SECTION 17

REMOTE CONTROL

SUB-SECTIONS

ILLUSTRATIONS

SECTION 17

REMOTE CONTROL MODULE

17.1 TECHNICAL DESCRIPTION

17.1.1 General Description

The Remote Control module is located in the rear panel card rack. It includes most of the projectors system logic and control. The module consists of a microprocessor, read only memory, random access memory, input/output expanders and digital-to-analog converters. See Figure 17-1.

External inputs to the Remote Control module are: the projector's built-in keypad, a wired remote keypad, an infrared remote keypad or an IR Switcher's built-in keypad. Internal inputs include input module status.

Outputs from the Remote Control module are the microprocessor address and data buses, and analog and digital control voltages to control projector functions.

The microcontroller powers up when the +5 V standby power supply goes high. Power-on reset circuitry holds the microcontroller in the reset mode while the power supply and crystal oscillators stabilize.

In the reset mode, the microcontroller retrieves settings stored in memory and uses them in the initial set-up sequence. The microcontroller then enters a user-input monitoring mode. A POWER command from a keypad causes the microcontroller to turn the projector ON.

When the projector is ON, the microcontroller monitors all keypads and fault sensors. During normal operation, the microcontroller leaves monitoring mode when it receives a keypad command. The microcontroller returns to the monitoring mode within 10 seconds.

Each time the microcontroller enters the monitoring mode it starts a watchdog timer. The timer resets the microcontroller if monitoring does not begin within 45 seconds.

A POWER command, received during projector operation, causes the microcontroller to load the current projector settings into memory and turn the projector OFF.

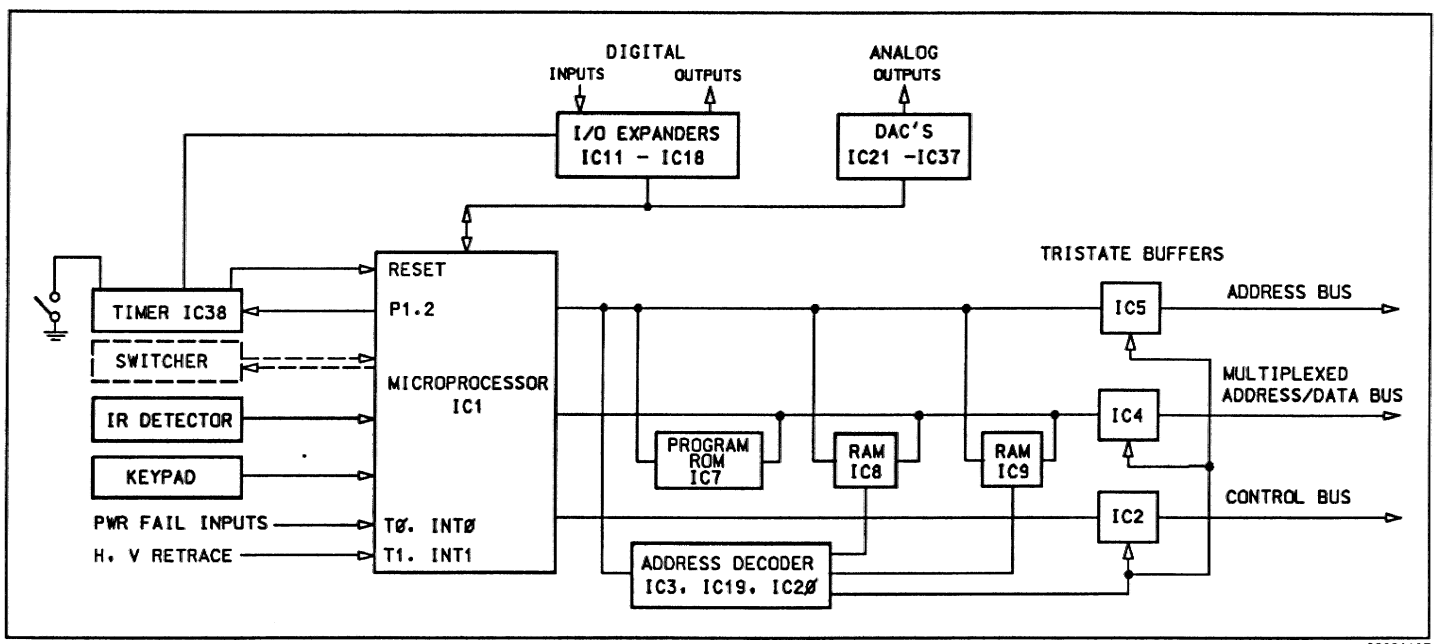

FIGURE 17-1. *Remote Control Module Block Diagram*

17.1.2 Circuit Description

17.1.2.1 Microcontroller.

When the projector is connected to AC power, the +5V standby power supply powers all critical microcontroller circuitry.

Reset Input.

a) During normal operation the reset input, pin 21 of edge connector PB1, is high.

b) IC22 provides power-on reset. Upon connection to AC, IC22 holds the reset input on IC21 high for about 1 second. During this period the microcontroller initializes.

c) IC21 continuously monitors the built-in keypad and the IR detector. An input from either device causes IC21 to leave the monitoring loop. It decodes and executes the command received, then returns to the monitoring loop.

d) During normal operation, the program is out of the monitoring loop for less than 10 seconds. A pulse from P1.2, pin 4, triggers timer IC13A each time the input monitor loop starts. IC13 is set for a 45 second delay, its output will remain high and the output of IC13B will remain low. If the program does not return to the monitoring loop, (i.e., the program crashes), IC13A does not trigger. Its output goes low, triggering IC13B. IC13B produces a 20 ms long inverted pulse and IC22 resets IC21.

e) A reset input for future expansion is provided on pin 21, row B.

External Interrupt Inputs

a) INT1, pin 15, monitors the vertical flyback. During vertical retrace, the vertical retrace pulse, connected to INT1 via tri-state buffer IC28, pulls INT1 low. This enables data transfer routines. During vertical scan, INT1 remains high and data transfer does not take place.

Timer Inputs

a) T0 monitors the +5 V supply line.

b) T1 input synchronizes the writing of the screen display characters to video memory and is used to measure vertical frequency.

Read and Write Strobes

a) The read strobe output connects to the 5 V standby supply through pull-up resistor RN9. Normally, it is high. During a data read, the read strobe goes low. This enables the data output lines of RAM ICs 26 and 29.

b) The read strobe also connects to pin 4 of bidirectional octal buffer IC28. During a data read, IC28 is set to receive data from the mother board. Side A is output and side B is input. During a data write, IC28 is set to send data to the bus. Side A is input and side B is output. The read strobe outputs to the mother board at pin 17, row B, through tri-state buffer IC28.

ALE Output

a) The ALE (address line enable) output and IC23 (tri-state octal latch) separate the lower 8 bits of address from the data on the address/data lines of IC21.

b) The ALE output connects to the system bus on the mother board through IC28 at pin 18, row B.

PSEN Output

a) The PSEN (program store enable) output enables the outputs of program ROM IC24 and IC25.

Address/Data Lines

a) Port 0 of IC21 is an 8 bit, bi-directional port. It connects to RN8, an external pull-up resistor network.

b) During data transfer, Port 0 either outputs the lower 8 bits of address, or receives or sends data. The ALE output indicates if Port 0 has address or data.

c) Port 2 of IC21, outputs the higher 8 bits of address. It connects directly to the address bus.

Serial I/O Port

a) The projector can communicate with an IR Switcher through the serial I/O port. The RXD input at pin 1 is the receive line. The TXD output at pin 11 is the transmit line. IC27 buffers the port.

Interface Port

a) Port 1 is the main interface to the projector.

b) P1.7 monitors the IR receiver. The IR receiver is connected to it through inverter IC27. P1.6 monitors the keypad via inverter IC27.

c) P1.5 is a serial clock output. The port expanders and the DACs use it. Serial data input, P1.4, connects the port expanders to the DACs.

d) Output P1.2, provides pulses for the watchdog timer.

e) P1.0, programmed as an output, enables the MENU.

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17.1.2.2 Memories

The remote control module contains 4 memories: IC24, IC25, IC26 (64K byte EPROMs) and IC29 (a 32K byte static CMOS RAM). IC24 and IC25 store the system program. IC26 stores the menu data. IC29 (32K battery-backed DS1235Y) stores projector settings when the projector is turned OFF.

17.1.2.3 Memory Address Space Allocation

The PSEN output of microcontroller IC21 enables program ROM (IC24 and IC25) during read cycles.

ICs 19, 20 and 27 are the address decoder. The address decoder enables the battery-backed RAM (IC29) if the address location is 0 to 24K. It selects the mother board address bus if the address location is 24K to 64K.

17.1.2.4 I/O Expanders

I/O expanders IC14, IC30, IC31 and IC32 communicate with the microcontroller through the SDA (serial data access) line. The SDA connects to P1.4 on IC21. Clock pulses from the microcontroller, received at the SCL (serial clock) input, cause data to transfer between the I/O expanders and IC21.

I/O expanders are address encoded using the A0, A1 and A2 inputs. IC30 encodes as #4, IC31 as #5, IC32 as #6 and IC14 as #7. The address of an expander and it's mode of operation are serially transferred on the SDA line.

IC30 and IC31, along with inverting bi-directional buffers IC35 and IC36, monitor the status of the seven input slots. They determine slots occupied by input cards.

IC31 outputs the horizontal and vertical automatic/ manual locking control functions. The DAC output from IC30 provides projector identification. IC32 and inverting buffer IC33, output seven digital control voltages. IC32 also outputs direction control to IC35 and IC36.

17.1.2.5 Digital-to-Analog Converters (DACs)

Digital-to-analog converters IC15, IC16, IC17 and IC18 receive digital information from the SDA line of the system bus. DAC select, DAC output select, and data signals from microcontroller IC21 are serially transmitted to each DAC. The A0, A1 and A2 lines on the system bus encode IC15 as #3, IC16 as #2, IC18 as #1 and IC17 as #0. The DACs provide control voltages for the projector.

The eight outputs of IC15 are paired, loaded by resistors, and amplified by non-inverting operational amplifiers IC1 and IC5. The HORIZ HOLD output has a range of 0 to 10 V, all other outputs have a range of ±10 V.

Six outputs of IC16 are paired. IC3, IC4 and IC6 weigh and amplify each pair. The pairs provide double precision analog outputs with a ±10 V range. IC6 buffers the remaining two outputs. These outputs provide single precision (64 step) analog outputs with a 0 to 10 V range.

IC2, IC3, IC6, IC9, IC10, IC11 and IC12 amplify the outputs of IC17 and IC18. They provide single precision analog outputs. The range of BOW, KEYSTONE, PIN TOP, PIN BOT, PIN SIDE and DACOUT outputs is ±10V. The range of the remaining outputs is from 0 to 10V.

All analog outputs connect to the mother board.

17.2 SERVICING AND ALIGNMENT

17.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.

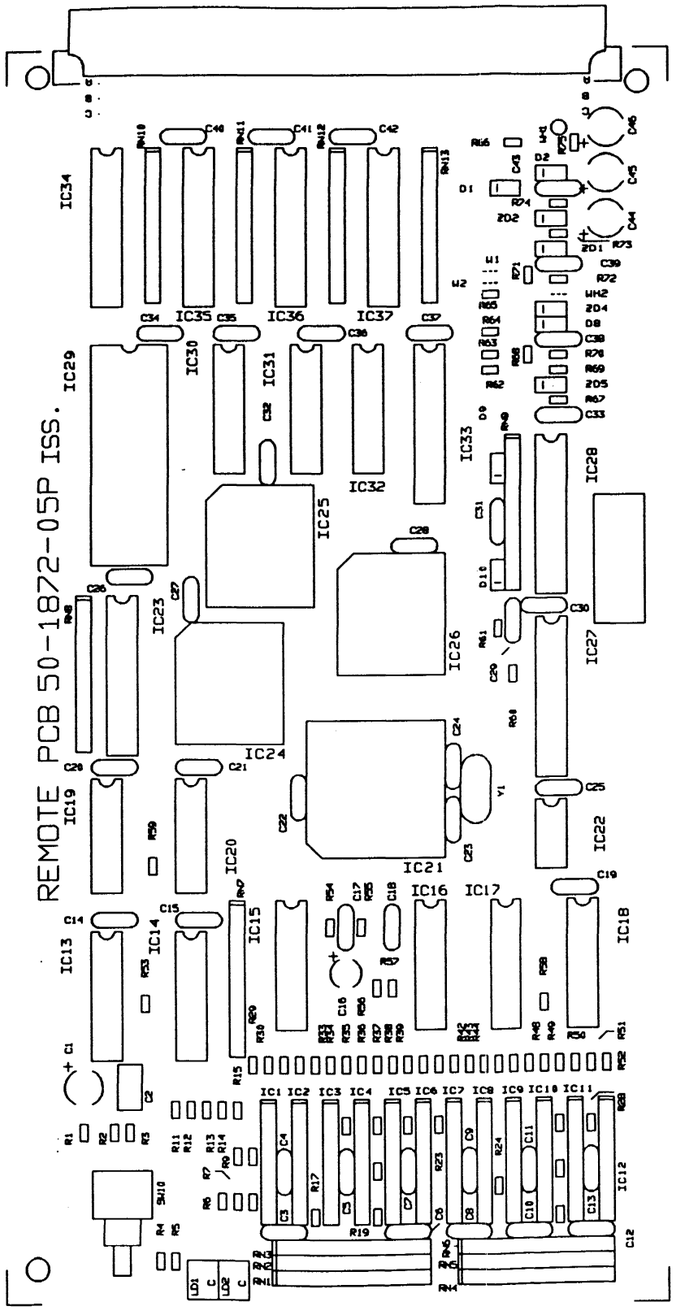
b) Locate the Remote Control module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack (as described in Section 5).

17.2.2 Alignment

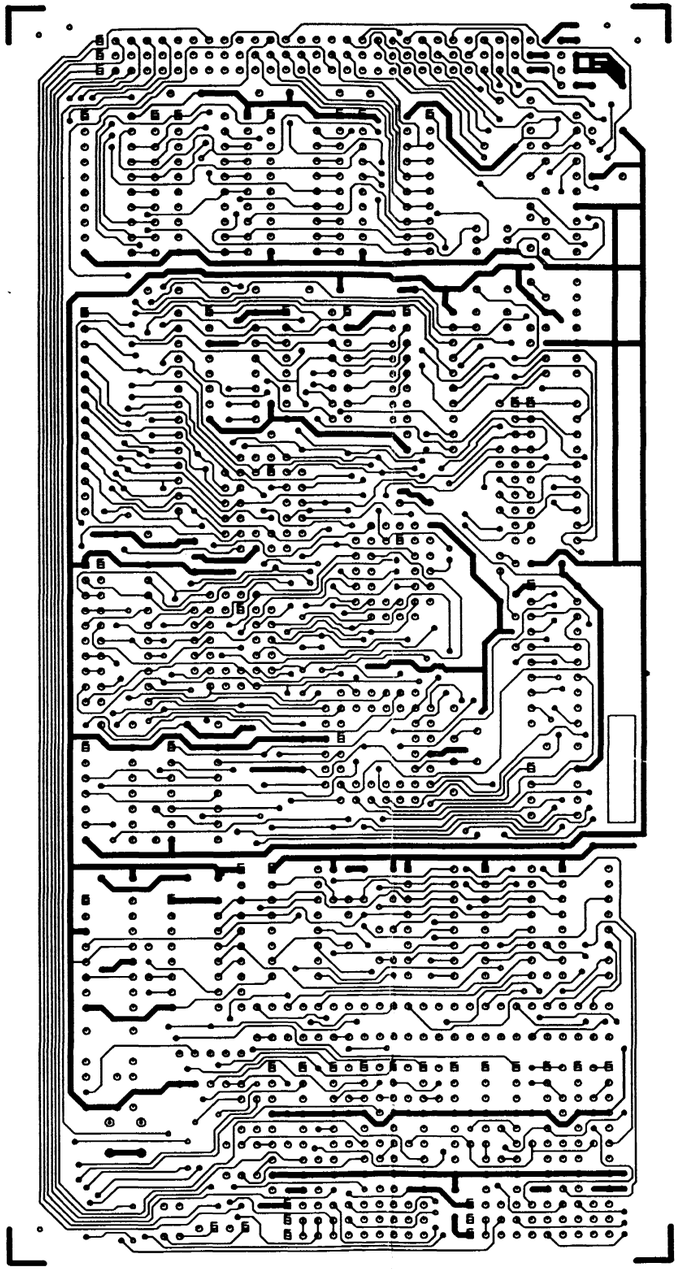
The Remote Control Module is adjusted/aligned during the Raster Centering procedure. Refer to Section 7.1.

17.3 COMPONENT LAYOUT AND SCHEMATICS

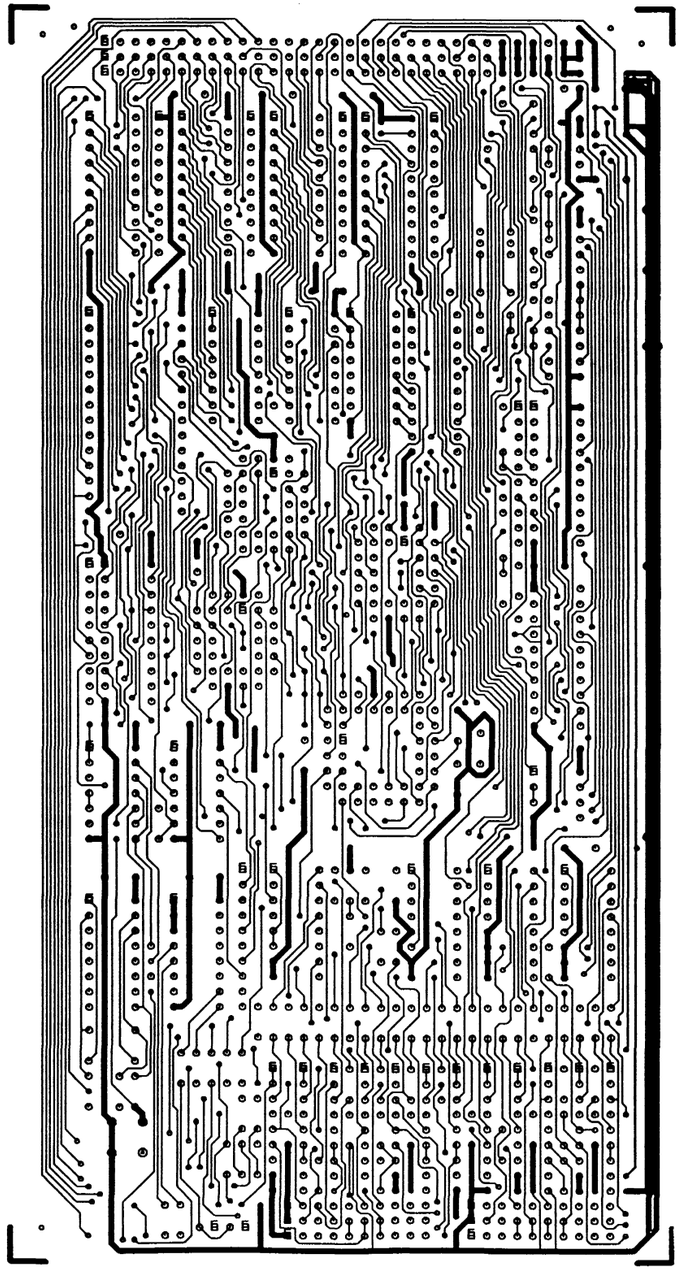
Refer to the following pages.



Component Layout



Solder Side
(Viewed from Component Side)



Component Side

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FIGURE 17-2. *Remote Control Module Component Layout*

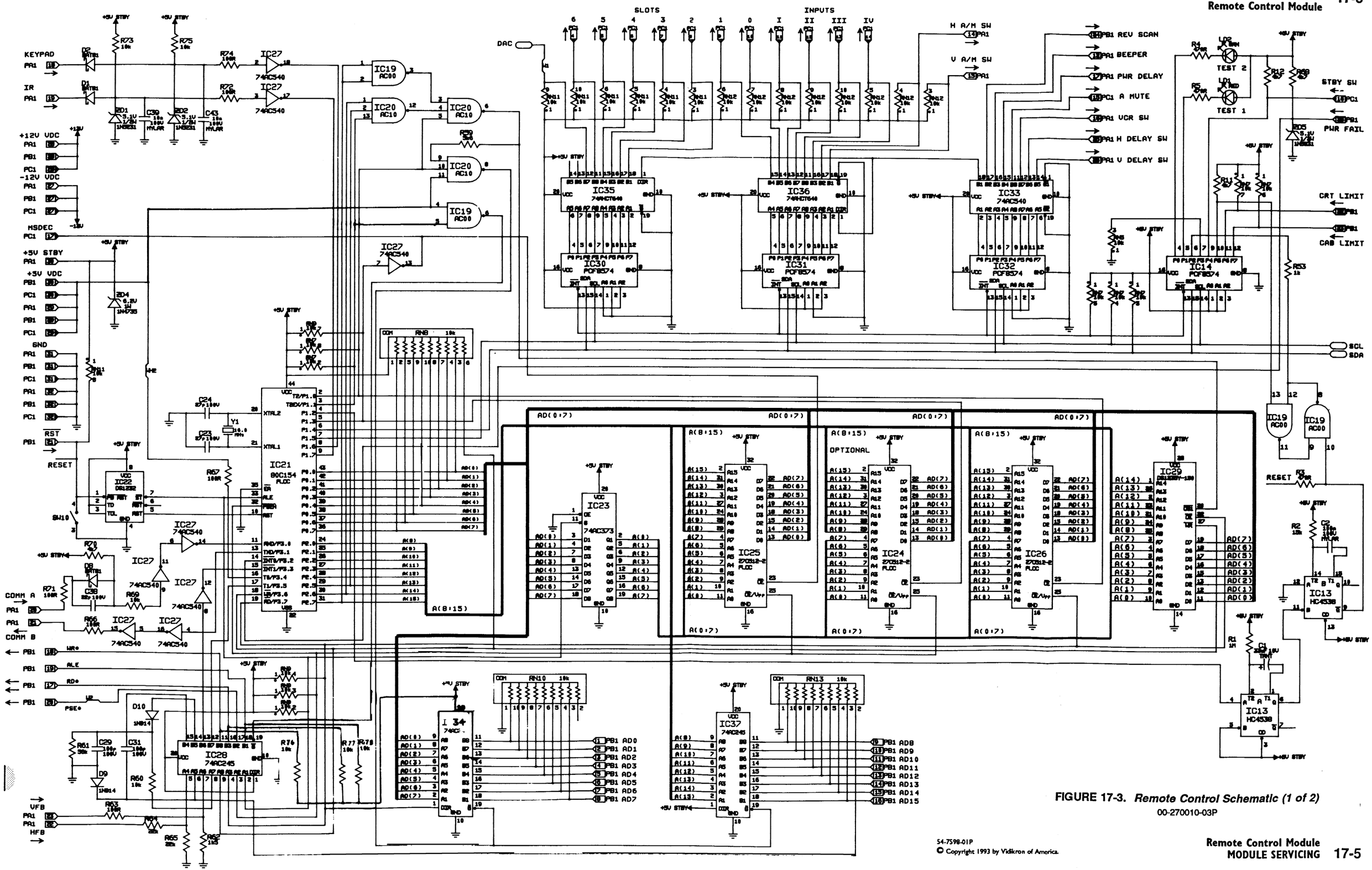

FIGURE 17-3. *Remote Control Schematic (1 of 2)*
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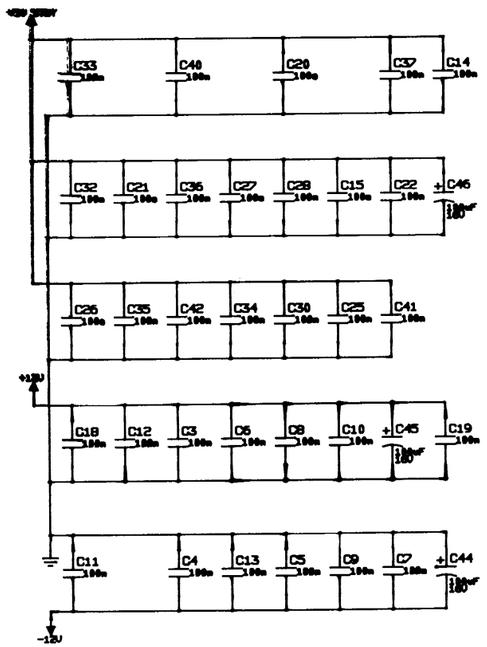

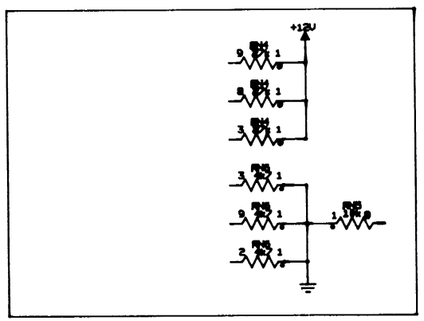

LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR µ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

IMPLICIT POWER CONNECTIONS

IC#	NAME	PIN#	POWER	PIN#	POWER
1	M5216L	4	-12V	8	+12V
2	M5216L	4	-12V	8	+12V
3	M5216L	4	-12V	8	+12V
4	M5216L	4	-12V	8	+12V
5	M5216L	4	-12V	8	+12V
6	M5216L	4	-12V	8	+12V
7	M5216L	4	-12V	8	+12V
8	M5216L	4	-12V	8	+12V

IMPLICIT POWER CONNECTIONS

IC#	NAME	PIN#	POWER	PIN#	POWER
9	M5216L	4	-12V	8	+12V
10	M5216L	4	-12V	8	+12V
11	M5216L	4	-12V	8	+12V
12	M5216L	4	-12V	8	+12V
13	74HC4538	8	GND	16	+5V STBY
19	74AC00	7	GND	14	+5V STBY
20	74AC10	7	GND	14	+5V STBY
27	74AC540	10	GND	20	+5V STBY

FIGURE 17-4. *Remote Control Schematic (2 of 2)*
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17.4 PARTS LIST

⚠ - CRITICAL SAFETY COMPONENT
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
Integrated Circuits		
IC1-IC12	IC-14-002836-01P	M5216L, dual large current op amp
IC13	IC-14-A04041-01P	MM14538B, CMOS, precision dual monostable
IC14,IC30-IC32	IC-14-A03036-01P	PCF8574, 8-bit I/O expander
IC15-IC18	IC-14-A03037-01P	TDA8444, octal 6 bit DAC
IC19	IC-14-A04074-02P	74AC00, 2 input nand
IC20	IC-14-A04085-01P	74AC10, 3 input nand
IC21	IC-14-A06011-01P	80C154, 16MHz microcontroller
IC22	IC-14-004702-01P	DS1232, micro monitor
IC23	IC-14-A04010-02P	74AC373, octal latch
IC24	IC-14-P01024-01P	27C512-170FM, 64KX8UV, EPROM, programmed, V3.1
IC25	IC-14-P01025-01P	27C512-170FM, 64KX8UV, EPROM, programmed, V3.1
IC26	IC-14-P01026-01P	27C512-170FM, 64KX8UV, EPROM, programmed, V3.1
IC27,IC33	IC-14-A04065-02P	74AC540, octal tri-state inverter/driver
IC28,IC34,IC37	IC-14-A04055-02P	74AC245, octal bi-directional transceiver
IC29	IC-14-A05045-03P	DS1230Y-150, SRAM, non volatile
IC35,IC36	IC-14-A04076-01P	74AHCT, octal bus tranc, tri-state
Transistors & Diodes		
D1,D2,D8	D-14-000533-01P	BAT81, Schottky barrier diode
D9,D10	D-14-000513-01P	1N914, diode, 0.075A, 75V
LD1	LED-14-001016-02P	LED, 3V, 0.09A, red
LD2	LED-14-001016-01P	LED, 3V, 0.09A, green
ZD1,ZD2,ZD5	DZ-14-000515-98P	1N5231, zener diode, 5.1V, 1/2W, 2%, T
ZD4	DZ-14-000531-38P	1N4735A, 6.2V ZENER, 5%, 1W
Capacitors		
C1	C-84-233138-01P	33 μF, 10V, tantalum
C2	C-88-171041-02P	100 nF, 100V, 10%, mylar
C3-C15,C17-C22, C25-C28,C30,C32-C37, C40-C42	C-89-000032-03P	100 nF, 50V, 20%, ceramic, multi layer
C16	C-84-410004-01P	10 μF, 25V, electolytic
C23,C24	C-86-627032-04P	27pF, 100V, ceramic
C29,C31	C-86-610134-04P	100 pF, 100V, NPO, ceramic
C38	C-86-622032-04P	22pF, 100V, ceramic
C39,C43	C-88-171031-12P	10 nF, 100V box type, mylar
C44-C46	C-84-410104-03P	100 μF, 25V, electolytic
Resistors		
R1,R2	R-80-110045-11P	1M, 1/2W, 5%, metal film
R3-R5	R-80-147005-11P	470R, 1/2W, 5%, metal film
R6-R8,R13,R17,R19, R24-R28	80-124025-11P	24K, 1/2W, 5%, metal film
R9,R10,R20,R58,R63, R66,R67,R71,R72,R74	R-80-110005-11P	100R, 1/2W, 5%, metal film

17.4 PARTS LIST (cont.)

⚠ - CRITICAL SAFETY COMPONENT
(REPLACE WITH IDENTICAL PART)

Item Ref.	Part No.	Description
Resistors (cont.)		
R11,R12,R15,R18, R30-R33,R35,R37-R52, R56,R68,R70	R-80-147015-11P	4.7K, 1/2W, 5%, metal film
R14,R21-R23,R29,R34, R36,R57	R-80-130035-11P	300K, 1/2W, 5%, metal film
R53	R-80-110015-11P	1K, 1/2W, 5%, metal film
R54	R-80-120015-11P	2K, 1/2W, 5%, metal film
R55,R60,R64,R65,R69, R73,R75-R78	R-80-110025-11P	10K, 1/2W, 5%, metal film
R59	R-80-156015-11P	5.6K, 1/2W, 5%, metal film
R61	R-80-156025-11P	56K, 1/2W, 5%, metal film
R62	R-80-115015-11P	1.5K, 1/2W, 5%, metal film
RN1,RN4	RN-43-000053-03P	27K, 10 pin, resistor network
RN2,RN5,RN7-RN13	RN-43-000053-02P	10K, 10 pin, resistor network
RN3,RN6	RN-43-000053-01P	4.7K, 10 pin, resistor network
Miscellaneous		
SW10	SW-26-000343-01P	switch, momentary contact
Y1	XTL-37-000020-04P	crystal, 16.0 MHz

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17.5 SPECIFICATIONS

Connector P1, Row A:

Pin 1 . . . . . analog output, **H HOLD**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 2 . . . . . analog output, **V HOLD**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 3 . . . . . analog output, **BV CENT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 4 . . . . . analog output, **BH CENT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 5 . . . . . analog output, **RV CENT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 6 . . . . . analog output, **RH CENT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 7 . . . . . analog output, **GV CENT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 8 . . . . . analog output, **GH CENT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 9 . . . . . analog output, **H PHASE**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 12 bit signal

Pin 10 . . . . . analog output, **V PHASE**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 11 . . . . . analog output, **ELEC FOCUS**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 12 . . . . . digital output, **BEEPER**
signal level . . . . . 0 to 5 VDC ±10%
NOTE: 6 bit signal

Pin 14 . . . . . analog output, **H A/M SW**
signal level . . . . . 0 to 5 VDC ±10%

Pin 15 . . . . . analog output, **V A/M SW**
signal level . . . . . 0 to 5 VDC ±10%

Pin 16 . . . . . analog output, **VCR SW**
signal level . . . . . 0 to 5 VDC ±10%

Pin 17 . . . . . output, **PWR RELAY**
signal level . . . . . 0 to 5 VDC ±10%

Pin 18 . . . . . digital input, **KEYPAD**
signal level . . . . . 0 to 12V ±10%

Pin 19 . . . . . digital input, **IR**
signal level . . . . . 0 to 12V ±10%

Pin 20 . . . . . digital input, **COMM A**
signal level . . . . . 0 to 5V

Pin 21 . . . . . digital output, **COMM B**
signal level . . . . . 0 to 5V ±10%

Pin 22 . . . . . digital input, **HFB**
signal level . . . . . 0 to 12V

Pin 23 . . . . . digital input, **VFB**
signal level . . . . . 0 to 5V

Pin 24 . . . . . output, **DACOUT1**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 25 . . . . . digital output, **H DELAY SW**
signal level . . . . . 0 to 5 VDC ±10%

Pin 26 . . . . . digital output, **V DELAY SW**
signal level . . . . . 0 to 5 VDC ±10%

Pin 27 . . . . . -12V power supply **-12VDC**
current level . . . . . 300 mA max

Pin 28 . . . . . +12V power supply **+12VDC**
current level . . . . . 350 mA max

Pin 29 . . . . . +5V power supply **+5VDC**
current level . . . . . 80 μA max

Pin 30 . . . . . +5V power supply **+5V STBY**
current level . . . . . 300 mA max

Connector P1, Row B:

NOTE: pins 1 through 7 are multiplexed data/ lower byte address bus

Pin 1 . . . . . digital in/output, **AD(0)** LSB
Pin 2 . . . . . digital in/output, **AD(1)**
Pin 3 . . . . . digital in/output, **AD(2)**
Pin 4 . . . . . digital in/output, **AD(3)**
Pin 5 . . . . . digital in/output, **AD(4)**
Pin 6 . . . . . digital in/output, **AD(5)**
Pin 7 . . . . . digital in/output, **AD(6)**
Pin 8 . . . . . digital in/output, **AD(7)** MSB

Connector P1, Row B: (cont.)

NOTE: pins 9 through 16 are the upper byte address bus
Pin 9 . . . . . digital input, **AD(8)** LSB
Pin 10 . . . . . digital input, **AD(9)**
Pin 11 . . . . . digital input, **AD(10)**
Pin 12 . . . . . digital input, **AD(11)**
Pin 13 . . . . . digital input, **AD(12)**
Pin 14 . . . . . digital input, **AD(13)**
Pin 15 . . . . . digital input, **AD(14)**
Pin 16 . . . . . digital input, **AD(15)** MSB

Pin 17 . . . . . digital input, $\overline{\textbf{RD}}$
NOTE: Read Signal

Pin 18 . . . . . digital input, $\overline{\textbf{WR}}$
NOTE: Write Signal

Pin 19 . . . . . digital input, **ALE**
NOTE: Address Latch Enable

Pin 20 . . . . . digital output, $\overline{\textbf{PSE}}$

Pin 21 . . . . . digital output, **RST**
Pin 22 . . . . . digital input, **CRT LIMIT**
Pin 23 . . . . . digital input, **CAB LIMIT**
Pin 24 . . . . . digital output, **REV SCAN**
Pin 25 . . . . . digital input, **PWR FAIL**
Pin 26 . . . . . digital output, **DACOUT2**

Connector P1, Row C:

Pin 1 . . . . . analog output, **COLOR**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 2 . . . . . analog output, **TINT**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 3 . . . . . analog output, **DETAIL**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 4 . . . . . digital output, **SLOT 6**
signal level . . . . . 0 to 5 VDC ±10%

Pin 5 . . . . . digital output, **SLOT 5**
signal level . . . . . 0 to 5 VDC ±10%

Pin 6 . . . . . digital output, **SLOT 4**
signal level . . . . . 0 to 5 VDC ±10%

Pin 7 . . . . . digital output, **SLOT 3**
signal level . . . . . 0 to 5 VDC ±10%

Pin 8 . . . . . digital output, **SLOT 2**
signal level . . . . . 0 to 5 VDC ±10%

Pin 9 . . . . . digital output, **SLOT 1**
signal level . . . . . 0 to 5 VDC ±10%

Pin 10 . . . . . digital output, **SLOT 0**
signal level . . . . . 0 to 5 VDC ±10%

Pin 11 . . . . . digital output, **INPUT I**
signal level . . . . . 0 to 5 VDC ±10%

Pin 12 . . . . . digital output, **INPUT II**
signal level . . . . . 0 to 5 VDC ±10%

Pin 13 . . . . . digital output, **INPUT III**
signal level . . . . . 0 to 5 VDC ±10%

Pin 14 . . . . . digital output, **INPUT IV**
signal level . . . . . 0 to 5 VDC ±10%

Pin 15 . . . . . digital output, **A MUTE**
signal level . . . . . 0 to 5 VDC ±10%

Pin 18 . . . . . analog output, **H SIZE**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 19 . . . . . analog output, **V SIZE**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 20 . . . . . analog output, **PIN TOP**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 21 . . . . . analog output, **PIN BOT**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 22 . . . . . analog output, **PIN SIDE**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 23 . . . . . analog output, **BOW**
signal level . . . . . -10 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 24 . . . . . analog output, **CONTRAST**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 25 . . . . . analog output, **BRIGHT**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

Pin 26 . . . . . analog output, **VOLUME**
signal level . . . . . 0 to 10 VDC ±10%
NOTE: 6 bit signal

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