

Digital Plotter PM8151

Service Manual

9499 430 01911

811028



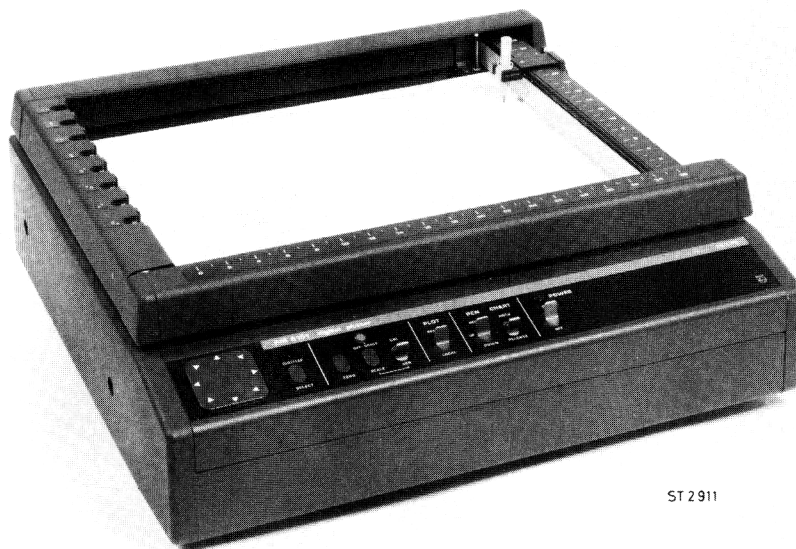
PHILIPS

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ST 2911



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IMPORTANT

In correspondence concerning this instrument, please quote the type number and serial number as given on the type plate.

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

WICHTIG

Bei Schriftwechsel über dieses Gerät wird gebeten, die genaue Typenbezeichnung und die Gerätenummer anzugeben. Diese befinden sich auf dem Leistungsschild.

BEMERKUNG: *Die Konstruktion und Schaltung dieses Geräts wird ständig weiterentwickelt und verbessert. Deswegen kann dieses Gerät von den in dieser Anleitung stehenden Angaben abweichen.*

IMPORTANT

RECHANGE DES PIECES DETACHEES (Réparation)

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques.

REMARQUES: *Cet appareil est l'objet de développements et améliorations continuels. En conséquence, certains détails mineurs peuvent différer des informations données dans la présente notice d'emploi et d'entretien.*

THIS SERVICE MANUAL IS INTENDED FOR USE WITH OPERATING MANUAL PM8151

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1. INSTRUMENT VERSIONS AND MODIFICATIONS

1.1 VERSIONS

The Digital Plotter PM 8151 is available in the following types:

- PM 8151S/xx a plotter with V24 CCITT (RS232C) and current - loop interface.
- PM 8151B/xx a plotter with IEC 625 (IEEE 488 - 1975) interface.

Both types of plotter are available in the following configurations:

- /01 basic instrument without options
- /21 basic instrument with a built-in input buffer extension.
- /98 basic instrument with an input buffer extension and a Greek character set built-in.
- /99 basic instrument with a built-in Greek character set.

Conversion from one configuration to another is possible.

When a Greek character set EPROM is required to be built-in, ensure that the EPROMs on the interface card have the correct release number.

These release numbers are:

- IEC 625 interface: 1.5 or higher
- V24 CCITT interface: 2.3 or higher

The Greek character set EPROM is labelled: CPU3 - 1.0.

The two RAMs, type 2114, necessary for the buffer extension can be placed on the CPU card directly in the empty sockets (see Fig. 1 - 1 IC 7 and IC 9)

During initialisation, the instrument determines whether or not an input buffer extension is fitted.

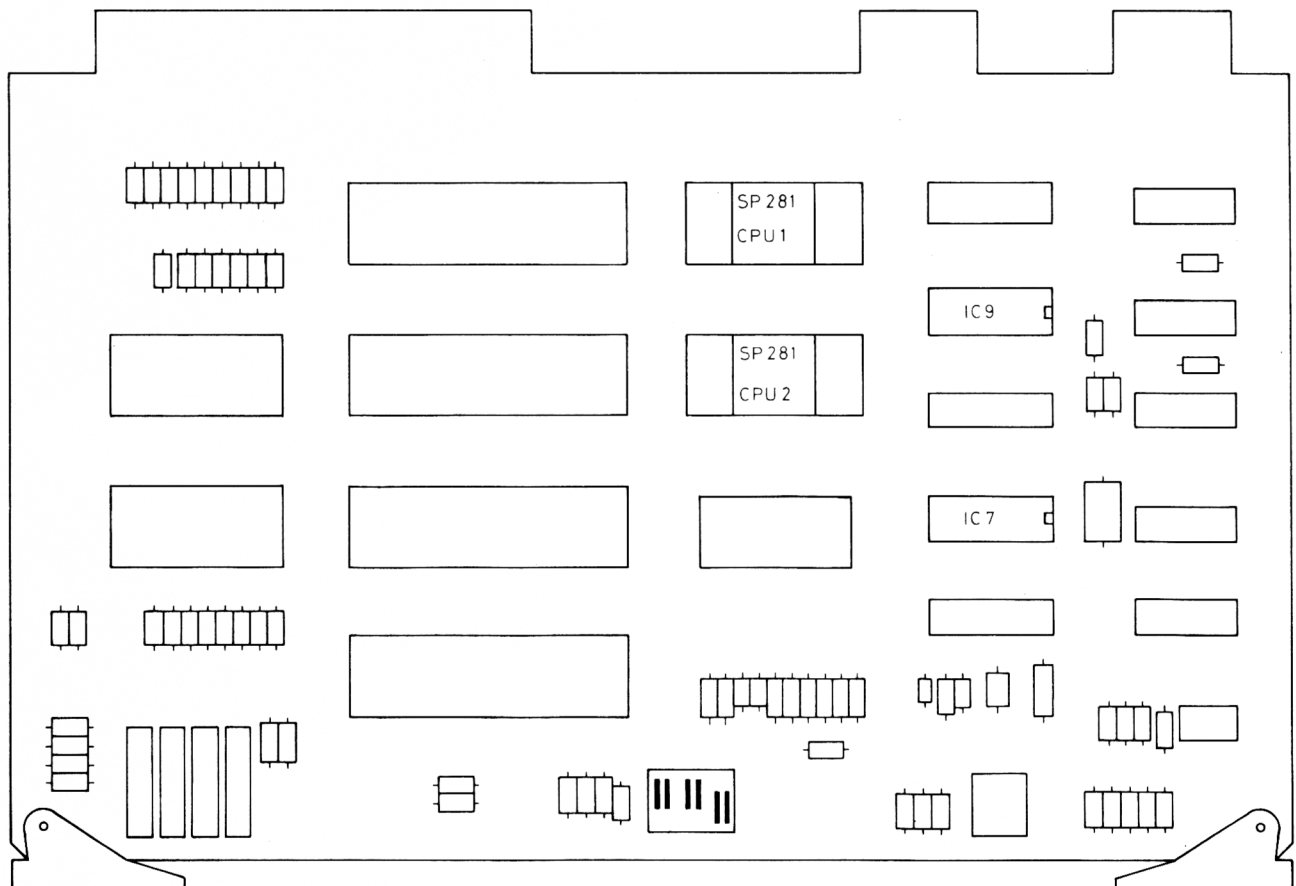


Fig. 1-1

1.2 MODIFICATIONS

1.2.1 Firmware Modifications

Plotters in current production are equipped with the following releases of the firmware:

| PM 8151S | PM 8151B |
|------------|------------|
| CPU1 - 1.2 | CPU1 - 1.2 |
| CPU2 - 1.1 | CPU2 - 1.1 |
| V24 - 2.3 | IEC - 1.5 |

The following survey outlines the important firmware modifications.

CPU1 - 1.1 to CPU1 - 1.2

The quality of character plotting has been improved.

NOTE: *When a CPU1 - 1.1 is replaced by a CPU1 - 1.2, a re-adjustment of the Plotter Coordinates Origin must be performed (see Sections 4.1.2, 4.2 and 4.3).*

V24 - 2.1 to V24 - 2.2

This modification affects the two commands, SET 1/0 PARAMETERS and REQUEST BUFFER STATUS.

In the former version, the initialised character for requesting buffer status is **not** DC1 as stated in the Operating Manual and the command SET 1/0 PARAMETERS does not assign the parameters correctly.

V24 - 2.2 to V24 - 2.3

This update is necessary when installing a special character set EPROM, labelled CPU3 - 1.0, for the Greek characters.

IEC 1.3 to IEC 1.4

Three changes are effected:

- The command string U64, indicating paper advance by 64 cm, is suppressed.
- The 'ADR' LED on the interface board also glows if the plotter is set to 'LISTEN ONLY'.
- Data output routines have been improved.

IEC 1.4 to IEC 1.5

This update is necessary when installing a special character set EPROM, labelled CPU3 - 1.0, for the Greek characters.

A summary of the valid firmware configurations is given in the following tables:

| PM 8151B | | | |
|----------|------|-------------|-----|
| CPU1 | CPU2 | CPU3 | IEC |
| 1.2 | 1.0 | not present | 1.3 |
| | 1.1 | | |
| | 1.0 | | |
| | 1.1 | 1.0 | 1.4 |
| | 1.0 | | 1.5 |
| | 1.1 | | |

| PM 8151S | | | |
|----------|------|-------------|-----|
| CPU1 | CPU2 | CPU3 | V24 |
| 1.2 | 1.0 | not present | 2.2 |
| | 1.1 | | |
| | 1.0 | 1.0 | 2.3 |
| | 1.1 | | |

1.2.2 Hardware Modifications

CPU board

The 'READY' circuit on the CPU board has been improved. This is designed to eliminate the phenomena whereby the plotter spuriously stops executing a command string before the complete string is executed.

The circuit diagram of the modified CPU is given in this Service Manual.

Briefly, the modification is as follows:

- D13 and D14 are short-circuited (base of T8 is connected directly to R35).
- D15 and D16 are short-circuited (emitter of T9 is directly connected to R64).
- Resistor R64 (4k7) has been added.
- Resistor R65 (10k) has been added.

It is recommended that instruments are modified as described when they are in for servicing.

In some cases, it is necessary to add a $10\text{k}\Omega$ resistor and a $0.47\mu\text{F}$ capacitor to the signal lines M_x and M_y on the mother board (see diagram).

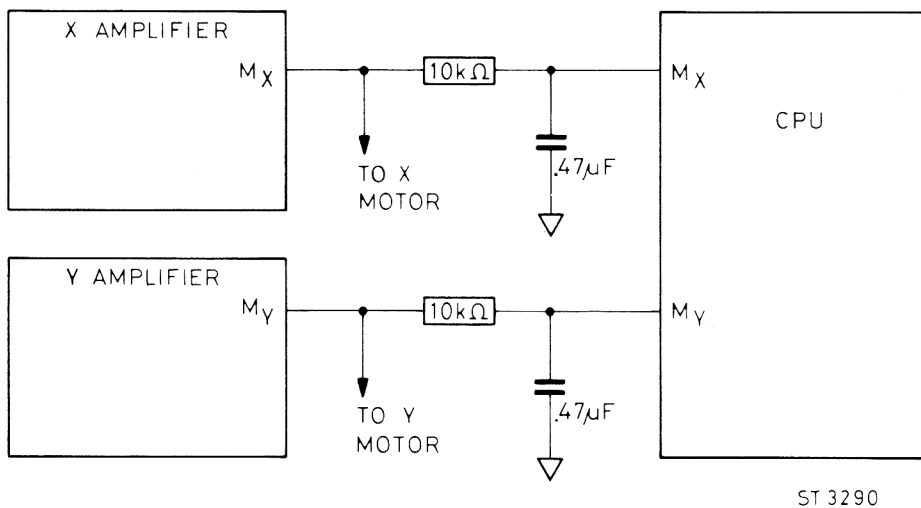


Fig. 1-2.

These components are fitted as standard on the new-type mother board.

Note that the power-up circuit formed by C7, C8 is not present in instruments with a new-type mother board (see 1.2.2.2).

Mother board

The power-up circuit formed by C7 and C8 on existing CPU boards is replaced by a new circuit located on the mother board. When a mother board is replaced by a new-type board, C7 and C8 on the CPU board, if present, must be removed.

When a new- CPU is fitted in an instrument containing an old-type mother board, check that C7 and C8 are mounted on the CPU board and fit, if necessary.

V24 interface board

On the REQUEST TO SEND and DATA TERMINAL READY lines of the MODEM connector, and the inputs WLSI, PS, SBS and PI of the UART, a $10\text{k}\Omega$ pull-up resistor is added.

A decoupling capacitor of $1\mu\text{F}$ is added to the +12 V and -12 V supplies.

A pull-up resistor of $10\text{k}\Omega$ is added at the TBRL output of the UART (IC7). This prevents hang-up of the host computer caused by arbitrary codes transmitted by the plotter when powered ON.

These modifications are shown in the circuit diagram.

Voltage Regulator - Standby board

To improve the plotters reaction to POWER ON and POWER OFF, the Voltage Regulator - Standby board has been modified. With this modification the pen remains at the last position, or moves only slightly away from it, when switched off.

Diode D1 has been replaced by a resistor of $10\text{k}\Omega$ (R6).

A resistor of $4\text{k}\Omega$ (R7) has been added from the base of transistor T2 to circuit zero (earth).

It is recommended that instruments are modified as described when they are in for servicing.

2. REPLACEMENTS

- 2.1 WARNING:** *The opening of covers or removal of parts, except those to which access can be gained by hand is likely to expose live parts, and accessible terminals may also be live.*

The instrument shall be disconnected from all voltage sources before any replacement or maintenance and repair during which the instrument will be opened.

If afterwards, any adjustment, maintenance or repair of the opened instrument under voltage conditions is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved.

Bear in mind that capacitors inside the instrument may still be charged even if the instrument is separated from all voltage sources.

2.2 PRINTED-CIRCUIT BOARDS

2.2.1 CPU Board

The CPU board is accessible after removing the front cover (see Fig. 2 -1).

When replacing a CPU board, check that:

- the same EPROM versions are used; if not, ensure that they are interchangeable types.
- capacitors C7 and C8 are removed when a mother board is fitted that includes a power-up circuit.
- the number of RAMs (two extra for a buffer extension) is the same as on the CPU being replaced.
- the setting of the DIL switch are correct **before switching on** the instrument. With an incorrect setting, the instrument can be damaged after switching on.

For electrical adjustment refer to Section 4.1.

2.2.2 Interface Board

The interface board is accessible after removing the front cover (see Fig. 2 - 1).

To remove, extract the interface board and take out the flat cable connectors.

When replacing an interface board, ensure that:

- the identical EPROM version is fitted,
- the flat cables are folded correctly to avoid being damaged,
- the switch settings are correct.

2.2.3 Keyboard p.c.b.

For access:

- remove the front cover,
- extract the CPU and interface boards,
- remove the flat cable connector and the three wires adjacent to the POWER ON switch,
- unscrew cylindrical-head screws A (see Fig. 2 - 2).

When re-assembling, first fix the rocker support post before clipping on the rocker.

2.2.4 Mains Input p.c.b.

For access:

- remove the bottom plate and front cover,
- extract the CPU board,
- unsolder the green/yellow earth wire,
- remove screw A (see Fig. 2 - 3),
- extract the mains input p.c.b.

2.2.5 Amplifier p.c.b.; Regulator Standby p.c.b.

For access:

- remove the bottom plate and front cover,
- unscrew the captive cylindrical-head screws to release the p.c.b.s. (see Fig. 2 - 4 item 2).

NOTE: *When replacing the X amplifier, first remove the connector which links the smoothing capacitors mounted on the mother board to the amplifier (Fig. 2 - 4 item 1).*

For electrical adjustments, refer to Section 4.

2.2.6 Mother board and Mains Transformer

For access:

- remove the bottom plate and front cover,
- extract the printed-circuit boards (see Section 2.2.1 . . . 2.2.5),
- unsolder the green/yellow earth wires,
- disconnect all external wiring from the mother board,
- remove all fixing screws, including those securing the mains transformer,
- to facilitate replacement of the mother board, it is also advisable to remove the printed-circuit board support bar (Fig. 2 - 3, item 1),
- remove the mother board to unsolder the mains transformer,

After re-assembly of the mother board, the straps of the mains transformer should be tightened to reduce transformer noise (hum) to a minimum.

2.3 X AXIS SERVO-SYSTEM

2.3.1 Measuring Potentiometer (Fig. 2 - 3 and 2 - 5)

For access:

- remove the bottom plate and front cover,
- unscrew the sliding contact (Fig. 2 - 5 item 1),
- unsolder the connections,
- release the Allen screws (Fig. 2 - 3 item 2) to remove the measuring potentiometer.

The measuring potentiometer should be cleaned with isopropyl alcohol.

Afterwards, apply a drop of potentiometer oil (Doduconta B10) on the resistance strip and wipe it over with a clean, lint-free cloth.

Re-assemble in reverse order. Align the sliding contact centrally on both tracks by adjusting the bracket (Fig. 2 - 5 item 2). The contact pressure of the sliding contact should be $20 \text{ g} \pm 10\%$. This corresponds to a contact-spring compression of 1.8 mm.

2.3.2 Servo-motor with Pinion

For access:

- remove the chart plate by unscrewing (Fig. 2 - 3 item 4),
- disconnect external wiring from the mother board,
- remove the cylindrical-head screws; the fourth is accessible through a hole in the gear assembly (Fig. 2 - 6 item 1).

NOTE: *After re-assembly, check the backlash between gear and motor pinion and re-adjust if necessary (see Section 2.3.4).*

2.3.3 Drive Cord

To replace:

- remove the chart plate,
- fit the drive cord as shown in Fig. 2 - 7,
- transport the carriage arm from left to right several times, before adjusting the cord tension, to eliminate the backlash in cord and pulleys.

2.3.4 Gear and Cord Drum

To remove:

- slip off the drive cord,
- remove the retaining ring (Fig. 2 - 6 item 2) to free the gear and cord drum.

NOTE: *After re-assembly, check the backlash between gear and motor pinion and re-adjust if necessary.*

The adjustment procedure is as follows:

- loosen the slotted nut (Fig. 2 - 4 item 3) of the bearing bolt and rotate the eccentric bearing bolt until the gear teeth engage without backlash at the closest position,
- tighten the slotted nut.

2.4 Y AXIS SERVO-SYSTEM

2.4.1 Pen Holder on Carriage

To remove the pen holder, loosen the screw (Fig. 2 - 8 item 5).

NOTE: *After remounting, check the pen-lift damping and re-adjust if necessary using the screw inside the damping plunger (Fig. 2 - 8 item 1).*

Do not lubricate the damping plunger.

If damping cannot be adjusted using this screw, this indicates that the screw (item 5) is too tight.

After adjustment, secure the screw with a little Loctite.

2.4.2 Scale Carrier

To remove:

- unscrew both front and rear covers by slackening the three retaining screws,
- remove the pen-lift coupling (Fig. 2 - 9 item 9) to free the scale carrier (take care not to loose the small spring located at the front).

2.4.3 Measuring Potentiometer

For access:

- remove the scale carrier,
- unsolder the connections,
- remove the sliding contacts,
- unscrew the cylindrical-head screws (Fig. 2 - 9 item 8).

2.4.4 Drive Cord

To renew:

- remove the scale carrier, and measuring potentiometer, as above,
- unscrew the cylindrical-head screws from the guide bar to remove (Fig. 2 - 9 item 14),
- unhook the tension spring (Fig. 2 - 9 item 5),
- lift the Y carriage, unhook the cord and detach it from the cord drum.

Before re-assembly, clean the guide bar with a clean cloth.

DO NOT LUBRICATE!

2.4.5 Servo-motor with Pinion

To remove:

- take off the bottom plate,
- slide the pen carriage arm to the left-hand stop,
- unscrew the cylindrical-head screws from the mounting bracket for the X-axis sliding contact (Fig. 2 - 5 item 3),
- remove the mounting bracket together with the ribbon cable, p.c.b. and sliding contact.

NOTE: *There may be adjustment washers between the mounting bracket and spacers.*

- unsolder the servo-motor wires,
- remove the servo-motor together with the mounting plate,
- dismantle the motor with pinion from the mounting plate.

Re-assemble in reverse order. Align the sliding contact centrally on both tracks by adjusting the bracket. The contact pressure of the sliding contact should be $20 \text{ g} \pm 10\%$. This corresponds to a contact spring compression of 1.8 mm.

2.5 PEN DEPOT

For access:

- remove the front and rear cover,
- unscrew the four retaining screws (Fig. 2 - 10 item 1) to release the pen depot assembly,
- remove screws (Fig. 2 - 11 item 1) for access to the separate pen depots. The separate pen depots are secured with screws, item 1 of Fig. 2 - 12.

2.6 CHART PLATE

- Unscrew the four screws (Fig. 2 - 3 item 4)
- Take-off the chart plate.

After re-assembly, check the distance between pen tip and chart plate. The distance should be equal at every corner. If not re-adjust.

In the first instruments, adjustment is effected by adding rings under the four spacers.

In the current instruments the height can be adjusted by threaded adjusting rings (see Fig. 2 - 3 item 5).

Cleaning the chart plate:

Clean the chart plate with a weak water - soap solution, using a clean cloth. Alcohol is also allowed but should be applied thrifty.

Do not use detergents as recommended for washing machines etc., because they frequently contain antistatic material.

2.7 PROGRAMMABLE PAPER ADVANCE UNIT (Fig. 2 - 13)

2.7.1 Chart Drive Assembly

To detach from plotter:

- remove the screw at the right-hand side and the nut at the left-hand side,
- disconnect the cable of chart drive unit.

Dismantling:

- to prevent damage, it is recommended that all covers be removed (see Fig. 2 - 13), starting with the left-hand cover, the motor cover plate and then the right-hand covers.

Tear-off ruler

Access is gained to the tear-off ruler retaining screws by the foregoing actions.

NOTE: *When re-assembling, it is necessary to check that the sprockets are running free from the ruler.*

Sprocket roller

- To free the complete roller, push the shaft carefully out of the roller, e.g. with a small diameter rod. The gear wheel can now be pulled from the sprocket wheel, and then the sprocket wheels can be extracted from the metal roller.

Teflon bearings for sprocket roller

- Remove the sprocket roller as described above, and pull the bearing from the frame.
Note that the bearings consist of two parts, and are not interchangeable.

Motor with gear wheel

- Loosen the printed-circuit board by removing the two screws.
- Disconnect the motor wiring, taking note of the connector pins and the corresponding colour coding of the wires.
- Unscrew the three motor plate retaining screws to free the motor assembly.
- The gear wheel can now be removed by loosening the Allen screw.

Printed-circuit board

- Disconnect all wires and the connector of the flat cable.
- Remove the motor with gear wheel, as previously described.

2.7.2 Chart Roll Holder

To detach from plotter:

- Remove the screw at the right-hand side, and the nut at the lefthand side.

Roll holder (left)

Dismantling:

- The left-hand section of the chart roll holder is a complete assembly, which can be freed after removing the grip ring.

Roll holder (right)

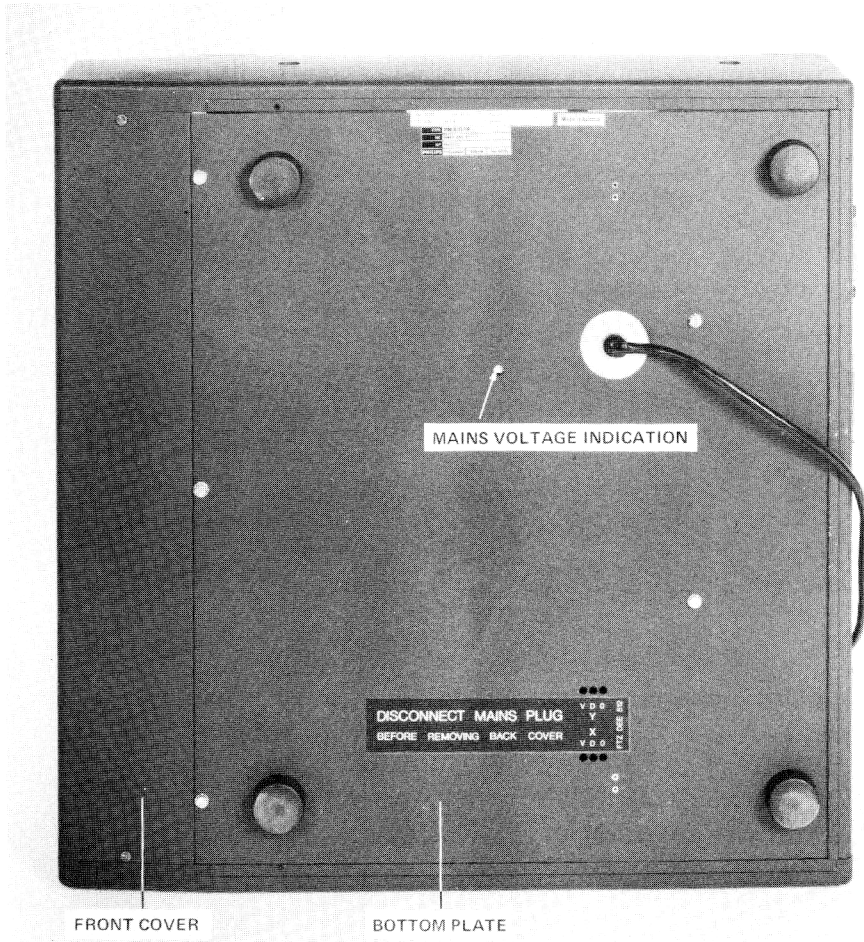
Dismantling:

- The right-hand section of the chart roll holder consists of three parts, which are accessible after removing the retaining ring.

Covers

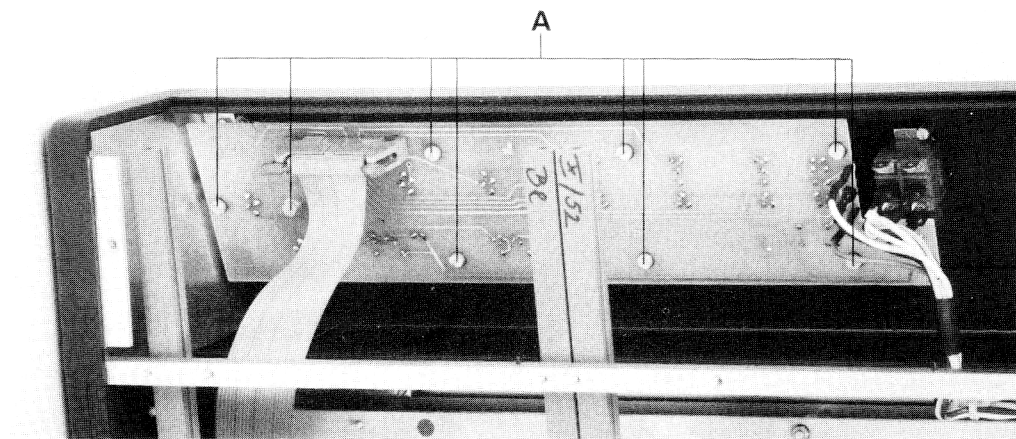
Dismantling:

- The covers can be removed after removing the relevant roll holder section, as described above.



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Fig. 2-1



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Fig. 2-2

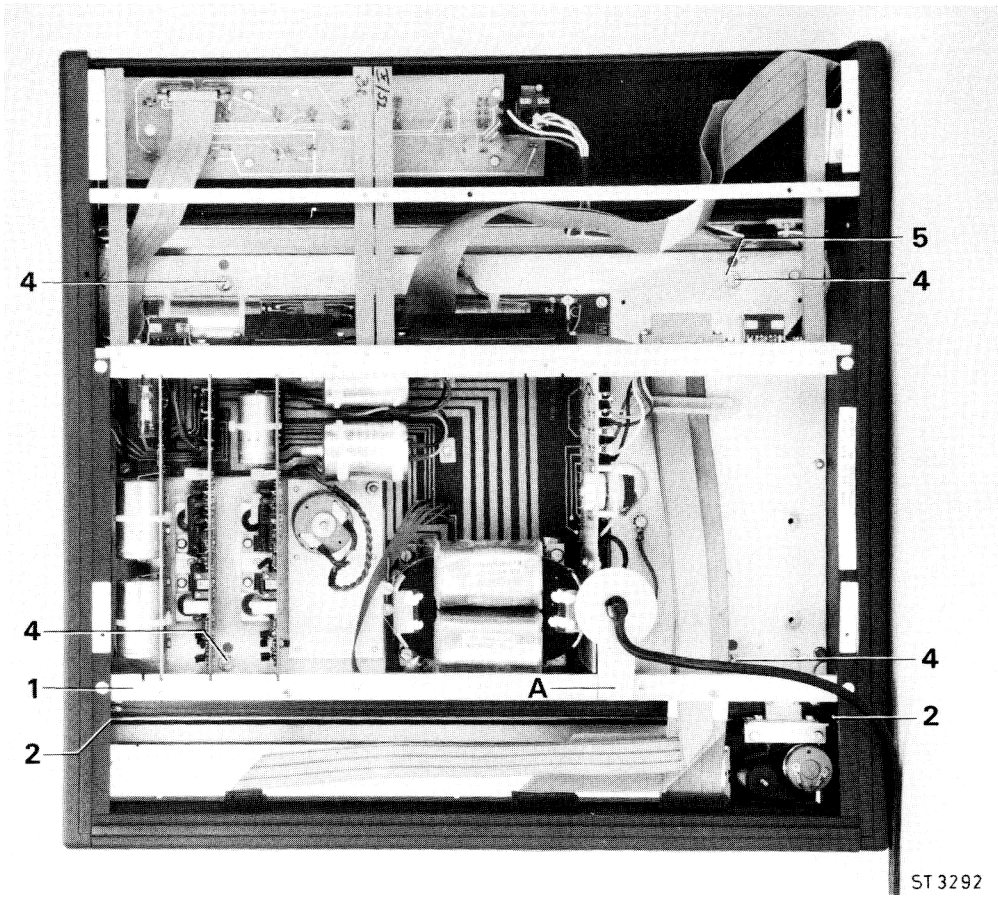


Fig. 2-3

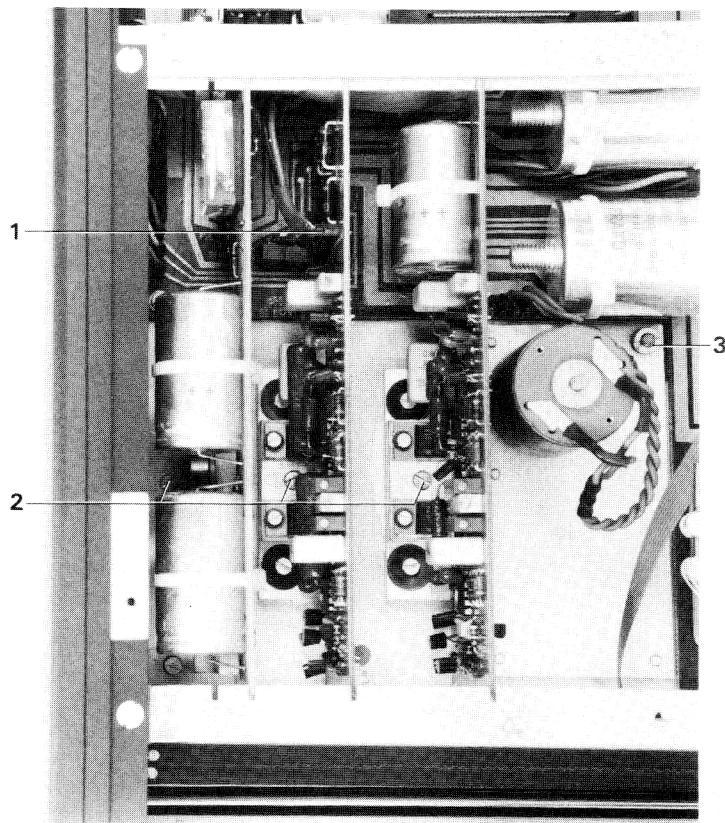
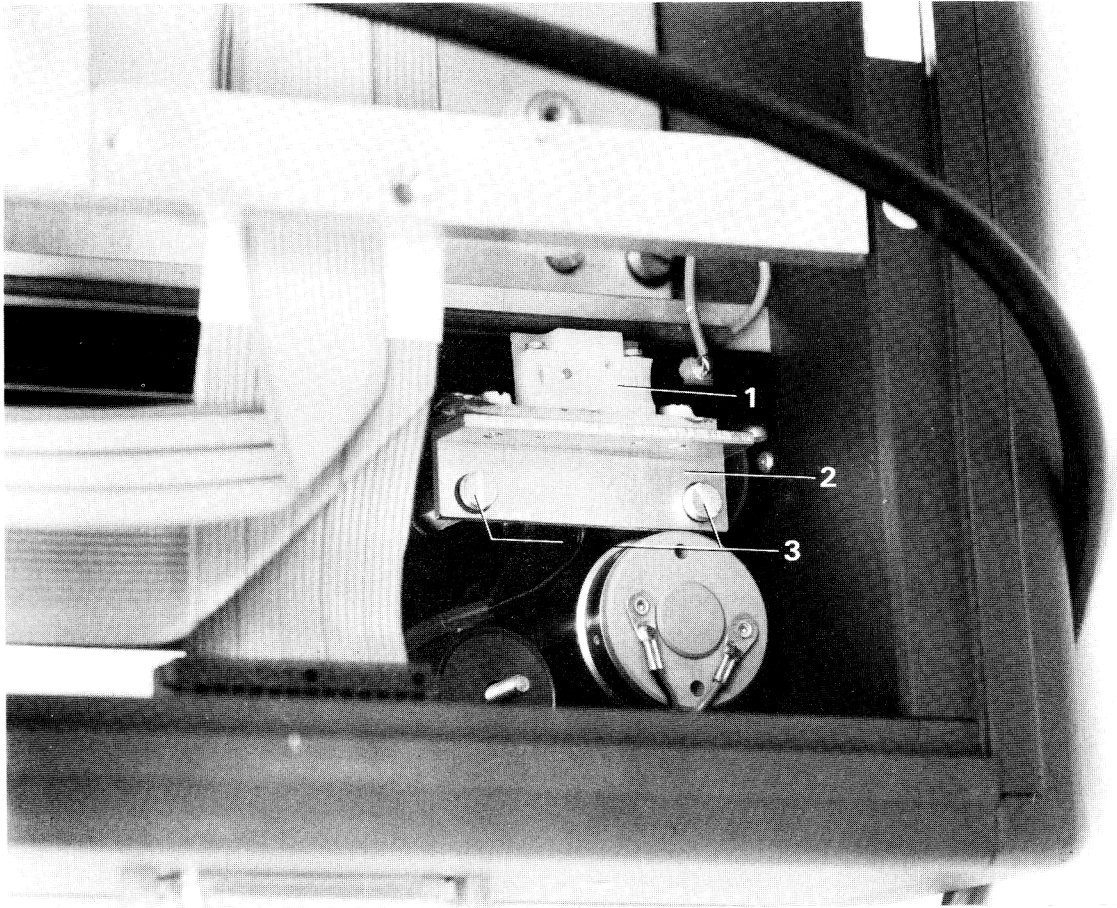
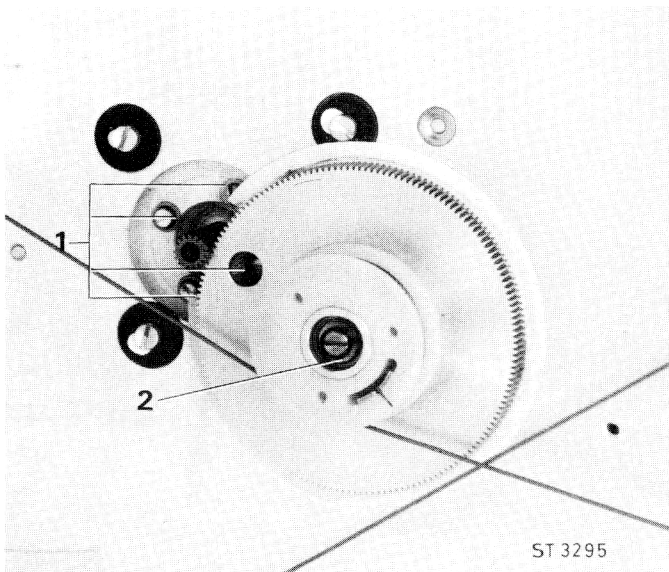


Fig. 2-4



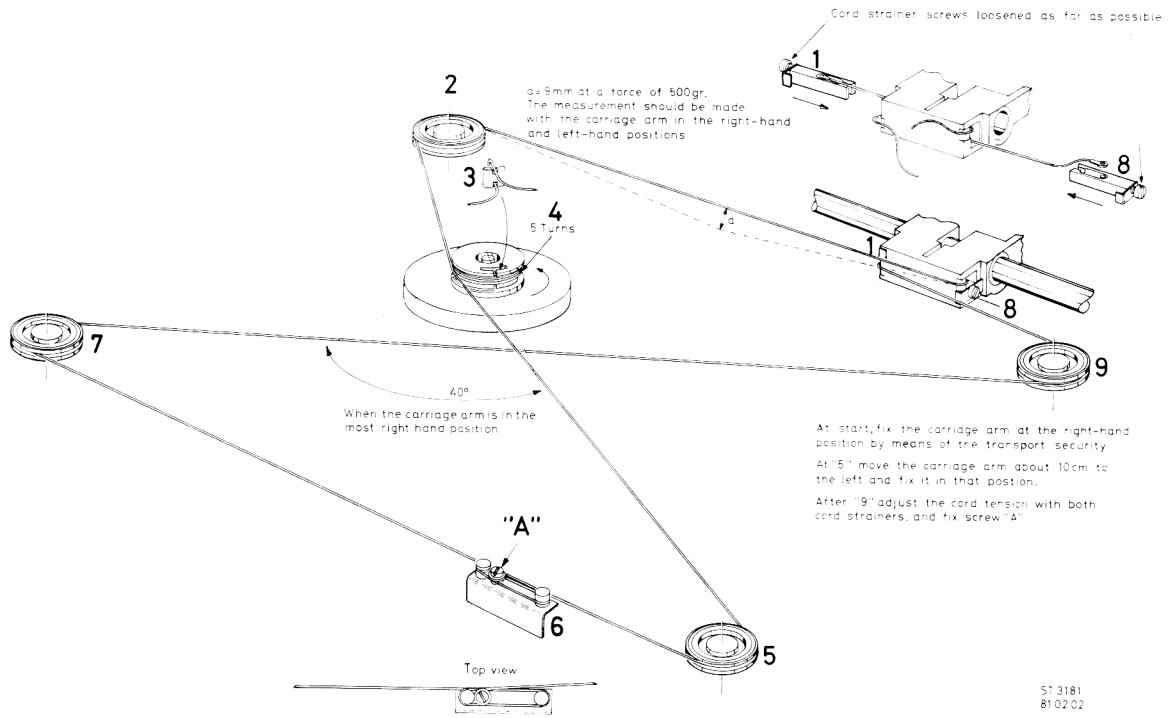
ST 3294

Fig. 2-5



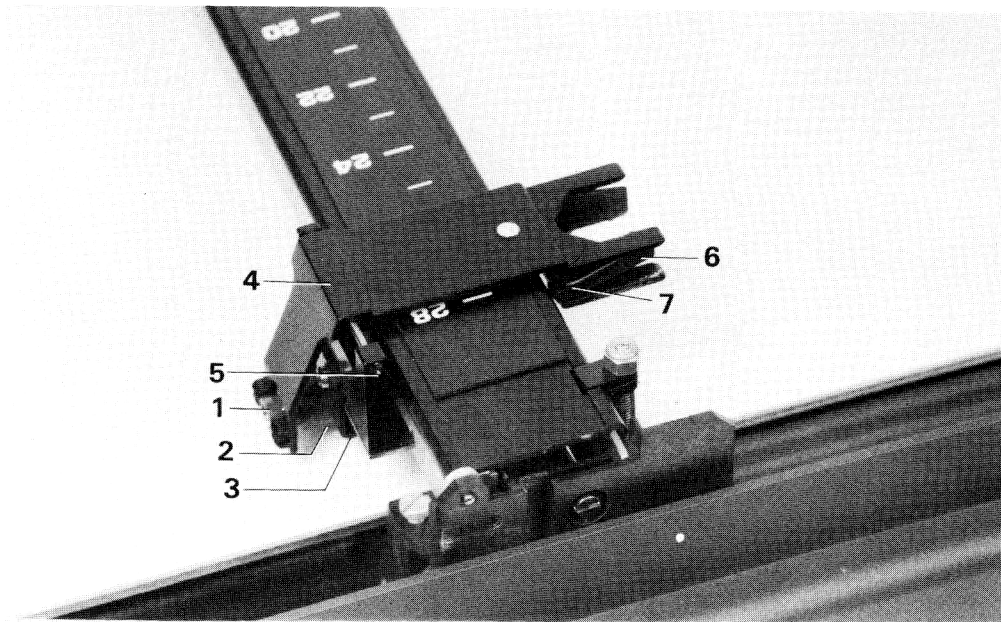
ST 3295

Fig. 2-6



ST 3181
810202

Fig. 2-7



ST 3296

Fig. 2-8



Fig. 2-10

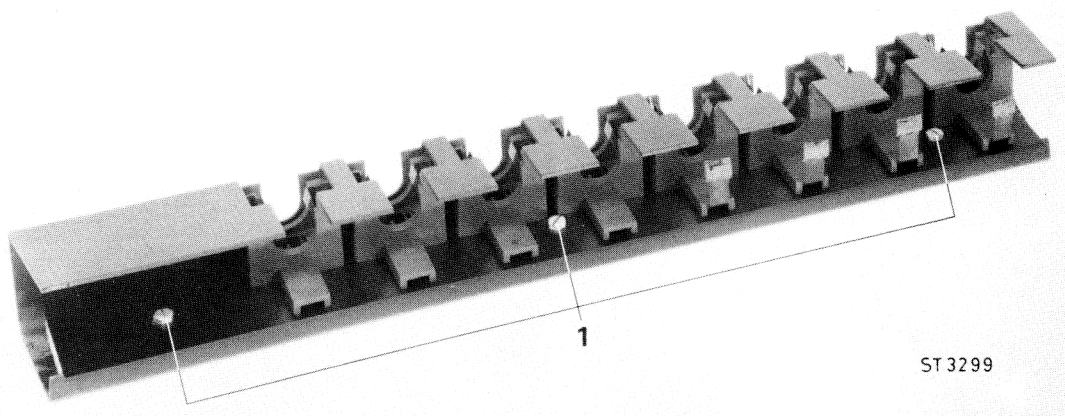


Fig. 2-11

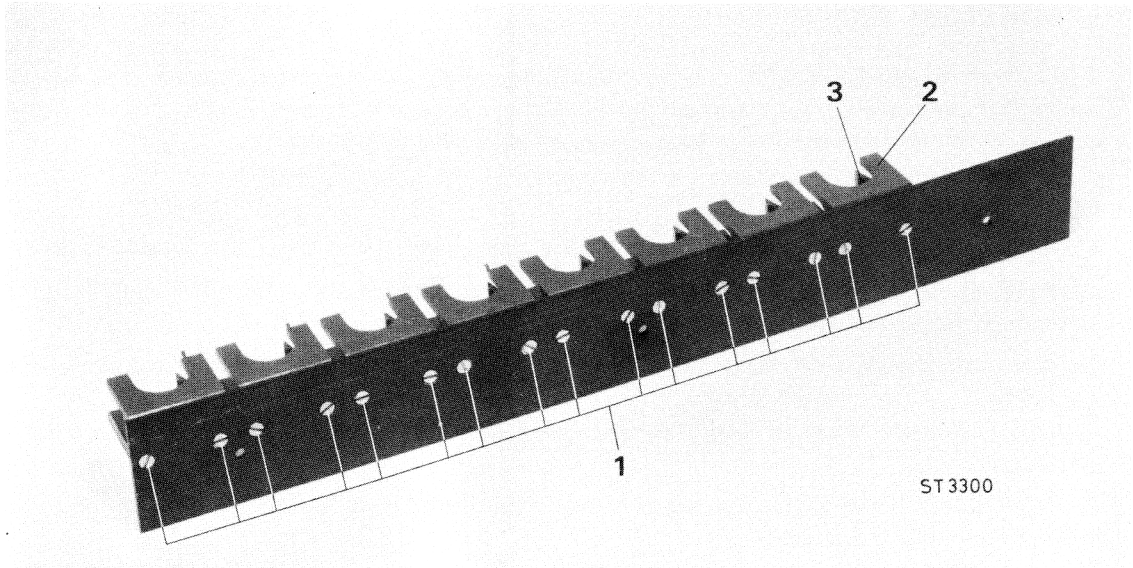


Fig. 2-12

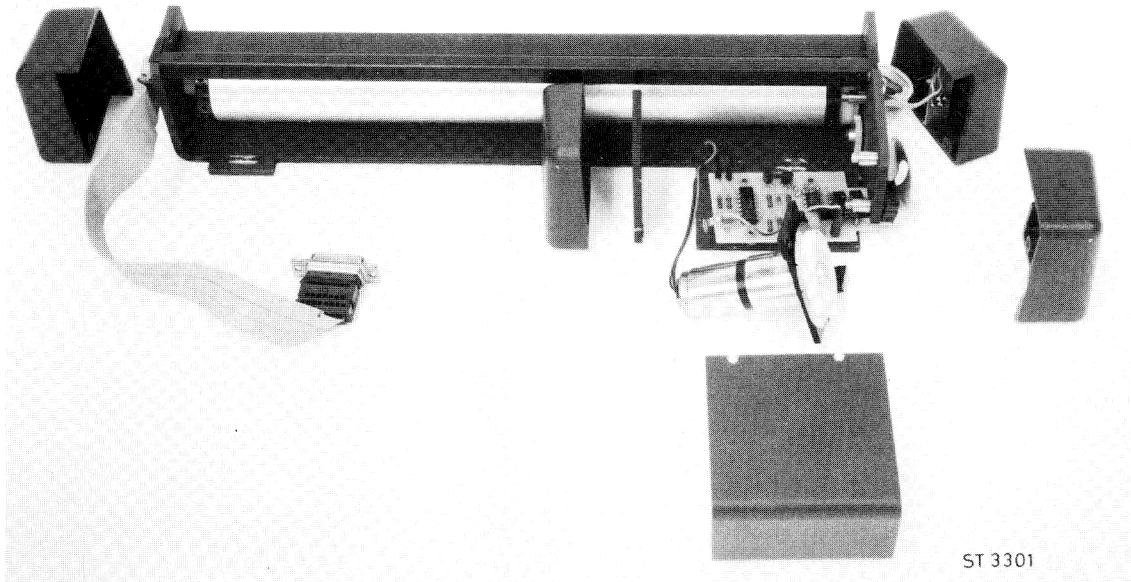


Fig. 2-13

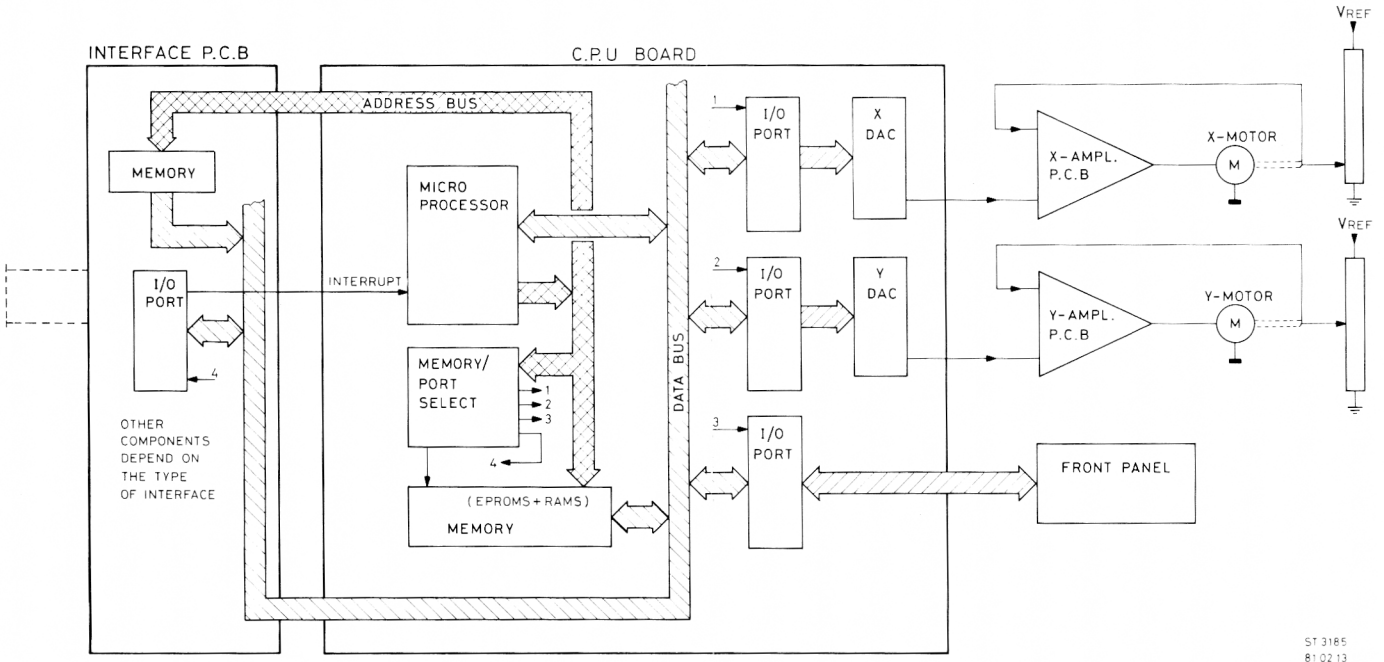


Fig. 3-1

ST 3185
81 02 13

3 CIRCUIT DESCRIPTION

This section first gives a simplified functional description of the complete instrument and then continues with detailed information of all printed-circuit boards. Where necessary, flow-charts of program routines have been included for better understanding of the sequence of actions on these boards.

3.1 SIMPLIFIED DESCRIPTION (Fig. 3 - 1)

This simplified functional description should be read in conjunction with the block diagram, Fig. 3 - 1.

The PM 8151 plotter is controlled by commands given by a controller, which has either an IEC/IEEE bus interface or a serial V24/RS232C interface, depending on the version of the plotter.

These commands are transmitted using the binary codes of ASCII characters that have been allocated to the commands.

Each ASCII character is sent in serial or parallel form, depending on version, to the interface board of the plotter.

Each time an ASCII character is received by the interface board, an INTERRUPT is generated to the microprocessor on the CPU board.

This interrupt signal causes the microprocessor to stop its current program and loads the character into its input buffer memory.

When the microprocessor continues with the main program, it reads the contents of the input buffer and starts with a program part that corresponds with the given command.

For example, assume that the command was 'MOVE TO COORDINATES 100 (for x) 200 (for y)'.

The microprocessor then arranges that the corresponding binary codes for the axes are sent (via the data-bus) to the input/output ports that are connected to the digital-to-analogue converters (X DAC, Y DAC).

The relevant codes now present on the output of the ports are fed to the inputs of the X and Y DACs. As a result, the outputs of the DACs each have a voltage that corresponds with the position of the coordinates.

These voltages are fed to the amplifiers of the servo-systems of the X and Y axes, which produce the required turning motion for the X and Y carriages respectively.

Each motor has a mechanical coupling with the servo potentiometer, which in turn, gives a voltage that corresponds with the position of the carriage. This voltage is fed back to the input of the servo amplifier.

As soon as the voltage from the potentiometer is equal to the output voltage of the DAC, the system is in equilibrium, and, in this example the X carriage is at coordinate 100 and the Y carriage at coordinate 200.

3.2 CPU BOARD

The CPU board of the PM 8151 contains the following circuits:

- central processor
- clock oscillator
- digital-to-analogue converter
- voltage controlled oscillator
- servo 'kill' logic
- pen up/down logic
- ready circuit
- reset circuit
- programmable paper advance logic

3.2.1 Central Processor

The central processor of the PM 8151 is built around a Z-80 microprocessor (μ P) with the 2716 Programmable Read-Only Memory (PROM) as program memory and the 2114 Random Access Memory (RAM) as data memory.

Communication with the hardware control functions and the interfaces is effected with Programmable Input-Output ports (Z-80 PIO).

The instrument firmware is loaded into two PROMs on the CPU board and one on the interface board. The latter contains the specific interface routines and a part of the basic instrument program.

The RAM is split-up into a working memory of 200 bytes for the μ P and an input buffer of 800 bytes. If a command is given by the controller, the μ P is forced by an interrupt to jump to that part of the program containing the input routines.

By this program, the command is put into the input buffer. If the μ P has executed this subroutine, it returns to the main program, and an action relating to the command taken from the input buffer by the μ P is performed by the plotter. The μ P points the instructions in the PROM with the 'ADDRESS BUS' and then the instruction is read by the μ P via the 'DATA-BUS'.

3.2.1.1 Memory addressing

The address of the memory location is selected with the address lines $A_0 \dots A_{10}$, together with a chip enable (CE) signal, which is decoded out of the address lines $A_{10} \dots A_{15}$ as given in the following table:

| MEMORY | A_{15} | A_{14} | A_{13} | A_{12} | A_{11} | A_{10} | ADDRESS (Hex) | $\overline{\text{MREQ}}$ | $\overline{\text{RD}}$ |
|----------------|----------|----------|----------|----------|----------|----------|----------------------|--------------------------|------------------------|
| PROM CPU 1 | 0 | 0 | 0 | 0 | 0 | x | 0 — 7FF | 0 | 0 |
| Interface PROM | 0 | 0 | 0 | 0 | 1 | x | 800 — FFF | 0 | 0 |
| PROM CPU 2 | 0 | 0 | 0 | 1 | 0 | x | 1000 — 17FF | 0 | 0 |
| PROM CPU 3* | 0 | 0 | 0 | 1 | 1 | x | 1800 — 1FFF | 0 | 0 |
| RAM 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2000 — 23 $\phi\phi$ | 0 | x |
| RAM 2** | 0 | 0 | 1 | 0 | 0 | 1 | 2400 — 27FF | 0 | x |

* Optional PROM for special characters

** Optional RAM for input buffer expansion

Decoding is achieved by the chip select circuit IC4 and IC6. The signals $\overline{\text{MREQ}}$, A_{13} and $\overline{\text{RD}}$ first select the memory, and then select between PROMs and RAM.

The 1k x 8 RAM is built from two 1k x 4 RAMs, which have the same $\overline{\text{CE}}$ signal. The four least-significant bits of a data byte are stored in IC8, and the four most-significant bits in IC10.

3.2.1.2 PIO addressing

To select the PIOs that serve as input-output devices between the μP and the hardware control functions or the interface, the address lines $A_0 \dots A_5$ and A_7 are decoded in the PIO select circuit as given in the table below:

| I/O DEVICE | | A_0 | A_1 | A_2 | A_3 | A_4 | A_5 | A_7 | ADDRESS (Hex) | $\overline{\text{IORQ}}$ |
|---------------|--------|-------|-------|-------|-------|-------|-------|-------|---------------|--------------------------|
| PIO 1 | PORT A | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 4 | 0 |
| | PORT B | 1 | 0 | | | | | | 5 | |
| PIO 2 | PORT A | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 8 | 0 |
| | PORT B | 1 | 0 | | | | | | 9 | |
| PIO 3 | PORT A | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 10 | 0 |
| | PORT B | 1 | 0 | | | | | | 11 | |
| PIO Interface | PORT A | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 20 | 0 |
| | PORT B | 1 | 0 | | | | | | 21 | |

The $\overline{\text{IORQ}}$ signal is used in conjunction with the B/A select (A_0), $\overline{\text{CE}}$ and $\overline{\text{RD}}$ signals to transfer commands and data between the μP and the Z-80 PIO.

When $\overline{\text{CE}}$, $\overline{\text{RD}}$ and $\overline{\text{IORQ}}$ are active, the port selected by B/A will transfer data to the μP . Conversely, when $\overline{\text{CE}}$ and $\overline{\text{IORQ}}$ are active, but $\overline{\text{RD}}$ is not active, the port addressed by A/B select will be written into from the μP with either data or control information as specified by the C/D signal.

3.2.1.3 Z-80 μ P pin description for PM 8151

The Z-80 μ P is packaged in an industrial standard 40-pin Dual In-line Package.

The I/O pins are shown in the figure below together with a description of the function of each.

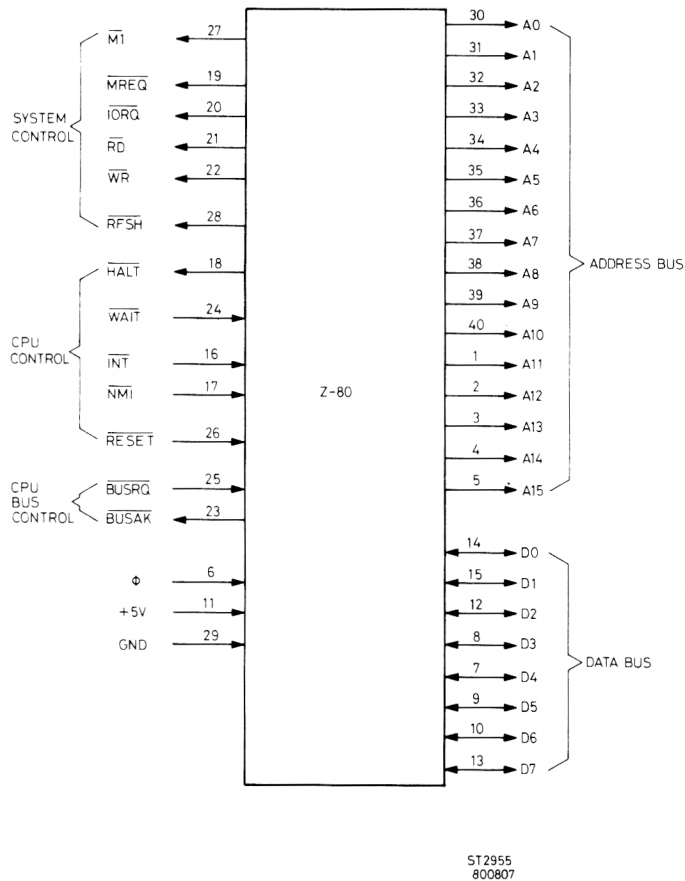


Fig. 3 - 2.

$A_0 - A_{15}$
(Address Bus)

Tri-state output, active high. $A_0 - A_{15}$ constitutes a 16-bit address bus, which provides the address for memory (up to 64K bytes) data exchanges and for I/O device data exchanges. I/O addressing uses the eight lower address bits to allow the user to directly select up to 256 output ports. A_0 is the least-significant address bit.

$D_0 - D_7$
(Data Bus)

Tri-state input/output, active high. $D_0 - D_7$ constitute an 8-bit bidirectional data bus, used for data exchanges with memory and I/O devices.

\overline{M}_1
(Machine Cycle one)

Output active low. \overline{M}_1 indicates that the current machine cycle is the OP code fetch cycle of an instruction execution. Note that during execution of 2-byte op-code, \overline{M}_1 is generated as each op byte is fetched. This two-byte op-code always begins with CBH, DDH, EDH or FDH. \overline{M}_1 also occurs with IORQ to indicate an interrupt acknowledge cycle.

\overline{MREQ}
(Memory Request)

Tri-state output, active low. The memory request signal indicates that the address bus holds a valid address for a memory read or memory write operation.

| | |
|---|--|
| $\overline{\text{IORQ}}$ (Input/Output Request) | Tri-state output, active low. The $\overline{\text{IORQ}}$ signal indicates that the lower 7 bits of the lower 7 bits of the address bus holds a valid I/O address for an I/O read or write operation. An $\overline{\text{IORQ}}$ signal is also generated with an $\overline{\text{M}}_1$ signal when an interrupt is being acknowledged, to indicate that an interrupt response vector can be placed on the data bus. Interrupt Acknowledge operations occur during $\overline{\text{M}}_1$ time while I/O operations never occur during $\overline{\text{M}}_1$ time. |
| $\overline{\text{RD}}$ (Memory Read) | Tri-state output, active low. $\overline{\text{RD}}$ indicates that the μP wants to read data from memory or an I/O device. The addressed I/O device or memory should use this signal to gate data on to the CPU data bus. |
| $\overline{\text{WR}}$ (Memory Write) | Tri-state output, active low. $\overline{\text{WR}}$ indicates that the μP data bus holds valid data to be stored in the addressed memory of the I/O device. |
| $\overline{\text{RFSH}}$ (Refresh) | Not used in PM 8151 |
| $\overline{\text{HALT}}$ (Halt state) | Not used in PM 8151, except in case of error; |
| $\overline{\text{WAIT}}$ | Not used in PM 8151 |
| $\overline{\text{INT}}$ (Interrupt Request) | Input, active low. The Interrupt Request signal is generated by I/O devices. A request will be honoured at the end of the current instruction if the internal software-controlled interrupt enable flip-flop (IFF) is enabled and if the $\overline{\text{BUSRQ}}$ signal is not active. When the μP accepts the interrupt, an acknowledge signal ($\overline{\text{IORQ}}$ during M_1 time) is sent out at the start of the next instruction cycle. |
| $\overline{\text{NMI}}$ (Non-Maskable Interrupt) | Input, negative-edge triggered. The non-maskable interrupt request line has a higher priority than $\overline{\text{INT}}$ and is always recognised at the end of the current instruction, independent of the state of the interrupt enable flip-flop. $\overline{\text{NMI}}$ automatically forces the Z-80 μP to restart at location 0066_{H} . The program counter is automatically saved in the external stack to enable the μP to return to the program that was interrupted. This $\overline{\text{NMI}}$ signal is generated by the voltage-controlled oscillator to control the speed of linear interpolation. |
| $\overline{\text{RESET}}$ | Input, active low. $\overline{\text{RESET}}$ forces the program counter to zero and initialises the μP . This initialisation includes: 1) Disable the interrupt enable flip-flop 2) Set Register 1 = 00_{H} 3) Set Register R = 00_{H} 4) Set Interrupt Mode 0 During the reset time, the address bus and data bus go to a high impedance state and all control output signals go to the inactive state. |
| $\overline{\text{BUSRQ}}$ (Bus Request) | Not used in PM 8151 |
| $\overline{\text{BUSAK}}$ (Bus Acknowledge) | Not used in PM 8151 |
| ϕ | Single phase TTL-level clock. |

3.2.1.4 Z-80 PIO pin description for PM 8151

A diagram of the Z80-PIO pin configuration is given below, with a description of the pin functions.

| | |
|----------------------|---|
| $D_7 - D_0$ | Z80- μ P Data Bus (bidirectional, tri-state). This bus is used to transfer all data and commands between the Z80- μ P and the Z80-PIO. D_0 is the least-significant bit of the bus. |
| $\overline{B/A}$ Sel | Port B or A Select (input, active high). This pin defines which port will be accessed during a data transfer between the Z80- μ P and the Z80-PIO. A low level on this pin selects Port A; a high level selects Port B. Address bit A_0 from the μ P is often used for this selection function. |
| $\overline{C/D}$ Sel | Control or Data Select (input, active high). This pin defines the type of data transfer to be performed between the μ P and the PIO. A high level on this pin during a μ P write to the PIO causes the Z80 data bus to be interpreted as a command for the port selected by the B/A Select line. A low level on this pin means that the Z80 data bus is being used to transfer data between the μ P and the PIO. Address bit A_1 from the μ P is often used for this function. |
| \overline{CE} | Chip Enable (input, active low). A low level on this pin enables the PIO to accept command or data inputs from the μ P during a write cycle or to transmit data to the μ P during a read cycle. This signal is generally a decode of four I/O port numbers that encompass port A and B, data and control. |
| ϕ | System Clock (input) The Z80-PIO uses the standard Z80 system clock to synchronise certain signals internally. This is a single-phase clock. |
| $\overline{M1}$ | Machine-Cycle-One Signal from μ P (input, active low). This signal from the μ P is used as a sync pulse to control several internal PIO operations. When $\overline{M1}$ is active and the \overline{RD} signal is active, the Z80- μ P is fetching an instruction from memory. Conversely, when $\overline{M1}$ is active and \overline{IORQ} is active, the μ P is acknowledging an interrupt. In addition, the $\overline{M1}$ signal has two other functions within the Z80-PIO: 1) $\overline{M1}$ synchronises the PIO interrupt logic. 2) When $\overline{M1}$ occurs without an active \overline{RD} or \overline{IORQ} signal the PIO logic enters a reset state. |
| \overline{IORQ} | Input/Output Request from Z80- μ P (input, active low). The \overline{IORQ} signal is used in conjunction with the B/A Select, C/D, and RD signals to transfer commands and data between the Z80- μ P and the Z80-PIO. When \overline{CE} , \overline{RD} and \overline{IORQ} are active, the port addressed by B/A will transfer data to the CPU (a read operation). Conversely, when \overline{CE} and \overline{IORQ} are active, but \overline{RD} is not active, then the port addressed by B/A will be written into from the μ P with either data or control information as specified by the C/D Select signal. |
| \overline{RD} | Also, if \overline{IORQ} and $\overline{M1}$ are active simultaneously, the μ P is acknowledging an interrupt and the interrupting port will automatically place its interrupt vector on the μ P data bus if it is the highest priority device requesting interrupt. |
| $\overline{IE1}$ | Read Cycle Status from the Z80- μ P (input, active low). If \overline{RD} is active, a MEMORY READ or I/O READ operation is in progress. The \overline{RD} signal is used with B/A Select, CE, and \overline{IORQ} signals to transfer data from the Z80-PIO to the Z80- μ P. |
| | Interrupt Enable In (input, active high). This signal is used to form a priority interrupt daisychain when more than one interrupt-driven device is being used. A high level on this pin indicates that no other devices of higher priority are being serviced by a μ P interrupt service routine. |

- IEO Interrupt Enable Out (output, active high).
The IEO signal is the other signal required to form a daisy-chain priority scheme. It is high only if IEI is high and the μ P is not servicing an interrupt from this PIO. Thus this signal prevents a lower priority device being serviced by its μ P interrupt service routine.
- $\overline{\text{INT}}$ Interrupt Request (output, open drain, active low).
When INT is active, the Z80-PIO is requesting an interrupt from the Z80- μ P.
- $A_0 - A_7$ Port A Bus (bidirectional, tri-state)
This 8-bits bus is used to transfer data and/or status or control information between Port A of the Z80-PIO and control circuits (e.g. DAC).
 A_0 is the least-significant bit of the Port A data bus.
- $\overline{\text{A STB}}$ Port A Strobe Pulse from Peripheral Device (input, active low).
Not used in the PM 8151.
- A RDY Register A Ready (output, active high).
Not used in the PM 8151.
- $B_0 - B_7$ Port B Bus (bidirectional, tri-state).
This 8-bit bus is used to transfer data and/or status or control information between Port B of the PIO and a peripheral device.
The Port B data bus is capable of supplying 1.5 mA at 1.5 V to drive Darlington transistors.
 B_0 is the least-significant bit of the bus.
- $\overline{\text{B STB}}$ Port B Strobe Pulse from Peripheral Device (input, active low).
Not used in the PM 8151.
- B RDY Register B Ready (output, active high).
Not used in the PM 8151.

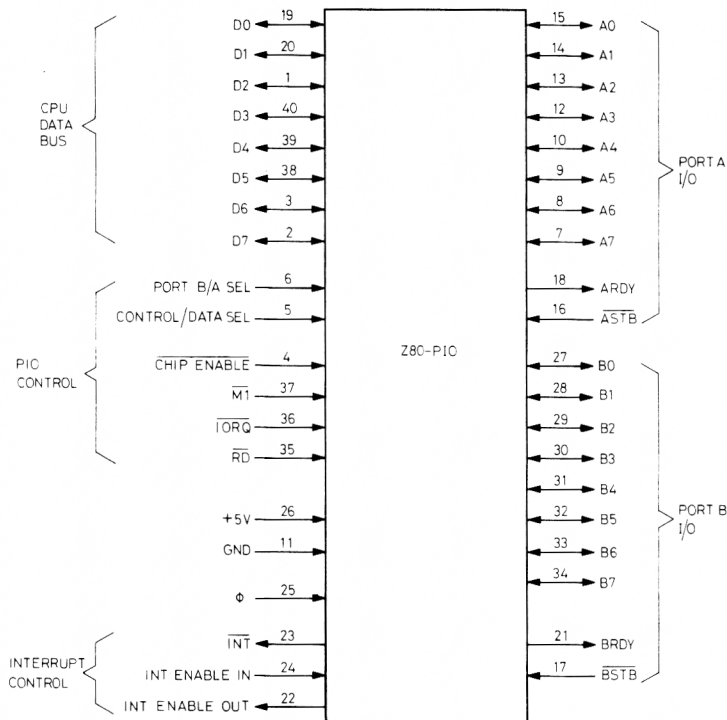


Fig. 3 - 3.

3.2.4 Voltage-Controlled Oscillator (IC1)

The voltage-controlled oscillator is used to control the speed for the linear interpolation. All drawing actions of the plotter are executed with the aid of linear interpolation.

The points by which a drawing is built-up are calculated by the μP . After a non-maskable interrupt of the μP , the new calculated point is transferred to the D/A converters. These non-maskable interrupts are generated by the voltage-controlled oscillator (VCO). This means that the output frequency of the VCO controls the speed of the linear interpolation and thus the writing speed of the plotter.

The frequency of the VCO is controlled by a 3-bit digital-to-analogue converter, consisting of the resistor network R27, R25, R23, R21, R24 and R26. The output voltage of this D/A converter is smoothed by capacitor C12. Via T1, connected as a voltage-follower, the output voltage of the D/A converter controls the VCO (IC1). The linear interpolation does not start at maximum speed, but accelerates within approximately 12 mm distance from zero to maximum.

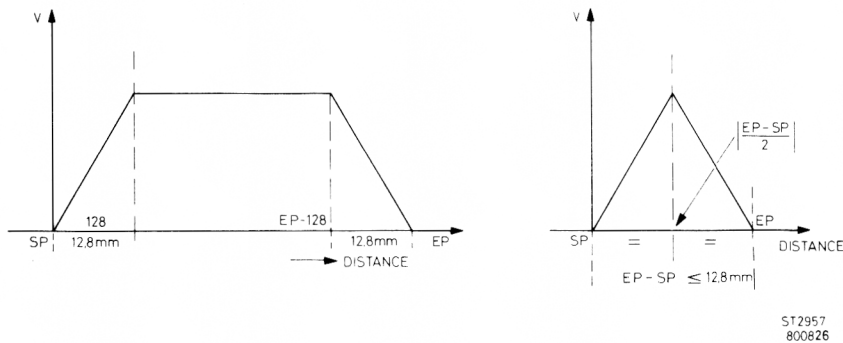


Fig. 3 - 5.

If the distance between starting point and end point is smaller than 12.8 mm, the speed will increase during the first half of the distance, and decrease during the second half of the distance ('high').

The signal ENABLE VCO (IC1/6) starts the linear interpolation. ENABLE VCO stops the linear interpolation.

If switch S1/5 (FLOW) is closed, the frequency control input is set at a fixed voltage. The linear interpolation is now executed at a low speed without acceleration.

With switch S1/4 (FADJ) closed, the VCO is continuously enabled, and at the same time the μP is permanently reset.

In this case, the VCO can be adjusted at the high frequency (1550 Hz) by capacitors C10 and C11.

The low frequency is adjusted to 580 Hz by means of potentiometer R5.

3.2.5 Servo 'Kill' Logic

The servo 'kill' logic is controlled by output B5 from PIO 1 (IC15/32). A logic 0 will kill the servo-system.

The +5 V supply of this circuit is the output of the Power-On delay circuit. Therefore, the servo-system will be active after a certain delay following power-on. This delay is necessary to safeguard the plotter against uncontrolled actions of the servo-system immediately after switching-on the instrument.

NOTE: *In the first instruments, this delay is effected by capacitor C7.
In later instruments, this power-on delay circuit is located on the mother board.*

The output signal SVO of the servo 'kill' logic controls the servo 'kill' relay on the voltage regulator/standby printed-circuit board.

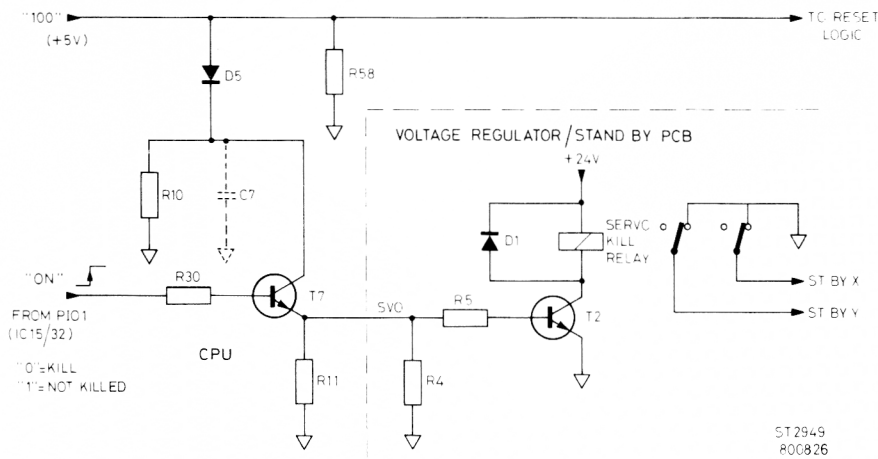


Fig. 3 - 6.

3.2.6 Pen Up/Down Logic

The pen-lift is controlled manually or remotely by the central processor.

Transistor T2 acts as a buffer voltage-follower for the pen control circuit of the voltage regulator/standby p.c.b. At a logic 0 from the PIO, the signal PEN is logic 0, if the PEN switch is in the REMOTE state. In this case, T1 is conductive. At a logic 1 of SVO, T3 is also conductive, and the pen UP/DOWN magnet is activated, which results in a pen DOWN.

If the SVO signal is logic 0, the pen will be lifted continuously. Also a logic 1 from the PIO results in a lifted pen.

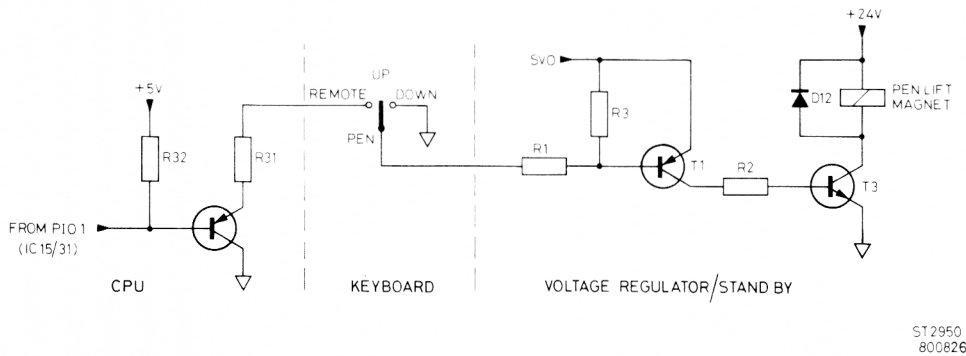
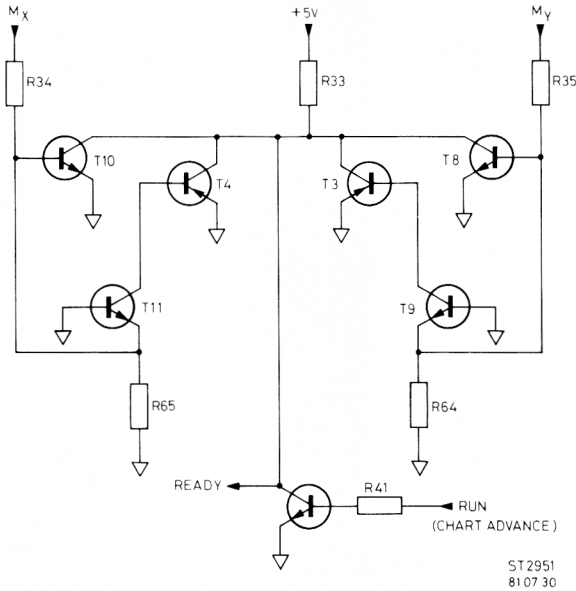


Fig. 3 - 7.

3.2.7. Ready circuit

To indicate the central processor that the X or Y servo system is still active, (executing a command) the output of the amplifiers is applied to a ready circuit which generates a READY signal if both outputs are smaller or equal to approximately $|0.8V|$ if M_x is larger than $|0.8V|$ depending on the polarity. T10, or T11 is conductive. If T11 is conductive, T14 will be conductive too. So in both cases the READY signal will be zero, indicating NOT READY via PIO 3 to the central processor. If M_Y is larger than $|0.8V|$ the same effect is happened via T8 or T3 and T9. Also when signal RUN is logic 1, indicating that the chart transport is functioning, READY is logic "0" and forbids executing of the next command.

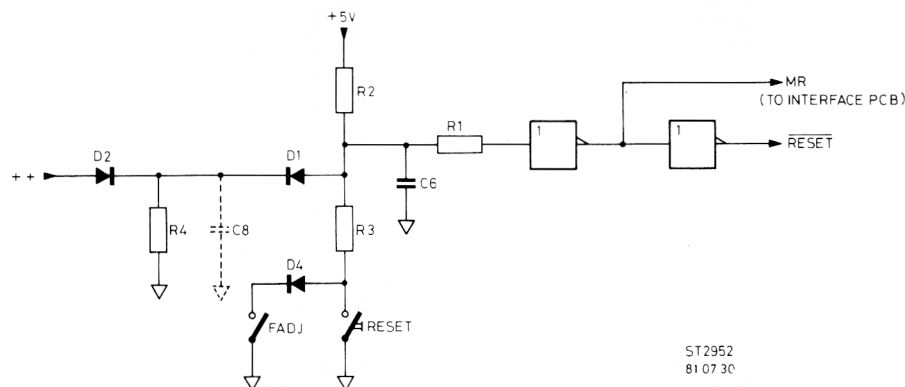


3.2.8. Reset logic

The RESET signal forces the program counter of the μP to zero and initializes them. During rest time the address bus and data bus go to a high impedance state and all control output signals go to an in active state. The RESET signal is active (low) if:

- the pushbutton RESET is depressed.
- switch FADJ is switched on.
- power on signal "100" has not reached the 5V level.
- capacitor C6 has not been charged completely after power on.

NOTE: *In the first instruments the power on delay is effected by capacitor C8. In the present instrument, the power on delay circuit, which the signal "100" generates, is located at the mother board.*



3.2.9 Programmable Paper Advance Logic

If an optional chart advance unit PM 9886 is fitted, the paper advance is controlled by the central processor. Initiating paper advance can be done in two ways:

- programmable via an ASCII character "U" from the controller,
- manual via a request to advance by depressing the ADVANCE pushbutton on the unit.

The relation between the control signals BW and RUN is shown in the timing diagram. If the chart is running, RUN is logic 1 and READY is logic 0, indicating NOT READY; this signal prevents the central processor from executing the next command.

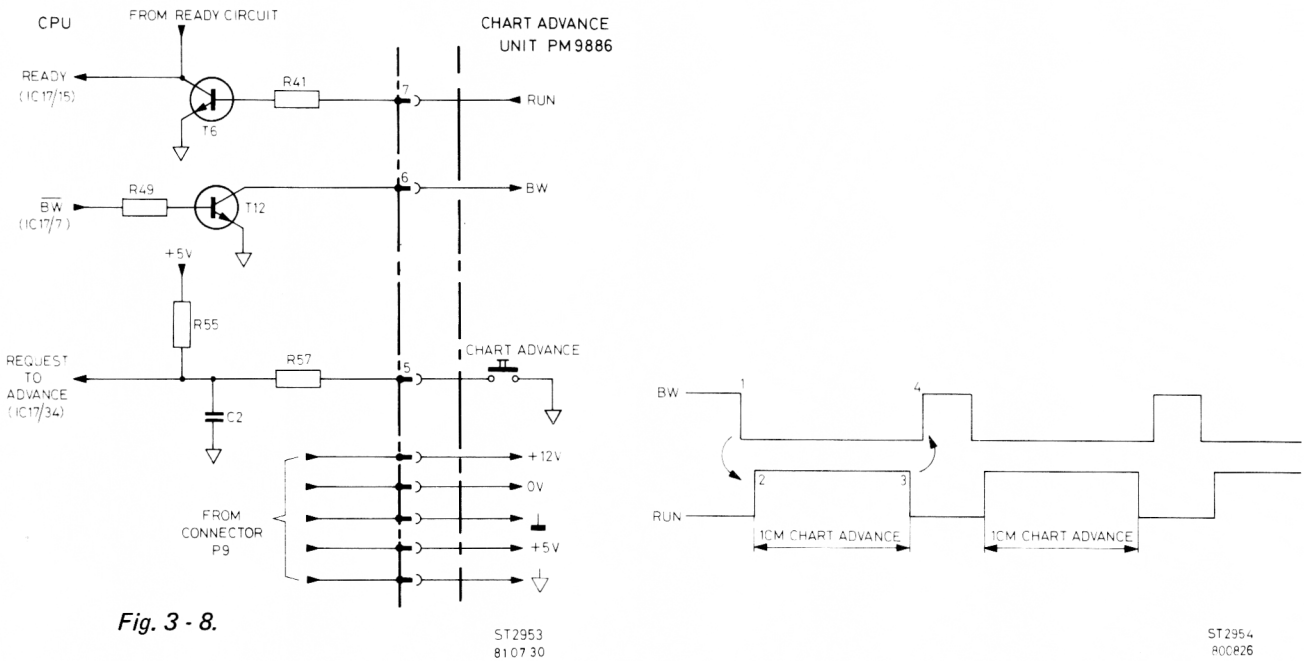


Fig. 3 - 8.

3.2.10 Flow-Charts

The following flow-charts give a basic idea of the instrument firmware.

They are intended to serve as a guide for understanding the functions of the instrument and do not pretend to be a complete firmware description.

3.2.10.1 Priority level of the routines

After initialisation, the instrument firmware can be divided into three priority levels:

- highest priority 1: Linear interpolation
- priority 2: Interface handling
- priority 3: Main program

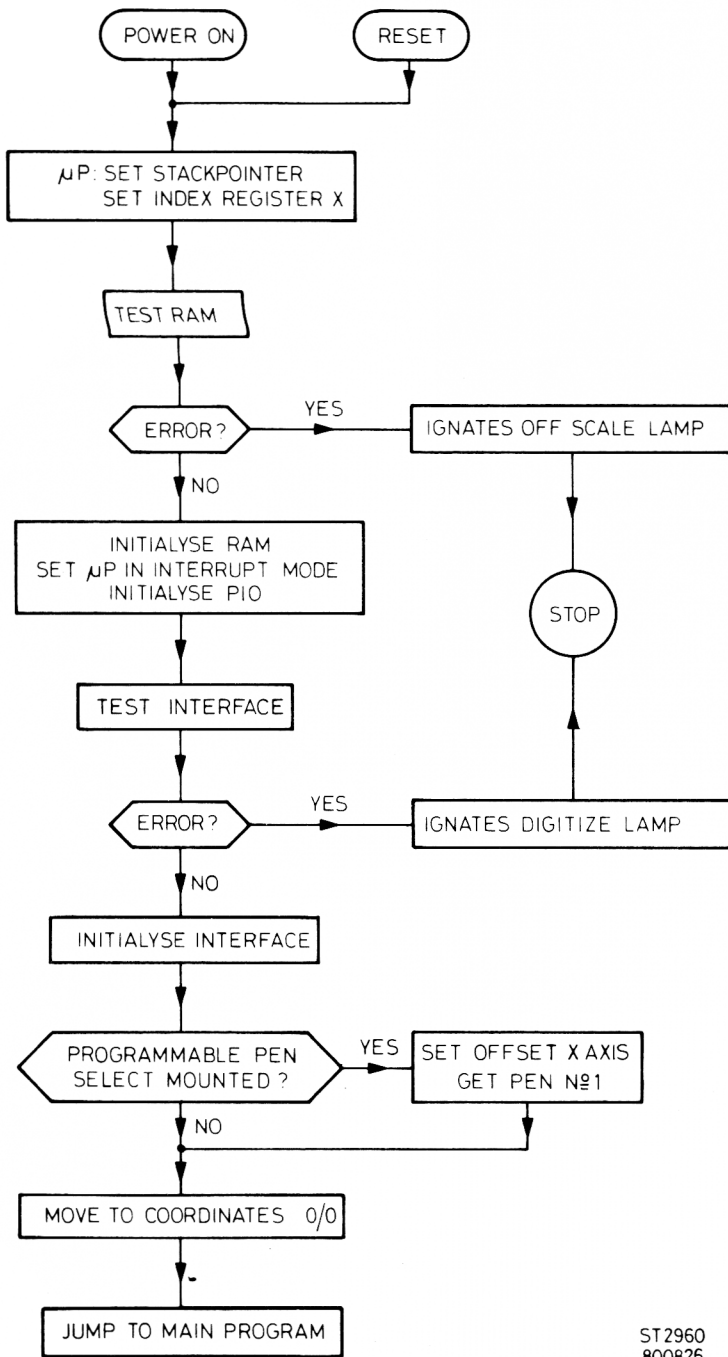
Linear interpolation is achieved by a non-maskable interrupt generated by the voltage-controlled oscillator (VCO).

Interface handling is achieved by an interrupt given by the interface.

In all other cases the instrument jumps to the main program.

The flow-chart for the interface handling is given in the interface description.

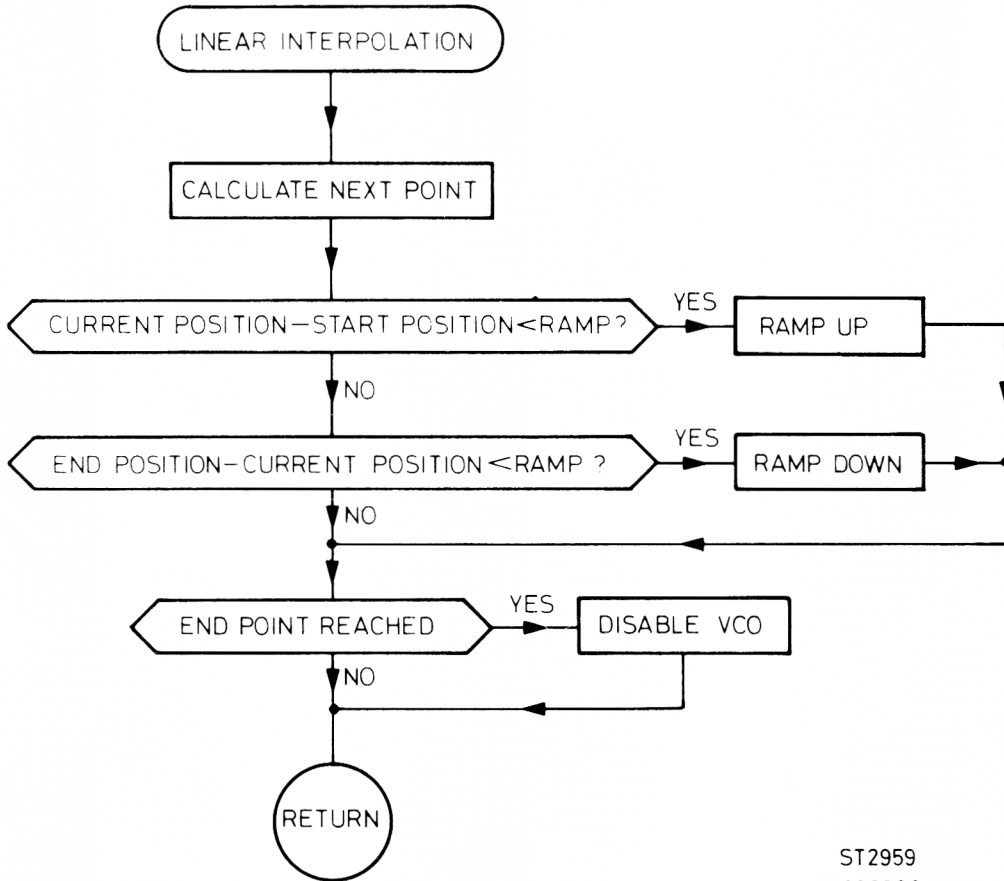
3.2.10.2 Initialisation



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3.2.10.3 Linear interpolation

At a non maskable interrupt, the central processor jumps to the sub-routine called linear interpolation, which is used to calculate the next point of a drawing. See also 3.2.4.



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The binary coded RAMP signal is applied to the A/D convertor of the VCO. The level of this RAMP signal defines the speed of the linear interpolation and thus the writing speed of the plotter. The length of the RAMP is calculated as follows:

$$\left| \frac{\text{Startpoint} - \text{Endpoint}}{2} \right| \geq 128 \rightarrow \text{length of RAMP} = 128$$

$$\left| \frac{\text{Startpoint} - \text{Endpoint}}{2} \right| < 128 \rightarrow \text{length of RAMP} = \left| \frac{\text{Startpoint} - \text{Endpoint}}{2} \right|$$

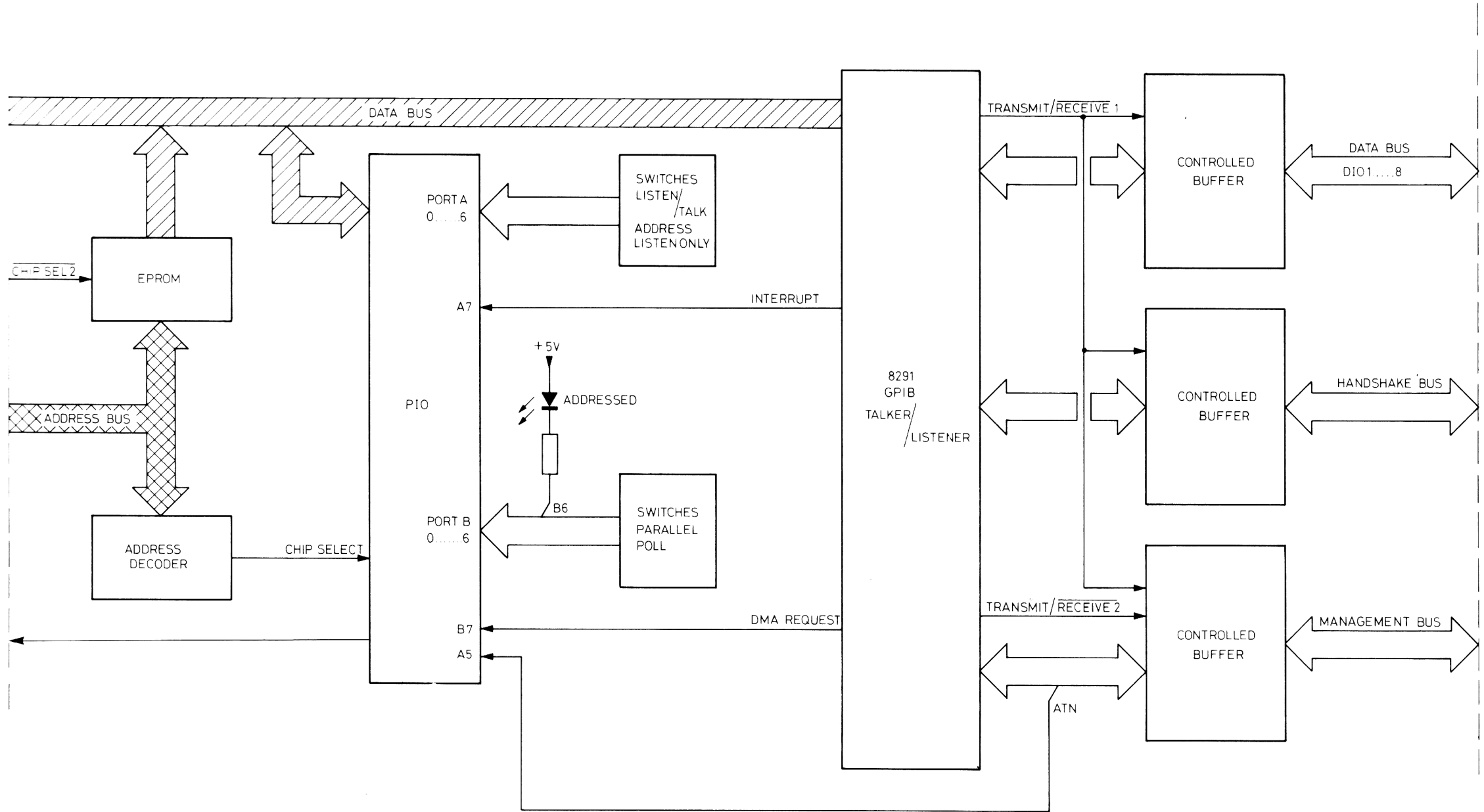
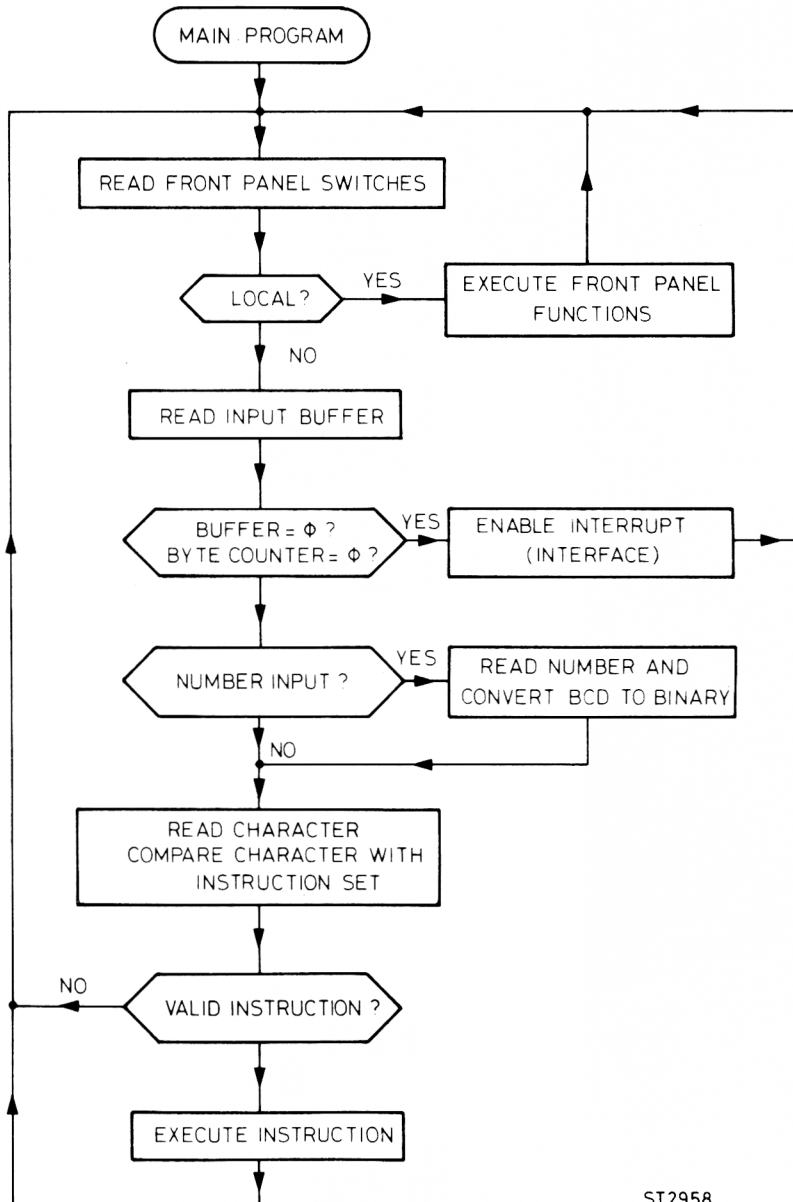


Fig. 3-10

3.2.10.4 Main program

This part of the program is situated in the interface PROM.



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3.3 IEC 625/IEEE 488 BUS INTERFACE

3.3.1 General Description (Block diagram Fig. 3.10 and circuit diagram)

An IEC-bus interface is used in multi-device systems to connect the instruments in parallel to the same interface lines. Each instrument has its own specific address (switch-selectable in the instrument) so that an instrument is listening only after it receives its specific address; in IEC terms, My Listen Address (MLA). The listen addresses are generated by the controller of the system (computer) and are then transmitted via the data lines of the bus. During an address or interface message, the attention line (ATN) is active to indicate that the information on the data lines has a special interface function.

The IEC bus can be subdivided into three functional parts; the data bus, the handshake bus and the management bus. These three functions can be briefly described as follows:

- The Data Bus: used to transport messages for the device functions as well as for the interface functions.
It consists of eight lines (DIO 1 . . . DIO 8).
- The Handshake Bus: controls the correct transfer of data bytes using the following three signals:
 - Data Valid (DAV) which indicates the condition of information on the 8 DIO lines.
 - Not Ready For Data (NRFD) which indicates the condition of readiness of device(s) to accept data.
 - Not Data Accepted (NDAC) which indicates the condition of acceptance of data by devices.

A timing diagram for the handshake cycle is shown in Fig. 3.11. Note that the speed of the cycle is only as fast as the slowest instrument.

- The Management Bus: used to manage an orderly flow of information across the interface. For this purpose, the following five signals are available:
 - Attention (ATN) which specifies how data on the DIO lines are to be interpreted:
Active indicates a message is transferred via the data bus (e.g. a listen address).
The ATN signal is non-active during normal data transfer (e.g. a command for the plotter).
 - Interface Clear (IFC) which places the interfaces of all interconnected devices in a known quiescent state.
 - Service Request (SRQ) indicating that one of the instruments wants the attention of the controller e.g. to give an error message.
 - Remote Enable (REN) to set an addressed instrument to its remote control mode. Not used for PM 8151.
 - End Or Identify (EOI) used to indicate the end of a multiple byte transfer, or as identify line during a Parallel Poll.

NOTE: Because of the negative logic used for the IEC-bus, the signals are 'true' (active) when they have a low level. However, all signals at the left-hand side of the buffers are given in positive logic, so 'true' is a high level.

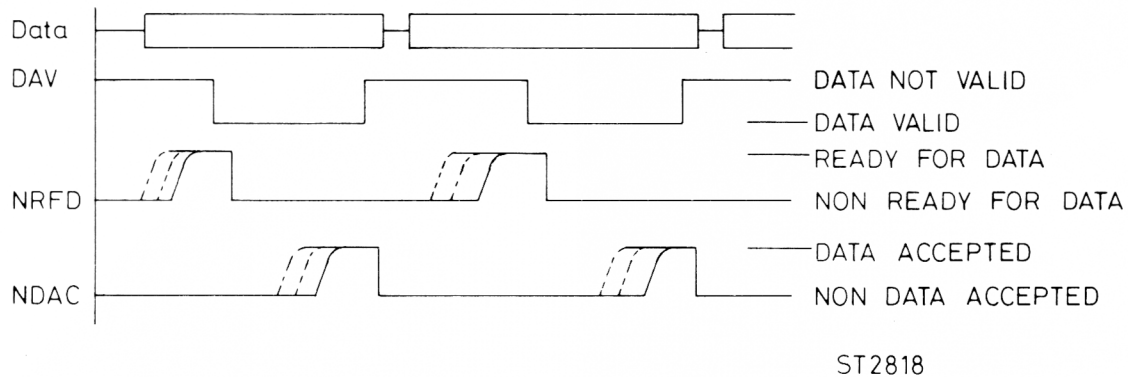


Fig. 3 - 11.

The IEC 625/IEEE 488 bus interface p.c.b. consists of the following parts:

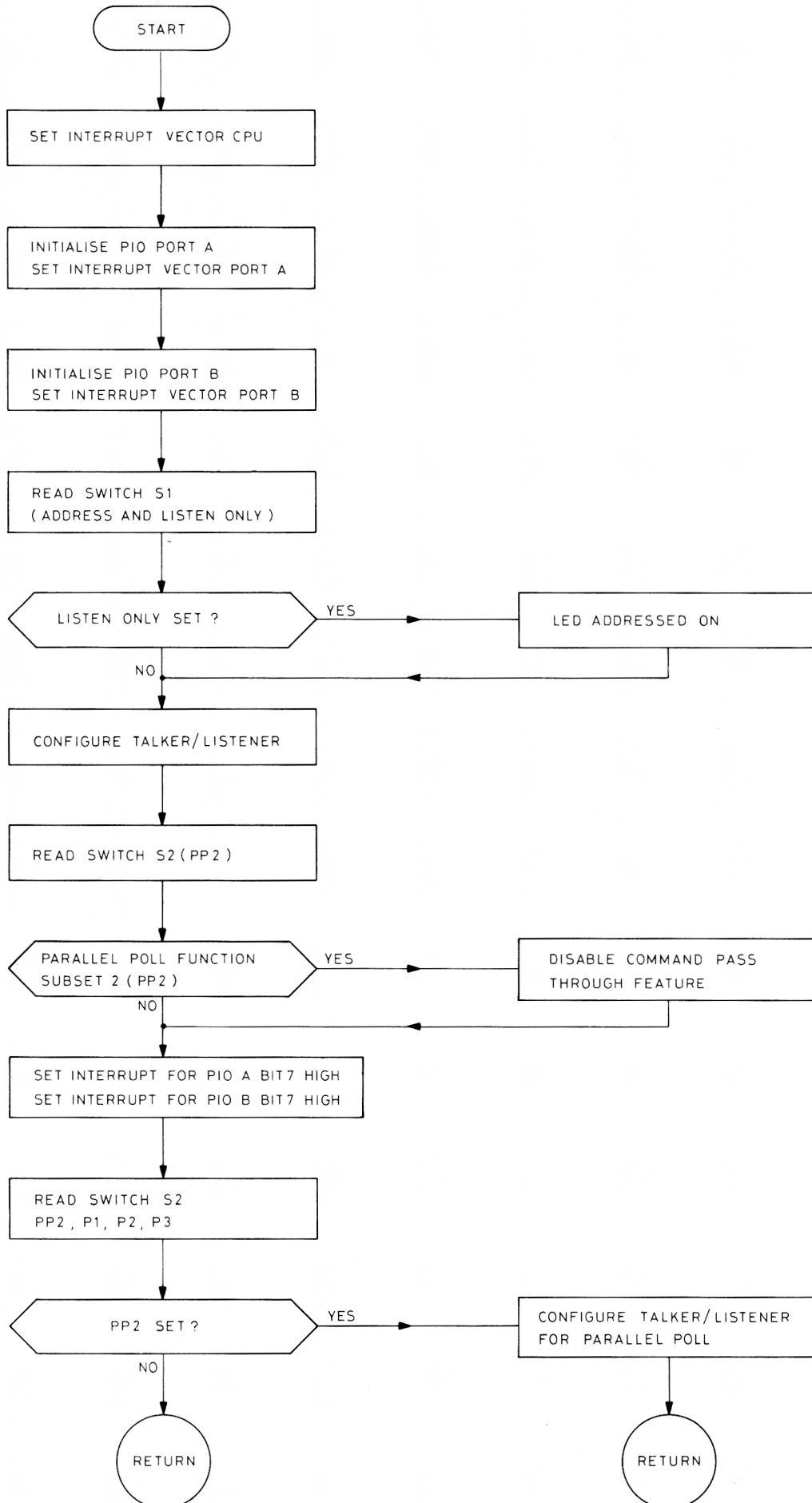
- EPROM, which has been loaded with part of the main program as well as the complete program for handling the IEC 625 protocol. The relevant program parts are dealt with on Page 45 - 54. The addresses of the EPROM are 0800 . . . 0FFF (Hex.).
- ADDRESS DECODER for selecting the PIO. The output of this circuit, IC9 pin 8 (\overline{CS}) is 'true' (low) if $A6 = 1$, $A5 = 0$, and $A7 = 0$.
- Z80-PIO. This integrated circuit is used as two 8-bit input ports.
 With port A the μP reads the status of the Listen/Talk address switches and the Listen Only switch during initialisation. Bit 7 is connected to the interrupt output of IC6 and causes an interrupt (IC5 pin 23) for the μP and an interrupt vector to the interface-state changes and output routine (see Program parts, Page 45 - 54).
 With port B the μP reads the status of the parallel poll switches during initialisation. Bit 7 has been connected to the Direct Memory Access REQuest output (DMAREQ) of IC6 and causes an interrupt (IC5 pin 23) for the μP and an interrupt vector to the input routine (see Program parts, Page 45 - 54), i.e. in the case of commands for the plotter; not for interface messages.
 Information on the Z80-PIO is given in Section 3.2.1.
- 8291 GPIB TALKER/LISTENER integrated circuit. The 8291 IC handles the communication between the CPU board and the interface bus. Its capabilities include data transfer, handshake, protocol, talker/listener procedures, device clearing, service request, and both parallel and serial polling schemes. In most procedures it does not disturb the μP unless a byte is awaiting input, or a byte being sent on output (output buffer empty).
 The chip includes 16 registers, eight of which may be written into by the μP and the other eight may be read. One of the read and write registers is used for the data transfer, while the other read registers are used to monitor the states of the interface bus and the various bus conditions. The write registers control the various features of the chip, such as masking of interrupts. For further details of the 8291, see section 6.
- CONTROLLED BUFFERS. Four chips (type 3448) are used as non-inverting bus transceivers (with open collector).
 The bus lines are enabled and disabled by the signals Transmit/Receive 1 and 2, which are controlled by the 8291 chip, with the exception of the signals IFC, REN, SRQ and ATN, which are unidirectional signals.

3.3.2 Flow Charts

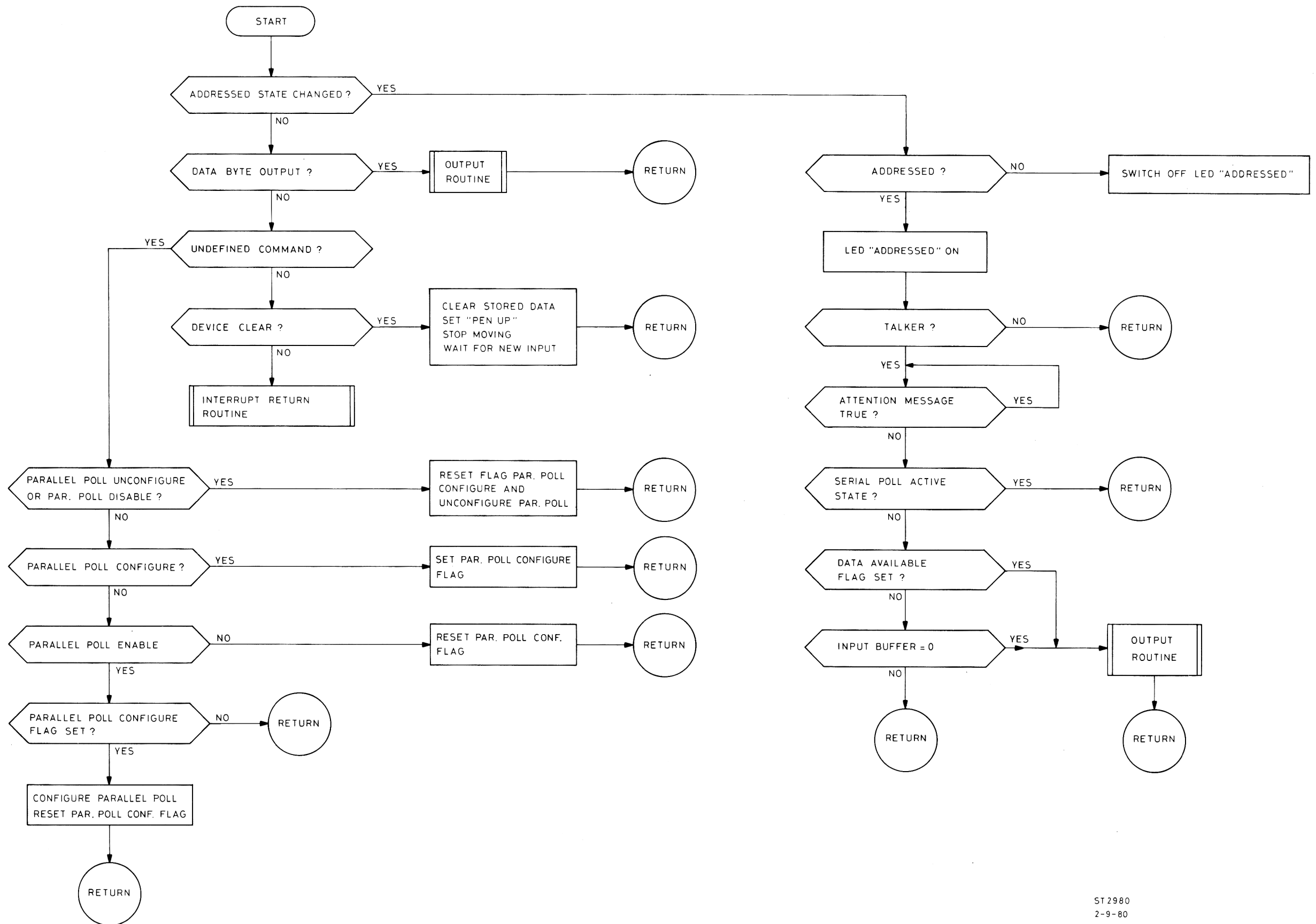
To explain the functioning of the interface board, the following flow-charts have been included:

- Initialisation of the interface
- Interrupt by interface-state changes and output availability
- Input routine
- Return from interrupt routine
- Output routine
- Digitise output
- Status routine
- Main program

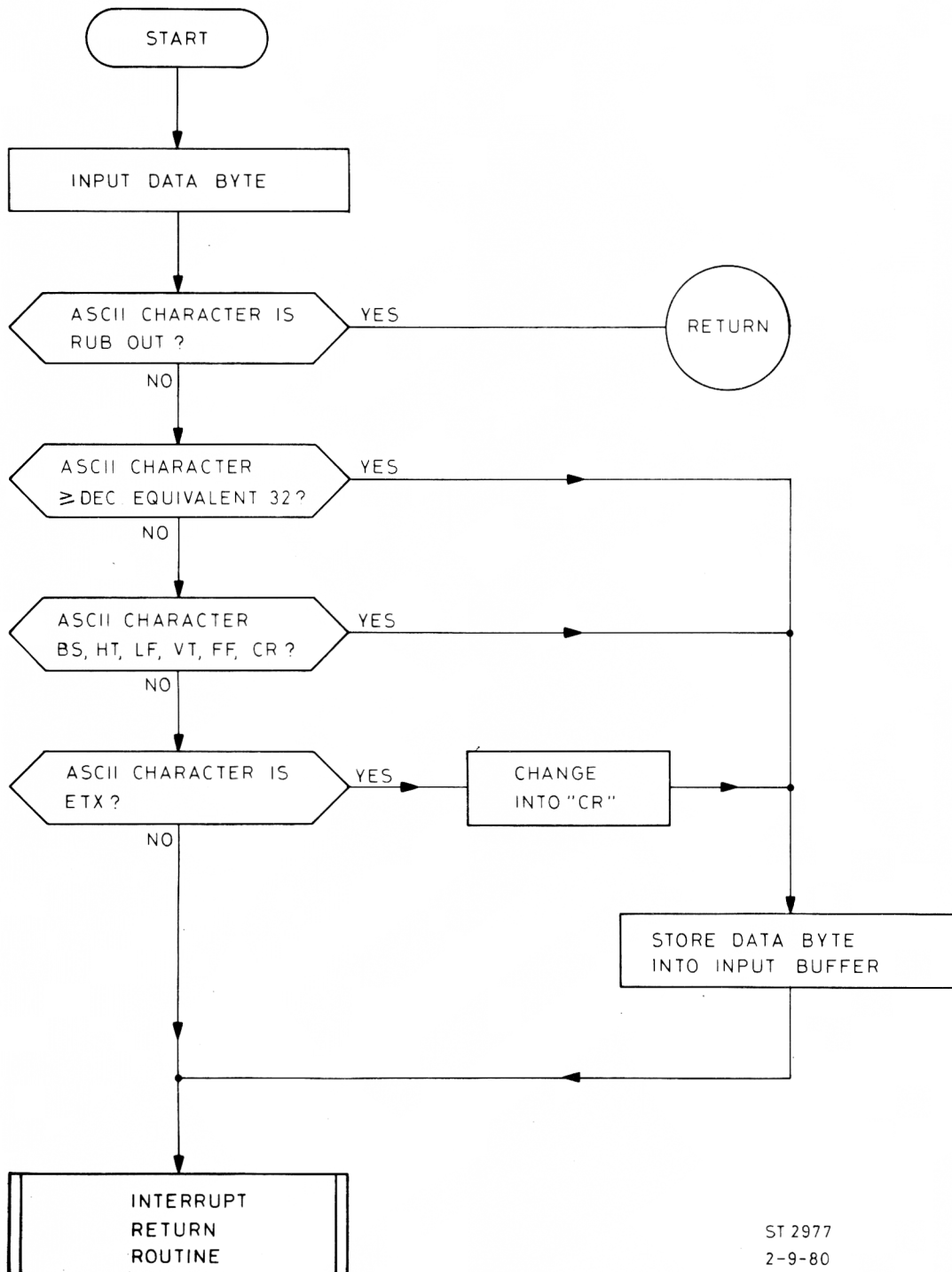
3.3.2.1 Initialisation of the interface



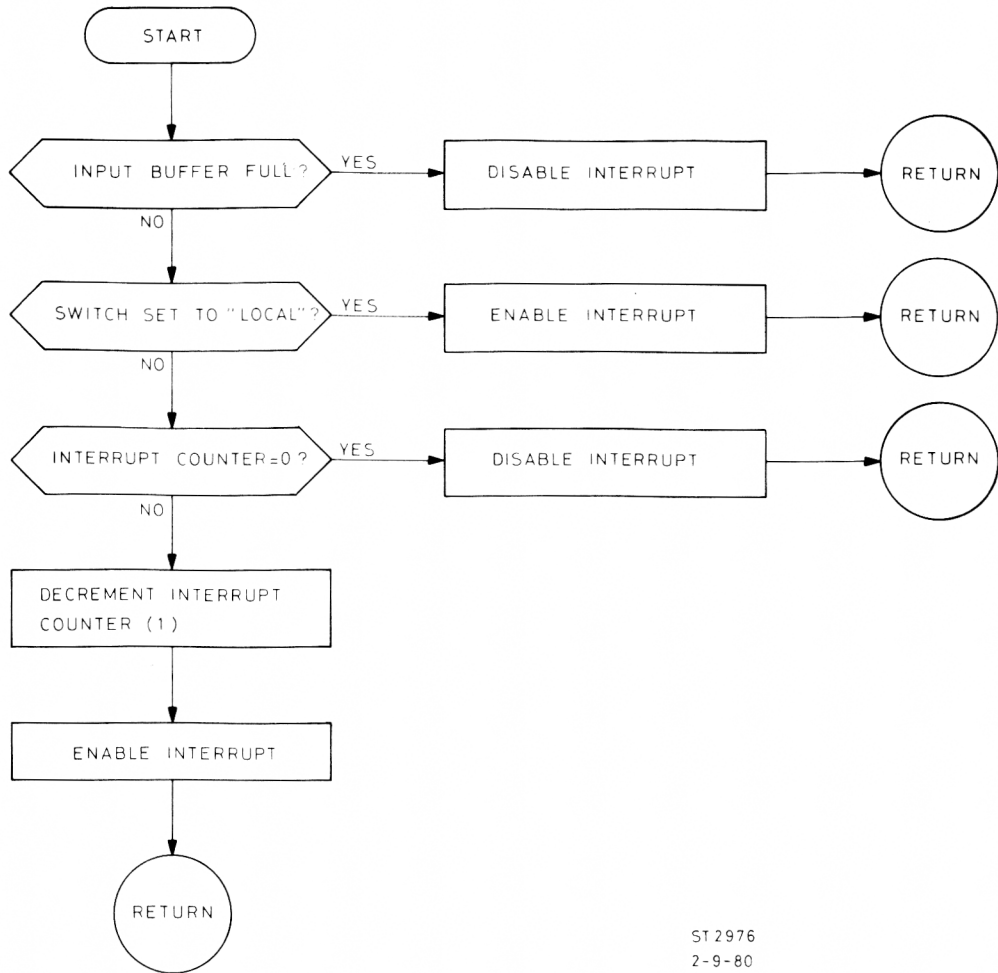
3.3.2.2 Interrupt by interface-state changes and output availability



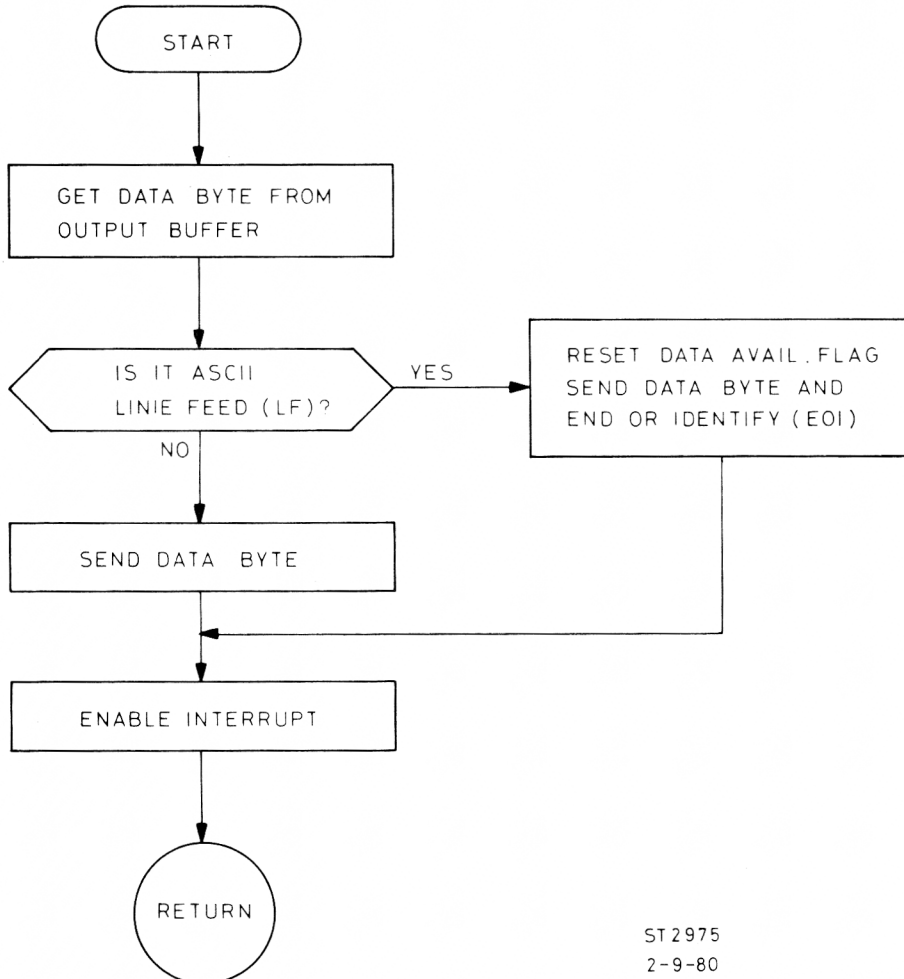
3.3.2.3 Input routine

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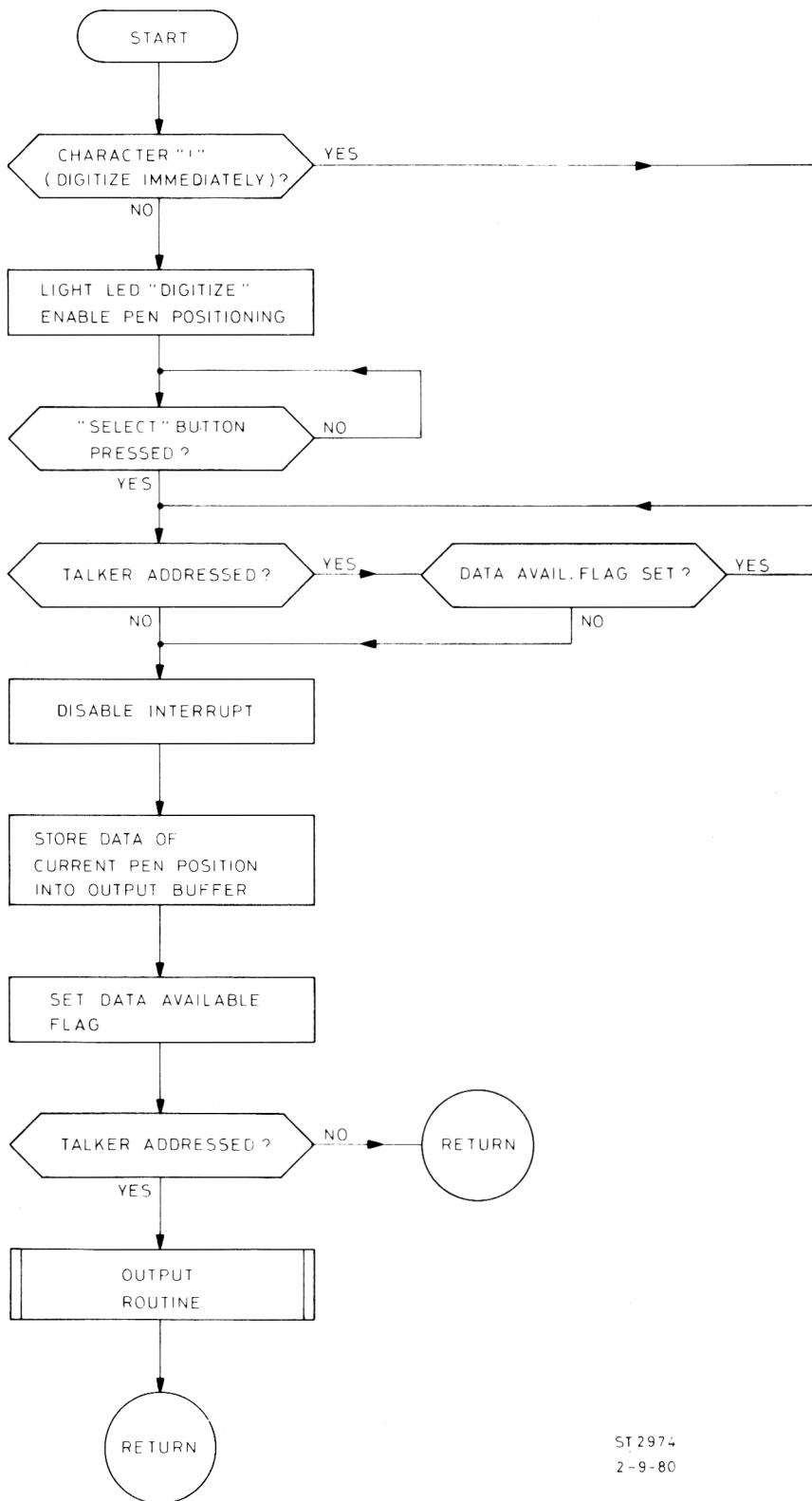
3.3.2.4 Return from interrupt routine



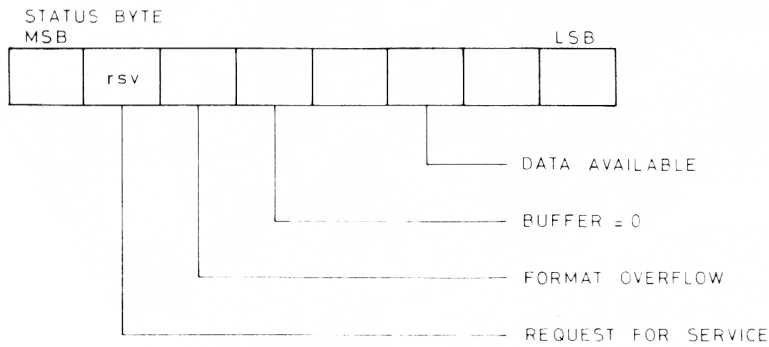
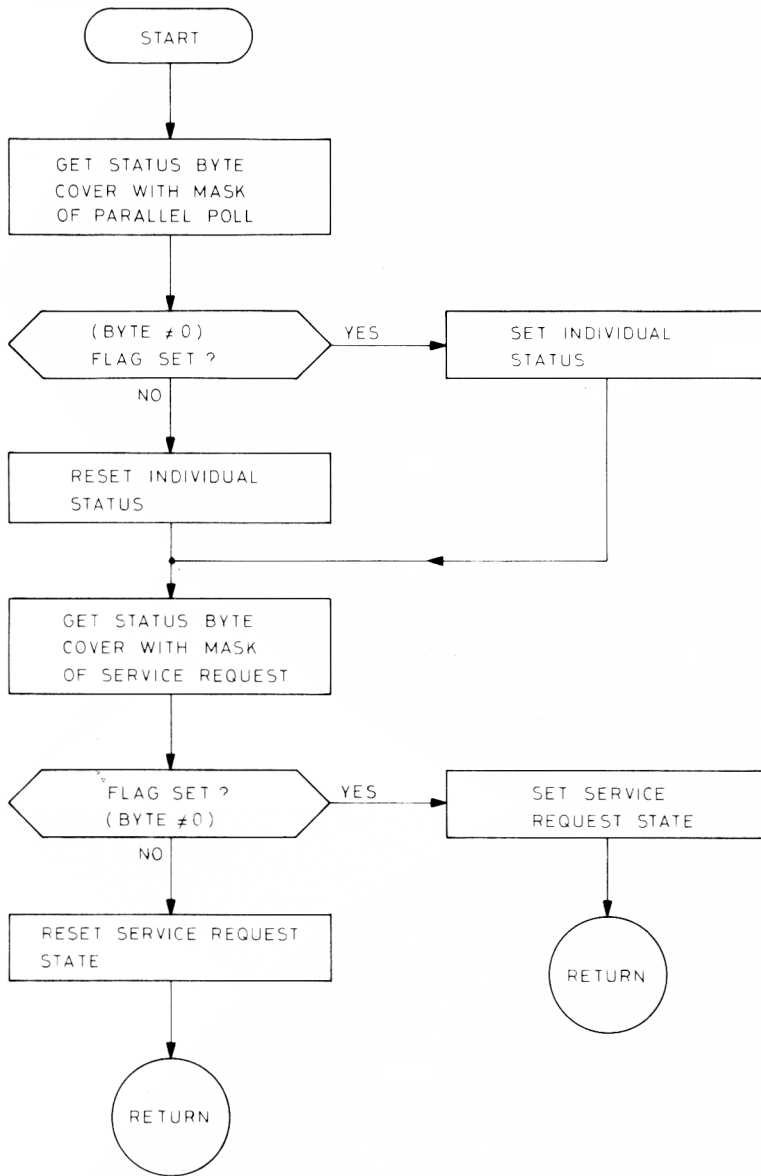
3.3.2.5 Output routine



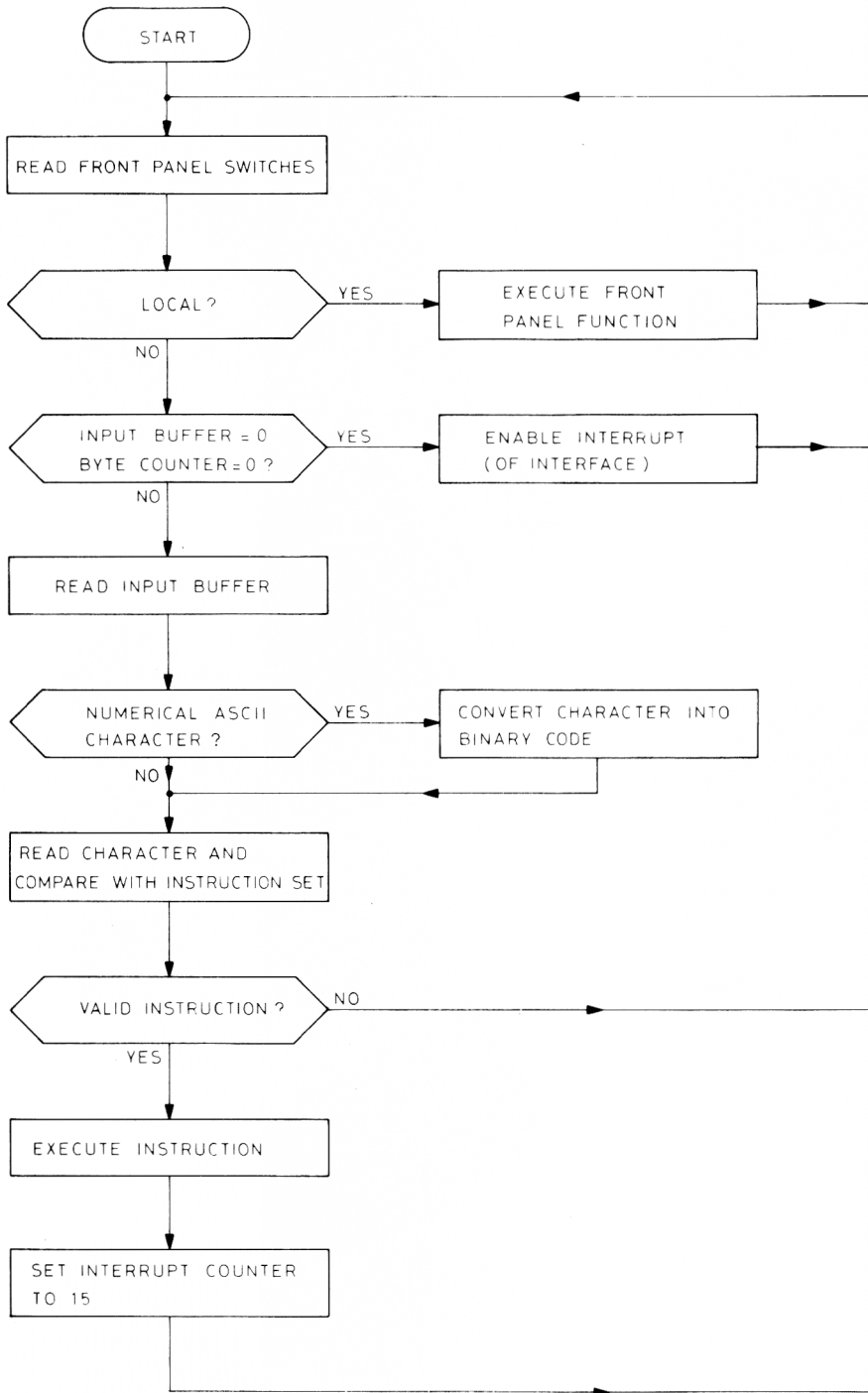
3.3.2.6 Digitise routine



3.3.2.7 Status routine



3.3.2.8 Main program



3.4 SERIAL COMMUNICATION INTERFACE

3.4.1 General Description Fig. 3 - 12

With the serial communication interface (SCI) of the PM 8151S, four kinds of interface mode can be selected, namely:

- Terminal mode
 - Modem mode
 - Timesharing mode
 - Current loop 20mA passive mode
- **Terminal mode** is identified by the plotter by a high level on the DATA TERMINAL READY line. If terminal mode is selected, the plotter generates automatically buffer status information. In the case of buffer empty (less than 512 bytes), DC1 is sent; at buffer full (more than 612 bytes), DC3 is sent. These signals control the transmitted data of the connected terminal or modem. In many mini-computers DC1 is used as transmit-on (Xon) and DC3 as transmit-off (Xoff). If a modem is connected to the MODEM connector of the plotter, terminal mode can be simulated by means of switch S4/1, labelled OFF. If this switch is open, the plotter identifies a terminal configuration.
- **Modem mode** is identified by a low level on the DATA TERMINAL READY input of the plotter. This is effected if no terminal is connected to the TERMINAL connector and S4/1, labelled OFF is closed. At the MODEM connector the lines, DATA TERMINAL READY, REQUEST TO SEND, DATA SET READY and CARRIER DETECT are always high. Buffer status information is not always sent automatically by the plotter, but is available on request by the signal DC1. The following table gives a survey of the I/O parameters set by the plotter during initialisation.

INITIALISED VALUES (decimal equivalent and milliseconds)

| PARAMETER | DEFINITION | CONFIGURATION | |
|-----------|--|-------------------|------------------------------|
| | | Modem | Terminal |
| BUFR | Request Buffer Status Character | 17 ^{DC1} | NONE |
| TRIG | Output Trigger Character | NONE | NONE |
| TURN | Turn Around Delay | 10 | 10 |
| OUTT2 | 2nd Output Terminator | 10 ^{LF} | 10 ^{LF} |
| OUTT1 | 1st Output Terminator | 13 ^{CR} | 13 ^{CR} |
| BS1E | Automatic Buffer Status Character; Buffer Empty | 13 ^{CR} | 17 ^{DC1} |
| BS1F | Automatic Buffer Status Character; Buffer Full | 26 ^{SUB} | 19 ^{DC3} |
| BS2E | Buffer Status Character on request; Buffer Empty | 01 ^{SOH} | 01 ^{SOH} (BUFR = 0) |
| BS2F | Buffer Status Character on request; Buffer Full | 26 ^{SUB} | 26 ^{SUB} |

- NOTES:**
1. *The initialised values of parameters depend on the configuration of switches S4/contact 5, labelled KAUT (read: Automatic Buffer Status Message disabled) and S4/contact 1 (OFF) and on the voltage level of pin 20 (Data Terminal Ready) of the TERMINAL connector.*
 2. *If S4/contact 5 (KAUT) is enabled, no Automatic Buffer Status Characters are generated by the plotter. This is equivalent to BS1E = 0 and BS1F = 0.*
 3. *If switch S4/contact 1 (OFF) has been disabled, the terminal parameters are initialised independent of the voltage on pin 20 (Data Terminal Ready) of the TERMINAL connector.*

These initialised parameters can be changed by the instruction "Set 1/0 Parameters" (see Operating Manual, Section 7.3).

- Timesharing mode is selected by switch S1. In this mode, the plotter should not be permanently addressed (switch S4/6 DADR disabled).
- Current loop 20 mA passive is selected by changing the flat cable between the MODEM connector and the PCB over to the connector labelled CL; switch S3 labelled V24 must be open.

The serial interface board consists of the following parts:

- EPROM, which has been loaded with part of the main program as well as the complete program for the correct handling of the serial communication interface. The relevant program parts are given on Page . . . The addresses of the EPROM are $\phi 8\phi\phi\phi FFF$ (Hex.).

- Z80-PIO, which acts as two 8-bit I/O ports. Port A, bits 0 . . . 6 are used for the input and output of data to/from the UART. Bit A7 has been connected via IC11 to the 'Data Receive' (DR) output of the UART.

The PIO is programmed so that if DR becomes active the interrupt output of the PIO goes low and the PIO generates an interrupt vector for the μP to jump to the input routine. Port B, bit B0 (input) is used to read the status of the DADR switch (read continuously addressed).

Bit B1 (input) reads the status of the KAUT switch (read no automatic buffer status message) during the initialisation. Bit B2 (output) disables the receiver outputs (RO 1 . . . 7) of the UART.

Bit B3 (input) reads the signal TRE (Transmitter Register Empty). When the latter becomes active, the PIO will generate an interrupt, and an interrupt vector to the μP to jump to the output routine (see Program Parts).

With B4 (input) the μP reads the status of the signal Data Terminal Ready during initialisation which determines the interface mode (terminal or modem mode).

Bit B5 (output) is used to load the output data, present on inputs T1 1 . . . 7 of the UART, into the transmitter buffer register of the UART.

Bit B6 (output) controls the Clear To Send line of the terminal connector.

In timesharing mode, the data-stream is controlled by B7 (output), which is high if switch S4, DADR, closed (before power-on). When this switch is open, B7 becomes high after the command "SOH" "P", and is reset by the "ETX" command.

- The mode select logic ensures a correct data flow in the various modes.

This data flow is shown in Figs. 5.5 - 5.9.

In the timesharing mode, the handshake lines are switched off from the UART.

If switch S4/6 (DADR) is disabled, the plotter must be addressed by the instruction "SOH" "P". If the SCI is unaddressed, it functions as a terminal to MODEM interconnection.

- Baud-rate generator

The clock pulses for the receiver as well as for the transmitter are generated by the baud-rate generator. With switch S2, this baud-rate is selectable between 110 baud and 2400 baud in five steps.

The crystal-controlled clock of the central processor (frequency 8.867 MHz) is used as input to the baud-rate generator.

For 110 baud, this clock input is divided in IC13 and IC14.

The output of IC17 supplies the 300, 600, 1200 and 2400 baud. The divided clock signal selected by S2 is applied to IC7/17 as receiver clock, and to IC7/40 as transmitter clock.

— UART TMS 6011

This integrated circuit converts the parallel data into a serial data-stream for the output data, and converts the serial input data into parallel form.

The serial output data is automatically provided with a start bit, and depending on the control inputs, with one or two stop bits and a parity bit.

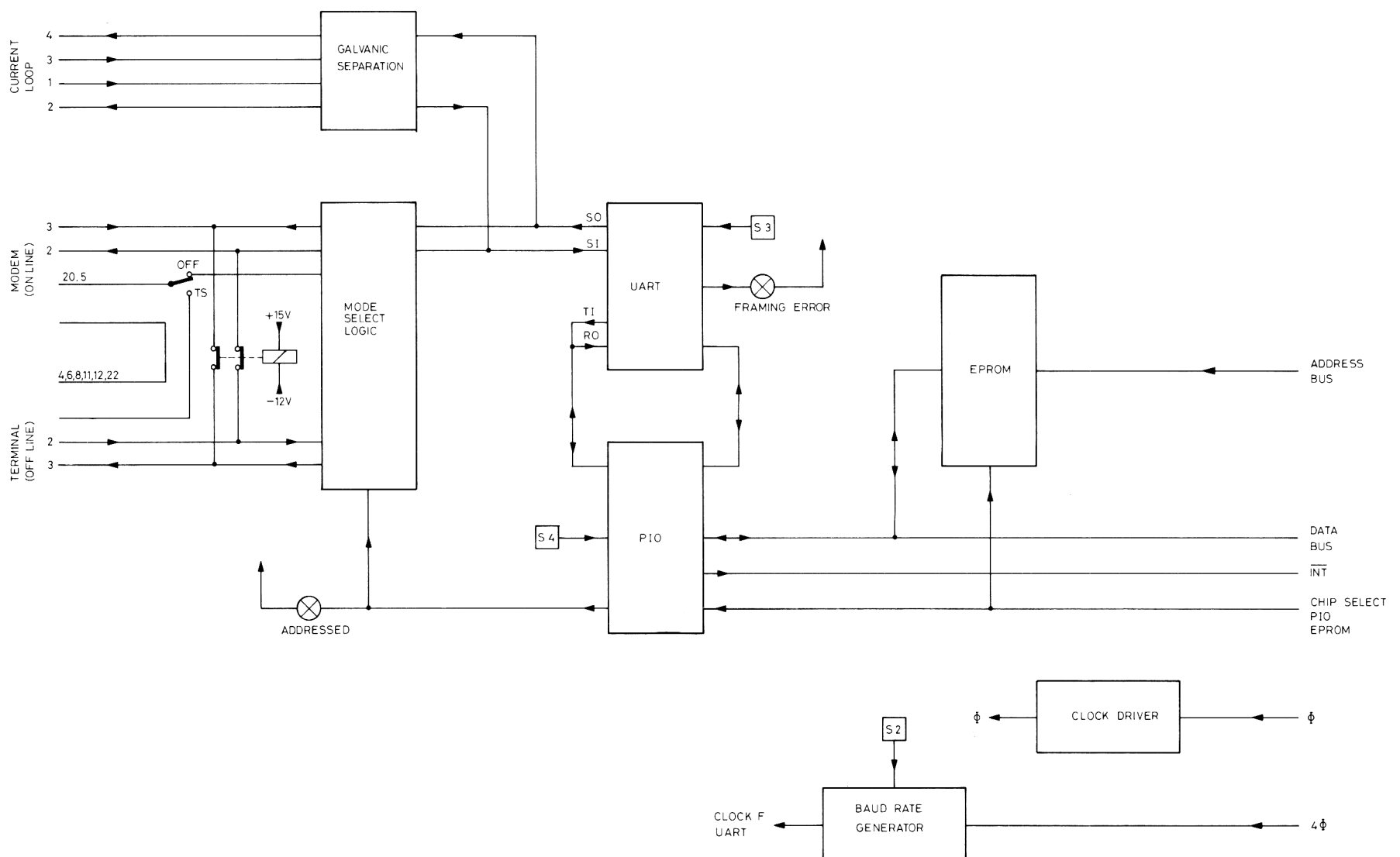
Also, the length of the data-stream depends on the status of control inputs (word-length select 1 and 2).

For more detailed information on the UART, refer to the manufacturer's data sheets. (see Section 6).

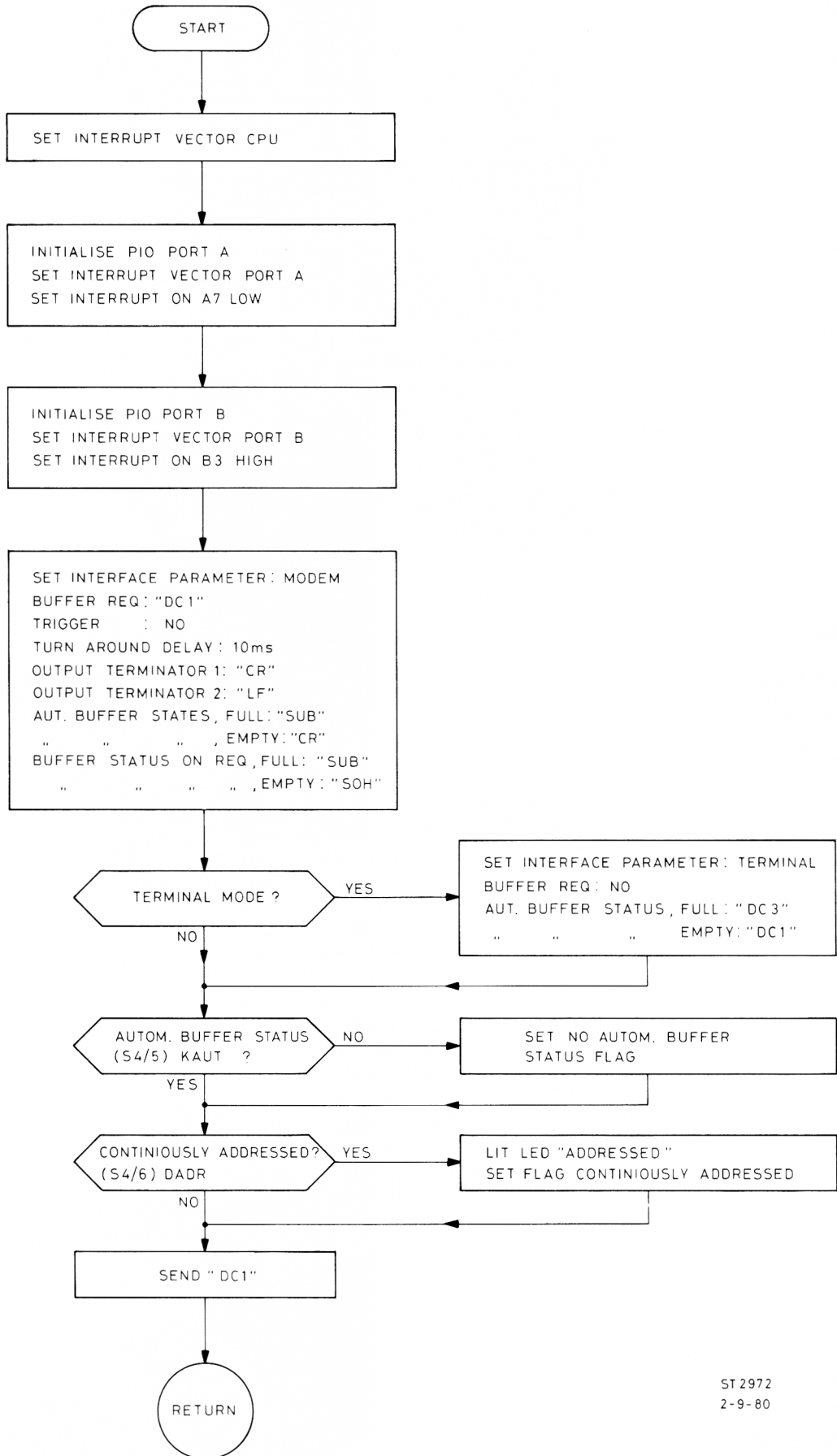
3.4.2 Flow Charts

The following flow-charts have been included to assist in understanding the function of the interface board in conjunction with the CPU board:

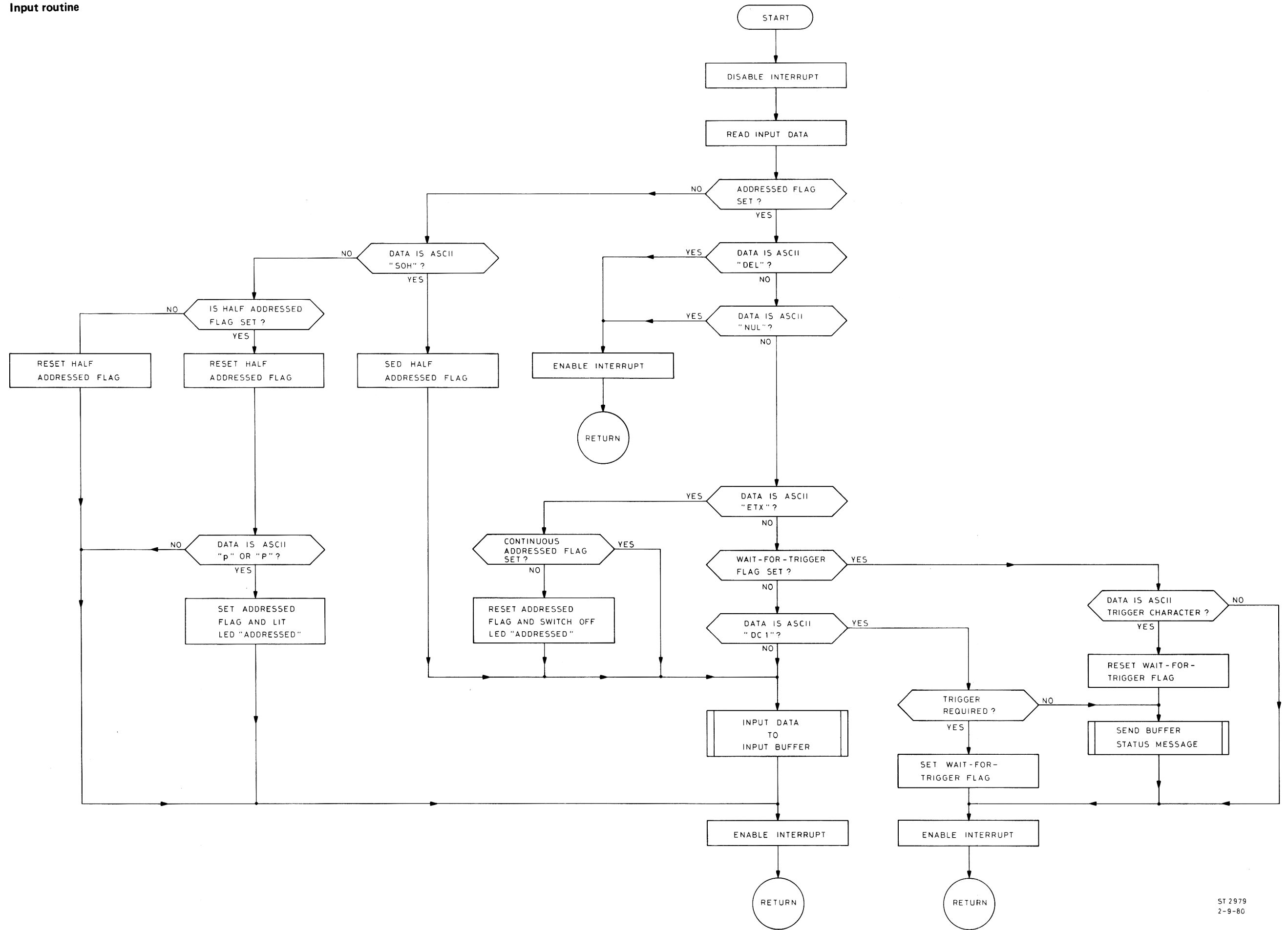
- Initialisation of the interface
- Input routine
- Output routine
- Digitise routine
- Main program



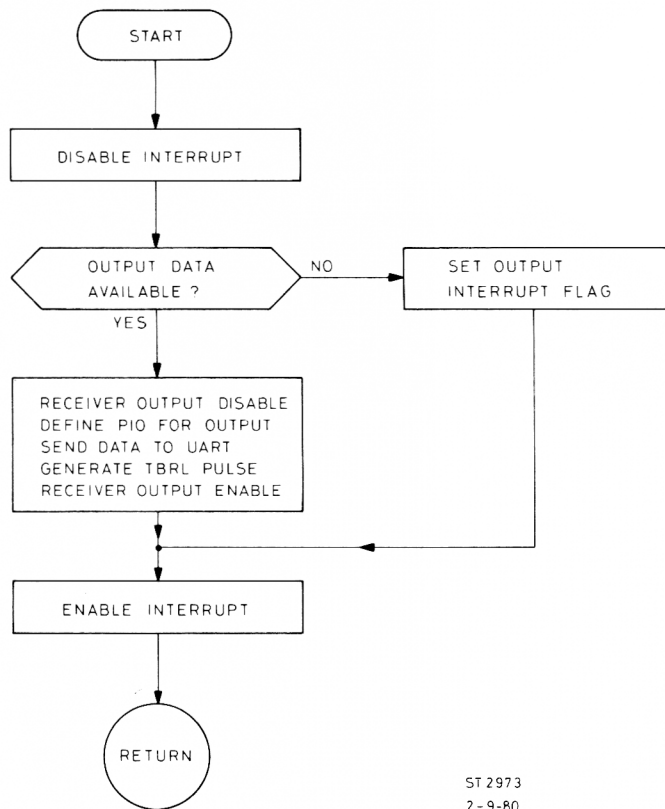
3.4.2.1 Initialisation of the interface



3.4.2.2 Input routine

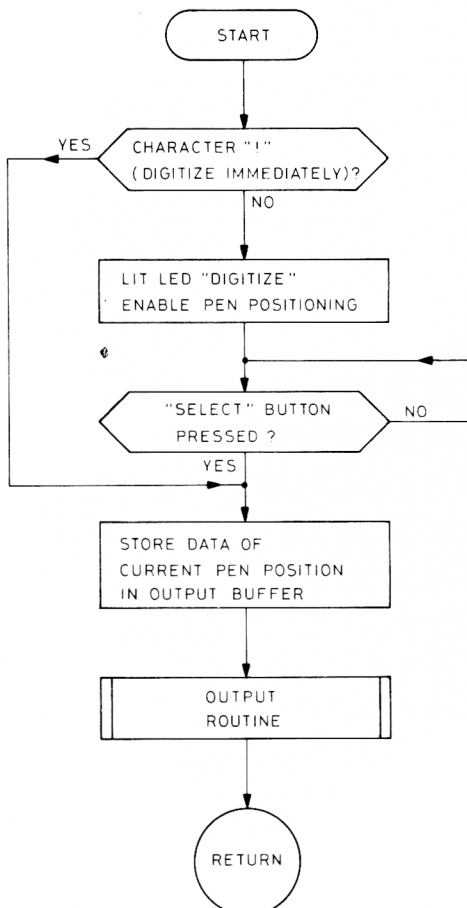


3.4.2.3 Output routine



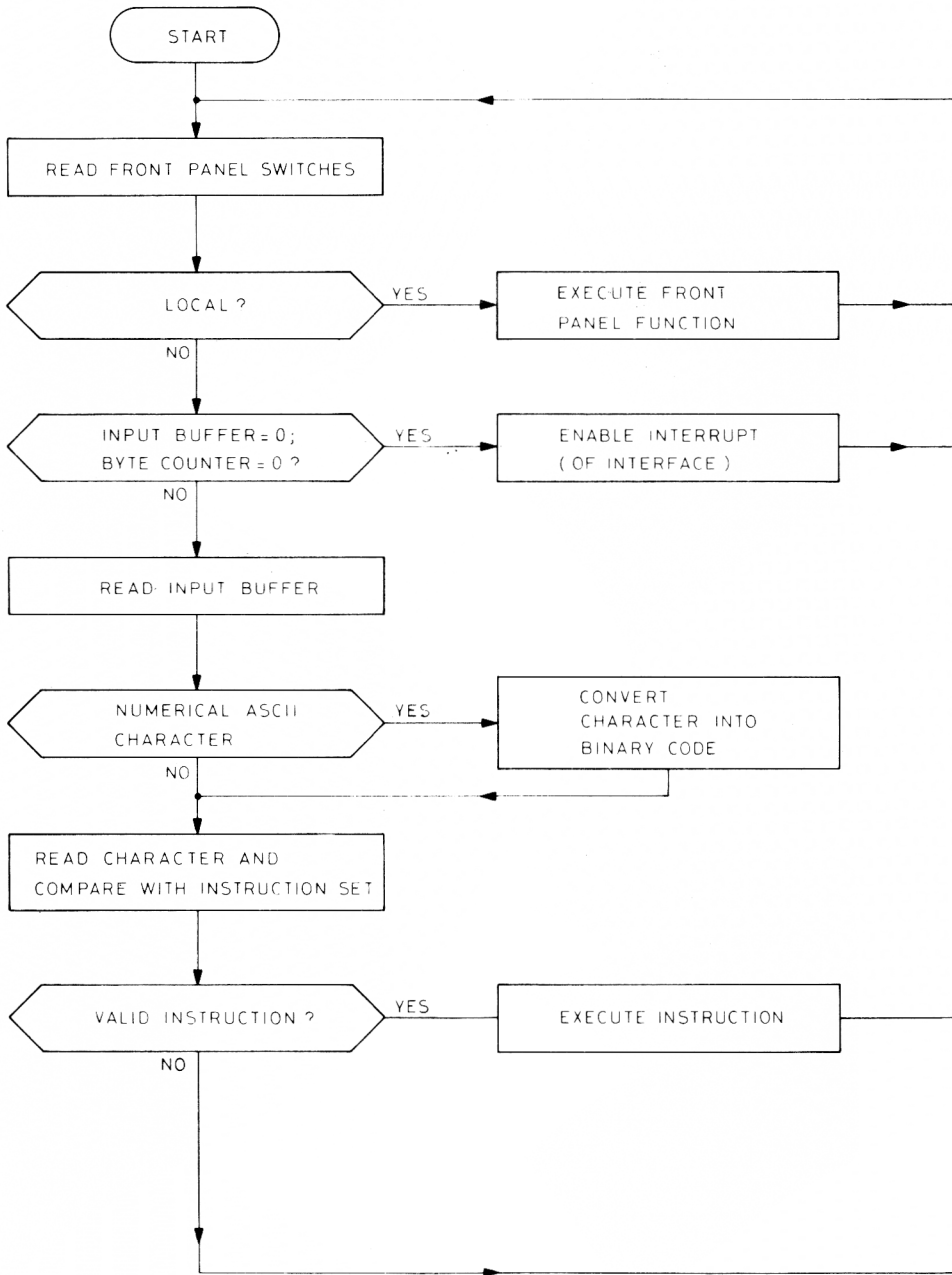
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3.4.2.4 Digitise routine



ST 2969
2-9-80

3.4.2.5 Main program



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81 07 30

3.5 X AND Y AMPLIFIER SERVO-SYSTEM

The servo-system consists of the servo amplifier, servo potentiometer and servo motor. The X-axis servo amplifier (A5) and the Y-axis servo amplifier (A6) differ only by the power supply of the output stage formed by D15, D16, D17, D18, C17 and C18. For the X-axis amplifier, C17 and C18 are mounted on the mother board.

The input sensitivity of the amplifiers is 280 mV/cm. This corresponds to a full-scale deflection voltage of 10,08 V for the X-axis and 7,84 V for the Y-axis. The input voltage is applied to the OP AMP IC2 via RC filter R3, C1 and R4. The amplification of IC2 is non-linear. For small input signals the amplification is determined by the ratio of R13 to R3+R4. If the output voltage rises above the diode-knee voltage, D3 or D4 becomes conductive and the amplification will be reduced as R12 is then switched in parallel with R13. IC2 acts as a summing amplifier. At the input, the input voltage, that is, the voltage from the measuring potentiometer via buffer IC1 and the zero control voltage are applied.

When the input current equals the reference current minus the zero control current, the input of IC2 is zero, and the servo-system is in balance.

The full-scale value of the servo-system is adjusted by R8, and zero by R1. The output of buffer IC1 is also applied to IC3, which is switched as a differentiator for the reference signal from the measuring potentiometer. The differentiator has a similar function to that of a tachogenerator. The damping of the system is adjusted by R15. The output of IC3, which depends on the speed of the servo-system, is fed to the OP AMP IC4, which controls the output stage. The gain of this output stage is 2, and is determined by

$$1 + \frac{R29}{R28}$$

The output current is limited by two equivalent circuits, one for a positive output voltage and one for a negative output voltage. For the positive side, T5 becomes conducting about 5 seconds after the current through R31 has been increased to 1 A. Then T3 will also be conducting, which causes T7 to be less conductive. The current at the negative side is limited in the same way. The network R34 and C9 serve to damp h.f. oscillations.

4 CHECKING AND ADJUSTING

WARNING: Before switching-on, ensure that the plotter has been installed in accordance with the instructions outlined in Section 5 of the Operating Manual.

The opening of covers or removal of parts, except those to which access can be gained by hand is likely to expose live parts, and accessible terminals may also be live.

The instrument shall be disconnected from all voltage sources before any replacement or maintenance and repair during which the instrument will be opened.

If afterwards, any adjustment, maintenance or repair of the opened instrument under voltage conditions is inevitable, it shall be carried out only by a skilled person who is aware of the hazard involved.

Bear in mind that capacitors inside the instrument may still be charged even if the instrument is separated from all voltage sources.

4.1 CPU BOARD (Fig. 4 - 1)

4.1.1 Voltage-Controlled Oscillator (VCO)

- Switch the power off.
- Set the DIL switch as given in Fig. 4 - 1.

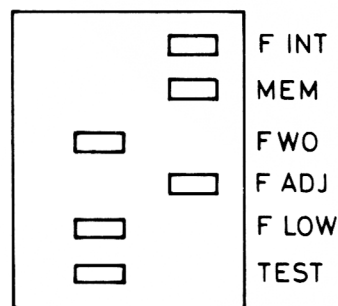


Fig. 4-1

- Turn the potmeter R5 (to the right of the two LEDs) counter-clockwise to the end-stop.
- Switch the power on.
- Connect a counter to test point 20; the frequency should be $1550 \text{ Hz} \pm 10\%$. If necessary, adjust the frequency with C10 and C11.
- Switch FLOW to ON and check the frequency on test point 20; it should be $580 \text{ Hz} \pm 20 \text{ Hz}$. If necessary, adjust with potmeter R5.
- Set FADJ and FLOW switch to OFF and switch the power off.

4.1.2 Digital/Analog Converters (DAC)

4.1.2.1 DAC for the X-axis

- Connect a calibrated d.c. voltmeter to test points 28 (SG) and 29 (X).
- Switch the instrument on, and check the voltage of TP29 is $0.616 \text{ V} \pm 2 \text{ mV}$; adjust as necessary with potmeter X0.
- Switch to LOCAL and depress the pen-positioning switch until the carriage is at the end of the X-scale.
- Check the voltage for full-scale on TP29 is $10.08 \text{ V} \pm 2 \text{ mV}$; adjust with potmeter XE as necessary.

NOTE: After adjusting the X-DAC, the X amplifier must also be re-adjusted.

4.1.2.2 DAC for the Y-axis

- Connect a calibrated d.c. voltmeter to test point 28 (SG) and 30 (Y).
- Switch the plotter on, and check the voltage on TP30 is $0\text{ V} \pm 2\text{mV}$.
If necessary, adjust with potmeter Y0.
- Switch the plotter to LOCAL and depress the pen-positioning switch until the carriage has reached the end of the Y-scale.
- Check the voltage for full-scale on TP30 is $7.84\text{V} \pm 2\text{mV}$; adjust with potmeter YE if necessary.

NOTE: After adjusting the Y-DAC, the Y amplifier must also be re-adjusted.

4.2 X AMPLIFIER

NOTE: Before any adjustment is performed, check the preceding adjustment of the X-DAC (Section 4.1.2.1).

4.2.1 Zero and full scale

- Set switch S1/6 to the TEST position.
- Place a pen into pen-depot 1 and into the holder of the carriage.
- Switch the instrument ON.
- Adjust the distance between the housings of the two pens to 0.1 mm as shown in Fig. 4 - 2 with potmeter X0, accessible via the bottom of the instrument.
- Set the TEST switch on the CPU to OFF and depress the reset switch (on CPU)
- Set the PEN switch to DOWN position and depress the pen-positioning switch in the X direction until the carriage has reached the end position; the line should have a length of $338.0\text{ mm} \pm 0.1\text{ mm}$.
- Adjust the length of the line with potmeter XV, accessible via the bottom of the instrument.

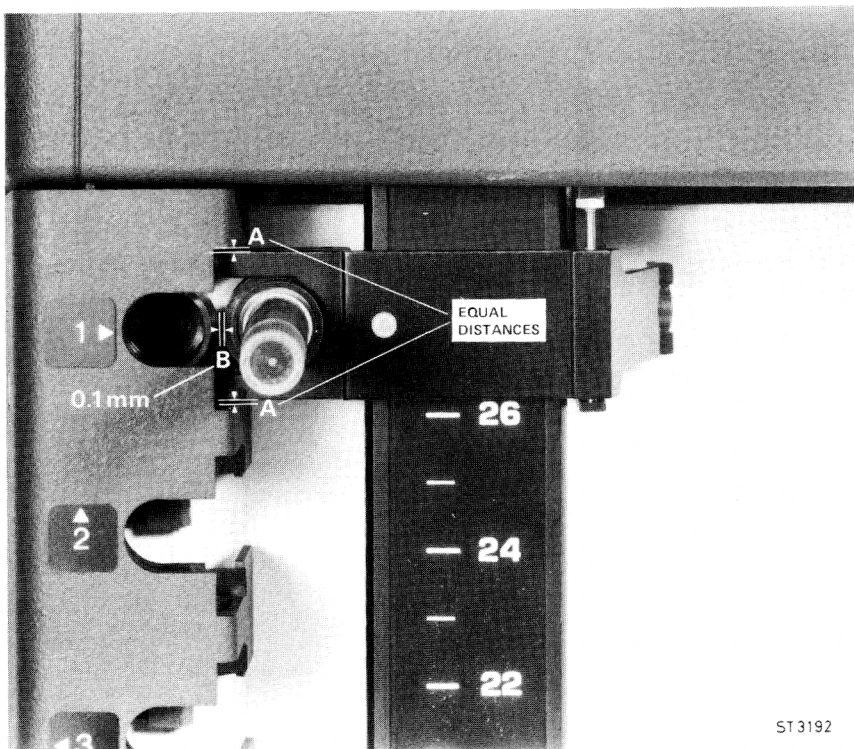


Fig. 4.2

4.2.2 Damping

- Switch the power ON, set the PLOT switch to 'REMOTE', the VAR/CAL switch to 'CAL' and the CHART switch to 'HOLD'.
- Set the DIL switch 6 (CPU board) to the TEST position.
- Set the PEN switch to DOWN.
- Depress the ZERO key; while this is depressed the plotter continues drawing as shown below.

The overshoot (A) should be not greater than 0,3 mm on both sides.

If necessary re-adjust with potentiometer XD, accessible under neath the instrument.

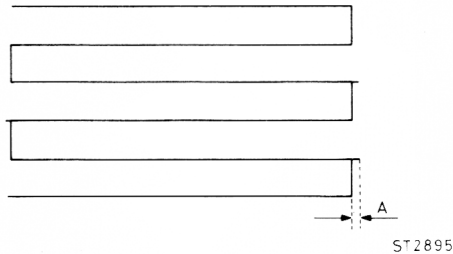


Fig. 4 - 3.

NOTE: *Damping influences the hysteresis, therefore check the hysteresis after each damping adjustment. See Section 4.4.*

4.3 Y AMPLIFIER

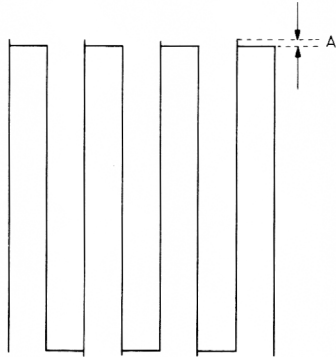
NOTE: *Before any adjustment is performed, check the preceding adjustment of the Y-DAC (Section 4.1.2.2).*

4.3.1 Zero and full scale

- Set switch S1/6 to the TEST position.
- Place a pen into pen-depot 1 and into the holder of the carriage.
- Switch the instrument ON.
- Adjust the distances 'A' as given in Fig. 4.2 so that they are equal, using potmeter Y0, accessible via the bottom of the plotter.
- Set the TEST switch on CPU to OFF and depress the reset switch.
- Set PEN switch to DOWN position and depress the pen-positioning switch until the carriage has reached the end position; the line drawn should have a length of 280.0 mm \pm 0.1 mm.
- Adjust the length of the line with potmeter XV, accessible via the bottom of the instrument.

4.3.2 Damping

- Switch the power ON, set the PLOT switch to 'REMOTE', the VAR/CAL switch to 'CAL' and the CHART switch to 'HOLD'.
- Set the DIL switch 6 (CPU board) to the TEST position.
- Set the PEN switch to DOWN.
- Depress the SELECT key. While this is depressed the plotter continues drawing as shown below.



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The overshoot (A) should be not greater than 0,3 mm on both sides.
If necessary re-adjust with potentiometer YD accessible underneath the instrument.

Fig. 4 - 4.

NOTE: *Damping influences the hysteresis, therefore check the hysteresis after each damping adjustment. See Section 4.4.*

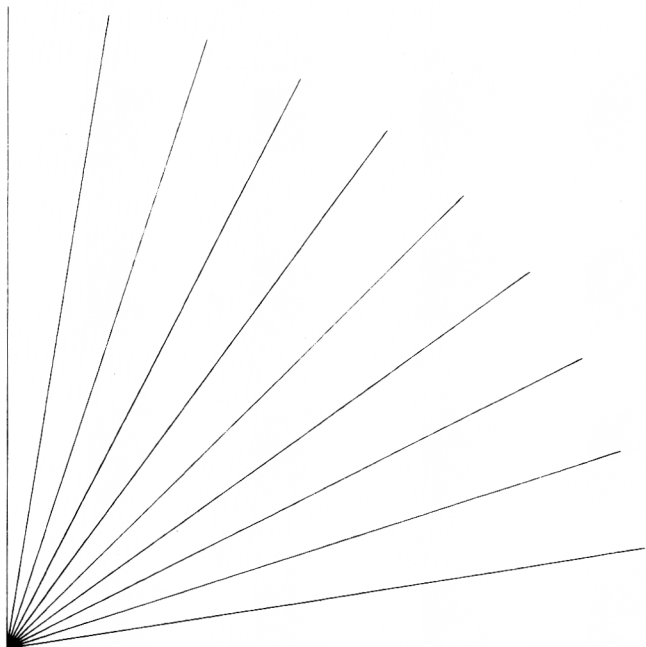
4.4 HYSTERESIS

- Install a pen with a thickness of 0.3 mm.
- Switch the power ON, set the PLOT switch to "REMOTE", the CAL/VAR switch to "CAL" and the CHART switch to "HOLD".
- Set the DIL switch 6 (CPU board) to the TEST position.
- Set the PEN switch to DOWN.

4.4.1 Amplifier version B (without hysteresis potentiometer)

- Press the SCALE key once.

The plotter will draw a test diagram (Fig. 4.5) to check the hysteresis.
No gap must be visible between the to lines (forward and reverse).



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Fig. 4 - 5.

- If there are gaps caused by a return line drawn at the left-hand side of the fore going line, the damping of the X amplifier has to be slightly increased (counterclock wise), or the damping of the Y amplifier slightly decreased (clock wise).
- If there are gaps caused by a return line drawn at the right-hand side of the fore going line, the damping of the X amplifier has to be slightly decreased (cw) or the damping of the Y amplifier slightly increased (ccw).

After adjustment, check the damping.

If the hysteresis cannot be adjusted correctly in respect with a correct damping, change C1.

When a amplifier version B has to be replaced, check that C1 has the same value as in the original amplifier.

4.4.2 Amplifier version A (with seperate hysteresis potentiometer)

- Press the SCALE key once.
The plotter will draw a test diagram (Fig. 4.5) to check the hysteresis. No gap must be visible between the two lines (forward and reverse). If there are gaps, re-adjust.

Coarse adjustment

- Press the ZERO key.
- Adjust the Y hysteresis potentiometer so that a correct square wave is drawn while the ZERO key is depressed.
- Press the SELECT key.
Adjust the X hysteresis potentiometer so that a correct square wave is drawn while the SELECT key is depressed.

Fine adjustment

- Press the SCALE key.
The plotter will draw a test diagram (Fig. 4 - 5).
- If there are gaps caused by a return line drawn at the right-hand side of the fore going line, the X hysteresis potentiometer has to be adjusted.
- If there are gaps caused by a return line drawn at the left-hand side of the fore going line, the Y hysteresis potentiometer has to be adjusted.

NOTE: *After hysteresis adjustment check the damping, see Section 4.2.2 and 4.3.2.*

4.5. MECHANICAL

For the mechanical adjustments, refer to the corresponding sub-sections in Section 2 Replacements.

5 FAULT-FINDING

5.1 GENERAL

5.1.1 Service hints

If servicing has to be carried out the following points should be taken into account in order to avoid damaging the instrument.

- Take care to avoid short-circuits with measuring clips and hooks if the instrument is switched-on.
- Use miniature soldering iron (35 W max.) with a tin cleaner or a vacuum soldering iron.
- Use an acid-free solder.
- When fault-finding, dismantle the instrument by removing front cover and bottom plate.
- Do not remove the chartplate, when not strickly necessary.
- After repair the instrument should be calibrated again.

5.1.2 Fault-finding procedure

In this chapter a number of events that occur during the initialisation, local mode and remote mode, are given to indicate the particular part of the instrument in which a possible cause of error may lie.

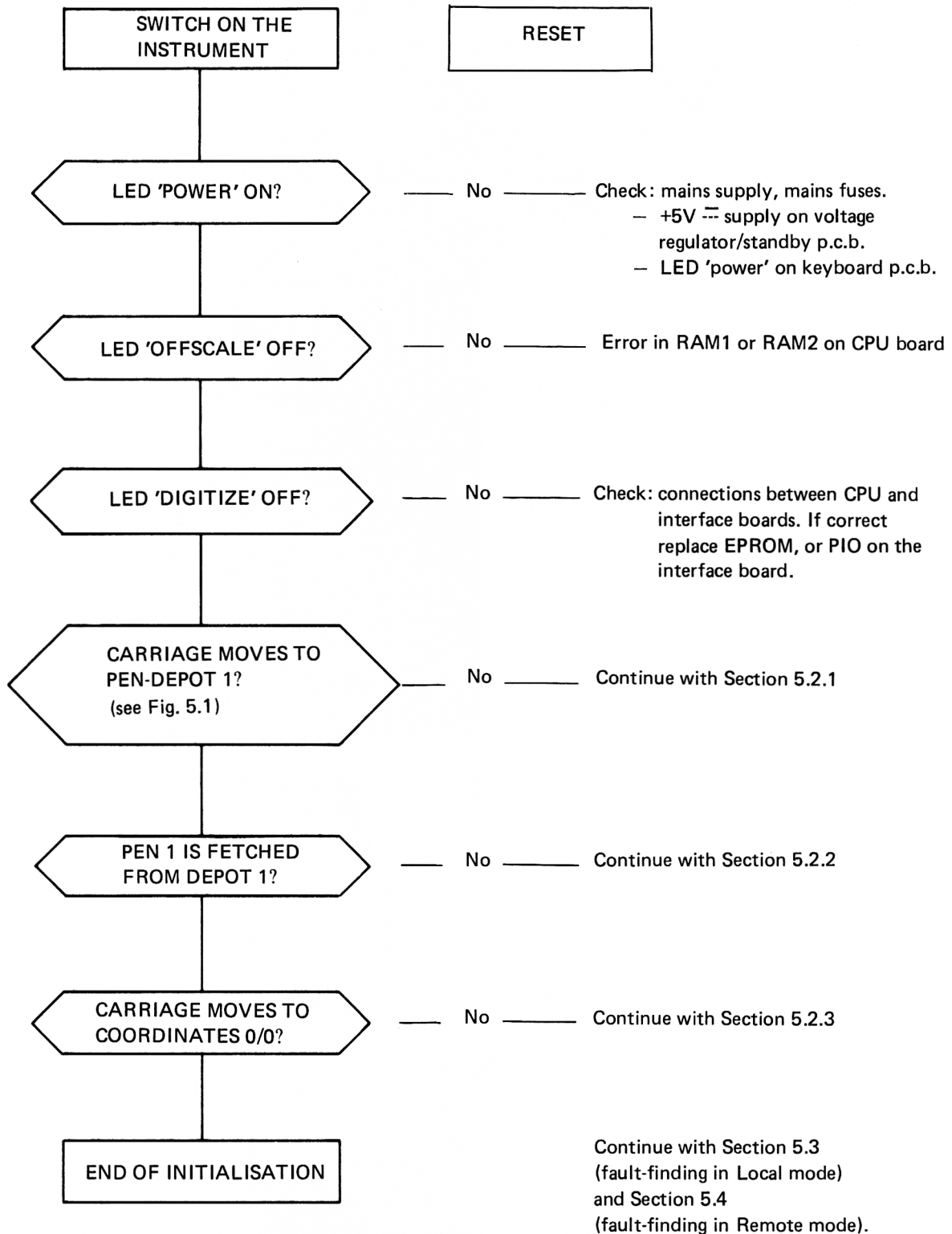
Section 5.2 gives a survey of events which occur at the moment the instrument is switched on.

Section 5.3 describes the method of checking in LOCAL mode and also the three TEST PROGRAMS that can be selected.

Section 5.4 describes the fault-finding procedure in REMOTE mode, i.e. in the interface section of the instrument.

- NOTES:**
- *In the instrument, positive logic with positive potential at TTL level is used. That means: Logic "1" = + 5V; Logic "0" = 0V.*
 - *In the circuit diagrams of the CPU board and the interface boards a survey of testpoints is given.*
 - *The fault-finding procedure is meant as an aid for fault-finding. This means that the incorrect component cannot be found in every case.*

5.2 INITIALISATION



5.2.1 Carriage does not move to Pen Depot 1

After switching on, the carriage must perform a particular sequence of movements before pen number 1 is fetched during the initialisation proces.

The sequence is given in Fig. 5 - 1.

As an incorrect sequence can give an idea in what particular circuit the fault exist, proceed as follows:

- Switch the power off and place the carriage manually in the lower right-hand position.
- Switch on the instrument and observe the actions accurately.

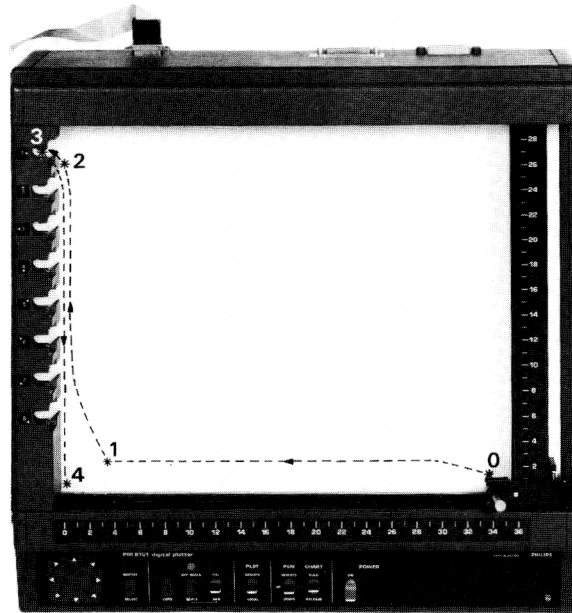


Fig. 5-1

ST 3191

5.2.1.1 Carriage does not move at all but can be manually pushed, without resistance of the motor

- Central processor unit is not started
 - Clock oscillator is not running
 - RESET input of the μ P is continuously low
 - Defective μ P.
- Servo system is killed

The servo system is killed if the signal SVO (P7/27) is low, caused by a low output of B5 of PIO1 at the CPU board.

- Check the servo kill logic at the CPU (T7)
- Check the switching circuit at the Voltage regulator/stand-by pcb
- Check the power supply.

5.2.1.2 Carriage moves immediately from *0 to *4 and bumps a number of times against the housing of the pen depots

- Check the Y-amplifier: remove the DAC (IC19) and connect a power supply between test points 30 (+ supply) and 28 (- supply) at the CPU.
Adjust the power supply to 0 V and switch the plotter on; the pen should be at the zero position of the Y-scale.
Adjust the power supply to $7.84\text{ V} \pm 2\text{ mV}$; the pen should be at the 2800 position of the Y-scale.
If one of these positions is not correct then continue with testing the amplifier circuits.
- Check the output of the Digital/Analog Converter on test point 30 of the CPU board in local mode with the aid of the pen-positioning switch; the voltage must increase to $7.84\text{ V} \pm 2\text{ mV}$ when the switch is pressed for the upwards Y-direction.
Also the digital input code must change during this action; this can be checked on pins 1 . . . 12 of IC19.
Check the +15 V and -15 V supply.

5.2.1.3 Carriage moves immediately from *0 to *4 and bumps only once against the housing of the pen depots

- Check the X-amplifier: remove the DAC (IC18) and connect a power supply between test points 29 (+ supply) and 28 (- supply) at the CPU.
Adjust the power supply to $0.616\text{ V} \pm 2\text{ mV}$ and switch the plotter on.
The pen should now be at position 0 of the X-axis.
Adjust the power supply to $10.08\text{ V} \pm 2\text{ mV}$; the pen should be at the end position (3380) of the X-axis.
If one of these positions is not correct then continue with the testing of the amplifier circuits.
- The output of the Digital/Analog Converter (IC18) should be checked (CPU board) in local mode, using the pen-positioning key. The voltage must increase from 0.616 V to 10.08 V when the key is pressed for the right direction.
During this key action, the digital input code of the DAC must also change; check on pin 1 . . . 12 of IC18.
Check the +15 V and -15 V supply.

5.2.1.4 Carriage moves immediately from *0 to *3

- Check the READY signal on test point 25, at the CPU board; if it is continuously high, then measure the signals of the ZERO DETECTOR circuit.
The READY signal should only be high if both servo-systems are in equilibrium.
If READY is low from *0 to *3 (Fig. 5 - 1) and becomes high at that moment, then check the signal Mx (P7/58) and transistors R4, T10 and T11 at the CPU board.

5.2.1.5 Carriage moves from position *0 to *1 (Fig. 5 - 1) and stays in that position

- Check the READY signal on test point 25.
If READY is high during this static position, this probably indicates a failure in the PIO (IC17) at the CPU board.
If READY is low during the rest position, it is necessary to check all the transistors that could cause this error (T6, T10, T4, T3, T8) on the CPU.

5.2.2 Pen 1 is not Fetched

If the carriage bumps against pen-depot 1 and subsequently, depot 2, 3 and so on, then the instrument must be re-adjusted.

To break this continuous cycle of pen-fetching, the power must be switched off and the TEST switch on the CPU board must be set to the test position.

The power must be then switched on.

The carriage will move to pen-depot 1 and stop in front of the depot. Proceed with the following adjustments:

- Adjust the AMPLIFIERS * as outlined in Sections 4.2.1 and 4.3.1.
 - Set the TEST switch to off.
 - Repeat the initialisation procedure (Section 5.2).
 - Check the adjustment of the CPU board (Section 4.1.2) and repeat the amplifier adjustment.
- * NOTE:** *When the carriage cannot be moved to the centre position of the depot with potentiometer Y0, (of amplifier) move it temporarily with YE (CPU).*

After the adjusting procedure, check that all pens can be fetched as follows:

- Set PLOT switch to LOCAL position.
- Press the SELECT button.
- Select one of the arrows of the pen-positioning switch.
- Repeat this procedure for all other pens.

If one of the pens is not fetched then check:

- the mechanical parts of the relevant depot.
- the linearity of the Y-potentiometer.

5.2.3 Carriage does not move to 0/0

- Check the voltages of the DACs (Section 4.1.2).
- If incorrect, check the code for the DAC and the voltage at the same time (e.g. by switching to local mode and operating the positioning switch).

5.3 LOCAL MODE

If the procedures described in Section 5.2 are all correct, then proceed with faultfinding in Local mode (PLOT switch to "LOCAL").

The following items must be checked:

- are all keys functioning correctly?
- is the electrostatic attraction of the chart plate adequate?
- are the test diagrams drawn correctly?

5.3.1 Incorrect Key Functioning (front panel)

- Check the signal of the relevant switch on the PIO (IC17) of the CPU board; if correct, then suspect the PIO.
- If the signal is incorrect, then check the connection between CPU board and Keyboard and also the relevant pull-up resistor.

5.3.2 Chart Hold Faulty

- Check that the voltage for the chart plate on pin 12 of the mother board (connect the -ve of the voltmeter to pin 10) is approximately 250 V a.c.
- Check that this 250 V a.c. is present on pin 11 when the chart hold switch is set to HOLD.
- In the HOLD position, check that this 250 V a.c. is present between pins 7 and 8.
- If present, then check the output voltage of the chart plate p.c.b. (in metal box under chart plate); this voltage should be 2000 V $\overline{\text{---}}$.

The voltmeter must have an input impedance of at least 100 M Ω .

NOTE: *The quality of the electrostatic attraction of the chart plates has been improved. Modified chart plates may be readily identified by the change in colour from WHITE (earlier version) to GREY (modified version).*

5.3.3 Incorrect Test Diagrams

During the test mode, a number of test programs can be started by means of the front-panel keys.

To enter the test mode, the following settings should be made in the following sequence:

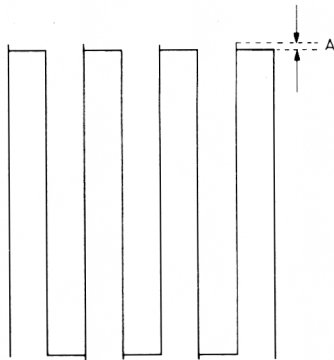
- Switch the power off and remove the front cover to gain access to the Dual-In-Line (DIL) switch on the CPU board.
- Switch the power on, set the PLOT switch to 'REMOTE', the VAR/CAL switch to 'CAL' and the CHART switch to 'HOLD'.
- Set the DIL switch 6 (CPU board) to the TEST position.

The test programs can now be performed.

5.3.3.1 Test program for Y damping

This program enables the overshoot of the Y-amplifier to be checked.

- Set the PEN switch to DOWN.
- Depress the SELECT key. While this is depressed the plotter continues drawing as shown below.



The overshoot (A) should be not greater than 0,3 mm on both sides.

Fig. 5 - 2.

ST 2896

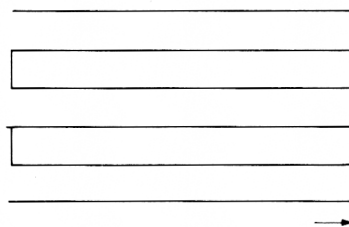
If the overshoot exceeds the specification then the damping of the Y-amplifier must be adjusted with potmeter YD, accessible underneath the instrument. After any adjustment, the hysteresis must be checked.

When the overshoot (on one side only) cannot be adjusted, then check resistor R31 and R33 on the Y-amplifier.

5.3.3.2 Test program for X damping

This program enables the overshoot of the X-amplifier to be checked.

- Set the PEN switch to DOWN.
- Depress the ZERO key; while this is depressed the plotter continues drawing as shown below.



The overshoot (A) should be not greater than 0,3 mm on both sides.

Fig. 5 - 3.

ST 2895

The overshoot can be decreased adjusting the damping of the X-amplifier with potmeter YD; accessible underneath the instrument.

When the overshoot (on one side) cannot be adjusted, the resistors R31 and R33 (X-amplifier) should be checked.

5.3.3.3 Test program for hysteresis check

For this check it is necessary to use a pen with a thickness of 0.3 mm.

- Press the SCALE key once.

The plotter will draw a test diagram (Fig. 5 - 4) to check the hysteresis. No gap must be visible between the lines (forward and reverse).

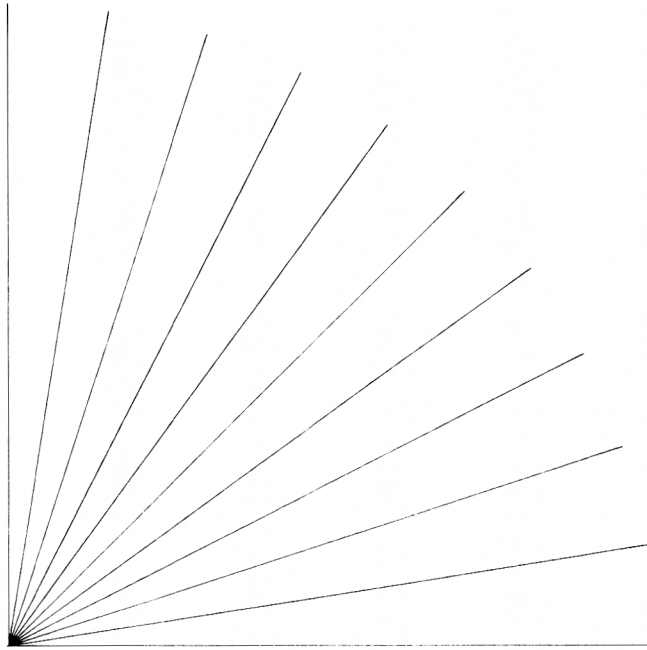


Fig. 5 - 4.

ST 2897

If there is a gap, re-adjust, see Section 4.4.

If dips occur in the lines at regular intervals, then the output voltage of the DAC on the CPU board must be checked (e.g. for dips to the left or to the right, check the DAC of the Y-axis).

For irregular dips, check the corresponding potentiometer (clean with isopropyl alcohol and apply a few drops of potentiometer oil to the resistance strip; wipe afterwards with a clean lint-free cloth).

5.3.3.4 Test program for line drawing

- Set the chart switch to RELEASE position. With the PEN switch in the DOWN position the plotter will continuously draw a line from coordinates 0/0 to 3380/2800 and to 0/0 again. If the PEN switch is set to REMOTE, the movement will be the same, but the pen will only make a point on coordinates 3380/2800.

NOTE: *If faults still occur after this procedure, continue with the faultfinding procedure outlined in remote mode, Section 5.4.*

5.4 REMOTE MODE

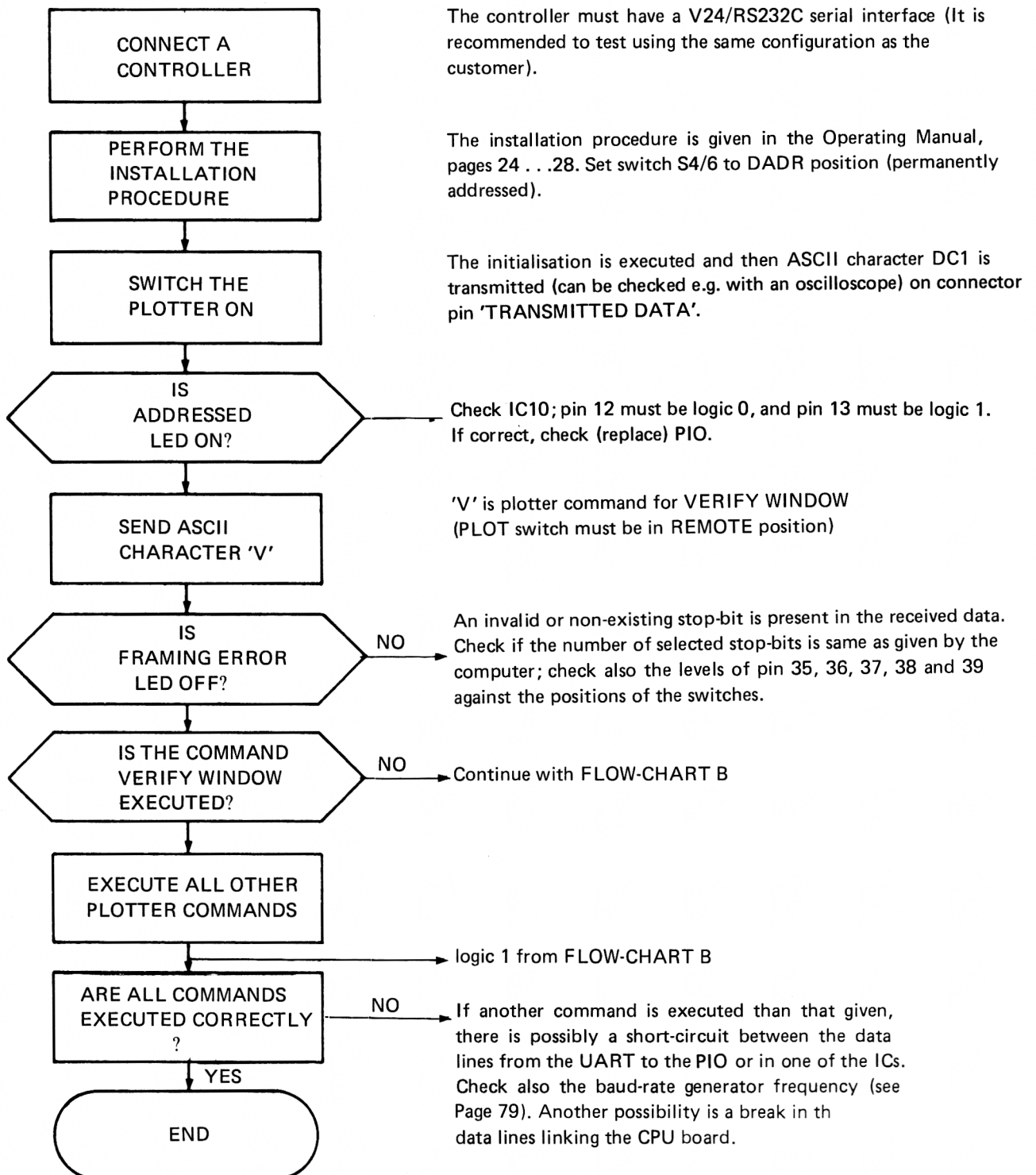
Section 5.4.1 gives information for fault-finding in the serial interface (PM 8151S) and Section 5.4.2 details the fault-finding in the IEC-625 interface (PM 8151B).

In order to check these two plotter versions it is necessary to use a controller (e.g. computer) which has the relevant interface.

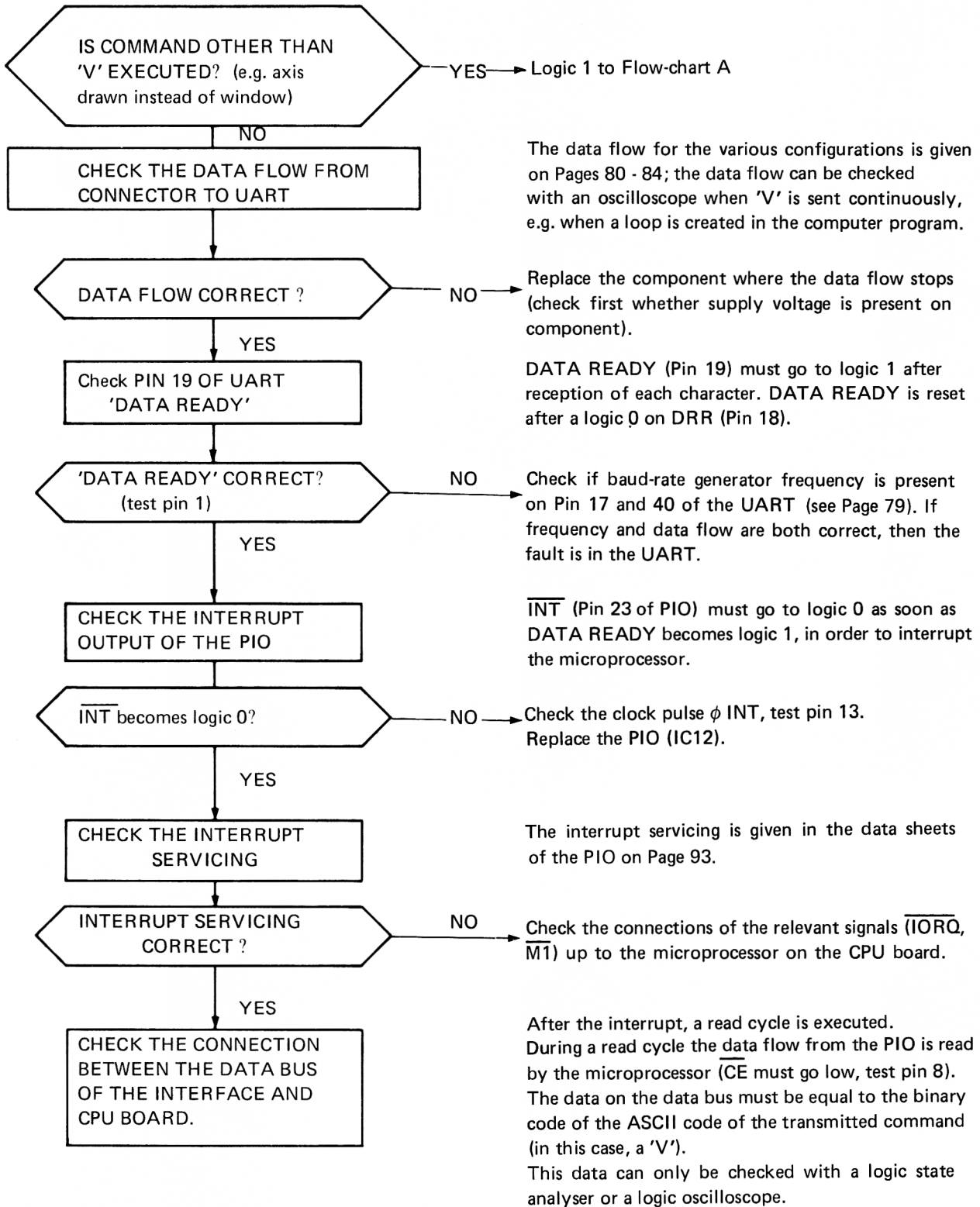
5.4.1 Fault-finding in Serial Interface

For locating a failure on the serial interface board, a flow-chart is included which should be followed closely. This chart is not intended to give a ready-to-hand solution, but serves to indicate the area of the circuit in which the fault may be found.

FLOW-CHART A



FLOW-CHART B



Baud-rate generator

— Check the frequencies at the following test points:

| | | | | |
|---------|---|--------|-----|-----------|
| P11/16 | : | 8.865 | MHz | $\pm 1\%$ |
| IC13/4 | : | 8.865 | MHz | $\pm 1\%$ |
| IC16/4 | : | 8.865 | MHz | $\pm 1\%$ |
| IC13/9 | : | 88.65 | kHz | $\pm 1\%$ |
| IC14/13 | : | 1.76 | kHz | $\pm 1\%$ |
| IC16/13 | : | 616.70 | kHz | $\pm 1\%$ |
| IC20/13 | : | 77.09 | kHz | $\pm 1\%$ |
| IC17/11 | : | 4.80 | kHz | $\pm 1\%$ |
| IC17/8 | : | 9.60 | kHz | $\pm 1\%$ |
| IC17/9 | : | 19.20 | kHz | $\pm 1\%$ |
| IC17/12 | : | 38.40 | kHz | $\pm 1\%$ |

On TP5 a frequency of 16 times the selected baud-rate should be measured.

SERIAL INTERFACE

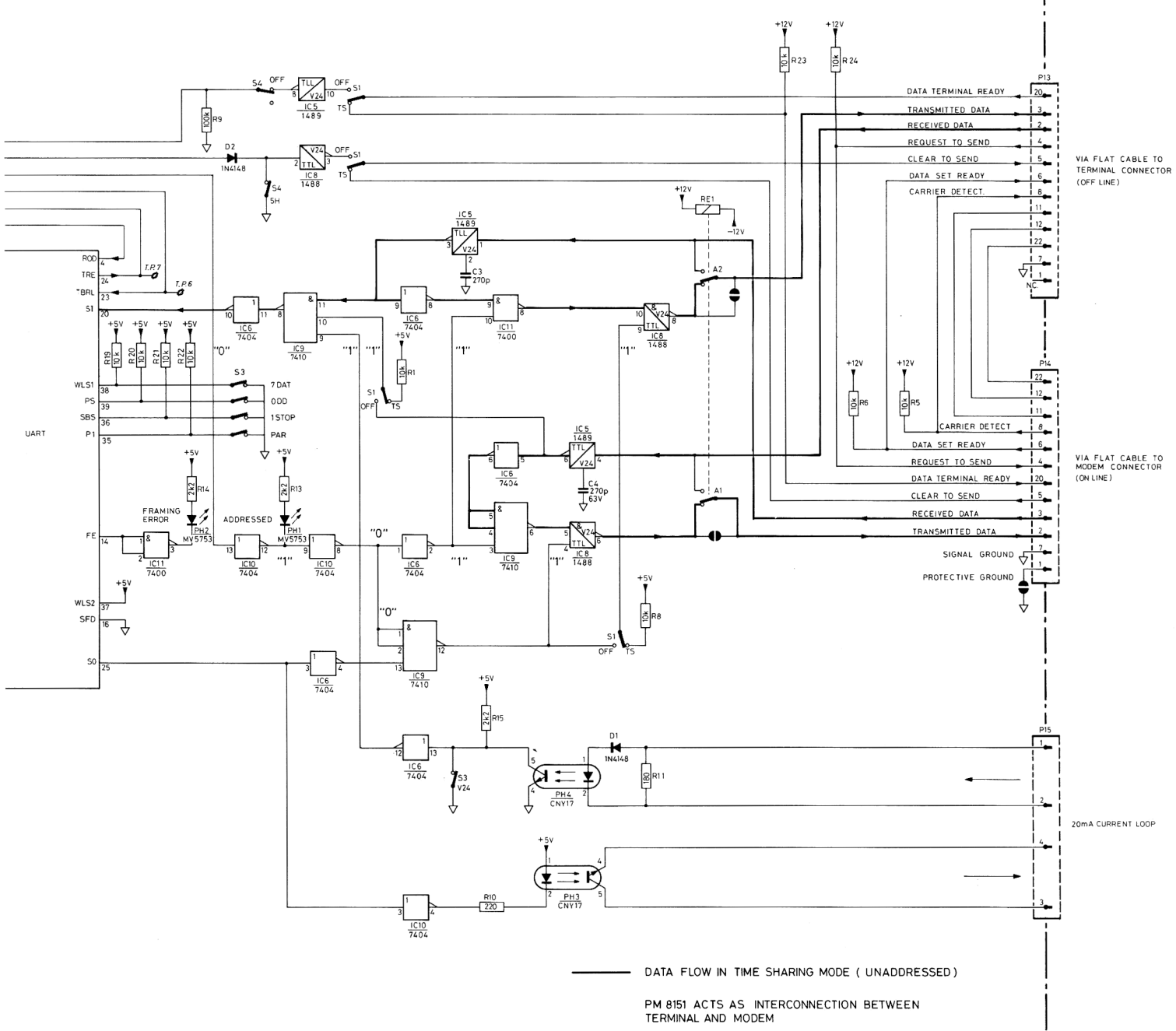


Fig. 5-7

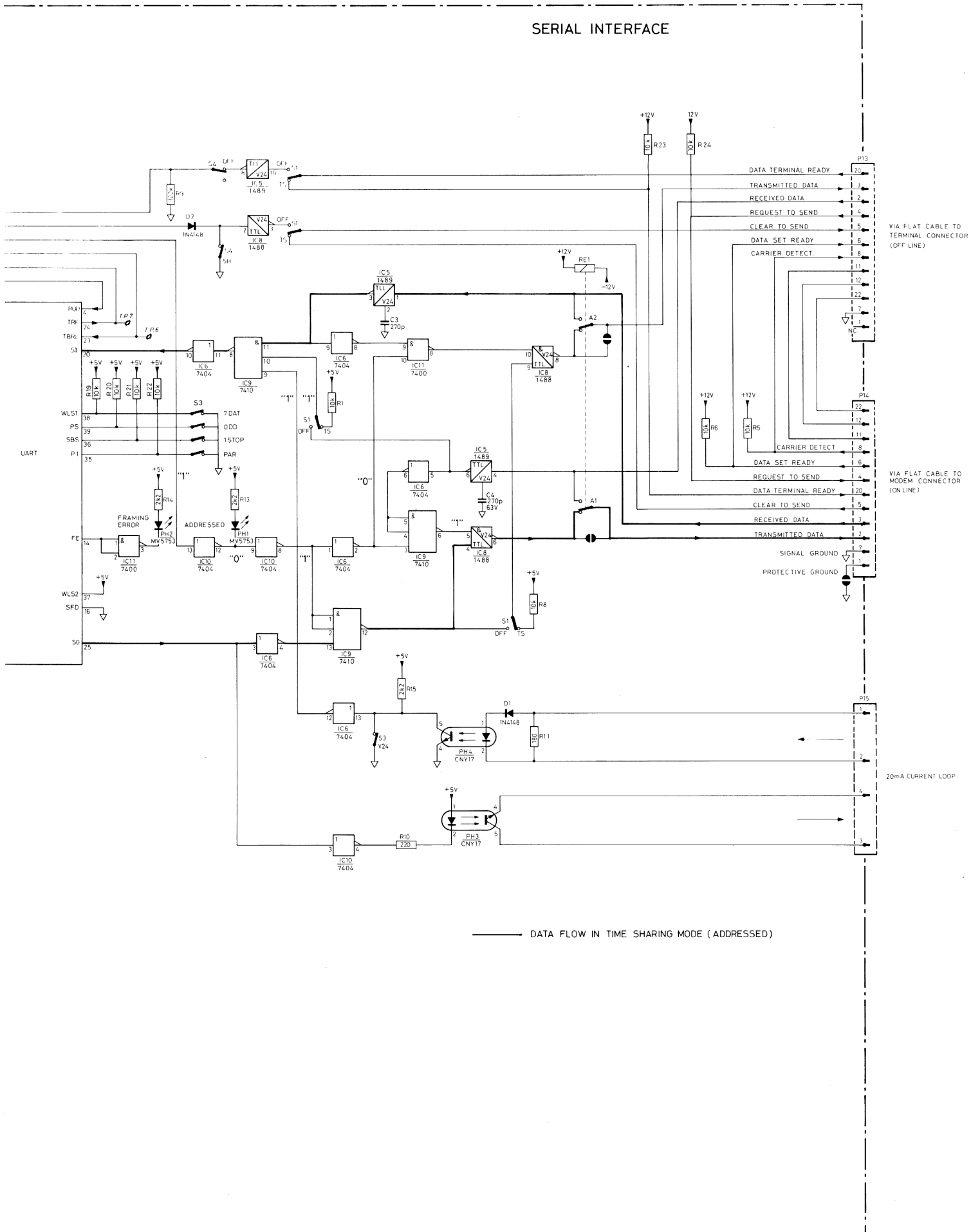


Fig. 5-8

SERIAL INTERFACE

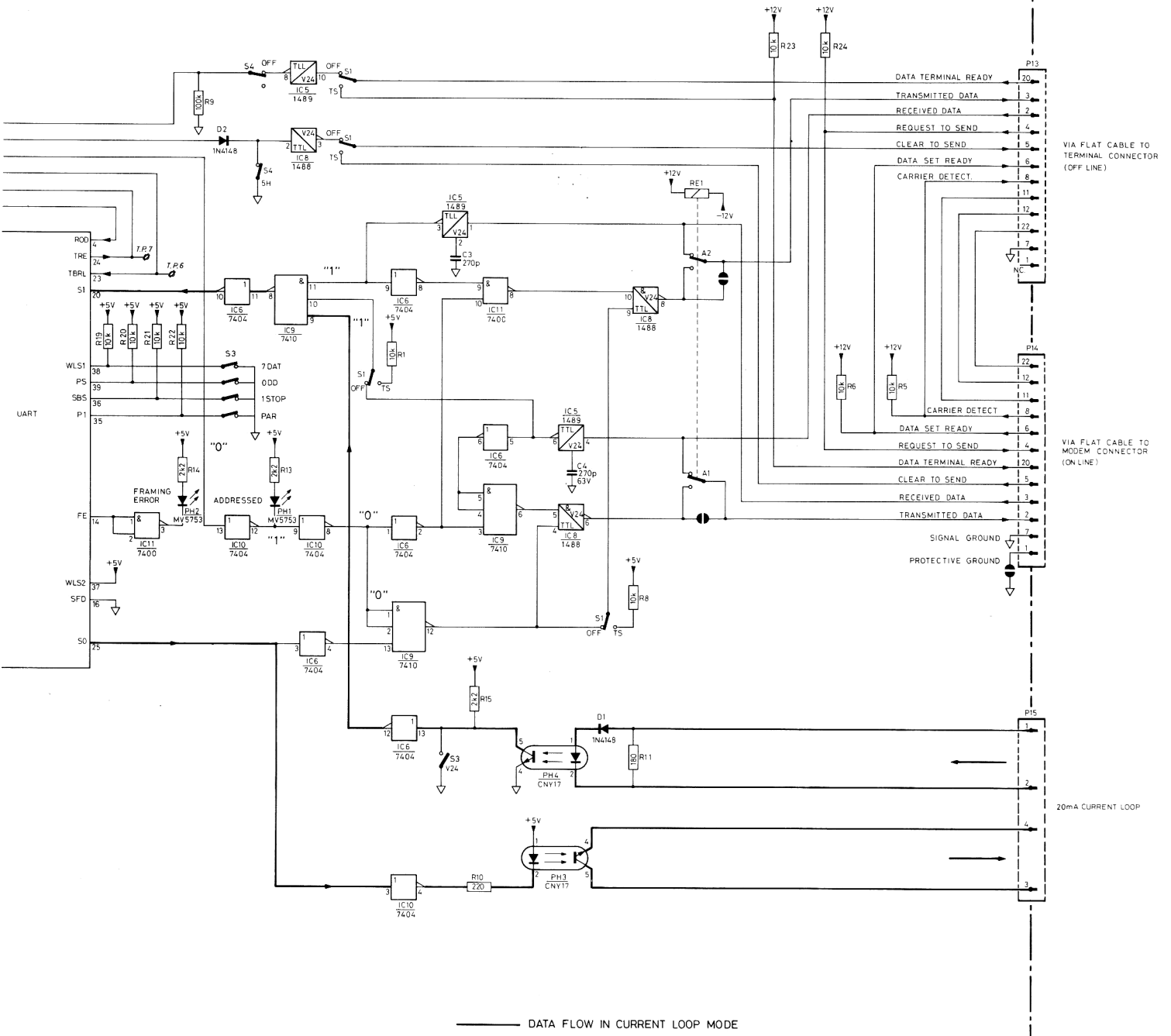


Fig. 5-9

5.4.2 Fault-finding in IEC-625 Interface

Before starting any measurement on the interface board, it is recommended to check the instrument in 'Listen-only' mode, and with the other instruments disconnected from the bus with the exception of the controller.

5.4.2.1 Checking after initialisation

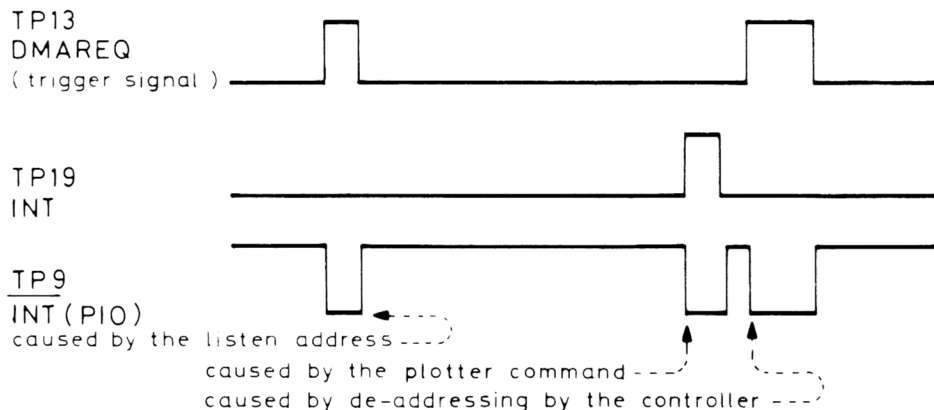
- Set the LON switch to position ON.
- Switch on the plotter, and check that the 'ADDRESSED' LED is on.
- If the LED is not on, check the level of output B5 (pin 32) of the PIO (IC5). After initialisation, B5 must go low.

More detailed fault-finding during initialisation is only possible with a logic scope (PM 3540) or a logic state analyser. It is then, for example, possible to check if the switches are read correctly by the microprocessor.

5.4.2.2 Checking during input

Connect the plotter to a controller and select the listen address of the plotter by means of switch S1 positions 1 . . . 5 on the interface board, and switch LON to off.

- Switch on the plotter. 'ADDRESSED' LED must be off.
- Send the selected listen address of the plotter by means of the controller. As a result, the DMA REQ output of IC6 (TP13) must go high, and therefore the $\overline{\text{INT}}$ (TP9) of the PIO must go low. This can be checked with a memory scope (see Fig. 5 - 9).
- Subsequently, send one plotter command (e.g. 'H', pen-up). The INT output (TP19) of IC6 must now go high, and consequently the $\overline{\text{INT}}$ output (TP9) of the PIO must go low. Check these signals with a memory scope (see also the following figure).



ST 3210

Fig. 5 - 10.

- Whilst sending plotter commands, it is possible to check the incoming data with a logic scope or logic state analyser. However, not all data on the bus will be plotter commands; therefore it is necessary to use correct trigger signals. For reading data, these are: $\overline{\text{CS}}$, $\overline{\text{INT}}$, $\text{RS } 0 \dots 2$ and $\overline{\text{RD}}$. Whilst transmitting commands, it is also possible to check visually if the plotter is addressed with the corresponding LED, but because of the very fast speed at which controllers transmit, it is necessary to use a longer string of commands.
- During input, check the level of the signal $\overline{\text{TRANSMIT/RECEIVE}}$ (TP18); this should be low.
- Using the ASCII characters NUL and DEL, check the transceiver circuits for the DIO lines. With DEL, all bits are low except DIO 8, and with NUL, all bits are high.

- If there is no input, and also no interrupt of the microprocessor given by the PIO, then it is necessary to check the handshake signals, NDAC, NRFD and DAV.

Start in the following sequence:

| | | |
|------|---|--------|
| TP16 | $\overline{\text{TRANSMIT/RECEIVE}}$ | = low |
| TP17 | $\overline{\text{TRANSMIT}}$ | = high |
| IC6 | DAV must go low when the controller transmits | |
| IC6 | $\overline{\text{NRFD}}$ | = high |
| IC6 | $\overline{\text{NDAC}}$ | = low |

The timing diagram of the handshake function is shown in the following figure:

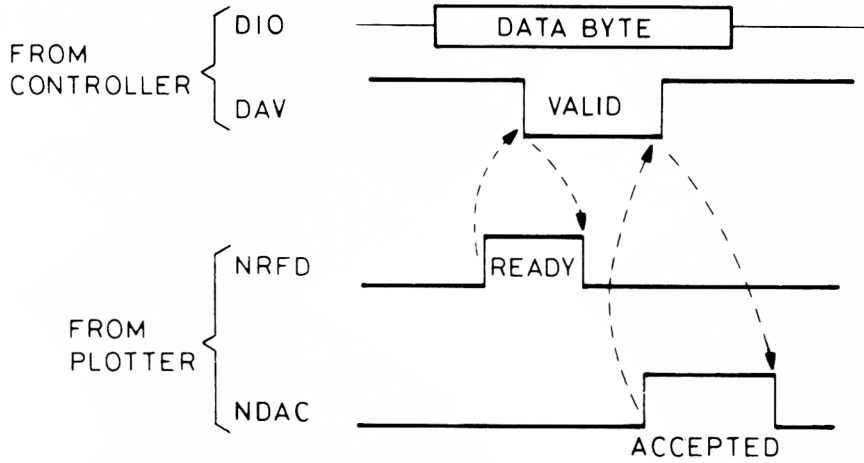


Fig. 5 - 11.

ST 3211

- Error in the handshake
 Acceptor handshake (for input)

| Static situation | | | POSSIBLE CAUSE |
|------------------|----------|----------------|--|
| NRFD (plotter) | DAV | NDAC (plotter) | |
| 1 (= low) | 0 (high) | 1 (low) | a) failure in IC6 b) defective buffer (NRFD) |
| 0 (high) | 0 (high) | 1 (low) | Incorrect handshake of controller (DAV) |
| 0 (high) | 1 (low) | 1 (low) | a) plotter handshake incorrect (IC6) b) buffer DAV defective |
| 1 (low) | 1 (low) | 1 (low) | a) plotter handshake incorrect (IC6) b) buffer NDAC defective |
| 1 (low) | 1 (low) | 0 (high) | Controller handshake incorrect (DAV) |
| 1 (low) | 0 (high) | 0 (high) | Plotter handshake incorrect (IC6) |

5.4.2.3 Checking during output

If the plotter functions correctly for input but not for output, then start by checking the handshake function given in the following figure.

To ensure that the error is not in one of the other instruments connected to the bus, it is recommended that they are all disconnected except the controller.

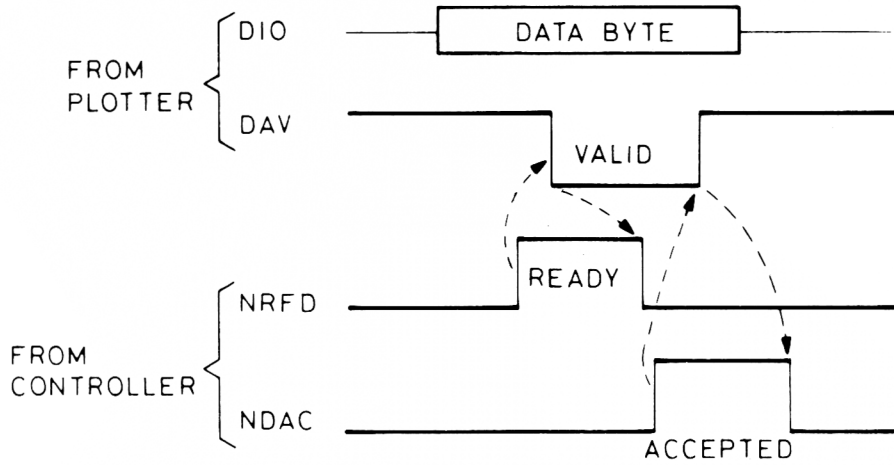


Fig. 5 - 12.

ST 3212

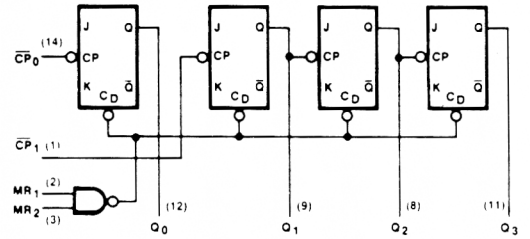
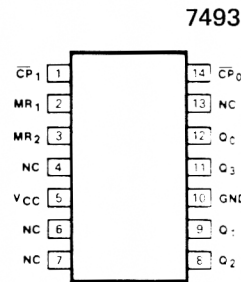
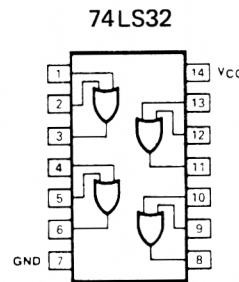
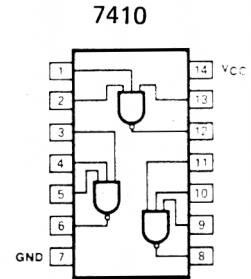
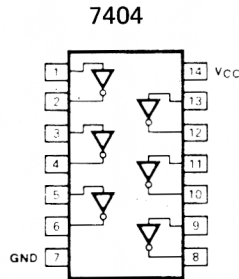
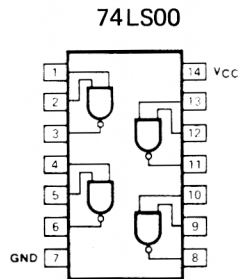
If the handshake is correct, but the data to the controller is a different character than expected, then start by checking the transceivers for the DIO lines and the cable up to the connector on the rear panel.

Source handshake (for output)

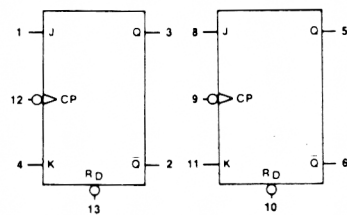
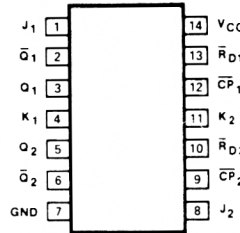
| Static situation | | | POSSIBLE CAUSE |
|------------------|------------------|----------|--|
| NRFD | DAV (plotter) | NDAC | |
| 1 (low) | 0 (high) | 1 (low) | Handshake of controller incorrect |
| 0 (high) | 0 (high) | 1 (low) | Buffer IC2 defective, wrong signal on test pin 16; IC6 defective. |
| 0 (high) | 1 (low) | 1 (low) | Controller handshake defective (NDAC) |
| 1 (low) | 1 (low) | 1 (low) | Controller does not accept data |
| 1 (low) | 1 (low) | 0 (low) | Failure in handshake logic (IC6) or buffer NDAC. |
| 1 (low) | 0 (high) | 0 (high) | Controller handshake defective. |

6. DATA OF COMPONENTS.

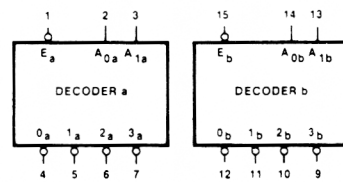
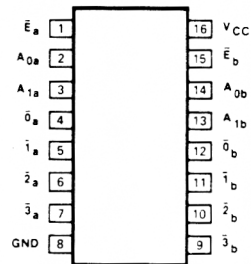
6.1. TTL CIRCUITS



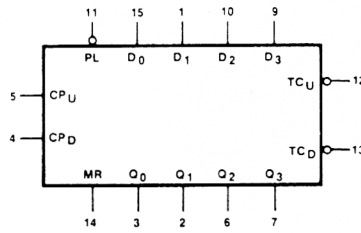
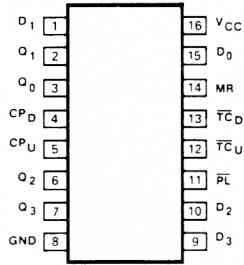
74107



74LS139

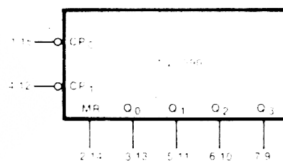
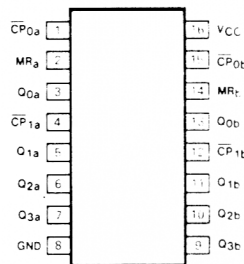


74LS193



| OPERATING MODE | INPUTS | | | | | OUTPUTS | | | |
|----------------|--------|----|-----------------|-----------------|---|---|------------------|------------------|--|
| | MR | PL | CP _U | CP _D | D ₀ , D ₁ , D ₂ , D ₃ | Q ₀ , Q ₁ , Q ₂ , Q ₃ | TC _U | TC _D | |
| Reset (clear) | H | X | X | L | X X X X | L L L L | H | L | |
| | H | X | X | H | X X X X | L L L L | H | H | |
| Parallel load | L | L | X | L | L L L L | L L L L | H | L | |
| | L | L | X | H | L L L L | L L L L | H | H | |
| | L | L | L | X | H H H H | H H H H | L | H | |
| | L | L | H | X | H H H H | H H H H | H | H | |
| Count up | L | H | H | H | X X X X | Count up | H ^(b) | H | |
| Count down | L | H | H | H | X X X X | Count down | H | H ^(c) | |

74LS390



BCD COUNT SEQUENCE

For 1 2 the "390"

| COUNT | OUTPUT | | | |
|-------|----------------|----------------|----------------|----------------|
| | Q ₀ | Q ₁ | Q ₂ | Q ₃ |
| 0 | L | L | L | L |
| 1 | H | L | L | L |
| 2 | L | H | L | L |
| 3 | H | H | L | L |
| 4 | L | L | H | L |
| 5 | H | L | H | L |
| 6 | L | H | H | L |
| 7 | H | H | H | L |
| 8 | L | L | L | H |
| 9 | H | L | L | H |

NOTE
Output Q₀ is connected to Input CP₁ with counter input on CP₀.

BI-QUINARY COUNT SEQUENCE

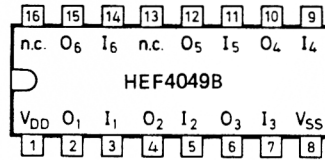
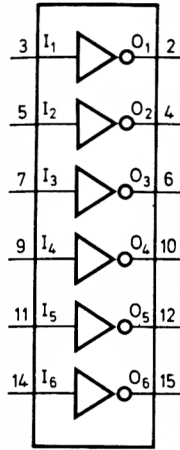
For 1 2 the "390"

| COUNT | OUTPUT | | | |
|-------|----------------|----------------|----------------|----------------|
| | Q ₀ | Q ₁ | Q ₂ | Q ₃ |
| 0 | L | L | L | L |
| 1 | L | H | L | L |
| 2 | L | L | H | L |
| 3 | L | H | H | L |
| 4 | L | L | L | H |
| 5 | H | L | L | L |
| 6 | H | H | L | L |
| 7 | H | L | H | L |
| 8 | H | H | H | L |
| 9 | H | L | L | H |

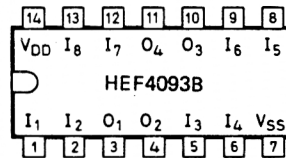
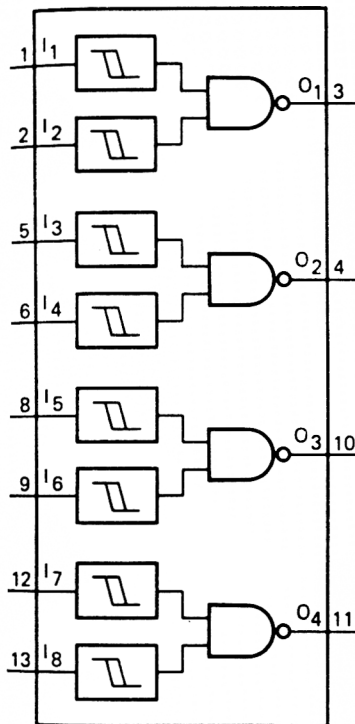
NOTE
Output Q₃ is connected to input CP₀ with counter input on CP₁.

6.2. LOC MOS CIRCUITS.

4049

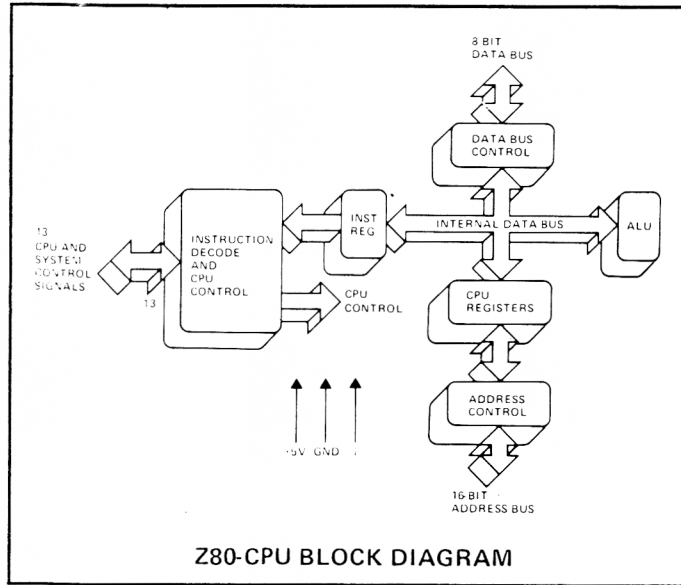
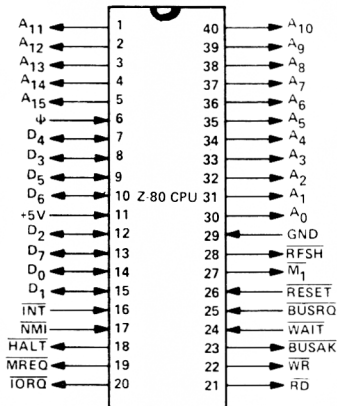


4093



6.3. Z80 FAMILY.

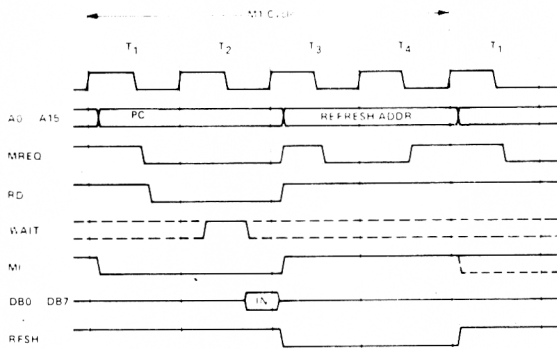
Z80 – CPU (MICROPROCESSOR)



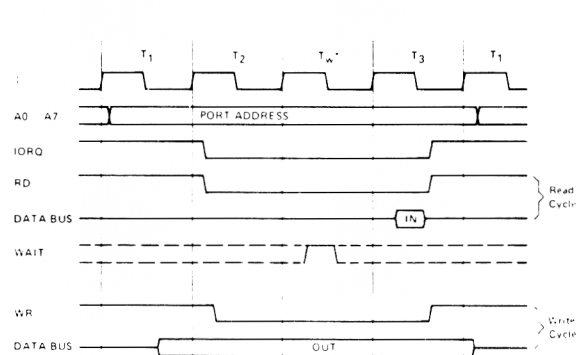
The functions of the pins (as used in PM8151) are described in chapter 3.2.1.

Timing Waveforms

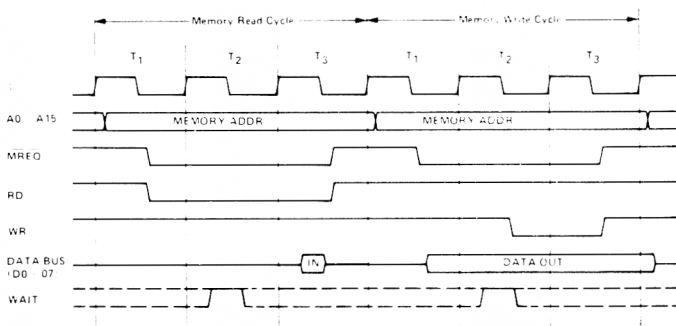
INSTRUCTION OP CODE FETCH



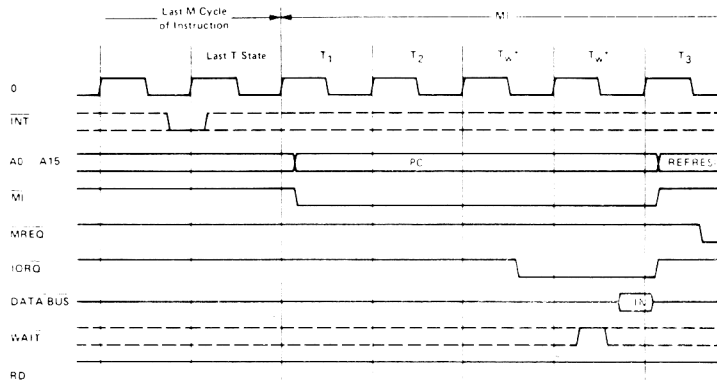
INPUT OR OUTPUT CYCLES



MEMORY READ OR WRITE CYCLES



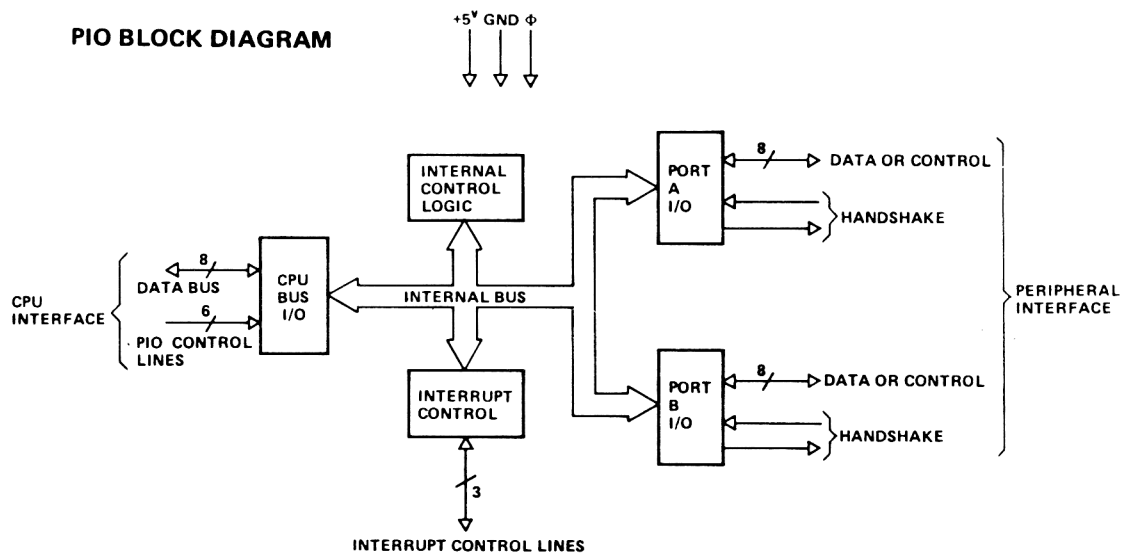
INTERRUPT REQUEST/ACKNOWLEDGE CYCLE



Z80 – PIO (Programmable Input/Output port)

The pinning and a description of the function of the pins is given in chapter 3.2.1.

All PIO's of the platter are used in the control mode (mode 3), so without handshake lines.

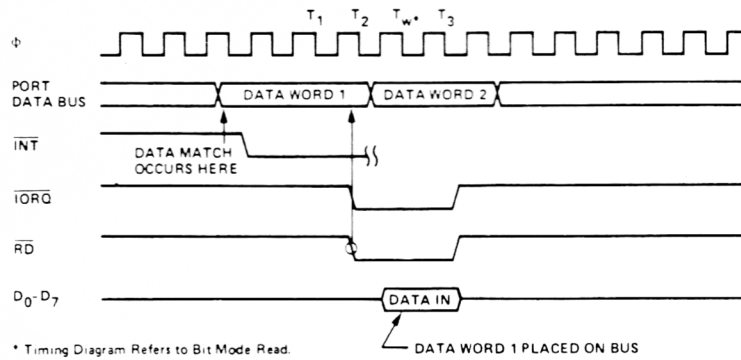


CONTROL MODE (MODE 3)

The control mode does not utilize the handshake signals and a normal port write or port read can be executed at any time. When writing, the data will be latched into output registers with the same timing as Mode 0.

When reading the PIO, the data returned to the CPU will be composed of output register data from those port data lines assigned as outputs and input register data from those port data lines assigned as inputs. The input register will contain data which was present immediately prior to the falling edge of RD.

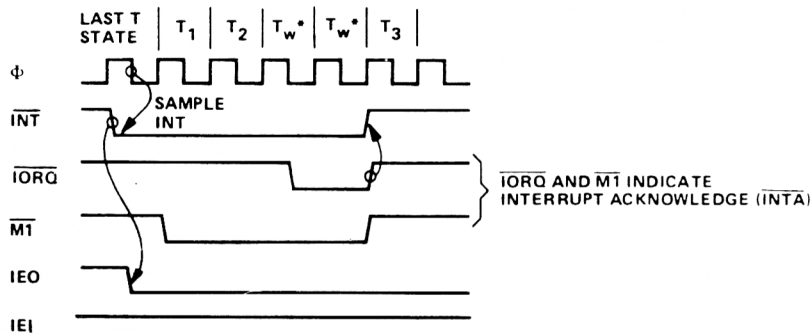
An interrupt will be generated if interrupts from the port are enabled and the data on the port data lines satisfies the logical equation defined by the 8-bit mask and 2-bit mask control registers.



INTERRUPT SERVICING

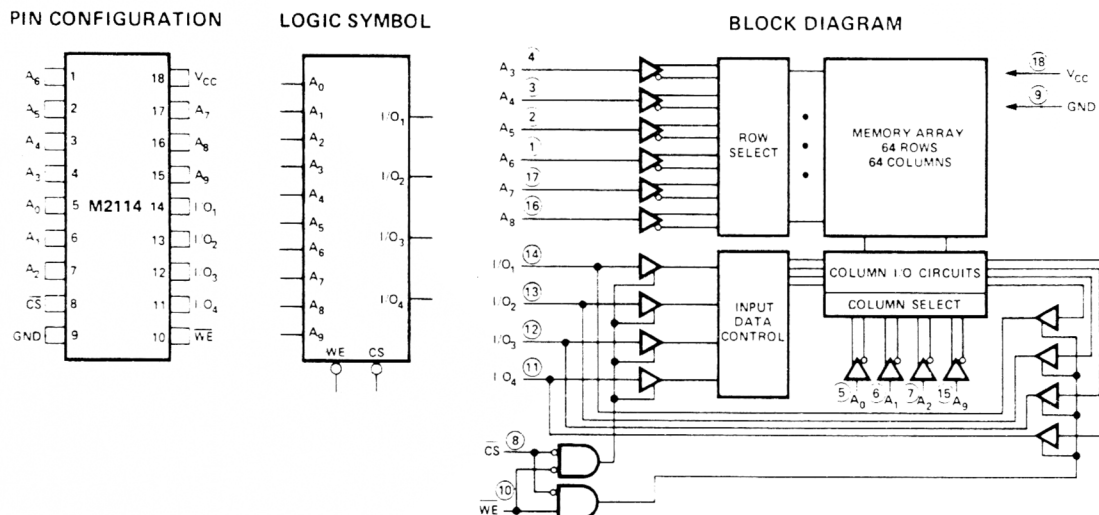
Some time after an interrupt is requested by the PIO, the CPU will send out an interrupt acknowledge ($\overline{M1}$ and IORQ). During this time the interrupt logic of the PIO will determine the highest priority port which is requesting an interrupt. (This is simply the device with its Interrupt Enable Input high and its Interrupt Enable Output low). To insure that the daisy chain enable lines stabilize, devices are inhibited from changing their interrupt request status when $\overline{M1}$ is active. The highest priority device places the contents of its interrupt vector register onto the Z80 data bus during interrupt acknowledge.

Figure 6.0-1 illustrates the timing associated with interrupt requests. During $\overline{M1}$ time, no new interrupt requests can be generated. This gives time for the Int Enable signals to ripple through up to four PIO circuits. The PIO with IEI high and IEO low during \overline{INTA} will place the 8-bit interrupt vector of the appropriate port on the data bus at this time.



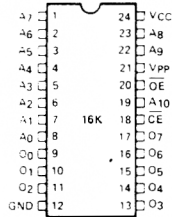
6.4. MEMORY.

2114 (1024 x 4 bit static ram)

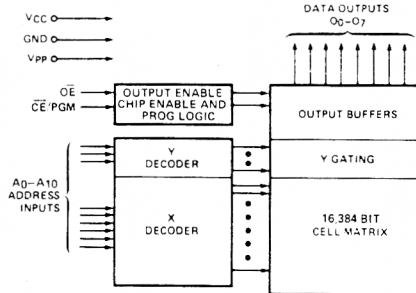


2716 (2K x 8 UV ERASABLE PROM)

PIN CONFIGURATION



BLOCK DIAGRAM



6.5. CIRCUITS FOR SERIAL INTERFACE.

TMS6011 (uart)

Pin configuration

| | | | | | |
|-----------------|--------------------------------|----|----|-------------------------------|------------------|
| VSS | VSS Power Supply | 1 | 40 | Transmitter Register Clock | TRC |
| VGG | VGG Power Supply | 2 | 39 | Parity Select | PS |
| VDD | VDD Power Supply | 3 | 38 | Word Length Select | WLS ₁ |
| RRD | Receiver Register Disable | 4 | 37 | Word Length Select | WLS ₂ |
| RR ₁ | Receiver Holding Register Data | 5 | 36 | Stop Bit(s) Select | SBS |
| RR ₂ | Receiver Holding Register Data | 6 | 35 | Parity Inhibit | PI |
| RR ₃ | Receiver Holding Register Data | 7 | 34 | Control Register Load | CRL |
| RR ₄ | Receiver Holding Register Data | 8 | 33 | Transmitter Register Input | TR ₈ |
| RR ₅ | Receiver Holding Register Data | 9 | 32 | Transmitter Register Input | TR ₇ |
| RR ₆ | Receiver Holding Register Data | 10 | 31 | Transmitter Register Input | TR ₆ |
| RR ₇ | Receiver Holding Register Data | 11 | 30 | Transmitter Register Input | TR ₅ |
| RR ₈ | Receiver Holding Register Data | 12 | 29 | Transmitter Register Input | TR ₄ |
| PE | Parity Error | 13 | 28 | Transmitter Register Input | TR ₃ |
| FE | Framing Error | 14 | 27 | Transmitter Register Input | TR ₂ |
| OE | Overrun Error | 15 | 26 | Transmitter Register Input | TR ₁ |
| SFD | Status Flags Disable | 16 | 25 | Transmitter Register Input | TR ₀ |
| RRC | Receiver Register Clock | 17 | 24 | Transmitter Register Empty | TRE |
| DRR | Data Received Reset | 18 | 23 | Transmitter Buffer Reg. Load | TBRL |
| DR | Data Ready | 19 | 22 | Transmitter Buffer Reg. Empty | TBRE |
| RI | Receiver Input | 20 | 21 | Master Reset | MR |

receiver section

The data is received in serial form on the receive input **RInput**

The data is presented in parallel form on the eight data outputs **RR₁** through **RR₈**

RInput is the data input terminal. The data from **RInput** enters the receiver register at a point determined by the character length, the parity, and the number of stop bits. **RInput** must be maintained High when no data is being received. The data is clocked through the **RR** clock. The clock rate is 16 times faster than the data rate.

Data is transferred from the receiver register to the receiver buffer register and appears on the 8 **RR** outputs. The MOS output buffers used for the eight **RR** terminals are 3 state push pull output buffers which permit the wire OR configuration through use of the **RRDisable** terminal. When a logic High is applied to **RRDisable**, the **RR** outputs are floating. If the word length is less than 8 bits, the most significant bits will be at a logic low. The output word is right justified. **RR₁** is the least significant bit and **RR₈** is the most significant bit.

A logic low applied to the **DRReset** terminal resets the **DReady** output to a logic Low.

Several flags are provided in the receiver section. There are three error flags (parity error, framing error and overrun error) and a data ready flag. All status flags may be disabled through a logic High on the **SFDisable** terminal.

A logic High on the **PError** terminal indicates an error in parity.

A logic High on the **FError** terminal indicates a framing error that is an invalid or nonexistent stop bit in the received word.

A logic High on the **OError** terminal indicates an overrun. An overrun occurs when the previous word has not been read, i.e., when the **DReady** line has not been reset before the present data was transferred to the data receive holding register.

A logic High on the **DReady** terminal indicates that a word has been received, stored in the receiver buffer register and that the data is available on outputs **RR₁** through **RR₈**. The **DReady** terminal can be reset through the **DRReset** terminal.

transmitter section

The transmitter section will accept data in parallel form, serialize it, format it, and transmit it in serial form.

Parallel input data is received on the transmitter-buffer-register data inputs TR₁ through TR₈.

Serial output data is transmitted on the TROutput terminal.

Input data is stored in the transmitter-buffer register. A logic Low on the TBRLoad command terminal will load a character in the transmitter-buffer register. If words of less than 8 bits are used, only the least significant bits are accepted. The character is justified into the least significant bit, TR₁.

The data is transferred to the transmitter register when TBRLoad terminal goes from Low to High. The loading of the transmitter register is delayed if the transmitter section is presently transmitting data. In this case the loading of the transmitter register is delayed until the transmission has been performed.

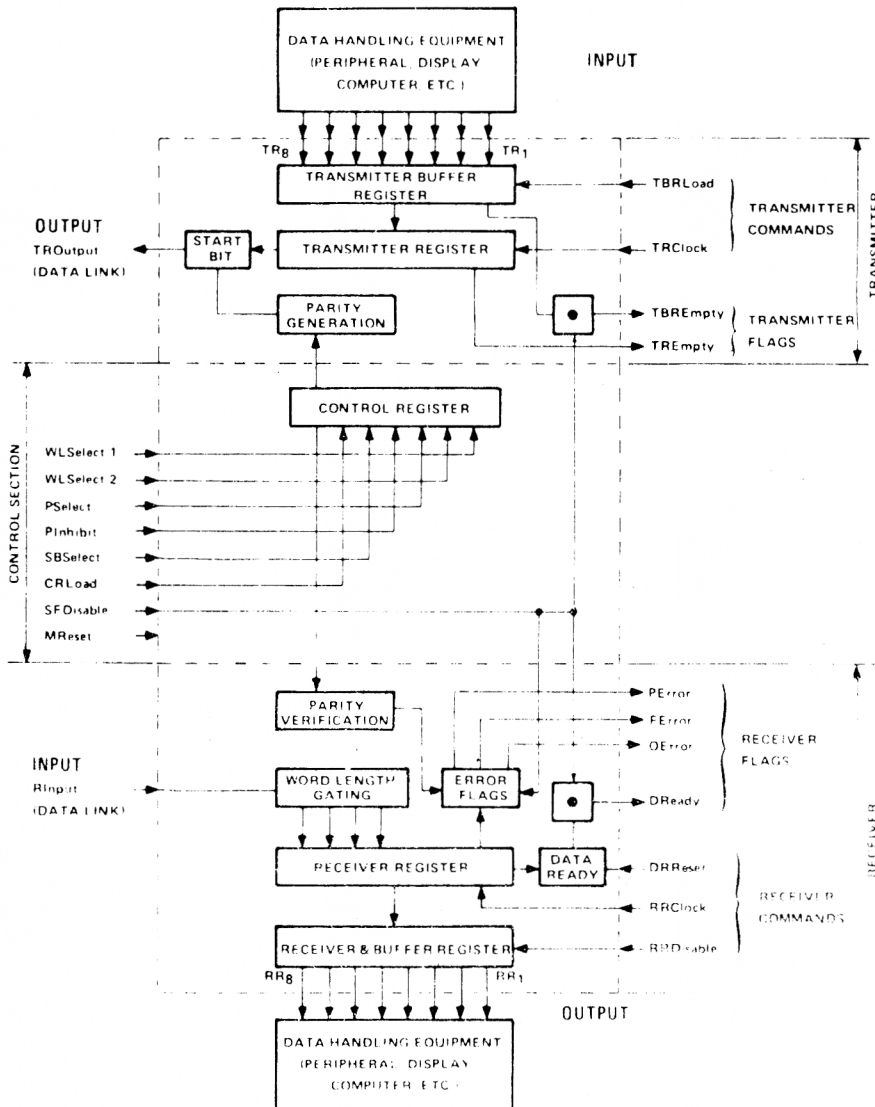
Output serial data (transmitted on the TROutput terminal) is clocked out by TRClock. The clock rate is 16 times faster than the data rate.

The data is formatted as follows: start bit, data, parity bit, stop bits (1 or 2). Start bits, parity bits, and stop bits are generated by the TMS 6011. When no data is transmitted the output TROutput sits at a logic High.

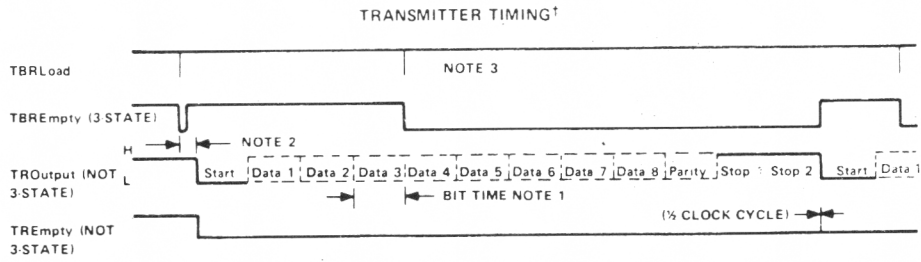
The start of transmission is defined as the transition of TROutput from a logic High to a logic Low.

Two flags are provided. A logic High on the TBREmpty flag indicates that a word has been transferred to the transmitter/receiver and that the transmitter buffer receiver is now ready to accept a new word. A logic High on the TREmpty flag indicates that the transmitter section has completed the transmission of a complete word including stop bits. The TREmpty flag will sit at a logic High until the start of transmission of a new word.

Both transmitter holding register and transmitter registers are static and will perform dc storage of data.

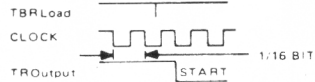


operation timing diagram



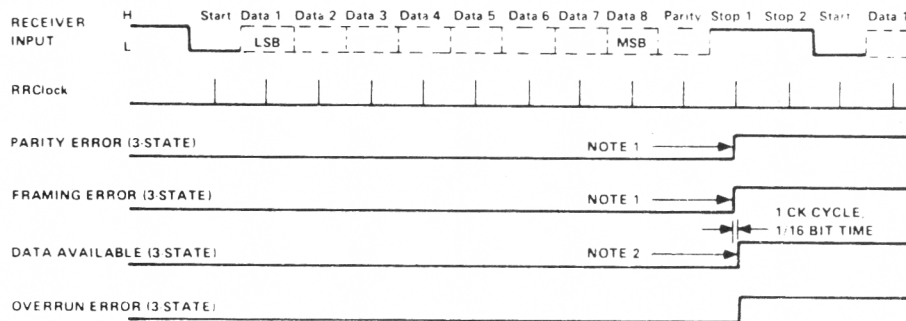
† Transmitter initially assumed inactive at start of diagram, shown for 8 level code and parity and 2 stops

- NOTES
- 1 Bit time is 16 clock cycles
 - 2 If transmitter is inactive the start pulse will appear on line within one clock cycle of time data strobe occurs (see detail below)



- 3 Because transmitter is double buffered, another data strobe can occur anywhere during transmission of character

RECEIVER TIMING

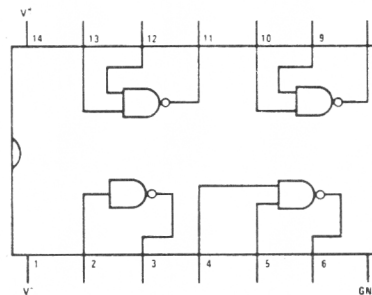


- NOTES
- 1 This is the point at which the error condition is detected, if error occurs
 - 2 Data available is set only when the received data has been transferred to the buffer register. Data available going High also transfers PE, FE, or the status word holding register (see block diagram).
 - 3 All information is good in buffer register until data available tries to set for next character.
 - 4 Above shown for 8-level code, parity and 2-stop. For no parity, stop bits follow data.
 - 5 For all level code, the data in the buffer register must be right justified i.e. RD₁ (pin 12).

DS1488 (quad line driver)

general description

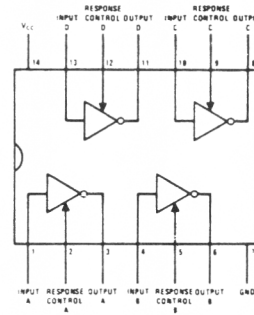
The DS1488 is a quad line driver which converts standard DTL/TTL input logic levels through one stage of inversion to output levels which meet EIA Standard No. RS-232C and CCITT Recommendation V. 24.



DS1489 (quad line receiver)

general description

The DS1489/DS1489A are quad line receivers designed to interface data terminal equipment with data communications equipment. They are constructed on a single monolithic silicon chip. These devices satisfy the specifications of EIA standard No. RS232C. The DS1489/DS1489A meet and exceed the specifications of MC1489/MC1489A and are pin-for-pin replacements. The DS1489/DS1489A are available in 14-lead ceramic dual-in-line package.



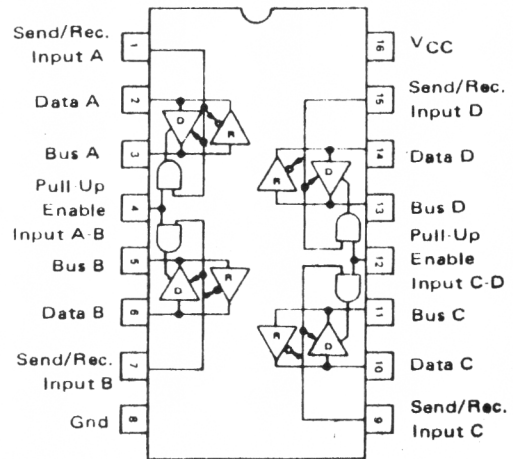
6.6. CIRCUITS FOR IEC/IEEE INTERFACE.

MC3448A (quad 3-state bus transceiver)

TRUTH TABLE

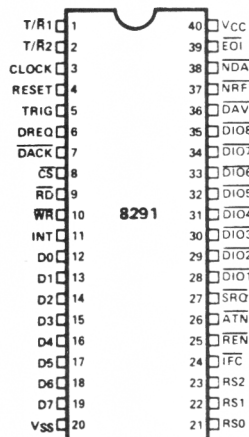
| Send/Rec. | Enable | Info. Flow | Comments |
|-----------|--------|------------|----------------|
| 0 | X | Bus → Data | |
| 1 | 1 | Data → Bus | Active Pull Up |
| 1 | 0 | Data → Bus | Open Col. |

X - Don't Care

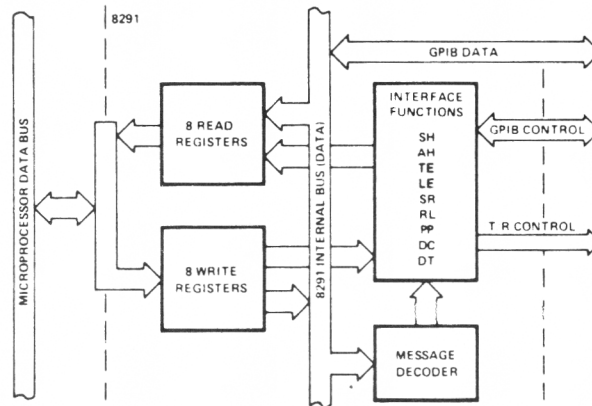


8291 (GPIB talker/listener)

PIN CONFIGURATION



BLOCK DIAGRAM



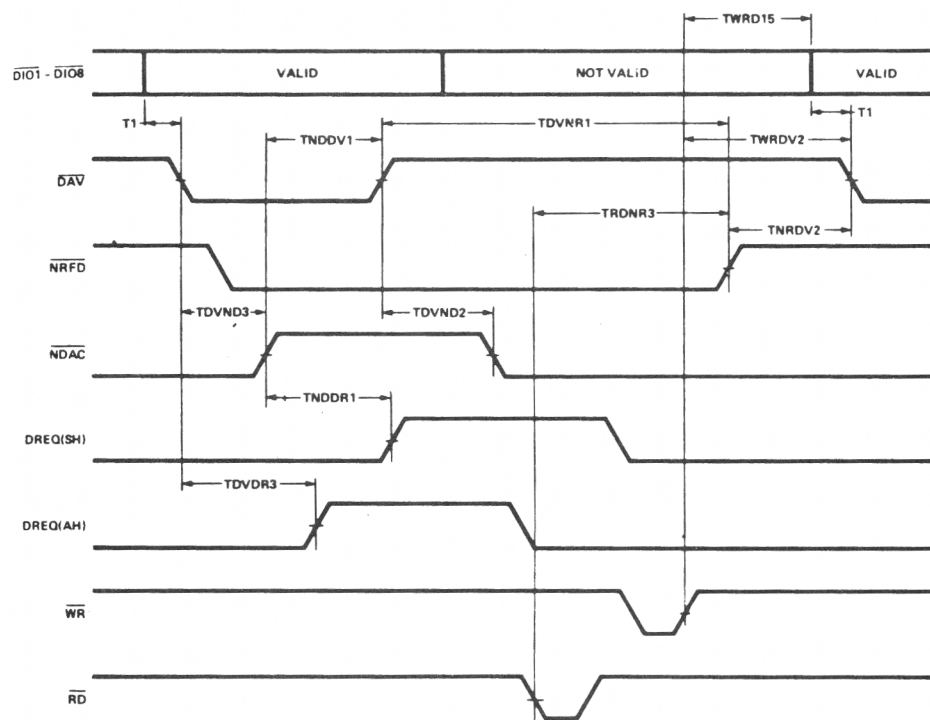
GENERAL DESCRIPTION

The 8291 is a microprocessor controlled device designed to interface microprocessors e.g., 8048, 8080, 8085, 8086 to the GPIB. It implements all of the interface functions defined in the IEEE 488 Standard. If an implementation of the Standard's Controller function is desired, it can be connected with an Intel® 8292 to form a complete interface.

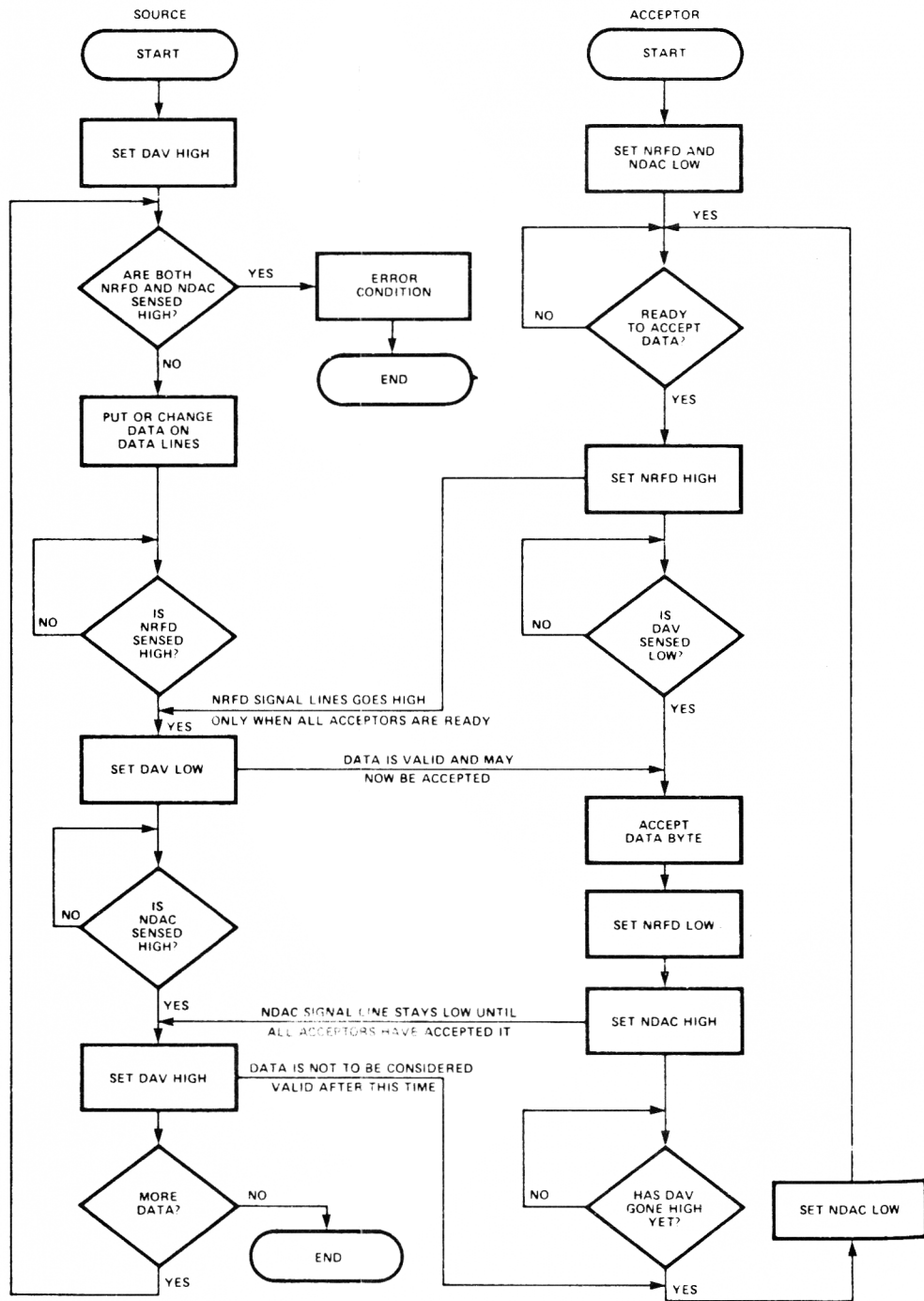
The 8291 handles communication between a microprocessor controlled device and the GPIB. Its capabilities include data transfer, handshake protocol, talker/listener addressing procedures, device clearing and triggering, service request, and both serial and parallel polling schemes. In most procedures, it does not disturb the microprocessor unless a byte is waiting on input or a byte sent on output (output buffer empty).

The 8291 architecture includes 16 registers. Eight of these registers may be written into by the microprocessor. The other eight registers may be read by the microprocessor. One each of these read and write registers is for direct data transfers. The rest of the write registers control the various features of the chip, while the rest of the read registers provide the microprocessor with a monitor of GPIB states, various bus conditions, and device conditions.

THE THREE WIRE HANDSHAKE



The figure shows the flowchart of the sequence of events during transfer of databytes. The plotter can act as listener (acceptor handshake) as well as talker (source handshake). More than one listener at a time can accept data because of logical-AND connection of NRFD and NDAC lines.



CODING SYSTEM OF FAILURE REPORTING FOR QUALITY
ASSESSMENT OF T & M INSTRUMENTS
(excl. potentiometric recorders)

The information contents of the coded failure description is necessary for our computerized processing of quality data.

Since the reporting of repair and maintenance routines must be complete and exact, we give you an example of a correctly filled-out PHILIPS SERVICE Job sheet.

| | | | |
|---------|----------------|---------------------|--------------------|
| ① | ② | ③ | ④ |
| Country | Day Month Year | Typenumber /Version | Factory/Serial no. |
| 3 2 | 1 5 0 4 7 5 | O P M 3 2 6 0 0 2 | D O 0 0 7 8 3 |

CODED FAILURE DESCRIPTION

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|------------------------|--|---|---|---|--|--|--|---|---|---|---|--|--|--|--|--|--|--|--|--|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|--|--|--|--|--|--|--|--|--|--|--|---|---|---|--|--|
| ⑤ | ⑥ | ⑦ | ⑧ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nature of call | Location | Component/sequence no. | Category | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> Installation <input type="checkbox"/> Pre sale repair <input type="checkbox"/> Preventive maintenance <input checked="" type="checkbox"/> Corrective maintenance <input type="checkbox"/> Other | <table border="1" style="width: 100%; height: 100%; text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>0</td><td>0</td><td>2</td><td>1</td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table> | | | | | | | | | 0 | 0 | 2 | 1 | | | | | | | | | <table border="1" style="width: 100%; height: 100%; text-align: center;"> <tr><td>T</td><td>S</td><td>0</td><td>6</td><td>0</td><td>7</td></tr> <tr><td>R</td><td>0</td><td>0</td><td>6</td><td>3</td><td>1</td></tr> <tr><td>9</td><td>9</td><td>0</td><td>0</td><td>0</td><td>1</td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table> | T | S | 0 | 6 | 0 | 7 | R | 0 | 0 | 6 | 3 | 1 | 9 | 9 | 0 | 0 | 0 | 1 | | | | | | | | | | | | | <table border="1" style="width: 100%; height: 100%; text-align: center;"> <tr><td>5</td></tr> <tr><td>2</td></tr> <tr><td>4</td></tr> <tr><td> </td></tr> <tr><td> </td></tr> </table> | 5 | 2 | 4 | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 2 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| T | S | 0 | 6 | 0 | 7 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| R | 0 | 0 | 6 | 3 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | 9 | 0 | 0 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | <input checked="" type="checkbox"/> Job completed <input type="checkbox"/> Working time | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | <table border="1" style="width: 100%; height: 100%; text-align: center;"> <tr><td> </td><td>1</td><td>2</td></tr> </table> Hrs | | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Detailed description of the information to be entered in the various boxes:

①Country: 3 2 = Switzerland

②Day Month Year 1 5 0 4 7 5 = 15 April 1975

③Type number/Version O P M 3 2 6 0 0 2 = Oscilloscope PM 3260, version 02 (in later oscilloscopes this number is placed in front of the serial no)

④Factory/Serial number D O 0 0 7 8 3 = DO 783 These data are mentioned on the type plate of the instrument

⑤ Nature of call: Enter a cross in the relevant box

⑥ Coded failure description

Location

| | | | |
|--|--|--|--|
| | | | |
|--|--|--|--|

These four boxes are used to isolate the problem area. Write the code of the part in which the fault occurs, e.g. unit no or mechanical item no of this part (refer to 'PARTS LISTS' in the manual).
Example: 0001 for Unit 1
 000A for Unit A
 0075 for item 75
If units are not numbered, do not fill in the four boxes; see Example Job sheet.

Component/sequence no.

| | | | | | |
|--|--|--|--|--|--|
| | | | | | |
|--|--|--|--|--|--|

These six boxes are intended to pinpoint the faulty component.
A. Enter the component designation as used in the circuit diagram. If the designation is alfa-numeric, the letters must be written (starting from the left) in the two left-hand boxes and the figures must be written (in such a way that the last digit occupies the right-most box) in the four right-hand boxes.
B. Parts not identified in the circuit diagram:
990000 Unknown/Not applicable
990001 Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002 Knob (incl. dial knob, cap, etc.)
990003 Probe (only if attached to instrument)
990004 Leads and associated plugs
990005 Holder (valve, transistor, fuse, board, etc.)
990006 Complete unit (p.w. board, h.t. unit, etc.)
990007 Accessory (only those without type number)
990008 Documentation (manual, supplement, etc.)
990009 Foreign object
990099 Miscellaneous

Category

| |
|--|
| |
|--|

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement (of transistor, resistor, etc.)
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

⑦ Job completed: Enter a cross when the job has been completed.

⑧ Working time: Enter the total number of working hours spent in connection with the job (excluding travelling, waiting time, etc.), using the last box for tenths of hours.

 1 2 = 1,2 working hours (1 h 12 min.)

7 PARTS LIST

7.1 ELECTRICAL PARTS ON PRINTED CIRCUIT BOARDS

7.1.1 CPU board

Capacitors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C1 | 4822 122 31056 | 12 p | 2 | 63 | Ceramic |
| C2 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C3 | 5322 122 34191 | 3.3 μ | +50 -20 | 35 | Tantal |
| C4 | 5322 122 34191 | 3.3 μ | +50 -20 | 35 | Tantal |
| C5 | 5322 122 34191 | 3.3 μ | +50 -20 | 35 | Tantal |
| C6 | 5322 122 34241 | 33 μ | +50 -20 | 16 | Tantal |
| C7 | 5322 122 34239 | 10 μ | +50 -20 | 35 | Tantal |
| C8 | 5322 122 34239 | 10 μ | +50 -20 | 35 | Tantal |
| C9 | 5322 122 34241 | 33 μ | +50 -20 | 16 | Tantal |
| C10 | 5322 122 34181 | 0,33 μ | 10 | 63 | Polyester foil |
| C11 | 5322 122 34178 | 68 n | 20 | 63 | Polyester foil |
| C12 | 5322 122 34184 | 0,47 μ | 10 | 63 | Polyester foil |
| C13 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C14 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C15 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C16 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C17 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C18 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C19 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C20 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C21 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C22 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C23 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C24 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C25 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C26 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |

Resistors*

| <i>Item</i> | <i>Ordering number</i> | <i>Value (Ω)</i> | <i>Tol (%)</i> | <i>Series</i> |
|-------------|------------------------|------------------------------------|----------------|---------------|
| R 5 | 4822 100 10027 | 2.2 k | 20 | Potentiometer |
| R12 | 5322 116 50536 | 464 | 1 | MR 24 |
| R13 | 5322 103 14074 | 500 | 10 | Potentiometer |
| R14 | 5322 116 50536 | 464 | 1 | MR 24 |
| R15 | 5322 103 14074 | 500 | 10 | Potentiometer |
| R23 | 5322 116 50483 | 38.3 k | 1 | MR 24 |
| R25 | 5322 116 54686 | 75 k | 1 | MR 25 |
| R27 | 5322 116 54712 | 147 k | 1 | MR 25 |
| R60 | 5322 103 10024 | 10 k | 10 | Potentiometer |
| R61 | 5322 103 10024 | 10 k | 10 | Potentiometer |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| D 1 - D 8 | 4822 130 30621 | 1N 4148 | 8 |
| D13 - D17 | 4822 130 30621 | 1N 4148 | 5 |
| T 1 - T 4 | 4822 130 44197 | BC 308 B | 4 |
| T 5 - T12 | 4822 130 40959 | BC 237 B | 8 |
| Ph1 - Ph 2 | 5322 130 34567 | MV 5753 LED | 2 |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|-------------------------|
| IC 1 | 5322 209 85181 | 74S124 Dual VCO |
| IC 2 | 5322 209 85267 | 74LS32 Dual OR |
| IC 3 | 5322 209 84023 | 74107 DUAL JK Flip Flop |
| IC 4 | 5322 209 14049 | 4049 Hex buffer |
| IC 5 | 5322 209 84823 | 74LS00 Quad Nand |
| IC 6 | 5322 209 85839 | 74LS139 2 To 4 Decoder |
| IC 7 | 5322 209 14697 | 2114 1kx4 Static RAM |
| IC 8 | 5322 209 14697 | 2114 1kx4 Static RAM |
| IC 9 | 5322 209 14697 | 2114 1kx4 Static RAM |
| IC 10 | 5322 209 14697 | 2114 1kx4 Static RAM |
| IC 11 | 5322 694 74024 | 2716 EPROM SP281/CPU3 |
| IC 12 | 5322 694 74023 | 2716 EPROM SP281/CPU2 |
| IC 13 | 5322 694 74022 | 2716 EPROM SP281/CPU1 |
| IC 14 | 5322 209 14716 | Z-80 Micro processor |
| IC 15 | 5322 209 14718 | Z-80 PIO |
| IC 16 | 5322 209 14718 | Z-80 PIO |
| IC 17 | 5322 209 14718 | Z-80 PIO |
| IC 18 | 5322 209 86353 | DAC-80 12 bit DAC |
| IC 19 | 5322 209 86353 | DAC-80 12 bit DAC |
| IC 20 | 5322 209 86368 | 75432 Dual NAND Driver |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------------|
| — | 5322 216 25573 | CPU board Complete |
| S 1 | 5322 271 34229 | DIL switch AMP 435166-4 |
| S 2 | 5322 276 14405 | Push button switch PREH N75120-000 |
| E 1 | 5322 242 74374 | Crystal ITT Q691 8867. 238 kHz |
| — | 5322 255 44217 | IC Socket 40 pole |
| — | 5322 255 44109 | IC Socket 24 pole |
| — | 5322 255 44112 | IC Socket 18 pole |

7.1.2 Serial interface board**Capacitors**

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 | 5322 122 34194 | 33 μ | +50 -20 | 25 | Tantal |
| C 2 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C 3 | 4822 122 31168 | 270 p | 2 | 63 | Ceramic |
| C 4 | 4822 122 31168 | 270 p | 2 | 63 | Ceramic |
| C 5 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C 6 | 5322 122 30128 | 4.7 n | 10 | 100 | Ceramic |
| C 7 | 5322 124 14075 | 1 μ | +50 -20 | 35 | Tantal |
| C 8 | 5322 124 14075 | 1 μ | +50 -20 | 35 | Tantal |

Semi conductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|-------------------------|
| D 1 | 4822 130 30621 | 1N4148 |
| D 2 | 4822 130 30621 | 1N4148 |
| Ph 1 | 5322 130 34567 | MV5753 LED |
| Ph 2 | 5322 130 34567 | MV5753 LED |
| Ph 3 | 5322 130 90073 | CNY 17/III Opto Coupler |
| Ph 4 | 5322 130 90073 | CNY 17/III Opto Coupler |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------|
| IC 5 | 5322 209 84308 | MC 1489 P Quad Line Receiver |
| IC 6 | 5322 209 80148 | 7404 Hex inverter |
| IC 7 | 5322 209 10162 | TMS 6011 MC UART |
| IC 8 | 5322 209 84307 | MC 1488 P Line Driver |
| IC 9 | 5322 209 85466 | 7410 Triple NAND |
| IC 10 | 5322 209 80148 | 7404 Hex inverter |
| IC 11 | 5322 209 84528 | 7400 Quad NAND |
| IC 12 | 5322 209 14718 | Z-80 PIO |
| IC 13 | 5322 209 86362 | 74LS390 Dual 4 bit Counter |
| IC 14 | 5322 209 86362 | 74LS390 Dual 4 bit Counter |
| IC 15 | 5322 694 74025 | 2716 EPROM SP281/V24 |
| IC 16 | 5322 209 85405 | 74LS193 4 bit BIN Counter |
| IC 17 | 5322 209 84929 | 7493 4 bit BIN Counter |
| IC 20 | 5322 209 85405 | 74LS193 4 bit BIN Counter |
| IC 22 | 5322 209 86357 | 7912 Voltage regulator -12V |
| IC 23 | 5322 209 85603 | 7812 Voltage regulator +12 V |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|---------------------------------|
| P13 | 5322 265 54065 | Plug 26 pole AMP 1 -825440-3 |
| P14 | 5322 265 54065 | Plug 26 pole AMP 1 -825440-3 |
| P15 | 5322 265 54065 | Plug 26 pole AMP 1 -825440-3 |
| S 1 | 5322 271 34232 | Slide switch ERG DS 16 B 4-2 |
| S 2 | 5322 271 34231 | Slide switch ERG DS 16 |
| S 3 | 5322 271 34229 | DIL Switch AMP 435166-4 |
| S 4 | 5322 271 34229 | DIL Switch AMP 435166-4 |
| RE 1 | 5322 280 84104 | Relay Sauer NF 2-24 |
| — | 5322 255 44217 | IC socket 40 pole |
| — | 5322 255 44171 | IC socket 24 pole |
| — | 5322 255 44073 | IC socket 14 pole |
| — | 5322 216 25579 | Serial interface board complete |

7.1.3 IE6 625/IEEE 488 interface board**Capacitors**

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 - C 12 | 5322 122 34177 | 68 n | +50 -20 | 63 | Ceramic |
| C13 | 5322 122 34194 | 33 μ | +50 -20 | 25 | Tantal |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|--------------------|
| Ph 1 | 5322 130 34567 | MV 5753 LED |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|-----------------------------|
| IC 1 | 5322 209 86358 | 3448 IEEE bus Transceiver |
| IC 2 | 5322 209 86358 | 3448 IEEE bus Transceiver |
| IC 3 | 5322 209 86358 | 3448 IEEE bus Transceiver |
| IC 4 | 5322 209 86358 | 3448 IEEE bus Transceiver |
| IC 5 | 5322 209 14718 | Z-80 PIO |
| IC 6 | 5322 209 86354 | 8291 GPIB Talker - Listener |
| IC 7 | 5322 694 74026 | 2716 EPROM SP281/IEC |
| IC 8 | 5322 209 84823 | 74LS00 Quad NAND |
| IC 9 | 5322 209 85267 | 74LS32 Quad OR |
| IC 10 | 5322 209 80148 | 7404 Hex Inverter |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|---------------------------------|
| — | 5322 216 25581 | IEC 625/IEEE 488 board complete |
| P 21 | 5322 265 54065 | Plug 26 pole AMP 1 -825440-3 |
| P 22 | 5322 265 54065 | Plug 26 pole AMP 1 -825440-3 |
| S 1 | 5322 271 34229 | DIL switch AMP 435166-4 |
| S 2 | 5322 271 34229 | DIL switch AMP 435166-4 |
| — | 5322 255 44217 | IC Socket 40 pole |
| — | 5322 255 44171 | IC Socket 24 pole |
| — | 5322 255 44111 | IC Socket 16 pole |

7.1.4 Mother board**Capacitors**

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 | 5322 124 74175 | 22000 μ | +50 -10 | 16 | Tantal |
| C 2 | 5322 124 20791 | 4700 μ | +50 -10 | 25 | Electrolytic |
| C 3 | 5322 122 34239 | 10 μ | +50 -20 | 35 | Tantal |
| C 4 | 5322 122 34184 | 47 μ | +10 -10 | 63 | Polyester foil |
| C 5 | 5322 122 34184 | 47 μ | +10 -10 | 63 | Polyester foil |
| C 6 | 5322 122 34184 | 47 μ | +10 -10 | 63 | Polyester foil |
| C 7 | 5322 122 34184 | 47 μ | +10 -10 | 63 | Polyester foil |
| C 8 | 5322 122 34184 | 47 μ | +10 -10 | 63 | Polyester foil |
| C 9 | 5322 122 34184 | 47 μ | +10 -10 | 63 | Polyester foil |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| D 1 - D 4 | 5322 130 34939 | 1N 5401 | 4 |
| D 5 - D 8 | 5322 130 34574 | 1N 4004 | 4 |
| D 9 | 4822 130 30621 | 1N 4148 | 1 |
| T 1 | 4822 130 44197 | BC 308 B | 1 |
| T 2 | 4822 130 44196 | BC 238 C | 1 |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|-----------------------|------------|
| — | 5322 216 25547 | Mother board complete | 1 |
| Tr 1 | 5322 146 64017 | Mains transformer | 1 |
| — | | Connector 18 pole | 3 |

7.1.5 Keyboard

Capacitors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 | 5322 121 44201 | 10 n | +10 –10 | 400 | Polyester foil |
| C 2 | 5322 121 44201 | 10 n | +10 –10 | 400 | Polyester foil |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|--------------------|
| T 1 | 4822 130 40959 | BC 237 B |
| T 2 | 4822 130 40959 | BC 237 B |
| T 3 | 4822 130 40959 | BC 237 B |
| T 4 | 4822 130 40959 | BC 237 B |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------------|
| Ph 1 | 5322 134 44207 | Indicator red |
| Ph 2 | 5322 134 44208 | Indicator green |
| Ph 3 | 5322 134 44209 | Indicator amber |
| S 1 - S 7 | 5322 276 14405 | Push button switch PREH M75120-000 |
| – | 5322 414 26403 | Knob for pushbutton switch |
| S 8 - S 9 | 5322 277 14323 | Toggle switch |
| S 10 | 5322 277 14324 | Toggle switch |
| S 11 | 5322 277 14325 | Toggle switch |
| – | 5322 414 64128 | Pen positioning knob (rocker) |
| – | 5322 520 24196 | Rocker support post |
| – | 5322 265 54066 | Plug 20 pole |
| – | 5322 216 25575 | Key board pcb complete |

7.1.6 Voltage regulator/Standby board

Capacitors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 | 4822 124 20791 | 4700 μ | +50 –10 | 25 | Electrolytic |
| C 2 | 4822 124 20791 | 4700 μ | +50 –10 | 25 | Electrolytic |
| C 3 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |
| C 4 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |
| C 5 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |
| C 6 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| D 2 - D 11 | 5322 130 34574 | 1N 4004 | 11 |
| T 1 | 4822 130 44197 | BC 308 B | |
| T 2 | 4822 130 40959 | BC 237 B | |
| T 3 | 4822 130 40981 | BC 337-25 | |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------|
| IC 1 | 5322 209 85764 | LM 323 Voltage regulator +5V |
| IC 2 | 5322 209 86361 | 7915 Voltage regulator –15V |
| IC 3 | 5322 209 86359 | 7815 Voltage regulator +15V |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|--|
| — | 5322 216 25578 | Voltage regulator/Standby pcb complete |
| RE 1 | 5322 280 84104 | Relay Sauer type NF2-24V |

7.1.7 X-axis amplifier**Capacitors**

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 2 | 5322 122 34188 | 1 μ | 10 | 100 | Polyester foil |
| C 3 | 4822 122 31165 | 330 p | 10 | 100 | Ceramic |
| C 5 | 4822 122 30103 | 22 n | +100 -20 | 40 | Ceramic |
| C 7 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 8 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 9 | 5322 122 34188 | 1 μ | 10 | 100 | Polyester foil |
| C 11 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 12 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 13 | 5322 122 34193 | 15 μ | +50 -20 | 20 | Tantal |
| C 14 | 5322 122 34193 | 15 μ | +50 -20 | 20 | Tantal |
| C 19 | 5322 122 34188 | 1 μ | 10 | 100 | Polyester foil |

Resistors*

| <i>Item</i> | <i>Ordering number</i> | <i>Value (Ω)</i> | <i>Tol (%)</i> | <i>Series</i> |
|-------------|------------------------|------------------------------------|----------------|---------------|
| R 1 | 5322 103 10024 | 10 k | — | Potentiometer |
| R 2 | 5322 116 55517 | 383 k | 1 | MR34E |
| R 3 | 5322 116 55003 | 16.0 k | 0.1 | MR24E |
| R 4 | 5322 116 55173 | 15.4 k | 1 | MR24E |
| R 5 | 5322 116 54155 | 100 k | 1 | MR24E |
| R 6 | 5322 116 50979 | 8.25 k | 1 | MR24E |
| R 7 | 5322 116 50979 | 8.25 k | 1 | MR24E |
| R 8 | 5322 103 10024 | 10 k | — | Potentiometer |
| R 9 | 5322 116 50589 | 31.6 k | 1 | MR24E |
| R 10 | 5322 116 54632 | 14.7 k | 1 | MR24E |
| R 12 | 5322 116 54704 | 121 k | 1 | MR30 |
| R 13 | 5322 116 54704 | 121 k | 1 | MR30 |
| R 15 | 5322 103 14075 | 100 k | | Potentiometer |
| R 31 | 5322 112 21076 | 68 | 10 | VRO617 |
| R 33 | 5322 112 21076 | 68 | 10 | VRO617 |
| R 36 | 5322 116 50536 | 464 | 1 | MR25 |
| R 37 | 5322 116 50536 | 464 | 1 | MR25 |
| R 42 | 5322 110 23036 | 2.2 k | 5 | 5W |
| R 43 | 5322 110 23036 | 2.2 k | 5 | 5W |
| R 44 | 5322 116 54619 | 10 k | 1 | MR25 |
| R 45 | 5322 103 14075 | 100 k | — | Potentiometer |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| D 3 - D 6 | 4822 130 30621 | 1N4148 | 4 |
| D 15 - D 18 | 5322 130 34939 | 1N5401 | 4 |
| D 19 - D 22 | 4822 130 30621 | 1N4148 | 4 |
| Z 1 - Z 2 | 5322 130 34796 | BZX83 - C12 | 2 |
| Z 3 - Z 4 | 5322 130 34941 | 1N937B | 2 |

7.1.5 Keyboard

Capacitors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 | 5322 121 44201 | 10 n | +10 –10 | 400 | Polyester foil |
| C 2 | 5322 121 44201 | 10 n | +10 –10 | 400 | Polyester foil |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|--------------------|
| T 1 | 4822 130 40959 | BC 237 B |
| T 2 | 4822 130 40959 | BC 237 B |
| T 3 | 4822 130 40959 | BC 237 B |
| T 4 | 4822 130 40959 | BC 237 B |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------------|
| Ph 1 | 5322 134 44207 | Indicator red |
| Ph 2 | 5322 134 44208 | Indicator green |
| Ph 3 | 5322 134 44209 | Indicator amber |
| S 1 - S 7 | 5322 276 14405 | Push button switch PREH M75120-000 |
| – | 5322 414 26403 | Knob for pushbutton switch |
| S 8 - S 9 | 5322 277 14323 | Toggle switch |
| S 10 | 5322 277 14324 | Toggle switch |
| S 11 | 5322 277 14325 | Toggle switch |
| – | 5322 414 64128 | Pen positioning knob (rocker) |
| – | 5322 520 24196 | Rocker support post |
| – | 5322 265 54066 | Plug 20 pole |
| – | 5322 216 25575 | Key board pcb complete |

7.1.6 Voltage regulator/Standby board

Capacitors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|-------------|------------------------|------------------|----------------|----------------|--------------------|
| C 1 | 4822 124 20791 | 4700 μ | +50 –10 | 25 | Electrolytic |
| C 2 | 4822 124 20791 | 4700 μ | +50 –10 | 25 | Electrolytic |
| C 3 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |
| C 4 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |
| C 5 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |
| C 6 | 5322 124 14075 | 1 μ | +50 –20 | 35 | Tantal |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| D 2 - D 11 | 5322 130 34574 | 1N 4004 | 11 |
| T 1 | 4822 130 44197 | BC 308 B | |
| T 2 | 4822 130 40959 | BC 237 B | |
| T 3 | 4822 130 40981 | BC 337-25 | |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------|
| IC 1 | 5322 209 85764 | LM 323 Voltage regulator +5V |
| IC 2 | 5322 209 86361 | 7915 Voltage regulator –15V |
| IC 3 | 5322 209 86359 | 7815 Voltage regulator +15V |

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| Z 5 - Z 6 | 5322 130 34156 | BZX83 - C15 | 2 |
| Z 7 - Z 8 | 5322 130 34798 | BZX83 - C3V6 | 2 |
| T 1 | 4822 130 41019 | BC 237 C | 1 |
| T 2 | 4822 130 44256 | BC 307 B | 1 |
| T 3 | 4822 130 40937 | BC 238 B | 1 |
| T 4 - T 5 | 4822 130 44197 | BC 308 B | 2 |
| T 6 | 4822 130 40937 | BC 238 B | 1 |
| T 7 | 5322 130 44872 | MJE 6040 | 1 |
| T 8 | 5322 130 44873 | MJE 6043 | 1 |
| T 9 | 4822 130 40981 | BC 337 - 25 | 1 |
| T 10 | 4822 130 44196 | BC 238 C | 1 |
| T 11 | 4822 130 44197 | BC 308 B | 1 |
| T 12 | 4822 130 41246 | BC 327 - 25 | 1 |
| T 13 | 4822 130 44196 | BC 238 C | 1 |
| T 14 | 4822 130 44196 | BC 238 C | 1 |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------|
| IC 1 | 5322 209 86356 | LM 307 N |
| IC 2 | 5322 209 86356 | LM 307 N |
| IC 3 | 5322 209 86356 | LM 307 N |
| IC 4 | 5322 209 86367 | μ A 748 C |
| IC 5 | 5322 209 86355 | LF 355 N (only in A version) |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|---------------------------------|
| — | 5322 216 25693 | X-axis amplifier board complete |

7.1.8 Y-axis amplifier

Capacitors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (F)</i> | <i>Tol (%)</i> | <i>Voltage</i> | <i>Description</i> |
|--|------------------------|------------------|----------------|----------------|--------------------|
| C 1** | 5322 122 34179 | 33 μ | 10 | 100 | Polyester foil |
| | 5322 122 34182 | 39 μ | 10 | 100 | Polyester foil |
| | 5322 122 34183 | 47 μ | 10 | 100 | Polyester foil |
| | 5322 122 34185 | 56 μ | 10 | 100 | Polyester foil |
| | 5322 122 34186 | 68 μ | 10 | 100 | Polyester foil |
| | 5322 122 34187 | 82 μ | 10 | 100 | Polyester foil |
| **C1 is an adjusting capacitor for the hysteresis adjustment of the amplifier version B, see chapter 4.4.1 | | | | | |
| C 2 | 5322 122 34188 | 1 μ | 10 | 100 | Polyester foil |
| C 3 | 5322 122 31165 | 330 p | 10 | 63 | Ceramic |
| C 5 | 5322 122 30103 | 10 n | +100 -20 | 40 | Ceramic |
| C 7 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 8 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 9 | 5322 122 34188 | 1 μ | 10 | 100 | Polyester foil |
| C 11 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 12 | 5322 122 34192 | 10 μ | +50 -20 | 10 | Tantal |
| C 13 | 5322 122 34193 | 15 μ | +50 -20 | 20 | Tantal |
| C 14 | 5322 122 34193 | 15 μ | +50 -20 | 20 | Tantal |
| C 17 | 5322 124 74044 | 2200 μ | +50 -10 | 40 | Electrolytic |
| C 18 | 5322 124 74044 | 2200 μ | +50 -10 | 40 | Electrolytic |
| C 19 | 5322 122 34188 | 1 μ | 10 | 100 | Polyester foil |

Resistors

| <i>Item</i> | <i>Ordering number</i> | <i>Value (Ω)</i> | <i>Tol (%)</i> | <i>Series</i> |
|-------------|------------------------|------------------------------------|----------------|---------------|
| R 1 | 5322 103 10024 | 10 k | | Potentiometer |
| R 2 | 5322 116 55517 | 383 k | 1 | MR 34 E |
| R 3 | 5322 116 55036 | 12.1 k | 1 | MR 24 E |
| R 4 | 5322 116 55036 | 12.1 k | 1 | MR 24 E |
| R 5 | 5322 116 50748 | 100 k | 1 | MR 24 E |
| R 6 | 5322 116 50979 | 8.25 k | 1 | MR 24 E |
| R 7 | 5322 116 50979 | 8.25 k | 1 | MR 24 E |
| R 8 | 5322 103 10024 | 10 k | | Potentiometer |
| R 9 | 5322 116 50589 | 31.6 k | 1 | MR 24 E |
| R 10 | 5322 116 54632 | 14.7 k | 1 | MR 25 |
| R 11 | 5322 116 54704 | 121 k | 1 | MR30 |
| R 12 | 5322 116 54704 | 121 k | 1 | MR30 |
| R 15 | 5322 103 14075 | 100 k | | Potentiometer |
| R 31 | 5322 110 23036 | 2.2 k | 5 | 5W |
| R 33 | 5322 110 23036 | 2.2 k | 5 | 5W |
| R 36 | 5322 116 50536 | 464 | 1 | MR25 |
| R 37 | 5322 116 50536 | 464 | 1 | MR25 |
| R 42 | 5322 110 23036 | 2.2 k | 5 | 5W |
| R 43 | 5322 110 23036 | 2.2 k | 5 | 5W |
| R 44 | 5322 116 54619 | 10 k | 1 | MR25 |
| R 45 | 5322 103 14075 | 100 k | | Potentiometer |

Semiconductors

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> | <i>Qty</i> |
|-------------|------------------------|--------------------|------------|
| D 3 - D 6 | 4822 130 30621 | IN4148 | 4 |
| D 15 - D 18 | 5322 130 34939 | IN5401 | 4 |
| D 19 - D 22 | 4822 130 30621 | 1N4148 | 4 |
| Z 1 - Z 2 | 5322 130 34796 | BZX83 - C12 | 2 |
| Z 3 - Z 4 | 5322 130 34941 | 1N937B | 2 |
| Z 5 - Z 6 | 5322 130 34156 | BZX83 - C15 | 2 |
| Z 7 - Z 8 | 5322 130 34798 | BZX83 - C3V6 | 2 |
| T 1 | 4822 130 41019 | BC 237 C | 1 |
| T 2 | 4822 130 44256 | BC 307 B | 1 |
| T 3 | 4822 130 40937 | BC 238 B | 1 |
| T 4 - T 5 | 4822 130 44197 | BC 308 B | 2 |
| T 6 | 4822 130 40937 | BC 238 B | 1 |
| T 7 | 5322 130 44872 | MJE 6040 | 1 |
| T 8 | 5322 130 44873 | MJE 6043 | 1 |
| T 9 | 4822 130 40981 | BC 337 - 25 | 1 |
| T 10 | 4822 130 44196 | BC 238 C | 1 |
| T 11 | 4822 130 44197 | BC 308 B | 1 |
| T 12 | 4822 130 41246 | BC 327 - 25 | 1 |
| T 13 | 4822 130 44196 | BC 238 C | 1 |
| T 14 | 4822 130 44196 | BC 238 C | 1 |

Integrated circuits

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|------------------------------|
| IC 1 | 5322 209 86356 | LM 307 N |
| IC 2 | 5322 209 86356 | LM 307 N |
| IC 3 | 5322 209 86356 | LM 307 N |
| IC 4 | 5322 209 86367 | μ A 748 C |
| IC 5 | 5322 209 86355 | LF 355 N (only in A version) |

Miscellaneous

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|---------------------------------|
| — | 5322 216 25694 | Y-axis amplifier board complete |

7.1.9 Mains input board

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|----------------------------|
| — | 5322 216 25577 | Mains input board complete |
| L 1 | 5322 121 44323 | Mains filter |
| F 1 | 4822 253 20014 | Fuse 0.5A DIN 41571 |
| F 2 | 4822 253 30021 | Fuse 1 A DIN 41871 |
| — | 5322 273 54065 | Mains voltage adapter |
| — | 5322 321 14056 | Mains cable |

7.1.10 Chart hold board

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|---------------|------------------------|------------------------------|
| — | 5322 216 25576 | Chart hold board complete |
| D 42 - D 47 | 4822 130 30799 | 1N4007 |
| C 61 - C 66 | 4822 121 41134 | 10nF 10% 630V Polyester foil |
| R 190 - R 192 | 5322 111 41007 | 100 M Ω |
| R 181 | 5322 111 90073 | 3.3 M Ω |

7.2 ELECTRICAL PARTS FRAME**7.2.1 Cables and connectors**

| <i>Item</i> | <i>Fig.</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|-------------|------------------------|------------------------------------|
| 1 | 7 - 1 | 5322 323 54051 | Flat cable Y axis |
| 2 | 7 - 1 | 5322 321 25016 | Flat cable keyboard - CPU |
| 3 | 7 - 1 | 5322 266 24035 | Wiring chartplate |
| 4 | 7 - 1 | 5322 321 25017 | Flat cable chart advance - CPU |
| — | — | 5322 321 20503 | Flat cable with IEEE connector |
| — | — | 5322 321 20502 | Flat cable with IEC connector |
| — | — | 5322 321 20501 | Flat cable with MODEM connector |
| — | — | 5322 321 20499 | Flat cable with TERMINAL connector |
| 5 | 7 - 1 | 5322 321 25088 | Flat cable CPU - Interface |

7.2.2 Servo System

| <i>Item</i> | <i>Fig.</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|-------------|------------------------|-------------------------------|
| 6 | 7 - 1 | 5322 105 94005 | X axis potentiometer |
| 13 | 7 - 4 | 5322 105 94004 | Y axis potentiometer |
| 7 | 7 - 1 | 5322 290 34124 | Sliding contact X and Y |
| 8 | 7 - 1 | 5322 361 24199 | X axis servomotor with pinion |
| 9 | 7 - 1 | 5322 361 24201 | Y axis servomotor with pinion |

7.2.3 Miscellaneous

| <i>Item</i> | <i>Fig.</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|-------------|------------------------|------------------------------|
| 10 | 7 - 1 | 5322 124 74063 | 10 000 μ F +50 –10% 40 V |
| 11 | 7 - 1 | 5322 277 14326 | Mains switch |
| 12 | 7 - 1 | 5322 281 54051 | Pen lift solenoid |
| — | — | 5322 214 94041 | Extension board CPU |
| — | — | 5322 214 94039 | Extension board Interface |

7.3 MECHANICAL PARTS**7.3.1 X-axis**

| <i>Item</i> | <i>Fig.</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|-------------|------------------------|------------------------------|
| 13 | 7 - 1 | 5322 535 84445 | Guide bar |
| | | 5322 466 94626 | End stop |
| 1 | 7 - 2 | 5322 358 34055 | Drive cord assy |
| 2 | 7 - 2 | 5322 466 85879 | Cord strainer |
| 3 | 7 - 2 | 5322 500 14259 | Screw for cord strainer |
| 4 | 7 - 2 | 5322 405 90012 | Bracket for cord strainer |
| | | 5322 528 84188 | Guide pully |
| 1 | 7 - 3 | 5322 522 34828 | Cord drum assy |
| 2 | 7 - 3 | 5322 532 14687 | Retaining ring for cord drum |
| 4 | 7 - 5 | 5322 450 34036 | Scale |

7.3.2 Y-axis

| <i>Item</i> | <i>Fig.</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|-------------|------------------------|--------------------------|
| 5 | 7 - 2 | 5322 535 84444 | Guide bar |
| 1 | 7 - 4 | 5322 466 94619 | End stop |
| 2 | 7 - 4 | 5322 358 34054 | Drive cord assy |
| 3 | 7 - 4 | 5322 492 64754 | Spring for cord strainer |
| 4 | 7 - 4 | 5322 528 84187 | Guide pulley |
| 5 | 7 - 4 | 5322 522 34827 | Drive gear assy |
| 6 | 7 - 4 | 5322 466 94642 | Pen holder carriage* |
| 7 | 7 - 4 | 5322 693 24049 | Pen holder complete |
| 8 | 7 - 4 | 5322 360 44063 | Damping plunger |
| 9 | 7 - 4 | 5322 532 64275 | Damping cilinder |
| | | 5322 405 54072 | Bearing hook |
| 10 | 7 - 4 | 5322 405 94182 | Clip for pen holder |
| — | — | 5322 492 64789 | Spring for pen clip |
| 5 | 7 - 5 | 5322 447 94609 | Scale carrier |
| 6 | 7 - 2 | 5322 466 94623 | Upper part Y carrier |
| 7 | 7 - 2 | 5322 520 24197 | Lower part Y carrier |
| 11 | 7 - 4 | 5322 693 24048 | Lateral part Y carrier |
| | | 5322 492 51338 | Spring for scale carrier |
| 3 | 7 - 5 | 5322 450 34037 | Scale |

7.3.3 Miscellaneous

| <i>Item</i> | <i>Fig.</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|-------------|------------------------|--------------------------------|
| | | 5322 693 24051 | Pen depot complete |
| 12 | 7 - 4 | 5322 466 94625 | Electrostatic chart hold plate |
| 14 | 7 - 1 | 5322 447 94607 | Side plate right |
| 15 | 7 - 1 | 5322 447 94608 | Side plate left |
| | | 5322 502 64059 | Screw |
| | | 5322 466 85881 | Disk |
| | | 5322 263 50089 | Rotring adaptor red. |
| | | 5322 263 50091 | Rotring adaptor white |
| 2 | 7 - 5 | 5322 456 94102 | Textplate |
| 1 | 7 - 5 | 5322 447 94655 | Cover without scale |
| — | — | 5322 466 94621 | Left hand stop |
| — | — | 5322 466 94622 | Right hand stop |
| 8 | 7 - 2 | 5322 466 85878 | Pen lift fixing piece |
| 9 | 7 - 2 | 5322 492 31908 | Spring for pen lift |

* (blank part with bearing only)

7.4 PM9886 PROGRAMMABLE PAPER ADVANCE UNIT

7.4.1 Electrical parts

| <i>Item</i> | <i>Ordering number</i> | <i>Description</i> |
|-------------|------------------------|-----------------------|
| C1 - C2 | 4822 121 50532 | 200p ±2% 63V |
| C3 | 4822 124 20722 | 1μ +50 -20 35V |
| IC1 | 5322 209 14927 | HEF4039BD |
| PH1 | 5322 130 44924 | CNY 17/IV OPTOCOUPLER |
| PH2 | 5322 130 44923 | OPT. SWITCH MCA 8. |
| T1 | 4822 130 41246 | BC327-25 |
| T2 | 4822 130 40959 | BC237 B |
| D1 | 5322 130 35008 | BZX 83 C4V7 |
| D2 - D4 | 4822 130 30621 | 1N4148 |
| | 5322 216 94276 | PCB COMPLETE |

7.4.2 Mechanical parts chart-roll holder

| <i>Ordering number</i> | <i>Description</i> |
|------------------------|-----------------------|
| 5322 447 94666 | COVER (RIGHT) |
| 5322 447 94667 | COVER (LEFT) |
| 5322 528 94259 | HOLDER ASSY (LEFT) |
| 5322 492 64799 | SPRING (HOLDER RIGHT) |
| 5322 466 85952 | DISK (HOLDER RIGHT) |
| 5322 466 85951 | FLANGE (HOLDER RIGHT) |
| 5322 532 14716 | RETAINING RING 3,2 |
| 5322 502 54065 | KNURLED ADJ. SCREW |
| 5322 502 34147 | GRUB SCREW |
| 5322 532 24596 | EXTENSION PIECE |

7.4.3 Mechanical parts chart-drive part

| <i>Ordering number</i> | <i>Description</i> |
|------------------------|--|
| 5322 447 94668 | SIDE COVER (RIGHT) |
| 5322 447 94669 | SIDE COVER (LEFT) |
| 5322 447 94671 | COVER (MOTOR PART) |
| 5322 520 24201 | BEARING FOR ROLLER(LEFT) |
| 5322 520 24202 | BEARING FOR ROLLER(RIGHT) |
| 5322 522 24071 | SPROCKET WHEEL(LEFT/RIGHT) |
| 5322 522 24069 | GEAR WHEEL FOR SPROCKET |
| 5322 528 94258 | METAL ROLLER |
| 5322 361 24225 | MOTOR COMPLETE WITH GEAR WHEEL ASSY |
| 5322 522 24068 | GEAR WHEEL (ON FRAME) |
| 5322 321 25095 | CABLE |
| 5322 275 14456 | PUSH-BUTTON ASSY |

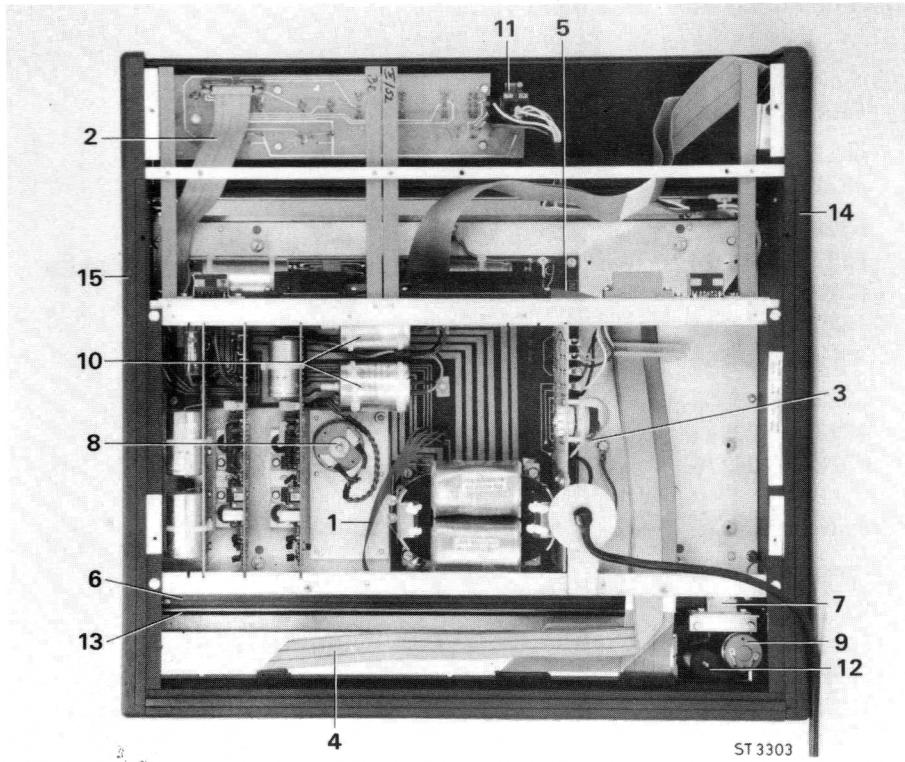


Fig. 7.1

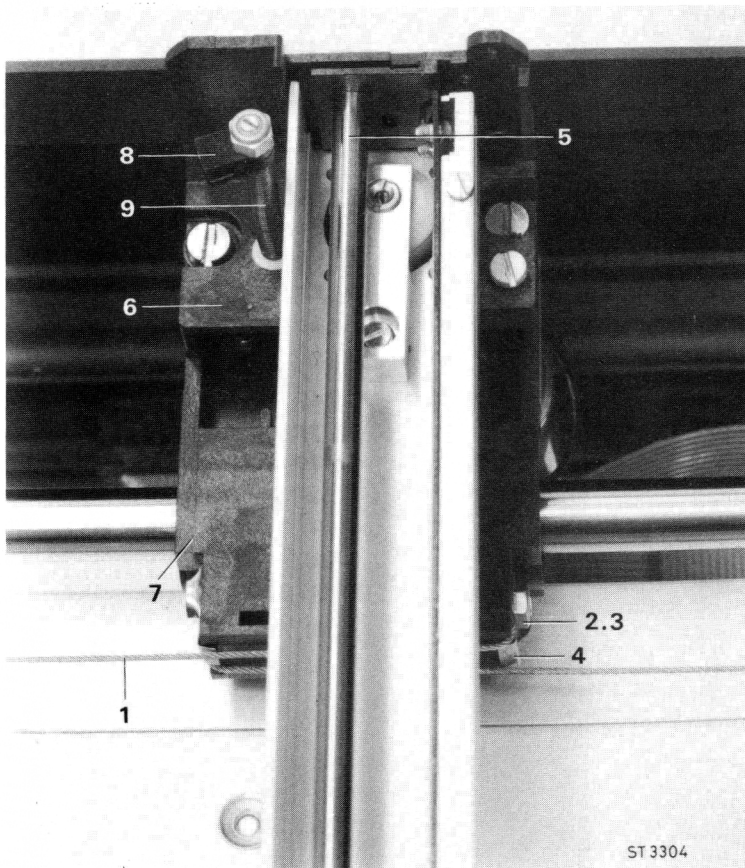
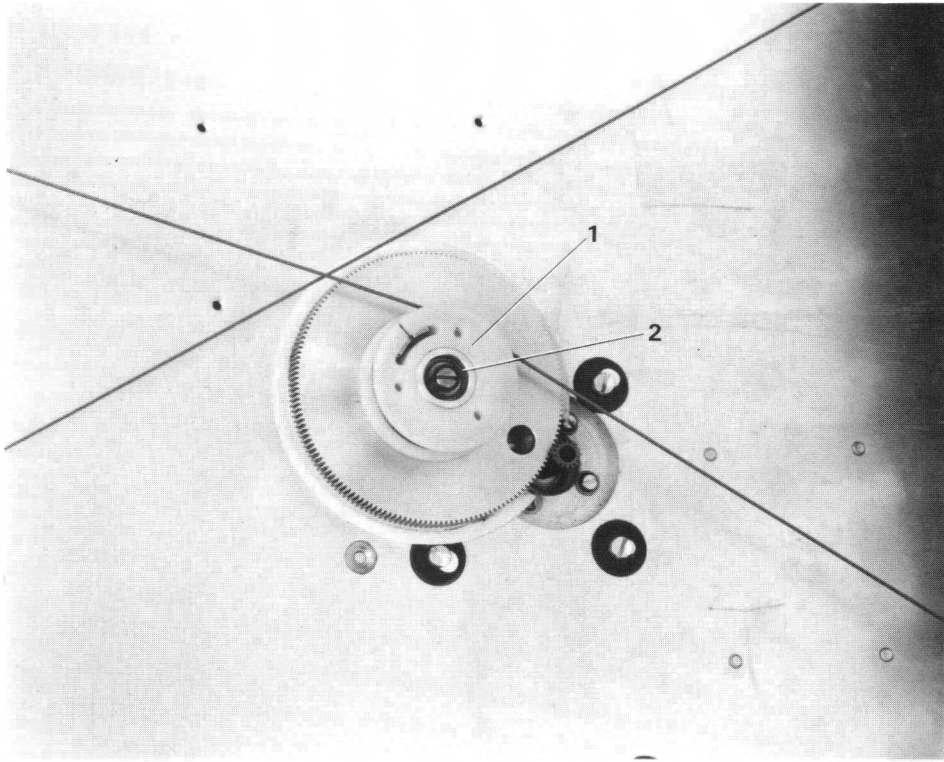
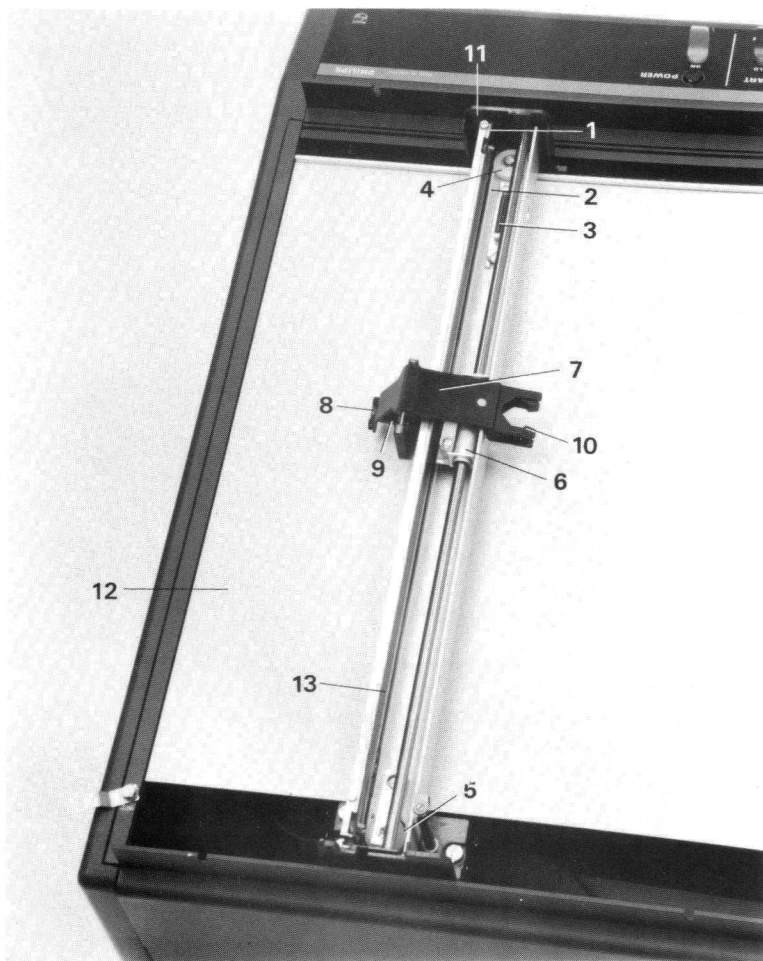


Fig. 7.2



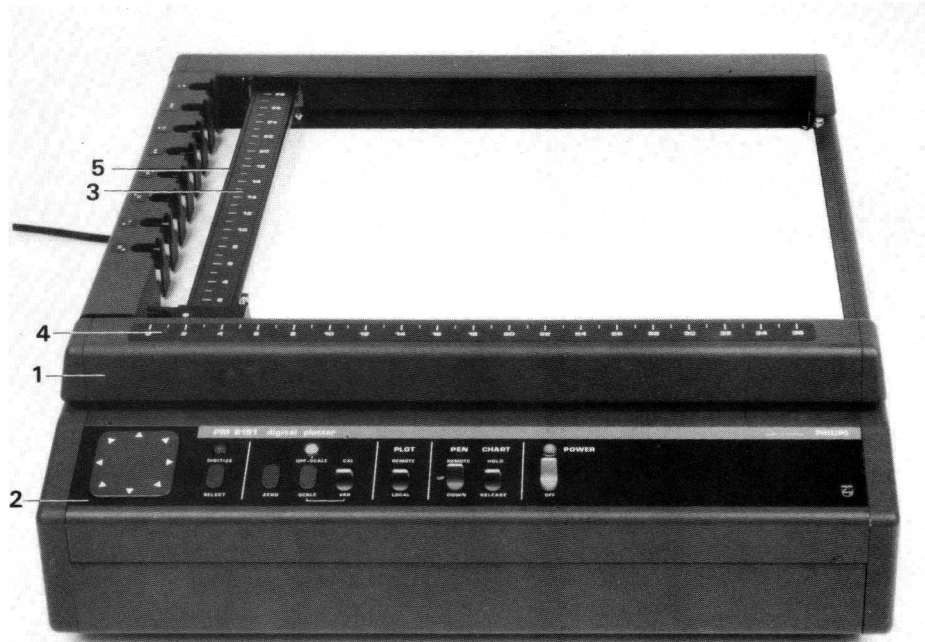
ST 3305

Fig. 7.3



ST 3306

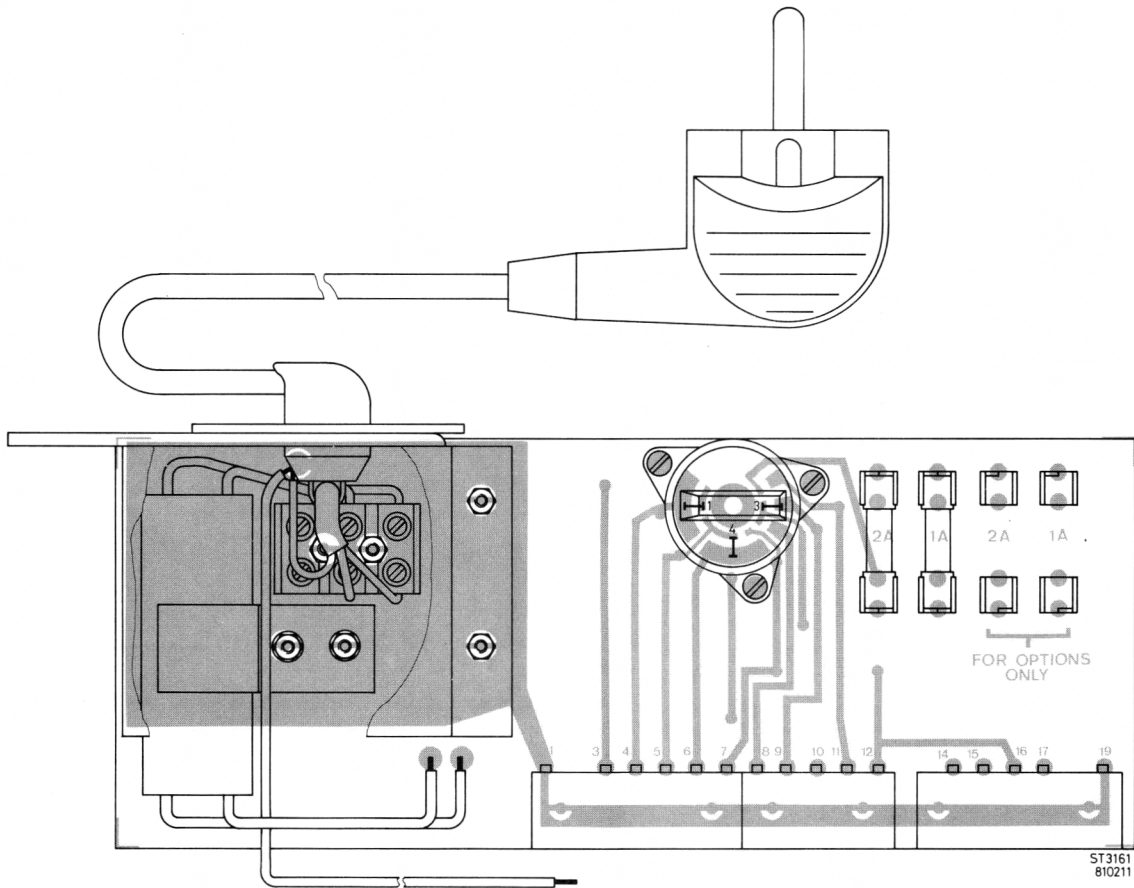
Fig. 7.4



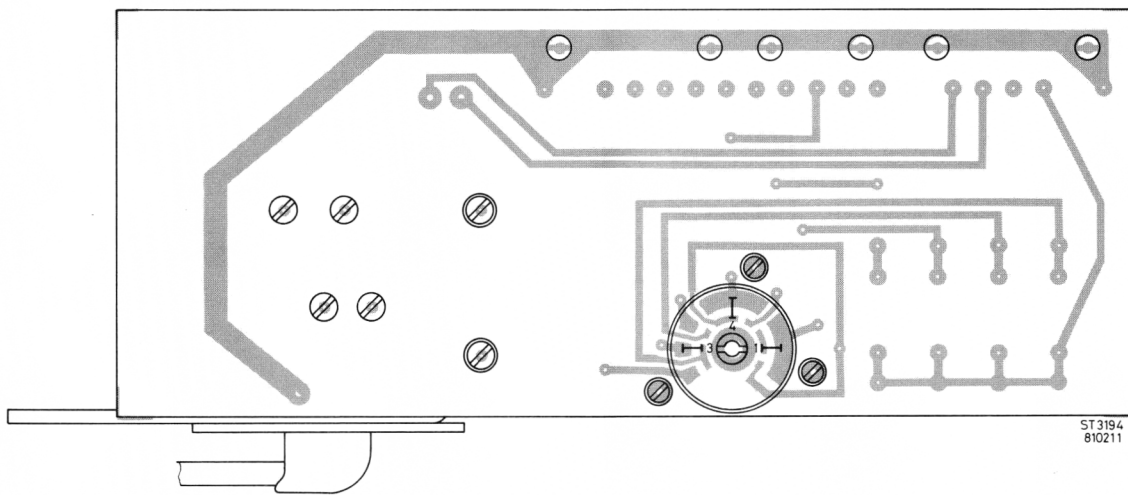
ST 3307

Fig. 7.5

8.2. MAINS INPUT P.C.B. (lay-out).

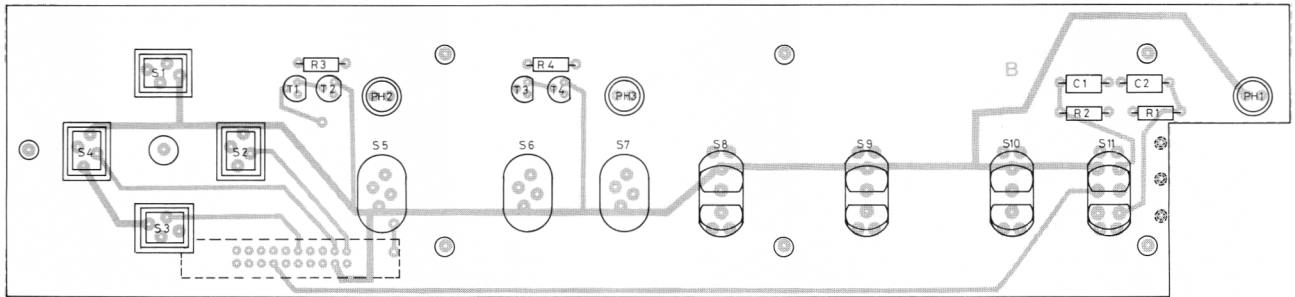


Component Side



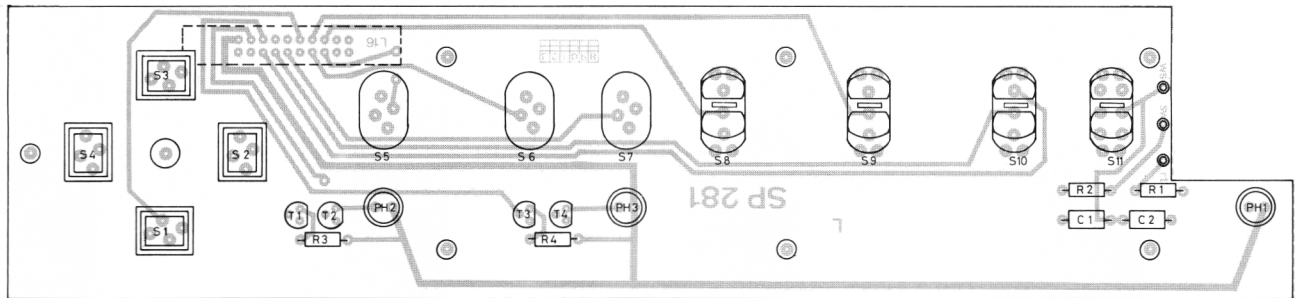
Conductor Side

8.3. KEYBOARD P.C.B. (lay-out).



Component Side

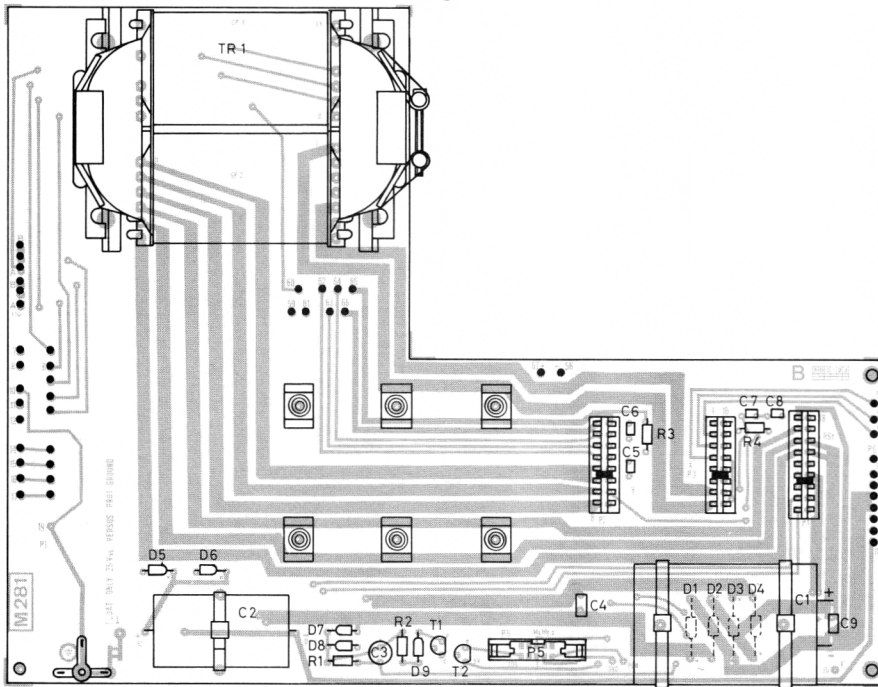
ST 3153
81-02-13



Conductor Side

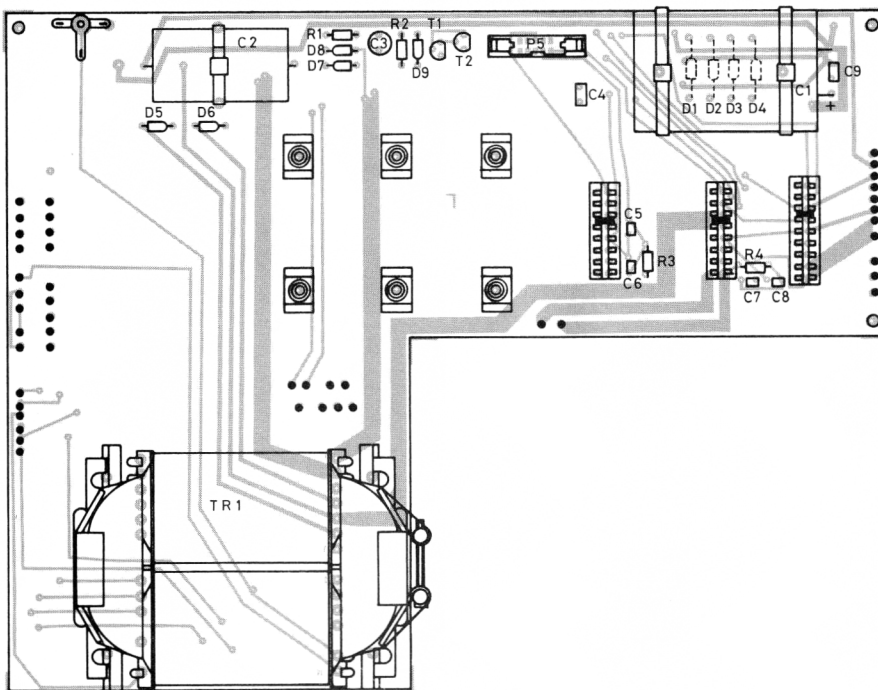
ST 3198
81-02-13

8.4. MOTHERBOARD (lay-out).



Component Side

ST 3158
81-02-10

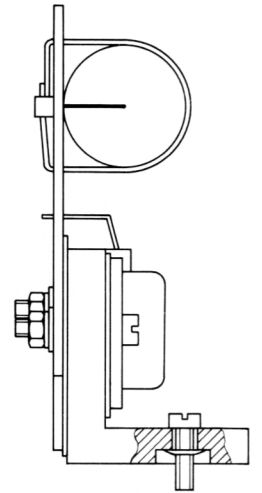
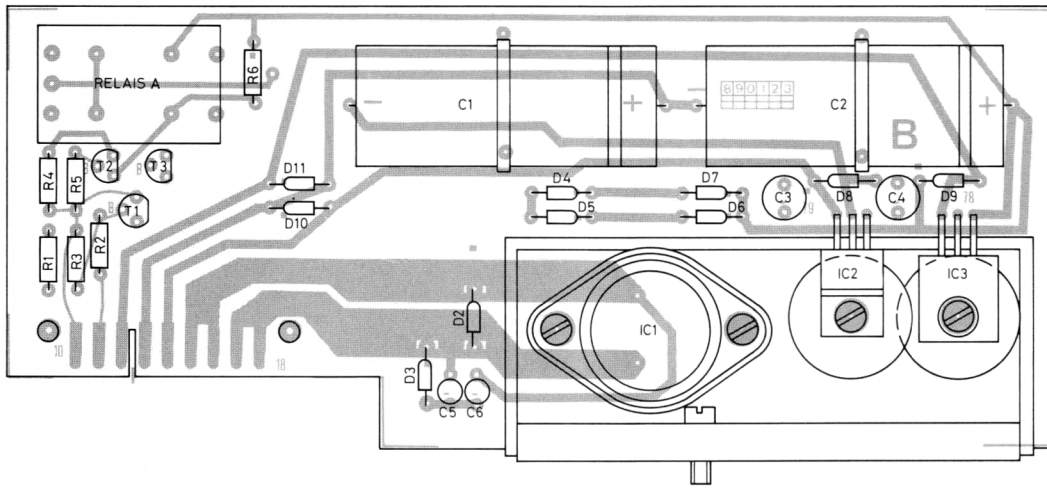


Conductor Side

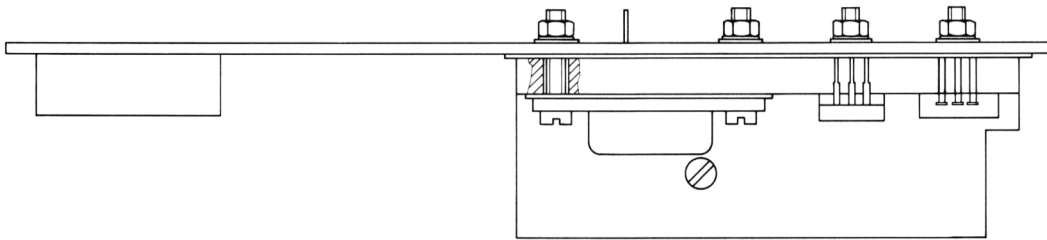
ST 3193
81-02-10

8.5. VOLTAGE REGULATOR AND STANDBY P.C.B.

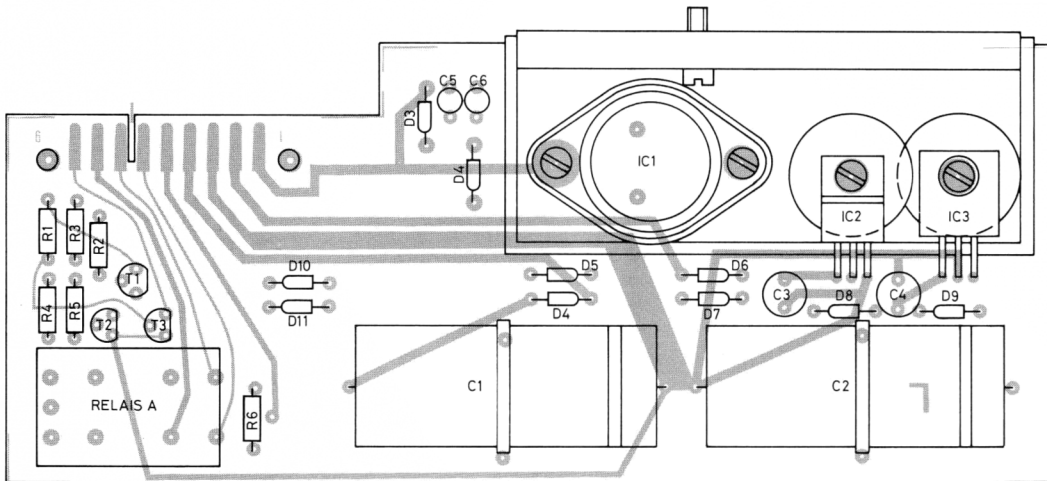
8.5.1. Lay-out.



ST3154
810209



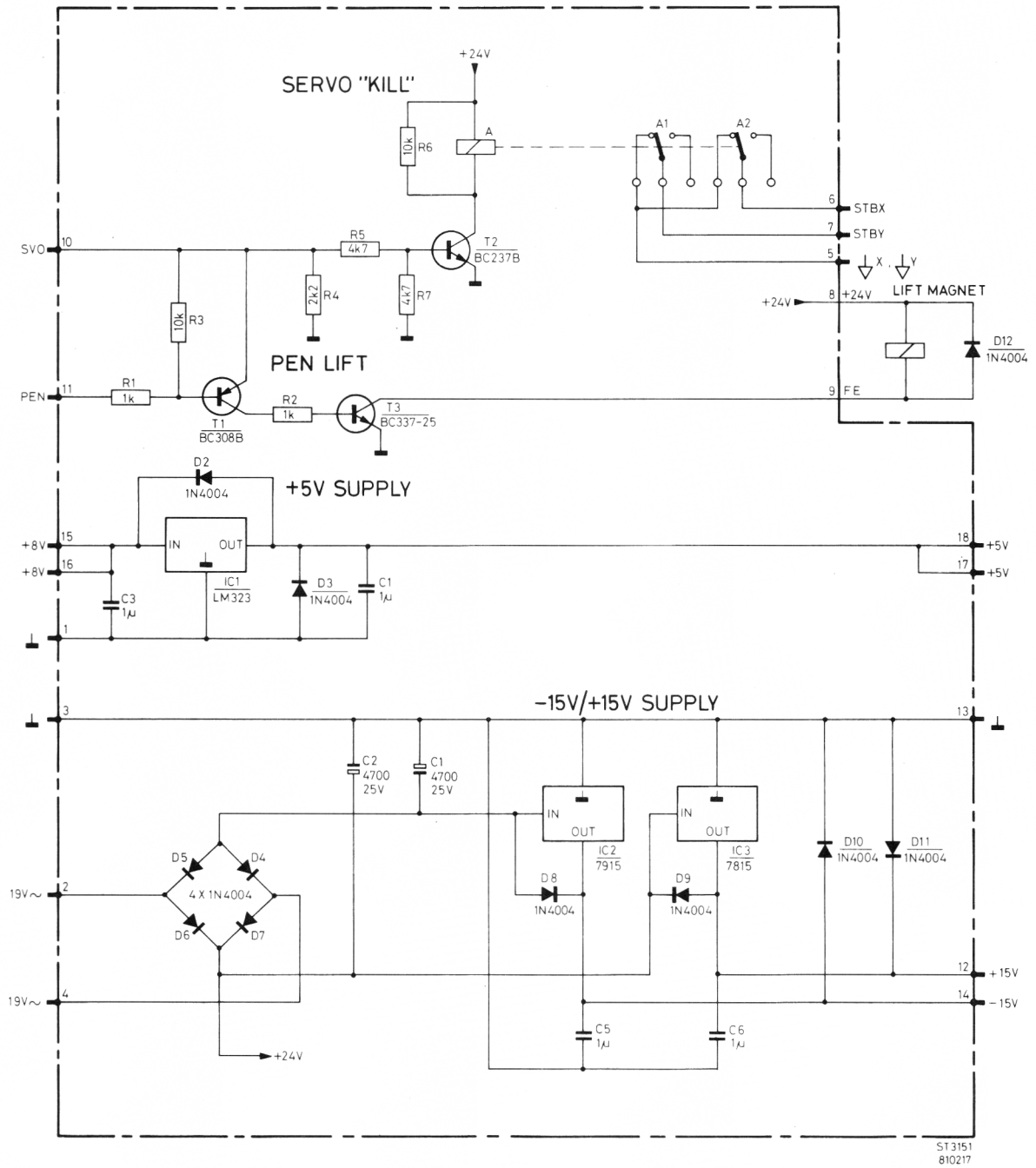
Component Side



ST3197
810209

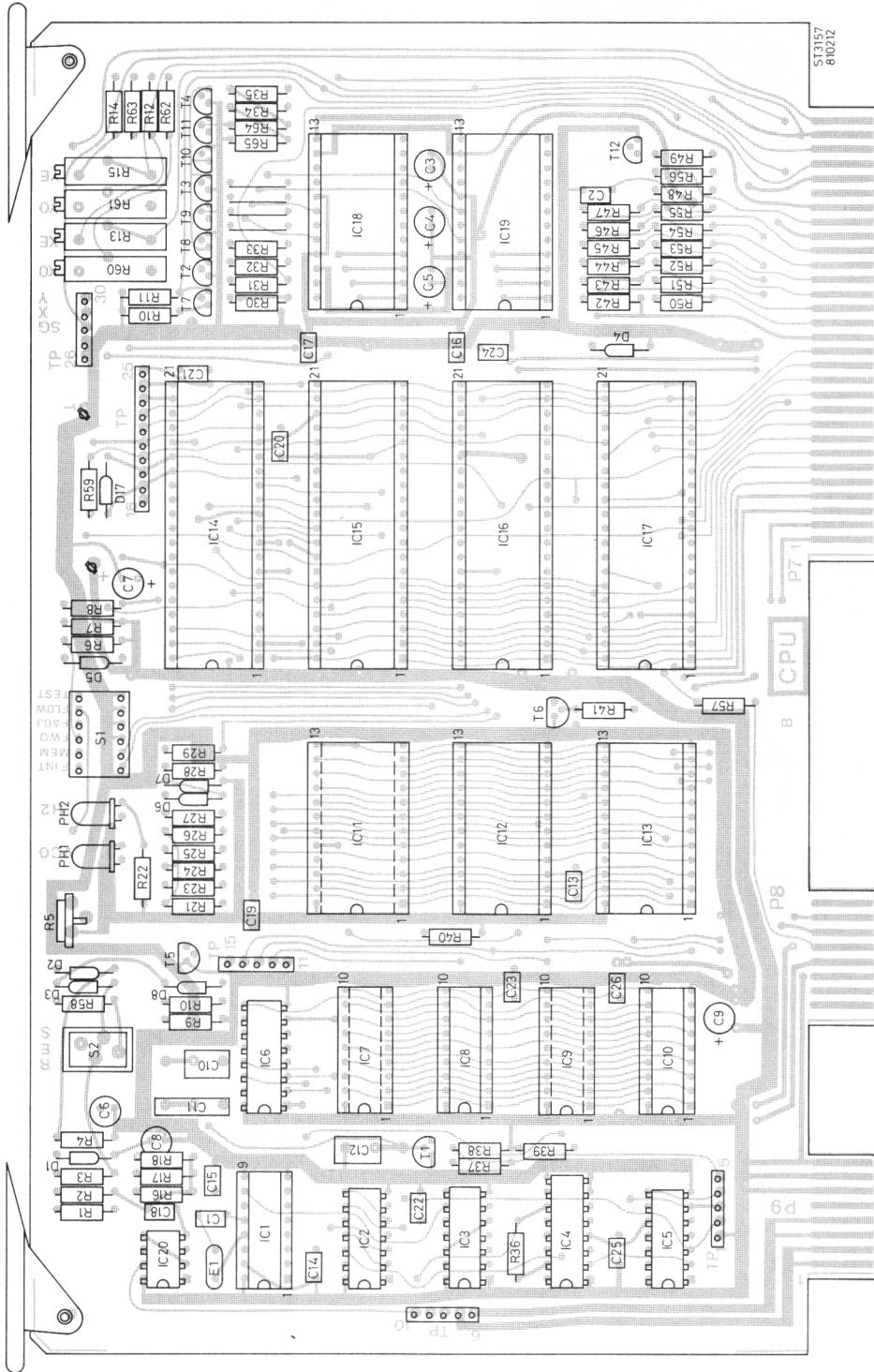
Conductor Side

8.5.2. Circuit diagram .

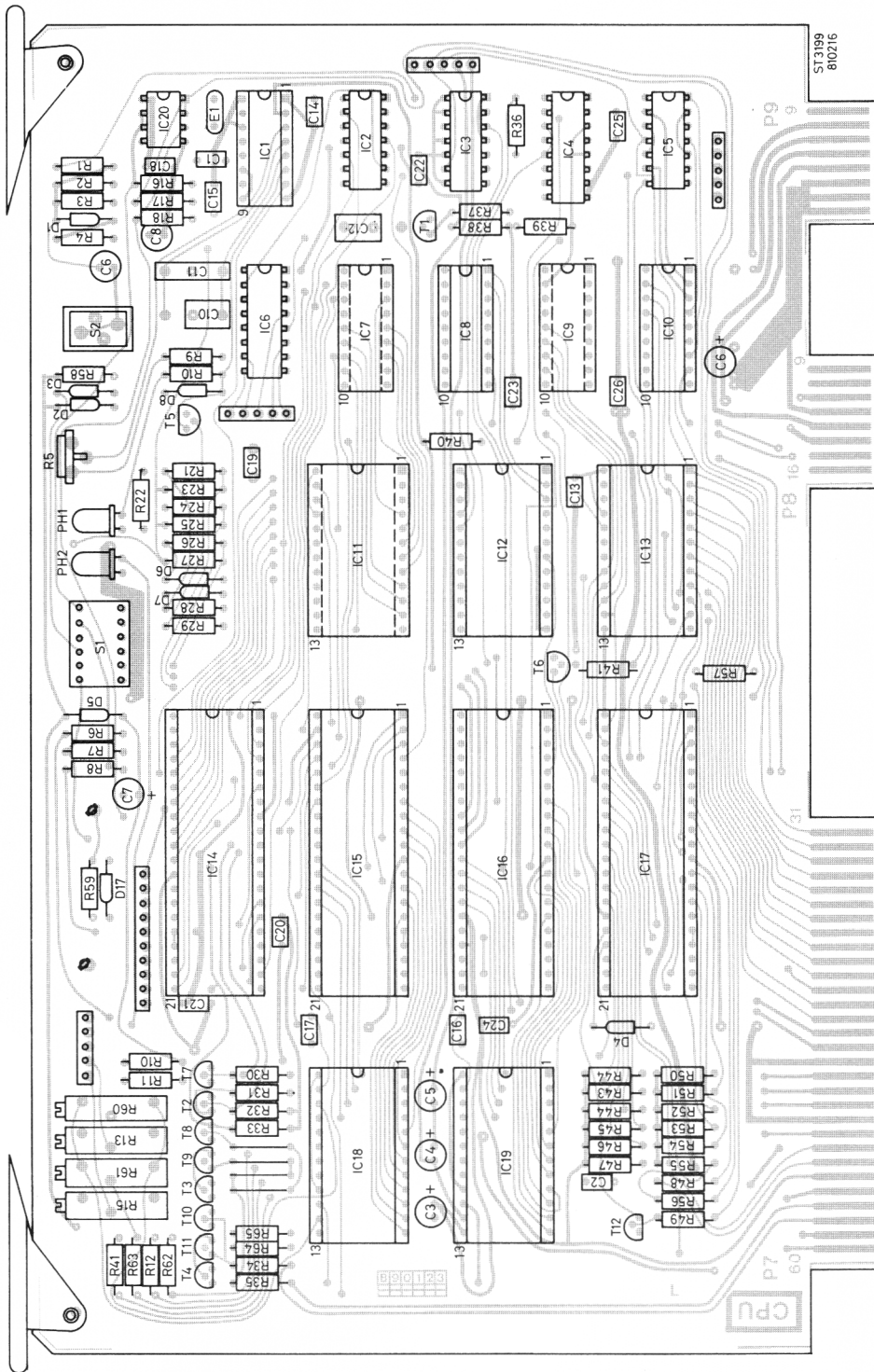


8.6. CPU BOARD.

8.6.1. P.c.b. lay-out.



Component Side

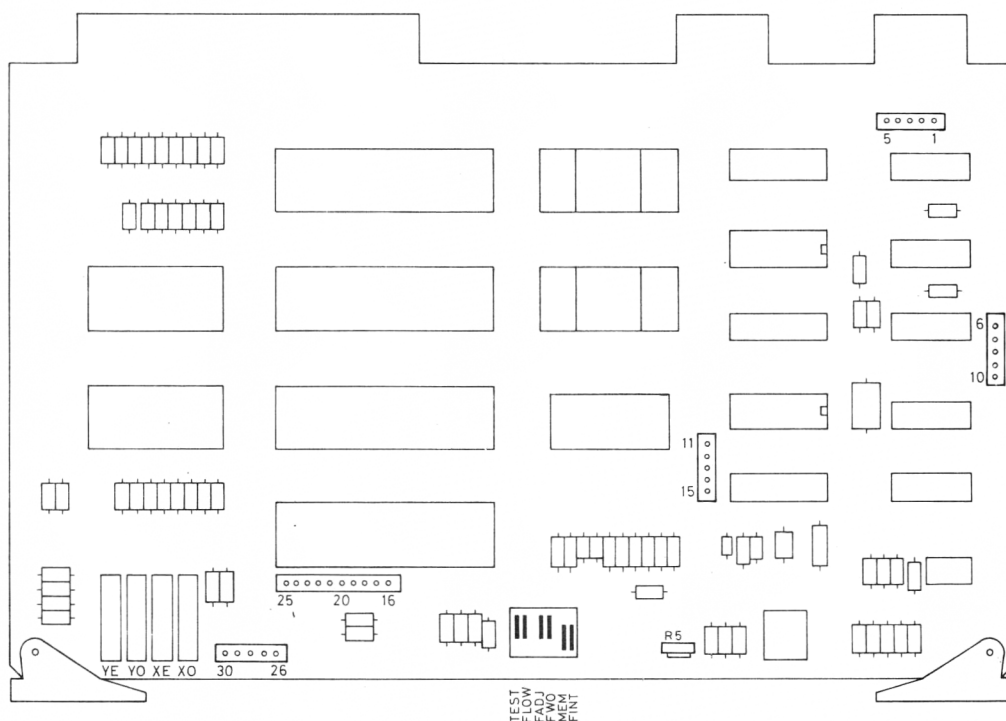


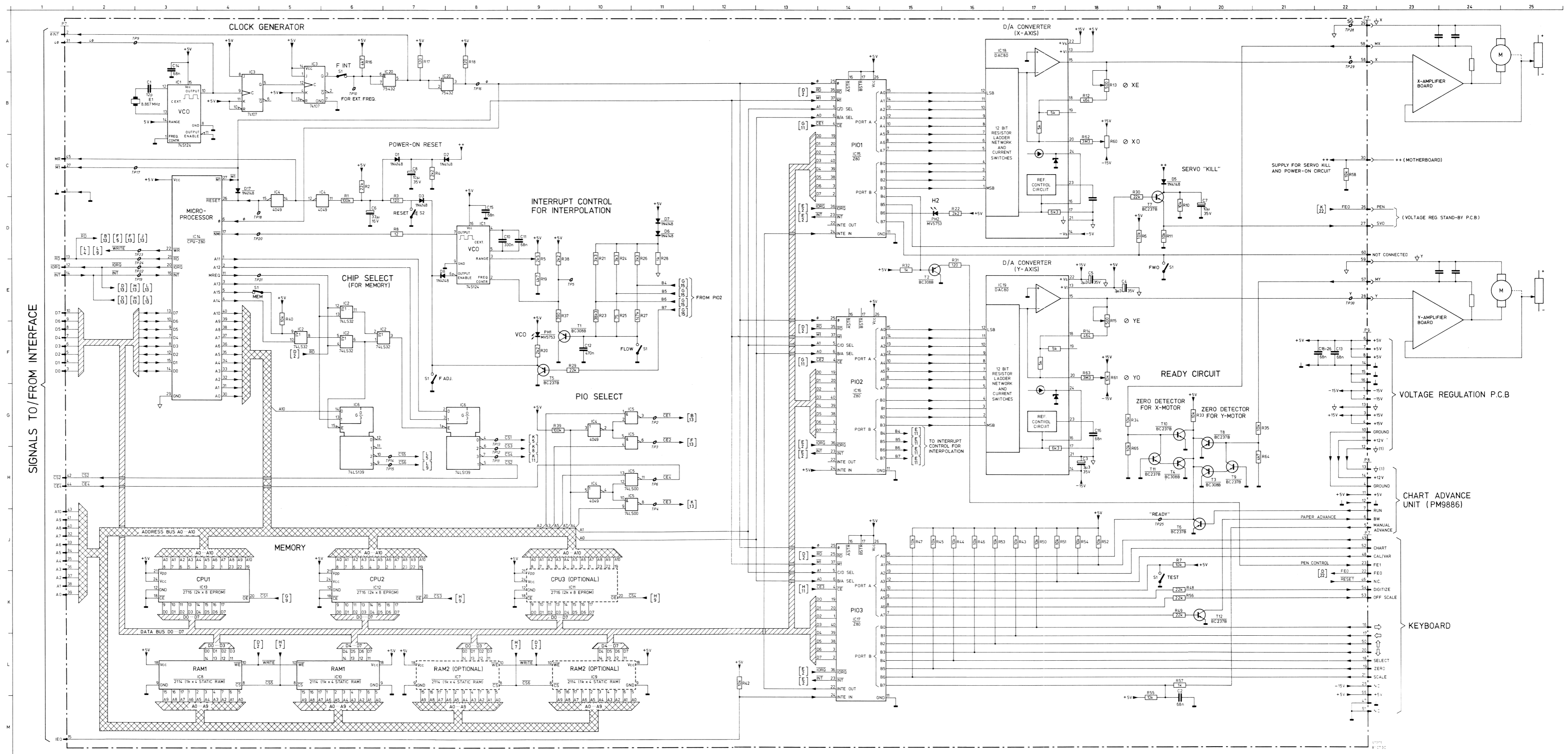
Conductor Side

8.6.2 Circuit diagram.

Test points on CPU board

| | | |
|------|-----------------------------|--|
| TP1 | : +5V | : Power +5V |
| TP2 | : $\overline{\text{CE1}}$ | : $\overline{\text{CHIP ENABLE}}$ (active low) for PIO 1 |
| TP3 | : $\overline{\text{CE2}}$ | : $\overline{\text{CHIP ENABLE}}$ (active low) for PIO 2 |
| TP4 | : $\overline{\text{CE3}}$ | : $\overline{\text{CHIP ENABLE}}$ (active low) for PIO 3 |
| TP5 | : RAMP | : VCO-voltage control f, low $\cong 1V$ f, high $\cong 5V$ |
| TP6 | : +15V | : Power +15V |
| TP7 | : -15V | : Power -15V |
| TP8 | : $\overline{\text{CE4}}$ | : $\overline{\text{CHIP ENABLE}}$ (active low) for PIO on interface |
| TP9 | : 4 \emptyset | : 8.867 MHz |
| TP10 | : \emptyset | : Clock for microprocessor or external test frequency ($\leq 2.5\text{MHz}$) |
| TP11 | : $\overline{\text{CS4}}$ | : $\overline{\text{CHIP SELECT}}$ for EPROM "CPU 3" (optional) IC11 |
| TP12 | : $\overline{\text{CS3}}$ | : $\overline{\text{CHIP SELECT}}$ for EPROM "CPU 2" IC12 |
| TP13 | : $\overline{\text{CS1}}$ | : $\overline{\text{CHIP SELECT}}$ for EPROM "CPU 1" IC13 |
| TP14 | : $\overline{\text{CS5}}$ | : $\overline{\text{CHIP SELECT}}$ for RAM1 IC8 and IC10 |
| TP15 | : $\overline{\text{CS6}}$ | : $\overline{\text{CHIP SELECT}}$ for RAM2 (optional) IC7 and IC9 |
| TP16 | : \emptyset | : Buffered clockpulse for microprocessor and PIO's |
| TP17 | : $\overline{\text{MI}}$ | : $\overline{\text{MACHINE CYCLE ONE}}$ (active low output) from micro proc. |
| TP18 | : $\overline{\text{RESET}}$ | : $\overline{\text{RESET}}$ (active low input) for microprocessor |
| TP19 | : $\overline{\text{INT}}$ | : $\overline{\text{INTERRUPT}}$ request (active low input) for microprocessor |
| TP20 | : $\overline{\text{NMI}}$ | : $\overline{\text{NON MASKABLE INTERRUPT}}$ (active low input) for micro-processor. |
| TP21 | : $\overline{\text{MREQ}}$ | : $\overline{\text{MEMORY REQUEST}}$ (active low output) from microprocessor |
| TP22 | : $\overline{\text{IOREQ}}$ | : $\overline{\text{INPUT/OUTPUT REQUEST}}$ (active low output) from microproc. |
| TP23 | : $\overline{\text{WR}}$ | : $\overline{\text{WRITE}}$ (active low output) from microprocessor |
| TP24 | : $\overline{\text{RD}}$ | : $\overline{\text{READ}}$ (active low output) from microprocessor |
| TP25 | : READY | : PEN EQUILIBRIUM POSITION AND NO CHART ADVANCE |
| TP26 | : GND | : Ground |
| TP27 | : GND | : Ground |
| TP28 | : SG | : Signal ground of D/A converter and X and Y amplifier |
| TP29 | : X | : Analog output for X amplifier (from DAC) |
| TP30 | : Y | : Analog output for Y amplifier (from DAC) |





SIGNALS TO/FROM INTERFACE

CLOCK GENERATOR

MICRO-PROCESSOR

CHIP SELECT (FOR MEMORY)

POWER-ON RESET

INTERRUPT CONTROL FOR INTERPOLATION

PIO SELECT

D/A CONVERTER (X-AXIS)

D/A CONVERTER (Y-AXIS)

READY CIRCUIT

ZERO DETECTOR FOR X-MOTOR

ZERO DETECTOR FOR Y-MOTOR

CHART ADVANCE UNIT (PM9886)

KEYBOARD

VOLTAGE REGULATION P.C.B

SUPPLY FOR SERVO KILL AND POWER-ON CIRCUIT

(MOTHERBOARD)

(VOLTAGE REG STAND-BY P.C.B)

NOT CONNECTED

FWD

TEST

RESET

DIGITIZE

OFF SCALE

SCALE

ZERO

SELECT

PEN CONTROL

FE1

FE2

FE3

MANUAL ADVANCE

BW

PAPER ADVANCE

RUN

CALLVAR

CHART

52

51

50

49

48

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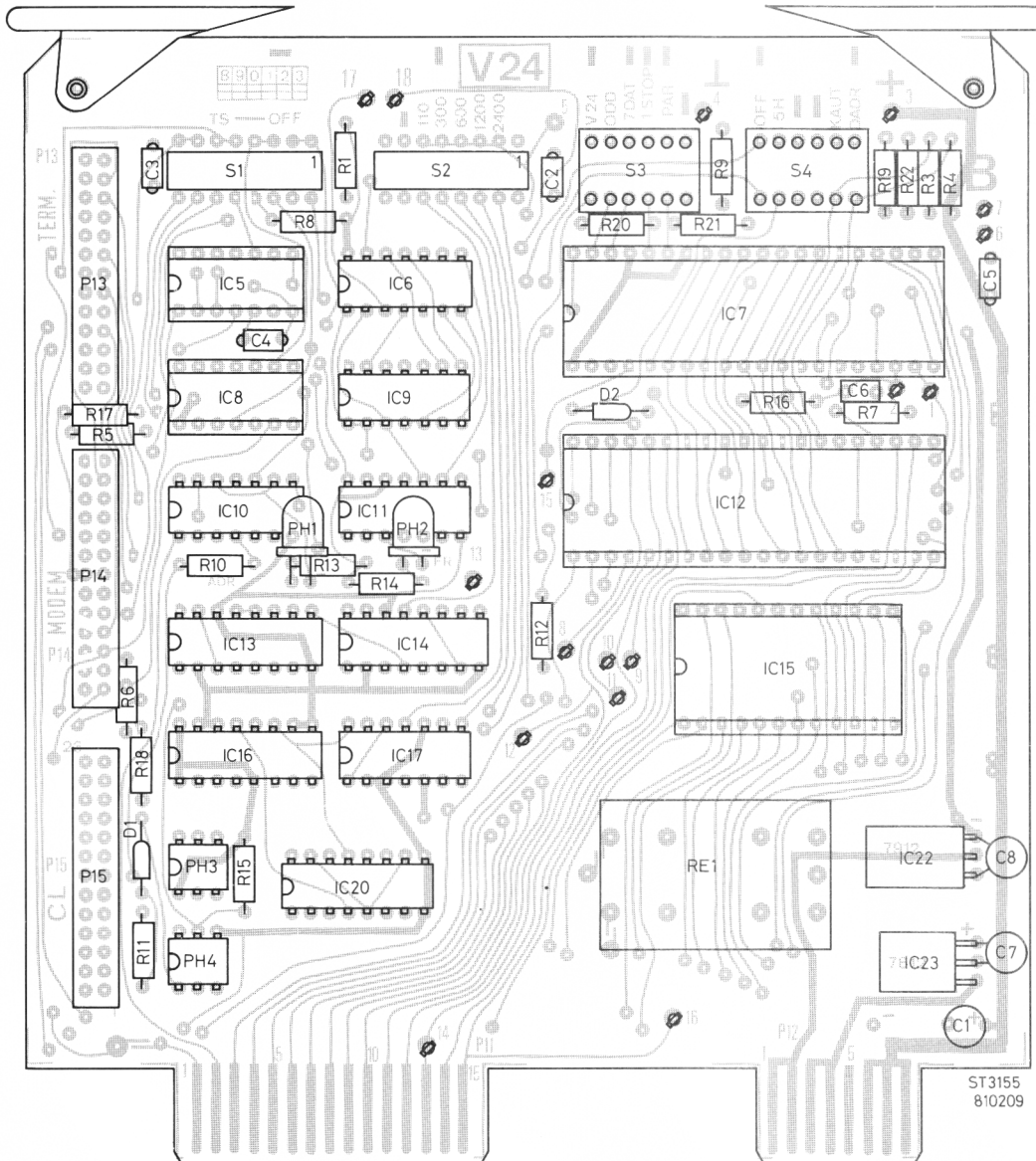
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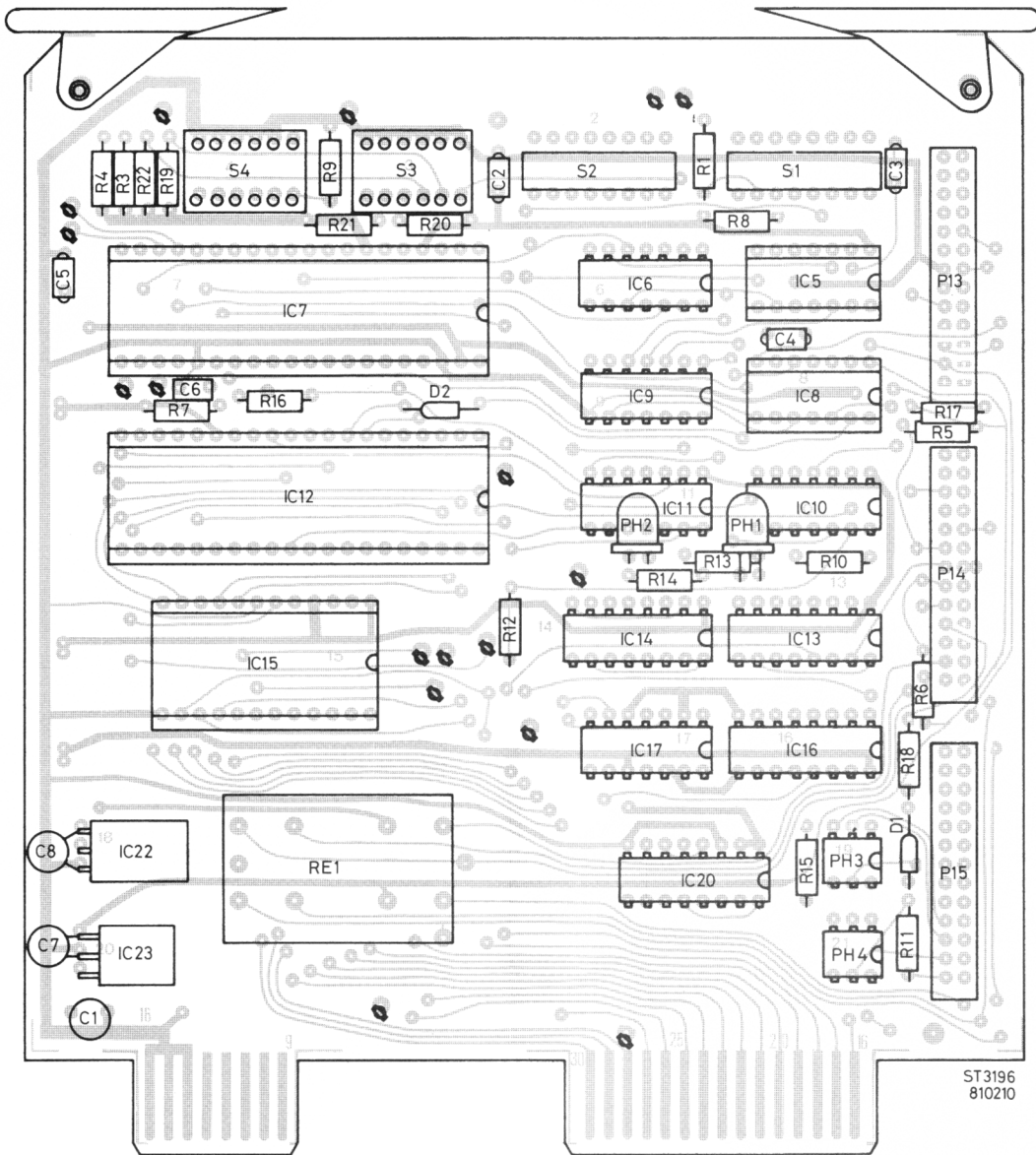
27</

8.7. V24/RS232C SERIAL INTERFACE.

8.7.1. P.c.b. lay-out.



Component Side

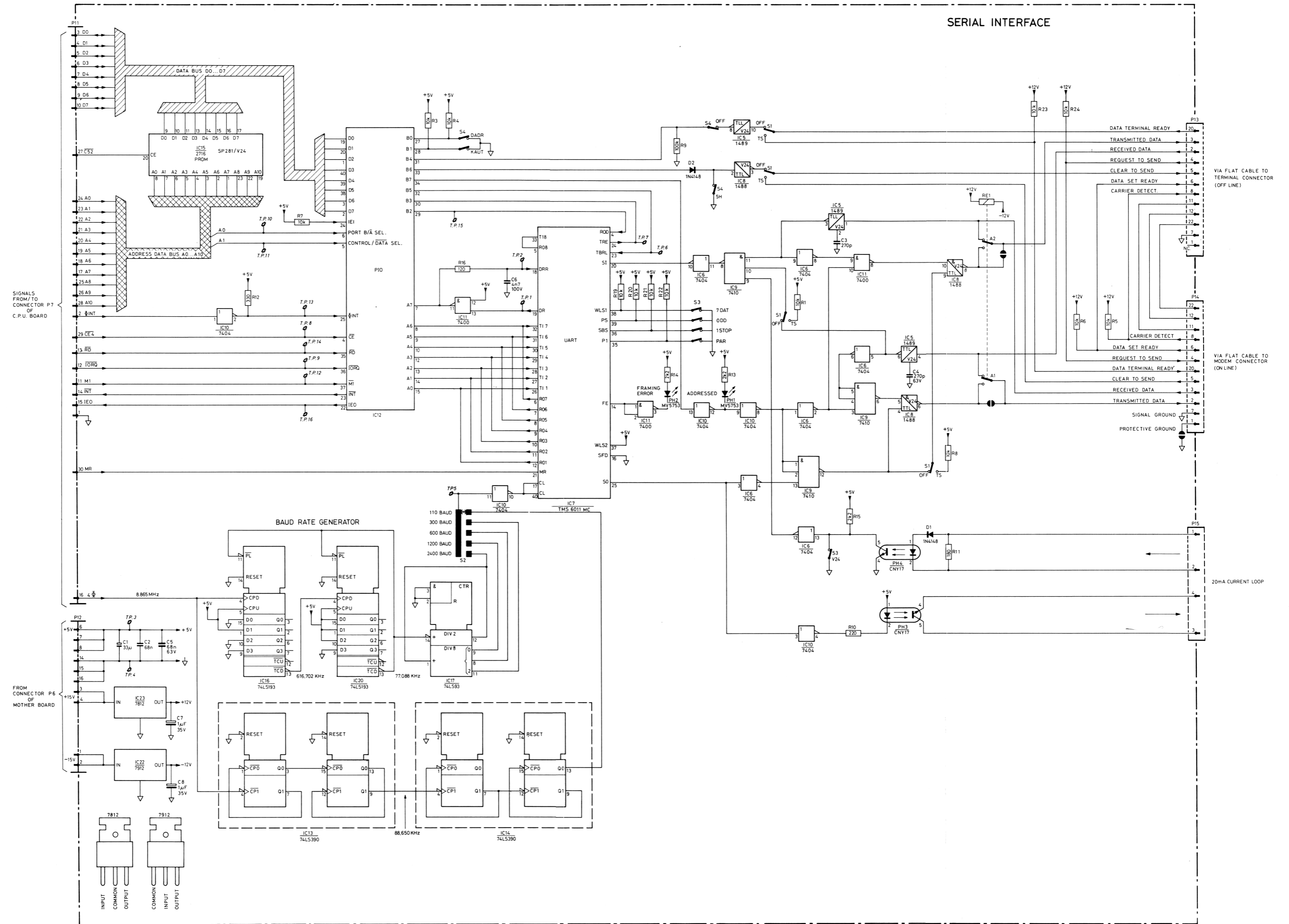


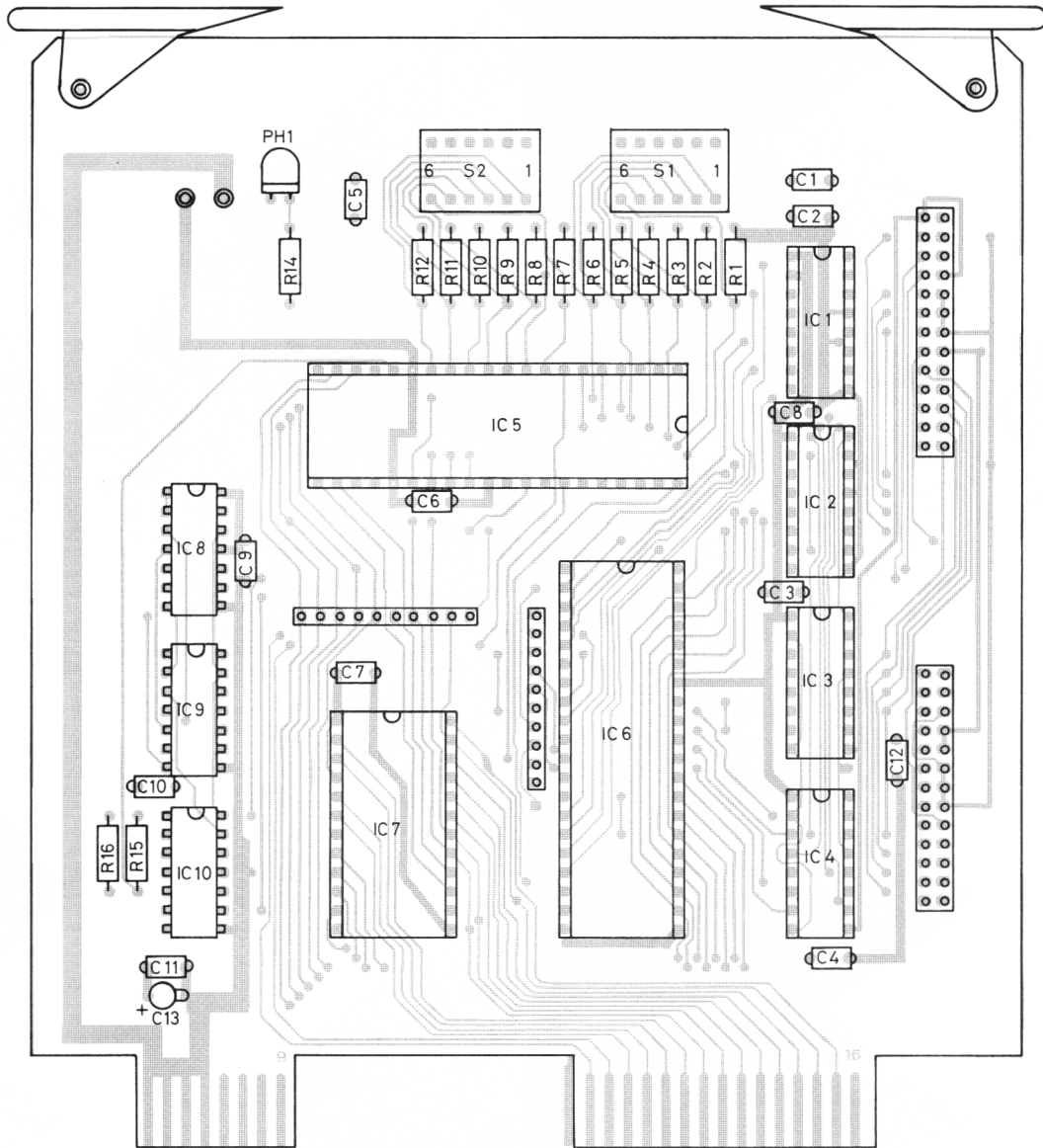
Conductor Side

8.7.2. Circuit diagram.

Test Points on the Serial Communication Interface board

| | | | | |
|------|---|---------------------------|---|----------------------------------|
| TP1 | : | DR | : | DATA READY (UART) |
| TP2 | : | DRR | : | DATA READY RESET (UART) |
| TP3 | : | +5V | : | POWER |
| TP4 | : | GROUND | : | |
| TP5 | : | BAUD RATE | : | $f = \text{BAUD RATE} * 16$ |
| TP6 | : | TBRL | : | TRANSMITTER BUFFER REGISTER LOAD |
| TP7 | : | TRE | : | TRANSMITTER REGISTER EMPTY |
| TP8 | : | $\overline{\text{CEPIO}}$ | : | CHIP ENABLE PIO INTERFACE |
| TP9 | : | $\overline{\text{IORQ}}$ | : | INPUT - OUTPUT REQUEST Z-80 |
| TP10 | : | AO | : | ADDRESS - LINE AO |
| TP11 | : | A1 | : | ADDRESS - LINE A1 |
| TP12 | : | $\overline{\text{M1}}$ | : | MACHINE CYCLE Z-80 |
| TP13 | : | \emptyset | : | μP - CLOCK BUFFERED |
| TP14 | : | $\overline{\text{RD}}$ | : | READ ENABLE - Z80 |
| TP15 | : | ROD | : | RECEIVER OUTPUT DISABLE (UART) |
| TP16 | : | IEO | : | INTERRUPT ENABLE OUT Z-80-PIO |
| TP17 | : | SO | : | TRANSMITTER OUTPUT (UART) |
| TP18 | : | SI | : | RECEIVER INPUT (UART) |





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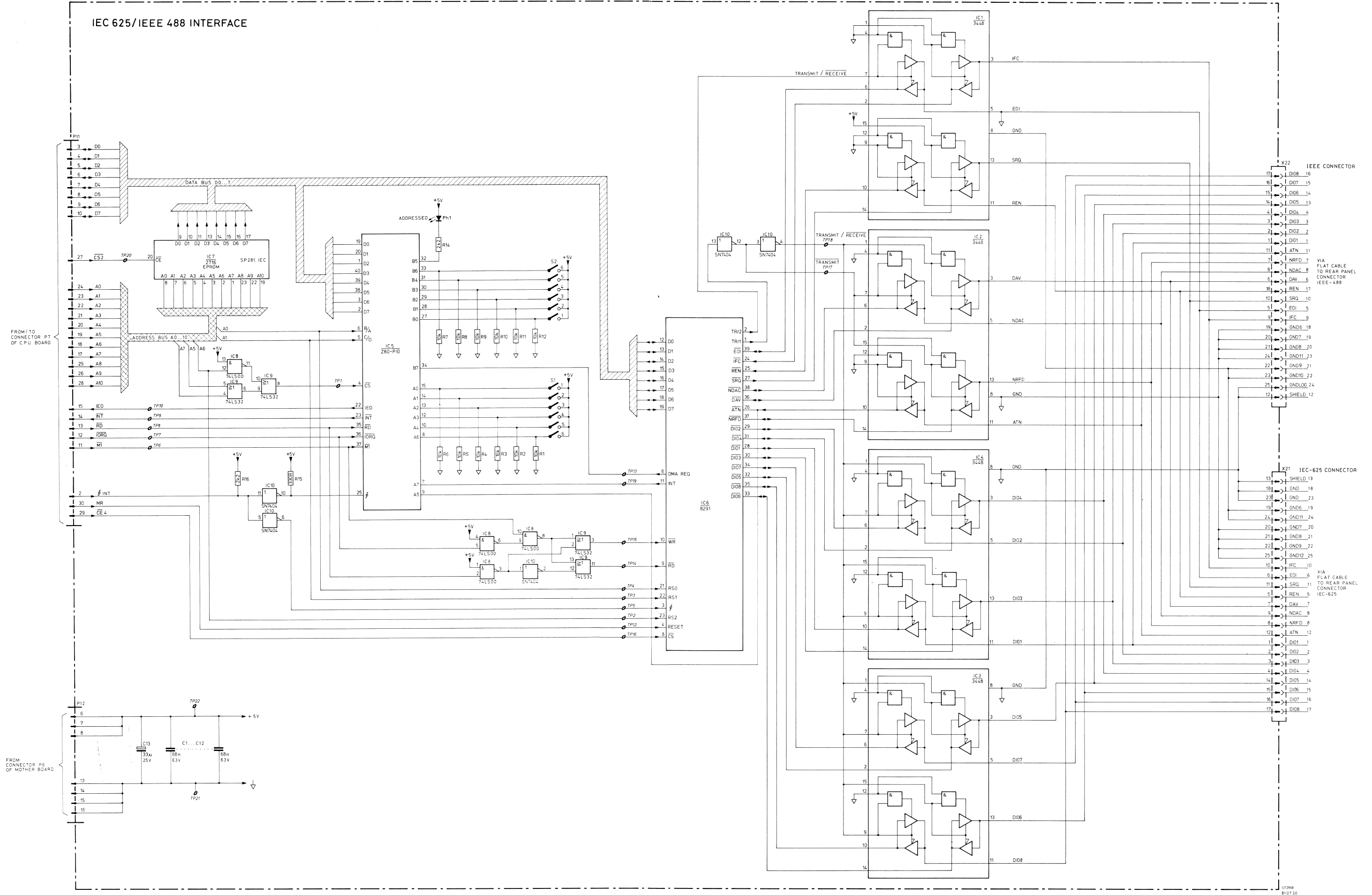
Conductor Side

8.8.2. Circuit diagram.

Test points on IEC-625/IEEE448 interface

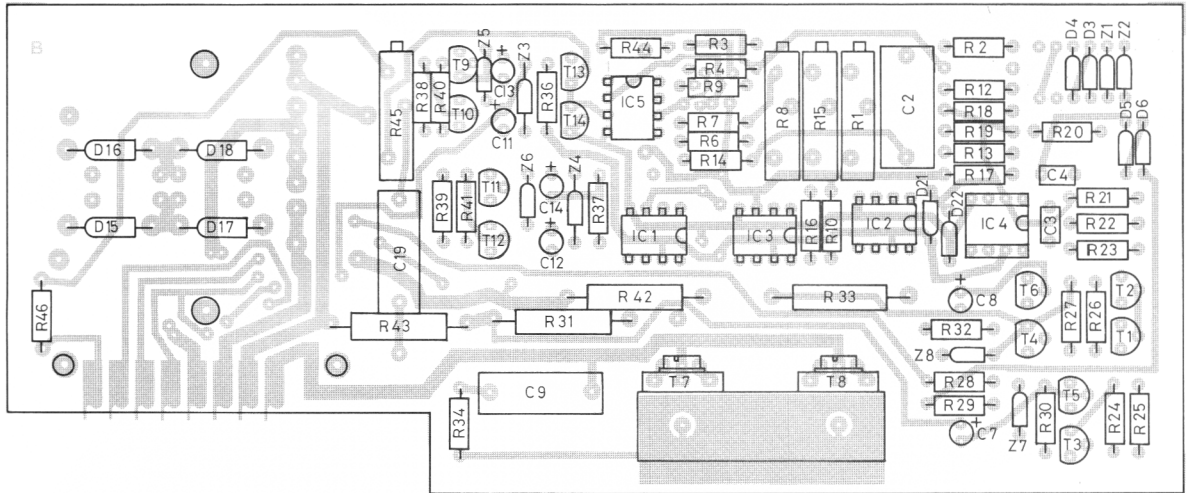
| | | |
|------|--|--|
| TP1 | : $\overline{\text{CS}}$ | : $\overline{\text{CHIP SELECT}}$ (PIO) |
| TP2 | : $\overline{\text{RS2}}$ | : $\overline{\text{REGISTER SELECT 2}}$ (for 8291) |
| TP3 | : $\overline{\text{RS1}}$ | : $\overline{\text{REGISTER SELECT 1}}$ (for 8291) |
| TP4 | : $\overline{\text{RS0}}$ | : $\overline{\text{REGISTER SELECT 0}}$ (for 8291) |
| TP5 | : $\overline{\emptyset}$ | : $\overline{\text{CLOCK PULSE}}$ (for 8291) |
| TP6 | : $\overline{\text{M1}}$ | : $\overline{\text{MACHINE CYCLE 1}}$ (From μ -processor) |
| TP7 | : $\overline{\text{IORQ}}$ | : $\overline{\text{INPUT/OUTPUT REQUEST}}$ (From μ -processor) |
| TP8 | : $\overline{\text{RD}}$ | : $\overline{\text{READ}}$ (from μ -processor) |
| TP9 | : $\overline{\text{INT}}$ | : $\overline{\text{INTERRUPT}}$ (To μ -processor) |
| TP10 | : $\overline{\text{IEO}}$ | : $\overline{\text{INTERRUPT ENABLE OUTPUT}}$ (PIO) |
| TP11 | : Not connected | |
| TP12 | : $\overline{\text{MR}}$ | : $\overline{\text{MASTER RESET}}$ (From reset-circuit on CPU) |
| TP13 | : $\overline{\text{DMAREQ}}$ | : $\overline{\text{INTERRUPT}}$ (From 8291 to PIO) |
| TP14 | : $\overline{\text{RD}}$ | : $\overline{\text{READ}}$ (for 8291) |
| TP15 | : $\overline{\text{WR}}$ | : $\overline{\text{WRITE}}$ (for 8291) |
| TP16 | : $\overline{\text{CE4}}$ | : $\overline{\text{CHIP ENABLE 4}}$ (for 8392) |
| TP17 | : $\overline{\text{TRANSMIT}}$ | : Direction of signals |
| TP18 | : $\overline{\text{TRANSMIT/RECEIVE}}$ | : Direction of signals |
| TP19 | : $\overline{\text{INT}}$ | : $\overline{\text{INTERRUPT}}$ (From 8291 to PIO) |
| TP20 | : $\overline{\text{CS2}}$ | : $\overline{\text{CHIP SELECT 2}}$ (to EPROM) |
| TP21 | : ∇ | : COMMON |
| TP22 | : +5V | : +5V |

IEC 625/IEEE 488 INTERFACE



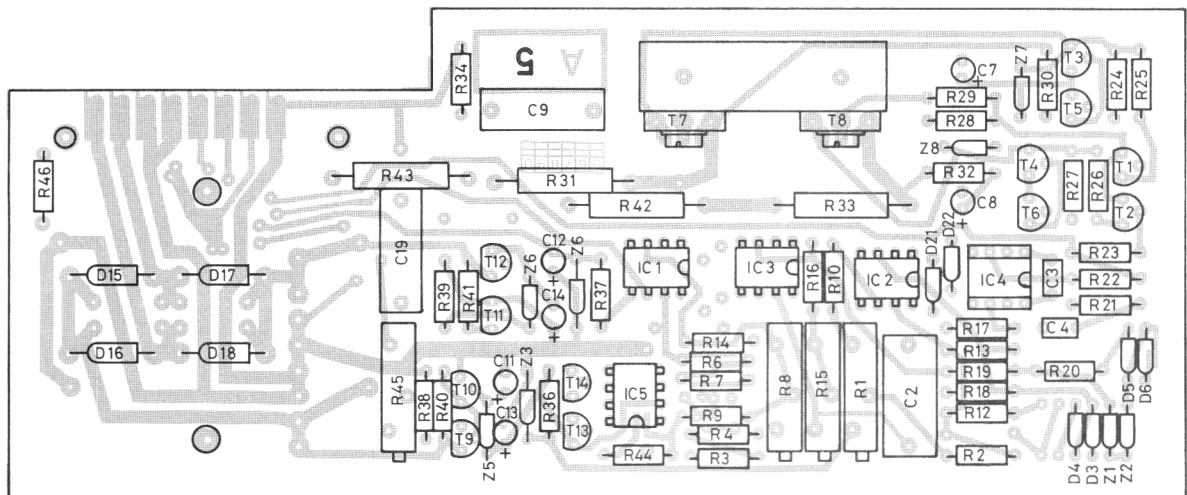
8.9. X AND Y AMPLIFIER.

8.9.1. P.c.b. lay-out of X-amplifier.



Component Side

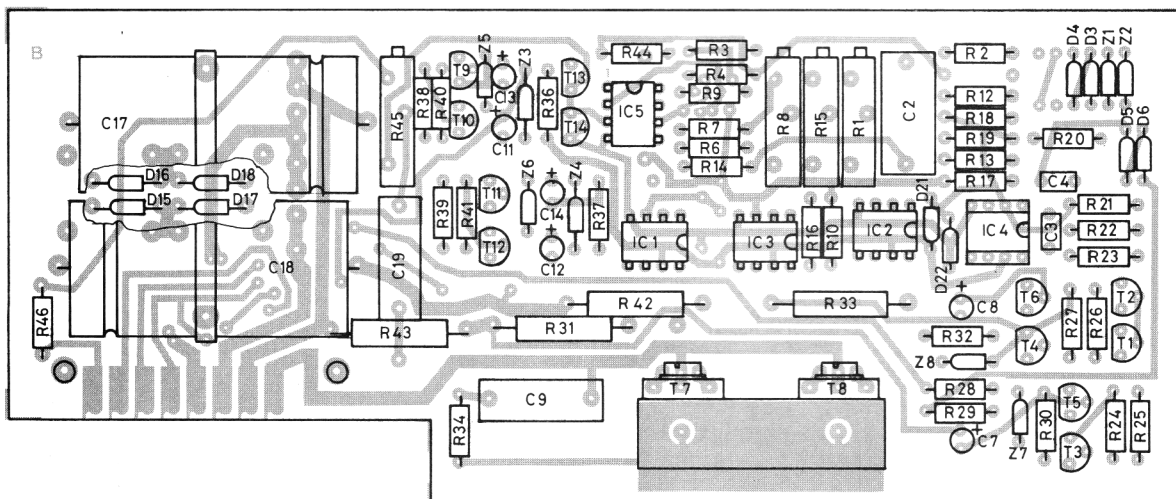
ST 3159
81-02-17



Conductor Side

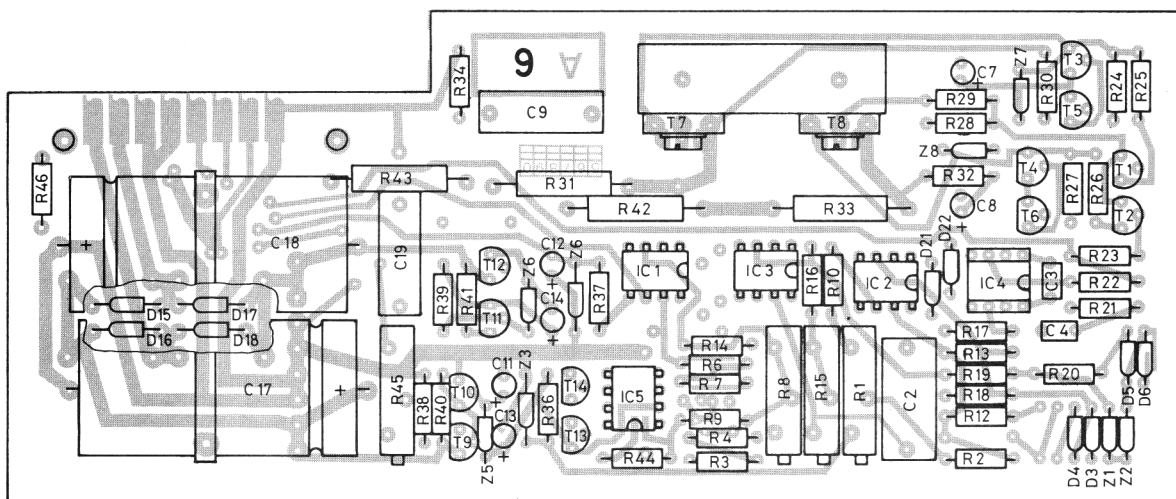
ST 3200
81-02-17

8.9.2. P.c.b. lay-out of Y-amplifier.



Component Side

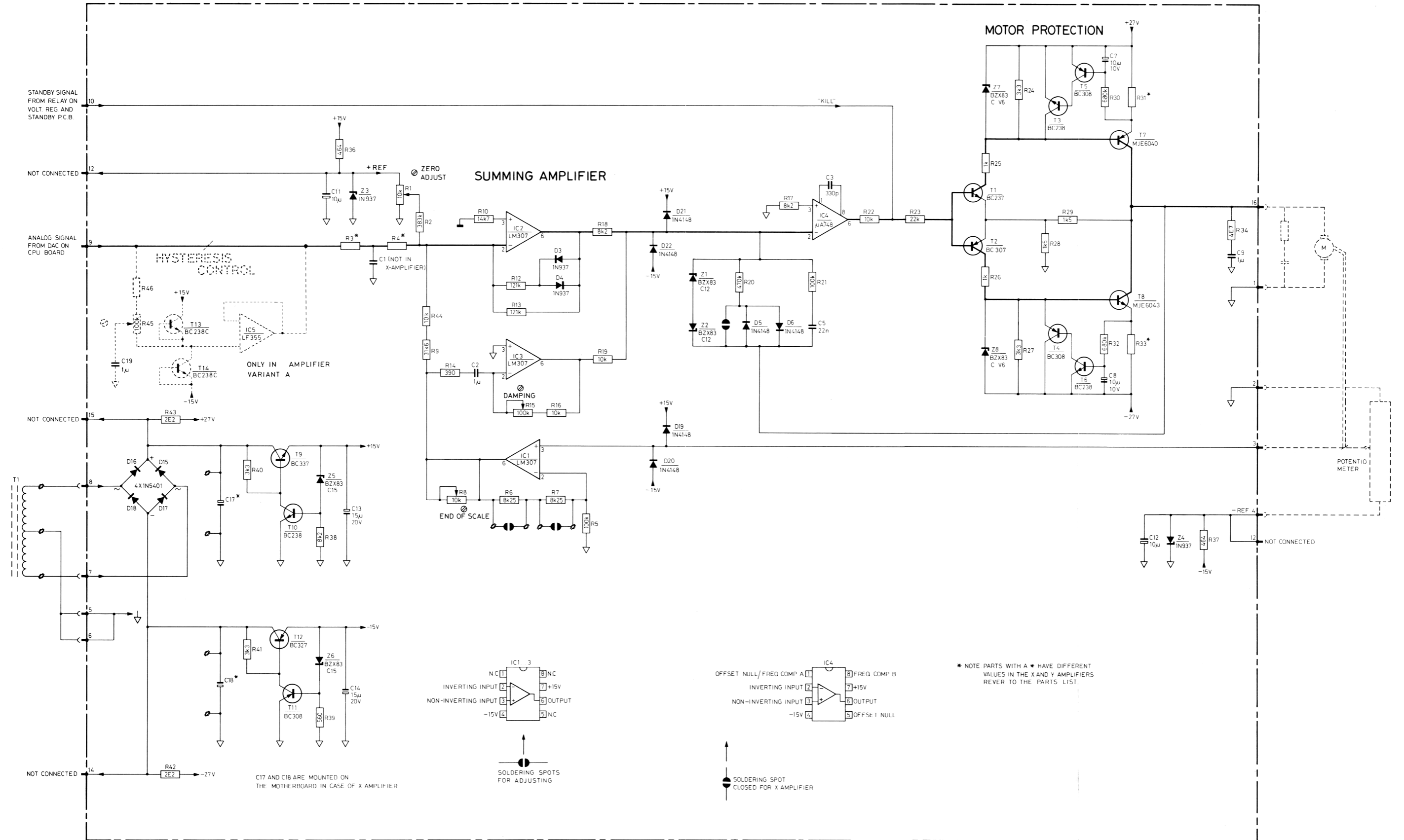
ST 3160
81-02-17



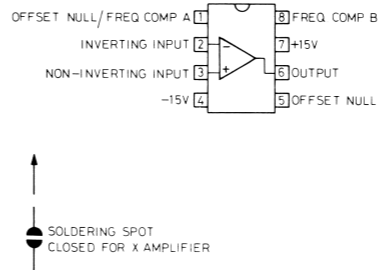
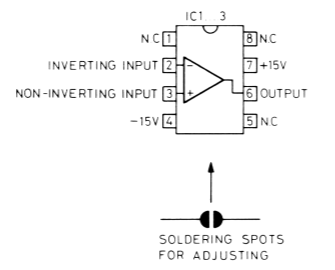
Conductor Side

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8.9.3. Circuit diagram (X and Y).



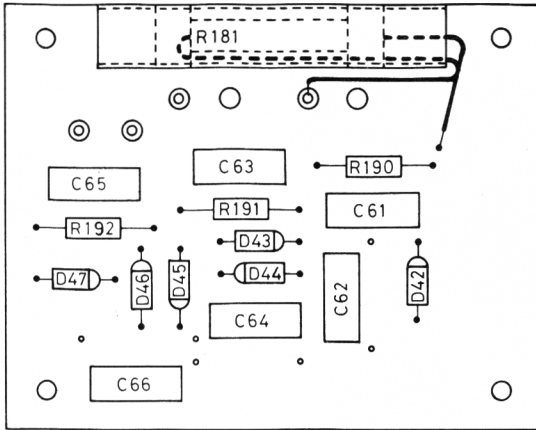
C17 and C18 ARE MOUNTED ON THE MOTHERBOARD IN CASE OF X AMPLIFIER



* NOTE PARTS WITH A * HAVE DIFFERENT VALUES IN THE X AND Y AMPLIFIERS REVER TO THE PARTS LIST.

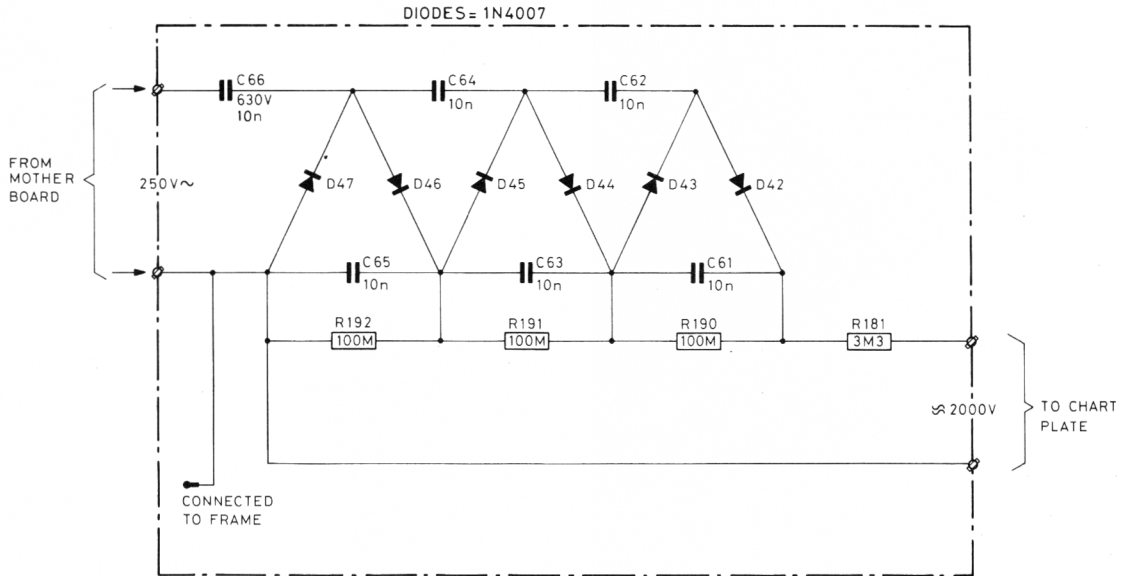
8.10. CHARTHOLD P.C.B.

8.10.1. P.c.b. lay-out.



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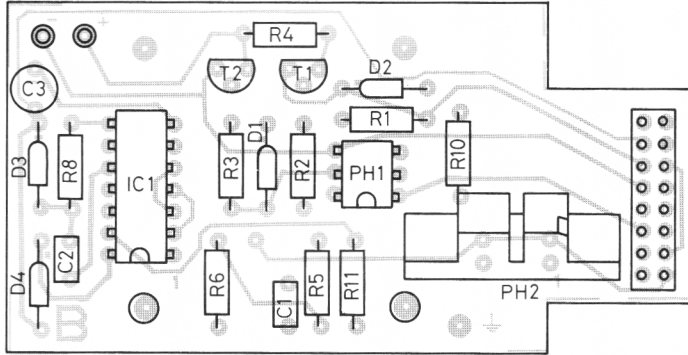
8.10.2. Circuit diagram.



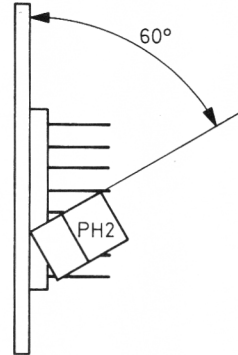
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8.11. PM9886 PROGRAMMABLE PAPER ADVANCE.

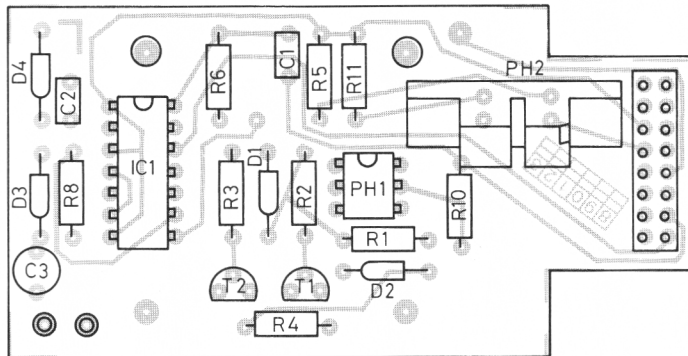
8.11.1. P.c.b. lay-out.



Component Side



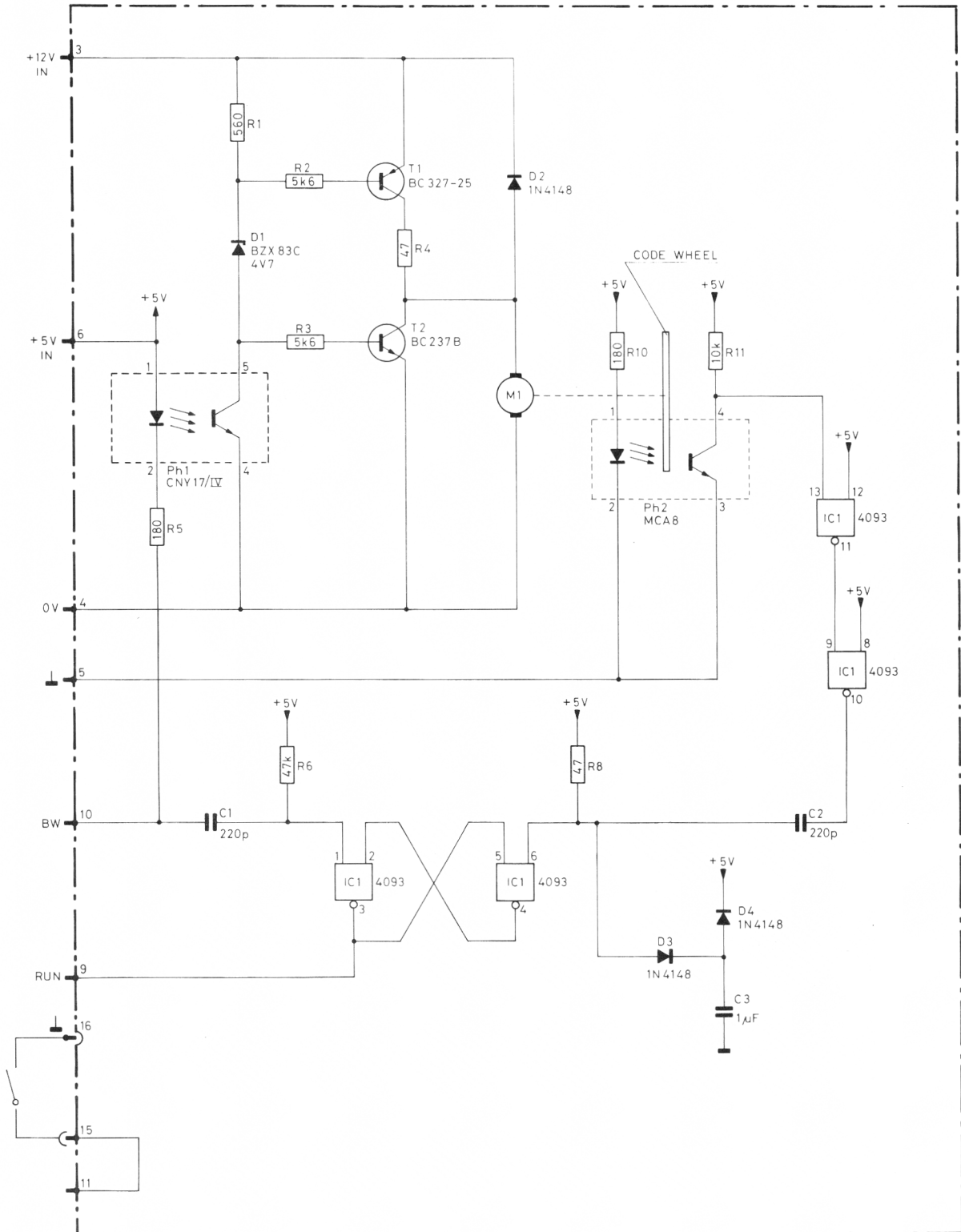
ST 3186
810211



ST3202
810211

Conductor Side

8.11.2. Circuit diagram.



Positive feedback

Now you are the user of a Philips test and measuring instrument. We trust that it will give you many years of faithful service. But we would like you to realize one thing: we can only supply the best in T & M equipment with **your** help, user.

We need to know what you have found to be the strong and weak points of this instrument; and we would be very interested to hear about any unusual or elegant applications you have devised for it. Some of this information can be passed on to our design and development departments; and some may be fed back to other users via our bimonthly publication **T & M News**.

May we therefore suggest that you fill in the reply card alongside and send it back to us right now. That way, you'll be helping to provide the positive feedback we need to help you!

All contributions that are published will be paid for at current rates; while as an inducement for you to fill in the reply card, we are offering a free subscription to T & M News or a free copy of Part I of our Digital Instrument Course to all who reply.

Erfahrungsaustausch

Meßgeräte müssen sich in der Praxis bewähren und die in sie gesteckten Erwartungen erfüllen; auch bei Ihnen, dem Besitzer eines Geräts aus der Serie der Philips Test- und Meßgeräte. Wir aber können T & M-Geräte nur zu Ihrer vollen Zufriedenheit herstellen, wenn wir alle Ihre Wünsche kennen.

Deshalb interessiert uns Ihre Meinung über die guten und weniger guten Eigenschaften dieses Gerätes. Außerdem suchen wir Erfahrungen über ungewöhnliche oder neue Anwendungsmöglichkeiten. Vielleicht können Sie unseren Entwicklungs- und Konstruktionsabteilungen einen guten Wink geben; vielleicht können wir Ihre Erfahrungen aber auch in unserer Publikation **Info-dienst** (nur in Deutschland) veröffentlichen, damit auch andere Anwender davon profitieren können.

Deshalb möchten wir Sie bitten, die anhängende Antwortkarte auszufüllen und an uns zurückzusenden. Damit helfen Sie uns, und wir können Ihnen helfen!

Alle veröffentlichten Beiträge werden dem üblichen Tarif entsprechend honoriert. Als Dank für das Ausfüllen der Antwortkarte bieten wir Ihnen ein Freiabonnenment auf Info-dienst (nur in Deutschland) oder ein kostenloses Exemplar von Teil I von unserem Kursus Digital Instrument.

L'intérêt du "feedback"

Vous voilà possesseur d'un instrument d'essai et de mesure Philips. Nous espérons qu'il vous donnera de nombreuses années de bons et loyaux services, mais nous voudrions attirer votre attention sur un point: ce n'est qu'avec **votre** aide que nous pouvons fournir des matériels d'essai et de mesure de toute première qualité.

Nous avons besoin de savoir quels en sont les points forts et les points faibles que vous avez découverts et nous serions très intéressés d'apprendre quelles applications inhabituelles ou élégantes vous lui avez trouvés. Certains de ces renseignements peuvent être transmis utilement à nos bureaux d'études; certains autres peuvent être communiqués à d'autres utilisateurs par l'intermédiaire de notre publication **T & M Informations** (édition française seulement en France).

C'est pourquoi nous vous serions reconnaissants de remplir la carte-réponse à côté et de nous la renvoyer. De cette façon, vous contribuerez à nous fournir le "feedback" dont nous avons besoin pour mieux vous servir!

Toutes les réponses publiées seront payées conformément aux tarifs en vigueur; pour vous inciter à remplir la carte-réponse, nous offrons un abonnement gratuit à T & M Informations ou un exemplaire gratuit de la première partie de notre cours sur les instruments numériques à tous ceux qui répondront.

Details of user:

Persönliche Angaben:

Expéditeur:

Company/
Firma/Société
Department/
Abteilung/Service
Street/Straße/Rue
Box/Postfach/Boîte Postale
City/Stadt/Ville
Country/Land/Pays
Name/Name/Nom
Phone/Telefon/Numéro de téléphone

Details of instruments:

Gerätedaten:

Instrument:

Name/Name/
Désignation
Type number/Typennummer/
Numéro de type
Serial number/Seriennummer/
Numéro de série
Date purchased/Kaufdatum/
Date d'achat

What are the main applications for which you use this instrument?
Wofür verwenden Sie dieses Gerät hauptsächlich?
Quelles sont les principales utilisations auxquelles vous affectez cet instrument?

Please, list what you consider to be the **strong points** and the **weak points** of the instrument. Zählen Sie bitte auf, was Ihrer Meinung nach die **guten Seiten** und was die **schwachen Stellen** dieses Geräts sind. Veuillez énumérer ce que vous considérez être les **points forts** et les **points faibles** de l'instrument.

Do you have any queries about the use of this instrument? If so, what?

Haben Sie irgendwelche Fragen über die Anwendung dieses Geräts? Wenn ja, welche?

Avez-vous des questions à poser sur l'emploi de l'instrument?

Si oui, lesquelles?

I have devised an interesting application for this instrument.

- I enclose a brief description (up to about 500 words) of this application
- Please send a representative to collect information about the application

Ich habe einen interessanten Verwendungszweck für dieses Gerät gefunden.

- Eine kurze Beschreibung hiervon (max. ca. 500 Wörter) erhalten Sie anliegend.
- Senden Sie bitte jemanden, der sich an Ort und Stelle über den Verwendungszweck informieren kann.

J'ai trouvé une application intéressante pour cet instrument

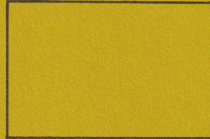
- Je joins une brève description (500 mots environ au maximum) de cette application.
- Veuillez envoyer un représentant à qui nous donnerons des renseignements sur l'application.


- I would like to receive **T & M News** regularly.
- Please send me Digital Instrument Course Part I.
- Ich möchte **Info-dienst** regelmäßig beziehen.
- Senden Sie mir Digital Instrument Course, Teil I.
- J'aimerais recevoir **T & M Informations** régulièrement.
- Envoyez moi la première partie du cours sur les instruments numériques.



PHILIPS

T & M News
 N.V. PHILIPS' GLOEILAMPENFABRIEKEN
 S & I TQ III - 2
 Test and Measuring Instruments Department
 Att. Mr. T. Sudar
 EINDHOVEN
 The Netherlands



please fold 



T & M News is your feedback unit

T & M News is a bimonthly publication issued by the T & M Measuring Department of Philips' Science & Industry Division, for distribution to actual and potential users of Philips' T & M equipment. It provides an effective means of exchanging information in the T & M field - both from the manufacturer to the customer and vice versa.

Apart from T & M News itself, we also issue T & M Reports, which provide a vehicle for (generally longer) articles of a more specialized and/or theoretical nature to supplement the information given in T & M News. These Reports, being of a more specialized interest, are generally sent to a more restricted group of users; though anyone who is interested can obtain them on request.

One special series that was brought out in supplements to T & M News is our Digital Instrument Course (Part I: Basic binary theory and logic circuits; Part II: Digital counters and timers; Part III: Digital voltmeters and multimeters; Part IV: IEC Bus Interface), which proved so popular with readers that each part of the course has been issued in booklet form.

Info-dienst für Ihren Erfahrungsaustausch

Info-dienst (nur in Deutschland) ist eine Publikation der Philips GmbH Unternehmensbereich für Elektronik für Wissenschaft und Industrie für die jetzigen Besitzer und potentiellen Kunden von Philips T & M-Geräten. Dieses Blatt strebt einen effektiven Informationsaustausch auf dem T & M-Gebiet zwischen Hersteller und Anwender sowie umgekehrt an.

Neben diesen Info-dienst geben wir auch die T & M Reports heraus (nur in englischer Sprache), in denen (im allgemeinen längere) Artikel mehr spezieller bzw. theoretischer Art als Ergänzung zu den Informationen in Info-dienst stehen. Diese Reports, an denen in allgemeinen nur Spezialisten interessiert sind, werden an eine begrenzte Anwendergruppe verteilt. Jeder, der daran interessiert ist, kann sie auf Anfrage erhalten.

Eine spezielle Serie, die gerade in den T & M News Supplements erschienen ist, war unser Digital Instrument Course (Teil I: Basic binary theory and logic circuits; Teil II: Digital counters and timers; Teil III: Digital voltmeters and multimeters; Teil IV: IEC Bus Interface). Diese Serie war bei den Lesern so populär, daß jeder Teil von diesem Kursus auch in Buchform herausgegeben wurde (nur in englischer Sprache).

T & M Informations est notre moyen de communiquer mutuellement

T & M Informations est une publication de département de Mesure de Philips, destinée aux utilisateurs effectifs et un puissance d'appareils d'essai et de mesure Philips. Elle constitue un moyen efficace de transmettre de l'information dans ce domaine, aussi bien du fabricant vers le client que vice versa.

A part la publication T & M Informations proprement dite, nous diffusons les T & M Reports (seulement en anglais) qui contiennent des articles (généralement plus longs) de nature plus spécialisée ou plus théorique, destinés à compléter l'information donnée dans T & M Informations. Etant donné leur nature, ces Reports ne sont généralement envoyés qu'à un cercle plus restreint d'utilisateurs; toutefois, quiconque s'y intéresse peut les obtenir sur demande.

Nous venons de publier dans les T & M News Supplements une série spéciale d'articles qui constituent un cours sur les instruments numériques (1ère partie: Théorie binaire de base et circuits logiques; 2ème partie: Compteurs numériques et minuteries; 3ème partie: voltmètres et multimètres numériques; 4ème partie: IEC Bus Interface) qui a rencontré un tel succès auprès des lecteurs que chaque partie du cours a été réimprimée sous forme de livret (seulement en anglais).



PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Automation
Advanced Automation Systems
Welding

Scientific &
Industrial
Equipment
Division

820629

PM8151

SRE51

- Re
- 1) Improvement Serial Interface PM8151S.
 - 2) Correction of the Partslist.
 - 3) Firmware modification IEC 1.5 to IEC 1.6 of PM8151B.
 - 4) Modification Programmable Paper Advance unit.
 - 5) X-Amplifier; Y-Amplifier

Already issued: SRE 46 Mounting procedure PM9886. (Included in Service Manual)
SRE 49 Correction Partslist (Obsolete by this service note).

1. IMPROVEMENT SERIAL INTERFACE PM8151S.

1.1 UART

When a CMOS UART is mounted on the serial interface board it might happen that the instrument will generate an arbitrary code direct after power on.

This sometimes leads to system hang-up of the host computer.

To avoid this, a resistor of 10kOhm is mounted as pull-up resistor from pin 23 of IC7 (TBRL) to the +5V.

It is advised to modify all instruments when received for repair.

Note: Printed circuit boards with lay-out number KL xxxx 05 already have this resistor mounted.

1.2 Power supply

To prevent damage of the power supply caused by high voltages from other devices, two diodes, labelled D3 and D4 (1N4148), are added to the outputs of IC 22 and IC 23.

1.3 Slew rate limitation.

To limit the slew rate of the output signals, C9, C10 and C11 (330pF) are added to the outputs 8,3 and 6 of the V24 driver IC 8 (DS1488).

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1.4. Addition of switch S4/4.

Plotters of the current production will be equipped with an updated version of the Serial interface.

In this version switch S4 contact number 4 is also used.

This switch labelled ROA enables plotter outputs even when the plotter is unaddressed.

To avoid unexpected buffer status messages when the plotter is not addressed, (switch S4/6 labelled DADR open and the plotter logically switched off, see Operating Manual page 89 and 90), this switch must always be closed. The interface is functionally and operationally identical to the previous version if switch S4/4 is set to ROA.

The ordering number of the interface board is not changed!

1.5 Modified pcb.

Above mentioned modifications have been result in a modified pcb, on which all former added components are properly mounted also.

A component lay-out of the new pcb is given in fig. 1. A corrected circuit diagram is given in fig. 2.

2. ADDITION TO THE PARTSLIST.

On request of some of our customers we have taken in stock the following parts of the pen depot as a service part. (See fig. 3.)

| Item | Ordering number | Description |
|------|-----------------|---------------|
| 1 | 5322 492 62577 | Spring |
| 2 | 5322 492 62576 | Leaf spring |
| 3 | 5322 462 40498 | Rubber insert |

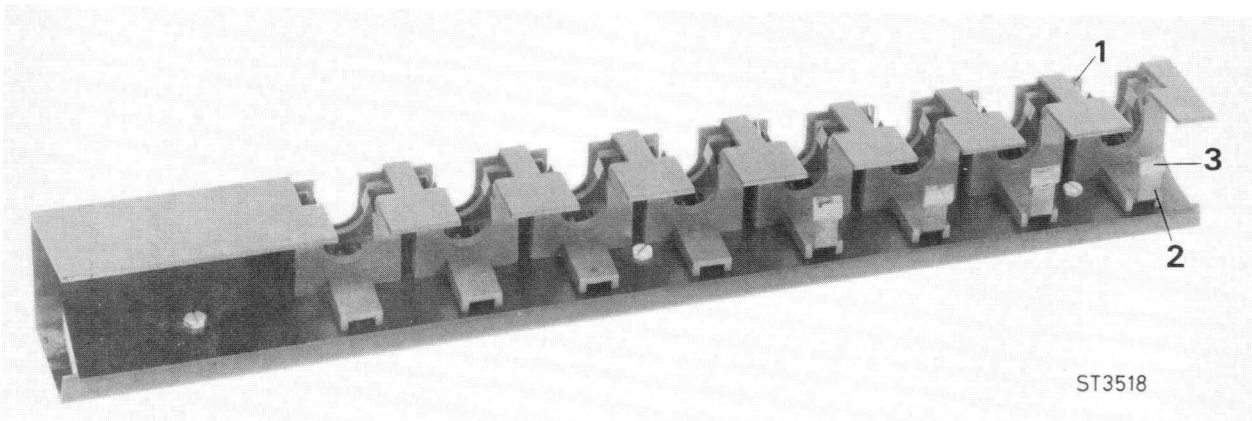


Fig. 3. Pen depot

Due to the modifications mentioned in section 1, the parts list of the Serial interface has to be corrected as follows:

| Item | Ordering number | Description |
|------|-----------------|---------------|
| D3 | 5322 130 30621 | 1N4148 |
| D4 | 5322 130 30621 | 1N4148 |
| C9 | 5322 122 31165 | 330pF 10% 63V |
| C10 | 5322 122 31165 | 330pF 10% 63V |
| C11 | 5322 122 31165 | 330pF 10% 63V |

In the parts list of the Service manual, page 112, some ordering numbers are given wrong.

The correct ordering numbers are:

Penholder carriage : 5322 466 94624
Spring for scale carrier: 5322 492 51388.

3. FIRMWARE MODIFICATION IEC 1.5 TO IEC 1.6.

From serial number 880 onwards, plotters with an IEC-bus interface are equipped with PROM version 1.6.

This modification effects the plotter status register in case of a SERIAL POLL.

The plotter status register is made up as follows now.

| Bit No | Decimal value if set | Contents | Explanation |
|--------|----------------------|----------|--|
| 7 | 128 | 0 | |
| 6 | 64 | RQS | Requested Service Message. Set if SRQ has been given by the plotter. |
| 5 | 32 | FO | Format Overflow. Set if the Plotter is in OFFSCALE position |
| 4 | 16 | BE | Buffer Empty. Set if input buffer is empty. |
| 3 | 8 | BH | Buffer High. Set when input buffer exceed 600 bytes. |
| 2 | 4 | DA | Data Available. Set when output data is available. |
| 1 | 2 | BL | Buffer Low. Set when input buffer drop below 100 bytes. |
| 0 | 1 | 0 | |

The ordering numbers of the PROMs are:

5322 694 74026 IEC-1.5.
5322 694 74032 IEC-1.6.

Instruments equipped with the 1.6 version are indicated with a sticker at the bottom of the instrument.

4. MODIFICATION OF THE PROGRAMMABLE PAPER ADVANCE UNIT.

Re: Occasionally the paper was advanced only 1 cm regardless the paper advance command parameter.

Modification: A resistor of 220 k $\pm 5\%$ is added from pin 1 of IC 1 to ground. See fig.4 and 5.

It is advised to modify all units when they come in for repair.

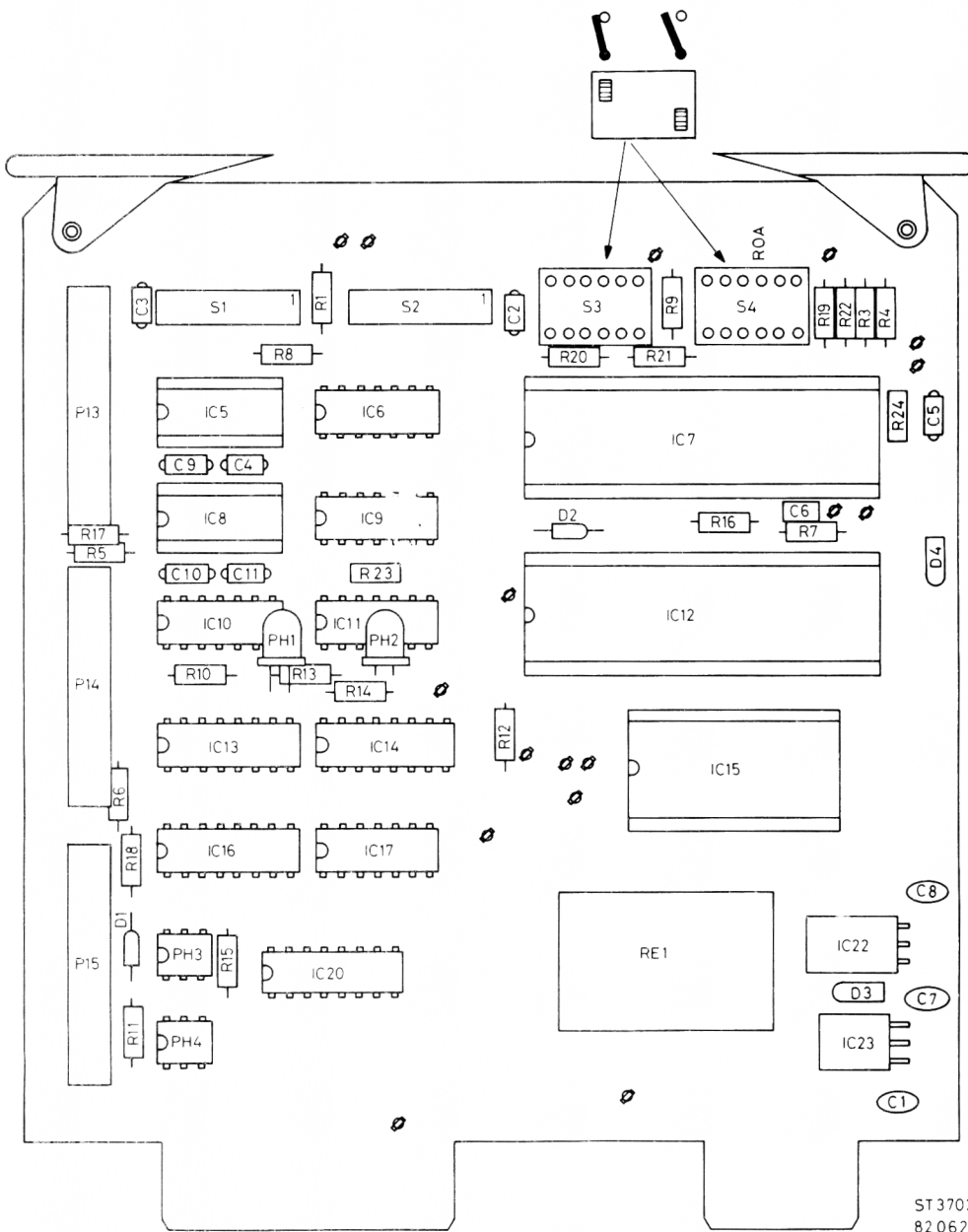
5. X-AMPLIFIER, Y-AMPLIFIER.

On the X- and Y-amplifier the power transistors MJE6040 and MJE6043 are replaced by 2N6040 and 2N6043.

As the pinning of these transistors are different, the pcb is modified accordingly.

The 2N6040 can be replaced by the BD648, ordering number 4822 130 41042.

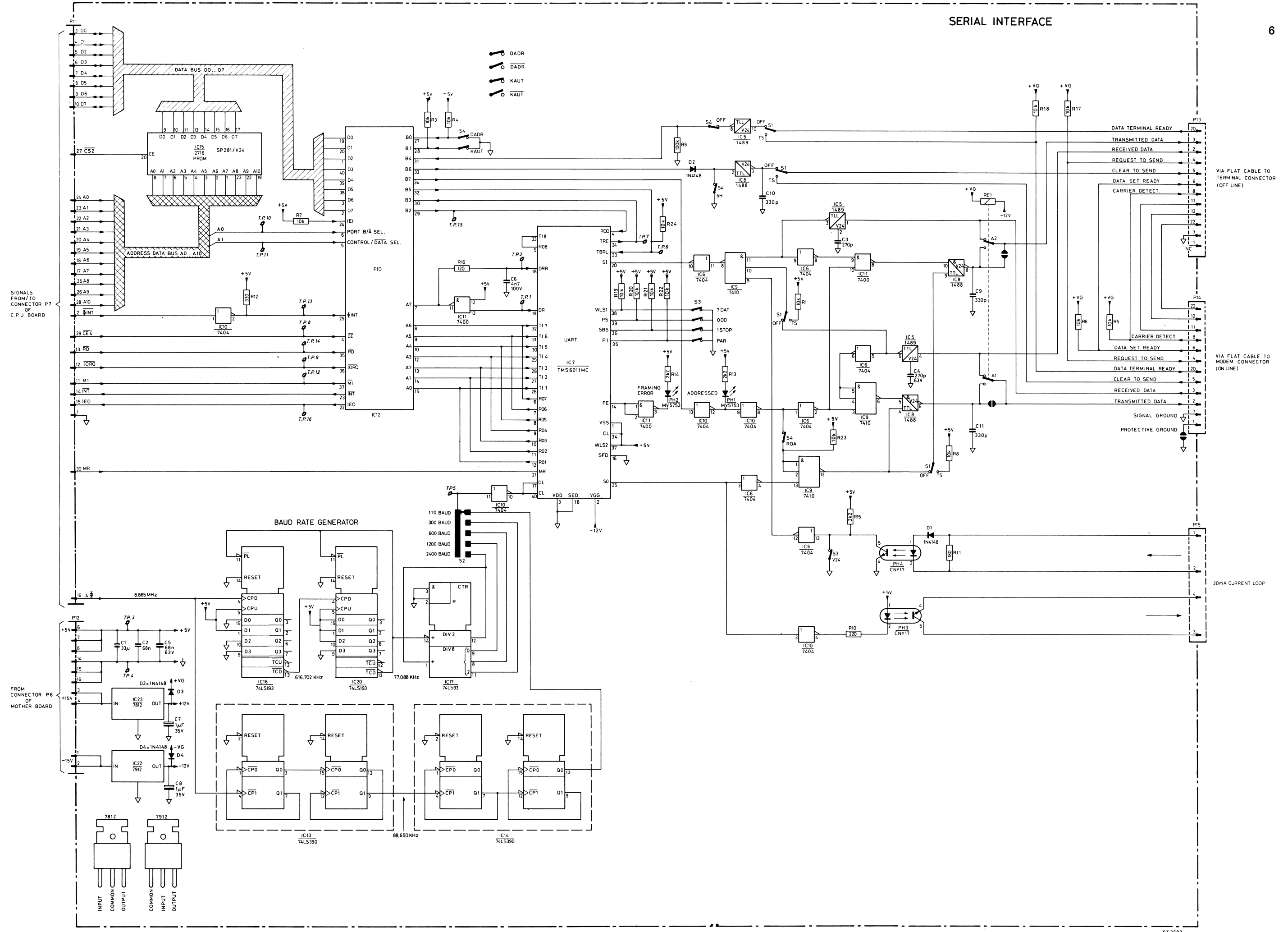
The 2N6043 can be replaced by the BD647, ordering number 4822 130 41003.



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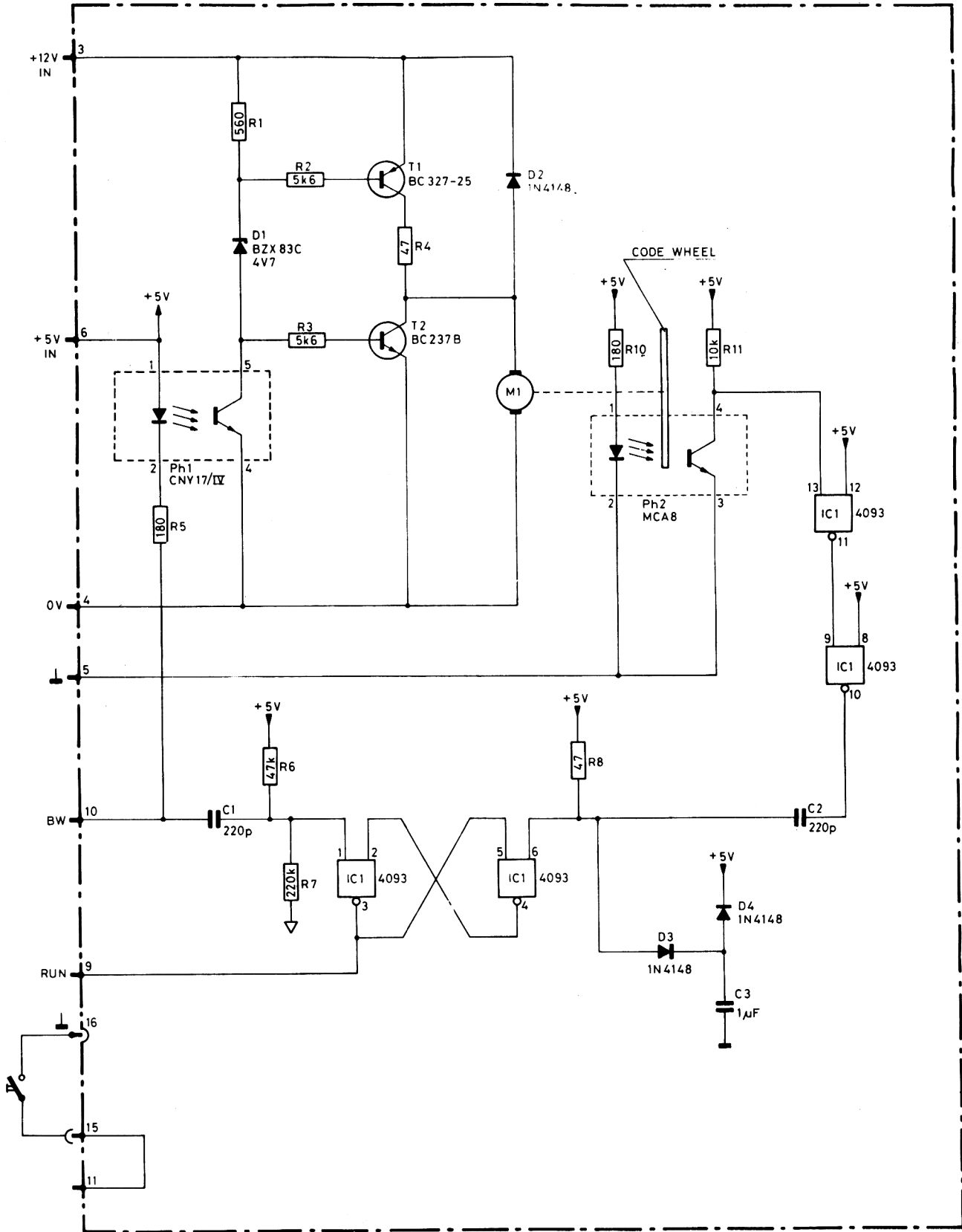
Fig. 1. Serial interface pcb

SERIAL INTERFACE



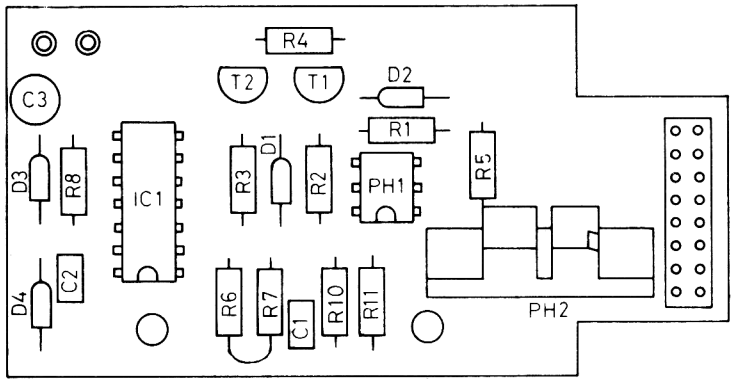
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82 06 23

Fig. 2. Circuit diagram serial interface

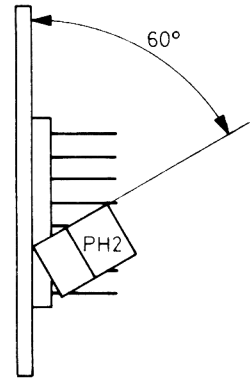


ST 3205
81 02 09

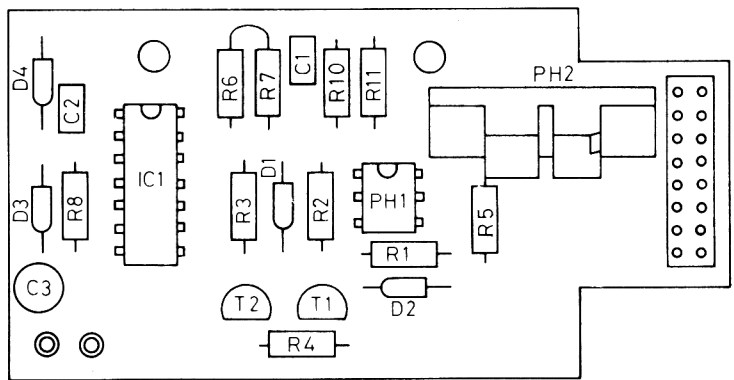
Fig. 4. Circuit diagram programmable paper advance



Component side



ST 3186
810211



ST3202
810211

Conductor side

Fig. 5. Programmable paper advance pcb



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PM8151

SRE68

Re: Correction Partslist.

Already issued: SRE46 Mounting procedure PM9886. (Included in Service Manual)
SRE51 Improvement Serial Interface PM8151S.
Correction partslist.
Firmware modification IEC 1.5 to 1.6 of PM8151B.
Modification Programmable Paper Advance unit.
X-Amplifier; Y-Amplifier.

Correction Partslist:

In the Service Manual, the description of the Rotring adaptors have to be interchanged.

The correct description is given below:

5322 263 50089 Rotring adaptor white $< 0.35\text{mm}$.
5322 263 50091 Rotring adaptor red $> 0.35\text{mm}$.

To the partslist the following code numbers have to be added:

5322 255 30108 Digitizing sight.
5322 462 40681 Dust cover.

9499 438 06311

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PM 8151

SRE 46

Mounting procedure for Programmable Chart Advance Unit PM 9886.

The typenumber covers the following parts:

- a motor drive unit with mounting material (at the bottom end a screw with hexagon head, spacer and washer, at the top end a grub screw, knurled adjusting nut, washer and nut).
- a holder for the chart supply roller with mounting material (at the bottom a screw with hexagon head, spacer and washer, at the top end a grub screw, knurled adjusting nut, washer and nut).
- 1 chart roll PM 9950/02.

Mounting and adjusting.

Remove both blanking inserts from the left and from the right hand side plate of the plotter respectively.

Remove the mounting material from the drive unit and from the holder.

Attach the holder to the right hand side plate as follows:

- Fit grub screw with knurled adjusting nut through the top hole in the side plate into the threaded hole.
- Fix holder by means of the washer and nut, do not yet tighten the nut. Fix holder at the bottom end by means of the screw (with hexagon head) with spacer. The latter is positioned between plotter and holder. Do not yet tighten the screw.

Fit the drive unit to the left hand side of the plotter in the same way as the holder is fitted to the right hand side.

Insert a chart roll into the holder, first at the top then at the bottom. Take care that the drive pin engages the hole in the roller (at the bottom end).

Feed the chart from the supply roll to the drive unit (underneath the Y potentiometer bar, pen cartridge holder and tear off ruler on the drive unit). Place the gear lever to the downward position so that the sprocket roll can rotate freely, which facilitates correct positioning of the chart on the sprocket roller. The sprocket pins must engage the sprocket holes in the chart.

Adjust the distance between bottom edge of the chart and bottom edge of the chart plate to 1 mm by moving the holder and the drive unit upwards or downwards.

Then tighten the fixing screws (with hexagon heads).

Adjust the knurled nut (on the grub screws) such that the chart lies flat on the table over the whole surface. Then tighten the nuts.

Insert the plug into the CHART ADV socket, switch on the chart drive motor and check the proper function. If necessary repeat the adjusting procedure.

