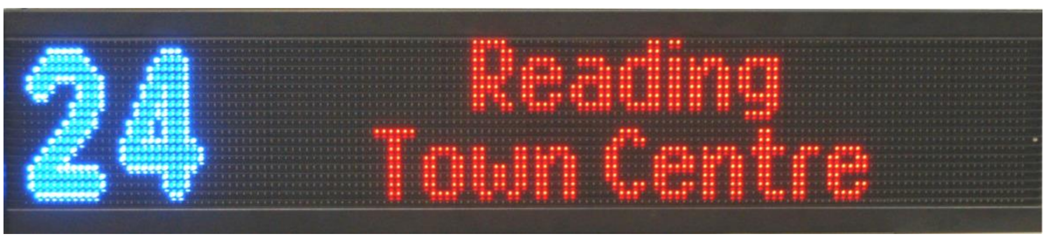
HANOVER

LED Destination Display

Installation and Service Manual



PASSENGER INFORMATION SYSTEMS

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1-540156-2

Revision History

Revision	Date	Notes
1-540156-1	09/28/2016	First version
1-540156-2	12/06/2016	Updates of: Identification, Key voltages: Diagnostic aids, 3V power supply board 7517

Please note that this document is subject to continual updating: please ensure you are using the latest edition.

This edition: **December 06, 2016**

CONTENTS

GLOSSARY

Explanations relate to the use of the word in this manual and other Hanover publications; the word or phrase may have other meanings elsewhere.

ALS - ambient light sensor

baud rate - The number of changes per second to the data being transmitted. Also called the signalling rate, baud rate is measured by the number of signalling events per second.

bootloader - the section of software a device runs when powered up that is responsible for starting the main application and for allowing software updates

busbar board - distributes power between adjacent display boards - sometimes referred to as interconnect board, connector board or moose board

controller - on-bus device used by driver to select destination / advert / information details that will be shown on the displays

database - collective term for the destination / advert / information details mentioned above, prepared using Helen software and loaded on to the controller

(destination) list - an electronic list of information for one or more routes / destinations (part of the database - see above)

direct drive - a system in which all the LEDs in a display required to make up the desired image are illuminated constantly at the same time (cf. multiplex). Used in OLED displays.

display-sizing (formerly sign-sizing) - the process on startup executed by the processor board to establish the display size

fast-on - automotive grade crimped connector

filter board - provides voltage overload and spike protection for the display

heartbeat - LED indicating operational status of a display processor board

Helen - **H**anover **E**xtended **L**ist **E**ditor for Destinatio**N** Displays - a software tool used to create and edit text, graphics and destination lists on a pc as they will appear on a Hanover display

IP - ingress protection: a measure of protection against dust and liquid ingress. Uses a rating system.

Keystone terminal - screw connection / fixing component found on display boards and the 7611 processor

LED - light-emitting diode

link jumper - short length of conductor used to close a break in, or bypass part of, an electrical circuit. Used to configure operation / function of printed circuit board.

Molex - ribbon data cable

moose (board) - busbar board (see above)

multi-drop - connection of several devices to a single communication or power line (in 'daisy chain' configuration)

multiplex - a system of powering the LEDs in a display sequentially in a rapidly repeated grid pattern to make up the desired image, thereby giving the illusion that they are permanently powered on. Used in OLEMS displays.

pcb - printed circuit board

power cycle - to turn a display off and then on again

RS485 - the name of the electrical standard used for communications between displays and a controller

Super-X - a system within the Helen software for determining the way text is presented on a display (e.g. scrolling text, animated images)

supermoose - 7564 busbar board with voltage overload and spike protection (a filter board)

1. Introduction

1.1 General

The best understanding of Hanover's LED Destination display equipment will be gained by reading the complete manual - but this is not always practicable for the user. The document has therefore been written in a modular fashion in order to allow users to refer only to those parts of it they need: topics should thus appear relatively self-contained. However, there are several useful cross-references, both to other points within this manual, to other manuals and to external documents as appropriate. Accordingly, when consulting this document using a pdf reader, it is helpful to have the 'Back' (or 'Previous') and 'Next' (or 'Skip' / 'Forward') buttons enabled to obtain maximum benefit from the intra-document cross-references. For example, in Adobe Reader, press F8 to view the toolbar if it is not already visible. Right-click on a blank section of the toolbar and, in the 'Page Navigation' menu, ensure that 'Previous View' and 'Next View' are ticked.

Please note that, in most territories, the terms 'display' and 'controller' are now being used in place of 'sign' and 'console' respectively. Consequently, they are the terms used in this manual.

Reference is occasionally made to the controllers and Helen software used with the displays covered by this manual. Detailed manuals for these products are available from Hanover.

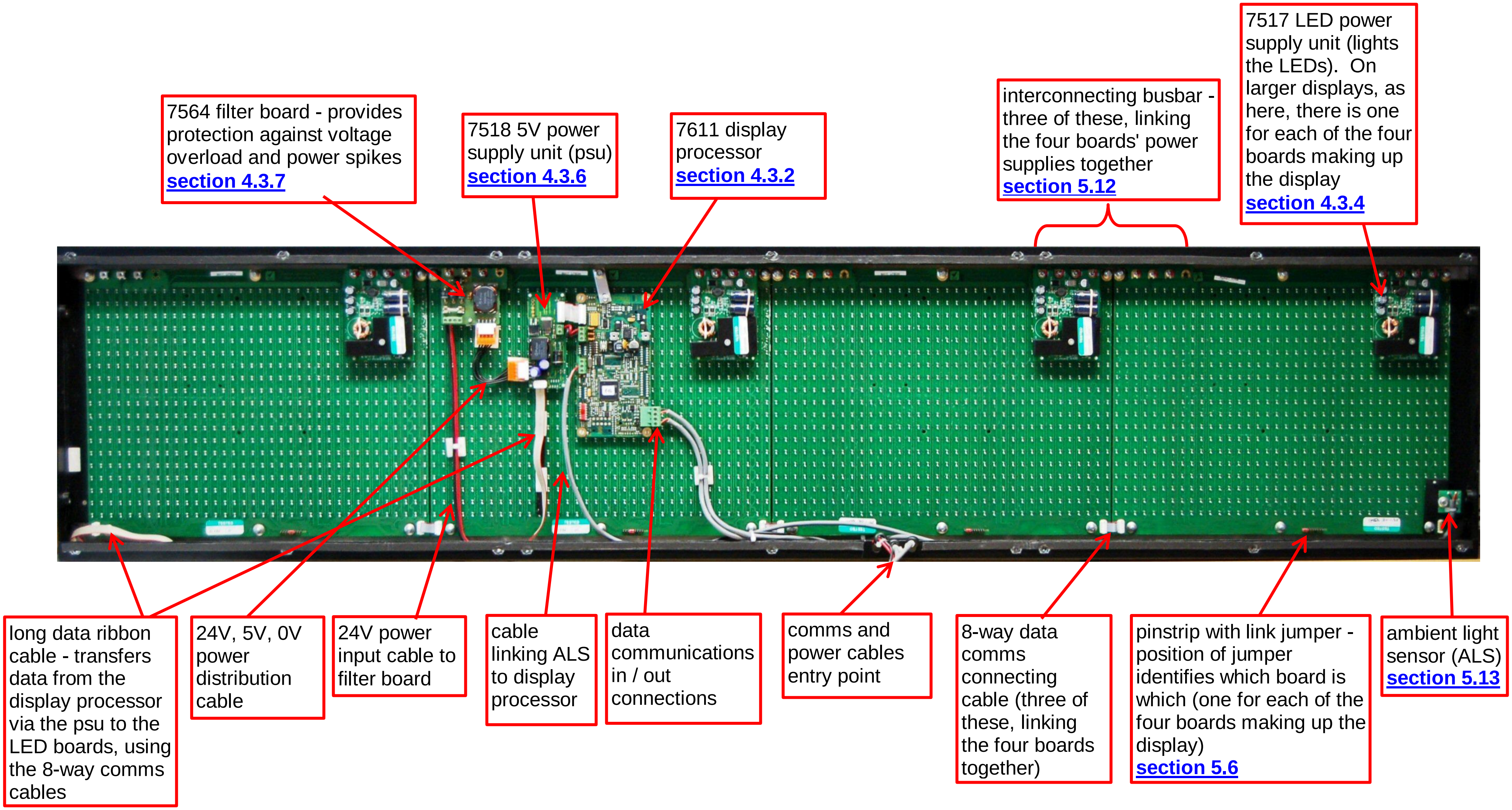
Destination displays for buses and coaches are normally used on the front, side and rear of the vehicle. This practice is so widespread that Hanover often uses 'front, side and rear' to describe equipment used in those positions. However, it is important to stress that any display can be used anywhere on a vehicle, subject to sufficient available space and the correct electrical / communications connections being made.

1.2 System overview

Hanover LED displays are built using high brightness LEDs arranged in a matrix. The cases are fitted with an angled metal louvre above each row of LEDs which improves contrast when the ambient light is high by providing shade for each LED so that reflection of sunlight from the LED bodies is minimized.

Information for all displays within a system (typically front destination, side information and rear route number) is created on a standard office computer using Helen display editing software. Each display has a processor with an address switch that is associated with the configuration set within Helen allowing it to receive the appropriate information via a controller which is connected to the display by a multi-drop communications network.

The example below shows a typical OLED direct drive monochrome display with its rear casing panel removed. It comprises four boards joined together with both power and display data connections. The OLED software uses a 7611 processor to control the overall display. The image is labelled with the key components: click on each label to jump to the part of the manual dealing with each component in more detail - or turn to the section indicated. Block diagrams of various display connectivity configurations are shown at sections 5.7 - 5.10.



A typical Hanover display consists of several printed circuit boards joined together. The display processor converts the message into a set of control signals, which determine which LEDs are to be illuminated on each of the boards. These control signals are routed to the first board by the 8-way ribbon cables. They are then passed from board 1 to board 2, 2 to 3 etc via the data cable links at the bottom corners of each board. The display continuously measures the level of ambient light falling on its surface with the ambient light sensor (ALS) and adjusts the brightness level accordingly.

Larger displays are generally fitted to the front of vehicles with smaller displays usually found on the side and rear. This is not mandatory: as long as the correct power supply and communications configurations are in place, they can be fitted anywhere. Larger models have more LEDs and need more power to drive both the processor boards and the LEDs themselves. These displays are therefore fitted with supplementary power supply boards.

1.3 Brief history

Hanover's LED destination displays have continued to evolve since their introduction. This document covers all such developments over the course of that evolution, throughout which, backward compatibility has been maintained. Principal changes were as follows:

- The first designs (OLEDs) had one 7517 power supply per display board and used the 7524 processor.
- Displays with a colour route number were introduced.
- The 7611 processor then superseded the 7524 processor (more powerful, increased space for software) and displays in full colour became available.
- More efficient amber LEDs followed, allowing power supplies to be shared between boards.
- Multiplexed OLEMS displays were introduced, using the 7766 processor.

1.4 Scope of this manual

This manual covers the installation and service of Hanover LED destination displays on buses and coaches. The different types are:

- Monochrome (amber) displays (OLxxx, DDxxx and OLAxxx series)
- Monochrome (amber) displays with multicolour route number (COLxxxMCR series - number to the right when viewing from outside the vehicle) (COLxxxMCL series - number to the left when viewing from outside the vehicle)
- Full colour displays (COLxxxFC series)
- Colour route number displays (COLxxx series)

The document also covers system wiring, detailed descriptions of functionality and fault finding at system level and within displays.

The manual does not cover:

- the technical specification for individual destination displays: this is provided separately for each variant (identified by product code);
- the operation of the displays or how to compose messages for them: this information can be found in the relevant controller manual and the Helen display-editing manual;
- the connection of third party equipment to drive displays or display systems; for information about this, contact Hanover;
- flipdot displays or in-vehicle displays;
- the installation of a display controller: this information can be found in the relevant controller manual;
- static / wayside display installations.

For information on these products, consult the relevant documentation or contact Hanover Displays.

Hanover produces many bespoke and custom systems - for example, with special wiring adaptations or software features. Much of the content of this manual is relevant to the displays in these systems but users are also advised to consult their system-specific documentation.

1.5 System supply voltages

For the purposes of this manual, supply voltage will be referred to as 24V. All Hanover 24V equipment is suitable for the full voltage supply range found on vehicles with a 24V battery. Some Hanover displays are compatible with 12V systems; please refer to the technical information for a specific product for supply voltage details.

1.6 Identification

The display's identification can be determined from the silver label on the rear of the casing.

In addition to identifying the display type, it may be necessary to identify which version of software the display uses, especially for technical support queries. To ascertain the software variant and version in use, the display must be put into test mode. Section 3.5 Diagnostic aids explains how to do this and how to interpret the information shown.

Features	Meaning	Description
Product no.	Product number	Identifies the display type and is explained in 1.6.1 Software variants. For example, for a product number of COL037MCL-K51, this means it is an OLED-type monochrome display with colour route number and wiring option 'K51'.
Position	-	Indicates where the display is likely to be fitted on the vehicle.

Features	Meaning	Description
Type	-	Installation type.
Our order no.	Our order number	Number used for internal use by Hanover.
Your O/N	Your Order Number	Number used to identify the order for this display.
Your Part no.	Your Part number	Specific to each display.
S/N	Serial Number	Specific to each display.
End User	-	Is generally the ultimate operator of the vehicle.
Builder	-	References the name/customer to which the product is shipped.
Job reference	-	For the use of builder or end user.
Manufactured	-	Date when the finished display is available for shipment after all checks, tests and approvals are complete.
Made in the UK	-	Shows the country of manufacture of the display.
Exx-yyR-zznnnn	United Nations Standard Type Approval (EMark) number	xx = country code. yy = regulation number. zz = regulation revision number. nnnn = approval certificate number.

1.6.1 Software variants

There are four software variants:

- OLED : used with the 7611 pcb on OL-series and COLxxxMCR/MCL-series displays;
- OLED-FC : used with the 7611 pcb on COLxxxFC-series displays.
  There are two sub-variants: –DD and –MX (direct drive and multiplex);
- ELD : used with the 7524 pcb on some older OL-series displays;
- OLEMS : used with the 7766 pcb on DD- and OLA-series displays.

1.7 Direct drive and multiplex displays

'Direct drive' displays use a system in which all the LEDs in a display required to make up the desired image are illuminated constantly at the same time. A 'Multiplex' system powers the LEDs in a display sequentially in a rapidly repeated grid pattern to make up the desired image, thereby giving the illusion that they are continuously powered. This is a more efficient use of the components.

OLED / ELD software is used in direct drive displays whilst multiplex systems use OLEMS software.

1.8 Firmware

Occasionally, it may be necessary to update the firmware in a display; this will be for one of two reasons:

- There is an error in the functionality of the display that affects its operation.

All software changes are tested thoroughly before release but even in the most rigorous test regime, it is possible for obscure bugs to remain undetected. Most installations deploying standard, well-proven functions are very unlikely to be affected by bugs of this type.

- A new feature has been introduced which the user wishes to deploy.

Before updating display software to take advantage of new features, users should contact Hanover Displays to see if there is a more convenient way to achieve the same effect - for example, via the controller or an aspect of the Helen software.

1.9 Hanover Technical Support

1.9.1 United Kingdom

Please do not hesitate to contact Hanover Technical Support located in Lewes, UK for any problem encountered or for any advice needed for using the LED destination display:

Contact	
Phone	+44 (0)1273 477528 Ext.615 or Option 2
Email	support@hanoverdisplays.com

1.9.2 United States of America

Please do not hesitate to contact Hanover Technical Support located in USA for any problem encountered or for any advice needed for using the LED destination display:

Contact	
Phone	+1 (773) 334 9934
Email	STL@hanoverdisplays.com

2. Installation

This section covers mounting and wiring of the display.

It is very important that installation is done correctly: most display problems stem from poor installation. Hanover service engineers are available to assist if required. Please note that Hanover accepts no liability for damage that occurs because of incorrect installation by the customer.

2.1 Ingress protection (water and dust)

Standard displays are not suitable for exterior mounting; they should be mounted behind a window in an area that is protected from water and dust. Specialized variants are available, fitted with their own windows, with an appropriate IP rating. Please consult Hanover should an IP-rated display be required.

2.2 Display mounting

Displays should be securely mounted using the fixings built into the edges of the casing. Brackets for many vehicle models are available from Hanover Displays. In addition, mechanical drawings for all display models are available on request.

Display brackets should be attached flush to the display casework in a way that does not restrict the release of the rear access panels. Brackets should be made of steel and have a thickness of at least 3mm.

- Display side fixings are threaded for M8 bolts; maximum insertion depth: 13mm.
- Display top and bottom fixings (where present) are threaded for M6 bolts; maximum insertion depth: 13mm.

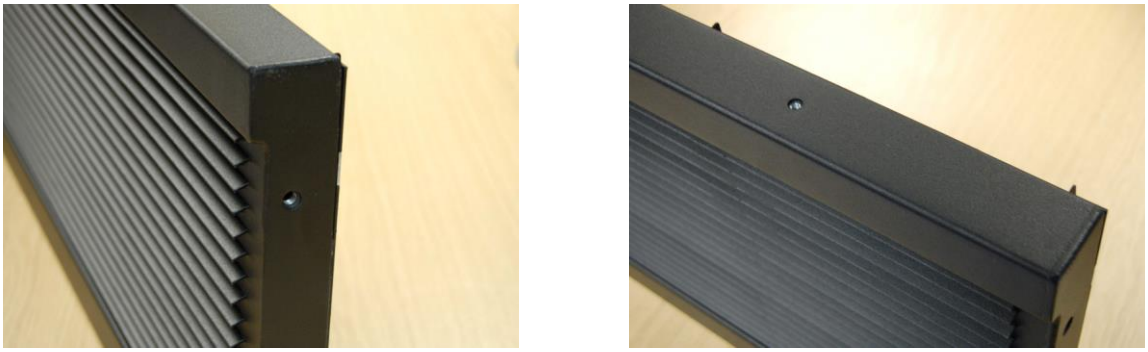


Figure 1 Display side and top fixings

The positioning of the display is extremely important to ensure maximum legibility from all angles. LED displays should be mounted as close as practicable to the vehicle glass: Hanover recommends a gap of 10mm.

In cases where the display must be fitted within only a few mm of the screen glass of the vehicle, a pre-compressed sealant foam strip can be applied to the horizontal front faces of the case (top and bottom) to prevent it banging against the vehicle's bodywork / screen glass. Hanover recommends ALFAS C-type foam, in 10mm width, with a maximum expandable dimension of 15mm. This foam seal will find its own level when released and create a seal between the display and the rest of the vehicle, thereby absorbing any impact through vibration etc. On some models, the display casing extends beyond the end of the metal louvres to form a vertical front face at each end: in these instances, the foam strip can also be applied here. Alternatively, additional brackets can be fitted to provide a suitable surface to which the foam can be affixed.

2.2.1 Front display mounting

Where displays are greater than 1000mm in width, the display must be mounted using both top and bottom fixing points. This will ensure that it has good support along its entire width.

Alternatively, it can be mounted by its side fixing points though in this case it is essential that additional support is added to the bottom of the display (see Figure 2).

Where a display is less than 1000mm in width, fewer fixings may be used. See section 2.2.2.

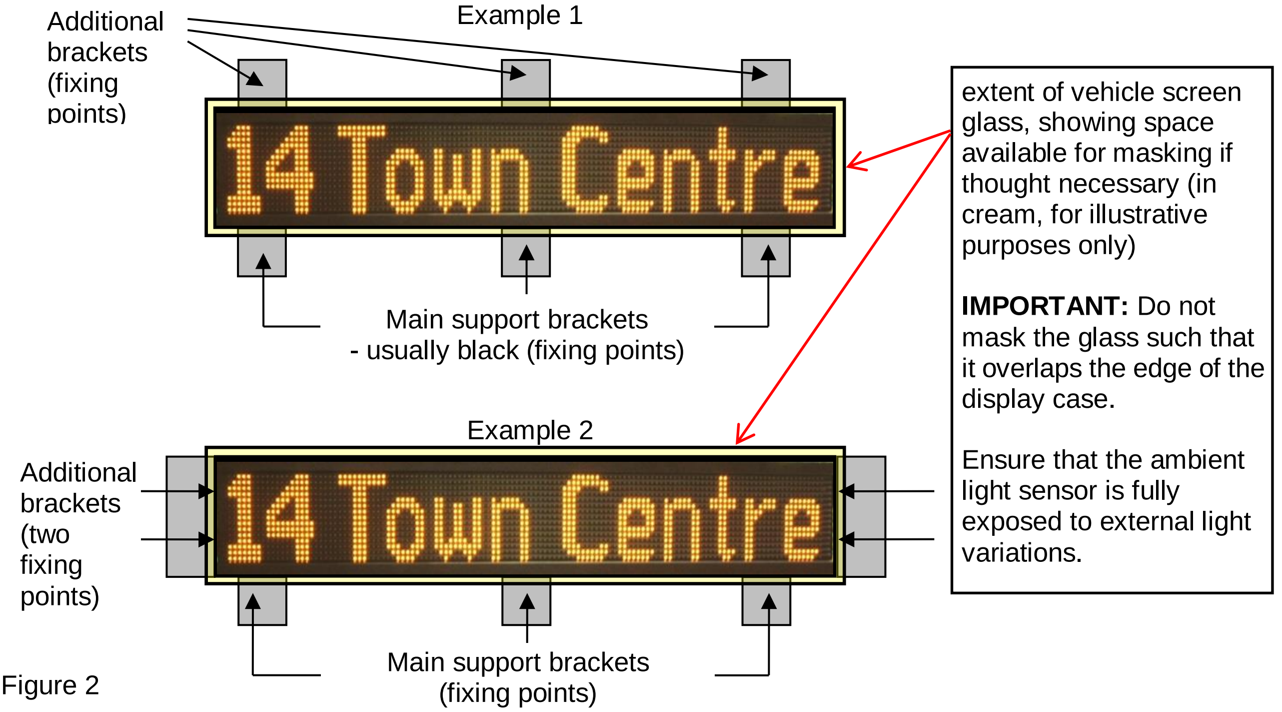


Figure 2

2.2.2 Side / rear and route number displays

Displays typically used on the side and rear of vehicles, providing they are less than 1000mm in length, can be mounted by the side fixing points only (see Figure 3). If they are longer than 1000mm, additional support is required. Route number displays should be mounted using the side fixing points.

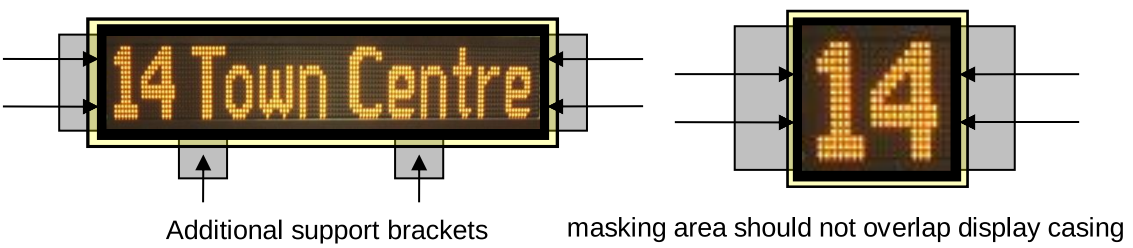


Figure 3

2.2.3 Viewing angles and masking the vehicle screen glass

In instances where the display is smaller than the vehicle's destination screen glass, it may be necessary to mask the latter although this can reduce the visibility of the destination details when viewed from an angle. If masking is undertaken, it should not be aligned to the display area, but to the outer dimensions of the case. If the clearance between the display and the screen glass is greater than the recommended minimum, then the masking on the display itself (see 'Masking areas of the display' in the Helen manual) must be correspondingly larger.

The display area should be viewable from every angle, e.g. front (head-on), side (from the pavement etc.) so that the text can be seen from all positions.

2.2.4 Ambient light sensor (ALS)

An ambient light sensor is mounted on the front face of every LED display at the side, top or bottom according to customer requirements (see Figure 4). The sensor automatically adjusts the brightness of the display to compensate for the level of ambient light falling on it. This ensures good contrast in all light conditions. See section 6.4 for a procedure to test this function.

The sensor must be fully exposed to external light variations to function effectively. If light cannot reach the sensor due to the way the screen glass is masked, the display will be too dim to read in sunlight. If there are difficulties in this regard when fitting the display, an ALS can be provided which is mountable via a flying lead to a window external to the display.

If the sensor is mounted behind tinted glass, it is possible to adjust its behaviour to compensate: see section 2.5.4.

Figure 4

2.3 System wiring

> It is important to use correctly rated fuses, cables and connections. Failure to do so may result in failure of the cables and displays, overheating and risk of fire.
>
> For series or parallel ('daisy chain') wiring, cables from the supply will carry a current equal to the total current for all displays connected. Wiring etc. must be rated for the total current.
>
> ALL cable insulation must meet appropriate heat, fire resistance and smoke standards to comply with local legislation requirements.

Hanover recommends that each display has its own individual 24V power feed.

The following wiring diagram (Figure 5) shows a proposed new Olem wiring system schematic 4-way SQ weatherpack connectors - single, 4-core wire (power and comms).

Information is sent from the controller to each of the displays in turn via the communication cables.

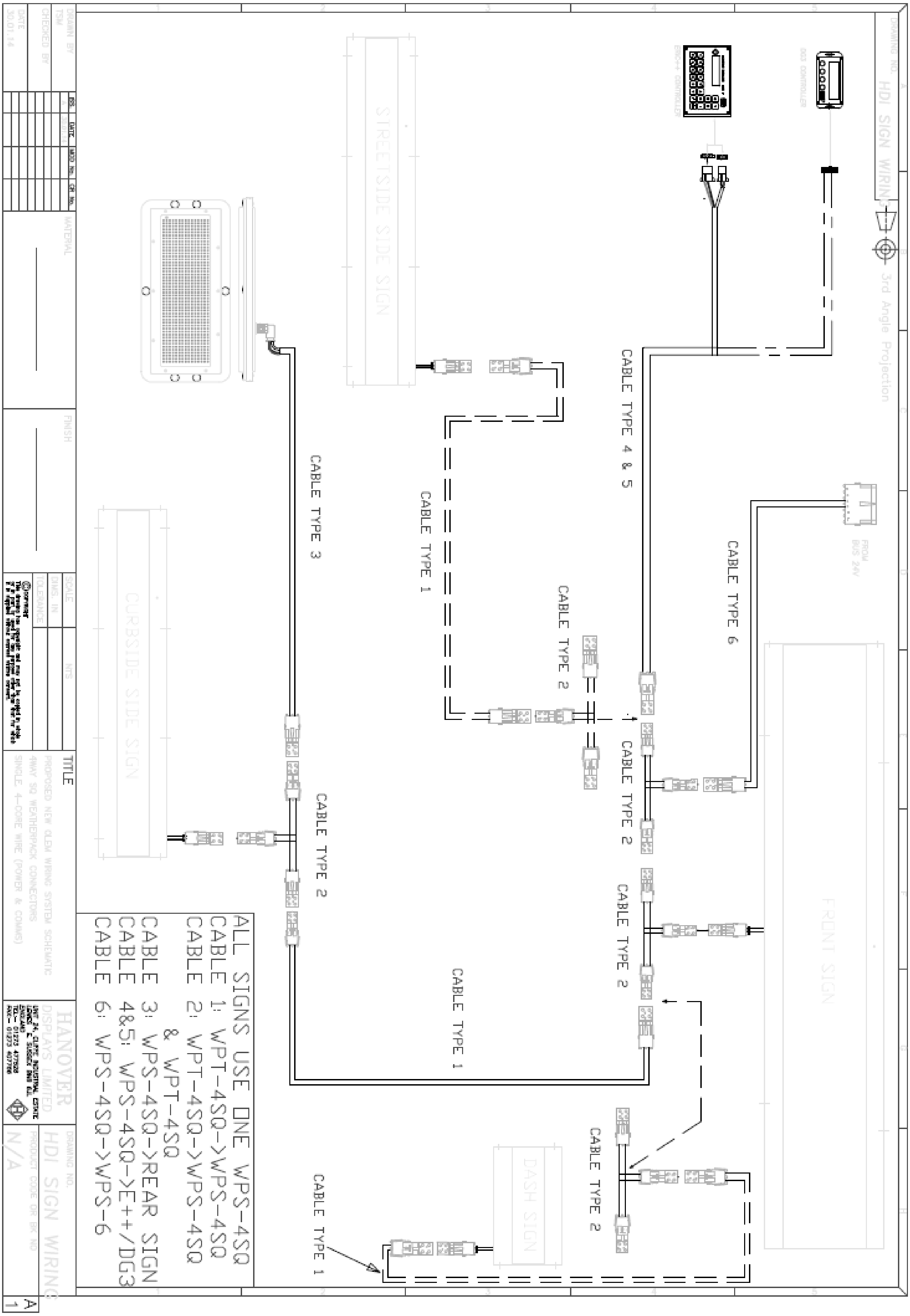

HDI SIGN WIRING
3rd Angle Projection
FROM BUS 24V
STREETSIDE SIDE SIGN
CURBSIDE SIDE SIGN
FRONT SIGN
DASH SIGN
CABLE TYPE 4 & 5
CABLE TYPE 3
CABLE TYPE 1
CABLE TYPE 2
CABLE TYPE 6
CABLE TYPE 2
CABLE TYPE 2
CABLE TYPE 2
CABLE TYPE 1
CABLE TYPE 2
CABLE TYPE 1
ALL SIGNS USE ONE WPS-4SQ
CABLE 1: WPT-4SQ->WPS-4SQ
CABLE 2: WPT-4SQ->WPS-4SQ
& WPT-4SQ
CABLE 3: WPS-4SQ->REAR SIGN
CABLE 4&5: WPS-4SQ->E++/DG3
CABLE 6: WPS-4SQ->WPS-6
TITLE
PROPOSED NEW OLEM WIRING SYSTEM SCHEMATIC
4WAY SQ WEATHERPACK CONNECTORS
SINGLE 4-CORE WIRE (POWER & COMMS)
HANOVER
DISPLAYS LIMITED
HDI SIGN WIRING
N/A

Figure 5

2.3.1 Cable rating and current considerations

The 24V power supply must use insulated cable of sufficient gauge to be able to handle the current required by all the connected displays.

There are two basic wiring methods:

- Connection in 'star' formation describes an arrangement where each display is connected to the power source individually and thus the cable ratings required must each be appropriate to their particular display.
- A daisy-chain type of connection means the amperage rating must be the sum of the individual display ratings.

Example 1 - monochrome amber display:

Front destination display: OL006 144 x 19 3.3A

Side destination display: OL010 96 x 8 0.9A

Rear destination display: OL020 32 x 17 0.7A

In-bus display: L042 96 x 8 1.1A

Example 2 - full colour display:

Front destination display: COL001FC 192 x 19 12.0A

Side destination display: COL051FC 96 x 8 1.9A

Rear destination display: COL020 32 x 17 1.9A

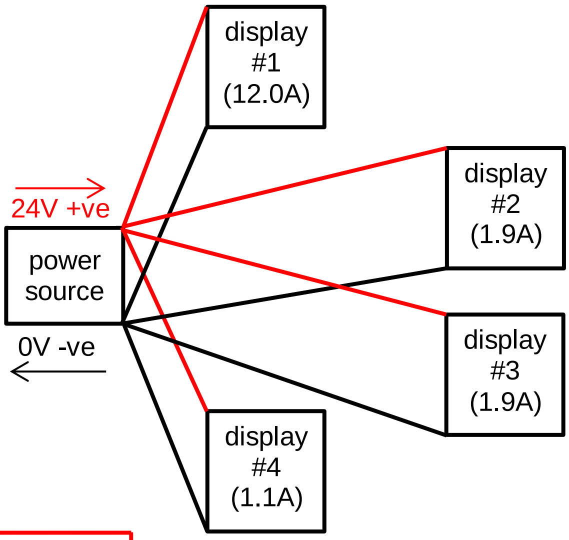
In-bus display: TCL031 96 x 8 1.1A

Although never likely to be used in practice, maximum power consumption (ie all LEDs on at 100% brightness) is assumed in all cases.

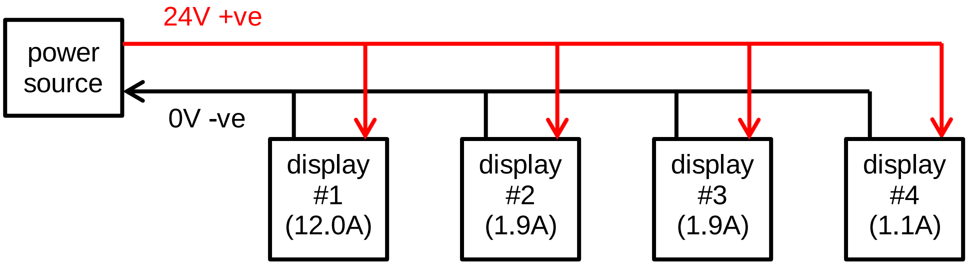
It can be seen that colour LEDs generally draw significantly more current than do monochrome amber LEDs. The larger the display (ie the greater the number of LEDs to be lit) the greater the current required. Extremely hot climates can have an effect too, as an increase in cable temperature will raise the resistance therein, requiring a correspondingly greater current. It is therefore sensible to allow a margin for this and other reasons when deciding on the wiring rating to use.

Wiring configurations

In the diagram to the right, the four displays in Example 1 are connected in 'star' formation so cables rated 15A, 5A, 5A and 3A respectively would be suitable:



In the diagram below, the same four displays are daisy-chained together and so the total current required to be driven is 12.0A + 1.9A + 1.9A + 1.1A = 16.9A. Thus 25A cable will be appropriate here:



However, note that there are two inherent disadvantages of daisy chain wiring:

i) a fault or break part-way along the cable can affect more than one display;

ii) significantly thicker wiring will be required.

2.3.2 Power / Communications connections

Power and communications connections to displays are by means of a 4-way weatherpack connector mounted on a flying lead. The switching, fusing and cabling must be adequately rated for the display's maximum current consumption. Electrical specifications for each individual destination display are contained in its data sheet.

In order to ensure a good return current path, the negative or 0v supply to the cables must be wired to the negative at the power supply, rather than connecting it to the chassis locally to the display.

Where each display is connected individually back to its power supply ('star connecting') cabling should be rated for the display in question. However, if power is run from one display to the next in series, switching, fusing and cabling must be rated for all the displays on the cable run added together.

2.3.2.1 N50 wiring option

- Rear centre

Figure 6A Power/communications and daisy-chain leads provided with the display are contained in a single sleeve

Figure 7B Power/communications and daisy-chain connectors: seals, crimps and housing

- Top left

Figure 7A Power/communications and daisy-chain leads provided with the display are contained in a single sleeve

Figure 7B Power/communications and daisy-chain connectors: seals, crimps and housing

2.3.2.2 N51 wiring option

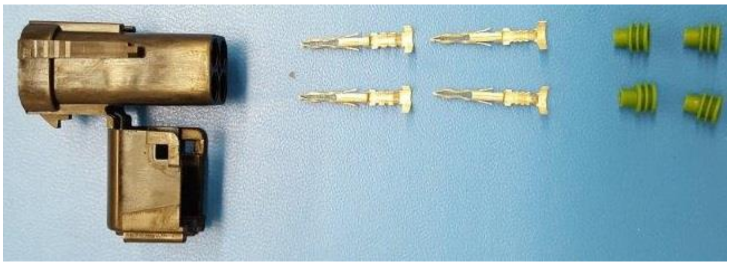


Figure 8 Power/communications connector: seals, crimps and housing

2.3.2.3 N52 wiring option

Figure 9A Power/communications lead provided with the display

Figure 9B Power/communications connector

2.4 Configuring the display

The display must be configured for the correct communications address and the correct running options. Displays are usually configured in the factory, but should be checked at the time they are installed.

Remove the rear access panel(s) to locate the display processor board. On larger displays, depending on the model, the board is most likely to be in the centre or to the left as viewed from the rear. For more information, see section.

2.4.1 Address setting

Each display in the system must be set to a unique address. Depending on the processor, this is done by setting either the rotary switch or the address links on the processor itself. Setting the address allows the display to distinguish which information it must use out of all the information present on the communications network. See section 4.3 for help in identifying the processor.

When the display information is configured with the Helen editor, addresses are assigned and must match the addresses that have been set on the displays themselves. For instance, assume that a system includes a display that has been set to address 0. When using Helen to configure the information to be shown, the address associated with that information should also be set to 0.

Typical display addresses	
Front display	0
Side display	1
Rear display	2
Further display location	3
In-bus displays†	4
Reserved for Hanover on-board computer	5
Further display locations if needed	6, 7
Further display locations if needed*	8, 9, A, B, C, D, E
For use with route number displays only when using the programmable route number facility. Refer to Helen display editor and relevant controller manual.	F
† Except that no specific address setting is required if the in-bus display is driven by (and connected to) an on-board computer using a separate serial connection.	
* Addresses 8-E are not available for displays with OLED software prior to version 1.16.	

2.4.2 Brightness setting at night

Automatic brightness control is fitted in the form of an ambient light sensor: this dims the display during dark conditions (e.g. nighttime, gloomy / overcast daytime weather, twilight etc) and makes it brighter in strong daylight and other good lighting situations.

For example, a brighter nighttime display is often preferred if a vehicle is used in a well-lit urban environment, whereas in a (less well-lit) suburban environment, a lower brightness may be more suitable. In an unlit rural environment, very low brightness may be best. If the automatic system in its default configuration does not give exactly the result required in all these situations, its behaviour may be adjusted as described in section 2.4.3 or via the controller as described in the Helen manual.

2.4.3 Configuration options

Some further display parameters may be set using the appropriate link jumper option on the processor board; the illustrations in section 4.3 can be used to identify these jumpers:

Link Jumper Options			
	ELD display (7524 PCB – LK3)	**OLED display (7611 PCB – LK3)**	**OLEMS display (7766 PCB – LK1)**
A	Fitted = enable low dim level	Fitted = enable low dim level	Not used
B	Fitted = enable 38k4 baud rate	Fitted = enable 38k4 baud rate	Fitted = enable 38k4 baud rate
C	Not used	Fitted = enable blank sign on 5mins communication timeout	Not used
D	Fitted = enable power/brightness limit	Fitted = enable power/brightness limit	Fitted = enable diagnostics display
E	Inserted after power-up starts self-test	Self-test (when fitted after state change)	Self-test (when fitted after state change)

A - enable low dim level allows the display to dim to 5% of maximum brightness. With the link removed (default setting), the minimum brightness is 10%. This feature should be used when a display is too bright at night.

Note: This feature is not available on OLEMS displays, where the default minimum is 5%.

B - enable 38k4 baud rate configures communications to run at 38k4 (38,400) baud. With the link removed (default setting) the communications run at 4,800 baud. **The controller and all the displays on the system must be set to run at the same communications speed**. 38k4 is the faster rate (8 x faster) and should be used when:

- there are very large displays or
- several displays on the system are required to page their information.

In these situations, the slower rate may mean the displays' information updates are unable to remain in sync with the pageing.

D - enable power/brightness limit limits maximum brightness to 75%.

Note: OLED displays only; this feature is not available on OLEMS displays.

- enable diagnostic display used for fault-finding - see section 4.1.1.

Note: OLEMS displays only; this feature is not available on OLED displays.

E - self-test if the link jumper is added to the display whilst the latter is running, a test pattern will be shown. The test pattern includes information on software version and display size. For more details, see section 3.5.

2.5 Other display options

Please contact Hanover's Technical Support department for information about deploying any of the features described in this section.

2.5.1 Digital inputs to control maximum brightness (for power saving)

Digital inputs set display brightness as follows (only applicable to OLED displays with a 7611 processor and software version 1.16 (X1.15) or newer):

7611 J7 Connector (found within the display)		
Pin 2	**Pin 6**	**Brightness**
24V	24V	100%
open	24V	50%
24V	open	25%
open	open	0% (display off)
Note: additional connections required: • connect Pin 3 to Pin 4 • connect Pin 8 to Pin 7		

2.5.2 Power saving (controller feature)

It is possible to control the brightness of the display using the controller. This includes dimming it for a programmable time after the ignition has been turned off and eventually blanking it completely.

2.5.3 Additional functions: bus reverse / emergency message (controller feature)

An additional trigger from reverse gear / the emergency switch connects to the controller digital input. The controller then sends the appropriate message to the display.

2.5.4 Brightness gain for tinted windows

Although the installation of displays behind tinted windows is not recommended, brightness gain is a controller feature to compensate for the disruption to the ambient light sensor in this instance. Brightness gain and maximum brightness are determined by the database parameters set in Helen.

For further information on these features, please contact Hanover.

2.6 Standard part numbers – crimps, seal and housing

Crimps, seal & housing for power / communications			
 **30-3043-0001-00** Display power/communications male crimp (NB: 2 crimps per housing)	 **30-3043-0008-00** Display power/communications male crimp (NB: 2 crimps per housing)	 **30-3043-0010-00** Seal	 **30-3043-0013-00** Display power/communications male housing
Crimps, seal & housing for daisy-chain			
 **30-3043-0003-00** Display daisy-chain female crimp (NB: 2 crimps per housing)	 **30-3043-0007-00** Display daisy-chain female crimp (NB: 2 crimps per housing)	 **30-3043-0010-00** Seal	 **30-3043-0014-00** Display daisy-chain female housing

3. On-vehicle troubleshooting

3.1 Introduction

This is a guide for users and operators to assist with testing, fault-finding and repair.

3.2 Water ingress inspection

Exposure to water is one of most common causes of display damage. It can cause intermittent operation of part or all of the equipment. Evidence of water ingress often only becomes apparent on close inspection of the display and its circuit boards. The common signs of water ingress are:

- water tracks in the casing, especially the removable rear covers
- green corrosion on data cable links
- water in the lower part of the display boards, especially where data cables plug in
- rust around the mounting nuts
- water between the LED board and the front.

Where evidence of water ingress is found, the problem should be fixed without delay. Some displays can be supplied with ingress protection and are IP-rated. Ask Hanover for details.

3.3 Quick diagnostics

The following examples illustrate some of the more commonly reported problems, with possible resolutions for those with a basic understanding of Hanover systems. Note that in addition to the diagnoses below, these symptoms can also indicate that the board itself is faulty.

Also see the diagnostic flow chart in section 3.4.

3.3.1 Blank display

Figure 8

1. Incorrect destination list - check that the right list for this display set-up / type is being used.
2. Incorrect processor address - set the correct address.
3. No power? - check there is power supplied to the display at input.
4. Failure of an internal component or circuit board causing display size failure - further diagnosis can be carried out by using the diagnostic flow chart in section 3.4.

3.3.2 Illegible information

Figure 9

1. Incorrect display information - check that the right list for this display configuration / type is being used.
2. Incorrect processor address - set the correct address.

3.3.3 LED lit top left-hand corner (may be flashing)

Figure 10

1. Display is working but is not receiving a valid message from the controller - check communications cable wiring; check the correct destination list for this display configuration / type is being used.
2. The destination list loaded does not contain any information for this display - check with whoever provided the list.

For more information on the function of the top left LED, see section 3.5.6.

3.3.4 One board or group of boards not working

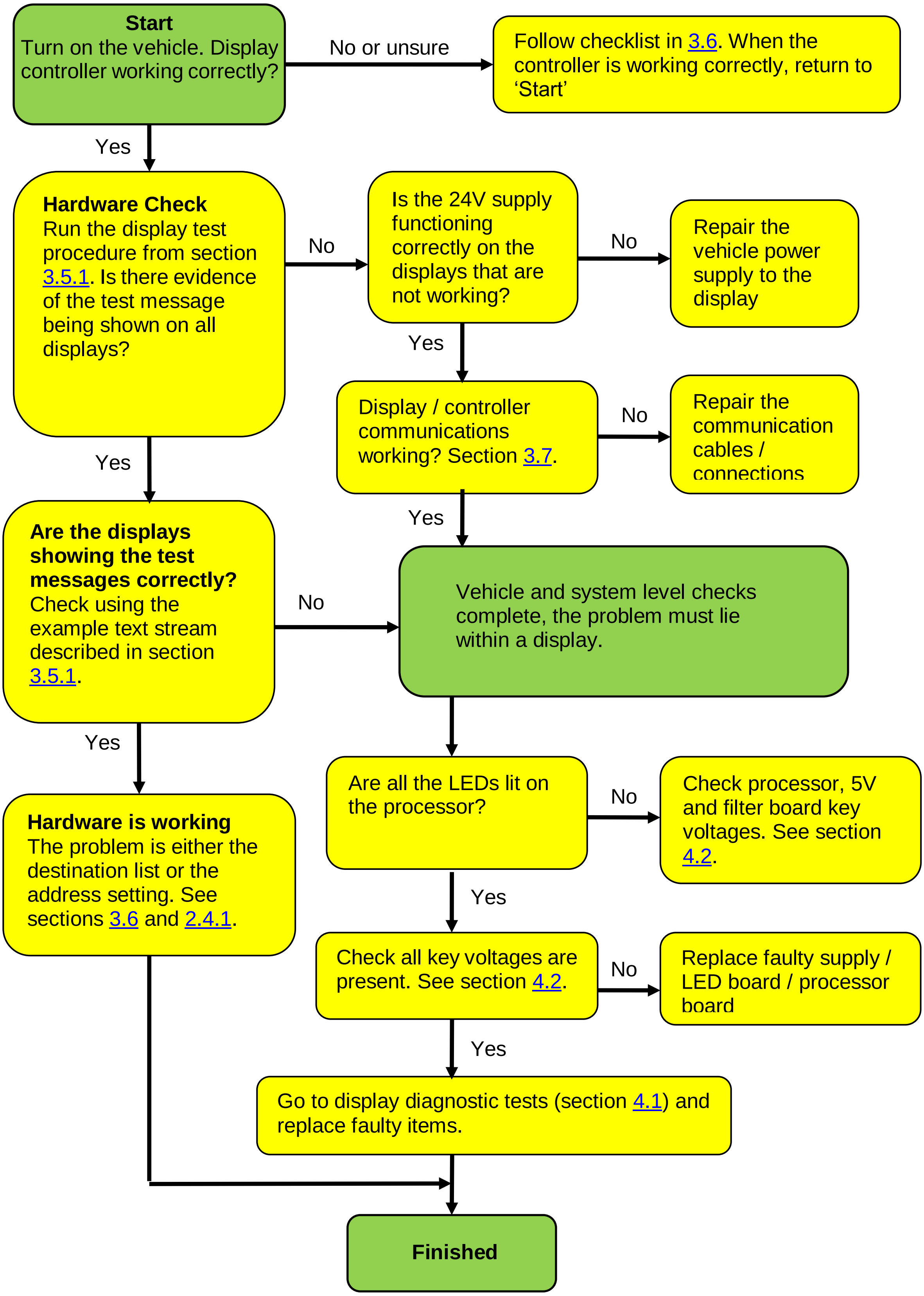
Figure 11

1. Failure of the power supply to the display board(s) and / or ...
2. ... failure of the display board(s) themselves.

Figure 12

1. Display board failure.

3.4 Diagnostic flow chart



For a detailed explanation of display components, see section 5.

3.5 Diagnostic aids

3.5.1 Display test instruction

This test can be used to determine the source of a problem, i.e. hardware, address settings or programming. The controller sends a message via the communications network and activates the display's internal test mode. This will work irrespective of any settings or destination list configurations in the display and in the controller.

In test mode, a sequence of test patterns and software information is shown, as indicated below. There will be some variation in what is scrolled across the display, depending on firmware, display size etc, but the key areas will be the same.

Example: **OLED v1.15 (X1.15) #0 144x19 C=3D00 P=65/100**.

OLED v1.15 = the display's base software type and version

(X1.15) = application software version (Super-X)

#0 = display address

144x19 = display size in LEDs (number of columns x number of rows)

(C=3D00) = for Hanover engineer

P= 65/100 = brightness of display. 100/100 is max (100%) while 5/100 is min (5%).

3.5.2 Using the DG3 controller to run the display's test mode

Figure 13a

- Press F/E until **Lock code:** appears.
- Enter lock code (default is 0101) using ◀ ▲ buttons.
- Press F/E - **Show status?** will appear.
- Press ▲ once to show **Test signs?**.
- Press F/E to show '**Testing…**' (test message can be viewed on displays)
- Press F/E to cancel when message viewed.

3.5.3 Using the EG3 controller to run the display's test mode

Figure 15b

- Press F until **Lock code:** appears.
- Enter lock code using number keys (default is 9876 or 0101).
- Press ENT - **Show status?** will appear.
- Press ▲ once to show **Test signs?**.
- Press ENT to show '**Testing…**' (test message can be viewed on displays)
- Press ENT to cancel when message viewed.

3.5.4 Using the Deric+ and DLC200 controller to run the display's test mode

- Press until LOCK CODE appears.
- Enter lock code (default is 0101) using buttons.
- Press - SHOW STATUS will be shown.
- Press once to show DISPLAY TEST.
- Press to show 'Testing' (test message can be viewed on displays).
- Press to cancel when message viewed.

Figure 14

Figure 15

3.5.5 Using the Eric++ controller to run the display's test mode

Figure 16

- Press **F** key - display will show LOCK CODE.
- Enter lock code using number keys (default is 9876 or 0101).
- Press - SHOW STATUS will be shown.
- Press once to show DISPLAY TEST.
- Press and 'Testing' will be shown.
- Press to cancel.

3.5.6 How to activate the display's test mode using the link jumpers

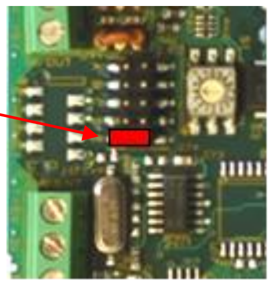
It is possible to force the display into test mode by placing a link jumper on the processor board. Use this test when the controller is not able to trigger the test or when a controller is not present.

First, unplug the display from the communications network. See section 3.7.1 for how to do this.

Remove the rear access panel(s) to locate the display processor. On larger models, depending on the variant, the processor is most likely to be in the centre or to the left as viewed from the rear.

On the processor there is a 5-position pinstrip marked A-E.

To activate display test mode, place a link jumper on to position E. This must be done whilst the display is running or the presence of the jumper will be ignored. Note: there may already be a jumper in place in another position; it is not necessary to remove it.



To stop test mode, remove the link jumper.

3.5.7 Operation status indicator

When the display is first powered on, the top left LED comes on until it receives the first valid communications message from the controller. If then it does not go out, it may signify a problem with the controller or the communications network wiring.

On an OLEMS display, there is an additional feature that checks the quality of the communications message:

- If the LED does not go out but flashes slowly (about once per second) it indicates that the display has received communications messages, but none were addressed to it. This might indicate a problem with the destination list or a problem with the address setting.
- If the LED flashes quickly, it indicates that the display has received a communications message but it is scrambled. This can indicate a network wiring fault such as RS485A and RS485B wires crossed or it might be because the correct baud rate has not been set (see section 2.4.3).

3.6 Problems with the display controller

Use the following list to determine whether or not the controller is working properly. For more information, see the relevant controller manual.

Possible controller displays with corresponding actions:

1. Valid destination showing on controller → controller is working correctly.
2. Blank display / display not illuminated → check voltage supply to controller.
3. Checked pattern across the screen → replace controller, reload list and check.
4. “Bad Memory” → replace controller, reload list and check.
5. Will only display “NCP01//” → carry out factory reset, reload and check. If unable to reset then replace controller. See relevant controller manual.
6. “Bad Destination” / “Bad Route” / “Idle” → ensure a valid code has been entered, then recheck displays; also, check correct destination list type has been loaded for the vehicle.
7. “NO DATA” → load list, recheck displays.
8. Unable to select desired code → check correct destination list type has been loaded for the vehicle.

There are other reasons why information might not be shown correctly relating to the compatibility of the destination list with the controller and the displays. This is because the destination list contains information on the display types and configuration information used by the controller as well as the text or graphics to be shown. For more information, see the Helen display editor manual.

If problems are experienced with destination display information, it is always worth trying more than one destination code when checking the controller, in case the first one to be tried is not present in the destination list.

3.7 Communications system

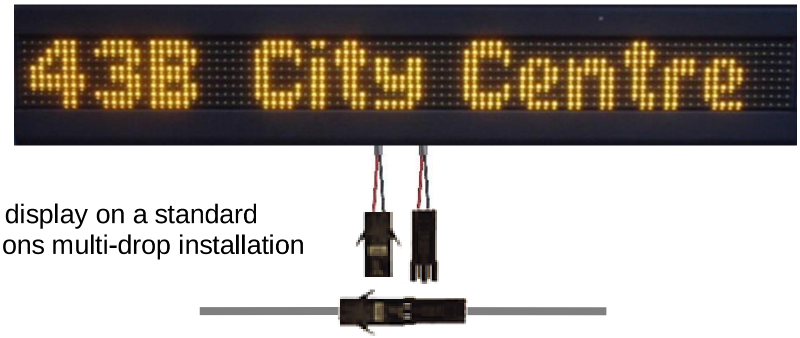
The controller and displays on the vehicle are generally connected in series - typically, controller, front, side, rear. There are other possible variations, but the same rules apply for all installations. When power is applied, if a display is working, the LED in the top left corner will light. The LED turns off once the display receives valid data.

The communications LED indicator on the processor will flash whenever data is received. If the display has not received any data after 60 seconds, this LED will be permanently lit (Figure 53). See section 4.1.2.

3.7.1 How to check communication signals and cable

The communication cable consists of two conductors with a differential voltage between them; they are generally marked as red (A) and black (B). The data is sent from the controller to each display which then makes use of it according to the address setting on the processor board. It is essential that the conductors are connected correctly, otherwise the message content will not be understood by the display. To check the wiring, see section 2.3.

Because all the displays share the same communications network, it is possible for a display to fail and corrupt the data so that other displays may also appear not to be working. To test for this kind of fault, bypass one of the displays as shown below. If all the others then start to work, the one that was bypassed is faulty. Repeat this process for each display in the system until the problem has been located. If a display is causing data loss, the most likely cause is the processor; this will need to be replaced.



Bypassing a display on a standard communications multi-drop installation

Figure 17

Some system wiring faults can be located by carrying out the following tests using a multimeter. There are several possible faults that can stop the communications network functioning correctly:

- open / short circuit conductor
- cut or damaged cable
- incorrect or crossed connection (i.e. black to red, red to black)

a) Testing communications cable voltages

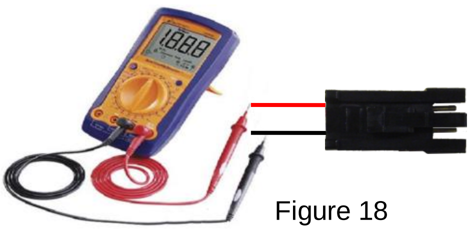


Figure 18

Set meter to DC volts and connect across the RS485 cable:

+ve probe to Pin 1 (red)

-ve probe to Pin 2 (black).

Conditions	Expected behaviour
With controller connected to communications network	This will change briefly when data passes (it may even go negative depending on message content).
With controller disconnected from communications network – all OLED signs	Voltmeter reads approximately 2.5V. If it reads -2.5V, lines are crossed.

With controller disconnected from communications network – any OLEM sign connected	Voltmeter reads approximately 4.5V to 5V. If it reads -4.5V to -5V, lines are crossed.

b) Testing for shorts to ground / chassis

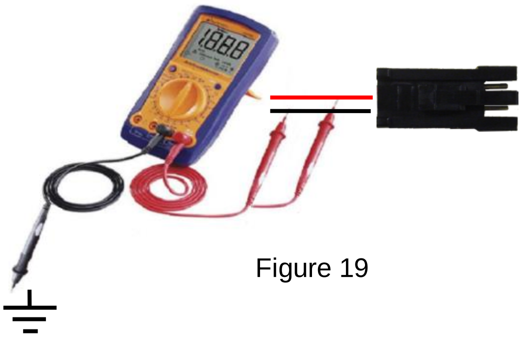


Figure 19

Unplug the cable to be tested. Set the meter to resistance or continuity mode.

Connect the -ve probe to the vehicle chassis.

Connect the +ve probe to RS485A and RS485B In turn.

The meter should show open circuit.

c) Testing for short circuit fault between conductors

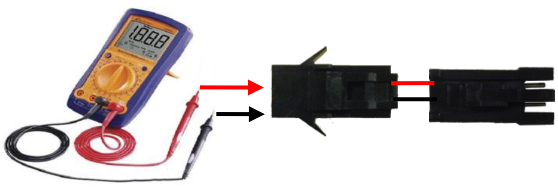


Figure 20

This is a test for the integrity of the wiring and connectors.

Disconnect both ends of the cable. Set the meter to resistance or continuity mode. The meter should show open circuit.

d) Checking cable continuity

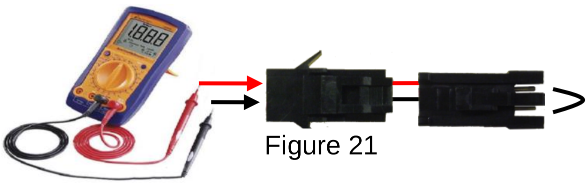


Figure 21

Disconnect both ends of the cable and bridge one end. Set the meter to resistance or continuity mode. The meter should show < 10Ω (for resistance mode) or should beep (for continuity mode).

4. Display troubleshooting

Using the following checks and tests should enable diagnosis of display failure down to the level of an individual board(s) or interconnect. This section and section 5 contain detailed reference diagrams and clarification.

Note: there are some OLED displays for which the information is not applicable because they have the processor function built into the circuit boards. Contact Hanover if diagnostic assistance is required. These 'ECO' models (including their variants) are:

OL068	OL069	OL071	OL072	OL073	OL076
OL077	OL080	OL081	OL082	OL083	OL084
OL090	OL091	OL103			

4.1 Diagnostic aids

4.1.1 Forced non-sized display – OLEMS displays only (OLA- and DD-series)

If there is a fault on a board or power supply unit that causes the processor not to recognise the display size, it will not display anything, which means it is not possible to immediately determine the faulty board. By setting the link jumper on the A-E pinstrip to position D and then powering up, if there is a fault, the processor will attempt to turn every LED on. The resulting display can be used to find the faulty board. If a board is blank or showing an error it might be a fault with the output of the preceding board or a fault with the board that is blank or showing an error.

Note: This feature is only available on OLEMS displays, but it is possible to diagnose a faulty board on other types by following the tests described in section 4.4.

4.1.2 Display processor LED indicators

Locations of the communications and heartbeat LED indicators (all are coloured red) are shown in the images for the individual processors, starting at section 4.3.1.

Heartbeat (numbered LED1 or LED2)

1) 0.5 sec on and 0.5 sec off - normal running

2) 4 secs on and 4 secs off - bootloader is present but no firmware is loaded.

3) Solid light and very quick blink every 4 seconds - firmware and bootloader are present but the processor is unable to display-size ('sign-size') the boards.

4) Off - bootloader is not present.

Communications (numbered LED2 or LED1)

1) Brief flash when the display receives a valid communications message.

2) Solid light and very quick blink every four seconds when firmware and bootloader are present but the processor is unable to display-size ('sign-size') the boards.

3) Long flash if the display receives a message with bad contents.

4) Permanently on if the display has not received a valid message from the controller within the previous 60 seconds.

5) Off when bootloader is not present.

4.1.3 Colour board LED indicators

Each multicolour LED board in a display has its own processor and diagnostic LED indicator (numbered D1 or D2). Under normal operation, when power is applied to the display, this LED will blink rapidly for the first 10 seconds, after which it will flash on / off every second (and continue to do so until power to the sign is removed). If the LED is not lit, check 24V, 5.3V and 5V are being supplied before replacing the board. Sections 4.2 and 4.3 cover voltage testing. Note that these LEDs are board-specific so do not diagnose problems relating to the display as a whole.

4.1.4 Display board link jumpers

Each OLED display board has a factory-fitted link jumper associated with its position as shown. If the link jumpers have been disturbed, they should be replaced as described in section 5.6.

Note: OLEMS displays do not have these link jumpers.

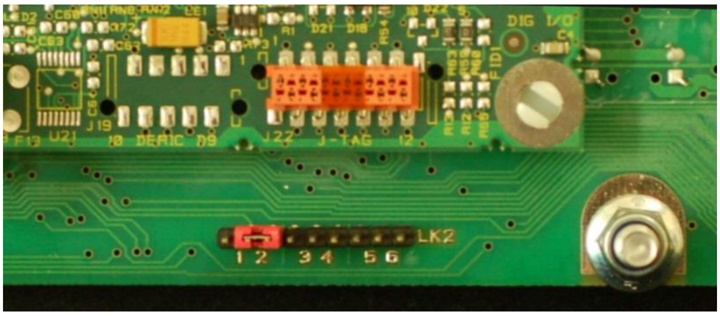


Figure 24

4.2 Checking display voltages

Power is transferred from source to the display boards via the busbar interconnect boards and keystone terminal screws along the top of the display. Ensure these are tight before continuing and that the tamper-proof seals are reapplied. All voltages are clearly marked; each set of terminals must be checked with a voltmeter.

Remember: there are different combinations of power supply units and busbar boards.

4.3 Display processors

When power is applied to the display, the processor calculates its size (number of LED columns x number of LED rows). It then selects the corresponding data sent from the controller and drives the message via the data cables to the display boards.

There are three display processors: the 7611 and 7524 for OLED displays, including COLxxxMCL- / MCR-series models, and the 7766 for OLEMS displays. Note that the 7524 is now largely obsolete, replaced by the 7611 in most instances; however, some older displays, including those with ELD software, still deploy this processor.

Each processor has an address for the display so it can receive the correct data for its location. For the 7524 and 7611, the address is set using a rotary switch on the board. The 7766 has a pinstrip where the address is set according to the position of a link jumper[1].

All processors have 24V power in, communications in and out connections and a 5-position pinstrip (marked A-E) which has various functions according to the position of the link jumper(s). When used on smaller displays, the 7611 processor also provides the 5V supply.

[1] In certain circumstances, the 7766 can be fitted with a rotary switch.

There are a number of variants to most processor boards: these are detailed in the following sections.

All boards carry a white label indicating the applicable variant, either on the surface or the underside. This is an example:

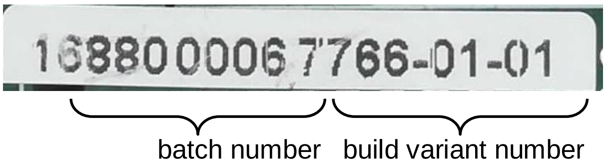


Figure25

Other principal components on the display boards are also labelled on the following images.

4.3.1 Key voltages: 7524 processors

Important: Before continuing, check all processor fuses and ensure all Keystone terminal screws are tight.

Select the build from the two options below and check the input then output voltages indicated. If all voltages are present but no LEDs are illuminated, this means the processor is not working and must be replaced. A block diagram showing the 7524 processor board can be seen at paragraph 5.9.

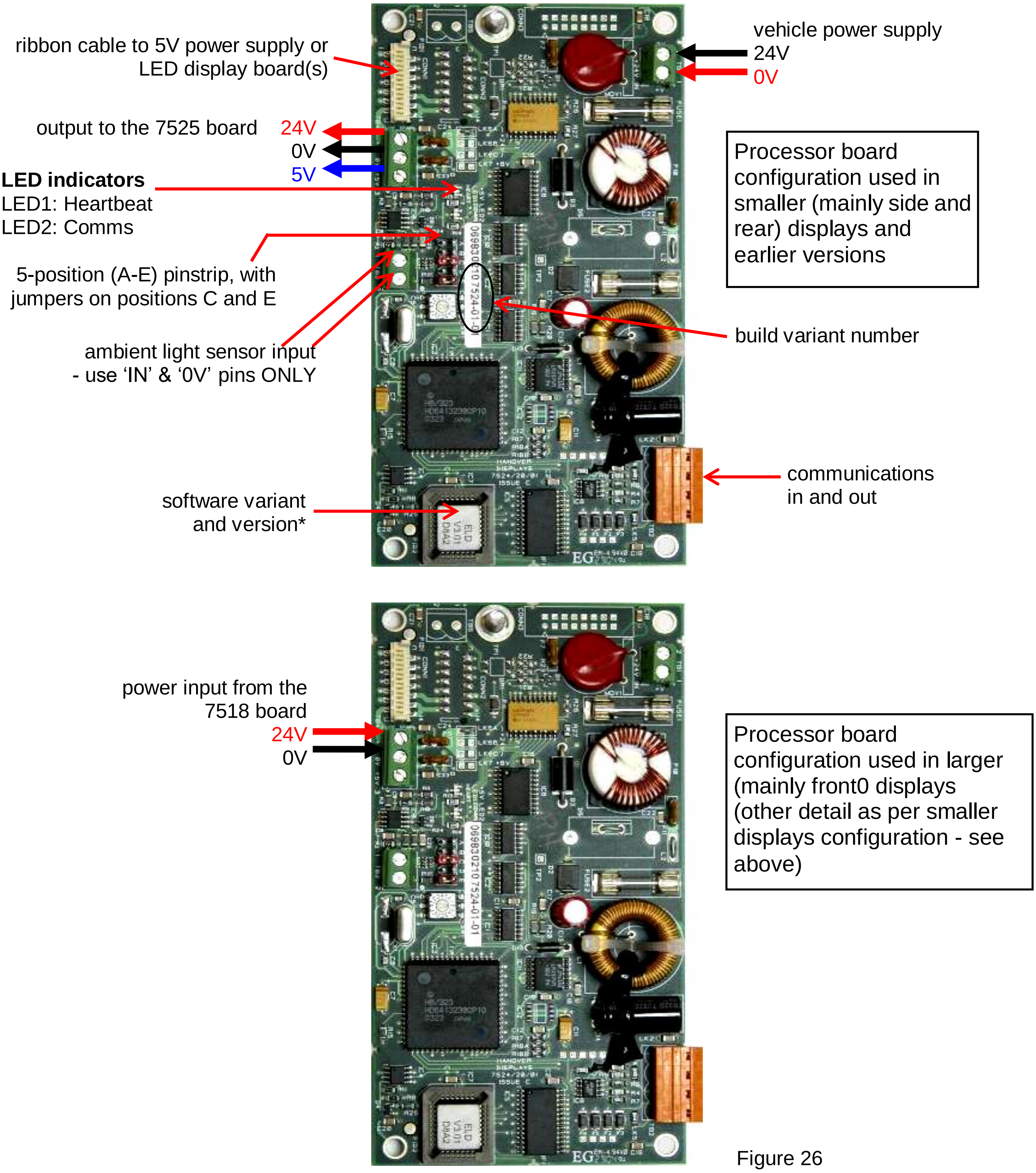


Figure 26

***Note:** Software version in this figure might not be up to date. For more information about the latest software version available, please contact Hanover Technical Support.

4.3.2 Key voltages: 7611 processors

OL-series, COLxxxMCL- / MCR-series and COLxxxFC-series

Variant	Description
7611-01-01	Display processor
7611-01-04	Display processor with plug-in interface and horizontal header
7611-01-09	Display processor with horizontal headers
7611-01-10	Display processor with plug-in interface and vertical header

Note: horizontal header - communications wires leave the processor through the side of the display casing; vertical header - they leave through the top.

Select the build from the two options below and check the input then output voltages indicated. If all voltages are present but no LEDs are illuminated, this means the processor is not working and must be replaced. A block diagram showing the 7611 processor board as fitted in larger displays can be seen at paragraph 5.7 and in smaller models, at paragraph 5.8.

Processor board configuration used in larger (mainly front) displays

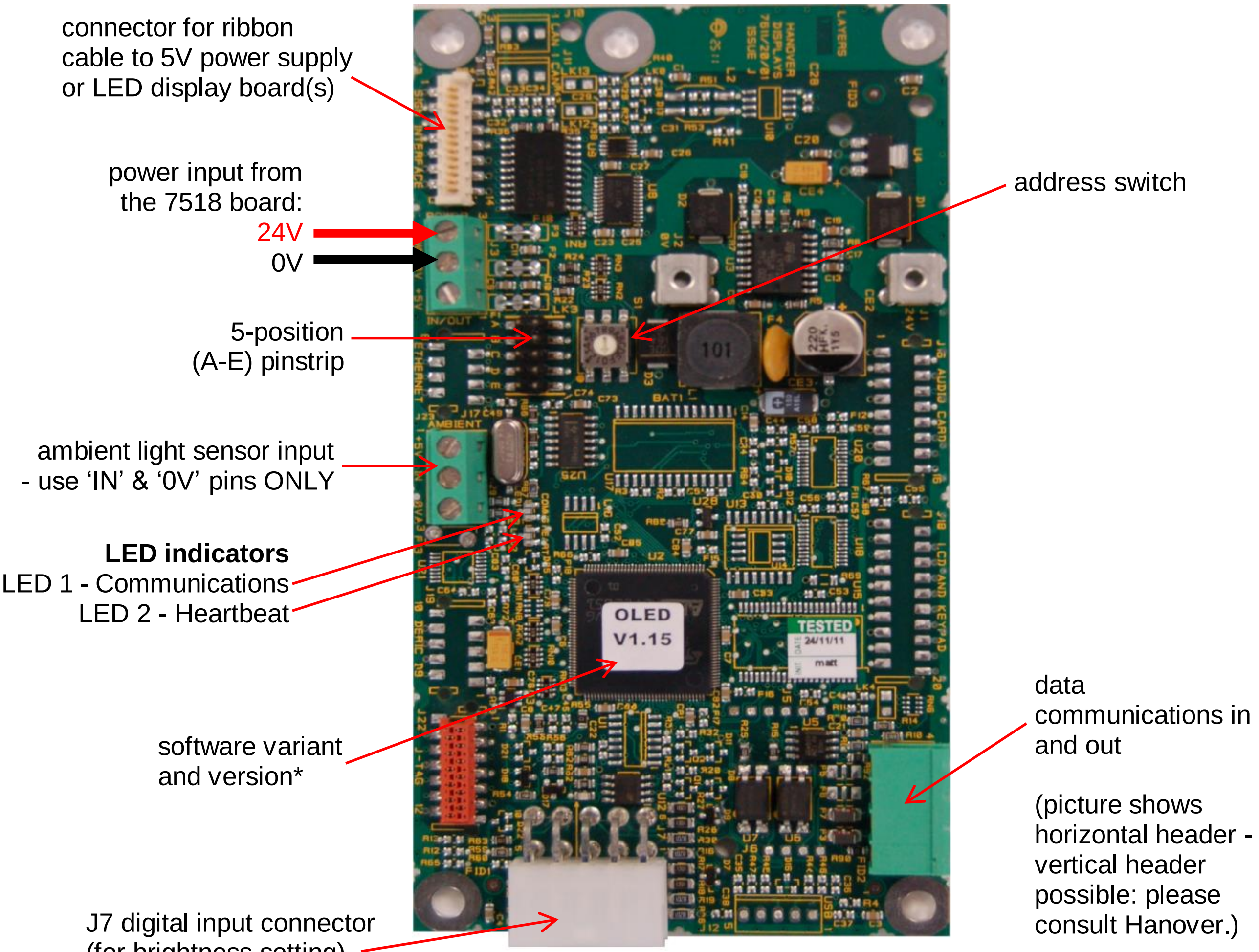


Figure 27

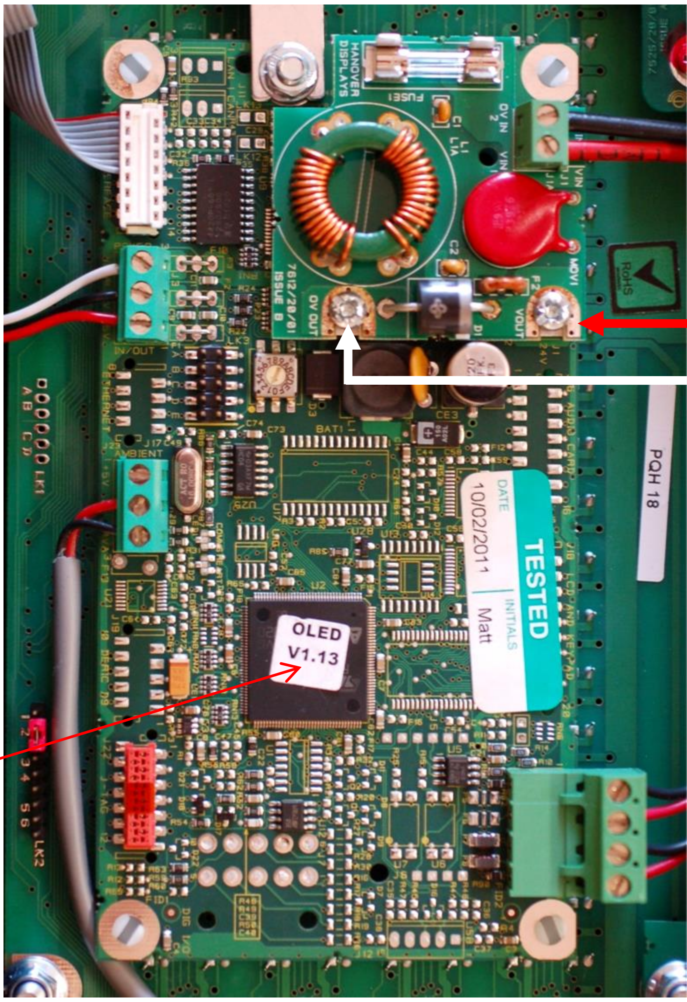
*__Note:__ Software version in this figure might not be up to date. For more information about the latest software version available, please contact Hanover Technical Support.

Processor board configuration used in smaller (mainly side / rear) displays

output to the 7525 board:
24V
0V
5V

vehicle power supply:
0V
24V

connections from 7612 filter board (mounted on top) to processor:
24V
0V



software variant and version*

Figure 28

***Note:** Software version in this figure might not be up to date. For more information about the latest software version available, please contact Hanover Technical Support.

address switch

4.3.3 Key voltages: 7766 processors
OLA- / DD-series

Variant	Description
7766-01-01	Display processor

Important: Before continuing, check all processor fuses and ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

Select the build from the two options below (the only difference is the location of the power supply and communications wiring) and check the voltages indicated. If all voltages are present but no LEDs are illuminated, this means the processor is not working and must be replaced. A block diagram showing the 7766 processor board can be seen at paragraph 5.10.

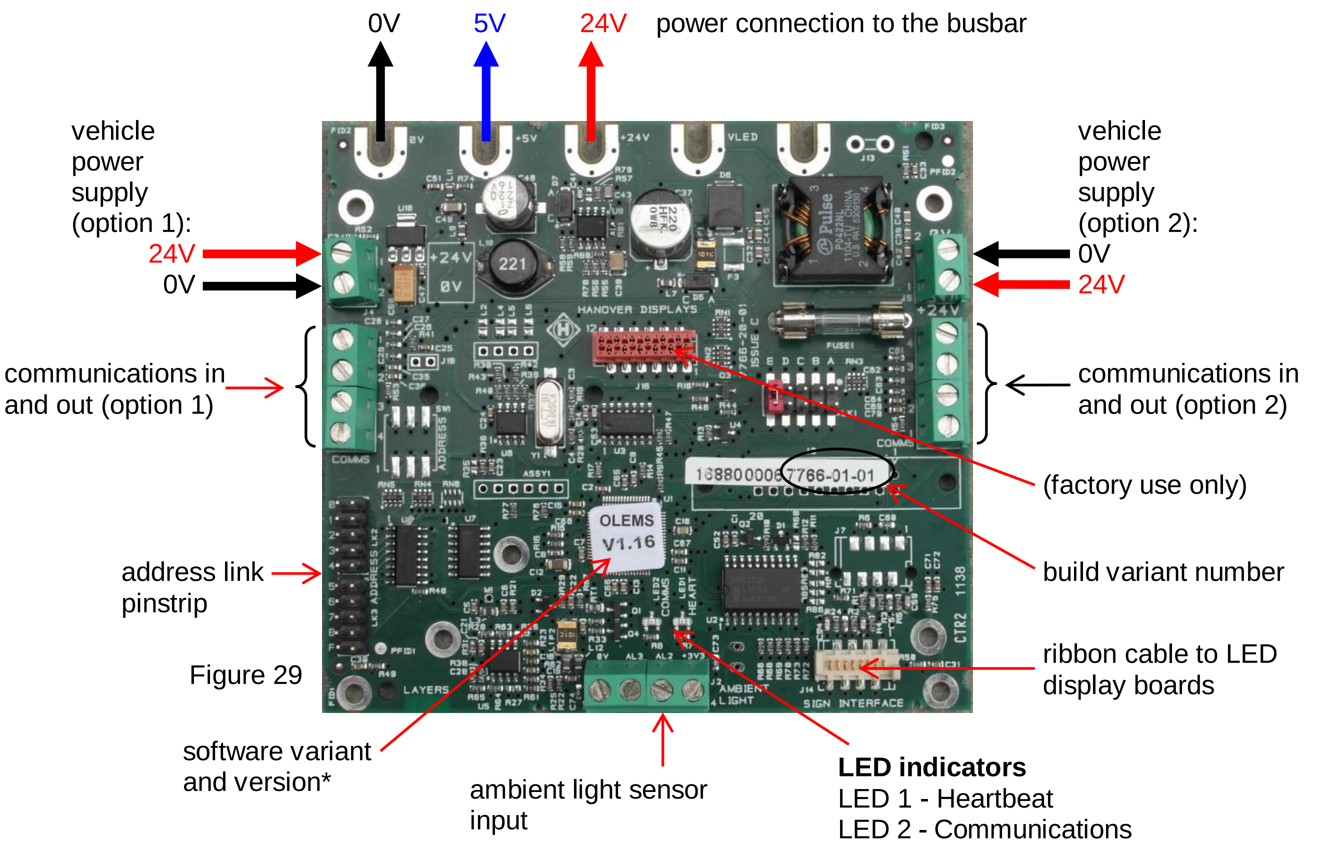


Figure 29

*__Note:__ Software version in this figure might not be up to date. For more information about the latest software version available, please contact Hanover Technical Support.

4.3.4 Key voltages: 3V power supply board 7517

For monochrome display boards

Important: Before continuing, ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

The power supply lights the LEDs. The number of supplies used per display will depend on the power demand: some display boards may share one supply.

Variant	Type of sign	LED colour	Description
7517-01-01	OLED	Amber	2.6V supply
7517-01-02	OLED	Amber	2.6V supply with large heat sink
7517-01-03	OLED	Amber	2.6V supply for LED displays with 12V input
7517-01-06	OLEM	Amber	3.45V supply for DD- / OLA-series displays
7517-01-08	OLED	White	3.9V supply for white LED displays
7517-01-09	OLED	White	3.9V supply for white LED displays with 12V input
7517-01-10	OLEM	White	4.2V supply for white LED displays
7517-01-11	OLEM	Amber	3.45V supply for amber LED displays with 12V input

Figure 30

4.3.5 Key voltages: 5.3V power supply board 7563

For multicolour display boards

Important: Before continuing, ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

Variant	Description
7563-01-01	5.3V supply with large heat sink
7563-01-02	5.3V supply with large heat sink with attachment for heat plate
7563-01-03	5.3V supply small heat sink with attachment for heat plate
7563-01-04	5.3V supply small heat sink, low current limit
7563-01-05	5.3V supply small heat sink

Note: the variant number can be found on the white label on either side of the PCB - see Figure 30 above as an example.

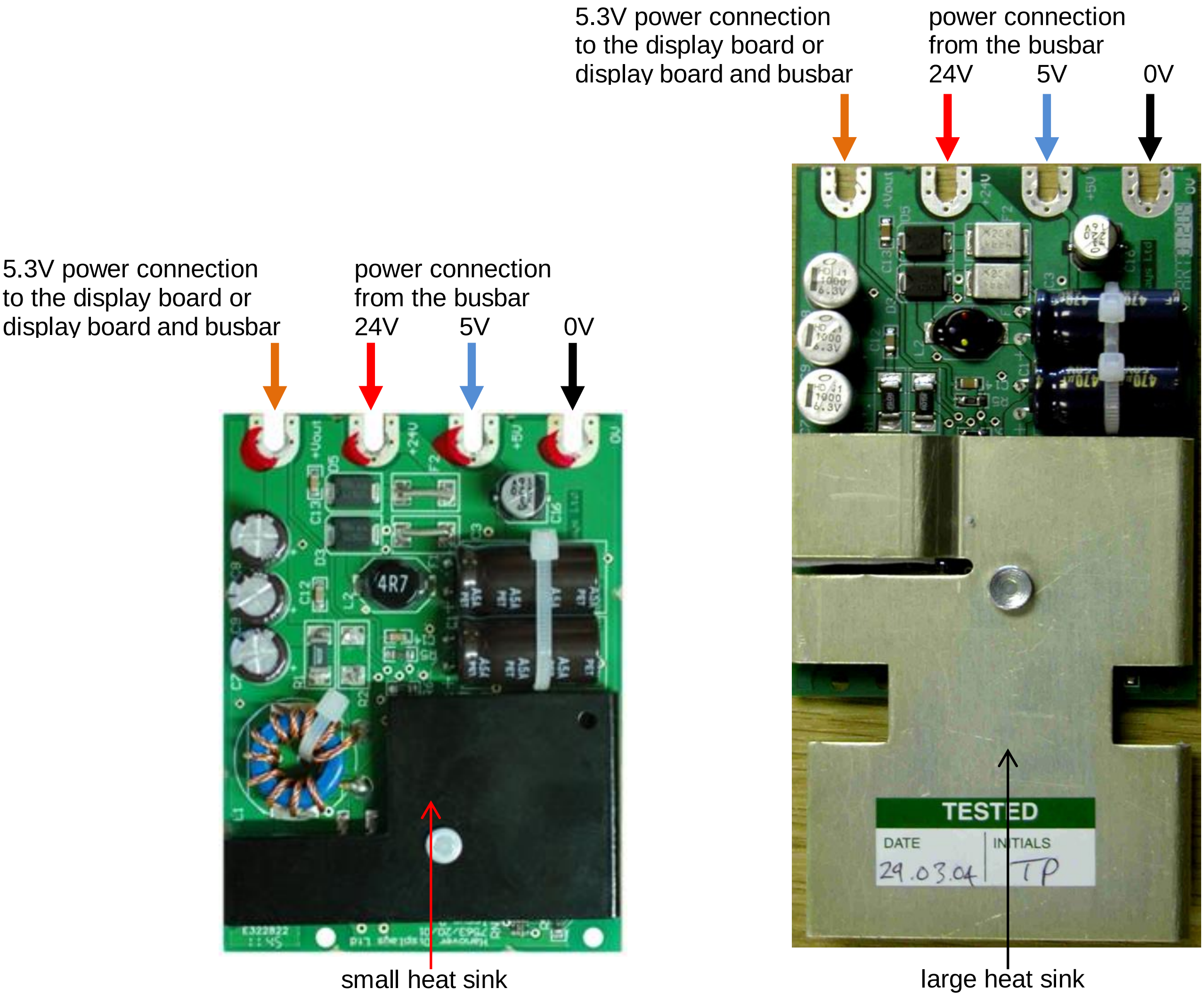


Figure 31

4.3.6 Key voltages: 5V power supply board 7518

This provides the additional current to power the integrated circuits on display boards which control the behaviour of the LED drive chips (ie when the LEDs do / do not illuminate) on each board. It is not required on route number displays or on OLEMS displays because sufficient power is provided by the processor.

Variant	Description
7518-01-01	5V supply

The function of the 5V power supply board is standard across the range although the flow of power may be different according to the accompanying boards within the build.

i) Build using 7524 processor and 7525 connector board

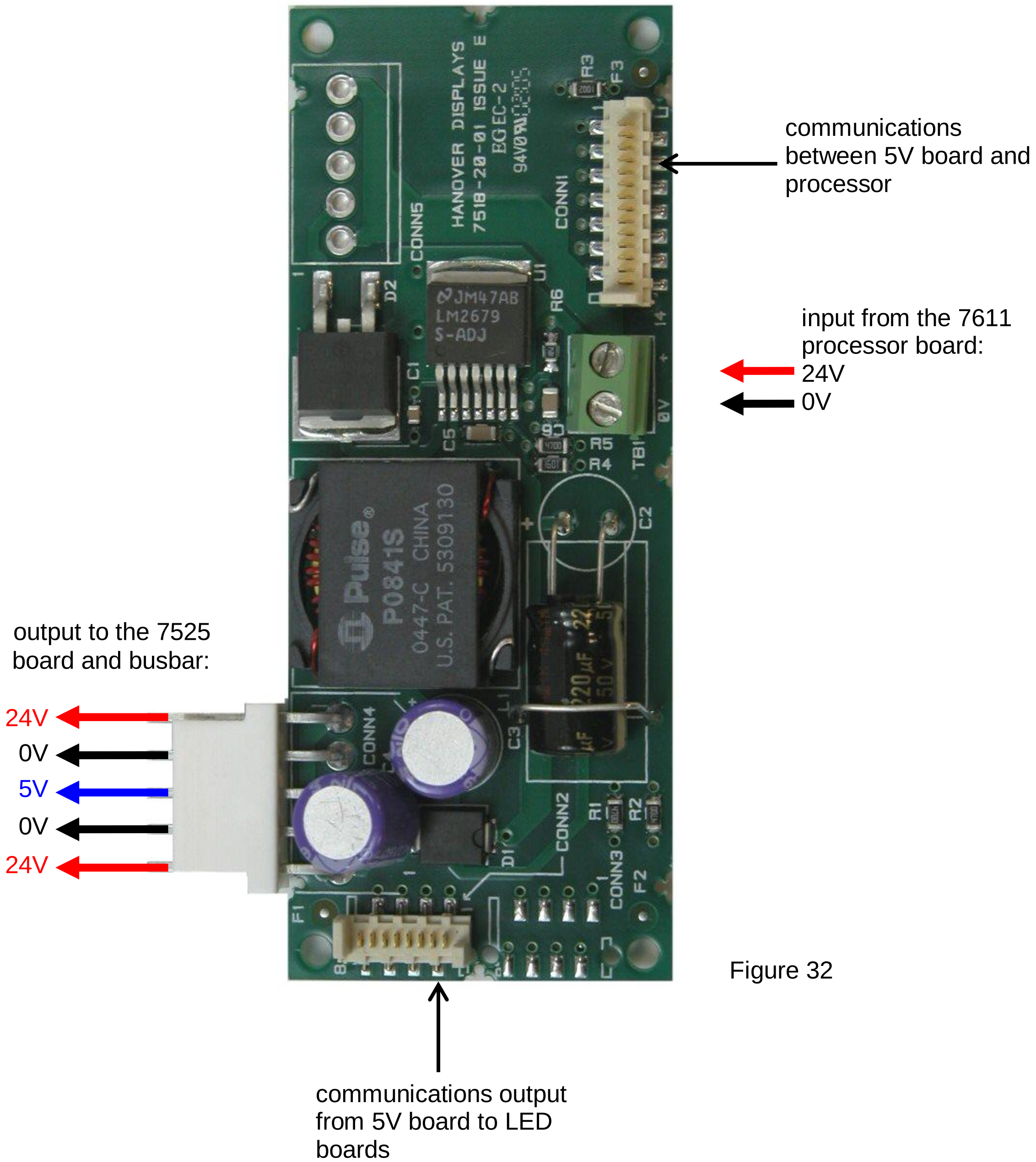


Figure 32

ii) Build using 7524 or 7611 processor and 7564 super moose board

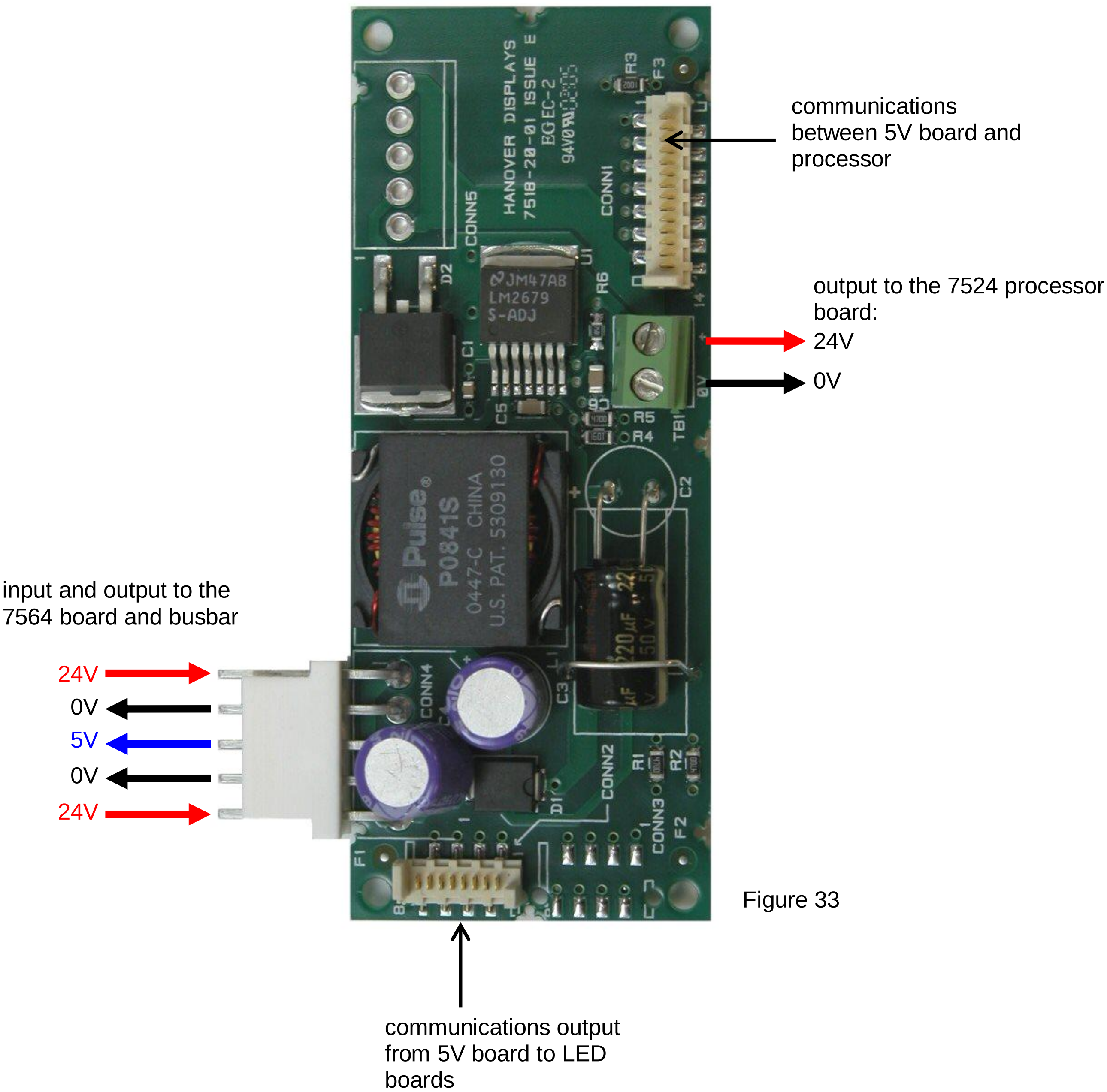


Figure 33

4.3.7 Key voltages: 7564 filter board

This board provides voltage overload and spike protection for displays fitted with a 7524 or 7611 processor.

It is not present on OLEMS displays because sufficient power is provided by the processor.

Variant	Description
7564-01-01	Interconnect power board

Important: Before continuing, check filter board fuses and ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

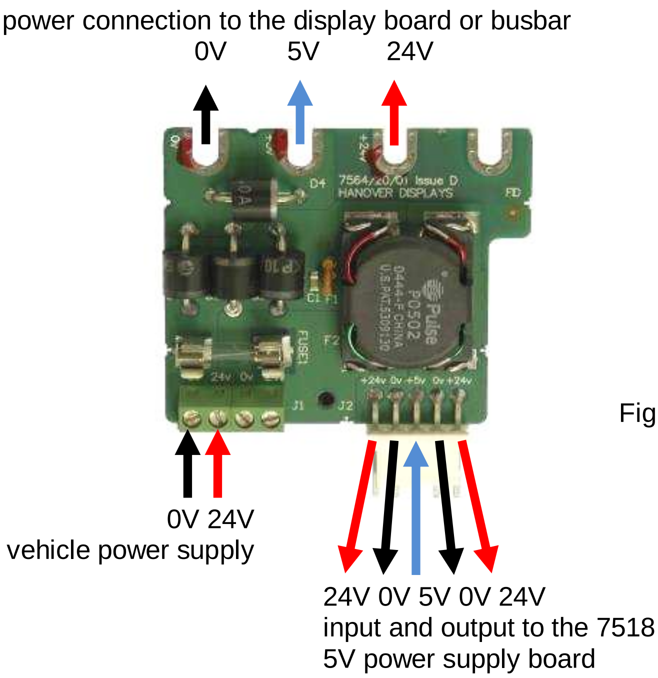


Figure 34

4.3.8 Key voltages: 7612 filter board

This board provides voltage overload and spike protection for displays fitted with a 7611 processor.

It is not present on OLEMS displays because sufficient power is provided by the processor.

Variant	Description
7612-01-01	Plug-in power assembly, 12.5A fuse
7612-01-03	Plug-in power assembly, 5A fuse

Important: Before continuing, check filter board fuses and ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

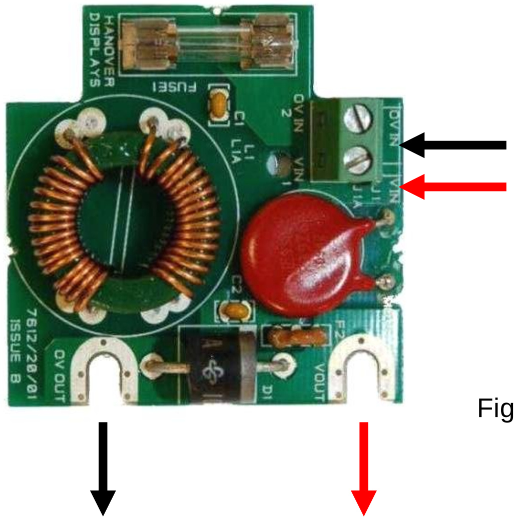


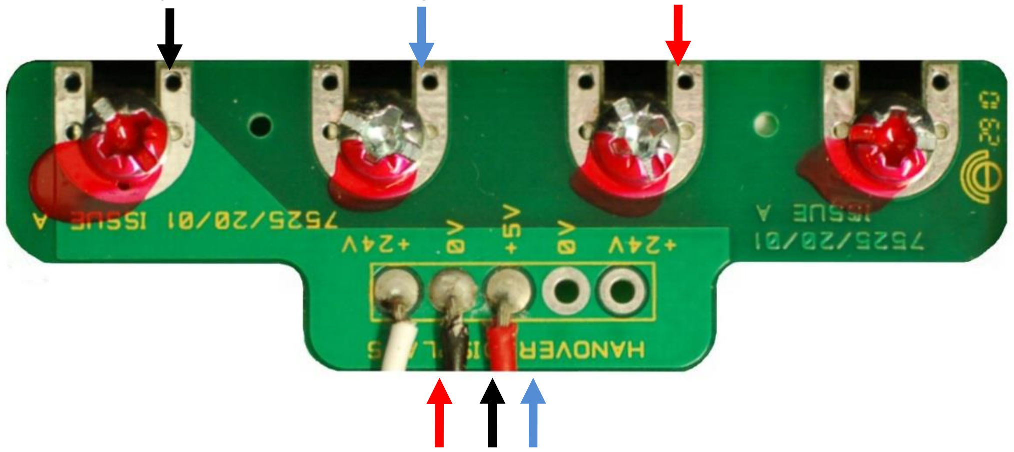
Figure 35

4.3.9 Key voltages: 7525 connector board

Important: Before continuing, ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

The 7525 boards vary according to whether or not a connector is fitted and the length of their leads. See the images in Figure below. They are not present on OLEMS displays because sufficient power is provided by the processor.

i) board using soldered wire connections



ii) board with connector

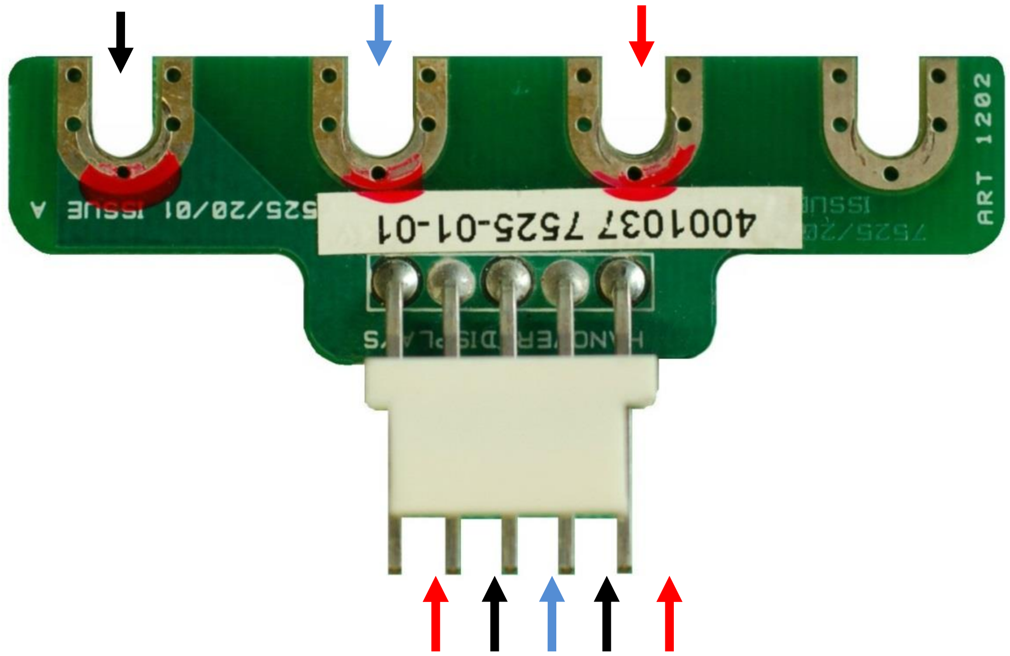


Figure 36

4.4 Checking LED boards

4.4.1 OL-series and COL-series test (OLED displays)

Important: Before continuing, ensure all Keystone terminal screws are tight. Remember to reapply the tamper-proof seals.

Note: This test is not applicable to OLEMS displays.

If there is a display failure which causes it not to be able to 'size' itself, then it is very difficult to know which board or boards have failed. However, there is a simple test which will work for most display sizes.

Note: earlier 7524 processors may not have all display sizes and boards in their software but for test purposes, a 7524 can be replaced with a 7611.

1. Turn off the power to the display.
2. Remove the comms connections so that no messages can reach the display.
3. Place all the display board jumper links in position 1 (see Figure 46). This has the effect of making all the display boards behave as if they were board number one in the series and will enable the single LED at top left (when viewing from the front) to be lit.
4. Re-apply the power.
5. Check that the display has 'sized' by observing the processor LEDs - see section 5.11 and Figure 53.
6. Look at the front of the display and check that a single amber LED is lit in the top left of each board (Figure 37). Any boards not lit are faulty.

Figure 37

If there are no boards lit, there may be a faulty 'long' data cable or processor: try another processor and / or carry out step 8.

The display's internal test can now be run by placing a link jumper at pin position E on the processor board. The test pattern will be repeated on every board, as described in section 2.4.3.

7. This test can be repeated to check each board individually in turn. Remove all 45mm data cables and connect one board at a time, using the long data cable (Figure 28). This can be done by connecting the cable to the left-hand connector of each board as viewed from the rear of the display.

   Note: not all builds have a data cable that will reach each board: if required, cables from other displays can be used.

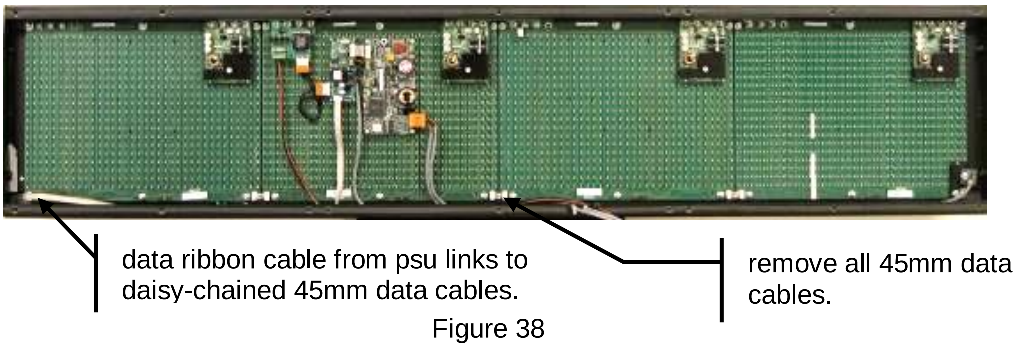


Figure 38

Caution: It is possible that all the display boards will work when running this test, but not when all the 45mm data cables and link jumpers are correctly in place. This generally means the 'return' signal from a display board is not being received by the processor. To verify this, carry out step 8 below.

8. Remove all data cables and carry out a continuity test on all eight connections. Also check the connection pins for evidence of fluid or mechanical damage. Replace any data cable which is open circuit and re-test.

   Note: connections are in like-for-like positions, i.e. the second terminal down in the right-hand column on the left of the connector corresponds to the second terminal down in the right-hand column on the right of the connector (see Figure 27 below).

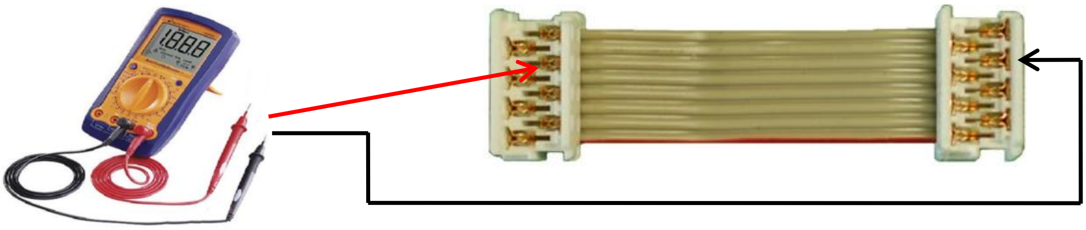


Figure 23

9. Remember to put all the links back correctly after testing is complete. See section 5.6.

4.4.2 OLA- / DD-series test (OLEMS displays)

Important: Before continuing, ensure all Keystone terminal screws are tight.

Note: This test is not applicable to OLED displays (including COL-series displays).

This test can be used to help determine which display board has failed if it is not obvious or possible to determine through other means.

1. Turn off the power to the display.
2. Remove the comms connections so that no messages can reach the display.
3. Remove all 45mm data cables.
4. Re-apply the power.
5. Check that the display has “sized” by observing the processor LEDs - see section 5.11 and Figure 53.
6. Look at the front of the display and check that a single amber LED is lit in the top left corner.

   If the LED is not lit, there may be a faulty 'long' data cable or processor: try another processor and / or carry out step 8.

   The display's internal test can now be run by placing a link jumper at pin position E on the processor board. The test pattern will only show on the right-hand board as viewed from the front.

7. This test can be repeated to check each board individually in turn. Disconnect the power and move the long data cable to the next board (left-hand connector of each board as viewed from the rear of the display). Return to step 4.

   Note: not all builds have a data cable that will reach each board. If required, cables from other displays can be used.

   Caution: It is possible that all the display boards will work when running this test, but not when all the 45mm data cables are correctly in place. This generally means the 'return' signal from a display board is not being received by the processor. To verify this, carry out step 8 below.

8. Remove all data cables and carry out a continuity test on all eight connections. Also check the connection pins for evidence of fluid or mechanical damage. Replace any data cable which is open circuit and re-test the display.

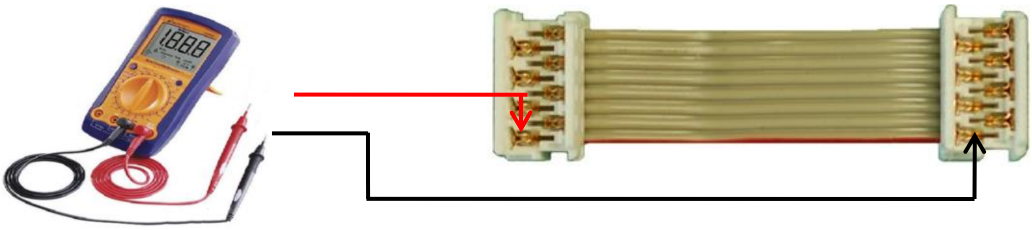


Figure 24

5. Components and connections

The images in the following sections illustrate how the main electrical assemblies of an LED display are connected together. The processor board transfers the information from the controller via the RS485 cable to show a message on the display.

All LED destination displays use generic components to provide power and control for the LED display boards. Below are examples of the four variants. Note the order of the boards, as seen from the rear, is right to left.

The following information is not applicable to some OLED displays because the processor function is built into the display boards. These (including their variants) are:

OL 068	OL 069	OL 071	OL 072	OL 073	OL 076
OL 077	OL 080	OL 081	OL 082	OL 083	OL 084
OL 090	OL 091	OL 103			

5.1 Monochrome OLED display

OL-series

This display is comprised of multiple monochrome boards.

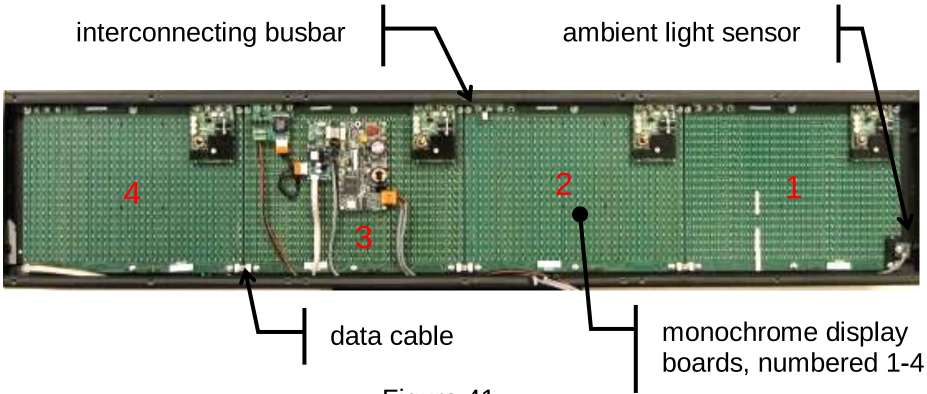


Figure 41

5.2 Monochrome OLED display with multicolour route number

COLxxxMCL- / MCR-series

The image shows the colour route number board mounted on the left as viewed from the front, but it can also be mounted on the right.

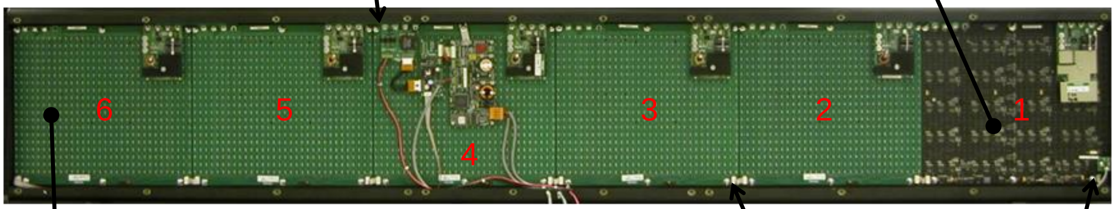


Figure 42

5.3 Internal OLED display connections

OL- and COLxxxMCL- / MCR-series

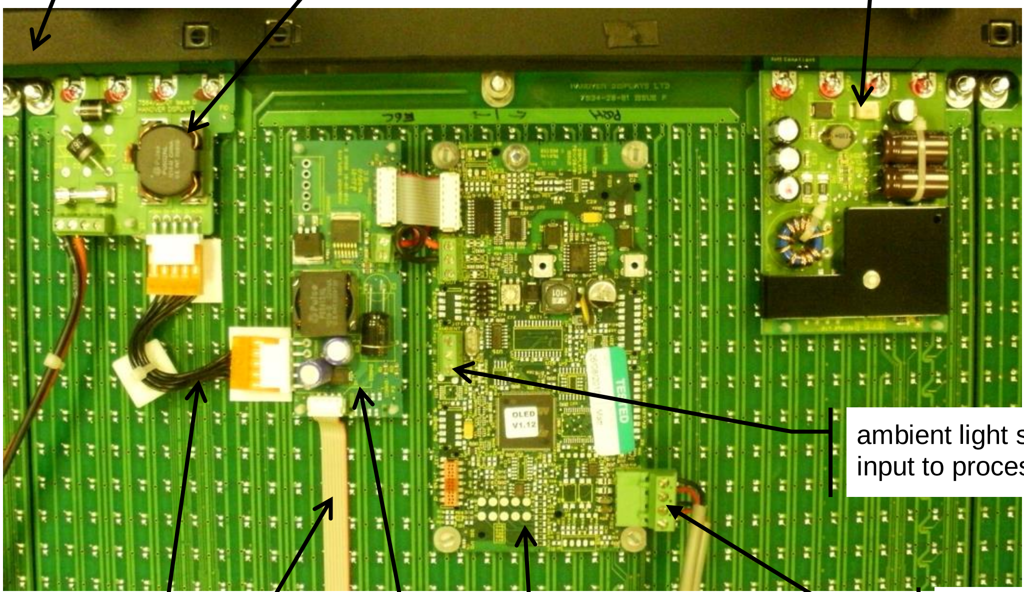


Figure 43

5.4 Typical OLED monochrome route number display

OL-series

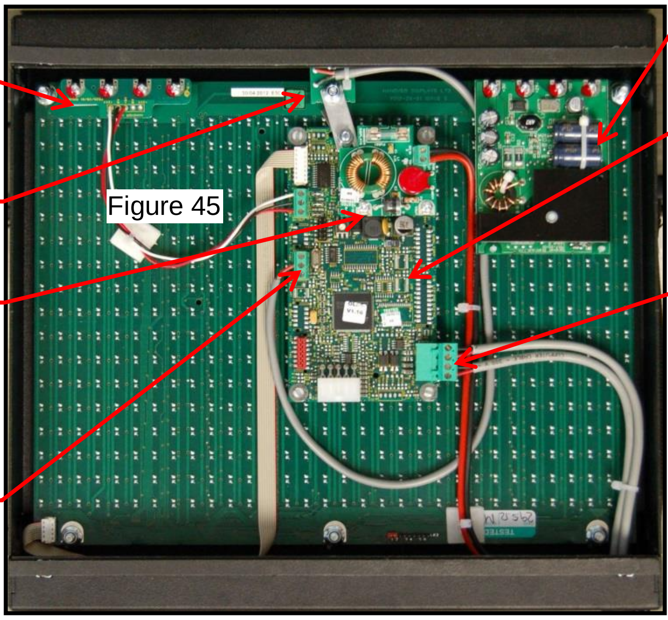


Figure 44

5.5 Full colour OLED display

- COLxxxFC-series

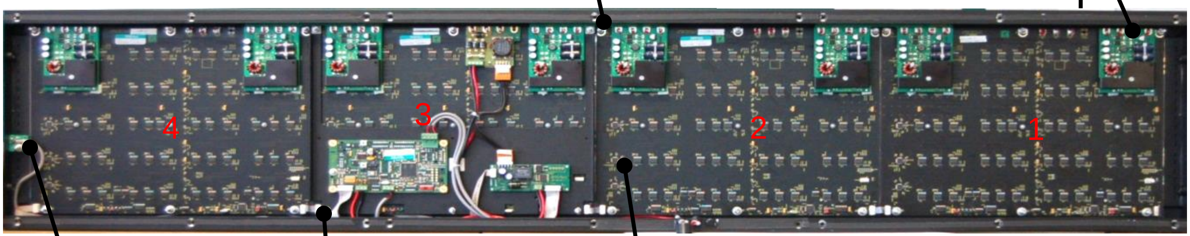


Figure 45

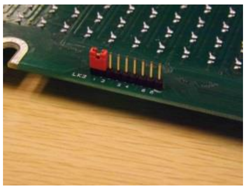
- Rear side (with covers removed) of a 200x24 display

5.6 Link jumpers for connecting boards in OLED displays

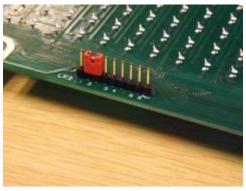
OL-series, COLxxxMCL- / MCR-series and COLxxxFC-series

Typically, these displays comprise between one and six identically-sized LED display boards. Each is allocated a unique identity by the position of the link jumper on the pinstrip (see Figure 46 below). The boards are connected via the 8-way ribbon cables and power supply busbars.

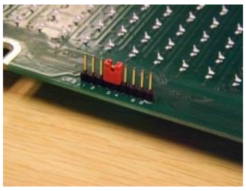
Link jumper positions for each board



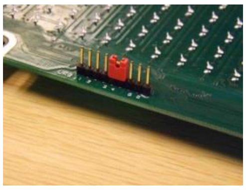
Link jumper position for board 1



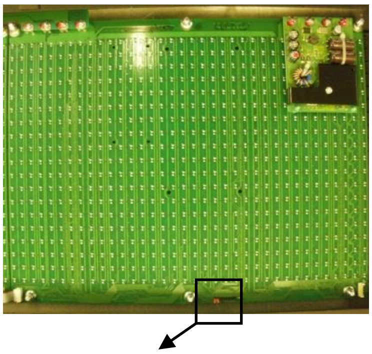
Link jumper position for board 2

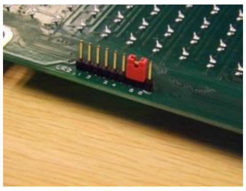


Link jumper position for board 3

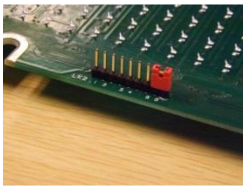


Link jumper position for board 4





Link jumper position for board 5



Link jumper position for board 6

Figure 46

Colour board link jumpers

Each colour board is fitted with a link jumper (as shown above) to indicate its position on the display. An example is labelled **A** in Figure 47 below.

They are also fitted with a 5-position link jumper, labelled **B** in Figure 47 below.

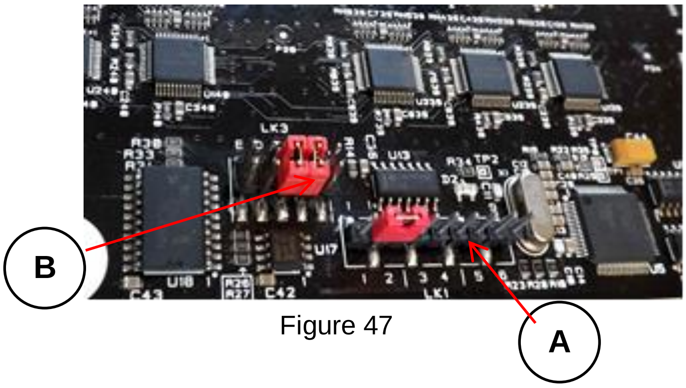


Figure 47

Make sure to note the actual positions of your link jumpers before doing any change.

Position E is used to initiate the self-test mode for the colour board. The link jumper, inserted into position E after power-up, starts self-test.

During self-test, the following test pattern will be displayed in a continuous cycle:

Version → Check-sum → Bin-grade → Size → 4 edges of colour panel lit → MRN.

An additional test can be made by powering the sign with link 'E' inserted and then removing it.

The following table will show the results of the various link jumper positions:

Link Jumper position (0 = not fitted; 1 = fitted)			
E	**D**	**C**	**Description**
0	0	0	Disabled
0	1	0	Size + bin-grade
1	0	0	Version + check-sum
1	1	0	512-colour palette
0	0	1	Red
0	1	1	Green
1	0	1	Blue

5.7 Block diagram – large OLED displays (typically for front displays)

OL-, COLxxxMCL/R-, COLxxFC-series

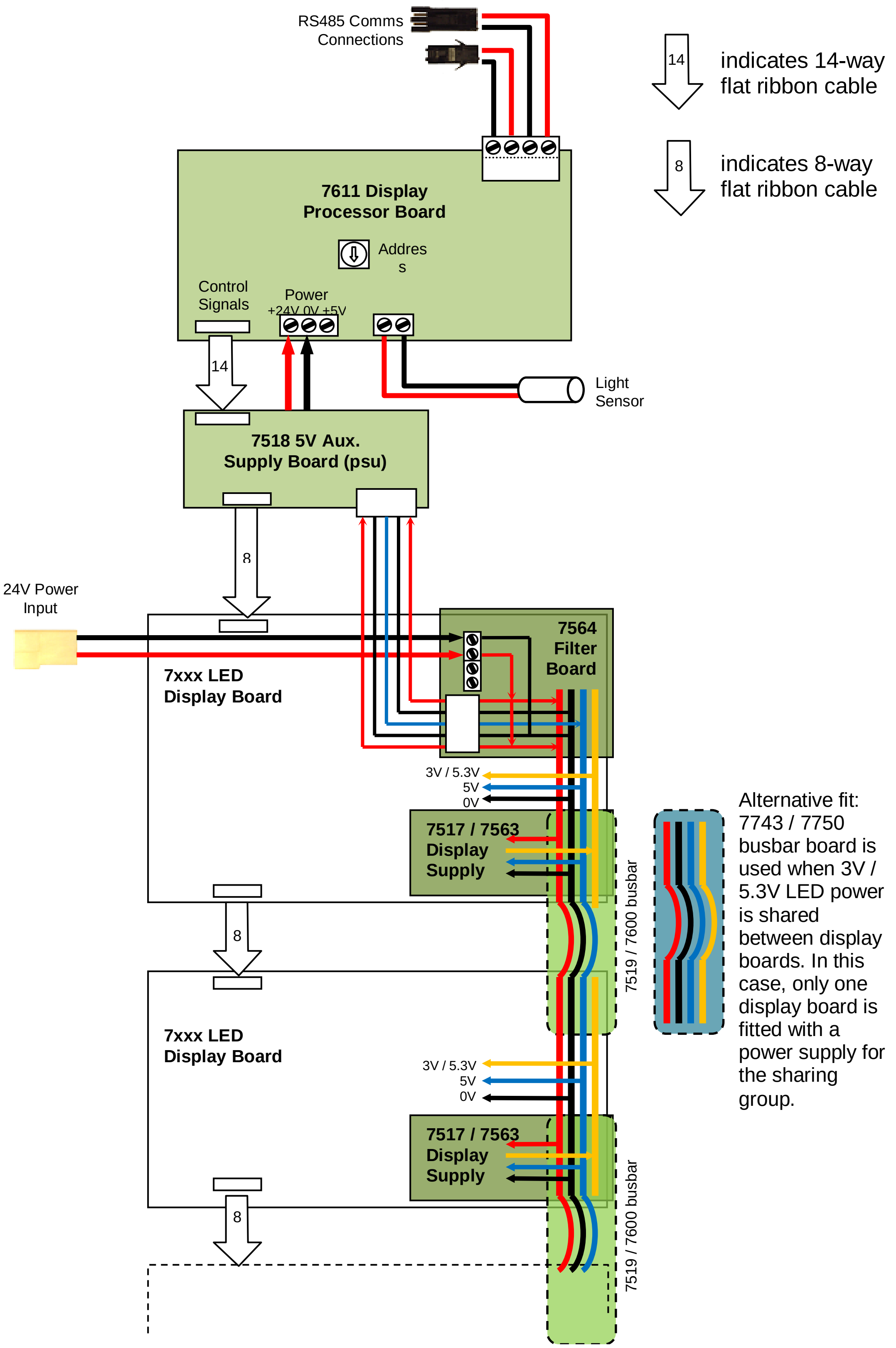


Figure 48 - Front and other larger displays: power input connections via 7564

5.8 Block diagram - small OLED displays

(typically side / route number displays) OL-, COLxxxMCL/R-, COLxxxFC-series

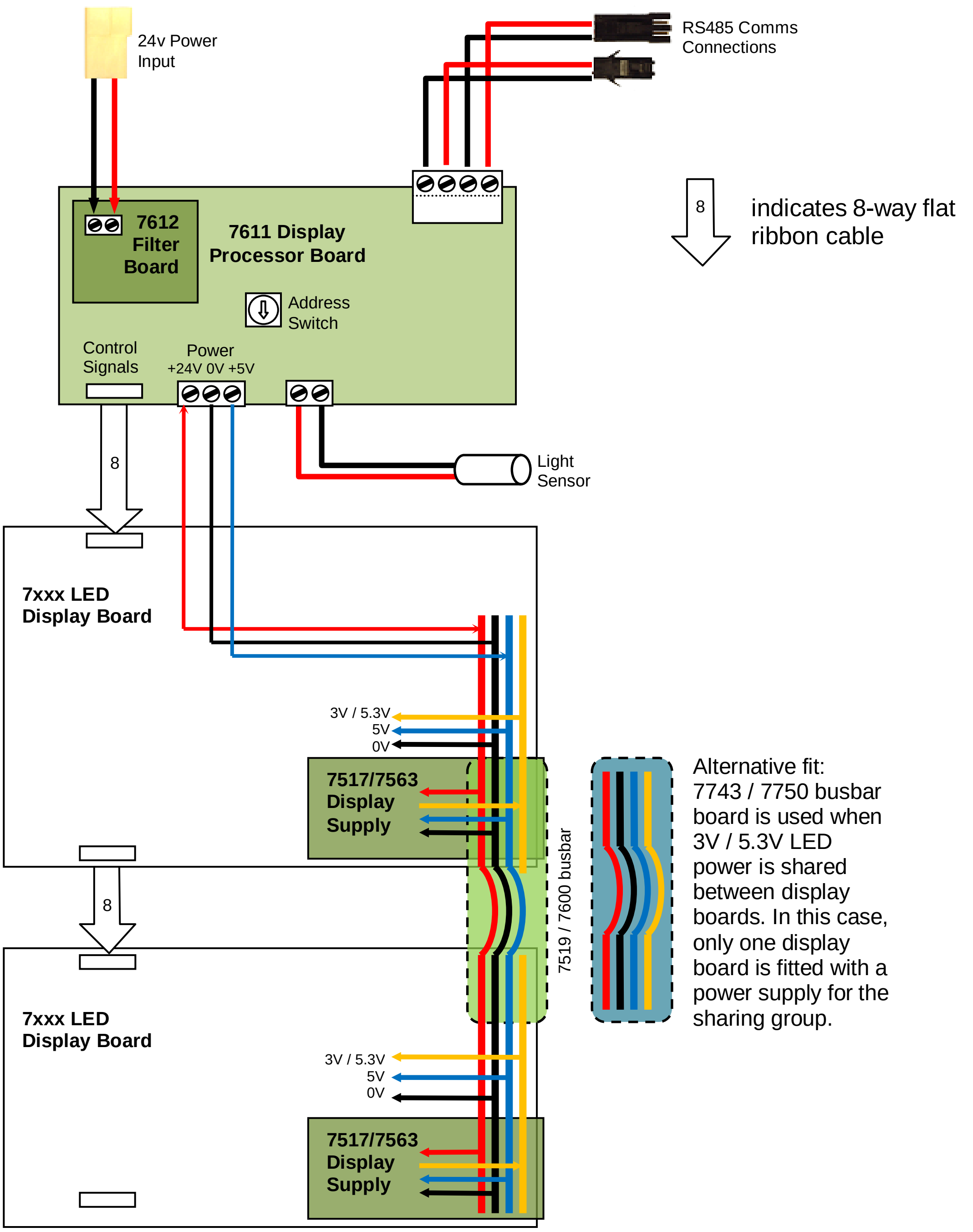


Figure 49 - 7611 processor, route number and small displays: power input connection via 7612 filter board

5.9 Typical block diagram: displays with 7524 processor

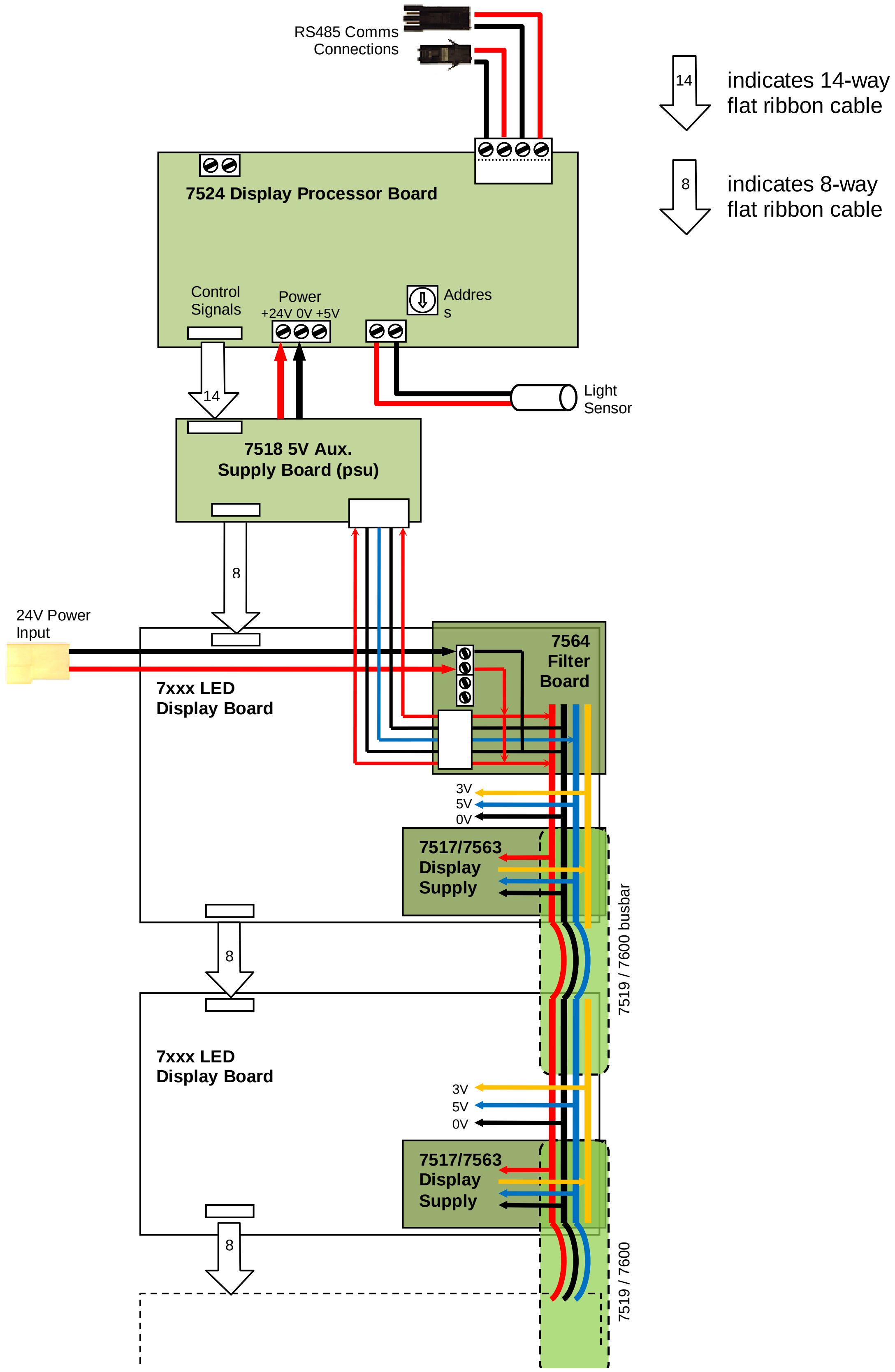


Figure 50

5.10 Monochrome OLEMS display
OLA- / DD-series

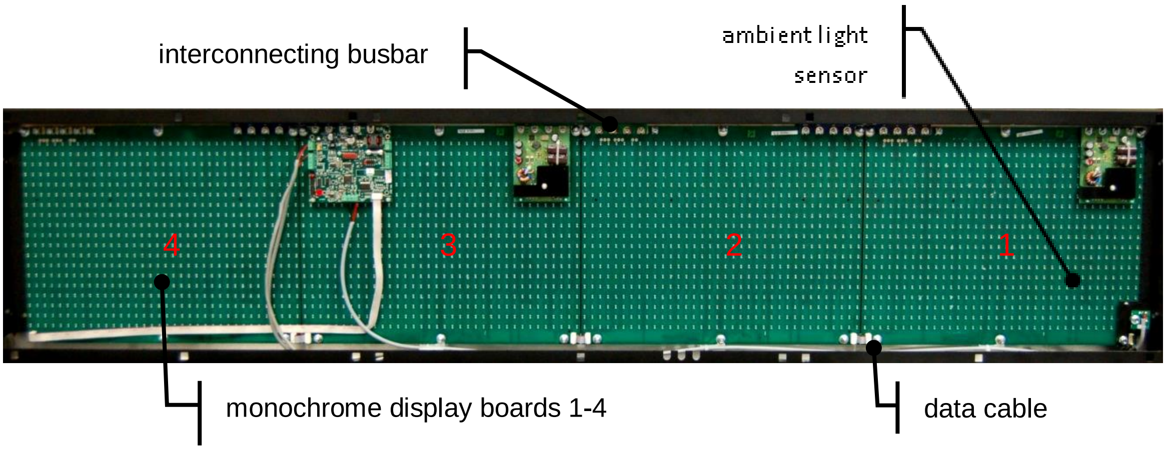


Figure 51

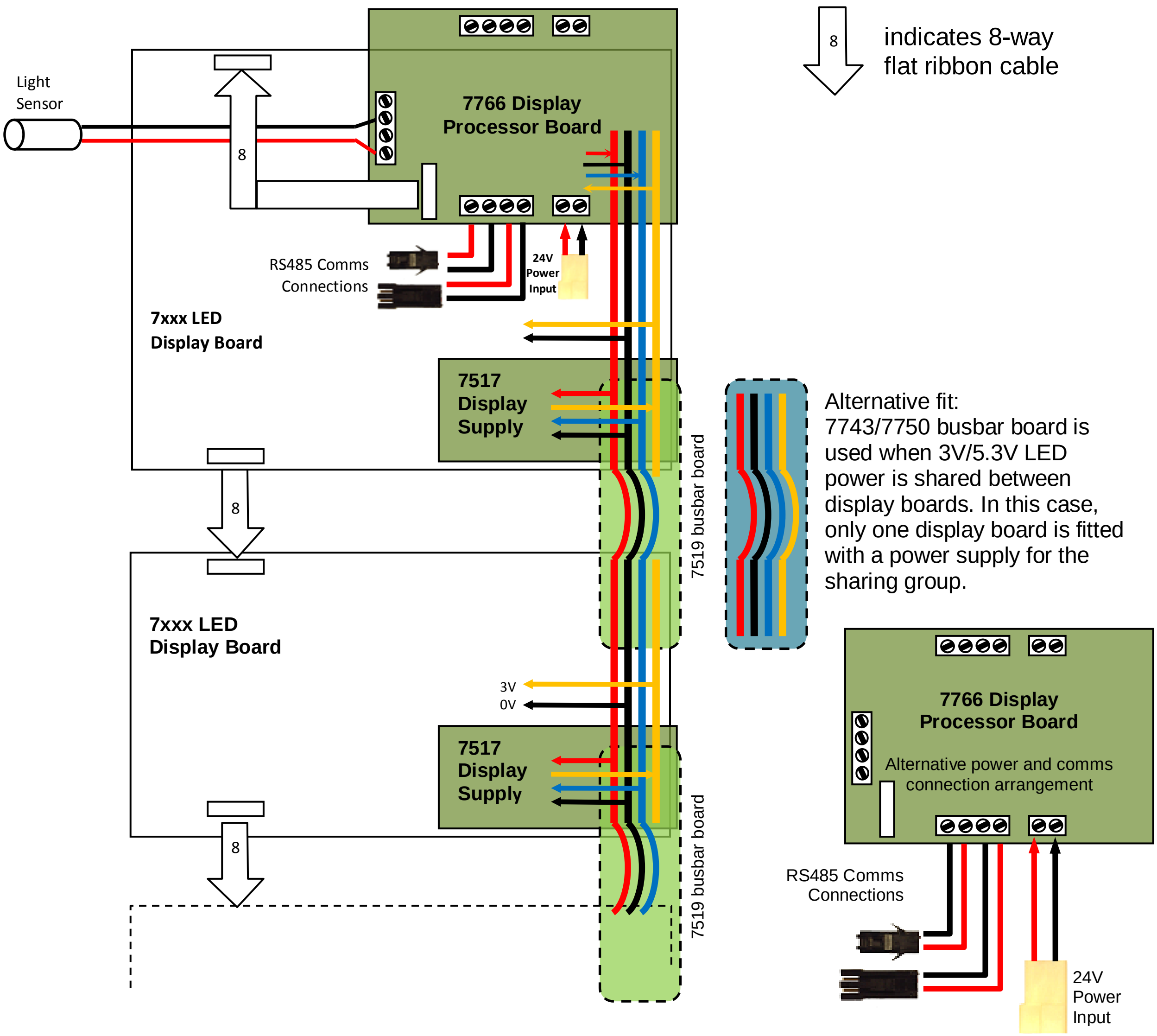


Figure 52

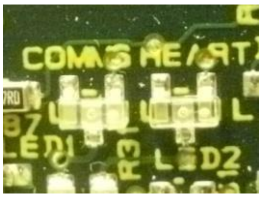
5.11 Processor LED diagnostics

During power-up and after a power cycle, the red LEDs on the processor board behave as follows:

1. Both will come on: at this point the processor is ‘sizing’, i.e. calculating the position and size of each display board.
2. After the processor has checked the firmware database, if a valid combination of height x width is found (this takes about two seconds) then both LEDs will go out briefly and the heart will blink half-a-second off / half-a-second on.
3. If any other sequence than described is observed, then the display has failed to size.

Power up, display-sizing: communications and heartbeat = ON

Display-sizing complete: communications and heartbeat = OFF



Display receiving valid data: communications = flashes briefly when communications received; heartbeat = ON 0.5sec + OFF 0.5sec

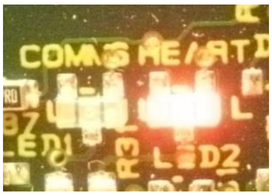


Figure 53

5.12 Busbar boards

Busbar boards distribute power both to the display boards and to the display board power supplies. The power distribution required differs between builds so when fitting a replacement, it is important to use the correct variant.

Variant	Example
7519-01-01	
7600-20-01	
7743-20-03	
7750-20-01	

5.13 Ambient light sensor

Each display has a light sensor unit. This measures ambient light and automatically adjusts the brightness of the display according to the prevailing light conditions. It is very important not to block the sensor such that light cannot fall upon it. See section 6.4 for a test to check the functioning of the sensor.

Figure 54

6. Queries, FAQs and other information

6.1 Introduction

The previous two sections provide in-depth information on diagnosing problems that can occur with displays. In addition, this 'how to' section provides quick reference answers to typical questions and queries, including some of the basic procedures required to undertake various tasks associated with an LED display. It includes additional tests and checks that can be performed if problems are encountered. Many are contained elsewhere in the manual - in which case, references and links are provided - whilst others follow within this section.

If the answer is not found here, users can contact Hanover Technical Support - see section 1.9 Hanover Technical Support.

6.2 Queries

to find out how to:	the user should:
compose a message for a display	consult the Helen manual
determine the specific technical specification of a display	consult the data sheet for the display in question
operate the display, including sending messages to it	consult the controller manual
connect third party equipment to a display system	contact Hanover
install a controller	consult the relevant controller manual
diagnose controller problems	see section 3.6 Problems with the display controller or consult the relevant controller manual
identify which display is fitted	see section 1.6 Identification
identify the display software	see section 1.6 Identification
put the display into test mode	see section 4.1 Diagnostic aids
test the ambient light sensor	see section 5.13 Ambient light sensor and 6.4 ALS function check
locate the display processor within the assembly	see section 6.5 Disassembly and board removal for certain OLED displays
adjust the operation of the ambient light sensor	see sections 2.4.2 Brightness setting at night and 2.4.3 Configuration options
adjust LED brightness levels manually	see section 2.5 Other display options
check for water ingress	see section 3.2 Water ingress inspection
diagnose common display problems	see section 3.3 Quick diagnostics and 3.4 Diagnostic flow chart
check communication signals and cable	see section 3.7.1 How to check communication signals and cable

6.3 Other frequently asked questions

What is the difference between direct drive and multiplex displays?
- see section 1.7 Direct drive and multiplex displays

Why might my firmware need updating?
- see section 1.8 Firmware

My displays are likely to be exposed to excessive amounts of dust and / or water: do I need to make special provision for this?
- see section 2.1 Ingress protection (water and dust)

What are the usual assignments for the display address settings?
- see section 2.4.1 Address setting

6.4 ALS function check

The ambient light sensor (ALS) is used to control the brightness of the display according to the ambient light level. To perform this test, a good quality torch is required.

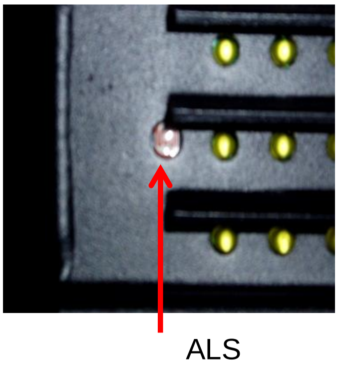


Figure 55

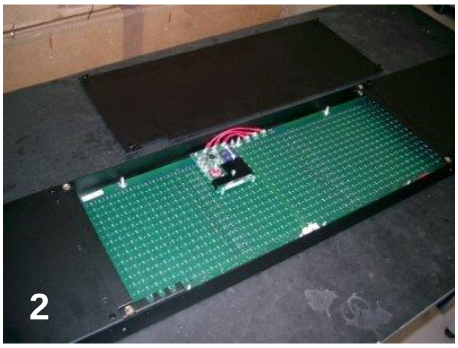
The location of the ALS varies between displays. In some applications, it is mounted externally to the display.

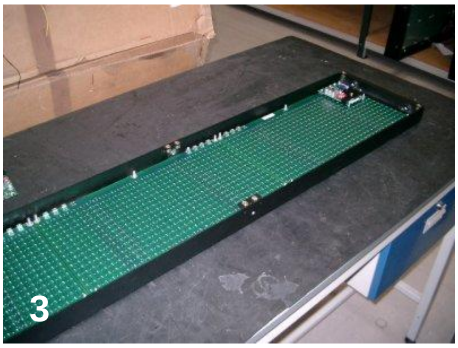
To test the ALS:

1. Ensure the display is powered up and is showing a destination or message.
2. Shine the torch directly onto the ALS through the vehicle's display screen glass.
3. Observe the LEDs: they should all increase in brightness uniformly until they reach a level where the display is uncomfortable to look at directly.
4. After removing the torch from the ALS, the LEDs should then uniformly decrease in brightness.
5. Test complete.

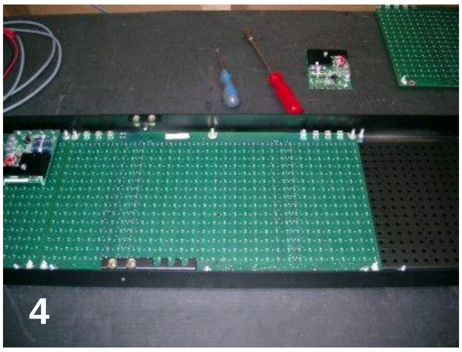
6.5 Disassembly and board removal for certain OLED displays

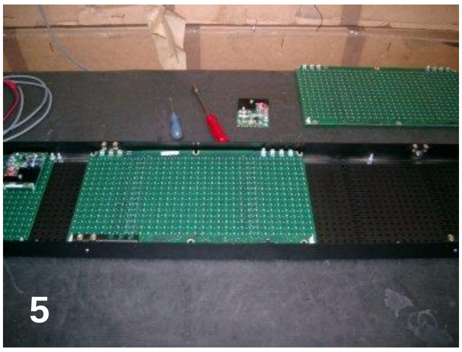
With some OLED displays, the boards cannot simply be lifted out: this section describes the access procedure.



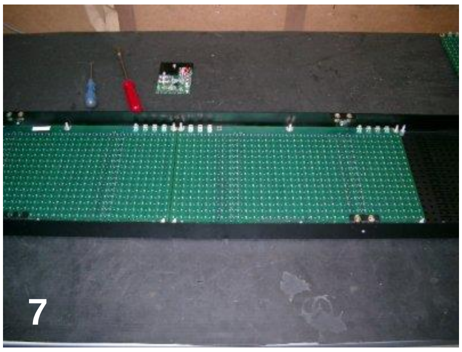


To remove the rear panels from the display, first undo the M4 Dzus winged fasteners in each corner of each panel (1). The centre panel must be removed first (2). Once all three panels have been removed, it is possible to access the M5 nyloc nuts which hold the LED boards in place (3). Each board has six fixings.





Due to the tabs on the rear of the case (which house the Dzus fixings) removal of the LED boards must follow a specific order. First, lift out the board on the far right of the display (4). The second board may now be lifted off its studs and moved along towards the right-hand end of the display case until it clears the Dzus tabs (5). Once clear of these, it is possible to lift the board straight out of the display (6).



Next, slide the third board along, again towards the right-hand end of the display until it clears the tabs (7) then lift it out (8). The board at the left-hand end of the display will lift straight out as with the first board (9). For reassembly, repeat the above procedure in reverse, taking care not to damage the LEDs when sliding the boards along.