coming into contact with hot surfaces, sparks or other ignition sources.

Keep the container tightly closed. Exclude sources of heat, sparks and open flame. Avoid the inhalation of dusts. Smoking, eating and drinking should be prohibited in all areas of storage and use. Observe the label precautions. Store between 5°C and 25°C in a dry, well-ventilated place away from sources of heat, ignition and direct sunlight. No smoking. Prevent unauthorised access. Opened containers should be properly resealed and kept upright to prevent leakage. The principles contained in the HSE guidance note Storage of Packaged Dangerous Substances should be observed when storing this product.

Fire Fighting Measures

Recommended extinguishing medium - Alcohol resistant foam, CO_2 blanket or water spray/mist.

NOT to be used - High pressure inert gas (e.g. CO_2) or water jets.

Fire will produce dense black smoke containing hazardous products of combustion that may include carbon monoxide, carbon dioxide and oxides of nitrogen. Exposure to decomposition products may be a hazard to health. Appropriate self-contained breathing apparatus may be required. Cool closed containers exposed to fire with water spray. Do not allow run-off from fire fighting to enter drains or watercourses.

Disposal Considerations

Do not allow into drains or watercourses or dispose of where ground or surface waters may be affected.

Wastes, including emptied containers, are controlled wastes and should be disposed of in accordance with regulations made under the Control of Pollution Act and the Environmental Protection Act. Obtain advice from the Waste Regulation Authority whether special waste regulations apply.

5.7 Spares

5.7.1 Component Parts

The VMS Signs contain no user serviceable parts except for fuses, bulbs and batteries. In the event of failure the whole faulty item must be replaced with an identical unit.

The Siemens part numbers and Yate stock code numbers of each spare part are listed below:

Version	Item	Siemens Part No.	NCD Code
All	Processor PCB assembly	667/1/24620/001	97 9893 02
All	- Lithium battery for the above	418/4/97186/000	N/A (see note on page 47)
LED	XY5 Row Driver PCB	667/1/24622/005	97 9913 02

Version	Item	Siemens Part No.	NCD Code
Disc	XY2 Row Driver PCB	667/1/24622/001	97 9894 02
LED	XY5 Column Driver PCB	667/1/24622/006	97 9914 02
Disc	XY2 Column Driver PCB	667/1/24622/002	97 9895 02
LED	Power Distribution PCB	667/1/24624/003	97 9897 02
Disc	Power Distribution PCB	667/1/24624/001	97 9896 02
LED 320	320 Character assembly	667/1/26959/304	97 9878 02
LED 420	420 Character assembly	667/1/26959/406	97 9879 02
Flip disc 320	F-P 320 Characters - 12I	434/4/91129/000	97 9876 02
Flip disc 420	F-P 420 Characters - 18I	434/4/91130/000	97 9877 02
All	Light Sensors	667/7/24680/000	97 9883 02
All	Sign Driver PSU 5V & 12V	667/7/22631/000	97 9884 02
All	PSU 48V	667/7/24684/000	97 9885 02
All	PSU 12V & 24V	667/7/24683/000	97 9886 02
LED	Heating Tape 40W/m 8.85mm	418/4/39817/000	97 9887 02
Flip disc 320	Heating Tape 60W 6m	418/4/39802/000	97 9815 02
Flip disc 420	Heater	667/7/24685/000	97 9888 02
All	Thermostat tamperproof 0-30°	408/4/56087/000	97 9889 02
All	Humidistat assembly	667/1/27303/000 (new) 408/4/56089/000 (superseded)	97 9890 02
All	Over Temperature Stat	408/4/56088/000	97 9891 02
All	RS485 Line Protection PCB	667/1/20584/202	97 9892 02
All	Door lock	SP-20379-00	97 9904 02
420	Door lock	667/7/26684/000	97 9905 02

5.7.2 Spares Kits

In addition to the spares listed above, spares kits may be ordered which contain the requisite number of each of the component parts and consumables needed for an installation.

Item	Siemens Part No.	NCD Code
320 Flip Disc Module spares kit	667/1/24637/001	97 9874 02
420 Flip Disc Module spares kit	667/1/24637/002	97 9875 02
320 LED Module spares kit	667/1/24637/003	97 9863 02
420 LED Module spares kit	667/1/24637/004	97 9864 02

5.7.3 Consumables

The maintenance engineer should carry these spares for every site visit.

Ref	Location	Type	Siemens Part No.	NCD Code
FS1	Mains Panel	SB16A 29 x 12.7MM BS88	518/4/90352/005	97 9899 02
FS2	Mains Panel	5A HRC 23 x 6.35MM BS1361	518/4/90638/000	97 9900 02
FS3	Mains Panel	5A HRC 23 x 6.35MM BS1361	518/4/90638/000	97 9900 02
FS4	PSU Panel	SB 5A 1.25 x 0.25" CERAMIC	518/4/90634/010	97 9901 02
FS5	PSU Panel	QB 12A 32V 1.25 x 0.25"	518/4/98006/015	97 9902 02
FS6	PSU Panel	QB 12A 32V 1.25 x 0.25"	518/4/98006/015	97 9902 02
FS7	PSU Panel	QB 12A 32V 1.25 x 0.25"	518/4/98006/015	97 9902 02
FS8	PSU Panel	QB 3.15A 250V 20 x 5MM BS4265	518/4/90285/007	97 9903 02
FS9	PSU Panel	QB 3.15A 250V 20 x 5MM BS4265	518/4/90285/007	97 9903 02
	Sign Driver	QB 1A 250V	518/4/90285/005	
	Processor PCB	QB 500mA fuse	518/4/90285/004	
	Lantern Assy	Lantern Lamp 12V	517/4/97062/000	97 4029 04
	Nr PCB Rack	Lead Acid Battery 12V (3 per EMS or EMI)	418/4/42314/010	97 9898 02
	Mains Panel	Timer Battery (3 per EMS or EMI)	Standard size N	
		Top Line Black UV resistant Cable Ties 4.8 x 300mm	TL134 0192-770	

> **WARNING: Fuses must only be replaced with ones of the correct type and rating. The use of incorrect fuses may irreparably damage the equipment.**

Note: The batteries have a limited shelf life and should not be stored by the Maintenance Engineer. Order direct from STCL Poole site as they are needed.

A   USE OF THE MAINTENANCE TERMINAL

A1   GENERAL DESCRIPTION

A1.1 Introduction

The VMS Diagnostics Terminal consists of a portable personal computer and installed software that operates in a Microsoft Windows environment. The Diagnostics Terminal has been designed to aid maintenance engineers with the varied day to day interface needs of the different variable message sign drivers. Simple to use menu driven operations enable set-up and maintenance tasks to be undertaken with ease.

Words enclosed by chevrons, e.g. <Enter>, <Esc>, indicate computer keys.

A1.2 Glossary of Terms

Check box	See your Windows handbook.
Dialog box	See your Windows handbook.
Radio button	See your Windows handbook.

A2   HARDWARE DESCRIPTION

The hardware required to run the VMS Diagnostics Terminal software is a standard (IBM compatible), portable, personal computer connected to the RS485 serial port of the sign driver via an RS232 to RS485 converter. See Figure 12 for details of the hardware and setup required.

It is also possible to drive the sign diagnostics via the PCs RS232 interface as shown in Figure 11. See Section 4.2.1 for the correct setting of mode switch S4-1.
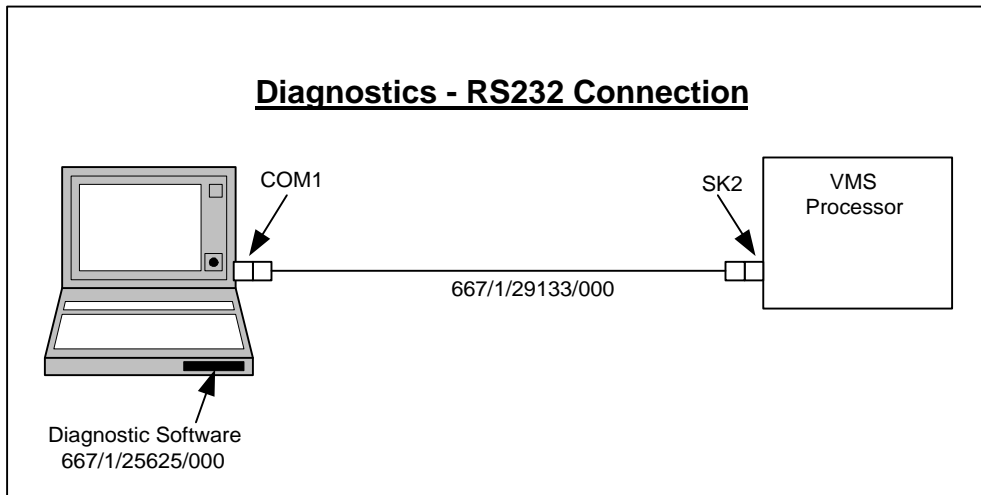
Figure 11 – Diagnostics Terminal RS232 Setup
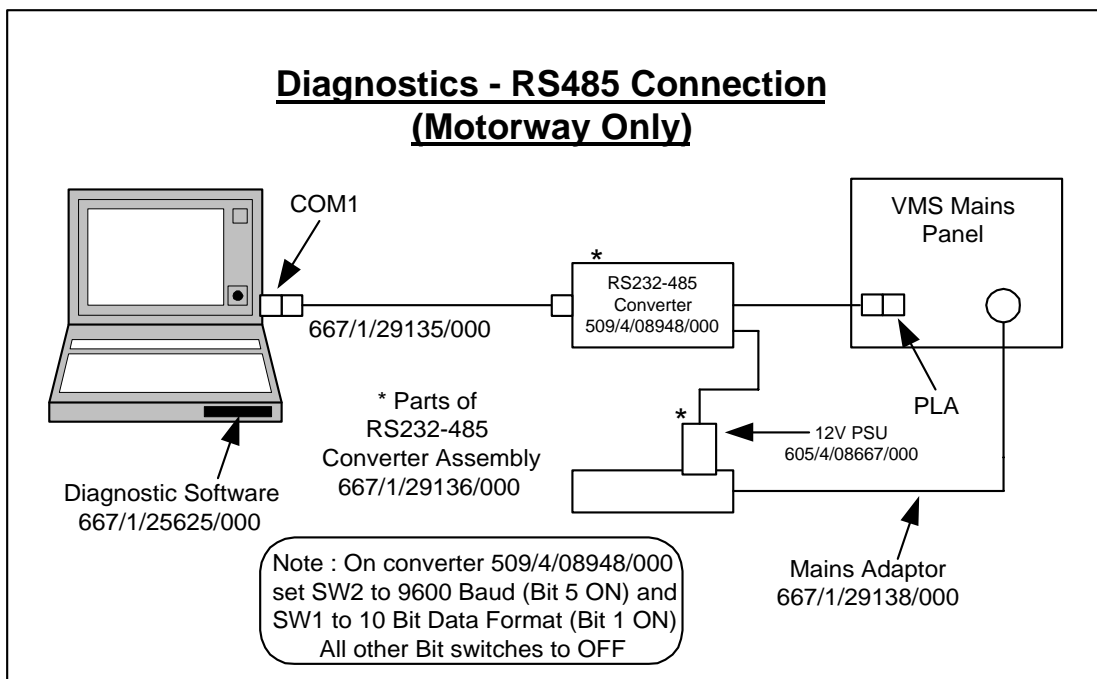
Figure 12 - Diagnostic Terminal RS485 Setup

As minimum requirements, it must have the following features:

- Processor of the 80386 family.
- 4 Mbytes of RAM.
- Hard disk drive - C drive (capacity: 40Mbyte minimum).
- One integral floppy disk drive (3.5", 1.44Mb) or access to one.
- One RS232C 9 way serial port; required cable connections as defined by STCL (part number 667/1/29135/000).
- One standard (25 pin, parallel) printer port.
- Operating system MS-DOS (version 3.3 minimum).
- Microsoft Windows version 3.1. Windows 3.11 is not compatible with the STCL software. If using Windows 95 see Appendix A3.2.1.
- Standard size display screen (80 columns x 25 lines), CGA compatible, colour or monochrome.
- Power supply from both mains (adapter) and batteries (rechargeable).
- Full QWERTY keyboard.
- Option: Mouse or trackerball.

A3   GETTING STARTED

A3.1 Introduction

The VMS Diagnostics Terminal software is supplied on a 3.5" 1.44 Mbyte floppy disk. It comes with an automatic installation program called SETUP. This program creates directories as needed and transfers files from your distribution disks to the PC's hard disk.

1 Mbyte of disk space will be needed on the destination drive for the Diagnostics Terminal software; this is in addition to space required for any report data files that may be created when the software is run.

It is assumed that MS-DOS and Windows have already been installed on the portable PC and that the operator is reasonably familiar with DOS commands.

A3.2 Installing the VMS Diagnostics Terminal Software

The VMS Diagnostics Terminal software is protected to stop unlicensed versions of the software being generated. The Customer issued disks will be limited to a certain number of installations. If subsequent installations are attempted the software will fail to be invoked.

To install the VMS Diagnostics Terminal software:

- Boot up the portable PC.
- Ensure that the DOS system prompt is displayed.
- Start Windows.
- Insert the installation disk (Diagnostics Terminal DISK #1, part number 667/1/25625/000) into drive A.
- From 'File Manager' select drive A and then double click on the 'setup' program.
- Follow the instructions displayed - this involves confirming or changing the destination pathname. The Windows group and icon are all created automatically.

A3.2.1   Using VMS Diagnostics Terminal Software with Windows 95

There is an identified problem running the software with Windows 95 that can be overcome in the following way:

- From the **Start** button select **Settings** and then **Control Panel**
- Double Click the **System** icon. This opens a dialog titled **System Properties**
- Select the **Device Manager** tab and scroll down the list until you reach an item labelled **Ports (COM and LPT)**
- Double Click the **Ports** item to show all the COM and LPT ports on the PC
- Select the COM port that is used to connect to the sign, and press the **Advanced** button
- Select the **Port Settings** tab and select the **Advanced** button from the displayed dialog
- Remove the tick from the check box labelled **Use FIFO Buffers**
- OK all the displayed dialogs and close the **Control Panel**.

It is now possible to run the Diagnostic Terminal and connect to the sign via the RS232-485 converter.

Note:

Some applications and utilities that make extensive use of the COM port (such as serial printers, or network comms applications) may require this to be re-enabled when used. If other applications use the COM port it is possible to re-enable the FIFO buffering and only disable it when using the VMS Diagnostic Tool. To re-enable the FIFO buffering follow the procedure outlined above, but make sure the **Use FIFO Buffering** check box has the tick enabled.

A3.3 System Start-Up

Once the VMS Diagnostics Terminal software has been installed, to start the program, enter Windows and then select the Diagnostics Terminal icon from the VMS DIAGNOSTIC window.

Alternatively, invoke the program from the FILE - Run option of the main window, specifying the path to the file VMS_DIAG.EXE.

When started the terminal will attempt to establish a connection with the VMS Sign. If it is unable to do this, the software will notify the operator and exit.

> **Note: The terminal software must be exited before disconnecting or switching the computer off, as the terminal must establish a disconnect with the VMS Sign.**

A4 USERS' GUIDE

A4.1 Menu Structure

The system is completely menu driven and the various facilities are invoked simply by selecting the required menu option. The following table lists the options available. The number associated with each menu option refers to the section where the facility is described in detail.

A4.2 Password Protection

Some of the menu options are protected by a password for security reasons. The operator is allowed three attempts to enter a valid password, after which the system will abort the selected option. However, it is only necessary to enter the password just once during a session, i.e. while still in the VMS Diagnostics Terminal. The Simulator Faults, Factory Self Test and MSG Seq. options are protected by two passwords for additional security.

A4.3 Control

```
                        VMS - Diagnostics Terminal : Issue #

 Control   Reports   Factory Self Test   Msg Seq

     Reset Fault Log
     RT Clock
     Settings
     Set Simulator Faults
     Tests
     Heater Test
     Set Password
```
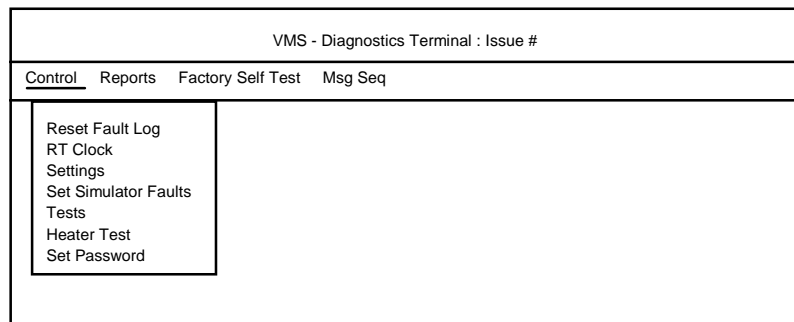
Figure 13 - Control Menu Options

A4.3.1   Reset Fault Log

This facility is protected by a password. On selection of this option, the operator is first prompted to enter the password unless one has been entered successfully during the current session.

Upon entry of a valid password, a dialog box is displayed which prompts selection of the 'Reset' button to reset the Fault Log. Select 'Cancel' to avoid clearance of the Fault Log.

If the 'Reset' button is selected, a message will confirm if the Fault Log has been cleared.

A4.3.2   RT Clock

This facility enables the sign driver clock to both be read and set, if there is one installed.

On selection of this option, the sign driver clock is read and the retrieved data displayed in a dialog box. Then either 'Quit' or change the time and/or date values and 'Send' the changes.

If 'Send' is selected and a password has not previously been entered during the current session, the operator will first be prompted to do so. When a valid password has been entered, the time and date are transmitted to the sign driver and used to reset the clock. The clock is immediately re-read and the new values sent back to the terminal and displayed.

Note: The data entry dialog box performs validation checks on the time and date values entered before sending them to the sign driver. Any errors are notified and the software offers an opportunity to correct them before proceeding. The terminal will not send an invalid date or time to the sign driver.

A4.3.3 Settings

```
┌─────────────────────────────────────────────────────────────────┐
│                   VMS - Diagnostics Terminal : Issue #            │
│                                                                   │
│  Control   Reports   Factory Self Test   Msg Seq                  │
│ ──────────────────────────────────────────────────────────────── │
│  ┌──────────────────────────┐                                     │
│  │ Reset Fault Log          │                                     │
│  │ RT Clock                 │                                     │
│  │ Settings                 │ ┌──────────────────────────┐        │
│  │ Set Simulator Faults     │ │ Set EMS message          │        │
│  │ Tests                    │ │ Set EMI drive code       │        │
│  │ Heater Test              │ │ Set Dim/Bright           │        │
│  │ Set Password             │ │ Set Lantern Override     │        │
│  └──────────────────────────┘ └──────────────────────────┘        │
│                                                                   │
└─────────────────────────────────────────────────────────────────┘
```
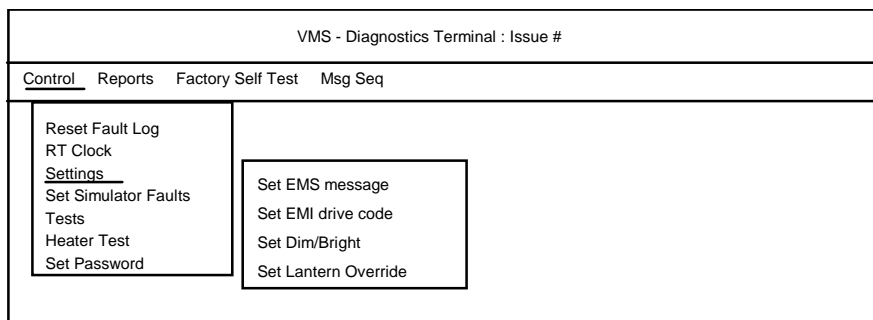
Figure 14 - Control - Settings Menu Options

A4.3.3.1 Set EMS Message

This option enables the operator to set the message on an EMS sign. It is password protected similar to the Reset Fault Log option.

The system checks the type of the sign connected. If the sign type is not EMS, an error message (see Appendix A5) is displayed to inform the operator of this and the option is aborted. Otherwise, the system proceeds and displays STATUTORY WARNINGS that must be read carefully to make sure that all the conditions are met before proceeding. Select 'Cancel' to abort if these conditions have not been met.

This facility enables the operator to set the text message on the sign, together with the lantern requirement (lanterns ON/OFF) and the lantern override switch (ON/OFF). The lantern requirement and lantern override switch are set by means of check boxes; an X in the check box indicates that the option is set to ON.

Note: If the 'lantern override' switch is set to OFF, the lantern requirement setting is ignored.

To specify the text to set, enter the text directly in the text message field, noting that to move to the next line press <CTRL + RTN>. The text will only be set on the sign if it is compatible with the sign's size. There is no error message concerning a set not being accepted.

To set the message on the EMS to one of the stored messages, the first character in the text message field **must** be '#' and **must** be followed immediately by the Stored Message Code (with no intervening spaces or tabs). The Stored Message Code must be in the range 0 to 47, e.g. #25; if it is not within the range an error message will be reported (see Appendix A5). The terminal will not send an out of range Stored Message Code to the sign driver.

This facility is also used to test all the characters on a sign during a routine maintenance visit (see section 5.2.2.1). This may be achieved by setting all the pixels of all the characters on one row of the sign, asking for a visual check and moving on to the next row. The way to set all the pixels on one character is by pressing <Alt>0146 at the numeric keypad.

Select 'Quit' to stop setting messages.

A4.3.3.2   Set EMI Drive Code

This option enables the operator to set the Aspect on an EMI sign. It is password protected similar to the Reset Fault Log option.

On selection of this option, after checking for entry of a valid password, the system checks the type of the sign connected. If the sign type is not EMI, an error message (see Appendix A5) is displayed to inform the operator of this and the option is aborted. Otherwise, the system proceeds and displays STATUTORY WARNINGS that must be read carefully to ensure that all the conditions have been complied with before proceeding. Select 'Cancel' to abort if these conditions have not been met.

This facility enables the operator to set the Drive Code and thereby set the Aspect on the sign, together with the lantern requirement (lanterns ON/OFF). The lantern requirement is set by means of a check box; an X in the check box indicates that the option is set to ON.

The Drive Code entered must be in the range 0 to 31; if it is not, an error message will be displayed (see Appendix A5). The terminal will not send an out of range Drive Code to the sign driver.

To stop setting Drive Codes on the EMI, select 'Cancel'.

A4.3.3.3   Set Dim/Bright

This option enables the operator to set the Dim/Bright level on both EMS and EMI sign types. It is password protected similar to the Reset Fault Log option.

On selection of this option, after checking for entry of a valid password, the system displays STATUTORY WARNINGS that must be read carefully to ensure that all the conditions have been complied with before proceeding. Select 'Cancel' to abort if these conditions have not been met.

The level is set to DIM or BRIGHT by means of "radio buttons", only one of which may be selected at any one time.

Select 'Quit' to leave this option.

A4.3.3.4   Set Lantern Override

This option enables the operator to set the lantern override switch on EMS signs to either ON or OFF. It is password protected similar to the Reset Fault Log option.

On selection of this option, after checking for entry of a valid password, the system checks the type of the sign connected. If the sign type is not EMS, an error message (see Appendix A5) is displayed to inform the operator of this and the option is aborted. Otherwise, the system displays STATUTORY

WARNINGS that must be read carefully to ensure that all the conditions have been complied with before proceeding. Select 'Cancel' to abort if these conditions have not been met.

The lantern override is set by means of a check box; an X in the check box indicates that lantern override is set to ON.

Select 'Quit' to leave this option.

Note: If the lantern override switch is off, the lantern requirement settings are ignored.

A4.3.4   Simulator Faults

For security reasons this option is protected by two passwords. If a password has already been entered during the current session, only the second password is required.

On selection of this option, after checking for entry of a valid password, the system displays a STATUTORY WARNING that must be read carefully to ensure that all the conditions have been complied with before proceeding.

A dialog box will be displayed, with a list of faults relevant to the type of sign connected to, either EMI or EMS. If the option has been accessed during the current session, the previously sent faults will already be highlighted, if the option has not been accessed before, then no faults will be highlighted.

A fault can be selected or de-selected by highlighting or un-highlighting it respectively. When the chosen faults have been selected, 'Send' can be selected to send the highlighted faults. None or more faults can be sent. If 'Cancel' is selected the dialog box is refreshed, and displays the faults previously sent (if any). If 'Stop' is selected the option will be aborted without sending any faults.

A4.3.5 Tests
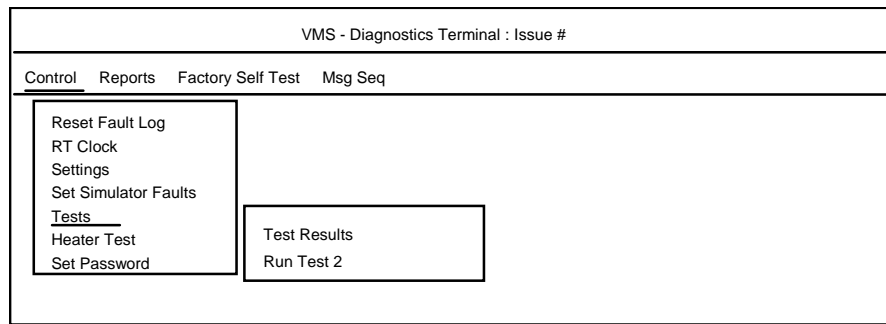
Figure 15 - Control Tests Menu Options

A4.3.5.1 Test Results

This facility provides a simple report consisting of the result of the last Test 2 run on the sign (see Appendix A4.3.5.2). It displays two bytes of data in binary format. It is not possible to save this report to a data file.

On selection of this option, the system checks the type of the sign connected. If the sign type is not EMS, an error message (see Appendix A5) is displayed to inform the operator of this and the option is aborted.

A4.3.5.2 Run Test 2

This facility enables the operator to run a Test 2 on an EMS. It is password protected similar to the Reset Fault Log option. Test 2 runs the following sequence:

1	Checkerboard1 on row1, 'SIGN TEST' on row2
2	Checkerboard2 on row1, 'SIGN TEST' on row2
3	'SIGN TEST' on row1, checkerboard1 on row2
4	'SIGN TEST' on row1, checkerboard2 on row2
5	'SIGN TEST' on row1, one block on row2, luminance level 1
6	'SIGN TEST' on row1, two blocks on row2, luminance level 2
7	'SIGN TEST' on row1, three blocks on row2, luminance level 3
7	'SIGN TEST' on row1, four blocks on row2, luminance level 4

Luminance level 1 is the level set when the ambient light is dimmest and level 4 is set when ambient light is brightest.

On selection of this option, after checking for entry of a valid password, the system checks the type of the sign connected. If the sign type is not EMS, an error message (see Appendix A5) is displayed to inform the operator of this and the option is aborted. Otherwise, the system proceeds and displays STATUTORY WARNINGS that must be read carefully to ensure that all the conditions have been complied with before proceeding. Select 'Cancel' to abort if these conditions have not been met.

Select 'Quit' to leave this option and the sign will be automatically cleared.

A4.3.6 Heater Test

This facility enables the operator to force the sign driver to perform a heater test; it then retrieves and displays the result which is either PASS or FAIL.

A4.3.7 Set Password

This facility enables the operator to reset the password. It is, of course, password protected. On selection of this option, after checking for entry of a valid password, the system displays a dialog box containing two fields:

- New Password.
- Confirm New Password.

Enter the new password in both fields before selecting the 'OK' button.

> **WARNING:** **The first level password can be changed by anyone with first level password access. Contact Poole site if the password is forgotten.**

Note: The password applies only to the machine on which the VMS Diagnostics Terminal software is installed; it is not written to the sign driver. It is not possible to reset the second level password.

A4.4 Reports

```
┌─────────────────────────────────────────────────────────────┐
│                    VMS - Diagnostics Terminal                 │
├─────────────────────────────────────────────────────────────┤
│  Control    Reports   Factory Self Test   Msg Seq             │
├─────────────────────────────────────────────────────────────┤
│         ┌──────────────────────────────┐                      │
│         │ Current Sign Driver Status    │                      │
│         │ Switch States                 │                      │
│         │ Fault Log                      │                      │
│         │ Monitor Light Sensors          │                      │
│         └──────────────────────────────┘                      │
│                                                               │
│                                                               │
└─────────────────────────────────────────────────────────────┘
```
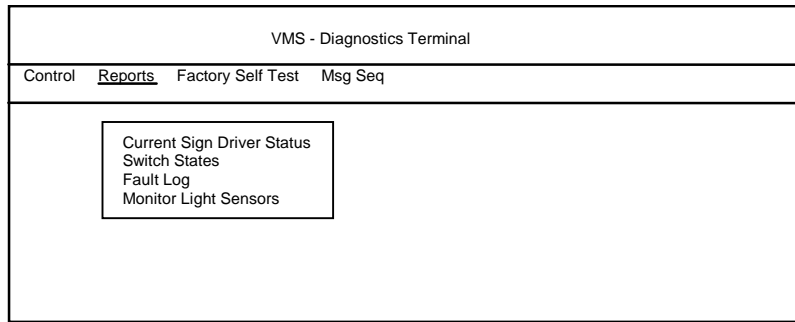
Figure 16 - Reports Menu Options

A4.4.1   Current Sign Driver Status

This option provides a report of the current sign status. The data is retrieved from the sign driver and, therefore, the terminal must be connected to a sign driver. If no sign driver is connected, an error message (see Appendix A5) is displayed instead of the report. It is not possible to save the contents of this report to a file.

The data retrieved and displayed is:

- Device Mod Code.
- Issue State.
- Message   (EMS).
- Drive Code   (EMI).
- CRC.
- Dim/Bright setting.
- Lantern Status (red and amber).

A4.4.2 Switch States


```
┌─────────────────────────────────────────────────────┐
│              VMS - Diagnostics Terminal               │
├─────────────────────────────────────────────────────┤
│  Control    Reports    Factory Self Test    Msg Seq   │
├─────────────────────────────────────────────────────┤
│       ┌──────────────────────────┐                    │
│       │ Current Sign Driver Status│   ┌────────────┐   │
│       │ Switch States            │   │ Sign Driver │   │
│       │ Fault Log                │   │ VMS Sign    │   │
│       │ Monitor Light Sensors    │   └────────────┘   │
│       └──────────────────────────┘                    │
│                                                       │
└─────────────────────────────────────────────────────┘
```
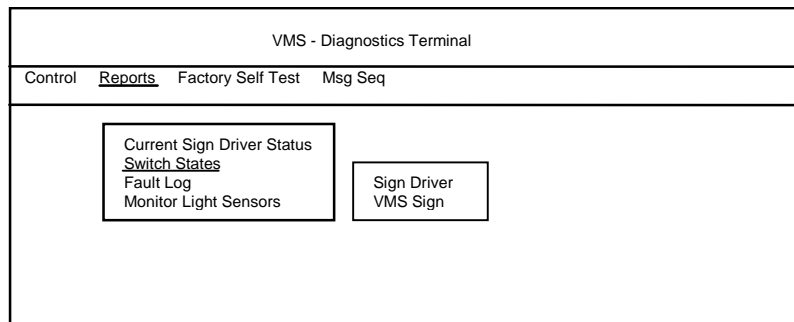
Figure 17 - Reports - Switch States Menu Options

A4.4.2.1 Sign Driver

This facility provides a report of the sign driver 'switch' states. However, the switches reported are not all switches in the common sense of the word. They are as follows:

- Address.
- EMS/EMI.
- EMS type.
- EMI type.
- Interface (Transponder/Stand Alone Controller).
- Luminance Override.

The following may appear in a number of fields:

1. N/A   - Not Applicable
2. U/A   - unavailable

A4.4.2.2 VMS Sign

This facility provides a report of the VMS Sign 'switch' states. However, the switches reported are not all switches in the common sense of the word. They are as follows:

- Address.
- EMS/EMI.
- Lithium Battery.

The following may appear in a number of fields:

1. N/A   - Not Applicable
2. U/A   - unavailable

A4.4.3   Fault Log


```
┌─────────────────────────────────────────────────────────────────┐
│                      VMS - Diagnostics Terminal                   │
├─────────────────────────────────────────────────────────────────┤
│  Control    Reports   Factory Self Test   Msg Seq                 │
├─────────────────────────────────────────────────────────────────┤
│          ┌─────────────────────────────┐                          │
│          │ Current Sign Driver Status  │                          │
│          │ Switch States               │                          │
│          │ Fault Log                   │                          │
│          │ Monitor Light Sensors       │                          │
│          └───────┬─────────────────────┴──────┐                   │
│                  │ Current Faults             │                   │
│                  │ Complete Fault  Log        │                   │
│                  └────────────────────────────┘                   │
│                                                                   │
└─────────────────────────────────────────────────────────────────┘
```
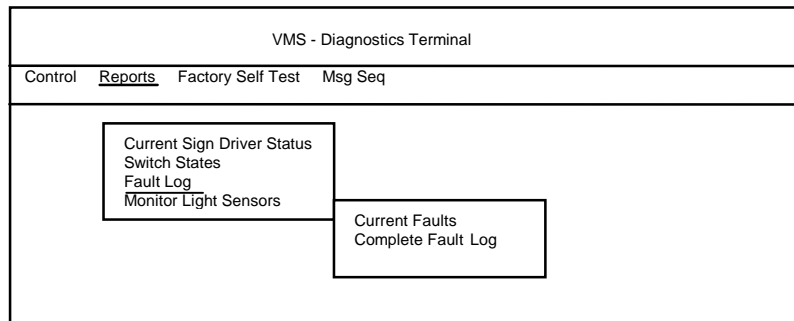
Figure 18 - Reports - Fault Log Menu Options

A4.4.3.1   Current Faults

This facility provides a report of the current faults obtained from the sign driver. The report is displayed in a dialog box.

This report may be saved to a data file by selecting the 'Save' button; enter a name for the file in which to store the report. All file names are subject to the usual MS-DOS limitations. The system checks the entered file name and, if it already exists in the system data file directory, flags an error; it is not possible to overwrite an existing file with the same name. The path for the VMS Diagnostics Terminal data file directory is \DATFILES, which is contained in the installation directory.

A4.4.3.2   Complete Fault Log

This facility provides a report of the complete fault history since the last reset. This is obtained from the sign driver. The report is displayed in a dialog box.

This report may be saved to a data file by selecting the 'Save' button; enter a name for the file in which to store the report. All file names are subject to the usual MS-DOS limitations. The system checks the entered file name and, if it already exists in the system data file directory, flags an error; it is not possible to overwrite an existing file with the same name. The path for the VMS Diagnostics Terminal data file directory is \DATFILES, which is contained in the installation directory.

A4.4.4   Monitor Light Sensors

This facility provides monitoring of the sign driver ambient light sensors. The values are displayed in a dialog box and are continually updated.

Select 'Quit' to leave this option.

Since the data in this report is dynamic, it is not possible to save this report to a data file.

A4.5 Factory Self Test

```
┌─────────────────────────────────────────────────────────┐
│               VMS - Diagnostics Terminal                 │
│                                                          │
│  Control    Reports    Factory Self Test    Msg Seq      │
│─────────────────────────────────────────────────────────│
│              ┌──────────────────────────┐                │
│              │ Start Factory Self Test   │                │
│              │ Stop Self Test            │                │
│              │ Report Self Test Results  │                │
│              │ Print Self Test Results   │                │
│              │──────────────────────────│                │
│              │ Test RS485 Link           │                │
│              │ Test RS232 Link           │                │
│              └──────────────────────────┘                │
│                                                          │
└─────────────────────────────────────────────────────────┘
```
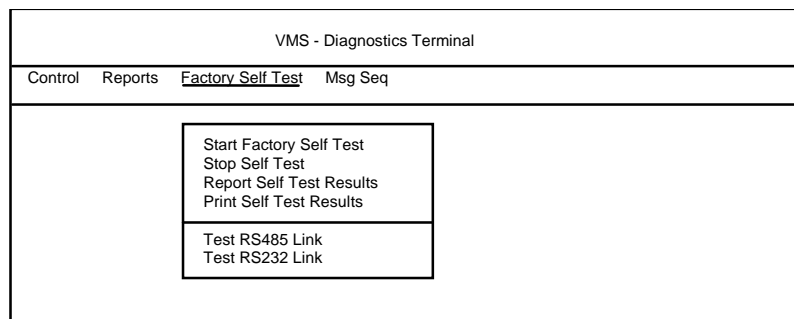
Figure 19 - Factory Self Test Menu Options

A4.5.1   Start Factory Self Test

This facility enables the operator to initiate a Factory Self Test. This test is used to soak test the signs in the factory. Each test consists of five sign settings as follows:

1. First set of alternate pixel rows set, lanterns off.
2. Second set of alternate pixel rows set, lanterns off.
3. First set of alternate pixel rows set, amber lanterns flashing.

4..Second set of alternate pixel rows set, red lanterns flashing (where fitted).

5..Sign blank, lanterns off.

Once a self test has been started, the sign driver takes over and performs the actual tests. For security reasons this option is protected by two passwords. If a password has already been entered during the current session, only the second password is required.

Note: This facility must not be invoked outside the factory even if the second password is known.

Before selecting this option, ensure that the RS485 port and the RS232 Engineers' Terminal port are connected using the RS485/RS232 Converter (part number 509/4/08948/000).

Before starting a Factory Self Test, a number of parameters must be entered:

- Lantern type   (red/amber/both).
- Sign size   (number of rows and number of columns).
- Test duration   (in hours).
- Cycle time   (in minutes).
- Setting time   (in seconds).

A maximum value of 255 applies to all these fields.

The **'Test duration'** parameter defines the overall time for the test to run. If the operator enters **0** for this parameter, the sign driver will run the test cycle **once** only.

The **'Cycle time'** parameter defines how often each cycle is to run during the self test, i.e. the gap between each test cycle. This value must be at least five times the 'setting time'.

The **'Setting time'** parameter defines how long each display remains set on the sign.

The **'Lantern type'** parameter defines which lanterns are tested (red, amber or red and amber). The lantern test requirement is set by means of two check boxes, one for the red lanterns and one for the amber lanterns.

All the parameters contain default values when the dialog box is first displayed. These values may be used or replaced.

In addition to the parameters entered, the system obtains the date on which the test is started from the PC and this is added to the parameter list automatically.

The sign size is validated before the test is started and the operator is informed if the size entered is different from that configured in the sign driver.

The Factory Self Test operates in cycles, each consisting of a set of pre-defined tests. In between cycles, the sign does not display anything and the sign driver appears to be inactive. The test cycle runs as many times as the overall test duration time will allow. Each display that is part of the test (including the lantern test) remains set for the duration of the **'Setting time'** parameter.

When all parameters have been entered, select the 'Start' button to start the test running. Once this has been done, the option may be exited and it is possible to continue working on other options or applications or to disconnect the terminal from the sign driver.

All faults detected are logged and counted.

The Factory Self Test may only be interrupted between test cycles and the Self Test Results obtained using the **Report Factory Self Test Results** option, (See Appendix A4.5.3). However, a report obtained at this time will obviously be incomplete and contain only the results so far.

It is possible to stop the Factory Self Test in between test cycles using the **Stop Self Test** option (See Appendix A4.5.2).

The Factory Self Test stops automatically at the end of the test duration time.

A4.5.2 Stop Self Test

This facility enables the operator to stop a Factory Self Test before it has completed.

Select the 'Stop' button to stop the test or 'Continue' to continue.

Note: Any commands selected during a Factory Self Test will only be accepted if they are sent between test cycles, i.e. while the Sign is Blank.

A4.5.3 Report Factory Self Test Results

This facility provides a report of the results of the Factory Self Test obtained from the sign driver. It may be invoked both during a Factory Self Test and after a Self Test has run to completion.

The report is similar to the fault log report but it also contains a count of occurrences of each fault. It also contains the Device Mod Code and Issue State of the sign driver together with the self test parameters that were used to start the test. The report is displayed in a dialog box.

This report may be saved to a data file by selecting the 'Save' button; enter a name for the file in which to store the report. All file names are subject to the usual MS-DOS limitations. The system checks the entered file name and, if it already exists in the system data file directory, flags an error; it is not possible to overwrite an existing file with the same name. The path for the VMS Diagnostics Terminal data file directory is \DATFILES, which is contained in the installation directory.

A4.5.4 Print Self Test Results

This facility is provided specifically to make it easy for the operator to obtain a print out of Factory Self Test Results. However, this facility may be used to print any data files that have been created using the 'Save' button in any of the reports.

A4.5.5   Test RS485 Link

A4.5.5.1   9600 Baud

This facility enables the operator to test the Sign Driver RS485 Link (9600 baud) at the Sign Enclosure. Once a test is started, a single test message is sent down the link and the software waits for the corresponding reply. The result is displayed as PASS or FAIL. For security reasons this option is protected by **two** passwords. If a password has already been entered during the current session, only the second password is required.

A4.5.5.2   2400 Baud

This facility enables the operator to test the Transponder RS485 Link (2400 baud) at the Sign Driver or at the Sign where no Sign Driver is installed. Once a test is started, a single test message is sent down the link and the software waits for the corresponding reply. The result is displayed as PASS or FAIL. For security reasons this option is protected by **two** passwords. If a password has already been entered during the current session, only the second password is required.

A4.5.6   Test RS232 Link

This facility enables the operator to test the SAC (Stand Alone Controller) RS232 Link at the Sign Driver or at the Sign where no Sign Driver is installed. Once a test is started, a single test message is sent down the link and the software waits for the corresponding reply. The result is displayed as PASS or FAIL. For security reasons this option is protected by **two** passwords. If a password has already been entered during the current session, only the second password is required.

A4.6 MSG Seq.

Figure 20 - Message Sequencing Menu

A4.6.1   Message Sequencing

This facility enables the operator to initiate a sequence of preset messages to be displayed on the VMS Sign.

For security reasons this option is protected by **two** passwords. If a password has already been entered during the current session, only the second password is required.
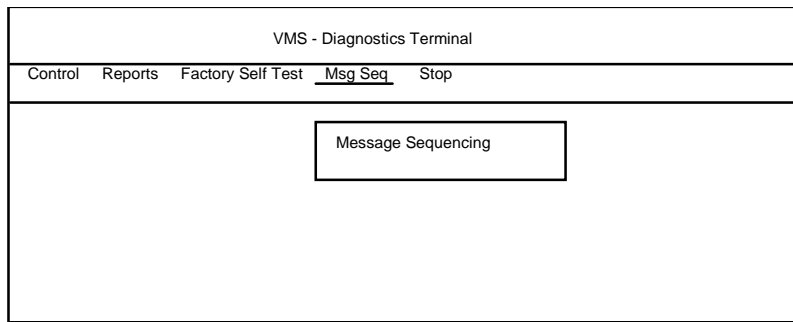
It retrieves and displays the result of the settings, which is either OKAY or FAIL.

Select the 'Stop' button to stop the sequencing. This will blank the Sign automatically.
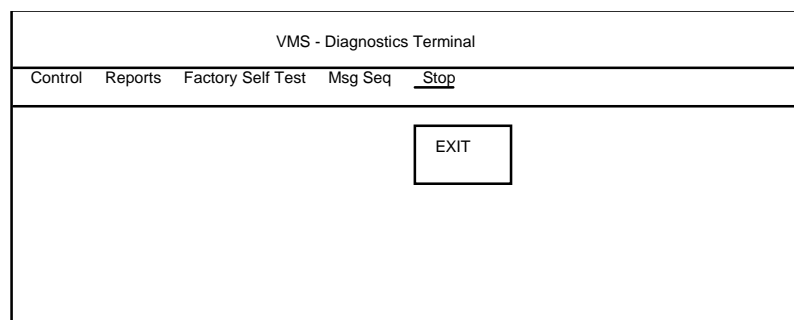
A4.7 Stop

Figure 21 - Stop Menu

A4.7.1 Exit

This will exit the current Diagnostic Terminal application. The exit function must be confirmed. If confirmed the Terminal will try to establish a disconnect with the VMS Sign. Only if the disconnect message is replied to correctly will the Diagnostic Terminal Application terminate.

A5 ERROR MESSAGES

The following is a list of error messages likely to be encountered, where they are likely to be encountered and a brief description of their likely cause.

Unable to Establish a Connection
The Diagnostic Terminal has not received a reply from the VMS Sign to its connection request messages. Check that the computer is connected to the Sign and to the correct port.

Unable to Disconnect from the VMS Sign
The Diagnostic Terminal has not received a reply from the VMS Sign to its disconnection request messages. Check that the Sign is still running and that the computer is connected to the Sign and to the correct port.

Error in TIME
RT Clock - either the 'hours' field contains a value greater than 23 or the 'minutes' field contains a value greater than 59.

Faulty Comms reception - sign driver reply corrupted
Most facilities - this usually means that the terminal is not properly connected to a sign driver.

File with entered name already exists - Please re-enter file name
Reports (when the 'Save' button has been selected and a name for a new file to be created entered) - the file name entered has been found in the data directory \DATFILES.

Invalid entry in DAY field
RT Clock - the value in the day field is either less than 1 or incorrect for the month and year combination, e.g. 31-4-95, 29-2-99.

Invalid entry in MONTH field

RT Clock - the month field contains a value greater than 12 or less than 1.

Invalid Password

All options that are password protected - the password has been entered incorrectly.

Invalid Password - Process Aborted

All options that are password protected - if, after three attempts, the password has still not been entered correctly, this message is displayed and the software then returns to the main menu of the Diagnostics Terminal.

New password and confirm password inconsistent

Set password - the character strings entered in the 'new password' field and the 'confirm password' field do not match; enter the new password in **both** of these fields **before** selecting the 'OK' button.

Number of characters or number of rows is incorrect for configuration

Start Factory Self Test - the sign size is configured in the sign driver; this message will appear if the values entered in the 'number of characters' field and/or 'number of rows' field are not the same as those in the sign driver configuration.

Range error in Drive Code, Drive Code must be 0-31

Set EMI - a Drive Code that is greater than 31 or less than 0 has been entered.

Self Test Parameter is greater than 255

One of the parameters entered in starting a factory self test is greater than 255.

Setting time and Cycle time contain inconsistent values - please correct

Start Factory Self Test - each cycle contains a number of pre-defined tests, each of which remains set for the number of seconds entered in the 'setting time' parameter; this message is displayed if the 'setting time' is such that the test cycle exceeds the cycle time parameter.

Sign Type is EMS - Red lanterns should not be set
Start Factory Self Test - EMS signs do not have red lanterns; this message appears if the terminal is connected to an EMS sign driver and red lanterns are selected as one of the lantern type parameters.

Stored Message Code entered is out of range
Set EMS - a Stored Message Code (after the '#') which is either greater than 31 or contains a non-numeric character which causes the code to go out of range (between 0 and 31).

Wrong sign type for function
Set EMS, Set EMI, Set Lantern Override, Test Results, Run Test 2 - the system checks the sign type before running any of the above facilities; this message appears with any one of the conditions shown below:

- The terminal is connected to an EMI sign driver and the operator tries to select the Set EMS option.
- The terminal is connected to an EMS sign driver and the operator tries to select the Set EMI option.
- The terminal is connected to an EMI sign driver and the operator tries to select the Set Lantern Override option.
- The terminal is connected to an EMI sign driver and the operator tries to select any of the Tests options (Test Results, Run Test 2).

A6 REPORTED FAULTS

Fault numbers not included in this table are for design proving only.

The first byte is the fault number,
the second byte is fault category:
- 00 WARNING
- 01 FAILURE
- 02 CLEARED
- 03 FATAL

bytes 3 to 6 are data bytes.

The following are example faults:

| 07 | 01 | 00 | 00 | 00 | 00 | The mains has failed or been switched off. |

07 01 00 00 00 00 The mains has failed or been switched off.

72 01 5D 01 63 01 Light sensor 1 is showing too little variance (it may be dirty or faulty). The minimum reading over 24 Hrs was 015D Hex and the maximum was 0163 Hex.

60 01 01 05 00 00 The sixth character from the left (viewing from the front) on the second row has two pixels with faulty LEDs.

Note: If a fault 11 other than those shown in the following table is logged, the fault and its data should be reported to Engineering.

A6.1 Sign Enclosure Faults

FAULT	FAULT NAME	DATA1	DATA2	DATA3	DATA4
7	MAINS POWERFAIL	00	00	00	00
11	SD TO SIGN COMMS FAULT	XX	09	00	00
11	SD REQUESTED RESET	XX	08	00	00
35	CLOCK FAULT	00	00	00	00
37	BATTERY FAULT	00	00	00	00
39	LANTERN BULB FAIL	01/02	00	00	00
50	HEATER FAIL	HEATER CURRENT	00	00	00
51	OVERTEMP FAIL	00	00	00	00
53	AMBER LANT PAIR FAULT		00	00	00
54	AMBER LANT CYC STS FAULT	01/02	00	00	00
55	RED LANT CYC STS FAULT	01/02	00	00	00
56	DISK SUPPLY FAIL	00	00	00	00
57	LANT SUPPLY FAIL	00	00	00	00
58	LED SUPPLY FAIL	00	00	00	00
59	LED FAULT	ROW	COL	00	00
60	CRITICAL LED FAULT	ROW	COL	00	00
63	CHAR LED SHORT CIRCUIT	ROW	COL	00	00
64	DISK FAULT	ROW	COL	00	00
65	CRITICAL DISK FAULT	ROW	COL	00	00
66	LIGHT SENSOR1 FAULT	LIGHT LEVEL		00	00
67	LIGHT SENSOR2 FAULT	LIGHT LEVEL		00	00

68	LUMINANCE FAULT	00	00	00	00
72	SENSOR 1 LIGHT VARIANCE FAULT	LIGHT LEVEL MIN		LIGHT LEVEL MAX	
73	SENSOR 2 LIGHT VARIANCE FAULT	LIGHT LEVEL MAX	LIGHT LEVEL MIN	00	00
74	EMI LUMINANCE INPUT FAULT	00	00	00	00
75	RED LANTERN PAIR FAULT		00	00	00
76,77,78	INTELLIGENT CHARACTER FLT	XX	XX	ADDR	00
128	RESTART MESSAGE	00	00	00	00

A6.2 Sign Driver Faults

FAULT	FAULT NAME	DATA1	DATA2	DATA3	DATA4
12	SD ADDRESS ERROR	00	00	00	00
129	SD BAD COMMS	00	00	00	00

A6.3 Literal Definitions

SYMBOL	VALUE
XX	IGNORE
01	TOP/LEFT
02	BOTTOM/RIGHT

B. SAMPLE CURRENT DRAW CALCULATIONS FOR VMS SIGNS

The current required to drive a VMS is made up of three components:
- (a) that required to run the electronics
- (b) that required to power the heaters
- (c) that required to illuminate the LEDs and lanterns when a message is being displayed.

(a) Electronics

Estimated as being equivalent to 1.5A at 5V continuous or 7.5W. Allowing for 75% efficient power supply gives 10W at 250V AC.

(b) Heaters

After a short term surge at switch-on, the heaters run at about 60mA/m directly from the 250V mains (i.e. 15W/m).

The heaters are controlled by thermostats (on at less than 20°C) and a hygrostat (on at greater than 95% RH).

The lengths of heater tape and power consumption of the signs of interest are:

> 320mm 2 x 12 – 16m – 240W
> 420mm 2 x 16 – 27m – 405W

(c) LEDs and Lanterns

Lanterns

Each lantern is 50W at 12V, allowing 75% efficient supply gives 67W at 250V AC. As two lanterns are on at any given time this equates to 134W.
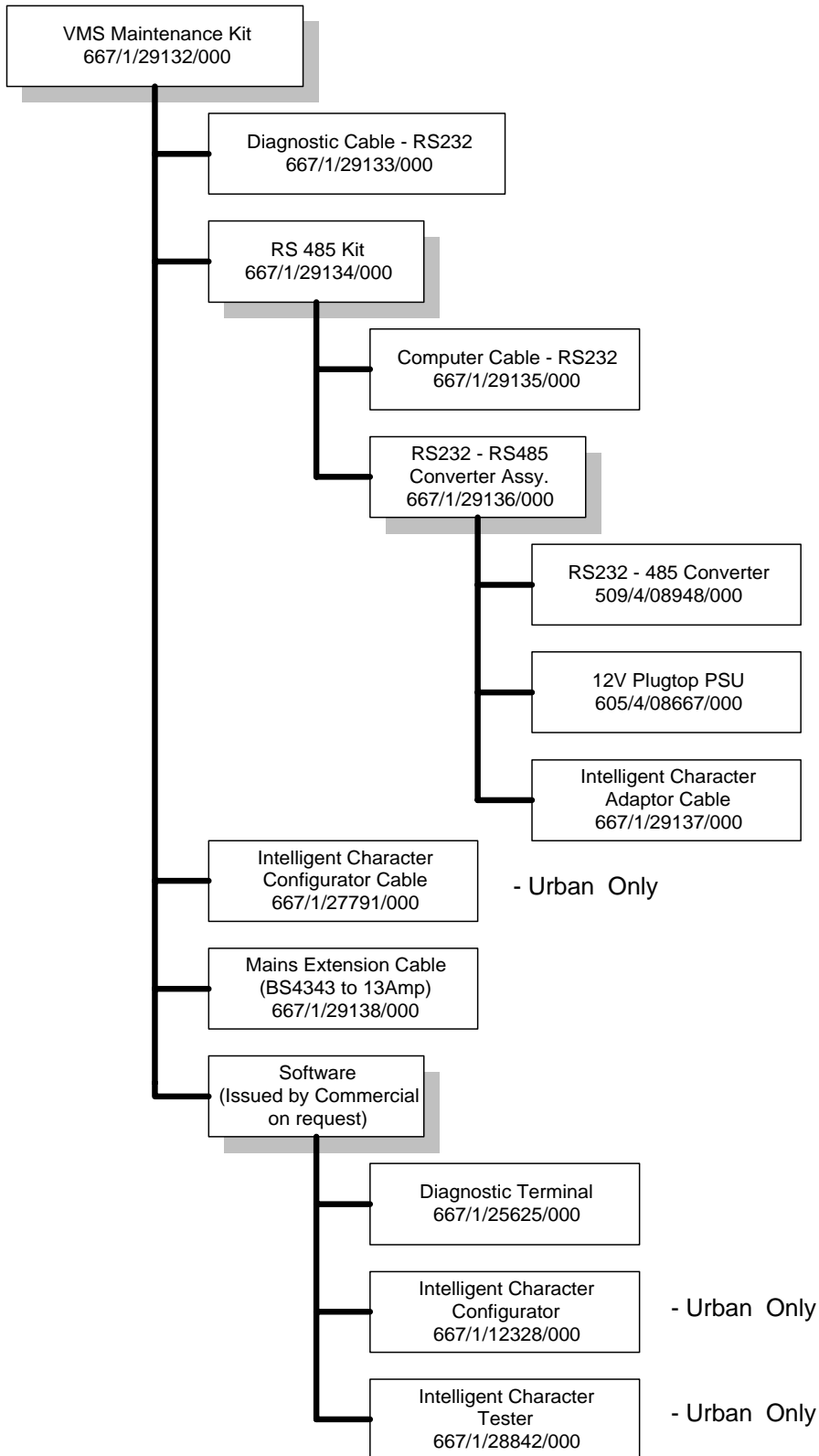
LEDs

The average number of LEDs illuminated when a character is activated is 15. The characters have their LEDs powered from 24V and each pixel passes 20mA. This equates to 9.6W per character at 250V allowing for 75% power efficiency.

For example:

A 420mm sign showing "ACCIDENT ON A31 DELAYS EXPECTED" for 3 hours and blank for the remaining 21 hours.

Electronics	24 hours at 10W	= 0.24kWh
Heaters	24 hours at 405W	= 9.72kWh
Message	3 hours at 27 x 9.6W +	
	134W	= 1.18kWh
Total power usage for 24 hours		= 11.14kWh

C. MAINTENANCE KIT

```
┌─────────────────────┐
│ VMS Maintenance Kit │
│   667/1/29132/000   │
└─────────────────────┘
  │
  │   ┌──────────────────────────┐
  ├───│ Diagnostic Cable - RS232 │
  │   │      667/1/29133/000     │
  │   └──────────────────────────┘
  │
  │   ┌─────────────────────┐
  ├───│     RS 485 Kit      │
  │   │   667/1/29134/000   │
  │   └─────────────────────┘
  │     │
  │     │   ┌──────────────────────────┐
  │     ├───│ Computer Cable - RS232   │
  │     │   │     667/1/29135/000      │
  │     │   └──────────────────────────┘
  │     │
  │     │   ┌──────────────────────────┐
  │     └───│     RS232 - RS485        │
  │         │     Converter Assy.      │
  │         │     667/1/29136/000      │
  │         └──────────────────────────┘
  │           │
  │           │   ┌──────────────────────────┐
  │           ├───│  RS232 - 485 Converter   │
  │           │   │     509/4/08948/000      │
  │           │   └──────────────────────────┘
  │           │
  │           │   ┌──────────────────────────┐
  │           ├───│     12V Plugtop PSU      │
  │           │   │     605/4/08667/000      │
  │           │   └──────────────────────────┘
  │           │
  │           │   ┌──────────────────────────┐
  │           └───│  Intelligent Character   │
  │               │     Adaptor Cable        │
  │               │     667/1/29137/000      │
  │               └──────────────────────────┘
  │
  │   ┌──────────────────────────┐
  ├───│  Intelligent Character   │   - Urban Only
  │   │    Configurator Cable    │
  │   │     667/1/27791/000      │
  │   └──────────────────────────┘
  │
  │   ┌──────────────────────────┐
  ├───│   Mains Extension Cable  │
  │   │    (BS4343 to 13Amp)     │
  │   │     667/1/29138/000      │
  │   └──────────────────────────┘
  │
  │   ┌──────────────────────────┐
  └───│        Software          │
      │  (Issued by Commercial   │
      │      on request)         │
      └──────────────────────────┘
        │
        │   ┌──────────────────────────┐
        ├───│   Diagnostic Terminal    │
        │   │     667/1/25625/000      │
        │   └──────────────────────────┘
        │
        │   ┌──────────────────────────┐
        ├───│  Intelligent Character   │   - Urban Only
        │   │      Configurator        │
        │   │     667/1/12328/000      │
        │   └──────────────────────────┘
        │
        │   ┌──────────────────────────┐
        └───│  Intelligent Character   │   - Urban Only
            │        Tester            │
            │     667/1/28842/000      │
            └──────────────────────────┘
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