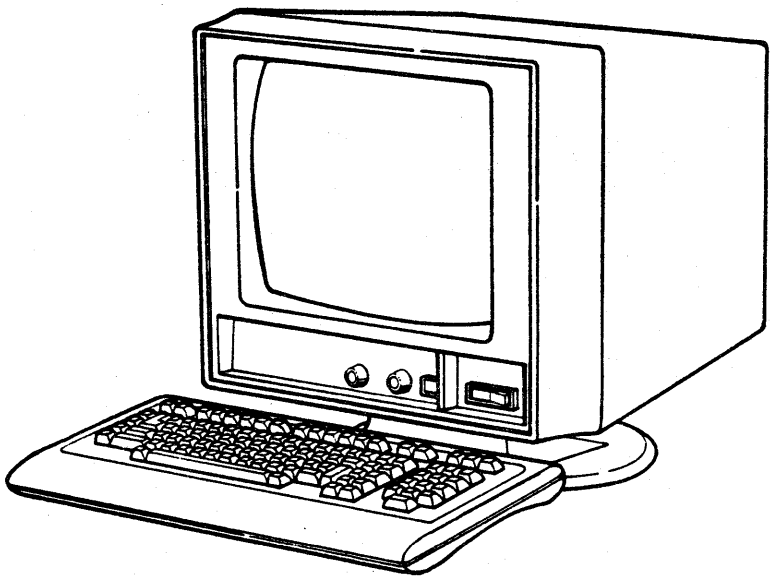
62950102

CONTROL DATA CORPORATION

CDC® 721
ENHANCED DISPLAY TERMINAL



HARDWARE REFERENCE MANUAL

REVISION RECORD	
REVISION	DESCRIPTION
01 (04-29-83)	Preliminary release.
02 (06-15-83)	Includes review comments.
A (08-29-83)	Manual released.
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or use Comment Sheet in the back of this manual.

New features, as well as changes, deletions, and additions to information in this manual are indicated by bars in the margins or by a dot near the page number if the entire page is affected. A bar by the page number indicates pagination rather than content has changed.

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PREFACE

This manual contains hardware reference information for the CDC® 721 Enhanced Display Terminal. This information consists of functional descriptions, parameter and mode selections, as well as a description of operator controls, indicators, and keysets. The 721 Enhanced Display Terminal may be either an:

- Enhanced production model (known as a CC634-B or CC638-B Display Terminal).
- Earlier built model (CC634-A or CC638-A Display Terminal) that has a YR109-A Enhanced Firmware Option installed in it.

This information provides an overview of the terminal and specifically covers its operation in CYBER mode. That mode is for operations with computer systems of the CDC CYBER 120 or 170 series.

Other associated manuals include the:

Title	Publication Number
721 Display Terminal Unpacking/Packing Instructions	62940038
721-21/31 Owner's Manual	62950101
721-301 Enhanced Graphics/Firmware Option	62950016

All manuals may be ordered from:

Control Data Corporation
Literature and Distribution Services
308 North Dale Street
St. Paul, Minnesota 55103

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2. FUNCTIONAL DESCRIPTION

3. OPERATOR CONTROLS AND INDICATORS

4. OPERATION

The CDC® 721-X0 Enhanced Display Terminal (figure 1-1) is a locally or remotely located input/output device capable of supporting several modes of operation. This capability is accomplished through use of a microprocessor and common bus based scheme that supports a large, loadable memory (loadable via the communications line, an attached flexible disk, or operator plug-in memory module). The basic resident terminal mode supports CYBER mode (722-10 TTY compatible advanced mode with enhancements and additional edit features) and a Control Data Shared Network (CDSN) downline load capability. Optional modes require optional hardware and include, Tektronix* 401X, graphics mode, PLATO and CP/M.

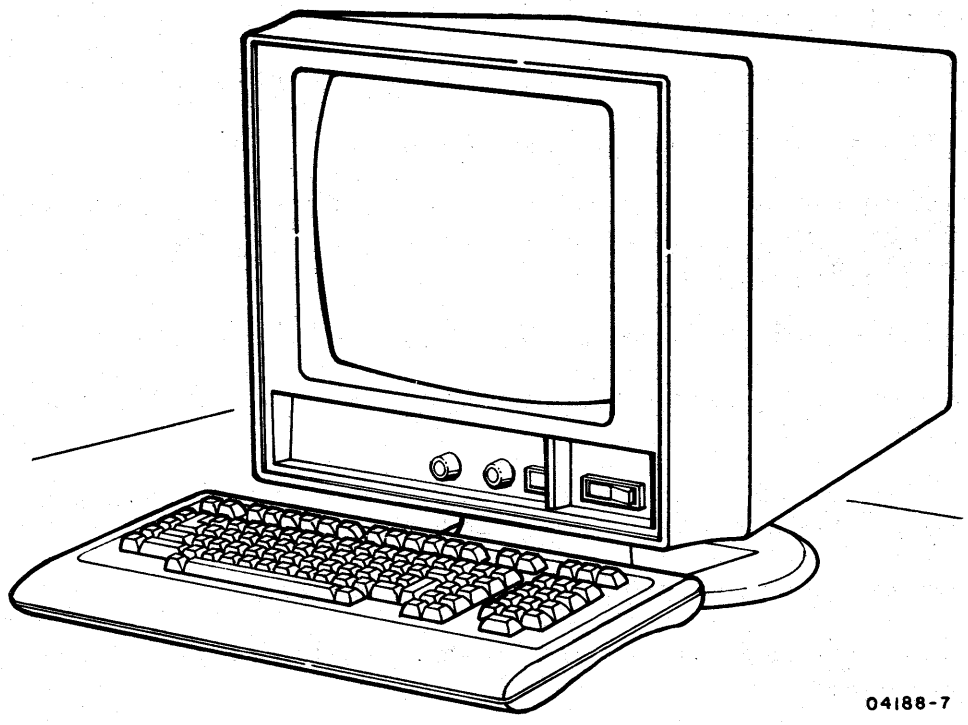

Figure 1-1. 721-X0 Enhanced Display Terminal

*Tektronix is a registered trademark of Tektronix Inc.

TERMINAL FEATURES

The following tabulations highlight the basic and optional features of the terminal.

BASIC TERMINAL FEATURES

The basic terminal features include the following:

- Tiltable display module with a 380 mm (15 in diagonal measurement) cathode-ray tube (CRT) and associated drive electronics
- Symbol generation circuits - 256 symbols in ROM, 64 loadable RAM symbols
- 32K ROM and 64K RAM, 256 x 4K nonvolatile memory (NVM), and 1K character generation RAM
- Nonvolatile memory (NVM) for parameter retention
- Detached alphanumeric keyboard
- Asynchronous RS-232-C/CCITT V.24 interface with selectable transmission speeds up to 19 200 bps (receive and transmit speeds may differ)
- ASCII downline load (CDSN compatible) capability
- 80- or 132-characters per line with 24 or 30 lines of data entry
- Window scroll, character attributes (inverse, dim, blink, blank, underscore, protected data, and validation)
- Memory module capability (16K maximum)
- Parameter selection performed via keyboard (no selection switches)
- Switch selectable 115/220 V ac operation
- Six foreign character sets

OPTIONAL TERMINAL FEATURES

Optional terminal features include:

- Full-vector graphic displays within either a 512- by 480-dot array or a 512- by 512-dot array
- 16- by 16-position touchpanel
- Peripheral options to support:
  - An alphanumeric character printer (dual asynchronous RS-232-C interface required)
  - An asynchronous RS-232-C peripheral device interface with two ports with transmission speeds up to 19 200 bps
  - Parallel peripheral interface to flexible disks and the CL607-A/B graphic printer
  - Rigid disk interface to Finch disk drives
- Internal Modem that transmits and receives data at 1200 bits per second (b/s) in either full- or half-duplex modes (Bell 212A compatible) and that has both auto-dial and auto-answer capabilities. Refer to Appendix D of this manual for more detailed information on the internal 1200/1200 baud modem.
- A YR107-A/B Graphics Memory Module (ROM pack)

TERMINAL CONFIGURATION

The terminal may be configured as a basic terminal as shown in figure 1-2 or as an expanded terminal as shown in figure 1-3. The basic terminal configuration supports CYBER mode operation and CDSN-compatible downline load, while the expanded configuration supports optional modes that allow emulation of several other terminal products.

The minimum configuration is a single PC board with 64K bytes of RAM and 32K bytes of ROM (20K bytes currently in use). The maximum configuration is limited by PC board space and power requirements. The terminal can be configured with a basic terminal control PC board, two large optional PC board modules, and three small optional PC board modules. The large modules (approximately 515 square centimeters) connect to the basic terminal control PC board via ribbon cables. The small modules (approximately 160 square centimeters) plug directly into a backpanel that connects into the basic terminal. Table 1-1 summarizes the available features and options available with the display terminal.

TABLE 1-1. DISPLAY TERMINAL FEATURES AND OPTIONS

FACTORY-INSTALLED FEATURES	DISPLAY TERMINALS			
	CC634-A	CC634-B	CC638-A	CC638-B
64K RAM (main logic board)	X	X	X	X
Dot graphics board with touchpanel			X	X
Enhanced (revision 4) firmware*		X		X
Power-cord interlock (enables internal 1200/1200 b/s modem and dot graphics board to be user installed)		X		X
120-V ac, 60-Hz operation	X	X	X	X

AVAILABLE OPTIONS THAT ARE SERVICE CENTER INSTALLED:

- XA358-A dot graphics board with touchpanel on CC634-A/B terminals.
- XA360-A internal 1200/1200 b/s modem on CC634-A/CC638-A terminals.
- XA368-A dot graphics board on CC634-A terminals.
- XA369-A touchpanel on CC634-A/B terminals with XA368-A dot graphics board installed.
- *YA109-A enhanced (revision 4) firmware (required on CC634-A/CC638-A terminals).

AVAILABLE OPTIONS THAT ARE CUSTOMER INSTALLED:

- XA360-A internal 1200/1200 b/s modem on CC634-B/CC638-B terminals.
- XA368-A dot graphics board on CC634-B terminals.
- YA274-A United Kingdom keycap kit.
- YA274-B Spanish keycap kit.
- YA274-C German keycap kit.
- YA274-D French keycap kit.
- YA274-E Swedish/Finnish keycap kit.
- YA274-F Danish/Norwegian keycap kit.
- YA275-A 220/240-V ac, 50-Hz power conversion kit.
- YR101-A dual asynchronous-interface board.
- YR102-A parallel-interface board.
- YR107-A/B graphics memory module (ROM pack).

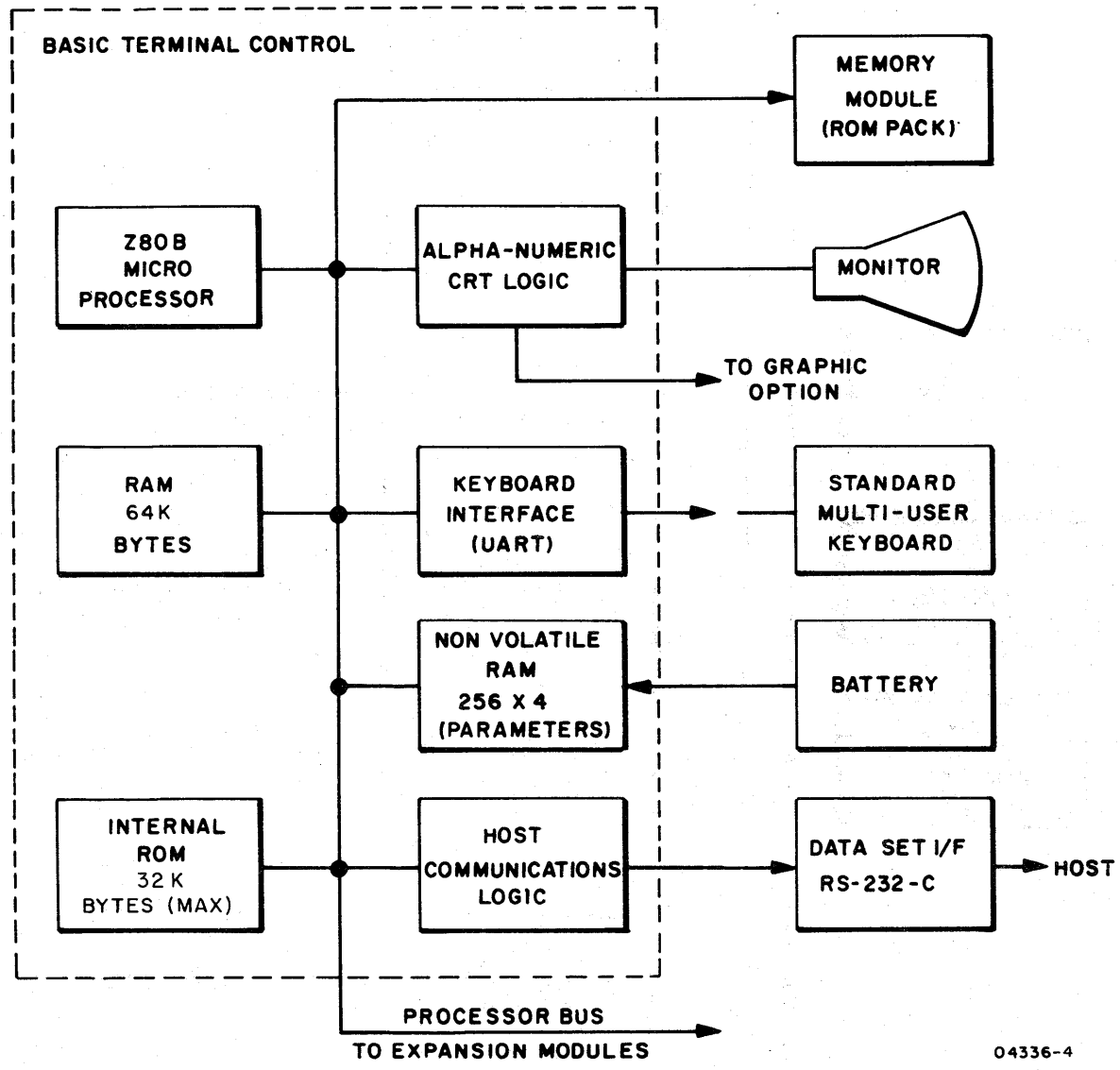

Figure 1-2. Basic Terminal Configuration

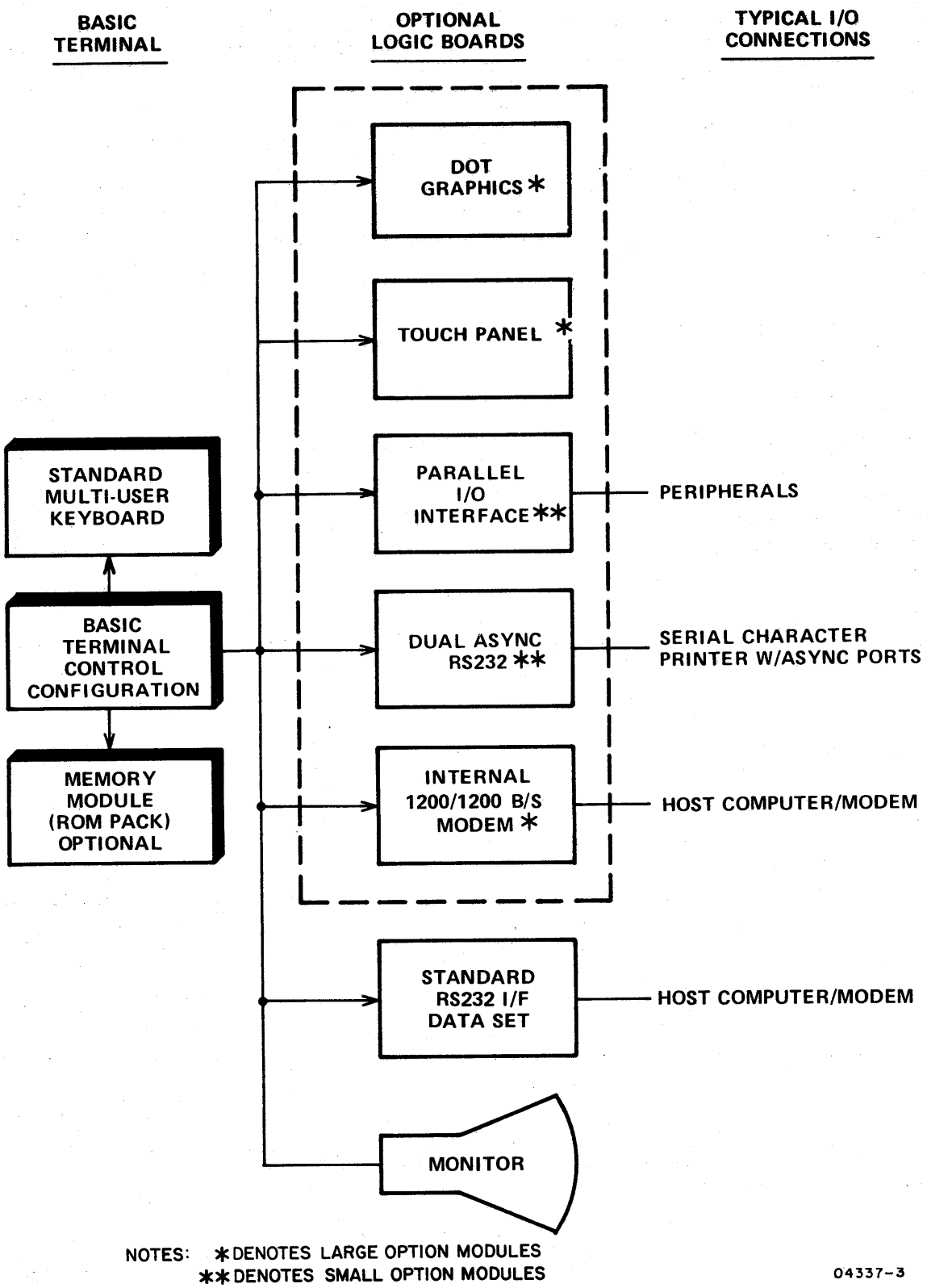

Figure 1-3. Expanded Terminal Configuration

EQUIPMENT SPECIFICATIONS

The following paragraphs describe the physical, electrical, and environmental specifications for the display terminal.

PHYSICAL SPECIFICATIONS

The size and weight of the monitor and control module and detached keyboard module are as follows:

- Monitor and control logic module

  Height: 440 mm (17.3 in) nominal position

  Width: 430 mm (16.9 in) maximum

  Depth: 430 mm (17.0 in) maximum

  Weight: 19.5 kg (43 lb) maximum

  Weight (packaged): 22.2 kg (49 lb) maximum

- Keyboard module

  Height: 51 mm (2.0 in) maximum
  80 mm (3.1 in) maximum (raised position)

  Width: 490 mm (19.3 in) maximum

  Depth: 230 mm (9.0 in) maximum

  Weight: 3.0 kg (8 lb)

  Weight (packaged): 4.5 kg (10 lb) maximum

ELECTRICAL SPECIFICATIONS

The display terminal has the following electrical power requirements:

	Basic Configuration	Full Configuration
o	120V ac, 50/60 Hz, at 1.0 A, nominal;	1.30 A, maximum
o	220V ac, 50/60 Hz, at 0.5 A, nominal;	0.71 A, maximum
o	240V ac, 50/60 Hz, at 0.5 A, nominal;	0.65 A, maximum
o	85 W (290 Btu/hr), heat dissipation configuration without options	

ENVIRONMENTAL SPECIFICATIONS

The display terminal has the following environmental requirements:

- OPERATING:

Temperature range:	10°C(50°F) to 40°C(104°F)
Temperature change:	10°C(18°F)/60 minutes
Relative humidity range:	20 to 80 percent
Humidity change:	10 percent/60 minutes
Altitude:	3000m (9850 ft) maximum

- NONOPERATING:

Temperature range:	-40°C(-40°F) to 60°C(140°F)
Temperature change:	20°C(36°F)/60 minutes
Relative humidity range:	5 to 100 percent
Humidity change:	10 percent/60 minutes

This section provides a brief description of the major functional areas and the optional features that may be configured with the display terminal:

- o CRT Monitor
- o Microprocessor
- o Memory
- o Display Refresh logic
- o Host Interface
- o Keyboard Interface
- o Optional Features

CRT MONITOR

The terminal crt measures 380 mm (15 in) diagonally with an approximate 203 mm (8 in) by 262 mm (10.3 in) viewable area. A green phosphor is used to optimize performance in the interlaced mode of operation. A reduced-glare green faceplate is standard.

MICROPROCESSOR

The terminal uses a type Z80B programmable microprocessor. It is an 8-bit parallel central processor unit (CPU) contained in one large scale integration (LSI) microcircuit chip. The microprocessor controls all operations inside the terminal as well as directing the operation of associated peripheral equipments, such as printers, disk drives, and modems. See figure 2-1 for a block diagram of primary microprocessor functions.

The CPU has six general purpose registers that can be used individually either as 8-bit or 16-bit register-pairs. It also has two sets of accumulator and flag registers. A group of exchange instructions designates each of the sets as main or alternate registers. The alternate set allows the programmer to operate in foreground-background mode or it may be reserved for very fast interrupt response. The microprocessor also contains a stack pointer, program counter, two index registers, a refresh counter, and an interrupt register.

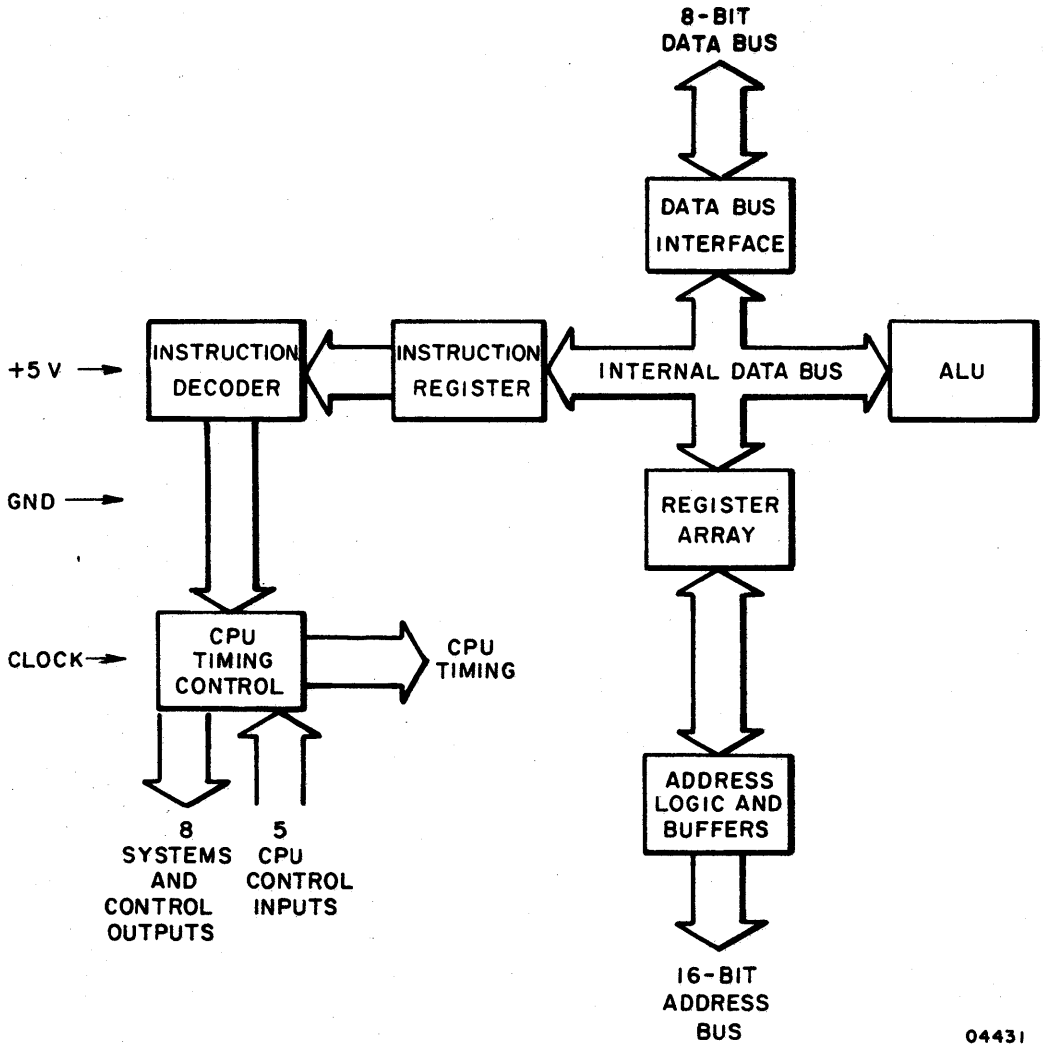

Figure 2-1. Microprocessor CPU Block Diagram

The Z80B instruction set contains the following categories of operations and the type of action performed by each category.

Category	Type of Action
8-Bit loads	Miscellaneous
16-Bit loads	Rotates and shifts
Exchanges	Bit set, reset and test
Memory block moves	Input and output
Memory block searches	Jumps
8-Bit arithmetic and logic	Calls
16-Bit arithmetic	Restarts
General purpose accumulator and flag operations	Returns

FEATURE DESCRIPTION

The resident ROM firmware consists of the following major program segments that interact to perform the overall desired functions.

- Common Entry-Jump Table and Variables
- Resident Diagnostics
- Parameter Selection
- Load Source Selection
- Load File Selection
- ASCII Network Loader
- Flexible Disk Loader
- ROM Pack Loader
- CYBER Mode

The terminal is capable of having a ROM pack or external controlware loaded into it. These external packages can use subroutines that already exist in the resident ROM.

The terminal does not use switches for parameter definition. Instead, it utilizes a nonvolatile memory (NVM) which stores parameters while the machine is turned off or unplugged. The resident ROM contains subroutines that allow qualified personnel to change the stored parameters. An initial value is forced into the NVM from ROM.

MEMORY

The terminal uses a 16-bit address bus that allows for a maximum of 64K bytes of direct memory addressing. However, since the terminal has more than 64K bytes of RAM and ROM, memory mapping is required. Refer to figure B-1 (in Appendix B) to see how the memory is divided into 16K banks. The memory mapping scheme used structures these banks into four blocks forming 64K of addressable memory locations as shown in figure B-2 (in Appendix B). Block 0 starts at address 0000, block 4 starts at address 4000, block 8 starts at address 8000, and block C starts at address C000.

DISPLAY REFRESH LOGIC

A block diagram of the display refresh logic is shown in figure 2-2. The display is refreshed from executable 64K RAM memory via dual-line buffers and a symbol generator. Each line buffer stores one line of displayable characters and character attributes. Line addresses, resident at fixed-byte locations in executable RAM, are read by the refresh hardware and used to define locations in the RAM where the strings of character and attribute codes are stored.

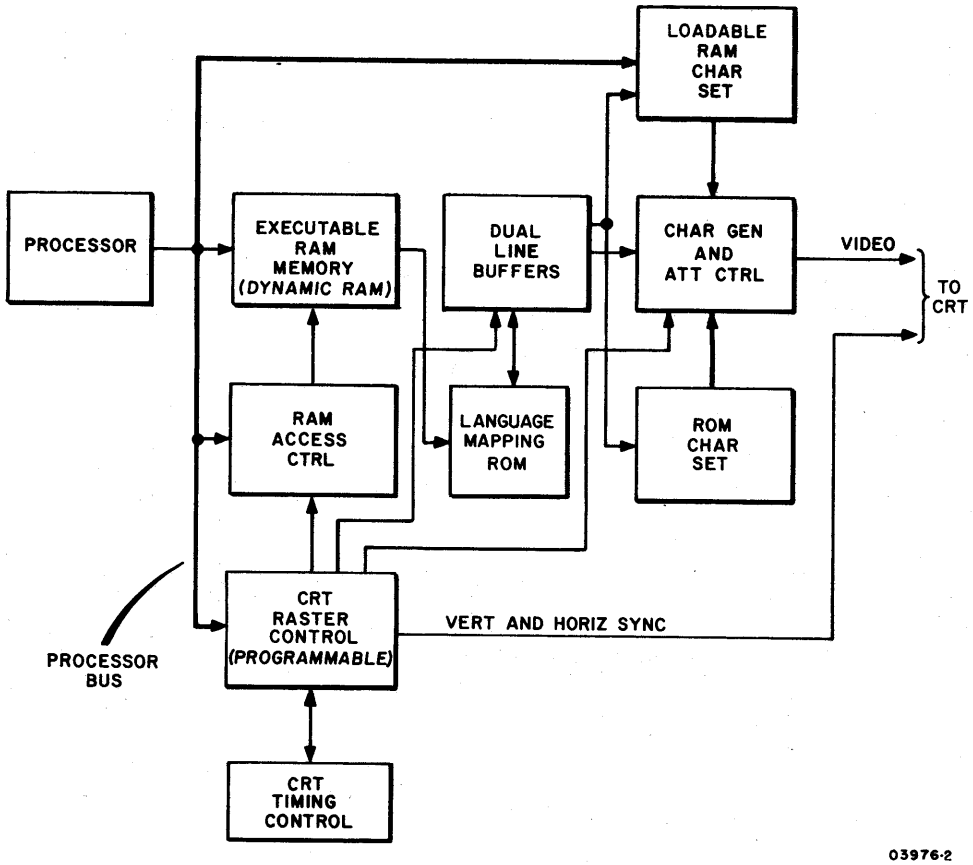

Figure 2-2. Display Refresh Logic - Alphanumeric Mode

The codes received from memory with conversion by foreign character ROM, determine what symbol is to be generated. If the most significant 2 bits are ones, the loadable symbol generator symbols are used. If either of the most significant 2 bits are a zero, the ROM based symbol generator is used.

ROM-Based Generator

The ROM-based generator provides the following symbols:

- 95 ANSI X3.4 Alphanumeric Characters (tables 2-1 through 2-7).
- 32 ANSI X3.4 Control Code Symbols and one special parity error symbol (table 2-8).
- 32 Line Drawing Symbols (table 2-9).
- 32 Foreign Language Symbols (table 2-10).

A ROM symbol-generator IC allows the terminal to accommodate foreign and special character sets. The 32 foreign language symbols accommodate character sets in British, German, French, Spanish, Swedish/Finnish, and Danish/Norwegian.*

Loadable Symbol Generator

The loadable symbol generator uses bit patterns that have been loaded into RAM from an external source. A maximum of 64 symbols can be stored. These symbols are host accessed by character codes 40_{16} thru $7F_{16}$ when preceded by an extended character command code. The symbol generator addressing scheme is shown in figure 2-3.

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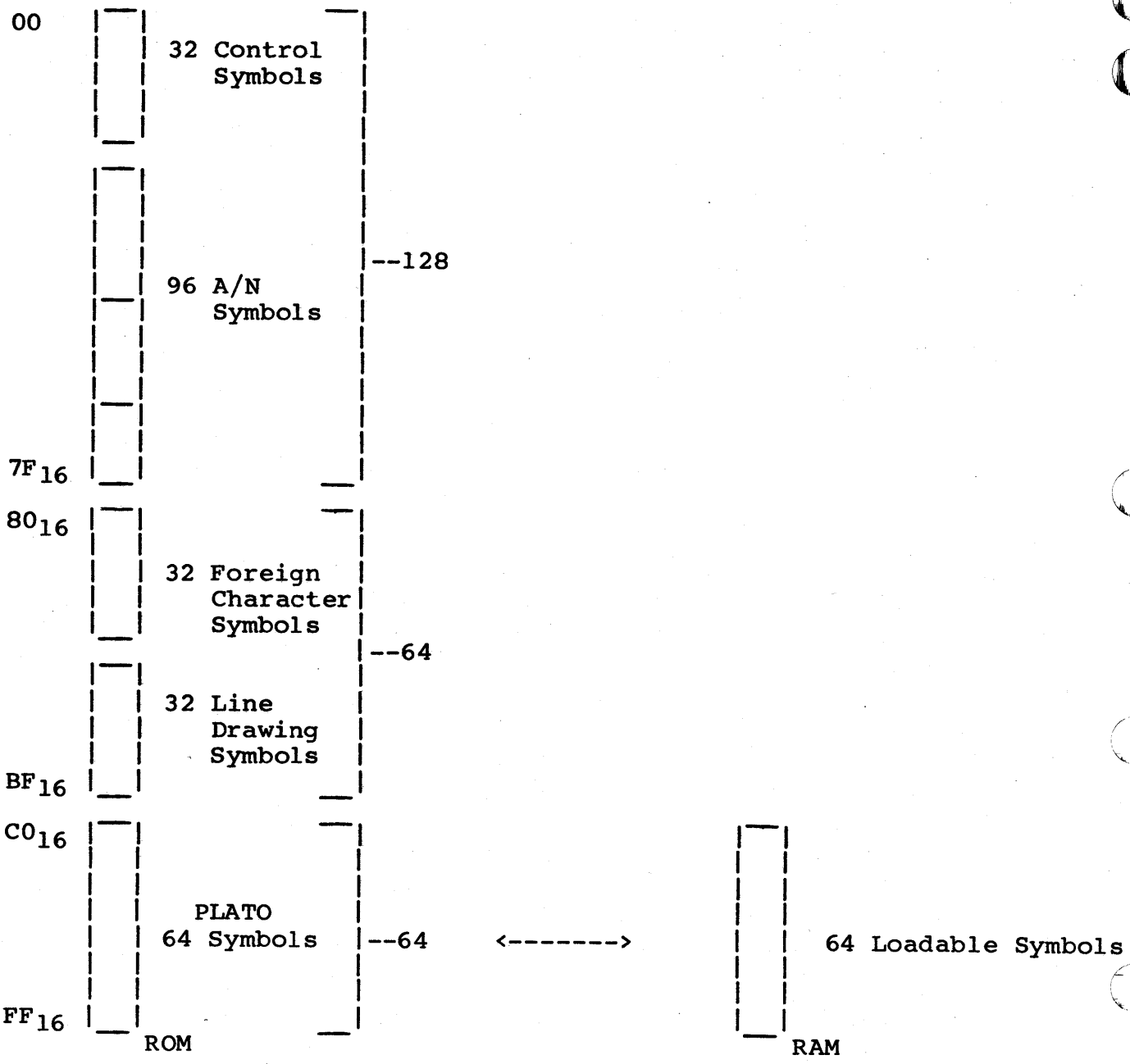
*Requires parameter selection and keycap kit option.



Eight memory bits address 256 symbols in ROM/RAM. An I/O bit controls overlay selection of 64 symbols.

Figure 2-3. Symbol Generator Addressing

TABLE 2-1. AMERICAN ALPHANUMERIC CHARACTER CODES

b7 →				0	0	1	1	1	1
b6 →				1	1	0	0	1	1
b5 →				0	1	0	1	0	1
BITS b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	@	P	`	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	#	3	C	S	c	s
0	1	0	0	4	$	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	[	k	{
1	1	0	0	12(C)	,	<	L	\	l	|
1	1	0	1	13(D)	-	=	M	]	m	}
1	1	1	0	14(E)	.	>	N	^	n	~
1	1	1	1	15(F)	/	?	O	_	o	

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TABLE 2-2. BRITISH ALPHANUMERIC CHARACTER CODES

b7 → / b6 → / b5 → / BITS					0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	@	P	`	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	£	3	C	S	c	s
0	1	0	0	4	$	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	[	k	{
1	1	0	0	12(C)	,	<	L	\	l	¦
1	1	0	1	13(D)	-	=	M	]	m	}
1	1	1	0	14(E)	.	>	N	^	n	¯
1	1	1	1	15(F)	/	?	O	_	o	

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TABLE 2-3. SPANISH ALPHANUMERIC CHARACTER CODES

b7 →				0	0	1	1	1	1
b6 →				1	1	0	0	1	1
b5 →				0	1	0	1	0	1
BITS b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
0	0	0	0	0	SP	0	§	P	`	p
0	0	0	1	1	!	1	A	Q	a	q
0	0	1	0	2	"	2	B	R	b	r
0	0	1	1	3	£	3	C	S	c	s
0	1	0	0	4	$	4	D	T	d	t
0	1	0	1	5	%	5	E	U	e	u
0	1	1	0	6	&	6	F	V	f	v
0	1	1	1	7	'	7	G	W	g	w
1	0	0	0	8	(	8	H	X	h	x
1	0	0	1	9	)	9	I	Y	i	y
1	0	1	0	10(A)	*	:	J	Z	j	z
1	0	1	1	11(B)	+	;	K	¡	k	°
1	1	0	0	12(C)	,	<	L	Ñ	l	ñ
1	1	0	1	13(D)	-	=	M	¿	m	Ç
1	1	1	0	14(E)	.	>	N	^	n	~
1	1	1	1	15(F)	/	?	O	_	o	

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TABLE 2-4. GERMAN ALPHANUMERIC CHARACTER CODES

b7 →				0	0	1	1	1	1
b6 →				1	1	0	0	1	1
b5 →				0	1	0	1	0	1
BITS	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
	0	0	0	0	0	SP	0	§	P	`	p
	0	0	0	1	1	!	1	A	Q	a	q
	0	0	1	0	2	"	2	B	R	b	r
	0	0	1	1	3	#	3	C	S	c	s
	0	1	0	0	4	$	4	D	T	d	t
	0	1	0	1	5	%	5	E	U	e	u
	0	1	1	0	6	&	6	F	V	f	v
	0	1	1	1	7	'	7	G	W	g	w
	1	0	0	0	8	(	8	H	X	h	x
	1	0	0	1	9	)	9	I	Y	i	y
	1	0	1	0	10(A)	*	:	J	Z	j	z
	1	0	1	1	11(B)	+	;	K	Ä	k	ä
	1	1	0	0	12(C)	,	<	L	Ö	l	ö
	1	1	0	1	13(D)	-	=	M	Ü	m	ü
	1	1	1	0	14(E)	.	>	N	^	n	β
	1	1	1	1	15(F)	/	?	O	_	o	

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TABLE 2-5. FRENCH ALPHANUMERIC CHARACTER CODES

b7 →					0	0	1	1	1	1
b6 →					1	1	0	0	1	1
b5 →					0	1	0	1	0	1
BITS	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ↓ ROW	2	3	4	5	6	7
	0	0	0	0	0	SP	0	à	P	`	p
	0	0	0	1	1	!	1	A	Q	a	q
	0	0	1	0	2	"	2	B	R	b	r
	0	0	1	1	3	£	3	C	S	c	s
	0	1	0	0	4	$	4	D	T	d	t
	0	1	0	1	5	%	5	E	U	e	u
	0	1	1	0	6	&	6	F	V	f	v
	0	1	1	1	7	'	7	G	W	g	w
	1	0	0	0	8	(	8	H	X	h	x
	1	0	0	1	9	)	9	I	Y	i	y
	1	0	1	0	10(A)	*	:	J	Z	j	z
	1	0	1	1	11(B)	+	;	K	°	k	é
	1	1	0	0	12(C)	,	<	L	Ç	l	ù
	1	1	0	1	13(D)	-	=	M	§	m	è
	1	1	1	0	14(E)	.	>	N	^	n	¨
	1	1	1	1	15(F)	/	?	O	_	o	

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TABLE 2-6. SWEDISH/FINNISH ALPHANUMERIC CHARACTER CODES

b7 →					0	0	1	1	1	1
b6 →					1	1	0	0	1	1
b5 →					0	1	0	1	0	1
BITS	b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	2	3	4	5	6	7
	0	0	0	0	0	SP	0	É	P	é	p
	0	0	0	1	1	!	1	A	Q	a	q
	0	0	1	0	2	"	2	B	R	b	r
	0	0	1	1	3	#	3	C	S	c	s
	0	1	0	0	4	¤	4	D	T	d	t
	0	1	0	1	5	%	5	E	U	e	u
	0	1	1	0	6	&	6	F	V	f	v
	0	1	1	1	7	'	7	G	W	g	w
	1	0	0	0	8	(	8	H	X	h	x
	1	0	0	1	9	)	9	I	Y	i	y
	1	0	1	0	10(A)	*	:	J	Z	j	z
	1	0	1	1	11(B)	+	;	K	Ä	k	ä
	1	1	0	0	12(C)	,	<	L	Ö	l	ö
	1	1	0	1	13(D)	-	=	M	Å	m	å
	1	1	1	0	14(E)	.	>	N	Ü	n	ü
	1	1	1	1	15(F)	/	?	O	_	o	

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TABLE 2-7. DANISH/NORWEGIAN ALPHANUMERIC CHARACTER CODES

b7 b6 b5 / BITS b4 b3 b2 b1	COLUMN / ROW	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
		2	3	4	5	6	7
0 0 0 0	0	SP	0	@	P	`	p
0 0 0 1	1	!	1	A	Q	a	q
0 0 1 0	2	"	2	B	R	b	r
0 0 1 1	3	#	3	C	S	c	s
0 1 0 0	4	$	4	D	T	d	t
0 1 0 1	5	%	5	E	U	e	u
0 1 1 0	6	&	6	F	V	f	v
0 1 1 1	7	'	7	G	W	g	w
1 0 0 0	8	(	8	H	X	h	x
1 0 0 1	9	)	9	I	Y	i	y
1 0 1 0	10(A)	*	:	J	Z	j	z
1 0 1 1	11(B)	+	;	K	Æ	k	æ
1 1 0 0	12(C)	,	<	L	Ø	l	ø
1 1 0 1	13(D)	-	=	M	Å	m	å
1 1 1 0	14(E)	.	>	N	^	n	~
1 1 1 1	15(F)	/	?	O	_	o	

02015-10

TABLE 2-8. CONTROL CHARACTER CODES

b7 →					0	0	1
b6 →					0	0	1
b5 →					0	1	1
BITS b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	0	1	7
0	0	0	0	0	NUL	DLE	
0	0	0	1	1	SOH	DC1	
0	0	1	0	2	STX	DC2	
0	0	1	1	3	ETX	DC3	
0	1	0	0	4	EOT	DC4	
0	1	0	1	5	ENQ	NAK	
0	1	1	0	6	ACK	SYN	
0	1	1	1	7	BEL	ETB	
1	0	0	0	8	BS	CAN	
1	0	0	1	9	HT	EM	
1	0	1	0	10 (A)	LF	SUB	
1	0	1	1	11 (B)	VT	ESC	
1	1	0	0	12 (C)	FF	FS	
1	1	0	1	13 (D)	CR	GS	
1	1	1	0	14 (E)	SO	RS	
1	1	1	1	15 (F)	SI	US	DEL(1)

02016

(1) This character code is used to denote a parity error.

TABLE 2-9. LINE DRAWING SYMBOL CODES

b7 → / b6 → / b5 →						0	0
						1	1
BITS						0	1
b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓		2	3
0	0	0	0	0			
0	0	0	1	1			
0	0	1	0	2			
0	0	1	1	3			
0	1	0	0	4			
0	1	0	1	5			
0	1	1	0	6			
0	1	1	1	7			
1	0	0	0	8			
1	0	0	1	9			
1	0	1	0	10 (A)			
1	0	1	1	11 (B)			
1	1	0	0	12 (C)			
1	1	0	1	13 (D)			
1	1	1	0	14 (E)			
1	1	1	1	15 (F)			

02016-2

TABLE 2-10. FOREIGN CHARACTER CODES

b7 →					0	0
b6 →					0	0
b5 →					0	1
BITS b4 ↓	b3 ↓	b2 ↓	b1 ↓	COLUMN → / ROW ↓	0	1
0	0	0	0	0	£	¤
0	0	0	1	1	à	É
0	0	1	0	2	è	Å
0	0	1	1	3	ù	å
0	1	0	0	4	é	é
0	1	0	1	5	ç	|
0	1	1	0	6	°	—
0	1	1	1	7	§	
1	0	0	0	8	Ä	O
1	0	0	1	9	Ö	Æ
1	0	1	0	10 (A)	Ü	Ø
1	0	1	1	11 (B)	ä	æ
1	1	0	0	12 (C)	ö	ø
1	1	0	1	13 (D)	ü	
1	1	1	0	14 (E)	β	Ñ
1	1	1	1	15 (F)	··	ñ

020167

TABLE 2-11. PLATO SYMBOL CODES

B7 B6 B5 / B4 B3 B2 B1	ROW \ COLUMN	1 Ø Ø	1 Ø 1	1 1 0	1 1 1
		4	5	6	7
Ø Ø Ø Ø	0		α	⊆	\
Ø Ø Ø 1	1	/	β	··	\
Ø Ø 1 Ø	2	≡	δ	□	/
Ø Ø 1 1	3	~	λ	○	/
Ø 1 Ø Ø	4	⇦	μ	◆	–
Ø 1 Ø 1	5	≠	π	×	–
Ø 1 1 Ø	6	↑	ρ	′	|
Ø 1 1 1	7	→	σ	′	|
1 Ø Ø Ø	8	↓	ω	˅	▒
1 Ø Ø 1	9	←	≤	↕	▒
1 Ø 1 Ø	10 (A)	×	≥	|	=
1 Ø 1 1	11 (B)	Σ	θ		=
1 1 Ø Ø	12 (C)	Δ	⋖		◣
1 1 Ø 1	13 (D)	∪	°		◣
1 1 1 Ø	14 (E)	∩	⋗		◢
1 1 1 1	15 (F)	÷	≫		◢

03415-3

CHARACTER ATTRIBUTES

A character attribute code (background) is loaded into the line buffer for every character display code (foreground). Of the eight bits available, bits zero through four are used by the hardware and bits five through seven are used by the controlware. These are:

Bit No.	Feature	Used by
0	Blank	Hardware
1	Underscore	Hardware
2	Inverse	Hardware
3	Blink	Hardware
4	Dim	Hardware
5	Modified	Controlware
6	Validate	Controlware
7	Protected	Controlware

DISPLAY TIMING

A crystal controlled oscillator provides the basic CRT timing. This method of timing, in conjunction with a programmable CRT controller IC allows flexibility in display modes of operation; that is, interlaced, 80- or 132-characters per row. A programmable bit allows this timing to be driven by an external source.

SYMBOL GENERATION

Two methods of symbol generation are provided. In the first method, used for 80-column display format, the characters are formed via a 8- by 16-dot symbol generator. The dot array for all characters normally occupies a 7 by 12 subset within the generator. In the second method, used for 132-column display format, the characters are formed on the screen in a 5- by 16-dot space with half-dot step positioning. The same character generator bit pattern is used for both methods.

CURSOR

The cursor indicates the current entry position. This position is represented on the screen in one of the following manners:

- Constant underline
- Blinking underline
- Solid block
- Blinking solid block

The type of cursor is determined by two operator selectable parameter bits.

HOST INTERFACE

There are two ways to communicate to a host. One way is via the 1200/1200 b/s internal modem and the other is through the interface conforming to RS-232-C/CCITT V.24 (data set interface). In asynchronous RS-232-C operation, a different send and receive data rate may be provided. The data rate and other communication parameters are entered via the keyboard. The interface selection is operator program selectable.

The RS-232-C/CCITT V.24 interface is described in Appendix C.

KEYBOARD INTERFACE

A serial keyboard interface is provided with a single, standard-length cable to allow 1 metre (39.4 in) keyboard to monitor separation.

OPTIONAL FEATURES

The following paragraphs describe the functions of the optional features that may be configured with the system:

TOUCHPANEL OPTION

The touchpanel option is part of the graphics display option. The touchpanel array size is 16 by 16 providing a 12.7 mm square grid on the monitor. Each square grid covers 4 characters by 2 lines in 80 character/line mode. Control logic for the touchpanel is located on the graphics option module.

In modes supporting touchpanel input, pressure applied to the touchpanel surface interrupts an X/Y scanning mechanism. When a touch is detected, the terminal captures the intersecting X/Y coordinates for processing. In CYBER mode, the cursor moves to the area touched.

GRAPHICS DISPLAY OPTION

The standard graphics display capability allows the terminal to display a 512- by 480- full-vector dot array on the monitor. The refresh memory is contained in a separate independent 32K bytes of dynamic RAM. This memory is mapped into processor memory space by the display driver when required. All bit patterns are written under normal processor-to-memory, operations.

A graphics mode selection allows full IST compatibility to display a 512- by 512- full-vector dot array. Both capabilities are provided on the same basic graphics module (program selectable). Refer to Control Data Publication No. 62950116 for additional information pertaining to the enhanced graphics module.

PARALLEL CHANNEL OPTION

The optional parallel channel interface control logic is contained on a small customer-installable module. This interface supports a graphics printer capable of printing 115 lines per minute. Graphics operation is described in Control Data publications No. 62950116. The parallel channel is also used by the flexible disk.

MEMORY MODULE (ROM PACK) OPTION

The ROM pack plugs into the terminal via an external slot accessible on the back of the display cabinet. Each ROM pack provides a maximum of 16K bytes of memory. Firmware in the basic terminal allows the ROM pack code to supersede resident mode and parameter selection. The ROM pack is packaged in a hand-sized module that has its connector contacts protected when not inserted in the terminal.

DUAL ASYNCHRONOUS INTERFACE OPTION

The optional dual (bidirectional) asynchronous interface is provided on a small customer-installable module and can connect to two RS-232-C-compatible devices. The dual interface supports the same data rate for both send and receive data on each port. Data rate and other communication parameters can be entered on the keyboard. The interface supports local devices with cable lengths less than 15 metres (50 ft).

FOREIGN KEYCAP OPTIONS

Foreign keycap kits are available for the following languages:

- o German
- o French
- o British
- o Spanish
- o Swedish/Finnish
- o Danish/Norwegian

A language selection in the terminal installation parameters (described in section 4) allows displayed characters to be changed to match the installed keycap kit.

INTERNAL 1200/1200 BAUD MODEM

The internal 1200/1200 baud modem is an option that mounts in the terminal in large option-board location I/F-4. This option enables the terminal to transmit and receive information over standard telephone lines at 1200 bit-per-second rates. The modem is Bell 212-A compatible and conforms to most industry, national, and international standards for data communications equipment. It incorporates automatic dialing and automatic answering capabilities so that unattended operation of the terminal during communications interchanges with a host computer is possible (with proper application software). Appendix D of this manual contains a more detailed description of the internal 1200/1200 baud modem and its special features.

This section describes the operator-accessible controls and indicators of the display terminal including the various keyboard configurations. Refer to section 4 for information on parameter selection and terminal operation.

CABINET-MOUNTED CONTROLS AND INDICATORS

All of the following items are mounted on the terminal cabinet (figure 3-1).

- POWER 0/1 (off/on) Switch - Allows the operator to control primary power application to the terminal. This switch is located at the front of the terminal.
- CB1 Circuit Breaker (BB1) - Provides line circuit over-current protection for the terminal. The switch is located at the rear of the terminal and can be reset when the over-current fault condition is cleared.
- TEST Switch - This slide switch allows maintenance loopback of the resident host interface (RS232C) and keyboard I/F for fault isolation capability. It is in the TEST (looped) position when the actuator is pulled out. This switch is located at the rear of the terminal
- RESET Switch - Allows operator to reset the terminal to a normal restart condition (provides a clear function to the terminal). This switch is located on the front of the terminal.
- BRIGHTNESS (Intensity) Control - Allows the operator to adjust the video intensity to the ambient lighting conditions. This control is located on the front of the terminal.
- CONTRAST Control - Allows the operator to adjust the intensity variation between the normal characters and background. This control is located at the front of the terminal.
- LINE VOLTAGE Switch - Allows for selection of the appropriate line voltage range (120/ 120/220 V ac) for terminal operation. This switch is located at the rear of the terminal. CAUTION: This switch must be set to equal line voltage.

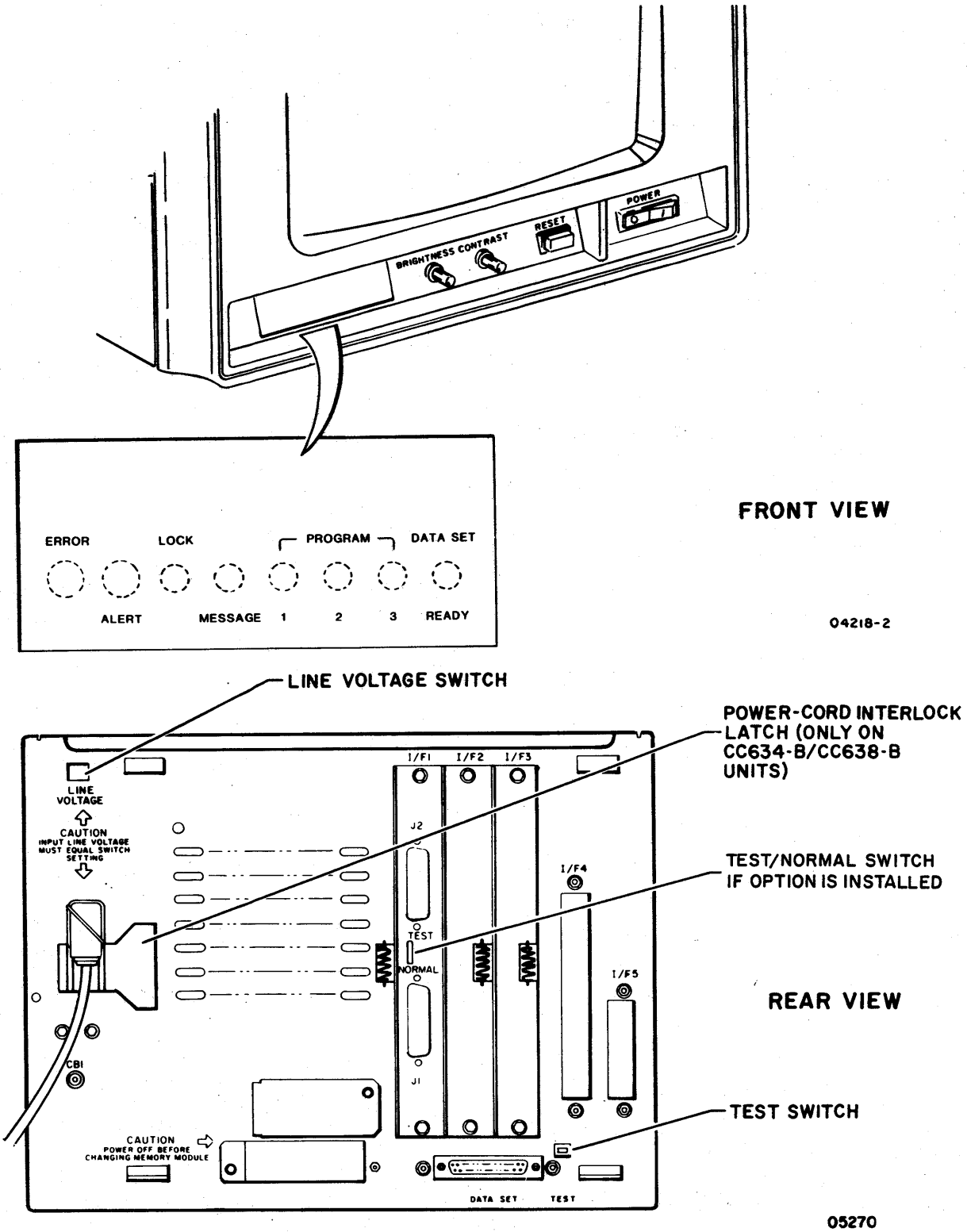


Figure 3-1. Location of Controls and Indicators

- DATA SET READY Indicator - The DATA SET READY indicator is located at the front of the terminal and is controlled by a programmable bit. It illuminates when the Data Set Ready signal at the modem (host) interface is present.

- LOCK (Keyboard Locked) Indicator - The LOCK indicator is located at the front of the terminal and illuminates during a page print operation. The keyboard is also locked and the LOCK indicator is lit if the terminal is unable to transmit data due to loss of modem control signals such as CTS or DATA SET READY while the terminal is online and ready to send, or if the terminal is disabled by host command. The keyboard is also locked out during block mode communication with the host.

- MESSAGE (Message Waiting) Indicator - The MESSAGE indicator is located on the front of the terminal and operates under program control.

- ALERT Indicator - The Alert indicator is located at the front of the terminal and can be used as an alternate visible alert when the audible alarm is disabled or cannot be heard. It is controlled by a programmable bit.

- ERROR Indicator - The Error indicator is located at the front of the terminal and is controlled by a programmable bit. It illuminates when a terminal subsystem or mode dependent error condition is detected.

- PROGRAM 1/PROGRAM 2/PROGRAM 3 (Programmable) Indicators - These indicators are located at the front of the terminal and operate under programmable control. They are illuminated when certain conditions are present as defined by the program.

- Audible Alarm - This audible alarm provides a two-level (loud/soft intensity) audible alarm signal. Operation is under firmware control and is also operator parameter bit-controlled. The following conditions cause an audible alarm to occur:

  After power on or RESET has run test 1

  - Improper key depressions during MODE selection.

  - Host code sequence

  - Entry of certain key while the cursor is in a protected position and auto tabbing is disabled

  - Entry on keyboard while the keyboard is locked

  - Entry of the cursor by the keyboard into the 8th position from end of line or into the last line caused by keyboard entry and margin alert enabled.

KEYBOARD CONFIGURATIONS

Figure 3-2 shows the standard keyboard. Figures 3-3 through 3-8 show the keyboard with foreign keycap kits installed. The symbols on the keys support standard alphanumeric requirements and mode dependent special functions. The keyboard function keys can be labeled with application-unique legends through use of special overlay templates.

All keys - including special functions such as Shift and Control - are under firmware control. If a foreign keycap kit is installed, the only change necessary is to specify the language in the terminal installation parameters. The foreign character sets supported are:

- o German
- o French
- o British
- o Spanish
- o Swedish/Finnish
- o Danish/Norwegian

Each keycap option consists of a user-installed keycap kit. The corresponding characters are displayed by changing the factory-set language in the terminal installation parameters. For changing terminal installation parameters, refer to appendix A of the CDC 721 Display Terminal Operator's Guide/Installation Instructions Manual (publication number is listed in preface).

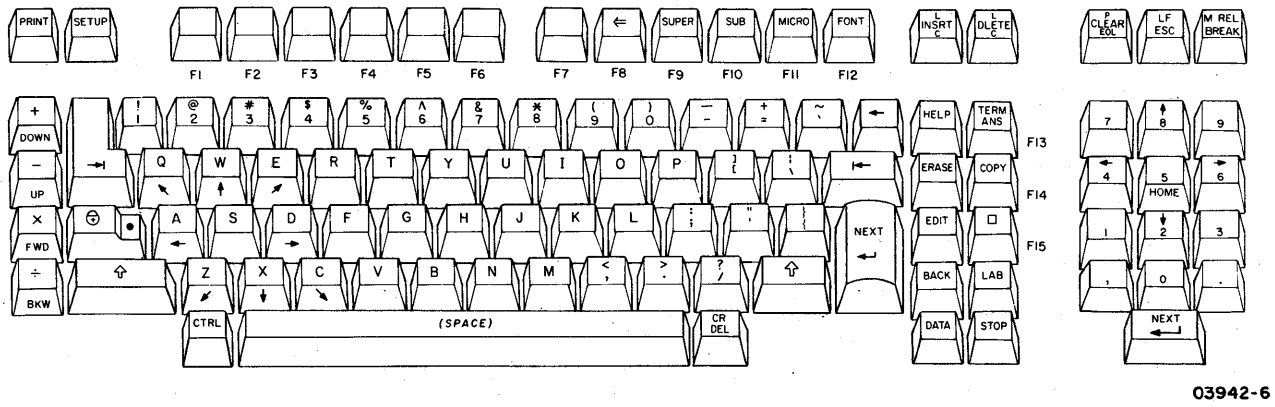
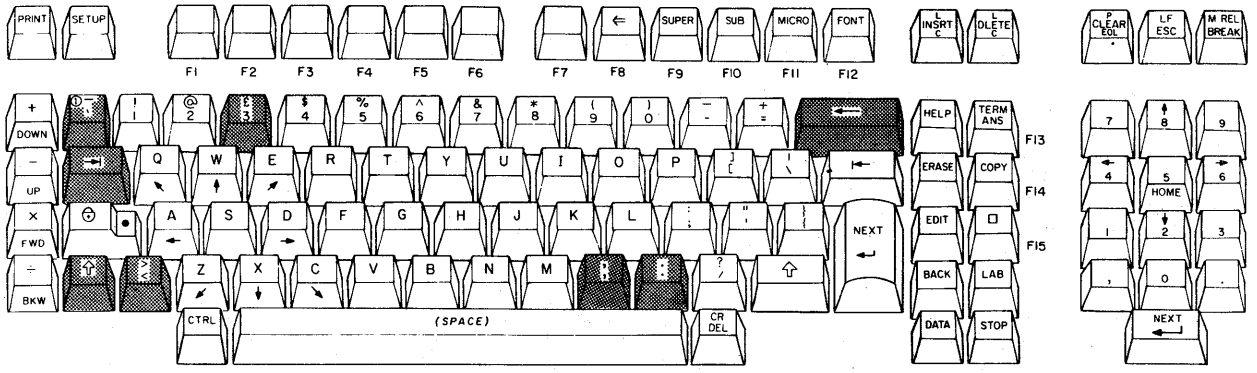


Figure 3-2. Keyboard with Standard English Keycaps

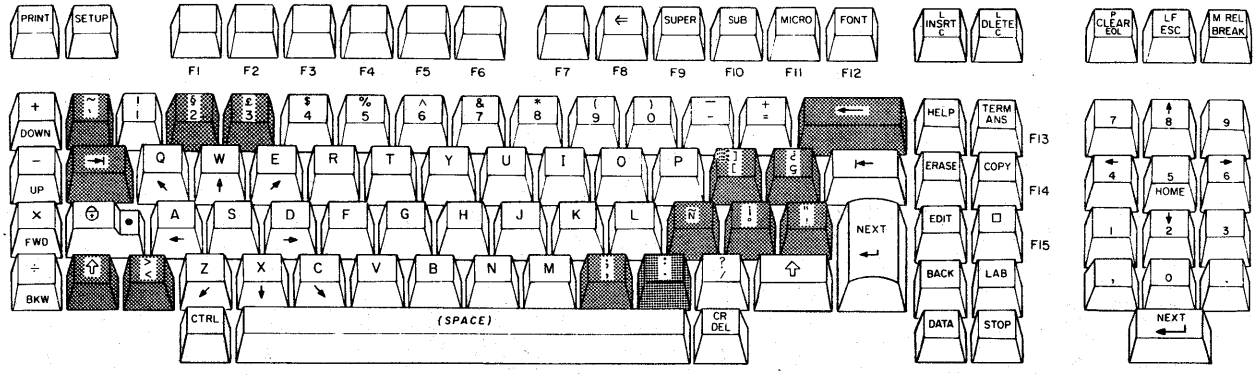


03942-19

(1) UPPER - OVER BAR
LOWER - GRAVE ACCENT

NOTES:
OPTIONAL KEYCAPS ARE SHADED
FOR ILLUSTRATING PURPOSES

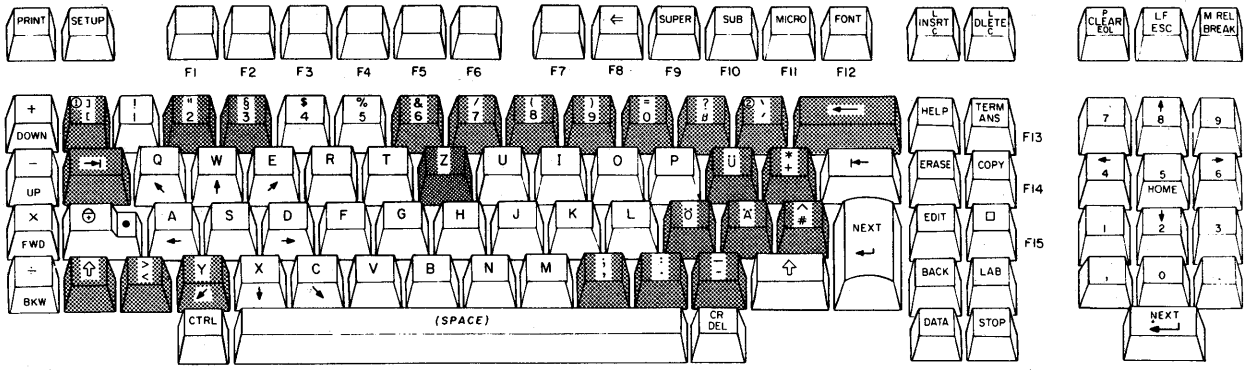
Figure 3-3. Keyboard with British Keycap Option



NOTES:
OPTIONAL KEYCAPS ARE SHADED FOR
ILLUSTRATING PURPOSES

03942-30

Figure 3-4. Keyboard with Spanish Keycap Option



NOTES:

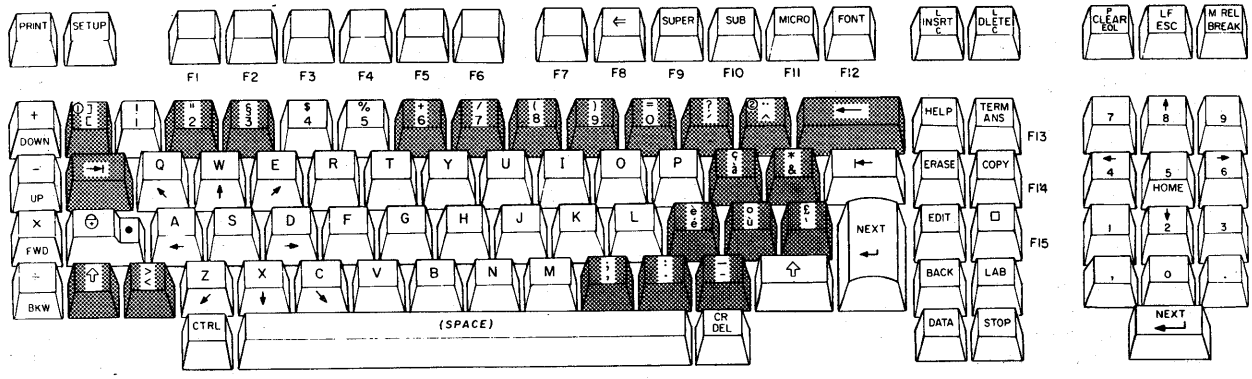
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

(1) PROVIDED FOR PLATO USAGE

(2) UPPER - GRAVE ACCENT
LOWER - APOSTROPHY, ACUTE ACCENT

03942-27

Figure 3-5. Keyboard with German Keycap Option



NOTES:

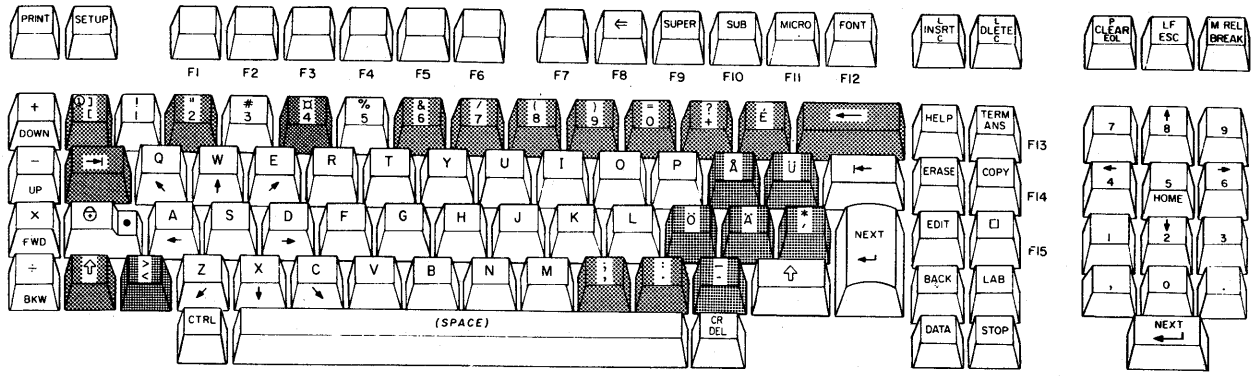
OPTIONAL KEYCAPS ARE SHADED FOR ILLUSTRATING PURPOSES

03942-18

(1) PROVIDED FOR PLATO USAGE

(2) UPPER - UMLAUT

Figure 3-6. Keyboard with French Keycap Option

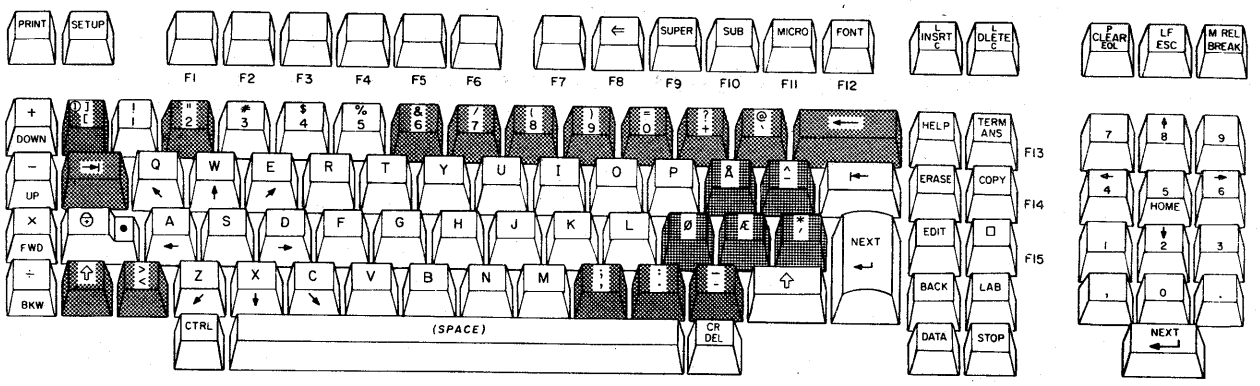


NOTES:

OPTIONAL KEYCAPS ARE SHADED
FOR ILLUSTRATING PURPOSES

03942-28

Figure 3-7. Keyboard with Swedish/Finnish Keycap Option



NOTES:

OPTIONAL KEYCAPS ARE SHADED
FOR ILLUSTRATING PURPOSES

03942-29

Figure 3-8. Keyboard with Danish/Norwegian Keycap Option

The keyboard provides for operator entry of desired symbols/commands. Figure 3-9 shows the keyboard keystation assignments. Each keystation, when pressed, sends an 8-bit serial code and parity to the terminal. A similar code is sent to the terminal when each keystation is released. This allows the terminal program to monitor the exact state of the keyboard and assign/define the resultant activity as desired. Refer to table 3-1 for keystation coding.

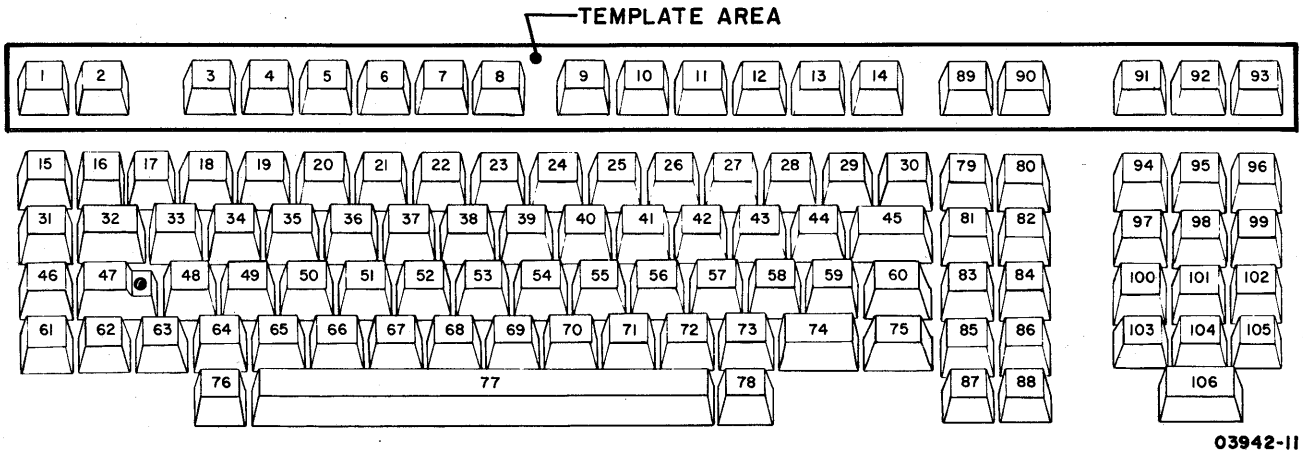


Figure 3-9 Keyboard Keystation Assignments

TABLE 3-1. KEYBOARD KEYSTATION CODING (HEXIDECIMAL)

KEY STATION NUMBER	OUTPUT CODE	
	DOWN	UP
1	10	90
2	18	98
3	20	A0
4	28	A8
5	30	B0
6	38	B8
7	40	C0
8	48	C8
9	50	D0
10	58	D8
11	60	E0
12	68	E8
13	70	F0
14	78	F8
15	11	91
16	19	99
17	21	A1
18	29	A9
19	31	B1
20	39	B9
21	41	C1
22	49	C9
23	51	D1
24	59	D9
25	61	E1
26	69	E9
27	71	F1
28	79	F9
29	7E	FE
30	76	F6
31	13	93
32	1B	9B
33	23	A3
34	2B	AB
35	33	B3
36	3B	BB
37	43	C3
38	4B	CB
39	53	D3
40	5B	DB
41	63	E3
42	6B	EB
43	73	F3
44	7B	FB
45	7F	FF

TABLE 3-1. KEYBOARD KEYSTATION CODING (HEX) (CONTD)

KEY STATION NUMBER	OUTPUT CODE	
	DOWN	UP
46	12	92
47	1A	9A
48	22	A2
49	2A	AA
50	32	B2
51	3A	BA
52	42	C2
53	4A	CA
54	52	D2
55	5A	DA
56	62	E2
57	6A	EA
58	72	F2
59	7A	FA
60	67	E7
61	14	94
62	1C	9C
63	24	A4
64	2C	AC
65	34	B4
66	3C	BC
67	44	C4
68	4C	CC
69	54	D4
70	5C	DC
71	64	E4
72	6C	EC
73	74	F4
74	7C	FC
75	66	E6
76	25	A5
77	2D	AD
78	35	B5
79	6E	EE
80	36	B6
81	77	F7
82	6F	EF
83	5F	DF
84	55	D5
85	5D	DD
86	56	D6
87	45	C5
88	4D	CD
89	7D	FD
90	75	F5

TABLE 3-1. KEYBOARD KEYSTATION CODING (HEX) (CONTD)

KEY STATION NUMBER	OUTPUT CODE	
	DOWN	UP
91	6D	ED
92	37	B7
93	1D	9D
94	16	96
95	1E	9E
96	26	A6
97	17	97
98	1F	9F
99	27	A7
100	4F	CF
101	47	C7
102	3F	BF
103	4E	CE
104	46	C6
105	3E	BE
106	3D	BD

INTRODUCTION

This section describes the procedures for initializing the terminal, selecting the parameters, selecting the load source, and the operation of the terminal when operating in CYBER mode.

INITIALIZATION

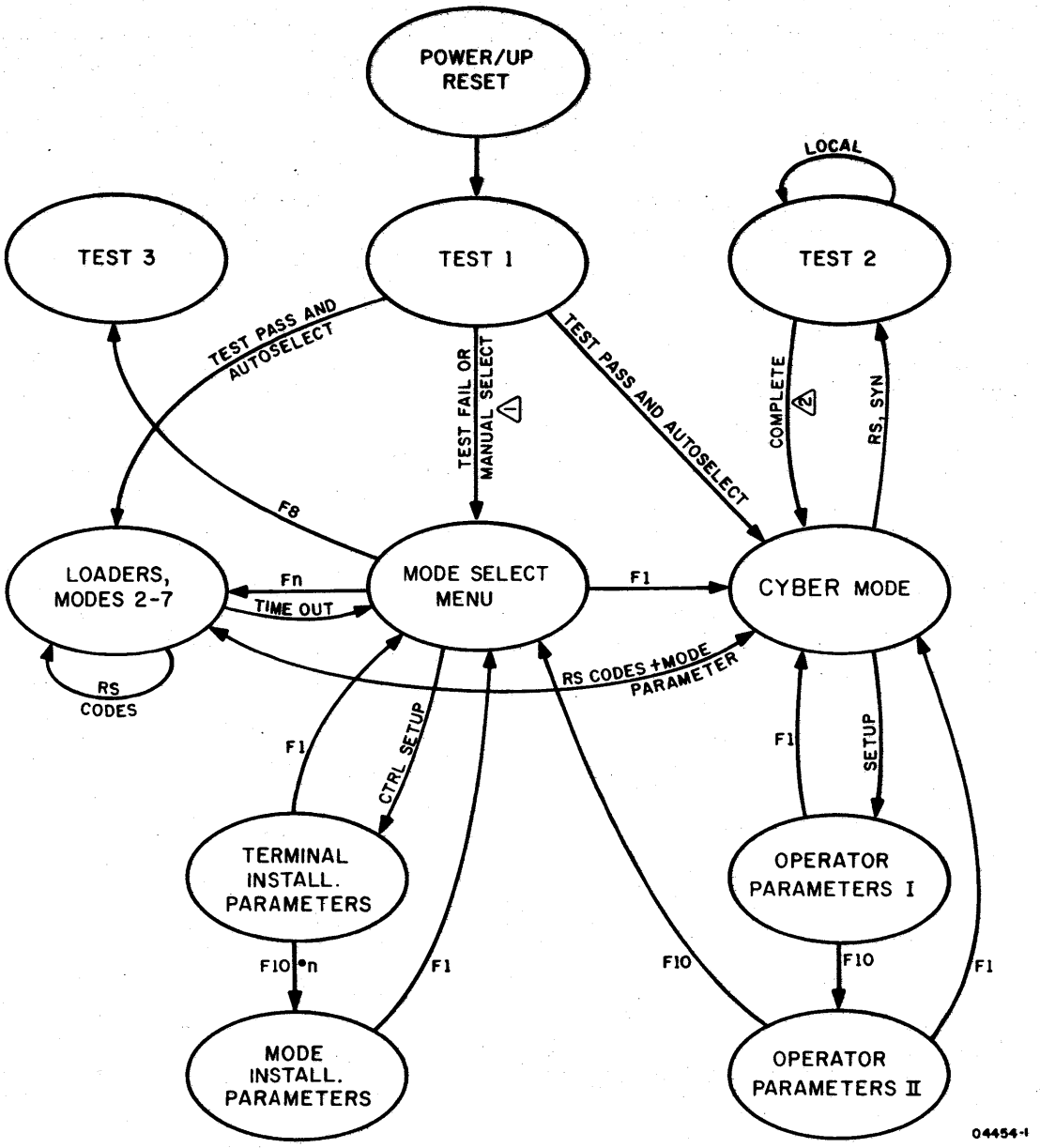
The terminal automatically performs an initialization routine whenever power is turned on or when its RESET switch is actuated.

This routine first checks to see if the non-volatile memory (NVM) that contains the operaing parameters has ever been loaded, or - has sustained a loss of power. If either one of the two conditions is detected, the terminal will automatically force certain default values to be loaded into the NVM. This is described later in the paragraph on default parameters.

The initialization routine then runs the first of three resident diagnostics (figure 4-1) (see Appendix A) to check the various functional sections of the terminal. Any errors detected at this time will be identified on the screen and the Mode Selection Menu prompt will be displayed.

If no errors occur, the Auto Select Enabled parameter is tested. If set, control is transferred to the the load activity identified during the resultant Load Source Selection process (Load Source Selection, figure 4-7).

If the Auto Select Enabled parameter is not set, then the operator must manually select the operating mode through a "soft" function key approach. This means that the various functions keys (F1 through F8) are used according to the functions assigned to them on the screen when the Mode Selection Menu is displayed (figure 4-2).



1 THIS PATH MAY ALWAYS BE FORCED BY TEST SWITCH ENABLED
2 LOCAL TEST 2 DOES NOT RETURN

Figure 4-1. General Flow of Events of Diagnostic Testing

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6	MODE 7	TERMNL		
CYBER	PLATO	*CP/M	*DISK	*C120	*	PACK	TEST		

0 10 20 30 40 50 60 70 80

LAST TWO ROWS DISPLAY (VIRTUAL LINES)

AFTER POWER ON OR RESET

CONVENTIONS:

1. LOWERCASE LABELS INDICATE A BRANCHING FUNCTION.

2. ALPHA CAPS LABELS INDICATE A DIRECT FUNCTION SELECTION.

3. "BOXES" ARE DISPLAYED IN INVERSE VIDEO.

4. F1 THROUGH F10 ARE SELECTED BY PRESSING (OPERATOR) FUNCTION KEYS F1 THROUGH F10.

5. AN * WILL APPEAR IN THE LOWER RIGHT CORNER OF THE BOX THAT IS THE AUTO SELECT MODE.

*A USER OR APPLICATION DEFINED 4 ALPHANUMERIC CHARACTER LABEL FOR MODES 3 THROUGH 6 AND OPERATOR DEFINED AT MODE INSTALLATION TIME. THE DEFAULT VALUES ARE SHOWN.

Figure 4-2. Mode Selection Menu

FUNCTION KEYS

Eight function keys are enabled when the MODE SELECTION MENU is displayed.

- F1 (MODE 1 CYBER) - If F1 is pressed, control will be transferred to CYBER mode.
- F2 (MODE 2 PLATO) - If F2 is pressed, the Mode 2 installation parameters will be examined to determine from where and how to load that mode (reference Load Source Selection paragraph).
- F3 through F6 (MODES 3 through 6) - These modes are set up by the owner or installer to any type mode. If enabled the mode installation parameters for the associated mode will be examined to determine from where and how to load that mode (reference Load Source Selection paragraph).
- F7 (MODE 7 PACK) - If F7 is pressed, a test will be made to see if a ROM PACK is installed. If a pack is installed, a test will be made to see if a function is contained within that pack (reference ROM Pack Loader paragraph). If a function is contained in the pack, control will be transferred to that function.
- F8 TERMNL TEST - If F8 is pressed, test 3 of the resident diagnostics will be run (reference Appendix A).
- PARAMETER ENTRY MODE - If the operator simultaneously presses the CTRL then SETUP keys, control will be passed to the Terminal Installation parameter entry mode (reference Terminal Installation Parameters paragraph). This mode should only be entered by terminal installation personnel or equivalent since knowledge of the operating system is required.

When a mode has been selected, the mode enabled/disabled parameter bit will be tested.

- If the mode is disabled, a message will appear FAILURE LOADING MODE, the alarm will sound, and the operator is required to enter another mode.
- When the mode is enabled, a test will be made to see if the access has been enabled for that mode (this is a mode installation parameter bit). If access is enabled, the following message will appear on line 27.

ENTER ACCESS CODE |____|____|____|____|

The four entry positions will appear in inverse video with the cursor at the first entry position. As a code is entered the inverse video will disappear and an X code will be displayed. Four entries are required. If the entered code (all four codes) does not match the access code entered into the mode installation parameters the word SORRY will be displayed, the alarm will sound and control sent back to require the selection of a new mode. If the access code is entered properly, control will transfer to the load source selection (reference Load Source Selection paragraph).

The operator can cause the terminal to run the initialization routine by pressing the RESET switch. After running test 1 of the resident diagnostic, the operator must select a mode that has been enabled. Note that at this point a qualified person could change parameters by pressing the CTRL then SETUP keys simultaneously. If the access for the selected mode has been enabled, the operator must type the proper access code sequence.

ABORTS AND RECOVERY

If the operator selects a mode that is not enabled or types an incorrect access code, the alarm is sounded and control is sent back to require entry of a new mode.

If the operator selects a mode that specifies a ROM pack, and a ROM pack has not been inserted, an error message FAILURE LOADING MODE is displayed and control is sent back to require entry of a new mode.

If any keys are pressed that have not been defined previously, the alarm will sound and the key will be ignored.

PARAMETER SELECTION

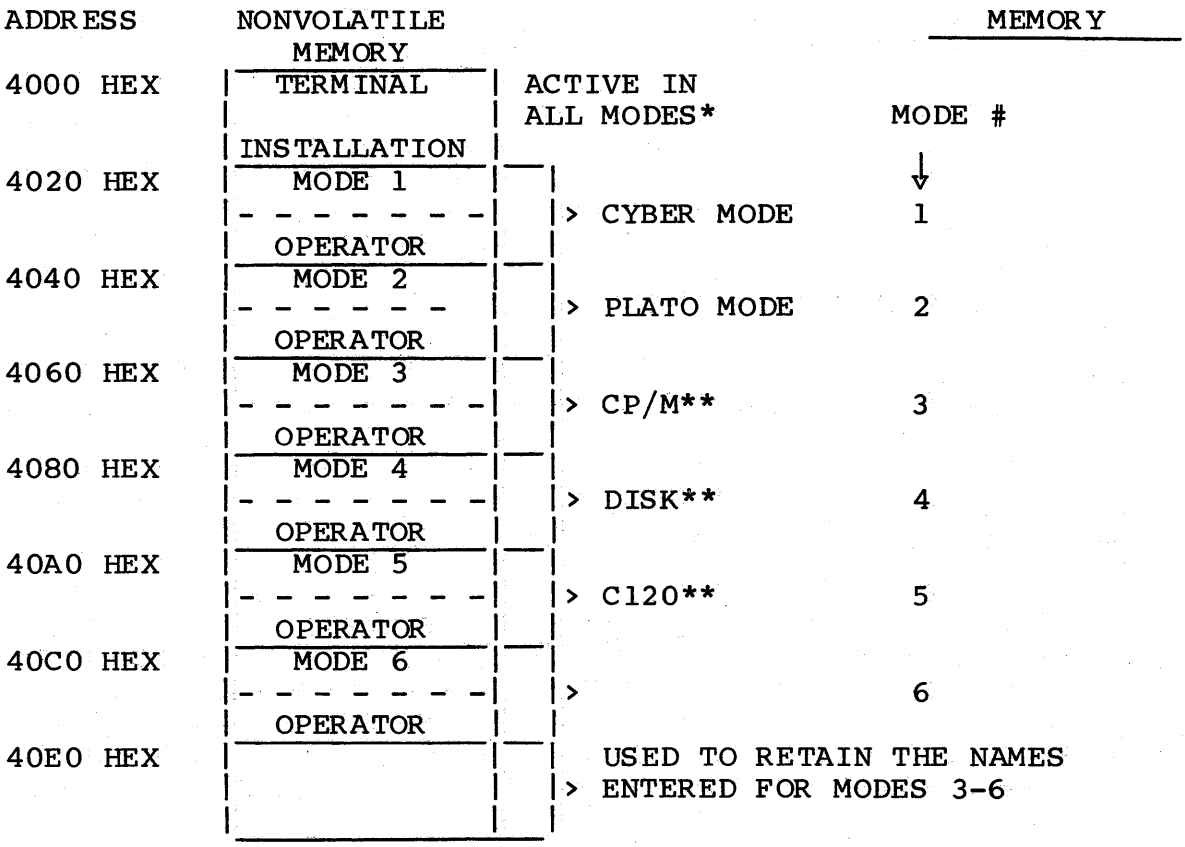
The terminal does not provide the operator with regular hardware-type switches for entering the operating parameters into the terminal. Instead, parameters are entered into the NVM via the keyboard and the processor. The NVM employs a small 9-volt battery to power the NVM and retain the parameters during the absence or loss of regular power.

The parameters should only be set or changed by terminal installation personnel or their equivalent since an understanding of the operating system is required. A firmware hook causes a jump to address 6000H (bank 13) when the Control-Setup keys are pressed. For the hook to work, address 6000H must contain a C3H. This hook allows a user-friendly parameter entry to be placed at address 6000H. The following describes what occurs should address 6000H not contain a C3H.

Three general groups of parameters are stored in the NVM.

- o Terminal Installation Parameters
- o Mode Installation Parameters
- o Mode Operator Parameters

There is one set of terminal installation parameters, and six sets of mode installation and operator parameters. The various modes and their associated memory addresses are shown in figure 4-3. The terminal installation parameters can be viewed and changed by simultaneously pressing the CTRL and SETUP keys prior to selecting the operator mode parameters.



*ANY MODE CAN BE ASSIGNED TO ANY BLOCK, EXCEPT 1 IS RESERVED FOR RESIDENT CYBER MODE AND 2 IS RESERVED FOR PLATO MODE.

**DEFAULT NAMES

Figure 4-3. Parameter Memory Assignments

The mode installation parameters (figure 4-3) can be viewed and changed by pressing F10 and the desired mode number. The parameters are changed in NVM by making the change on screen and pressing the COPY key.

The mode operator parameters are viewed and temporarily changed by pressing SETUP while in an active mode.

TERMINAL INSTALLATION PARAMETERS

The Terminal Installation parameters (figure 4-4) are used in all modes. They can be viewed and changed by simultaneously pressing CTRL, and SETUP while the MODE SELECTION MENU (figure 4-3) is being displayed. To change any installation parameter, the cursor must be positioned under the item to be changed. To do this the following keys are operable:

- Space - Moves cursor to next changeable parameter. If cursor is under the last changeable parameter, it will wrap around and reposition again under the first changeable parameter.
- Backspace - Moves cursor back to next changeable parameter. If cursor is under the first changeable parameter, it will stop.
- 0 - 7 - Enters 0 or 7 at cursor if field requires an octal value.
- 0 - 1 - Enters 0 or 1 at cursor if field requires a binary value.
- 0-9, A-F - Enters 0 to 9_{16} or A through F_{16} at cursor if field requires a hexadecimal value.
- COPY - Stores the current line of parameters displayed in NVM.
- F1 (Return) - Returns to Mode Selection Menu.
- F2 - F9 - Moves cursor under first changeable parameter in the associated field.
- F10 - Goes to mode installation parameters.

F	return	F	CONFIG	F	CONFIG	F	CONFIG	F	CONFIG	F	AS X Y	F	L ID	F	PORT A	F	PORT B	F	instl
1		2	123456	3	123456	4	123456	5	123456	6	O O H	7	O HHHH	8	H H	9	H H	10	mode n

1-6 = BINARY
O = OCTAL
H = HEX

F2 CONFIGURATION (BINARY)

1 1 = SPARE
2 1 = TOUCH PANEL OPTION IN
3 1 = DUAL SERIAL INTERFACE OPTION IN
4 1 = GRAPHIC PRINTER OPTION (726-10) ATTACHED
5 1 = FLEXIBLE DISK OPTION ATTACHED
6 1 = SERIAL GRAPHIC PRINTER (726-20) ATTACHED

F3 CONFIGURATION (BINARY)

1 1 = 1200/1200 INTERNAL MODEM OPTION IN
2 1 = SPARE
3 1 = GRAPHIC OPTION IN
4 1 = PARALLEL PORT OPTION IN
5 1 = SPARE
6 1 = FIXED DISK OPTION IN

F4 CONFIGURATION (BINARY)

1 1 = AUTO SELECT ENABLED 0 = AUTO SELECT DISABLED
2 1 = USE PRINTER SRTS 0 = IGNORE PRINTER SRTS
3 1 = RUN INTERNAL MODEM LOOPBACK
4 1 = TONE DIAL 0 = PULSE DIAL
5 1 = MONITOR PRINTER READY 0 = IGNORE PRINTER READY
6 1 = MONITOR BI-DIR READY 0 = IGNORE BI-DIRECTIONAL READY

F5 CONFIGURATION (BINARY)

1 1 = SPARE
2 1 = SPARE
3 1 = SPARE
4 1 = SPARE
5 1 = SPARE

Figure 4-4. Terminal Installation Parameters (Sheet 1 of 3)

F6 AS AUTO SELECT (MODE NUMBER) (OCTAL)

0 = CYBER MODE
1 = CYBER MODE
2 = PLATO MODE
3 = MODE 3
4 = MODE 4
5 = MODE 5
6 = MODE 6
7 = ROM PACK FUNCTION

F6 X DISPLAY DISPLACEMENT RIGHT/LEFT (OCTAL)

0 = NO DISPLACEMENT	4 = NO DISPLACEMENT
1 = RIGHT 1 CHARACTER	5 = LEFT 1 CHARACTER
2 = RIGHT 2 CHARACTER	6 = LEFT 2 CHARACTER
3 = RIGHT 3 CHARACTER	7 = LEFT 3 CHARACTER

F6 Y DISPLAY DISPLACEMENT UP/DOWN (HEX)

0 = NO DISPLACEMENT	8 = NO DISPLACEMENT
1 = UP 1 SCANS	9 = DOWN 1 SCANS
2 = UP 2 SCANS	A = DOWN 2 SCANS
3 = UP 3 SCANS	B = DOWN 3 SCANS
4 = UP 4 SCANS	C = DOWN 4 SCANS
5 = UP 5 SCANS	D = DOWN 5 SCANS
6 = UP 6 SCANS	E = DOWN 6 SCANS
7 = UP 7 SCANS	F = DOWN 7 SCANS

Figure 4-4. Terminal Installation Parameters (Sheet 2 of 3)

F7 L LANGUAGE (OCTAL)

0 = ENGLISH
1 = ENGLISH
2 = FRENCH
3 = GERMAN
4 = SWEDISH/FINNISH
5 = BRITISH
6 = SPANISH
7 = DANISH/NORWEGIAN

F7 ID TERMINAL IDENTIFICATION

F8 PORT A (HEX)
1ST VALUE

B0 0 = 7 DATA BITS	1 = PORT A 8 DATA BITS
B1 0 = PORT A PARITY ODD/SPACE	1 = PORT A PARITY EVEN/MARK
B2 0 = PORT A PARITY ENABLED	1 = PORT A PARITY DISABLE
B3 0 = PORT A PRINTER	1 = PORT A BIDIRECTIONAL

2ND VALUE - BAUD RATE (HEX)

0 = 75 BAUD	4 = 300	8 = 2400	C = 19.2K
1 = 110	5 = 600	9 = 4800	D = 19.2K
2 = 150	6 = 1200	A = 9600	E = 19.2K
3 = 200	7 = 1800	B = 19.2K	F = 19.2K

F9 PORT B
Same as PORT A

F10 INSTALLATION PARAMETERS FOR MODE n

THE FOLLOWING MESSAGE WILL BE DISPLAYED

ENTER MODE n |_|

ENTER MODE NAME |____| (FOR MODES 3-6)

Figure 4-4. Terminal Installation Parameters (Sheet 3 of 3)

The cursor advances to the next changeable location after each data entry. Cursor movement is not limited to the selected function key group; a new function group may be selected as required. See figure 4-4 for terminal installation parameters.

The meanings of the displayed inverse blocks are further described in the following paragraphs. Refer to figure 4-4 for the options associated with the configuration blocks.

F1 Return

Indicates that pressing the F1 key returns control to Mode Selection Menu.

F2 CONFIG (Configuration)

Each parameter bit in this block must be set to 1 for each option present. If an option is not present or disabled, the corresponding bit must be set to 0.

F3 CONFIG (Configuration)

Each parameter bit of the F3 block must be set to 1 for each option present or set to 0 if the option is not present or disabled.

F4 CONFIG (Configuration)

- F4-1 AUTO SELECT Enabled/Disabled - If this bit is set to a 1, the mode selected in the AUTO SELECT (AS) field (see F6) will automatically be loaded if test 1 detected no errors. If this bit is set to 0, the Mode Selection Menu will appear after running test 1.
- F4-2 USE/IGNORE PRINTER SRTS - If this bit is set to 1, a 200 msec. delay will follow every Carriage Return (CR) and Line Feed (LF) sent to the serial printer if the Secondary Request To Send (SRTS) is in a marking or open condition. If this bit is set to a 0, no delays will be used when sending data to a serial printer.

Recommended settings:

NIP - 1	SCAMP - 0
PM70-1	Letter Quality - 0
	Matrix - 0
	Centronic Graphic - 0

- F4-3 RUN INTERNAL MODEM LOOPBACK - The internal modem performs four subtests.

  - ROM checksum
  - Local loopback on the 8250
  - Local loopback of the modem card
  - Displayed revision level

  The loopback of the modem card can be disabled during the Quicklook diagnostic (Appendix A) by setting this parameter to a 0.

- F4-4 PULSE/TONE Dial - If this parameter is set to 0, the internal modem firmware will use the pulse dialing technique for dialing the modem during auto dial. If this parameter is set to 1, tone dialing is used.

- F4-5 MONITOR PRINTER Ready - If this parameter is set to 0 (Ignore Printer Ready) online data will be sent to the printer port with or without Ready active. If this parameter is set to 1 (Monitor Printer Ready) online data will be sent to the printer port only if the Ready signal is active.

NOTE

If this parameter is set to monitor the printer Ready signal, and the device is turned off, any online communication with a host will be locked up until the Ready signal is made active.

Note that on a serial printer the Ready refers to DSR input active and on a parallel printer the Ready refers to the Ready status.

- F4-6 MONITOR BI-DIRECTIONAL Ready - If this parameter is set to 0 (Ignore Bi-directional), data directed to the bi-directional port will be sent with or without the Ready signal active. If this parameter is set to 1 (Monitor Bi-directional Ready) data directed to the bi-directional port will be sent only if the Ready signal is active.

NOTE

If this parameter is set to monitor the Bi-directional Ready signal and the signal is not active, online communications with a host will be locked up and can be corrected only by making the Ready signal active.

F5 CONFIG (Configuration)

All bits in this parameter block are spare at this time.

F6 CONFIG (Configuration)

The F6 parameters are:

- AS (AUTO SELECT) - This parameter allows the entry of a number between 0 and 7. The parameter value is used as the mode number if auto select enable is selected.

  0-1 - Executes CYBER mode.
  2-6 - Executes the appropriate mode.
  7 - Executes function in a ROM PACK.

- X (Screen Move in X Direction) - As the CRT ages the picture raster may drift. This parameter allows the installer to move the raster left or right up to approximately three characters in width. It is set to 0 when aligned at factory.

  The following parameters permit horizontal adjustment of the raster.

0 = No move	4 = No move
1 = Move right 1 character	5 = Move left 1 character
2 = Move right 2 characters	6 = Move left 2 characters
3 = Move right 3 characters	7 = Move left 3 characters

- Y (Screen Move in Y Direction) - This parameter allows the installer to move the raster up or down, up to seven scans. It is set to 0 when aligned at factory. The following parameters permit vertical adjustment of the raster.

0 = No move	8 = No move
1 = Move up 1 scans	9 = Move down 1 scans
2 = Move up 2 scans	A = Move down 2 scans
3 = Move up 3 scans	B = Move down 3 scans
4 = Move up 4 scans	C = Move down 4 scans
5 = Move up 5 scans	D = Move down 5 scans
6 = Move up 6 scans	E = Move down 6 scans
7 = Move up 7 scans	F = Move down 7 scans

F7 CONFIG (Configuration)

This configuration allows the selection of language characters and the terminal identification code.

- L - Language - This parameter permits the display of special foreign characters; only the numbers 0 through 7 are allowed. The unit must be reset after changing this parameter.

  0 = English
  1 = English
  2 = French
  3 = German
  4 = Swedish/Finnish
  5 = British
  6 = Spanish
  7 = Danish/Norwegian

- ID - (Terminal Identification Code) - The terminal ID code is broken up into 4 codes. Each code can be set between 0 and F_{16}. This code can be used as a physical or logical identifier (host defined). They will be sent to the host with the Mode Report Request in CYBER mode.

F8 (PORT A)

This block establishes the data transmission parameters for Port A of the dual asynchronous interface option.

- 1st Value - This is an encoded value to select different parameters for Port A.

  - Bit 3 Printer/Bi-Directional - This parameter is used by the firmware to determine if an ASCII type printer (including the serial graphics printer) is connected to the terminal. In order to connect an ASCII printer, the Dual Serial Interface Option must be installed. This option has two serial I/O Ports, A and B. This parameter must be set to 0 if the printer is connected to Port A. Otherwise, it must be set to 1 for a bi-directional port, which is supported by the resident firmware.

NOTE

The firmware tests for a printer on Port A first. If both ports are set for a printer, Port A will be used.

  - Bit 2 (Parity Enabled/Disabled) - If this parameter is set to Parity Enable, even or odd parity is transmitted with each code and tested for on each code received. If this parameter is set to Parity Disabled, the parity checking logic is disabled and the terminal will transmit either a mark or space condition in the parity position of each code. Transmission of either mark or space parity is determined by the setting of the Port A Parity Odd/Even.

  - Bit 1 (Parity Odd/Even, Space/Mark) - This parameter interacts with Port A Parity Enabled/Disabled. If Channel A Parity Enabled is selected and:

    - This parameter is set to Parity Odd - The terminal will transmit and test for odd parity.

    - This parameter is set to Parity Even - The terminal will transmit and test for even parity.

If Port A Parity Disabled is selected and:

  - This parameter is set to Parity Odd - The terminal will transmit a space in place of the parity bit.

  - This parameter is set to Parity Even - The terminal will transmit a mark in place of the parity bit.

- Bit 0 (7/8 Data Bits).

  This parameter is set to a 1 to select 8 data bits. The default parameter is 1, 8 data bits.

The three parameters above work together to select the proper comunication format for ports A and B. The following example illustrates the use of the ID codes:

Example: Dual Serial UART Word Format

WORD FORMAT	7/8 (BIT 0)	ODD/ EVEN (BIT 1)	ENABLE/ DISABLE (BIT 2)	PRINTER BI-DIR (BIT 3)
8 data bits, even parity	1	1	0	X
8 data bits, odd parity	1	0	0	X
8 data bits, no parity	1	X	1	X
7 data bits, even parity	0	1	0	X
7 data bits, odd parity	0	0	0	X
7 data bits, mark parity	0	1	1	X
7 data bits, space parity	0	0	1	X
	7=0 8=1	Odd = 0 Even = 1 X = 1 or 0	Enable=0 Disab =1	PRNT=0 BI-DIR=1 X = 1 or 0

One stop bit is always enabled.

- 2nd Value (PORT A Baud Rate) - This parameter will be used to select the send and receive baud rate of Port A. The value is encoded; 0 through F may be entered. (See figure 4-3).

F9 (PORT B)

This block establishes data transmission parameters for Port B of the dual asynchronous interface option.

NOTE

The same descriptions apply, except substitute port B for port A.

- 1st Value - This is an encoded value to select different parameters for Port B.
  - Bit 3 (Printer/Bidirectional) - Same as described for Port A.
  - Bit 2 (Parity Enabled/Disabled) - Same as described for Port A.
  - Bit 1 (Parity Odd/Even) - Same as described for Port A.
  - Bit 0 (7/8 Data Bits) - Same as described for Port A baud rate.
- 2nd Value - Same as regards Port A baud rate.

F10 [Instl Mode n (Installation Mode n)]

Mode installation parameters are entered as follows.

When F10 is pressed the following message will be displayed on line 27:

ENTER MODE n (1-6) |___|

The number 1 through 6 must be entered. It will be displayed where the inverse box is, and the inverse will go to normal intensity. If any other key is pressed, the alarm will sound and the key is ignored.

If mode 3 through 6 are selected, the following message will be displayed on line 28:

ENTER MODE NAME |___|___|___|___|

The current mode name will be displayed in the inverse boxes. If no change is desired, the NEXT key can be pressed. A change can be made by entering the new codes. When all four codes are entered (or the NEXT key pressed) control will transfer to mode installation parameter entry.

There are six sets of mode installation parameters (figure 4-5), one set for each mode the terminal is to operate in. Modes 1 through 5 have factory-assigned, default, mode installation parameters. These parameters automatically load into NVM when no parameters have been stored (further details are given later in this section under Default Parameters). The default parameters establish mode 3 as CP/M mode, mode 4 as DISK mode, and mode 5 as C120 mode. If desired, the names for these mode numbers may be changed as described in the preceeding paragraph and new modes assigned by entering new mode installation parameters. The mode installation parameters for mode 1 (CYBER mode) and mode 2 (PLATO mode) may be changed as needed but not the names. Mode 6 is for a user assigned mode.

To enter this mode, you must press F10 and enter the desired mode while in the terminal installation parameter entry mode. To change any parameter, the cursor must be positioned under the item to be changed. To do this the following keys are enabled.

- F1 - Returns to Mode Selection Menu.
- F2-F10 - Moves cursor under first changeable parameter in the associated field.
- The Copy, Space, Backspace, and 0 through F keys operate as previously described for the terminal installation parameters.

The cursor advances to the next changeable location after each data entry. If an entry is not allowed in the field the alarm will sound and the key ignored.

F1 Return

Return control to Mode Selection Menu.

```
ENTER MODE n (1-6) 1

| F | return | | F | CONFIG | | F | CONFIG | | F | CONFIG | | F | CONFIG | | F | OPR DF | | F | A-DIAL | | F | A-DIAL | | F | DF T R | | F | ACCESS |
| 1 |        | | 2 | 123456 | | 3 | 123456 | | 4 | 123456 | | 5 | 123456 | | 6 | HHHH   | | 7 | HHHHHH | | 8 | HHHHHH | | 9 | OH H H | | 10| HHHH   |
```

F2 CONFIGURATION (BINARY)

1	0 = MODE DISABLED	1 = MODE ENABLED
2	0 = ACCESS DISABLED	1 = ACCESS ENABLED
*3	0 = USE DEFAULT SOURCE/FILE/PHONE NUMBER	1 = OPERATOR SELECT SOURCE/FILE/PHONE NUMBER
*4	0 = RUN INTERNAL	1 = LOAD EXTERNAL
*5	0 = LOAD FROM HOST	1 = LOAD FROM FLEXIBLE DISK
6	0 = HOST INTERFACE	1 = 1200/1200 INTERNAL MODEM INTERFACE

F3 CONFIGURATION (BINARY)

1	0 = DIAL ONCE	1 = CONTINUOUS DIAL
2	0 = AUTO DIAL DISABLED	1 = AUTO DIAL ENABLED
3	0 = HOST 7 BITS (DATA)	1 = HOST 8 BITS (DATA)
4	0 = HOST PARITY DISABLE	1 = HOST PARITY ENABLE
5	0 = HOST PARITY ODD/SPACE	1 = HOST PARITY EVEN/MARK
6	0 = HOST 1 STOP BIT	1 = HOST 2 STOP BITS

F4 CONFIGURATION (BINARY)

1	0 = DTR CONSTANT	1 = DTR SWITCHED
2	0 = RTS CONSTANT	1 = RTS SWITCHED
3	0 = TYPAMATIC ON	1 = TYPAMATIC OFF
4	0 = DATA ONLY OFF	1 = DATA ONLY ON
5	0 = HOME UPPER LEFT	1 = HOME LOWER LEFT
6	0 = AUTO LF OFF	1 = AUTO LF ON

*NOT CHECKED IF MODE 1 SELECTED.

Figure 4-5. Mode Installation Parameters (Sheet 1 of 3)

F5 CONFIGURATION (BINARY)

1	0 = PACING DISABLED	1 = PACING ENABLED
2	0 = BIAS DISABLED	1 = BIAS ENABLED
3	0 = AUTOMATIC CARRIAGE RETURN ON	1 = AUTOMATIC CARRIAGE RETURN OFF
4	0 = SPARE	
5	0 = SPARE	
*6	0 = CYBER MODE	1 = LOAD FROM ROM PACK

F6 OPERATOR DEFAULT PARAMETERS (HEX)

1ST VALUE

B0	0 = ONLINE	1 = LOCAL
B1	0 = PRINTER DESELECTED	1 = PRINTER SELECTED
B2	0 = MARGIN ALERT OFF	1 = MARGIN ALERT ON
B3	0 = ALERT SOFT	1 = ALERT LOUD

2ND VALUE (HEX)

B0	0 = ALPHA LOCK	1 = SHIFT LOCK
B1	0 = NUMERIC PAD NORMAL	1 = NUMERIC PAD SHIFT
B2	0 = PAGE SCREEN	1 = ROLL SCREEN
B3	0 = ADV. / SMALL CYBER	1 = NATIVE / LARGE CYBER

3RD VALUE (HEX)

B0	0 = BACKGROUND DARK	1 = BACKGROUND LIGHT
B1	0 = CURSOR LINE	1 = CURSOR BOX
B2	0 = CURSOR BLINK	1 = CURSOR SOLID ON
B3	0 = NOT USABLE	1 = NOT USABLE

*NOT CHECKED IF MODE 1 SELECTED.

Figure 4-5. Mode Installation Parameters (Sheet 2 of 3)

4TH VALUE (HEX)

B0	0 = HALF DUPLEX	1 = FULL DUPLEX
B1	0 = 80 CHARACTERS/LINE	1 = 132 CHARACTERS/LINE
B2	0 = 24 LINES	1 = 30 LINES
B3	0 = TRANSPARENT OFF	1 = TRANSPARENT ON

F7 A-DIAL AUTO DIAL NUMBER PART 1 (HEX)

F8 A-DIAL AUTO DIAL NUMBER PART 2 (HEX)

F9

DF DEFAULT FILE NUMBER (HEX)

T TRANSMIT BAUD RATE (HEX)

0 = 75	4 = 300	8 = 2400	C = 19.2K
1 = 110	5 = 600	9 = 4800	D = 19.2K
2 = 150	6 = 1200	A = 9600	E = 19.2K
3 = 200	7 = 1800	B = 19.2 K	F = 19.2K

R RECEIVE BAUD RATE

SAME AS TRANSMIT BAUD RATE

F10 ACCESS CODE (HEX)

THIS IS THE CODE THAT MUST BE ENTERED IF ACCESS ENABLED BEFORE ENTERING A MODE.

Figure 4-5. Mode Installation Parameters (Sheet 3 of 3)

F2 CONFIG (Configuration)

- F2-1 Mode Disabled/Enabled - When this parameter is set to 0, the mode is disabled and will not be executed. All the other parameters in the block can be set to perform a given load. This could allow a supervisor to simply disable or enable a mode. When this parameter is set to 1, the mode is enabled and can be executed.

- F2-2 Access Off/On - If this parameter is set to 1 (Access On), the operator will be required to enter the proper access code before the mode is loaded. If this parameter is set to 0 (Access Off), the load will commence immediately after mode selection.

- F2-3 Load Default/Operator Selected Source/File/Phone Number - If the host load has been selected and this parameter is set to 0, the default source and file parameters will be used to select the load source and file. If the parameter is set to 1, the operator will be allowed to select the source and phone number (phone number is to be used with 1200/1200 auto dial modem).

- F2-4 RUN Internal/Load External - This parameter must be set to 0 to execute CYBER mode or a mode from ROM pack. This parameter must be set to 1 to load a mode from host or disk.

- F2-5 Load From Host/Disk - This parameter works in conjunction with the Run Internal/Load External parameter. If the Load External (1) is selected and this parameter is set to 0, a load from host will be initiated. If this parameter is set to 1, a load from disk is initiated.

- F2-6 Use Resident Host/Internal Modem Interface - This parameter works in conjunction with LOAD FROM HOST/DISK. If LOAD FROM HOST is selected and this parameter is set to 0, the Resident Host interface is used. If this parameter is set to 1, the internal 1200/1200 modem is used.

F3 CONFIG (Configuration)

- F3-1 Dial Once/Continuous Dialing - This parameter is used by the internal modem firmware to determine how many times to dial a number. It is not supported by the resident firmware. Refer to appendix D of this manual for more detailed information on the internal modem.

- F3-2 Auto Dial Off/On - If the host load has been selected using the internal modem, the internal modem option is installed, and this parameter is a 1, the auto dial or operator entered number will be used. If this parameter is a 0, the operator will be requested to make an external phone connection.
- F3-3 Host 7/8 Bits.
- F3-4 Host Parity Enabled/Disabled.
- F3-5 Host Parity Odd/Even, Space/Mark.
- F3-6 Host 1/2 Stop Bits.

These four parameters work together to select the proper word format when transmitting to the host. If the 8-bit option is selected, eight data bits are sent. The parity bit is dependent upon Parity Enabled/Disabled and Parity Odd/Even. If the 7-bit option is selected, only seven data bits are sent. Selecting this latter option with parity disabled will send seven data bits and a mark or space parity bit.

If 8 bits is selected and parity is disabled, the Even/Odd parameter is used to select a mark or space in place of the parity bit 8th bit. Received data is not tested for mark or space parity when 8 bits have been selected, and CYBER mode will not display any parity errors.

Table 4-1 is to aid in selecting the proper word format.

TABLE 4-1. HOST UART WORD FORMAT

WORD FORMAT	7/8	ENABLED/ DISABLED	ODD/ EVEN	STOP 1/2
8 data bits, even parity	1	1	1	X
8 data bits, odd parity	1	1	0	
8 data bits, no parity	1	0	X	X
7 data bits, even parity	0	1	1	X
7 data bits, odd parity	0	1	0	X
7 data bits, mark parity	0	0	1	X
7 data bits, space parity	0	0	0	X
	7 = 0 8 = 1	Odd = 0 Even = 1 X = 1 or 0	Enable=0 Disab =1	PRNT=0 BI-DIR=1 X = 1 or 0

1. 8 bits, parity enabled

S	1	2	3	4	5	6	7	8	E/O	S

2. 8 bits, parity disabled

S	1	2	3	4	5	6	7	8	S

3. 7 bits, parity enabled

S	1	2	3	4	5	6	7	E/O	S

4. 7 bits, parity disabled

S	1	2	3	4	5	6	7	M/S	S

F4 CONFIG (Configuration)

- F4-1 DTR Constant/Switched - If this parameter is set to 0 (DTR Constant), the DTR (Data Terminal Ready) signal on the host connector will be held on at all times. If this parameter is set to 1 (DTR Switched), the DTR signal on the host connector will be switched off if the mode is in local operation. DTR is maintained in the on condition at all other times. Received data is ignored if DTR is off.

- F4-2 RTS Constant/Switched - If this parameter is set to 0 (RTS Constant), the RTS (Request to Send) signal will be on whenever DSR and DTR are on. If this parameter is set to 1 (RTS Switched), the RTS signal will operate as follows if DSR and DTR are on, and Data Only Off:

  - Half Duplex - RTS is on with the first keystroke and is switched off a minimum of 1 millisecond, maximum of 16 milliseconds following transmission of a CR, LF, ACK, or NAK. RTS is switched off following the transmission of the appropriate codes for all function keys and special action keys. RTS will be placed to off if a break is received, or local operation is selected. Automatic responses to the host will cause RTS to be on for the duration of the response and switched off 1 to 16 milliseconds following the last word transmitted.

  - Full Duplex - RTS is on until local operation is selected.

- F4-3 Typamatic On/Off - If Typamatic is on the keys shown in table 3.9.11 will repeat at a rate of 15 ± 3 characters per second if held down longer than 1 second. If typamatic is off, no keys will repeat when held down.

- F4-4 Data Only Off/On - If this parameter is set to 0 (Data Only Off), the terminal honors the DSR and DTR when sending and CO when receiving. If this parameter is set to 1 (Data Only On), the terminal will disregard the RS-232-C modem control signals. Data is transmitted without regard to the presence of DSR or CTS. Received data is acted upon without regard to CO or DSR. DTR operates normally.

- F4-5 Home Upper/Lower Left - This parameter may be ignored in some modes. In the resident CYBER mode it is operational, but should be set to Upper Left to be compatible with a CDC 722-10 (CC628) TTY Display Terminal.

  If this parameter is set to a 0, the cursor will be placed to upper left for home. If this parameter is set to a 1, the cursor will be placed to lower left for home.

- F4-6 Auto LF Off/On - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to a 0 (Auto LF Off), it is intended that a carriage return operation position the cursor to the beginning of the current line. If this parameter is set to a 1 (Auto LF On), it is intended that a line feed operation in addition to a carriage return operation be performed upon actuation of the CR key or receipt of the carriage return code.

F5 CONFIG (Configuration)

- F5-1 Pacing Disabled/Enabled - When this parameter is set to 1, the rate of data being sent to the host will be limited to one code every 8 milliseconds regardless of the baud rate. This gives an effective throughput of 1200 baud. If the parameter is set to 0, no limiting is performed.

- F5-2 Code Bias Off/On - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to a 0 (Code Bias Off, no bias is added to the cursor address when sending or subtracted when receiving X/Y positioning information or set scroll field information. If this parameter is set to a 1 (Code Bias On), a bias of 20 hex is added to the cursor address when sending or subtracted when receiving X/Y positioning information or set scroll field information.

- F5-3 AUTOMATIC CARRIAGE RETURN ON/OFF - When this parameter is set to a 0 (ON or enabled), the cursor automatically advances to the beginning of the next line when the last position of a line is entered with data. When the parameter is set to a 0 (OFF or disabled), the cursor remains in the last column when data is entered from the host. The host can also enable or disable this parameter via the RS,0 and RS,' commands.

- F5-4 Spare.

- F5-5 Spare.

- F5-6 CYBER MODE/ROM PACK - If the Run Internal Parameter is selected this parameter will be tested to determine if control is passed to CYBER mode or to the ROM PACK.

F6 OPR DF (Operator Default)

All of the Mode Operator Parameter default values are encoded in hexadecimal digits and consist of the initial operator parameters when a mode is selected. They are not the same in all modes and therefore must be defined in the ERS for each mode. To do this, the initial value is moved from NVM into an active RAM table to allow temporary changes by operator or host.

- F6 1st Digit

  - Bit 0 - Online/Local - This parameter may be ignored in some modes. In the resident CYBER mode it determines the initial state. If this parameter is set to 1 (Local), the transmit portion of the terminal is disabled and data originating at the keyboard is displayed. Modem interface circuits are also affected. If this parameter is set to 0 (Online), data originating at the keyboard is transmitted in character mode and block mode transmission is enabled. It is possible to receive data while in local mode if Constant DTR is selected.

  - Bit 1 Printer Off/On - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to 1 (Printer On), the initial condition will have the printer interface active. The host can also change the active value. If this parameter is set to 0 (Printer Off), the initial condition will have the printer interface disabled. When the printer is on, all data sent or received in Character mode will be printed while it is being displayed.

- Bit 2 Margin Alert Off/On - This parameter may be ignored by some modes. In the resident CYBER mode it is operational. If this parameter is set to 1 (Margin Alert On), the audible alarm will sound whenever the cursor is advanced into the eighth position from the end of a line during keyboard entry. The audible alarm will also sound when the cursor is moved into the last line from the previous line during keyboard entry. If this parameter is set to 0 (Margin Alert Off), the audible alarm will not sound due to cursor movement from the keyboard.

- Bit 3 Alert Soft/Loud - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to 1 (Alert Loud), the audible alarm will be at a higher volume. If this parameter is set to 0 (Alert Soft), the audible alarm will be at a lower volume.

o F6 2nd Digit

- Bit 0 Shift/Alpha Lock - When this parameter is set to 1, the LOCK key will be a shift lock (all keys used as shifted). If the parameter is set to 0, the LOCK key will lock only alpha keys.

- Bit 1 Numeric Pad - When this parameter is set to 0 (normal), the 13 key numeric pad will be used with the normal shift and control features. When the parameter is set to 1 (shift), the 13 key numeric pad will be used as if the shift key were depressed.

- Bit 2 Roll/Page Screen - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to 1 (Roll Screen), the scroll feature is enabled, the field scroll feature is unaffected. It is recommended to set this parameter to Roll Screen to be compatible with the CDC 722-10 (CC628) TTY Display Terminal. The host has the capability to switch the active value. If this parameter is set to 0 (Page Screen), the initial value will disable the scroll feature.

- Bit 3 Small/Large CYBER Operation - This parameter will determine which code is sent as keys are pressed (table 4-2) and the reaction to the received codes (table 4-9).

- F6 3rd Digit

  - Bit 0 Background Dark/Light - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to 0 (Background Dark), characters will be displayed as light characters on a dark background. If this parameter is set to 1 (Background Light), characters will be displayed as dark characters on a light background (inverse video).

  - Bit 1 Cursor Line/Block - This parameter may be ignored in some modes. In the resident CYBER mode it is operational. If this parameter is set to 0 (Cursor Line), the cursor will appear as an underline. It may be blinking or solid depending upon the next parameter. If this parameter is set to 1 (Cursor Block), the cursor will appear as a solid box. It may be blinking or solid depending upon the next parameter.

  - Bit 2 Cursor Blink/Solid On - This parameter may be ignored by some modes. In the resident CYBER mode it is operational. If this parameter is set to 0 (Cursor Blink), the cursor will blink. If this parameter is set to 1 (Cursor Solid On), the cursor will be always on.

  - Bit 3 Not usable - This position is used for operator selection of baud rate in Operator Parameter Entry.

- F6 4th Digit

  - Bit 0 Half/Full Duplex - This parameter may be ignored in some modes. In the resident CYBER mode a 0 selects Half Duplex and a 1 selects Full Duplex. In half-duplex operation, data is displayed, printed (if enabled), and sent to the host as it is typed. In full-duplex operation data is only sent to the host as it is typed. In either operation, data will be displayed and printed (if enabled) as data is received from the host. This parameter is ignored if the terminal is in local or block mode operations.

  - Bit 1 80/132 Characters/Line - This parameter may be ignored by some modes. In the resident CYBER mode it is operational. If this parameter is set to 0 (80 Characters/Line), 80 characters will be the maximum number per line. If this parameter is set to 1 (132 Characters/line), 132 characters will be the maximum number per line.

- Bit 2 24/30 Lines - This parameter is ignored by some modes. In the resident CYBER mode it is operational. If this parameter is set to 0 (24 Lines), there will be a maximum of 24 lines displayed. If this parameter is set to 1 (30 Lines), there will be a maximum of 30 lines displayed.

- Bit 3 Transparent - This parameter may be ignored by some modes. In the resident CYBER mode it is operational. If this parameter is set to 1 (transparent on) all control codes received and entered on the keyboard will be displayed and not acted upon. When set to 0 (off) control functions will be performed.

F7 A-DIAL and F8 A-DIAL Auto Dial number parts 1 and 2

The F7 and F8 fields can hold up to 12 characters (0 to F_{16}; where 0 to 9 are numerics, A is not used, B is the * symbol, C is the # symbol, D is the ! symbol, E is the ? symbol, and F terminates an entry not filling the entire 12-digit area). These fields are used if: 1) the internal modem is available for host communciations, 2) the default values for source/file/phone number are selected, and 3) the auto-dial function is selected.

F9 - DF - Default File Number

This parameter may be used when requesting a downline load (reference the Load File Selection paragraph, for when it is used).

- o T - Host Transmit Baud Rate - This parameter will be used to select the host transmit baud rate. It can be set to a value between 0 and F hex, which represents baud rates between 75 and 19.2K baud (see figure 4-5).

- o R - Host Receive Baud Rate - This parameter will be used to select the host receive baud rate. It can be set to a value between 0 and F hex, which represents baud rates between 75 and 19.2K baud (see figure 4-5).

NOTE

The Transmit and Receive baud rate may be set to different rates when selected here. If the operator changes the rate in Operator Parameter Entry mode the Transmit and Receive rates will be forced to the same rate.

F10 ACCESS - Access Code

This parameter is used if the Access On parameter is selected. It contains four hexadecimal digits. The operator is required to type in the same four digits before the mode is entered. If the Access Disabled parameter is selected, these parameters are ignored.

MODE OPERATOR PARAMETERS

Operator parameters are mode dependent. It is intended that all mode operator parameters are displayed on the screen and operate similar to the resident CYBER mode operator parameters described in the following paragraphs.

The initial state of each operator parameter is determined when setting the mode installation parameters. The operator mode parameters are moved into an active RAM section and can only be temporarily changed by the operator or host. The operator cannot change the NVM values.

To change the operator parameters, the operator must press SETUP while in an operating mode to view the eight parameters that are written in inverse blocks located on the two bottom lines of the screen. To change any parameter, the operator must press the FUNCTION key number that precedes the word block. The alternate state will then be displayed. If there are more parameters, F10 will say "MORE SELECT". Pressing F10 will display eight new parameters. If there are no more parameters, F10 will say "mode SELECT". Pressing F1 at any time will exit the operation.

If the operator does not change the 80/132 Characters/Line parameter, or 24/30 lines parameter, the data on the display will not change. If the parameters are changed, the CRT will be cleared and the cursor placed at home.

The only keys operational in this mode are:

- F1 return - return to mode.
- F2-F9 - alternate state of that parameter.
- F10 - display next group or go to MODE SELECTION MENU.

All other keys are inoperable. See figure 4-6 for CYBER Mode Operator Parameters.

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
return	LINE (OFF) (ON) (HANGUP) (ANSWER) (DIAL)	PRINTR (BLANK) (OFF) (SERIAL) (PARALL)	MARGIN (OFF) (ON)	ALERT (SOFT) (LOUD)	LOCK (ALPHA) (SHIFT)	N PAD NORMAL (SHIFT)	SCREEN (ROLL) (PAGE)	CYBER (SMALL) (LARGE)	MORE SELECT

0 10 20 30 40 50 60 70 80

SETUP #1

1. OPERATOR SELECTED AFTER MODE ACTIVE BY DEPRESSING SETUP KEY.

2. F(N) KEY SELECTION ACTIVATES ALTERNATE SPECIFIED FUNCTION.

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
return	BACKGD (DARK) (LIGHT)	CURSOR (LINE) (BLOCK)	CURSOR (BLINK) (SOLID)	BAUD (75-19.2)	DUPLEX HALF (FULL)	CH/LN (80) (132)	LINES (24) (30)	XPARNT (OFF) (ON)	mode SELECT

0 10 20 30 40 50 60 70 80
Character Position

SETUP #2

1. OPERATOR SELECTED VIA F10 = more select IN SETUP #1.

2. F(N) KEY SELECTION ACTIVATES ALTERNATE SPECIFIED FUNCTION.

Figure 4-6. CYBER Mode Operator Parameters

F2 LINE

Pressing F2 will toggle the associated word block between ON and OFF line. If the internal modem is installed and the Enable Auto Answer Flag has been set, F2 will toggle between ON, OFF, HANGUP, ANSWER, and DIAL. When operating in CYBER mode, the Enable Auto Answer Flag is normally set.

When the F1 key is pressed, one of the following parameters can be selected from the LINE block:

- ON - Enter online operation.
- OFF - Enter offline operation.
- HANGUP - This will hangup the internal modem and go to online.
- ANSWER - This will display "WAITING TO ANSWER" on the last line and call a subroutine in the internal modem firmware that will monitor the Ring Indicator (RI) and answer after 2 rings. The BREAK key can be used to terminate the monitoring.
- DIAL - This routine calls a subroutine of the internal modem firmware that either autodials the default phone number of the current mode selection or requests the operator to enter a new phone number.

Printer

Pressing F3 will toggle the online PRINTR block between OFF, SERIAL, and PARALL (if both serial and parallel type printers are installed). If only a serial printer is installed, the block will toggle between OFF and SERIAL. If only a parallel printer is installed, it will toggle between OFF and PARALL. If the words SERIAL or PARALL are displayed, all data received from and

sent to the communications port will be sent to the associated printer. If there are no printers on the system the PRINTR block will be blank and the function cannot be toggled.

Nothing will be written in this block if:

- Both ports of the dual serial interface option are set to bidirectional.
- The 726-10 graphic printer option is not installed.

Baud Rate

When the second line of the CYBER Mode Operator parameters are being displayed (see figure 4-6), the transmit baud rate will be shown in block F5. If the F5 key is pressed, both the transmit and receive rates will be set to the next faster rate. (Transmit and receive will be set to the same rate). When changing from 19.2, the slowest rate will be selected.

DEFAULT PARAMETERS

When the terminal is first powered up or if the unit is ever turned off and the battery removed, the following default parameters are forced into NVM:

Default Terminal Installation Parameters

Function Key	721-20 terminals	721-30 terminals
F2	000000	010000
F3	000000	001000
F4	000000	000000
F5	000000	000000
F6	0 0 0	0 0 0
F7	0 0000	0 0000
F8	0 6	0 6
F9	A 6	A 6

Default Mode Installation Parameters

	MODES				
Function	CYBER	PLATO	CP/M	Disk	C120
F2	100000	100100	100110	100110	100000
F3	000110	000110	000100	000110	000000
F4	000000	000001	000000	000001	000000
F5	010000	000000	000000	000000	000000
F6	4C04	6C24	6C25	6C24	4421
F7	000000	000000	000000	000000	000000
F8	000000	000000	000000	000000	000000
F9	00 6 6	08 6 6	00 6 6	00 6 6	00 9 9
F10	0000	0000	0000	0000	0000

The initial values must be set up before a mode is selected as previously discussed.

LOAD SOURCE SELECTION

If the operator selects modes 2 through 6 and has met the access requirement or the host selects a mode change, the resident controlware must determine which load source is to be used. This is accomplished by the resident controlware looking at the preset Mode Installation parameters. Figure 4-7 illustrates the basic decisions and branching that occurs during this process.

The Load Source Selection feature allows either automatic or manual selection of the load source for any mode. Any of the following load sources can be selected if present in the terminal.

- Resident Host or Internal Modem
- Optional Flexible Disk Subsystem
- Optional ROM Pack

Automatic or operator selection of load source is accomplished by presetting these Mode Installation Parameters.

- Use Default/Operator Select-Source/File/Phone Number
- Run Internal/Load External
- Load From Host/Load From Disk
- Resident Host/Internal Modem
- CYBER Mode/ROM Pack

The Load Source Selection process is initiated for selecting the load source if:

- The Auto Select enable parameter is a 1 and Auto Select number is 2-6.
- If F2 through F6 (modes 2 through 6) are depressed while displaying the mode selection menu.

The "USE DEFAULT/OPERATOR SELECT" parameter is tested first.

- If USE DEFAULT SOURCE/FILE is selected the Mode Installation parameters RUN INTERNAL/ LOAD EXTERNAL(F2-4 CONFIG), CYBER MODE/ROM PACK (F5-6 CONFIG), and LOAD FROM HOST/LOAD FROM DISK (F2-5 CONFIG) will be checked.
- If OPERATOR SELECT SOURCE/FILE/PHONE NUMBER (F2-3 CONFIG) is selected, the following prompt will be displayed:

  SELECT LOAD SOURCE > DISK HOST ROM

  In this case, selection of the load source is accomplished at the keyboard by pressing key D, H, or R. Pressing the NEXT key will result in auto selection of the load source using the installation parameters.
- If either the Load Internal or ROM Pack is selected as the load source, the ROM pack load will be performed and if succesful, control transferred to the loaded controlware reference ROM Pack Loader paragraph).
- If Load External is selected, the controlware must then look at the Load From Host/Disk parameter.
- If Load From Disk is selected, the flexible disk loader is performed.
- If Load From Host is selected:

  The firmware will first test if the host interface is used or the 1200/1200 internal modem is used.

  If the 1200/1200 Internal Modem is selected, it is used with the ASCII Network Loader. If the internal modem is selected but the modem board is not installed, the error message "FAILURE LOADING MODE" will be displayed.

If Auto Dial is not selected, the terminal assumes that the operator will make the connection.

If Auto Dial is selected, the Operator Select - Source/File/Phone Number parameter will be tested.

- If Default is indicated - The Auto Dial number is used.
- If Operator is indicated - The message "ENTER PHONE NUMBER" is displayed. If the operator presses "NEXT" without entering a number, the Auto Dial number is used. If an operator makes a mistake, the ERASE key will clear all entries and start over. When the operator has entered the correct number the NEXT key will cause the number to be dialed.

The controlware next determines the load file number as described in the following Load File Selection paragraph.

ABORTS AND RECOVERY

If an operator error is made during number entry, the ERASE key will clear all entries.

ERRORS

If an internal modem is not present but is erroneously specified in the Mode Installation parameters for host communications (F2-6 CONFIG = 1), the error message FAILURE LOADING MODE appears on the terminal display screen along with the Mode Selection Menu. Other messages may appear if the modem is present and not able to communicate with the host. For more detail on messages associated with operation of the internal modem, refer to Appendix D of this manual.

INSTALLATION PARAMETERS

Refer to description under Mode Installation Parameters heading.

LOAD FILE SELECTION

When the communications host has been selected, this feature allows selection of a controlware load file to be loaded into the terminal. This can be done either automatically or manually. One default value can be used in the mode installation parameters or one of 64 different files may be selected manually.

NOTE

A suggested scheme for setting up Load File Parameters is shown in figure 4-7.

INTERFACES

Automatic selection of a load file is done if the Use Default Source/File/Phone Number parameter is selected in the mode installation parameters. Manual selection is done if the Operator Selected Source/File/Phone Number parameter is selected. The terminal requests the load file selection with the following prompt:

SELECT LOAD FILE _

The operator then selects the desired load file by using the keyboard. Entry is done by entering one or two hexadecimal digits followed by pressing the NEXT key. The file number entered must be less than 40 hexadecimal. If an error is made during entry, the ERASE key may be pressed to start over. Other keyboard keys are ignored.

If the file number entered is 40_{16} or more, the program will force entry to start over; the same as if ERASE had been pressed.

If the NEXT key is pressed before any other entry is made, the program will select the automatic default file; the same as if the Load Default File parameter were selected.

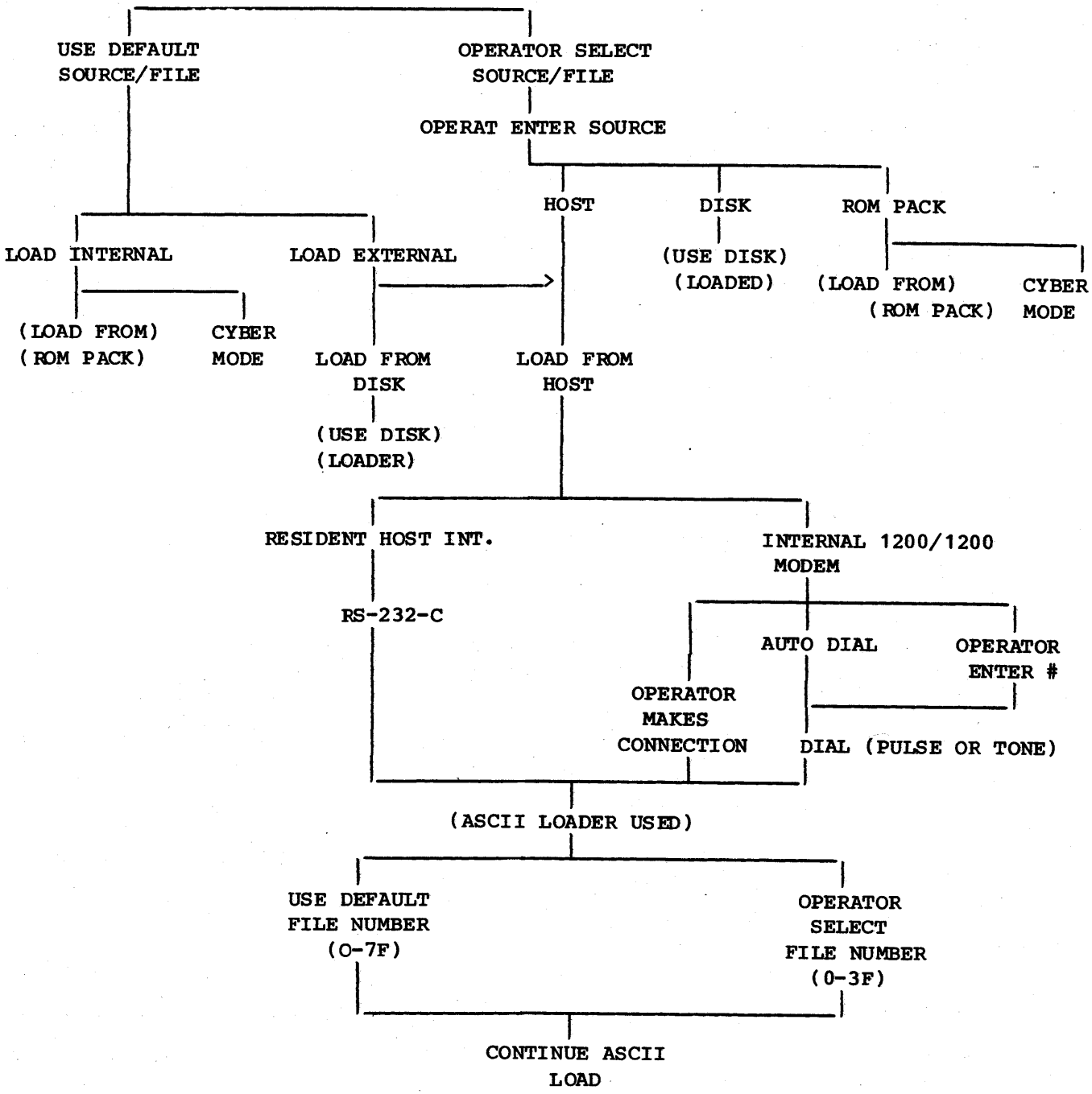


Figure 4-7. Load Source/File Selection

ABORTS AND RECOVERY

If operator error is made during number entry, the ERASE key will clear all entries.

ASCII NETWORK LOADER

The ASCII network loader allows the terminal to load a selected controlware program from an ASCII communications network that supports the protocol described in the following paragraphs.

DESCRIPTION

The ASCII communications loader loads a selected controlware file into the RAM of the terminal. Once the load file is selected, the load process proceeds automatically until control is transferred to the loaded controlware or until an unrecoverable error situation occurs. Both the local host interface (data-set connector at rear of terminal) and the internal 1200/1200 b/s modem use the ASCII communications loader to load information from the host computer. This section describes the communications protocol for loading the terminal from the ASCII communications network.

The protocol contains the following features:

- All data transmitted to the terminal from the network is in blocks and a cyclic redundancy check is associated with each block. Transmit and receive data is automatically switched to 8 bits of data and no parity.
- The load process generates a memory checksum of the loaded controlware. It is intended that the loaded controlware have a routine that utilizes this checksum for checking the integrity of the loaded controlware during operation.
- The RESET switch can be used to exit from operation on the ASCII network if other techniques do not work.
- Automatic error recovery during loading is limited to three attempts. After three unsuccessful load attempts, the terminal aborts the load.
- Partial loading of selected blocks is not supported. Checksum errors or aborted loads require full reloads.

- The maximum number of production load files is 64. Block lengths are variable with a maximum number of 240 data characters per block. The maximum number of host blocks in a file is 65536.

- The first block is loaded starting at a host-defined memory address and all succeeding blocks are loaded contiguously after this block. No auxiliary block loading table is used. The host is restricted from using hexadecimal addresses 0000 through 3FFF and D870 through FFFF.

- If no carrier is detected within 30 seconds after mode selection, the message HOST NOT CONNECTED appears on the display screen. No carrier detection after 40 seconds (time for manual phone number entry) causes HOST LOAD FAILURE and FAILURE LOADING MODE messages to appear along with the redisplay of the mode-selection menu.

AUTOLOAD MESSAGE FORMATS

The following message formats are utilized by the host communications line autoload routine (currently supported on the DSN). Unless otherwise specified, communications characters are those in the ASCII character set with even parity.

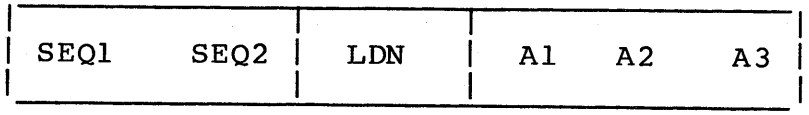
- Load Block
- Load Request
- NAK Sequence
- Load Complete

Load Block

Each Load Block received from the host (DSN-compatible) is formatted as follows:

DLE	STX	HEADING	DATA	DLE	ETB or ETX	CRC

The heading is formatted as follows:



Each block begins with a DLE STX character sequence and ends with either a DLE ETB or DLE ETX character sequence followed by a block cyclic redundancy check. The DLE ETB sequence is used on all blocks except for the last one. In this case, a DLE ETX sequence is used, signifying to the terminal that this is the last block of the load. The CRC is a 2-character, 16-bit cyclic redundancy check; that is, the remainder after polynomial division modulo two. The polynomial divisor is $X^{16}+X^{15}+X^{2}+1$. The end of the block occurs immediately after the CRC characters. The division is performed on all characters except the initial DLE STX sequence and the first DLE of any DLE DLE sequence in the block.

The heading and data parts of the block can be comprised of any 8-bit character sequences. If any character happens to be a DLE, it is prefixed by another DLE.

SEQ1 SEQ2 is a 2-character, 16-bit binary number which uniquely identifies each load block being transmitted. SEQ1 SEQ2 = 0 for the first load block and is incremented by one for each subsequent load block initially transmitted.

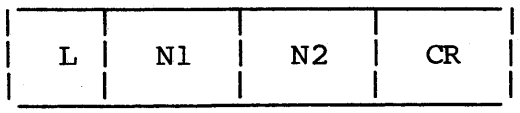
LDN is a single 8-bit character which uniquely identifies the particular load file. The load file can be selected by the operator if desired.

A1 A2 A3 is a three-character, 24-bit binary number which identifies the absolute starting address of the load data in the present block. The address sequence must be in sequential ascending order with all load data being loaded contiguously in memory. Only the lower 16 bits are used.

The data portion of the block may be variable in length from 1 to 240 8-bit load-data characters.

Load Request

The down-line load operation from the host is initiated by the terminal sending the following character sequence, termed a Load Request.

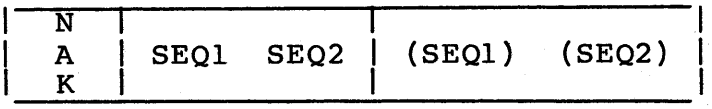


The sequence begins with an upper case ASCII L and ends with an ASCII CR. The N1 N2 sequence is an ASCII representation of the desired load file. Each N is a hexadecimal number represented by the corresponding ASCII character (upper case for the numbers A through F). N1 N2 corresponds to the LDN binary number in the resulting load blocks. All four ASCII characters have even parity.

NAK Sequence

If the terminal detects an error during the load process that can be corrected by retransmitting the load block, it sends a 5-character NAK Sequence indicating the block to be retransmitted.

DSN Compatible



The NAK is the corresponding ASCII NAK character. SEQ1 SEQ2 is a 2-character sequence identifying the load block from which point retransmission is to occur. This sequence corresponds to the SEQ1 SEQ2 16-bit binary number in the load block where the error occurred. (SEQ1) (SEQ2) is a one's complement of SEQ1 SEQ2 and is used for error detection.

The use of NAK does not alter the sequence of alternating acknowledgements. The same positive reply (ACK 0 or ACK 1) is used for successful retransmission as would have been used if the previous transmission of the unaccepted block had been successful.

Load Complete

Upon successful receipt of the last load block, the terminal sends the following Load Complete message to the DSN.

D	E
L	O
E	T

The characters are the corresponding ASCII characters with even parity.

AUTOLOAD SEQUENCE

After the host autoload routine is initiated, the following sequence occurs:

1. The terminal transmits a Load Request upon detection of the network sign-on message (ASCII "/"). If the default file is not selected, the terminal waits for the operator to select the desired load file from the keyboard before transmitting the load request. The message LOADING FILE MM is also displayed to indicate that file number MM is the selected load file.

2. The network must then send Load Blocks to the terminal. As it receives the load blocks, the terminal checks for valid SEQ1 and SEQ2 characters. If they are too large, a NAK sequence is sent and the terminal waits for successful retransmission of the desired block. If they are too small, the terminal ignores the block. The terminal also checks the LDN and A1 A2 A3 characters to see if they match the values expected by the terminal. If not, the terminal sends a NAK sequence and awaits retransmission of the block. After the header has been verified, the terminal stores data characters at sequentially-increasing RAM addresses. When the end of the block is encountered, the received CRC characters are compared to the CRC calculated by the terminal on the received data. If they do not agree, the terminal sends a NAK sequence to request retransmission of the load block.

3. If the two CRC values agree, the block has been received successfully. For DSN operation, if this was not the last load block, the terminal then updates the expected values for the header and awaits receipt of the next block (no positive acknowledgement is sent). If this was the last load block, the terminal sends a Load Complete message signaling a positive acknowledgement of completing the load process.

4. The network then returns to its sign-on phase and awaits operator action. The loader, upon detection of the sign-on phase, turns control over to the loaded controlware.

5. During the load process, the loader program calculates an 8-bit arithmetic-sum checksum of the loaded RAM controlware and saves it for use by the memory checksum routine.

While each block is being loaded the message LOADING FILE MM BLOCK NN is displayed to indicate that block number NN of load file MM is being loaded.

During the load, various timeout conditions can occur. When this happens, the ERROR light is turned on and error recovery is attempted.

If no response to a NAK sequence has been received, the NAK sequence is resent. After three tries without success, the load is aborted with a load-failure message being displayed.

If no response to a load request has been received, the load request is retried up to three times. If there is still no success, the load is aborted with a load-failure message being displayed.

If the network does not return to the sign-on phase after the load-complete message has been sent, the load-complete message is resent. After three retries without success, the load is aborted with a load-failure message.

INTERFACES

The operator interface consists of a series of displays on the CRT screen indicating progress of the load operation. The load process is automatic and does not require any operator interaction.

The message LOADING FILE MM is displayed whenever the terminal sends a load request to the network, indicating that a load of controlware file number MM has been initiated.

The message LOADING FILE MM BLOCK NN is displayed to indicate that block NN of controlware load file MM is being loaded. Error messages are listed below in the Errors paragraph.

At the end of a completed ASCII load, the following common variables are present:

LINFO is set to X1 (ASCII loader used)

ABORTS AND RECOVERY

If the load is unsuccessful due to checksum errors, or no response from the network for 30 seconds, or loss of carrier on the selected RS-232-C communications interface, the ASCII loader displays a HOST LOAD FAIL, FAILURE LOADING MODE message and then returns to the mode selection routine.

Pressing the RESET switch on the terminal front panel results in the terminal aborting the load and running diagnostics again.

ERRORS

The following error messages can be generated on the CRT screen during the course of the load process.

NO REPLY - Indicates that the load operation has not progressed for 30 seconds due to no response or incorrect response from the network. The terminal then sends a new load request and tries loading again up to three times.

HOST LOAD FAIL - Indicates that the load process has been aborted after three unsuccessful load attempts or that host carrier has been lost. The terminal will return to load file selection after momentarilly displaying this message.

In addition, the ERR light on the front panel will be lit whenever a load error has occurred and will remain lit until the error has been recovered or the load has been aborted.

HOST NOT CONNECTED - Indicates no initial carrier signal was detected within 30 seconds of load initialization.

PERFORMANCE

The ASCII loader program in the terminal is capable of loading programs from the ASCII network at communication line rates specified by the send and receive parameters in the mode installation parameters. A typical controlware load will take about 3 to 4 minutes at 1200 bps.

INSTALLATION PARAMETERS

Transmit and receive rates are selectable in the mode installation parameters. These rates must be set to the desired value at the time of installation (see Parameter Selection at the beginning of this section). The last transmit and receive is forced to 8 data bits and no parity.

ROM PACK LOADER

The ROM pack loader transfers control to a program in an internal ROM pack option if the option is present. When a ROM pack is selected as the load source, control is transferred to the ROM pack loader. The presence of a ROM pack is tested first by sensing status. If the status check indicates the presence of a ROM pack, a memory read is performed on the ROM pack to verify its presence. If the ROM pack is present, control is then transferred to the ROM pack. If the ROM pack is not present, a loading failure message appears on the CRT screen.

The ROM pack can contain diagnostics or special functions.

DESCRIPTION

The ROM Pack can be used in many different ways. It can contain a mode like the graphics firmware ROM pack, diagnostics, or special functions routines. In fact, a pack can contain a combination of one, two or all three operations.

The ROM pack has a name, revision level, and three entry points which are located at hexadecimal addresses 8000, 8003, and 8006 as illustrated:

Address	Data	Description
8000	C3 __ __	Entry point to Mode
8003	C3 __ __	Entry point to Diagnostic
8006	C3 __ __	Entry point to Function
800A	X X X	3 ASCII codes of Pack name
800D	X X X	3 ASCII codes of Pack version

- Mode entry - When ROM pack is selected as the load source (see Load Source Selection paragraph), control will be transferred to address 8000 if that address contains a $C3_{16}$ with the mode parameters loaded in RAM. If the C3 is not read, the message "FAILURE LOADING MODE" will be displayed.

- Diagnostic Entry - When test 1 is complete, it will test address 8003 for a C3. If a C3 is read control will be transferred to 8003. If a C3 is not read, control is not transferred and test 1 will be completed. The ROM pack should contain a checksum of its own ROM, test any special hardware it uses and display its name and revision.

- Function Entry - When the terminal is displaying the Mode Selection Menu and the F7 key is depressed, or if Auto Select Mode 7 is selected control will be transferred to address 8006 if it contains a C3. If the C3 is not read the alarm will sound, the message "FAILURE LOADING MODE" will be displayed and control transferred to the mode selection menu.

ABORTS AND RECOVERY

See ERRORS paragraph that follows.

PERFORMANCE

The ROM pack load requires the presence of a ROM pack option at address 8000_{16} bank 5, with the entry table containing a C3 for each entry that is enabled. The operation of the ROM pack load takes less than one second to execute.

INSTALLATION PARAMETERS

A ROM pack option must be installed. See the Load Source Selection paragraph for selecting the proper Mode Installation parameter when using the ROM Pack as the load source. The ROM pack must contain the proper format (the format is contained in the Description paragraph for the the ROM Pack Loader).

INTERFACES

Selection of the ROM pack is described in the Load Source Selection section. Once selected, loading proceeds automatically without operator intervention. If the ROM pack option is not present, the FAILURE LOADING MODE message is displayed.

The common variables are set as follows before the jump to ROM:

- o LINFO is set to a value of X4 hexadecimal (ROM loader used).

ERRORS

If the ROM pack option is not present, the message FAILURE LOADING MODE is displayed on the screen.

FLEXIBLE DISK LOADER

This feature loads a controlware file from the optional flexible disk subsystem. The loadtime is dependent upon the controlware residing on the flexible disk.

DESCRIPTION

The operator must make the flexible disk subsystem ready and insert the desired autoload flexible disk into the flexible disk subsystem before selecting the flexible disk subsystem as the load source. Once loading starts, it continues automatically without operator intervention until successfully completed or until the load fails. The CRT screen is used to display a load failure message should the load fail for some reason.

When the load from flexible disk function (F2-5 CONFIG = 1) is selected by the load source selection process, control is transferred to the Flexible Disk Loader. Loading from the flexible disk subsystem is performed by sending an autoload command from the terminal firmware to the flexible disk subsystem. If no errors occur, the flexible disk subsystem sends controlware in the form of binary data to the terminal. The terminal firmware stores this data in RAM locations and then returns control to the caller program. If the disk load was caused by mode selection, control will be passed to the initial load address in the controlware.

The following steps occur when loading the terminal from the flexible disk which is connected to the parallel I/O interface of the terminal.

1. The terminal sends out a load command (OE_{16}) and looks for a status reply (48_{16}). If the correct reply status is not received, a timeout occurs and the disk load is terminated.

2. The terminal sends out an inverse load command ($F1_{16}$) and looks for a status reply ($4A_{16}$). If the correct reply status is not received, a timeout occurs and the disk load is terminated.

3. The terminal inputs the terminal memory address at which to start storing data, this starting address is stored and used as an entry point. Then the number of data bytes and the data itself. The address and number of bytes are each two bytes long, with the least significant byte being read first.

4. The terminal inputs two bytes of checksum data, which are compared to a calculated checksum of the data bytes. If the checksums to not agree, the disk load is terminated. If they do agree, the terminal firmware returns control to the calling routine.

   Checksum algorithm:

   ```
   H - (H .XOR. DATA) CLS 1    First Byte
   L = (L .XOR. DATA) CRS 1    Second Byte
   ```

   H and L are both 0 initially.

The common variables are set as follows at the end of the Flexible Disk Load.

- o LINFO is set to a value of X2 hex (disk loader used).
- o The other variables are not used.

ABORTS AND RECOVERY

Should the Flexible Disk Load fail for some reason, the terminal will display a DISK LOAD FAIL message on the CRT screen. To recover, the operator must correct the problem with the flexible disk subsystem and then RESET. The terminal will then run the diagnostics and prompt for the operator to enter the mode block number again, this will then return the operation to the Load Source Selection.

PERFORMANCE

This feature requires the presence of an optional flexible disk subsystem. Loading time depends on controlware residing on the flexible disk.

INSTALLATION PARAMETERS

An optional Flexible Disk Subsystem must be connected to the parallel I/O interface of the terminal. Refer to the Flexible Disk Subsystem documentation for installation parameters of the Flexible Disk Subsystem itself. Refer to the preceeding paragraph on Load Source Selection for information on selecting the proper parameters for using the Flexible Disk Subsystems as the load source. The device address of the disk must be set to 7.

CYBER MODE OPERATION

The resident terminal mode is CYBER mode. CYBER mode consists of two operating submodes: Small CYBER mode is functional on CYBER-C120 compatible systems and Large CYBER Mode is functional on CYBER C170/C180 compatible systems. Small CYBER mode emulates an enhanced Advanced Mode operation compatible with the CC628 TTY Display Terminal. Small CYBER and Large CYBER alternate submodes

are both host and operator selectable. The differences are covered by tables 4-2 and 4-9. See table 4-9 for CYBER control codes and escape sequences.

The CYBER mode supports character mode operation and block mode operation, in both protect and nonprotect operation modes.

GENERAL INFORMATION

Refer to section 3 for a description of the terminal operator controls, indicators and audible alarms.

Cursor

In CYBER mode, the cursor indicates the current entry position on the screen and is represented in one of the following manners:

- Constant underline
- Blinking underline
- Solid block
- Blinking solid block

The type of cursor is determined by two operator selectable Mode Installation parameter bits (F6 CONFIG) that form part of the character attribute code.

Character Attributes

A character attribute code (background) is loaded into the display memory for every character display code (foreground). These are:

Bit No.	Feature	
0	Blank	Used by Hardware
1	Underscore	
2	Inverse	
3	Blink	
4	Dim	
5	Modified	
6	Validate	
7	Protect	

The terminal has a host command that can enable (1E,05; table 4-10) or disable (1E,2D) the use of the old attribute. This means that as data is entered from the host or keyboard while the Use Old Attribute is enabled, only the entered data is stored into memory; the character's existing attribute code is not changed (except that the modified bit is set for keyboard input).

If the Use Old Attribute is disabled, a new background code is stored along with the new character in the following manner:

1. The modified bit is always set if the displayable character came from the keyboard and cleared if received from the host (Comm Input).
2. With Protect disabled, a new attribute code will be stored with each keyboard input and Comm Input.
3. With Protect enabled, the old attribute remains unchanged if Comm Input - and with the modified bit set if keyboard input.
4. The validate bit is not changed with keyboard input.

Line Attribute

Two line attribute bits are available, but not used.

Parity Errors

If parity errors are received while alphanumeric display information is being received from the keyboard, the code is ignored.

KEYBOARD OPERATION

In CYBER mode, the keyboard operates with all 128 ASCII codes. Table 4-2 contains a listing of the keyboard codes and legends. Refer to section 3 for figures of keycap options, the languages supported, and the keystation assignments. Refer to tables 4-3 through 4-8 for the keycodes associated with the foreign language keyboards.

TABLE 4-2. KEYCODES AND LEGENDS OF STANDARD KEYBOARD

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
1	DS, L		PRINT					
		Small CYBER Mode			1E,11	1E,01	1E,11	1E,01
		Large CYBER Mode			1E,02	1E,01	1E,02	1E,01
2			SETUP		-	-	-	-
3	D, L		(F1)		1E,71	1E,61	1E,31	1E,21
4	D, L		(F2)		1E,72	1E,62	1E,32	1E,22
5	D, L		(F3)		1E,73	1E,63	1E,33	1E,23
6	D, L		(F4)		1E,74	1E,64	1E,34	1E,24
7	D, L		(F5)		1E,75	1E,65	1E,35	1E,25
8	D, L		(F6)		1E,76	1E,66	1E,36	1E,26
9	D, L		(F7)		1E,77	1E,67	1E,37	1E,27
			⇐					
10	D, L		(F8)		1E,78	1E,68	1E,38	1E,28
			SUPER					
11	D, L		(F9)		1E,79	1E,69	1E,39	1E,29
			SUB					
12	D, L		(F10)		1E,7A	1E,6A	1E,3A	1E,2A
			MICRO					
13	D, L		(F11)		1E,7B	1E,6B	1E,3B	1E,2B
			FONT					
14	D, L		(F12)		1E,7C	1E,6C	1E,3C	1E,2C
15	L,D		+	DOWN **	1E,12,20	1E,12,21	1E,12,22	1E,12,23
16	R, L				-	-	-	-
17	R	1		!	31	21	31	21
18	R	2		@	32	40	00	00
19	R	3		#	33	23	33	23
20	R	4		$	34	24	34	24
21	R	5		%	35	25	35	25
22	R	6		^	36	5E	36	5E
23	R	7		&	37	26	37	26
24	R	8		*	38	2A	38	2A

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TABLE 4-2. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
25	R	9		(	39	28	39	28
26	R	0		)	30	29	30	29
27	R	-		—	2D	5F	1F	1F
28	R	=		+	3D	2B	1E	1E
29	R	`		~	60	7E	60	7E
30	R		←					
		Small CYBER Mode			19	19	19	19
		Large CYBER Mode			08	08	08	08
31	L,D		—	UP **	1E,12,24	1E,12,25	1E,12,26	1E,12,27
32	R,L,DS		→|		09	09	1E,12,57	1E,12,57
33	R		Q	↖ **	71	51	11	11
34	R		W	↑ **	77	57	17	17
35	R		E	↗ **	65	45	05	05
36	R		R		72	52	12	12
37	R		T		74	54	14	14
38	R		Y		79	59	19	19
39	R		U		75	55	15	15
40	R		I		69	49	09	09
41	R		O		6F	4F	0F	0F
42	R		P		70	50	10	10
43	R	[		]	5B	5D	1D	1D
44	R	\		¦	5C	7C	1C	1C
45	R,L,DS		|←		1E,0B	1E,0B	1E,12,58	1E,12,58
46	D,L		X	FWD **	1E,12,28	1E,12,29	1E,12,2A	1E,12,2B
47			⊖		-	-	-	-
48	R		A	← **	61	41	01	01
49	R		S		73	53	13	13
50	R		D	→ **	64	44	04	04
51	R		F		66	46	06	06
52	R		G		67	47	07	07
53	R		H		68	48	08	08

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TABLE 4-2. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
54	R		J		6A	4A	0A	0A
55	R		K		6B	4B	0B	0B
56	R		L		6C	4C	0C	0C
57	R	;		:	3B	3A	3B	3A
58	R	'		"	27	22	27	22
59	R	{		}	7B	7D	7B	7D
60	See Key 75				-	-	-	-
61	D, L		÷	BKW **	1E,12,2C	1E,12,2D	1E,12,2E	1E,12,2F
62			⇧		-	-	-	-
63	R				-	-	-	-
64	R		Z	↙ **	7A	5A	1A	1A
65	R		X	↓ **	78	58	18	18
66	R		C	↘ **	63	43	03	03
67	R		V		76	56	16	16
68	R		B		62	42	02	02
69	R		N		6E	4E	0E	0E
70	R		M		6D	4D	0D	0D
71	R	,		<	2C	3C	2C	3C
72	R	.		>	2E	3E	2E	3E
73	R	/		?	2F	3F	2F	3F
74			⇧		-	-	-	-
75	L	↵		NEXT				
		Small CYBER Mode			0A	0A	0A	0A
		Large CYBER Mode			0D	0D	0D	0D
76			CTRL		-	-	-	-
77	R		(Space)		20	20	20	20
78		DEL		CR	7F	0D	7F	0D
79	D, L		HELP		1E,5C	1E,58	1E,5C	1E,58
80	D, L	ANS	(F13)	TERM	1E,7D	1E,6D	1E,3D	1E,2D

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TABLE 4-2. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

KEY NO.	NOTES*	KEY LEGENDS LOWER	CENTER	UPPER	PRESSED WITH KEY ... GENERATE	⇧	CTRL	⇧ •CTRL
81	DS, L		ERASE					
		Small CYBER Mode			1E,5D	1E,59	1E,5D	1E,59
		Large CYBER Mode			1F	1E,5D	1E,5D	1E,59
82	D, L		COPY					
			(F14)		1E,7E	1E,6E	1E,3E	1E,2E
83	D, L		EDIT		1E,5E	1E,5A	1E,5E	1E,5A
84	D, L		□					
			(F15)		1E,70	1E,60	1E,30	1E,20
85	D, L		BACK		1E,5F	1E,5B	1E,5F	1E,5B
86	D, L		LAB		1E,12,31	1E,12,32	1E,12,33	1E,12,33
87	D, L		DATA		1E,12,35	1E,12,36		
88	D, L		STOP		1E,49	1E,4A	1E,49	1E,4A
89	DS, L, R	C	INSRT	L	1E,4F	1E,52	1E,4F	1E,52
90	DS, L, R	C	DLETE	L	1E,4E	1E,51	1E,4E	1E,51
91	L	EOL	CLEAR	P	0B	0C	0B	0C
92		ESC		LF	1B	0A	1B	0A
93		BREAK		M REL	BREAK	11	BREAK	11
94	R, L,N		7		37	-	37	-
95	R, L,N	8		↑	38	17	38	17
96	R, L,N		9		39	-	39	-
97	R,L,N,	4		←				
	D	Small CYBER Mode			34	19	19	1E,19
		Large CYBER Mode			34	08	34	08
98	R,L,N,	5		HOME**				
	D	Small CYBER Mode			35	08	08	1E,08
		Large CYBER Mode			35	19	35	19
99	R,L,N,	6		→				
	D	Small CYBER Mode			36	18	18	1E,18
		Large CYBER Mode			36	18	36	18
100	R, L,N	1			31	-	31	-

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TABLE 4-2. KEYCODES AND LEGENDS OF STANDARD KEYBOARD (CONTD)

KEY NO.	NOTES*	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
		LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
101	R,L,N,	2		↓				
	D	Small CYBER Mode			32	1A	1A	1E,1A
		Large CYBER Mode			32	1A	32	1A
102	R, L,N	3			33	-	33	-
103	R, L,N	,			2C	-	2C	-
104	R, L,N	0			30	-	30	-
105	R, L,N	.			2E	-	2E	-
106	L,N	←┘		NEXT				
		Small CYBER Mode			0A	0A	0A	0A
		Large CYBER Mode			0D	0D	0D	0D

*Key to Notes:

N - Modified if the Numeric Pad parameter is set to SHIFT.
R - Auto repeat if TYPAMATIC is on.
L - Host loadable.
D - Delimiter. CR sent when enabled by host.
DS - Delimiter. CR sent when enabled by host in small CYBER mode.
\- - No code generated.
** - Labeled on skirt of keycap.

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TABLE 4-3. KEYCODE AND LEGEND ADDENDUM FOR GERMAN KEYCAP KIT

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		§	33	40	33	40
22	6		&	36	26	36	26
23	7		/	37	2F	37	3F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	ß		?	7E	3F	1F	1F
28	´		`	27	60	1E	1E
29				-	-	-	-
38		Z		7A	5A	19	19
43		Ü		7D	5D	1D	1D
44	+		*	2B	2A	1C	1C
57		Ö		7C	5C	7C	5C
58		Ä		7B	5B	7B	5B
59	#		^	23	5E	23	5E
63	<		>	3C	3E	3C	3E
64		Y		79	59	1A	1A
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

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TABLE 4-4. KEYCODE AND LEGEND ADDENDUM FOR FRENCH KEYCAP KIT

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ ·CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		§	33	5D	33	5D
22	6		+	36	2B	36	2B
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	´		?	27	3F	1F	1F
28	^		¨	5E	7E	1E	1E
29				-	-	-	-
43	à		ç	40	5C	1D	1D
44	&		*	26	2A	1C	1C
57	é		è	7B	7D	7B	7D
58	ù		o	7C	5B	7C	5B
59	`		£	60	23	60	23
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

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TABLE 4-5. KEYCODE AND LEGEND ADDENDUM FOR SWEDISH/FINNISH KEYCAP KIT

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
19	3		#	33	23	33	23
20	4		¤	34	24	34	24
22	6		&	36	26	36	26
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	+		?	2B	3F	1F	1F
28		É		60	40	1E	1E
29				-	-	-	-
43		Å		7D	5D	1D	1D
44		Ü		7E	5E	1C	1C
57		Ö		7C	5C	7C	5C
58		Ä		7B	5B	7B	5B
59	´		*	27	2A	27	2A
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

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TABLE 4-6. KEYCODE AND LEGEND ADDENDUM FOR BRITISH KEYCAP KIT

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
16	`		¬	60	7E	60	7E
19	3		£	33	23	33	23
29				-	-	-	-
63	<		>	3C	3E	3C	3E
71	,		,	2C	2C	2C	2C
72	.		.	2E	2E	2E	2E

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TABLE 4-7. KEYCODE AND LEGEND ADDENDUM FOR SPANISH KEYCAP KIT

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
16	`		~	60	7E	60	7E
18	2		§	32	40	00	00
19	3		£	33	23	33	23
29				-	-	-	-
43	]		[	1E, 4B	1E, 4D	1D	1D
44	ç		Ç	7D	5D	1C	1C
57		Ñ		7C	5C	7C	5C
58	º		¡	7B	5B	7B	5B
59	'		"	27	22	27	22
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A

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TABLE 4-8. KEYCODE AND LEGEND ADDENDUM FOR DANISH/NORWEGIAN KEYCAP KIT

KEY NO.	KEY LEGENDS			PRESSED WITH KEY ... GENERATE			
	LOWER	CENTER	UPPER		⇧	CTRL	⇧ •CTRL
16	[		]	1E, 4B	1E, 4D	1E, 4B	1E, 4D
18	2		"	32	22	00	00
22	6		&	36	26	36	26
23	7		/	37	2F	37	2F
24	8		(	38	28	38	28
25	9		)	39	29	39	29
26	0		=	30	3D	30	3D
27	+		?	2B	3F	1F	1F
28	`		@	60	40	1E	1E
29				-	-	-	-
43		Å		7D	5D	1D	1D
44	¯		^	7E	5E	1C	1C
57		ø		7C	5C	7C	5C
58		Æ		7B	5B	7B	5B
59	´	¨	*	27	2A	27	2A
63	<		>	3C	3E	3C	3E
71	,		;	2C	3B	2C	3B
72	.		:	2E	3A	2E	3A
73	-		_	2D	5F	2D	5F

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Seven keyboard languages are supported by CYBER mode. The operator indicates the language chosen via the F7 CONFIG entry when entering the Terminal Installation parameters.

Figure 3-2 illustrates the 48-key proposed ANSI standard keyboard array. Figures 3-3 through 3-8 show the 48-key ISO standard keyboard with foreign keycap kits installed. Figure 3-9 displays the keyboard keystation assignments. In this figure, the symbols on the top of the keys support the standard alphanumeric requirements and mode dependent special function keys. Special templates may be overlaid on the keyboard to allow the keys to be labled with application-unique legends. The keyboard conforms to ANSI X4.14-1971 and the 46-key subset of ISO 3243 Standard. A provision is made to support full compatibility with the 48-key ISO 3243 Standard and the proposed 48-key ANSI X4A12 Standard.

All code generation is controlled by the terminal firmware. Also, the terminal firmware provides typamatic action on all keys. This typamatic action provides a repeat rate of 15 $\pm$3 characters per second after a 1-second delay when the operator holds a key pressed. Typamatic action can be disabled by host command or by Mode Installation parameter selection (F4 CONFIG). All terminal code generation is controlled by the terminal firmware.

The transmission of keyboard input is governed by the transmission mode being used, which is host controlled. As described later under Character-Transmit Mode and Block-Transmit Mode, transmission may either occur immediately as a key is pressed (character mode) or input may be stored until the operator initiates transmission (block mode).

For protected character locations (with Auto Tabbing disabled), actuating any alphanumeric or control code key causes the alarm to sound with no other action taken. The cursor does not move when this condition occurs. Cursor control operation, however, is always allowed when the keyboard is enabled.

For protected character locations with Auto Tabbing enabled, the cursor will be tabbed over protected areas after keyboard entry.

Keyboard codes can function in three different ways:

- Normal - Pressing a key causes the corresponding code (table 4-2) to be sent to the host (immediately in character mode or subsequently in block mode).

- Host-Loaded Code Sequence - If the host has loaded a code sequence for that key (table 4-2 indicates the keys which are loadable), the loaded code sequence will be sent to the host in place of the normal key codes. If the terminal is in half-duplex routing, the codes will not be acted upon by the terminal.

- Host-Loaded Controlware - If the host has loaded Z80 code controlware for that key, a call will be made to the loaded controlware.

The following paragraphs describe the function of the basic keys and the operations they perform.

⇧ (Shift) Keys

When two symbols share the same key, the upper symbol or control function is active only while either one of the two Shift keys is actuated.

Pressing the Shift key in conjunction with a key labeled with a single legend causes the transmission of the uppercase code for the symbol shown on the key as indicated in table 4-2.

⊕ (LOCK) Key/Indicator

The Lock key is operator-parameter selectable (F6, Operator parameter) to perform a shift-lock or alpha-lock function. In shift-lock mode, all function, control and alpha/numeric keys unconditionally transmit the level two column shifted keycode definition shown in table 4-2. Operator care must be exercised to ensure intended operation of all keys when shift-lock mode is active. Shift lock is provided for single key activation ease of use.

In alpha-lock mode when lit, causes all alphabetic keys to transmit only the uppercase code until pressed a second time. The alpha-lock mode is provided to disable the generation of lowercase codes. If this key is in the lock position, uppercase characters are generated in place of the lowercase characters. Special function, control, and numeric keys are unaffected. This key contains an indicator that is illuminated when in lock mode.

CTRL (Control) Key

Pressing the CTRL key in conjunction with any data key or combination of data key and Shift key causes the generation of the codes outlined in the level three and level four columns of table 4-2, respectively, unless modified by loaded codes.

For protected locations and block mode operation, pressing the CTRL key in conjunction with any data key causes an audible alarm and no action is taken.

RESET Switch

Actuating the RESET switch initiates the power-on reset function that causes the terminal to reinitialize and perform a self-test routine. At the completion of the self-test routine, the terminal checks the terminal installation parameters to determine whether to display the Mode Menu (manual-mode selection) or to load/enter the designated mode (automatic-mode selection).

Activating the RESET switch halts any data transfer to or from the terminal, including terminal to host and terminal to printer transfers.

Host Multiple Code Sequences

There are many host-initiated functions which have multiple-code sequences. (See table 4-9.) These sequences contain either two codes (RS, X) or three codes (RS, DC2, X). When the terminal receives the RS code, keyboard inputs will be ignored until one of the following conditions is met:

- The next code is processed (unless it is a DC2 code).
- The next code is DC2 and keyboard inputs are ignored until one more code is received.

NOTE

If the RS code or RS, DC2 codes are received without another code following, the keyboard may be hung up. The manual release (M REL) function re-enables the keyboard.

Validation

The host has the ability to load validation code, (see the Host Specified Code Sequence/Controlware) and start/stop validation.

As the host is entering data on the screen, the start validation will store the validate bit in background memory for each code stored while the start validation is active.

As keys are pressed on the keyboard, the following conditions are tested against the question:

Is the key a host-loadable key?

- o If YES-perform loadable key function
- o If NO-is current position a validate position?
  - If NO-perform normal function
  - If YES-has host loaded validation code?

    --If NO-perform normal function

    --If YES-call host loaded validation code. When control is returned, the normal function will be performed if the ZERO flag is clear. Nothing will be done if the ZERO flag is set.

Example of Loading Validation Code

Following is an example of loading validation code that requires a 0 through 9 to be entered. If the code is not between 0 through 9, the alarm will sound and nothing displays on the screen.

First the identification codes are sent.

ASCII	RS,	HT,	V,	W
HEX	1E,	09,	30,	32

Next the address of the code is sent (must be broken up with 20 added to odd numbered codes and 60 added to even numbered codes). Example shows address $D095_{16}$.

HEX 2D, 60, 29, 65

Next the code is sent (must be broken up with 20 added to upper half of each 8 bit code and 60 added to the lower half).

Following is a listing of Z80 codes (0_{16}).

```
1:                      ;       ENTER WITH ASCII CODE TO TEST IN REG. B
2: 0000                 VAL     EQU     $
3: 0000 ┌78            |       LD      A,B             ; MOVE CODE TO A
4: 0001 | FE30          |       CP      30H             ; COMPAIR TO ASCII 0
5: 0003 | 3806      000B$       JR      C,VALERR        ; JUMP TO ERROR IF CODE LESS THAN 0
6: 0005 | FE3A          |       CP      3AH             ; COMPAIR TO CODE ABOVE 9
7: 0007 | 3002      000B$       JR      NCVALERR        ; JUMP TO ERROR IF CODE > OR = 3AH
8:      |               |   ;   ENTER HERE TO SET THE ZERO FLAG (CODE IS OKAY)
9: 0009 | AF            |       XOR     A               ; SET ZERO FLAG
10: 000A| C9            |       RET                     ; RETURN
11:     |               |   ;   ENTER HERE TO SOUND THE ALARM, CLEAR THE ZERO FLAG AND RETURN
12: 000B|               |   VALERR EQU    $
13: 000B| CD33 00       |       CALL    0033H           ; CALL ALARM ROUTINE
14: 000E| AF            |       XOR     A               ; CLEAR A
15: 000F| 3C            |       INC     A               ; CLEAR ZERO FLAG
16: 0010| C9            |       RET                     ; RETURN
17: 0011                        end             ;End of file on input
```

27, 68, 2F, 6E, 23, 60, 23, 68, 20, 66, 2F, 6E, 23, 6A, 23, 60, 20, 62, 2A, 6F, 2C, 69, 2C, 6D, 23, 63, 20, 60, 2A, 6F, 23, 6C, 2C, 69

Next the termination code is sent:

Z

CR

$0D_{16}$

Prologue Code

The primary use of the prologue characters is as a screen or transaction identifier which would be unknown, not modifiable, and not displayable by the terminal operator. The user is able to down-load a series of characters to be used as a screen prologue. In block mode, the screen prologue characters, if active, will be sent back to the host prior to sending the unprotected fields on the screen.

Prologue characters are down-loaded using the following command:

RS, HT, (V), (W), (X), (Y), (Z)

where:

V = 5F (the prologue command identifier)
W = 31 (the host code sequence)
X = the address in RAM where the code is to be loaded
Y = the prologue character sequence (same as the host code sequence)
Z = termination code (CR)

To clear the prologue characters, the user sends the following command:

RS, HT, (V), (W), (X), (Y), (Z)

where:

V = 5F (the prologue command identifier)
W = 30 (clears the function)
X = not required
Y = not required
Z = termination code

Printer Operation

The CYBER modes support an RS-232-C printer connected to either port on the dual serial interface board and the 726-10 graphic printer on the parallel channel. As data is received from the host, it is sent to the printer if the Printr On parameter is selected. As data is entered from the keyboard, it is sent to the printer only if the Printer On parameter is selected and half duplex is active.

There are two reasons for data to be sent to a printer:

1. Online receive data

2. Local print key

The terminal can send data to either serial or parallel printers, depending upon the printer type specified in the operator parameters.

Online Printing

When printing online data, the terminal can be set to either monitor the Printer Ready signal or ignore it.

Online data is sent to a serial printer if the serial printer is selected in the operator parameters and:

1. Monitor printer DSR parameter is not set.
2. Monitor printer DSR parameter is set and the DSR input signal from the printer is active.

NOTE

The terminal will hang waiting if the monitor DSR parameter is set and the DSR input signal from the printer is not active.

Online data is sent to a parallel printer if the PARALL printer is selected in the operator parameter and:

1. Printer is turned on and the monitor printer DSR parameter is not set.
2. Printer is turned on and the monitor printer DSR parameter is set and the Printer Ready status is active. Printer is not ready if:

   a. Paper out

   b. The platen yoke assembly is not closed

   c. A vertical format unit fault occurs

   d. A paper jam or paper motion fault occurs

   e. Printer is off-line (deselected)

NOTE

The terminal will hang waiting if the monitor printer DSR parameter is set and the printer is not ready and selected.

Off-line Printing

Since the terminal does not check the monitor printer DSR parameter, the printer must be made ready before printing local data using the print key (or host print commands to print the screen).

Local prints to a serial printer requires:

1. Printer ON
2. DSR input signal from the printer active.

Local prints to a parallel printer requires:

1. Printer ON
2. Printer ready and selected.
3. If no serial printer is connected, that ports A and B of the dual serial-interface board be set in the terminal installation parameters for bidirectional operation. This applies even though no dual serial-interface board may be installed.

Printer Buffer Control

The printer X-ON/X-OFF condition is supported on the serial printers. If the printer sends an X-OFF signal to the terminal, the terminal will stop taking data from the buffer and sending it to the printer. When the X-ON signal is received from the printer, data transfer is resumed.

When the host communication input buffer reaches three-quarter capacity, an X-OFF signal is sent to the host. If it is desired to communicate with the host after the printer has sent an X-OFF signal, the manual release operation will send an X-ON signal to the host and the terminal will resume sending data to the printer even if it cannot accept it.

When CYBER is selected, an ESC,4 will be sent to the 726-20 serial graphic printers to select the basic character set. The ESC,4 is also sent when the Print key is pressed.

Autodial

CYBER mode can be set to run with the internal 1200/1200 baud modem. The modem can be set either to automatically dial a previously entered phone number or to request the operator to enter a phone number via the keyboard. The autodial routine is located in the firmware for the internal modem. This routine may be invoked in either of the following ways: 1) automatically when CYBER mode is selected, or 2) when the SETUP key is pressed, the F2 key is toggled to select the DIAL function, and the F1 key is pressed to return to the operating mode of the terminal. Refer to Mode Installation parameters for the terminal, to appendix D of this manual, and to the associated terminal operator's guide to determine how a phone number is actually entered and dialed by the internal modem.

Auto-answer

CYBER mode can be made to enter an Auto-answer mode. In this mode, control passes to the internal modem firmware to monitor the phone line and to answer an incoming phone call. After answering a call, control passes back to the operating mode. The auto-answer function can be invoked by pressing the SETUP key, toggling the F2 key to select the DIAL function, and pressing the F1 key to return to the operating mode of the terminal. Bringing the modem back to an on-hook state may be accomplished by using either the auto or manual hangup functions.

Auto/Manual Hangup

If the carrier on (CO) signal is absent for more than 5 seconds while using the internal modem, the Monitor routine of the resident program calls the auto-hangup routine of the modem. This routine then places the internal modem back in the on-hook state. The internal modem may also be placed in the on-hook state by pressing the SETUP key, toggling the F2 key to select the HANGUP function, and pressing the F1 key to return to the operating mode of the terminal.

CHARACTER-TRANSMIT MODE OPERATION

The basic type of transmission in CYBER mode is character transmission which emulates the operation of the CC628 TTY Display Terminal. This transmission mode is in effect unless a command to enter block mode is received from the host. CYBER mode also includes the protect enable/disable feature which when enabled, provides the capability to protect each screen character position selectively. The protect feature is discussed more fully in later paragraphs.

The keyboard employs two types of keys; alphanumeric keys and control/function keys. The alphanumeric keys send codes and display symbols whereas control/function keys send codes and perform special actions. These special actions are defined later.

As keys are pressed the associated codes are sent directly to the host if the terminal is operating online. The associated codes are displayed if the terminal is operating in local or half-duplex. The attribute word is stored in background memory with modified bit set as the codes are displayed. (Reference table 4-11 for definition of attribute codes.)

If autotab is disabled and the cursor occupies a protected position, no data is sent to the host and the alarm will sound when a displayable key is pressed.

If autotabbing is enabled and the cursor occupies a protected position, the cursor will be tabbed to the first unprotected position when a displayable key is pressed.

The cursor is allowed in protected areas. The host must do a Protect Disable to perform Clear functions.

When a function requires the clearing of data, the modified attribute bit is cleared for each position cleared.

CYBER mode supports host loadable code sequences or host loaded controlware. The codes specified by tables 4-9,4-10 and 4-11 can be acted upon in one of three ways:

- Normal - As a key is pressed, the associated code is sent to the host.

- Host Loaded Code Sequence - If the host has loaded an ASCII code sequence for that key, those codes will be sent to the host instead of the normal keycode. If the terminal is in half duplex, the codes will not be acted upon by the terminal.

- Host Loaded Controlware - If the host has loaded Z80 code controlware for that key, a call will be made to the Z80 code controlware.

  For more information on Host Specified Code Sequence or Host Loaded Controlware see the following Host Specified Code Sequence/Controlware paragraph.

To minimize redundancy, the following paragraphs discussing keyboard key operations will in some cases, describe the key operation in the protect-enabled mode - although the protect enable feature is itself not discussed until later in the manual.

PRINT Key (Character Mode)

Pressing the PRINT key initiates the transmission of a page print code sequence to the host. If half-duplex is selected, the terminal causes all data from the top of page to the end of page to be printed as it appears on the screen. A form feed code is first sent to the printer. All codes 7F through FF (line drawing, PLATO, loadable codes) are replaced by spaces and a carriage return/line feed is inserted at the end of each line. When online, all incoming codes are ignored (not lost) until completion of the print transmission. Received data is placed into the receive buffer, and an X-Off may be sent (see following paragraph on sending X-Off/X-On) if the buffer becomes too full.

Print completion is signaled by the terminal transmitting a print complete code (ACK) or if the operation is aborted by actuating the SHIFT/M REL key; transmission of an abnormal completion sequence (RS, NAK). No response is sent in Large CYBER mode. (Note: Actuating Shift/M REL will first send an X-On (DC1) to the host).

If the PRINT key is actuated in conjunction with the SHIFT key, a print form code sequence is generated. If half-duplex is selected, the terminal sends all data as previously described except dimmed data is replaced with space codes for transfer to the printer.

The keyboard is locked during the print operation. A 250 ms delay is inserted after each CR, LF, FF if the SRTs is off and the Use Printer SRTS parameter (Terminal Installation parameter F4-2 CONFIG) is active. If the printer is not ready, DTR off, or goes not ready, nothing will be sent to the printer until DTR goes on or the print sequence is aborted by the M/REL function.

Printing is supported on three different types of printers.

1. Serial Graphics Printer (726-20)
2. Serial Printers (Letter Quality, Matrix)
3. Graphic Printer (726-10)

There are three ports that can be used for a printer.

1. Dual Serial Port A
2. Dual Serial Port B
3. Parallel Port

When the PRINT key is pressed, the printers will be tested in the above order. The first one that is found to be ready will be used.

If the serial graphics printer is installed and ready, an ESC. 4 command is sent to switch to default character mode before any printing is started.

SETUP Key (Character Mode)

Activating the SETUP key causes the terminal to display the operator mode status (eight parameters) on the bottom two lines of the display. The bottom lines are not lost. When displayed, mode operating parameters can be changed. Activating the F1 (Return) key causes deletion of the status line and returns screen data to its original position. If data is received from the host, it is placed into the 992 character COMM INPUT BUFFER. If online, an X-OFF will be sent to the host when the buffer reaches 768 characters.

NOTE

If the mode is exited by pressing F10, F10, the host may be left with the X-OFF active.

Special Function Keys (Character Mode)

Fifteen four-level special function keys (F1 through F15) are contained on the keyboard. When pressed, these keys cause the transmission of a 2-character sequence. The first character is an $1E_{16}$, the second character is unique to the individual function key whether it is shifted, unshifted, or activated in conjunction with the CTRL (Control) key (refer to table 4-2).

The following additional host-defined actions are also available:

- A host-selectable CR ($0D_{16}$ code delimiter added to the code sequence defined in table 4-2.
- A host-specified code sequence or a host defined controlware sequence executed in response to a key activation. The host-specified action includes a key identifier, a code sequence or controlware sequence selector, and the actual code sequence or controlware sequence.

L/INSRT/C Key (Character Mode)

When unshifted this key causes the entry of a space code in the present cursor position. The character that occupied that position and all characters to the right of the cursor are moved one position to the right. This character shift to the right is continued to the end of the line or to the end of the unprotected field whichever occurs first. The rightmost character is then lost. This key is ignored and the audible alarm is activated if the cursor currently occupies a protected position. The space that was inserted will retain the old attribute in background memory.

When shifted this key causes the entry of a line of space codes into the display line presently occupied by the cursor. The line of data that occupied the cursor line is then moved down one line position. This line shift is continued until the bottom line or until a line with protected data is encountered. The data in the bottom line, or just above the line with any protected data is lost. This shifted key is ignored and the audible alarm is activated if the cursor currently occupies a line with any protected character positions. The background memory will not be changed. The modified attribute bit is cleared in character mode and set in block mode for all character locations changed.

L/DLETE/C Key (Character Mode)

Unshifted, this key causes the deletion of the character code in the present cursor position. The character code to the right of the cursor is moved one position to the left and this character shift to the left continues to the end of the unprotected field or to the end of the line, whichever occurs first. The rightmost position shifted left is then replaced with a space code. This key is ignored and the audible alarm is activated if the cursor currently occupies a protected position. The new space code will retain the old attribute in background memory.

Shifted, this key causes the deletion of line of codes in the line presently occupied by the cursor. The lines below this line are then shifted up one line position. This shift continues until the bottom line or until a line with any protected data is encountered. The line position of the last line shifted up is then over replaced with space codes. This shifted key is ignored and the audible alarm is activated if the cursor currently occupies a line with any protected position. The background memory will not be changed if the Use Old Attribute is enabled.

P/CLEAR/EOL (Erase Page and Erase End of Line) Key (Character Mode)

When unshifted this key causes the entry of a space code into all unprotected display positions from, and including, the current cursor position to the end of line. The cursor is not moved. The modified attribute bit is cleared in character mode and set in block mode for all character locations cleared.

When shifted this key causes the entry of a space code into all unprotected display positions. The cursor is moved to the home position. The modified attribute bit is cleared in character mode and set in block mode for all character locations cleared.

LF/ESC (Line Feed/Escape Key (Character Mode)

Unshifted, this key causes and ESC code to be sent to the host. Shifted, this key causes an LF code to be sent to the host.

M REL/BREAK Key (Character Mode)

Actuation of the M REL/BREAK key in the unshifted positions causes the transmitted data signal to be held to a space (logical 0) condition for approximately 250 milliseconds. If a break is received, a parity error symbol is entered at the cursor position and the audible alarm is actuated (7-bit operation only).

Actuation of this key in the shifted position causes a manual release operation to be executed. This provides a controlware/ firmware break function and sends an X-ON (DC1) signal to the host. If a print operation is active, it will be aborted, the keyboard unlocked and the comm input buffer cleared.

NEXT/ ←┘ (New Line) Key (Character Mode)

Small CYBER - The NEXT/New Line key moves the cursor to the first location of the next line and causes a new line code (OA_{16} to be transmitted.

Large CYBER - Moves the cursor to the first location of the current line and causes a carriage return code (OD_{16}) to be transmitted. If the Auto LF is enabled a line feed is performed.

If the new position is protected and the autotabbing is enabled, a forward tab will be performed.

→|(Tab Forward) Key (Character Mode)

Pressing this key causes the transmission of the tab sequence. If pressed in conjunction with the Control key it will set the current column as a tab stop. If protect is not enabled, the key will move the cursor to the first position following the low intensity field or next column tab, whichever comes first. If none are present, the cursor moves to the top of page. If protect is enabled, this key will cause the cursor to move right to the beginning of the next unprotected field or the next unprotected column tab or the home position if none are found. If the cursor is at the beginning of an unprotected field or at a protected character position, the cursor will move to the beginning of the next unprotected field or the home position, if neither is found.

⇤ (Tab Backward) Key (Character Mode)

Activating this key causes the transmission of the back tab sequence. If protect is enabled, the backtab key moves the cursor left to either the beginning of the current unprotected field or the next unprotected column tab, or to the upper left-hand position, whichever is reached first.

If protect is not enabled, the key will move the cursor backwards to the start of the current or previous unprotected field or to the next unprotected column tab position, whichever comes first. If none are present, the cursor moves to the home position; if this position is protected, another backtab is performed. If pressed in conjunction with the CTRL key, the tab backward key clears the current column as a tab stop.

Cursor Control (Up ↑, Down ↓, Left ←, Right → and HOME) Keys (Character Mode)

Five keys (↑ , ↓ , ← , → , HOME) in the numeric cluster are used to enable cursor movement. The cursor control keys must be used in conjunction with the Shift key or the Shift and CTRL keys. The numeric pad keys are also affected by the N PAD NORMAL/SHIFT parameter. Key functions are described as follows:

- Cursor Up - The shifted numeric 8 key moves the cursor up one line. If the cursor up key is activated in the top line, the cursor moves to the current column position in the last line. If the character position that the cursor is to occupy is protected, the cursor moves to the protected position.
- Cursor Down - The shifted numeric 2 key moves the cursor down one line. If the cursor down key is activated and the cursor is in the bottom line, the cursor moves to the current column position in top line. If the character position that the cursor is to occupy is protected, the cursor moves to the protected position.
- Cursor Left - The shifted numeric 4 key or Backspace key moves the cursor left one character position. If the cursor is in column 1 when the key is activated, the cursor moves to the last column position (80 or 132) of the previous line. If the cursor is at upper-left, it will move to the last column of the bottom line. If the position the cursor is to occupy is protected, the cursor moves either to the protected position if autotabbing is disabled, or is tabbed to the next unprotected field if enabled.

- Cursor Right - The shifted numeric 6 key moves the cursor right one character position. If the cursor is in the last column position (80 or 132) when the key is activated, the cursor moves to column 1 of the next line. If the cursor is at the last column of the bottom line, it moves to upper-left if page operation is selected or causes the screen to scroll in roll operation. If the position the cursor is to occupy is protected, the cursor moves to the protected position if autotabbing is disabled.

- Home - The shifted numeric 5 key moves the cursor to the home position. If the position the cursor is to occupy is protected, the cursor moves to the protected position if autotabbing is disabled.

CR/DEL (Carriage Return/Delete) Key (Character Mode)

Unshifted, the CR/DEL key transmits a delete (DEL) code. Shifted, the CR/DEL key transmits a carriage return (CR) code.

Special Action (+, -, x, ÷, HELP, ERASE, EDIT, BACK, LAB, DATA, STOP) Keys (Characetr Mode)

Eleven special action keys are available on the keyboard. Action keycodes and code sequences as defined by table 4-1 are transmitted to the host.

All keys identified in table 4-1 that are not function keys and support a host-specified optional code sequence or controlware sequence support the additional host defined action:

- A host-specified code sequence or a host-defined controlware sequence is executed in response to a key activation. The host-specified action includes a key identifying a code sequence or controlware sequence selector and the actual code sequence or controlware sequence.

- ERASE - This key performs a LINE CLEAR and carriage return or a destructive backspace in half-duplex. See Protect Operation later in this section.

The basic terminal CYBER mode includes the capability to perform operator entry and editing on a page basis offline to the host. When the operator completes an offline activity, a block mode transmission is then initiated by the operator to the host.

As alphanumeric keys are pressed, the associated 7-bit code is stored in display memory. Bit 2^7 in display memory will not be modified. Therefore, a graphic, PLATO, RAM generator character will be displayed if the previous code stored there was a graphic, PLATO, or RAM generator character. The attribute word will be stored in background memory with the modified bit set. The cursor will advance to the next position. If the cursor occupied a protected position, a TAB will be performed before storing the data. If the operator initiates a function which requires the clearing of data, the modified attribute bit will be set for each position cleared.

As alphanumeric codes are received from the host they will be stored along with the new attribute bits and the modified bit will be cleared. If protect is enabled the attributes will not be stored with received data. If the cursor is at a protected position when data is received, a TAB will be performed before storing the data.

Host Communications (Block Mode)

The host uses two commands to initiate and terminate block mode transmission:

- Enter Block Mode - When block mode is active, the operator enters and/or changes data locally at the terminal on a page basis without host intervention. Block transmission is initiated by the operator when the current page activity is completed.
- Exit Block Mode - Terminates local terminal activity.

  Block mode selection can only be activated by host command (not an installation parameter). When the block mode operation is active, the host utilizes the following commands to properly support block mode operation.

  - Enable/Disable Keyboard - Enables/disables operator keyboard entry during block mode transmission activity.
  - Load/Define Function Keys - This allows the host to define any or all function keys to perform desired block mode code sequence or controlware sequence.

Terminal Operation (Block Mode)

When an enter block mode command is received, the terminal disables upline communication to the host. It performs all allowed operator actions, such as data-entry and editing functions locally (offline to the host). These actions are performed on a page basis.

The terminal remains in this state until the operator initiates a send function by activating any one of the 15 function keys or ten special action keys (all but the ERASE key). This indicates to the terminal that the operator has completed the current page activity and requests transmission to the host. The terminal then performs the following:

- Enables upline communication to the host.
- Disables keyboard to the operator.
- Saves the current cursor position.
- Resets cursor to upper left.
- Sends PROLOGUE codes if loaded.
- If the Send to Current Position command has been received, the terminal will send all unprotected data from start of page up to, but not including, the current position. If the send to current position command has not been received, the terminal will send all unprotected data on the entire screen.
- Restores the cursor to original position.
- Sends the function code sequence for the key pressed.
- Sends current cursor XY position.
- Sends a page block terminator to the host (CR).
- Disables upline communication.
- Enables the keyboard.

Keyboard Operation (Block Mode)

Keyboard operation with block mode active is described in the following sections.

Alphanumeric and Control Code Entry (Block MOde)

Alphanumeric key operation in block mode is the same as character and/or protect mode operation.

Unaffected Keys (Block Mode)

The following keys perform the same as described by character and/or protect mode operation with the exception that they are performed offline to the host:

- ⇧ (Shift) key
- ⇪ (Lock) key
- SETUP key
- M REL/BREAK key
- Cursor Control keys
- ← (Backspace) key
- NEXT/↵ key
- ⇤ (Back Tab) key
- ERASE key*
- PRINT key

CTRL Key (Block Mode)

Pressing the CTRL key in conjunction with any other key performs the same function as for character and/or protect operation only locally.

Special Action Keys (Block Mode)

Function keys F1 through F15 and special action keys (+, -, X, HELP, EDIT, BACK, LAB, DATA, STOP) are used by the operator to initiate a block transfer to the host. The significance of any or all function keys is dependent only upon the host or host application.

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*The modified bit is set (instead of cleared) in block mode for all locations that are cleared.

L/INSRT/C and L/DLETE/C Keys (Block Mode)

Unshifted, the insert character or delete character action is performed the same as for standard character and/or protect mode operation.

Shifted, the insert line or delete line will:

- Send insert line or delete line keycode sequence
- Not perform the insert or delete line operation

TAB Forward Key (Block Mode)

This key operates the same as character mode except when in small CYBER mode when it will cause the tab to be performed.

P/CLEAR/EOL Key (Block Mode)

This key operates the same as described in character mode except if the Clear Exit Block Mode command has been received.

If the clear page function is performed and the Clear Exit Block Mode command has been received the following functions will be performed:

1. Disable protect
2. Clear all data including attribute bits
3. Exit Block Mode

PROTECT OPERATION

The basic terminal CYBER mode includes the capability to protect each screen character position selectively through the use of a character-associated protect attribute code. Attribute codes prevent the operator from accidentally overwriting or changing host-specified screen positions.

Host Communications (Protect Operation)

The host uses two commands to specify desired protect attribute bit conditions:

- Start Protect - Store protect bit for each succeeding character received.
- Clear Protect - Clear protect bit for each succeeding character received.

The state of the protect attribute bit by itself has no effect on normal terminal operation. The protect system active condition must be present before the terminal utilizes the protect attribute bit. The host uses two additional commands to select desired protect system conditions.

- Enable Protect System - All protected characters (protect attribute set) are protected from operator action.
- Disable Protect System - All character positions can be entered/changed by operator action. If an operator changes a character location with its protect bit set, the character is entered and the current attribute word is stored.

  As alphanumeric codes are received from the host, they are displayed at the cursor position if protect is disabled. If protect is enabled and the position following the current cursor position is protected, a tab is performed after displaying the data.

Protect System Disable (Protect Operation)

In CYBER Mode with the protect system off, all terminal keyboard and communications operations are the same as the basic terminal CYBER Mode operation.

Protect System Enabled (Keyboard Operation) (Protect Operation)

The terminal has an autotabbing feature which will automatically tab the cursor out of a protected area due to alphanumeric entry (except for cursor up and cursor down keys).

- Automatic field tabbing enabled - Moves the cursor out of a protected field due to alphanumeric entry or input.
- Automatic field tabbing disabled - Allows the cursor to remain in protected fields. This is the power-up default condition.

If the auto field tabbing is enabled, the following functions will leave the cursor in a protected area:

- CURSOR UP
- CURSOR DOWN

The following functions will cause a backward search of the protected area:

- Backspace
- CURSOR LEFT
- Erase character

All other functions will perform a forward tab if the cursor enters a protected position.

Keyboard operation with the protect system enabled is described in the following sections.

Alphanumeric and Control Code Entry (Protect Operation)

For unprotected character locations, actuating either a alphanumeric or control code key causes the operation for that key to be performed the same as the current mode operation.

For protected character locations, actuating any alphanumeric key will cause a tab (to the next unprotected position) function to be performed before storing the data.

⓪, ⇧ , CTRL, M REL/BREAK, and SETUP Keys (Protect Operation)

The SHIFT, LOCK, Control, Release/BREAK, and SETUP keys perform the same function as the standard character mode operation for all character locations.

CR/DEL and LF/ESC Keys (Protect Operation)

Pressing either of these keys causes the same action as for the current mode operation.

P/CLEAR/EOL (Erase Page and Erase End of Line) Key (Protect Operation)

When unshifted, this key causes the entry of a space code into all unprotected display positions from, and including, the current cursor position to the end of the current unprotected field or the end of line. The cursor is not moved. The modified attribute bit is cleared in character mode and set in block mode for all character locations cleared.

When shifted this key causes the entry of a space code into all unprotected display positions. The cursor is moved to the home position. The modified attribute bit is cleared in character mode and set in block mode for all character locations cleared.

→| , |← (Forward Tab and Back Tab) Keys (Protect Operation)

Activating these keys cause the same actions as previously defined.

Cursor Control Keys and Backspace Key (←) (Protect Operation)

Activating these keys cause the same actions as previously defined.

NEXT/ ←┘ (New Line) Key (Protect Operation)

Small CYBER - The NEXT/New Line key moves the cursor to the first location of the next line.

Large CYBER - The NEXT/New Line key moves the cursor to the first location of the current line. If the Auto LF is enabled, a line feed is performed.

If the new position is protected and the autotabbing is enabled, a forward tab will be performed

L/INSRT/C Key (Protect Operation)

When unshifted, this key causes the entry of a space code in the present cursor position. The character that occupied that position and all characters to the right of the cursor are moved one position to the right. This character shift to the right is continued to the end of line or to the end of the unprotected field, whichever occurs first. The rightmost character is then lost. This key is ignored and an audible alarm is activated if the cursor currently occupies a protected position. The space that was inserted will retail the old attribute in background memory.

When shifted, this key causes the entry of a line of space codes into the display line presently occupied by the cursor. The line of data that occupied the cursor line is then moved down one line position. This line shift is continued until the bottom line or until a line with protected data is encountered. The data in the bottom line, or just above the line with any protected data is lost. This shifted key is ignored and the audible alram activated if the cursor currently occupies a line with any protected positions. The background memory will not be changed. The modified attribute bit is cleared in character mode and set in block mode for all character positions changed.

L/DLETE/C Key (Protect Operation)

Unshifted, this key causes the deletion of the character code in the present cursor position. The character code to the right of the cursor is moved one position to the left and this character shift to the left continues to the end of the unprotected field or to the end of the line, whichever comes first. The rightmost

position shifted left is then replaced with a space code. This key is ignored and the audible alarm activated if the cursor presently occupies a protected position. The new space code will retain the old attribute in background memory.

Shifted, this key causes the deletion of a line of codes in the line presently occupied by the cursor. The lines below this line are then shifted up one line position. This shift continues until the bottom line or until a line with any protected data is encountered. The line position of the last line shifted up is then over replaced with space codes. This shifted key is ignored and the audible alarm activated if the cursor presently occupies a line with any protected position. The background memory will not be changed if the Use Old Attribute is enabled.

Function Keys (Protect Operation)

The function keys generate the same basic code sequences as standard character mode operation and initiates the transmit function when in block mode operation.

PRINT Key (Protect Operation)

Unshifted this key operates the same as standard character mode operation.

Shifted this key operation is the same as previously defined except that dimmed or protected characters are replaced with space codes.

ERASE Key (Protect Operation)

The ERASE key causes the entry of a space code into all unprotected display positions in the current unprotected field. This includes all unprotect positions from current cursor position to the beginning of the field or the beginning of the line, and all unprotected positions from current cursor position to the end of the field or end of the line (whichever comes first). The cursor is moved to the beginning of the field. The attribute memory is not changed except the modified attribute bit is cleared in character mode and set in block mode for all locations cleared.

If the cursor currently occupies a protected position, an audible alarm is activated, the cursor is left unchanged, and no additional action is taken.

If Large CYBER mode is selected and this key is pressed without the shift or control an Erase character is performed. The cursor will be backspaced and if the new position is not protected the position will be cleared, if the position is protected and the autotabbing is enabled, a back tab will be performed before the erase.

Special Action (+, -, X, HELP, EDIT, BACK, LAB, DATA, STOP) Keys (Protect Operation)

The special action keys operate the same as previously defined.

PROTECT SYSTEM ACTIVE DISPLAY OPERATION

As mentioned previously, the basic terminal CYBER mode includes the capability to protect each screen character position selectively through the use of character-associated protect attribute codes. When active, the protect bit in a character's attribute code protects the character's screen position (or specified screen locations) from being accidently changed by the operator.

Display operation is controlled by the character attributes blink, protect, underscore, dim, inverse, and blank) and the character set, and edit control commands (line drawing, external loadable characters, scroll/page field, line length and format).

The character attribute commands enable the video display characteristic named with the protect system active. The line drawing and extended character commands cause the display to substitute the selected character set for part of the standard ASCII set. And the line length command selects 80-or 132-character line operation - all other functions are not affected.

Table 4-9 summarizes all host-received commands and I/O responses. The listing is by alphabetical order of the command names. Table 4-10 presents the same information assembled in numerical order of the hexadecimal command codes. Table 4-11 presents the same information grouped according to command function. Table 4-12 lists the Read Parameter Data Word Format. Table 4-13 identifies the Host-Loaded Keyword Functions.

NOTE

Multiple word responses made by the terminal are subject to the Pacing parameter in mode installation parameters.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Alarm	BEL	07	Sounds audible alarm for 250 milliseconds.
Back Tab	RS, VT	1E, 0B	Causes the cursor to move back to the first position following a preceding low-intensity field, following a preceding protected field position, at preceding column tab or to Home position if none are encountered. See Back Tab key for more detailed definition. Completion response is identical to Read Status response. No response is sent in large CYBER mode.
Backspace	RS, EM	1E, 19	See Backspace (EM, 19).
Backspace Large CYBER	US	1F	Moves cursor left one position and clears the data. Protected data is not cleared. If new position is protected and auto tab is enabled, the cursor moves backwards to the next unprotected position.
Basic Char	RS, GS	1E, 1D	Causes terminal to interpret received data as normal characters.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Blind Printer	RS, DEL	1E, 7F	Causes terminal to stop transferring received and transmitted data to printer. Initial value selected by parameter. RS, DEL is transmitted to printer. The completion response is identical to Read Status. No response is sent in large CYBER mode.
Carriage Return	CR	0D	Moves cursor to first character position in line that it is on. If the Auto Line Feed parameter is selected a LF is performed.
Clear			
o All Data	RS, P	1E, 50	See Clear Fields.
Clear All Host Loaded Codes/ Controlware	RS, .	1E, 2E	Causes all previously loaded codes/ controlware to be cleared. This includes host loaded subroutines, host specified codes for keys, host loaded controlware for loaded keys. Validation controlware, prologue loaded codes and host controlware functions.
Clear All Tabs	RS, DC2, Y	1E, 12, 59	Clear all column tabs.
Clear Column Tab	RS, DC2, X	1E, 12, 58	Causes the terminal to clear the column tab position of current column.
Clear Protect	RS, DC2, J	1E, 12, 4A	Clear Protect bit of each succeeding character received to a 0.
Clear field			
o Low Intensity	RS, ?	1E, 3F	Causes terminal to clear all unprotected data from cursor position to end of page for all data or only unprotected high- or low-intensity areas as selected. No response is provided to I/O commands during operation. Modified attribute bits for all cleared character positions are cleared. The "Read Status" is sent back to indicate operation complete. No response is sent in large CYBER mode.
o High Intensity	RS, @	1E, 40	
o All Data	RS, P	1E, 50	

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Clear to EOL Extend Attribute	RS, *	1E, 2A	This function will clear to the end of line just like the EOL (VT, 0B) command except the background memory will be set to the current attributes.
Clear to EP Extend Attribute	RS, +	1E, 2B	This function will clear to end of page just like the Clear All Data (RS, P, 1E 50) command except the background memory will be set to the current attributes.
Cursor Down Large CYBER	LF	0A	Moves cursor down one line while remaining in the same position. If on the last line, screen will scroll and cursor moved to first column if roll enabled, cursor moves to top line if page enabled.
Cursor Down	RS, SUB	1E, 1A	See Cursor Down (SUB, 1A).
Cursor Down	SUB	1A	Moves cursor down one line while remaining in same column (character) position. If cursor is on the last line it will wrap around to the top. Stored data is not affected.
Cursor Left Large CYBER	BS	08	Moves cursor left one character position. Stored data is not affected. It new position is protected and auto tab is enabled, the cursor will move backwards to the first unprotected position.
Cursor Left Small CYBER	EM	19	Moves cursor left one character position. Stored data is not affected. If new position is protected and autotab is enabled, the cursor will move backwards to the first unprotected position.
Cursor Up	ETB	17	Moves cursor up one line while remaining in same column (character) position. Stored data is not affected.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Define Function or Action Key Code Sequence or Controlware Sequence	RS, HT, (V), (W) (X), (Y...), (Z)	1E, 09, (V), (W) (X), (Y...), (Z)	Causes a code sequence or controlware sequence to be defined by the host. See paragraph on Host Specified Code Sequence/Controlware V = Key identifier and address pointer. W = Function. X = Address. Y = Code sequence or controlware Z = Specified delimiter. The terminal will respond with an ACK if all codes received okay and an RS, NAK if not. No response is sent in large CYBER mode.
Delete Character	RS, N	1E, 4E	Deletes one character. All characters to the right of the cursor are shifted left one position. If protect enable is active, shift occurs only up to protected data and the old attribute is reused for the last position.
Delete Line	RS, Q	1E, 51	Causes all unprotected line data and associated highlight fields below cursor and within the logical page or unprotected area limits to be moved up one position; current line is lost; buttom line is cleared. No response to I/O commands during operation. Completion response is identical to Read Status response. No response is sent in large CYBER mode. Modified attribute bits for all cleared character positions are cleared.
Disable Automatic Carriage Return	RS, '	1E, 27	Causes the cursor to remain in the last line position of a line until a control code is received that moves it.
Disable Automatic Tabbing	RS, #	1E, 23	Allows the cursor to remain in protected fields. (Default condition.)
Disable Blink	EOT	04	Disables character blinking on display page.
Disable Clear Key	RS, %	1E, 25	Causes the clear page function to clear all unprotected data. (Default condition.)
Disable Code Bias	RS, 1	1E, 31	Causes the terminal to accept XY positioning and set scroll field information without the 20 HEX bias.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Disable CR Delimiter	RS, DC2, Z	1E, 12, 5A	Disables the CR delimiter for multiple code and controlware sequences.
Disable Display	RS, DC2, O	1E, 12, 4F	Disables change to display refresh memory for normal terminal operation. All incoming commands are ignored until the Enable Display is received.
Disable Host Loaded Code	RS, 3	1E, 33	Causes all host loaded codes/controlware to be ignored. All host loaded keys, subroutines and controlware will remain loaded but not used.
Disable Keyboard	RS, DC2, M	1E, 12, 4D	Disable keyboard entry, until reenabled by host or a reset condition.
Disable Protect	RS, DC2, L	1E, 12, 4C	Disables protected characters on the display page. If an operator changes a character location, its protect bit is determined by the state of the start/clear protect bit flag.
Disable Send to Current Position	RS, !	1E, 21	Causes the terminal to send all unprotected data on the page during a block mode send. (Default condition.)
Disable Touchpanel	RS, DC2, Q	1E, 12, 51	Disables input from the touchpanel.
Disable Typamatic	RS, DC2, j	1E, 12, 6A	Disable typamatic keys defined by table 4-2.
Driver Request	RS, DC2, h	1E, 12, 68	Causes the terminal to test for presence of a driver. A Status response is sent to the host or control is passed to the driver. o RS, NAK if transfer not successful. (See paragraph on Flexible Disk Operation, Intended Use).
Enable Automatic Carriage Return	RS, &	1E, 26	Causes the cursor to automatically move to the next line after the last position of a line is filled. (Default condition.)
Enable Automatic Tabbing	RS, "	1E, 22	Causes the cursor to automatically tab out of protected fields, except for cursor-up and cursor-down functions.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Enable Blink	ETX	03	Blinks characters whose blink bit is set to 1 (refer to Start Blink command). Following power-up or page erase, blink is automatically enabled.
Enable Clear Key to Exit Block Mode	RS, $	1E, 24	Causes the clear page function to disable protect, clear screen, and exit block mode if enabled.
Enable Code Bias	RS, 1	1E, 31	Causes the terminal to accept XY positioning and set scroll field information without the 20 HEX bias.
Enable CR Delimiter	RS, ENQ,	1E, 05	Caused a CR delimiter (0D) to be added to certain Host responses.
Enable Display	RS, DC2, P	1E, 12, 50	Enables normal display operation.
Enable Keyboard	RS, DC2, N	1E, 12, 4E	Enable keyboard entry.
Enable Protect	RS, DC2, K	1E, 12, 4B	Protected characters (with their protect bit set) are protected from operator action and can only be changed by host action.
Enable Send to Current Position	RS, SP	1E, 20	Causes the terminal to send all unprotected data from the top of screen to, but not including the current cursor position during a block mode send.
Enable Touchpanel	RS, DC2, R	1E, 12, 52	Enables input from the touchpanel. (See paragraph on Touchpanel Operation/ Raster Alignment.)
Enable Typamatic	RS, DC2, i	1E, 12, 69	Enable typamatic keys defined by table 4-2.
End Blank	RS, DC2,	1E, 12, 5C	Clear the blank attribute bit.
End Dim	GS	1D	Sets dim bit to 0. Each succeeding displayed character received is displayed at full intensity on the screen.
End Inverse	RS, E	1E, 45	Clear inverse bit of each succeeding character received.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
End Underscore	NAK	15	Sets underscore bit to 0. Each succeeding displayed character received is not underlined.
End Validation	RS, DC2 n	1E, 12, 6E	Clear the character validation attribute bit for each character stored.
Enter Block Mode	RS, DC2, a	1E, 12, 61	Enter block mode operation.
Enter Large CYBER mode	RS, DC2, B	1E,12, 42	Enter Large CYBER mode of operation.
Enter RAM Extended Character Mode	RS, (, (X)...	1E, 28 (X)	Causes the terminal to display all codes between 40 through 7F from the RAM character generator. Codes outside of this range will perform the normal operation.
Enter Small CYBER mode	RS, DC2, A	1E, 12, 41	Enter Small CYBER mode of operation.
EOL (Erase to End of Line)	VT	0B	Erases all unprotected characters from, and including current cursor position to end of current unprotected field or the end of that line. Enters 20 in affected positions. The background memory is cleared. Modified attribute bit for all cleared character positions are cleared. The modified bit is set in block mode if keyboard input.
EP (Erase Page)	FF	0C	Erases all unprotected characters on screen. Cursor moves to home position. Enters 20 in affected positions. Clears background memory and enables blink if previously disabled. Return to enter normal data (clears enter blink, underscore, reduced intensity, dim, and blank). Modified attribute bits are cleared, or set in block mode if keyboard input.
Erase	RS,]	1E, 5D	All character locations in the current unprotected field are cleared to spaces and the cursor is moved to the beginning of the unprotected field.
Erase	RS, Y	1E, 59	See RS,] (1E, 5D).
Exit Block Mode	RS, DC2, b	1E, 12, 62	Exit block mode operation.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Exit Host DLL	RS, B	1E, 42	Reserved for host command to loaded controlware.
Exit RAM Extended Character Mode	RS,)	1E, 29	Causes the terminal to display normal ASCII codes for all codes between 40 through 7F. (Default condition.)
Extended Character	RS, T,(X)	1E, 54,(X)	Causes terminal to interpret (X) as character to be displayed from RAM character generator. Code must be in field 40 through 7F. Codes outside of this field cause entry of parity error symbol. Restriction: Extended characters cannot be simultaneously displayed with PLATO characters.
Field Scroll Down	RS, V	1E, 56	Causes each line to be relocated down one position between upper-and lower-field delimiters. Lowest line is lost; uppermost line in scroll field is cleared. No response to I/O commands is provided during operation. Completion response is identical to Read Status. No response is sent in large CYBER mode.
Field Scroll Up	RS, U	1E, 55	Causes each line to be relocated up one position between upper-and lower-field delimiters. Uppermost line in scroll field is lost; bottom line in scroll field is cleared. No response to I/O commands is provided during operation. Completion response is identical to Read Status. No response is sent in large CYBER mode.
Home Small CYBER	BS	08	Moves cursor to home position as defined by parameter setting.
Home Large CYBER	EM	19	Moves cursor to home as determined by the the parameter bit.
Home	RS, BS	1E, 08	See Home BS, (08).
Host Execute Loaded Controlware	RS,DC2 p-DEL	1E, 12 70-7F	If the host has loaded controlware for the appropriate function, a call will be made to the starting address (see paragraph on Host Specified Code Sequence/Controlware. If the host has not loaded any controlware for the appropriate function this will be a No operation.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Initiate Host DLL	RS, A	1E, 41	Initiates a host specified downline load (DLL). Control will be passed to the ASCII Network Loader (paragraph on ASCII Network Loader) (Note: The ASCII Network Loader changes to 8-bit data). If the load completes successfully, control is transferred to the loaded controlware. If unsuccessful, terminal responds with RS, NAK (1E, 15). See paragraph on ASCII Network Loader. (Note: This function is not operational if initiated from keyboard).
Initiate Test	RS, SYN	1E, 16	Causes terminal to perform self-test (Test 2) operation; no response to further commands until self-test is completed. Terminal signals completion of self-test by automatically sending a Read Status response. Refer to Self-Test Routines paragraph for further description. This command should not be done in modes that have loaded controlware in the terminal.
Insert Character	RS, 0	1E, 4F	Inserts one space character. Character in cursor position and all characters to the right of the cursor are shifted right one position. If protect enable is active, shift occurs only up to protected data and the old attribute is reused for the new position.
Insert Line	RS, R	1E, 52	Causes all unprotected line data and associated highlight field on current line to be relocated one line down; bottom line within logical page or unprotected area is lost; current line is cleared. No response to I/O commands is provided during operation. Insert line timing and completion response are identical to delete line. Modified attribute bits for all cleared character positions are cleared.
Line Drawing	RS, FS	1E, 1C	Causes terminal to interpret any following data words received from 20 to 3F as line drawing characters. Refer to table 2-9 for codes.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Load RAM Extended Character Generator	RS,S,(W), (X), (Y), (Z)	1E, 53,(W) (X), (Y), (Z)	Causes the terminal to interpret the characters following the RS, S, [1E, 53] (W) (X), (Y), (Z) command as information concerning the RAM character generator. Loading the generator requires the character be specified (40 through 7F, six bits, 64 characters). It also requires the starting scan be specified (one of sixteen numbered top to bottom, four bits) the dot patterns may then be specified (eight possible dots); left to right, lowest to highest order bit position. The data words are formatted as follows: o Word 1 (W) - Character Code. Code must be between 40 through 7F. Codes outside this field cause an RS NAK to be sent to the host when the termination code is received. o Word 2 (X) - Start Scan Count. Bits 2^0 through 2^3 contain the start count. 2^4 must be 0, 2^5 must be 1, 2^6 must be 0. o Word 3 (Y) - Dot Pattern. Dot Patterns are sent in groups of 2. Bits 2^0 through 2^3 of the first word are the right 4 dots and 2^0 through 2^3 of the second word are the left 4 dots. Bit 2^4 must be 0, 2^5 must be 1, 2^6 must be 0 for first word and 1 for the second word. If an error is received an RS, NAK will be sent to host when the termination code is received. o Word 4 (Z) - Termination Code CR. An ACK will be sent to host if no errors received otherwise an RS, NAK is returned. No response is sent in large CYBER mode. (See paragraph on Load RAM Extended Character Generator.)

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Mode Select	RS, DC2, S, (n)	1E, 12,53, (n)	Selects mode n = 30-37 (0-7) and transfers control to selected mode. Mode enable and mode security are by passed. See Auto-Select parameter in Terminal Installation parameter (paragraph on Terminal Installation Parameters). If n is outside of range an RS, NAK and delimiter is returned.
Model Report Request Large CYBER	RS, C,(n)	1E, 43,(n)	n = 30 Terminal installation parameters n = 31-36 Requesting that modes NVM only n = 37 Active status from RAM The terminal sends the following code sequence to the host system 1E Header Code 6F Header Code 23 Indicates model report request data follows 21 Indicates a Viking X terminal XXX Configuration Code; See paragraph on Model Report Request. YYY Firmware code ZZZ Termination code
New Line Small CYBER	LF	0A	Moves cursor to first character position in next line.
NOOP Small CYBER	ACK	06	No operation.
NOOP Large CYBER	DC4	14	No Operation.
NOOP	DEL	7F	No operation.
NOOP Large CYBER	DLE	10	No Operation.
NOOP	ESC	1B	No operation.
NOOP Small CYBER	HT	09	No Operation.
NOOP	NUL	00	No operation performed.
NOOP	RS,\	1E, 5C	No operation.
NOOP	RS,^	1E, 5E	No operation.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
NOOP	RS, [	1E, 5B	No operation.
NOOP	RS, _	1E, 5F	No operation.
NOOP	RS, * thru RS, ;	1E, 2E thru 1E, 2E	No operation.
NOOP	RS, 0 thru RS, >	1E, 30 thru 1E, 3E	No operation.
NOOP Small CYBER	RS, C	1E, 43	No operation.
NOOP	RS, DC2 -	1E, 12, 5F	No operation.
NOOP	RS, DC2 '	1E, 12, 60	No operation.
NOOP	RS, DC2, C	1E, 12, 43	No operation.
NOOP	RS, DC2, c	1E, 12, 63	No operation.
NOOP	RS, DC2, d	1E, 12, 64	No operation.
NOOP	RS,DC2,SP thru RS,DC2,?	1E, 12, 20 thru 1E, 12, 3F	No operation.
NOOP	RS, DC2, g	1E, 12, 67	No operation.
NOOP Large CYBER	RS,EOT	1E,04	No operation.
NOOP	RS, I	1E, 49	No operation.
NOOP	RS, J	1E, 4A	No operation.
NOOP	RS, K	1E, 4B	No operation.
NOOP	RS, M	1E, 4D	No operation.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER)(CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
NOOP	RS, X	1E, 58	No operation.
NOOP	RS, Z	1E, 5A	No operation.
NOOP Small CYBER	STX	02	No operation.
NOOP Small CYBER	SYN	16	No operation.
NOOP Small CYBER	US	1F	No operation.
Normal Numeric Pad	RS, DC2 1	1E, 12, 6C	Returns the numeric keypad to normal operation.
PLATO Character	RS, DC2, T, (X)	1E, 12,54, (X)	Causes terminal to interpret (X) as PLATO character to be displayed. Code must be in field 40 thru 7F. Codes outside this field will cause entry of parity error symbol. Restriction: Cannot simultaneously display extended and PLATO characters. See table 2-11.
Page Print Small CYBER	DC1	11	Transfers to printer all displayed data from current line to end of page. Keyboard is locked and received data ignored until end of operation (not lost). Printing may be aborted by pressing SHIFT/M REL. Print completion is signaled by terminal transmitting an 06 or if the operation is aborted by actuating SHIFT/M REL by transmission of RS, NAK (1E, 15) sequence. If there is no printer DTR when the Page Print command is received an RS, NAK is sent. No completion response is sent in large CYBER mode.
Page Print Small CYBER	RS, DC1	1E, 11	See Page Print (DC1).
Page Print	RS, STX	1E, 02	See Page Print (DC1).
Print Form	RS, SOH	1E, 01	See Print Form (SOH).

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Print Form	SOH	01	Transfers all nondimmed displayed data to printer from beginning of current line to end of page. Dimmed data is sent as space code (20). Keyboard locks, comm data is received but ignored until end of operation (not lost). Printing may be aborted by actuation of SHIFT/M REL. Print completion is signaled by terminal transmitting an 06 (ACK) or, if the operation is aborted due to actuating SHIFT/M REL, by transmission of an 1E, 15 (RS, NAK) sequence. If there is no printer DTR when the Print Form command is received an RS, NAK is sent. There is no completion response in large CYBER mode.
Print I/O	RS, F	1E, 46	Causes terminal to direct all received data, and transmitted data in half duplex, or local, to printer interface. Completion response is identical to Read Status, No response is sent in large CYBER mode.
Read Attribute	RS, SO	1E, 0E	Causes terminal to respond with two characters containing attributed character at cursor position. Cursor is not advanced; stored data is not affected. First Word Format 0 - Not Used 1 - Underscore 2 - Blink 3 - Dim 4 - 1 5 - 1 6 - 0 = Standard Character (table 2-8 or tables 2-1 through 2-7. 1 = Special Character (Line Drawing, PLATO, or RAM Extended Character
Read Cursor Address	ENQ	05	Causes terminal to send cursor address header code (1F) followed by codes containing column and row address. Column position transfers first and is numbered from left to right (00 through 4F) for 80 column mode. In 132 column mode a 7E code preceeds the column position

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Read Cursor Address (Contd)			address producing a code sequence of 7E, 00, 00 through 4F for the first 80 columns 01, 00 through 33 for columns 81 through 132. The next code is line position numbering from top to bottom (00 through 1D). Row/ column addresses may be biased to avoid codes 00 through 1F by enabling code bias parameter selection. When CODE BIAS is enabled, cursor position 00 equals 20. Addressing continues in normal binary progression through 6F for 80 column mode. The 132 column mode sequence is 7E, 20, 20 through 7E, 21, 53 for columns 0 through 132 respectively. The line position address is 20 through 3D for both 80 and 132 column modes.
Read Data	RS, DLE	1E, 10	Causes data word stored in memory at cursor position to be transferred to interface. Cursor is not advanced. Seven data bits are transferred. Determining if the code represents an alphanumeric character, line drawing, extended character, or control code requires that the attribute character be read. Refer to read attribute command.
Read Parameter Small CYBER	RS, DC3	1E, 13	Causes terminal to transmit settings of terminal operating parameters. Settings are sent out in data words preceded by sequence 02, 06, 25 and terminated with a Read Status response. See table 4-12. No response sent in large CYBER mode.
Read Parameter	RS, SI	1E, 0F	See RS, DC3.
Read Status	RS, DC4	1E, 14	Causes terminal to respond 02, 06, 06 (STX, ACK, ACK) if all preceding self-test operations were completed successfully. The response 02, 06, 15 (STX, ACK, NAK) is transferred if any self-test failed.
Reserved	RS, DC2, E	1E, 12, 45	No operation.
Reserved	RS, DC2, F	1E, 12, 46	No operation.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Roll Disable Small CYBER	DC3	13	Enables page mode; moves cursor to home position when new line code is received and cursor is on bottom line.
Roll Disable Large CYBER	SYN	16	Roll disable (see DC3).
Roll Enable	DC2	12	Enables roll mode; screen scrolls up one line each time cursor overflows bottom line or if a new line code is received when cursor is on bottom line, cursor moves to first character position on bottom line. Bottom line clears; top line is lost. Powering-on terminal enables scroll feature.
Select 24 lines	RS, DC2,]	1E, 12, 5D	Set 24 lines.
Select 30 lines	RS, DC2, ^	1E, 12, 5E	Set 30 lines.
Select Bidirectional Port N	RS, DC2, U, (N)	1E, 12,55, (N)	Selects bidirectional port N where N = 0-1. When selected the port can transmit transparent bidirectional data until a deselect is issued. See paragraph on Host Select Bidirectional Port for definition and response.
Set 80 Character Line	RS, DC2, H	1E, 12, 48	Causes the terminal to display 80 characters/line. If the initial line length is 132 characters per line, the display is cleared and cursor is moved to Home.
Set 132 Character Line	RS, DC2, G	1E, 12, 47	Causes the terminal to display 132 characters/line. If the initial line length is 80 characters per line, the display is cleared and cursor is moved to Home.
Set All Protect Bits	RS, G	1E, 47	This command will Disable Protect and set the protected bit in the background code for every character position. Note: If the protect enable command is received before any unprotected data is displayed the terminal will lock up.
Set Column Tab	RS, DC2, W	1E, 12, 57	Causes the terminal to set a column tab for the current column.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Set Scroll Field	RS,W,(U,)(L)	1E, 57, U, L	Causes terminal to store upper (U) and lower (L) line addresses of scroll page field. Refer to write cursor address command for line addressing definition. Receipt of line numbers other than 1 through 30 causes entry of line 30 (lower) and 1 (upper). Address biasing is supported if selected. Note: This works in conjunction with Field Scroll Up and Down.
Shift Numeric Pad	RS, DC2, k	1E, 12, 6B	Causes the numeric keypad to operate as if the shift key were active.
Skip	CAN	18	Moves cursor right one character position. Stored data is not affected. If new position is protected and autotab is enabled, a tab will be performed.
Skip	RS, CAN	1E, 18	See Skip (CAN, 18).
Start Blank	RS, DC2, [	1E, 12, 5B	Set the blank attribute bit.
Start Blink	SO	0E	Sets blink bit to 1 in those succeeding characters received and stored in terminal memory.
Start Block Mode Send	RS, DC2, D	1E, 12, 44	The terminal sends all unprotected data characters. See Block Mode Send for format of data. (See paragraph on Terminal Block Mode Operation.) A CR delimiter indicates the end of operation.
Start Dim	FS	1C	Sets dim bit to 1. Each succeeding displayed character received is dimmed on the screen.
Start Inverse	RS, D	1E, 44	Set inverse bit of each succeeding character received to 1.
Start Protect	RS, DC2, I	1E, 12, 49	Set Protect bit of each succeeding character received to a 1.
Start Underline Large CYBER	ACK	06	Sets the underline attribute bit to 1.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Start Underscore Small CYBER	DC4	14	Sets underscore bit to 1. Each succeeding displayed character received is underlined on the screen.
Start Validation	RS, DC2 m	1E, 12, 6D	Sets the character validation attribute bit for each character stored. (See paragraph on Validation.)
Stop Blink	SI	0F	Sets blink bit to 0 in succeeding characters received.
Store Mode Parameters in NVM	RS,DC2 o	1E, 12, 6F	Causes the active mode parameters in RAM to be stored into the NVM memory as the new default parameters.
TAB Large CYBER	HT	09	Causes cursor to be advanced to the first position following the next low-intensity field or next column tab (whichever comes first) if protect is not enabled. Causes cursor to be advanced to the next unprotected field or the next unprotected column tab if protect is enabled. Cursor will move to top of page if none present. The cursor will not be left in a protect position. No completion response sent in large CYBER mode.
Tab Small CYBER	RS, EOT	1E, 04	If protect is not active, this will cause the cursor to advance to the first position following next low-intensity field or next column tab (whichever comes first). If none are present, moves to top of page. If protect is active, moves to the next unprotected area or the next unprotected column tab. If none are present, moves to top of page. The cursor will be tabbed again if the upper left is protected. Completion response is identical to Read Status response. No response is sent in large CYBER mode.
Turn Off Indicator	RS, DC2, f, (N)	1E, 12,66, (N)	Causes terminal to turn off indicator specified by (N). N = 30: Alert indicator N = 31: Programmable indicator 1 N = 32: Programmable indicator 2 N = 33: Programmable indicator 3 N = 34: Message indicator

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
Turn On Indicator	RS, DC2, e, (N)	1E, 12,65, (N)	Causes terminal to turn on indicator specified by (N). N = 30: Alert indicator N = 31: Programmable indicator 1 N = 32: Programmable indicator 2 N = 33: Programmable indicator 3 N = 34: Message indicator
Use Old Attribute Disabled	RS, -	12, 2D	This function will disable the reusing of the old attribute. As data is entered during host and keyboard data entry, the new attribute is stored. During clear operations the attribute is cleared. This is the default condition.
Use Old Attribute Enable	RS, ,	1E, 2C	This function will enable the reusing of the old attribute during host and keyboard data entry and during all clear operations.
Write Cursor Address Small CYBER	DLE	10	Interprets next characters as cursor column and row address. Cursor moves to position defined by addresses. Column address is numbered from left to right (00 through 4F) for 80 column mode. In 132 column mode, a 7E code preceeds the column position address producing a code sequence of 7E, 20, 00 through 4F for columns 0 through 80, and 7E, 21, 00 through 33 for columns 81 through 132. Line position is numbered from top to bottom (00 through 1D). If column position code is greater than 4F in 80 column mode or 01, 33 in 132 column mode, cursor control logic wraps around. Line position operates in a similar manner (e.g., 1F equals 01). Row and column addresses may be biased in same manner as described for Read Cursor Address.
Write Cursor Address Large CYBER	STX	02	See Write Cursor Address (DLE).
Write New Mode Parameters	RS, DC2, V, (Y), (Z)	1E, 12,56, (Y), (Z)	Causes the terminal to write the RAM (dynamic) parameter memory specified. Y = Write data to parameter memory in format specified by paragraph on Write New Mode Parameters Z = Delimeter. CR Note: To change NVM see RS, DC2, o.

TABLE 4-9. CYBER MODE RECEIVE & I/O RESPONSES (ALPHA-ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE	TERMINAL RESPONSE
X-Off* Large CYBER	DC3	13	Causes the terminal to temporarily halt transmission to the host until the X-On is received. When sent to the host means data cannot be acted upon. See paragraph on X-OFF/X-ON.
X-On* Large CYBER	DC1	11	Enables transmission to the host or initiates continuation of suspended transmission from the host. See paragraph on X-ON/X-OFF.

*The X-On (DC1) and X-Off (DC3) can be received at anytime. If they are received during a multiple code sequence, they will perform the X-On and X-Off functions and will not be interpreted as part of the multiple code sequence.

NOTES:
1. Multiple words response sequences are subject to character pacing as described in Transmitted Data paragraph.
2. All RS, ACK and RS, NAK response to the host will be followed by a CR if the CR delimiter is enabled.

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
NOOP	NUL	00
Print Form	SOH	01
NOOP Small CYBER	STX	02
Write Cursor Address Large CYBER	STX	02
Enable Blink	ETX	03

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Disable Blink	EOT	04
Read Cursor Address	ENQ	05
NOOP Small CYBER	ACK	06
Start Underline Large CYBER	ACK	06
Alarm	BEL	07
Home Small CYBER	BS	08
Cursor Left Large CYBER	BS	08
NOOP Small CYBER	HT	09
TAB Large CYBER	HT	09
New Line Small CYBER	LF	0A
Cursor Down Large CYBER	LF	0A
EOL (Erase to End of Line)	VT	0B
EP (Erase Page)	FF	0C
Carriage Return	CR	0D
Start Blink	SO	0E
Stop Blink	SI	0F
Write Cursor Address Small CYBER	DLE	10

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
NOOP Large CYBER	DLE	10
Page Print Small CYBER	DC1	11
X-On* Large CYBER	DC1	11
Roll Enable	DC2	12
Roll Disable Small CYBER	DC3	13
X-Off* Large CYBER	DC3	13
Start Underscore Small CYBER	DC4	14
NOOP Large CYBER	DC4	14
End Underscore	NAK	15
NOOP Small CYBER	SYN	16
Roll Disable Large CYBER	SYN	16
Cursor Up	ETB	17
Skip	CAN	18

*The X-On (DC1) and X-Off (DC3) can be received at anytime. If they are received during a multiple code sequence, they will perform the X-On and X-Off functions and will not be interpreted as part of the multiple code sequence.

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Cursor Left Small CYBER	EM	19
Home Large CYBER	EM	19
Cursor Down	SUB	1A
NOOP	ESC	1B
Start Dim	FS	1C
End Dim	GS	1D
NOOP Small CYBER	US	1F
Backspace Large CYBER	US	1F
NOOP	DEL	7F
Print Form	RS, SOH	1E, 01
Page Print	RS, STX	1E, 02
Tab Small CYBER	RS, EOT	1E, 04
NOOP Large CYBER	RS,EOT	1E,04
Enable CR Delimiter	RS, ENQ,	1E, 05
Home	RS, BS	1E, 08
Define Function or Action Key Code Sequence or Controlware Sequence	RS, HT, (V), (W) (X), (Y...), (Z)	1E, 09, (V), (W) (X), (Y...), (Z)
Back Tab	RS, VT	1E, 0B
Read Attribute	RS, SO	1E, 0E

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Read Parameter	RS, SI	1E, 0F
Read Data	RS, DLE	1E, 10
Page Print Small CYBER	RS, DC1	1E, 11
Read Parameter Small CYBER	RS, DC3	1E, 13
Read Status	RS, DC4	1E, 14
Initiate Test	RS, SYN	1E, 16
Skip	RS, CAN	1E, 18
Backspace	RS, EM	1E, 19
Cursor Down	RS, SUB	1E, 1A
Line Drawing	RS, FS	1E, 1C
Basic Char	RS, GS	1E, 1D
Enable Send to Current Position	RS, SP	1E, 20
Disable Send to Current Position	RS, !	1E, 21
Enable Automatic Tabbing	RS, "	1E, 22
Disable Automatic Tabbing	RS, #	1E, 23
Enable Clear Key to Exit Block Mode	RS, $	1E, 24
Disable Clear Key	RS, %	1E, 25
Enable Automatic Carriage Return	RS, &	1E, 26

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Disable Automatic Carriage Return	RS, '	1E, 27
Enter RAM Extended Character Mode	RS, (, (X)...	1E, 28 (X)
Exit RAM Extended Character Mode	RS,)	1E, 29
Clear to EOL Extend Attribute	RS, *	1E, 2A
Clear to EP Extend Attribute	RS, +	1E, 2B
Use Old Attribute Enable	RS, ,	1E, 2C
Use Old Attribute Disabled	RS, -	12, 2D
NOOP	RS,	1E, 2E
	RS,/	1E, 2F
NOOP	RS, 4 thru RS, ;	1E, 34 thru 1E, 3E
Clear field o Low Intensity	RS, ?	1E, 3F
o High Intensity	RS, @	1E, 40
o All Data	RS, P	1E, 50
Initiate Host DLL	RS, A	1E, 41
Exit Host DLL	RS, B	1E, 42
Model Report Request Large CYBER	RS, C,(n)	1E, 43, (n)
NOOP Small CYBER	RS, C	1E, 43

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Start Inverse	RS, D	1E, 44
End Inverse	RS, E	1E, 45
Print I/O	RS, F	1E, 46
Set All Protect Bits	RS, G	1E, 47
NOOP	RS, I	1E, 49
NOOP	RS, J	1E, 4A
NOOP	RS, K	1E, 4B
NOOP	RS, M	1E, 4D
Delete Character	RS, N	1E, 4E
Insert Character	RS, O	1E, 4F
Clear o All Data	RS, P	1E, 50
Delete Line	RS, Q	1E, 51
Insert Line	RS, R	1E, 52
Load RAM Extended Character Generator	RS,S,(W), (X), (Y), (Z)	1E, 53,(W) (X), (Y), (Z)
Extended Character	RS, T,(X)	1E, 54,(X)
Field Scroll Up	RS, U	1E, 55
Field Scroll Down	RS, V	1E, 56
Set Scroll Field	RS,W,(U,) (L)	1E, 57, U, L
NOOP	RS, X	1E, 58
Erase	RS, Y	1E, 59

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
NOOP	RS, Z	1E, 5A
NOOP	RS, [	1E, 5B
NOOP	RS,	1E, 5C
Erase	RS,]	1E, 5D
NOOP	RS,	1E, 5E
NOOP	RS, _	1E, 5F
Blind Printer	RS, DEL	1E, 7F
NOOP	RS, DC2, SP thru RS, DC2, ?	1E, 12, 20 thru 1E, 12, 3F
Enter Small CYBER mode	RS, DC2, A	1E, 12, 41
Enter Large CYBER mode	RS, DC2, B	1E, 12, 42
NOOP	RS, DC2, C	1E, 12, 43
Start Block Mode Send	RS, DC2, D	1E, 12, 44
Reserved	RS, DC2, E	1E, 12, 45
Reserved	RS, DC2, F	1E, 12, 46
Set 132 Character Line	RS, DC2, G	1E, 12, 47
Set 80 Character Line	RS, DC2, H	1E, 12, 48
Start Protect	RS, DC2, I	1E, 12, 49

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Clear Protect	RS, DC2, J	1E, 12, 4A
Enable Protect	RS, DC2, K	1E, 12, 4B
Disable Protect	RS, DC2, L	1E, 12, 4C
Disable Keyboard	RS, DC2, N	1E, 12, 4D
Enable Keyboard	RS, DC2, N	1E, 12, 4E
Disable Display	RS, DC2, O	1E, 12, 4F
Enable Display	RS, DC2, P	1E, 12, 50
Disable Touchpanel	RS, DC2, Q	1E, 12, 51
Enable Touchpanel	RS, DC2, R	1E, 12, 52
Mode Select	RS, DC2, S, (n)	1E, 12, 53, (n)
PLATO Character	RS, DC2, T, (X)	1E, 12, 54, (X)
Select Bidirectional Port N	RS, DC2, U, (N)	1E, 12, 55, (N)
Write New Mode Parameters	RS, DC2, V, (Y), (Z)	1E, 12, 56, (Y), (Z)
Set Column Tab	RS, DC2, W	1E, 12, 57,
Clear Column Tab	RS, DC2, X	1E, 12, 58,

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Clear All Tabs	RS, DC2, Y	1E, 12, 59
Disable CR Delimiter	RS, DC2, Z	1E, 12, 5A
Start Blank	RS, DC2, [	1E, 12, 5B
End Blank	RS, DC2,	1E, 12, 5C
Select 24 lines	RS, DC2,]	1E, 12, 5D
Select 30 lines	RS, DC2,	1E, 12, 5E
NOOP	RS, DC2 -	1E, 12, 5F
NOOP	RS, DC2 '	1E, 12, 60
Enter Block Mode	RS, DC2, a	1E, 12, 61
Exit Block Mode	RS, DC2, b	1E, 12, 62
NOOP	RS, DC2, c	1E, 12, 63
NOOP	RS, DC2, d	1E, 12, 64
Turn On Indicator	RS, DC2, e, (N)	1E, 12, 65, (N)
Turn Off Indicator	RS, DC2, f, (N)	1E, 12, 66, (N)
NOOP	RS, DC2, g	1E, 12, 67

TABLE 4-10. CYBER MODE RECEIVE AND I/O RESPONSES (HEX CODE NUMERICAL ORDER) (CONTD)

COMMAND NAME	ASCII MNEMONIC	HEX CODE
Driver Request	RS, DC2, h	1E, 12, 68
Enable Typamatic	RS, DC2, i	1E, 12, 69
Disable Typamatic	RS, DC2, j	1E, 12, 6A
Shift Numeric Pad	RS, DC2, k	1E, 12, 6B
Normal Numeric Pad	RS, DC2 l	1E, 12, 6C
Start Validation	RS, DC2 m	1E, 12, 6D
End Validation	RS, DC2 n	1E, 12, 6E
Store Mode Parameters in NVM	RS,DC2 o	1E, 12, 6F
Host Execute Loaded Controlware	RS,DC2 p-DEL	1E, 12 70-7F

NOTES:

1. Multiple words response sequences are subject to character pacing as described in Transmitted Data paragraph.

2. All RS, ACK and RS, NAK response to the host will be followed by a CR if the CR delimiter is enabled.

TABLE 4-11. CYBER MODE RECEIVE AND I/O RESPONSE (COMMON FUNCTIONS)

HEX CODE	COMMAND NAME
	ATTRIBUTES
06 (LC)	Start Underline (Large CYBER)
0E	Start Blink
0F	Stop Blink
14 (SC)	Start Underscore (Small CYBER)
15	End Underscore
1C	Start Dim
1D	End Dim
1E, 44	Start Inverse
1E, 45	End Inverse
1E, 47	Set All Protect Bits
1E, 12, 49	Start Protect
1E, 12, 4A	Clear Protect
1E, 12, 5B	Start Blank
1E, 12, 5C	End Blank
1E, 12, 6D	Start Validation
1E, 12, 6E	End Validation
	CLEARS
0B	EOL (Erase to End of Line)
0C	EP (Erase Page)
1E, 2A	Clear to EOL Extend Attribute
1E, 2B	Clear to EP Extend Attribute
1E, 24	Enable Clear Key to Exit Block Mode

TABLE 4-11. CYBER MODE RECEIVE AND I/O RESPONSE (COMMON FUNCTIONS) (CONTD)

HEX CODE	COMMAND NAME
	CLEARS (CONTD)
1E, 25	Disable Clear Key to Exit Block Mode
1E, 2E	Clear all Host Loaded Codes/Controlware
1E, 30	Enable Code Bias
1E, 31	Disable Code Bias
1E, 32	Enable Host Loaded Code
1E, 33	Disable Host Loaded Code
1E, 3F	Clear Field - Low Intensity
1E, 40	Clear Field - High Intensity
1E, 50	Clear Field - All Data
1E, 59	Erase (Current Unprotected Field)
1E, 5D	Erase (Current Unprotected Field)
	CHARACTER SELECTIONS
1E, 1C	Line Drawing
1E, 1D	Basic Character
1E, 28	Enter RAM Extended Character Mode
1E, 29	Exit RAM Extended Character Mode
1E, 54	Extended Character (X)
1E, 12, 54	PLATO Character
	CURSOR MOVEMENT
02 (LC)	Write Cursor Address (Large CYBER)
08 (SC)	Home (Small CYBER)
08 (LC)	Cursor Left (Large CYBER)
0A (SC)	New Line (Small CYBER)

TABLE 4-11. CYBER MODE RECEIVE AND I/O RESPONSE (COMMON FUNCTIONS) (CONTD)

HEX CODE	COMMAND NAME
	CURSOR MOVEMENT (CONTD)
0A (LC)	Cursor Down (Large CYBER)
0D	Carriage Return
10 (SC)	Write Cursor Address (Small CYBER)
17	Cursor Up
18	Skip
19 (SC)	Cursor Left (Small CYBER)
19 (LC)	Home (Large CYBER)
1A	Cursor Down
1E, 08	Home
1E, 18	Skip
1E, 19	Backspace
1E, 1A	Cursor Down
1E, 26	Enable Automatic Carriage Return
1E, 27	Disable Automatic Carriage Return
	ENABLES/DISABLES
1E, 12, 4B	Enable Protect
1E, 12, 4C	Disable Protect
1E, 12, 4D	Disable Keyboard
1E, 12, 4E	Enable Keyboard
1E, 12, 4F	Disable Display
1E, 12, 50	Enable Display
1E, 12, 51	Disable Touchpanel
1E, 12, 52	Enable Touchpanel

TABLE 4-11. CYBER MODE RECEIVE AND I/O RESPONSE (COMMON FUNCTIONS) (CONT)

HEX CODE	COMMAND NAME
	ENABLES/DISABLES (CONTD)
1E, 05	Enable CR Delimiter
1E, 2C	Enable - Use of old attribute
1E, 2D	Disable - Use of old attribute
1E, 12, 5A	Disable CR Delimiter
1E, 12, 5D	Select 24 lines
1E, 12, 5E	Select 30 lines
1E, 12, 47	Set 132 Character Line
1E, 12, 48	Set 80 Character Line
1E, 12, 69	Enable Typamatic
1E, 12, 6A	Disable Typamatic
1E, 12, 6B	Shift Numeric Pad
1E, 12, 6C	Normal Numeric Pad
	HOST READS
1E, 0E	Read Attribute
1E, 0F	Read Parameter
05	Read Cursor Address
1E, 10	Read Data
1E, 13 (SC)	Read Parameter (Small CYBER)
1E, 14	Read Status
1E, 43 (LS)	Model Report Request (Large CYBER)
1E, 12, 44	Start Block Mode Send
	INSERT/DELETE
1E, 4E	Delete Character

TABLE 4-11. CYBER MODE RECEIVE AND I/O RESPONSE (COMMON FUNCTIONS) (CONT)

HEX CODE	COMMAND NAME
	INSERT/DELETE (CONTD)
1E, 4F	Insert Character
1E, 51	Delete Line
1E, 52	Insert Line
	LOADING
1E, 41	Initiate Host Downline Load (DLL)
1E, 42	Exit Host Downline Load (DLL)
1E, 53	Load RAM Extended Character Generator
1E, 12, 56	Write New Mode Parameters
	PRINTER
01	Print Form
11 (SC)	Page Print (Small CYBER)
1E, 01	Print Form
1E, 02	Page Print
1E, 11 (SC)	Page Print (Small CYBER)
1E, 46	Print I/O
1E, 7F	Blind Printer
	SCROLL/PAGE
12	Roll Enable
13 (SC)	Roll Disable (Small CYBER)
16 (LC)	Roll Disable (Large CYBER)
1E, 55	Field Scroll Up
1E, 56	Field Scroll Down
1E, 57	Set Scroll Field

TABLE 4-11. CYBER MODE RECEIVE AND I/O RESPONSE (COMMON FUNCTIONS) (CONT)

HEX CODE	COMMAND NAME
	TABS
09 (LC)	Horizontal Tab (Large CYBER)
1E, 04 (SC)	Tab (Small CYBER)
1E, 22	Enable Automatic Tabbing
1E, 23	Disable Automatic Tabbing
1E, 12, 57	Set Column Tab
1E, 12, 58	Clear Column Tab
1E, 12, 59	Clear All Tabs
	GENERAL
07	Alarm
11 (LC)	X-On (Large CYBER)
13 (LC)	X-Off (Large CYBER)
1E, 09	Define Function or Key Code or Controlware Sequence
1E, 16	Initiate Test
1E, 20	Enable Send to Current Position
1E, 21	Disable Send to Current Position
1E, 12, 41	Enter Small CYBER Mode
1E, 12, 42	Enter Large CYBER Mode

CYBER mode supports touchpanel operation. This support is as follows:

- The touchpanel has 16 vertical and 16 horizontal strips. Each strip is 0.5 inches wide. Where the vertical and horizontal strips intersect is a 0.5-inch square cell. With 80 characters per line, the cell covers two lines by four characters. With 132 characters-per-line, the cell covers two lines by 6.2 characters.
- Touchpanel activated selection to a defined single character position located within the activated cell. Normally, this is intended to be the bottom center character located in the touchpanel cell. The exact X, Y positions are described later in this section.
- The hardware supports the displaying of 32 lines. When 30 or 40 lines are displayed, they are centered on the screen.

Line Display

When 30 lines are displayed, the top line is under the bottom half of the top strip of the touchpanel, and the last line is under the top half of the bottom strip. When 24 lines are displayed, the top 2 and bottom 2 strips of the touchpanel have no data under them.

NOTE

The displayable area of 30 lines by 80 characters is 7.5-inches high by 10-inches wide. The area covered by the touchpanel is 8 inches by 8 inches. This means one inch (8 characters) on each side is not covered by the touchpanel and 0.25-inches on top and bottom have no display under the touchpanel

The following charts show the X and Y positions (decimal) used when positioning the cursor.

Char/ Line	TOUCHPANEL STRIPS LEFT TO RIGHT															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
80	11	15	19	23	27	31	35	39	43	47	51	54	58	62	66	70
132	20	26	33	39	45	51	57	64	70	76	82	88	95	101	107	113

Lines/ Screen	TOUCHPANEL STRIPS LEFT TO RIGHT															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
24	1	1	2	4	6	8	10	12	14	16	18	20	22	24	24	24
30	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	30

Host Communications

The host utilizes two special commands to support touchpanel operation. The host can enable or disable the function. If enabled, it is supported by operator initiated selection input to the host. The host can request terminal configuration status to determine if the touchpanel option is present.

Terminal Operation

When a touchpanel operation is active, the following occurs:

1. The operator determines desired selection or position.
2. The operator touches the touchpanel at the desired position.
3. The terminal computes X/Y position activated.
4. The terminal moves cursor to X/Y position activated.
5. The terminal sends a Select function (RS, M code [1E, $4D_{16}$] sequence) to the host.
6. The terminal sends a Read Cursor Address function to the host to specify the X/Y cursor position. Refer to table 4-9 for a definition. The terminal then sends a CR (OD_{16}) termination character.

FLEXIBLE DISK OPERATION (Intended Use)

The flexible disk controlware is stored on the auto-track of the diskette. The operator must make the flexible disk subsystem ready and insert the desired autoload diskette into the subsystem. Either the host or the operator can load the controlware.

The operator can load the controlware by simultaneously pressing CTRL/DATA. An X-OFF code will be sent to the host. If the controlware has not been loaded, a load is still attemped. If the load fails, the message DISK LOAD FAIL will be displayed and an X-ON sent to the host. Control will be transferred to the starting address + 3 when the controlware has been loaded or a load is completed. When control is returned, an X-ON is returned.

The host can also initiate the load as shown by the codes in table 4-9. If the controlware has not been loaded, the host will still attempt a load. When a load fails, the DISK LOAD FAIL message will be displayed and an RS, NAK sent back to the host. If the controlware has been loaded, control will be transferred to the starting address.

HOST LOADED CODE SEQUENCE/CONTROLWARE

The host has the ability of redefining 58 keyboard keys and sixteen resident subroutines by using host-loaded control software. In addition, there are sixteen host-loaded controlware functions that can be initiated by host command.

NOTE

It is not intented to have external users redefining the resident subroutines. These features are added to make it easier for internal users (such as CP/M, PLATO, 401X) to modify operating modes..

The host can specify if a key is to act as previously defined, send a different code sequence, or execute loaded controlware. A 2K block of RAM is reserved for this function (D000 to $D7DF_{16}$ bank 4). If the disk controlware is not going to be used, the 3K between C000 to $CAFF_{16}$ can be used for defining the keys. The last 288 locations make up a table used by the firmware to determine which operation is to be performed on each key.

TABLE 4-12. READ PARAMETER DATA WORD FORMAT

	WORD 1	WORD 2	WORD 3	WORD 4	WORD 5
b0	0 = PAGE 1 = ROLL	0 = EOL BELL 1 = DISABLE BELL	0 = PAR ODD 1 = PAR EVEN	Baud Rate 2^3	1
b1	0 = HALF DUP 1 = FULL DUP	0 = AUTO LF 1 = Normal	0 = 2 STOP BITS 1 = 1 STOP BIT	Baud Rate 2^2	1
b2	PRINTER DSR (READY)	1	0 = PARITY DISABLE 1 = PARITY ENABLE	Baud Rate 2^1	0 = DTR SWITCHED 1 = DTR CONSTANT
b3	BIDIRECTION PORT DSR (READY) *	1	0 = DATA ONLY 1 = NORMAL	Baud Rate 2^0	0 = RTS SWITCHED 1 = RTS CONSTANT
b4	1	1	1	1	1
b5	1	1	1	1	1
b6	1	1	1	1	1

*In order for this bit to reflect the accurate state, the Select Bidirectional Port command must be executed and terminated.

An enable or disable command will either allow or not allow the use of the loaded codes codes/controlware (RS,2)(RS,3). The host can also send a command that will clear all previously loded codes/controlware (RS, .)(1E,2E).

- o Host Interface - The host can specify keys and load code sequences or controlware in the following manner.

  - RS, HT, (V), (W), (X), (Y...), Z

    -- V = Key identifier
    -- W = Function
    -- X = Address
    -- Y = Code sequence or controlware code
    -- Z = Terminator code

  - V (Key Identifier)

TABLE 4-13. HOST-LOADED KEYCODE FUNCTIONS

"V"	KEY NUMBER	DESCRIPTION OF KEY OR FUNCTION	INITIATE A SEND IN BLOCK MODE
20		ADVCR (Advance Cursor)	
21		CLEAR (Clear Screen)	
22		CRDOWN (Cursor Down)	
23		CRLEFT (Cursor Left)	
24		CR UP (Cursor Up)	
25		DELC (Delete Character)	
26		DELL (Delete Line)	
27		INSRTC (Insert Character)	
28		INSRTL (Insert Line)	
29		KBDINP (Keyboard Input)	
2A		PRINTB (Print Code in B)	
2B		PRINTC (Print next Character)	
2C		DISPB (Display the code in B)	
2D		SEND (Send)	
2E		TAB BK(Tab Backwards)	
2F		TAB FW(Tab Forwards)	
30		VALIDATION	
31	3	F1	*
32	4	F2	*
33	5	F3	*
34	6	F4	*
35	7	F5	*
36	8	F6	*
37	9	F7	*
38	10	F8	*
39	11	F9 SUPER	*
3A	12	F10 SUB	*
3B	13	F11 MICRO	*
3C	14	F12 FONT	*
3D	80	F13 TERM ANS	*
3E	82	F14 COPY	*
3F	84	F15	*
40	32	TAB →|	
41	45	TAB |←	
42	67+106	NEXT ←┘	
43	15	+	*
44	31	-	*
45	46	X	*
46	61	÷	*
47	79	HELP	*

*This key will initiate a send in block mode.

TABLE 4-13. HOST-LOADED KEYCODE FUNCTIONS (CONTD)

"V"	KEY NUMBER	DESCRIPTION OF KEY OR FUNCTION	INITIATE A SEND IN BLOCK MODE
48	81	ERASE	
49	83	EDIT	*
4A	85	BACK	*
4B	86	LAB	*
4C	87	DATA	*
4D	88	STOP	*
4E	89	INSRT	
4F	90	DLETE	
50	91	CLEAR	
51	1	PRINT	
52	100	1	
53	101	2 ↓	
54	102	3	
55	97	4 ←	
56	98	5 HOME	
57	99	6 →	
58	94	7	
59	95	8 ↑	
5A	96	9	
5B	104	0	
5C	103	,	
5D	105	.	
5E		NOT USED	
5F		PROLOGUE	
60	2	SETUP	
61	92	ESC LF	
62	93	BREAK/MREL	
63	30	←	
64	78	CR DEL	
65	43	[ ]	
66	44	| \	
67	57	: ;	
68	58	" '	
69	59	{ }	
6A	71	, <	
6B	72	. >	
6C	73	/ ?	
6D		NOT USED	
6E		NOT USED	
6F		NOT USED	

*This key will initiate a send in block mode.

TABLE 4-13. HOST-LOADED KEYCODE FUNCTIONS (CONTD)

"V"	KEY NUMBER	DESCRIPTION OF KEY OR FUNCTION	INITIATE A SEND IN BLOCK MODE
70		HOST CONTROLWARE FUNCTION	
71		HOST CONTROLWARE FUNCTION	
72		HOST CONTROLWARE FUNCTION	
73		HOST CONTROLWARE FUNCTION	
74		HOST CONTROLWARE FUNCTION	
75		HOST CONTROLWARE FUNCTION	
76		HOST CONTROLWARE FUNCTION	
77		HOST CONTROLWARE FUNCTION	
78		HOST CONTROLWARE FUNCTION	
79		HOST CONTROLWARE FUNCTION	
7A		HOST CONTROLWARE FUNCTION	
7B		HOST CONTROLWARE FUNCTION	
7C		HOST CONTROLWARE FUNCTION	
7D		HOST CONTROLWARE FUNCTION	
7E		HOST CONTROLWARE FUNCTION	
7F		HOST CONTROLWARE FUNCTION	

- W (Function)

  -- 30 = Disable - send normal code - default value
  -- 31 = Host specified code sequence (send only)
  -- 32 = Host defined controlware
  -- 33 = Host Validation controlware
  -- 34 = Host specified code sequence (send and do if half duplex)

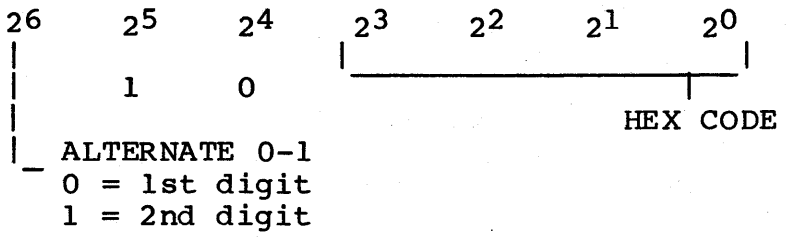
Default for all keys is 30.

- X (Address)

NOTE

This parameter is not required if W = 30.

This parameter is four codes wide. It contains the address where the code sequence/controlware starts. The address is converted to a modified hex value for each digit, sending the most significant digit first. The modified hex value is:



Example: Address D090 - RS, HT, V, W, 2D, 60, 29, 60

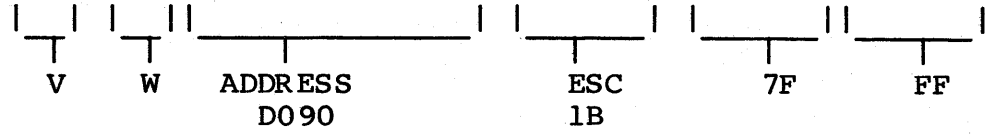
- Y (Code Sequence/Controlware Code)

NOTE

This parameter is not required if W = 30. This is the information that is stored in RAM starting at the address previously loaded. These words are formatted like the address.

- o If information being loaded is a code sequence, the last word (two codes) will be a FF. Following is an example of how the host would change F1 to send ESC, 7F when pressed (store code at D090). The codes are stored in memory.

RS, HT, 31, 31, 2D, 60, 29, 60, 21, 6B, 27, 6F, 2F, 6F, CR



- o If information being loaded is controlware, the FF is not needed. Information is stored until the termination code is detected.

  If a parity error, framing error, or improper bit 6 occurs, data will be ignored until the termination code is received at which time an RS, NAK will be sent back to the host. If no error occurred, an ACK will be returned. No response will be returned in large CYBER mode.

  -Z (Termination Code)

  CR (0D) is the termination code.

- o Keyboard Operation Character Mode - As each key is pressed it will be tested first to see if it is a key that the host can modify. If it is, the firmware will next test the function code in the table.

- If it is a disable code (30), the normal operation will be performed.

- If it is a host specified code sequence (31), the controlware will go to the address specified and send codes until the FF is found.

- If it is a host defined controlware (32), a call will be made to the address specified.

- If it is a host specified code sequence (34), (send and do), the controlware will go to the address specified and send codes until the FF is found and act upon all codes as if in half duplex operation.

o Keyboard Operation Block Mode

As each key is pressed it will be tested first to see if it is a key that the host can modify. If it is, the firmware will next test the function code in the table.

- If it is a disable code (30), the normal operation will be performed.

- If it is a host specified code sequence (31) the block send is initiated. The Host Specified Code Sequence will be sent inplace at the normal function key code.

- If it is a host defined controlware (32), a call will be made to the address specified.

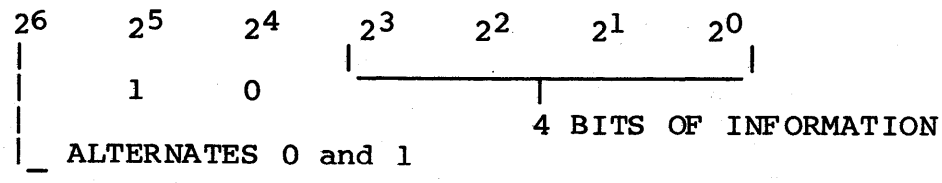
Model Report Request

The host can request the terminals model, configuration, and parameters using this request (RS, C, (n)) in large CYBER mode only. The CYBER mode will respond to this request with the following:

```
1E      HEADER CODE
6F      HEADER CODE
23      INDICATES MODEL REPORT REQUEST DATA
21      INDICATES A VIKING X TERMINAL
XXX_|
 |  |
 |  |-- CONFIGURATION AND PARAMETERS   (See CONFIGURATION AND
 |  |                                    PARAMETERS below)
XXX_|
 Y      FIRMWARE REVISION LEVEL
 Z      TERMINATION CODE
```

Each code sent contains 4 bits of information.

EXAMPLE



CONFIGURATION AND PARAMETERS

- Word 1

  2^0, 2^1, 2^2, 2^3 > Current Mode Active

  0

- Word 2

  2^0 = Not Used
  2^1 = Not Used
  2^2 = Battery Low
  2^3 = ROM PACK Option Installed. 0 = ROM PACK IN

- Word 3

  2^0 = Channel A DSR
  2^1 = Channel A CTS
  2^2 = Channel B DSR
  2^3 = Channel B CTS

  > If no dual port present all bits = 0

- Word 4

  2^0 = Not Used
  2^1 = Not Used
  2^2 = Not Used
  2^3 = Not Used

The next 32 words are determined by the n value.

If n = 30 the Terminal Installation Parameters from NVM are sent (see table 4-14).

If n = 31-36 the Mode Installation Parameters from NVM are sent (see table 4-15).

If n = 37 the Active Mode Parameters from RAM are sent.

- o Y Firmware Revision Level - Two codes will be sent:
  - 1st code 1 to F = Release level; first release = 4
  - 2nd code 1 to F = Revision level; first revision = 0
- o Z Termination Code
  - CR (0D)

TABLE 4-14. MODEL REPORT REQUEST TERMINAL PARAMETERS

TERMINAL PARAMETERS	BIT 0-3	WORD NUMBER IN MRR*
Not Used	0	5
Touchpanel Option In	1	5
Dual Serial Interface Option In	2	5
Graphic Printer Attached (726-10)	3	5
Flexible Disk Option Attached	0	6
Serial Graphic Printer Attached (726-20)	1	6
1200 Baud Internal Modem Option In	2	6
Not Used	3	6
Graphic Option In	0	7
Parallel Option In	1	7
Not Used	2	7
Fixed Disk Option In	3	7
Auto Select Enabled	0	8
Use Printer SRTS	1	8
Run Internal Modem Loopback	2	8
Tone Dial	3	8
Monitor Printer Ready	0	9
Monitor Bidirectional Ready (DSR)	1	9
Not Used	2	9
Not Used	3	9
Not Used	0	10
Not Used	1	10
Not Used	2	10
Not Used	3	10
Auto Select Number	0-2	11
Not Used	3	11
Delta X Display Displacement	0-2	12
Not Used	3	12
Delta Y Display Displacement	0-3	13
Language	0-2	14
Not Used	3	14
Terminal ID Digit #1	0-3	15
Terminal ID Digit #2	0-3	16
Terminal ID Digit #3	0-3	17

TABLE 4-14. MODEL REPORT REQUEST TERMINAL PARAMETERS (CONTD)

TERMINAL PARAMETERS	BIT 0-3	WORD NUMBER IN MRR*
Terminal ID Digit #4	0-3	18
Port A 7/8 Data Bits	0	19
Port A Odd/Even, Space/Mark	1	19
Port A Parity Enabled/Disable	2	19
Port A Printer/Bidirectional	3	19
Port A Baud Rate	0-3	20
Port B 7/8 Data Bit	0	21
Port B Odd/Even, Space/Mark	1	21
Port B Parity Enabled/Disable	2	21
Port B Printer/Bidirectional	3	21
Port B Baud Rate	0-3	22
Not Used	0-3	23
Not Used	0-3	24
Not Used	0-3	25
Not Used	0-3	26
Not Used	0-3	27
Not Used	0-3	28
Not Used	0-3	29
Not Used	0-3	30
Not Used	0-3	31
Not Used	0-3	32
Not Used	0-3	33
Not Used	0-3	34
Not Used	0-3	35
Not Used	0-3	36

*Model Report Request

TABLE 4-15. MODEL REPORT REQUEST MODE PARAMETERS

MODE PARAMETERS	BIT 0-3	WORD NUMBER IN MRR*	WORD NUMBER IN WNMP**	AFFECTED BY WNMP ***
Mode Disabled/Enabled	0	5	1	*
Access Disabled/Enabled	1	5	1	*
Use Default Source/File/Phone	2	5	1	*
Run Internal/Load External	3	5	1	*
Load from Host/Disk	0	6	2	*
Host/Internal Modem Interface	1	6	2	*
Dial Once/Continuous	2	6	2	*
Auto Dial Disabled/Enabled	3	6	2	*
Host 7/8 Data Bits	0	7	3	*
Host Parity Disabled/Enabled	1	7	3	*
Host Parity Odd/Even	2	7	3	*
Host 1/2 Stop Bits	3	7	3	*
DTR Constant/Switched	0	8	4	Yes
RTS Constant/Switched	1	8	4	Yes
Typamatic On/Off	2	8	4	Yes
Data Only Off/On	3	8	4	Yes
Home Upper/Lower Left	0	9	5	Yes
Auto LF On/Off	1	9	5	Yes
Pacing Disabled/Enabled	2	9	5	Yes
Bias Disabled/Enabled	3	9	5	Yes
Auto Advance On/Off	0	10	6	Yes
Not Used	1	10	6	Yes
Not Used	2	10	6	Yes
CYBER/ROM Pack	3	10	6	*
Online/Local	0	11	7	Yes
Printer Deselected/Select	1	11	7	Yes
Margin Alert Off/On	2	11	7	Yes
Alert Soft/Load	3	11	7	*
Alpha/Shift Lock	0	12	8	Yes
Numeric Pad Normal/Shifted	1	12	8	Yes
Page/Roll Screen	2	12	8	Yes
Small/Large CYBER	3	12	8	Yes
Background Dark/Light	0	13	9	*
Cursor Line/Box	1	13	9	*
Cursor Blink/Solid	2	13	9	*
Not Useable	3	13	9	*
Half/Full Duplex	0	14	10	Yes
80/132 Characters Per Line	1	14	10	*
24/30 Lines	2	14	10	*
Transparent Off/On	3	14	10	Yes
Auto Dial Digit #1	0-3	15	11	*
Auto Dial Digit #2	0-3	16	12	*
Auto Dial Digit #3	0-3	17	13	*
Auto Dial Digit #4	0-3	18	14	*
Auto Dial Digit #5	0-3	19	15	*
Auto Dial Digit #6	0-3	20	16	*
Auto Dial Digit #7	0-3	21	17	*

TABLE 4-15. MODEL REPORT REQUEST MODE PARAMETERS (CONTD)

MODE PARAMETERS	BIT 0-3	WORD NUMBER IN MRR*	WORD NUMBER IN WNMP**	AFFECTED BY WNMP ***
Auto Dial Digit #8	0-3	22	18	*
Auto Dial Digit #9	0-3	23	19	*
Auto Dial Digit #10	0-3	24	20	*
Auto Dial Digit #11	0-3	25	21	*
Auto Dial Digit #12	0-3	26	22	*
Default File Number #1	0-3	27	23	*
Default File Number #2	0-3	28	24	*
Transmit Baud Rate	0-3	29	25	*
Receive Baud Rate	0-3	30	26	*
Access Code Digit #1	0-3	31	27	*
Access Code Digit #2	0-3	32	28	*
Access Code Digit #3	0-3	33	29	*
Access Code Digit #4	0-3	34	30	*
Not Used	0-3	35	31	*
Not Used	0-3	36	32	*

*Data is stored in RAM but does not affect the current operation

**Model Report Request

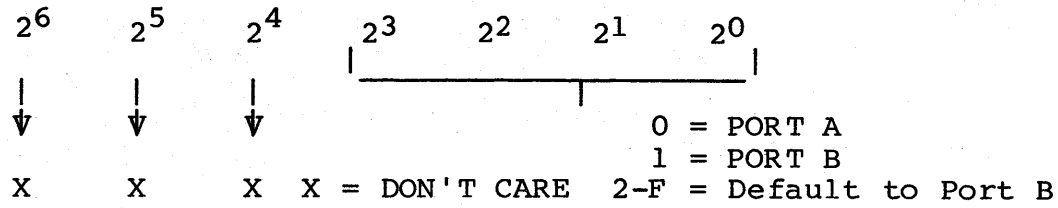
***Write New Mod Parameters

Host Select Bidirectional Port

In CYBER mode the host can select and send or receive information to either Port A or Port B of the optional bidirectional RS-232-C ports. The parameter bits for both ports must be set up before entering CYBER mode. The host must make sure the transmit buffer is empty by ensuring X-On is active.

If the Monitor Bi-directional DSR parameter is active, data will be sent only if the DSR is active. The host can determine if the Bidirectional DSR is active by performing a Read Parameter (RS,S1). If the printer is selected, the receive data will also be sent to the printer.

When the terminal receives the host select bidirectional port sequence, it will interpret the next code (port) as follows:



At this point the terminal will return either an ACK or RS, NAK. DTR, RTS and CO will be sent to the selected port.

The ACK is returned if:

- The monitor bi-directional DSR parameter is disabled.
- The monitor bi-directional DSR is enabled and the DSR is active.

The RS, NAK is returned if:

- The monitor bi-directional DSR parameter is enabled and the DSR is not active.

A carriage return will be returned if the enable CR delimeter command has been received.

At this time all data received from the host will be sent to the selected port and will not be acted upon by the display, except the DC1 and DC3 in Large CYBER mode. As data is received from the port it is placed into the comm output buffer to be sent to the host. The standard host communication protocol is used to send the data as if it came from the keyboard (Full/Half duplex, Constant/Switched RTS, Data Only).

The terminal also supports an X-On/X-Off protocol between itself and the device connected to its bidirectional port. A DC1 or DC3 received from the device does not pass to the host; rather, the X-Off from the device causes the terminal to stop sending information to the device until the device returns the X-On to the terminal. Because the terminal only has a 192 character transmit buffer, exercise caution in sending data from the bidirectional device to the host. That is, data may be lost if the host has sent an X-Off to the terminal and the device sends more information than can be held in the transmit buffer.

If an RS is received from the host, it is not sent to the port. The next code is examined.

- If it is an RS, a single RS will be sent to the port, this allows the host to send an RS to the port.
- If it is a DC2, the bidirectional port will be deselected. DTR, RTS, and CO will remain active.
- If it is anything except the DC2, the code will be sent to the port and the previous RS ignored.
- If a parity error is received from the host, a 7F is sent to the port.

X-Off/X-On

- Receiving X-Off/X-On - Transmit off/Transmit on (X-Off/X-On) is supported by Large CYBER mode. Each operating mode is defined in the following text.

- Character mode - When the X-Off is received from the host, all codes being sent to the host will be placed in the comm output buffer until the buffer becomes full. At this time the keyboard is locked. When the X-On is received, the buffer will send and the keyboard unlocked.

- Block Mode - When the X-Off is received from the host, no information will be sent to the host; keyboard entry is still allowed. If a send function is initiated the comm output buffer will be filled and no other operations will be performed until the X-On is received. When X-On is received, transmission will continue; the keyboard will remain locked until cleared by the completion of block send.

- Bidirection Port - When the bidirectional port is selected. X-On must be active.

In Large CYBER mode the X-On and X-Off can be placed any where in the data stream.

- Sending X-Off/X-On - This feature is supported in both Large and Small CYBER modes. The terminal has a receive buffer of 992 characters. If this buffer ever reaches 768 characters the X-Off will be sent to the host and the X-ON sent when the count goes down to 256.

Write New Mode Parameters

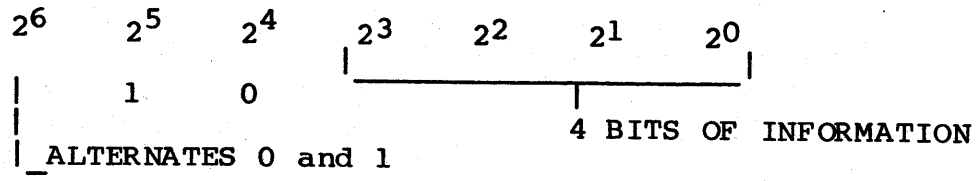
The host can temporarily override the CYBER mode installation parameters by changing them in the active RAM table. (RS, DC2, V.)

NOTE

The host can change the Nonvolatile Memory table by sending a store mode parameters in NVM command.

Before writing new parameters, a Model Report Request should be performed (RS, C, 7) to get the active status from RAM. Then changes can be made and all data sent back in the Write New Mode Parameters command (see Model Report Request paragraph for bit and words).

When CYBER mode receives the write new mode parameter command, it will input up to 32 codes and replace the active mode parameter words with them. The 32 words correspond to the 32 groups found in the paragraph on Mode Installation Parameters and the Model Report Request paragraph. The 32 codes are received in the following format.



The first code received should have 26 = 0. If an error is received during the code sequence, data will be ignored until the termination code is received at which time an RS, NAK is sent to the host. If no errors are detected, an ACK is sent to the host. See the column labeled "Affected by WNMP" to determine if parameter is affected. (See the Model Report Request paragraph.)

NOTE

No response is sent in large CYBER mode.

Load RAM Extended Character Generator

The host can define its own character by loading character patterns in RAM. Once the pattern has been loaded the host can display it by sending an RS, T, (X), where X is the code that was loaded. The X code must be between 40 and 7F hex, or a parity error symbol will be displayed.

Restrictions: The hardware cannot simultaneously display extended RAM characters and PLATO characters. The hardware will be selected to display either the extended RAM character or the PLATO character when the command is received to display the associated character.

To load the RAM extended character, follow this procedure:

1. Draw the desired character in an 8 by 16 matrix.

	Second				First			
Bit / Scan	0	1	2	3	0	1	2	3
0								.
1								.
2							.	
3				.	.		.	
4			.			.	.	
5		.					.	
6	.	.					.	.
7		.		.	.		.	
8		.		.	.		.	
9		.					.	
A		.					.	
B		.					.	
C		.					.	
D	.	.	.	.	.	.	.	.
E								
F								

2. The top row of dots is scan 0. The right half of the character is the first word. The left half of the character is the second word. The leftmost dot of a word is 2**0. The rightmost dot of a word is 2**3.

3. Select the character code that will be represented by the new symbol. (Must be between 40 and 7F hex.) In our example we will use 40.

4. Send the RS, S, code (1E, 53, 40).

5. Send the scan count, remember to add 20 hex. For scan 0, send 20.

6. Send the data. Each scan has two bytes. Remember to add 20 hex to the first and 60 hex to the second bytes.

Example for the dot pattern shown:

Scan 0	28,60
1	28,60
2	24,60
3	25,68
4	26,64
5	24,62
6	2C,63
7	25,6A
8	25,6A
9	24,62
A	24,62
B	24,62
C	24,62
D	2F,6F
E	20,60
F	20,60

7. Send a carriage return (CR) code (0D) to terminate. The CR may be sent at any time if not all scans need to be changed.

The resident diagnostics contain three tests. Test 1 runs after a power up or RESET and rquires no operator verification or intervention. Test 2 is a host or operator-initiated test. Test 3 contains a setup raster and other tests that require operator verification or intervention. Resident diagnostics test the basic hardware, and some options. In test 1 if any failure occurs, a message will be displayed, an error flag will be set and the MODE SELECTION MENU displayed. If no errors are detected, no messages will be displayed and the mode selection process will begin.

NOTE

While running the diagnostics the modem control signals may change.

DESCRIPTION

TEST 1 (QUICKLOOK)

Test 1 runs after power on or by pressing the RESET switch. It is also run if test 2 is run. Keyboard entry during this test may cause invalid errors. Test 1 contains the following subtests:

- Character RAM Test - A 55 hex and AA hex are written, read and compared throughout the RAM Character Generator memory. A failure of this test is signaled by displaying "CHARACTER RAM FAIL on the next line of the CRT. Nothing will be displayed if there is no failure.

- RAM Test - A 55 hex and AA hex are written, read, and compared throughout the 64K resident RAM. A failure of this test is signaled by displaying RAM FAIL XXXX AA EE on the next line of the CRT (assuming a failure does not prevent display) where: XXXX = failing address; AA = actual data read; EE = expected data read. Nothing will be displayed if there are no failures. Parity error interrupts are enabled during the RAM test, and the above failure will be reported if a parity error is detected. (Note: If actual = expected the parity chip itself may be bad.)

- Graphics RAM Test - If this option is present, the graphics RAM will be selected and a 55 hex and AA hex pattern will be stored and tested. A failure of the test will be displayed on the next line saying GRAPHICS FAIL XXXX, AA EE. Nothing will be displayed if there are no failures.

- Graphics Bulk Write Test - If the option is present, a bulk write function will be performed writing all zeros into the graphics RAM. If the bulk write busy status does not set and clear, the message "GRAPHICS FAIL" will be displayed. The same message will be displayed if the graphics RAM does not contain all zeros after the completion of the bulk write function.

- ROM Test - A checksum is run on each memory chip of the resident ROM. A failure of this test is signaled by displaying "ROM FAIL XX XX XX". The first value is ROM #1, the second is ROM #2 and the third is ROM #3. A value other than 00 is bad.

- NVM Test - A checksum will be run on the nonvolatile memory (NVM). A failure of this test is signaled by displaying "NVM ALTERED" on the next line of the CRT. Nothing will be displayed if there are no failures.

- Loopback Tests - The test is comprised of transferring 128 characters from the processor to the communications UART, which is conditioned to echo rather than transmit data. The data is tested as it is received. Transmitter speed is fixed at 9600 baud. A failure of the test is signaled by displaying "COMM FAIL" on the next line of the CRT. The same test is conducted on the UART to the keyboard. A failure of this test is signaled by displaying "KEYBOARD FAIL" on the next line of the CRT.

- Timer Test - The timer will be started for a 5-millisecond delay with the timer interrupt enabled. If a timer interrupt does not occur before 6 milliseconds, interrupts will be disabled and the message TIMER FAIL displayed.

- Battery Test - This test will sample the battery low status. If the battery voltage level is low, "BATTERY LOW" will be displayed. This is not an error condition, but indicates battery should be replaced before NVM is lost.

- Serial Ports - If this option is present, this test will transfer 128 characters to the UART on ports A and B which are conditioned to echo rather than transmit data. The data is tested as it is received. Transmission speed is fixed at 9600 baud. A failure of the test is signaled by displaying "PORT A or PORT B FAIL".

- Test Switch - The test switch on the main logic board is tested. If not enabled it will go to the next section. If enabled it will:

  - Keyboard Clock - The keyboard clock is fed into the CTC timer chip, the timer is tested to see if it runs, if not the message KBD CLOCK FAIL will be displayed.

  - Keyboard Loopback - The keyboard UART, transmitter, and receiver will be tested. 128 characters, 00 to 7F hex, will be transmitted, they should be looped back through the switch and tested as they are received. The message EXT KBD LOOPBACK FAIL will be displayed if an error occurs.

  - The message "TEST SWITCH ENABLED" will be displayed.

- Internal Modem Test - If the 1200/1200 Baud internal modem option is in, a call will be made to address 8009 if it contains a C3. The following tests will be performed:

  - ROM Checksum - A checksum will be run on the internal modem firmware. A failure of this test is signaled by displaying "INTERNAL MODEM CHECKSUM FAIL" on the next line. Nothing will be displayed if there are no failures.

  - UART Loopback - The 8250 UART will be placed into local loopback mode. All 128 codes, 00 to 7F hex, will be transmitted and tested as they are received. If a failure is detected the message "INTERNAL MODEM UART FAIL" will be displayed.

  - Modem Card Loopback - This test will be run only if F4-3 in the terminal parameters is set to a 1. The modem card will be placed into loopback mode. All 128 codes, 00 to 7F hex, will be transmitted and tested as they are received. If a failure is detected the message "INTERNAL MODEM LOOPBACK FAIL" will be displayed. This test will be run twice, once in originate mode and once in answer mode. This test will not be run if a mode has been selected and the terminal is online.

  - Modem Firmware Revision Level - The message INTERNAL MODEM REV X.X will be displayed.

- Serial Port Test Switch - If the test switch on the Dual Serial Interface board is in the test position, the message "SERIAL PORT TEST SWITCH ENABLED" will be displayed.

- Diagnostic ROM Pack - If a ROM PACK containing a diagnostic is installed, a call will be made to the ROM PACK diagnostic input. The ROM PACK diagnostic should do a ROM checksum, test any additional hardware used, display any error messages and display ROM PACK name and revision. If an error occurs, the call is returned with non-zero condition active, else it is returned with zero active.

- Revision Level - This section displays the revision level of the resident firmware. Note: This is only seen if Auto-select is disabled. The release and revision numbers may be different than shown.

RES REV 4.0

- Alarm - Completion of test 1 is signaled by the audible alarm sounding for one-quarter second at a soft level, one-quarter second at a loud level and followed by another one-quarter second at a soft level. See figure A-1 for internal diagnostic failure format after test.

```
COPYRIGHT CONTROL DATA 1983
CHARACTER RAM FAIL
RAM FAIL XXXX XX XX
GRAPHIC FAIL XXXX XX XX
GRAPHIC FAIL
ROM FAIL XX XX XX
NVM ALTERED
COMM FAIL
KEYBOARD FAIL
TIMER FAIL
BATTERY LOW
PORT A FAIL
PORT B FAIL
KBD CLOCK FAIL
EXT KBD LOOPBACK FAIL
INTERNAL MODEM FAIL
INTERNAL MODEM CHECKSUM FAIL
INTERNAL MODEM UART FAIL
INTERNAL MODEM LOOPBACK FAIL
INTERNAL MODEM REV X.0
SERIAL PORT TEST SWITCH ENABLED
TEST SWITCH ENABLED
(DIAGNOSTIC ROM PACK MESSAGES HERE)
RES REV 4.0
COPYRIGHT CONTROL DATA 1983
```

Figure A-1 DIAGNOSTIC DISPLAY TEST 1 IF EVERYTHING FAILED

TEST 2

Test 2 can be initiated from the keyboard in local character mode or upon receipt of the Initiate Test command from the host while

running in resident CYBER mode (1E, 16). Test 1 is rerun. If an error occurs, the error flag will be set. Keyboard entry during this test may cause invalid errors.

- Host Initiated - At the completion of the test, if the error flag is set an error response is sent to the host (STX, ACK, NAK). The error message will not remain on the screen. If the error flag is not set, a positive response is sent (STX, ACK, ACK) to the host and the screen will be cleared.

- Locally Initiated - If the operator holds down the CTRL key and presses =, V (RS, SYN) while in local CYBER mode, the test will be run, as long as no errors are detected the test will loop and keep running. This can only be cleared by pressing RESET. If an error occurs, the test will halt displaying the failure and the RESET must be pressed to exit.

TEST 3

Test 3 is initiated if the operator presses the F8 key while the Mode Selection Menu is being displayed.

- Graphic Video - If the graphics option is present the graphics video will be enabled and the graphics RAM will be filled with an alternate dot pattern. This display will switch between 480 and 512 scans at approximately a 1 second rate. Depressing any key will disable the graphics video and continue test.

- Alignment Raster - This test enters an alignment pattern around the outer edge of the display area.

- ROM Character Generator - Seven lines will be displayed as follows:

  - 32 Control codes
  - 33 Numeric and special characters
  - 32 Uppercase alpha and special characters
  - 31 Lowercase and special characters
  - 32 Foreign character symbols
  - 32 Line drawing characters
  - 64 PLATO characters

NOTE

If a foreign character set is selected they will appear in their assigned locations.

NOTE

The external RAM characters will not be displayed because they cannot be displayed simultaneously with PLATO characters.

- Attribute Test - A line saying, "BLINK DIM UNDERSCORE INVERSE BLANK" will be displayed with each word having the associated bit set in background. If BLANK is seen on the CRT, the function is not working.

- Keyboard Test - This test displays "KEYBOARD TEST". As the operator presses a key, the hex code received from the key will be displayed after the words KEYBOARD TEST.

NOTE

The keyboard sends a hex code whenever a key is depressed or released. Bit 2^7 is clear whenever a key is pressed and the same code with bit 2^7 set when the key is released. The codes sent by the keyboard are not ASCII codes. See figure 2-1 for codes generated by the keyboard. The following is an example.

KEYBOARD TEST 10 (when the PRINT key is pressed)
KEYBOARD TEST 90 (when the PRINT key is released)

As keys are pressed, the CYBER modes keyboard interrupt routine will be used to receive the code. This routine will ignore unused keys. Only one code will be used under double keycaps. The language parameter determines which keys are ignored.

- Indicator Test - The eight indicators that are controlled by the firmware will be stepped on and off at a slow rate. After the first indicator is lit a short while, it will be shifted right. After the last indicator has been lit the first will again be lit.

- Touchpanel Test - The touchpanel interrupt will be enabled. When the screen is touched an interrupt occurs and the cursor will be moved to the area touched.

- External Loopback - A message displays near the bottom of the screen explaining how to run external loopback. It displays "TO RUN EXTERNAL LOOPBACK - ENABLE TEST SWITCHES".

  When the test switch on the main logic board is enabled, the following tests will be looped on;

  - The UART clock for the keyboard I/F will be tested and the message "KBD CLOCK OK" or "KBD CLOCK FAIL" will be displayed.

  - PARALLEL PORT - If a graphic printer is installed, it must be powered-on and selected, then deselected (or wait about 20 seconds) or an error will occur. A 55 hex and AA hex will be sent to the printer which is conditioned to echo data. If incorrect data is received back or no response received, the error message "PARALLEL PORT FAIL" will be displayed and there will be no further test on this port. If no error is detected, the message "PARALLEL PORT OK" is displayed.

    If the graphic printer is not installed, a test will be made for flexible disk present. A read ID will be sent to the disk. If an improper status is received, the message "PARALLEL PORT FAIL" will be displayed. If proper status is received, the message "PARALLEL PORT OK" will be displayed.

  - KEYBOARD LOOPBACK - The message "KEYBOARD RUNNING" will be displayed. 128 characters, 00 hex to 7F hex, will be looped back continuously. If an error occurs, the word "RUNNING" will change to "FAIL".

  - COMMUNICATIONS LOOPBACK - The message "COMM RUNNING" will be displayed. 128 characters, 00 hex to 7F hex, will be looped back continuously. If an error occurs, the word "RUNNING" will change to "FAIL".

  - SERIAL PORT A and B - If the Dual Serial Port board is installed, the message "PORT A (or B) RUNNING" will be displayed. 128 characters from 00 hex to 7F hex will be looped back continuously. If an error occurs, the word "RUNNING" will change to "FAIL".

NOTE

The test switch on this board must be switched to TEST before starting the test or an error will occur.

To exit test 3, the operator must press the RESET switch (see figure A-2 for display format of test).

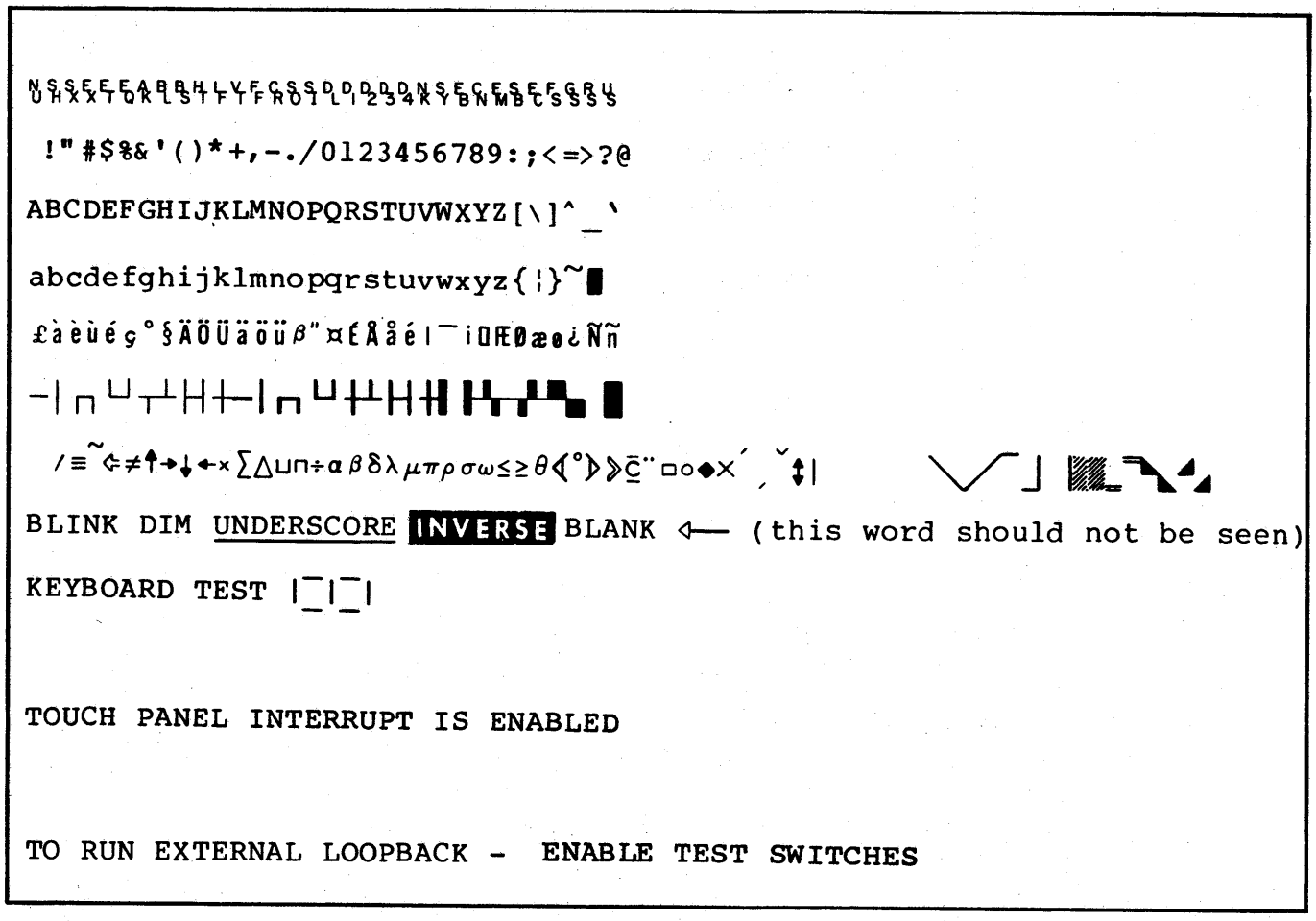


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Figure A-2 DIAGNOSTIC DISPLAY TEST 3 (ENGLISH)

INTERFACES

- Test 1 - The only operator interface required to run test 1 is to power on unit or press RESET. Operator can verify failures by displayed messages.

- Test 2 - Host selectable in CYBER mode only, and operator selectable in local CYBER mode by pressing CTRL and =, CTRL and V.

- Test 3 - The operator is required to press F8 while the Mode Selection Menu is displayed. The operator can verify all symbol shapes, indicators, touchpanel and keyboard. Symbols will be displayed according to language selected. Figure A-2 shows English selected. To run external loopback, the operator must pull the TEST switch.

ABORTS AND RECOVERY

- Test 1 - If an error occurs, the remainder of that section is aborted, an error message is displayed, and the test will continue. Depression of RESET will rerun Test 1.

- Test 2 - If initiated while on line and an error occurs, test 2 is aborted and a negative response is sent to the host. If initiated while local and an error occurs, Test 2 will halt with message displayed. Operator must press RESET to recover.

- Test 3 - If an error occurs during loopback, the failing section will no longer be run, the test will continue running all good sections. Operator must press RESET to end test. Pushing in the TEST switch will start Test 3 over.

ERRORS

- Test 1 - Errors display on the screen. If no error occurs, nothing is displayed. (Figure A-1)

- Test 2 - An error message is sent back to the host (STX, ACK, NAK).

- Test 3 - Operator verification required, except during external loopback. (Figure A-2)

- See figure A-1 and the preceding paragraphs for error messages.

- Test 1 - Requires less than 6 seconds to run if the internal modem loopback is disabled, and less than 20 seconds if enabled and present.
- Test 2 - Same as Test 1.
- Test 3 - No time limit, test ends when RESET is pressed.
- Usage of internal diagnostics in conjunction with manuals will allow 98-percent error detection.
- Usage in combination with manuals will allow 95 percent isolation to the field replaceable module.

MEMORY LAYOUT

The terminal has more than 64K bytes of RAM and ROM in its maximum configuration, since a 16-bit address bus allows only 64K of direct addressing, memory bank controls are added.

Figure B-1 shows all of the present memory broken up into 16K banks. The 64K of addressing is broken up in 4 blocks (see figure B-2). Block 0 starts at address 0000; block 4 starts at 4000; block 8 starts at 8000; and block C starts at C000. Banks can be selected into certain blocks to achieve the desired mode configuration. See figure B-3 for some mode configurations.

When the terminal is powered on or reset, banks 0, 2, 3 and 4 are selected in blocks 0, 4, 8, and C, respectively. The following bank selections will take place in the resident firmware depending upon type of load.

- CYBER Mode - No bank selection is performed.
- Load from ROM Pack - Bank 5 is selected in block 8.
- Load from Host - When the ASCII loader is selected, no bank selecting is performed. This could accommodate a load from 4000 of bank 2, and all of bank 3. At the completion of the load, control is tranferred to the first address designated in the load. If the loaded controlware does not want to use the ASCII display (banks 0 and 4), it must select the desired bank configuration.
- Load from Disk - When the disk loader is selected, no bank selecting is performed. At the completion of the disk load, control is transferred to the address specified by the first two words from the disk. If the loaded controlware does not want to use the ASCII display (banks 0 and 4), it must select the desired bank configuration.

  EXAMPLE for loading PLATO:

  The resident loader will select banks 0, 2, 3, 4 in block 0, 4, 8, C respectively. The code would be loaded into bank 3 (block 8) and control transferred to it. The loaded controlware selects banks 7 and 8 in block 0 and 4.

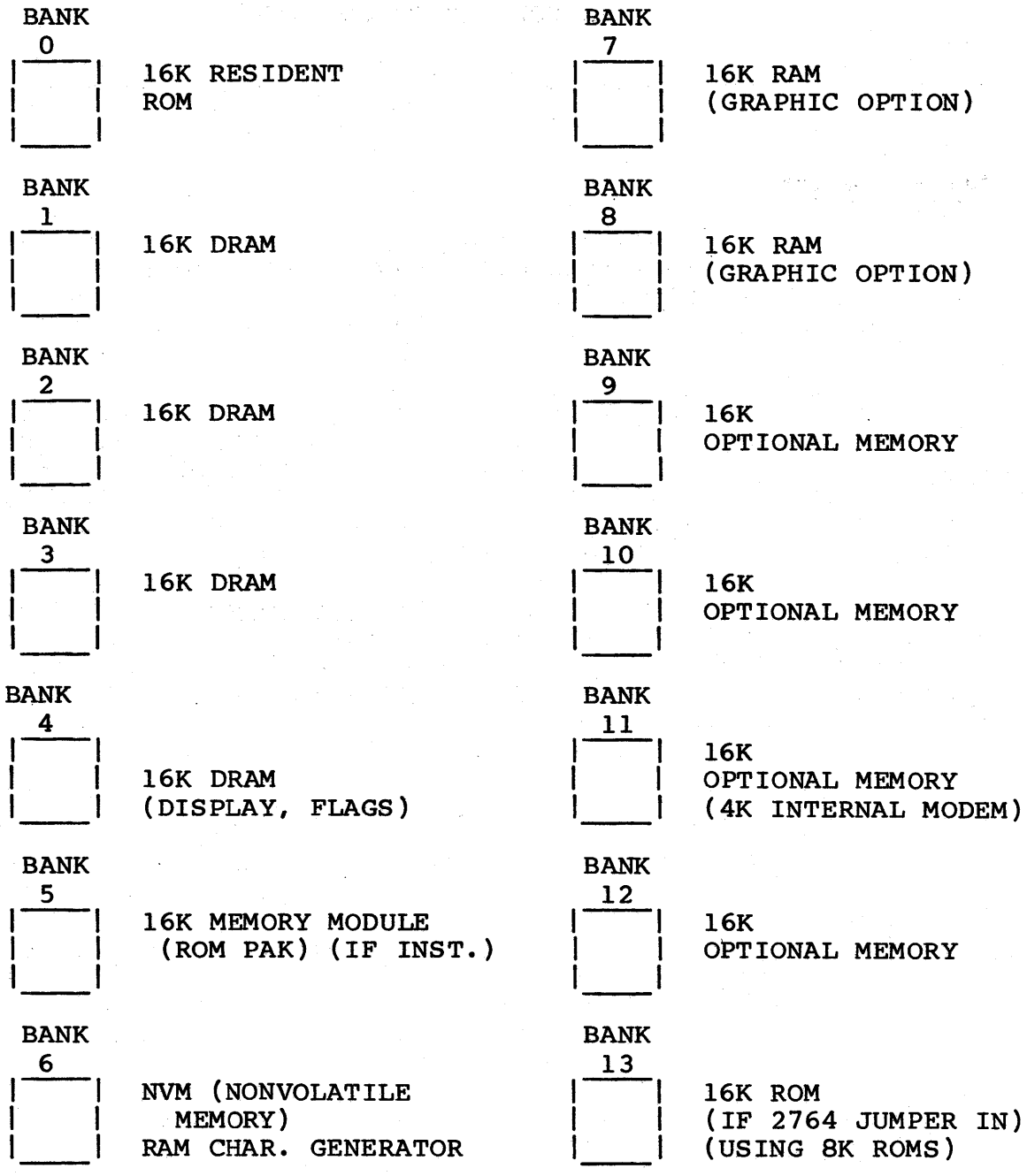
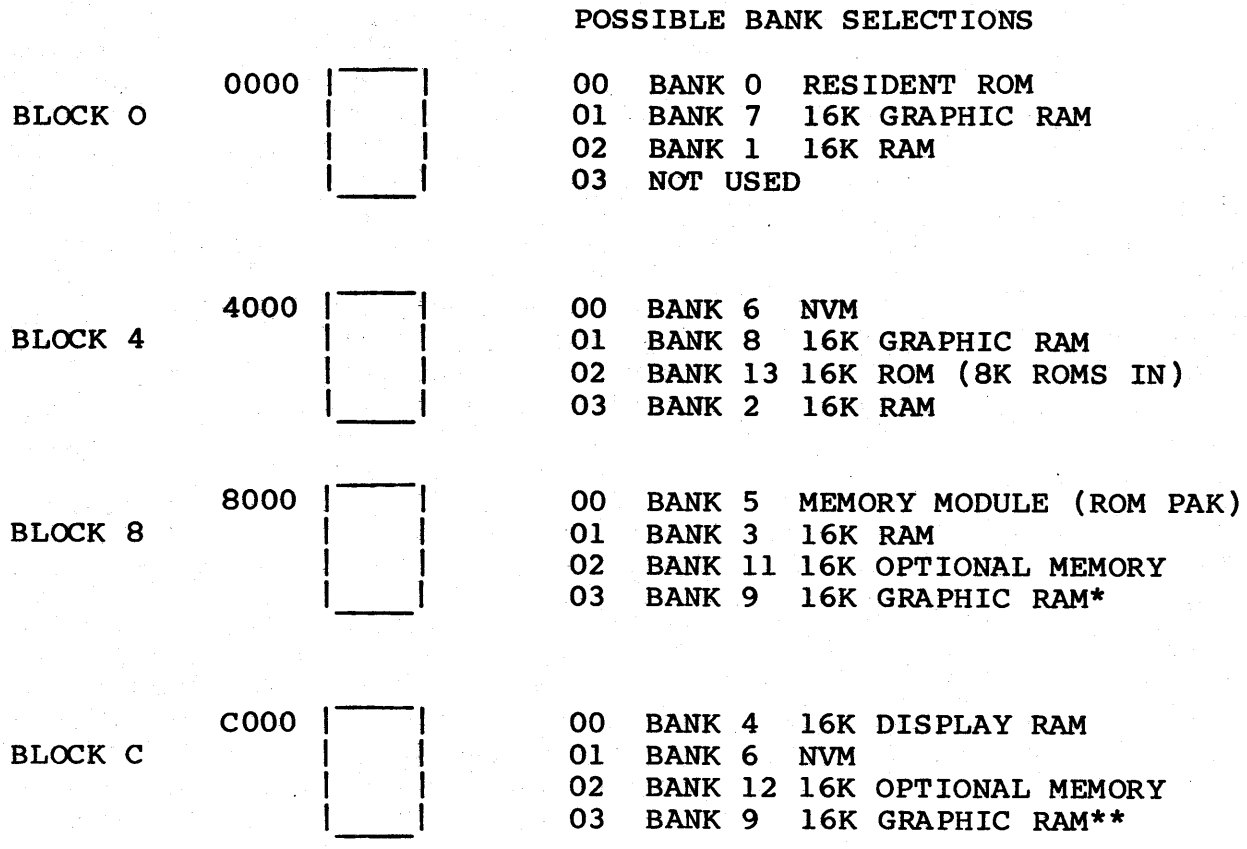


Figure B-1. BANK CONFIGURATIONS



*DEFAULTS TO BANK 7 IF GRAPHIC OPTION IS INSTALLED.

**DEFAULTS TO BANK 8 IF GRAPHIC OPTION IS INSTALLED.

Figure B-2. MEMORY BLOCK CONFIGURATIONS

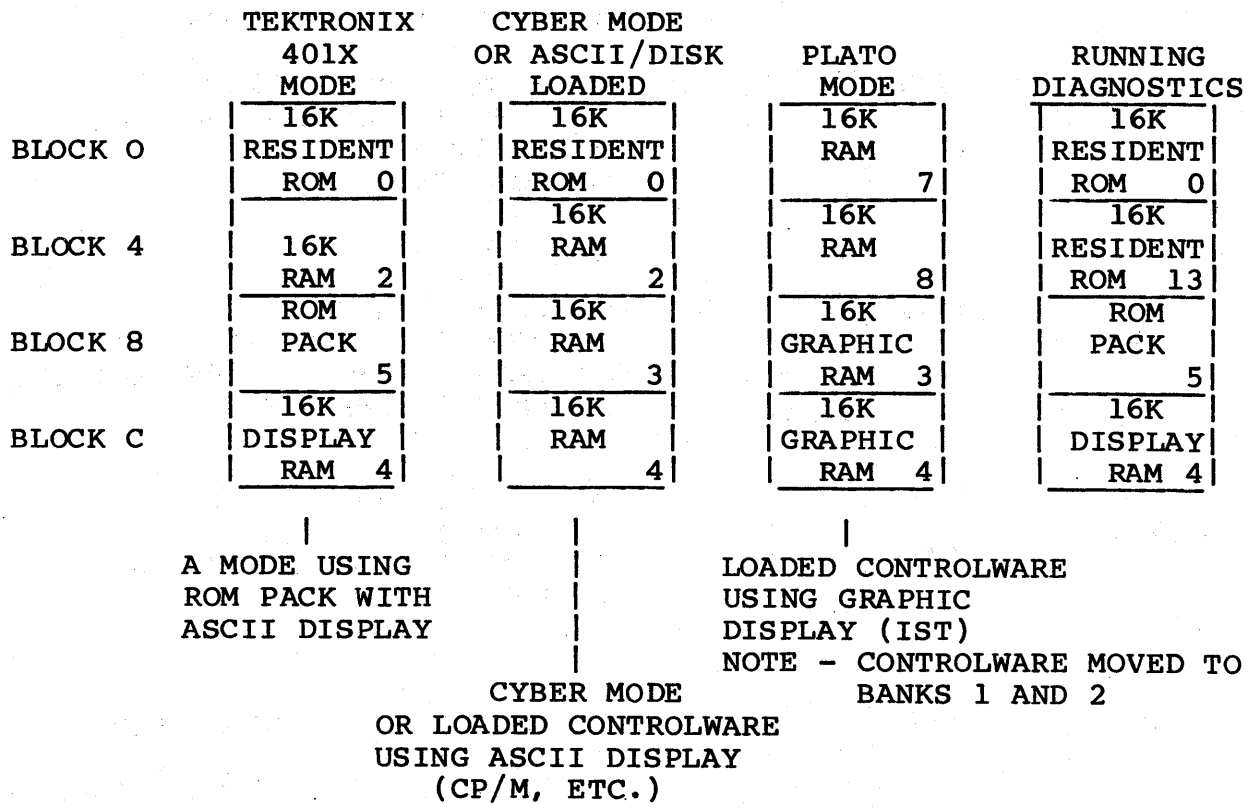


Figure B-3. MEMORY BLOCK CONFIGURATIONS

BANK 4 LAYOUT

Bank 4 contains 16K of dynamic random-access memory (DRAM). The ASCII display hardware uses this bank of memory for display refresh. The CYBER mode uses this bank also for flags, buffers, stack pointer and interrupt table. Table B-1 shows the layout.

Bank 4 contains 16K of DRAM that is used by CYBER mode to display information. The data is arranged in lines. A line can be anywhere in the 16K area, but must start on an even address. The data is stored at even addresses and the attributes are stored at the next odd addresses.

A table is setup in the middle of the memory that tells the hardware where each line starts. See table B-2 for an example of how the table and display DRAM are setup in CYBER mode.

TABLE B-1. BANK 4 LAYOUT

ADDRESS	DESCRIPTION	SIZE
C000 CAFF	DISK OPERATING CONTROLWARE	4096
CB00 CEFF	RESERVED FOR CP/M	1024
CF00 CFFF	RESERVED FOR INTERNAL MODEM	256
D000 D7DF	HOST LOADABLE CODES/CONTROLWARE	2014
D7E0 D8FF	HOST LOADABLE AREA TABLE	288
D900 DB0F	2 STATUS LINES	528
DB10 DB1F	KEYBOARD INPUT BUFFER	16
DB20 DEFF	COMM INPUT BUFFER	992
DF00 DFBF	COMM OUTPUT BUFFER	192
DFC0 DFFF	STACK POINTER	64
E000 E03B	DISPLAY TABLE	60
E03C E03F	LOAD FLAGS	4
E040 E0FF	ACTIVE RAM AND FLAGS	192
E100 E10F	INTERRUPT TRAPS	16
E110 FFFF	30 X 132 X 2 DISPLAY DATA	7920

TABLE B-2. INITIAL DISPLAY MEMORY LAYOUT

ADDR	TABLE		ADDR	DISPLAY RAM
E000	1	0	<----------E110	
E001	E	1	LINE 1	DATA+ATTRI LINE 1
E002	1	8		
E003	E	2	LINE 2<----E218	LINE 2
E004	20			
E005	E3		LINE 3 E320	LINE 3
E006	28			
E007	E4		LINE 4 E428	LINE 4
E008	30			
E009	E5		LINE 5 E530	LINE 5
E00A	38			
E00B	E6		LINE 6 E638	LINE 6
E00C	40			
E00D	E7		LINE 7 E740	LINE 7
E00E	48			
E00F	E8		LINE 8 E848	LINE 8
E010	50			
E011	E9		LINE 9 E950	LINE 9
E012	58			
E013	EA		LINE 10 EA58	LINE 10
E014	60			
E015	EB		LINE 11 EB60	LINE 11
E016	68			
E017	EC		LINE 12 EC68	LINE 12
E018	70			
E019	ED		LINE 13 ED70	LINE 13
E01A	78			
E01B	EE		LINE 14 EE78	LINE 14
E01C	80			
E01D	EF		LINE 15 EF80	LINE 15
E01E	88			
E01F	F0		LINE 16 F088	LINE 16
E020	90			
E021	F1		LINE 17 F190	LINE 17
E022	98			
E023	F2		LINE 18 F298	LINE 18
E024	A0			
E025	F3		LINE 19 F3A0	LINE 19
E026	A8			
E027	F4		LINE 20 F4A8	LINE 20

TABLE B-2. INITIAL DISPLAY MEMORY LAYOUT (CONTD)

ADDR	TABLE		ADDR	DISPLAY RAM
E028	B0			
E029	F5	LINE 21 <-----	F5B0	LINE 21
E02A	B8			
E02B	F6	LINE 22	F6B8	LINE 22
E02C	C0			
E02D	F7	LINE 23	F7C0	LINE 23
E02E	C8			
E02F	F8	LINE 24	F8C8	LINE 24
E030	D0			
E031	F9	LINE 25	F9D0	LINE 25
E032	D8			
E033	FA	LINE 26	FAD8	LINE 26
E034	E0			
E035	FB	LINE 27	FBE0	LINE 27
E036	E8			
E037	FC	LINE 28	FCE8	LINE 28
E038	F0			
E039	FD	LINE 29	FDF0	LINE 29
E03A	F8			
E03B	FE	LINE 30	FEF8	LINE 30
			FFFF	

USER INTERFACE TO RESIDENT SUBROUTINES

The resident ROM firmware contains routines that can be used by user loaded controlware. A jump table has been placed at the beginning so that changes can be made to the resident firmware without requiring all external users to change their programs. The table in B-3 shows the fixed address that an external user can call. Note: These addresses are to remain fixed and any new jumps are to be added to the end of the list.

TABLE B-3. ENTRY POINT JUMP LISTING

ADDRESS	NAME	DESCRIPTION
0000	INIT	; INITIALIZATION
0003	INIT00	; INITIALIZATION 00
0006	INIT01	; INITIALIZATION 01
0009	INIT02	; INITIALIZATION 02
000C	CRT80	; SET CRT TO 80 CHR/LINE
000F	CRT132	; SET CRT TO 132 CHR/LINE
0012	CINIT	; COMM INITIALIZATION
0015	KINIT	; KEYBOARD INITIALIZATION
0018	PINIT	; PRINTER INITIALIZATION

TABLE B-3. ENTRY POINT JUMP LISTING (CONTD)

ADDRESS	NAME	DESCRIPTION
001B	INTDIS	; INTERRUPT DISABLE
001E	INTENA	; INTERRUPT ENABLE
0021	CMTRAP	; COMM INTERRUPT TRAP
0024	KBTRAP	; KEYBOARD INTERRUPT TRAP
0027	TMTRAP	; TIMER INTERRUPT TRAP
002A	TPTRAP	; TOUCHPANEL INTERRUPT TRAP
002D	ADVCR	; ADVANCE CURSOR
0030	ADVMD	; ADVANCED MODE
0033	ALARM	; ALARM
0036	ALARMI	; ALARM IF ENABLED
0039	BDISPN	; DISPLAY B - PERFORM FUNCTION
003C	BFTB	; COMM BUFFER TO B
003F	BLDADD	; BUILD ADDRESS
0042	CLEAR	; CLEAR
0045	CLREOL	; CLEAR TO END OF LINE
0048	CLREOP	; CLEAR TO END OF PAGE
004B	CRDOWN	; CURSOR DOWN
004E	CRGRTN	; CARRIAGE RETURN
0051	CRLEFT	; CURSOR LEFT
0054	CRLNFD	; CARRIAGE RETURN LINE FEED
0057	CRUP	; CURSOR UP
005A	DISPB	; DISPLAY B - STORE ON SCREEN
005D	DLYEN1	; DELAY ENABLE 1
0060	DLYEN2	; DELAY ENABLE 2
0063	DSTRNG	; DATA STRING
0066	HASCII	; HEX TO ASCII
0069	KBDAS	; CONVERT NEXT KEYBOARD CODE TO ASCII
006C	KBDASC	; KEYBOARD TO LOWERCASE ASCII
006F	KINPUT	; KEYBOARD INPUT
0072	MODENE	; DISPLAY FAILURE LOADING MODE
0075	PABI	; PORT A BIDIRECTIONAL
0078	PBBI	; PORT B BIDIRECTIONAL
007B	PRINTB	; PRINT B
007E	RESET	; RESET
0081	SCROLL	; SCROLL
0084	SEND	; SEND NEXT CODE FROM COMM BUFFER
0087	SENDB	; STORE B IN COMM SEND BUFFER
008A	SETDE	; SET CURSOR TO DE
008D	SETCR	; SET CURSOR
0090	ST_TM	; START DELAY TIMER
0093	TABBK	; TAB BACKWARDS
0096	TABFW	; TAB FORWARD
0099	TABCLR	; TAB CLEAR
009C	TABSET	; TAB SET
009F	TPINP	; TOUCHPANEL INPUT
00A2	SENDB8	; STORE B IN COMM SEND BUFFER
00A5	MNTOR	; USER ENTRY TO MONITOR
00A8	ADVINI	; ADVANCED MODE INITIALIZATION

TABLE B-3. ENTRY POINT JUMP LISTING (CONTD)

ADDRESS	NAME	DESCRIPTION
00AB	KBDINP	; ADVANCED MODES KEYBOARD INPUT
00AE	CMTRPU	; COMM INTERRUPT TRAP-USER
00B1	KBTRPU	; KEYBOARD INTERRUPT TRAP-USER
00B4	TMTRPU	; TIMER INTERRUPT TRAP-USER
00B7	TPTRPU	; TOUCHPANEL INTERRUPT TRAP-USER
00BA	TIPRAM	; MOVE TERMINAL INSTALLATION
00BD	CRTOUT	; OUTPUT VALUES TO 5037 CRT CONTROLLER
00C0	ADDB15	; ADD BIAS IF ENABLES
00C3	BFTDSP	; PROCESS ONE CODE FROM COMM BUFFER
00C6	KBDLCK	; LOCK KEYBOARD
00C9	KBDUNL	; UNLOCK KEYBOARD
00CC	PILSR	; INPUT PRINTER LSR
00CF	PRINTC	; PRINT NEXT CHARACTER
00D2	PTTRAP	; PRINTER INPUT TRAP
00D5	RSETXY	; RESET CURSOR TO OLD XY
00D8	SAVE XY	; SAVE CURRENT XY POSITION
00DB	TBLKKY	; TEST IF BLOCK MODE + KEYBOARD INPUT
00DE	REL	; RELEASE NUMBER (ASCII)
00DF	REV	; REVISION NUMBER (ASCII)
00E0	CK1	; CHECKSUM
00E1	MODESL	; MODE SELECTION MENU
00E4	RTNBKS	; RETURN TO (BANKS) SELECTED
00E7	CLINIT	; COMM LINE INITIALIZATION
00EA	KBDINP2	; KEYBOARD INPUT #2
00ED	CDIAL3	; AUTO DIAL 3.0
00F0	CDIAL4	; AUTO DIAL 4.0
00F3	CBLDDIR	; BUILD 60 DIGIT PHONE NUMBER
00F6	CTSTMD	; INTERNAL MODEM TEST MODE
00F9	CLWRCYB	; FORCE LOWER CYBER
00FC	HANGUP	; INTERNAL MODEM HANG UP
00FF	CUSRDL	; AUTO DIAL - USER CONTROLWARE
0102	CUSRSTS	; MODEM STATUS
0105	CUSRMDM	; SET MODEM CONTROL PARAMETERS
0108	CANSWR	; INTERNAL MODEM AUTO ANSWER
010B	CANSWRB	; AUTO ANSWER ON TWO RINGS
010E	CADIALZ	; AUTO DIAL - USE MODE DEFAULT PARAMETERS
0111	CUTONE	; AUTO DIAL TONE
0114	CADIALY	; AUTO DIAL - USE 60 DIGIT NUMBER
0117	CATODLX	; AUTO DIAL
011A	CATODLY	; AUTO DIAL
011D	CANSW70	; GO OFF-HOOK
0120	THANGUP	; TEST FOR HANGUP

Common Variables

Common variables and flags are stored in Bank 4 and can be read or changed by the resident or user programs. They are broken up in terminal parameters, mode parameters and flags (table B-4).

The terminal parameters are moved from NVM to the RAM area during initialization (before any mode is selected). The mode parameters are moved to the RAM area when the mode has been determined (before the mode has been loaded). The flags can be cleared by calling Advanced Mode Initialization (ADVINI).

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE

```
;*********************************************************
;
;  M O D E   I N S T A L L A T I O N   R A M / E Q U
;
;*********************************************************
E040    RAMST   .EQU    0E040H
E040    MBYTE1  .EQU    RAMST
0001    MODEEN  .EQU    01          ; MODE ENABLED
0002    SECEN   .EQU    02          ; SECURITY ENABLED
0004    OPSLSF  .EQU    04          ; OPERATOR SELECT SOURCE/FILE
0008    LDEN    .EQU    08          ; LOAD ENABLED (FROM HOST OR DISK)
E041    MBYTE2  .EQU    MBYTE1+1
0001    LDDISK  .EQU    01          ; LOAD FROM DISK
0002    INTMDM  .EQU    02          ; USE INTERNAL 1200-BAUD MODEM
0004    CDIAL   .EQU    04          ; CONTINIOUS DIAL
0008    AUTODL  .EQU    08          ; AUTO DIAL
E042    MBYTE3  .EQU    MBYTE2+1
0001    H8BIT   .EQU    01          ; HOST 8 BITS
0002    HPEN    .EQU    02          ; HOST PARITY ENABLED
0004    HPEVEN  .EQU    04          ; HOST PARITY EVEN
0008    H2STOP  .EQU    08          ; HOST 2 STOP BITS
E043    MBYTE4  .EQU    MBYTE3+1
0001    DTRSW   .EQU    01          ; DTR SWITCHED
0002    RTSSW   .EQU    02          ; RTS SWITCHED
0004    RPTDIS  .EQU    04          ; REPEAT DISABLED (TYPAMATIC OFF)
0008    DTONLY  .EQU    08          ; DATA ONLY OPERATION
E044    MBYTE5  .EQU    MBYTE4+1
0001    HOMELL  .EQU    01          ; HOME LOWER LEFT
0002    AUTOLF  .EQU    02          ; AUTO LINE FEED ENABLED
0004    PACEEN  .EQU    04          ; PACING ENABLED
0008    BIASEN  .EQU    08          ; BIAS ENABLED
E045    MBYTE6  .EQU    MBYTE5+1
0001    AADVDS          01          ; AUTOMATIC ADVANCE DISABLED
        ;               02          ; NOT USED
        ;               04          ; NOT USED
0008    RUNPAK  .EQU    08          ; 0 = RUN CYBER  1 = RUN ROM PACK
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
                ;*****************************************************
                ;                 O P E R A T E R   P A R A M E T E R S
                ;*****************************************************
E046    OBYTE1  .EQU    MBYTE6+1
0001    LOCAL   .EQU    01          ; LOCAL
0002    PTSEL   .EQU    02          ; PRINTER SELECTED
0004    MRGEN   .EQU    04          ; MARGIN ALERT ENABLED
0008    ALERTL  .EQU    08          ; ALERT LOUD
E047    OBYTE2  .EQU    OBYTE1+1
0001    SFLOCK  .EQU    01          ; SHIFT LOCK
        NPADIV  .EQU    02          ; NUMERIC PAD SHIFTED
0004    ROLLSC  .EQU    04          ; ROLL SCREEN
000B    PAGESC  .EQU    0BH         ; .PAGE SCROLL
008     LARGE   .EQU    08          ; LARGE CYBER
E048    OBYTE3  .EQU    OBYTE2+1
0001    BGLITE  .EQU    01          ; BACKGROUND LIGHT
0002    CRBOX   .EQU    02          ; CURSOR BOX
0004    CRSLD   .EQU    04          ; CURSOR SOLID ON
        ;       .EQU    08          ; NOT USABLE
E049    OBYTE4  .EQU    OBYTE3+1
0001    FULL    .EQU    01          ; FULL DUPLEX
0002    CL132   .EQU    02          ; 132 CHARACTERS PER LINE
0004    LN30    .EQU    04          ; 30 LINES
0008    TRANS   .EQU    08          ; TRANSPARENT
                ;*****************************************************
                ;       M O R E   M O D E   P A R A M E T E R S
                ;*****************************************************
E04A    ADILE   .EQU    OBYTE4+1    ; AUTO-DIAL NUMBER
E056    DFILE   .EQU    ADILE+12    ; DEFAULT FILE NUMBER
E058    TBAUD   .EQU    DFILE+2     ; TRANSMIT BAUD RATE
E059    RBAUD   .EQU    TBAUD+1     ; RECEIVE BAUD RATE
E05A    SECURE  .EQU    RBAUD+1     ; SECURITY CODE
E060    OEND    .EQU    0E060H      ; END OF OPERATOR PARAMETERS
                ;*****************************************************
                ;       T E R M I N A L   P A R A M E T E R S
                ;*****************************************************
E060    TBYTE1  .EQU    OEND
0001            .EQU    01H         ; SPARE
0002    TPOPT   .EQU    02H         ; TOUCHPANEL OPTION IN
0004    DSOPT   .EQU    04H         ; DUAL SERIAL OPTION IN
0008    GPOPT   .EQU    08H         ; GRAPHIC PRINTER OPTION IN
E061    TBYTE2  .EQU    TBYTE1+1
0001    FDOPT   .EQU    01H         ; FLEXIBLE DISK OPTION IN
0002    SGPOPT  .EQU    02H         ; GRAPHIC PRINTER OPTION IN
0004    IMOPT   .EQU    04H         ; INTERNAL 1200 MODEM OPTION IN
0008            .EQU    08H         ; SPARE
E062    TBYTE3  .EQU    TBYTE2+1
0001    GOPT    .EQU    01H         ; GRAPHIC OPTION IN
0002    PAROPT  .EQU    02H         ; PARALLEL OPTION IN
0004            .EQU    04H         ; SPARE
0008    FXDOPT  .EQU    08H         ; FIXED DISK OPTION IN
E063    TBYTE4  .EQU    TBYTE3+1    ; SPARE
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
0001    ASELEN  .EQU    01H         ; AUTO SELECT ENABLE
0002    DLSRTS  .EQU    02H         ; DELAY ON PRINTER SRTS
        RILOOP  .EQU    04H         ; RUN INTERNAL MODEM LOOPBACK
        TDIAL   .EQU    08H         ; TONE DIAL
E064    TBYTE5  .EQU    TBYTE4+1
0001    MPTDSR  .EQU    01          ; MONITOR PRINTER Ready
0002    MBIDSR  .EQU    02          ; MONITOR BIDIRECTIONAL Ready
E065    TBYTE6  .EQU    TBYTE5+1
E066    ASEL    .EQU    TBYTE6+1    ; AUTO SELECT 0-7 (DEFAULT MODE)
E067    XDELTA  .EQU    ASEL+1      ; SCREEN MOVE X DELTA
E068    YDELTA  .EQU    XDELTA+1    ; SCREEN MOVE Y DELTA 0-F
E069    LANG    .EQU    YDELTA+1    ; LANGUAGE 0-7
E06A    ID      .EQU    LANG+1      ; TERMINAL ID NUMBER 0000-FFFF
E06E    CHAPAR  .EQU    ID+4        ; CHANNEL A PARAMETERS
0001    DS8BIT  .EQU    01H         ; 7/8 DATA BITS
0002    PAREV   .EQU    02H         ; PARITY EVEN
0004    PARDIS  .EQU    04H         ; PARITY DISABLED
0008    BIDIR   .EQU    08H         ; BIDIRECTIONAL PORT
E06F    CHABD   .EQU    CHAPAR+1    ; CHANNEL A BAUD 0-F
E070    CHBPAR  .EQU    CHABD+1     ; CHANNEL B PARAMETERS
E071    CHBBD   .EQU    CHBPAR+1    ; CHANNEL B BAUD 0-F
E080    TEEND   .EQU    0E080H      ; TERMINAL EQUATE END
        ;*****************************************************
        ;       BIDIRECTIONAL PORT
        ;*****************************************************
E080    BDATAR  .EQU    TEEND       ; BIDIR DATA IN/OUT
0001    IER     .EQU    01H         ; INTERRUPT ENABLE REGISTER
0002    IIR     .EQU    02H         ; INTERRUPT ID REGISTER INPUT
0003    LCR     .EQU    03H         ; LINE CONTROL REGISTER OUTPUT
0004    MCR     .EQU    04H         ; MODEM CONTROL REGISTER OUTPUT
0005    LSR     .EQU    05H         ; LINE STATUS REGISTER INPUT
0006    MSR     .EQU    06H         ; MODEM STATUS REGISTER INPUT
        ;
        ;*****************************************************
        ;       COMM I/O STORED IN RAM
        ;*****************************************************
E081    CDATAR  .EQU    BDATAR+1    ; COMM DATA IN/OUT
        ;
E082    PDATAR  .EQU    CDATAR+1    ; PRINTER DATA IN/OUT
        ;
        ;*****************************************************
        ;
        ;       I N P U T   B U F F E R S
        ;
        ;*****************************************************
E083    BFCNT   .EQU    PDATAR+1    ; NUMBER OF CHARACTERS IN COMM BUFFER
E085    BFINAD  .EQU    BFCNT+2     ; ADDRESS OF NEXT OPEN SLOT IN BUFFER
E087    BFOTAD  .EQU    BFINAD+2    ; ADDRESS OF NEXT CHARACTER TO BE
        ;                             TAKEN FROM COMM INPUT BUFFER
E089    KBCNT   .EQU    BFOTAD+2    ; NUMBER OF CHARACTERS IN KEYBOARD
        ;                             BUFFER
E08A    KBINAD  .EQU    KBCNT+1     ; ADDRESS OF NEXT OPEN SLOT IN BUFFER
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
E08C    KBOTAD  .EQU    KBINAD+2    ; ADDRESS OF NEXT CHARACTER TO BE
        ;                           TAKEN FROM KEYBOARD INPUT BUFFER
E08E    TXCNT   .EQU    KBOTAD+2    ; NUMBER OF CHARACTERS IN TRANSMIT
        ;                           BUFFER
E08F    TXINAD  .EQU    TXCNT+1     ; ADDRESS OF NEXT OPEN SLOT IN BUFFER
E091    TXOTAD  .EQU    TXINAD+2    ; ADDRESS OF NEXT CHARACTER TO BE
        ;                           TAKEN FROM TRANSMIT BUFFER
        ;*****************************************************
        ;
        ;       D E L A Y S
        ;
        ;*****************************************************
E093    ALRACT  .EQU    TXOTAD+2    ; 250 MS ALARM DELAY ACTIVE
001F    ALRTM   .EQU    31          ; 31 X 8 = 248
E094    BRKACT  .EQU    ALRACT+1    ; 250MS. BREAK DELAY ACTIVE
001F    BRKTM   .EQU    31          ; 31 X 8 = 248
E095    KBDACT  .EQU    BRKACT+1    ; 1 SEC. KEYBOARD DELAY IS ACTIVE
007D    KBDTM   .EQU    125         ; 125 X 8 = 1 SEC
E096    KBRACT  .EQU    KBDACT+1    ; 60MS. KEYBOARD REPEAT IS ACTIVE
0008    KBRTM   .EQU    8           ; 8 X 8 = 64
E097    PCDACT  .EQU    KBRACT+1    ; 8 MS. PACING DELAY ACTIVE
E098    PNTACT  .EQU    PCDACT+1    ; 200MS. PRINTER DELAY ACTIVE
0019    PNTTM   .EQU    25          ;
E099    TXDACT  .EQU    PNTACT+1    ; 8MS. TRANSMIT DELAY IS ACTIVE
E09A    UD1ACT  .EQU    TXDACT+1    ; USER DELAY 1 ACTIVE
E09B    UD1ADD  .EQU    UD1ACT+1    ; USER DELAY 1 ADDRESS
E09D    UD2ACT  .EQU    UD1ADD+2    ; USER DELAY 2 ACTIVE
E09E    UD2ADD  .EQU    UD2ACT+1    ; USER DELAY 2 ADDRESS
        ;*****************************************************
        ;
        ;       I N T E R R U P T   M A S K
        ;
        ;*****************************************************
E0A0    INTMSK  .EQU    UD2ADD+2    ; INTERRUPT MASK
        ;
0001    INTCM   .EQU    01H         ; INT. 0 COMM MASK
0002    INTIM   .EQU    02H         ; INT. 1 INTERNAL MODEM
0004    INTDP   .EQU    04H         ; INT. 2 DUAL RS-232-C PORT MASK
0008    INTPP   .EQU    08H         ; INT. 3 PARALLEL PORT/FIXED DISK
                                    MASK
0010    INTTP   .EQU    10H         ; INT. 4 TOUCHPANEL MASK
0020    INTKB   .EQU    20H         ; INT. 5 KEYBOARD MASK
0040    INTTM   .EQU    40H         ; INT. 6 TIMER MASK
0080    INTPE   .EQU    80H         ; INT. 7 PARITY ERROR
        ;*****************************************************
        ;
        ;       K E Y B O A R D   T A B L E
        ;
        ;*****************************************************
E0A1    KNSNC   .EQU    INTMSK+1    ; ADDRESS OF NO SHIFT, NO CONTROL
                                    TABLE
E0A3    KSNC    .EQU    KNSNC+2     ; ADDRESS OF SHIFT, NO CONTROL TABLE
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
E0A5   KNSC    .EQU   KSNC+2     ; ADDRESS OF NO SHIFT, CONTROL TABLE
E0A7   KSC     .EQU   KNSC+2     ; ADDRESS OF SHIFT, CONTROL TABLE
       ;*****************************************************
       ;
       ;       D I S P L A Y   R A M
       ;
       ;*****************************************************
E0A9   ATTRIB  .EQU   KSC+2      ; ATTRIBUTES WORD
       BLANK   .EQU   01H        ;   2**0=BLANK
       UNDLN   .EQU   02H        ;   2**1=UNDERSCORE
       INVERS  .EQU   04H        ;   2**2=INVERSE
       BLINK   .EQU   08H        ;   2**3=BLINK
       DIM     .EQU   10H        ;   2**4=DIM
       MODIFY  .EQU   20H        ;   2**5=MODIFIED DATA
       VALID   .EQU   40H        ;   2**6=VALIDATE CHARACTER
       PROTD   .EQU   80H        ;   2**7=PROTECT
E0AA   ATTSAV  .EQU   ATTRIB+1   ; A PLACE TO SAVE ATTRIB
E0AB   BLKMD   .EQU   ATTSAV+1   ; BLOCK MODE ACTIVE
E0AC   BLKSND  .EQU   BLKMD+1    ; BLOCK SEND ACTIVE
E0AD   BSCRPE  .EQU   BLKSND+1   ; BACKSPACE CURSOR IN PARAMETER ENTRY
       ;                           MODE
E0AE   CCDSR   .EQU   BSCRPE+1   ; CURRENT COMM DSR
E0AF   CEOL    .EQU   CCDSR+1    ; 1= CLEAR TO EOL ACTIVE
E0B0   CHNCHG  .EQU   CEOL+1     ; CHANGE IN NUMBER OF CHARACTERS
E0B1   CHRCNT  .EQU   CHNCHG+1   ; CHARACTER COUNT 0-4F, 0-83
E0B2   CHRSAV  .EQU   CHRCNT+1   ; A PLACE TO SAVE CHARACTER COUNT
E0B3   CLRTYP  .EQU   CHRSAV+1   ; TYPE OF CLEAR
       ;                           00= ALL
       ;                           02= UNDERSCORE
       ;                           08= BLINK
       ;                           10= DIM
       ;                           1F= NORMAL
E0B4   COMPNT  .EQU   CLRTYP+1   ; COMM PRINT ACTIVE
E0B5   CONT    .EQU   COMPNT+1   ; 1=CONTROL KEY ACTIVE
E0B6   CPSLK   .EQU   CONT+1     ; 0=CAPS LOCK NOT ACTIVE
E0B7   CURSOR  .EQU   CPSLK+1    ; CURSOR ADDRESS
E0B9   DLMENA  .EQU   CURSOR+1   ; DELIMITER ENABLED
E0BA   DRVADD  .EQU   DLMENA+1   ; 0= DRIVER NOT LOADED, ELSE ADDRESS
       ;                           OF DRIVER
E0BC   DSPDIS  .EQU   DRVADD+2   ; DISPLAY DISABLED
E0BD   ERROR   .EQU   DSPDIS+1   ; 2**0 = SECURITY CODE INCORRECT
E0BE   FLAG1   .EQU   ERROR+1    ; FLAG WORD 1
       STOCR   .EQU   01H        ; 2**0 SEND TOP TO CURSOR
       AUTOFT  .EQU   02H        ; 2**1 AUTO FIELD TABBING
       CBLKMD  .EQU   04H        ; 2**2 CLEAR KEY TO EXIT BLOCK MODE
       BAUDCH  .EQU   08H        ; 2**3 BAUD RATE HAS CHANGED
       PTXOFF  .EQU   10H        ; 2**4 PRINTER XOFF RECEIVED
       HLCDIS  .EQU   20H        ; 2**5 AUTO ADVANCE DISABLED
       PNTBLD  .EQU   40H        ; 2**6 PRINT B IS BEING LOADED
       EXTATT  .EQU   80H        ; 2**7 EXTEND ATTRIBUTES ON CLEAR
       ;
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
E0BF    FLAG2    .EQU   FLAG1+1    ; FLAG WORD 2
        FLDSCR   .EQU   01H        ; 2**0 FIELD SCROLL ACTIVE
        SRDOWN   .EQU   02H        ; 2**1 SCROLL DOWN
        TABFLG   .EQU   04H        ; 2**2 TAB SEARCH FLAG
        OLDATT   .EQU   10H        ; 2**4 USE ODD ATTRIBUTES
        ;
E0C0    GRACHR   .EQU   FLAG2+1    ; GRAPHIC CHARACTERS
        GRCHR    .EQU   01H        ; 2**0 GRAPHIC CHR ENABLED
        RAMCHR   .EQU   02H        ; 2**1 RAM CHR ENABLED
        ;
E0C1    HDCSER   .EQU   GRACHR+1   ; HOST DEFINED CODE SEQUENCE
E0C2    HMSGA    .EQU   HDCSER+1   ; HOST MESSAGE ACTIVE
E0C3    HMSGSV   .EQU   HMSGA+1    ; HOST MESSAGE STORAGE
        EAANSW   .EQU   20H        ; 2**5 ENABLE AUTO ANSWER
        BIDACT   .EQU   40H        ; 2**6 BIDIRECTIONAL DATA ACTIVE
        SDOHLC   .EQU   80H        ; 2**7 SEND AND DO HOST LOADED CODES
E0C7    INDON    .EQU   HMSGSV+4   ; INDICATOR ON ACTIVE
E0C8    KBCODE   .EQU   INDON+1    ; KEYBOARD CODE FROM TABLE
E0C9    KBINP    .EQU   KBCODE+1   ; 1=KEYBOARD INPUT ACTIVE
E0CA    KBLKD    .EQU   KBINP+1    ; 2**0=KEYBOARD LOCKED
        ;                            2**1=COMM LOCKED
E0CB    FLAG3    .EQU   KBLKD+1    ; NOT USED
        AAACT    .EQU   01H        ; 2**0 AUTO ANSWER ACTIVE
        BIXOFF   .EQU   02H        ; 2**1 BIDIRECTIONAL X-OFF RECEIVED
E0CC    LASTKY   .EQU   FLAG3      ; LAST KEY FROM KEYBOARD
E0CD    LASTLN   .EQU   LASTKY+1   ; LAST LINE, 23 OR 29
E0CE    LIGHTS   .EQU   LASTLN+1   ; CURRENT LIGHTS, 1=ON 0=OFF
E0CF    LOCK     .EQU   LIGHTS+1   ; 1 = FIRST TIME DOWN, 2 = SECOND
        ;                            TIME DOWN
E0D0    LOCKLT   .EQU   LOCK+1     ; 0 = LOCK LIGHT OFF, 2 = LOCK LIGHT
                                     ON
E0D1    LNCNT    .EQU   LOCKLT+1   ; CURRENT LINE COUNT 0-17
E0D2    LNNCHG   .EQU   LNCNT+1    ; CHANGE IN NUMBER OF LINES
E0D3    LNSAV    .EQU   LNNCHG+1   ; A PLACE TO SAVE LINE COUNT
E0D4    LNSIZE   .EQU   LNSAV+1    ; LINE SIZE, 79 OR 131
E0D5    MLTCNT   .EQU   LNSIZE+1   ; THE COUNTER USED WHEN MULTIPLE
        ;                            INPUT-ACTIVE
E0D6    MLTACT   .EQU   MLTCNT+1   ; MULTIPLE CODE SEQUENCE ACTIVE
E0D7    MLTADD   .EQU   MLTACT+1   ; CALL ADDRESS STORED HERE
E0D9    MODEST   .EQU   MLTADD+2   ; MODE START IN CMOS OR RAM
E0DA    PCRLF    .EQU   MODEST+1   ; PRINT CR, LF
E0DB    PNTNXT   .EQU   PCRLF+1    ; THIS CODE IS TO BE PRINTED NEXT
E0DC    POSPRO   .EQU   PNTNXT+1   ; POSITION IS PROTECTED
E0DD    PRINTA   .EQU   POSPRO+1   ; 1= PRINT ALL ACTIVE
        ;                          ; 3= PRINT NORMAL ACTIVE
E0DE    PROTE    .EQU   PRINTA+1   ; PROTECT IS ENABLED
E0DF    RPTACT   .EQU   PROTE+1    ; 1=REPEAT ACTIVE
E0E0    RSRCV    .EQU   RPTACT+1   ; RS LAST CODE RECEIVED
E0E1    RXOFF    .EQU   RSRCV+1    ; RECEIVED X-OFF
E0E2    SAVEA    .EQU   RXOFF+1    ; STORAGE LOCATION A
E0E3    SAVEB    .EQU   SAVEA+1    ; STORAGE LOCATION B
E0E4    SAVEHL   .EQU   SAVEB+1    ; STORAGE LOCATION HL
E0E5    SCRSV    .EQU   SAVEHL+1   ; STORAGE LOCATION FOR SCROLL
```

TABLE B-4. COMMON VARIABLES IN RESIDENT FIRMWARE (CONTD)

```
E0E6    SHIFT    .EQU   SCRSV+1    ; SHIFT FLAG
        SFT      .EQU   01H          2**0 = SHIFT KEY 1 DOWN
        SFTLK    .EQU   02H        ; 2**1 = SHIFT LOCK ACTIVE
        SFT2     .EQU   04H        ; 2**2 = SHIFT KEY 2 DOWN
        ;
E0E7    SPFLAG   .EQU   SHIFT+1    ; 1= LINE TESTED, NOT ALL SPACES
                                     TO EOL
E0E8    SRLFST   .EQU   SPFLAG+1   ; 1ST LINE OF SCROLL FIELD . 0-17
E0E9    SRLLST   .EQU   SRLFST+1   ; LAST LINE OF SCROLL FIELD . 1-18
E0EA    STALN    .EQU   SRLLST+1   ; STATUS LINE ACTIVE
E0EB    SXOFF    .EQU   STALN+1    ; SENT X-OFF
E0EC    TABLE    .EQU   SXOFF+1    ; 0 = ADV .TBL, 1=TABLE 1, 2=TABLE 2
E0ED    TABST    .EQU   TABLE+1    ; 1 = TAB SET ACTIVE
E0EE    TIPE     .EQU   TABST+1    ; TERMINAL INSTALLATION PARA . ENTRY
E0EF    TOGAL    .EQU   TIPE+1     ; 2**4=0, 2**5=1, 2**6=TOGAL
E0F0    TXEMPF   .EQU   TOGAL+1    ; TRANSMIT EMPTY
E0F1    XPOS     .EQU   TXEMPF+1   ; X POSITION FROM COMM
E0F2    BANKS    .EQU   XPOS+1     ; CURRENT BANKS SELECTED
E0F3    T3RUN    .EQU   BANKS+1    ; TIMER 3 RUNNING
E0F4    T3TCV    .EQU   T3RUN+1    ; TIMER 3 TIME CONSTANT VARIABLE
E0F5    FNCODE   .EQU   T3TCV+1    ; FUNCTION KEY CODE TO SEND AFTER
                                     BLOCK SEND
E0F6    SAVECR   .EQU   FNCODE+1   ; SAVE CURSOR POSITION FOR SEND TOP
                                     TO CURSOR
E0F8    NOPTR    .EQU   SAVECR+2   ; NO PRINTER ASSIGNED
E0F9    PTSTAT   .EQU   NOPTR+1    ; PRINTER STATUS
        COMSER   .EQU   01H        ; 2**1 COMM TO SERIAL PRINTER
        COMPAR   .EQU   02H        ; 2**2 COMM TO PARALLEL ACTIVE
        LOCSER   .EQU   04H        ; 2**3 LOCAL SERIAL PRINTER
        LOCPAR   .EQU   08H        ; 2**4 LOCAL PARALLEL PRINTER
        NOPTRI   .EQU   010H       ; 2**5 NO SERIAL OR PARALLEL PRINTER
E0FA    SAVE8    .EQU   NOPTR+1    ; SAVE ALL 8 BITS OF COMM INPUT
        ;*********************************************************
        ;
        ;          L O A D   F L A G S
        ;
        ;*********************************************************
        ;
E0FC    LINFO     .EQU   0E03CH    ; LOAD INFO
        ASCIIL    .EQU   01H       ; ASCII LOADER
        DISKL     .EQU   02H       ; DISK LOADER
        ROML      .EQU   04H       ; ROM PACK
        RS232C    .EQU   10H       ; USING RS232C HOST INT.
        I1200     .EQU   40H       ; USING INTERNAL 1200/1200
E0FD    FILEN     .EQU   LINF0+1   ; FILE NUMBER
E0FE    MDACT     .EQU   FILEN+1   ; MODE ACTIVE
        MD        .EQU   07H       ; MODE
E0FF    ERRORF    .EQU   MDACT+1   ; ERROR FLAG
        DERROR    .EQU   01H       ; DIAGNOSTIC ERROR
        BATTL     .EQU   02H       ; BATTERY LOW
FFFF    RAMEND    .EQU   0FFFFH
```

INIT Initialization

This routine is entered after power-on or depressing of the reset switch. See appendix A for a definition of what this routine will do.

In general INIT will:

- Set up the 8255 to have all ports as outputs.
- Set the Stack Pointer to E000 hex.
- Select Banks 0, 2, 3, 4.
- Turn off alarm, enable ASCII video with internal clock, disable graphic video.
- Move terminal installation parameters from NVM to active RAM flags.
- Go to Test 1.
- After returning from Test 1.
- Select Bank 0, 2, 3, 4.
- Clear Flags - Except LIGHTS and ERROR F.
- Select Interrupt Mode 2.
- Enable Timer and Keyboard Interrupt.
- Test Error Flag
  - Go to Mode Select without clear if error set (MDSLNC).
- Test Auto Select
  - Go to Mode Select with clear if not enabled (MODESL).
  - Go to Default mode select if set (DFMODE).

INIT00 Initialization 00

This routine is used to set up for interrupts.

In general INIT00 will:

- Clear timer 3 of interrupts.
- Set (T3TCV) for 8 ms time constant.
- Call enable blink (ABLKE) output in 8255.
- Move the interrupt trap addresses to the interrupt trap table at E100 hex.

- Select Mode 2 interrupts.
- Call keyboard initialization (KINIT).
- Set interrupt mask to allow keyboard and timer interrupts.
- Return.

INIT01 Initialization 01

This routine is used to set up the 5037 for 30 lines by 80 characters.

In general INIT01 will:

- Turn off keyboard lock light.
- Call CRT80 to select 30 lines by 80 characters.
- Select blinking, box cursor with normal background.
- Calls INIT02 to clear comm send and receive buffers. See paragraph INIT02.
- Return.

INIT02 Initialization 02

This routine is used to reset comm send and receive buffers.

In general INIT02 will:

- Clear comm send and receive buffer counts (BFCNT, TXCNT).
- Set comm send and receive buffer pointers to start (BFINAD, BFOTAD, TXINAD, TXOTAD).
- Return.

CRT80 Set CRT to 80 Char/Line

This routine is used to set up the 5037 CRT controller chip for 80 characters per line.

In general CRT80 will:

- Select 80 characters in Port C of the 8255.
- Set (LNSIZE) = 4F hex (79).
- Test (OBYTE4) for 24 or 30 lines
  - Output 7 values to the 5037 depending on 24/30 lines, (XDELTA) and (YDELTA).
- Call clear screen (CLEAR).
- Return.

CRT132 Set CRT to 132 Char/Line

This routine is used to set up the 5037 CRT controller chip for 132 characters per line.

In general CRT132 will:

- Select 132 characters in Port C of 8255.
- Set (LNSIZE) = 83 hex (131).
- Test (OBYTE4) for 24 or 30 lines
  - Output 7 values to the 5037 depending on 24/30 lines, (XDELTA) and (YDELTA).
- Call clear screen (CLEAR).
- Return.

CINIT Comm Initialization

This routine is used to select and set up the proper 8250 UART for Comm interface. There are two possible Comm interfaces.

1. The Resident Data set.
2. The 1200/1200 Auto-Dial modem.

In general CINIT will:

- o First determine which interface is going to be used. If the option card is not installed for the interface selected, control is sent to Mode Not Enabled (MODENE).
- o The flag (CDATAR) is set to the device number for the 8250 selected. 40 = Resident Interface, C0 = Internal Modem.
- o The interrupt trap table is set to CMTRAP. The transmit baud rate is sent to the 8250. Timers 1 and 2 are set for the receive baud rate. (Needed for resident only.)
- o Output to the 8250 line control register LCR to select 7/8 bits, parity enabled/disabled, parity even/odd, and 1/2 stop bits.
- o Enable receive data interrupt in the 8250.
- o Light or clear the DSR indicator.
- o Output to the 8250 modem control register MCR to select proper data terminal ready (DTR).
- o Request to send (RTS) and secondary RTS (SRTS).
- o Clear interrupts in the 8250.
- o Delay about one half second to allow 8250 to settle.
- o Return.

KINIT Keyboard Initialization

The routine is used to set up the 8250 UART to the keyboard.

In general KINIT will:

- Clear keyboard buffer count (KBCNT).
- Set buffer in and out addresses to start (KBINAD) (KBOTAD).
- Set 8250 to 9600 baud.
- Select 8 bits, 1 stop bit, odd parity.
- Select receive data interrupt in 8250.
- Output to the modem control register to select language and alert volumn.
- Call unlock keyboard (KBDUNL).
- Select the residents keyboard tables.
- Clear interrupts.
- Return.

PINIT Printer Initialization

This routine is used to set up the proper 8250 on the Dual Serial Board to talk to a serial printer.

In general PINIT will:

- Test (CHAPAR) if printer is on Port A
  - Set (PDATAR) = 80 if Port A - Jump over Test B.
- Test (CHBPAR) if printer is on Port B
  - Set (PDATAR) = 90 if Port B.
- If neither have a printer, clear printer selected flag (OBYTE1).
- Output baud rate to selected Port.
- Set up the Line Control Register LCR for 7/8 bits, parity enabled/disabled, paritiy even/odd and 1 stop bit.
- Set up the modem control register MCR with DTR, RTS and Carrier On.
- Disable interrupts in the 8250.

- o Delay 1/2 second to settle the 8250.
- o Return.

INTDIS Interrupt Disable

This routine will disable the mask for a specified interrupt. In general INTDIS will:

- o Get the current interrupt mask.
- o Remove the proper mask bit.
- o Save new mask (INTMSK).
- o Output new mask to Port B of the 8255.
- o Return.

INTENA Interrupt Enable

This routine will enable the mask for the device specified and store the address of the trap.

In general INTENA will:

- o Store DE in the proper interrupt trap table.
- o Get the current interrupt mask (INTMSK).
- o Add the proper bit in B.
- o Save new mask (INTMSK).
- o Output new mask to Port B of the 8255.
- o Return.

CMTRAP Comm Interrupt Trap

This routine will input one character from the Comm 8250, test it for errors and store the proper code in the receive buffer.

In general CMTRAP will:

- o Input the data from the proper Comm interface (CDATAR).
- o Accept the data only if
  - Data only is active
  - DSR and CO are active
  - DSR and Constant RTS are active
  - DSR and Switched RTS and full duplex.
- o If a Break is received
  - Sound the alarm
  - Drop RTS if needed
  - Clear send and receive buffers.
- o Place a parity error code (FF) in buffer if
  - Overrun error
  - Parity error
  - Framing error
  - Break received.
- o Enable interrupts.
- o Return.

KBTRAP Keyboard Interrupt Trap

This routine will input one code from the keyboard 8250 UART and place it into the keyboard buffer. If code has an error status set, the code is not put into the buffer.

TMTRAP Timer Interrupt Trap

This routine is entered whenever the timer interrupt occurs. It tests to see which delays are active. It will take the appropriate action when a delay has finished. If a delay is not finished the timer will be started again.

Each delay has a flag indiciating the delay is active. The number stored in an active flag is the number of times remaining to go through the timer before the delay is finished.

Example: The alarm is a 250 ms delay. The timer length set by CYBER mode is 8 ms. Therefore 250 divided by 8 equals 32. 32 decimal equals 20 hex. So to sound the alarm 250 ms:

- The alarm must be turned on
- 20 stored in the active flag (ALRACT)
- The Start Timer (STTM) called.

The length of the timer can be changed by a user by storing the time constant in location (T3TCV) before calling (STTM).

Here is a list of delays and what happens when each times out.

- User delay 2 (UD2ACT) - A call is made to address stored in (UD2ADD) when finished.
- Keyboard delay (KBDACT) - This is a 1 second delay which starts the Keyboard Repeat delay when finished.
- Keyboard Repeat delay (KBRACT) - A call is made to KBDRPT to process another character, and the Repeat delay is started again.
- Alarm delay (ALRACT) - The alarm will be turned off when finished.
- Transmit delay (TXDACT) - A call is made to SENDTM to drop RTS when finished.
- Printer delay (PNTACT) - The (PNTACT) is cleared when finished.
- Pacing delay (PCDACT) - The (PCDACT) is cleared when finished.
- Break delay (BRKACT) - The Break signal is dropped from the Comm interface when finished.
- User delay 1 (UD1ACT) - A call is made to address stored in (UD1ADD) when finished.

NOTE

A user can call DLYEN1 or DLYEN2 to start user delays 1 or 2.

TPTRAP Touchpanel Interrupt Trap

This routine will move the cursor under the area touched and send the XY position on the Comm line.
In general TPTRAP will:

- Save all registers.
- Call TPINP - See paragraph TPINP.
- Move cursor to DE.
- Send RS, M, X, Y and CR if enabled.
- Restore all registers.
- Return.

NOTE

The user can call TPINP if it is not desired to move the cursor and send the XY position.

ADVCR Advance Cursor

This routine will advance the cursor to the next position.

- The alarm is sounded when the cursor enters the eighth position from end of line or last line and the margin alert is enabled.
- If cursor is at the end of line it is moved to the start of next line.
- If cursor is at the end of the last line:
  - its moved to upper left if page mode selected.
  - the screen is scrolled if scroll mode selected.

ADVMD Advanced Mode (CYBER Mode)

This is the entry point to advanced mode (CYBER Mode). It does not return if called. See the definition of CYBER Mode if needed.

ALARM Alarm for 250 ms

This routine will turn on the alarm and start the alarm delay for 250 ms.

ALARMI Alarm if Margin Bell Enabled

This routine will call ALARM if a keyboard input is active and the margin alert parameter flag is active.

BDISPN Display B

This routine will display (or process) the code in the B register. Function code will be processed.

BFTB Buffer to B

This routine will take the next code out of the Comm buffer and return with the code in the B register and interrupt disabled.

BLDADD Build Address

This routine will calculate the starting address of a line.

This routine will clear 30 lines by 132 character per line, enable the blink, and clear the attribute word. The cursor will be reset to home position.

CLREOL Clear to End of Line

This routine will clear data from current position to the end of line.

- o If protect is enabled - only unprotected data is cleared.
- o The background code is cleared - except in Block mode with keyboard input the modified bit is set.

CLREOP Clear to End of Page

This routine will clear data from current position to the End of Page.

- o If protect is enabled - only unprotected data is cleared.
- o The background code is cleared - except in Block mode with keyboard input the modified bit is set.

CRDOWN Cursor Down

This routine will move the cursor to the same relative position on the next line. If cursor is on the last line:

- o Page mode - move cursor to top line.
- o Roll mode - scroll screen and move cursor to start of last line.

CRGRTN Carriage Return

This routine will move the cursor to the beginning of the current line. If the Auto Line Feed parameter is active the cursor is moved to the beginning of the next line.

CRLEFT Cursor Left

This routine will move the cursor left one position. If in the first position of a line it will move to the last position of the line above. If in the first position of top line it will move to last position of last line.

CRLNFD Carriage Return Line Feed

This routine will move the cursor to the first position of current line and call CRDOWN. See paragraph CRDOWN.

CRUP Cursor Up

This routine will move the cursor up one line in the same relative position. If on the top line, cursor is moved to same position on bottom line.

DISPB Display the Code in B

This routine will store the code in the B register at the current cursor position and store the current attributes in the background memory:

- If the current position is protected a keyboard input alarm will sound and code not stored.
- If the graphic flag is active - 2**7 is added to codes between 20 and 3F hex.
- If keyboard input is active the modified bit is added to the background code.

The cursor is advanced to next position if code was stored.

NOTE

Function codes are displayed.

DLTEN1 Delay Enable 1

This routine will save the number of times the user wants to go through the timer (8 ms if not modified) and save the address it will call when the delay is finished. When the delay is finished a call will be made to the user address and the user must do a return as soon as possible.

DLYEN2 Delay Enable 2

Same as DLYEN1. (See paragraph DLTEN2 Delay Enable 1.)

DSTRNG Data String

This routine will take data from memory starting at address in HL and call BDISPN (see paragraph BDISPN). HL is incremented after each call until an FF HEX code is found.

HASCII Hex to ASCII Conversion

This routine will conver the lower 4 bits in the A register to its ASCII value.

KBDAS Keyboard to ASCII

This routine will wait for the next keyboard interrupt by calling KINPUT (see paragraph KINPUT Keyboard Input). If the code is not a Shift, Lock, or Control key the appropriate code will be taken from the keyboard table.

KBDASC Keyboard to Lower Case ASCII

This routine will select the proper code from the No Shift No Control keyboard table and return with code in A.

KINPUT Keyboard Input

This routine will loop waiting for a code in the keyboard buffer. It will input the code to register B and return.

MODENE Mode Not Enabled

This routine will display "MODE NOT ENABLED" on line 27 and display the mode selection menu.

This routine must have 30 lines selected. This can be done by calling INITO1 (see paragraph INITO1) before jumping to MODENE.

This routine will not return, it requires the operator to fix any problem and select another mode.

PABI Port A Bidirectional

This routine will set up Port A as the bidirectional RS-232-C port. It requires HL to be present to BDATAR.

In general PABI will:

- o Store 80 at (HL).
- o Output baud rate to the 8250 UART.
- o Set up the Line Control (LCR) for
  - 7/8 bit
  - Parity enabled/disabled
  - Parity even/odd
  - One stop bit
- o Set up the Modem Control Register (MCR) with DTR, RTS and Carrier On.

PBBI Port B Bidirectional

Same as PABI except for Port B is initialized. (See paragraph PABI Port A.)

PRINTB Printer Code in B Register

This routine will send the code in the B register to the printer if printer is selected and the UART has a data ready. It will loop waiting for data ready.

RESET Reset Cursor

This routine will move the cursor to the upper-left or lower-left depending on the cursor home parameter.

SCROLL Scroll Screen

This routine will scroll a field. The top and bottom lines must be preset.

(SRLFST) = Top line to scroll.

(SRLLST) = Bottom line to scroll.

(FLDSCR) = Direction of Scroll 0 = scroll up, 1 = scroll down. The cursor is moved to lower left if total scroll up.

SEND Send Next Code From Comm Buffer

This routine will send one byte of data if:

- Pacing delay not active.
- The host has not sent an X-OFF code.
- UART Has a data request.

- o Data only parameter active.
- o DTR and DSR and RTS and CTS are active.
  - If DSR is not active the keyboard is locked.

The routine will first send data from transmit buffer. If nothing is in the buffer the send is assumed to be a block mode send and the code is then taken from the screen.

SENDB Send the Code in B Register

This routine will place the code in the B register into the transmit buffer if online is active.

Return with NZ if local.
Return with Z if online and code is in buffer.

Before placing the code in the buffer bit 7 is cleared if space parity selected or set if mark parity selected.

NOTE

This routine will only send a 7-bit code. To send 8-bits see SENDB8 (paragraph 4.3.3.58).

SETDE Set Cursor to Location in DE

This routine will move the cursor to location specified by DE. D = Character Count, E = Line Count.

SETCR Set Cursor

This routine will move the cursor to the location specified by Character Count (CHRCNT) and Line Count (LNCNT).

STTM Start Timer

This routine will start the delay timer by outputing the variable count stored in (T3TCV). This location is set for 8 ms during initialization. If the timer is currently running it will not be restarted.

TABBK

This routine will move the cursor backwards to the next tab set position or to the start of the next non-dim field if protect is disabled or to the start of the next unprotected field if protect is enabled. The cursor will stop at upper-left if no found. If the cursor is at upper-left it will start search from lower-right corner.

TABFW Tab Forward

This routine will move the cursor forward to the next tab set position or to the next non-dim position following a DIM position of protect is disabled or to the next unprotected position following a protected position if protect is enabled. The cursor will be moved to upper-left if none are found.

TABCLR Tab Clear

This routine will clear the current column as a tab stop.

TABSET Tab Set

This routine will set the current column as a tab stop.

TPINP Touchpanel Input

This routine will input touchpanel data and return with the actual data in B, the character count in D and the line count in E.

SENDB8 Send the 8-Bit Code in B Register

This routine will place the code in the B register into the transmit buffer if online is active.

Return with NZ if local.

Return with Z if online and code in buffer.

MNTOR User Entry to Monitor

This entry will make one pass through the MDNITOR Routine and return. The monitor will:

- Print one character if print is active.
- Process one character if data in receive buffer.
- Process one keyboard code if data in keyboard buffer.
- Send one code if data in send buffer.
- Send one code if block mode send active.
- Update the DSR indicator.

ADVINI Advanced Mode Initialization

This routine will do the following initialization before returning:

- Clear RAM flags and host load table.
- Set up to use resident keyboard tables.
- Turn off keyboard lock light.
- Set up the 5037 according to 24/30 lines and 80/132 characters.
- Select cursor type.
- Call INIT00 (see paragraph INIT00).

- Call INIT02 (see paragraph INIT02 Initialization 02).
- Call PINIT (see paragraph PINIT Printer Initialization.
- Select keyboard and timer interrupt masks.
- Call CINIT (see paragraph CINIT Comm Initialization.

KBDINP Keyboard Input (CYBER Mode)

This routine will process the next keyboard code using all of the CYBER mode function table.

In general it will:

- Input the next code.
- Convert code using tables.
- Send the proper CYBER mode code(s) by placing them in the send buffer.
- If half duplex - process code(s) internally.

CMTRPU Comm Interrupt Trap for User

This routine does the same as CMTRAP (see paragraph CMTRA Comm Interrupt Trap) except it will not enable interrupts before returning.

KBTRPU Keyboard Interrupt Trap for User

The routine is the same as KBTRAP (see paragraph KBTRAP Keyboard Interrupt Trap) except it will not enable interrupts before returning.

TMTRPU Timer Interrupt Trap for User

This routine does the same as TMTRAP (see paragraph TMTRAP Timer Interrupt Trap) except registers must be saved before calling and it will not enable interrupts before returning.

TPTRPU Touchpanel Interrupt Trap for User

This routine does the same as TPTRAP (see paragraph TPTRAP Touchpanel Interrupt Trap) except it will not enable interrupts before returning.

TIPRAM Move Terminal Installation Parameters to RAM

This routine will move the terminal installation parameters from NVM to there active locations in RAM.

Bank 6 must be selected in Block 4 and Bank 1 must be selected in Block C before calling this routine.

CRTOUT CRT Output

This routine will output seven values to the 5037 CRT controller chips. A register pair is used to point to the starting value in memory.

ADDBIS Add Bias if Enabled

This routine will add 20 HEX to register B if the bias parameter is set.

BFTDSP Process One Code from Communication Buffer

This routine will process the next code from the Comm Input Buffer.

KBDLCK Lock the Keyboard

This routine will set the keyboard locked flag and turn on the indicator.

KBDUNL Unlock the Keyboard

This routine will clear the keyboard locked flag and turn off the indicator.

PILSR Input Printers LSR

This routine will input the Line Status Resister from the RS-232-C Printer.

PRINTC Print Next Character

This routine will print the character at the cursor and advance the cursor to the next position.

PTTRAP Printer Input Trap

This routine will input data from the printer channel and test it for:

a. DC1 - XON
   Clear printer off flag

b. DC3 - XOFF
   Set printer off flag

c. Everything else is ignored

RSETXY Reset Cursor to Old XY Position

This routine will move the cursor to the positions saved by the SAVE XY routine.

SAVEXY Save Current XY Position

This routine will save the current XY position in RAM to be used later by the RSETXY routine.

TBLKKY Test for Block Mode + Keyboard Input

This routine will return with the non-zero condition active if Block Mode and Keyboard Input. Else the zero condition will be active.

REL

This location contains the ASCII code equal to the resident release level.

REV

This location contains the ASCII code equal to the residents revision number.

CK1

This location contains the checksum for chip 1.

MODESL Mode Select

This routine will display the mode selection menu.

RTNBKS

This routine will output the contents stored in (BANKS) to the bank selection register and then return.

CANSWR

This routine will switch banks and call the internal modems subroutine that will do an auto answer. A return is made to the caller if the internal modem is not installed, the phone is answered or the BREAK key is pressed.

HANGUP

This routine will switch banks and call the internal modems hang up subroutine. A return is made to the caller if the internal modem is not installed or after hanging up the line.

CLINIT

This routine will light the DSR indicator if DSR is present and output the proper word to the Modem Control Register.

KBDINP2

This routine enables CP/M entry to the keyboard input routine. It functions much the same as the KBDINP1 routine with the exception that this routine processes the code in B instead of fetching a code from the keyboard buffer.

Programming Considerations

General Guidelines

1. The listing of the firmware provides added information on entries, exits and operational details. The listing has the same part numbers as the firmware chips and is a controlled document which cannot be distributed outside Roseville Operations without approval of the Roseville General Manager or his/her designate.

2. Never read from or write into NVM directly. Always use Bank 4 parameters.

3. All user callable routines will not enable or disable interrupts (except BFTB will return with interrupts disabled).

4. All user callable routines will not change interrupt mask (except interrupt enable and disabled).

5. All user callable routines will return bank selects to equal the value stored in (BANKS).

6. Bank 0 must be selected in Block 0 and Bank 4 must be selected in Block C when using any callable routines.

Position the Cursor

There are many ways to position the cursor to a desired position.

1. SETDE - Place the character count in Register D, the line count in Register E and call SETDE.

2. DSTRNG - In a display string of data the X, Y positioning can be used. Example using a system configured to small CYBER, 80 characters per line, bias off. Move cursor to line 4, character 0 and display HELP.

   ASCII - DLE, X, Y, H, E, L, P
   HEX - 10, 03, 48, 45, 4C, 50, FF

   Load (HL) with starting address of hex codes in memory and call DSTRNG.

3. CRDOWN - Call CRDOWN to do DOWN ARROW.

4. CRGRTN - Call CRGRTN to do carriage return.

5. CRLEFT - Call CRLEFT to backspace.

6. CRLNFD - Call CRLNFD to do carriage return and line feed.

7. CRUP - Call CRUP to do up arrow.

Displaying One Character

There are two ways to display a character.

1. DISPB - To display the code in B without reacting to control codes call DISPB.

2. BDISPN - To display the code in B while reacting to control codes (see table 4-12) call BDISPN.

Display a String of Characters

Store the message in memory, terminating it properly. Call DSTRNG.

Get One Code From Keyboard

When it has been determined there is something in the keyboard buffer:

1. KINPUT - Call this to get the raw code from the keyboard.
2. KBDAS - Call this to convert the raw code into an ASCII code.

Transmit Data

Transmitting data is a two step operation.

1. SENDB - Call this routine to place the code in Register B into the transmit buffer.
2. SEND - If there is something in the transmit buffer call this routine to send the next code if conditions are ready.

Receive Data

The initial set up has the host receive interrupt enabled. The interrupt (CMTRPU) will input one code and put it into the receive buffer.

BFTB - This route can be called to take the next code from the buffer and put it into B.

Delays

There are two user delays. A timer is run that has a user defined time constant. The user defines the number of times through the timer and the address to be called when finished.

1. The timers time constant is initialized to 8 ms. This can be changed by storing a new time constant variable at (T3TCV). Example for a 5 ms time constant: 5000 000 = 42666 · T3TCV

   117 =

   T3TCV
2. DLYEN1 or DLYEN2 - Call these routines with the proper register set to number of times through the timer and the proper registers set to address to call when finished.

Restrictions and Limitations

This firmware does not support the Graphic option. It is intended to have a ROM pack or external loaded controlware to support the Graphic option.

This resident firmware does not support the Graphic or IST PLATO load option. It is intended to have a ROM pack or external loaded controlware to support them.

Certain tables and variables described in section 4 are in fixed memory locations and cannot be moved.

The following paragraphs describe the physical, electrical, and functional requirements of the RS-232-C/CCITT V.24 Interface.

PHYSICAL AND ELECTRICAL REQUIREMENTS

The interface signals conform to EIA Standard RS-232-C and CCITT Recommendation V.24 as applied to asynchronous telecommunications.

All levels are referenced to Signal Ground and must not exceed ±15 volts.

For the Received Data circuit, a voltage more negative than -3 volts is interpreted as a marking condition; a voltage more positive than +3 volts is interpreted as spacing condition. During periods of no receiver activity, the Received Data circuit is expected to be held to a marking condition.

For control circuits originating at the modem, a voltage more negative than -3 volts open circuit is interpreted as an off condition; a voltage more positive than +3 volts is interpreted as an on condition.

For the Transmitted Data circuit, the terminal provides a voltage equal to, or greater than -5 volts as a marking condition and a voltage equal to or greater than +5 volts as a spacing condition. During periods of no transmission activity, the Transmitted Data circuit is held to a marking condition.

For control signals originating at the terminal, a voltage equal to or greater than -5 volts is provided as an off condition; a voltage equal to or greater than +5 volts is provided as an on condition.

Recommended maximum cable (P/N 61409028-32) length is 15.2 metres (50 feet). The connector is a 25 pin female AMP part 745114-2 or equivalent.

SIGNAL CHARACTERISTICS

Interface circuit signal definitions are provided as follows:

- Protective Ground (Pin 1) - Protective ground is electrically connected to the terminal frame and to the power source protective ground through the terminal ac power system.

- Transmitted Data (TXD) (Pin 2) - The Transmitted Data signal transfers data from the terminal to the modem. Data is transmitted as a 10- or 11-bit serial word and supports 7- or 8-bit data. In the order of transmission, the data word contains: a start bit (spacing), data bits 2^0 through 2^6 for 7-bit data and 2^0 through 2^7 for 8-bit data, a parity bit, and one or two stop bits (marking). The number of stop bits is selected by operator parameter bit selection. Within the field created by the start and stop bits, a marking condition is provided for a binary one indication and a spacing condition is provided as binary zero indication. Rate of transmission is determined by the Transmit Data Rate Select parameter setting. The transmit rate is independent of the receive data rate.

- Received Data (RXD) (Pin 3) - The Receive Data signal transfers data from the modem to the terminal. The received data word contains, in the order of reception: a start bit (spacing), data bits 2^0 through 2^6 for 7-bit data or 2^0 through 2^7 for 8-bit data a parity bit, and a stop bit (marking). Rate of reception is determined by the Receive Data Rate select parameter setting. Within the field created by the start and stop bits, a marking condition is interpreted as a binary one and a spacing condition is interpreted as a binary zero.

- Request to Send (RTS) (Pin 4) - This signal is generated by the terminal to condition the modem for data transmission. The transition of this signal from OFF to ON instructs the modem to enter the transmit mode. The transition of this signal from ON to OFF instructs the modem to complete the transmission on the communication channel of all data previously transferred on the terminal/modem interface and then to assume a nontransmit mode.

Once this signal has been turned OFF, it must not be turned ON again until Clear to Send has been turned OFF.

- Clear to Send (CTS) (Pin 5) - This signal is generated by the modem to indicate that the modem is ready to transmit data. The ON state of this signal is a response to the ON state of Request to Send, indicating that the modem is in the transmit mode. The OFF state of this signal is a response to the OFF state of Request To Send, indicating that all information previously transferred on the terminal/modem interface has been transferred to the communication channel and the modem is in the nontransmit mode.

- Data Set Ready (DSR) (Pin 6) - This signal is generated by the modem to indicate its status. The "ON" state signifies that the modem is connected to a communication channel; is not in test, talk or dial mode; and had completed all operations required of it to establish a connection to a remote modem. The ON state does not signify that a connection has actually been established. The OFF state indicates that the terminal must disregard all other interface signals except Ring Indicator unless the Data Only parameter is active. The OFF state of this signal must not impair the operation of the Ring Indicator or Data Terminal Ready Signals.

- Signal Ground (Pin 7) - Signal Ground establishes the common ground reference potential for the control and data signals.

- Received Line Signal Detector (Carrier On) (Pin 8) - This signal is generated by the modem. The ON state indicates that the modem is receiving a signal on the communication channel which meets the "Suitability Criteria" of the modem.

- Secondary Request to Send (Pins 11 & 19) - The modem generates this signal to indicate the condition of the unmodulated carrier on the secondary channel. The ON state indicates that a carrier signal is present. The OFF state indicates the absence of the carrier.

- Data Terminal Ready (DTR) (Pin 20) - This signal is generated by the terminal to indicate to the modem that the terminal is ready to receive or transmit information and that the modem may connect to or remain connected to the communication channel.

- Ring Indicator (Pin 22) - The modem generates this signal. It indicates to the terminal that a ringing signal is being received on the communication channel.

- Data Signal Rate Selector (Pin 23) - The Data Signal Rate Selector circuit is maintained in the on condition when power is applied to the terminal.

This appendix provides general description and programming aids information about the internal 1200/1200 bit-per-second modem. The general description portion of this appendix includes the functional and physical characteristics of the modem, a features summary of the capabilities of the modem, and a description of the internal and external interfaces of the modem. The programming aids portion of this appendix lists the code and character sequences that provide modem control or retrieve status information from the modem.

GENERAL DESCRIPTION

The topics related to the internal 1200/1200 b/s modem that are discussed in this portion of the appendix are as follows:

- Modem identification and physical characteristics
- Summary listing of the more notable modem features
- Fuctional description of the modem and its principal components
- Internal and external interfaces

MODEM IDENTIFICATION AND PHYSICAL CHARACTERISTICS

The modem option (equipment number XA360-A) is installed in large option-board location I/F-4 at the rear of the Viking X terminal (the main body of this text identifies the specific terminal equipments that can use the modem option). Figure D-1 indicates how the modem mounts within the terminal. The presence of a modem in a terminal is easily established because the rear of the assembly is prominently visible through a slot in the rear of the terminal at the I/F-4 location. Although installation requires access to the inside of the terminal, the modem is a customer/service-center installed option; instructions for installing the modem may be found in the Operator's Guide/Installation Instructions for the enhanced display terminal (refer to preface of this manual). Figure D-2 indicates the appearance and physical size of the modem assembly. Notice that the assembly consists of two printed-circuit boards. The larger of boards is the actual modem while the smaller board provides a control logic interface between the host terminal and the modem.

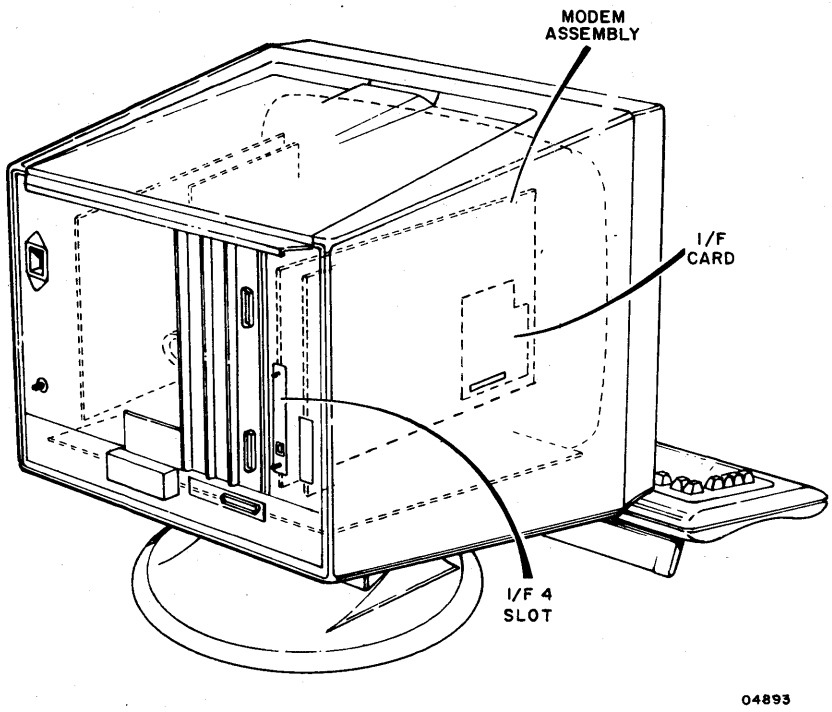


Figure D-1. Location of Modem Assembly in Terminal

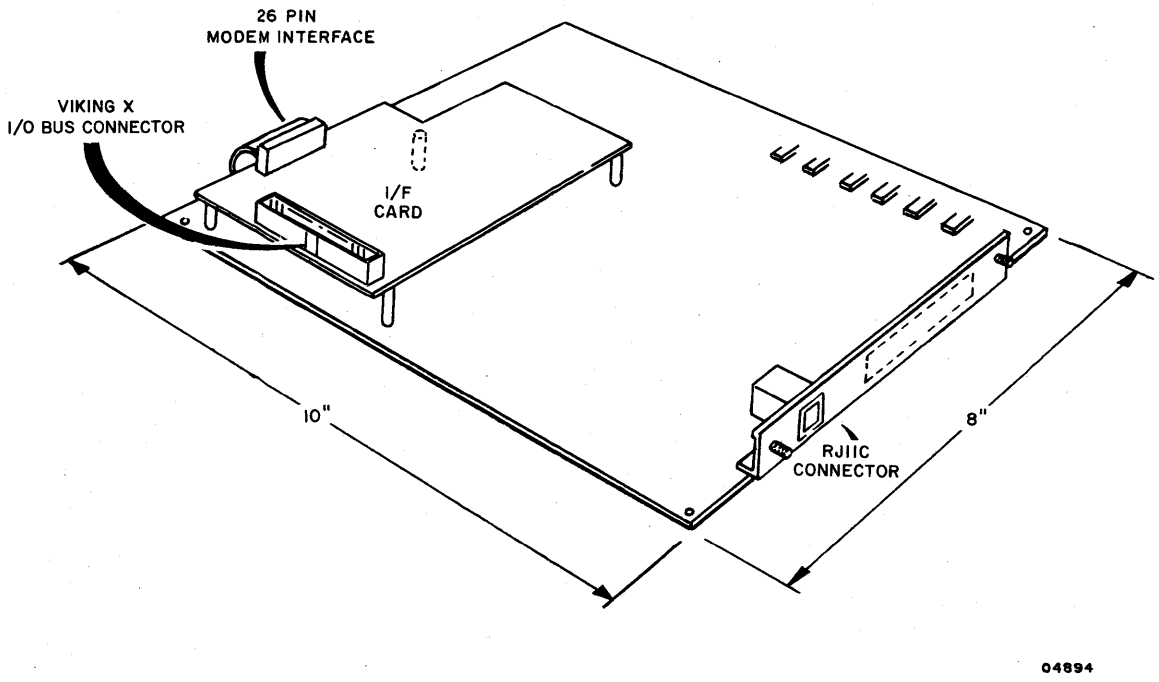


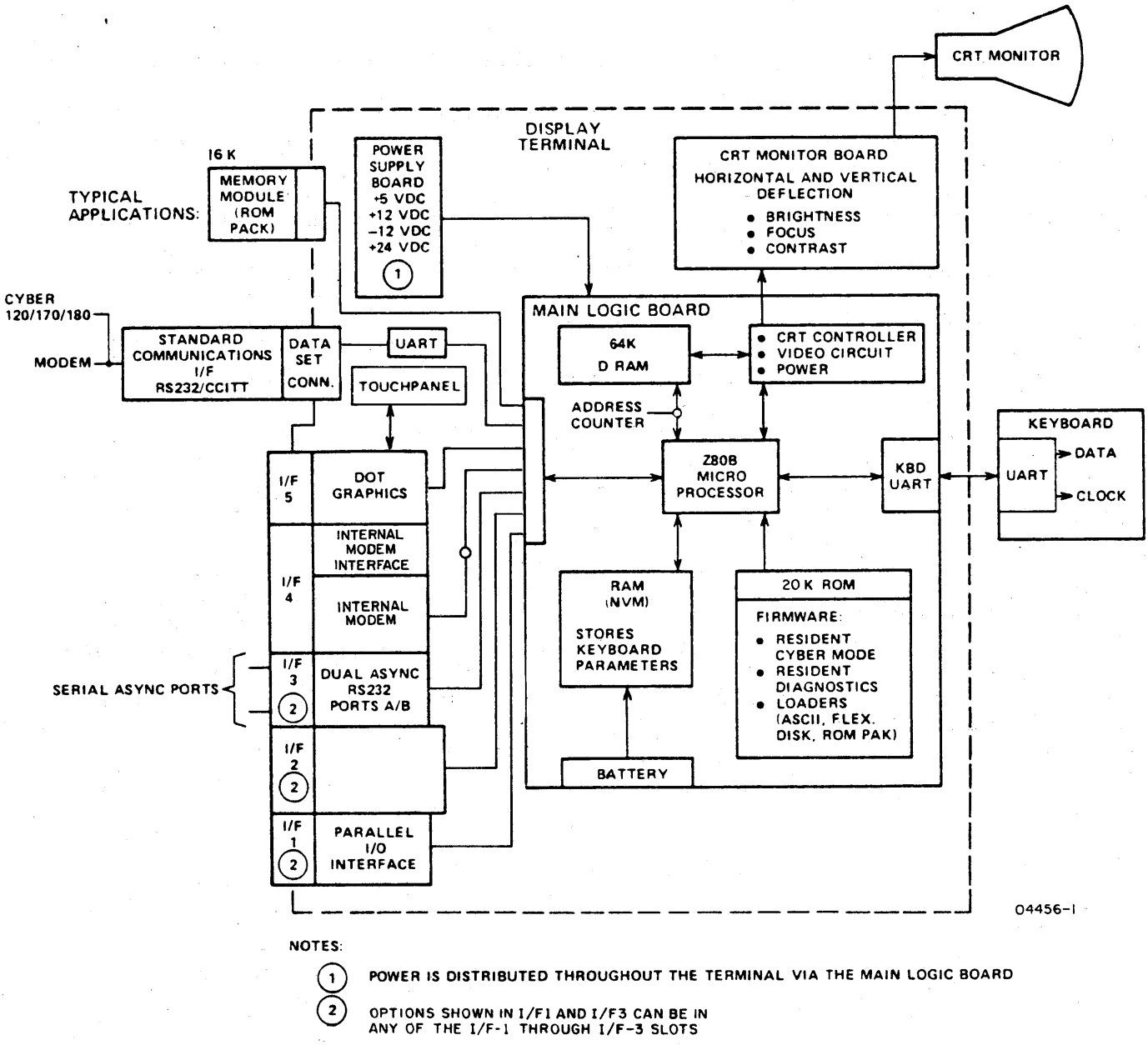
Figure D-2. Physical Appearance and Size of Modem Assembly

SUMMARY LISTING OF MODEM FEATURES

The 1200/1200 b/s modem provides the Viking X terminal with a telephone line interface capable of data reception and transmission at a rate of 1200 bits per second (approximately 120 characters per second). The modem is compatible with Bell 212A data communication equipment requirements and is capable of either full- or half-duplex 1200 b/s data transfers on standard telephone transmission lines. The modem has been designed and manufactured for conformance to most of the commonly recognized industry, national, and international standards. Some of the more notable features and capabilities of the modem are listed below:

- Bell 212A compatibility for 1200 b/s data exchange rates
- Capable of full-duplex transmissions on 2-wire, switched-network local or long-distance telephone lines without special conditioning
- Automatic dual-tone multi-frequency dialing (touch-tone)
- Automatic pulse dialing (standard dial-phone dialing)
- Operation in auto-answer mode
- Operation in either call originate or call answer mode
- Operation in both digital and analog loopback test mode
- A firmware-resident self-test feature
- Standard telephone line interface: 1) a RJ11C modular phone-jack connector accessible at rear of terminal, and 2) a 4.3 metre (14 foot) cable with a RJ11 plug at one end and a RJ11 duplex (T) connector at the other end for connecting both the terminal and a telephone to the same line
- A 4k read-only memory containing modem operation-control subroutines

The principal use of the internal modem is to permit its host terminal to communicate over the telephone lines with a host computer system or with other terminals using a compatible interface to the same telecommunications network. The automatic features of the modem permit its use either for automatically downloading an operating mode from the host computer of the system, or for use in communicating with the host computer or other network terminals during typical system applications. Figure D-3 is a block diagram of the terminal that indicates how the modem assembly interfaces with the other functional assemblies within the terminal.



NOTES:

1. POWER IS DISTRIBUTED THROUGHOUT THE TERMINAL VIA THE MAIN LOGIC BOARD
2. OPTIONS SHOWN IN I/F1 AND I/F3 CAN BE IN ANY OF THE I/F-1 THROUGH I/F-3 SLOTS

Figure D-3. Block Diagram of Host Terminal

Figure D-4 is a functional block diagram of the modem assembly. The following text briefly summarizes the purpose of each block on the diagram, and includes brief descriptions of the address, data, and control signal buses shown on the diagram.. The blocks labeled buffers, memory, UART, and registers (REGS.) are all mounted on the interface PC board (small PC board) of the modem assembly. The block labeled modem in the figure represents the actual modem printed circuit board (large PC board) of the assembly (also refer to figure D-2).

Address, Data, and Control Signal Buses

The address buses shown in figure D-4 are 12-bit buses that carry address information from the terminal processor to the modem assembly. As is the case with the terminal processor, the function of the information on the address bus varies with the state of the I/O- and memory-request signal control lines. The memory-request control line gates address information to to the memory bank on the modem assembly; whereas, the I/O-request control line enables addressing modem input/output operations directly. The data bus is an 8-bit bidirectional bus that passes data bytes, including functional control and status information, betweeen the terminal processor and the modem assembly. The control bus carries terminal processor control signals (memory request, I/O request, memory-bank select, etc.) to the modem assembly in order to coordinate modem activity with other terminal operations. Further information on these buses is included later in this appendix under the Internal and External Interfaces heading.

Buffers

The buffers shown in figure D-4 simply provide a means for temporarily buffering the information carried on the three signal buses described above. The data buffer actually consists of transceivers for passing bidirectional data and status information between the modem assembly and the terminal processor.

Read-only Memory (4K x 8)

The 4K X 8 ROM holds the control firmware for the modem assembly. The terminal processor accesses this ROM via bank 11 addresses (block 8000 to $8FFF_{16}$). The processor uses jump-table entry addresses to access the particular function (auto-dial, auto-answer, test, etc.) of the ROM that it requires. The actual addresses used to access a particular function depend upon

whether the resident (CYBER) operating mode is making the subroutine call or an applications mode program is making the call. More detailed information regarding the jump-table entry addresses for the various modem functions are provided later in this section under the Programming Aids heading.

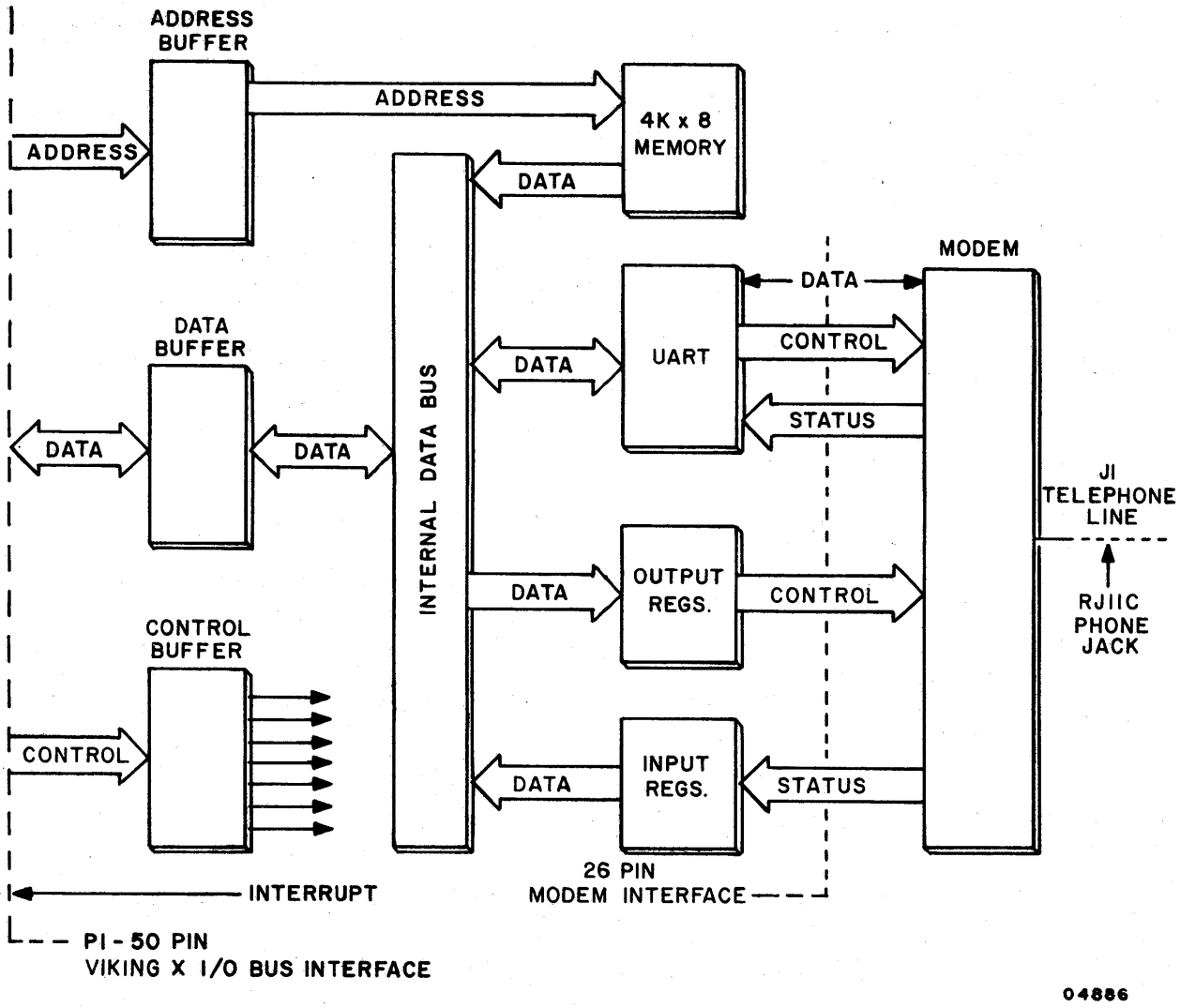


Figure D-4. Functional Block Diagram of Modem Assembly

Universal Asynchronous Receiver Transmitter (UART)

Besides the usual functions of serializing transmit data and assembling received data into parallel data bytes, this UART contains a number of registers for holding both line and modem control and status information. These internal UART registers are used in conjunction with external registers (identified on the block diagram as output and input registers) to provide control of all modem operations and to enable monitoring modem/line status during the call-placing process. In addition, the modem can be directed to enter a loopback test mode.

The internal registers of the modem are accessed via processor I/O addresses in the $C0_{16}$ through $C6_{16}$ range. By further using the most significant bit of the line control register (address $C3_{16}$) as a function select bit and read/write signals to select between the receive and transmit data buffers, the UART can actually perform ten different control, data and status operations, including read/write data, interrupt enable and identification, modem/line control, read modem/line status, and set transmit/receive data rate (fixed at 1200 b/s in this application). For more detailed information on accessing and using these UART registers during I/O operations (applications program oriented), refer to the Programming Aids portion of this appendix.

Output and Input Registers

The blocks labeled output and input registers in figure D-4 actually consist of two output registers and a single input register. The output registers are accessed by the terminal processor via I/O addresses $C8_{16}$ and $C9_{16}$, while the input register responds to CA_{16}. As with the UART registers, these registers are used for modem control and status operations. The output register accessed by address $C8_{16}$ is the call-control register and the input register accessed by address CA_{16} is the call-status register. The output register associated with address $C9_{16}$ provides control for the dual-tone multi-frequency dialing portion of the modem. For more detailed information on accessing and using these registers during I/O operations (applications program oriented), refer to the Programming Aids portion of this appendix.

Modem

As noted previously, the modem is compatible with Bell 212A requirements. It is capable of either call originate or auto-answer operation in either full- or half-duplex modes. Call

dialing is possible using either pulse or dual-tone multi-frequency techniques (where available). The modem can monitor and report status (ringing, busy, etc.) while a call is in progress, and it can also be directed to enter an analog-loopback mode for testing purposes. In transmit mode, the internal interface of the modem accepts serial TTL-level signals from the interface board, modulates these signals using phase-shift-encoding techniques, and places these signals on the transmission lines for sending to the distant receiver. In receive mode, the phase-shift encoded signals from the transmission lines are demodulated, converted to TTL-level signals, and passed to the UART on the interface board. The modem uses a four-step phase-shift-modulation technique in which each step represents one of four possible dibit codes on the transmission line. Although the modem has the capability of transmitting/receiving data at other rates, in this application, the transmit/receive data rate is fixed at 1200 b/s (600 baud). The transmit/receive characteristics of the modem are listed later in this appendix under the External Interface heading.

MODEM ASSEMBLY INTERFACES

Figure D-4 indicates the internal and external interfaces of the 1200/1200 b/s modem. The following text briefly describes each of these interfaces.

Internal Interface

The internal modem interface is compatible with control, data, and address signal buses of the terminal processor in the host terminal. The interface is implemented via a 50-pin male connector that mounts on the interface PC board of the modem assembly and connects to a mating ribbon-cable connector of the host terminal. All voltages on the interface are TTL compatible and have levels falling within the following indicated ranges (as referenced to ground pins 1, 2, and 4 of the interface cable).

- A high-level output is defined as having a voltage range between +2.4 and +5.25 volts (minimum to maximum)
- A low-level output is defined as having a voltage range between 0 and +0.5 volts (minimum to maximum)
- A high-level input is defined as having a voltage range between +2.0 and +5.25 volts (minimum to maximum)
- A low-level input is defined as having a voltage range between 0 and +0.8 volts (minimum to maximum)

TABLE D-1. VIKING I/O BUS CONNECTOR SIGNALS AND PIN ASSIGNMENTS

CONN PIN NO.	SIGNAL DESCRIPTION	LOADING (L)/DRIVE (D)	SIGNAL ORIGIN*
1	Power Ground		Power
2	Power Ground		Power
3	6-MHz Osc	L High: 20 uA, Low: -0.4 mA	Input
4	Power Ground		Power
5	-Interrupt 1	D High: -0.400 mA, Low: 8 mA	Output
6	1.8432-MHz Osc	L High: 20 uA, Low: -0.2 mA	Input
7	(Not used)		
8	(Not used)		
9	-Refresh	L High: 50 uA, Low: -0.4 mA	Input
10	(Not used)		
11	(Not used)		
12	-Bank 11	L High: 20 uA, Low: -0.2 mA	Input
13	-IORQ	L High: 50 uA, Low: -0.4 mA	Input
14	-Reset	L High: 20 uA, Low: -0.2 mA	Input
15	-Wait	D Low: -20 mA, Open Collector	Output
16	-M1	L High: 50 uA, Low: -0.4 mA	Input
17	(Not used)		
18	(Not used)		
19	Data Bus 23	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
20	Data Bus 22	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
21	Data Bus 24	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
22	Data Bus 21	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
23	Data Bus 25	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
24	Data Bus 20	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
25	Data Bus 26	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
26	Address Bus 20	L High: 20 uA, Low: -0.2 mA	Input
27	Data Bus 27	L High: 20 uA, Low: -0.2 mA D High: -12 mA, Low: 24 mA	Bi-Dir
28	Address Bus 21	L High: 20 uA, Low: -0.2 mA	Input
29			
30	Address Bus 22	L High: 20 uA, Low: -0.2 mA	Input
31	Addr's Bus 210	L High: 50 uA, Low: -0.4 mA	Input
32	Address Bus 23	L High: 20 uA, Low: -0.2 mA	Input
33	-Read	L High: 20 uA, Low: -0.2 mA	Input

*Input and output are defined relative to the modem assembly.

TABLE D-1. VIKING I/O BUS CONNECTOR SIGNALS, ETC. (CONTD)

CONN PIN NO.	SIGNAL DESCRIPTION	LOADING (L)/DRIVE (D)	SIGNAL ORIGIN*
34	Address Bus 2^4	L High: 20 uA, Low: -0.2 mA	Input
35	Addr's Bus 2^{11}	L High: 50 uA, Low: -0.4 mA	Input
36	Address Bus 2^5	L High: 20 uA, Low: -0.2 mA	Input
37	Address Bus 2^9	L HIgh: 50 uA, Low: -0.4 mA	Input
38	Address Bus 2^6	L High: 20 uA, Low: -0.2 mA	Input
39	Address Bus 2^8	L High: 50 uA, Low: -0.4 mA	Input
40	Address Bus 2^7	L High: 20 uA, Low: -0.2 mA	Input
41	(Not used)		
42	(Not used)		
43	-MEMREQ	L High: 50 uA, Low: -0.4 mA	Input
44	(Not used)		
45	-12 V dc	L 76 mA max.	Power
46	-Write	L High: 20 uA, Low: -0.2 mA	Input
47	+12 V dc	L 80 mA max.	Power
48	+5 V dc	L 1010 mA	Power
49	+5 V dc		Power
50	+5 V dc		Power

*Input and output are defined relative to the modem assembly.

As indicated earlier, the internal modem responds to two different types of requests from the terminal processor. During memory request operations directed to memory bank 11 (the 4K ROM on the modem assembly), the terminal processor performs a data output to buffer a bank 11 select signal and it then uses an address in the 8000_{16} to $8FFF_{16}$ range to access the 4K ROM of the modem. The lower 12 bits of the address select a particular memory location in the 4K ROM and place the contents of that location on the data bus for reading by the processor. During an I/O request operation, the processor uses address bits 2^0 through 2^7, the I/O request signal, and either the read or write signal to complete the desired input/output operation from/to the modem. To perform input/output operations directed to the modem, the processor sets the address bits as follows:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	0	0	X	X	X	X

where XXXX corresponds to the desired modem register-select address (also refer to the information given previously under the Universal Asynchronous Receiver Transmitter and Output and Input Registers headings).

External Interface

The external interface of the modem consists of single, six-pin, RJ11 female connector (standard modular telephone connector). Pin 3 of this connector carries the transmit data signals and pin 4 accepts the receive data signals. This interface connects the modem to a two-wire full-duplex (simultaneous transmit and receive) data transmission line. Following are the characteristics for the transmitter and receiver circuits of the internal modem. The modem at the far end of the transmission line should have characteristics compatible with those listed below.

Transmitter:

Carrier frequency: 1200 Hz ± 0.24 Hz in originate mode
2400 Hz ± 0.48 Hz in answer mode

Level into 600 ohm load: -10 dBm ±1 dBm maximum

Source impedance: 600 ohms ± 6 ohms

Transmit data rate: 1170 to 1212 b/s

Receiver:

Carrier frequency: 2400 Hz ± 7 Hz in orginate mode
1200 Hz ± 7 Hz in answer mode

Dynamic range: -43 to -10 dBm

Source impedance: 500 to 1700 ohms

Carrier detect level: On is -43 dBm, minimum, between 1800 and 3000 Hz in originate mode or between 600 and 1800 Hz in answer mode.

Off is -50 dBm, maximum, or signal levels outside the 1000-Hz to 5300-Hz band in originate mode or outside the 350-Hz to 3200-Hz band in answer mode

Carrier detect hysteresis: 2 dBm, minimum

Receive-carrier carrier-detect delay: -155 ± 55 ms off/on
-17 ± 7 ms on/off

PROGRAMMING AIDS

This portion of the appendix provides useful information for writing applications programs that use the internal modem. The following text covers two interrelated aspects of using the modem: using the subroutines in the modem firmware for initiating and terminating communications with a remote device and accessing the modem hardware to provide communications I/O control and status information.

USING THE MODEM FIRMWARE

The following listing gives the entry points for various modem subroutines. Notice that the listing divides the subroutines into two general categories: resident and applications subroutines. Also notice that some of the subroutines are listed more than once. Those listed more than once within a general category (e.g., Auto-dial 1 and Auto-dial 2) indicate subroutines that either are used with different revision levels of the terminal firmware or have slightly different functions. Those subroutines appearing in both categories (e.g., Auto-dial 1 and Auto-dial 3) perform similar functions but operate differently because of their status as either a resident subroutine or an applications subroutine.

Resident Subroutines	Applications Subroutines
Auto-dial 1 (8000_{16})	Auto-dial 3 (8012_{16})
Auto-dial 2 (8003_{16})	Get phone-call status (8015_{16})
Generate Phone Directory (8006_{16})	Set control parameters (8018_{16})
Run modem tests (8009_{16})	Auto-answer 1 ($801B_{16}$)
Reserved ($800C_{16}$)	Auto-answer 2 ($801E_{16}$)
Hang-up phone ($800F_{16}$)	Auto-dial 4 (8021_{16})
	Send tone-dial info (8024_{16})
	Auto-dial 5 (8027_{16})
	Auto-dial 6 ($802A_{16}$)
	Auto-dial 7 ($802D_{16}$)
	Auto-answer 3 (8030_{16})

The apparent redundancy of subroutines for resident (CYBER) mode and applications mode subroutines is due to the undefined nature of the applications modes (operating modes defined and created by the user). That is, the resident mode firmware is a fixed entity that has defined exit and re-enty points for each of the modem subroutines. The applications mode programs, on the other hand, are as of yet undefined and therefore do not have defined exit and re-entry points. Despite the undefined nature of the exit and entry points for the applications mode programs, the modem subroutines (in modem firmware) used by the applications modes can be defined and can have fixed entry points. The preceding listing includes the subroutines accessible to both types of operating modes (resident and applications), and it also includes the jump-table entry address (as a hexadecimal number in parentheses) for each subroutine.

The following text first describes the modem subroutines accessible by the resident terminal mode. It then provides information, including a series of figures, to indicate how parameter lists are set up for use by the modem subroutines and what status information is furnished by the modem subroutines.

Resident-Accessible Modem Subroutines

As indicated in the above listing, the current version (4.0) of the terminal-resident firmware supports the following three general functions of the version 3.0 firmware for the 1200/1200 b/s internal modem:

- Modem-assembly quick-look test
- Modem-assembly auto-dial functions
- Modem-assembly hang-up subroutine

These three subroutines are actually pre-mode subroutines. That is, they are normally used prior to actually loading an operating mode into the terminal. The run-modem-tests subroutine normally occurs automatically upon terminal power up or reset as an extension of the terminal quick-look tests. It can, however, be initiated at other times by other means. The normal function of the auto-dial subroutine is to connect a remotely located host computer for the purpose of: 1) operating the terminal in resident mode as a CYBER terminal, or 2) downloading one of the other possible (applications) operating modes from the connected computer. The hang-up subroutine simply places the modem back on hook after the terminal is finished using it. The following paragraphs briefly describe each of resident accessible modem subroutines.

Modem-assembly Quick-look Test

The resident firmware requests a quick-look test of the terminal hardware upon one of the following occurrences:

- Terminal power on or reset
- An operator request (CTRL = V) while operating in local CYBER mode
- A host-processor initiated request

Just as the resident firmware performs quick-look tests upon the basic terminal hardware following terminal power on or reset, the internal modem firmware incorporates checks of the modem hardware. These checks include a ROM checksum test, a UART loopback test, and a modem loopback test. The modem tests are run as an extension of the resident quick-look test. That is, as the resident quick-look is running, it checks the terminal installation parameters to determine if an internal modem is installed in the terminal (terminal installation parameter F3P1 = 1).*

If the modem is installed, the resident quick-look makes a call to 8009_{16} to initiate the a checksum test of the modem ROM. When the checksum test is complete and its pass/fail status flag set, a check is made to determine if the terminal is presently operating online (quick-look test was host initiated). If so, the UART and modem loopback tests are bypassed and the pass/fail status of the quick-look tests (including the modem ROM checksum test) is sent to the host. In this instance, the modem quick-look tests are complete. The UART and modem loopback portions of the modem quick-look test are bypassed because it is necessary to hang up the modem to run either of these tests (disconnect the host computer).

If an operating mode is not selected (power-up/reset) or the terminal is not online (local mode operation selected), the modem quick-look checks continue with the UART loopback test. When this test is complete, terminal-installation parameter bit F4P3 is tested to determine whether the modem quick-look should either continue with the modem loopback test (F4P3 = 1) or bypass it (F4P3 = 0). Running or bypassing this last test is made a terminal installation option because running the modem loopback test takes approximately 16 seconds to complete. The test checks both the call originate and call answer circuits of the modem.

If any of the modem quick-look tests detect an error condition, it causes the display of a corresponding test-failure message. If no errors are detected during the test, only the modem and resident firmware revision levels and the copyright statement appear on the terminal display screen in the following format:

```
INTERNAL MODEM REV X.X
RES REV X.X
COPYRIGHT CONTROL DATA 1983
```

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* The FXPY convention is used to indicate an entry position (P) within either terminal- or mode-installation parameter-entry fields F0 through F10. In using this convention, X indicates the parameter field number (for example, F2, F3, etc.) associated with the corresponding function key on the terminal keyboard, and Y indicates a 1 through 6 position number within a field when counting possible positions from left to right.

The test-failure messages associated with the modem quick-look tests are as follows:

- INTERNAL MODEM CHECKSUM FAIL
- INTERNAL MODEM UART FAIL
- INTERNAL MODEM LOOPBACK FAIL

Upon completion of the modem quick-look tests, a return is made to the resident quick-look tests.

Modem-assembly Auto-dial Functions

Upon terminal power up or reset, the resident firmware examines both the terminal installation and the mode installation parameters (TIPs and MIPs). If TIP F3P1 is equal to 1, the resident firmware knows that the internal modem is installed in the terminal and includes the modem in the terminal quick-look tests. The set or clear status of TIP F4P3 determines whether the modem loopback test is run or not during the quick-look tests. TIP F4P4 determines whether the modem uses its pulse- or tone-dialing circuits when automatically dialing a phone number. Upon completion of the quick-look tests, an operating mode is either automatically or manually selected (depends on TIP entries in F4P1 and F6P1). Regardless of how mode selection is initiated, it is at this time that the resident loader examines the MIPs to determine such things as:

- Whether loader uses the default source, file, and phone number parameter entries - MIP F2P3. The load source is determined by some of the MIPs listed below. The F9P1 and F9P2 MIP entries determine the default file number, and the F7 and F8 MIP fields contain the default phone number.
- Whether the load is internal (resident) or external (applications) - MIP F2P4
- Whether, if external, the load is to be from the host computer or another external source (e.g., a disk unit) - MIP F2P5
- Whether, if from the host, the load is to be from the RS-232-C Data Set interface or from the internal modem - MIP F2P6
- Whether the modem is to dial once or redial upon failure to connect - MIP F3P1
- Whether, if from the host and using the internal modem, the auto-dial feature of that modem is to be used - MIP F3P2

Assuming the following:

- terminal installation parameter F3P1 = 1, indicating the internal modem is installed
- mode installation parameter F2P3 = 1, indicating the default source, file, and phone number parameters are not to be used
- mode installation parameter F2P4 = 1, indicating the operating mode is to load from an external source
- mode installation parameter F2P5 = 0, indicating the operating mode is to be loaded from the host computer
- mode installation parameter F2P6 = 1, indicating the internal modem is to be used for the load
- mode installation parameter F3P2 = 1, indicating the auto-dial function of the internal modem is to be used

the operator-action and display-message sequence depicted in figure D-5 would occur.

Setting mode installation parameter F2P3 to 0 while the other parameter entries given above remain the same causes essentially the same sequence to occur. In this instance, however, the boxed-in display messages do not appear because the default phone number, load source, and file values automatically replace the operator entered values.

Setting mode installation parameters F2P3 and F3P2 both to 0's while the other entries remain the same bypasses the entire upper half of figure D-5. That is, selecting a host loaded operating mode with out using either the default-values or auto-dial function drops the user immediately to the following display message on the diagram:

SELECT LOAD SOURCE > DISK HOST ROM

In this instance, the operator keys an H to select the host load, and a short time later, a HOST NOT CONNECTED message appears on the display screen. Assuming that a hand set is connected to the same telephone line as the internal modem (via T or Y line adapter), the terminal operator has approximately 40 seconds to complete the following tasks. Dial the number of the load source (host computer) on the telephone, wait until the phone is answered and an answer tone is heard, and hang up the telephone. The internal modem senses the answer tone at the same time the operator hears it and the terminal to host computer connection is made.

Operator-action/Comments

Possible Display Messages

Operator selects an operating mode that uses internal modem, but does not use default source/file/phone-number values stored in mode parameter entries; F2, for example.

Operator keys in phone number and presses NEXT key. See text for allowable entries.

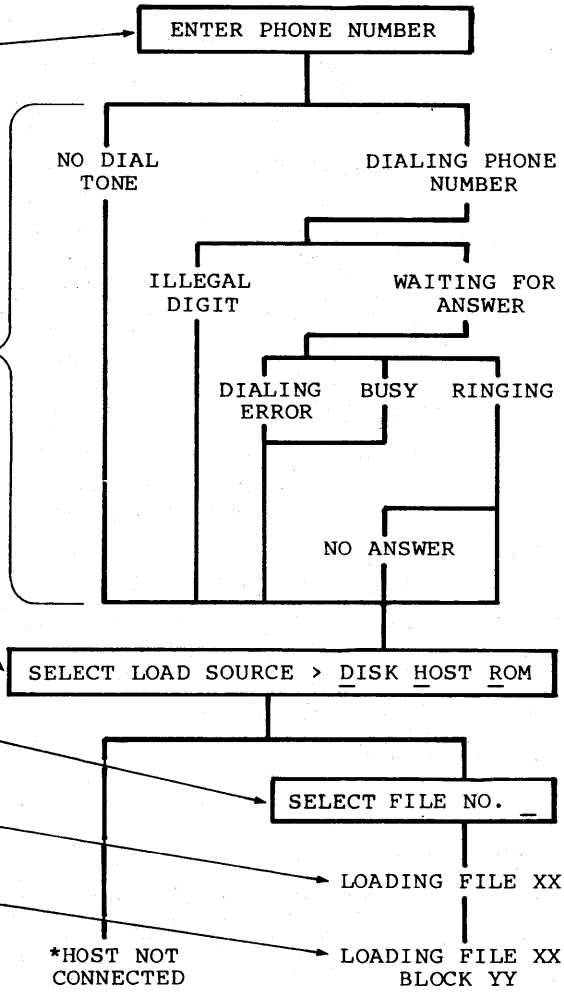
The next messages appear one at time in sequence. Where more than one message possibility is available, only the message that reflects the actual condition of the phone line appears.

Operator keys in desired load source (H), or default value can be used.

Operator keys in desired file number (00 to $3F_{16}$ range), or default value can be used.

This message reflects loading of file specified by operator (or default value).

The YY_{16} portion of this message increments as each block of the selected file loads.



*The last message (HOST HOT CONNECTED) only appears if the source-select message is entered via the no-dial-tone, illegal-digit, dialing-error, busy, or no-answer route. About 40 seconds after this last message appears, a loading failure message appears along with the redisplay of the mode-selection menu. The 40-second delay allows the operator time to manually dial (if T-connector is used) the desired number to verify the cause of the connection failure. If connection is made, the modem should respond to answer tone, and therefore, the operator can simply hang up the phone and let the operation continue normally at this point.

Figure D-5. Auto-dial and Not-default-value Load from Host

Notice that in the three previously described sequences for connecting the host, the auto-dial function is only used in two of them, the first and the second. The third sequence bypasses the auto-dial function completely and allows the internal modem to be used similarly to a modem/handset combination. In the two sequences using the auto-dial subroutine of the modem, however, the resident loader detects the presence of the auto-dial parameter entry and uses jump-table entry address 8000_{16} to access the auto-dial 1 subroutine. The auto-dial 1 subroutine consists of the following support subroutines:*

- Get phone number - fetches phone number from mode installation parameter fields F7 and F8 (if default values are used) or displays request for operator entered number on the terminal screen and returns number as it is entered.**
- Dial number - takes the modem off hook, determines whether a dial tone is present, and checks terminal installation parameter F4P4 to determine whether to use pulse or tone dialing on the line. It then uses the get-phone-number data to dial the telephone number and jumps to the connect support subroutine. If a dial tone is not detected, this routine bypasses the connect subroutine and returns to the resident, which displays the select-load-source message.
- Connect - monitors telephone line to determine whether desired phone number is busy, ringing, does not answer, etc. and displays appropriate messages on terminal screen. Returns control to resident along with status information that indicates whether or not connection has been made.

---

* The Auto-dial 2 and Generate Phone Directory subroutines (jump table addresses 8003_{16} and 8006_{16}) are not used with the current revision level (4.0) of terminal firmware.

** Allowable entries for either the F7/F8 mode-installation parameter fields (default number) or the operator-entered telephone number include 0 through F_{16}; where 0 through 9 are standard numeric entries, A is not used, B represents the * symbol (for later use in tone dialing), C represents the # symbol (for later use in tone dialing), D represents a ! symbol and causes a pause in the dialing sequence until a tone is detected, E represents a ? symbol and causes a pause in the dialing sequence until no tone is detected for 3 seconds, and F is only used in the mode-installation parameter-entry fields (F7/F8) to indicate the end of a phone number that does not entirely fill the 12 symbol spaces available.

Modem-assembly Hang-up Subroutine

Assuming the download of an operating mode is to occur, the resident ASCII loader is given control of the load operation once the phone-line connection is established. The loader monitors the download operation, and when the load is complete, the loader calls the modem firmware to hang up the modem (jump-table entry address $800F_{16}$). The modem firmware issues a command to place the modem back on hook, and then returns control to the loader.

Modem-subroutine Parameter Lists and Status

As noted earlier in this appendix, the undefined nature of the applications operating modes requires the use of modem subroutines that differ from those of the resident mode. The following text and figures indicate how parameter lists are to set up for use by the applications modes and what status information the modem subroutines make available for use by the applications modes. Information is included for the following applications-mode subroutines of the modem:

Applications-mode Subroutines

Auto-dial 3 (8012_{16})
Get phone-call status (8015_{16})
Set control parameters (8018_{16})
Auto-answer 1 ($801B_{16}$)
Auto-answer 2 ($801E_{16}$)
Auto-dial 4 (8021_{16})
Send tone-dial info (8024_{16})
Auto-dial 5 (8027_{16})
Auto-dial 6 ($802A_{16}$)
Auto-dial 7 ($802D_{16}$)
Auto-answer 3 (8030_{16})

Auto-dial 3 (8012_{16})

The applications program must incorporate a parameter list that conforms to the format indicated in figure D-6. Upon entry to the auto-dial subroutine, the HL registers point to a parameter list containing the information indicated in figure D-6.

Parameter Number	Address	Byte	Data	
1	(HL)+0	1	Address of Phone Number (LSB)	(hex)
	(HL)+1	2	Address of Phone Number (MSB)	(hex)
2	(HL)+2	3	Misc Control	(binary) (see chart)
3	(HL)+3	4	Ring Count	(ASCII) (0-9)
4	(HL)+4	5	Redial Attempts Units Digit	(ASCII) (0-9)
	(HL)+5	6	Redial Attempts Tens Digit	(ASCII) (0-9)

Figure D-6. Auto-dial Parameters List

The following paragraphs and figures more thoroughly describe the contents of each required parameter.

Auto-dial Parameter 1 (Phone Number Address): The first two bytes of the auto-dial parameters list contain the address of the phone number to be dialed. The LSB of address information is the first entry and the MSB is next. The applications auto-dial subroutine only accepts the following ASCII characters as valid telephone number entries:

- Numeric entries 0 through 9
- Special character entries *, #, !, and ?
- Character entries A and F

The * and # special characters are only used when tone dialing is enabled. Using these characters in an other than tone dialing phone number sequence causes a dialing error to occur. The ! and ? special characters may be included in a dialing sequence to perform the following functions: the ! causes the dialing

sequence to pause until a tone is detected on the line (e.g., wait for a dial tone after dialing an outside line), and the ? causes a 3 second pause in the dialing sequence provided a tone is not detected on the line. The A character is currently not used, but the F character may be used following the last entry of a phone number as an end-of-number delimiter.

Auto-dial Parameter 2 (Miscellaneous Control): Figure D-7 shows the format and indicates the functions for the second parameter entry of auto-dial parameters list. The text following the figure explains the meaning of some of the bits whose significance may not be immediately apparent from the figure.

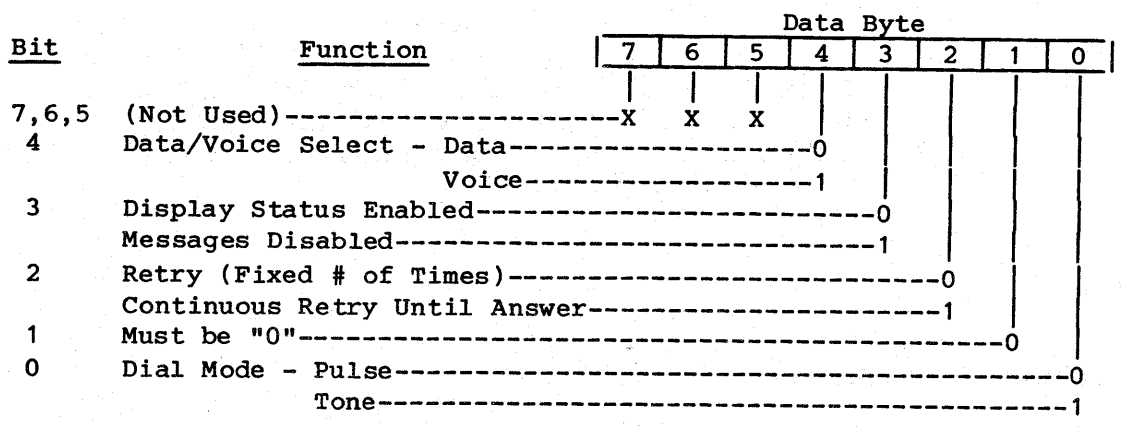


Figure D-7. Auto-dial Parameter 2: Miscellaneous Control

Bit 4 is used to let auto-dial enable voice communications. That is, if this bit is set to a 1, the modem completes an auto-dialing sequence, waits for an answer, and hangs up (goes back on hook) after detecting the first ring. To use this feature properly, the terminal operator should therefore pick up the handset receiver while the WAITING FOR ANSWER message is appearing on the terminal display screen.

Bit 3 enables or disables the display of line and modem status messages on the terminal display screen.

Bit 2 controls whether the modem continuously redials a number until a connection is made, or whether it only redials a specified number of times (refer to Retries entry of parameter 4).

Bit 0 controls the dialing mode. If this bit is a 0, the modem employs its pulse dialing circuits; if this bit is a 1, it uses the tone dial circuits.

Auto-dial Parameter 3 (Ring Count): This parameter entry determines the number of rings the modem detects before assuming a no answer and aborting the call. The entry accepts ASCII numerics 0 through 9, with a 0 entry defaulting to five rings.

Auto-dial Parameter 4 (Retries): This parameter accepts ASCII numeric entries between 00 and 99. It controls the number of times that the modem attempts redialing number before aborting the phone call and returning control to the calling routine. An entry of 99 for this parameter forces continuous retries in a manner similar to setting bit 2 of the parameter entry 2 to a 1.

NOTE

Canadian Department of Communications (DOC) regulations restrict dialing retries made in this manner to a maximum of ten (10).

Get-Phone-Call Status (8015_{16})

A call to this modem subroutine via jump-table address 8015_{16} returns modem status information in the following format. Upon return, the HL registers point to the beginning of a 6-byte status table. Figure D-8 indicates the contents and layout of that status table.

Status-table Parameter 1 (Miscellaneous): This status byte reflects the settings of the bits in the miscellaneous control byte of auto-dial parameter 2. Refer figure D-7 and to the preceding text describing that control byte for more detailed information.

Parameter Number	Address	Byte	Data Type	Entry Type
1	(HL)+0	1	Misc. Status	(binary) refer to text
2	(HL)+1	2	Phone Call Status	(binary) refer to figure E-9
3	(HL)+2	3	Self-Test Status	(binary) refer to figure E-10
4	(HL)+3	4	ROM Revision	(hex) refer to figure E-11
5	(HL)+4	5	Redial Attempts Units Digit	(ASCII 0-9) refer to text
	(HL)+5	6	Redial Attempts Tens Digit	(ASCII 0-9) refer to text

*Count wraps around to 00 after count of 99.

Figure D-8. Get-phone-call-status Table

Status-table Parameter 2 (Phone-call Status): The phone-call status byte has the format shown in figure D-9. The figure also indicates the function of each bit in the phone-call status byte.

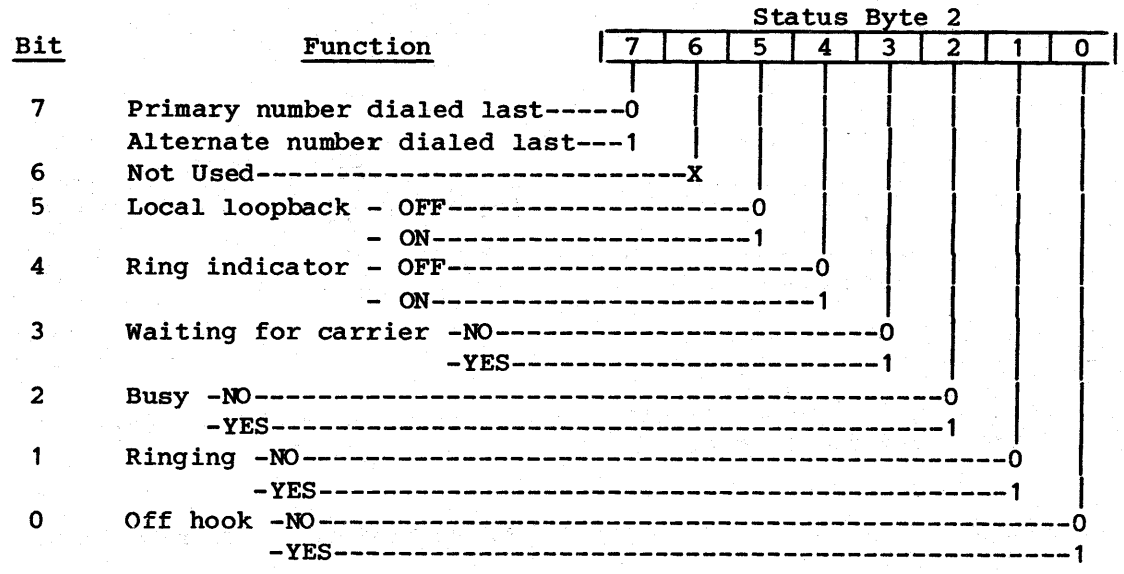


Figure D-9. Status-table Parameter 2: Phone-call Status

Status-table Parameter 3 (Self-Test Status): The self-test status byte has the format shown in figure D-10. The figure also indicates the function of each bit in the self-test status byte.

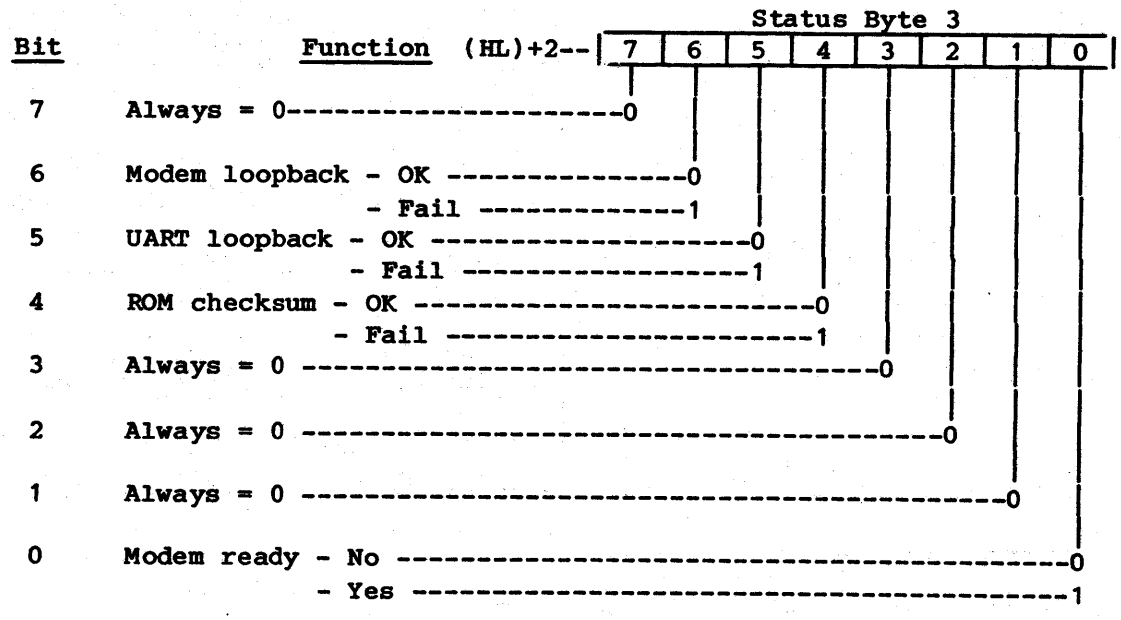
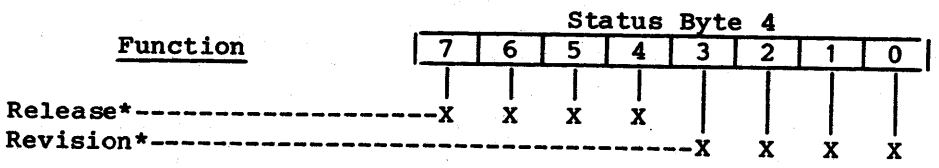


Figure D-10. Status-table Parameter 3: Self-test Status

Status-table Parameter 4 (ROM Revision): Figure D-11 shows the layout of the ROM revison status bit. The upper four bits of the byte contain a hexadecimal code that indicates the release level of the modem firmware. The hexadecimal code in the lower four bits indicates the revision level of the modem firmware.



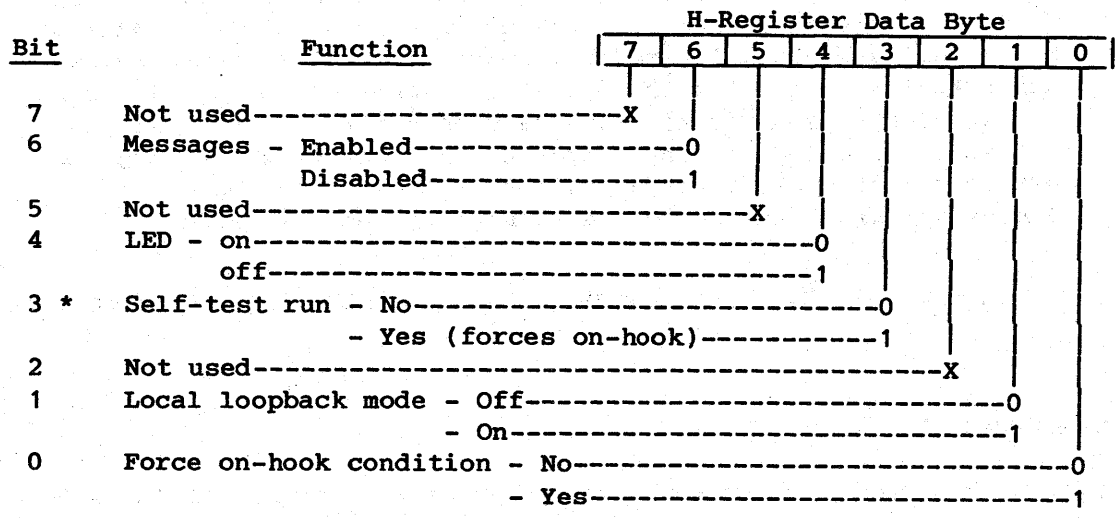
* Release and revision levels are each represented by a single 4-bit hexadecimal code.

Figure D-11. Status-table Parameter 4: ROM Revision

Status-table Parameter 5 (Dial Retries): Bytes 5 and 6 of the status table accessed via jump-table address 80015_{16} contain a two-character ASCII numeric that indicates the number of redials the modem is to make in attempting to connect the host computer. That is, these two bytes reflect the settings of auto-dial parameter 4. Byte 5 contains units- place redial-count information, and byte 6 contains tens-place information.

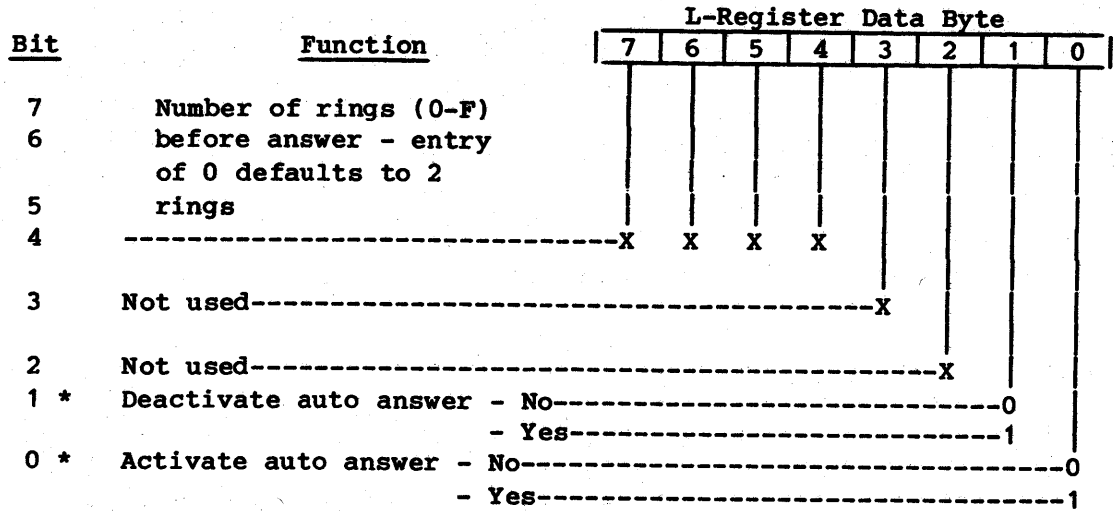
Set Modem-control Parameters (8018_{16})

Upon entry to this subroutine, the H and the L registers each contain a byte of modem control information. Figures D-12 and D-13 reflect the possible contents of these two control bytes. Each figure indicates the significance and usage of each bit in each register. Upon initialization both of these bytes contain all zeroes.



* Setting bit 3 enables running of the modem self-tests in accordance with the following modifiers. If bit 0 of RAM location $E046_{16}$ is equal to 0, the terminal is online and only the ROM checksum test is run. Running the loopback tests when the terminal is online hangs up on the host computer (places modem on hook). If bit 0 of $E046_{16}$ is equal to 1, the terminal is offline (in local mode) and all of the modem self tests may be run.

Figure D-12. Set Modem-Control Byte 1 (H Register)



* Bit 1 is given priority over bit 0. Setting bit 0 to 1 and bit 1 to 0 causes modem firmware to status the incoming ring indicator. If a ring is present the modem firmware remains in control and connects the call after the specified number of rings. If no ring is detected, the modem firmware returns control to the calling routine. Checking for the presence of a carrier or testing the off-hook status bit of phone-call-status byte 2 provides an indication of whether or not a connection has been made.

Figure D-13. Set Modem-Control Byte 2 (L Register)

Auto-answer 1 ($801B_{16}$)

An applications program call to jump-table entry address $801B_{16}$ causes the modem firmware to remain in control until the modem detects a ring status and makes a connection (answers after two rings). After answering a phone call this subroutine returns control to the calling routine. Note that this subroutine can cause the terminal to "hang" until a phone call is received (i.e., no other activity is permitted while this subroutine has control).

Auto-answer 2 ($801E_{16}$)

An applications program call to jump-table entry address $801E_{16}$ causes the modem firmware to the ring indicator status of the modem. If a ring is present, the firmware connects the incoming call after two rings and returns control to the calling routine. If no ring is present, the modem firmware returns control immediately.

Auto-dial 4 (8021_{16})

This modem subroutine is not used with current revision level (4.0) of the terminal resident firmware.

Send Tone-dial Information (8024_{16}))

Use of this modem subroutine is restricted to communications lines capable of making tone-dial connections. The subroutine enables the user to send dual-tone multi-frequency (DTMF) information over the phone line at any time. This can be accomplished in the following manner:

1. Defining a table of bytes in memory
2. Loading the HL registers with the address of the first byte in the table
3. Calling this routine

The format of the table is shown in figure D-14, and the following text explains some of the limitations of DTMF data transmissions.

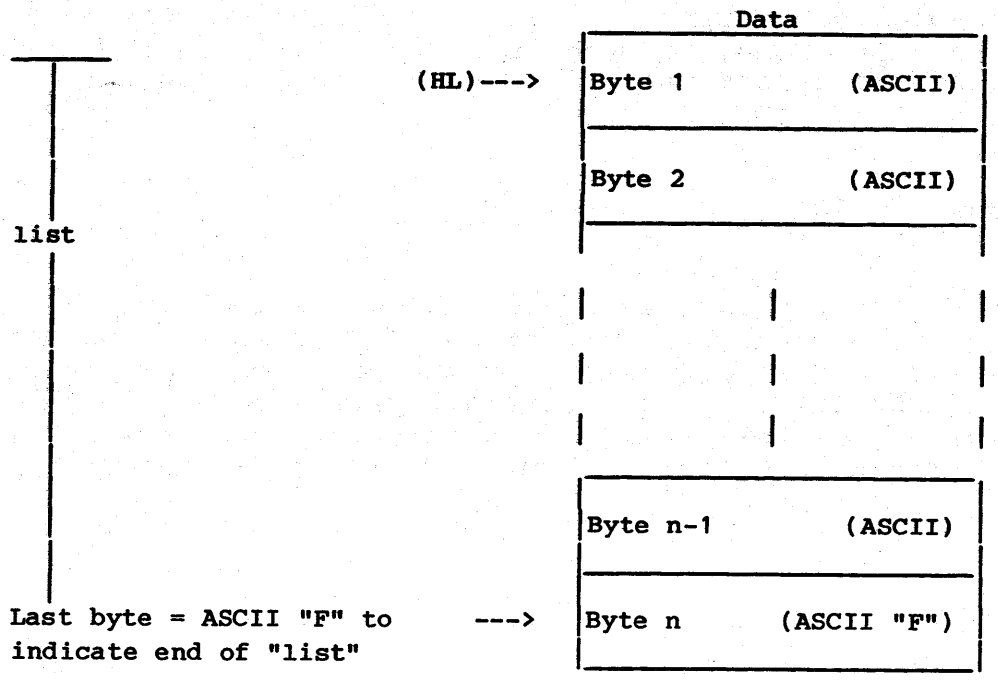


Figure D-14. Data-byte Table for Sending DTMF Information

Data in the table is stored as ASCII characters representing the characters 0-9, *, and # (touch-tone dial characters). An ASCII F (46_{16}) must be included as the last byte in the table to indicate the end of the table. This routine does not check any status (e.g., off-hook, carrier detect, etc.) prior to execution. The user must ensure that a connection exists before using this subroutine to send data. Use of the ! or ? symbols, which are used on pulse-dial lines, cause a no-op to occur (i.e., no tone information is sent).

Auto-dial 5 (8027_{16})

This modem subroutine is not used with current revision level (4.0) of the terminal resident firmware.

Auto-dial 6 ($802A_{16}$)

This auto-dial subroutine is similar to the auto-dial 1 subroutine with the exception that this one forces the terminal operator to make the phone number entry via the keyboard.

Auto-dial 7 ($802D_{16}$)

This auto-dial subroutine is also very similar to the auto-dial 1 subroutine. This one, however, returns control to the calling routine instead of the resident firmware loader routine.

Auto-answer 3 (8030_{16})

This subroutine provides a more basic auto-answer function than the other two auto-answer subroutines. This subroutine simply takes the modem off hook, turns on the modem carrier signal, and returns to the caller. No checks are performed; it is the responsibility of the calling routine to see that any other necessary status and control functions are performed as required.

The preceding portion of this appendix discussed how to use the modem firmware in order to establish communications between the terminal and its host system computer. This portion of the text provides the information necessary for effective use of the communications lines once a terminal-to-host connection has been established. That is, the following paragraphs describe how to access the control and status registers of the internal modem.

The terminal processor uses the lower eight address bits, the I/O request signal line, and either a read or a write signal to perform I/O operations. To access the modem, the terminal processor uses the lower eight address lines as follows:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	0	0	X	X	X	X

where XXXX designates a particular modem-interface status or control register.

The addressable entities within the modem assembly include eight UART registers, two UART latches, and three other modem control and status registers - a total of thirteen addressable items. The usable I/O address range for accessing the modem is between $C0_{16}$ and CF_{16}. Although it seems there are more than enough addresses allocated for accessing the 13 addressable entities of the modem, access to the ten items within the modem UART is restricted to the address range of $C0_{16}$ to $C6_{16}$. The three addressable modem registers external to the UART use addresses $C8_{16}$, $C9_{16}$, and CA_{16}. Addresses $C7_{16}$ and CB_{16} through CF_{16} are not used for addressing the modem.

Obtaining ten functions from seven UART addresses requires using additional information to differentiate between redundant addresses that have different functions. The most significant bit of one of the UART registers is used as a function designator for two redundant addresses (two of the UART addresses become four). In addition, the read and the write control signals from the processor are used to further breakdown one of the already redundant addresses into two functions (the same two UART addresses become five). Figure D-15 and Table D-2 summarize the addressable UART functions. In the table notice that the eighth bit (divisor latch access bit, or DLAB) of the line control register (UART address $C3_{16}$) is the one used to obtain different functions from redundant addresses ($C0_{16}$ and $C1_{16}$). Also notice that this bit only has to be set (DLAB = 1) to enable loading of the divisor latches which determine the transmit/receive rate of the UART. The UART divisor latches are loaded with 0060_{16} for 1200 b/s operation. The following text discusses the function of each of the registers and latches listed in table D-2.

DLAB	A3	A2	A1	A0	UART Register
0	0	0	0	0	Receiver Buffer (Read), Transmitter Holding Register (Write)
0	0	0	0	1	Interrupt Enable Register
X	0	0	1	0	Interrupt ID Register (Read Only)
X	0	0	1	1	Line Control Register
X	0	1	0	0	Modem Control Register
X	0	1	0	1	Line Status Register
X	0	1	1	0	Modem Status Register
X	0	1	1	1	None
1	0	0	0	0	Divisor Latch (Least Significant Byte)
1	0	0	0	1	Divisor Latch (Most Significant Byte)

Figure D-15. UART Register and Latch Addressing

Receive Buffer Register

To access the receive-buffer register of the UART, bit 7 of the UART line-control register must have previously been set to 0 (DLAB = 0). Once this has been done, an I/O-request operation to address $C0_{16}$, along with the appropriate read signal, enables received data to be read from the receive-buffer register. This UART register presents data received from the telephone interface to the internal interface. The presence of new data in this register is indicated when the data-ready bit (bit 0) of the UART line-status register is set (bit 0 = 1). Data is assembled in an internal receiver shift register, least significant bit first. Data must be read from the receive-buffer register before the next received word is transferred to avoid an overrun error.

Transmit Holding Register

To access the transmit-holding register of the UART, bit 7 of the UART line-control register must have previously been set to 0 (DLAB = 0). Once this has been done, an I/O-request operation to address $C0_{16}$, along with the appropriate write signal, enables transmit data to be written into the transmit-holding register. This UART register accepts data from the internal interface for sending over the telephone-line interface. Writing to this register initiates the transmission of the 8-bit data word, with its attendant start and stop bits, from the internal transmitter

TABLE D-2. ADDRESSABLE UART REGISTERS AND LATCHES

	REGISTER ADDRESSES AND FUNCTIONS									
	C0 DLAB=0	C0 DLAB=0	C1 DLAB=0	C2	C3	C4	C5	C6	C0 DLAB=1	C1 DLAB=1
	Receive Buffer Regular (Read only)	Transmit Holding Register (Write Only)	Interrupt Enable Register	Interrupt Identification Register	Line Control Register	Modem Control Register	Line Status Register	Modem Status Register	Divisor Latch (LS)	Divisor Latch (MS)
Bit										
0	Data Bit 0	Data Bit 0	Enable Receive Data Available Interrupt	"0" if Interrupt Pending	Word Length Select Bit 0	Data Terminal Ready DTR	Data Ready DR	Delta Clear to Send DCTS	Bit 0	Bit 8
1	Data Bit 1	Data Bit 1	Enable Transmitter Holding Register Empty Interrupt	Interrupt ID Bit (0)	Word Length Select Bit 1	Request to Send RTS	Overrun Error OE	Delta Data Set Ready DDSR	Bit 1	Bit 9
2	Data Bit 2	Data Bit 2	Enable Receiver Line Status Interrupt	Interrupt ID Bit (1)	Number of Stop Bits	Output Bit 1 Not Used OUT1	Parity Error PE	Trailing Edge Ring Indicator TERI	Bit 2	Bit 10
3	Data Bit 3	Data Bit 3	Enable Modem Status Interrupt	0	Parity Enable	Output Bit 2 Not Used Out2	Framing Error FE	Delta Carrier Detect DCD	Bit 3	Bit 11
4	Data Bit 4	Data Bit 4	0	0	Even Parity Select	Loopback	Break Interrupt BI	Clear to Send CTS	Bit 4	Bit 12
5	Data Bit 5	Data Bit 5	0	0	Stick Parity	0	Transmitter Holding Register Empty THRE	Data Set Ready DSR	Bit 5	Bit 13
6	Data Bit 6	Data Bit 6	0	0	Set Break	0	Transmitter Shift Register Empty TSRE	Ring Indicator RI	Bit 6	Bit 14
7	Data Bit 7	Data Bit 7	0	0	Divisor Latch Access Bit (DLAB)	0	0	Carrier Detect CARDET	Bit 7	Bit 15

shift register. Data may be written to this register whenever the transmitter holding-register-empty indicator bit (bit 5) of the UART line-status register is set (bit 5 = 1). Data is transmitted least significant bit first.

Interrupt Enable Register

To access the interrupt-enable register of the UART, bit 7 of the UART line-control register must have previously been set to 0 (DLAB = 0). Once this has been done, an I/O-request operation to address $C1_{16}$, along with the appropriate write signal, enables interrupt enable information to be written into the interrupt-enable register of the UART. This register enables four separate UART interrupt sources to activate the interrupt output signal.

- Bit 0 - This bit enables the received data available interrupt when set to logical 1.
- Bit 1 - This bit enables the transmitter holding register empty interrupt when set to logical 1.
- Bit 2 - This bit enables the receiver line status interrupt when set to logical 1.
- Bit 3 - This bit enables the modem status interrupt when set to logical 1.
- All bits (0-3) are reset to logical 0 upon completion of the associated interrupt service routine.
- Bits 4 through 7 - These bits are permanently set to logical 0.

Interrupt Identification Register

An I/O-request operation to address $C2_{16}$, along with the appropriate read signal, accesses the interrupt-identification register of the UART. This register contains information that both identifies the source of an interrupt and indicates its priority level. The UART classifies interrupts into one of four priority levels in the following manner: Receiver Line Status (priority 1); Received Data Ready (priority 2); Transmitter Holding Register Empty (priority 3); Modem Status (priority 4). Information indicating that a prioritized interrupt is pending and source of that interrupt are stored in the UART interrupt-identification register (IIR). Following is a brief description of the signicance for each bit position in the IIR (also refer to Table D-3).

TABLE D-3. INTERRUPT CONTROL FUNCTIONS

INTERRUPT IDENTIFICATION REGISTER			INTERRUPT SET AND RESET FUNCTION			
BIT 2	BIT 1	BIT 0	PRIORITY LEVEL	INTERRUPT FLAG	INTERRUPT SOURCE	INTERRUPT RESET CONTROL
0	0	1	-	None	None	-
1	1	0	1st	Receiver Line Status	Overrun Error Parity Error Framing Error Break Int.	Reading the Line Status Register
1	0	0	2nd	Received Data Available	Receiver Data Available	Reading the Receiver Buffer Register
0	1	0	3rd	Transmitter Holding Register Empty	Transmitter Holding Register Empty	Reading the IIR Register (if source of interrupt) or Writing into Transmitter Holding Register
0	0	0	4th	Serial Interface Status	Clear to Send or Data Set Ready or Ring Indicator or Carrier Detect	Reading the Modem Status Register

- Bit 0 - This bit can be used in either a hardwire prioritized or polled environment to indicate when an interrupt is pending. When this bit = 0, an interrupt is pending and the IIR contents may be used as a pointer to the appropriate interrupt service routine. When this bit = 1, no interrupt pending, polling continues.

- Bit 1 and 2 - These two bits are used to identify the highest priority interrupt pending as indicated in Table D-3.

- Bits 3 through 7 - These bits permanently set to zero.

Line Control Register

An I/O-request operation to address $C3_{16}$, along with the appropriate write signal, accesses the line-control register of the

UART. This register controls the format of the data communications. The format used is one start bit, eight data bits, no parity, and one stop bit. The contents of this register are described as follows:

- Bits 0 and 1 - These two bits specify the number of bits in each transmitted and received serial character. In this application, eight-bit characters are used, and so the both bit 0 and bit 1 must be set to 1.

- Bit 2 - This bit specifies the number of stop bits in each transmitted or received serial character. A single stop bit must be used. If bit 2 = 0, one stop bit is generated.

- Bit 3 - This bit is parity enable bit. Parity must not be used. When bit 3 = 0, no parity bit is generated or checked.

- Bit 4 - This bit is not used. Either a 0 or a 1 may be programmed.

- Bit 5 - This bit is not used. Either a 0 or a 1 may be programmed.

- Bit 6 - This bit is the set break control bit. When bit 6 = 1, the serial output is forced to the spacing (logical 0) state and remains there (until reset by bit 6 = 0), regardless of other transmitter activity.

- Bit 7 - This bit is the divisor latch access bit (DLAB). It must be set high (bit 7 = 1) to access the divisor latches of the baud rate generator during a read or write operation. It must be set low (bit 7 = 0) to access the Receiver Buffer, Transmitter Holding, or Interrupt Enable register.

Modem Control Register

An I/O-request operation to address $C4_{16}$, along with the appropriate write signal, accesses the modem-control register of the UART. This register controls the modem interface in the following manner:

- Bit 0 - This bit controls the DTR output of the UART. Setting this bit to a 1 enables the modem to transmit and receive data. All modem transmitting and receiving is terminated when this bit is set to 0. An 0-to-1 transition (inactive to active condition) initiates one of two handshaking sequences depending on whether the terminal is operating in phone call originate or answer mode.

- Bit 1 - Request to Send (RTS) - Not used.
- Bit 2 - Output bit 1 (Out1) - Not used.
- Bit 3 - Output bit 2 (Out2) - Not used.
- Bit 4 - This bit provides a digital loopback feature for diagnostic testing of the UART. When bit 4 is set to logical 1, the Transmitter Serial Output (SOUT) is set to logical 1, the receiver Serial Input (SIN) is disconnected, the output of the Transmitter Shift Register is looped back into the Receiver Shift register input, the four modem control inputs (CTS, DSR, CARDET, and RI) are disconnected, and the four modem control outputs (DTR, RTS, OUT1, and OUT2) are internally connected to the four modem control inputs as follows: CTS = RTS, CARDET = OUT2, DSR = DTR, and RI = OUT1
- Bits 5 through 7 - These bits are permanently set to logical 0.

Line Status Register

An I/O-request operation to address $C5_{16}$, along with the appropriate read or write signal, accesses the line-status register of the UART. This register provides status information to the terminal processor concerning a data-transfer operation. The contents of this register provide the following status information.

- Bit 0 - This bit is the receiver data-ready (DR) indicator. It is set to a 1 whenever a complete character has been received and transferred to the receiver buffer register. The terminal processor may set this bit to 0 either by writing a 0 to it or by reading the data in the receiver buffer register.
- Bit 1 - This bit is the overrun-error (OE) indicator. Displacement of an unread data character in the receiver buffer register by an incoming character causes this bit to set to a 1 as an indication that data has been lost. This bit is set to a 0 when the terminal processor reads the contents of the line-status register.
- Bit 2 - This bit is the parity-error (PE) indicator. This bit is set to a 1 when a received data character does not have the correct even or odd parity. It sets to a 1 upon detection of a parity error and clears (sets to 0) when the terminal processor reads the line-status register. Parity is not used.

- Bit 3 - This bit is the framing-error (FE) indicator. It sets to 1 to indicate that a received character did not have a valid stop bit; that is, it sets to 1 when the bit following the last data or parity bit has spacing level (0).

- Bit 4 - This bit is the break-interrupt (BI) indicator. It sets to 1 when the received data input is held at a spacing level (0) for longer than a full word transmission time.

NOTE

Bits 1 through 4 are the error conditions that produce a receiver line status interrupt.

- Bit 5 - This bit is the transmitter-holding-register-empty (THRE) indicator. It is set to a 1 to indicate that the UART is ready to accept a new transmit character. In addition when this bit is high, it causes the UART to issue an interrupt to the terminal processor if the THRE interrupt enable bit is high. The THRE bit sets to a logic 1 when a character is transferred from the transmitter holding register into the transmitter shift register. It clears to a logic 0 as the terminal processor loads the holding register.

- Bit 6 - This bit is the transmitter-shift-register-empty (TSRE) indicator. It is set to a 1 whenever the transmitter shift register is idle. It clears to a 0 upon data transfer from holding register to shift register.

- Bit 7 - This bit is permanently set to zero.

Modem Status Register

An I/O-request operation to address $C6_{16}$, along with the appropriate read signal, accesses the modem-status register of the UART. This register provides status information regarding the current state of the control lines between the modem and the terminal processor. In addition to this information, four bits of the modem-status register provide status change information. Each of these four bits set to a logic 1 whenever its associated control-input signal from the modem changes state. They clear to logical 0 when the terminal processor reads the modem-status register. Following is a brief description of the function of each of the modem-status register bits:

- Bit 0 - This bit is the delta clear-to-send (DCTS) indicators. Bit 0 indicates that the CTS input has changed state since the last time it was read by the terminal processor.

- Bit 1 - This bit is the delta data-set-ready (DDSR) indicator. Bit 1 indicates that the DSR input has changed state since the last time it was read by the terminal processor.

- Bit 2 - This bit is the trailing-edge-of-ring-indicator (TERI) detector. Bit 2 indicates that the RI input has changed from an On (logical 1) to an Off (logical 0) condition.

- Bit 3 - This bit is the delta carrier-detect (DCD) indicator. Bit 3 indicates that the CARDET input has changed state.

NOTE

When bit 0, 1, 2, or 3 is set to a logic 1, a modem-status interrupt is generated.

- Bit 4 - This bit is the clear-to-send (CTS) input. If bit 4 (loop) of the modem-control register (MCR) is set to a 1, this bit is equivalent to RTS in the MCR.

- Bit 5 - This bit is the data-set-ready (DSR) input. The DSR input is wired to CARDET. If bit 4 of the MCR is set to a 1, this bit is equivalent to DTR in the MCR.

- Bit 6 - This bit is the ring-indicator (RI) input. If bit 4 of the MCR is set to a 1, this bit is equivalent to OUT1 in the MCR.

- Bit 7 - This bit is the carrier-detect (CARDET) input. If bit 4 of the MCR is set to a 1, this bit is equivalent to OUT2 of the MCR.

Divisor Latches

To access the divisor latches, bit 7 of the UART line-control register must have previously been set to 1 (DLAB = 1). Once this has been done, successive I/O-request operations to addresses $C0_{16}$ and $C1_{16}$ enable setting the least significant and most significant divisor latches, respectively. The contents of these latches acts as a divisor for the UART transmit/receive clock generator. The dividend input for the clock generator is a

1.8432 MHz clock pulse. The output of the clock generator must be 16 times the desired transmit/receive rate of the modem, and therefore the divisor setting for the desired 1200 b/s rate of the internal modem is 0060_{16}. Once the divisor latches of the UART have been properly set, bit 7 of the UART line-control register (the DLAB bit) should be cleared since none of the other UART functions require that this bit be set.

NOTE

The following three registers are modem registers that are external to the UART.

Call Control Register

An I/O-request operation to address $C8_{16}$, along with the appropriate write signal, accesses the call-control register of the modem. This interface control register provides control for the telephone line interface. The contents of this register are indicated in Table D-4 and are described as follows:

- Bit 0 - This bit is the modem off-hook control (-OH). Setting this bit to zero places the modem in an off hook condition and enables communication through the telephone interface. Setting this bit to a one places the modem on-hook. This bit should be initialized to one after power up.

- Bit 1 - This bit is modem Originate/Answer mode control (-OR). Setting this bit to zero places the modem in originate mode, and setting this bit to a one places the modem in answer mode. This state of this bit must be set before DTR is brought high and must remain in the same state for the duration of DTR active.

- Bit 2 - This bit is the modem Analog Loopback control (-LL). If -LL is active (low) at the time DTR goes high, the normal telephone interface handshake sequence is disabled. Instead the transmitter and receiver do the following:

  1. The transmitter sends Marking data.

  2. The transmitter reacts as follows depending on the state of the -OR

     a. If -OR is high, the transmitter becomes the answer unit and the receiver becomes the Originate Unit with corresponding carrier frequency of 2400 Hz.

b. If -OR is low, the transmitter becomes the originate unit and the receiver becomes the answer unit with corresponding carrier frequency of 1200 Hz.

3. Carrier-detect detects carrier and becomes active within 270 ±40 ms; CTS becomes active at which time the terminal processor sends and receives test data.

4. All modem transmission and receiving is terminated when DTR is brought low.

o Bit 3 through Bit 7 - Not used.

TABLE D-4. SUMMARY OF MODEM INTERFACE REGISTERS

	REGISTER ADDRESS		
	C8	C9	CA
BIT	CALL CONTROL	DTMF DIAL	CALL STATUS
0	-Off Hook	-Row 1	-Call Progress
1	-Originate	-Row 2	-Off Hook
2	-Analog Loopback	-Row 3	-Originate
3	X	-Row 4	-Analog Loopback
4	X	-Column 1	0
5	X	-Column 2	0
6	X	-Column 3	0
7	X	X	0

DTMF Dial Register

NOTE

Using the following register for its intended purpose is only possible on communications lines supporting tone-dial operation.

An I/O-request operation to address $C9_{16}$, along with the appropriate write signal, accesses the DTMF-dial register of the modem. This register provides control for the dual-tone multi-frequency (DTMF) tones to the telephone interface. Each tone is individually enabled by setting its control bit to a zero. Setting a control bit to a one disables its associated tone. After powering on the terminal, this register should be set to all 1's (FF_{16}). The contents of this register are indicated in Table D-4 and are described as follows:

- Bit 0 - Row 1 697 Hz
- Bit 1 - Row 2 770 Hz
- Bit 2 - Row 3 852 Hz
- Bit 3 - Row 4 941 Hz
- Bit 4 - Column 1 1209 Hz
- Bit 5 - Column 2 1336 Hz
- Bit 6 - Column 3 1477 Hz
- Bit 7 - Not used.

Call Status Register

An I/O-request operation to address CA_{16}, along with the appropriate read signal, accesses the call-status register of the modem. This interface control register is used to input the status of the telephone line interface. The contents of this register are indicated in Figure D-4, and each bit is briefly described as follows:

- Bit 0 - This bit is the modem call-progress status bit (-CP). A low level on this bit indicates that the telephone line is currently receiving a busy signal, a dial tone, or an outgoing ringing signal. This bit is not latched, and timed samples must be taken to determine exact status.

- Bit 1 - This bit is a copy of the off-hook control bit (-OH), which is bit 0 of the call-control register.

- Bit 2 - This bit is a copy of the originate/answer-mode control bit (-OR), which is bit 1 of the call-control register.

- Bit 3 - This bit is a copy of the analog-loopback control bit (-LL), which is bit 2 of the call-control register.

- Bit 4 - Zero.

- Bit 5 - Zero.

- Bit 6 - Zero.

- Bit 7 - Zero.

COMMENT SHEET

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