

PTS 3100 HARDWARE
Training and Maintenance Manual
Volume 1

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data systems

MATRIX PRINTER PTS 3100

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Training and Maintenance Manual

Issued 73 09 01

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Terminalsystem
Fack
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1.1 Generals view-points

1.1.1 PTS 3100 in standard design

The printer PTS 3100 is a compact serial matrix printer designed for use in many applications. See figure 1.1:1.

It is able to handle continuous peg-fed paper with up to four copies as well as friction-fed paper. The printer can be provided with a platen of three different length for printing of 69, 80 or 110 characters.

The PTS 3100 can be used as an operators station, an input/output terminal, or basic printer. Depending on the application chosen the printer may be supplied with a keyboard for input/output use, and various interfacing options.

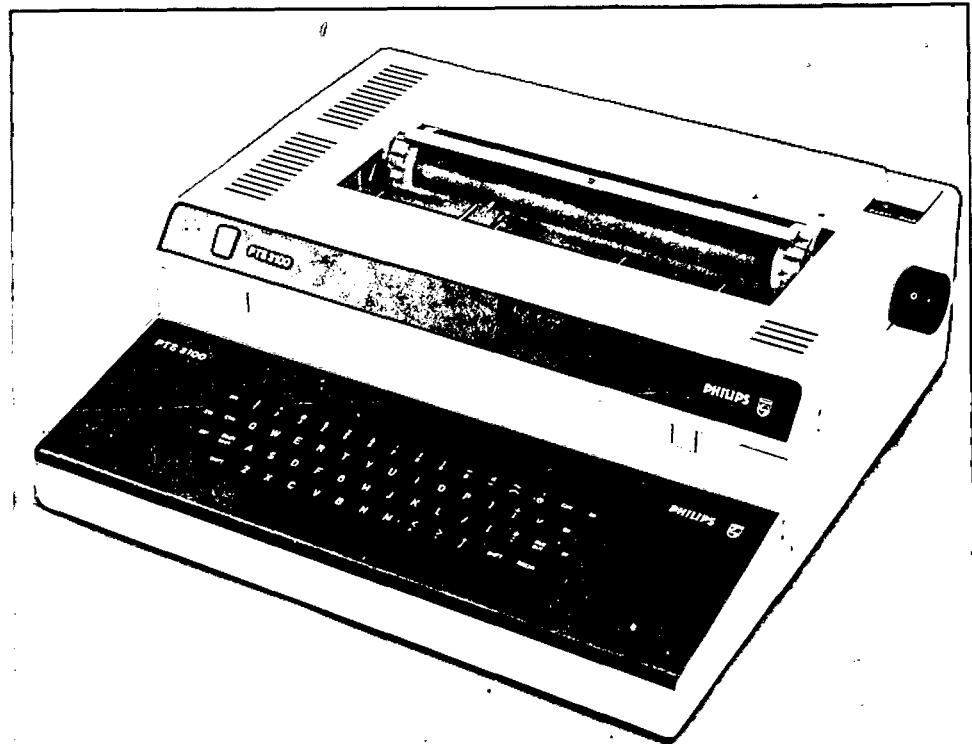


Figure 1.1:1 The printer PTS 3100

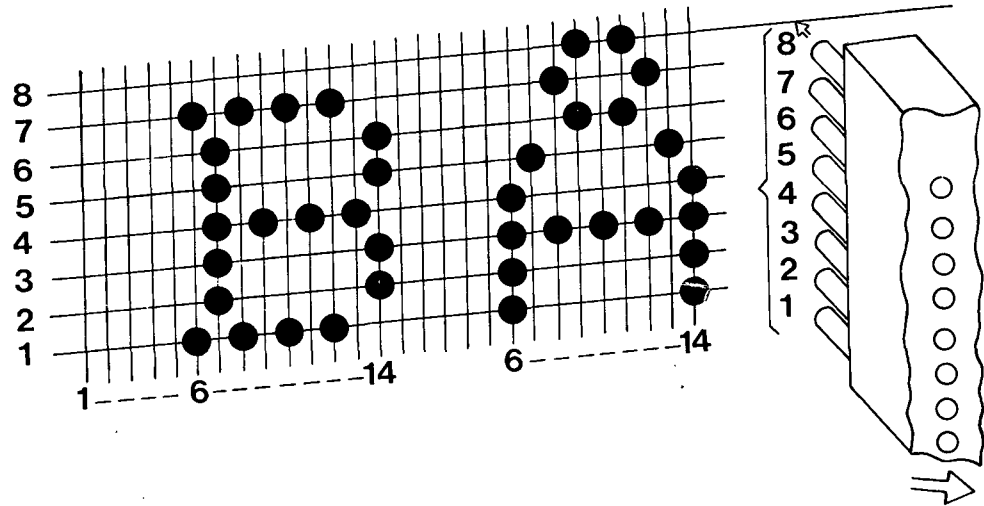


Figure 1.1:2 The matrix printing principle

PTS 3100 prints at rates up to 50 characters per second. The print head consists of eight individually controlled solenoids, each of which controls its own needle, the whole mounted on a carriage. The printing is accomplished by selective activation of the solenoids, pushing the needles onwards and pressing an inked ribbon against the paper. In that way the characters are formed by dotted patterns. See figures 1.1:2 and 1.1:3

PRINTING EXAMPLE FROM A PHILIPS MATRIX PRINTER.

ABCDEFGHIJKLMNOPQRSTUVWXYZÄÖ
 #%&*+,-./:=? .0123456789 0123456789

THE CHARACTERS ARE FORMED BY PRINTING OF A CERTAIN COMBINATION OF DOTS IN AN 8*9 DOTS MATRIX. THIS GIVES MANY POSSIBILITIES TO FORM DIFFERENT FONTS AND SPECIAL CHARACTERS AND A HIGH PRINTING SPEED.

Figure 1.1:3 Printing example

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In the standard design the printer is unbuffered and lacks a keyboard. It may, however, as an option be furnished with a plug-in type keyboard.

PTS 3100 is a completely closed unit in which are housed the mechanical and the electro-mechanical components, control logic, the character generator and the power supply. See the block diagram in figure 1.1:4.

The interface and the electronic control circuits are built-up of integrated circuits designed as modules for the utmost exchange flexibility at service and flexibility in interchanging different types of systems.

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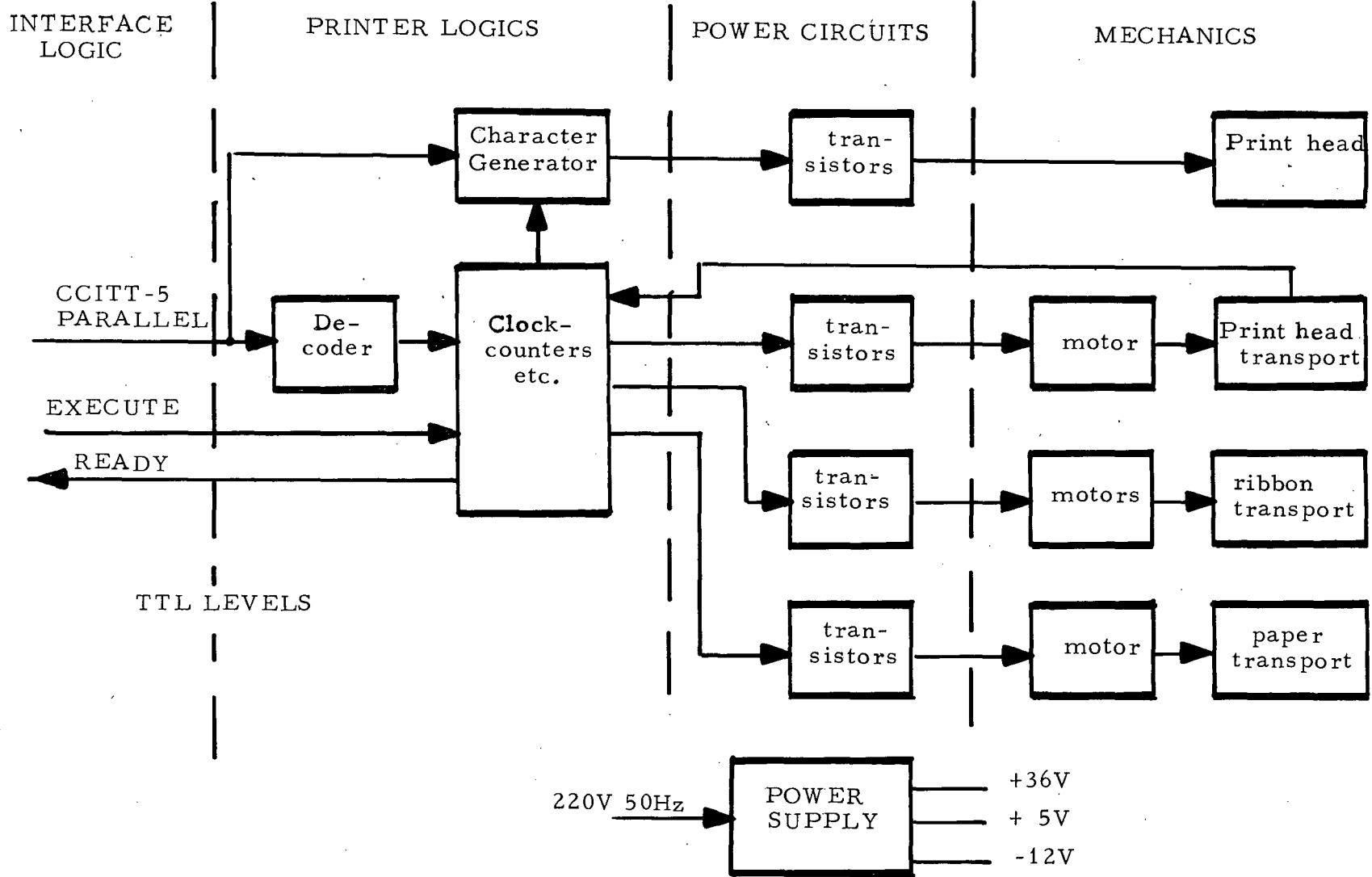


Figure 1.1:4 PTS 3100 block diagram



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1.2 Optional Features

1.2.1 Platens

PTS 3100 can be supplied with platens for 69, 80 or 110 characters per line on peg-fed paper.

The printer can also be provided for friction-fed paper and, as far as friction feed is concerned, be adjustable for paper widths between 148 mm and 297 mm.

1.2.2 Character Generator

The printer is provided with an exchangeable "character penetrator" which stores 64 different characters. As standard the character set is in the ASCII-code, see figure 1.2:1, exchangeable to other codes as the ISO or Swedish character set to meet the various customer requirements.

1.2.3 Interfaces

To adapt the printer to the line, different types of "interface boards" are available for the handling of various, mainly point-to-point communication procedures, different line speeds and buffer needs.

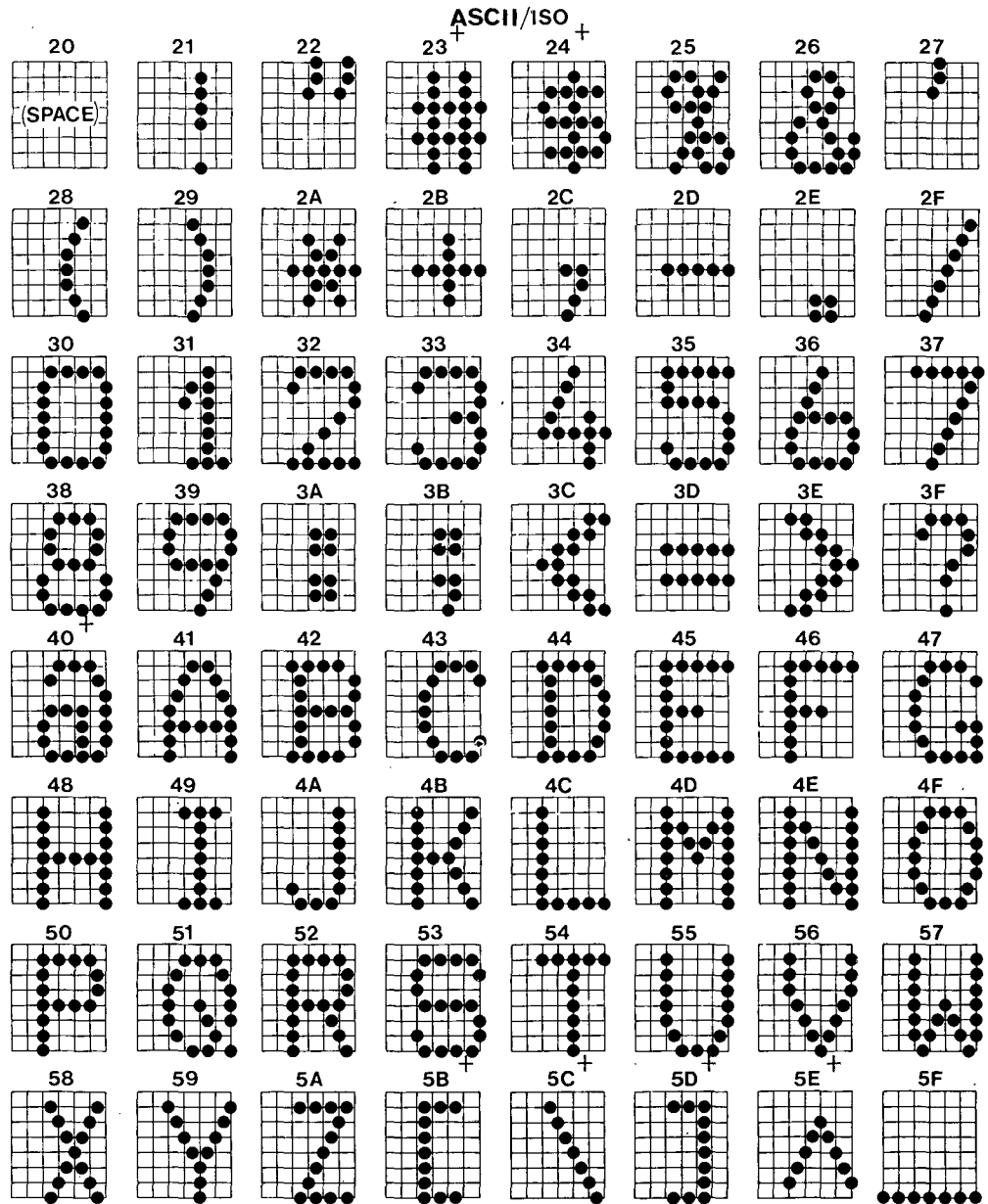
The interface holds the electronics for an "Alphanumeric keyboard".

For the handling of more complicated line procedures, as multidrop, the internal interface is not always sufficient. In such cases a separate "Interface Unit", located close to the printer, adapts the line to the printer, and the PTS 3100 is provided with a dummy-card instead of an internal interface card.

1.2.4 Additional Functions

The following functions are built-in on the standard board and can easily be added:

- Vertical Form Control (VFC), that enables the printing be started at the same place on e.g. tickets and forms
- End of Line, that alarms acoustically when the print head reaches the fifth position before the last position on each line or whenever a specific BEL-character is received from the central computer or the keyboard.



+ Not included in ISO

Figure 1.2:1 PTS 3100 ASCII/ISO character printing set (8 x 9 dot matrix)



1.3 Principle of Function

1.3.1 Input

For character printing on the PTS 3100 the data inputs must in standard design be supplied with "Data" according to the ASCII 7-bit code. To perform printing an "Execute" signal is needed for each character.

The printer responds to each character with the signal "Ready", as a receipt that the character has been printed. The Ready signal causes the Execute signal to cease, and the printer will be ready to immediately accept the next character.

1.3.2 Data Decoding

The data on the input lines are decoded so as to perform the correct command e.g. print character, line feed, carriage return, etc.

If the decoded command is "Print character," a pattern in accordance with the ASCII code is selected from the character generator, and a character is printed column by column while the print head is moving 7 steps.

When the printing of a character is completed the Ready signal is emitted.

1.3.3 Commands

The decoded commands control the platen to feed paper, the print head carriage to move in either direction, and the print head solenoids to print characters.

During operation the carriage moves along the print line from left to right until a carriage return command is decoded.

If the command is Line feed, the platen moves the form one or several steps vertically.

The form can be jumped to pre-set points by the command Form feed, if an optional Form Feed Assembly is included.

1.3.4 Last Printed Character made Visible

To enable reading of the last printed character the print head is advanced one character position, on the condition that new data are not applied to the printer within approx. one second's time.



1.4 Printer Characteristics

1.4.1 Printer Data

Number of columns	69 char/line, peg distance 203,2 mm 80 char/line, peg distance 231,8mm 110 char/line, peg distance 314,3mm For ABIS only, peg distance 136,0mm
Character space	1/10 of an inch (2.54 mm). Tolerance max 0.4 %
Character set	64 characters, space included, see 2.1.3
Character font	Matrix font, vertically max eight positions with 0.4 mm spacing, horizontally max 14 positions with 0.18 mm spacing. Horizontal positions next to one another may not be activated. Normally the font is formed by 7 x 9 dots and controlled by the character generator.
Character size	About 2.8 x 1.9 mm (7 x 9 matrix). See figure 1.4:1.
Print speed	50 char/s + starting-up time
Carriage return rate	100 char/s + max 0.2 s per line
Average print rate	Appr. 30 char/s for 80 columns; carriage return and line feed included.
Line spacing	1/3, 1/4 and 1/6 of an inch, manually switchable.

1.4.2 Ink Ribbon

The Ink Ribbon, which is easily exchange or turned by the operator, should have a useful life of 600 000 characters including one turnover.

Type Single colour, 8 mm, nylon
Length 6 m wound on twin No. 20 spools

Trade marks I Kores
II Rosendahls
III Zenith

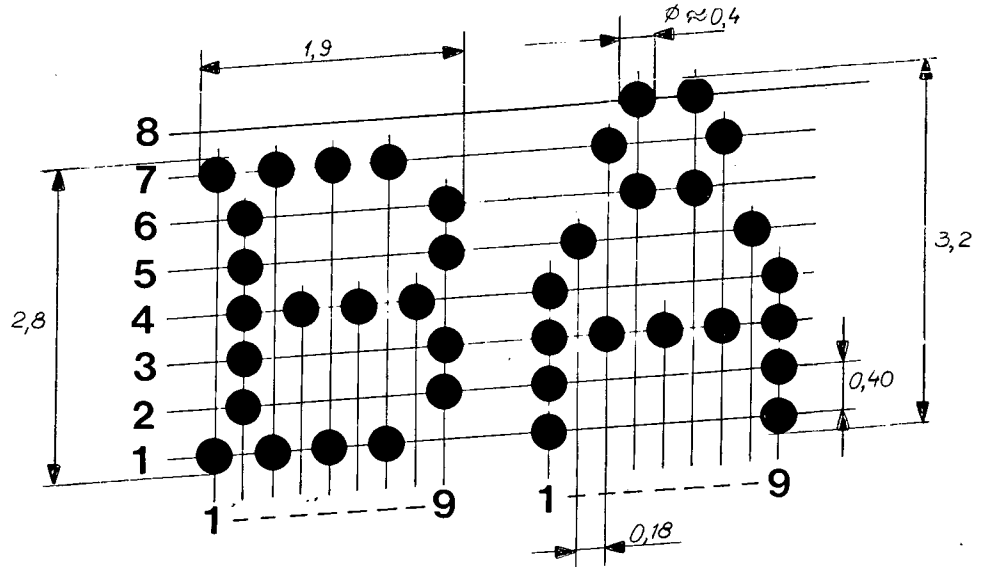


Figure 1.4:1 Character size



1.5 Paper Characteristics

1.5.1 Paper Handling

Paper feed 45 mm/s, corresponding to 10 lines/s at the line space $\frac{1}{6}$ of an inch

Form control Mechanical assembly option, see 2.2.8 and 2.4.3

1.5.2 Paper Specification (Figure 1.5:1)

The printer can handle continuously supplied peg-fed as well as friction-fed paper.

The vertical distance between two pegs is $\frac{1}{2}$ of an inch (12.7 mm).

The diameter of the punched holes should be appr. $\frac{5}{32}$ of an inch (3.97 mm).

The first and the last characters on each line can be printed at a distance of 14 mm from the centre of resp. peg.

The width of the friction-fed paper can be between 148 mm and the peg distance, minus 15 mm.

The printer accepts single sheet paper ranging in weight from 45 gr/sq.m. up to 110 gr/sq.m. The recommended weight is 65 gr/sq.m.

Peg-fed paper sets with a maximum of original sheet + 3 copies (about 4 x 60 gr) with three carbon papers of 25 gr/sq.m., or the equal from a printing point of view, can be handled.

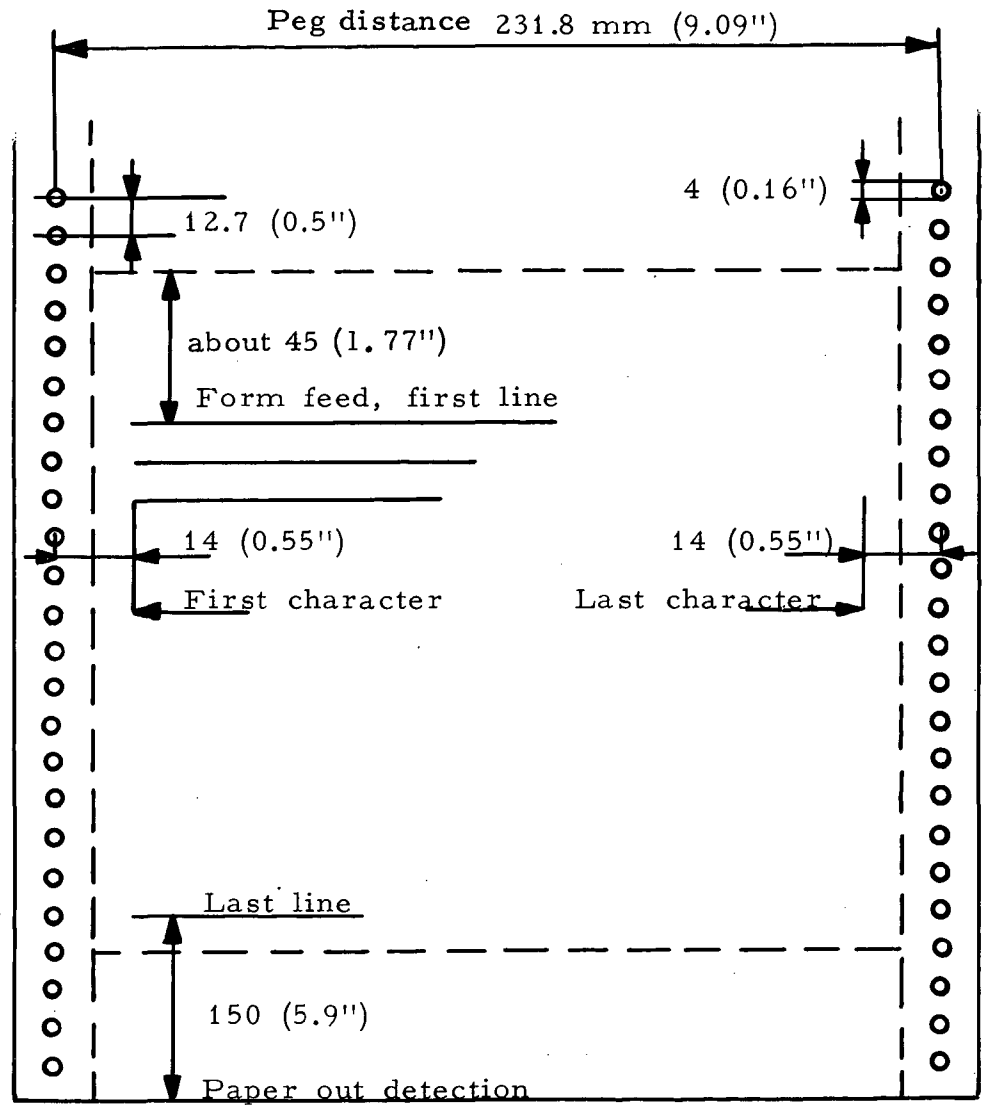


Figure 1.5:1 Paper specification



1.6 Environmental Conditions

The printer PTS 3100 withstands the following environmental conditions without being damaged or the performance deteriorated:

1.6.1 Climatic conditions

Temperature:

Transport and storage: -40°C to $+70^{\circ}\text{C}$

Operating: $+10^{\circ}\text{C}$ to $+40^{\circ}\text{C}$

Rate of change: $1^{\circ}\text{C}/\text{minute}$

Humidity:

Relative humidity without condensation

Operating: 20-80 %

Non-operating: 20-90 %

1.6.2 Mechanical conditions

Vibration

Operating: 5-150 Hz, 10 m/s^2 acceleration

Shock

Non-operating: 100 falls at the acceleration 150 m/s^2 in the direction of the normal location (or transportation, if not the same).



1.7 Reliability

1.7.1 Useful life

The printer; printhead excluded, has a useful life of 200 M characters printed or seven years, whichever ever first occurs.

The easy exchangeable printhead has a useful life time of 30 M characters.

During that time MTBF shall not be decreased.

1.7.2 Mean time between failures (MTBF)

The MTBF is the ratio of the number of operating hours and the number of equipment failures.

The MTBF is more than 1.000 hours, at a printing cycle of max 25%.

1.7.3 Mean time to repair (MTTR)

The MTTR is the average time an adequately trained and competent service man will need to diagnose and correct an equipment malfunction.

The MTTR is an half hour.

1.7.4 Preventive maintenance time (PMT)

The PMT is the time required by a suitably trained service man to perform the preventive maintenance procedure.

The PMT will not exceed two hours per 1.000 operating hours.

1.8 Typenumber-serie for PTS 31001.8.1 Printer unit

PTS 3111-001	Basic printer unit 50 Hz 220 V (reconnectible 100-240 V)
PTS 3112-001	Basic printer unit 60 Hz 115 V

1.8.2 Platen

PTS 3121-001	Platen 69 character Peg feed and friction feed
-002	Platen 80 character Peg feed and friction feed
-003	Platen 110 character Peg feed and friction feed
-011	Platen 69 character for SJ Peg feed
-012	Platen for ABIS Peg feed

1.8.3 Interface

PTS 3131-001	ECMA-C like, (Dummycard) Basic line interface
PTS 3132-001	CCITT V 24, line interface
PTS 3133-001	KSR 33 teletype line interface
PTS 3134-011	SJ, (SNAP) line interface

1.8.4 Character generator

PTS 3141-001	ASCII(= standard ISO-7 and ECMA-6) 64 characters
-011	Generator for SJ
-012	Generator for ABIS



- PTS 3142-001 Basic ISO-7, 57 characters with encoder.
- 002 PROM for PTS 3142-001, 7 characters, unprogrammed
- 011 PROM for PTS 3142-001 7 characters, Swedish P1000-version.
- 012 PROM for PTS 3142-001 7 characters, Danish P1000-version
- 013 PROM for PTS 3142-001 7 characters, Swedish standard
- 014 PROM for PTS 3142-001 7 characters, German P460
- 015 PROM for PTS 3142-001 7 characters, French P460
- 016 PROM for PTS 3142-001 7 characters, Swedish/Finnish P460
- 017 PROM for PTS 3142-001 7 characters, Danish/Norwegian P460
- 018 PROM for PTS 3142-001 7 characters, Italian P460
- 019 PROM for PTS 3142-001 7 characters, Spanish P460

1.8.5 Keyboard

- PTS 3150-001 Keyboard Basic unit
- 002 Dummy plug, for generating standard-codes, and only CAPITALS
- 003 PROM unprogrammed. facilitates small changes of codes
- 004 Textpanel for LED, unprinted
- 011 PROM, Swedish layout
- 012 Textpanel för LED P1000-version

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PTS 3151-001	Keytop-layout ECMA-23 C/V1, Standard for teletype
-002	Keytop-layout, ECMA-23 C/V1. Swedish for teletype
-011	Keytop-layout, ECMA-23 C/1, Standard for P1000
-012	Keytop-layout, ECMA-23 C/V1 Swedish for P1000
-013	Keytop-layout, ECMA-23 C/V1, Danish for P1000

1.8.6 Line adapter Multidrop

PTS 3161-011	P1000 Control unit buffer 2x127 characters
-012	Buffer extension for PTS 3161-011, 2x128 characters

1.8.7 Auxiliary device

- Form feed
- | | |
|--------------|--|
| PTS 3191-001 | Basic mechanical assembler |
| -002 | Complete set of form lengths
(from 1.5 to 12.5 inches) |
| -008-030 | Exchange part for PTS 3191-001
to get different form length.
One part for each 0.5 inch
from 1.5 to 12.5 inches |



- Supervisors
 - PTS 3192-001 Bell
 - 011 Cover open indication,
SJ.
 - 012 Buzzer, SJ.

- Printer support
 - PTS 3193-001 Pedestal stand, with fanfold
paper container and receiver

- Paper handling
 - PTS 3194-002 Paper-roll holder

- Labels
 - PTS 3195-001 Label"PTS 3100" (SJ, PTS and CS)
 - 002 Label"PER 3100" (OEM)
 - 003 Label"P 1094" (P1000-system)
 - 004 Label"PTS 6000" (Apoteksbolaget)
 - 005 Label"P 842" (P800-system)
 - 006 Label"X 1452" (Data Entry)



2 PRINTER

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2.1 Physical Description

2.1.1 General

The mechanical and the electrical parts are mounted on a mother board on the frame.

The printed board assemblies and the mother board hold the electronic components.

The printer PTS 3100 consists of the following functional parts:

- Print mechanism
- Paper feed assembly
- Ribbon feed assembly
- Electronics
- Power supply

- Print mechanism

The print mechanism houses the following components:

- Print head
- Carriage drive unit
- Platen

See figure 2.1:3

The print head is a very compact unit with eight vertically oriented print needles, each driven by an electro-magnet. The matrix print head is placed on a carriage that slides along guides which are driven by a stepper motor through a gear belt.

One character can be formed upon stepping, since each of the print needles will be activated up to seven times. The characters have each a maximum of 14 positions, however, needle positions next to each other in the horizontal direction are not activated.

- Paper feed assembly

The paper feed assembly consists of a stepper motor that drives the platen through a gear box.

- Ribbon feed assembly

Each reel is separately driven by a motor with gear box. The change of direction feature is controlled by a micro-switch that detects the end of ribbon.

- Electronics

The electronics is placed on vertically mounted printed board assemblies and on a horizontally mounted mother board, located at the bottom of the printer.



Space is reserved for two optional interface boards.

- Power supply

The power supply consists of:

- Mains filter
- Fuses (the mains fuse exchangeable by the operator)
- Mains transformer
- Regulating circuits.

Printer dimensions

Height: 166 mm

Width: 500 mm, platen knob excluded

Depth: 305 mm

Weight: About 20 kgs

The cover is made of steel.

The top part is supplied with a transparent window which renders reading of the printed text possible.

For paper loading, ribbon exchange and top of form setting, the top of the printer can be opened.

2.1.2 Mechanical construction

- Dismantling

The printer is supplied as a table model, however, it can also be provided with a pedestal.

The unit is enclosed by a cover with two movable members, one front cover and one rear cover. These can easily be raised by hand, thereby exposing all the parts the operator must have access to for his carrying out the routine actions such as paper and ribbon exchange. See figure 2.1:1.

The instructions for the routine measures are given in the "Interface and Operation" manual.

The cover assembly is attached with two screws on the lower part of the rear cover. When these screws, and another two screws on the upper part of the rear cover, which must be removed first, have been unscrewed, the printer assembly can be drawn out of the case from the rear.

Figure 2.1:3 shows the printer assembly after dismantling.

The electronic boards are housed in a screened can with top cover which is removed when pulled upwards.

- Electronic components

The majority of the electronic components is mounted on the electronics board that is placed upright on the left side

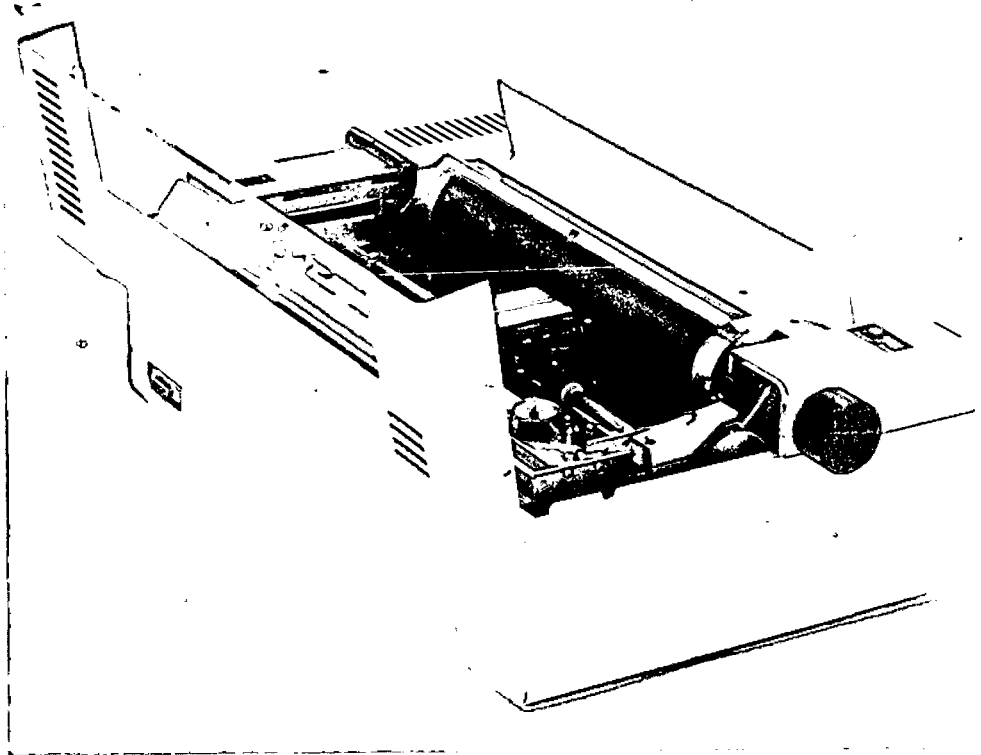


Figure 2.1:1 PTS 3100 with covers turned-up

member. Physically the board consists of two boards, one large and one small board, screwed together with distance tubes to one plug-in type unit. This unit is plugged into a connector on the mother board. The mother board is placed flat at the bottom of the printer assembly. When plugged-in the component side of the unit must be turned to the right. The mother board, covering the entire bottom area, accommodates only passive components and serves, in other respects, purely as a link between the electronics board and other units of the printer assembly.

Beside this printer logic board are the connectors for the interface boards and the special function boards. See figure 2.1:2



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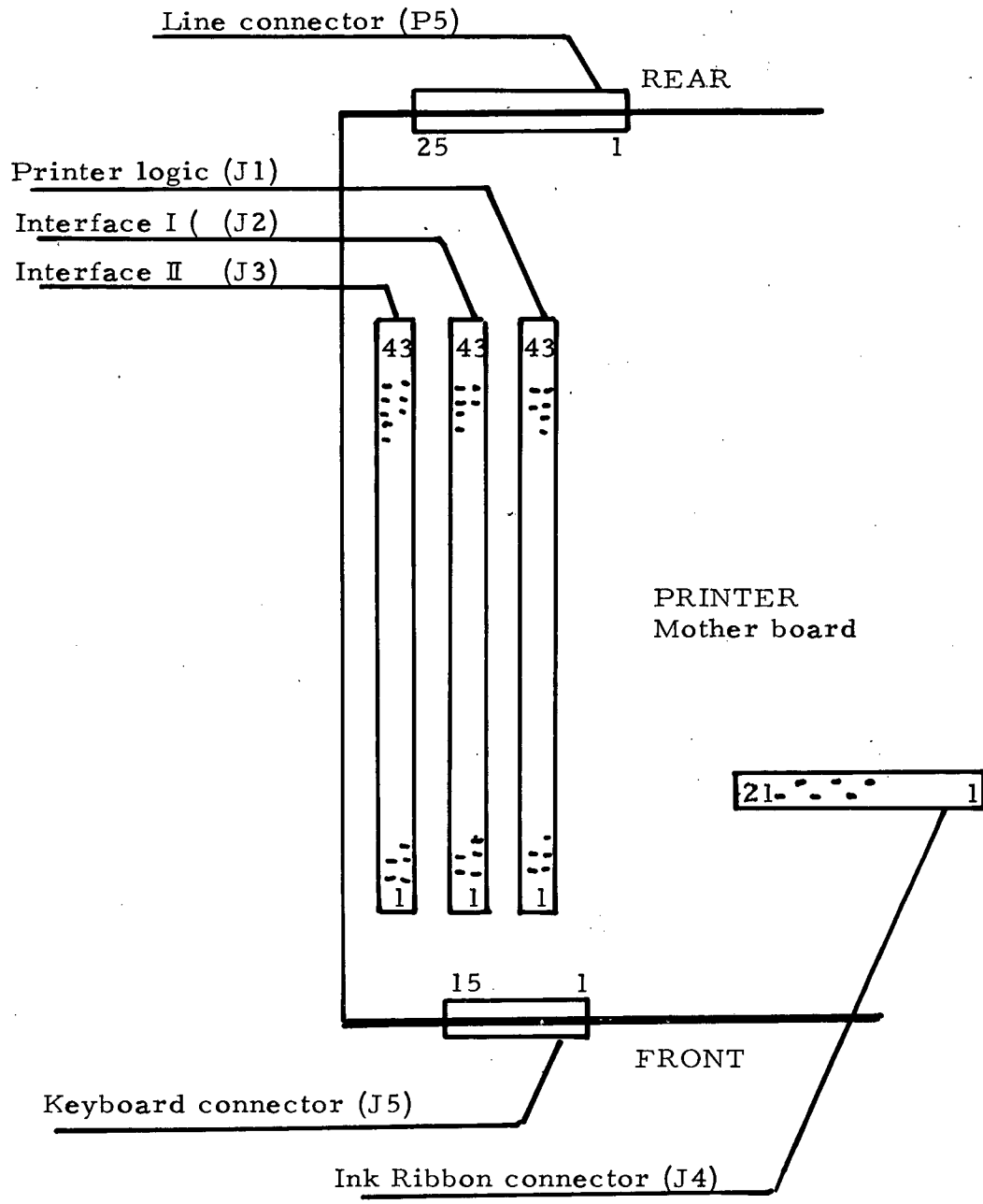


Figure 2.1:2 Board location



Those electronic components which control the ribbon are mounted on a third printed board, the ribbon control board. This board too is a plug-in type board, plugged into a connector on the front of the mother board and connected in a flat position.

Figure 2.1:3 shows the positions of the following electro-mechanical components:

- Print head^{*}, that contains eight individually controlled magnets, each of which controls its own needle. See also figure 2.1:4
- Carriage motor, a stepper motor that drives the carriage on which the print head is attached, through a gear device. In standard design the drive system is designed in such a way that the character spacing becomes 1/10".
- Optical carriage detector, a 2-channel opto switch used for detecting the home position of the carriage.
- Ribbon feed assembly, containing all the items required for feeding the ribbon in accordance with the control signals received from the ribbon control board.
- Platen motor, a stepper motor which through a gearing device drives the platen.
- Line space selection switch, used for manual selection of the desired line spacing. In standard design the line spacing can be set to 1/2", 1/3" or 1/6".
- Manual line feed key, used for manual control of the continuous paper feed.

- Fuses

The mains fuses are placed on the rear of the printer. They are exchangeable without dismantling the printer.

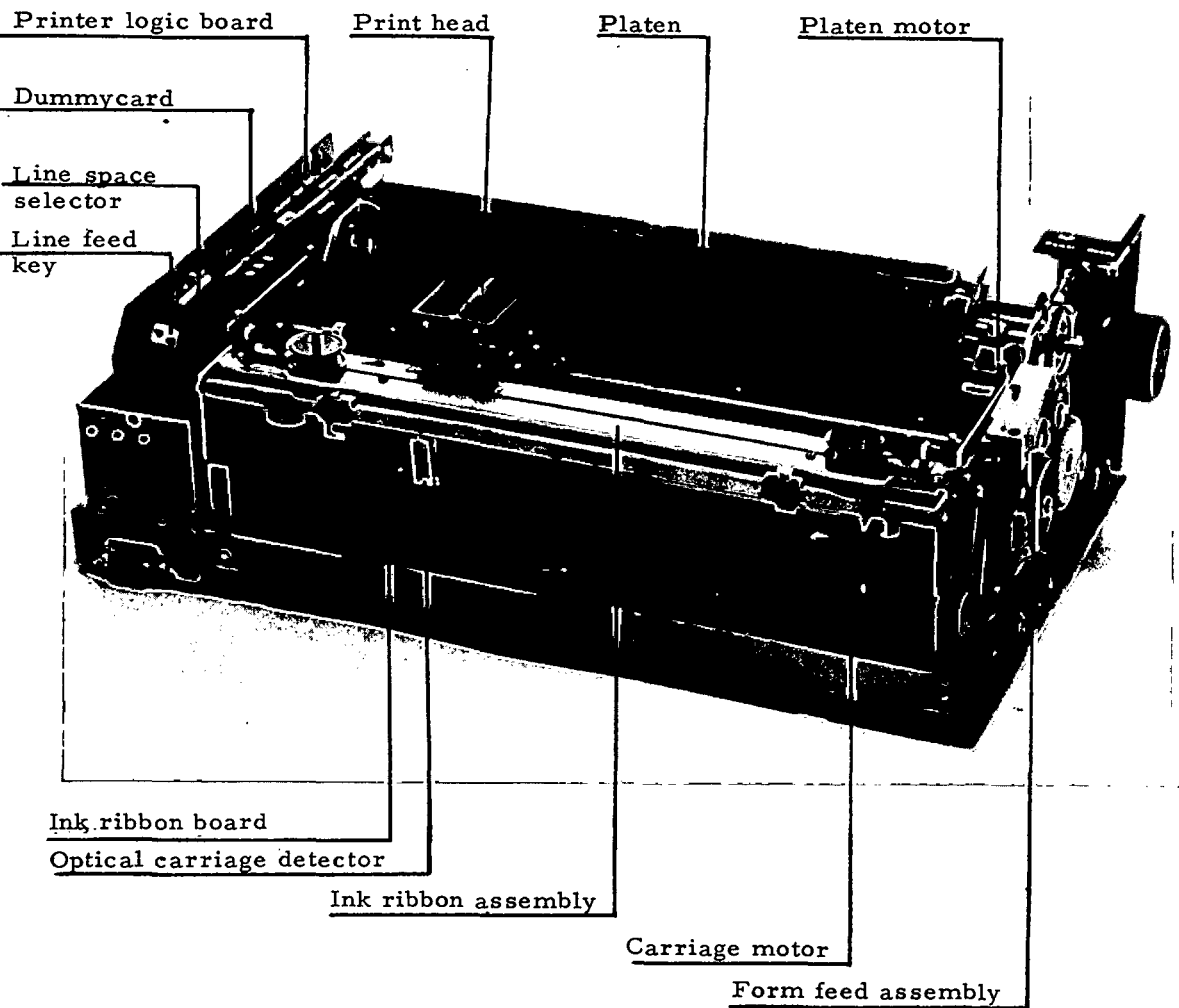
In the PTS 3100 assembly there are 8 fuses of 2A, designated F1-F8. These fuses are in series with the eight magnet windings of the print head and they are placed on the mother board, to the right of the ribbon control board.

The power supply contains another three fuses. See 2.3.1

*

CAUTION

WHEN MOVING THE PRINT HEAD BY HAND, (WHEN POWER IS OFF) PUSH ON THE CARRIAGE AND NOT ON THE TOP OF THE PRINT HEAD, WHICH CAN BE DAMAGED.



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Figure 2.1:3 PTS 3100 Main components

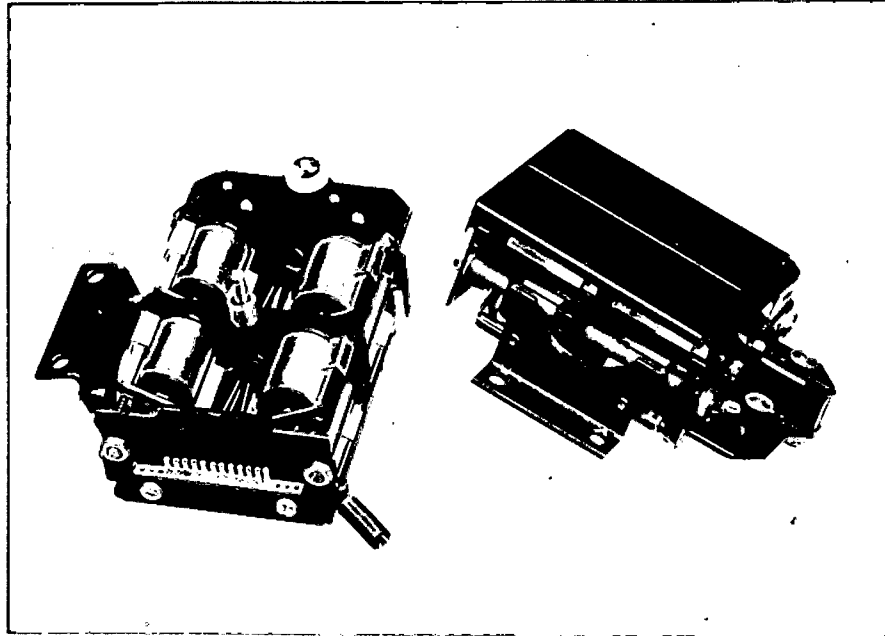


Figure 2.1:4 The print head

2.1.3 Application adaption

As was mentioned in 1.1.2 the platen can easily be replaced. Before replacing takes place the rear cover must be removed in accordance with the instructions in part 2.1.1 The existing platen is then released by lifting the catch on the inside of each side member. See figure 2.1:5.

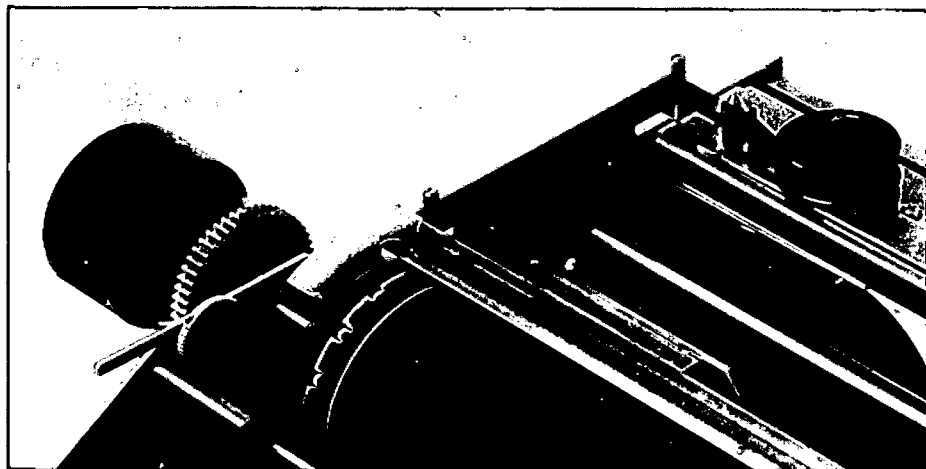


Figure 2.1:5 The platen exchange mechanism



When the new platen has been mounted it is locked in position by pushing the catches downwards. The stop ring, see figure 2.1:5 must then be sufficiently moved to the left in order to prevent the print head from reaching the right-hand locking mechanism of the platen paper holder.

In the case of special application requirements the printer PTS 3100 can also be equipped for friction-fed paper.

The character and line spacings stated previously are applicable for the standard version of the printer. Other spacings can be arranged for if there are other application demands. The character spacing can be changed, by relatively simple means, from 10 into $11 \frac{2}{3}$ char/inch. Similarly, the line spacing can be changed to suit any special demand.

The printer has a character repertory of 64 characters withing the code interval 20-5F. The characters of the standard version are those shown in figure 2.1:6. If other characters are required for a specific application, integrated circuits on the electronics board are easily changed. This arrangement is made possible because the 64 characters are stored in integrated read only memories.

Usually the character generator is not changed, however, another two circuits, one for seven new characters and one for address decoding, are added into prepared locations.

The commands are basic functions and are not included in the character generator.

07 = Bell BEL
08 = Back space BS
0A = Line feed LF
0C = Form feed FF
0D = Carriage return CR



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b7	b6	b5	b4	b3	b2	b1		0	1	2	3	4	5	6	7
							b7	0	0	0	0	1	1	1	1
							b6	0	0	1	1	0	0	1	1
							b5	0	1	0	1	0	1	0	1
								0	1	2	3	4	5	6	7
			0	0	0	0	0			SP	0	@	P		
			0	0	0	1	1			!	1	A	Q		
			0	0	1	0	2			”	2	B	R		
			0	0	1	1	3			#	3	C	S		
			0	1	0	0	4			\$	4	D	T		
			0	1	0	1	5			%	5	E	U		
			0	1	1	0	6			&	6	F	V		
			0	1	1	1	7			'	7	G	W		
			1	0	0	0	8			(	8	H	X		
			1	0	0	1	9			)	9	I	Y		
			1	0	1	0	10 (A)			*	:	J	Z		
			1	0	1	1	11 (B)			+	;	K	[
			1	1	0	0	12 (C)			,	<	L	\		
			1	1	0	1	13 (D)			-	=	M]		
			1	1	1	0	14 (E)			.	>	N	^		
			1	1	1	1	15 (F)			/	?	O	_		

Figure 2.1:6 ASCII standard character set



2.2 Function

2.2.1 General

- Switches and lamp

The printer is provided with one indicating lamp and one switch, Power ON/OFF, and in addition one switch for turning off the operational signal to the line. There is also a switch for Paper run, and a switch for line spacing control is located beneath the front cover.

- Input/Output connector

For input and output signals a 25-pin Cannon DB-25-P connector is used. The I/O-signals are distributed to the interface board connectors. When no interface is mounted, the over-ride interface board, called Dummycard, forwards the I/O-signals direct to the internal logic.

For connection of the keyboard a 15-pin Cannon DA-15-P keyboard connector is permanently mounted on the front of the printer, and it is connected to the interface connectors. When a keyboard is not connected a cover protects the connector.

- Input lines

The input lines are:

- Seven Data lines. The character code or the command code is applied to these parallel input lines. All codes should be in accordance with the character set mentioned in 2.1.3.
Data must be stable before the Execute signal arrives, and remain in set state until the operation is carried out and a Ready signal is given.
- One Command line (Execute signal). This line is used to initiate all printer operations. The Execute signal must remain in set state until the Ready signal is delivered but then disappear within 100 μ s.

The terminal printer of PTS 3100 provides the following response lines:

- Ready signal lines (true and false). The Ready signal is used to acknowledge the Execute signal. It indicates that the printer command has been executed and that the printer is ready for the next character. The Ready signal disappears when the Execute signal is removed. The next character can be executed immediately after the disappearance of the Ready signal. If the Data signal and the Execute signal for the next character are delivered within 1.25 μ s the printer will maintain its operation at the highest possible speed, otherwise it executes, after about 0.8 s, one extra spacing.



When the next character appears, the printer will carry out back-spacing and then accelerate onwards again.

- End of Line signal. This signal is delivered when reading a manually adjustable position on each line. The signal can be used for an acoustic output, if the optional bell assembly is included.
- Operational signal. When the power is on and End of Paper is not detected, an operational signal is delivered in the form of a closed relay contact. This signal disappears when the remaining length of paper is about 150 mm, or if the Ready switch beside the Power ON/OFF switch is activated.

2.2.2 Basic timing

- General

All commands are in the printer PTS 3100 executed at a speed which is determined by a controllable clock pulse generator. When the printer is free, i.e. there are no commands awaiting execution, the clock pulse generator operates at its basic frequency of approximately 30 Hz. However, as soon as a command is received, the frequency is increased by acceleration in accordance with an exponential function.

- Frequency accelerations

Acceleration is applied in case of commands which mean that the carriage motor must move the carriage with the print head. If this occurs in connection with printing or back-spacing, the frequency is accelerated towards a maximum of about 730 Hz. In connection with carriage return the frequency is allowed to reach approximately 1450 Hz. See the frequency diagram in Appendix 2.2:1.

The reason for the acceleration procedure is that the carriage motor must be given the possibility to gradually build up the torque required to start the carriage. If the frequency was increased as a jump to the required value, the motor would be unable to move the carriage.

- Frequency reductions

Frequency changes in the other direction, i.e. from a high to a low frequency, take place either through retardation according to an exponential function, or as a jump. See Appendix 2.2:1.

In principle, the reason for the retardation procedure is the same as for the acceleration procedure, i.e. the carriage motor should have a possibility to successively adapt itself to the new frequency.



A too rapid change of frequency would cause the motor to fall out of phase and as a result the motor would be unable to drive the carriage when the frequency 730 Hz was reached.

Consequently the jump frequency changes occur only in the printer, at returns to the basic frequency 30 Hz.

- Command scanning

Irrespective of the frequency the Clp pulses delivered by the clock pulse generator have a duration of about 0.5 μ s. Each pulse is used, among other things, to check whether a change of command, necessitating a change of frequency, has taken place. This check is accomplished by scanning the commands in gates, and the actual command is applied to a flip-flop for frequency control. The output signals of the flip-flop are noted by the clock pulse generator. If there is no command present, the check results in the clock pulse generator's returning to, and maintaining, the basic 30 Hz frequency. See the gate system to the left of the clock pulse generator in Appendix 2.2:1.

A return to 30 Hz can also be ordered by a Time out signal, that inhibits the blocking caused by a carriage stop owing to a mechanical obstruction.

Other frequency changes are described in conjunction with the relevant command.

2.2.3 Command signals

- General

The printer performs the following operations in response to the input signals:

- Print character.
The print head needle drivers are activated to print the character column by column, as determined by a pattern stored in a character generator (read only memory). Simultaneously the head motor is advanced one step for every two columns.
- Space.
The print head is moved forward one character position.
- Back space.
The print head is moved backwards one character position.
- Carriage return.
The print head is returned to a position to the left of the margin.



- Line feed.
The paper is advanced one line. The line spacing is 6, 4 or 3 lines per inch, and switchable.
- Form feed.
The paper is advanced until the next form is detected. If a mechanical assembly for the form feed (FF) is not mounted the paper advances 1/12".
- Bell
A Ready signal is immediately produced. If a mechanical assembly for Bell (BEL) is included, an acoustic alarm is given.

2.2.4 Print character command

- General

Character printing is commanded quite simply by feeding out the relevant character select code from the interface. As stated previously there are in all 64 such codes, all resulting in the signal 2X-5X = Print character, after decoding in the printer. See Appendix 2.2:1. The decoded signal, like all the other output signals from the printer decoder, is gated with the Execute signal from the interface logic and is thereafter ready to control the course of events in the printer.

- Frequency control

The way in which the clock frequency generator responds to the signal 2X-5X depends on the actual operating mode of the generator. Three cases can be distinguished:

- If the preceding command was neither of 2X-5X, 0D or 08, the generator frequency will remain at 30 Hz. The signal 2X-5X will initiate an acceleration towards 730 Hz.
- If the preceding command was Carriage return or Back spacing, i.e. the direction of the carriage has to be reversed, at least one Clp must pass before the signal 2X-5X can be registered by the generator and thereby initiate an acceleration towards 730 Hz. During this delay, caused by the flip-flop D in the command buffer, the generator returns to the basic frequency of 30 Hz, thus the frequency from which the acceleration starts. The reason for the frequency reduction is the same as that for the previously mentioned acceleration and retardation procedures.
- If the preceding command was also Print character, the generator operates at a frequency that is already accelerating towards 730 Hz, and this limit has already been reached.



In such case the signal 2X-5X means that the acceleration shall continue or that the maximum frequency shall be retained.

- Carriage control

The carriage motor is controlled by a pulse generator that in principle consists of a reversible Johnson-counter. When counting is ordered in either direction, the counter is stepped at the frequency $f_c/2$, where f_c is the actual Clp frequency. In this case the 2X-5X signal selects the counting direction, which means that the carriage with the print head moves to the right.

The four-phase signals from the pulse generator are taken care of by drivers which have been specially designed to allow a somewhat unconventional use of the carriage stepper motor. With unconventional is meant that the four windings of the motor are connected in parallel in pairs. See Appendix 2.2:1. This arrangement enables the motor to reach a higher speed than would else be possible.

- Print head control

The bits 2^0-2^5 of the received character select code are also applied to the read only memory in which all the character patterns are stored. In the memory the bits are decoded into a signal that selects one of the 64 patterns. Each pattern consists of 16 x 8 bits arranged as a matrix of sixteen columns with eight bits in each column. However, as is explained later, only fourteen columns are actually made use of. Reading is carried out column by column. Each column reading provides eight bits in parallel which through drivers affect the eight print head magnets, each of which can be activated up to seven times per pattern. See Appendix 2.2:1.

The columns of the selected pattern are scanned by means of a column counter, the position of which is decoded in the memory, in order to get the required column selection signals. The columns counter is set to 2_{10} (or 3_{10} depending on the position of the bit 2^0 of the pulse generator for carriage control) by the carry signal each time a character is scanned.

The Clp will advance the counter if the following conditions are satisfied:

- Printing must have been commanded by the signal 2X-5X.
- The column counter requires the condition LCD_{on} before it can be stepped forward by the Clp. This means that the carriage with the print head must be positioned within the printing range before printing can take place. See Appendix 2.2:1.



This latter condition implies that the carriage must abandon the home position, where both the upper carriage detector (UCD) and the lower carriage detector (LCD) are in the OFF position. The carriage must also leave the LCD mask ruler.

Each time the column counter steps forward, the mono-stable flip-flop F is triggered and generates a printer pulse of 0.75 ms duration. This pulse opens the output buffer in the read only memory (ROM) for the signals from the memory array to the print head in order to activate the needles corresponding to the selected pattern.

It should be noticed that the first five columns scanned (2-6) normally include no information, because they correspond to the space between the preceding character and the character to be printed. Hence the character pattern is usually contained in the columns 7-15, with the exception of certain special characters.

When the last column (15) in the pattern is scanned, the column counter is in position 15_{10} and will deliver a carry signal at the next Clp. This signal resets the flip-flop N that loads the counter to its start position 2_{10} , or 3_{10} , if the counter in the pulse generator for carriage control is in an odd position, implying that the counter is between two motor steps.

When the flip-flop N is reset the signal One character scanned, will set the flip-flop A with the result, that the printer delivers a Ready signal to the interface, see figure 2.2:1. The signal Execute ceases, whereby the flip-flop A will be reset and the signal 2X-5X blocked.

- Output requirements

If the printed character is one of several on a not yet finished line, the next character select code with accompanying Execute signal ought to arrive before the next Clp. If not doing so, the clock pulse generator will return to the basic frequency of 30 Hz, i.e. the printer will be unable to utilize the speed reached earlier, and the acceleration must start again.

This means, as far as the highest frequency 730 Hz is concerned, that the new command ought to arrive within appr. 1.37 ms after the Ready signal.

- Last character made visible

Normally the print head stands in the way for the last printed character. In order to make this character visible the print head is advanced one character in case new data have not reached the printer within approximately 0.7 ms. When printing is to continue the printer is first reversed one character prior to print start. This is put into prac-

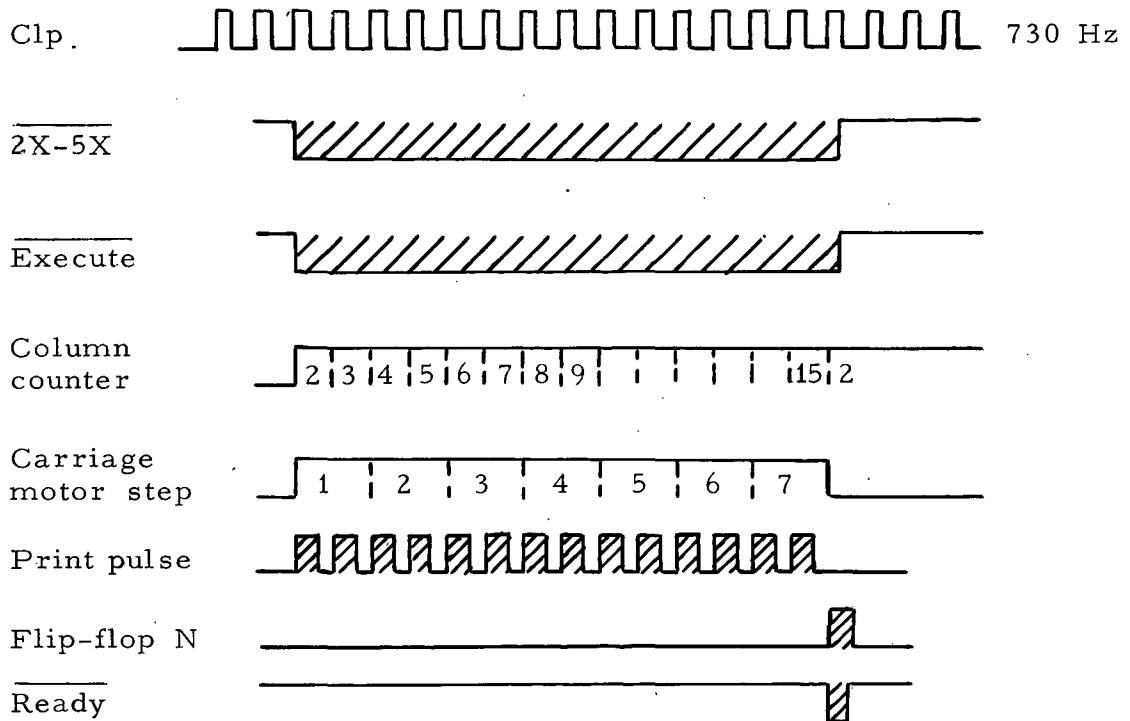


Figure 2.2:1 One character print

tice as indicated on figure 2.2:2. The print head is moved backwards two character positions by two back-spacing (BS) commands and then moved onwards by one space command (SP2), all generated in the printer when a print command 2X-5X is applied.

The function Last character visible, starts if the pulses One character scanned, cease for more than 0.7 ms, because then the monostable flip-flop H will return to zero and via a derivating circuit delivers to the flip-flop K a trigger pulse of appr. 0.2 ms duration, if there is no new command 2X-5X or 08.

When the flip-flop K is set the following will happen, see figure 2.2:3:

- The decoder will decode 8_{10} because the only high level input is 2^3 . The signal SP1 allows the Clp to advance the pulse generator for carriage control and the column counter in such a way that the print head moves one character and executes a space.
- No print pulse will be obtained. It is inhibited by the signal Visible.
- When the column counter reaches the position 15_{10} , the signal One character scanned sets the flip-flop L to prepare for back-spacing.

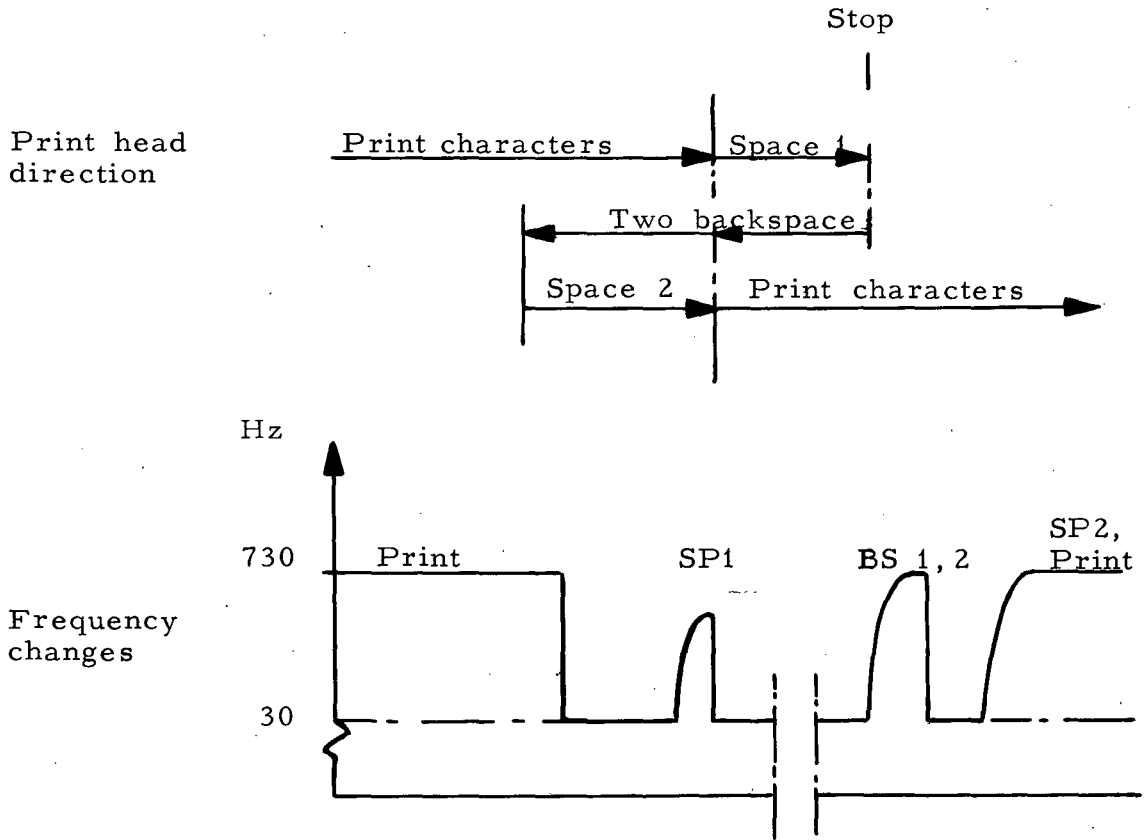


Figure 2.2:2 Last character visible function

- The subsequent character to print out delivers the command $2X-5X$, and the decoder delivers 2_{10} , since now 2_1 is the only high level input. The signal BS permits the Clp to count down the pulse generator for carriage control, so that the print head moves one character to the left.
- The carry signal from the column counter produces the pulse One character scanned, that sets the flip-flop M and resets the flip-flop L.
- The signal decoded will be 1_{10} that starts a new backspacing. When the print head has moved, the pulse One character scanned sets again the flip-flop L, and the decoded signal this time will be $3_{10} = SP2$.
- The signal SP2 advances the print head one space to the right so that the head now is in the correct position to continue printing.

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- When the receipt pulse of the last space, the pulse One character scanned, arrives, the flip-flop K will be reset, and the command 2X-5X (=4₁₀) is delivered by the decoder.

Note. If the print command 2X-5X arrives when the first space is in progress, the decoder changes from 8₁₀ (=SP1) into 0₁₀ (=SP1), and the printer completes the space. Then the printer executes the usual two back spaces and the space before it can print the incoming character.

The function Last character visible can easily be disconnected by a service technician if the capacitor in the derivating circuit is removed.

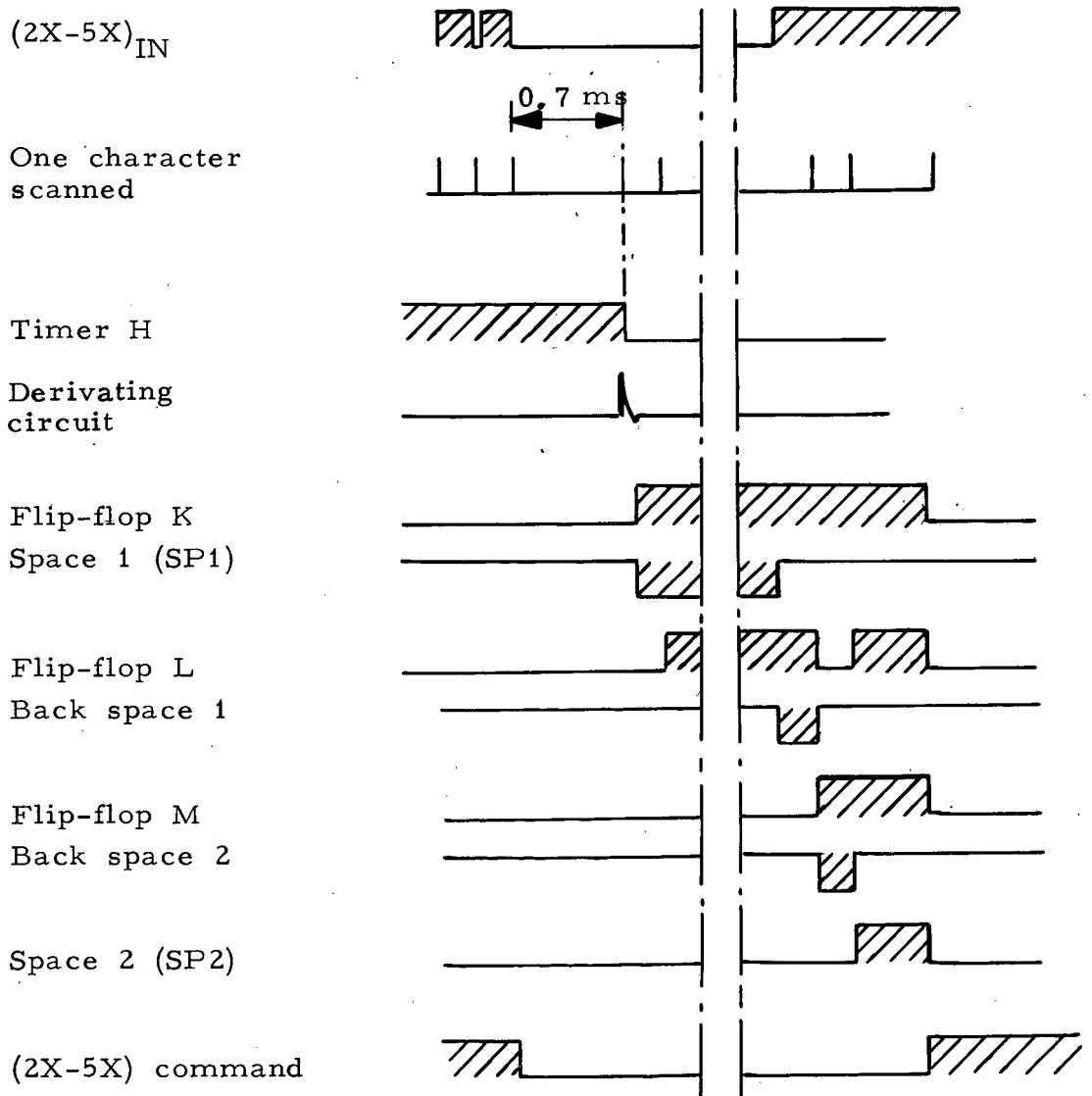


Figure 2.2:3 Last character visible timing



- Ribbon control

The ribbon is reversible and changes direction automatically when reaching an end position. Each of the two ribbon spools is driven by a separate stepper motor which is controlled by a pulse generator on the ribbon control board.

This pulse generator too consists in principle of a reversible Johnson counter. The counter is stepped by bit 2^1 from the column counter, i.e. in every other column in the character pattern. The counting direction is determined by the position of the ribbon switch, that is controlled by an end rivet at each end of the ribbon. In the switch position shown in Appendix 2.2:1 the Johnson counter is stepped in such a way that the ribbon is carried to the right.

Hence, the left-hand motor drives the ribbon supply reel and the right-hand motor drives the ribbon take-up reel. Each motor is provided with windings which through drivers are fed with pulse trains being 90° out of phase with one another. It should be noted that the pulse train to the right-hand motor has a frequency which is four times higher than the frequency of the pulse train to the left-hand motor. The reason is to ensure that the ribbon is always kept well stretched.

When the ribbon switch is in the other position, i.e. when the ribbon is to be driven to the left, the phases of the pulse trains to the windings of the motor are changed. The frequency relationship is also reversed. The higher frequency will now be fed to the left-hand motor.

The ribbon is also advanced at carriage return. See parts 2.2.5 and 2.2.6.

2.2.5 Carriage return command

- General

The command Carriage return, 0D, implies that the carriage with the print head must be moved to the home position at the extreme left. Normally this command follows immediately after a Print character command, which means that the direction of the carriage must be reversed. Instead of moving at high speed to the right the carriage must now move to the left.

- Frequency control

The fact that the carriage direction has to be reversed means that the frequency must be returned to 30 Hz before the acceleration towards 1450 Hz begins. This return of the frequency to 30 Hz is brought about by the flip-flop E, that ensures the passing of at least one Clp before the clock pulse generator is allowed to register the signal 0D.



The possibility of retarding the frequency from 1450 Hz to 730 Hz, which originally arose for reasons explained previously, is also exploited for braking of the carriage when it approaches the home position. The braking takes place within the retardation range defined by the distance where LCD and UCD indicate off and on respectively. See figure 2.2:4.

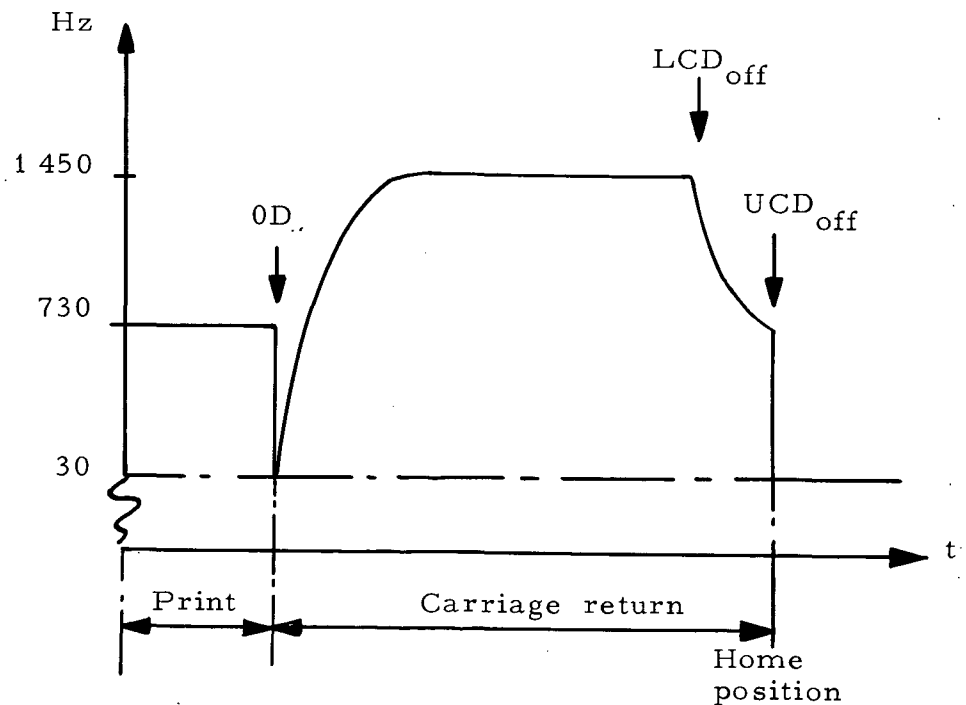


Figure 2.2:4 Carriage return frequency control

- Carriage control

The pulse generator for carriage control, a Johnson counter is now stepped in a direction that causes the carriage to be moved to the left. The phase of the output signals, to the carriage motor drivers is therefore reversed in comparison with the relationship at printing. The Ready signal is generated almost immediately as the command 0D is decoded and the flip-flop O is set. The Ready signal from the flip-flop A causes the Execute signal to cease with the result that the flip-flop A is reset and the signal 0D from the decoder is blocked, however, the command 0D is still present because of the flip-flop O. This flip-flop will remain set until the carriage has reached the home position where the LCD and the UCD are in off-position and reset the flip-flop.



When the carriage return is in progress the printer can execute line feed and prepare the printing of the next character. See figure 2.2:5.

- Ribbon control

The printer ribbon as well is advanced at Carriage return commands. The aim is to get the wear as even as possible. The pulse generator for the ribbon control, a Johnson counter, is now stepped by a signal obtained by dividing the Clp frequency by eight. As a result the printer ribbon is advanced at about the same speed as during printing.

2.2.6 Back-spacing command

- General

The command Back-spacing, 08, implies that the carriage with the print head has to be moved to the left a distance corresponding to the width of one character. Normally this command follows direct after a Print character command, which means that the carriage direction must be reversed.

- Frequency control

As is always the case when the carriage direction has to be reversed the frequency must be reduced to 30 Hz prior to start accelerating, in this case towards 730 Hz. The return to the frequency of 30 Hz is now ensured by the flip-flop E that prevents the generator from registering the signal 08 until at least one Clp has passed.

- Carriage control

The carriage motor is controlled in the same manner as during the Carriage return commands.

- Ready signal generation

The column counter is used here to decide when the carriage has been moved the desired distance. i.e. when the Ready signal shall be delivered. In a similar way as during the function Last character visible, triggering of the monostable flip-flop F is prevented, implying that the magnets of the print head are unaffected. The Ready signal is delivered when the column counter leaves the state 15_{10} . The normal sequence then commences: the Execute signal ceases, the flip-flop A is reset and the signal 08 is blocked.

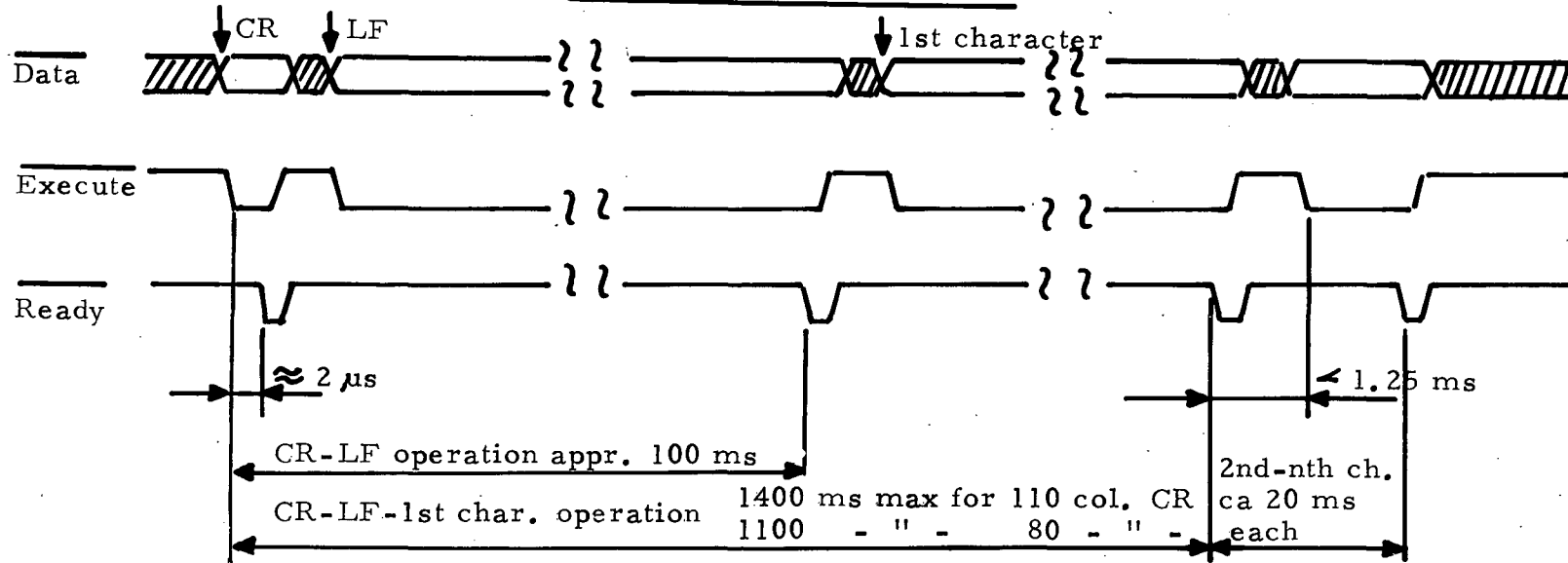
2.2.7 Line feed command

- Command from interface

The command Line feed, 0A, means that the paper must be advanced a distance corresponding to the line spacing

PHILIPS

CR - LF TIMING DIAGRAM



CHARACTERWISE OUTPUT

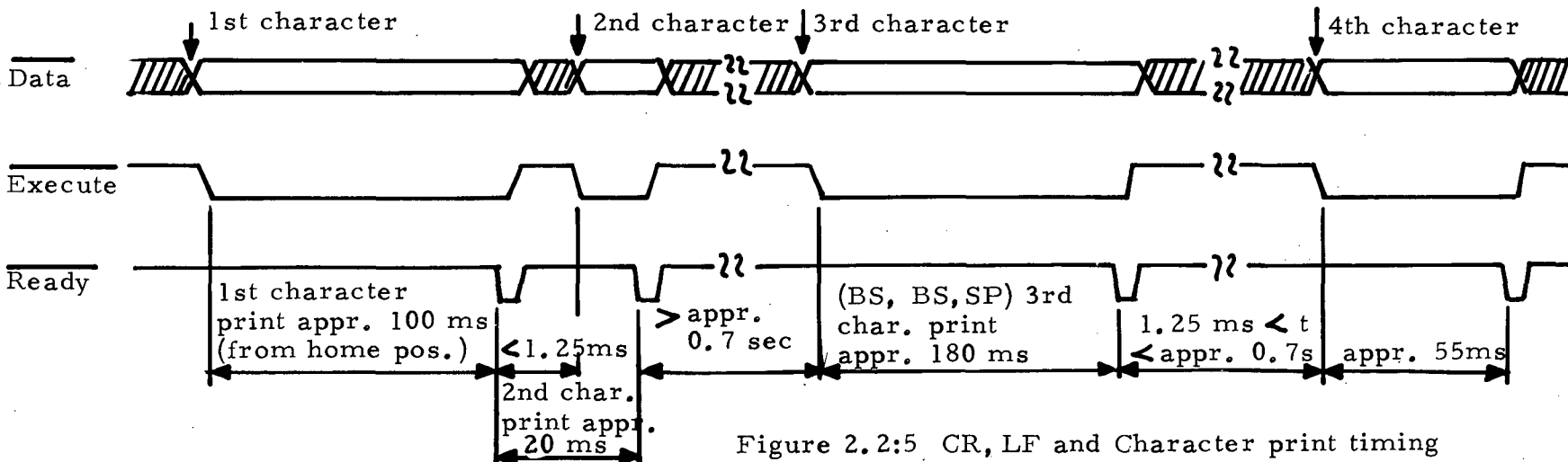


Figure 2.2:5 CR, LF and Character print timing



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chosen. The signal 0A gates pulses with a frequency of 160 Hz from a line feed clock pulse generator into the pulse generator for line feed control, a Johnson counter. Each of the four phase signals from this counter is fed, through a driver, to a separate winding on the platen motor which is a stepper motor. It is possible, with the Line space selection switch, to select 1, 1.5 or 2 line spaces by pre-setting the counter to 8, 4 or 0, each time the Execute signal ceases.

If one line space has been selected, the counter is set to 8, and after eight clock pulses, i.e. after appr. 50 ms, the motor has advanced the paper a distance that corresponds to the smallest line spacing selectable, which in the standard design is 1/6 of an inch. At this instant the counter generates a carry signal, that creates the Ready signal. The carry signal also sets the flip-flop G, which reloads the counter to the selected space value. If on the other hand the line spacing was set to 1.5 or 2, the Ready signal would not be generated before 12 and 16 clock pulses resp.

As on all the other occasions the Ready signal causes the Execute signal to cease, the flip-flop A to be reset and the signal 0A to be blocked. See figure 2.2:5.

- Manual command

Forward paper feeding can take place also on a command from the manual line feed key. This results in the same function as during the command 0A, with the exception that no Ready signal is generated. It should be noted that the manual command will be blocked if a command with an accompanying Execute signal reaches the printer. The line feed will now go on as long as the flip-flop B is held set by the line feed key. When the key is released, the flip-flop B can be reset by the carry signal.

2.2.8 Form feed command

- General

The command Form feed, 0C, advances the paper until the subsequent form is detected. The form detector is an exchangeable mechanical assembly that can easily be adjusted to the start position of the form. The assembly is described in 2.4.3.

The form feed is an option, and in case the mechanical assembly is not mounted, the paper will advance 1/12" if the command 0C is delivered.

- Function

The signal 0C gates the clock pulses to the pulse generator for line feed, that steps the platen motor. This line feed



will continue until the assembly in the vertical form control has reached its home position, where the flip-flop P can be set by the clock pulse. The output from the flip-flop P is gated with the bits 2^0 and 2^1 from the line feed Johnson counter, i.e. a Ready signal can be delivered with the accuracy of $1/12''$, which is the same value as one step of the motor.

The Ready signal causes the Execute signal to cease, and the command 0C will be blocked.

2.2.9 BEL command

The command BEL, 07, triggers a monostable flip-flop (Q) that delivers a signal with a duration of appr. 0.1 s to the mechanical bell assembly. This assembly can be activated also by the End of Line signal, produced when the print head carriage reaches the adjustable End of Line marker and causes the UCD to indicate off. If a BEL signal is wanted, the End of Line signal must pass a strap on the interface board.

A Ready signal will immediately be produced when the command 07 is decoded.

The mechanical bell unit is an option.

2.2.10 Dummy codes

The codes 00-06, 09, 0B, 0E, 0F, 1X, 6X and 7X are so-called dummy codes.

The feeding out of any of these codes results in an immediate Ready signal, without anything happening.



2.2.11 Motor Drivers

- General

The printer includes stepper motors for the driving of:

- the print head carriage (Philips PD 18)
- the platen (Philips ID 05)
- the ink ribbons (Philips 9904 111 07431)

The drive stages for the carriage motor and the platen motor are mounted on the logic board A, and the drive stages for the two ink ribbon control motors are mounted on a specific board called the Ink ribbon control board.

- Stepper Motor Principles

The position assumed by the shaft of a stepper motor depends upon the relationship between a number of magnetic poles on its stator assembly and a number of magnetic poles on its rotor. Since the latter is a permanent magnet, the poles are fixed. The stator assembly, however, comprises two or more stators, each having a coil through which current is passed to form a magnet. By reversing the direction of current flowing in a coil, therefore, the north and south poles can be transposed. Reversing the current-flow through successive stator coils creates a rotating magnetic field which the permanent-magnet rotor follows. The speed of rotation is thus governed by the rate at which the stator coils (and hence the magnetic poles) are switched and the direction of rotation by the actual switching sequence.

There are two methods by which the current-flow through stator coils can be reversed and this has led to two classes of stepper motor: those designed for uni-polar drive and those for bi-polar drive.

For ease of description, illustrations in this section which give a diagrammatic representation of a stepper motor show only a 2-pole rotor although it could have as many as 24. The operating principles, however, are the same.

● Motors for uni-polar drive

Each stator coil of a motor designed for uni-polar drive is provided with a centre-tap which is connected to one side of the supply, say, the positive. The direction of current flowing through a coil is then determined by the end to which the negative supply line is connected via a switching device. Switching coil-halves results in the magnetic poles of the relevant stator being reversed.



2-stator motors (4-phase)

Figure 2.2:6 (a) shows a 4-phase stepper motor in which phases P and R are energized: the rotor assumes the position indicated. If switch S1 is now operated (phases Q and R energized), the conditions illustrated in Figure 2.2:6 (b) obtain, i.e. the rotor has moved through 90 degrees. From this it can be seen that by operating switches S1 and S2 alternately, the rotor can be made to rotate in 90° steps. The direction of rotation can be reversed by altering the switching sequence.

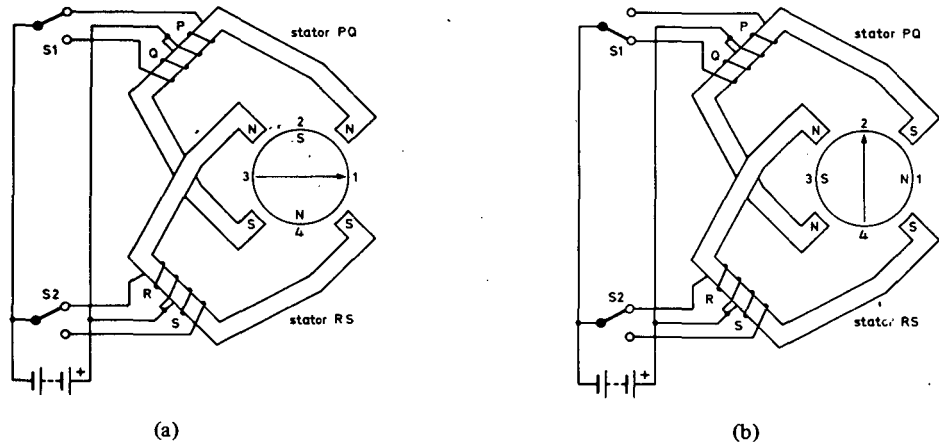


Figure 2.2:6 The 4-phase, 2-pole motor for uni-polar drive

- Motors for bi-polar drive

The stator coils of a motor designed for bi-polar drive have no centre-tap. Instead of using alternate coil-halves to produce a reversal of current-flow through the stator windings (as for uni-polar drive), the current is now reversed through the entire coil by switching both supply lines. Operation of a motor with bi-polar drive is identical to that of one with uni-polar drive.

2-stator motors (2-phase)

Operation of a 2-phase motor with bi-polar drive is illustrated in Figure 2.2:7.

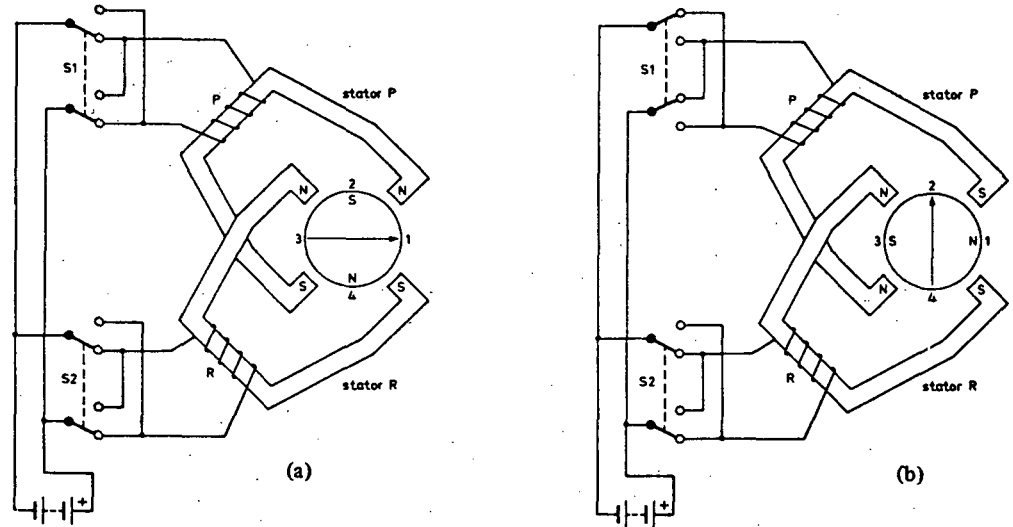


Figure 2.2:7 The 2-phase, 2-pole motor for bi-polar drive

- Carriage Motor Drive

The drive stages for the carriage motor are designed in a somewhat unusual manner, as far as stepper motor drive is concerned.

The stepper motor PD 18 is equipped with a 4-phase stator and a permanent-magnet rotor with 24 poles. The four stator windings of the motor are connected in two parallel pairs, with the object of achieving a higher speed than otherwise possible. The motor drive is coupled as in a bi-polar drive system with an electronic switch, known as a bi-polar constant current drive (BCCD). The BCCD-unit converts the incoming control pulses into the requisite current reversals through successive stator coils, supplying them from a 36 V source which employs a chopper circuit. This ensures that the current through a stator coil reaches its maximum value in the shortest possible time, maintains that value irrespective of opposing currents generated by the rotor and reduces the power consumption of the overall system.

Figure 2.2:8 shows a basic constant current bi-polar drive circuit for one stator coil. Transistors TR1-TR4 perform the bi-polar switching function for a stator coil L and correct sequential switching of a number of these circuits, to provide "step-wise" rotation of the motor in either direction, is controlled by the logic circuit. If TR1 and TR4 are conducting (TR2 and TR3 off), conventional current-flow through the stator coil is from 1 to 2 (Figure 2.2:8), if TR2 and TR3 are conducting (TR1 and TR4 off), it is in the opposite direction, i.e. from 2 to 1.

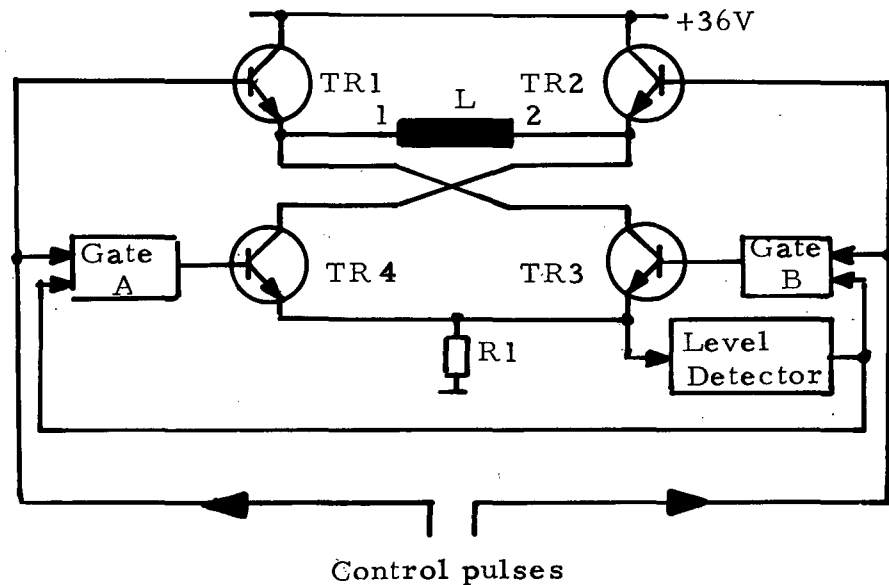


Figure 2.2:8 Basic constant current bi-polar drive circuit for one stator coil

When TR1 and TR4 are switched on by the control logic, current starts to flow and quickly increases exponentially through resistor R1, transistor TR1, stator coil L and transistor TR4. On reaching a predetermined maximum permissible value, the voltage developed across R1 causes the level detector to operate. The output from the level detector is fed to gate A and this switches off TR4 as soon as that value is reached. At this moment, the energy stored in the magnetic field of the stator coil maintains a temporarily increasing voltage across the coil and an exponential fall in current results through the circuit R1, TR1, L and diode D2, reducing the voltage across R1. When a predetermined minimum value is reached, the level detector causes TR4 to conduct again and this action continues for as long as the logic circuit demands the conduction of TR1 and TR4. The resultant current-flow is shown in Figure 2.2:9.

A similar action occurs when the control logic demands the conduction of TR2 and TR3 but, in this case, TR3 is being switched by gate B.

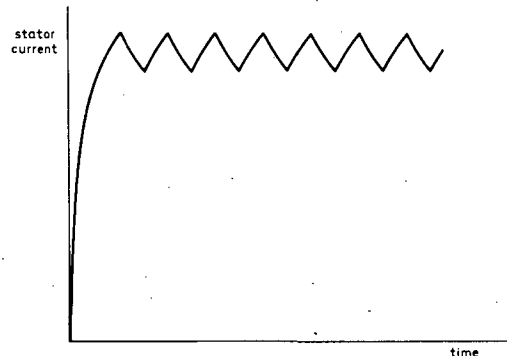


Figure 2.2:9 Current rise-time and flow using BCCD

- Platen Motor Drive

The stepper motor ID 05 includes a 4-phase stator and a 24-pole permanent-magnet rotor.

The motor has a conventional uni-polar drive, containing darlington transistors. This motor drive is not that complex as the carriage motor drive.

The only specific feature with the platen motor drive is that the stator windings, when the motor is in the non-running state, are fed with a weak excitation current over a series resistance. In doing so the platen is held absolutely stationary during the printing procedure, resulting in straight text lines.

When the motor has to be advanced for line feed or form feed, the series resistance is short-circuited by a transistor, and the entire excitation voltage is applied to the windings.

- Ink Ribbon Drive

For the ribbon drive there are two 110 V reversible synchronous motors, connected to a 36 V source and driven as stepper motors by pulse trains which mutually are phase displaced 90° . As a consequence of the low voltage the motors are weaker than normally, but the force is sufficient for moving the ribbon. The ribbon is stretched by feeding the motors with pulse trains of different frequency. The pulling motor is fed with a higher frequency than the other, slightly braking, motor:

The direction of rotation of the motors is altered by changing the phase displacement of the pulse trains 180° .

The drive stages are built up of transistors which are switched from TTL-circuits.



2.3 Power Supply

2.3.1 General

The printer PTS 3100 accommodates its own power supply, and it is provided with a 3-wire power cable. When power is switched on and when power is regained after a power failure, the electronics will be reset in such a way that no erroneous functions or characters are generated.

- Power requirements

Voltage: 100, 110, 200, 220, 240 $\pm 10\%$
single phase, switchable from the inside (by a service technician)

Frequency: 50 Hz $\pm 2\%$
(As option 60 Hz $\pm 2\%$)

Consumption: 100 VA, average

- DC Power sources

+36 V $\pm 10\%$, 2 A	For the stepper motors
+ 5 V $\pm 2\%$, 3 A	For the integrated circuit logics
-12 V $\pm 5\%$, 0.5 A	For the read only memories

The following DC power sources are available for the interface boards:

+36 V $\pm 10\%$, 0.2 A
+ 5 V $\pm 2\%$, 1.7 A
-12 V $\pm 5\%$, 0.4 A

- Function

The power supply equipment is placed on the rear wall of the printer. It contains three fuses, one for each power source. When a fuse is to be exchanged, the upper rear cover must first be removed.

The power source for +5 V is regulated in order to get a sufficient accuracy for the integrated circuits. The output is provided with a zener diode, used to protect the circuits against over-voltages. See figure 2.3:1.

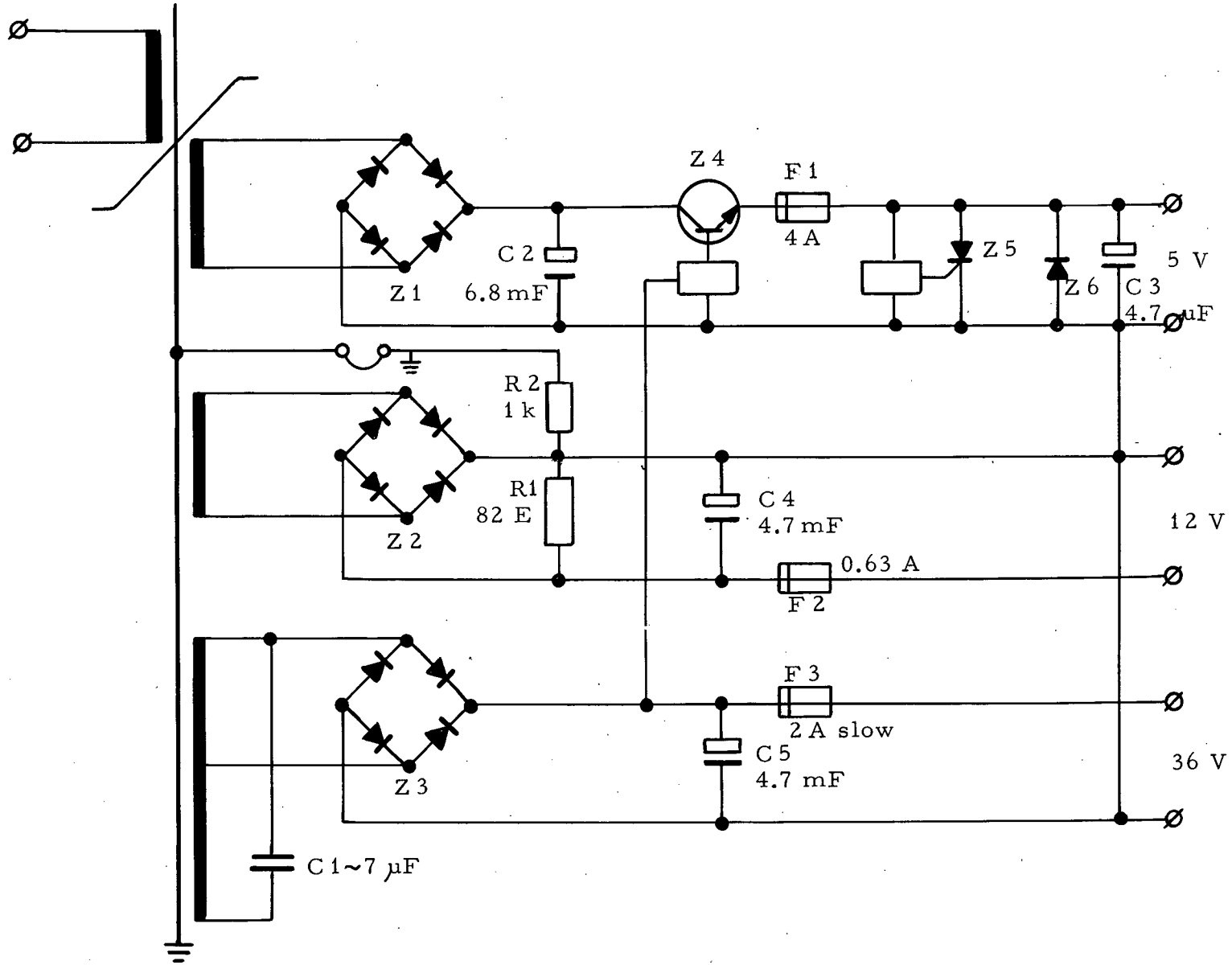
The voltages -12 V and +36 V are not regulated because this is unnecessary. R1 is a bleeder, a load resistance, to limit the voltage, since the normal current consumption from -12 V for the read only memory is inconsiderable.

R2 is used as an equipotential connection between protective earthing and signal earthing, at the same time separating them.

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220 V
50 Hz

Figure 2.3:1 The power supply



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2.3.2 Power faults

A specific circuit has been designed for the generation of a pulse system reset, **Master Clear (MCL)**, resetting the flip-flops and the registers when power is switched on or disappears that long that the function of the printer will be affected.

This MCL-pulse is delivered also to the interface board and to a relay that indicates that the printer is "Operable" in case the power is on, paper loaded and the Ready switch is set. See figure 2.3:2

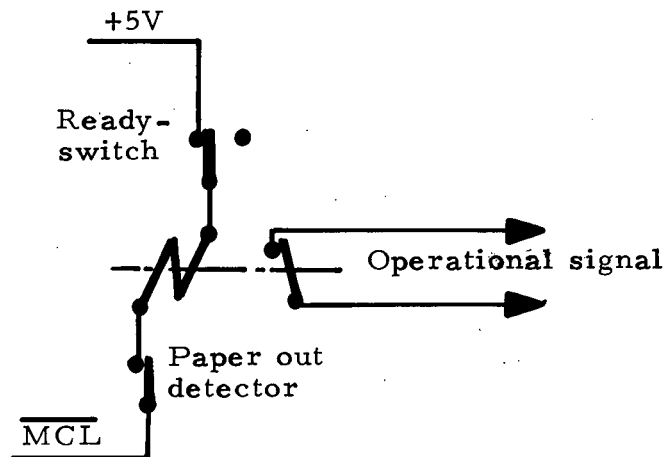


Figure 2.3:2 Printer operable Relay

- Function

The MCL-circuit consists of an amplifier, a timer and a schmitt-trigger. The schmitt-trigger can be activated either when power is switched on and a 150 ms MCL -pulse is generated while the capacitor, connected to the input, is charged, or when the monostable flip-flop R is triggered by the amplifier.

The amplifier output goes low if the voltage +5 V drops more than 0.7 V, the forward voltage drop of a diode, for more than 2-3 μ s. This will trigger the flip-flop R which will then generate a 25 ms MCL-pulse. See figure 2.3:3 and appendix 2.2:1

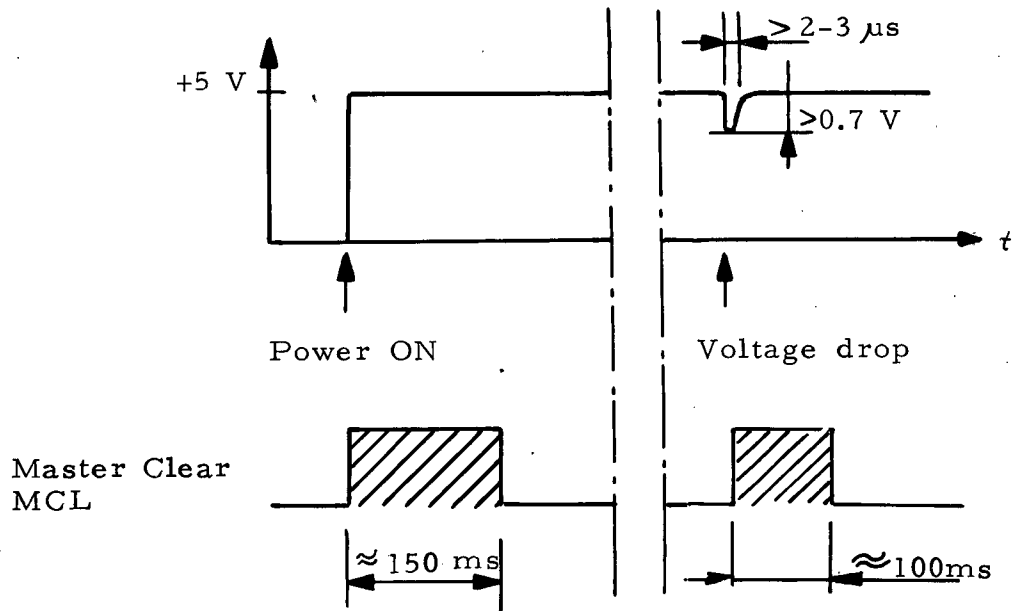


Figure 2.3:3 Reset pulse at power fault

2.3.3 Changing over mains voltage

The PTS 3100 is as standard delivered with the Power Supply internal strapped for connection to 220 V mains voltage.

However, it is possible to change over to mains voltage as shown in figure 2.3:4

This will be done on the connector P2, located closed to the Power ON switch. To get access to P2 the rear cover has to be removed



PRINTER REAR

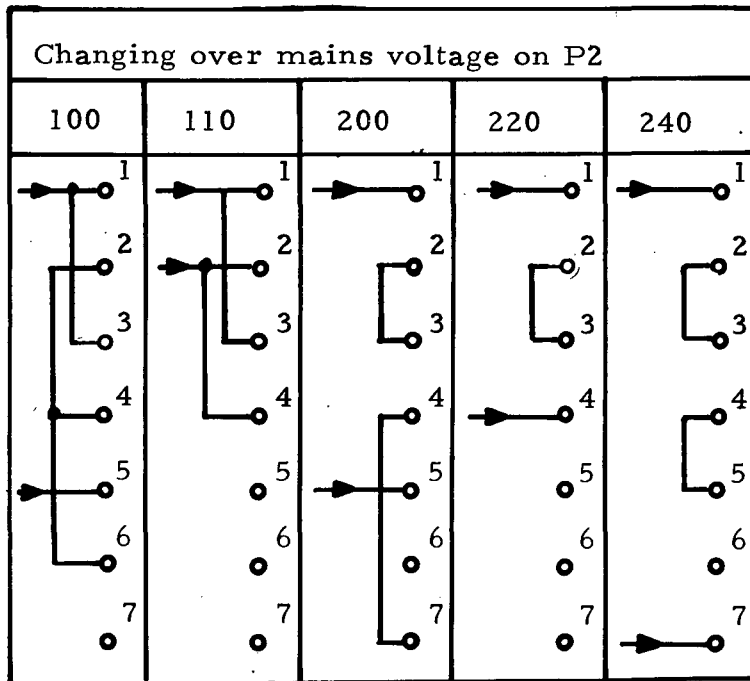
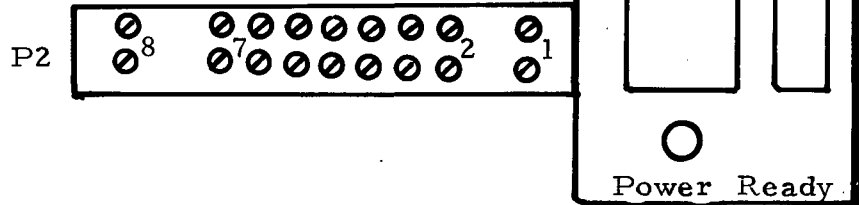


Figure 2.3: 4 Changing over mains voltage.

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2.4 Options

2.4.1 Platens

The printer PTS 3100 can be provide with platens of three different length and they are supplied with peg-feed as well as friction-feed assembly. (See 1.4.1)

The friction feed roolers are housed in the tear off bar and can be attached to the paper by turning a screw on the bar.

2.4.2 Character set

The printer is provided with an exchangeable character generator (ROM) that stores the 64 different characters. Furthermore, another and smaller character generator (ROM) can be supplied. This read only memory stores up to seven national characters in the positions 2/3, 2/4, 4/0 5/B, 5/C, 5/D, 5/E. In this case the corresponding positions of the larger character generator must be cleared. In most of the cases an exchange of this smaller character generator is sufficient to satisfy different needs from the customers.

- Basic ISO character set

In this character set the seven national characters are cleared. See figure 2.4:1. This set is intended to be used together with a character generator for the national characters.

- Special Swedish character set

This character set is shown in figure 2.4:2.

- 7 characters generator

In connection with the Basic ISO-7 character generator a 7 characters generator (PROM), it is possible to generate codes for special Swedish and Danish characters and also to get an unprogrammed memory to generate wanted characters. See figure 2.4:3.

2.4.3 Form feed mechanical assembly

An exchangeable disc, mounted on a gearwheel driven by the platenmotor, handles the form feed detection. See figure 2.4:4.



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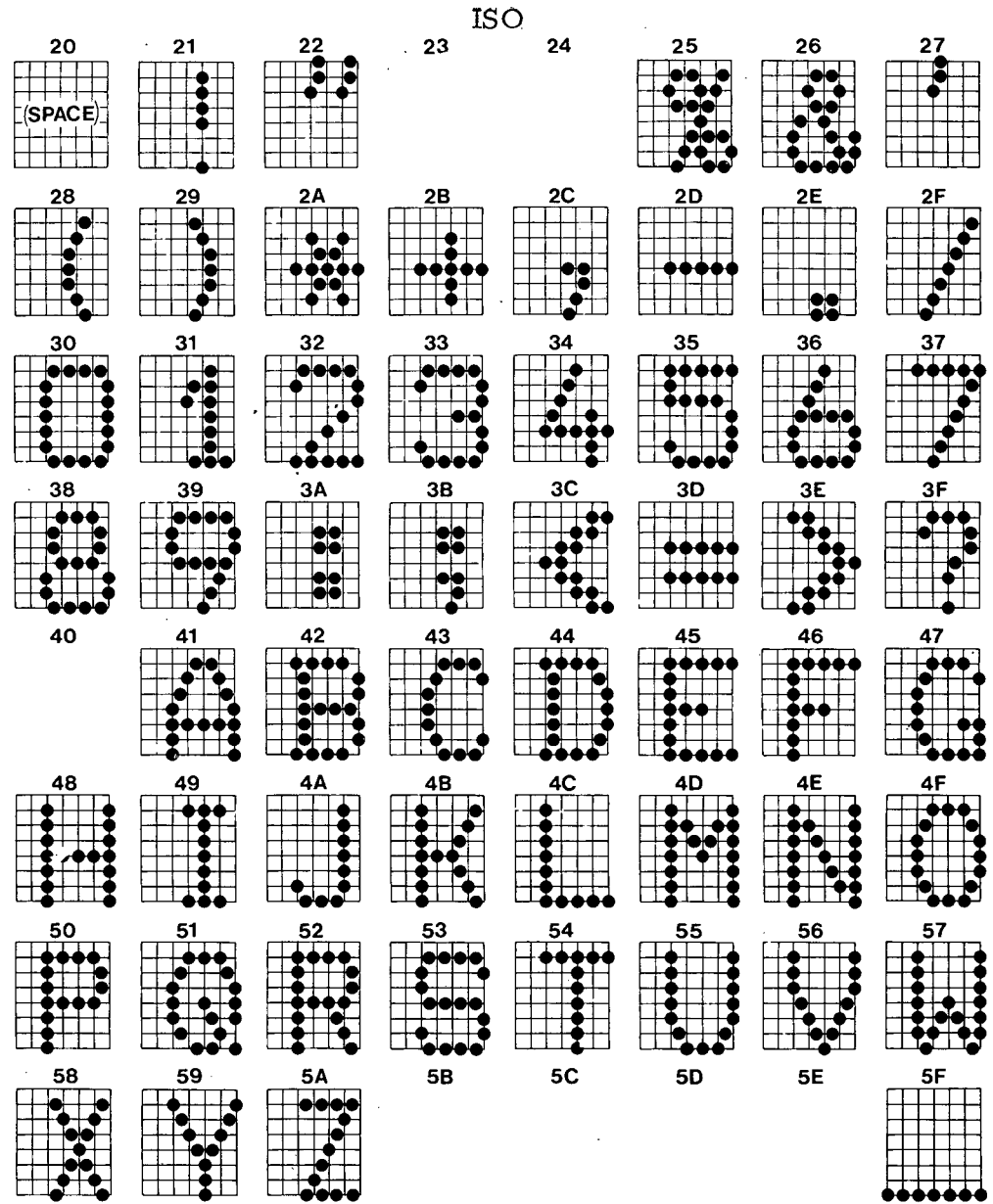
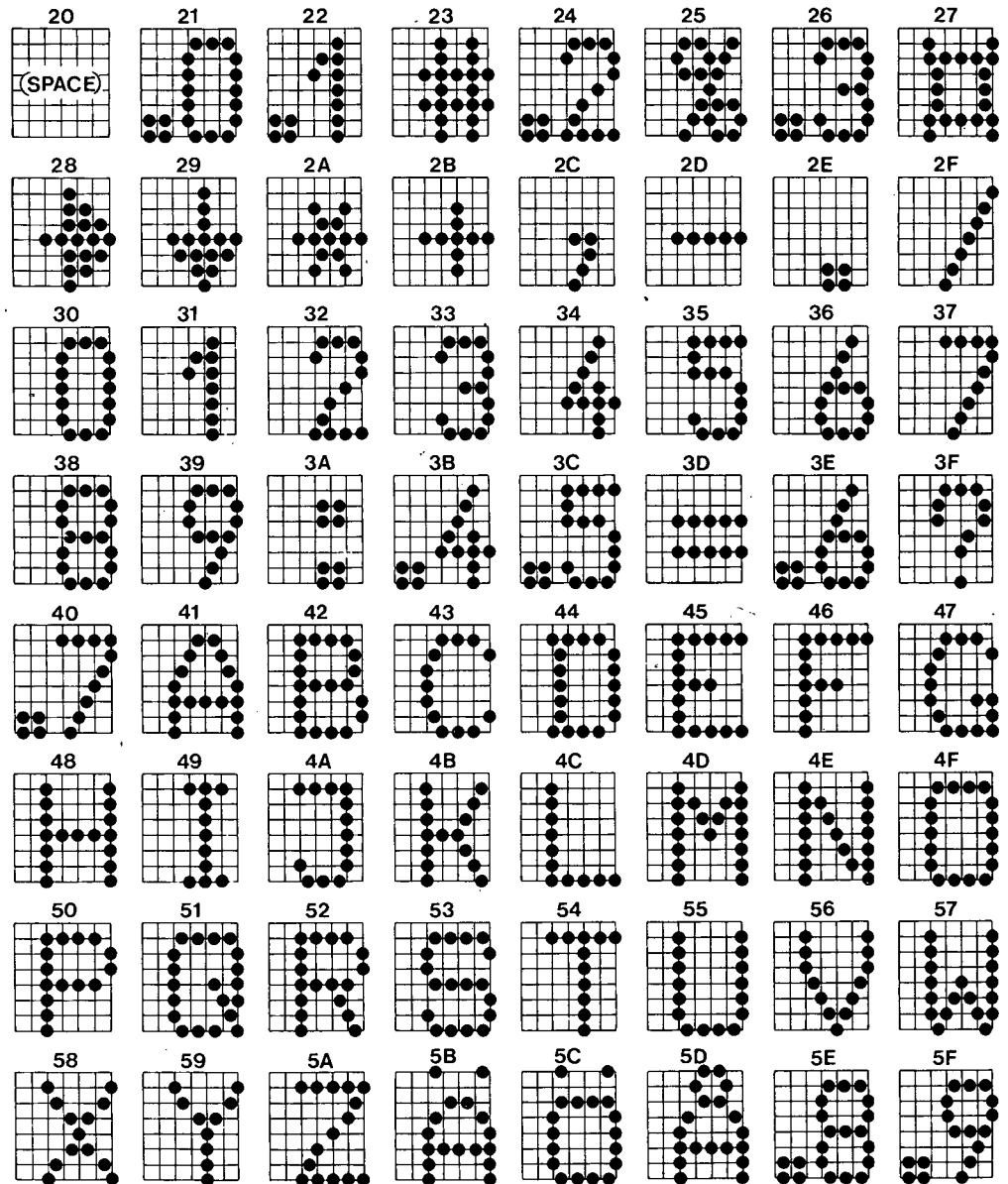


Figure 2.4:1 The basic ISO Character set



SWEDISH SPECIAL



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Figure 2.4:2 The special Swedish character set



Layout of 7 character - PROM in connection with PTS 3142-001

Typenumber	Character/position in the ISO-7 code table							12 NC-code
	2/3	2/4	4/0	5/B	5/C	5/D	5/E	
PTS 3142-002								ZES 9332 365 20112
PTS 3142-011	Ä	Å	Ö	(₁)	\ ₁)	]₁)	^	ZES 5131 101 05001
PTS 3142-012	Æ	À	Ø	(₁)	\ ₁)	]₁)	^	ZES 5131 101 01870

Notes

1) Keytops for these characters are not existing on

PTS 3151-012/-013 and PTS 3152-012/-013.

Figure 2.4:3 7 character generators

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Figure 2.4:4 Form feed assembly



At paper loading the operator shall turn the platen to feed paper and simultaneously depress the spring arm on the form feed assembly. The platen will then be driven until the form feed can make an optional switch to signal "top of form" and switch off a lamp to indicate the home position. With the form feed spring still depressed the paper shall be fed until the tear initiation just has passed the cutting bar. The form feed feature is now working until a paper exchange is made.

VFC-settings from 3.0 to 12.5" will be available in steps of 1/2". Change from one VFC-length into another is performed by exchanging mechanical parts. This operation is accomplished by a service technician.

When a VFC is ordered the parts delivered are adapted to 11.5" forms.

2.4.4 Bell assembly

In order to get an acoustic output from the BEL-signal a bell can be included. The bell can be used also to get an acoustic signal from End of Line.

2.4.5 Mains frequency

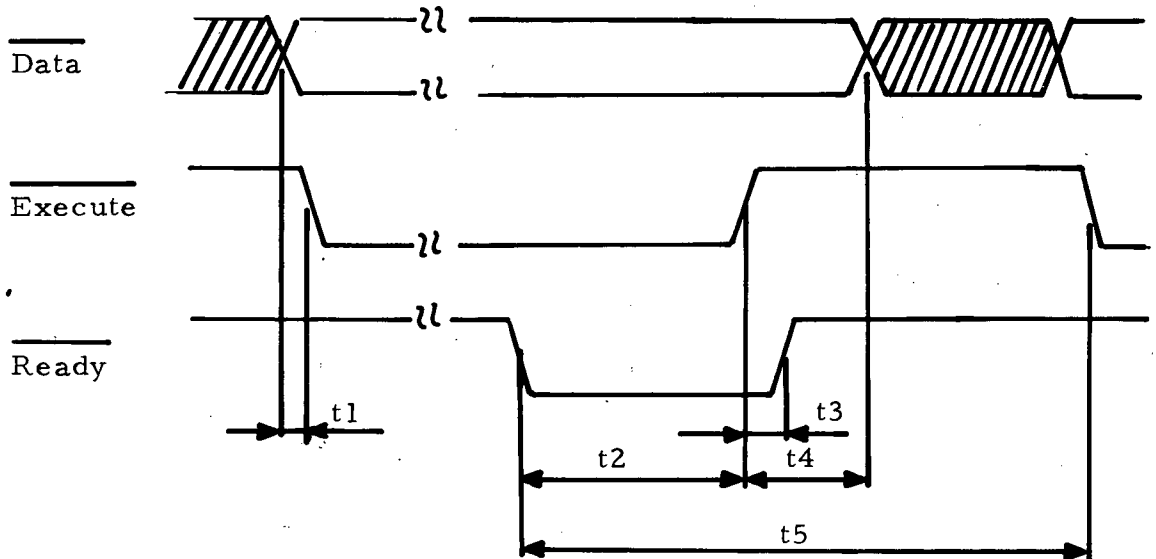
The printer is as standard provided with a power supply equipment for connection to the mains frequency 50 Hz $\pm 2\%$.

If the printer has to be connected to a mains frequency of 60 Hz the power supply equipment must be exchanged.

2.4.6 Interface

The printer can be provided with different kinds of interfaces and in chapter 4 "Line Interfaces" are the interfaces, designed by PTS for CCITT-V24 and KSR 33 teletype, described.

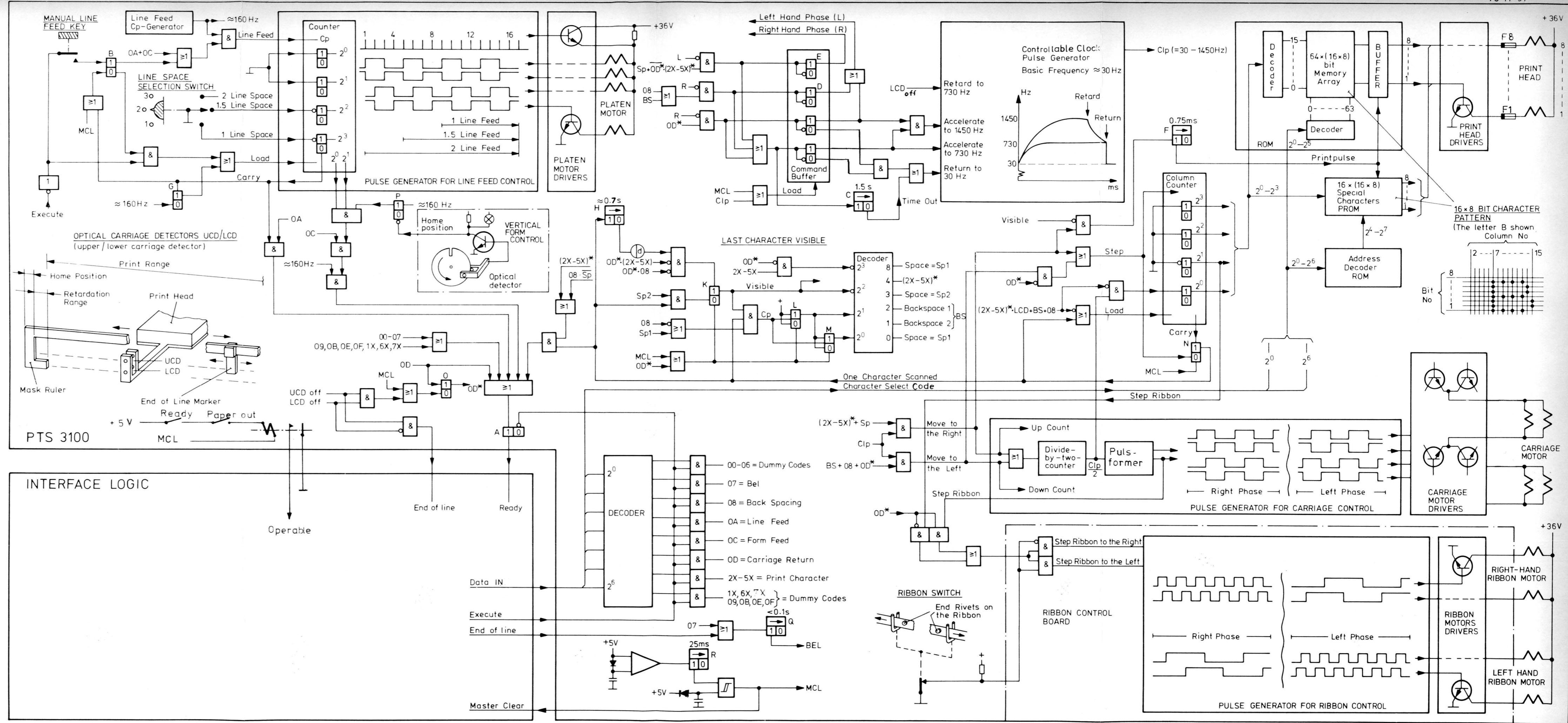
However, if a user of PTS 3100 printer likes to do his own interface, he has to consider the timing necessity as shown in figure 2.4:5.



- $0 < t1 > 0$
- $t2 < 500 \mu s$
- $t3 \text{ approx } 2 \mu s$
- $t4 \geq 5 \mu s$
- $t5 < 1.25 \text{ ms for max speed during printing}$

Note Special characters may start in column 2 of the character pattern(see appendix 2.3:1) but then the time t5 must not exceed 40 μs .

Figure 2.4:5 Printer logic interface, timing diagram



PTS 3100

INTERFACE LOGIC

PTS 3100 Printer logic Appendix 2.2:1



3

KEYBOARD

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3.1 General

3.1.1 Connection

Normally the keyboard is connected to the printer PTS 3100 by screwing the units together to form one assembly. The connectors of the two units are thereby connected to each other.

The keyboard and the printer can also be placed separated from one another. The connection is then established with a cable, the length of which may be 3 meters between the keyboard and its interface. The cable is plugged into the appropriate connectors.

The keyboard delivers for each key depression the actual key code which is transmitted in serial form to the interface board of the printer. Dependent on the construction of the interface, the signals can be carried on from the interface to a computer, through the line to which the printer is connected. See figure 3.1:1.

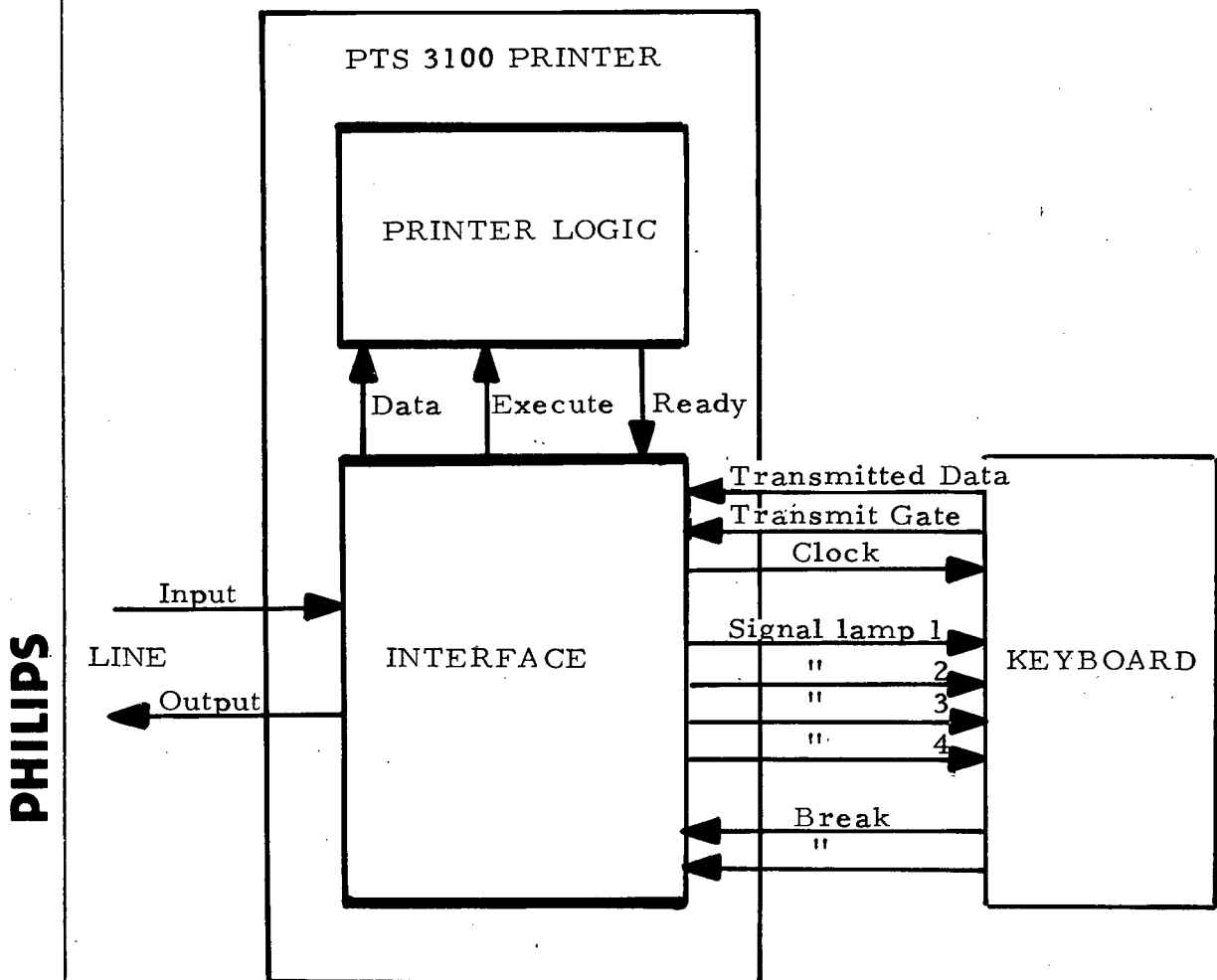


Figure 3.1:1 Keyboard connections

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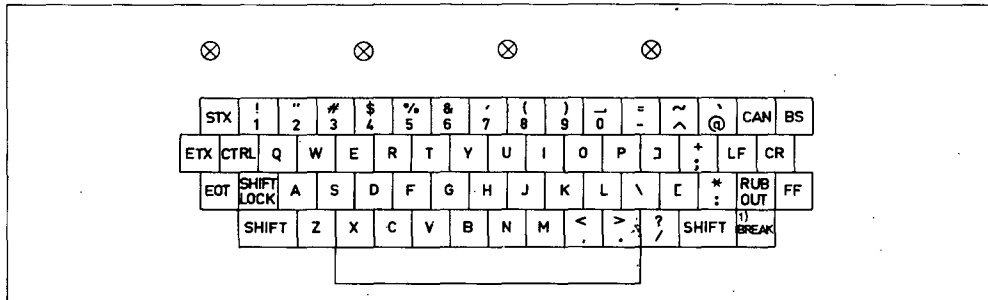
Data from the keyboard can also be connected directly to the printer logic through the interface board.

3.1.2 Keyboard Layout

In standard design the keyboard is composed in accordance with the ECMA 23C standard, version 1, without a 10-key group. The keyboard designation is then PTS 3150-001, see figure 3.1:2.

On the keyboard there are also four indicating lamps of the light emitting diode type. The lamps are activated from the interface board. The text for the lamps is adapted to the requirements of the customers. It is easily replaced.

Note. The keytops are exchangeable and they can have different symbols and because of that they are optional



1) When Break is activated a closure is made between two pins in the keyboard connector

Figure 3.1:2 ECMA 23C standard keyboard layout for teletype control keys



3.2 Keyboard PTS 3150-001

3.2.1 Mechanical Constuction

The keyboard is mounted in a case and the appearance is shown in figure 3.2:1

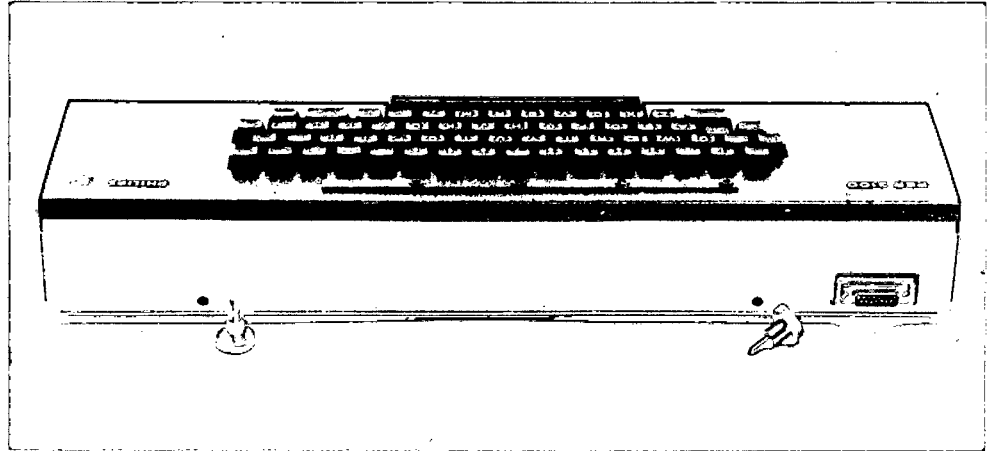


Figure 3.2:1 The appearance of keyboard PTS 3150

The width of the keyboard equals that of the printer PTS 3100.

Two large knurled screws accessible through the bottom plate are used for attaching the keyboard to the printer. The keyboard case can be removed after the unscrewing of four large screws underneath. In doing so the entire keyboard panel with keys and electronic board is released.

The keys are depressed through square holes in the panel whereby they will be hanging in their own collars.

The keys are soldered direct on a printed board which is attached to the panel with screws running through distance tubes. Another printed board, on which the light emitting diodes are soldered, is attached with screws under the panel.

The key tops with symbols can easily be pressed on to the keys, and they are easily removable.

3.2.2 Application Adaption

As standard the keyboard is equipped with 61 keys. See figure 3.1:2. The function and the marking of the keys may, however, vary from one application to the other. In order to move the key function within the keyboard an integrated circuit, a Programmable Read Only Memory (PROM) which



code converts the desired functions, is inserted.

As option the number of keys can be varied. The maximum number of keys to be connected is 90 pcs.

Each key may, in principle, activate four functions which are selected by means of the key marked CTRL (control) and one of the three parallel-connected keys marked Shift.

The keys are connected to the junctions in a 9-row by 10-column matrix. At the depressing of a key a communication between a row and a column is brought about. The position of the keys in the matrix determines their identity code.

The code is obtained from a decoder consisting of a Read Only Memory (ROM) that is scanned by a scanner. The scanner halts on the address that corresponds to the position of the key in the matrix.

3.2.3 Electronical design

The keyboard electronics is built-up on a printed board. The main part of the electronics consists of one integrated circuit that produces the keyboard decoding. See Appendix 3.2:1.

The integrated circuit (IC) is a 40-pin Dual-in-line package containing:

- a 3600-bit Read Only Memory (ROM),
- a scanner consisting of a 9-step and a 10-step ring counter, which scans the key matrix and states the corresponding address in the Read Only Memory,
- a 10-bit comparer,
- a timing circuit with an external network to eliminate the effect of contact bounces,
- a 90-bit memory for storing of the position of a decoded key, for n key roll-over operation,
- a clock oscillator the frequency of which can be controlled by an external RC-circuit,
- an output data buffer,
- output drivers,
- a mode decoder.

In addition to this 40-pin integrated circuit the following are housed on the electronics board:

- a 12-bit data out buffer which converts from parallel into serial data, out of which 11 bits are used,
- a counter generating a gate pulse for the transmission of 9 bits,



- two flip-flops for the control of the buffer and the counter.

As options the following circuits can be included. The circuits are to be inserted in prepared locations.

- clock pulse generator, if clock pulses are missing from the interface board,
- a key code converter, if key functions are to be changed,
- a parity generator for generating parity bit when key code converter is used.

Note. The key code converter location is in standard supplied with a dummyplug

3.2.4 Function, Key Decoding

The ROM-portion in the keyboard decoder, see Appendix 3.2:1, is arranged in four groups, each of 90 pcs 10-bit words.

The groups are selected by the control and shift keys which are decoded in a mode decoder. From this decoder one of the following four signals is obtained:

$\bar{S} \cdot \bar{C}$ = N = Normal mode
 $S \cdot \bar{C}$ = S = Shift mode
 $\bar{S} \cdot C$ = C = Control mode
 $S \cdot C$ = SC = Shift control

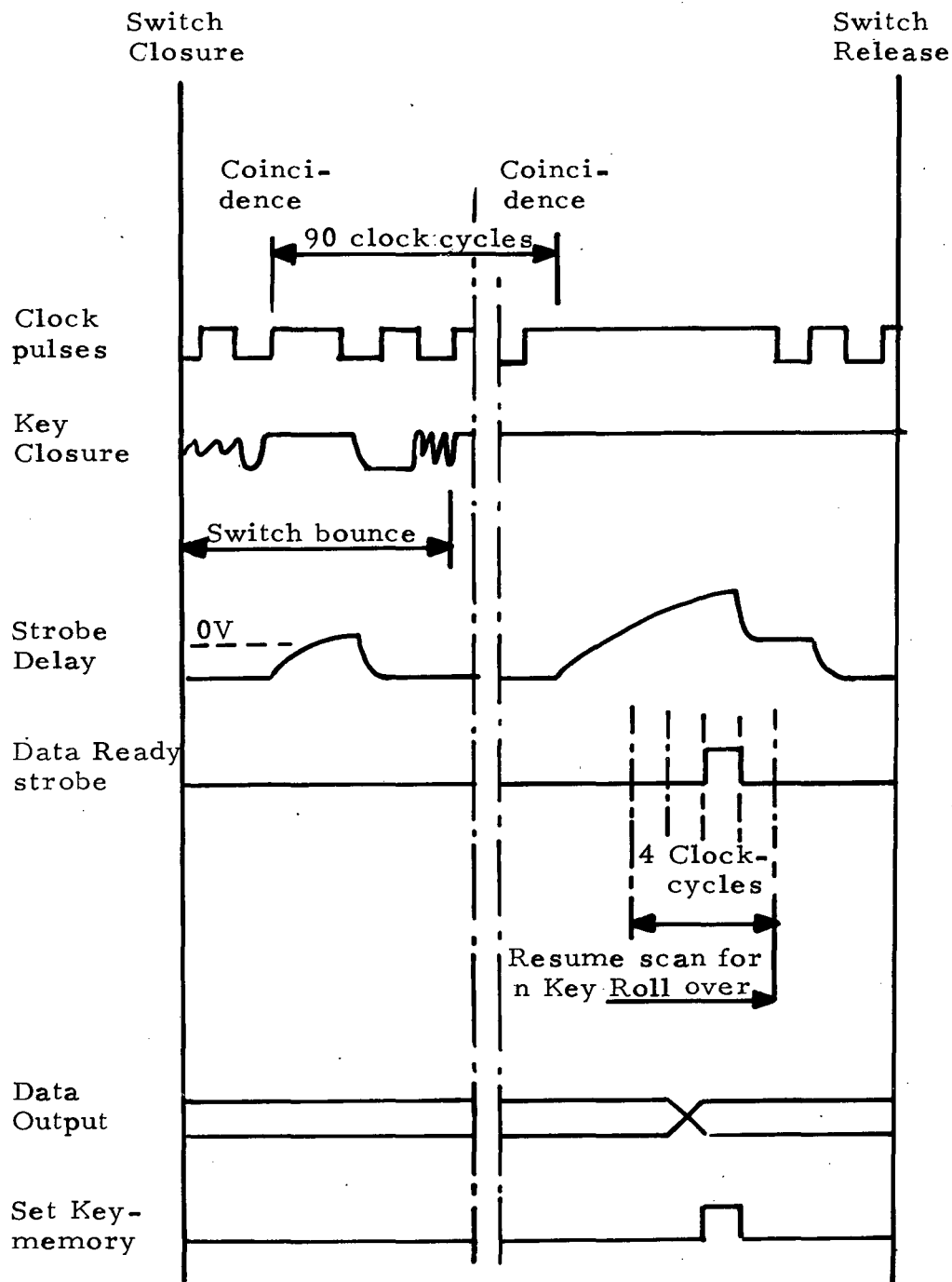
Shift will be obtained if one of the three parallel keys, left-hand, right-hand or shift lock, is activated.

The locations in the memory of the 90 individual words are addressed by the two ring counters, i.e. the ROM-address is formed by the combination of shift and control input with the two counters

The external outputs from the 9-step counter are connected to the X-wires in an X-Y matrix where the keys are connected to the junctions.

In the idle state, with no key depressed, the two ring counters are advanced by clock pulses from an internal 50 kHz oscillator in the package. The counters state the ROM-addresses in sequence simultaneously as the X-Y matrix is scanned for key closure.

Upon depression of a key a communication is established from an X-wire to an Y-wire. This communication is taken to a 10-bit comparer. After a number of clock cycles the position of the counters is such that a signal passes from the 9-step counter, through the key, to the comparer input that corresponds with the position of the 10-step counter. Thereby the signal Coincidence is obtained, the scanner halts and the timing circuit starts. See figure 3.2:2.



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Figure 3.2:2 Key decoding



The timing circuit delays setting of the key code in the output buffer until the contact bounce has ceased and the signal from the key has been lying still that long that the external capacitor (Cd) in the delay network has been charged. During clock cycles after setting in to output buffer Data Ready strobe is obtained. Simultaneously a "1" is set into the 90-bit Decoded key memory remembering that a key is decoded. Thereafter the scanning commences again but as long as the same key is kept depressed the coincidence signal is unable to affect the timing circuit because an inhibiting signal arrives from the Decoded key memory. This signal makes it clear that the key is already decoded.

If coincidence occurs for any other key the procedure will be repeated and the code of this key will be set in the output buffer. The code for the last decoded key remains in the output buffer.

3.2.5 N Key Roll-Over Function

N key roll-over means that the signal from a key, being depressed and held depressed, can be transferred only once from the keyboard. If the key is maintained in depressed position, simultaneously another key is depressed, the signal from the latter key will be transferred. Consequently, if several keys are held depressed the signals from these will be transferred, however only once, in the order in which they are scanned by the scanner.

The reason for the signals being transferred just once is the 90-bit Decoded key memory. This memory is in reality a shift register that remembers the depression of a key last time the shift register was in that position, therefore the transfer of the signal from this key will be prevented to be repeated until the shift register has circulated one turn and the bit in the position concerned has been reset owing to the fact that the key was not depressed during this turn.

3.2.6 Function, data transfer

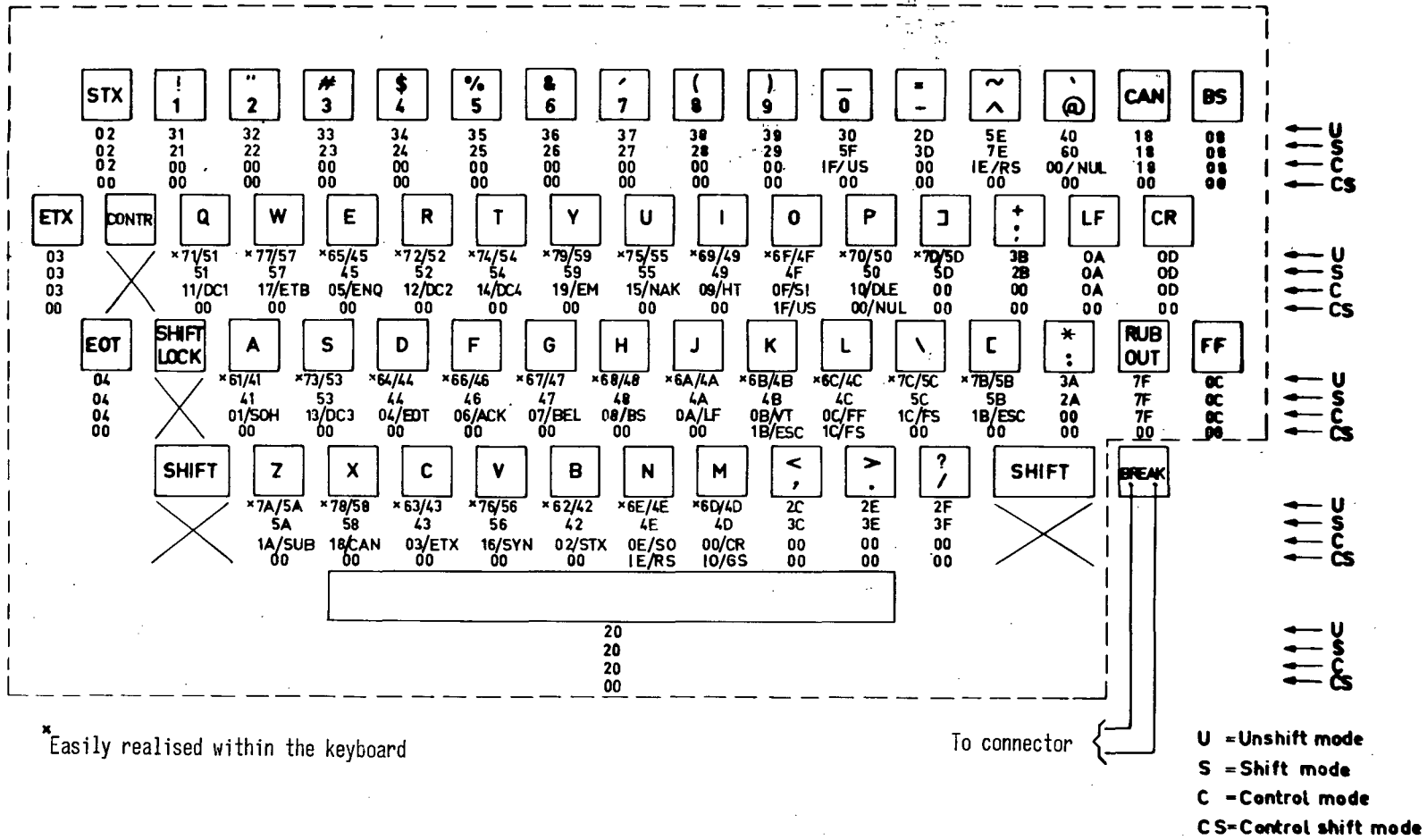
The Data Ready strobe sets the key code from the output data buffer through output drivers in the data out buffer. At the same time the flip-flop A is set.

The code being set in the data out buffer consists of eight data bits, the eighth of which is an even parity bit. See Figure 3.2:3. The data bit 2^5 is obtained from the output drivers in the shape of two signals called $2^5 I$ and $2^5 II$.

In the standard layout the signal $2^5 II$ is used at which the code for the upper case letters is achieved, no matter whether it is the normal or the shift mode.

The signal $2^5 I$ is an option. See 3.3.3.

Figure 3.2:3 Keyboard codes





At the same time as the key code is set in the data out buffer it is supplemented by a low level start bit and two high level stop bits. See Appendix 3.2:1.

The flip-flop A opens the transistor V1 that short-circuits the capacitor Cd to the chassis, thereby closing the timing circuit until the key code has been transferred to the interface board in the printer and the flip-flop A is reset.

The flip-flop A sets also the flip-flop B. This latter flip-flop initiates stepping of a 16-step Transmit bit counter, which starts from the position 610. Start-bit and the 8-bit are decoded in a gate and a Transmit gate pulse is transmitted to the interface board. Simultaneously the flip-flop B opens up for serial shift of data from the data out buffer, through the line Transmitted Data, to the interface board. Thus, data are transferred in serial form along with a gate pulse to the interface board, without awaiting an answer from the board.

The bit output takes place in step with clock pulses (Cp) from the interface board. If such pulses are not available a clock pulse generator, an option, can be inserted on the keyboard board. See 3.3.5.

When the Transmit bit counter arrives at the position 1610, a carry signal is obtained. This signal resets the flip-flops A and B. Thereby the transistor V1 is cut-off and the timing circuit locking ceases. The subsequent key code can then be stored in the output data buffer.

3.2.7 Power Supply

The keyboard has no power supply and fuses of its own. The power supply is obtained from the printer, that delivers the voltages:

- + 5 V 0.4 A
- -12 V 0.1 A

3.2.8 Master Clear

At turning on the power, or at power failure of a duration that can jeopardize the function of the printer, the signal Master Clear will be delivered by the printer.

This signal is a pulse which at power on has a duration of about 150 ms and at a power failure a duration of about 100ms. It resets the flip-flops A and B.

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3.3 Options

3.3.1 Changing the Character Codes

The character codes can be changed by the insertion of a specific IC-package for code conversion of the characters. This package is inserted on a prepared location which usually is supplied with a dummyplug.

At the insertion of this package the data bit 2^5I is used. In order to transmit the data bit to the data out buffer a strapping marked C must be altered.

To get the correct parity a parity generator must be added on another, prepared location. Furthermore the strapping D must be altered.

The data bit 2^5I can be used also in the absence of these packages. It is then possible, by means of the shift keys, to shift between upper case and lower case letters.

3.3.2 Changing Key-Tops

The key-tops are exchangeable. However, when a key-top with a certain engraved symbol is replaced by a top with another symbol the previous code for the key remains, unless code conversion is accomplished in accordance with 2.3.3.

Not used keys can be furnished with dummy plugs which are unable to activate.

3.3.3 Internal Clock Generator

When external clock pulses are lacking from the interface an IC-package can be inserted on a prepared location in order to bring about a clock pulse generator. This generator then delivers pulses to the keyboard and to the interface, provided that two strapings, E and F, are altered.

Frequencies can be selected within the interval 50 Hz - 100 kHz. The clock pulses are edged-up by schmitt-triggers



3.3.4 Changing Key-Tops

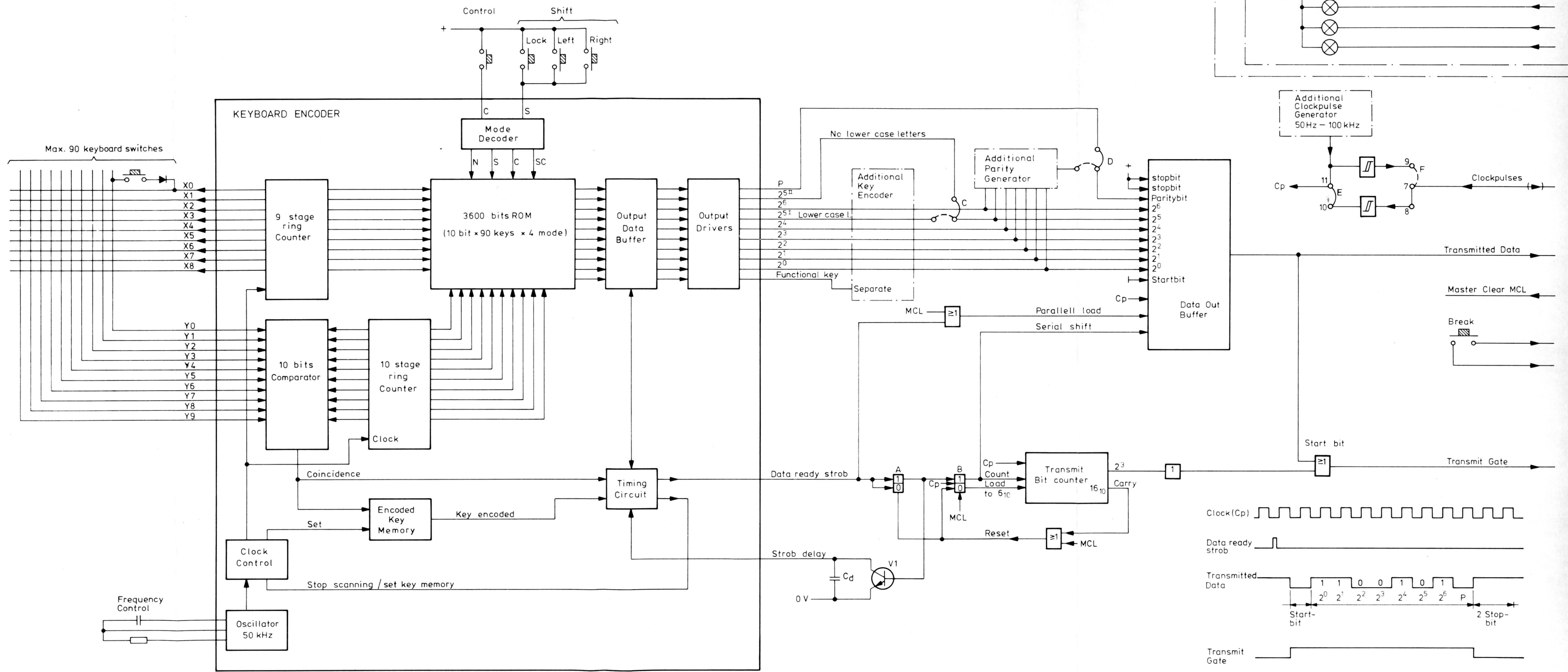
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4.1 Line Interfaces, brief description

4.1.1 General

The task of an interface is to adapt incoming line signals to the internal logic signals required to operate the printer.

Standard interface boards are to be available to enable easy adaptation of the printer into existing systems.

Individual interfacing is also possible, using the available board connectors and specially designed boards and in this manner the printer may be adapted to suit the requirements of any specific system.

The interface can be located outside the printer in a closed placed control unit or in a computer, and in such a case a dummy card, that connects the input line connector to the printer logic, must be inserted in the interface connector I.

4.1.2 KSR 33 Interface

The purpose of the KSR 33 interface is to adapt the printer in such a manner that it is able to directly replace an operator teletype equipment.

As such the printer may be used without a keyboard as a receive only device, or with a keyboard as a send/receive device.

Input and output levels are at standard teletypewriter levels and the keyboard, when fitted, is handled via the interface at TTL-logic levels.

The interface can be adapted to transfer speeds from 50 to 600 baud. In two or four wire operation.

No response is given from the interface but it has a FI/FO-register that can store 16 8-bits character, and if the transfer speed is higher than the printing speed idle characters must be fed out to the interface.

The interface also contents input/output channels for V24 level adaptation.



4.1.3 Send/Receive Character Confirmation S/R CC (V24)

The purpose of this interface is to adapt the printer control and response logic in such a manner that it is able to be handled by a control unit operating to CCITT-V24 unbuffered interface specification.

The interface logic is also designed to handle the printer keyboard input when a keyboard is fitted, and thus allows the printer to be used as a send/receive device or as a receive only device.

The interface accepts and transmits data at selectable line transfer speeds between 110 and 9600 baud.

The interface contains no buffer but it accepts one 8 bits character while the printer is executing the one before.

For each character transferred to the interface, a receipt is given back, but the interface is also able to be used without response if output of characters do not exceed the printing speed. Otherwise idle characters must be fed out to the interface.

4.1.4 DUMMY Interface board

The purpose of this interface is to provide the direct links between the printer, the keyboard, and the line via the standard wiring at the respective connectors.

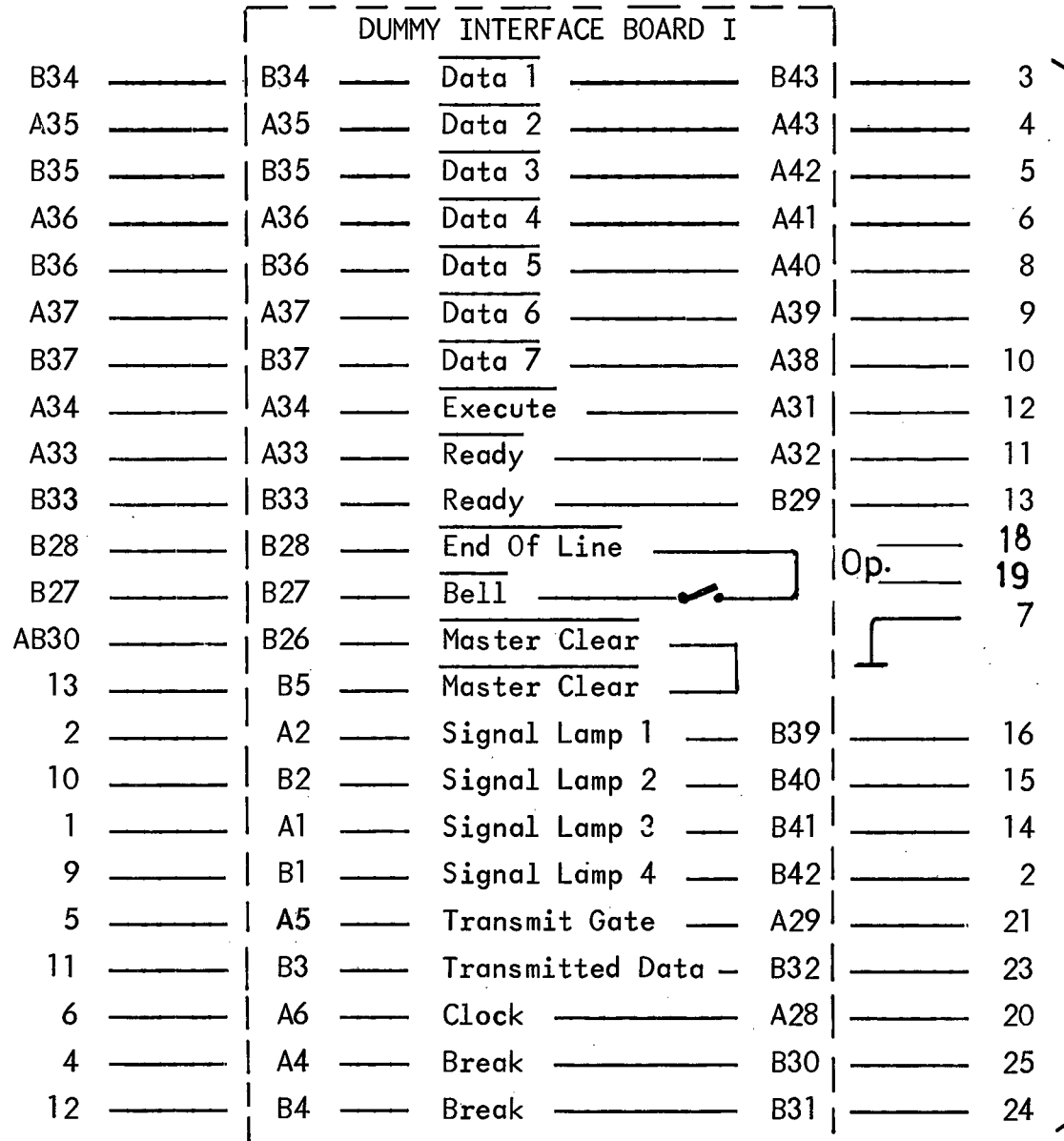
When the DUMMY Interface board is used the controlling logic, outside the printer, must be able to handle the serial output from the keyboard, if one is fitted, and provide the necessary parallel interface signals to operate the printer directly from the line connections.

The interface board is inserted into interface position I (J2) in the printer, that is directly along side, and to the left of the printer logic board.

Figure 4.1:1 shows the direct links on the DUMMY interface board and the standard wiring connections to the printer logic, line, and keyboard connectors.

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Figure 4.1:1
Printer Logic
Connector J1
Pin Connections
Dummy Interface



Line Connector
Pin Connections

Keyboard
Connector
Pin Connections



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4

LINE INTERFACES

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4.2 KSR 33 Interface

4.2.1 General

The teletype interface KSR 33 is built up on a printed board that is inserted in a connector beside the standard board in the printer PTS 3100.

The task of the interface board is to convert serial information from a 2-wire or a 4-wire communication into parallel information for the printer. See figure 4.2:1.

The interface is of the non-acknowledging type, with a buffer accommodating sixteen 8-bit characters (128 bits) and with so called FIFO-function, i.e. First IN-First OUT function. The buffer is divided into one IN-buffer and one OUT-buffer, into which input and output of data are carried out asynchronously, i.e. data are read into the buffer and fed out from the output buffer at different speeds. The transfer of characters between the buffers is effected in the intervals between the printing of characters.

Data from the keyboard are carried through this board to the line, or, if the switch marked LINE, OFF, LOCAL, is placed in position LOCAL, the key code is taken direct to the printer for printing.

4.2.2 Transfer Principle

The data transmission is asynchronous and the transfer rate between 50 and 600 baud (50, 110, 150, 300, 600 baud). Each character is divided into 11 bits, see figure 4.2:2.

At normal outputs to the printer consideration must be taken to the transmission speed. If this speed exceeds the printing speed of the printer, idle characters (NUL) must be fed out after every carriage return (CR) and line feed (LF). In addition, the CR character must always be fed out before eventual LF- or FF characters. (FF = Form Feed.)

- Transmission speed 50-110 baud:

The capacity of the printer is greater than that of all CR and LF combinations. The character buffer is sufficient for all characters during CR, LF. At FF idle characters must, in general, be delivered if the feeding exceeds ca 45 mm. The number of idle characters (NUL) is dependent on the size of the form.

- Transmission speed 150-300 baud:

At normal printings the capacity of the printer is greater than that of the line. At short lines (many CR, LF), the capacity of the line is, however, greater. In order to be sure not to lose information, idle characters ought to be inserted in accordance with the following table.

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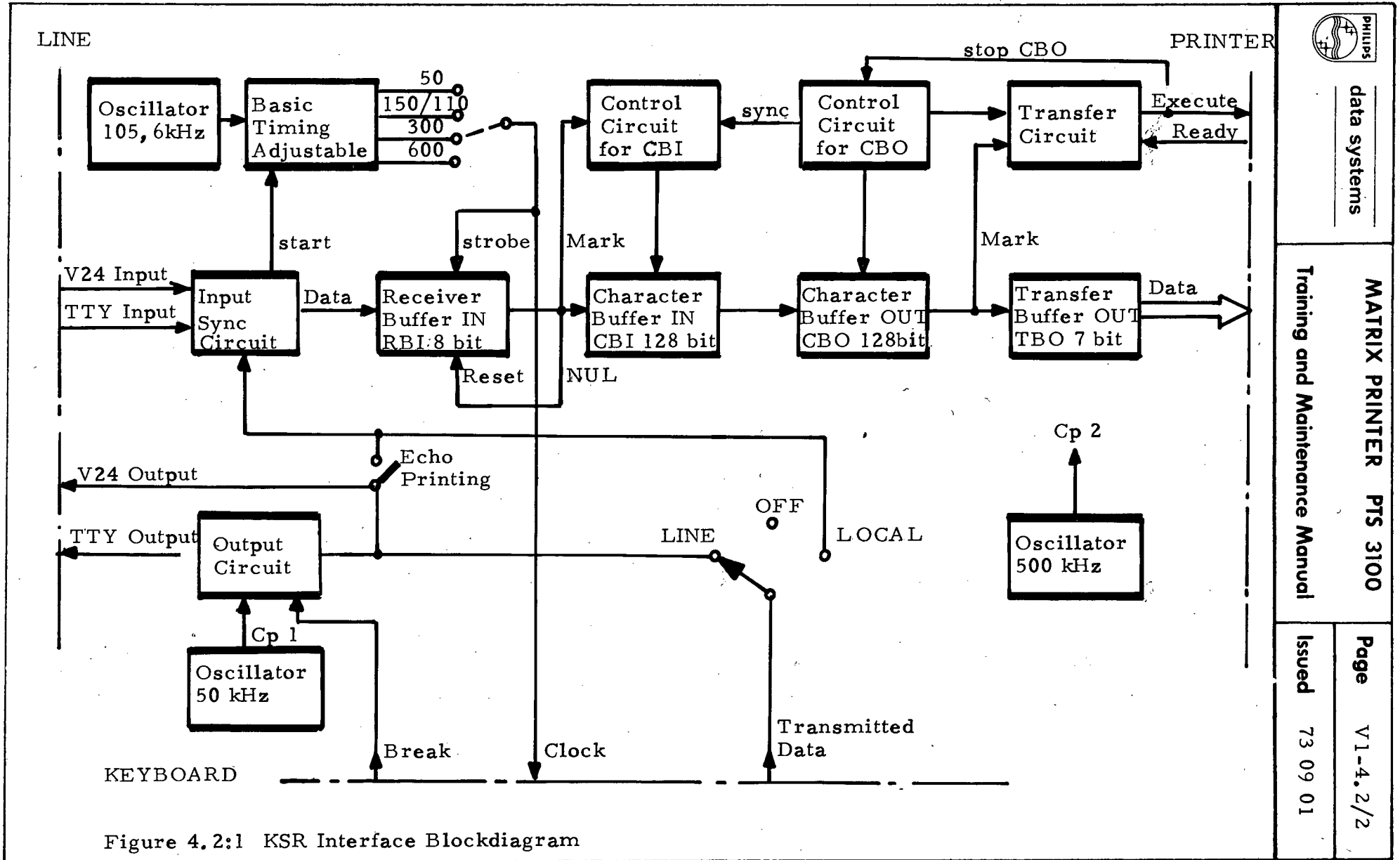


Figure 4.2:1 KSR Interface Blockdiagram



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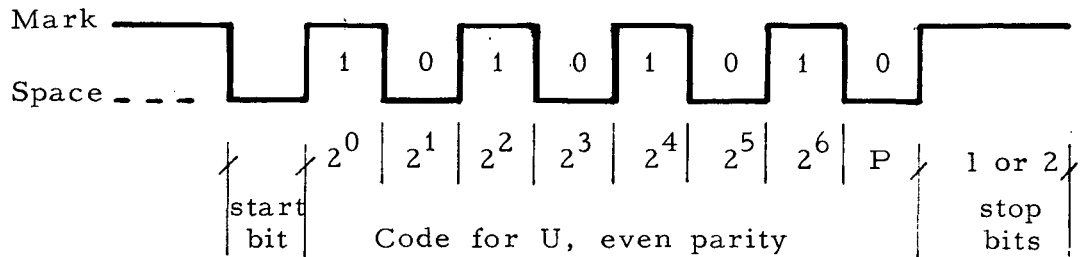


Figure 4.2:2 Current wave form

Mark: Interval with current flowing in the signal line
 Space: Interval without current flowing in the signal line.

To get synchronism between the transmitting- and the receiving devices, a start bit is always sent as a "Space" at the beginning of the character. One/two stop bits are sent as a "Mark" at the end of the character.

- Transmission speed 600 baud:

The capacity of the line is always greater than that of the printer. Output of characters shall be carried out with a frequency ≤ 50 per second. Idle characters are required in accordance with the table below.

150 baud	300 baud	600 baud	
$n \cdot 0,14 + 3$	$n \cdot 0,28 + 8$	$n \cdot 0,50 + 16$	NUL's after each CR
1	2	4	NUL's after each LF
5	9	15	NUL's per inch feeding after FF

where n = the number of characters on the latest line written. $n \cdot 0,14$, $n \cdot 0,28$ and $n \cdot 0,50$ respectively shall be rounded off to the nearest greater integer.

Example: Transmission speed 300 baud.

The number of characters on a line is 66 pcs.

$66 \cdot 0,28 + 8 = 18,5 + 8 = 27$ NUL's, i.e. to get the carriage return completed in due time 27 NUL characters are required before a proper character is allowed to be transmitted on the line.



4.2.3 2-wire Transfer

The interface board is designed for connection to 2-wire or 4-wire communications. The bridgings needed are done in the connector that connects the line to the printer PTS 3100.

Voltage for current feed on the line can be taken from either the printer, through the interface board, or the unit situated at the other end of the line.

On the interface board the line is galvanically separated from the signal earth in those cases when the voltage is taken from the other end of the line.

The standard value of the line current is 20 mA. It can be altered to 40 mA or 60 mA by changing resistors (R 24, 25 and 26) on the interface board.

Figure 4.2:3 shows connection of a 2-wire line and the way in which voltage to the tape reader is obtained if the unit at the other end lacks that voltage.

4.2.4 4-wire Transfer

No alterations are needed on the interface board to connect the board to a 4-wire communication instead of to a 2-wire communication, without bridging in the line-connecting connector. The current feed is the same as that at a 2-wire communication. Figure 4.2:4 illustrates connection of a 4-wire line and tape reader feed from the interface board.

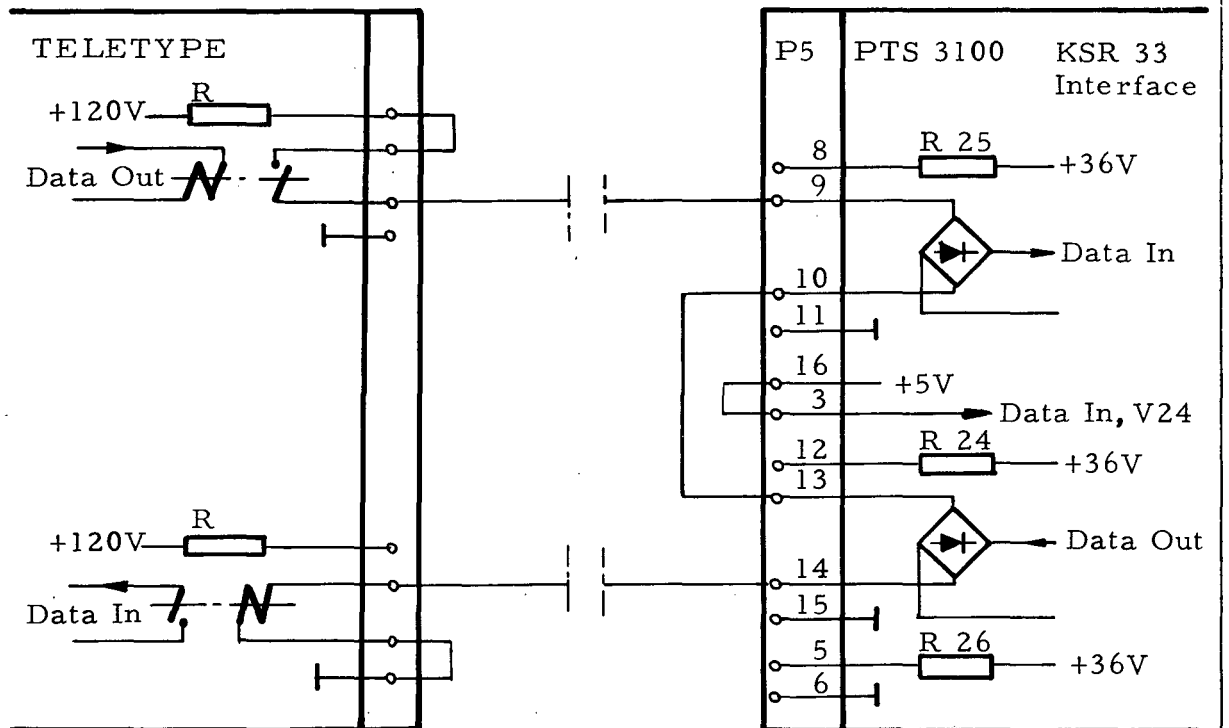
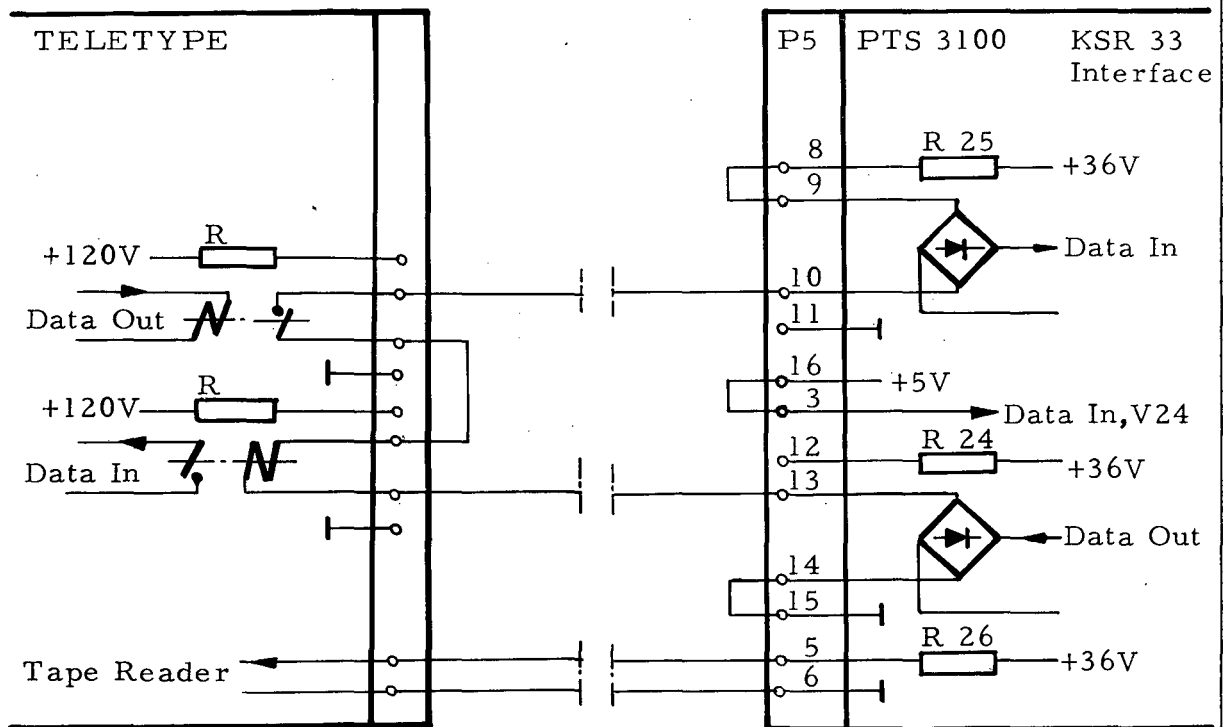
4.2.5 Reading of Data into the Receiving Buffer

The data from the line, see Appendix 4.2:1, arrive in the form of current pulses which are rectified so that, irrespective of how the line is connected, the current pulses to the optical switch always proceed in the same direction. The switch converts the signals into TTL level at the same time as it separates the interface logic from the line. The signals are strengthened in a schmitt trigger that is also capable of receiving signals from the keyboard or from the V 24 input, in case the interface is connected to such a line.

The start bit of the arriving character sets the flip-flop A which starts a divide-by-16 counter from the position 8_{10} , and which splits up the area for the incoming data bit into 16 parts and delivers a strobe pulse in the middle of each data bit.

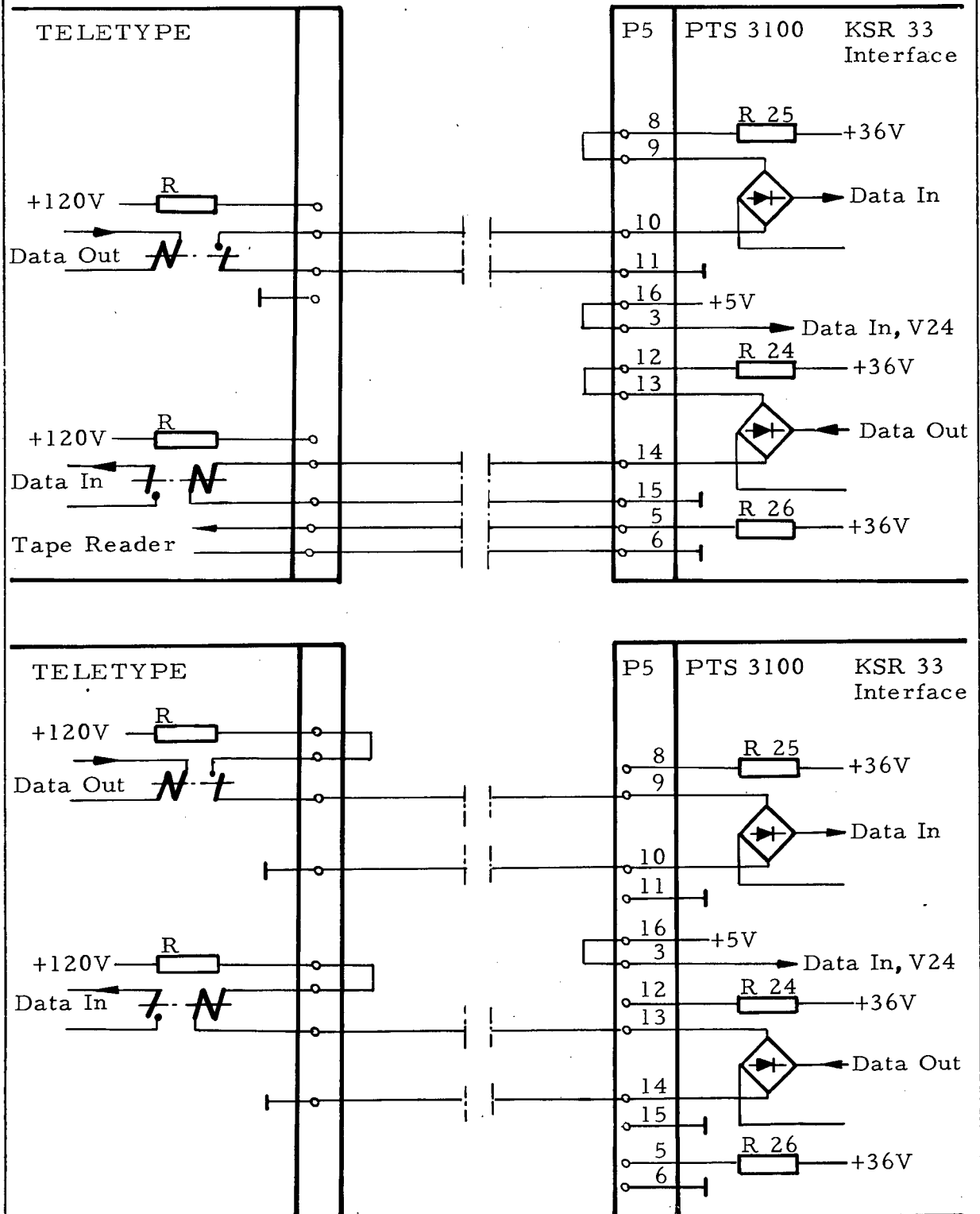
The counter is stepped by pulses from an oscillator, the frequency of which is 105,6 kHz. The frequency is divided downwards by the aid of counters and flip-flops in order to be adapted to the line frequency.

The oscillator is, from factory, adjusted to ± 200 Hz (0.2%) which corresponds to $\pm 1\%$ all over the temperature- and voltage range. It is trimmed with R 12 and R 13.



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Figure 4.2:3 2-wire connection, with alternative power supply



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Figure 4.2:4 4-wire connection, with alternative power supply.



By strappings in a coupling field that pulse frequency is selected that corresponds to the transmission speed of the line required for generation of the strobe pulses which are to set data into the Receiver Buffer IN, RBI.

If the line speed is e.g. 300 baud, a strapping has to be done from point 5 to point 8, this causing the oscillator frequency to be divided by 11. This new frequency is halved in the flip-flop B. Through a strapping between the points 2 and 7 counting pulses are obtained to the divide-by-16 counter, whose output pulses are synchronized with the internal clock pulse frequency (Cp2) on 500 kHz of the interface. These synchronized pulses arrive in the middle of each incoming data bit and are used to set the data into RBI. See step 1 in the pulse diagram of Appendix 4.2:1.

Strobe frequency example:

$$\frac{105,6}{11 \cdot 2 \cdot 16} = 300 \text{ baud}$$

The first strobe pulse from the pulse synchronizer will set the flip-flop I that cares that the divide-by-16 counter continues the generation of strobe pulses until a complete character, 8 + 2 bits, is available in the RBI.

In RBI data are shifted-in in serial form by the strobe pulses, and in order not to fall out of time with the line, RBI is supplemented by another two flip-flops, D and E, where the parity bit and the stop bit will be available, but not made use of. When the startbit has been shifted trough RBI, it will come out in the other end indicating that a complete character has been stored in RBI.

4.2.6 Transfer of Data to the IN-Buffer

That in the RBI stored character has now to be transferred into the Character Buffer IN, CBI. This buffer is a 128-bit shift register. Owing to the fact that each character consists of 7 bits + parity bit, 16 characters can be stored in CBI. See step 2 in the pulse diagram of Appendix 4.2:1.

The flip-flops G and H will be set and I reset by the signal Full character in RBI, if a start bit is available foremost in the RBI and the NUL detector does not sence the presence of a NUL character (= all bits are binary one)

The flip-flop G opens up a gate so that clock pulses can advance a counter eight steps (= the number of bits in a character). The trailing edge of these clock pulses triggers the monostable flip-flop J, which delivers a clock pulse, being delayed one Cp2, to the CBI. This delay has been included in order to get data out from the RBI to lie steadily when being read into the CBI.



The flip-flop H on the one hand delivers a signal, Select input, to the CBI, causing input A to be opened for Data IN, on the other hand opens up, together with the flip-flop G, a gate in order to let Cp2 through as a clock pulse to the RBI. Thereby the character in RBI can be shifted into the CBI. When eight bits have been shifted in, the bit counter has reached the position 16_{10} (start at 8_{10}), and it delivers a carry signal that resets the flip-flops with the designations G and H, and loads the counter to the start position 8_{10} .

4.2.7 Transfer of Data to the OUT-Buffer

When the interface has no data to transmit to the printer the contents in the Character Buffer OUT is continuously shifted. If no data have been entered into the buffer, dummy codes will be shifted.

Assume that a character has been entered into the CBI. This character has now to be transmitted to the CBO.

CBO includes, like the CBI, a bit counter starting at the position 8_{10} and which re-starts after eight clock pulses. During these eight clock pulses are shifted either data from the CBI, or dummy codes into the CBO.

The counter is controlled by the flip-flop K, that can be set into 1-position in the absence of the signal Execute only.

When a complete character has been set in the CBI, and the flip-flops G and H have been reset, the signal Synchronizing of shift CBI → CBO is let through, with the result that the two 8-bit counters are synchronously advanced, because the flip-flops G and K are simultaneously set.

This data shift from CBI to CBO will continue until an interval, a "Mark", (= 1 bit of a character), appears on the output of CBO, indicating that a character has been placed in the foremost position in the CBO.

This "Mark" sets the flip-flop N, and when the bit counter arrives at the position 16_{10} , it delivers a carry signal as a receipt that a complete character of eight bits has been shifted out from CBO to the Transfer Buffer OUT, TBO. The carry signal is also clock pulse for the setting of flip-flop O.

The flip-flop O inhibits the data transfer from CBI to CBO, simultaneously the flip-flop L is set. This flip-flop emits the signal Execute to the printer and prevents the flip-flop K from being set. Thereby the bit counter is brought into an idle state, and there will be no more shift in CBO and TBO. The character that has to be transmitted to the printer is steadily positioned on the outputs of the TBO.



As soon as the synchronization between CBI and CBO ceases, shift will be let through to CBI and the unit will be filled with characters from the line through RBI.

The carry signal resets also the flip-flop K which, by a forced action, resets the flip-flop N and, on the subsequent carry signal, the flip-flop O will be reset. The flip-flops will then be ready when the next character is available on the output of CBO.

A signal called Select input is applied to the buffers CBI and CBO. Dependent on whether this signal is a high-level or a low-level signal, input A or input B will be selected.

The signal Select input is e.g. a high-level one when the flip-flop H is set. Characters are then shifted into the CBI through input A, i.e. data from RBI. When the flip-flop H is reset, dummy codes are shifted into CBI.

The same procedure is applicable for the flip-flop O and the buffer CBO.

4.2.8 Transfer of Data to the Printer

Data to the printer are transmitted from the TBO on seven parallel wires. Simultaneously the signal Execute is sent.

When the printer has printed the character, or performed the command being transferred on the data lines, it acknowledges with a Ready signal. This signal resets the flip-flop L, at which the signal Execute ceases, and as a result, also the Ready signal ceases. See Appendix 2.2:1 The Ready signal also sets the monostable flip-flop P.

The flip-flop P generates, after each Ready signal, a pulse with a duration of ca 0,4 ms. This pulse inhibits the transfer between RBI and CBI that long that the contents in CBI (128 bits) can be transferred to the CBO, but only if flip-flop O is reset and that is when CBO is empty of Marks.

Transfer is possible as soon as the Execute signal ceases. Then the flip-flop K can be set and synchronization of the counters obtained.

4.2.9 Transfer of Data to the Line

Through the teletype interface KSR 33 data can be transmitted from the printer PTS 3100 keyboard on to the line, which is connected to the interface board.

By the aid of a 3-way switch it is possible to select the routing of the information from the keyboard: either on to the line, or for printing locally on the printer.

The switch is called PRINT KEYBOARD SELECTOR and it has three positions: LINE, OFF, LOCAL.

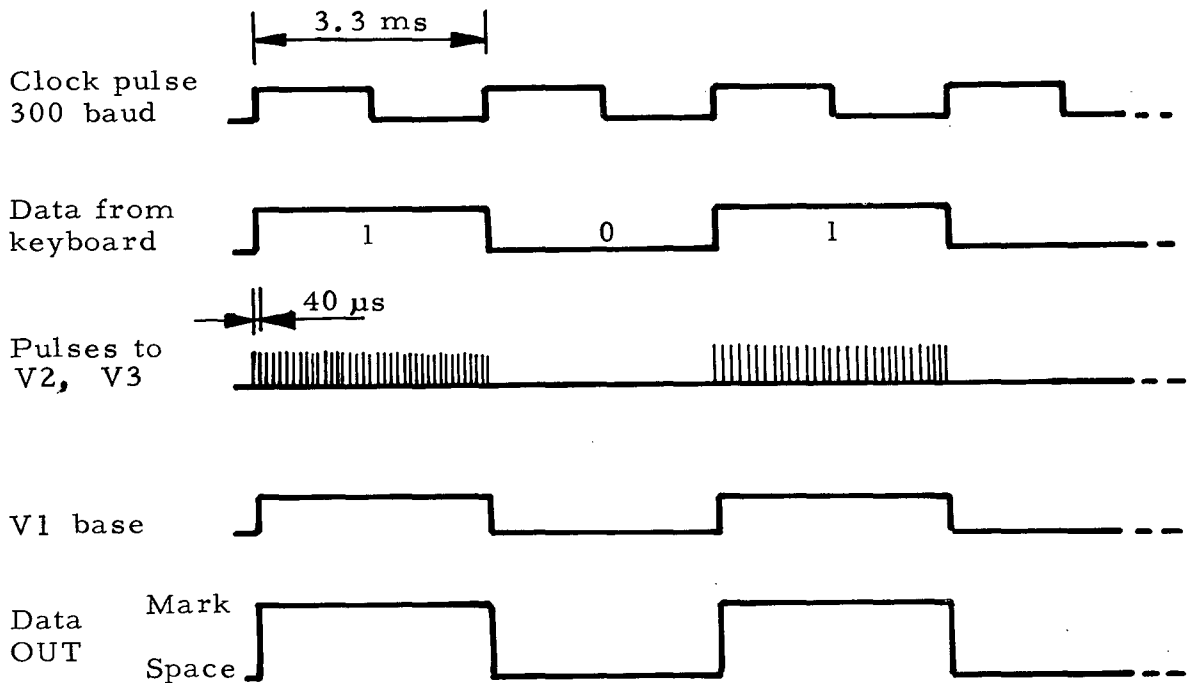


- LINE, which means that the keyboard is connected to the OUT-line for both teletype and V 24. With another switch, ECHO - PRINTING, the information is, simultaneously, transferred to the printer from the keyboard.
- OFF, which means that the line and the keyboard are shut-down from the interface.
- LOCAL, which means that the keyboard is connected to the printer only.

For data transfer on the OUT-channel for teletype there is an oscillator available, that delivers clock pulses with a frequency of $f_1 \approx 50$ kHz to the flip-flop Q. This flip-flop, with its high-level inputs, strokes in step with the oscillator. Every 0-bit in the characters that in serial form arrive from the keyboard, opens the two gates which control the transistors V2 and V3.

These transistors generate an alternating voltage in the transformer T1, the duty of which is to galvanically separate the interface from the line.

The voltage from T1 is rectified and inhibits the transistor V1. Thereby the line current passing through the rectifier to which the line is connected, will be shut-down. See figure 4.2:5.



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Figure 4.2:5 Data to the line



A "Space" can be obtained also if the key BREAK on the keyboard is depressed.

BREAK activates the relay K1 on the interface board, and a contact short-circuits V1 base to earth, at which V1 inhibits and a "Space" is generated on the line as long as BREAK is held depressed.

4.2.10 Keyboard and Printer used locally

When the PRINT KEYBOARD SELECTOR is placed in position LOCAL, the information proceeds from the keyboard direct to the printer.

The information passes the same way as Data IN through the interface, this being described in parts 4.2.5 - 4.2.8.

In the position LOCAL (and OFF) the Data IN lines for teletype and V24 are blocked as a consequence of the schmitt trigger R, that lets data through only in the position LINE.



INSTALLATION OF A KSR 33 INTERFACE

1. Line frequency adaptation

Select the desired line frequency by putting two jumpers as shown in the table below

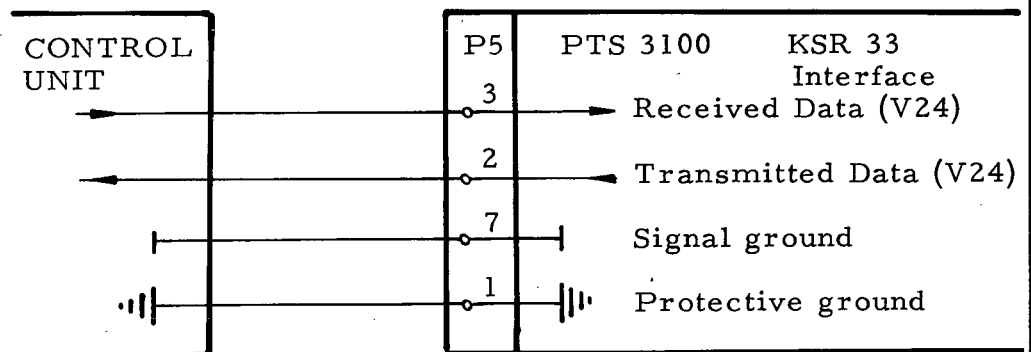
Frequency	Connect	
50 baud	5 - 8	4 - 7
110 "	6 - 8	3 - 7
150 "	5 - 8	3 - 7
300 "	5 - 8	2 - 7
600 "	5 - 8	1 - 7

2. Select mode

- Insert the board into Interface Connector I
- Select On Line or Local mode with S1
- Select Echo Print if it is desirable (with S2)

3. Data input/output at V24 - level

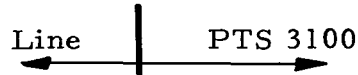
If the V24 - level Data input/output are used instead of the normal TTY current loop, connect the line as shown below



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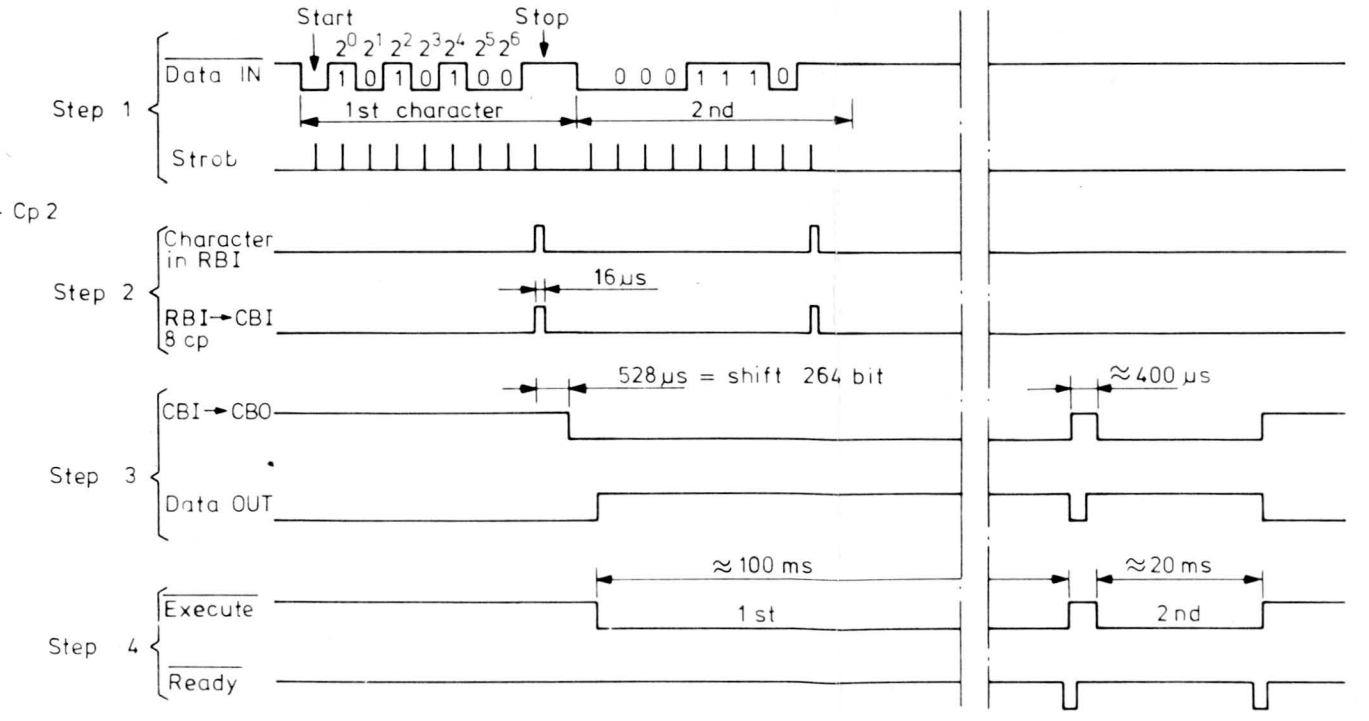
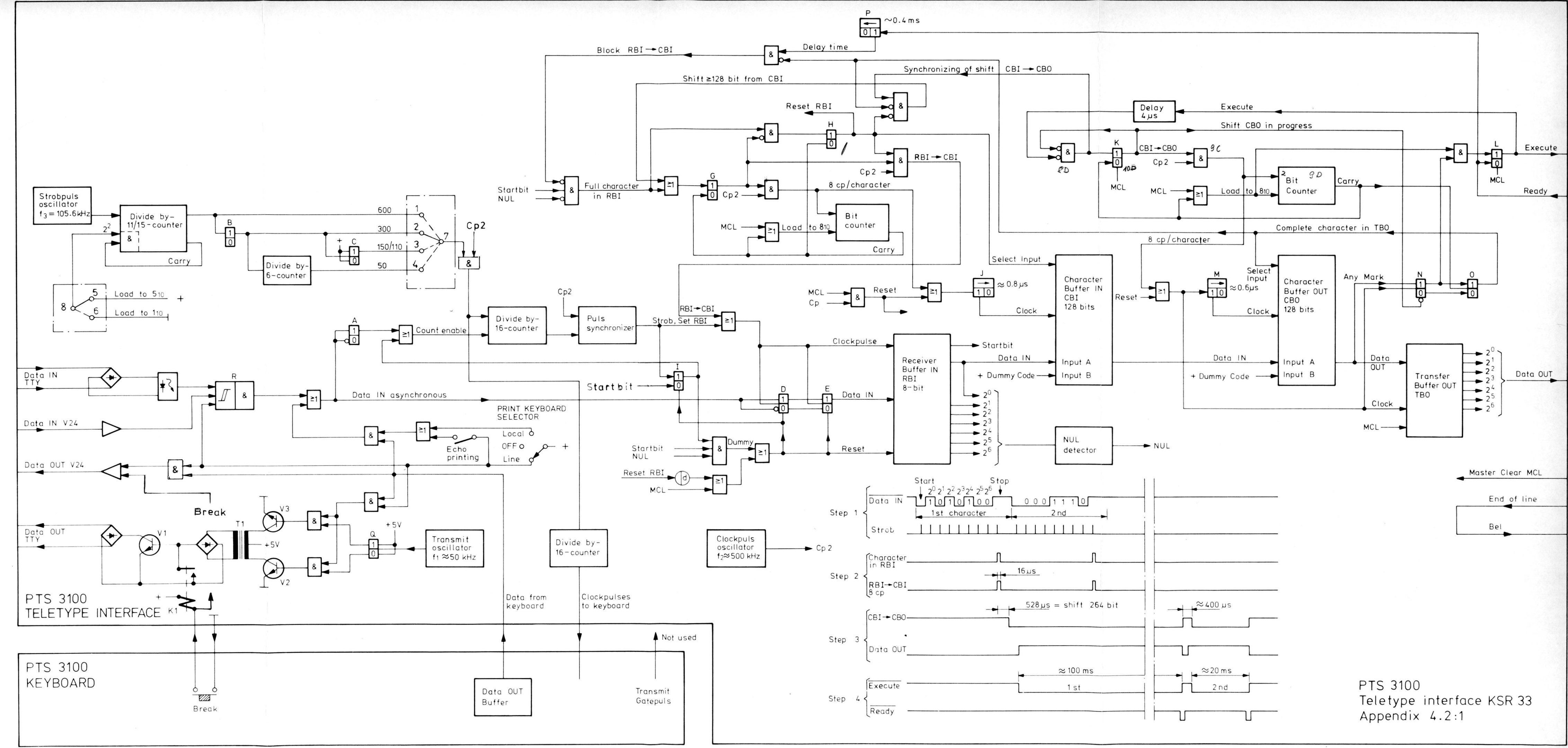
4. Signal lines (See figure 4.2:3 and 4.2:4)



Line connector	Teletype Interface	Signal
1	—	Protective ground
2	B 42	Data output, V24
3	B 43	Data input, V24
4	—	
5	A 42	R 26 (+36V)
6	A 41	Line ground
7	AB 20-22	Signal ground
8	A 40	R 25 (+36V)
9	A 39	Data input, TTY
10	A 38	" " "
11	A 32	Line ground
12	A 31	R 24 (+36V)
13	B 29	Data output, TTY
14	B 41	" " "
15	B 40	Line ground
16	B 39	+5V
17	—	
18	—	
19	—	
20	—	
21	—	
22	—	
23	—	
24	—	
25	—	

CAUTION

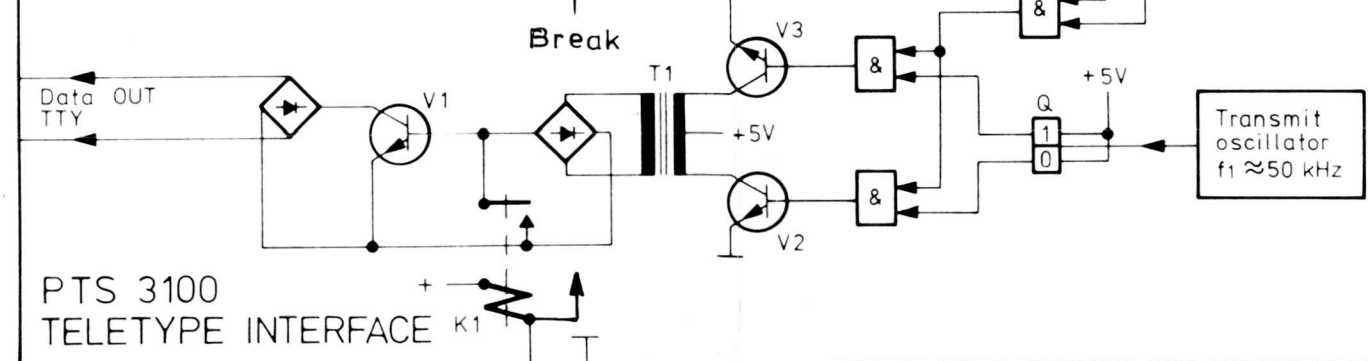
WHEN V24-INPUT IS NOT USED, IT MUST BE CONNECTED TO +5V. i.e. LINK 3 TO 16



PTS 3100 Teletype interface KSR 33 Appendix 4.2:1

PTS 3100 TELETYPE INTERFACE K1

PTS 3100 KEYBOARD



Data OUT Buffer

Transmit Gatepuls

Master Clear MCL
End of line
Bel



4

LINE INTERFACES

Contents

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4.3 Send/Receive Character Confirmation, S/R CC (V24)

4.3.1 General

The S/R CC (V24) interface is used mainly for direct connection to a controller. The line interface is built up on a printed board to be inserted in a connector beside the standard board in the printer PTS 3100.

The task of the interface is to convert serial bi-polar information from the line into parallel TTL-adapted information for the printer.

The interface is acknowledging, however, it may as well operate as a non-acknowledging interface. It includes one 10-bit Receiver Buffer and one 7-bit Transfer Buffer. See Figure 4.3:1.

The line transfer speed ranges from 100 to 9 600 bits/s (baud). Data are clocked into the Receiver Buffer IN (RBI) by strobe pulses, the frequency of which must be adapted to the transfer speed.

Keyboard data are clocked from the interface with the same frequency as that for the strobe pulses.

On the V24 interface board there is a switch for Direct printing, at the same time as data are transmitted to the line. The data received from the line inhibit the Direct printing, therefore, interference cannot occur.

4.3.2 Transfer Principle

The data transfer is asynchronous and the transfer speed lies in the range 100 to 9 600 baud (100, 150, 200, 300, 600, 1 200, 2 400, 4 800 and 9 600 baud). Each character consists of 11 bits: 1 start bit, 8 data bits and 2 stop bits. See Appendix 4.3:1.

The signal level is bi-polar, i.e. the start bit and the binary 0 are positive (more than +3 V), and the binary 1 and the stop bits are negative (more than -3 V).

At normal output to the printer the receipt signal Ready for Receiving is used. Even though the line transfer speed is 9 600 baud, the character transfer speed to the V24 interface is determined by the printer.

If, on the other hand, the signal Ready for Receiving is not used as an acknowledgement that the subsequent character can be transmitted, consideration must be taken to the line transfer speed. If this speed exceeds the printing speed of the printer, idle characters (NUL) must be fed-out between the ordinary characters, as well as after CR (Carriage Return) and LF (Line Feed).

In addition, the CR-character must always be fed-out before any LF- or FF (Form Feed) characters.

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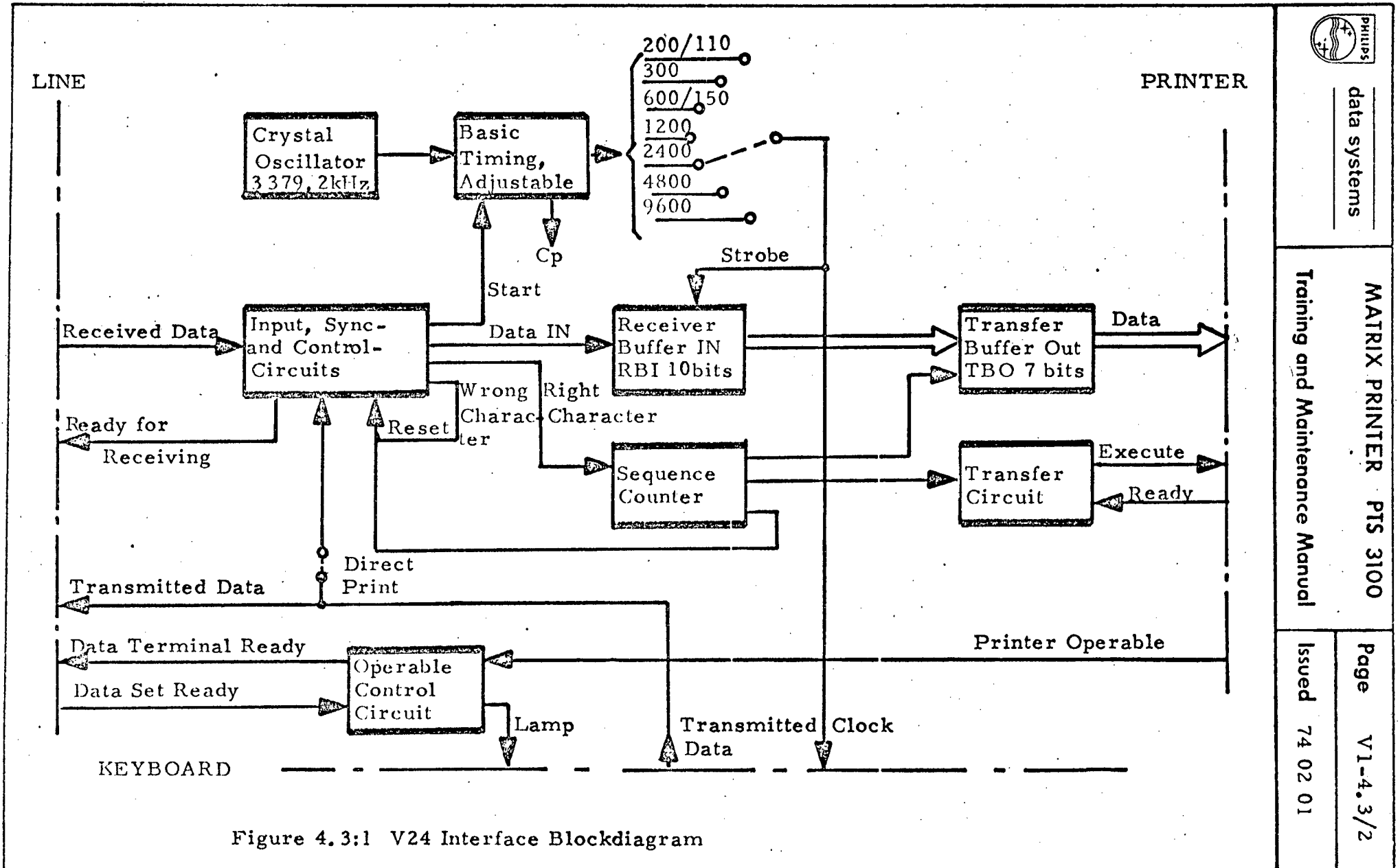


Figure 4.3:1 V24 Interface Blockdiagram



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4.3.3 Basic Timing

For generation of the strobe pulses, which clock the Received data into the RBI, and the clock pulses for data transfer from the keyboard, the V24 interface contains basic timing circuits, controlled by a crystal oscillator with a frequency of 3 379.2 kHz. This frequency is divided into several steps, and in one step also doubled. See Appendix 4.3:1.

The first divider, preselectable to 5_{10} or 4_{10} , divides by 11 or 12, the result being the clock pulse frequency for the interface.

When the divider, a divide-by-16-counter, reaches position 16, a carry pulse will be generated for the next counter, loading again, through a delay circuit, the first counter to the preselected value.

The next divider incorporates four flip-flops, each of which halves the frequency so as to get the line adapted frequencies 2 400, 1 200, 600 and 300.

To secure the frequencies 200, 150 and 100, a preselected strapping for setting of 10_{10} or 6_{10} , to divide by 6 or 10, must be carried out. To get a load-signal, another strapping must be done.

If the value 9 600 is wanted, the frequency is generated by a circuit consisting of two timers, triggered by the leading edge and the trailing edge respectively of the clock pulse, and in that way the required frequency doubling is obtained.

One of the frequencies is then strapped to the inputs of two equivalent counters. These counters are set to 12_{10} for frequencies equal to or higher than 300 baud and set to 0_{10} for frequencies equal to or lower than 200 baud.

The carry signals from the counters pass a delay circuit, and the counters are re-loaded. The carry signals also count down the last two divide-by-16-counters, and their output pulses are synchronized and shorted with the Cp.

One of the counters delivers clock pulses to the keyboard, the other counter, being able to count only when the signal Strobe enable is present, generates the strobe pulses used to clock the data bits into the RBI. This counter starts at 8_{10} , to get the first strobe pulse in the middle of the start bit, i.e. after $4 \cdot 8 = 32$ clock pulses.

Example. Wanted are strobe pulses for 2 400 baud, so:

$$\frac{3\,379.2}{11 \cdot 2 \cdot 4 \cdot 16} = 2\,400$$

The clock pulse frequency is at least 64 times higher than the strobe frequency up to 4 800 baud but only 32 times higher for 9 600 baud.



4.3.4 Reading Data into the Receiver Buffer

See Appendix 4.3:1 and its pulse diagram.

When the start bit from the line (104) appears, the flip-flop C (FF-C) will be set. This setting creates the signal Strobe enable, that starts the counters producing the strobe pulses.

The first strobe pulse arrives after 32 clock pulses, i.e. in the middle of the start bit, the second strobe pulse after 64 clock pulses, i.e. in the middle of the next data bit, and so forth.

The strobe pulse passes through flip-flop E (FF-E) and is delayed one clock pulse before it clocks data from the line (or the keyboard) into the RBI.

When the 11 bits have been set in the RBI the first and the next but one positions in the buffer are decoded in order to find out whether they constitute Right character, i.e. one start bit and one stop bit. If so, the flip-flops F and G will be reset, provided the Execute mode is not at hand. These two flip-flops were set by the first strobe pulse and flip-flop F, which remains set until the buffer is filled, has inhibited the clock pulses to FF-C. This flip-flop too has been set for the same period of time to enable strobe pulses. Upon arrival of the signal Right character, that resets flip-flop G, a binary 1 will be set into a shift register, owing to the one clock pulse delay in the resetting of FF-G. The shift register is called the sequence counter.

If the start bit is correct but the stop bit is missing, the signal Wrong character is generated and the interface will skip it. By this the flip-flop J will be set with the object of delivering a reset signal to RBI and to all flip-flops. The character in RBI disappears, and the interface will be ready for the next character.

4.3.5 Transferring Data to the Transfer Buffer

The sequence counter is always running, shifting binary zeros. The function, when a binary 1 is applied and shifted forwards, is the following:

The first two steps are not used. The third step clocks data from RBI into the Transfer Buffer OUT (TBO), in parallel form. The fourth step sets the flip-flop H, that generates the signal Execute to the printer. The fifth step resets RBI and FF-K. This flip-flop was set by the first strobe pulse, like the flip-flops F and G.

Flip-flop K is controlling the line Ready for Receiving (133) and is set when a start bit has set flip-flop C and the first strobe pulse arrives. K indicates that the interface is not ready to receive new characters from the line (104). However, when data are now transferred from RBI to TBO and RBI is cleared, the FF-K can be reset and by that the line 133 indicates "Ready for Receiving".



4.3.6 Transferring Data from Keyboard to Line

Keyboard data to the V24 interface are clocked by pulses generated by the interface. The data codes for the keys are transferred direct to the line (103) Transmitted Data, if the printer is operable, i.e. the power ON, the paper is inserted, the READY switch is in position ON and Data Set Ready also in position ON.

The V24 interface provides also Direct Printing, when a link is inserted between two sockets. Upon arrival of a start bit from the keyboard and with the Direct link set, the flip-flop D is set, enabling strobe pulses to feed the keyboard data into RBI, like Received data from the line ((104). For Direct Printing the keyboard data are inhibited by flip-flop C or K, but data are transferred like Transmitted Data (103) to the line.

4.3.7 Data simultaneously from Line and Keyboard

Applicable here are Data from line first and Data from keyboard first.

- Data from line

The flip-flop C will be set, thereby inhibiting the Echo printing.

- Data from keyboard

The flip-flop D is set, and data setting into RBI is in progress.

Now, when data arrive from the line (104) the flip-flop C will be set. Along with the flip-flop D a resetting signal is generated to RBI and to the flip-flops, and also FF-D will be reset. Data from the line will be stored in RBI instead of data from the keyboard.

4.3.8 Data Terminal Ready

Refer to the pulse diagram in Appendix 4.3:1.

Before data can be transferred in or out of the V24 interface the printer must be operable, and the signal Data Terminal Ready be sent to the controller. The controller has to acknowledge, using the signal Data Set Ready. This signal is indicated on the indicator at the extreme left on the keyboard.

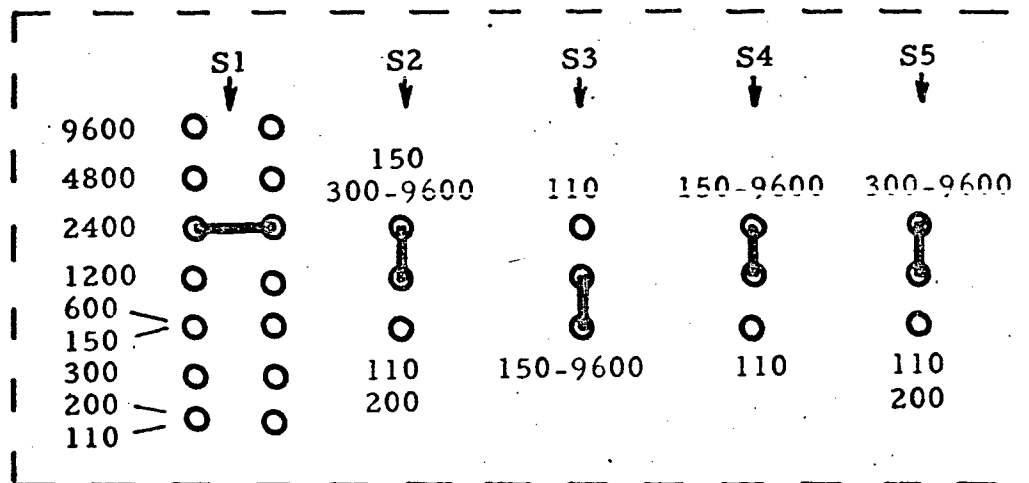
When the printer is operable a relay contact is closed. The forced resetting of flip-flop L ceases, and the flip-flop can be set into a binary 1 position. In doing so, the signal Data Terminal Ready (108/2) goes high, and shortly thereafter the controller answers by emitting the signal Data Set Ready (107). When the terminal and the controller are ready, data from the keyboard can be transferred like the Transmitted Data (103).



INSTALLATION OF A S/R CC (V24) INTERFACE

1. Line frequency adaptation

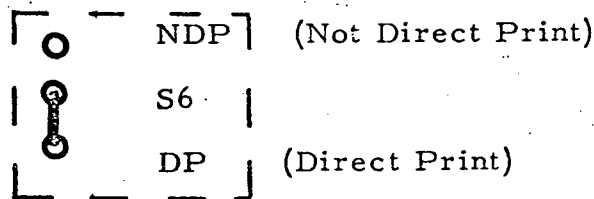
Select the desired line frequency by putting the five jumpers S1 - S5 as shown below



Selecting of 2400 baud Line speed is shown

2. Selecting Direct Print

Direct Print is selected by jumper S6



3. Board location

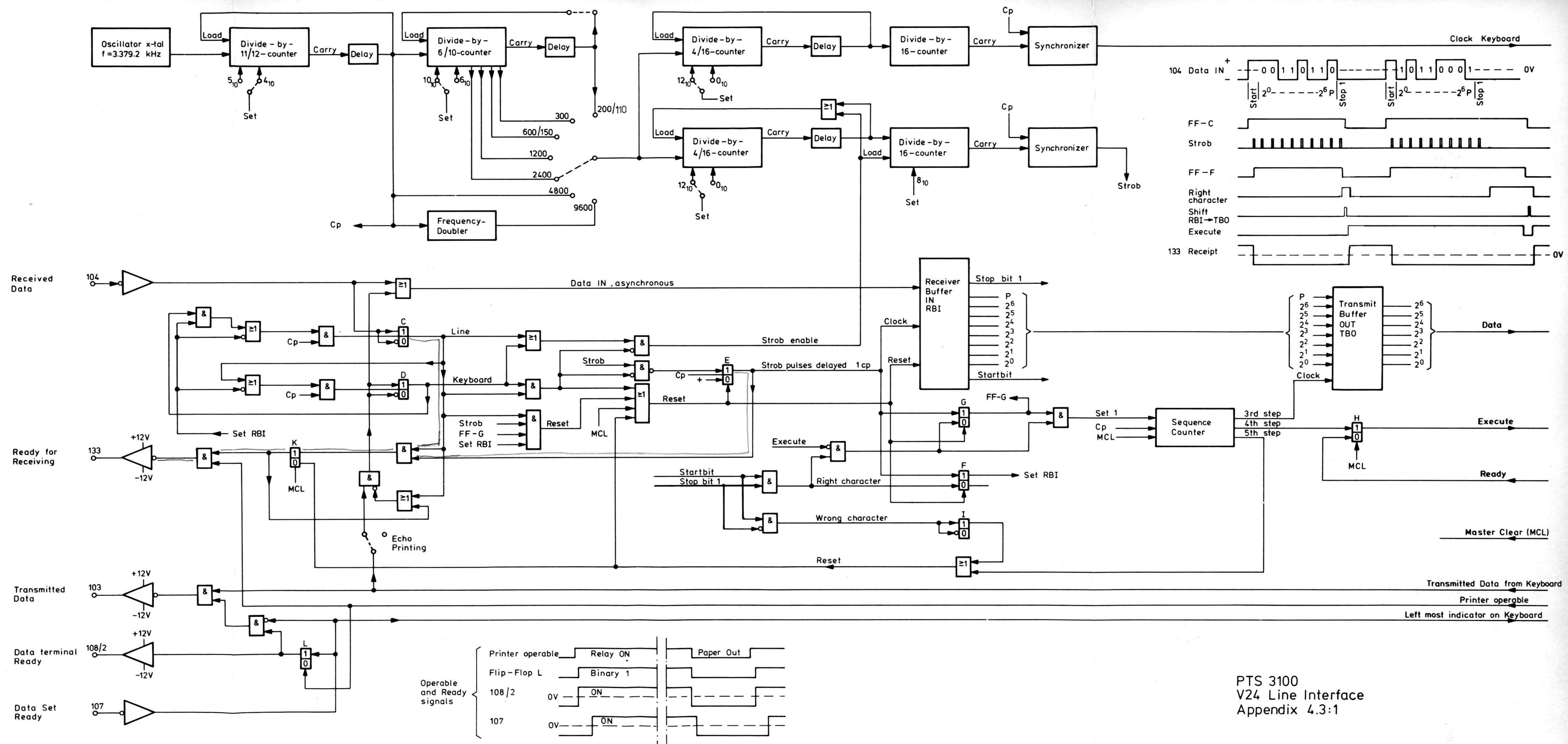
Insert the board into Interface Connector I



4. Signal lines

Line	PTS 3100	line connector	S/R CC Interface	Signal	V 24 circuit
		1	—	Protective ground	101
		2	B 42	Transmitted Data	103
		3	B 43	Received Data	104
		4	—		
		5	—		
		6	A 41	Data Set Ready	107
		7	AB20-22	Signal ground	102
		8	—		
		9	—		
		10	—		
		11	—		
		12	—		
		13	—		
		14	—		
		15	—		
		16	—		
		17	—		
		18	A26	Operational signal) ¹ " ")	
		19	A 27		
		20	A 28		Data Terminal Ready	108/2
		21	—		
		22	—		
		23	—		
		24	—		
		25	B 30	Ready for Receiving	133

1) The Operational signal is generated by the printer logic and is internally connected to the interface board



PTS 3100
 V24 Line Interface
 Appendix 4.3:1





5

CONTROL UNIT

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5.1 General

5.1.1 Buffered Terminal P1094

The buffered terminal P1094 is an input/output device for alphanumeric data in the P1000 system. Figure 5.1:1 shows those units included in the terminal

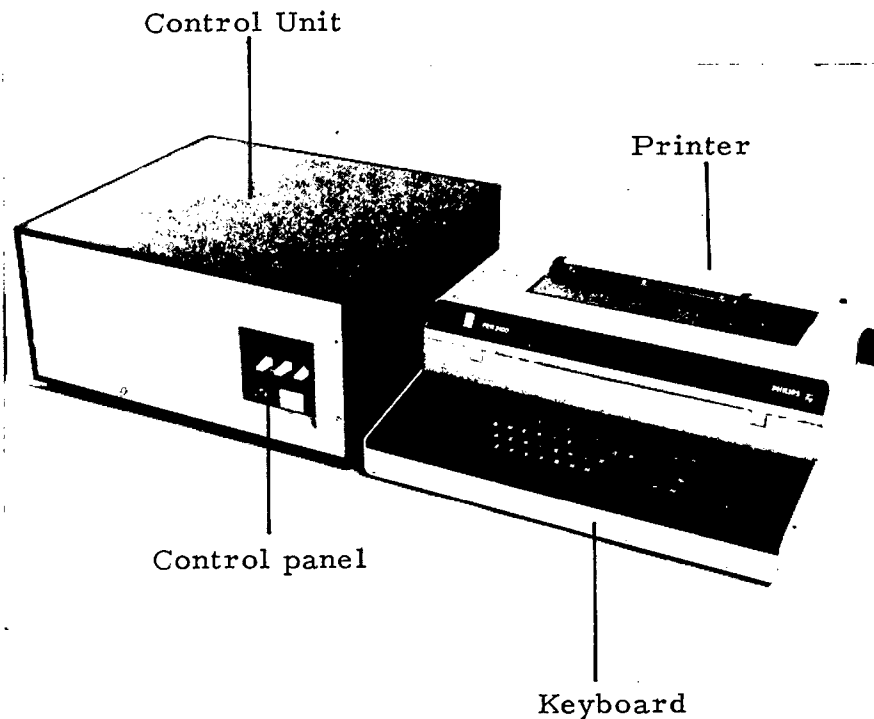


Figure 5.1:1 Buffered Terminal P1094

The terminal shall be connected to a P1000 computer system over data communication lines which are controlled by a line control unit, LCU5 or LCU7.

For data input to the computer a PTS 3100 keyboard is used, for data output a PTS 3100 printer is connected.

The terminal includes, in addition, a control unit, that adapts the printer and the keyboard to the line transmission speed, which ranges from 600 to 9600 baud.

The control unit contains a micro computer, MCS-4, accommodating a program memory with a permanently stored program and a data memory, which partly is used for the forming of two buffers, each for storing of 127 8-bit



characters. The buffers can manually be connected in series (buffer chaining), thus forming one buffer of 255 characters.

The buffers can be extended up to 255 characters each, giving one 511 character buffer when chained.

In the buffers are stored input from the keyboard to the P1000 computer or output to the printer.

Simultaneously with data output to the printer from the one buffer, the other buffer can be filled up from the transmission lines.

It is not possible to simultaneously perform input and output transmission of data.

The control unit contains also a control panel with some switches and indicators.

The line procedure and message editing at input are handled by the micro computer of the control unit.

5.1.2 Functional Units

The buffered terminal P1094 shall be connected to out-plant or inplant modems with V24-levels. See Figure 5.1:2, page 5.1/3.

The terminal consists of three main parts:

- Printer PTS 3111-001
- Keyboard PTS 3150-001
- Control Unit PTS 3161-011

The function of the printer and the keyboard is dealt with in sections 2 and 3 of this description.

The parts of the control unit, and their functions, are the following: See Figure 5.1:3 page 5.1/5.

- Micro Computer

- to control the data flow from the line to the printer and from the keyboard to the line,
- to edit messages from the terminal,
- to control the line procedure from the terminal,
- to check the buffers.

- Data Buffers

- to store messages to/from the terminal.

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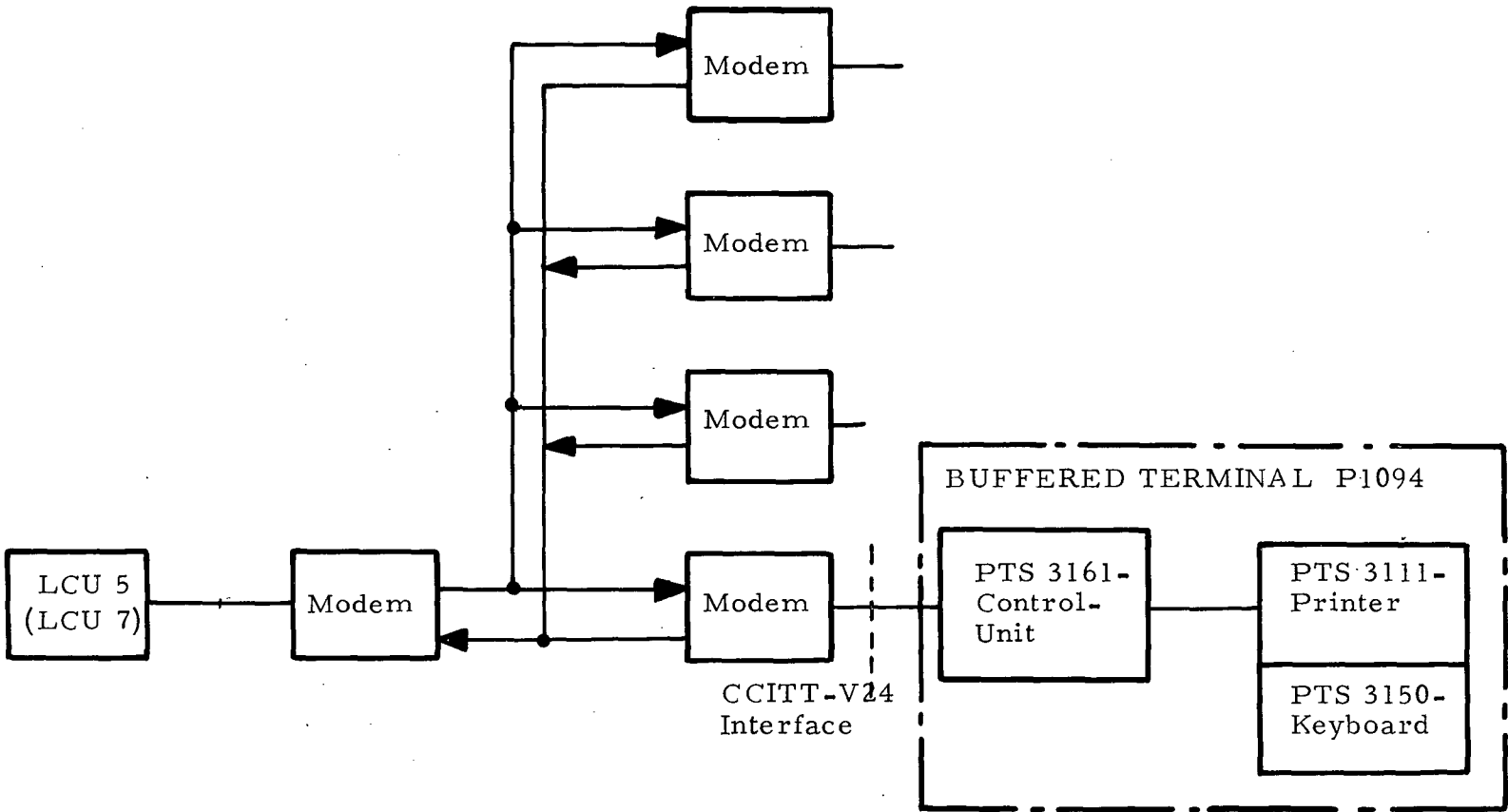


Figure 5.1:2 The line configuration



data systems

MATRIX PRINTER PTS 3100

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- Printer Control
 - to adapt the character output to the speed of the printer
 - to check whether the printer is operable.
- Keyboard Control
 - to convert the serial data of the keyboard into parallel data for the control unit
 - to control the indicators of the keyboard
- Timer
 - to be used for supervision of certain sequences, e.g. Line procedure and Keyboard time out
- Line Control with CCITT-V24 Interface
 - to **synchronize** the terminal and to receive data
 - to transmit data, if the modem is ready
 - to convert the signal levels from the TTL-logic of the terminal into V24-level of the line and vice versa

5.1.3 References

For acting of the P1094 Control Unit toward the line, reference is made to:

- the appropriate P1000 documentation to which the procedures for P1094 corresponds with one exception, the Flash Write procedure

For the use of the micro computer, for hardware and software, reference is made to:

- Intel: MCS-4 Micro Computer Set, User's Manual.

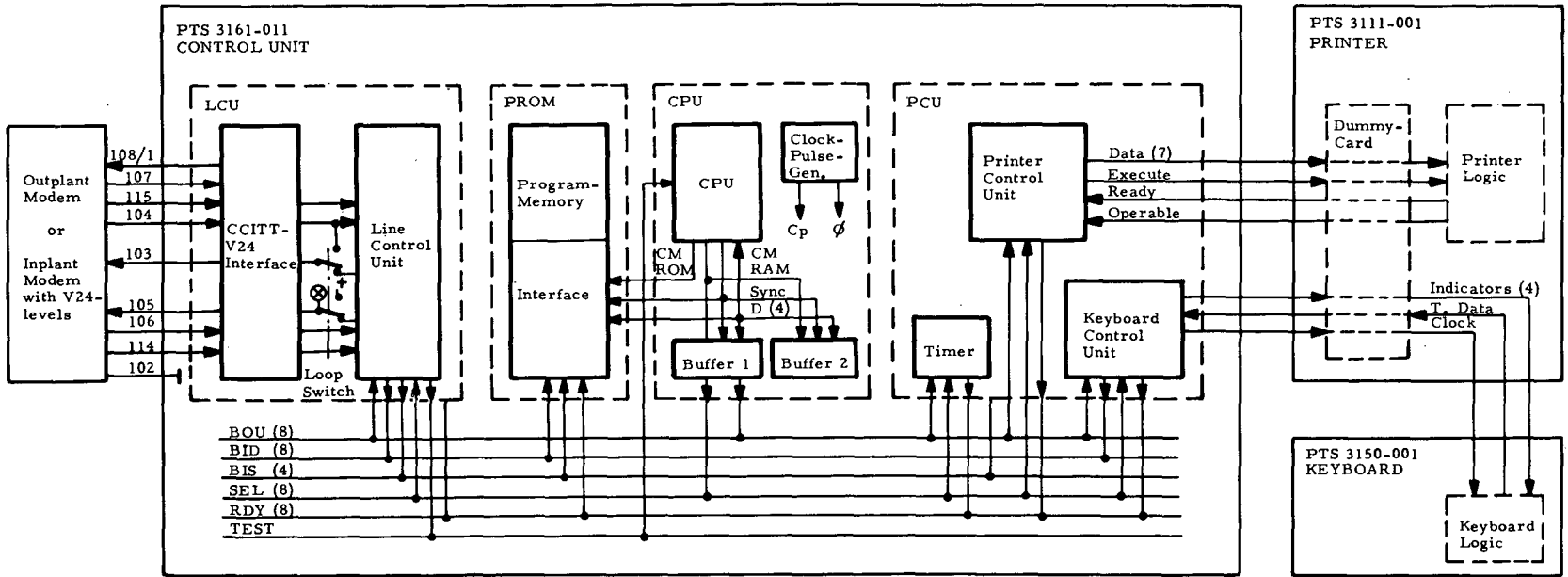


Figure 5.1:3 Buffered Terminal P1094 Block diagram



5.1.4 Technical Data

- Printer

- Printer speed: max 50 char/s
- Line length: available 69, 80 or 110 characters
- Character set: available ASCII or Basic ISO-7.
- Logic levels: the incoming signals should have negative representation at TTL level. The same levels will be maintained for output signals, i.e.

True (logic 1) = 0.0 to +0.4 V

False (logic 0) = +2.4 to +5.0 V

- Signal line termination: the incoming lines terminate at a TTL circuit 7413 or equivalent with a pull up resistor of 1 kohm to +5 V.

The outgoing lines are driven by TTL logic gates 7404 or equivalent with a 27 ohm resistor in series for noise suppression.

For more detailed printer data reference is made to section 1.4.

- Keyboard

- Key top layout: ECMA-23C/V1 standard key tops, available control keys for different nationality and use
- Code: ASCII with some codes exchangeable for national character sets
- Data: serial, clocked with 45 kHz from the control unit
- Indicators: 4 LED governed from the control unit
- Signal levels: the interface is a TTL-level interface where logical 1 is represented by high level.

- Control Unit

- Line procedure: in accordance with LCU 5 line procedure
- Line speed: 600 to 9600 baud
- Levels: CCITT-V24 levels to line and TTL-levels to printer and keyboard
- Buffer capacity: 2 buffers with 127 characters each, extendable to 2 x 255 characters. The buffers may be chained to one buffer of 255 characters or 511 respectively.
- Character code: ASCII



- Control panel,
with indicators: Modem ready
Loop
Paper out
Hold
and switches: Print suppress
Paper out Reset
Hold-Release
- Auxiliary switch: LOOP
and indicator: RTS
on the board LCU
on the board PROM :TEST and Buffer Chaining
- Micro Computer including,
program memory: 1.25 k octads receive only and
2 k octads send/ receive.
Maximum is 4k octads

data memory: see buffer capacity

instruction cycle
time: $8 \times 1.4 \mu\text{s} = 11.2 \mu\text{s}$

instruction set: 45 instructions.
- Power consumption
- Control Unit: 55 W
220 V $\pm 10\%$
50 Hz $\pm 2\%$
- Printer 100 VA average
220 V $\pm 10\%$
50 Hz $\pm 2\%$
- Keyboard 10 W, included in printer con-
sumption.
- Dimensions (H x W x D)
- Control Unit: 235 x 499 x 437 mm
- Printer: 166 x 500 x 305 mm
- Keyboard: 83 x 500 x 160 mm
- Mass
- Control Unit: ca 20 kgs
- Printer: ca 20 kgs
- Keyboard: ca 3 kgs
- Environment
- Ambient temperature: $+5^{\circ}\text{C}$ to $+40^{\circ}\text{C}$
- Relative humidity: 20-80 %



5.2 Operation

5.2.1 Switching on

The voltage must be switched on not only on the printer but also on the control unit, to which the printer is connected. See Figure 5.2:1.

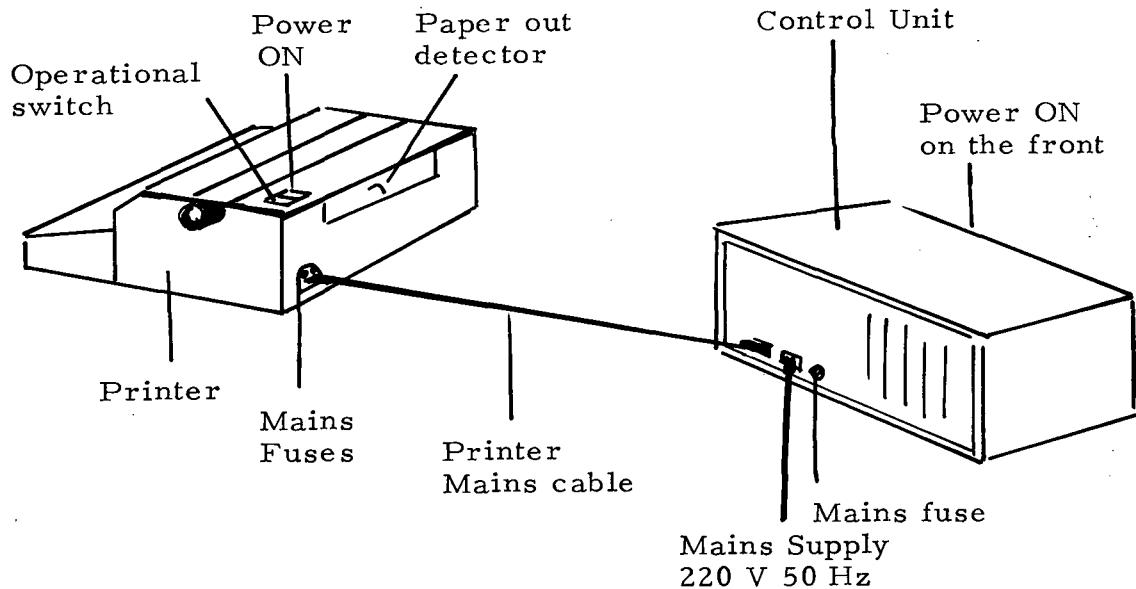


Figure 5.2:1 Mains connection

The switched on voltage will be indicated by the lamps beside the switch concerned.

To be able to use the printer it must be loaded with paper, this being indicated by the paper out detector in the OFF position. Besides, the operational switch READY on the printer must be in position ON.

5.2.2 Control Panel

The Control Unit panel, see Figure 5.2:2, includes the following control functions:

- POWER ON/OFF

Consists of a switch and an indicator lamp. When switched on the terminal enters the ATTENTION SELECT status



and one CR and one LF are generated.

- MODEM READY

Consists of an indicator lamp which is lit when data set is ready (CCITT interchange circuit 107).

- LOOP

Consists of an indicator lamp which, when lit, indicates that the output line from the computer is internally connected to the input line of the computer in the terminal. This switching is performed manually with a LOOP SWITCH placed on the LCU board, in order to test that the line and the modem are functioning faultlessly.

- PRINT SUPPRESS

Consists of a locking switch which, when activated, generates a signal to the micro computer. The signal affects the control unit in such a way that, at input from the keyboard, nothing will be printed on the printer. However, the printhead of the printer moves, because SPACE characters are transmitted to the printer. Input to the central computer is, however, not suppressed

- PAPER OUT and RESET (paper out)

Consists of a non-locking switch and an indicator lamp. When the switch is depressed the terminal switches from INOPERABLE into BUSY state, if the previous state was BUSY, otherwise the terminal enters the ATTENTION SELECT state.

The RESET switch is functioning only when the terminal is in the INOPERABLE state, this owing to the paper out condition. Paper out is checked only when performing Form Feed.

- HOLD and HOLD/RELEASE

Consists of a locking switch and an indicator lamp. When the HOLD/RELEASE switch is set to HOLD, printing will immediately be stopped and the lamp HOLD lit. The state of the terminal will be unaffected.

When the HOLD/RELEASE switch is set to RELEASE, the lamp HOLD will go out. Printing will then be resumed without any loss of characters.

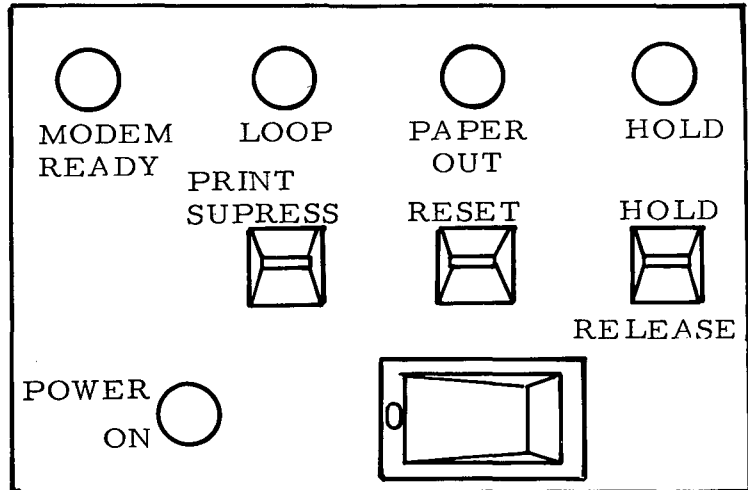


Figure 5.2:2 The control unit panel

5.2.3 Keyboard, control functions

The field mountable plug-in keyboard is an option. Given below is a description of the control keys which are added to the standard layout of the alphanumeric (ECMA-23C, version I) keyboard. Two control keys, CR and LF, which commonly are known will not be described below, as their functions are well-defined. See Figure 5.2:3.

- INPUT MODE

Consists of a red indicator lamp which, when lit, indicates either that the terminal is in the BUSY state and that data may be keyed into the terminal buffers, or that the transmission from the printer is carried out.

The lamp goes out when the transmission has been completed successfully.

If no key on the keyboard is depressed for one minute, the time-out function will release the input mode lamp, and a CANCEL will automatically be generated, see below.

- BREAK

With this key the operator enter the Input Mode which is indicated by the lamp on the Keyboard and simultaneously one CR and one LF will automatically be generated to the printer. The terminal switches from OPERABLE into BUSY state and now the operator can start typing the message.

- TRANSMIT (TRA)

When depressed, this key causes the terminal to switch from BUSY into the ATTENTION POLL state.

An exclamation mark (!) will be printed.



- ALARM and RELEASE alarm (REL)

Consists of a red indicator lamp and a key (REL). The ALARM lamp will be lit when the terminal has entered the INOPERABLE state, owing to the recovery alarm. Reference to LCU-manuals

Upon depression of the RELEASE key, the terminal goes from INOPERABLE state into the ATTENTION POLL state. The RELEASE key is functioning only when the terminal is in the INOPERABLE state, owing to the recovery alarm.

If, in the ALARM condition, the operator decides not to attempt re-transmission by depressing the RELEASE key, the terminal can, instead, be cleared by switching the power off-on. This switching causes the buffers to be erased, and the terminal enters the ATTENTION SELECT state.

- CANCEL

When this key is depressed during message input, the status of the terminal switches from BUSY into the ATTENTION SELECT, and the contents of the buffer will be erased. When depressed, a question mark (?) will be printed, and one CR and one LF will automatically be generated to the printer.

When, at data input, a buffer overflow situation occurs, an automatic CANCEL will be issued.

- BACK SPACE

When this key is depressed, the last character keyed-in will be erased. If depressed more than once, a corresponding number of characters will be erased until the buffer is empty.

Upon depression an underline (_) will be printed.



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ALARM INPUT MODE

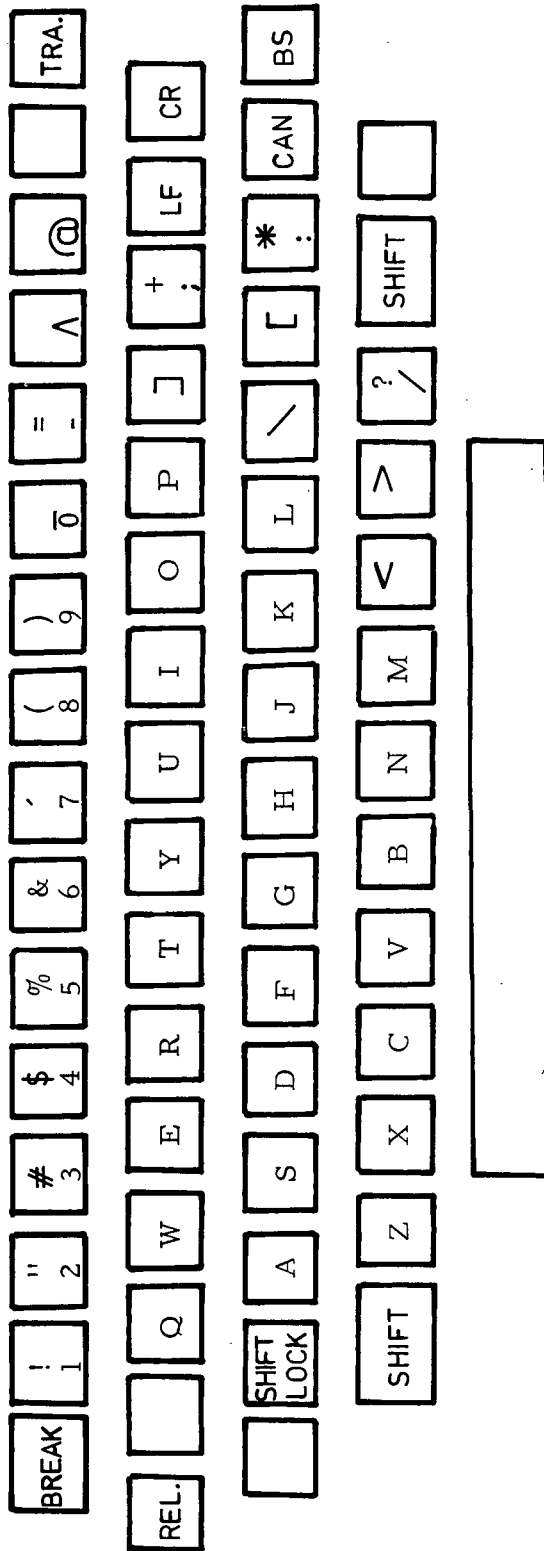


Figure 5.2:3 Keyboard layout according to ECMA-23C, version 1. (Keytop layout PTS 3151-011)



5.3 Control Unit PTS 3161-011, physical description

5.3.1 General

The control unit included in the P1094 terminal, is designated PTS 3161-011.

It is designed as a table model, and the parts like logic boards and power supply unit are mounted in a box with the dimensions (h x w x d): 235 x 499 x 437 mm. The height measure includes the feet.

The mass of the unit is appr. 20 kgs.

On the front of the control unit is a control panel which is attached to the box with four screws. When undoing these screws the panel can be moved forwards. Thereby the connectors with connections of the logic boards as well as the back of the power supply unit will be visible. See Figure 5.3:1, page 5.3/2.

The back of the control unit is covered by a plate with holes for self-ventilation of the unit. This plate can be removed after the loosening of four screws. Thereby the panels with connectors and switches of the power supply unit and the logic boards will be visible. See Figure 5.3:2, page 5.3/3.

5.3.2 Board locations

The control unit logic is built-up on four boards which are made in the form of plug-in units with a panel for each of the boards. See Figure 5.3:2.

The boards are named after their principal function. They are placed from right to left according to the following:

PROM	Contains the program memory and the interface of the micro computer
CPU	Contains the micro computer and its data memory
LCU	Contains reception- and transmission circuits and CCITT-V24 interface toward the line
PCU	Contains control circuits for the printer and the keyboard and a timer.



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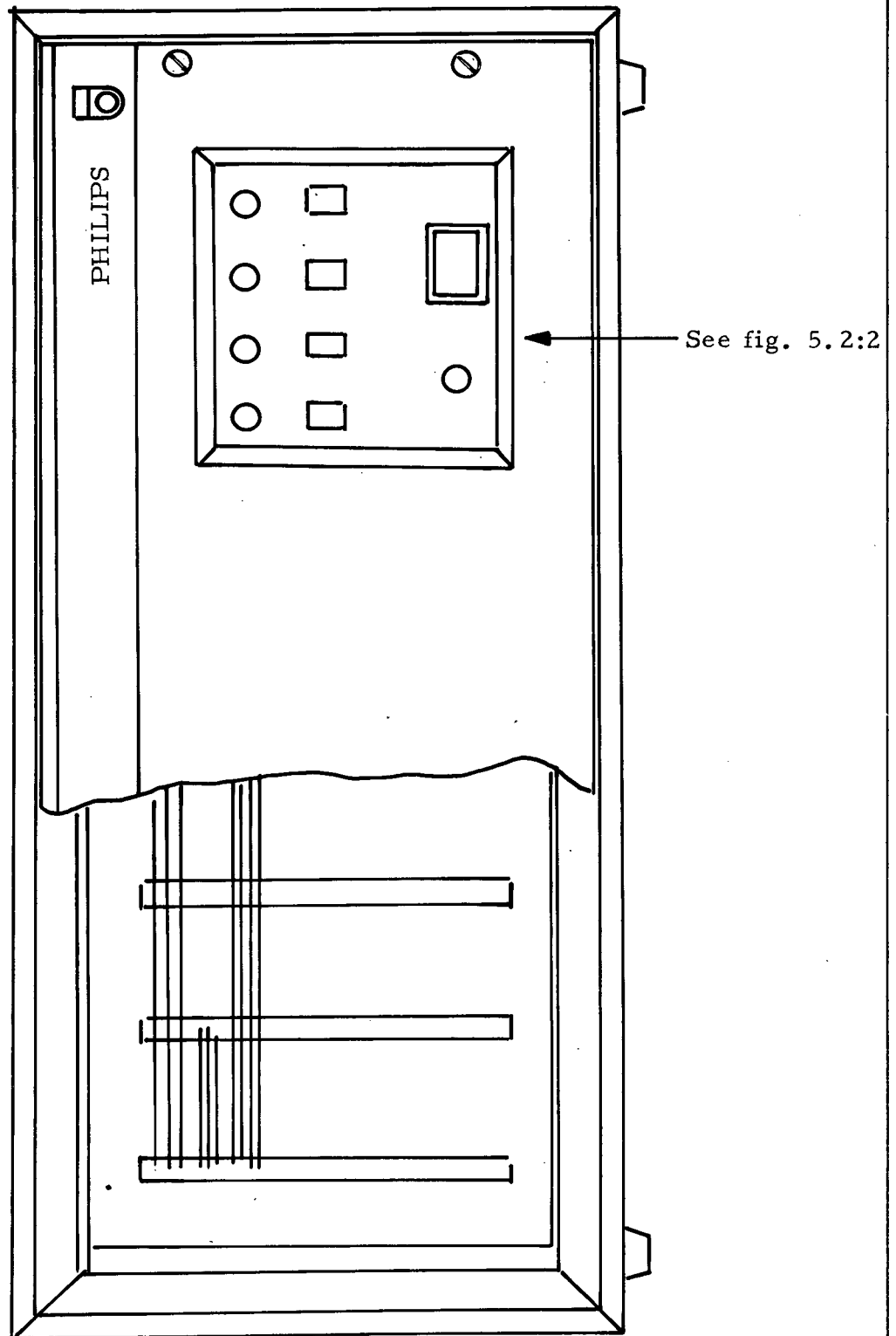


Figure 5.3:1 The front side of the control unit



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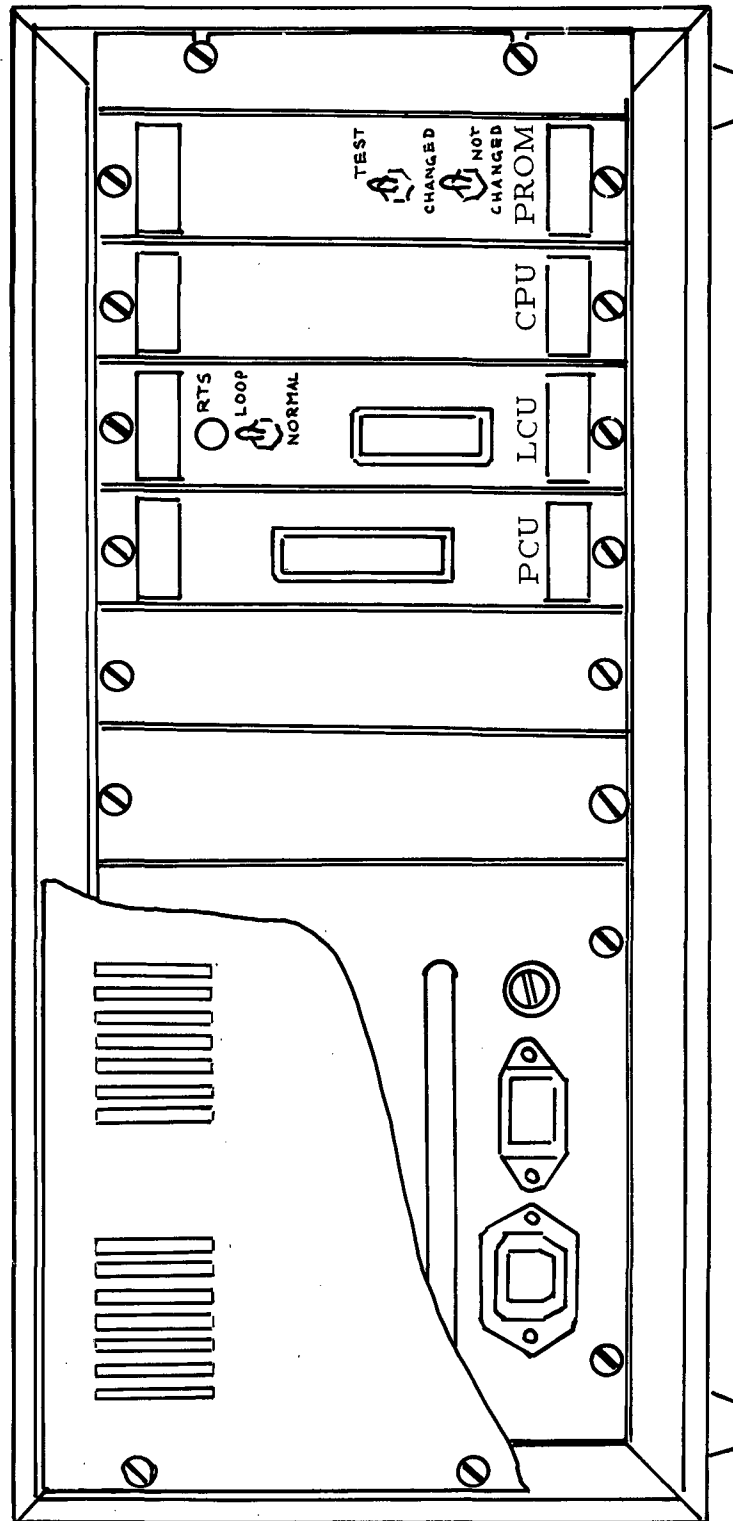


Figure 5.3:2 Rear view of control unit, back plate removed



On the panel of the board PROM there are two switches marked TEST and BUFFER CHAINING respectively:

- TEST

If this switch is placed in position TEST and the mains voltage is switched on, the terminal will take the inoperable state, and the printer will print all existing characters inclusive Carriage Return, Line Feed, Bell and Form Feed. Tested with this function is the micro computer and its program for print-out on the printer, and the control circuits for the printer.

- BUFFER CHAINING

If this switch is placed into position, the two buffers, each of 127 or 255 characters, will be coupled up to one buffer of 255 or 511 characters

On the panel of the board LCU there are a lamp marked RTS (Request to Send) and a switch marked LOOP:

- RTS

This lamp will glow when the modem signal CCITT interchange circuit 105 is applied from the terminal. Normally the lamp will flash when the terminal responds to the status query, selection or polling.

- LOOP

When this switch is set into position, line "transmitted data" is directly connected to line "received data" and the modem signal RTS is applied.

Line-transmitted data is CCITT interchange circuit 103, line-received data is CCITT interchange circuit 104, and RTS is CCITT interchange circuit 105.

By means of this function the entire transmission system can be checked out.

Beneath this switch there is a 15-pin Cannon connector to which the line from the modem is connected through a screened cable.



LCU Terminal Pin No	Modem Pin No	CCITT circuit	Designation
1	20	108/1	CDSL
2	7	102	Common return
3	2	103	TDAT
4	3	104	RDAT
5	4	105	RTS
6	5	106	RFS
7	15	114	TSET
8	17	115	RSET
9	6	107	DSR

On the panel of the PCU there is only one 25-pin Cannon connector to which the printer is connected through a screened cable, the length of which must not exceed 3 m. In case a keyboard is incorporated its signals will proceed through this cable.

PCU Terminal Pin No	Printer Pin No	Keyboard Pin No	Designation
2	2	2	<u>Indicator I0</u>
3	3		<u>Data 2⁰</u>
4	4		<u>Data 2¹</u>
5	5		<u>Data 2²</u>
6	6		<u>Data 2³</u>
7		14	<u>Common</u>
8	8		<u>Data 2⁴</u>
9	9		<u>Data 2⁵</u>
10	10		<u>Data 2⁶</u>
11	11		<u>Ready</u>
12	12		<u>Execute</u>
13	13		Ready
14	14	10	Indicator I1
15	15	1	Indicator I2
16	16	9	Indicator I3
18	18		Printer operable
19	19		Printer operable
20	20	6	Keyboard clock
23	23	11	Data from keyboard



5.3.3 Power Supply

The power supply unit is placed at the extreme left, if viewing the control unit from behind.

It is a plug-in unit with two terminals for connection to the voltage and signal wires of the logic boards.

On that end of the unit that points towards the front of the control unit the control panel is attached. On that end pointing towards the back there are two mains connectors. To the left-hand connector the printer is connected, to the right-hand connector the mains voltage, through a 3 m cable. Beside the connectors there is a 2 A mains fuse.

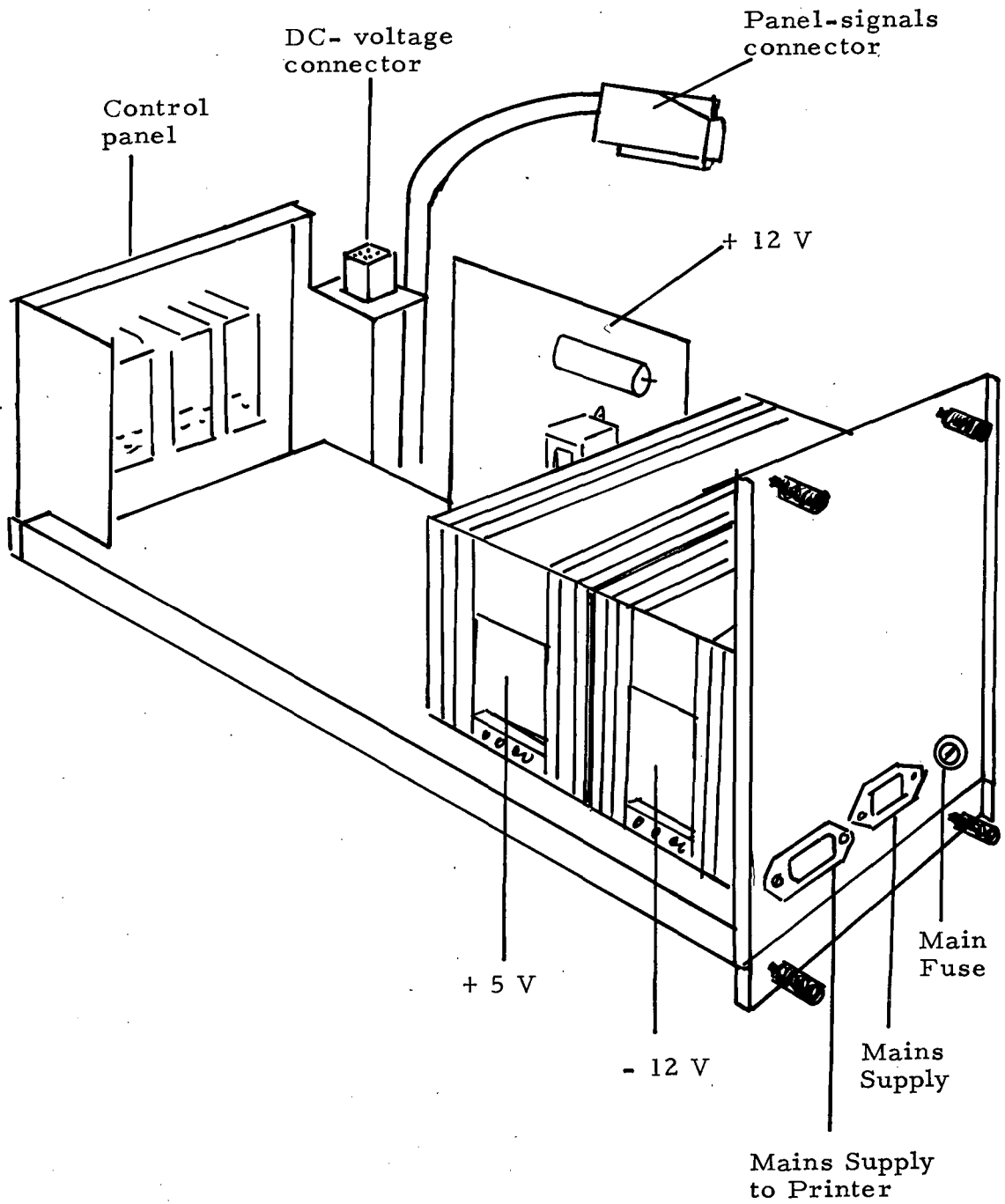
The unit can be removed backwards after undoing four knurled screws and after loosening an earthing plait on the front by means of a spanner. Furthermore, the connectors to the board-rack must be disconnected.

The power supply unit consists of three units which generate the voltages +5 V, +12 V and -12 V. See Figure 5.3:3.

- +5 V is generated by the unit STABPAC MkII MTC 5-3, a stabilized power supply unit delivering
 - +5 V \pm 0.05 %
 - 3 A max
- -12 V is generated by a similar unit, STABPAC MkII MTC 12-1.7, delivering
 - 12 V \pm 0.05 %
 - 1.7 A max
- +12 V is generated by a unit built-up on a printed circuit board delivering zener stabilized voltage
 - +12 V \pm 10 %
 - 30 mA max

The three units are short-circuit proof and neither is secured but with the main fuse. Between the fuse and the units there is a mains filter for noise suppression.

Automatic resetting of control unit and printer occurs when the power is switched on. The terminal is entering the ATTENTION SELECT state.



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Figure 5.3:3 Power supply unit



The connectors between the power supply unit and the panel and the board frame are a 9-pole Molex- and a 15-pole Cannon connector.

- Molex

Pin No	Designation
1	+ 5 V (common)
2	+ 5 V
3	-12 V (common)
4	-12 V
5	+12 V (common)
6	+12 V

- Cannon

Pin No	Designation
1	LIT 3
2	LIT 2
3	LIT 1
4	LIT 0
5	SW 3
6	SW 2
7	SW 1
8	SW 8
9	MC



5.4 Control Unit PTS 3161-011, functional description

5.4.1 General

As shown in Appendix 5.4:1 the logic of the control unit is built up on four boards:

- LCU, the Line Control Unit,
- PROM, the Programmable Read Only Memory,
- CPU, the Central Processor Unit,
- PCU, the Printer Control Unit.

These boards are connected with each other through an Input/Output bus (I/O), on which data and control signals are transferred with a rate of ca 700 000 bits/s.

The micro computer of the control unit is designed with LSI (Large Scale Integration) technique. The CPU (Central Processor Unit) with its RAM (Random Access Memory) are housed in 16-pins DIP packages, made by Intel and designated MCS -4 Micro Computer Set. The program memory consists of the PROMs and these are accommodated in 24-pins DIP packages. For a more detailed description of the packages reference is made to the Users Manual of Intel. For this description the units, the designations and the quantities are:

- CPU 4004 1 pc
- RAM 4002-1 4 pcs, max 8 pcs
4002-2 4 pcs, max 8 pcs
- PROM 1702A 5 pcs without keyboard and
3 pcs with keyboard, max 16 pcs
- Interface 4008 1 pc
- Interface 4009 1 pc

5.4.2 Input/Output (I/O) bus

The board connectors of the control unit are connected with wires which connect connector terminals with the same number for all connectors, thereby forming an input/output bus. This implies, that it is possible to insert the boards on different locations in the board frame and also that the control unit can be extended with other boards to be inserted on one of the spare locations, which as well are connected to the I/O-bus.

The boards CPU and PROM, however, have definite locations because there is a separate data and control bus between them.



The signal levels on the I/O-bus are TTL standard levels and all signals have negative logic data representation, i.e.

logic 0 = +2.4 V to +5.0 V
logic 1 = 0 to +0.4 V

The wires of the bus have various functions, their designations and number are given below:

BOU 0 - BOU 7	DATABUS OUT, an 8-wire bus on which CPU transmits data, either to printer and keyboard through PCU, or to the line through LCU
BID 0 - BID 7	DATABUS IN, an 8-wire bus on which data are transmitted to the CPU, either from the line or from the keyboard
BIS 0 - BIS 3	STATUSBUS IN, a 4-wire bus on which status signals for certain functions are transmitted to the CPU, e.g. parity check on data from the line or the keyboard
SEL 0 - SEL 7	SELECT BUS, an 8-wire bus by means of which CPU selects the device to which data are to be transmitted or from which data are to be fetched. With signals on these lines also some functions in the control unit, e.g. the timer on PCU, are activated
RDY 0 - RDY 7	READY BUS, an 8-wire bus on which the various devices communicate with CPU, either with call signals or with receipt signals
TEST	TEST is just one wire on which a READY signal is sent to CPU from LCU having direct access to CPU via an instruction JCN (Jump on Condition).

To the bus belong also a number of wires on which clock pulses are transmitted from basic timing circuits on the CPU board. There are clock pulses partly on TTL level, called Cp, partly on a level between +5 V and -10 V, called \emptyset , used for timing of CPU and PROM.

Also generated on the CPU board is a Reset signal, that resets all logic in the control unit at power on, and when the +5 V voltage is reduced to under +4 V. This signal is called MC (Master Clear).



Additional wires connect the boards and the control panel with one another:

LIT 0 - LIT 3 LAMP INDICATOR BUS, a 4-wire bus on which signals to the lamps on the control panel are transferred

SW 0 - SW 3 SWITCH BUS, a 4-wire bus through which the switches of the control panel can activate certain functions in the control unit.

5.4.3 CPU and PROM function

The micro computer and its program memory are housed on two boards, CPU and PROM, and between these boards are separate wires which do not belong to the I/O-bus.

Owing to the fact that the micro computer communicates with its program memory on these wires, the boards mentioned must be described together.

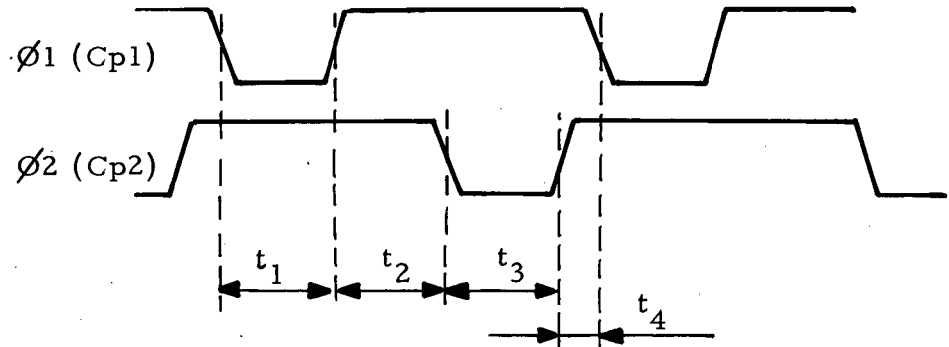
- Basic timing

For the correct operation of the micro computer two non-overlapping clock phases, Cp1 and Cp2, are used on TTL-level and $\phi 1$ and $\phi 2$ on LSI-level (+5 V to -10 V).

These clock pulses are generated on the CPU board by a crystal-controlled oscillator with a frequency of 5 MHz.

The pulses from the oscillator are divided in a divide-by-7-counter, down to ca 714.2 kHz. The outputs of the counter are decoded such that two phase displaced signals are obtained. See Figure 5.4:1.

Data and control signals on the I/O-bus are timed with Cp2 while Cp1 is used for setting of flip-flops and buffers within the board concerned.



$$t_1 = t_2 = t_3 \approx 400 \text{ ns}$$

$$t_4 \approx 150 \text{ ns}$$

$$\phi_1, \phi_2 = +5 \text{ V to } -10 \text{ V}$$

$$Cp1, Cp2 = 0 \text{ to } +5 \text{ V}$$

Figure 5.4:1 Non-overlapping clock phases

- Master Clear

On the CPU board there is a circuit that generates a Reset signal called MC (Master Clear). This signal resets all logic in the control unit at power on, and when the +5 V voltage is reduced to under +4 V.

The duration of this pulse is ca 30 ms. It is delivered by the flip-flop K to CPU and its RAMs, and also out on to the I/O-bus to the other boards.

For CPU the Reset signal must be applied for at least 8 full instruction cycles (64 clock cycles) and for the RAMs 256 clock cycles are needed.

- Micro computer

The heart of the MCS-4 micro computer set is the 4004 CPU. This device has a powerful and versatile instruction set which allows the system to perform a wide variety of arithmetic, control and decision functions.

The features of the CPU are:

- 4-bit parallel CPU with 45 instructions
- Decimal and binary arithmetic modes
- 11.2 μs instruction cycle
- Addition of two 8-digit numbers in 850 μs
- 16 4-bit general purpose registers
- Nesting of subroutines up to three levels
- The instruction set includes conditional branching, jump to subroutine and indirect fetching



- 2-phase dynamic operation
- Synchronous operation with memories
- Direct drives up to: 4k by 8 PROMs (16 1702A's)
1 280 by 4 RAMs (16 4002's)
- Memory capacity expandable through bank switching
- 16-pin DIP package
- P-channel silicon gate MOS .

The CPU communicates with its RAMs (data memory) and PROMs (program memory) over a 4-wire data bus (D0 - D3). This data bus is used for all information flow between the packages, with the exception of the control signals, which are transmitted to the RAMs and the PROMs over another five command control lines. Four of these lines (CM RAM, CM 0 - CM 3) are used for controlling the RAM packages (each line controls four RAMs) and one line is used for control of the PROMs (CM ROM).

In addition, from CPU comes an extra line, Sync, on which a synchronization signal is sent out every eighth clock period to the RAMs and the PROMs. The synchronization signal indicates the beginning of each instruction cycle in the micro computer.

The instruction repertory of the 4004 consists of:

- 16 machine instructions, five of which are of double length
- 14 accumulator group instructions
- 15 input/output and RAM instructions.

The instruction cycle of the micro computer has a duration of 11.2 μ s.

The basic instruction execution requires 8 or 16 cycles of a ca 700 kHz clock. In a typical sequence the CPU transmits 12 bits of address (in three 4-bits on the data bus) to the PROMs in the first three cycles (A_1 , A_2 , A_3). This address selects 1 out of 16 chips and 1 out of 256 8-bit words in that chip. The selected PROM chip sends 8 bits of instruction (OPR, OPA) back to the CPU in the next two cycles (M_1 , M_2). This instruction is sent over the 4-wire data bus in two 4-bits. The instruction is then interpreted and executed in the final three cycles (X_1 , X_2 , X_3). See Figure 5.4:2.

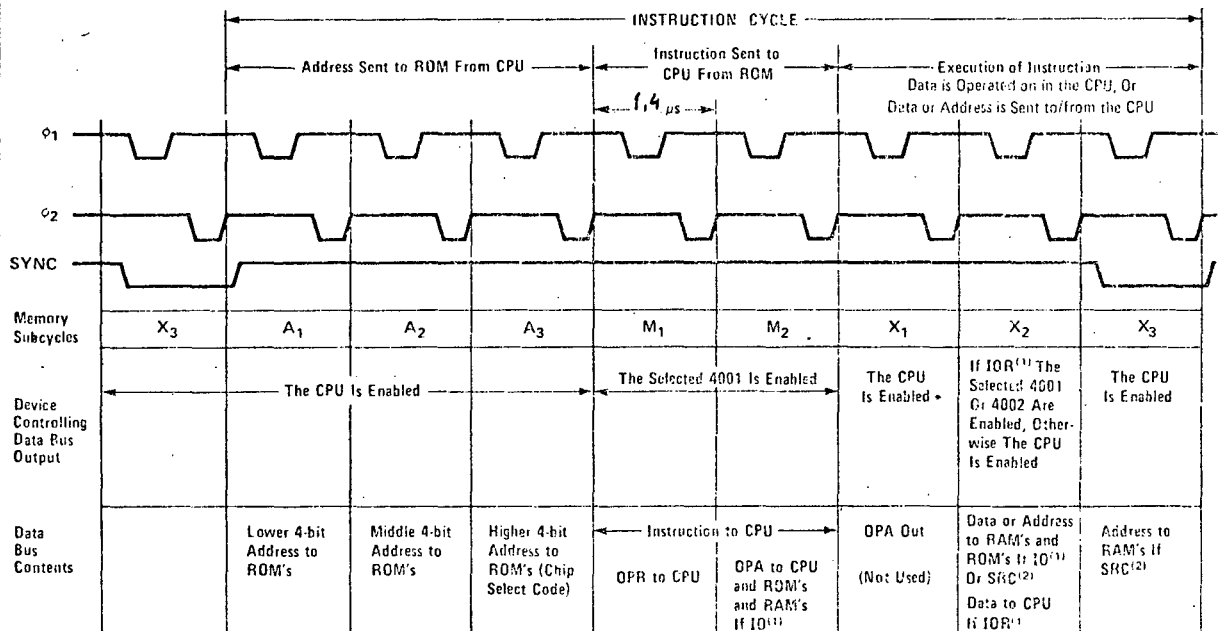
When an I/O instruction is received from the PROM, data are transferred to the CPU accumulator on the four PROM input lines during X_2 time.

A set of four RAMs is controlled by one of four command control lines from the CPU. The address of a RAM chip, register and character is stored in two index



registers in the CPU and is transferred to the RAM during X_2 , X_3 time when a RAM instruction is executed. When the RAM output instruction is received by the CPU, the contents of the CPU accumulator is transferred to the four RAM output lines.

The CPU, RAMs and PROMs can be controlled by an external Reset line which is connected to the Master Clear function. While RESET is activated, the contents of the registers and the flip-flops are cleared. After RESET the CPU will start from address 0 and CM-RAM₀ is selected



(1) IO instructions control the flow of information between accumulator in CPU, I/O lines in ROM's and RAM's and RAM storage. IOR stands for IO Read. In this case the CPU will receive data from RAM storage locations or I/O input lines of 4001's.
 (2) The SRC instruction designates the chip number and address for a following IO instruction.

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Note. 4001 (ROM) replaced by 1702A (PROM)

Figure 5.4:2 MCS-4 basic instruction cycle



- Data memory

As data memory are used the packages 4002-1 and 4002-2 deviating only in the use of the chip selection pin No 11 (P₀).

When a 4002 package is used as RAM, 320 bits arranged in four registers containing four status characters and 16 main memory characters, are stored. See Figure 5.4:3.

	Status characters	Main memory characters
1 chip 4002	4 x 4 bits	16 x 4 bits
	"	"
	"	"
	"	"

Figure 5.4:3 4002 package used as RAM

That part of the package where the main memory characters are stored constitutes the buffer in which the 8-bit data characters, to be sent from or having been received by the terminal, are stored. Each chip, therefore, is able to store 32 8-bit characters. From this is made clear that four chips of the 4002 type are needed to form buffer 1, accommodating 128 8-bit characters, and the same number of chips is required for buffer 2.

Note. From a hardware point of view the buffers consequently accommodate 128 characters, however, one character position is used program-wise for storing of an end character. Therefore, each buffer is able to receive 127 characters from the line or from the keyboard. If the buffers are chained together to one buffer, one end character only is needed, and 255 characters can be received. However, keyboard buffer is always 127

- Output system

Each 4002-RAM contains also a 4-bit latch, in which data (BOU 0-7) and the destination of the data (SEL 0-7) to be let out, over drivers, on the I/O bus, are set.

By putting in 8 more 4002 (RAM)- Chips the buffer will be extended to 2 buffers having room for 255 characters each, or 511 characters at, buffer chaining. Still keyboard buffer is 127 characters.



- Program memory

As program memory is used package 1702A-PROM, being a Programmable Read Only Memory, storing 256 8-bit program instructions or data tables.

If the keyboard is not connected to the control unit, only five packages 1702 A PROM are needed. On the other hand, if a keyboard is included in the terminal P1094, another three PROMs are required.

The max number of PROMs is 16, selectable with signal on 1 out of 16 chip select lines (CS0 - CSF). These lines are coming from a binary/decimal converter which receives chip select information in binary form from the lines C0 - C3, which also select 1 out of 8 inputs on a multiplexer, for fetching of data from the I/O-bus.

The correct address within each chip 1702A is selected with 8 address lines, A0 - A7, and as a response on an address selection an 8-bit instruction is received on the lines D0 - D7. The instruction is transferred in two steps with 4 bits at a time.

- PROM interface

On the PROM board there are two types of interface, one for adaption between CPU and PROMs, and one for adaption between the I/O-bus and CPU.

As interface between 4004 CPU and 1702A PROM the packages 4008 and 4009 are used.

The 4008 is the address latch chip which interfaces the 4004 to standard PROMs and RAMs used for program memory. The 4008 latches the 8-bit program address sent out by the CPU during A1 and A2 time. See Figure 5.4:2. During A3 time it latches the PROM chip number from the 4004. The 8-bit program address is then presented at pins A0-A7 and the 4-bit chip number (also referred to as page number) is presented at pins C0-C3. These four bits must be decoded externally and one page of program memory is selected.

The 4009 then transfers the 8-bit instruction from program memory to the 4004 four bits at a time at M1 and M2. The command signal sent by the CPU activates the 4009 and initiates this transfer.

When the CPU executes an SRC (Send Register Control) instruction, the 4008 responds by storing the I/O address in its 8-bit SRC register. The content of this SRC register is always transferred to the address lines (A0-A7) and the chip select lines (C0-C3) at X1 time.



The appropriate I/O port is then selected by decoding the chip select lines. The IN line (Enable input) of the 4009 indicates when an input operation will occur.

The 4009 is primarily used as an instruction and input transfer device. When the CPU executes an RDR (Read PROM Port) instruction, the 4009 will send an input strobe (pin 9) to enable the selected input port. It also enables I/O input buffers to transfer the input data from the I/O bus to the data bus.

The interface between the I/O bus and CPU includes the 4009 and a multiplexer.

The multiplexer consists of four packages, each with eight inputs, selected by the same lines as those selecting chip in the program memory. From the multiplexer is received, on four parallel lines, information about the state of four inputs at a time. When Enable Input is generated by the 4009, the information will be transferred to CPU over the 4009 and the data bus D0-D3. The four parallel lines mentioned above are designated I0-I3.

The following lines are connected to the 32 inputs of the multiplexer and divided into eight 4-bit groups, which are transferred to the CPU, one at a time.

Out-put bus	Multiplexer Input Groups							
	0	1	2	3	4	5	6	7
I0	BID 0	BID 4	BIS 0	RDY 0	RDY 4	B 0	B 4	B 8
I1	1	5	1	1	5	1	5	9
I2	2	6	2	2	6	2	6	10
I3	3	7	3	3	7	3	7	11

The BID, BIS and RDY signals come from the I/O bus, this being the way data and ready signals from the line, keyboard, printer a.o. are fetched in to the CPU.

The signals B0 - B11, on the other hand, are fetched at the moment when power is switched ON. The information to B0-B11 is received partly from a 10-bits terminal field, where the address number of the terminal is selected by jumpers and partly from the switches Buffer chaining (B10) and Test (B11).

N.B. No notice will be taken of adjustments of the switches after power is switched on.

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- Terminal address

Since the terminals P1094 are connected in parallel over modem units to a multidrop connection system, they must be distinguished by addressing.

This addressing is brought about either by "One address system", if the number of connected terminals is less than 32 or by "Two address system", if the number of connected terminals exceeds 32 (max number of terminals = 256).

By strapping of the lines B0-B9 either to earth or to +5 V the address of the terminal will be formed. This address is at call from the line fetched in to the CPU and compared with the address sent out on the line by the central computer.



The terminal has three different addresses, dependent on the function of the data transmission:

- SELECT ADDRESS Used when data are sent to the terminal or at status enquiry
- POLL ADDRESS Used as invitation to the terminal to transmit
- IDENTIFICATION ADDRESS Terminal identification as answer on status enquiry or polling

The addresses consist of one or two 8-bit address characters having a fixed part stored in the program and a variable part which can be altered with "jumpers" in the strapping field of the PROM. The codes of the various address characters are shown in the table below.

B8 is used for the distinguishing between 1- and 2-address systems.

B9 is used for informing about the size of the buffer, either 2 x 127 (B9 = 0) characters or 2 x 255 (B9 = 1) characters corresponding to 8 or 16 RAM:s 4002 respectively.

- 1-address system, B8 = 0
Max number of terminals = 32

Address function	Character codes							
	P	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
SELECT	X	1	1	} B4	} B3	} B2	} B1	} B0
POLL	X	1	0					
IDENT.	X	0	1					

Variable by jumpers

Ex. POLL ADDRESS for Terminal No 6

(6)₁₀ = (0 1 0 0 0 1 1 0)₂

- 2-address system, B8 = 1
Max number of terminals 256 (FF)

Address function	Character codes								
	P	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰	
SELECT	} 1	X	1	1	} B3	} B2	} B1	} B0	
POLL		X	1	0					1
IDENT.		X	0	1					1
SELECT	} 2	X	1	1	} B7	} B6	} B5	} B4	
POLL		X	1	0					0
IDENT.		X	0	1					0

Variable by jumpers

Ex. See next page

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Ex. SELECT ADDRESS for Terminal No 49 (decimal)
 $(49)_{10} = (31)_{16} = \text{character 1 } (01110011)_2$
 $\text{character 2 } (01100001)_2$

5.4.4 LCU

- General

The Line Control Unit, LCU, is placed on a board with designation.

The LCU operates in half duplex, meaning that there is an input channel and an output channel but simultaneous transmission of messages in both directions is not possible. with the transmission rate up to 9600 baud.

The LCU is connected to 4-wire multidrop lines over a modem, that can be outplant (for transmission on leased lines) or inplant (for transmission on own lines).

The signals towards the modem are in accordance with the standard for the CCITT-V24 interface, i.e. the signals levels should be either $> +3\text{ V}$ or $< -3\text{ V}$.

The significance of the different signals between the LCU and the modem is shown below.

Circuit 108.1	CDSL	Connect Data Set to Line. If ON, this signal switches the modem on the line, if OFF, the modem is switched off the line
Circuit 107	DSR	Data Set Ready. If ON, this signal indicates that the modem is ready to operate. Receipt on circuit 108.1
Circuit 105	RTS	Request to Send. This signal asks the modem to switch on its transmitter
Circuit 106	RFS	Ready for Sending. If ON, this signal indicates that the modem has switched on its transmitter upon RTS. Delay between RTS and RFS is called τ_{106}
Circuit 103	TMD	Transmitted Data. The data to be modulated and transmitted by the modem
Circuit 104	RCD	Received Data. The data received and demodulated in the modem



Circuit 114	TSET	Transmitter Signal Element Timing. Synchronous clock signal for the transmitting circuits in the LCU
Circuit 115	RSET	Receiver Signal Element Timing. Synchronous clock pulse for the receiving circuits in the LCU
Circuit 102		Common return

The LCU performs the following functions:

- Modem control
- CCITT-V24 level adaption
- Input data buffer
- Output data buffer
- Idle character buffer
- Serializer
- Deserializer
- Timing and control

- Modem control

When mains voltage is applied the control unit, a +12 V voltage will be applied the circuit 108.1 (CDSL) over a resistor. If the modem is ready to operate it responds with a voltage level on 107 (DSR), at which the transistor V1 will open and short-circuit LIT 3 on the I/O bus to earth. In doing so, the lamp Modem Ready will be lit on the control panel.

When the CPU transmits the command SEL 4, along with BOU 7, on the I/O bus, these signals proceed to the LCU board and set the flip-flop J. Thereby a signal level will be applied on circuit 105 (RTS) and, simultaneously, the lamp RTS will be lit.

As soon as the modem has switched on its transmitter on RTS it responds, on circuit 106 (RFS), with a signal level that transmission is ready from the terminal.

The CPU disconnects RTS with the command SEL 4 · BOU 6 at which the flip-flop J will be reset and the lamp RTS goes out.

This means, the lamp will flash when the terminal answers status queries.



- CCITT-V24 level adaption

Most of the signals (not 102, 107 and 108.1) to and from the modem pass amplifiers which adapt the TTL-levels on the LCU to plus and minus voltages of the line. From the LCU the lines are driven with +12 V and -12 V, and the levels of the signals to the LCU must be $> +3$ V or < -3 V.

- Input channel

The main part of the input channel consists of a MOS circuit (MC 2259) in a 28-pin package called Terminal receiver. There is also a detector for the detection of the character SYN, coming from the line with the object of establishing synchronism between the modem and the LCU.

Included in the input channel are also some flip-flops and gates. (Some gates are used as amplifiers, and they are not indicated in Appendix 5.4:1.)

When the LCU operates in input mode (IM), i.e. the flip-flop C reset, data arrive in serial form on circuit 104 and are timed by 115 in the Terminal receiver where they are shifted into a data buffer, the outputs of which are detected by the SYN detector.

The data characters are shifted into the data buffer (8-bit) in a continuous flow but nothing happens in the LCU until the code for a SYN character is detected. At that instant the flip-flop A is set and generates the signal SYN Detected. This signal shuts the outputs of the data buffer and starts a count-to-8 counter, stepped by RSET at the same time as the next 8-bit character is set into the data buffer.

When a complete character has been stored in the data buffer the counter has reached 8 and sets the flip-flop B that indicates Buffer filled.

Since the flip-flop C is in the input mode, a signal proceeds on to the TEST line and a call is made to the CPU that a data character is to be fetched on the LCU.

The CPU applies the command SEL7 on the I/O bus. This command enters the LCU to the Terminal receiver which generates a strobe pulse that opens the outputs of the data buffer. The code for the character proceeds over D0-D7 to gates which are opened by SEL7. Two other gates are also opened in order to let out information whether there is an overflow or a parity error on the data character.

The outputs of these gates are connected to the I/O bus, BID 0-7 for data and BIS 0-1 for status.



BIS 1 lacks significance for the CPU, which neglects it. Parity error will be reset after being read on SEL 7.

The CPU fetches the character from the I/O bus. In case this character too is a SYN character, the terminal remains synchronized, else the program sends SEL 4•BOU 5 to reset synchronism. Those bits, which continuously arrive on the in-channel are stored in the Terminal Receiver buffer and when the buffer is filled the flip-flop B will again be set. Another TEST signal informs the CPU that characters can be fetched on the LCU. SEL 7 strobes out the character on the I/O bus and resets the flip-flop B.

When the terminal wants to transmit the CPU sends SEL 5 that sets the flip-flop C into Output mode (OM). Then SEL 4•BOU 7 is sent for setting the modem to transmission.

- Output channel

The output channel contains a complex MOS circuit (MC 2257) in a 24-pin package called Terminal transmitter.

The Terminal transmitter can be fed with data either from the IDLE character buffer (IDLE = e.g. SYN, BSC, AOC) or from the Character buffer, where data to be sent from the terminal are placed.

For character control from either buffer there is a number of flip-flops, some of which are set by the CPU with the SELECT signal.

Also two multiplexers are included in the output channel.

- IDLE character buffer

Transmission of idle characters occurs when the LCU is in the input mode.

In the output mode idle characters are transmitted when no data character has been sent to the normal output buffer, the Character buffer.

Output of data to the idle buffer is carried out with 8 bits and parity is not generated during transmission. This enables the sending of any character.

The characters being set in the IDLE buffer arrive from the CPU over the I/O bus wires BOU 0-BOU 7 and are set by the command SEL 5.

SEL 5 sets by force also the flip-flop H indicating New Idle Stored. The flip-flop remains set until the Idle character has been taken to the line.

This is effected in that way that the Terminal transmitter being loaded with parallel data from the Idle buffer over a multiplexer, is shifting out data on the line 103 (TMD) in serial form.



Each time a complete 8-bit character has been sent out "Empty" will be signalled.

By that the flip-flops E and F will be reset. The "Load" signal opens up for the next character, "Empty" ceases and the flip-flops E and F will again be set.

The flip-flop D has not changed its state, the reset state, indicating Idle selected to the multiplexer, which selects the data inputs from the Idle buffer.

When the flip-flop E activated the flip-flop F and brought it into set state, the signal also proceeded through some gates. A clock pulse is let through for resetting of flip-flop H, at which a TEST signal leaves for CPU which transmits new characters, Idles or valid characters.

Note. If the terminal remains in the Output mode but the CPU does not feed out new characters to the Idle buffer, the last character is still in the buffer and since the Terminal transmitter runs continuously the last character will be transmitted repeatedly.

- Character buffer

When the CPU decides to transmit a valid character, it feeds out the character on the I/O bus wires BOU0-BOU6 along with the command SEL6.

Thereby the character will be set into the Character buffer. The flip-flop G is set and the signal Character Stored is received. This signal sets the flip-flop D that selects the other eight multiplexer inputs letting through the character stored in the Character buffer to the Terminal transmitter. This character contains only seven bits and the parity bit is generated in a specific circuit for getting odd parity.

As soon as the complete character has been sent out on the line, the Terminal transmitter signals "Empty", by that the flip-flops E and F will be reset.

These flip-flops are again set when "Empty" ceases. By that the flip-flop D will be reset but before that a clock pulse will reset flip-flop G. This flip-flop sends a TEST signal to the CPU, informing that the LCU is ready for the next character.



- Loop function

On the LCU board there is a switch called LOOP by means of which a switching can be made so that incoming data to the terminal, on circuit 104 (RCD), are sent back on circuit 103 (TMD).

This switching is used at trouble-shooting to test the line and the modem.

With the LOOP switch inputs on a multiplexer are selected. The multiplexer consists actually of three multiplexers with two inputs each. The inputs are selected simultaneously. The first one selects between output data from the Terminal transmitter and input data from circuit 104 (RCD), to be sent out as TMD. The second one lights the lamp RTS, either from flip-flop J (output) or from a fixed voltage level. This means that the lamp will glow with a steady light in the position LOOP.

The third multiplexer sends out RTS either from the flip-flop J (output) or from a fixed level (LOOP). When the LOOP switch is set into position LOOP the signal LIT 2 will also be applied to the I/O bus. Thereby the lamp LOOP on the control panel will glow.

- Selection possibilities on the LCU board

There is a possibility of switching the clock signals to the Terminal transmitter. These signals arrive normally as TSET or as RSET. The switching is effected by resoldering a strap between two soldering lugs.

The other switching possibility is that one can select whether the parity bit on the incoming data shall be sent to the CPU, or not.

Normally the parity bit BID 7 is not required to the CPU since the parity check is already carried out in the Terminal Receiver, and the result sent on BIS 0. In this way programs are saved because no parity test by CPU is needed. This switching too is effected by soldering.



5.4.5 PCU

On the PCU board there are circuits for data adaption, data transferred between the control unit and printer and keyboard.

The following circuits are incorporated:

- Printer control unit
- Printer operable circuit
- Timer
- Keyboard display buffer
- Keyboard control unit

- Printer Control Unit (PCU)

Printing is performed character by character. The control unit includes a buffer for two characters. A ready signal is generated as soon as there is room for next character in the printer control unit buffer.

The printer will accept codes according to Figure 2.1:6. Other codes will generate a ready signal only.

Ready signal and command according to Figure 2.4:5.

When the CPU applies data on the I/O bus wires BOU 0-BOU 6, concurrently with the command SEL 0, the character is set into the Printer Character IN buffer.

The flip-flop L is, simultaneously, set by force by SEL 0 thereby indicating Character Stored. This signal passes an AND-gate, if the flip-flops N and O are reset, i.e. no printing is in progress.

From this AND-gate the signal proceeds partly to the OUT buffer, being loaded with the character from the IN-buffer, partly to the flip-flop M, being set.

The condition that flip-flop M is "1" and flip-flop N is "0" is sent back and lets through a clock pulse Cp2 for resetting of the flip-flop L. Thereby a receipt that data have been stored in the OUT buffer is sent to CPU over RDY 0 on the I/O bus.

When flip-flop M has been set, it sets, one Cp1 later, the flip-flop N, and Execute will be sent to the printer for printing of the character available on the data lines from the OUT buffer. As long as the flip-flop N is in the set state, the OUT buffer can not be loaded with new characters.

As soon as the printer completed the character it responds with Ready, this setting the flip-flop O, that resets the flip-flops M and N. The Execute ceases and thereby also Ready, causing resetting of the flip-flop O.



The OUT buffer will now be able to receive the next character which during Execute has been loaded into the IN buffer, i.e. PCU is able to store two characters.

If the switch HOLD is placed in position Hold (instead of the normal position Release), the printer will be halted, because RDY0 will be inhibited and the CPU will stop sending more characters to the PCU.

- Printer operable circuit

Before the control unit can start the transmission of data to the printer the CPU must test, on the line RDY1, that the printer is operable.

This test is done after every Form Feed command to the printer in order to check that "Paper out" condition is not at hand in the printer.

RDY1 comes from the flip-flop P which, if reset, sends out RDY1 concurrently with LIT1, which lights the lamp Paper out on the control panel.

Flip-flop P is set by the signal Printer operable, along with either the RESET switch (SW1) on the control panel, or at power on by a pulse the duration of which is ca 300 ms. This pulse is generated by MC (Master Clear). See the timing diagram in Figure 5.4:4.

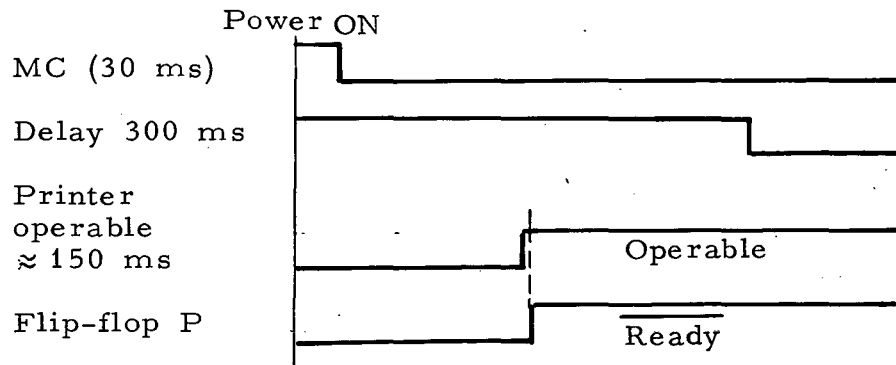


Figure 5.4:4 Operable timing

The RESET switch has the same function as MC but is used after loading the printer with new paper, this in order to get rid of the RDY1 signal and to extinguish the Paper out lamp on the control panel.



- Timer

The terminal is equipped with a timer for time supervision of certain sequences. The timer is connected to the ready line RDY2 and ready is the initial state after power on. When the command Activate timer is given, the ready signal is reset and occurs again after 300 ms. If another command Activate timer is given before the previous one has disappeared, time measurement will be re-started and the ready signal appears 300 ms after the last activation.

The Activate timer command is BOU4 together with SEL4.

- Keyboard Display Buffer

The keyboard accommodates four indicating lamps which can be lit and extinguished under program control. A lit lamp corresponds to a "1" bit. The least significant bit concerns the lamp to the extreme right.

The information to the lamps is stored in the Keyboard display buffer, consisting of four latches being set by data from the I/O bus wires BOU0-BOU3, along with the command SEL2. BOU0 = Input Mode, BOU1 = Alarm.

- Keyboard Control Unit (KCU)

Upon depression of a key on the keyboard a ready signal RDY3 will be generated. This is to be sensed by the CPU and the character read. The keyboard character consists of eight bits out of which the most significant one, the parity bit, is always zero on the I/O bus. If another key is depressed before reading the first one, the code for the last depressed key will be stored in the KCU buffer. Note. Storing of the code for the first depressed key is enabled by a reconnection.

The codes from the keyboard are in accordance with those shown in Figure 3.2:3.

The KCU incorporates a clock pulse generator consisting of a divide-by-16 counter, stepped by Cp1 and generating three pulse trains:

- 45 kHz Clock pulses for the keyboard
- 90 kHz used for setting flip-flops in the KCU
- Set (carry) Pulses for stepping a bit-counter and for shifting in data into a converter

See Figure 5.4:5.

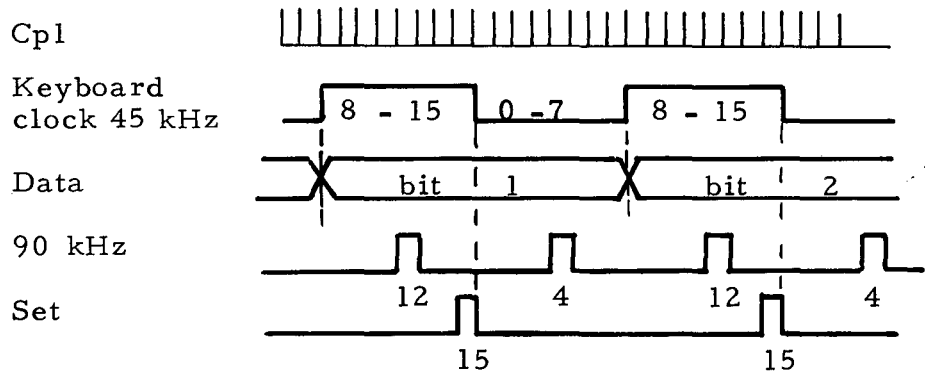


Figure 5.4:5 KCU clock pulse timing

In Figure 5.4:5 is shown how the various positions of the divide-by-16 counter are used.

- Data are shifted by the pulses 8-15
- The start bit is controlled during 12 and 4
- The data bits are set into the converter during 15

When the start bit of a character from the keyboard reaches KCU flip-flop Q is set when pulse 12 clocks it. Then the flip-flop R can be set, when clocked by pulse 4. If these two flip-flops, Q and R, have been set, the signal Enable will be generated and a bit-counter can be advanced by the Set pulses which also set the bits into a series to parallel converter.

Note. The start bit is checked by reading it twice. First during pulse 12, when the flip-flop Q is set, then during pulse 4, when the flip-flop Q can be reset if the start bit is not steady. In that case the flip-flop R will never be set with the result that the bit-counter does not start.

If the start bit is free from error, the bit-counter starts the advancing at the same rate as the bits are set into the converter. When the counter reaches position 8 the character will be parallel set into the Keyboard buffer, simultaneously the flip-flop S is set and RDY 3 leaves for CPU, informing that data are available for fetching from the Keyboard buffer. (The bit-counter is reset also by 8.)

The CPU responds with SEL1 that resets the flip-flop S at the same time as the information on BID 0-BID 6 (BID 7 always 0) and BIS 0, originating from a parity check circuit, is fetched in.

- Selection possibility on PCU

Normally the last depressed key is stored but if a strapping is resoldered to flip-flop S instead of to SEL1, the first depressed key will be stored.



This last mentioned case therefore occurs as long as the flip-flop S remains set (and so it is until SEL1 fetches the character) preventing bit 8 from the bit-counter from reloading the Keyboard buffer.

PRINT SUPPRESS is an other selection possibility which can be done with a switch on the control panel
If the switch is activated all entered characters are replaced by spaces before printing.

When activated the switch puts out the signal RDY 4 on the I/O - bus and when someone is typing on the keyboard, the CPU will send Space to the printer instead of the codes of the keys.

This means , with the switch in position Print Suppress the print head will be moving one character space for every character that should have been printed.



5.5 Control Unit Routines

5.5.1 General

The following definitions have been made below:

- Output: transfer modem ► terminal
- Input: transfer terminal ► modem

- The code of the terminal

The terminal P1094 uses codes which are equivalent to the ASCII/ISO-7 code table in Figure 2.1:6, and codes for the below mentioned characters which, however, lack significance for the printer. (If e.g. STX is inserted in a message, the printer does not take any consideration to it.) Such characters are:

- SOH (01) Start of heading
- STX (02) Start of text
- ETX (03) End of text
- EOT (04) End of transmission
- ENQ (05) Enquiry
- ACK (06) Message accepted
- NAK (15) Message not accepted
- SYN (16) Synchronization character

For input the same codes as above are used, however, with the following exceptions:

- BEL (07) Bell
- BS (08) Backspace
- FF (0C) Form feed

- Text format for output mode

The texts transmitted to the terminal have these formats:

a)

S				E B
T		---- Text ----		T C
X				X C

b)

S			S		E B
O		---- Heading ----	T		---- Text ----
H			X		X C

BCC = Block Check Character

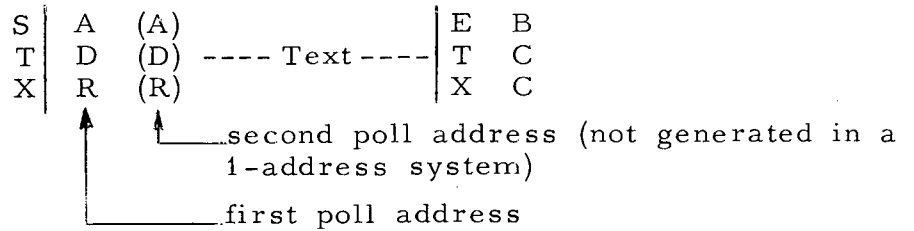
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It is the duty of the central computer to insert CR LF in the proper positions in order not to go beyond the line capacity of the printer.

- Text format for input mode

The max length of the text transmitted from the terminal is 127 characters, with the following format:



Only the text part is generated by the keyboard. Each text may consist of one or more lines, separated by CR LF.

The keyboard operator need not care about all extra characters required for the transmission of a message but start by just depressing the key BREAK whereupon the terminal switches to the input mode as soon as the two buffers are free.

Input mode is indicated by the rightmost lamp on the keyboard.

- Terminal status

See the flow charts for the terminal, Figures 5.5:1 and 5.5:2.

The terminal can take a number of status, with and without keyboard:

- ATTENTION SELECT A state of transition after Power ON, Paper OUT and Busy conditions. When the terminal receives the enquiry/select sequence from LCU 5, the terminal shifts from this state into the OPERABLE state

- OPERABLE The normal state of the terminal. When the two buffers of the terminal are occupied, or when the Break key is depressed, it shifts into the BUSY state



- BUSY

The terminal state when no buffer is available or when the Break key is activated for transmission of a message from the terminal. Normally the terminal shifts from BUSY into ATTENTION SELECT state when the buffers have been printed. If, however, paper out occurs before, the terminal will shift into the inoperable state

- INOPERABLE

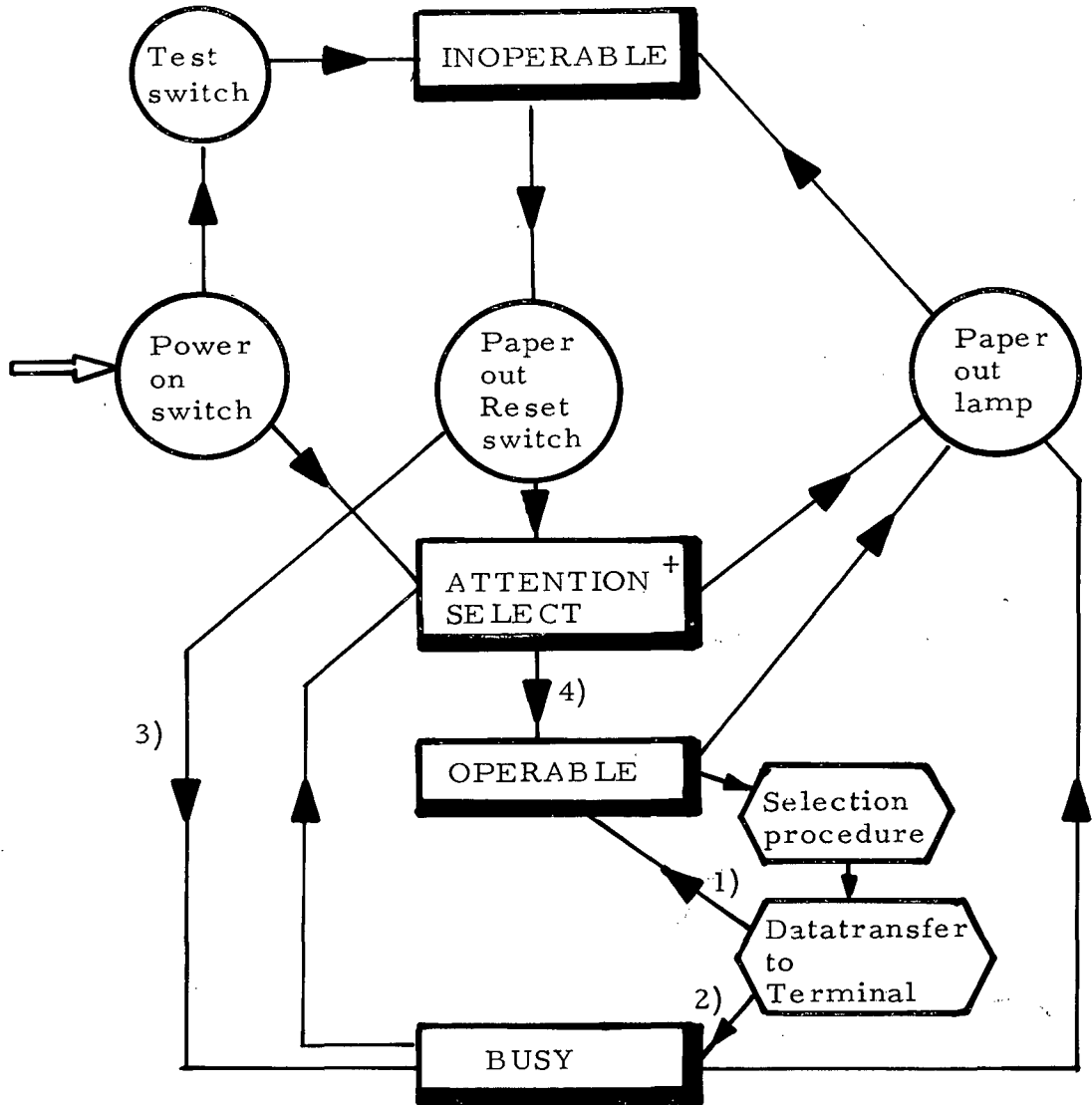
Terminal state if

- paper is out and Form Feed or Line Feed is printed. The terminal switches into ATTENTION SELECT when paper has been inserted and Paper Out Reset key is pressed

- input transfer was after three attempts not successful and the alarm lamp lights (recovery alarm). The terminal switches into ATTENTION POLL when the Release key is depressed.

- ATTENTION POLL

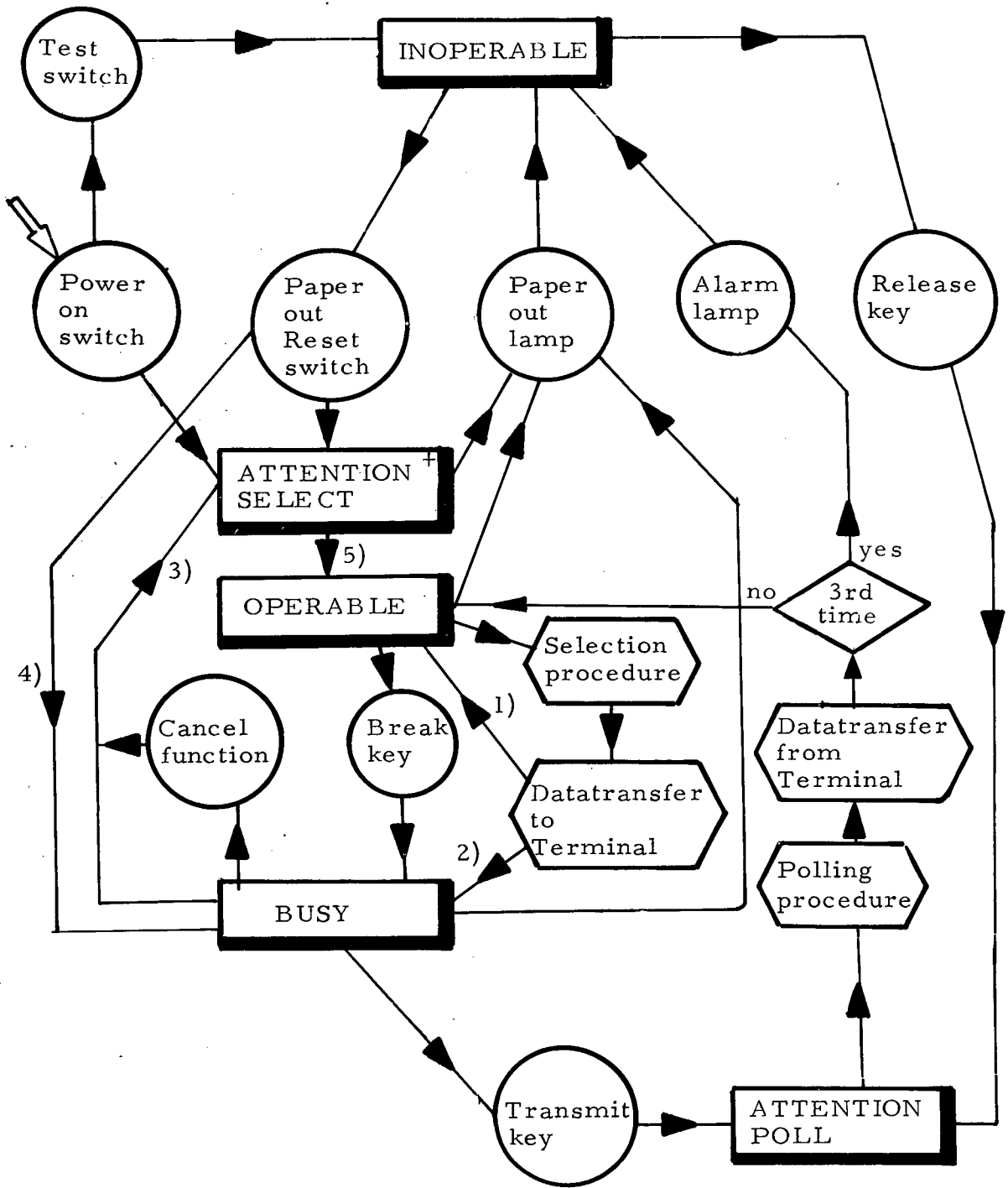
This state will be taken by the terminal if the transmit key is depressed. Then transfer will start from the terminal. If the message is not approved it will be repeated up to three times if necessary. However, if the transfer is not successful the alarm lamp will glow on the keyboard and the terminal becomes INOPERABLE.



+ The terminal shifts into operable status after sending attention select status identification character once.

- 1) When 1st buffer is printed out and 2nd buffer is empty
- 2) Two buffers occupied
- 3) If previous state was BUSY
- 4) The terminal goes to OPERABLE after it is addressed

Figure 5.5:1 Status flow chart for terminal without keyboard



+ The terminal shifts into operable status after sending attention select status identification character once.

- 1) When 1st buffer is printed out and 2nd buffer is empty
- 2) Two buffers occupied
- 3) One buffer printed out and BREAK not depressed
- 4) If previous state was busy
- 5) To OPERABLE after the terminal is addressed

Figure 5.5:2 Status flow chart for terminal with keyboard

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5.5.2 Line procedure

3 Basic datacommunication procedures are used.

- Enquiry during which the LCU 5 asks for status of one or more terminals.
- Write during which the LCU 5 transfers a message to one or more terminals.
- Read during which one terminal transfers a message to LCU 5.

Beside the transmission control characters (SOH, STX....) mentioned in 5.5.1 are other characters

ADR "Address characters" (1 or 2), used to select terminal with.

The address characters are different depending of what kind of procedure is determined.

SELECT Enquiry/write procedure

POLL Read procedure

IDT "Identification characters" (1 or 2) used as an answer from a terminal when selected from LCU 5 during Enquiry/write procedure.

SIC (1-5) "Status information character" used as an answer from a terminal when LCU 5 asks for "status enquiry".

- SIC 1 - NAK: Inoperable
- SIC 2 - NAK: Busy
- SIC 3 - NAK: Attention POLL
- SIC 4 - ACK: Attention SELECT
- SIC 5 - ACK: Operable

BCC Block check character

- Enquiry procedure

During the Enquiry procedure the status of one or more terminals is investigated.

The Enquiry procedure is stopped only when an I/O interrupt occurs because

- LCU 5 will transfer a message to a terminal
- A Terminal replies Attention POLL/SELECT.

See figure 5.5:3



To send a reply the terminal has to generate the signal RTS (Request to Send) which make the modem to start the carrier and then answer RFS (Reading for Sending).

The RTS will cease when the LCU 5 terminates the communication with EOT.

- Write procedure

During a Write procedure a message is sent from the central computer to one or more terminals. The terminal must be selected by address select characters, and the terminal has to send answer upon the message.

If the terminal has received the message correctly, it answers with ACK, upon which the LCU 5 terminates the communication with EOT. This make the RTS to cease.

If the message was wrong the terminal answers NAK.

If the message is sent 3 times with NAK as reply the communication is ended with EOT.

See figure 5.5:4

Is the reply not a correct ACK or NAK the LCU 5 make a resynchronization to invite the terminal to repeat its ACK or NAK.

This is made twice and if it is not successful the communication terminates with EOT.

- Read procedure

During a Read procedure a message is sent from the terminal to the control computer.

When the terminal has a message to send it will during the Enquiry procedure answer "Attention POLL".

Then the LCU 5 sends EOT-POLL address - ENQ to invite the terminal to send the message.

If it is correctly received the LCU 5 answer ACK. Then the terminal sends EOT upon which the LCU 5 terminates the communication with EOT.

If the message is not correctly received the LCU 5 answers NAK.

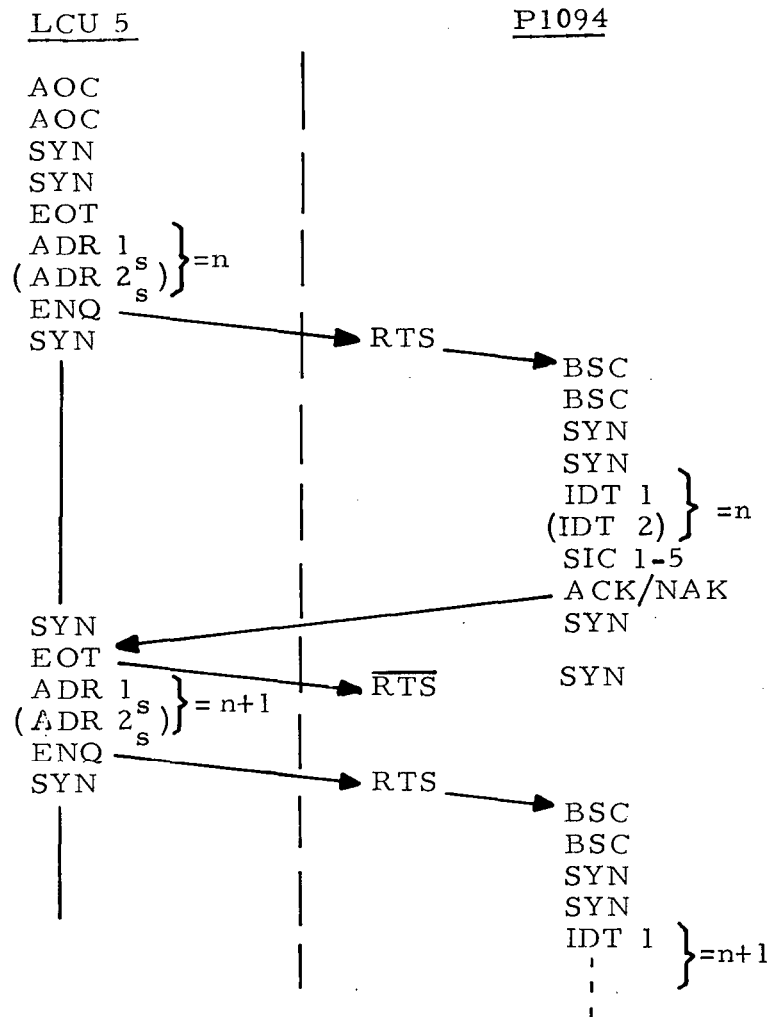
Upon NAK the terminal tries again, and after 3 NAK it sends EOT to LCU 5. Then LCU 5 terminates the communication with EOT.



If the terminal doesn't get a correct answer (ACK or NAK) it starts a resynchronization procedure and sends an ENQ to invite LCU 5 to repeat its ACK or NAK.

This is made twice and if it is not successful the terminal sends EOT AND THE LCU 5 answer EOT.

See figure 5.5:5.

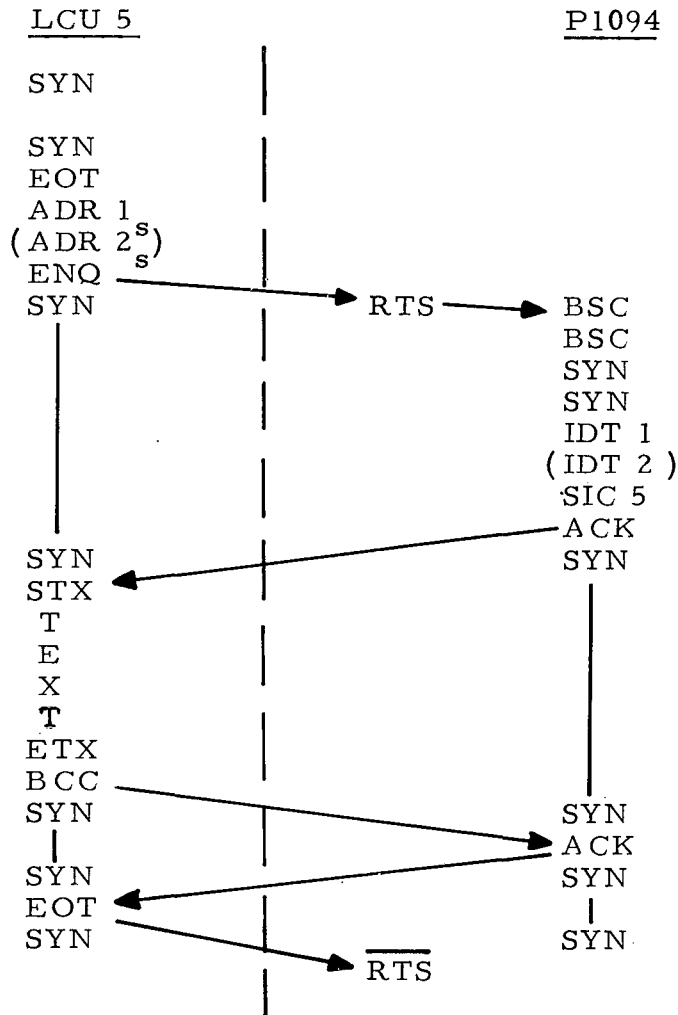


Character abbreviations

- ACK = acknowledged
- ADR 1 = select address 1
- ADR 2^s = " " 2
- AOC =^s all one character (FF)
- BSC = bit synchronization character (AA)
- IDT 1 = identification 1
- IDT 2 = " " 2
- EOT = end of transmission
- ENQ = enquiry
- SYN = synchronizing
- SIC 1-5 = status identification 1-5

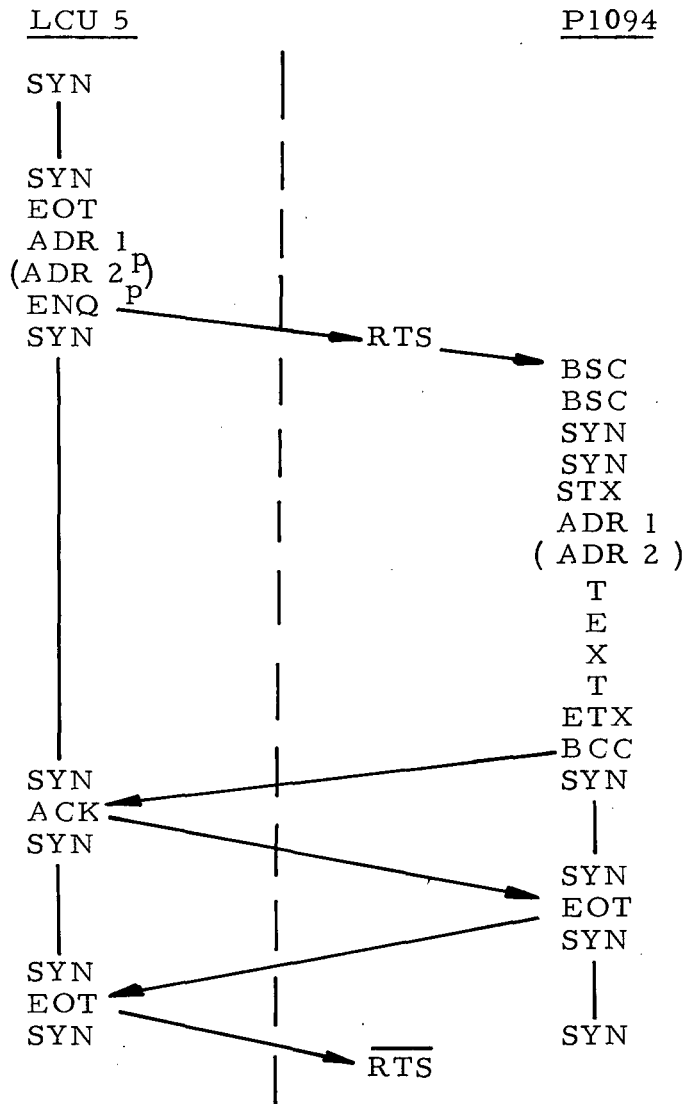
Figure 5.5:3 The basic structure of Enquiry procedure

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Figure 5.5:4 The basic structure of Write procedure



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Figure 5.5:5 The basic structure of Read procedure



5.5.3 CPU-PROM routines

The CPU package 4004 of the terminal contains the following functional blocks:

- Address register (program counter and stack organized as 4 words of 12 bits each) and address incrementer
- (Index) register (64 bits organized as 16 words of 4 bits each)
- 4-bit adder (accumulator)
- Instruction register (8 bits wide), decoder and control
- Peripheral circuitry.

The functional blocks communicate internally through a 4-line bus. They are shown in Appendix 5.4:1.

The 16 4-bit registers and the instruction register are the most important sections in the present context. The index registers can be used either singly for temporary storage during computations, or in pairs to address memory and to store data fetched from the read-only memory.

The 8-bit instruction register can hold at any one time a 4-bit operation code and a 4-bit operand. Some instructions in the 4004 are of double length (16 bits instead of 8), have multiple operands, and are stored in successive read-only memory locations. They take two system cycles for execution instead of one.

The 4004 has a total of 45 instructions in its repertory, plus a no-operation dummy instruction that uses up one instruction cycle but doesn't do anything. The 4-bit operand code in an instruction can specify, among other things, one of the 16 individual registers, or, with 3 bits one of the eight register pairs. The upper end (most significant bits) of the register pair is the same as one of the even-numbered individual registers.

- Address modes

The 4004 CPU uses the following address modes.

- Pointer This permits a machine with a short word length to address a large memory array. And because such large arrays may require more bits in an address representation than can be contained in an instruction word, the address is kept in a special register or pair of registers preloaded by an instruction in the program. Subsequent instructions then refer to locations in



the memory, which are addressed by the contents of the pointer register. However, the preloading instruction adds to the overhead in machine operation, reducing the over-all performance.

- Immediate The instruction word consists of an operation code (Op code) and an operand code (to be operated upon). When the operand code is an immediate address, the processor executes the instruction on the operand code itself.
- Indirect When the operand code is an indirect address, the processor executes the instruction on data found at the address specified by the operand.

Indirect addressing and pointer addressing are similar, except that the address points to a PROM word instead of a main-memory location. The particular mode of address is identified by the op code itself or by a flag bit associated with the op code.

Indirect addressing is a powerful tool in all software systems. It's particularly powerful in minicomputers, where the limited word length prevents direct access to more than a small part of the memory, and for the same reason, it can be equally powerful in microprocessors.

- Interrupt

The 4004 CPU doesn't operate with interrupt, however, it can be reset by a reset (MC) signal.

TEST signal is used to inform CPU, through an instruction JCN (Jump conditionally) that LCU is ready, i.e. a character is available for fetching or that a character has been sent.

- Instruction time

CPU operates with two types of instructions:

- 1-word instruction with an 8-bit code and an execution time of 11.2 μ s
- 2-word instruction with a 16-bit code and an execution time of 22.4 μ s



Due to the time-multiplexed operation of the system, the 8-bit instruction is fetched with 4 bits at a time on two successive clock periods. The first 4-bit code is called OPR, the second 4-bit code is called OPA.

For a single word machine instruction the operation code (OPR) contains the code of the operation that is to be performed (add, subtract, load, etc.). The modifier (OPA) contains one of four items:

- (1) a register address
- (2) a register pair address
- (3) four data bits
- (4) an instruction modifier

For a 2-word machine instruction the first word is similar to a 1-word instruction, however, the modifier (OPA) contains one of four items:

- (1) a register address
- (2) a register pair address
- (3) the upper portion of another PROM address
- (4) a jump condition

More detailed information is given in MCS-4 User's Manual.

- RETOPS program in MCS - 4
- Use of registers

A0 - A5 General purpose registers used by both foreground and background programs. Contents are modified by foreground.

A6 - A13 Registers used by foreground program. Contents may not be changed background.

A14 - A15 Registers reserved for background . Contents may not be changed by foreground.

- Subroutine levels

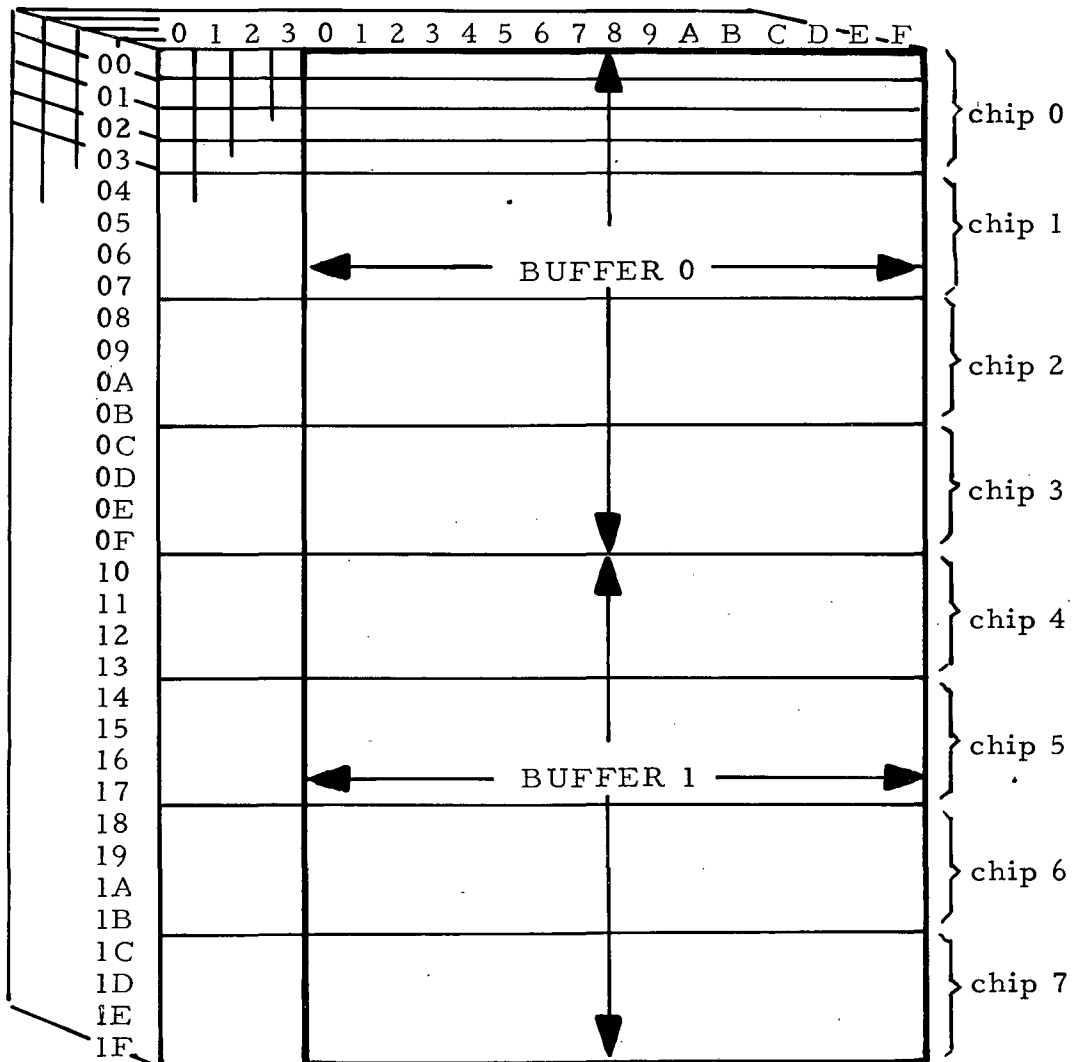
Level 0 is origin

Background subroutines may be called by programs on levels 0 - 2

Foreground is one subroutine and may be called from levels 0 and 1. Foreground may only go down one subroutine level.



• Data Memory



Status

Main Memory

BUFFER 0 : 000 - 0FF

BUFFER 1 : 100 - 1FF

When the buffer is extended

BUFFER 0 : 000 - 1FF

BUFFER 1 : 200 - 3FF

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● Use of Data Memory

Main Memory Characters are regarded as a continuous buffer. When a message is stored in the buffer the End is indicated by a character (80)₁₆ after the last character. This is the only character which has bit 2⁷ = 1 (parity bit). In all other characters is the parity bit = 0. This means that only 7-bit characters can be stored in the Data Memory.

Status Characters :

ST00	Not used	
ST01	Not used	
ST02	ST020	Only used in routine PRBUF = 0 Break key not depressed = 1 Break key depressed: branch to keyboard module after printing
	ST021	Not used
	ST022	No buffer chaining indicator = 0 Buffer chaining = 1 Double buffers
ST03		Used in routine PRBUF Contains print buffer pointer
	ST031	Most significant 4 bits
	ST032	Middle significant 4 bits
	ST033	Least significant 4 bits
	ST030	Contains next terminal status when paper is out = 0 Inoperable = 3 Attention select = 6 Operable = 9 Busy = C Attention poll
ST04	Not used	
ST05	"	
ST06	"	
ST07	"	
ST08	"	
ST09		Select address
	ST090 } ST091 }	Address in one address system or first address two address system ST090 contains zone part ST091 contains data part
	ST092	= 0 for one address system = 6 for two address system
	ST093	Data part for second address in two address system

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ST0A	Not used	
ST0B	"	
ST0C	ST0C0	Terminal program status = 0 Inoperable = 3 Attention select = 6 Operable = 9 Busy = C Attention poll
	ST0C1	= 0 Status change allowed = 1 Status change locked
	ST0C2	= 0 Lower buffer = 1 Upper buffer
	ST0C3	Base for upper buffer and end of lower buffer. = 1 2 x 127 character = 2 2 x 255 character or 1 x 255 (= 2 x 127 chained) = 4 1 x 511 (= 2 x 255 chained)
ST0D		Used during resynchronization at reception to store address for next function.
	ST0D0	Chip select
	ST0D1	Address within the chip ST0D1 is most significant
	ST0D2	
	ST0D3	Not used
ST0E	Not used	
ST0F	"	

No further status characters are used.



- Input/Output channel programming (see Figure 5.5:6)

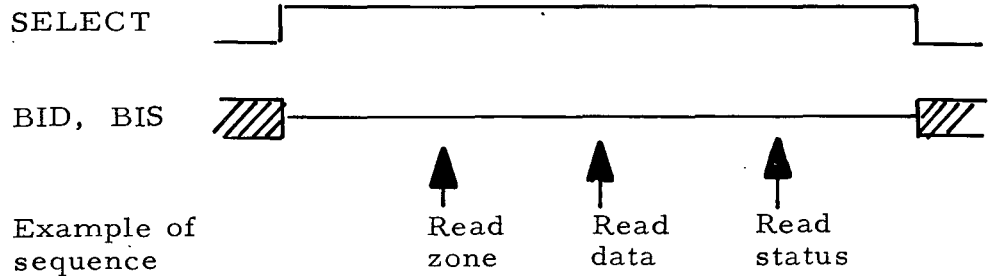
Input sequence:

1. Select device
2. Read the character from BID lines
3. Remove device select

Output sequence:

1. Apply the character on the BOU lines
2. Select device
3. Remove device select

Input



Output

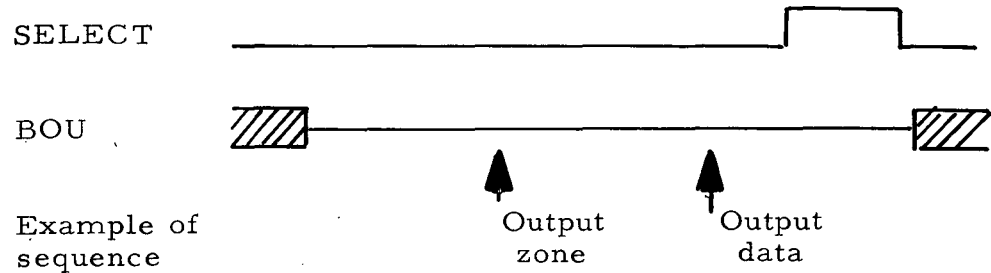
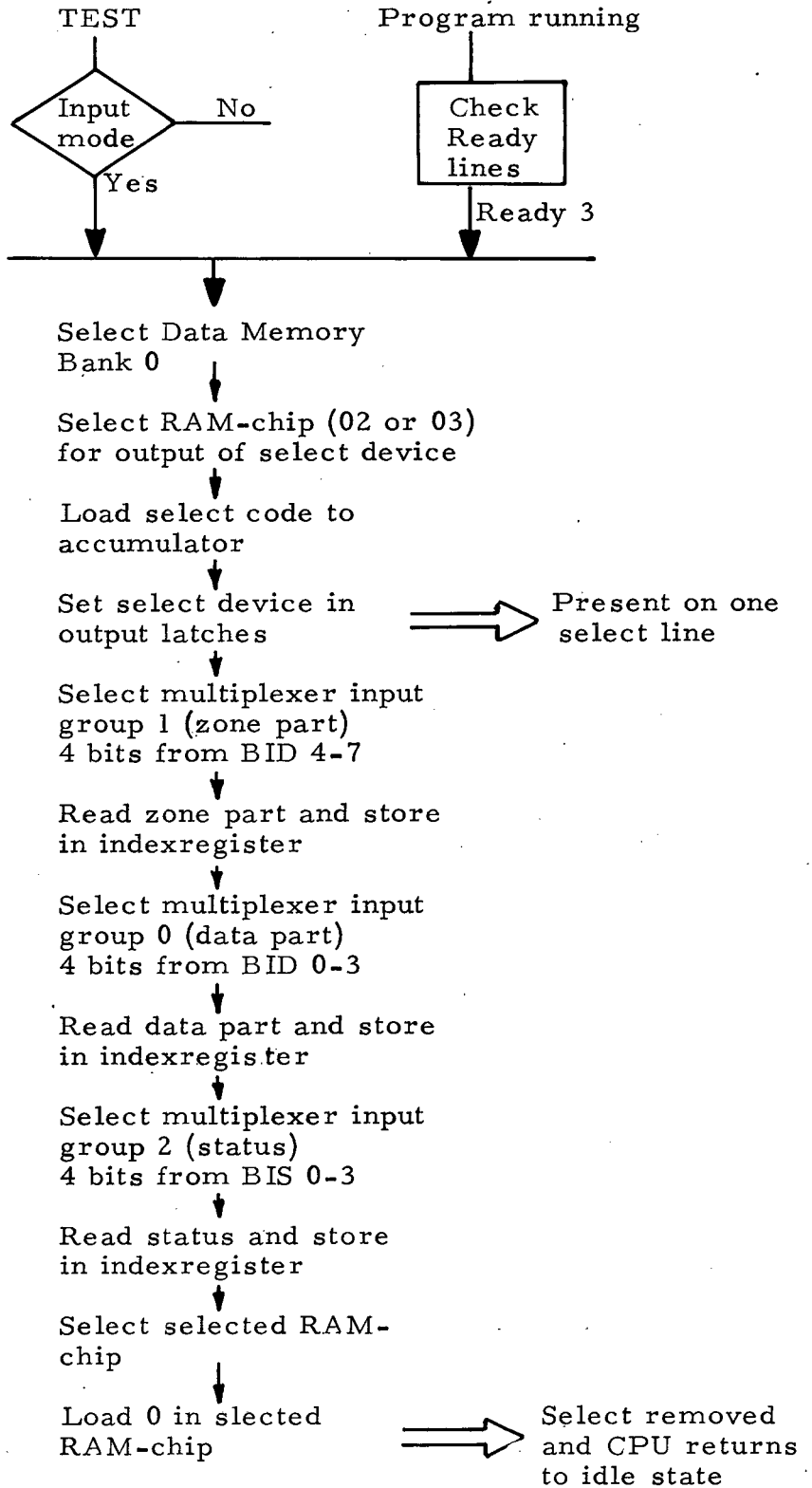


Figure 5.5:6 Timing diagram

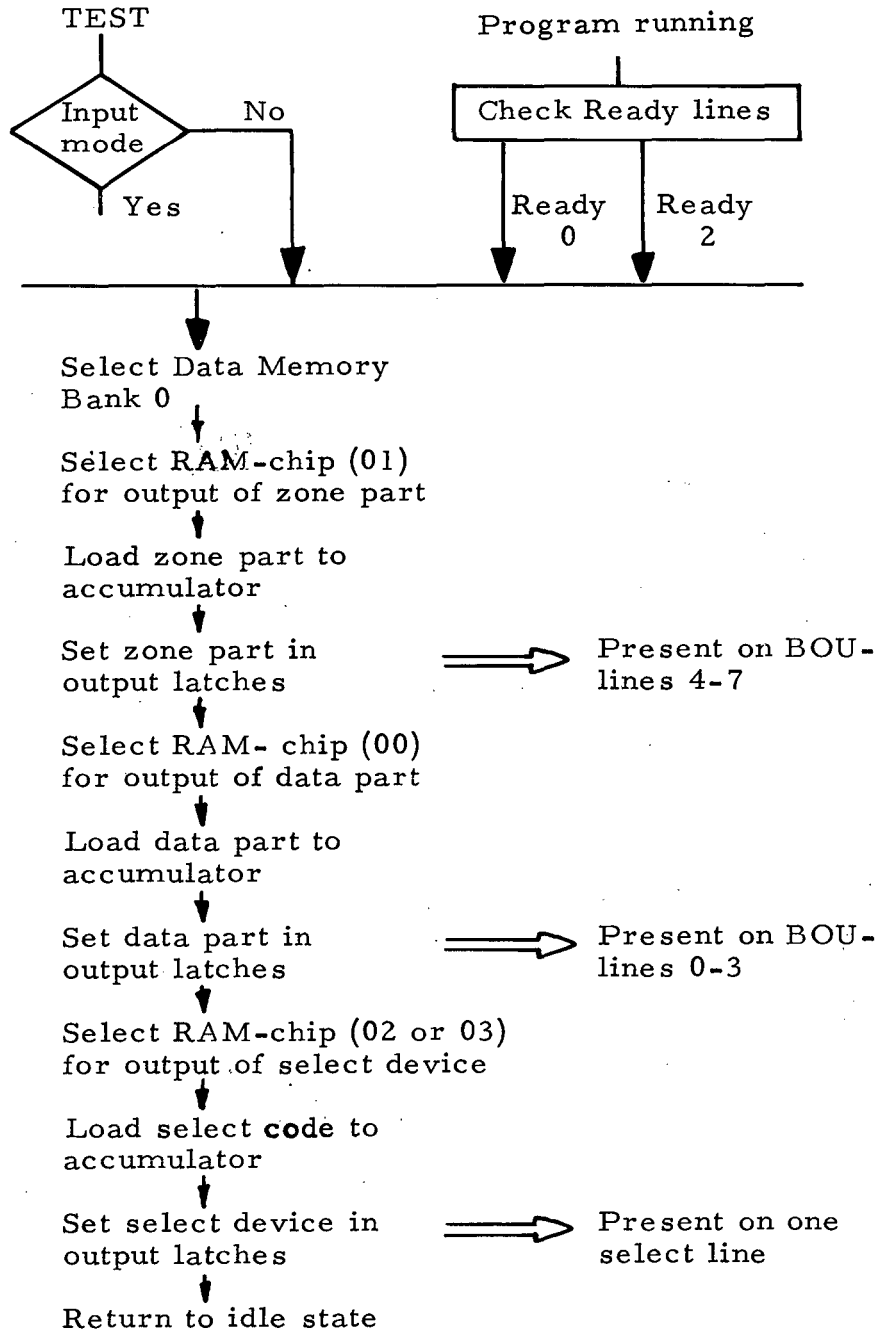


- Sequence for input of one character to CPU (4004)





- Sequence for output of one character from CPU (4004)



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- Commands and Ready signals used by CPU in the Control Unit

• Command

<u>Select line</u>	<u>Function</u>
SEL 7	LCU input
SEL 6	LCU output to output buffer
SEL 5	LCU output to idle buffer
SEL 4	LCU command controlled by output data
	BOU 7=1 Request to sent
	BOU 6=1 Remove request to send
	BOU 5=1 Reset sync
	BOU 4=1 Activate timer
	BOU 3=1 Reserve
	BOU 2=1 Reserve
	BOU 1=1 Reserve
	BOU 0=1 Reserve
SEL 3	Reserve
SEL 2	Display output (data in BOU 3-BOU 0)
SEL 1	Keyboard input
SEL 0	Printer output

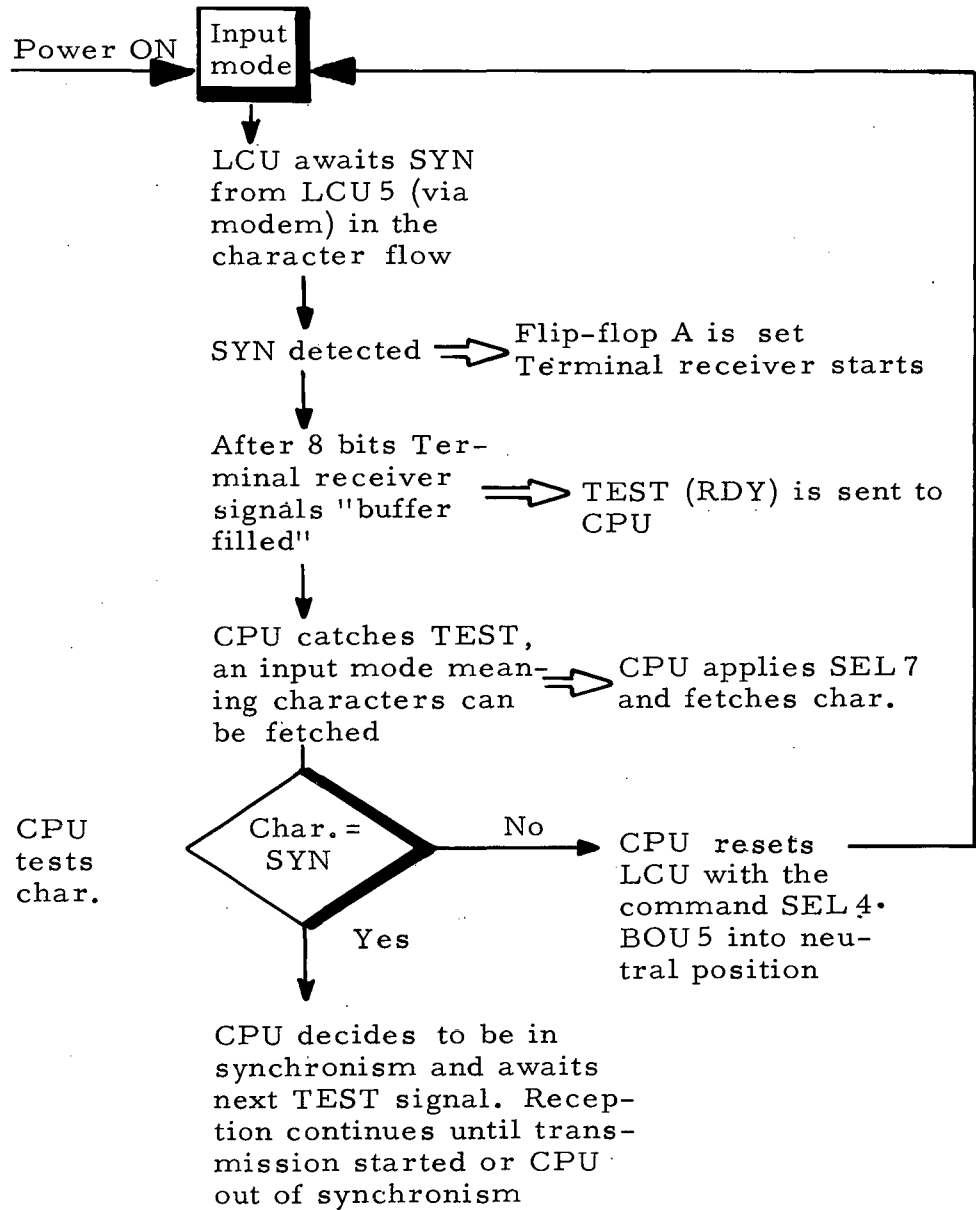
Note. In idle state all select lines are inactive

• Ready

<u>Ready signal</u>	<u>Description</u>
RDY 7	Reserve
RDY 6	Reserve
RDY 5	Reserve
RDY 4	Print suppress
RDY 3	Keyboard input
RDY 2	Timer ready
RDY 1	Paper out
RDY 0	Printer ready
TEST	LCU ready



5.5.4 Receive routine





Cont. from page 5.5/

Next char. ⇒ TEST to CPU

a.s.o.

End of message

CPU transmits dummy select for shift to reception ⇒ SEL 7

EOT from LCU 5

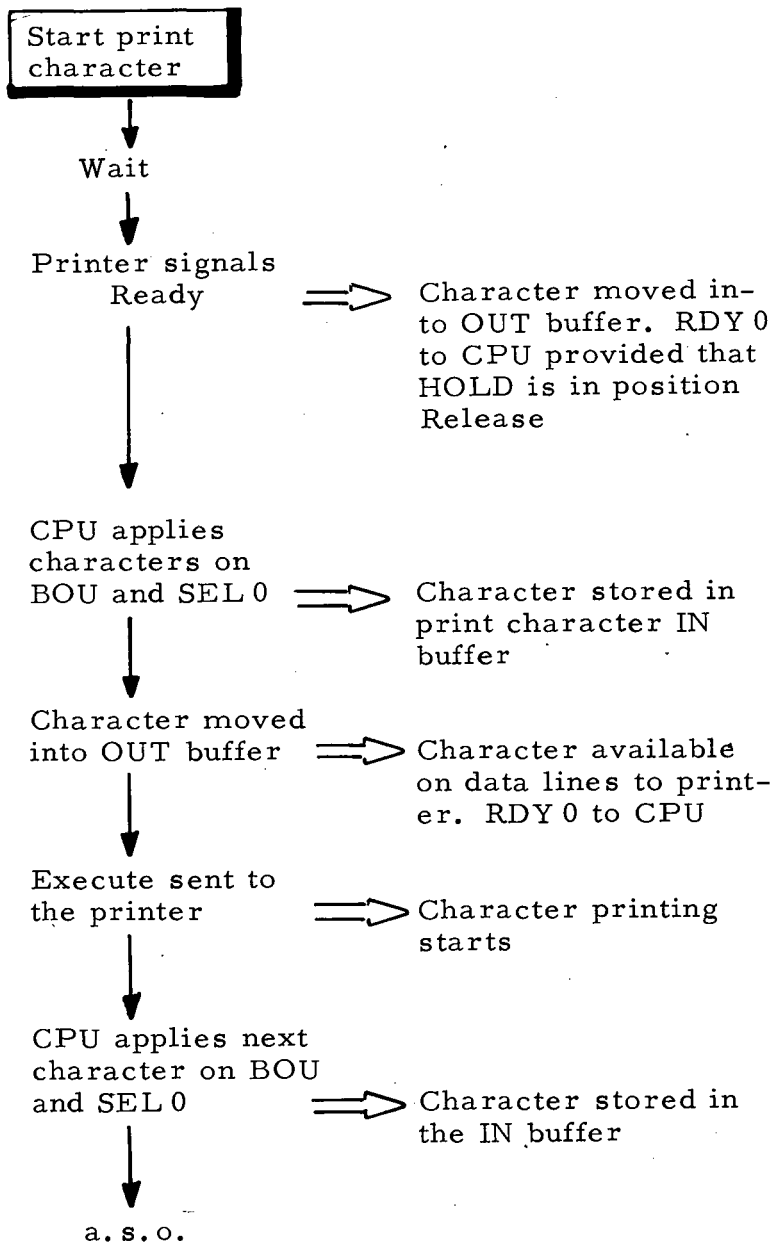
No

Yes

Transmission finished ⇒ SEL 4 · BOU 6 from CPU to LCU yields reset of RTS

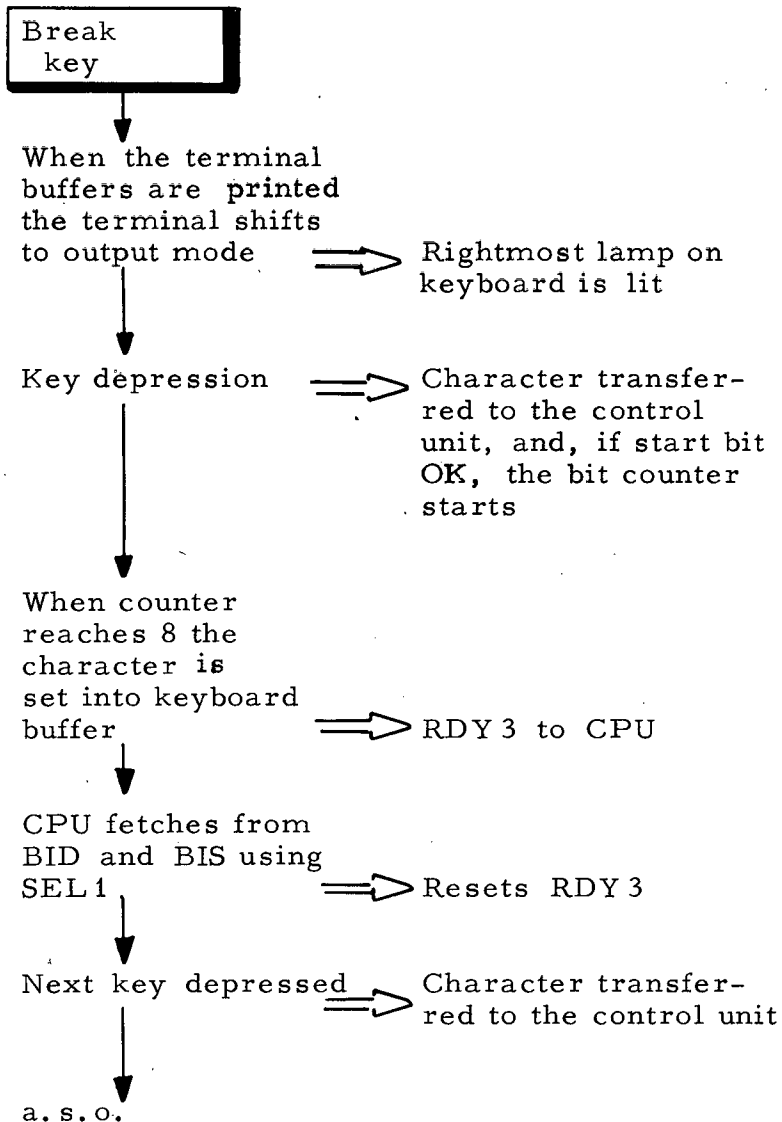


5.5.6 Printer routine





5.5.7 Keyboard routine



5.5.8 Signal labels

Mnemonic	Designation	Remarks
102	Signal ground	To modem
103	Transmitted data	To modem
104	Received data	From modem
105	Request to send	To modem
106	Ready for sending	From modem
107	Modem ready	From modem
108/1	Connect data set to line	To modem
114	Transmitter signal element timing	From modem
115	Receiver signal element timing	From modem
BOU (8)	Bus output, data	Internal bus from CPU
BID (8)	Bus input, data	Internal bus to PROM
BIS (4)	Bus input, status	Internal bus to PROM
SEL (8)	Select signals	Internal bus from LCU, CPU
RDY (8)	Ready signals	Internal bus to PROM
Test	Ready signal from LCU to CPU	Internal bus to CPU
LIT (4)	Lamp signals	Internal bus to panel
Cp	Clock pulse Cp1, Cp2	From CPU
∅	Non-overlapping clock phases ∅ ₁ , ∅ ₂	From CPU
MCL	Master clear	System reset signal from CPU
D (4)	Data bus	Bus between CPU, PROM and buffer 1, 2
Sync	Synchronization signal	From CPU
CM PROM	Control mode for PROM	From CPU
CM RAM	Control mode for RAM	From CPU

5.6 P 1094 typenumber list

5.6.1 Printer

P 1094	PTS	Part	Data
XXX	3111-001	Basic printer unit	220 V 50 Hz
	3131-001	Basic line interface (Dummy card)	ECMA-C like
	3191-001	Form Feed assembly	
	3191-008- -030	Different form length for 3191-001	1,5" - 12,5"
	3192-001	Bell	
	3195-003	Label	P 1094
020	3121-001	Platen peg feed and friction feed	69 ch
019	-002	" "	80 ch
021	-003	" "	110 ch
210 (standard)	3141-001	Ch gen. standard	ASCII, 64 chs
204 (Swedish)	3142-001	Ch. gen basic	ISO -7, 57chs
	3142-011	Swedish P 1000 PROM (for 3142-001)	7 chs
201 (Danish)	3142-001	Ch. gen. basic	ISO -7, 57 chs
	3142-012	Danish P 1000 PROM	7 chs

5.6.2 Keyboard

P 1094	PTS	Part	Data
XXX (standard)	3150-001	Basic Unit with code gen.	ECMA-23 C/V1
	3150-002	Dummy plug for 3150-001/005	
	3150-012	Lamp text panel	
	3151-011	Std keytops	
XXX (Swedish)	3150-001	Basic unit with code gen.	ECMA-23 C/V1
	3150-011	PROM, scand, layout	
	3150-012	Lamp text panel	
	3151-012	Swedish keytops	
XXX (Danish)	3150-001	Basic unit with code gen.	ECMA-23C/V1
	3150-011	PROM, scand, layout	
	3150-012	Lamp text panel	
	3151-013	Danish keytops	

5.6.3 Control Unit

P 1094	PTS	Part	Data
XXX	3161-011	Control unit, basic	2 x 127 chs
XXX	3161-011	Control unit, basic	2 x 127 chs
	3161-012	Buffer extension (for 3161-011)	2 x 127 chs
XXX	3161-011	Control unit, basic	2 x 127 chs
	3161-013	Keyboard adaptation	
XXX	3161-011	Control unit, basic	2 x 127 chs
	3161-012	Buffer extension	2 x 127 chs
	3161-013	Keyboard adaptation	



In all P 1094 numbers for Control unit are following parts included.

Part	Used for	12 NC
Power connector	Printer	
Power connector	Control unit	
Cover	Printer	
Interface cable	Printer → Control unit	



TERMINAL ADJUSTMENTS IN P 1094 CONTROL UNIT

On the cards you will find bridges to adjust the terminal and on some cards you must check that they have the right number of RAM:s(if extended buffer is wanted) and PROM:s (for keyboard)

The adjustments are made by jumpers or soldering straps between nubered bridge pins, in accordance with the configuration and adjusting information given below.

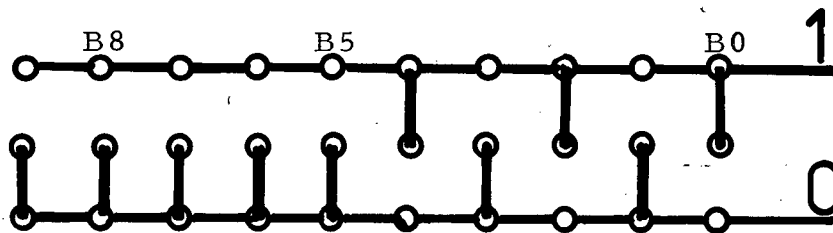
- Card PROM

- Adjustment of terminal address

Table for 1-address system, B8 = 0, B9 = 0.

Terminal - number					
Decimal	Binary				
	B4	B3	B2	B1	B0
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
.
.
.
30	1	1	1	1	0
31	1	1	1	1	1

Address selection field



Ex. 1 - address, number $21_{10} = 15_{16}$



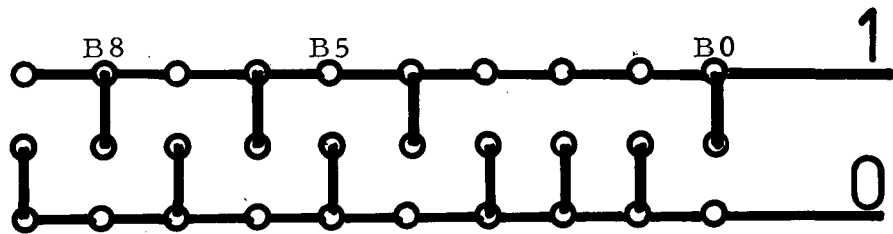
Table for 2-address system, B8 = 1, B9 = 0.

Terminal number									
Decimal	Hexa-decimal	Binary							
		B7	B6	B5	B4	B3	B2	B1	B0
0	00	0	0	0	0	0	0	0	0
1	01	0	0	0	0	0	0	0	1
2	02	0	0	0	0	0	0	1	0
3	03	0	0	0	0	0	0	1	1
·	·	·	·	·	·	·	·	·	·
·	·	·	·	·	·	·	·	·	·
·	·	·	·	·	·	·	·	·	·
31	1F	1	1	1	1	0	0	0	1
32	20	0	0	0	0	0	0	1	0
·	·	·	·	·	·	·	·	·	·
·	·	·	·	·	·	·	·	·	·
149	95	0	1	0	1	1	0	0	1
·	·	·	·	·	·	·	·	·	·
·	·	·	·	·	·	·	·	·	·
255	FF	1	1	1	1	1	1	1	1

least significant

most significant

Address selection field



Ex. 2 - address, number $21_{10} = 15_{16}$

Note. If the buffer is extended to 2 x 255 characters, set B9 = 1.



- Check the quantity of PROM:s (1702A)

	Chip in location							
Receive only	1C	2C	3C	4C	1D	-	-	-
Send/Receive	1C	2C	3C	4C	1D	2D	3D	4D

- Card CPU

- Check the quantity of RAM:s (4002)

Buffer size	Chip in location							
	4002-2				4002-1			
2 x 127 chs	1B	2B	1C	2C	3B	4B	3C	4C
2 x 255 chs add chips in	1D	2D	1E	2E	3D	4D	3E	4E

- Card LCU

- Parity bit (= BID 7)

6A9 (D7) soldered strap to ground (standard)
 6A9 (D7) " " to 5A12 (option)

- SYN-character

ASCII-code { 2D12 soldered to 5A2 } (standard)
 { 2D13 " to 5B7 }
 EBCDIC-code { 2D12 soldered to 5A3 }
 { 2D13 " to 5B4 }

- Clockpulses to terminal transmitter

TSET | 2E11 soldered to 4G11 (standard)
 RSET | 2E11 " to 4G10 (option)

- Card PCU

- Store first or last depressed key

Last key | 2E11 soldered to 2E12 (standard)
 First key | 2E11 " to 1F.3 (option)



6

MAINTENANCE

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6.1 General

6.1.1 Service methods

- Preventive service

The preventive service takes place two times a year or after 250 hours of printing operation, if the printers are used in several shifts.

The preventive service is split up in at least two different service occasions regularly spread over the year. Steps to be taken are to be mentioned in part 6.2.

- Corrective service

The corrective service is made in four different levels according to the following:

- Level 1 is limited to field service at the customer and comprises the following service interventions:
 - a) trouble-shooting by means of test unit
 - b) repair by changing broken modules
 - c) check of function by executing on-line/off-line tests

The interventions are estimated to take about half an hour.

The spare parts list in chapter 8 defines the modules that are allowed to be exchanged in level 1. These modules must therefore be included in the supplies that the service man brings with him.

- Level 2 comprises service of complete modules at the area service office. The steps taken are limited to simpler works and exchange of parts, estimated to take about two hours. A complete module, e.g. a keyboard is taken to the area service office for exchange of a component that could not be exchanged at the customer due to the time required. The level 2 spare parts are also defined in the spare parts list in chapter 8.



- o Level 3 corresponds to service carried out at the work shops of the national organizations, or at the PTS supply centre service organizations. The service measures are:

- a) repair of boards by using a tester
- b) exchange of mechanical and electrical components
- c) adjustment, calibration and functional check

- o Level 4 means repair of broken parts or complete modules at the PTS supply centre service organization. Modules that must be repaired on level 4 are:

matrix print heads

Prices for repair of boards are firm. As to repair of complete modules this will be charged according to the time needed for the repair.

The total repair time at the PTS supply centre organization is about two weeks from the time the unit has arrived in the factory till it has left the factory. Costs for customs and freight to be charged to the customer.

- Demands and offers from the PTS supply centre

A monthly fault report has to be sent to the PTS supply centre service organization in order to enable a statistics study of the error rate. Further details are given in chapter 7.

The PTS supply centre also offers technical assistance in case of intricate service problems.

6.1.2 Relations to the customer

- Planning preventive service visits.

When planning preventive service, the service man has to agree the time suitable for his visit with the office in question. That agreement will be done at least three days before the visit. In busy working times, the service man will try to avoid to implement such service measures that may cause to deject the registration of the entire office.



- Access to customer's telephone

Service personnel is provided free of charge with a possibility to use telephone and a suitable place for writing necessary for their service work.

6.1.3 Service requisites

- Basic set for corrective service, level 1 and 2

To carry through corrective service at level 1 and 2, the following basic set of service requisites is necessary.

- One service case with the contents specified in the appendix 6.1:1
- One Exerciser

- Additional set for preventive service

To be able to carry out preventive service, the service man must also access to the following tools and instruments

- Spring balance 0 - 200 p
- Voltmeter, 5V accuracy of $\pm 0.5\%$
0 - 36V range of measurement
- Vacuum cleaner
- Consumption material
- Linnen cloth for cleaning
- Cleaning liquid
- Oil, grease, solvent
See appendix 6.2:1



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Recommended tools

Item	Article	Qty	Type
1	Knife	1	
2	Box wrench		5,0 mm
3	Box wrench		5,5 mm
4	Extension board, Printer	1	PTS 5131 191 11200
5	Instrumentpocket lamp	1	
6	Needle files	1 set	
7	Pliers	1	Cutting type
8	Pliers	1	Flat type
9	Pliers	1	Flat type pointed
10	Pliers	1	Polygrip 150 mm
11	Stripping plier	1	For wire AWG18-ANG30
12	Pair of scissors	1	125 mm
13	Screwdriver	1	2,3 x 50
14	Screwdriver	1	3,2 x 125
15	Screwdriver	1	5,3 x 125
16	Screwdriver	1	6 x 150
17	Screwdriver	1	8 x 150
18	Screwdriver	1	4,5 x 80 pozidrive
19	Screwdriver	1	6,2 x 100 pozidrive
20	Screwdriver	1	4 x 100 mm Angled
21	Screwdriver	1	6 x 100 mm Angled
22	Sliding calliper	1	140 mm
23	Soldering iron	1	20 - 25 W
24	Adjustable spanner	1	100 mm
25	P-U spanner	1	5 mm
26	P-U spanner	1	5,5 mm
27	P-U spanner	1	7 mm
28	Tin sucker	1	
29	Tweezer	1	150 mm
30	Tweezer	1	150 mm Angled
31	Universalmeasuring-instrument	1	VA - meter
32	Feeler gauge	1	0,5 - 1 mm
33	Wireunwrapper	1	For 0,25 mm wire
34	Wire wrapper	1	For 0,25 mm wire
35	Extension board P 1094	1	PTS 5131 191 23400

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Appendix 6. 1:1 The contents of the Service Case



6.2 Preventive service

6.2.1 General

- The object of the preventive service is to keep the equipment in good condition functionally by regular maintenance actions.
- The service is carried out twice a year
- Contact is taken up with the contact representative of the customer at least three days before the planned service action at which time it shall be agreed upon the day and time for the service.
- Upon arrival to the customer the service engineer shall inform the contact representative as to the extent of the service.
- Disconnect the line and start preventive service.

6.2.2 Keyboard

- Remove the rear top cover of the printer and put in the Exerciser.
- Check the function of the keyboard.
- Clean the shield using a linen cloth and cleaning fluid.
- General visual inspection.

6.2.3 Printer

CAUTION

WHEN MOVING THE PRINT HEAD BY HAND, APPLY PRESSURE ON THE CARRIAGE. DO NOT PUSH ON THE PRINT HEAD ITSELF. DOING SO MAY CAUSE MISALIGNMENT.

- Remove the cover and the protection plate.
- Remove Ink Ribbon
- Clean the printer at all accessible places, using vacuum cleaner.
- Clean the moveable parts of the ink ribbon mechanism with a fine hair brush and cleaning fluid.
- Clean the matrix print head guide bars, the platens and nose bearing with a fine hair brush and cleaning fluid.



- Clean the guide bars for the carriage using a linen cloth and cleaning fluid.
- Clean the gear belt and the driving wheel with a brush.
- As a last action when the printer is reassembled after lubrication and checks, clean the shield using a linen cloth and cleaning fluid.

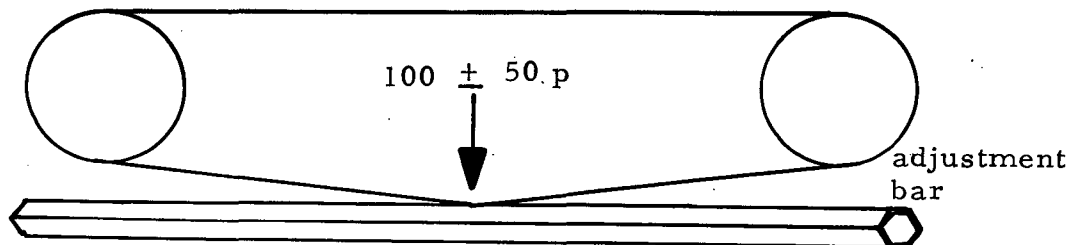
- Lubrication

Lubrication is performed according to the lubrication chart on appendix 6.2:1. Clean the lubrication site properly prior to lubrication.

- Checks

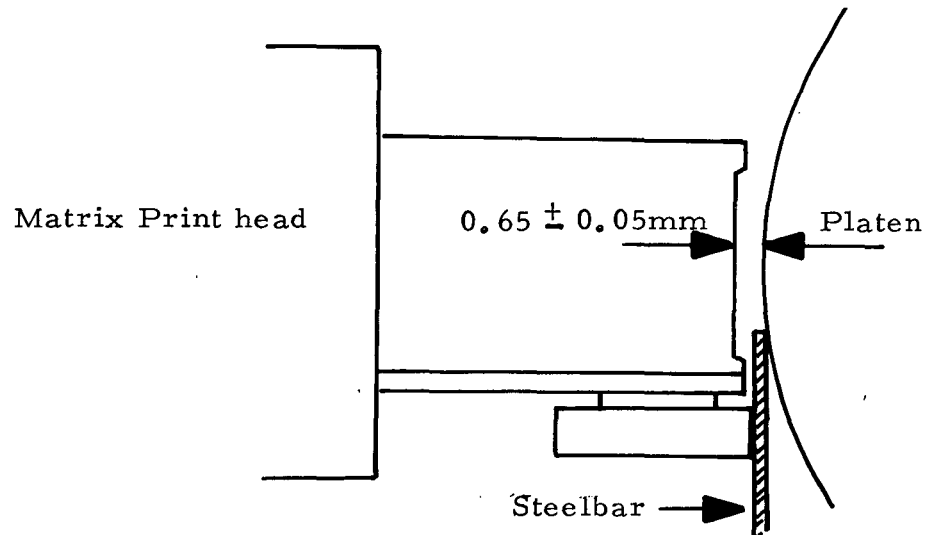
● Belt tension

The tension in the carriage driving belt should be such that 100 ± 50 p are required to depress the lower part against the six side bar placed under it. When measuring, there must be a flat side turned upwards. Use the relay spring balance for measuring. If adjustment is necessary, both the screws holding the bar are to be unfastened and the bar twisted. Tighten the screws again.





- The matrix print head is driven by hand towards the platen and the distance is measured with a feeler gauge according to the sketch below. If it is not correct change the head.



- Printing checks

Insert the logic board and the Exerciser.

Mount the protection plate

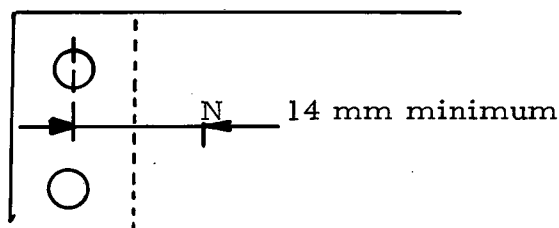
Supply the printer with a new Ink Ribbon.

Connect the printer to the mains and make Power ON.

- Check the voltage tolerances
 - + $5V \pm 2\%$
 - $12V \pm 5\%$
 - + $36V \pm 10\%$
- Ink Ribbon feed.
 - Check that the ink ribbon feed is smooth.
 - Check that the feeding direction reverses when the ink ribbon link is moved from the one position to the other.
 - Check that the rivet in the ink ribbon is able to operate the link.
- Check the manual line feed and proper printing on the lines. If it is not correct remove the platen and put it back with the gear wheel in an other position, and try printing again.



- Check the Paper out switch and the Operational switch when printing from the Exerciser.
- Home position
Check the width of the left margin, i.e the distance between the hole centre (not the paper's edge) and the first character (N). See the sketch below. The distance is adjusted by moving the home position bar.



- The printing quality and the character set
Check, with the help of a printing sample from the Exerciser, that the printing quality is good. If it is not, replace the matrix print head.
If Error is found in the character set, replace the electronics logic board

6.2.4 Ending the preventive service

- Reassembled the printer and check that the screws are tightend.
- Connect the line cable.
- Perform a test transaction from the line.
- Inform the contact representative that the service is completed, and fill in the service report.



PRINTER LUBRICATION INSTRUCTION

General

Lubrication intervals

Lubrication according to the following instruction is, normally, to be carried out once a year. However, excepted are:

- carriage guide bars (lubrication point 5)
- print head spindles (lubrication point 2)

These parts must be lubricated every half year, i.e at each preventive service occasion. At occasions when only the excepted parts are to be lubricated, it is, however, recommend to inspect the remaining parts as far as possible without removing any protection plates.

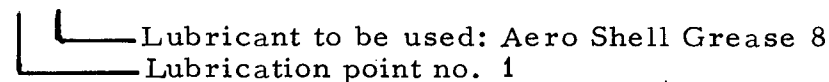
Lubricants and solvent to use

Besides lubricants also a solvent is necessary when lubricating. The types to be used are:

Lubricant/solvent no.	Type
1	Shell Tellus Oil 15
2	Shell Tellus Oil 41
3	Aero Shell Grease 8
4	Solvent of the white spirit type

In the figures showing the lubrication points, the lubricant/solvent to be used is indicated by the number in accordance with the table above. Example:

1-3



It is of great importance that no lubricant is running, dripping or splashing from a lubrication point. If so, contacts, switches, ink ribbons etc. may be spoiled.

CAUTION

DO NOT USE ALCOHOL OR FREON TO CLEAN THE PRINT HEAD. THESE SOLVENTS LEAVE NO OIL FILM AND THE PRINT NEEDLES RUN DRY. DO NOT OIL THE NEEDLES. USE ONLY SOLVENT OF THE WHITE SPIRITE TYPE. (= Lacknafta in Sweden, and Terpentina Shell in Holland)



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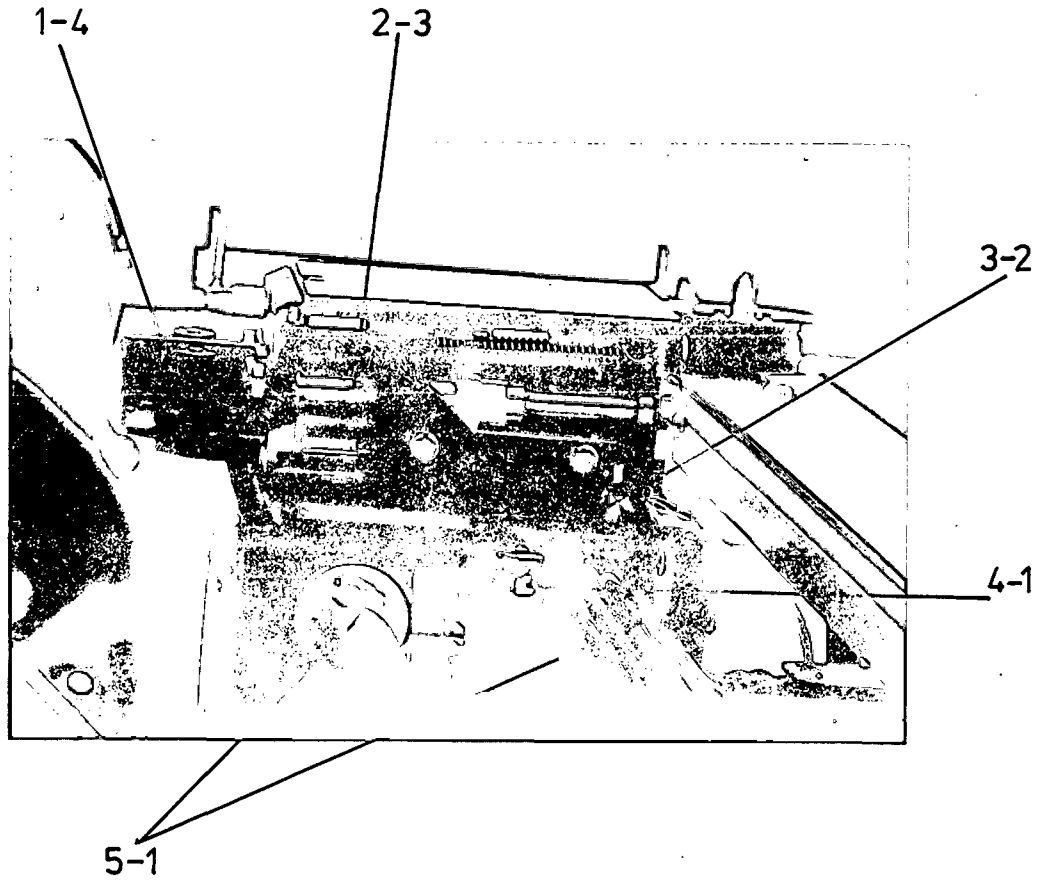
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PRINTER; PTS 3111-001



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Reference	Part designation	Remarks
1-4	Print head	Top of the nose section
2-3	Spindle	Sliding surface (2 pcs)
3-2	Arm	Bearing
4-1	Roller	Bearing
5-1	Guide bar	Sliding surface (2 pcs)



data systems

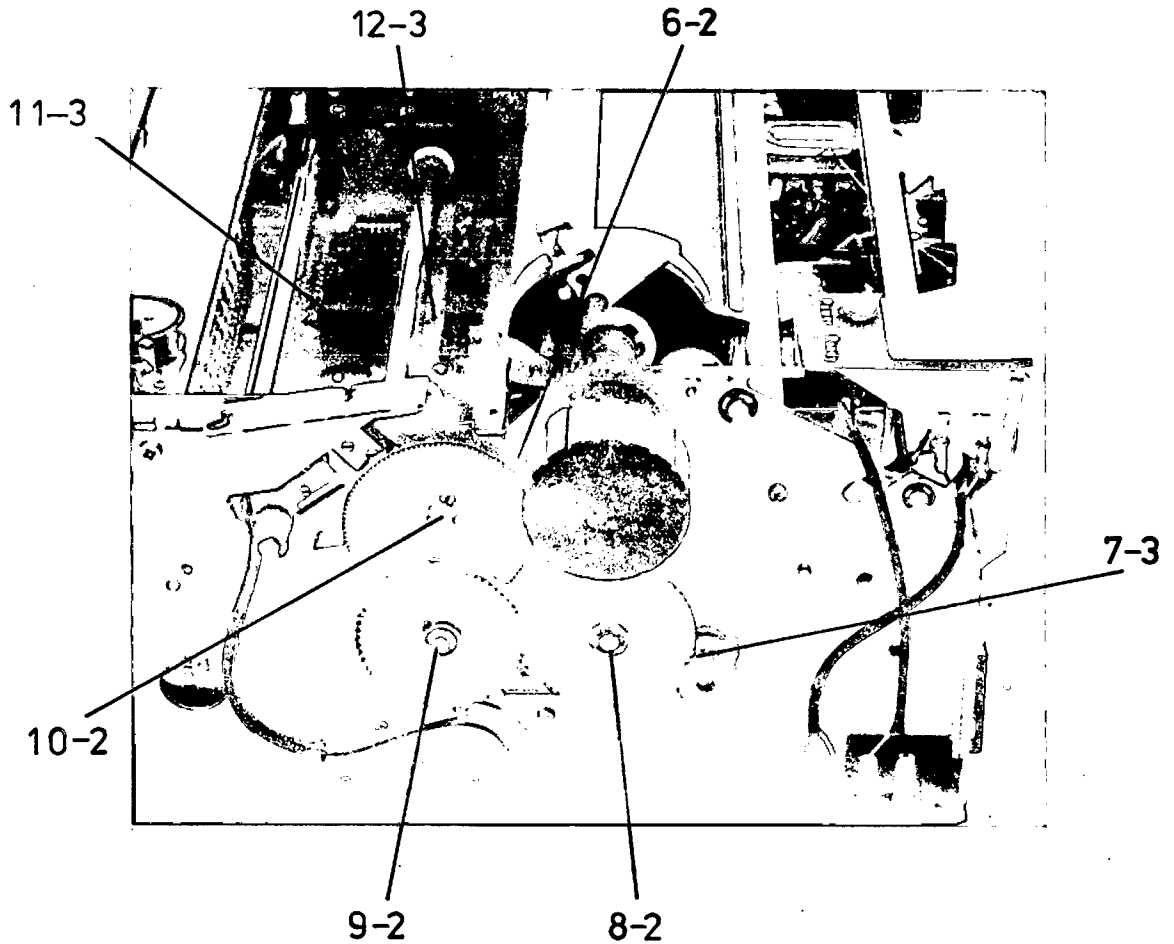
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Reference	Part Designation	Remarks
6-2	Shaft with a track	Hide behind the Form-Feed gear-wheel
7-3	Gear wheel	Gears
8-2	Gear wheel	Bearing
9-2	Gear wheel	Bearing
10-2	Gear wheel	Bearing
11-3	Gear box	Gears
12-3	Carriage belt	Inside



6.3 Corrective service

6.3.1 Trouble shooting

For check and uncomplicated trouble-shooting of the printer and the keyboard with their indicating lamps a so called Exerciser is used.

The Exerciser consists of a board with a number of TTL-circuits, a Programmable Read Only Memory (PROM) and some switches.

With the aid of this board, to be inserted in the interface I location of the printer, it is possible to check all characters and functions of the printer and all codes from the keyboard as well as the status of the indicating lamps.

The Exerciser is divided into three functional parts, see Figure 6.3:1:

- Printer exerciser,
- LED exerciser,
- Keyboard exerciser

- Printer exerciser

The printer exerciser part accommodates a Test Character Generator, consisting of a PROM, which is exchangeable and programmable in various ways to suit different purposes.

This PROM is read with an address counter that states those consecutive addresses in the memory which apply data on to the seven data lines to the printer.

Between the address counter and the test character generator there is a program selector, controlled by a 3-way switch by which it is possible to select either the printing of all characters stored in the memory or the printing of the first or the second half of the memory.

Test character print-outs from the printer commence if the switch READY (beside POWER) is activated. The switch resets the address counter which reads the first character in the memory the code of which is applied the data lines.

The READY-switch triggers, through a delay circuit A, also the flip-flop B, that emits an Execute-signal to the printer. The printer answers with a Ready-signal as soon as the character is printed. This signal resets flip-flop B and the Execute-signal ceases. However, the Ready-signal also proceeds, through another delay circuit C and advances the address counter one increment, at which a new character is applied on to the data lines.

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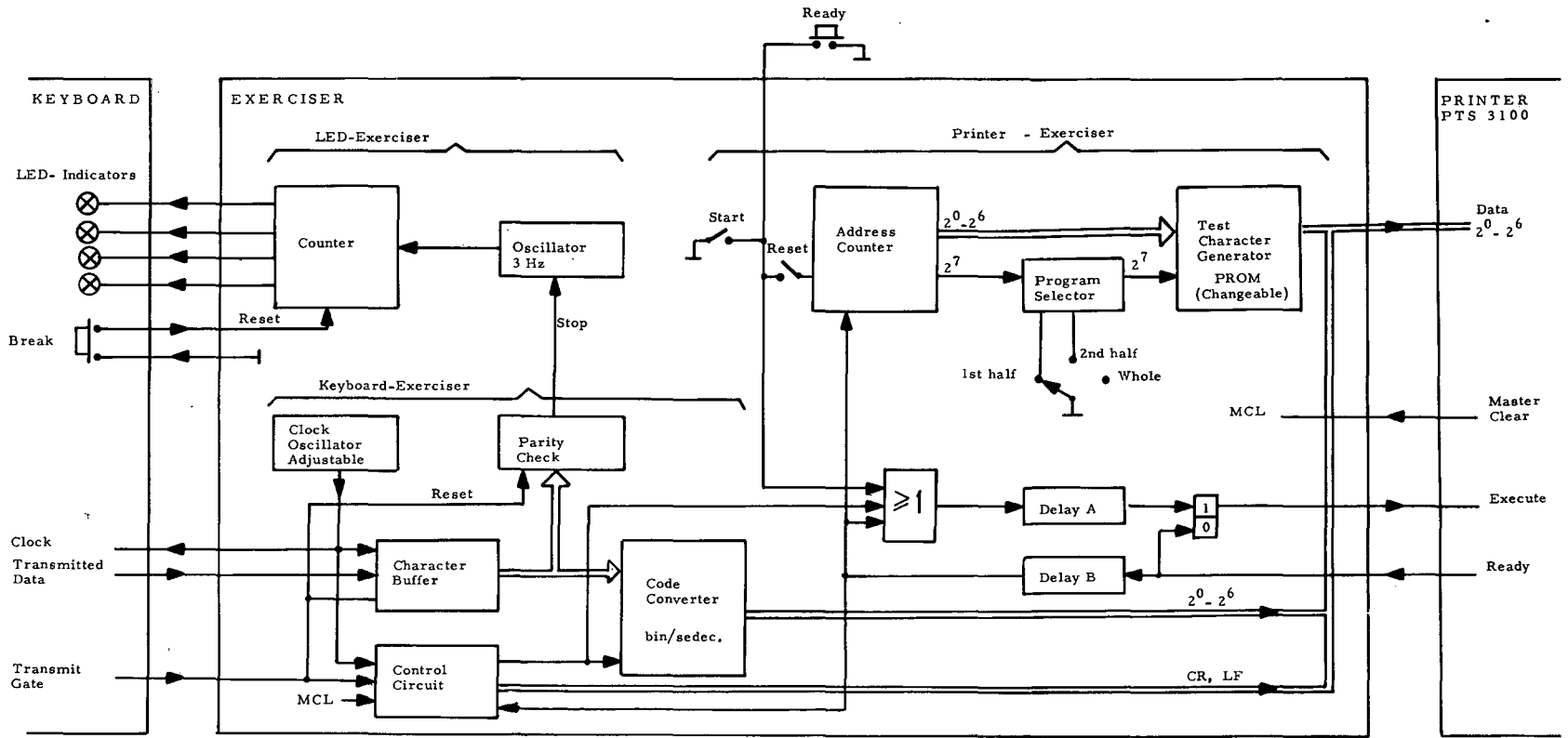


Figure 6.3:1 Exerciser block diagram



The delayed Ready-pulse triggers, through the delay circuit A, again the flip-flop B, and a new Execute-signal is obtained.

This print-out sequence will continue through the entire memory repeatedly until the switch READY is placed in position OFF.

If the switch is again activated the address counter starts from zero, unless the reset signal is broken by a switch on the board. Would that be the case, the address counter continues from the position where it stopped.

The printer exerciser can be started also by an internal switch on the board. In this case character print-out continues until the switch is released.

- LED exerciser

The keyboard includes four indicators consisting of Light Emitting Diodes (LED) which are tested by a LED exerciser.

This exerciser is formed by an oscillator that starts when the board is inserted, and a counter to which the light emitting diodes are connected.

The LED's will be put on in binary form, keeping time with the counter steps, as soon as the exerciser is used. They can be put off when operating the BREAK-key on the keyboard. When activated this key resets the counter and all lamps are turned on. This procedure is used for test of the BREAK-key, which has separate wires to the printer.

- Keyboard exerciser

All keys but BREAK can be tested by the keyboard exerciser.

Upon depression of a key its sedecimal code is written on the printer which then performs carriage return and line feed. This is carried out in the following way.

When a key is depressed the keyboard transmits in serial form the code of the key. The code is sent as Transmitted data, along with a Transmit gate pulse to the keyboard exerciser. The keyboard receives its clock pulses from an adjustable clock oscillator on the exerciser. The oscillator is adjustable (50 Hz - 200 kHz) in order to allow a test of different transfer rates from the keyboard. For the frequency change a capacitor is attached between two soldering lugs.

The Transmit gate pulse opens for letting through the data of the key into a character buffer, simultaneously it resets a parity check circuit and starts a control circuit, containing a 4-step sequence counter.



The first two stages open a code converter, that reads the code in the character buffer, four bits at each reading, and converts these bits into two sedecimal characters, which are being transmitted, one after the other, to the data lines of the printer.

Next sequential stage transmits carriage return, and the last stage transmits line feed to the data lines.

At each sequential stage an Execute signal has been sent to the printer. The answer from the printer is a Ready signal that advances the sequence counter. After the fourth stage the counter is reset.

If a parity error is obtained at a key depression, a flip-flop in the parity check circuit will be set. The parity check circuit transmits a stop signal to the LED exerciser. The counter in the exerciser, as a result, stops and the indicators stop flashing, instead they glow with a fixed light corresponding to the position of the counter.

- Application

At trouble-shooting or test the following aids are needed:

- Exerciser,
- Voltmeter,
- Open-ended spanner, 7 mm,
- 25-pole Cannon connector,
- Screwdriver

To be able to measure the voltages in the printer and to install the exerciser, the top part of the printer cap must be removed.

- 1 Switch off the mains voltage
- 2 Draw out the line connector (J5)
- 3 Raise the front part of the cap and unscrew the rear part. Remove the top of the screening can to make the logic boards visible
- 4 Remove the interface board
- 5 Insert J5, the 25-pole connector available, that should have a wire connected to terminal 7 (earth reference)
- 6 Switch on the mains voltage and measure the voltages
 - +36 V (on fuse in the power supply unit)
 - -12 V (on fuse in the power supply unit)
 - + 5 V (on the power supply unit)
- 7 Insert, if the voltages are correct, the exerciser on the location of the interface board



- 8 Check, if the keyboard is connected, that the indicators flash and go out when the key BREAK is depressed
- 9 Test the printer by operating the READY-switch of the printer, or by holding the START of the exerciser depressed, at which the printing starts. Select, with the remaining two switches of the exerciser, printing of the first or second half, or printing of the whole test program. Also to be selected is whether the program has to be reset at each start
- 10 Check the sedecimal code of each key (see Figure 3.2:2) by activating the keys, one at a time. The two digits of the code are written on the printer, thereafter a carriage return and a line feed are carried out
- 11 Depress several keys concurrently and notice that all of them are printed. In this way the N-key-roll-over function of the keyboard is tested
- 12 Check the line feed with various line feed selector settings
- 13 If a form feed assembly is included, check its function and check also that it corresponds with the paper format it, automatically, has to feed.
- 14 Check that the ink ribbon moves each time the print head is transported. Move the arm for changing the ribbon direction to the position not used for the moment and notice that the moving direction is reversed
- 15 Exchange any faulty unit and check again
- 16 Switch off the mains voltage and restore the printer into the original state. Connect the line and switch on the voltage.



6.3.2

TROUBLESHOOTING P 1094

For troubleshooting on the terminal P 1094 there are in the Control Unit two testswitches, the LOOP-switch to test the line and TEST-switch to test the printer, by means of which it is possible to trace a faulty board in the Control Unit.

Symptom	Probable cause	Action
Power lamps on the Control Unit or the Printer do <u>not</u> lit	Power cables are <u>not</u> connected properly	Check the cables
	Mains fuse in the Control Unit	Check the fuse(2A S.B.) located on the rear
	Mains fuse in the Printer	Check the fuses(1.6A S.B.) located above the mains cable inlet on the rear
	Faulty lamp	If manual Line Feed works on the printer, a lamp is faulty. Replace it
P 1094 does <u>not</u> answer when called	Line connection to P1000 is broken	Check if the Loop Test is OK. If it is not, check the line connection and the modems
	LCU-board defective	If the line seems to be OK replace the LCU-board
	Power supply faulty	Try the printer test by switching the power Off and set TEST-switch On. Switch power On. If the printer does not print check the DC-voltages on an extension board inserted instead of the LCU-board. Measure on the pins soldered on strip no. 1 = signalground 2 = +5V 4 = -12V 6 = +12V Replace the faulty Power Supply



Symptom	Probable cause	Action
(continued)	PROM-board is defective or wrong address is coded	If the Loop Test is OK and the voltages OK but printer test does not work, replace the PROM-board and make a new printer test
	CPU-board faulty	If it still does not work replace the CPU-board
	LCU- modem cable defective	Check every part in the cable. Replace or repair it if necessary
	I/O-bus defective	Replace the whole Control Unit
Printer does <u>not</u> work	PCU-printer cable defective	Make manual line feed and if it is OK, check or replace the cable
	PCU-board defective	If P1094 answer when called but does not print, replace the PCU-board
	Printer faulty	Disconnect the printer cable. Make a link in the printer connector between pin No. 7 = ground 12 = Execute 3 = 2 ⁰ 10 = 2 ⁶ and a string of A:s will be written If the printer does not print, go on to the TROUBLESHOOTING PRINTER
Input from the Key-board does <u>not</u> work. The Input Mode lamp does not lit when the BREAK-key is depressed	PCU-printer cable defective	Check/replace the cable
	Bad connection between Printer and Keyboard	Check if the Keyboard is properly fitted to the printer

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Symptom	Probable cause	Action
(continued)	Keyboard faulty	Disconnect the Printer-PCU cable and insert the Exerciser in the printer and test the codes from the keys, particularly the BREAK-code. Replace the Keyboard if necessary
	PCU-board faulty	Replace the board
	PROM-board defective	Make the Printer test and if it is OK check that the PROM-board is provided with 8 PROM-chips. Replace the board if necessary
	CPU- board defective	Make the Printer test and even if that works alright some RAM-chip may be faulty. Replace the CPU-board
Input Mode lamp is continuously lighting	The P1000-system does <u>not</u> collect the buffer contents	The TRANSMIT-key is activated to transfer data to P1000, but this does not happen so P1094 is blocked. Switch power Off and On and try BREAK-key again. If it works, check the line, modems and LCU-board

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6.3.3

TROUBLESHOOTING PRINTER PTS 3100

This troubleshooting chart is supposed to be a reminder and an aid at corrective service.

Start all troubleshooting, on the printer, by making a manual line feed (LF-test) and if it is working the power supply is OK.

As next step always check the operable switch (Ready) and the paper out detector switch.

Symptom	Probable cause	Action
Power lamp does not lit	Power cable is not connected	Check/replace the mains cable
	Mains fuses are blown	Check the fuses (1.6A S.B) located above the mains inlet on the rear
	Power lamp is faulty	If LF-test is OK the lamp is faulty. Replace it.
	+ 5V - fuse (4A) is blown	Remove the top-back-cover. Then the fuses in the power supply are accessible. Check/replace the faulty fuse and measure the voltages, +5V, -12V, +36V on the fuses (see item 8.1.1 - 27, 28, 29)
The printer does not print. The power lamp is lighting	The fuse for +36V is blown	Make LF-test, remove the top-back-cover and check/replace the faulty fuse. Measure the three voltages on the fuses.
	The print head is for some reason to the left of the home position.	If LF-test is OK the head can be to the left of home position and if the printing starts with a Carriage Return, the head never can reach the home-position and because of that no Ready signal is given.



Symptom	Probable cause	Action
(continued)	The printer logic board is defective	If the voltages are correct remove the interface board and insert the Exerciser. Make a printer test and if nothing happens replace the logic board. An error on the board may cause that some fuse blows but it is not necessary so.
	The Interface board is faulty	If the print test from the Exerciser works Ok the error may be in the Interface board. Replace it.
	Printer line cable	Check/replace the cable
	Paper out-detector switch or Ready switch are not On.	If this switches are not switched on Relay k1 it cannot generate the operable signal to the interface. The operable signal can be measured as a short circuit (when active) between pin 18 and 19 in the line connector. Replace the faulty switch.
Manual line feed error	The line feed switch on the logic board is defective	Replace the switch
	The spring that affect the switch may be wrongly bended.	Check the spring and adjust it if necessary. The spring is located in the top front cover under the manual line feed button.
	The logic board is defective	Replace the board.

Symptom	Probable cause	Action
Line feed error	The logic board is defective	Remove the line connector and the top covers and insert the Exerciser instead of the Interface board. If the line feed is not working replace the logic board.
	Some gear wheel may be loosened.	Check the wheels while moving the platen knob by hand. Check also that the motor shaft is moving then. If it is not, screw up the loosened wheel.
	The platen motor is defective	Remove the cover plate over the mother board and measure with oscilloscope the pulses to R3 - R6, and if they are Ok Replace the motor.
The carriage speed is going down to 30 Hz during CR.	The printer must be cleaned and lubricated	Follow the Lubrication Instruction in Appendix 6.2:1.
	The logic board is defective	Replace the board
The carriage tries to go further on in the Home-position	The optical carriage detector is defective or the cables are faulty.	Measure directly on the pins of the detector with an oscilloscope or voltmeter. See if the level switch from low to high when you put a paper in the detector.
	The logic board is defective	Replace the board.
The carriage passes the whole plate without printing.	The optical carriage detector is defective.	Check/replace the detector.
	The logic board is defective.	Replace the board.

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Symptom	Probable cause	Action
Characters are missing	The logic board is defective.	Disconnect the line and put in the Exerciser and make printer test. Replace the logic board if it is not Ok.
	The Interface board is defective or has wrong line speed selected.	If printer test from the exerciser was Ok, check the speed selector jumpers or replace the board.
	The printer cable is defective.	Check/replace the cable.
	Program error.	The interface is fed with characters too fast. Put in idle-characters in the program.
Character error, parts of the characters are lost.	The printhead is defective.	Check if all needles are printing Ok. If it's not, clean the head. If this does not help, replace the head.
	Carriage Ribbon cable broken	Check/replace the cable.
	Character-generator is defective.	Replace the generator and the PROM if there is one.
	The logic board is defective	Replace the board.
	The interface board	If the printer makes the characters Ok when using the Exerciser, replace the Interface board.
The ink ribbon is not moving or badly moved.	The ink ribbon board is defective.	Take away the spools and check if the motorshafts are moving. If not, change the board.
	The cables to one of the motors are defective.	Check/replace the ink ribbon feed assembly.

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Explanation of the Exerciser testprogram

The testprogram is stored in a PROM (1702) which when delivered from PTS contains the following testprogram for 80 characters Platen (see figure 1). However the PROM can be programmed in an other way to suit other platens length and special wishes.

The testprogram is split up in two halves.

- The first half starts with one line of text.

Next line contents 80 characters starting and ending with 8 stars and in between all the 64 characters in the character generator set.

If the printer logic is provided with Basic ISO character set (57 character) without the extra PROM for the 7 special characters, there will be 7 empty places in the printed line.

The first half ends with two line feed, to separate it from the second programhalf.

- The second half starts with one line of text, telling a line feed and backspace (3 backspace) will be done, and then repeated once (check that the three dots are located under each other indicating that the Back Space command is all right).

After the last three dots, there is the text Carriage Return (CR) to tell that a carriage return without line feed will be done.

And in the beginning of the same line as for CR commands Bell, CR and Form Feed (FF) is printed and also executed.

And the program ends with three "Underline" and two line feed.

If a form feed assembly is included the Top of form can be checked by the location of this underline, which when no FF assembly is included will be 1/12 inch under the last printed line.

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MATRIX PRINTER PTS 3100

Appendix 6.3:i/2

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```
PTS 3100 CHARACTER PRINTOUT TEST :  
***** !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ[\]^_*****  
TEST COMMANDS : LINE FEED (LF) , BACK SPACE BS)...  
...  
BELL , CR , FORM FEED (FF) ... CARRIAGE RETURN (CR)
```

Figure 1 The lay-out of Exerciser testprogram



6.4 Exchanging spare parts in Printer PTS 3100

6.4.1 General

Applicable as a general rule is that the power supply on the printer must be switched off, and the line connector disconnected. If a keyboard is directly mounted to the printer, they have to be separated before the printer cover can be removed.

6.4.2 PTS 3100 Printer, type PTS 3111-001

In part 8.1. the spare parts of the printer, are listed and shown. When dismantling the printer the rear cover is unfastened by removing two screws along the rear edge of the paper inlet groove. Furthermore there are two more screws, one on each front inside, that can be loosened just a few turns with an openended sparrow of 7 mm. If then the platen knob is removed the rear cover can be lifted off from the remaining part of the case. In order to also remove the latter, two catches along the lower part and two on each side of the back of the printer must be loosened and lifted up. By that the printer can be drawn out of the case from the rear. Inside the printer there are also two protection plates that must be removed at certain exchange actions, see below.

- Notes and tips

Printed board assemblies

- When exchanging the electronic's board; turn up the front cover and remove the rear cover, as described above. Then the board protection cover can be lifted up by force.
- Exchange of the ribbon control board demands the whole case and the protection plate under the carriage to be removed.

Matrix print head

- Turn up the front case, unhook the two print head draw springs and disconnect the ribbon cable
- Unfasten the print head by removing the two screws on its right-hand side
- Before mounting a new print head, check that it is provided with a nose roller.
- When mounting, check that the head is attached perpendicular to the platen



- After mounting, check that the head is moving forwards and backwards easily and freely
- Check that the draw springs are able to pull the head back and that the ribbon cable runs freely without obstructing the movement of the head
- Check that the head reaches the print level along the entire printing range without touching the fore part of its spindle guides.

Carriage roller

- Turn up the front case, unhook the two print head draw springs and disconnect the ribbon cable
- Unfasten the print head by removing the two screws on its right-hand side
- Remove the head and unscrew the arm holding the roller
- Before mounting a new roller, clean the bearing and lubricate it with Shell Tellus Oil 15
- When fastening the print head, check that the head is attached perpendicular to the platen
- After fastening, check that the head is moving forwards and backwards easily and freely
- Check that the draw springs are able to pull the head back and that the ribbon cable runs freely without obstructing the movement of the carriage.

Carriage bushes

- Remove the case and separate the bracket combining the carriage with its opto switch
- Replace the bushes and reassemble so that the play between the bushes and the guide bar is minimized
- Check that the carriage runs without being obstructed by the ribbon cable, the tabulate markers or the mask ruler

Carriage opto switch

- Remove the case and unfasten the carriage opto switch
- After mounting a new switch, check that the switch runs freely from the tabulate markers and the mask ruler.

Carriage ribbon cable

- Remove the case and the protection plate under the carriage
- Unfasten the ribbon cable beginning at the print head/opto switch end
- Check that the new ribbon cable runs freely without obstructing the movement of the head.



Carriage motor

- Remove the case and the protection plate under the carriage
- Disconnect the motor from the mother board, unscrew and lift out the motor
- When mounting a new motor, make sure that the motor shaft fits into the braking disc
- Correctly mounted the gear shall be practically free from play.

Ribbon feed assembly

- Remove the case, the protection plate under the carriage and the electronic's board protection cover
- Disconnect the ribbon feed assembly from the mother board and unfasten the assembly by removing two screws at each side member
- After mounting a new assembly, check that the carriage opto switch runs freely from the tabulate markers and the mask ruler.

Ribbon motor

- Remove the case, the protection plate under the carriage and the electronic's board protection cover
- Unfasten the ribbon feed assembly by removing two screws at each side member and tilt the assembly forwards in order to get at the ribbon motor to be replaced
- When mounting a new motor, make sure that it fits properly into the gear without jamming and without too much play.

Ribbon switch

- Remove the case, the protection cover over the electronic's board and the itself
- Unfasten the ribbon feed assembly by removing two screws at each side member and tilt the assembly forwards in order to get at the ribbon switch
- Adjust the new switch into a position where the ribbon link can easily be moved between its end positions

Platen motor

- Remove the case, disconnect the platen motor from the mother board and unscrew the motor
- The new motor shall be mounted in such a way that the gear play is minimized



Power supply

- The power supply can be unfastened by unscrewing 5 screws from the bottom and 4 screws on the rear of the printer
- Access to the power transistor is possible if the rear protection plate is unfastened by loosening 4 screws

Other details

- When exchanging platen; turn up the front cover and remove the rear cover. Loosen the platen catches and lift the platen upwards-backwards
- Paper catches are exchanged in the following way. Turn up the front cover, remove the rear cover and unhook the draw spring of the catch to be replaced. Then the catch is unfastened by removing its locking washer
- Exchange of fuses for the print head demands the case and the protection plate under the carriage to be removed

Exchange of fuses in the power supply, the rear cover must be removed

The mains fuses are exchanged from the rear without any dismantling

- From feed assembly is easily detached when the case is removed

Note: It is not necessary to detach the form feed assembly for exchange of form feed, which can be done without dismantling the printer

- The Bell assembly can be exchanged if the power supply is removed
- Exchange of platen knob can be done if the knob is pushed off from the platen shaft by force and the new one can be pulled on

6.4.3 Keyboard, type PTS 3151-001

In part 8.2 the spare parts of the keyboard, are listed and shown. Before exchange of parts the keyboard has to be separated from the printer by loosening two cordoned big screws on the printer underside. The keyboard is dismantled by removing four screws from the underside.

- Notes and tips

- When exchanging a keyboard switch, the key set has to be separated from the front panel by removing four screws accessible from the inside. Then the switch can be soldered away from the printed board



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- A LED-indicator can be exchanged if the panel is removed. Then the printed board for the LED's can be unfastened by loosing two screws, and the diod can be exchanged by soldering.
- Dummy plug, type 3151-002 can be exchanged to a PROM type 3151-003 if the panel and the PC-board for LED are removed. The exchange will be done through a hole in the key set plate
- Exchange of the Keyboard Encoder is done in the same way as described for the dummy plug.

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MAINTENANCE ADMINISTRATION

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7.1 PTS supply centre service organization

7.1.1 Main structure of the organization

The PTS supply centre service organization, SCS, consists of management and five main sections according to fig. 7.1:1. The five sections are

- Documentation section, producing documents required for training and maintenance
- Training section, offering training courses for service engineers
- Technical support section, offering technical assistance in cases of intricate installation or service problems
- Technical order (TO) section, issues technical orders on the basis of a statistics study of faults reported by the MMG- service department. The section also handles spare parts which are directly affected by technical orders. See part 7.1.2.
- Spare part section, offers spare parts for sale and acts as an intermediary section when receiving spare parts for repair. The section is also responsible for returning the repaired spare parts to the MMG-service department. See part 7.1.3.

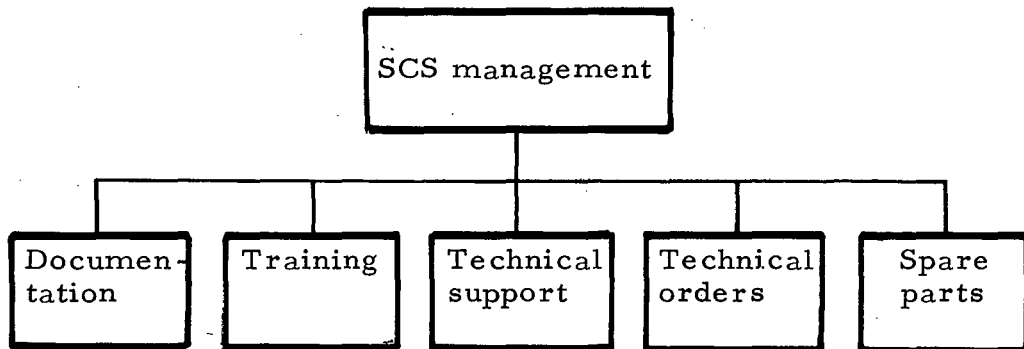


Fig. 7.1:1 Main structure of the PTS supply centre service organization, SCS.



7.1.2 The technical order section

- General

The technical order section can be divided into three activities according to fig. 7.1:2. One activity consists of a statistics study of the faults reported by the MMG-service department. Fault statistics obtained is presented to the development department, which decides if reasons exist to issue any change orders. An issued change order causes a technical order to be edited by representatives from the development department, SCS and the production department. The resulting technical order is then distributed (the second activity) by the TO section of the SCS. The third activity means handling of spare parts related to the technical orders.

- Input from MMG-service department

In fig. 7.1:2 there are three inputs indicated. The far left one of these corresponds to a fault reporting by routine, which is the base for a successful statistics study and hence also the base for issuing of technical orders. Therefore, it is of great importance that MMG-service department really report all faults that are discovered. The fault reporting by routine is excepted to take place monthly, when all faults discovered since the preceding report occasion are summarized.

The second input indicates a way for immediate reporting of obvious design faults that may be discovered.

The third input corresponds to the receiving of spare parts that, as a consequence of technical orders, are to be modified by PTS.

- Output to MMG-service department

Fig. 7.1:2 shows two outputs to MMG-service department. One of these indicates the distribution of technical orders, the other one indicates the returning of modified spare parts.

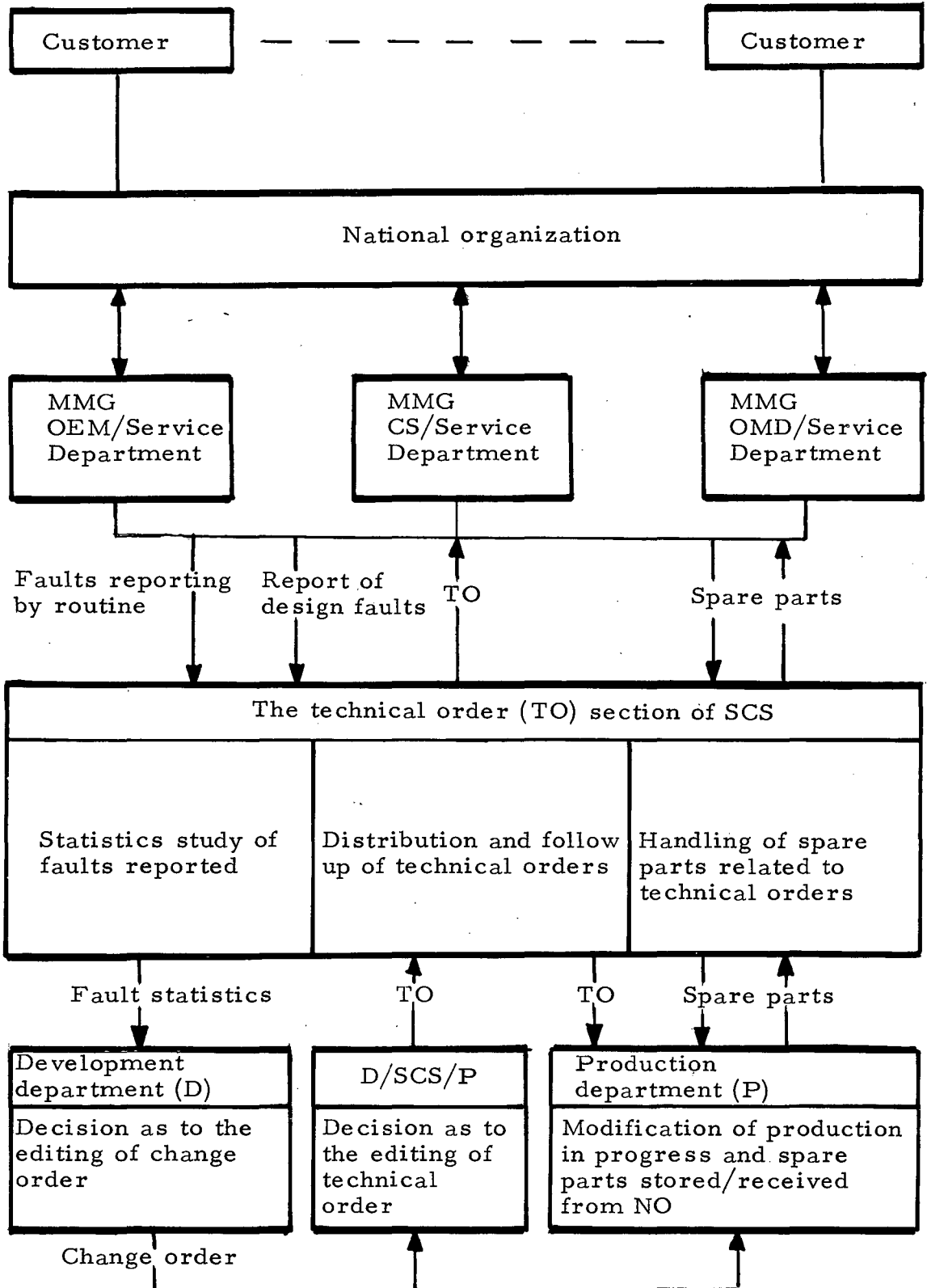
7.1.3 The spare part section

The connections between the spare part section of SCS and the MMG-service department are shown in fig. 7.1:3. The figure shows that the connections consist of two branches, one salesbranch and one service branch.

In the salesbranch the following communications take place



Fig. 7.1:2 Activities in the technical order section



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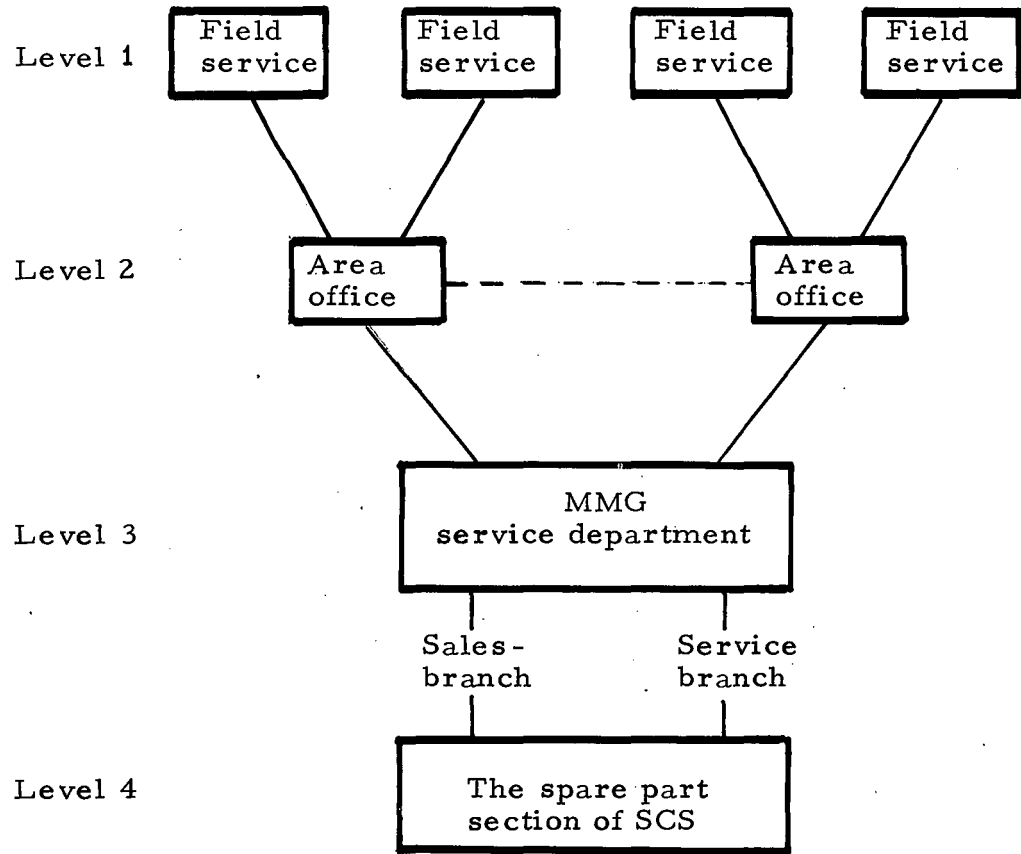


Fig. 7.1:3 Connections between the SCS spare part section and MMG-service department

- the spare part section of SCS recommends each MMG-service department a spare part stock adapted to existing orders under their control
- once a year the MMG-service department are presented a standard spare parts list with actual prices
- required spare parts are ordered by MMG-service department using the spare parts list as a reference

The service branch is used for communications regarding questions of corrective service measures which are to be taken on level 4, i.e. at PTS.

The communication routine is as follows

- corrective service is ordered by MMG-service department when the module in question is sent to the spare part section of SCS.



- the section returns the module after a repair time estimated to exclusive transport times

In cases a MMG-service department is temporarily short of certain modules, the spare part section also offers a quick delivery of separate modules from the supply centre stock.



7.2 Fault reports by routine

7.2.1 General

All service measures taken are to be reported by means of service report forms provided by SCS. Each service report written results in three sheets, one for the customer, one punching sheet to be sent to SCS (in monthly batches) and one copy to be kept by actual service organization. A set of service report forms is shown in the appendices 7.2:1 - 7.2:3.

The SCS is only interested in the information noted for punching of cards, see the specification in part 7.2.3. Would of any reason, the MMG-service department consider the service report forms as unsuitable for their administrative routines, the information specified must nevertheless be noted on the punching sheet and sent to SCS.

7.2.2 Disposition of the service report punching notes

Each service report form has space for punching notes about six different modules, provided that these modules can be headed in the same way, i.e. if the information up to and including column 40 is common for all the modules. Remaining columns of a punched card are utilized in such a way, that individual notes about two modules are placed in the columns 44 - 58 and 61 - 75 respectively. A service report concerning six modules therefore gives rise to three punched cards, all of which have the same information in the columns 1 - 40. See the service report set in the appendices 7.2:1 - 7.2:3.

7.2.3 Information requested by SCS

In the monthly fault report, fed back from the MMG-service department, the following information must be included in each service report.

- Column 4 - 9, service report no. (when using the SCS forms the number is already printed in the upper right-hand corner of the forms)
- Column 16 - 18, code for national organization, NO. See part 7.5.1.
- Column 24 - 29, date when the service measures were finished (year, month, day)
- Column 40, reason for the service measures taken (the alternatives are given in the form)



- Column 44 - 47 (61 - 64), report code for the exchanged/repaired module. See part 7.5.3.
- Column 48 - 52 (65 - 69), series number of the exchanged/repaired module
- Column 53 - 55 (50 - 72), absolute modification status, i.e. the last number marked on the sticker card
- Column 56 (73), relative modification status. Note 1 if all issued technical orders concerning this module are taken care of, otherwise note 0 (see also part 7.4.3)
- Column 57 - 58 (74 - 75), error type in accordance with the table in part 7.5.2. Service measures taken on level 1 will in most cases result in code 99, as the service philosophy on that level means exchanging of complete modules. When the exchanged module then is repaired on a higher service level a new service note has to be done (if possible on the same form as used on level 1).



Svenska AB Philips
Terminal Systems
Fack, S-162 10 Vällingby
Sweden

SERVICE REPORT
Punching sheet

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Delivery address			Customer			Service No. 4 - 9 Z 0043		
						Service request		
						Date	Time	
Reference to			Service finished			Date		
<input type="checkbox"/> PTS 6000 <input type="checkbox"/> PTS 3100 <input type="checkbox"/> Other						Time		
Error cause								
Service executed by								
Customer (Sign)								
Checked								
Warranty								
<input type="checkbox"/> Yes		<input type="checkbox"/> No						
Key type 1 - 3	NO 16 - 18	Service finished 24 - 29	40 <input type="checkbox"/> 1 Preventive service		40 <input type="checkbox"/> 2 Corrective service		40 <input type="checkbox"/> 3 Modification	
						40 <input type="checkbox"/> 4 Installation		
Code 44 - 47	Series No. 48 - 52	Status 53 - 55	All TO's executed *) 56	Error type 57 - 58	Replaced by series No.		Remark	
61 - 64	65 - 69	70 - 72	73	74 - 75				
44 - 47	48 - 52	53 - 55	56	57 - 58				
61 - 64	65 - 69	70 - 72	73	74 - 75				
44 - 47	48 - 52	53 - 55	56	57 - 58				
61 - 64	65 - 69	70 - 72	73	74 - 75				
Job description								

PTS 60024 (73.05)

PLEASE, send this copy to Svenska AB Philips, Terminal System, Fack, 162 10 Vällingby, Sweden

(* Yes = 1, No = 0)

PTS 3100 T&MM
Appendix 7.2:2



Svenska AB Philips
Terminal Systems
Fack, S-162 10 Vällingby
Sweden

SERVICE REPORT
Service copy

PHILIPS

Delivery address		Customer		Service No. 4 - 9 Z 0043		
Reference to <input type="checkbox"/> PTS 6000 <input type="checkbox"/> PTS 3100 <input type="checkbox"/> Other		Error cause		Service request Date Time		
Service finished Date Time		Service executed by		Customer (Sign)		
Checked		Warranty <input type="checkbox"/> Yes <input type="checkbox"/> No				
Key type 1 - 3	NO 16 - 18	Service finished 24 - 29	40 <input type="checkbox"/> 1 Preventive service	40 <input type="checkbox"/> 2 Corrective service	40 <input type="checkbox"/> 3 Modification	40 <input type="checkbox"/> 4 Installation
Code 44 - 47	Series No. 48 - 52	Status 53 - 55	All TO's executed * 56	Error type 57 - 58	Replaced by series No.	Remark
61 - 64	65 - 69	70 - 72	73	74 - 75		
44 - 47	48 - 52	53 - 55	56	57 - 58		
61 - 64	65 - 69	70 - 72	73	74 - 75		
44 - 47	48 - 52	53 - 55	56	57 - 58		
61 - 64	65 - 69	70 - 72	73	74 - 75		
Job description						
Transport method <input type="checkbox"/> Car km <input type="checkbox"/>			Travel costs		Living-out allowances amount costs	

PTS 60024 (73.05)

(* Yes = 1, No = 0)

PTS 3100 T&MM
Appendix 7.2:3



7.3 Technical orders

7.3.1 General

Technical orders (TO) are issued in all cases where important technical information about equipment in use is to be distributed. The most important kind of technical orders are those concerning hardware modifications. Technical orders of that kind are in principle edited in accordance with the standard rules given by NV Philips-Electrologica, Apeldoorn. However, technical orders from the PTS supply centre service organization have a simplified numbering system, described in part 7.3.2.

7.3.2 Numbering system

The forms used for technical orders have the appearance shown in the appendices 7.3.1 - 7.3.2. In the upper right-hand corner the TO number is placed. The number consist of the letters ZET followed by two groups of numerals, as shown by: ZET-XXXX-XXX. The letters ZE indicate the origin of the document, i.e. Svenska AB Philips - Terminalsystem, Stockholm - Vällingby, Sweden. The letter T stands for information sheet.

In the first group of four numerals the report code of the module concerned will be found. As regards the report codes, see part 7.5.3.

The second group of three numerals form the running number of technical orders concerning this particular module.

7.3.3 Contents of a modification TO

In the field "Concerning" below the head of the first TO form (appendix 7.3.1) a modification TO is announced in the following way:

PTS 3100, modification of (unit designation), type (relevant type designation)

The field "Description" starts with a title and gives then the required information under the following headlines

1. Information
 - Short description :
 - To be accomplished by :
 - Caused by :



- Start of execution :
 - Status change :
 - Kit number :
 - Classified :
 - Spare parts affected :
 - Other TO's affected :
 - Documents affected . :
 - Serial number affected :
 - Estimated time :
2. Reasons and purpose
 3. Modification procedure
 4. Test procedure
 5. Document change actions
 6. Supply data
 7. Kit of installation tools
 8. Manhours required per unit
 9. Status change

It should be noted, that part 1 of the description, Information, is a summary given on the first TO form, shown in appendix 7.3.1. Remaining parts, the more detailed descriptions, are then written on forms shown in appendix 7.3.2.



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TECHNICAL ORDER

ZET -

Issued

Concerning

Description

SUBJECT: _____

1. Information

- Short description :
- To be accomplished by :
- Caused by :
- Start of execution :
- Status change :
- Kit number :
- Classified :
- Spare parts affected :
- Other TO's affected :
- Documents affected :
- Serial number affected :
- Estimated time :



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TECHNICAL ORDER

ZET -

Issued



7.4 Device status cards

7.4.1 General

To each module provided with a sticker card, see part 7.5.3, belongs a device status card that will follow the module through its lifetime. The device status card is used to follow up all modifications carried out as a consequence of issued technical orders.

The device status cards belonging to a certain equipment are to be kept in connection to the installation site, easily accessible to the service engineers.

Would any status card be lost or damaged, the SCS will, if asked, issue a new one.

7.4.2 Layout of the device status cards

The layout of the device status cards is shown in appendix 7.4.1. In the right-hand corner of the head the status card number will be found. The number consists of the letters ZET followed by four numerals, equal to the report code of the module. Compare with the numbering of technical orders.

Below the head there is a field where the following information is provided.

- Product, e. g. PTS 3100
- Unit/serial number, designation and serial number of the module corresponding to the report code included in the status card number
- Type, defines the particular version of the module
- Article number (12 NC), the 12 NC of the module
- Located in, defines the nearest superior unit of the equipment

The next two fields of the status card are intended for the sign of a district manager and for any special remarks. With district manager is meant that person who is responsible for execution of the modifications.

The rest of the status card embraces the area to be used for the real status notes. In the top of the very left column



the two first parts of the technical order number (ZET-XXXX-) will be found. The last part of the number, the running number of technical orders concerning this particular module, is to be noted in the column according as the orders are received. The numbers formed by these three numerals are equal to the numbers that are to be marked on the sticker card when executing the modifications.

In the next column the classification given in the technical orders will be noted. Three classifications are used.

- mandatory, note M
- retrofit on failure, note F
- optional, note O

The third column is intended for a short description given on the first page of each TO.

In the last columns are specified when the modifications were executed, by whom and the organization to which the executant belongs. The latter information is noted by an X in the relevant column, PTS or NO.

7.4.3 Handling the device status cards

Each technical order received must immediately be noted on the corresponding status cards, irrespective of whether the modification is executed or not. The reason for that is to make it possible for the service engineers to include the relative modification status in their service reports, cf. part 7.2.3.

Do not forget to enclose the status card when a module is taken to an area service office, to a national service department or is sent to PTS for repair/modification.



7.5 Reference tables

7.5.1 Table of national organization codes

Country	Code
Europe	010
USA	130
Belgium	170
Denmark	300
Germany	320
Finland	370
France	380
Great Britain	420
Ireland	460
Italy	520
Japan	540
Netherlands	670
Norway	710
Austria	720
Portugal	790
Spain	850
Iceland	950
Sweden	970
Switzerland	980

7.5.2 Table of error type codes

<u>Nature of error</u>	<u>Code</u>	<u>Remarks</u>
Mechanical	10	
Broken	11	
Worn	12	
Bent	13	
Loose	14	
Dirty	15	
Adjustment	16	
Missing part	17	
Production failure	18	
Electrical	30	
Short circuit	31	
Burnt	32	
Interruption	33	
Component failure	34	
Value changed	35	
Cable failure	36	
Bad soldering	37	
Spark-over	38	
Fuse	39	
Other	50	
Unknown	51	
External cause	52	
Program failure	53	
Operator's mistake	54	
Transport damage	55	
To be found out	99	The module concerned has only been replaced by a new one and then taken to a higher service level for repair

7.5.3 Table of report codes

- Basic Printer unit, type PTS 3111-001

Module/component	Report code	Article no. (12NC)	Remarks (S= sticker card)
Basic Printer Unit	3000	5131 190 59900	S/ 50 Hz 220V
Basic Printer Unit	3001	70900	S/ 60 Hz 115V
Electronics board	3100	5131 191 14900	S
Ink ribbon feed board	3101	05300	
Matrix Print Head	3102	190 19800	
Ink ribbon feed assy	3103	38000	
Ink ribbon motor	3104	59200	
Carriage motor	3105	58900	
Platen motor	3106	63600	
Opto switch carriage	3107	100 08920	
Ink ribbon switch	3108	2422 120 00353	
Line space selection switch	3109	2412 127 00001	
Paper out detection switch	3110		
Carriage ribbon cable	3111	5131 191 04300	
Carriage bush	3112	100 12150	
Carriage roller	3113	09410	
Print head draw spring	3114	13120	
Paper catch	3115	18250	
Platen knob	3116	18780	
Peg mech. cpl.	3117	190 48500	right
Peg mech. cpl.	3118	48600	left
Paper tearing off	3119	58700	
Line feed switch	3120	2412 128 02088	



Module/ component	Report code	Article no.	Remarks (S= sticker card)
Power Supply, PE 1446	3140	5131 100 64000	S/ 50 Hz 220V
Mains switch	3141		1602 0101 Marq.
Lamp power ON	3142		
Operation mode switch	3143		1601 0101 Marq.
Relay	3144		PRME 1500 S AB
Fuse 1 A fast	3145		
Fuse 2 A fast	3146		
Fuse 0.63 A fast	3147		
Fuse 4 A fast	3148		
Fuse 1.5 A slow	3149		
Fuse 2 A slow	3150		
Power Supply	3151		S/ 60 Hz 115V
Character Generator	3160	5131 100 01771	64 Chs.
Character Generator	3161	01761	SJ
Character Generator	3162	01781	57 Chs.
PROM for code 3162	3170	9332 365 20112	7 Chs. unprogr.
PROM for code 3162	3171	5131 101 05001	7 Chs. Sw. P1000
Platen peg feed	3175	5131 191 71000	69 Chs.
Platen peg feed	3176	64800	80 Chs.
Platen peg feed	3177	64900	110 Chs.
Platen peg feed	3178	64700	69 Chs. for SJ
Basic mech. assy for auto form feed	3180	5131 190 62900	
Form length 3.0 in. for 3180	3181	62300	
" 3.5 in. "	3182	69200	
" 4.0 in. "	3183	62400	
" 4.5 in. "	3184	69300	
" 5.0 in. "	3185	69400	
" 5.5 in. "	3186	69500	
" 6.0 in. "	3187	69600	
" 6.5 in. "	3188	69700	
" 7.0 in. "	3189	69800	
" 7.5 in. "	3190	69900	

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MATRIX PRINTER PTS 3100

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Module/component	Report code	Article no.	Remarks (S=sticker card)
Form length 8.0 in. for 3180	3191	5131 190 70000	
" 8.5 in. "	3192	70100	
" 9.0 in. "	3193	70200	
" 9.5 in. "	3194	70300	
" 10.0 in. "	3195	70400	
" 10.5 in. "	3196	70500	
" 11.0 in. "	3197	70600	
" 11.5 in. "	3198	70700	
" 12.0 in. "	3199	70800	
" 12.5 in. "	3200	62600	
Bell	3210	5131 191 18200	
Cover open indication	3211	190 66300	SJ
Buzzer	3212	191 15600	SJ
Basic line interface	3230	5131 191 15400	S/Dummy card
Line interface	3231	18300	S/CCITT V-24
Line interface	3232	15100	S/ KSR 33
Line interface	3233	15000	S/ SJ

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- Keyboard, basic unit, type PTS 3150-001

Module/ component	Report Code	Article no.	Remarks (S=sticker card)
Keyboard, basic unit	3250	5131 190 60400	S/ECMA 23C
Solid state lamp	3251		
Keyboard switch	3252	2422 128 01446	
Keyboard switch, (lock type)	3253		
Dummy plug for PTS 3150-001	3260	5131 191 19800	
PROM unprogr. for "	3261	101 02190	

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- Control Unit, type PTS 3161-011

Module / component	Report Code	Article no.	Remarks (S=sticker card)
Control Unit for P1000	3300	5131 190 61700	S/Buffer
Power Supply assy			2x127 chs
With control panel	3301		S
Power supply Oltronix	3302		MkII MCA +5V-3
-"- -"- -"-	3303		-"- -"- -12V
-"- -"- PTS	3304	5131 191 6400	-1,7
Switch (Panel)	3305	5122 010 20941	
-"- -"-	3306	5122 010 29961	
-"- Power on	3307		
Lamp -"-	3308		
Light emitting diode	3309	9332 247 20112	
Board PROM	3310	5131 190 68500	S
Board CPU	3311	5131 190 68600	S
Board LCU	3312	5131 190 68400	S
Board PCU	3313	5131 190 68700	S
Connector retainer	3314		
-"- -"-	3315		
Power cable	3316	5131 191 17800	Printer
-"- -"-	3317		Control Unit
Cable PCU-Printer	3318	5131 191 16500	
Cable LCU-Modem	3319	5131 191 17500	

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SPARE PARTS

Prefatory note

The spare parts listed below are those required for service on level 1 and 2 (the levels defined in chapter maintenance administration). The spare parts stock are estimated for ca 25 printer installations and one area service office.

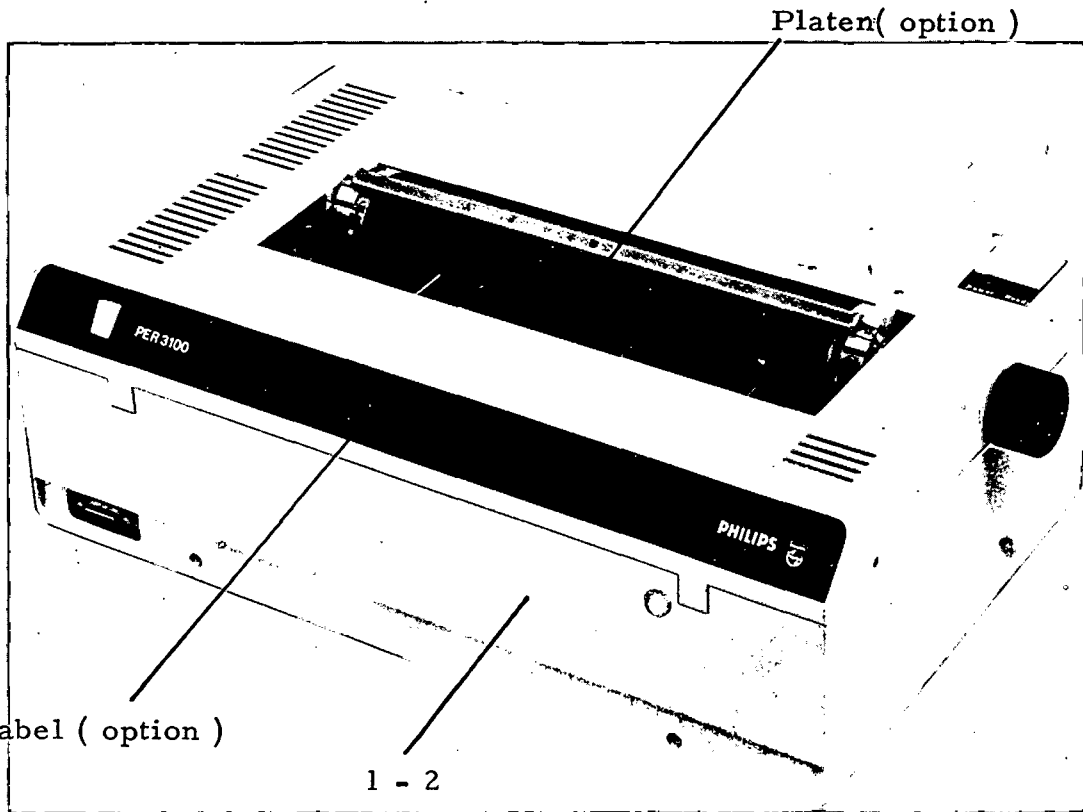
Contents

- 8.1 PRINTER, type PTS 3111-001
 - 8.1.1 Basic Unit
 - 8.1.2 Options
- 8.2 KEYBOARD, type PTS 3151-001
 - 8.2.1 Basic Unit
 - 8.2.2 Options
- 8.3 TOOLS
 - 8.3.1 Exerciser
 - 8.3.2 Extension board
- 8.4 CONTROL UNIT
 - 8.4.1 Basic Unit
 - 8.4.2 Board CPU
 - 8.4.3 Board PROM
 - 8.4.4 Board LCU



8.1 Printer, type PTS 3111-001
8.1.1 Basic unit

Item 8.1.1-

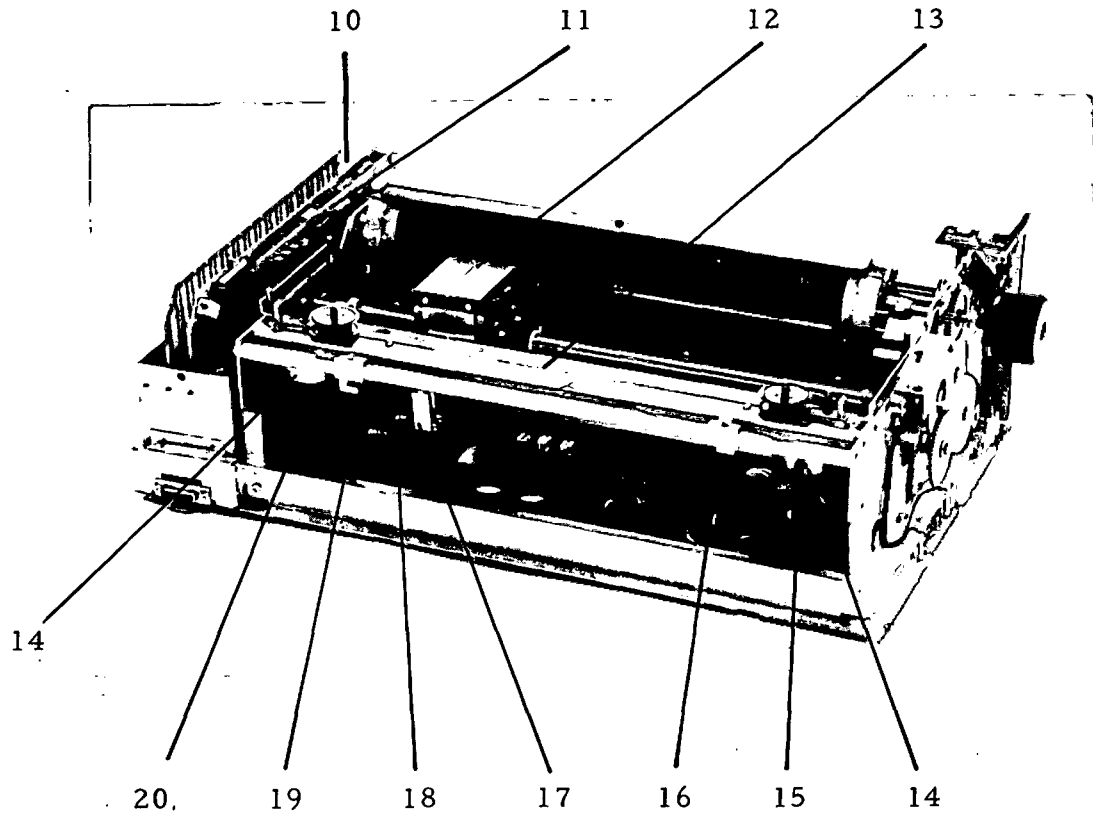


Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.1-					
1	3111-001	Basic Printer Unit (50Hz 220V)	5131 190 59900	1	1
2	3112-001	Basic Printer Unit (60Hz 115V)	70900	1	1
3					
4					
5					
6					
7					
8					
9					

PHILIPS



Item 8.1.1-

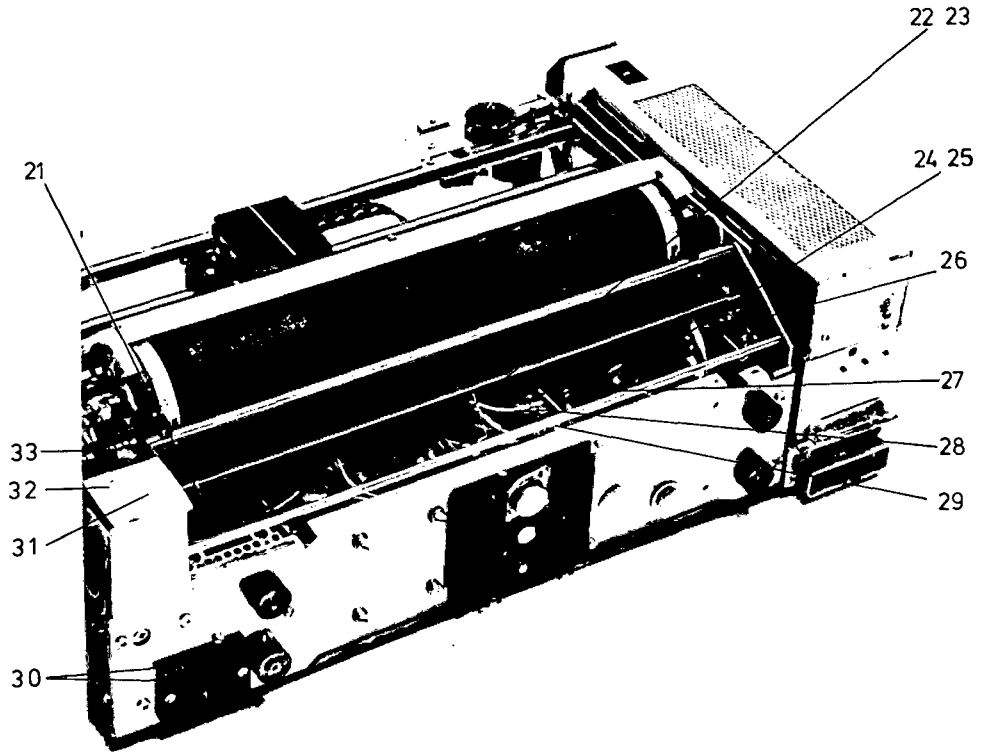


PHILIPS

Item	Type. no.	Designation	Article no.	Pieces on level	
				1	2
8.1.1-					
10		Relay (on the mother-board) PRME 1500 5 AB		-	2
11		Electronics Board	5131 191 14900	1	2
12		Matrix Print head	190 19800	2	3
13		Ink Ribbon feed assy	38000	1	2
14		Ink Ribbon motor	59200	-	1
15		Carriage motor	58900	-	1
16		Fuses 1 A fast	2422 086 00033	10	20
17		Opto switch, carriage	100 08920	1	2
18		Board, Ink ribbon	191 05300	1	2
19		Ink Ribbon Switch	2422 120 00353	2	5
20		Carriage Ribbon Cable	5131 191 04300	1	2



Item 8.1.1-

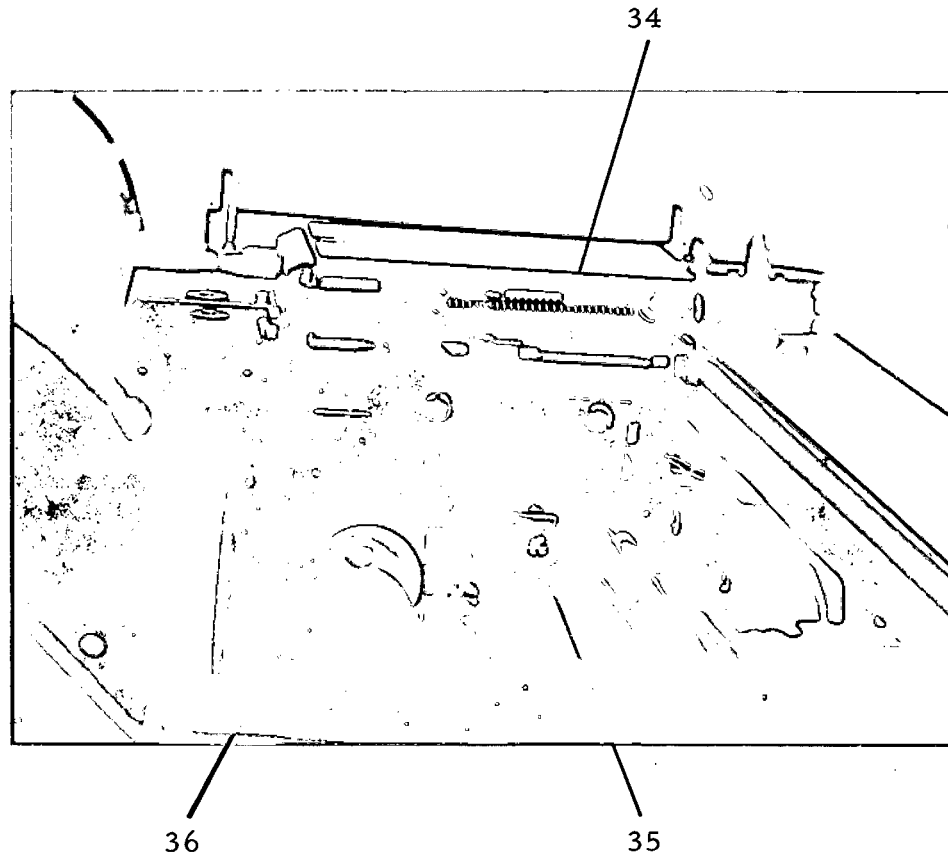


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Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.1-					
21		Platen Motor	5131 190 63600	-	1
22		Power Supply	66800	1	2
23		Power Supply (60 Hz 115V)		1	2
24	3192-001	Bell	191 18200	1	2
25	3192-012	Buzzer (for SJ)	15600	1	2
26		Paper out detection Switch		-	5
27		Fuse 0.63 A fast (-12V, 5 x 20 mm)	2422 086 00026	10	20
28		Fuse 2 A slow (+36V, 5 x 20 mm)	01031	10	20
29		Fuse 4 A fast (+5V, 5 x 20 mm)	00047	10	20
30		Fuses 1.6 A slow (Mains, 5 x 20 mm)	01026	10	20
31		Mains Switch (1602 0101 Marquart)		-	2
32		Operation mode Switch (1601 0101 Marquart)		-	2
33		Lamp, Power ON (T 4.6 24V 0.02 A)		2	3



Item 8.1.1-

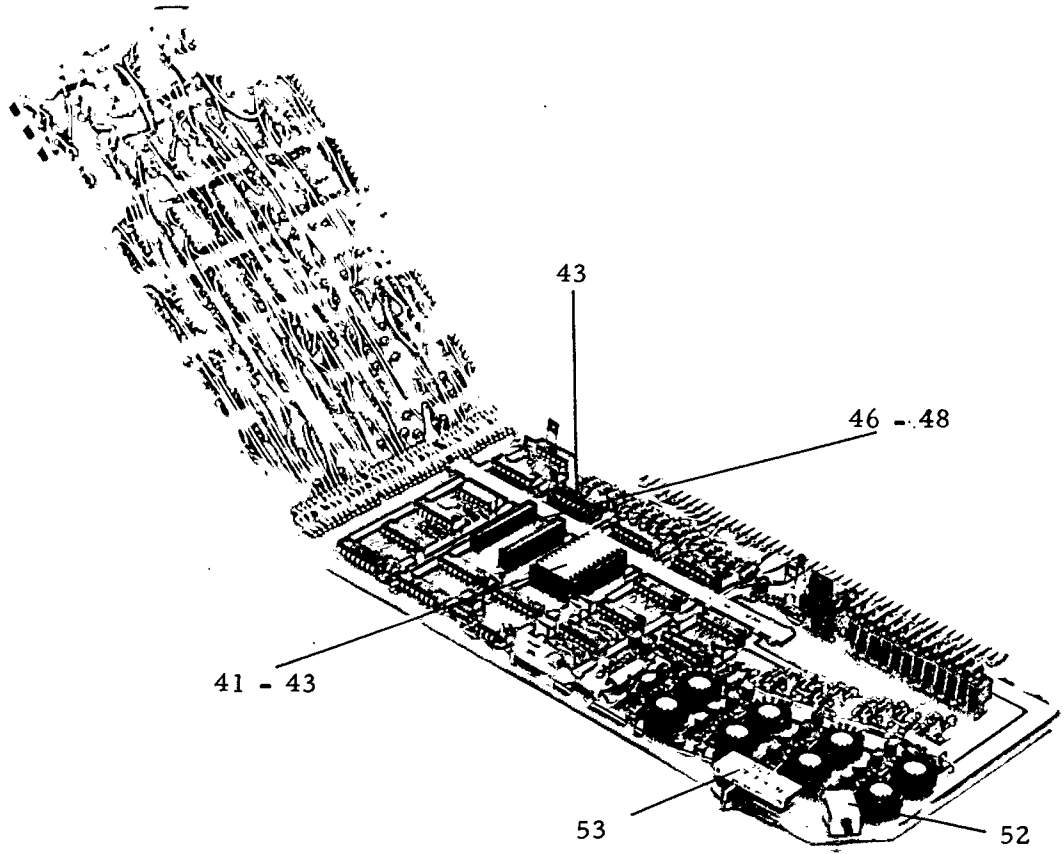


PHILIPS

Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.1-					
34		Print head draw spring	5131 191 13120	2	3
35		Carriage roller	100 09410	1	2
36		Carriage bush	12150	-	3
37					
38					
39					
40					



Item 8.1.1-



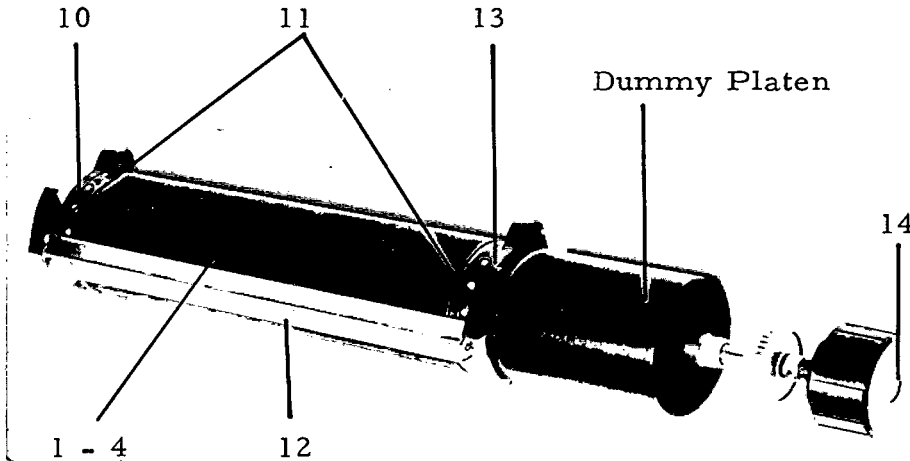
PHILIPS

Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.1-					
41	3141-001	Character Generator (ASCII, 64 Chs)	5131 101 01771	1	2
42	3141-011	Character Generator (SJ)	01761	1	2
43	3142-001	Character Generator (Basic ISO-7 +encoder)	01781	1	2
44					
45					
46	3142-002	PROM for Item 43 (7 Chs unprogr.)	9332 365 20112	1	2
47	3142-011	PROM for Item 43 (7 Chs Sw. P 1000)	5131 101 05001	1	2
48	3142-012	PROM for Item 43 (7 Chs Da. P 1000)	01870	1	2
49					
50					
51					
52		Line feed Switch	2412 128 02088	-	5
53		Line space selection Switch	2412 127 00001	-	5



8.1.2 Options

Item 8.1.2-



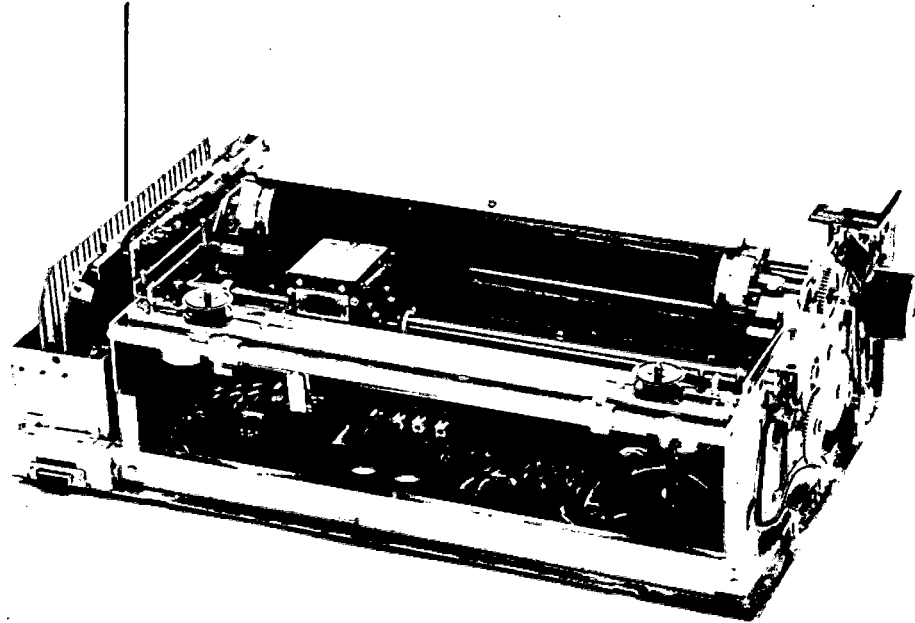
Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.2-					
1	3121-001	Platen Pegfeed (69 Chs)	5131 190 71000	1	2
2	3121-002	Platen Pegfeed (80 Chs)	64800	1	2
3	3121-003	Platen Pegfeed (110 Chs)	64900	1	2
4	3121-011	Platen Pegfeed (69 Chs for SJ without frictionfeed)	64700	1	2
5					
6					
7					
8					
9					
10		Peg mech. cpl(left)	48600	-	2
11		Paper catch	18250	2	3
12		Papertearing off	58700	1	2
13		Peg mech. cpl(right)	48500	-	2
14		Platen knob	18780	1	2
15					
16					
17					

PHILIPS



Item 8.1.2-

18 - 21



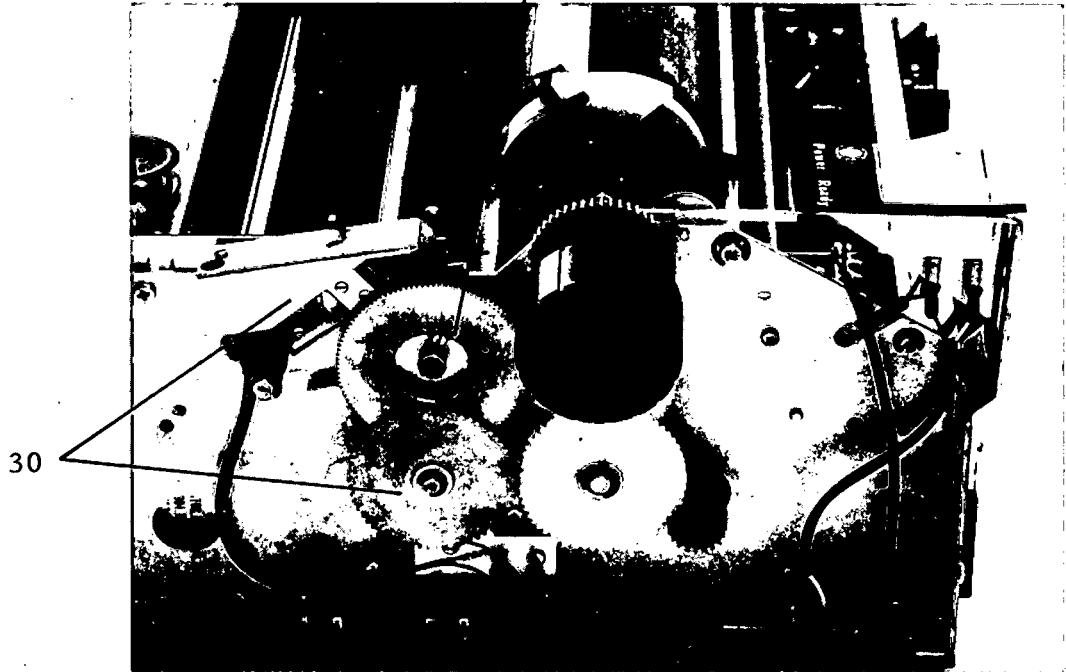
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Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.2-					
18	3131-001	Basic line interface (ECMA-C like)	5131 191 15400	1	2
19	3132-001	Line interface (CCITT V-24)	18300	1	2
20	3133-001	Line interface (Teletype KSR 33)	15100	1	2
21	3134-011	Line interface (For SJ(SNAP))	15000	1	2
22					
23					
24					
25					
26					
27					
28					
29					



Item 8.1.2-

31 - 50



PHILIPS

Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.2-					
30	3191-001	Basic mech. assy for auto form feed	5131 190 62900	1	2
31	3191-011	Form length 3.0 in. (for item 30)	62300	1	2
32	3191-012	" 3.5 in.	69200	1	2
33	3191-013	" 4.0 in.	62400	1	2
34	3191-014	" 4.5 in.	69300	1	2
35	3191-015	" 5.0 in.	69400	1	2
36	3191-016	" 5.5 in.	69500	1	2
37	3191-017	" 6.0 in.	69600	1	2
38	3191-018	" 6.5 in.	69700	1	2
39	3191-019	" 7.0 in.	69800	1	2
40	3191-020	" 7.5 in.	69900	1	2
41	3191-021	" 8.0 in.	70000	1	2
42	3191-022	" 8.5 in.	70100	1	2
43	3191-023	" 9.0 in.	70200	1	2
44	3191-024	" 9.5 in.	70300	1	2
45	3191-025	" 10.0 in.	70400	1	2



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Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.1.2-					
46	3191-026	Form length 10.5 in. (for item 30)	5131 190 70500	1	2
47	3191-027	" 11.0 in.	70600	1	2
48	3191-028	" 11.5 in.	70700	1	2
49	3191-029	" 12.0 in.	70800	1	2
50	3191-030	" 12.5 in.	62600	1	2
51					
52					
53					
54					
55					
56					
57					
58					
59					

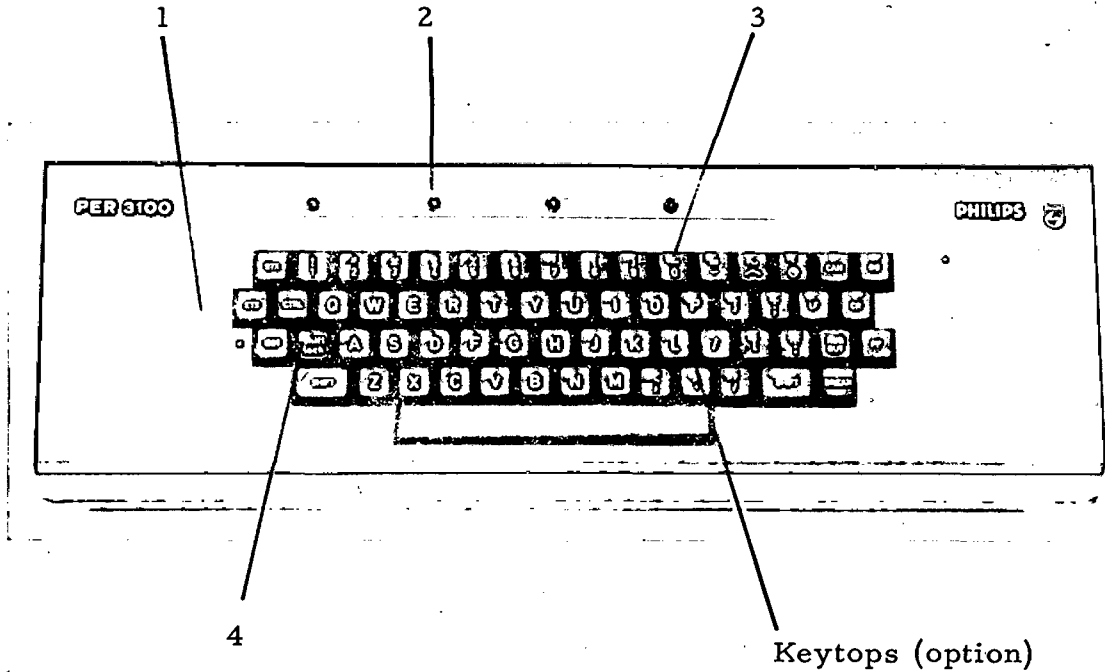
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8.2 Keyboard, type PTS 3150-001

8.2.1 Basic unit

Item 8.2.1-



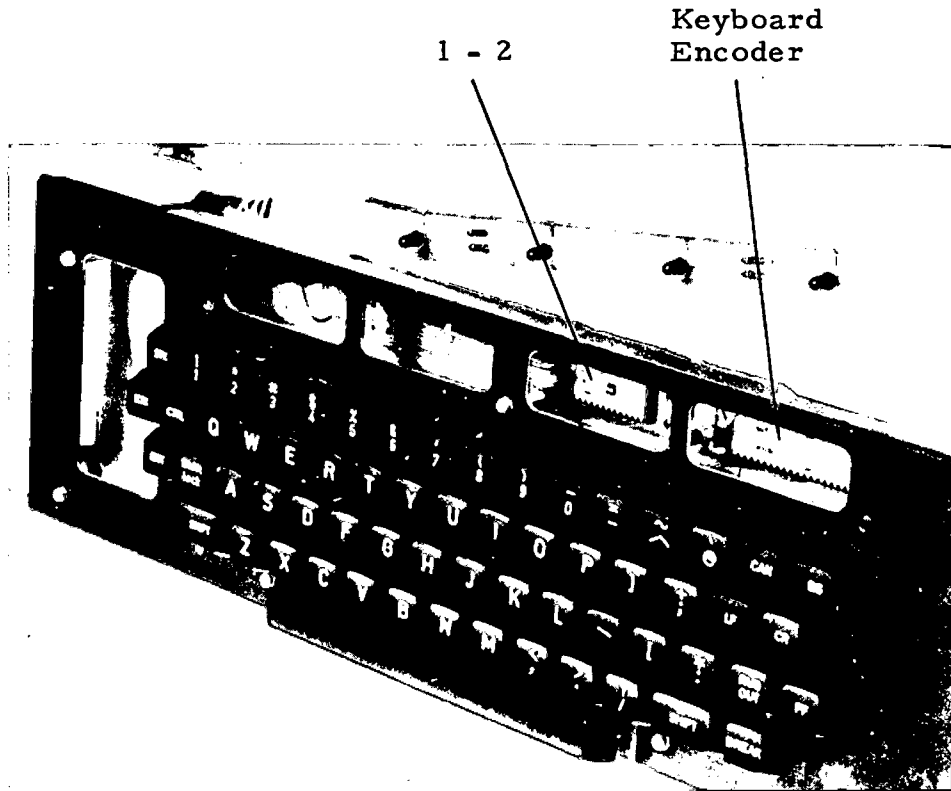
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Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.2.1-					
1	3150-001	Keyboard Basic unit	5131 190 60400	1	1
2		Solid state lamps (LED) Hewlet Packard	9332 247 20112	-	5
3		Keyboard Switch	2422 128 01446	-	5
4		Keyboard Switch (lock type)		-	5
5					
6					
7					
8					
9					
10					



8.2.2. Options

Item 8.2.2-



Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.2.2-					
1	3150-002	Dummy plug	5131 191 19800	1	2
2	3150-003	PROM unprogrammed	5131 101 02190	-	1
3					
4					
5					
6					
7					
8					
9					
10					

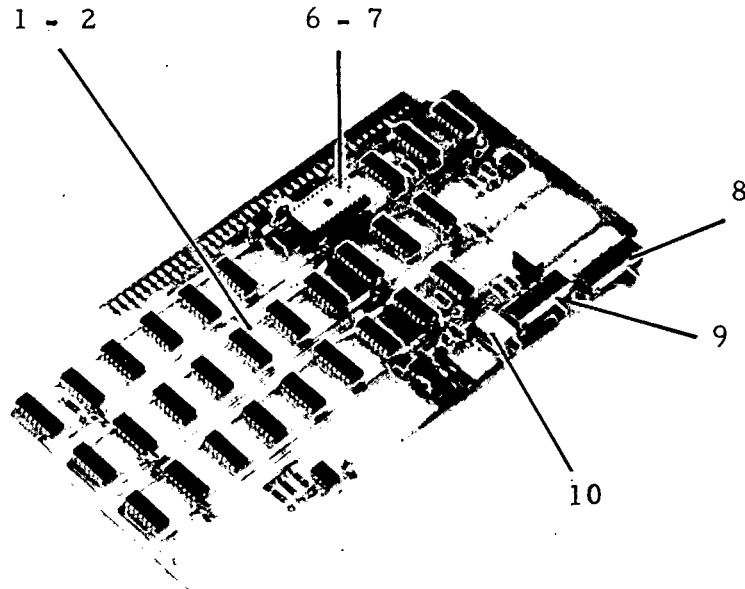
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8.3 Tools

8.3.1 Exerciser

Item 8.3.1-



PHILIPS

Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.3.1-					
1	3192-013	Demo Exerciser	5131 191 21100	-	-
2		Service Exerciser	21200	1	1
3					
4					
5					
6		PROM for Demo ¹⁾	5131 101 08120	-	-
7		PROM for Service ²⁾	08120	-	-
8		Reset switch	2412 127 00001	1	1
9		Program selector	00001	1	1
10		Start switch	128 02088	1	1

1) Demo-program 5131 110 00092, Component Mark 1031
 2) Service-program 5131 110 00102, Component Mark 1032



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8.3.2 Extension board

Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.3.2-					
1		Extension board, for Printer.	5131 191 11200	1	1
2		Extension board, for P1094	23400	1	1

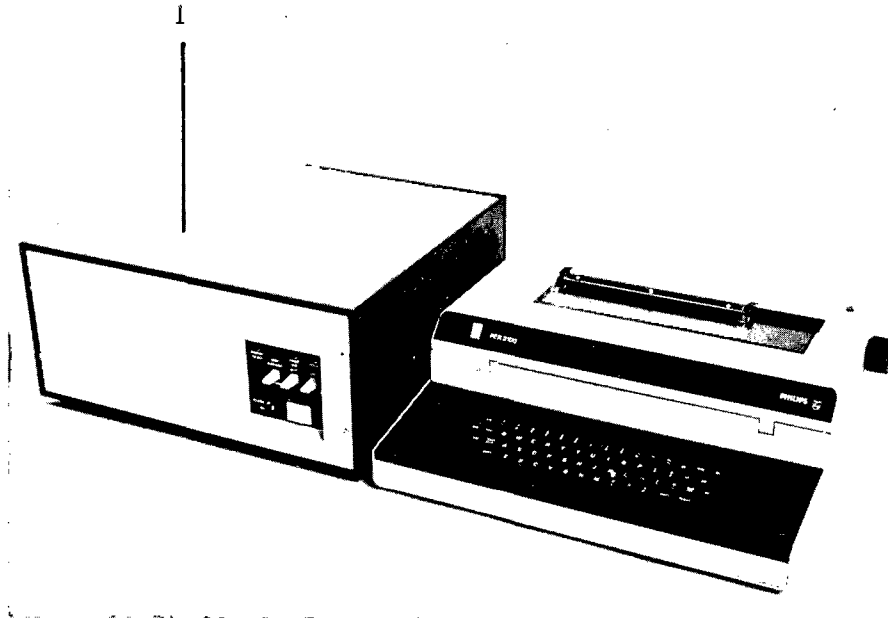
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8.4 Control Unit, type PTS 3161-011

8.4.1 Basic Unit

Item 8.4.1-

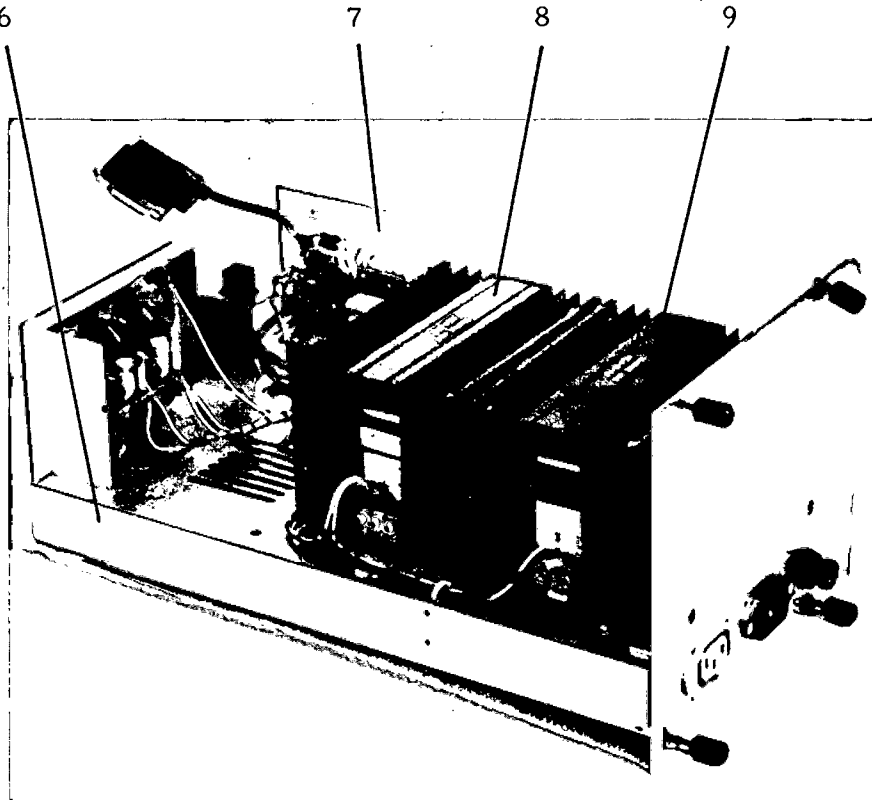


Item	Type no.	Designation	Article no	Pieces on level	
				1	2
8.4.1-					
1	3161-011	Control Unit	5131 190 61700	1	1
2					
3					
4					
5					

PHILIPS



Item 8.4.1-

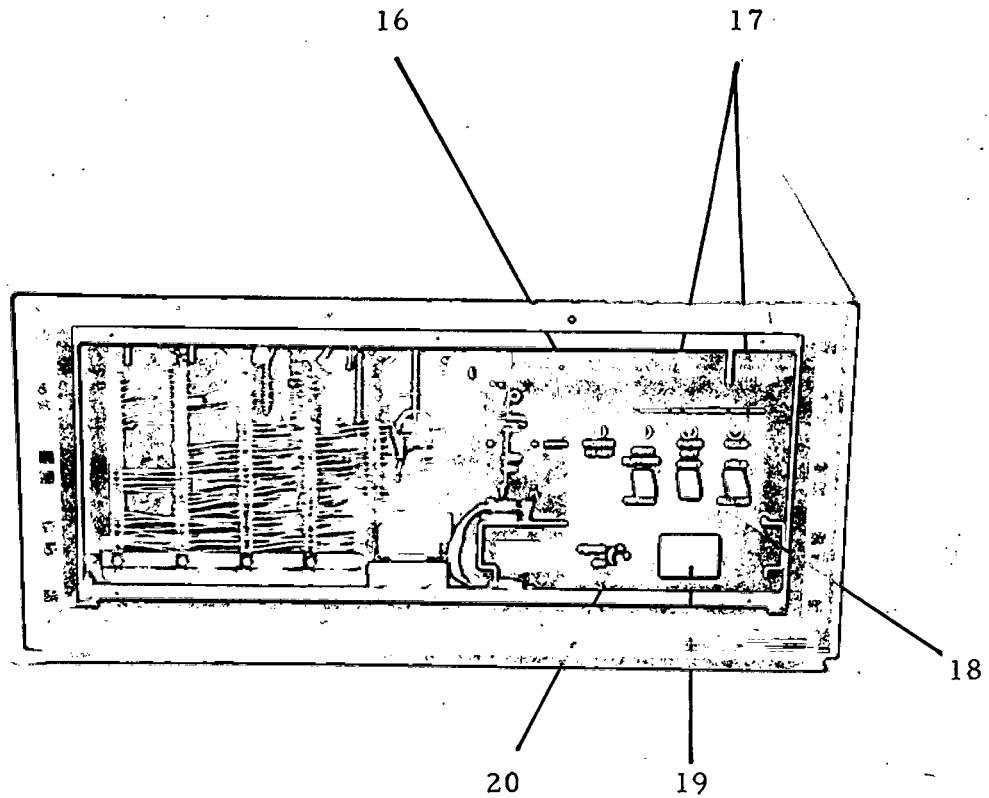


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Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.4.1-				1	2
6		Power Supply assy with control panel	5131 190 67700	1	2
7		Power Supply +12V PTS	5131 191 16400	-	1
8		Power Supply, +5V Oltronix MkII MCA	2731 150 00015	-	1
9		Power Supply, -12V Oltronix MkII MCA	00014	-	1
10					
11					
12					
13					
14					
15					



Item 8.4.1-

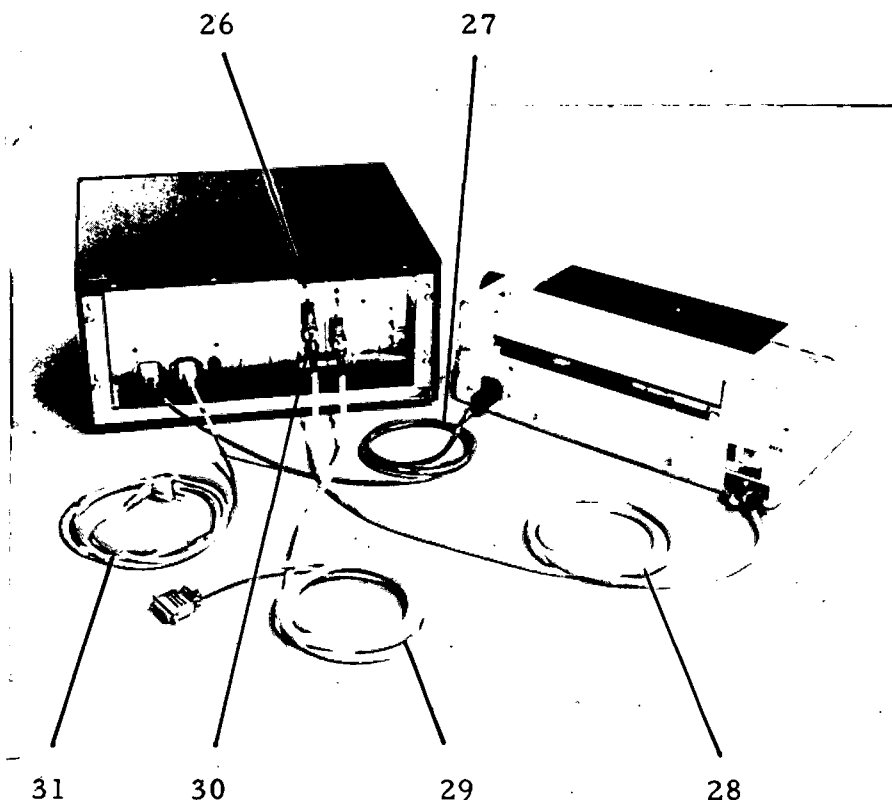


Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.4.1-					
16		Light emitting diode	9332 247 20112	-	4
17		Switch	5122 010 20941	-	2
18		Switch (non-locking)	20961	-	2
19		Switch (Power On)	2422 125 01265	-	2
20		Lamp -"-	5131 190 22200	-	2
21					
22					
23					
24					
25					

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Item 8.4.1-



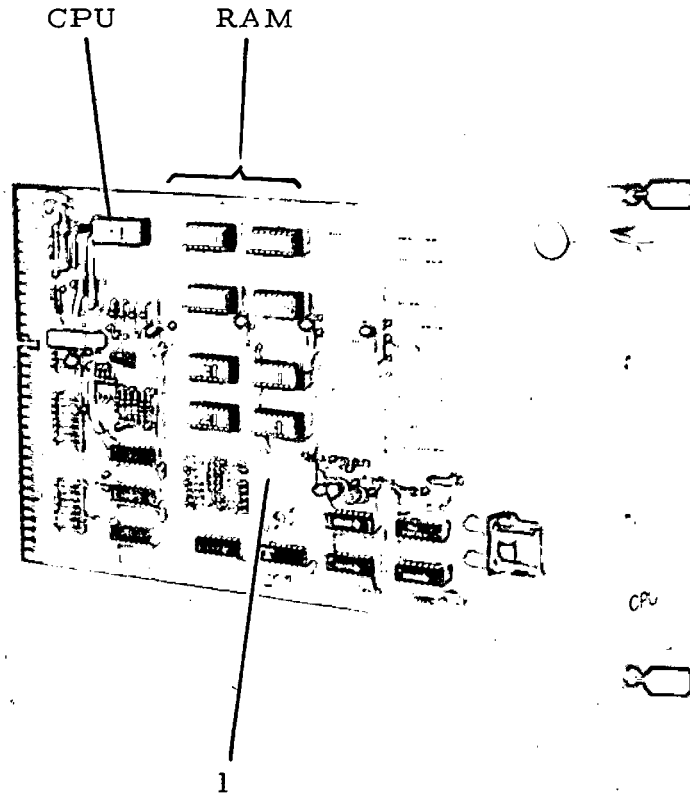
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Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.4.1-					
26		Board PCU	5131 190 68700	1	2
27		Power cable(Printer)	191 17800	1	1
28		Cable PCU-Printer	16500	1	1
29		Cable LCU -Modem	17500	1	1
30		Connector retainer for 25-pin. con.	190 27300	1	2
31		Power cable (Control Unit)		1	1
32					
33					
34					
35					



8.4.2 Board CPU

Item 8.4.2-

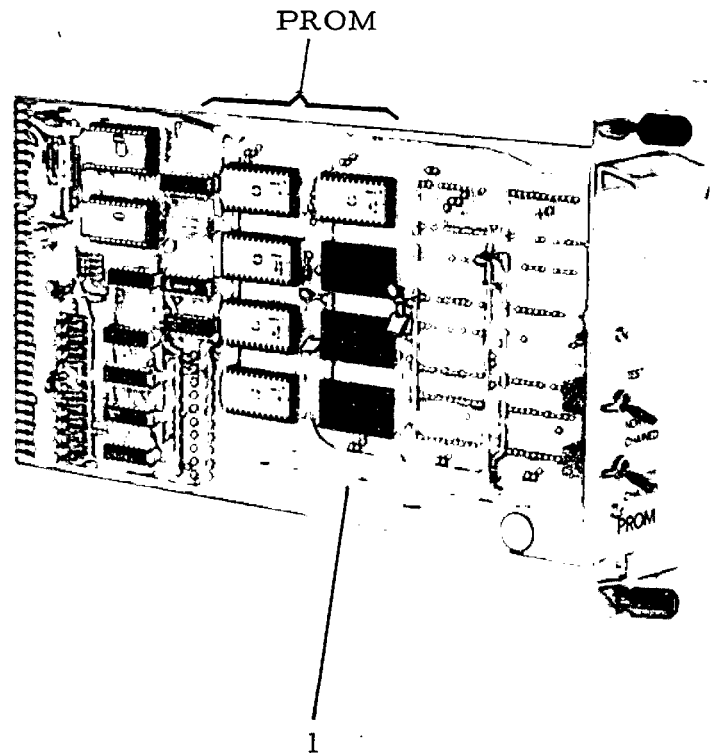


Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.4.2-					
1		Board CPU	5131 190 68600		



8.4.3 Board PROM

Item 8.4.3-



PHILIPS

Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.4.3-					
1		Board PROM	5131 190 68500	1	2
2					
3					
4					
5					
6					
7					
8					
9					

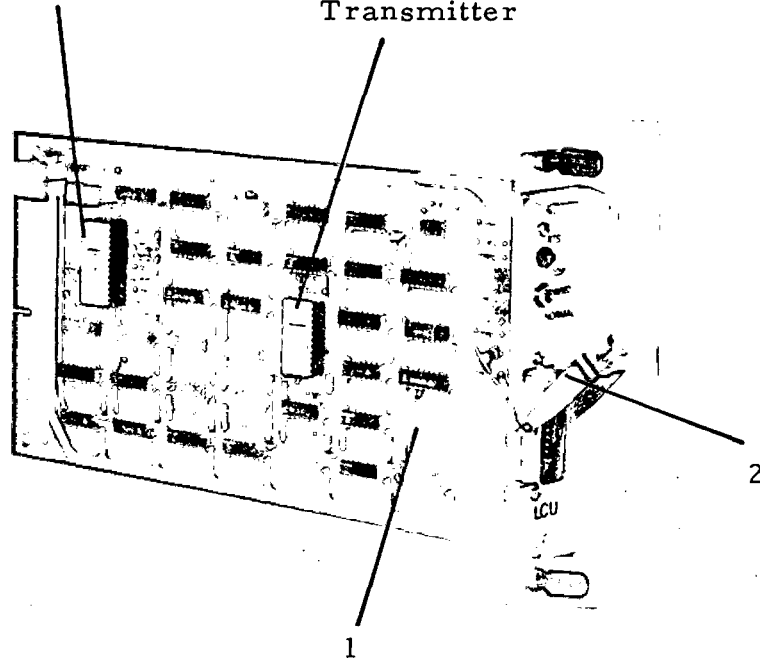


8.4.4 Board LCU

Item 8.4.4-

Receiver

Transmitter



Item	Type no.	Designation	Article no.	Pieces on level	
				1	2
8.4.4-					
1		Board LCU	5131 190 68400	1	2
2		Retainer	32800	1	2
3					
4					
5					
6					
7					
8					
9					

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