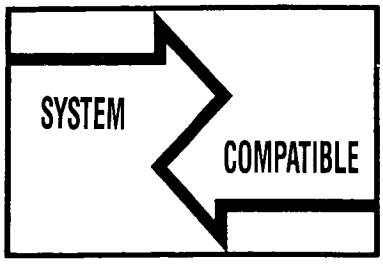

RS232-C/V24 Interface for Digital Storage Oscilloscope PM3350 or PM3352

PM8958

Instruction Manual

4822 872 03335
880104

I&E

Industrial & Electro-acoustic Systems Division

PHILIPS

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Electro-acoustic Systems

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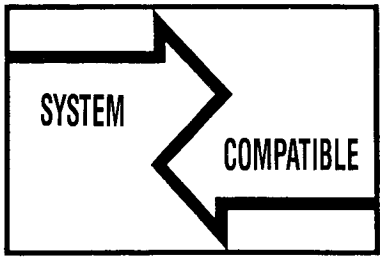

RS232-C/V24 Interface for Digital Storage Oscilloscope PM3350 or PM3352

PM8958

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NOTE: The design of this interface is subject to continuous development and improvement. Consequently, this instrument may incorporate minor changes in detail from the information contained in this manual.

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CONTENTS

1. INTRODUCTION

This interface is a general purpose bus interface according to the RS232-C/V24 document by which the oscilloscope is adapted to make communication possible with other RS232-C/V24 compatible measuring instruments.

For more detailed information about the bus system refer to the PHILIPS INSTRUMENTATION SYSTEMS "REFERENCE MANUAL" 9499 997 00411.

2. INSTALLATION INSTRUCTIONS

2.1 INITIAL INSPECTION

Check the contents of the shipment for completeness and note whether any damge has occured during transport. If the contents are incomplete, or there is damage, a claim should be filed with the carrier immediately, and the Philips Sales or Service organisation should be notified in order to facilitate the repair or replacement of the instrument.

The following parts should be included in the shipment:

- 1 plug-in printed circuit board
- 1 flatcable with connectors and screws
- 1 instruction manual

2.2 REMOVING THE INSTRUMENT COVERS

WARNING: The removal of covers is likely to expose live parts, and also accessible terminals may be live. The instrument shall be disconnected from all voltage sources before any installation during which the instrument will be opened.
If afterwards any adjustment, maintenance or repair of the opened instrument under voltage is inevitable, it shall be carried out only by a qualified person who is aware of the hazards involved. Bear in mind that capacitors inside the instrument may still be charged even if the instrument has been separated from all voltage sources.

- Switch the power ON/OFF pushbutton switch to OFF.
- Disconnect the oscilloscope from the mains supply.

The instrument is protected by two covers: a top cover and a bottom cover. To remove these covers, proceed as follows:

- Slacken the two screws that secure both covers, located at the rear of the instrument.
- Gently push each cover backwards until it can be lifted.
- The covers can be removed by lifting them clear of the instrument.

2.3 INSTALLING THE P.C.B. AND THE CABLES

For installation of the printed circuit board and the cables, see also figure 2.1. Proceed as follows:

- Unscrew the screw that fix the mains cord to the rear of the chassis.
- Break out the cut-out for the RS232-C socket at the rear of the instrument.
- Take the P^2CCD unit and the time base unit out of the instrument.
- Unlock the two mains wires on the metal plate and take out the metal rear plate.
- Install the RS232-C connector with flat cable by shifting the flatcable through the hole reserved for this connector.
- Fix the connector with the two screws to the metal rear plate.
- Reinstall the metal rear plate and fix the two earth wires again.

NOTE: Take care to position the flat cable to the correct place. Do not damage this cable when mount the P^2CCD unit and the time base unit again.

- Reinstall the P^2CCD unit and the time base unit.

- Remove the digital unit and take-off the metal cover.
- Insert the RS232-C pcb in slot A11.
- Fix the metal cover and the flat cable connectors again.

NOTE: Take care to connect flat cable A101, that was connected to X97, to the new connector X96 (see also figure 2.1).

- Reinstall the digital unit.

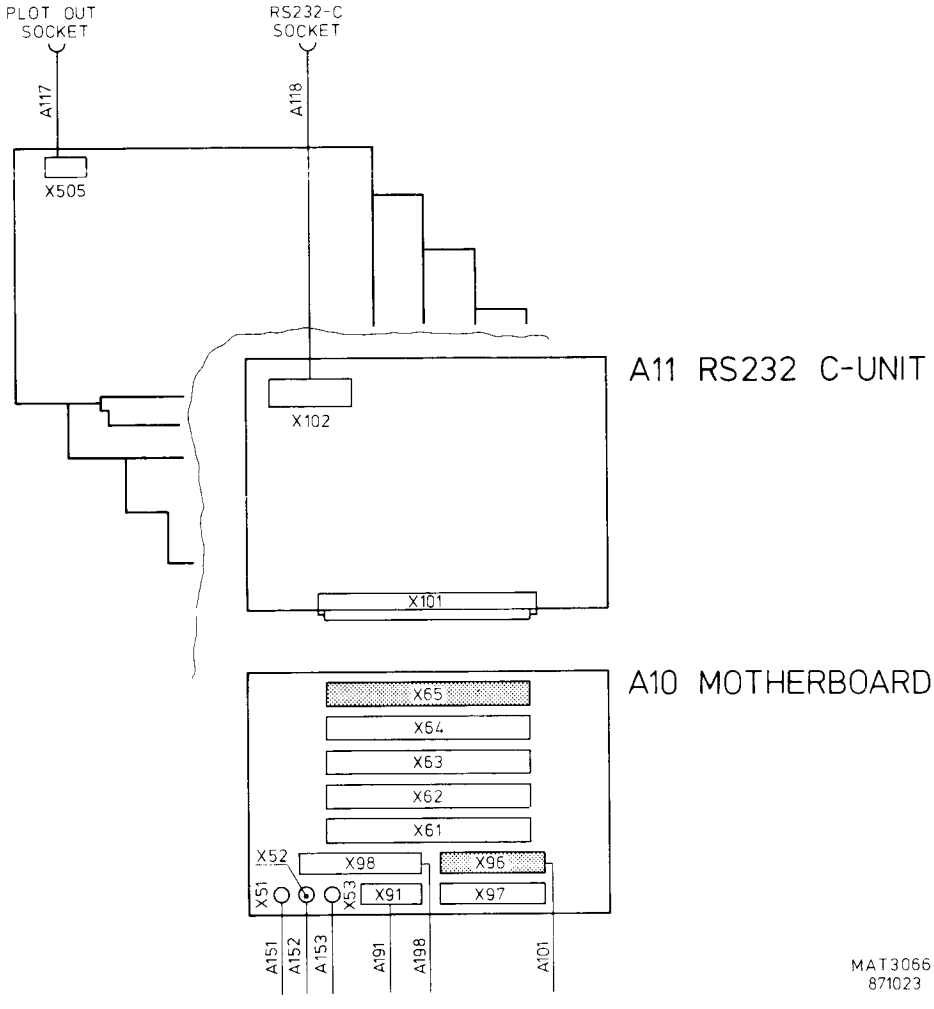


Figure 2.1 Installing the RS232-C unit

2.4 INSTALLING THE INSTRUMENT COVERS

- Reinstall the covers by executing the steps mentioned in section 2.2 in the reversed sequence.
- Connect the peripheral equipment (e.g. a controller) to the RS232-C connector on the rear panel.
- Reconnect the oscilloscope to the mains supply.
- Switch the instrument on.

2.5 SETTINGS OF THE INTERFACE

Various settings should be done via the service menu. Therefore, refer to section 3.2 of this manual.

3. OPERATING INSTRUCTIONS

This chapter outlines the procedures and precautions necessary for operating the additional features, provided by this option.
It identifies and briefly describes the practical aspects of operation to the operator.

3.1 SWITCHING ON

After the oscilloscope has been connected to the mains (line) voltage in accordance with section 3 of the operating manual PM3350 it can be switched on with the power ON/OFF switch on the front panel.

If no back-up batteries are installed and the oscilloscope is switched on, the instrument is set in the SOFTSTART condition.
With back-up batteries installed, the oscilloscope settings at the moment of switching-off are restored and the oscilloscope starts up with the same settings.

3.2 SETTING THE INTERFACE

After switching-on the instrument is set to 1200 baud, no parity, 1 stop bit and 8 data bits, provided that the instrument has no back-up batteries installed.

However this can be changed in the application select sub-menu "RS232" of the oscilloscope. To do so, proceed as follows:

- Press MENU and keep it pressed.
- Press also AUTO SET.
- Now the Service menu has been entered, the LCD should indicate "*".
- Press APPL, which is one of the CRT softkeys; the CRT should indicate "APPLICATION PRESELECT MENU" on the upper left side of the screen.
- Press RS232; the CRT should indicate the RS232 installation menu for baudrate and data.

Now the input baudrate can be set to the following speed: 75, 110, 150, 300, 600, 1200, 2000, 2400, 9600 and 19200.
The output baudrate can be set to: 75, 110, 150, 300, 600 and 1200.

Next the following DATA can be selected:

- PARITY to EVEN, ODD or NO.
- STOP BITS to 1 or 2.
- DATA BITS to 7 or 8.

The same can also be programmed as follows:

- SPL INTERFACE,INTF RS232_IN.Ø,BAUDRATE XXXX	input baudrate
- SPL INTERFACE,INTF RS232_OUT.Ø,BAUDRATE XXXX	output baudrate
- SPL INTERFACE,INTF RS232_IN.Ø,PARITY XXXX	input parity
- SPL INTERFACE,INTF RS232_OUT.Ø,PARITY XXXX	output pariry
- SPL INTERFACE,INTF RS232_OUT.Ø,STOP X	output stop bits
- SPL INTERFACE,INTF RS232_IN.Ø,DATA X	input data bits
- SPL INTERFACE,INTF RS232_OUT.Ø,DATA X	output data bits

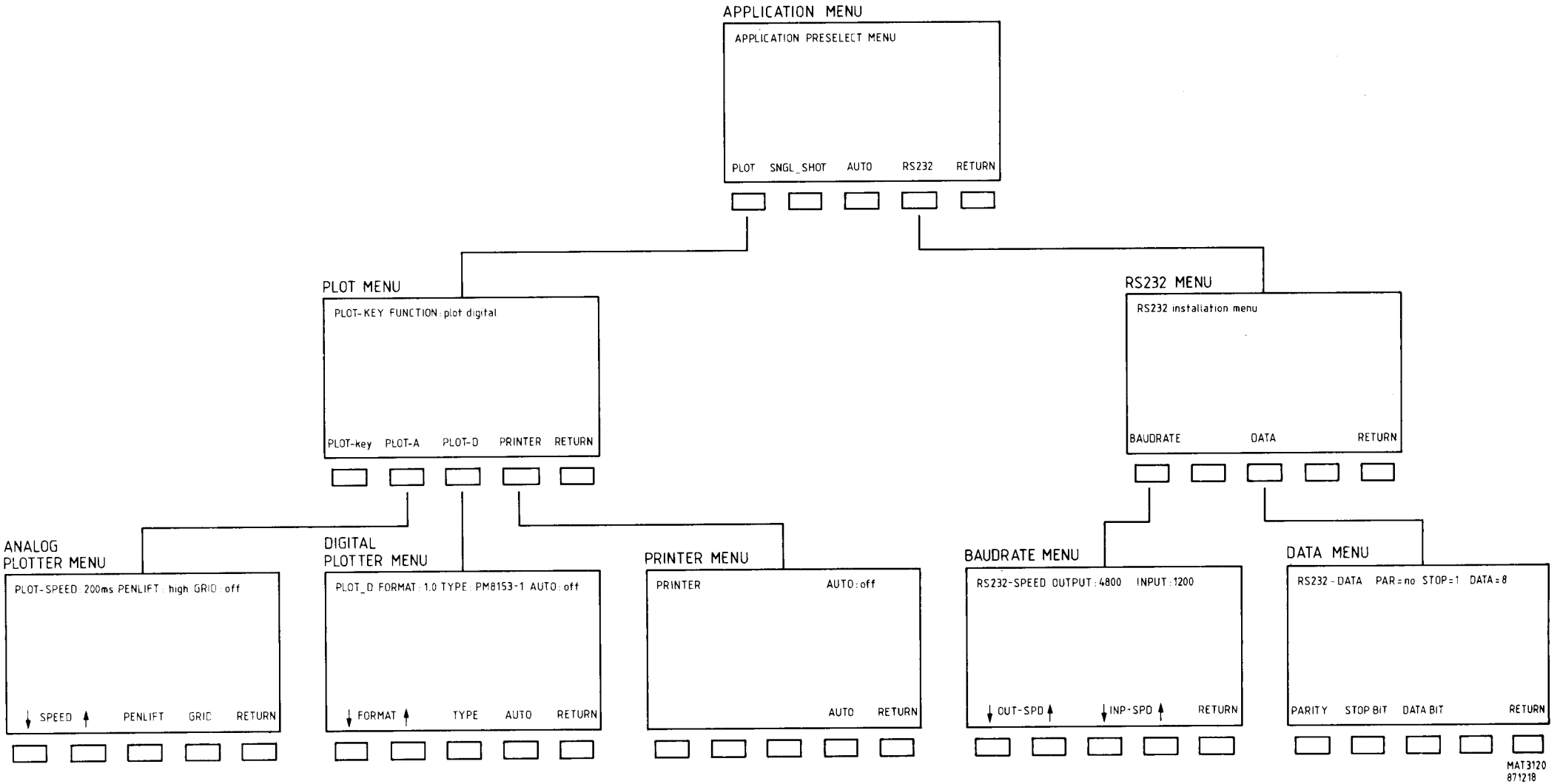


Figure 3.1 Application menu structure

3.3 DIGITAL PLOT AND PRINTER MODES

The oscilloscope functions are now extended with DIGITAL PLOT and PRINTER modes. Both modes are split-up into screen plot (printer) and auto screen plot (printer) mode.

After switching-on the instrument is set to the analogue plot condition, provided that the instrumenthas no back-up batteries installed. Then the data for analogue plot is present on the ANALOGUE PLOT OUT socket.

However this can be changed in the application preselect menu "PLOT" of the oscilloscope. To do so, proceed as follows:

- Press MENU and keep it pressed.
- Press also AUTO SET.
- Now the Service menu has been entered, the LCD should indicate "APPLICATION PRESELECT MENU" on the upper left side of the screen.
- Press PLOT; the CRT should indicate the plot key function. This function can be changed between PLOT ANALOGUE, PLOT-DIGITAL and PRINTER by means of the CRT function softkey "PLOT-KEY".

Note that the information for the PLOT-DIGITAL and PRINTER are present on the RS232-C output socket at the rear of the oscilloscope.

NOTE: 1. To assure a good plotter-oscilloscope initialisation, first switch-on the plotter and then the oscilloscope in sequence. Also use this way of initialisation when you change the plotter language (HPGL-Philips and visa versa).

2. When for some reason the interface initialisation went wrong and the interface is blocked, a message
**********DIGITAL PLOT ERROR**********
is displayed on the screen of the oscilloscope. In this case:
   - Re-initialise the oscilloscope (switch off/on).
   - Check the cable connections to your plotter or printer.
   - Check the interface parameter settings.
   - Check the plotter (printer) interface selection.

3.3.1 Digital plot specification

Pressing the PLOT softkey activates the digital plotter and the PLOT segments on the LCD will light-up. During the plot action the text DIGITAL PLOTTER ACTIVE is visible on the bottom side of the screen. Pressing the PLOT softkey another time stops the plot action. The LCD shows also the progress of the plot action by means of a lightning segment of the DISPLAY PART.

Plotters:

Different plotter types can be selected in the PLOT-D menu.
These types are:

- PM8153/1
- PM8153/6
- PM8154
- PM8155
- HP7475A
- HP7550

Plotter pens:

- Pen 1 is used for the data of channel A.
- Pen 2 is used for the data of channel B.
- Pen 3 is used for the data of register A.
- Pen 4 is used for the data of register B.
- Pen 5 is used for the text and the graticule.

Text:

Both text lines as displayed before the text DIGITAL PLOT ACTIVE is visible, are always plotted. For this pen 5 of the plotter is used.

Plot format:

The data plot area is 8 div. (H) x 10 div. (W).

NOTE: Full size plotting is not possible for the PM8154 plotter.

The plot format (including text) can be changed via menu PLOT-D with a multiplication factor. With a factor of 1.0, each division is 1 cm (H) x 1 cm (W). This factor has a range of 0.5 ... 2.0 with a resolution of 0.1

When AUTO OFF (screen plot mode) has been selected in the PLOT-D menu, the oscilloscope will return to its previous condition after completing the plot action.
But when AUTO ON (auto screen plot mode) has been selected, the instrument will perform a new single shot each time that a previous plot action has been completed.This means also that the instrument will then start a new plot action.

3.3.2 Printer specification

ATTENTION: This specification is only valid for EPSON FX80 printers or compatibles.

Pressing the plot softkey activates the printer and the plot segments in the LCD will light-up. During the print action the text "PRINTER ACTIVE" is visible on the bottom side of the screen. Pressing the plot softkey another time stops the print action. The LCD displays also the progress of the print action by means of a lighted segment of the DISPLAY PART.

Text:

Both text lines as displayed before the text "PRINTER ACTIVE" is visible, are always printed.

Print format:

The data print area is 8 div. (H) x 10 div. (W) and each division is 1 cm.

When AUTO OFF (screen print mode) has been selected in the PRINT menu, the oscilloscope will return to its previous condition after completing the print action.
But when AUTO ON (auto screen print mode) has been selected, the instrument will perform a single shot each time that a previous print action has been completed. This means also that the instrument will then start a new print action.

4. CHARACTERISTICS

4.1 ELECTRICAL SPECIFICATIONS

Characteristics	Specification	Additional information
* Type of interface	RS 232-C	
* Connector	RFI/EMI	25-pole male connector according MIL-C-24308
* Bus drivers:		
Data circuits		
- Spacing "0"	$\geq$ +3 V	TxD and RxD lines
- Marking "1"	$\leq$ -3 V	
Control circuits		
- ON	$\geq$ +3 V	RTS, CTS, DSR and DTR lines
- OFF	$\leq$ -3 V	
Current output	$\leq$ 10 mA	
Impedance		
- Output	300 ohm	
- Input	$\geq$ 3 kiloohm $\leq$ 7 kiloohm	
Voltage		
- Output	-7 V...+7 V	
- Input	-25 V...+25 V	
* Interfacing function		
Repertoiry:		
software	XON/XOF	
Baud-rate		
- transmitting	75, 110, 150, 300 600, 1200, 2000, 2400, 4800, 9600 19200	Receive and transmit separately selectable via Service menu
- receiving	75, 110, 150, 300 600, 1200,	Receive and transmit separately selectable via Service menu
Number of STOP bits	1 or 2	
- Parity	odd, even or no	
- Character length	7 or 8	
Transmission mode	Asynchrone, full duplex	

Characteristics	Specification	Additional information
Handshake		
- Software	XON/XOF	
- Hardware	DSR/DTR and CTS/DTR	
- Serial Poll	ESC 7	ESC is HEX 1B or Decimal 27
- Go to Remote	ESC 2	
- Go to Local	ESC 1	
- Device Clear	ESC 4	
- Device trigger	ESC 8	
* Front panel control		
Modes:	Local	Front panel exclusively under manual control Remote LCD: off
	Remote locked	Front panel exclusively under RS 232-C Remote LCD: on
Pushbuttons:	Command and question	Except ON/OFF switch
Cont. controls:	Command	Except CRT controls, variables and x-position
- Y-position	Centre: 0 Resolution: 16348	
- Level	Centre: 0 Resolution: 16348	
Probe identity:	Question only	
* Text-on crt control	Command and question	
Modes:	Text only Text combined with: Signal trace Settings read-out Cursors or channel identification	
Number of pages:	1	
Number of lines per page:	2	
Numbers of char. per page:	40	Including blanks

Characteristics	Specification	Additional information
* Cursor control	Command	Cursor read-out automatically updated when cursors are set by IEEE 488 bus
	Question	Cursor position can be sent to controller
Resolving power:	1 : 4096	Absolute setting on screen (4000 equals 10 divisions horizontal)
Fully to the right of graticule at	4000	
Fully to the left of graticule at	0	Full memory 4095
Centre of graticule	2000	Mid-memory 2048
* Digital plot		Plot action is indicated on the screen
Instruments covered	PM8153/1 PM8153/6 PM8154 PM8155 HP7475A HP7550	
Plot modes	Screen Auto screen	
Numbers of used pens	5	
Plotted text	displayed text	
Format	0,5x ... 2x	1x equals 1 cm x 1 cm
* Printer		
Instrument covered	FX 80	
Print modes	Screen Auto screen	

4.2 MECHANICAL SPECIFICATIONS

For RS232-C interface a 25-pole connector is used (see figure 4.1).

Connector requirements:

- The instrument is provided with a plug-type connector (male).
- The cable is provided with receptacle connectors (female).
- The number of contact pins on the connector is 25.
- Locking screws are provided to enable cable mounting.
- The connector meets the military specification MILC-24308 or equivalent.

Cable requirements:

- The cable shall be as short as possible.
- The cable length may not exceed 15 meters.

However, where a longer cable is required, the total capacitance may not exceed 2500 pF.

- The cable will be a "null modem" cable. A null modem cable implies that the wire links between the pins needed to connect two DTEs are provided within the cable (e.g. pin 2 connected to pin 3 of the other terminal).

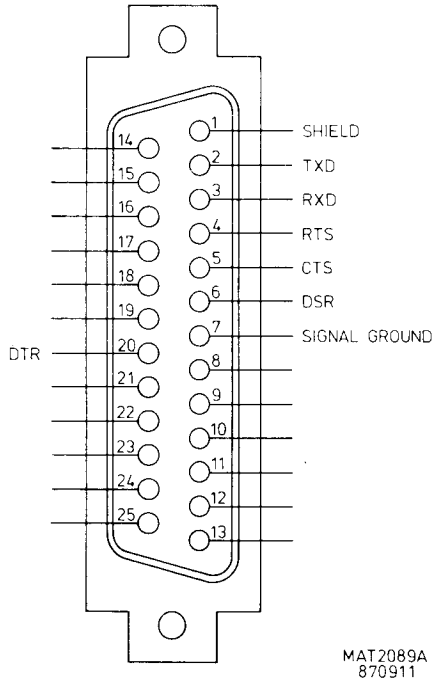


Figure 4.1 RS232-C connector

5. DESCRIPTION OF RS232-C/V24 INTERFACE

5.1 INTRODUCTION

The serial interface described in this section is primarily intended to interconnect measuring instruments with other instruments to form a measuring system. A number of disciplines are already laid down for serial interfaces, but these disciplines mainly relate to interchanges between data terminal equipment (DTE) and data communication equipment (DCE). For measuring systems, the serial interfaces referred to must be regarded as connecting data terminal equipment to another DTE. As a consequence, these former disciplines and procedures are not always valid for measuring systems and modifications may be necessary as outlined in this chapter.

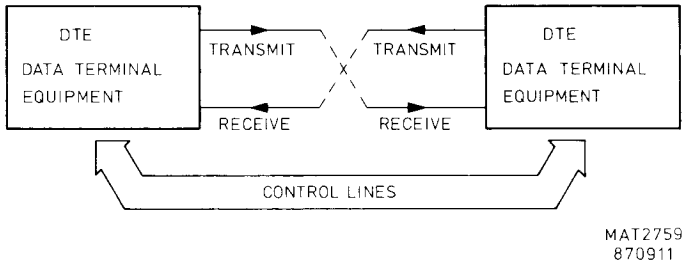


Figure 5.1 Typical configuration in measuring systems

5.2 DEFINITION OF THE RS232-C INTERFACE

The V24 interface is based on the CCITT-Standard V24,28 giving specified signal characteristics for connecting data terminal equipment (DTE) and data communication equipment (DCE). V24 gives the functional specification of the circuits, whereas V28 specifies the electrical compatibility. The standard ISO 2110 assigns connector pin numbers to the circuits. All these documents are covered by the American Standard EIA-RS232-C except for the interchange circuit identification.
The mode of data transfer is digital, using the bit serial, byte serial method, over one signal line with common return.

5.3 DATA TRANSMISSION

For efficient data transfer, the following characteristics must be considered.

5.3.1 Synchronization

To enable correct detection of characteristics received, some synchronization between transmitter and receiver is necessary. This is achieved by adding framing information to the data (ISO 1177).
For the oscilloscope asynchronous data transfer is used.

Asynchronous formatting is mostly used for measuring systems; common for low speed applications. It adds framing information bits to each data character.
Framing information is one start bit preceeding a data character and one or two stop bits following it.

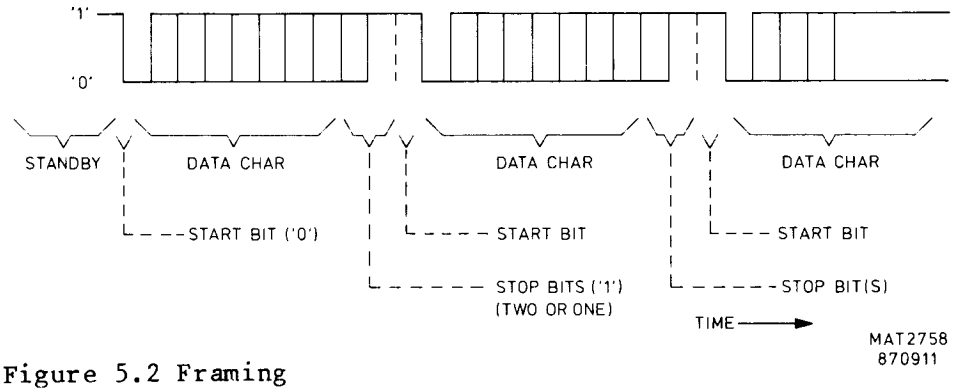


Figure 5.2 Framing

Interfaces operating at speeds up to 1200 baud normally use two stop bits; those operating above this speed normally use one stop bit. In the "standby" state, when no characters are ready to be transmitted the transmit line is held in the logical "1" state.
In asynchronous transmission mode, the even parity is the default value.

5.3.2 Character length

Different character lengths are possible. In measuring systems, 7 or 8 bit lengths are typical and are often switch-selectable. The character length excludes parity, start and stop bits. Normally, the ISO 7-bit code (ASCII equivalent) is used, the 8th bit being used for the parity. The least significant bit (LSB) is sent first.

5.3.3 Baudrate

The speed of the data transmission is specified in bits/sec by the baud rate, which must be selected to apply both to the transmitter and the receiver.

Baudrates in use are:

75, 110, 150, 300, 600, 1200, 2000, 2400, 4800, 9600, 19K2 baud (bits/sec).

5.3.4 Interface transmission modes

A serial interface is said to operate in a simplex mode or a duplex mode depending on whether it can handle data transfer in one or both directions.

This interface handles data transfer in both directions; i.e. it can transmit and receive (Full Duplex mode).

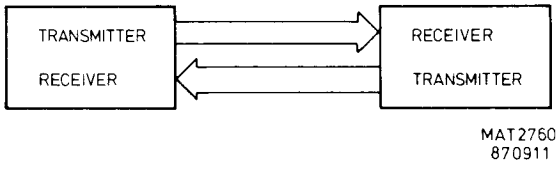


Figure 5.3 Transmission modes

Full duplex means that:

- The interface can handle data transfer in both directions simultaneously.
- Transmitted data is assumed to be returned via the receive line (echoing).

5.4 SPECIAL INTERFACE FUNCTIONS

This section deals with a number of protocols that are not standarized in V24,28 documents, but are applied to instruments equipped with a serial interface.

5.4.1 Service request and serial polling

The service request and serial poll protocol were originally developped and intended for IEC interfaces, but its application has been extended to serial interfaces. This section deals with the implementation of the protocol for serial interfaces in Philips test and measuring instruments.
Serial interfaces do not provide a dedicated service request interrupt line. This means that the facilities for service request in devices equipped with these interfaces are somewhat restricted.
If a not masked reason for service request exists, the RQS-bit in the status byte indicates that service is required; if the reason to request for service is masked, the RQS-bit is not set. In any case, the reason may be specified in other bits of the status byte.
A controller operating with devices via serial interfaces can periodically poll the devices to check whether service is required or not.
The controller executes a serial poll by sending the interface message ESC7 (1/B, 3/7) to a device. Upon receipt of such a poll command, the device will respond by transmitting the ASCII equivalent of the status byte. If the oscilloscope status is LOCAL, an ESC7 should be terminated with an SPR. The oscilloscope will put the status word on the bus immediately after the receipt of the SPR.
If the oscilloscope status is REMOTE, an SPR is not necessary;, the status word will be put on the bus immediately after the receipt of ESC7. Example:

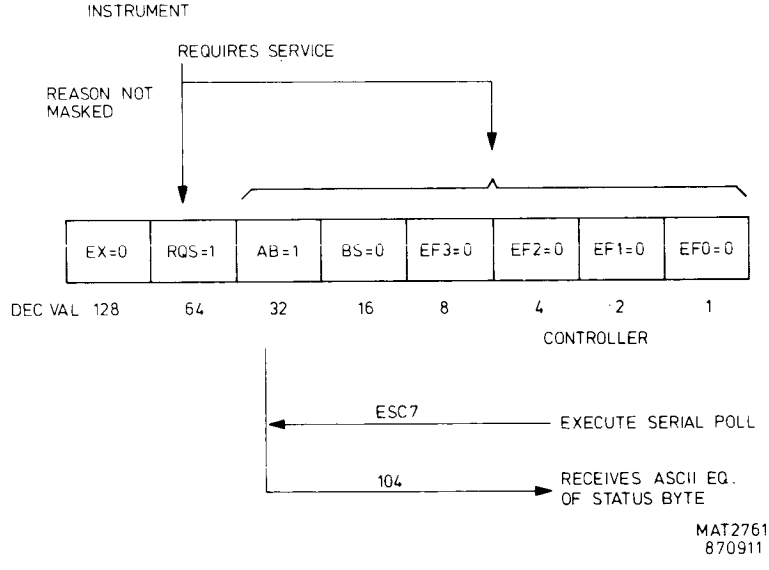


Figure 5.4 Serial poll action

The status word can have a few different values:

Ø : nothing of interest is happening.
1 : programming error.
4 : valid data is on the bus (used during transfer).
8 : input buffer full.
16 : the oscilloscope is busy with a programmed measurement.
32 : something is wrong : ABNORMAL.
64 : the oscilloscope has an active service request.

There can also be a combination of these basic values.

Possible values of the status word for this instrument are given below:

65 : Service request with CRT softkey 1 pressed or released.
66 : Service request with CRT softkey 2 pressed or released.
67 : Service request with CRT softkey 3 pressed or released.
68 : Service request with CRT softkey 4 pressed or released.
69 : Service request with CRT softkey 5 pressed or released.
97 : Programming error.
100 : Data ready to be transferred.
104 : Input buffer of oscilloscope full (only in case that no separator is received).

5.4.2 Remote local protocol

This protocol was also originally intended for application with IEC interfaces; but extended to serial interfaces. This section deals with the implementation for serial interfaces for Philips test and measuring instruments.
The following possibilities exist for devices equipped with a serial interface and provided with a remote local interface function.

Local to Remote:

A transfer from the local to the remote state can only be performed by a controller by sending the interface message ESC2 (1/B, 3/2). Upon receipt of this "Go to remote" message, an instrument will unconditionally go into the remote state.

Remote to Local:

A transfer from the remote to the local state can be performed either by the controller or by the device in the following ways:

the controller sends:
ESC1 (1/B, 3/1) Go to local
or ESC3 (1/B, 3/3) Go to local and unlock

the device sends (only if unlocked):
return to local (RTL=1)

After power on, the remote local function is always in the local state.

5.4.3 Device clear

Instruments equipped with a serial interface and provided with a device clear function, execute this function on receipt of the interface message ESC4 (1/B, 3/4) i.e. device clear. The device clear function returns the device function to a predetermined state.
Interface settings (e.g. block separator) and local/remote status are not affected.

5.4.4 Device trigger

Instruments equipped with a serial interface and provided with a device trigger function, execute this function on receipt of the interface message ESC8 (1/B, 3/8) i.e device trigger.
The trigger starts a predetermined device action.

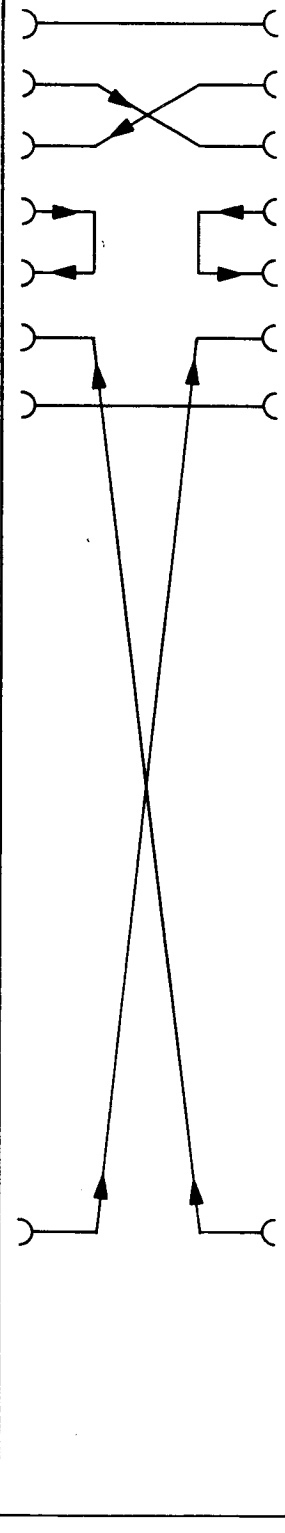
Pin no.	CCIT V24 circuit	RS232-C eq.	CCITT-V24 descr. For DTE-DCE	Cable connection DTE DTE
1	101	AA	Protective ground	
2	103	BA	Transmitted data (TxD)	
3	104	BB	Received data (RxD)	
4	105	CA	Request to send (RTS)	
5	106	CB	Ready for sending (CTS clear to send)	
6	107	CC	Data set ready (DSR)	
7	102	AB	Signal ground	
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20	108.2	CD	Data terminal ready (DTR)	
21				
22				
23				
24				
25				

Figure 5.5 Pin and circuit allocation

6. PROGRAMMING AN OSCILLOSCOPE

6.1 DESCRIPTION OF POSSIBLE ACTIONS

The interface is capable to carry out the following actions:

SYSTEM FUNCTIONS:

- Call for "identity" (IDT).

SYSTEM INTERFACE FUNCTIONS:

- Program a "unit separator" (USP).
- Program a "block separator" (BSP).
- Program a "record separator" (SPR).

SUPER FUNCTIONS:

Front handling (FRO Ø).

- Transfer of frontpanel settings from oscilloscope to controller.
- Transfer of frontpanel settings from controller to oscilloscope.

Register handling (REG Ø or REG 1)

- Transfer of register contents from oscilloscope to controller.
- Transfer of register contents from controller to oscilloscope.

SERVICE REQUEST:

- The oscilloscope can ask for service and will respond with its status word when the controller executes a serial poll.

MULTI-LINE MESSAGES:

- Do a GO TO LOCAL
- Do a GO TO REMOTE
- Do a SERIAL POLL

6.2 TEST INTERFACE DEVICE COMMAND

The interface test is executed by means of the command TSI.
The belonging ASCII-character is "U". This character is represented as 85 in decimal code, 55 in hex. code and Ø1ØØØ1 in binary. This binary bitpattern is sent from the controller via the bus to the RS232-C interface in the oscilloscope.
The RS232-C interface inverts this bitpattern into 1Ø1Ø1Ø1Ø.
Belonging Decimal code is 170 and hex. code is AA. The inverted bitpattern is returned via the bus to the controller. Depending on the type of controller that you use, a certain character will be displayed on the screen. Some controllers may print 170 on their screen. However for the following controllers the result is as follows;

HP85 If test OK: * on screen
Philips P2000C If test OK: └ on screen
Philips P3100 If test OK: ┐ on screen

With the above test, the greatest part of the interface can be tested for correct functioning.

6.3 MESSAGE PROTOCOL FOR OSCILLOSCOPES

6.3.1 Introduction

This section deals with the user friendly messages sent to an oscilloscope or to receive from an oscilloscope via a controller. The basic purpose of the message structure is to provide a flexible tool for moving instructions and/or data into and out of the oscilloscope.

A message record consists of a sequence of one or more message blocks; each message block consists of one or more message units. They are terminated with the record-, block- and unit-separator respectively.

A MESSAGE RECORD IS A SEQUENCE OF SO CALLED MESSAGE UNITS.

- A message unit is the smallest possible sequence of characters (or bytes) constituting a related data set, generated, processed or interpreted as a unit.
- A message block is a sequence of one or more related message units. In practice, the number of characters within a block is restricted.
- A unit consists of two parts. A header and a body.
- Header and body are always separated by a space (SRØ).
- Units can be concatinated in a message.
- Units are always separated with a so called unit separator (SR1).
- Messages can be separated (using a block separator SR2 or a record separator SR3).

```
< HEADER > <  BODY  > < HEADER > <  BODY  > < HEADER > <  BODY  >

        SP        USP        SP        USP        SP        SPR

        SRØ       SR1        SRØ       SR1        SRØ       SR3

  First message unit    Second message unit    Third message unit

                        MESSAGE RECORD
```

Message structure

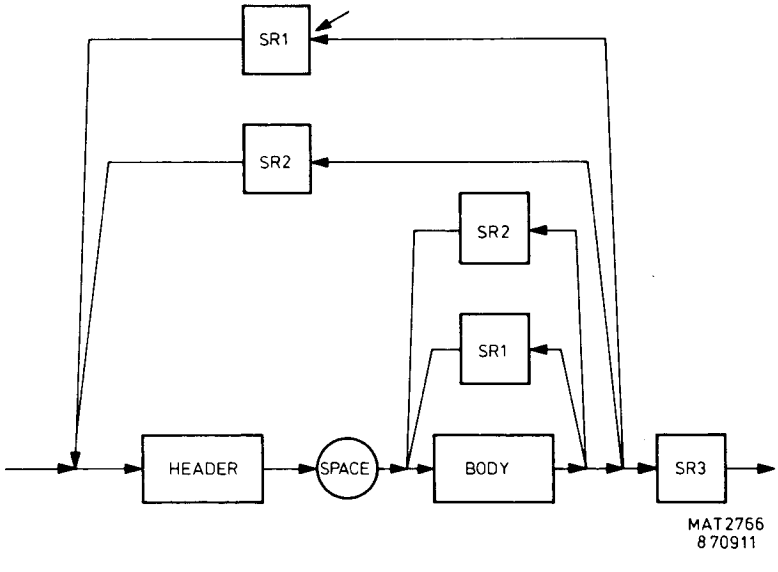


Figure 6.1 Message structure

A message record is a sequence of one or more message blocks constituting the complete device-message. A message begins when a device starts sending data for the first time following a reset or a previously sent record separator; it ends with the record separator.

6.3.2 Separators

Separators are used to distinguish between the various parts in the message, and to mark the several hierarchical levels. In desceeding order of level they are denoted as SR3, SR2 and SR1, for respectively, the record-, block- and unit- separator.

Following separators are used:

TO SEPARATE A HEADER AND A BODY

Indicated as:	SRØ
Preferred: space	
Hexadecimal representation	20
Decimal representation	32

TO SEPARATE TWO UNITS (UNIT SEPARATOR)

The unit separator is used within a block to distinguish between related message units. However, it is quite usual that the header of the next unit implies the unit separator.

Indicated as:	SR1
Preferred: comma	,
Hexadecimal representation	2C
Decimal presentation	44

TO SEPARATE TWO BLOCKS OF UNITS (BLOCK SEPARATOR)

The block delimiter is used within a message to distinguish between message blocks. Also here it is common practice that the header of the next block implies the block separator if a message exclusively consists of blocks that only contain one message unit.

Indicated as:	SR2
Preferred: linefeed	LF
Hexadecimal representation	ØA
Decimal representation	10

TO TERMINATE THE LAST BLOCK TRANSMITTED (RECORD SEPARATOR)

The record separator is used to terminate a message. It indicates that there is no additional information available. In IEEE interfaces the END message is sent (via the ATN and the EOI-lines), concurrent with the NL message on the data bus.

Indicated as:	SR3
Preferred: linefeed + END	LF
Hexadecimal representation	ØA
Decimal representation	10

End activates the EOI interface management line.

6.3.3 Message unit

The message unit consists of:

HEADER indicating the type or quality of the data following in the body. They refer in general to the quantity of the data rather then to units.

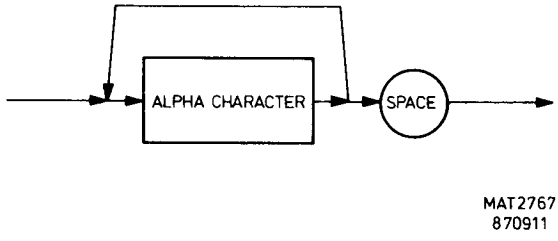


Figure 6.2 Header

- Alpha characters are alpha numerical characters.
- The header defines which function we want to program in an oscilloscope.

BODY containing the data to be transferred. It may represent different data types.

6.4 OSCILLOSCOPE PROGRAMMING

An oscilloscope can be set in the local or in the remote states:

Local state : The operator can control the oscilloscope manually. (REMOTE segment in LCD off).
Remote state: The controller on the bus can control the oscilloscope. (REMOTE segment in LCD on).

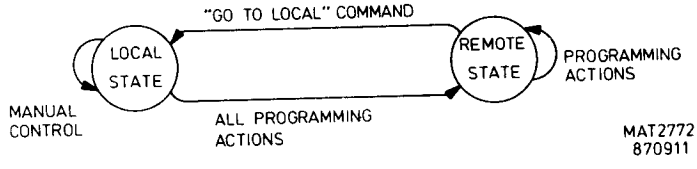


Figure 6.3 Two states of the osciloscope

In the oscilloscope we can devide the REMOTE state into two different states:

Front handling state : Used for programming a new acquisition setting
Register handling state: Used for programming in stored settings and for data transfer. This function is typical for a digital storage oscilloscope.

The way to enter another state is to ask for that state.
However, there are exceptions.

- Coming from the local state, any programming action that is not preceeded by a new state request, is ending up in the front handling state.

Once in a certain state, a transition can only be made when a new state is programmed.

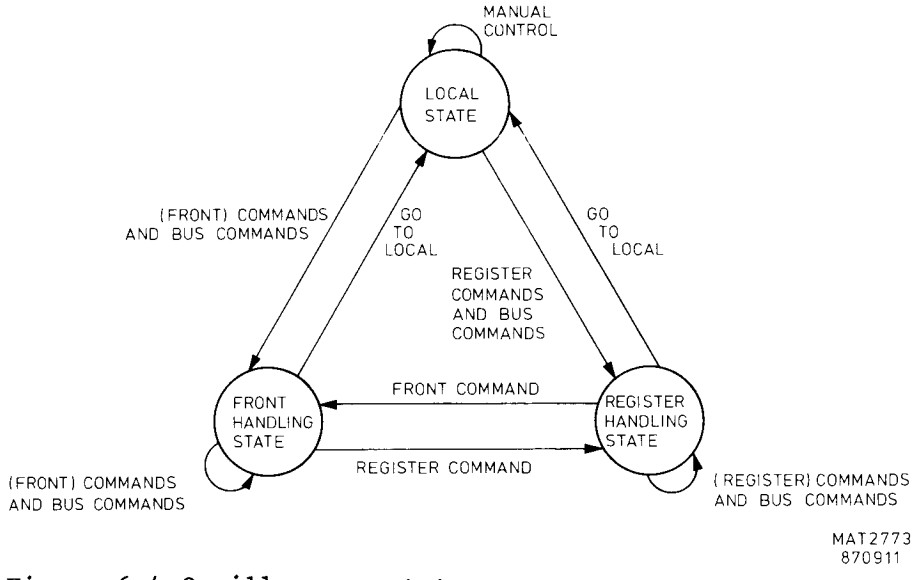


Figure 6.4 Oscilloscope states

Commands between brackets are commands specific for that state.

- In the front handling state, we can change the actual settings of the oscilloscope.
- In the register handling state, we can change the stored settings.

Possible states within front and register handling state.

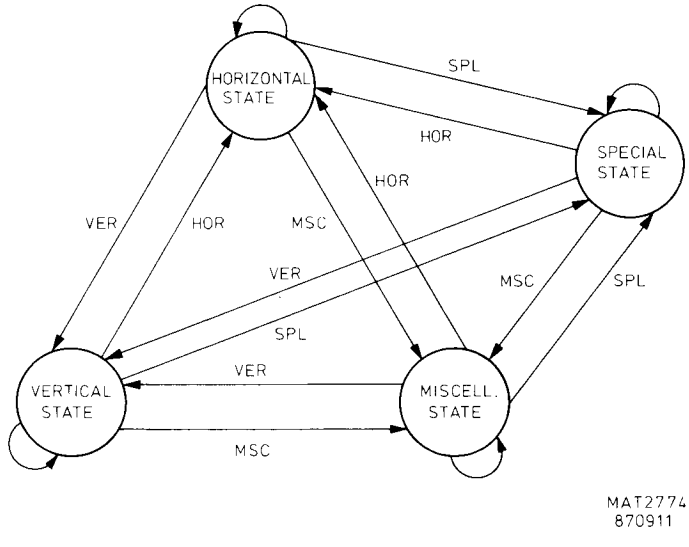


Figure 6.5 Detailed oscilloscope states

Transition from one state to another can only occur if the command for entering that state is given.

For each oscilloscope function, which has to be programmed, first a SUPER FUNCTION must be selected, then a so-called MAIN FUNCTION and then one (or more) LOW FUNCTION(S).

So:

< HEADER >	< BODY >	< HEADER >	< BODY >	< HEADER >	< BODY >
SP	USP	SP	USP	SP	SPR
SRØ	SR1	SRØ	SR1	SRØ	SR3

SUPER FUNCTION MAIN FUNCTION LOW FUNCTION

Example:

FRO	Ø	HOR	MTB	MGN	ON
SP	USP	SP	USP	SP	SPR

In this way the front panel is changed: time base magnification is switched on.

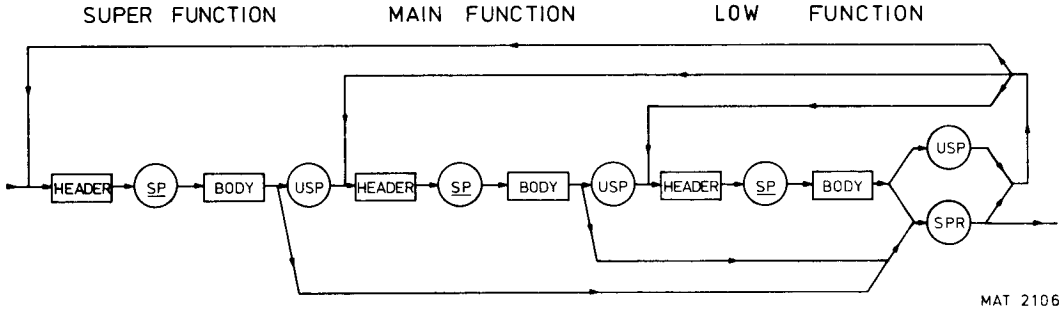


Figure 6.6 Programming structure

7. PROGRAMMING CODES

7.1 INTRODUCTION

This section deals with the code formats to be used for controlling the oscilloscope.

The codes are divided into a number of groups:

- SYSTEM CODES : Code for the programming of identity.
- SYSTEM INTERFACE CODES: Codes for the programming of separators and wait time delay.
- SUPER FUNCTION CODES : Codes for the transition to the register handling state or the front handling state.
- MAIN FUNCTION CODES : Codes for the transition within the register handling state or the front handling state.
- LOW FUNCTION CODES : Codes for the functions within a main function.
- DATA HANDLING CODES : Codes for the handling of the signal information which is stored in the digital memories. Data handling is a typical digital storage oscilloscope feature.
  A special group of programming codes is defined to read and write this information.
  Normally the signal data will be in NR1 notation. If data is transmitted in decimal notation, a multiple body can be used.

  ! Data handling can only be done in the register handling state.

  ! Data handling acts only on the data of the register which is currently selected by the bus.

NOTE: - It is always possible to use a "?" as a body. A "?" is defined for a bus controller to ask for information about a specific function. The answer from the oscilloscope will be, the header and the current situation (body or bodies).
- An error message occurs if a code is sent that is not implemented in the oscilloscope.

7.2 SYSTEM CODES

The following section describes the system codes to be used for programming.

7.2.1 Separator (SPR)

The SPR-command programs the RECORD SEPARATOR at the end of a record of a number of header/body combinations. The operator can program the RECORD SEPARATOR to which the oscilloscope will listen.
For output (from device to controller) this separator must be used.
For input (from controller to device) termination is on one of the following conditions:

- At receipt of the specified separator characters.
- Any other non printable ISO-code character.
- As preferred separator the default value is LF (0A Hex, 10 Dec).

NOTE: It is not allowed to use the ESC-character as a separator (1B Hex, 27 Dec).

The ISO-character is the RECORD SEPARATOR character itself which can be filled in by the operator/controller.
From the moment that the oscilloscope has interpreted this command sequence, it will only accept the defined character as a RECORD SEPARATOR at the end of a unit or a number of HEADER/BODY combinations. The oscilloscope will then also send this character at the end of a record or a number of HEADER/BODY combinations.

The SPR-command is very useful when a controller does not know the LF as a RECORD SEPARATOR: with this instruction it can program the oscilloscope to listen to the RECORD SEPARATOR the controller does know and to send the RECORD SEPARATOR the controller does know.

Example: SPL INTERFACE,SPR 10 (see also section 7.3.3.4, table XI).

7.2.2 Block separator (BSP)

The BLOCK SEPARATOR is the separator between the blocks of a unit.
The operator can program the block separator.
Only a single non printable ISO-character can be programmed, default value is LF (0A Hex, 10 Dec).

NOTE: It is not allowed to use the ESC-character as block separator (1B hex, 27 Dec).

The ISO-character is the BLOCK SEPARATOR character itself which can be filled in by the operator/controller.
From the moment that the oscilloscope has interpreted this command sequence, it will only accept the defined character as a BLOCK SEPARATOR at the end of a unit or a number of HEADER/BODY combinations. The oscilloscope will then also send this character. The BLOCK SEPARATOR is used as separator in data-transfer.
When the oscilloscope is sending characters to the controller, after 200 characters a BSP is sent unconditional.

This command is very useful when a controller does not know the LF as a BLOCK SEPARATOR. With this instruction it can program the oscilloscope to listen to the BLOCK SEPARATOR the controller does know and to send the BLOCK SEPARATOR the controller does know.

Example: SPL INTERFACE,BSP 10 (see also section 7.3.3.4, table XI).

7.2.3 Unit separator (USP)

The UNIT SEPARATOR is the separator between two units (header/body combinations). The operator can program the UNIT SEPARATOR to which the oscilloscope will listen.
Any, ISO character can be used to define the UNIT SEPARATOR. The default character is the COMMA (2C Hex, 44 Dec).

The ISO-character is the UNIT SEPARATOR character itself which can be filled in by the operator/controller.
From the moment that the oscilloscope has interpreted this command sequence, it will only accept the defined character as a UNIT SEPARATOR between the HEADER/BODY combinations.
The oscilloscope will then also send this character as SEPARATOR between two HEADER/BODY combinations.

This command is very useful when a controller does not know the COMMA as a UNIT SEPARATOR: with this instruction it is possible to program the oscilloscope to listen to the UNIT SEPARATOR the controller does know and to send the UNIT SEPARATOR the controller does know.

Example: SPL INTERFACE,USP 44 (see also section 7.3.3.4, table XI).

7.2.4 Call for identitity (ID) (IDT)

The programmer can ask the PM number of the device and the used software release of the device and the option in use.

Following syntax is used:

~~ID(T)~~ IDT	?	Request for IDENTITY.
		Answer, returned from the oscilloscope will be:
		ID(T) PM.....Vxx usp PM.....Vyy
		Where xx defines the used software release of the oscilloscope and yy defines the used software release of the option.

7.3 FUNCTION CODES

7.3.1 Super functions

SUPER FUNCTIONs that can be selected for this oscilloscope:

Header:	Body:	Function:
FRO	?	Request for front panel selection Answer may be: FRO Ø or REG X (where "X" is the register number).
FRO	Ø	Select front panel.
FRO	OFF	Switches off the selected front (same effect as REG Ø).
REG	?	Request for register selection Answer may be: REG X or FRO Ø (where "X" is the register number).
REG	X	Selects the register X = Ø for RØ X = 1 for R1
REG	OFF	Switches off the selected register (same effect as FRO Ø).

7.3.2 Main functions

The frontpanel functions of this oscilloscope can be split-up into four MAIN FUNCTIONS.

VER ---> VERtical channels
HOR ---> HORizontal channel
MSC ---> MiSCellaneous
SPL ---> SPeciaL

MAIN FUNCTIONS valid for FRO Ø

Header:	Body:	Function:
VER	?	Request for vertical front panel settings.
VER	A	Selection of vertical channel A.
VER	B	Selection of vertical channel B.
VER	ADD	Selection of the ADD mode of the vertical channels (A + B).
HOR	?	Request for horizontal front panel settings.
HOR	MTB	Selection of the Main Time-Base.
HOR	EXD	Selection of the X-deflection.

Header:	Body:	Function:
MSC	?	Request for miscellaneous frontpanel settings.
MSC	AUX	Selection of miscellaneous auxiliary functions.
MSC	RØ	Selection of register Ø functions.
MSC	R1	Selection of register 1 functions.
SPL	?	Request for special mode settings. NOTE: The replay SPL INTERFACE will only be given when this function was selected in a previous stage.
SPL	CURSOR	Selection of the cursor functions.
SPL	TEXT	Selection of the text functions.
SPL	SERVICE	Selection of the service menu mode.
SPL	INTERFACE	Selection of the special interface functions.

MAIN FUNCTIONS valid for REG Ø or REG 1

Header:	Body:	Function:
VER	?	Request for vertical register settings.
VER	A	Selection of vertical channel A.
VER	B	Selection of vertical channel B.
HOR	?	Request for horizontal register settings.
HOR	MTB	Selection of the Main Time-Base.
MSC	?	Request for miscellaneous trace settings. NOTE: This request is only valid after an already selected MSC TRACE. Otherwise it gives an ERROR message.
MSC	TRACE	Selection of the trace functions.
SPL	?	Request for special mode settings. NOTE: This request is only valid after an already selected SPL INTERFACE. Otherwise it gives an ERROR message.
SPL	INTERFACE	Selection of the special interface functions.

For each MAIN FUNCTION there is a TABLE with so-called LOW FUNCTIONS which can be selected after the selection of the MAIN FUNCTION.
The next tables give a clear overview of the available low functions.

7.3.3 Low functions

7.3.3.1 Main Function VER ...

TABLE I: Low functions valid for VER A or VER B

NOTE: The functions indicated with * are valid for FRO Ø, REG Ø and REG 1.
The functions without this indication are only valid for FRO Ø.

Header:	Body:	Function:
*FCN	?	Request for state of main function Answer may be : FCN ON or FCN OFF
*FCN	ON	Selected channel ON --> active state
*FCN	OFF	Selected channel OFF --> INactive state
*ATT	?	Request for actual input sensitivity Answer may be: 2E-03 (2 mV/div.) 5E-03 (5 mV/div.) 10E-03 (10 mV/div.) 20E-03 (20 mV/div.) 50E-03 (50 mV/div.) .1E+00 (.1 V/div.) .2E+00 (.2 V/div.) .5E+00 (.5 V/div.) 1E+00 (1 V/div.) 2E+00 (2 V/div.) 5E+00 (5 V/div.) 10E+00 (10 V/div.)

NOTE: The given answer represents the input sensitivity of the oscilloscope without the influence of a connected attenuator probe.

*ATT	XXESYY	Input sensitivity can be programmed: values for XXESYY as mentioned above between 2E-03 (2mV/div.) and 10E+00 (10V/div.).
*PRO	?	Request for connected probe Answer may be: PRO 1, PRO 10 or PRO 100. (Only valid when a probe with range indication is used otherwise PRO1 will be returned)
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.

Header:	Body:	Function:
*CPL	?	Request for coupling of the selected channel. Answer may be : CPL DC, CPL AC, CPL ZERO,
CPL	DC	Selected channel is DC coupled.
CPL	AC	Selected channel is AC coupled
CPL	ZERO	Input of selected channel is set to ZERO
ALT	?	Request for state of alternate display mode. Answer may be ALT ON or ALT OFF.
ALT	ON	Alternate function ON.
ALT	OFF	Alternate function OFF.
CHP	?	Request for state of chopped display mode. Answer may be CHP ON or CHP OFF.
CHP	ON	Chopped function ON.
CHP	OFF	Chopped function OFF.
INV	?	Request for inversion of channel B. Answer may be: INV ON or INV OFF.
INV	ON	Invert function active for channel B.
INV	OFF	Invert function INactive for channel B.
RDY	?	Request for state of time base. Answer may be: YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be: NO if not received a trigger pulse yet.
VAR	?	Request for the absolute position of the variable gain setting of the selected channel. The answer may be: VAR CAL or VAR LOCAL.
VAR	CAL	The variable gain control is put in the calibrated position (knob turned fully clockwise). This is only possible in the REMOTE state.
VAR	LOCAL	The variable gain control is set to LOCAL, user can use the function manually.
*CAL	?	Request for state of VAR control of selected channel. Answer may be ON for calibrated control or OFF for uncalibrated control.

Header:	Body:	Function:
POS	?	Request for the absolute position of the horizontal shift. Answer may be: POS SXXXX or POS LOCAL. "S" represents the sign (- or +), "XXXX" represents the value and can be between -8192 (means knob fully counter clockwise) and +8191 (means knob fully clockwise).
POS	SXXXX	The shift position is set to the absolute position, represented by the number SXXXX.
POS	LOCAL	The shift position is set to LOCAL, user can use the function manually.

Table II: Low functions valid for VER ADD

Header:	Body:	Function:
FCN	?	Request for state of main function Answer may be : FCN ON or FCN OFF
FCN	ON	Selected channel ON --> active state
FCN	OFF	Selected channel OFF --> INactive state
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
ALT	?	Request for state of alternate display mode. Answer may be ALT ON or ALT OFF.
ALT	ON	Alternate function ON.
ALT	OFF	Alternate function OFF.
CHP	?	Request for state of chopped display mode. Answer may be CHP ON or CHP OFF.
CHP	ON	Chopped function ON.
CHP	OFF	Chopped function OFF.
RDY	?	Request for state of time base. Answer may be: YES if the time base has received a trigger pulse and is ready to start upon receipt of a trigger pulse. Answer may be: NO if not received a trigger pulse yet.

7.3.3.2 Main function HOR ...

Table III: Low functions valid for HOR MTB

NOTE: The functions indicated with * are valid for FRO Ø, REG Ø and REG 1.
The functions without this indication are only valid for FRO Ø.

Header:	Body:	Function:
FCN	?	Request for state of main function. Answer may be: FCN ON or FCN OFF. FCN OFF is only valid for X deflection.
FCN	ON	Main function ON or active
*TIM	?	Request for actual time base sweep speed. Answer may be: 50E-09 (50 ns/div.) .1E-06 (0,1 µs/div.) .2E-06 (0,2 µs/div.) .5E-06 (0,5 µs/div.) 1E-06 (1 µs/div.) 2E-06 (2 µs/div.) 5E-06 (5 µs/div.) 10E-06 (10 µs/div.) 20E-06 (20 µs/div.) 50E-06 (50 µs/div.) .1E-03 (100 µs/div.) .2E-03 (0,2 ms/div.) .5E-03 (0,5 ms/div.) 1E-03 (1 ms/div.) 2E-03 (2 ms/div.) 5E-03 (5 ms/div.) 10E-03 (10 ms/div.) 20E-03 (20 ms/div.) 50E-03 (50 ms/div.) .1E+00 (0,1 s/div.) .2E+00 (0,2 s/div.) .5E+00 (0,5 s/div.) 1E+00 (1 s/div.) (roll mode) 2E+00 (2 s/div.) (roll mode) 5E+00 (5 s/div.) (roll mode) 10E+00 (10 s/div.) (roll mode) 20E+00 (20 s/div.) (roll mode) 50E+00 (50 s/div.) (roll mode)
NOTE: - The given answer represents the sweep speed of the oscilloscope without the influence of the TB MAGNifier. - When in PLOT mode, every new setting of the time base will restart the acquisition.		
*TIM	XXESYY	Time-base setting can be programmed: values for XXESYY as mentioned above between 50E-09 and 50E+00

Header:	Body:	Function:
ROLL	?	Request for the ROLL mode. Answer will be: ROLL TRIGGERED.
ROLL	TRIGGERED	Starts the acquisition when in ROLL mode. The ROLL mode is stopped by a trigger signal. The triggered stop can be delayed by selecting a trigger delay. Each new selection of this function will restart the triggered ROLL mode.
*TRD	?	Request for trigger delay. Answer is: TRD SXXX. "S"represents the sign (- or +), "XXX" represents the value and can be between -10 ... +250. NOTE: The time base magnifier is not taken in account.
TRD	SXXX	The trigger delay (DIV) can be set to the value represented by the number SXXX, where XXX is the number of divisions. NOTE: When in ROLL mode every new setting of the trigger delay will restart the acquisition.
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
*TRG	?	Request for state of Trigger mode selection Answer may be: TRG AUT, TRG TRI, TRG SNG or TRG MUL.
TRG	AUT	AUTO FREE-RUN mode
TRG	TRI	Triggered mode
TRG	SNG	SINGLE shot mode. NOTE: "TRG SNG" will reset the time base.
TRG	MUL	Multiple trigger mode.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.

Header:	Body:	Function:
*TSO	?	Request for state of trigger source. Answer may be: TSO A, TSO B, TSO COM, TSO EXT or TSO LINE.
TSO	A	Trigger signal derived from channel A.
TSO	B	Trigger signal derived from channel B.
TSO	COM	Trigger signal derived from the composite trigger signals of channel A and channel B.
TSO	EXT	Trigger signal derived from the external input.
TSO	LINE	Trigger signal derived from the line frequency Note: can only be selected for HOR MTB.
*TSL	?	Request for state of the trigger slope Answer may be: TSL POS or TSL NEG
TSL	POS	Triggering on the positive going slope of the trigger signal.
TSL	NEG	Triggering on the negative going slope of the trigger signal.
*CPL	?	Request for state of trigger coupling. Answer may be: CPL PEAK, CPL DC, CPL TVF or CPL TVL.
CPL	PEAK	Triggering Peak Peak coupled.
CPL	DC	Triggering DC coupled.
CPL	TVF	Triggering coupled for TV frame pulse recognition.
CPL	TVL	Triggering coupled for TV line pulse recognition.
*EXT	?	Request for state of external coupling. Answer may be: EXT AC or EXT DC.
EXT	AC	External input is AC coupled.
EXT	DC	External input is DC coupled.
MGN	?	Request for state of TB MAGN function. Answer may be: MGN ON or MGN OFF
MGN	ON	TB MAGN ON (active)
MGN	OFF	TB MAGN OFF (inactive)

Header:	Body:	Function:
LEV_VIEW	?	Request for state of LEVEL VIEW. Answer may be: LEV_VIEW ON or LEV_VIEW OFF.
LEV_VIEW	ON	LEVEL VIEW function ON.
LEV_VIEW	OFF	LEVEL VIEW function OFF.
VAR	?	Request for the absolute position of the variable gain setting of the time base. Answer may be: VAR CAL or VAR LOCAL.
VAR	CAL	The variable gain control is put in the calibrated position (knob turned fully clockwise). This is only possible in the REMOTE state.
VAR	LOCAL	The variable gain control is set to LOCAL, user can use the knob manually.
CAL	?	Request for state of VAR control of time base. Answer may be ON for calibrated control or OFF for uncalibrated control.
LEV	?	Request for state of LEVEL. Answer may be: LEV SXXXX or LEV LOCAL. "S" represents the sign (- or +). "XXXX" represents the value and can be between -8192 ... +8191.
LEV	SXXXX	The trigger level is set to the absolute value, represented by the number SXXXX.
LEV	LOCAL	The variable LEVEL control is set to LOCAL, user can use the knob manually.
HLO	?	Request for the absolute position of the HOLD OFF setting. ANSWER may be: HLO CAL or HLO LOCAL.
HLO	CAL	The HOLD OFF control is put in the calibrated position (knob turned fully clockwise). This is only possible in the REMOTE state.
HLO	LOCAL	The HOLD OFF control is set to LOCAL, user can use the knob manually.

Table IV: Low function valid for HOR EXD

Header:	Body:	Function:
FCN	?	Request for state of main function. Answer may be: FCN ON or FCN OFF.
FCN	ON	Main function ON or active
FCN	OFF	Main function OFF or INactive
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
XCH	?	Request for state of X-deflection source. Answer may be: XCH A, XCH B, XCH EXT, or XCH LINE.
XCH	A	Command for X-deflection via trigger source A.
XCH	B	Command for X-deflection via trigger source B.
XCH	EXT	Command for X-deflection via external trigger input
XCH	LINE	Command for X-deflection via the LINE trigger signal.
INV	?	Request for state of X DEFL polarity.
INV	ON	Horizontal deflection by X DEFL is inverted.
INV	OFF	Horizontal deflection by X DEFL is not inverted.
EXT	?	Request for state of external coupling. Answer may be: EXT AC or EXT DC.
EXT	AC	External input is AC coupled.
EXT	DC	External input is DC coupled.

7.3.3.3 Main function MSC ...

Table V: Low functions valid for MSC AUX

Header:	Body:	Function:
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.
MEM	?	Request for state of digital storage mode. Answer may be: MEM ON or MEM OFF.
MEM	ON	Digital storage mode ON.
MEM	OFF	Real time mode ON.
LCK	?	Request for LOCK state. Answer may be: LCK ON or LCK OFF.
LCK	ON	Digital memory is locked.
LCK	OFF	Display is not locked and can be refreshed.
CLR	?	Request for clear state. Answer may be: CLR ON or CLR OFF.
CLR	ON	Clears register RØ until the function CLR OFF is programmed.
CLR	OFF	Stop clearing register RØ.
PART	?	Request for selected display part. Answer will be: PART XX. "XX" represents the value and can be between 1 and 63.
PART	XX	Display part can be programmed, values for "XX" as mentioned above. NOTE: Selection of display part depends on the MGN setting, in formula: max. PART XX= PART (MGN * 2).

Header:	Body:	Function:
MGN	?	Request for state of horizontal magnification. Answer will be: MAGN XX. "XX" represents the value and can be 1, 2, 4, 8, 16 or 32.
MGN	XX	Horizontal magnification can be programmed: values for "XX" as mentioned above.
DOT	?	Request for the DOT state. Answer may be DOT ON or DOT OFF.
DOT	ON	Display of only dots.
DOT	OFF	DOT joined display.
SCREENPLOT	?	Request for the state of the screenplot function. Answer may be: SCREENPLOT ANALOG or SCREENPLOT OFF.
SCREENPLOT	ANALOG	Selection and start of the analog screenplot action.
SCREENPLOT	OFF	The current screenplot action stops.
PLOTTIME	?	Request for the current plottime. Answer will be: PLOTTIME XXXX. "XXXX" represents the selected plottime per dot in ms. (ms/dt) and can be between 20 and 2000.
PLOTTIME	XXXX	Plottime can be set in ms/dot: values for "XXXX" as mentioned above.
PENUP	?	Request for the penlift state. Answer may be: PENUP Ø or PENUP 1.
PENUP	Ø	Selection of a low level TTL signal on the penlift output.
PENUP	1	Selection of a high level TTL signal on the penlift output.
XPOS	?	Request for the absolute position of the vertical shift. Answer may be: XPOS CALL or XPOS LOCAL.
XPOS	CALL	The horizontal position is set to the pre-defined position. This is only in the REMOTE state.
XPOS	LOCAL	The horizontal position is set to LOCAL, user can use the knob manually.

Table VI: Low functions for MSC RØ or R1.

Header:	Body:	Function:
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.
SEL	?	Request for the state of the register. Answer may be: SEL A or SEL B.
SEL	A	Assigns the Y POS to the A channel of the selected register.
SEL	B	Assigns the Y POS to the B channel of the selected register.
DSP	?	Request for the display state. Answer may be: DSP ON or DSP OFF.
DSP	ON	The display of the selected register is switched ON.
DSP	OFF	The display of register RØ or R1 is switched OFF.
SETTING_TEXT	?	Request for the SETTING_TEXT state. Answer may be: SETTING_TEXT ON or SETTING_TEXT OFF.
SETTING_TEXT	ON	The vertical and horizontal setting information of the selected register is displayed in the upper side of the screen.
SETTING_TEXT	OFF	The vertical and horizontal setting information is not displayed on the screen.
SAV	?	Request for state of the save function (R1 only). Answer will be: SAV OFF.
SAV	ON	The contents of RØ is saved in register R1.

Header:	Body:	Function:
RYPOS	?	Request for the relative vertical position of the signal of the selected register. Answer will be: RYPOS SXXX. "S" represents the sign (- or +), "XXX" represents the value and can be between -255 and +255.
RYPOS	SXXX	The vertical position is set to the relative position. "SXXX is the number over which the stored trace can be shifted over the screen. At the moment that the trace is stored (loaded) into the register, the relative position is set to Ø.

Table VII: Low functions valid for MSC TRACE

Header:	Body:	Function:
CHANNEL	?	Request for the selected channel(S). Answer may be: CHANNEL A, CHANNEL B or CHANNEL ALL.
CHANNEL	A	Selection of channel A for data transfer.
CHANNEL	B	Selection of channel B for data transfer,
CHANNEL	ALL	Selection of the complete register contents for data transfer.
PRT	?	Request for the state of the PART function. Answer may be: PRT REAL or PRT ALL.
PRT	REAL	Selects only the measured samples which belong to the selected channel(s) in the register for data transfer. The oscilloscope will always start the transfer by sending DAT followed by the number of samples which can be expected to be transferred.
PRT	ALL	Selects the measured and the interpollated samples which belong to the selected channel(s) on the register for data transfer.
BGN	?	Request for the begin address. Answer will be: BGN SXXXX. "S" represents the sign (+), "XXXX" represents the value and can be Ø ... +4095.
BGN	SXXXX	Selection of the register begin address for data transfer: values for "SXXXX" as mentioned above.

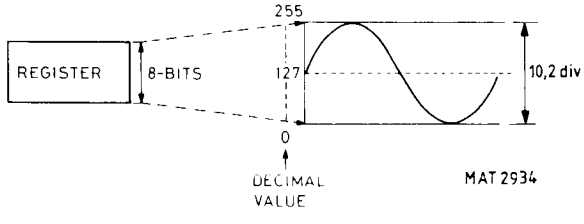
Header:	Body:	Function:
END	?	Request for the end address. Answer will be: BGN SXXXX. "S" represents the sign (+), "XXXX" represents the value and can be Ø ... +4095.
END	SXXXX	Selection of the register begin address for data transfer: values for "SXXXX" as mentioned above.
CNT	?	Request for the count factor. Answer will be: BGN SXXXX. "S" represents the sign (+), "XXXX" represents the value and can be Ø ... +4095.
CNT	SXXXX	Selection of the count (or resolution) factor for data transfer: values for "SXXXX" as mentioned above.
DATA_TYPE	?	Request for the selected data type. Answer may be: DATA_TYPE DECIMAL or DATA_TYPE BINARY.
DATA_TYPE	DECIMAL	Selection of data transfer in decimal values. These decimal values are separated for each other block by block separators. The string is terminated by a separator. Format: DAT YYYY bsp XXXX bsp XXXX ... XXXX spr where YYYY is the number of decimal values to be transferred and XXXX is a decimal value between Ø and +255 in the selected data type. "bsp" is a block separator and "spr" is a separator.
DATA_TYPE	BINARY	Selection of data transfer in binary values. Format: DAT Y bsp #B<H><L><D><D> ... <D><C> spr where Y is the number of data words to be transferred. The first high and low order byte (H=high byte and L=low byte) combination after #B contains the number of bytes to be transferred in binary notation. Then follows a number of combinations of bytes each containing a data word <D>. The last byte "C" contains a checksum byte which is calculated over all data bytes except the two length bytes which are transferred after #B. Each data word is an unsigned integer. NOTE: After the #B has been sent to the scope, some time is needed to prepare the internal set-up of this oscilloscope. A delay of 1 s approx. has to be programmed before continuing the data transfer.
DAT	?	Request for data (of the selected register) from the oscilloscope. The format of the answer is the same as decribed under DATA_TYPE DECIMAL and DATA_TYPE BINARY.

Header:	Body:	Function:
DAT	....	Transfer data to the oscilloscope. The format of the string to be sent has to be the same as described under DATA_TYPE DECIMAL and under DATA_TYPE BINARY.

Maximum available points for data transfer:

TIME/DIV	SINGLE CHANNEL MODE		DUAL CHANNEL MODE			
			CHANNEL ALL		CHANNEL A or B	
	PRT REAL	PRT ALL	PRT REAL	PRT ALL	PRT REAL	PRT ALL
.5 us	512	1024	1024	2048	512	1024
1 us	512	1024	1024	2048	512	1024
2 us	512	1024	1024	2048	512	1024
5 us	512	1024	1024	2048	512	1024
10 us	512	1024	1024	2048	512	1024
20 us	512	1024	1024	2048	512	1024
50 us	512	1024	1024	2048	512	1024
.1 ms	512	1024	1024	2048	512	1024
.2 ms	512	1024	1024	2048	512	1024
.5 ms	512	1024	1024	2048	512	1024
1 ms	512	1024	1024	2048	512	1024
2 ms	512	1024	1024	2048	512	1024
5 ms	4096	4096	4096	4096	2048	2048
10 ms	4096	4096	4096	4096	2048	2048
20 ms	4096	4096	4096	4096	2048	2048
50 ms	4096	4096	4096	4096	2048	2048
.1 s	4096	4096	4096	4096	2048	2048
.2 s	4096	4096	4096	4096	2048	2048
.5 s	4096	4096	4096	4096	2048	2048
1 s	4096	4096	4096	4096	2048	2048
2 s	4096	4096	4096	4096	2048	2048
5 s	4096	4096	4096	4096	2048	2048
10 s	4096	4096	4096	4096	2048	2048
20 s	4096	4096	4096	4096	2048	2048
50 s	4096	4096	4096	4096	2048	2048

Vertical:



Horizontal:

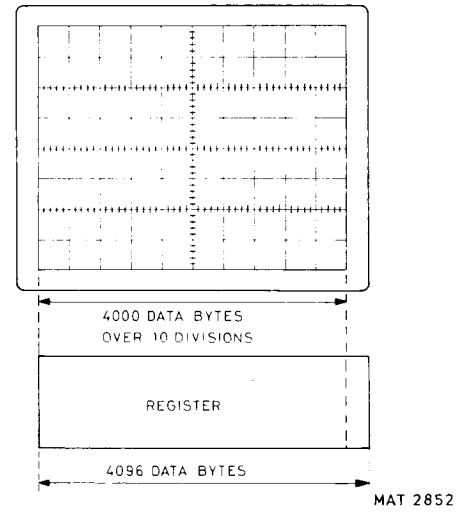


Figure 7.1 Register contents versus display

7.3.3.4 Main function SPL...

Table VIII: Low functions valid for SPL CURSOR

Header:	Body:	Function:
FCN	?	Request for state of main function. Answer may be: FCN ON or FCN OFF.
FCN	ON	Main function ON or active
FCN	OFF	Main function OFF or INactive
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.
FIRST	?	Request for the absolute value of the horizontal position of the first cursor. Answer may be: FIRST XXXX. "XXXX" represents a value between and can be Ø ... 4095.
FIRST	XXXX	The horizontal position of the first cursor is set to the absolute value: values for "XXXX" as mentioned above.
SECOND	?	Request for the absolute value of the horizontal position of the second cursor. Answer may be: SECOND XXXX. "XXXX" represents a value between and can be Ø ... 4095.
SECOND	XXXX	The horizontal position of the second cursor is set to the absolute value: values for "XXXX" as mentioned above.
CUR	?	Request for the register for which the cursors are displayed. Answer may be: CUR RØ or CUR R1.
CUR	XX	Selection of the register for which the cursors have to be displayed. "XX" represents RØ or R1.

Header:	Body:	Function:
SEL	?	Request for the selected channel. Answer may be: SEL A or SEL B.
SEL	A	The cursors are displayed on channel A of the selected register.
SEL	B	The cursors are displayed on channel B of the selected register.
DVOLT	?	Request for the measured dV value. Answer will be: DVOLT XXESYY.
DTIME	?	Request for the measured dt value. Answer will be: DTIME XXESYY.
PEAK	?	Request for the measured p-p value. Answer will be: PEAK XXESYY.
PEAK	ON	Switches on the p-p voltage measurement.
PEAK	OFF	Switches off the p-p voltage measurement.
RISE	?	Request for the measured rise time measurement. Answer will be: RISE XXESYY.
RISE	ON	Switches on the rise time measurement.
RISE	OFF	Switches off the rise time measurement.
FREQ	?	Request for the measured frequency value. Answer may be: FREQ XXESYY or FREQ ERROR.
FREQ	ON	Switches on the frequency measurement.
FREQ	OFF	Switches off the frequency measurement.
INV_DTIME	?	Request for the measured 1/dt value. Answer may be: INV_DTIME XXESYY or INV_DTIME ERROR.
INV_DTIME	ON	Switches on the 1/dt measurement.
ACQUISITION	?	Request for the acquisition state. Answer may be: ACQUISITION RESTART or ACQUISITION RETURN.
ACQUISITION	RESTART	Activation of the RESTART function.
ACQUISITION	RETURN	Activation of the REVERSE function.

Table IX: Low functions valid for SPL TEXT

Header:	Body:	Function:
FCN	?	Request for state of main function. Answer may be: FCN ON or FCN OFF.
FCN	ON	Main function ON or active on selected main menu.
FCN	OFF	Main function OFF or INactive. This clears always the current text on the screen.
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.
TEXT	X	"X" is a string with ASCII characters, which form together the usertext to be displayed on the screen in the selected text area.
CHAR	?	Request for the last programmed special character. Answer will be: CHAR INACTIVE. "XXX" represents a number (32 ... 126).
CHAR	X	This command followed by one or more decimal numbers results in text or figures written into one or more screen positions. The decimal numbers must be separated by a unit separator (multiple body construction). The decimal figures result in the characters and figures as given in the table below.

	..0	..1	..2	..3	..4	..5	..6	..7	..8	..9
03.				!	"	#	$	%	&	'
04.	(	)	*	+	,	-	.	/	0	1
05.	2	3	4	5	6	7	8	9	:	;
06.	<	=	>	?	@	A	B	C	D	E
07.	F	G	H	I	J	K	L	M	N	O
08.	P	Q	R	S	T	U	V	W	X	Y
09.	Z	[	\	]	^	_	`	a	b	c
10.	d	e	f	g	h	i	j	k	l	m
11.	n	o	p	q	r	s	t	u	v	w
12.	x	y	z	{	¦	}	~			

MAT 2958

Header:	Body:	Function:·
LINE	?	Request for the current textline. Answer may be: LINE Ø or LINE 1.
LINE	Ø	Selection of the top textline.
LINE	1	Selection of the bottom textline.
OWNER	?	Request for the current owner state.
OWNER	OSC	Oscilloscope sets the softkey text in the previous selected line on the screen.
OWNER	USER	User can set any text on the screen in the previous selected line.
COLUMN	?	Request for the current text column. Answer may be: COLUMN XX. "XX"represents a number between Ø and 39.
COLUMN	XX	Selection of one of the fourty available horizontal columns Ø ... 39.

Table X: Low functions valid for SPL SERVICE

Header:	Body:	Function:
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.

Header:	Body:	Function:
SERVICE	?	Request for the state of the service menu. Answer may be: SERVICE X.XX or SERVICE OFF. "X.XX" represents the selected service menu.
SERVICE	0.0	Selects the main service menu.
SERVICE	1.0	Selects the applications menu.
SERVICE	2.0	Selects the brief checking procedure, DC input coupling. NOTE: Each step of this menu can be switched on directly or can be found by one or more SERVICE UP or SERVICE DOWN actions.
SERVICE	2.1	AC input coupling.
SERVICE	2.2	Roll mode.
SERVICE	2.3	Display part x1.
SERVICE	2.4	Display part x8.
SERVICE	2.5	Display part x32.
SERVICE	2.6	Trigger delay 0 div.
SERVICE	2.7	Pre-trigger 6 div.
SERVICE	2.8	Trigger delay 94 div.
SERVICE	2.9	Multi display A+B.
SERVICE	2.10	Register display.
SERVICE	2.11	Dotted display.
SERVICE	2.12	Locked display.
SERVICE	3.0	Selects the offset menu for adjusting the oscilloscope, adjusting R 1036 (R 1136). NOTE: Each step of this menu can be switched on directly or can be found one or more SERVICE UP or SERVICE DOWN actions.
SERVICE	3.1	Adjusting R 1064 (R 1164).
SERVICE	3.2	Adjusting R 1072 (R 1172).
SERVICE	3.3	Adjusting R 1091.
SERVICE	3.4	Adjusting R 1191.
SERVICE	3.5	Adjusting R 1217.
SERVICE	3.6	Adjusting R 2212.
SERVICE	3.7	Adjusting R 3007.
SERVICE	4.0	Selects display menu for adjusting the oscilloscope adjusting R 550. NOTE: Each step of this menu can be swtched on directly or can be found one or more SERVICE UP or SERVICE DOWN actions.
SERVICE	4.1	Adjusting R 542.
SERVICE	4.2	Adjusting R 601.
SERVICE	4.3	Adjusting R 606.
SERVICE	4.4	Adjusting R 553.
SERVICE	5.0	WATCHDOG test menu and the service menu is leaved.

Header:	Body:	Function:
SERVICE	UP	Performance of the NEXT function within a selected service menu.
SERVICE	DOWN	Performance of the PREVIOUS function within a selected service menu.
SERVICE	OFF	The oscilloscope leaves the service menu again and starts the SOFTSTART procedure. NOTE: After leaving the service menu, the USP be defined again (see section 6.2.1).
SOFTKEY	?	Request for the last used CRT softkey number and its status. Answer may be: SOFTKEY OSC or SOFTKEY USER.
SOFTKEY	OSC	Switches all the CRT softkeys back to the oscilloscope again.
SOFTKEY	USER	Switches all the CRT softkeys for definition by the user. The CRT softkeys generate a service request on the bus and the status word gives the value 65, 66, 67, 68 or 69 depending on what softkeys is depressed.
KEY	?	Request for the status of the last used key. Answer may be: KEY ON, KEY OFF or KEY INACTIVE. This is only possible when SOFTKEY USER has already selected.

ATTENTION: To assure the proper use of the SOFTKEY and KEY functions, the oscilloscope has to be in the REMOTE state.

Table XI: Low functions valid for SPL INTERFACE

ATTENTION: To assure the proper operation a waittime of 1 s approx. must be programmed when changing a function in this mode.

Header:	Body:	Function:
SET	?	Request for state of AUTO SET mode. Answer will be: SET INACTIVE
SET	AUT	Command for AUTO SET procedure.
SET	STANDARD	Command to call the STANDARD setting.
RDY	?	Request for state of time base. Answer may be YES if the time base has received a trigger pulse and is not ready to start upon receipt of a trigger pulse. Answer may be NO if not received a trigger pulse yet.
INTF	RS232_IN.0	Selects the RS232 interface for data input.
INTF	RS232_OUT.0	Selects the RS232 interface for data output.

The next functions are lower level functions for:
SPL INTERFACE,INTF RS232_IN.0 or SPL INTERFACE,INTF RS232_OUT.0

Header:	Body:	Function:
SPR	?	Request for the value of the RECORD SEPARATOR. ANSWER will be: SPR XX. "XX" represents any number between Ø and 31 (decimal equivalent), except 27 (ESC).
SPR	XX	Sets the RECORD SEPARATOR to the new selected value, represented by the number "XX".
BSP	?	Request for the value of the BLOCK SEPARATOR. Answer will be: BSP XX. "XX" represents any number between Ø and 31 (decimal equivalent>, except 27 (ESC).
BSP	XX	Sets the BLOCK SEPARATOR to the new selected value, represented by the number "XX".
USP	?	Request for the value of the UNIT SEPARATOR. Answer will be: USP XXX. "XXX" represents any number between Ø and 255, except 27 (ESC).
USP	XXX	Sets the UNIT SEPARATOR to the new selected value, represented by the number "XXX". It is also possible to set the UNIT SEPARATOR drectly, by typing the desired character on your keyboard. USP / will set the UNIT SEPARATOR to / (slash)-(2F Hex, 47 Dec).
BAUDRATE	?	Request for the state of the baudrate speed. Answer will be: BAUDRATE XXXXX. "XXXXX" represents 75, 110, 150, 300, 600, 1200, 2000, 2400, 9600, 19200 for the input speed and 75, 110, 150, 300, 600, 1200 for the output speed.
BAUDRATE	XXXXX	Sets the input or output baudrate speed to the new value.
DATA	?	Request for the number of the data bits. Answer may be: DATA 7 or DATA 8.
DATA	X	Sets the number of data bits to the requested value.
STOP	?	Request for the number of stop bits. Answer may be: STOP 1 or STOP 2. NOTE: Only valid for INTF RS232_OUT.0.
STOP	X	Sets the number of stop bits to the sequested value. NOTE: Only valid for INTF RS232_out.0.
PARITY	?	Request for the state of the parity bit. Answer may be: PARITY EVEN, PARITY ODD or NO PARITY.
PARITY	EVEN	Selection of even parity (even number of "ones" in the data part of the frame).
PARITY	ODD	Selection of odd parity (odd number of "ones" in the data part of the frame).
PARITY	NO	Selection of no-parity.

8. PROGRAMMING EXAMPLES

8.1 INTRODUCTION

This chapter gives a driver program for a the IBM controller.

8.2 DRIVER PROGRAM

```
10 REM last rev. date:                    870709
20 KEY OFF:CLS:CLOSE
30 VIEW PRINT
40 FALSE =0:TRUE= NOT FALSE
50 XOFF$=CHR$(19):XON$=CHR$(17)
60 LOCATE 1,1:PRINT "THE CURRENT INTERFACE SETTING IS 1200,N,8,1"
70 INPUT "DO YOU WANT TO CHANGE THIS (Y/N)";A$
80 IF LEFT$(A$,1)="Y" OR LEFT$(A$,1)="y"THEN GOTO 110
90 SPEED$="1200":DBIT$="8":STP$="1":PARIT$="N"
100 GOTO 150
110 LOCATE 4,1:LINE INPUT "SPEED(75...9600)      :?";SPEED$:IF SPEED$="" THEN SPE
ED$="1200"
120 LOCATE 5,1:LINE INPUT "DATA BITS(7,8)        :?";DBIT$:IF DBIT$="" THEN DBIT$
="8"
130 LOCATE 6,1:LINE INPUT "STOP BITS(1,2)        :?";STP$:IF STP$="" THEN STP$="1
"
140 LOCATE 7,1:LINE INPUT "PARITY (No,Odd,Even) :?";PARI$:IF PARI$="" THEN PARI$
="N"
150 COMFIL$="COM1:"+SPEED$+","+PARIT$+","+DBIT$+","+STP$+",RS,LF
160 OPEN COMFIL$ AS#1
170 CLS
180 FOR T=1 TO 80:PRINT"=";:NEXT T
190 PRINT"            I N T E R A C T I V E   P R O G R A M            type yo
ur command"
200 FOR T=1 TO 80:PRINT"=";:NEXT T
210 VIEW PRINT 5 TO 25
220 PAUSE=FALSE
230 LOCATE 25,1
240 B$="":N=0
250 A$=INKEY$:IF A$="" THEN 340
260 IF A$=CHR$(8) THEN GOTO 400
270 N=N+1
280 B$=B$+A$
290 LOCATE 25,N
300 PRINT A$;
310 IF ASC(A$)<>13 THEN GOTO 250
320 N=0
330 PRINT#1,B$:B$=""
340 IF EOF(1) THEN 250
350 IF LOC(1)>128 THEN PAUSE =TRUE:PRINT #1,XOFF$
360 A$=INPUT$(LOC(1),#1)
370 PRINT A$;:IF LOC(1)>0 THEN 350
380 IF PAUSE THEN PAUSE =FALSE:PRINT#1,XON$;
390 GOTO 250
400 IF B$="" THEN PRINT CHR$(7);:GOTO 250
410 B$=LEFT$(B$,(LEN(B$)-1))
420 IF N<=0 GOTO 250
430 LOCATE 25,N
440 PRINT " ";
450 LOCATE 25,N
460 N=N-1
470 GOTO 250
```

8.3 HOW TO USE THE DRIVER PROGRAM?

Just type in this program in your controller and run it.
The program asks you to enter commands as described in chapter 7.

Example:

When the program is executed, the interface is cleared, set to a predefined status, and the oscilloscope performs an autoset.

The screen is cleared and the controller asks you to enter a command:

COMMAND: ?

Then you can enter your command after the ? mark, and after typing return the oscilloscope returns its statusword (SERIAL POLL:...) and/or the data you asked for.

(Example) MSC ?

```
MSC ?
MSC R0,SET INACTIVE,RDY NO,DSP ON,SEL A,RYPOS 0,SETTING_TEXT OFF,MSC R1,SET INAC
TIVE,RDY NO,SAV OFF,DSP ON,SEL A,RYPOS 0,SETTING_TEXT OFF,MSC AUX,SET INACTIVE,M
GN 1,RDY NO,MEM ON,DOT OFF,LCK OFF,CLR OFF,XPOS LOCAL,PENUP 1,PLO
TTIME 200,SCREENPLOT OFF,PART 1
```

9. CIRCUIT DESCRIPTION

The RS232-C unit A11 mainly consists of :

- RS232-C interface
- Decoders
- Potentiometer switches

9.1 RS232-C interface

This circuit contains the DUART chip D116 and the V24-TTL converters D117/D118.

D116 handles the communication between the microprocessor and the RS232 interface.
The most important pin connections are:

* DATA bus port DØ ... D7 (pin 16...19 and 22...25).
* ADDRESS bus port AØ ... A3 (pin 1, 2, 3 and 6).
  Select the DUAL internal registers and ports for read/write operations.
* CLOCK inputs X1 and X2 (pin 32 and 33.
* Interrupt request output (INTR) on pin 21.
* Received data input (RxD) on pin 31.
* Transmitted data output (TxD) on pin 30.
* Ready for sending input (CTS) on pin 7.
* Request to send output (RTS) on pin 29.
* Data terminal ready output (DTR) on pin 12.

D118 converts the V24 input levels (-12 V and +12 V) into the TTL levels (0 V and +5 V). D117 converts in its turn the TTL levels into the V24 output levels.

9.2 DECODERS

The decoders D101 and D102 decode the address lines A0, A1 and A2 into the DLEN (Data Latch Enable) lines according to the next table:

Line	address (Hex)
SW0	C0000
SW1	C0001
SW2	C0002
SW3	C0003
SW4	C0004
SW5	C0005
SW6	C0006
SW7	C0007
DLPA	D0000
DLPB	D0001
DLLV	D0003

D104 and D106 convert the TTL output of D102 into the SW0...SW7 signals which are at a high voltage CMOS level.

9.3 POTENTIOMETER SWITCHES

* DA converters:

The digital-to-analog converters (DAC) N102...N106 convert the digital information of the potentiometer controls for POS A, POS B and LEVEL on the SDA input into an analogue current (pin 22). In turn, this current is converted into a voltage via N101. The voltage range is 0...+10 V. These four voltage outputs are applied to the multiplexers D112...D114.

* Multiplexers:

Depending on the level of SWØ...SW7, the control lines to the different circuit can be influenced by the analogue potentiometers at the front of the instrument (when SWØ...SW7 is low) or by the IEEE bus (when SWØ...SW7 is high). POS A, POS B and LEVEL can digitally controlled over the complete range via the IEEE bus. Next the POS X is set to the mid-position, while the four other potentiometers VAR A, VAR B, VAR X and HOLD OFF are set in their CAL position.

9.4 SIGNAL NAME LIST

Signal name	Description	Signal source	Signal destination(s)
A0...2	Address bus lines	D214	D101 - D116
CTS	Clear to send	X102	D118
D0...7	Data bus	D214	D116
DACCS-LT	Digital analog conversion chip select	D213	D101
DHOFF	Digital hold off	D114	R4301
DGPTCS-LT	Digital potmeters chip select	D213	D102
DLEVEL	Digital level	D114	R2369
DLLV	Data latch enable level	D101	N106
DLPA	Data latch enable position A	D101	N102
DLPB	Data latch enable position B	D101	N103
DLPX	Data latch enable position X	D101	N104
DPOSA	Digital position ch. A	D112	R2201
DPOSB	Digital position ch. B	D112	R2206
DPOSX	Digital position X	D113	R4722
DSR	Data set ready	X102	D118
DTR	Data terminal ready	D117	X102
DVARA	Digital variable ch. A	D112	R1084
DVARB	Digital variable ch. B	D113	R1184
DVARX	Digital variable X	D113	R4101
HOFF	Hold off	N7002	D114
LEVEL	Level	N7003	D114
POS A	Position ch. A	N7003	D112
POS B	Position ch. B	N7002	D112
POS X	Position X	N7003	D113 - R560

Signal name	Description	Signal source	Signal destination(s)
RESET-LT	Reset	V208	D116 - D214 - D318
RS23CSLT	RST232 chip select	D201	D116
RTS	Request to send	D117	X102
RXD	Received data	X102	D118
SCL0	Serial clock 0	D223	D221 - N102
SDA0	Serial data 0	D223	D221 - N102
SW0...7	Switches 0...7	D104/D106	D112 - D113 - D114
TXD	Transmitted data	D117	X102
VAR A	Variable ch. A	N7002	D112
VAR B	Variable ch. B	N7003	D113
VAR X	Variable X	N7002	D113
WRITE-LT	Write signal	D213	D116 - D217 - D218

10. PARTS LIST (subject to alteration without notice)

POSNR	DESCRIPTION		ORDERING CODE
CAPACITORS			
C 0101	10%	1NF	4822 122 30027
C 0102	-20+50%	10NF	4822 122 31414
C 0103	-20+50%	10NF	4822 122 31414
C 0104	10%	1NF	4822 122 30027
C 0105	-20+50%	10NF	4822 122 31414
C 0106	63V 10%	100NF	5322 121 43083
C 0107	63V 10%	100NF	5322 121 43083
C 0108	63V 10%	100NF	5322 121 43083
C 0109	63V 10%	100NF	5322 121 43083
C 0110	-20+50%	10NF	4822 122 31414
C 0111	63V 10%	100NF	5322 121 43083
C 0112	-20+50%	10NF	4822 122 31414
C 0113	-20+50%	10NF	4822 122 31414
C 0114	-20+50%	10NF	4822 122 31414
C 0116	-20+50%	10NF	4822 122 31414
C 0117	-20+50%	10NF	4822 122 31414
C 0118	10%	1.5NF	4822 122 31169
C 0119	63V 10%	100NF	5322 121 43083
C 0121	10%	1NF	4822 122 30027
C 0122	-20+50%	10NF	4822 122 31414
C 0123	-20+50%	10NF	4822 122 31414
C 0124	10%	1NF	4822 122 30027
C 0125	-20+50%	10NF	4822 122 31414
C 0126	63V 10%	100NF	5322 121 43083
C 0127	63V 10%	100NF	5322 121 43083
C 0128	63V 10%	100NF	5322 121 43083
C 0129	63V 10%	100NF	5322 121 43083
C 0130	-20+50%	10NF	4822 122 31414
C 0131	63V 10%	100NF	5322 121 43083
C 0132	-20+50%	10NF	4822 122 31414
C 0133	-20+50%	10NF	4822 122 31414
C 0134	-20+50%	10NF	4822 122 31414
C 0136	-20+50%	10NF	4822 122 31414
C 0137	-20+50%	10NF	4822 122 31414
C 0138	10%	1.5NF	4822 122 31169
C 0139	63V 10%	100NF	5322 121 43083
C 0140	-20+50%	10NF	4822 122 31414
C 0142	-20+50%	10NF	4822 122 31414
C 0143	-20+50%	10NF	4822 122 31414
C 0146	0.25PF	4.7PF	4822 122 31822
C 0147	0.25PF	4.7PF	4822 122 31822
C 0148	10%	1NF	4822 122 30027
C 0149	10%	1NF	4822 122 30027
C 0151	10%	1NF	4822 122 30027
C 0152	10%	1NF	4822 122 30027
C 0153	2%	330PF	4822 122 31353
C 0154	2%	330PF	4822 122 31353
C 0156	2%	330PF	4822 122 31353
C 0157	2%	330PF	4822 122 31353
C 0159	-20+50%	10NF	4822 122 31414
C 0160	-20+50%	10NF	4822 122 31414
C 0161	10%	1NF	4822 122 30027
C 0162	-20+50%	10NF	4822 122 31414
C 0163	-20+50%	10NF	4822 122 31414
C 0164	10%	1NF	4822 122 30027
C 0165	-20+50%	10NF	4822 122 31414
C 0166	63V 10%	100NF	5322 121 43083
C 0167	63V 10%	100NF	5322 121 43083
C 0168	63V 10%	100NF	5322 121 43083
C 0169	63V 10%	100NF	5322 121 43083
C 0170	-20+50%	10NF	4822 122 31414
C 0171	63V 10%	100NF	5322 121 43083
C 0172	-20+50%	10NF	4822 122 31414
C 0173	-20+50%	10NF	4822 122 31414
C 0174	-20+50%	10NF	4822 122 31414
C 0176	-20+50%	10NF	4822 122 31414
C 0177	-20+50%	10NF	4822 122 31414
C 0178	10%	1.5NF	4822 122 31169
C 0179	63V 10%	100NF	5322 121 43083
C 0180	-20+50%	10NF	4822 122 31414
C 0181	-10+50%	220UF	4822 124 20681
C 0182	-20+50%	10NF	4822 122 31414
C 0183	-20+50%	10NF	4822 122 31414
C 0184	-10+50%	47UF	4822 124 20699
C 0186	-20+50%	10NF	4822 122 31414
C 0187	-20+50%	10NF	4822 122 31414
C 0188	-10+50%	220UF	4822 124 20681
C 0189	-20+50%	10NF	4822 122 31414
C 0190	-20+50%	10NF	4822 122 31414
C 0191	-20+50%	10NF	4822 122 31414
C 0192	-20+50%	10NF	4822 122 31414
C 0193	-20+50%	10NF	4822 122 31414
C 0195	-20+50%	10NF	4822 122 31414
C 0196	-20+50%	10NF	4822 122 31414
C 0197	-20+50%	10NF	4822 122 31414
C 0198	-20+50%	10NF	4822 122 31414
C 0199	-20+50%	10NF	4822 122 31414

POSNR	DESCRIPTION		ORDERING CODE
RESISTORS			
R 0101	MRS25	1% 2K61	5322 116 53327
R 0102	MRS25	1% 82E5	5322 116 53538
R 0103	MRS25	1% 619E	5322 116 53337
R 0104	MRS25	1% 2K37	5322 116 53536
R 0106	MRS25	1% 2K87	5322 116 53513
R 0108	MRS25	1% 19K6	5322 116 53258
R 0109	MRS25	1% 100E	5322 116 53126
R 0111	MRS25	1% 2K61	5322 116 53327
R 0112	MRS25	1% 82E5	5322 116 53538
R 0113	MRS25	1% 619E	5322 116 53337
R 0114	MRS25	1% 2K37	5322 116 53536
R 0116	MRS25	1% 2K87	5322 116 53513
R 0118	MRS25	1% 19K6	5322 116 53258
R 0119	MRS25	1% 100E	5322 116 53126
R 0128	MRS25	1% 4K64	5322 116 53212
R 0129	MRS25	1% 4K64	5322 116 53212
R 0131	MRS25	1% 2K61	5322 116 53327
R 0132	MRS25	1% 82E5	5322 116 53538
R 0133	MRS25	1% 619E	5322 116 53337
R 0134	MRS25	1% 2K37	5322 116 53536
R 0136	MRS25	1% 2K87	5322 116 53513
R 0138	MRS25	1% 19K6	5322 116 53258
R 0139	MRS25	1% 100E	5322 116 53126
R 0141	MRS25	1% 100K	4822 116 52973
R 0142	MRS25	1% 10K	4822 116 53022
R 0182	MRS25	1% 5E11	4822 116 52999
R 0183	MRS25	1% 5E11	4822 116 52999
R 0184	MRS25	1% 5E11	4822 116 52999
R 0186	MRS25	1% 10E	4822 116 52891
R 0193	MRS25	1% 3K16	4822 116 53021
R 0197	MRS25	1% 3K16	4822 116 53021
SEMI-CONDUCTORS			
V 0192	BZX79-C5V1		4822 130 34233
V 0196	BZX79-C12		4822 130 34197
V 0197	BAW62		4822 130 30613
V 0198	BAW62		4822 130 30613
INTEGRATED CIRCUITS			
D 0101	PC74HCT259P		5322 209 11115
D 0102	PC74HCT259P		5322 209 11115
D 0104	HEF4104BP		4822 209 10273
D 0106	HEF4104BP		4822 209 10273
D 0109	EPROM 27010		5322 209 51464
D 0112	HEF4053BP		5322 209 10576
D 0113	HEF4053BP		5322 209 10576
D 0114	HEF4053BP		5322 209 10576
D 0116	SCN68681C1N40		5322 209 11561
D 0117	MC1488L		5322 209 84307
D 0118	MC1489AL		5322 209 86103
N 0101	LM324N		4822 209 80587
N 0102	TDA1540P		4822 209 81453
N 0103	TDA1540P		4822 209 81453
N 0106	TDA1540P		4822 209 81453
COILS			
L 0181	15UH		5322 157 52539
MISCELLANEOUS			
X 0101	96-P PEN		5322 265 61029
X 0102	26-P DBL RT.ANG		5322 265 61135
	DIL SOCKET 32-P		5322 255 40829
	RIB CABLE CON		5322 267 70175
	RS232 UNIT		5322 216 51212
	RS232 SOCKET		5322 265 51199
	RS232 STICKER		5322 455 81066

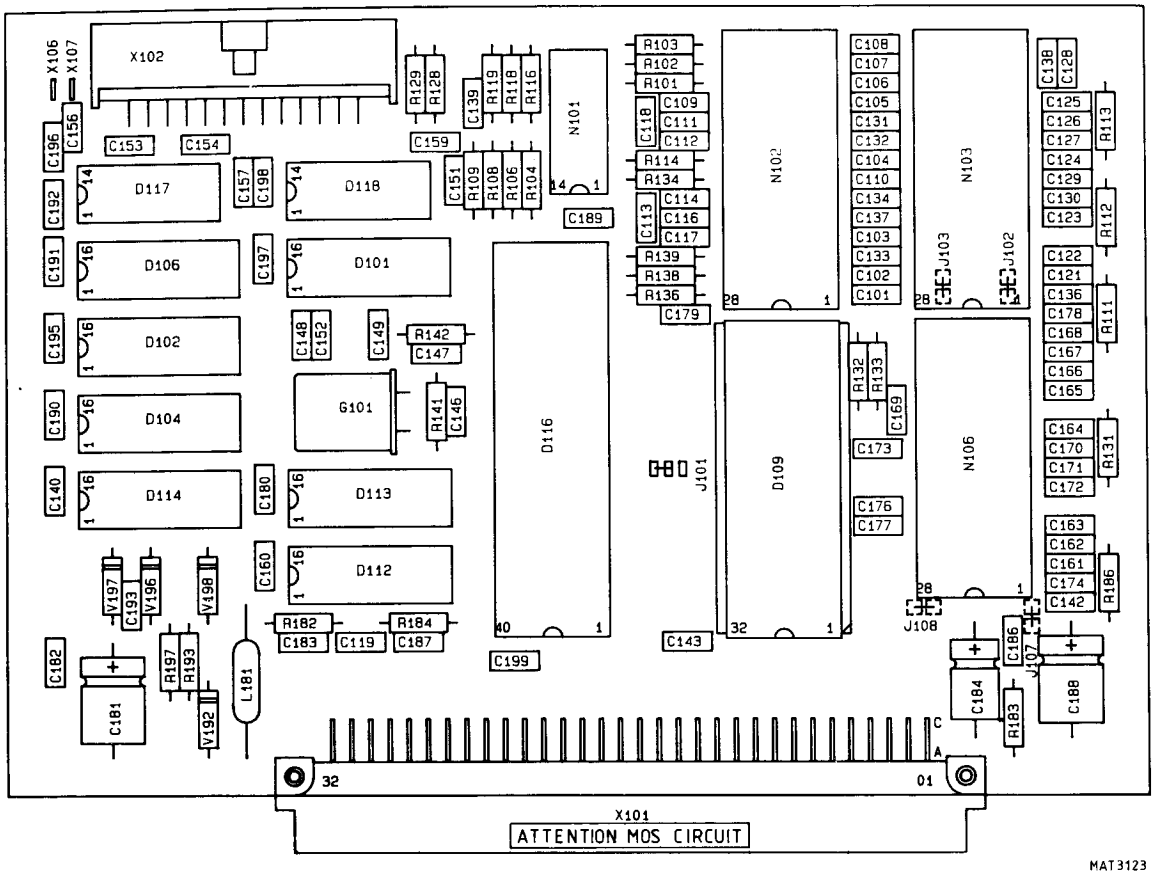
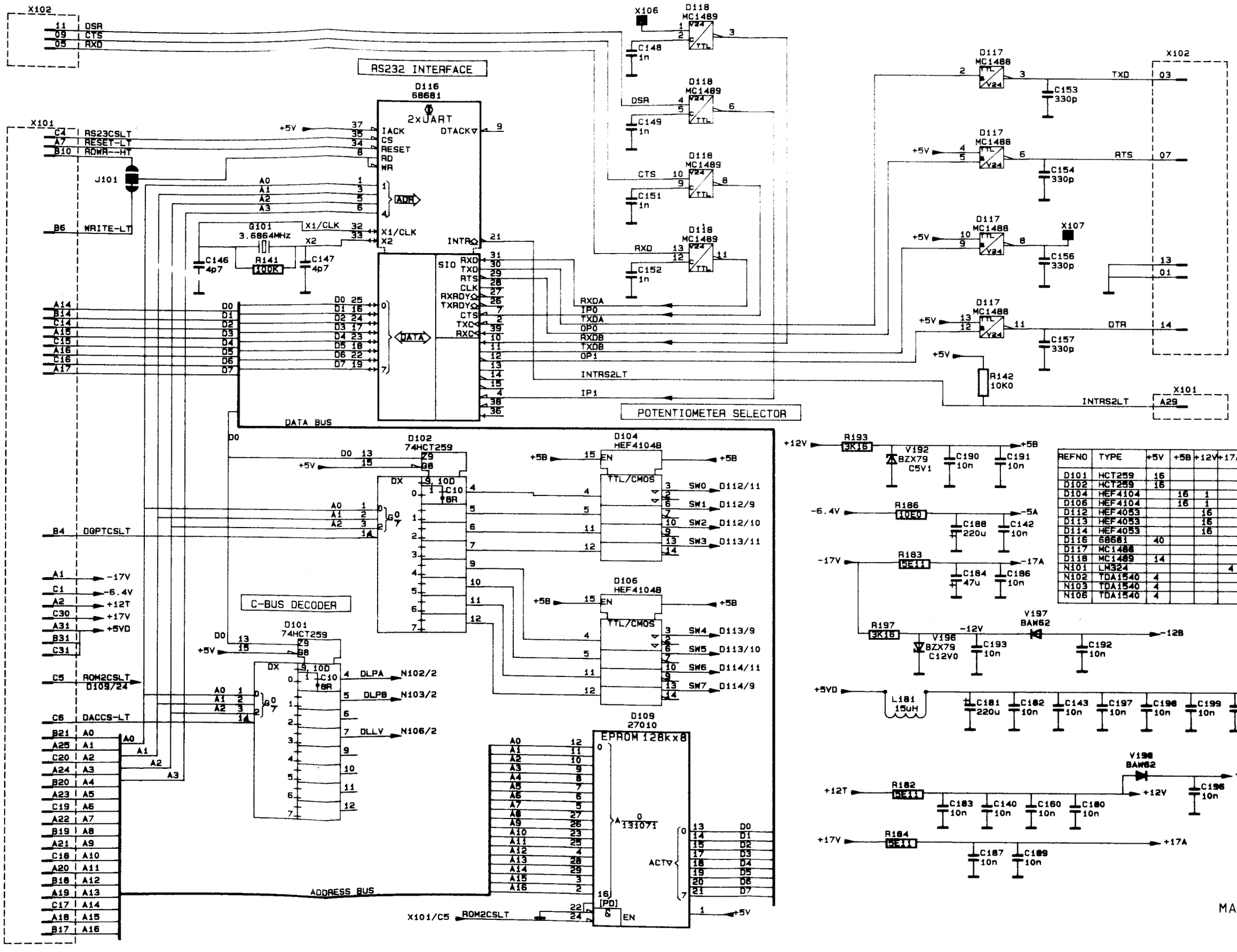


Figure 11.2 RS232 unit p.c.b.

11. CIRCUIT DIAGRAMS AND P.C.B. LAY-OUTS



REFNO	TYPE	+5V	+5B	+12V	+17A	-12B	+12B	⊥
D101	HCT259	16						8
D102	HCT259	16						8
D104	HEF4104		16	1				8
D106	HEF4104		16	1				8
D112	HEF4053			16				8,7
D113	HEF4053			16				8,7
D114	HEF4053			16				8,7
D116	68681	40						20
D117	MC1488				1	14		8
D118	MC1489	14						8
N101	LM324				4			11
N102	TDA1540	4						6
N103	TDA1540	4						6
N106	TDA1540	4						6

Figure 11.1 Circuit diagram of RS232 unit, RS232 interface

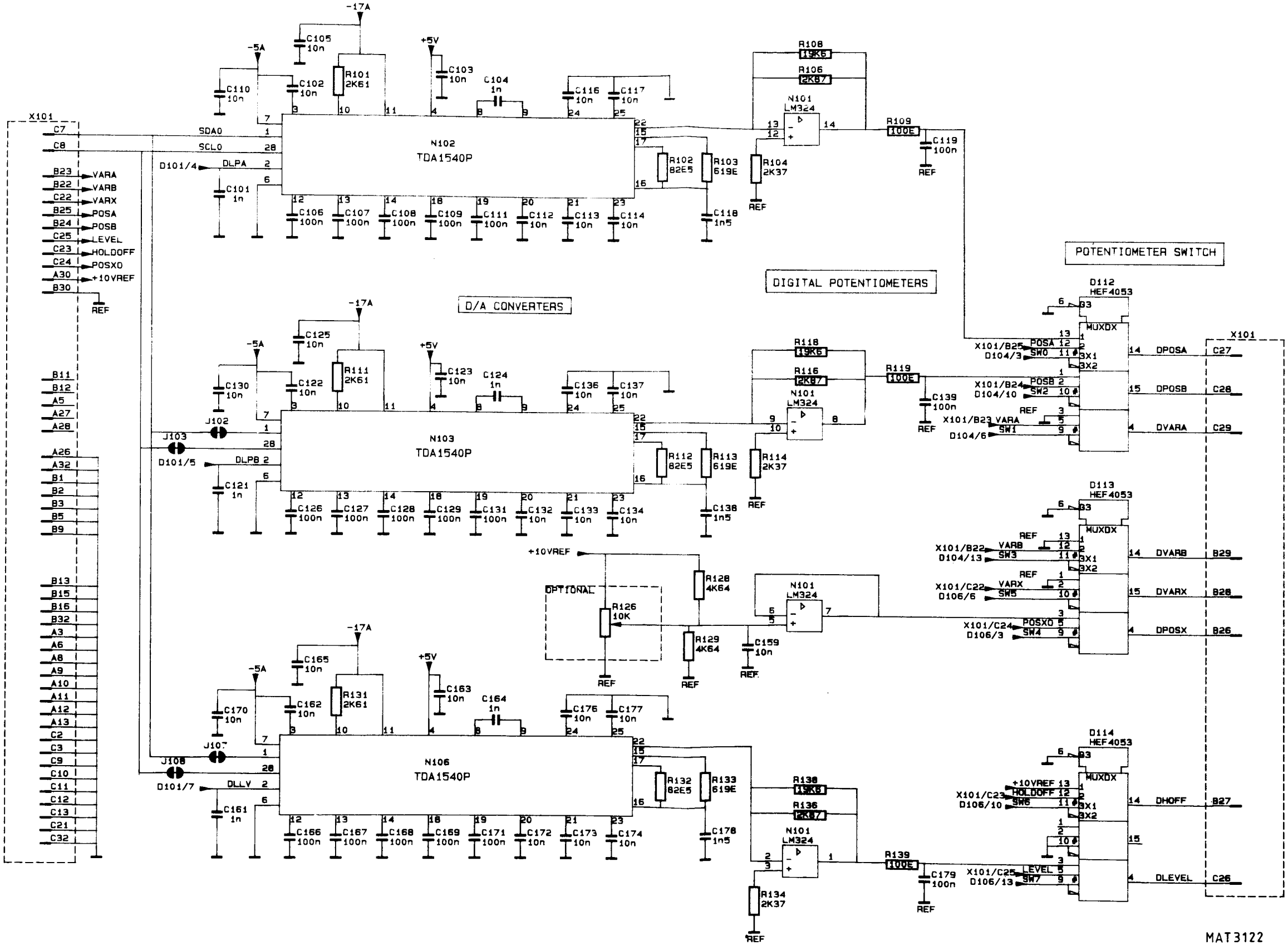


Figure 11.3 Circuit diagram of RS232 unit, digital potentiometers