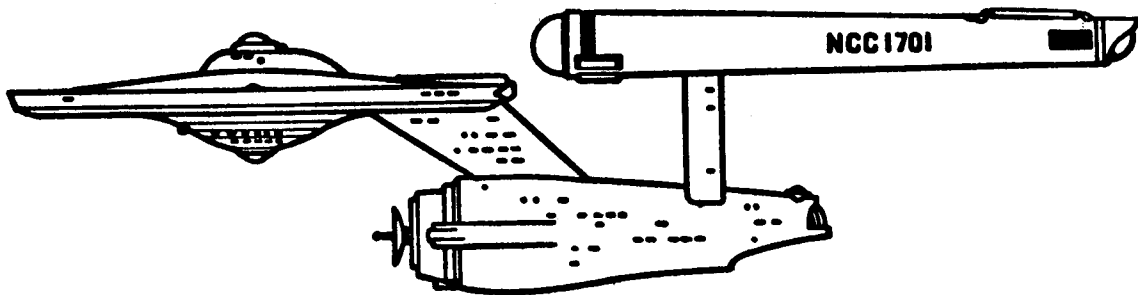


# STAR TREK™



## Owner's Manual

Manufactured By

**SEGA®**

TLX 910-335-1621

**STAR TREK™ Owner's Manual**

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## INTRODUCTION

STAR TREK<sup>TM</sup> is a microprocessor based coin-operated electronic game, that makes extensive use of digital integrated circuitry and television monitor concepts. This manual is designed for the use of the maintenance technician who possess a general working knowledge of solid-state circuitry and video monitor theory. Any individual NOT knowledgeable in these areas SHOULD NOT attempt repair of the electronic portions of the game.

In addition to this manual and training in electronics, troubleshooting and repair will be facilitated by: access to general electronic-type handtools, a multimeter, a 50 to 100 MHz oscilloscope and a logic probe would be helpful.

Technical assistance is available toll-free by calling:

1-800-854-1938 outside California

1-800-722-8576 inside California

Parts information assistance is available toll-free by calling:

1-800-854-1900 outside California

1-800-722-8575 inside California

Questions or comments concerning STAR TREK<sup>TM</sup> or any of our games are welcome and should be directed to:

Customer Service Manager

SEGA Electronics, Inc.

16250 Technology Drive

San Diego, California 92127-1985

## GAME SET-UP AND INSPECTION

### 1. Inspection

a) Before plugging in your new game, inspect it closely to spot any possible shipping damage. Check to ensure the graphics are in place, the monitor is not damaged and that the overall cabinet is in good condition.

b) Open the rear service door and inspect the inside of the game electronics compartment. Be sure no components or connectors have come loose. Proper connector fittings must be checked before game power is applied. Check all related connectors for good contact. Although disconnected connectors are easily spotted, poor contacts are difficult to locate. The connectors should therefore be pushed in firmly and then loosened to spot poor connections.

c) Check to ensure the fuses are intact. There are five fuses (not counting the monitor fuses). One fuse is located on the AC Junction Box. The other four are on the power supply PC board.

### 2. Voltage Selection

Before plugging in your game, make sure that the game voltage is correct for your location. Locate the two leads from the AC Junction Box to the power transformer. For 110 VAC, they should be connected to terminals 1 and 3 on the power transformer. For 100 VAC, connect 1 and 2, and for 220 VAC applications, they should be connected to 1 and 4. You will also notice on the AC junction box that there is a safety interlock switch. When the front panel is in place the switch is depressed and the game receives power. Removing the front panel, the switch returns to its original position and the power is cut off from the game. For servicing, this switch can be pulled out and power will be restored.

### 3. Game Specifications

Power 100 VAC, 60 Hz (nominal), 150 watts maximum

### 3. Game Specifications (Cont)

Power 110 VAC, 60 Hz (nominal), 150 watts maximum  
220 VAC, 60 Hz (nominal), 150 watts maximum

### 4. Important Notes

a) The following note is included in compliance with FCC rules:

WARNING: This equipment generates and uses radio frequency energy and if not installed and used properly, i.e., in strict accordance with the instruction manual, may cause harmful interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment.

Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

b) Miscellaneous

NEVER remove circuit board connections while power is on.

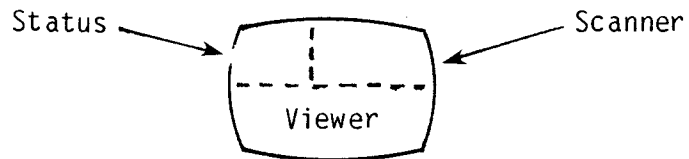
NEVER replace any components with anything other than exact replacement parts.

DO NOT replace fuses with anything other than proper value. A blown fuse indicates an overload condition within the game. Replacing the fuse with a higher value can cause damage to internal components, if an overload occurs.

## GAME CONCEPT

STAR TREK™ is a one or two player SEGA Color X-Y video game with computerized speech synthesis. The player finds himself the Captain of the Starship Enterprise, his mission being to rid the universe of a number of threats to the United Federation of Planets.

STAR TREK™ has a unique method of displaying the information vital to the game play. This method involves the separation of the CRT into three completely separate "screens".



The "Scanner" is where the player sees a "top down" or plan view of local space, with the Enterprise always in the center of this screen. The "Viewer" is where the player sees actual "apparent 3-D" images, as if he were looking out the ships front window. The "Status" screen displays player score in addition to Shield strength, number of Photon Torpedoes, and amount of Warp energy remaining.

The game begins by introducing Klingons, Starbases and the Enterprise into the Scanner with an exciting "shrink down" animation sequence. The Enterprise starts with one to four Shields and Photon Torpedoes (switch selectable). By actuating the rotary knob and depressing the Thrust button the player may maneuver about the Scanner screen.

In order to destroy enemies the player may use either of two weapons; Phasers (the Fire button) or Photon Torpedoes. Each has unique properties.

- \* Phasers are instantaneous, can destroy only one enemy at a time, and are in unlimited energy supply.

- \* Photon Torpedoes require time to travel, can destroy many enemies, and are in LIMITED supply. Displayed in the Status screen, Photon Torpedo supply appears as a red bar (squares).

For high speed the player may depress the WARP button. While this button is held down the Enterprise moves very quickly and cannot be damaged in any way by anything. A blue bar in the Status screen displays the amount of Warp energy available and shrinks as the Warp button is held down.

The Enterprise is shrouded by an automatic Shield, which protects the Enterprise from enemy fire and collisions. The Shields are displayed in the Status screen as green line segments (a bar). Once the strength of the Shields is depleted, the ship can sustain damage. When damaged, the Enterprise loses ship functions in the following order: Shields, Photon Torpedoes, Warp Drive. If all of these are damaged, the next hit will destroy the Enterprise and end the game.

In order to repair this damage the player may choose to dock with a Starbase. Docking is accomplished by merely flying into a Starbase. The "DOCKED" message appears, all damage is repaired, and a Shield unit, Photon Torpedo, and some Warp time are added to the ships supplies. Although only four of each supply unit is displayed at any one time, 255 can be collected.

The primary enemy is the Klingon Battle Cruiser, which comes in three colors:

- \* Red Klingon - ignores the Enterprise and sets out to destroy a Starbase, after which the Klingon turns purple.
- \* Purple Klingon - ignores Starbases and attempts to destroy the Enterprise by firing plasma energy balls. Purple Klingons will stop a certain distance away while attacking so as not to risk collision. After a certain period of time (depending on round), purple Klingons turn white.
- \* White Klingons - sometimes known as "Maniac Klingons", these Klingons will move VERY QUICKLY and attempt to ram the Enterprise.

Anti-Matter Saucers appear randomly and move about the screen in a "confusing" fashion. These saucers can be destroyed only with Phasers. If the saucer collides with the Enterprise, it will attach itself, drain your ships Warp energy, then leave quickly.

After a number of rounds, the player advances to the Nomad round. In this sequence Nomad zips about the screen depositing dangerous mines. The mines

cause chain reactions which should be avoided. Nomad can only be destroyed with Phasers. Once Nomad has delivered its total load of 30 mines, it waits for the last mine to detonate, leaves the screen and ends the round.

Every 10,000 to 40,000 points (operator selectable) the player is awarded a bonus Shield unit, Photon Torpedo and Warp time unit. The two player game is played with players alternating with each complete round. Whenever a player is eliminated, the other player continues and finishes the game.

### SCORING

Points are awarded for destroying enemies and for the "Starbase Bonus".

\* Enemies

Klingons . . . . .	25 + (round number X 25) Points
Anti-Matter Saucer . . . . .	5,000 Points
Nomad . . . . .	30,000 Points

\* Starbase Bonus - at the end of a round

Used Starbase . . . . .	(round number X 250) Points
Un-used Starbase . . . . .	(round number X 1,000) Points



OPTION SELECTION

OPTION	SWITCH #1								
		1	2	3	4	5	6	7	8
VOICE DURING ADVERTISING		X	X	X	X	X	X	C	X
NO VOICE DURING ADVERTISING		X	X	X	X	X	X	0	X
PHOTON TORPEDOES:	1	X	X	X	X	C	C	X	X
	2	X	X	X	X	C	0	X	X
	3	X	X	X	X	0	C	X	X
	4	X	X	X	X	0	0	X	X
DIFFICULTY:	EASY	X	X	C	C	X	X	X	X
	MEDIUM	X	X	C	0	X	X	X	X
	HARD	X	X	0	C	X	X	X	X
	TOURNAMENT	X	X	0	0	X	X	X	X
BONUS	10,000 pts	C	C	X	X	X	X	X	X
	20,000 pts	C	0	X	X	X	X	X	X
	30,000 pts	0	C	X	X	X	X	X	X
	40,000 pts	0	0	X	X	X	X	X	X

OPTION	SWITCH #2							
	1	2	3	4	5	6	7	8
4 COIN/1 CREDIT	C	C	C	C	C	C	C	C
3 COIN/1 CREDIT	C	C	C	0	C	C	C	0
2 COIN/1 CREDIT	C	C	0	C	C	C	0	C
1 COIN/1 CREDIT	C	C	0	0	C	C	0	0
1 COIN/2 CREDIT	C	0	C	C	C	0	C	C
1 COIN/3 CREDIT	C	0	C	0	C	0	C	0
1 COIN/4 CREDIT	C	0	0	C	C	0	0	C
1 COIN/5 CREDIT	C	0	0	0	C	0	0	0

OPTION SWITCH SETTINGS - (cont.)

<u>OPTION</u>	<u>SWITCH #2</u>							
	1	2	3	4	5	6	7	8
1 COIN/6 CREDIT	0	C	C	C	0	C	C	C
2 COIN/1 CREDIT	0	C	C	0	0	C	C	0
4 COIN/2 CREDIT								
5 COIN/3 CREDIT								
2 COIN/1 CREDIT	0	C	0	C	0	C	0	C
4 COIN/3 CREDIT								
1 COIN/1 CREDIT	0	C	0	0	0	C	0	0
2 COIN/2 CREDIT								
3 COIN/3 CREDIT								
4 COIN/4 CREDIT	0	C	0	0	0	C	0	0
5 COIN/6 CREDIT								
1 COIN/1 CREDIT	0	0	C	C	0	0	C	C
2 COIN/2 CREDIT								
3 COIN/3 CREDIT								
4 COIN/5 CREDIT								
1 COIN/1 CREDIT	0	0	C	0	0	0	C	0
2 COIN/3 CREDIT								
1 COIN/2 CREDIT	0	0	0	C	0	0	0	C
2 COIN/4 CREDIT								
3 COIN/6 CREDIT								
4 COIN/8 CREDIT								
5 COIN/11 CREDIT								

OPTION SWITCH SETTINGS - (cont.)

<u>OPTION</u>	<u>SWITCH #2</u>							
	1	2	3	4	5	6	7	8
1 COIN/2 CREDIT	0	0	0	0	0	0	0	0
2 COIN/4 CREDIT								
3 COIN/6 CREDIT								
4 COIN/9 CREDIT								

X = NOT USED                      0 = OPEN                                      C = CLOSED

## SELF-TEST

The G-80 system contains a built-in self-test system, activated by depressing the red self-test switch located on the CPU Board. If the cover to the G-80 card cage is in place, the switch can be activated by putting a pen or pencil through the hole provided on the cover.

Basic diagnostics test sequence:

1. CPU RAM
2. Maskable interrupts
3. First 1K of game ROMs
4. Video RAM and Hardware multiplier
5. Player start buttons
6. Display screen (visual)
7. All game ROMs
8. System inputs
9. Game controls
10. Sounds/Voice

Individualized diagnostics descriptions and procedures:

1. CPU RAM - tests all RAM on CPU card before proceeding, system needs to use this RAM for stack and variables during other tests so if any locations are bad processor will halt (halt light will come on).

2. Maskable interrupts - video interrupt is enabled through output port bit and all maskable interrupts are enabled inside processor, CPU then executes several HALT instructions to insure that at least one edge triggered interrupt has occurred. If no interrupts occur during this test the halt light will remain on constantly. This is the same result as a bad CPU RAM. This ambiguity can be eliminated by checking the vertical interrupt another way. The system reset/power-up logic will also halt if the video interrupt is not functioning, to try this press the RESET switch.

3. First 1K of game ROMs - the first 1K of the first game ROM will be checked for validity. If this portion of the first ROM is bad the system will not be able to proceed because vital information defining parameters of the game are stored in this first 1K. If an error occurs during this validity check, the CPU will lock up and repeatedly flash the halt light.

4. Video RAM and Hardware multiplier - the video RAM is tested first and in the event that it tests good then the hardware multiplier is checked. If the video RAM is good, the message "ALL VIDEO RAM GOOD, MULTIPLIER GOOD" appears. If a bad video RAM chip is found, then the message "BAD VIDEO RAM, CHIP U##" appears on the screen along with that chip's location. Due to the fact that sometimes a bad video chip causes the display to be erratic, the system also flashes out the bad chip's location on the halt light, over and over again separating the U#s with a one second on pulse.

The hardware multiplier is used in the game to multiply two 8 bit numbers together to form one 16 bit product. This test performs a select group of multiplications, over 2,000 multiplications in actuality, designed to thoroughly exercise the process of multiplication between the software and the hardware multiplier. The messages "GOOD" or "BAD" are the only indication of functionality with respect to this test.

5. Player start buttons - one of the two "game start" push buttons on the front of the cabinet is very special. The "one player start" button was designated by the system as a way to terminate the test that is currently being run. The reason that these two buttons were tested relatively early in the sequence, was so that the remaining tests could use the "one player start"

button for a termination signal. To be sure that these two buttons are functioning properly, see that when untouched the status indicated is "0" (for open switch contact) and that when pushed or depressed momentarily the indicated status is "C" (for closed switch contact) during the time the button is down. This notation for switches being in the open or closed state, "0" or "C", will be used throughout the diagnostic sequence whenever the status of a switch is being displayed on the screen.

6. Screen - this test is supplied by the game logic, external to the CPU ROM, to provide a visual indication of how well the display screen is functioning. It tests beam deflection and colors to check that all electron guns are functioning. In the display, you should see some sort of test showing the colors white, red, green and blue.

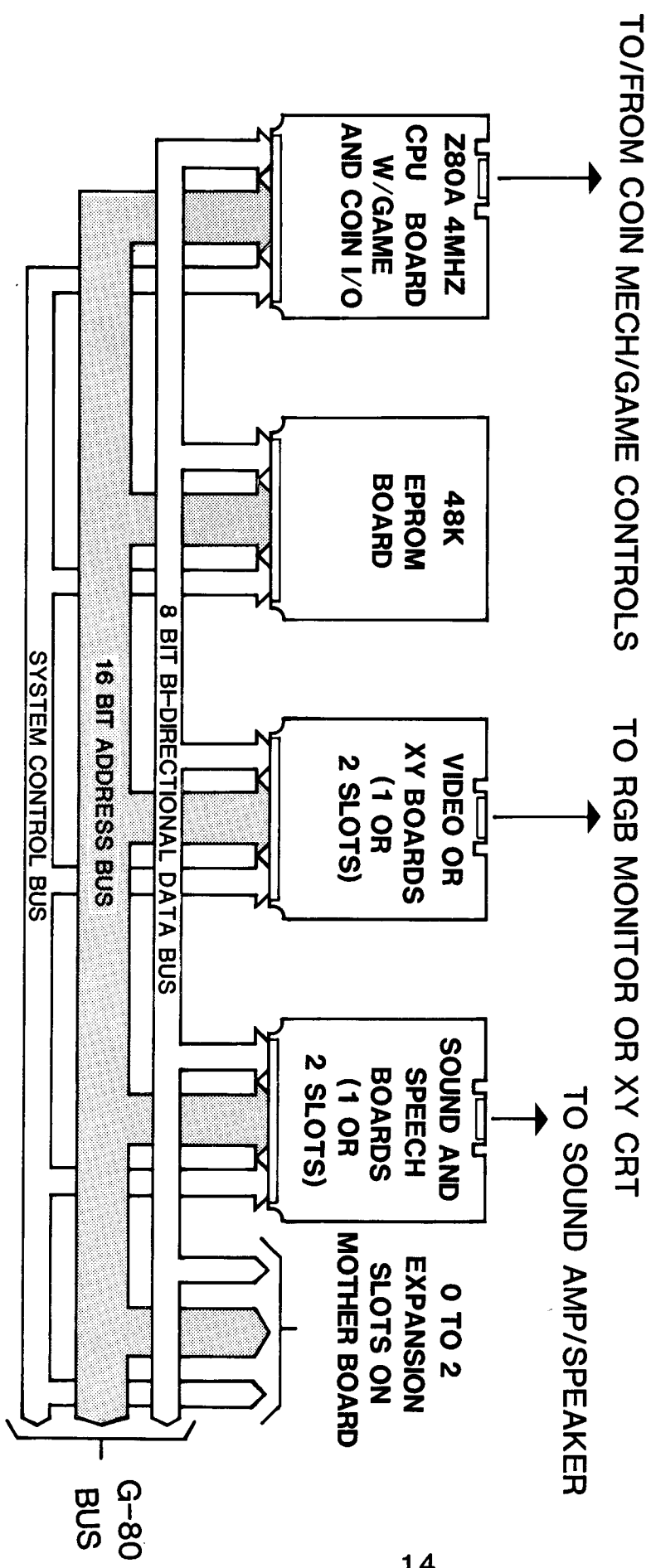
7. All game ROMs - the intent of this test was to insure the integrity of all of the data in all of the game ROMs. At the time the ROMs for a game were originally generated there was an algorithm performed on each 1K block of data. Each of these calculations, a form of CRC (cyclic redundancy check, similar to a checksum), produced one 16-bit word. These words are stored, along with a Gremlin part number, in the first ROM. When this test is run, all of these 16-bit CRC words are regenerated and are compared to the known values stored in the table in the first ROM. If one of these newly calculated values does not match its corresponding stored value, then the system kicks out an error which amounts to the message "BAD ROM" followed by one or more bad part numbers of that ROM that was found in mis-match. If all ROMs are good the screen displays: "ALL ROMS GOOD". Then the system quickly proceeds on to the next test.

8. System inputs - these inputs are referred to as 'system inputs', simply because they control system functions, such as credit accumulation, coinage options, game configuration, etc. The diagnostic user may check to see that the coin switches, service switch, and option dip switches are functioning properly. The open and closed switch notation applies here as described earlier.

9. Game controls - the names of the controls that the game player would use to control the action on the screen is what this test was designed to check. Make sure that when hands are off of the controls all of the switches are open. When a particular control is twisted, pushed, turned or in whatever way activated, watch to see that the status of that control, and only that particular control, changes to reflect the action on the control panel. The screen should display from open to closed.

10. Sounds/Voice - just sit back, listen and watch this one. All of the sounds made by the game will be produced and their respective names will appear in the center of the screen. The termination button acts sluggish during this test due to the fact that some of the sounds must be created by subroutines external to the CPU ROM. After completion of this test, the system will return to the advertising mode.

# G-80 BUS DETAIL





G-80 MOTHER BOARD BUS PIN ASSIGNMENTS

1	GROUND	GROUND	A
2	A15	A7	B
3	A14	A6	C
4	A13	A5	D
5	A12	A4	E
6	A11	A3	F
7	A10	A2	H
8	A9	A1	J
9	A8	A0	K
10	D7	D3	L
11	D6	D2	M
12	D5	D1	N
13	D4	D0	P
14	$\overline{\text{WAIT}}$	$\overline{\text{RESET}}$	R
15	$\overline{\text{INT}}$	$\overline{\text{EDGINT}}$	S
16	$\overline{\text{NMI}}$	$\overline{\text{EXT } \Phi}$	T
17	$\overline{\text{EXT } \Phi \text{ SEL}}$	$\overline{\Phi \text{ OUT}}$	U
18	$\overline{\text{MEMR}}$	$\overline{\text{MEMW}}$	V
19	$\overline{\text{INPUT}}$	$\overline{\text{OUTPUT}}$	W
20	$\overline{\text{RFSH}}$	$\overline{\text{MREQ}}$	X
21	$\overline{\text{INTACK}}$	$\overline{\text{AC}}$	Y
22	+5V	+5V	Z
23	+5V	+5V	a
24	-5V	-5V	b
25	+12V	+12V	c

26	-12V	-12V	d
27			e
28	$\overline{\text{HLT}}$	MI	f
29	$\Phi/2$		h
30	$\overline{\text{PANEL RESET}}$		j
31	SRC		k
32	$\overline{\text{ADD}}$		l
33		$\overline{\text{FETCH}}$	m
34		$\overline{\text{PCC}}$	n
35			p
36		7.5Mhz	r
37			s
38			t
39			u
40			v
41		$\overline{\text{PCR}}$	w
42		SPEECH READY	x
43	GROUND	GROUND	y

G-80 MOTHER BOARD BUS PIN ASSIGNMENTS  
CPU BOARD

1	GROUND U38	U36 GROUND	A
2	A15 U38	U36 A7	B
3	A14 U38	U36 A6	C
4	A13 U38	U36 A5	D
5	A12 U38	U36 A4	E
6	A11 U38	U36 A3	F
7	A10 U38	U36 A2	H
8	A9 U38	U36 A1	J
9	A8 U38	U36 A0	K
10	D7 U35	U35 D3	L
11	D6 U35	U35 D2	M
12	D5 U35	U35 D1	N
13	D4 U35	U35 D0	P
14	WAIT U31	U30 RESET	R
15	TINT U31	U31 EDGINT	S
16	NMI U31	U19 EXT $\Phi$	T
17	EXT $\Phi$ SEL U18, U19	U34 $\Phi$ OUT	U
18	MEMR U34	U34 MEMW	V
19	INPUT U34	U34 OUTPUT	W
20	RFSH U34	U34 MREQ	X
21	TINTACK U34	AC	Y
22	+5V	+5V	Z
23	+5V	+5V	a
24	-5V	-5V	b
25	+12V	+12V	c

26	-12V			-12V	d
27					e
28	$\overline{\text{HLT}}$	U30		U30 MI	f
29	$\Phi/2$	U30			h
30	$\overline{\text{PANEL RESET}}$	U31			j
31	SRC				k
32	$\overline{\text{ADD}}$				l
33				$\overline{\text{FETCH}}$	m
34				$\overline{\text{PCC}}$	n
35					p
36				7.5Mhz	r
37					s
38					t
39					u
40					v
41				$\overline{\text{PCR}}$	w
42				SPEECH READY	x
43	GROUND			GROUND	y

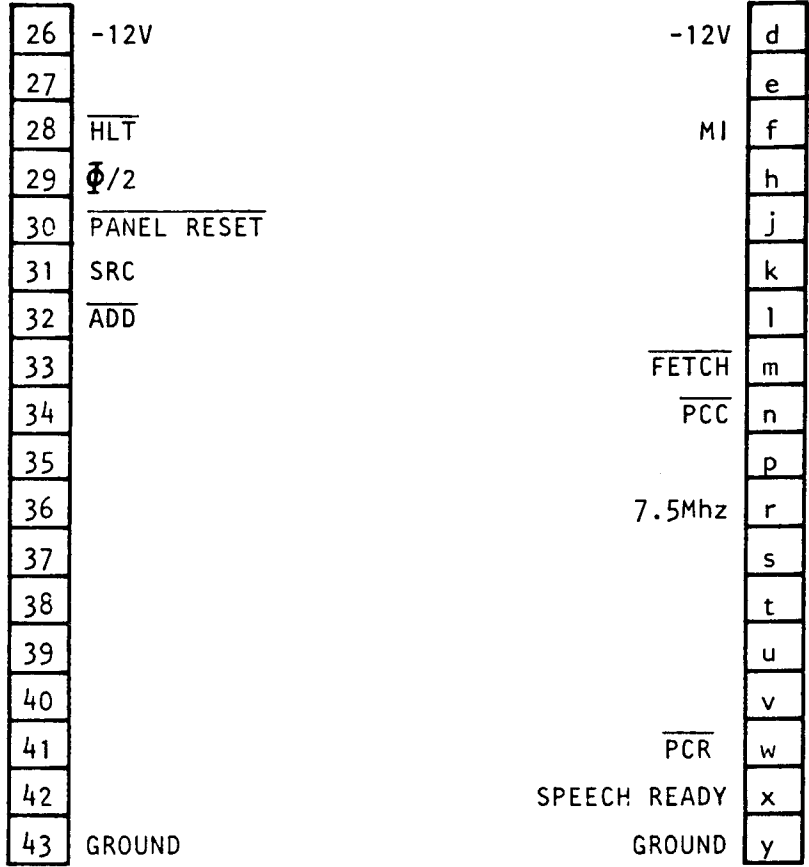
**G-80 MOTHER BOARD BUS PIN ASSIGNMENTS**  
**EPROM BOARD**

1	GROUND		GROUND	A
2	A15	U29	U28 A7	B
3	A14	U29	U28 A6	C
4	A13	U24, U30	U28 A5	D
5	A12	U24, U30	U28 A4	E
6	A11	U24, U30	U27 A3	F
7	A10	U26	U27 A2	H
8	A9	U26	U27 A1	J
9	A8	U26	U27 A0	K
10	D7	U25	U25 D3	L
11	D6	U25	U25 D2	M
12	D5	U25	U25 D1	N
13	D4	U25	U25 D0	P
14	WAIT		RESET	R
15	INT		EDGINT	S
16	NMI		EXT $\Phi$	T
17	EXT $\Phi$ SEL		$\Phi$ OUT	U
18	MEMR	U26	MEMW	V
19	INPUT		OUTPUT	W
20	RFSH		MREQ	X
21	INTACK		AC	Y
22	+5V		+5V	Z
23	+5V		+5V	a
24	-5V		-5V	b
25	+12V		+12V	c

26	-12V	-12V	d
27			e
28	$\overline{\text{HLT}}$	MI	f
29	$\Phi/2$		h
30	$\overline{\text{PANEL RESET}}$		j
31	SRC		k
32	$\overline{\text{ADD}}$		l
33		$\overline{\text{FETCH}}$	m
34		$\overline{\text{PCC}}$	n
35			p
36		7.5Mhz	r
37			s
38			t
39			u
40			v
41		$\overline{\text{PCR}}$	w
42		SPEECH READY	x
43	GROUND	GROUND	y

**G-80 MOTHER BOARD BUS PIN ASSIGNMENTS**  
**UNIVERSAL SOUND BOARD**

1	GROUND		GROUND	A
2	A15	U37, U40	U48, U57, U59	A7
3	A14	U37, U40	U48, U57, U59	A6
4	A13	U37, U40, U48	U57, U59	A5
5	A12	U37, U40	U57, U59	A4
6	A11	U58	U56, U59	A3
7	A10	U58	U56, U59	A2
8	A9	U58	U56, U59	A1
9	A8	U58	U56, U59	A0
10	D7	U52, U54, U55	U52, U54, U55	D3
11	D6	U52, U54, U55	U52, U54, U55	D2
12	D5	U52, U54, U55	U52, U54, U55	D1
13	D4	U52, U54, U55	U52, U54, U55	D0
14	WAIT		U39, U48	RESET
15	INT			EDGINT
16	NMI			EXT $\Phi$
17	EXT $\Phi$ SEL			$\Phi$ OUT
18	MEMR	U37	U37	MEMW
19	INPUT	U37	U37	OUTPUT
20	RFSH			MREQ
21	INTACK			AC
22	+5V			+5V
23	+5V			+5V
24	-5V			-5V
25	+12V			+12V

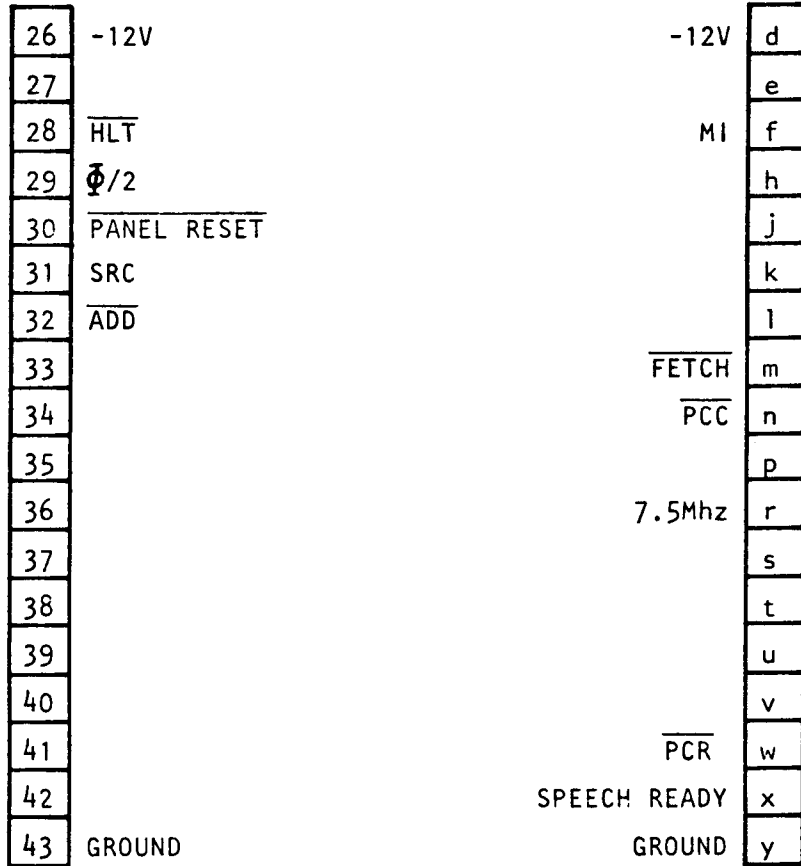




G-80 MOTHER BOARD BUS PIN ASSIGNMENTS

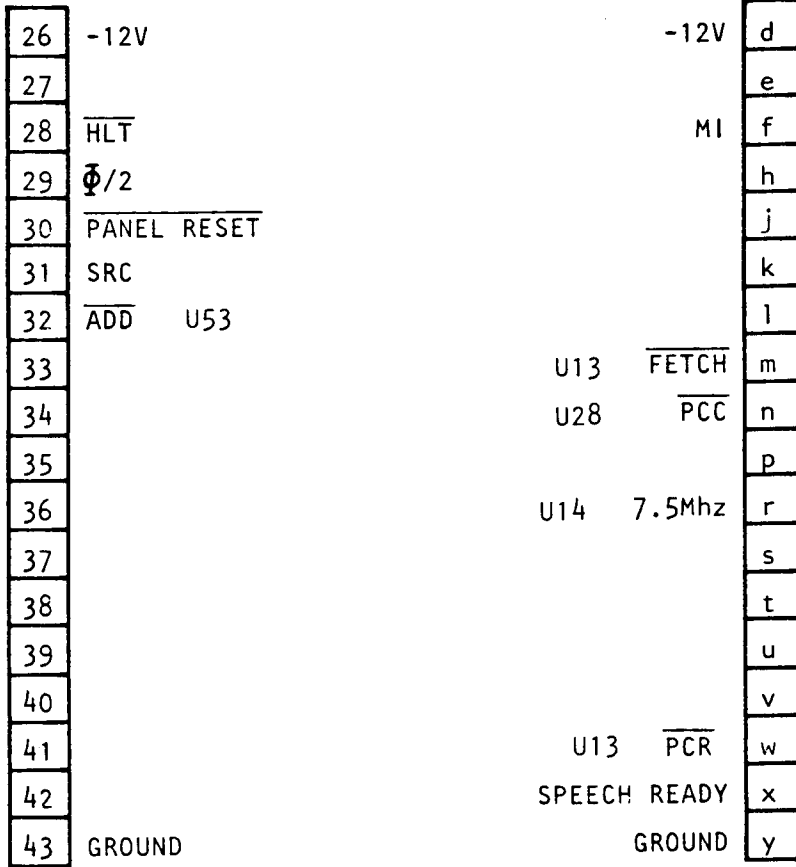
SPEECH BOARD

1	GROUND		GROUND	A
2	A15		U38 A7	B
3	A14		U38 A6	C
4	A13		U37 A5	D
5	A12		U37 A4	E
6	A11		U37 A3	F
7	A10		U30 A2	H
8	A9		U24, U30 A1	J
9	A8		U24, U30 A0	K
10	D7 U21, U24, U27	U20, U21, U24	D3	L
11	D6 U21, U24	U20, U21, U24	D2	M
12	D5 U20, U21, U24	U20, U21, U24	D1	N
13	D4 U20, U21, U24	U20, U21, U24	D0	P
14	WAIT	U18, U20, U21	RESET	R
15	INT		EDGINT	S
16	NMI		EXT $\Phi$	T
17	EXT $\Phi$ SEL		$\Phi$ OUT	U
18	MEMR		MEMW	V
19	INPUT U35, U36	U35, U36	OUTPUT	W
20	RFSH		MREQ	X
21	INTACK		AC	Y
22	+5V		+5V	Z
23	+5V		+5V	a
24	-5V		-5V	b
25	+12V		+12V	c



G-80 MOTHER BOARD BUS PIN ASSIGNMENTS  
X-Y TIMING BOARD

1	GROUND		GROUND	A
2	A15		A7	B
3	A14		A6	C
4	A13		A5	D
5	A12		A4	E
6	A11		A3	F
7	A10		A2	H
8	A9		A1	J
9	A8		A0	K
10	D7		D3	L
11	D6		D2	M
12	D5		D1	N
13	D4		D0	P
14	WAIT		RESET	R
15	INT	U40	EDGINT	S
16	NMI	U30	EXT $\Phi$	T
17	EXT $\Phi$ SEL		$\Phi$ OUT	U
18	MEMR		MEMW	V
19	INPUT		OUTPUT	W
20	RFSH		MREQ	X
21	INTACK		AC	Y
22	+5V		+5V	Z
23	+5V		+5V	a
24	-5V		-5V	b
25	+12V		+12V	c



G-80 MOTHER BOARD BUS PIN ASSIGNMENTS  
X-Y CONTROL BOARD

1	GROUND	GROUND	A
2	A15 U50	U47, U48 A7	B
3	A14 U50	U42, U48 A6	C
4	A13 U50	U47, U48 A5	D
5	A12 U42	U47, U48 A4	E
6	A11 U49	U47, U48 A3	F
7	A10 U49	U47, U48 A2	H
8	A9 U49	U46, U48 A1	J
9	A8 U49	U46, U48 A0	K
10	D7 U14, U44, U45	U14, U43, U45 D3	L
11	D6 U14, U44, U45	U14, U43, U45 D2	M
12	D5 U14, U44, U45	U14, U43, U45 D1	N
13	D4 U14, U44, U45	U14, U43, U45 D0	P
14	$\overline{\text{WAIT}}$ U39	$\overline{\text{RESET}}$	R
15	$\overline{\text{INT}}$	$\overline{\text{EDGINT}}$	S
16	$\overline{\text{NMI}}$	$\overline{\text{EXT } \Phi}$	T
17	$\overline{\text{EXT } \Phi \text{ SEL}}$	$\overline{\Phi \text{ OUT}}$	U
18	$\overline{\text{MEMR}}$ U38	U42 $\overline{\text{MEMW}}$	V
19	$\overline{\text{INPUT}}$ U37	U37 $\overline{\text{OUTPUT}}$	W
20	$\overline{\text{RFSH}}$	$\overline{\text{MREQ}}$	X
21	$\overline{\text{INTACK}}$	$\overline{\text{AC}}$	Y
22	+5V	+5V	Z
23	+5V	+5V	a
24	-5V	-5V	b
25	+12V	+12V	c

26	-12V		-12V	d
27				e
28	$\overline{\text{HLT}}$		MI	f
29	$\Phi/2$			h
30	$\overline{\text{PANEL RESET}}$			j
31	SRC			k
32	$\overline{\text{ADD}}$ U32			l
33		U42, U48, U49	$\overline{\text{FETCH}}$	m
34		U23, U34	$\overline{\text{PCC}}$	n
35				p
36		U44, U45	7.5Mhz	r
37				s
38				t
39				u
40				v
41		U32, U34	$\overline{\text{PCR}}$	w
42			SPEECH READY	x
43	GROUND		GROUND	y

## STAR TREK™ TROUBLESHOOTING PROCEDURES

STAR TREK is a "state-of-the-art" electronic microprocessor based, video game. The result of hundreds of hours of work, design, research, experiment and more work. However, as with any electronic device, component failure or other problems can result in a game that doesn't function properly, or doesn't function at all. In either case, your game is "down", and so critically, are your profits.

Your objective is to fix it as quickly as possible, and logical troubleshooting goes a long way toward that repair. Although many troubleshooting methods may be familiar to you, procedural logic is common among them, and might be stated in this order: visual inspection, symptom recognition, symptom isolation, function isolation, component isolation and repair. Familiarity with the equipment in question will allow you to bypass one or more of these steps, as any particular problem may be obvious to you, or may have happened before. In general though, these 6 steps form a good premise upon which to approach your "down" game.

An extremely important item in our procedure is the first mentioned, giving the gear the "once over". A large percentage of failures found in electronics, show themselves visually and often a great deal of time can be saved by inspecting for burnt or blown components, loose or disconnected wiring or connectors, or PCB traces burnt or pulled up. Thorough visual inspections become increasingly important the closer you get to the faulty item, and should be repeated each time another portion of the game is eliminated. Symptom recognition (as with all electronic troubleshooting) in your game depends first, on knowing what a proper display is, and second, knowing how your display differs from a normal one. Symptom isolation follows naturally; (i.e., "I have no picture", "I have no sound", "I have no control over the car", "the picture is scrambled"), ergo, a video, audio, input or logic problem. Function isolation, such as a sync problem with the video, requires that you consider those functions that go to make up video sync. Is it a monitor problem, or an "on-the-board" problem? A monitor input check to verify the signal will tell you. Does the board have the voltage (from the power supply) that it needs? Yes? We must have a board failure, as we've just isolated down to function.

Taking our sync problem further, before we begin our search for an individual component, let's reapply that first item in our "Logical Troubleshooting Procedure". Look at the board. Open resistors, diodes, and capacitors often give themselves away.

Noticing a trace literally burned open can save you serious "down-time". The board looks OK, so on we go. Specific component isolation relates to the specific nature of the failure, component commonality, proper inputting (both signal and power) and proper outputting (as in the case of an output held high, low, or floating by input port failure in the succeeding state). More general problems (such as a total loss of video sync) requires the more involved procedure of systematic elimination of possibilities. This operation can be expedited however, by dividing the circuit in half, establishing a "go-no/go" at that point, and again dividing the suspect circuit portion in half. The largest possible areas can be eliminated in this manner, dividing and subdividing until the individual component failure is found.

As we've outlined previously, any electronic repair procedure consists of a series of efforts to isolate a problem down to a "managable" level; restating our Logical Troubleshooting Procedure in 6 steps, 1. Visual Inspection, 2. Symptom Recognition, 3. Symptom Isolation, 4. Function Isolation, 5. Component Isolation, and 6. Repair.

In our STAR TREK game system, we are dealing with, essentially, 3 major functional components:

1. The Power Supply
2. The G-80 Boards (Card Cage Module)
3. The Color X-Y Monitor

So, in a typical maintenance procedure, having isolated down to Function (Step 4.), we would next attempt to determine which of the 3 major elements is defective. In the following paragraphs, we will look at each element and some of its sub-divisions as a guide in isolating further.



Usually, the power supply can be eliminated as the source of a problem if the games comes up on the screen. The major exception is when the game plays normally but no sounds are produced. In this case, the power supply's amplifier circuit should be checked for audio signals from the sound and speech boards. If they are present on the amplifier output, then a bad speaker or connection is probably the cause of the problem. If the signals are not there, suspect the amplifier circuits on the sound and/or speech boards.

If the picture does not appear on the screen, check the power supply for the main AC voltage to the primary of its transformer; then ensure that the G-80 boards are supplied with the correct DC voltages from the power supply. Also make sure the 3 VAC reset signal is being applied to the CPU board. If all these tests prove normal, then eliminate the power supply as cause of the problem and proceed to check the remaining functional game components - G-80 boards and monitor.

In most cases, a simple test will help to isolate a problem of no picture to either the G-80 boards or monitor. On an oscilloscope, look for varying voltage signals on pins 1 and 4 of the 4-pin Molex connector on the Timing Board. If the signals look similar to those shown in Figure 1, check for signals swinging between 0 and +4 volts on the RGB outputs (4-pin Molex connector pins 4, 1, 2 respectively) on the Control Board. If all three outputs are at 0 volts, suspect the X-Y boards. If the signals appear normal, suspect the monitor as the cause of the problem. If however, pin 1 (to the monitors horizontal input) is held at or near +4 or -4 volts DC, suspect one or both X-Y boards. If pin 4 (to the vertical input) is held at or near +3 or -3 volts, suspect the other G-80 boards. In either case, TURN OFF THE POWER AND IMMEDIATELY DISCONNECT THE X-Y MONITOR. Proceed to check the inputs to D/A converters U1 and U4 (T5) for active signals. Verify that none of the Character Data lines (C0-C7) are pulled high or low, or are floating. Check for the XCL and YCL clock signals from U28 (T6). Verify that the 15 MHz crystal clock is operating and that a 40 Hz signal is present on pin-11 of U13 (T7). Check BOS signal to be sure it is not held; signal DRAW should be switching high and low. On the Control Board, observe the signal FETCH to ensure it pulses high and low. Also, none of the Data lines (D0-D7) should be held high, low, or floating (C5). Check for clock signals PCC and SCL (C5).

Look for input changes on U1 and U5 of the color circuit (C6); also, pin-3 of U4 should be active high and low. (See figure 1 in the illustrations section).

When the monitor is suspected of a problem, check for all correct power supply voltages as shown in the schematic. Isolate incorrect voltages to either the monitor power supply or to the circuit receiving the voltage.

NOTE: The Color X-Y Monitor contains a circuit that shuts off the high-voltage oscillator when no vertical or horizontal inputs are present. DO NOT ATTEMPT TO RAISE OR LOWER EITHER INPUT WHEN TESTING THE MONITOR. DOING SO WOULD CREATE EXCESSIVE DEFLECTION CURRENT THAT COULD SEVERELY DAMAGE THE MONITOR. For testing the monitor, use only the outputs of the G-80 hardware. In addition, DO NOT operate the monitor WITHOUT proper fuses in the main AC line. If a monitor is blowing main fuses, check the deflection amp power transistors Q605, Q606, Q705 and Q706, WITH THE POWER OFF. Shorted transistors or diodes in the deflection amplifiers will also blow main line AC fuses.

Check the transistors in the color drive circuits for shorts or opens when one or more colors is missing from the display, and the G-80 boards are known to be good.

## COLOR X-Y MONITOR AND G-80 CIRCUIT DESCRIPTION

To begin our discussion of the Color X-Y Monitor, let's first pay tribute to the "other kind of monitor" - the raster-scan. As you may remember from your knowledge of raster-scan displays (like those in a TV), that the electron-beam inside the tube always moves in a predictable way. That is, it always starts at the top left of the screen and scans across it, forming a pattern of horizontal lines on the inside surface of the tube as it moves downward. When it gets to the bottom, the beam is forced back to its starting point and repeats the raster-scan movement. To create a simple display (for example, a large "+" symbol) on the raster-scan monitor, we figure out first, where we want it to appear on the screen; let's say the center, in this case. Then we generate a video signal that represents the "+", plug the signal into the monitor, and we get a "+" on the display. What we have done is intensify the electron-beam so that only those points corresponding to the "+" light up on the raster. (To see how it would look close-up, refer to figure 2 in the illustrations section.)

Notice how the vertical line is not much of a line, but more a column of stacked lines. This occurs because the raster lines, which run horizontally inside the CRT, are spaced slightly as the beam traces them. So what we see, looking at our line from top to bottom is a tiny segment of the lit up raster, then a black space, another lit up segment, another black space, and so on. Now the horizontal line of our figure is perfect, one solid, lit up line corresponding to that particular "raster". The fact that you can't get high-quality traces in both directions is what led to the development of the X-Y monitor. If we create that same centered "+" on an X-Y display, we would see two perfect, solid lines - no gaps anywhere. (Refer to figure 3.) What produces the high-quality, solid lines in any direction in an X-Y monitor is the electron-beam inside the CRT (there are actually three electron-beams, one for each of the three colors, red, green, and blue, although it is often simpler to think of it as one beam). Unlike the beam in a raster-scan unit, the X-Y beam can be moved in any direction we choose. All we have to do is determine where we want to move it. We also need to tell the beam when to turn on, or intensify, to "draw" the design we want, how big to make the

design, what color the lines should be, what angles the lines will take, and when to stop drawing. For now, remember that we are directly influencing the X-Y beam to create our lines by moving it and turning it on when necessary; in the raster-scan, all we had to do was turn on the beam at the right times.

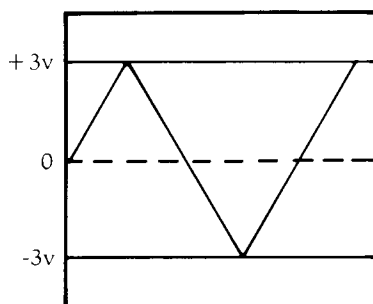
Important differences between the raster and X-Y monitors are that the X-Y's have no need for vertical or horizontal oscillators and drive circuits, since these predetermine the electron-beam's movement. Also, no flyback pulse is needed in the X-Y to move the beam to the top of the raster. However, a very high voltage is still necessary in the X-Y to attract the electron-beam to the front surface of the tube.

Before we delve into the circuits that make up the color X-Y monitor, let's consider how we actually control an electron-beam. Inside the picture tube neck, there is a piece of metal called a cathode. When it is charged with a voltage, it generates electrons. As the electrons are emitted, they are shaped to form a thin ray, or beam, that strikes the front of the monitor. The only way the beam will move up or down, left or right is if a magnetic field is applied around the beam. This is what the deflection coils located around the CRT neck do. There are two coils, one to move the beam up or down (VERTICAL DEFLECTION COIL) and one to move it left or right (HORIZONTAL DEFLECTION COIL). So, by running some current through either coil, we create a magnetic field around the beam to deflect it in any direction. The larger the current we put through either coil, the stronger the magnetic field and the more the beam will deflect.

While we're on the subject of beam movement, consider why this monitor is called an "X-Y monitor". Picture our "+" symbol on the screen again; the horizontal line is called the "X" axis and the vertical line is the "Y" axis, hence "X-Y monitor". Make a mental note that when we move the beam horizontally, we are moving it on the X-axis; moving the beam vertically occurs on the Y-axis. Let's look closer at the color X-Y monitor circuits and see where this deflection coil current comes from. (For the following explanation, please refer to the schematic of the monitor in this manual.) The circuitry primarily consisting of IC 600 (15-2156-01) accepts two varying voltage levels, one for Vertical, one for Horizontal, from the G-80 boards. These

voltages are called ANALOG signals because they represent all voltage levels between two pre-determined levels.

Let's say that we want an analog signal that can vary between two voltages, +3 and -3 volts. We could control it to look like this on an oscilloscope:



As the signal changes, it moves through all possible voltage levels that exist between +3 and -3 volts. Don't confuse this type of signal with a digital one. The digital signal switches between 0, and typically, +5 volts. It does not drop to a negative voltage level. As these varying voltages come into the X-Y monitor, they activate, first the Input Driver, intended to set a proper reference, and the X and Y power amplifiers (Q 600-606, Q 700-706). These amplifiers control the current that flows into the X and Y deflection coils, depending on the voltage levels on the inputs, and the input current set by Limiters Q 201, 202, 251, 252. Remember that this current controls the electron-beam movement, so if we vary the input voltage, we vary the output current and the direction of the beam. The following chart will clarify this:

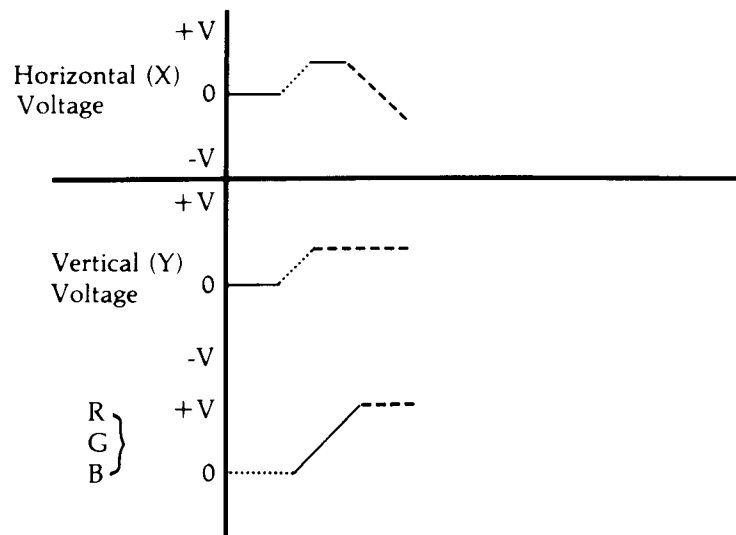
	<u>INPUT VOLTAGE</u>	<u>BEAM MOVEMENT</u>
Y-AMP	Positive	Up
(Vertical)	Negative	Down
X-AMP	Positive	Right
(Horizontal)	Negative	Left

Earlier, we said that there has to be a way to turn on, or intensify the electron-beam to create an image on the screen. Well, there are three more inputs to the X-Y that allow us to do just that; they are the color inputs R,G,B and they accept analog signals from the G-80 hardware. These color

signals activate the three color electron-beams through the circuits in the Video PCB. Using what we know so far, let's apply it to an actual example of drawing something simple on the screen - a white line for instance. (Refer to figure 4 - illustrations section.)

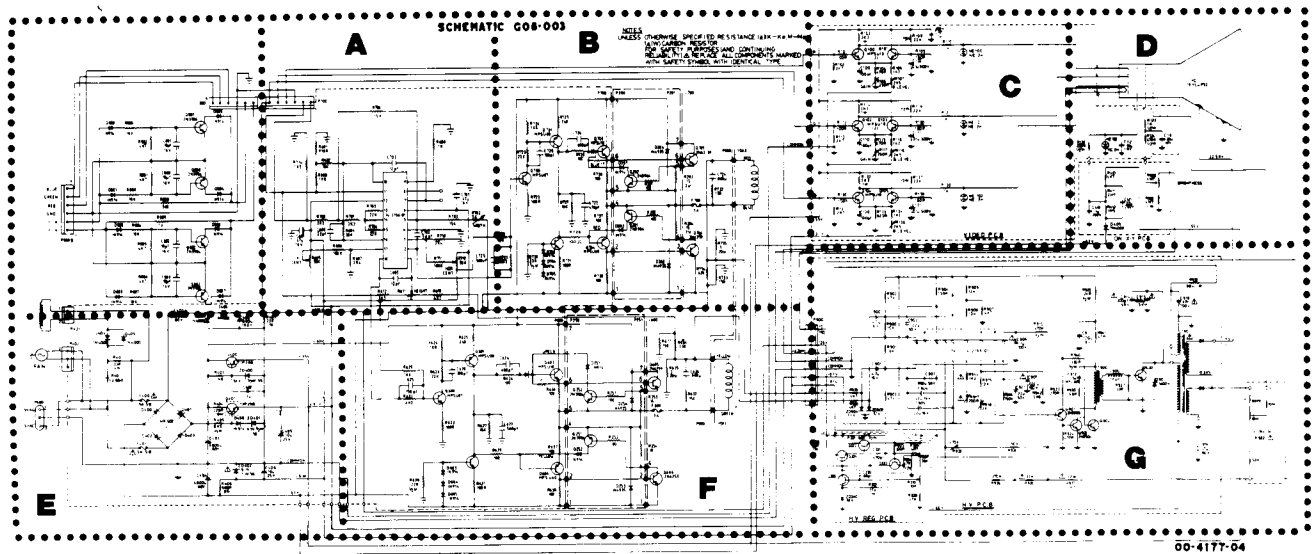
Point A, the center of the screen, is the starting point for the electron-beam. To move the beam to point B, we have to supply voltages to the monitor's inputs that cause the beam to move at a 45 degree angle. To do that requires two increasing positive voltages on the horizontal and vertical inputs. (See the chart above). Not only are these voltages positive in this case, they also have to be equal. And if they are equal, the deflection coils will force the beam the same distance both upward, and to the right, at the same time. Moving at any other angle is just a matter of making one coil deflect more or less than the other. Again, notice that both coils force beam deflection simultaneously.

Since we don't want this 45 degree line to show up on the screen, we don't feed any voltages to the RGB inputs. But, we know the beam is at point B, awaiting further deflection. Now, we cause the voltage on the horizontal (X) input to go negative and leave the vertical voltage where it is. Also, we turn on the RGB inputs to give us a white line. From the chart, you can see that these voltages will cause the beam to move to the left, horizontally, to point C. Our line is complete, and here is what our input signals looked like during this process:



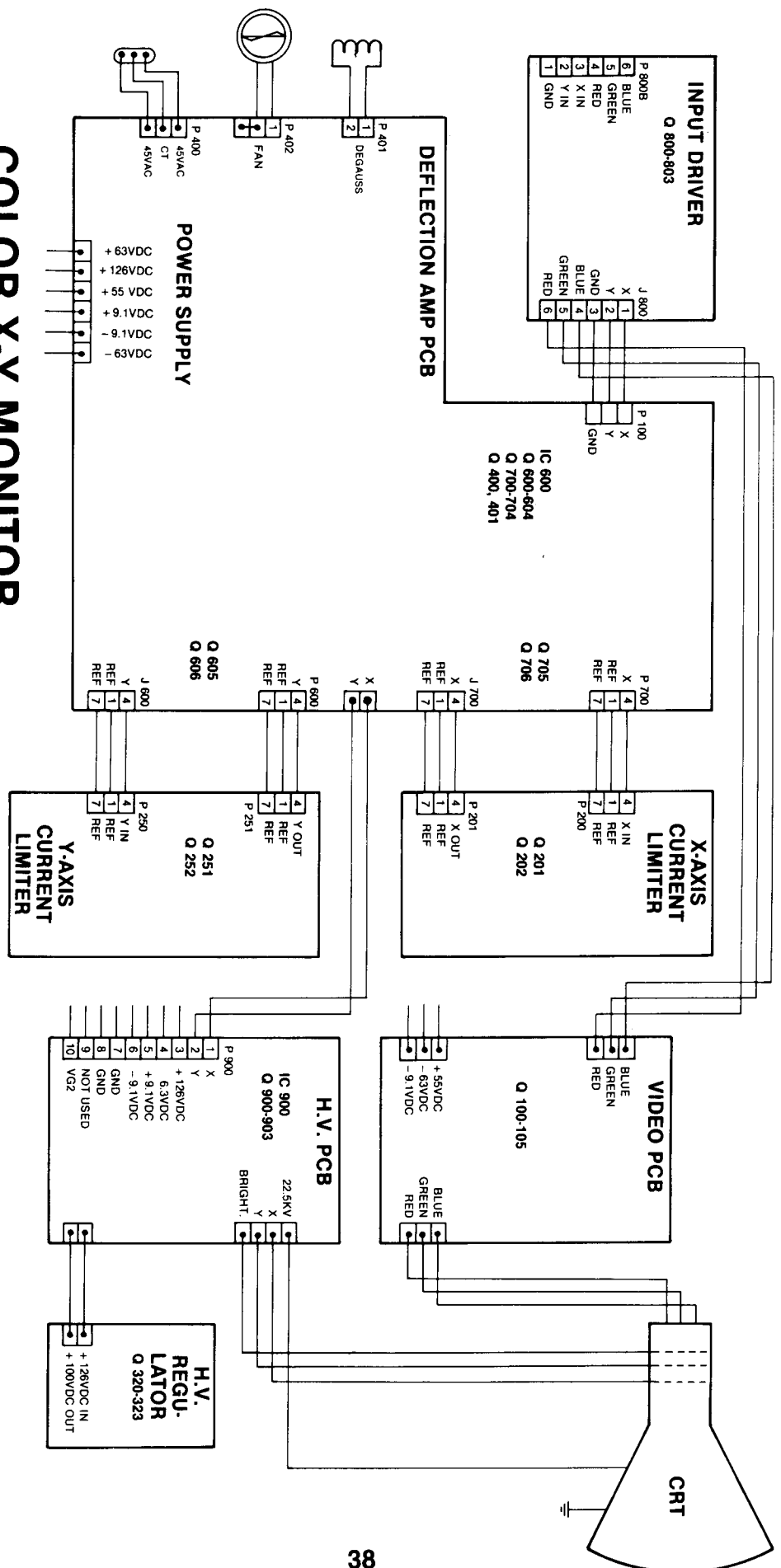
In our example, we made a very short line, considering we could have drawn one clear across the screen. In order to draw longer lines, in any direction, we simply increase the positive or negative voltage on the inputs. Remember - the higher the voltage, the more the deflection, the longer the line.

The remaining circuits in the monitor are a power supply, a CRT and brightness control (CRT PCB), and high voltage generator. Here are Functional Block, and Signal Flow diagrams for the Color X-Y Monitor:



# COLOR X-Y MONITOR

## MODEL G08-003





Referring back to the monitor schematic for the following discussion, the circuitry in block A serves two purposes. First, it compensates for a type of distortion known as the pin-cushion effect. This occurs because the electron-beam must travel a greater distance when striking the edges of the CRT than when it hits the center. If we cause the beam to trace along the edges of the CRT, the beam would draw a box with its left and right sides bowed inward. To compensate for the effect, this circuit offsets the point where the beam would normally strike the CRT surface.

Secondly, this circuit contains two error amplifiers, one for the horizontal and one for the vertical inputs. Each error amp has two inputs; one is set to zero volts, the other accepts the analog signal from the G-80 system, sensing current movement in the deflection coil. The analog signal is allowed to pass through the error amps and drive the deflection (power) amps. The deflection amps are shown in blocks B and F. The outputs of the X and Y power amps pass current through their respective deflection coils. The output leads of the two coils are connected back to the analog inputs of the respective error amps, as mentioned above. This acts as an error, or feedback, signal and ensures that the current through the deflection coil remains proportional to the voltage on the error amp inputs. If this signal were not provided, there would be a slight deflection error when an analog input signal was present.

The outputs of the X and Y deflection amps can swing between +60V and -60V. This voltage is high enough to provide up to 8 amps, peak-to-peak, of current through the deflection coils.

The color drive circuits are located in schematic block C and they accept a 4 volt maximum signal on the RGB inputs. The outputs drive the three electron-beams in the CRT. Three neon glow-bulbs, NE-100, 101, and 102 act as spark arrestors for the color-drive outputs to the CRT. In block D, the CRT is shown, as well as the brightness adjustment for it. The circuit of D 409, R 411; R 410 is a spot-killer that prevents the electron-beams from burning a hole in the phosphor surface of the CRT when the monitor is turned off. Section G of the schematic consists of the high-voltage oscillator in IC 900 (14-2155-01) which operates the high-voltage transformer, T 901. This transformer is technically a flyback type, but it is not used to deflect the beam.

The IC serves two other functions; it senses the presence of the 10.3KV through R 921 and R 932 and compares it against the 9.1 supply voltage to ensure a regulated output, and also senses the varying current in either deflection coil. If no change is detected, the IC shuts down the high-voltage oscillator to prevent the beam from "burning" the face of the CRT.

Finally, the X-Y power supply is shown in block E, generating the following voltages:

- +60V to X-Y power amplifiers
- +55V to RGB video drivers and spot killer
- +9.1V to the IC's
- +120V to the EHT oscillator

A degaussing circuit is provided through D 404, D 405, and R 400. The CRT is automatically degaussed when R 400 is cooled sufficiently to conduct current through the degaussing coil.

### G-80

It's not hard to imagine how fast the input signals to the color X-Y monitor must be changing in order to produce the game displays. It's also obvious that a computer must be making all this happen. That is exactly the case with the G-80 hardware used in Color X-Y game. It contains two new boards, the X-Y Timing and X-Y Control boards that produce the X-Y monitor input signals. The G-80 still relies on its CPU, EPROM, Sound, and Speech boards to complete the computer.

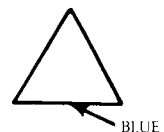
But what does a digital computer have to do with producing the analog signals required by the X-Y monitor? Basically, the computer converts certain digital signals into analog ones. On the G-80 X-Y boards are circuits (some are actually single IC's) called Digital-to-Analog converters, D/A for short. These circuits accept a particular digital word, that is, a string of 0 and +5V voltage levels. The D/A converter senses the word and outputs one and only one voltage level which corresponds to the digital word. For example, we could design a simple D/A converter that would generate the following voltages when we input certain digital words:

DIGITAL WORD	ANALOG OUTPUT
0000	-1 Volt
1111	+1 Volt
1000	0 Volt

This is a very basic case, but it shows that, for a particular D/A converter, we always produce one voltage level from the corresponding digital input. If we cycle through a variety of digital inputs, we'll get a variety of output voltages. If we do this fast enough, we actually create a rapidly varying range of output voltages. This output is exactly the kind of signal we need to drive the deflection coils in the monitor.

Now that we know where the analog signals come from, what about the digital ones? Before we can display anything on our X-Y screen, we have to ask some questions: (Answers are provided for examples sake)

QUESTIONS	ANSWERS
1. What do you want on the screen?	A triangle.
2. How many?	One.
3. What design? - What angle?	Equalateral (3-60 <sup>0</sup> angles).
4. What size?	3" on a side.
5. Positioning?	Centered on the screen.
6. What colors?	2 sides white, 1 side blue.
7. Screen alignment?	Like this:

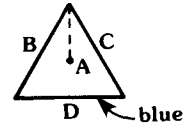


8. What will it do?

Just sit there.

9. How many lines does the electron-beam have to trace?

In our triangle, the beam must make 4 lines:



A (even though we don't see it), B, C, and D.

Now that we have our specifications, we have to store this information someplace so the Timing and Control boards can get to it and understand. That place is video memory RAM (or Random Access Memory). It holds 4096 eight-bit words or bytes. Naturally, we don't place all this into memory and hope the X-Y boards can find it; it's stored in an orderly fashion.

First, we divide the video memory into two main groups - let's call them 1) The Symbol Instructions and, 2) The Line Instructions. Into the Symbol Instructions Section we store one group of ten words for every symbol or design we put on the screen. In our example, we have only one symbol, so we use only 10 words. Into the Line Instructions Section we put one group of four words for every Line that the beam has to draw. So, for our triangle, which requires 4 lines, we would store 4 groups of 4 words in the Line Instructions space. Every word we store in memory has one and only one address, so the same word can be called on over and over. Now let's look closer at the Symbol Instructions memory space. Here is what the 10 words do: (Don't be concerned with the actual values of those words right now.)

WORD 1        It tells the X-Y boards either to make the beam draw the symbol in this group of words or not to draw it. And the same word informs the boards that either this group of words is the only group or that there are more 10-word groups to follow.

WORD 2 and 3 These tell the boards where the beam is on the X-axis.

WORD 4 and 5 These tell the boards where the beam is on the Y-axis. The last four words then, give the exact coordinates of the electron-beam.

WORD 6 and 7 Words 6 and 7 tell the X-Y hardware what the first address is of the Line Instructions section.

WORD 8 and 9 These tell the hardware how the complete symbol (our triangle) will appear on the screen, or at what angle.

WORD 10 This word tells what the overall size of the design will be.

Again, since we're only making one design, there will be no more 10-word groups after the one above. Now take a look at the Line Instructions section of memory:

#### GROUP 1

WORD 1 This word tells the G-80 boards either to blank or to unblank the line. And, it informs the boards that either additional 4-word groups follow or no more groups follow. Finally, it defines the color this particular line is to be.

WORD 2 This word represents the length of the line the beam is to draw.

WORD 3 Word 3 tells the hardware at what angle the beam should make its line.  $45^{\circ}$ ?,  $90^{\circ}$ ?

WORD 4 Word 4 defines in which of the four sections of the screen the line is to appear - which quadrant.

The remaining 4-word groups contain the same representations of their respective lines, as in Group 1. The values will be different, of course,

depending on how the lines differ. In our triangle example we would find 3 more groups of four words after Group 1.

By now, you may be wondering what all these "words" really are. Since we are dealing with a digital computer, the "words" we described above must be digital. More accurately, they are digital values of the specifications required to create our designs. We have taken the specifications for sizes, angles, shapes, colors and locations and converted them into digital words and create displays that the word represent.

Before we go any further, you should know that the words read from the video RAM didn't get there by magic. The microprocessor put them there. All words that represent all the characters and designs in a game are kept safely in EPROM (Erasable Programmable Read Only Memory), on the EPROM board. When the game is powered up the CPU moves the various word groups from EPROM to RAM. Once situated in video memory, the words are made available to the Timing and Control boards to create displays. Briefly, here is what the two X-Y boards do with the words:

After all the character words are loaded into video RAM, the Program Counter is forced to call on the first RAM address. Here the Program Counter finds the first word in the Symbol Instructions section. One at a time, these ten words are taken out of RAM and latched into specific parts of the X-Y boards. This sequence is controlled by the Timing Generator which generates 15 active-low signals; only one signal pulses low at a time to latch the words. Next, the following sequence occurs:

1. Word 1 is latched into U52, Last Symbol block.
2. Words 2 and 3 (from the Symbol Instructions) are loaded into the X-axis Up/Down counters.
3. Words 4 and 5 are loaded into the Y-axis Up/Down counters.
4. Words 6 and 7 are stored in the Vector Address counter.

5. Words 8 and 9 are stored in the Symbol Angle latch.
6. Word 10 is loaded into the Serial Multiplier.

Now the first 10 words of a character we wish to display are stored somewhere. If we had not wanted to draw this character, the Program Counter would have jumped to the next set of 10 symbol words, if there were another symbol. Once the Program Counter is finished moving out the words, the Vector Address counter takes control of memory. This switching between the Program and Vector Address counters is governed by the Multiplexer. Through it, the G-80 Address Bus or one of the other counters can address video memory. Only one device is allowed access to memory at a time. When it is the Vector Address counter's turn to get into memory, the counter addresses the first word of the Line Instructions section. The reason for this, is that the Vector counter was previously loaded with words 6 and 7 in the Symbol Instructions section. These words tell the Vector Address counter the locations of the first word in the Line Instructions section. Now the Vector counter causes the Line Instruction words to be moved out of memory, one at a time. Here is what happens to the group of four words:

1. Word 1 is stored in the Color Latch and in U52, Last Vector.
2. Word 2 is stored in the Vector Length counters.
3. Word 3 is loaded into the Vector Angle circuit.
4. Word 4 is used in the Vector Angle circuit.

Up to this point then, 10 words that describe some symbol and 4 words that represent one line in that symbol have been clocked out of memory. When the Vector Address counter takes out the last group of words that represents the last line to be drawn, memory access is switched back to the Program Counter. It will now either restart the sequence as before (if there is another symbol to be drawn) or it will stop until the counter is reset to the beginning again.

Now the system is ready to draw its first line, to actually move the beam, because we have given it exact specifications to do so. The position of the electron-beam is now known, (Words 2 through 5 in the Symbol Instructions) so

we know where the beam will start to draw. Then, the X-Y boards calculate the length and angle of our first line. And they know the color, if any, of this line. (In our triangle, recall that our first line, A, is one that we shouldn't see, although it must be drawn. We also know that it must be drawn at a  $0^{\circ}$  angle, straight up.) The boards calculate the line length and angle by assigning a certain number of digital clock pulses to these qualities. The circuitry acts as a digital "ruler" and "protractor" and measures any line, in terms of how many pulses in length and angle it is. All this figuring is performed by the Full Adder's, 2708 EPROM and Rate Multipliers. The output of each Rate Multiplier (XCL and YCL) is a string of clock pulses that clock the respective Up/Down counter, X or Y. But the pulses are not just random pulses, they are the digital equivalents of a line with a particular length and angle. So we clock both Up/Down counters at the same time with these pulses. Doing so we force the counters to start counting from the beam position words previously stored in the counters. The important point is this; if we change the digital values of the beam position words, we change the position of the beam through the D/A converters. How far, and at what angle we change the beam depends on the amount of pulses applied to the Up/Down counters. Just before the beam is moved, the color of the line (black included) is sent to the monitor through the RGB D/A converters.

There you have it - one line. For more lines, the G-80 system rapidly follows the same procedure of reading the symbol and line words, latching them, calculating line values, color values, and then forcing the beam line-by-line to form complete symbols.

Notice that throughout our discussion, we have mentioned the microprocessor's role just once; loading the character word into memory. During an actual game however, it does more than act as a "loader". Whenever we want to move our symbols on the screen, for example rotate the triangle, we need some way of changing all those words to represent new lines and angles. The CPU fulfills this job nicely. Under program control, the CPU is told when and how to alter these words to create a whole range of dynamic displays - different colored lines, new angles, longer or shorter lines, bigger or smaller characters, whatever the game play calls for. Also, the microprocessor governs functions such as player control and coin inputs, or sound and speech outputs.



The CPU then, gives us the variety and color in our X-Y games. - PLEASE NOTE: The designations in parenthesis will be used throughout the following detailed discussion to refer the reader to the proper schematics. C = X-Y Control Board (P/N 800-0163) sheets 5 and 6. T = X-Y Timing Board (P/N 800-0161) sheets 5, 6, and 7. e.g. (C6) = Control Board, sheet 6.

The CPU addresses video memory, U24-U31, through multiplexer IC's U48 and U49 (C5). Character words are taken from memory as the Program Counter, ICs U33, U34, U22 (C5), addresses them through multiplexers U36, U49, U35, and U21 (C5). If Word 1 (Symbol Instructions) says to not display a symbol, the Program Counter is advanced 10 counts by U33, a full adder, which adds 10 to the counter when signal ADD goes low. The Vector Address counter is composed of U10, U11, and U12 (C5) and is loaded with the first address of the Line Instructions from video memory's Character Data Bus, CDO-CD7. The CPU's Data Bus, DO-D7, is brought to the memory through a bi-directional buffer, U14 (C5). The signal labelled FETCH (C5) latches the various Character Data words from memory. The MUX (C5) signal commands the multiplexer ICs to allow either the CPU, Program Counter or Vector Address counter to address memory. MEMR (memory read) and MEMW (memory write) come from the CPU board to read from or write to the RAM. Signal VCE (C5), Vector Clock Enable, increments the Vector Address Counter. PCC (Program Counter Clock) is the string of pulses that advances the Program Counter; PCR (Program Counter Reset) ensures that the Program Counter starts counting at the first location in video RAM each time PCR goes low. This signal occurs first at power-up and then 40 times a second during program execution. So, it causes the X-Y monitor to draw and re-draw each symbol on the screen 40 times a second. The signal is generated from the master clock (crystal Y1 and U14, T7) by U31-U34 and U22 (T7). The other clock signals (VCE, PCC, FETCH, ADD, MUX, and VCL) are all generated by the X-Y Timing board (T7).

The outputs of the Last Symbol and Last Vector latches (U52, T7) are AND gated together with the signal END, which originates from the Control board's U18 (C6). When U18's output goes low, it signifies that no more symbols are to be drawn. Then the Program Counter is reset by the 40 Hz signal to the start of the video memory to repeat the display sequence. U22 (T7) is the DRAW latch and its output, through U21, creates the DRAW signal which initiates a

sequence that causes the beam to draw. This sequence occurs on the Timing Board, sheet 6; by this time, all video words have been stored in their proper places in the system. On the Timing Board (T7), the vector angle is in U56, the symbol angle in U55. So when DRAW goes high, it causes strings of digital pulses that represent the vector and symbol angles to be generated. These streams of pulses (from U28, T6) are the ones that clock the X and Y Up/Down counters, shown on T5 (U15-U20). U25 (T6) tells the counters in which direction to count, up or down (D/U X, D/U Y). Then, the outputs of the Up/Down counters, X and Y, become the digital words that are converted to analog signals by D/A converters U1 and U4 (T5). On Amps U2 and U3 (T5) convert current from the D/A converters to voltage levels. These levels drive the Vertical and Horizontal inputs to the monitor. Signals DRAW and VCL are combined in U28 (T6) to form DCL (Draw Clock). This signal clocks down the Vector Length counters U15, U16 and U17 (C6) which contain words that represent various lengths of the lines to be displayed. When the counters have counted down to 0, the END signal becomes active. As the X and Y Up/Down counters are clocked, their outputs are sensed by U5-U10 (T5), which are multiplexers. The multiplexers are necessary to tell the system when the beam is off the screen. It does this by generating the BOS signal (T5). Then BOS is AND gated with DRAW at U5 (C6), to blank (turn off) the beam whenever BOS goes low.

U3 (C6) compensates for the inherent delay in deflecting the electron-beams. It provides a number of taps to select a range of delay times. From U2 (C6), the color word is read and applied to the RGB D/A converters U5, U1 and associated diodes and resistors. The RGB outputs go directly to the color X-Y monitor.

U50, a 74LS154 (T7) decoder IC, selects one of 15 outputs by making the output low. The outputs sequentially store the video memory words, one at a time. U50 is enabled at pin 18, forty times per second by U22 (T7), and at pin 19 by U21. U51 sequences U50 through its 15 count cycle; at count 14, pin 16 of U50 goes low to initiate the DRAW signal through U40, U21 and U22 (T7).

The circuitry at the top of schematic C6 (U45, U51-U54) is not used in generating and displaying characters on the X-Y monitor. Its function is to perform lengthy calculations under software control.

# Illustrations

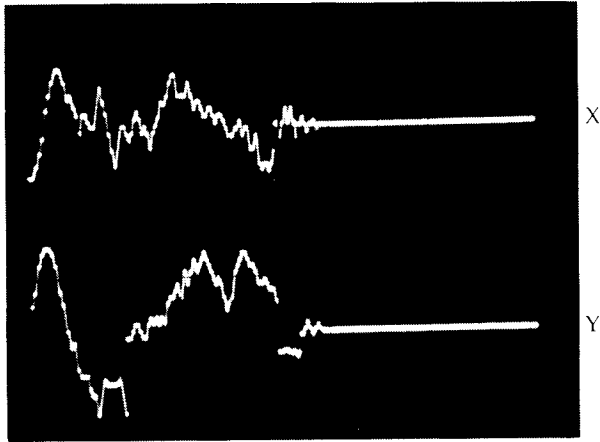


Figure 1

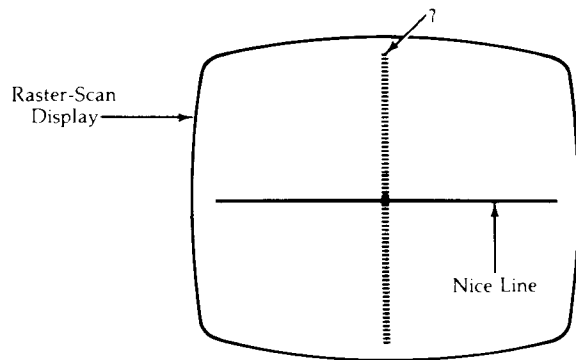


Figure 2

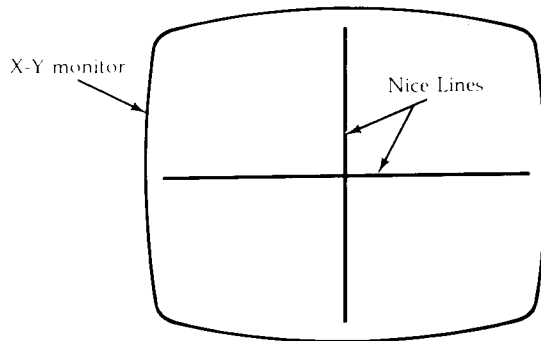


Figure 3

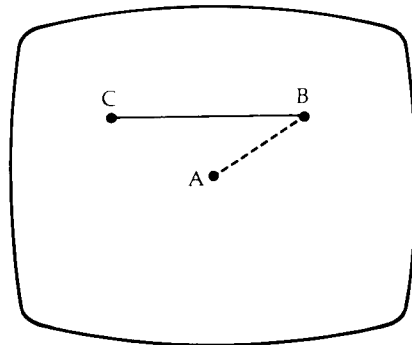


Figure 4

## ADJUSTMENTS AND SPECIFICATIONS

On the X-Y Timing Board, there are two potentiometers that adjust the outputs of the X and Y current-to-voltage converters (U2 and U3, respectively); they are:

R3 (X)	U2
R6 (Y)	U3

On the monitor, there are a number of factory-set adjustments. DO NOT USE THESE CONTROLS. They are:

R106	R917
R117	R918
R611	R920
R702	

The following controls can be used to adjust the monitor if necessary:

R605	Vertical
R712	Horizontal
R107	Red
R118	Green
R136	Blue
R930	Brightness
R922	Focus

Input specifications from the G-80 boards to the color X-Y monitor are:

Vertical Input	+3V maximum
Horizontal Input	+4V maximum
Red Input	+4V @ full brightness
Green Input	+4V @ full brightness
Blud Input	+4V @ full brightness

VOLTAGE ANALYSIS FOR THE G08-003 COLOR X-Y MONITOR

DEFLECTION PCB

P 900 (EHT)

Pin 1	2.8 VAC
2	3.5 VAC
3	-9.1 VDC
4	9.1 VDC
5	GRD
6	GRD
7	5.0 VAC
8	120 VDC
9	OPEN
10	400 VDC

D 401 - cathode	63 VDC
D 403 - cathode	63 VDC
D 400 - anode	-63 VDC
D 402 - anode	-63 VDC
ZD 400	59 VDC
ZD 401	9.0 VDC
ZD 402	-9.1 VDC

Q 400 - base 59 VDC, - emitter 58.8 VDC, - collector 63.5 VDC

Q 401 - base 9.7 VDC, - emitter 9.1 VDC, - collector 17 VDC

IC 600

Pin 1	0	10	0
2	4.2 VDC	11	0
3	0	12	-9.1 VDC
4	0	13	0
5	0	14	0
6	9.1 VDC	15	0
7	7.5 VDC	16	0
8	0	17	0
9	0	18	4.2 VDC
Q 600 - collector	34.5 VDC	Q 700 - collector	35.9 VDC
Q 601 - collector	0.8 VDC	Q 701 - collector	0.5 VDC

Q 602 - collector	-0.5 VDC	Q 702 - collector	-0.8 VDC
Q 603 - collector	63.5 VDC	Q 703 - collector	63.5 VDC
Q 604 - collector	-63.9 VDC	Q 704 - collector	-63.5 VDC
Q 605 - collector	63.9 VDC	Q 705 - collector	63.9 VDC
- base	0.1 VDC	- base	0.1 VDC
- emitter	0.1 VDC	- emitter	0.1 VDC
Q 606 - collector	-63.9 VDC	Q 706 - collector	-63.9 VDC
- base	-0.1 VDC	- base	-0.1 VDC
- emitter	-0.1 VDC	- emitter	-0.1 VDC

EHT PCB

IC 900

Pin 1	0.4 VDC	10	1.7 VDC
2	0	11	8.7 VDC
3	0.1 VDC	12	8.7 VDC
4	-9.1 VDC	13	2.3 VDC
5	9.0 VDC	14	9.0 VDC
6	0.7 VDC	15	0.5 VDC
7	1.7 VDC	16	0.1 VDC
8	7.5 VDC	17	8.7 VDC
9	0.1 VDC	18	0

Q 901 - emitter	8.0 VDC
- base	7.5 VDC
- collector	0.3 VDC
Q 902 - emitter	0
- base	0.3 VDC
- collector	0.5 VDC
Q 903 - emitter	0
- base	0.5 VDC
- collector	3.0 VDC

## UNIVERSAL SOUND BOARD CIRCUIT DESCRIPTION

The Universal Sound Board operates under control of stored program data. These digital signals are converted to an analog signal (clocked sinusoidal wave), by the use of digital-to-analog converters, summed together and fed through an output amplifier. This final output may or may not be filtered.

The sound board is sub-divided into three independent and identical sound blocks or envelopes (CTC0, CTC1 and CTC2). Refer to the table for IC assignments for the individual blocks.

A sound block consists of (a) Programmable Interval Timer, an 8253; (b) a decode multiplexer which provides a WR signal for the D-to-A converters (74LS139's); (c) three independent and identical output channels (AD7524's); (d) a filtering network, made up of analog switches (4053's) and a controller IC (74LS74's); and (e) a summing amplifier (TL082's).

Under program control the sound data is simultaneously sent to the timing IC's (8253's) and the D-to-A converters. The Programmable timer generates three sine wave outputs (OUT 0, 1, 2) which provides a timing signal for the D-to-A converters and the filter network. Simultaneously, the decoder multiplexers (74LS139's) under program control develops a WR signal that allows the program data, already available, to be written into the D-to-A converters. The output of the D-to-A converters (pin 1) are fed into the op-amps (TL082's) which provides a sine wave output that varies between plus and minus two volts. The output of these three channels are then summed together by the op amps. The resulting output can then either be sent directly to the output amp or be re-routed and fed through the filtering network.

The filtering network is under control of the signal switch(s) which is developed by the controller IC's (74LS74). When the signal switch equals one (a HI), the filtering network is on, and the output is being filtered. The opposite is true when the signal switch equals zero (a LO). Circuit configuration in the analog switches are: xy to y for one (HI), and xy to x for zero (LO). The switch signal also allows development of a filtered or un-filtered noise output.

Finally, the analog sound output of the filters is then routed to the output amplifier TL082 (U1).

STAR TREK SOUNDS

11/23/82

2 ms. clock rate (USB jumper P2 set at pin #5)

Enterprise Impulse Drive . . . . . uses SB0, channel A, switch=1  
Enterprise Warp Drive . . . . . uses SB0, channels A, B and C, switch=1  
Enterprise Phaser . . . . . uses SB1, channels A, B and C, switch=0  
Enterprise Photon Torpedo . . . . . uses SB0, channels A, B and C, switch=1  
Enterprise Red Alert . . . . . uses SB1, channel B, switch=0  
Enterprise Targeting . . . . . uses SB2, channels A and B, switch=0  
Enterprise Command Deny . . . . . uses SB1, channel A, switch=0  
Enterprise Shields Hit . . . . . uses SB2, channel B, switch=0  
Enterprise Hit . . . . . uses SB2, channels A, B and C, switch=0  
Enterprise Explosion . . . . . uses SB1, channels A, B and C, switch=0,  
SB2, channel C, switch=0  
Enterprise Introduction . . . . . uses SB0, SB1 and SB2, channels A and B,  
switch=1  
Klingon Photon Torpedo . . . . . uses SB , channel B, switch=0  
Klingon Explosion . . . . . uses SB1, channels A, B and C, switch=0,  
SB2, channel C, switch=0  
Klingon Introduction . . . . . uses SB0, SB1 and SB , channels A and B,  
switch=1  
Star Base Dock . . . . . uses SB0, channels A and B, switch=1  
Star Base Hit . . . . . uses SB2, channels A, B and C, switch=0  
Star Base Damage Critical . . . . . uses SB1, channel A, switch=0  
Star Base Explosion . . . . . uses SB1, channels A, B and C, switch=0,  
SB2, channel C, switch=0  
Star Base Bonus Used . . . . . uses SB1, channel A, switch=0  
Star Base Bonus Unused . . . . . uses SB1, channel A, switch=0  
Star Base Introduction . . . . . uses SB0, SB1 and SB2, channels A and B,  
switch=1  
Saucer Warp Suck . . . . . uses SB2, channel B, switch=0  
Saucer Exit . . . . . uses SB2, channel B, switch=0  
Saucer Warp Suck/Exit Off . . . . . uses no channels  
Nomad Moving . . . . . uses SB2, channel B, switch=0  
Nomad Stationary . . . . . uses SB2, channel B, switch=0  
Nomad Movement/Stationary Off . . . . . uses no channels  
Player Change . . . . . uses SB0, channel B, switch=0  
Game End . . . . . uses SB2, channel B, switch=0  
High Score Music . . . . . uses SB0 and SB1, channels A and B,  
switch=1, SB2, channel A, switch=1  
Coin Drop Music . . . . . uses SB0 and SB1, channels A and B,  
switch=1, SB2, channel A, switch=1



UNIVERSAL SOUND BOARD  
SOUND BLOCK IC ASSIGNMENTS

	<u>Sound Block 0</u>	<u>Sound Block 1</u>	<u>Sound Block 2</u>
P. I. Timer (8253's)	U41	U42	U43
Channel A	U26, U19	U12, U3	U27, U20
Channel B	U25, U18	U13, U4	U28, U21
Channel C	U24, U17, U7	U14, U5, U16	U 9, U22, U31
Filter Network	U8	U16, U9, U7, U15	U30, U23, U31
Controller IC for			
Filter Network	U38	p/o U2	p/o U2
Decoder Multiplexer	U10	p/o U11	p/o U11
Summing Amp	U6	U9	U23

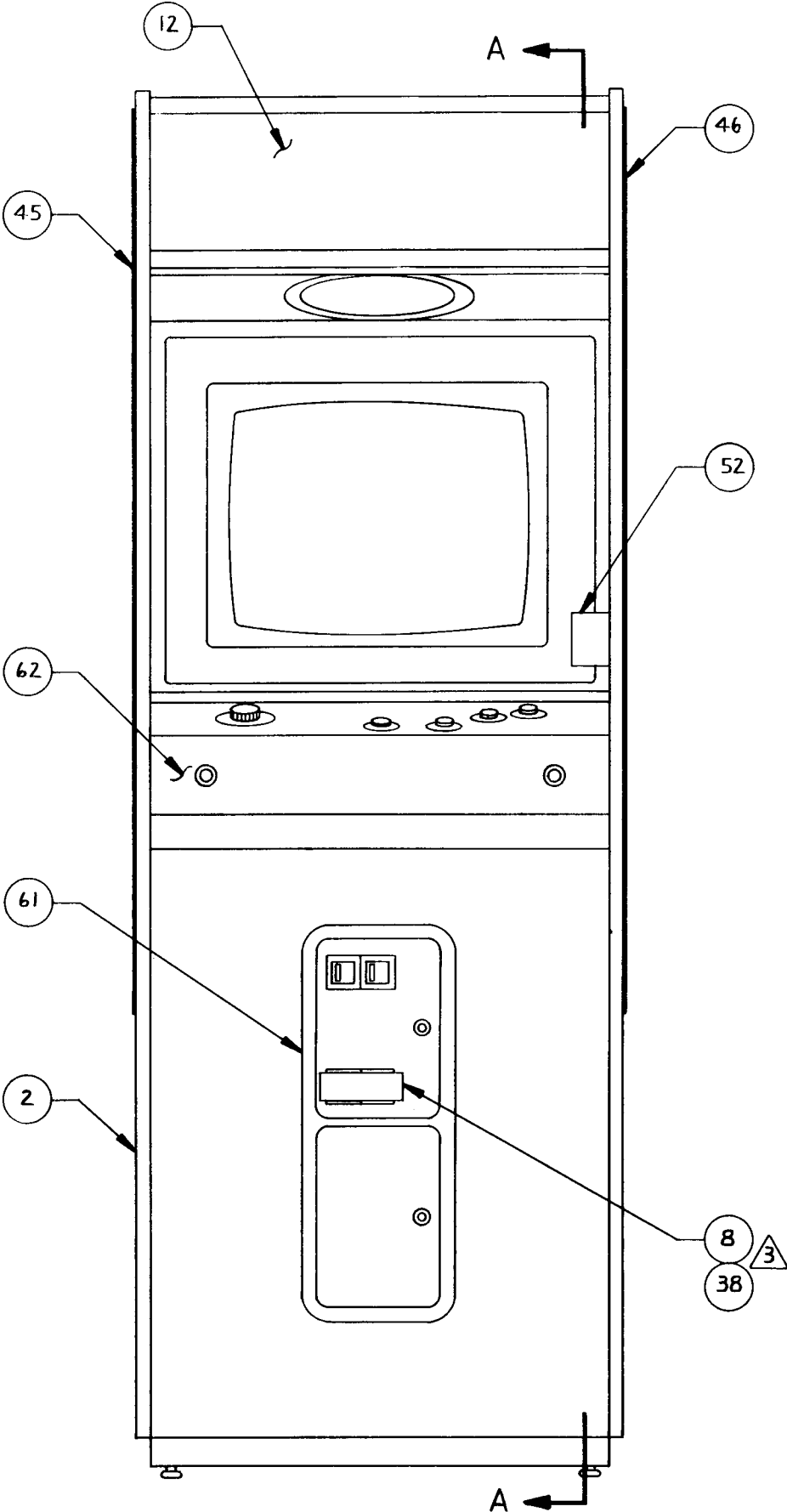
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>
1	140-0021-00	1	Cover Junction Box
2	140-0111-00	1	Cabinet Model 104
3			
4	220-0178-00	2	Draw Catch
5	250-0568-01	1	Logo Panel Molding
6	250-0568-02	1	Logo Panel Molding
7	253-0228-00	1	Clear Monitor Panel
8	253-0238-00	1	Plastic Bag 3.00 x 4.00 Vinyl
9	253-0254-00	1	CRT Mask, 19"
10	253-0281-00	1	Envelope, 12 x 15, Clear
11	253-0285-00	1	Horizontal Plastic CRT Bezel
12	253-0291-00	1	Logo Panel
13			
14	260-0001-00	1	Axial Cooling Fan
15	280-0005-00	40	Cable Tie
16			
17	280-0475-00	60	Staple
18	280-0495-00	1	Compression Spring
19	281-0045-28	2	Screw, 10-16 x 1.75 PN HD Phil Sheet Metal Type AB
20	281-0045-12	7	Screw, 10-16 x .750 PN HD Phil Sheet Metal Type AB
21	281-0134-12	8	Screw, 8-18 x .750 PN HD Phil Sheet Metal Type AB Black
22	281-0185-24	4	Screw, 10-16 x 1.50, 82° Flat HD Phil Sheet Metal Type AB Black
23	281-0042-32	4	Screw, 6-20 x 2.00 PN HD Phil Sheet Metal Type AB
24	282-0017-24	4	Bolt, ¼-20 x 1.50 Hex HD Machine THD
25	282-0019-32	1	Bolt, 3/8-16 x 2.00 Hex HD Machine THD
26	283-0060-18	4	Washer, #6 Flat, Steel

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>
27	283-0060-25	3	Washer, #10 Flat, Steel
28	283-0060-34	4	Washer, # $\frac{1}{4}$ Flat, Steel
29	283-0060-40	1	Washer, #3/8 Flat, Steel
30	283-0061-06	7	Washer, #10 Lock, Split, Steel
31	283-0061-08	4	Washer, # $\frac{1}{4}$ Lock, Split, Steel
32	283-0061-10	1	Washer, #3/8 Lock, Split, Steel
33	283-0071-14	1	Nut, 10-24 Wing, Steel, Machine
34			
35	289-0002-02	1	Cable Clamp .250 Nylon
36	320-0020-00	4'	Sealant Foam
37			
38	320-0053-00	.66'	Duct Tape
39	420-0030-00	1	Decal, Caution 115V
40	420-0656-00	1	Decal, Self-Test Instructions
41	420-0713-00	1	Advertising Pouch
42	420-0793-00	1	Decal, Toll-Free Numbers
43	420-0855-00	1	Star Trek Manual
44	420-0856-00	1	Interior Graphic
45	420-0857-00	1	Left Side Graphic
46	420-0858-00	1	Right Side Graphic
47	420-0860-00	1	Decal, Dip Switch Settings
48	420-0861-00	1	Box Decal
49	420-0864-00	1	Light Baffle
50			
51	420-0912-00	1	Decal, FCC Compliance
52	420-0913-04	1	Decal, Original Game Seal
53	420-0917-00	1	Decal, FCC Warning
54	420-0936-00	1	Decal, Trademark
55			
56	800-0145-01	1	Assy AC Junction Box
57	800-0322-00	1	Assy Fan Cord

TOP ASSEMBLY STAR TREK

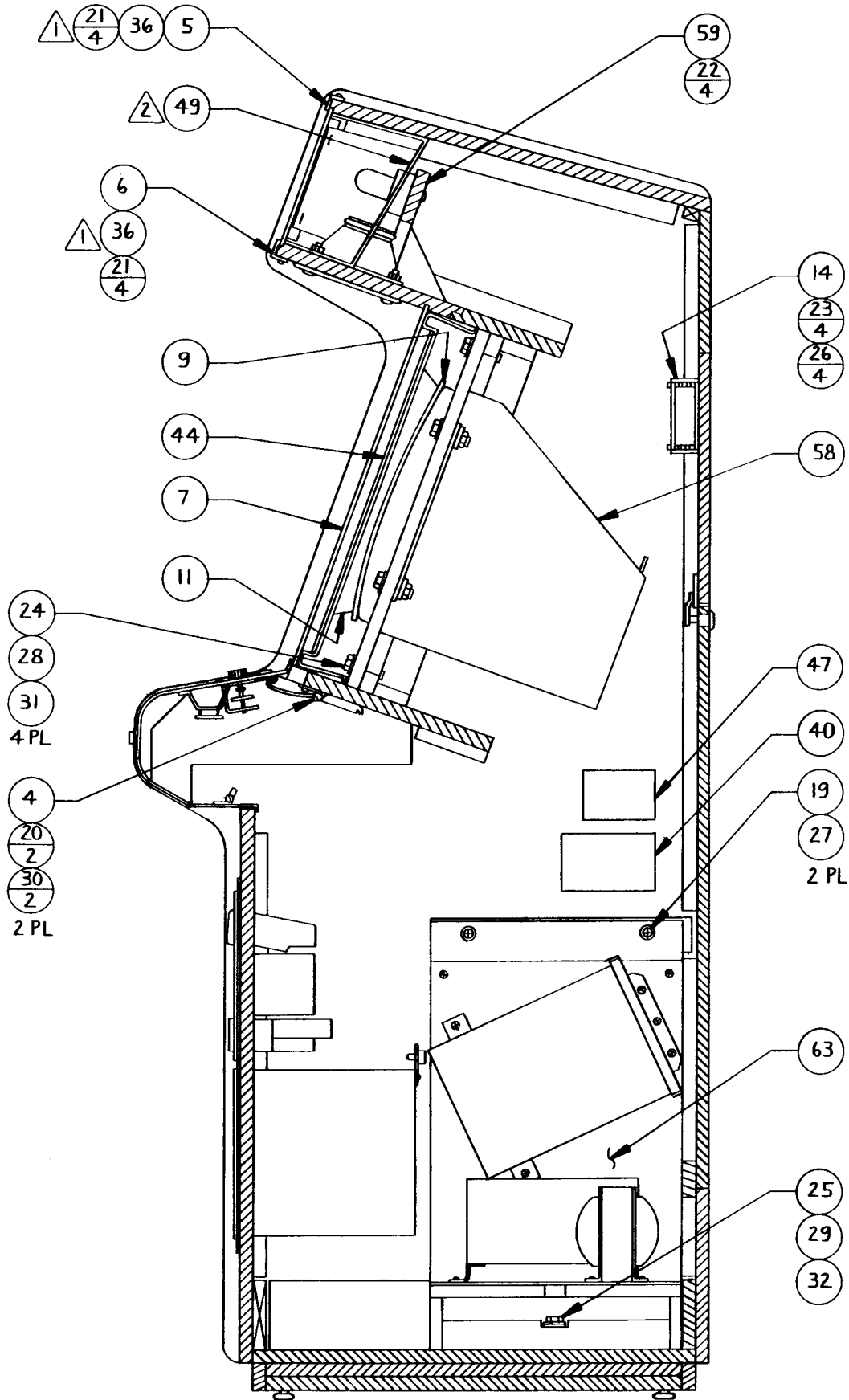
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<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>
58	800-0375-00	1	Assy X-Y Monitor
59	800-0415-02	1	Assy Light and Speaker
60			
61	800-3294-02	1	Assy Coin System
62	800-3302-00	1	Assy Control Panel
63	800-3304-00	1	Assy Component Shelf
64	800-3335-00	1	Assy Coin System Interface Harness
65	800-3336-00	1	Assy Control Panel Interface Harness
66	800-3341-00	1	Assy Video X-Y Interface Harness
67	800-0255-00	1	Assy AC Monitor Harness

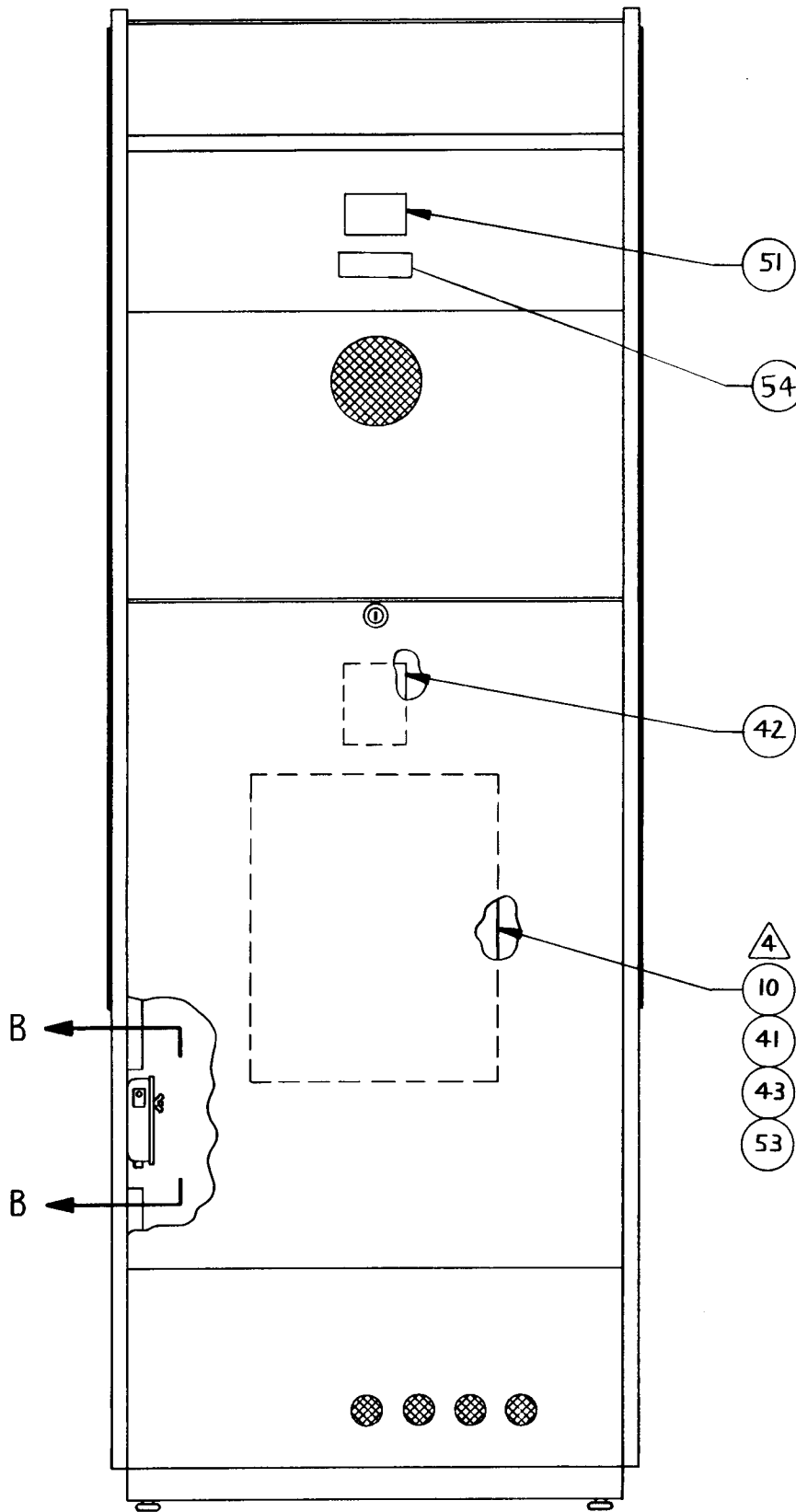


# Top Assembly

700-0109

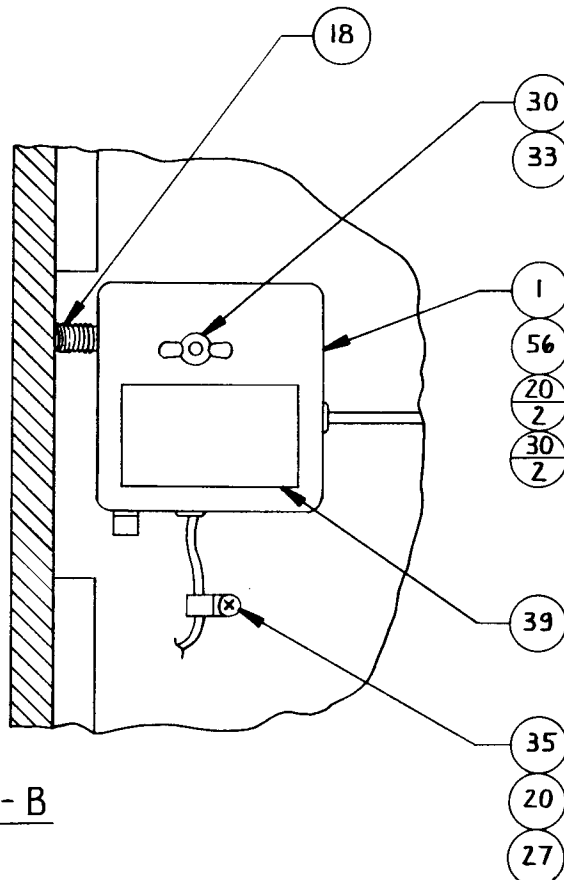
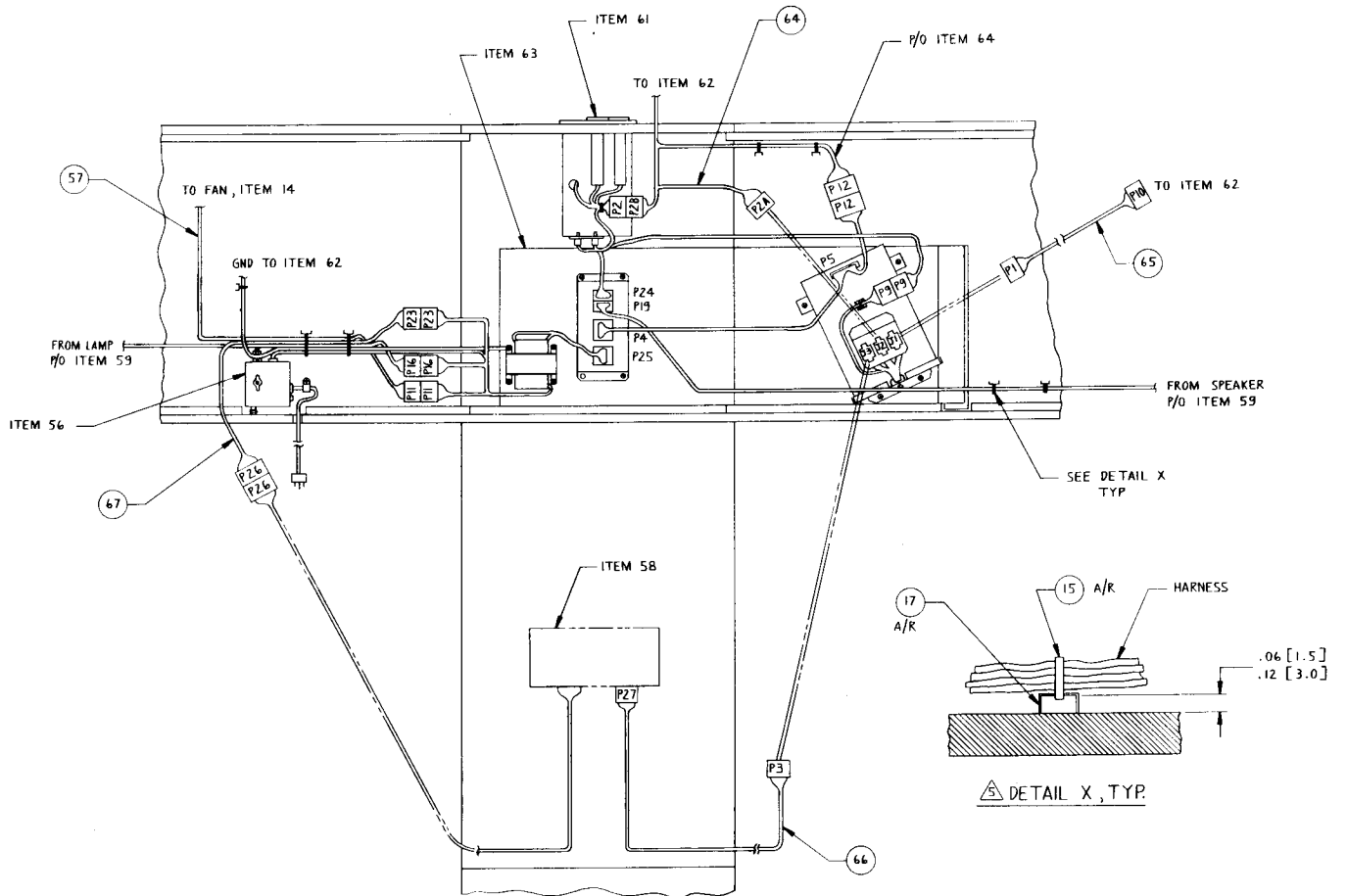


## SECTION A - A



# Top Assembly

700-0109



SECTION B - B



A.C. JUNCTION BOX ASSEMBLY  
A.C. JUNCTION BOX ASSEMBLY  
A.C. JUNCTION BOX ASSEMBLY

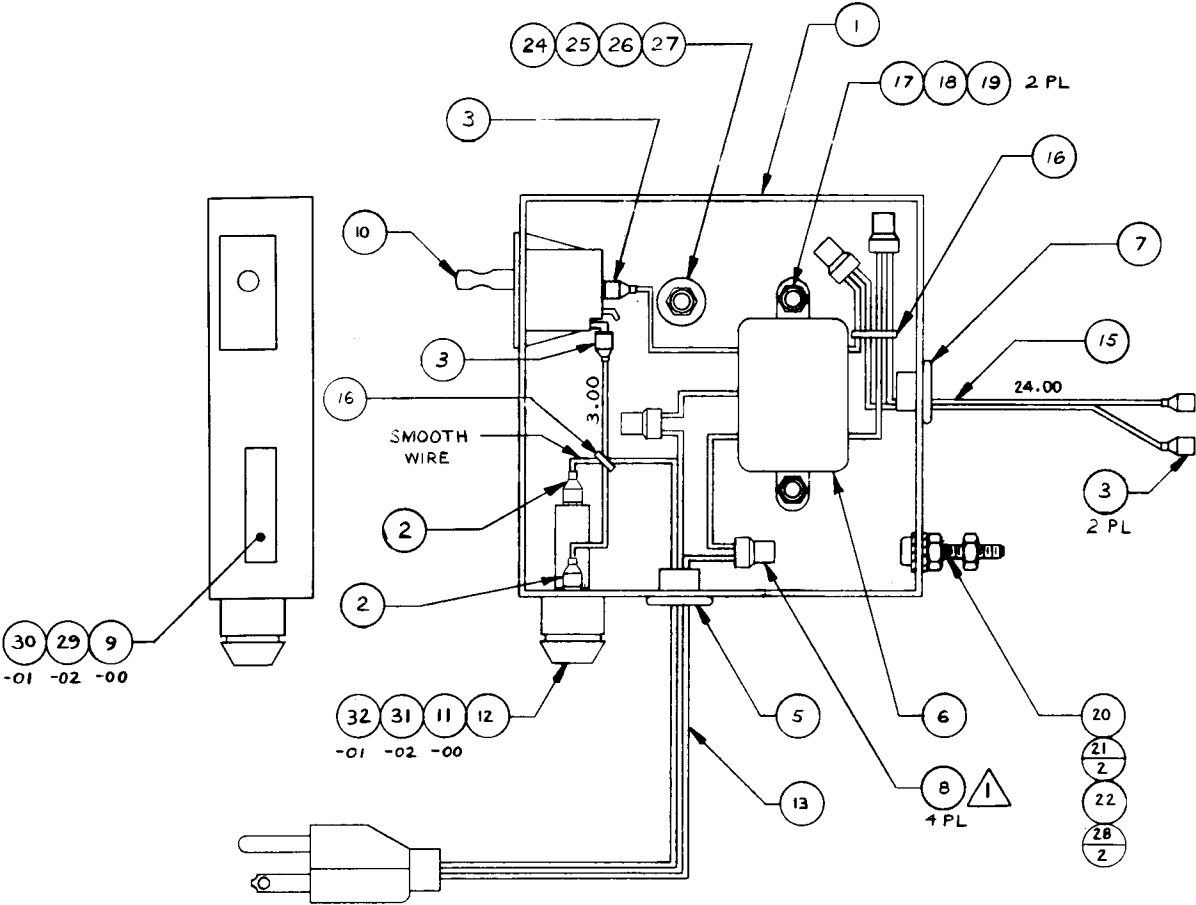
DRAWING NUMBER 800-0145-00  
DRAWING NUMBER 800-0145-01  
DRAWING NUMBER 800-0145-02

ITEM NO.	PART NO.	QTY REQD.			DESCRIPTION
		-00	-01	-02	
1	140-0020	1	1	1	Junction Box Metal
2	211-0165	2	2	2	Conn Quick Fem Fully Insl. .250 x .032 (AWG 18-22)
3	211-0164	4	4	4	Conn Quick Fem Fully Insl. .187 x .020 (AWG 18-22)
4					
5	280-0361	1	1	1	Bushing S/Rel AC Cord
6	270-0001	1	1	1	Filter EMI
7	280-0007	1	1	1	Bushing S/Rel 1/2
8	280-0362	4	4	4	Electric Crimp Sleeve AWG 24-18
9	420-0013	1	-	-	Decal 2 Amp Fuse
10	510-0013	1	1	1	Switch SPDT Cherry
11	514-0001	1	-	-	Fuse 2 Amp 250V S.B.
12	514-0005	1	1	1	Holder Fuse
13	600-0001	1	1	1	Cord Line 3 Cond.
14					
15	600-0079	2 FT.	2 Ft.	2 Ft.	Cord Line Zip
16	280-0005	2	2	2	Cable Tie
17	218-0002-10	2	2	2	SCR PN HD Phil #6-32 x .625 Mach
18	283-0022-00	2	2	2	Nut Hex HD #6-32 Mach
19	284-0042-00	2	2	2	Washer Lock Int. Tooth #6
20	281-0004-12	1	1	1	SCR PN HD Phil #8-32 x .750 Mach
21	283-0024-00	2	2	2	Nut Hex HD #8-32 Mach
22	284-0044-00	1	1	1	Washer Lock Int. Tooth #8
23					
24	284-0007-00	1	1	1	Washer Flat STD O.D. #1/4
25	283-0025-00	1	1	1	Nut Hex HD #10-24 Mach
26	282-0005-28	1	1	1	Bolt Carriage #10-24 x 1.750 Mach
27	310-0016-16	1	1	1	Insul TGB .187 ID

A.C. JUNCTION BOX ASSEMBLY-Continued  
A.C. JUNCTION BOX ASSEMBLY-Continued  
A.C. JUNCTION BOX ASSEMBLY-Continued

DRAWING NUMBER 800-0145-00  
DRAWING NUMBER 800-0145-01  
DRAWING NUMBER 800-0145-02

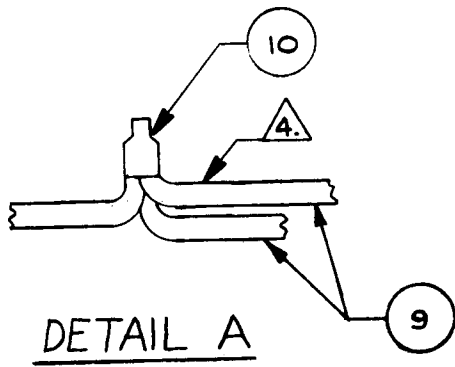
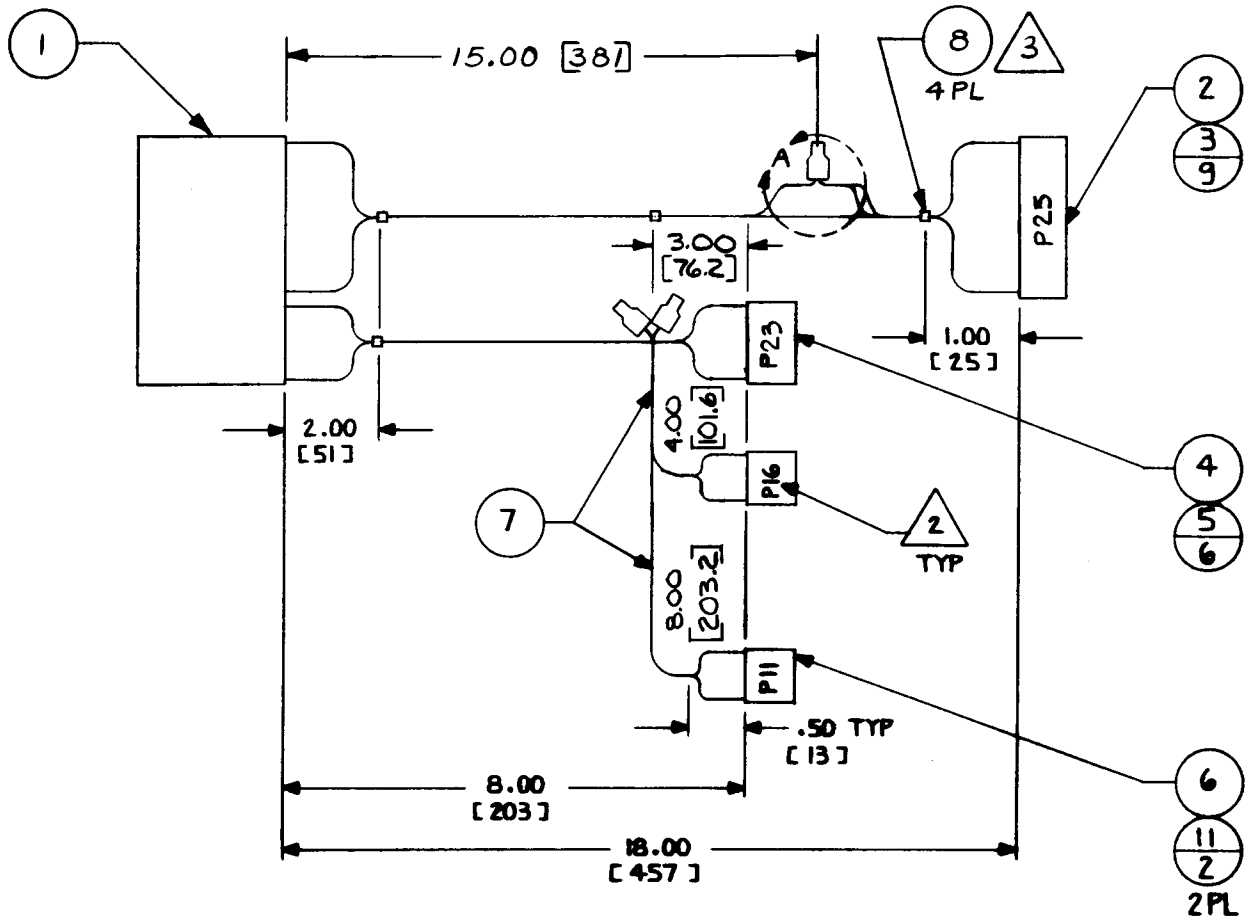
ITEM NO.	PART NO.	QTY REQD.			DESCRIPTION
		<u>-00</u>	<u>-01</u>	<u>-02</u>	
28	284-0004-00	2	2	2	Washer Flat STD O.D. #8
29	420-0597	-	-	1	Decal 1 Amp Fuse
30	420-0634	-	1	-	Decal 5 Amp Fuse
31	514-0051	-	-	1	Fuse 1 Amp 250V
32	514-0053	-	1	-	Fuse 5 Amp S.B.



## TRANSFORMER EMI ASSEMBLY

DRAWING NUMBER 800-0190

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>
1	560-0055	1	G-80 Power Supply Transformer
2	212-0016	1	Connector, Female, 10 Pin
3	211-0005	9	Connector Crimp
4	211-0045	1	Connector Plug Amp, 6 Pin
5	211-0042	6	Connector Socket
6	211-0043	2	Connector Plug Amp, 2 Pin
7	600-0079	1 foot	Zip Cord
8	280-0005	4	Cable Tie
9		0.5 feet	Electric Strand Wire, Black, AWG 18
10	280-0359	3	Electric Crimp Sleeve
11	211-0077	4	Connector Terminal Socket, 20-14 AWG



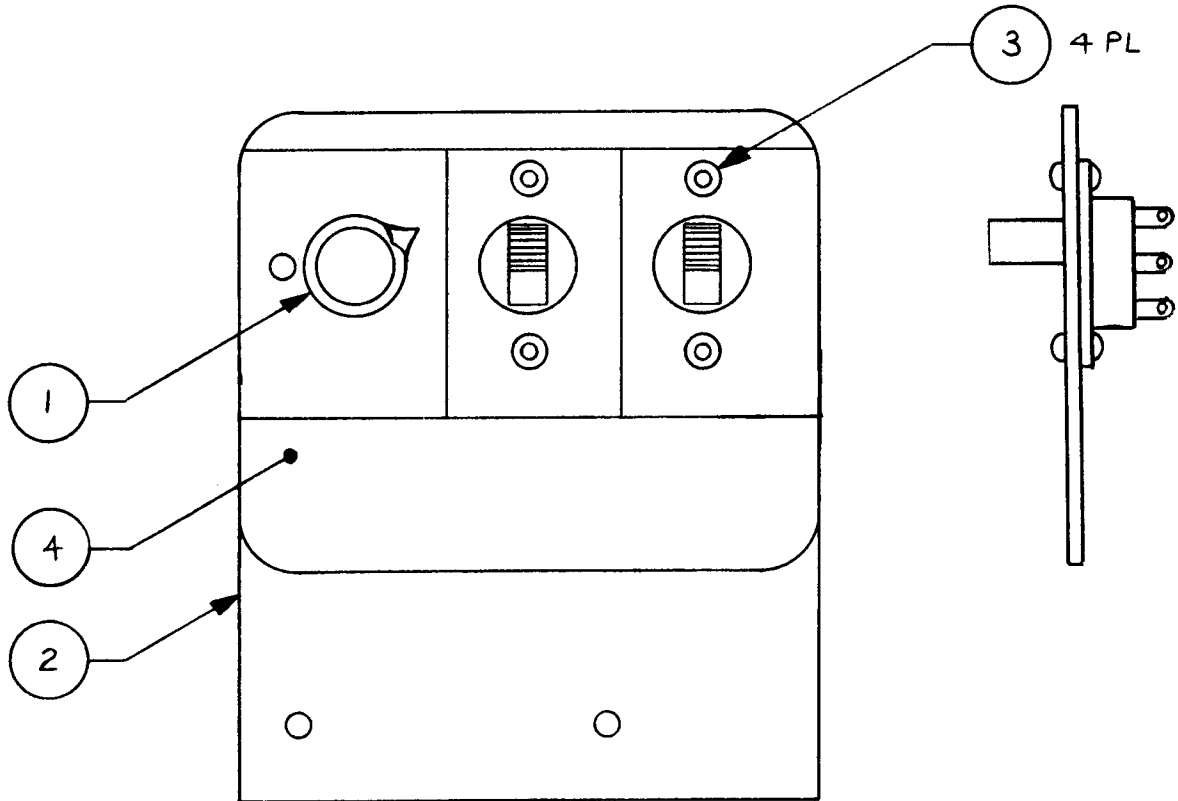
## VOLUME CONTROL BLOCK ASSEMBLY

DRAWING NUMBER 800-3282

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>			<u>DESCRIPTION</u>	<u>REF DES</u>
		<u>-00</u>	<u>-01</u>	<u>-02</u>		
1	240-0001-00	1	1	1	Volume Control Knob	
2	250-0569-00	1	1	-	Bracket Volume Control Block	
3	289-0003-14	4	4	4	Eyelet Rolled FLG HD	
4	420-0829-00	1	1	-	Decal, E-Z Adjust Cont	
5	475-0007-00	1	-	1	Pot 10K Car Panel Mount	
6	510-0051-00	2	2	2	Switch, Pushbutton Slide	
7	420-0395-00	-	-	1	Decal, Serv SW/Vol Cont	
8	211-0041-00	5	5	6	Conn Pin Amp	
9	211-0182-00	4	4	5	Terminal .110 x .020 22-18 AWG Quick, Fully Insul. Female	
10	280-0005-00	4	4	3	Cable Tie	
11	310-0041-02	.08'	-	.08'	Tubing .125 ID Clr Polyolefin Shrink	
12	470-0101-00	1	-	1	Resistor 100 ohm $\frac{1}{4}$ W, 5%	
13	600-0029-00	1.38'	1.38'	-	CA 2 CONDCT Sheild 22 AWG	
14	600-0092-47	1.46'	1.46'	.75'	Wire 22 AWG Violet	
15	600-0092-48	1.54'	1.54'	-	Wire 22 AWG Gray	
16	600-0092-50	1.62'	1.62'	1.116'	Wire 22 AWG Black	
17	475-0034-00	-	1	-	Pot 200 ohm Car Panel Mount	
18	600-0013-00	-	-	3.1'	CA 1 Condition Sheild	
19	600-0092-42	-	-	.75'	Wire 22 AWG Red	
20	600-0092-44	-	-	.83'	Wire 22 AWG Yellow	
21	211-0005-00	-	-	2	Conn Crimp Lock	P24
22	211-0046-00	-	-	1	Conn Cap Amp 6 Pin	P9
23	212-0005-00	-	-	1	Conn Female Black 4 Pin	
24	250-0569-01	-	-	1	Bracket Volume Control Block	
25	211-0166-00	-	-	1	Conn Ring Lug #10	
26	283-0063-04	-	-	1	Washer, #10 Lock, Ext Tooth Star	
27	283-0070-03	-	-	1	Nut, Nylon, Self Locking #10	
28	281-0005-06	-	-	1	Screw, #10 x .375 PN HD Phil Machine	

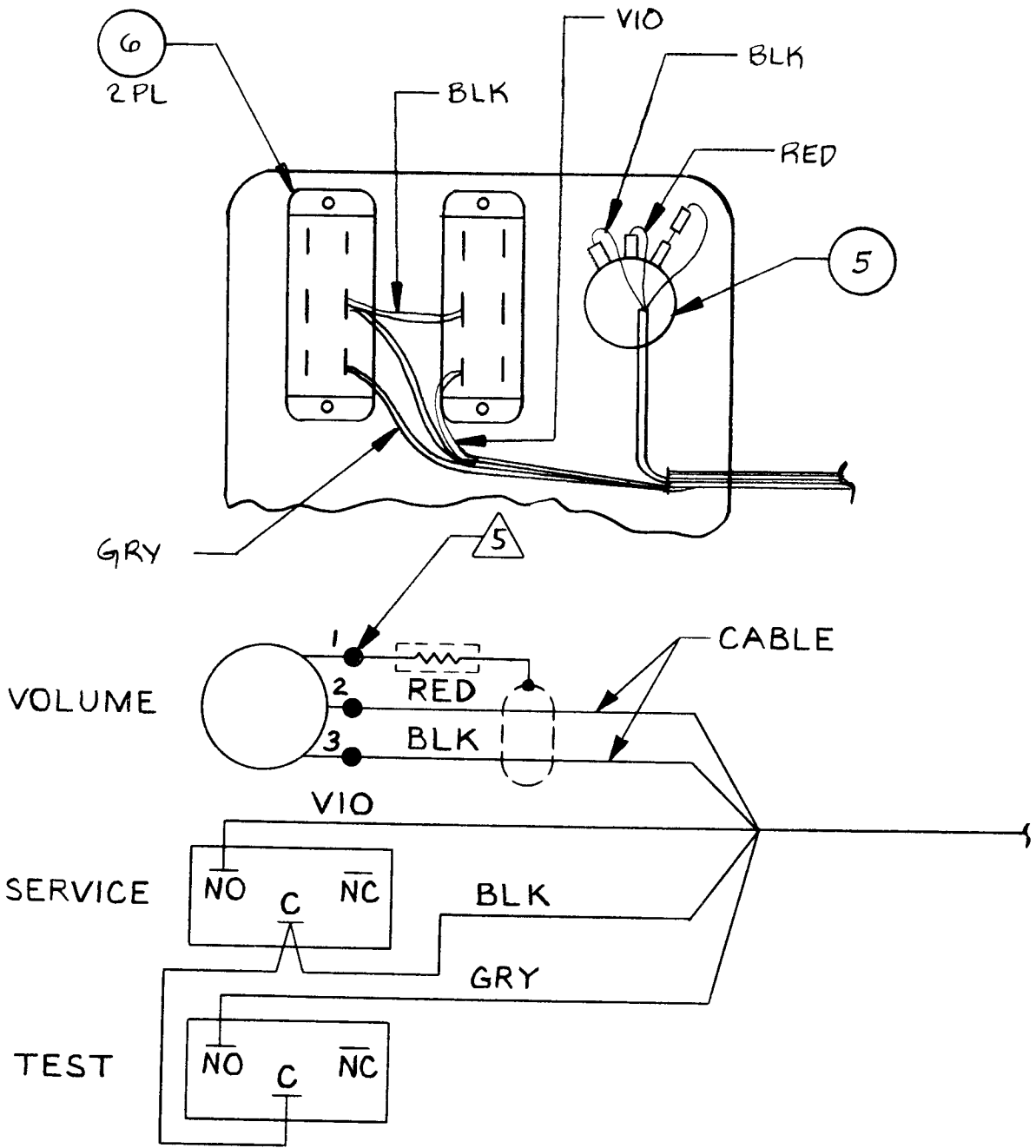
# Volume Control Block Assembly

800-3282-00



# Volume Control Block Assembly

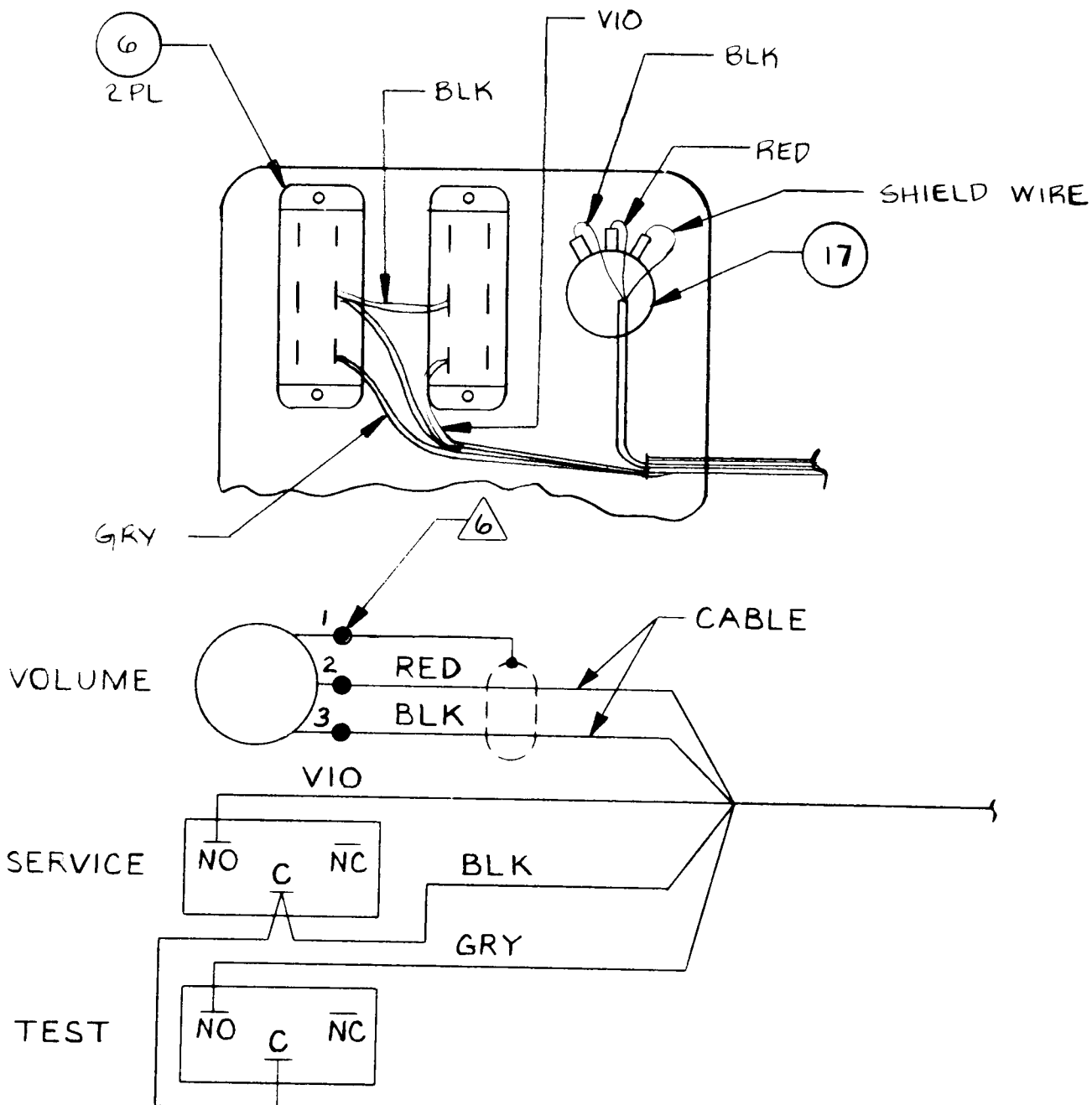
800-3282-0





# Volume Control Block Assembly

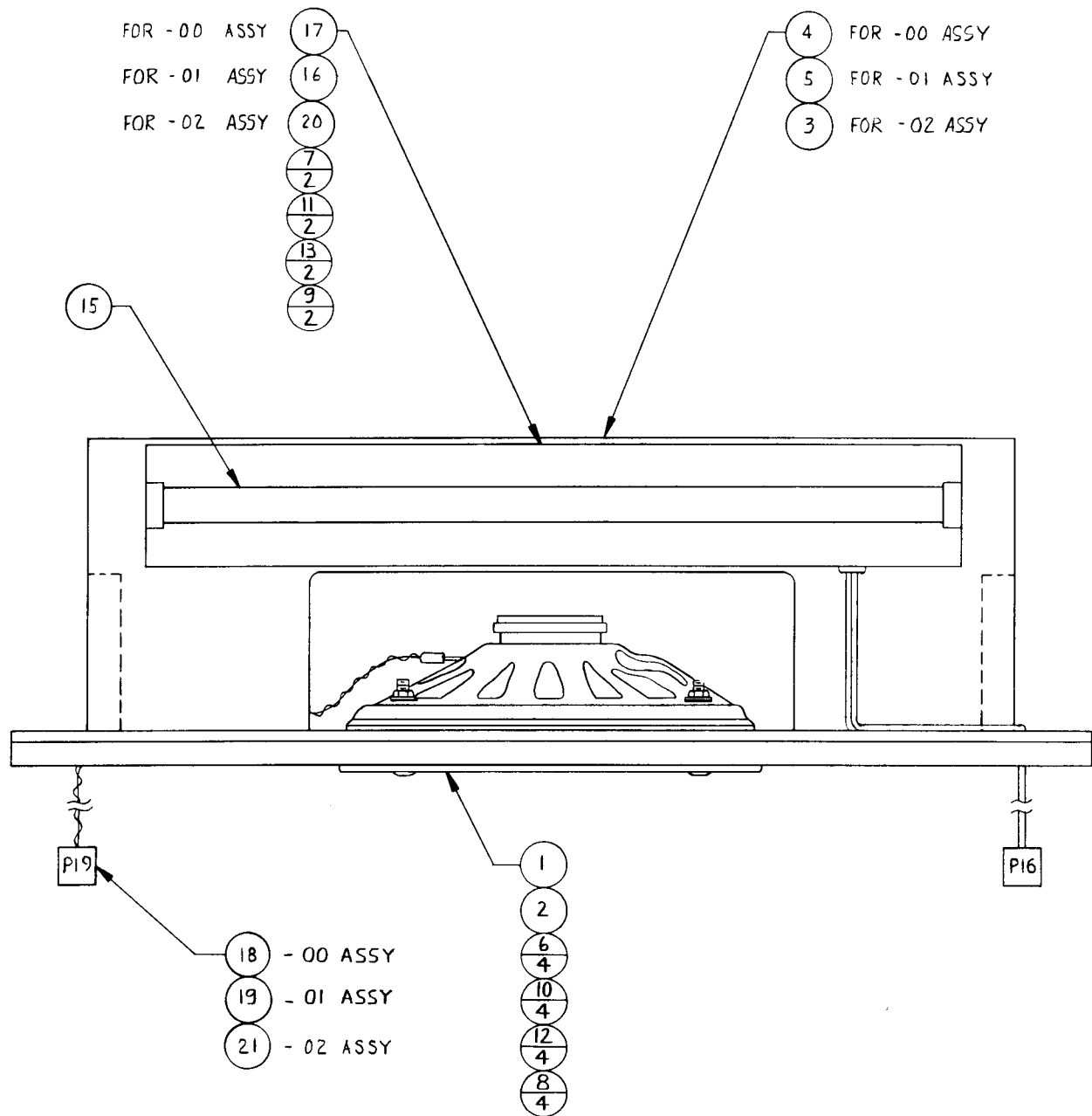
800-3282-01



## LIGHT AND SPEAKER ASSEMBLY

DRAWING NUMBER 800-0415

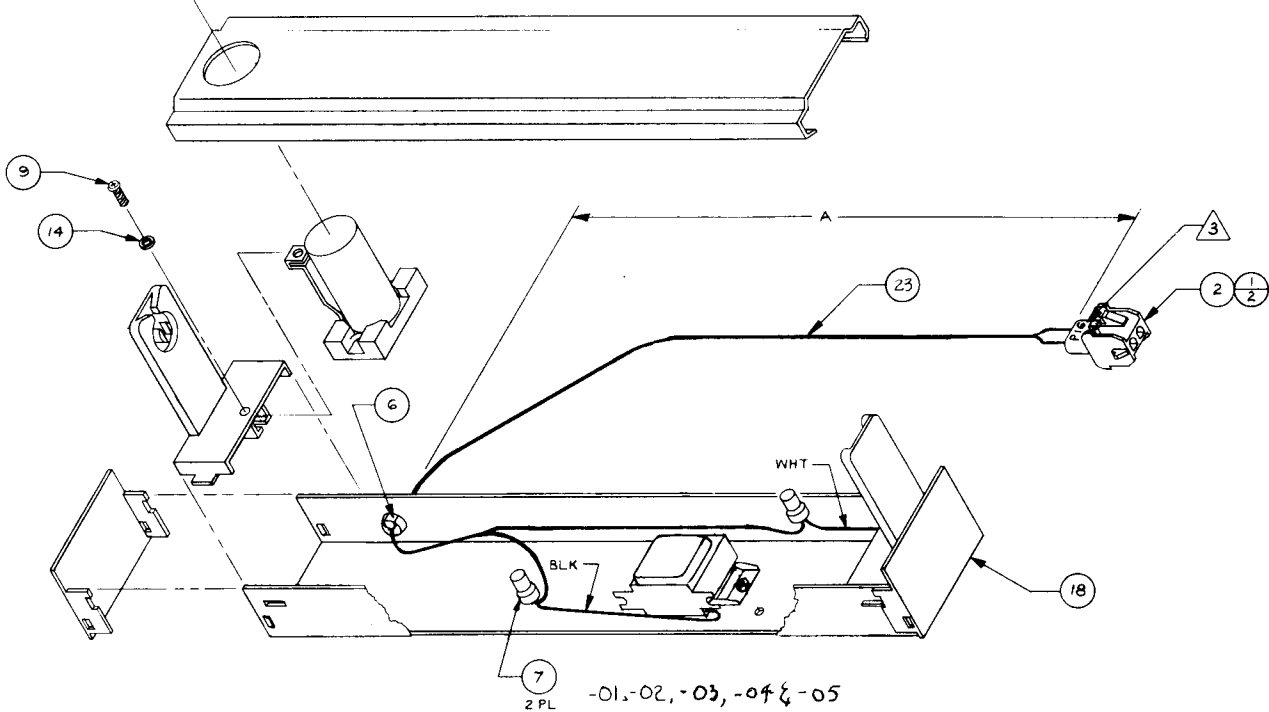
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>			<u>DESCRIPTION</u>
		<u>-00</u>	<u>-01</u>	<u>-02</u>	
1	130-0002-00	1	1	1	Speaker, Cover
2	130-0020-00	1	1	1	Speaker, 6 x 9, 10W
3	252-0213-01	-	-	1	Panel, Speaker and Light
4	252-0213-00	1	-	-	Panel, Speaker and Light
5	252-0242-00	-	1	-	Panel, Speaker and Light
6	281-0014-28	4	4	4	Screw, 8-32 x 1.75 LG OVH Phil Machine THD Black
7	282-0005-20	2	2	2	Bolt 10-24 x 1.25 LG CRG HD Machine THD BLACK
8	283-0072-13	4	4	4	Nut 8-32 Hex, Machine THD
9	283-0072-15	2	2	2	Nut 10-24 Hex, Machine THD
10	283-0060-21	4	4	4	Washer, #8 Flat, Steel
11	283-0060-24	2	2	2	Washer, #10 Flat, Steel
12	283-0061-05	4	4	4	Washer, #8 Lock, Split, Steel
13	283-0061-06	2	2	2	Washer, #10 Lock, Split, Steel
14					
15	390-0019-00	1	1	1	Lamp Fluorescent
16	800-0147-02	-	1	-	Fluorescent Lamp Assy
17	800-0147-03	1	-	-	Fluorescent Lamp Assy
18	800-0371-00	1	-	-	Speaker Harness Assy
19	800-0412-00	-	1	-	Speaker Harness Assy
20	800-0147-05	-	-	1	Fluorescent Lamp Assy
21	800-0403-01	-	-	1	Speaker Harness Assy



FLUORESCENT LAMP 2 ASSEMBLY

DRAWING NUMBER 800-0147

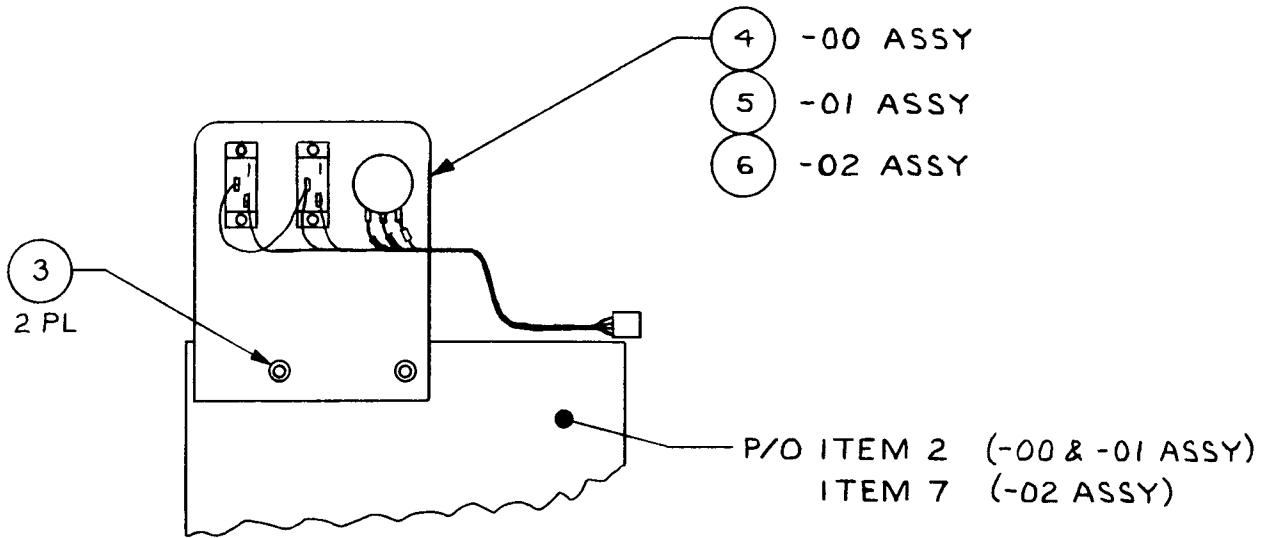
ITEM NO.	PART NO.	QTY REQD.						DESCRIPTION
		-00	-01	-02	-03	-04	-05	
1	211-0041-00	2	2	2	2	2	2	Conn Pin Amp
2	211-0044-00	1	1	1	1	1	1	Conn Cap Amp 2 Pin
3								
4	211-0166-00	1	-	-	-	-	-	Conn Crimp Ring #10
5								
6	280-0361-00	-	1	1	1	1	1	Bushing Strain Rel, AC Cord
7	280-0362-00	-	2	2	2	2	2	Elec Crimp Sleeve 24-18 AWG
8								
9	281-0002-06	1	1	1	1	1	1	Screw, #6-32 x .375 PAN HD, Phil, Mach THD
10								
11								
12								
13								
14	283-0060-19	-	1	1	1	1	1	Washer #6 Flat, Steel
15								
16								
17	390-0083-00	1	-	-	-	-	-	Fluorescent Lamp Fixt. 18"
18	390-0117-00	-	1	1	1	1	1	Fluorescent Lamp Fixt. 18"UL
19								
20								
21								
22								
23	600-0079-00	-	5.9'	7.6'	4.0'	4.4'	6.75'	CA 2 Cond Zip Cord



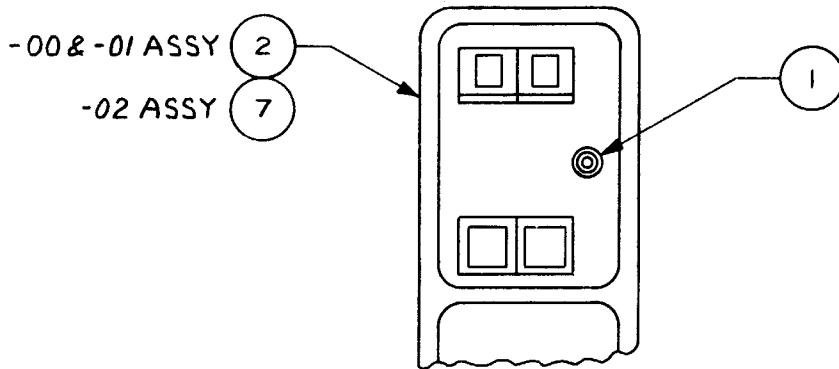
COIN SYSTEM ASSEMBLY

DRAWING NUMBER 800-3294

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>			<u>DESCRIPTION</u>
		<u>-00</u>	<u>-01</u>	<u>-02</u>	
1	220-0212-00	1	1	1	Lock Panel 4-Way
2	220-0265-00	1	1	-	Coin Mech - Double Frame, Mini-Door
3	285-0001-04	2	2	2	Rivet, .125 Dia x .250 LG, MDRL Pull, AL
4	800-3282-00	1	-	-	Volume Control Block Assy
5	800-3282-01	-	1	-	Volume Control Block Assy
6	800-3282-02	-	-	1	Volume Control Block Assy
7	220-0265-01	-	-	1	Coin Mech - Double Frame, Mini-Door



REAR VIEW OF  
COIN ENCLOSURE



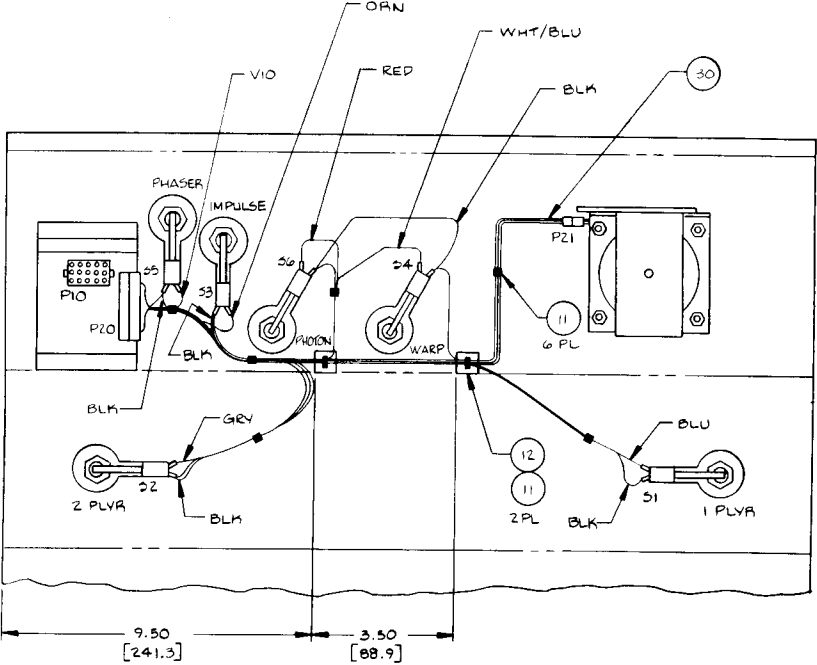
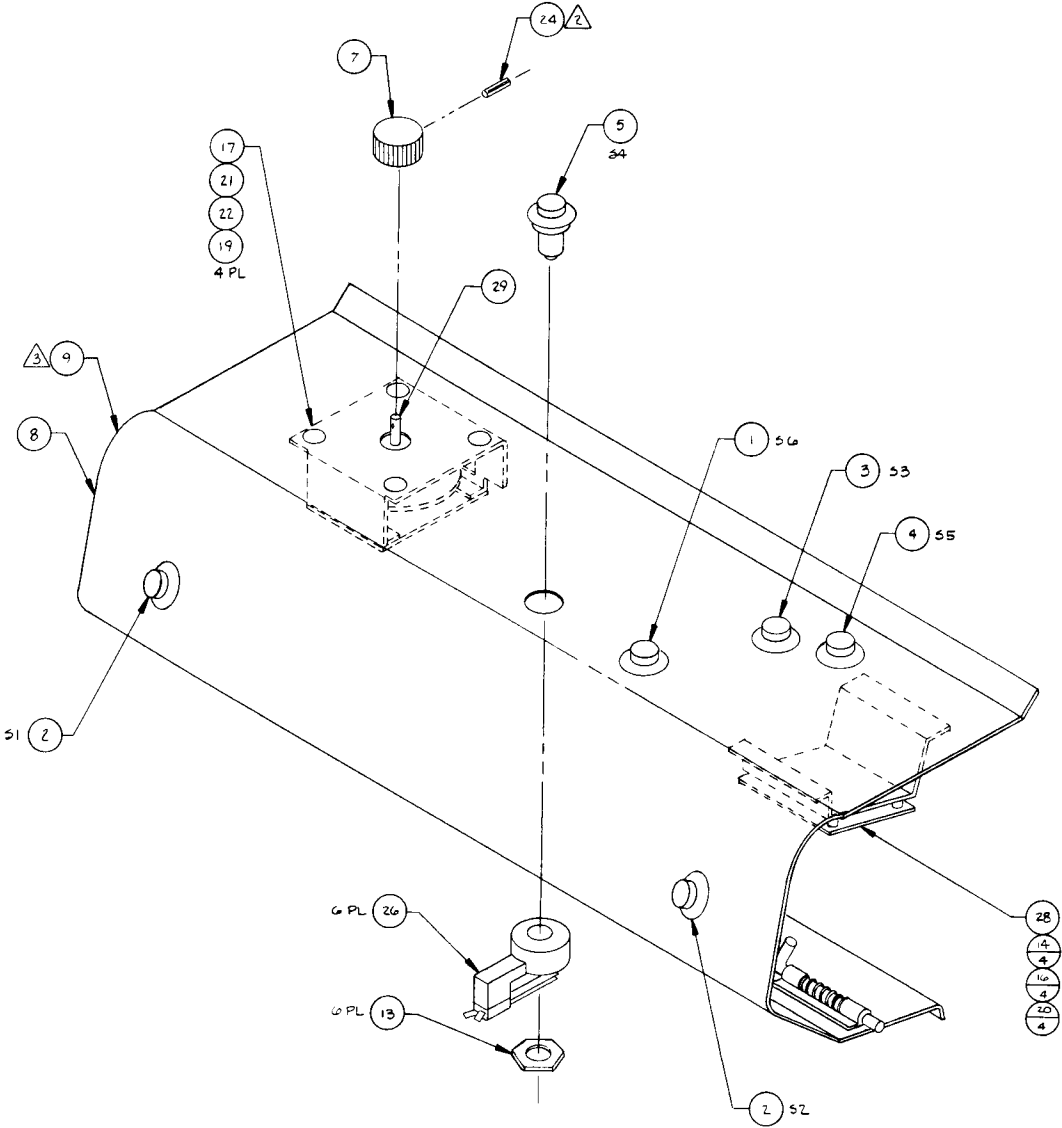
FRONT VIEW

## CONTROL PANEL ASSEMBLY

DRAWING NUMBER 800-3302

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>
1	240-0006-00	1	Button, Plunger, Red
2	240-0007-00	2	Button, Plunger, Black
3	240-0009-00	1	Button, Plunger, Yellow
4	240-0109-00	1	Button, Plunger, Orange
5	240-0111-00	1	Button, Plunger, Blue
6			
7	250-0565-00	1	Control Knob
8	250-0616-00	1	Control Panel
9	253-0312-00	1	Control Panel Graphic
10			
11	280-0005-00	8	Cable Tie
12	280-0327-00	2	Base Tie Wrap
13	280-0329-00	6	½in. - 13 Hex Pal Nut
14	280-0465-00	4	Spacer .140 ID x .250 OD X .250 LG Nylon
15			
16	281-0002-10	4	Screw 6-32 x .625 LG PNH Phil, Machine THD
17	282-0005-12	4	Bolt 10-24 x .750 LG CRG HD, Machine THD Black
18			
19	283-0070-03	4	Nut 10-24 Hex, Self Locking, Machine THD
20	283-0060-18	4	Washer #6 Flat, Steel
21	283-0060-24	4	Washer #10 Flat, Steel
22	283-0061-06	4	Washer #10 Lock, Split, Steel
23			
24	289-0001-12	1	Pin .099 Dia x .750 LG, Roll, Spring Steel
25			
26	510-0064-00	6	Switch, Push Button, Metal, Panel
27			
28	800-0374-00	1	Single Player Control Panel Interface Assy
29	800-0390-00	1	Rotary Control Assy
30	800-3303-00	1	Control Panel Harness Assy



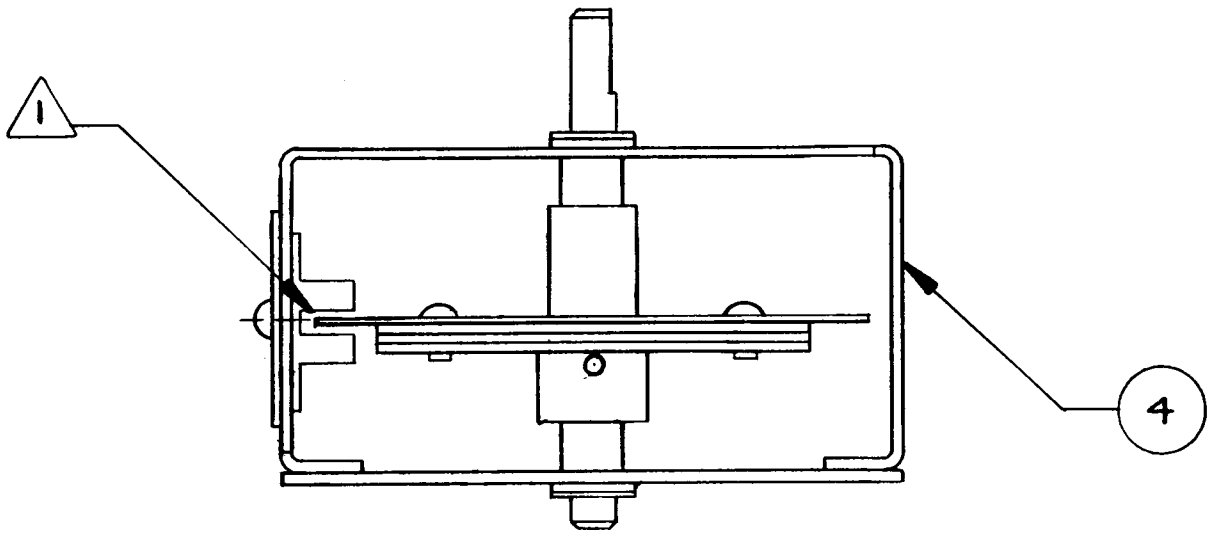
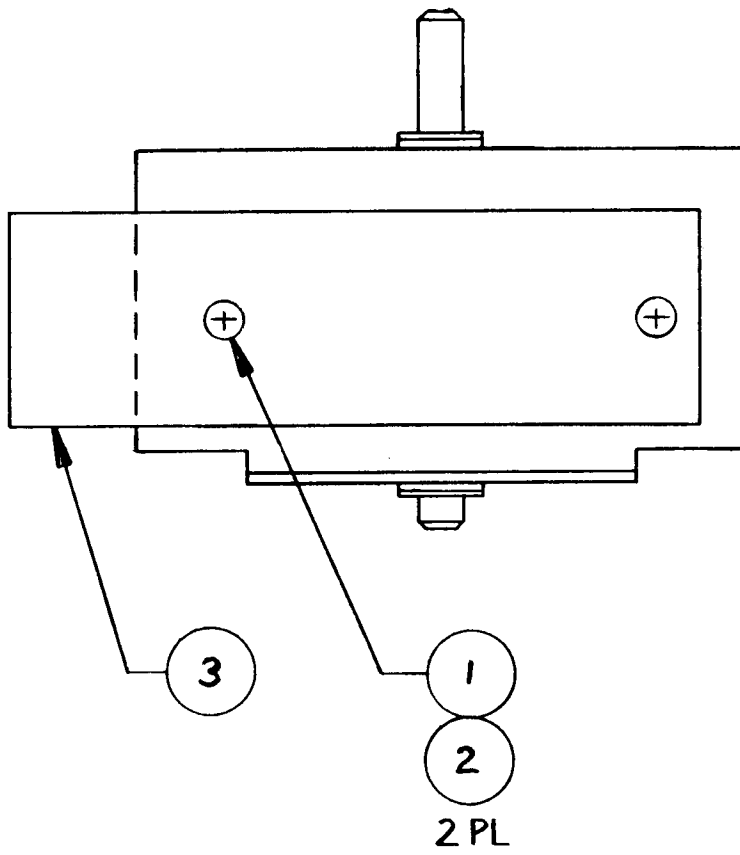


REAR VIEW

ROTARY CONTROL ASSEMBLY

DRAWING NUMBER 800-0390

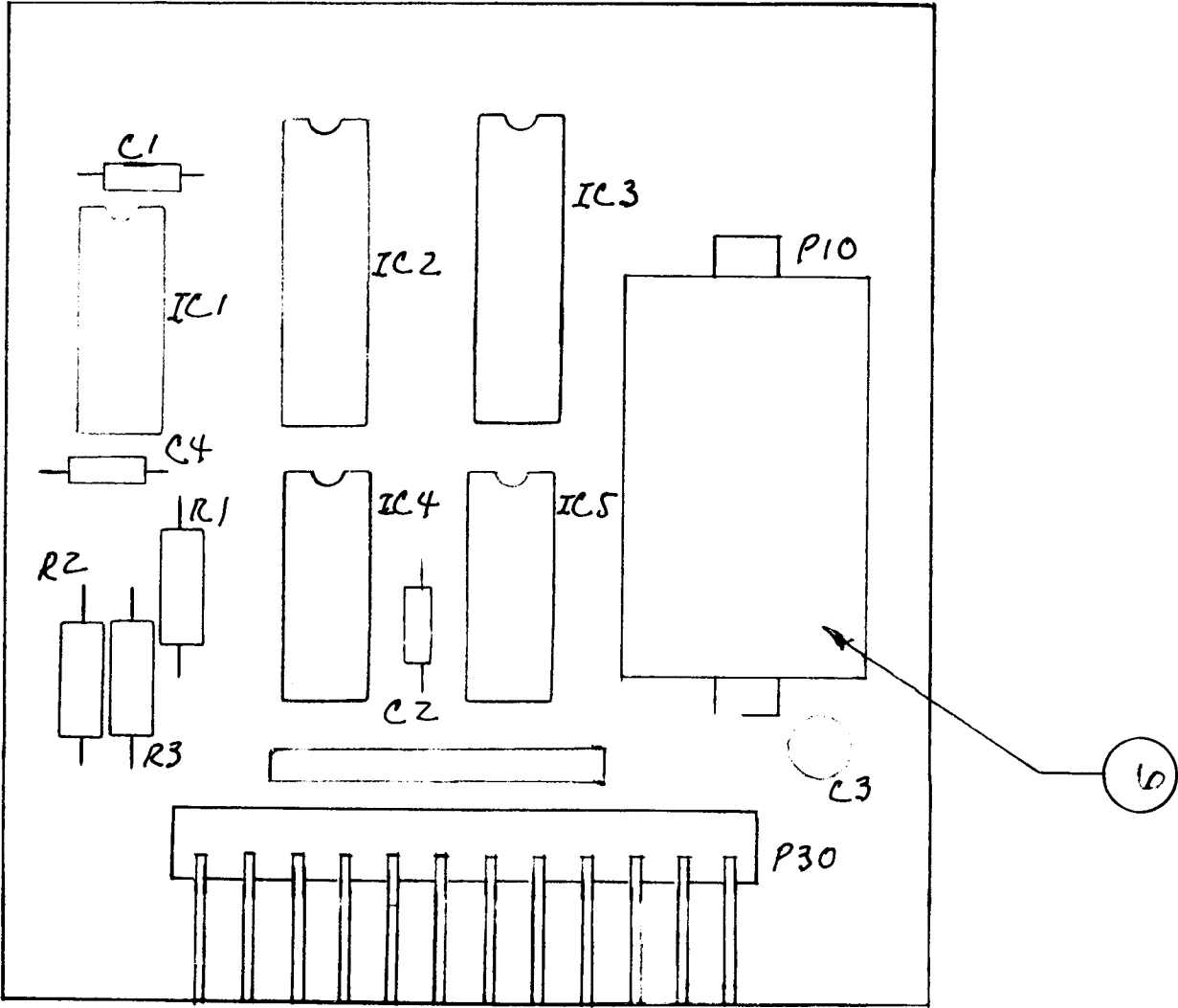
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>
1	281-0031-04	2	Scr #4-40 X 1/4" PN HD Thd Forming
2	284-0011-05	2	Wshr #4 F1, SM OD, Stl
3	800-0382	1	Rotary Interface Assy
4	800-0383	1	Rotary Bracket Assy



## SINGLE PLAYER CONTROL PANEL INTERFACE ASSEMBLY

DRAWING NUMBER 800-0374

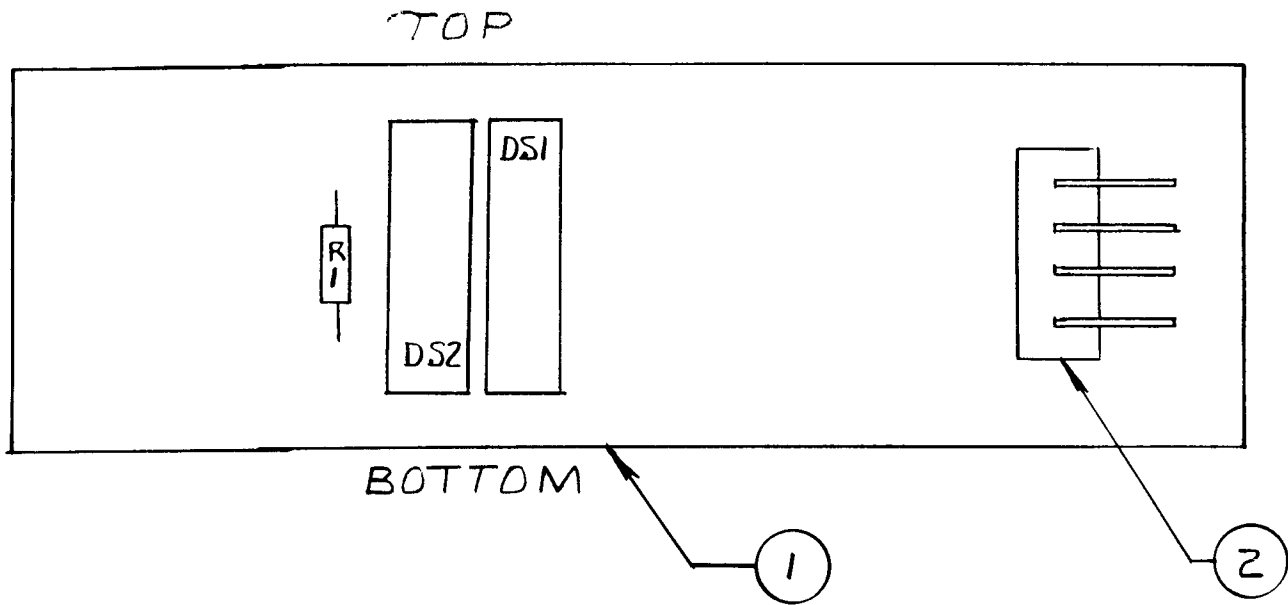
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	
<u>REF DES.</u>				
1	150-0088	1	Cap E 10 uf 25V RDL	C3
2	151-0058	2	Cap .01 uf 16V AX	C1, C2
3	151-0059	1	Cap .001 16V AX	C4
4	170-0258	1	PC Board	
5	212-0024	1	Conn 12 Pin M RTA PLRZD	P30
6	212-0156	1	Conn Header 15 Pin	P10
7	314-0055	2	IC 74LS244	U2, U3
8	314-0062	1	IC 74LS74	U5
9	314-0075	1	IC 74LS39	U1
10	314-0085	1	IC 74LS14	U4
11	471-0102	3	Res 1K Ohm 1/2W 5%	R1-R3



ROTARY ASSEMBLY INTERFACE

DRAWING NUMBER 800-0382

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	170-0160	1	PC Board	
2	212-0081	1	Conn M 4 Pin RTA PLRZD	P1
3	285-0001-04	4	Rivet .125 Dia X .25 Lg	
4	370-0006	2	Opto Electric Encoder XSTR	DS1, DS2
5	470-0101	1	Res 100 Ohm 1/4W 5%	R1



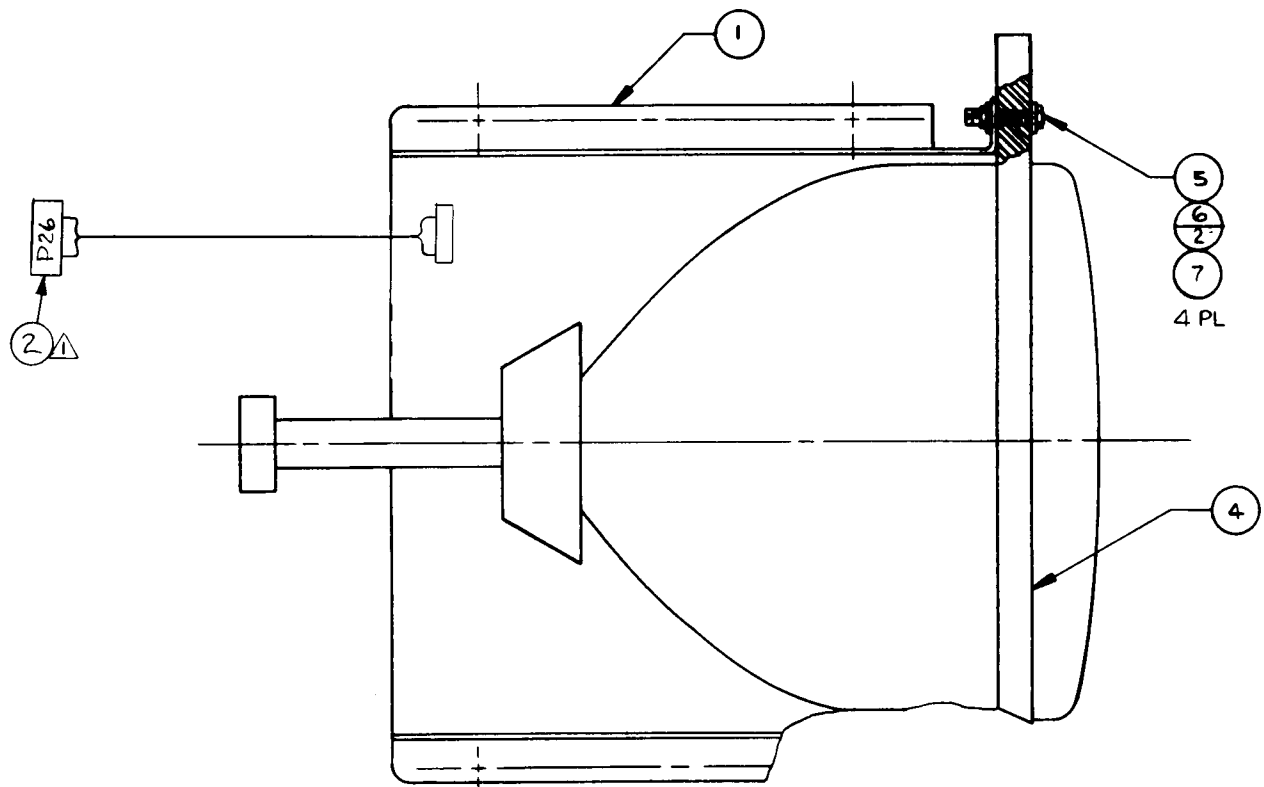
DEVICE NUMBER	ORIENTATION MARK	LOCATION
H21A2	NOTCH	FACING BOTTOM
H21A3	NOTCH	FACING BOTTOM
K-2133	DOT	FACING TOP
K-2133A	DOT	FACING TOP

## COLOR MONITOR ASSEMBLY

DRAWING NUMBER 800-0375

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>
1	200-0025-00	1	X-Y Color Monitor, 19"
2	211-0059-00	1	Conn Plug 3 Pin Amp
3			
4	252-0175-00	1	Monitor Mounting Board
5	282-0017-24	4	Hex HD Bolt, $\frac{1}{4}$ - 20 x 1.500 LG
6	283-0060-34	8	Washer, Flat $\frac{1}{4}$ - 1.250 LG O.D. Fender
7	283-0070-05	4	Nut, $\frac{1}{4}$ - 20 Hex Self-locking, Mach THD





<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>RES. DES.</u>
EHT SUPPLY ASSEMBLY		
SEMI-CONDUCTORS		
315-0118	EHT Control Circuit	IC900
481-0211	Zener Diode	ZD903, 904
481-0207	Rectifier 1A 1400V	D901
482-0062	Transistor 3906	Q901
482-0244	Transistor MPSU07	Q902
482-0030	Transistor 3904	Q903
TRANSFORMERS		
560-0062	Horiz. Buffer Trans.	T900
560-0073	Horiz. Output Trans.	T901
COILS		
180-0010	Horiz. Delay Choke	L900
CAPACITORS		
150-0007	4.7 uf 16V	C900
152-0053	0.22 uf 50V	C902
151-0109	2000 uf 50V	C903
150-0015	22 uf 16V	C904
151-0110	0.1 uf 100V	C906, 912
150-0222	0.022 uf 100V	C907
150-0010	100 uf 16V	C911
150-0221	High Current Cap	C914, 915
151-0113	47 uf 160V	C916
152-0027	0.047 uf 100V	C918
RESISTORS		
470-0103	10K 1/4W 5%	R900, 901, 906
460-0008	47K 1/4W 5%	R902
470-0154	150K 1/4W 5%	R904, 916, 934
470-0123	12K 1/4W 5%	R905, 915
471-0472	4.7K 1/4W 5%	R907, 938, 939
471-0474	470K 1/ W 5%	R910
460-0016	1.2K 1/4W 5%	R914

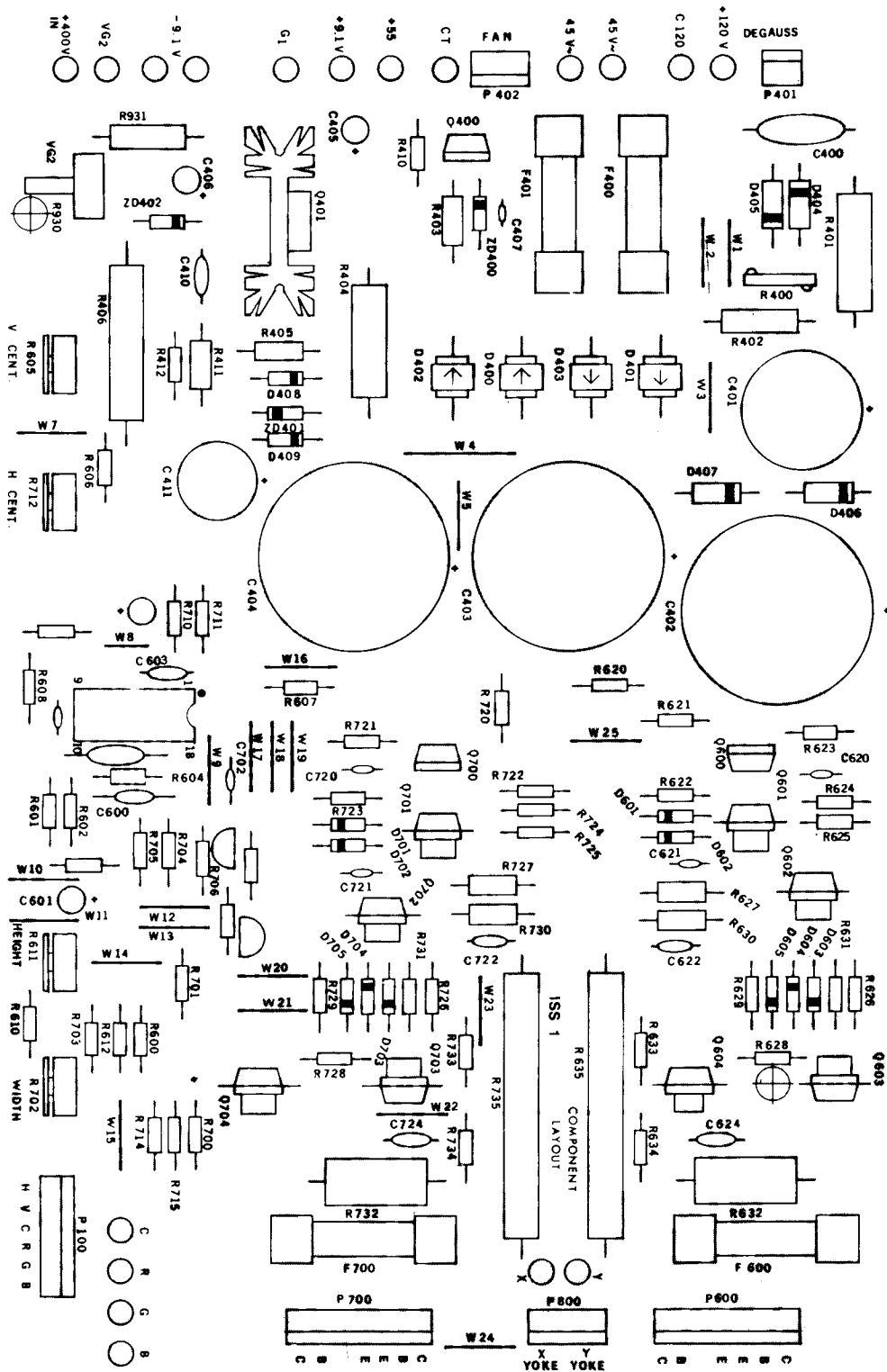
<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>RES. DES.</u>
EHT SUPPLY ASSEMBLY CONT'D		
RESISTORS		
475-0043	200 Ohms Control	R917
475-0044	2K Control	R918
470-0271	270 Ohm 1/4W 5%	R923
470-0471	470 Ohm 1/4W 5%	R924
471-0240	24 Ohm 1/2W 5%	R925
470-0330	33 Ohm 1/4W 5%	R927
470-0680	68 Ohm 1/4W 5%	R930
462-0001	68 Ohm 1W 5%	R932
464-0114	470K Control	R933
470-0333	33K 1/4W 5%	R935
470-0274	270K 1/4W 5%	R936
471-0475	4.7M 1/2W 5%	R937
471-0331	330 Ohm 1/2W 10%	R940
472-0470	47 Ohm 1W 5%	R941
470-0562	5.6K 1/4W 5%	R942
EHT SUPPLY ASSEMBLY KIT		
482-0242	PWR Transistor 5A 1400V	Q900
475-0035	Focus Control	R922
EHT REGULATOR ASSEMBLY		
SEMI-CONDUCTORS		
482-0268	2N 6558	Q320, 321, 323
482-0269	TIP 47 (Motorola)	Q322
481-0204	1N 5263	ZD340
CAPACITORS		
152-0149	68 pf 500V	C330
151-0108	470 pf 500V	C331
472-0223	22K 1W 5%	R300
471-0683	68K 1/2W 5%	R301
472-0273	27K 1W 5%	R302
471-0473	47K 1/2W 5%	R304

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>RES. DES.</u>
EHT REGULATOR ASSEMBLY CONT'D		
RESISTORS		
470-0331	330 Ohm 1/4W 5%	R305
471-03R3	3.3 Ohm 1/2W 5%	R306
470-0363	36K 1/4W 5%	R307
460-0008	47K 1/4W 5%	R308
475-0048	10K Control Pot.	R310
DEFLECTION AMP PCB ASSEMBLY		
SEMI-CONDUCTORS		
315-0117	Input Amplifier IC	IC600
481-0202	Rectifier	D400-403
481-0020	Rectifier 1A 200V	D404-407, 409, D408, 601-605 701-705
481-0006	Diode 1N 914	
481-0204	Zener Diode 1N 5263B 1/2W 56V	ZD400
481-0205	Zener Diode 1N 5239B 1/2W 9.1V	ZD401
481-0179	Zener Diode 9.1V 1W 5% (Motorola)	ZD402 (1N4739)
482-0248	Transistor TIB 29B	Q400, 401
482-0244	Transistor MPSU60 (Motorola)	Q600, 700
482-0245	Transistor 300V 1/2A	Q601, 604, 701, 704
482-0243	Transistor MPSU10 (Motorola)	Q602, 603, 702, 704
CAPACTORS		
150-0211	100 uf 80V	C401
150-0212	680 uf 160V	C402
150-0213	6800 uf 80V	C403, 404
150-0004	10 uf 25V	C405
151-0046	Ceramic 0.1 uf	C407, 621, 721
152-0056	0.1 uf 200V	C410
150-0220	22 uf 250V	C411

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>RES. DES.</u>
DEFLECTION AMP PCB ASSEMBLY CONT'D		
CAPACITORS		
152-0145	2.2 pf 500V	C600
152-0146	12 pf 500V	C603, 703
152-0147	100 pf 10% 500V	C620, 720
152-0023	47 pf 10% 500V	C622, 722
151-0107	0.068 uf 200V	C624, 724
152-0149	5.6 pf 10%	C702
152-0150	560 pf 500V 20%	C725
RESISTORS		
478-0006	Thermistor 120V 60 Ohm	R400
473-0330	33 Ohm 4W 10%	R401
472-0223	22K 1W 10%	R402
470-0222	2.2K 1/4W 5%	R403
474-0220	220 Ohm 10W	R404
471-0822	8.2 1/2W 5%	R405
474-0680	680 Ohm 6W	R406
470-0472	4.7K 1/4W 5%	R410
470-0275	2.7M 1/4W 5%	R411
470-0155	1.5M 1/4W 5%	R412
470-0621	620 Ohm 1/4W 5%	R600
471-0911	910 Ohm 1/4W 5%	R601
470-0103	10K 1/4W 5%	R602
470-0182	1.8K 1/4W 5%	R603, 624, 724
470-0303	30K 1/4W 5%	R604
475-0037	50K Trim Pot	R605
470-0104	100K 1/4W 5%	R606
470-0242	2.4K 1/4W 5%	R607, 710
470-0102	1K 1/4W 5%	R608, 636, 637, 715, 736, 737
475-0038	1K Trim Pot	R611
470-0183	18K 1/4W 5%	R620, 720

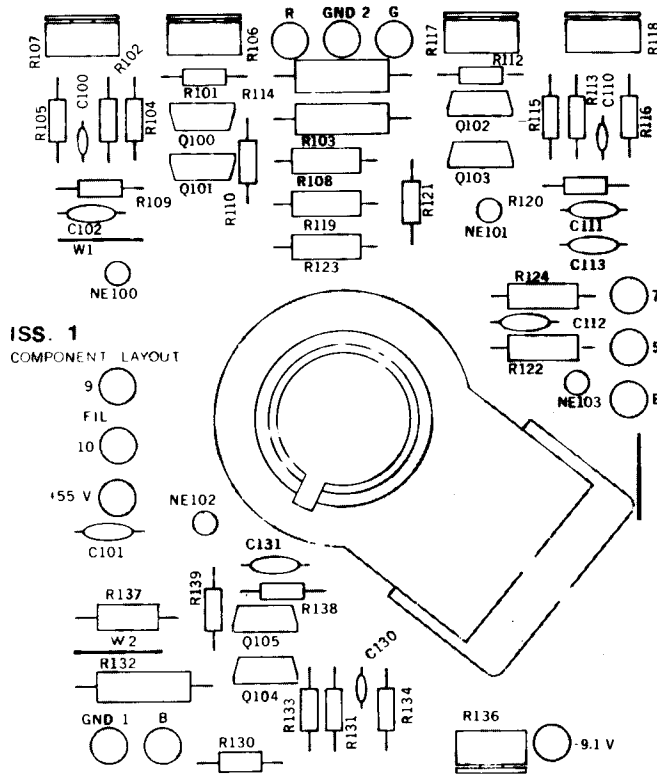
<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>RES. DES.</u>
DEFLECTION AMP PCB ASSEMBLY CONT'D		
RESISTORS		
470-0622	6.2K 1/4W 5%	R621, 721
470-0181	180 Ohm 1/4W 5%	R622, 625, 631, 722, 725, 731
470-0223	22K 1/4W 5%	R623, 704, 705, 723
470-0101	100 Ohm 1/4W 5%	R626, 629, 726, 729
471-0183	18K 1/2W 10%	R627, 727
470-0271	270 Ohm 1/4W 5%	R628, 728
471-0223	22K 1/2W 5%	R630, 730
472-0471	470 Ohm 2W 5%	R632
470-0151	150 Ohm 1/4W 5%	R633
460-0056	82 Ohm 1/4W 5%	R634
474-0150	1.5 Ohm 10W	R635
470-0222	2.2K 1/4W 5%	R700, 701
475-0039	5K Trim Pot	R702
470-0153	15K 1/4W 5%	R703, 706
470-0152	1.5K 1/4W 5%	R714
472-0391	390 Ohm 2W 5%	R732
470-0475	4.7M Trim Pot	R930, 931
CRT SOCKET PCB ASSEMBLY		
SEMI-CONDUCTORS		
482-0243	Transistor MPS u10 (Motorola)	Q100-105
LAMPS		
390-0107	Lamp	NE100-103
CAPACITORS		
151-0067	100 pf 500V	C100, 110, 130
151-0112	0.1 uf 200V	C101
151-0050	0.01 uf 500V 10%	C102, 111, 131
151-0096	0.01 uf 1000V	C112, 113

<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>RES. DES.</u>
RESISTORS		
470-0101	100 Ohm 1/4W 5%	R101, 112, 130
470-0275	2.7K 1/4W 5%	R102, 113, 131
462-0056	3.3K 1W 5%	R103, 114, 132
472-0471	470 Ohm 1/4W 5%	R104, 115
470-0122	1.2K 1/4W 5%	R105, 116, 134
475-0041	250 Ohm Trim Pot	R106, 117
475-0042	2.5K Trim Pot	R107, 118, 136
471-0222	22K 1/2W 5%	R108, 119, 137
470-0181	180 Ohm 1/4W 5%	R109, 121
470-0102	1K 1/4W 5%	R110
471-0224	220K 1/2W 5%	R122
471-0102	1K 1/2W 5%	R123
471-0474	470K 1/2W 5%	R124
470-0621	620 Ohm 1/4W 5%	R133
HEAT SINK ASSEMBLY		
482-0260	2N 6259	Q605, 606, 705, 706
260-0010	Motor Blower Fan	M01
MISCELLANEOUS		
200-0040	CRT	V01
180-0009	Deflection Yoke	DY01
180-0017	Degaussing Coil	L100
213-0019	CRT PCB Socket	J101
280-0208	Yoke Wedge	X
800-0307	Input Limiter PCB	X
800-0319	Input Clamp PCB	X

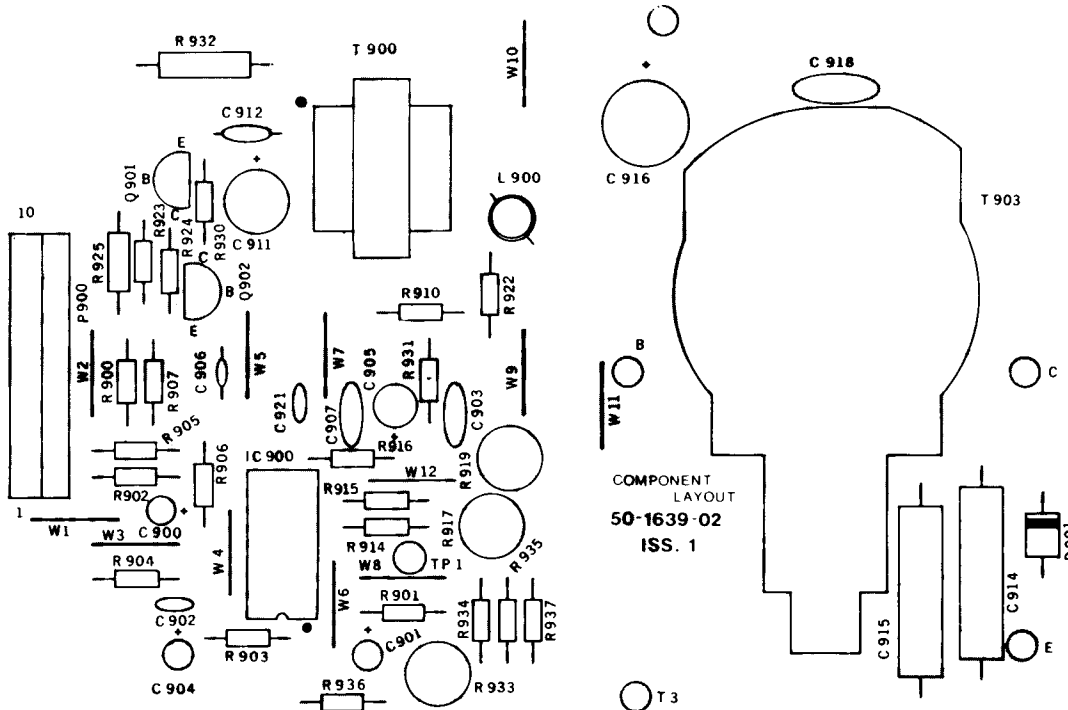


X-Y P.C.B. COMPONENT LAYOUT





C.R.T. P.C.B. COMPONENT LAYOUT

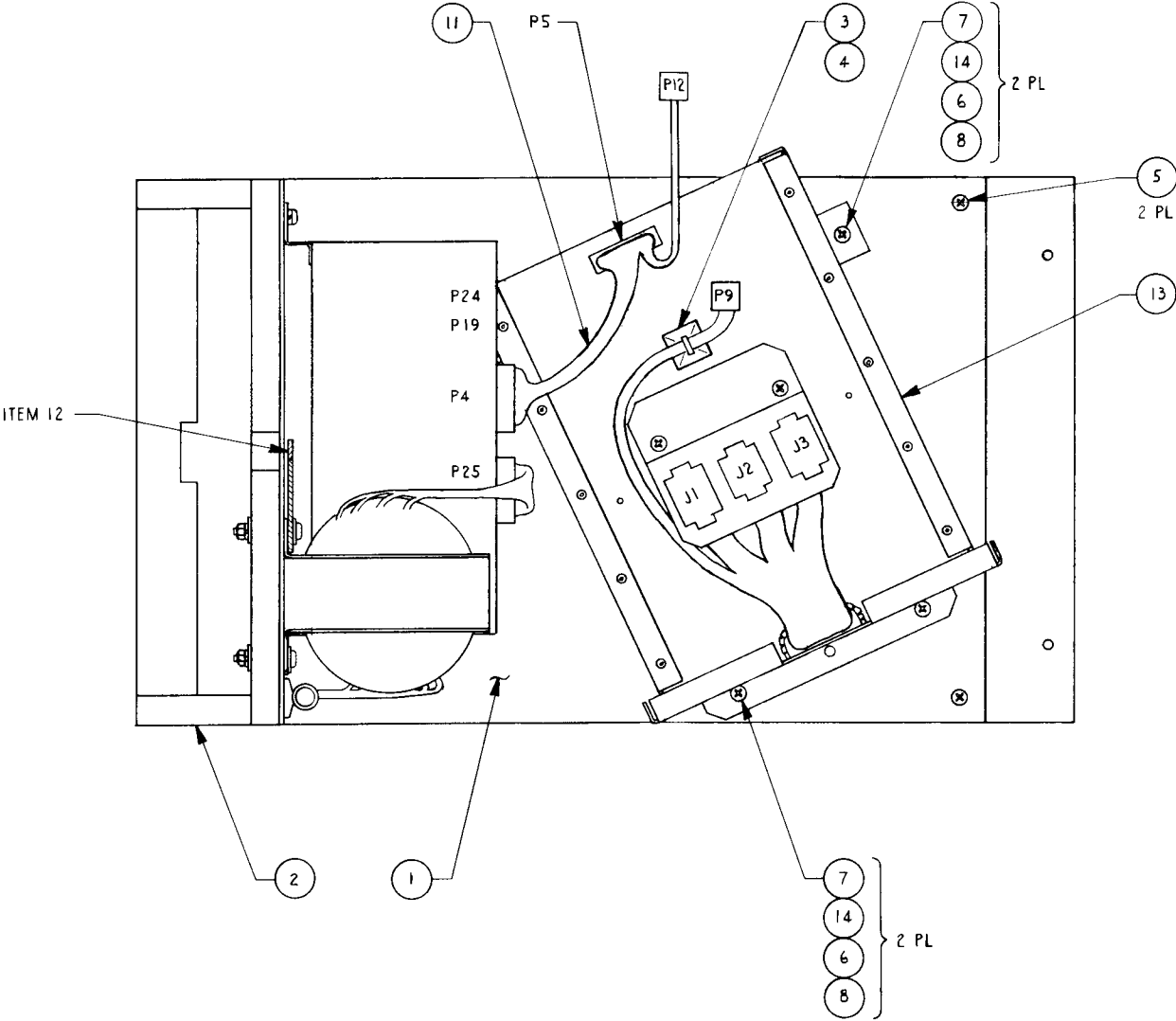


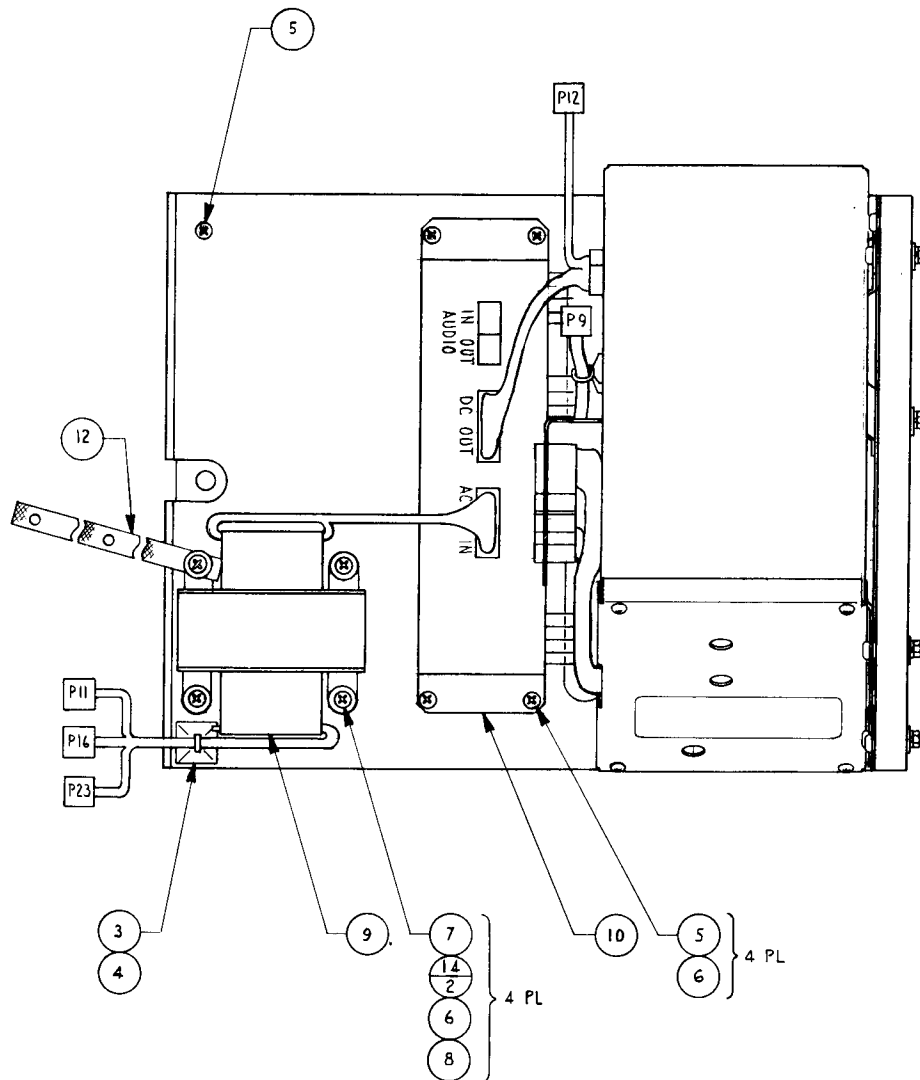
EHT P.C.B. COMPONENT LAYOUT

## COMPONENT SHELF ASSEMBLY

DRAWING NUMBER 800-3304

<u>ITEM NO.</u>	<u>PART NO.</u>	QTY <u>REQD.</u>	<u>DESCRIPTION</u>
1	250-0458-00	1	Saddle G-80 Cage
2	252-0142-00	1	Component Shelf UP. CAB.
3	280-0324-00	1	Cable Clamp Nylon
4	281-0045-12	15	SCR 10-12 x 3/4" PN HD Type A/AB
5	284-0016-08	15	Washer Flt #10 Small OD 1/2"
6	284-0036-00	15	Washer Lock Split #10
7	280-0005-00	5	Cable Tie
8	800-0190-00	1	Assy XFMR EMI
9	800-0191-00	1	Assy Game Pwr Supply G-80
10	800-0277-00	1	Assy Volume Control Block
11	800-0285-00	1	Assy Harn Gnd Game Elec.
12	800-0286-00	1	Assy Harn Gnd Pwr Supply
13	800-0314-00	1	Assy Harn Pwr
14	800-3305-00	1	Game Elec. Assy
15	280-0475-00	12	Staple

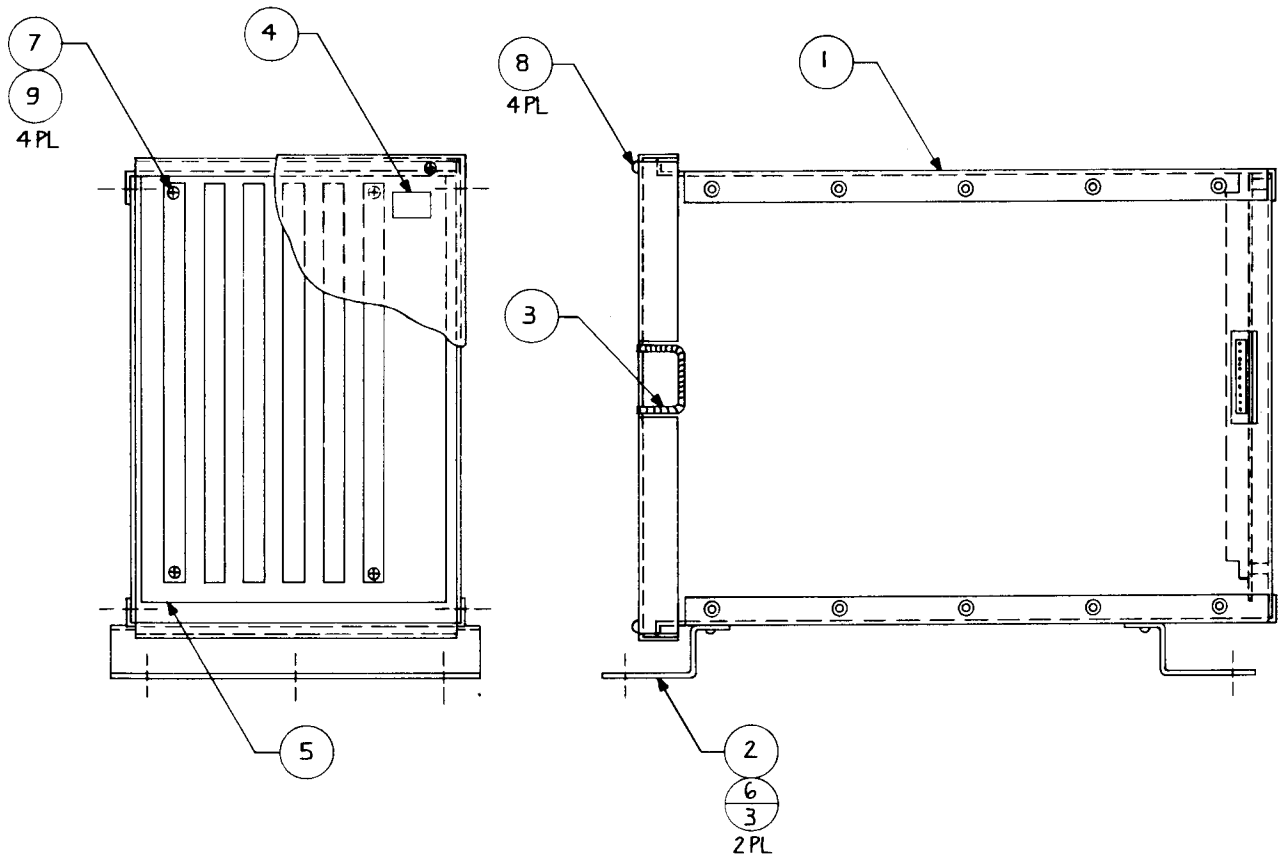




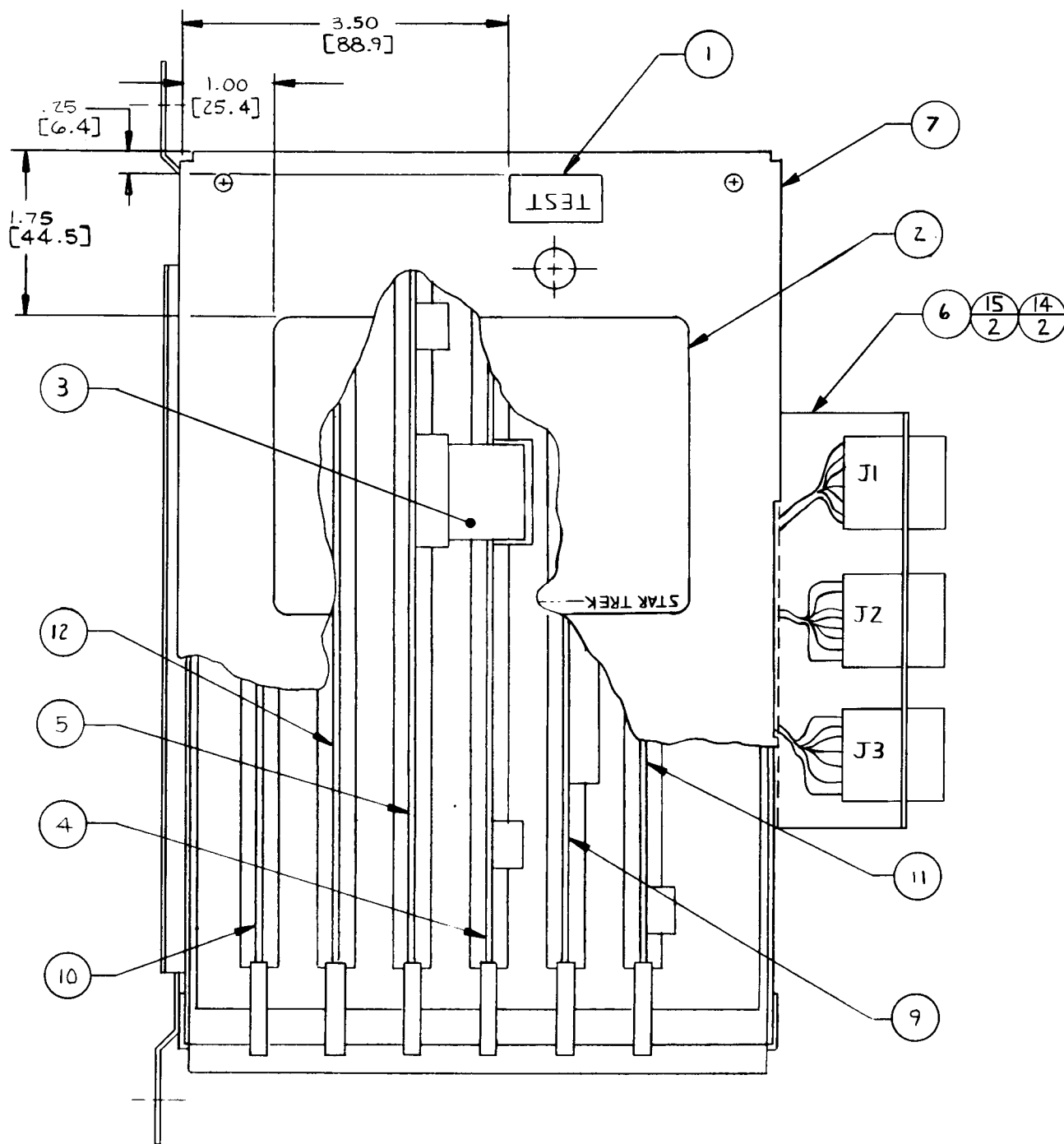
## G-80 CAGE UNIVERSAL ASSEMBLY

DRAWING NUMBER 800-0296

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>
1	250-0456	1	G-80 Cage Assembly
2	250-0499	2	G-80 Cage Bracket
3	280-0343	1	Split Grommet
4	420-0560	1	Test Button Decal
5	800-0105	1	6-Slot Master Board Assembly
6	281-0045-06	6	Pan Head Phillips Screw, Type AB, 10- 12 x .375 Lg
7	281-0001-12	4	Pan Head Phillips Machine Screw, #4-40 x 3/4
8	281-0001-06	4	Pan Head Phillips Machine Screw, #4-40 x 3/8
9	284-0001-00	4	Flat Washer, #4



<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>
1	420-0560-00	1	Decal Test Button
2	420-0054-00	1	Decal Electronics
3	600-0089-00	1	Cable X-Y Interface
4	800-0161-00	1	Assy X-Y Timing PCB
5	800-0163-00	1	Assy X-Y Control PCB
6	800-0282-00	1	Assy Harn Video X-Y Intf
7	800-0296-00	1	Assy G-80 Gage Univ
8	800-0378-00	1	CPU Master Harn Assy
9	800-3307-00	1	Assy CPU PCB
10	800-3306-00	1	Assy 2716 Prom PCB
11	800-3270-00	1	Sound Board Assy
12	800-0294-00	1	Speech Board Assy-2732





## CPU BOARD ASSEMBLY

DRAWING NUMBER 800-3307

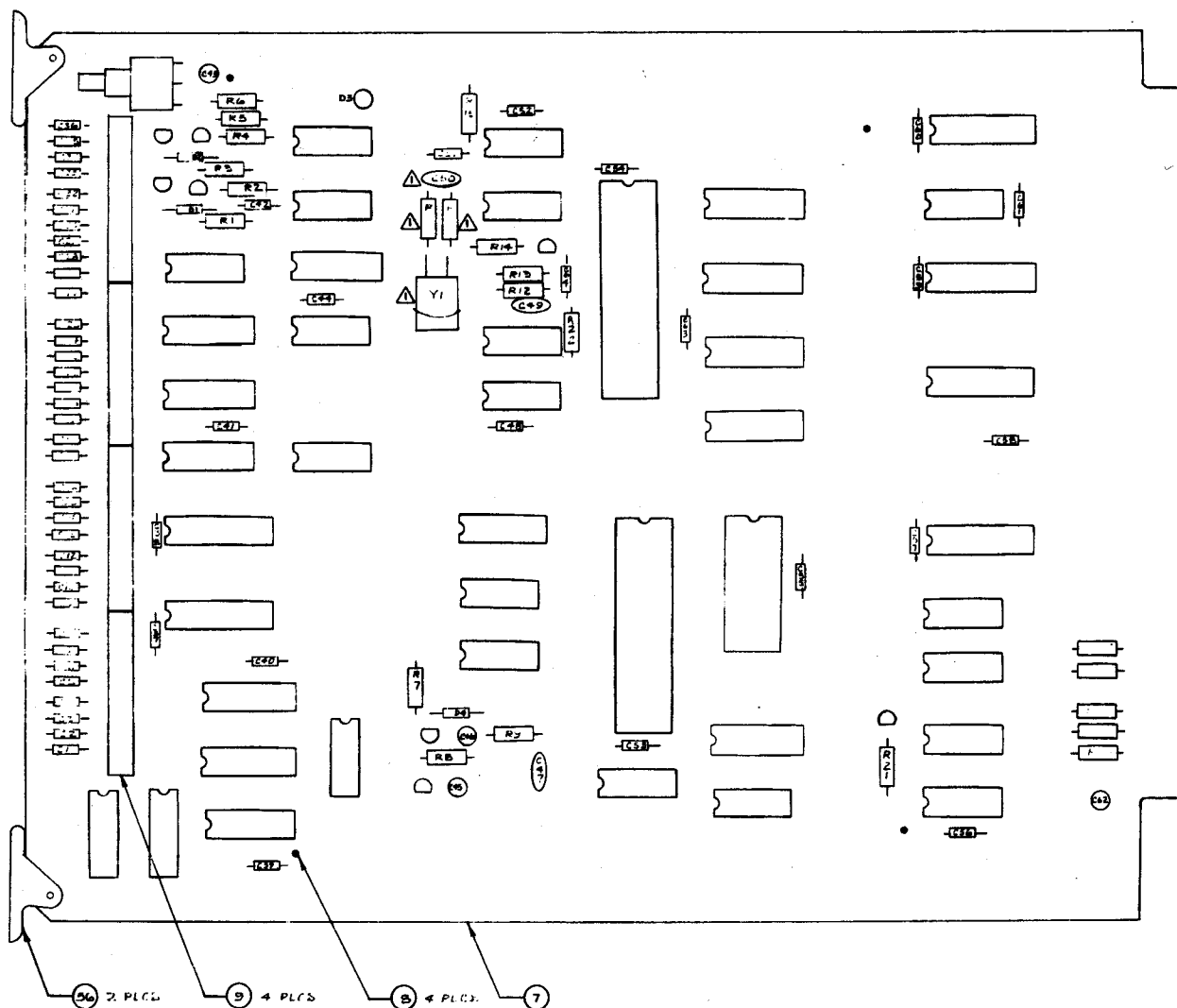
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES</u>
1	800-0107-02	1	CPU Board Assy	
2	316-1873-00	1	IC EPROM 2716	U25
3	315-0064-00	1	Chip 315-0064	

## CPU BOARD ASSEMBLY

DRAWING NUMBER 800-0107

<u>ITEM NO.</u>	<u>PART NO.</u>	QTY <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	150-0088	3	Cap E 10 uf 25V	C43, C46, C62
2	151-0005	1	Cap CER 680 pf 50V	C50
3	151-0012	1	Cap CER .1 uf 50V	C47
4	151-0020	1	Cap CER 33 pf 50V	C49
5	151-0060	21	Cap CER .1 uf 16V AX	C37-C42, C44, C48, C51-C61, C63, C64
6	151-0061	36	Cap CER 220 pf 16V AX	C1-C36
7	170-0194	1	PC Board	
8	211-0008	4	Conn Pin Test PT	TP1-TP4
9	212-0098	4	Conn M 10 Pin RTA	
10	230-0013	1	XTAL 8.000 MHZ	Y1
11	314-0001	1	IC NE555	U12
12	314-0015	1	IC 7404	U30
13	314-0018	4	IC 74LS00	U6, U8, U14, U19
14	314-0019	1	IC 74LS04	U18
15	314-0055	3	IC 74LS244	U34, U36, U38
16	314-0058	1	IC 74LS08	U13
17	314-0062	5	IC 74LS74	U10, U11, U17, U20, U39
18	314-0066	1	IC 74LS27	U16
19	314-0067	1	IC 74LS30	U37
20	314-0068	2	IC 74LS32	U32, U33
21	314-0078	1	IC 74LS 2	U23
22	314-0083	1	IC 74LS240	U4
23	314-0085	2	IC 74LS14	U7, U31
24	314-0087	1	IC 74LS139	U24
25	314-0093	1	IC 74LS374	U3
26	314-0099	1	IC 74LS245	U35
27	314-0105	4	IC 74LS253	U1, U2, U5, U9
28	315-0041	1	IC Z80A	U22
29	315-0046	4	IC 2114	U26-U29

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
30	315-0050	1	IC 2516 (2716)	U25
31	316-0764	1	IC Prom 32x8	U15
32				
33	390-0003	1	Led Red	D3
34	471-0101	1	Res 100 Ohm 1/2W 5%	R5
35	471-0102	2	Res 1K Ohm 1/2W 5%	R1, R3
36	471-0103	1	Res 10K Ohm 1/2W 5%	R6
37	471-0104	3	Res 100K Ohm 1/2W 5%	R7, R8, R22
38	471-0122	1	Res 1.2K Ohm 1/2W 5%	R12
39	471-0220	1	Res 22 Ohm 1/2W 5%	R14
40	471-0221	3	Res 220 Ohm 1/2W 5%	R2, R4, R13
41	471-0331	8	Res 330 Ohm 1/2W 5%	R10, R11, R15-R20
42	477-0002	3	Res Pack 15x2.2K	RP1-RP3
43	481-0001	2	Diode 1N4002	D1, D2
44	481-0006	1	Diode 1N914/IN4148	D4
45	482-0006	1	XSTR N4403	Q7
46	482-0010	2	XSTR PE8050	Q1, Q2
47	482-0014	5	XSTR N4401	Q3-Q6, Q8
48	510-0052	1	SWITCH PIANO DIP	SW1
49	510-0053	1	SW Pushbutton Side PCM	SW3
50	213-0001	1	SKT 24 Pin Dual INLN	XU25
51	213-0002	4	SKT 18 Pin Dual INLN	XU26-XU29
52	213-0004	1	SKT 16 Pin Dual INLN	XU15
53	213-0005	2	SKT 40 Pin Dual INLN	XU21, XU22
54	510-0049	1	Switch 8 Pos Dip	SW2
55	471-0472	1	Res 4.7K Ohm 1/2W 5%	R21
56	280-0420	2	Card Ejector, Snap On	
57	471-0473	1	Res 47K Ohm 1/2W 5%	R9
58	151-0031	1	Cap CER .22 uf 16V	C45

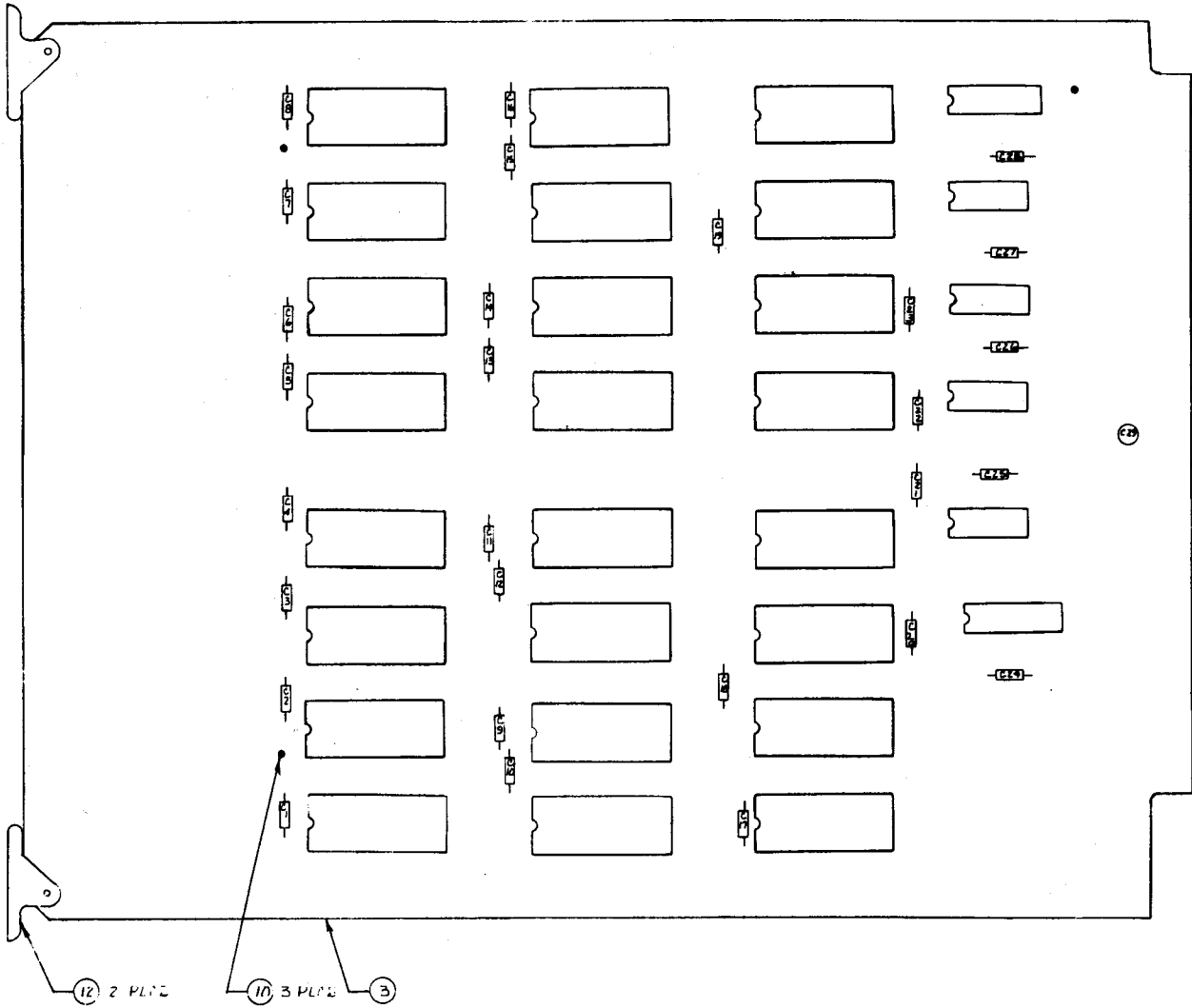


## 2716 PROM BOARD ASSEMBLY

DRAWING NUMBER 800-3306

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD</u>	<u>DESCRIPTION</u>	<u>REF DES</u>
1	800-0151-00	1	Assy G-80 2716 PROM Board	
2	316-1848-00	1	IC EPROM 2716	U1
3	316-1849-00	1	IC EPROM 2716	U2
4	316-1850-00	1	IC EPROM 2716	U3
5	316-1851-00	1	IC EPROM 2716	U4
6	316-1852-00	1	IC EPROM 2716	U5
7	316-1853-00	1	IC EPROM 2716	U6
8	316-1854-00	1	IC EPROM 2716	U7
9	316-1855-00	1	IC EPROM 2716	U8
10	316-1856-00	1	IC EPROM 2716	U9
11	316-1857-00	1	IC EPROM 2716	U10
12	316-1858-00	1	IC EPROM 2716	U11
13	316-1859-00	1	IC EPROM 2716	U12
14	316-1860-00	1	IC EPROM 2716	U13
15	316-1861-00	1	IC EPROM 2716	U14
16	316-1862-00	1	IC EPROM 2716	U15
17	316-1863-00	1	IC EPROM 2716	U16
18	316-1864-00	1	IC EPROM 2716	U17
19	316-1865-00	1	IC EPROM 2716	U18
20	316-1866-00	1	IC EPROM 2716	U19
21	316-1867-00	1	IC EPROM 2716	U20
22	316-1868-00	1	IC EPROM 2716	U21
23	316-1869-00	1	IC EPROM 2716	U22
24	316-1870-00	1	IC EPROM 2716	U23

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	151-0058	13	Ceramic Capacitor, .01 uf, 16V AX	C2, C4, C6, C8, C9, C11, C14, C16, C18, C21, C23, C25, C27
2	151-0060	15	Ceramic Capacitor, .1 uf, 16V AX	C1, C3, C5, C7, C10, C12, C13, C15, C17, C19, C20, C22, C24, C26, C28
3	170-0211	1	PC Board	
4	213-0001	23	24-Pin Dual Inline Socket	XU1-XU23
5	314-0055	1	IC 74LS244	U25
6	314-0058	3	IC 74LS08	U26-U28
7	314-0059	1	IC 74LS10	U29
8	314-0104	1	IC 74LS138	U30
9	314-0120	1	IC 74LS154	U24
10	211-0008	3	Test Point Connector Pin	TP1-TP3
11	150-0088	1	Electrolytic Capacitor, 10 uf, 25V	C29
12	280-0420	2	Card Ejector, Snap On	



## X-Y TIMING ASSEMBLY

DRAWING NUMBER 800-0161

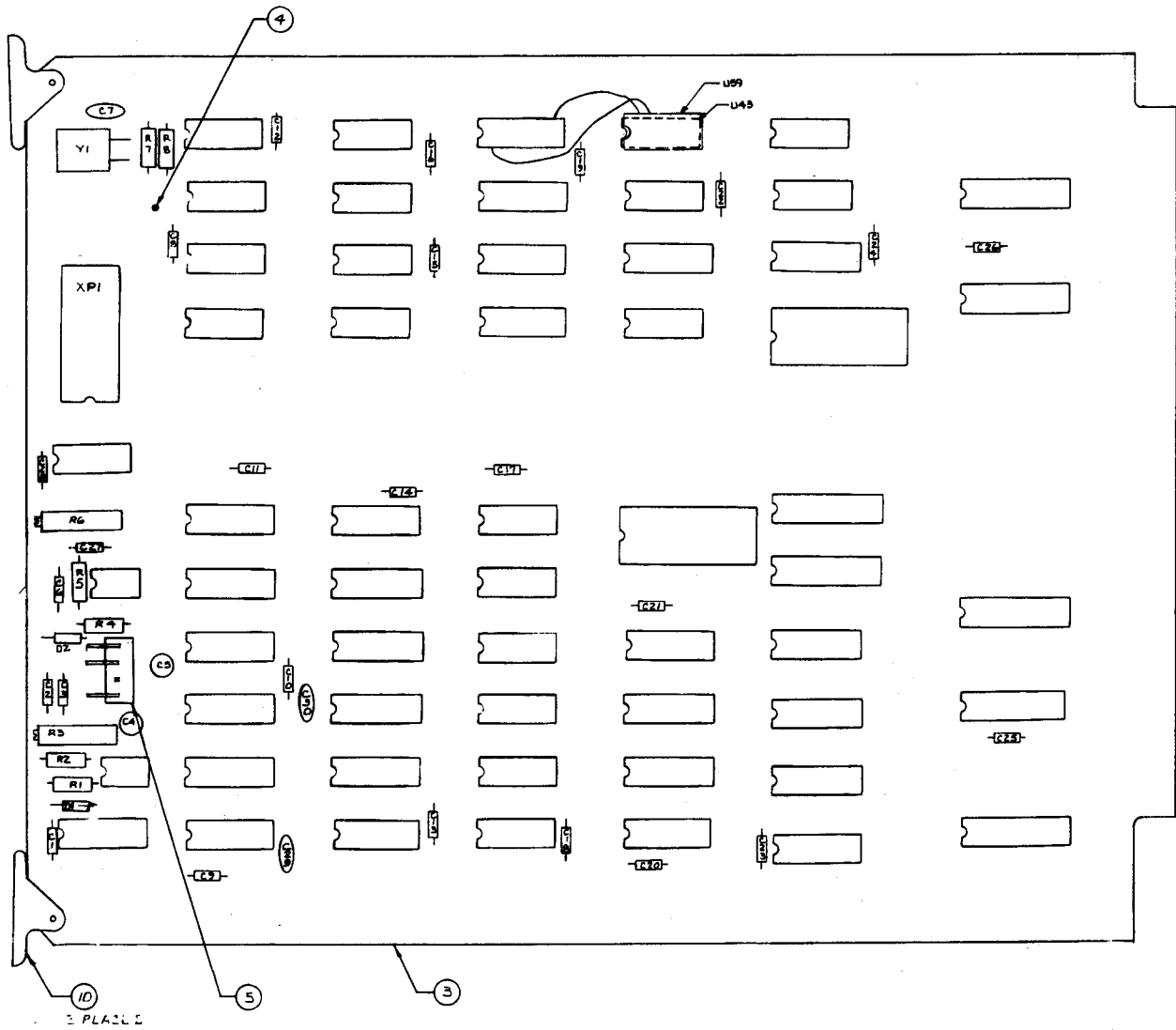
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	151-0005	1	Cap CER 680 pf 50V	C7
2	151-0058	25	Cap .01 uf 16V AX	C1-C3, C6, C8-C28
3	170-0218	1	PC Board	
4	211-0008	1	Conn Pin Test PT	TP1
5	212-0101	1	Conn 4 Pin M RTA	
6	213-0001	3	SKT 24 Pin Dual INLN	XP1, XU39, XU50
7	213-0004	2	SKT 16 Pin Dual INLN	XU1, XU4
8	213-0010	2	SKT 8 Pin Dual INLN	XU2, XU3
9	230-0009	1	Xtal 15.46848	Y1
10	280-0420	2	Card Ejector	
11	313-0004	2	IC LM741EN Dip	U2, U3
12	313-0044	2	IC AD561	U1, U4
13	314-0018	1	IC 74LS00	U28
14	314-0019	2	IC 74LS04	U30, U40
15	314-0040	1	IC 74LS125	U27
16	314-0046	1	IC 74LS04	U14
17	314-0055	3	IC 74LS244	U54, U57, U58
18	314-0058	2	IC 74LS08	U13, U21
19	314-0062	5	IC 74LS74	U25, U26, U42, U43, U52
20	314-0070	1	IC 74LS86	U29
21	314-0073	4	IC 74LS175	U35-U38
22	314-0074	6	IC 74LS191	U15-U20
23	314-0076	6	IC 74LS157	U5-U10
24	314-0078	1	IC 74LS02	U53
25	314-0093	4	IC 74LS374	U48, U49, U55, U56
26	314-0097	6	IC 74LS161	U31-U34, U41, U51
27	314-0101	4	IC 74LS283	U44-U47
28	314-0108	4	IC 74LS107	U11, U22-U24
29	314-0120	1	IC 74LS154	U50
30	314-0135	1	IC 74LS11	U12



<u>ITEM NO.</u>	<u>PART NO.</u>	QTY <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
31	315-0019	1	IC 2708	U39
32	471-0202	2	Res 2K Ohm 1/2W 5%	R2, R4
33	471-0331	2	Res 330 Ohm 1/2W 5%	R7, R8
34	471-0392	2	Res 3.9K Ohm 1/2W 5%	R1, R5
35	475-0024	2	Pot 1K 10 Turn	R3, R6
36	151-0008	2	Cap CER .001 uf 50V	C29, C30
37	150-0088	2	Cap E 10 uf 25V RDL	C4, C5
38	151-0042	1	Cap, Cer 470 pf 50V	C31
39	481-0006	2	1N914 Diode	D1, D2
40	151-0002	2	Cap CER 100 pf 50V	C32, C33

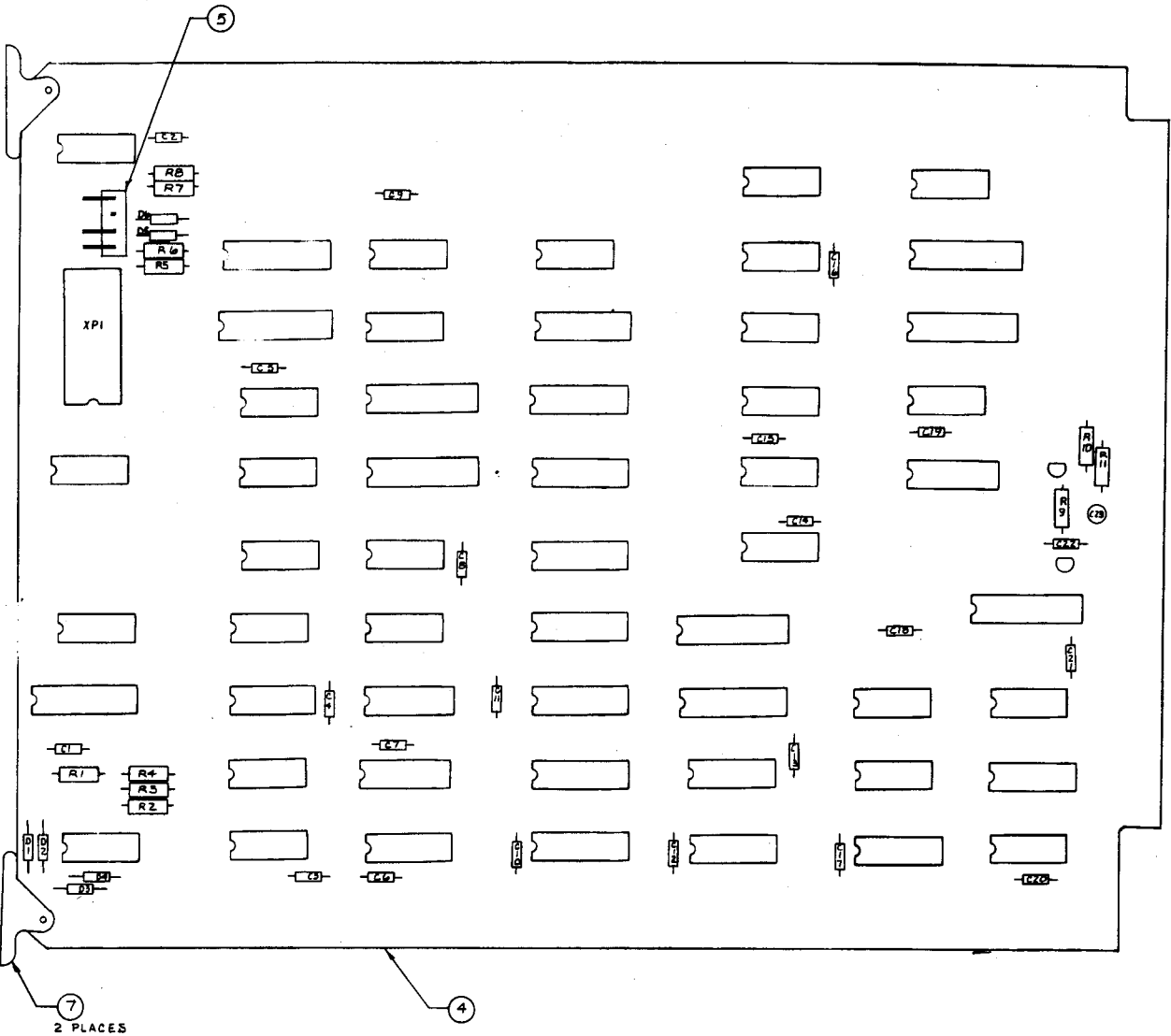
# X-Y Timing Board Assembly

800-0161



<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	150-0088	1	Cap E 10 uf 25V	C23
2	151-0002	1	Cap CER 100 pf 50V	C14
3	151-0058	21	Cap CER .01 uf 16Y AX	C1-C13, C15-C22
4	170-0219	1	PC Board	
5	212-0101	1	Conn 4 Pin M RTA	
6	213-0001	1	SKT 24 Pin Dual INLN	XP1
7	280-0330	2	Card Ejector	
8	314-0018	1	IC 74LS00	U40
9	314-0019	3	IC 74LS04	U9, U32, U42
10	314-0040	1	IC 74LS125	U39
11	314-0055	7	IC 74LS244	U20, U21, U35, U36, U48, U49, U54
12	314-0058	1	IC 74LS08	U37
13	314-0059	2	IC 74LS10	U18, U41
14	314-0060	1	IC 74LS20	U50
15	314-0062	2	IC 74LS74	U19, U51
16	314-0067	1	IC 74LS30	U47
17	314-0068	2	IC 74LS32	U4, U38
18	314-0074	3	IC 74LS191	U15-U17
19	314-0075	1	IC 74LS393	U22
20	314-0078	1	IC 74LS02	U23
21	314-0087	1	IC 74LS139	U46
22	314-0093	2	IC 74LS374	U2, U13
23	314-0097	5	IC 74LS161	U10-U12, U34, U52
24	314-0099	1	IC 74LS245	U14
25	314-0101	1	IC 74LS283	U33
26	314-0108	1	IC 74LS107	U53
27	314-0127	1	IC 74LS164	U3
28	314-0128	4	IC 74LS95	U6, U7, U44, U45
29	314-0137	2	IC 74LS09	U1, U5
30	315-0046	8	IC 2114	U24-U31

<u>ITEM NO.</u>	<u>PART NO.</u>	QTY <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
31	315-0072	2	IC AM25LS14	U8, U43
32	471-0123	3	Res 12K Ohm 1/2W 5%	R1, R3, R5
33	471-0472	1	Res 4.7K Ohm 1/2W 5%	R7
34	471-0622	3	Res 6.2K Ohm 1/2W 5%	R2, R4, R6
35	481-0006	6	Diode 1N914/1N4148	D1-D6
36	212-0002	8	Socket 18 Pin	XU24-XU31
37	471-0471	1	Res 470 Ohm 1/2W 5%	R8
38	471-0103	1	Res 10K Ohm 1/2W 5%	R9
39	471-0332	1	Res 3.3K Ohm 1/2W 5%	R11
40	471-0512	1	Res 5.1K Ohm 1/2W 5%	R10
41	482-0006	1	XSTR 2N4403	Q1
42	482-0014	1	XSTR 2N4401	Q2



## UNIVERSAL SOUND BOARD ASSEMBLY

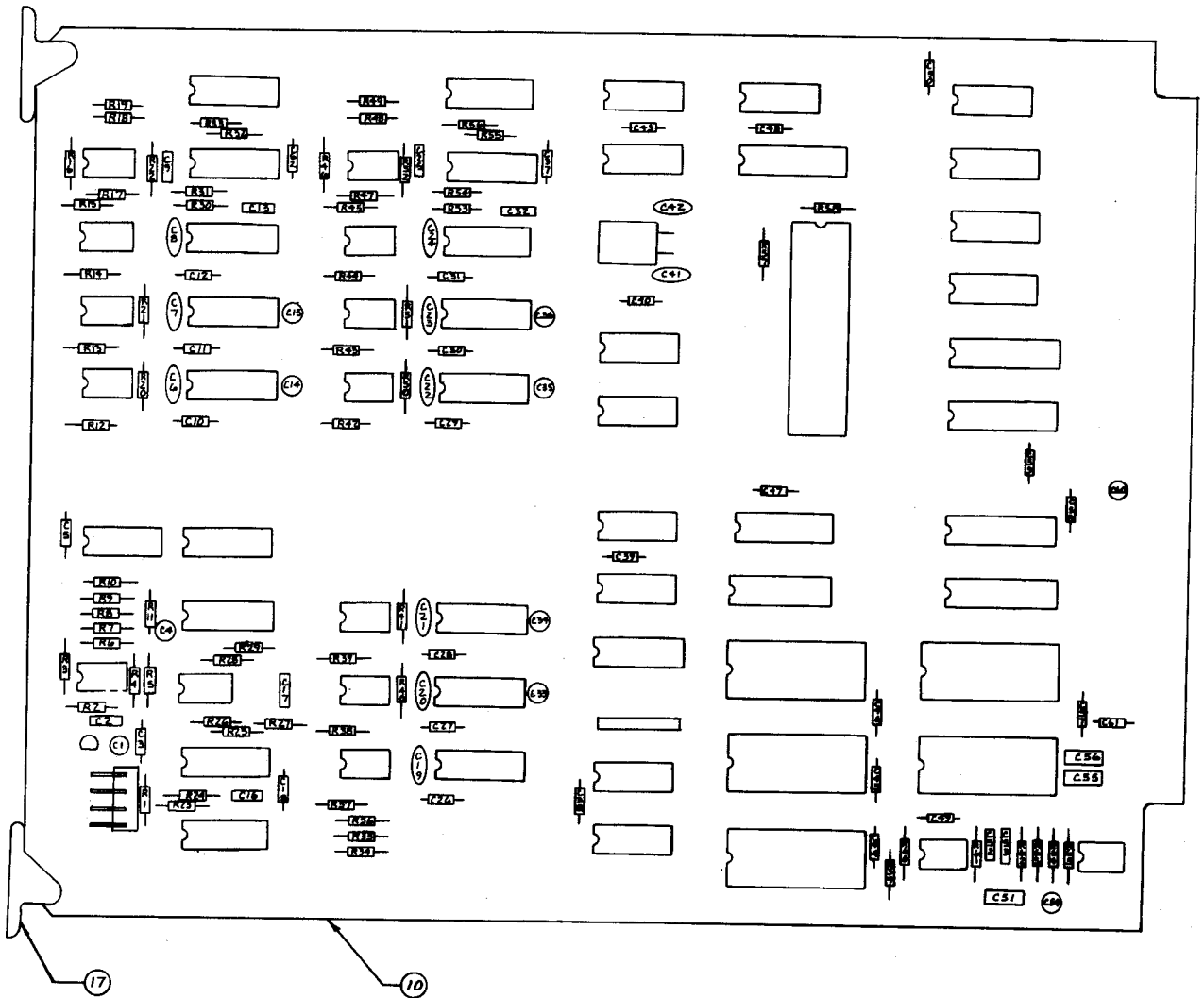
DRAWING NUMBER 800-0377

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	150-0087	2	Cap-E 4.7 f 25V RDL	C1, C4
2	150-0090	1	Cap-E 33 f 25V RDL	C60
3	150-0135	7	Cap-E 1 f 25V RDL	C14, C15, C33-C36, C54
4	151-0002	9	Cap-CER 100 pf 50V	C6-C8, C19-C24
5	151-0021	2	Cap-CER 20 pf 50V	C41, C42
6	151-0060	29	Cap .1 f 16V AX	C3, C5, C10-C12, C18, C26-C31, C37-C40, C43-C50, C57-C59, C61, C62
7	151-0011	3	Cap-F .15 f 50V	C51, C55, C56
8	152-0085	6	Cap-F .01 f 50V	C9, C13, C16, C17, C25, C32
9	152-0144	1	Cap-F .082 f 50V	C53
10	170-0259	1	PC Board	
11	212-0081	1	Conn 4 Pin M RTG PLZD	P1
12	213-0001	2	Skt 24 Pin Dual INLN	XU50, XU51
13	213-0022	2	Skt 18 Pin Dual INLN	XU44, XU45
14				
15	213-0005	1	Skt 40 Pin Dual INLN	XU46
16	230-0037	1	XTAL 6.0 MHz	Y1
17	280-0420	2	Card Ejector Snap On	
18	313-0037	1	IC TL081	U49
19	313-0038	13	IC TL082	U1, U3-U6, U9, U17-U23
20	314-0018	1	IC 74LS00	U36
21	314-0055	1	IC 74LS244	U55
22	314-0060	1	IC 74LS20	U40
23	314-0062	2	IC 74LS74	U2, U38
24	314-0067	1	IC 74LS30	U59

<u>ITEM NO.</u>	<u>PART NO.</u>	QTY <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
25	314-0068	3	IC 74LS32	U35, U37, U39
26	314-0075	2	IC 74LS393	U32, U33
27	314-0076	3	IC 74LS157	U56-U58
28	314-0085	1	IC 74LS14	U48
29	314-0087	2	IC 74LS139	U10, U11
30	314-0099	2	IC 74LS245	U52, U53
31	314-0100	1	IC 74LS273	U54
32	314-0104	1	IC 74LS138	U34
33	314-0131	1	IC 74LS373	U47
34	315-0035	1	IC MM5837	U60
35	315-0046	2	IC 2114	U44, U45
36	315-0059	3	IC 8253	U41-U43
37	315-0077	1	IC 8035	U46
38	315-0079	6	IC CD4053	U7, U8, U15, U16, U30, U31
39	315-0132	9	IC AD7524	U12-U14, U24-U29
40	315-0133	2	IC 2K x 8 Static RAM	U50, U51
41	470-0102	8	Res 1K Ohm 1/4W 5%	R23, R24, R30, R33, R53, R56, R59, R63
42	470-0103	11	Res 10K Ohm 1/4W 5%	R20-R22, R27, R40, R41, R50-R52, R57, R58
43	470-0104	29	Res 100K Ohm 1/4W 5%	R1, R7-R10, R12, R13, R15, R16, R18, R19, R25, R28, R29, R31, R32, R34-R36, R38, R39, R42, R43, R45, R46, R48, R49, R54, R55
44	470-0105	2	Res 1M ohm 1/4W 5%	R2, R11
45	470-0124	1	Res 120K Ohm 1/4W 5%	R6

<u>ITEM NO.</u>	<u>PART NO.</u>	QTY <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
46	470-0222	2	Res 2.2K Ohm 1/4W 5%	R5, R60
47	470-0271	1	Res 270 Ohm 1/4W 5%	R62
48	470-0272	2	Res 2.7K Ohm 1/4W 5%	R64, R65
49	470-0333	4	Res 33K Ohm 1/4W 5%	R14, R37, R44, R61
50	470-0334	1	Res 330K Ohm 1/4W 5%	R3
51	470-0562	3	Res 5.6K Ohm 1/4W 5%	R17, R26, R47
52	470-0332	1	Res 3.3K Ohm 1/4W 5%	R4
53	482-0023	1	XSTR 2N4093	Q1
54	152-0054	1	Cap-F .001 f 50V	C2
55	152-0076	1	Cap-F .1 f 50V	C52
56	212-0158	1	Conn Header 8 Pos	P2
57	212-0159	1	Conn Jumper	





## SPEECH BOARD ASSEMBLY

DRAWING NUMBER 800-3308

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES</u>
1	800-0294-00	1	Assy 2732 Speech PCB	
2	316-1607-00	1	IC EPROM 2716	U7
3	316-1871-00	1	IC 2732	U6
4	316-1872-00	1	IC 2732	U5

SPEECH BOARD ASSEMBLY

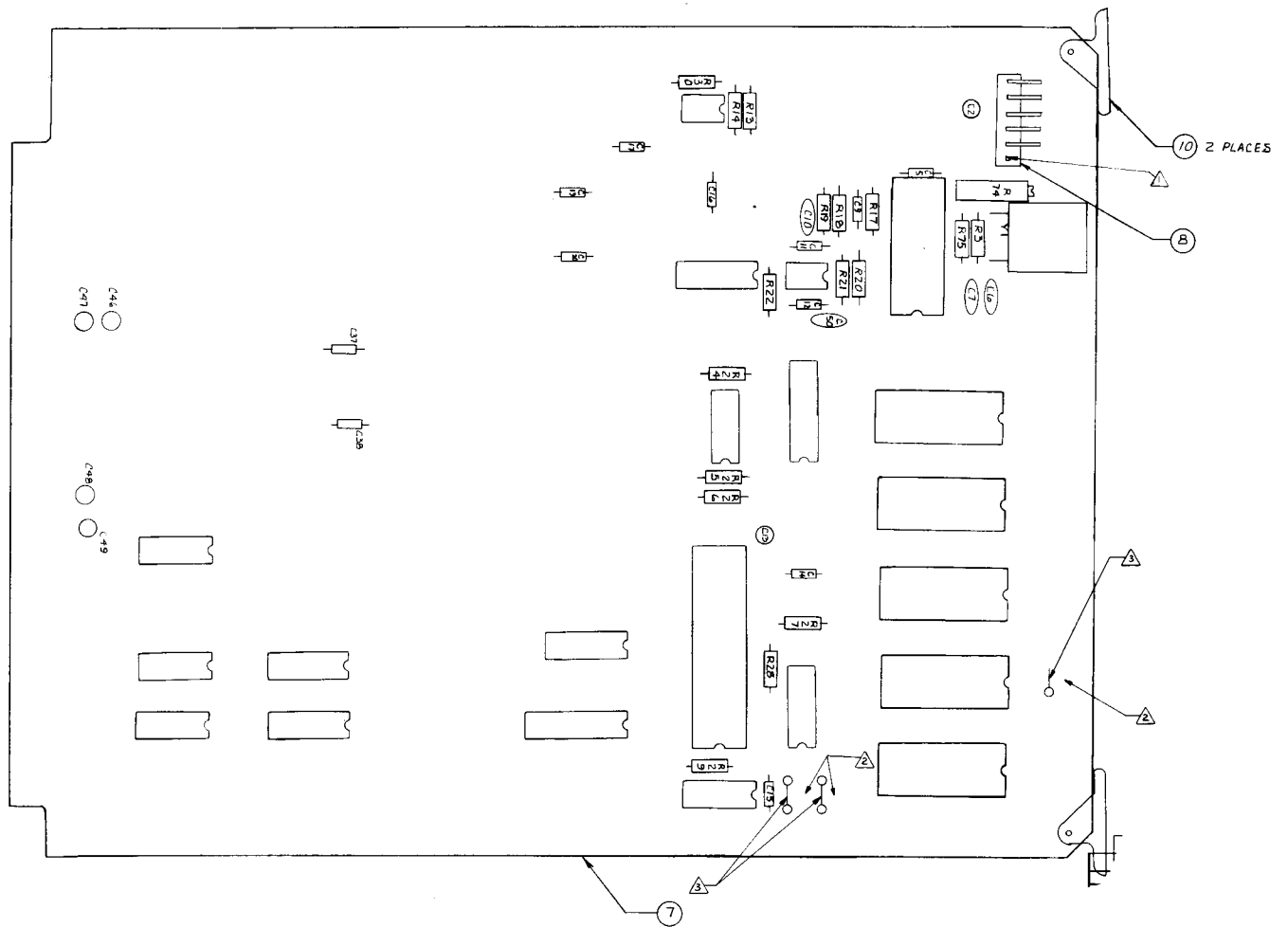
DRAWING NUMBER 800-0294

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	150-0087	1	Cap E 4.7 uf 25V	C2
2	150-0088	5	Cap E 10 uf 25V	C13, C46-C49
3	151-0021	2	Cap Cer 20 pf 50V	C6, C7
4	151-0056	1	Cap Cer .047 uf 50V	C10
5	151-0058	10	Cap Cer .01 uf 16V AX	C5, C11, C12, C14- 17, C19, C20, C44
6	151-0060	3	Cap Cer .1 uf 16V AX	C9, C37, C38
7	170-0223	1	PC Board	
8	212-0012	1	Conn 6 Pin M	
9	230-0033	1	Crytral 3.12 MHZ	Y1
10	280-0420	2	Card Ejector	Snap On
11	313-0037	1	IC TL081 CP	U8
12	313-0038	1	IC TL082 CP	U11
13	314-0058	1	IC 74LS08	U35
14	314-0062	1	IC 74LS74	U15
15	314-0067	1	IC 74LS30	U37
16	314-0072	1	IC 74LS174	U20
17	314-0085	1	IC 74LS14	U38
18	314-0087	1	IC 74LS139	U10
19	314-0100	1	IC 74LS273	U21
20	314-0042	1	IC 7406	U13
21	314-0131	1	IC 74LS373	U9
22	315-0061	1	IC ST-32034	U2
23	315-0077	1	IC 8035	U14
24	315-0079	1	IC CD4053	U12
25	316-0788	1	IC Prom Speech Bd Decoder	U30
26	471-0103	5	Res 10K Ohm 1/2W 5%	R17, R21, R27-R29
27	471-0106	1	Res 10 Meg Ohm 1/2W 5%	R3
28	471-0222	1	Res 2.2K Ohm 1/2W 5%	R24
29	471-0223	4	Res 22K Ohm 1/2W 5%	R13, R14, R18, R22
30	471-0274	1	Res 270K Ohm 1/2W 5%	R19

## SPEECH BOARD ASSEMBLY-Continued

DRAWING NUMBER 800-0294

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
31	471-0471	2	Res 470 Ohm 1/2W 5%	R25, R26
32	477-0002	1	Res Pack 15x2.2K	RP2
33	471-0683	1	Res 68K Ohm 1/2W 5%	R30
34	475-0022	1	Pot 100K 10T PC MNT	R74
35	151-0009	1	Cap Cer .003 uf 100V	C50
36	471-0472	1	Res 4.7K Ohm 1/2W 5%	R20
37	21 -0001	5	SKT 24 Pin Dual INLN	XU3-XU7
38	213-0004	1	SKT 16 Pin Dual INLN	XU30
39	213-0005	1	SKT 40 Pin Dual	XU14
40	213-0008	2	SKT 20 Pin Dual INLN	XU9, XU21
41	213-0010	2	SKT 8 Pin Dual INLN	XU8, XU11
42	213-0012	1	SKT 28 Pin Dual INLN	XU2
43	471-0102	1	Res 1K Ohm 1/2W 5%	R75

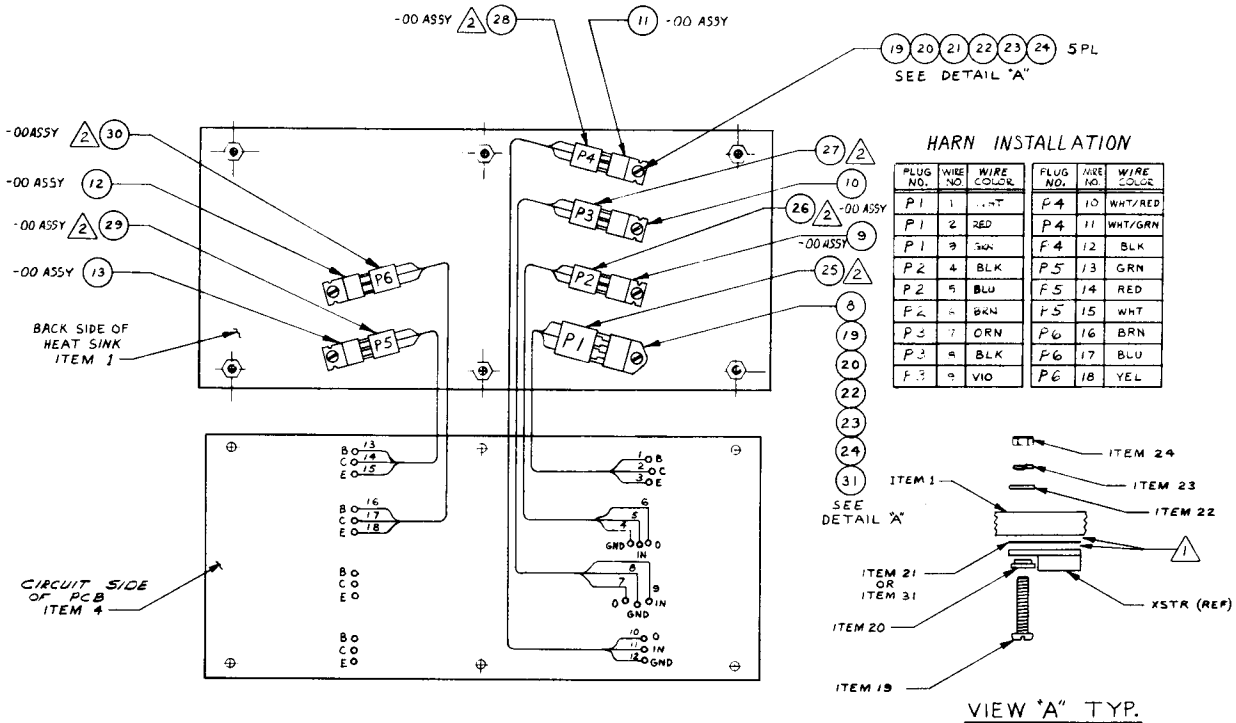
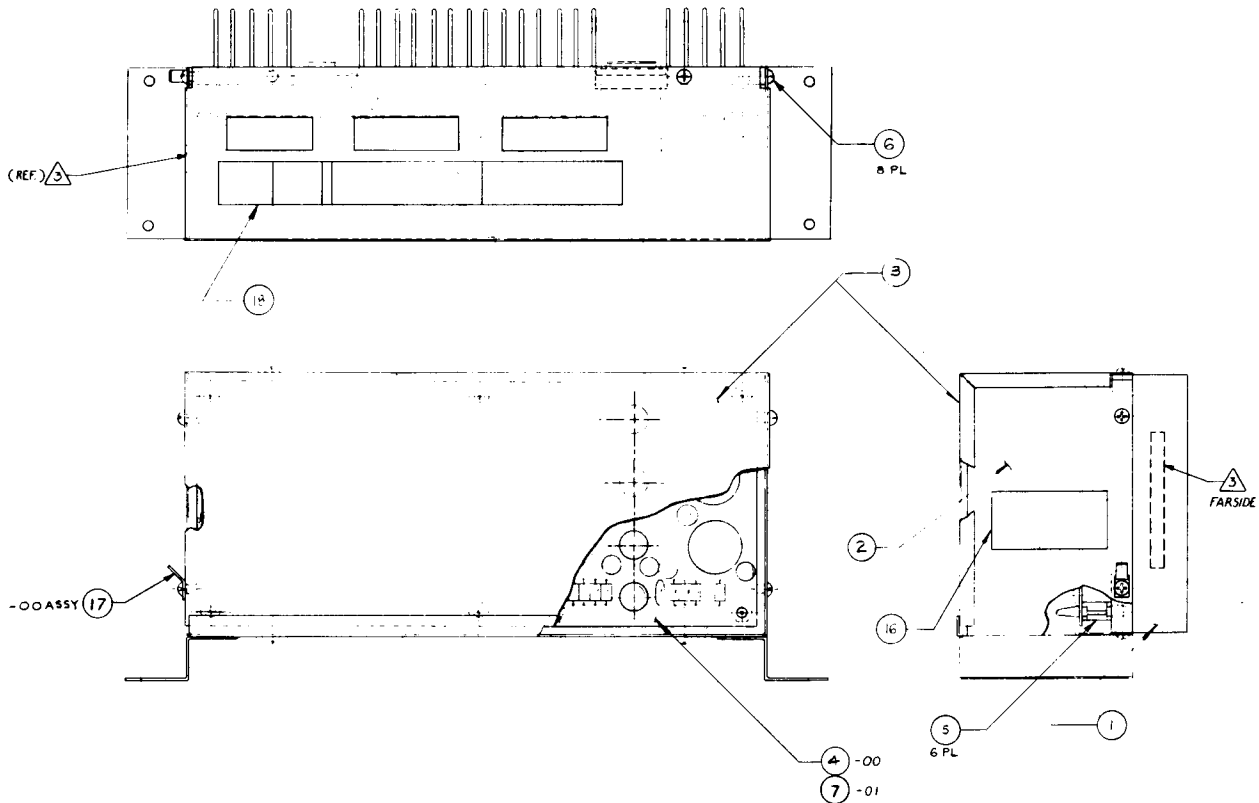


## G-80 POWER SUPPLY CHASSIS ASSEMBLY

DRAWING NUMBER 800-0191

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	530-0016	1	Heat Sink, G-80 Pwr Sup.	
2	250-0460	1	Chassis Support	
3	250-0461	1	Cover	
4	800-0170	1	PCB Assembly	
5	253-0206	6	PCB Support, Threaded	
6	281-0032-06	8	Thread Forming Screw, #6 Type B, 3/8 long	
7				
8	482-0104	1	Power Transistor	TIP 141
9	313-0023	1	Negative 5 Volt Regulator	320T5
10	313-0014	1	Positive 12 Volt Regulator	340T12
11	313-0015	1	Negative 12 Volt Regulator	320T12
12	482-0100	1	Power Transistor (Audio Amp)	TIP 125
13	482-0019	1	Power Transistor (Audio Amp)	TIP 120
14				
15				
16	420-0557	1	Fuse Decal	
17	280-0117	1	Tab Rivet Male 1/4"	
18	420-0575	1	Power Supply B Decal	
19	281-0001-08	6	Pan Head Phillips Screws, 4-40x1/2" Lg	
20	280-0341-00	6	Shoulder Washer, #4	
21	310-0006-01	6	Transistor Insulator, T0-220	
22	284-0001-00	6	Flat Washer #4	
23	284-0031-00	6	Split Lock Washer #4	
24	283-0021-00	6	Machine Hex Nut, 4-40	
25	800-0243	1	G-80 Transistor Harness Assembly P1	

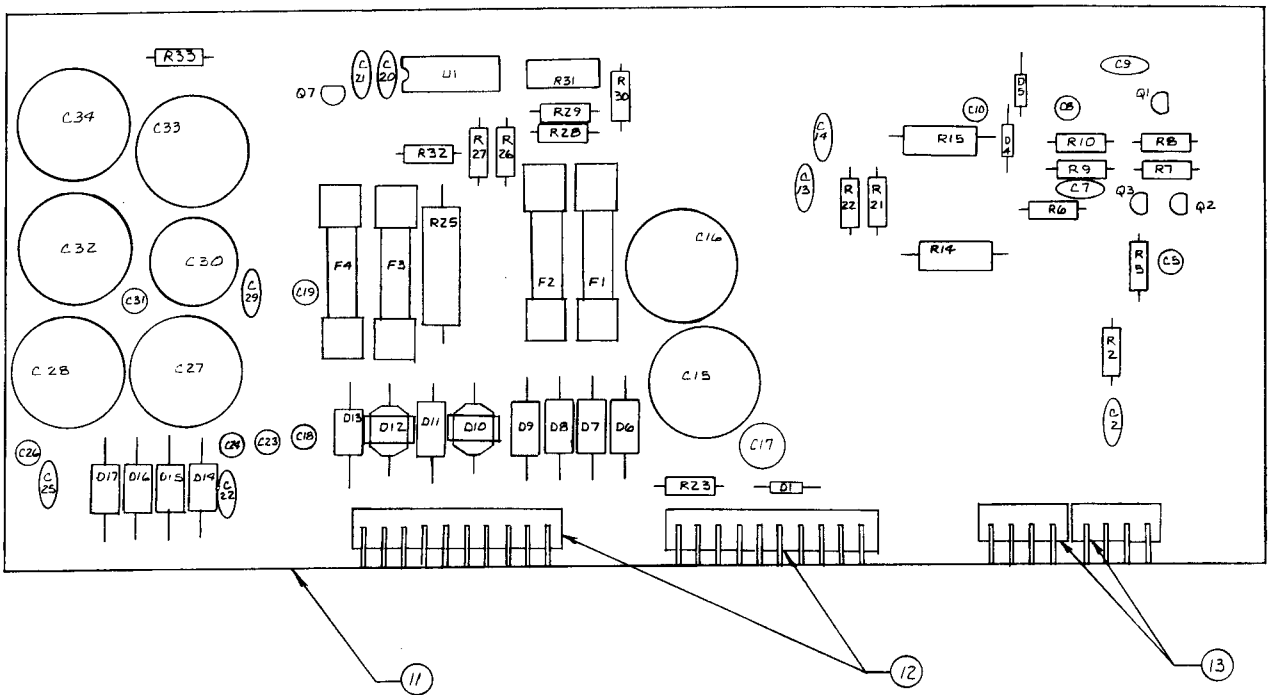
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
26	800-0244	1	G-80 Transistor Harness Assembly, P2	
27	800-0245	1	G-80 Transistor Harness Assembly, P3	
28	800-0246	1	G-80 Transistor Harness Assembly, P4	
29	800-0247	1	G-80 Transistor Harness Assembly, P5	
30	800-0248	1	G-80 Transistor Harness Assembly, P6	
31	310-0007-01	1	Transistor Insulator "H", T0-218	





<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
1	150-0088	9	Electrolytic Capacitor, 10 uf, 25V	C5, C8, C10, C18, C19, C23, C24, C26, C31
2	150-0092	1	Electrolytic Capacitor, 100 uf, 25V	C17
3	150-0095	1	Electrolytic Capacitor, 3300 uf, 25V	C30
4	150-0096	3	Electrolytic Capacitor, 6800 uf, 16V	C32-C34
5	150-0097	4	Electrolytic Capacitor, 4700 uf, 25V	C15, C16, C27, C28
6	151-0002	1	Ceramic Capacitor, 100 pf, 50V	C9
7	151-0007	1	Ceramic Capacitor, .005 uf, 100V	C20
8	151-0011	4	Ceramic Capacitor, .01 uf, 50V	C21, C22, C25, C29
9	151-0012	3	Ceramic Capacitor, .1 uf, 50V	C2, C13, C14
10	151-0021	1	Ceramic Capacitor, 20 pf, 50V	C7
11	170-0222	1	PC Board	
12	212-0020	2	10-Pin Male Connector RTA	
13	212-0081	2	4-Pin Male Connector RTA	
14	313-0001	1	IC LM723 Dip	U1
15	471-0011	1	Resistor, 10 Ohm, 1/2W 5%	R2
16	471-0101	1	Resistor, 100 Ohm, 1/2W 5%	R32
17	471-0102	3	Resistor, 1K Ohm, 1/2W 5%	R10, R27, R29
18	471-0103	2	Resistor, 10K Ohm, 1/2W 5%	R6, R30
19	471-0104	1	Resistor, 100K Ohm, 1/2W 5%	R23
20	471-0222	2	Resistor, 2.2K Ohm, 1/2W 5%	R21, R22

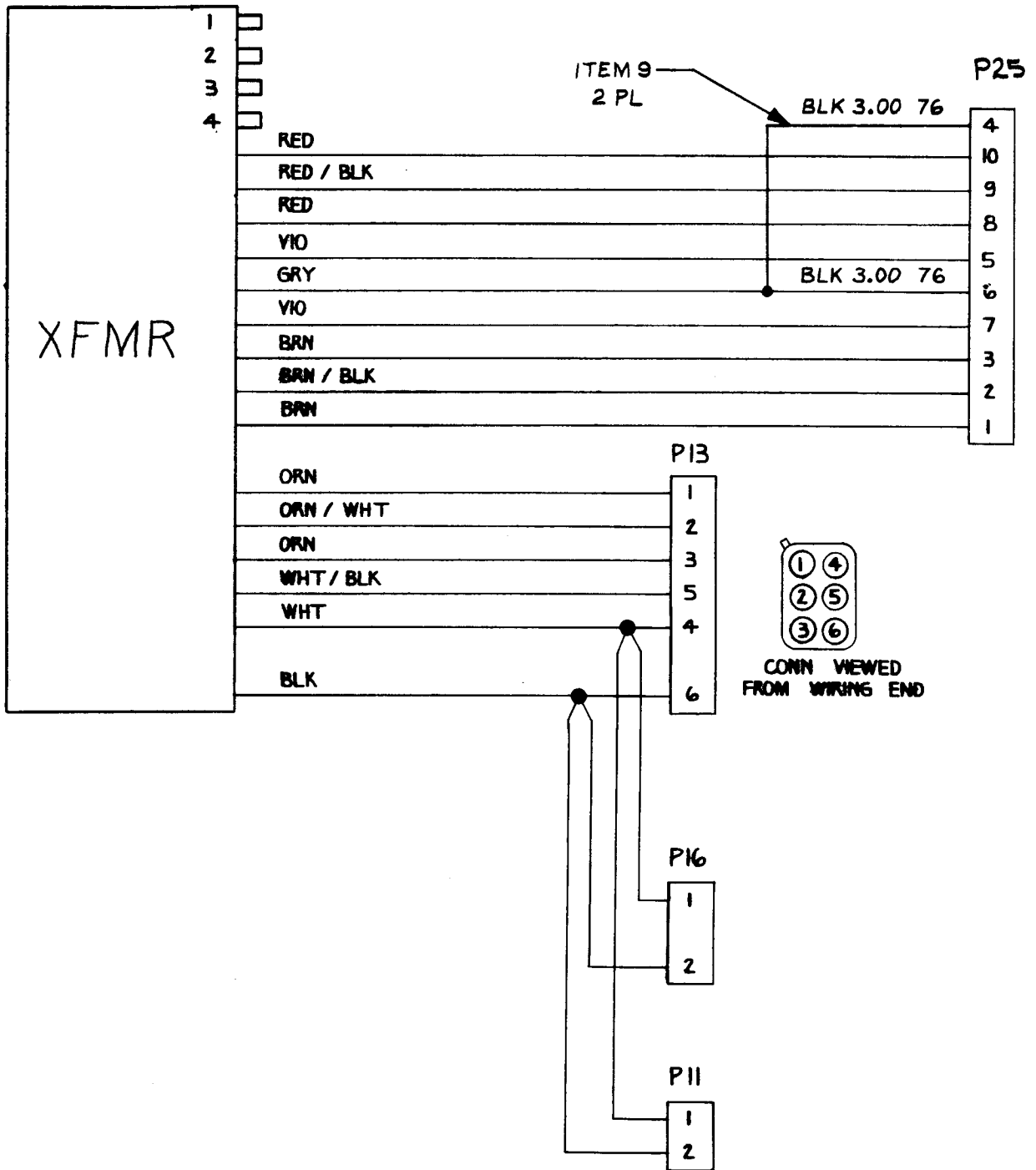
<u>ITEM NO.</u>	<u>PART NO.</u>	<u>QTY</u> <u>REQD.</u>	<u>DESCRIPTION</u>	<u>REF DES.</u>
21	471-0223	2	Resistor, 22K Ohm, 1/2W 5%	R5, R9
22	471-0332	1	Resistor, 3.3K Ohm, 1/2W 5%	R28
23	471-0182	1	Resistor, 1.8K Ohm, 1/2W 5%	R26
24	471-0681	1	Resistor, 680 Ohm, 1/2W 5%	R7
25	473-05R0	1	Resistor, .05 Ohm, 5W 3%	R25
26	473-00R2	2	Resistor, .2 Ohm, 3W 5%	R14, R15
27	475-0004	1	Pot 1K Car PCMTV	R31
28	481-0002	2	Diode MR751	D10, D12
29	481-0004	10	Diode MR501	D6-D9, D11, D13-D17
30	481-0006	3	Diode 1N914/1N4148	D1, D4, D5
31	482-0006	2	Transistor 2N4403	Q1, Q7
32	482-0014	2	Transistor 2N4401	Q2, Q3
33	514-0002	2	Fuse 3A Norm	F1, F2
34	514-0003	8	Clip Fuse Mounting	
35	514-0006	1	Fuse 1.5A Norm	F4
36	514-0008	1	Fuse 10A Slow Blow	F3
37	800-0191	1	Schematic Reference	
38	471-0220	1	Resistor, 22 Ohm, 1/2W 5%	R8
39	471-0221	1	Resistor, 220 Ohm, 1/2W 5%	R33





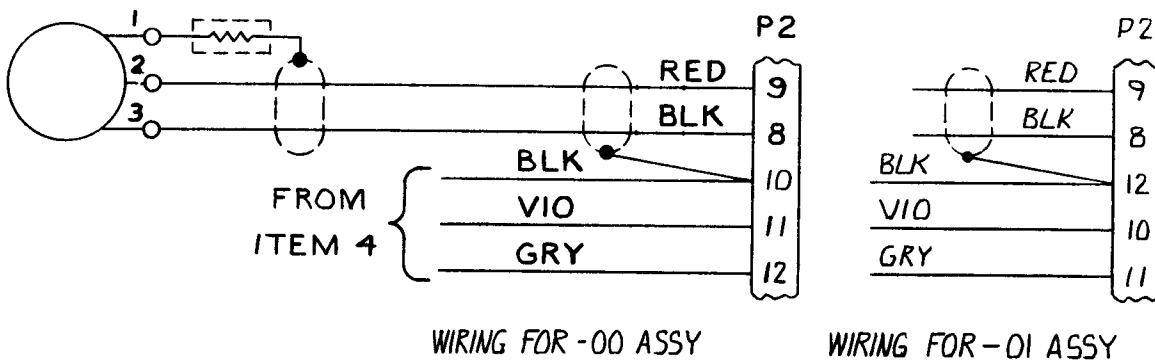
# EMI Transformer Assembly

800-0190



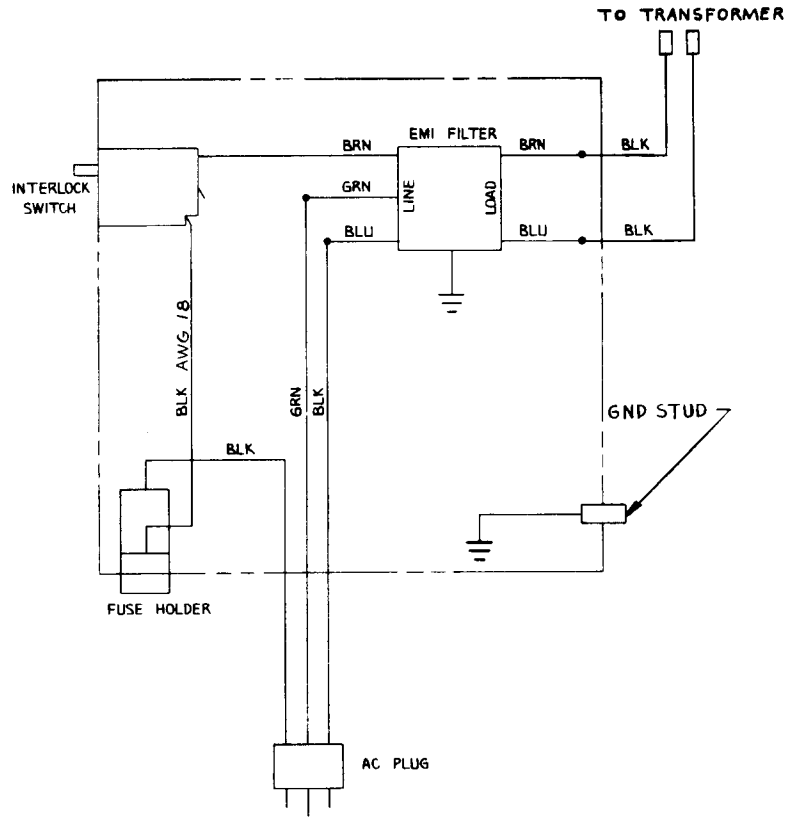
# Coin System Assembly

800-3294



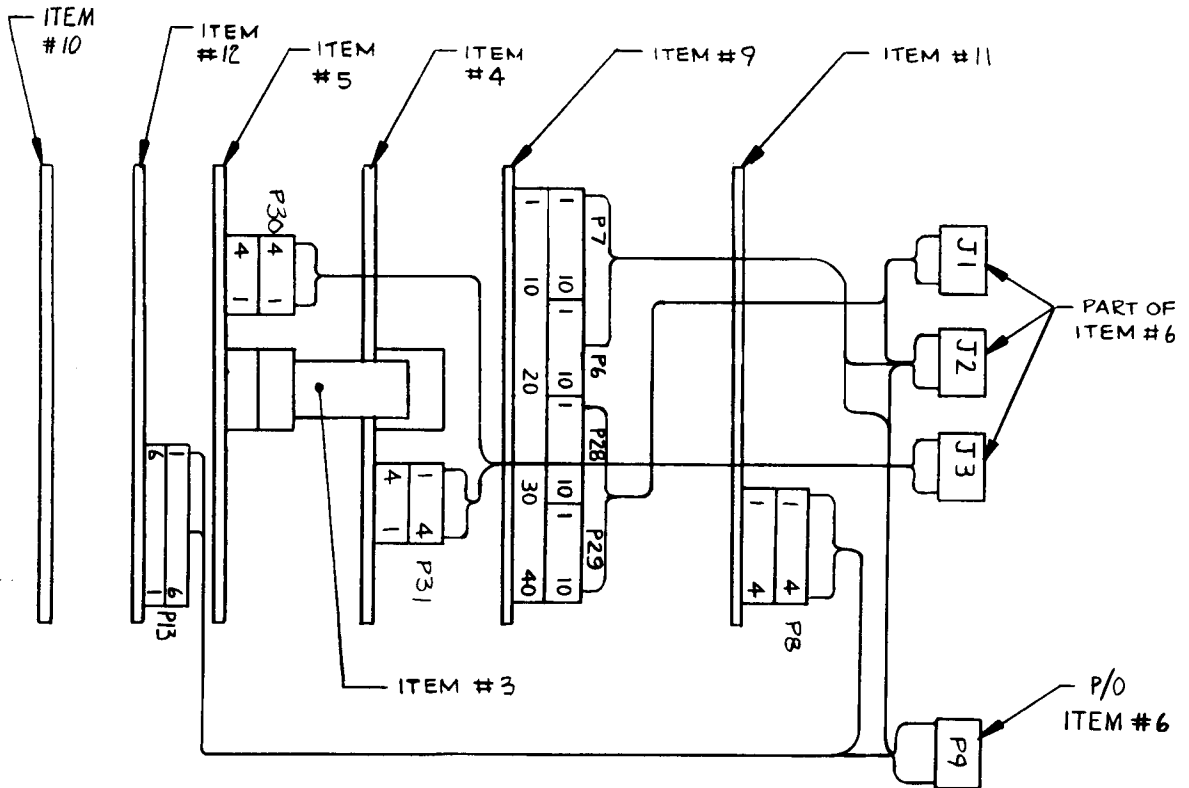
# AC Junction Box Assembly

800-0145



# Game Electronics Assembly

800-3305

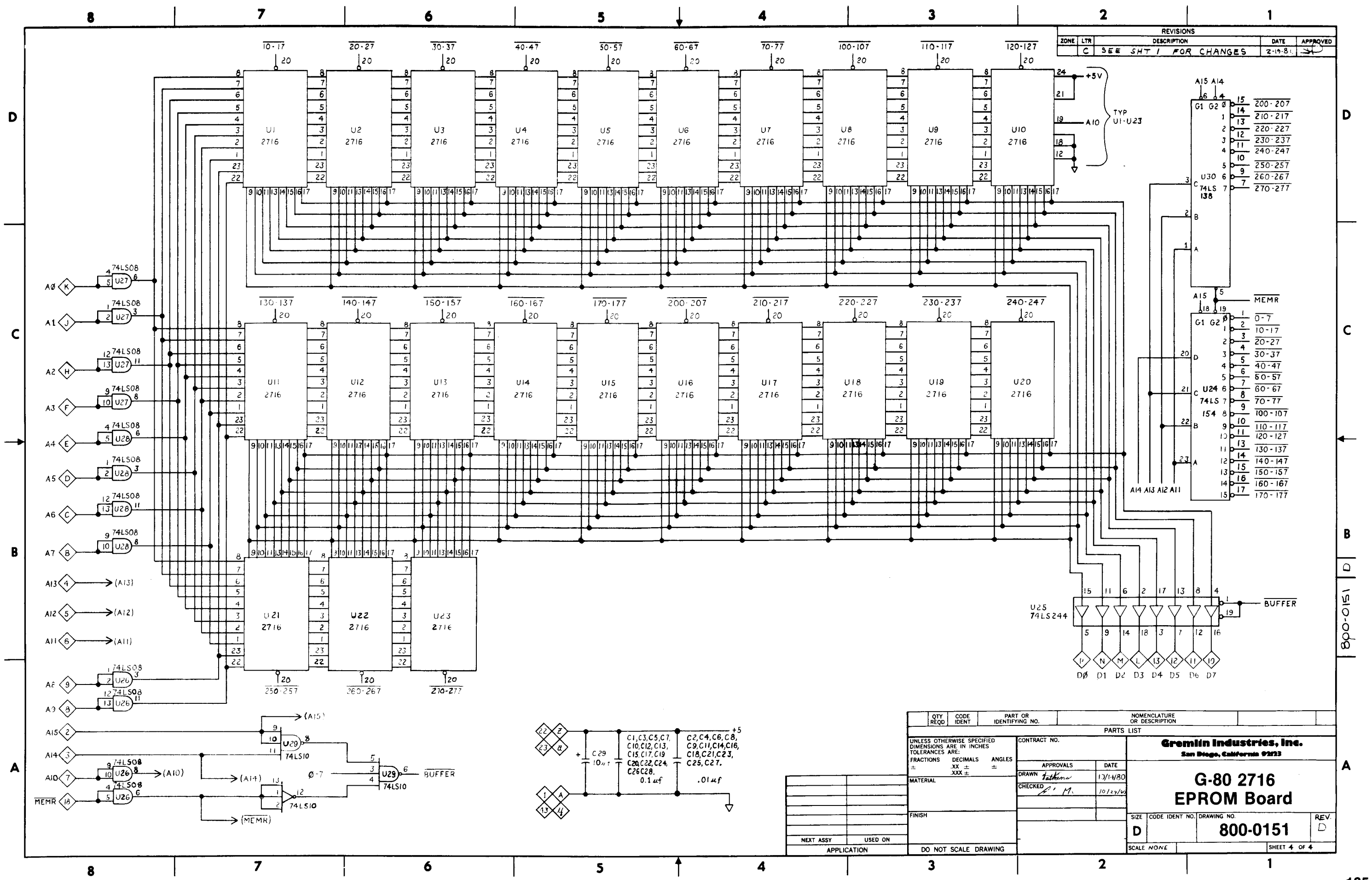












REVISIONS			
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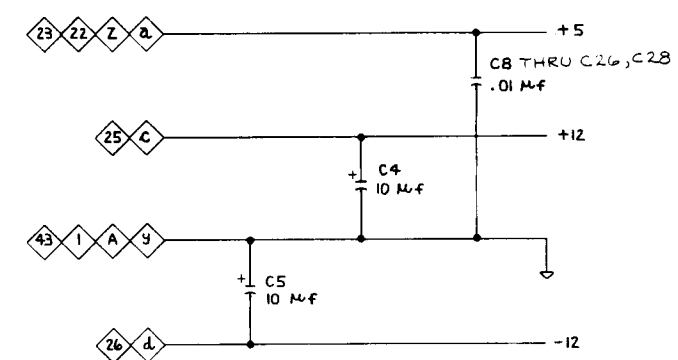
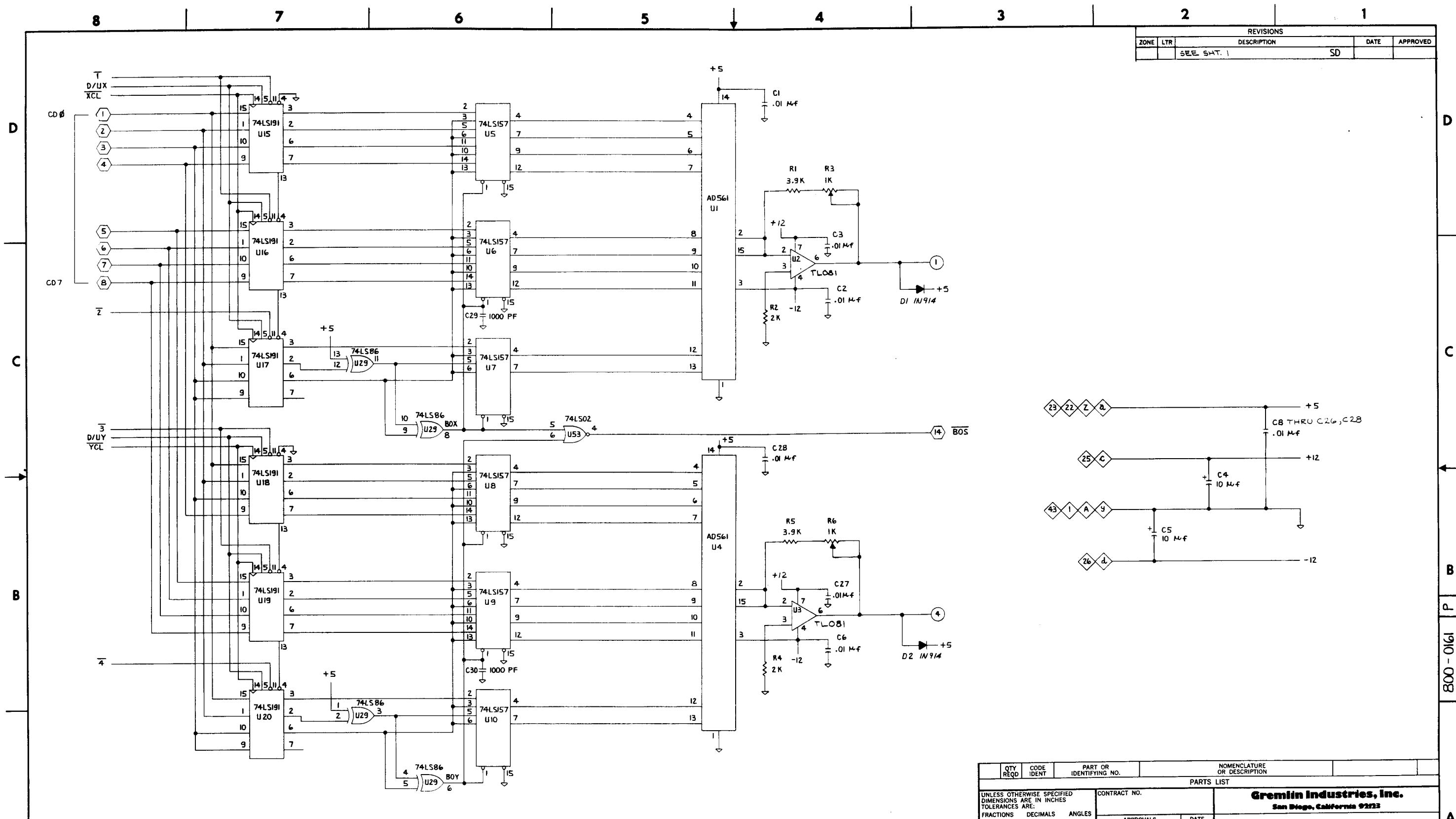
U30	U31	U32	U33	U34	U35	U36	U37
15	14	13	12	11	10	9	8
200-207	210-217	220-227	230-237	240-247	250-257	260-267	270-277

MEMR	U24	U25
1	6	1
2	7	2
3	8	3
4	9	4
5	10	5
6	11	6
7	12	7
8	13	8
9	14	9
10	15	10
11	16	11
12	17	12
13		13
14		14
15		15

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:			
FRACTIONS	DECIMALS	ANGLES	
±	XX ±	±	
	XXX ±		
MATERIAL		CONTRACT NO.	
FINISH		APPROVALS	
NEXT ASSY		DATE	
USED ON		DRAWN <i>Tabbina</i>	
APPLICATION		CHECKED <i>P. M.</i>	
DO NOT SCALE DRAWING		10/23/80	
SCALE NONE		G-80 2716 EPROM Board	
SHEET 4 OF 4		800-0151	

800-0151 D B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SHT. 1		SD

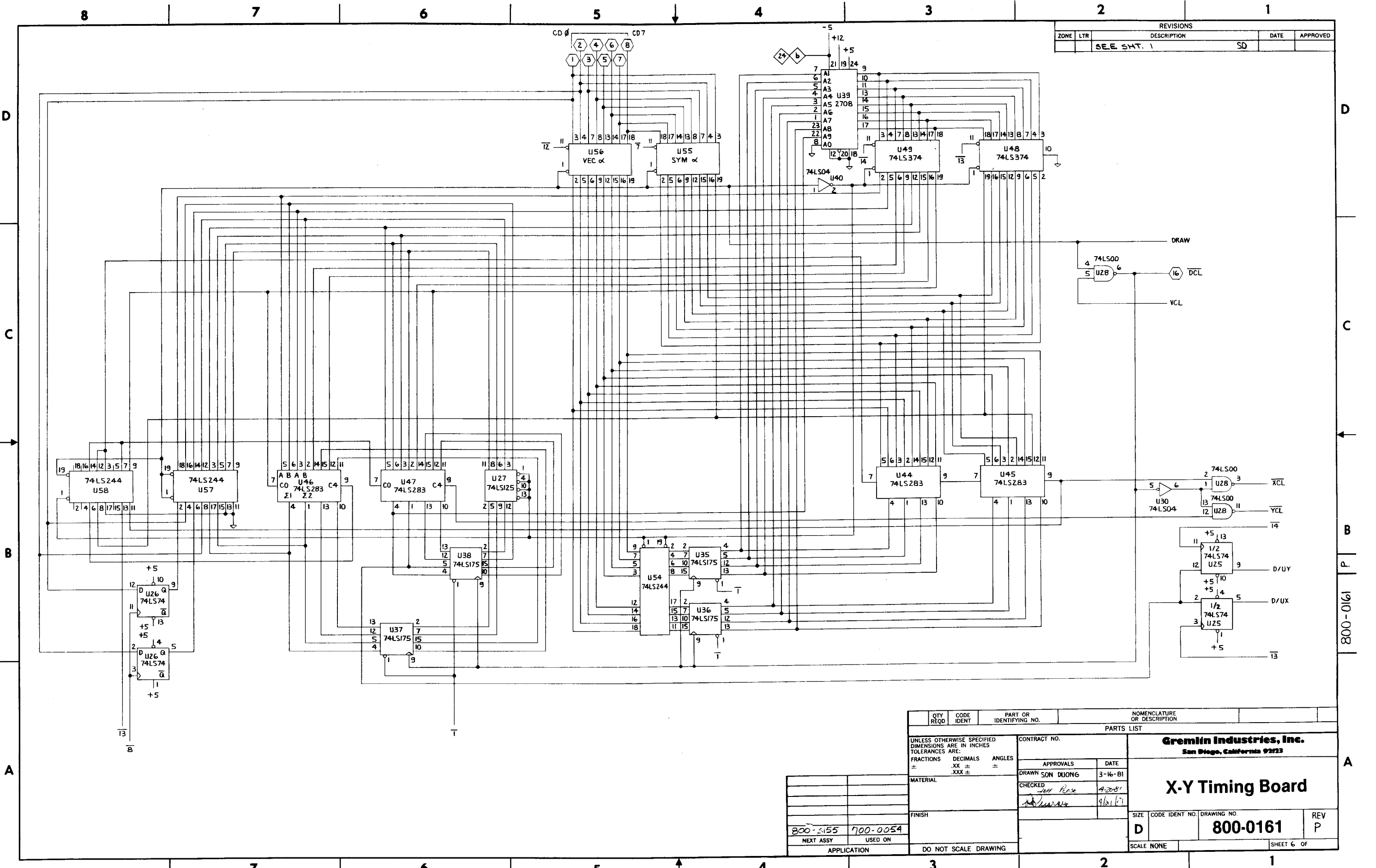


- ◇ = 86 PIN CONNECTOR .
- = 4 PIN MOLEX .
- ⬡ = 24 PIN SOCKET .

NOTES :

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.	
FRACTIONS ±	DECIMALS .XX ±	ANGLES ±	
MATERIAL		APPROVALS	
FINISH		DATE	
NEXT ASSY USED ON		DRAWN SON DUONG 3-12-81	
APPLICATION		CHECKED <i>[Signature]</i> 4-20-81	
DO NOT SCALE DRAWING		DATE <i>[Signature]</i> 4-20-81	
		SIZE CODE IDENT NO. DRAWING NO.	
		D 800-0161	
		REV P	
		SCALE NONE SHEET 5 OF	

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
		SEE SHT. 1	SD

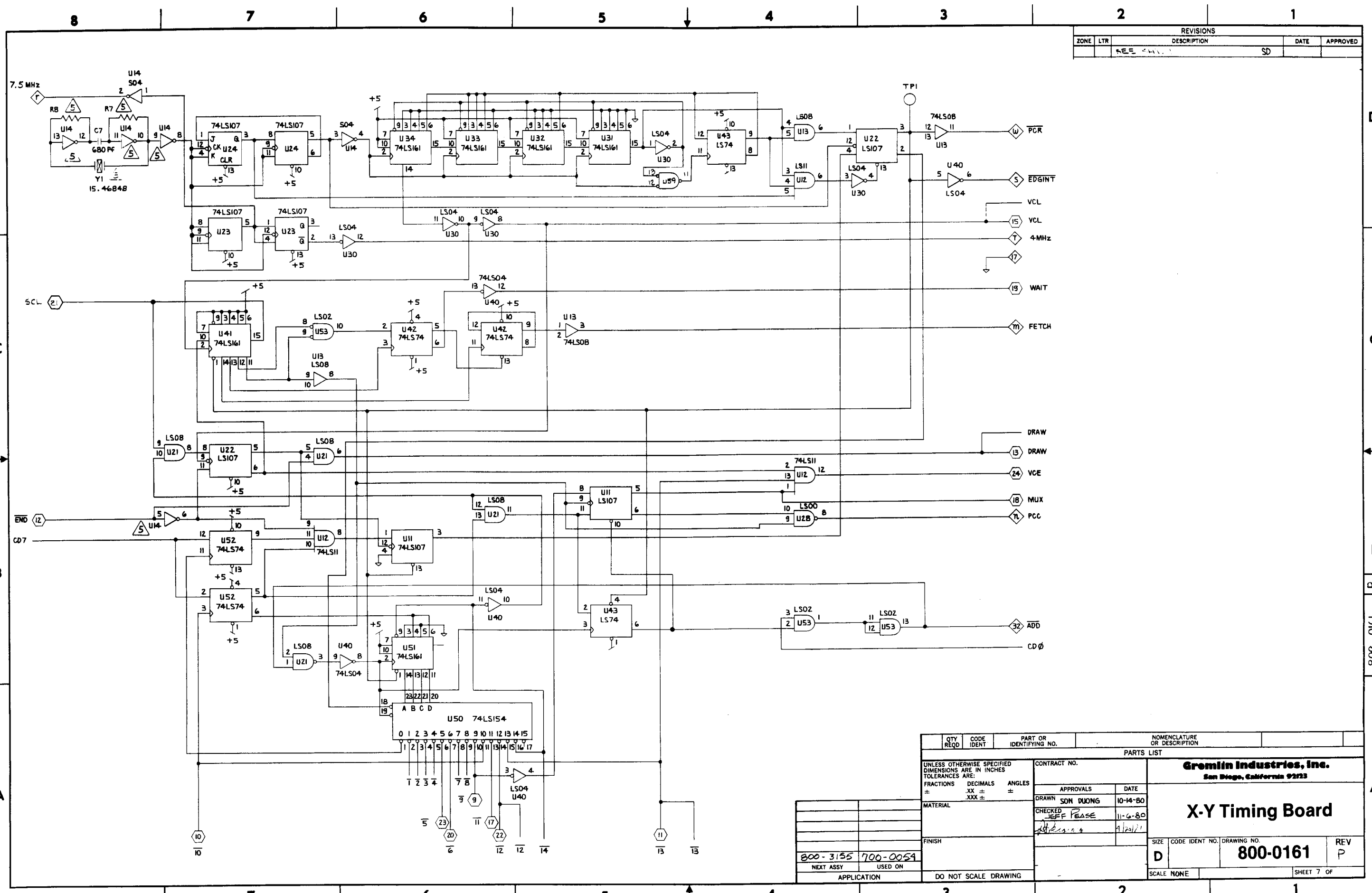


800-2155	700-0054
NEXT ASSY	USED ON
APPLICATION	

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:			<b>Gremlin Industries, Inc.</b> San Diego, California 92123
FRACTIONS	DECIMALS	ANGLES	
±	.XX ±	±	APPROVALS: _____ DATE: 3-16-81 DRAWN: SON DUONG CHECKED: Jeff Rose 4-20-81 _____ 9/21/81
MATERIAL			<b>X-Y Timing Board</b>
FINISH			
DO NOT SCALE DRAWING			SIZE: D CODE IDENT NO.: 800-0161 DRAWING NO.: 800-0161 REV: P
SCALE: NONE			SHEET 6 OF

800-0161

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		REV. 11/11/80		SD



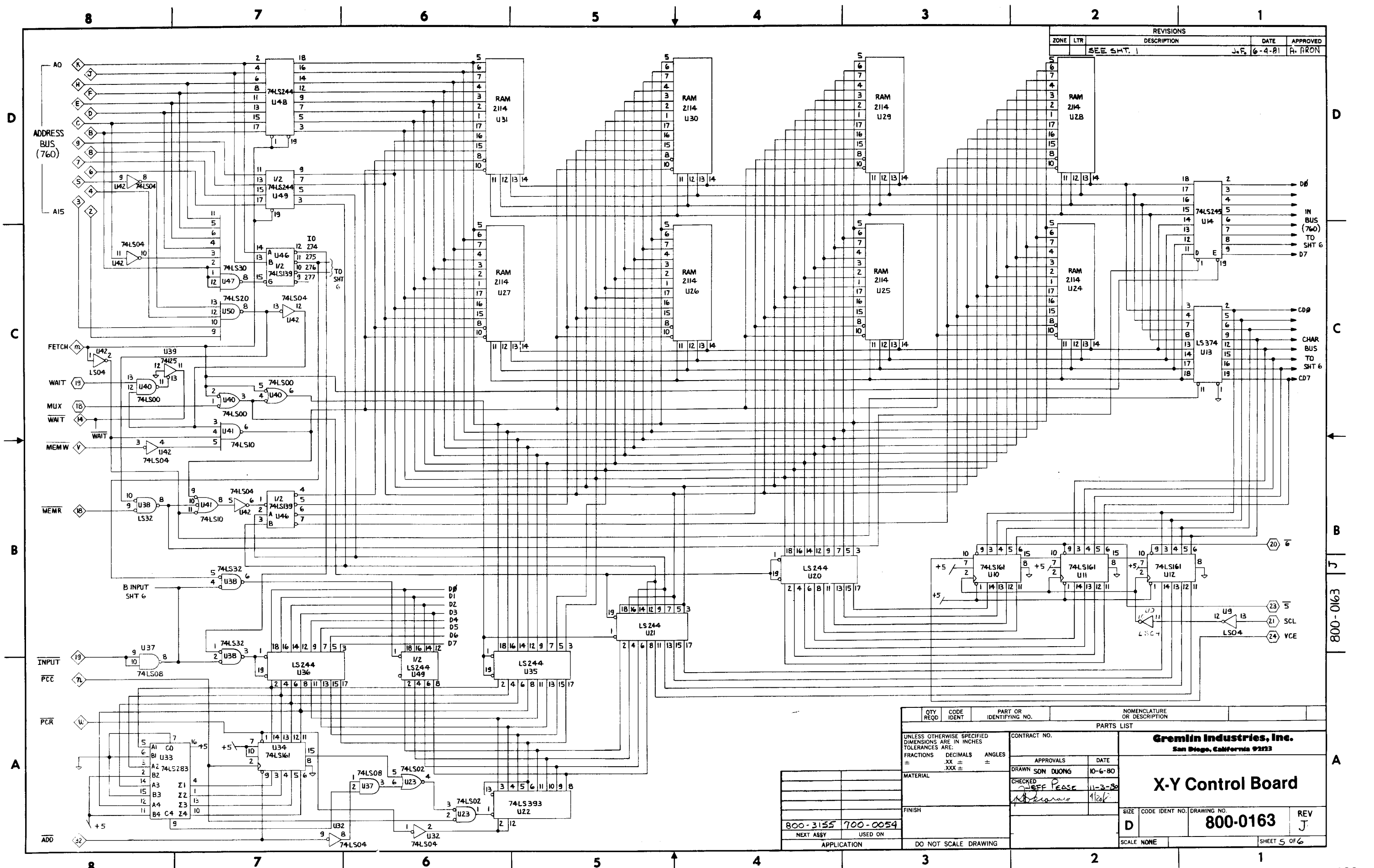
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PARTS LIST			
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FRACTIONS	DECIMALS	ANGLES	
±	.XX ±	±	
	.XXX ±		
MATERIAL		APPROVALS	DATE
FINISH		DRAWN SOM DUONG	10-14-80
NEXT ASSY USED ON		CHECKED JEFF PEASE	11-6-80
APPLICATION		DATE	
DO NOT SCALE DRAWING			

**Gremlin Industries, Inc.**  
San Diego, California 92123

# X-Y Timing Board

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D		800-0161	P

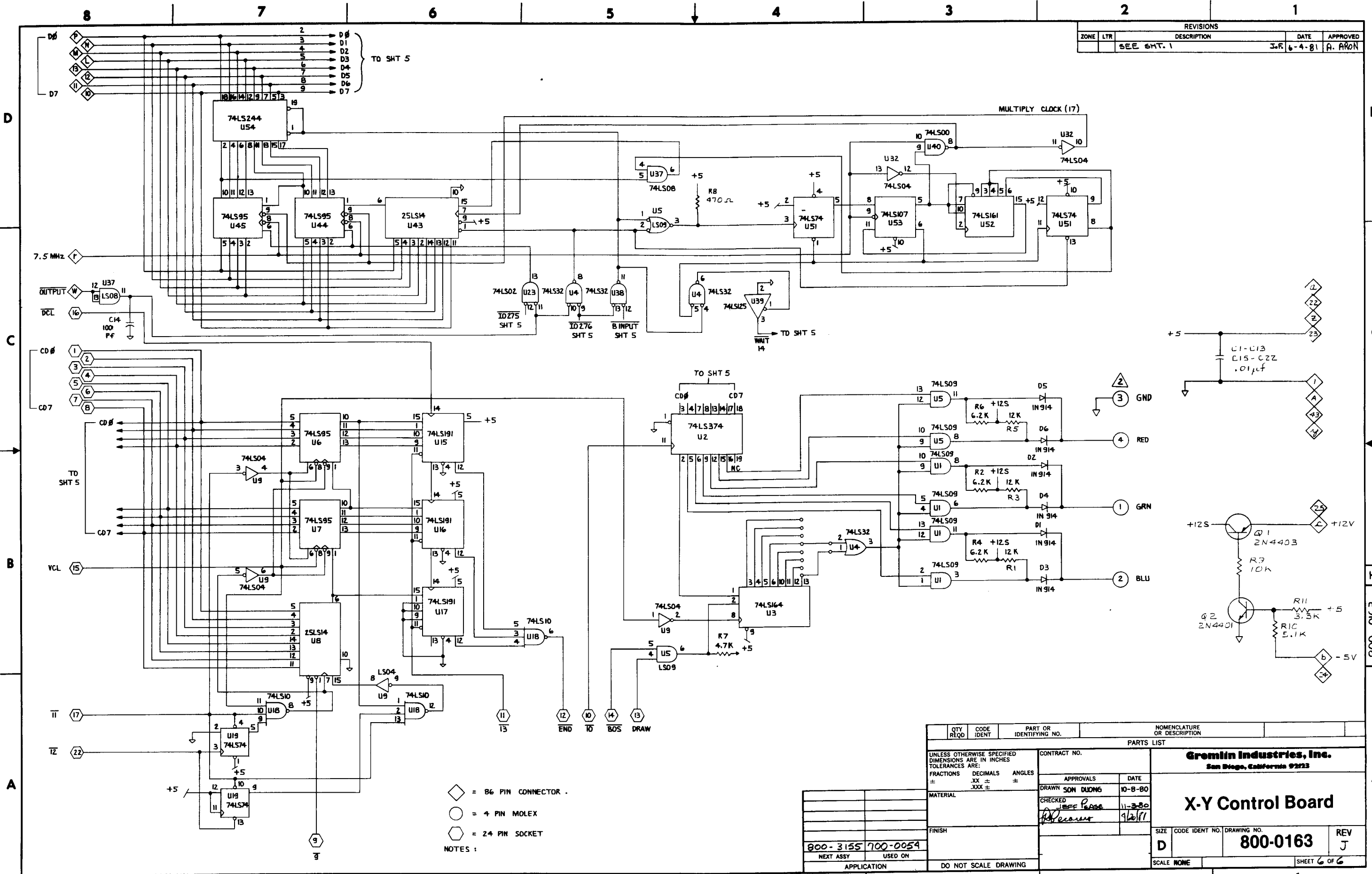
SCALE NONE SHEET 7 OF



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SHT. 1	J.F. 6-4-81	R. BRON

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS .XX ± DECIMALS .XXX ± ANGLES ±			
CONTRACT NO.		APPROVALS	
MATERIAL		DATE	
FINISH		DRAWN SON DUONG 10-6-80	
800-3155 700-0054		CHECKED JEFF PEARSE 11-3-80	
NEXT ASSY USED ON		APPROVED [Signature]	
APPLICATION		DO NOT SCALE DRAWING	
SIZE D		CODE IDENT NO. 800-0163	
SCALE NONE		DRAWING NO. 800-0163	
		REV J	
		SHEET 5 OF 6	

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SHT. 1	J.F. 6-4-81	A. ARON



◆ = 86 PIN CONNECTOR.  
 ○ = 4 PIN MOLEX  
 □ = 24 PIN SOCKET  
 NOTES:

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.	
FRACTIONS	DECIMALS	ANGLES	
±	±	±	
MATERIAL		APPROVALS	DATE
FINISH		DRAWN SON DUONG	10-8-80
NEXT ASSY USED ON		CHECKED JEFF PEARCE	11-3-80
APPLICATION		DO NOT SCALE DRAWING	
800-3155 700-0059			
SCALE NONE			SHEET 6 OF 6

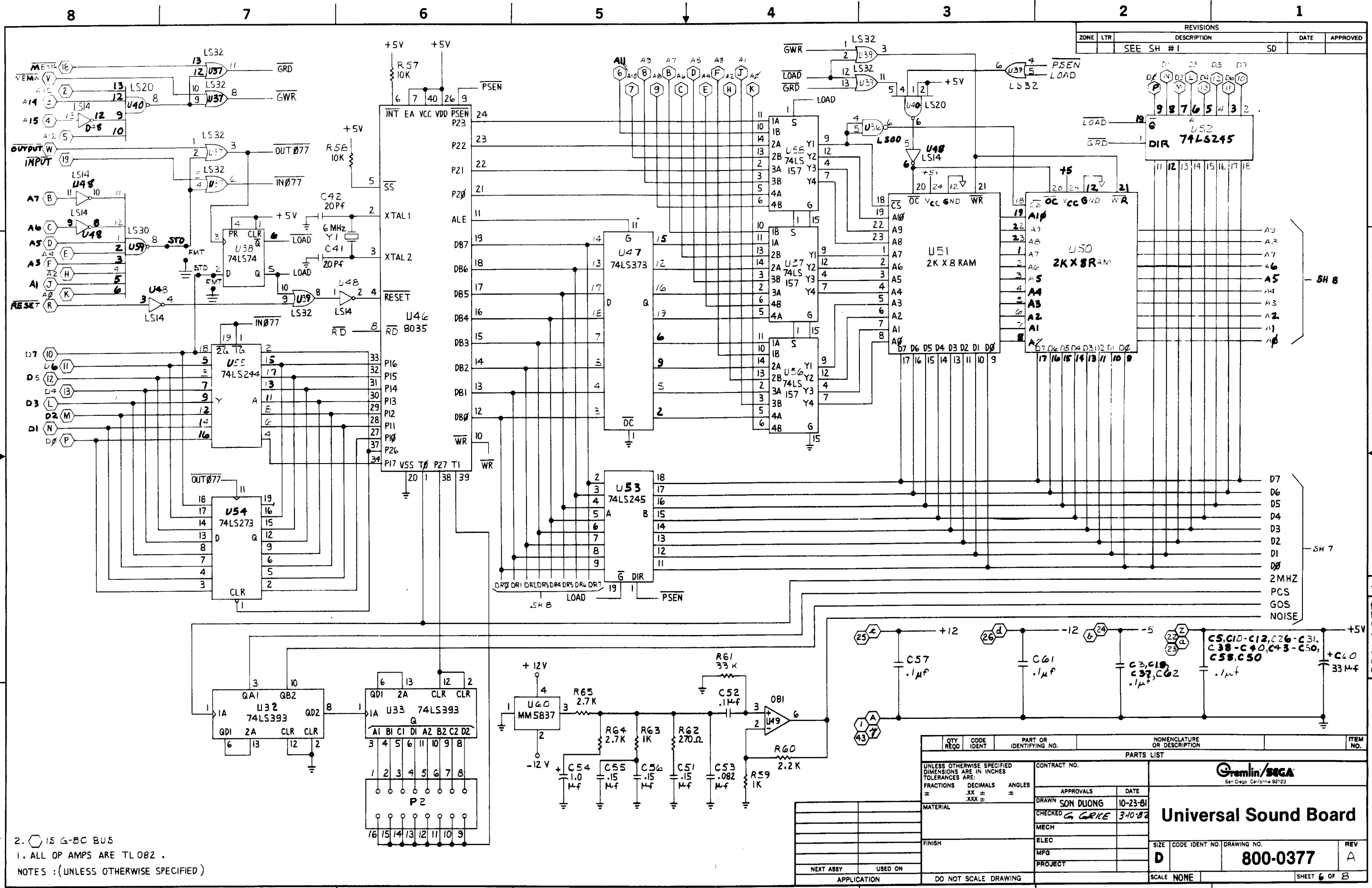
**Gremlin Industries, Inc.**  
San Diego, California 92123

## X-Y Control Board

SIZE D CODE IDENT NO. DRAWING NO. 800-0163 REV J





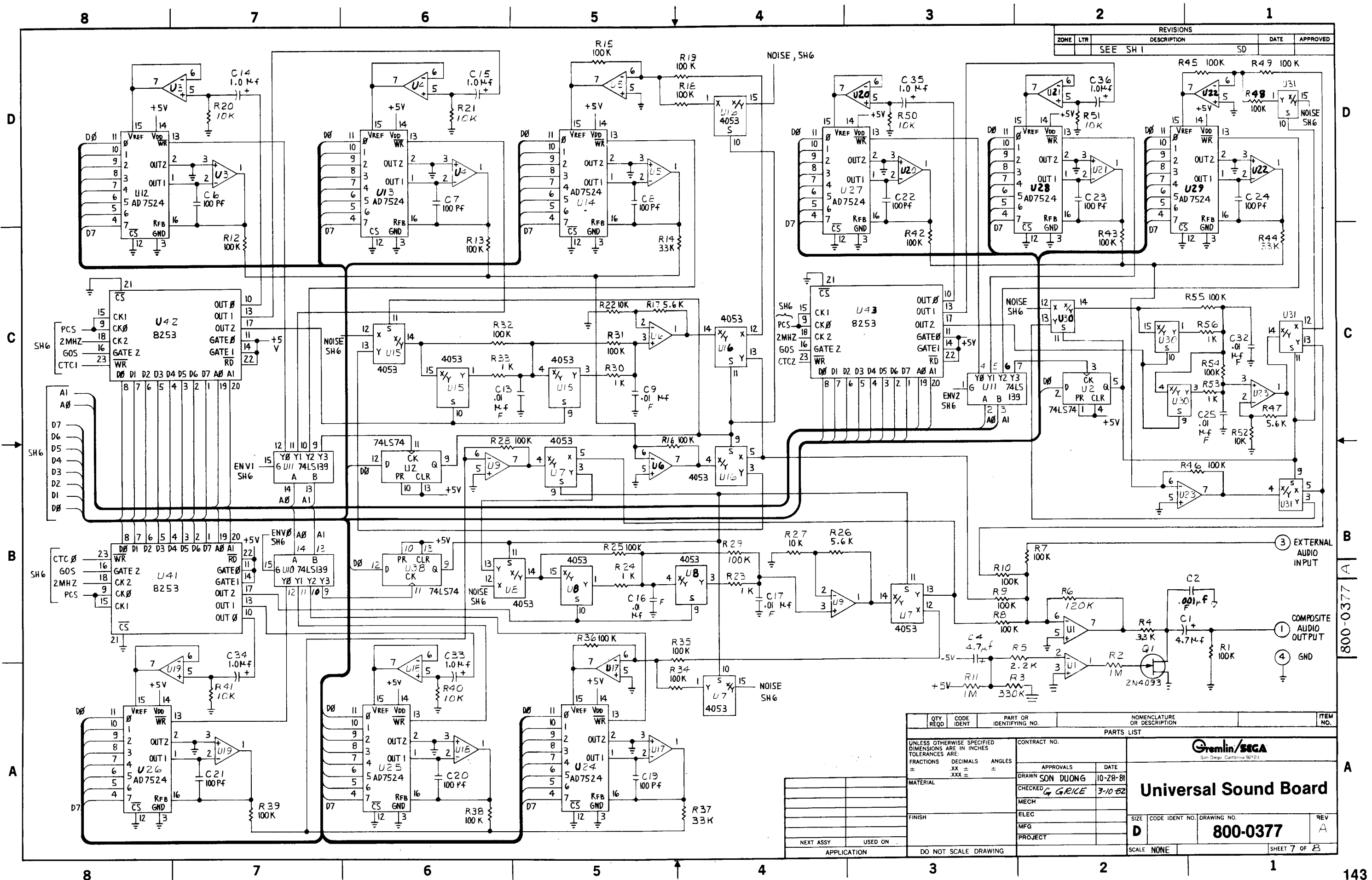


REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
		SEE SH #1	SD	

800-0377 A B C D

2.  $\square$  IS G-BC BUS  
 1. ALL OP AMPS ARE TL082.  
 NOTES : (UNLESS OTHERWISE SPECIFIED)

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ITEM NO.
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.		
FRACTIONS	DECIMALS	ANGLES	APPROVALS	
=	.XX	=	DRAWN SON DUONG 10-23-81	
	.XXX		CHECKED G. GRICE 3-10-82	
MATERIAL		MECH		
FINISH		ELEC		
NEXT ASSY		MFG		
USED ON		PROJECT		
APPLICATION		DO NOT SCALE DRAWING		
				REV
<b>Universal Sound Board</b>				A
SIZE CODE IDENT NO. DRAWING NO.				REV
<b>D 800-0377</b>				A
SCALE NONE				SHEET 6 OF 8



REVISIONS			
ZONE	LTR	DESCRIPTION	DATE
		SEE SH 1	SD

QTY	REQD	CODE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ITEM NO.
PARTS LIST					
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:					
FRACTIONS	DECIMALS	ANGLES			
±	±	±			
MATERIAL					
FINISH					
NEXT ASSY USED ON APPLICATION					
DO NOT SCALE DRAWING					
SCALE NONE					
SHEET 7 OF 8					

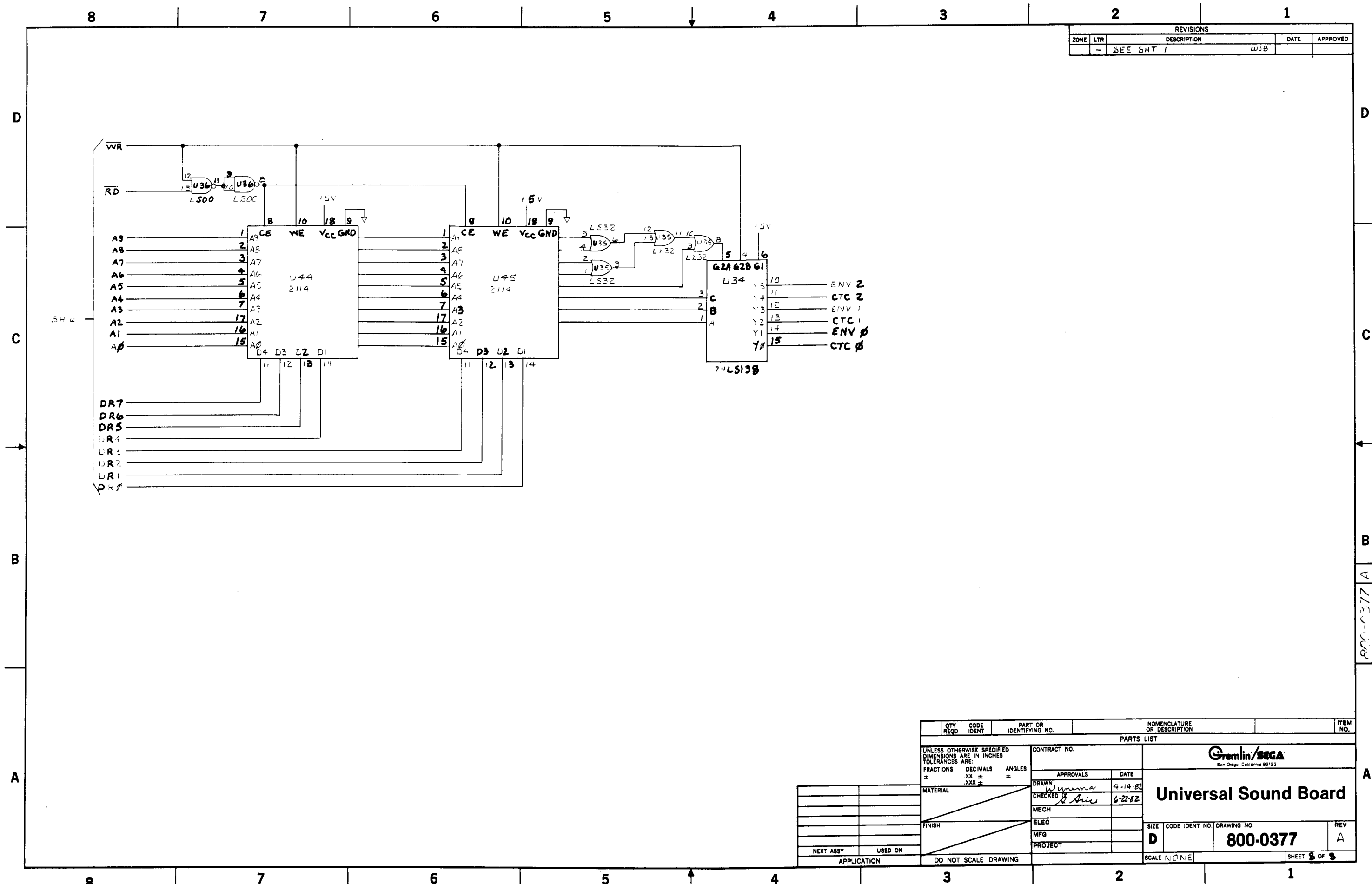
**Gremlin/SEGA**  
San Diego, California 92123

**Universal Sound Board**


DRAWN SON DUONG 10-28-81  
CHECKED G GRICE 3-10-82

SIZE CODE IDENT NO. DRAWING NO. REV  
**D 800-0377 A**

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
-		SEE SHT 1	WJB	

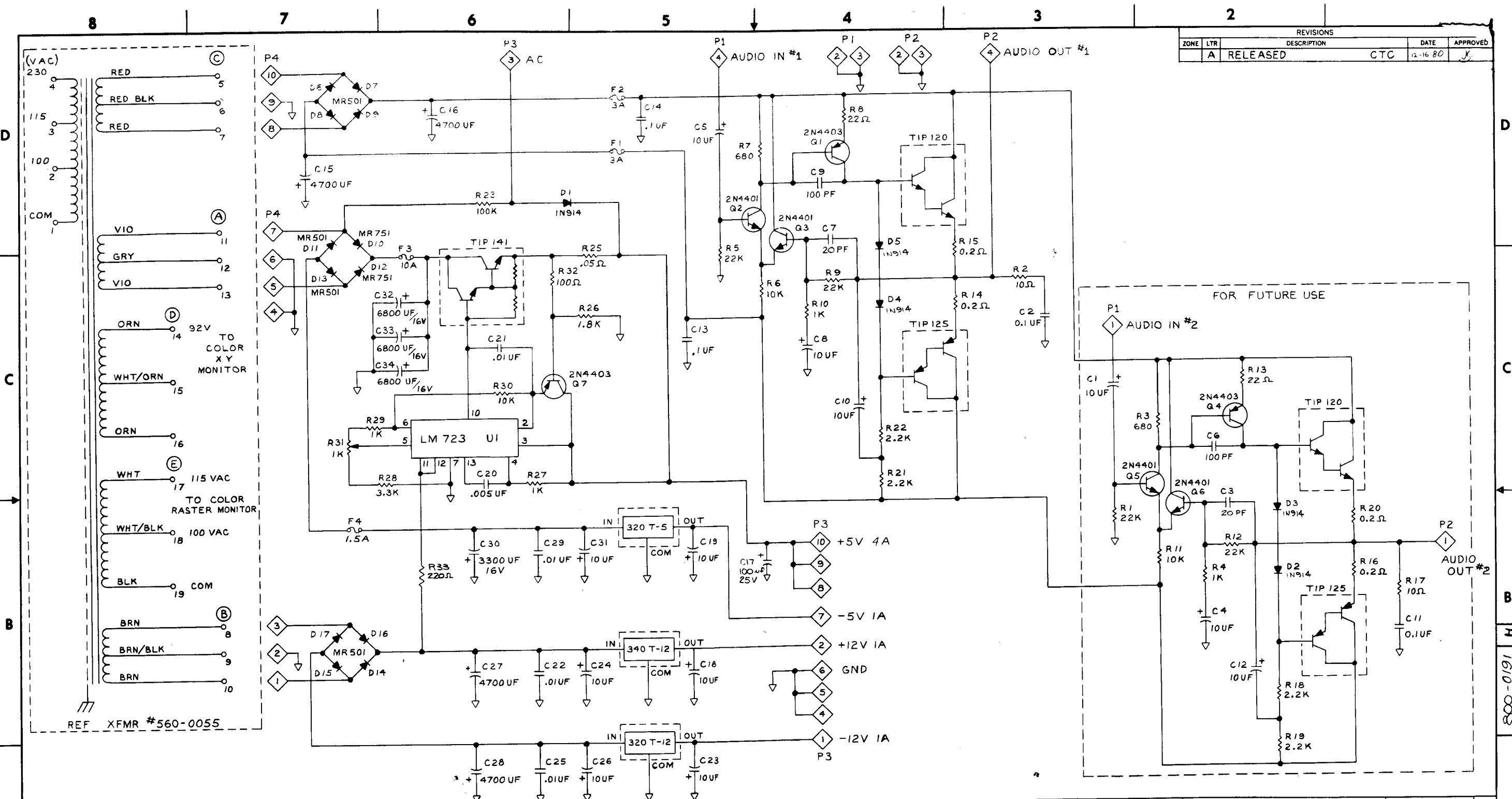


QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	ITEM NO.
PARTS LIST				
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.		
FRACTIONS ±	DECIMALS .XX ±	ANGLES ±	APPROVALS	
	.XXX ±		DATE	
MATERIAL	FINISH		DRAWN <i>W. Yama</i> 4-14-82	
			CHECKED <i>A. Hies</i> 6-22-82	
			MECH	
			ELEC	
			MFG	
			PROJECT	
NEXT ASSY	USED ON	APPLICATION		DO NOT SCALE DRAWING
		SCALE NONE		SHEET 8 OF 8

  
 San Diego, California 92123  
**Universal Sound Board**  
 SIZE CODE IDENT NO. DRAWING NO. REV  
**D** **800-0377** **A**

800-0377 A

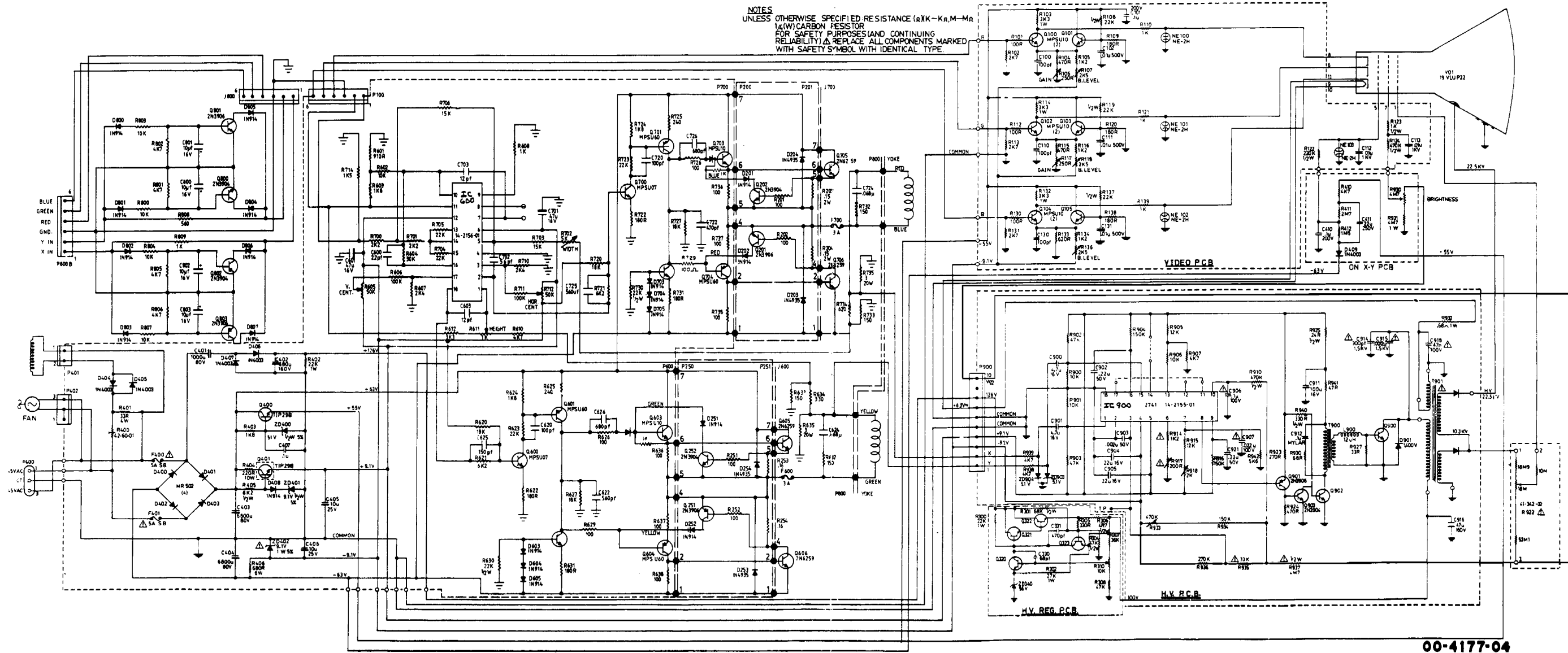
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
A		RELEASED	12-16-80	CTC



NOTE: ALL RESISTANCE VALUES ARE IN OHMS, 1/2 W ± 5%.

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.	
FRACTIONS	DECIMALS	ANGLES	APPROVALS
±	.XX ±	±	DATE
±	.XXX ±		
MATERIAL		DRAWN CATTELL 12/11/80	
FINISH		CHECKED JEFF LEASE 12-16-80	
NEXT ASSY		USED ON	
APPLICATION		DO NOT SCALE DRAWING	
Gremiin Industries, Inc. San Diego, California 92123			G-80 Power Supply
SIZE	CODE IDENT NO.	DRAWING NO.	
D		800-0191	REV 1H
SCALE NONE			SHEET 3 OF 3

800-0191 H



# Model Number GO8-003

19" X-Y Color Monitor  
200-0025