

GENERAL DESCRIPTION
OF
CONRAC MODEL 480/25
MICROPROCESSOR BASED CRT TERMINAL

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I. INTRODUCTION

The Model 480/25 is the result of two years' intensive effort by the members of Conrac Data Products Senior Staff. The program initially commenced as a value engineering program whose target was to reduce the number of components required in a sophisticated CRT Terminal, and also to design a CRT Terminal which could be upgraded through reconfiguration to suit unique customer requirements.

Early in the program, it became clear that the then new microprocessor technology was the path to follow, in that it allowed extensive changes in terminal characteristics through program changes.

CRT Terminals designed to interact with central computers are not a simple device. There are a number of criteria which should be fulfilled, some of which require compromise between what might be best for the central processor and what might be more efficient for the CRT Terminal.

For instance, there are several specific functions which a terminal must implement (regardless of line protocol) if it is to become an efficient partner to a system; some of the more important requirements are:

- A. Ability to operate up to and including 9600 baud.
- B. Ability to scroll or page (switch under CPU control).
- C. Ability for CPU to address cursor.

Cursory examination of A, B and C above would show that most CRT Terminals available today contain these features. A more detailed examination, however, would show that if one is operating at 9600 baud and in a scroll mode, that most CRT's require several hundred milliseconds after a line feed before the CRT is ready to accept a valid character from the computer for the first character of the next line. This requires a large number of "zero fill" or "padding characters" (generally nulls). This greatly reduces line efficiency and increases recurrent line charges. The Conrac 480/25 will operate at 9600 baud with no padding characters required.

Another important function is "screen clear". It is imperative that the screen (memory) be cleared in a minimal time after a screen clear command is given, otherwise the line must be padded and again line efficiency drops.

The ability to address and read the cursor position was pioneered by Conrac several years ago, and this feature is included as standard. This also increases line

efficiency by allowing the CPU to generate specific formats on the screen without the necessity of "null" fill transmissions.

In the initial design phases of the Model 480/25 Terminal, Conrac's Senior Technical Staff evaluated virtually all available microprocessors in production. It quickly became apparent that all evaluated were I/O limited and when configured with proper software to emulate a CRT Terminal, they were too slow.

In mid-1974 a prototype 6800 processor was made available to Conrac. It immediately became apparent that the 6800, with its unique bus structure architecture, had a great advantage. The significance of this primarily is that the 6800 is perhaps the first microprocessor that is not input/output limited. Through extensive use of the data and address buses, it is possible to implement various software functions in hardware. In addition, because of the unique I/O structure of the 6800 processor, it becomes an easier task to implement management of peripheral devices ("floppy discs", printers, etc.), as well as complex communication protocols (Burroughs, Univac, etc.).

The important point to be made is that all original design objectives were met:

Reduction of component count needed for a complex Terminal.

Reduction of labor required to assemble a complex Terminal.

Increase of MTBF.

Decrease of MTTR (to module level).

Ability to quickly reconfigure by software change.

Less possibility of early obsolescence.

Ability to handle all communication protocols from simple TTY to complex poll and select routines.

Ability of the 480/25 to handle all normal CRT "housekeeping" in a more efficient fashion than it was heretofore attainable (few if any null fill or line padding required from CPU).

II. MODEL 480/25 SYSTEM DESCRIPTION

The Model 480/25 CRT Terminal is a microprocessor based unit which is capable of displaying 2000 alphanumeric characters on a 12" (diagonal) screen in an 80 character per line/25 line format. There is a "26th" line which displays 10 each bright rectangles. These are under program control, and are generally utilized as status indicators or annunciators. The individual functions are identified by proper nomenclature silk screened upon the bezel directly below the 26th line. The unit basically can operate in a half duplex, full duplex or remote (stand-alone) modes. Mode operation, as well as all other terminal functions, are completely under program control and vary widely from program to program.

The heart of the system is the 6800 processor, which operates with a basic set of 72 instructions, many of which are modified or implemented through the use of up to 5 addressing modes. The basic operating system (program which causes the 480/25 system to emulate a CRT terminal) is contained in the basic 4K PROM on the microprocessor board. An additional 2K of PROM program storage is available on the de-bug board during program debug, and/or if the debug board is a permanent part of the system.

The 80 characters per line/25 line format is generated by hard logic on the CRT driver board, and is always constant. However, virtually all other terminal parameters are determined by the operating system program, i.e.,: communication line protocol; parity checks; CRC checks; code conversion, if necessary; scrolling; protected fields, etc. A number of programs have been written by Conrac; those available at this time are:

TTY Emulation

Enhanced TTY Emulation with Extensive Edit Features

Burroughs TD800 Series Line Protocol Emulation

Univac Uniscope Line Protocol Emulation

Hazeltine 2000 emulation

In addition, a number of diagnostic routines are available for use during routine preventive maintenance performance, as well as for use in pinpointing specific failures.

The CRT Display assembly consists of a 12" (diagonal measure) Cathode Ray Tube and all necessary components, which enable the unit to accept video and sync signals, draw a 262-line raster on the screen and to superimpose up to 2000 characters on the raster, with each character composed by a 5 X 7 dot matrix in a 7 X 9 field.

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The keyboard assembly varies slightly from customer to customer. There is a basic 53 key version which is upper case only, and fully teletype compatible. At the other end of the spectrum is a 93 key version, which can generate both upper and lower case. This 93 key version also contains a 16 key numeric pad and 13 special function control keys.

The 480/25 is fully modular and consists of:

- a CRT display assembly
- a microcomputer sub-system
- a keyboard assembly
- a power supply

all integrated into an attractive cabinet.

The heart of the system is a "card cage" which contains several printed circuit logic cards. One of these cards contains the microcomputer and program storage for the computer. It is this program storage which determines the functional operating characteristics of the unit.

III. PHYSICAL DESCRIPTION OF 480/25 TERMINAL

The cabinet dimensions are: 20.37" D, 17.5" W, 14.4"H, and is self contained. A picture and outline dimensions are attached. As noted previously, the cabinet contains:

1. A Conrac 12" CRT subassembly
2. A 6800 microprocessor based card cage subassembly
3. A TTY compatible ASCII encoded keyboard subassembly
4. A 117/220 VAC 50/60 Hz power supply
5. All necessary cables, hardware, etc., to allow the units to interconnect and function as a terminal.

IV. SUBASSEMBLY DESCRIPTION

1. CONRAC 12" (DIAGONAL) CRT ASSEMBLY

This unit is manufactured by Conrac and is optimized for use in alphanumeric data display applications. It has separate video and sync inputs and anticipates these signals from TTL level logic. The amplifier is gaussian and thus the unit can display

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shades of gray in addition to black and white. The unit is powered by 24 VDC at 1.4 amperes which is furnished by the system power supply.

Resolution of the unit is 850 lines at center and 700 lines at the CRT edges. Brightness is controlled by an external adjustment mounted on the cabinet and available by the terminal operator.

2. MICROCOMPUTER CARD CAGE ASSEMBLY

The Microcomputer Card Cage assembly can hold up to 8 (16) logic cards. Each logic card is 5.0" X 10.0" in size. All logic cards plug into a bus oriented, printed circuit mother board via the use of PC board edge connectors. Since the back plane is bus oriented, i.e., data bus, address bus, and power buses, the card locations are not keyed, and any card can plug into any of the 8 (16) positions.

All input and output signals to and from the card cage are via use of connectors mounted on the top edge of the respective cards as noted below.

2.1 MPU CARD

This card contains the 6800 microprocessor, 4 ea 1K X 8 (total of 4K bytes) PROM or ROM program storage and 512 X 8 (512 bytes) of RAM plus a number of standard TTL logic elements. The 6800 microprocessor: has a bused I/O; can directly address up to 65K bytes of memory; contains a basic set of 72 instructions, many of which can be modified through the use of up to 5 addressing modes; and communicates with all other cards via the data and address I/O buses.

2.2 CRT DRIVER CARD

This card contains all necessary logic, shift registers, and counters necessary to: convert master computer clock signals into vertical and horizontal sync signals for the CRT display subassembly; character generator which converts 7 bit ASCII codes to the proper dot matrix character pattern; generate a proper video drive signal for presentation to the CRT Display Sub Assembly.

2.3 I/O CARD

This card contains all basic system input/output interfaces and support logic. Contained on this card are: 6850 ACIA RS232 line interface; 6820 PIA logic chip

utilized as a keyboard interface; and a second 6850 ACIA interface which can be utilized as either a second line interface or as a printed driver. Line baud rate switch selectors are on this card.

2.4 REFRESH RAM MEMORY

Contained on this card is the necessary 2K X 10 RAM memory which is utilized as the storage and refresh for the screen. Since the screen configuration is 80 characters per line by 25 lines, this memory holds 2000 characters. In the case of this memory the character itself is defined in 7 bits (ASCII 128) and the 8th, 9th, and 10th bits are utilized to flag whether the character is: protected; blinking; or intensified. This card is normally supplied in a single 2K X 10 configuration (one page) but is available with 2 X 2K X 10 (two addressable pages) as an option.

The above cards then constitute a minimum operating system. The specific operating characteristics are defined by an operating system program held in the 4K ROM or PROM on the MPU card (2.1 above). Programs currently available are: TTY emulation; Burroughs TD800 emulation; Univac U100/U200 emulation; and a Hazeltine 2000 emulator. All of these programs are shorter than 2000 bytes. Since there are 4000 bytes available on the MPU card, most CRT type programs can be accommodated on this card.

There are a number of enhancement cards available, which when implemented to the basic minimum configuration above, considerably expand the capability of the 480/25 terminal. Currently available expansion cards are:

2.5 EDIT LOGIC CARD

There are a number of functions in a CRT program which, if implemented in software, are quite time consuming. These are normally those functions which require searching and extensive memory read/rewrite cycling. Due to the unique architecture of the 6800 microprocessor, it is possible through utilization of the bus structure to implement specific functions in firmware (logic) as opposed to software (program).

This Edit Logic Card contains hard wired logic to perform:

- Character Blinking
- Character Intensification
- Character Protect

2.5 EDIT LOGIC CARD (Continued)

- Character Insert/Delete**
- Line Insert/Delete**
- Clear Unprotected Data**
- Clear Screen**
- Tab Set/Clear**
- Local Mode Operation**
- Full Duplex TTY Mode Operation**
- Block Transmit Mode Operation**

While these functions can be performed in software with extended execute times (400 milliseconds for a screen clear, for example) through the use of this edit card, these times are reduced to normally less than one millisecond.

2.6 EXTENDED MEMORY RAM CARD

This card contains 4K X 8 bits (bytes) of Static RAM Memory. The computer can directly address up to 65K bytes of memory, and this memory in 4K increments can be utilized for program storage. On the edge of each card is a DIP switch, which presets the proper 4K address decode for that card. All RAM memory cards are identical, and each can have its own 4K address manually set.

2.7 DUAL FLOPPY DISC INTERFACE CARD

This is designed to interface to two discs, each capable of storing up to 100 pages (screens) of information and/or program storage (up to 200,000 bytes). The disc drives themselves are external to the terminal cabinet and are connected directly to the connectors situated on the top of this card. PROM and RAM memories are located on this card, which are utilized to hold the disc bootstrap program utilized to roll in the disc operating system from the disc itself.

2.8 DE-BUG CARD

This card is designed for use primarily during program writing and de-bugging. It contains 4K of PROM, a 16-bit programmable breakpoint register, and 512 bytes of RAM. This card normally is utilized during program de-bugging. It is completely dependent upon the de-bug routine held in PROM. A typical operation would be to insert a program breakpoint into the 16-bit breakpoint register, and start the program run. When the breakpoint is reached, the run stops and displays on one line of the screen whatever was programmed for display, i.e., typically the instruction being

executed, last instructions executed and next instructions to be executed. In addition, the data may also be displayed. It is possible to display up to 25 lines of program information at any time. Further, the display could show the contents of A, B and X registers, or virtually any status or index register. This card would normally be removed after a specific program becomes operational.

The above listed cards, then, are those currently available. New cards are continually being developed, and will be added to the list of those available when released to production.

3.0 POWER SUPPLY

Primary Input 117/220 VAC \pm 50/60 Hz

Two power supplies are available:

- a. For 8 card cage — 100 watts
- b. For 16 card cage — 140 watts

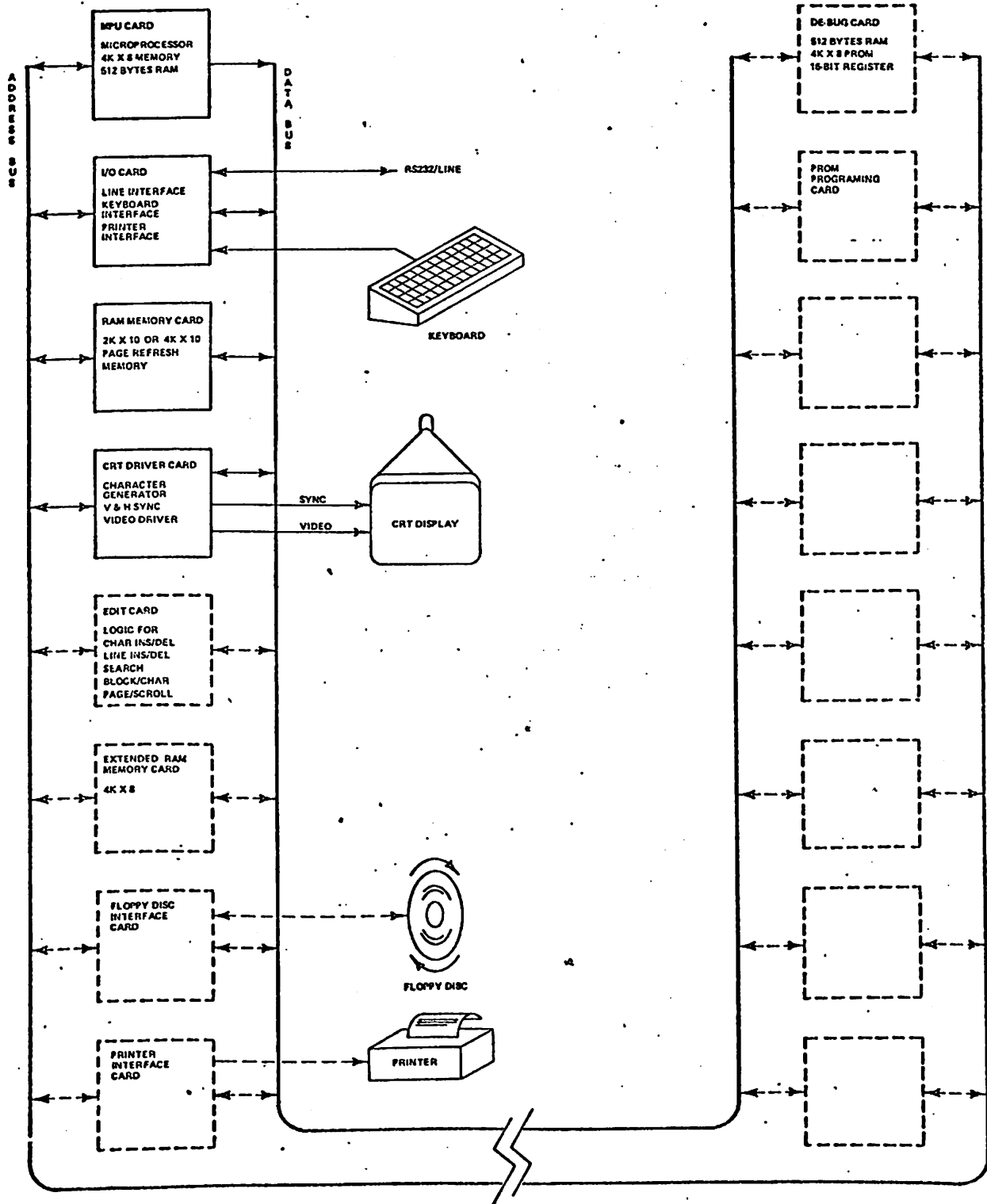
4.0 KEYBOARD

Several different keyboards are available. See Appendix A.

This completes the subassembly description.

**AMI PROGRAM
ADDRESS ASSIGNMENT
FOR
CONRAC MODEL 480/25**

Hexa Decimal	0000 - BFFF	Contiguous General Purpose Memory
Decimal	0000 - 49,151	can be EAROM, PROM, ROM but will generally be RAM
	C000 - DFFF	RAM Display and/or Program Support
	49,152 - 57,343	
	E000 - F7FF	ROM/PROM Program Storage
	57,344 - 63,487	
	F800 - FA7F	Input/Output
	63,488 - 64,127	
	FA80 - FAFF	Terminal Internal Addresses
	64,128 - 64,255	
	FB00 - FBBF	Input/Output
	64,256 - 64,447	
	FBC0 - FBFF	Reserved for AMI
	64,448 - 64,511	
	FC00 - FFFF	RAM, except FFFE, FFFF points to E000
	64,512 - 65,535	512 Bytes on CPU Card 512 Bytes on De-Bug Card



6 CARD BASIC 480/25

16 CARD EXTENDED 480/25

— BASIC CONFIGURATION
 - - - - - EXPANDABLE CARDS

MODEL 480/25
 INTERACTIVE CRT TERMINAL

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