RCSL No: 42-i1696

Edition: October 1981

Author: Pierce C. Hazelton

Title:

RC851 Display Terminal
Reference Manual

RCSL 42-i1592

A/S REGNECENTRALEN
af 1979

Keywords:

RC851, Display Terminal, Reference Manual.

Abstract:

Reference manual for the RC851 Display Terminal. Describes terminal functions, including the character code transmitted by the RC851 and the reactions of the RC851 to received character codes. Also describes terminal interfaces. Does not describe communication with specific host computers.

(60 printed pages)

Printed by A/S Regnecentralen af 1979, Copenhagen

RCSL 42-i1592

FOREWORD

First edition: RCSL No 42-i1696.
The present manual, together with the RC851 Operating Guide (RCSL No 42-i1611), replaces the publication RC851 Display Terminal (RCSL No 52-AA1023).

Pierce C. Hazelton
A/S REGNECENTRALEN af 1979, October 1981

TABLE OF CONTENTS PAGE

TABLE OF CONTENTS (continued) PAGE

FIGURES PAGE

1. INTRODUCTION 1.

The RC851 Display Terminal is designed for use in data processing, data entry, process control, and data communication systems.

The RC851 is a member of the RC850 family of intelligent display terminals. The use of a microcomputer as the basis of all RC850 display terminals makes it possible to emulate a number of different terminals on the market as well as to access a variety of applications from the same terminal. RC850 display terminals exist accordingly in several different versions.

The RC851 is a hard-programmed version: a versatile input/output station, which can be used in practically any computer system as an alternative to teletypewriter equipment.

As an interactive display terminal communicating with a host computer, the RC851 is well-suited to a variety of system applications, e.g. administrative data processing, data entry, and education. Characteristic of the RC851, however, is its ability to meet the user's demand for functional flexibility.

In the RC851, all display terminal functions are implemented by software, which is executed by the microprocessor from a read-only memory in the display unit. All functions are performed under program control. A wide selection of built-in standard functions facilitates the adaption of the RC851 to individual user requirements. Thus the application program can as needed place the RC851 in the page mode, define protected areas, address the cursor to any position on the display screen, and perform other functions by means of control codes.

2. DISPLAY TERMINAL FUNCTIONS

2.1 General Description

The RC851 Display Terminal is a full duplex (echoplex) terminal consisting of two separate units, the keyboard and the display, which interact via the host computer. The keyboard generates character codes and transmits them to the host (see section 2.2). Character codes received from the host cause the picture on the display screen to be modified (see section 2.3). The character codes include codes for graphic symbols and control codes.

2.1.1 Operating Modes

Self-test mode. When power is switched on, the terminal enters the self-test mode and automatically executes a built-in test procedure, which concludes with a display screen picture indicating the transmission speed, line status, and any malfunction (see subsection 2.1.2). If no malfunction was detected, the terminal enters the scroll mode.

Scroll mode. In the scroll mode the display screen is like an endless roll of paper. Whenever the screen is completely filled, the top line is removed (irrevocably) and all of the other lines are moved up, so that a new, empty line becomes available at the bottom of the screen.

Page mode. As soon as the screen contains a protected area (a character or field which appears brighter), the terminal is in the page mode. The display screen is now like a single sheet of paper, which remains in place, but can be overwritten repeatedly. The cursor will move accordingly from the bottom to the top line.

Set-up mode. From the scroll or the page mode, the operator can place the terminal in the set-up mode in order to give commands to the terminal (see subsection 2.1.2).

Supervisor mode. From the set-up mode the operator can place the terminal in the supervisor mode in order to monitor communication with the terminal. Graphic symbols for all of the character codes in the character set are displayed in this mode, and no functions are performed (see subsection 2.3.1).

2.1.2 Set-Up Mode

2.1.2

In the set-up mode the operator can enter parameters defining the terminal's characteristics by means of keyboard commands. These parameters are stored in a built-in non-volatile memory (NVM) and thus remain valid until the operator chooses to modify them.

The line command enables the operator to define the transmission speed of the LINE I and LINE II interfaces (see section 3.1). The cursor command permits the selection of one of four different cursor forms. The test command places the terminal in the self-test mode and runs the built-in test procedure in a loop. The sup command places the terminal in (and returns the terminal from) the supervisor mode. The end command returns the terminal from the set-up mode to the scroll mode.

2.2 Keyboard

2.2

2.2.1 Common Features

2.2.1

The keyboard consists of a main keyboard and a numeric pad, each containing character keys and control keys. All code-generating keys repeat automatically, at the rate of 10 characters a second, when held depressed for longer than three-quarters of a second. Some keys are furnished with a light-emitting diode (LED) indicator. The keyboard emits a click when a key is depressed properly.

2.2.2 Layouts

2.2.2

The RC851 keyboard has a standard layout and a special, data-entry layout. Both layouts have in turn a number of variants, e.g. USASCII, UKASCII, German language, Swedish language, and Danish language. The available layouts are shown in appendix C.

Fig. 1 shows the standard keyboard layout (Danish variant).

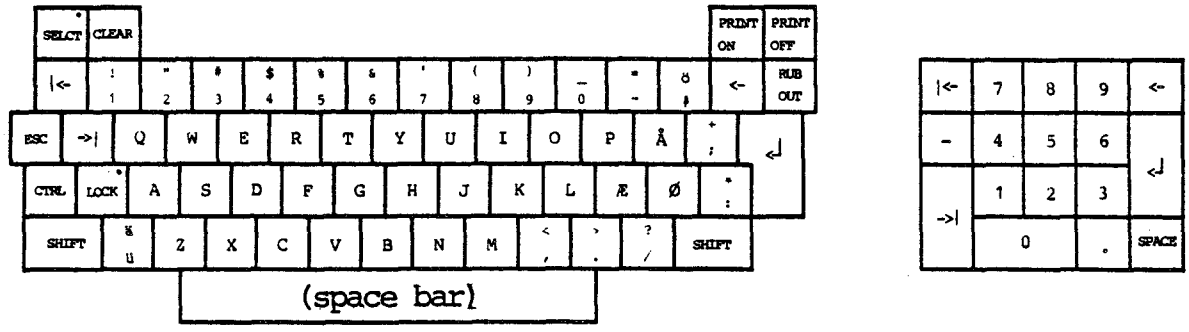


Figure 1: Standard Keyboard Layout (Danish Variant).

Remarks to Fig. 1

1. The following descriptions apply only to the standard keyboard (Danish variant).

2. The control keys on data-entry keyboards are application-dependent, and are therefore described in the documentation for the application in question.

2.2.3 Keys

2.2.3

If the terminal is connected to the host computer and the defined transmission speed (see subsection 2.1.2) is appropriate, all character codes generated by the keyboard will be transmitted to the host. The latter then decides whether to echo the code or to return it in a converted form.

Fig. 2 shows a table containing the 128 character codes which can be generated by the keyboard, either directly or by means of the SHIFT and CTRL keys (cf. fig. 1).

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	SELCT	,	<	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	ö
1	1	1	1	(F)15	SI		US		/	?	O	_	o	RUB OUT

Figure 2: Keyboard Codes.

Remarks to Fig. 2

1. The character codes are expressed in hexadecimal form, e.g. 6D. In the table, the column number (0-7) is the first digit of the code and the row number (0-F) is the second digit. Thus 6D, as may be seen, is the code for the graphic symbol m.

2. The corresponding bit patterns are indicated by b7, b6, ..., b1. (Bit 8, the parity bit, is not shown). Thus 1101101 corresponds to 6D.

3. The code 6D, for the graphic symbol m, is generated by depressing the character key marked M.

4. The code 4D, for the graphic symbol M, is generated by depressing the character key marked M simultaneously with the SHIFT key (see subsection 2.2.3.2).

5. The control codes, 00 to 1F, are generated in two ways, for example:

   a. The code 0B, for ASCII VT, is generated by depressing the character key marked + (code 2B) or K (code 4B or 6B) simultaneously with the CTRL key (see subsection 2.2.3.2).

   b. The code 0C, for ASCII FF, is generated by depressing the CLEAR key (see subsection 2.2.3.3).

6. The code 20 is generated by depressing the SPACE key (bar).

The keyboard contains three kinds of keys: character keys, local control keys, and remote control keys. Character keys are of one color, control keys of another.

2.2.3.1 Character Keys

2.2.3.1

The character keys generate codes corresponding to the graphic symbol or symbols with which the key is marked (cf. figs. 1 and 2) either directly or by means of the SHIFT key (see subsection 2.2.3.2). The graphic symbols include the letters of the alphabet, the digits from 0 to 9, and various special symbols. Note that a space is reckoned a graphic symbol, and that the SPACE key (bar) generates the code 20.

2.2.3.2 Local Control Keys

2.2.3.2

The local control keys, marked SHIFT, LOCK, and CTRL, perform local control functions, but do not themselves generate codes.

SHIFT. The SHIFT key can be used in conjunction with any character key on the main keyboard, but has no effect on the numeric pad. SHIFT must be depressed simultaneously with the character key in order to generate the desired code. The function performed by SHIFT terminates as soon as the keys are released. Some examples:

Key Marked	Code Generated
M	6D (i.e. m, lower case)
M and SHIFT	4D (i.e. M, upper case)
ä ü	40 (i.e. ü)
ä ü and SHIFT	60 (i.e. ä)
& 6	36 (i.e. 6)
& 6 and SHIFT	26 (i.e. &)

Note that SHIFT is also used locally in conjunction with the SELCT key (see subsection 2.2.3.3) to place the terminal in the set-up mode (see subsection 2.1.1).

LOCK. The LOCK key is used to place the keyboard in and remove the keyboard from the alpha-lock mode (as well as to light and extinguish the indicator on the LOCK key). In the alpha-lock mode, the function of the SHIFT key is applied automatically to all character keys marked with letters of the alphabet (excepting ä, ö, and ü). The SHIFT key itself can, of course, be used in conjunction with all of the other character keys (including ä, ö, and ü) while the keyboard is in the alpha-lock mode.

CTRL. The CTRL key is used in conjunction with certain other keys to generate control codes (cf. fig. 2). Thus the codes in column 0 (00 to 0F) are generated by depressing CTRL simultaneously with the key on the same row in column 2, 4, or 6, and the codes in column 1 (10 to 1F) by depressing CTRL simultaneously with the key on the same row in column 3, 5, or 7. CTRL can be used in this way to generate control codes for which there is no dedicated key (see subsection 2.2.3.3). Some examples:

Key Marked	Code Generated
& (code 26) and CTRL or F (code 46) and CTRL or F (code 66) and CTRL	06 (i.e. ASCII ACK)
6 (code 36) and CTRL or V (code 56) and CTRL or V (code 76) and CTRL	16 (i.e. ASCII SYN)

2.2.3.3 Remote Control Keys

2.2.3.3

Certain control codes can be generated by means of a dedicated key, called a remote control key (cf. figs. 1 and 2). Note that the depression of such a key will have no effect on the display screen picture unless the character code is echoed (see section 2.3). The remote control keys are as follows:

Key Marked	Control Function	Code Generated	Decimal Value
|←	Delete Line	05 (ASCII ENQ)	5
←	Delete Character	08 (ASCII BS)	8
→|	Tabulate	09 (ASCII HT)	9
CLEAR	Clear Screen	0C (ASCII FF)	12
←|	Carriage Return	0D (ASCII CR)	13
PRINT ON	Printer On	12 (ASCII DC2)	18
PRINT OFF	Printer Off	14 (ASCII DC4)	20
ESC	Escape	1B (ASCII ESC)	27
SELCT	Local Attention	1C (ASCII FS)	28
RUB OUT	Rub Out	7F (ASCII RUBOUT)	127

Note that when the terminal is in the set-up mode (see subsection 2.1.1), the codes generated by the keys marked ← and ←| are interpreted locally by the terminal microprocessor (see appendix A). Note also that for the SELCT key the stated control function applies to RC8000 host computers.

2.3 Display and Control Codes 2.3

This section describes the reactions of the terminal to character codes received from the host computer.

2.3.1 Display Codes and Character Set 2.3.1

The receipt of codes for graphic symbols (codes 20 to 7F, decimal values 32 to 127) causes the corresponding graphic symbol to be displayed. Note that when the terminal is in the supervisor mode (see subsection 2.1.1), the receipt of control codes (codes 00 to 1F, decimal values 0 to 31) also causes a corresponding graphic symbol to be displayed, and no function is performed.

Fig. 3 shows a table containing the 128 graphic symbols which can be generated by the RC851 character generator (see appendix A).

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	Ñ	ñ	"	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	Ö	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	

Figure 3: Character Set.

Remarks to Fig. 3

1. The character codes are expressed in hexadecimal form, e.g. 6D. In the table, the column number (0-7) is the first digit of the code and the row number (0-F) is the second digit. Thus 6D, as may be seen, is the code for the graphic symbol m.

2. The corresponding bit patterns are indicated by b7, b6, ..., b1. (Bit 8, the parity bit, is not shown). Thus 1101101 corresponds to 6D.

3. 20 is the code for the graphic symbol SPACE.

4. The graphic symbols corresponding to the control codes, 00 to 1F, are displayed only in the supervisor mode (see subsection 2.1.1).

2.3.2 Control Codes and Functions

2.3.2

The receipt of control codes causes the corresponding function to be performed.

Fig. 4 shows a table containing the 20 control codes to which the RC851 Display Terminal will react.

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	▒

Figure 4: Control Codes.

Remarks to Fig. 4

1. The character codes are expressed in hexadecimal form, e.g. 0D. In the table, the column number (0-7) is the first digit of the code and the row number (0-F) is the second digit. Thus 0D, as may be seen, is the code for the control function RETURN.

2. The corresponding bit patterns are indicated by b7, b6, ..., b1. (Bit 8, the parity bit, is not shown). Thus 0001101 corresponds to 0D.

3. 20 is the code for the graphic symbol SPACE.

4. The terminal will not react to codes to which no function is assigned.

The following list describes the reactions of the terminal to received control codes.

Note that the page mode (see subsection 2.1.1) affects the cursor movement functions. If the cursor is moved to a protected area, it generally seeks the first free character position to the right of the protected area.

DELETE LINE — Delete Line (ASCII ENQ, code 05, decimal value 5)

Scroll mode:
Moves the cursor to the beginning of the current line and erases the latter.

Page mode:
Moves the cursor to the beginning of the current line and erases all unprotected characters on the latter.

START ADDR — Start Address (ASCII ACK, code 06, decimal value 6)

Moves the cursor to the character position (x-y address) defined by the two following characters. The character sequence is:

<start address><column number><row number>

The display screen has 80 columns (character positions) and 25 rows (lines). <column number> and <row number> are defined by certain character codes, which are assigned numerical values according to the table shown in fig. 5 at the end of this chapter.

BELL — Bell (ASCII BEL, code 07, decimal value 7)

Lights the indicator on the SELCT key and causes the keyboard to emit a beep.

DELETE CHAR — Delete Character (ASCII BS, code 08, decimal value 8)

Scroll mode:

Moves the cursor one character position to the left on the current line.

Page mode:

Moves the cursor one character position to the left on the current line. If the cursor is moved to a protected area, it seeks the first free character position to the right of the protected area. If the protected area occupies the beginning of the line, the cursor remains in the first free character position on the line.

TAB — Tabulate (ASCII HT, code 09, decimal value 9)

Scroll mode:

Moves the cursor to the next tabulation position on the current line (character position 5, 9, ..., 77). At the end of the line, the cursor is moved down to the beginning of the next line (position 1). At the end of the bottom line, the top line of the display screen is removed (irrevocably) and the cursor is moved down to the new, empty line.

Page mode:

Moves the cursor to the first free character position to the right of the next protected area on the screen. At the end of the screen, the next protected area is the first protected area at the top of the screen.

LINE FEED — Line Feed (ASCII LF, code 0A, decimal value 10)

Scroll mode:
Moves the cursor one line down from the current line. If the latter is the bottom line, the top line of the display screen is removed (irrevocably) and the new bottom line is empty.

Page mode:
Moves the cursor one line down from the current line. If the latter is the bottom line, the cursor moves to the top line in the current column.

CLEAR — Clear Screen (ASCII FF, code 0C, decimal value 12)

Erases the display screen, protected areas included, moves the cursor to its home position (upper left corner), and places the terminal in the scroll mode (see subsection 2.1.1). Cf. SET PROTECT and RESET.

RETURN — Carriage Return (ASCII CR, code 0D, decimal value 13)

Moves the cursor to the beginning of the current line and extinguishes the indicator on the SELCT key.

LAMP ON — Indicator On (ASCII DC1, code 11, decimal value 17)

Lights the indicator on the SELCT key.

PRINT ON — Printer On (ASCII DC2, code 12, decimal value 18)

Enables the copying of all following received characters (codes) to a printer, if the latter is connected to the LINE II interface (see section 3.2).

LAMP OFF — Indicator Off (ASCII DC3, code 13, decimal value 19)

Extinguishes the indicator on the SELCT key.

PRINT OFF — Printer Off (ASCII DC4, code 14, decimal value 20)

Disables the copying of received characters (codes) to the printer and closes the LINE II connection.

SET PROTECT — Page Mode (ASCII NAK, code 15, decimal value 21)

Causes all following received characters to be protected (and appear brighter). Also places the terminal in the page mode (see subsection 2.1.1) when required. Cf. CLEAR and RESET.

CURSOR FWD — Cursor Forward (ASCII CAN, code 18, decimal value 24)

Scroll mode:

Moves the cursor one character position to the right on the current line. At the end of the line, the cursor is moved down to the beginning of the next line. At the end of the bottom line, the top line of the display screen is removed (irrevocably) and the cursor is moved down to the new, empty line.

Page mode:

Moves the cursor one character position to the right on the current line. At the end of the line, the cursor is moved down to the beginning of the next line. At the end of the bottom line, the cursor moves to the leftmost character position on the top line.

CURSOR UP — Cursor Up (ASCII SUB, code 1A, decimal value 26)

Moves the cursor one line up from the current line. If the latter is the top line, the function is not performed.

ESC — Escape (ASCII ESC, code 1B, decimal value 27)

No function is performed when this code is received.

RESET — Reset (ASCII FS, code 1C, decimal value 28)

Used to terminate a protected area. The terminal remains in the page mode. Cf. SET PROTECT and CLEAR.

HOME — Cursor Home (ASCII GS, code 1D, decimal value 29)

Moves the cursor to its home position (upper left corner).

EEOL — Erase to End of Line

(ASCII RS, code 1E, decimal value 30)

Erases all unprotected characters from and including the cursor position to the end of the current line. The cursor is not moved.

EEOS — Erase to End of Screen

(ASCII US, code 1F, decimal value 31)

Erases all unprotected characters from and including the cursor position to the end of the screen. The cursor is not moved.

1	ä	96	21	t	116	41	H	72	61	Ø	92
2	a	97	22	u	117	42	I	73	62	Å	93
3	b	98	23	v	118	43	J	74	63	↑	94
4	c	99	24	w	119	44	K	75	64	_	95
5	d	100	25	x	120	45	L	76	65	SPACE	32
6	e	101	26	y	121	46	M	77	66	!	33
7	f	102	27	z	122	47	N	78	67	"	34
8	g	103	28	æ	123	48	O	79	68	#	35
9	h	104	29	ø	124	49	P	80	69	$	36
10	i	105	30	å	125	50	Q	81	70	%	37
11	j	106	31	ö	126	51	R	82	71	&	38
12	k	107	32	RUB OUT	127	52	S	83	72	'	39
13	l	108	33	ü	64	53	T	84	73	(	40
14	m	109	34	A	65	54	U	85	74	)	41
15	n	110	35	B	66	55	V	86	75	*	42
16	o	111	36	C	67	56	W	87	76	+	43
17	p	112	37	D	68	57	X	88	77	,	44
18	q	113	38	E	69	58	Y	89	78	-	45
19	r	114	39	F	70	59	Z	90	79	.	46
20	s	115	40	G	71	60	Æ	91	80	/	47

Figure 5: Cursor Positioning Table.

Remarks to Fig. 5

1. In the table, the numerical value, i.e. the column or row number, assigned to the character code is given on the left, and the graphic symbol corresponding to the character code is shown on the right, followed by the decimal value of the code.

2. Thus the code (decimal value 71) for the graphic symbol G, for example, is interpreted as column number 40, and the code (decimal value 107) for the graphic symbol k as row number 12.

3. The reaction of the cursor to character codes other than those represented in this table is undefined.

3. DISPLAY TERMINAL INTERFACES 3.

The RC851 Display Terminal has three interface connectors for the attachment of signal cables to a modem or local processor (LINE I connector), a printer or auxiliary device (LINE II connector), and the keyboard (KEYBOARD connector). Each interface performs serial data transmission to and from the connected device.

Fig. 6 shows the LINE I and LINE II interface connections.

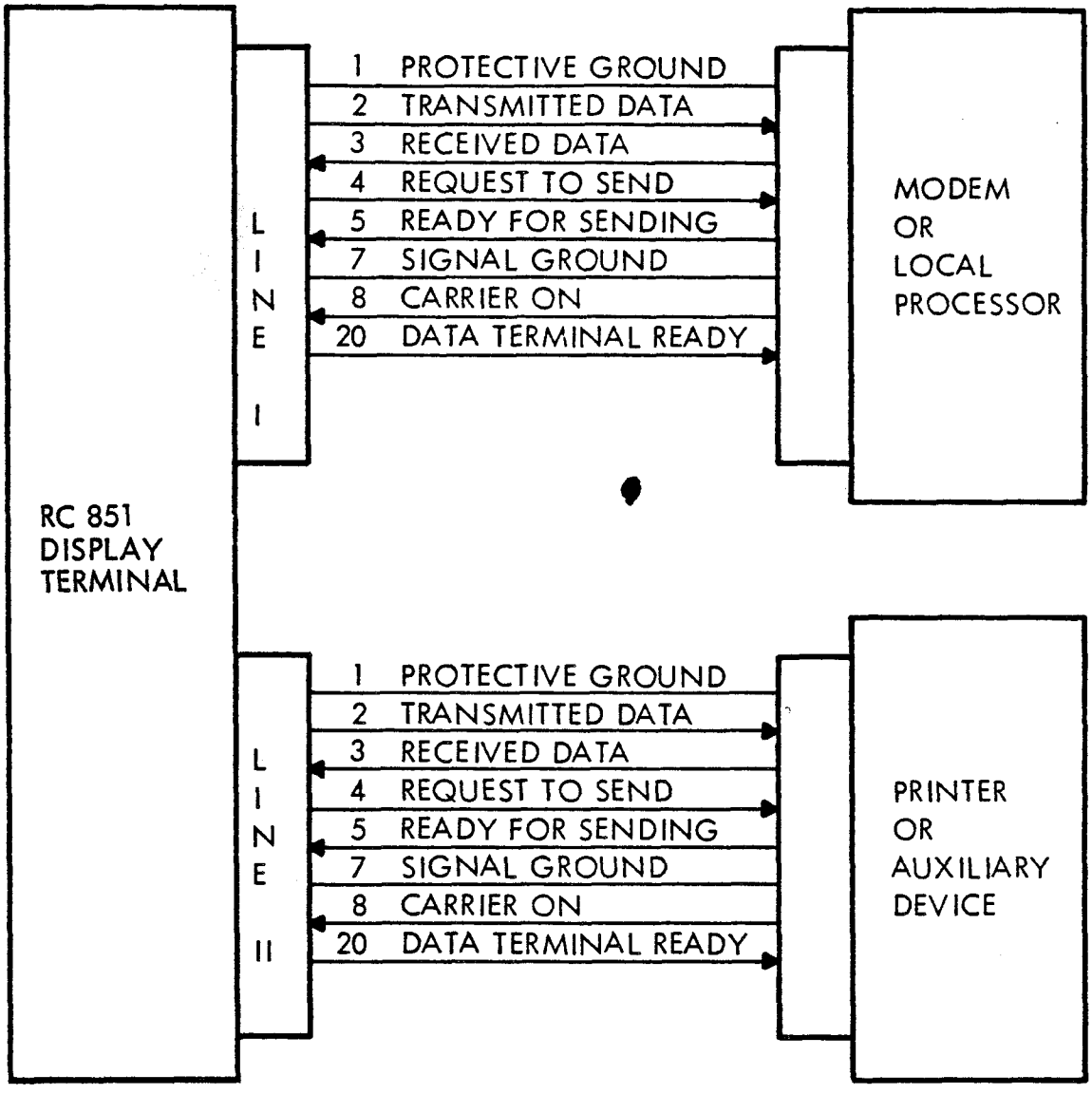


Figure 6: LINE I and LINE II Interface Connections.

3.1 LINE I Interface (Host Computer Connection) 3.1

The LINE I interface is intended for a modem or local processor.

The transmission speed is defined in the set-up mode (see subsection 2.1.2). The following baud rates are available: 110, 300, 600, 1200, 2400, 4800, and 9600 bps. The transmission speeds of the LINE I interface and the LINE II interface (see section 3.2) are always set to the same value.

The transmission mode is always full duplex, i.e. the keyboard and the serial transmitter act as an independent unit driving the "transmit" side of the communication line, whereas the serial receiver and the display are driven by the "receive" side of the communication line (see appendix A). In order to display keyboard data on the screen, the processor at the other end of the communication line must echo the characters back via the "receive" line.

3.1.1 V.24 Interface 3.1.1

The LINE I and LINE II interfaces conform to CCITT V.24 (DTE description) and EIA RS-232-C specifications.

Fig. 7 gives the signal levels for the LINE I and LINE II interfaces.

	TRANSMITTER	RECEIVER
D A T A	Mark level: (logical 1) -5.5 V Space level: (logical 0) +5.5 V	Input impedance: 3 to 7 K Mark level: -4 V to -12 V Space level: +4 V to +12 V See NOTE.
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 See NOTE.

IF AN INPUT LEVEL IS LEFT FLOATING, IT ASSUMES ITS NEGATIVE LEVEL.

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

Figure 7: Signal Levels.

3.1.2 Serial Data Transfer

3.1.2

Fig. 8 shows the bit sequence used for transmitted and received data.

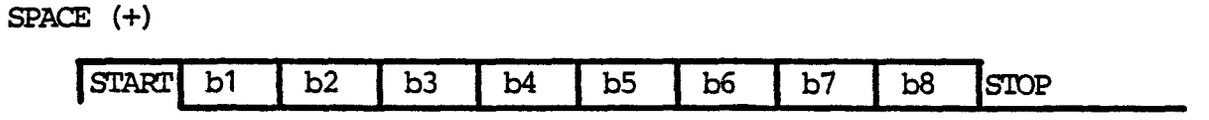


Figure 8: Serial Data Transfer.

Remarks to Fig. 8

1. The data bits are indicated by b1, b2, ..., b7.

2. The parity bit is indicated by b8. Data is transmitted and received by the display terminal with even parity. Received characters containing a parity error are indicated on the display screen by the RUB OUT symbol (code 7F, decimal value 127, cf. fig. 3).

3. Two STOP bits are used.

Fig. 9 shows the pin assignments in the LINE I interface connector, which is a 25-pin type DB 25S connector with a screw lock.

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

Figure 9: LINE I Interface Connector.

Remarks to Fig. 9

1. NC indicates no connection.

2. The keyboard and the display can be tested without a connection to the host computer by connecting pin 2 to pin 3, pin 4 to pin 5, and pin 8 to pin 20.

3. The signal READY FOR SENDING (RFS) must be "ON" to transmit data. If there is no connection to RFS (pin 5), it should be connected to REQUEST TO SEND (RTS, pin 4).

4. The signal CARRIER ON (CO) must be "ON" to receive data. If there is 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

The LINE II interface is intended for a printer or auxiliary device. For transmission speed, V.24 interface, and serial data transfer, see the LINE I interface (section 3.1). Note that data received at the LINE I receiver will be routed to the LINE II transmitter by the PRINT ON control code and unrouted by the PRINT OFF control code (see subsection 2.3.2).

Fig. 10 shows the pin assignments in the LINE II interface connector, which is a 25-pin type DB 25S connector with a 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 (RTS)	17	NC
5	READY FOR SENDING (RFS)	18	NC
6	NC	19	NC
7	SIGNAL GROUND	20	DATA TERMINAL READY (DTR)
8	CARRIER ON (CO)	21	NC
9	NC	22	NC
10	NC	23	NC
11	NC	24	NC
12	NC	25	NC
13	NC		

Figure 10: LINE II Interface Connector.

Remarks to Fig. 10

1. NC indicates no connection.

2. The signal READY FOR SENDING (RFS) must be "ON" to transmit data. If there is no connection to RFS (pin 5), it should be connected to REQUEST TO SEND (RTS, pin 4).

3. The signal CARRIER ON (CO) must be "ON" to receive data. If there is no connection to CO (pin 8), it should be connected to DATA TERMINAL READY (DTR, pin 20).

4. The signal READY FOR SENDING (RFS) can be used to indicate BUSY from a printer as shown in fig. 11.

PRINTER	READY FOR SENDING
BUSY	"OFF" (negative)
READY	"ON" (positive)
feature not used	"ON" (positive, REQUEST TO SEND)

Figure 11: Printer BUSY Indication.

3.3 KEYBOARD Interface 3.3

Data is transferred between the keyboard and the display logic in serial form. The signal levels are TTL levels.

A. DISPLAY TERMINAL MODULES A.

The RC851 Display Terminal is a microcomputer based terminal, in which all terminal functions are implemented by software. The RC851 hardware comprises seven main modules, designated the CPU, CRT, video, connector, power supply, monitor, and keyboard module.

Fig. 12 shows all of the modules as they are found in the display terminal.

Fig. 13 contains a functional diagram showing the CPU, CRT, video, and connector modules.

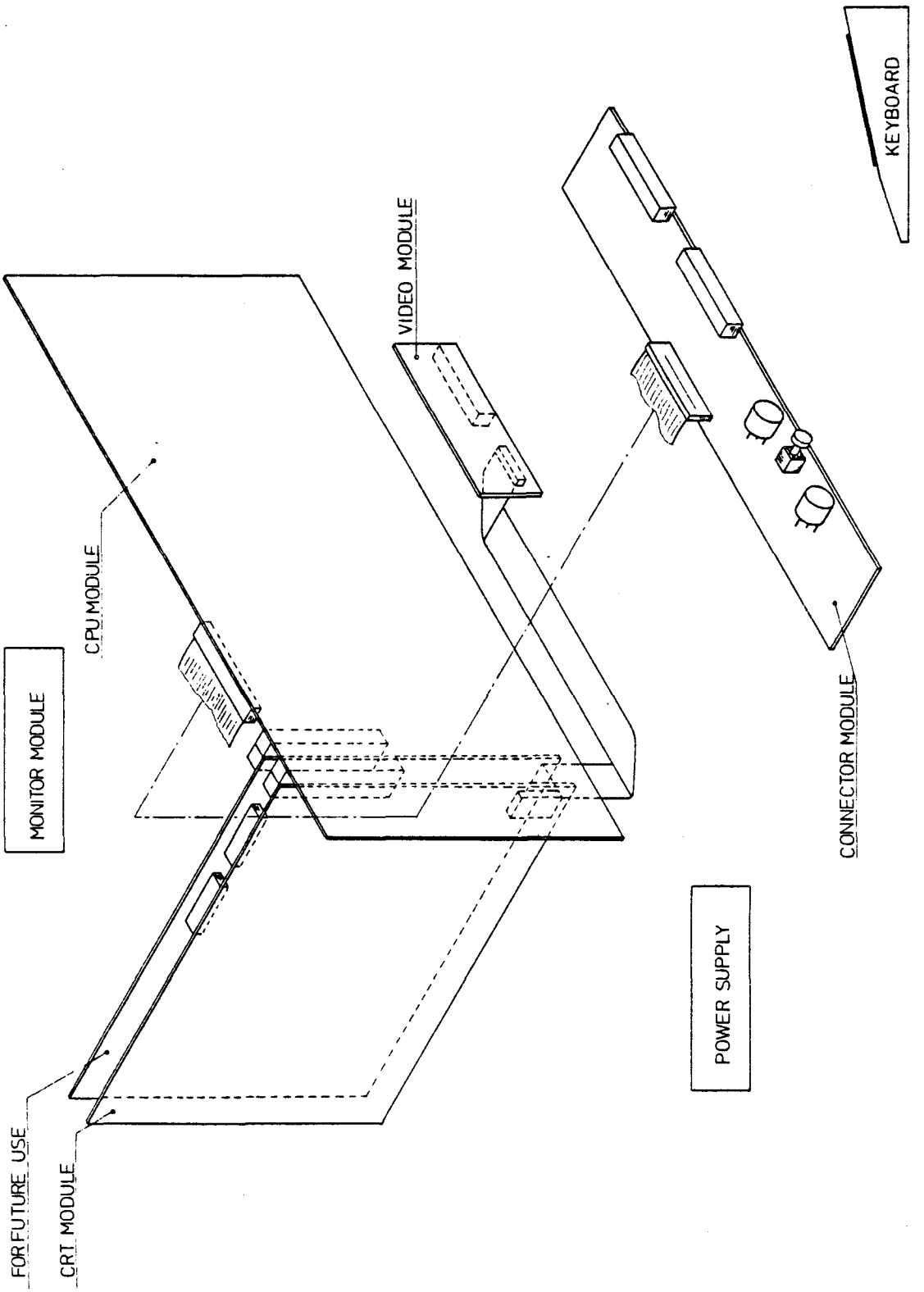


Figure 12: Module Survey.

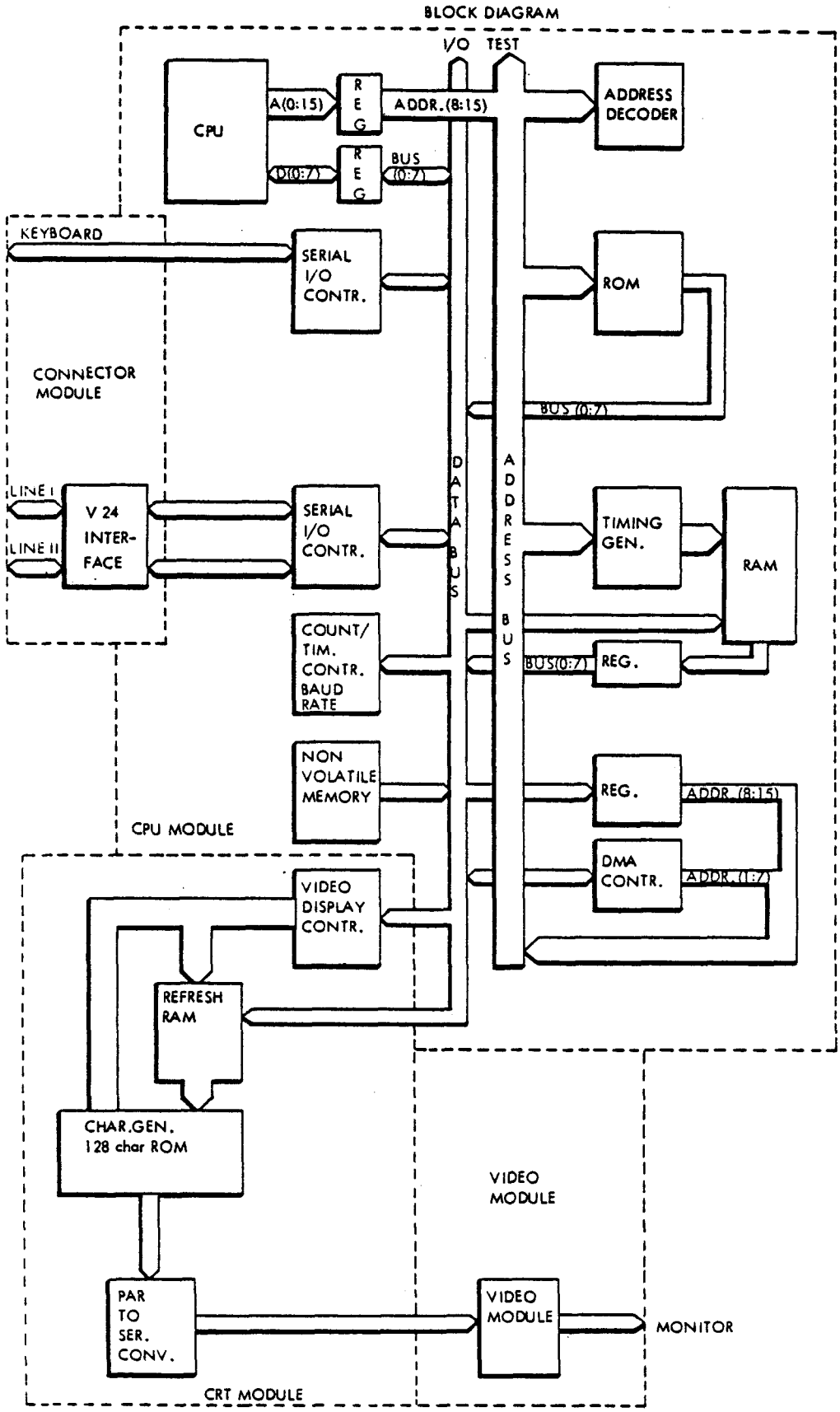


Figure 13: Functional Diagram.

A.1 CPU Module A.1

The CPU module contains the following:

Microprocessor. Reads and interprets the program stored in the ROM (read-only memory). All functions 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 for the CPU module. Includes a phase lock circuit for the CRT timing to ensure a steady picture on the display screen.

ROM. Read-only memory. Contains the program for the microprocessor.

RAM. Dynamic random-access memory. Used as buffer memory. Also contains the display screen picture, which is copied in the refresh RAM of the CRT module in order to release the main memory from time-consuming refresh operations.

NVM. Non-volatile memory. Used for permanent storage of parameters defining the terminal's characteristics, e.g. the transmission speed. Such "set-up" parameters are entered and modified under program control.

Serial I/O controllers. Serve as communication channels for the keyboard, LINE I (host computer connection), and LINE II (printer connection). All handling of serial input/output is performed by these two controllers, which convert the serial data to parallel and vice versa, check and generate parity and hold status, and control information to and from the interfaces.

A.2 CRT Module A.2

The CRT module contains the following:

Video display controller. Performs all formatting of the display screen under program control, i.e. horizontal and vertical timing, sequential addressing of the refresh RAM, and addressing of the character generator.

Refresh RAM. Random-access memory. Contains a copy of the display screen picture, which is automatically updated from the RAM memory in the CPU module. 7 bits are used to represent the data and 1 bit to indicate increased brightness (protected areas).

Character generator. Generates the dot matrices to be displayed on the screen. (There are 128 graphic symbols in the character set, each represented by a 16 x 14 dot matrix). The matrices are stored in a ROM memory.

Parallel-to-serial converter. Converts the parallel output from the character generator to serial input for the video module.

A.3 Video Module A.3

Performs signal conditioning and pulse shaping to provide a sharp, clear picture on the display screen.

A.4 Connector Module A.4

Performs signal conditioning in conformity to CCITT V.24 (DTE description) and EIA RS-232-C specifications. All interface connectors are found in this module.

A.5 Power Supply Module A.5

Contains an alternating current (AC) section, including an on/off switch, fuse, noise filter, and transformer with thermal shut-down, and a direct current (DC) section, including a switching regulator for +5 V and two serial regulators for +12 V and -12 V. The power supply has overvoltage and current fold-back features.

A.6 Monitor Module A.6

Contains a 15 inch (diagonal) cathode ray tube (CRT) monitor of high quality, resolution, and reliability. A separate AC power supply is included in this module.

A.7 Keyboard Module A.7

Has its own microprocessor, which performs scanning of the keys to ascertain key closures. The microprocessor also converts the key input to a serial bit stream, directing the latter to one of the serial I/O controllers in the CPU module. Output to the keyboard (i.e. key click, display line beep, and indicators) is also received in serial form.

The keys are of the capacitative type to ensure long, reliable operation. To indicate proper key closure, a click sounds whenever the CPU module receives a character. The volume of the key click as well as the display line beep can be adjusted (or silenced).

B. DISPLAY TERMINAL SPECIFICATIONS B.

B.1 Processors B.1

CPU module:	Z80A (4 MHz). 158 instructions, including Intel 8080 instruction set. Self-test feature.
Keyboard module:	Intel 8035.

B.2 Display B.2

Screen capacity:	2000 characters.
Characters per line:	80.
Number of lines:	25.
Refresh memory:	Separate 2K x 8 bits RAM.
Screen:	Non-glare CRT, P31 phosphorus (green). 38 cm (15 inches) diagonal. Height adjustable $\pm$5 cm. Tiltable (without tools) $\pm$10°.
Character generation:	16 (wide) x 14 (high) dot matrix.
Character size:	3 (wide) x 6 (high) mm.
Displayable characters:	128 from ROM. 128 in supervisor mode. 96 in other modes.
Refresh rate:	50 times per second.
Scanning method:	Raster.

Horizontal scanning frequency:	18.24 KHz.
Vertical scanning frequency (refresh rate):	50 Hz. Phase locked to mains.
Cursor:	Selectable in set-up mode: underline, flashing underline, box, or flashing box.
Cursor control:	Position addressable. Up, down, left, right, home, return, and tabulate.
Attribute functions:	Protected areas.
Editing functions:	X-Y address. Up, down, left, right, home, and return. Tabulate (by 4 character positions or, in page mode, to next free position). Delete line. Erase all unprotected characters to end of line or end of screen. Clear screen.
Operating modes:	Full duplex (echoplex). Self-test, scroll/page, set-up, and supervisor modes.

B.3 Standard Keyboard

B.3

Remote control keys:	14 (4 of which are duplicates).
Local control keys:	4 (1 of which is a duplicate).

Character keys:	61 (13 of which are duplicates).
Type of key:	Capacitative.
Encoding principle:	Scanning controlled by microprocessor.
Key functions:	N-key rollover, automatic repetition, adjustable key click and display line beep (may be silenced).
Indicators:	Lamp on LOCK key indicates alpha-lock mode. Lamp on SELCT key is lit (and beep emitted) when BELL code is received. Lamp is extinguished on next RETURN code. Lamp may also be turned on and off by other control codes.
Connection:	Serial, TTL levels to display unit.

B.4 Communication

B.4

LINE I (host computer connection):	CCITT V.24 Socket conforms to ISO 2110.
LINE II (printer connection):	CCITT V.24 Socket conforms to ISO 2110.
Transmission speeds:	Selectable in set-up mode: 110 to 9600 bps.
Data format:	Serial, asynchronous, with 1 start bit, 7 data bits, 1 parity bit (even parity), and 2 stop bits.

Peripheral device connection:	A printer may be connected to LINE II. Output is enabled and disabled by control codes.
Cable length:	Up to 25 m to modem, current loop coupler, or host computer.

B.5 Physical Data

B.5

Power voltage:	220 V AC ±10%. Optionally 240 V AC ±10%.
Power frequency:	50 HZ ±2 Hz.
Power consumption:	100 W.
Temperature, ambient:	10-35°C.
Humidity, relative:	0-95%, non-condensing.
Altitude, maximum:	3,400 m (10,000 feet).
Standard finish:	Tan and brown.

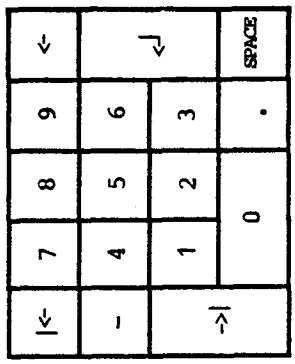
Size and weight:	Display	Keyboard
Height:	490 mm (maximum)	85 mm
Width:	470 mm	440 mm
Depth:	330 mm (not tilted)	250 mm
Weight:	20 kg	3 kg

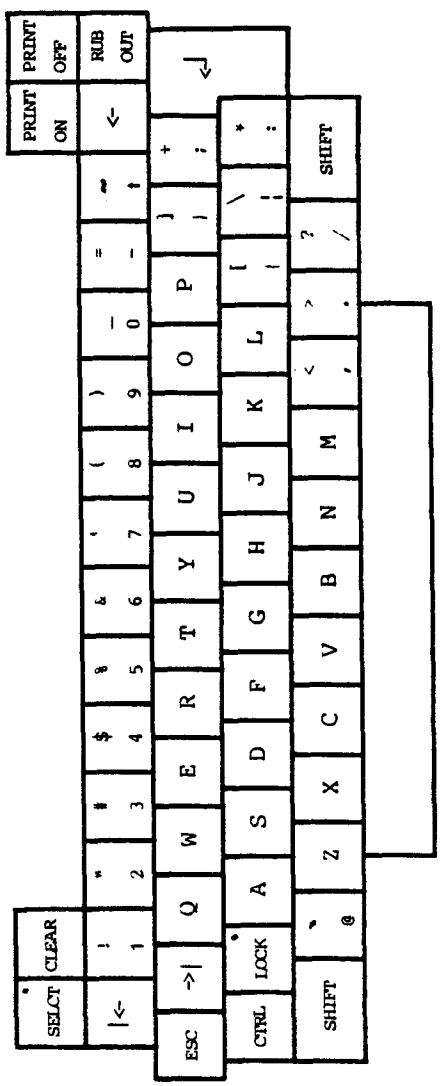
All specifications are subject to change without notice.

C. KEYBOARD LAYOUTS C.

C.1 USASCII C.1

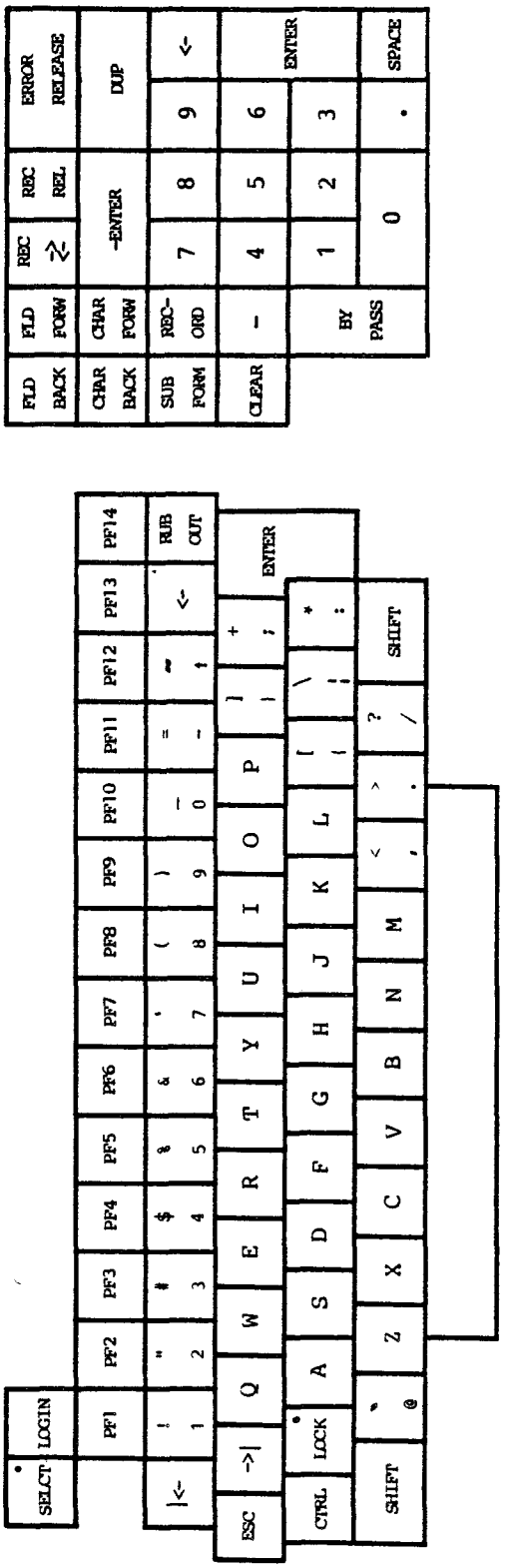
C.1.1 Standard C.1.1





C.1.2 Data-Entry

(USASCII)

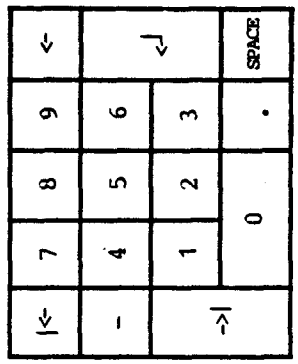


C.2 UKASCII

C.2

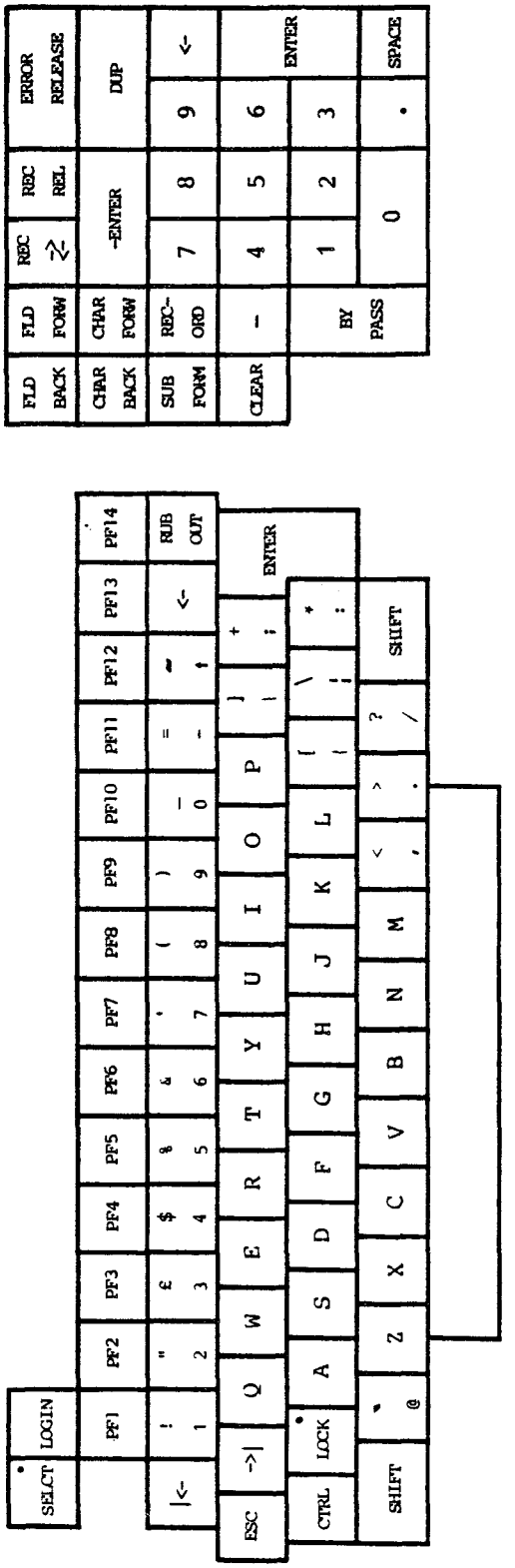
C.2.1 Standard

C.2.1



C.2.2 Data-Entry

(UKASCII)

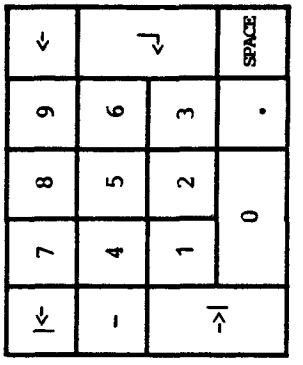


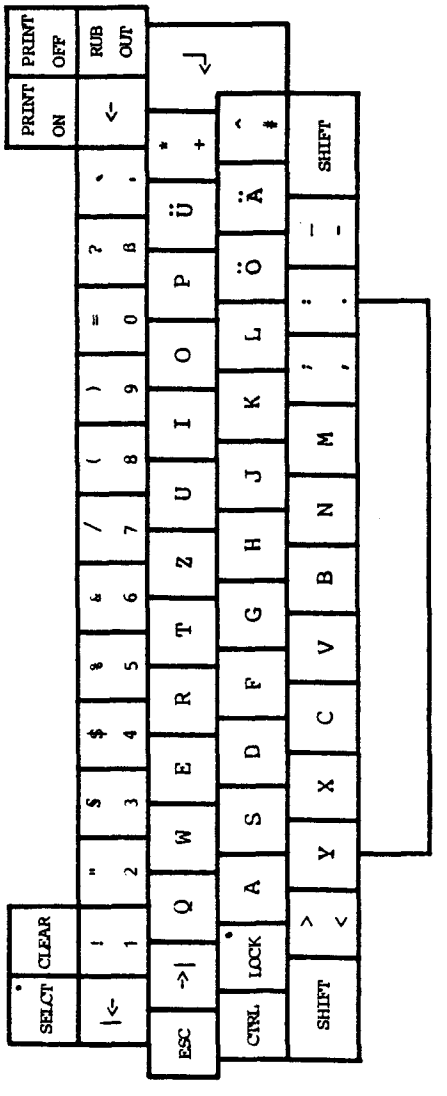
C.3 German Language

C.3

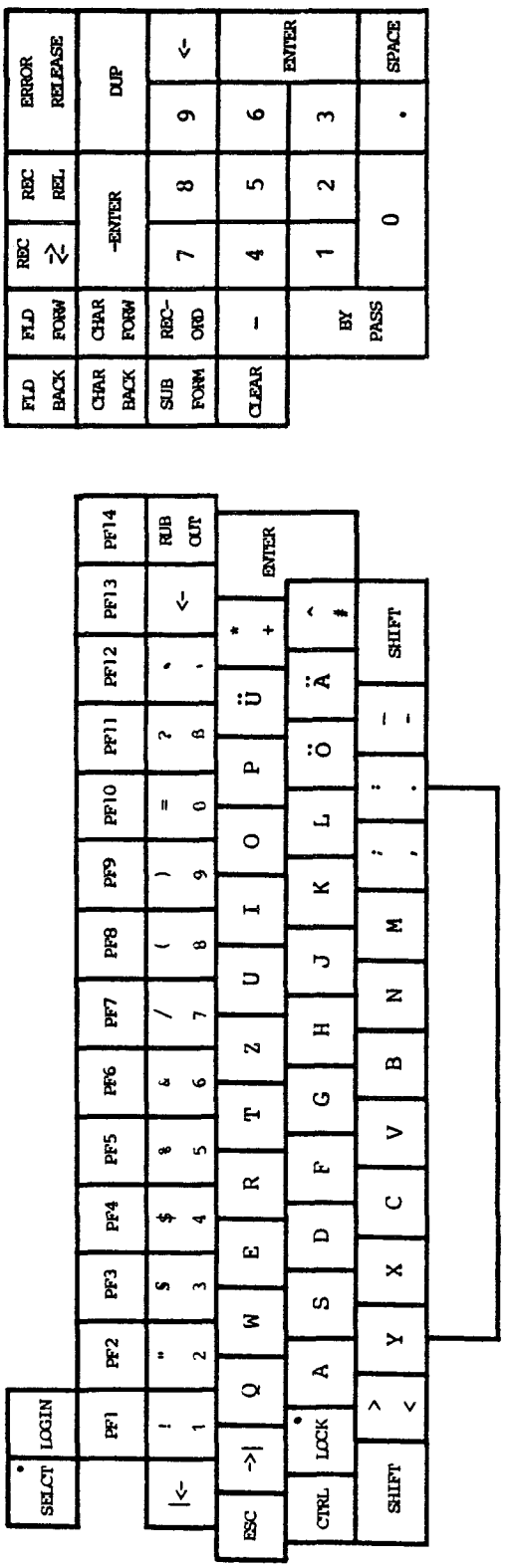
C.3.1 Standard

C.3.1



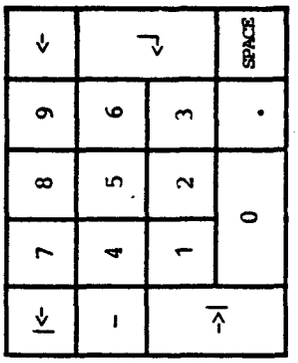


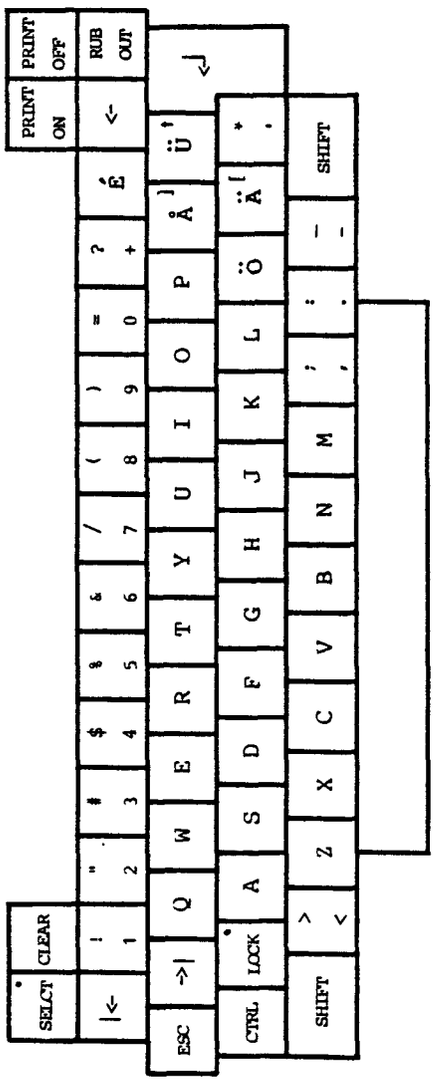
(German Language)



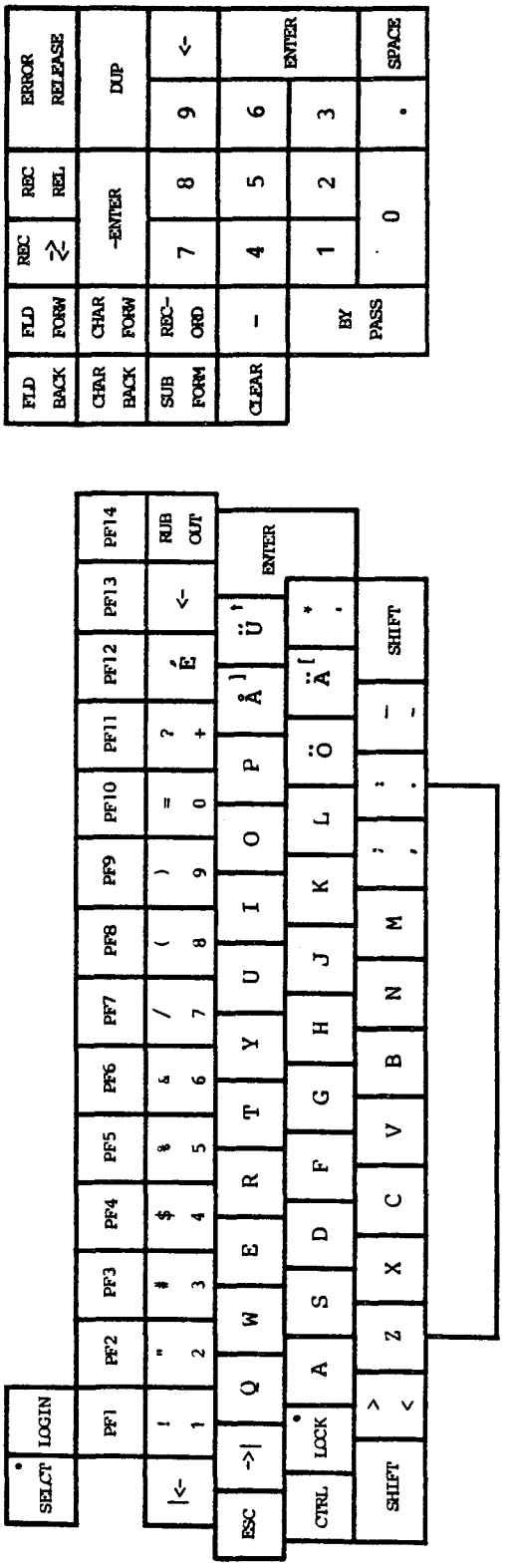
C.4 Swedish Language C.4

C.4.1 Standard C.4.1





(Swedish Language)

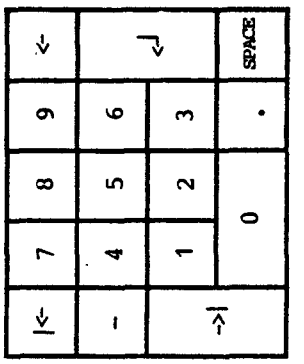


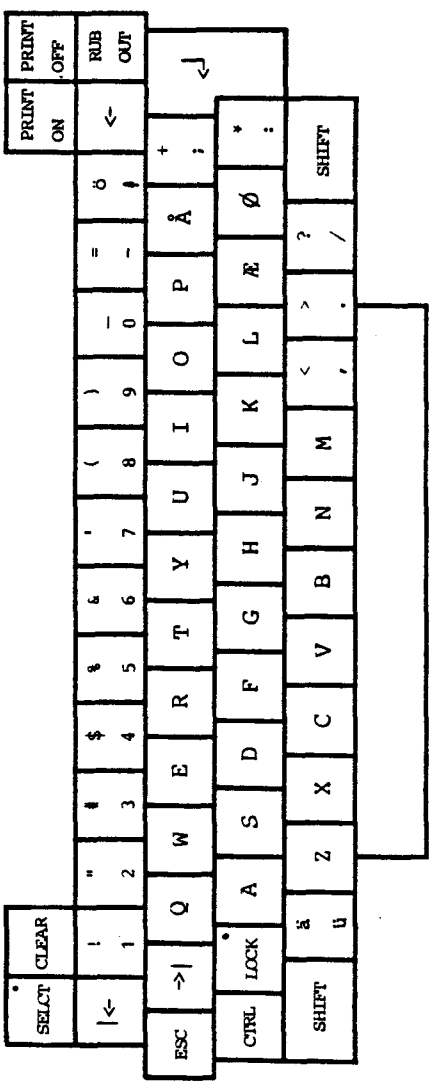
C.5 Danish Language

C.5

C.5.1 Standard

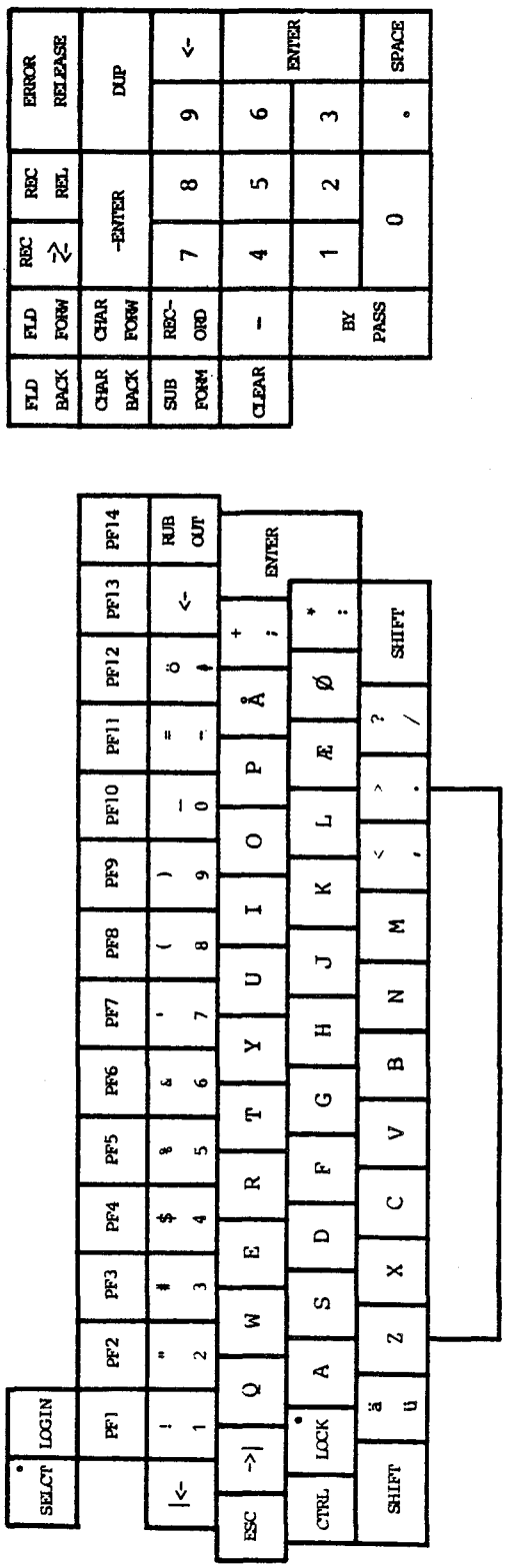
C.5.1





C.5.2 Data-Entry

(Danish Language)



D. INDEX D.

RETURN LETTER

Title: RC851 Display Terminal Reference Manual

RCSL No.: 42-i1696

A/S Regnecentralen af 1979/RC Computer A/S maintains a continual effort to improve the quality and usefulness of its publications. To do this effectively we need user feedback, your critical evaluation of this manual.

Please comment on this manual's completeness, accuracy, organization, usability, and readability:

_____

_____

_____

_____

Do you find errors in this manual? If so, specify by page.

_____

_____

_____

_____

How can this manual be improved?

_____

_____

_____

_____

Other comments?

_____

_____

_____

_____

_____

Name: _____ Title: _____

Company: _____

Address: _____

Date: _____

Thank you

42-i 1288

..... Fold here .....

..... Do not tear - Fold here and staple .....

Affix
postage
here

REGNECENTRALEN
af 1979

Information Department
Lautrupbjerg 1
DK-2750 Ballerup
Denmark