The Mono FlipDot-System

Operating Instructions

Version: 1.2.a

Stand: 10.05

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LAWO - Mark IV Industries GmbH

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1 Introduction

First of all we would like to thank you for having chosen a LAWO full matrix system. This system conforms to the state-of-the-art and was produced and tested according to the highest European quality standards. The unit is very flexible in meeting the specific requirements of transport companies. Please contact your nearest LAWO representative for further information on special system adaptations.

We also offer a very comfortable editing system, TED®PLUS , to edit destinations and character sets and to input, modify and position texts within displays. You can also use this PC-DOS-based program to create and modify characters sets and symbols.

Explanation of certain terms used:

Bistable elements:

Pixels or dots mainly black / yellow reflecting in octagonal form in 2 sizes:

10 mm and 15 mm in diameter.

Motherboard (printed circuit board):

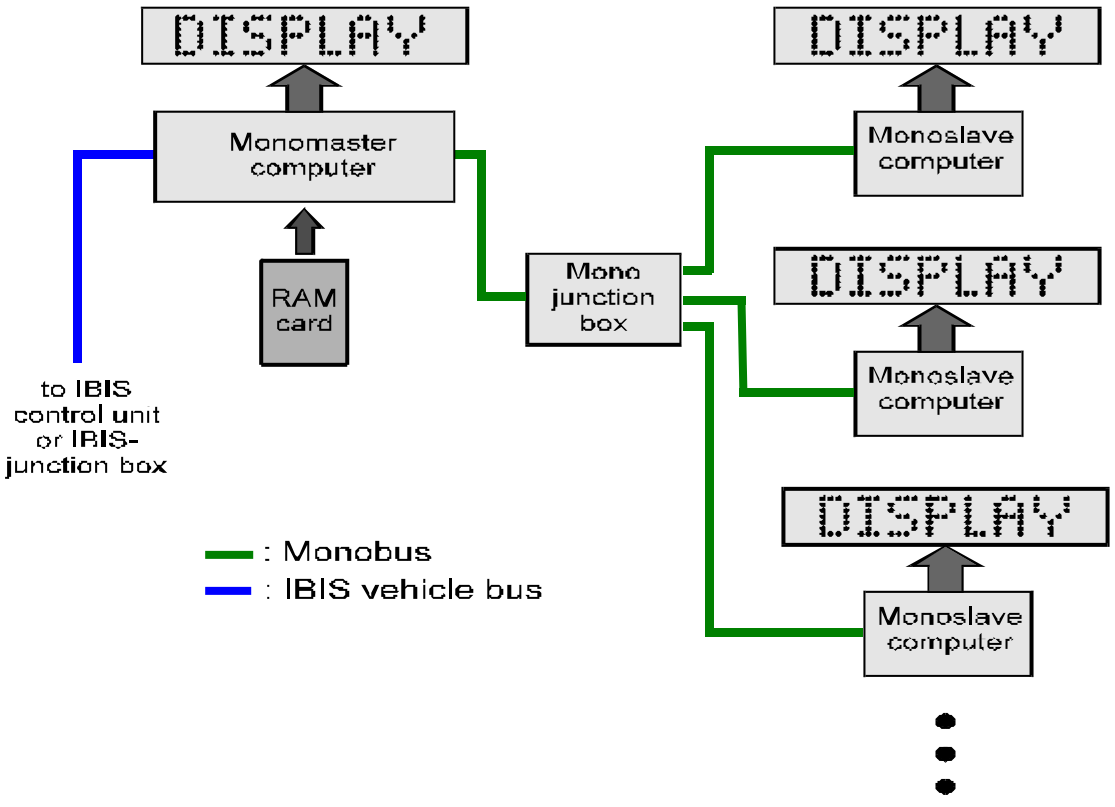
The module equipped with the black/yellow bistable elements (pixels, dots).

The most common resolutions are (in dots):

H 16 x W 28; H 7 x W 28; H 13 x W 28; H 24 x W 28; H 19 x W 28.

AZR: Display computer.

2 General System Description



2.1 Mono Unit Components

A monobus system comprises one monomaster computer that manages all the data as well as a maximum of 13 slaves and a monobus distributor. A commercial IBIS distributor can be used as the monobus distributor and conventional IBIS cables for the wiring.

The master computer within the monobus system supplies voltage, dot power as well as data in bit-map form to all the slaves. It is usually located in the front display housing and directly controls the front display. The monomaster computer receives its data per IBIS download, per memory card or via the boot interface (on the 25-pole connector of the monomaster computer). The same interface, apart from IBIS download, can also be used to load a new operating program into the monomaster computer. The master computer is the only component that is directly connected to the IBIS bus.

All of the slave computers receive their display data from the monomaster computer via the monobus as bit-maps, one column at a time.

2.2 Electrical Data

Power supply for the display: 24 volts DC ± 20%
60 - 200mA when idle
360 - 560 mA during display setting (depending on display size)

Power supply for the illumination: 24 volts DC ± 10%
0,5 - 5,5 A (depending on type of illumination)

2.3 Installation

The matrix displays are usually fitted and wired by the vehicle manufacturer. Please consider the following information if you want to install the display by yourself. In this case we offer support, just let us know.

The displays have to be mounted to the correct side of the vehicle for which it is intended. The displays might have the same appearance but programming, addressing and data are different for each side. Please check the display designation label located on the lower frame side of the panel.

Avoid touching the screen because it has a special antistatic coating that prevents the screen from becoming dirty too quickly.

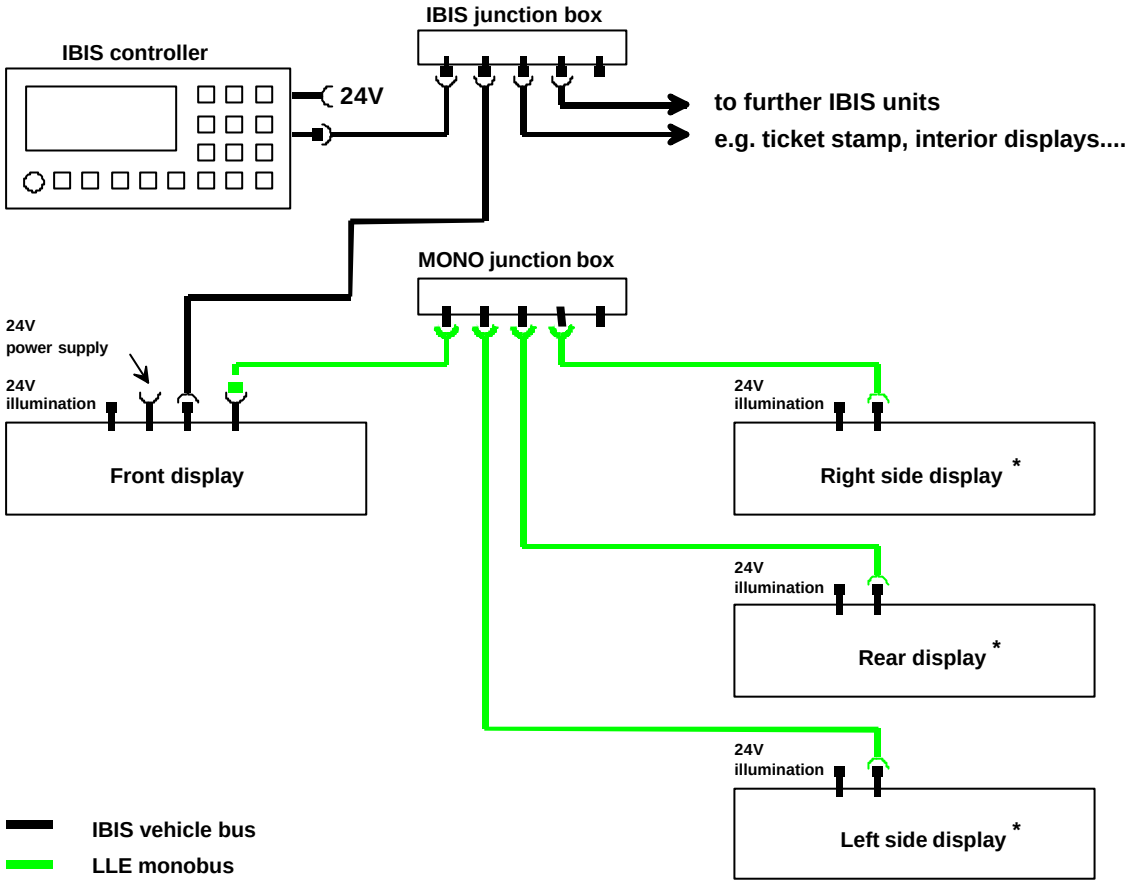
Make sure the display is supported evenly. The fitting should not distort the display in any way. Extreme tension can otherwise damage the dot matrix board because vehicle impacts and torsion cannot be fully absorbed which may result in breaking off retainers.

If you have to drill holes into the display housing, be sure to vacuum clean the interior of the housing carefully and thoroughly because metal debris may interfere with components of the display which operate on a magnetic basis.

Lead all feed circuits, such as IBIS data lines, power supply, illumination supply and flat cables carefully to the display to avoid kinks and chafing. Use cable clamps to keep circuits away from critical locations. Take care not to pinch cables or plug-in connectors when closing display housings and display covers.

Warranty is void if these conditions are not met.

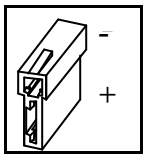
2.4 System Cable Layout

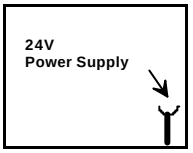


*) These displays do not require a separate 24V DC operating voltage for the slave computer but illumination power has to be supplied separately.

2.5 Plug-in Connections Description

24 volts power supply:



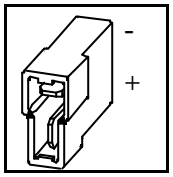


2-pole AMP socket

Rectangular housing : type QSFG2-B

Rectangular sleeve 6.3 mm for insertion (2x) : type QSFH6M3-G

24 volts illumination:



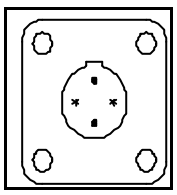
2-pole AMP connector

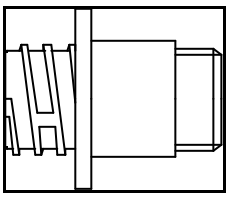
Rectangular housing : type QSFG2-S

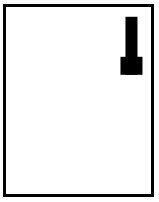
Rectangular sleeve 6.3 mm for insertion (2x) : type QSFS6M3-G

Data plug-in connectors for the IBIS vehicle bus and the monobus

CPC connector (contact pins)





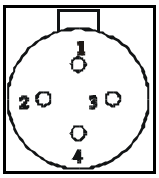


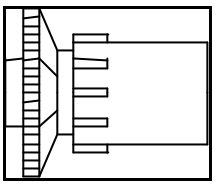
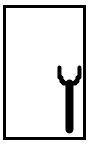
CPC connector housing for pins : Plastic type QSCS4-P

Metal type QSCS4-M

CPC crimp contact pins (4x) : type QSCK-S-C

CPC socket (contact sleeves)



CPC socket housing : Plastic type QSCB4-P
Metal type QSCB4-M
CPC crimp contact socket (4x) : type QSCK-B-C
CPC strain relief : Plastic type QSCH4-P
Metal type QSCH4-M

Type specifications are **LAWO order numbers**.

2.6 External connection assignment

Attention :

Ensure the correct assignment of all connectors.

Wrong connections might severely damage the display.

Use a voltmeter to check the exact assignment of the counter-plug before connecting it to the display.

2.6.1 Power supply to the display computer

Connector for the display power supply.

Recommendation : Connect this connector to **'Ignition plus'**.

2.6.2 Power supply to the illumination

Recommendation : Connect this connector to the **parking lights** to avoid frequent switching on and off.

2.6.3 IBIS vehicle bus plug-in connections

(Top view of connector contacts)

This connector and its connections are according to the **VDV standard**.

Pin 1:	WBSD	Vehicle Bus Send Data	Calling bus plus	white
Pin 2:	WBSM	Vehicle Bus Send Ground	Calling bus minus	brown
Pin 3:	WBEM	Vehicle Bus Receive Ground	Replying bus minus	green
Pin 4:	WBED	Vehicle Bus Receive Data	Replying bus plus	yellow

Tip : What is connector 1 ?

The vehicle-side counter-plug of connector 1 can easily be tested with a voltmeter in case a control unit (!) is connected:

Pin 1 to **Pin 2** : approx. + 24 volts;

Pin 4 to **Pin 3** : approx. + 24 volts.

2.6.4 Monobus connections:

(Top view of connector contacts)

PIN 1:	Power supply to rotate the dots (power source on master computer)	white
PIN 2:	Common ground (0 volt)	brown
PIN 3:	Serial data	green
PIN 4:	Voltage supply for the slave computer and driver (8 volts).	Yellow

2.7 The Monobus

2.7.1 Circuits:

The monobus is a bus system especially developed for the **LAWO-Mono-Matrix-System**.

In the vehicle the monomaster-computer is connected to the monoslave-computers via the mono-junction-box.

This monobus serves to reliably transfer all relevant information between the master and the slave computers at high speed. It also provides the voltage supply to the slave computers.

Conventional 4-wire IBIS cables, usually fitted by vehicle manufacturers in the vehicles, are used for the circuits. The display plugs are CPC plugs in accordance with the IBIS standard.

This can lead to confusion with the connections in the vehicle but this will not damage the electronic components on the IBIS bus or monobus!

The data transfer on the monobus runs via an asynchronous, bi-directional, serial interface at 19200 baud.

The interface has one data line for both transfer directions. The general system ground is used as reference potential.

To avoid conflicts during transfers (only one bus participant can send at any one time!), the slave computer may only reply after having received an inquiry sent by the monomaster

This assumes that all slaves operate at different addresses (refer to 2.8) so that unique addressing is ensured.

2.7.2 Function:

A monobus system comprises one monomaster that manages all the data as well as a maximum of 13 slaves and a monobus distributor (mono-junction-box).

A commercial IBIS distributor can be used as the monobus distributor and conventional IBIS cables for the wiring.

The master computer within the monobus system supplies

- ⇨ voltage,
- ⇨ dot power and
- ⇨ data (in bit-map form)

to all the slaves.

It is usually located in the front display housing and directly controls the front display.

The master computer is the only computer within the mono matrix system that is directly connected to the IBIS bus.

A simplified AHDLC protocol is used for all telegrams on the monobus. Slave computers may only send after having received a request from the master computer.

Each slave computer has a rotary coding switch (see 2.8) to set the address under which it can be addressed via the monobus. The slave addresses must be unique, equal addresses are not allowed and always lead to functional errors!

A slave is required to send a reply telegram after an inquiry telegram has been sent by the monomaster computer. The monomaster computer again attempts to send an inquiry telegram **twice** if the reply is not received within a certain time-out interval. In case the slave still fails to reply, the attempt to communicate with this particular slave is terminated.

The overall behaviour of the mono system is seen by the user exactly as an IBIS system, i.e. the monobus can be regarded as an **extension** to the IBIS vehicle bus.

After receiving a telegram from the IBIS control unit requesting an output on the displays (e.g. az-telegram), the mono master computer firsts checks which components in the monosystem configuration can be addressed and what destination data is available. The display data is compiled (bit-map) and output serially to all displays corresponding to these addresses.

The IBIS control unit can determine, in the same way as in a pure IBIS system, whether all computers in the monosystem are still operative. To do this, the monomaster computer cycles through all slaves (one slave per second) trying to address them by sending an inquiry to their corresponding addresses. This is also done to a specific slave, in case some date is available for it. After this inquiry the slave has to reply within a certain time limit.

If the result is negative, i.e. a slave does not reply within the time-out interval even after three attempts in total, this particular slave is **deleted from the list of available slaves**.

The monomaster continues addressing such a slave and it is added to the slave list immediately (within just a few seconds) as soon as it is responding again.

If a control unit sends a status inquiry regarding a certain display address, the monomaster computer checks whether its own address matches the address inquired or whether a slave listed as being present corresponds to this address. The monomaster computer instead sends back a positive reply in such cases.

The download process accepts all data received from memory card or via DL coupling regardless of the connected slave computers. This procedure can also be used to update or reload the operating system.

Downloading with a memory card is the fastest method and should therefore preferably be used instead of other downloading methods.

The following must be observed when beginning with the creation of the TED®PLUS -configuration file 'custom.cfg' as the first step in configuring a monosystem:

A prerequisite to transparency of the monobus is that each device, master and slave, within the overall vehicle has a unique address, independent of wether the device is either connected to the IBIS bus or to the monobus respectively!

Furthermore, the physical monomaster address as well as the physical slave address must match the address entry of the corresponding display within the TED®PLUS -file 'custom.cfg'.

Disregarding this convention results in malfunctioning of the system!

2.8 Matrix System Addressing

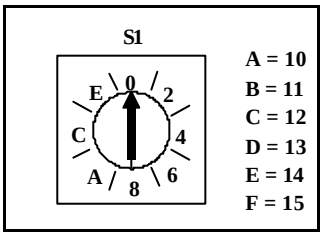
As we have explained in the previous chapter, correct addressing of the displays is a very important part of the overall vehicle system because the control unit or the ticket printer as well (input device near the driver) must be able to contact (address) the IBIS peripherals, including the displays in this case, with a unique address. The following addresses are assigned at the factory if you do not specify your own addresses when you place your order:

Display location	Address
Front	1
Right side	2
Rear	3
Left side	4

LAWO can provide the address assignment in vehicles with more complex systems (e.g. articulated bus). Ask LAWO for more information in this case.

When replacing the display computer make sure the new display computer is set to the correct address.

Use the rotary switch S1 to set the display computer to the desired address:



After setting rotary switch S1 to the correct address make sure the ignition is switched off and on again because the addresses are only read in during initialisation of the system (after switching on).

All addresses within the monosystem must be different!

A wrong setting of the rotary coding switch S1 always leads to system faults.

To ensure that the status reply as well as the IBIS-download works correctly, the display addresses on the IBIS bus (i.e. an LVA) must not overlap with the addresses within the monosystem.

3 Matrix System Modules

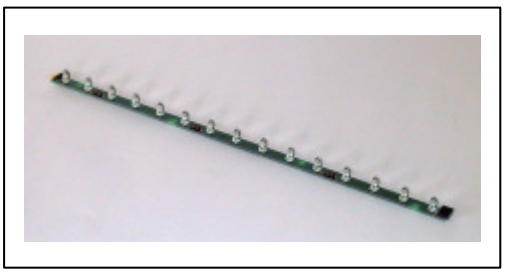
The full matrix display comprises of 4 units (modules) as described in this Section:

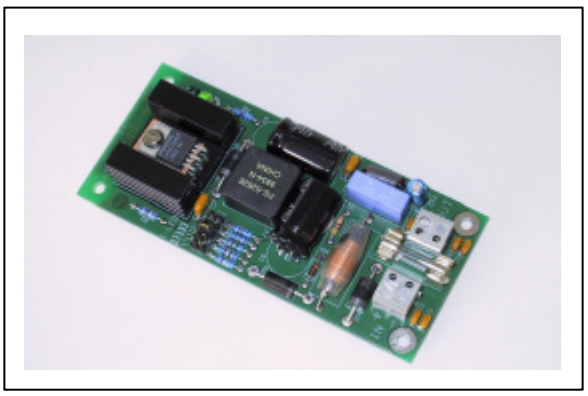
- The housing with front screen, fixing parts and rear panels, which can be removed in some cases.
- The LED illumination unit and the necessary wiring in case OPTIMA technology is not used.
- The display computer to control the matrix unit.
- The dot matrix circuit board. This board is available in various resolutions and dot sizes.

3.1 Illumination

If OPTIMA technology is not used there has to be some type of illumination.

In this case LED InLine sticks in conjunction with switching power supply can be used.





3.2 The Monomaster Computer

The monomaster computer, usually located in the front display housing, is the heart of the LAWO monosystem. It controls the front display in the same manner as a regular LAWO-IBIS display computer. The monomaster computer is **the only device** within the monosystem that is connected to the vehicle **IBIS bus**.

The master computer uses the so-called monobus to provide operating voltage and data to all slave computers in the other displays of the vehicle.

Up to 13 slave computers can be connected to one master computer.

Display data, as bit-map information, is sent to the slaves via an asynchronous serial interface at a transfer rate of 19200 baud and a voltage level of 24 volts.

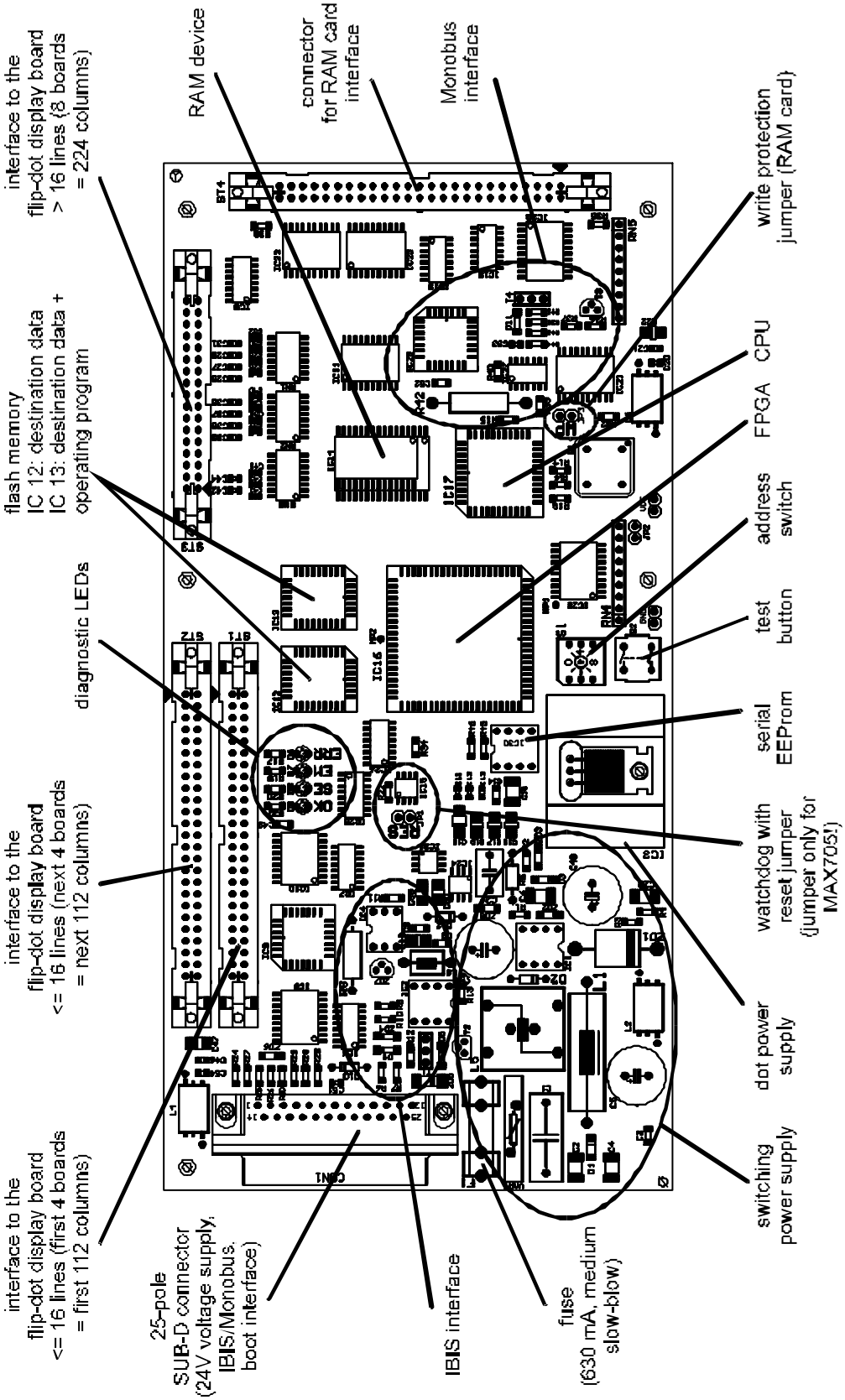
The monomaster computer is equipped with a PCMCIA Type II compatible card reader.

The computer takes over the complete data handling for the overall system, thus allowing rapid loading of all destination data, character sets etc. in the centerpoint of the system at the front display housing. A complete load cycle takes about 15 seconds depending on the data volume to be loaded. A multi-coloured LED shows a successful load process or any faults.

This card reader can also be used to load new operating programs to the master computer.

Apart from that, destination data can still be loaded using a conventional LAWO download device.

3.2.1 Monomaster Computer Component Placement



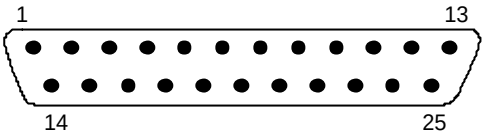
3.2.2 Monomaster Computer Hardware Description

This Section describes the significant components of the monomaster computer. Use the component placement plan to localise the components on the board.

CON1: 25-pole SUB-D connector:

This connector provides all the important connections to external devices. The pin assignment (see the diagram) is compatible to all nine LAWO computers and to the older LAWO-FD computer 802/15 with regard to voltage supply and/or IBIS connection.

Pin assignment (diagram shows the connection side):



PIN No.:	Description:
1 :	System GND
14 :	Boot interface TTDI (data line PC -> LAWO-computer)
2 :	Boot interface TTCLK (shift clock)
15 :	Boot interface TTMS (pass on/execute selection)
3 :	Boot interface TTDO (data line LAWO-computer-> PC)
4,16,17 :	reserved
5 :	Monobus GND circuit (slave ground circuit)
18 :	Monobus VPP circuit (dot current for the slaves from IC 3)
6 :	Monobus +8V circuit (slave voltage supply)
19 :	IBIS vehicle bus WBSD (calling bus data line)
7 :	IBIS vehicle bus WBSM (calling bus ground)
20 :	Monobus MONODAT circuit (data line to slaves)
8 :	reserved
21 :	IBIS vehicle bus WBED (reply bus data line)
9 :	IBIS vehicle bus WBEM (reply bus ground)
22,10 :	reserved
11,23 :	+24V voltage supply
12,24 :	reserved
25,13 :	voltage supply GND (via filter section)

D6: (ERR) red error LED:

This LED goes on for any overall system error. Refer to the Troubleshooting Section for detailed information.

D7: (EM) yellow receive LED:

This LED goes on when the computer receives a telegram via the IBIS vehicle bus. Together with the red error LED (D6) it signals an error on the IBIS calling bus in the system. Refer to the Troubleshooting Section for detailed information.

D8: (SE) yellow send LED:

This LED goes on when the computer sends a telegram via the IBIS vehicle bus. Together with the yellow receive LED (D7) it signals a download. Refer to the Troubleshooting Section for detailed information.

D9: (OK) green watchdog LED:

This LED is directly coupled to the watchdog component of the computer. It flickers during normal operation because the watchdog is toggled continually. Refer to Section 7 for detailed information.

F1: Fuse 630mA:

Standard glass tube fine-wire fuse with retainer, type MT (medium slow-blow fuse).

JP3: Write protection connector:

Pushing a jumper onto this connector strip disables the write protection for the RAM card as seen from the monomaster computer (the write protection on the RAM card remains active).

S1: Address coding switch:

Used to set the logical IBIS or monobus address of the computer.

S2: Yellow / black button:

Serves to control either the computer output on the displays or the transfer of output data to the slaves. Pressing the button during computer start switches all displays in the system to yellow. Pressing the button again switches all the displays to black and then to a chessboard pattern. By pressing the button again the last destination before power off will be shown on all displays again.

When the yellow / black button has been pressed and a new IBIS telegram that can be processed by the computer arrives, the test cycle is interrupted immediately and the new destination text is displayed.

ST1: Flip-dot output port 50-pole (for the first 4 flip-dot boards <= 16 lines)

Used to control up to 4 flip-dot display boards with <=16 lines, each with 28 columns. The logical column addresses are between 1 and 112 (first 4 boards).

ST2: Flip-dot output port 50-pole (for a further 4 flip-dot boards <= 16 lines)

Used to control up to a further 4 flip-dot display boards with <= 16 lines, each with 28 columns. The logical column addresses are between 113 and 224.

ST3: Flip-dot output port (for 8 flip-dot boards > 16 lines)

Used to control up to 8 flip-dot display boards with >16 lines, each with 28 columns.

The logical column addresses are between 1 and 224.

ST4: RAM cards interface 50-pole:

Used to connect an E300801 adapter board using a 50-pole flat conductor cable. The PCMCIA connector for the RAM cards is located on this board.

3.2.3 Monomaster Computer Troubleshooting

This Section describes the possibilities to diagnose faults on the monomaster computer without having to use additional test hardware. The conventional IBIS diagnostic devices as well as a RS232 monobus interface (L550/) run on 24 volts are available for faults that cannot be located in this manner. This device can be combined with a PC or Notebook to analyse telegrams on the monobus.

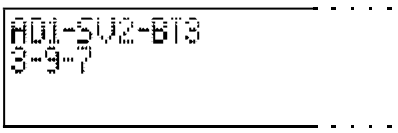
Yellow/black test:

Pressing the button (S2) on the master computer first switches all displays to yellow, then to black and then to a chessboard pattern and, finally, back to the current destination. Any information arriving for the displays in a new telegram is displayed immediately, independent of the status of the displays.

Configuration test:

The computer status is output on the flip-dot displays during the master computer start, i.e. after the complete black and yellow display switching and before the first destination is output. The information output differs for the master and slave computers. Nothing is displayed or the output is partially unreadable when no configuration data are found for the display addresses.

Example for an output on the monomaster computer:



The output for the monomaster computer has the following significance:

Top line: ADx: Address set on the monomaster computer is ´x´. (Address 1 is set in the example)

SVx: The monomaster has software version ´x´.´x´ can be a number or a sting such as ´3B´. (Software version 2 is loaded in the example).

BTx Bus type ´x´ is set. '255' means that no bus type has been set! (Bus type 3 is set in the example).

Bottom line:

1st number: Number of the configuration files found in the destination memory. The number of preference forms is identical to the number of devices that can be addressed in the monosystem, including the master computer. It does not show how many devices are actually connected but, for correct operation, the number of slaves connected should be one less than this number. (3 configurations were found in the example, i.e. apart from the master computer, 2 slave computers are also addressed within the system)

2nd number: Number of character sets found in the destination memory. The number is significant when certain characters or texts cannot be displayed. The number must match the number of character sets show in TED®PLUS . (9 character sets were found in the example)

3rd number: Number of destination files found in the destination memory. (7 destination files were found in the example)

Diagnostic LEDs:

Four LEDs on the monomaster computer circuit board (D6-D9) as well as a three-coloured LED on the cards interface are available for error diagnostics. The LED on the cards interface shows the status of a download using the RAM card. The LEDs on the computer board also have a different significance during a data download with the RAM card!

To simplify diagnostics, all LED outputs as well as the effect on the flip-dot display output follow in tabular form in two groups ('normal function' and 'malfunction').

The LEDs on the mono master computer board support the following diagnostics in **normal operation:**:

All LEDs (D6 - D9):

All LEDs light up for a short time after the supply voltage has been switched on or after a reset. The red and the two yellow LEDs go off and the green LED starts to flicker rapidly.

Red error LED (´ERR´, D6):

This LED signals a fault in the overall system and remains off during normal operation.

Yellow receive LED (´EM´, D7):

This LED goes on when the computer receives a telegram via the IBIS vehicle bus. When this LED blinks simultaneously with the yellow send LED (D8) this signals that an IBIS download is in progress.

Yellow send LED (´SE´, D8):

This LED goes on when the computer sends a telegram (e.g. status reply) via the IBIS vehicle bus. When this LED blinks simultaneously with the yellow receive LED (D7) this signals that an IBIS download is in progress.

Green watchdog LED (´OK´, D9):

This LED is directly coupled to the watchdog component of the computer. It flickers during normal operation.

Malfunctions:

All LEDs :

All LEDs remain off after the supply voltage has been applied: check the power supply. The main connection of the computer may be defective.

LEDs remain on after the supply voltage has been applied or after a reset: computer does not start. The operating program should be reloaded with a RAM card. If this has no effect, the operating program on the RAM card is also defective (check the memory board battery!) or there is a severe error in the computer.

LEDs go on cyclically after a certain interval: see green LED.

Green LED :

The green LED no longer flickers and all LEDs then go on for a short time: the operating program aborts. The operating program is probably defective in Flash (see also 'All LEDs').

Yellow send LED :

The yellow send LED does not go on even though a status inquiry to be replied to has been send by the master computer: computer not sending. There is either no device with the corresponding address on the monobus (check addresses set on the master computer and the slave computer, especially wether the rotary coding switch functions correctly) or the status inquiry telegram was not received (see also 'Yellow receive LED' and/or 'Red LED').

The computer does not return any display data to the control unit, i.e. the yellow LED does not go on when a new destination telegram is received or does not flicker cyclically when cycling destinations on the display to reply. Check the correctness of the control unit L8014 entry and/or the send address entry in the customised TED®PLUS file 'custom.cfg'. Also check whether text entries were copied to the alphanumeric LCD reply field in TED®PLUS .

The yellow send LED does not blink during an IBIS download: the computer is not in downloadmode, i.e. no download telegram was recognised. Check the connection of the download device. Either the IBIS download device or the download coupling could be defective.

Yellow receive LED :

The yellow receive LED never goes on and the red LED is switched off: computer is not receiving valid IBIS telegrams. Either the receive part of the computer or the IBIS control unit is possibly defective.

The yellow receive LED and the red LED are permanently on: see Red LED.

The yellow receive LED does not blink during an IBIS download: the computer is not in download mode, i.e. no download telegram was recognised. Check the connection of the download device. Either the IBIS download device or the download coupling could be defective.

The yellow receive LED blinks alternately with the red LED: see Red LED.

Red LED :

The red LED keeps going on in combination with the yellow receive LED: the IBIS callingbus is interrupted. Check the circuits in the display and/or vehicle. It could be that either the IBIS control unit or the receive part of the master computer is defective. The yellow receive and the red LED start to blink alternately after one minute.

The red LED goes on for a short time or several times during receipt (the yellow receive LED flickers): telegrams with the wrong parity have been received. Check the IBIS control unit!

The red LED blinks alternately with the yellow receive LED: no IBIS telegrams relevant for the monomaster computer have been received for longer then one minute. This blinkoutput has a lower priority than the display for a calling bus interruption so that it is not very likely that the calling bus is defective. It is more likely that the configuration is wrong or the IBIS control unit is defective.

Flip-dot output : Display > 16 dots height:

Display does not react during computer switch-on:

The computer has an erroneous configuration for this display. Check the computer address (it must match the address entered in the TED®PLUS configuration file 'custom.cfg'). Check the monobus and/or the slave computer when this display is controlled by a slave computer.

The display switches to black and then to yellow during computer switch-on but only a part or none of the computer status information appears and no destinations are shown: The computer has either erroneous configuration data or none at all for this display. Check the computer address (this must match the address entered in the customised TED®PLUS file 'custom.cfg'). When necessary, reload the computer or copy the data to the memory board again (check the memory board battery!).

The display switches to black after 1 minute:

The computer has not received a relevant telegram via the IBIS bus for at least 1 minute. The display switches to black because a malfunction in the IBIS wiring or control unit must be assumed (compare diagnostic LEDs on the computer board). This switching to black can be avoided by entering the control unit L8014 in the customised TED®PLUS configuration file 'custom.cfg'.

Display <=16 dot height:

Display does not react when the computer is switched on:

see display >16 dot height.

The display switches to yellow and then to black and back to yellow during computer switch-on but no computer status information appears:

The computer has either erroneous configuration data or none at all for this display. Check the computer address (this must match the address entered in the customised TED®PLUS file 'custom.cfg'). When necessary, reload the computer or copy the data to the memory board again (check the memory board battery!).

Display switches to black after approx. 1 minute:

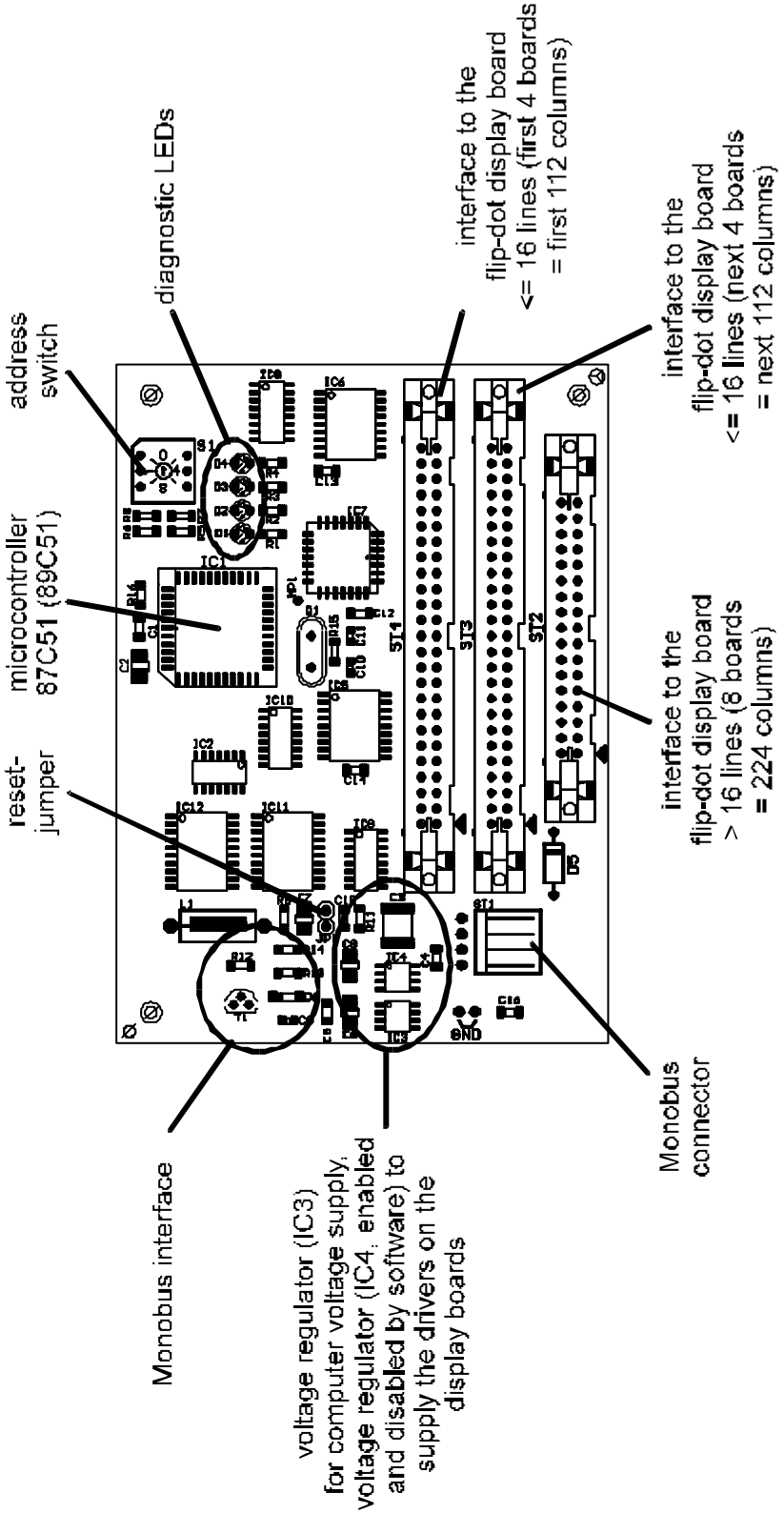
see display >16 dot height.

3.3 The Monoslave Computer

The monoslave computer serves to control the flip-dot display and, compared to the master computer, has no own IBIS connection and no own data memory so that the slave computer can only be used in combination with a monomaster computer.

The monoslave computer receives its supply voltage and dot current from the monomaster computer via the monobus. The monomaster also transfers the display data as bit-maps via a serial interface (part of the monobus) at 19200 baud and a supply voltage of 24 volts. The monomaster recognises when a slave computer aborts via the monobus and passes this onto the control unit during a status inquiry. The monobus uses the IBIS wires already available in the vehicle via a second IBIS junction box. Please notice that it is not allowed, that the original IBIS wires and the Mono bus wires have any electrical connections.

3.3.1 Monoslave Computer Component Placement



3.3.2 Monoslave Computer Hardware Description

This section describes the significant components of the monoslave computer. Use the component placement plan to localise the components on the board.

D1: Green voltage supply LED:

This LED is on when the computer is supplied with voltage via the monobus and the microcontroller functions correctly.

D2: Yellow send LED:

This LED is on during the time the slave computer sends a telegram via the monobus.

D3: Yellow receive LED:

This LED is on during the time the slave computer sends a telegram via the monobus.

D4: Red initialisation LED:

This LED goes on after the voltage supply has been switched on and remains on until the first time display data received via the monobus.

JP1: Reset jumper:

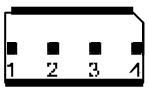
Shorting both contacts resets the computer.

S1: Address coding switch:

Used to set the logical monobus address.

ST1: Monobus plug-in connection:

Serves to provide the computer with the supply voltage, dot current and display data. Pin assignment (viewed from the connection side):



PIN-No.:

1 : Dot power supply to rotate the dots

2 : GND

3 : Data line for the serial interface

4 : +8 volts supply voltage

ST2: Flip-dot output port 34-pole (for 8 flip-dot boards > 16 lines)

Used to control up to 8 flip-dot display boards with >16 lines, each with 28 columns.

ST3: Flip-dot output port 50-pole (for 4 further flip-dot boards <= 16 lines)

Used to control up to 4 further flip-dot boards with <= 16 lines, each with 28 columns. The logical column addresses are between 113 and 224.

ST4: Flip-dot output port 50-pole (for the first 4 flip dot boards <= 16 lines)

Used to control up to 4 flip dot boards with <=16 lines, each with 28 columns. The logical column addresses are between 1 and 112 (first four boards).

3.3.3 Monoslave Computer Troubleshooting

This section describes the possibilities to diagnose faults on the monoslave computer without having to use additional test hardware. An RS232 monobus interface is available for faults that cannot be located in this manner. This device can be combined with a PC or Notebook to analyse telegrams on the monobus.

Yellow/black test:

The yellow/black test is started on the monomaster computer.

When the monomaster computer is switched on, the display first switches to black, then to yellow. The status of the slave computer then follows. After a short delay, which serves to check the complete readability of the status information, the last or new destination set on the control unit is displayed.

Configuration test:

The status of all slave computers is output on the flip-dot display during the master computer start, i.e. after the complete black and yellow display switching and before the first destination is output. Nothing is displayed or the output is partially unreadable when the master computer has not found any configuration data for the respective display address. The following describes how to interpret the error conditions and how to clear the error.

Example for an output on a monoslave computer:

The output for the monoslave computer has the following significance:

1st number: Address set for the slave computer. (The slave computer in the example is set to address 2).

2nd number (or string): Software version on the slave computer. (Software version ´01A´ is shown in the example).

Diagnostic LEDs:

Four LEDs on the monoslave computer circuit board (D1 - D4) are available for error diagnostics. These LEDs primarily serve to analyse the functions on the monobus and have the following significance:

To simplify diagnostics, all LED output as well as the effect on the flip-dot display output follow in tabular form in two groups ('normal function' and 'malfunction').

Normal function:

Green voltage supply (D1):

This LED is on when the computer is supplied with voltage via the monobus and the microcontroller is functioning, i.e. when the operating program has started correctly.

Red initialisation LED (D4):

This LED goes on together with the green voltage supply LED after the computer has started correctly. The LED is switched off after the Setup command has been received, i.e. before the display is written to for the first time.

Yellow send LED (D2):

This LED goes on during a send transaction (but only after the yellow receive LED goes on because the slave computer on the monobus can only send after receiving a telegram from the master computer). The LED flickers during the output on the flip-dot display because the display data are transferred in columns, each of which is acknowledged. The LED also goes on for a short time during cyclic status inquiries from the monomaster computer but then only when this particular slave computer has been addressed. It replies to an inquiry with a status message.

Yellow receive LED (D3):

This LED goes on when a telegram is received even when the telegram was not meant for this slave computer (whether the telegram was actually addressed to this slave computer can be seen when the slave computer sends a reply telegram, i.e. when the yellow send LED flashes immediately after the yellow receive LED goes on).
The yellow receive LED flickers during output to any one of the flip-dot displays (with slave computer) in the system because the display data are transferred from the monomaster computer to the slaves in columns. The LED also goes on for a short time at each cyclic status inquiry from the monomaster computer. When the LED flashes three times this signals that a slave address was addressed but could not be found within the system.

Malfunctions:

all LEDs : All LEDs remain off after the supply voltage has been applied:

Check the voltage supply on the monobus. The mains connection of the monomaster computer may be defective or the monoslave computer may have a severe error.

red LED :
The red LED goes on after the supply voltage has been applied and then remains on and the display does not react:

The master computer is not supplying data to the display address. The vehicle wiring or the monobus part of the master or slave computer could be defective, i.e. the computer is not receiving telegrams anymore. The yellow receive LED can be used for diagnostics.

The address of the slave computer in the display should also be checked. It must match the display address entered in the customised TED®PLUS file 'custom.cfg'. It may be necessary to reload the data to the master computer (using the memory card, IBIS download or via the boot interface) because the data could have been destroyed.

yellow send LED :
The yellow send LED never goes on even though the yellow receive LED flickers continually:
The slave computer only receives data not addressed to it. Check the address of the slave computer in the display. It must match the display address entered in the customised TED®PLUS 'custom.cfg'. It may be necessary to reload the data to the master computer (using the memory card, IBIS download or via the boot interface) because the data could have been destroyed.

yellow receive LED :
The yellow receive LED never goes on and the flip-dot display does not react:
The slave computer does not receive any data at all, i.e. not even data addressed to another slave.The bus wiring or the monobus part of the master or slave computer is probably defective. The LEDs on slave computers in other displays should be observed in this case.

Flip-dot display :

When the display malfunctions, first check the diagnostic LEDs. If these do not signal a malfunction, the fault probably lies within the data memory in the monomaster computer.

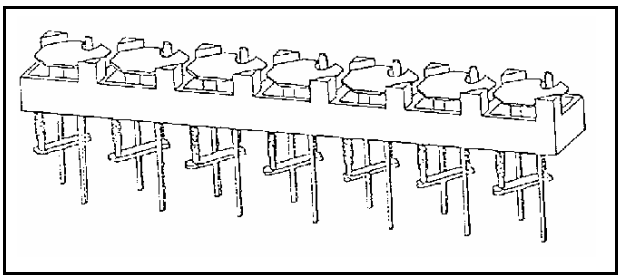
3.4 Matrix board

Matrix boards are modules that create a display surface when laid next to each other. The matrix boards each have dots (pixels, lamellas), drivers, diodes and plug-in connectors.

Dots

A dot is a pixel comprising a lamella, a low-retentivity magnet and a coil. The lamella is coated on one side with a fluorescent colour (mainly yellow) that is protected against fading with fine UV filter foil. Black is normally selected for the other side of the lamella in order to attain a good contrast to the fluorescent colour. A permanent magnet is laid in the lamella, i.e. it has a constant North-South polarisation. The low-retentivity magnet located in the frame is polarised by the coil underneath it by a current impulse. The permanent magnet in the lamella is attracted or repelled depending on the polarisation of the low-retentivity magnet. The polarisation of the low-retentivity magnet has a service life of approx. 2 years. For technical reasons, 7 dots are always grouped together as a strip.

Strip:



3.5 Internal Wiring

It is not possible to describe the multitude of illumination systems in the displays here in detail. 24 volts are fed through the 2-pole AMP connection to the control gears, which in turn create the ignition voltage and power supply for the fluorescent lamps. The output voltage of a control gear is approx. 130 volts. Upon request and specification of the display type, we can send you a circuit diagram for the respective type. The power supply for the Mono master computer is fed through the external 2-pole AMP connector to the 25-pole SUB-D connector. The external 4-pole CPC IBIS data connector is also connected to this 25-pole connector. The power supply of the Mono slave computer is realised via the Mono bus.

3.5.1 Flat Conductor Cable Connections

Three basically different systems are used here depending on the vertical number of dots.

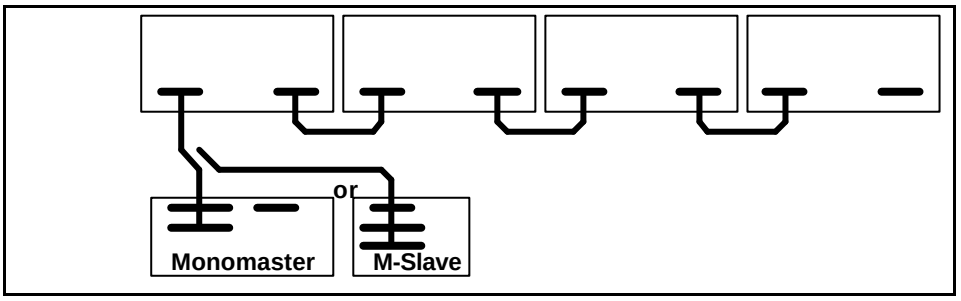
The 7-dot system

An adapter cable (50-pole to 34-pole) is needed here. The 50-pole connector is fixed to J2 and the 34-pole connector in the left matrix board (as seen from the rear). Further wiring is then principally the same as for the 13/15/16 dot system..

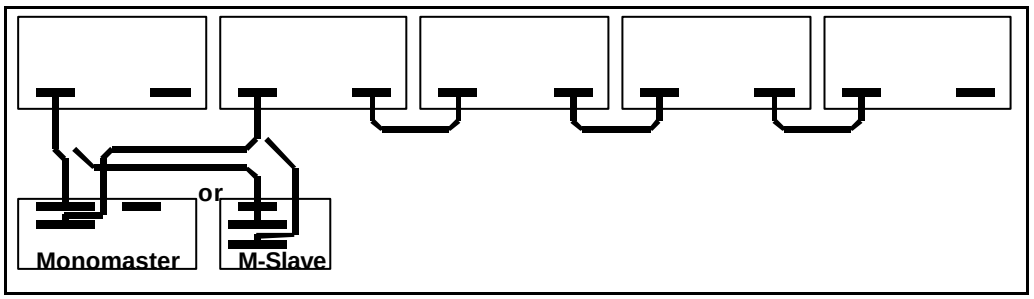
The 13/15/16 dot system

The 50-pole flat conductor cable is fixed to J2 and in the left matrix board. The following diagrams show the further wiring steps. All boards can generally be freely swapped as long as they have the same resolution (height x width, e.g. 16 x 28). The matrix boards can be connected to either the monomaster or slave computer.

The following wiring diagram is applicable for a display width of 4 matrix boards. View from the rear:



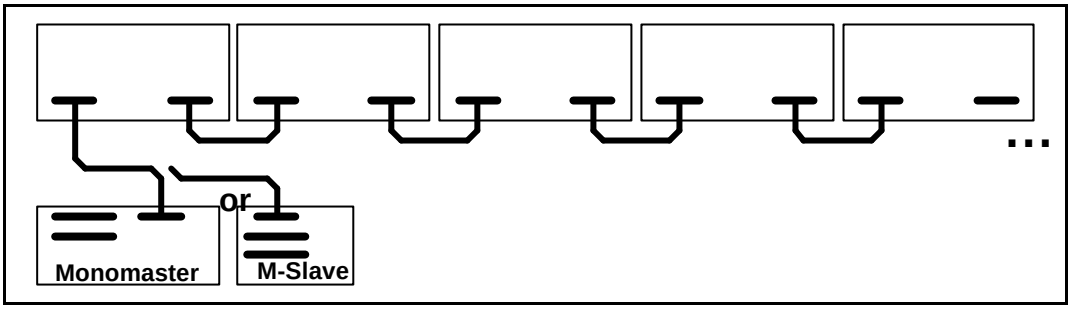
The following wiring diagram is applicable for a display width of more than 4 matrix boards:



The 19,24 or 28 dot system

For resolutions with a height above 16 dots, a maximum number of 8 boards without extension boards can be laid next to each other. The number of poles for the flat conductor cable in this system is 34.

View from the rear:



4 System Servicing and Maintenance

4.1 Changing Lamps

Switch the vehicle's ignition off and check that there is no voltage directly on the display (both 2-pole AMP plug-in connections). Each control gear has an LED that displays the primary voltage of 24 volts.

- Open or remove the rear panel of the housing
- Change the fluorescent lamps
- Close the rear panel of the housing

Note:

Always use high-quality tubes with the same wattage. Test the illumination.

Caution : High voltage ! Only change the fluorescent lamps when the complete system is free from current.

4.2 Cleaning the Display

Cleaning the matrix module: Blow onto the dot side of the matrix board with a compressed-air gun from a distance (depending on the pressure) and from various directions. Remove small threads and splinters with a pair of tweezers.

Cleaning the screen: Always use a clean, soft and non-fluffy cloth for cleaning to avoid scratching the screen. Use a damp cloth first when the screen is very dirty and then wipe it dry. Wipe on a film cleaner with a soft cloth to avoid extreme static charging which leads to premature screen dirtying.

5 General Troubleshooting

Look through the following fault descriptions for the error that has occurred or read the Section on error diagnostics on the display computer. Please contact us when you do not find the fault in the list. It is assumed that the system to be tested has already functioned or that at least one error-free vehicle of the same type exists. Otherwise the fault could one of the following errors:

- system wrongly configured
- software error
- wiring principally wrong

It is recommended to send a short fault description with devices returned to LAWO in order to avoid damage to the newly fitted part.

- Display appears inverse.

* Wrong software configuration.
* Wrong computer address.

- A dot (display pixel) does not rotate

* In most cases, 'dirtying' of the bearing in which the axle journal of the bistable elements is located and rotates is the reason for dots not rotating. This dirtying is caused by larger, whirled up dust particles, threads from cleaning cloths etc. The fault can be cleared by removing the bistable element and using compressed air to clean the bearing as well as wiping the axle journal of the element. An additional running in of the unit is also necessary.
* Coil defective
* Cold soldering joint

- Several dots do not rotate.

* In most cases, 'dirtying' of the bearing in whichthe axle journal of the bistable elements is located and rotates is the reason for dots not rotating. This dirtying is caused by larger, whirled up dust particles, threads from cleaning cloths etc. The fault can be cleared by removing the bistable element and using compressed air to clean the bearing as well as wiping the axle journal of the element. An additional running in of the unit is also necessary.
* Check whether the fault appears as a cross, i.e. a vertical and a horizontal line. A diode is defective on the rear side at the intersection or has shorted with the diode next to it.

- A pixel line does not rotate on the complete display.

* Remove a flat conductor cable from a functioning display and swap it sequentially for those in the defective display.
* Separate all flat conductor cable connections on the boards. Connect the boards one after the other to the flat conductor cable connected to the display computer. Depending on the fault, check the diodes in one column or line for short-circuits when the fault only occurs on one board.

* Swap the board or position the first one to show a fault behind it. Numbering at the rear of the display is from the left to the right.

* Swap the printed circuit board or position one behind it which then sits, electrically, in front of the one showing the fault. Numbering at the rear of the display is from the to the right.

- A pixel line does not rotate on part of the display

* Remove a flat conductor cable from a functioning display and swap it sequentially for those in the defective display.

* Separate all flat conductor cables connections on the boards. Connect the boards one after the other to the flat conductor cable connected to the display computer. Depending on the fault, check the diodes in one column or line for short-circuits when the fault only occurs on one board.

* Swap the board or position the first one to show a fault behind it. Numbering at the rear of the display is from the left to the right.

* Swap the printed circuit board or position one behind it which then sits, electrically, in front of the one showing the fault. Numbering at the rear of the display is from the left to the right.

- A pixel column does not rotate on the display

* Remove a flat conductor cable from a functioning display and swap it sequentially for those in the defective display.

* Separate all flat conductor cable connections on the boards. Connect the boards one after the other to the flat conductor cable connected to the display computer. Depending on the fault, check the diodew in one column or line for short-circuits when the fault only occurs on one board.

* Swap the board or position the first one to show a fault behind it. Numbering at the rear of the display is from the left to the right.

* Swap the printed circuit board or position one behind it which then sits, electrically, in front of the one showing the fault. Numbering at the rear of the display is from the left to the right.

- A board is defective

* Swap the board or position the first one to show a fault behind it. Numbering at the rear of the display is from the left to the right.

* Swap the printed circuit board or position one behind it which then sits, electrically, in front of the one showing the fault. Numbering at the rear of the display is from the left to the right.

- Wrong displays appear

* Wrong software configuration.
* Wrong computer address.

- Text is not centred across the whole display area

* Wrong software configuration.
* Wrong computer address.

- Destinations not displayed

* Check the LED displays on the display computers (see the description of display computers (master and slave computers)).
* Yellow/black test with the S2 button on the monomaster computer: Check data lines when OK (the display computer receives no data from the control unit).
* No data loaded.
* Swap the display computer.
* Remove a flat conductor cable from a functioning display and swap it sequentially for those in the defective display.

- Display shows a text that should appear on a different display.

* Wrong computer address.

6 Software

The standard version includes an operating program to be loaded per card. The operating software is set by a configuration file in the destination memory. Standard data records are telegrams defined according to VDV : DS001, DS003, DS020 with reply DS120. Other data records can be programmed on request: DS003a, DS003b, DS021 amongst others.

Edit procedure:

The TED®PLUS editor is available to enter destinations and route numbers. TED®PLUS is a very comfortable editor that supports free positioning of text components, frames, underlining, italics (only with resolutions above 19 dot height), WYSIWYG principle, icon and window interface. Minimum system requirements: PC386, DOS5.0, hard disk 3MB, 1MB extended memory, mouse, 1 free serial port (com1/com2), 1 printer port (parallel), standard VGA colour monitor.

Data telegrams to test the display as it could be sent from a laptop via a V24/IBIS converter:

Testing the reply circuit: IBIS telegram DS201 (aVHFP) requests a reply telegram DS1201 (aV6CFP).

Testing the display: New data records not recorded in the VDV front trigger the display to the following reaction.

aTHZFP

'a'	-	Telegram designation Display	
'T'	-	Extended telegram designation Test	
H='0..?'	-	'0'	= all displays
		'1'..'?'	= display address
Z='0..3'	-	'0'	= complete display to black
		'1'	= complete display to light (yellow)
		'2'	= chessboard pattern
		'3'	= chessboard pattern inverse
		'9'	= yellow/black test alternately
FP		CR + parity according to IBIS	

6.1 Control Unit Status Inquiry

A control unit according to the IBIS standard sends status inquiries every 10 seconds across the IBIS vehicle bus to all displays configured which must then reply within a time-out interval. This serves as failure control for all display computers.

This is also possible without restrictions on the monosystem. The monomaster computer checks the function of all connected slave computers cyclically via the monobus and maintains an internal list of functional computers. When a status inquiry is now received from the control unit via the IBIS vehicle bus, the master computer checks whether a functional computer is entered under the respective address. It sends a status reply back to the control unit when this is the case otherwise it does not send a reply.

This is why the display addresses in the monosystem must not overlap (see Section 7) with those for other displays on the IBIS bus . In such cases, several status replies would be sent for one status inquiry, which is bound to lead to errors in the status display of the IBIS control unit.

6.2 IBIS Download

All destination data in the monosystem can still be edited with the TED®PLUS editor and loaded to the monomaster computer with the IBIS download device. The monomaster computer then receives data for all the addresses that were configured in the monosystem.

Here again it is very important that the addresses within the monosystem do not overlap the addresses of other displays on the IBIS bus when all displays are to be provided with data using the IBIS download.

The monomaster computer can still handle the 4-baud rates of the older download device as well as 28200 baud (only with PC download).

The Flash memory used to hold the data has the disadvantage that it can only be cleared in blocks. This is why it is not possible to realise the highly flexible storage management as in the previous download to the display computers using RAM memory. This is why the monosystem always loads **all** data to the computer during a download. When character sets are used in several displays in the monosystem, these are only loaded once into the monomaster computer per download.

6.3 Loading the Display with the Memory Card

6.3.1 Card Type

The requirements for the generally used card type are defined as follows:

- PCMCIA/JEIDA standard
- 68 pins
- SRAM technology
- (max.) access time 200ns
- without attribute memory
- Storage capacity >= 128 Kbytes

The PCMCIA cards can be ordered from LAWO with the following order numbers:

- PCMCIA cards with 128 Kbytes storage - QVP-S-0E128
- PCMCIA cards with 512 Kbytes storage - QVP-S-0E512

6.3.2 Handling PCMCIA Cards

- Avoid high temperatures and direct sunlight.
- Do not bend the cards and avoid extreme impacts.
- Keep the cards dry.
- Never touch the contacts.
- Keep away from fire. (risk of explosion)
- Install the battery according to the instructions. (see illustration on the card)
- Change the battery at least every 5 years.

6.3.3 Using the Card for the First Time

You can ignore this point when you have received the card direct from LAWO because all the cards delivered byLAWO are already formatted and include the boot program (card loading software on the card).

The card must first be formatted with the format program delivered with your drive, e.g. 'TCFORMAT D:' ('D:' is the drive name for your card drive and can vary depending on the PC configuration). Copy the LAWO card software from the delivered LAWO floppy disks to your hard disk if you have not already done this. Copy the data into the directory with your destination data (e.g. 'TED®PLUS '). Switch to the directory with the destination data created with TED®PLUS (e.g. CD\TED®PLUS). Edit the file 'CARD.CFG' with a DOS or the Norton editor and enter the drive name (without a colon) for your card drive under CARDDRIVE. Save the data when leaving the editor. Start the program 'MCD' (MCD.EXE) and select Menu item 4. Answer the questions after you have carefully read the screen contents. Your card is now prepared for the LAWO card loading system .

6.3.4 Loading the Card on a PC

Please remember that only either the operating program or destination data for one bus type can be loaded on one card. A bus type is a group of buses with the same display type (resolution, i.e. front 16x126, side 13x28 + 16x112, rear 13x28). A further bus type must be managed as soon as just one bus display varies (i.e. in the rear).

Start the program MCD ('MCD.EXE').

Loading destination data:

Select Menu item 1, the TED®PLUS data (destination, configuration and character sets) are prepared for the monosystem. After answering the security prompt with 'J', select the bus type to be copied to the card. The data are now copied (in max. 5 seconds). Label the card with the bus type name that you loaded!!! Repeat this sequence for each bus type. You can view the card contents with Menu item 2.

Loading the operating program for the monomaster computer

This is only necessary when you receive a new operating program per floppy disk (or modem) from LAWO. Select Menu item 3, select the program that must be entered in the file 'CARD.CFG' (normally only one present) to be copied to the card. Label the card with 'PROGRAM' because only the operating program is on this card (and no destination data)!!! You can view the card contents with Menu item 2.

6.3.5 Loading the Display with the Card

First edit the destination data as usual with TED®PLUS . Then call the program 'mcd.exe' which prepares the data provided by TED®PLUS and writes them to the card under menu control.

The program 'mcd.exe' can also be used to write the operating program to the card. The data can then be easily transferred, with the supply voltage switched on, by inserting the card in the card adapter of the master computer (mainly in the front display). A three-coloured LED provides the following information on the load status:

LED is yellow: Data are being loaded to the computer

LED is green: The load process is successfully completed, the card can be removed.

LED blinks red: An error has occurred. It is possible that the data have not been loaded correctly. A blink code shows the error type. The monosystem returns to operation after the card has been removed

6.3.6 Error Messages During Card Download

Notes and/or error messages that the load program outputs usning 'blink codes' (red LED) on the card LED follow. When a message is necessary, the LEDs on the display computer, 1 red and 2 yellow LEDs, have special significance. The green LED has no significance. These three LEDs serve to identify the message exactly.

Card LED **- RED -** Blink code value	Note / Error message	Computer LED status red	yellow	yellow	green
2	Set bus type has been overwritten	off	off	off	X
3	No data found for computer	off	off	off	X
4	General error in command file (*.LAWO)	off	off	off	X
4	Command file not found	off	off	on	X
4	Unexpected number of parameters in command file	off	on	off	X
4	Unknown parameter in command file	off	on	on	X
4	Command file too large	on	off	off	X
4	Read error in command file	on	off	on	X
5	Checksum error in a file	off	off	off	X
5	Form header error in a file	off	off	on	X
5	Read error during card access	off	on	off	X
6	File not found	off	off	off	X
7	No operating program present	off	off	off	X
8	Unknown computer type	off	off	off	X
10	Not enough memory available on computer	off	off	off	X
11	Memory component defective	off	off	off	X
12	Operating current too low	off	off	off	X
15	General, unspecified error	off	off	off	X