

I. AUTOMATA

OVERVIEW

Theater of Hybrid Automata is a multimedia presentation. First constructed in 1990, it comprises two subsystems: (1) a tubular steel frame structure, approximately 10 feet on a side, with a centrally located roll/pan/tilt (RPT) head, a video camera, targets, lights and speakers; and (2) a separate console containing various electronic equipment. It operates in a pre-programmed, non-interactive, mode. The frame subsystem setup is shown in Figure I-1.

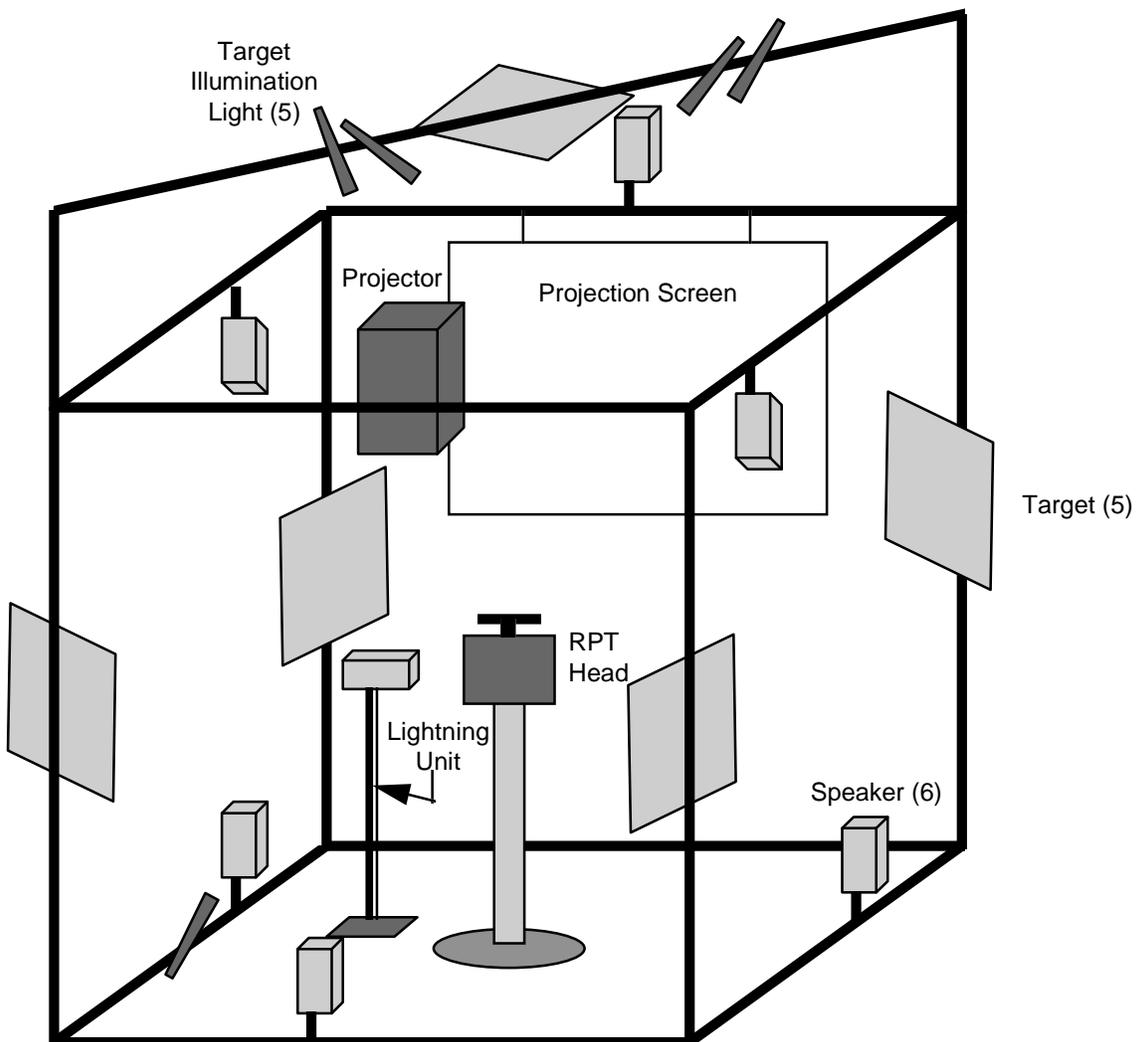


Fig. I-1. Theater of Hybrid Automata Setup

The Automata console is shown schematically in Figure I-2.

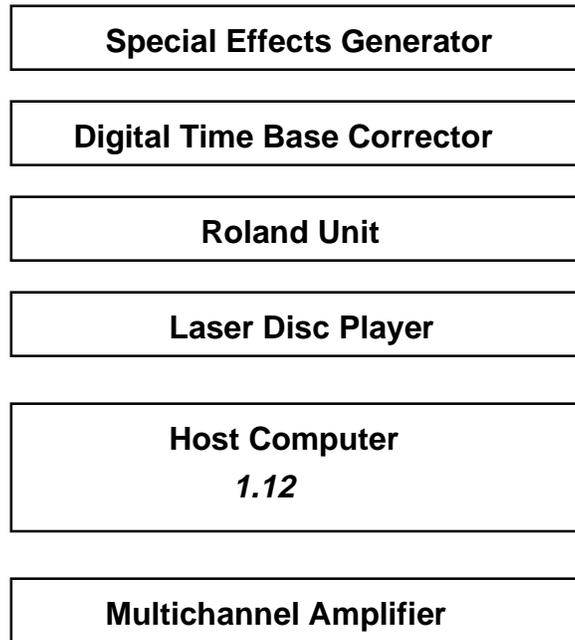


Fig. I-2. Electronics Console Setup

The electronic components are listed in Table I-1. A block electrical diagram of the system is given in Figure I-3.

Table I-1. AUTOMATA EQUIPMENT LIST

ITEM	DESCRIPTION
Special Effects Generator	Panasonic WJ-4600C
Digital Time Base Corrector	FOR.A Model FA-400
Digital Sampler	Roland Mod. S-330
Laser Disc Player	Pioneer Laser Vision Player LD-V8000 Ser. No. JH3904327
Host Computer	Custom -built
Camera Power Supply	Sony CMA-D1
Power Supply	Lambda
Multichannel Amplifier	RANE Model MA-6
Voice Box	MicroDyn II Speech Processing System
Speaker	Sony 2-way
Speakers (6)	JBL 2-way
Projector	SHARP LCD, Mod. XG-2000U, 105-210 mm Zoom lens, 1:4.5, Ser. No. 312922
Lightning Unit	Lightning Mod. 900, Ser. No. 1048
Video Camera	Sony CCD Mod. DCX-101, Ser. No. 12436
Stepper Driver	Custom-built
Light Controller	Custom-built
Transformer Bank	Custom-built
RPT Head	Custom-built

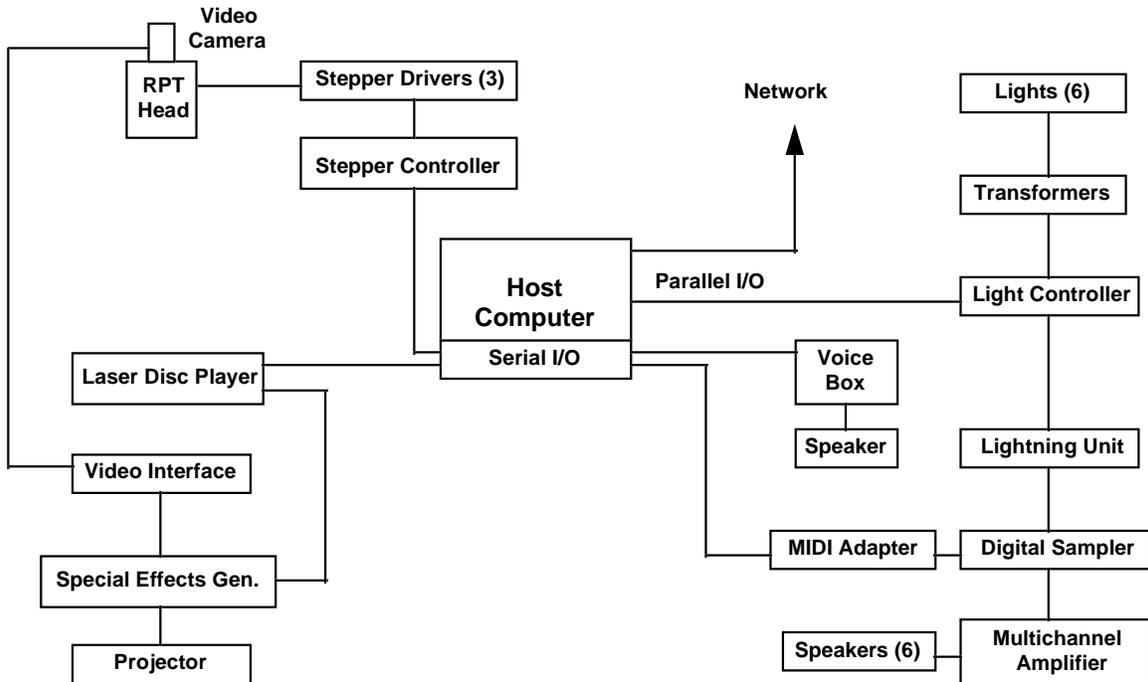


Fig. I-3. System Block Electrical Diagram

VIDEO DISPLAY

The video component of the presentation is provided by the combination of a prerecorded laser disc and the camera mounted on the RPT head. The mixed signals are then transmitted to the projector for projection onto the screen. The RPT camera can view each of the five targets as well as the display on the Lightning unit.

The RPT camera output is fed to the FA-400 Digital Time Base Corrector, shown just below the Special Effects Generator (SEG) in Figure I-4(a).

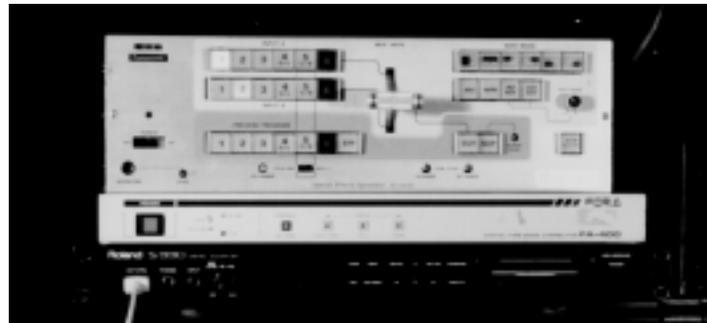


Fig. I-4(a) SEG and FA-400

The FA-400 back panel is shown schematically in Figure I-4(b).

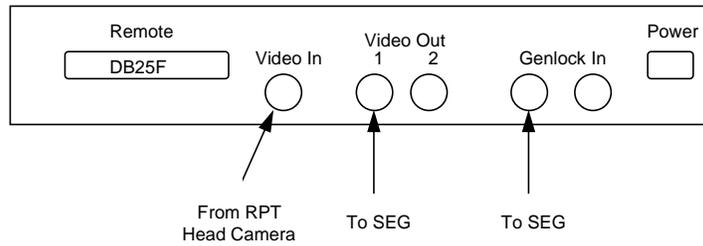


Fig. I-4(b) Digital Time Base Corrector

The SEG back panel, with connections indicated, is shown in Figure I-4(c).

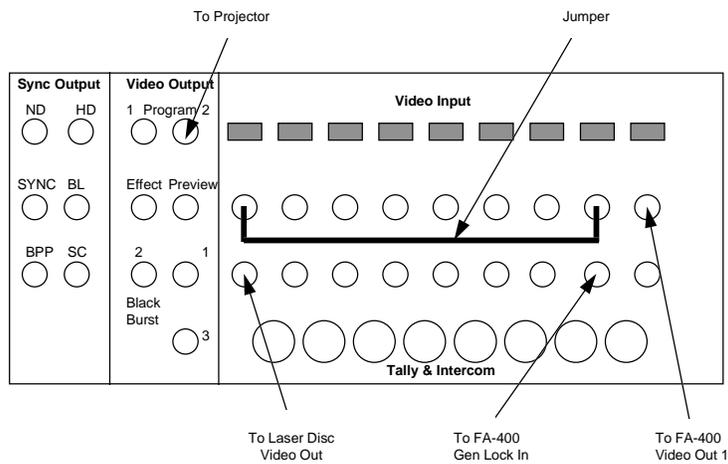


Fig. 1.4(c). Special Effects Generator

The video output of the SEG is directed to the overhead projector and screen arrangement indicated in Figure I-1. The projector back panel is shown in Figure I-5.

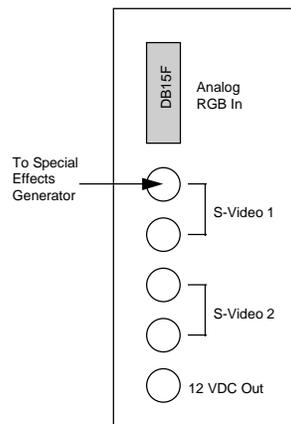


Fig. I-5. Back Panel of Projector

LIGHTING

As illustrated in Figure I-1, lights illuminate each of the five targets plus the RPT head. The lights are controlled by signals originating within the master controller relay card and passed to the lighting controller. The lighting controller output is fed to a bank of 120VAC/12VAC transformers which supplies power to the lights. The lighting controller is shown in Figure I-6.

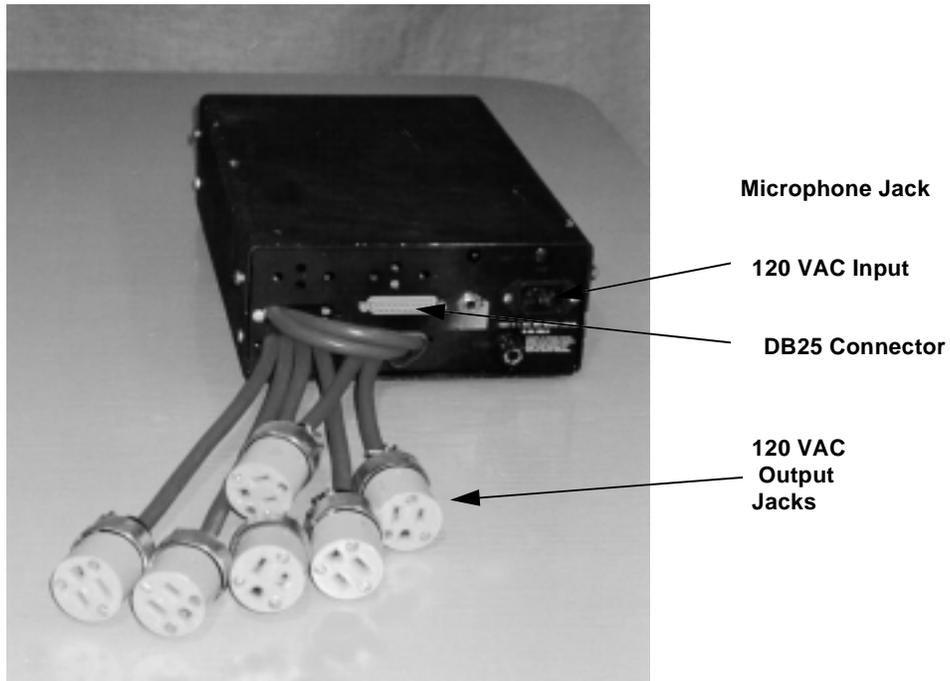


Fig. I-6. Lighting Controller

The major component of the lighting controller is an Opto22 relay board, model PB8. A block schematic of the light box layout is given in Figure I-7. Pin correspondences between the DB25 input connector to the light box and the 50-pin connector to the Opto22 board are given in Table I-2.

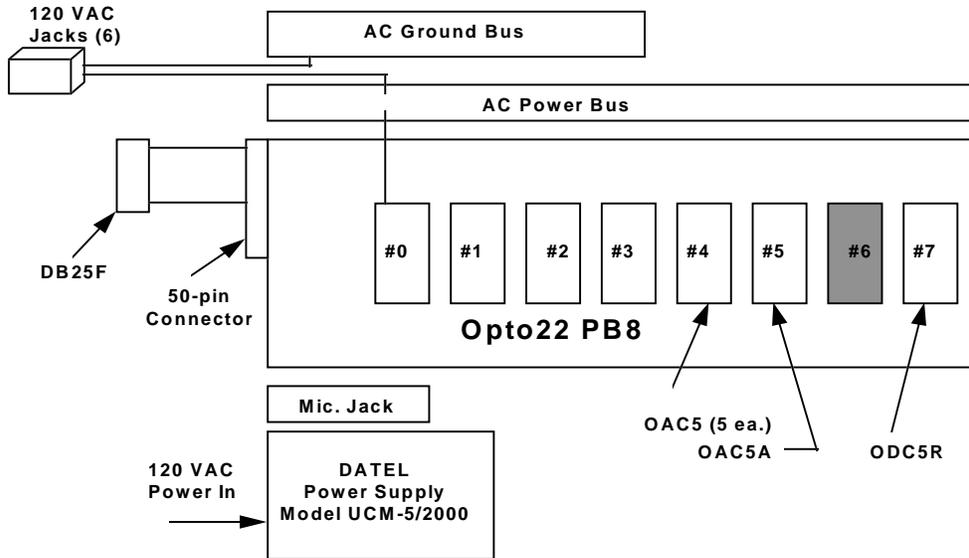


Fig. I-7 Block Schematic, Lighting Controller

Table I-2. Light Box Pin Correspondences

DB25 Pin No.	Opto 22 50-Pin Con. No.	Function	DB25 Pin No.	Opto 22 50-Pin Con. No.	Function
1	-	N/C	14	-	N/C
2	47	Control, Relay 0	15	-	N/C
3	45	Control, Relay 1	16	-	N/C
4	43	Control, Relay 2	17	-	N/C
5	41	Control, Relay 3	18	50	Ground
6	39	Control, Relay 4	19	48	Ground
7	37	Control, Relay 5	20	-	N/C
8	35	Control, Relay 6	21	44	Ground
9	33	Control, Relay 7	22	42	Ground
10	30	ACK (Gnd)	23	38	Ground
11	-	Busy (Gnd)	24	36	Ground
12	-	Paper Out (Gnd)	25	34	Ground
13	-	N/C			

AUDIO

Automata uses two principal audio sources: a speech processing system (herein called the Voice Box) with preprogrammed statements as determined by the Controller, and the Lightning unit.

The Voice Box back panel and connections are shown in Figure I-8.

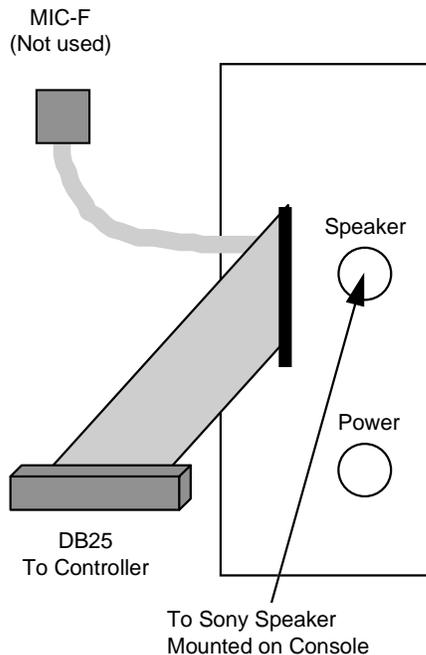


Fig. I-8. Voice Box Connections

Lightning is a MIDI controller that senses the movement of infrared sources in space and transforms the resultant information to MIDI signals for expressive control of electronic musical instrumentation.

Lightning operates on principles of optical triangulation, gathering its information by tracking tiny infrared transmitters. The transmitter used in Automata is located on top of the RPT head as indicated in Fig. I-1. Lightning senses horizontal and vertical location from each infrared source. From this information, its signal processor computes velocity and acceleration, performs some elementary analysis, and converts the information to MIDI signals.

The Lightning unit, shown in Fig. I-9(a), is mounted on a stand in proximity to the RPT head (See Fig. I-1). Communication is established with the video portion of the presentation through the RPT camera. A relay in the relay card located in the Master Controller is dedicated to the Lightning unit, and connection is made

through the Light Controller. The back panel of the Lightning unit, with connections indicated, is shown in Figure I-9(b).



Fig. I-9(a). The Lightning Unit

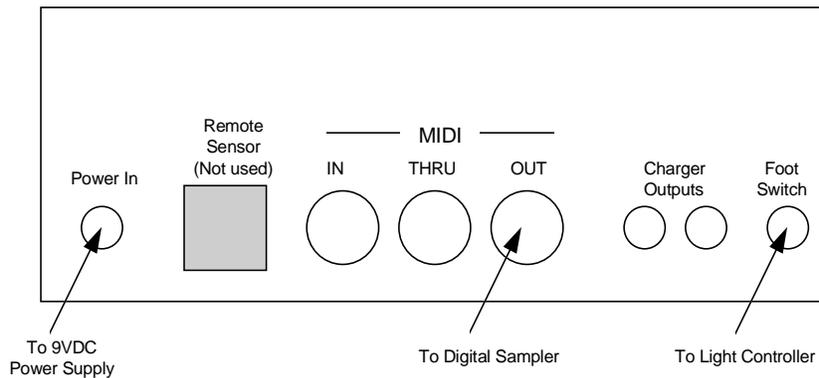


Fig. I-9(b). Back Panel of Lightning Unit

The remainder of the audio portion comprises the Digital Sampler, the Multichannel Amplifier, and the six JVC speakers, as shown in Figure I-10.

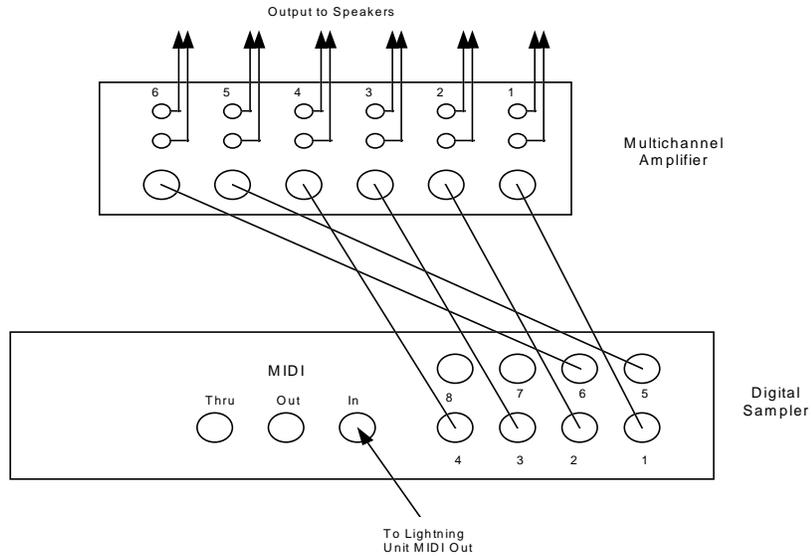


Fig. I-10. Audio Components and Connections

ROLL/PAN/TILT HEAD

Central to the Automata presentation is the roll/pan/tilt (RPT) head. This complex component comprises three stepper motors, associated slip rings and limit switches, and a video camera. It is mounted on a stand, and is positioned near the center of the tubular frame as illustrated in Figure I-1.

Figure I-11(a) shows the three axes of motion:

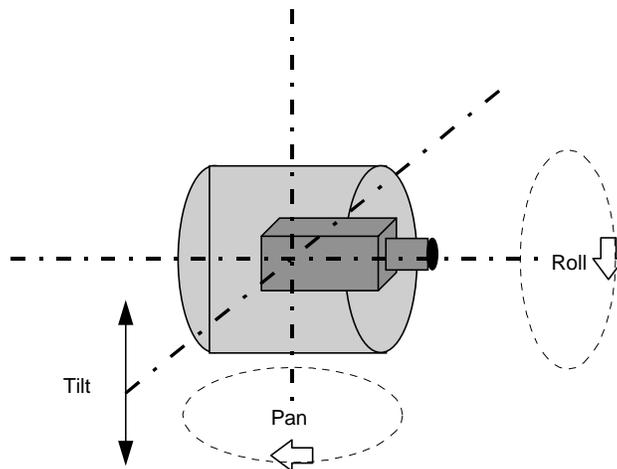


Fig. I-11(a) RPT Head Axes of Motion

The major components required to effect the three-axis motion are shown in the photographs given in Figures I-12(a) through I-12(d). They include stepper

motors, slip ring assemblies, home position sensors, and intermediate connectors.

Stepper motor power, control signals and limit-switch cutoff signals are transmitted between the stepper driver and the RPT head by means of a multiconductor cable. The cable is terminated with a 37-pin connector at the RPT head and at the stepper controller.

The stepper controller and stepper driver modules are shown in Figure 11(b):

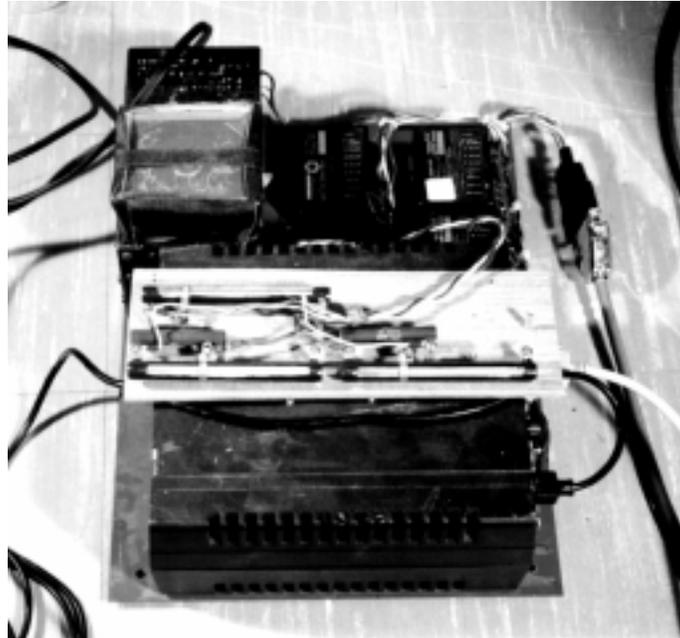


Fig. I-11(b). Automata Stepper Controller

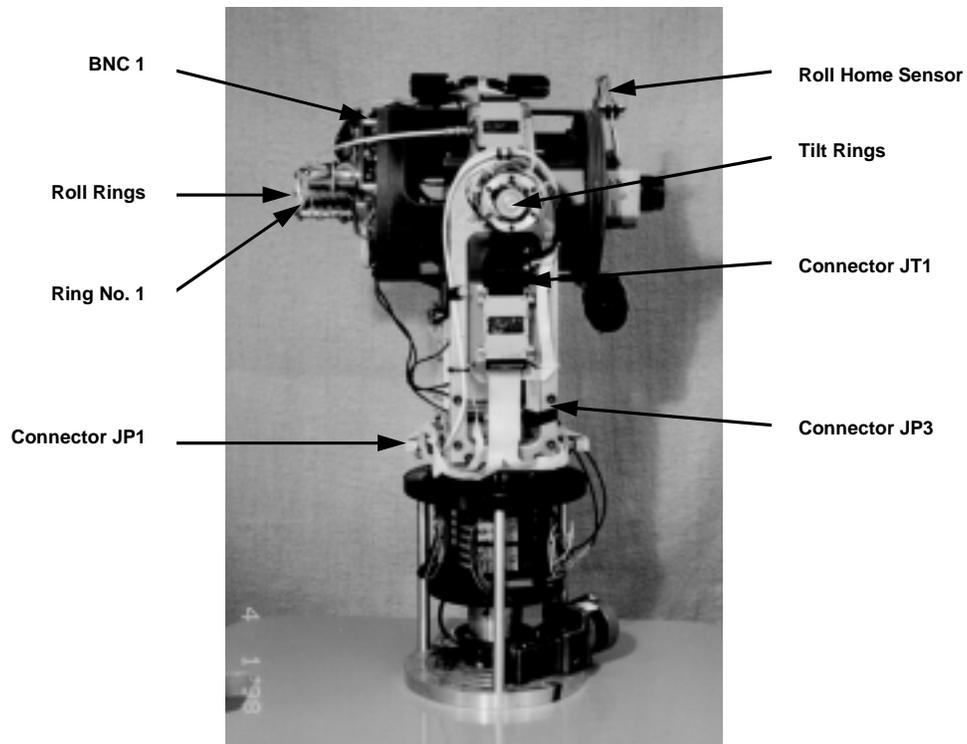


Fig. I-12(a) RPT Head Assembly

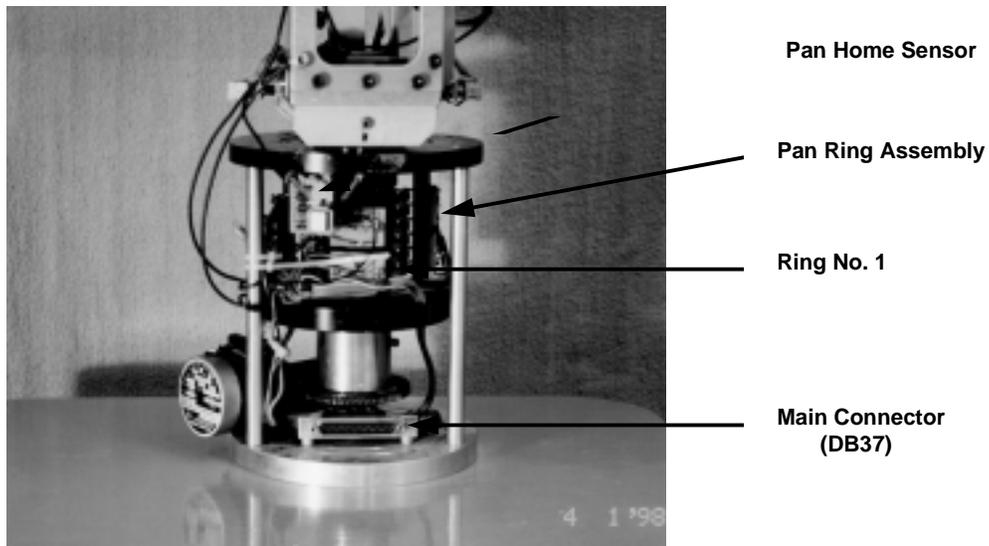


Fig. I-12(b) RPT Pan Ring Assembly

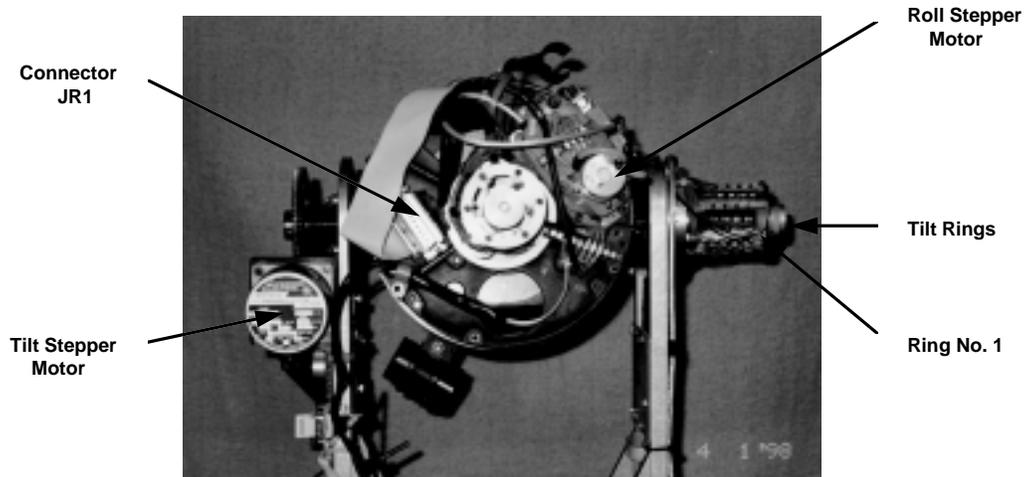


Fig. I-12(c) RPT Tilt and Roll Assembly

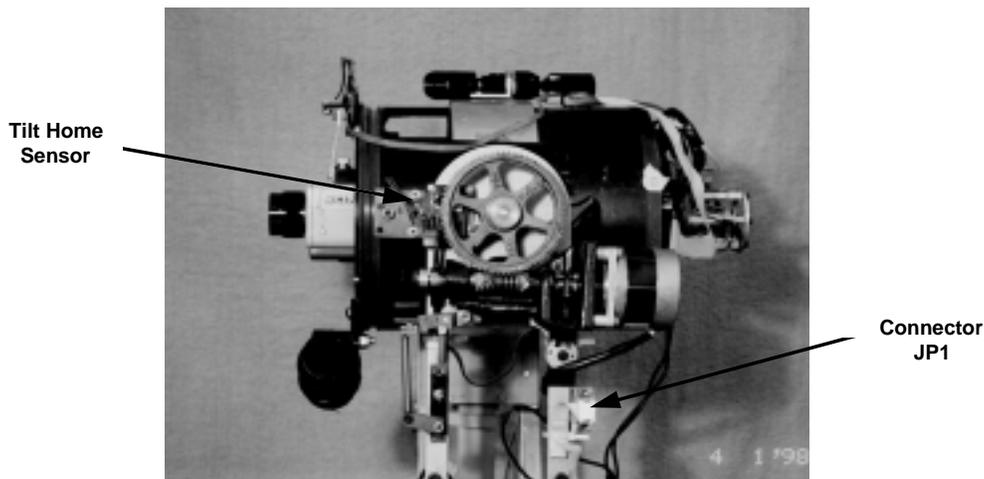


Fig. I-12(d) RPT Side View

SLIP RINGS

Three slip ring assemblies are an integral part of the RPT head and serve to provide continuous electrical paths regardless of the RPT head motion. The roll slip rings carry camera power and video signals. The tilt slip rings carry (1) camera signals, (2) roll stepper motor signals, and (3) the roll stepper “home” index signal. The pan slip rings carry all of the tilt slip ring signals, plus (1) the tilt stepper motor and tilt motor “home” index signals. All the signals are transmitted to the console via the 37-pin connector.

The roll slip ring assembly comprises 14 rings, although many are not used. The tilt slip ring assembly comprises 16 rings. For the purpose of identification, the slip rings in each assembly are numbered sequentially, with the first ring (Ring #1) being the outermost ring, i.e., the ring farthest from the RPT head.

The pan slip ring assembly, Figure 12(b), comprises a stack of six discs. Each of the six discs carries four rings two on the bottom of the disc, and two on the top, as shown in Figure I-13 for a single disc.

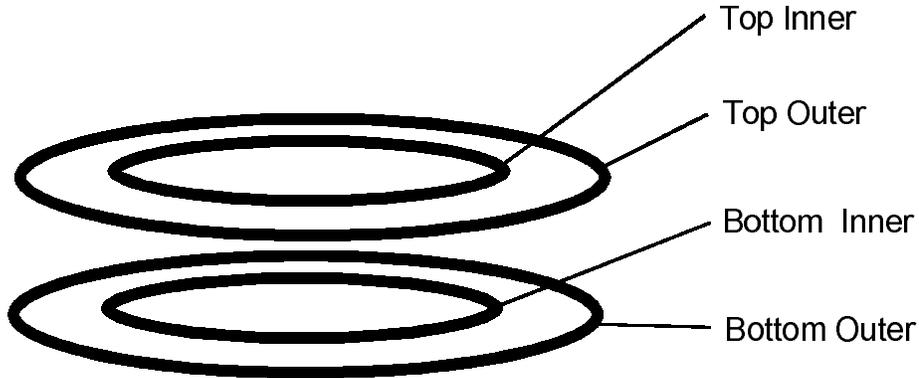


Fig. I-13. Ring Locations on a Single Pan Disc

The rings are numbered according to the disc number (disc #1 is at the bottom of the assembly) and position, as shown in Table I-3.

Table I-3. Pan Ring Identification

Disc No.	Bottom Outer	Bottom Inner	Top Outer	Top Inner
1	1	2	3	4
2	5	6	7	8
3	9	10	11	12
4	13	14	15	16
5	17	18	19	20
6	21	22	23	24

Connections between the slip rings are shown in Figure I-14:

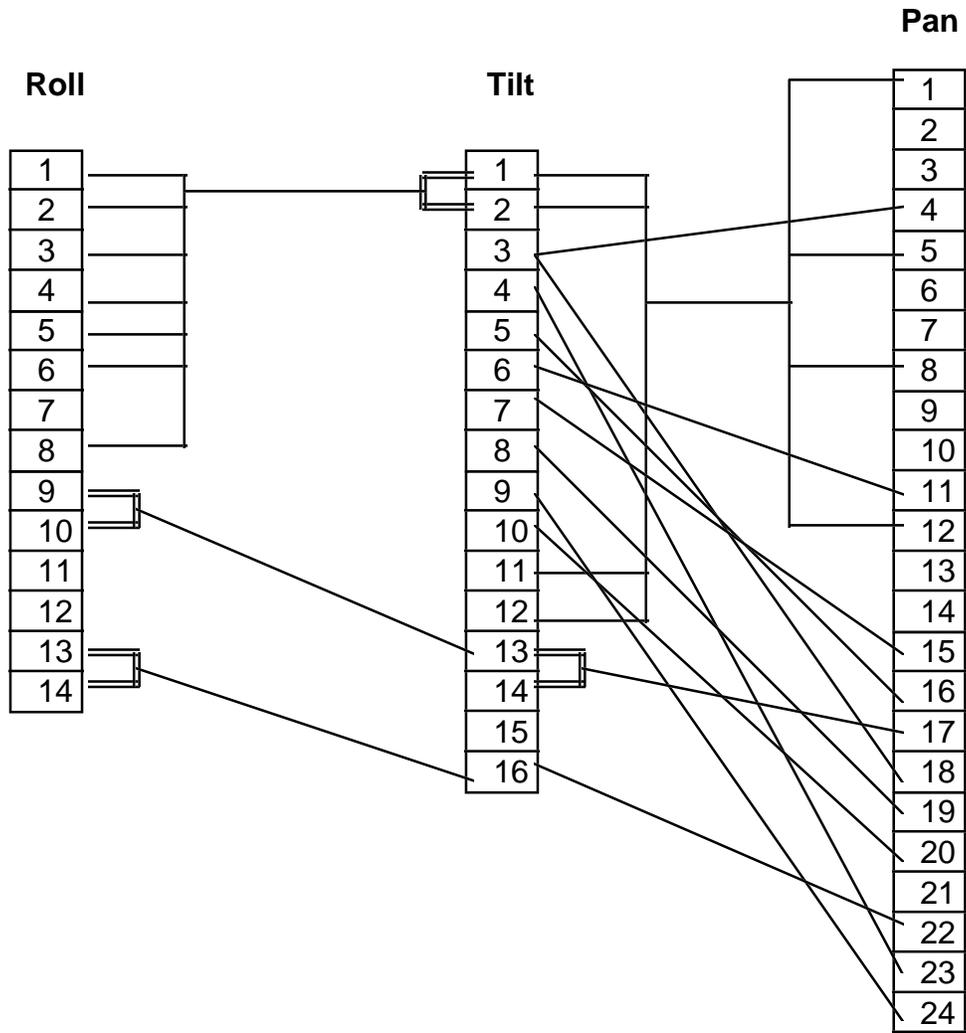


Fig. I-14. Slip Ring Interconnections

Interconnections between the main connector, the slip ring assemblies, and several intermediate connectors, are given in Table I-4.

Table I-4. RTP Pin and Slip Ring Connections

Main Connector (DB37) Pin No.	Function	Pan Rings	JP1 (DB15) Pin No.	JP2 (DB9) Pin No.	JP3 (DB15) Pin No.	JT1 (DB25) Pin No.	Tilt Rings Ring No.	Roll Rings Ring No.	JR1 (DB25) Pin No.
		Ring No.						12 11	3 4
1	Unconnected Wire								
2	Unconnected Wire								
3	None ?	13	3						
4	None ?	9	4						
5	Unconnected Wire								
6	Unconnected Wire								
7	Roll Home Sensor (ctr)	23			10	14	4		24
8	Roll Home Sensor (rt)	4,18			11	12	3		23
9	Camera DC-	1,5,8,12	5,8		12	5,6,16,17	1,2,11,12	1-6	9-12
10	Power DC-	1,5,8,12	6,7		13		1,2,11,12	1-6	
11	Roll Home Sensor (lt)	16			14	15	5		25
12	Roll Stepper Motor, red	20			15	7	10		16
13	Pan Home Sensor, gray								
14	Roll Stepper Motor, yellow	24	9			8	9		17
15	Roll Stepper Motor, black	19	10			9	8		18
16	Roll Stepper Motor, white	15	11			10	7		19
17	Roll Stepper Motor, green	11	12			11	6		20
18	Tilt Stepper Motor, red	7	13	1					
19	Tilt Stepper Motor, green	3	14	2					
20	Tilt Stepper Motor, ?	21		3	3				
21	Tilt Stepper Motor, ?	2		4	4				
22	Tilt Stepper Motor, ?	6		5	5				
23	Tilt Home Sensor	10		7	6				
24	Tilt Home Sensor	14		6	7				
25	Tilt Home Sensor	4,18		8	8		3		
26	Pan Stepper Motor, orange								

Main

Connector (DB37) Pin No.	Function	Pan Rings Ring No.	JP1 (DB15) Pin No.	JP2 (DB9) Pin No.	JP3 (DB15) Pin No.	JT1 (DB25) Pin No.	Tilt Rings Ring No.	Roll Rings Ring No.	JR1 (DB25) Pin No.
27	Pan Stepper Motor, green								
28	Pan Stepper Motor, wht/red								
29	Pan Stepper Motor, wht/grn								
30	Pan Stepper Motor, blk, wht								
31	Pan Home Sensor, red								
32	Pan Home Sensor, black								
33	Unconnected black wire								
34	Unconnected red wire								
35	Chassis ground								
36	Chassis ground								
37	Chassis ground								
BNC1	Camera Video Out	22					16	13,14	
BNC2	Camera DC+	17				3,4	13,14	9,10	5-8