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Title:

RC851 Display Terminal

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Abstract:

This manual is intended as a description of the RC851 Display Terminal. It covers the information necessary to check out and operate the terminal.

It gives no information on how to communicate with specific host processor systems.

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FOREWORD

This paper is an updated version of RCSL No 52-AA983.

The changes are listed below:

1. Section 1.5 Operator Accomodation is added. This is only a documentation change, and not a junction change in the RC851.

2. Change of the subsection 2.7.3. The display pictures during power up (running the selftest) are made easier for the operator to understand.

3. On page 44 is added the specification section of the values for horizontal and vertical scanning frequency.

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1. INTRODUCTION 1.

1.1 The RC850 Family 1.1

The RC850 Display Terminals are all members of a powerful, intelligent terminal-family. A family for which the phrase "application-independent" will become true.

This statement indicates that we will regard the terminal as the -center- of the system or rather the systems. Future will show that the operator will require access to different applications, which in today's technology requires different terminals with different characteristics.

The RC850 family of Display Terminals are microprocessor-based terminals which are able to emulate several terminals of the market. There will be different versions reaching from the "hard-programmed" version to the "soft-programmed down line loaded" version or even the microcomputer -high-level- language version.

Common to all versions is the real professional design of the cabinet and keyboard. No efforts have been avoided to obtain the most comfortable and reliable place of work. Special human engineering has taken place in the areas: Operator accomodation, operating-environment, and service-ability.

In this manual the RC851 Display Terminal is described.

RC851 is a hard programmed, versatile, professional input/output station, which is readily adaptable to any standard computer system and which may be connected directly to the computer or located via modems.

RC851 is intended for use in data processing, data entry, process control, and data communication systems.

1.2 Unpacking 1.2

RC850 terminals are carefully packed to ensure safety during shipment. But freight damages may happen, therefore please inspect the carton carefully for any signs of damages. After the equipment is unpacked, inspect for missing parts or signs of damage that may have occured during shipment. If any damage is found, note it carefully for possible claims at a later date.

1.3 Installation, Power and Signal Wiring 1.3

RC851 Display Terminal includes an AC power cord of 2.5 m length. Signal cables may be supplied by the customer or, if required, RC will free of charge supply an I/O cable (LINE), either for modem (5, 12, or 25 m) connection or for direct connection (25 m) to the host.

The keyboard unit is delivered with a 1 m signal cable, which attaches to the keyboard connector on the back panel of the display unit (see fig. 1.3.1).

Optional hard copy printer may be connected to the LINE II connector. For pin assignments of input/output connectors, see chapter 3.

1.4 Inspection/Power On 1.4

1. Examine the units (keyboards and display) for any external damage. If any damage is visible, don't apply power to the unit, but return it to the factory or call an RC technician.

2. Visually inspect that the display unit is labelled with the correct AC voltage level.

3. Visually inspect to assure that the unit is properly grounded via the power connector. A standard three-pin wall outlet with ground should be used.

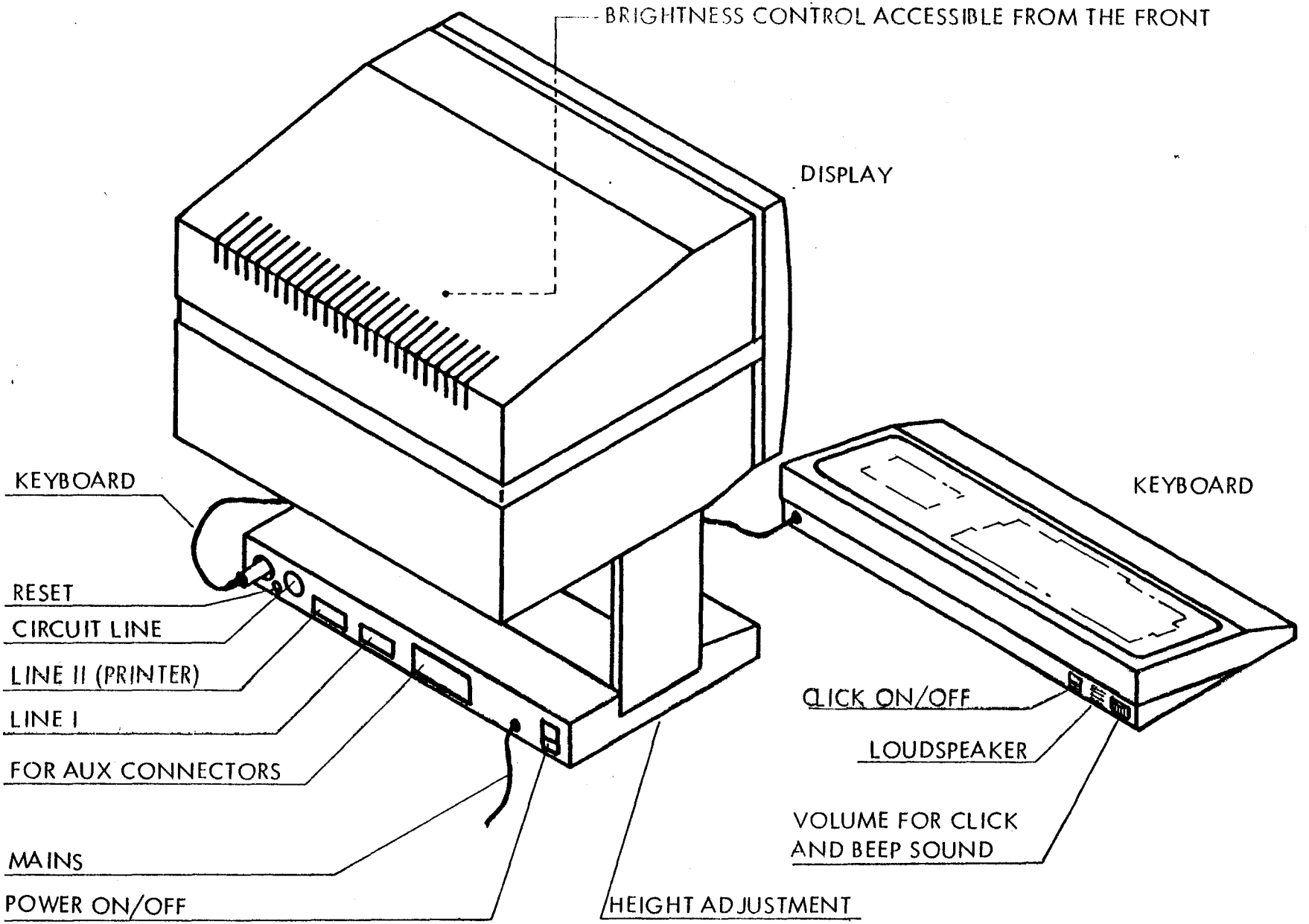


Fig. 1.3,1

RC 850 Backpanel connector and switch locations

Initial operation (for location of switches and connectors, see fig. 1.3.1).

1. Connect the LINE cable to the 25-pin LINE connector. Fasten the screws.

2. Connect keyboard cable to the round 5 pin KEYBOARD connector. Fasten the screw connection.

3. Connect the power cable to the wall outlet.

4. Depress the power switch to the ON position and the unit will power up.

5. During the warm-up period of approx. one minute the built-in self-test procedure will examine the display unit and the keyboard.

6. After the warm-up period turn the brightness control clockwise until the "raster" appears and then counterclockwise until a crisp and clear picture appears. Note that too high brightness both reduces the lifetime of the monitor and irritates the operator's eyes with headache as a result.

7. The picture on the display now automatically tells you the status of the display including transmission speeds, line status, and more. See section 2.7: Terminal Setup.

1.5 Operator Accomodation 1.5

It is vital, in order to avoid operator fatigue, that the display and keyboard can be placed and adjusted individually.

Therefore, special care has been taken to secure that the RC850 Display Terminal can accommodate operators in practically all environments.

Keyboard and Display are separate units that can easily be placed according to individual wishes.

The keyboard is easily moved around with only a tiny cable to connect with the display, but when placed it stays steady during operation. A hand rest in front of the keys, more than 70 mm wide, is incooperated in the design, and the low profile of the keyboard (60 mm to the upper key-line of the typewriter layout) ensures the best typing condition.

The display may be adjusted in height $\pm$ 5 cm to enable the best possible viewing angle for individual operators. This is done by means of a screw driver through a hole in the bottom plate (see fig. 1.3.1). The right viewing angle is recommended to be between 5° to 30° from the horizontal viewing line.

Also the display may be tilted forward and backward $\pm$ 10° from vertical (by pushing the display top) in order to avoid reflections from the surrounding lights, that may occur even though the screen surface itself is treated against reflections.

It is recommended to take special care when an operator position is designed. Some hints:

- Best viewing distance to the screen is from 500-700 mm.

- Best viewing angle is 5°-30° from horizontal.

- Avoid to install a terminal in such a way that the operator faces a window or so that the terminal faces a window.

- Take care of lights behind and above the operator to avoid reflections.

Above mentioned features and hints will help you to minimize or avoid operator eye strain and general discomfort.

2. DISPLAY TERMINAL FUNCTIONS 2.

The RC851 is a full duplex terminal.

In principle the terminal consists of two separate units: the keyboard and the display. The keyboard generates character codes and transmits them to the host computer. Received character codes cause the picture on the display to be updated.

Character codes fall in two categories: codes for graphic symbols and function codes. Graphic symbols are simply displayed on the screen, whereas function codes cause some modification of the display or the mode of terminal.

Althrough the two units, keyboard and display, in practice interact, the following description will regard them as separate units.

2.1 Modes 2.1

The following modes may exist in the terminal:

- Roll mode
- Protected mode
- Terminal setup mode
- Self test mode
- Supervisory mode

In ROLL mode the terminal reacts like an "endless roll of paper", i.e. whenever the screen is filled up, data will move up one line and add a new free line to the operator's disposal.

As soon as just one PROTECTED character (increased intensity) appears on the screen, the nature of the screen will change. Now there will be only "one piece of paper" that may be overwritten again and again. This means that whenever a protected character or field exists, cursor movements are from the bottom line to the top line (no roll).

In TERMINAL SETUP mode, which may be entered in either of above mentioned modes, different commands like baud rate, selftest, etc. can be given to the terminal as described in section 2.7: Terminal Setup Procedure.

The terminal always powers up in the SELF TEST mode in order to check out the terminal for proper operation. After the self test the terminal switches to ROLL mode and is ready for use. Self test mode can be selected for longer periods of testing by means of the Terminal setup procedure.

The SUPERVISORY mode is a convenient and easy way to monitor (supervise) data communication to terminal. In this mode all function codes will be displayed by the matching character of the function (control) field (see fig. 2.6.1: RC851 character set and fig. 2.6.2: function codes). No functions will take place in this mode. The supervisory mode is selected by means of the Terminal setup procedure.

2.2 Keyboard Layout 2.2

The RC851 keyboard is configured with national letters and a numeric block with additional function keys in order to accomodate the operator and make date entry more feasible.

The layout of the keyboard is shown in fig. 2.1.1.

The table in fig. 2.2.2 shows the character set communicated to the host.

All characters in column 0 and 1 may be communicated by pressing CTRL-key and the corresponding character in column 6 or 7.

2.3 Keyboard Operation 2.3

To practice using the keyboard, connect a jumper between pin 2 and 3 in the LINE connector (see chapter 3: Interface Descrip-

DANISH KEYBOARD AND CHARACTERS

RC 851, 203 DANISH ALPHABET

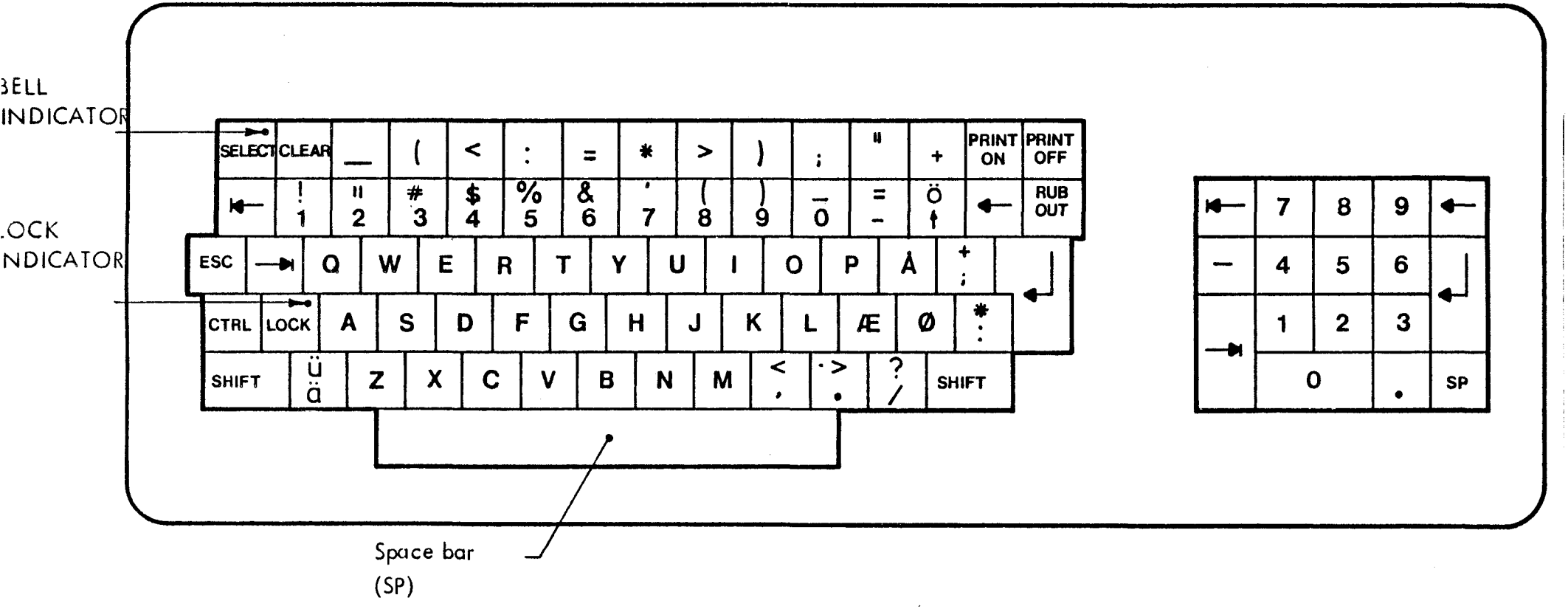


Fig. 2.2.1

KEYBOARD LAYOUT

The codes in Column 0 and 1 may be obtained by pressing CTRL and the corresponding character in Column 6 and 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
b4	b3	b2	b1	COLUMN / ROW	0		1		2	3	4	5	6	7
0	0	0	0	0	NUL		DLE			0	ü	P	ä	p
0	0	0	1	1	SOH		DC1		!	1	A	Q	a	q
0	0	1	0	2	STX		DC2	PRINT ON	"	2	B	R	b	r
0	0	1	1	3	ETX		DC3		#	3	C	S	c	s
0	1	0	0	4	EOT		DC4	PRINT OFF	$	4	D	T	d	t
0	1	0	1	5	ENQ	⊢—	NAK		%	5	E	U	e	u
0	1	1	0	6	ACK		SYN		&	6	F	V	f	v
0	1	1	1	7	BEL		ETB		'	7	G	W	g	w
1	0	0	0	8	BS	←	CAN		(	8	H	X	h	x
1	0	0	1	9	HT	—→	EM		)	9	I	Y	i	y
1	0	1	0	(A)10	LF		SUB		*	:	J	Z	j	z
1	0	1	1	(B)11	VT		ESC	ESC	+	;	K	Æ	k	æ
1	1	0	0	(C)12	FF	CLEAR	FS	SELECT	,	<	L	Ø	l	ø
1	1	0	1	(D)13	CR	←┘	GS		-	=	M	Å	m	å
1	1	1	0	(E)14	SO		RS		.	>	N	↑	n	ä
1	1	1	1	(F)15	SI		US		/	?	O	_	o	RUB OUT

Fig. 2.2.2

RC 851 KEYBOARD CODE CHART

tion), turn power "ON", and await for the cursor to appear.

Depress any of the alpha-numeric keys, and each character should appear on the screen. 8 character positions from the end of the line an audible alarm signal from the kayboard will sound (see NOTE).

The depression of the keys is also indicated by a "click" sound to indicate proper function.

NOTE: Both the "click" sound and the audible alarm signal may be adjusted to an appropriate level (or turned totally off) by the potentiometer on back of the keyboard. The "click" sound may be switched off separately (fig. 1.3.1).

All keys that generate codes will automatically repeat 10 characters per second if they are held down for longer than approximately 0.75 second.

The depession of the LOCK key (ON indicated by the LED indicator) will force the keyboard in or out of ALPHA-LOCK mode. In this mode only upper case alpha-characters are generated (except ä, ü, and ö), other keys are not affected. The mode is released by pressing the key once again.

2.4 Key Description 2.4

If the terminal is connected to a host and the proper LINE speed is selected (see section 2.7: Terminal Setup Procedure) all codes generated by the keyboard will be transmitted to the host computer. This host computer then decides whether the code shall be echoed or not, or if it shall be returned in a converted form.

The keyboard can generate all 128 codes shown in the keyboard code chart, fig. 2.2.2 (directly or by help of control and shift keys).

There are 3 types of keys present on the keyboard: Character keys, control keys, and function keys.

Character keys are indicated by one colour, while control and function keys differ by the colour in order to ease operation.

2.4.1 Character Keys 2.4.1

The character keys generate, when depressed, a code which corresponds to the graphic symbol (letter, number, etc.) that is engraved (see fig. 2.2.1 and fig. 2.2.2).

If the SHIFT key is depressed simultaneously with a character key, the upper case code will be generated.

If the LOCK key has been depressed (indicated by the light), only alpha keys will generate upper case codes (except ä, ü, and ö). SHIFT will still be active on number keys, sign keys, and ä, ü, ö.

NOTE: The following character keys are not affected by the SHIFT and LOCK keys:

The upper row of the alpha-numeric block.
The whole numeric block.

For displayable codes and graphic symbols, see section 2.6: Display and Function Codes.

2.4.2 Control Keys 2.4.2

The control keys are those which perform local functions (i.e. no codes are generated).

The functions of the control keys are described below.

SHIFT KEYS - When depressed simultaneously with a character key the upper case code for the letter (or for two-symbol keys: the code for the top symbol) will be generated.

The only keys that are not affected by the SHIFT KEYS are the upper row of the alpha-numeric block and the whole numeric block. SHIFT keys are momentary keys, which means that the function ends, when the keys are released.

LOCK KEY - When depressed the keyboard will be forced into or out of ALPHA-LOCK mode (ON is indicated by the light in the button). In this mode only upper case alpha character codes are generated (except ä, ü, ö). The SHIFT keys are still active on two-symbol keys.

CTRL KEY - Control key. When depressed simultaneously with a character key the keyboard generates a code between 00 and 1F [Hex], i.e. column 0 and 1 in fig. 2.2.2. This may be used to generate other function codes than the ones which have a dedicated key. The reaction on received control codes is described in section 2.6: Display and Function Codes.

CTRL KEY + SELECT KEY - Depression of these two keys simultaneously is used to select the Terminal Setup Mode. In this mode the display terminal can be programmed to different operations (i.e. LINE I speed, LINE II speed, test loop, and so on). See section 2.7: Terminal Setup Procedure for details.

2.4.3 Function Keys

2.4.3

Some function codes are generated by the stroke of a single key, a function key. Note that this has no effect on the display unless the character code is echoed (see section 2.6: Display and Function Codes).

ESC	Escape [1B]
→|	Tabulate [09]
|←	Delete Line [05]
CLEAR	Clear Screen [0C]
↵	Return [0D]
←	Delete Char. [08]
RUB OUT	[7F]
PRINT ON	[12]
PRINT OFF	[14]
SELECT	Local attention [1C]

2.5 Keyboard Indicators 2.5

The keyboard includes 2 indicators:

LOCK - indicates that the ALPHA-LOCK mode is selected. Lamp is turned on and off by depressing the LOCK key.

SELECT - This indicator is turned on when a BELL-code [07] or a LAMP ON-code [11] is received. If the BELL-code is received, the light indication will be accompanied by an audible alarm.

The indicator is turned off when a CR-code [0D] or a LAMP OFF-code [13] is received.

2.6 Display and Function Codes 2.6

This section describes the reactions on codes received by the terminal.

2.6.1 Character Set 2.6.1

In fig. 2.6.1 all displayable characters of the RC851 character generator are shown. Note that characters in column 0 and 1 (hex: 00 to 1F) can only be displayed in SUPERVISORY MODE (see section 2.7).

2.6.2 Function Codes 2.6.2

Fig 2.6.2 shows the function codes of RC851.

The following list describes the terminal reactions on function codes received from the host.

Note that if the cursor is moved to a protected area (high lighted), it seeks the first free position to the right of the protected area (only exception is <— (BS), see description).

[ASCII - Hex code]

DELETE LINE - Delete Line [ENQ - 05].
Moves the cursor to the beginning of the same line and erases the line.

START ADDR - Start address [ACK - 06].
Moves the cursor to a character position defined by the two following characters.

Character sequence:
<start address><column no.><row no.>

Row number/column number to character value is shown in fig. 2.6.3: Cursor positioning table.

Character values outside this table will force the cursor to its home position (upper left corner).

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
b4	b3	b2	b1	COLUMN / ROW	0	1	2	3	4	5	6	7
0	0	0	0	0	Ü	••		0	ü	P	ä	p
0	0	0	1	1	à	ß	!	1	A	Q	a	q
0	0	1	0	2	N̄	n	"	2	B	R	b	r
0	0	1	1	3	£	§	#	3	C	S	c	s
0	1	0	0	4	¤	ù	$	4	D	T	d	t
0	1	0	1	5	@	è	%	5	E	U	e	u
0	1	1	0	6	Ä	`	&	6	F	V	f	v
0	1	1	1	7	Ë	ë	'	7	G	W	g	w
1	0	0	0	8	Ç	ç	(	8	H	X	h	x
1	0	0	1	9	Ō	ì	)	9	I	Y	i	y
1	0	1	0	(A)10	É	é	*	:	J	Z	¡	z
1	0	1	1	(B)11	[	{	+	;	K	Æ	k	æ
1	1	0	0	(C)12	\	¦	,	<	L	Ø	l	ø
1	1	0	1	(D)13	]	}	-	=	M	Å	m	å
1	1	1	0	(E)14	Ö	∝	.	>	N	↑	n	ö
1	1	1	1	(F)15	~	ò	/	?	O	_	o	▒

Displayed only in SUPERVISORY MODE

HEX CODE CONVERSION: First digit is column number, second digit is the row number 0-9 and A-F
Example: Hex code for ↑ = 5E

Fig. 2.6.1

RC 851 CHARACTER SET

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
b4	b3	b2	b1	COLUMN / ROW 0			1		2	3	4	5	6	7
0	0	0	0	0	NUL		DLE			0	ü	P	ä	p
0	0	0	1	1	SOH		DC1	LAMP ON	!	1	A	Q	a	q
0	0	1	0	2	STX		DC2	PRINT ON	"	2	B	R	b	r
0	0	1	1	3	ETX		DC3	LAMP OFF	#	3	C	S	c	s
0	1	0	0	4	EOT		DC4	PRINT OFF	$	4	D	T	d	t
0	1	0	1	5	ENQ	DELETE LINE	NAK	SET PROTECT	%	5	E	U	e	u
0	1	1	0	6	ACK	START ADDR	SYN		&	6	F	V	f	v
0	1	1	1	7	BEL	BELL	ETB		'	7	G	W	g	w
1	0	0	0	8	BS	DELETE CHAR	CAN	CURSOR FWD	(	8	H	X	h	x
1	0	0	1	9	HT	TAB	EM		)	9	I	Y	i	y
1	0	1	0	(A)10	LF	LINE FEED	SUB	CURSOR UP	*	:	J	Z	j	z
1	0	1	1	(B)11	VT		ESC	ESCAPE	+	;	K	Æ	k	æ
1	1	0	0	(C)12	FF	CLEAR	FS	RESET	,	<	L	Ø	l	ø
1	1	0	1	(D)13	CR	RETURN	GS	HOME	-	=	M	Å	m	å
1	1	1	0	(E)14	SO		RS	EEOL	.	>	N	↑	n	ö
1	1	1	1	(F)15	SI		US	EEOS	/	?	O	_	o	▒

EEOL: Erase to End Of Line

EEOS: Erase to End Of Screen

Fig. 2.6.2

RC 851 FUNCTION CODES

The Display Terminal does not respond to unasigned codes.

BELL - Bell [BEL - 07].
When received, an audible alarm will sound and the SELECT (BELL) indicator will turn on. The indicator stays on until the next CP-code or LAMP OFF code is received.

DELETE CHAR - Delete character [BS - 08].
Moves the cursor one character position to the left on the same line.

If the cursor reaches a protected field, it seeks to the first free position left to the protected field. If the protected field covers the beginning of the line, the cursor will stay at the first free position of the line.

TAB - Tabulate [HT - 09].
Moves the cursor forward 4 character positions (position 1, 4, 8, and on). At the end of the line the cursor is moved to the next line.

If this is done from the bottom line, data will be rolled up one line and the cursor moved to the new, blank line.

If any protected characters are present (protect mode), the cursor will be moved to the first free position after a protected field. The 4-character-TAB-function is then cancelled.

LINE FEED - Line feed [LF - 0A].
Moves the cursor one line down. If done on the bottom line the picture will roll up one line. The top line of data is lost and the bottom line becomes blank.

In protect mode the cursor will move from the bottom line to the top line, same column.

Row/Column address:

1	ä	21	t	41	H	61	Ø
2	a	22	u	32	I	62	Å
3	b	23	v	43	J	63	↑
4	c	24	w	44	K	64	—
5	d	25	x	45	L	65	(SP)
6	e	26	y	46	M	66	!
7	f	27	z	47	N	67	"
8	g	28	æ	48	O	68	#
9	h	29	ø	49	P	69	$
10	i	30	å	50	Q	70	%
11	j	31	ö	51	R	71	&
12	k	32	Rub out	52	S	72	'
13	l	33	ü	53	T	73	(
14	m	34	A	54	U	74	)
15	n	35	B	55	V	75	*
16	o	36	C	56	W	76	+
17	p	37	D	57	X	77	,
18	q	38	E	58	Y	78	-
19	r	39	F	59	Z	79	.
20	s	40	G	60	Æ	80	/

Fig. 2.5.3

CURSOR POSITIONING TABLE

CLEAR - Clear [FF - OC].
Erases all characters (including protected characters) and places the cursor in upper left corner. The display is switched to Roll mode.

RETURN - Carriage return [CR - OD].
Moves the cursor to the beginning of the same line. Clears the SELECT (BELL) indicator.

LAMP ON - Indicator ON [DC1-11].
Turns on the SELECT (BELL) indicator. No audible alarm will sound.

PRINT ON - Printer on [DC2-12].
This code enables all following received characters (codes) to be copied to a hard copy printer (if connected to LINE II connector).

LAMP OFF - Indicator off [DC3-13].
Turns off the SELECT (BELL) indicator.

PRINT OFF - Printer off [DC4-14].
This code closes the copying of characters (codes) to the hard copy printer (closes the LINE II connection).

SET PROTECT - Protect mode [NAK - 15].
This code causes all following characters to be protected (indicated by high lighted characters). This mode is terminated by the RESET code.

The protect mode influences the cursor movement functions (see section 2.6).

CURSOR FWD - Cursor forward [CAN - 18].
Moves the cursor one character position to the right on the same line. At the end of the line the cursor is moved to the start of the next line. When the bottom line is reached, data will roll up one line.

In protect mode the cursor will move from the bottom line to the top line, leftmost position.

CURSOR UP - Cursor up [SUB - 1A].
Moves the cursor up one line. If placed on top line no function occurs.

ESC - Escape [ESC - 1B].
No function.

RESET - Reset [FS - 1C].
This code clears the protect mode and returns the terminal to ROLL mode. All following characters are written with normal intensity and are not protected.

HOME - Cursor home [GS - 1D].
Moves the cursor to the upper left corner.

EEOL - Erase to end of line [RS - 1E].
Erases all unprotected characters from the cursor position (included) to the end of the line. The cursor is not moved.

EEOS - Erase to end of screen [US - 1F].
Erases all unprotected characters from the cursor position (included) to the end of the screen. The cursor is not moved.

2.7 Terminal Setup Procedure 2.7

The RC851 has a built-in non-volatile-memory (NVM) in which different commands to RC851 may be stored by the operator. When written in this NVM information (the command) will not disappear, not even if the power is turned off. This means that the operator is able to define the characteristics of his terminal by means of the keyboard, and these characteristics will remain valid until changed by the operator again.

No mechanical switches need to be set up!

2.7.1 Local Commands 2.7.1

When depressing the CTRL and SELECT keys simultaneously, the terminal will enter the terminal setup mode and different characteristics may be programmed according to the following description.

Each command is terminated by the " " (Return) key.

Each command will be answered with one of the following outputs:

OK	If command is correct
* WHAT	If command is unknown
* <error text>	Specified by each command.

In order to terminate the setup mode write: END, and the terminal will return to ROLL mode.

List of commands:

Baud rate setup:
    LINE speed

Self test feature:
    TEST loop
    TEST select

Supervisory feature:
SUP mode

End command mode:
END command

2.7.2 Baud Rate Setup 2.7.2

This command is used to set up the wanted transmission speed for the LINE I channel and for the LINE II channel.

Note: As LINE II is used for a hard copy PRINTER output, LINE I and LINE II speeds are set to the same value (normally defined by the max. speed of the connected printer).

Possible baud rates:

<baud rate>::= { 110 | 300 | 600 | 1200 | 2400 | 4800 | 9600 }

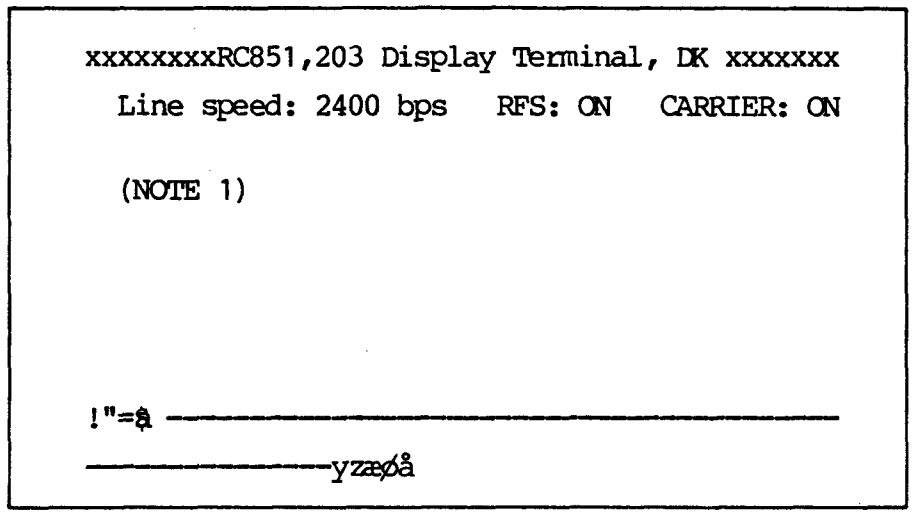
LINE speed
Syntax: line <baud rate>

Error message: * bad rate { the specified baud rate (speed) is not valid

2.7.3 Self Test Feature 2.7.3

During power up the RC851 terminal executes a self test procedure in order to secure that all vital parts are functioning correctly.

After a period of approx. 10 seconds (performed during warm-up of the picture tube) the self test feature ends with a picture as shown in fig. 2.7.1.



NOTE 1: Error messages, see below

Figure 2.7.1: RC851 Test.

Error messages:

- ROM checksum error: program ROM defect, one of 4 PROM's has to be replaced.

- RAM memory error, address = xxxx : Random Access Memory error in address xxxx (Hex), one of 4 RAM's has to be replaced.

- CPU error: the CPU fails and must be replaced.

If no picture appears at all, see section 7: Trouble shooting guide.

For maintenance purposes RC851 features the possibility to use the self test feature in the error seeking procedure.

In this mode the whole self test procedure is repeated continuously until stopped as mentioned below.

Looping is done by means of the following command:

TEST loop.
Syntax: test loop.

To stop test loop press SELECT key until setup mode is entered.

2.7.4 Supervisory Feature 2.7.4

This mode allows the display of all 128 characters of the code chart (fig. 2.6.1: RC851 Character set).

Codes from 00 to 1F are shown on the display as different European characters and graphic symbols and no function will occur when a function code is received.

Syntax: sup <x>:

<x>::= { on : supervisory mode ON
off : supervisory mode OFF

2.7.5 End Command Mode 2.7.5

To terminate the command mode following command should be used:

Syntax: end

After this the RC851 functions as a terminal with the characteristics just loaded.

3. INTERFACE DESCRIPTION 3.

The RC851 Display Terminal is equipped with 3 interface connectors:

LINE I Connector
LINE II Connector
KEYBOARD Connector

Each performing serial data transmission to and from the respective units.

The transmission speed of LINE I and LINE II is always set to the same value. Following Baud rates may be selected by the Terminal Setup Procedure (section 2.7):

110 - 300 - 600 - 1200 - 2400 - 4800 - 9600 bps.

The interfaces and connectors are shown in fig. 3.1.1: Interface Connections, and are described in the following.

3.1 LINE I Interface (HOST Connection) 3.1

The transmission speed of the LINE I interface may be selected from the keyboard by means of the Terminal setup procedure (section 2.7) to a rate between 110 and 9600 bps.

Transmission mode is always FULL DUPLEX, which means that the keyboard and the serial transmitter serve as an independent unit driving the "transmit" side of the communications line, whereas the serial receiver and the display unit are driven by the "receive" side of the communications line. To record keyboard data on the screen the processor at the other end of the communications line must "echo" the character back via the "receive" line.

Line I interface is prepared for CCITT X21 (optional).

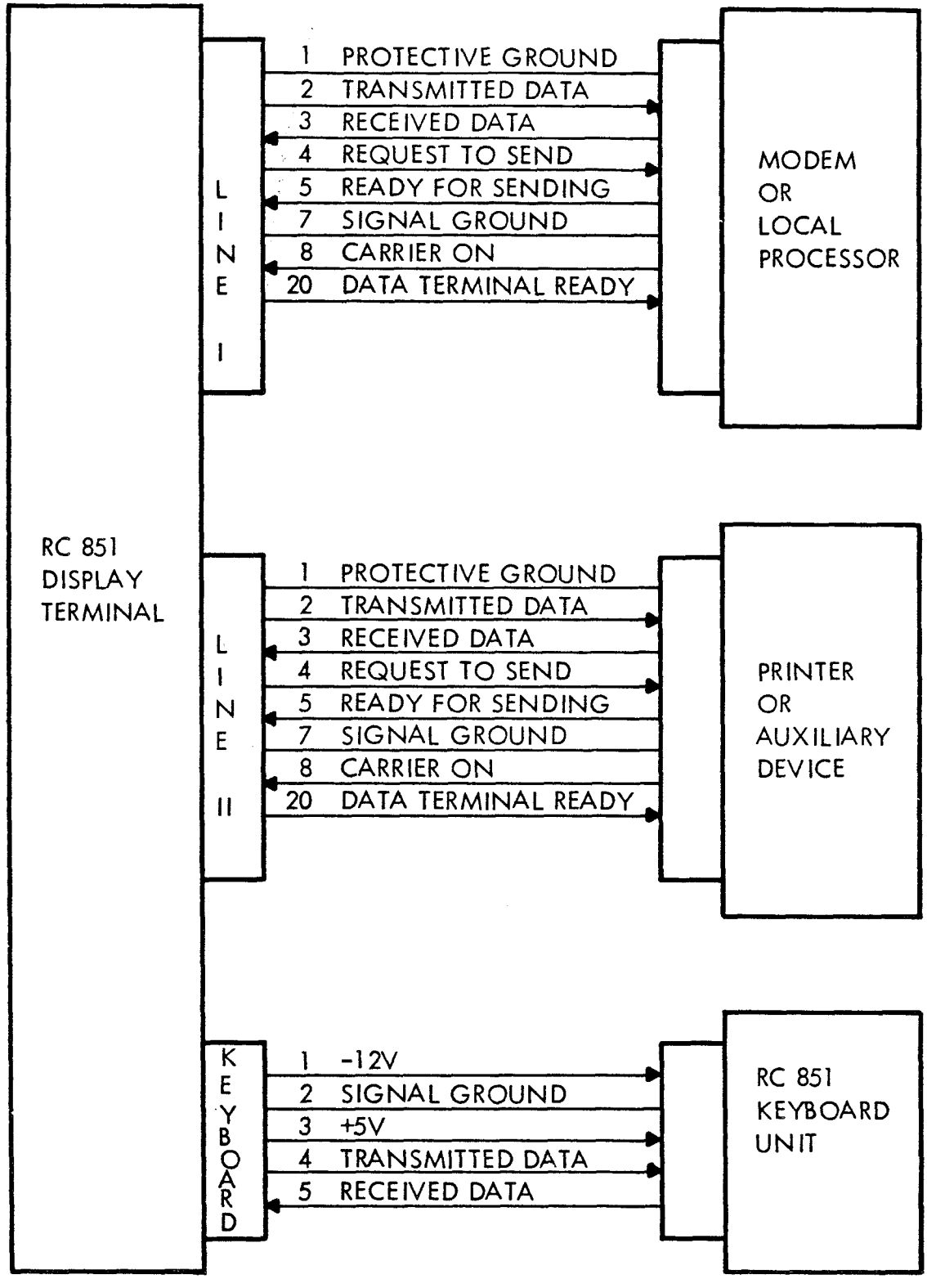


Fig. 3.1.1

INTERFACE CONNECTIONS

3.1.1 V24 Interface

The LINE I and LINE II interfaces comply with the recommendations of CCITT V.24/X.26 and RS-232-C (DTE descriptions).
Specifications of these interfaces are:

	TRANSMITTER:	RECEIVER:
D A T A	Mark level: (logic "1") -5,5 V Space level: (logic "0") +5,5 V	Input impedance: 3 to 7 K Mark level: -4 V to -12 V Space level: +4 V to +12 V NOTE 1.
C O N T R O L	ON : +5,5 V OFF: -5,5 V	ON: +4 V to +12 V OFF: -4 V to -12 V NOTE 1.
IF AN INPUT LINE IS LEFT FLOATING, IT ASSUMES ITS NEGATIVE LEVEL.		

NOTE 1: The interface is protected to accomodate the voltage levels specified in CCITT V.28 (up to $\pm$ 25 V).

Figure 3.1.2: Signal Levels.

3.1.2 Serial Data Transfer

The following bit sequence is used for transmitted and received data.

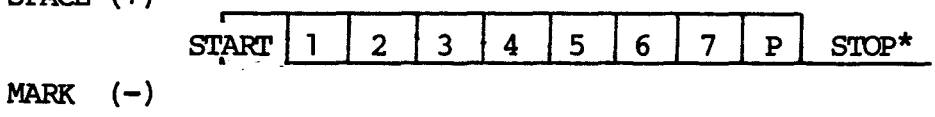


Figure 3.1.3: Serial data transfer.
* 2 stop bits at 110 bps, 1 stop bit at other baud rates.

The display terminal transmits and receives even parity (P). Received characters with parity error are indicated on the screen with RUB OUT [7F] symbol (see fig. 2.6.1: Character set).

LINE I interface connector: (NC = No Connection).

Connector: 25 pin type DB 25S with screw lock.

	NAME			NAME	
PIN	V.24	X.24*	PIN	V.24	X.24*
1	PROTECTIVE GROUND	SHIELD	14	NC	S(B)
2	TRANSMITTED DATA	T(A)	15	RESERVED	S(A)
3	RECEIVED DATA	R(A)	16	NC	B(B)
4	REQUEST TO SEND	C(A)	17	RESERVED	B(A)
5	READY FOR SENDING	I(A)	18	NC	R(B)
6	NC		19	NC	
7	SIGNAL GROUND	G, T(B), C(B)	20	DATA TERMINAL READY	
8	CARRIER ON		21	NC	
9	NC		22	NC	
10	NC		23	NC	
11	NC		24	NC	
12	NC	I(B)	25	NC	
13	NC				

Figure 3.1.4: Line interface connector.
* prepared for CCITT X.21 (optional)

The signal Ready For Sending (RFS) must be "ON" to transmit data. If no connection to RFS (pin 5), it should be connected to Request To Send (RTS, pin 4).

The signal Carrier ON (CO) must be "ON" to receive data. If no connection to CO (pin 8), it should be connected to Data Terminal Ready (DTR, pin 20).

3.2 LINE II Interface (Printer Connection) 3.2

This interface is intended for use as a Printer or auxiliary device interface. All specifications concerning transmission speed, V24 interface, and serial data transfer are the same as for LINE I interface (section 3.1).

NOTE: Data received at LINE I receiver will be routed to LINE II transmitter by print ON command and disabled by print OFF command.

LINE II interface connector: (NC = No Connection).
Connector: 25 pin type DB 25 S with screw lock.

PIN	NAME	PIN	NAME
1	PROTECTIVE GROUND	14	NC
2	TRANSMITTED DATA	15	NC
3	RECEIVED DATA	16	NC
4	REQUEST TO SEND	17	NC
5	READY FOR SENDING	18	NC
6	NC	19	NC
7	SIGNAL GROUND	20	DATA TERMINAL READY
8	CARRIER ON	21	NC
9	NC	22	NC
10	NC	23	NC
11	NC	24	NC
12	NC	25	NC
13	NC		

Figure 3.2.1: LINE II interface connector

The signal Ready For Sending (RFS) must be "ON" to transmit data. The signal RFS may be used to indicate BUSY from a printer following the table below (fig. 3.2.2). If no connection to RFS (pin 5), it should be connected to Request To Send (RFS, pin 4).

The signal Carrier ON (CO) must be "ON" to transmit data. If no connection to CO (pin 8), it should be connected to Data Terminal Ready (DTR, pin 20).

PRINTER	READY FOR SENDING (RFS)
BUSY	"OFF" (negative)
READY	"ON" (positive)
Feature not used	"ON" (positive, RTS)

Figure 3.2.2: Printer busy indication (LINE II Connector).

3.3 KEYBOARD Interface 3.3

Data between the keyboard and the display logic are communicated in serial form.

Signal levels are low power schottky TTL levels.

KEYBOARD interface connector:
Connector: 5 pin round connector, binder type 680 with screw connection.

PIN	NAME
1	-12 V
2	SIGNAL GROUND
3	+5 V
4	TRANSMITTED DATA
5	RECEIVED DATA
⏚	PROTECTIVE GROUND

Figure 3.3.1: Keyboard interface connector.

4. MAINTENANCE 4.

Except for the daily cleaning of the surfaces of the display terminal with a firmly wrung cloth, no maintenance is required.

Still, on occasion, due to component aging or hard shipments, the power supply and the monitor require some adjustments. Likewise, it might be necessary to adjust, when the operating voltage and/or the frequency has been changed.

> If such adjustments are required, we recommend it to be done by qualified personel only, and with EXTREME CAUTION being used since HAZARDOUS VOLTAGES ARE PRESENT.

For removal of the covers of the terminal, and for possible exchange of modules, please see chapter 7.

Power supply and monitor adjustments are described in the RC850 Technical Manual.

4.1 High Intensity Level Adjustment 4.1

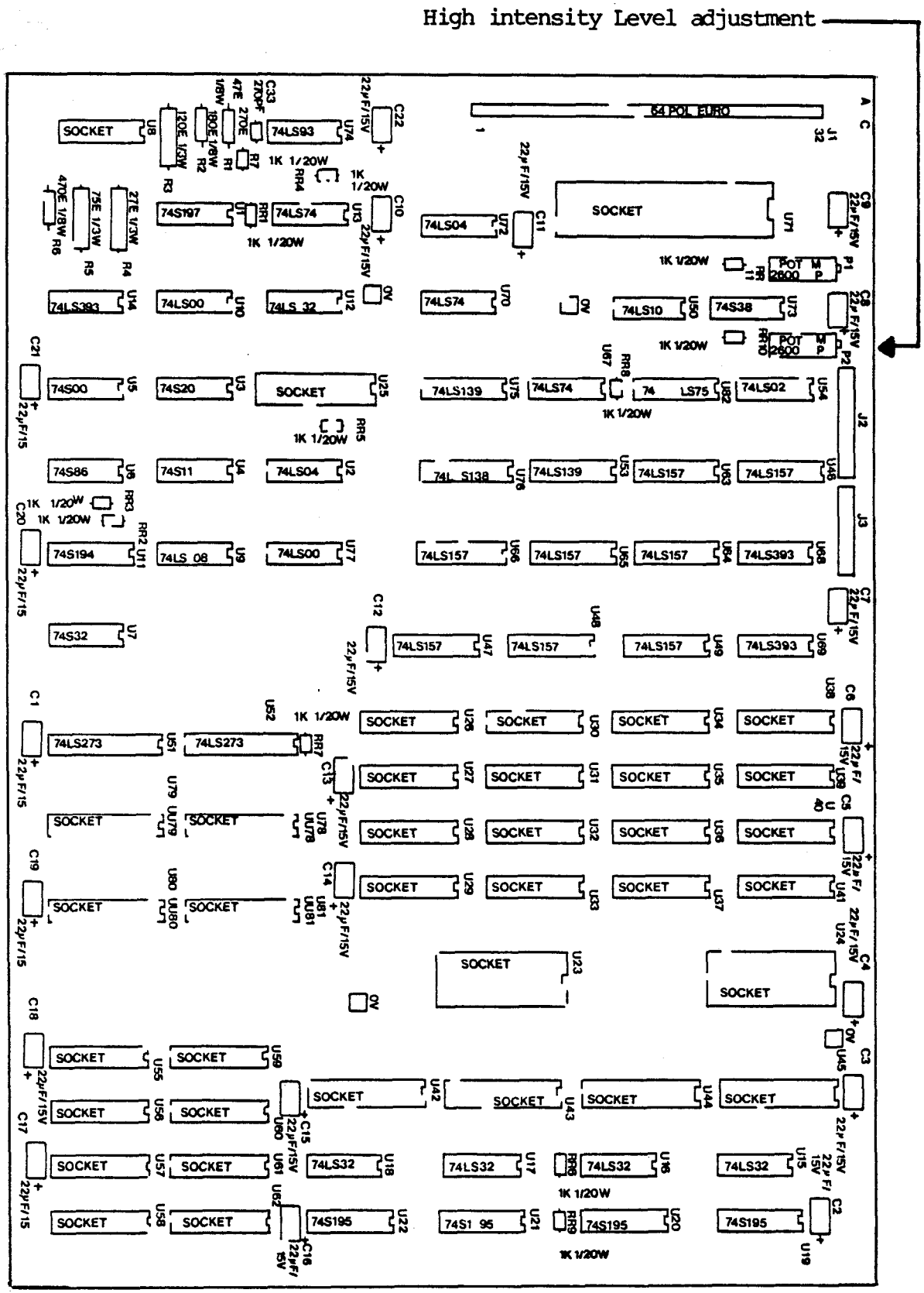


Figure 4.1.1: CRT-module layout.

5. OPTIONAL EQUIPMENT

5.

5.1 RC861 Hard Copy Printer

5.1

To be supplied later.

5.2 RC860 Printer Terminal

5.2

To be supplied later.

6. DISPLAY TERMINAL MODULES 6.

The RC851 is a microcomputer based terminal, where all terminal functions are programmed.

6.1 Module Survey 6.1

In fig. 6.1.1 the functional diagram of RC851 is shown, and fig. 6.1.2 shows the actual module layout of the terminal.

6.2 Module Description (ref. fig. 6.1.2) 6.2

6.2.1 CPU-Module 6.2.1

The CPU-module contains the microprocessor, oscillator, program source ROM's, RAM, an NVM for terminal setups, and the serial input-output communications.

Microprocessor - This unit reads and interprets the program held in the ROM. All controls are performed under program control. A DMA (Direct Memory Access controller) enables fast data transfer to and from the CRT module.

Oscillator - Provides all necessary timing to the CPU-module. Includes a phase lock circuit for the CRT timing in order to keep a steady picture on the screen.

Program Source ROM's - Read Only Memories that contain the program to the microprocessor.

RAM - Random Access Memory, 16 K of 8 bits dynamic RAM, used as buffer memory. Contains also a copy of the refresh memory.

NVM - Non Volatile Memory used to remember significant terminal constants, like baud rate etc., throughout terminal power off.

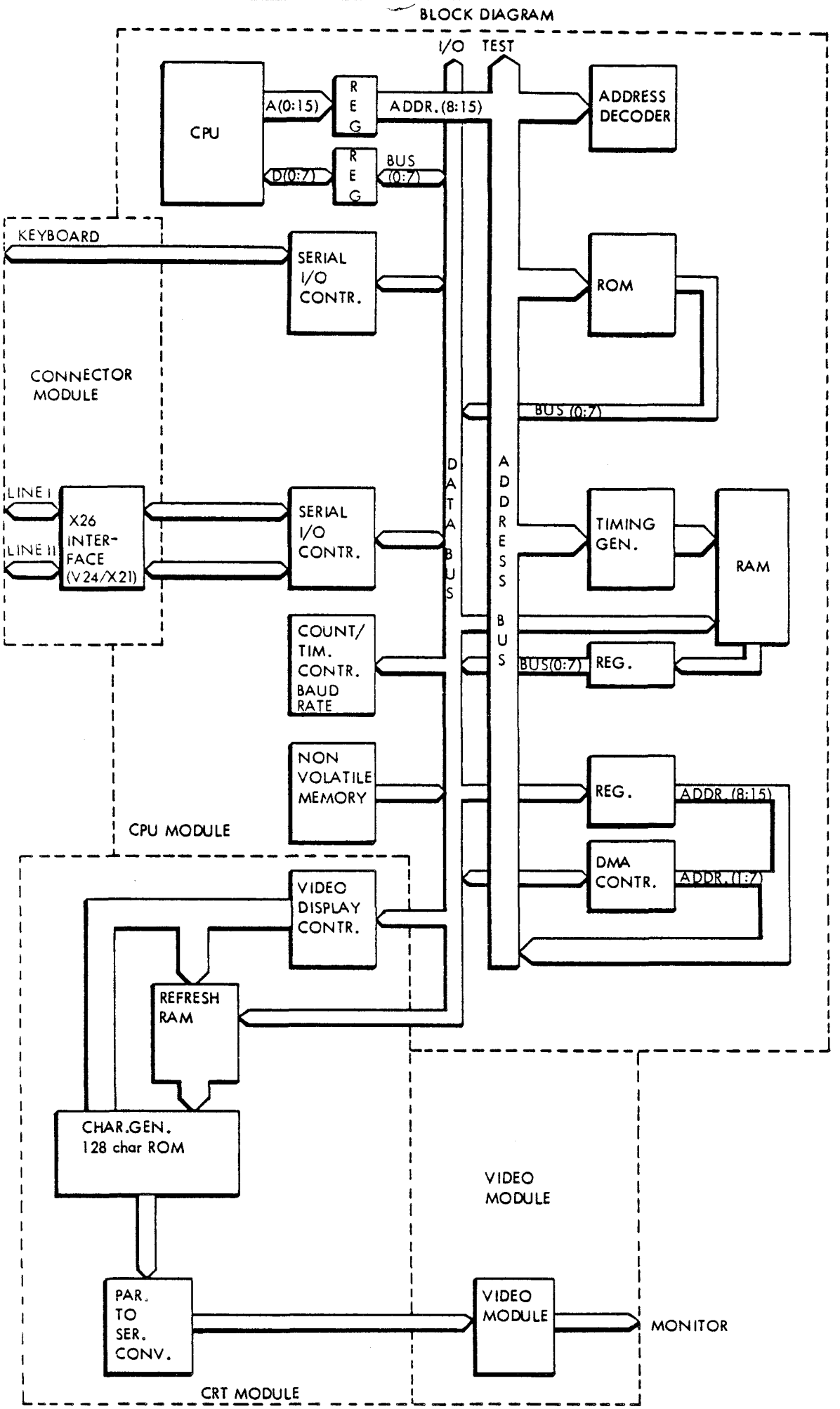

BLOCK DIAGRAM
I/O
TEST
CPU
A(0:15)
REG
ADDR.(8:15)
ADDRESS DECODER
D(0:7)
REG
BUS (0:7)
KEYBOARD
SERIAL I/O CONTR.
ROM
CONNECTOR MODULE
BUS (0:7)
DATA BUS
ADDRESS BUS
LINE I
LINE II
X26 INTER-FACE (V24/X21)
SERIAL I/O CONTR.
TIMING GEN.
RAM
COUNT/ TIM. CONTR. BAUD RATE
BUS(0:7)
REG.
NON VOLATILE MEMORY
REG.
ADDR.(8:15)
CPU MODULE
DMA CONTR.
ADDR.(1:7)
VIDEO DISPLAY CONTR.
REFRESH RAM
CHAR.GEN. 128 char ROM
VIDEO MODULE
PAR. TO SER. CONV.
VIDEO MODULE
MONITOR
CRT MODULE

Fig. 6.1.1

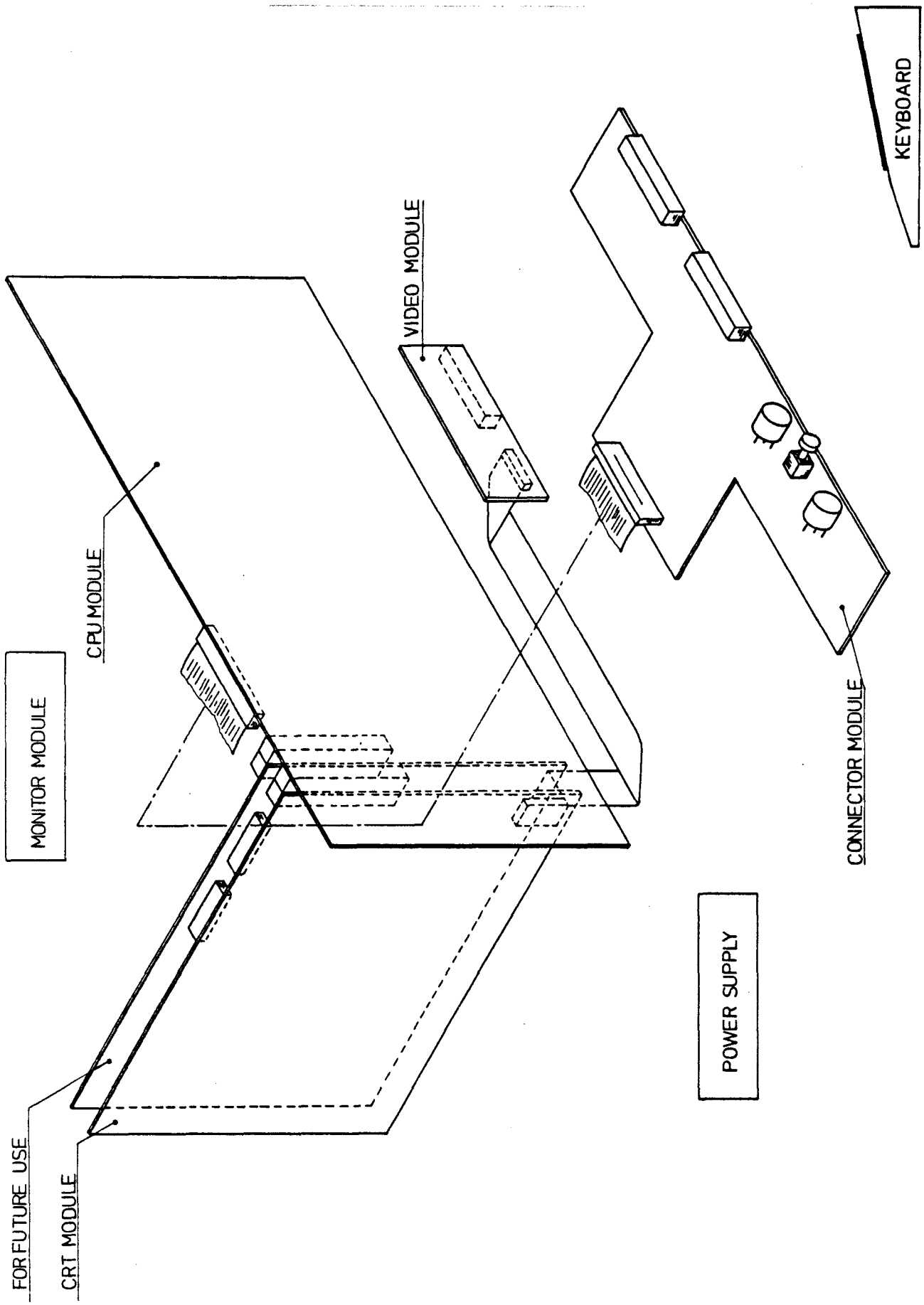


Fig. 6.2.1

RC 851 MODULE SURVEY

Serial Input-Output Communications - Used as communication channels to keyboard, LINE I and LINE II respectively.

All handling of serial data is performed by 2 serial Input/Output (SIO) elements. The SIO converts the serial data to parallel and vice versa, checks and generates parity and holds status, and control information from/to the line interface.

All setups are under program control and may be stored in the NVM during power off.

Signal conditioning to the CCITT X26 specifications is performed in the connector module.

6.2.2 CRT-Module

6.2.2

The CRT-module contains the CRT-controller, refresh RAM, the character generator, and the parallel-to-serial conversion of video information.

CRT-Controller - Performs under program control all formatting of the display screen, i.e. horizontal and vertical timing, sequential addressing of the refresh-memory, and addressing of the character generator.

Refresh RAM - 2 K of 8 bits Random Access Memory used to contain the picture of the screen.

7 bits are used for data representation and 1 bit for high intensity indication (protected fields). The refresh RAM contains a copy of part of the main memory, which includes the picture. This is done to release the main memory from the time consuming refresh work. The refresh RAM is automatically updated from the main memory.

Memory Generator - Generates the dot matrix to be displayed on the screen. Characters are presented in a 16 x 14 (w x h) dot ma-

trix. The dot information is stored in 2 x 2616 ROMs (2 K x 8 each). All most common European national letters are covered by these ROMs.

Parallel-to-Serial Video Conversion - Converts the parallel output from the character generator to serial video information. This again is fed to the video module (see below) for pulse shaping. The level of brightness for high intensity characters may be adjusted in this module. See section 4.5: High Intensity Level Adjustment.

6.2.3 Video Module 6.2.3

This module performs signal conditioning and pulse shaping in order to obtain a crisp and clear picture on the screen.

6.2.4 Connector Module 6.2.4

This module contains the line conditioning circuits for CCITT (V24, X21, RS 232 C). All connectors in and out of the Display Terminal are assembled here.

6.2.5 Power Supply Module 6.2.5

This module is assembled of an AC (Alternate Current) part including ON/OFF switch, fuse, noise filter and a transformer with thermal shut-down, and a DC (Direct Current) part including a switching regulator for +5 V, and 2 serial regulators for +12 V and -12 V. The power supply includes overvoltage and current fold-back features.

6.2.6 Monitor Module

This module contains a high quality, high resolution and high reliable CRT (Cathode Ray Tube) monitor of 15" diagonal. A separate AC module is incorporated in the monitor.

6.2.7 Keyboard Module

This module includes its own microprocessor, which does the scanning of the keys to determine key closures. The microprocessor also converts the key information to a serial bit stream, which is sent to the SIO placed in the CPU-module. Output to the keyboard ("beep", "click", and indicators) are likewise received in serial form.

The keys are of the capacitive type to ensure long and reliable life. To indicate a proper key closure a "click" will sound, whenever the CPU-module has received a character. This sound together with the "beep" sound may be adjusted (even to zero) by the regulator on back of the keyboard.

7. TROUBLE-SHOOTING GUIDE 7.

7.1 Fault Analysis 7.1

If the RC851 Display Terminal should fail, it is recommended either to call qualified personnel or to return the Display Terminal to the nearest Technical Service Department.

Prior to that a few simple checks done by the operator would ease maintenance and maybe prevent wrong service calls.

7.1.1 Check Outs 7.1.1

Power on, no picture.

Try to turn the brightness control clockwise; if no picture or cursor appears, turn power off and check the mains fuse. If blown, replace it by a new one of the same kind. If the fuse continues to blow, or if not blown at all, disconnect the terminal and make an error report.

Any kind of "wrong" picture.

Turn power off, and then on again allowing the self test feature to examine the Display Terminal. Check the read out for any malfunctions.

Good cursor, no character entry.

Check both LINE I and KEYBOARD cables (in both ends) for bad connections. (All cable screws must be fastened). Try to turn power off and on again allowing the self test feature to check the line connection to the host processor. Check LINE rate to be correct.

Steady "wrong" picture.

If the picture is not corrected by a power off, power on sequence, a malfunction has occured in the CPU- or CRT-module. Make an error report.

7.2 Subassembly Removal/Replacement 7.2

Before an access to the internal parts of the Display Terminal and the Keyboard, turn the power switch OFF and disconnect the power cord from the wall outlet.

7.2.1 Cover Removal, Display Unit 7.2.1

To be supplied later.

7.2.2 CRT-Module Removal 7.2.2

To be supplied later.

7.2.3 CPU-Module Removal 7.2.3

To be supplied later.

7.2.4 Monitor Module Removal 7.2.4

To be supplied later.

7.2.5 Power Supply and/or Connector Module Removal 7.2.5

To be supplied later.

7.2.6 Keyboard Removal 7.2.6

To be supplied later.

8. SPECIFICATIONS 8.

8.1 Processors 8.1

CPU-module	Z80A (4 MHz) 158 instructions inclusive 8080 instruction set. Self Test Feature.
Keyboard module	8048 mask programmed.

8.2 Display 8.2

Screen capacity, characters	2000
Characters per line	80
Number of lines	25
Refresh memory	Separate 2 K x 8 bit RAM.
Screen	Non glart CRT, P31 phosphor (green) 15" (38 cm, diagonal). Adjustable ± 5 cm in height. Tiltable ± 10° without tools.
Character generation	16 x 14 dot matrix.
Character size	3 x 6 mm (w x h)
Displayable characters	128 from ROM (Danish Alphabet), 128 in Supervisory mode, and 96 in normal mode.
Refresh rate	50 times per second. Optionally 60 times per second.
Scan method	Raster

Horizontal scanning frequency	18.24 KHz
Vertical scanning frequency (refresh rate)	50 Hz; 60Hz optional (phase locked to mains)
Cursor	Blinking inversion of character.
Cursor control	Position addressable. Up, down, left, right, home, return, TAB.
Attribute functions	Protected fields.
Editing functions	Return. Up, down, left, right, home. Erase all unproteched char. to end of line. Erase all unprotected char. to end of screen. Clear. Tabulation 4 character positions or in protected mode to next free position. X-Y address. Delete line.
Modes	Full duplex only. Roll mode/protected field mode. Terminal setup mode. Self test mode. Supervisory mode.

8.3 Keyboard 8.3

Function keys	14 keys
Control keys	4 keys

Alphanumeric keys	72 keys
Type of keys	Capacitive
Principle of encoding	Scan principle controlled by local microprocessor.
Key functions	N-key rollover, auto repeat, adjustable key sound and alarm (may be silenced completely).
Indicators	Bell, LOCK. Bell indicator is turned on together with a short "beep" when BELL code [07] is received. It is turned off on next CR (Return). Bell indicator may also be turned on and off by separate control characters. Bell indicator is physically placed in the SELECT button. LOCK indicator indicates alphalock mode.
Connection	Serial, TTL levels to display unit.

8.4 Communication 8.4

LINE I Connection	CCITT V.24/X.26 Socket confirms to ISO 2110 CCITT x.21/X.24 (optional)
LINE II (PRINTER) Connection	CCITT V.24/X.26 Socket confirms to ISO 2110
Transmission speeds	110 to 9600 bps., selectable by Terminal Setup Procedure.

Data format	Serial, asynchronous, 1 start bit, 7 data bits, 1 parity bit (even parity), (110 bps: 2 stop bits).
Peripheral connection	Hard copy printer is connected to LINE II connector. Output is enabled by print ON function and disabled by print off function.
Cable length	Max. 25 m to modem, current loop coupler, or host.

8.5 Physical

8.5

Power voltage	110/220 V AC ± 10%
Power frequency	50 Hz ± 2 Hz (60 Hz optional)
Power consumption	100 W
Temperature, ambient	10-35°C
Humidity, relative	0-95% non-condensing
Altitude	10,000 ft. max. (3400 m)
Standard finish	Tan/brown

Dimensions:	Display	Keyboard
Height	490 mm (highest position)	85 mm
Width	470 mm	440 mm
Depth	330 mm (non-tilted)	250 mm
Weight	20 kg	3 kg

All specifications subject to change without notice.

RETURN LETTER

Title: RC851 Display Terminal RCSL No.: 52-AA1023

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