INTECOLOR

8800/3800 SERIES

USER'S MANUAL

(PART ONE & PART TWO)

999439-060   **March 1989**

This User's Manual has been expanded to cover Intecolor 3800/8800 Series Terminals constructed with a wire-frame chassis, Intecolor's patented Auto-ranging power supply and Version 2.0 firmware.

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W A R N I N G

This equipment generates and can radiate radio frequency
energy and may cause interference to radio and television
reception if not installed and used according to the
guidelines set forth in this manual. Any change in terminal
or cable configuration may adversely affect its
specifications for FCC compliance.

Intecolor 8800/3800 Series terminals have been tested and
found to comply with the limits for Class A computing
devices established by the FCC Rules, Part 15, Subpart J,
which are designed to limit interference to levels
acceptable in a commercial installation. Operation of this
equipment in a residential environment may cause
interference for which the user may be required to take
corrective action at his own expense.

To minimize the risk of interference, follow the procedure
set forth in Appendix A (Installation and Connection) of
this manual. Additional guidance is available in Federal
Communications Commission booklet, "How to Identify and
Resolve Radio-TV Interference Problems." This booklet is
available from the U.S. Government Printing Office,
Washington, DC, 20402, Stock No. 004-000-00343-4.

DEFINITIONS

WARNING!

Where the word **WARNING!** is used in this manual, the associated note refers to operations or procedures which involve possible exposure to dangerous voltages, contact with which could result in personal injury or even death.

CAUTION!

Where the word **CAUTION!** is used in this manual, the associated note refers to operations or procedures which involve possible damage to equipment.

TRAINED AND QUALIFIED

Where the words PERSONS TRAINED AND QUALIFIED are used in this manual, they refer to either of two types of individuals:

1) Persons who through general technical training are aware of the possible dangers in working in proximity to hazardous voltages and know how to avoid personal injury in working with equipment involving safety hazards.

or

2) Persons who have received specific training in use of the procedures involved and in the safe performance of these procedures.

PREFACE

This 8800/3800 Series Terminal User's Manual is provided in two parts.

Part One describes early 8800/3800 Series Terminal's hardware and firmware. General information covering Intecolor 8001 Series logic functionality is also described here.

Terminals covered in Part One are:

13" PRODUCTS		19" PRODUCTS	
Low Res.	Med. Res.	Low Res.	Med. Res.
3810	3820	8810	8820
3860			
3881			

Part Two covers 8800/3800 Series Terminals with a wire-frame chassis and Version V2.0 or newer firmware.

Terminals covered in Part Two are:

14" PRODUCTS		20" PRODUCTS	
Low Res.	Med. Res	Low Res.	Med. Res.
3815	3825	8814	8824
3865	3875	8825	8825
		8816	8826
		8865	8875

Principle Schematics, Troubleshooting Information, and Theory Of Operation is contained within Intecolor's Maintenance Manual Part No. 999440.

3800/8800 USER'S MANUAL
PART ONE

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SECTION I

INTRODUCTION

I. INTRODUCTION

The Manual

This manual is intended to be a user's instruction manual and reference guide for the 8800/3800 Series Intecolor terminals. It describes the use of the features of the Intecolor 8810, 3810, 3860 and 3881 standard resolution terminals, including the graphics submodes. It also includes a section for the medium resolution versions — 8820 and 3820.

Prior experience with or knowledge of other computer terminals, although helpful, is not at all essential in learning to use the Intecolor 8810 (and other terminals in the series) with the use of this manual. The limited amount of technical detail included is intended for use by applications personnel rather than by the regular user.

> Section II includes instructions for connection to a host computer, to an RS-232-C compatible modem, to a current loop and to a printer.

> Section III describes the operation and serves as an operator's handbook.

> Section IV describes the routine adjustment procedures.

Circuit descriptions and other maintenance information are beyond the scope of this manual but may be found in the Maintenance Manual for the 8800/3800 Series Terminals (Intecolor P/N 999440).

The Intecolor 8810/3810 Terminals

The 8810 or 3810 is a high-performance eight-color CRT intelligent data terminal. It is a self-contained desk top unit.

It can receive control data from either:

> The included keyboard (when enabled), or
> Through an input port (usually serial) from an outside source.
> > (The outside source usually is a host computer.)

The serial connection to a host computer or other terminal can be:

> Direct,
> Via common voice telephone line through RS-232-C compatible modems,
> Or via a current loop connection.

There is an auxiliary serial I/O port and an additional output serial port which operate at RS-232-C level.

There is an option for an 8-bit parallel port, which can be either output only for a Centronics-type printer or an input/output port.

SIMPLIFIED BLOCK DIAGRAM OF THE INTECOLOR 8810 TERMINAL

EXTERNAL
INPUTS

MICROCOMPUTER

```
                    ┌──────────────┐
                    │   TERMINAL   │
                    │   CONTROL    │
                    │   SOFTWARE   │
                    └──────┬───────┘
                           │
                           ▼
 ┌──────────┐       ┌──────────────┐
 │  HOST    │◄─────►│   TERMINAL   │◄──┐
 │ COMPUTER │       │   PROCESSOR  │   │
 └──────────┘       └──────┬───────┘   │
                           │           │
 ┌──────────┐              │           │
 │ KEYBOARD │─────────────►│           │
 └──────────┘              ▼           │
                    ┌──────────────┐   │
                    │   DISPLAY    │   │
                    │   MEMORY     │   │
                    └──────┬───────┘   │
                           │           │
                           ▼           │
 ┌──────────┐       ┌──────────────┐   │
 │  LIGHT   │──────►│   DISPLAY    │◄──┘
 │ PEN (Opt)│       │  GENERATOR   │
 └──────────┘       └──────┬───────┘
                           │
                           ▼
                    ┌──────────────┐
                    │    SCREEN    │
                    │              │
                    └──────────────┘
```

DISPLAY
SYSTEM

1.02
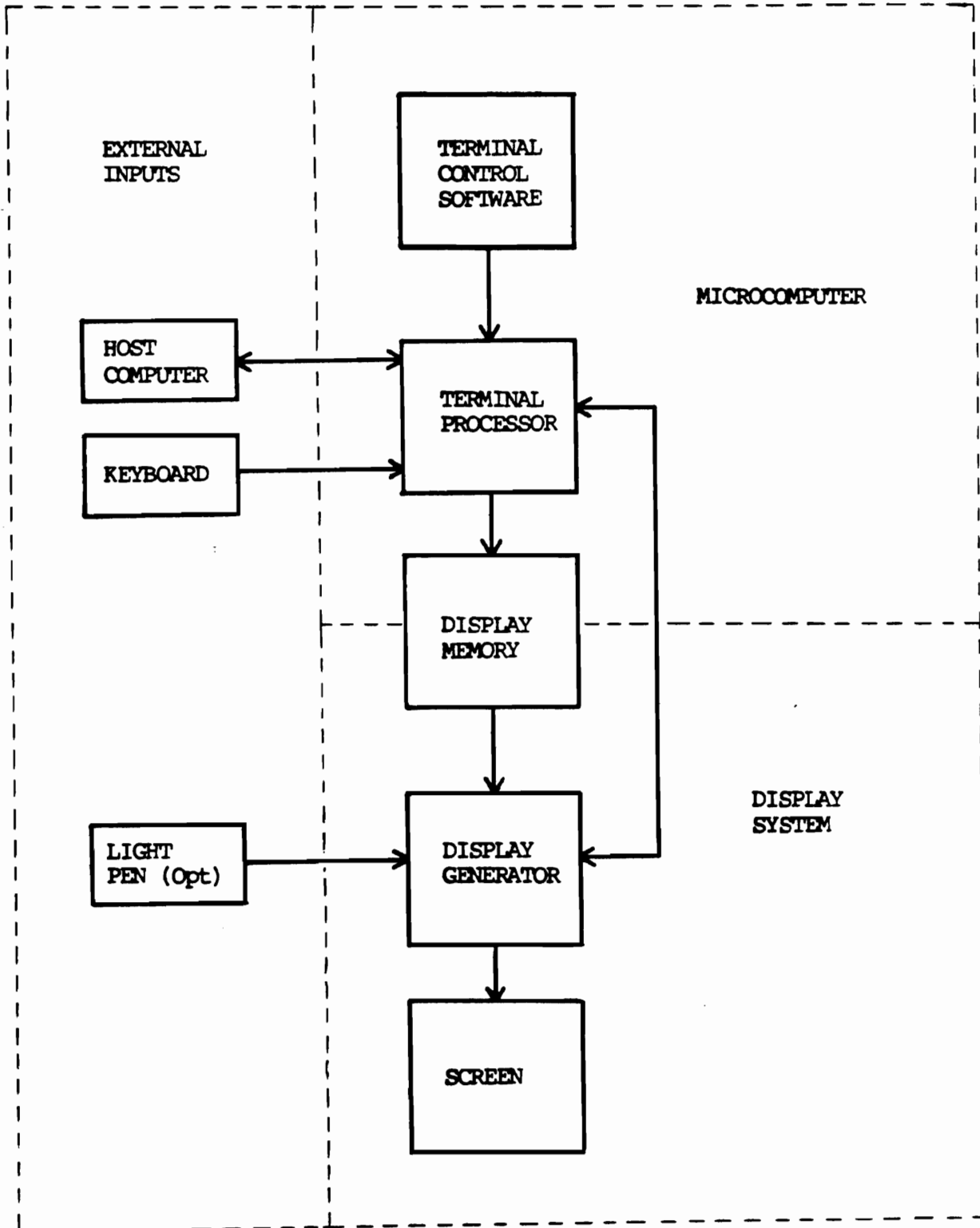
The cathode ray tube display uses any of eight foreground colors, selected for each character space — red, blue, green, yellow, magenta, cyan, black and white. There is choice of the same eight colors for background.

The display format is 80 characters per line, with 48 lines of normal height characters or 24 lines with double-height characters.

The 8810 or 3810 also has extensive plotting capability. Additional screen editing capability and the added convenience of a 16-key numeric pad and a 9-key color/command pad are included on the 101-key extended keyboard. An optional 117-key keyboard also has 16 function keys used in generation of additional codes for plot functions.

Standard features include 64 uppercase ASCII alpha and numeric characters, 32 lowercase, 32 control representation characters, 64 special process characters and 64 line drawing characters. More detailed specifications are listed at the end of this section.

The pages immediately following briefly describe the theory of operation. Although mostly from a beginner's viewpoint, the part concerning display memory and character generation may be of interest to the more experienced user.

How the Terminal Works

If a microprocessor-based terminal is new to you, you may be interested in an outline of how the Intecolor 8810 does its job. The page at left shows a simplified block diagram of the terminal. The terminal is considered as three parts:

A microcomputer with its associated software control

A display system which includes the cathode ray tube for display

Input/Output devices which include the keyboard

The microprocessor is the workhorse of the microcomputer portion. It has the ability to respond to instructions from the terminal software -- special programs stored in memory -- from the keyboard or from other inputs, such as a "host" computer. It can accept data, perform logical operations, address memory locations, output the results of operations on input data and the like.

The controlling software or information consists of step by step instructions stored in a nonvolatile or fixed memory. For example, when the terminal is turned on, the first few instruction steps include such things as clearing the screen, setting certain display colors, and displaying the initial message concerning the mode of operation the terminal has entered. It also sets the rate at which it will accept data from an outside source initially.

The microcomputer responds to input from either the keyboard or some other source, such as the host computer. These instructions are received "serially", one bit after another on one line. Each "bit" represents a "one" or a "zero" — "mark" or "space" in teletype terms. A group of eight bits may be called a "byte" or a "word". Within the microcomputer, the instructions and data are handled as 8-bit words.

In addition to the standard serial input ports for the host computer, keyboard and auxiliary serial input device, there can be an option for accepting input in "parallel", eight bits at a time on eight input lines (conducting paths).

When the received instructions — whether originating at the host computer, the keyboard or the control software — indicate material for display on the cathode ray tube screen, the microprocessor puts the appropriate "words" in the display memory.

The display memory or screen refresh memory is the principal link between the microcomputer and the display generator. This is a memory which can be written into or read from. The words read from the display memory by the display generator determine what is displayed on the screen. The microcomputer writes into the display memory two eight-bit words for each character position on the screen. The terminal has 3,840 character positions arranged in 48 lines of 80 characters each. The display memory then must store 7,680 words. The first of the two words for the character position defines the shape of the character and the second defines the attributes or character composite information (CCI) — colors, etc.

The upper byte or first of the two words contains the 7-bit ASCII code for a specific character or symbol and the A7 bit which defines the character height as normal or double. In plotting, this first word defines the combination of plot blocks within a character position. The word is used to address a read-only memory which contains the details of the character or plot block formation.

The lower byte or second word defines foreground color, background color, foreground blink and whether the character word defines one of the 64 ASCII characters (or lower case or special characters) or whether it specifies plotting information.

The make-up of the two words is shown below.
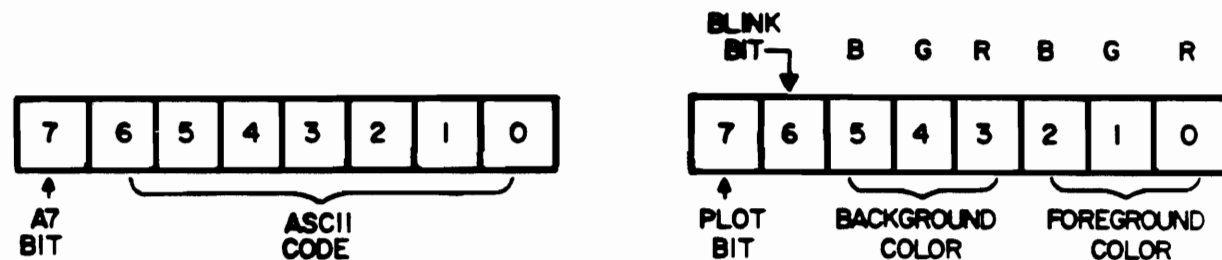
Each character or plot block is described within a 6 x 8 dot matrix and is
displayed on the screen in eight horizontal sweeps of the electron beams
from the three color guns. As the beams pass each dot position, the
information derived from the character and status words determines which
color beam(s) is (are) turned on. The display generator provides the
synchronizing signals for the circuitry that controls the cathode ray tube
used for display to keep the electron beam sweep in step with the
information being fed out from the display generator.
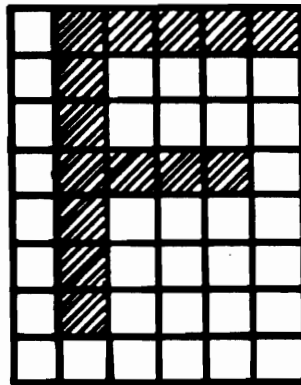
Input devices such as a host computer send in instructions and information
as eight-bit code words (256 possible combinations) in serial form. Most
of these codes also can be sent in from the keyboard.

RS-232-C is an industry standard which specifies the electrical format of
the data for a type of serial transmission. Industry conventions have
assigned the control signals and the use of the terminal pins in the
connecting plugs and sockets. Among other things, the industry convention
usually has the data from the host computer received by the terminal on pin
3 of the terminal's RS-232-C connector. Binary "zero" on the receive line
is represented by a positive voltage within a certain range; a binary "one"
is represented by a negative voltage. The terminal sends information out
at pin 2 of the connector by similar use of positive and negative voltage
levels. The speed at which the binary bits are sent one after the other is
expressed as a Baud rate — the Baud rate is approximately the same as bits
per second and a higher Baud rate means faster data transmission.

If the communication with the host computer is by common voice telephone
line, the data signals of most computers and of the Intecolor terminal must
be modified somewhat — the usual telephone line will not transmit the plus
and minus voltages as sent by the computer or terminal. Devices called
modems -- modulator-demodulators, sometimes called data sets — are used
between the terminal and the telephone line and between the computer and
the telephone line. Within the modem the data signals are used to modulate
or control other signals that will go over the telephone lines. The modem
at the other end of the line demodulates the signals to return the data to
its original form. This pair of modems also makes the connections in such
a way that the transmit output of the terminal goes to the receive input of
the computer and vice versa. "RS-232-C compatible modems" use the RS-232-C
format for signal levels and connector pin numbering.

The light pen shown is another optional input device which enables the user to move the cursor to a position on the screen by pointing the pen to the desired position and actuating a touch-sensitive switch on the pen. Then the terminal can transmit a series of bytes which define the cursor location and the screen display at that location.

The terminal has two additional serial ports. In the standard unit, the keyboard uses the receive portion of one of them. A serial type printer can use the the transmit portion. The second or auxiliary serial port is both input and output.

The terminal also can communicate by data in parallel as eight-bit words at a parallel port, available as two options. One option provides for use of the parallel port as a transmit-only port for a Centronics-type printer. The other option provides for its use for both send and receive for two-way communication with a computer or other device. The two options are mutually exclusive.

Section III of this manual describes the use of binary code words for sending instructions and information to the 8810, 3810, 3860 and 3881 Terminals and the medium resolution versions of these units.

The 3800 Series units operate in the same manner as the 8810. The have a smaller CRT (14" or 13" bezel diagonal), have different analog circuitry and are housed in different enclosures. The 3810 has an ergonomic cabinet of contemporary design, with adjustable tilt. The 3860 and 3881 are designed for mounting in a standard 19" rack.

Specifications

Operating Conditions

Power	103-127 volts, 50/60 Hz., 150 watts (By transformer tap selection, 93-147 VAC) (Optionally 190-250 volts, 50/60 Hz.)
Temperature	$0^{\circ}C$ to $+40^{\circ}C$ operating $-30^{\circ}C$ to $+70^{\circ}C$ for storage only
Humidity	10% to 95% non-condensing
Altitude	Sea level to 10,000 feet operating Sea level to 40,000 feet storage

Physical Dimensions

	Console	Keyboard
Height	17.5"	2.75"
Width	19.5"	18.75"
Depth	22.5"	7"
Weight	100 lbs.	5.5 lbs.
	Shipping 126 lbs. total	

19" diagonal preconverged, high-contrast CRT,
with auto-degaussing at power-up
186 square inch total screen area

Screen tilt fixed at viewing angle of 7 degrees
off vertical

All metal enclosure with quarter-turn fasteners
for top and rear covers.

Display

Size

Width	13"	Aspect ratio
Height	10"	approximately
Area	130 sq. in.	4 x 3

Color

Eight Foreground Colors and eight background colors -- Red, Green, Blue, Magenta, Cyan, Yellow, White and Black -- selectable on character cell basis, Standard

Format

80 Characters per Line
48 Lines per Page (or 24 Lines of 2X Characters)

Characters

64 upper case ASCII Characters, 5x7 dot matrix within a 6x8 dot pattern (or double-height 5x14 in a 6x16 pattern), Standard

Selectable 64-character set with 32 lowercase ASCII and 32 control representation characters, or 64 Special Process characters, or 64 Line Drawing characters, Standard

Up to four additonal selectable 64-character sets, optionally available.

Total characters available for use at a given time not to exceed 128, including 64 ASCII

Selectable character blink and/or double-height, Standard

Graphics

Graphic capability for point plotting on a 160 x 192 grid, generation of bar graphs and vectors and incremental plot modes, Standard

Cursor

White blinking underscore

Input/Output

Serial

Receive-only serial keyboard port for RS-232-C level signals, Standard

Host interface RS-232-C compatible with full modem controls, ten selectable Baud rates from 110 to 38,400 with one or two stop bits, 7 or 8 data bits, selectable parity or none, Standard

Selectable software handshake Intecolor 8001, ANSI XON/XOFF or none, Standard

Additional higher speed rate of 76,800 Baud, optionally available

20/60 mA current loop for Host Serial Port, optionally available

Auxiliary RS-232-C compatible serial port with full modem controls, Baud rates to 9600, selectable parity or none, Standard

Transmit-only serial printer port with RS-232-C level signals and Clear to Send, Standard

Color printer driver (for characters and standard resolution graphics), Standard

Parallel   8-bit parallel transmit-only for Centronics compatible printer, optionally available

8-bit parallel I/O port, for high speed full duplex communication with host or other device, optionally available

The parallel port options are mutually exclusive

Microprocessor   5.5 MHz Z80B

Memory

Screen Refresh   8K x 8, Standard

Additional pages of screen memory (for total of two or four), optionally available

Program ROM   24K x 8, Standard

One other socket available for optional ROM

Set-up EEPROM   2K x 8 non-volatile memory for retention of selectable set-up characteristics, Standard

Other RAM   2K x 8 static RAM for use as buffer, Standard

One additional socket for added 2K x 8 or 8K x 8 static RAM. One of ROM sockets configurable for static RAM, 8K x 8 only

Keyboard

Type   101 gold crossbar commercial key switches

Options include increment to 117 keys or decrement to 72 keys or deletion of keyboard

Keyboard serial interface adapter includes
                    microprocessor for transmitting data to console
                    in serial form at 1200 Baud, TTL levels

Features   101-key keyboard includes Cursor controls, CPU
                    Reset, Color select, Erase line/page, Blink, a
                    Color/Command cluster, a Numeric pad and
                    Insert/Delete Character/Line keys

Programmable Features

    Initial Character Set   Flow Control
    Line/Local   Line Monitor
    Echo   CRT Saver
    Audible keyclick
    Host, Auxiliary and Serial Printer baud rates, stop bits, parity

Certifications

    FCC Class A, UL 478
    CSA C22.2 No. 154-1983 pending

*** The 8820 Terminal ***

The 8820 Intecolor Terminal includes all of the features of the 8810
Terminal. It includes in addition dot addressable color graphics in a 480
x 384 grid. There is a separate screen memory for the bit-mapped graphics.
The higher resolution display and the standard resolution display overlay
each other. They can be displayed separately or together. Either can be
changed without affecting the other.

The circuits for the dot addressable graphics are contained on a single
plug-in module. This board is mounted in the card frame adjacent to the
Logic Module. Its power is provided by the Analog Module via the Card
Frame Motherboard.

    Operating Conditions: As for the 8810, except power 200 watts

    Physical Dimensions: As for the 8810, except 3 pounds heavier

    Display: All features listed for the 8810 Terminal plus a higher
               resolution display overlaying the standard display.

               Each dot in the 480 x 384 grid individually addressable
               as to location and color. Choice of eight colors
               including black, white, red, green, blue, yellow,
               magenta and cyan.

Commands for point plot, relative point plot, vectors, relative vectors, concatenated vectors, rectangles, circles and arcs.

Super pixel in 4x4 matrix definable in any of 96 hues, 16 levels of saturation and 16 levels of intensity. Commands for generation of bars of super pixels.

Commands for definition of line style, fill patterns and for change of color displayed.

Input/Output: Input commands may be entered from the keyboard or via the Logic Module I/O ports.

Host I/O rates to 38,400 Baud, Standard. (Note: The 76.8K Baud option is not available for the 8820.)

Normal output is a set of three video signals to the Video Driver Module. The standard video signals and the medium resolution video signals are ORred in the Graphics Module.

Content of screen memory can be read by the Logic Module's CPU.

Microprocessor: 5.5 MHz Z80B

Memory: Three screen refresh memory planes for medium resolution display, providing three bits of information for each video dot, used as address bits to the color palette which outputs the three color video signals.

One page of medium resolution display, Standard. Four pages of medium resolution display optionally available.

Each dynamic RAM plane is 16K x 16 (64K x 16 when there are four pages of display).

RAM refresh is provided by address pattern used in the read sequence for display.

Access to memory by CPU and display generator on time-shared basis. The CPU has access for read or write during alternate half-microsecond periods.

Program ROM is 32K x 8.

1.11

*** The 3810 Terminal ***

The specifications for the 3810 Terminal are similar to those for the 8810 Terminal. It uses the same keyboard as the 8810. Differences are noted below.

Input Power	105 watts
Dimensions	Console Height 15" Width 15.25" Depth 17"
Weight	Console 34 lbs. Keyboard 5.5 lbs. Total shipping weight 60 lbs.
Screen	14" diagonal preconverged, high-contrast, high-resolution CRT, built-in degaussing with manually operated switch.
Display	9.5" wide by 7.25" high

The enclosure is contemporary style plastic with adjustable tilt. Screen tilt is adjustable from zero to 15 degrees off vertical.

Certifications FCC Class A, UL 478,
CSA C22.2 No. 154-1983 (pending)
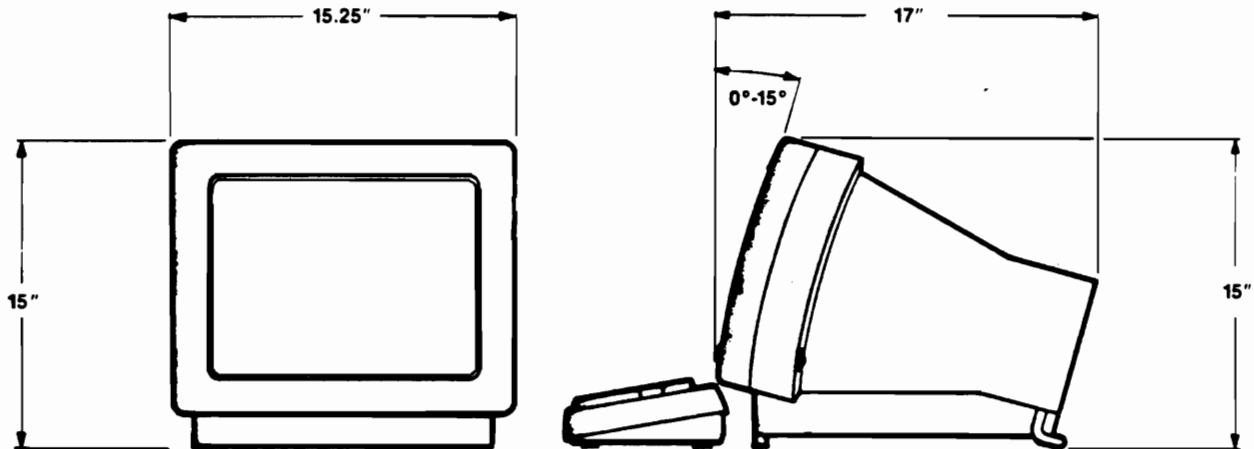
*** The 3820 Terminal ***

The 3820 Terminal has medium resolution graphics capability in addition to the features of the 3810. Exterior dimensions remain the same. Console weight is increased approximately 3 lbs. Power consumption increases some 50 watts.

The specifications for the 3860 Terminal are similar to those for the 3810 Terminal except for the physical arrangements. The 3860 has an all metal enclosure with a 19" rack-mountable front panel. Screen tilt is fixed at zero degrees off vertical. The bezel opening for the CRT is 13" diagonal. The CRT is high-contrast, high-resolution, with built-in degaussing. Total power consumption is 110 watts. The size is 14" high, 15" wide (16.5" when side rails are included and the front panel is 19" wide), 15.5" deep. Weight is approximately 40 lbs. FCC Class A certification.

The sketches below indicate the overall space requirements rather than the exact shape of the enclosure.
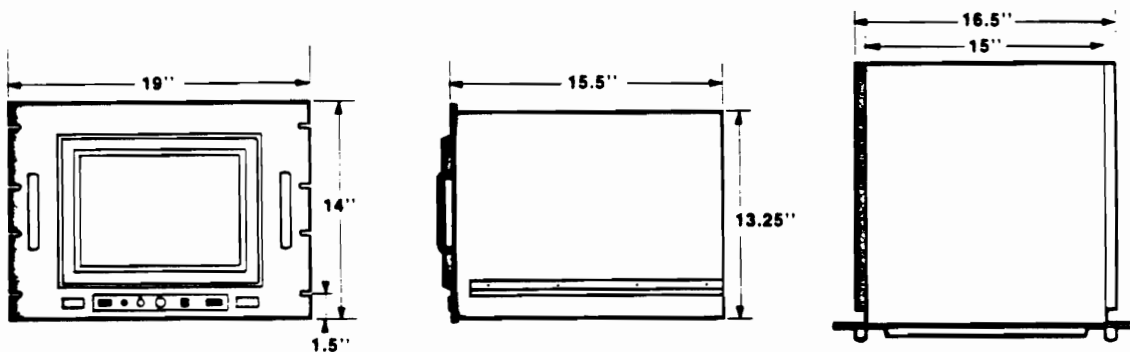
*** The 3881 Terminal ***

The 3881 Terminal is an earlier rack-mountable version of the 3810 Terminal. Its vertical panel space requirement is 14", the same as for the 3860 above. Behind the panel it was 17" wide and 17" deep.

SECTION II

INSTALLATION

II. INSTALLATION

General Considerations

Intecolor terminals in the 8800/3800 Series, other than the rack mount versions, are intended for use on a desk or table or any similar vibration-free horizontal surface that is free from dust and lint. A desk space 20 inches wide by 30 inches deep is adequate if there are two or three inches of space behind the desk for cables. Allow for 18 inches in height. The specifications in Section I list the exterior dimensions.

The 3860 and 3881 terminals are designed for mounting in a standard 19" rack. The panel height is 14". Depth requirement is 15.5" to 17", plus another two inches for mating connectors and cables. (The brightness control, power switch and a socket for the keyboard cable are on the front panel.)

The terminal may be used under normal room lighting conditions, but direct sunlight and excessively bright room lighting should be avoided (as would be the case for a color television set). It may be installed adjacent to most types of electrical and electronic equipment, provided that it is not located within a strong magnetic field. (Operation within a strong magnetic field may affect the quality of the display.)

While no special cooling provisions need be made for the terminal, there must be free flow of air around the console. Except for connections to other devices, the only external connections from the console are the flexible cable to the keyboard and the 6 1/2 foot 3-wire power cord to a source of 115 VAC power (or 220 VAC if the options for this voltage are present). The power requirement is no more than 250 watts, somewhat less in the standard resolution 8810, and no more than 160 watts for 3800 series units.

Other devices should not be connected to the unit until proper operation of the 8800 or 3800 Series Terminal has been verified.

Unpacking and Visual Inspection

The shipping package contains the console, the detachable keyboard with its connecting cable, the 3-wire power cord and this user's manual. Please report any evidence of shipping damage to the transportation company, filing a claim if appropriate. If any problems are encountered in initial test, please contact the Intecolor Technical Support group.

Prior to applying power to a new 8800 Series terminal it is good to make a visual inspection of the interior of the unit to verify that nothing has been dislodged by unusually severe shocks sometimes encountered in shipment.

At the rear of the 8800-Series unit, use a #2 Phillips screwdriver to loosen two screws holding the rear cover in place. (Note: Early production units require a hex-head tool rather than a #2 Phillips.) Tilt the lower edge of the cover out slightly and remove the rear cover downward.

(Note the shape of the internal part of the quick-release screws. The flat part must be horizontal when the cover is replaced. To lock the cover in place, rather than turning the screw, simply press the screw until a locking "click" is felt or heard.)

In the interior of the unit, note the items listed below.

1) In the 8800-Series terminals the circuit card(s) should be secure in the card cage on the left side. The card slots, from left to right, may hold cards as follows. (The cards actually present depend upon the configuration ordered):

> #1 -
> #2 -
> #3 - Medium Resolution Graphics card in 8820
> #4 - Logic Module

2) The Video Driver board, mounted by its included CRT socket, should be secure on the back of the CRT (the picture tube).

3) All cable sockets should appear securely in place.

4) All components should appear securely in place.

The cover(s) should be replaced before applying power to the unit (unless the person performing the work is trained and qualified and thus aware of the hazards present when the unit is operated with the covers off).

Turn-on and Initial Test

Your Intecolor unit was completely aligned and adjusted at the factory. Following shipment, minor adjustment touch-up and/or degaussing sometimes may be needed. The brief tests outlined in the following paragraphs will indicate whether these procedures, described in Section IV of this manual, are necessary. (Allow at least 30 minutes warm-up before attempting any readjustment.)

Place the console in position on a desk or table. The keyboard normally is placed just in front of the console. However, the keyboard may be located elsewhere within cable reach if more convenient. Connect the keyboard cable to the Keyboard socket (J1) on the Logic Module rear panel (or front panel of a rack mounted unit).

Verify that the power switch is in the off position. The "o" edge of the switch should be depressed. (The power switch is on the rear panel of the 8800 Series units, on the left side in the 3810 or 3820, on the front of the rack mounted units. In early 8800 Series units, the lower edge of the white switch at the rear should be depressed.)

Insert the power cord in its socket on the rear panel and then connect to a source of 115 VAC 60 Hz. power (or other type of power source if the options for 220 volts and/or 50 Hz. are installed in the unit).

After the unit has been connected to a source of power (and prior to connecting it to other devices), operate the power switch to the on position -- depress the "1" edge (or upper edge in early 8800). The unit goes through a series of self-test procedures at power-up. These usually are completed before the CRT completes warm-up. No results are seen unless an error is found. The initial display usually seen in the upper left corner is, in green, yellow, magenta and cyan single height characters:

                    INTECOLOR 8810 Vx.y

The characters actually seen instead of x and y indicate the vintage of the system software. They may vary and should be noted for future reference.

Hold down a SHIFT key and operate the SETUP key to examine the Set-up Mode. If the Local/Line Mode is shown as On Line, change the mode of operation to Local by operating the HOME key. Then operate RETURN. (Note: Section III describes the Set-up Mode and contains information regarding the error codes.)

For check of purity and of display size, select the background color red:

   1. Operate the BG ON key. (To enable background color selection.)

   2. Operate the red key in the color cluster at the left side of the keyboard. (On a 72-key keyboard, hold the CONTROL key operated while operating the Q key.) (This designates the background color as red.)

   3. Operate the ERASE PAGE key. (This causes all foreground color to be erased and the entire raster appears in the background color.)

The display area in the selected color should be approximately:

   10 inches high by 13 inches wide in the 8800-Series
   7.25 inches high by 9.5 inches wide in the 3800-Series

The edges of the display should appear reasonably straight. The color should be fairly uniform over the entire display area. Lack of color uniformity indicates a need for degaussing. (Substantial bowing of the raster sides indicates a need for pincushion adjustment. See Section IV for degaussing, display size adjustment and pincushion adjustment.)

To verify convergence, use a full-screen display of white letters against a black background:

   1. Operate the BG ON key. (To enable background color selection.)

   2. Operate the black dot key in the color cluster (or the P key with the CONTROL key held down). (To designate black as the background color.)

   3. Operate the FG ON key. (To enable foreground color selection.)

   4. Operate the white dot key in the color cluster (or the W key with the CONTROL key held down). (To designate white as the color for foreground.)

5. Select double height characters by operating the 2X CHAR ON key.

6. Operate the ALPHA LOCK to the down position. (To cause alpha characters to be in uppercase -- this key does not affect other characters.)

7. In sequence, one after the other, operate the ESC, the Y and the L keys. (The ESC Y sequence results in a full-screen display of the next character whose key is depressed.)

In the full-screen display of double-height white L characters, any red, blue or green edges on the letters should be minimal. Rows and columns should appear straight and linear. (Substantial bowing indicates a need for pincushion adjustment. Appreciable non-linearity is unusual in a new unit and would require adjustment. Lack of convergence of red, blue and green could indicate a need for degaussing. See manual Section IV.)

Operation via the serial I/O port can be verified by typing in the Line Mode with Echo Off. Terminals 2 and 3 of the Host Serial I/O Port J2 must be connected by a shorting plug for the test.

Go to the SET-UP Mode (see page 3.06) to change to Line with Echo Off. Then operate the RETURN key. Typed keyboard inputs now go to the serial output port (J2, pin 2) and return via the jumper to the serial input port (pin 3) for display on the screen.

With the shorting plug removed, operation of the alpha-numeric keys will not result in display.

Return to the SET-UP Mode to select and save the desired modes to be used in operation. Then power down by depressing the "o" edge of the power switch (or lower edge in the earlier 8800 unit).

Interconnections

For connections to a modem or other device, the user provides the necessary cabling and any required interface device. For an RS-232-C compatible modem, the terminals on the 25-pin connectors J2 and J3 at the console rear are shown in the table on the next page. (The Auxiliary Serial I/O Port J3 is an optional feature.) The usual modem connections are indicated; however, the modem manufacturer's instructions should be consulted.

The length of the cable between the Intecolor Host or optional Auxiliary I/O socket (J2 or J3) on the console rear panel and the device to be connected should not exceed 50 feet. (The current loop option is recomended for longer distances.)

For direct connection to the host computer (instead of through modems), Transmit and Receive data line connections likely must be reversed somewhere in the cable. (The host computer's Receive will be the Intecolor's Transmit; the host computer's Transmit will be the Intecolor's Receive.) Likewise, the modem control wiring, if used, also may require reversals.

For communication via the 20 mA current loop instead of by way of the RS-232-C port, connector J2 is used. The table at the bottom of this page lists the connections for the cable.

A cable for connection of an RS-232-C compatible device to the optional Auxiliary Serial I/O Port J3 is wired exactly the same as listed for the RS-232-C compatible connection to J2. However, there is no provision for use of the Auxiliary Serial I/O Port with current loop.

RS-232-C INTERFACE J2 or J3

Term. No.	Signal	Comments
1	AA – Protective Ground	Connects to chassis ground and to terminal 7.
2	BA – Transmitted Data	From Intecolor to DCE[*] "1" = Mark = -V "0" = Space = +V
3	BB – Received Data	From DCE[*] to Intecolor "1" = Mark = -V "0" = Space = +V
4	CA – Request to Send	Conditions the DCE[*] for transmission.
5	CB – Clear to Send	Indicates DCE[*] ready.
7	AB – Signal Ground	Connects to terminal 1.
8	CF – Data Carrier Detect	Input from DCE[*].
20	CD – Data Terminal Ready	From Intecolor to DCE[*] to signal that Intecolor is ready.

DCE[*] = Modem or other Data Communication Equipment

Current Loop Interface J2

Term. No.	Signal
11	Receive +
18	Receive -
21	Transmit +
25	Transmit -
9	+12 VDC
10	-12 VDC

Several configurations of the current loop interface are possible. Two of these are illustrated in Appendix A of this manual.

Connections to terminal 9 or 10 are used when the 8810 or 3810 Terminal sources the current for the loop(s). (Jumper W2 and/or W19 also would be involved in a few early production units.)

When using the asynchronous serial RS-232-C I/O port J2 (or the serial current loop I/O, if that option is installed), the following information may be of interest.

The Intecolor 8800/3800 Series unit is furnished with a crystal clock and provides, in the Setup Mode, a keyboard selectable baud rate of 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19,200 or 38,400 Baud. A higher speed option makes 76,800 Baud available.

The terminal has a 628-byte serial input buffer. (The higher speed options involve a larger buffer.) When this buffer goes from less than 50% full to more than 50% full, the terminal sends an 07 code. When the input buffer goes from more than 50% full to less than 25% full, an 06 code is sent. Codes for this purpose can be changed to 13 (DC3 for XOFF) and 11 Hex (DC1 for XON) in SET-UP.

A serial-type printer may be connected to the Intecolor 8810 or 3810 at the optional Serial Output J4.

Serial Output Port J4

Term. No.	Signal
1	Protective Ground
2	Serial Transmit — RS-232-C level
5	Clear to Send from printer
7	Signal Ground
20	4.7K ohms to +12 VDC

For interconnection with the optional 8-bit Parallel Port J5, the connector wiring depends upon which option is present.

    The optional parallel printer output port uses a 25-pin connector.
    The optional bi-directional parallel I/O port connector has 34-pins.

The table on the next page shows the terminal numbers for both the 25-pin and the 34-pin connectors.

Parallel Port J5

25-pin Term. No.	34-pin Term. No.	Signal
NC	1	Strobe from external device
NC	3	Busy to external device
1	5	Strobe to external device
2	8	Output data bit 0
3	10	1
4	12	2
5	14	3
6	16	4
7	18	5
8	20	6
9	22	Output data bit 7
11	26	Busy from external device
12	NC	PE from external device
13	NC	Select from external device
NC	34	Input data bit 0
NC	32	1
NC	30	2
NC	28	3
NC	27	4
NC	29	5
NC	31	6
NC	33	Input data bit 7
18 through 25	2,4,6,9,11,13,15, 17,19,21,23,24,25	Ground

SECTION III

OPERATION

III. OPERATION

Introduction

The 8810 Terminal and others in the 8800/3800 Series have the operating features of the Intecolor F8001G Terminal. They have, in addition, several ANSI X3.64 standard sequences. Further, a number of parameters for initialization at power-up can be set by the user.

At power-up the terminal executes a series of self-test procedures. If no errors are found -- the usual case -- the self test will be completed before the CRT warm-up is complete. The operator would hardly be aware that a self-test sequence has been executed. If there is an error, the result depends upon the type of error -- more on that after a discussion of the keyboard.

References to the 8810 apply also to other units in the 8800/3800 Series.

The Keyboard

The Intecolor keyboard is similar to a typewriter keyboard in many respects. However, there are some differences and many keys serve more than one function.

SETUP   Unshifted: When operated without SHIFT, the SETUP key unlocks the keyboard if locked. It also interrupts and terminates any self-test in progress.

                           Shifted: When operated with a SHIFT key held down, the SETUP key provides entry to the Set-Up Mode. The shifted SETUP key also effects exit from the Set-Up Mode from any level of the Set-Up procedure. (Use of the RETURN key effects exit from the current Set-Up level to the next higher level.)

                           This key never transmits codes to the host.

SHIFT   There are two SHIFT keys. One of these must be held down while the selected alphanumeric key is operated if a shifted function is desired. Note that the SHIFT key does not lock in the down position.

                           When a terminal is operated with the ALPHA LOCK key in the down position, special characters are generated by holding the SHIFT key down while operating the desired alpha or symbol keys. To generate the special characters obtained by operation of certain symbol keys, the SHIFT key must be down regardless of the position of the ALPHA LOCK key.

ALPHA LOCK   This key affects only the alpha keys A through Z. When it
              is operated to the down position, operation of the alpha
              keys will result in upper case characters. When it is
              released to the up position, operation of the alpha keys
              will result in special characters or in lower case ASCII
              characters, depending upon the character set selected. Use
              of the SHIFT key when the ALPHA LOCK key is down negates the
              effect of the ALPHA LOCK key. Operation of the SHIFT key
              does not release the ALPHA LOCK key.

CONTROL   This key must be held down while operating the selected
              alpha, symbol or numeric key to generate a desired control
              code.   The control functions are listed and described later
              in this section.

ESC   Operation of this key initiates generation of standard
              escape codes. The ESC key is depressed and released and
              then the alpha or symbol key for the desired escape code is
              depressed and released. Escape codes also are listed and
              described later in this section.

COMMAND   This key makes easier the generation of codes requiring the
              operation of both the CONTROL key and a SHIFT key in
              combination with another key. Pressing the COMMAND key
              yields the same result as pressing both the CONTROL and
              SHIFT keys at the same time.

Cursor Control These keys generate codes to move the cursor in the
              direction indicated by the arrow on the key top. Cursor
              movement repeats in the indicated direction while an arrow
              key is held down. There is a brief pause before repeat.

              When the cursor is at the right end of a line, operation of
              the Cursor Right key moves the cursor to the left end of the
              next line down. When the cursor is at the right end of the
              bottom line, operation of the Cursor Right key will, in page
              mode, move the cursor to the top left corner of the screen;
              in scroll mode it will cause the page to scroll upward two
              lines and the cursor will be at the left end of the next to
              bottom line. If the cursor is on the bottom line, pressing
              of the Cursor Down key will, in page mode, move the cursor
              to the upper left corner of the screen; in scroll mode it
              will cause the page to scroll upward two lines and the
              cursor moves to the left end of the next to bottom line.

              The HOME key moves the cursor to the home position at the
              upper left corner of the screen.

TAB   Operation of this key moves the cursor to the right to the
              next character position divisible by eight (or to the start
              of another line in case of line overrun).

2X CHAR ON   Operation of this key initiates generation of double-height
              characters. (The A7 bit of the character word in screen
              memory is set on.)

BLINK ON   Operation of this key causes foreground blink to background
              color in display generated after operation of the key.

2X/BL OFF   Operation of this key negates the effect of both the 2X CHAR
              ON and the BLINK ON operations. (So if one wishes to cancel
              blink but maintain double-height characters, it is necessary
              to operate the 2X CHAR ON key again after operating the
              2X/BL OFF key.)

FG ON   Operation of the FG ON key, followed by operation of by
              operation of a color key in the color pad (or the required
              alpha key with CONTROL down) results in selection of
              foreground color for display created subsequently.

BG ON   Operation of the BG ON key allows selection of the
              background color for subsequent display in similar fashion.

              Note that operation of the BG ON key sets a flag which
              remains set until reset by operation of the FG ON key. This
              flag also is involved in character set selection.

Color Pad   Operation of one of the eight color keys combines the
              effects of CONTROL down with alpha key operation for color
              selection.

Number Pad   Most of the keys in the number simply duplicate, in a
              different physical layout, the functions of other keys.
              However, the Multiplication, Add and Equal keys combine the
              effects of a key strike with SHIFT.

REPT   When a character key is held down, the character will be
              repeated while the REPEAT key is held down.

ERASE LINE   Operation of this key affects the line on which the cursor
              is located. The line is erased to the background color and
              the cursor is moved to the left end of the line.

ERASE PAGE   Operation of this key erases the page of display to the
              background color. The cursor is moved to the home position
              at the upper left corner of the screen.

INSERT CHAR   Operation of this key, followed by the operation of a
                character key, causes a character to be inserted at the
                position defined by the cursor. Characters to the right on
                the same line are moved one character position to the right.
                The character at the last position on the line is lost. The
                cursor moves one character position to the right.

DELETE CHAR   After the Insert/Delete Character mode has been entered by
                operation of the INSERT CHAR key, operation of the DELETE
                CHAR key results in deletion of the character at the
                position defined by the cursor. Characters to the right on
                the same line are moved one character position to the left.
                The last character position on the line becomes a space.
                The cursor does not move.

DELETE LINE   When this key is operated, the cursor moves to the beginning
                of the line it is on. The line then is deleted. Lines
                below on the page are moved up one line. A new line is
                created at the bottom of the page.

INSERT LINE   When this key is operated, the cursor moves to the beginning
                of the line it is on. The line itself, and all lines below
                it on the page, are moved down one line. The cursor remains
                at the beginning of the newly created line. The original
                last line on the page is lost.

Function Keys   Keys F0-F15 are present in the optional 117-key keyboard.
                They are used for easy entry to plot submodes.

AUTO   This key is not used in the standard 8810 terminal.

Power-up and Self Test

The power switch is located on the console rear panel. Depress the upper
edge of the switch to apply power to the unit. (The power switch is on the
left side in the 3810/3820, on the front panel in the 3800 Series rack
mounted units. Depress the "1" edge for power on.)

The self test procedure is invoked automatically at power-up. (It also can
be invoked from the keyboard — procedure to be described later.) Certain
operations of parts of the digital circuitry are checked:

                Internal memory
                Nonvolatile memory
                Video (screen) memory
                Data communications interface

One of several possible events, as described on the next page, will
follow.

If the test is invoked for one cycle and there are no problems, the test will conclude and the terminal will become ready for use.

If there are no hardware problems, but the test finds invalid data in the nonvolatile memory, the terminal will enter the SET-UP mode. The factory default options for all set-up features will be set. If other options for the set-up features are desired, they can be set at this time. In either case -- default options or saved selected options -- the terminal is ready for use after exit from the SET-UP mode. (If this particular problem exists every time the unit is powered up, the nonvolatile memory is not retaining the stored data.)

If the self test is invoked from the keyboard in the SETUP Mode, the self test program will repeat until it finds an error, until terminated by operation of the unshifted SETUP key, or until the unit power is turned off (or there is a power interruption of sufficient duration to cause PFL and terminal reset).

The self test program may find an error. The result in this case depends upon the type of error.

Self Test Error Codes

If the self test routines detect an error, the terminal will enter an ERROR mode to display an error code -- provided enough of the system is operating correctly to allow such a display. The terminal will not communicate with the host computer.

Error	Code Displayed
Read-Only Memory	ROM
Set-up Memory	NONV
Screen Memory	SCRN
Host I/O	HOST
Keyboard/Printer	KEYB

If an error in the Set-up Memory is indicated, the operator usually can use the SET-UP procedure (to be described shortly) to select the desired values for initialization and proceed. Errors in other areas usually require analysis and correction of hardware faults. Appendix D of this manual provides additional information regarding the self test routines.

First, let's assume the usual no-error condition at turn-on. The initial display, in red, yellow, magenta and cyan normal height characters, is:

INTECOLOR 8810 Vx.y

or similar, where the variable "x.y" indicates the version of software in the terminal. The SET-UP selections now may be examined.

Three SETUP Menus are used in a terminal with V1.7 software (for earlier software, see Appendix C):

The HOST I/O MENU is invoked by use of the SETUP key with SHIFT.

With the HOST I/O MENU displayed, one selection is OPERATOR PREFERENCE MENU. This menu has a selection for return to the HOST I/O MENU.

With the HOST I/O MENU displayed, a HARDWARE CONFIGURATION menu can be invoked (entry described later). One selection in this menu is RETURN TO THE HOST I/O MENU.

The factory default menu for a new standard 8810, invoked by use of the SETUP key with SHIFT, is similar to that shown below.

	Local/Line	On line
	Echo	Off
	Flow Control	^S^Q
H	Backspace Code	^H
O	Protect	Disable
S	Data Rate	9600
T	Stop Bits	1 Stop Bit
	Parity	8 bits, none
I		
/	OTHER MENU	OPERATOR PREFERENCE MENU
O		
M		
E		Special Selections
N		1. SAVE current setup menu.
		2. RECALL old setup menu.
U		3. Recall FACTORY Default Setup Menu.
		4. Recall '8001G' Default Setup Menu.
		5. EXIT through Self Tests.

```
| Arrow Keys    select an item |
| Return        ends Setup Mode |
```

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The terminal designation in the last line depends upon the type of terminal — 3810 (shown for 3810 or 3860), 3820, 8810, 8820.

The above Host I/O Menu shows the factory defaults for the standard 8810. If the "4" key is operated to obtain the '8001G' defaults, only Flow Control and Backspace Code change.

	8001G	FACTORY
Flow Control	^F^G	^S^Q
Backspace Code	^Z	^H

Changes in the selections are made by using the up or down arrow keys to move the cursor to the desired item. Then the HOME or right arrow key will increment the selection. The left arrow key will decrement the selection. (The Data Rate and Parity items each have several selections, so the use of the left or right arrow keys make selection easier.)

Data Rate choices for the standard 8810 with V1.7 or later software are:

110	300	1200	4800	19200
150	600	2400	9600	38400

Parity choices are quite numerous:

8 bits, none	7 bits, none	7 bits, low
8 bits, odd	7 bits, odd	7 bits, high
8 bits, even	7 bits, even	
8 bits, odd, ignore	7 bits, odd, ignore	
8 bits, even, ignore	7 bits, even, ignore	

Where the choice includes "ignore", codes are transmitted by the terminal with parity as indicated. For received codes the incoming parity bit is accepted but not tested.

If changes are made in the selections, the new Host I/O Menu can be saved in memory by operation of the "1" key. (Operator Preference Menu and Hardware Configuration are not affected.) The new Host I/O setup will then be effective at next power-up. (The terminal initializes at power-up in accordance with the last setup menu saved.)

If changes are made and then one wishes to get back to the customized menu prior to these changes (and before the latest changes have been saved), operation of the "2" key will recall the last setup menu saved.

Operation of the "3" key recalls the factory default setup menu for the 8800/3800 series terminals. Operation of the "4" key recalls the factory default menu for the 8001G terminal.

If the "5" key is operated the self test routine is invoked. The self test can be terminated by operation of the SETUP key without shift. (The terminal is initialized in accordance with the last SETUP menu selections — which may not be the last selections "saved".)

The SETUP mode — when in any of the three menus — can be exited by operation of the SETUP key with SHIFT or by pressing the RETURN key.

With the Host I/O Menu displayed, the Operator Preference Menu is accessed by moving the cursor to that item and then operating the HOME or right or left arrow key. Factory defaults for the 8810 terminal are shown below.

```
O
P       Keyclick              On
E       Scroll Mode           scroll
R       CRT Saver             On
A       Line Monitor          Off
T       Character Set         lower case
O       Aux Port Data Rate    9600
R       Stop Bits             1 Stop Bit
        Parity                8 bits, none
P       Light Pen             Disable
R
E       OTHER MENU            HOST I/O MENU
F
E
R              Special Selections
E
N       1. SAVE current setup menu.
C       2. RECALL old setup menu.
E       3. Recall FACTORY Default Setup Menu.
        4. Recall '8001G' Default Setup Menu.
M       5. EXIT through Self Tests.
E
N       _____
U       | Arrow Keys      select an item  |
        | Return          ends Setup Mode |
        _____
```

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Operation of the "4" key will change the selections to the '8001G' factory defaults. The items that are different are:

```
        Keyclick              Off
        Scroll Mode           page
        CRT Saver             Off
        Character Set         Process
```

Auxiliary Port Data Rate choices are:

```
        110     150     300     600
        1200    2400    4800    9600
```

Stop Bits and Parity choices are the same as those for the Host I/O Menu — one or two stop bits and several 7-bit and 8-bit parity choices, including 'none' and 'ignore'.

If the Light Pen selection is changed to Enable, blue strike-through lines appear at the blink rate — two of the eight scan lines in each character row blink to blue.

With the Host I/O Menu displayed, the Hardware Configuration menu is invoked by typing in the three lowercase characters i, s and c.

```
                    RETURN TO THE          HOST I/O MENU

H
A           Line Lock              Enable
R
D           CRT Size               8800
W
A           Keyboard               101 Key Keyboard
R
E           Light Pen X Offset         3
                      Y Offset         2

C
O
N                    Special Selections
F
I           1. SAVE current setup menu.
G           2. RECALL old setup menu.
U           3. Recall 8800 Default Setup Menu.
R           4. Recall 3800 Default Setup Menu.
A           5. EXIT through Self Tests.
T
I           _____
O           | Arrow Keys      select an item  |
N           | Return          ends Setup Mode |
            _____


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```

The 8800 defaults are shown above. Use of Special Selection 4 changes the CRT Size to 3800 and Line Lock to Disable. (See Line-Lock Notes, page 9.)

Some selections in the Hardware Configuration menu — Line Lock and CRT Size -- are not effective immediately. If saved, they become effective at the next power-up.

The effect of Keyboard choices — 72 Key, 101 Key and 117 Key — will be discussed in connection with code generation from the keyboard. The Keyboard selection is effective during the current power-up,

Light Pen Offset selections are used to cause the cursor to move to the indicated position when the light pen is used — the exact timing varies a bit in the various terminal models.

Operation of the "1" key results in display of a question in red:

        Are you certain that this menu must be saved?

If Y (uppercase or lowercase) is typed, the Hardware Configuration menu is saved in memory for use in initialization at the next power-up. The question in red is replaced by a statement in yellow:

This menu has been saved.

If any character other than Y is entered, the question in red remains and the menu is not saved.

Saving the Hardware Configuration menu does not affect the Host I/O Menu or Operator Preference Menu — these must be saved separately.

Return to the Host I/O Menu is effected by use of the up or down arrow keys to place the cursor over the RETURN TO THE HOST I/O MENU selection and then operating the HOME or right or left arrow key.

The SETUP mode may be exited directly by operation of the SETUP key with SHIFT or by pressing the RETURN key.

Points to remember regarding the SETUP menus:

For a customized initialization of the terminal, each of the three menus must be saved separately. SAVE (Special Selection 1) affects only the menu displayed at the time.

At power-up the terminal initializes in accordance with the last SETUP choices saved.

(Certain Hardware Configuration selections, such as Line Lock and CRT Size, may not have been effective during the current power-up. However, if saved, they do become effective at the next power-up. And if the selections were erroneous, problems may result. Hardware Configuration selections should be made with care.)

RECALL (Special Selection 2) brings up the last menu saved. An 'old Menu' is lost when a later menu is saved.

The FACTORY defaults are always available for implementation via the designated 'Special Selection'.

The SETUP mode can be exited by operation of the SETUP key with SHIFT or by pressing the RETURN key — no matter which menu is on display.

The SETUP mode does not have a selection for Printer Serial Port Baud rate. This presently is fixed at 9600 Baud, one stop bit, no parity.

Software versions preceding V1.6 had a single Set-Up menu offering fewer choices. See Appendix E.

The Initialized State

Following power-up and the associated self-tests, the terminal is in its initialized state. Options listed in the SET-UP menu are as last set. Certain other items in the standard unit are as listed below.

A.	Visible foreground	White
B.	Visible background color	Black
C.	Reverse field flag	"0" (lower case for alpha keys enabled unless ALPHA LOCK key is in down position)
D.	Visible A7 bit	"0" (single height chararacters)
E.	Plot bit	"0"
F.	Operation	Scroll Mode
G.	Write mode	Left to right, visible cursor
H.	Blind foreground color	Red
I.	Blind background color	Black
J.	Blind A7 bit	"0"
K.	Blind plot bit	"0"
L.	Blind cursor	Home (top left corner of screen)

The visible cursor is in the first character position of the line below the one-line display. The unit is now ready to accept commands from the keyboard and/or from the Host Serial input, depending upon the settings of Local/On-Line and Echo in the SETUP menu. If a cleared screen is desired, operation of the ERASE PAGE key will clear the screen and move the cursor to the "home" position at the upper left corner of the screen (if in Local or if Echo is ON in On-Line).

Control, Escape, Plot and ANSI X3.64 Codes

Display commands can be entered through the keyboard and/or the Host Serial I/O Port, depending upon the SET-UP menu selections. These may take the form of Control, Escape and Plot codes as well as the codes for ASCII and special characters. A number of ANSI X3.64 standard sequences also may be used.

The commands are entered in serial form. The hexadecimal, binary and decimal values of the 8-bit codes are listed in Appendix A-3.

In many cases data, in the form of binary code words, also is required after entry into a mode of operation. An example of generation of binary code values from the keyboard is described below.

But first, the method for entering commands. From the keyboard the commands are entered as follows:

Control Code   While holding the CONTROL key operated, press the required character key.

Escape Code   Press and release the ESC key and then the key (or keys) for the desired escape code in sequence.

Plot Code   Enter by CONTROL B and follow as described under Graphic Plot Submodes Details.

ANSI X3.64   Press and release the ESC key and then the [key (or other specified key). Follow in sequence with operation of other specified keys.

Detailed instructions for the use of these commands begin on page 3.15, following the paragraphs on binary code generation.

Binary Code Generation

At the standard keyboard, when it has a 500239-040 microprocessor and the terminal has V1.6 software, operation of a key or a combination of keys can result in generation of binary code words for the decimal range of zero through 127 and a number of those in the range of 128 through 255. A keyboard with the 16 function keys (F0-F15) has zero through 255 range.

The Intecolor code set used by the F8001 is shown in Appendix A-3. The 8810 with V1.6 software and 500239-040 keyboard processor generates these same codes from the keyboard. In the chart the decimal values are shown in the key blocks which cover most of the chart. The binary codes and their hexadecimal values are shown at the left and across the top of the page.

An examination of the headings for the columns of key blocks in the chart indicates that the keys may be considered as four sets of 16 keys each:

```
        @ A B C D E F G H I J K L M N O
        P Q R S T U V W X Y Z [ \ ] ^ _
        0 1 2 3 4 5 6 7 8 9 : ; < = > ?
  F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15
```

Operation of one of these keys alone results in generation of a specific code. Operation of the same key with CONTROL and/or SHIFT usually results in generation of a different code.

The first two sets of 16 include the upper case alpha characters. This indicates that operation with the ALPHA LOCK key in the locked down position is assumed — and this is the case.

The third set of 16 keys shown above has a pattern difference which could result in a bit of confusion. The characters 0 through ; are obtained without SHIFT. However, < through ? are obtained with SHIFT.

Thus generation of the codes equivalent to decimal 60 through 63 require SHIFT even though the column heading may appear to indicate that shift is not required. Generation of codes equivalent to decimal 44 through 47 do not require SHIFT. This pattern follows through wherever these particular characters are involved.

Appendix A-2 describes a diagonal plotting exercise which may be used to go through the code chart step by step. Although not the normal way to plot a diagonal, the method is suggested to provide immediate feedback of the results of keyboard operations.

Two more examples of the use of the keyboard to generate binary codes are described below. Begin with the ALPHA LOCK key in the locked down position.

There is a mode called CCI which can be used for color selection. When the CCI Mode is entered, the next byte provides the 8-bit visible status word specifying foreground color, background color, blink and plot.

The lower order three bits represent foreground color.
The next three bits specify background color.
The A6 bit determines foreground blink.
A7 is a plot character bit which causes the display to interpret
  the ASCII word as a 2x4 plot array instead of an ASCII character.

(128)	(64)	(32)	(16)	(8)	(4)	(2)	(1)
A7	A6	A5	A4	A3	A2	A1	A0
		BACKGROUND			FOREGROUND		
PLOT	BLINK						
		BLUE	GREEN	RED	BLUE	GREEN	RED

In the above table the figures in parentheses represent the decimal value of the binary digit. For example, a decimal code of 97 corresponds to the binary code

| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |

This code specifies red foreground, blue background and blink. The key operations required are shown on the next page.

In the CRT Mode the keyboard operations are:

CONTROL F   To enter the CCI Mode

SHIFT A   To generate the binary code
                         corresponding to decimal 97

The terminal automatically exits the CCI mode. Subsequent typing will be
displayed as blinking red characters against a blue background. If the
ERASE LINE key is operated, the line will be erased to a background of
blue. Operation of the ERASE PAGE results in a full raster in the
background color blue.

To change to green foreground against a black background without blink, the
CCI binary code word is:

              0 0 0 0 0 0 1 0

corresponding to decimal 2. The key operations are:

CONTROL F   To enter the CCI Mode

CONTROL B   To generate the binary code
                 corresponding to decimal 2

Subsequent typing will now be green against black. Operate the ERASE PAGE
key to clear the screen to the background color black.

One more example, for the moment, of binary code generation: Instead of
using the cursor movement keys, space bar or other key operations for
moving the cursor a space at a time, the cursor may be moved to a desired
point on the screen by use of a mode called Cursor XY.

In the Cursor XY mode, the cursor position is designated by character
position and line, starting from the upper left corner as character
position 0, line 0. A point near the center of the screen is character
position 39, line 23. A review of the code chart shows these codes can be
generated by SHIFT 7 and CONTROL W. When already in the CRT Mode, the key
strokes are:

CONTROL C   To enter the Cursor XY Mode

SHIFT 7   To generate the binary code
                 corresponding to decimal 39

CONTROL W   To generate the binary code
                 corresponding to decimal 23

The cursor moves to screen center; subsequent typing begins at that point.

Other examples of code generation are given in the Control and Graphic Plot
Submode descriptions in the following pages. In these descriptions the
generation of certain codes by the specialized keys will be mentioned.

Control Code Details

All display commands can be entered either through the Host Serial I/O Port or via the keyboard. The Host Serial I/O has the highest priority of all inputs.

Through both the keyboard input and the Host Serial I/O Port, control is exercised with 8-bit binary code words. The discussion in this section shows the decimal equivalents of these code words. The chart in Appendix A-3 shows the make-up of the binary words at the left side and across the top of the page.

> Note: With some display commands delays may be required when input is at the higher baud rates.

There are 32 Control Codes. Use of one of these codes for entry to the Escape Code table provides for 32 additional display commands. Use of another of the Control Codes for entry into the plot mode provides 16 more codes for use in creating graphics. The flow diagram for these commands is included in Appendix A-8.

The terminal employs two input pointer flags, one for the keyboard and one for the RS-232-C input. Each flag may point to a different mode of operation. Thus the terminal may respond differently to keyboard input as compared to RS-232-C input.

In this section details for the various Control Codes, Escape Codes and Plot Submode Codes list both the decimal equivalent of the code used via the Host Serial I/O Port and the keyboard stroke combination used for exercise of the display command. In addition to the keystroke combinations shown, a number of the commands can be exercised by use of keys designated for entry of these commands — e.g., ERASE PAGE, HOME, 2X CHAR ON.

Code 0   Null — CONTROL @

This control is not used and has no effect on the display.

Code 1   Protect Mode — CONTROL A

⊢—⇒   The Protect mode allows the host computer or the Intecolor terminal to set up protected areas on the screen and allow the user of the terminal to fill in or edit data in the unprotected areas or fields. The procedure is as follows:

1. Select the foreground/background color combination (e.g., red foreground against a black background) to be used for data in unprotected fields. These unprotected fields may be defined now, using any characters, or at step 3 if more convenient.

2. Create the screen display that is to be protected. This display may have any foreground/background color combinations except that selected for data in unprotected fields.

3. Set the status (foreground/background color combination) to that selected for data in unprotected fields. Define the unprotected fields, using any characters, if this was not done at step 1.

4. Execute a CONTROL A and follow this with a fill character (such as a blank space or an underline) that is to be used in erasing unprotected fields.

5. The cursor now moves to the beginning of the first unprotected field. Data can now be entered and edited in the unprotected fields. The fields are not erased upon entry to the Protect mode in order that the host computer may initialize any fields that have a default value. These fields will be transmitted as though the data were entered from the keyboard. (However, they can be edited via the keyboard.)

While in the Protect mode a number of the control functions operate in a somewhat different manner:

Control	Normally	While in Protect Mode
A	Enter Protect	Exit from the Protect mode. (ESC) also causes exit from Protect.
H	Home	Moves cursor to the first unprotected position on the screen.
I	Tab	Moves the cursor to the beginning of the next field. If the cursor is in the last unprotected field, it moves to the home position. The next TAB moves it to the start of the first unprotected field.
J	Line Feed	Moves the cursor to the first character position of the first field in the next line down that has an unprotected area. If the cursor is in the last unprotected field, it moves to the home position.
K	Erase Line	Erases from the current cursor position to the end of the current unprotected field by filling all positions with the fill character entered in (4) of the procedure above.
L	Erase Page	Erases from the current cursor position to the end of the screen by filling all unprotected positions with the fill character entered in step (4).
M	Return	From any position on the screen, Control M or operation of the RETURN key will cause the entire unprotected portion of the screen (plus CR:13 or other terminating character) to be transmitted to the serial port. The cursor moves back to the first unprotected field.

Y	Cursor Right	Moves the cursor to the next unprotected position (to the first character position of the next unprotected field if already at the end of an unprotected field).
Z	Cursor Left	Moves the cursor back one position (to the end of the preceding unprotected field if already at the first character position of an unprotected field).
\	Cursor Up	Moves the cursor to the last character position of the last field of the last line above that contains an unprotected field.

The cursor control keys affect cursor movement like the corresponding control codes listed above. All other control codes have absolutely no effect upon the display or the data stored. The format of the screen may not be accidently altered unless the user first escapes from the Protect mode via operation of the ESC key or a Control A. Note also that escape codes may not be used while in the Protect mode because operation of the ESC key causes exit from Protect.

Code 2   Graphic Plot Mode — Control B

The general Graphic Plot Mode is entered by a binary code 2 or a Control Code B. The XY Plot Mode is entered at the same time. Therefore, if a plot mode other than the XY Point Plot is desired, the next word that follows should be a binary code in the range of 240 to 254 (or, from the keyboard, another control code). These codes represent the various plot submodes as described under Graphic Plot Submodes.

The convenience of easy erasure of a graphic plot is available by setting the Flag Bit on before entering the plot mode (Control Code 30 or BG ON). This causes an XOR function to exist when plotting. If the same point, bar or vector is plotted twice, the second time erases the original. Set the Flag Bit on by striking the BG ON key or by a code 30 through the Host Serial I/O Port.

Once in the general plot mode, any of the plot submodes may be entered by sending the corresponding code to the terminal. When this code is received, a flag internal to the terminal, known as PLOFL, is set placing the terminal in the appropriate plot submode. It should be noted that in many of the plot submodes, PLOFL is automatically set to a different value upon completion of the operation of that submode, causing the terminal to enter a new submode. (As will be described in the X Point Plot Submode, for example, as soon as the X value for the point plot has been entered, the terminal changes automatically to the Y Point Plot Submode to await entry of the Y value for the point to be plotted.) This is done to make coding and operation of the terminal in the various plot functions easier for the operator.

Code 3   Cursor XY -- Control C

        The visible cursor may be positioned anywhere on the screen
by sending a 3-word sequence beginning with 03. The next two words that
follow determine the X character position (0-79) and the Y line position
(0-47).   Both X and Y values must be in binary form when entered through
the Host Serial I/O Port. The cursor home position in the top left corner
of the screen is 0,0. The bottom right corner is 79,47. For example, to
send the cursor to the position of the 12th character on the 8th line, the
keyboard sequence is CONTROL C, CONTROL L (or ERASE PAGE), CONTROL H (or
HOME) -- the latter two key operations being determined by reference to
Appendix A-3. Via the RS-232-C port, the sequence of binary code words
would be 3, 12, 8.

If the cursor is positioned at X=80, then the blinking visible cursor will
disappear. But if a character is typed, it will be positioned at the
beginning of line Y + 1 and the cursor appears at position X=1 on that
line. If, instead of a character, a cursor movement command is given, then
the cursor will reappear at the proper position relative to character
position 0, line Y+1.

A form of tabbing is available through the Cursor XY Mode. For horizontal
tabbing, a sequence of 3,x,127 (where x is a code in the range of 0-79)
will keep the cursor on its present line and move it to the character
position specified by x. For vertical tabbing, a sequence of 3,127,y (with
y a code in the range of 0-47) will maintain the cursor in its present
character position and move it to the line specified by y.

If the X value is greater that binary 80, then the blind cursor mode is
entered and the terminal ignores this as a visible cursor X value. Once in
the blind cursor mode, three additional bytes must be sent: the blind
cursor X value, the blind cursor Y value, and the blind status word (see
Control Code 6 for the format of the status word). The blind X value must
be in the range of 0-79 and the blind Y value 0-47. The Blind A7 Bit will
be set on by sending values from 128 to 255 instead of 81 to 127 when going
from the visible Cursor XY mode to the blind Cursor XY mode. The Blind A7
Bit is set off when a value from 81 to 127 is used.

As an example, the host computer can cause the terminal to enter the blind
cursor mode and display the word QUESTIONS near screen center by the
following sequence (keystrokes for codes shown in parentheses):

        03   81   36   23   2   QUESTIONS
    (CONTROL C)   (Q)   (SHIFT 4) (CONTROL W) (CONTROL B)

The word will appear in single height letters (the value for entry into the
blind cursor mode is in the range of 81-127) in green against a black
background (specified by 2 -- see later discussion of the CCI Code). The
word starts at character position 36, line 23.

Once in the blind cursor mode, if the value entered for the X position is
greater than 79, the terminal software will reduce the value entered to a
value within the range of 0-79. In either the visible or the blind cursor
mode, if the value for the Y position is greater than 47, the software will
reduce it to fall within the range of 0-47.

After receiving the five-byte blind cursor XY sequence, the terminal is left in the blind cursor mode for whatever input device caused the mode to be entered. For example, if the keyboard causes the blind cursor XY mode to be addressed, then the keyboard will be left in the blind cursor mode while the RS-232-C is still in the visible cursor mode. Thus the keyboard and the RS-232-C can use two different cursors. The device causing entry into the blind cursor mode can return to the visible cursor mode by an ESC ESC -- or code 27,27 -- sequence.

Most of the control codes affect only the visible cursor mode -- all cursor positioning codes except Cursor XY (which can affect both) and ERASE PAGE (which resets both the visible and the blind cursor to position 0,0). The setting of the Flag Bit is used by both the visible and the blind cursor modes to select the proper character set.

The blind Cursor XY mode also can be entered by the ESC A sequence. The ESC ESC sequence returns the input to the visible cursor mode without changing the cursor address, composite color status word, or A7 Bit of the two cursor modes.

**** NOTE ****

In the 8800/3800 Series it is important that the sequence for return to the visible cursor mode be ESC ESC and not ESC [. The latter sequence is used in the 8800/3800 Series as introducer for an ANSI X3.64 command sequence.

Code 4   Reserved

Code 5   Reserved

Code 6   CCI -- Control F

        When this mode is entered, the next byte provides the 8-bit visible status word specifying foreground color, background color, blink and plot. The lower order three bits represent foreground color, the next three bits background color, the A6 bit determines blink, and the A7 bit is a plot character bit which causes the display to interpret the ASCII word as a 2x4 plot array.

(128) A7	(64) A6	(32) A5	(16) A4	(8) A3	(4) A2	(2) A1	(1) A0
PLOT	BLINK	BACKGROUND			FOREGROUND		
		BLUE	GREEN	RED	BLUE	GREEN	RED

In the preceding table the figures in parentheses represent the decimal value. For example, a decimal value of 103 corresponds to the binary code

0   1   1   0   0   1   1   1

This value (which could be generated from the keyboard by a SHIFT G) following entry into the CCI Mode would specify blue background, white foreground and foreground blink.

If the binary code word following a CONTROL F or Code 6 were

0   0   0   0   1   0   0   0

corresponding to a decimal value of 8, then the background for subsequent entries is red and the foreground is black.

If the binary word following code 6 is

1   1   1   1   0   0   0   1

corresponding to a decimal value of 241, background of cyan and foreground of red are specified. The foreground will blink. The code words following will be interpreted as plot arrays rather than as ASCII characters -- see the paragraphs on Character Plot under Graphic Plot Submodes. (However, the situation here is not quite the same as the Graphic Character Plot Submode — functional in the range of 32 to 127 only.)

Code 7   Bell — Control G

        When this code is received, a tone will sound for about 150 milliseconds.

Code 8   Home — Control H

        This code causes the cursor to move to the "home" position (0,0) at the upper left corner of the screen. (Exception: When the terminal is operating in the Protect Mode, the cursor moves to the first unprotected position on the screen.) From the keyboard, this command can be either the CONTROL H key combination or the HOME key.

Code 9   Tab — Control I

        Receipt of this code causes the cursor to move to the next tab position on the line. The tab positions are fixed and are at every eight character positions from zero (left end of line). If the cursor is at a character position of 72 to 79, the cursor moves to the left end of the next line. In this latter case, if the cursor is already on the bottom line, it moves to the left side of the screen; if the terminal is in scroll mode the display scrolls upward two lines and the cursor moves to the next line up from the bottom; if the terminal is in page mode, the cursor moves to the left end of the top line. From the keyboard, either a stroke of the TAB key or the CONTROL I combination results in the tab movement of the cursor.

Code 10   Line Feed -- Control J

        Receipt of this code causes the cursor to move down one
line. This is the only code for cursor down. If the cursor is already on
the bottom line, its movement is determined by the terminal mode: In page
mode the cursor moves to the top line on the screen; in scroll mode the
display scrolls upward two lines and the cursor goes to the left end of the
next to bottom line.

Code 11   Erase Line -- Control K

        When this code is received, a carriage return is initiated
and the characters from the beginning to the end of the line are replaced
with spaces of the same color and status as the present visible CCI status.
(E.g., if the background is black, the entire line becomes black.   If the
background color is red, the entire line becomes red.)   The cursor is
always positioned at the beginning of the line -- the same line it was on
at the time of receipt of Code 11. Operation of either the ERASE LINE key
or the CONTROL K combination accomplishes the line erase.

Code 12   Erase Page -- Control L

        Receipt of this code causes the entire screen to be replaced
with spaces that have the same color and CCI status as the present visible
status.   (E.g., if the background color is black, the screen goes black.
If the background color is blue, the entire display goes blue.)   The cursor
always moves to the home position. The blind cursor also is positioned at
home.   At the keyboard, either the ERASE PAGE key of the CONTROL L
combination will accomplish page erase.

Code 13   Carriage Return -- Control M

        When this code is received, the cursor returns to the
beginning of the line it is presently on. Either the RETURN key or the
CONTROL M combination will cause carriage return.

Code 14   A7 on -- Control N

        This code causes the A7 bit in the code words for subsequent
characters to be forced to a "1" and results is the characters being
displayed at twice the normal height.

3.21

Code 15   <u>Blink / A7 Off</u> -- Control O

        When this code is received the codes for the characters
which follow have the A7 bit set to "0", resulting in normal height display
of the characters in the 48-line unit. The Blink bit, A6 of the composite
status word, also is set to zero. Characters following will be
non-blinking.

If the intent is to stop blink but retain double height characters, two
codes must be received: Code 15 to stop blink and then Code 14 to reset
double height character.

Codes 16 to 23 <u>Display Color</u> -- Controls P through W

        When one of these codes is received the color of the display
is set. If the Flag bit is off, the foreground color is set to the color
of the key top. If the Flag bit is on, the background color is set.

			<u>A2</u>	<u>A1</u>	<u>A0</u>
Black	CONTROL P	Code 16	0	0	0
Red	CONTROL Q	Code 17	0	0	1
Green	CONTROL R	Code 18	0	1	0
Yellow	CONTROL S	Code 19	0	1	1
Blue	CONTROL T	Code 20	1	0	0
Magenta	CONTROL U	Code 21	1	0	1
Cyan	CONTROL V	Code 22	1	1	0
White	CONTROL W	Code 23	1	1	1

Via the Host Serial I/O Port the Flag bit is set off by Code 29 and on by
Code 30. The keyboard has keys for setting the Flag bit off or on (BG ON
for Flag bit on or FG ON for Flag bit off). The Flag bit remains in the
last condition set until the terminal receives the appropriate code to
change it. For example, if the Flag bit were last set off, the foreground
color will be set upon reciept of one of the codes in the table above.
Receipt of a different color code will change the foreground color for
subsequent characters -- the Flag bit is still off, so there is no need to
set it off.

When the keyboard has the 9-key color/command cluster at left, one of the
color keys in the pad can be used in place of the CONTROL and letter key
combination. The setting of the Flag bit still determines whether the
color key affects the foreground or the background. (Note: With the
color/command cluster, when the plot via color pad mode -- to be described
later -- is in effect, the color pad keys select plot blocks rather than
color. See the description of Escape B.)

Code 24   Transmit — Control X

On receipt of Code 24, the terminal starts transmission from
the visible cursor present position and continues to the end of the screen
(page) or until it detects an FF,00 Hex sequence in the screen refresh
memory.   That transmission consists of each 8-bit word in memory — ASCII
character, then the status word for that character, then the next ASCII
character, and then the status word for that character and so on — until
the FF,00 sequence is detected.   During the transmission the moving cursor
is visible on the screen.

When the terminal finds the FF,00 sequence, it then terminates transmission
of the screen and sends an FF,00 followed by an 0D (or an 8D — at the
customer's option).

This data thus transmitted may be sent back to the 8810 terminal via the
Block Receive Mode.   See Escape] under Escape Code Details.

Code 25   Cursor Right — Control Y

Without destroying any information, the cursor moves one
character position to the right on receipt of this code.   At the keyboard,
use of the Cursor Right control key or the CONTROL Y key combination will
accomplish the same thing.

Code 26   Cursor Left — Control Z

This code results in movement of the cursor one character
position to the left without destroying any information.

Code 27   Escape — Control [

Use of this code requires that at least one more code word
follow in order to have a desired function performed.   (Exception: If the
terminal has the Protect option, Code 27 or operation of the ESC key
results in exit from the Protect Mode.)   See the Escape Code Details for
use of the additional command capability thus provided.

From the keyboard the usual sequence is operation of the ESC key followed
by operation of one of the letter keys.   Through the RS-232-C port the
sequence is Code 27 followed by one of the escape codes.

Code 28   Cursor Up — Control \

This code causes the cursor to move up one line without
destroying any information — effectively the opposite of Line Feed.

Code 29   Flag Off -- Control]

          When this code is received the Flag Bit is set to "0" (off).
The setting of the Flag Bit affects the operation of a number of other
codes: color selection (Codes 16-23), special character generation (Codes
96-127) and the plot submodes.

Code 30   Flag On -- Control ^

          Receipt of this code causes the Flag Bit to be set to "1"
(on). The condition of the Flag Bit affects color selection. Foreground
color is selected by Codes 16-23 when the Flag Bit is off; background color
is selected when the Flag Bit is on. The Flag Bit also affects generation
of special characters and the plot submodes.

Code 31   Blink On -- Control _

          When this code is received the Blink Bit A6 of the composite
status word is set to "1" (on). In display generated subsequently, the
foreground blinks on and off at a rate slightly under two times per second.
Receipt of Code 15 or operation of the 2X/BL OFF key resets the Blink Bit
to "0" (off).

Codes 32-95   Numbers and Letters

          These codes are used for the standard 64 ASCII upper-case
characters, numbers, punctuation marks, symbols and spaces. Refer to the
Intecolor Code Set, Appendix A-3.

Codes 96-127   Special Characters

          These codes provide two sets of 32 special characters.
These may be ASCII lowercase, control representation, Process special, line
drawing or customer specified characters. For each set of 64 characters,
the setting of the Flag Bit determines which set of the two sets of 32 will
be generated.

In Intecolor character set charts, operation with the ALPHA LOCK key in the
locked down position is assumed. SHIFT is required for generation of
special characters. When the Flag Bit is off, the codes generated go into
screen refresh memory unchanged and result in the characters of one set of
32. When the Flag Bit is on, the codes have 96 subtracted before going
into screen refresh memory and the characters of the other set of 32
result.

When ASCII lowercase characters are being used, operation with the ALPHA
LOCK key in the released or up position is not unusual. Use of the alpha
keys without SHIFT results in lowercase characters. SHIFT is used to
obtain uppercase alpha characters. However, the ALPHA LOCK key affects
only the alpha characters. Without SHIFT, the other six symbols in of the
lowercase set are not obtained. With SHIFT, the corresponding special
symbols in the lowercase set are obtained.

                              3.24

With only lowercase special characters in use, operation with the ALPHA
LOCK key up much of the time results in very little confusion. It is
necessary only to remember that entry of display commands -- the Escape and
Plot Submode Codes -- require the effect of ALPHA LOCK down.

The effect of ALPHA LOCK key position is similar when the 64-character
process special characters are in use. With the ALPHA LOCK key up, some of
the special characters can be obtained without SHIFT and some require
SHIFT. Confusion then is quite likely, so operation with the ALPHA LOCK
key down is recommended.

The standard 8810 Terminal has the Process special character set, the ASCII
Lowercase/Control Representation character set and a Forms (line drawing)
character set. There is provision for four more optional special character
sets.

At any one time the keyboard can use the standard 64-character ASCII
uppercase set and one special character set of up to 64 characters. The
special character set to be used is selected by use of an ANSI X3.64
sequence Select Character Set.

Control Sequence	Character Set
ESC (B	ASCII lowercase and Control Representation Characters
ESC (C	Process special characters
ESC (D	Forms (line drawing) characters
ESC (E	Optional set #1
ESC (F	Optional set #2
ESC (G	Optional set #3
ESC (H	Optional set #4

Notes: In earlier software the four optional sets #1 through #4 were
accessed as D, E, F and G rather than as E, F, G and H.

The line drawing character set (Forms) was added in software
version V1.6.

3.25

Escape Code Details

The Escape Codes effectively provide a subset of up to 32 additional control codes for the terminal. Use of this subset requires at least a two-code sequence. Via the Host Serial I/O Port the sequence is Code 27, followed by the Escape Code, and then additional codes for any required data. At the keyboard the stroke sequence is ESC followed by a character key and then keystroke combinations required to generate codes for any additional data needed. (The Intecolor Code Chart, Appendix A-3, shows the keystroke combinations used to generate the various codes. In the Escape sequence headings below -- e.g., "A or Code 1" -- there may seem to be some contradiction. The code for an upper case A is 65 decimal. However, following code 27 or ESC, the A6 bit in the next code only is ignored. So the "A" from the keyboard is seen as a code "1" in the Escape sequence.)

@ or Code 0 — Reserved

A or Code 1 — Blind Cursor Mode

This mode provides for a dual cursor operation. Normally the host computer will operate in the blind cursor mode and the keyboard in the visible cursor mode. The two modes will not interact with each other. There is also a blind status which may be different from the visible status. The only blind cursor movements allowed are a subset of the Cursor XY positioning. See Control Code 3 - Control C for details of operation in the Blind Cursor Mode.

B or Code 2 — Character Plot via Color Pad

This mode enables the user to select plot blocks via the color pad on the 101-key and 117-key keyboards. Each character matrix is divided into eight plot blocks, each three dots wide by two dots high. In the sketch below the one to one correspondence between the color select pad and the character plot blocks can be seen.

BLACK	BLUE
RED	MAGENTA
GREEN	CYAN
YELLOW	WHITE

COLOR SELECTION
PAD
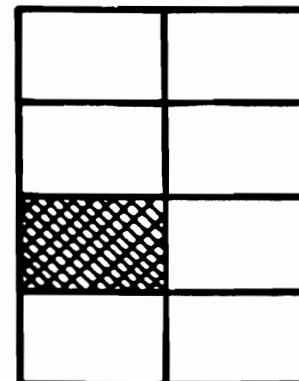
ONE
CHARACTER PLOT
ARAY
ONE PLOT BLOCK SELECTED BY GREEN

3.26

The sketch shows the selection of one plot block by operation of the green color key. The top right plot block can be intensified by operating the top right key in the color pad (the blue key or Control T or Control Code 20). Once a plot block has been intensified, any other plot block in the character matrix can also be intensified, for the cursor does not advance automatically.

The mode provides for extinguishing a plot block by a second operation of the appropriate key in the color pad. In the illustration shown, if the green key were operated again, the block would be erased. Thus any one plot block can be intensified or erased. After all desired plot blocks have been intensified or extinguished, the cursor may be advanced by use of the cursor controls without escaping from this special character plot mode. All of the control codes are effective while in this mode except the color select control codes. Any ASCII text characters can be entered and displayed also. An ASCII character when entered and displayed advances the cursor as usual in the visible mode, but the plot blocks generated by the color pad do not advance the cursor. So when a character position has been used to display plot blocks, a cursor command must be given to advance the cursor to the next character position.

Any code that requires a two or more key sequence (such as Cursor XY, CCI, and ESC) will terminate this special character plot mode.

All plot blocks within a given character matrix will have the same color (that of the last block plotted).

C or Code 3 -- Transmit Cursor X,Y

        This mode causes the terminal to send the following seven word sequence to the Host Serial I/O Port:

                03 X Y 06   Status ASCII Character <CR>

The X and Y values represent the cursor position on the screen (the character position from 0 to 79 on a line and the line 0 to 47). The status is that of the ASCII character at that cursor location. The Carriage Return may be either a code 0D or 8D Hex as specified by the customer when ordering. The sequence of transmission is the same as that provided by the light pen when that option is present.

    CAUTION! The X or Y value can be a code for XOFF. Therefore the host's operating system flow control should be disabled when a code 03 is received. Further, receipt of ESC C by the terminal may result in transmission of an XOFF by the terminal prior to its sending the cursor X-Y sequence. In such case the XOFF should not be echoed back to the terminal.

D or Code 4 -- Reserved

E or Code 5 -- Reserved

F or Code 6 -- Reserved through software version V1.6. In V1.7 and later,
            Full Duplex Mode -- please see Appendix H.

G or Code 7 -- Reserved

H or Code 8 -- Reserved through software version V1.6. In V1.7 and later,
            Half Duplex Mode -- please see Appendix H.

I or Code 9 -- Reserved

J or Code 10 - Write Vertical Mode

            This mode affects the visible cursor mode only and causes
the terminal to enter characters vertically one below the other. All other
cursor movements still are possible via the cursor mode. After a character
is entered the cursor is moved down one line awaiting the next character.
Upon reaching the last line, the display scrolls upward two lines if the
terminal is still in the initialized Scroll Mode. If the terminal is in
the Page Mode, the next character will be on the top line (i.e., wrap
around occurs).

K or Code 11 - Scroll Mode

            When this mode is in use, the terminal will write left to
right and will cause a page roll up when the last line has been filled.
This roll up will be two lines at a time (or one, if double height
characters are being used). Note that the plot mode and the blind cursor
mode work only in the non-roll or Page Mode.

L or Code 12 - Reserved through software version V1.6. In V1.7 and later,
            Local Mode -- please see Appendix H.

M or Code 13 - Screen Dump to Printer Serial Output Port

            Receipt of this code with an additional parameter code
causes the content of screen memory to be sent to the printer serial output
port J4. For use of this sequence

                              ESC M Pn

see page 3.59, "Operation with Color Printer".

N or Code 14 - Reserved

O or Code 15 - Reserved

P or Code 16 - Reserved

Q or Code 17 - Character Insert
─────────────

            This mode allows insertion of a character. Once in this
mode the terminal behaves as though in normal visible cursor operation
except for control commands requiring a two or more character sequence
(e.g., Cursor XY, CCI, ESC).

While the terminal is in this mode, when any character is entered on the keyboard or received via an RS-232-C port, it is inserted within the line at the present position of the cursor; every character after the cursor, to the end of the line, is shifted right one character position. The last character on the line is lost. The cursor is advanced one position to the right.

The foregoing is true except for control codes and for the operation of the DELETE CHAR key and the "_" key with SHIFT (Code 127). Operation of the DELETE CHAR key or receipt of code 127 via an RS-232-C port will cause the deletion of the character at the cursor present position. All characters to the end of the line are shifted left one space. The last character on the line becomes a space. The cursor does not advance.

An escape sequence (operation of the ESC key and then a character key) terminates the insert-delete mode after the operation of the second key in the sequence. The sequence should be simply ESC ESC.

**** NOTE ****

Do not use the sequence ESC [as exit from the insert-delete mode. In the 8800/3800 Series, ESC [is used as introducer for an ANSI X3.64 command sequence.

R or Code 18 -- Reserved

S or Code 19 -- Reserved

T or Code 20 -- Entry to Medium Resolution Graphics

In the 8820 terminal this code provides entry to the medium resolution graphics mode. A description of the use of this mode for graphics in a 480 x 384 grid, with each dot addressable for both position and color, begins on page 3.62.

In the standard 8810 terminal, an Escape T sequence results in Page Mode Write Right to Left, Bottom to Top. The terminal may be returned to the more normal Write Left to Right in the Scroll Mode by an Escape K or to the Page Mode by an Escape X.

U or Code 21 -- Insert Line

When this optional feature is present and this mode is selected, the cursor moves to the beginning of the line it is presently on. This line and all lines below it on the page are shifted down one line. A new line of 80 spaces is inserted, with the cursor remaining at the beginning of this new line. What had been the last line on the page is pushed off the screen and lost.

Normally the cursor will be positioned at the beginning of the line to be inserted when this mode is used. After the line has been inserted and a carriage return performed, the terminal returns to the normal visible cursor mode.

<u>V or Code 22</u> — Delete Line

When this optional feature is present and this mode is selected, the cursor moves to the beginning of the line it is presently on and this line is deleted. All lines below it on the page are shifted up one line and a new line of 80 spaces is inserted at the bottom of the page. The cursor remains at the beginning of the line that had been deleted. After deletion of the line, the terminal returns to the normal visible cursor mode.

<u>W or Code 23</u> — Reserved

<u>X or Code 24</u> — Page Mode Write Left to Right

When in this mode the terminal will not scroll up when the last line on the page has been filled. It will begin at home again. Writing is left to right.

This mode affects all modes that use the visible cursor. The blind cursor, transmit and plot modes will force the terminal to this page mode of operation.

<u>Y or Code 25</u> — Test Pattern

When this mode is selected the next character that follows will cause the screen to be filled with that character. For example, receipt of a code sequence 27, 25, 76 via the Host Serial I/O port will cause the screen to be filled with lines of the letter L. The letters are normal height if A7 is off, double-height if A7 is on. At the keyboard the sequence is ESC, Y, L.

<u>Z or Code 26</u> — 45 Degrees Write Down

Entry into this mode changes the pattern of cursor movement following entry of a character. The next character entered following receipt of this code is displayed at the cursor present position. Then there is a line feed as well as a cursor right movement. The next character entered is displayed one line below and one character position to the right of the previous character displayed. When the bottom of the page is reached, the next character appears at the top of the screen — wrap around occurs.

<u>[or Code 27</u> — Entry to ANSI X3.64 Sequence or Visible Cursor Mode

If the received code sequence is truly 27, 27 — generated by ESC ESC or CONTROL [twice — the Visible Cursor mode is entered. This is the terminal's normal mode of operation. A received character is placed at the visible cursor location. The cursor then advances one position awaiting the next character. Normal cursor control operations may be used to place the cursor at different locations. This mode is initialized at terminal turn-on.

In the 8810, ESC [(without shift) is the lead-in for an ANSI X3.64 sequence. The code for [(91 decimal) does not have its A6 bit ignored. ESC [is not interpreted as Escape Code 27. If the characters immediately following complete a legitimate ANSI X3.64 sequence, the command is executed. In other cases the terminal will not display the next character received and will remain in its existing mode of operation to display characters other than the one immediately following the ESC [sequence.

**** IMPORTANT NOTE ****

Programs written for the 8000 Series terminals may use the ESC [sequence (codes 27,91 decimal) for exit from the insert-delete mode or other return to the visible cursor mode. In such case these sequences must be changed to the ESC ESC sequence (codes 27,27 decimal) before being used with the 8800/3800 Series terminals.

\ or Code 28 — 45 Degrees Write Up or Erase Medium Resolution Graphics

In the standard resolution terminal (8810/3810) the cursor movement pattern changes upon receipt of this code. Following entry of a character, which will be displayed at the cursor present position, there is a cursor up as well as a cursor right. The next character entered will be displayed one line above and one character position to the right of the previous character displayed. When the top of the page is reached, the next character will appear at the bottom of the screen — something of a reverse wrap.

In the terminal with medium resolution graphics (8820/3820) entry of this escape code results in erasure of the accessible page of medium resolution graphics memory.

] or Code 29 — Block Receive
_____

Receipt of this code causes the terminal to enter the Block Receive Mode. The terminal uses the blind cursor to position the data on the screen. Starting with the present position of the blind cursor, data is received and displayed until an FF,00 Hex sequence is received. (The FF,00 sequence is not displayed.) Receipt of the FF,00 sequence terminates the Block Receive Mode and the terminal returns to the Visible Cursor Mode. This receive mode is somewhat similar to the Control X transmit mode.

^ or Code 30 — Reserved

_ or Code 31 — Reserved
_____

Graphic Plot Submodes Detail

The general Graphic Plot Mode is entered by a binary code 2. This binary code word may be received through the serial input port or it may be generated at the terminal by the keystroke combination CONTROL B. The XY Plot Mode is entered at the same time. If a plot mode other than XY Point Plot is desired, then the next word should be a binary code in the range of 240 to 254 decimal (or, from the keyboard, the appropriate control sequence). These codes represent the various plot submodes. If the plot erase feature is desired, the Flag Bit should be set on (operate the BG ON key) before entering the plot mode. This causes an XOR function to exist when plotting -- if the same point, bar or vector is plotted twice, the second time erases the original.

When, after entry into the general plot mode, a plot submode is entered, a flag is set within the terminal -- PLOFL (Plot Flag) -- placing the terminal in the designated plot submode. In some of the plot submodes the PLOFL is set automatically to a different value upon completion of the operation of the given submode and the terminal enters a new submode. This enables the operator to perform certain plot functions more easily.

In addition to capability for entering plot submodes from the general plot mode, any plot submode may be entered from any other plot submode with the the exception of the Character Plot submode.

The CRT screen display is 80 characters wide by 48 lines high. In plotting, each character is further divided into eight blocks, each 3 dots wide by 2 dots high. (Each character matrix is 6 dots wide by 8 dots high.) The plot grid, then, is 160 by 192. The zero reference point for plotting is the lower left corner of the screen. Positive directions are to the right (X) and up (Y); negative directions are left and down. The XY coordinates for the screen corners are: lower left (0,0); lower right (159,0); upper right (159,191); upper left (0,191). (The keyboard operations required to obtain these codes may be determined by reference to Appendix A-3 or A-6.)

Colors may be defined on a character by character basis only. The color of an individual plot block and of all other intensified plot blocks within that character matrix will be the most recent color defined when the most recent block is intensified in that character. To change a color it is necessary to terminate the plot mode or submode, change the color, and then re-enter the plot mode.

All plot submodes and the general plot mode are exited or terminated by the binary code 255, entered through an input port or generated from the keyboard by CONTROL ? (which requires SHIFT) -- or by the F15 key when the function keys are present. Whenever this code is received, the plot modes are terminated and must be re-entered as described above.

> NOTE: The 16 function keys F0-F15 control the entrance to the plot submodes -- their operation results in generation of codes 240-255. In order to provide entrance to the plot submodes when the function keys are not present, alternate key combinations CONTROL 0 through CONTROL ? provide these codes 240-255 when the Hardware Configuration selection is 101 or 72 Key Keyboard in the SETUP mode (assuming V1.6 software).

<u>Plot Mode Escape</u> — Code 255 binary

This code is used to exit from a plot submode and from the general plot mode as well. Exit from the plot mode also is possible by CONTROL ? or, when the function keys are present, by operation of the F15 key. (Note that SHIFT is required to obtain CONTROL ?.)

<u>Character Plot</u> — Code 254 binary

The Character Plot submode is entered by a 254 after the general plot mode is entered via code 2 or CONTROL B. It also may be entered from any of the other plot submodes via code 254 — from the keyboard, CONTROL > or F14. SHIFT is required in obtaining CONTROL >.

After Character Plot is entered, the next word is treated as a plot character except for code 255 binary (all eight bits 1's). Receipt of code 255 terminates the plot mode.

Other plot submodes may <u>not</u> be entered from the Character Plot submode. To enter other plot submodes it is necessary to terminate the plot mode, re-enter the general plot mode and enter the desired plot submode.

Plot characters are defined by codes 0 through 254. The sketch below shows the eight individual blocks within the character matrix to be defined by decimal codes 1, 2, 4, 8, 16, 32, 64 and 128 (1, 2, 4, 8, 10, 20, 40, and 80 hexadecimal).

1 Dec		16 Dec
01 Hex		10 Hex
2 Dec		32 Dec
02 Hex		20 Hex
4 Dec		64 Dec
04 Hex		40 Hex
8 Dec		128 Dec
08 Hex		80 Hex
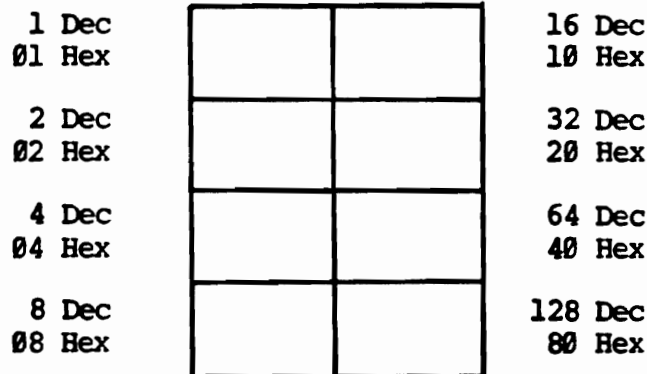
The codes may be ORed to define more than one block within a character matrix — e.g., code 9 (generated from the keyboard by TAB or CONTROL I) will cause plotting of the upper left and lower left plot blocks in the illustration shown on the next page. (For operation from the keyboard, the terminal is assumed to be in the Local Mode or with Echo on. The cursor controls and TAB may be used to position the cursor nearer screen center before entering the Plot Mode if desired.)

In the example on the following page, the ALPHA LOCK key must be left in the up position.

Function	By Code Via Host I/O	By Keyboard Operations
Entrance into general plot mode	2	CONTROL B
Enter Character Plot submode	254	CONTROL > or F14
Define first character	9	CONTROL I (or TAB)
Define next character	102	F
Define third character	144	CONTROL SHIFT P
Exit plot mode	255	CONTROL ? or F15

The plot should appear as shown below.
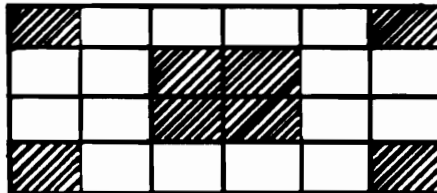
The A7 Bit should be off (2X/BL OFF) when in the Character Plot mode or it will cause the lower right plot block to be intensified along with the selected block. Intensification of all eight blocks by entry of one code is not possible — this would require code 255, which results in exit from the plot mode. However, this result can be achieved in other ways, such as entry of a character space in an appropriate background color.

X Point Plot — Code 253 binary

The X Point Plot submode is entered automatically upon receipt of the general plot mode code 2 or CONTROL B. It also may be entered directly from any other plot submode except Character Plot via code 253 through the serial input port or generated by the keyboard combination CONTROL = or F13. After X Point Plot is entered the next word defines the X value of the block to be plotted. The X value may be in the range of 0 to 159 — a larger value will have 160 subtracted to obtain a valid X value. Refer to Appendix A-3 for the keyboard operations used to obtain these codes.

Entry of the X value does not cause the block to be intensified — only the X coordinate has been defined. Instead the terminal automatically goes to the Y Point Plot submode and awaits the Y value. Upon receipt of the Y value the now defined plot block is intensified on the screen. The terminal automatically reverts to the X Point Plot submode and the next word will be treated as an X value.

Therefore, once in the X Point Plot submode, new blocks may be defined simply by sending X values and Y values consecutively. There is no need to send codes for re-entry of the X or the Y Point Plot submodes.

The X Point Plot in conjuction with the Y Point Plot allows any block on the 160 by 192 grid to be positioned and intensified. If the new block is within a character position that contains a previously intensified ASCII character, that ASCII character will be completely replaced by the new block and its associated color. If a new block is within a character position that has a previously intensified plot block, the previously intensified plot block will take on the color of the new plot block.

The X Point Plot submode may be terminated by code 255 (which causes the general plot mode to be terminated as well). Any of the other plot submodes may be entered directly from the X Point Plot submode simply by entry of the appropriate code in the range of 240 to 254.

As an example, the following sequence will intensify plot blocks near the four corners of the display:

Function	By Code Via Host I/O	By Keyboard Operations
Entrance into general plot mode and X Point Plot submode	2	CONTROL B
Define lower left corner block	0 0	CONTROL @ CONTROL @
Define lower right corner block	159 0	CONTROL SHIFT _ (underline) CONTROL @
Define upper right block	159 175	CONTROL SHIFT _ CONTROL /
Define upper left block	0 175	CONTROL @ CONTROL /
Exit plot mode	255	CONTROL ? or F15

Y Point Plot — Code 252 binary

The Y Point Plot submode is entered by code 252 binary after the general plot mode has been entered. It may be entered via a keyboard CONTROL < or F12 and it may be entered directly from any of the other plot submodes except Character Plot. It is more commonly entered automatically from the X Point Plot submode. Following entry into Y Point Plot, the next word defines the Y value of the block to be plotted. The terminal uses whatever previous X value may be in memory to complete definition of the block to be plotted and the block is intensified. The Y value may be in the range of 0 to 191 -- larger values will cause subtraction of 192 for calculation of a valid Y value.

Upon receipt of the Y value, the terminal automatically enters the X Point Plot submode. The X value of the next block to be plotted may then be entered as described in the paragraphs on X Point Plot.

The Y Point Plot submode is terminated by code 255 (which causes the general plot mode to be terminated also). Any of the other plot submodes may be entered directly from Y Point Plot simply by entry of the appropriate code in the range of 240 to 254.

XY Incremental Point Plot — Code 251 binary

The XY Incremental Point Plot submode is entered by code 251 after entry into the general plot mode — or via a keyboard CONTROL ; or F11. It may be entered directly from any of the other plot submodes except Character Plot. After entry into XY Incremental Point Plot, the next word defines the next two increments as shown in the table below. This word may be in the range of 0 to 239 binary — binary 240 through 255 codes are used for plot submodes.

128 B7	64 B6	32 B5	16 B4	8 B3	4 B2	2 B1	1 B0
$\Delta X1$		$\Delta Y1$		$\Delta X2$		$\Delta Y2$	

Plot Block 1   Plot Block 2

B(n+1) B(n)

0	0	No change
1	0	Positive increment
0	1	Negative increment
1	1	No change

Where n = 0, 2, 4, 6

For example, creation of horizontal line that zig-zags up and down as it crosses the page requires that all X increments be positive (to keep the points moving to the right) and that the Y increments alternate between positive and negative (to move the points up and then down). After one block is plotted as a starting point and then the XY Incremental Point Plot Mode is entered, the four bits 1010 define the location of the next block as one block to the right and one block up. Four similar bits define the next point to be located an additional block right and up. The binary code word

1 0 1 0 1 0 1 0

(decimal value 128 + 32 + 8 + 2 = 170) causes two blocks to be plotted to the right and upward from the starting point.

In Appendix A-3, looking at the bit patterns at the top of each column on the chart, column A (the 10th column) has the required pattern for the first four bits. Then, looking at the bit patterns at the left of each line, line A has the required pattern for the second four bits. The intersection of line and column shows that operation of the "*" key with both CONTROL and SHIFT held down will generate the desired code.

The binary code word

                    1 0 0 1 1 0 0 1

(decimal value 128 + 16 + 8 + 1 = 153) causes two blocks to be plotted to the right and downward from the last point plotted. Reference to Appendix A2 indicates that operation of the "Y" key with both CONTROL and SHIFT held down will generate this code.

To create the zigzag line, then, the code entries through the serial port or the keyboard operations are, with ALPHA LOCK up:

Function	By Code Via Host I/O	By Keyboard Operations
Enter general plot mode	2	CONTROL B
Define starting point at left center	0 80	CONTROL @ SHIFT P
Enter XY Incremental Point Plot submode	251	CONTROL ; or F11
Increment up and right (for two blocks)	170	CONTROL SHIFT *
Increment down and right (for two blocks)	153	CONTROL SHIFT Y

Continue alternating the last two operations to continue the pattern across the page.

The B0-B3 bits do not have to duplicate the B4-B7 bits. The binary code word

                    1 0 1 0 1 0 0 1

(decimal value 128 + 32 + 8 + 1 = 169) locates the first additional block right and up and the second additional block right and down. In the above example use code 169, keyboard operation CONTROL SHIFT), instead of codes 170 and 153.

If only one incremental block (rather than two) is desired, the B4-B7 bits are made zero and the B0-B3 bits are used for the increment. The binary code word

                    0 0 0 0 1 0 0 1

(decimal value 8 + 1 = 9) locates one additional block right and down.

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If "skipping" of a block is desired, bits B0-B3 are made zero and B4-B7 are used for the increment. The binary code word

$$0\ 1\ 1\ 0\ 0\ 0\ 0\ 0$$

(decimal value 64 + 32 = 96) will increment left and up to plot an invisible block — i.e., leave the new block in the background color. For example, a broken line left and upward from a starting point may be created as follows (ALPHA LOCK up):

Function	By Code Via Host I/O	By Keyboard Operations
Enter General Plot Mode	2	CONTROL B
Define starting point in lower right quadrant	140 32	CONTROL SHIFT L SHIFT 0 (zero)
Enter XY Incremental Point Plot submode	251	CONTROL ; or F11
Increment left and up to plot one block	6	CONTROL F
Increment left and up but not plot	96	SHIFT @
Increment left and up and plot two blocks	102	F
Increment left and up but not plot	96	SHIFT @
Increment left and up and plot two blocks	102	F

Alternate codes 96 and 102 to continue the broken line. Use code 255 (keyboard CONTROL / or F15) to exit the plot mode.

The sketch below shows the codes for one-block increments. The code in the shaded area causes the block to be intensified. The code in the unshaded area results in an increment to the block but no plot ("invisible" block).
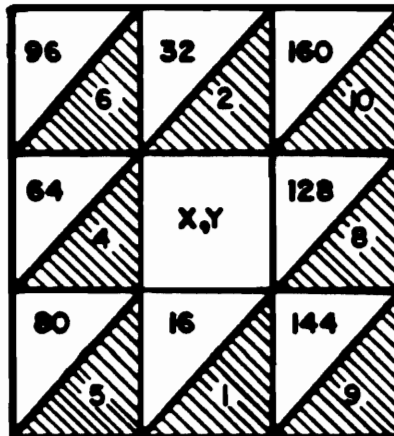
The XY Incremental Point Plot submode does not automatically transfer the terminal to any other plot submode upon receipt of an incremental change word. It remains in the XY Incremental Point Plot submode ready to receive another incremental change word. Thus a series of incremental movements may be made by sending consecutive incremental change words with or without points being plotted.

The XY Incremental Point Plot submode may be terminated by code 255, which also causes the general plot mode to be terminated. Any of the other plot submodes may be entered directly from XY Incremental Point Plot simply by entry of the appropriate code in the range of 240 to 254.

X Bar Graph, X0 Value — Code 250 binary

After entry into the general plot mode, the X Bar Graph, X0 Value submode is entered by a binary 250 code or via a keyboard CONTROL : or F10. It may be entered from any of the other plot submodes except Character Plot. Following entry into the X Bar Graph, X0 Value submode, the next word defines the X0 Value, the left horizontal start block of the horizontal bar graph. The graph grid is referenced to the lower left corner of the screen. The X0 Value may be in the range of 0 to 159 — larger values will have 160 subtracted for calculation of a valid position.

Following receipt of the X0 Value, this value of X0 is stored in memory and the terminal is placed automatically in the X Bar Graph, Y Value submode. It now awaits the next word to define the Y position of the bar graph. Upon receipt of the Y Value, the terminal then is placed automatically in the X Bar Graph, X Max Value mode and awaits the next word to define the X Max Value. Upon receipt of the X Max Value, the bar is drawn on the screen. The terminal is placed automatically back in the X Bar Graph, Y Value submode, ready to receive a new Y value for another bar.

As can be seen from the above process, once in the X Bar Graph, X0 Value submode and an X0 Value received, only two words (Y and X Max) are required to define bar graphs with the same X0 horizontally. After the first bar graph sequence, additional bar graphs can be described simply by entry of the new Y position and the X Max Value. Each bar is drawn, using the original X0 Value, upon receipt of the X Max Value.

This mode allows bar graphs in any of the colors to be drawn with a width as small as one plot block. Areas under curves may be filled in easily. If multiple color bars are to be drawn, the bars should be character multiples in height — only one foreground color and one background color per character position may be used.

Any of the three X Bar Graph submodes may be entered independently and any of the other plot submodes may be entered directly by entry of the appropriate binary code in the range of 240 to 254. The submode and the general plot mode are terminated on receipt of code 255.

As an example, to plot a bar across screen center, starting a quarter of the way in from the left and continuing to a point a quarter of the way in from the right, the sequence may be as listed on the next page.

Function	By Code Via Host I/O	By Keyboard Operations
Enter general plot mode	2	CONTROL B
Enter X Bar Graph, X0	250	CONTROL : (colon) or F10
Define X0 as 39	39	SHIFT 7 (single quote mark)
Define Y as 95	95	_ (underline)
Define X Max as 119	119	W
Exit plot mode	255	CONTROL ? or F15

Prior to exit from the plot mode, the bar could have been made double height (or "heavier") by additional codes 96 (SHIFT 0) and 119.

X Bar Graph, Y Value -- Code 249 binary

After entry into the general plot mode, the X Bar Graph, Y Value submode is entered by a binary code 249 or via a keyboard CONTROL 9 or F9. It may be entered from any of the other plot submodes except Character Plot. However, it is more commonly entered automatically from the X Bar Graph, X0 Value submode or the X Bar Graph, X Max Value submode. After entry into the X Bar Graph, Y Value submode, the next word defines the Y Value, the vertical position of the horizontal bar graph being drawn. This Y Value may be in the range of 0 to 191 -- larger values result in subtraction of 192 for calculation of a valid Y Value.

Upon receipt of the Y Value, this value of Y is stored in memory and the terminal is placed automatically in the X Bar Graph, X Max Value submode.

Any of the other plot submodes may be entered directly from X Bar Graph, Y Value by entry of the appropriate code in the range of 240 to 254. Receipt of code 255 terminates the submode and the general plot mode.

X Bar Graph, X Max Value — Code 248 binary

After entry into the general plot mode, the X Bar Graph, X Max Value submode is entered by code 248 or via a keyboad CONTROL 8 or F8. It may be entered from any other plot submode except Character Plot. However, it is more commonly entered automatically from the X Bar Graph, Y Value submode. Following entry into the X Bar Graph, X Max Value submode, the next word defines the X Max horizontal point of the horizontal bar graph being drawn. This value may be in the range of 0 to 159 — larger values will result in subtraction of 160 for calculation of a valid X Max Value.

Upon receipt of the X Max Value the bar graph is drawn on the screen in the predefined color in accordance with the X0 and Y values stored in memory from previous operations. The terminal then is placed automatically in the X Bar Graph, Y Value submode.

Any of the other plot submodes may be entered directly from X Bar Graph, X Max Value by entry of the appropriate code in the range of 240 to 254. Code 255 terminates the submode and the general plot mode.

X Incremental Bar Graph -- Code 247 binary

After entry into the general plot mode, X Incremental Bar Graph is entered by a binary 246 code or via a keyboard CONTROL 7 OR F7. It may be entered from any of the other plot submodes except Character Plot. Following entry into the X Incremental Bar Graph submode, the next word defines the next two horizontal and vertical increments for two horizontal bar graphs. In this manner a bar graph may be positioned on either side of the present location with an increment added to or subtracted from the original previously defined. The coding of the word is similar to that for the XY Incremental Point Plot submode (code 251).

For example, going back to the bar graph example on page 3.40, the X Incremental Bar Graph Mode could be used to make the bar graph several blocks high. Using the same initial operations, but prior to exit from plot via code 255:

Function	By Code Via Host I/O	By Keyboard Operations
To enter X Incremental Bar Graph Mode	247	CONTROL 7 or F7
To increment downward twice, X values unchanged	17	CONTROL Q
To repeat above	17	CONTROL Q
To exit plot mode	255	CONTROL ? or F15

Rather than making a "heavier" bar graph line, a shaded area could be created by using the plot skip technique in the X Incremental Bar Graph Mode. Again, starting as in the example on page 3.40:

Enter X Incremental	247	CONTROL 7 or F7
Increment downward without plotting	16	CONTROL P
Repeat X bar line after skip	1	CONTROL A
Increment downward without plotting	16	CONTROL P
Repeat bar	1	CONTROL A
Exit plot mode	255	CONTROL ? or F15

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Other methods can be used for large shaded areas, but this example serves to illustrate the use of the X Incremental Bar Graph Mode. Appendix B-6 shows other examples.

<u>Y Bar Graph, Y0 Value</u> —— Code 246 binary
<u>Y Bar Graph, X Value</u> —— Code 245 binary
<u>Y Bar Graph, Y Max Value</u> - Code 244 binary
<u>Y Incremental Bar Graph</u> — Code 243 binary

The above four submodes operate in much the same manner as their corresponding X Bar Graph submodes. After entry into the general plot mode, any of them may be entered by receipt of the appropriate code or via a keyboard CONTROL 6, 5, 4 or 3 or F6, F5, F4 or F3 respectively.

<u>Vector Mode, X0 Value</u> —— Code 242 binary

After entry into the general plot mode, the Vector Mode, X0 Value is entered by a binary 242 code or via a keyboard CONTROL 2 or F2. It may be entered from any other plot submode except Character Plot. Following entry into the Vector Mode, X0 Value, the next word defines the X0 Value point of the vector being drawn. This X0 Value must be in the range of 0 to 159 (larger values will have 160 subtracted).

The Vector Mode requires definition of two end points —— X0,Y0 and X1,Y1. The X1,Y1 point should have been defined previously by way of the X and Y Point Plot submodes (codes 253 and 252).

Upon receipt of the X0 Value the terminal is placed automatically in the Vector Mode, Y0 Value (code 241) and awaits receipt of the Y0 Value. Upon receipt of the Y0 Value, the terminal then determines the best straight line fit between X0,Y0 and X1,Y1 using plot blocks. The vector is drawn in the predefined color. The terminal then reverts to the Vector Mode, X0 Value, ready to receive a new X0 Value for another vector. Unless a new X1,Y1 point is defined by way of the X and Y Point Plot routine, this new vector will use the last X0,Y0 point as its X1,Y1.

Code 255 terminates the submode and the general plot mode. Other plot submodes may be entered by use of the appropriate code.

As an example, the following sequence generates a diagonal from screen upper left to lower right:

Function	By Code Via Host I/O	By Keyboard Operation
Enter general plot mode (and X Point Plot)	2	CONTROL B
Define X1,Y1 as 0,175	0 175	CONTROL @ CONTROL /

Enter Vector Mode, X0	242	CONTROL 2 or F2
Define X0,Y0 as 159,0	159	CONTROL SHIFT _ (underline)
	0	CONTROL @

To continue a vector up the right side of the screen and back across the top to the upper left corner before exiting the plot mode, the sequence following 159,0 would be:

Define new X0,Y0 as 159,175	159	CONTROL SHIFT _
	175	CONTROL /
Define new X0,Y0 as 0,175	0	CONTROL @
	175	CONTROL /
Exit plot mode	255	CONTROL ? or F15

Vector Mode, Y0 Value — Code 241 binary

After entry into the general plot mode, the Vector Mode, Y0 Value is entered by a binary 241 code or via a keyboard CONTROL 1 or F1. It may be entered directly from any other plot submode except Character Plot. However, it is more commonly entered automatically from Vector Mode, X0 Value. Following entry into the Vector Mode, Y0 Value submode, the next word defines the Y0 Value of the vector being drawn. This Y0 value must be in the range of 0 to 191 (larger values will have 192 subtracted). Following receipt of the Y0 Value, the vector is drawn and the terminal is placed automatically in the Vector Mode, X0 Value submode.

Code 255 terminates the submode and the general plot mode. Other plot submodes may be entered directly from Vector Mode, Y0 Value by entry of the appropriate code.

Incremental Vector Mode — Code 240 binary

After entry into the general plot mode, the Incremental Vector Mode is entered by a binary 240 code or via a keyboard CONTROL 0 or F0. It may be entered also from any other plot submode except Character Plot. However, when entered from any submode other than the Vector Mode the results may be somewhat difficult to predict.

Following entry into the Incremental Vector Mode, the next word defines the increments in X0, Y0, X1 and Y1 point values for the vector from X1,Y1 to X0,Y0. This word may be in the range of 0 to 239. (Codes 240 through 255 are used for plot submodes.)

As in the XY Incremental Point Plot submode, the word has two bits available for each of the four point coordinates (X0, Y0, X1 and Y1). In this case a "1" in the bit location defines the incremental change as shown in the table following on the next page.

B7	B6	B5	B4	B3	B2	B1	B0
X1+1	X1-1	Y1+1	Y1-1	X0+1	X0-1	Y0+1	Y0-1

If both bits describing a point are 1 or 0, no increment will take place —
e.g., if both B5 and B4 are 1 or both are 0, then there will be no
increment for the Y1 point.

A vector will be drawn only when both halves (B0 through B3 and B4 through
B7) are non-zero. If either half of the word is all zero, then the X,Y
corresponding to the other half will be changed but no vector drawn. This
enables "skip" of points.

The Incremental Vector Mode does not transfer control automatically to any
other mode. It remains in this incremental mode until terminated by a plot
submode code. Therefore, a series of incremental movements in both X0,Y0
and X1,Y1 may be made by sending consecutive incremental change words.

Any other plot submode may be entered directly from the Incremental Vector
Mode by entry of the appropriate code. Code 255 terminates both the
submode and the general plot mode.

As one example, the Incremental Vector Mode may be used to create a solid
triangular area (ALPHA LOCK up):

Function	By Code Via Host I/O	By Keyboard Operations
Enter Plot Mode	2	CONTROL B
Define X1,Y1 as 65,65	65 65	SHIFT A (upper case letter) SHIFT A
Enter Vector Mode, X0	242	CONTROL 2 or F2
Define X0,Y0 as 90,90	90 90	SHIFT Z (upper case letter) SHIFT Z

      (vector drawn from 65,65 to 90,90)

Enter Incremental Vector Mode	240	CONTROL 0 (zero) or F0
Increment X1, decrement Y0 and plot new vector	129	CONTROL SHIFT A

      (the binary code word is 1 0 0 0 0 0 0 1
which redefines the vector end points as
66,65 and 90,89 and plots a new vector
between these points)

Continue process until triangle is complete	129	CONTROL SHIFT A twenty-four more times

(additional vectors are plotted, the final "vector" being a one-block plot)

Exit plot mode	255	CONTROL ? or F15

As another example the following, which creates a small diagonally shaded rectangular area, uses a number of the features of the Incremental Vector Mode, including the skip feature. The area is begun with one point. Then a second point three blocks higher is defined. Next the Vector Mode is entered and a vector plotted. The Incremental Vector Mode then is entered and the original vector end points moved (first one end, then the other) without plotting. Then both end points are moved and a new vector plotted. In this example the ALPHA LOCK key can be down.

Function	By Code Via Host I/O	By Keyboard Operations
Enter general plot mode	2	CONTROL B
Define the lower right corner of rectangle	80 80	P (upper case letter) P

(Plot block intensified at point 80,80)

Define one end point for start of a vector	80 83	P S

(Plot block intensified at point 80,83)

Enter Vector mode, X0	242	CONTROL 2 or F2
Define X0,Y0 as 77,80	77 80	M (upper case letter) P

(Vector drawn from 80,83 to 77,80)

Enter Incremental Vector Mode	240	CONTROL 0 (zero) or F0
Increment X1,Y1 upward twice without plotting	32 32	SHIFT 0 (zero) SHIFT 0
Decrement X0,Y0 left twice without plotting	4 4	CONTROL D CONTROL D

(The binary code words for these two movements are 0 0 1 0 0 0 0 0 and 0 0 0 0 0 1 0 0. When either B0-B3 or B4-B7 are all zero, there is point movement but no plot.)

Increment Y1, decrement X0 and plot	36	SHIFT 4

           (The binary code word 0 0 1 0 0 1 0 0
           moves both end points and causes a new
           vector to be drawn from 80,86 to 74,80.)

Increment without plot	32,32	SHIFT 0 two times
Decrement without plot	4, 4	CONTROL D two times
Increment, decrement, plot	36	SHIFT 4

           (Vector drawn from 80,89 to 71,80.)

Increment without plot	32,32	SHIFT 0 two times
Decrement without plot	4, 4	CONTROL D two times
Increment, decrement, plot	36	SHIFT 4

           (Vector drawn from 80,92 to 68,80.)

Decrement X1,Y1 left twice without plotting	64 64	@ @

           (Here the binary code is 0 1 0 0 0 0 0 0,
           which decrements X1, leaves Y1 unchanged and
           does not plot — bits B0-B3 are all zero.)

Decrement X0,Y0 left twice without plotting	4 4	CONTROL D CONTROL D
Decrement both and plot	68	D

           (The binary code word 0 1 0 0 0 1 0 0
           leaves the Y values unchanged, decrements
           both X1 and X0 and plots a new vector
           from 77,92 to 65,80.)

Decrement without plot	64,64	@ two times
Decrement without plot	4, 4	CONTROL D two times
Decrement both and plot	68	D

           (Vector drawn from 74,92 to 62,80.)

Decrement X1,Y1 left twice without plotting	64 64	@ @
Increment X0,Y0 upward twice without plotting	2 2	CONTROL B CONTROL B

Decrement, increment, plot   66   B

        (Vector drawn from 71,92 to 62,83.)

Decrement without plot   64,64   @ two times

Increment without plot   2, 2   CONTROL B two times

Decrement, Increment, plot   66   B

        (Vector drawn from 68,92 to 62,86.)

Decrement without plot   64,64   @ two times

Increment without plot   2, 2   CONTROL B two times

Decrement, increment, plot   66   B

        (Vector drawn from 65,92 to 62,89.)

Decrement without plot   64,64   @ two times

Increment without plot   2, 2   CONTROL B two times

Decrement, increment, plot   66   B

        ("Vector" drawn from 62,92 to 62,92 — one block.)

Exit plot mode   255   CONTROL ? or F15

The result should be a series of diagonal lines defining a rectangular
area.

This completes the description of the operation of the Intecolor 8810
terminal in the various plot submodes. As a general reference, Appendix B
summarizes most of the plot submode functioning.

Page reserved for future use

ANSI X3.64 Control Sequences

The Intecolor 8810 Terminal has several control sequences based upon the American National Standards Institute X3.64 Standard. These are in addition to the control sequences found in the F8001G Terminal.

The ANSI standard allows commands to include arguments of varying lengths. The arguments are interpreted in accordance with the final character in the command sequence. This flexible format permits the command set to be expanded without extensive rewriting of terminal software. It also permits a terminal to ingore them if it is not equipped to execute them.

The command structure for many ANSI sequences is as follows:

> The command begins with a Control Sequence Introducer.
> A variable number of numeric arguments (parameter values) follow.
> The numeric arguments are set off by semicolons.
> A final character defines the operation to be performed.

* The control sequence introducer (CSI) is an ASCII Escape code followed by a left bracket: ESC [

* A numeric parameter value is always in the range of 0-255 decimal and is given as a string of ASCII numeric characters. Numeric parameters include items such as x and y coordinates.

* A selective parameter value is a special type of numeric value. Selective parameters distinguish subfunctions within the general functions indicated by the command's final control character.

* Semicolon delimiters only are used to separate parameter values in a sequence. No delimiter is used between the control sequence introducer and the first parameter value. No delimiter is used between the last parameter value and the final control character.

* The control character is an ASCII upper case or lower case alpha character or punctuation mark other than the semicolon. Such a character always terminates the command sequence when received following the CSI. The control character indicates a major terminal function, in terms of which the preceeding parameter values are interpreted. The number of parameters evaluated in a command sequence depends upon this character.

NOTE: An ASCII control code may be embedded in an ANSI command sequence. If the terminal receives a control code following reception of the CSI and before the reception of the ANSI control character, the control code is treated as not belonging to the sequence and is acted upon as usual. The ANSI sequence is acted upon subsequently when the ANSI control character has been received.

The ANSI command sequences presently available in the 8810 Terminal are described on the following pages.

KAM Keyboard Action Mode   —   HOST to Terminal

    ESC [2 h   —   to Set Mode (SM)

    ESC [2 l   —   to Reset Mode (RM)

(The final character in the sequence above is a lower case L.)

The set state disables the keyboard. Keyclick will not sound when a key is pressed.

The reset state enables the keyboard. When keys other than CONTROL or SHIFT are pressed, keyclick will sound if ON in the SET-UP menu.

(Note that if the Host has set KAM and fails to reset it, the operator may regain control of the keyboard by pressing the SETUP key.)

SM Set Mode   — HOST to Terminal

    ESC [Pn ; Pn ... Pn h

The Set Mode (SM) command sequence sets one or more of the ANSI modes within the terminal as specified by the selective parameters. Each mode to be set is specified by a separate parameter. The valid selective values are:

Parameter	Mode	Function
0, 1	***	** Not assigned **
2	KAM	Keyboard Action Mode — if set, this mode locks the keyboard.
29	PDFK	Default Function Key Mode - if set, function keys transmit their default values.
31	PFFK	Fast Function Key Mode — if set, characters in a function key sequence are transmitted as fast as the terminal's processing time and baud rate will allow.

RM   **Reset Mode**   — HOST to Terminal

ESC [Pn ; Pn ... Pn l

(The last character in the above sequence is a lower case L.)

The Reset Mode (RM) command sequence resets one or more of the ANSI modes within the terminal as specified by the selective parameters. Each mode to be reset is specified by a separate parameter. The valid selective values are listed below.

Parameter	Mode	Function
0, 1	***	** Not assigned **
2	KAM	Keyboard Action Mode — if reset, unlocks the keyboard.
29	PDFK	Default Function Key Mode — if reset, function keys generate their user-assigned values.
31	PFFK	Fast Function Key Mode — if reset, characters in function key sequence are transmitted at rate of 60 per second.

SCS   **Select Character Set**   — HOST to Terminal

This command assigns one of seven possible character sets as the special character set for display. Three of the sets -- special PROCESS characters, ASCII lower-case/control representation characters and Forms (line drawing) characters -- are standard on all 8810 terminals. The remaining four are optional sets.

Control Sequence	Character Set
ESC (B	ASCII Lowercase and Control Representation Characters
ESC (C	Special PROCESS character set
ESC (D	Forms (line drawing) character set
ESC (E	Optional set #1
ESC (F	Optional set #2
ESC (G	Optional set #3
ESC (H	Optional set #4

Note that (follows ESC, not the usual [.

PFI Power Failure Indicator   — HOST to Terminal

ESC [0 n   Host asks, "Have you had a power failure
                                         resulting in hardware reset since my last
                                         request of this nature?"

The host computer uses the above sequence to determine whether the
terminal has been powered down -- and thus lost the content of its
screen memory -- since the last such request. The power down could
result from power failure sufficient to cause hardware reset as well
as from operation of the power switch to the off position.

The terminal, assuming it is on line at the time of the request,
responds with one of the following sequences:

ESC [0 n   Meaning, "I have had no power turn off or
                                         interruption sufficient to cause hardware
                                         reset since your last such request."

ESC [3 n   Meaning, "I have had a hardware reset since
                                         your last such request."

SP   Select Page   — HOST to Terminal

ESC [Pn ; Pn ; ... Pn p

              where Pn is in the range of 0 to 255

This command sequence specifies actions involving the screen pages.
All characters following the command in the data stream will be
diverted to the currently accessible screen page — which may or may
not be visible on the CRT. Up to nine parameters may be sent in one
command sequence.

| Parameter	Definition
0	** Reserved **
1	Set accessible page #1
2	Set accessible page #2
3	Set accessible page #3
4	Set accessible page #4
5 to 9	** Reserved **
10	Blank the displayed screen immediately
11	Set displayed page #1
12	Set displayed page #2
13	Set displayed page #3
14	Set displayed page #4
15 to 255	** Reserved **

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The 8810 may have, with options, up to four pages of screen memory. Each page has its own visible cursor, blind cursor, color attributes, plot modes and data.

Only one page can be displayed upon the screen at a given time. Also, only one page can be accessible for data entry at a given time. The "displayed" page and the "accessible" page are not necessarily the same page. If the pages are the same, data entered on the accessible page is immediately visible on the CRT screen. However, if the pages are not the same, data entered on the accessible page is not immediately visible. It becomes visible only when that page becomes the displayed page.

The diagram below illustrates page access and display.

> Parameters 1 through 4 set the left hand switch to select the page for CPU access for read or write.
>
> Parameters 11 through 14 set the right hand switch to select the page to be displayed on the CRT screen.
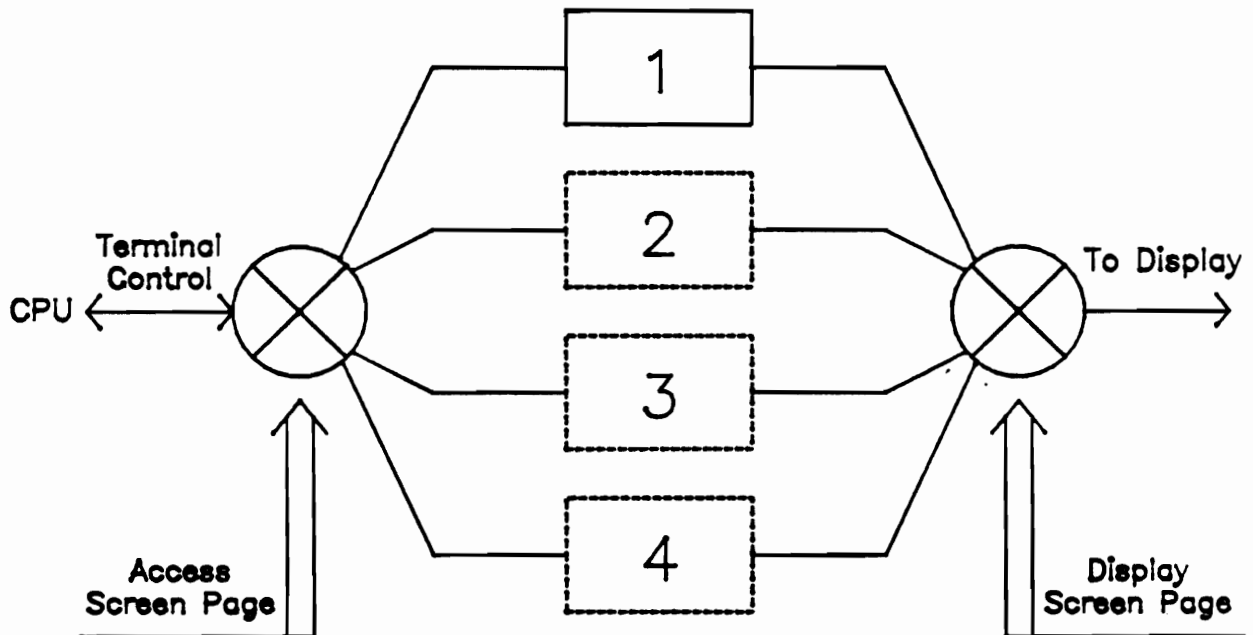
Further notes:

> When the accessible page has been filled, entry of additional data will cause upward scroll (if in scroll mode) or wrap to top of screen (if in page mode). Data formerly at the top of the page will be lost in scroll mode. In page mode new data entered will replace the old, starting at the top of the page.
>
> Entry to the Setup mode destroys existing data on the highest numbered page. If there is only one page of screen memory, entry to Setup effectively erases the previously existing screen display. Exit from Setup will be to a blank screen.

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PPFK (Private) Program Function Key   — HOST to Terminal

ESC [Pk ; Pn ; Pn ; ... Pn ; s

where Pk = number of Function key, 0 through 63

Pn = decimal code of character in key definition in
the range of 0 through 255 (although codes above
127 should be used with caution)

and the Control Sequence Termination character is a
lowercase s

This command permits the host to load definitions of up to 40
characters each for function keys in the terminal's RAM.

In software versions 1.2 and above, the function keys F0 through F15
can be programmed in this fashion. In the 1.7 software version, up to
48 function key definitions can be loaded.

Function keys alone	16
Function keys with SHIFT	16
Function keys with CONTROL	16

Software version 2.0 will permit 64 definitions, adding function keys
with COMMAND to the list.

When the key alone (without SHIFT or CONTROL) is to be defined,
it's number for Pk in the command sequence is the corresponding 0
to 15.

When SHIFT is to be used with the function key, 16 is added to the
number. (Function key F2 with SHIFT down becomes 2 + 16 = 18.)

When CONTROL is to be used with the function key, 32 is added to
the number. (Function key F2 with CONTROL down becomes 2+32=34.)

When COMMAND is to be used with the function key, 48 is added to
the number. (Function key F2 with COMMAND down becomes 2+48=50.)

The key definition values Pn normally should be in the ASCII range of
0 to 127 decimal. Greater values must be used with caution. For
example, a function key may be defined for plot of a graphic pattern
such as vectors to form a rectangle. However, in such a definition
X-Y values greater than 127 can produce odd results. Also, no
function key definition may reference another function key.

Definitions down loaded from the host are loaded in volatile RAM and
thus are not saved at power down. Definitions loaded from the
keyboard with this ANSI type sequence also are not saved at power
down. (Key definitions can be saved only when loaded from the
keyboard in the Setup Mode, as described later in this section.)

Examples: The sequence below loads the message TEST F2 into function key F2. Following this loading the message will be transmitted whenever the F2 key is operated. The sequence is listed by the ASCII characters involved.

ESC [2;84;69;83;84;32;F;50;s

The host would send the binary equivalents of decimal codes, as shown below.

ESC [2 ; 8 4 ; 6 9 ; 8 3 ; 8 4 ;
27 91 50 59 56 52 59 54 57 59 56 51 59 56 52 59

3 2 ; 7 0 ; 5 0 ; s
51 50 59 55 48 59 53 48 59 115

From the keyboard, with Echo on or in Local mode, the keys shown on the first line could be used. Keys would be operated in sequence, without spaces.

The usual reason to define a function key or combination is to relieve the operator of typing of phrases used extensively. In such cases the definitions consist of the codes for ASCII characters. The keys can be defined for other uses, such as certain graphics patterns. However, caution must be employed in such use.

An example used for plot of a vector could be:

ESC [21;2;50;50;242;125;125;255;s

Following the loading, operation of the F5 key with SHIFT (5+16=21) would cause a vector to be drawn from point 50,50 to point 125,125. The '2' in the sequence places the terminal in the plot mode. A point is plotted at point 50,50. '242' places the terminal in the vector submode and the vector is drawn to point 150,150. Then '255' causes the terminal to exit the plot mode.

In current software, X-Y values should remain in the range of 0 to 127. Values above 127 produce odd results.

A function key could be used for color change:

ESC [32;14;6;39;s

Then operation of the F0 key with CONTROL (0+32=32) would result in subsequent characters being displayed in white on blue, double height. '14' in the sequence sets the A7 bit on for double height. '6' causes entry to the CCI mode, where 39 specifies blue background and white foreground. Again, the value following the '6' should be no more than 127 (and normally there is no need to exceed this value).

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Following loading of the function key definition, the characters defined will be transmitted each time the function key is operated. For instance, assuming the F2 key were programmed as described on the previous page, operation of the F2 will cause the terminal to send the sequence TEST F2 to the host. If Echo is on, the message also will be displayed on the terminal screen. If the terminal had been returned to the Local mode, the message would be displayed on the CRT screen, but there would be no transmission out the serial port.

The sequences just described load the function key definitions in RAM; they are lost at power down.

Function key definitions can be saved in non-volatile RAM if they are loaded from the keyboard in the Setup Mode and saved. Any key definition may contain up to 40 characters. However, the total space in non-volatile RAM available for this use, approximately 1000 bytes, will not allow all function key combinations to have 40-character definitions saved in this fashion.

To program the keys from the keyboard:

1) Enter the Setup Mode by holding down a SHIFT key and pressing the SETUP key. The HOST I/O MENU is displayed.

2) With the HOST I/O MENU displayed, operate the function key (F0 to F15) to be programmed. (Hold down the SHIFT, CONTROL or COMMAND key while pressing the function key if one of these combinations is to be programmed.)

3) Directions for programming the function key will be displayed.

4) Use the keyboard to type in the definition. (Remember that the function keys themselves cannot be used in the definition.)

5) Then operate the function key (or combination) again. The HOST I/O MENU display returns.

6) Other function keys may then be defined, using the same procedure.

7) If the definitions are to be saved, press the 'l' key to SAVE the current setup menu prior to exiting the Setup Mode.

8) After exiting the Setup Mode by operation of the RETURN key, the function key definitions will be in effect.

CONTROL CODE SUMMARY

Code	Character	Function

0 Control @ Has no effect
1 Control A **Protect** Mode is entered
2 Control B **Graphic Plot** Mode is entered (see plot submodes)
3 Control C **Cursor XY** address mode for either visible or blind cursor

4 Control D Reserved
5 Control E Reserved
6 Control F **CCI** Mode entered — next character defines visible status
7 Control G **Bell** — 150 millisecond tone sounds

8 Control H **Home** — cursor moves to top left corner of display
9 Control I **Tab** — cursor advances to next column
10 Control J **Line Feed** — cursor moves down one line
11 Control K **Erase Line** — line erased, cursor moves to left margin

12 Control L **Erase Page** — screen erased, cursor moves to home position
13 Control M **Return** — cursor moves to left margin of present line
14 Control N **A7 On** — x2 character height, or set one stop bit
15 Control O **Blink/A7 Off** — both Blink Bit and A7 Flag turned off

16 Control P **Black** Color
17 Control Q **Red** Color
18 Control R **Green** Color
19 Control S **Yellow** Color   Sets foreground color if Flag
                                         is off — sets background color
20 Control T **Blue** Color   if Flag is on
21 Control U **Magenta** Color
22 Control V **Cyan** Color   .
23 Control W **White** Color

24 Control X **Transmit** — starting from visible cursor position
25 Control Y **Cursor Right** — cursor moves right one position
26 Control Z **Cursor Left** — cursor moves left one position
27 Control [**Escape** — entry to Escape Code table, added code required

28 Control \ **Cursor Up** — cursor moves up one line
29 Control] **Flag Off** — sets the Flag Bit off
30 Control ^ **Flag On** — sets the Flag Bit on
31 Control _ **Blink On** — sets Blink Bit on to cause foreground blink

Control is exercised by specified code received at first RS-232-C port or by operation of the specified key with the CONTROL key held down. Some control codes require additional characters or codes for completion.

ESCAPE CODE SUMMARY

Code Character Function

Code	Character	Function
0	@	Reserved
1	A	**Blind Cursor** Mode entered
2	B	Character **Plot via Color Pad**
3	C	**Transmit Cursor X,Y** position — visible character & status
4	D	Reserved
5	E	Reserved
6	F	Set **Full Duplex** — sets terminal on line without echo
7	G	Reserved
8	H	Set **Half Duplex** — sets terminal on line with echo
9	I	Reserved
10	J	**Write Vertical** Mode set
11	K	**Scroll** Mode
12	L	Set **Local** Mode — keyboard operations go to screen only, screen also responds to line input
13	M	**Screen Dump to Printer Serial Output Port**
14	N	Reserved
15	O	Reserved
16	P	Reserved
17	Q	**Character Insert**
18	R	Reserved
19	S	Reserved
20	T	**Medium Resolution Graphics** (8820) or **Write Right to Left**
21	U	**Insert Line**
22	V	**Delete Line**
23	W	Reserved
24	X	**Page Mode** set, with Write Left to Right
25	Y	**Test** — page filled with next character
26	Z	**45 Degrees Write Down** mode set
27	ESC	**Visible Cursor** mode set
28	\	**Erase Medium Resolution** (8820) or **45 Degrees Write Up**
29	]	**Block Receive** — display starts at blind cursor location
30	^	Reserved
31	_	Reserved

Code 27 or operation of the ESC key is required before entry of the escape
code or operation of the specified key. Some escape codes require entry of
additional codes or additional key operations for completion of the
sequence.

GRAPHIC PLOT SUBMODE SUMMARY

RS-232 Input Code	Plot Submode	Normal Keyboard Operation	Function Key Operation
255	Plot Mode Escape	Control ?	F 15
254	Character Plot	Control >	F 14
253	X Point Plot	Control =	F 13
252	Y Point Plot	Control <	F 12
251	X-Y Incremental Point Plot	Control ;	F 11
250	X_O of X Bar Graph	Control :	F 10
249	Y of X Bar Graph	Control 9	F 9
248	X max of X Bar Graph	Control 8	F 8
247	Incremental X Bar Graph	Control 7	F 7
246	Y_O of Y Bar Graph	Control 6	F 6
245	X of Y Bar Graph	Control 5	F 5
244	Y max of Y Bar Graph	Control 4	F 4
243	Incremental Y Bar Graph	Control 3	F 3
242	X_O Vector Plot	Control 2	F 2
241	Y_O Vector Plot	Control 1	F 1
240	Incremental Vector Plot	Control 0	F 0

Incremental Direction Code Summary

	$\triangle$X1		$\triangle$Y1		$\triangle$X2		$\triangle$Y2	
If bit = 1	A7	A6	A5	A4	A3	A2	A1	A0
Direction	+	−	+	−	+	−	+	−
Value (Hex)	80	40	20	10	8	4	2	1
(Decimal)	128	64	32	16	8	4	2	1

ANSI X3.64 CONTROL SEQUENCE SUMMARY

KAM **Keyboard Action Mode** — HOST to Terminal

    ESC [2 h   — to Set Mode
    ESC [2 l   — to Reset Mode

PFI **Power Failure Indicator** — HOST to Terminal

    ESC [0 n   — asking, "any hardware reset since last request?"

    Terminal responds ESC [0 n for "no" or ESC [3 n for "yes"

RM **Reset Mode** — HOST to Terminal

    ESC [Pn ; Pn ... Pn l

    (Where Pn identifies the functions being reset)

SCS **Select Character Set** — HOST to Terminal

    ESC (x

    (Where x is the set identifier B, C, D, E, F, G or H)

SM **Set Mode** — HOST to Terminal

    ESC [Pn ; Pn ... Pn h

    (Where Pn identifies the functions being set)

SP **Select Page** — HOST to Terminal

    ESC [Pn ; Pn ; ... Pn p

    (Where Pn as 1, 2, 3 or 4 selects page to be accessible and as 11,
    12, 13 or 14 selects page to be displayed. 10 blanks screen.)

In the command sequences, where "l" appears at the end of the sequence, it is a lower case letter L.

Light Pen Operation

The Intecolor Light Pen, available as Option 28, is designed to move the cursor on the terminal CRT screen to a desired position. The user simply points the pen to the desired screen position and touches the touch-sensitive end of the pen with a finger. Actuation of this touch-sensitive switch causes the pen to look for color on the screen at that point. When it signals detection of color, the CPU moves the cursor to that point.

When the pen is activated, it is allowed two frames (two CRT vertical scans) to detect color at the desired point. Then if no color has been detected — as would be the case if that point on the screen were blank — a series of blue strike-through lines is initiated. In each data row two of the horizontal scans are in blue, ensuring that there is color at each character position.

As long as the touch-sensitive switch on the light pen remains activated, the cursor follows the pen to any display position. Blue strike-through is initiated when there is no color on the screen at the point under the light pen.

When the cursor is at the desired location and the finger is lifted from the touch-sensitive switch, normal display is resumed and software causes a 7-word sequence to be sent to the Host Serial I/O Port:

3	Cursor X-Y Code
X	X Cursor Coordinate
Y	Y Cursor Coordinate
6	CCI Code
Status	Status Character
ASCII	ASCII, Special or Plot Character
ØD	Carriage Return
	(optionally 8D)

This sequence is transmitted only when the light pen is activated (by the finger touching the touch-sensitive switch area of the pen or by the pen being pressed against the CRT face), color is detected by the pen, and then the light pen is deactivated (by lifting the finger from the end of the pen and lifting the pen from the CRT face).

> **CAUTION!** When the light pen is activated, the terminal may very well transmit an XOFF to the host -- the CPU is monitoring the light pen, likely for a second or two, and the input buffer can fill. Further, the code for the X or Y cursor coordinate could be the code for XOFF. So the host's operating system flow control should be disabled by receipt of code 3. (The terminal's codes for Xon/Xoff are selected in the Setup mode as Ø6/Ø7 or 11/13 hex.)

There is one adjustment for light pen sensitivity. This adjustment is in the pen itself. The procedure is outlined on page 4.30.

Operation with Color Printer

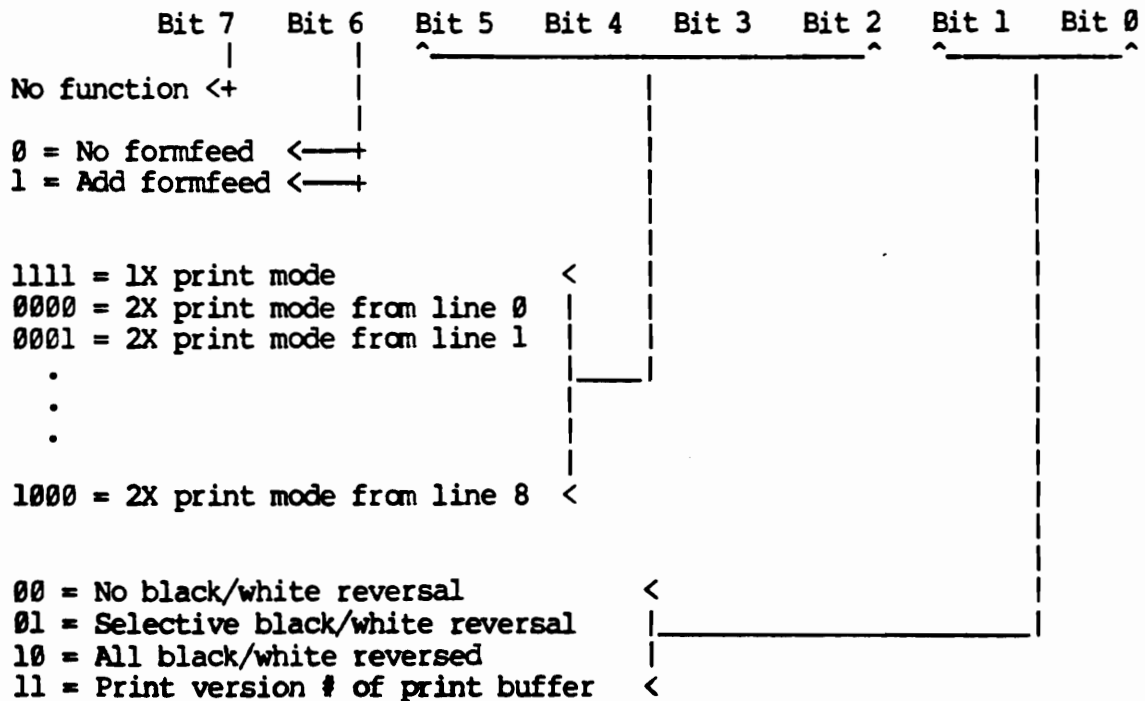Standard 8810 software includes drivers for a color printer.

The serial-to-parallel buffer for the printer is connected to the 8810's Serial 3 - Printer port (J4). (The color printer package available from Intecolor includes the required cable and all necessary instructions. For other, see page 2.06 for cable terminal connections.)

For a screen dump to the buffer for the color printer:

1. With the terminal in the Setup mode, select 9600 Baud, No Parity.

2. Exit the Setup mode. Verify that the screen display is as desired.

3. Execute an Escape M sequence. (Alpha Lock key in the down position; press and release the ESC key, then the M key; then a key combination to specify the print parameters.)

                `<ESC> M Pn`

where Pn specifies the print parameters as follows.

```
            Bit 7   Bit 6   Bit 5   Bit 4   Bit 3   Bit 2   Bit 1   Bit 0
              |       |     ^_____^     ^_____^
No function <+        |                     |                    |
                      |                     |                    |
0 = No formfeed  <---+                     |                    |
1 = Add formfeed <---+                     |                    |
                                           |                    |
                                           |                    |
1111 = 1X print mode              <        |                    |
0000 = 2X print mode from line 0  |        |                    |
0001 = 2X print mode from line 1  |        |                    |
   •                              |___|                    |
   •                              |                         |
   •                              |                         |
                                  |                         |
1000 = 2X print mode from line 8  <                         |
                                                            |
                                                            |
00 = No black/white reversal            <                  |
01 = Selective black/white reversal     |_____|
10 = All black/white reversed           |
11 = Print version # of print buffer    <
```

Note that the most significant bit 7 serves no function. The functions of other bits in the parameter code are are described in greater detail on the next page.

In the parameter code Pn of the <ESC> M Pn sequence:

Bit 6 determines whether the printer will perform a formfeed at the end of the print. With bit 6 high there will be a trailing formfeed. With bit 6 low there will be no formfeed.

In the color printer available from Intecolor, the trailing formfeed advances the paper approximately 1 1/8 inches. If the print begins when the paper is even with the tear-off bail at the top of the printer and tear-off is made after the trailing formfeed, the printed image will be fairly well centered on the paper.

Bits 5 through 2 specify the print as single-height or double-height. For double height the area of screen to be reproduced also is specified.

All four bits high (1111) cause the image to be oriented horizontally on the paper, with the image about 5.75 inches wide and 4.5 inches high. All 48 character rows of the CRT display are printed.

Bit patterns of 0000 through 1000 cause the image to be oriented vertically on the paper, making it approximately 5.75 inches by 9 inches. However, not quite all of the CRT screen display can be reproduced in the 2X mode. Bit pattern 0000 causes the top 40 rows (rows 0 through 39) of characters (ASCII or plot block) to be used. 0001 causes use of rows 1 through 40, 0010 rows 2 through 41 and so on. Pattern 1000 causes use of the lower 40 rows 8 through 47.

(The limitation to 40 rows of characters in the 2X mode is predicated on a printer resolution of 640 dots horizontally. In the 2X mode, the printer's horizontal printing corresponds to the vertical on the CRT screen. On the CRT, each character row is 8 dots high and thus requires 16 dots in the 2X print mode. So at 16 dots per row, the printer's 640 dots can accomodate exactly 40 rows.)

Bits 1 and 0 concern mostly the handling of screen black and white in the printed image. Use of white paper in the printer is assumed.

The 00 pattern results in print of screen black as black and white as white. There is no reversal from CRT to paper.

The 01 pattern causes selective reverse of black and white. All screen black background is changed to white in the print. All screen white foreground on black background is changed to black in the print. Where black is foreground color or where white foreground is on background of other than black, the colors are not reversed.

The 10 pattern causes all screen black to be printed as white and all screen white to be printed as black.
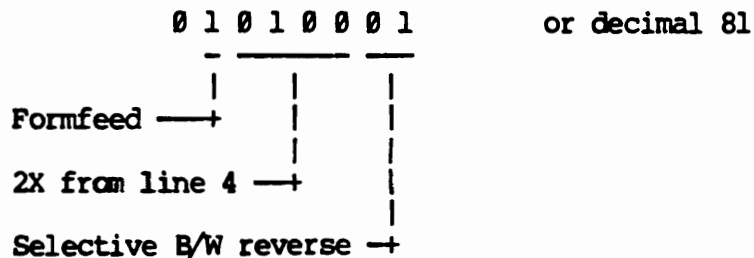
The 11 pattern of these two bits causes a print of serial-to-parallel buffer type and software version. When Pn has these two least significant bits high, all other bits are ignored until the next byte.

The table on the next page lists the key combinations for the commonly used parameter sets.

Commonly Used Values for Pn
in an <ESC> M Pn Sequence

Key Comb.	Binary Code	Decimal Code	1X	2X Lines Printed	No B/W Rever.	Select Rever.	All B/W Rever.	Form Feed
Ctr @	00000000	0	–	0 – 39	*	–	–	–
Ctr A	00000001	1	–	0 – 39	–	*	–	–
Ctr B	00000010	2	–	0 – 39	–	–	*	–
Space	00100000	32	–	8 – 47	*	–	–	–
!	00100001	33	–	8 – 47	–	*	–	–
"	00100010	34	–	8 – 47	–	–	*	–
<	00111100	60	*	– – –	*	–	–	–
=	00111101	61	*	– – –	–	*	–	–
>	00111110	62	*	– – –	–	–	*	–
@	01000000	64	–	0 – 39	*	–	–	*
A	01000001	65	–	0 – 39	–	*	–	*
B	01000010	66	–	0 – 39	–	–	*	*
`	01100000	96	–	8 – 47	*	–	–	*
a	01100001	97	–	8 – 47	–	*	–	*
b	01100010	98	–	8 – 47	–	–	*	*
|	01111100	124	*	– – –	*	–	–	*
}	01111101	125	*	– – –	–	*	–	*
~	01111110	126	*	– – –	–	–	*	*
?	00111111	63	Prints out version number of printer buffer					

Other combinations may be determined by use of the code chart in Appendix A-3. For example, to use the 2X mode for lines 4 through 43 with selective reversal of black and white and a trailing formfeed, the binary code from the previous pages is:

```
            0 1 0 1 0 0 0 1          or decimal 81
            -  ----- ---
            |     |   |
Formfeed ——+     |   |
                 |   |
2X from line 4 ——+   |
                     |
Selective B/W reverse —+
```

An upper case Q generates the required code.

Medium Resolution Graphics

Medium resolution graphics are available in the Intecolor 8820, 3820 and 3870 Terminals.

The Medium Resolution Graphics package enables one to address each dot in a 480 x 384 grid for color as well as for location. The Graphics Mode software includes subroutines for generation of vectors, arcs, circles and rectangles as well as for point plots. Lines may be solid, dashed or dotted. The Graphics Mode also provides for definition of the "super-pixel" (4x4) in any of over 4000 distinct colors and for the generation of bars made up of super-pixels. There is also the facility for filling a region with a color or a pattern.

The medium resolution graphics display and the standard alphanumeric display are separate. They overlay each other. Each may be changed or erased without affecting the other. The medium resolution graphics display can be generated off screen and then presented in the time of one vertical CRT sweep. This versatility provides a powerful tool for creation of graphics displays.

The memories for the graphics display are entirely separate from the standard screen refresh memory. Output from the graphics memory for screen display is OR'd with the companion standard alphanumeric video color signal. Graphics memory input and output are under control of the Graphics Mode software.

In the medium resolution terminals, all the features of the standard 8810/3810/3860 terminals remain available except the Write Right to Left Mode and the 45 Degrees Write Up Mode.

In the medium resolution graphics terminals, ESC T is used for entry into the Medium Resolution Graphics Mode (rather than Write Right to Left).

ESC \ is used to erase the accessible page of medium resolution memory when the terminal is not in the Medium Resolution Graphics Mode (rather than 45 Degrees Write Up).

(Important hardware note: The medium resolution terminals have, in addition to an added graphics generator board, a minor modification in the logic board — the IC in location U78 must be removed.)

The content of this section for Medium Resolution Graphics is indicated on the page at right.

Graphics Mode Command Summary

The Graphics Mode is invoked by an ESC T sequence. All commands within the Graphics Mode are single character plus parameter(s). Exit from the Graphics Mode is via the question mark (?) character. The commands may be entered via the keyboard (local) or from the host computer via the serial I/O port (line).

Command Character	Decimal Code(s)	Function		Comment
ESC T	27,84	Enter Graphics Mode	From CRT Mode	
ESC \	27,92	Clear Graphics Screen	When in CRT Mode	
%	37	Relative Vector	%X,Y,	
(	40	Circle	(X,Y,r,	r = radius
*	42	Display Super-Pixel	*X,Y,	X,Y = lower left corner of super-pixel
+	43	Concatenated Vector	+X,Y,	
.	46	Point	.X,Y,	
/	47	Vector	/X1,Y1,X2,Y2,	
:	58	Relative Point	:X,Y,	
<	60	Rectangle	<X1,Y1,X2,Y2,	
?	63	Exit Graphics Mode		
A	65	Arc	AX,Y,r,s,e,	r = radius s = starting angle e = ending angle
B	66	Super-Pixel Bar	BX,Y,w,h,	X,Y = lower left corner of bar w = bar width in super-pixels h = bar height in super-pixels
C	67	Clear	Cp,	p = plane(s): 0-7
D	68	Display Enable	Dp,	p = plane(s): 0-7
E	69	Fill Screen	Ep,	p = plane(s): 0-7

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F	70	Fill Region	FX,Y,c,t,	X,Y = interior point c = boundary color t = pattern choice
H	72	Select Color Number	Hn,	n = color number
I	73	Init Color Definition	I	
J	74	Set Color Definition	Jn,c,	n = color number c = color
L	76	Line (vector)	LX1,Y1,X2,Y2,	
P	80	Set Fill Pattern	P12345678	digits = pattern
R	82	Read Point	RX,Y,	
S	83	Define Super-Pixel	Sh,s,i,	h = hue 0-95 s = saturation 0-16 i = intensity 0-16
T	84	Line Style	Tn1,n2,	n1 = dots on n2 = dots off
W	87	Write Enable	Wp,	p = plane(s): 0-7
[	91	Open Polygon Definition		
]	93	Close Polygon Definition		

Note that where alpha characters are used as commands they are uppercase.
Each parameter is followed by a delimiter -- a comma, space, tab or
linefeed.

Parameter Entry

Under the Graphics Mode, the parameters may be entered in either of two forms:

1) Decimal values followed by delimiters:

A delimiter may be a comma, space, tab, line feed or carriage return. (The examples given in this manual use the comma.)

From the keyboard a parameter 150 can be entered by pressing the 1 key, the 5 key, the 0 key and the comma (,) key in sequence. From the host computer the string "150," would be sent.
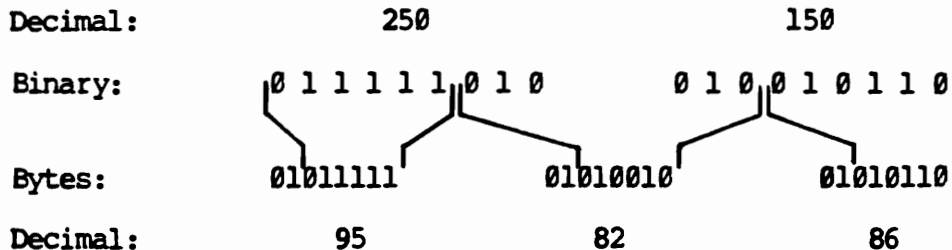
Two parameters such as 250 and 150 would be entered from the keyboard by successive strokes of the 2, 5, 0, comma, 1, 5, 0 and comma keys. From the host computer the string sent would be "250,150," — eight codes in all.

2) Pack of parameters into binary notation:

This method permits higher transmission rates by packing two parameters into three successive codes. The binary pack(s) of parameters for each command are preceded by the dollar ($) character (to indicate binary pack). The introductory $ (code 36) may be followed by enough binary code words to complete the set of parameters for any command.

Parameters for the medium resolution grid (480 x 384) are in the range of 0-511 decimal, which can be defined in nine binary digits — or a total of 18 digits for two parameters. Six digits are available in each of the three bytes (the least significant six bits). The second most significant bit (A6) must be turned on in each of the three bytes (causing all byte values to be in the range of 64-127 decimal or 40-7F hexadecimal).

To use the illustration for two parameters given above, 250 and 150 can be packed into binary notation by the codes 36, 95, 82, 86 (four codes instead of eight). The "packing" is done as follows:

Decimal:	250		150	
Binary:	0 1 1 1 1 1	0 1 0	0 1 0	0 1 0 1 1 0
Bytes:	01011111	01010010		01010110
Decimal:	95	82		86

These codes can be generated at the keyboard by use of the $ key, the _ (underline) key, the R key and the V key.

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Should a function require only one parameter, the parameter would be passed in two bytes, using only the upper nine bits of the 12 bits available. For example:

Decimal: 123

Binary: 0 0 1 1 1 1 0 1 1

Bytes: 01001111   01011000

Decimal: 79   88

These can be generated at the keyboard by the letters O and W.

The effect of the '$' symbol in designating binary pack ends at the conclusion of the parameters for a command. For example, the four parameters for a vector may be put in binary pack by the $ symbol followed by six codes. However, plot of two successive points requires the $ symbol followed by three codes and then a repeat of the '$' symbol before sending the next three codes.

The user may switch from one form of parameter passing to the other between functions, but not within the parameter list of a single function. The Graphics Mode determines whether decimal parameters are being passed by checking for ASCII characters 0-9 (codes 48-57) and the delimiter. The $ or code 36 indicates binary pack parameters follow. If the Graphics Mode encounters garbage character streams it simply ignores them.

Important Note: Except as indicated below, all parameters must be integers. When a formula used in a BASIC program may not result in an integer value, the function INT(x) must be used.

Graphics Mode Command Details

Graphics Mode commands may be exercised following entry into the Graphics Mode via an ESC T sequence. The single-character commands under the Graphics Mode include the characters listed in the summary on pages 3.64 and 3.65. In addition, the '$' symbol is used to indicate parameters in binary pack. A delimiter, which may be a comma, carriage return, linefeed, tab or space, follows each decimal parameter. Note the usual syntax for Graphics Mode commands (spaces are used for clarity):

[Command Character] [Parameter] [Delimiter]....[Parameter] [Delimiter]

or

[Command Character] $ [Codes for binary pack of parameters]

The use of these commands is described in the following pages. Examples assume uppercase characters, screen blank and color numbers set to their default colors. If other operations have resulted in different conditions, use an ERASE PAGE code to clear the standard resolution screen prior to the ESC T sequence. Then use I to set the color numbers to their default values. Use a sequence of C7, to clear the medium resolution screen.

Point

                    . [X parameter] , [Y parameter] ,

        or

                    . $ [three codes for binary pack of two parameters]

The Point command '.' followed by two parameters for X and Y defines the
plot of a single dot at point (X,Y). The lower left corner of the screen
is point (0,0). The X value is in the range of 0-479 decimal; the Y value
is in the range of 0-383. Each decimal value must be followed by a comma,
a space or other delimiter (or the binary parameter passing mode described
on page 3.66 may be used).

Entry of another pair of parameters results in plot of another point.
There is no need to repeat the '.' command for point plotting until some
other Graphics Mode command intervenes. (e.g., if after plot of a point
the write color is changed by a 'W' command, then it is necessary to
command '.' before entry of parameters for another point.)

Example: ESC T   To enter the Graphics Mode
            .240,192,   X,Y parameters, with commas as delimiters — dot
                                appears at mid-screen
            240,90,   Dot appears a few inches below first dot
            360,90,   Dot appears a few inches to right of last dot
            ?   Exit Graphics Mode

Relative Point

                    : [X increment] , [Y increment] ,

        or

                    : $ [three codes for binary pack of two parameters]

The Relative Point command ':' followed by two parameters for X and Y
values defines the plot of a single dot, location incremented by the
indicated amounts from the previous point. Entry of another pair of
parameters results in plotting of another point, incremented by the
indicated amounts from the last point — the relative point mode continues
until another Graphics Mode command is issued.

Increments downward or to the left are negative, so indicated by a '-' sign
preceding the value. Values without the '-' sign are considered positive
— upward or to the right.

Example: ESC T   Enter Graphics Mode
            .250,200,   Plot initial point near screen center
            :50,0,   Enter Relative Point mode and plot point to right
                                of first point
            0,50,   Another point, above last one
            -50,0,   Another point, to left of previous one
            ?   Exit Graphics Mode

Vector

or

/ [Xl value] , [Yl value] , [X2 value] , [Y2 value] ,

/ $ [six codes for binary pack of four parameters]

The Vector command '/' followed by four parameters for X1, Y1, X2 and Y2 defines a vector to be drawn from the point (X1,Y1) to the point (X2,Y2).

The Line command (L) followed by four parameters also may be used to define a vector or line.

L [Xl value] , [Yl value] , [X2 value] , [Y2 value] ,

Example: ESC T   Enter Graphics Mode
/100,200,50,350,   Vector from (100,200) to (50,350)
100,100,250,250,   Another vector from (100,100) to (250,250)
?   Exit Graphics Mode

Relative Vector

or

% [X increment] , [Y increment] ,

% $ [three codes for binary pack of two parameters]

The Relative Vector command '%' followed by two parameters for X and Y values defines a vector to be drawn from the previous point to a point offset by the indicated amounts. Offsets to the left or down are preceded by the '-' (minus) symbol. Values not preceded by '-' are assumed to be positive, to the right or up.

Example: ESC T   Enter Graphics Mode
.200,100,   Initial point
%100,100,   First vector, up and to right
100,-100,   Second vector, right and down
?   Exit Graphics Mode

Concatenated Vector

+ [X end value] , [Y end value] ,

The Concatenated Vector command '+' followed by two parameters for X1 and Y1 defines a vector to be drawn from the previous point (X0,Y0) to the designated point (X1,Y1).

Example: ESC T   Enter Graphics Mode
.100,100,   Starting point
+300,100,200,50,100,100,   Draw three concatenated vectors to
                                  form a triangle
?   Exit Graphics Mode

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Rectangle

                    < [lower left corner X] , [lower left corner Y] ,
                            [upper right corner X] , [upper right corner Y] ,
        or
                    < $ [Six codes of binary pack for four parameters]

The Rectangle command '<' followed by four parameters for X1, Y1, X2 and Y2
defines a rectangle with one corner at point (X1,Y1) and its diagonally
opposite corner at point (X2,Y2).

Example: ESC T   Enter Graphics Mode
            <100,100,300,300,   Enter Rectangle Mode, define corners
            ?   Exit Graphics Mode

Circle

                    ([X center] , [Y center] , [Radius] ,
        or
                    ($ [five codes of binary pack for three parameters]

The Circle command '(' followed by parameters for the center point and the
radius defines a circle.

Example: ESC T   Enter Graphics Mode
            (200,200,   Define circle center point
            100,   ·   Define radius
            ?   Exit Graphics Mode

Arc

                    A [X center] , [Y center] , [Radius] ,
                            [Start angle in degrees] , [End angle in degrees] ,
        or
                    A $ [eight codes of binary pack for five parameters]

The Arc command 'A' followed by parameters for the center point, the
radius, the start degree and the end degree defines an arc. The reference
for degrees is a line directly to the right from the center point. Degrees
are measured counter-clockwise from this point. All arcs are generated in
a counter-clockwise direction.

Example: ESC T   Enter Graphics Mode
            A300,100,   Arc with center at (300,100)
            150,   a radius of 150
            90,180,   arc from 90° to 180°
            ?   Exit Graphics Mode

Select Color Number

                H [color number] ,

The Select Color Number command 'H' followed by a parameter in the range
0-63 sets the foreground and background color numbers for the Graphics
Mode.   The parameter is the foreground color number + (8 x the background
color number).   For example, 'H43' sets the background color number to 5
(default of magenta) and the foreground color number to 3 (default of
yellow), i.e. 43 = 5x8 + 3.   Colors already on the screen are not affected
by the 'H' command.

Until the 'H' command is used for the first time, color numbers are the
same as in the character mode.   If the 'ESC \' command is later used while
in the character mode, colors return to those of the character mode.

Example: ESC T   Enter Graphics Mode
            H42,   Select color number 2 as primary (foreground)
                              and color number 5 as secondary (background)
            <0,0,50,50,   Small rectangle in color number 2
            H5,   Color number 5 primary, number 0 secondary
            (75,75,20,   Small circle in color number 4
            ?   Exit Graphics Mode without clearing screen

Set Color Definition

                J [present color number] , [new display color] ,

The Set Color Definition command 'J' followed by two parameters causes all
pixels of the first value or color number to be displayed in the second
color.   This affects present display as well as pixels entered for display
subsequently.   Note that the brush palette color rather than the screen
memory is changed — i.e., a different color is assigned to the pixel data
value in screen memory.   This command is useful for experimenting with
colors for a display without need to recreate the display for each change
of color.

Example: ESC T   Enter Graphics Mode
            J5,3,   Set color number 5 to yellow
                           Previously drawn circle changes from color number 5
                              to yellow (but memory content is not changed)
            J2,1,   previously drawn rectangle changes from color
                              number 2 to red (no change in memory content)
            ?   Exit Graphics Mode without clearing screen

NOTE: "Present color number" means the color number used when the display
was created.   For example, if the rectangle just changed from color number
2 to red is to be changed again to blue, the command is J2,4, — not
J1,4,.

Initialize Color Definition

                    I

The Initialize Color Definition command 'I' resets the values of all color
numbers to their default colors. The default definitions/values for the
color numbers are:

0-black 1-red 2-green 3-yellow 4-blue 5-magenta 6-cyan 7-white

This affects existing display by reseting the color map. If the created in
the two previous examples remains on the screen, an ESC T I sequence will
change the colors to their default values.

Fill Polygon

              [(define polygon)] color_number , pattern ,

The Fill Polygon command defines a polygon to be filled and then fills it
with a 'pattern' using a specified color number. The characters to open
and close the definition of the polygon are '[' and ']' respectively.

The defined polygon can be a series of points, a rectangle, a circle or pie
slice (defined as an arc). The other parameter values are:

    color_number   0 - 7   (fill is additive — overlays existing color)
                    10 - 17 (fill is destructive — replaces existing color)

    pattern   0 — empty (boundary only)
                     1 — solid
                    10 — horizontal lines (wide)
                    11 — horizontal lines (narrow)
                    12 — horizontal bars & stripes
                    20 — vertical lines (wide)
                    21 — vertical lines (narrow)
                    22 — vertical bars & stripes
                    30 — horizontal and vertical lines (wide)
                    31 — horizontal and vertical lines (narrow)
                    32 — horizontal and vertical bars & stripes
                    40 — 45 degree right diagonal lines (wide)
                    41 — 45 degree right diagonal lines (narrow)
                    42 — 45 degree right diagonal bars & stripes
                    50 — 45 degree left diagonal lines (wide)
                    51 — 45 degree left diagonal lines (narrow)
                    52 — 45 degree left diagonal bars & stripes
                    60 — 45 degree crossed diagonal lines (wide)
                    61 — 45 degree crossed diagonal lines (narrow)
                    62 — 45 degree crossed diagonal bars & stripes

Polygons to be filled may be defined in a number of ways, as described on
the next page.

Polygon Fill using Points

The polygon definition using points is specified by a series of points. If the last point of the definition is not the same as the first point, the terminal will close the polygon by connecting the last point with the first point.

[X1,Y1,X2,Y2,X3,Y3, ...] color_number, pattern ,

Example: [10,10,80,10,80,60,10,10,]2,1,   draw polygon with points
(10,10), (80,10), (80,60) and
back to point (10,10); solid
fill with color number 2

Polygon Fill Using a Rectangle

The polygon definition of a rectangle is given as a standard rectangle.

[< X1,Y1,X2,Y2,] color_number, pattern,

Example: [<90,90,200,200,]1,10,   draw rectangular polygon with
opposite corners (90,90) and
(200,200); fill with pattern
of wide horizontal lines
using color number 1

Polygon Fill Using a Circle

The polygon definition of a circle is given as a standard circle.

[(X, Y, Radius,] color_number, pattern,

Example: [(300,300,50,]3,21,   draw circular polygon with
center (300,300) and radius
50; fill with pattern of
narrow vertical lines using
color number 3

Polygon Fill Using a Pie Slice

The polygon definition of a pie slice is given as a standard arc.

[X, Y, A X, Y, Radius, Begin_Angle, End_Angle, X, Y,]
color_number, pattern,

Example: [200,200,A200,200,100,90,180,200,200,]5,61,

draw pie slice with center
(200,200) and radius 100 from
90 degrees to 180 degrees;
fill with pattern of narrow
diagonal crossed lines using
color number 5

The syntax of the Fill Polygon command is quite exacting. Note, for instance, in the pie slice example how the second entry of the arc center point parameters is made immediately following the completion of the arc parameters -- use of the '.' command prior to the last '200,200,' would change the result.

Note also that the Fill Polygon command holds for one pattern at a time. Further, the specified polygon definition is retained in memory. The display may be cleared from the screen with a 'C7,' sequence, but the polygon definition is retained in memory. A '[ ] color_number, pattern,' sequence will fill the previous polygon with the new pattern in the new color. The polygon defined by this sequence remains in memory until a new polygon is defined by use of the Fill Polygon sequence.

If the next polygon to be filled is defined by a series of dot coordinates the coordinates must begin immediately after the [. The '.' command for point plot must not be used. If it is, the points will be plotted, but the filled polygon will be the previously defined one.

Fill Region

F X , Y , boundary_color_default , fill pattern number ,

The Fill Region command (F) followed by four parameters causes a region of the screen to be filled with a pattern. The first two parameters are the X and Y coordinates respectively of an arbitrary point within the region to be filled. The third parameter is the color number of the boundary of the region. The fourth parameter is 0 if the region is to be filled with a pattern previously defined by use of a 'P' command (described on the next page). Otherwise, it is a number indicating the desired pattern:

1	-	solid color
2	-	widely-spaced verticals
3	-	narrowly-spaced verticals
4	-	widely-spaced right diagonals
5	-	narrowly-spaced right diagonals
6	-	widely-spaced left diagonals
7	-	narrowly-spaced left diagonals
8	-	widely-spaced orthogonals (checkered)
9	-	narrowly-spaced orthogonals (checkered)
10	-	widely-spaced diagonals in diamond pattern
11	-	narrowly-spaced diagonals, diamond pattern

The pattern selected by one of the numbers 1-11 will be in the same color as the boundary.

Example:	ESC T	Enter Graphics Mode
	H5,	Select color number 5
	<100,100,200,200,	Draw a rectangle
	F150,150,	Fill rectangle from 150,150
	5,	Boundary is color number 5
	10,	Pattern is widely-spaced diagonals in diamond pattern
	?	Exit Graphics Mode

3.77

The boundary 'color number' is that of the data written into memory. For instance, assume the values of all color numbers set to their default values by the Initialize Color Definition command (I). A circle is drawn in the foreground color white (default value 6). Next, a Set Color Definition command J7,3 is used to cause the circle to be displayed in yellow. If a Fill Region command is entered, it must specify the boundary color number as 7 -- the data value in memory, not the current display color value.

For purposes of a region fill, the edges of the screen are considered as boundaries of a region. Therefore, the outside of a region may be filled by using coordinates of an exterior rather than an interior point.

   Important note: There exist conditions in which the region may not be filled completely by this command. This may happen if the shape of the region is too complex. It may also happen if a solid horizontal line of pixels dividing the region into two parts are all of the colors they will be if the region is filled. A third cause is the attempted use of a user pattern that has not been defined by a 'P' command. Should filling not occur, or only partially occur, repeat the command using an interior point not yet filled or change FG and/or BG color number.

Set Fill Pattern

The Set Fill Pattern command (P) followed by 8 characters (without delimiters between) defines an 8 by 8 matrix of dots according to the bit configurations of the character codes to form a pattern which can later be used for filling regions. The 1's of the pattern will be at positions where the foreground color is to appear when the pattern is used and the 0's are at positions where the background color is to appear. The successive characters in the 'P' command define the rows from bottom to top. Note that the foreground and background color numbers in effect when the pattern is defined are the ones used when filling occurs.

Example: ESC T   Enter Graphics Mode
             PAAAAUUUU   Define pattern
             ?   Exit Graphics Mode

Since the bit pattern for the A code is 01000001 and the bit pattern for the U code is 01010101, the pattern is

```
                0 1 0 1 0 1 0 1
                0 1 0 1 0 1 0 1
                0 1 0 1 0 1 0 1
                0 1 0 1 0 1 0 1
                0 1 0 0 0 0 0 1
                0 1 0 0 0 0 0 1
                0 1 0 0 0 0 0 1
                0 1 0 0 0 0 0 1
```

   NOTE: If any row of the matrix is all 0's, the fill command may fail to work if the colors for the pattern are the same as the colors presently in effect. A fill with another color first is a solution to the problem.

Define Super-pixel

        S [Hue] , [Saturation] , [Intensity] ,

The Define Super-Pixel command 'S' followed by the parameters for hue, saturation and intensity defines a 4x4 dot "super-pixel". This command provides capability for display of 4x4 blocks in any of over 4000 distinct colors. The parameter ranges are as follows:

Hue	0 to 95	0 is red, 32 is green and 64 is blue 95 "loops back" to be almost red
Saturation	0 to 16	0 is white 16 is fully saturated color
Intensity	0 to 16	16 gives full intensity 0 = "all dots off".

Examples: S32,16,16,   yields green, saturated, with full intensity

          S40,16,16,   adds a bit of blue to the green but not quite
                            enough to make the color cyan

Display Super-pixel

        * [X of lower left corner] , [Y of lower left corner] ,

The Display Super-Pixel command '*' followed by two decimal parameters results in display of a previously defined super-pixel at a point on the screen. The lower left corner of the super-pixel is at the screen location (X,Y), defined by the two parameters.

Super-pixel Bar

        B [lower left X] , [lower left Y] ,
               [Width in super-pixels] , [Height in super-pixels] ,

The Super-Pixel Bar command 'B' followed by four decimal parameters defines a bar made up of super-pixels. The first two parameters define the location of the lower left corner of the bar. The next parameter defines the bar width (in an "X" direction) in super-pixels. The fourth parameter defines the bar height in super-pixels.

Example: ESC T   Enter Graphics Mode
           S8,16,16,   Define reddish yellow super-pixel
           B350,20,11,48,   Vertical bar 11 wide (44 dots), 48 high
                             (192 dots), located in the lower
                             right portion of the screen

           S62,16,10,   Define medium intensity blue super-pixel
           *370,220,   Place one super-pixel above vertical bar
           ?   Exit Graphics Mode

                            3.79

Read Point

                    R [X value] , [Y value] ,

The Read Point command 'R' followed by the coordinates of a point on the medium resolution screen causes a report containing the coordinates of the point and the color number (0-7) present.

Example: R100,200,   request report of value at (100,200)

            100 200 4   report returned by terminal (in ASCII)
                                    indicating that the value at
                                    (100,200) is 4

Write Enable

                    W [parameter] ,

The Write Enable command 'W' followed by a digit in the range of 0-7 and a delimiter defines the graphics memory plane or planes to be enabled for write. The plane(s) affected are determined as shown below:

Parameter	Plane(s) Affected
0	None
1	Plane 1
2	Plane 2
3	Planes 1 and 2
4	Plane 3
5	Planes 1 and 3
6	Planes 2 and 3
7	Planes 1, 2 and 3

Graphics Mode is initialized with all three planes enabled for write. However, only those foreground color numbers already enabled for the alphanumeric display can be used. For example, upon power-up, the foreground color number is 7 (white). If Graphics Mode is entered, any of the three planes can be written into; the graphics can be in any of the eight color numbers and the super-pixel color range is tremendous.

Display Enable

                    D [parameter] ,

The Display Enable command 'D' followed by a digit in the range of 0-7 and a delimiter defines the graphics memory plane or planes to be displayed on the CRT screen. The parameter defines the plane(s) affected as indicated in the table above for Write Enable. The system is initialized with all planes displayed when Graphics Mode is invoked.

Fill Screen

E [parameter] ,

The Fill Screen command 'E' followed by a digit in the range of 0-7 and a delimiter defines the graphics memory plane or planes to be completely filled on the CRT screen.

Parameter	Plane(s) Affected
0	None
1	Plane 1
2	Plane 2
3	Planes 1 and 2
4	Plane 3
5	Planes 1 and 3
6	Planes 2 and 3
7	Planes 1, 2 and 3

Clear

C [parameter] ,

The Clear command 'C' followed by a digit in the range of 0-15 and a delimiter defines the graphics memory plane or planes to be cleared (erased). The graphics memory planes are identified as 0-7 and if the parameter value is 8 or larger, the alphanumeric screen also is cleared.

Example: C11,   clear graphics memory planes 1 and 2 in addition to
                        the alphanumeric screen (11 = (1+2) + 8).

Line Style

T [number of dots on] , [number of dots 'off'] ,

The Line Style command 'T' followed by two decimal parameters defines the line style. The default style is solid lines -- each dot in the line turned on. The T command can be used to change to dotted or dashed lines. The first decimal parameter following the T command defines the number of dots on (present foreground color number) and the second decimal parameter defines the number of dots off (present background color number). Each decimal parameter must be followed by a delimiter.

Example: T3,6,   set line style to short dashes of 3 dots with 6 dots
                        'off' between dashes

Exit

The Exit command '?' results in exit from the Graphics Mode and returns to the system that entered the Graphics Mode.

Select Medium Resolution Graphics Page

X [page accessed] , [page displayed] ,

The Select Page command 'X' followed by two parameters is used for page selection when the option for four pages of medium resolution graphics screen memory is present. The first parameter defines the page accessible by the CPU and the second parameter defines the page to be displayed on the CRT screen. Both parameters, each followed by a delimiter, must be included.

The parameter values are:

Parameter	Meaning
0	no action
1	graphic page #1
2	graphic page #2
3	graphic page #3
4	graphic page #4
5-254	** reserved **
255	report graphic page status

The parameter 0 is used when the page accessed or the page displayed is not to be changed.

Examples:	X2,3,	select graphic page 2 for CPU access and graphic page 3 for CRT display
	X0,1	select graphic page 1 for display and leave the last selection for access in effect

The color assignment, the selected color number and the current position (last point plotted) are maintained separately for each page of screen display. The values assigned when a page was last accessed remain in effect when that page is selected for display. The parameters for all pages are set to the default values at power-up.

When a report is specified by the parameter value 255, the terminal response at the MODEM port is similar in format to that used to select the current status -- except the parameters would always be in the range of 1 to 4. The report is terminated by a carriage return.

Example:	Host command:	X0,255,	
	Terminal response:	X2,3,<cr>	(graphic page 2 set for access, page 3 for display)

SECTION IV

ADJUSTMENT AND ALIGNMENT

IV. ADJUSTMENT AND ALIGNMENT

Section Content

This section describes the adjustment and alignment procedures for the Intecolor 8800/3800 Series Terminals and the optional Light Pen.

All Intecolor units are completely adjusted and thoroughly tested before shipment from the factory. In normal use, no more than minor touch-up adjustment should be required. Both terminals use preconverged in-line cathode ray tubes, so the convergence adjustments associated with delta gun CRTs are not required. Following repairs, all adjustments should be checked while the unit is in the shop.

> **Important!** Please read the entire applicable procedure before beginning adjustment. The job goes more smoothly when you know how to obtain a stable display of approximately the correct size at power up.

Preliminary

Hazards — First, a few words regarding possible hazards:

> **WARNING!** Any maintenance performed with power on and cover off subjects the operator to electrical shock hazards that could cause injury or death. Such maintenance should be performed only by trained and qualified service personnel who are aware of the existing hazards.

> **WARNING!** Operate the unit on single phase AC power only. The power supply protection circuit is designed for single phase only. Do not attempt to operate 220-volt units on standard U.S. domestic two-phase 230 VAC.

> **WARNING!** The upper line voltage limit (250 VAC) must not be exceeded — the line filter, fuse, fuseholder and switch are rated at 250 VAC maximum.

Temperature: In all cases, the temperature of the unit should be fairly stable when final adjustments are made. For initial adjustments, if the unit has been stored under unusually cold or warm conditions its temperature should be in the operating range (between 0° and $+40^{\circ}$ C) for at least 30 minutes before proceeding.

Power Voltage: **Verify that the AC power to be used is correct for the unit involved.** All standard units manufactured by the Intecolor Corporation are intended for use with single phase AC power only.

The standard 8800/3800 Series Terminals use 115 volts 60 Hz. Option 11 provides for operation at 220 volts 50 Hz. In no case shall the upper voltage limit of 250 VAC be exceeded.

Touch-Up vs. Complete Alignment: The instructions in this section assume beginning the procedure after repair of the Analog Assembly or after substantial misadjustment has occurred. For routine touch-up adjustment of an operating unit, some steps may be omitted.

In either case, enclosure removal is required for access to the controls.

Tools and Instrumentation

Adjustments are more easily made when the correct tools and instruments are available. Tools include:

> #2 Phillips screwdriver (for cabinet fasteners)
>
> 10" screwdriver with flat blade 1/8" or slightly less, shaft insulated (The blade should be similar to that of a jeweler's screwdriver, for adjustment of small potentiometers in the 8800/3800 Series terminal. Plastic tools also may be used.)
>
> 3-32" hex plastic alignment tool (for 3810 inductors)

Instrumentation needs include:

> Multirange voltmeter, Fluke 8020B or similar recommended
> 40KV high voltage probe (such as Fluke 80K-40) or meter
> Test oscilloscope, DC to 15 MHz
>
> 0-1 DC milliammeter, insulated for at least 35KV, with connectors for insertion into the CRT anode path. (One such is the RCA PIX-509 current meter from RCA Video Component Display Division, Lancaster, PA 17604. The recommended method for adjustment of CRT beam currents requires such a meter. An alternate procedure is given for use when a beam current meter is not available.)

Section Plan

The procedure for the 8810/8820 Terminal begins on page 4.03, at right.

The procedure for the 3810/3820/3860/3870 Terminal begins on page 4.15.

Notes regarding adjustment of the 3881 Terminal begin on page 4.27.

The adjustment procedure for the optional Light Pen follows on page 4.30 and notes regarding multiple screen memories and other items follow.

The procedures generally assume that the Set-Up menu is, for alignment purposes, for LOCAL mode with Echo ON. See page 3.06 of this manual for a description of the use of the Set-Up Mode. Briefly:

1. Hold down a SHIFT key and press SETUP to enter the SET-UP mode.
2. Use the cursor arrow key(s) to position the cursor on a selection.
3. Press the HOME key to change the selection.
4. When the SET-UP menu is as desired, press the RETURN key.

Enclosure Removal

Power should always be off when the console's enclosure is being removed.

For complete alignment, remove the rear and top covers. Loosen two quick release screws (turn CCW) near the lower edge of the rear cover. Tilt the lower edge out at bit and remove the cover downward. Loosen two screws on either side of the console, near the lower edge. Then lift the cover off.

Initial Control Settings

Control positions should be correct as the unit is received from the factory. No more than touch-up should be required. Following corrective maintenance involving parts replacement, it may be well to begin alignment with the affected controls preset at the center of the range.

R49 on the analog board no higher than mid-range following repair.

Overall BRIGHTNESS on rear panel no higher than mid-range.

(See drawing on page 4.04 for location of controls.)

Line Fuse

For 115V operation, time lag 5mm x 20mm, 4A 125V (Bel type 5MT)
For 220V operation, time lag 5mm x 20mm, 2A 250V (Bel type 5ST)

WARNING! For continued protection against fire, replace only with the correct rating and type fuse.

Line Voltage Adjustment

The 8810 provides transformer primary tap selection. Units are shipped with the tap selected for the normally specified line voltage:

115 VAC +/- 10% for the standard unit.
220 VAC +/- 10% for the unit with Option 11

If the local power line voltage is known to be consistently above or below that value, a different tap can be used.

The tap selection is is made on a connector block located on the power transformer mounting plate. The wiring is shown in the upper left corner of drawing 102910. The brown jumper normally connects terminal 2B to terminal 4B. If local line voltage is substantially different from the values listed in the terminal specifications above, the jumper can be changed to another tap. Disconnect the brown jumper from terminal 4B and connect it to terminal 3B, 5B or 6B as the available power line voltage indicates. See table on page 4.05.
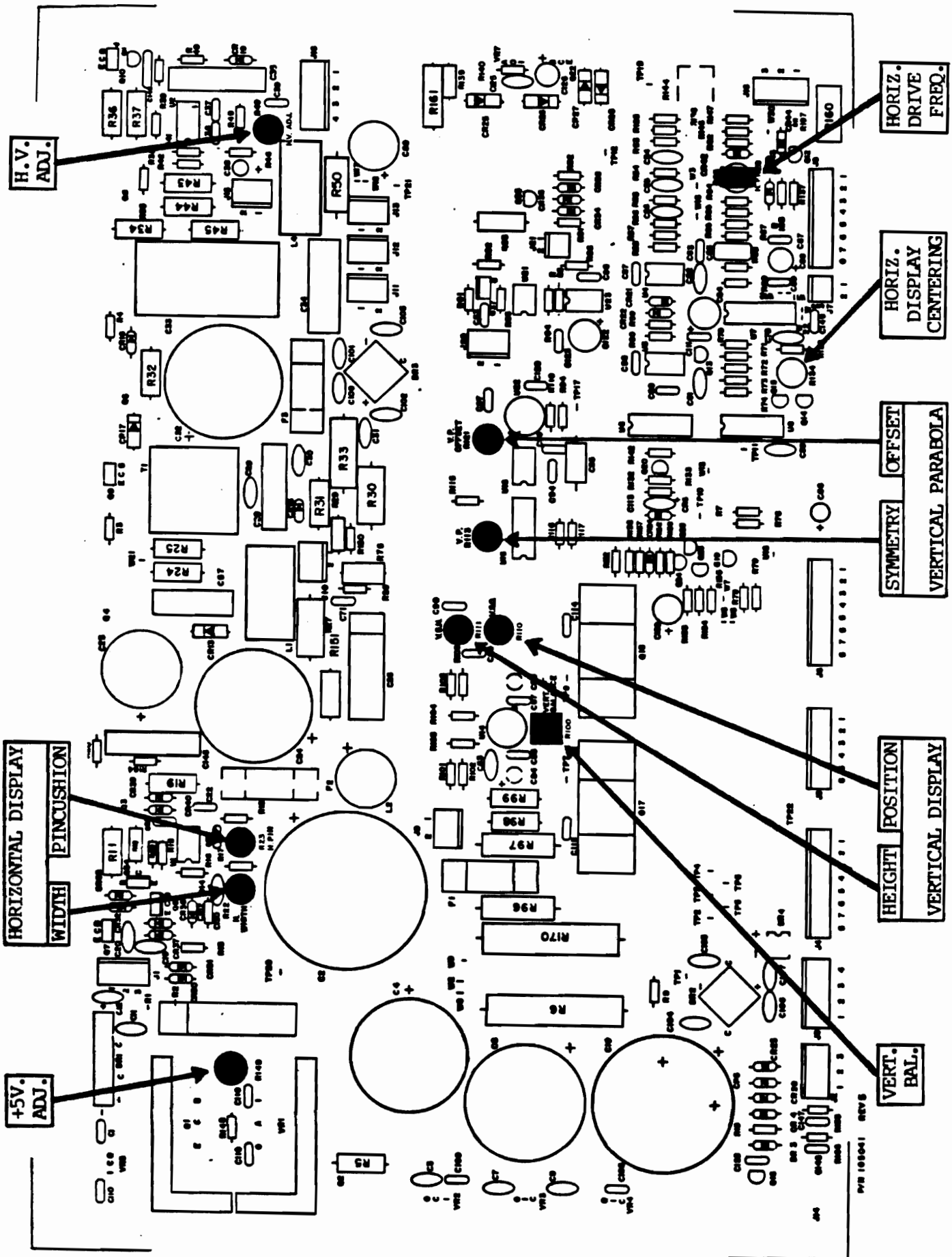
8810/8820 ANALOG CONTROLS
4.04

The jumper from terminal 2B is connected to one of the terminals listed
below. To change the other end, press the bar in the terminal with a small
screwdriver or similar tool to release or insert the lead.

Block Terminal Number	115 VAC Transformer	220 VAC Transformer
3	105 VAC	210 VAC
4	115 VAC	220 VAC
5	125 VAC	230 VAC
6	135 VAC	240 VAC

The selection should result in a voltage of 115 VAC +/- 10% at terminal 4
in the standard unit (or 220 VAC +/- 10% for a unit with Option 11).

Line Frequency Configuration

The analog module accepts vertical sync at either 60 Hz or at 50 Hz. No
change in jumpers in the Analog Module are required. (The analog jumpers
are listed on sheet 1 of schematic drawing 105040. The 8810 uses jumpers
W2, W3, W12, W17 and W22. The locations of W3, W12 and W22 in the sync
input circuit are shown on Sheet 3.)

High Voltage Adjustment

If the terminal has been powered up, turn power off and wait one minute
before connecting the high voltage meter or probe.

With power off, connect the ground lead of a high voltage meter (capable of
measurements to 35KV) to the unit chassis ground. Then connect the probe
of the meter to the anode connector on the CRT. (Lift the edge of the
connector insulation. Then, avoiding personal contact with the conducting
part of the probe, slide the probe under the connector insulation to make
metal-to-metal contact with the CRT high voltage connector.)

> **WARNING!** The electrical potential is capable of causing
> injury or death. Connect the high voltage meter
> only when the AC power is OFF.

> **CAUTION!** The meter used to measure the CRT high voltage
> must be capable of withstanding at least 35KV.
> The high voltage will be set to 25KV.

> **WARNING!** Be sure the ground lead of the HV probe is
> connected to frame ground and that the HV probe
> (the conducting part) is isolated from equipment
> other than the CRT anode and anode lead — and
> also isolated from personnel.

Apply power and allow a minute for warm-up and the appearance of the initial display line. Note that the display is stable. Make any quick adjustments required to get a stable display -- advance reading of the entire adjustment procedure helps here. Then adjust the high voltage.

Adjust **HV ADJUST R49** on the Analog PCB for an indication of **25 KV**.

Observe the meter for several seconds to verify that the indication is stable. Then erase the screen in the background color white. (Keyboard operations are noted below.) Adjust the BRIGHTNESS control on rear panel to obtain a normal level of brightness.

> The high voltage meter indication should change no more than 200 volts (0.2 KV) as the screen goes from black to white.

The keyboard operations for erasing the screen in white are:

1. Press the BG ON key and then release it. (This sets a flag on in preparation for background color selection.)

2. In the color pad on the left side of the keyboard, press and release the white key to designate white as the background color. (In a 72-key keyboard without the color pad, with the CONTROL key held down, press and release the W key. P instead of W would designate black, Q red, R green, S yellow, T blue, U magenta, and V cyan.)

3. Press and release the ERASE PAGE key. (This makes every character space on the screen background color.)

If a change of more than 200 volts is indicated when the screen goes from black to white, the usual problem is lack of good contact between the probe and the high voltage connector at the CRT -- lack of good contact results in erroneous indications. Otherwise there is a problem in the high voltage regulation circuit which requires correction.

Press and release the SETUP key. The screen initial display returns. High voltage should return to 25 KV.

> **WARNING!** Excessive CRT high voltage results in greater X-radiation. The government agency specifications for CR Tubes list the maximum allowable X-radiation as 0.5mR/hr. For all Intecolor product of current manufacture, X-radiation is below this level for any voltage obtainable under normal operation. For the 8810 or 8820 unit, the X-radiation is less than 0.5mR/hr with anode voltages up to 32KV.
>
> Excellent display definition is obtained with a CRT high voltage of 25KV. Do not adjust the high voltage to a greater value.

Turn off power. Allow one minute for filter capacitors to discharge. Then disconnect the high voltage meter probe from the CRT anode connector and finally the high voltage meter ground lead from the chassis.

After disconnecting the high voltage meter, turn power back on in preparation for the +5V adjustment.

+5V Regulator Adjustment

Connect a digital meter between ground (TP22 near the rear edge of the analog board) and J13 pin 4 on the card cage. On the analog layout drawing on page 4.04, note the location of R149 at upper left.

With a long-handle, small blade screwdriver,

Adjust **R149** to obtain an indication of exactly **5.1 VDC**.

Note: If the regulator device is near the high end of its tolerance, the voltage may not come this low. 4.75 to 5.25 VDC is satisfactory.

Low Voltage Check

The remainder of the regulated low voltages in the 8810 Terminal are fixed. These may be checked at test points on the Analog PCB.

8810	DC Voltage
TP6	+11.4 to +12.6
TP3	−11.4 to −12.6
TP4	+19.8 to +24.2
TP1	−19.8 to −24.2
TP19	+63 to +77
Fuse F3	+155 to +190

Vertical Ramp and Parabola Adjustments

For a complete adjustment following repair or accidental maladjustment, a test oscilloscope should be used to check waveform adjustment. An oscilloscope bandwidth of 15 MHz is adequate. Waveforms are cleaner with no or minimal visible display. (Operate the ERASE PAGE key)

For viewing the vertical parabola, a sweep speed of 5 milliseconds per division and a vertical deflection sensitivity of 2 volts per division are suggested. Sync on the line voltage.

View waveform at **TP17**.

Adjust Analog **R113** to make parabola end points equal in height.

(See top of next page for sketch of waveform.)
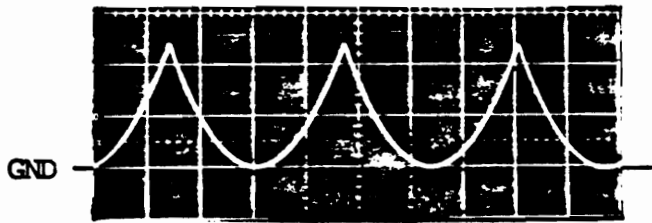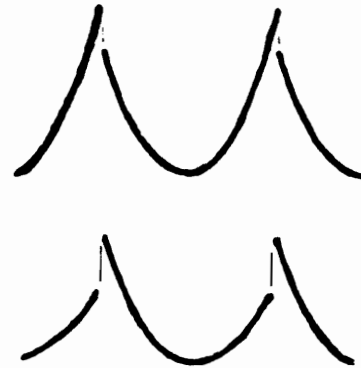
Correct   Incorrect

Adjust **R121** to set the bottom of the parabola at ground level.

GND   Bottom of
                                            waveform to
                                            be at ground
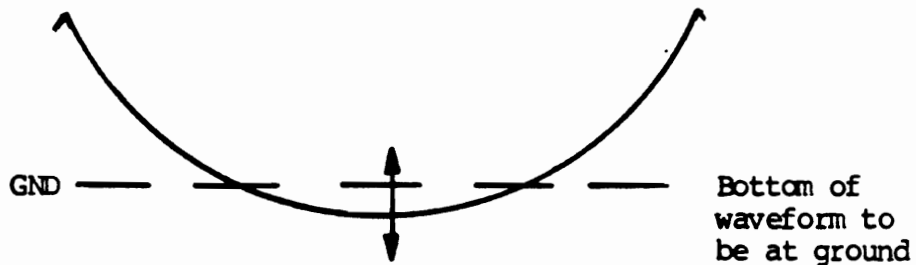
Display Size Adjustment

Erase the screen in the background color red.

1. Operate the BG ON key.
2. In the color pad, operate the red key (or Q with CONTROL down).
3. Operate the ERASE PAGE key.

  Adjust Analog **R111** to obtain a pattern height of 9.5 inches.
      Adjust Analog **R110** to center the display vertically.

  Adjust Analog **R22** to obtain a display width of 12.375 inches.
      Adjust Analog **R134** to center the display horizontally.

  Adjust Analog **R23** to make the sides of the display straight.

If the upper corners only are still out of line, touch up the adjustment of Analog **R63** to square the upper corners of the display.

Color and Beam Current Adjustments

With the screen still erased in the background color red, examine the display to determine whether the entire display is a fairly uniform red. Lack of color uniformity indicates a need for degaussing.

The unit has a built-in degaussing coil, active at power-up. However, depending upon the magnetic environment, additional degaussing sometimes is necessary.

If the unit has the Option R51 manual degaussing switch mounted on the rear panel, hold the switch operated for three or four seconds. For another degaussing operation, wait 10 minutes or more (to allow the posistor in the degaussing circuit to cool) before operating the manual switch again.

Without the optional manual degaussing switch, the unit power may be turned off. Then, after a wait for the posistor to cool, power-up the unit again. If two or three such power-on power-off sequences do not provide adequate degaussing, use of an external coil is necessary.

Degaussing Procedure

The terminal should be oriented in a north-south position (or in place in its normal viewing location). With the degaussing coil at an angle of 90° to the screen, apply power to the coil.

Bring the coil close to and parallel with the CRT screen and move it in a circular pattern over the face of the CRT, around the sides of the unit, and then back around screen center.

While continuing the circular pattern in the same direction, gradually withdraw from the front of the unit to a distance of six feet or more and then turn the coil 90° before disconnecting the coil from its AC power source.

When purity is satisfactory, proceed with beam current adjustment.

Adjustments of the individual color and bias controls on the Video Driver board ideally are made by measurement of CRT beam current. This procedure will be given first. It requires use of a well insulated (for at least 35KV) one-milliampere meter having connectors for this use. In absence of such a meter, an alternate method will be described.

Adjustment of CRT beam current:

WARNING! This shall be done only by trained and qualified personnel, aware of the possible shock hazard.

1. Turn unit power off. Allow a minute for capacitors to discharge.

2. On the Video Driver Module, turn the three square drive controls R6, R22 and R38 to minimum. This is the fully counter-clockwise position except in the case of a few units having blue potentiometers with an H in the nomenclature on the edge.

Turn the three background controls **R9**, **R25** and **R41** (at upper left) fully **counter-clockwise** to minimum. Turn the G2 bias control **R52** at upper right fully **counter-clockwise**. The multiturn potentiometers have no noticeable stop, so just turn them back 10 or 12 turns to bring them near minimum.

3. On the console rear panel, turn the **BRIGHTNESS** control fully **clockwise** to the maximum brightness position.

4. Insert a one-milliampere meter, insulated for at least 35KV, in the CRT high voltage circuit:

   a. Disconnect the high voltage connector from the CRT socket.
   b. Connect the high voltage connector to the meter positive side.
   c. Connect the negative meter terminal to the CRT HV socket.

5. Turn unit power on. Then allow 10 minutes or more for warm-up.

6. Adjust the G2 bias control **R52** (single potentiometer at upper right) CW until raster just appears. Note the color of the raster.

7. Next, individually adjust one or two of the background controls **R9**, **R25** and **R41** (at upper left) CW to make the raster appear white. (E.g., if at step 6 the raster appeared red, leave the red adjustment R9 fully CCW and adjust R25 and R41 CW to make the raster appear white.)

8. Turn the G2 bias control **R52** CCW until the raster just disappears. Then turn it CCW one full turn more.

   Important note: Room lighting on the face of the CRT must be rather subdued for this adjustment. Shade the CRT face or dim the room lights. The G2 adjustment will be set too high if there is too much light on the CRT face.

9. Erase the screen with the background color red:

   a. Operate the BG ON key.
   b. In the color pad, operate the red key (or Q with CONTROL down).
   c. Operate the ERASE PAGE key.

10. Adjust Video Driver red drive control **R6** (square potentiometer facing upwards) to obtain a CRT beam current of **160 microamperes**.

11. Erase the screen with the background color green. (Press the green color key, or R with CONTROL down. Then ERASE PAGE.) Adjust the green drive control **R38** (innermost potentiometer facing right) to obtain a beam current of **170 microamperes**.

12. Erase the screen with the background color blue. (Blue color key, or CONTROL T, then ERASE PAGE.) Adjust the blue drive control **R22** (the potentiometer nearer right edge, facing right) to obtain a beam current of **125 microamperes**.

13. Erase the screen with the background color white. (White color key, or CONTROL W, then ERASE PAGE.) The total beam current then should be between **440** and **470 microamperes**.

14. View the various color combinations to determine whether they are as desired. (Yellow color key, or CONTROL S, and ERASE PAGE. Magenta color key or CONTROL U and cyan color key or CONTROL V.) The individual drive controls may be adjusted slightly to obtain the desired color mix.

    Total beam current must be limited to 470 microamperes.

15. As a final check, turn unit power off and allow the unit to cool for at least five minutes. Then reapply power. A raster should not appear. If a raster does appear, turn the G2 bias control R52 CCW until the raster just disappears.

    Allow five or ten minutes warm-up. Then re-check the individual and total beam currents, readjusting if necessary to bring them to the specified values.

    (NOTE: At power-up the beam currents may be 10 to 20 percent higher than normal. Allow time for them to stabilize before adjusting.)

16. Adjust the rear panel BRIGHTNESS control for the desired viewing level in the operating location.

17. Turn unit power off. Wait a minute for capacitors to discharge.

18. Disconnect the one milliampere meter and return the high voltage connector to the CRT HV socket.

19. Check the high voltage adjustment again -- see page 4.05.

Adjusting color without a beam current meter:

Measurement of CRT beam current is the recommended method for color adjustment. In absence of the required meter, the method described below is suggested.

1. With power OFF, measure the values of Video Driver board resistors R16, R32 and R48. (They should be in the range of 95 to 105 ohms.)

2. Apply power and allow five minutes warm-up. Adjust the G2 Bias control and the individual background controls exactly the same as just described -- steps 2, 3 and 5 through 8. Be sure to observe the note regarding light level on the CRT face.

3. Use a Fluke 8020B multimeter or equivalent to measure the voltages across series resistors R48, R32 and R16 on the Video Driver board in the following steps. The voltages given in these steps assume resistor values of 100 ohms. If the values measured in step 1 were near the high or low end of the tolerance, adjust the voltage values accordingly by use of Ohm's law.

4. Erase the screen in the background color green. With the voltmeter connected across R48, adjust drive control R38 to obtain an indication of 17.0 millivolts.

5. Erase the screen in the background color red. With the voltmeter connected across R16, adjust drive control R6 to obtain an indication of 16.0 millivolts.

6. Erase the screen in the background color blue. With the voltmeter connected across R32, adjust drive control R22 to obtain an indication of 12.0 millivolts.

7. Erase the screen in the background color white. Touch up the drive controls to obtain a satisfactory white screen.

8. In succession, erase the screen in the background colors cyan, magenta and yellow to determine whether these colors are satisfactory.

9. After final adjustments of the three drive controls for desired color mix have been completed, again erase the screen in the background color white.

   Measure and record the voltages across R16, R32 and R48. The total of the three voltages should be no more than 47.0 millivolts. If the total should be higher, adjust the G2 bias control R52 a bit CCW to bring the total of the voltages within the range of 44.0 to 47.0 millivolts.

10. Adjust the rear panel BRIGHTNESS control for the desired level of brightness in the operating location.

NOTE

In the procedure without the beam current meter, if any of the colors should appear abnormally bright or dim, the value of the series resistors and the voltage calculations should be checked again.

Focus Adjustment

With background black and foreground white, create a full-screen display of L characters. Adjust the FOCUS control (the potentiometer with the ceramic shaft, to the right of the CRT as viewed from the rear) for optimum focus over all of the display area. Also note that the staffs in the upper row are vertical — touch up R63 if necessary.

Other Adjustments

Routine maintenance by a qualified technician also may include check of the PFL signal and the operation of the alternate sync circuit. These test procedures are described on page 4.14.

If components in the vertical deflection amplifier have been replaced, the vertical balance adjustment should be checked. The description of this procedure begins on the next page.

Vertical Output Balance Adjustment

Analog R100 determines the operating mode of the two transistors comprising the vertical deflection output stage. The adjustment of this Vertical Output Balance control need be checked only when parts such as the vertical amplifier transistors Q17 or Q18 or their 540-type driver U14 are replaced or whenever there is evidence of the amplifier transistors overheating.

If need for adjustment of the Vertical Output Balance is indicated, first turn power off and use a small screwdriver to break the potentiometer seal. Then, with power on and the screen erased in black, proceed as follows.

1. Connect the test oscilloscope to Analog J9 terminal 1. The sawtooth waveform is a bit over 3 volts p-p. If necessary, adjust VERTICAL POSITION R110 a bit to make the waveform symmetrical about ground.

2. With the oscilloscope isolated from AC ground and chassis ground, connect the common lead of the oscilloscope to TP8 and the probe to TP7.

   > CAUTION! Damage to equipment can result if the test
   > oscilloscope common is not isolated from
   > the ground circuits in the terminal.

3. Adjust the VERTICAL OUTPUT BALANCE R100 to bring the tip of the triangular waveform about 25 millivolts below ground level.

   The sketch on below indicates the type of waveform expected. But for final adjustment, use a deflection sensitivity of 50 millivolts per division.
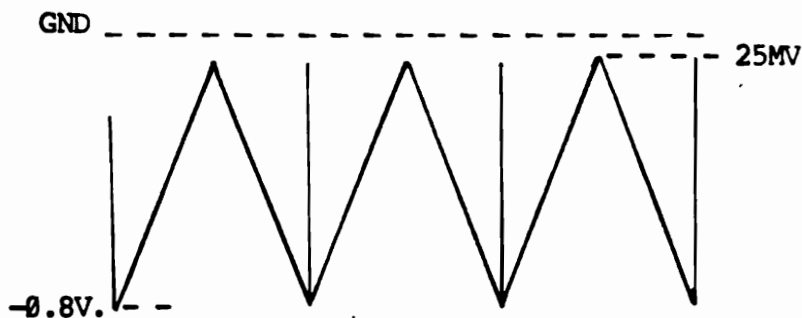
   (The tips of the waveform will be slightly rounded. Placing the tip a little below ground level insures that both transistors are not off at the same time. Placing it much too far below ground level causes them to conduct excessively and overheat.)

4. Erase the screen in the background color blue. Examine for any appearance of a horizontal line across the center of the screen. If a line is observed, readjust R100 slightly to eliminate the line.

5. Disconnect the oscilloscope. If necessary, readjust VERTICAL POSITION R110 to center the display vertically.

Check of PFL and Alternate Sync

For check of PFL, connect the test oscilloscope to Analog J6 terminal 6. The PFL signal should be high — near +5V.

Turn power off. Then turn power back on. The PFL signal should be low momentarily after power is turned back on. It returns high after this very brief delay.

For check of alternate sync, turn unit power off. Disconnect the cable from Analog J6. Turn unit power back on. There should be a display of sorts, indicating presence of both horizontal and vertical deflection. (The display size may be different and the content jumbled; but there should be a display.)

Turn power off. Reconnect the cable to Analog J6. Turn power back on. Operation should be normal. Any full-screen displays created should be well defined in the correct colors.

Multiple Pages of Screen Memory

See page 4.31 near the end of this section of the manual.

4.14

First, please read pages **4.01** and **4.02** of this section, noting **warnings** and preliminary **cautions.** Then note the following:

WARNING! Never apply power to the unit with circuit boards improperly secured or resting haphazardly on metal frame parts or on the inner surfaces of the cabinet. Short circuits and/or dangerous voltages on the frame could result. (The inside surfaces of the base pan and cover are coated with a conductive paint.)

Enclosure Removal

The power cord should be disconnected when the console's enclosure is being removed or when the base pan is being lowered. Remove four Phillips head screws holding the main cover, two near the top front and two at the rear. Hold lower front sides out a bit and slide the cover off to the rear. Use care to avoid damage to the BRIGHTNESS control.

If necessary, the base pan and Logic Module first may be moved downward at the rear after removal of two holding screws at the rear corners. Use care to avoid damage to the POWER switch.

As viewed from the front of the unit, the Power Supply board is on the left side and the Deflection Circuit board is on the right side. Most controls are accessible from the solder side through holes in the boards.

Configuration Check

Circuit boards in the 3810 may be used in other terminals, perhaps configured differently by jumper changes. If there is any question as to the configuration, it may be checked as follows.

In the Power Supply board the 3810 has jumper W1 in place. Jumpers W2, W3 and W4 are in the A position.

In the Deflection board W9 is used (not W8 and not W10). Jumpers W1, W3 and W6 are in the B position. Jumpers W2, W4, W5 and W7 are in the A position.

Fusing and Line Voltage

Verify that the voltage selector switch **SW1** on the Power Supply board is in the correct position for the power voltage to be used — 115V or 220V, visible on the red portion of the switch.

The line fuse should be correct for the voltage to be used:

For 115V operation, time lag 5mm x 20mm, 4A 125V (Bel type 5MT)
For 220V operation, time lag 5mm x 20mm, 2A 250V (Bel type 5ST)

(The power cord must be disconnected when the fuse is to be removed. Then a small screwdriver can be used to pop out the small fuse holder.)

HIGH
VOLTAGE

CURRENT
LIMIT
ADJ.

POWER
SUPPLY
FREQ.
ADJ.

+5 VOLTS
ADJ.
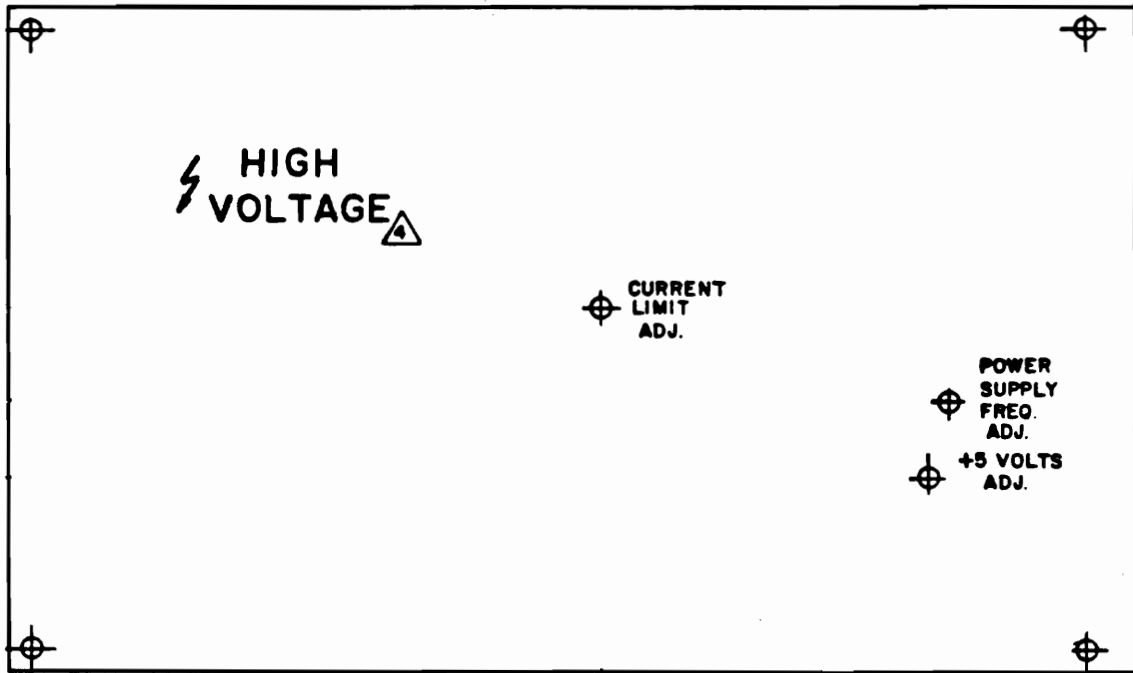
KM-2 POWER SUPPLY PHOTOPLOT 18/18/84 REV-2

Power Supply Board

4.16
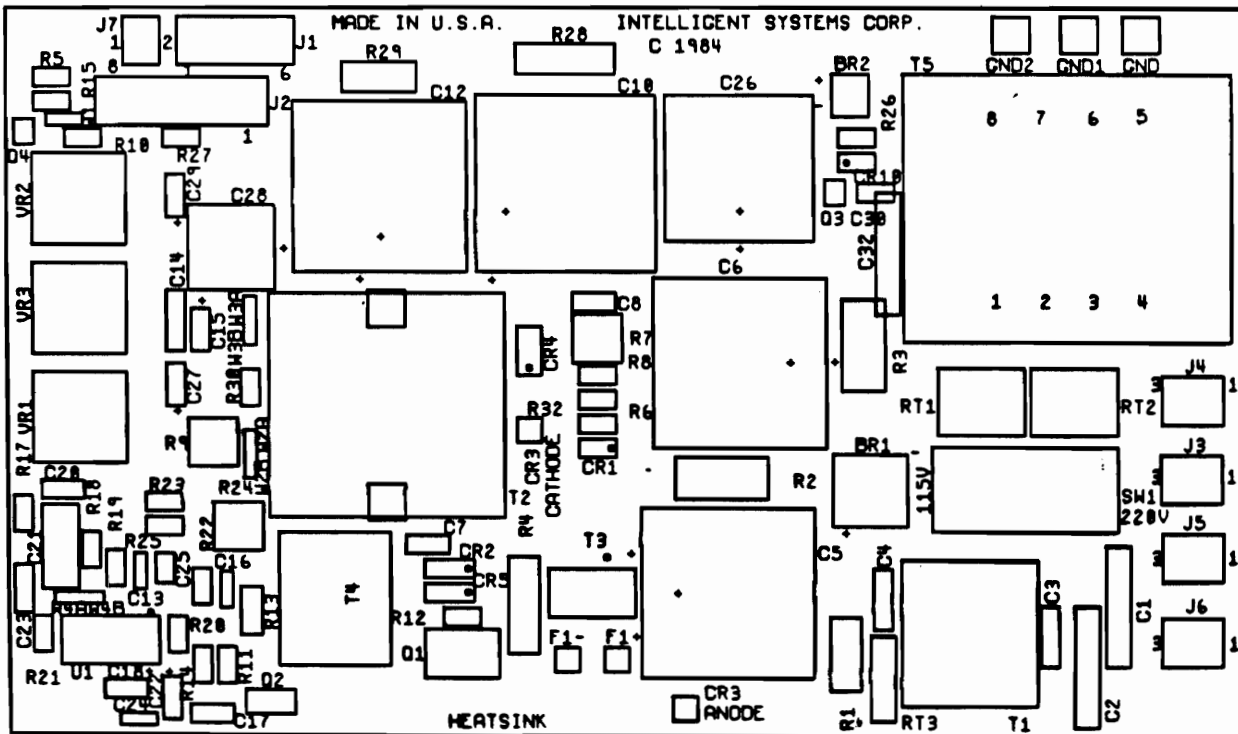
Complete Adjustment vs. Touch-up

For routine touch-up adjustments of a normally operating unit, all connections may remain intact and the various controls may be left as-is initially. The procedure can begin with the +5V adjustment, page 4.19.

If substantial maladjustment of the controls is suspected, they may be pre-set as follows. Most of them are accessible from the solder side through holes in the boards.

Power Supply Board

R24	+5V Adj.	Mid-range
R9	Pwr. Sup. Freq.	Mid-range
R22	Overcurrent Sens.	** As-is

(** Leave the overcurrent adjustment as-is unless suitable loads are available for use in adjustment.)

Deflection Circuit Board

R31	High Voltage Adj.	Mid-range	Screen CRT G2	**As-is
——	Focus	Mid-range	Brightness	3/4 CW

(** The CRT G2 control may be seen from the rear. The shorter ceramic shaft, usually sealed, is G2. Leave it as-is if the seal is intact. Turn it fully CCW if the seal has been broken. The longer ceramic shaft is FOCUS. The BRIGHTNESS control is on the side of the unit opposite the power switch.)

R96	Hor. Freq. (Hold)	3/4 CW		R67	Vert. Size	Mid-range
R106	Hor. Centering	Mid-range		R68	Vert. Linearity	Mid-range
L4	Hor. Linearity	Arbitrary		R89	Vert. Centering	Mid-range
L5	Hor. Size	Slug in		R84	Pincushion	Fully CCW

Video Board

ILVA Video Driver Gain controls R3, R6 and R17 mid-position
(After power-up, touch-up may be required to obtain adequate display.)

Following repair, or where substantial maladjustment is suspected, it may be best to disconnect several components prior to adjustment of the power supply. The disconnections advisable depend upon the type of repair. To check the Power Supply board alone, disconnect cables from connectors as follows:

Power Supply board J1	(Power to Deflection board)
Power Supply board J2	(Power to Logic Module)
Power Supply board J5	(Auxiliary AC)

Usually there is no need to disconnect the degaussing coil (from J4) or the fan (from J3) unless the line fuse is failing and these items are suspected to be the cause.

HORIZ PINCUSHION ADJ.

HORIZ FREQ. ADJ.

HORIZ CENTERING ADJ.

HIGH VOLTAGE ADJ.

VERT LINEARITY ADJ.

HORZ WIDTH ADJ.

HORIZ LINEARITY ADJ.

VERT SIZE ADJ.

⚡ HIGH VOLTAGE ⚠

VERT CENTERING ADJ.

Deflection Board

4.18
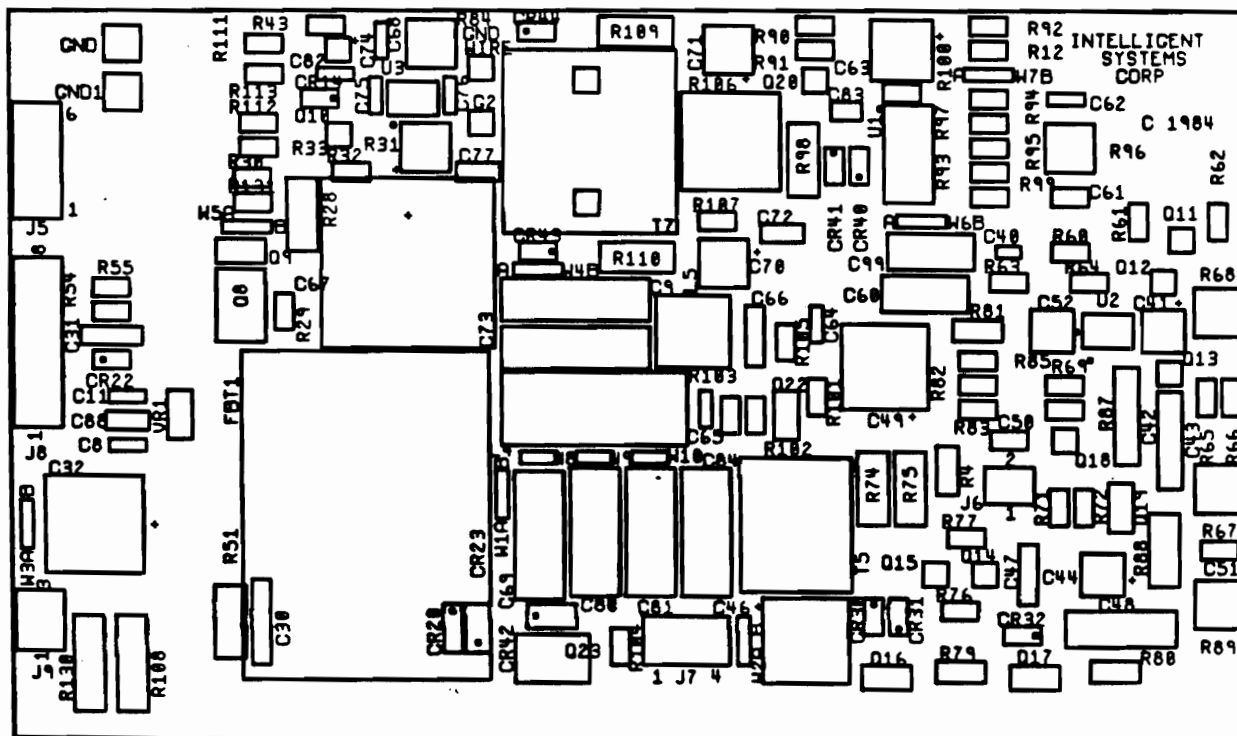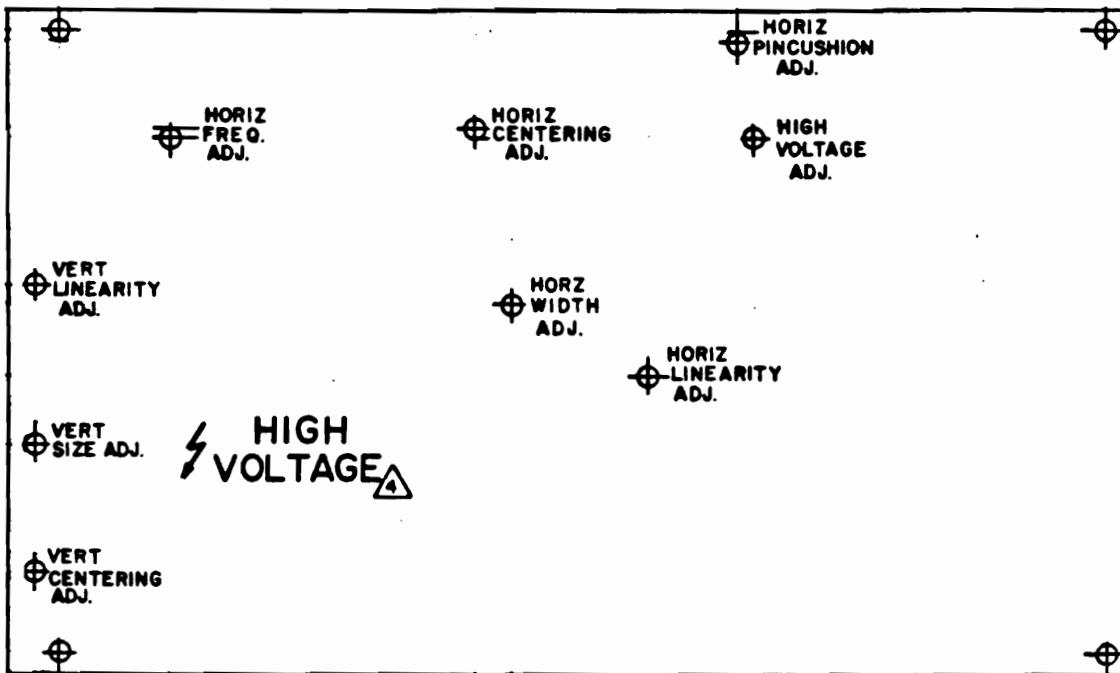
Low Voltage Check and Adjustment

Apply power to the unit. Then use a voltmeter, preferably digital, to verify the presence of DC voltages as follows. The reference is chassis ground or Power Supply Board J2 terminal 5 or 7.

Power Supply J2 terminal 8   Approximately +5 VDC
                                    Adjust the +5V ADJ R24
                                    to obtain +5.1 VDC

"   "   J2 terminal 4   +12 +/- 0.6 VDC
"   "   J2 terminal 6   -12 +/- 0.6 VDC
"   "   R9 "hot" end   +90 +/- 9 VDC

The CURRENT LIMIT R7 adjustment normally should not be changed. Correct adjustment requires loads of 6 amperes on the +5V supply and 100 to 150 milliamperes on the +90V supply. With these loads, R7 is adjusted at the point just prior to where the +5V level begins to fold back. This usually is near R7 mid-range.

Following verification of the level of the +5V supply and other regulated supplies, if cables were disconnected earlier, turn power off.

Reconnect all cables at the Power Supply board.

Verify all connections per Wiring Diagram 103499.

Routine touch-up adjustments begin at this point.

+5V Adjustment

Apply power to the unit. Adjust **Power Supply** board **R24 (+5V ADJ)** to obtain **exactly +5.10 VDC (+0.05V/-0.00V)** at the **Logic Board** +5V Test Point, using the adjacent GND test point as reference.

These Logic Board test points are near the rear edge, close to the keyboard input connector. They are more accessible when the bottom pan containing the Logic Board is allowed to drop down. With power off, release two screws near the lower rear corners to allow the pan to drop. Then the bottom pan will rest on the bench top.

The logic circuitry includes a precision reset circuit that is activated when the +5V line drops below +4.75 volts. If the +5V supply is set too low -- much below +5.0 volts -- slight fluctuations due to loading or to power line changes can trigger reset. The display could go blank or possibly roll.

If the +5V supply cannot be adjusted to the required level, examine the CURRENT LIMIT adjustment for signs of tampering. A correct adjustment requires loads as described above. If these are not available and if there is evidence of +5V foldback and if there is no evidence of overheating in any circuits, adjust R7 to the point where the +5V level can be adjusted to +5.10V at the Logic Board. There normally should be no fold back as signals are input to the terminal from the keyboard or through another serial input.

4.19

High Voltage Adjustment

Turn power off and allow a minute for capacitors to discharge. Connect the ground lead of a high voltage meter or probe to the 3810 metal chassis. Then slip the meter probe under the CRT anode cap. The probe tip must make good metal-to-metal contact with the anode cap connector.

After the high voltage probe has been connected, apply power to the unit.

> **NOTE:** Unless otherwise indicated, all instructions here regarding keyboard commands assume the terminal is operating in the Local Mode with the ALPHA LOCK key in the locked down position.
>
> To verify the operating mode at power-up, hold down a SHIFT key and press the SETUP key to enter the Setup Mode -- unless the terminal entered the Setup Mode at power-up on its own initiative.
>
> If necessary, adjust the HOR FREQ ADJ R96 to obtain a stable display. Adjust BRIGHTNESS and FOCUS to obtain a readable display.
>
> If the menu indicates LINE rather than LOCAL, use the cursor controls to position the cursor over LINE and then operate the HOME key to obtain LOCAL.
>
> Operate the 2 key to save this mode of operation at subsequent power-ups. Then operate the RETURN key to end the Setup Mode.

If there is any display other than the cursor, press the ERASE PAGE key to clear the screen to black. Then adjust **Deflection** board **R31 (HV ADJ)** to obtain a meter indication of **25KV**.

Next, erase the screen in the background color white.

> Press the BG ON key (to enable background color selection).
> Press the white color key (or the W key with CONTROL held down).
> Press the ERASE PAGE key.

The high voltage should change no more than 1KV as the screen goes from black to white.

Turn power off and disconnect the high voltage meter probe from the unit. Disconnect the meter ground lead last.

X-RADIATION

> In a properly adjusted 3810 Terminal with a CRT anode voltage of 25KV, X-radiation will average near 0.05 mRh/hr -- well below the government specified maximum of 0.5 mRh/hr. X-radiation will be below this value of 0.5 for anode voltages up to 32KV. However, we strongly recommend that the anode voltage be set no higher than 25KV.

Horizontal Frequency Adjustment

The free-running frequency of the horizontal oscillator in U1 on the Deflection board must be adjusted a bit below the frequency of the horizontal sync from the Logic Module.

Use a DC voltmeter to measure the voltage at U1 pin 9. Adjust R96 to obtain an indication of **between +6 and +7 VDC.**

Create a full-screen pattern of double-height L characters.

> Press the 2X CHAR ON key to select double-height characters.
> In sequence, operate the ESC key, the Y key and the L key.

If necessary, readjust R96 to make the L characters as straight as possible, noting especially the upper row of characters.

If R96 is too far either CW or CCW, synchronization with the video from the Logic Module is lost, resulting in a garbage display. If R96 is within the synchronization range but not at the optimum point, the vertical lines in the upper row may be slanted right or left.

Power Supply Frequency Adjustment

The power supply switching frequency also is adjusted to make it a bit lower than that of the synchronized horizontal oscillator. Use an oscilloscope to monitor the signal at the collector of Q2 on the Power Supply board.

> Sweep speed of 10 microseconds per division.
> Vertical deflection sensitivity of 5V per division.
> DC coupling.

With Power Supply board **R9** correctly adjusted, there is a single, sharply defined switching signal at 41.25 microsecond intervals. Adjust R9 CW until this signal changes. Then return R9 CCW to obtain the correct signal. Continue R9 another 30 degrees CCW.

If R9 is too far either CW or CCW, synchronization of the switching rate with the horizontal scan frequency will be lost. If the power supply switching frequency is not synchronized with the horizontal sweep frequency, the display tends to be unstable.

Display Size Adjustment

Erase the display in the background color green.

> Press the BG ON key (to enable background color selection).
> Press the green color key (or the R key with CONTROL held down).
> press the ERASE PAGE key.

On the Deflection board:

Adjust VERTICAL HEIGHT control **R67** for a display height of **7.25 inches**.
Adjust VERTICAL CENTERING control **R89** to **center** the display **vertically**.

Adjust HORIZ. SIZE control **L5** for a display width of **9.5 inches**.
Adjust HORIZ. CENTERING control **R106** to **center** the display **horizontally**.

Adjust PINCUSHION control **R84** to make the **sides** of the display **straight**.

> **NOTE:** With R84 fully CCW, the sides of the display will be
> noticeably concave. As R84 is turned CW, the top and bottom
> corners will draw in to straighten the sides.

Display Linearity Adjustment

First, select foreground color green and background color black.

Press the FG ON key (to enable foreground color selection).
Press the green color key (or the R key with CONTROL held down).
Press the BG ON key (to enable background color selection).
Press the black color key (or the P key with CONTROL held down).

Create a display of 24 horizontal lines.

Press the 2X CHAR ON key to select double-height characters.

In sequence, operate the ESC key, then the Y key and then the
underline key (the key just left of the left cursor control key).

On the Deflection board:

Adjust VERTICAL LINEARITY control **R68** for **equal spacing** of the lines.

Next, create a display of vertical dot-dash lines.

In sequence, operate the ESC key, the Y key and then, with SHIFT
held down, the 1 key.

On the Deflection board:

Adjust HORIZ. LINEARITY control **L4** for **equal spacing** of the lines.

> NOTE: An alternate pattern for use in both vertical and horizontal
> linearity is the full-screen pattern of double-height L characters.
> Operate the 2X CHAR ON key. Then in sequence operate the ESC key,
> the Y key and the L key.

If the linearity control adjustments were changed substantially, it would
be well to re-check the display size adjustment again.

Color and Beam Current Adjustment

The adjustments of beam current and color controls are best made with use of a beam current meter. The meter itself can be a simple one milliampere DC meter. However, it must be insulated for 35KV from grounded circuitry and it must have suitable high voltage connectors.

The procedure using the beam current meter will be described first. Then an alternate, but much less desirable, procedure for use without the meter will be outlined.

ILVA Video Driver

Procedure with Beam Current Meter

1. Turn unit power off. Allow a minute for capacitors to discharge. Then insert the beam current meter in the CRT anode path.

   a) Disconnect the HV lead from the CRT anode and connect it to the positive terminal of the current meter.
   b) Connect the meter negative lead to the CRT anode.

   > **WARNING!** The meter must be well insulated from ground. The anode lead is at 25KV.

2. Use a screwdriver to break the seal holding the "screen" CRT G2 control -- the shorter of the two white ceramic controls on the Deflection Circuit board. Turn the G2 control fully counter-clockwise.

   > **NOTE:** Do not adjust the G2 control in absence of the beam current meter unless absolutely necessary!

3. Turn all three color controls on the Video Driver board, R3, R6 and R17, fully counter-clockwise. Turn the unit's BRIGHTNESS control fully clockwise.

4. Apply power to the unit. Then erase the screen in the background color black. (Operate BG ON, black color key or CONTROL P, and ERASE PAGE).

5. Turn the G2 control slowly in a clockwise direction until a faint full-screen display is seen. Then adjust the G2 control a bit counter-clockwise until the raster just disappears.

6. Erase the screen in the background color green. (BG ON, green color key or CONTROL R, ERASE PAGE.)

   While observing the beam current meter, adjust the GREEN color control on the Video Driver board (R6) to obtain a meter indication of 154 microamperes.

   NOTE: While the GREEN gain control is being turned up, it would be well to observe the display as well as the beam current meter. If the right edge of the display begins to expand to the right, the drive has been made too high.

4.23

7. Erase the screen in blue. (Blue color key or CONTROL T, ERASE PAGE.) Adjust the **BLUE** color control (R3) to obtain a beam current of **122** microamperes.

   Again, it would be well to observe the display as well. Too much drive causes the display to expand to the right.

8. Erase the screen in red. (Red color key or CONTROL Q, ERASE PAGE.) Adjust the **RED** color control (R17) to obtain a beam current of **118** microamperes.

9. Erase the screen in white. (White color key or CONTROL W, ERASE PAGE.) Turn the BRIGHTNESS control CCW to obtain a display of half intensity.

   Touch up the adjustment of the RED, GREEN and BLUE controls on the Video Driver board slightly, if necessary, to obtain a white screen.

10. Turn the BRIGHTNESS control fully clockwise. The screen should remain white. Total beam current should be between 356 and 435 microamperes.

11. Adjust BRIGHTNESS to a desired level. Check the color of the display with the background erased in the various colors to determine that the color mix is as desired. (BG ON, followed by the color key and then ERASE PAGE. In the 72-key keyboard, the colors black, red, green, yellow, blue, magenta, cyan and white are selected by CONTROL P, Q, R, S, T, U, V and W respectively.)

12. The final adjustment of the G2 control on the Deflection board and of the three video gain controls on the Video Driver board should result in a beam current of 356 to 435 microamperes with the screen erased in white and the BRIGHTNESS control fully clockwise.

    With the screen still erased in white, turning the BRIGHTNESS control counter-clockwise all the way should darken the screen.

    With the screen erased in black, and the BRIGHTNESS control returned to the fully clockwise position, the screen should be dark.

13. Turn unit power off. Wait a minute before disconnecting the beam current meter. Re-connect the anode lead to the CRT.

14. Using the procedure given for High Voltage Adjustment (page 4.20), check the high voltage. With the screen erased in black the CRT anode voltage should be 25KV. It should change no more than 1KV when the screen is erased in white.

    NOTE: There is some interaction between the CRT HV and the G2 adjustments. If the high voltage were increased at step 14, the beam current should be checked again to verify that it does not exceed 435 microamperes at maximum brightness with the screen erased in white.

ILVA Procedure without Beam Current Meter

This is not truly a recommended procedure. However, in absence of a suitable beam current meter:

1. With power OFF, measure the values of Video Driver board resistors R7, R10 and R13. (They should be in the range of 33 ohms +/- 10%.)

2. Apply power and allow five minutes warm-up. Leave the "screen" G2 control on the Deflection board at its factory setting unless a change is positively indicated. A test of sorts may be made as follows:

   a) Erase the screen in the background color black. (BG ON, black color key or CONTROL P, ERASE PAGE.) With the BRIGHTNESS control fully clockwise, the screen should be dark or very nearly so. If a raster is observed under normal lighting, the G2 control is set too high.

   b) Erase the screen in the background color white. (BG ON, white color key or CONTROL W, ERASE PAGE.) With the BRIGHTNESS control turned fully counter-clockwise, the screen should go dark. If the screen does not go dark, readjustment of the G2 control is indicated.

3. If readjustment of the G2 control is indicated, use a screwdriver to break the seal on the G2 control and turn the G2 control fully counter-clockwise.

   Turn the BRIGHTNESS control fully clockwise. On the Video Driver board, turn the RED, GREEN and BLUE gain controls R3, R6 and R17 fully counter-clockwise.

4. Erase the screen in the background color black. Slowly adjust the G2 control clockwise until a very dim raster appears on the screen. Then return the G2 control counter-clockwise to the point where the raster disappears.

5. Erase the screen in the background color green. (BG ON, green color key or CONTROL R, ERASE PAGE.)

6. Adjust the GREEN gain control slowly clockwise to obtain a green display. Note that brightness increases noticeably at first as the gain is increased. Then when a normal usable level of brightness is reached, further increase in gain does not increase brightness in proportion. Further, the display begins to expand to the right. The GREEN gain control should be adjusted to achieve a adequate level of brightness but not beyond that point.

   As an additional check, use a meter such as the Fluke 8020B to measure the voltage across R10 on the Video Driver board. It should be approximately 5.1 millivolts. (This assumes R10 is 33 ohms. If the value measured in step 1 is different, use an Ohm's law calculation to adjust the voltage value.)

7. Adjust the BRIGHTNESS control 1/4 counter-clockwise or so to bring the screen down to approximately half intensity.

8. Erase the screen in the background color white. (BG ON, white color key or CONTROL W, ERASE PAGE.)

9. Adjust the RED and BLUE gain controls to obtain a white screen.

10. Turn the BRIGHTNESS control to fully clockwise. The screen should remain white. There should be very little, if any, red, green or blue showing to the right of the white display. A stripe or vertical line of a color indicates the drive for that color likely is too high.

   The voltage across R13 should be approximately 4 millivolts and that across R7 near 3.9 millivolts, both possibly a bit less rather than greater.

11. Turn the BRIGHTNESS control slowly counter-clockwise. The display should gradually dim to grey and eventually go dark with the control fully counter-clockwise.

When the G2 control and drive controls are correctly adjusted:

   The screen is dark with BRIGHTNESS fully counter-clockwise.

   With BRIGHTNESS fully clockwise and the screen erased in black, the screen is dark.

   Satisfactory, but not excessive, brightness of a color screen is possible with the BRIGHTNESS control near maximum clockwise.

   The colors are reasonably true.

The G2 should be sealed with adhesive to prevent accidental change.

Focus Adjustment

The focus control, the longer of the two white ceramic shafts on the Deflection Circuit board, is adjusted for best focus over the entire screen. This likely was done automatically during the procedure. It may be checked by placing a full-screen pattern of pound sign characters on the screen -- e.g., ESC, Y, #.

Adjust the FOCUS control for best focus over the entire screen. The dots should have no trailing edges. (Trailing edges indicate the CRT beam current is too high.)

Light Pen Sensitivity Adjustment

If the 3810 has the optional light pen, see page 4.30 for the sensitivity adjustment procedure.

This completes the adjustment of the 3810 Terminal.

3881 ADJUSTMENT

The adjustment procedure for the rack-mounted 3881 Terminal is similar to that for the 3810/3860, described on pages 4.15-4.26. The 3881's analog circuitry on a single board is similar to that of the 3810's Power Supply and Deflection Circuit boards. The different component designations and locations are shown on the next page.

The Analog Schematic Drawing 102350 includes a configuration table in the upper right quadrant. The 3810 column components are used in the 3881.

The auto-restart modification, per drawing 103387, is on an added small printed circuit board.

Notes on page 4.29 apply to the 3881 when using the 3810/3860 adjustment procedures.

3881 Analog

4.28
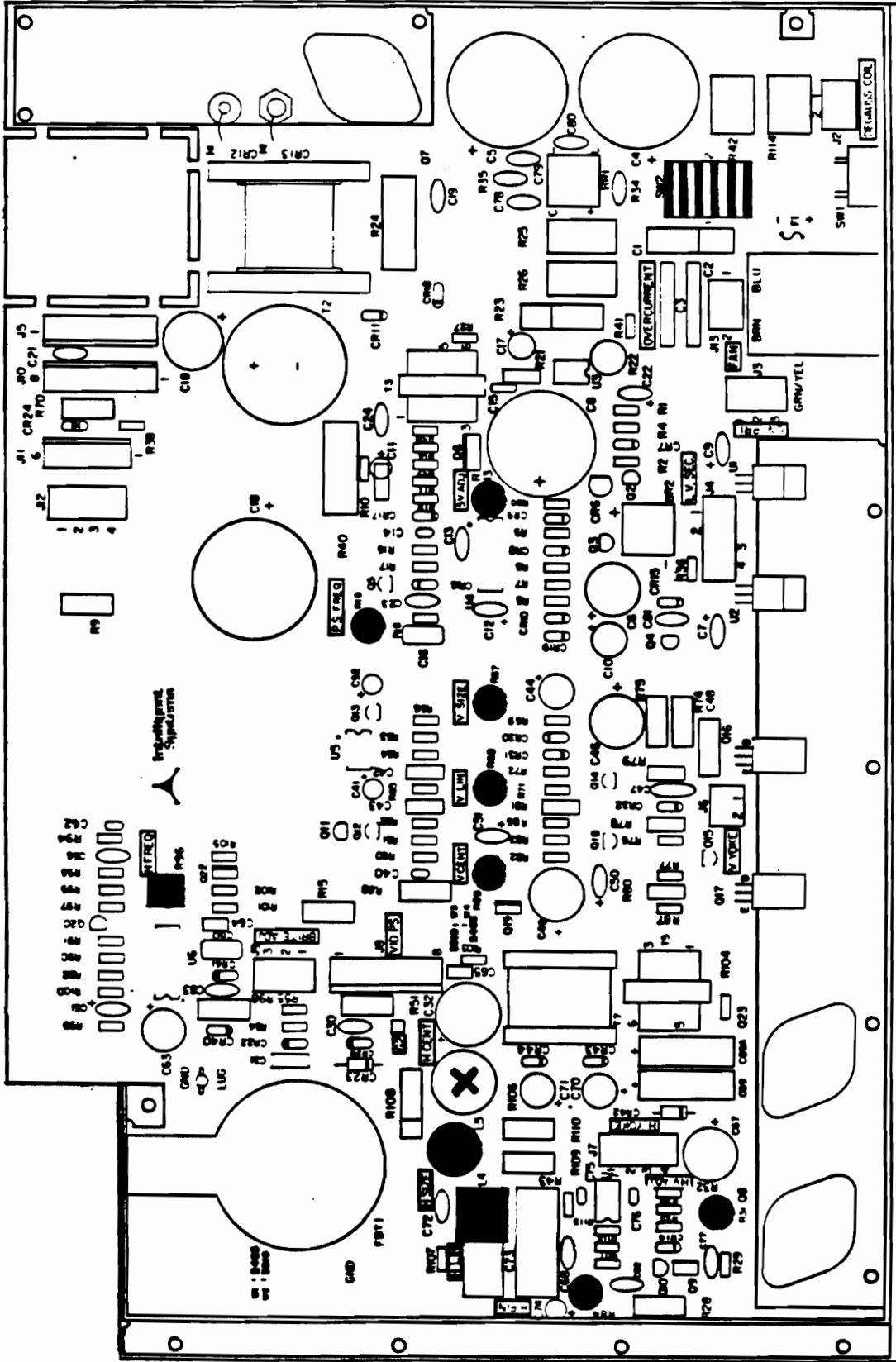
With reference to the procedure beginning on page 4.15, in the 3881:

Configuration jumpers are in the W2 and W3 positions.

SW1 is set for the AC power voltage to be used, 115 or 220 VAC.

The Line Fuse (of a type different from that of the 3810) is 1.5A for 115V operation, 0.75A for 220V operation.

The initial control position suggestions (page 4.17), as designated by name, apply. (If, following repair, disconnection of other circuitry is deemed advisable, see the schematic drawing.)

Regulated Low Voltages (page 4.19) may be measured at J5:

    J5 terminal 8   +5.1 VDC following adjustment
    J5 terminal 6   -12 +/- 0.6 VDC
    J5 terminal 4   +12 +/- 0.6 VDC
    R9 "hot" end   +90 +/- 9 VDC

For +5V Adjustment (page 4.19), in the 3881 the +5V ADJ control is R13. The Current Limit adjustment is R17 on the small added PCB. The +5V level is measusred at J5 terminal 8.

For High Voltage Adjustment (page 4.20), the control is R31.

For Horizontal Frequency Adjustment (page 4.21), the control is R96. The DC measurement is made at U6 pin 9.

For Power Supply Frequency Adjustment (page 4.21), the control is R19. The waveform is viewed at the Q6 collector.

For Display Size and Display Linearity Adjustments (pages 4.21 and 4.22), the control designations are the same as for the 3810.

Video Driver Adjustments (and G2 Adjustment and Focus Adjustment, when applicable) are the same as for the 3810.

Light Pen Sensitivity Adjustment

The light pen available as Option 28 has a sensitivity adjustment. In models currently shipped, the adjustment is in the body of the pen itself, accessible through a small hole mid-way on the housing. The adjustment is made at the factory and readjustment normally is not required. If a problem should develop, sensitivity may be readjusted.

1. Begin with the sensitivity adjustment counter-clockwise.

2. Point the pen at the center of the screen (erased in black), tip perhaps a quarter inch from the screen.

3. Touch a finger to the touch-sensitive portion of the barrel near the tip end. Blue strike-through lines will occur in two of the horizontal scans in each of the 48 rows on the screen.

4. Turn the sensitivity adjustment clockwise until the cursor moves to the point under the pen and the blue strike-through lines cease at that point. The partial-screen blue strike-through now repeats regularly.

5. Move the pen to a corner of the raster (the screen may be erased in the background color red to define the corners) and increase sensitivity as required to cause the cursor to follow the pen to the corner. Blue strike-through may or may not occur.

6. Check this adjustment at all four corners of the screen to determine that the cursor will follow the pen to any point in the normal display area when the pen tip is brought within one-eighth inch of the screen and the touch-sensitive switch actuated.

7. Verify that the sensitivity setting is not too high by bringing the pen tip a couple of character spaces outside the display area, rather close to the screen, and actuating the switch; there should be a repeating full-screen blue strike-through. The cursor should not move.

8. As an additional check, erase the screen in black. Use the normal cursor controls to move the cursor near screen center.

   At this point type an upper case white X. The press the HOME key to move the cursor to screen upper left.

   Touch the light pen to the screen over the white X. The cursor should move to that point. Blue strike-through should not occur. (The pen is given two frames of display to detect a character at the point touched before blue strike-through is initiated.)

9. The final adjustment of the light pen sensitivity should have the pen responding to upper case characters in colors containing blue. It should not respond to a character one or two character spaces away from the pen's location.

When correctly adjusted the pen can cause the cursor to move to any desired point in the display area; but it will not be unduly influenced by adjacent illuminated characters.

Multiple Pages of Screen Memory

Both the 8810 and the 3810 have options for one or three additional pages of screen memory — for totals of either two pages or four pages.

The additional pages require the use of the larger 8Kx8 RAM 28-pin devices in locations U82, U83, U84 and U85 on the logic board. The 24-pin devices in these locations are removed and the higher capacity devices installed. The address decoder PROM P/N 108027 in location U45 also is changed.

For two pages of screen memory, two type 6264 devices are installed in locations U83 and U85. (U82 and U84 are left empty.) The decoder PROM to be installed in location U45 is P/N 108076-010.

For four pages of screen memory, four type 6264 devices are installed in locations U82, U83, U84 and U85. The decoder PROM to be installed in location U45 is P/N 108033.

One jumper on the logic board, located between U85 and U86, also must be changed when going from one page of screen memory to either two or four pages:

Jumper W26 on the solder side of the board is cut.
W27, a small wire jumper, is added on the component side.

Later versions of the logic board have a jumper block instead of foil. The "suitcase" jumper is in location W26 for one page of screen memory. It is moved to location W27 for either two or four pages.

If a board is modified in the field, power should be off when the Logic Module is removed from the card frame. Orientation of the chips must be correct. With the 28-pin devices, pin one is near the edge of the board. With the 24-pin devices, there are four vacant spots in the sockets near the edge of the board — socket pins 1,2,27 and 28 are not used; pin 12 of the chip is in socket pin 14.

One page of
screen memory

W26 is present

U82   U83   U84   U85   U86
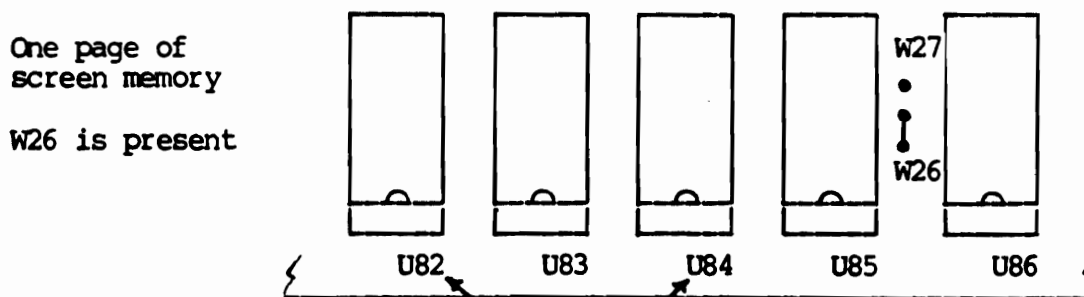
For two pages of screen memory,
these two sockets are empty
For four pages, U82, U83, U84
and U85 are used.

W27 is present and W26 is not used with either two pages or four pages.

(U86 is shown for reference only. It is not changed.)

4.31

Up-date Notes

Logic Board Versions

Initial production used the P/N 102506 Rev.1 logic board, schematic drawing 102505. Later in production a small add-on board provided for synchronization of the vertical frame rate to the power line frequency. A diode was inserted in the keyboard reset line (between U88 pin 1 and J1 pin 3). A jumper between U60 pin 3 and J2 pin 20 was added to carry the DTR signal.

Later production used the P/N 102506 Rev.2 logic board. The add-on board for "line-lock" of the vertical frame rate is present. Board foils provided for the diode in the keyboard reset line and for the DTR trace.

Both versions of the P/N 102506 logic board are used for 4 MHz CPUs only.

The P/N 105150 Rev.1 logic board (P/N 105666 in the 8820) can be used with 5.5 MHz or 4 MHz CPUs. It is always used in the 8820 at 5.5 MHz.

APPENDICES
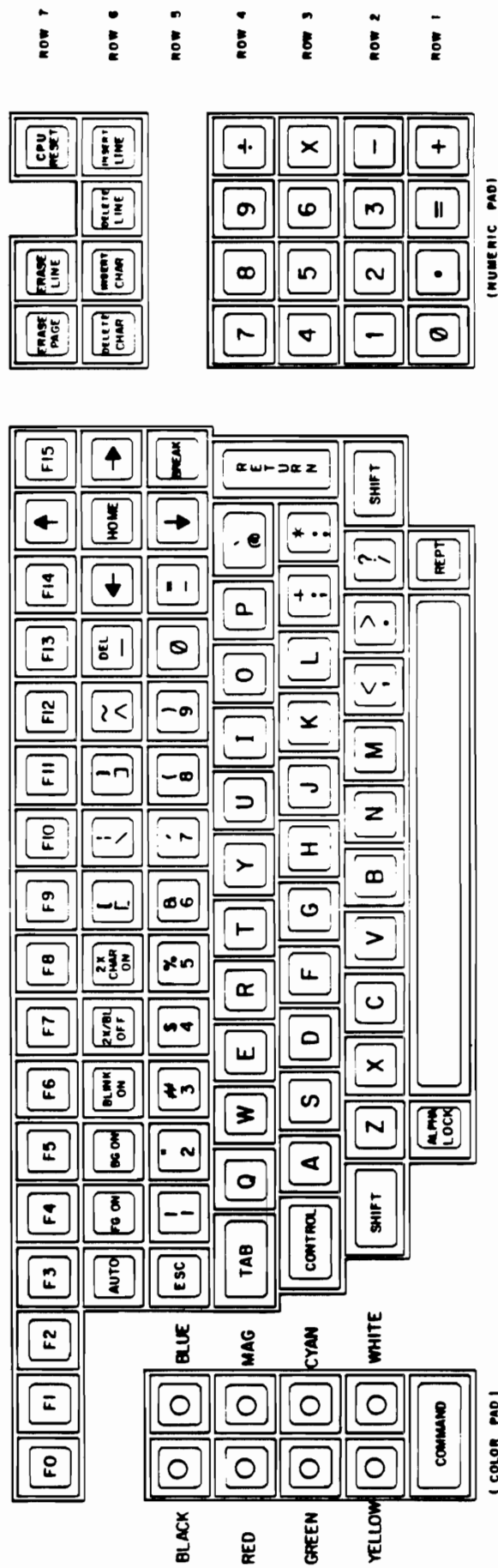
The layout of the Intecolor 117-key keyboard is shown above.

The 101-key keyboard does not include the 16 functions keys F0-F15.

The standard 72-key keyboard omits the 9-key color pad (left side), the 16-key numeric pad (right side) and the 4 keys for insert/delete (at right, just above the number cluster) as well as the 16 functions keys F0-F16.

KEYBOARD LAYOUT

Appendix A-1

Binary Code Generation

At the standard keyboard, operation of a key or a combination of keys can result in generation of binary code words.

The Intecolor 8001 code set is shown on sheet A-3, at right. In the chart the decimal values are shown in the key blocks which cover most of the chart. The binary codes and their hexadecimal values are shown at the left and across the top of the page. In the 8800/3800 Series unit with V1.6 software and 500239-040 keyboard processor, these codes can be generated from the keyboard — zero through 191 with the 110 or 72 key keyboard, zero through 255 with the 117 key keyboard.

An examination of the headings for the columns of key blocks in the chart indicates that the keys may be considered as four sets of 16 keys each:

@ A B C D E F G H I J K L M N O

P Q R S T U V W X Y Z [\ ] ^ _

0 1 2 3 4 5 6 7 8 9 : ; < = > ?

F0 F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15

Operation of one of these keys alone results in generation of a specific code. Operation of the same key with CONTROL and/or SHIFT may result in generation of a different code.

The first two sets of 16 include the upper case alpha characters. This indicates that operation with the ALPHA LOCK key in the locked down position is assumed. And this is the case with V1.6 software and the 500239-040 keyboard processor. (With earlier software, the ALPHA LOCK key must be in the up position for codes above 128.)

The third set of 16 keys shown above has a pattern difference which could result in a bit of confusion. The characters 0 through ; are obtained without SHIFT. However, < through ? are obtained with SHIFT. Thus generation of the codes equivalent to decimal 60 through 63 require SHIFT even though the column heading may appear to indicate that shift is not required. Generation of codes equivalent to decimal 44 through 47 do not require SHIFT. This pattern follows through wherever these particular characters are involved.

A diagonal plotting exercise may be used to go through the code chart step by step. Although not the normal way to plot a diagonal, the method is suggested here to provide immediate feedback of the results of keyboard operations.

The point plot mode is used. In this mode the screen is treated as a grid 160 blocks wide by 192 blocks high. In XY coordinate terms, the lower lefthand corner of the screen is point (0,0). The upper righthand corner is point (159,191).

INTERCOLOR 8001 CODE SET

Each cell shows the character (or function) and its decimal code. Columns are indexed by the high hex nibble; rows by the low hex nibble.

Hex	0 CONTROL @ TO _	1 CONTROL P TO _	2 SHIFT @ TO ?	3	4 @ TO O	5 P TO _	6 SHIFT* @ TO O	7 SHIFT* P TO _	8 CONT-SHIFT @ TO O	9 CONT-SHIFT P TO _	A CONT-SHIFT @ TO ?	B CONT @ TO ?	C CONTROL F0-F15	D SHIFT F0-F15	E CONT-SHIFT F0-F15	F F0-F15
0	NULL (0)	BLACK (16)	SPACE (32)	0 (48)	@ (64)	P (80)	`/G0 (96)	P/G16 (112)	@ (128)	P (144)	SPACE (160)	0 (176)	F0 (192)	F0 (208)	F0 (224)	F0 (240)
1	PROTECT (1)	RED (17)	! (33)	1 (49)	A (65)	Q (81)	a/G1 (97)	Q/G17 (113)	A (129)	Q (145)	! (161)	1 (177)	F1 (193)	F1 (209)	F1 (225)	F1 (241)
2	PLOT MODE (2)	GREEN (18)	" (34)	2 (50)	B (66)	R (82)	b/G2 (98)	R/G18 (114)	B (130)	R (146)	" (162)	2 (178)	F2 (194)	F2 (210)	F2 (226)	F2 (242)
3	CURSOR X-Y MODE (3)	YELLOW (19)	# (35)	3 (51)	C (67)	S (83)	c/G3 (99)	S/G19 (115)	C (131)	S (147)	# (163)	3 (179)	F3 (195)	F3 (211)	F3 (227)	F3 (243)
4	FREE (4)	BLUE (20)	$ (36)	4 (52)	D (68)	T (84)	d/G4 (100)	T/G20 (116)	D (132)	T (148)	$ (164)	4 (180)	F4 (196)	F4 (212)	F4 (228)	F4 (244)
5	FREE (5)	MAGENTA (21)	% (37)	5 (53)	E (69)	U (85)	e/G5 (101)	U/G21 (117)	E (133)	U (149)	% (165)	5 (181)	F5 (197)	F5 (213)	F5 (229)	F5 (245)
6	CCI (6)	CYAN (22)	& (38)	6 (54)	F (70)	V (86)	f/G6 (102)	V/G22 (118)	F (134)	V (150)	& (166)	6 (182)	F6 (198)	F6 (214)	F6 (230)	F6 (246)
7	BELL (7)	WHITE (23)	' (39)	7 (55)	G (71)	W (87)	g/G7 (103)	W/G23 (119)	G (135)	W (151)	' (167)	7 (183)	F7 (199)	F7 (215)	F7 (231)	F7 (247)
8	HOME (8)	TRANSMIT (24)	((40)	8 (56)	H (72)	X (88)	h/G8 (104)	X/G24 (120)	H (136)	X (152)	((168)	8 (184)	F8 (200)	F8 (216)	F8 (232)	F8 (248)
9	TAB (9)	CURSOR RIGHT (25)	) (41)	9 (57)	I (73)	Y (89)	i/G9 (105)	Y/G25 (121)	I (137)	Y (153)	) (169)	9 (185)	F9 (201)	F9 (217)	F9 (233)	F9 (249)
A	LINE FEED (10)	CURSOR LEFT (26)	* (42)	: (58)	J (74)	Z (90)	j/G10 (106)	Z/G26 (122)	J (138)	Z (154)	* (170)	: (186)	F10 (202)	F10 (218)	F10 (234)	F10 (250)
B	ERASE LINE (11)	ESC (27)	+ (43)	; (59)	K (75)	[(91)	k/G11 (107)	[/G27 (123)	K (139)	[(155)	+ (171)	; (187)	F11 (203)	F11 (219)	F11 (235)	F11 (251)
C	ERASE PAGE (12)	CURSOR UP (28)	, (44)	< (60)	L (76)	\ (92)	l/G12 (108)	\/G28 (124)	L (140)	\ (156)	, (172)	< (188)	F12 (204)	F12 (220)	F12 (236)	F12 (252)
D	CR (13)	FOREGND ON FLAG OFF (29)	- (45)	= (61)	M (77)	] (93)	m/G13 (109)	]/G29 (125)	M (141)	] (157)	- (173)	= (189)	F13 (205)	F13 (221)	F13 (237)	F13 (253)
E	A7 ON (14)	BACKGND ON FLAG ON (30)	. (46)	> (62)	N (78)	^ (94)	n/G14 (110)	^/G30 (126)	N (142)	^ (158)	. (174)	> (190)	F14 (206)	F14 (222)	F14 (238)	F14 (254)
F	BLINK A7 OFF (15)	BLINK ON (31)	/ (47)	? (63)	O (79)	_ (95)	o/G15 (111)	_/G31 (127)	O (143)	_ (159)	/ (175)	? (191)	F15 (207)	F15 (223)	BREAK (F15) (239)	F15 (255)

Optional Function Key assignments:

Key	Function
F0	Xo-Yo INCREMENTAL VECTOR
F1	Yo VECTOR PLOT
F2	Xo VECTOR PLOT
F3	INCREMENTAL Y BAR
F4	Ym-YBAR
F5	X-Y BAR
F6	Yo-Y BAR
F7	INCREMENTAL XBAR
F8	Xm-X BAR
F9	Y-X BAR
F10	Xo-X BAR
F11	X-Y INCREMENTAL PLOT
F12	Y-POINT PLOT
F13	X-POINT PLOT
F14	CHAR PLOT
F15	PLOT ESCAPE

NOTE: THE TERMINAL ACCEPTS ALL R0 TO FF HEX CODES FROM THE KEYBOARD AND REASSIGNS THEM F0 TO FF HEX WHEN IN THE PLOT MODE, UNLESS THE OPTIONAL KEYS ARE INSTALLED THEREFORE WITHOUT THE FUNCTION KEYS THE KEYBOARD CAN PLOT IN A RANGE OF 0 TO 175.

* COLUMNS 6 AND 7 WILL BE TRANSLATED TO COLUMNS 0 AND 1 RESPECTIVELY IN THE CRT REFRESH RAM IF THE FLAG ON HAS BEEN SET BEFORE ENTERING THESE CODES THEY WILL THEN APPEAR AS THE SECOND GROUP OF 64 CHARACTERS IF THAT OPTION IS SUPPLIED

STATUS (bits 7 6 5 4 3 2 1 0): PLOT | BLINK | BA | RG | | | | FB

In the exercise the plot mode and point plot modes are entered. Then successive pairs of key operations provide the X and Y values for individual points to plot a diagonal from lower left (0,0) to point (159,159) at the right side, part way down from the upper right corner.

The reverse field flag is set on so that points may be erased readily — when a plot block has been intensified by entry of the XY values, it can be erased by a second entry of the same values.

1. With the ALPHA LOCK key in the locked down position, and with the terminal in the Local Mode, proceed with key operations as follows:

    ERASE PAGE   To clear the screen

    BG ON   To set the reverse field flag on.

    CONTROL B   Operation of the B key with the CONTROL key
                   held down. To enter the General Plot Mode.

    CONTROL @   Operation of the @ key with the CONTROL key
                   held down. To generate the code for zero
                   (our X value).

    CONTROL @   To generate the code for zero (our Y value).

Following the last key operation a small plot block at the lower left corner of the screen is intensified.

2. Now with the CONTROL key held down, strike the A key twice to generate the codes for position (1,1). Another small block appears just above and to the right of the first one.

Continue in order through the alphabet, holding the CONTROL key down and striking each alpha key twice. With the CONTROL key still down, perform dual operations of the [\ ] ^ and _ keys (all in the same row as the HOME key). The plot blocks now form a diagonal one-fifth of the way across the screen.

If an error was made at any point, it can be erased by repetition of the same pair of key strokes that caused the error.

3. Next, with the SHIFT key held down (CONTROL is released), operate the 0 key twice and then follow with dual operations of keys 1 through 9 and * and +. The diagonal continues step by step.

4. Release the SHIFT key and perform dual operations of the , - . and / keys. (The - key is the one just to the left of the Cursor Down key.) With both SHIFT and CONTROL still released, continue with dual operations of the 0 and 1 through 9 keys and the : and ; keys.

5. Then with SHIFT held operated, continue with the < = > and ? keys. The diagonal is now two-fifths of the way across the screen. The last point plotted was (63,63).

6. With both CONTROL and SHIFT released, operate the @ key twice. Continue with A through Z, followed by the [\ ] ^ and _ keys. Next, with the SHIFT key held operated, repeat the sequence of dual operations of keys @ and A through Z and [\ ] ^ and _. The diagonal is now at point (127,127), four-fifths of the way across the screen.

7. The same @ through _ sequence with both CONTROL and SHIFT held down will generate the codes for 128 through 159. (However, with software prior to V1.6 the ALPHA LOCK key must be up and code 155 causes entry to the SET-UP mode. So skip CONTROL SHIFT [. If the SET-UP mode is entered, simply press the RETURN key to regain the display.) The diagonal is now complete to the right side of the screen at point (159,159).

8. Now, with both CONTROL and SHIFT still held down, continue with dual operations of keys 0 through 9 and : and ;. Note that a new diagonal has begun at the left side of the screen up toward the top. As will be described in the discussion of plot submodes, this is because the microprocessor automatically subtracts 160 from any X value above 159. The XY value entered as (160,160), for example, has been plotted as (0,160).

9. Release SHIFT (but CONTROL still held down) and continue with dual operations of keys < = > ?.

With a 72 or 101 key keyboard, this is as far as the exercise goes. Hold down CONTROL and and SHIFT and strike the ? key to exit from the plot mode.

With the 117 key keyboard, V1.6 software and the 500239-040 keyboard processor, the exercise may include a few more codes.

10. With CONTROL held down, continue with dual operations of keys 0 through 9 and : and ;. Then with both CONTROL and SHIFT down, continue with dual operations of the < = > ? keys. The diagonal reaches the top of the screen.

11. With CONTROL down (SHIFT released), continue with dual operations of keys F0 through F15. A new diagonal begins at point (32, 0). (160 has been subtracted from the X value and 192 from the Y value.)

12. Now release CONTROL and hold down the SHIFT key while repeating the dual operations of the F0-F15 keys. Then with both CONTROL and SHIFT held down, again repeat the dual operations of keys F0-F15. The diagonal continues to point (79,47). (With software prior to V1.6, keys F0-F15 can be used with both CONTROL and SHIFT down.)

Do not use F0-F14 alone in this exercise -- the codes resulting from these key operations cause entry into other plot submodes and cannot be used for plotting XY points. Operate the F15 key alone to exit from the plot mode. After exit from the plot mode, operation of the ERASE PAGE key will clear the screen and return the cursor to the upper left corner of the screen.

GENERATION OF DECIMAL CODES FROM THE KEYBOARD

Use keystroke combinations as indicated

ALPHA LOCK key down at all times

SHIFT required for char. such as ! $ etc.

Table for V1.6 software and 500239-040 keyboard processor

Dec	Key	Dec	Key	Dec	Key	Dec	Key
0	Ctr @	64	@	128	Ctr-Sh @	192	Ctr F0
1	Ctr A	65	A	129	Ctr-Sh A	193	Ctr F1
2	Ctr B	66	B	130	Ctr-Sh B	194	Ctr F2
3	Ctr C	67	C	131	Ctr-Sh C	195	Ctr F3
4	Ctr D	68	D	132	Ctr-Sh D	196	Ctr F4
5	Ctr E	69	E	133	Ctr-Sh E	197	Ctr F5
6	Ctr F	70	F	134	Ctr-Sh F	198	Ctr F6
7	Ctr G	71	G	135	Ctr-Sh G	199	Ctr F7
8	Ctr H	72	H	136	Ctr-Sh H	200	Ctr F8
9	Ctr I	73	I	137	Ctr-Sh I	201	Ctr F9
0	Ctr J	74	J	138	Ctr-Sh J	202	Ctr F10
11	Ctr K	75	K	139	Ctr-Sh K	203	Ctr F11
12	Ctr L	76	L	140	Ctr-Sh L	204	Ctr F12
13	Ctr M	77	M	141	Ctr-Sh M	205	Ctr F13
14	Ctr N	78	N	142	Ctr-Sh N	206	Ctr F14
15	Ctr O	79	O	143	Ctr-Sh O	207	Ctr F15
16	Ctr P	80	P	144	Ctr-Sh P	208	Sh F0
17	Ctr Q	81	Q	145	Ctr-Sh Q	209	Sh F1
18	Ctr R	82	R	146	Ctr-Sh R	210	Sh F2
19	Ctr S	83	S	147	Ctr-Sh S	211	Sh F3
20	Ctr T	84	T	148	Ctr-Sh T	212	Sh F4
21	Ctr U	85	U	149	Ctr-Sh U	213	Sh F5
22	Ctr V	86	V	150	Ctr-Sh V	214	Sh F6
23	Ctr W	87	W	151	Ctr-Sh W	215	Sh F7
24	Ctr X	88	X	152	Ctr-Sh X	216	Sh F8
25	Ctr Y	89	Y	153	Ctr-Sh Y	217	Sh F9
26	Ctr Z	90	Z	154	Ctr-Sh Z	218	Sh F10
27	Ctr [	91	[	155	Ctr-Sh [	219	Sh F11
28	Ctr \	92	\	156	Ctr-Sh \	220	Sh F12
29	Ctr]	93	]	157	Ctr-Sh]	221	Sh F13
30	Ctr ^	94	^	158	Ctr-Sh ^	222	Sh F14
31	Ctr _	95	_	159	Ctr-Sh _	223	Sh F15
32	Sh 0	96	Sh @	160	Ctr-Sh 0	224	Ctr-Sh F0
33	!	97	Sh A	161	Ctr !	225	Ctr-Sh F1
34	"	98	Sh B	162	Ctr "	226	Ctr-Sh F2
35	#	99	Sh C	163	Ctr #	227	Ctr-Sh F3
36	$	100	Sh D	164	Ctr $	228	Ctr-Sh F4
37	%	101	Sh E	165	Ctr %	229	Ctr-Sh F5
38	&	102	Sh F	166	Ctr &	230	Ctr-Sh F6
39	'	103	Sh G	167	Ctr '	231	Ctr-Sh F7
40	(	104	Sh H	168	Ctr (	232	Ctr-Sh F8
41	)	105	Sh I	169	Ctr)	233	Ctr-Sh F9
42	*	106	Sh J	170	Ctr *	234	Ctr-Sh F10
43	+	107	Sh K	171	Ctr +	235	Ctr-Sh F11
44	,	108	Sh L	172	Ctr ,	236	Ctr-Sh F12
45	-	109	Sh M	173	Ctr -	237	Ctr-Sh F13
46	.	110	Sh N	174	Ctr .	238	Ctr-Sh F14
47	/	111	Sh O	175	Ctr /	239	Ctr-Sh F15
48	0	112	Sh P	176	Ctr 0	240	F0 or Ctr 0
49	1	113	Sh Q	177	Ctr 1	241	F1 or Ctr 1
50	2	114	Sh R	178	Ctr 2	242	F2 or Ctr 2
51	3	115	Sh S	179	Ctr 3	243	F3 or Ctr 3
52	4	116	Sh T	180	Ctr 4	244	F4 or Ctr 4
53	5	117	Sh U	181	Ctr 5	245	F5 or Ctr 5
54	6	118	Sh V	182	Ctr 6	246	F6 or Ctr 6
55	7	119	Sh W	183	Ctr 7	247	F7 or Ctr 7
56	8	120	Sh X	184	Ctr 8	248	F8 or Ctr 8
57	9	121	Sh Y	185	Ctr 9	249	F9 or Ctr 9
58	:	122	Sh Z	186	Ctr :	250	F10 or Ctr :
59	;	123	Sh [	187	Ctr ;	251	F11 or Ctr ;
60	<	124	Sh \	188	Ctr <	252	F12 or Ctr <
61	=	125	Sh]	189	Ctr =	253	F13 or Ctr =
62	>	126	Sh ^	190	Ctr >	254	F14 or Ctr >
63	?	127	Sh _	191	Ctr ?	255	F15 or Ctr ?

A-6

COMPOSITE COLOR CODES
(Used following Control Code 6)

Background BLACK			Background BLUE		
Foreground	Plot	Blink	Foreground	Plot	Blink
BLACK	0	64	BLACK	32	96
RED	1	65	RED	33	97
GREEN	2	66	GREEN	34	98
YELLOW	3	67	YELLOW	35	99
BLUE	4	68	BLUE	36	100
MAGENTA	5	69	MAGENTA	37	101
CYAN	6	70	CYAN	38	102
WHITE	7	71	WHITE	39	103

Background RED			Background MAGENTA		
Foreground	Plot	Blink	Foreground	Plot	Blink
BLACK	8	72	BLACK	40	104
RED	9	73	RED	41	105
GREEN	10	74	GREEN	42	106
YELLOW	11	75	YELLOW	43	107
BLUE	12	76	BLUE	44	108
MAGENTA	13	77	MAGENTA	45	109
CYAN	14	78	CYAN	46	110
WHITE	15	79	WHITE	47	111

Background GREEN			Background CYAN		
Foreground	Plot	Blink	Foreground	Plot	Blink
BLACK	16	80	BLACK	48	112
RED	17	81	RED	49	113
GREEN	18	82	GREEN	50	114
YELLOW	19	83	YELLOW	51	115
BLUE	20	84	BLUE	52	116
MAGENTA	21	85	YELLOW	53	117
CYAN	22	86	CYAN	54	118
WHITE	23	87	WHITE	55	119

Background YELLOW			Background WHITE		
Foreground	Plot	Blink	Foreground	Plot	Blink
BLACK	24	88	BLACK	56	120
RED	25	89	RED	57	121
GREEN	26	90	GREEN	58	122
YELLOW	27	91	YELLOW	59	123
BLUE	28	92	BLUE	60	124
MAGENTA	29	93	MAGENTA	61	125
CYAN	30	94	CYAN	62	126
WHITE	31	95	WHITE	63	127

A-7

INPUT CODE FLOW DIAGRAM

ANY ONE OF 256 INPUT CODES

ANY ONE OF STRIP A7 TO 128 INPUT CODES

32 SPECIAL CHARACTER CODES

64 ASCII CHARACTER CODES

IF FLAG BIT — OFF / ON

IF ONE OF 32 CONTROL CODES

1ST 32 SPECIAL CHARACTERS CODE 96-127

2ND 32 SPECIAL CHARACTERS CODE 0-31

CONTROL CODE 2 PLOT MODE OPTION — SEE PLOT SUB MODES

CONTROL CODE 3 CURSOR X-Y MODE — CURSOR MODES

CONTROL CODE 6 CCI MODE — ONE OF 256 COLOR AND BLINK STATUS WORDS **

CONTROL CODE 27 ESC — ONE OF 32 ESCAPE CODES

CONTROL CODE 29 REVERSE FIELD OFF * — NORMALLY FOLLOWED BY A COLOR CODE OR G0 TO G31

CONTROL CODE 30 REVERSE FIELD ON * — NORMALLY FOLLOWED BY A COLOR CODE OR G0 TO G31

ALL OTHER CONTROL CODES

EXCEPT ESC [INTRODUCES ANSI X3.64 SEQUENCE
ESC (USED IN CHARACTER SELECT SEQUENCE

* THIS CODE DOES NOT REQUIRE ANY FOLLOW-ON CODE

ANY FOLLOW-ON CODE

** SEE PAGE A-8 DEFINITION OF THE 8 BITS OF THE STATUS WORD

A-8

REV 1
REVISED NOV 28 '77
CKD

Option 46C required for use with Centronics-type parallel printer

Option 46D required for use as 8-bit parallel I/O port

Standard in 8800/3800 Series Terminals for use with serial-type printer

Standard in 8800/3800 Series Terminals for use as Auxiliary Serial I/O Port

Standard in 8800/3800 Series Terminals

Standard in 8800/3800 Series Terminals

8800/3800 Terminal Rear Panel Connectors

CURRENT LOOP CONFIGURATIONS

Numerous current loop configurations are possible, depending upon whether a two-wire or four-wire loop is desired and upon the source of power for the current. A simplified schematic of a two-wire current loop, with power from the Intecolor terminal, is shown below.
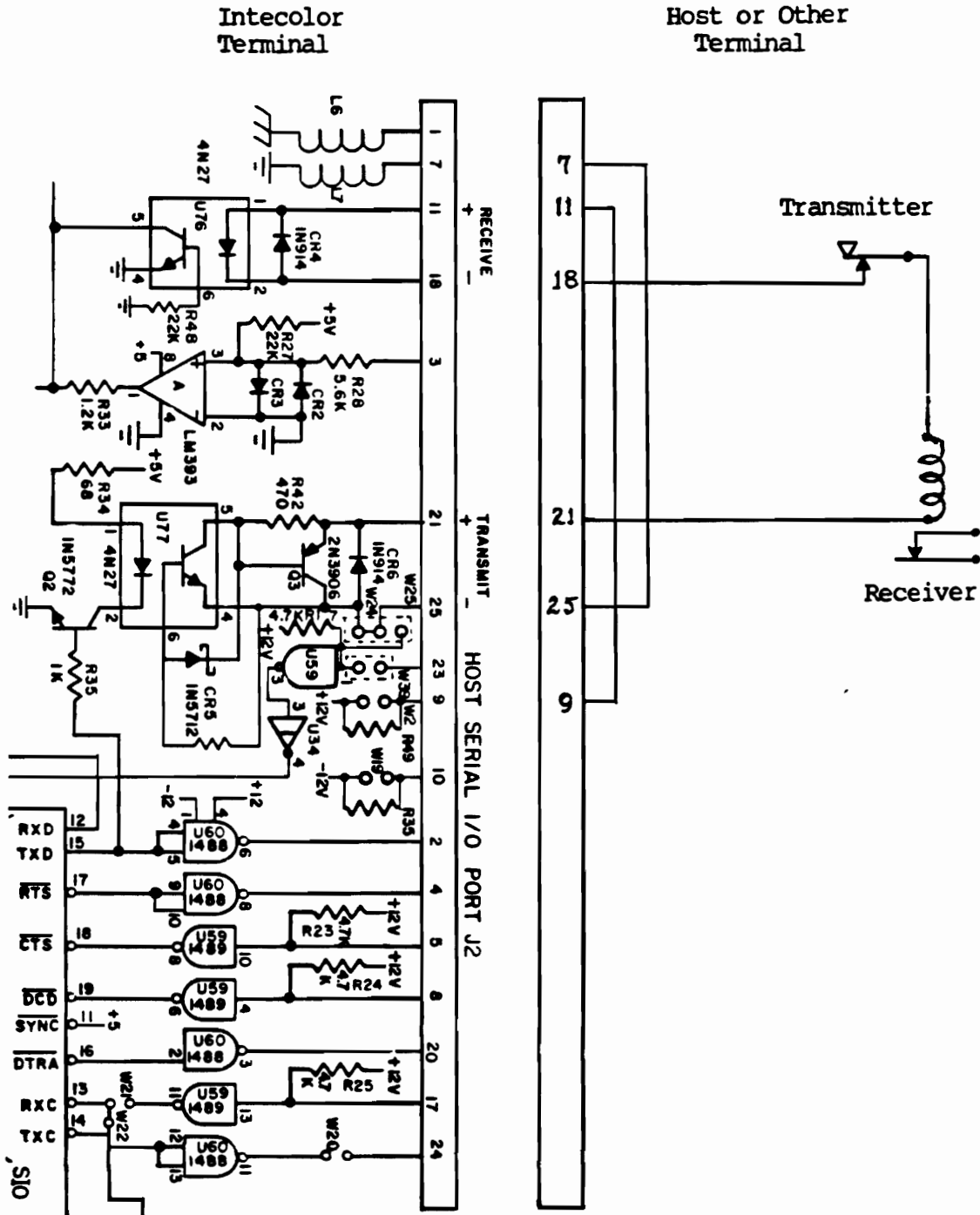
Note that a jumper on the Logic board must be in the W24 position and that two jumpers are installed in the connecting plug.

In the two-wire configuration, only one end can send at a time. Both receivers follow the device transmitting.

The general case for four-wire current loop configurations is shown below to illustrate the two important considerations:

There must be a source of current, shown here as a battery.
There must be resistance in the circuit to limit current.

Battery	Resistance
12 volts	470 ohms
24 volts	1000 ohms
48 volts	2000 ohms
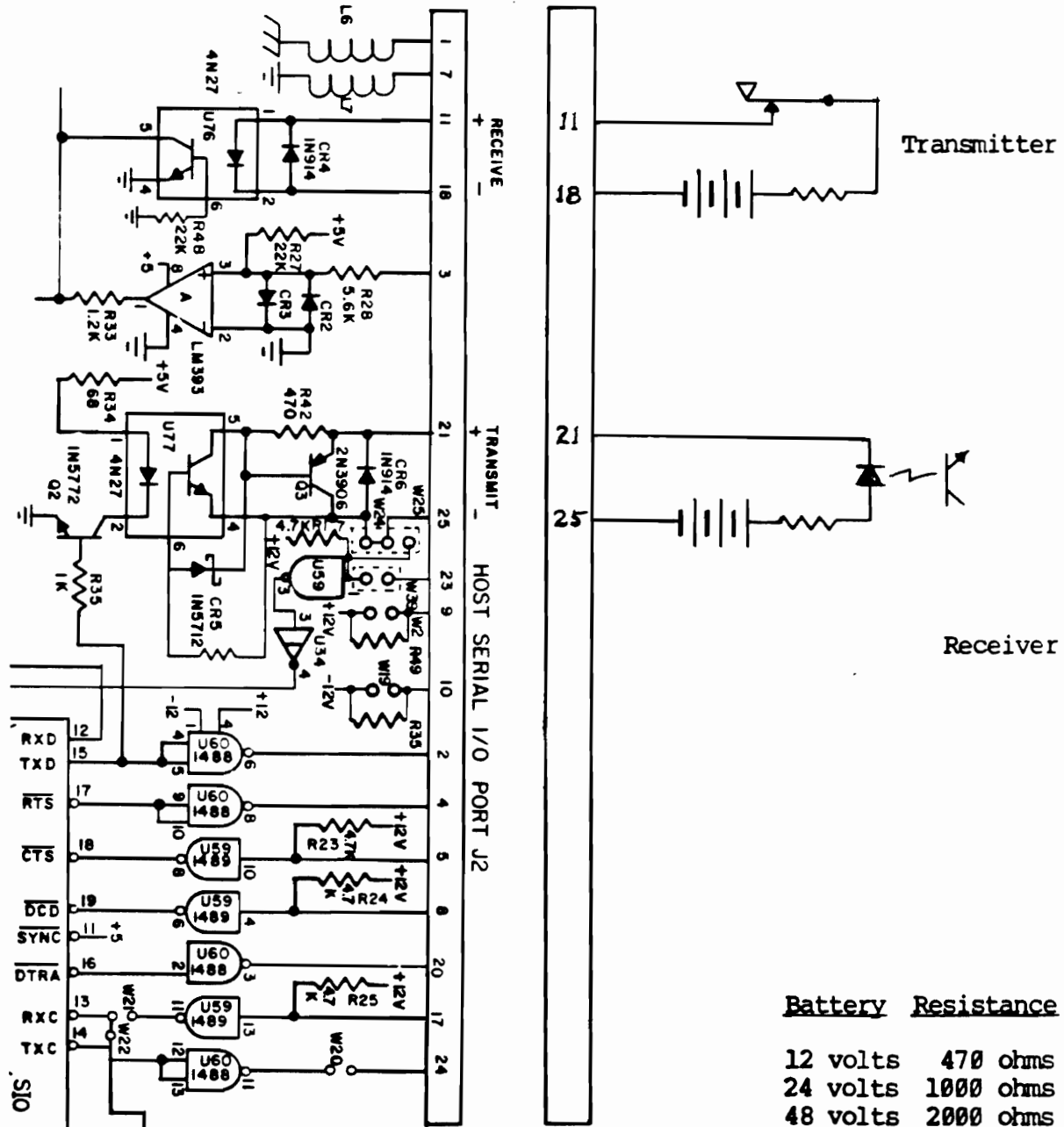
The current source (battery) and resistance may reside within the host, an interfacing device or the Intecolor terminal.

APPENDIX B

PLOT MODE FUNCTIONS

PLOT MODE
OR
CONTROL CODE B
SETS PLOFL = 2

	255	254	253	252	251	250	249	248
BINARY CODE =	255	254	253	252	251	250	249	248
TWO'S COMPLEMENT =	(-1)	(-2)	(-3)	(-4)	(-5)	(-6)	(-7)	(-8)
SETS PLOFL TO =	0	1	2	3	4	5	6	7
FUNCTION =	PLOT ESCAPE	CHARACTER PLOT	X-Y POINT PLOT	X-Y POINT PLOT	INCREMENTAL X-Y PLOT $\Delta X_1\,\Delta Y_1\,\Delta X_2\,\Delta Y_2$	X BAR GRAPH	X BAR GRAPH	X BAR GRAPH
NEXT WORD =	N/A	PLOT CHARACTER	X VALUE	Y VALUE		X_o VALUE	Y VALUE	X MAX VALUE
RANGE FROM = TO =	N/A N/A	0 254	0 159	100[191]	0 239	0 159	100[191]	0 159
CHANGE PLOFL TO =	N/A	1 (SAME)	3	2	4 (SAME)	6	7	6

	247	246	245	244	243	242	241	240
BINARY CODE =	247	246	245	244	243	242	241	240
TWO'S COMPLEMENT =	(-9)	(-10)	(-11)	(-12)	(-13)	(-14)	(-15)	(-16)
SETS PLOFL TO =	8	9	10	11	12	13	14	15
FUNCTION =	X INCREMENTAL BAR GRAPH $X_1\,Y_1\,X_2\,Y_2$	Y BAR GRAPH	Y BAR GRAPH	Y BAR GRAPH	Y INCREMENTAL BAR GRAPH $\Delta X_1\,\Delta Y_1\,\Delta X_2\,\Delta Y_2$	VECTOR	VECTOR	INCREMENTAL X-Y VECTOR $\Delta X_1\,\Delta Y_1\,\Delta X_o\,\Delta Y_o$
NEXT WORD =		Y_o VALUE	X VALUE	Y MAX VALUE		X_o VALUE	Y_o VALUE	
RANGE FROM = TO =	0 239	100[191]	0 159	100[191]	0 239	0 239	0 191	0 239
CHANGE PLOFL TO =	8 (SAME)	10	11	10	12 (SAME)	14	13	15
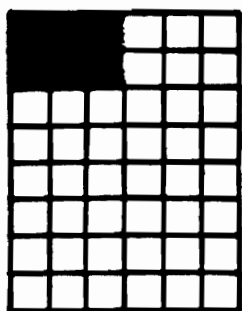
01 HEX
01 DEC
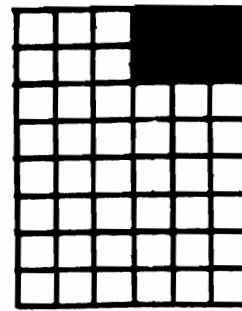
0 0 0 0 0 0 0 1

10 HEX
16 DEC

0 0 0 1 0 0 0 0
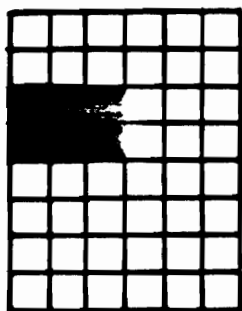
02 HEX
02 DEC

0 0 0 0 0 0 1 0
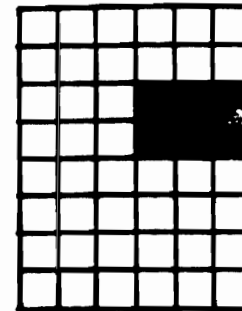
20 HEX
32 DEC

0 0 1 0 0 0 0 0
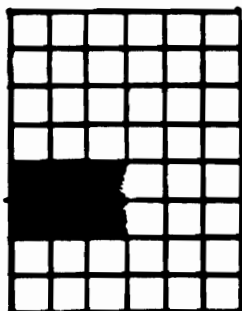
04 HEX
04 DEC

0 0 0 0 0 1 0 0
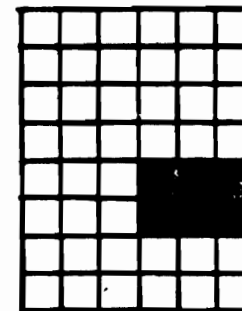
40 HEX
64 DEC

0 1 0 0 0 0 0 0
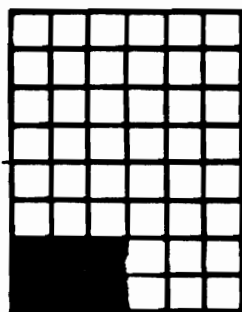
08 HEX
08 DEC

0 0 0 0 1 0 0 0
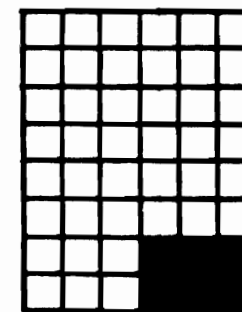
80 HEX
128 DEC

1 0 0 0 0 0 0 0

B-2

Note: Each of the above codes may be "ORed" for composite
       symbols.

PLOT MODE CHARACTERS AND CODES
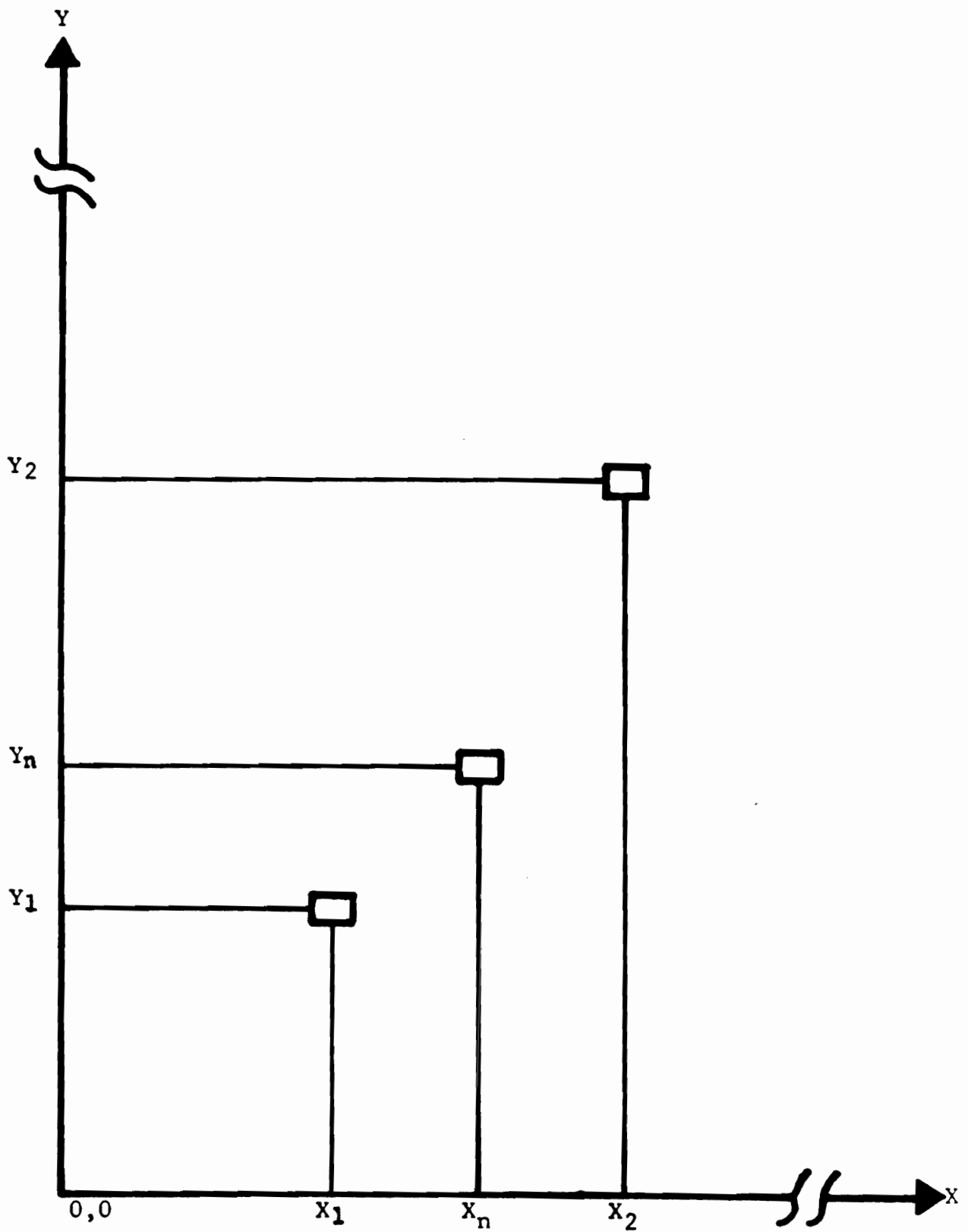
B-3

X POINT PLOT AND Y POINT PLOT

b_7	b_6	b_5	b_4	b_3	b_2	b_1	b_0
ΔX_1		ΔY_1		ΔX_2		ΔY_2	
1	0	1	0	0	1	1	0
ΔX_3		ΔY_3		ΔX_4		ΔY_4	
1	0	1	0	1	0	1	0

$\Delta X_3 \ \Delta Y_3$

$\Delta X_4 \ \Delta Y_4$
Finish

$\Delta X_2 \ \Delta Y_2$

$\Delta X_1 \ \Delta Y_1$ (1010)

Start

Y

X

0,0 Movement and Coding Example

Y

(0010)
(0110) $\Delta Y=+1$ $\Delta X=+1$ (1010)
$\Delta X=-1$ $\Delta X= 0$ $\Delta Y=+1$
$\Delta Y=+1$

Y_o (0100) $\Delta X=+1$ (1000)
$\Delta Y=0, \Delta X=-1$ $\Delta Y= 0$

$\Delta X=-1$ $\Delta X=+1$ (1001)
$\Delta Y=-1$ $\Delta Y=-1$
(0101) $\Delta Y=-1$ (0001)
$\Delta X= 0$

0,0 X_o X

Movement Possibilities

B-4

XY INCREMENTAL POINT PLOT MOVEMENTS

Y BAR GRAPH

X AND Y BAR GRAPH MODES

B-5

Y Incremental Bar Graph

b7	b6	b5	b4	b3	b2	b1	b0
ΔX1		ΔY1		ΔX2		ΔY2	
1	0	1	0	1	0	0	1
ΔX3		ΔY3		ΔX4		ΔY4	
1	0	1	0	1	0	1	0

X Incremental Bar Graph

b7	b6	b5	b4	b3	b2	b1	b0
ΔX1		ΔY1		ΔX2		ΔY2	
1	0	0	1	0	1	0	1
ΔX3		ΔY3		ΔX4		ΔY4	
1	0	0	1	1	0	0	1

Appendix B6

X INCREMENTAL BAR GRAPH, Y INCREMENTAL BAR GRAPH
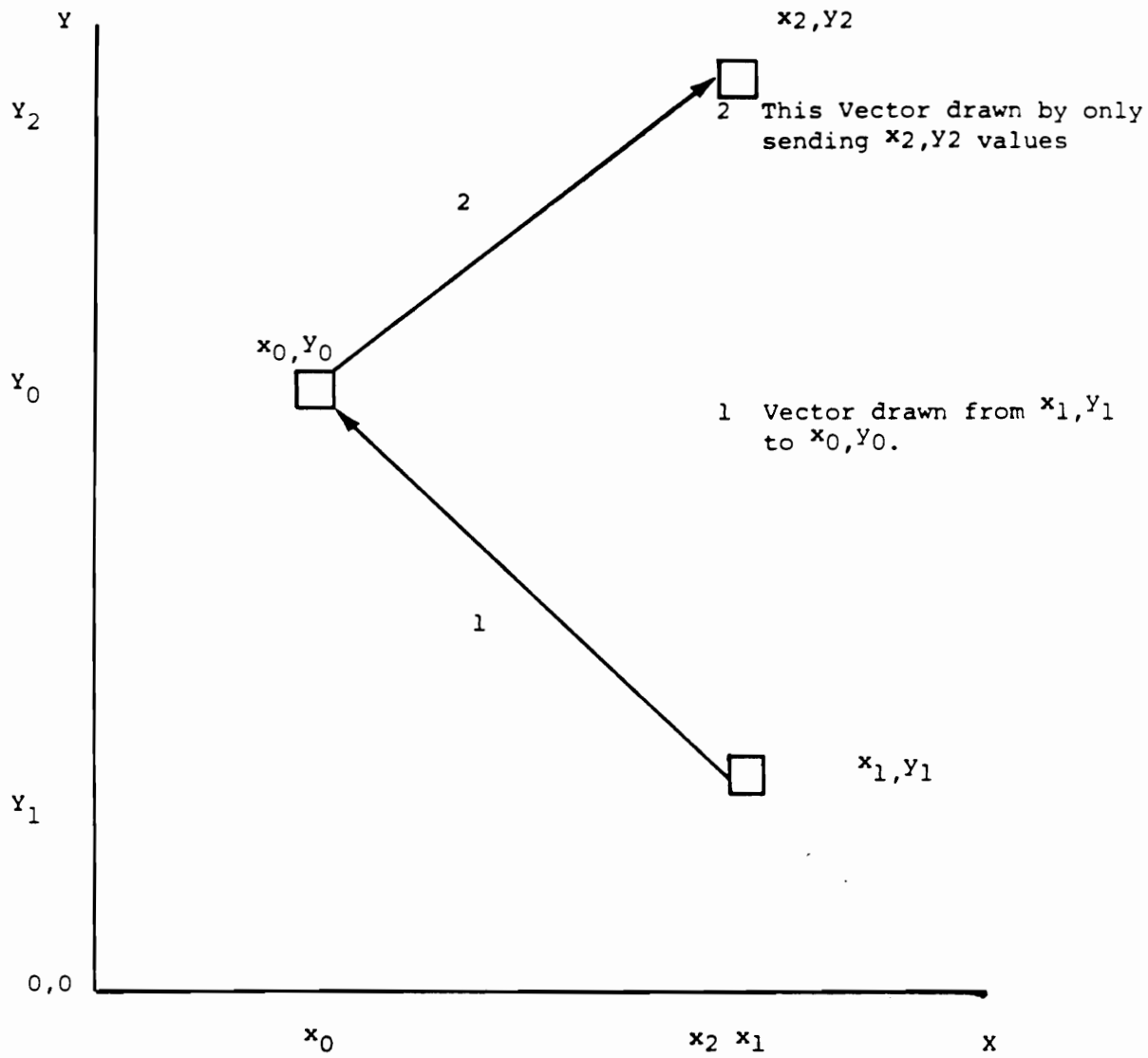
NOTE: After the 1st Vector was drawn, then the x_0, y_0 values become a new set of x_1, y_1 for the second Vector going to x_2, y_2.

B-7

$X_0\ Y_0$ Vector Plot Mode

APPENDIX C

ORDERING INFORMATION & TECHNICAL ASSISTANCE

The Intecolor Corporation maintains a knowledgeable staff of customer service and technical support personnel. They are glad to provide information and assistance concerning ordering, use, maintenance and repair of terminals and other equipment manufactured by Intecolor. The business address is:

△ Intecolor®

2150 Boggs Road • Duluth, GA 30136
404/623-9145 • FAX 404/623-9163

Regular office hours are 8:30 A.M. to 5:00 P.M., Eastern Time, Monday through Friday.

Order Information and Placement

For placing an order or for obtaining information regarding additional options, spare parts, repair components, prices and the like, please call or write:

Customer Service

Technical Assistance

For technical assistance regarding software or usage problems, repair of hardware faults and similar, please ask for:

Technical Support

Many problems can be solved over the phone. To save time, please tell the operator whether the assistance needed concerns hardware or software.

Equipment Return

Before returning any equipment for repair or replacement, either in or out of warranty, always obtain a Return Authorization number or Field Service number from an applications engineer. The correct "ship to" address, usually not the same as the business address above, also will be given.

The RA number (for repair at the factory) or FS number (for repair at an authorized repair center) is required in all cases. The applications engineers also can help determine the most expeditious method of repair.

Please show the **RA Number** or **FS Number** on the **outside** of the packing carton. This speeds delivery of the equipment to the correct area.

APPENDIX D

SELF TEST ROUTINES

The 8800/3800 Series terminal software includes a number of self test programs. One series of these routines is invoked at power-up. A repeating series of these routines can be invoked from the SETUP mode. The tests check a number of operating features in the digital circuitry.

When errors are detected by a test, there are two possible indications of the area at fault:

    The screen may display an error code (see page 3.05).

    One or more of a set of four LEDs on the logic board may be lighted.

The logic board LEDs are the more exact indicators of digital problems.

During the performance of the self test routines, all four LEDs remain lighted most of the time. They blink off very quickly only at certain times during the routines. Only on completion of the test, or on the finding of an error, does the LED-lighted pattern give indication of a potential problem area. (The diagnostic patterns are listed on page 2 of this appendix.)

If the repeating series of self test routines is allowed to run for an extended period of time, the following points should be noted.

1) The test series may be interrupted by a momentary power failure. Usually such an interruption results in terminal reset and a display of the initial message:

    INTECOLOR 8810 Vx.y

or similar (x.y indicating the software version). Possibly the Host I/O Menu may be displayed instead. Or, if the unit had been operating with the CRT Saver feature on, the screen may be blank. (If the CRT Saver blanked the screen, entry of any character from the keyboard will bring back a display.)

2) Power glitches or other strong electrical interference may possibly result in a minor data error that results in an error display or suspension of a test.

3) In any case, if the repeating self test routine apparently stops of itself, or if an error indication appears, the first step should be a repeat of the self test series. If there truly is a problem, the unit will fail test and give the same indication as before.

4) If an error still is indicated on the second and third self test tries, the type of screen display and the LED pattern should be noted. (Information as to the display and the LED pattern will assist the repair center in verifying and analyzing the fault.)

The diagnostic LEDs can be seen from the rear of the console. Look in through the narrow slit to the left of the logic board rear panel. LED #1 is the upper of the four LEDs, numbered 1 through 4 from top to bottom.

The LED array can assist in identification of problems ranging from bent pins on memory ICs or incorrectly installed firmware to certain hardware failures.

LED Number					
4	3	2	1	Message	Terminal Condition
•	•	•	•		Terminal passes diagnostics
•	•	•	x	ROM	Program ROM checksum error
•	•	x	•	RAM	System workspace RAM error
•	•	x	x	CRTC	CRT controller problem
•	x	•	•	SCRN	Character screen RAM error
•	x	•	x	KEYB	Keyboard port error (3801 STI)
•	x	x	•	HOST	Host port error (Z80 SIO)
•	x	x	x	NONV	Non-volatile ROM error (EEPROM)
x	•	•	•	SYNC	Failure to detect Line Sync
x	•	•	x	RROM	Graphics ROM checksum error
x	•	x	•	RRAM	Insufficient system RAM
x	•	x	x		- reserved -
x	x	•	•	GRAP	Graphic screen RAM error

x = LED lighted

At power-up, all four LEDs light to indicate that they are working. When tests are completed without error, all four LEDs are extinguished, the 'bell' sounds and the terminal is ready for use. If an error is found during test, the corresponding pattern of LED(s) light, a message is sent to the screen and the terminal is not enabled for use. The terminal must pass the power-up diagnostic tests in order to operate.

SETUP MENU FOR PORT TESTS

When in the SETUP MODE, with the Host I/O Menu displayed, a submenu of port tests can be invoked by operation of the '6' key.

> Self-Tests Menu
>
> 1. Host and Aux port tests
> 2. Parallel port test
> 3. Printer port test
> 4. Quit: Reset system
>
> Enter your choice.

Use of the tests require jumper plug connections at one or more ports.

The simplest for the HOST I/O PORT or the AUX I/O PORT alone requires only a jumper between pins 2 and 3.

For the serial PRINTER PORT test, a cable connects the Printer Port terminal 2 to the Auxiliary Port terminal 3. Printer Port terminal 21 is connected to Auxiliary Port terminal 20.

A reminder to use the jumper(s) is included in the display when one of the tests is invoked.

Following display of the Self-Tests Menu, pressing of the '1' key or the '3' key results in display of the Host & Aux Test submenu or the Serial Printer Test submenu:

Host & Aux Test   Serial Printer Test
Insert Host and Aux jumpers   Insert Printer/Aux jumper
Hit any key   Hit any key

The test begins when a key is pressed. Passing the test is reported in green. Failure is reported in red. Then when a key is pressed again the Selt-Tests Menu returns.

Since the parallel port option is not supported in the standard terminal, use of the '2' key brings up a display with instruction to abort:

Parallel Port Test
Insert parallel port jumper
Hit RETURN to abort

Use of the '4' key results in exit from the Setup Mode via a cycle of self-test followed by system reset. Unless changes made in the Setup Menu since power-up have been saved, the Setup selections are returned to those in effect at system power-up. The initial display appears.

SET-UP MENU FOR SOFTWARE PRIOR TO V1.6

To enter the SET-UP mode, hold down a SHIFT key while pressing the **SETUP** key and then releasing it. A SET-UP menu will be displayed.

A terminal with software prior to V1.6 shows the following SET-UP menu:

SETUP MODES

Configuration Menu

Local/On-Line	Line
Echo	Off
Xon / Xoff	^F ^G
Keyclick	On
Line Monitor	Off
Screen Saver	On
^H ^Z Swap	Normal
Character Set	Lower-case
CRT Size	19 inch

	Rate	**Parity**
Host I/O	9600	None

Special selections

1. RECALL old Menu
2. SAVE new Menu
3. FACTORY default Menu
4. Self-Test

```
 _____
|                                             |
|   Arrow keys          select an item        |
|   HOME                changes an item        |
|   RETURN              ends Setup Mode         |
|                                             |
 _____
```

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As indicated, to change a selection, operate one of the cursor arrow keys to move the cursor to the item to be changed. Then press the HOME key to change the selection. An option may have several possible selections. Press the HOME key repeatedly to scroll through the selections. (Eventually the original selection will be reached again.)

To exit the SET-UP mode, press the **RETURN** key and then release it. The displayed SET-UP menu selections will be in effect. To save the new menu in the nonvolatile memory for use in subsequent power-ups until changed again, press the 2 key to complete SAVE prior to pressing RETURN. The shifted SETUP key also effects exit from the SET-UP mode. The SET-UP features are described in the paragraphs following.

Local/On-Line   Settings: **Local** & **Line**

The operator may place the terminal ON-LINE or in the LOCAL mode. In the LOCAL mode no communication takes place between the host computer and the terminal. Keyboard operations affect the CRT display, but nothing is sent to the host computer.

When ON-LINE the terminal is in communication with the host computer, normally via the Host Serial I/O Port. Codes resulting from keyboard operations are sent to the host. They may affect the CRT display.

Echo   Settings: **On** & **Off**

This option determines whether the CRT screen responds directly to keyboard operations when the terminal is On-Line. It has no effect when the terminal is in Local.

When ECHO is ON, keyboard operations go to the CRT screen and also to the Host Serial I/O Port, if On-Line. If the host computer returns the results of terminal keyboard operations, the CRT displays a double response to keyboard typing. This is similar to "half duplex".

With ECHO OFF, keyboard operations can go only to the Host Serial I/O Port. The screen responds only to what the host computer returns. This is similar to "full Duplex".

Xon/Xoff   Settings: ^F ^G, Off & ^S ^Q

This option determines whether the terminal automatically sends XON and XOFF codes to the host computer. When OFF the codes are not sent.

When enabled by selection of ^F^G or ^S^Q, XOFF is sent when any of the following occur:

> 1. The terminal is placed in the SET-UP mode.
> 2. A CONTROL G (or CONTROL S) is entered at the keyboard.
> 3. The receive buffer becomes more than half full.

An XON is sent only after an XOFF has been sent. The XON indicates:

> 1. The terminal is back ON-LINE, or
> 2. A CONTROL F (or CONTROL Q) has been entered, or
> 3. The receive buffer has dropped below one-fourth full.

The ASCII code for XON may be 06 (for CONTROL F) or 17 decimal (11 Hex, for CONTROL Q). For XOFF it may be 07 (for CONTROL G) or 19 decimal (13 Hex, for CONTROL S).

Keyclick   Settings: **On** & **Off**

When ON, a keyclick tone is generated whenever any key except CONTROL or
SHIFT is pressed. However, if the host computer has locked the
keyboard, no tone will be generated. Use of KEYCLICK ON may contribute
to more accurate typing as well as providing an indication of keyboard
lock. When OFF, no keyclick tone is generated — though the noise of
the key bottoming out may be heard.

Line Monitor   Settings: **On** & **Off**

This option enables or disables the Control Representation mode. When
ON, all incoming data and control sequences are displayed but they are
not executed. The terminal effectively becomes a data stream analyzer.

When OFF, the terminal functions as a "normal" graphics terminal,
executing control and escape sequences.

Screen Saver   Settings: **On** & **Off**

This option is intended to prolong the life of the CRT by blanking the
screen when there is no activity for an extended period of time.

When ON, if there is no keyboard or HOST activity for some eight
minutes, the screen is blanked temporarily. Data remains in screen
memory. And the display returns when data is input from the HOST or the
keyboard. (However, the first keyboard strike will not cause data to be
sent to the HOST.)

^H ^Z Swap   Settings: **Normal** & **Swap**

With this option at NORMAL, receipt of a code 26 (1A hex) results in
"backspace". Receipt of a code 08 results in "cursor home". When the
option is set to SWAP, the results of receipt of these two codes are
reversed. Use of the keyboard left arrow key and the HOME key still
move the cursor as indicated on the terminal screen. However, the codes
sent to the host when the terminal is On-Line are reversed.

This option allows use of the terminal with a host that requires code 08
for "backspace" and code 26 (1A hex) for "cursor home".

Character Set   Settings: **Lower-case** & **Process**

When this option is set to NORMAL, all characters will be displayed on
the screen in accordance with the default character set. When the
option is set to any other entry, characters will be displayed in
accordance with another character set. In the standard 8810 the other
choice is PROCESS. Other sets are available via the Options 17 series.

The standard 8810 character generator includes 64 ASCII upper case, 64
special PROCESS and 32 ASCII lower case/32 control representation
characters.

Character Set "Lower-case" results in display of either ASCII upper case, ASCII lower case or control representation characters. Character Set "Process" results is display of upper case ASCII or PROCESS special characters. Up to seven character sets are available when the required character options are present.

CRT Size   Settings: **19 inch & 13 inch**

This selection affects the timing of the CRT horizontal drive, which in turn affects the centering of the display. Use 19 inch for the 8810, 13 inch for the 3810. (The software version line at the bottom of the SET-UP menu will reflect this following RETURN and shifted SETUP.)

Host I/O   Rate Settings: **110, 150, 300, 600, 1200, 2400, 4800, 9600, or 19200**

                       Parity Settings: **None, Even, Odd, High,** or **Low**

This option allows the operator to select a new baud rate, with parity as defined, for communicating with the host computer. To select a new baud rate, press the HOME key repeatedly until the desired rate is visible in the colored field. The selected rate will go into effect when the SET-UP mode is exited by the pressing of the RETURN key.

Special hardware options allow higher rates of 38.4K and 76.8K Baud and EXTernal. SET-UP includes these choices when the option is present.

Press the 1 key to restore the original menu — the one in effect before this editing of the setup menu began.

Press the 2 key to save the new menu for use at subsequent power-ups.

Press the 3 key to restore the factory default menu.

Press the 4 key to initiate the self-test procedure. Within about three seconds a crazy-quilt-like pattern will flash on the screen twice at approximately 3-second intervals. Press the SETUP key alone to exit the self-test program and obtain the initial display. Appendix D contains important information regarding use of the repeating self test routine.

When all SET-UP selections are as desired, press the **RETURN** key to put the selected options into effect. The CRT display will return to that in effect before entry to the SET-UP mode. The new SET-UP selections will not be effective in the next power-up unless special selection 2 was executed prior to pressing RETURN.

THE ASCII CODE and LINE MONITOR MODE DISPLAY

In the Line Monitor Mode characters representing the codes received are displayed in sequence on the screen. Control codes other than SPace are displayed as two-part characters but are not acted upon. The space code results in an actual space. Codes other than control codes and the space code result in display of the conventional ASCII character. The display is in foreground green for codes 0-127, in red for codes 128-255. If the previous character is displayed on the last position of a line, the next character is displayed on the first position of the next line.

Character					Character				
ASCII	Display	ADE	Hex	Binary	ASCII	Display	ADE	Hex	Binary
NUL	N_U	0	00	0000 0000	DLE	D_L	16	10	0001 0000
SOH	S_H	1	01	0000 0001	DC1	D_1	17	11	0001 0001
STX	S_X	2	02	0000 0010	DC2	D_2	18	12	0001 0010
ETX	E_X	3	03	0000 0011	DC3	D_3	19	13	0001 0011
EOT	E_T	4	04	0000 0100	DC4	D_4	20	14	0001 0100
ENQ	E_Q	5	05	0000 0101	NAK	N_K	21	15	0001 0101
ACK	A_K	6	06	0000 0110	SYN	S_Y	22	16	0001 0110
BEL	B_L	7	07	0000 0111	ETB	E_B	23	17	0001 0111
BS	B_S	8	08	0000 1000	CAN	C_N	24	18	0001 1000
HT	H_T	9	09	0000 1001	EM	E_M	25	19	0001 1001
LF	L_F	10	0A	0000 1010	SUB	S_B	26	1A	0001 1010
VT	V_T	11	0B	0000 1011	ESC	E_C	27	1B	0001 1011
FF	F_F	12	0C	0000 1100	FS	F_S	28	1C	0001 1100
CR	C_R	13	0D	0000 1101	GS	G_S	29	1D	0001 1101
S0	S_0	14	0E	0000 1110	RS	R_S	30	1E	0001 1110
SI	S_I	15	0F	0000 1111	US	U_S	31	1F	0001 1111

ASCII &					ASCII &				
Display	ADE	Hex	Binary		Display	ADE	Hex	Binary	
SP	32	20	0010 0000		0	48	30	0011 0000	
!	33	21	0010 0001		1	49	31	0011 0001	
"	34	22	0010 0010		2	50	32	0011 0010	
#	35	23	0010 0011		3	51	33	0011 0011	
$	36	24	0010 0100		4	52	34	0011 0100	
%	37	25	0010 0101		5	53	35	0011 0101	
&	38	26	0010 0110		6	54	36	0011 0110	
'	39	27	0010 0111		7	55	37	0011 0111	
(	40	28	0010 1000		8	56	38	0011 1000	
)	41	29	0010 1001		9	57	39	0011 1001	
*	42	2A	0010 1010		:	58	3A	0011 1010	
+	43	2B	0010 1011		;	59	3B	0011 1011	
,	44	2C	0010 1100		<	60	3C	0011 1100	
-	45	2D	0010 1101		=	61	3D	0011 1101	
.	46	2E	0010 1110		>	62	3E	0011 1110	
/	47	2F	0010 1111		?	63	3F	0011 1111	

ASCII & Display	ADE	Value Hex	Binary		ASCII & Display	ADE	Value Hex	Binary
@	64	40	0100 0000		`	96	60	0110 0000
A	65	41	0100 0001		a	97	61	0110 0001
B	66	42	0100 0010		b	98	62	0110 0010
C	67	43	0100 0011		c	99	63	0110 0011
D	68	44	0100 0100		d	100	64	0110 0100
E	69	45	0100 0101		e	101	65	0110 0101
F	70	46	0100 0110		f	102	66	0110 0110
G	71	47	0100 0111		g	103	67	0110 0111
H	72	48	0100 1000		h	104	68	0110 1000
I	73	49	0100 1001		i	105	69	0110 1001
J	74	4A	0100 1010		j	106	6A	0110 1010
K	75	4B	0100 1011		k	107	6B	0110 1011
L	76	4C	0100 1100		l	108	6C	0110 1100
M	77	4D	0100 1101		m	109	6D	0110 1101
N	78	4E	0100 1110		n	110	6E	0110 1110
O	79	4F	0100 1111		o	111	6F	0110 1111
P	80	50	0101 0000		p	112	70	0111 0000
Q	81	51	0101 0001		q	113	71	0111 0001
R	82	52	0101 0010		r	114	72	0111 0010
S	83	53	0101 0011		s	115	73	0111 0011
T	84	54	0101 0100		t	116	74	0111 0100
U	85	55	0101 0101		u	117	75	0111 0101
V	86	56	0101 0110		v	118	76	0111 0110
W	87	57	0101 0111		w	119	77	0111 0111
X	88	58	0101 1000		x	120	78	0111 1000
Y	89	59	0101 1001		y	121	79	0111 1001
Z	90	5A	0101 1010		z	122	7A	0111 1010
[	91	5B	0101 1011		{	123	7B	0111 1011
\	92	5C	0101 1100		|	124	7C	0111 1100
]	93	5D	0101 1101		}	125	7D	0111 1101
^	94	5E	0101 1110		~	126	7E	0111 1110
_	95	5F	0101 1111		■	127	7F	0111 1111

Custom Character Sets

In the Intecolor terminal the normal character is displayed in a 6 x 8 dot matrix. CRT display of a row of characters is created in eight successive horizontal scans. Eight words in the character ROM define the eight 6-dot character portions of each scan dot by dot (or pixel by pixel). For example, an uppercase A:

```
00010000        Scan 1
00101000        Scan 2
01000100        Scan 3
01000100        Scan 4
01111100        Scan 5
01000100        Scan 6
01000100        Scan 7
00000000        Scan 8
```

In this pattern a zero specifies 'background' and a binary one specifies 'foreground'. The actual background and foreground colors are determined by the 'attribute' word, which is associated with each character word in screen memory. (The 'character' word from memory is used to address the character ROM, with scan count bits supplying the rest of the address.)

Normally the left column of dots or pixels and the last row are left background for spacing of characters. However, if characters for graphics are involved this may not be the case. The right two columns are not used since the matrix is just six dots wide.

The ROM allows 16 bytes for each character, but the last eight in the ROM space allotted each character are not used (and left as zero). The usual character set consists of 128 characters. The standard 2764 EPROM has space for the three sets -- Lowercase, Process, and Forms -- plus the standard resolution plot character set.

When custom sets are added, a 27128 EPROM replaces the 2764 in Logic Board location U81. Jumper W31 is removed and jumper W30 is installed. The addresses of the character sets in the EPROM are as follows:

	Hexadecimal	Decimal
Lowercase	0000 - 07FF	0 - 2047
Plot	0800 - 0FFF	2048 - 4095
Process	1000 - 17FF	4096 - 6143
Forms	1800 - 1FFF	6144 - 8191
Custom 1	2000 - 27FF	8192 - 10,239
Custom 2	2800 - 2FFF	10,240 - 12,287
Custom 3	3000 - 37FF	12,288 - 14,335
Custom 4	3800 - 3FFF	14,336 - 16,383

The Lowercase, Process and Forms sets have 128 characters, of which 64 are the standard ASCII uppercase. The arrangement in the EPROM is as follows:

0-31   A set of 32 characters, such as those used in the Line Monitor Mode, which is paged in when the Background Flag is set on. The ASCII decimal equivalent (ADE) of these characters is 96 through 127. Half of the Process or Forms characters also are handled in this way.

32-95   The space, symbols, numbers, punctuation and uppercase characters, with ADE of 32 through 95.

96-127 A set of 32 characters, such as lowercase, paged in when the Background Flag is reset to off (or Foreground on). The ADE range is 96 through 127.

It may be easier logically to consider operation of the Intecolor keyboard with the ALPHA LOCK key locked down. Then uppercase alpha characters, numbers and symbols -- characters in the range of 32-95 -- will be displayed as indicated by the keycaps. The keycaps indicate which symbols require SHIFT. All characters in the range of 0-31 and 96-127 will require shift. The @ key, the 26 alpha keys and the five keys just to the left of the <- key comprise the 32-key set to be used with SHIFT. The condition of the Background Flag determines whether characters in the range of 0-31 or 96-127 result.

The Plot set is a bit different. It consists of 256 characters. The character matrix is divided into eight plot blocks, each 3 dots wide and 2 dots high. There are 256 possible combinations of the eight plot blocks. These normally are not accessed directly from the keyboard. The graphics software selects them to fulfill requirements for plot of points or vectors invoked by commands in the plot submodes. 255 of them can be accessed directly from the keyboard in the Character Plot mode. The other one, all eight plot blocks up, can be simulated by a space in the appropriate background color.

The Intecolor Corporation will generate custom character sets from a customer-supplied worksheet for a development charge ($500 per set, as this addendum is printed). Terminals with such custom character sets will then be available at a rather nominal incremental charge.

APPENDIX H

UP-DATE NOTES

This appendix contains operational change information received after completion of the main body of the manuscript.

Escape Sequences F, H and L

Escape codes F, H and L have been implemented in the 8800/3800 Series, beginning with software version V1.7, for compatibility with the Full Duplex, Half Duplex and Local modes of the Intecolor F8000 Series product.

In the Setup Mode, the Host I/O Menu has an additional ECHO selection — 'Local' has been added to the 'On' and 'Off' choices.

F or Code 6 — Full Duplex Mode

When this mode is selected the keyboard characters are sent to the HOST SERIAL I/O PORT. They are not processed by the terminal. The screen will display the characters sent only if they are echoed back by the host computer to the terminal's input.

The host effectively has control of the terminal's display. The operator can, if necessary, regain control of the terminal via the Setup Mode.

The Setup Menu indicates the presence of this mode as ON-LINE with ECHO OFF.

H or Code 8 — Half Duplex Mode

When this mode is selected the keyboard characters are processed and displayed by the terminal. They also are sent to the HOST SERIAL I/O PORT. The terminal's display is affected by both keyboard operations and input from the host computer.

If the host echoes back the characters transmitted by the terminal, the terminal will display each character twice — once as it is received from the keyboard and again as it is received via the serial input port.

Change to another mode of operation can be effected by either the host or by the terminal operator's use of an escape sequence or the Setup Mode.

Half duplex is shown in the Setup Menu as ON-LINE with ECHO ON.

<u>L or Code 12</u> — Local Mode

In this mode the keyboard characters are displayed on the terminal screen, but they are not sent to any output port. The terminal still responds to input via the HOST SERIAL I/O PORT, either for display or for change of mode of operation.

While in the Local Mode, receipt of a Control X or an ESC C sequence can cause the terminal to transmit screen data out the serial port.

This mode varies from the Setup Mode choice of LOCAL (rather than ON-LINE) in that the terminal still responds to serial input. The presence of this Local Mode is reflected in the Setup Menu by the indication of 'LOCAL' as the ECHO choice, with the terminal 'ON-LINE'.

Software Problem Report

Use this form to report software/firmware errors or problems in Intecolor Corporation's products. Please report only one problem per form.

Mail to: **Intecolor®**

2150 Boggs Road • Duluth, GA 30136
404/623-9145 • FAX 404/623-9163

Your name and address:

Date _____

_____ Model of Unit _____

_____ Software Version _____

_____ Serial Number of Unit _____

_____ Purchase Date _____

Phone number where you can be reached during

the working day _____

Description of the problem and the circumstances surrounding its occurrence. It is best if the problem can be reduced to a simple test case. Include a diskette or write on the back of this form if you wish.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Please do not write below this line)

Disposition

_____

_____

_____

Sequence _____   Date _____

ECN _____   Programmer _____   ICP 4/85

8800/3800 USER'S MANUAL
PART TWO

PART TWO
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V   Troubleshooting

PART TWO
APPENDICES

CHAPTER I

INTRODUCTION

CHAPTER I

INTRODUCTION

Improvements in Intecolor analog circuitry led to the development of new products for the 3800/8800 Series color graphics terminals. The analog systems described in this addendum feature Intecolor's patented Auto-ranging Power Supplies, and improved deflection and video circuitry.
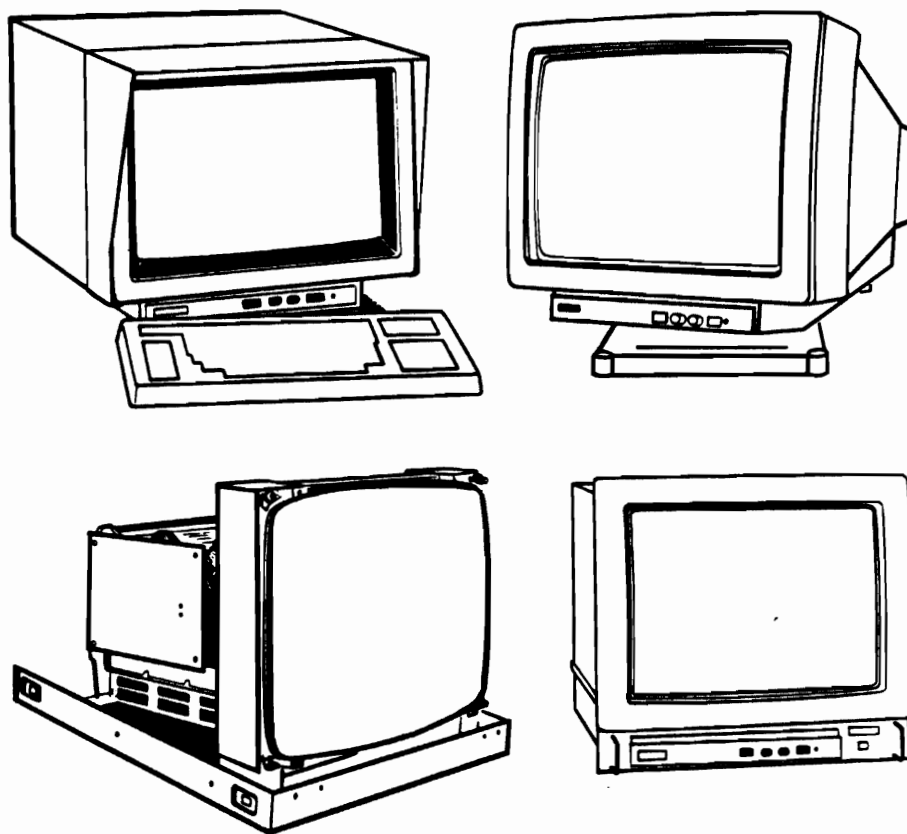
All 3800/8800 Series terminals provide color alphanumeric displays on an 80 X 48 character grid. In addition, two levels of graphics resolution are available for all 3800/8800 Series terminals.

```
                   Graphics Grid:
    Normal Resolution    160 wide X 192 high
    Medium Resolution    480 wide X 384 high
```

Screen size, monitor cabinet, graphics capabilities and analog circuitry used, determine the model number for each unit. See the chart in appendix A, for the available models of 3800/8800 Series terminals.

SYSTEM OVERVIEW

Three analog printed circuit boards, an interface/mother board, the logic board, and a pre-converged color CRT are included in basic 3800/8800 units described in this addendum. Units with extended graphics capabilities also use an additional logic board.

A **system block diagram** of 3800/8800 Series terminals described in this Addendum is shown below.
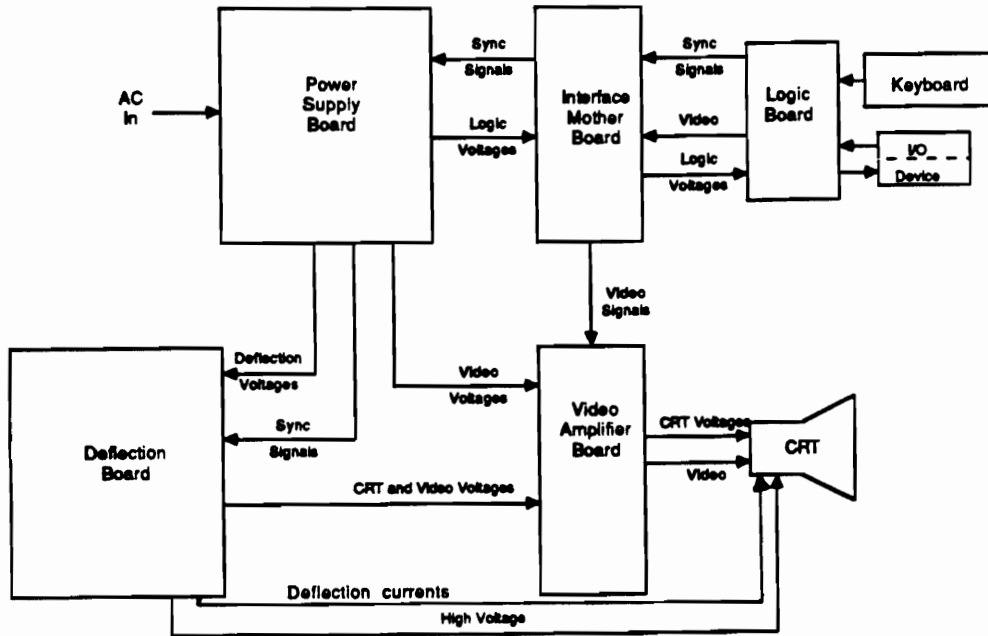
Power Supply circuitry converts input AC voltage into the many DC voltages required by other circuitry of the terminal.

Deflection circuits develop linear sawtooth currents to move an electron beam, synchronized with the logic, across the CRT screen. The high anode voltage and other CRT biasing voltages are also generated by deflection circuitry.

Video circuitry amplifies the one bit video signals from the logic to drive the CRT red, green, and blue cathodes.

Interface/Mother board circuitry provides inter-connection of the logic, power supply, video and optional light pen circuitry.

Logic circuitry generates the timing signals for synchronization with other circuitry and processes data to generate video and communication signals.

CRT displays characters and graphics generated by the Logic board.

3800 DESCRIPTION

Two units, similar to the 3810 and 3820 14" CRT terminals, incorporate the KM-3 or KM-4 Autoranging Power Supply, KM-3 or KM-4 Deflection, and TC-1 Video Amplifier assemblies. These terminals are called **3815** and **3825**. All "Desk top" 3800 terminals use similar ergonomic plastic cabinets.
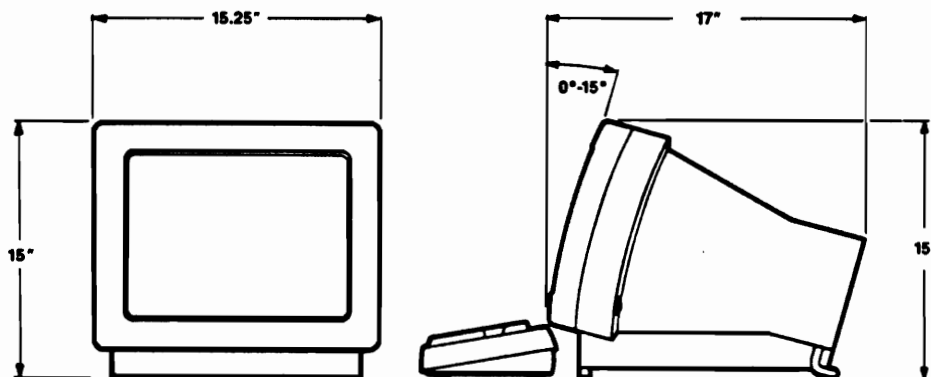
3865 and **3875** are rack-mount versions of 3815 and 3825 terminals which supersede the older 3860 and 3881 models. All rack-mount 3800 terminals use similar metal enclosures.
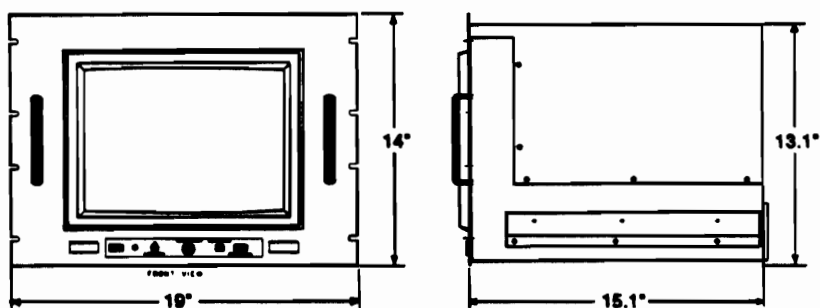
ALL 3800 units share the same wire frame chassis, and 14" CRT. 3800 units with the Dot Addressable Graphics board installed use #105119 Interface/Mother board. All other 3800 units use #103496 Interface/Mother board.

3800 CONTROLS

The 3815 and 3825 terminals share the same controls as the 3810. The 3865 shares the same controls as the 3860.
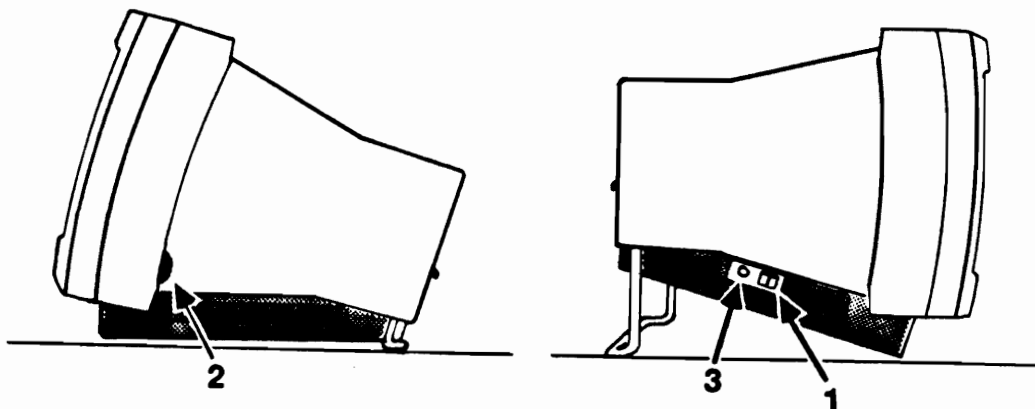
1. Power Switch. Turn the terminal on by pressing the side of the switch marked I. Turn the unit off by pressing the side of the switch marked 0.

2. Contrast Control. Use the contrast control to vary the difference between the display's light and dark elements. With a suitable image displayed on the screen, adjust the contrast control to achieve the best balance between image brightness and fine detail rendition. The optimum setting may vary with different types of displays and changes in ambient light level, as well as with individual taste.

3. Manual Degaussing Button. The terminal is degaussed each time power is turned on. The manual degauss button may be used when additional degaussing is required during an operating session. Degaussing eliminates color impurities and other distortions in the display by neutralizing the effects of magnetic fields in the surrounding environment.

8800 DESCRIPTION

To improve 8800 Series 19" CRT terminals, the analog board used in 8810 and 8820 terminals was replaced by the AR-2 Auto-ranging Power Supply and the AR-2 Deflection modular printed circuit boards. Video signal amplification is provided by either a TC-3 Video Amplifier or an AR-2 Video Amplifier board.

The smaller modular circuit boards allow the use of a new wire frame chassis similar to the chassis in 3800 units. A two slot card cage and #105471 mother board are mounted to the bottom of the wire frame chassis for plug-in installation of the #105150 Logic and #105194 or #105408 Dot Addressable Graphics boards.

Two 8800 units are available with the new analog boards and the wire frame chassis mounted to the old style base pan foundation of the 8810. The **8814** and **8824** are console mount units shipped with no cover installed for OEM applications.
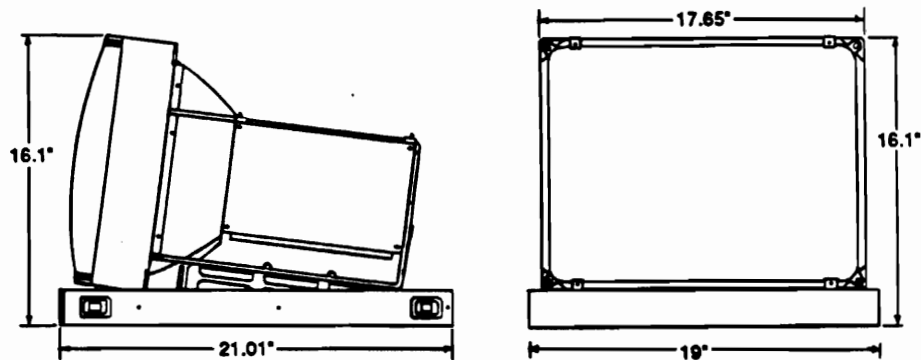
Two 8800 units feature a new plastic ergonomic cover with a tilt-swivel base and the new analog boards with the wire frame chassis. These terminals are called **8815** and **8825**.
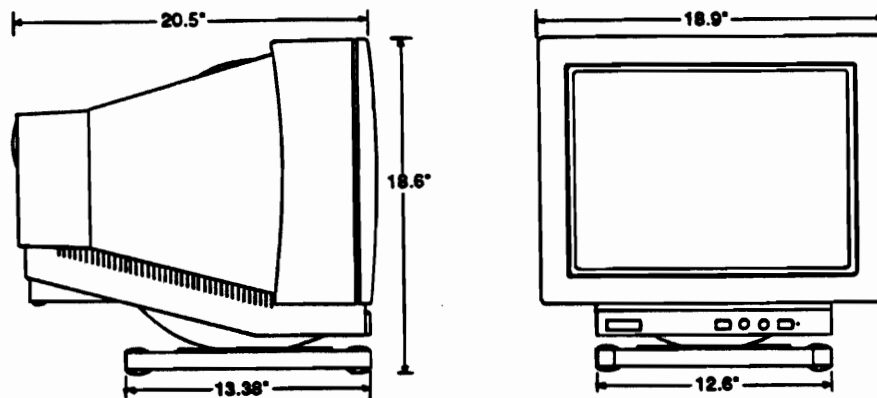
Two 8800 units designed to meet NEMA-2 standards are available.
These units feature a desktop enclosure constructed of metal,
which provides protection from falling dirt and liquids.   The
NEMA-2 terminals with the new modular analog circuitry and wire
frame chassis are called **8816** and **8826**.
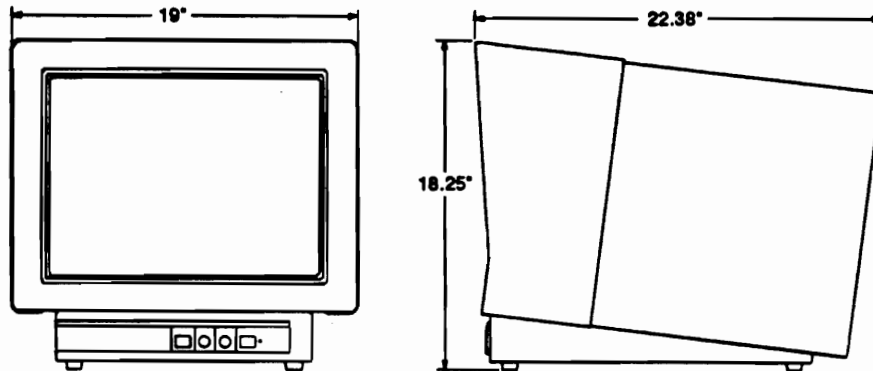
A 19" diagonal CRT rack-mount 8800 series terminal is available
in two versions.   Both 8800 rack mount units feature the analog
boards and wire frame chassis of the 8815 and 8825.   These new
rack mount terminals are called **8865** and **8875**.
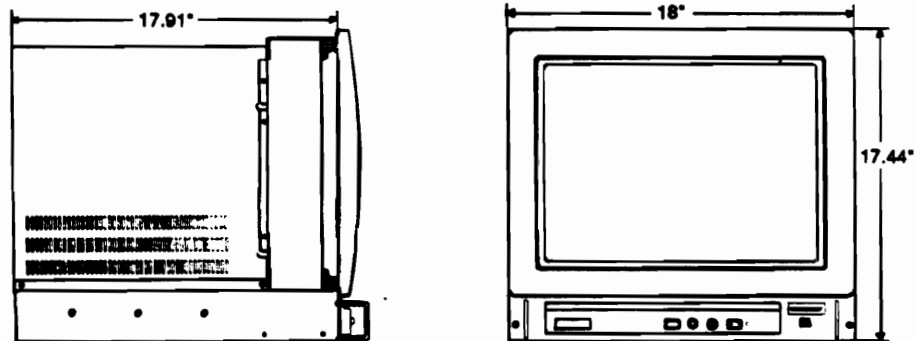
8800 CONTROLS

The 8814, 8815, 8816, 8824, 8825, 8826, 8865, and 8875 controls
are normaly located in the front, below the CRT bezel. Some
8814, 8824, 8865, and 8875 terminals have the control panel
installed in the rear of the unit. An additional receptical is
provided with the controls to connect the keyboard from the
front of the unit in the 8865 and 8875 Rack-mount 19" CRT
terminals.
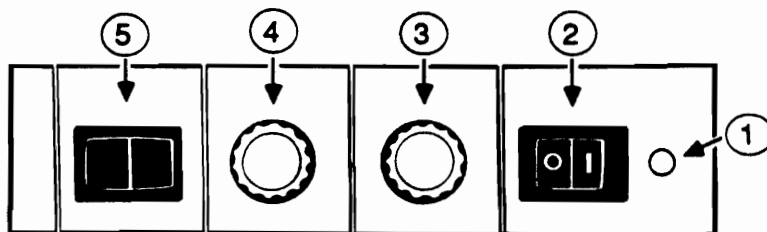
1. Status Indicator. The green LED on the right side of the power switch will be illuminated whenever the monitor is operating safely. **The LED is not a power on indicator!!**

IF THE LED IS NOT ILLUMINATED WITH POWER APPLIED AND TURNED ON, A FAULT HAS BEEN DETECTED BY THE UNIT AND ONLY THE HIGH VOLTAGE CIRCUITRY FOR THE CRT IS SHUT DOWN.

Circuit boards inside the unit still have power to them and standard safety precautions should be observed.

2. Power Switch. Turn the terminal on by pressing the side of the switch marked **I**. Turn the unit off by pressing the side of the switch marked **0**.

3. Contrast Control. Use the contrast control to vary the difference between the display's light and dark elements. With a suitable image displayed on the screen, adjust the contrast control to achieve the best balance between image brightness and fine detail rendition. The optimum setting may vary with different types of displays and changes in ambient light level, as well as with individual taste.

4. Brightness Control. Use the brightness control to adjust the overall intensity level of the display. After allowing the unit to warm up, adjust for the amount of brightness needed to make the display clearly visible.

5. Manual Degaussing Button. The terminal is degaussed each time power is turned on. Degaussing eliminates color impurities and other distortions in the display by neutralizing the effects of magnetic fields in the surrounding environment.

If the unit is left on continuously or is repositioned following power-up, the screen may pick up additional magnetic flux, causing the display colors to appear "blotchy" or otherwise distorted. If this happens, degauss the screen manually by pressing and releasing the degaussing button.

Manual degaussing may be repeated as required, but FOR FULL EFFECTIVENESS, ALLOW AT LEAST FIVE FULL MINUTES BETWEEN APPLICATIONS. Shorter intervals may result in incomplete removal of flux and residual color impurities.

If the unit is located near electric transformers, motors, loudspeakers, or other strong magnetic sources, degaussing alone may be insufficient. Try reorienting the unit relative to the magnetic source or increasing the distance between them.
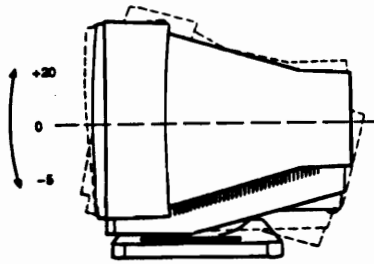
6. Viewing Angle Adjustment. The tilt-swivel base of the 8815 and 8825 monitor cabinet allows a full 360-degree horizontal rotation. The display axis can be tilted vertically through a range of about 5-degrees below and above the horizontal.

ANALOG FEATURES

The analog circuitry featured in the units described in this Addendum provides improved performance and reliability of 3800/8800 Series terminals.

The Auto-ranging Power Supply

* Intecolor developed a switching power supply that adjusts to line voltage and frequency variations automatically. Input line voltage may vary from 90 VAC to 250 VAC and line frequency may range from 40Hz to 70Hz. Output voltages are maintained even as line variations occur.

* Fault detection circuitry in the Auto-ranging Power Supply will shut the unit off when input line voltage is below specifications, or if certain problems are detected by the circuitry.

* Soft-start circuitry in the Auto-ranging Power Supply controls start-up of the switching circuitry to reduce stresses associated with extremely varied operating conditions.

* Current limiting circuitry limits the maximum amount of current output from the power supply to a preset level to guard against short circuited boards.

Automatic Beam Current Limiting (ABL)

* ABL circuitry (sometimes called Extended High Voltage Regulation or EHVR) limits the overall screen intensity to prolong the life of the CRT.

* CRT average beam current is limited to a preset value to provide bright characters and detail while protecting the CRT from large areas of white background color.

* Circuitry on the Video board and Deflection board work together to limit the gain of the video amplifier so that color quality does not depreciate when current limiting occurs.

3800/8800 LOGIC

Use of the terminal keyboard, diagnostic and logic functions is described in the existing INTECOLOR MAINTENANCE MANUAL for the 8800 & 3800 SERIES TERMINALS.

The 105150 Logic Board is installed in all 3800/8800 Series terminals and may feature either V1.70 or V2.00 firmware. To upgrade firmware in the field, see Appendix B of this Addendum.

Two Dot Addressable Medium Resolution Graphics Boards are available. The 105194 and 105408 are similar to the 102913 Dot Addressable Graphics Module used in earlier 3800/8800 Series units.

Circuitry of the 102913 Graphics Module was physically rearranged to make the 105194 Graphics Module, providing room for installation of a fan.

An optional 105408 Graphics Module is similar to the 105194 with larger capacity memory installed to include four pages of graphics screen memory. Software commands are available to access and display each of the four screens.

Circuit Description of the 105194 and 105408 Graphics Modules is similar to that of the 102913. See the Dot Addressable Graphics Module -- 8820 section in the existing maintenance manual. Schematic drawing #102911 is used for circuit analysis of 105194 and 105408 Graphics Modules.

The twelve screen memory IC's in the 105408 Graphics Module, UH6 through UH17 shown in the upper left quadrant of schematic #102911, are 64K X 4 dynamic ram 4464-type devices.

See Appendix D, for arrangement of the components on the PCB for 105194 and 105408 Graphics Modules.

Check the INTECOLOR MAINTENANCE MANUAL for the 8800 & 3800 SERIES TERMINALS for Functional Description of System, Software, Input/Output interface circuits, Applications, and Logic Board descriptions.

CHAPTER II

INSTALLATION

CHAPTER II

INSTALLATION

SPACE REQUIREMENTS

Space required by 3800 and 8800 series terminals may be judged
with reference to the table of dimensions below. Additional
clearance should be allowed at the rear and on either side of
the monitor cabinet to allow access to connectors and controls.
Some overhead clearance should also be allowed so that air can
circulate freely about the unit.

Model	Height	Width	Depth
3815	15.00"	15.25"	17.00"
3825	15.00"	15.25"	17.00"
3865	14.00"	19.00"	15.50"
3875	14.00"	19.00"	15.50"
8814	16.10"	19.00"	21.01"
8815	18.60"	18.90"	20.50"
8816	18.25"	19.00"	22.40"
8824	16.10"	19.00"	21.01"
8825	18.60"	18.90"	20.50"
8826	18.25"	19.00"	22.40"
8865	17.40"	19.00"	17.90"
8875	17.40"	19.00"	17.90"

ENVIRONMENTAL CONSIDERATIONS

The **relative humidity** of the ambient air should be between 10%
and 95% (non-condensing).

**In especially dry environments, preventive measures against
static discharge may be required to protect the terminals'
internal components from damage.**

The terminal should not be situated within **strong magnetic fields**, such as those present around power transformers and live voltage regulators. These fields can cause distortion and discoloration of the CRT display.

Dust and smoke particles can cause problems with most units because they are attracted by the units' high voltage components and can collect at ventilating holes as well as on the screen. The NEMA-2 enclosure provides protection against all but the finest dust particles.

ELECTRICAL REQUIREMENTS

The terminal is designed to draw power from **single-phase AC lines only**. Input voltage may vary from 90 VAC to 250 VAC.

CAUTION: Under no circumstances should the unit be exposed to line voltages in excess of 250 VAC.

INTERCONNECTION

CAUTION: Be sure power switch is in the OFF position before connecting electrical power cord.

Power cord: Attach the power cord by plugging its female connector into the back of the terminal. Then plug the 3-pronged connector into a grounded outlet. If a three-pronged outlet is unavailable, provide an earth ground by using a 3-prong to 2-prong adapter whose green lead is grounded. Ground other units attached to the system and keep interconnecting cables as short as possible to minimize the risk of RF interference.

Keyboard: Connect the keyboard by plugging its RJ45S keyed telephone-type plug into the keyboard connector. Hold down the plug's lock-tab, slide it into the connector, and release the tab, making sure the plug is securely seated. To disconnect the keyboard, hold down the lock-tab and gently withdraw the plug.

INSTALLATION
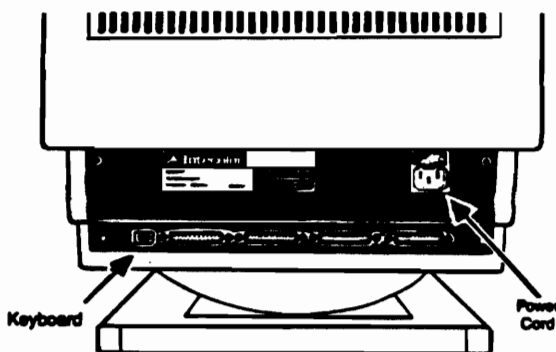
**Verify correct terminal operation before connecting it to a
host or to any peripheral devices. See POWER ON section.**

Host I/O: The panel on the back of the terminal provides four
    DB25 female connectors for host and peripheral connections
    in addition to the RJ45S keyboard connector.

    Refer to the existing Intecolor Maintenance Manual for the
    8800 & 3800 Series Terminals, page 3.06 for descriptions of
    all Host and I/O connections.

POWER ON

Switch the unit on by pressing the "I" edge of the power
switch. The terminal performs diagnostic self-tests while the
CRT warms up, then displays a header message in the upper left-
hand corner of the screen, giving its model number and the
firmware installed. For example:

```
┌─────────────────────────────────────────┐
│INTECOLOR 8800 V2.0                       │
│                                          │
│                                          │
│                                          │
│                                          │
│                                          │
└~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

WHEN THE TERMINAL DISPLAYS ITS HEADER, IT IS READY FOR USE.

The number following "V" is the currently installed firmware
version.

If no message is displayed, or an error code appears on screen,
the power-on diagnostics have not been completed
satisfactorily. The terminal will not operate properly until
it completes these tests, so turn off the power and turn it
back on after a brief pause. Usually this solves the problem,
since many difficulties are due to brief power-line
irregularities. If an error code is still displayed, it
identifies the area where a problem has been found.

Code	Meaning
ROM	Check Read-Only Memory
NONV	Check Non-volatile Memory used for Set-up Parameters
SCRN	Check Screen Memory
HOST	Host I/O Problem
KEYB	Keyboard/Printer Problem

CHAPTER III

DIAGNOSTIC TESTS

CHAPTER III

DIAGNOSTIC TESTS

SETUP MENU

The most fundamental checkout is performed by accessing the
terminal's Setup menus. These menus let you display the
terminal's configuration, set essential parameters, and perform
some basic tests. To access the Setup menus, **hold down the
Shift key and press the Setup key**. This causes the main Setup
Menu (the Host I/O Menu) to be displayed and, through it, lets
you access the other Setup menus and displays. The main Setup
Menu looks something like this:

```
                  Local/Line              On line
                  Echo                    Off
                  Flow Control            ^S^Q
   H              Backspace Code          ^H
   O              Protect                 Disable
   S              Data Rate               9600
   T              Stop Bits               1 Stop Bit
                  Parity                  8 bits, none

   I              OTHER MENU              OPERATOR PREFERENCE
   /                                      CONFIGURATION REPORT
   O
                  Special Selections
   M          1.  SAVE current setup menu.
   E          2.  RECALL old setup menu.
   N          3.  Recall FACTORY Default Setup Menu.
   U          4.  Recall '8001G' Default Setup Menu.
              5.  Exit through Self Tests.

        _____
       |                                           |
       | Arrow keys        select an item          |
       | Return            ends Setup Mode          |
       |                                           |
       |                                           |
       |                                           |
       |                                           |
       |_____|
```

Whenever you want to return to this main Setup menu, you must
enter the Shift-Setup combination.

This menu lets you set fundamental parameters for host
communications. The factory default values are shown in the
right-hand column above. Use the cursor control (arrow) keys
to select an item for change. The HOME key may be used as a
toggle input to make the change.

To exit Setup, press the Return key.

AUTOMATIC SELF-TESTS

The Automatic Self-Test routines are entered at power-up. They run one time without interruption, unless an error is detected. These same automatic self-tests may also be run in a continuous "loop".

Continuous Self-Tests may be initiated from the keyboard or by using a Diagnostic Test Plug. Once started, they will run until

- an error is detected, or
- an outside condition causes interruption

Use the **keyboard** (locally) to enter SETUP and access the Host I/O Menu. Push "5" to begin the diagnostic self-tests. When initiated in this manner, the self-tests run indefinitely until an error is detected. Press the Setup key to stop the tests.

In applications where the terminal is not fitted with an Intecolor Keyboard or where a special function keyboard is used in place of the standard Intecolor Keyboard, a **Diagnostic Test Plug** may be used to initiate Continuous Self-Tests.

A Diagnostic Test Plug can be fabricated by shorting together pins 2,4, & 6 on an 8-pin RJ45 Male Connector.
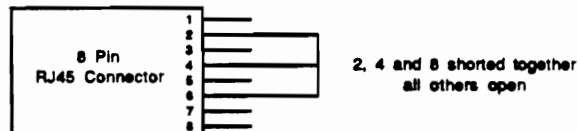
Diagnostic Test Plug

To start the continuous self tests with the test plug:
1. Turn power off.

2. Unplug the keyboard connector and plug the test plug into the keyboard port.

3. Turn power on.

When initiated in this manner, the self-tests run indefinitely until an error is detected or the unit is shut down.

Do not allow the continuous diagnostic tests to proceed unattended. These are primarily intended for confidence testing and as a troubleshooting aid. Since they do not include automatic retry, they cannot distinguish true hardware failures from the apparent failures caused by line surges, noise, and the like. Hence, their use in a continuous loop for burn-in testing will give misleading results. Errors reported must always be verified and only after an error has been reported consistently in each of several test runs. Each test run should be initiated by cycling the power. A reported condition may only be verified in this manner.

In relation to this statement, take note of the following:

1. Continuous tests may be interrupted by a momentary power failure. This will result in one of the following:

    * Reset of the terminal and display of the header message.

    * Display of the Host I/O Menu   (only in some cases.)

    * Screen goes blank, if the unit was operating with the CRT Saver feature on. Entry of any character from the keyboard will bring back the display.

2. Power glitches or other strong electrical interference may result in a minor data error. This will cause an error display or suspension of a test.

3. If the Continuous Self-Test routine stops, or if an error indication appears, the test should be restarted. If a problem actually exists, the unit will fail a second time with the same indications.

4. If an error still exists on the second and third time around, the type of screen display and the logic board LED pattern should be noted.

    Refer to the existing Intecolor Maintenance Manual for the 8800 & 3800 Series Terminals, appendix G for a description of Logic Diagnostic LEDs.

PORT TESTS

Another series, called Port Tests, may only be initiated from the Host I/O Menu, accessible through SETUP.

From the Host I/O Menu (SETUP), a Submenu of PORT TESTS (below) may be displayed on screen by pushing the "6" on the keyboard.

                    SELF TESTS MENU

          1.   Host and Aux port tests
          2.   Parallel port test
          3.   Printer port test
          4.   Quit: Reset system

               Enter your choice

Each test begins when a key is pressed. Results of the tests are reported on the screen, concluding with a pass or' fail indication. When a key is pressed again, the Port Tests Submenu returns.

In order to use these tests, **JUMPER** connections must be installed as described below. When one of the tests is chosen, a reminder to use the jumper(s) is included in the display.

> "1" Testing either the Serial 1-Host or
> the Serial 2-Aux Ports require a jumper
> between pins 2 and 3 of each port.

Host and Aux Test

> "3" Testing the Printer Port requires that a
> cable be connected from Serial 3-Printer
> port pin 2, to Serial 2-Aux port pin 3;
> and another cable between Serial 3-Printer
> port pin 21 to Serial 2-Aux port pin 20.

Printer Port Test
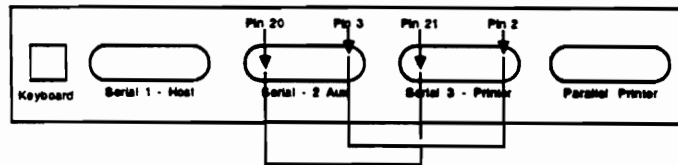
Selection of a Port Test from the submenu will result in the following displays:

```
| Host & Aux Test                                    |
|         "1"     Insert Host and Aux jumpers        |
| Hit any key                                        |
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

(Since the parallel port option is not supported in the standard terminal, use of the "2" key brings up a display with instruction to abort.)

```
|   Serial Printer Test                              |
|         "3"     Insert Printer/Aux jumper          |
|   Hit any key                                      |
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

> "4" Results in exit from Setup via
> one cycle of the Automatic Self
> Test Routine, followed by reset.

SERIAL I/O PORT TEST

Operation of the Serial 1-HOST port may be verified by entering data from the keyboard when the terminal's Setup parameters are set to "ON LINE" communications, with ECHO "OFF".

To perform this test, terminals 2 and 3 of the Serial 1-Host port (J2) must be connected by a shorting plug.

1. Push Shift + Setup simultaneously to bring up SETUP.

2. Use an Arrow Key to to change the mode of operation back to the factory default value "ON LINE". Then, push RETURN.

3. After installing the jumper, described above, the display screen will reflect any data that is entered at the keyboard. Keyboard inputs will go to the serial output port (pin 2 of J2) and will return via the jumper to the serial input port (pin 3 of J2) for display on the screen. With the jumper plug removed, operation of the keyboard will not result in display.

4. Return to Setup to select and save the desired parameters for further use of the terminal.

ANALOG DIAGNOSTIC CHECK

This procedure describes a quick diagnostic check to determine the performance of the analog boards used in 3800/8800 Series terminals. The covers of the unit need not be removed to perform these checks.

COMPLETE ALL STEPS WHEN POSSIBLE BEFORE PROCEEDING TO THE ALIGNMENT PROCEDURES OR TROUBLESHOOTING CHARTS.

1. Turn the power on and wait 60 seconds for the unit to warm up. The model number and version of firmware should be displayed in green, yellow, magenta, and cyan single height characters in the upper left corner of the screen.

2. Hold down the "SHIFT" key and press the "SET UP" key, then release both keys. Verify that "LOCAL" is high-lighted. If not, press and release the "HOME" key to toggle between "LINE" and "LOCAL".

3. Press and release the "FG ON", "white dot", "ESC", "Y", and "E" keys. Observe a full screen of single height E's.

4. Check the characters for solid white letters, vertical linearity, horizontal linearity, position stability, distortions, and video noise.

The screen of the CRT can be flooded with selected solid colors by pressing and releasing the "BG ON", the key with the desired color dot, and the "ERASE PAGE" key.

5. One at a time display a full red, blue, and green screen.

   Check each display for video noise and that it is centered both horizontally and vertically.

   If 19" CRT, check each display for 13" width by 9 3/4" height.

   If 14" CRT, check each display for 9 1/2" width by 7 1/8" height.

Automatic Beam Current Limiting (ABL)
Perform the following checks on all units equipped with ABL circuitry. 3810, 3820, 3860, 8810, and 8820 terminals are not equipped with ABL circuitry.

6. Display a black screen.

7. Flood the display with a full white screen. The screen intensity should decrease within one second after initial white screen is displayed.

If the display **fails** any of the **Analog Preventive Maintenance checks** perform the alignment procedures outlined in Chapter IV or see the troubleshooting charts in Chapter V.

CHAPTER IV

ALIGNMENT PROCEDURES

CHAPTER IV

ALIGNMENT
PROCEDURES

INTRODUCTION

All Intecolor terminals are completely adjusted and thoroughly tested before shipment from the factory. 3800 and 8800 terminals are shipped with preconverged in-line cathode ray tubes installed. Convergence adjustments associated with delta gun CRTs are not required.

A complete alignment in the prescribed order should be performed when repairs are completed, or the display fails the Analog Diagnostic Check (pg. III.5)

Two alignment procedures are provided:

Section One 3800 describes the alignment of 3815, 3825, 3865 and 3875 terminals. This section begins on page IV.3.

Section Two 8800 describes the alignment of 8814, 8815, 8816, 8824, 8825, 8826, 8865 and 8875 terminals. This section begins on page IV.13.

Perform all of the adjustment procedures in the order presented by this manual. Any adjustments performed out of sequence must be followed by a complete check of all alignments in the prescribed order.

Read the entire procedure and determine the location of adjustable components before beginning alignment.

The cover must be removed to perform the adjustments described. See Appendix C for instructions of cover removal.

WARNING! Any maintenance performed with power on and covers off subjects the operator to electrical shock that could cause injury or death. Only properly trained and qualified technicians who are aware of the existing hazards should attempt this level of maintenance.

WARNING! Operate the unit on single phase AC power only. The power supply protection circuit is designed for single phase only. The upper line voltage limit of 250 VAC must not be exceeded; the line filter, fuse, fuseholder, and switch are rated at 250 VAC maximum.

WARNING! For the technician's safety, it is recommended that an isolating transformer be used between the unit and the AC voltage supply.

Tools and Equipment Required

1. Shaft insulated, flat blade screwdriver (1/8" tip)
2. 3/32" hex, plastic alignment tool
3. Multimeter, Fluke 8020B or similar
4. High Voltage Probe, 40KV rating
5. Oscilloscope, DC to 15 MHz.
6. 0-1 DC Milliammeter, insulated for at least 35KV, with connectors for insertion into the CRT path.
7. Isolation transformer for line AC.

Warm-up

Allow the terminal a full 20 minutes to warm-up before proceeding with the alignment. After this initial warm-up, the terminal may be shut down for short periods so that test equipment may be connected or disconnected. In all cases, the temperature should be fairly stable when final adjustments are made.

Preliminary Adjustments

Press the degauss button during the warm-up period to ensure that the terminal is fully degaussed. Turn the contrast control (and brightness control on 8800 Series terminals) to the full clockwise position.

Line Fuse

The line fuse installed in 3800 and 8800 units with the auto-ranging power supply should be a 5mm X 20mm, 4.0A, 250V Slow Blow type fuse.

Line Voltage and Frequency

The auto-ranging power supply adjusts automatically to line voltage variations in the range of **97 to 250 VAC** and line frequency variations from **40 to 70 Hz**. The auto-ranging power supply provides stable output voltages even as changes in line voltage and frequency occur.

Assembly Number

More than one version of some assemblies may be used in a series of terminals. For example; either of two different video assembly boards may be installed in 8814, 8815, 8816, 8824, 8825, 8826, 8865 and 8875 terminals. The part number for each modular assembly is printed on a sticker which normally can be found on the component side of the PCB.

SECTION ONE 3800

The following alignment procedure is intended for maintenance
and alignment of 3815, 3825, 3865, and 3875 terminals. While
not specifically intended for troubleshooting, they may also
serve as diagnostic tools.

The instructions are given in step-by-step form and in the
recommended order of execution. Direction of rotation is
specified when adjusting from the back of the printed circuit
board.

PRELIMINARY

Before beginning alignment, technicians should verify that all
jumpers are in the correct position and become familiar with
the location of adjustable components. The adjustable
components should be set at the suggested pre-set positions if
a board has been repaired or replaced, or the technician
suspects gross mis-adjustment.

Power Supply Jumpers

The following table lists the proper jumper configuration for
both the #105669 KM-3 and the #105766 KM-4 power supply when
used in 3800 Series terminals.

KM-3 and KM-4		Function
W1	on	disconnects HSYNC from PS
W2	hard wired	not used
W3	A	selects V1 output voltage
W4	A	selects PS switching frequency

PCB P/N 105668   PCB P/N 105765   REV-2A
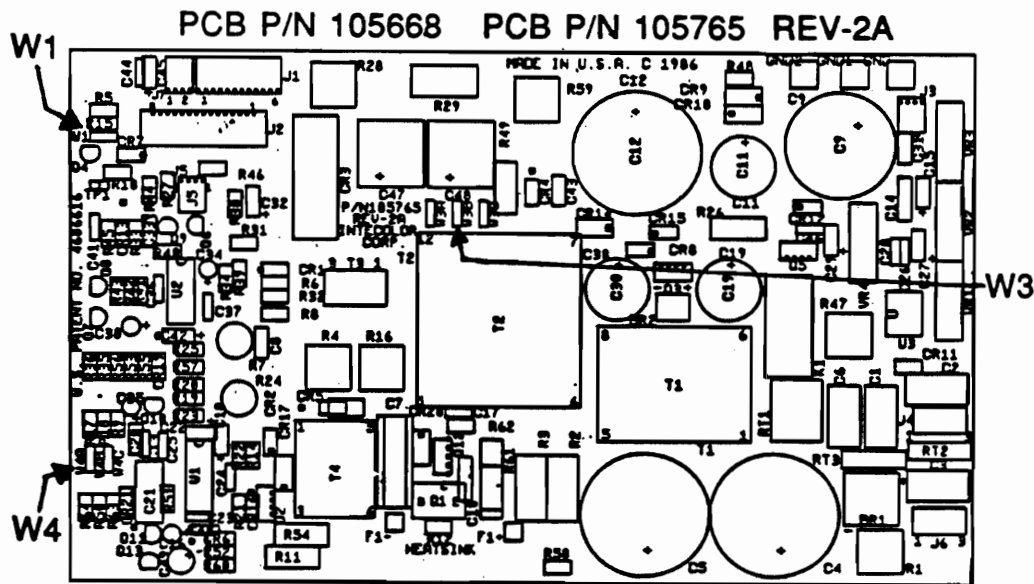
Deflection Jumpers

The following table lists the proper jumper configuration for
the #103302 KM-3 and #105763 KM-4 deflection boards when used
in 3800 Series terminals.

KM-3		KM-4		Function
W1	¦B	W1	¦B	selects source for G1 voltage
W2	¦off	W2	¦B	selects cathode bias voltage
W3	¦A	W3	¦A	selects filament voltage
W4	¦A	W4	¦A	selects capacitor for Hor. width ckt.
W5	¦A	W5	¦A	selects feedback for HV adjust
W6	¦A	W6	¦A	selects frequency of Hor. oscillator
W7	¦A			selects Hor. oscillator feedback
		W7	¦A	selects inductor for Hor. width ckt.
W8	¦off	W8	¦off	selects filter capacitor for V2
W9	¦on	W9	¦on	selects filter capacitor for V2
W10	¦off	W10	¦off	selects filter capacitor for V2
W11	¦A			selects inductor for Hor. width ckt.
W12	¦on			alternate selection of G1 voltage
W13	¦on			bypasses the optional brightness pot.
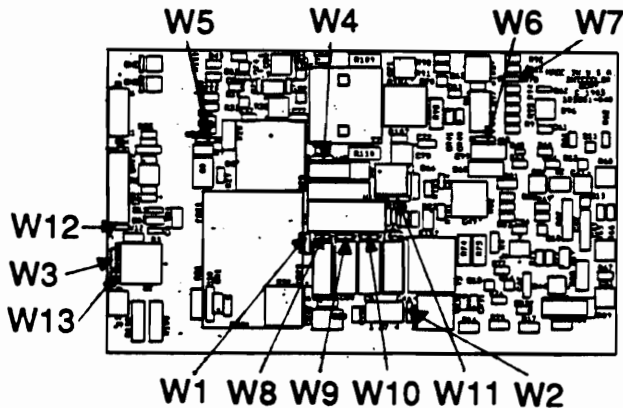
PCB P/N 103301
KM3 DEFLECTION REV-4
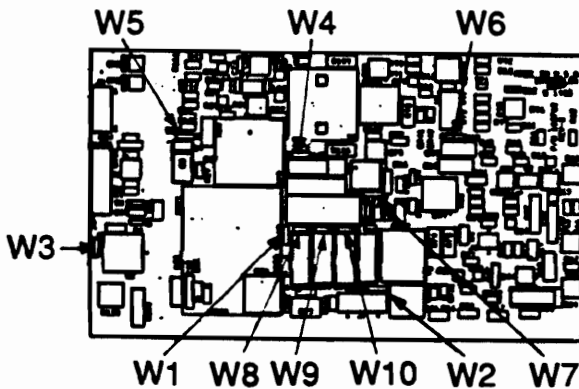
PCB P/N 105762 REV-2
KM4 DEFLECTION

Video Jumpers

The #105112 TC-1 video board was designed to process one or two bit logic. Jumpers W1, W2, and W3, should be installed for one bit operation as is the output from Intecolor 3800 series terminals.

PCB P/N 105111 REV-4
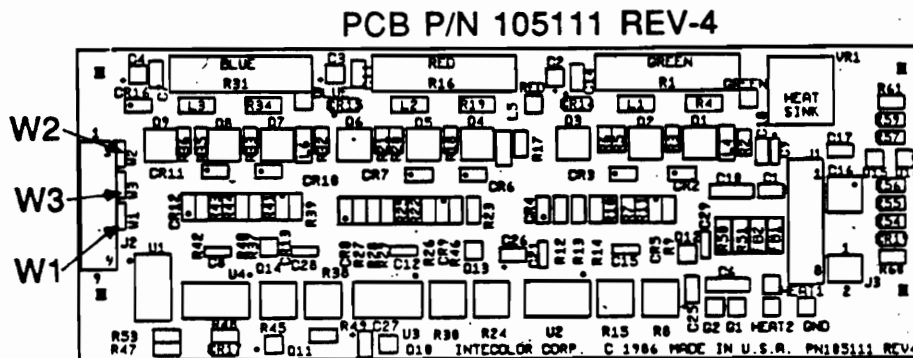
TC-1 Video

Power Supply adjustable components

The following list describes the adjustable components for both the #105669 KM-3 and #105766 KM-4 power supplies when used in 3800 Series terminals. Pre-set adjustments are provided but may not always be necessary.

Component	Function	Pre-set
* R24	+5 VDC output adjust	Mid-range
* R7	Current limit adjust (Pre-adjusted at the factory using special loads)	DO. NOT ADJUST!
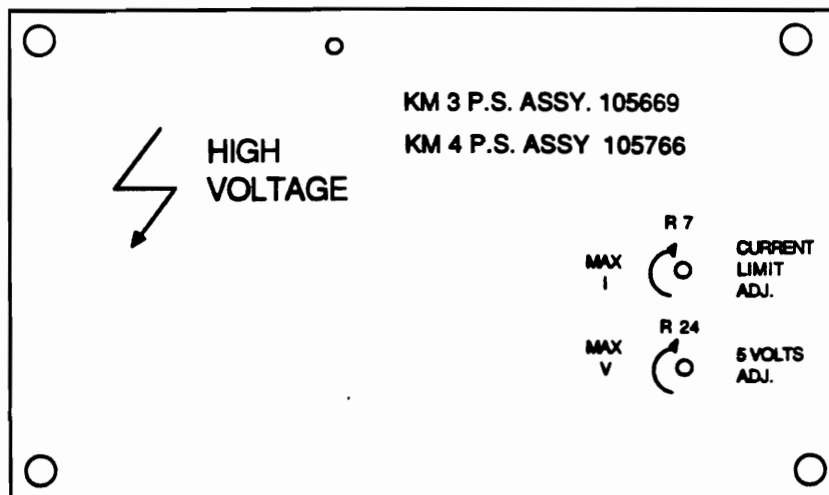
KM-3 and KM-4 Power Supply

Deflection Adjustable Components

The following list describes the adjustable components for
both the #103302 KM-3 and #105763 KM-4 deflection boards when
used in 3800 Series terminals. Pre-set adjustments are
provided but may not always be necessary.

Component	Function	Pre-set
R68	Vertical linearity	Mid-range
R67	Vertical height	Mid-range
R89	Vertical centering	Mid-range
R84	Horizontal pincushion	Mid-range
R96	Horizontal frequency	Mid-range
R31	High voltage	Full CCW
L4	Horizontal linearity	Mid-range
L5	Horizontal size	Mid-range
R106	Horizontal centering	Mid-range
R2	ABL	Mid-range
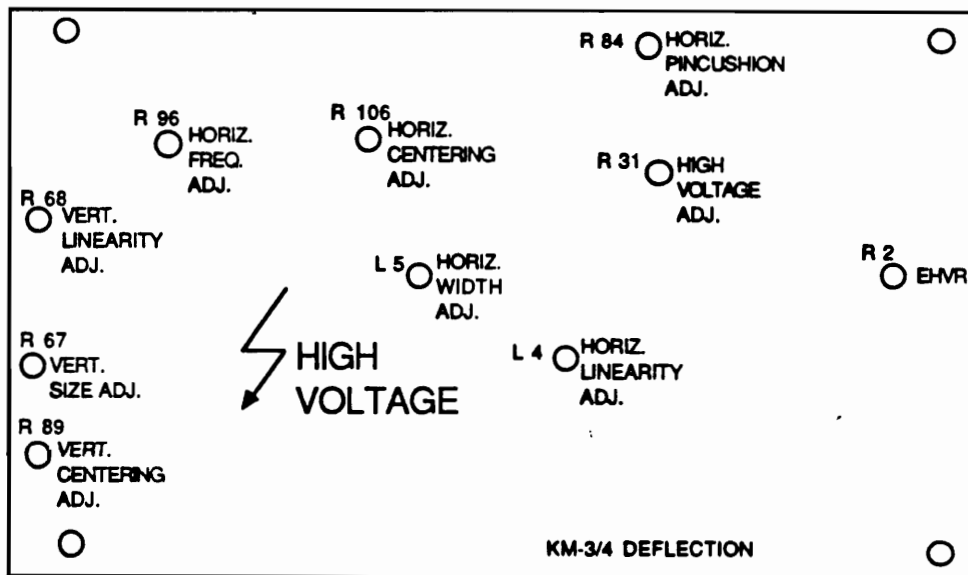
KM-3 and KM-4 Deflection

Video Adjustable Components

The following list describes the adjustable components for the
#105112 TC-1 video board when used in 3800 Series terminals.
Pre-set adjustments are provided but may not always be
necessary.

Component	Function	Pre-set
R8	Green Gain	Mid-range
R15	Green Background	Full CCW
R24	Red Gain	Mid-range
R30	Red Background	Full CCW
R36	Blue Gain	Mid-range
R45	Blue Background	Full CCW

```
┌─────────────────────────────────────────────────────────┐
│  O        ╱  HIGH VOLTAGE                            O    │
│          ↙                                                │
│                              TC-1 VIDEO                   │
│                                                           │
│            GREEN          RED          BLUE               │
│                 BACK-        BACK-        BACK-           │
│  O        GAIN GROUND  GAIN GROUND  GAIN GROUND      O    │
│            O    O       O    O       O    O              │
│            R8  R15     R24  R30     R36  R45             │
└─────────────────────────────────────────────────────────┘
```
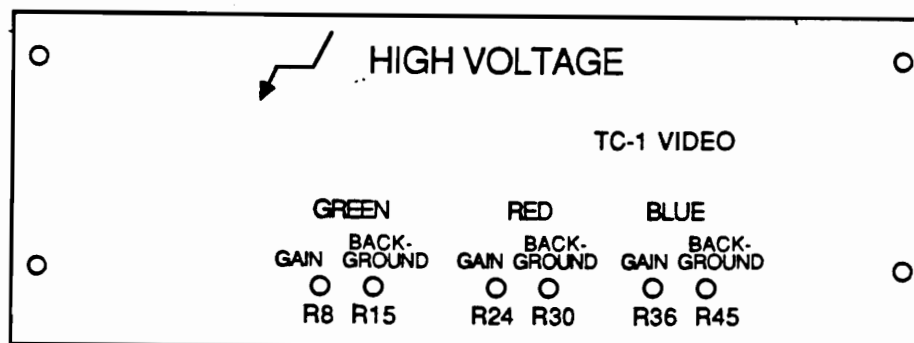
TC-1 VIDEO

3800 ALIGNMENT PROCEDURE:

STEP ONE
The adjustable components described in this step are located
on the **power supply module**.

+5 VDC Adjust and Output Voltages

1. **Power Off.** Connect voltmeter to the +5 VDC test point on
   the logic board and a logic board ground test point. Apply
   power to the unit and wait 60 seconds.

2. Check voltmeter for reading of +5.1 VDC (+/- .1 V).
   Adjust for this voltage with potentiometer R24.

3. Check J2, pin 4 for +12 VDC (+/- .6 V).

4. Check J2, pin 6 for -12 VDC (+/- 1.2 V).

5. Check J2, pin 1 for +16 to 20 VDC.

6. Check J2, pin 3 for V1 (+85 to +95 VDC).

7. **Power Off.**

STEP TWO
The adjustable components described in this step are located
on the **deflection module**.

High Voltage

1. With the **Power Off.** Slip the high voltage probe tip under
   the anode cap of the CRT. Metal to metal contact must be
   maintained at the probe tip and the metal anode clip.
   Connect the ground lead of the high voltage probe to the
   metal wire frame chassis for a secure ground. (See the
   drawing on page IV.8).
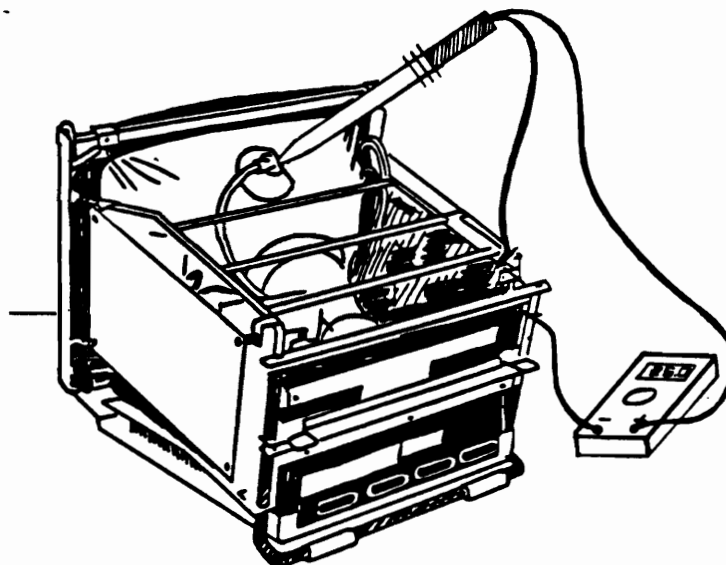
WARNING! Extreme high voltage potentials exist in the flyback
transformer and CRT.

2. Turn the unit on and wait 60 seconds for it to warm up.

3. Adjust R31 for a preliminary HV of 25KVDC.
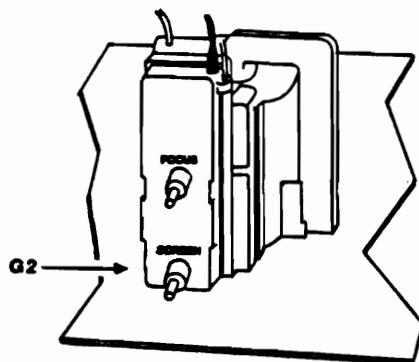
WARNING! Extreme high voltage potentials exist in the flyback
transformer and CRT.

4. Adjust G2 (on flyback transformer) clockwise until raster
   scan lines are visible then rotate counter-clockwise until
   no raster is visible.

5. Adjust R96 if the video is unstable.

Verify that the terminal is in the Local mode by holding down
the shift key and pressing the setup key. "Local" should be
high-lighted. If it isn't, press the Home key to toggle from
"Line" to "Local".

6. Get a blank screen by pressing and releasing the "BG", "black dot" and "ERASE PAGE" keys.

7. Adjust R31 for 25KVDC (+/- 200 VDC). If a raster scan becomes visible on the screen, turn G2 (on the flyback transformer) counter-clockwise until the raster just disappears.

5. **Power Off.** Disconnect the HV probe.

Horizontal Deflection Oscillator

1. With **Power Off**, connect the voltmeter to R97 (leg farthest from U1) and ground.
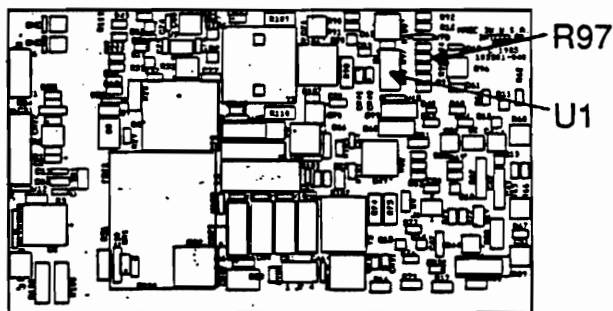
2. Apply power to the unit and wait 60 seconds.

3. Adjust R96 for +6.0 VDC on the voltmeter. Turn **power off** and disconnect the voltmeter.

Automatic Beam Current Limiting

1. With **Power Off**, connect insulated milliameter in series between the anode cap and the CRT.
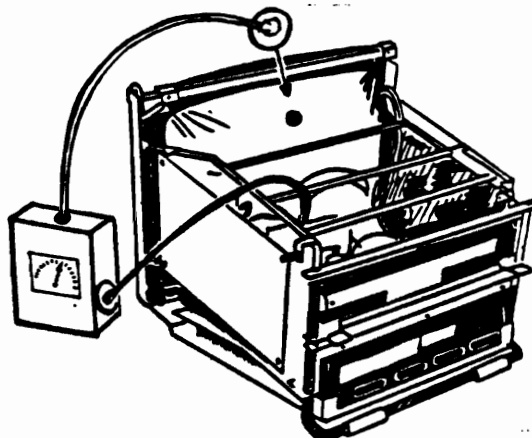
WARNING! Extreme high voltage potentials exist in the flyback transformer and CRT.

2. Turn the unit on and wait 60 seconds.

3. Flood the screen with white by pressing and releasing the "BG" key, "white dot" key, and "ERASE PAGE" key.

4. Adjust R2 for 400 micro-amps on the milliammeter.

NOTE: If CRT beam current is too low the Video board may need adjustment first. Rotate R2 clockwise 3/4 turn and proceed to STEP THREE. Return to this adjustment after completing the adjustments described in STEP THREE.

STEP THREE
The adjustable components described in this step can be found on the video amplifier module.

NOTE: It is very important that the terminal be on for the full 20 minute warm-up period before starting the alignment of the video circuitry.

Background adjustment

1. Get a blank screen by pressing and releasing the "BG ON", "black dot" and "ERASE PAGE" keys.

   Rotate the G2 control, on the deflection flyback transformer, clockwise until raster scan lines are visible. Then rotate the G2 control counter-clockwise until the raster just disappears.
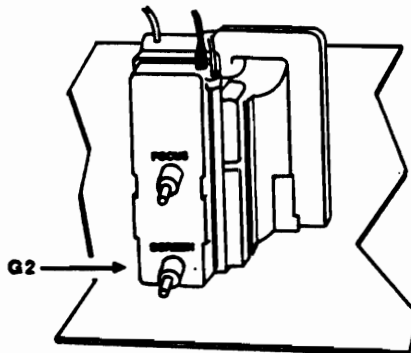
WARNING! Extreme high voltage potentials exist in the flyback transformer and CRT.

2. With R15, R30 and R45 in the full CCW position, rotate the G2 control clockwise until the raster is just visible. Decide which color is predominant in the raster: red, green, or blue.

3. Leave the background potentiometer of the predominant color in the full counter-clockwise position. Adjust either or both of the two remaining background potentiometers clockwise for a gray raster on the screen.

4. Turn the G2 control counter-clockwise until raster scan lines disappear.

Gain adjust

The screen of the CRT can be flooded with selected solid colors by pressing and releasing the "BG ON" key, the key with the desired color dot, and the "ERASE PAGE" key.

1. Flood the screen with red. Adjust R24 for 168-178 micro-amps on the milliammeter.

2. Display a full green screen. Adjust R8 for 220-230 micro-amps on the milliammeter.

3. Now display a full blue screen. Adjust R36 for 168-178 micro-amps on the milliammeter.

6. Flood the screen with white. Check the display for uniform white color across the screen.

NOTE: If the CRT beam current is not limited to 400 micro-amps, perform the Automatic Beam Current Limiting adjustments described in STEP TWO.

STEP FOUR
The components described in this step can be found on the **deflection module.**

Display Size, Centering, and Focus

1. Get a blank display on the screen. Flood the screen with white E's by pressing and releasing the "FG ON", "white dot", "ESC", "Y" and "E" keys.

2. Adjust focus control for crisp, clear characters. (See the drawing of the flyback transformer on page IV.10).

3. Check the letters for uniform vertical size. Adjust R68 for vertical linearity.

4. Check the letters for uniform width. Adjust L4 for horizontal linearity.

5. Flood the display with any color.

6. Check the display for 7 1/8" (181mm +/- 3mm) vertical height. Adjust R67 as required.

7. Check that the display is centered vertically. Adjust R89
   to move·the display up or down.

8. Check horizontal width of display for 9 1/2" (241mm).
   Adjust L5 to change the width of the display.

9. Check that the sides of the display are straight. Adjust
   R84 if the sides are not straight.

10. Check the horizontal centering of the display. Adjust R106
    to move the display from side-to side.

11. Verify the adjustments performed in this STEP. Screen size
    and character linearity are subject to change slightly, due
    to interaction of the circuitry.

SECTION TWO 8800

The following alignment procedure is intended for maintenance checks and alignment of 8814, 8815, 8816, 8824, 8825, 8826, 8865, and 8875 terminals. While not specifically intended for troubleshooting, these checks may be useful when diagnosing system problems.

The instructions are given in step-by-step form and in the recommended order of execution. Direction of rotation is specified when adjusting from the back of the printed circuit board.

PRELIMINARY

Before beginning alignment, technicians should verify that all jumpers are in the correct position and become familiar with the location of adjustable components. The adjustable components should be set at the suggested pre-set positions if a board has been repaired or replaced, or the technician suspects gross mis-adjustment.

Power Supply Jumpers

Two jumpers are on the AR-2 power supply. Jumper W2 is hard-wired and should not be changed. Jumper W1, when removed, allows a check of the free-run switching frequency of the power supply. Jumper W1 should be installed for normal operation. **Damage to the power supply could result if W1 is changed with power on.**

PCB P/N 105683 REV-2

W1
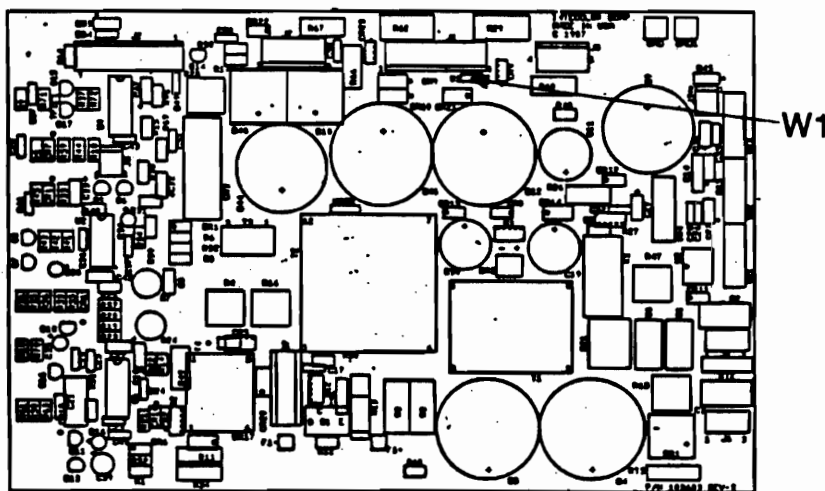
AR-2 POWER SUPPLY

Video Jumpers

The three jumpers W1, W2, and W3, should be installed on the
TC-3 Video.

PCB P/N 105201
REV-2
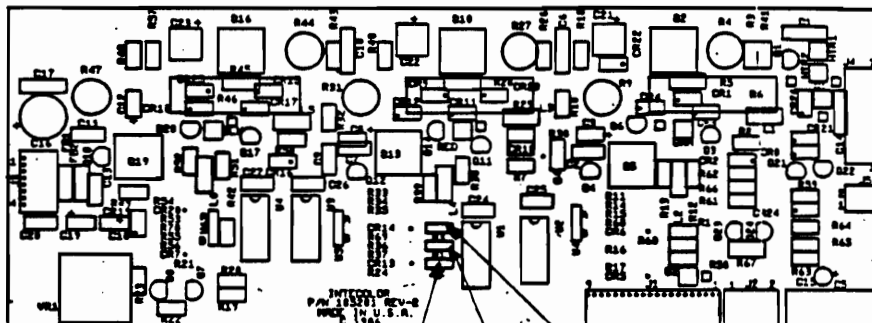
TC-3 Video   W2 W1 W3

Power Supply Adjustable Components

The following list describes the adjustable components for the
#105684 AR-2 power supply when used in 8800 Series terminals.
Pre-set adjustments are provided but may not always be
necessary.

Component	Function	Pre-set
* R24	+5 VDC output adjust	Mid-range
* R7	Current limit adjust (Pre-adjusted at the factory using special loads)	DO NOT ADJUST!
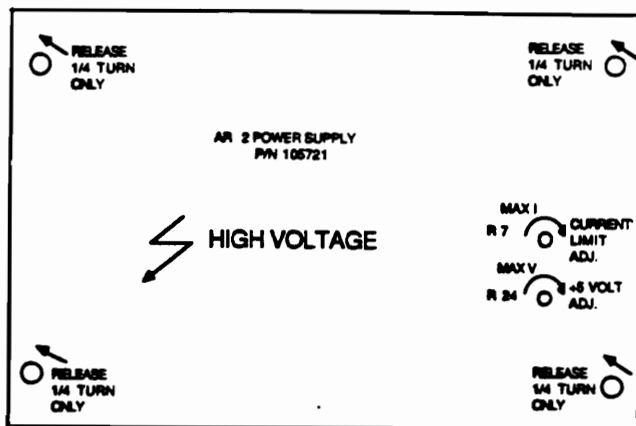
AR-2 Power Supply

Deflection

The following list describes the adjustable components for the
#105157 AR-2 deflection board when used in 8800 Series
terminals. Pre-set adjustments are provided but may not
always be necessary.

Component	Function	Pre-set
R10	Horizontal centering	Mid-range
R43	Vertical hold	Mid-range
R25	Horizontal hold	Mid-range
R78	ABL	Mid-range
R89	High Voltage	**Do Not Adjust**
R102	Parabola gain	Mid-range
R103	X-Ray protection	Full CCW
R114	Parabola symmetry	Mid-range
R120	Top corner correct	Full CCW
R124	Horizontal size	Mid-range
R138	Vertical down	Full CCW
R139	Vertical up	Full CCW
R134	Vertical size	Mid-range
R143	Vertical crossover	Full CCW
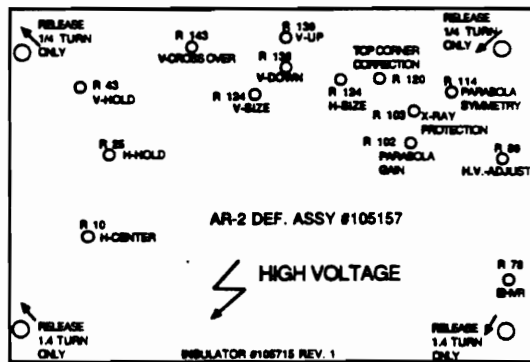
AR-2 Deflection

Video

The following list describes the adjustable components for the #105202 TC-3 video and the #105199 AR-2 video amplifier boards when used in 8800 Series terminals. Pre-set adjustments are provided but may not always be necessary.

Component		Function	Pre-set
TC-3	AR-2		
R9	R34	Green Gain	Mid-range
R4	R39	Green Background	Full CCW
R31	R13	Red Gain	Mid-range
R27	R18	Red Background	Full CCW
R47	R56	Blue Gain	Mid-range
R44	R61	Blue Background	Full CCW
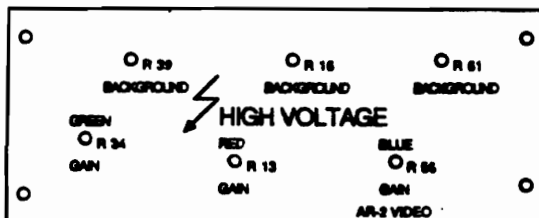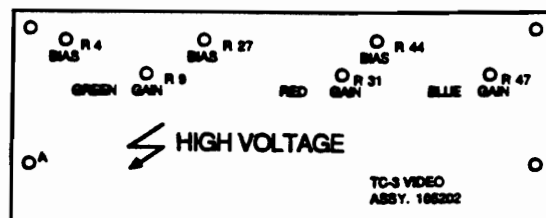
TC-3 Video   **AR-2 Video**

8800 ALIGNMENT PROCEDURE:

STEP ONE
   The adjustable components described in this step can' be found
   on the power supply module.

   +5 VDC Adjust and Output Voltages

   1. **Power Off.** Connect voltmeter to the +5 VDC test point on
      the logic board and a logic ground test point. Apply power
      to the unit and wait 60 seconds.

   2. Check the voltmeter for reading of +5.1 VDC (+/- .1 V).
      Potentiometer R24 may be used to adjust the +5 VDC.

   3. Check J1, pin 1 for -16 VDC (+/- 1.4 V)

   4. Check J1, pin 3 for +16 VDC (+/- 1.4 V)

   5. Check J1, pin 5 for +28 VDC (+/- 1.6 V)

   6. Check J1, pin 7 for +90 VDC (82 to 92)

   7. Check J2, pin 4 for +12 VDC (+/- .6 V)

   8. Check J2, pin 6 for -12 VDC (+/- .6 V)

   9. Check J8, pin 3 for +12 VDC (+/- .6 V))

STEP TWO
   The adjustable components described in this step can be found
   on the deflection module.

   High Voltage and X-Ray protect

   1. **Power Off.** Connect the ground lead of the high voltage
      probe to the wire frame chassis. Securely slip the high
      voltage probe tip under the anode cap of the CRT. Metal to
      metal contact must be maintained at the probe tip and the
      metal anode clip.
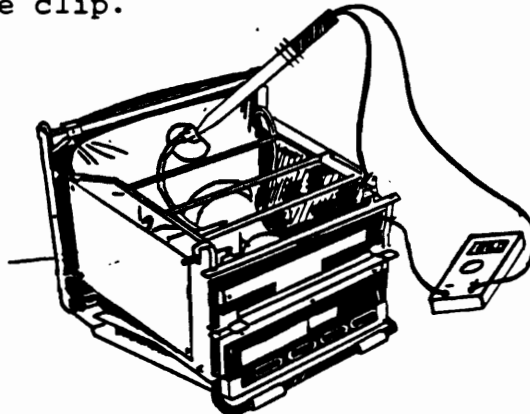
   WARNING! Extreme high voltage potentials exist in the flyback
      transformer and CRT.

2. Apply power to the unit, wait 60 seconds.

3. Adjust R89 for preliminary HV setting of 25KVDC.

4. Adjust G2 (on flyback transformer) clockwise until rasters appear and then adjust counter-clockwise for no rasters.
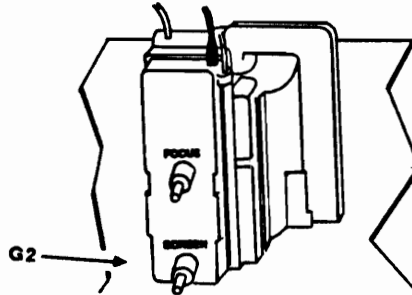
WARNING! Extreme high voltage potentials exist in the flyback transformer.

5. Adjust R25 if the display is not stable

6. Adjust R43 if the video rolls vertically.

7. Slowly adjust R89 clockwise and observe that the HV drops off between 28 and 29KVDC. If a raster scan becomes visible on the screen, turn G2 (on the flyback transformer) counter-clockwise until the raster disappears.

   Once the X-ray protect circuitry is activated, **turn the unit off to reset the circuitry** and turn R89 CCW 1/4 turn.

   Perform the following Xray adjust procedure ONLY IF THE UNIT DOES NOT SHUT DOWN AT THE PROPER VOLTAGE.

   X-Ray adjust
   A. **Power Off.** Adjust R89 and R103 fully counter-clockwise.
   B. Turn the power on and wait 60 seconds. Adjust R89 clockwise until the voltmeter reads 29KV.
   C. While observing the voltmeter, slowly adjust R103 clockwise until the HV output drops out.
   D. **Power Off.** Turn R89 fully counter-clockwise.
   E. Turn the power on and wait for the unit to stabilize. Slowly adjust R89 counter-clockwise while observing voltmeter. HV output should drop out between 28KV and 29KV.
   F. **Power Off** (to reset the X-ray circuitry).

8 Turn the **Power on**, and wait 60 seconds.

Verify that the unit is in local mode by holding down the Shift key and pressing the Setup key and observing that "LOCAL" is high-lighted. If "LOCAL" is not high-lighted, press the "HOME" key to toggle from "LINE" to "LOCAL".

8. Get a blank display on the screen by pressing and releasing the "BG-ON", "black dot", and "ERASE PAGE" keys. '

9. Adjust R89 for 25KV (+/- 200 VDC) on the voltmeter.

5. **Power Off** and disconnect the HV probe.

Horizontal and Vertical Hold

1. **Power Off.** Disconnect connector plug P2 from J2 of the deflection board.

2. Apply power to the unit and wait 60 seconds. The video will roll across the screen from side to side.

3. Adjust R25 until the video on the screen almost stops rolling.

4. **Power Off.** Connect P2 to J2.

5. Apply power to the unit and wait 60 seconds.

6. Adjust R43 clockwise and observe that the display rolls across the screen from top to bottom, adjust R43 counter-clockwise and observe that the display stops rolling then begins rolling in the opposite direction.

7. Adjust R43 to the center of the range in which the screen stops rolling in both directions.

Parabola Symmetry

1. **Power Off.** Connect scope probe to the top of R51 (between heat sinks of Q4 and Q2) and the scope ground lead to ground.
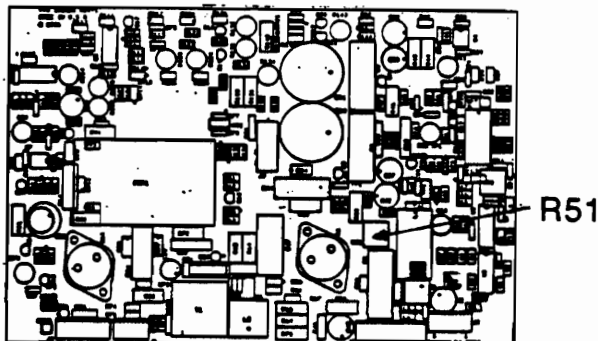
2. Set the scope for 2mS/Div and 0.5 V/Div on an AC scale. Apply power to the unit and wait 60 seconds.

3. Adjust R114 for symmetrical parabola waveform (the points of the parabola come together).

4. **Power Off.** Disconnect the scope leads.

Automatic Beam Current Limiting

1. **Power Off.** Connect insulated milliammeter in series between the anode cap and the CRT.
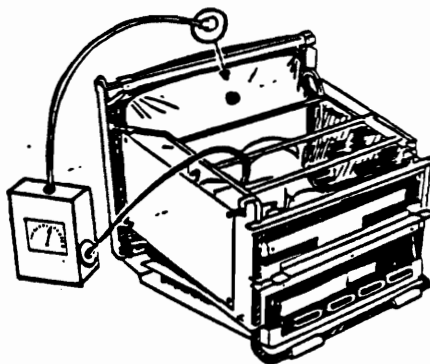
WARNING! Extreme high voltage potentials exist in the flyback transformer and CRT.

2. Turn the unit on and wait 60 seconds.

3. Flood the screen with white by pressing and releasing the "BG" key, "white dot" key, and "ERASE PAGE" key.

4. Adjust R78 for 400 micro-amps on the milliammeter.

NOTE: If CRT beam current is too low the Video board may need adjustment first. Rotate R2 clockwise 3/4 turn and proceed to STEP THREE. Return to this adjustment after completing the adjustments described in STEP THREE.

STEP THREE
The adjustable components described in this step can be found on the video module.

NOTE: It is very important that the terminal be on for the full 20 minute warm-up period before starting the alignment of the video circuitry.

Background adjustment

1. Get a "blank" screen by pressing and releasing the "BG ON", "black dot" and "ERASE PAGE" keys.
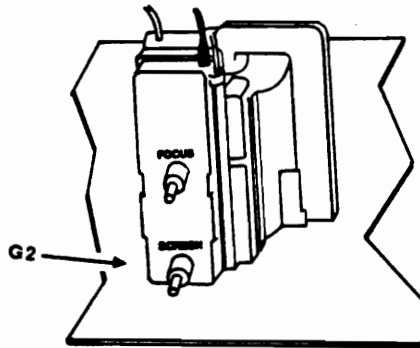
WARNING: Extremely high voltage potentials exist in the flyback transformer.

2. With the three background potentiometers on the video board in the full counter-clockwise position rotate the G2 control, on the deflection flyback transformer, clockwise until raster scan lines are barely visible.

3. Determine which color is predominant in the raster: red, green, or blue.

4. Leave the background potentiometer of the predominant color in the full counter-clockwise position. Adjust either or both of the two remaining background potentiometers for a gray raster on the screen.

5. Rotate the G2 control counter-clockwise until the raster scan lines disappear.

Gain adjust

The screen of the CRT can be flooded with selected solid colors by pressing and releasing the "BG ON" key, the key with the desired color dot, and the "ERASE PAGE" key.

1. Flood the screen with red.

   Adjust R31(TC-3) or R13(AR-2) for 160-170 micro-amps on the milliammeter.

2. Flood the screen with green.

   Adjust R9(TC-3) or R34(AR-2) for 180-190 micro-amps on the milliammeter.

3. Now flood the screen with blue.

   Adjust R47(TC-3) or R56(AR-2) for 120-130 micro-amps on the milliammeter.

6. Flood the screen with white. Check the display for uniform white color across the screen.

NOTE: If the CRT beam current is not limited to 400 micro-amps, perform the Automatic Beam Current Limiting adjustments described in STEP TWO.

STEP FOUR
   The adjustment components described in this step can be found on the deflection module.

Display Size, Centering, and Focus

1. Get a blank display on the screen. Flood the screen with white E's by pressing and releasing the "FG ON", "white dot", "ESC", "Y" and "E" keys.

2. Adjust the focus control on the flyback transformer for sharp clear characters. (See the drawing of the flyback transformer on page IV.20).

2. Flood the screen with any color.

3. Adjust R124 for a display width of 13 inches.

4. Adjust R134 for a display height of 9 3/4 inches.

5. Adjust R10 to move the display to the horizontal center of screen.

6. Adjust R138 and R139 fully counter-clockwise (from back of board).

7. Adjust R138 if display is too high on the screen.
   Adjust R139 if display is too low on the screen.

NEVER ADJUST BOTH R138 AND R139 to center the display. These potentiometers cancel the effects of each other.

Pincushion and Top Corner correction

1. With a full screen of any color adjust R102 to make the sides of the display straight.

2. Adjust R120 to make the top corners of the display square.

3. Verify the adjustments performed in STEP FOUR. Screen size and character linearity are subject to change slightly, due to interaction of the circuitry.

CHAPTER V

TROUBLESHOOTING

CHAPTER V
TROUBLESHOOTING

MODULAR CIRCUIT BOARD SYSTEM

Intecolor's modular circuit board design is well suited to both board level and/or component level repair. Modular circuit boards allow **faster** troubleshooting and more **cost effective** repair.

Down time can be reduced when suspected bad circuit boards are swapped with known good circuit boards to repair terminals.

Isolation of defective circuitry is easier due to the many interconnecting points.

DESCRIPTION OF TROUBLESHOOTING TABLES

The following tables offer suggestions for troubleshooting the modular analog circuitry of **3815, 3825, 3865, 3875, 8814, 8815, 8816, 8824, 8825, 8826, 8865,** and **8875** Series terminals.

The tables list common **symptoms**, some of the **possible problems** that may cause the symptom, and other things to **check** to further isolate defective circuits.

The Troubleshooting Tables are organized into four sections:

> SYSTEM TROUBLESHOOTING TABLE; 3800 and 8800
>
> POWER SUPPLY; KM-3 or KM-4 and AR-2 Power Supply
>
> DEFLECTION; KM-3 or KM-4 and AR-2
>
> VIDEO; TC-1, AR-2, and TC-3

The **SYSTEM TROUBLESHOOTING TABLE** provides assistance when troubleshooting either 3800 or 8800 Series systems to board level. The suggestions here may help determine which analog **board** may cause the symptoms listed.

The board **TROUBLESHOOTING TABLE**s provide more ways to help prove that the suspected board is defective. Many suggestions help isolate defective circuitry and/or components.

Troubleshooting Intecolor modular printed circuit boards may be aided by constructing extender cables. Be sure that exact pin to pin connection is observed.

Note: Cable length should be kept to a minimum.

WARNING: Be sure to place nonconductive pad (insulated for at least 40KV) under extended board.

Basic Troubleshooting Tips:

1. Carefully observe all symptoms of the problem and list them.

2. Check all fuses.

3. Check all connectors and plugs for secure fit.

4. Visually inspect all components for burns or discoloration.

5. Check for foreign objects that may have fallen into the terminal.

6. Check all circuit boards for secure installation.

7. Check Power Cord.

3800/8800 ANALOG SYSTEM
TROUBLESHOOTING
TABLE

SYMPTOM	POSSIBLE PROBLEM	CHECK
No Video	No High Voltage	Check for static electricity on face of CRT by placing fore-arm near face of CRT
	Power supply	Verify video source voltages. If bad, go to Power Supply troubleshooting chart.
	Video	Verify CRT filament voltage. If bad, check associated circuitry on Video and Deflection boards.
		With oscilloscope, verify output from video amps. If bad, go to Video troubleshooting chart
No High Voltage	Power supply	Verify output voltages at power supply connectors. If bad, go to Power Supply troubleshooting chart.
	Deflection	If power supply checks good, go to Deflection troubleshooting chart.
Discolored Letters	Screen needs degaussing	Press the Degauss Button (sometimes more than one one application is necessary)
	Video	With oscilloscope, verify TTL output from each color video amp If one color bad, go to Video troubleshooting chart.
		Verify voltage regulators on video amp board.
		Verify video alignment.
Display distorted, Bent letters	Power Supply	Verify power supply voltages, with oscilloscope, check for ripple in DC voltages.
	Deflection	Verify deflection alignment.

TROUBLESHOOTING

SYMPTOM	POSSIBLE PROBLEM	DO THIS
Thin horizontal or vertical line in center of screen	Deflection	With oscilloscope, check vertical and horizontal oscillator output.
Video unstable	Deflection	With oscilloscope, check for ripple in low voltage regulators on deflection board.
	Power Supply	With oscilloscope, check for ripple in DC voltages from power supply.
Noise in video (wavering lines, or "snow")	Power Supply	With oscilloscope, check for dubble-pulsing in power supply switching transistor.
	Video	With oscilloscope, check each color amplifier output of video PCB for unsynchronized TTL pulse
	Deflection	Verify deflection alignment.

KM-3/4 POWER SUPPLY
TROUBLESHOOTING TABLE
KM-3 assembly #105669
KM-4 assembly #105766

SYMPTOM	POSSIBLE PROBLEM	CHECK THIS
No output	Fuse F1 blown	Replace F1 and check Q1 for short, check R12 and R47, for increased value, if bad replace. Remove J1, J2, J3, and J7. Power unit on and check output voltages.
	Start Up voltage defective	Check collector tab of Q2 (when power is first applied) for +12 to +65 VDC. If bad, check K1, T1, BR2, and RT2.
		Check VRAW2 (when power is first applied) for +12 to +30 VDC. If bad check CR8, Q3, C30, and VR1.
		Check VREF1, if bad verify VRAW2 and/or replace VR1.
		Check U1, pin 10 for TTL low input, if bad, troubleshoot Delay Restart (U2), VRAW2 and Fault Monitor circuits.
	Oscillator defective	Check U1, pin 11 for TTL 41.6 us square wave, if bad check U1, pin 9 for some positive voltage, if bad troubleshoot Soft-Start circuitry and Current Limiting
	Voltage Buss defective	Check positive leg of BR1 for positive voltage (87% of line voltage) Check negative leg of BR1 for negative voltage (87% of line), if bad check RT3 and R1
	Driver Circuit defective	Check collector Q2 for approx. 30 Vpp square wave, if bad, check T4 and associated components, and VRAW2.
		With F1 removed and floating ground oscilloscope, (use Delta ground) check base of Q1 for switching signal if bad check Q12 and associated circuits.
		Check collector of Q1 for high positive flyback pulses, if bad check Q1, and T2.

SYMPTOM	POSSIBLE PROBLEM	CHECK
Unit Blows F1 with load on	Q1 defective	Check Q1 for shorts (Always check Q1 if F1 blows). Replace F1 and/or Q1, disconnect J1 and J2, and check output voltages
	Driver Circuitry defective	Check CR5, R4, and R16.
	Soft Start defective	Check Q11, Q13, and associated circuits.
	Current Limiting defective	Check C8, and CR1
Unit Blows F1 with all loads removed	Q1 defective	Check Q1 for shorts. Always check Q1 if F1 blows.
	Driver Circuitry defective	Check CR5, R4, and R16.
	Output Voltage circuitry defective	Check for near short to ground at J1, pins 1, 3, J2, pin 8, and CR10 anode.
	Oscillator defective	Check U1, pin 11, for less than 50% positive duty cycle square wave signal.
Unit shuts down with loads on	Defective Load	Remove J1 and J2, Check output voltage.
	Driver Circuitry defective	Check R12, R61, Q12, and CR20 for open.
	Reference Voltage regulators defective	Check VR1, VR2, VR3, and VR4.
	Output Voltage circuitry defective	Check +5 VDC circuit. Check other output circuitry.

SYMPTOM	POSSIBLE PROBLEM	CHECK
Unit shuts down with loads removed	Reference Voltage circuitry defective	Check CR8, VR1, VR2, VR3, and VR4.
	Output Voltage circuitry defective	Check +16 VDC output and +5 VDC output circuitry and other output circuits.
	Current Limiting circuitry defective	Check CR1, C8, and R51.
Power Supply causes noise on screen	HSYNC circuitry defective	With W1 removed check collector of Q4 for HSYNC pulse.

**AR-2 POWER SUPPLY
TROUBLESHOOTING TABLE
AR-2 Assembly # 105684**

SYMPTOM	POSSIBLE PROBLEM	CHECK
No output	Fuse F1 blown	Replace F1 and check Q1 for short, check R12 and R13, if bad replace. Remove J1, J2, J3, J7, and J8. Power unit on and check output voltages.
	Start Up Voltage defective	Check collector tab of Q2 (when power is first applied) for +12 to +65 VDC. If bad, check K1,T1, BR2, and RT2
		Check VRAW2 (when power is first applied) for +12 to +30 VDC. If bad check CR8, Q3, C30, and VR1
		Check VREF1, if bad verify VRAW2 and/or replace VR1
		Check U1, pin 10 for TTL low input, if bad troubleshoot Delay Restart (U2), VRAW2 and Fault Monitor circuits
	Oscillator defective	Check U1, pin 11 for TTL 41.6 uS square wave, if bad check U1, pin 9 for some positive voltage, if bad troubleshoot Soft-Start circuitry and Current Limiting
	Voltage Bus defective	Check positive leg of BR1 for positive voltage (approx. 87% of line voltage) Check negative leg of BR1 for negative voltage (approx. 87% of line), if bad check RT3 and R1
	Driver Circuit defective	Check collector Q2 for approx. 30 Vpp square wave, if bad, check T4 and associated components, and VRAW2
		With F1 removed and floating ground oscilloscope, (use Delta ground) check base of Q1 for switching signal if bad check Q12 and associated circuits

SYMPTOM	POSSIBLE PROBLEM	CHECK
No Output (Cont.)		Check collector of Q1 for high positive flyback pulses, if bad check Q1, and T2
Unit Blows F1 with load on	Q1 defective	Check Q1 for shorts Always check Q1 if F1 blows. Replace F1 and/or Q1, disconnect J1, J2, J3, and J8 and check output voltages
	Driver Circuitry defective	Check CR5, R4, and R16
	Soft Start defective	Check Q11, Q13, and associated circuits
	Current Limiting defective	Check C8, and CR1
Unit Blows F1 with all loads removed	Q1 defective	Check Q1 for shorts Always check Q1 if F1 blows
	Driver Circuitry defective	Check CR5, R4, and R16
	Output Voltage circuitry defective	Check for near short to ground at J1, pins 1, 3, J2, pin 8, and CR10 anode
	Oscillator defective	Check U1, pin 11 square wave signal for less than 50% positive duty cycle,
Unit shuts down with load on	Defective Load	Remove J1, J2, J3, and J8, check output voltages
	Driver Circuitry defective	Check R12, R61, Q12, and CR20 for open
	Reference Voltage regulators defective	Check VR1, VR2, VR3, and VR4
	Output Voltage circuitry defective	Check +5 VDC circuit Check other output circuitry

SYMPTOM	POSSIBLE PROBLEM	CHECK
Unit shuts down with loads removed	Reference Voltage circuitry defective	Check CR8, VR1, VR2, VR3, and VR4
	Output Voltage circuitry defective	Check +16 VDC output and +5 VDC output circuitry and other output circuits
	Current Limiting circuitry defective	Check CR1, C8, and zero ohm R51
Power Supply causes noise	HSYNC circuitry defective	With W-1 removed check collector of Q4 for HSYNC pulse
		Check PLL circuitry

KM-3/4 DEFLECTION
TROUBLESHOOTING TABLE
KM-3 Assembly #103302
KM-4 Assembly #105763

SYMPTOM	POSSIBLE PROBLEM	CHECK
No video	No High Voltage	Check for 25KV at anode of CRT. If incorrect, Go to "No High Voltage" symptom
	No Filament voltage	Check for approx 20 VAC at J8, pin 7
	Defective Logic	Verify Logic Board
	Defective Video	Go to Video troubleshooting and/or Alignment
Thin horizontal line in center of CRT screen	Defective Vertical Oscillator	Check Vertical Oscillator output ramp Emitter Q13
	Defective Vertical Deflection	Check for +45 VDC at R74. If bad check C2 and CR1
		Check for signal at collector Q14
Bent Letters	Defective Pincushion correction	Check for parabola at collector Q18
	Defective Horizontal Voltage Regulator	Check for 0VDC at U3 pin 2
		Check Q8, Q9, Q10 for short or open
	Jumper misplaced	Check Jumper configuration table
Video Rolls Vertically on Screen	Vertical Sync Defective	Check collector of Q12 for Sync pulse
	Vertical Oscillator Defective	Check for consistent ramp signal output at U2, pin 6
Video Rolls Across Screen Side to Side	Horizontal Sync Defective	Check collector of Q20 for Sync pulse
	Defective Retrace Pulse	Check for open R98 Check for shorted C83, CR40 or CR41
	Defective Horizontal Oscillator	Check U1, pin 9 for +6 VDC, U1, pin 4 for square wave signal

SYMPTOM	POSSIBLE PROBLEM	CHECK
No High Voltage	Defective Horizontal oscillator	Check +12 VDC Check U1, pin 4 for square wave signal
	Defective Base Drive	Check collector Q22 for Base Drive Pulse
	Defective Power Supply	Verify Power Supply
	Defective Horizontal Deflection	With J7 disconnected, check J7, pin 3 for 100 VDC +/-10 VDC
	Defective Voltage Regulator	Check U3 and associated circuitry
	Defective Q23 or CR42	Check components for open/short
NOTE: If Q23 or CR42 are found short, disconnect J5 and verify that power supply operates properly.		
Thin vertical line in center of screen	Defective Horizontal Deflection	Check for open in jumper W4, L4, L5, R106 or yoke of CRT
Noise in Video	Ripple in +12 VDC	Check +16 VDC Input from Power Supply
		Check +12 VDC Regulator
	Ripple in -12 VDC	Check -12 VDC Input from Power Supply

AR-2 DEFLECTION
TROUBLESHOOTING TABLE
AR-2 Assembly #105159

SYMPTOM	POSSIBLE PROBLEM	CHECK
No video	No High Voltage	Check for 25KV at anode of CRT. If incorrect, Go to "No High Voltage" symptom
	No Filament voltage	Check for approx 20 VAC at J4, pin 4 if good go to Video troubleshooting
	Defective Logic	Verify Logic Board inputs to video board
	Defective Video	Go to Video troubleshooting and/or Alignment
Thin horizontal line in center of CRT screen	Defective Vertical Oscillator	Check Vertical Oscillator output ramp U3, pin 5
	Defective Vertical Deflection	Check +28 VDC from power supply
Bent Letters	Defective Pincushion correction	Check for parabola at U5, pin 7
	Defective Horizontal Voltage Regulator	Check emitter of Q2 for parabola signal on B+ voltage
Video Rolls Vertically on Screen	Vertical Sync defective	Check collector of Q22 for Sync pulse
	Vertical Oscillator Defective	Check for ramp signal at U3, pin 2
Video Rolls Across Screen Side to Side	Horizontal Sync Defective	Check U1, pin 1 for HSYNC pulse
	Horizontal centering defective	Check U2, pin 5 for a 4us TTL pulse
	Defective Retrace Pulse	Check U3, pin 13 for a 3 Vpp ramp with fast rise and slow fall time

SYMPTOM	POSSIBLE PROBLEM	CHECK
No High Voltage	X-ray protect	Check U5 pin 1 for -12 VDC, if +12 VDC X-ray circuit is shutting off hor. oscillator. See Tips on Trouble-shooting AR-2 deflection at the end of this chart
	Horizontal protect	Check base of Q10 for positive bias voltage
	Defective Power Supply	Verify Power Supply
	Defective Voltage Regulator	Check +12 VDC U3, pin 22, and pin 11
	Defective Q8 or CR4	Check components for open/short

NOTE: If Q8 or CR4 are found short, disconnect J5 and
       verify that power supply operates properly.

Noise in Video	Ripple in +12 VDC	Check +16 VDC Input from Power Supply
		Check +12 VDC Regulator
	Ripple in -12 VDC	Check -12 VDC Input from Power Supply

Tips on Troubleshooting the AR-2 Deflection.

When operating properly, a positive voltage at U3, pin 8, from the X-Ray protect circuitry disables the horizontal oscillator output from U3, pin 9, whenever the high voltage exceeds 29KV.

Damage to other circuitry may result if the X-Ray protect circuitry is modified (disabled). However, the high voltage circuitry may be disabled by lifting one end of Resistor R30 (see PCB Silkscreen in Appendix D).

With the high voltage generation circuitry disabled, the voltage from the X-Ray protect circuitry to U3, pin 8, should be -12 vdc. If this voltage is positive when the HV is disabled, troubleshoot the X-Ray protect circuitry.

Check the components in the HV circuitry if the X-Ray protect circuits are functioning properly.

TC-1 VIDEO AMPLIFIER
TROUBLESHOOTING TABLE
TC-1 Assembly #105112

SYMPTOM	POSSIBLE PROBLEM	CHECK
Discolored characters	No output from one or more video amps	Determine which amp is defective by checking full screen floods of Red, Green, and Blue. Go to "No output of amp"
	Weak output from one or more video amps	Determine which amp is defective by checking full screen floods of Red, Green, and Blue. Go to "Weak output of amp"
	VR1 defective	Check +5 VDC output of VR1 (also check for ripple)
Full screen of white rastors	+60 VDC supply low	Disconnect J1 check +60 VDC from power supply
	Shorted U1	Check U1 inputs for short to ground
		Check U1 outputs for TTL square wave, if +5 VDC (no square wave) output, replace U1
	Defective G2 voltage	Check R50 for open
Red, Green, or Blue rastors	Shorted component or components in affected color	Check components in Amplifier and Low Level Video Control circuits for short to ground
	+5 VDC bad	Check for short at output of VR1
	Push pull amp defective	Check components in upper part of push-pull amplifier circuitry
No video	Defective logic	Check for TTL square wave at pins 1, 3, and 5 of J2
	+12 VDC defective	Disconnect J1 and check +12 VDC from power supply
	Defective U1	Check output pins for TTL square wave
	Defective Tube Bias or filament voltages	Check J1; pin 7, for 20 +/- 6 VAC heater voltage, pin 4 for -100 VDC G1 voltage

SYMPTOM	POSSIBLE PROBLEM	CHECK
Weak video	Defective logic	Check J2 pin 9, for +5 VDC (no INT BIT)
	Defective Intensity Bit Control circuitry	Check Q11 and Q12 and associated circuitry
	Defective ABL circuitry	With black screen check J1 pin 3 for some voltage less than -7.5 volts (CR24 begins to conduct at-7.5 VDC)
		Check Q16, Q15 and associated circuits
No output of amp	Defective Low Level Video Control circuitry	Check for TTL square wave through Low Level Video Control circuits
	Defective "control" transistor	Check for open collector to emitter Q3 Green, Q6 Red, Q9 Blue
	VR1 defective	Check +5 VDC output of VR1.
	Defective Gain Adjust amp	Check Gain amp Q12 Green, Q13 Red Q14 Blue and associated circuits
	Defective Push-pull amp	Check transistor Q1, Q2 Green, Q4, Q5 Red, Q7, Q8 Blue and associated circuitry
	Defective +12 VDC supply voltage	Check +12 VDC from power supply
	Shorted diode	Check CR14 Green, CR15 Red, CR16 Blue
Weak output of amp	Defective Low Level Video Control circuitry	Check resistors between emitter of "control" transistor and NAND gates for opens
	Defective "control" transistor	Replace transistor Q3 Green, Q6 Red, Q9 Blue
	VR1 defective	Check +5 VDC output of VR1
	Defective Gain Control amp	Rotate Gain Control potentiometer CW (from rear of board) and check base of "control" transistor Q3 Green, Q6 Red, Q9 Blue for

SYMPTOM	POSSIBLE PROBLEM	CHECK
Weak output of amp. (cont.)		+6 VDC (+/- 1.5 VDC)
	Increased impedance in "control" amp supply voltage line	Check R1, L4 Green, R16, L5 Red, R31, L6 Blue
	Defective +12 VDC	Check +12 VDC from power supply
	Jumpers	Jumpers must be installed
No ABL	+5 VDC bad	Check +5 VDC from VR1
	ABL circuitry defective on deflection board	Check J1, pin 3 for voltage greater than -7.5 VDC with full white screen

AR-2 VIDEO AMPLIFIER
TROUBLESHOOTING TABLE
AR-2 Assembly #105199

SYMPTOM	POSSIBLE PROBLEM	CHECK
Discolored characters	No output from one or more video amps	Determine which amp is defective by checking full screen floods of Red, Green, and Blue. Go to "No output of amp"
	Weak output from one or more video amps	Determine which amp is defective by checking full screen floods of Red, Green, and Blue. Go to "Weak output of amp"
	VR1 defective	Check +5 VDC output of VR1 (also check for ripple)
Full screen of white rastors	+90 VDC supply low	Disconnect J3 and J4, check +90 VDC from power supply
	Defective G2 VDC	Check R15 for open
Red, Green, or Blue rastors	Shorted component/ components in affected color	Check components in Amplifier and Low Level Video Control circuits for short to ground
	Open component/ components in affected color	Check components in background circuit and between its output and collector of: Q18 Green, Q10 Red, Q26 Blue
		Check components in upper part of push-pull amplifier circuitry
No video	Defective logic	Check for TTL square wave at pins 1, 3, and 5 of J1
	+12 VDC defective	Disconnect J3 and J4, check +12 VDC from power supply
	Defective Tube Bias and filament voltages	Check J4; pin 4, for 20 +/- 6 VAC heater voltage, pin 3 for -100 VDC
Weak video	Defective logic	Check J1 pin 9, for +5 VDC (no INT BIT)
	Defective Intensity Bit Control circuitry	Check Q7 and Q8 and associated circuitry

SYMPTOM	POSSIBLE PROBLEM	CHECK
Weak Video (cont.)	Defective Vertical Retrace Blanking circuitry	Check Q1, Q2, Q29, emitter to base, for short
		Check J4 pin 2, for blanking pulse
	Defective ABL circuitry	With black screen check J4 pin 6 for some voltage less than -7.5 volts (CR24 begins to conduct at-7.5 VDC)
		Check Q3, Q4 and associated circuits
No output of amp.	Defective "control" transistor	Check for open, collector to emitter, Q18 Green, Q10 Red, Q26 Blue
	VR1 defective	Check +5 VDC output of VR1.
	Defective Gain Adjust amp	Check Gain amp Q16 Green, Q8 Red Q24 Blue and associated circuits
	Defective Push-pull amp	Check transistor Q19, Q20 Green, Q11, Q12 Red, Q27, Q28, Blue and associated circuitry
	Defective +12 VDC supply voltage	Check +12 VDC from power supply
Weak output of amp	Defective "control" transistor	Replace transistor Q18 Green, Q10 Red, Q26 Blue
	VR1 defective	Check +5 VDC output of VR1
	Defective Gain Control amp	Rotate Gain Control potentiometers CW (from rear of board) and check base of "control" transistor Q18 Green, Q10 Red, Q26 Blue for +6 VDC (+/- 1.5 VDC)
	Increased impedance in "control" amp supply voltage line	Check components in "control" amp supply line
	Defective +12 VDC	Check +12 VDC from power supply

TC-3 VIDEO AMPLIFIER
TROUBLESHOOTING TABLE
TC-3 Assembly #105202

SYMPTOM	POSSIBLE PROBLEM	CHECK
Discolored characters	No output from one or more video amps	Determine which amp is defective by checking full screen floods of Red, Green, and Blue. Go to "No output of amp"
	Weak output from one or more video amps	Determine which amp is defective by checking full screen floods of Red, Green, and Blue. Go to "Weak output of amp"
	VR1 defective	Check +5 VDC output of VR1 (also check for ripple)
Full screen of white rastors	+90 VDC supply low	Disconnect J3 and J4, check +90 VDC from power supply
	Shorted U1	Check U1 inputs for short to ground. If short replace U1
		Check U1 outputs for TTL square wave, if +5 VDC (no square wave) output, replace U1
	Defective G2 voltage	Check R67 for open
Red, Green, or Blue rastors	Shorted component/ components in affected color	Check components in Amplifier and Low Level Video Control circuits for short to ground
		Check for short at output of VR1
	Open component/ components in affected color	Check components in background circuit and between its output and collector of: Q5 Green, Q13 Red, Q19 Blue
		Check components in upper part of push-pull amplifier circuitry
No video	Defective logic	Check for TTL square wave at pins 1, 3, and 5 of J1
	+12 VDC defective	Disconnect J3 and J4, check +12 VDC from power supply

SYMPTOM	POSSIBLE PROBLEM	CHECK
No video (cont.)	Defective U1	Check output pins for TTL square wave
	Defective Tube Bias and filament voltages	Check J4; pin 4, for 20 +/- 6 VAC heater voltage, pin 3 for -100 VDC
Weak video	Defective logic	Check J1 pin 9, for +5 VDC (no INT BIT)
	Defective Intensity Bit Control circuitry	Check Q7 and Q8 and associated circuitry
	Defective Vertical Retrace Blanking circuitry	Check Q1, Q22, Q22, emitter to base, for short
		Check J4 pin 2, for blanking pulse
	Defective ABL circuitry	With black screen check J4 pin 6 for some voltage less than -7.5 volts (CR24 begins to conduct at-7.5 VDC)
		Check Q24, Q23 and associated circuits
No output of amp	Defective Low Level Video Control circuitry	Check for TTL square wave through Low Level Video Control circuits
	Defective "control" transistor	Check for open collector to emitter Q5 Green, Q13 Red, Q19 Blue
	VR1 defective	Check +5 VDC output of VR1.
	Defective Gain Adjust amp	Check Gain amp Q4 Green, Q12 Red Q18 Blue and associated circuits
	Defective Push-pull amp	Check transistor Q3, Q6 Green, Q11, Q14 Red, Q17, Q20 Blue and associated circuitry
	Defective +12 VDC supply voltage	Check +12 VDC from power supply
	Shorted diode	Check CR2 Green, CR10 Red, CR16 Blue

SYMPTOM	POSSIBLE PROBLEM	CHECK
Weak output of amp	Defective Low Level Video Control circuitry	Check resistors between emitter of "control" transistor and NAND gates for opens
	Defective "control" transistor	Replace transistor Q5 Green, Q13 Red, Q19 Blue
	VR1 defective	Check +5 VDC output of VR1
	Defective Gain Control amp	Rotate Gain Control potentiometer CW (from rear of board) and check base of "control" transistor Q5 Green, Q13 Red, Q19 Blue for +6 VDC (+/- 1.5 VDC)
	Increased impedance in "control" amp supply voltage line	Check R6, L1 Green, R29, L3 Red, R46, L5 Blue
	Defective +12 VDC	Check +12 VDC from power supply

APPENDICES

APPENDIX A

3800/8800 PRODUCT LINE CHART

	CRT		Enclosure				Logic		Analog	
	19"	15"	Rack	Ergo	OEM	NEMA-2	Standard	Extended	Modular	Old Style
3810		X		X			X			X
3815		X		X			X		X	
3820		X		X				X		X
3825		X		X				X	X	
3860		X	X				X			X
3865		X	X				X		X	
3875		X	X					X	X	
8810	X			X			X			X
8814	X				X		X		X	
8815	X			X			X		X	
8816	X					X	X		X	
8820	X			X				X		X
8824	X				X			X	X	
8825	X							X	X	
8826	X					X		X	X	
8865	X		X				X		X	
8875	X		X					X	X	

FIRMWARE UPGRADE

Modifying 8800/3800 logic cards for V2.00 Firmware.

The modifications required for upgrading to V2.00 firmware for 8800/3800 Series Terminals can be accomplished on the logic assemblies 105150 and 105666 (PCB# 105149). The assemblies requiring hardware modification are based on the PCB# 105149, Rev. 1, 2, 2A and 2B. The PCB number and revision can be found in the "foil" on the back side of the logic card near the keyboard connector. Earlier logic cards (PCB# 102506) cannot be upgraded.

The modifications are listed below by revision level of the logic board.

PCB# 105149, Rev. 3 and later

     a) Remove old firmware (U1-U4) and install new firmware.
     b) Replace the decoder in socket U20 (108032-040) with the new decoder 108100-200.
     c) Set the jumpers W3/W4, W5/W6, W7/W8 and W9/W10 for the 27256 EPROM (27128 and 27256 EPROMs use the same setting). See label on logic board.
     d) Set the jumper W11/W12 for an EPROM at U4.
     e) Set the jumper W40/W41 for the 27256 EPROM (W41 setting).

PCB# 105149, Rev. 2, 2A, 2b

     a) Remove old firmware (U1-U4) and install new firmware.
     b) Replace the decoder in socket U20 (108032-040) with the new decoder 108100-200.
     c) Cut jumper defaults on jumpers W3/W4, W5/W6, W7/W8, W9/W10 and W11/W12 (see figure, details B and D). Install three-pin headers with shorting plugs ("suitcases").
     d) Set the jumpers W3/W4, W5/W6, W7/W8 and W9/W10 for the 27256 EPROM (27128 and 27256 EPROMs use the same settings).
     e) Set the jumper W11/W12 for an EPROM at U4.
     f) Cut the trace that runs from the W6 side of the W5/W6 jumper toward socket U2 (see figure, detail C) and install jumper from pin 26 of U2 to the center pin of jumper W5/W6 (see figure, detail D).
     g) Cut the trace that runs from the W8 side of the W7/W8 jumper toward socket U3 (see figure, detail C) and install jumper from pin 26 of U3 to the center pin of jumper W7/W8 (see figure, detail D.)

h) Cut the jumper default on jumper W40/W41 (see figure,
    detail A) and install a three-pin header with shorting
    plug ("suitcase").
i) Set the jumper W40/W41 for the 27256 EPROM (W41
    setting).
j) For 8810/3810/3860 terminals also do the following:

    1) Cut the jumper defaults on jumpers W13/W14 and
        W15/W16 (see figure, detail B). Install three-pin
        headers with shorting plugs ("suitcase").
    2) Remove the 2Kx8 RAM from U5 and install two 8Kx8
        Ram chips in sockets U5 and U6.
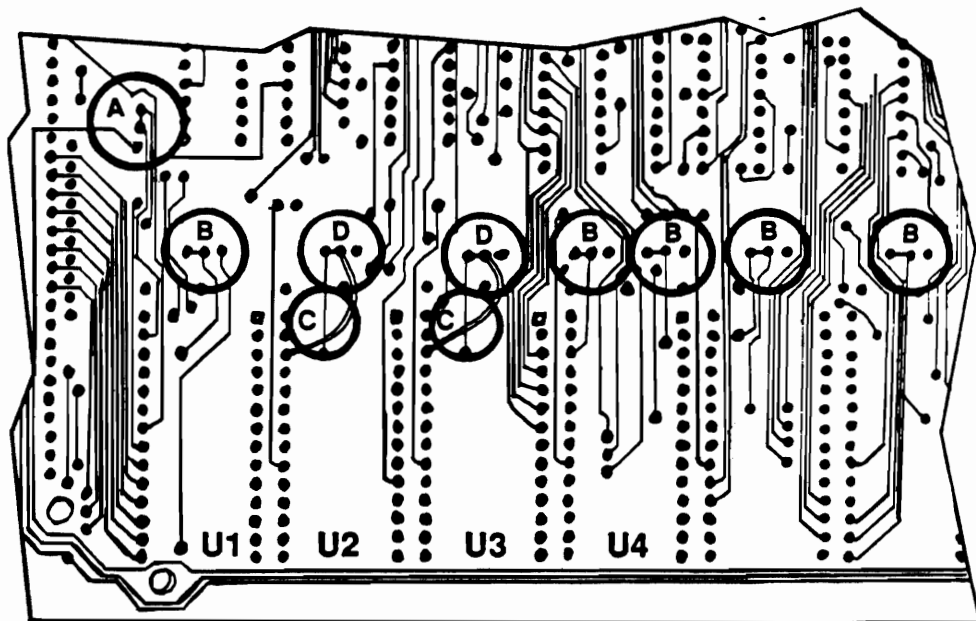
represents cutting a jumper/trace

a) Remove old firmware (U1-U4) and install new firmware.
b) Replace the decoder in socket U20 (108032-040) with the new decoder 108100-200.
c) Cut jumper defaults on W3/W4, W5/W6, W7/W8, W9/W10 and W11/W12 (see figure, details B and D). Install three-pin headers with shorting plugs ("suitcase").
d) Set the jumpers W3/W4, W5/W6, W7/W8, and W9/W10 for the 27256 EPROM (27128 and 27256 EPROMs use the same setting).
e) Set the jumper W11/W12 for an EPROM at U4.
f) Cut the trace that runs from the W6 side of W5/W6 jumper toward socket U2 (see figure, detail C) and install jumper from pin 26 of U2 to the center pin of jumper W5/W6 (see figure, detail D).
g) Cut the trace that runs from the W8 side of the W7/W8 jumper toward socket U3 (see figure, detail C) and install jumper from pin 26 of U3 to th center pin of jumper W7/W8 (see figure, detail D).
h) Cut the jumper default on jumper W40/W41 (see figure, detail A) and install a three-pin header with a shorting plug ("suitcase").
i) Set the jumper W40/W41 for the 27256 EPROM (W41 setting).
j) For 8810/3810/3860 terminals also do the following:
   1) Cut the jumper defaults on jumpers W13/W14 and W15/W16 (see figure, detail B). Install three-pin headers with shorting plugs ("suitcase").
   2) Remove the 2Kx8 RAM from U5 and install two 8Kx8 Ram chips in sockets U5 and U6.
k) If the light pen is to be used with assembly and it was not previously installed, other modifications may be required; consult factory.

After installing the new firmware, power the unit on and wait until it successfully completes the selftest (Tone sounds and power up message appears) or it displays the Setup menu. In the Setup menu set the appropriate parameters (defaults are suggested), save these and exit. In V2.00 firmware, there are two main menus (Host I/O and Operator Preference) and the Hardware Configuration menu.

If there are questions or comments, please call Intecolor Technical Support at (404) 449-5961.

APPENDIX C
COVER REMOVAL

Power should always be removed before servicing a unit.

A #2 Phillips screwdriver is required for cover removal.

WARNING! Do not apply power to the unit with circuit boards hanging from the chassis by connecting cables and cords. Electrical shock and/or damage to the unit could result. The inside of the covers are painted with a conductive coating.

WARNING! Any maintenance performed with power on and cover off subjects the operator to electrical shock hazards that could cause injury or death. Such maintenance should be performed by trained and qualified service personnel who are aware of the existing hazards.

The **3815**, and **3825** terminals use the same cover as the **3810**.

First, remove the two Phillips head screws at the top rear of CRT bezel.

Second, remove the two Phillips head screws at the rear bottom of cabinet.

Third, lift the rear of the cover up, then slide the cover to the rear and off the unit.
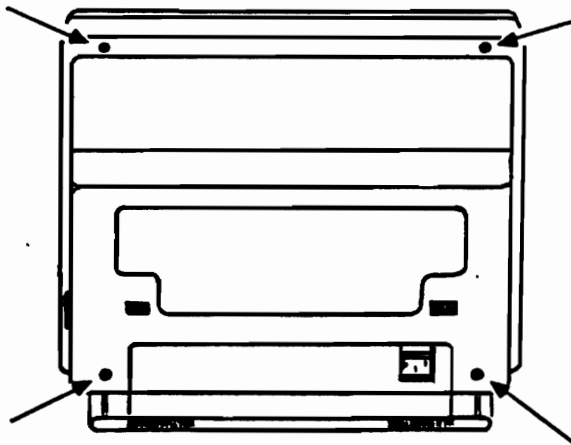
1st - remove phillips screws
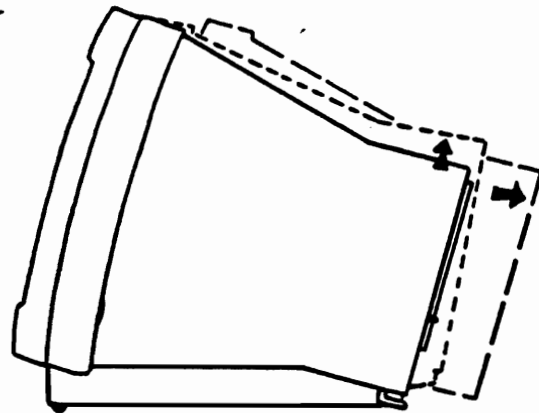
2nd - lift up and slide back

The **8815** and **8825** cover may be removed following the instructions below.

First, remove the four Phillips screws at the top and bottom rear of the CRT bezel.

Second, carefully slide the cover toward the rear and off the chassis.

2nd - lift up and slide back
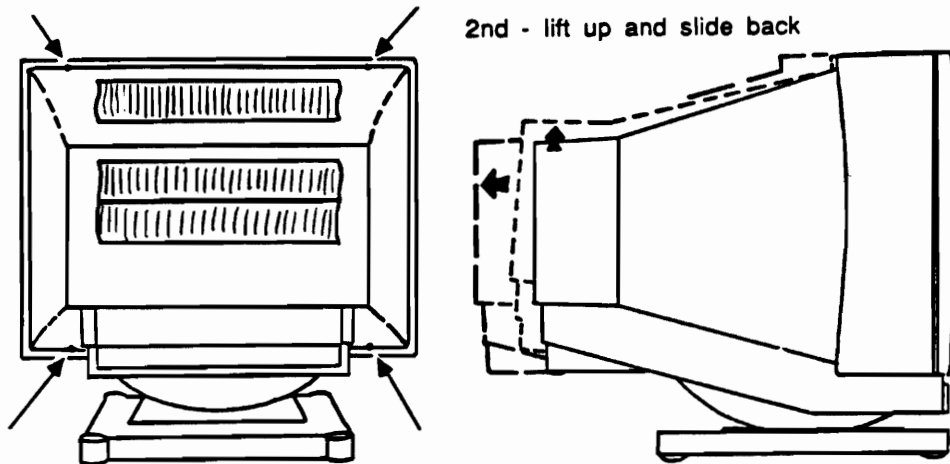
1st - remove phillips screws from rear

Rack-mount unit cover removal is described below.

First, remove the three Phillips head screws down the front of each side of the metal cover. (6 screws total)

Second, remove the two Phillips head screws along the bottom of each side of the metal cover. (4 screws total)

Third, remove the three Phillips screws above the I/O port plate on the rear of the metal cover.

Fourth, carefully slide the metal cover to the rear and off the unit.

4th - lift up and slide back
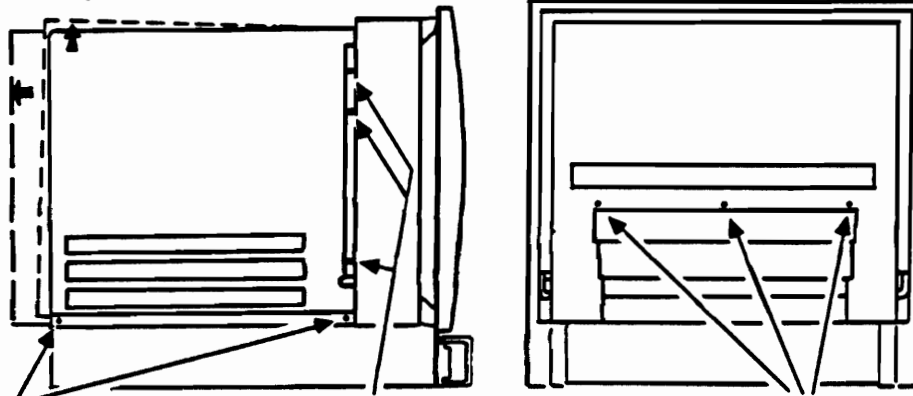
2nd - remove phillips screws   1st - remove phillips screws   3rd - remove phillips screws
(each side of unit)   (each side of unit)   from rear

NEMA-2 enclosure removal is described below.

First, remove the five Phillips head screws fastening the cover to the rear connector panel (three along the top and one on each side of the connector panel).

Next, carefully slide the metal cover to the rear and off the unit.

1st - remove phillips screws

2nd - lift up and slide back
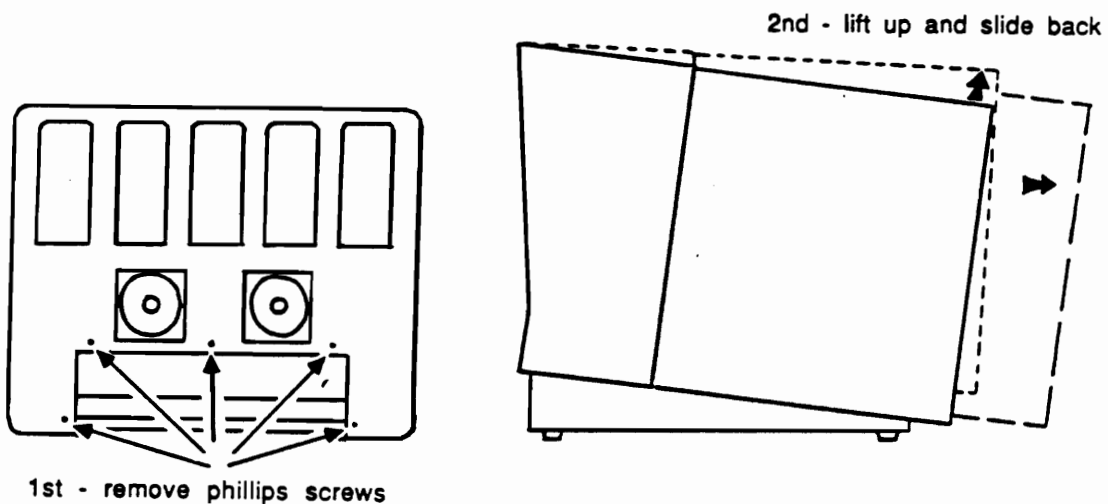
APPENDIX D
CIRCUIT BOARD LAYOUT

Printed Circuit Board (PCB) silkscreen drawings are provided for parts and test point location on the circuit assemblies.

The part number for each modular assembly is printed on a sticker which normally can be found on the component side of the PCB.

Only the assemblies described in this addendum are provided.

PCB P/N 105473 REV-2 MOTHERBOARD

INTECOLOR
PN105473 REV 2
MADE IN USA

D.2
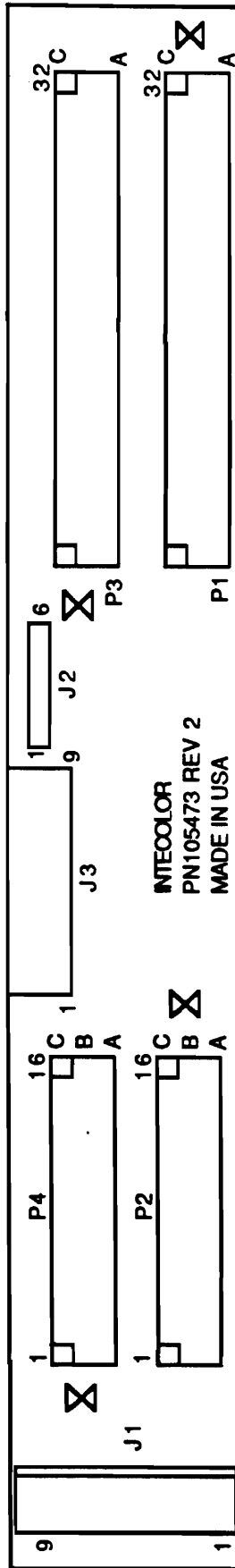
PCB P/N 102912 REV-3 GRAPHICS BOARD
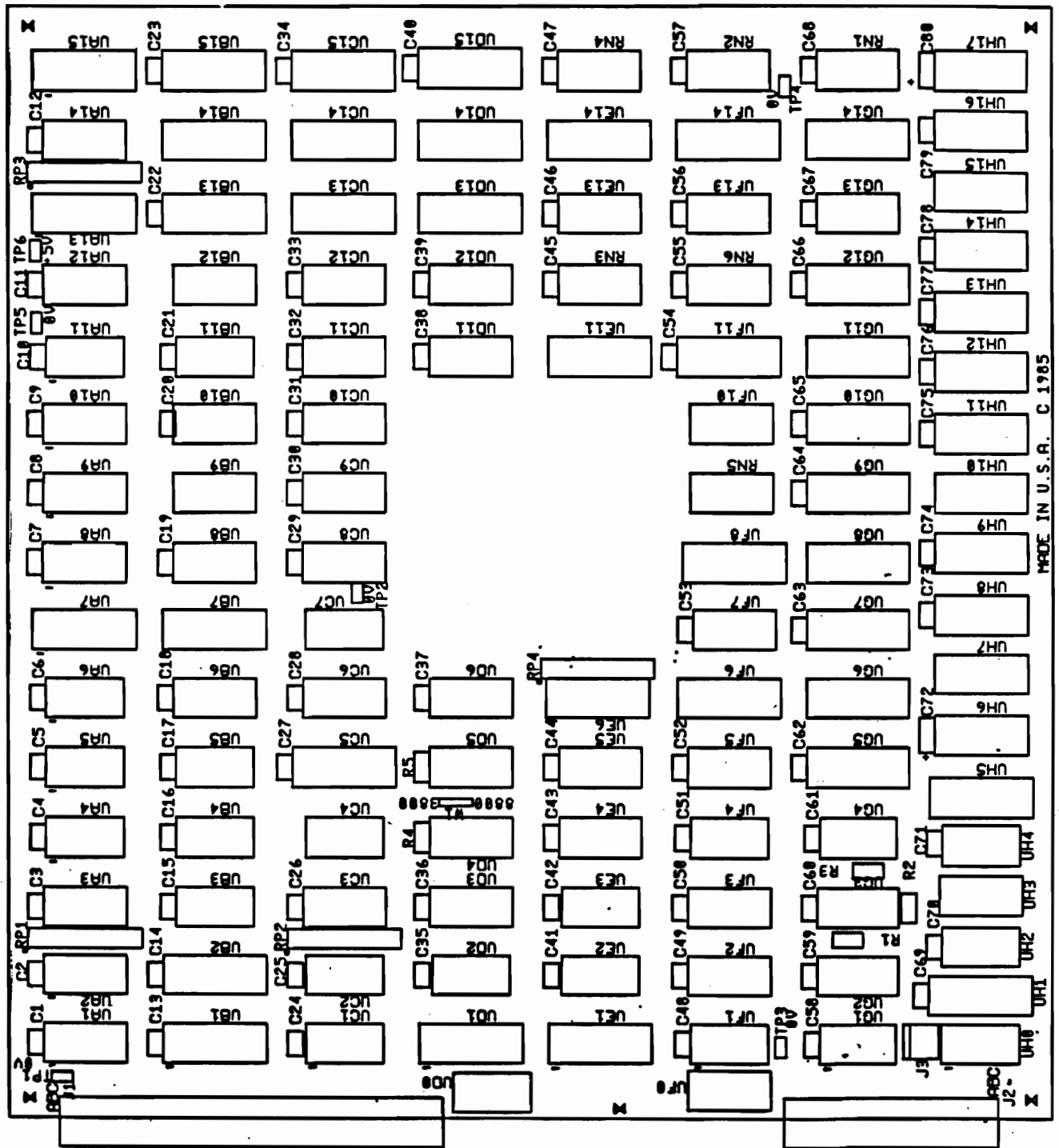
MADE IN U.S.A. C 1985

PCB P/N 105668 REV-2 KM-3 POWER SUPPLY

D.4
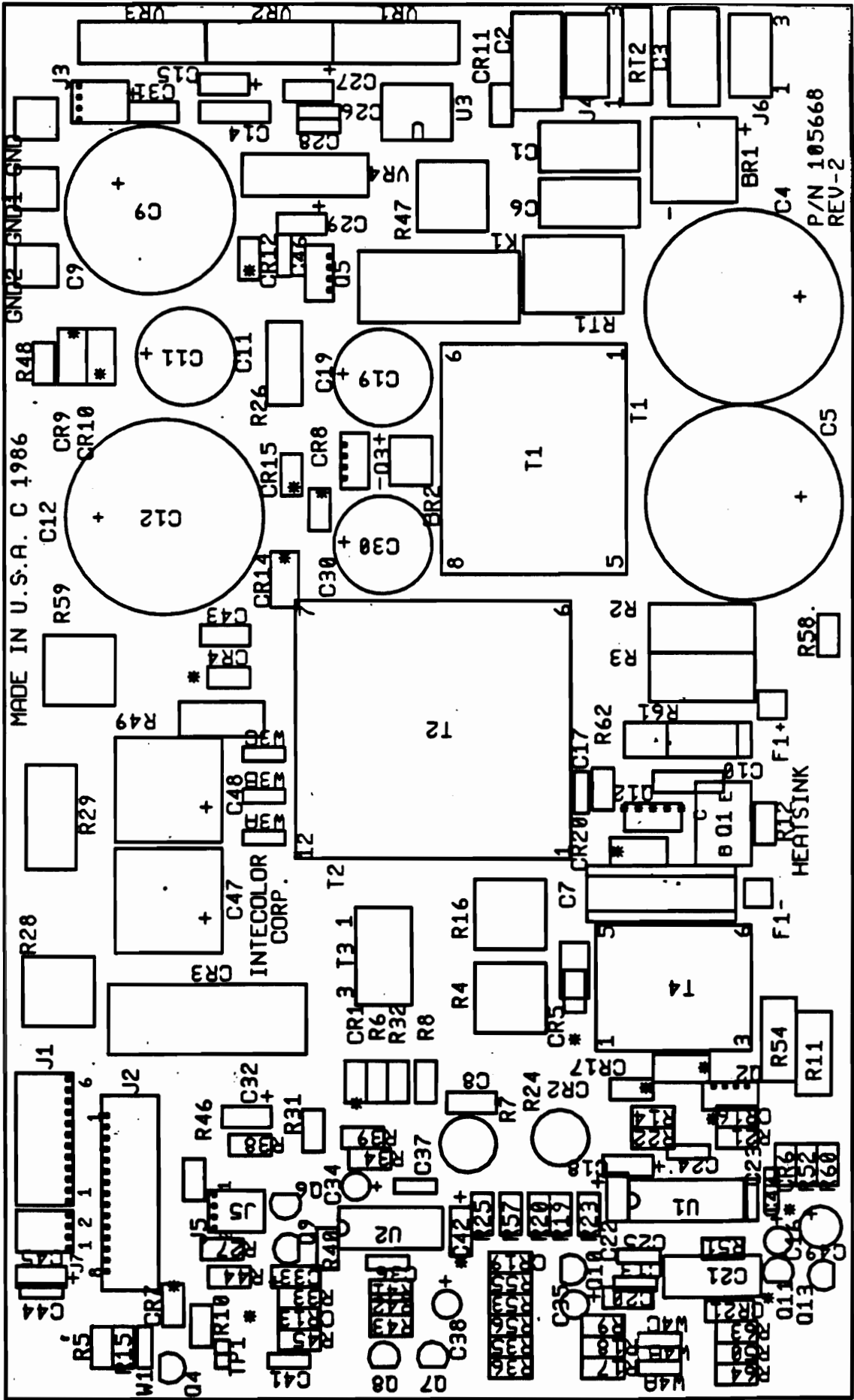
PCB P/N 105765 REV-2A KM-4 POWER SUPPLY

MADE IN U.S.A. C 1986

INTECOLOR CORP.
P/N105765
REV-2A

PATENT NO. 4686616
U.S.

HEATSINK

D.5
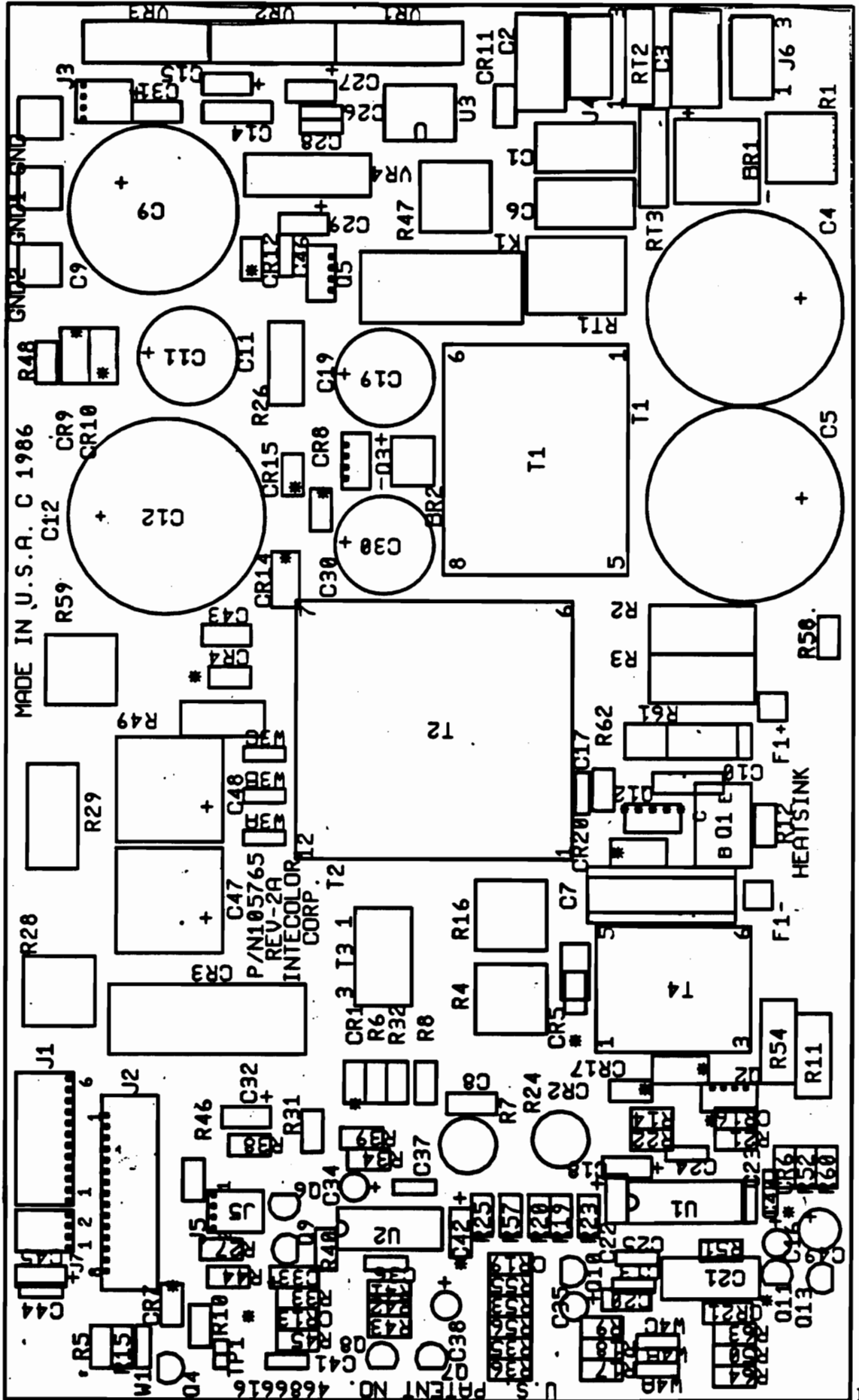
PCB P/N 105683 REV-2 AR-2 POWER SUPPLY

INTECOLOR CORP.
MADE IN USA
C 1987

P/N 105683 REV-2

D.6
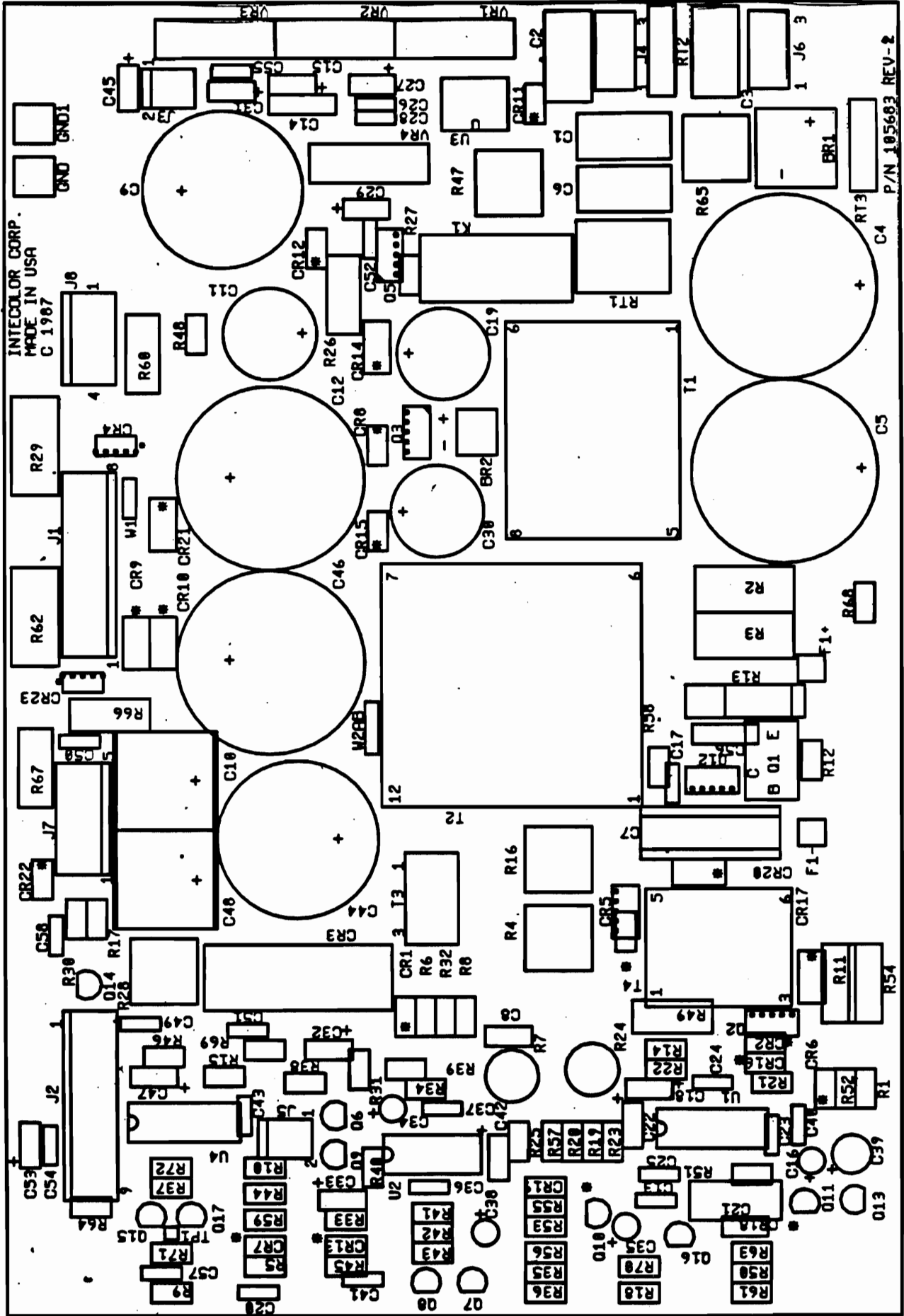
PCB P/N 103301 REV-4 KM-3 DEFLECTION

D.7

PCB P/N 105762 REV-2 KM4 DEFLECTION

D.8
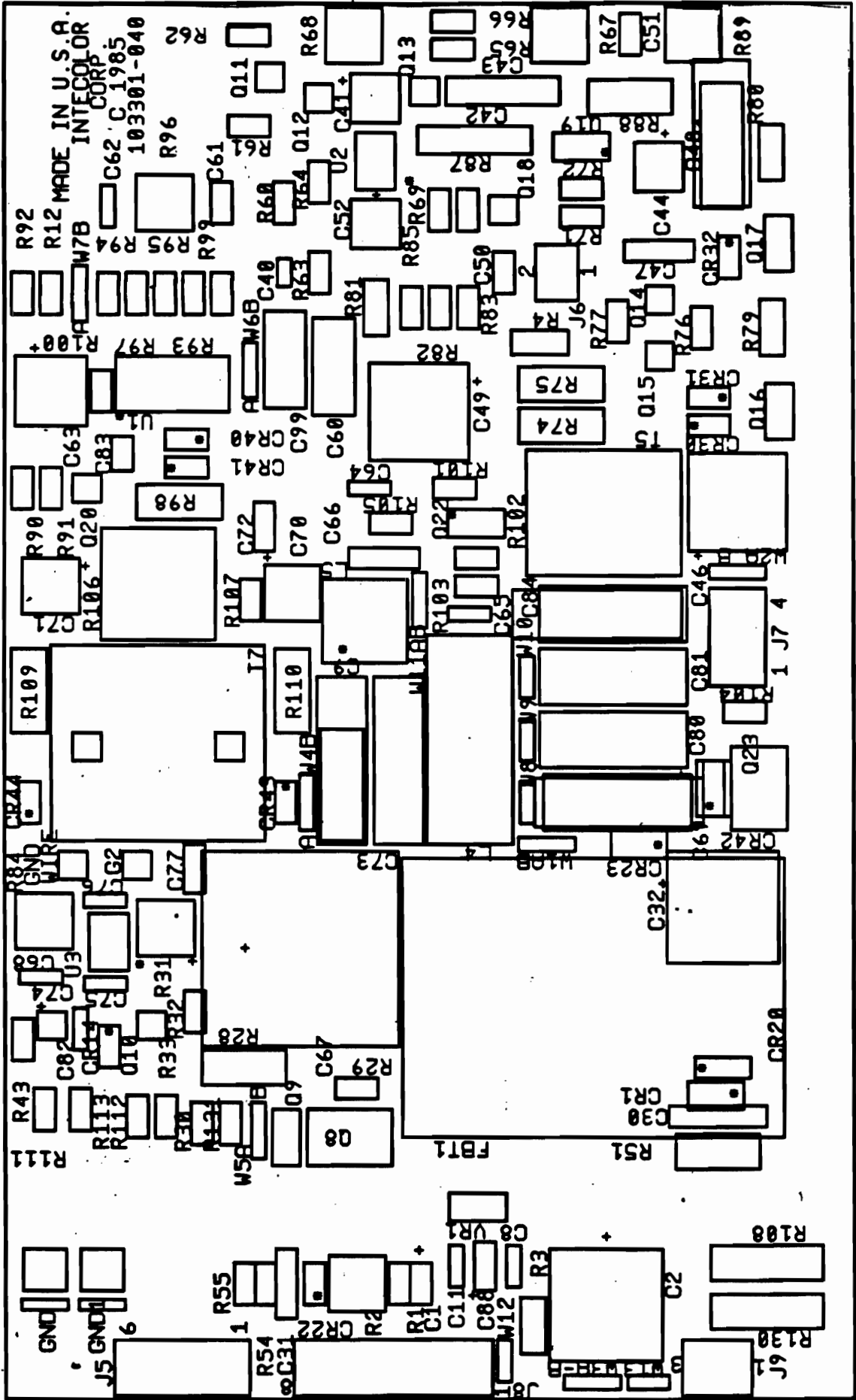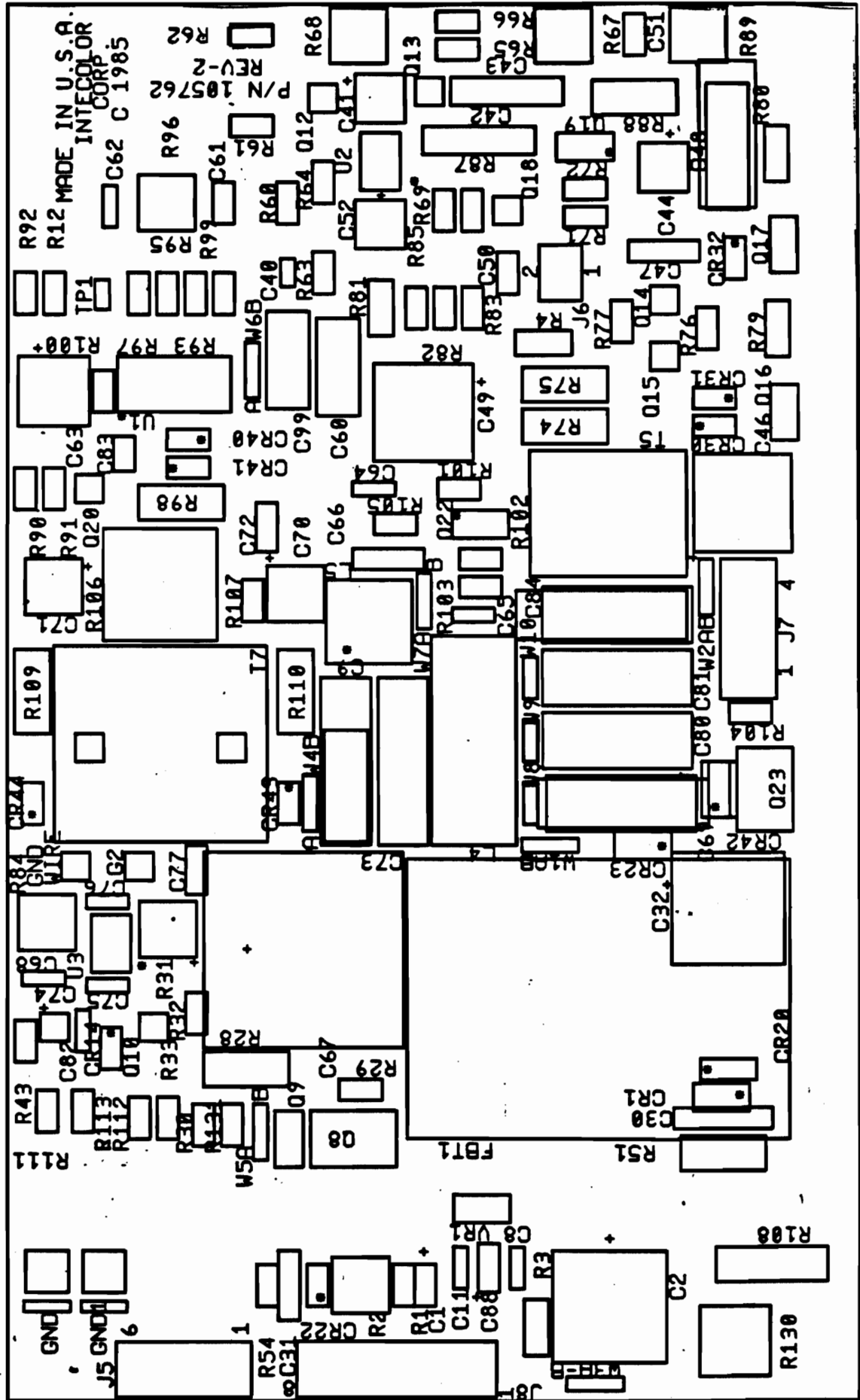
PCB P/N 105156 REV-1 R AR-2 DEFLECTION
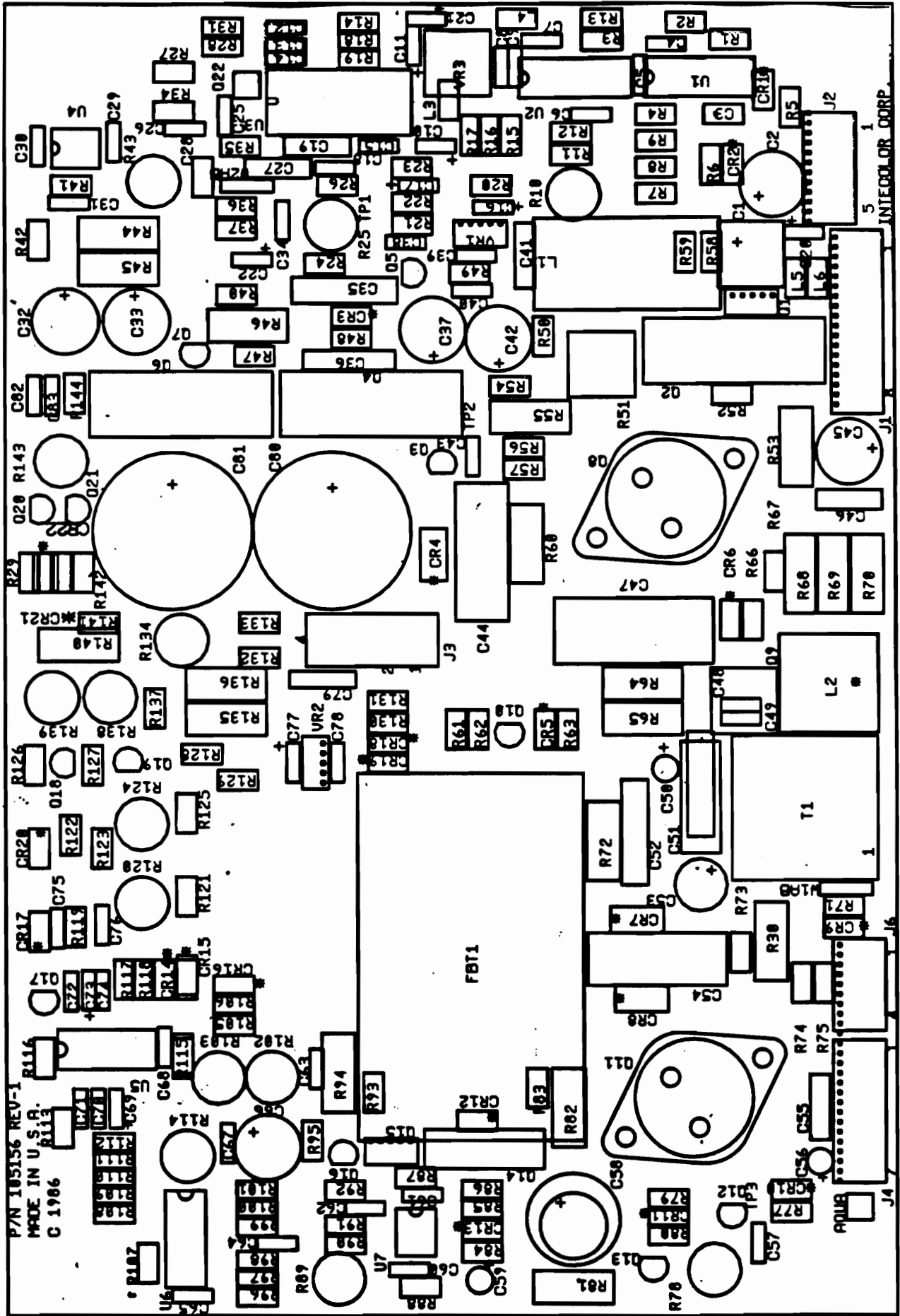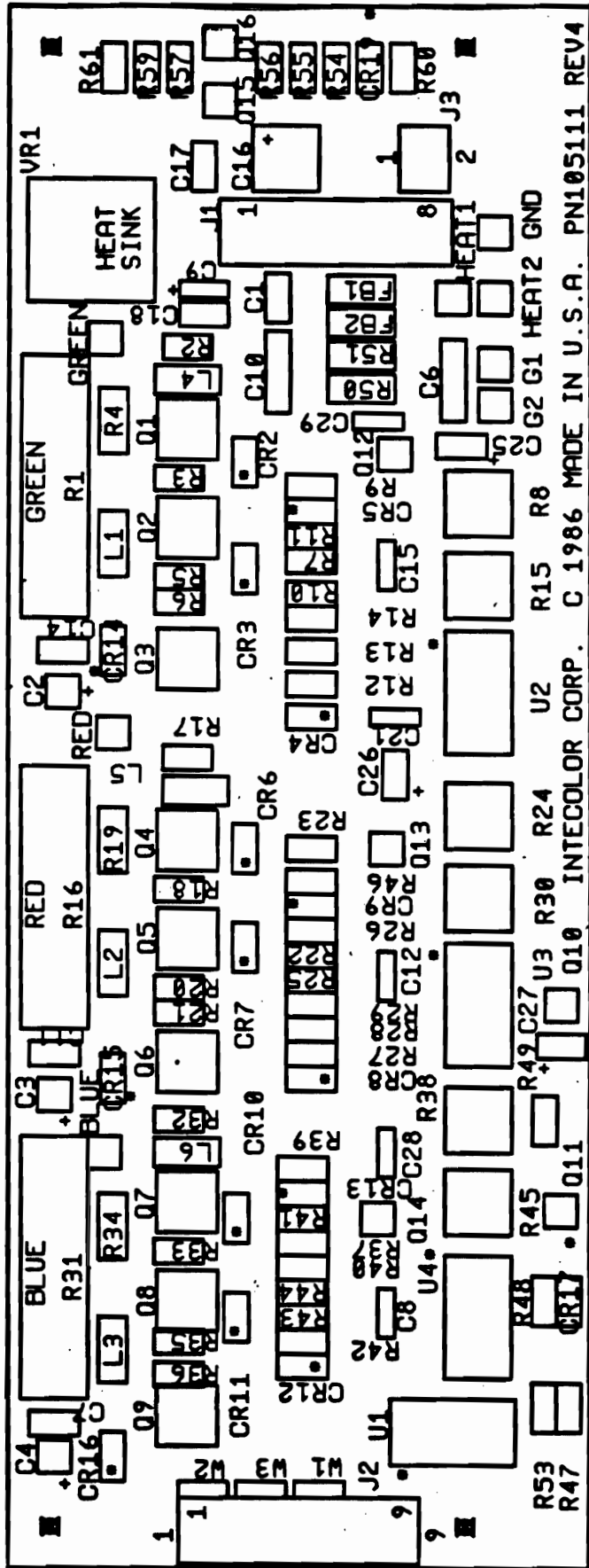
INTECOLOR CORP

D.9

PCB P/N 105111 REV-4 TC-1 VIDEO

PCB P/N 105201 REV-2 TC-3 VIDEO
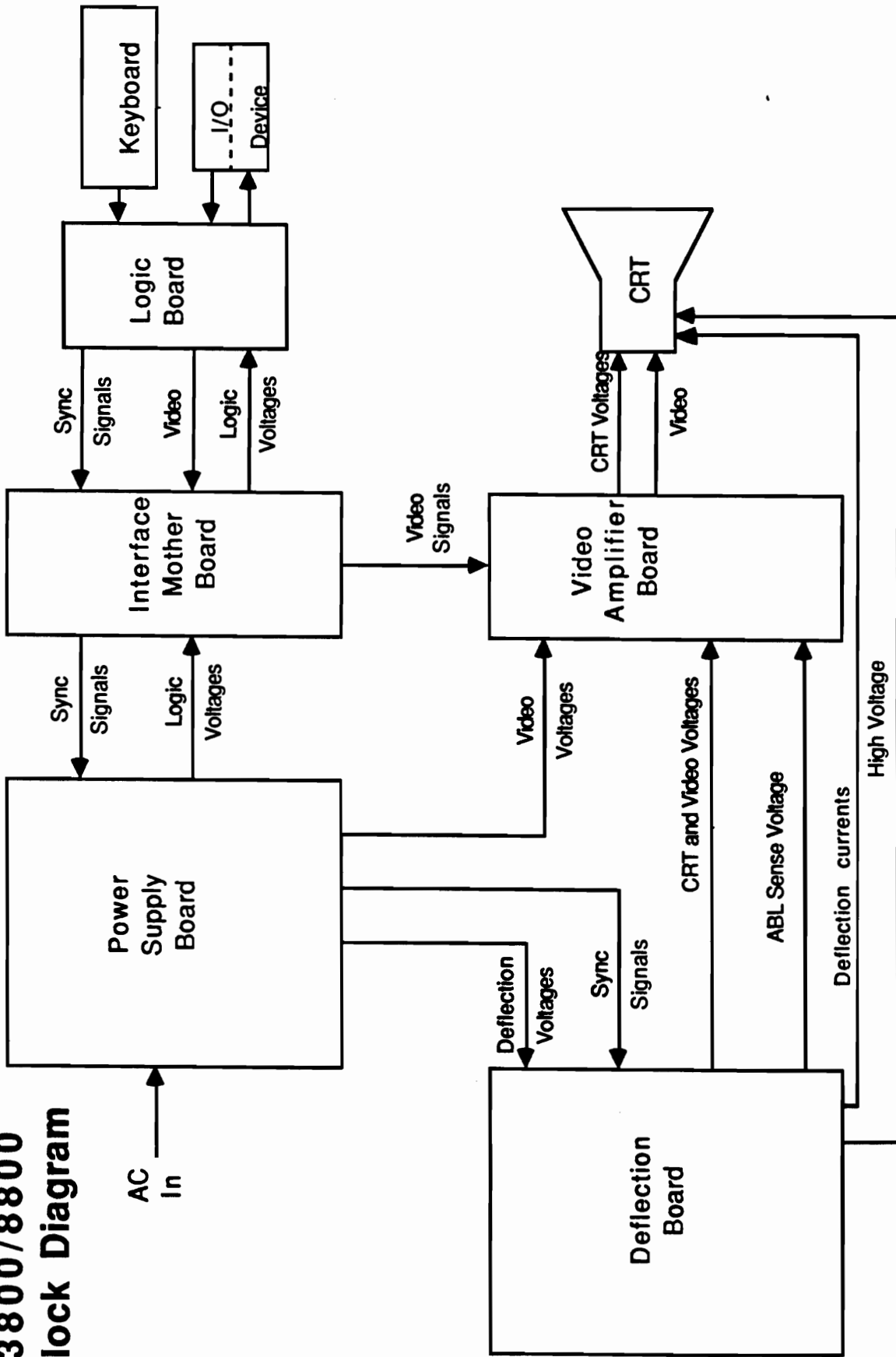
D.11
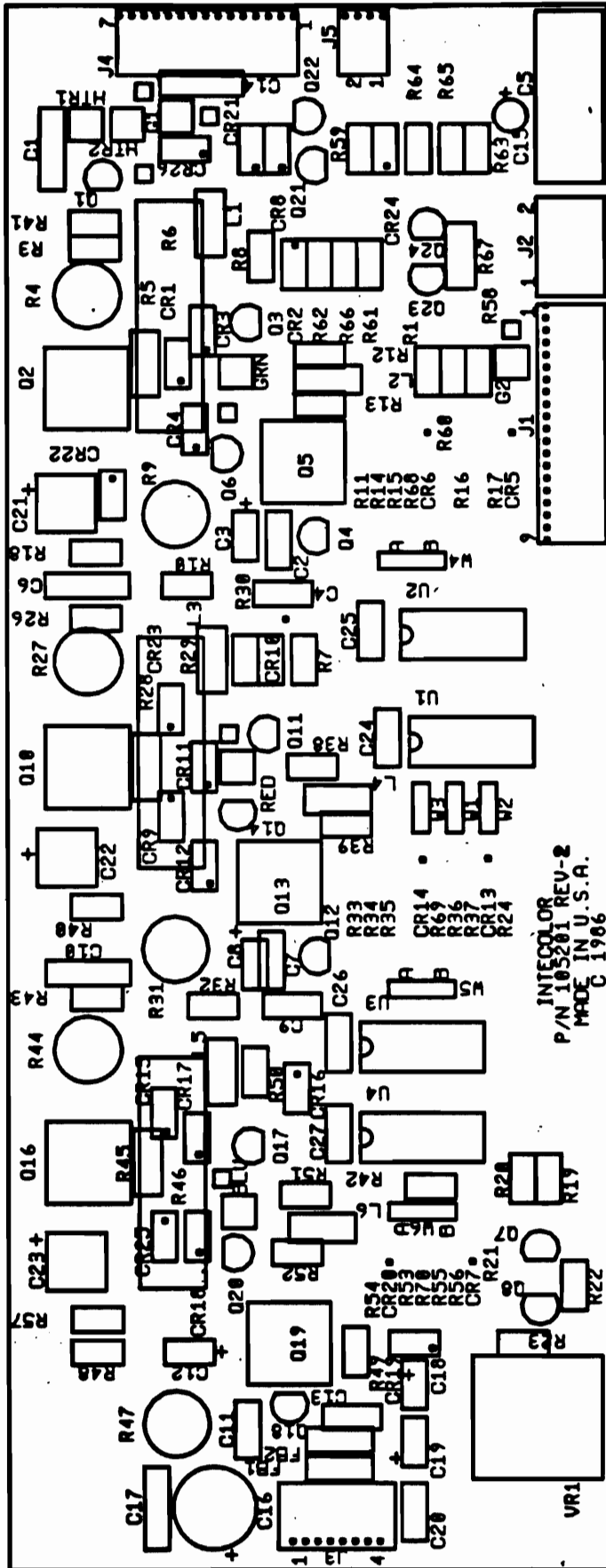
PCB P/N 105198 REV-1 AR-2 VIDEO
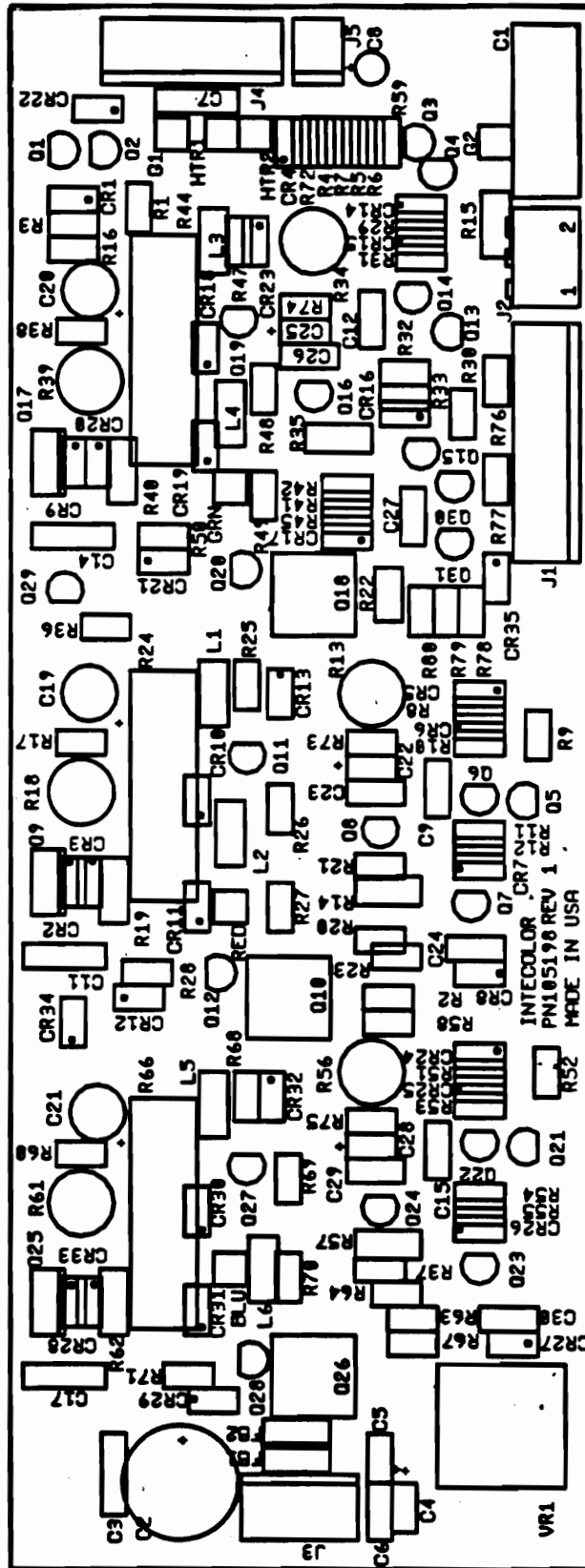
APPENDIX E
ANALOG BOARD BLOCK DIAGRAMS
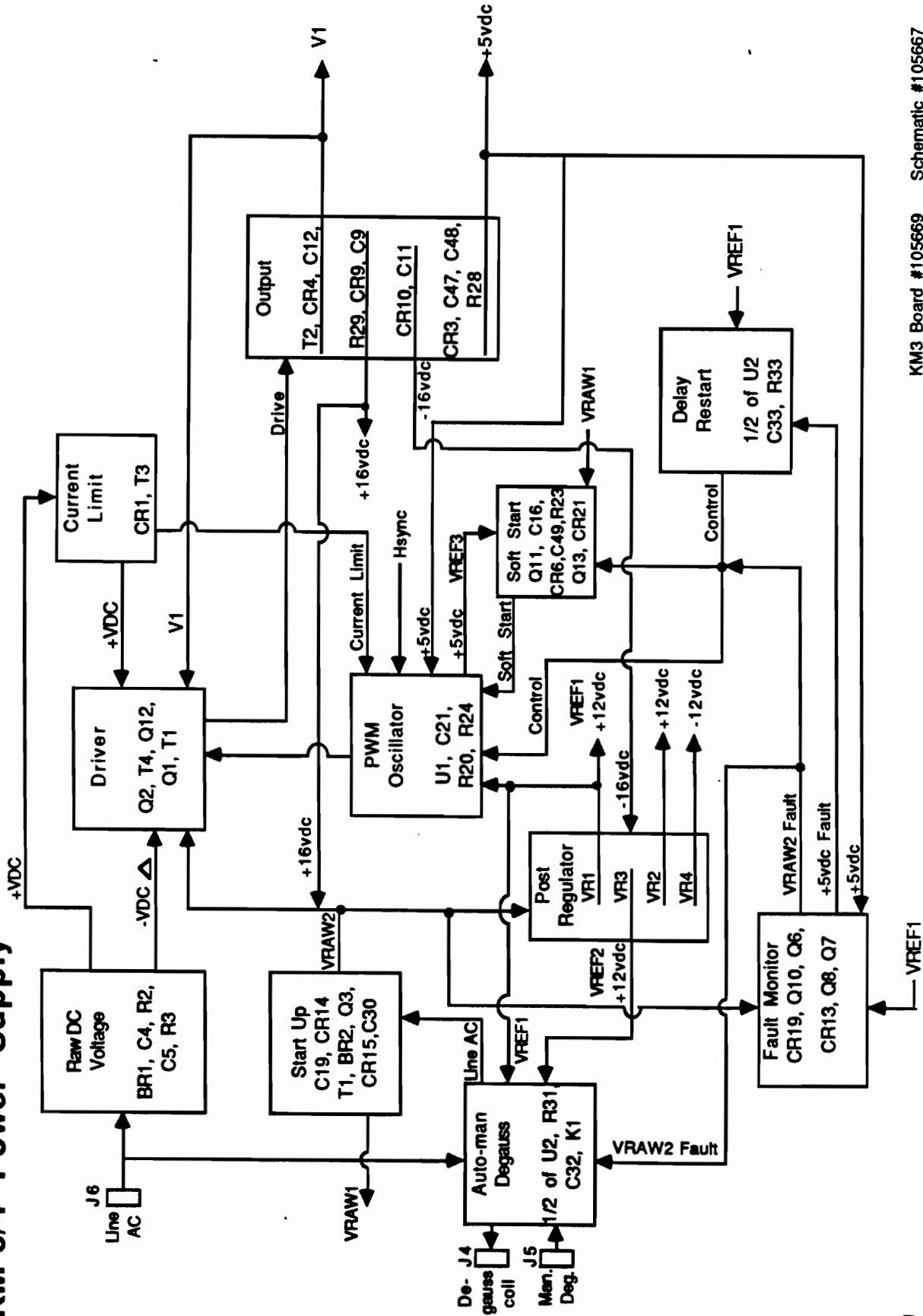
Block diagrams for each analog board described in the circuit description section of this addendum are provided.

3800/8800 Block Diagram

Keyboard

I/O Device

Logic Board

Interface Mother Board

Power Supply Board

Video Amplifier Board

Deflection Board

CRT

Sync Signals

Video

Logic Voltages

Sync Signals

Logic Voltages

AC In

Video Signals

Video Voltages

CRT and Video Voltages

ABL Sense Voltage

Deflection currents

High Voltage

Deflection Voltages

Sync Signals

CRT Voltages

Video

E.2
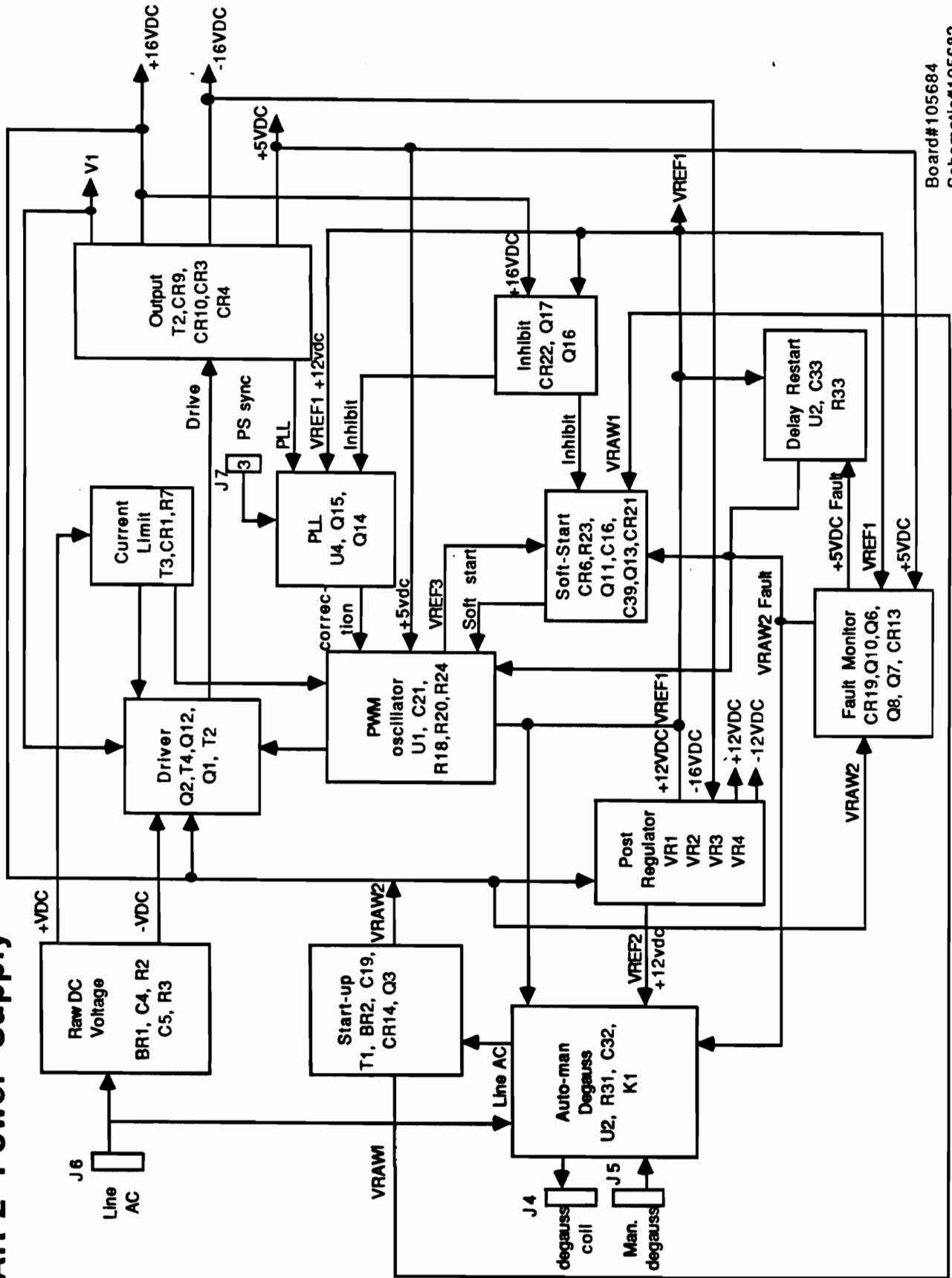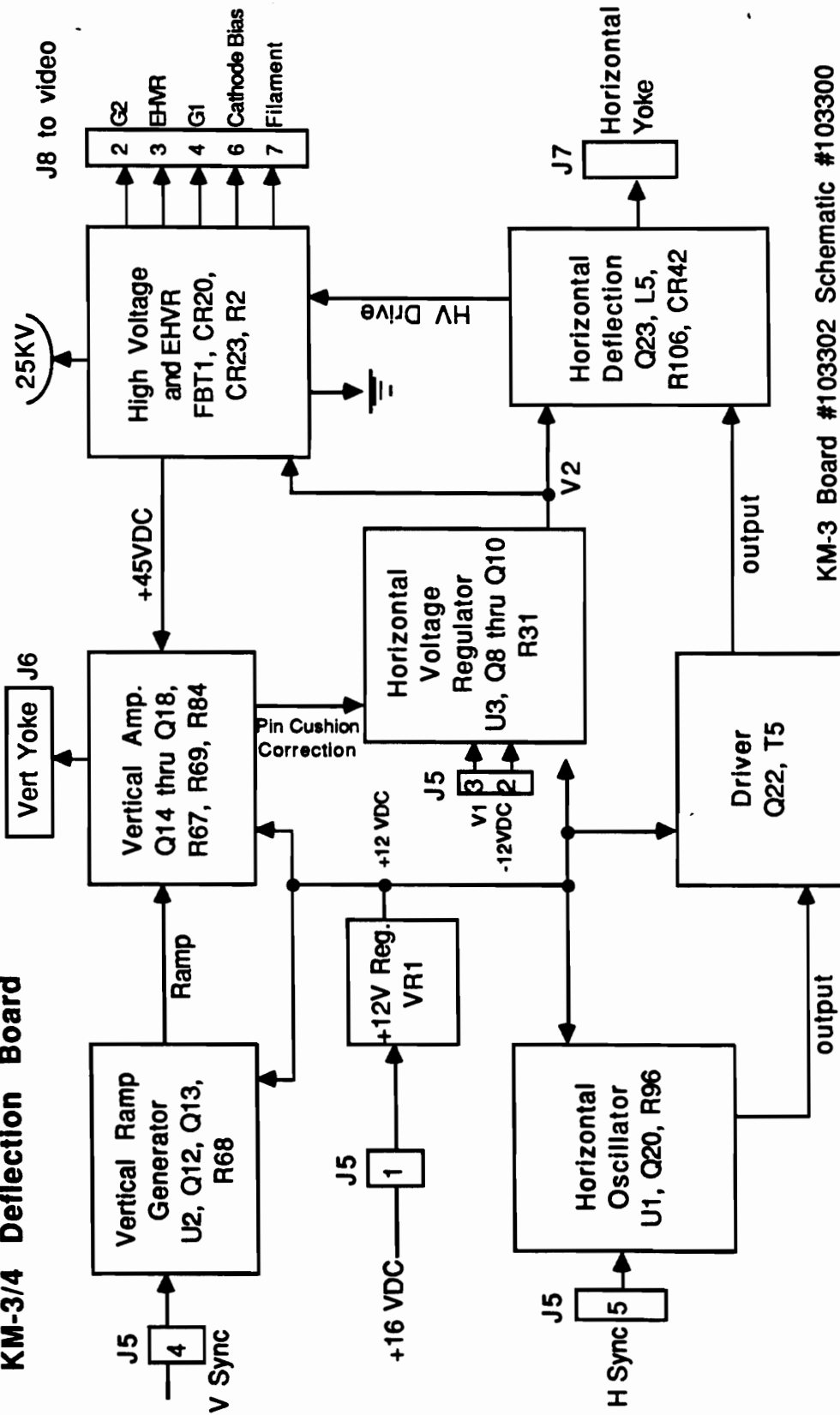
KM-3/4 Power Supply

KM3 Board #105669   Schematic #105667
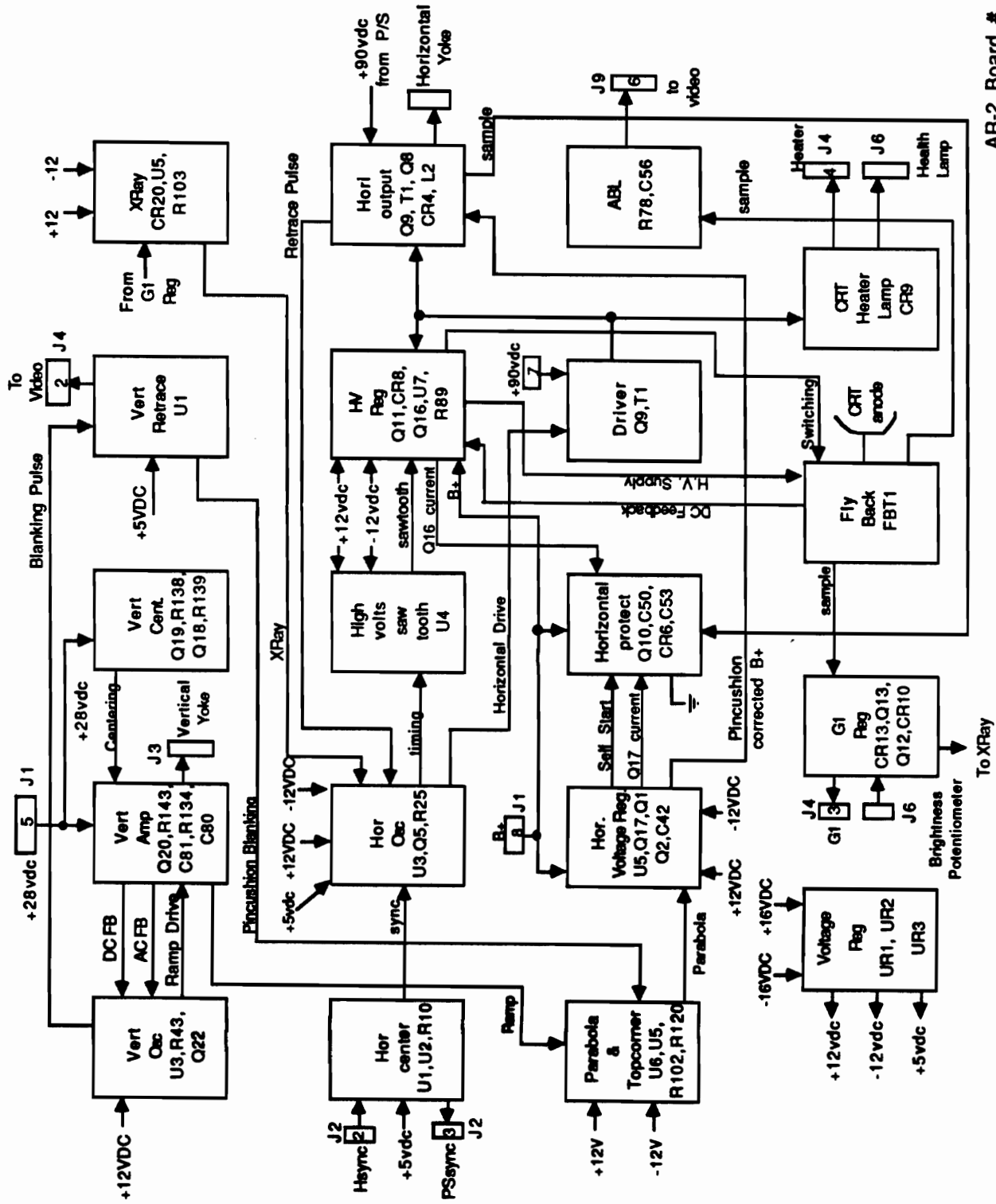KM4 Board #105766   Schematic #105764

E.3

AR-2 Power Supply

E.4

KM-3/4 Deflection Board

J8 to video

2	G2
3	EHVR
4	G1
6	Cathode Bias
7	Filament

High Voltage and EHVR FBT1, CR20, CR23, R2

25KV

Horizontal Deflection Q23, L5, R106, CR42

J7 Horizontal Yoke

HV Drive

+45VDC

Vertical Amp. Q14 thru Q18, R67, R69, R84

Vert Yoke J6

Horizontal Voltage Regulator U3, Q8 thru Q10 R31

V2

Pin Cushion Correction

J5 | 3 | v1
J5 | 2 | -12VDC

+12 VDC

Ramp

+12V Reg. VR1

Driver Q22, T5

output

J5 | 1

+16 VDC

Horizontal Oscillator U1, Q20, R96

output

J5 | 4

V Sync

J5 | 5
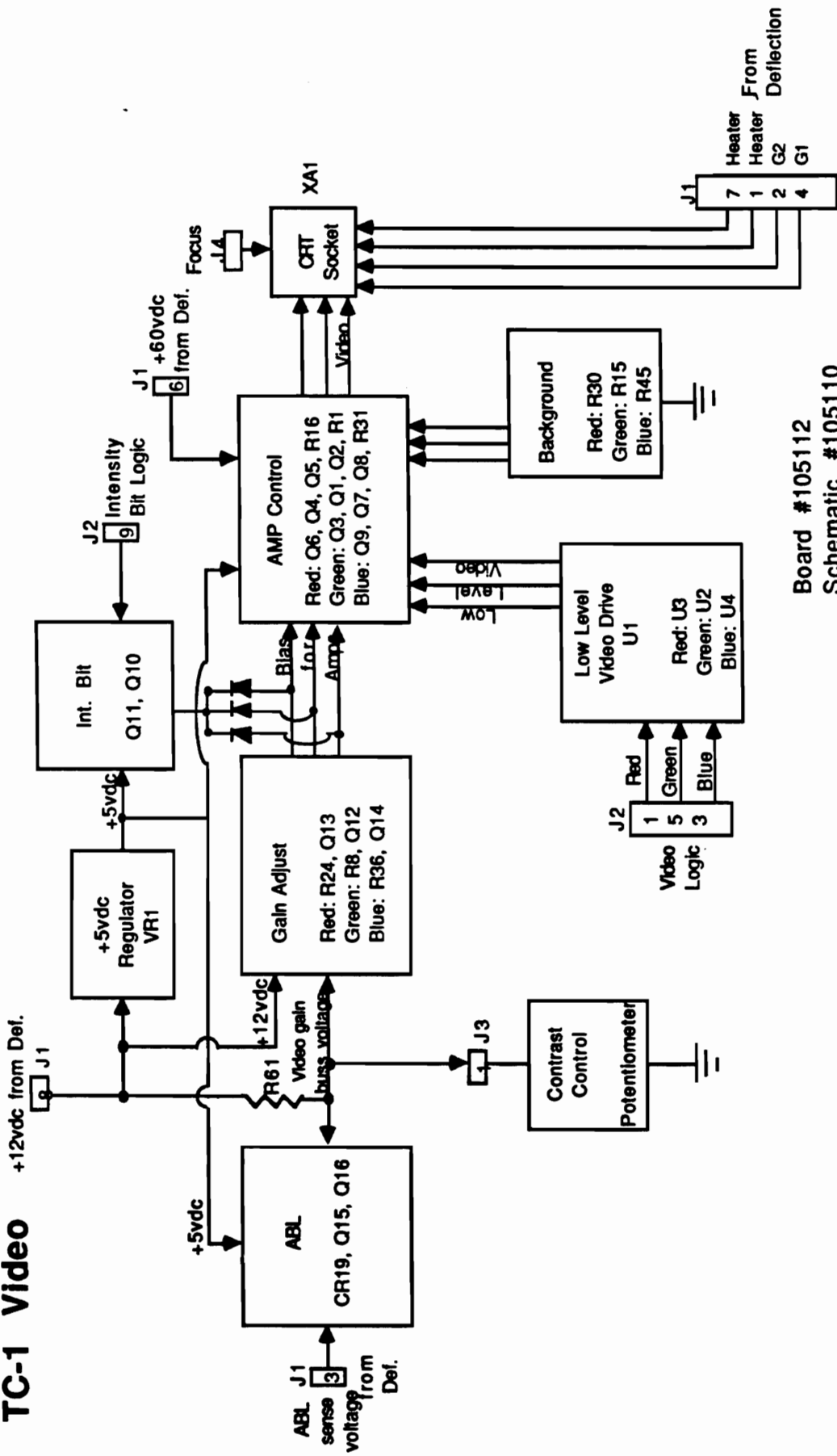
H Sync

Vertical Ramp Generator U2, Q12, Q13, R68

KM-3 Board #103302 Schematic #103300
KM-4 Board #105763 Schematic #105761

E.5

AR-2 Deflection Board
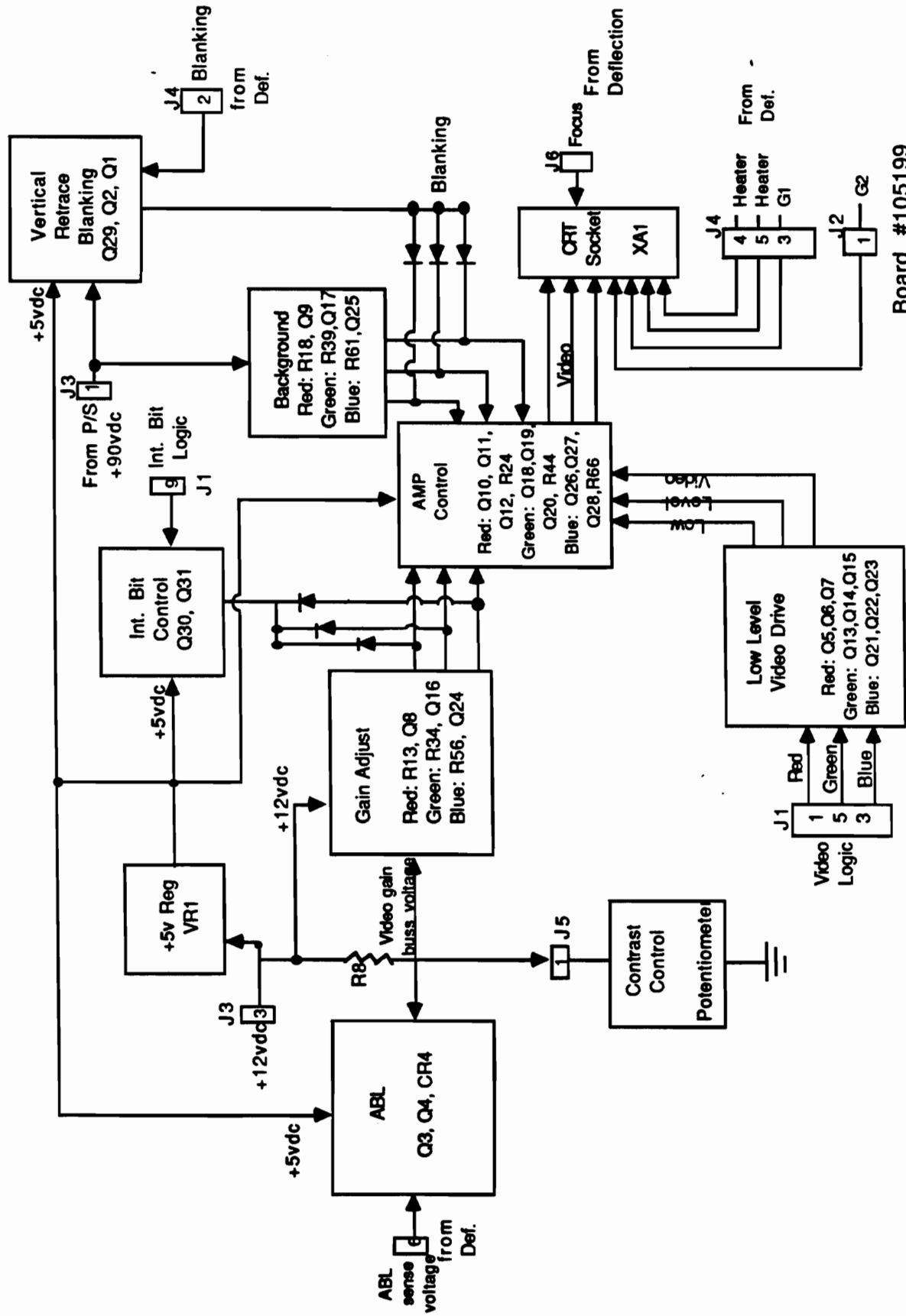

AR-2 Board # 105157
AR-2 Schematic # 105155

E.6

TC-1 Video

Board #105112
Schematic #105110

E.7

TC-3 Video

Blanking from Def.

J4 2

Vertical Retrace Blanking Q22, Q21, Q1

Blanking

J6 Focus

From Def.

CRT Socket XA1

Heater
Heater
G1

J4 4 5 3

J2 1 G2

+5vdc

From P/S
+90vdc

J3 1

Background
Red: R27, Q10
Green: R4, Q2
Blue: R44, Q16

Blanking
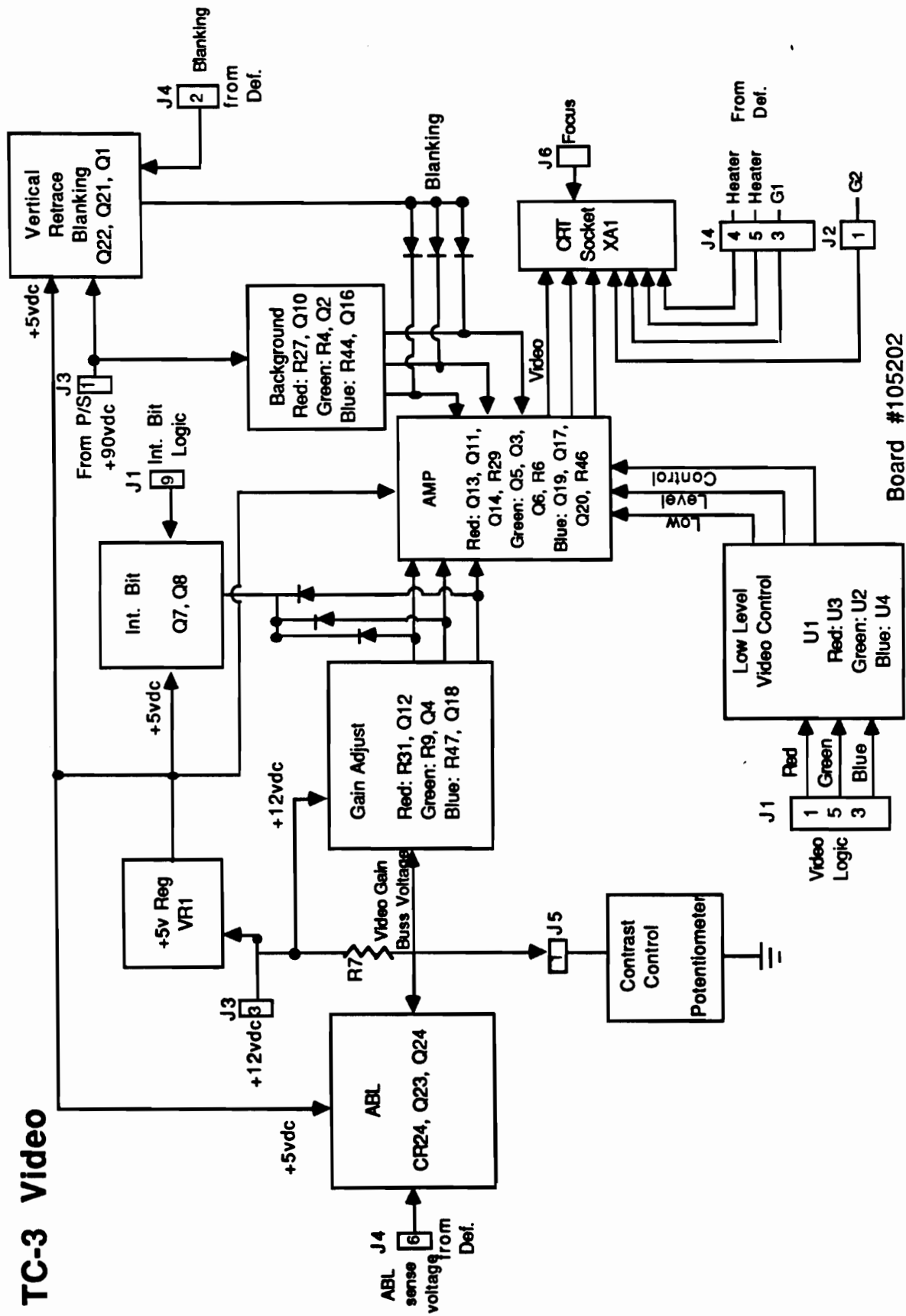
Video

Board #105202
Schematic #105200

J1 Int. Bit Logic 9

AMP

Red: Q13, Q11, Q14, R29
Green: Q5, Q3, Q6, R6
Blue: Q19, Q17, Q20, R46

Control

Level

Low

Int. Bit Q7, Q8

+5vdc

Low Level Video Control
U1
Red: U3
Green: U2
Blue: U4

Gain Adjust
Red: R31, Q12
Green: R9, Q4
Blue: R47, Q18

+12vdc

Red
Green
Blue

J1 1 5 3

Video Logic

+5v Reg VR1

+5vdc

Video Gain Buss Voltage

R7

J5

Contrast Control

Potentiometer

J3 3

+12vdc

ABL
CR24, Q23, Q24

+5vdc

ABL sense voltage

J4 6 from Def.

E.8

AR-2 Video