Radio Shack®
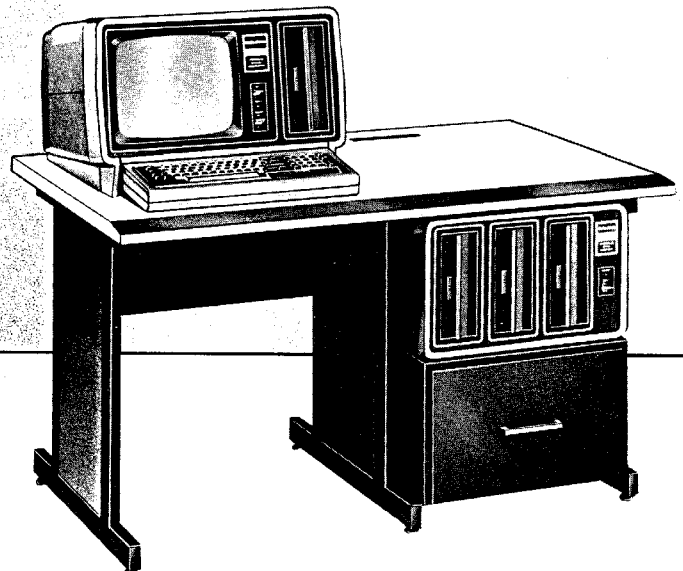

TRS-80 ™ Model II
Operation Manual

A Guide to Using the Computer:
Connection, Power-Up and Operation

Contents

1 / Brief Description of System

The Radio Shack TRS-80 Model II is a disk-based computer system consisting of two major components:
- a Display Console with built-in disk drive
- a separate Keyboard Enclosure

The Operating System software is loaded from diskette by a built-in "bootstrap" program.

Here is a brief description of the functional elements of the Computer.

Processor

At the heart of the Computer is a Z-80A microprocessor operating at its maximum design speed (4 million machine-cycles per second).

The processor receives power-up and reset instructions from read-only memory (ROM). After the TRSDOS initialization program is loaded from disk, this ROM is electronically switched out of the system and replaced with random access memory (RAM).

Random Access Memory (RAM)

The basic system includes 32K bytes of random access memory. (1K = 1024.) An additional 32K bytes can be added, for a total of 64K bytes of addressable RAM.

Video Display

The Video Display has its own LSI controller chip, to free the Z-80A processor from display refresh and related tasks.

The Display offers two modes: 80 characters by 24 lines, and 40 characters by 24 lines. The displayable character set includes the full ASCII set (upper and lower case alphabet, numbers, and special symbols), plus 32 graphics characters. Each character can be displayed as white on black or black on white. See **Displayable Characters** in Section 7.
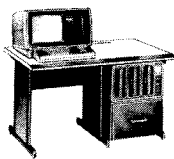
Keyboard

The Model II Keyboard has its own LSI controller to free the Z-80A processor from keyboard scan and related tasks. The Keyboard is in a separate case and is connected to the Display Console via a built-in cable at the bottom front of the Console.

The Model II has the standard typewriter keys (letters, numbers and punctuation symbols); however, each of these keys can output several different codes to the Computer, depending on which mode the Keyboard is in: Unshift, Shift, Caps, or Control. In addition, the Keyboard features a Repeat key and two programmable "function" keys. (See **Keyboard Operation**.)

Floppy Disk Drive

The Model II includes a built-in 8" disk drive. Up to 3 more drives can be added in an external Expansion Unit. (See Section 6, **Add-Ons**.) Because of a special high-density recording technique, each diskette can contain 509,184 bytes of information, which is more than 5 times the capacity of a 5-1/4" diskette. (It would take a 70 wpm typist 24 hours of typing at speed to fill an 8" diskette.)

Note: Actual space available to user is determined by the Operating System.

The "System Drive" (the one that's built-in) must always contain an Operating System diskette. The other optional drives can de devoted exclusively to the storage of user programs and data. (See the **Disk Operating System Manual** for actual diskette space allocation.)

Peripheral Interfaces

There are four interface connections on the back of the Display Console:
- Two serial (RS-232-C) Input/Output (I/O) channels
- A parallel I/O channel, e.g., for connection to TRS-80 standard parallel-interface line printers
- Floppy-disk I/O channel for connection of the Model II Disk Expansion Unit

The Display Console also provides connectors and slots for future expansion. (See Section 6, **Add-Ons**.)

Display Console ⌐
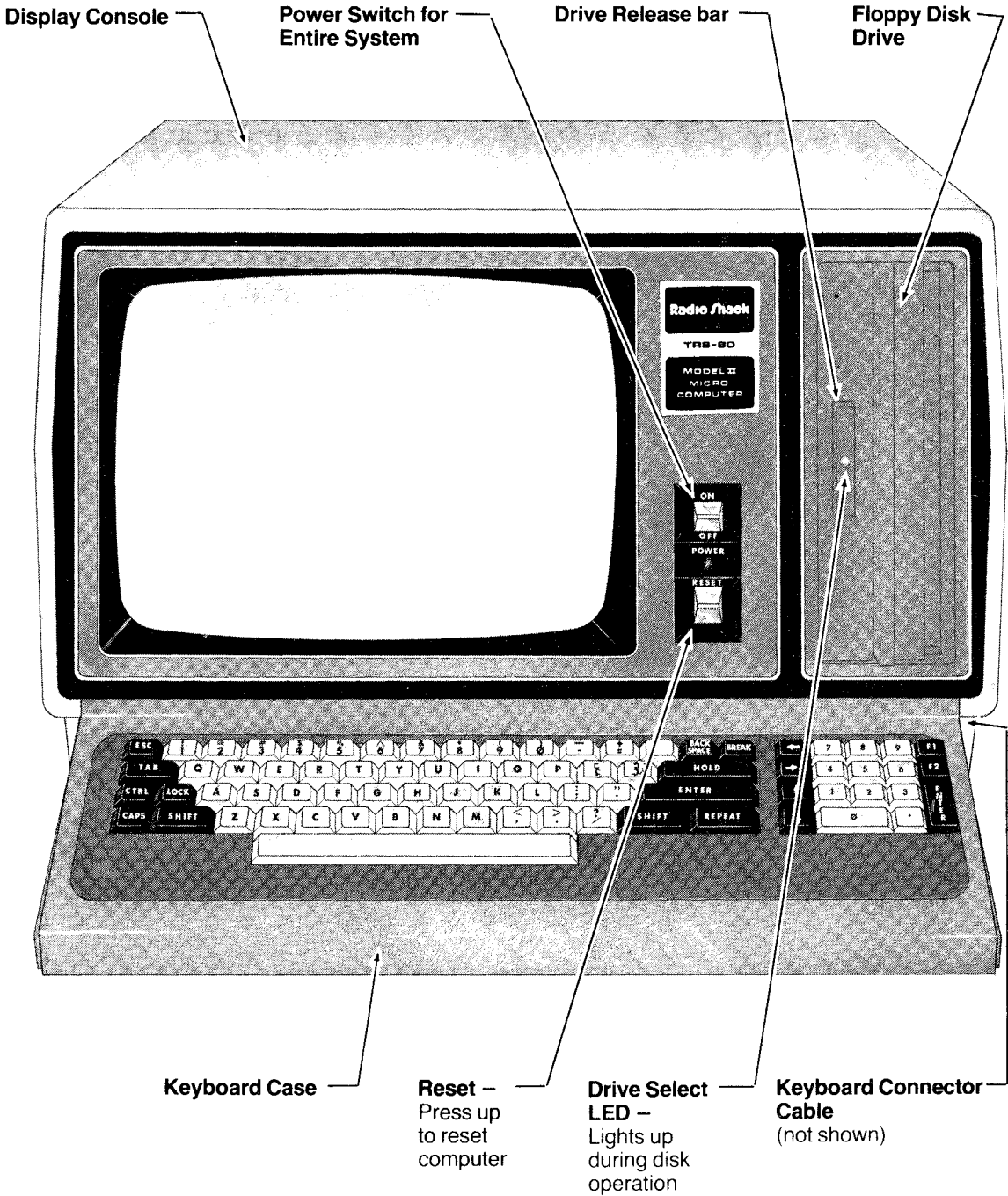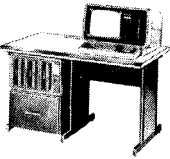
Power Switch for ⌐
Entire System

Drive Release bar ⌐

Floppy Disk ⌐
Drive

Keyboard Case ⌐

Reset – ⌐
Press up
to reset
computer

Drive Select ⌐
LED –
Lights up
during disk
operation

Keyboard Connector ⌐
Cable
(not shown)

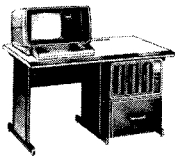*Figure 1: TRS-80 Model II*

2 / Installation

Carefully unpack the System. Remove all packing material and save it in case you ever need to transport the System. Be sure you locate all cables, papers, diskettes, etc.

Place the Display Console on the surface where you'll be using the Computer. The Computer should be near a 120 VAC outlet, so that extension cables won't be necessary. (See Notes on AC Power Sources.)

Notice the cable at the bottom right of the Display Console. Plug this into the jack on the right rear of the Keyboard Case. (See **Figure 2.**)

Once connected, the Keyboard Case can be pushed back into the recessed area at the base of the Display Console, or moved to any convenient place within 2 - 2 1/2 feet of the Console.

(For connection of additional peripheral equipment, see Section 6, **Add-Ons.**)

Connect the female plug on the Power Cord to the back of the Display Console. Connect the other end to a source of 120 VAC, 60 Hz. (See **Figure 3.**)
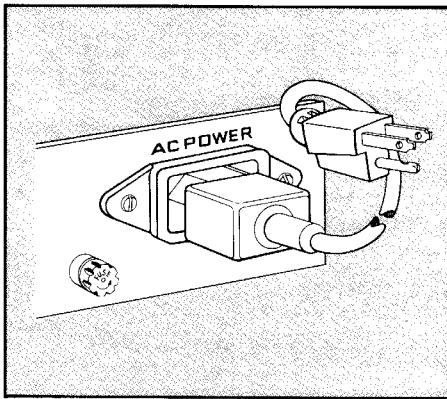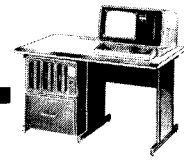

Figure 3. Power Cord connected to Display Console
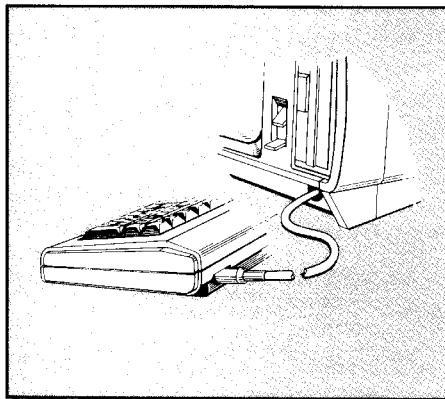
Figure 2. Display Console connected to keyboard.

Note: The power cord has a three-prong safety plug to provide a reliable ground for the system. This ground is very important to the System. If at all possible, plug it directly into a three-prong socket. Otherwise use a 3-to-2 prong adapter and **ground the adapter.**

Notes on AC Power Sources

Computers are sensitive to fluctuations in the power supply at the wall socket, from very short-duration (millionths of a second) voltage spikes, to prolonged drops in current or voltage. This is rarely a problem unless you are operating in the vicinity of heavy electrical machinery. The power supply may also be unstable if some appliance or office machine in the vicinity has a defective switch which arcs when turned on or off.

Your TRS-80 Model II contains a specially designed, built-in AC line filter. It should eliminate all but the most severe interference problems. Should you still experience power-line interference, you should take some or all of the following steps:

- Install bypass/isolation devices to the noisy appliance
- Fix the defective switch
- Install a separate power line
- Install a special line filter designed for use with computers and other electronic equipment

In severe conditions, all actions may be required.

Power line problems are rare and many times can be prevented by proper choice of installation location. The more complex the system and the more serious the application, the more consideration you should give to providing an ideal power-source for your Computer.
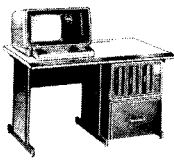
3 / Operation

1. Be sure all drives in the System are empty, and all components are turned off. If no Disk Expansion System is present, be sure to connect the Disk Terminator plug to the Computer.
2. Turn on the Computer (Display Console). Wait until the message "INSERT DISKETTE" appears on the display. If the message fails to appear within 10 seconds, press RESET. If it still fails to appear, turn the Computer off and check all connections. Wait at least 15 seconds before starting over at step 1.
3. When "INSERT DISKETTE" is displayed, turn on the Disk Expansion System (if connected) and all other peripherals.
4. Insert the System diskette into drive 0 and close the drive door. The Computer will load the operating system and prompt you to enter the date and time.
5. Before turning the Computer off, remove all diskettes from all drives. Then turn off the entire system.
6. After any power-down, wait at least 15 seconds before turning the System on again. Start at step 1.
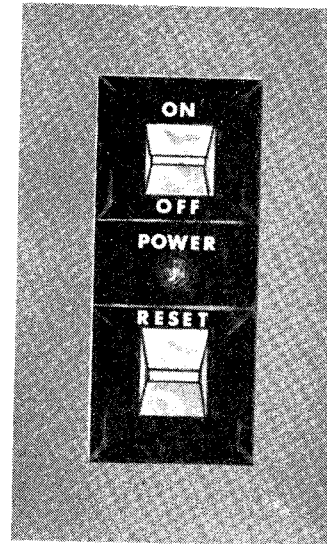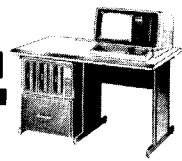
Using the RESET Switch

If you should ever lose Keyboard control of the System, or you simply want to re-initialize, press RESET up momentarily and release it. The Computer will repeat the power-up sequence, but the contents of user memory will not be affected.

Note: You do not need to remove the diskette during this Reset sequence.

Notes on Diskettes

Diskettes are precision recording media. Handle them carefully, as described under Section 5, **Care and Maintenance.** Be sure you don't touch the exposed diskette surfaces.

Before inserting the diskette, check the write protect notch. (See illustration.) If you do not want to write to that diskette, it is a good idea to leave it "write-protected". This way, the Operating System will not let you accidentally write to that diskette. To write-protect a diskette, just leave the write-protect notch UNcovered. (See **Figure 4.**)

If you **do** want to write to the diskette, cover the write protect notch with gummed-foil tape provided with the diskette.

Label — Leave Uncovered —
for Write-Protection

Cover to allow —
Disk Writes

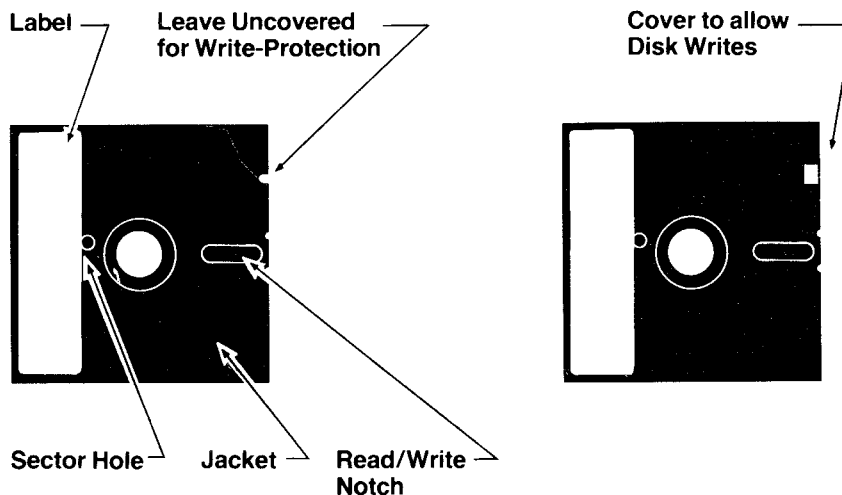Sector Hole — Jacket — Read/Write —
Notch

Figure 4. A diskette and a write-protected diskette.

Note: Any alteration of the data on the diskette — even the deletion of data or programs, requires that the diskette **not** be write-protected. (Cover the notch with gummed foil tape.)

Inserting a Diskette

1. If the drive door is closed, open it by pressing the release bar until the door springs open. (Refer to **Figure 5.**)
2. Remove the Operating System diskette from its storage envelope. Grasp the label side with the label facing away from the Display and insert it into the drive slot (see photo).
3. Gently push the diskette all the way into the slot.
4. Close the door by moving it toward the left until it clicks into place. Some pressure may be required.
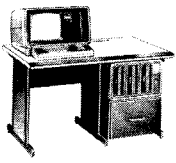
Removing a diskette

Never remove a diskette while the Drive Select light is on, or while a disk file is Open.

Press the Drive Release Bar. The door will open and the diskette will be partly ejected. Carefully remove it, taking care that the shiny diskette surface doesn't touch the chassis or drive door on the way out.

Note: Once a diskette has been seated in the drive, you must shut the drive door before you can remove the diskette.
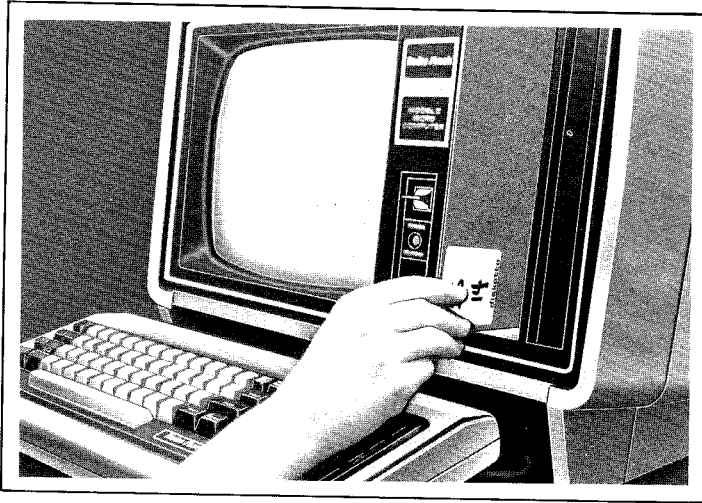
Figure 5. Inserting a diskette (Label might extend vertically across the diskette).

Loading the Operating System

When the Computer prompts you to INSERT DISKETTE, carefully insert the Operating System diskette into the drive.

As soon as you close the drive door, the Computer will begin the Operating System bootstrap.

(If nothing happens when you close the drive door, the diskette is probably inserted incorrectly. Remove it and re-insert it correctly.)

The Computer will then execute a dignostic program before starting the Operating System. This lets you verify that the entire system is in working order — before you attempt any data processing.

After Completing the Diagnostic Program, the Computer will load the Operating System. See the **Operating System Manual** for details.
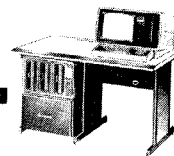
Keyboard Operation

The Keys can be divided into four functional groups: **Alphanumerics, Mode-Select, Numeric Keypad,** and **Control Keys,** as illustrated below:
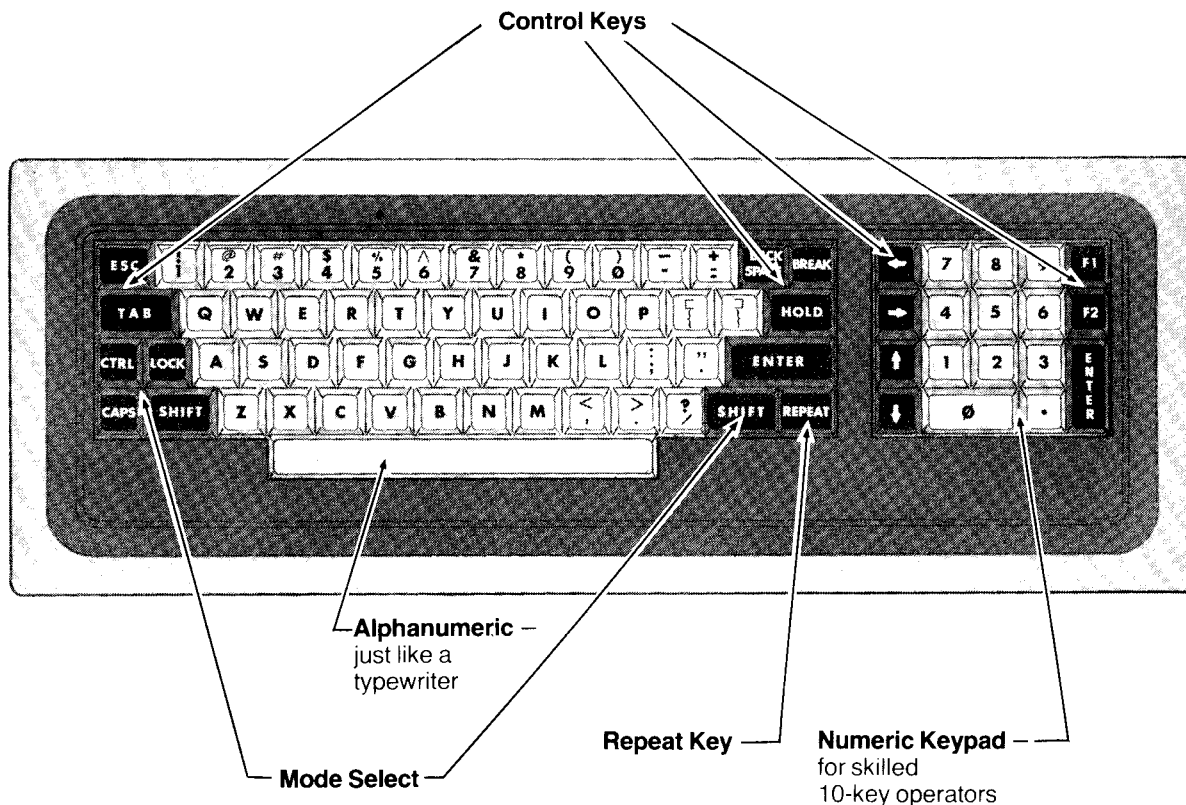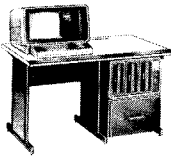

Figure 6. Functional groups of Model II keyboard.

You use the alphanumeric keys just as you would on a normal typewriter. However, each of these keys can send more than one character or code to the Computer, depending on which mode you've selected.

Keyboard Modes

The table below describes the *typical* use of the various modes. This use is determined by the Operating System or by the program currently in execution.

Unshift — Lets you input lower case letters, numbers and unshift punctuation symbols.

SHIFT

LOCK

Shift — Lets you input capital letters and shift punctuation symbols. Hold down **SHIFT** while pressing the desired key, or press the **LOCK** key once so the red light comes on; while that light is on the Keyboard will output only Shifted characters. To return to the Unshift mode, press **SHIFT** again.

CAPS

Caps — Press the **CAPS** key once and the red light will come on. Typically, in the Caps mode, the alphabet keys A-Z send capital-letter codes only, and all other keys are unaffected. To return to the Unshift mode press **CAPS** once so the red light goes off.

CTRL

Control — Hold down the **CTRL** key while pressing one of the alphanumerics; this will output the "control" code assigned to that key.

Note: The Shift mode over-rides the Caps mode. So if both **LOCK** and **CAPS** lights are on, the Keyboard is in the Shift mode.
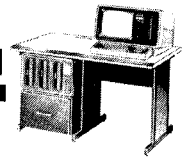
Control Keys

There are 13 Control Keys. Each key outputs a single control code — regardless of what mode the keyboard is in. How the Computer interprets these control codes depends on the Operating System, but here's a description of the *typical function* of each Control Key:

ESC

Escape – Usually used to exit for a subcommand, ignoring preceding characters in the current line.

TAB

Tab – Advances the cursor to the next tab position. The software typically sets Tab positions at 8, 16, 24, 32, etc.

Control Keys (cont.)

BACKSPACE   **Cancels** the last character typed and moves the cursor back one space.

BREAK   **Interrupts** anything in progress in the machine and returns to the command level.

HOLD   **Pauses** execution of the current program. Press **HOLD** a second time to continue execution.

ENTER   Signifies the **end of the current line**. The Display Cursor will drop to the beginning of the next line. Note that the two **ENTER** keys are identical. The rightmost **ENTER** is for convenient use with the numeric keypad.

SPACE BAR   Enters a **space** (blank) character and moves the cursor one space forward.

←   **Cursor Control — Moves cursor back** one space without cancelling previous character.

→   **Cursor Control — Moves cursor forward** one space without entering a blank-space character.

↑   **Cursor Control — In some programs, moves cursor up** one line without erasing previously entered characters.

↓   **Cursor Control — In some programs, moves cursor down** one line without erasing previously entered characters; does not signify end-of-line.

F1

F2   **Function Keys — Software Programmable.** Outputs a control code which can be used by the Operating System or Applications Software for special functions.
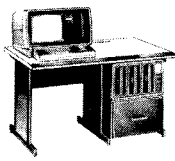
Numeric Keypad

Clustered at the right of the Keyboard is a set of number keys, arrow keys and a second ENTER key. The arrow keys and ENTER keys are described above. The number keys are identical to the number keys on the top row of the main key cluster — except that these number keys output numeric character codes **only**. SHIFT , LOCK , CAPS and CTRL keys do not affect the output from the numeric key cluster.

These keys are convenient for data entry by skilled 10-key operators.
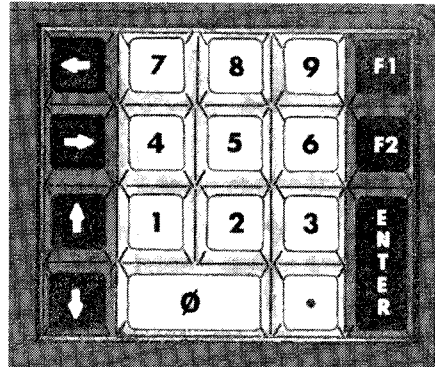
Repeat Key

This special convenience key works in conjunction with any key combination in any mode. Simply hold down REPEAT while you press the desired key(s). While you hold down these keys, the keyboard will output a steady stream of the desired characters.

Video Display Adjustment

Brightness and Contrast controls are located in the recessed area at the bottom left of the Display Console. Adjust as necessary for a comfortable display quality.
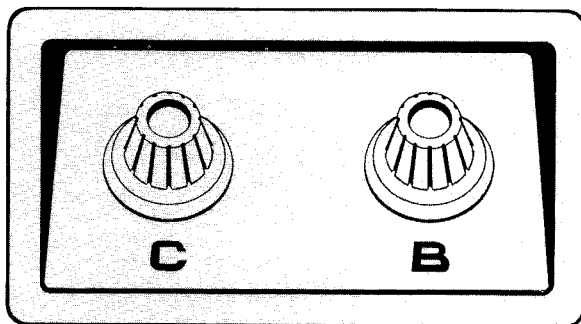
4 / Power-Up Diagnostic Messages

Whenever the Computer is turned on or Reset, it executes a built-in diagnostic program to help insure that the system is in good working order. If the Computer detects a hardware fault or other problem, it will display an error message and then stop. This checkout program reduces the chance that you will lose time or data by using a defective system without knowing it.

If one of these error messages is displayed, the first thing you should do is Reset the Computer, and attempt to duplicate the error. If the message re-appears, consult the table below.

Note: This program does not check for multiple faults; as soon as a single fault is found, the Computer displays the appropriate message and stops.

Error Code	What it means — What to do about it
DC	Floppy Disk Controller Error. Defective Diskette — Try another. Defective DC Chip or Drive.
D0	Drive not Ready. Improperly inserted diskette — Re-insert and reset. Defective diskette — Try another. Defective Drive.
SC	CRC Error. Invalid data on diskette or defective diskette — Try another.
TK	Record not found on bootstrap track. Improperly formatted diskette or defective diskette — Re-format or try another.
LD	Lost Data during read. FDC or Drive fault.
RS	Non Radio Shack diskette. Diskette is not Radio Shack Model II Operating System format — Remove, insert proper diskette, and reset.

(Continued on next page)
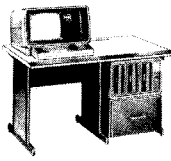
| Error Code	What it means — What to do about it
CK	ROM Checksum Error. Defective ROM.
Z8	Z-80 Fault. Defective CPU.
MF	RAM Fault. Defective RAM in address range X'1000'-X'7FFF'
PI	PIO Chip Failure.
DM	DMA Chip Failure.
MB	RAM Fault. Defective RAM in address range X'0000'-X'0FFF'
MH	RAM Fault (on 64K systems only). Defective RAM in address range X'8000'-X'FFFF'
SI	SIO Chip Failure.

Before you ask for help . . .

Try the operation several times. Try using other diskettes. Recheck to see that all power and interconnections are right.
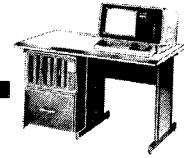
5 / Care and Maintenance

Care of Diskettes

In general, handle diskettes carefully, using the same precautions you use with tape cassettes and high-fidelity records. A small indentation, dust particle, or scratch can render all or part of a diskette unreadable —
permanently.

- Keep the diskette in its storage envelope whenever it is not in one of the drives.
- Do not place a diskette in the drive while you are turning the system on or off.
- Keep diskettes away from magnetic fields (transformers, AC motors, magnets, TVs, radios, etc.). Strong magnetic fields will erase data stored on a diskette.
- Handle diskettes by the jacket only. Do not touch any of the exposed surfaces. **Don't try to wipe or clean the diskette surface**; it scratches easily.
- Keep diskettes out of direct sunlight and away from heat.
- Avoid contamination of diskettes with cigarette ashes, dust or other particles.
- Do not write directly on the diskette jacket with a hard point device such as a ball point pen or lead pencil; use a felt tip pen only.
- Store diskettes in a vertical file folder on a shelf where they are protected from pressure to their sides (just as phono records are stored).
- In very dusty environments, you may need to provide filtered air to the Computer room.

Tips on Labeling Diskettes

Each diskette has a permanent label on its jacket. This label is for "vital statistics" that will never change. For example, to help keep track of diskettes, it's a good idea to assign a unique number to each diskette. Write such a number on the permanent label. You might also put your name on the diskette, and record the date when the diskette was first put into use. Remember, use only a felt tip pen for marking.

This "permanent" label is not a good place to record the contents of the diskette — since that will change, and you don't want to be erasing or scratching out information from this label.
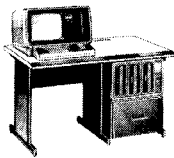
Keep such directory information on the storage box or in a separate
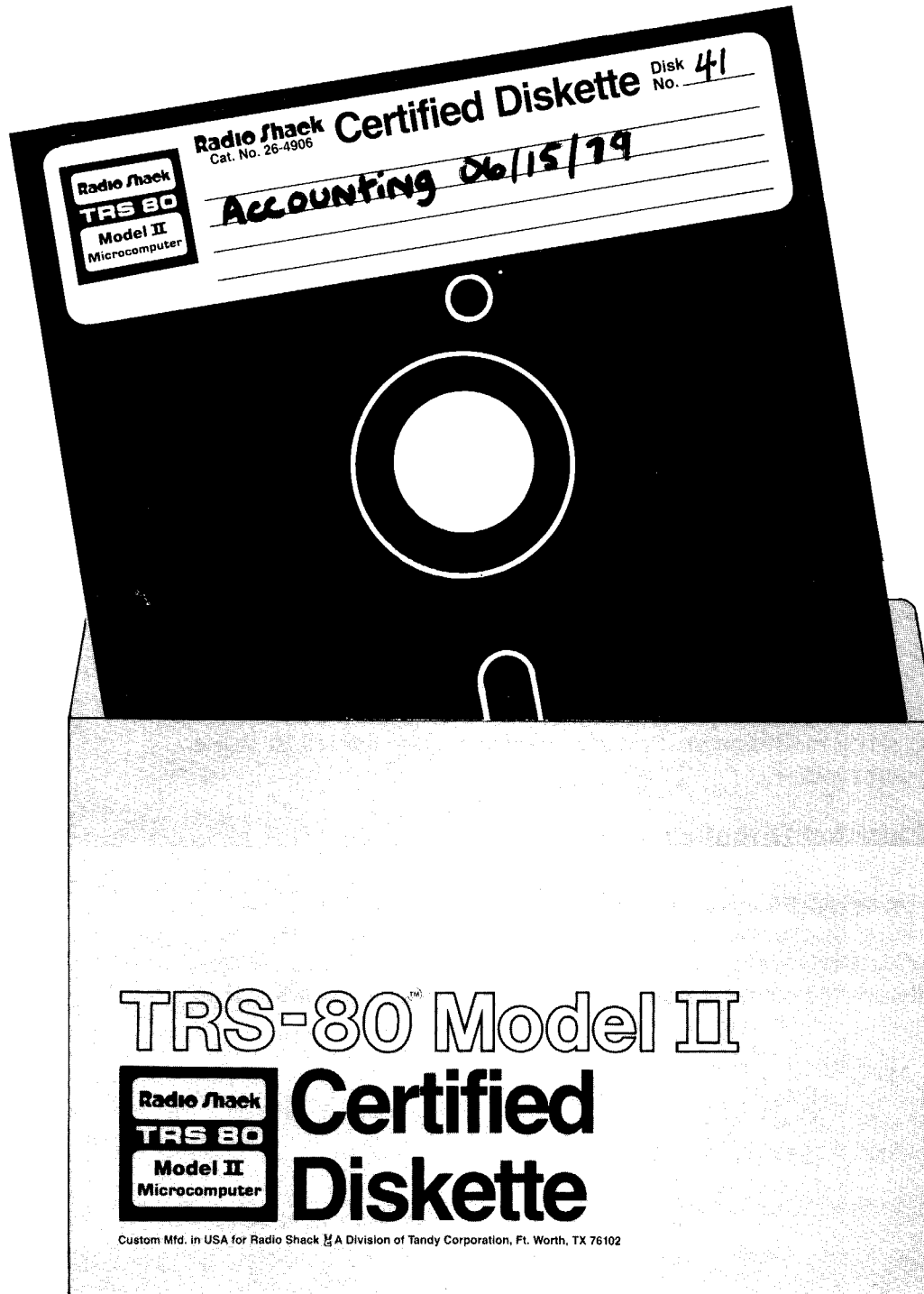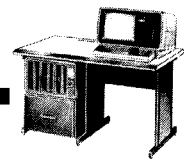record book, using the diskette number as a key to all record-keeping.
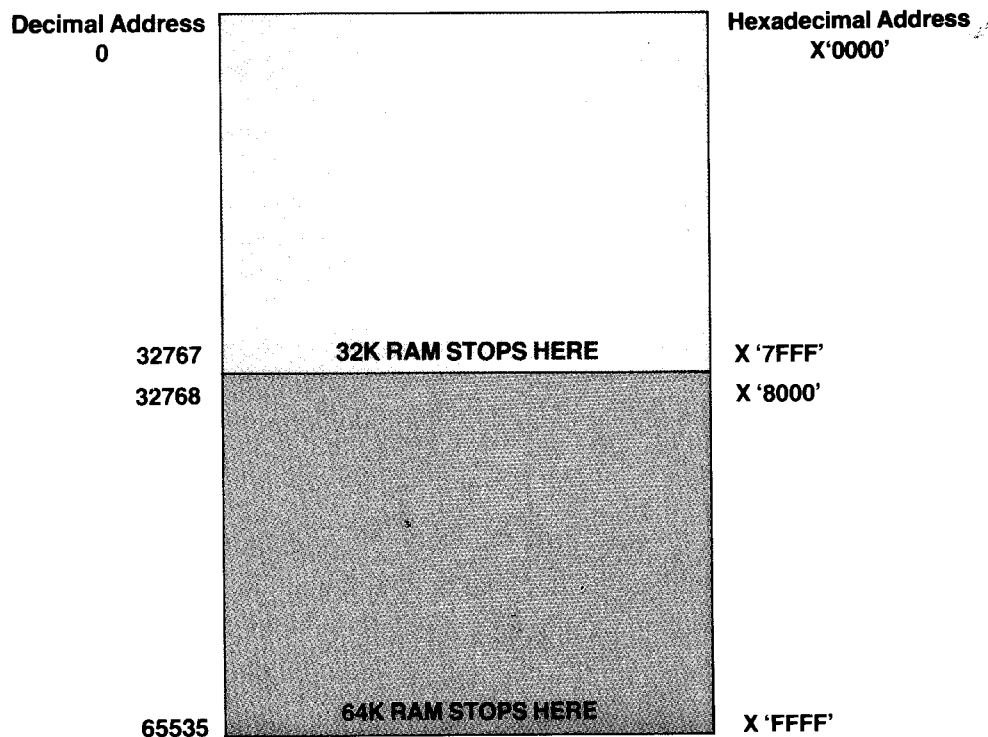
Figure 7. Labeled diskette.

6 / Add-Ons

Inside the Display Console are slots for eight printed circuit boards. Four of these slots are taken up by the boards required by the basic system — Processor, Video Display, Floppy Disk Controller, and Random Access Memory (RAM).
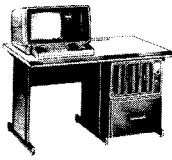
Adding RAM

If your system has 32K of RAM, you can add another 32K by returning the unit to Radio Shack. Another 32K board will be added to the card-cage, leaving three slots still open for future enhancement of your system.

Systems shipped with 64K of RAM have four slots open for future additions, since a single 64K board is used in place of two 32K boards.

Decimal Address		Hexadecimal Address
0		X'0000'
32767	32K RAM STOPS HERE	X '7FFF'
32768		X '8000'
65535	64K RAM STOPS HERE	X 'FFFF'

**RANDOM ACCESS MEMORY CONFIGURATION AFTER SYSTEM IS INITIALIZED**

Adding Disk Drives

Each drive you add will increase the on-line storage of your system by 509,184 bytes (roughly equivalent to 300 double-spaced typewritten pages).

Connection of additional Disk Drives is quite simple. The connector is on the back of the Display console, and a connector cable will be supplied with the Disk Expansion Unit.

Note: When the Disk Expansion Unit is **not** connected to the Model II, a special terminator **must** be connected to the Disk Expansion connector on the back of the Display Console. This terminator is included with the Computer; connect it to the DISK EXPANSION jack.

Further instructions are provided with the Expansion Unit, and can be added at the end of this Operation Manual.
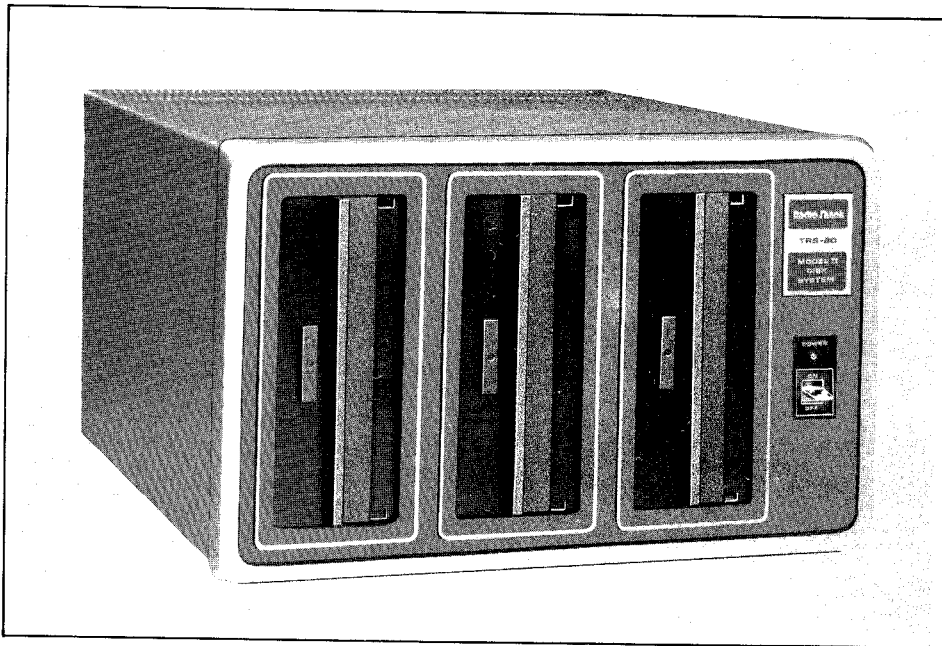
Figure 8. Disk Expansion Unit with three additional Disk Drives.
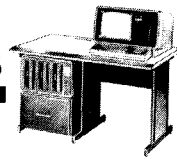
Connecting Serial Interface Equipment

The Model II provides two serial I/O channels, for connection to equipment like Telephone Interface Modems, Serial Line Printers, etc. Connection instructions will be provided with the serial equipment. You can add such instructions at the end of this Operation Manual. (See **Specifications** for a description of the Serial Interface Signals.)
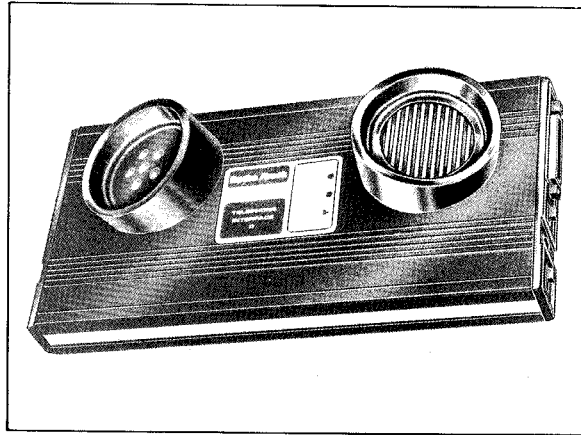

Figure 9. Radio Shack Telephone Interface II Modem
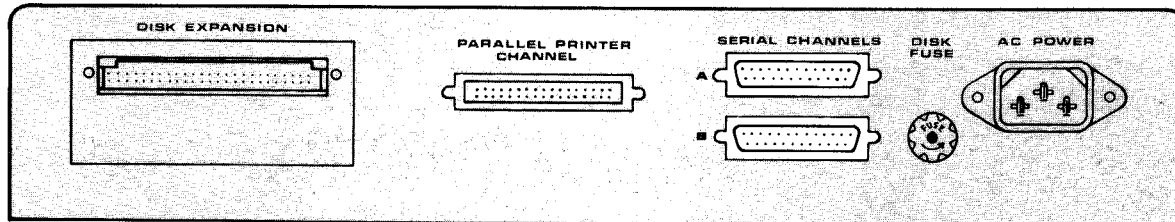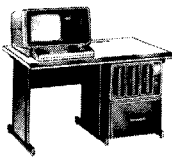*for connection of computer system to telephone line.*

Figure 10. Connect Telephone Interface Modem (or other serial I/O device) to serial
channel connection on the back panel of the video screen.

Parallel Interface Equipment

The Model II provides one parallel I/O channel, for connection to Radio
Shack Line Printers and other compatible parallel-interface equipment.
Connection instructions will be provided with the equipment. You can add
such instructions at the end of this Operation Manual. (See **Specifications** for
a description of Parallel Interface Signals.)
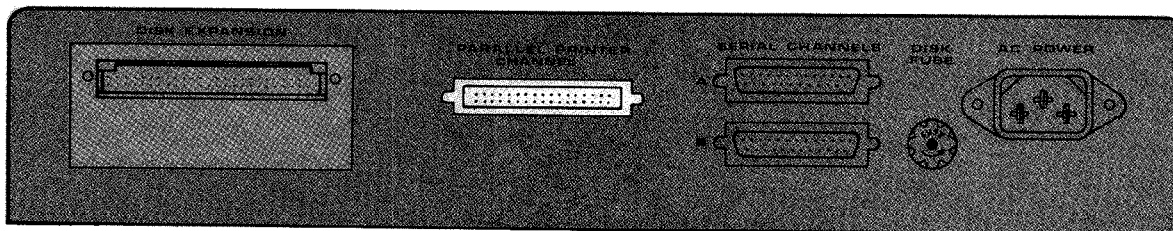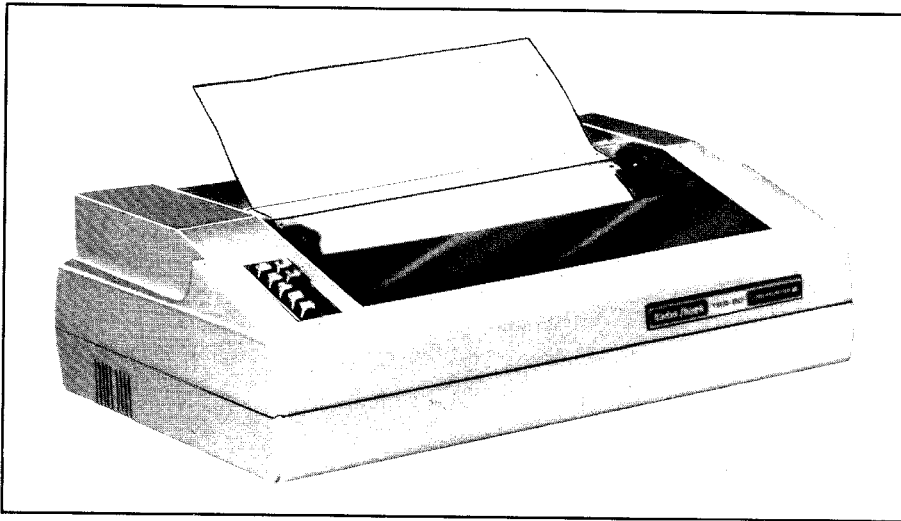
7 / Specifications

Display Character Set

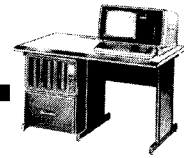Here are the 32 graphics characters available on the Model II Display, along with their corresponding hexadecimal character codes. For further detail on the use of these codes, see the **Operating System Reference Manual.**

Note: A reverse-character (black on white) is available for each of the display characters, including alphanumerics.

00	01	02	03	04	05	06	07
08	09	0A	0B	0C	0D	0E	0F
10	11	12	13	14	15	16	17
18	19	1A	1B	1C	1D	1E	1F
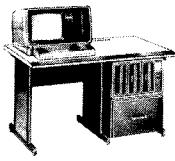
Power Supply

Power Requirements   105 - 130 VAC, 60 Hz
240 VAC, 50 Hz (Australian)
220 VAC, 50 Hz (European)
Grounded Outlet
Maximum current drain: 2.0 Amps
Typical current drain: 1.5 Amps
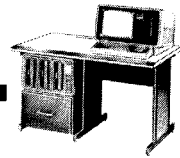
Operating Temperature

32 to 110 degrees Fahrenheit
0 to 43 degrees Centigrade

Floppy Disk Drive

Total Storage Capacity (for User Data Capacity, See **Operating System Manual**)	**509,184 bytes per diskette***

Diskette Organization

Tracks per Diskette	**77 (0-76)**
Sectors per Track*	**26 (0-25)**
Bytes per Sector*	**256** (except Track 0 = 128)

Data Transfer Rate	**500,000 bits per second** (except track 0 = 250,000 bps)
Required Media	**Radio Shack 8" Floppy Diskettes,** Catalog Number 26-4905, or 26-04906 (pkg of 10)
Preventive Maintenance Interval	**8000 Power-On Hours** (typical usage) **5000 Power-On Hours** (heavy usage)
Diskette Life†	**3.5 million passes per track**

*These values are determined by the operating system software. See the **TRSDOS Reference Manual,** Technical Information section.

†In practice, diskette life is usually limited by improper handling. Follow handling recommendations for maximum use.
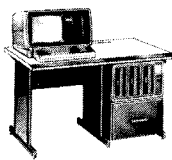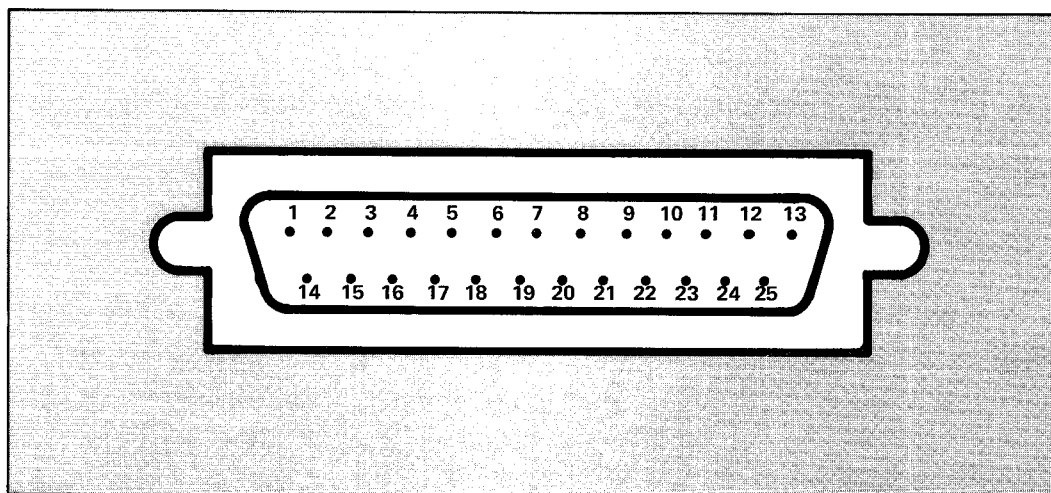
Serial Interface Signals and Levels

Two channels are available, via the DB-25 connectors on the back of the Display Console. The signals and levels conform to the RS-232-C standard.

Channel A is designed to allow asynchronous or synchronous transmission. Channel B is designed for asynchronous transmission only.

The DB-25 connector pin-outs and signals available are listed below.

CHANNEL A

STANDARD RS-232-C SIGNAL	(PIN #)
I/O TRANSMIT S.E.T.	15
GROUND	1,7
RECEIVED DATA	3
RECEIVER CLOCK	17
TRANSMIT CLOCK	24
DATA SET READY	6
CLEAR-TO-SEND	5
CARRIER DETECT	8
TRANSMIT DATA	2
REQUEST-TO-END	4
DATA TERMINAL READY	20

CHANNEL B

STANDARD RS-232-C SIGNAL	PIN #
GROUND	1,7
RECEIVED DATA	3
RECEIVER XMITTER CLOCK	17
DATA SET READY	6
CLEAR-TO-SEND	5
CARRIER DETECT	8
TRANSMIT DATA	2
REQUEST-TO-SEND	4
DATA TERMINAL READY	20

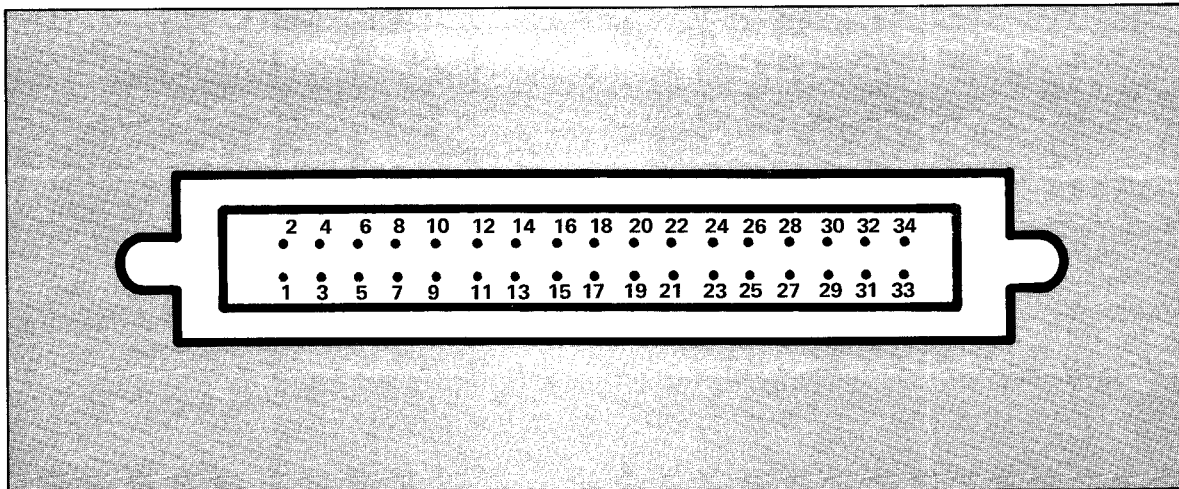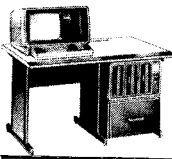# Parallel Interface Signals and Levels

The Model II includes a parallel interface designed for connection to a line
printer via the 34-pin connector on the back panel of the Display Console.
Eight data bits are output in parallel, and four data bits are input. All levels
are TTL compatible.

The connector pin-outs and signals available are listed on the next page.

SIGNAL	FUNCTION	PIN#
STROBE*	1 µS pulse to clock the data from processor to printer	1
DATA 0	Bit 0 (lsb) of output data byte	3
DATA 1	Bit 1 of output data byte	5
DATA 2	Bit 2 of output data byte	7
DATA 3	Bit 3 of output data byte	9
DATA 4	Bit 4 of output data byte	11
DATA 5	Bit 5 of output data byte	13
DATA 6	Bit 6 of output data byte	15
DATA 7	Bit 7 (msb) of output data byte	17
ACK*	Input to Computer from Printer, low indicates data byte received	19
BUSY	Input to Computer from Printer, high indicates busy	21
PAPER EMPTY	Input to Computer from Printer, high indicates no paper — if Printer doesn't provide this, signal is forced low	23
SELECT	Input to Computer from Printer, high indicates device selected	25
PRIME*	Output to Printer to clear buffer and reset printer logic	26
FAULT*	Input to Computer from Printer low indicates fault (paper empty, light detect, deselect, etc.)	28
GROUND	Common signal ground	2,4,6,8,10 12,14,16,18, 20,22,24,27, 31,33
NC	Not connected	29,30,32,34

*These signals are active-low.

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NOTE: Good data processing procedure dictates that the user test the program, run and test sample sets of data, and run the system in parallel with the system previously in use for a period of time adequate to insure that results of operation of the computer or program are satisfactory.

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