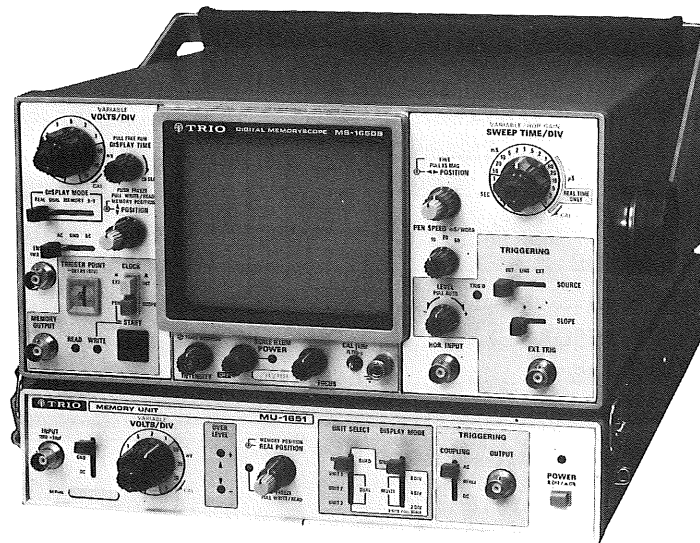


MS-1650

MU-1651



 **TRIO**

<Note>

Differences of the MS-1650, MS-1650A, and MS-1650B

★ **Function**

The MS-1650A is the MS-1650 plus FREE RUN function. The MS-1650B is basically the MS-1650A quad-trace digital memory scope plus FREEZE function, 1 MHz fixed read out function, expanded memory position range, control signal output lines for the MU-1651, and memory waveform input connectors (BNC type) from the MU-1651. Its memory is backed up with big capacitor and, therefore, no battery compartment is provided for.

★ **Circuitry**

The MS-1650A is the MS-1650 plus the FREE RUN unit (X77-1230-00). The MS-1650B is the MS-1650A plus the VERTICAL SUB UNIT (X73-1470-00) and HORIZONTAL SUB UNIT (X74-1330-00) units.

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SPECIFICATIONS; MS-1650B

[]: The item bracket is for MS-1650A

CATHODE RAY TUBE

Type

E2713B31A

Acceleration voltage

Approx. 2 kV

Display area

8 div × 10 div (1 div = 9.5 mm)

VERTICAL AXIS

Sensitivity

10 mV/div — 20 V/div, ±5%

Attenuator

10 mV/div — 20 V/div, 1-2-5 sequence

11 ranges, fully adjustable

Input impedance

1 MΩ, ±5% 26 pF ±3 pF [22 pF ±4 pF]

Frequency response

Oscilloscope DC: DC-10 MHz (−3 dB)

AC: 2 Hz-10 MHz (−3 dB)

Digital memory DC: DC-250 kHz (−3 dB)

AC: 2 Hz-250 kHz (−3 dB)

Rise time

35 ns (Oscilloscope operation)

Maximum input voltage

600 V_{p-p} or 300 V (DC + AC peak, at 1 kHz)

Operating mode

REAL: Oscilloscope operation or memory free-run

DUAL: Real time and memory waveforms, dual trace operation (CHOP mode of approx. 500 kHz)

MEMORY: Memory waveform readout

X-Y: X-Y scope operation

A/D CONVERTER

Resolution

8 bits

Conversion system

Successive Approximation type A/D converter

Scale-over

8 div vertical scale

SWEEP CIRCUIT

Sweep system

Trigger sweep (NORM), auto sweep (AUTO)

Sweep time

1 μs/div — 1 s/div, ±5%

1-2-5 sequence

19 ranges, fully adjustable

Magnifier

X5 MAG ±10%

Linearity

Less than 3% (5 μs/div — 1 s/div)

Less than 5% (1 μs/div — 2 μs/div)

SYNC CIRCUIT

Sync input

INT: Vertical input signal

LINE: Line frequency

EXT: EXT TRIG input signal

Polarity

Positive or negative

Sync voltage

INT: More than 1 div of amplitude on the CRT

LINE: Within the specified power supply voltage

EXT: More than 1 V_{p-p}

Sync frequency

INT: 20 Hz — 10 MHz

EXT: DC — 10 MHz

External sync input voltage

±15 V (DC + AC peak) [20 V (DC + AC peak)]

HORIZONTAL AXIS

Operating system

DISPLAY MODE selector switch to X-Y position

Sensitivity

150 mV/div (±20%, HOR. GAIN MAX)

Frequency response

DC: DC—1 MHz (−3 dB) (HOR. GAIN MAX)

Input impedance

100 kΩ ±20%, 35 pF or less

Maximum input voltage

50 V (DC + AC peak, HOR. GAIN MAX)

MEMORY UNIT

Memory capacity

1024 words (100 words/div)

Write speed

0.1 ms/div — 1 s/div, 13 ranges (equivalent to

1 μs/word — 10 ms/word)

EXT (MS-1650B only):

Rising edge of EXT CLOCK input signal.

Repetition rate frequency: Less than 500 kHz

High level pulse width: Not less than 1 μs

Low level pulse width: Not less than 500 ns

Rise time: Not less than 500 ns

Readout speed

SCOPE: Same as write speed

Fixed read out. (at 1 μs/word for DISPLAY TIME pulled position).

PEN: 10 ms/word, 20 ms/word 50 ms/word, 3 ranges

(Switchable to 100 ms/word, 200 ms/word,

500 ms/word by changing jumper wire connection on the P.C. Board).

EXT: Rising edge of EXT CLOCK input signal.

Repetition rate frequency: Less than 1 MHz

Input signal:

High level pulse width: Not less than 1 μs

Low level pulse width: Not less than 500 ns

Rise time, Not less than 500 ns

SPECIFICATIONS; MS-1650B

Input voltage: TTL level
 Maximum input voltage: 20 V (DC + AC peak)
 Input resistance: Approx. 30 k Ω

Delay
 — DELAY (0—9 div, DIG SW setting)

SIGNAL OUTPUT

Display time
 The amount of time for which memory signals are displayed can be varied from approx. 1 to approx. 20 seconds.

Memory out and Memory out for pen (Output only in PEN mode)

Display time
 Output wave: Memory wave
 Output voltage: 1.6 Vp-p, full scale (at 8 div)
 Output resistance: Approx. 430 Ω [approx. 470 Ω]

Read gate
 Output wave: Positive pulse (1 word) of final address
 Output voltage: TTL level
 Output resistance: Approx. 220 Ω

Read gate for pen (Output only in PEN mode)
 Output voltage: TTL level (LOW active)
 Output resistance: 220 Ω

Sweep gate
 Output wave: Positive pulse coincident with sweep signal
 Output voltage: TTL level
 Output resistance: Approx. 220 Ω

CAL (Calibrating voltage)
 Output wave: 1 kHz, $\pm 10\%$, square wave
 Output voltage: 1 Vp-p $\pm 5\%$

Data out
 Data output:
 8 bit binary parallel output, positive output (TTL level)
 Timing pulse:
 Positive and negative outputs (TTL level)
 Read gate out:
 Positive output of the final-address one word
 Output resistance: Approx. 220 Ω (TTL level)
 Ext. clock:
 TTL level clock input of 1 MHz or below
 High level pulse width: Not less than 1 μ s
 Low level pulse width: Not less than 500 ns
 Rise time: Not more than 500 ns
 Input resistance: Approx. 30 k Ω

MEMORY SIGNAL INPUT (MS-1650B only)

3 inputs for MU-1651(T), MU-1652(T)
 Sensitivity: 1.6 Vp-p, full scale (200 mV/div)
Frequency response: DC— approx. 1 MHz (—3 dB), Smoother; off
 DC— approx. 150 kHz (—3 dB), Smoother; on
Input impedance: Approx. 60 k Ω
Maximum input voltage: 20 Vp-p or 10 V (DC + AC peak)

INTENSITY MODULATION

Input voltage
 TTL level (Intensity increasing with more positive levels)
Input impedance
 Approx. 15 k Ω
Input frequency
 DC — 1 MHz
Maximum input voltage
 50 V (DC + AC peak)

POWER REQUIREMENT

Voltage 100/120/220/240 V, $\pm 10\%$, 50/60 Hz
Power consumption Approx. 60 W [approx. 50 W]

DIMENSIONS

Width 284 mm (328 mm)
Height 138 mm (153 mm)
Depth 400 mm (463 mm)
 () dimensions include protrusions from basic case outline dimensions
Weight Approx. 9 kg

OPERATING TEMPERATURE

Operating temperature for guaranteed specification:
 0° ~ 40°C
 Full operating temperature: 0° ~ 50°C

ACCESSORY

Probe (PC—22) 1 piece
 Attenuation 1/10
 Input impedance 10 M Ω
 Less than 18 pF
 Replacement fuse 1.5 A, 2 pieces
 0.7 A, 2 pieces
 Instruction manual 1 copy
 AC power cord 1 piece
 Digital output plug 1 piece

PIN CONFIGURATION

14-pin cable receptacle #	Data contents	14-pin cable receptacle #	Data contents
Pin # 1	Data LSB	Pin # 8	MSB
Pin # 2	BIT 2	Pin # 9	Timing pulse MOS
Pin # 3	BIT 3	Pin # 10	Timing pulse MOS
Pin # 4	BIT 4	Pin # 11	EXT. CLOCK
Pin # 5	BIT 5	Pin # 12	GND
Pin # 6	BIT 6	Pin # 13	GND
Pin # 7	BIT 7	Pin # 14	READ GATE OUT

OPTION (MS-1650B only)

Joiner CZ-84

CIRCUIT DESCRIPTION; MS-1650B

VERTICAL AMPLIFIER UNIT (X73-1370-02)

The vertical signal input via the BNC connector is applied to the first ATT via the AC-GND-DC switch which is selected as required. The ATT output signal is applied to the dual FETs (IC201), which has a high input impedance. (Use of dual FETs ensures stable DC balance under varying temperature conditions.) The signal is then applied to emitter followers Q204 and Q205, which have a low output impedance and are connected to the second ATT. The second ATT varies the degree of amplification by changing the emitter resistances of Q206 and Q207. DC balance of the source follower at the first stage of the second ATT is obtained with VR201. The vertical signal is then applied to the variable amplifier consisting of Q208 and Q209, where the signal level is adjusted. VR203 adjusts the DC balance of the variable amplifier so that the trace does not shift when the VR is turned. VR1a varies the DC level balance between the collectors of Q208 and Q209 to adjust vertical positioning of the waveform on the CRT. The vertical signal is then applied to both the mode selection circuit and the buffer amplifier stage of the A/D converter.

The mode selection circuit consists of IC203, IC205 and IC206. IC203 operates as a mode selection switch, IC205 passes the input signal and IC206 passes the memory signal. Q216 and Q217 form a cascode amplifier which amplifies the signal to a sufficient level. The signal is then amplified by the output amplifier consisting of Q220 through Q227. Finally, the vertical signal is applied to the vertical deflection plates of the CRT.

VR205 and VR206, connected to pins 1 and 13 of IC205 and 206, respectively, adjust their gain. The memory signal is amplified by IC204 after it is subjected to D/A conversion, and is then applied to IC206. Vertical positioning of the memory signal waveform is adjusted with VR16, which is connected to IC204.

The D/A buffer amplifier output signal applied to the cascode amplifier consisting of Q210 through Q213, its level is shifted by zener diodes D204 and D205. The signal is then applied to IC202, which has single ended output. The IC202 output signal is applied to the D/A input terminal of the control section. The signal from the emitter of Q214 is interconnected with the horizontal circuits and is used as the sync signal.

VERTICAL SUB UNIT (X73-1470-00)

Logic signals from the UNIT SELECT and DISPLAY MODE switches of MEMORY UNIT (MU-1651, 1652) are converted to a 2-bit signal by IC802 and IC803.

IC801 selects MEMORY OUT signals from, MAIN and MEMORY UNIT 1, 2, and 3 according to the 2-bit signal. Q801, RY1, and RY2 controls attenuation for the output signal of IC801.

Q802 and Q803 are switches of the circuit which interpolate between sampling points of Q801's output. The

rear-panel SMOOTHER switch turns on and off Q802 and Q803.

When the MU-1651 is connected, a switching signal comes from it to IC802 and IC803. IC801 and Q801 selects either the memory signal output from IC201 of the MS-1650B's vertical amplifier or the memory signal entered from the MU-1651 to MEMORY SIGNAL IN 1, 2 and 3, and delivers the signal selected to IC203 of the vertical amplifier. IC804, RY1, and RY2 select attenuations 1/1, 1/2 and 1/4. When the MU-1651 is not connected, only the memory signal comes into IC203.

HORIZONTAL UNIT (X74-1240-02)

The trigger signal selected with the SOURCE switch (INT/LINE/EXT) is applied to differential amplifier IC401. The rising or falling edge of the waveform is used to determine the sweep starting point. The edge used is selected with the SLOPE switch. Variable resistor VR4 varies the DC level of the trigger signal to shift the sweep starting point. The trigger signal, after selection with the SLOPE switch, is applied to a Schmitt trigger circuit consisting of gate circuits in IC403 through emitter follower Q402. The waveform of the trigger signal is shaped into a square wave which is used as the clock pulse signal for sweep control flip-flop IC404. The flip-flop inverts its state according to the clock pulse signal to turn Q403 OFF, then the Miller integrator starts charging.

The Miller integrator determines the sweep time according to the time constant of C and R, which is selected with the SWEEP TIME/DIV selector. It produces a saw-tooth waveform with good linearity. The state of hold-off timer IC405 is inverted when the Miller integrator output level at Q413 rises. Therefore, sweep is stopped for the time determined by the hold-off time constant. After the hold-off time has been passed, the next clock pulse is waited.

When the TRIG AUTO switch is ON, the trigger signal output from the Schmitt trigger drives the automatic sweep circuit, which consists of Q406 through Q408. The collector level of Q408 is LOW and the flip-flop is in the free running state when adequate trigger signal is absent. The flip-flop is synchronized with the clock signal when the trigger signal is input.

The saw-tooth wave generated with the Miller integrator is applied to the horizontal amplifier, which consists of Q416 through Q421, via the SWEEP/EXT H selector IC407, and its signal level is amplified to the desired level. Then, the saw-tooth wave signal is applied to the horizontal deflection plates of the CRT.

When the DISPLAY MODE switch is set at EXT-H, the SWEEP/EXT H switch switches from the Miller integrator to the buffer amplifier and connects to horizontal output amp. The sweep circuit stops if the DISPLAY TIME switch is in the pushed position at this time. The signal coming from the vertical amplifier enters the Y-input. When the

CIRCUIT DESCRIPTION

DISPLAY TIME switch is pulled, the sweep circuit operates and the MEMORY OUT signal comes to the Y-input. And memory read-out clock is fixed to 1 μ s/word rather than determined with the SWEEP TIME/DIV rotary switch.

MEMORY SIGNAL FIXED READ OUT CIRCUIT

If DISPLAY TIME is pulled during observation of memory waveforms, SWEEP TIME/DIV is electrically fixed at 0.1 msec/div. Normally, Q708 is on and Q706, Q704, and Q703 operate. During fixed read out, Q707 is on with Q705, Q702, and Q701 operating to sweep. D704, D705, and IC702 work to stop sweeping during X-Y operation at REAL mode.

HORIZONTAL SUB unit

Part of the Miller integrator of the horizontal sweep circuit is installed in this units and is switched with READ/WRITE signal for fixed read out operation.

DIGITAL MEMORY CIRCUIT

The vertical input signal applied to the A/D converter from the A/D buffer amplifier is converted into a digital signal. The A/D converter circuit consists of the following circuits: analog comparator IC530, which compares the A/D converter input signal with the D/A converter output signal; sequential comparison register IC529, which compares and latches MSB through LSB of the analog comparator output in that order, and D/A converter consisting of Q507-Q514. The A/D converter output is latched by register IC578 each time one word is converted. The sampling speed is determined by the A/D start signal supplied by the time base unit.

The time base unit consists of a crystal controlled oscillator (IC541), which generates 10 MHz, and a frequency divider (IC553, IC564, IC563, IC552, IC551, IC540 and IC539). The frequency dividing ratio is determined by the SWEEP TIME/DIV switch. When the CLOCK switch is set in the INT position in the SCOPE mode, a clock signal with a period of 1/100 of the period specified by the SWEEP TIME/DIV switch is output from pin 8 of IC538. When the CLOCK switch is in the INT position and in the PEN mode, a clock signal with a period of 10, 20 or 50 ms (according to the setting of the PEN SPEED switch) is output from pin 11 of IC538. When the CLOCK switch is in the EXT position, the clock signal input to the EXT CLOCK terminal is output from pin 12 of IC549. However, when the SWEEP TIME/DIV switch is set in the range from 1 μ s through 50 μ s, the frequency divider stops operation so that the A/D converter does not operate.

The clock signal generated by the time base unit is applied to the address counter (IC526, IC519 and IC511) and the delay counter (IC533, IC532 and IC531) to write the data into memory (IC574 and IC575) in sequence when the

WRITE START switch is depressed to ON. When a trigger pulse comes in, the delay counter starts counting by the number which is the complement of the number set by the digital switch of TRIGGER POINT until the member of the end which is 1024 and stop writing into memory. A latch circuit (IC503 and IC502) stores the initial point number. Memory read out starts in synchronization with the SWEEP GATE signal after memory write has been completed. Memory output data are latched by IC573, then applied to a D/A converter consisting of Q515 through Q522 so that it is converted into an analog signal. The analog signal is applied to a voltage follower consisting of IC501 and IC580 (FOR PEN), then is applied to the memory amplifier in the vertical amplifier and to the MEMORY OUT terminal. IC584 is a buffer used to deliver control signals to the MU-1651 and it is connected to CONTROL OUT.

FREE RUN CIRCUIT

S1a,b (X77-1230-01) switches between the normal and free run modes.

The free run mode is selected by pulling the S1a,b knob out. In the free run mode, the ground level is applied to one input terminal of IC2 via diode D1 and the R/W C signal is applied to the other input terminal of IC2. When the R/W C signal becomes low during its READ period, the gate output level also becomes low; therefore, the timer (IC1) is triggered. This ground level signal from the gate circuit is applied to pin 2 (the clear terminal) of IC203 in the vertical amplifier and pin 2 (the clear terminal) of IC404 in the horizontal amplifier through diodes D2 and D3, respectively. The timer (IC1) holds pin 2 at the high level for the time determined by VR1. When pin 2 of IC1 drops to the low level, pin 6 of IC555 in the control unit is set to the low level through diode D1 so that the write state is entered (i.e., the R/W C signal level is high). After memory write has been finished, the gate of IC2 described above outputs a GND level signal again to trigger the timer. The above process is repeated automatically.

CRT POWER SUPPLY CIRCUIT

The CRT (Cathode Ray Tube) requires a voltage of about 2 kV. This high voltage is generated using a DC-DC converter, and is regulated by a feedback-type voltage regulator. A negative feedback amplifier and a DC reproducing circuit are used to prevent the high voltage from varying when the brightness is increased and to improve the unblanking characteristics during high speed sweep.

All the power supply circuits use voltage regulators; the main power supply circuit uses a tracking generator, so it is particularly stable.

MS-1650B BLOCK DIAGRAM

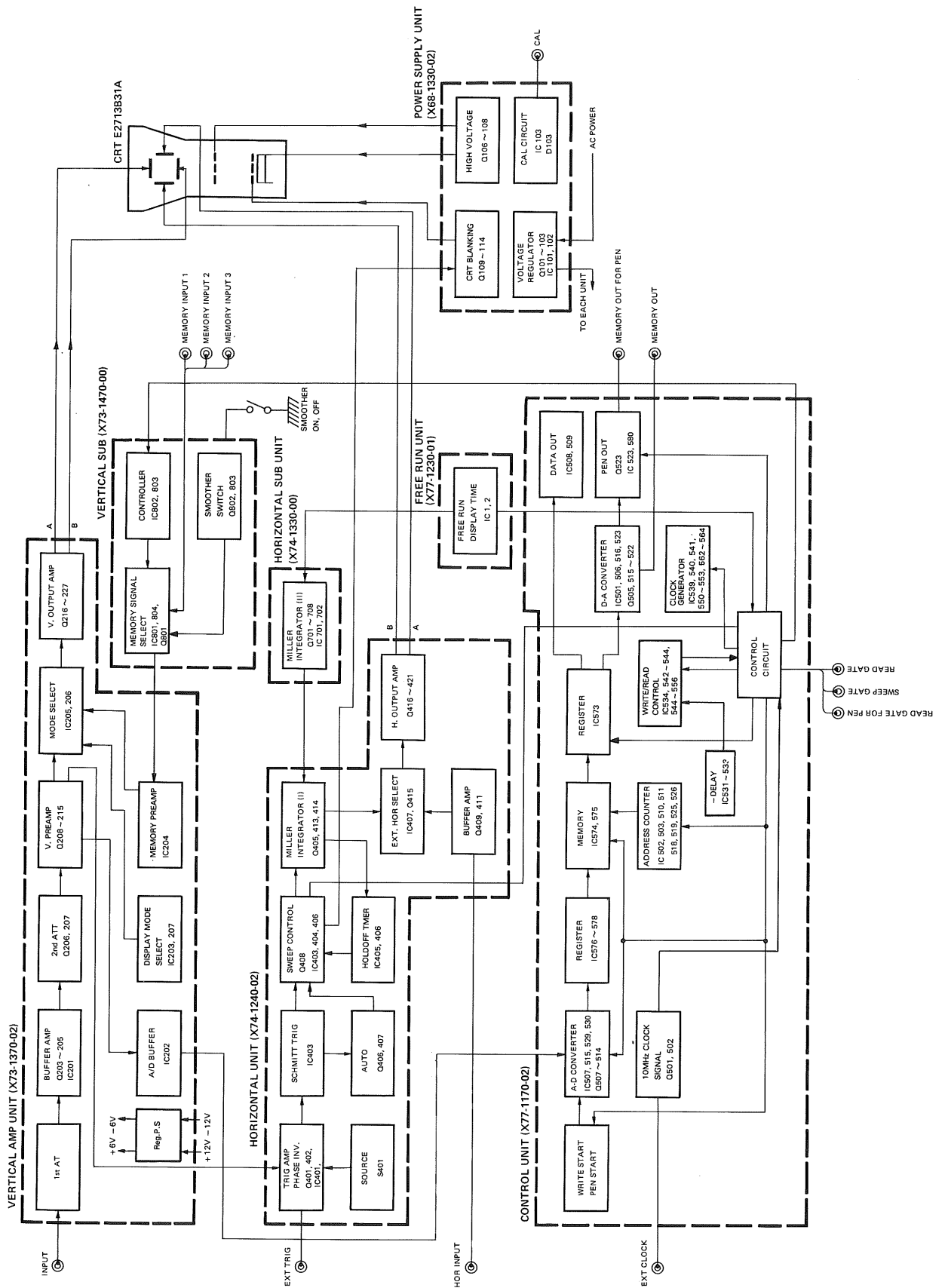


Fig. 1

CIRCUIT DESCRIPTION; MS-1650B

ABBREVIATIONS

MCLK1	10MHz CLOCK	CLK
PEN	PUSH PEN-SCOPE SW	READ MODE (RMD)
FRZ	PUSH FREEZE	RMD
SCOPE	PEN-SCOPE SW	RMD
WR CLK	CLOCK for WRITE & READ	CLK
WSTS	PUSH WRITE START SIGNAL	WRITE MODE (WMD)
PSTS	PUSH PEN START SIGNAL	WMD
SWP	SWEEP SIGNAL from IC 404-6 pin	WMD
W R	WRITE MODE or READ MODE SIGNAL	WMD
LAS	DECISION LAST (FIRST) ADDRESS	WMD
PWRES	POWER ON RESET	WMD
CSP	COUNT DOWN STOP PULSE (CARRY)	WMD
CUP	COUNT UP PULSE (BORROW)	WMD
WSP	WRITE STOP PULSE $390 \Omega \times 1000P (\mu\text{sec})$	WMD
WP	WRITE PULSE	WMD
WRS	WRITE RESET	WMD
PSP	STOP PEN	
WST	WRITE START	
PST	PEN START	
PLD	PEN LOAD	
CHAT		
CUK	COUNT UP CLOCK	WMD
CDK	COUNT DOWN CLOCK	WMD
SWP	SWEEP CLOCK	WMD
CLK (EXT)	OUTPUT of EXTERNAL CLOCK INPUT	
CLK (PEN)	CLOCK OUTPUT of PEN MODE	
CLK (W & R)	CLOCK OUTPUT of WRITE MODE/READ MODE	
PST	PEN START PEN START signal goes out when the PEN START button gets depressed.	

PRES	PEN RESET PEN SCOPE signal develops at IC559 pin 3 and one-shot pulse goes out. When PEN MODE is entered with PEN-SCOPE SW depressed, this state gets reset with initial address by PEN LOAD and PEN OUT output changed to saturation level.
PSTP	PEN STOP This signal is used to stop pen action and is a signal developed (at IC569 pin 11) when ADDRESS reaches 1024 is utilized.
PLD	LOAD FOR PEN LOAD signal for PEN. The first address enters ADDRESS COUNTER.
CHAT	Retaining signal while PEN-SCOPE SW is OPEN.
READ	Signal output during READ MODE.
RLD	LOAD FOR READ MODE By SWEEP SIGNAL during READ MODE.
PCLK	PEN CLOCK READ CLOCK during PEN MODE.
RCLK	READ CLOCK READ CLOCK during READ MODE.
W CLK	WRITE CLOCK WRITE CLOCK during WRITE MODE.
R CLK	READ CLOCK READ CLOCK during READ MODE.
LOAD	LOADs the first address of ADDRESS COUNTER.
SWP	Signal used to perform read in time with SWEEP SIGNAL during READ. SWEEP SIGNAL is output in time with CLOCK.
SWPP	See TIME CHART. (See Fig.11.)

(I) CLOCK

CLOCK (MCLK 1) of 10 MHz coming from IC541 pin 6 changes to CLOCKS of $1 \mu\text{sec}$, $2 \mu\text{sec}$, and $5 \mu\text{sec}$ and to CLOCKS of $1 \mu\text{sec}$, $10 \mu\text{sec}$, $100 \mu\text{sec}$ and 1msec processed by IC553, IC563, IC552, IC551, IC540 and IC539. INTERNAL CLOCK for WRITE/READ is determined according to control signals coming from P506 and the setting of SWEEP TIME/DIV. IC549 pin 8 is associated with 1sec/div . (See Fig. 2, 3)

CIRCUIT DESCRIPTION

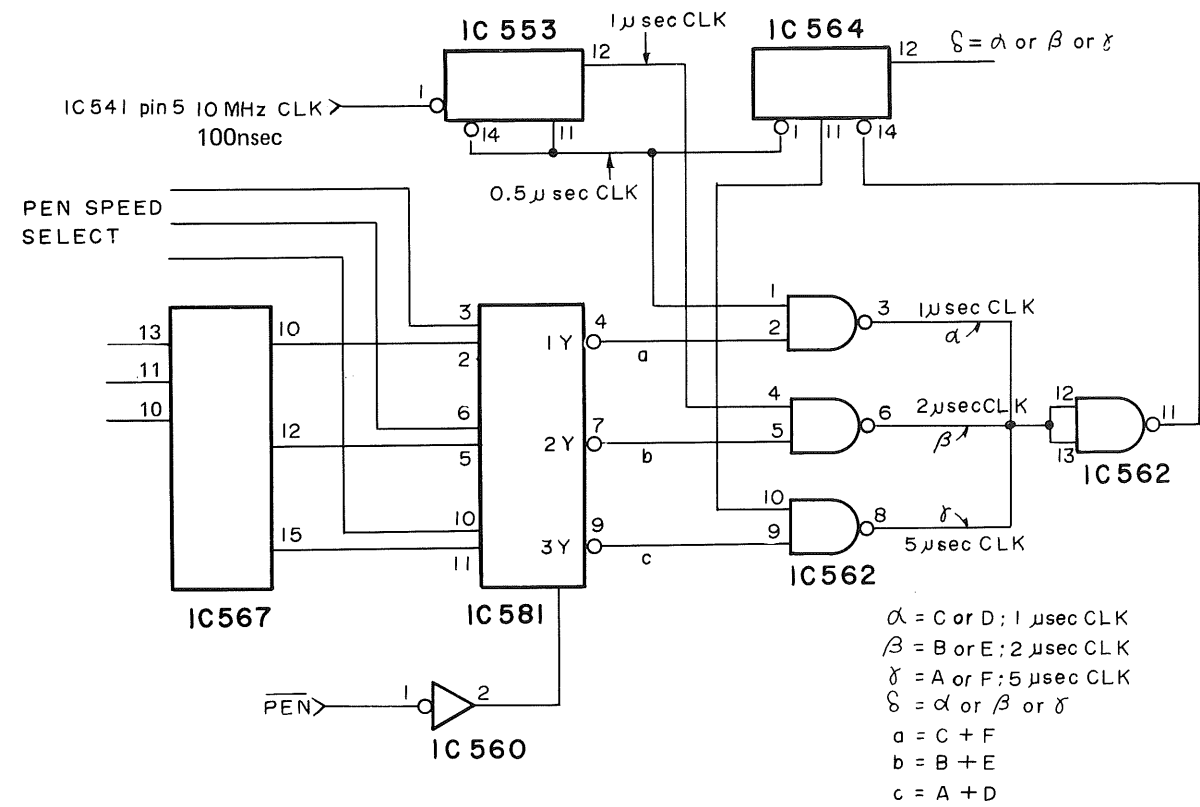


Fig. 2

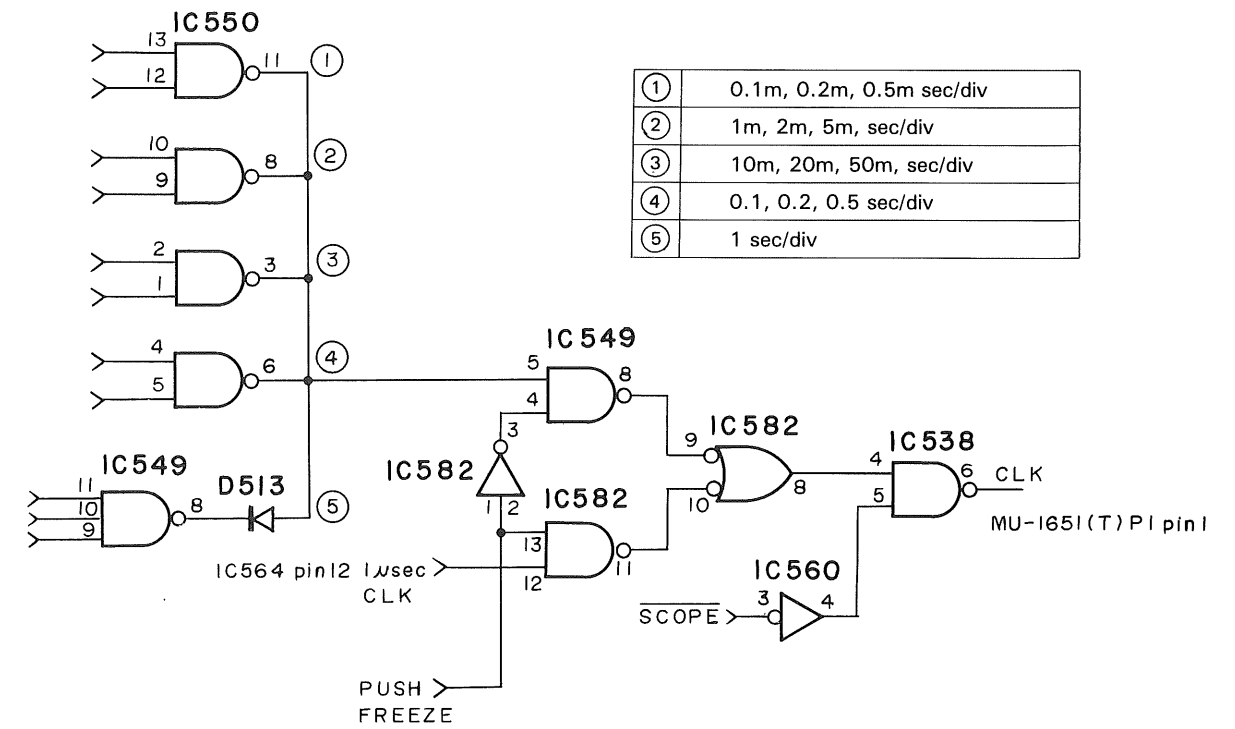


Fig. 3

CIRCUIT DESCRIPTION

(II) WRITE MODE

WRITE mode is entered by WRITE START. It COUNTS DOWN according to -DELAY function (or COUNTS UP during LOAD mode) and waits for trigger. When a trigger comes in, it COUNTS UP and generates LAS signal, terminating WRITE mode. The COUNT DOWN count corresponds to -DELAY and data which have come before the trigger are stored.

After the trigger, therefore, the COUNT UP count is 1024 -COUNT DOWN count.

Address are given right. (Fig. 4)

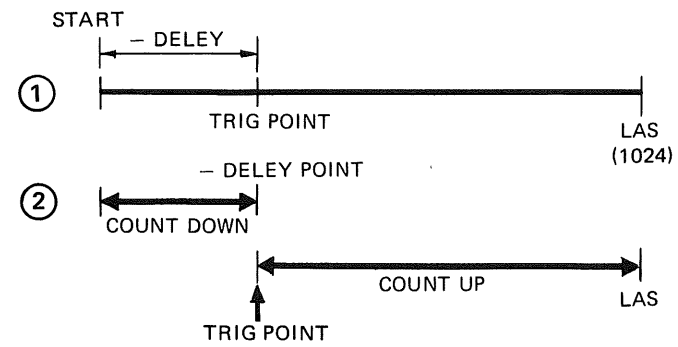


Fig. 4

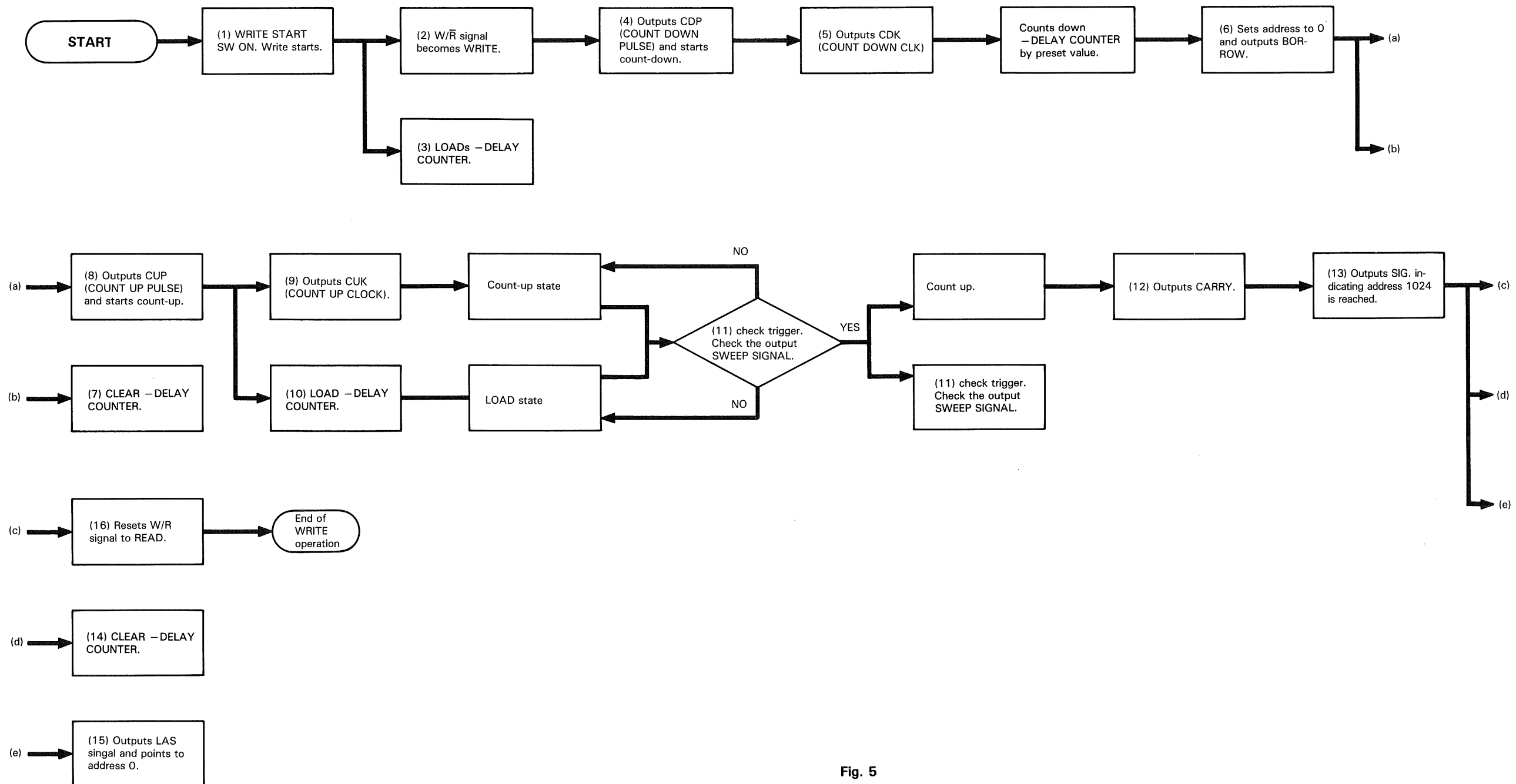


Fig. 5

CIRCUIT DESCRIPTION

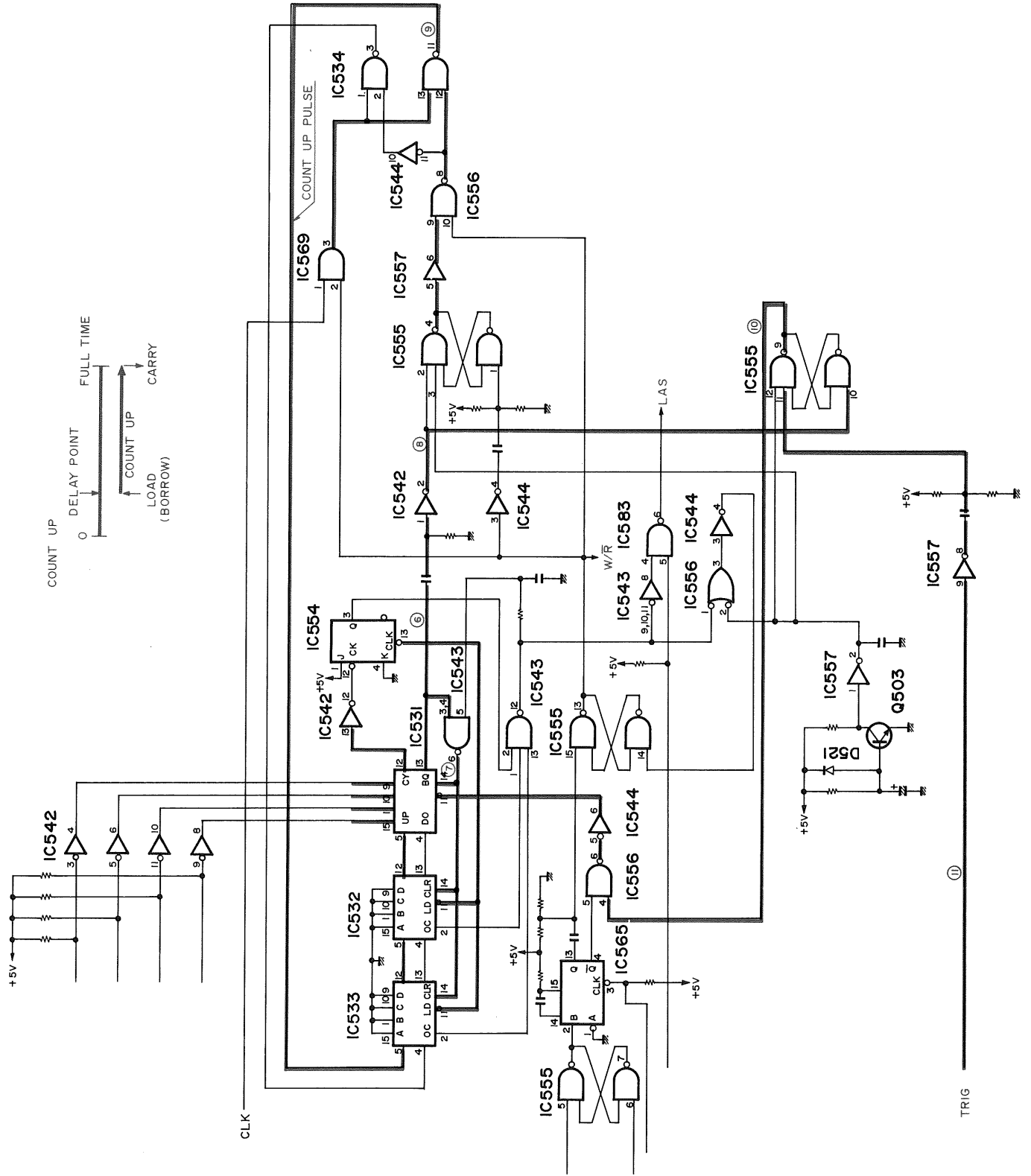


Fig. 6

CIRCUIT DESCRIPTION

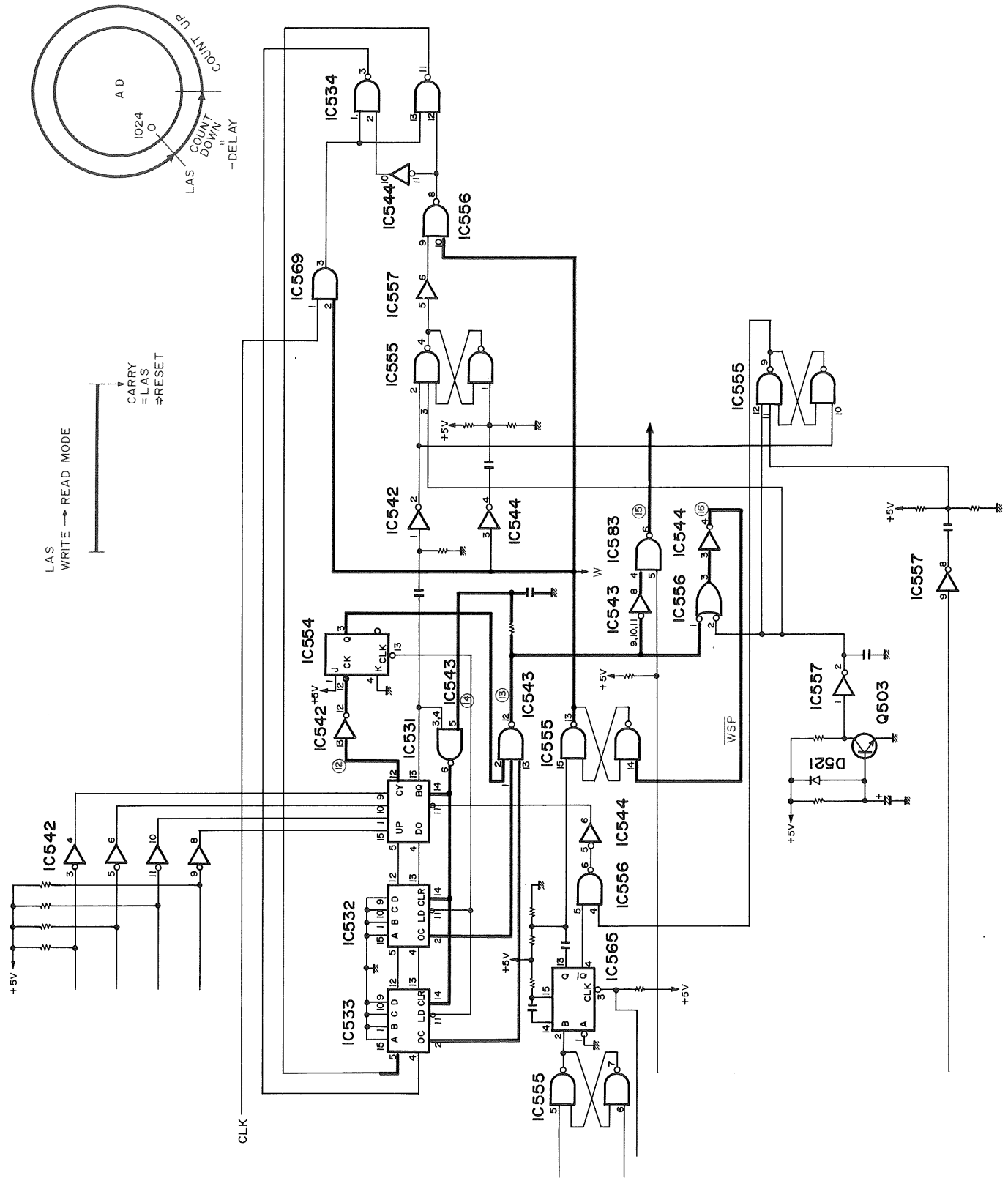


Fig. 7

CIRCUIT DESCRIPTION

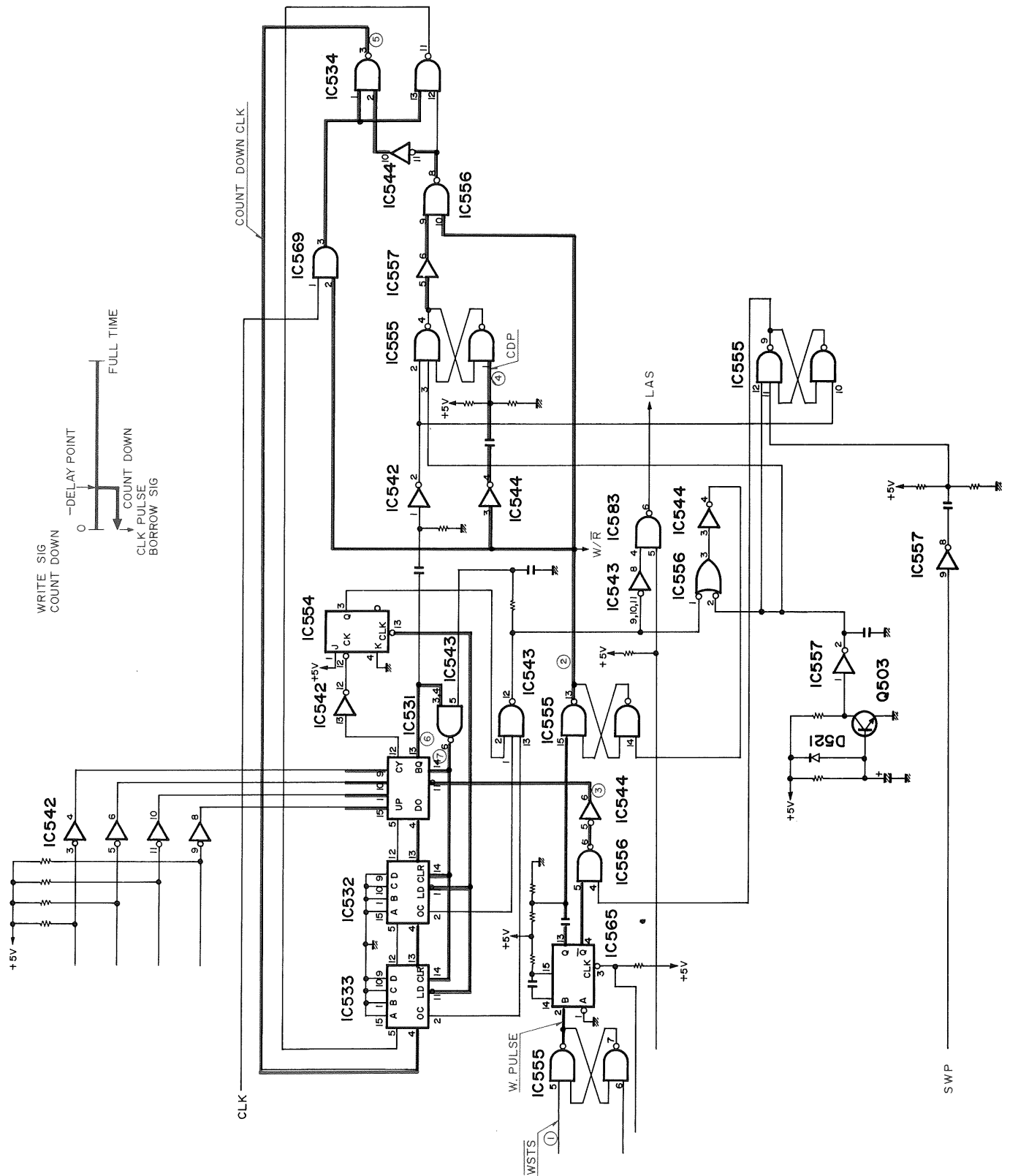


Fig. 8

CIRCUIT DESCRIPTION

(III) READ or PEN MODE

CLK (EXT)	Output then EXTERNAL CLOCK comes in.
CLK (PEN)	CLOCK output during PEN MODE.
CLK (W & R)	CLOCK output during WRITE MODE and PEN MODE.
$\overline{\text{PST}}$	PEN START PEN START signal goes out when the PEN START button gets depressed.
$\overline{\text{PRES}}$	PEN RESET PEN-SCOPE signal develops at IC559 pin 3 and one-shot pulse goes out. When PEN MODE is entered with PEN-SCOPE SW depressed, this state gets reset with initial address by PEN LOAD and PEN OUT output changed saturation level.
$\overline{\text{PSTP}}$	PEN STOP This stops PEN operation started in PEN MODE. The signal developing (at IC569 pin 11) when ADDRESS reaches 1024 is utilized.
$\overline{\text{PLD}}$	LOAD FOR PEN LOAD signal for PEN. The first address enters ADDRESS COUNTER.
CHAT	Retaining signal while PEN-SCOPE SW is OPEN.
READ	Signal output during READ MODE.
$\overline{\text{RLD}}$	LOAD FOR READ MODE By SWEEP SIGNAL during READ MODE.
$\overline{\text{PCLK}}$	PEN CLOCK READ CLOCK during PEN MODE.
$\overline{\text{RCLK}}$	READ CLOCK READ CLOCK during READ MODE.
$\overline{\text{WCLK}}$	WRITE CLOCK WRITE CLOCK during WRITE MODE.
$\overline{\text{RCLK}}$	READ CLOCK READ CLOCK during READ MODE.
$\overline{\text{LOAD}}$	LOADs the first address of ADDRESS COUNT.
$\overline{\text{SWP}}$	Signal used to perform read in time with SWEEP SIGNAL during READ. SWEEP SIGNAL is output in time with CLOCK.
SWPP	See TIME CHART. (Fig. 9, 10)
CLK'	CLK (W & R) during READ. CLK (PEN) during PEN.
TCHG	Switches clock. During READ, generates 1-2-5 sequence.

During PEN, generates 1-2-5 sequence. (from 10, 20, and 50 msec)

PENSIG Outputs signal for PEN during PEN.

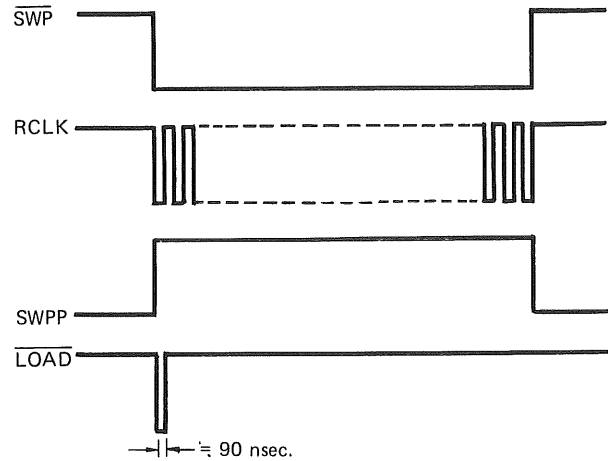


Fig. 9 READ MODE

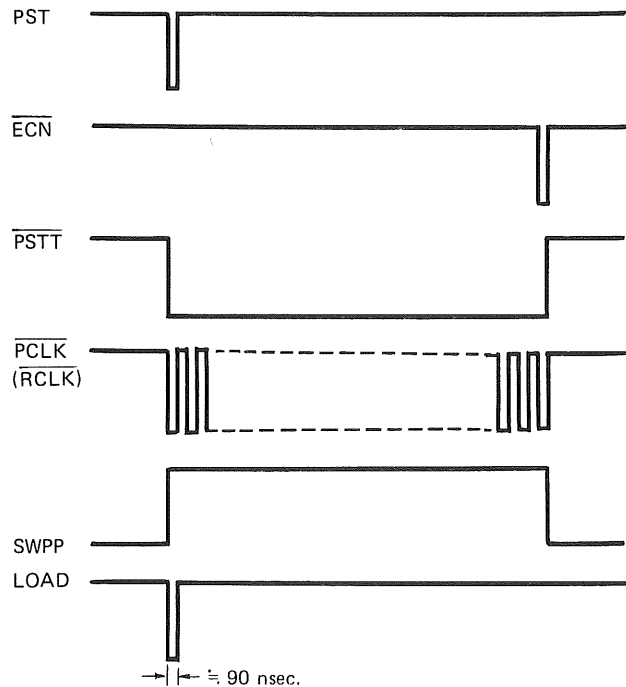


Fig. 10 PEN MODE

CIRCUIT DESCRIPTION

(IV). WRITING

How to enter WRITING state.

All you have to do is put the system in the state in which a trigger signal is waited for as shown in WRITE MODE timing diagram. A red LED lights to indicate WRITE MODE. The easiest way to check WRITING is to see that a signal which has the same waveform as of the input signal is developing at two inputs of COMP (NE529).

- \overline{WE} Write enable signal which enables write into memory.
- WST A/D conversions start signal.
- EOC Signal indicating the end of A/D conversion and the establishment of digital data.
- STROBE Latch signal.
- ADCLK Address clock signal.
- WCLK Write clock signal.

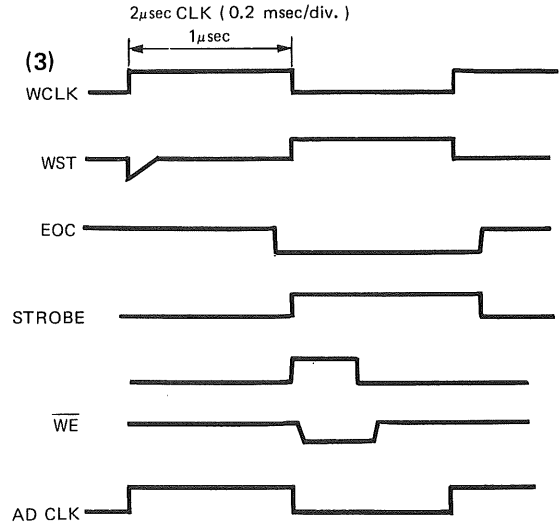
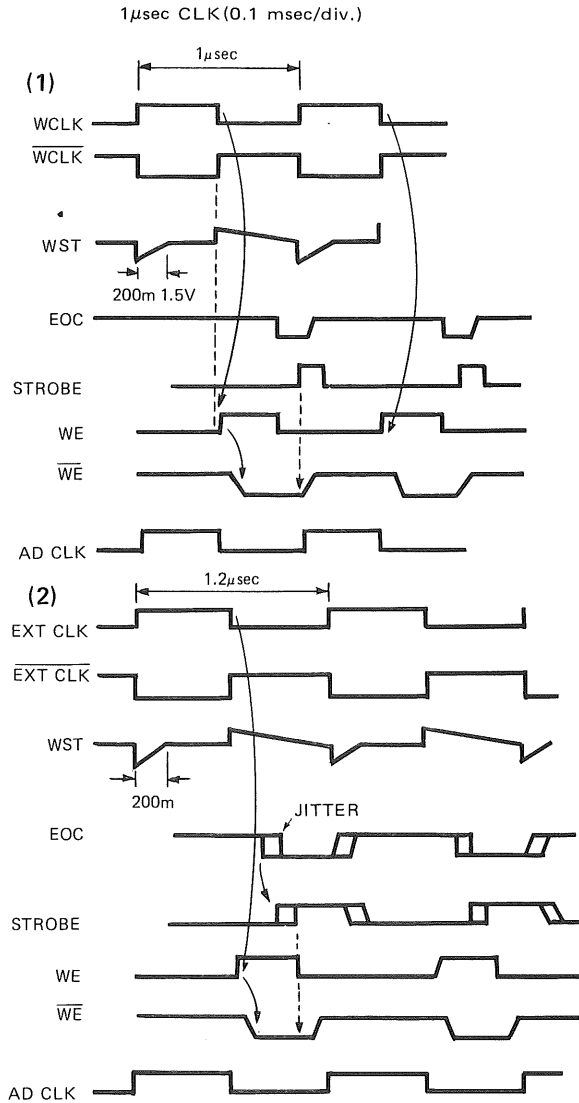


Fig. 11 WRITE MODE



CIRCUIT DESCRIPTION

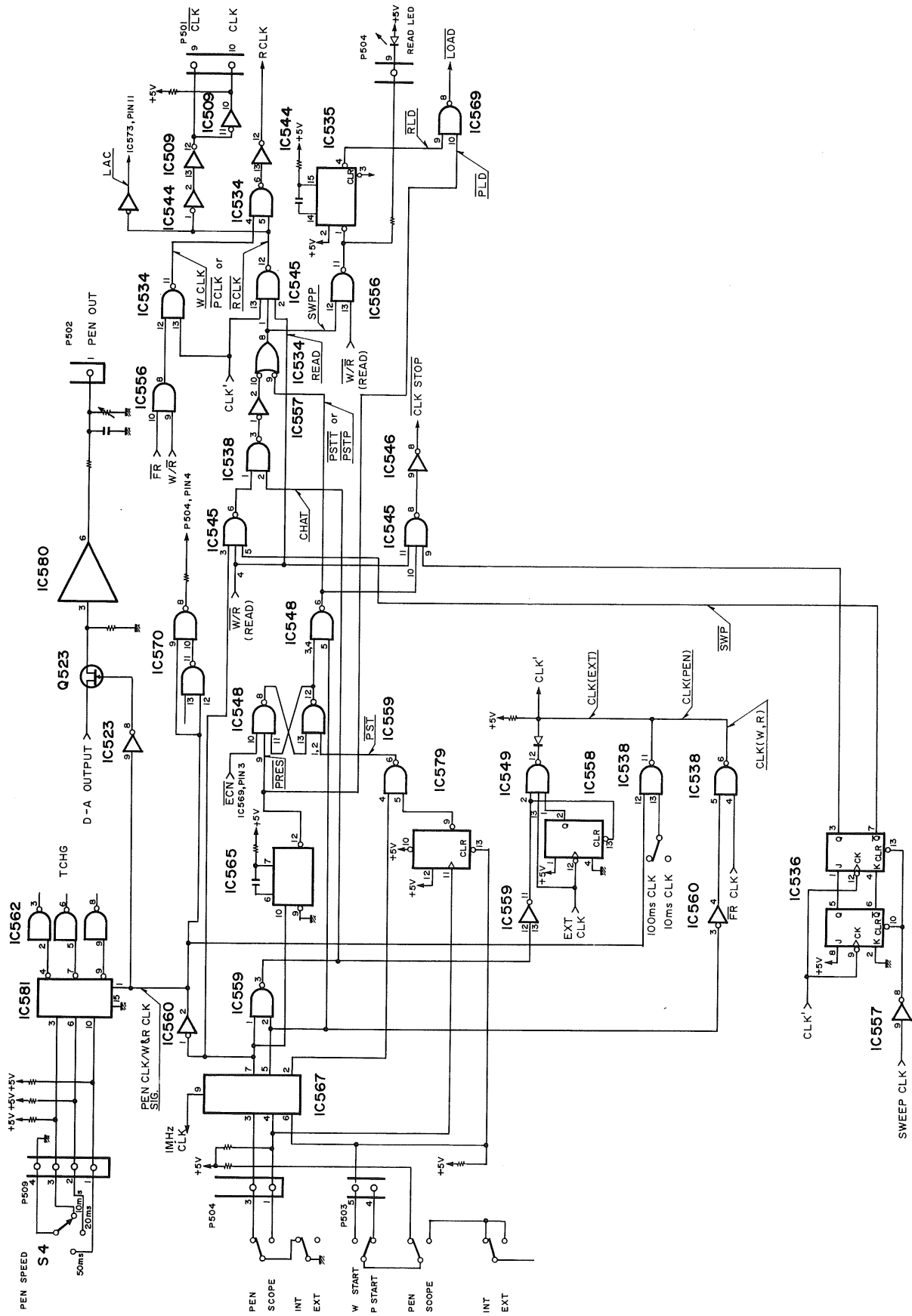


Fig. 12

CIRCUIT DESCRIPTION

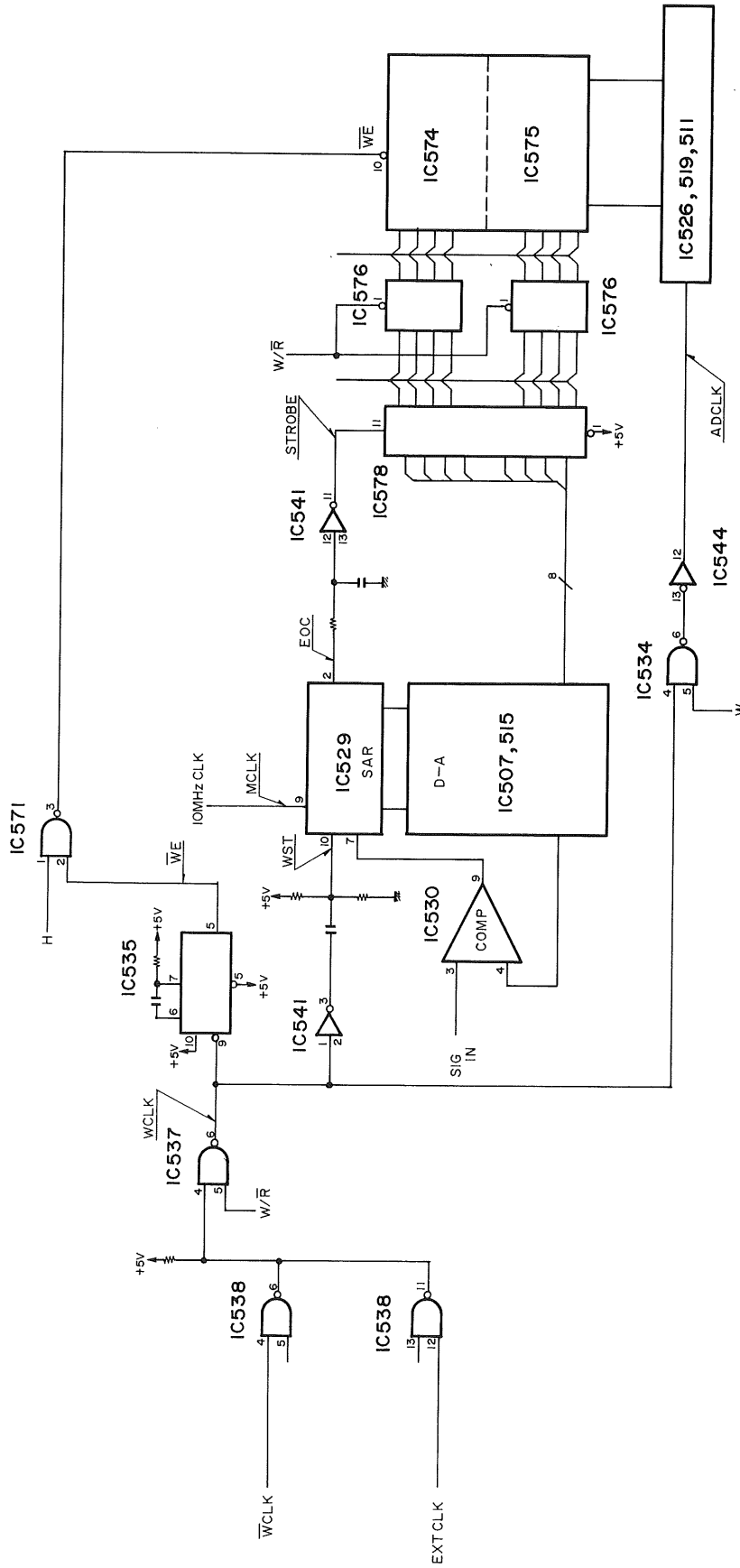


Fig. 13

CIRCUIT DESCRIPTION

(V) READING

As the description, timing chart, and circuit diagram of READ MODE, data are read, triggered by \overline{LOAD} , latched in LAC, converted to analog data and output. Digital data are output through the DATA OUT terminal.

LAC Latches data of each address read out from

\overline{CL}

memory and delivered to D/A and DATA OUT.

Clears data latched and makes the outputs of D/A and DATA OUT to saturation level.

VST

Basic switching voltage for the switching transistor of the D/A converter.

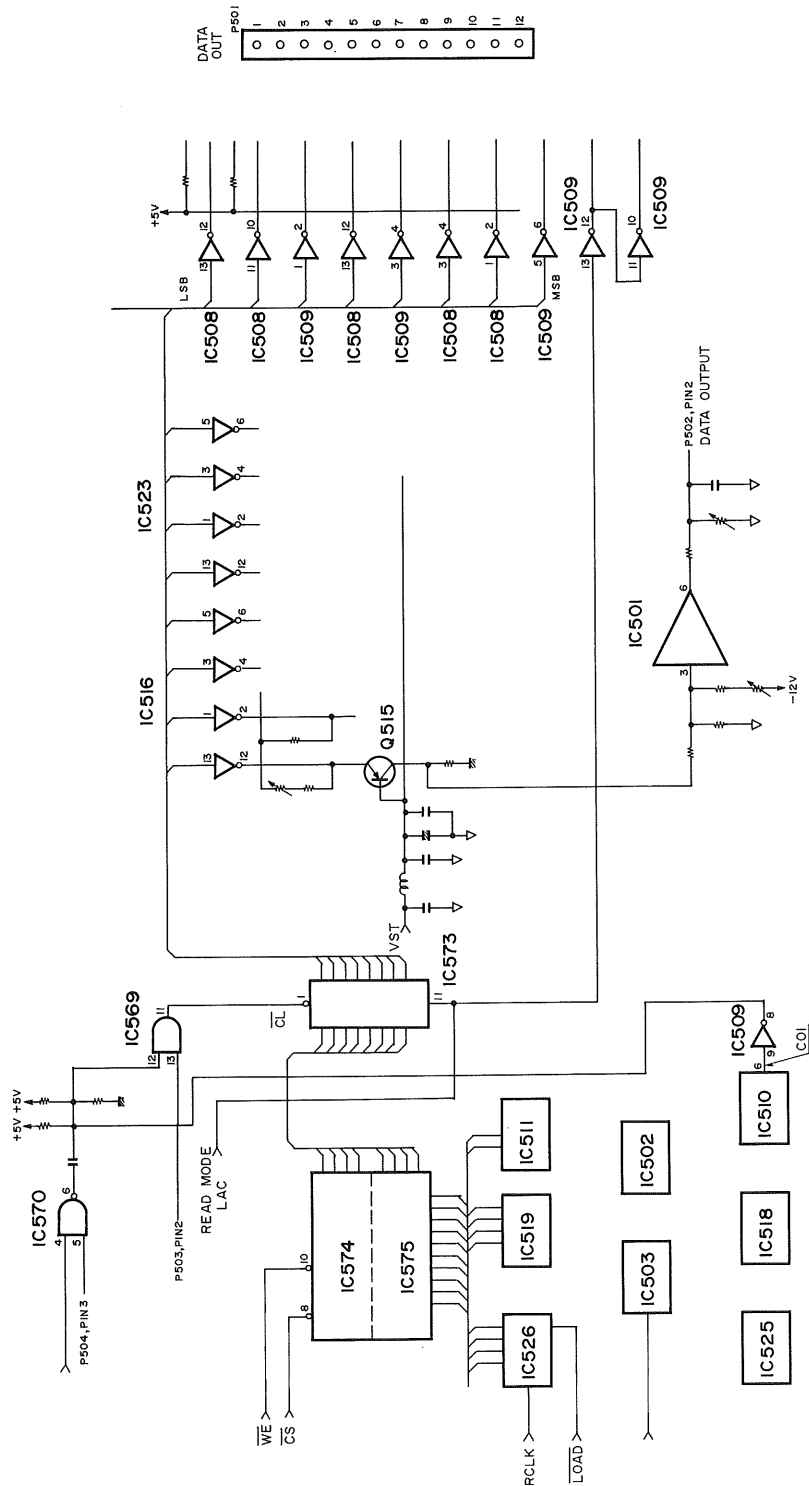


Fig. 14

CIRCUIT DESCRIPTION

DISPLAY MODE FUNCTION TABLE (VERTICAL SUB UNIT)

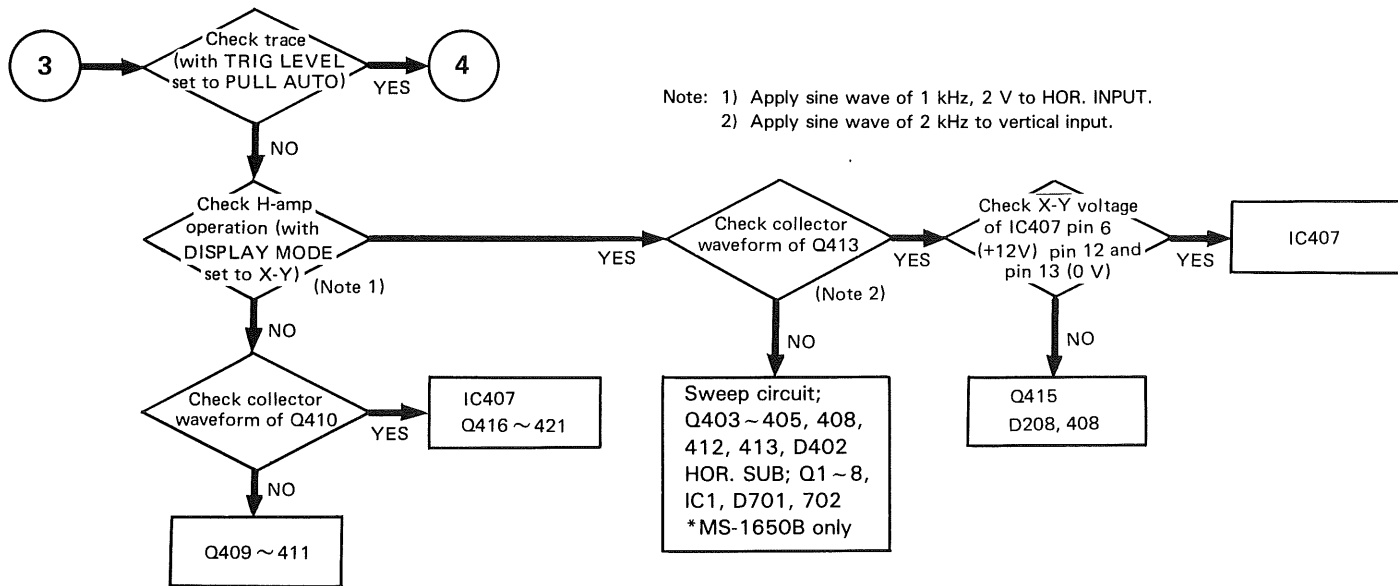
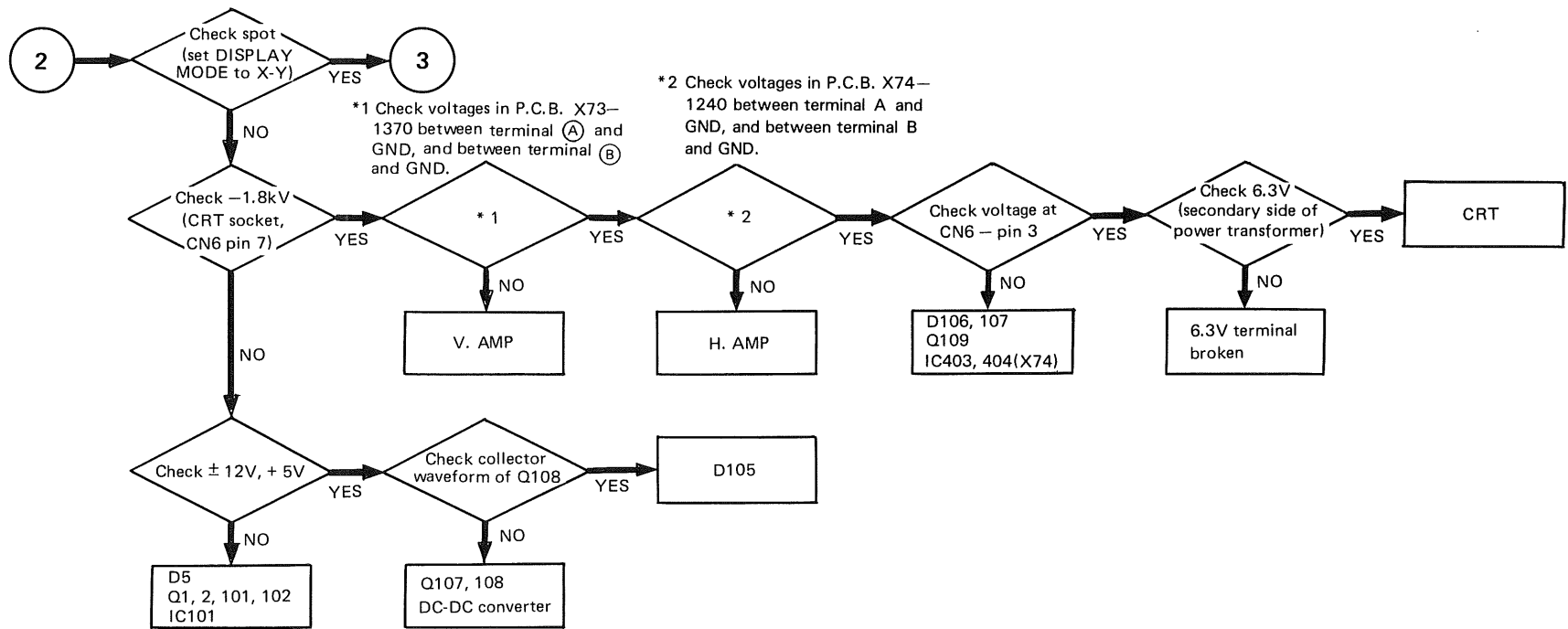
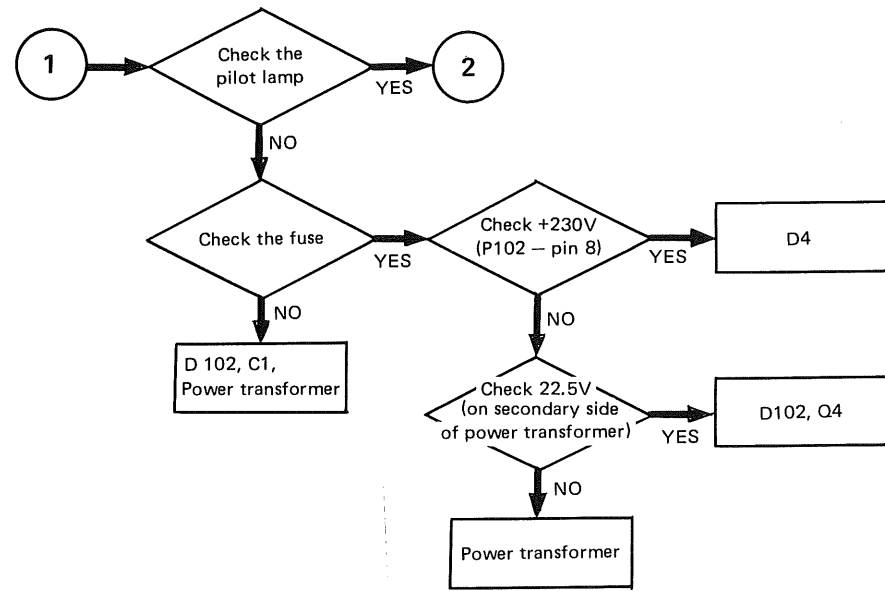
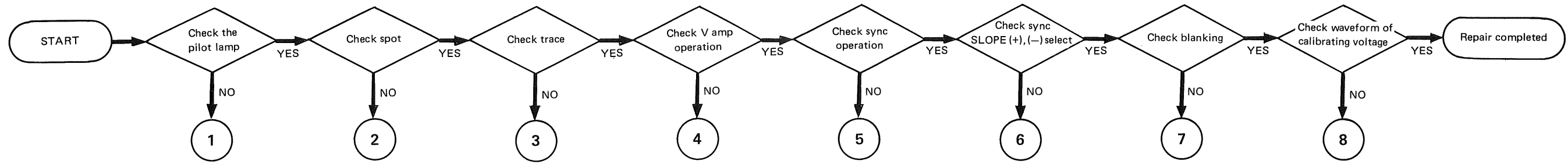
		DISPLAY MODE			
		REAL	DUAL	MEMORY	X-Y
DISPLAY TIME	PUSH	A	B	C	D
	PULL	E	F	G	H

A; REAL WRITE ENABLE (READ)
 B; REAL WRITE ENABLE and MEMORY READ
 C; MEMORY READ
 D; REAL (READ)
 E; (REAL) WRITE and MEMORY READ
 F; REAL READ only
 MEMORY READ only
 G; MEMORY READ
 H; MEMORY READ
 H; REAL SWEEP OFF

SWEEP TIME DIV; 0.1 msec/div fixed

H= MEMORY
 SWEEP TIME/DIV; 0.1 msec/div fixed

TROUBLE SHOOTING



TROUBLE SHOOTING

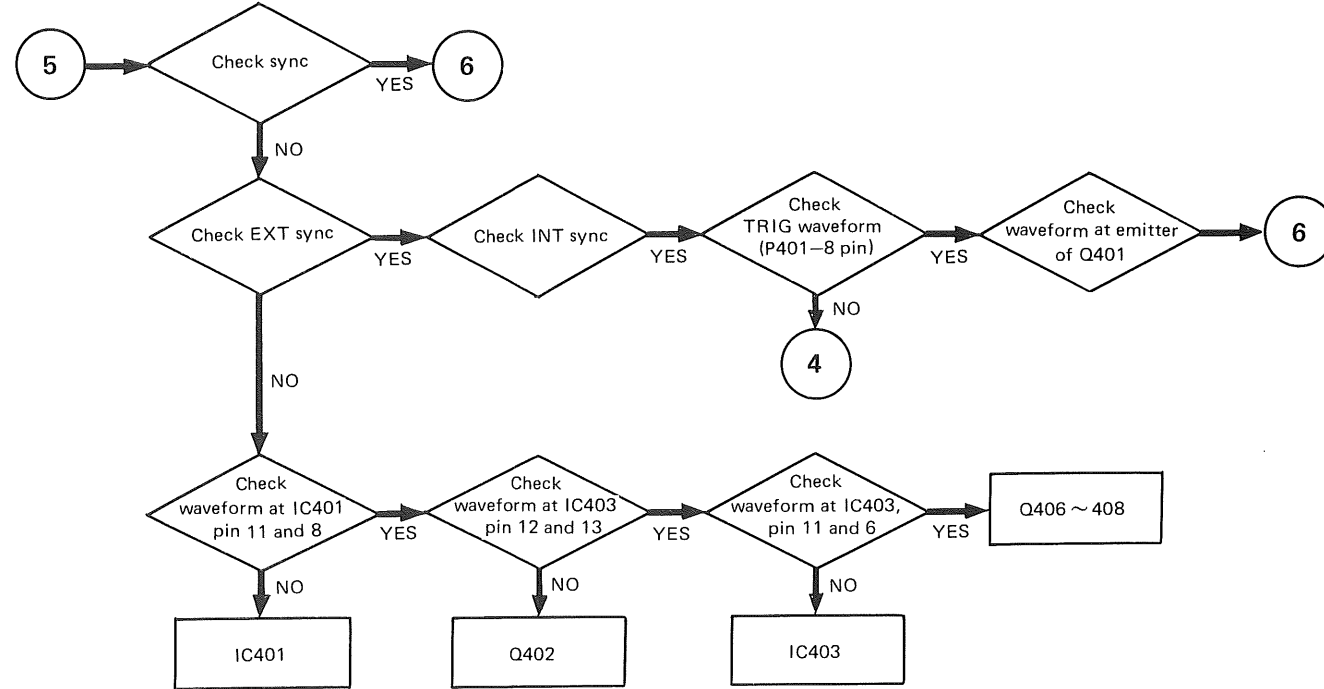
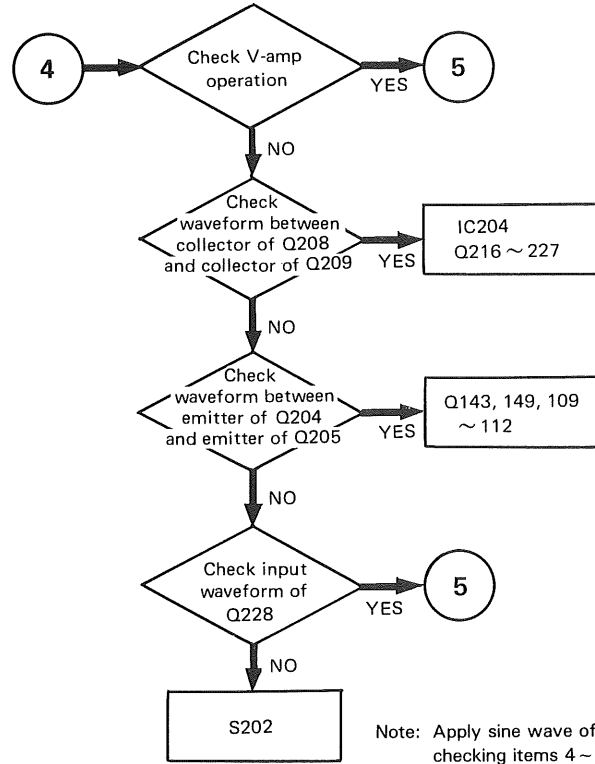
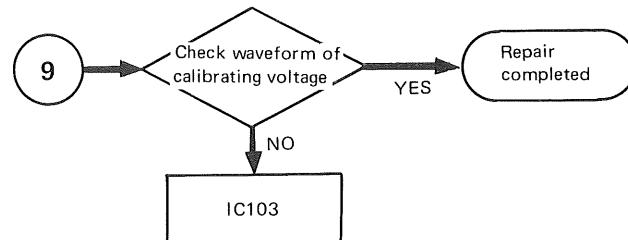
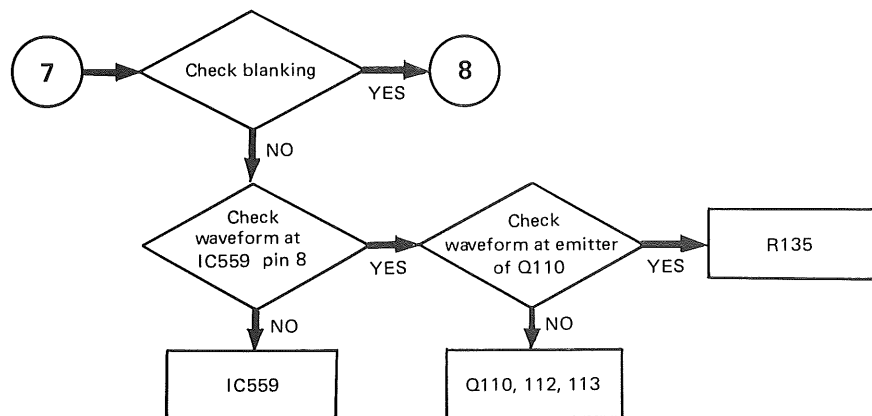
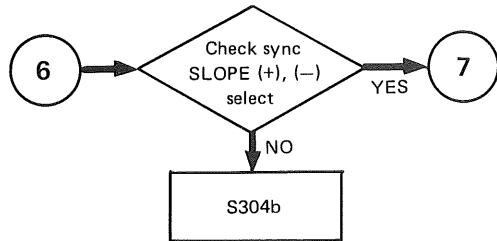
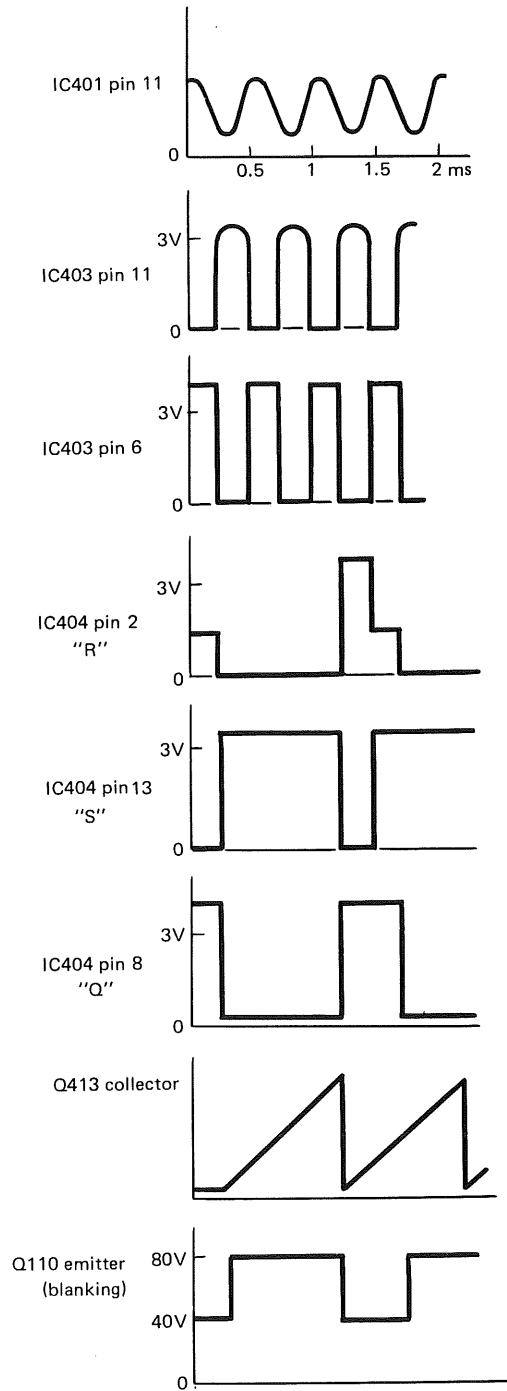


Fig. 15 - Waveform in Sweep Circuit.
(Input signal 2 kHz, sine wave, SWEEP TIME/ DIV. 0.1 ms/div.)



ADJUSTMENT: MS-1650B

CONTROL SETTINGS

The control settings listed below must be used for each adjustment procedure. Exceptions to these settings will be noted as they occur. After completing an adjustment, return the controls to the following settings.

SWEEP TIME/DIV	0.1ms/div
SWEEP VARIABLE	CAL
H POSITION	mechanical center
x 5 MAG	PUSH
INTENSITY	3 o'clock position
TRIG LEVEL	PULL, mechanical center
SOURCE	INT
FOCUS	optimum position
V POSITION	mechanical center
AC-GND-DC	DC
VOLTS/DIV	10 mV/div
V VARIABLE	CAL
FREE RUN	PUSH
DISPLAY MODE	REAL
CLOCK INT/EXT	INT
CLOCK PEN/SCOPE	SCOPE

TEST EQUIPMENT REQUIRED

The following instrument or their equivalent should be used for making adjustments.

Digital multimeter	DL-720	TRIO
Sine wave generator	SG-502	TEKTRONIX
Square wave generator	PG-506	TEKTRONIX
Q meter	4343B	YHP
Oscilloscope	CS-2100A	TRIO
Time marker	TG-501	TEKTRONIX
High voltage probe		
Frequency counter	FC-754A	TRIO

Check of transformer's primary voltage

1. Select the equipment to 100 V and measure the resistance of the power transformer's winding at the AC input connector.
2. Perform the same procedure with the equipment adapted to each of 120 V, 220 V, and 240 V.
100 V.....approx 8 Ω 220 V.....approx 36 Ω
120 V.....approx 9 Ω 240 V.....approx 40 Ω

Check of power supply voltage

1. Check +5 V, ± 12 V, +230 V and +200 V at check-point on the power supply board.

— 1.8 kV adjustment

1. Measure the voltage at P103 pin 2 with a dc voltmeter, through a high-tension/high-impedance probe.
2. Adjust VR103 so as to read -1.8 kV.

INTENSITY adjustment

1. Set the DISPLAY MODE to X-Y to display a spot.
2. Adjust VR 104 so that the spot disappears when the INTENSITY control is between "9 and 12 o'clock" positions.

ASTIG adjustment

1. Adjust VR105 to make the trace equally thick everywhere. Perform the ASTIG and FOCUS controls adjustments together. Once adjusted, no readjustment is needed.

SCALE ILLUM adjustment

1. Make adjustment so that the illumination is bright sufficiently and equally on the screen when rotated the SCALE ILLUM control to maximum clockwise.

Check of the TRACE ROTATION

1. Rotating the TRACE ROTATION control, check how much the trace varies to the center of the graduation.

VERTICAL ATT adjustment

Control setting SWEEP TIME/DIV; 0.2 ms/div

1. Apply a 1 kHz, 0.5 - 100 Vp-p square wave signal to the vertical input terminal.
2. Select the VOLTS/DIV control to 0.1 V/div position and adjust TC202 to make the square wave appear best.
3. Make adjustment similarly with TC204 then TC206 respectively at 1 V/div and 10 V/div ranges.

DC BAL adjustment (I)

1. Perform the adjustment below if the trace moves vertically when rotating the VOLTS/DIV control.
2. Set the DISPLAY MODE to REAL position and AC-GND-DC to GND and adjust the V-position control to bring the trace on the center of the screen.
3. Turn the VARIABLE of the vertical attenuator fully counterclockwise. Adjust VR201 so that the trace does not move vertically when rotating the VOLTS/DIV control.

DC BAL adjustment (II)

1. Perform the adjustment below if the trace moves vertically when rotating the VARIABLE control.
2. Turn the VARIABLE of the vertical attenuator fully counterclockwise and adjust the V-position control to bring the trace to the center of the graduation. Next, turn the VARIABLE control fully clockwise and, if it has moved, bring it back to the center with VR203.
3. Repeat the above steps until the trace stays at the center when turned the VARIABLE.

V. POSITION adjustment

1. Set the V POSITION control to its mechanical center and bring the trace to the center of the graduation with VR208.

ADJUSTMENT

Vertical sensitivity adjustment

Control setting SWEEP TIME/DIV; 0.2 ms/div

1. Select the VOLTS/DIV control to 10 mV/div and turn the VARIABLE control to fully clockwise (CAL position).
2. Apply a 50 mVp-p square wave to the vertical input terminal.
3. Adjust VR205 to display a waveform of 5div vertical amplitude.

Input capacity adjustment

V input;

1. Set the VOLTS/DIV control to 10 mV/div and measure the input capacity using a Q-meter and note it's value.
2. Adjust TC201 for 0.1 V/div so that the input capacity becomes same as the noted value above.
3. Adjust TC203 for 1 V/div and TC205 for 10 V/div respectively.

HOR input;

1. Check that the input capacity is less than 35 pF with a Q-meter.

Overshoot adjustment

Control setting VOLTS/DIV; 0.1 V/div, SWEEP TIME/DIV; 2 μ s/div

1. Apply a 10 kHz or 100 kHz square wave of fast rise time to the vertical input terminal.
2. Adjust middle range of the waveform with TC207.
3. Shape the rise portion of the waveform with VR207.

Check of the frequency response

Control setting VOLTS/DIV; 0.1 V/div, SWEEP TIME/DIV; 1 μ s/div. SWEEP TIME/DIV; 1 μ s/div

1. Using an oscillator of good frequency response, apply a 1 kHz sine wave to the vertical input terminal to display a waveform of 6 div vertical amplitude.
2. Keeping the oscillator's output voltage fixed, check that the amplitude is less than -3 dB at 10 MHz.

Sweep time adjustment

Control setting VOLTS/DIV; 1 V/div

1. Turn the SWEEP TIME/DIV and VARIABLE controls fully clockwise to CAL.
2. Adjust sweep time with reference to time markers.
3. Adjust VR407 for sweep time of 1 sec to 20 msec.
4. Adjust C431 for sweep time of 10 msec to 0.2 msec.
5. Adjust TC402 for sweep time of 0.1 msec to 2 μ sec.
6. Adjust TC401 for sweep time of 1 μ sec.

Sweep length adjustment

1. Adjust VR406 so that the total length is 11 div with the reference to time marker.

× 5 MAG adjustment

1. Set the SWEEP TIME/DIV control to 0.1 ms/div and apply a 0.1 msec time marker to the vertical input.
2. Adjust H. POSITION so that 11 shots of pulses appear

each just on a vertical graduation of the screen.

3. With the MAG switch pulled, adjust VR408 so that every interval between pulses becomes 5 div.

MAG center adjustment

Control setting × 5 MAG; pulled out

1. Set the SWEEP TIME/DIV to 20 μ s/div and apply a 0.1 msec time marker to the vertical input terminal.
2. Make adjustment so that three shots of pulse appear each just on the left-end, center, and right-end graduation of the screen.
3. With the MAG switch pulled out, adjust VR409 so that the pulse appearing at the center and the center graduation of × 1 stay there.

EXT H, horizontal position adjustment

1. Set the DISPLAY MODE to EXT H and H POSITION to its mechanical center.
2. Turn the sweep VARIABLE fully clockwise to CAL position.
3. Adjust VR405 so that the spot comes to the middle of the horizontal axis.

EXT sensitivity adjustment

Control setting DISPLAY MODE ; X-Y

1. Apply a 1.5 Vp-p, 1 kHz sine wave to the HOR INPUT terminal.
2. Adjust VR404 so that the trace extend for 10 div on the screen.

Trigger level adjustment

1. Apply a 1 kHz sine wave to the vertical input terminal. Set the SOURCE switch to INT position.
2. Adjust VR401 so that, when switched the SLOPE to + and - respectively. The trace starts at the same position on inverted waveforms.

Trigger start point adjustment

1. In the same setting as in "trigger level adjustment", set the trigger level control at its mechanical center and adjust VR410 so that the trace begins right at the vertical center.

Check of the sweep start position

1. Bring the spot at the center of the graduation, then let it sweep.
At this time, measure the difference between the left end of the trace and that of the graduation line. (If it exceeds 1 div, make adjustment with R465(4.7 k Ω))

Calibration voltage adjustment

1. Apply a calibration voltage to the vertical input terminal. Select the VOLTS/DIV to 0.2 V/div and the SWEEP TIME/DIV to 0.2 ms/div.

ADJUSTMENT

2. Adjust frequency to 1 kHz with VR102 and duty ratio to 50:50 with VR106.
3. Adjust output voltage to 1 Vp-p with VR101.

Memory input adjustment

Control setting DISPLAY MODE; MEMORY

1. Apply a 1.6 Vp-p sine wave to MEMORY INPUT terminal (1) of MS-1650B.
2. Set the MU-1651, UNIT SELECT to UNIT (1) SINGLE.
3. Adjust VR206 so that the amplitude becomes 8 div.

Memory waveform adjustment

Control setting AC-GND-DC; DC
 DISPLAY MODE; REAL
 FREE RUN; pulled out
 DISPLAY TIME; fully CCW
 SOURCE; INT
 FREEZE; pulled out

1. Apply approx. 1 kHz triangular wave to MEMORY INPUT terminal to display two cycles of waveform of 6 div vertical amplitude on the screen and memorize it. Then adjust VR503 and VR504 to make a smooth MEMORY waveform as shown below.

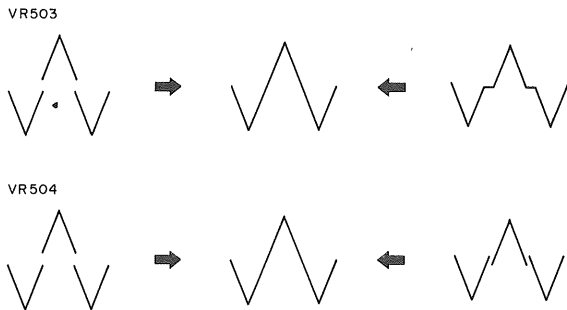


Fig. 16

2. Connect an oscilloscope to MEMORY OUT and observe waveform.
3. Memorize a waveform which extends beyond graduation.
4. Get the top and bottom of the waveform saturated, and adjust its saturation level and gain with VR506 and center level with VR505.
5. The saturation level should be within $\pm(4 + 0.2)$ div of the vertical center.
6. Adjust gain of the oscillator so that the waveform amplitude becomes 8 div.
7. Connect an oscilloscope to MEMORY OUT. Observing and writing waveform, adjust MEMORY waveform center level with VR502 and gain with VR501 at 1.6 Vp-p.
8. Set the DISPLAY MODE to REAL, and adjust deviation of REAL and MEMORY waveforms. Adjust gain with VR801 to remove deviation.
9. Memorize the trace along the top and bottom of the graduations. Set the PEN/SCOPE at PEN. And depress

PEN START. Observation MEMORY OUT FOR PEN adjust VR507 to attain +0.8 V at the top and -0.8 V at the bottom.

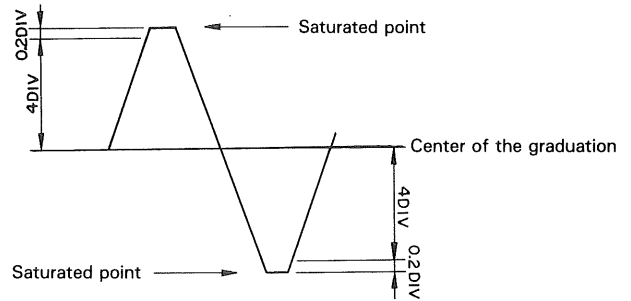


Fig. 17

Check of FREEZE

Control setting FREEZE ; pushed in

1. Push and turn on the FREEZE control and check that any new waveform is not written. Next, pull and turn off FREEZE and check that new waveforms may be written.

Check of minus DELAY

Control setting FREE RUN; pulled, DISPLAY TIME; fully CCW

1. Memorize a waveform of one cycle at 0 on the CRT screen. Check that it moves by approx. 1 div at every position of up to 9.

FREE RUN waveform adjustment

Control setting FREE FUN; pulled out

1. Set the DISPLAY MODE to REAL position. Let 1 kHz appear on the screen. Turn on FREE RUN. Adjust MEMORY waveform along the time base with VR701 so that it fits to REAL waveform.

MEMORY OUT FOR PEN adjustment

Control setting CLOCK PEN; pushed in, START

1. Apply a triangular wave to the MS-1650B and adjust the oscillator so that its amplitude becomes 8 div.
2. Start with waveform written and CLOCK at PEN, adjust VR507 so that MEMORY OUT FOR PEN becomes 1.6 Vp-p.

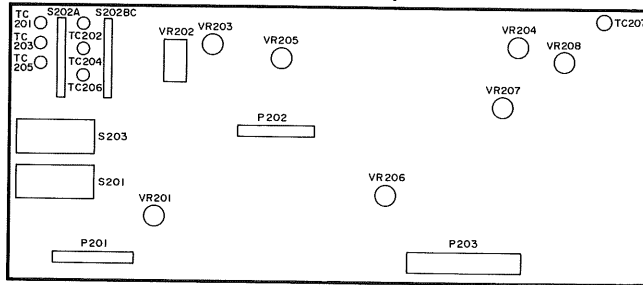
READ GATE OUT FOR PEN

Control setting CLOCK PEN; pushed in, START

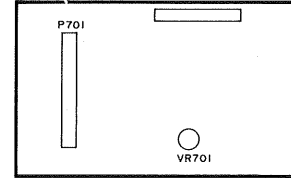
1. Operate PEN START, and READ GATE OUT FOR PEN level varies from Hi to Lo.
 As PEN OUT ends, READ GATE OUT FOR PEN varies from Lo to Hi.

ADJUSTMENT

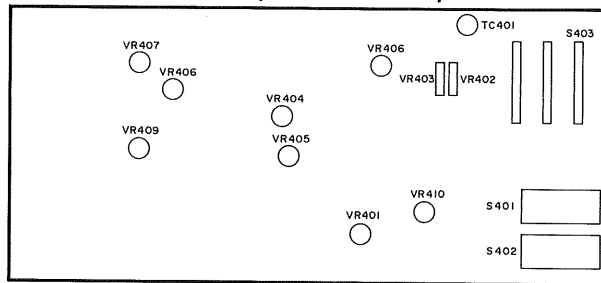
VERTICAL UNIT (X73-1370-02)



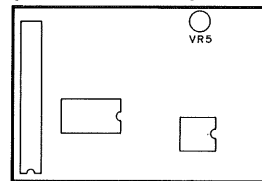
HORIZONTAL SUB UNIT (X74-1330-00)



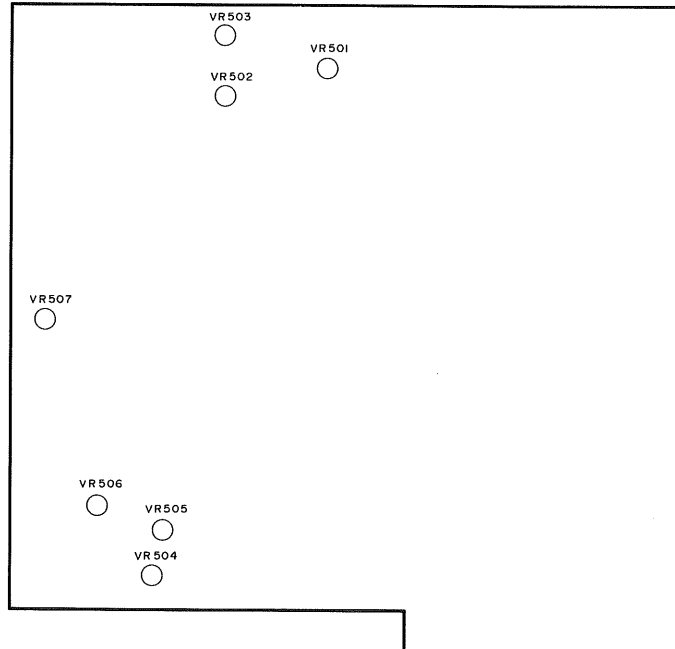
HORIZONTAL UNIT (X74-1240-02)



FREERUN UNIT (X77-1230-01)



CONTROL UNIT (X77-1170-02)



POWER SUPPLY UNIT (X68-1330-02)

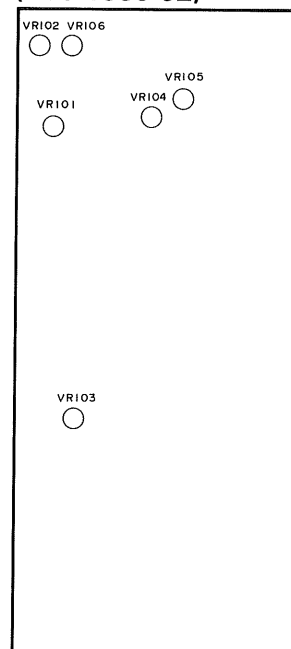


Fig. 18 Location of Adjustment Controls

SPECIFICATIONS; MU-1651(T), and MU-1652(T)

AMP SECTION

Sensitivity

5 mV/div-10 V/div, $\pm 3\%$

Attenuator

5 mV/div-10 V/div in 1-2-5 sequence, all 11 ranges with fine adjustment.

Input impedance

1 M Ω $\pm 3\%$
Approx. 32 pF

Frequency response

DC: DC-300 kHz (-3 dB)
AC: 2 Hz-300 kHz (-3 dB)

Maximum input voltage

500 V_{p-p} or 300 V (DC + AC peak)

Input over lamp

LED lights up at an input of over approx ± 4 div

TRIGGERING

Output voltage

Approx. 1 V/div

Output impedance

Approx. 1 k Ω

Frequency response

DC: DC-300 kHz (-3 dB)
AC: 2 Hz-300 kHz (-3 dB)
HF_{REJ}: DC-1.5 kHz (approx. 3 dB attenuation at 1.5 kHz)

A/D CONVERTER

Resolution

8 bit (1 word)

Conversion system

Successive approximation type A/D converter

MEMORY SECTION

Memory capacity

1024 words (100 words/div displayed)

Write speed

Via MS-1650B

INT: 13 ranges selectable 1 μ s/word-10 ms/word
(equivalent to 0.1 ms/div-1 s/div)

EXT: Rising edge of EXT CLOCK input signal repetition rate frequency: less than 500 kHz

Read out speed

Via MS-1650B

SCOPE: Same as write speed

Fixed at 1 μ s/word for DISPLAY TIME switch at pulled out position.

PEN: 10 ms/word,
20 ms/word,
50 ms/word
3 ranges switchable

With the internal switching, 100ms/word, 200ms/word and 500ms/word are possible.

EXT: Rising edge of EXT CLOCK input signal repetition rate frequency: less than 1 MHz

Delay

Via MS-1650B

0-9 divisions (adjustable each 1 div step on the screen)

D/A CONVERTER

Memory out for scope: 1.72 V $\pm 3\%$ full scale

Memory out for pen: 1.72 V $\pm 3\%$ full scale

Output impedance: Approx. 430 Ω
(Output of only PEN mode)

OPERATING TEMPERATURE

0°C — 40°C, Less than 80% of relative humidity

FULL OPERATING TEMPERATURE

0°C — 50°C, Less than 80% of relative humidity

POWER SUPPLY

Line voltage

AC100/120/220/240 V $\pm 10\%$ (50/60 Hz)

Selectable by internal wiring

Power consumption

Approx. 15 W

WEIGHT

Approx. 4.0 kg

DIMENSIONS

284 mm(W) \times 60 mm(H) \times 400 mm(D)

ACCESSORIES

AC power cord

Instruction Manual

Connection cable (CB-2402F)

BNC cable (CA-34)

Replacement fuse 0.2A
0.4A

CIRCUIT DESCRIPTION; MU-1651(T), and MU-1652(T)

The AMP UNIT (X73-1460-00) amplifies or attenuates the input signal of a certain level and its signal is converted the output signal of 3 Vp-p at full scale and is fed to the MEMORY UNIT (X81-1170-00 or X81-1310-00).

After amplified further to 8 Vp-p at full scale, the signal passes through the TRIGGERING switching circuit to TRIG OUT.

In the MEMORY UNIT, the output signal passed the AMP UNIT is converted to digital signal according to control signals coming from the MS-1650B, stored in C-MOS memory, converted back to analog signal, and output to MEMORY OUT. The waveform is observed on the CRT of the MS-1650B, and it is possible to produce hard copy of analog signal coming from PEN OUT.

Digital data are output through the DATA OUT terminal.

The POWER SUPPLY UNIT (X68-1380-00) not only supplies power to the AMP UNIT and MEMORY UNIT but also relays control signals coming from the MS-1650B.

The control signals control operations of the MEMORY UNIT such as WRITE/READ, become controls signals such as DISPLAY MODE and UNIT SELECT of the AMP UNIT and POSITION SET of the rear panel, and control the VERTICAL SUB UNIT (X73-1470-00) of the MS-1560B to control operation of the CRT display.

The MU-1651 is also capable of suspending WRITE operation of the MEMORY UNIT with FREEZE switch.

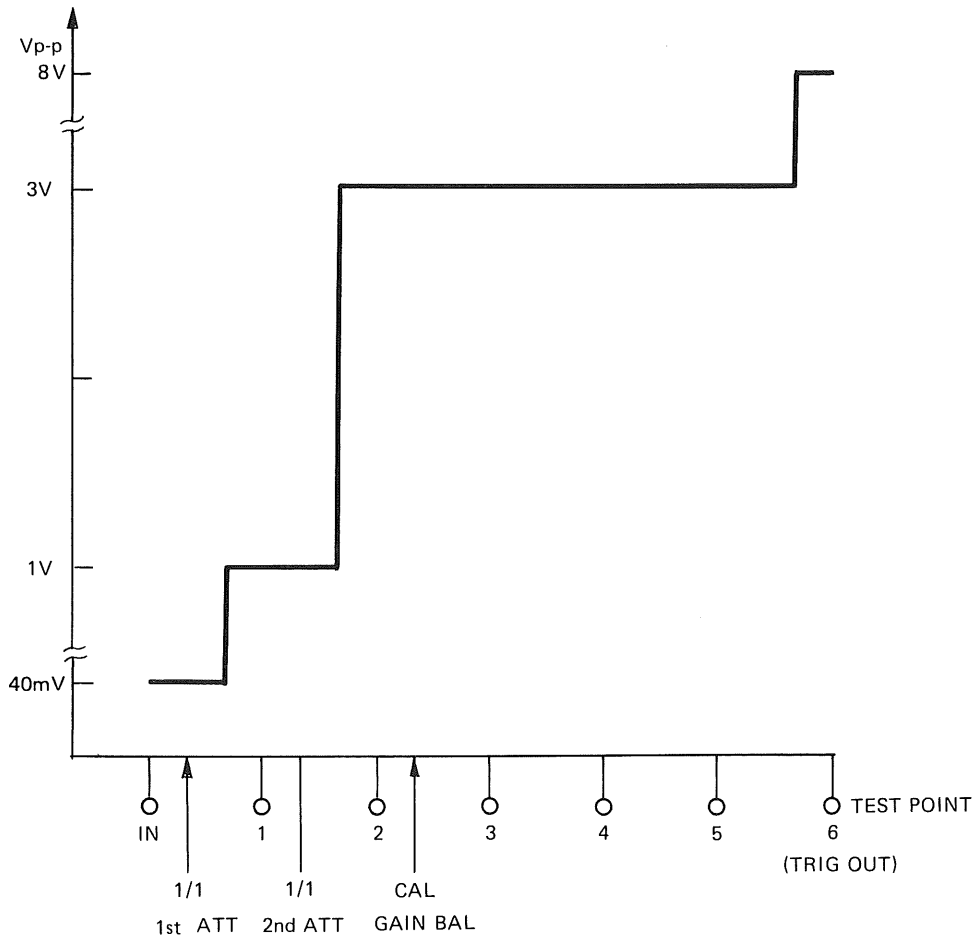


Fig. 19

BLOCK DIAGRAM; MU-1651(T), and MU-1652(T)

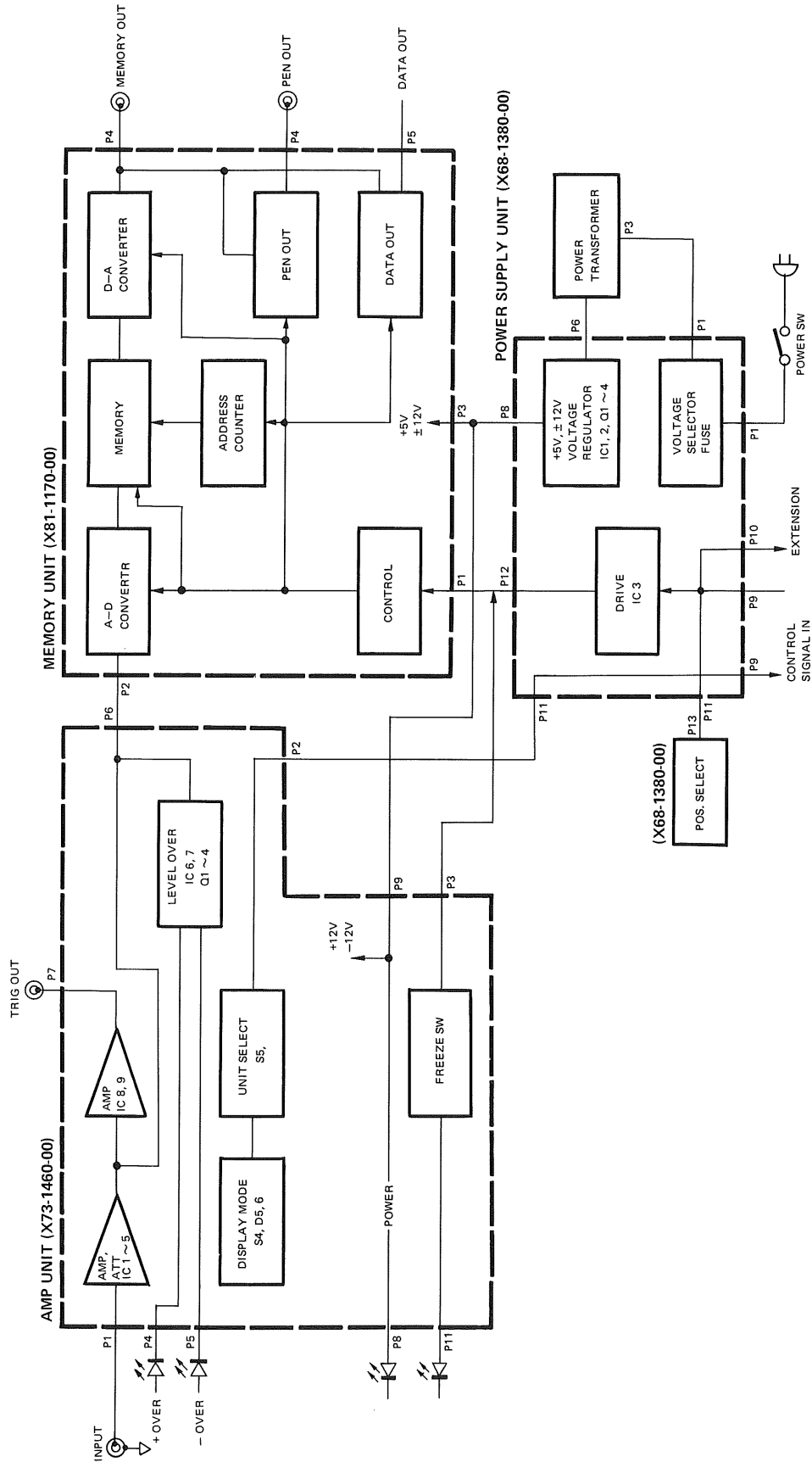


Fig. 20

CIRCUIT DESCRIPTION

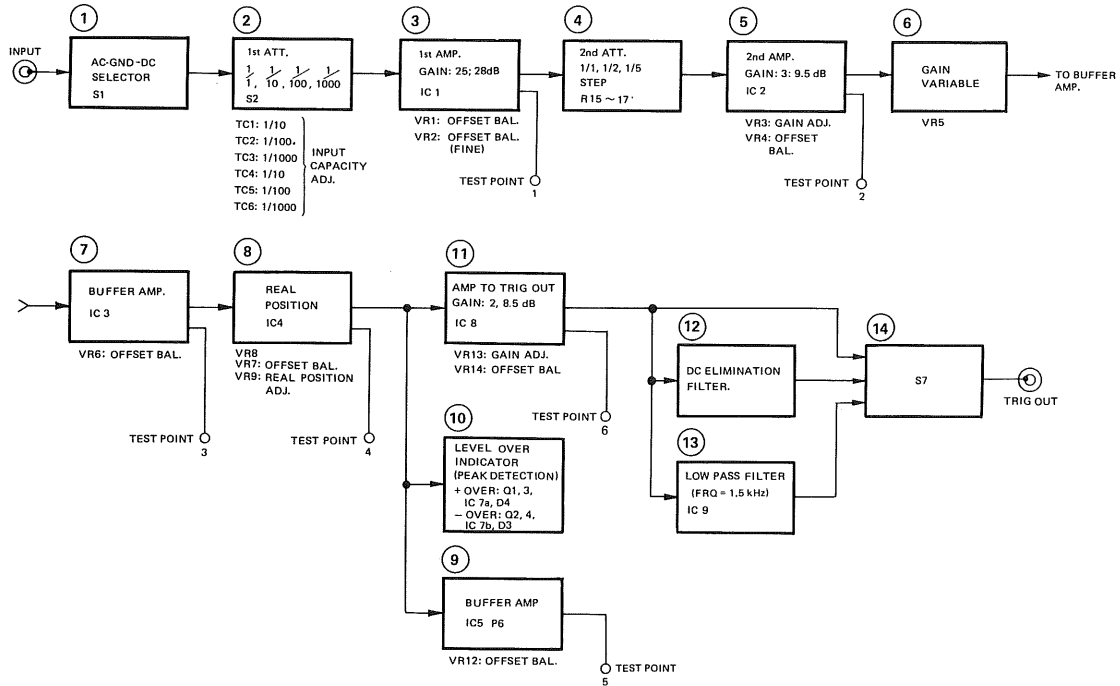


Fig. 21

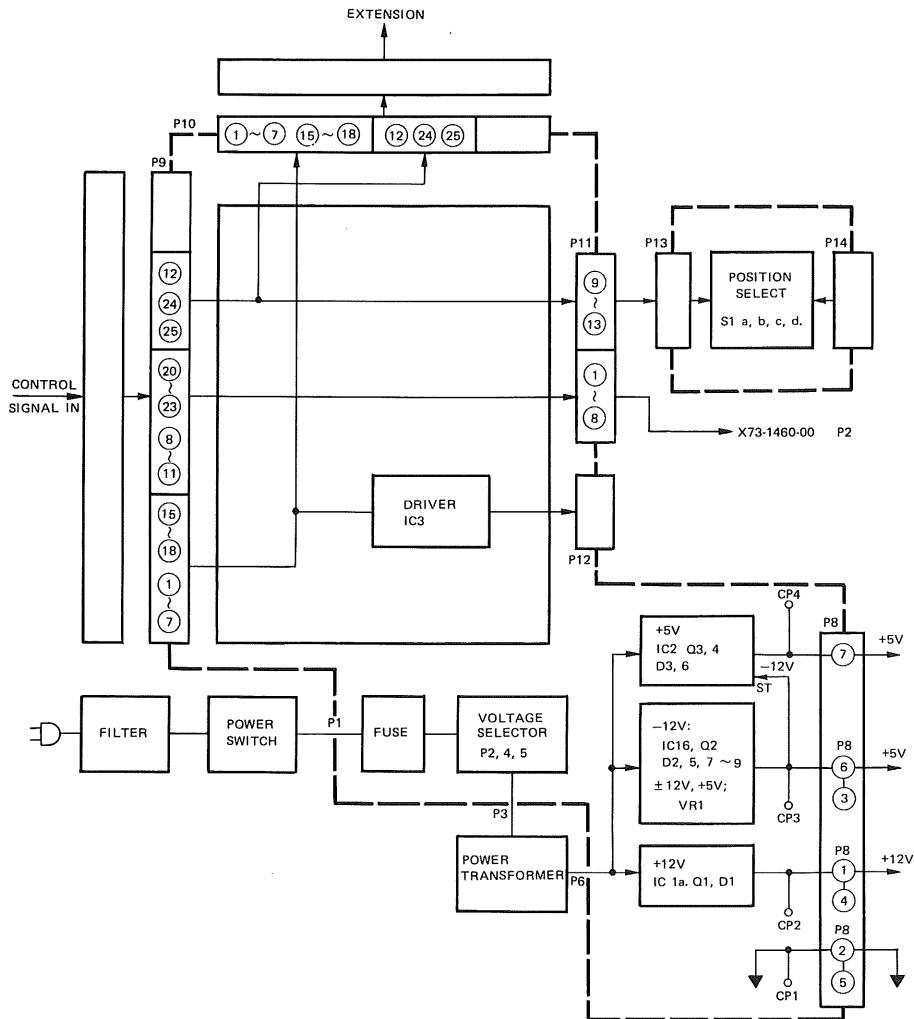


Fig. 22

CIRCUIT DESCRIPTION

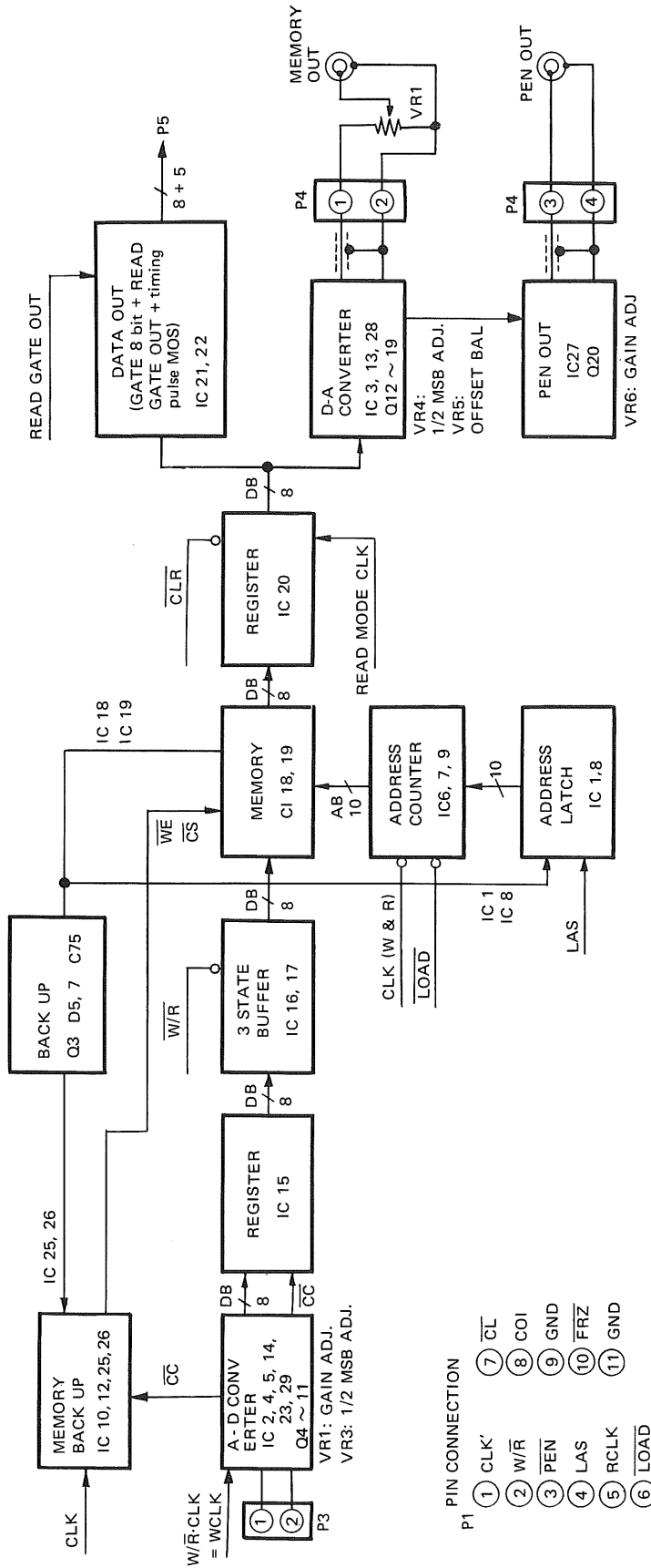


Fig. 23

CIRCUIT DESCRIPTION

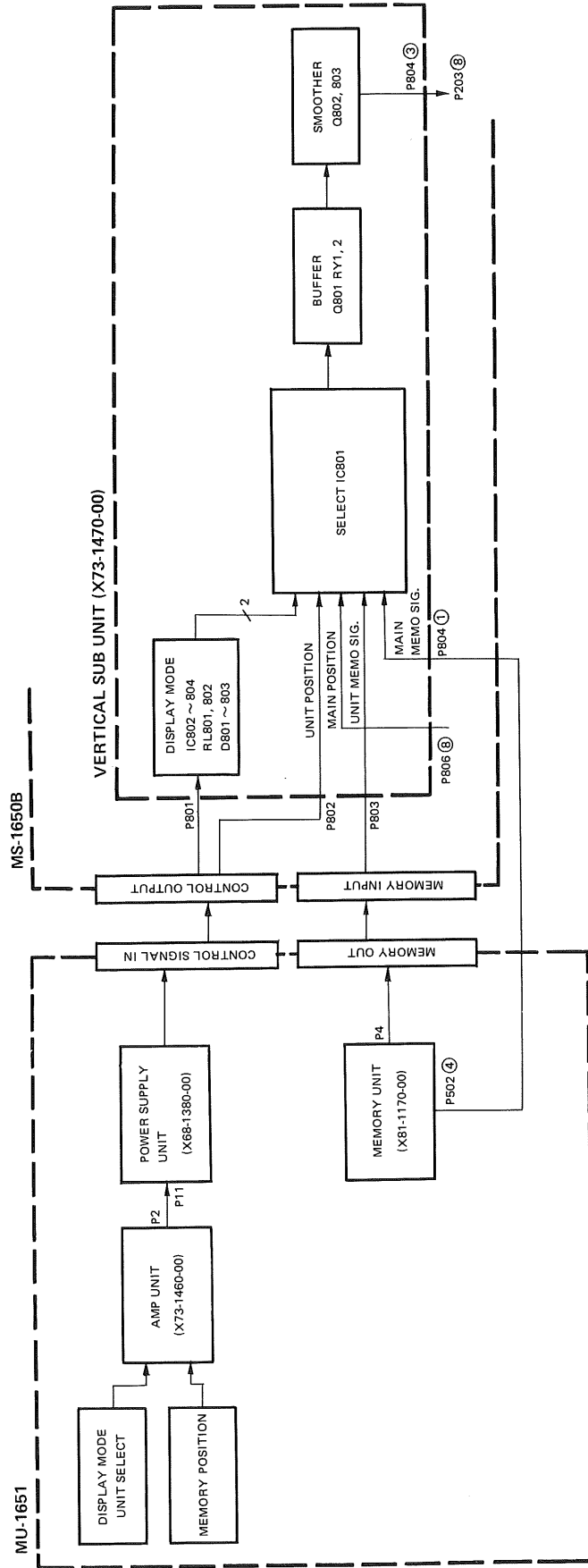


Fig. 24 Relation between MU-1651 and MS-1650B

ADJUSTMENT; MU-1651(T), and MU-1652(T)

The control setting listed below must be used for each adjustment procedure. Exceptions to these settings will be noted as they occur. After completing an adjustment, return the controls to the following settings.

MU-1651

Control Setting	
POWER	ON
AC-GND-DC	DC
VOLTS/DIV	5 mV/div
VARIABLE	CAL
REAL POSITION	12 o'clock position
MEMORY POSITION	12 o'clock position
PUSH FREEZE	PULL
UNIT SELECT	MAIN
DISPLAY MODE	SINGLE
TRIG COUPLING	DC
POSITION SET	1 (on Back panel)

MS – 1650B

Control setting	
POWER	ON
INTENSITY	3 o'clock position
FOCUS	Optimum position
VOLTS/DIV	1 V/div
V. VARIABLE	CAL
AC-GND-DC	DC
DISPLAY MODE	REAL
PULL FREE RUN	PUSH
V. POSITION	12 o'clock position
MEMORY POSITION	12 o'clock position
TRIG POINT(– DELAY)	0
CLOCK INT/EXT	INT
PEN/SCOPE	SCOPE
SWEEP TIME/DIV	1 ms/div
H.VARIABLE	CAL
H.POSITION	12 o'clock position
FINE	12 o'clock position
PULL × 5 MAG	PUSH
PEN SPEED	10 ms/word
TRIG SOURCE	INT
TRIG SLOPE	+
TRIG LEVEL	12 o'clock position
PULL AUTO	PULL

Adjustment of the power supply

1. Turn on power and make sure that the POWER LED lights.
2. Check the voltage at CP 2 and adjust VR 1 to read 12.0 V.
3. Check the voltage at CP 3 and CP 4 and make sure that you read -12 ± 0.3 V and $+5 \pm 0.2$ V respectively.

ADJUSTMENT OF THE AMP UNIT

Control setting
 REAL POSITION: 12 o'clock position
 AC-GND-DC: GND

DC OFFSET adjustment

1. Turn OFF (rear panel side)S 7 (X73-1460-00) and adjust voltage to 0 V at the pins given below.

Pin	Control adjustment	Voltage
①	VR 1 (coarse) VR 2 (vernier)	0 V \pm 0.2 mV
②	VR4	0 V \pm 2 mV
③	VR6	0 V \pm 10 mV
④	VR7	0 V \pm 10 mV
⑤	VR12	0 V \pm 10 mV
⑥	VR14	0 V \pm 10 mV

2. Turn ON (front panel side)S 7(X73-1460-00) and adjust voltage to 0 V at the pins given below.

Pin	Control adjustment	Voltage
④	VR9	0 V \pm 10 mV

Checking of STEP ATT BAL.

Control setting VOLTS/DIV; 1 V/div (MS-1650B)

1. Connect a BNC-BNC cable between MU-1651 TRIG OUT terminal and MS-1650B vertical input terminal and observe the real time trace.
2. Make sure that, when turned the VOLTS/DIV control, the trace does not move vertically.

Checking of VARI BAL.

Control setting VOLTS/DIV; 1 V/div (MS-1650B)

1. Connect a BNC-BNC cable between MU-1651 TRIG OUT terminal and MS-1650B vertical input terminal and observe the real time trace.
2. Make sure that, when turned the V.VARIABLE control, the trace does not move vertically.

ADJUSTMENT

Checking of AC-GND-DC switch

1. Connect a BNC-BNC cable between MU-1651 TRIG OUT terminal and MS-1650B vertical input terminal and observe the trace.
2. Apply a 1 kHz square wave signal to MU-1651 vertical input terminal and check that the waveform varies as shown below when switched the AC-GND-DC switch to from AC to DC.

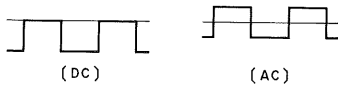


Fig. 25

3. The trace should not move more than 0.2div when operated the AC-GND-DC with no signal applied.

Waveform shaping

1. Observe the TRIG OUT signal with an oscilloscope.
2. Apply a 10 kHz square wave signal to MU-1651 INPUT terminal to display a waveform of 6 div vertical amplitude.
3. Make adjustment with trimmers listed below so that the waveform is the best when turned the VOLTS/DIV.

VOLTS/DIV setting	Adjustment control
50 mV	TC4
0.5 V	TC5
5 V	TC6

Input capacity adjustment

Control setting, VOLTS/DIV; 5 mV/div

1. Check that the input capacity is $32 \text{ pF} \pm 3 \text{ pF}$.
2. Make adjustment with trimmers listed below so that the input capacity do not vary when turned the VOLTS/DIV.

VOLTS/DIV setting	Adjustment control
50 mV	TC 1
0.5 V	TC 2
5 V	TC 3

GAIN adjustment

Control setting AC-GND-DC; AC

1. Apply a 1 kHz sine wave signal of full scale to INPUT terminal (VOLTS/DIV setting by 8 division) (see note).
2. Checking the voltage with DMM(digital multi meter). Make adjustment as given below.

Pin	VOLTAGE	Adj.control
⑤	1.06 Vrms (3 Vp-p)	VR 3
⑥	2.83 Vrms (8 Vp-p)	VR13

Note; Signals of full scale are as follows.

VOLTS/DIV	Voltage(p-p)	Voltage(rms)
5 mV	40 mVp-p	14.14 mVrms
20 mV	160 mVp-p	56.57 mVrms

OVER LEVEL LED adjustment

1. Apply a 1 kHz sine wave signal whose amplitude is 8.2 times of VOLTS/DIV setting (see note).
2. Turn VR11 until the “+” LED lights. Then turn VR11 reversely just until the LED goes out.
3. Make adjustment for the “-” LED in the same way with VR10.

Note;

VOLTS/DIV	Voltage(p-p)	Voltage(rms)
5 mV	41 mVp-p	14.50 mVrms
20 mV	164 mVp-p	57.98 mVrms

Adjustment of memory unit

A special jig is required to adjust the memory unit, (R/W (READ/WRITE) jig), and it is fitted up in the following sequence (see Fig. 26).

1. First turn off the set's POWER switch, and connect the R/W jig to P1 on the memory unit (disconnect connector P1 from the power supply).
2. Wire up P5 on the R/W jig to P5 on the memory unit.
3. Attach the clip of the R/W jig to pin 16 (5 V line) of IC 12 on the memory unit.
4. Disconnect connector P2 from the memory unit.
5. Cut out the 2 jumpers (in front of VR2 at the front right as seen from the front, and to the left of R54 on the left of the unit).

CAUTION:

1. When adjusting the memory unit, input the supply test voltage directly to P2 unless otherwise specified.
2. When adjusting the memory unit, use test point 3 (TP3) on the earth side for voltage measurements.
3. Before making adjustments, check that the 2 jumpers are out of circuit.

ADJUSTMENT

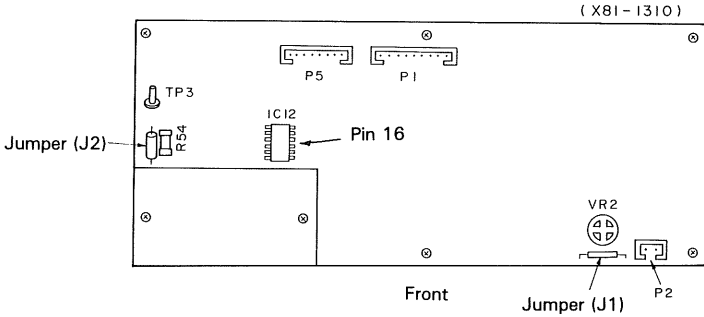
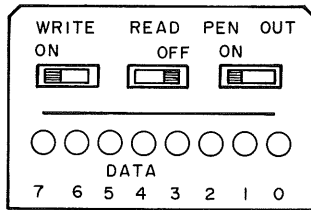


Fig. 26

- When adjusting the memory unit, adjust to a higher precision than the specification. The specification corresponds to the values obtained when carrying out a re-check after making adjustments. Take readings with a digital multimeter.

Set the R/W jig as follows:



Illumination is indicated by 1, and non-illumination by 0.

Fig. 27

D/A OUT full-scale adjustment (J₁, J₂ open)

Supply 5 V DC to connector P2 on the memory unit from a DC power supply (denoted hereafter as DC standard), and then measure the voltage at TP1. Check that the voltage at TP1 does not vary even if DC standard is greater than 5 V (i.e. TP1 is saturated).

If the latter does vary, make the voltage a saturating voltage by supplying more than 5 V.

Let the voltage at this time be E₂. Adjust VR4 such that E₂ satisfies the equation:

$$E_2 = (E_1 + 1.72) \pm 3 \text{ mV}$$

Specification	1.72 V ± 10 mV
---------------	----------------

D/A OUT offset adjustment (J₂ shorted)

Connect jumper J₂. By varying DC standard, apply a voltage to P2 within the range 1.6 V ± 0.5 V. Adjust the DC standard output voltage such that the LED of the R/W jig indicates 7F (7F shows, in 16-bit code, that the LED of the R/W jig is 01111111).

Then adjust VR5 such that the voltage at TP1 is 0 V ± 3 mV.

CAUTION:

If jumper J₂ is connected, the voltage at TP1 is halved.

Specification	0 V ± 10 mV
---------------	-------------

A/D OUT offset adjustment (J₁, J₂ shorted)

Connect jumper J₁. Adjust VR2 such that when P2 is shorted, the LED of the R/W jig indicates 7F.

A/D OUT full-scale adjustment (J₁, J₂ shorted)

Apply 1.6 V to P2 from DC standard. Adjust VR6 such that the voltage at TP2 is 0.8 V ± 3 mV.

Specification	0.8 V ± 10 mV
---------------	---------------

Checking A/D, D/A (J₁, J₂ shorted)

Check that, when the following voltages are input to P2, the voltages at TP1 are as given in the table below:

P2 input voltage	Voltage at TP1
0 V	0 V ± 10 mV
1.6 V	0.8 V ± 10 mV
-1.6 V	-0.8 V ± 10 mV

Checking DC offset on PEN OUT

Check that PEN OUT of the R/W jig in ON. Short P2 and measure voltage at TP2. Let the voltage at this time be E₄. Check that E₄ is within specification.

Specification	0 V ± 10 mV
---------------	-------------

PEN OUT full-scale adjustment

Input 1.72 V to P2 from DC standard, and measure voltage at TP2. Let voltage at this time be E₅. Adjust VR6 such that E₅ satisfies the relation:

$$E_5 = (E_4 + 0.86 \text{ V}) \pm 3 \text{ mV}$$

Specification	$E_5 = (E_4 + 0.86 \text{ V}) \pm 3 \text{ mV}$
---------------	---

Checking PEN OUT A/D, D/A

Check that, when the following voltages are input to P2 from DC standard, the voltages at TP2 are as given in the table below:

P2 input voltage	Voltage at TP2
0 V	0 V ± 10 mV
1.6 V	0.8 V ± 20 mV
-1.6 V	-0.8 V ± 20 mV

ADJUSTMENT

Linearity check on MEMORY OUT

Apply the voltages in the table below to P2 from DC standard, and check that the voltages at the PEN OUT and FOR SCOPE terminals on the rear of the set correspond to the following values:

P2 input voltage	PEN OUT terminal	FOR SCOPE terminal
Short	$0\text{ V} \pm 10\text{ mV}$	$0\text{ V} \pm 10\text{ mV}$
0.4 V	$0.2\text{ V} \pm 20\text{ mV}$	$0.2\text{ V} \pm 10\text{ mV}$
0.8 V	$0.4\text{ V} \pm 20\text{ mV}$	$0.4\text{ V} \pm 10\text{ mV}$
1.2 V	$0.6\text{ V} \pm 20\text{ mV}$	$0.6\text{ V} \pm 10\text{ mV}$
1.6 V	$0.8\text{ V} \pm 20\text{ mV}$	$0.8\text{ V} \pm 10\text{ mV}$
More than 2 V	Saturated at more than 0.86 V	Saturated at more than 0.86 V
-0.4 V	$-0.2\text{ V} \pm 20\text{ mV}$	$-0.2\text{ V} \pm 10\text{ mV}$
-0.8 V	$-0.4\text{ V} \pm 20\text{ mV}$	$-0.4\text{ V} \pm 10\text{ mV}$
-1.2 V	$-0.6\text{ V} \pm 20\text{ mV}$	$-0.6\text{ V} \pm 10\text{ mV}$
-1.6 V	$-0.8\text{ V} \pm 20\text{ mV}$	$-0.8\text{ V} \pm 10\text{ mV}$
More than -2 V	Saturated at more than -0.86 V	Saturated at more than -0.86 V

Checking MEMORY OUT

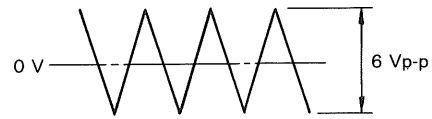
Set up a oscilloscope for monitor as follows:

AC-GND-DC→DC

VOLTS/DIV→0.2 V/DIV approx. (when using as a probe, set to the 20 mV range approx.)

SWEEP TIME/DIV →0.5 mS approx.

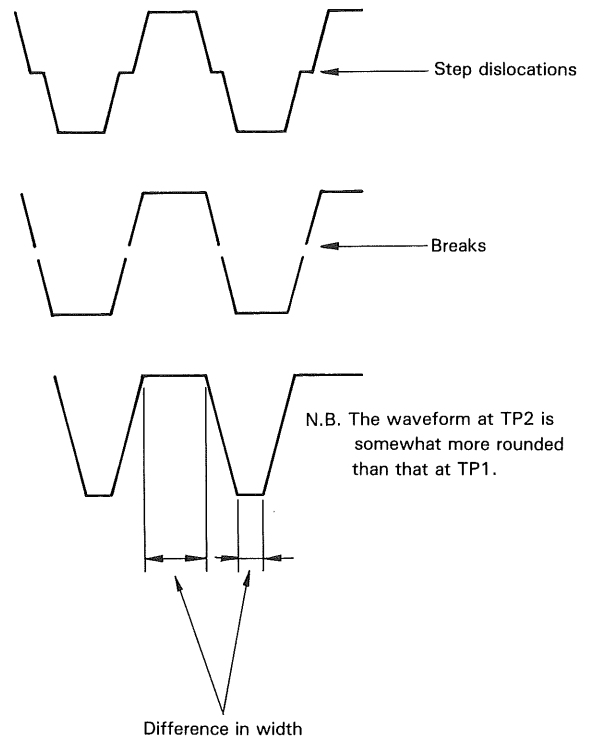
Input the following signal to P2 from the function generator.



Chopping wave of frequency approx. 1 kHz

Fig. 28

Observe the points TP1 and TP2 on the oscilloscope by means of a probe. Check the waveforms do not have any of the features shown below:



Note: The above are unsatisfactory, and constants, etc., must therefore be revised.

Fig. 29

ADJUSTMENT

Checking UNIT SELECT DISPLAY MODE

The 3 MU-1651 (-T) are first connected up, and the waveforms for MS-1650B and each unit are memorized.

• DISPLAY MODE→ SINGLE

Switch UNIT SELECT from MAIN through UNIT 3, and check the corresponding memorized waveforms are displayed in a single mode.

• DISPLAY MODE→MULTI 8 DIV UNIT SELECT→ QUAD

Check the memorized waveforms on MAIN, UNIT 1, UNIT 2 and UNIT 3 are displayed in quad-trace.

Check also that when DISPLAY MODE is set to 4 DIV and 2 DIV, the amplitudes of the corresponding waveforms are cut to 1/2 and 1/4 respectively.

• UNIT SELECT→ DUAL

Check that when UNIT SELECT is switched from UNIT 1 through UNIT 3, the waveforms for MAIN and UNIT 1, MAIN and UNIT 2, MAIN and UNIT 3 are displayed in dual-trace.

Checking POSITION SET

MU-1651

UNIT SELECT→QUAD, DISPLAY MODE→MULTI

MS-1650B

DISPLAY MODE→MEMORY

Set for quad-trace operation as described above. Switching through POSITION SET and operating MEMORY POSITION, check the unit behaves as follows:

POSITION SET→ALL

The positions of all waveforms, from UNIT 1 through UNIT 3, are controlled by turning the MEMORY POSITION.

POSITION SET→1

The position of the waveform for UNIT 1 is controlled.

POSITION SET→2

The position of the waveform for UNIT 2 is controlled.

POSITION SET→3

The position of the waveform for UNIT 3 is controlled.

Checking variable range of MEMORY POSITION

UNIT SELECT→ALL

Measures the voltage on pin 25 of connector P9 of the power unit (X68-1380). Check that when the MEMORY POSITION control is set as follows, the pin voltages are as given below:

Control

Full clockwise rotation.....more than - 1.5 V

Full counterclockwise rotation.....more than + 1.5 V

12 'o' clock position.....0 V±0.75 V

Checking PUSH FREEZE

MU-1651

AC-GND-DC→DC, PUSH FREEZE→PULL
UNIT SELECT→ UNIT 1, DISPLAY MODE→SINGLE

MS-1650B

DISPLAY MODE→REAL, PULL FREE RUN→PULL
DISPLAY TIME→MIN, TRIG SOURCE→EXT
PULL AUTO→AUTO

Input a suitable signal, and memorize the waveform in the FREE RUN mode above.

Then, FREEZE the unit by pushing the PUSH FREEZE button. Set AC-GND-DC to GND, and check that the memorized waveform has been retained.

Switch POWER SW to OFF, leave a certain time to elapse, and switch POWER SW to ON again. Check that the memorized waveform has been retained.

Checking AUTO FREEZE (MU-1652(T) only)

Set POSITION SET at rear to 3.

Pull the PULL FREERUN (PULL WRITE/READ) control of MS-1650B, set DISPLAY MODE to REAL, and set TRIG control to PULL (AUTO). Apply a suitable signal to the input terminals, and display it on the screen of MS-1650B.

By varying the PULL FREERUN control on MS-1650B, set DISPLAY TIME so that WRITE/READ operation is easily visible.

Observe WRITE/READ lamp of MS-1650B and FREEZE lamp on the unit. Check that when AUTO FREEZE is set to AUTO-RESET, WRITE/READ of MS-1650B flashes on and off 4 times, and the FREEZE lamp on the unit lights up green.

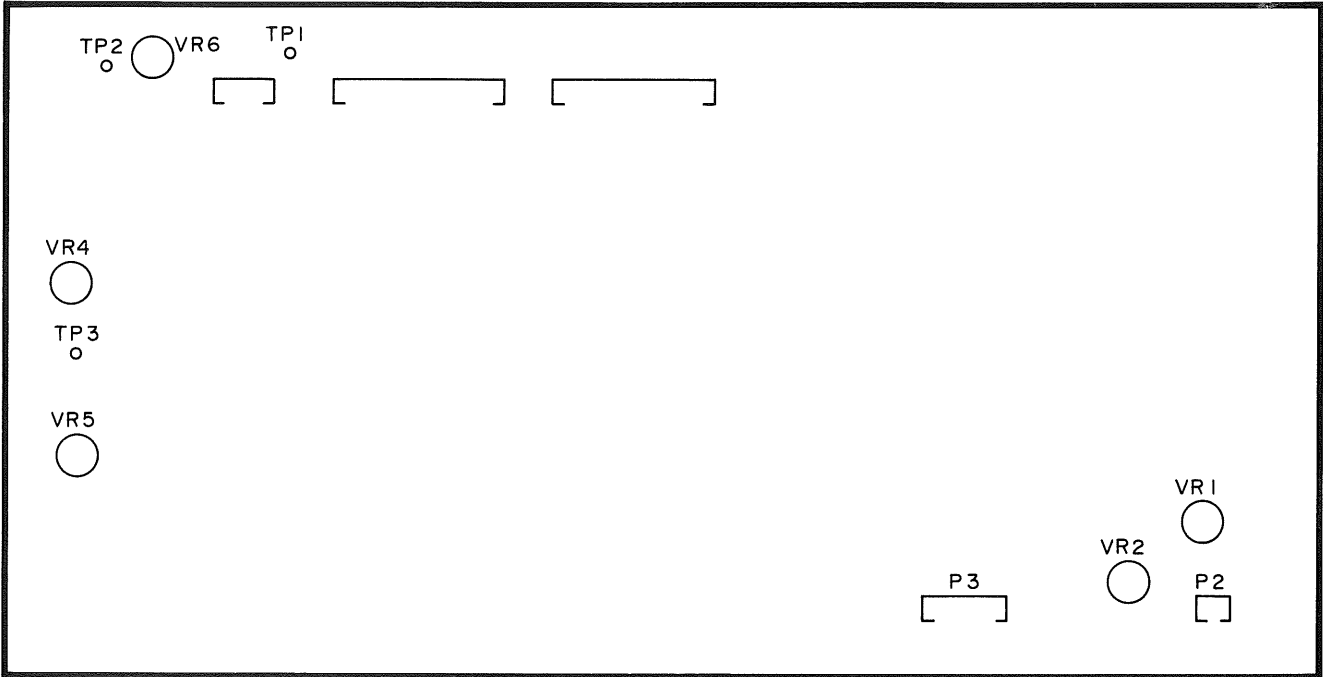
Note:

When toggle switch is set to upper position, AUTO FREEZE is "NORMAL" and has the same functions as MU-1651. When the switch is set to lower position, the unit is RESET, and the FREEZE condition is released. When MS-1650B is set to REAL, and DISPLAY TIME is set to PULL, the unit enters the WRITE condition, i.e. the trigger waiting condition.

When the no. of times for FREEZE is set with POSITION SET and the unit is RESET by the AUTO FREEZE switch, AUTO FREEZE can then be executed by setting MS-1650B to FREE RUN.

ADJUSTMENT

MEMORY UNIT (X-81-1310-00)



AMP UNIT (X73-1460-00)

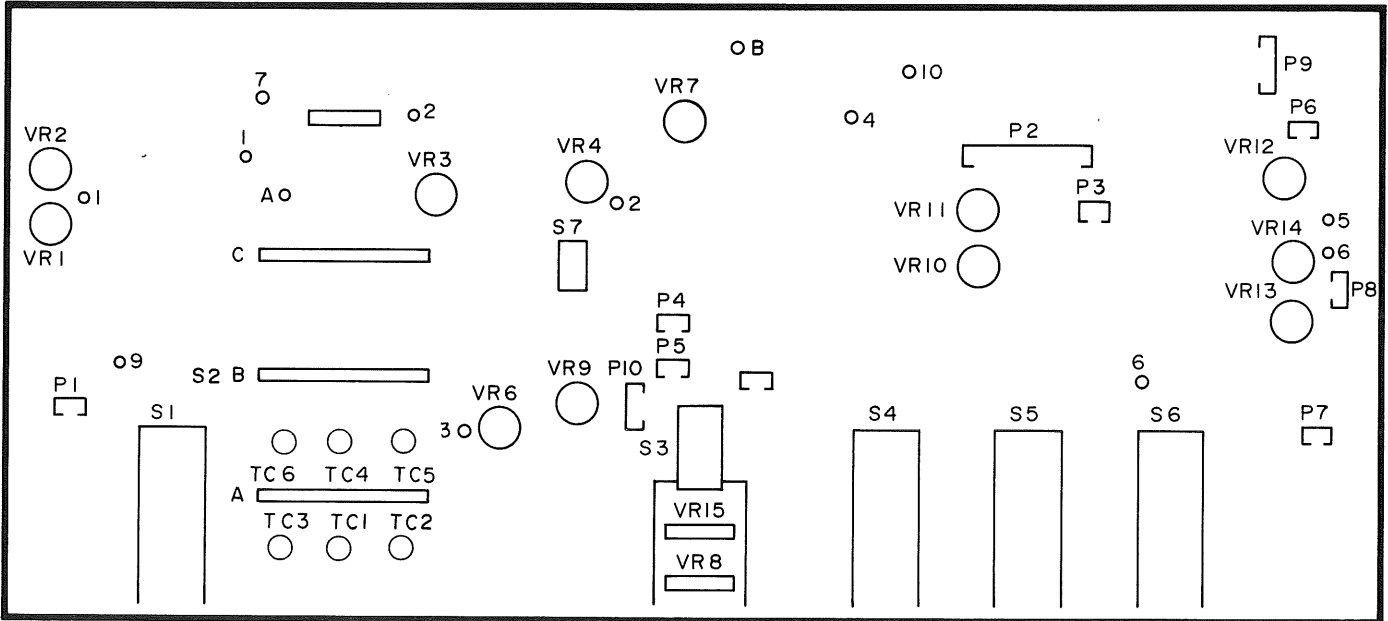


Fig. 30 Location of Adjustment Control

APPENDIX

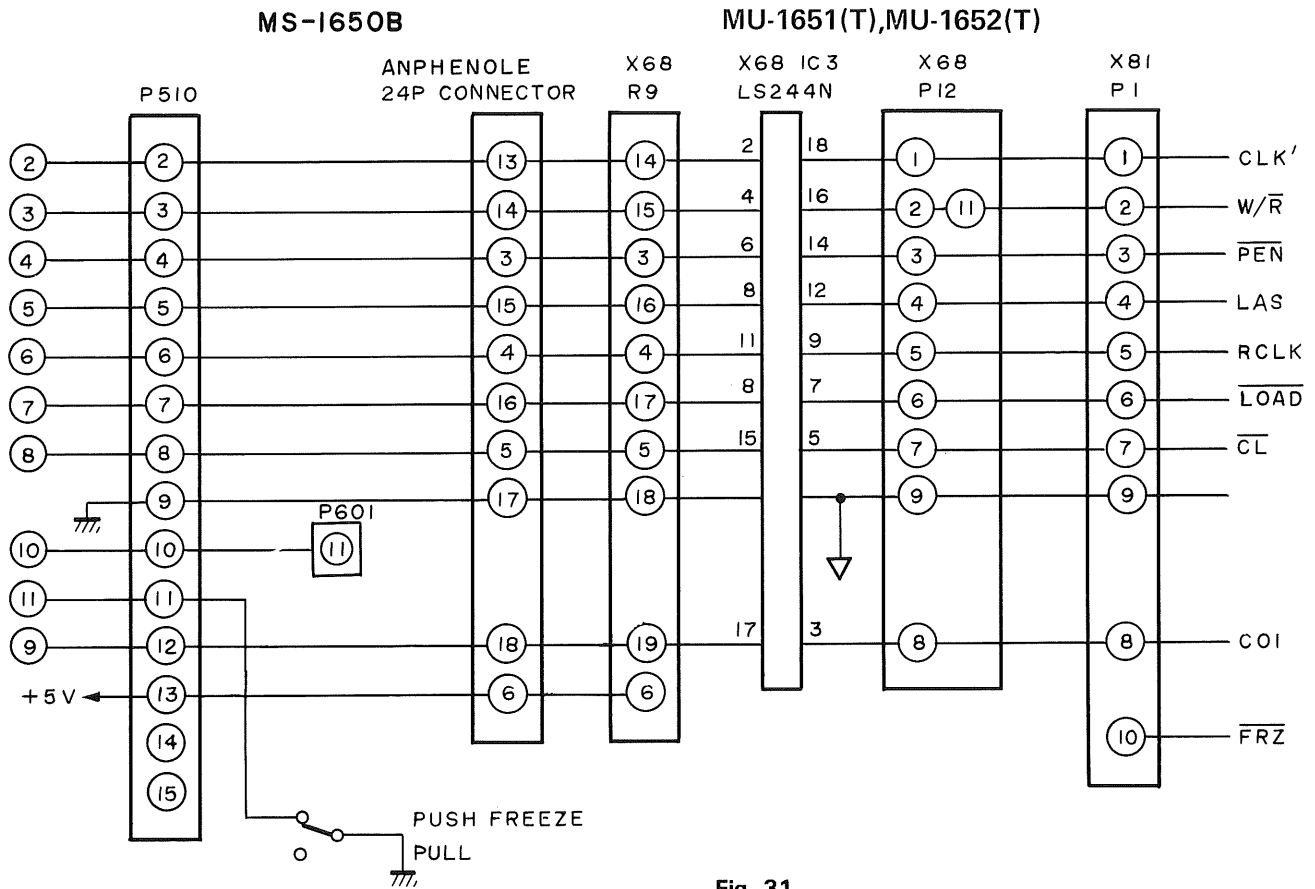


Fig. 31

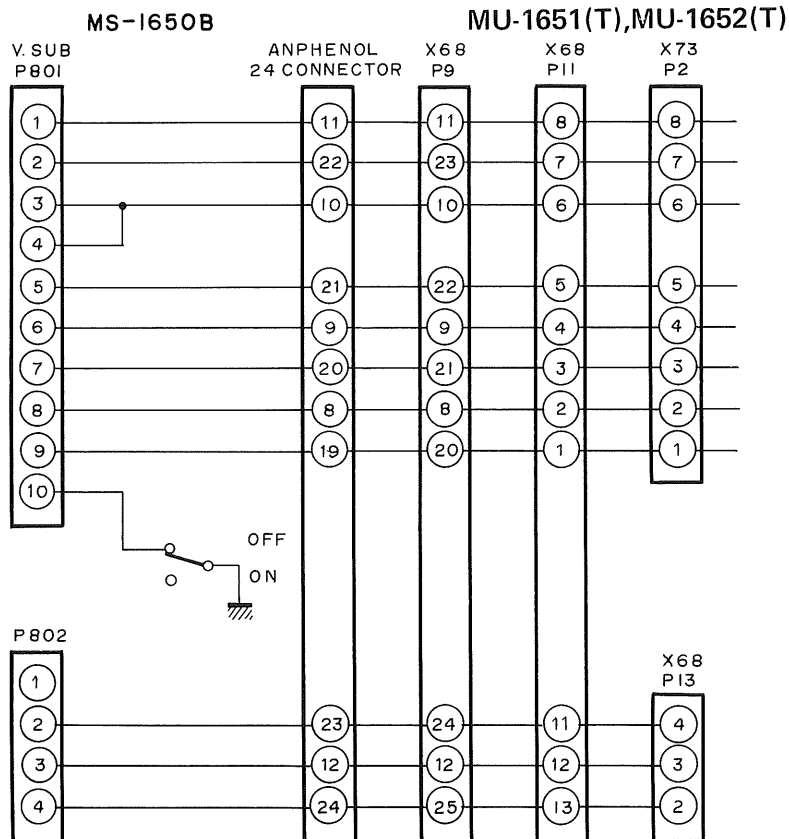


Fig. 32

APPENDIX

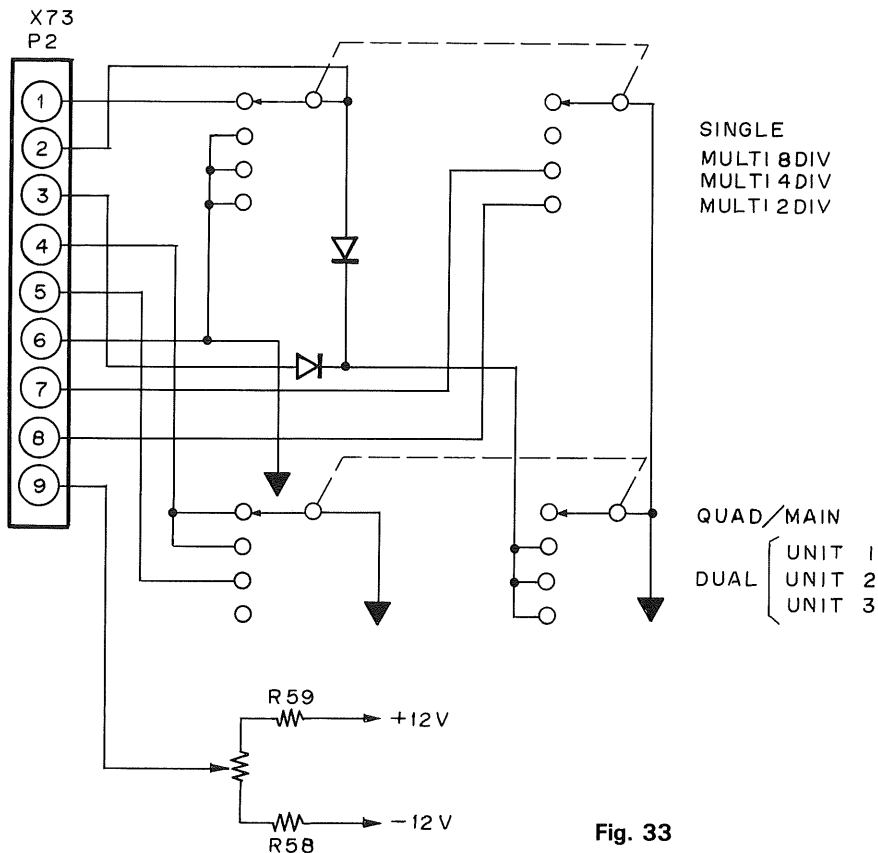


Fig. 33

Independent operation of the MU-1651(T), MU-1652(T)

The device shown below is helpful to check and adjust

WRITE/READ function of the memory unit when the MU-1651 is used independently.

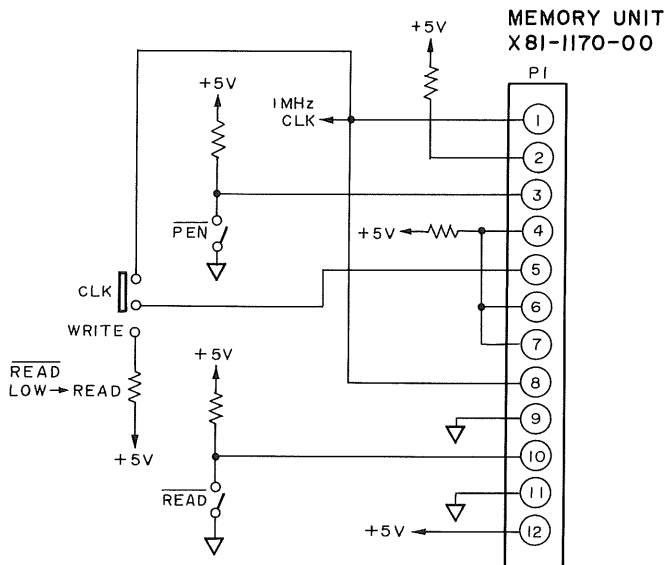


Fig. 34

Device for independent operation of the MU-1651

Switch

PEN;

When this switch is on, data coming from D/A develops at the PEN OUT terminal.

READ;

When this switch is on, data may be read from the memory. The WRITE

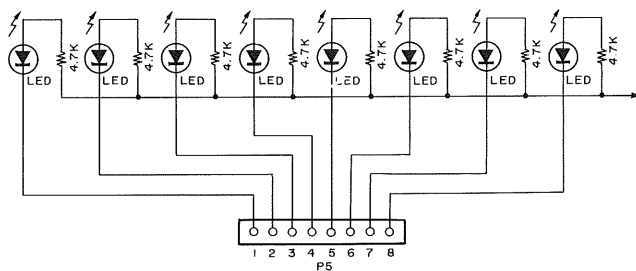


Fig. 35 MU-1651 Jig

CLK/WRITE;

switch below may also be used to enter READ mode.

When this switch is set at CLK, write to the memory becomes possible. At this time, the READ switch must be off. When this switch is set at WRITE, write data is output from D/A.

PARTS LIST; MS-1650B

CHASSIS ASSEMBLY (MS-1650B)

Fig. & Index No.	Parts No.	Description	Fig. & Index No.	Parts No.	Description
	A01-0895-08	Case		G02-0606-04	Spring (for handle)
1-1	A13-0761-08	Frame (R)	1-32	G13-0705-04	Rubber (for CRT)
1-2	A13-0762-08	Frame (L)	1-32	G13-0710-14	Rubber (for CRT band)
1-3	A23-1640-03	Rear panel	1-33	G13-0711-14	Rubber (for CRT band)
1-4	A20-2753-25	Die cast panel	1-34	G13-0712-14	Rubber (for lamp)
1-5	A21-1017-04	Decorative panel (1)		H01-2965-04	Carton box
1-6	A21-1013-04	Decorative panel (2)		H10-2812-12	Pad (formed styrene)
1-7	A21-0871-04	Decorative panel (3)		H12-0531-04	Pad (carton)
1-8	A22-0819-03	Sub panel (1)		H20-1713-14	Polyethylene bag
1-9	A22-0822-03	Sub panel (2)		J02-0507-05	Leg
1-10	B07-0122-04	Push escutcheon		J21-2906-05	Gear
1-11	B07-0706-04	Push escutcheon (rectangular form)		J21-2907-05	Ring
	B07-0710-02	Rear escutcheon		J21-2912-05	Holder (for LED)
1-12	B19-0721-03	Filter	1-35	J21-2956-04	Mounting hardware (for BNC)
1-13	B19-0710-04	Acryl (for light focus)	1-36	J21-2974-08	Mounting hardware (for electrolytic cap.)
	B20-0916-04	Graticule	1-37	J21-2975-08	Mounting hardware (for transformer)
1-14	B30-0920-05	Lamp (for graticule) DN1 ~ 4	1-38	J21-2976-08	Bracket (for push SW)
	B09-0011-04	Cap (rubber)		J29-0508-08	Retainer (for TR)
1-15	B40-2765-04	Serial number plate		J39-0516-08	Post (cyndrical)
	B41-0726-04	Voltage indication sheet		J39-0517-08	Post (cyndrical)
	B50-2979-00	Instruction manual (M)		J39-0518-08	Post (cyndrical)
1-16	D23-0061-04	Retainer		J39-0519-08	Post (cyndrical)
1-17	D22-0402-05	Coupling		J39-0514-08	Post (bakelite, cyndrical)
1-18	D21-0905-08	Extension shaft		J29-0509-08	Retainer plate (bakelite)
1-19	E01-1404-05	CRT socket		J39-0520-08	Post (bakelite, cyndrical)
1-20	E18-0351-05	Power connector		J59-0001-05	Gromet
1-21	E08-1081-05	Voltage selector (reseptacle)		J59-0002-05	Plunger
1-22	E09-0681-05	Voltage selector (plug)		J42-0521-08	Bushing
1-23	E21-0654-04	CAL terminal (TP1)		J61-0049-05	Cable band
	E21-0657-04	Metalic terminal (TP1, 2)		K01-0512-05	Handle
	E30-1818-05	Power cord (JIS)	1-66	K21-0293-14	Push knob
	E30-1819-05	Power cord (CEE)	1-39	K21-0819-03	Knob
	E30-1821-05	Power cord (SAA)	1-40	K21-0822-14	Knob
	E31-0781-05	Lead wire anphenole connector (14P)	1-41	K21-0825-04	Knob
	E04-0251-05	BNC receptacle	1-42	K21-0831-24	Knob
	E29-0526-08	Pin connector (plug) 3P	1-43	K21-0832-14	Knob
	E29-0527-08	Pin connector (receptacle) 3P	1-44	K21-0833-14	Knob
	E29-0528-08	Pin connector (plug) 2P	1-45	K27-0526-04	Lever knob (grey)
	E29-0529-08	Pin connector (receptacle) 2P	1-46	K27-0504-04	Knob (rectangular form, lightgrey)
	E29-0530-08	Pin connector (receptacle) 6P	1-47	K27-0505-00	Knob (rectangular form, lightblue)
	E29-0531-08	Pin connector (plug) 6P	1-48	L01-9286-08	Power transformer
	E29-0532-08	Pin connector (plug) 10P	1-49	L79-0504-08	Noise filter (FL-1)
	E29-0533-08	Pin connector (receptacle) 10P		L77-1002-05	Crystal 10MHz
	E22-0781-08	Lug terminal	1-50	L39-0517-08	Rotator coil
	E23-0523-08	Terminal	1-51	S31-2007-05	slide switch
	E08-2483-05	Lead wire/anphenole connector (24P)	1-52	S37-2005-05	Lever switch
	F01-0231-14	Heat sink	1-53	S32-2013-05	Lever switch
	F07-0908-14	Handle cover	1-54	S32-4007-05	Lever switch
1-25	F11-0950-02	CRT shield cover (1)	1-58	S02-1501-05	Rotary switch
1-26	F11-0954-04	CRT shield cover (2)	1-55	S42-3509-08	Key switch
1-27	F11-0960-04	CRT shield cover (3)	1-56	S29-1501-08	Thumb wheel switch
	F15-0701-04	Felt		W01-0503-04	Cord wrap
1-28	F15-0712-04	Reflector	1-57	O02-0006-05	Shield gaseket
1-29	F19-0703-04	Voltage selector plate	1-59		CRT E2713B31A
	F20-0637-04	Insulation sheet (for handle)	1-60	R23-9501-05	Variable res. 1kΩ/5kΩB
	F05-1521-05	Fuse 1.5 A	1-63	R01-8503-05	Variable res. with push SW 2MΩ
	F05-7011-05	Fuse 0.7 A	1-61	R19-9504-08	Variable res. 500Ω/10kΩB
	F10-1562-08	Shield cover (for push SW)	1-62	R19-9505-08	Variable res. 5kΩ/10kΩB
	F15-0726-08	Blind cover	1-64	R01-4507-08	Variable res. 50kΩ
	F07-0922-08	Shield cover (vertical amp. P.C.B.)	1-63	R05-8503-08	Variable res. 3MΩ
	F01-0834-08	Heat sink (for Tr)	1-65	R03-2504-08	Variable res. (with SW) 5kΩ
1-30	F02-0508-08	Fin	1-67	S01-2509-08	Rotary switch
1-31	F02-0509-08	Fin	1-69	R03-8503-05	Variable res. 2MΩ
	F10-1563-08	Shield cover	1-68	S01-3503-08	Rotary switch
			R1	RW98A3H201J	Winding res. 200Ω ±5% 5W

PARTS LIST ; MS-1650B

Ref. No.	Parts No.	Description
R2	RC05GF3A185K	Carbon res. 1.8MΩ ± 10% 1W
C1	CE02W2V470M	Electrolytic cap. 47μF 350W
C2	CK45E3D103P	Ceramic cap. 1000pF ± 10% 2kV
C3	C91-0566-05	Gold cap. 1F 5.5V
D1, 2		LED AR4133S
D3		LED PG4133SX
D4		LED AR4133S
D5		Doide rectified S2VB20
Q1		IC REG FS7812M
Q2		IC REG FS7912M
Q3		Transistor 2SD288
Q4		Transistor 2SB630

Ref. No.	Parts No.	Name & Description
R258	RN14BK2E1002F	Metal film res. 10kΩ ± 1% 1/4W
R259	RN14BK2E5101F	Metal film res. 5.1kΩ ± 1% 1/4W
R260	RN14BK2E1002F	Metal film res. 10kΩ ± 1% 1/4W
R261,262	RD14BB2E222J	Carbon res. 2.2kΩ
R263,264	RD14BB2E472J	Carbon res. 4.7kΩ
R265,266	RN14BK2E3001F	Metal film res. 3kΩ ± 1% 1/4W
R267	RN14BK2E2202F	Metal film res. 22kΩ ± 1% 1/4W
R268	RD14BB2E470J	Carbon res. 47Ω
R269		No use
R270	RD14BB2E223J	Carbon res. 22kΩ
R271	RD14BB2E222J	Carbon res. 2.2kΩ
R272,273	RD14BB2E682J	Carbon res. 6.8kΩ
R274	RD14BB2E471J	Carbon res. 470Ω
R275,276	RN14BK2E3001F	Metal film res. 3kΩ ± 1% 1/4W
R277,278	RN14BK2E6800F	Metal film res. 680Ω ± 1% 1/4W
R279 ~ 282	RD14BB2E470J	Carbon res. 47Ω
R283,284	RD14BB2E102J	Carbon res. 1kΩ
R285	RD14BB2E472J	Carbon res. 4.7kΩ
R286	RD14BB2E103J	Carbon res. 10kΩ
R287	RD14BB2E223J	Carbon res. 22kΩ
R288	RD14BB2E470J	Carbon res. 47Ω
R289 ~ 292	RD14BB2E562J	Carbon res. 5.6kΩ
R293	RD14BB2E470J	Carbon res. 47Ω
R294	RD14BB2E102J	Carbon res. 1kΩ
R295	RD14BB2E472J	Carbon res. 4.7kΩ
R296	RD14BB2E102J	Carbon res. 1kΩ
R297 ~ 300	RD14BB2E470J	Carbon res. 47Ω
R301	RD14BB2E332J	Carbon res. 3.3kΩ
R302	RD14BB2E474J	Carbon res. 470kΩ
R303	RD14BB2E332J	Carbon res. 3.3kΩ
R304,305	RD14BB2E102J	Carbon res. 1kΩ
R306,307	RD14BB2E222J	Carbon res. 2.2kΩ
R308	RD14BB2E471J	Carbon res. 470Ω
R309,310	RD14BB2E470J	Carbon res. 47Ω
R311,312	RD14BB2E472J	Carbon res. 4.7kΩ
R313,314	RD14BB2E333J	Carbon res. 33kΩ
R315	RD14BB2E331J	Carbon res. 330Ω
R316	RD14BB2E822J	Carbon res. 8.2kΩ
R317	RD14BB2E331J	Carbon res. 330Ω
R318,319	RD14BB2E101J	Carbon res. 100Ω
R320	RD14BB2E104J	Carbon res. 100kΩ
R321	RD14BB2H683J	Carbon res. 68kΩ ± 5% 1/2W
R322	RD14BB2E104J	Carbon res. 100kΩ
R323,324	RD14BB2E101J	Carbon res. 100Ω
R325	RD14BB2E331J	Carbon res. 330Ω
R326	RD14BB2E101J	Carbon res. 100Ω
R327	RD14BB2E223J	Carbon res. 22kΩ
R328,329	RD14BB2E103J	Carbon res. 10kΩ
R330	RD14BB2E101J	Carbon res. 100Ω
R331	RD14BB2E223J	Carbon res. 22kΩ
VR201	R12-1002-05	Semifixed res. 1kΩB
VR202	R02-2508-05	Semifixed res. 5kΩB
VR203	R12-0401-05	Semifixed res. 100ΩB
VR204	R12-3002-05	Semifixed res. 10kΩB
VR205,206	R12-0505-05	Semifixed res. 200ΩB
VR207	R12-1002-05	Semifixed res. 1kΩB
VR208	R12-4503-05	Semifixed res. 50kΩB
C201	C91-0561-08	Ceramic cap. 0.1μF 600V
C202	CC45CH2H470J	Ceramic cap. 47pF ± 5% 500V
C203	CK45B2H471J	Ceramic cap. 470pF ± 5% 500V
C204	CC45CH2H050D	Ceramic cap. 5pF ± 0.5pF 500V
C205	CK45B2H332K	Ceramic cap. 3300pF ± 10% 500V
C206	C90-0261-05	Ceramic cap. 0.047μF 25V

VERTICAL AMPLIFIER UNIT (X73-1370-02)

Unless otherwise specified, all resistors are ± 5%, 1/8W.

Ref. No.	Parts No.	Name & Description
R201,202	RD14BB2E470J	Carbon res. 47Ω
R203	RN14BK2H9003F	Metal film res. 900kΩ ± 1% 1/2W
R204	RN14BK2E1113F	Metal film res. 111kΩ ± 1% 1/4W
R205	RN14BK2H9903F	Metal film res. 990kΩ ± 1% 1/2W
R206	RN14BK2E1012F	Metal film res. 10.1kΩ ± 1% 1/4W
R207	RN14BK2H9993F	Metal film res. 999kΩ ± 1% 1/2W
R208	RN14BK2E1001F	Metal film res. 1kΩ ± 1% 1/4W
R209	RN14BK2E1004F	Metal film res. 1MΩ ± 1% 1/4W
R210	RD14BB2E104J	Carbon res. 100kΩ
R211,212	RD14BB2E101J	Carbon res. 100Ω
R213,214	RN14BK2E4991F	Metal film res. 4.99kΩ ± 1% 1/4W
R215	RD14BB2E101J	Carbon res. 100Ω
R216	RD14BB2E102J	Carbon res. 1kΩ
R217,218	RD14BB2E153J	Carbon res. 15kΩ
R219 ~ 221	RD14BB2E101J	Carbon res. 100Ω
R222,223	RN14BK2E4301F	Metal film res. 4.3kΩ ± 1% 1/4W
R224	RN14BK2E7410F	Metal film res. 741Ω ± 1% 1/4W
R225	RN14BK2E3830F	Metal film res. 383Ω ± 1% 1/4W
R226	RD14BB2E4R7J	Carbon res. 4.7Ω
R227	RN14BK2E1050F	Metal film res. 105Ω ± 1% 1/4W
R228	RD14BB2E100J	Carbon res. 10Ω
R229	RD14BB2E181J	Carbon res. 180Ω
R230	RN14BK2E1820F	Metal film res. 182Ω ± 1% 1/4W
R231	RD14BB2E100J	Carbon res. 10Ω
R232	RN14BK2E1820F	Metal film res. 182Ω ± 1% 1/4W
R233	RD14BB2E152J	Carbon res. 1.5kΩ
R234,235	RD14BB2E470J	Carbon res. 47Ω
R236	RN14BK2E6800F	Metal film res. 680Ω ± 1% 1/4W
R237	RD14BB2E471J	Carbon res. 470Ω
R238	RN14BK2E6800F	Metal film res. 680Ω ± 1% 1/4W
R239,240	RD14BB2E682J	Carbon res. 6.8kΩ
R241,242	RD14BB2E470J	Carbon res. 47Ω
R243	RD14BB2E222J	Carbon res. 2.2kΩ
R244	RD14BB2E101J	Carbon res. 100Ω
R245	RD14BB2E331J	Carbon res. 330Ω
R246,247	RD14BB2E472J	Carbon res. 4.7kΩ
R248	RD14BB2E101J	Carbon res. 100Ω
R249	RD14BB2E222J	Carbon res. 2.2kΩ
R250,251	RD14BB2E102J	Carbon res. 1kΩ
R252 ~ 255	RD14BB2E472J	Carbon res. 4.7kΩ
R256	RD14BB2E470J	Carbon res. 47Ω
R257	RN14BK2E5101F	Metal film res. 5.1kΩ ± 1% 1/4W

PARTS LIST; MS-1650B

Ref. No.	Parts No.	Name & Description	Ref. No.	Parts No.	Name & Description
C207,208	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	C268	CK45B2H332K	Ceramic cap. 3300pF \pm 10% 500V
C209	CE04W1A470M	Electrolytic cap. 47 μ F 10V	C269	CK45B1H471K	Ceramic cap. 470pF \pm 10%
C210	C90-0261-05	Ceramic cap. 0.047 μ F 25V	C270	CK45B2H332K	Ceramic cap. 3300pF \pm 10% 500V
C211,212	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	C271	CK45B1H471K	Ceramic cap. 470pF \pm 10%
C213	CE04W1A470M	Electrolytic cap. 47 μ F 10V	C272	CK45B2H103P	Ceramic cap. 0.01 μ F \pm 100% -10% 500V
C214	CK45B2J332K	Ceramic cap. 3300pF \pm 10% 630V	C273	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C215	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	C274	CE04W1A470M	Electrolytic cap. 47 μ F 10V
C216	CC45CH1H100D	Ceramic cap. 10pF \pm 0.5pF	C275	CE04W2E330M	Electrolytic cap. 33 μ F 250V
C217	CC45SL1H330J	Ceramic cap. 33pF \pm 5%	C276	CK45B2H103P	Ceramic cap. 0.01 μ F \pm 100% -0% 500V
C218	CE04W1A101M	Electrolytic cap. 100 μ F 10V	C277,278	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C219,220	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	C279	C90-0261-05	Ceramic cap. 0.047 μ F 25V
C221	CC45SL1H560J	Ceramic cap. 56pF \pm 5%	C280,281	CK45B1H102K	Ceramic cap. 1000pF \pm 10%
C222	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	C282,283	C90-0261-05	Ceramic cap. 0.047 μ F 25V
C223	CE04W1C470M	Electrolytic cap. 47 μ F 16V	C284	CK45B1H221K	Ceramic cap. 220pF \pm 10%
C224	C90-0261-05	Ceramic cap. 0.047 μ F 25V	TC201	C05-0404-05	Ceramic trimmer 10pF
C225	CE04W1C470M	Electrolytic cap. 47 μ F 16V	TC202	C05-0403-05	Ceramic trimmer 6pF
C226	CC45CH1H050D	Ceramic cap. 5pF \pm 0.5pF	TC203	C05-0404-05	Ceramic trimmer 10pF
C227,228	CE04W1C470M	Electrolytic cap. 47 μ F 16V	TC204	C05-0403-05	Ceramic trimmer 6pF
C229	C90-0261-05	Ceramic cap. 0.047 μ F 25V	TC205	C05-0404-05	Ceramic trimmer 10pF
C230	CC45SL1H330J	Ceramic cap. 33pF \pm 5%	TC206	C05-0403-05	Ceramic trimmer 6pF
C231	CK45B1H103K	Ceramic cap. 0.01 μ F \pm 10%	TC207	C05-0404-05	Ceramic trimmer 10pF
C232	CE04W1C470M	Electrolytic cap. 47 μ F 16V	IC201		FET DUAL 2SK228-1-2or-1-3
C233	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC202		IC OP AMP μ PC159A
C234	CE04W1C470M	Electrolytic cap. 47 μ F 16V	IC203		IC TTL SN7472
C235	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC204		IC DUAL μ PA15
C236	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC205,206		Transistor array, DUAL AN904
C237	CK45B1H221K	Ceramic cap. 220pF \pm 10%	IC207		IC TTL SN7400
C238,239	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	Q201		Transistor 2SC1815
C240	CE04W1A470M	Electrolytic cap. 47 μ F 10V	Q202		Transistor 2SA1015
C241,242	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	Q203		FET 2SK30(0)
C243	CE04W1C470M	Electrolytic cap. 47 μ F 16V	Q204,205		Transistor 2SC1815
C244	C90-0262-05	Ceramic cap. 0.047 μ F 25V	Q206,207		Transistor 2SC1215
C245	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	Q208,209		Transistor 2SC1815
C246	CC45CH1H220J	Ceramic cap. 22pF \pm 5%	Q210,211		Transistor 2SC1015
C247	CC45SL1H221J	Ceramic cap. 220pF \pm 5%	Q212 ~ 219		Transistor 2SC1815
C248	CE04W1C470M	Electrolytic cap. 47 μ F 16V	Q220,221		Transistor 2SC1215
C249	C90-0261-05	Ceramic cap. 0.047 μ F 25V	Q222,223		Transistor 2SC1628
C250	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	Q224,225		Transistor 2SA818
C251	CE04W1A470M	Electrolytic cap. 47 μ F 10V	Q226,227		Transistor 2SC1815
C252	CE04W1C470M	Electrolytic ceramic cap. 47 μ F 16V	D201,202		Diode RD6, 8E
C253	C90-0261-05	Ceramic cap. 0.047 μ F 25V	D203		Diode 1S953
C254	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	D204,205		Diode RD6, 8E
C255	CE04W1A470M	Electrolytic cap. 47 μ F 10V	D206 ~ 208		Diode 1N34
C256	No use		D209,210		Diode 1S953
C257	CC45SL1H221J	Ceramic cap. 220pF \pm 5%	D211		Diode RD10E
C258	CE04W1C470M	Electrolytic cap. 47 μ F 16V	D212,213		Diode 1N34
C259,260	C90-0261-05	Ceramic cap. 0.047 μ F 25V	D214,215		Diode 1S953
C261	CC45CH1H130J	Ceramic cap. 13pF \pm 5%	L201 ~ 204	L40-4701-03	Ferri inductor 47 μ H
C262	CK45F1H103Z	Ceramic cap. 0.01 μ F \pm 80% -20%	L205,206	L40-6801-03	Ferri inductor 68 μ H
C263,264	CC45CH1H010C	Ceramic cap. 1pF \pm 0.25pF	P210,202	E40-1064-05	Pin connector 10P
C265	CK45E2H103P	Ceramic cap. 0.01 μ F \pm 100% -0% 500V	P203	E40-7001-08	Pin plug 10P
C266,267	CC45CH1H010C	Ceramic cap. 1pF \pm 0.25pF	P204,205	E23-0503-05	Pin connector 1P

PARTS LIST; MS-1650B

VERTICAL SUB UNIT (X73-1470-00)

Unless otherwise specified, all resistors are $\pm 5\%$, 1/8W.

Ref. No	Parts No.	Name & Description
R801 ~ 810	RD14BB2E103J	Carbon res. 10k Ω
R811 ~ 815	RD14BB2E101J	Carbon res. 100 Ω
R816	RN14BK2E3002F	Metal film res. 30k Ω $\pm 1\%$ 1/4W
R817,818	RN14BK2E1502F	Metal film res. 15k Ω $\pm 1\%$ 1/4W
R819,820	RD14BB2E103J	Carbon res. 10k Ω
R821	RD14BB2E102J	Carbon res. 1k Ω
R822	RD14BB2E223J	Carbon res. 22k Ω
R823	RD14BB2E103J	Carbon res. 10k Ω
R824	RD14BB2E392J	Carbon res. 3.9k Ω
R825	RD14BB2E102J	Carbon res. 1k Ω
C801,802	CK45B1H103K	Ceramic cap. 0.01 μ F $\pm 10\%$
C803 ~ 805	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C806	CK45B1H103K	Ceramic cap. 0.01 μ F $\pm 10\%$
C807	CC45CH1H471J	Ceramic cap. 470pF $\pm 5\%$
C808	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C809	CC45CH1H101J	Ceramic cap. 100pF $\pm 5\%$
C810	CC45SL1H220J	Ceramic cap. 22pF $\pm 5\%$
C811	CK45B1H103K	Ceramic cap. 0.01 μ F $\pm 10\%$
C812 ~ 815	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
RL801,802	S51-1510-05	Reed relay
IC801		IC CMOS TC4052BP
IC802		IC TTL SN74LS03
IC803		IC TTL SN74LS112
IC804		IC M54603
Q801		FET DUAL 2SK228T
Q802,803		Transistor 2SC945P
D801 ~ 809		Diode 1S953
P801	E40-1064-05	Pin connector 10P
P802	E40-0464-05	Pin connector 4P
P803,804	E40-0364-05	Pin connector 3P
P805	E40-1264-05	Pin connector 12P
P806	E40-1064-05	Pin connector 10P

HORIZONTAL SWEEP UNIT (X74-1240-02)

Unless otherwise specified, all resistors are $\pm 5\%$, 1/8W.

Ref. No	Parts No.	Name & Description
R401	RD14BB2E101J	Carbon res. 100 Ω
R402	RD14BB2E222J	Carbon res. 2.2k Ω
R403	RD14BB2E104J	Carbon res. 100k Ω
R404	RD14BB2E154J	Carbon res. 150k Ω
R405	RD14BB2E153J	Carbon res. 15k Ω
R406	RD14BB2E511J	Carbon res. 510 Ω
R407	RD14BB2E103J	Carbon res. 10k Ω
R408	RD14BB2E101J	Carbon res. 100 Ω
R409	RD14BB2E682J	Carbon res. 6.8k Ω
R410	RD14BB2E333J	Carbon res. 33k Ω
R411	RD14BB2E332J	Carbon res. 3.3k Ω
R412	RD14BB2E152J	Carbon res. 1.5k Ω
R413,414	RD14BB2E332J	Carbon res. 3.3k Ω
R415	RD14BB2E822J	Carbon res. 8.2k Ω
R416,417	RN14BK2E1003F	Metal film res. 100k Ω $\pm 1\%$ 1/4W
R418	RD14BB2E122J	Carbon res. 1.2k Ω
R419	RN14BK2E1503F	Metal film res. 150k Ω $\pm 1\%$ 1/4W
R420	RN14BK2E2493F	Metal film res. 249k Ω $\pm 1\%$ 1/4W

Ref. No	Parts No.	Name & Description
R421	RN14BK2E4993F	Metal film res. 499k Ω $\pm 1\%$ 1/4W
R422	R92-1015-08	Carbon res. 1.5M Ω $\pm 1\%$ 1/8W
R423	R92-1016-08	Carbon res. 2.5M Ω $\pm 1\%$ 1/8W
R424	RD14BB2E391J	Carbon res. 390 Ω
R425	RD14BB2E471J	Carbon res. 470 Ω
R426	RD14BB2E682J	Carbon res. 6.8k Ω
R427	RD14BB2E103J	Carbon res. 10k Ω
R428	RD14BB2E152J	Carbon res. 1.5k Ω
R429	RD14BB2E223J	Carbon res. 22k Ω
R430	RD14BB2E152J	Carbon res. 1.5k Ω
R431	RD14BB2E223J	Carbon res. 22k Ω
R432 ~ 434	RD14BB2E104J	Carbon res. 100k Ω
R435	RD14BB2E511J	Carbon res. 510 Ω
R436	RD14BB2E103J	Carbon res. 10k Ω
R437	RD14BB2E683J	Carbon res. 68k Ω
R438	RD14BB2E103J	Carbon res. 10k Ω
R439	RD14BB2E222J	Carbon res. 2.2k Ω
R440	RD14BB2E472J	Carbon res. 4.7k Ω
R441,442	RD14BB2E182J	Carbon res. 1.8k Ω
R443	RD14BB2E221J	Carbon res. 220 Ω
R444,445	RD14BB2E152J	Carbon res. 1.5k Ω
R446	RD14BB2E332J	Carbon res. 3.3k Ω
R447	RD14BB2E682J	Carbon res. 6.8k Ω
R448	RD14BB2E183J	Carbon res. 18k Ω
R449	RD14BB2E123J	Carbon res. 12k Ω
R450		No use
R451	RD14BB2E103J	Carbon res. 10k Ω
R452	RD14BB2E223J	Carbon res. 22k Ω
R453	RS14AB1A823J	Metal oxide film res. 82k Ω $\pm 5\%$ 1W
R454,455	RD14BB2E223J	Carbon res. 22k Ω
R456	RD14BB2E153J	Carbon res. 15k Ω
R457	RD14BB2E103J	Carbon res. 10k Ω
R458	RD14BB2E222J	Carbon res. 2.2k Ω
R459 ~ 461	RD14BB2E103J	Carbon res. 10k Ω
R462	RD14BB2E272J	Carbon res. 2.7k Ω
R463	RD14BB2E473J	Carbon res. 47k Ω
R464	RD14BB2E471J	Carbon res. 470 Ω
R465	RD14BB2E472J	Carbon res. 4.7k Ω
R466	RD14BB2E682J	Carbon res. 6.8k Ω
R467,468	RD14BB2E472J	Carbon res. 4.7k Ω
R469	R92-1017-08	Carbon res. 13k Ω 7W
R470	RD14BB2E331J	Carbon res. 330 Ω
R471	R92-1017-08	Carbon res. 13k Ω 7W
R472	RD14BB2E470J	Carbon res. 47 Ω
R473	RD14BB2E822J	Carbon res. 8.2k Ω
R474	RD14BB2E392J	Carbon res. 3.9k Ω
R475,476	RD14BB2E821J	Carbon res. 820 Ω
R477-479	RD14BB2E472J	Carbon res. 4.7k Ω
R480	RD14BB2E471J	Carbon res. 470 Ω
R481	RD14BB2E151J	Carbon res. 150 Ω
VR401	R12-1002-05	Semifixed res. 1k Ω B
VR402,403	R19-9506-08	Semifixed res. A = 3k, B = 100k Ω B
VR404	R12-0555-05	Semifixed res. 500 Ω B
VR405	R12-1003-05	Semifixed res. 2.2k Ω B
VR406	R12-2502-05	Semifixed res. 5k Ω B
VR407	R12-1002-05	Semifixed res. 1k Ω B
VR408	R12-0505-05	Semifixed res. 200 Ω B
VR409	R12-0555-05	Semifixed res. 500 Ω B
VR410	R12-1002-05	Semifixed res. 1k Ω B
C401,402	CE04W1H010M	Electrolytic cap. 1 μ F 50V
C403	CC45SL1H050C	Ceramic cap. 5pF ± 0.25 pF
C404	C90-0261-05	Ceramic cap. 0.047 μ F 25V

PARTS LIST; MS-1650B

Ref. No	Parts No.	Name & Description
C405	CC45SL1H100D	Ceramic cap. 10pF ±0.5pF
C406,407	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C408	CE04W1A470M	Electrolytic cap. 47μF 10V
C409	C90-0261-05	Ceramic cap. 0.047μF 25V
C410	CC45CH1H101J	Ceramic cap. 100pF ±5%
C411 ~ 414	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C415	CE04W1A470M	Electrolytic cap. 47μF 10V
C416	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C417	CE04W1C100M	Electrolytic cap. 10μF 16V
C418 ~ 420	CE04W1H010M	Electrolytic cap. 1μF 50V
C421	CK45B1H102K	Ceramic cap. 1000pF ±10%
C422	CK45F1H103Z	Ceramic cap. 0.01μF +80% -20%
C423	CC45SL1H101J	Ceramic cap. 100pF ±5%
C424	CK45B1H471K	Ceramic cap. 470pF ±10%
C425	C90-0261-05	Ceramic cap. 0.047μF 25V
C426	CE04W1C470M	Electrolytic cap. 47μF 16V
C427	CC45SL1H221J	Ceramic cap. 220pF ±5%
C428	CE04W1A470M	Electrolytic cap. 47μF 10V
C429	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C430	C91-0562-08	Ceramic cap. 1μF ±2% 50V
C431	C91-0556-08	Ceramic cap. 0.01μF ±2% 50V
C432	CC45CH1H910J	Ceramic cap. 91pF ±5%
C433	CC45CH1H390J	Ceramic cap. 39pF ±5%
C434,435	CS15E1A4R7K	Tantalum cap. 4.7μF 10V
C436	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C437	CC45CH1H100D	Ceramic cap. 10pF ±0.5pF
C438	CE04W1C470M	Electrolytic cap. 47μF 16V
C439,440	C90-0261-05	Ceramic cap. 0.047μF 25V
C441,442	CE04W1C470M	Electrolytic cap. 47μF 16V
C443	C90-0261-05	Ceramic cap. 0.047μF 25V
C444	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C445	CK45B1H102K	Ceramic cap. 1000pF ±10%
C446	CC45SL1H331J	Ceramic cap. 330pF ±5%
C447	CK45B1H472K	Ceramic cap. 4700pF ±10%
C448	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C449,450	CE04W1A470M	Electrolytic cap. 47μF 10V
C451,452	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C453	C90-0261-05	Ceramic cap. 0.047μF 25V
C454	CE04W1C101M	Electrolytic cap. 100μF 16V
C455	C90-0261-05	Ceramic cap. 0.047μF 25V
C456	CE04W1C101M	Electrolytic cap. 100μF 16V
C457	CE04W2E470M	Electrolytic cap. 47μF 250V
C458	C90-0298-05	Semiconductor ceramic 0.1μF 12V
C459,460	CE04W1A470M	Electrolytic cap. 47μF 10V
C461	CK45B1H471K	Ceramic cap. 470pF ±10%
C462	CC45SL1H020C	Ceramic cap. 2pF ±0.25pF
C463	CE04W1C101M	Electrolytic cap. 100μF 16V
C464	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C465	CK45F1H103Z	Ceramic cap. 0.01μF +80% -20%
C466	CC45SL1H331J	Ceramic cap. 330pF ±5%
TC401,402	C05-0405-05	Ceramic trimmer 20pF
IC401		IC VIDEO AMP AN606
IC402		IC TTL SN74123

Ref. No	Parts No.	Name & Description
IC403		IC TTL SN74S00
IC404		IC TTL SN7472N
IC405		IC TIMER LM555CN or MC1455P
IC406		IC TTL SN75453BP
IC407		IC ANLG. SW. CD4016AE
Q401,402		Transistor 2SC1815
Q403,404	No use	
Q405 ~ 408		Transistor 2SC1815
Q409		FET 2SK30(0)
Q410,411		Tansistor 2SC1815
Q412	No use	
Q413,417		Transistor 2SC1815
Q418,419		Transistor 2SC1505
Q420,421		Transistor 2SC1815
D401		Diode RD3, 9E
D402	No use	
D403,404		Diode 1N34
D405		Diode 1S953
D406 ~ 408		Diode 1N34
D409,410		Diode 1S953
L401 ~ 405	L40-4701-03	Ferri inductor 47μH
P401	E19-1261-08	Pin plug 12P
P402	E40-1064-05	Pin connector 10P
P403	E40-1264-05	Pin connector 12P
P406	E23-0503-05	Pin connector 1P

HORIZONTAL SUB UNIT (X74-1330-00)

Unless otherwise specified, all resistors are ±5%, 1/8W.

Ref. No.	Parts No.	Name & Description
R701	RN14BK2E3003F	Metal film res. 300kΩ ±1% 1/4W
R702	RN14BK2E1201F	Metal film res. 1.2kΩ ±1% 1/4W
R703	RN14BK2E8201F	Metal film res. 8.2KΩ ±1% 1/4W
R704,705	RD14BB2E101J	Carbon res. 100Ω
R706 ~ 711	RD14BB2E103J	Carbon res. 10kΩ
VR701	R12-1521-05	Semifixed res. 4.7kΩB
C701	CM93BD2A152J	Mica cap. 1500pF ±5% 100V
C702,703	CK4B1H103K	Ceramic cap. 0.01μF ±10%
C704,705	CC45SL1H470J	Ceramic cap. 47pF ±5%
C706	C90-0298-05	Semiconductor ceramic cap. 0.1μF 12V
C707	CK45B1H103K	Ceramic cap. 0.01μF ±10%
IC701		IC CMOS TC4066B
IC702		IC TTL SL74LS00
Q701		Transistor 2SA495
Q702		Transistor 2SC373
Q703		Transistor 2SA495
Q704		Transistor 2SC373
Q705,706		FET 2SK30A(0)
Q707,708		Transistor 2SA495

PARTS LIST; MS-1650B

Ref. No	Parts No.	Name & Description	
D701 ~ 703		Diode	1S953
P701	E40-1264-05	Pin connector	12P

CONTROL UNIT (X77-1170-02)

Unless otherwise specified, all resistors are $\pm 5\%$, 1/8W.

Ref. No.	Parts No.	Name & Description	
R501	No use		
R502	No use		
R503 ~ 515	RD14BB2B472J	Carbon res.	4.7k Ω
R516	RD14BB2B221J	Carbon res.	220 Ω
R517 ~ 522	RD14BB2B472J	Carbon res.	4.7k Ω
R523 ~ 525	RD14BB2B102J	Carbon res.	1k Ω
R526	RD14BB2B103J	Carbon res.	10k Ω
R527	RD14BB2B102J	Carbon res.	1k Ω
R528,529	No use		
R530,531	RD14BB2B222J	Carbon res.	2.2k Ω
R532	RD14BB2B331J	Carbon res.	330 Ω
R533	RD14BB2B472J	Carbon res.	4.7k Ω
R534,535	RD14BB2B222J	Carbon res.	2.2k Ω
R536	RD14BB2B391J	Carbon res.	390 Ω
R537	RD14BB2B333J	Carbon res.	33k Ω
R538	RD14BB2B103J	Carbon res.	10k Ω
R539	RD14BB2B222J	Carbon res.	2.2k Ω
R540	RD14BB2B102J	Carbon res.	1k Ω
R541	RD14BB2B471J	Carbon res.	470 Ω
R542	RD14BB2B104J	Carbon res.	100k Ω
R543	RD14BB2B472J	Carbon res.	4.7k Ω
R544	RD14BB2B103J	Carbon res.	10k Ω
R545	RD14BB2B472J	Carbon res.	4.7k Ω
R546	No use		
R547,548	RD14BB2B222J	Carbon res.	2.2k Ω
R549	RD14BB2B101J	Carbon res.	100 Ω
R550	RD14BB2B561J	Carbon res.	560 Ω
R551	RD14BB2B102J	Carbon res.	1k Ω
R552	RD14BB2B104J	Carbon res.	100k Ω
R553,554	RD14BB2B152J	Carbon res.	1.5k Ω
R555	RD14BB2B221J	Carbon res.	220 Ω
R556	RD14BB2B103J	Carbon res.	10k Ω
R557	RD14BB2B680J	Carbon res.	68 Ω
R558	RS14AB3A220J	Metal oxide film res.	22 Ω $\pm 5\%$ 1W
R559	RD14BB2B222J	Carbon res.	2.2k Ω
R560	RD14BB2B821J	Carbon res.	820 Ω
R561 ~ 567	RN14BK2E9100F	Metal film res.	910 Ω $\pm 1\%$ 1/4W
R568 ~ 575	RN14BK2E1800F	Metal film res.	180 Ω $\pm 1\%$ 1/4W
R576 ~ 582	RN14BK2E3600F	Metal film res.	360 Ω $\pm 1\%$ 1/4W
R583 ~ 585	RD14BB2B222J	Carbon res.	2.2k Ω
R586	RD14BB2B682J	Carbon res.	6.8k Ω
R587	RD14BB2B472J	Carbon res.	4.7k Ω
R588	RD14BB2B102J	Carbon res.	1k Ω
R589	RD14BB2B821J	Carbon res.	820 Ω
R590 ~ 596	RN14BK2E9100F	Metal film res.	910 Ω $\pm 1\%$ 1/4W
R597 ~ 603	RN14BK2E1800F	Metal film res.	180 Ω $\pm 1\%$ 1/4W
R604 ~ 611	RN14BK2E3600F	Metal film res.	360 Ω $\pm 1\%$ 1/4W
R612	RD14BB2B472J	Carbon res.	4.7k Ω
R613	RD14BB2B221J	Carbon res.	220 Ω
R614	RD14BB2B331J	Carbon res.	330 Ω
R615	RD14BB2B391J	Carbon res.	390 Ω
R616	RD14BB2B221J	Carbon res.	220 Ω
R617	RD14BB2B102J	Carbon res.	1k Ω
R618	RD14BB2B103J	Carbon res.	10k Ω

Ref. No.	Parts No.	Name & Description	
R619	RD14BB2B471J	Carbon res.	470 Ω
R620 ~ 629	RD14BB2B472J	Carbon res.	4.7k Ω
R630	No use		
R631	RD14BB2B332J	Carbon res.	3.3k Ω
R632	RD14BB2B223J	Carbon res.	22k Ω
R633	RD14BB2B472J	Carbon res.	4.7k Ω
R634	RD14BB2B221J	Carbon res.	220 Ω
R635	RD14BB2B472J	Carbon res.	4.7k Ω
R636	No use		
R637,638	RD14BB2B472J	Carbon res.	4.7k Ω
R639	RD14BB2B103J	Carbon res.	10k Ω
R640	RD14BB2B473J	Carbon res.	47k Ω
R641	RD14BB2B471J	Carbon res.	470 Ω
R642	RD14BB2B223J	Carbon res.	22k Ω
R643	RD14BB2B363J	Carbon res.	36k Ω
R644	RD14BB2B472J	Carbon res.	4.7k Ω
R645,646	No use		
R647,648	RD14BB2B471J	Carbon res.	470 Ω
R649 ~ 651	RD14BB2B472J	Carbon res.	4.7k Ω
R652	RD14BB2B332J	Carbon res.	3.3k Ω
R653	RD14BB2B472J	Carbon res.	4.7k Ω
VR501	R12-0505-05	Semifixed res.	200 Ω
VR502	R12-1026-05	Semifixed res.	3k Ω
VR503,504	R12-0505-05	Semifixed res.	200 Ω
VR505	R12-1026-05	Semifixed res.	3k Ω
VR506,507	R12-3002-05	Semifixed res.	10k Ω
C501 ~ 504	No use		
C505	CK45B1H221K	Ceramic cap.	220pF $\pm 10\%$
C506	CK45B1H101K	Ceramic cap.	100pF $\pm 10\%$
C507	No use		
C508,509	CK45B1H101K	Ceramic cap.	100pF $\pm 10\%$
C510	CK45B1H102K	Ceramic cap.	1000pF $\pm 10\%$
C511	CK45B1H331K	Ceramic cap.	330pF $\pm 10\%$
C512	No use		
C513	CK45B1H101K	Ceramic cap.	100pF $\pm 10\%$
C514	CC45CH1H220J	Ceramic cap.	22pF $\pm 5\%$
C515	CK45B1E103K	Ceramic cap.	0.01 μ F $\pm 10\%$ 25V
C516	CE04W1A470M	Electrolytic cap.	47 μ F 10V
C517	No use		
C518	CK45B1H221K	Ceramic cap.	220pF $\pm 10\%$
C519	CK45CH1H100D	Ceramic cap.	10pF $\pm 0.5p$ F
C520	CE04W1C470M	Electrolytic cap.	47 μ F 16V
C521	C90-0261-05	Ceramic cap.	0.047 μ F 25V
C522	C90-0298-05	Semiconductor ceramic cap.	0.1 μ F 12V
C523	CE04W1A470M	Electrolytic cap.	47 μ F 10V
C524,525	C90-0298-05	Semiconductor ceramic cap.	0.1 μ F 12V
C526	CK45B1H221K	Ceramic cap.	220pF $\pm 10\%$
C527	CC45CH1H331J	Ceramic cap.	330pF $\pm 5\%$
C528	CK45B1H473K	Ceramic cap.	0.047 μ $\pm 10\%$
C529	CE04W1C101M	Electrolytic cap.	100 μ F 16V
C530	CE04W1A101M	Electrolytic cap.	100 μ F 10V
C531,532	C90-0261-05	Ceramic cap.	0.047 μ F 25V
C533	CE04W1C101M	Electrolytic cap.	100 μ F 16V
C534	C90-0298-05	Semiconductor ceramic cap.	0.1 μ F 12V
C535	C90-0261-05	Ceramic cap.	0.047 μ F 25V
C536	CE04W1A101M	Electrolytic cap.	100 μ F 10V
C537	C90-0261-05	Ceramic cap.	0.047 μ F 25V
C538	C90-0298-05	Semiconductor ceramic cap.	0.1 μ F 12V
C539	C90-0261-05	Ceramic cap.	0.047 μ F 25V

PARTS LIST; MS-1650B

Ref. No.	Parts No.	Name & Description	Ref. No.	Parts No.	Name & Description
C540	CE04W1C101M	Electrolytic cap. 100 μ F 16V	IC526		IC TTL SN74LS193
C541	CE04W1A101M	Electrolytic cap. 100 μ F 10V	IC527,528		No use
C542	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC529		IC 8 BIT REGISTER AM2503DC
C543	CE04W1A101M	Electrolytic cap. 100 μ F 10V	IC530		IC OP AMP NE529N
C544	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC531 ~ 533		IC TTL SN74LS192
C545	CE04W1C101M	Electrolytic cap. 100 μ F 16V	IC534		IC TTL SN7400
C546	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC535		IC TTL SN74123
C547	CE04W1C470M	Electrolytic cap. 47 μ F 16V	IC536		IC TTL SN74LS107
C548	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC537		IC TTL SN7400
C549	CK45B1H102K	Ceramic cap. 1000pF \pm 10%	IC538		IC TTL SN7403
C550	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC539,540		IC TTL SN74LS90
C551	CE04W1C101M	Electrolytic cap. 100 μ F 16V	IC541,542		IC TTL SN7404
C552	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC543		IC TTL SN7410
C553	CE04W1A101M	Electrolytic cap. 100 μ F 10V	IC544		IC TTL SN7404
C554 ~ 588	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC545		IC TTL SN7410
C589	CE04W1A101M	Electrolytic cap. 100 μ F 10V	IC546		IC TTL SN7404
C590 ~ 595	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC547	No use	
C596	CK45B1H221K	Ceramic cap. 220pF \pm 10%	IC548,549		IC TTL SN7410
C597	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F \pm 5% 12V	IC550		IC TTL SN7403
C598	CK45B1H221K	Ceramic cap. 220pF \pm 10%	IC551 ~ 553		IC TTL SN74LS90
C599	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC554		IC TTL SN74LS107
C600	No use		IC555		IC TTL SN74279
C601	C91-0558-08	Ceramic cap. 0.2 μ F 12V	IC556		IC TTL SN7400
C602 ~ 605	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC557		IC TTL SN7404
C606	CK45B1H102K	Ceramic cap. 1000pF \pm 10%	IC558		IC TTL SN74LS107
C607	CK45B1H101K	Ceramic cap. 100pF \pm 10%	IC559		IC TTL SN7400
C608	CK45B1H102K	Ceramic cap. 1000pF \pm 10%	IC560		IC TTL SN7404
C609,610	C90-0261-05	Ceramic cap. 0.047 μ F 25V	IC561		IC TTL SN7402
C611,612	C91-0559-08	Ceramic cap. 0.2 μ F 12V	IC562		IC TTL SN7403
C613	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC563,564		IC TTL SN74LS90
C614	CC45SL1H220J	Ceramic cap. 22pF \pm 5%	IC565		IC TTL SN74123
C615	CK45B1H472K	Ceramic cap. 4700pF \pm 10%	IC566		IC TTL SN74121
C616	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V	IC567,568		IC TTL SN74LS174
C617,618	C91-0559-08	Ceramic cap. 0.2 μ F 12V	IC569		IC TTL SN7408
C619	CC45SL1H470J	Ceramic cap. 47pF \pm 5%	IC570		IC TTL SN74S00
C620	CS15E0J150M	Turtalum electrolytic cap. 15 μ F 6.3V	IC571		IC CMOS CD4011BE
C621 ~ 626	C90-0298-05	Semiconductor ceramic 0.1 μ F 12V	IC572		IC CMOS CD4013BE
IC501		IC OP AMP LM310	IC573		IC TTL SN74LS273
IC502		IC CMOS MC14174	IC574,575		IC COMS μ PD444C
IC503		IC CMOS MC14175	IC576,577		IC TTL SN74367
IC504,505	No use		IC578		IC TTL SN74LS273
IC506		IC OP AMP MC1741	IC579		IC TTL SN7474
IC507 ~ 509		IC TTL SN7406	IC580		IC OP AMP LM310
IC510		IC TTL SN74LS85	IC581		IC TTL SN74158
IC511		IC TTL SN74LS193	IC582		IC TTL SN7400
IC512 ~ 514	No use		IC583		IC TTL SN7408
IC515,516		IC TTL SN7406	IC584		IC TTL SN74244
IC517	No use		Q501		Transistor 2SA1015
IC518		IC TTL SN74LS85	Q502 ~ 506		Transistor 2SC1815
IC519		IC TTL SN74LS193	Q507 ~ 522		Transistor 2N5771
IC520 ~ 522	No use		Q523		FET E175
IC523		IC TTL SN7406	D501 ~ 515		Diode 1N34
IC524	No use		D516 ~ 523		Diode 1S953
IC525		IC TTL SN74LS85	D524,525		Diode 1N34
			D526 ~ 528		Diode 1S953
			D529		Diode RD6.2E
			L501 ~ 508	L40-4701-03	Ferri inductor 47 μ H
			X501	L77-1002-05	Crystal 10MHz

PARTS LIST; MS-1650B

Ref. No.	Parts No.	Name & Description
P501	E40-1266-05	Pin connector 12P
P502	E19-0461-08	Pin connector 4P
P503,504	E40-1266-05	Pin connector 12P
P505	E40-0461-08	Pin connector 4P
P506,507	E40-1066-05	Pin connector 10P
P508	E19-0362-08	Pin connector 3P
P509	E19-0461-08	Pin connector 4P
P510	E40-1566-05	Pin connector 15P

POWER SUPPLY UNIT (X68-1330-02)

Unless otherwise specified, all resistors are $\pm 5\%$, 1/4 W

Ref. No.	Parts No.	Name & Description
R101	R92-1010-08	Winding res. 0.4 Ω 2W
R102	RD14BB2E332J	Carbon res. 3.3k Ω
R103	RN14BK2E4991F	Metal film res. 4.99k Ω $\pm 1\%$ 1/4W
R104	RN14BK2E1182F	Metal film res. 11.8k Ω $\pm 1\%$ 1/4W
R105	RD14BB2E391J	Carbon res. 390 Ω
R106	RS14AB3A220J	Metal oxide res. 22 Ω $\pm 5\%$ 1W
R107	RD14BB2E152J	Carbon res. 1.5k Ω
R108	RD14BB2E220J	Carbon res. 22 Ω
R109	RD14BB2E152J	Carbon res. 1.5k Ω
R110	RD14BB2E104J	Carbon res. 100k Ω
R111	RD14BB2B220J	Carbon res. 22 Ω
R112	RN14BK2E1502F	Metal film res. 15k Ω $\pm 1\%$ 1/4W
R113	RN14BK2E3013F	Metal film res. 301k Ω $\pm 1\%$ 1/4W
R114	RD14BB2E473J	Carbon res. 47k Ω
R115	RD14BB2E683J	Carbon res. 68k Ω
R116,117	RD14BB2E222J	Carbon res. 2.2k Ω
R118	RD14BB2E102J	Carbon res. 1k Ω
R119,120	RS14AB3A101J	Metal oxide res. 100 Ω $\pm 5\%$ 1W
R121	RD14BB2E154J	Carbon res. 150k Ω
R122	RD14BB2E473J	Carbon res. 47k Ω
R123	RD14BB2E472J	Carbon res. 4.7k Ω
R124	RD14BB2E471J	Carbon res. 470 Ω
R125	RD14BB2E104J	Carbon res. 100k Ω
R126	RD14BB2E470J	Carbon res. 47 Ω
R127	R92-1011-08	Winding res. 3.6M Ω 1W
R128	R92-0146-25	Winding res. 2.2M Ω 1W
R129	R92-1012-08	Carbon res. 2M Ω 1W
R130	R92-0146-25	Winding res. 2.2M Ω 1W
R131	R92-1013-08	Carbon res. 1.8M Ω 1W
R132	RD14BB2H473J	Carbon res. 47k Ω 1/2W
R133,134	R92-1014-08	Solid res. 22M Ω 1/2W
R135	RD14BB2E473J	Carbon res. 47k Ω
R136	RD14BB2E153J	Carbon res. 15k Ω
R137	RD14BB2E224J	Carbon res. 220k Ω
R138	RD14BB2E223J	Carbon res. 22k Ω
R139	RD14BB2E102J	Carbon res. 1k Ω
R140	RD14BB2E101J	Carbon res. 100 Ω
R141	RD14BB2E154J	Carbon res. 150k Ω
R142,143	RD14BB2E101J	Carbon res. 100 Ω
R144	RD14BB2E683J	Carbon res. 68k Ω
R145	RD14BB2E123J	Carbon res. 12k Ω
R146	RD14BB2E332J	Carbon res. 3.3k Ω
R147,148	RD14BB2E102J	Carbon res. 1k Ω
R149	RD14BB2E822J	Carbon res. 8.2k Ω
R150	RD14BB2E682J	Carbon res. 6.8k Ω
R151	RD14BB2E101J	Carbon res. 100 Ω
R152	RD14BB2E472J	Carbon res. 4.7k Ω
R153	RD14BB2E221J	Carbon res. 220 Ω
R154	RD14BB2E103J	Carbon res. 10k Ω
R155	RD14BB2E224J	Carbon res. 220k Ω
R156	RD14BB2E104J	Carbon res. 100k Ω

Ref. No.	Parts No.	Name & Description
R157,158	RD14BB2E152J	Carbon res. 1.5k Ω
R159,160	RD14BB2E102J	Carbon res. 1k Ω
VR101	R12-1002-05	Semifixed res. 1k Ω B
VR102~104	R12-4503-05	Semifixed res. 50k Ω B
VR105	R12-6005-05	Semifixed res. 330k Ω B
VR106	R12-4503-05	Semifixed res. 50k Ω B
C101	CE04W1C222M	Electrolytic cap. 2200 μ F 16V
C102	CE04W1A101M	Electrolytic cap. 100 μ F 10V
C103	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C104,105	CE04W1E102M	Electrolytic cap. 1000 μ F 25V
C106	CE04W1C101M	Electrolytic cap. 100 μ F 16V
C107	C90-0261-05	Ceramic cap. 0.047 μ F 25V
C108	CE04W1C101M	Electrolytic cap. 100 μ F 16V
C109	C90-0261-05	Ceramic cap. 0.047 μ F 25V
C110	CK45E2H103P	Ceramic cap. 0.01 μ F $\pm 100\%$ 500V
C111	C91-0556-08	Polystyrene cap. 0.01 μ F $\pm 2\%$
C112	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C113	No use	
C114	CK45F1H223Z	Ceramic cap. 0.022 μ F $\pm 80\%$ -20%
C115	CE04W1H471M	Electrolytic cap. 470 μ F 50V
C116	CK45F1H103Z	Ceramic cap. 0.01 μ F $\pm 80\%$ -20%
C117~122	CK45E3D103P	Ceramic cap. 0.01 μ F $\pm 100\%$ -0% 2000V
C123	CE04W2E330M	Electrolytic cap. 33 μ F 250V
C124	CE04W2E010M	Electrolytic cap. 1 μ F 250V
C125	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C126,127	CC45CH1H010C	Ceramic cap. 1pF $\pm 0.25\mu$ F
C128	CC45SL1H050C	Ceramic cap. 5pF $\pm 0.25\mu$ F
C129	CK45E1H222P	Ceramic cap. 2200pF $\pm 100\%$ -0%
C130	CC45SL1H050C	Ceramic cap. 5pF $\pm 0.25\mu$ F
C131~134	C90-0261-05	Ceramic cap. 0.047 μ F 25V
C135,136	C90-0298-05	Semiconductor ceramic cap. 0.1 μ F 12V
C137	C91-0560-08	Film cap. 0.47 μ F 50V
C138	C91-0557-08	Ceramic cap. 0.1 μ F 50V
IC101,102		IC OP AMP μ A741CN
IC103		IC TIMER LM555CN
Q101		Transistor 2SC1509
Q102		Transistor 2SC1815
Q103		Transistor 2SA777
Q104		Transistor 2SC1509
Q105		Transistor 2SA777
Q106		Transistor 2SC1815
Q107		Transistor 2SA1015
Q108		Transistor 2SD401
Q109		Transistor 2SC2229
Q110		Transistor 2SC1566
Q111,112		Transistor 2SC2229
Q113		Transistor 2SC1215
Q114		Transistor 2SC1815
D101		Rectifier S1QB10
D102		Rectifier S1QB60
D103,104		Diode 1S953
D105		Diode LA80
D106,107		Diode W06C

PARTS LIST; MS-1650B

Ref. No.	Parts No.	Name & Description	
D108		Rectifier	RD30ER
D109		Diode	W06C
D110		Diode	1S953
D111		Diode	1S955
D112		Diode	RD5.1E
L101,102	L40-4701-03	Ferri inductor	47 μ H
T1	L19-0019-05	Converter transformer	
N101 ~ 103		Neon lamp	NE-2
P101	E19-0361-08	Pin connector	3P
P102	E40-1064-05	Pin connector	10P
P103	E19-0861-08	Pin connector	8P
P104	E19-0561-08	Pin connector	5P
P105,106	E40-1064-05	Pin connector	10P

FREE RUN UNIT (X77-1230-00)

Ref. No	Parts No.	Name & Description	
R1	RD14BB2B472J	Carbon res.	4.7 k Ω
R2,3	RD14BB2B222J	Carbon res.	2.2k Ω
R4	RD14BB2B183J	Carbon res.	18k Ω
VR1	R01-8503-05	Variable res.	2M Ω B
C1	C90-0298-05	Semiconductor ceramic cap.	0.1 μ F 12V
C2	CK45B1H471K	Ceramic cap.	470pF \pm 10%
C3	CS15E1A100M	Tantalum cap.	10 μ F 10V
C4	CK45B1H103K	Ceramic cap.	0.01 μ F \pm 10%
IC1		IC TIMER	NE555
IC2		IC TTL	SN7432
D1 ~ 4		Diode	1N34
D5		Diode	1S953
P601	E40-7002-08	Pin connector	12P

PARTS LIST; MU-1651(T)

MU-1651(T) CHASSIS ASSEMBLY

REF. NO	PARTS NO	NAME & DESCRIPTION
1	A01-0892-03	CASE
2	A01-0893-13	CASE
3	A21-1014-23	DECORATIVE PANEL
4	A22-0830-03	SUB PANEL
5	A23-1638-03	REAR PANEL
6	B01-0703-13	ESCUTCHEON
7	B07-0706-04	ESCUTCHEON
	B09-0011-04	CAP
8	B30-0935-05	LAMP
9	B30-0939-05	LAMP
10	B40-2765-04	NAME PLATE (SERIAL NO)
	B41-0724-04	CAUTION LABEL
	B41-0737-04	CAUTION LABEL
	B50-2981-10	INSTRUCTION MANUAL
11	E04-0251-05	BNC RECEPTACLE
12	E04-0253-05	BNC RECEPTACLE
13	E21-0657-04	TERMINAL (GND)
	E23-0015-04	EARTH LUG
	E23-0513-05	EARTH LUG
	E30-1818-05	POWER CORD
	E30-1849-05	LEAD WIRE WITH CONNECTOR
	E31-2297-05	LEAD WIRE WITH CONNECTOR
	E31-2298-05	LEAD WIRE WITH CONNECTOR
	E31-2342-05	LEAD WIRE WITH CONNECTOR
	E31-2343-05	LEAD WIRE WITH CONNECTOR
	E31-2344-05	LEAD WIRE WITH CONNECTOR
	E31-2345-15	LEAD WIRE WITH CONNECTOR
	E31-2346-05	LEAD WIRE WITH CONNECTOR
	E31-2347-05	LEAD WIRE WITH CONNECTOR
	E31-2348-15	LEAD WIRE WITH CONNECTOR
	E31-2349-05	LEAD WIRE WITH CONNECTOR
	E31-2351-05	LEAD WIRE WITH CONNECTOR
	E31-2358-05	LEAD WIRE WITH CONNECTOR
	E33-4025-00	WIRE ASSY
14	F01-0824-04	HEAT SINK
	F05-2018-05	FUSE
	F05-4018-05	FUSE
15	F15-0721-04	BLIND PLATE
	F20-0516-05	INSULATOR
	F29-0014-05	INSULATOR
	H01-2966-04	CARTON BOX
	H12-0537-13	PAD
	H12-0547-04	PAD
	H20-1720-04	VINYL COVER
	H25-0029-04	BAG
16	J02-0323-05	LEG
	J19-1620-05	CORD CLAMP
17	J21-2963-04	BRACKET FOR TRANSFORMER
18	J32-0831-04	BOSS
	J61-0049-05	WIRE BAND
19	K21-0819-03	KNOB
20	K21-0822-14	KNOB
21	K21-0831-24	KNOB
22	K21-0832-14	KNOB
23	K21-0833-14	KNOB
24	K27-0506-04	KNOB
25	K27-0526-04	KNOB
26	L01-9336-05	POWER TRANSFORMER
27	L79-0502-05	FILTER
	N09-0709-05	SCREW
	N10-2030-46	NUT, HEX
	N10-2040-46	NUT
	N15-1040-41	WASHER
	N17-1030-41	LOCK WASHER
	N17-1060-46	LOCK WASHER
	N30-2608-41	SCREW, PAN HD M 2.6X8
	N30-3008-41	SCREW, PAN HD M 3X8
	N30-4008-41	SCREW, PAN HD M 4X8
	N32-3004-46	SCREW, FLAT HD M 3X4
	N32-3006-46	SCREW, FLAT HD M 3X6
	N88-3008-41	SCREW, FLAT HD TAP TITE
	N89-3006-41	SCREW, BINDING TAP TITE
	R92-0150-05	JUMPING RES. ZERO OHM
28	S40-2514-05	PUSH SWITCH
29	X68-1380-00	POWER SUPPLY UNIT
30	X73-1460-00	AMPLIFIER UNIT
31	X81-1310-00	MEMORY UNIT
	Y87-1900-00	BNC CORD
	2SA1111(Q)	TR. SI, PNP
	2SC2591(Q)	TR. SI, NPN
	212-2014-05	TUBE (PLASTIC)

POWER SUPPLY UNIT (X68-1380-00)

REF. NO	PARTS NO	NAME & DESCRIPTION
	E23-0508-04	
	J13-0020-05	FUSE HOLDER
	J13-0039-05	FUSE HOLDER
	J25-2981-02	PCB (UNMOUNTED)
	R92-0150-05	JUMPING RES. ZERO OHM
	Z18-2981-09	
	Z19-2981-09	
	Z20-2981-09	
	Z21-2981-09	
	Z23-2981-09	
	Z83-0962-02	
	Z12-1018-05	TUBE (PLASTIC)
C001	CE04W1E102M	CAP. ELECTRO 1000 20% 25V
C002	CE04W1E471M	CAP. ELECTRO 470 20% 25V
C003	CE04W1C222M	CAP. ELECTRO 2200 20% 16V
C004	CE04W1E101M	CAP. ELECTRO 100 20% 25V
C005	CQ93M1H103K	CAP. MYLAR 0.01 10% 50V
C006	CE04W1E101M	CAP. ELECTRO 100 20% 25V
C007	CQ93M1H103K	CAP. MYLAR 0.01 10% 50V
C008	CE04W1E101M	CAP. ELECTRO 100 20% 25V
C009	CQ93M1H103K	CAP. MYLAR 0.01 10% 50V
C010	C90-0298-05	
D001	S1R8A40	DIODE
D002	S1Q840	DIODE
D003	S2V840F	DIODE, BRIDGE
D004	WZ-100	DIODE, ZENER 10V
D005	WZ-100	DIODE, ZENER 10V
D006	WZ-120	DIODE
D007	1S257	DIODE
D008	1S257	DIODE
IC001	NJM4558D	IC DUAL OP AMP.
IC002	NJM4558D	IC DUAL OP AMP.
IC003	SN74LS244N	IC
P001	E40-0332-05	PIN CONNECTOR
P002	E40-0328-05	PIN CONNECTOR
P003	E40-0632-05	PIN CONNECTOR
P004	E40-0528-05	PIN CONNECTOR
P005	E40-0528-05	PIN CONNECTOR
P006	E40-0632-05	PIN CONNECTOR
P007	E40-1373-05	PIN CONNECTOR 13P
P008	E40-0873-05	PIN CONNECTOR 8P
P009	E40-2685-05	PIN CONNECTOR
P010	E40-2685-05	PIN CONNECTOR
P011	E40-1373-05	PIN CONNECTOR 13P
P012	E40-1273-05	PIN CONNECTOR
P013	E40-0473-05	PIN CONNECTOR 4P
P014	E40-0573-05	PIN CONNECTOR 5P
P015	E40-0573-05	PIN CONNECTOR 5P
Q001	2SA733(Q)	TR. SI, PNP
Q002	2SC945(Q)	TR. SI, NPN
Q003	2SA733(Q)	TR. SI, PNP
Q004	2SA733(Q)	TR. SI, PNP
R001	RS14AB3A1R2J	RES. METAL FILM 1.2 5% 1W
R002	RD14BB2E182J	RES. CARBON 1.8K 5% 1/4W
R003	RD14BB2E391J	RES. CARBON 390 5% 1/4W
R004	RN14BK2E1202F	RES. METAL FILM 12K 1% 1/4W
R005	RN14BK2E1202F	RES. METAL FILM 12K 1% 1/4W
R006	RD14BB2E3R3J	RES. CARBON 3.3 5% 1/4W
R007	RD14BB2E182J	RES. CARBON 1.8K 5% 1/4W
R008	RD14BB2E391J	RES. CARBON 390 5% 1/4W
R009	RN14BK2E4701F	RES. METAL FILM 4.7K 1% 1/4W
R010	RN14BK2E1101F	RES. METAL FILM 1.1K 1% 1/4W
R011	RD14BY2H1R5J	RES. CARBON 1.5 5% 1/2W
R012	RD14BB2E182J	RES. CARBON 1.8K 5% 1/4W
R013	RD14BB2E391J	RES. CARBON 390 5% 1/4W
R014	RN14BK2E1002F	RES. METAL FILM 10K 1% 1/4W
R015	RN14BK2E2402F	RES. METAL FILM 24K 1% 1/4W
R016	RD14BY2H1R5J	RES. CARBON 1.5 5% 1/2W
1.SG01	S01-2510-05	ROTARY SWITCH
VR001	R12-1511-05	RES. SEMI FIXED

AMP UNIT (X73-1460-00)

REF. NO	PARTS NO	NAME & DESCRIPTION
	E23-0508-04	
	F02-0012-05	HEAT SINK
	J25-2982-12	PCB (UNMOUNTED)
	R92-0150-05	JUMPING RES. ZERO OHM
	Z18-2982-09	
	Z19-2982-09	

PARTS LIST; MU-1651(T)

REF. NO	PARTS NO	NAME & DESCRIPTION				REF. NO	PARTS NO	NAME & DESCRIPTION					
	Z20-2982-09					R024	RN14BK2E1002F	RES.	METAL FILM	10K	1%	1/4W	
	Z83-0962-02					R025	RN14BK2E5101F	RES.	METAL FILM	5.1K	1%	1/4W	
	001-0004-05	COATING WIRE					R026	RN14BK2E4301F	RES.	METAL FILM	4.3K	1%	1/4W
C001	C91-0525-05					R027	RN14BK2E1001F	RES.	METAL FILM	1K	1%	1/4W	
C002	CM93BD2A470J	CAP.	MICA	47P	5%	100V	R028	RN14BK2E1101F	RES.	METAL FILM	1.1K	1%	1/4W
C003	CM93BD2A471J	CAP.	MICA	470P	5%	100V	R029	RN14BK2E1001F	RES.	METAL FILM	1K	1%	1/4W
C004	CM93BD2A472J	CAP.	MICA	4700P	5%	100V	R030	RN14BK2E1001F	RES.	METAL FILM	1K	1%	1/4W
C005	C91-0502-05	CAP.	METAL FILM	0.01	20%	630V	R031	RN14BK2E1003F	RES.	METAL FILM	100K	1%	1/4W
C006	CE04W1H010M	CAP.	ELECTRO	1	20%	50V	R032	RD14BB2E104J	RES.	CARBON	100K	5%	1/4W
C007	CE04W1H010M	CAP.	ELECTRO	1	20%	50V	R033	RD14BB2E104J	RES.	CARBON	100K	5%	1/4W
C008	CF93AN2A105J	CAP.	POLYESTHEL	1	5%	100V	R034	RN14BK2E1201F	RES.	METAL FILM	1.2K	1%	1/4W
C009	CQ93BP2A152F	CAP.	MYLAR	1500P	1%	100V	R035	RN14BK2E1002F	RES.	METAL FILM	10K	1%	1/4W
C010	CQ93BP2A302F	CAP.	MYLAR	3000P	1%	100V	R036	RN14BK2E1002F	RES.	METAL FILM	10K	1%	1/4W
C011	CC45CH1H100D	CAP.	CERAMIC	10F	0.5P	50V	R037	RN14BK2E1201F	RES.	METAL FILM	1.2K	1%	1/4W
C012		NO USE					R038	RD14BB2E273J	RES.	CARBON	27K	5%	1/4W
C013	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R039	RD14BB2E681J	RES.	CARBON	680	5%	1/4W
C014	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R040	RD14BB2E273J	RES.	CARBON	27K	5%	1/4W
C015	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R041	RD14BB2E681J	RES.	CARBON	680	5%	1/4W
C016	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R042	RN14BK2E1002F	RES.	METAL FILM	10K	1%	1/4W
C017	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R043	RN14BK2E1002F	RES.	METAL FILM	10K	1%	1/4W
C018	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R044	RN14BK2E5101F	RES.	METAL FILM	5.1K	1%	1/4W
C019	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R045	RN14BK2E5101F	RES.	METAL FILM	5.1K	1%	1/4W
C020	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R046	RN14BK2E1302F	RES.	METAL FILM	13K	1%	1/4W
C021	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R047	RN14BK2E5101F	RES.	METAL FILM	5.1K	1%	1/4W
C022	CE04W1E101M	CAP.	ELECTRO	100	20%	25V	R048	RN14BK2E2003F	RES.	METAL FILM	200K	1%	1/4W
C025	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R049	RD14BB2E104J	RES.	CARBON	100K	5%	1/4W
C026	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R050	RN14BK2E1001F	RES.	METAL FILM	1K	1%	1/4W
C027	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R051	RD14BB2E122J	RES.	CARBON	1.2K	5%	1/4W
C028	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R052	RN14BK2E2402F	RES.	METAL FILM	24K	1%	1/4W
C029	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R053	RN14BK2E2402F	RES.	METAL FILM	24K	1%	1/4W
C030	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R054	RN14BK2E7500F	RES.	METAL FILM	750	1%	1/4W
C031	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R055	RN14BK2E1000F	RES.	METAL FILM	100	1%	1/4W
C032	CQ93M1H103K	CAP.	MYLAR	0.01	10%	50V	R056	RN14BK2E1000F	RES.	METAL FILM	100	1%	1/4W
	D001	1S1544A	DIODE				R057	RN14BK2E1000F	RES.	METAL FILM	100	1%	1/4W
	D002	1S1544A	DIODE				R058	RN14BK2E8201F	RES.	METAL FILM	8.2K	1%	1/4W
	D003	DS442X	DIODE				R059	RN14BK2E8201F	RES.	METAL FILM	8.2K	1%	1/4W
	D004	DS442X	DIODE				R060	RD14BB2E105J	RES.	CARBON	1M	5%	1/4W
	D005	1N60	DIODE GERMA				R061	RD14BB2E681J	RES.	CARBON	680	5%	1/4W
	D006	1N60	DIODE GERMA										
	IC001	LF357H-T	IC				1	S001	S32-4007-05	SLIDE SWITCH			
	IC002	LF356H	IC				2	S002	S01-3504-05	ROTARY SWITCH			
	IC003	TL071CP	IC		OP AMP.		3	S003		NO USE			
	IC004	TL071CP	IC		OP AMP.		4	S004	S37-2005-05				
	IC005	TL071CP	IC		OP AMP.		5	S005	S37-2005-05				
	IC006	LF356N	IC				6	S006	S32-4007-05	SLIDE SWITCH			
	IC007	NJM4558D	IC		DUAL OP AMP.			S007	S31-1501-05	SLIDE SWITCH			
	IC008	LM318N	IC				TC001	C05-0030-15	CAP. TRIMMER				
	IC009	TL072CP	IC				TC002	C05-0030-15	CAP. TRIMMER				
	P001	E40-0273-05	PIN CONNECTOR		2P		TC003	C05-0030-15	CAP. TRIMMER				
	P002	E40-0973-05	PIN CONNECTOR		2P		TC004	C05-0062-05	CAP. TRIMMER				
	P003	E40-0273-05	PIN CONNECTOR		2P		TC005	C05-0062-05	CAP. TRIMMER				
	P004	E40-0273-05	PIN CONNECTOR		2P		TC006	C05-0062-05	CAP. TRIMMER				
	P005	E40-0273-05	PIN CONNECTOR		2P		VR001	R12-3518-05	RES. SEMI FIXED				
	P006	E40-0273-05	PIN CONNECTOR		2P		VR002	R12-0533-05	RES. SEMI FIXED				
	P007	E40-0273-05	PIN CONNECTOR		2P		VR003	R12-2405-05	RES. SEMI FIXED				
	P008	E40-0273-05	PIN CONNECTOR		2P		VR004	R12-3518-05	RES. SEMI FIXED				
	P009	E40-0473-05	PIN CONNECTOR		4P		VR005	R01-3509-05	V.R.				
	P010	E40-0373-05	PIN CONNECTOR		3P		VR006	R12-5510-05	RES. SEMI FIXED				
	P011	E40-0273-05	PIN CONNECTOR		2P		VR007	R12-5510-05	RES. SEMI FIXED				
	Q001	2SC945(P)	TR. SI, NPN				VR008	R19-9507-05	V.R.				
	Q002	2SA733(P)	TR. SI, PNP				VR009	R12-0531-05	RES. SEMI FIXED				
	Q003	2SC945(P)	TR. SI, NPN				VR010	R12-1510-05	RES. SEMI FIXED				
	Q004	2SA733(P)	TR. SI, PNP				VR011	R12-1510-05	RES. SEMI FIXED				
	R001	RD14BB2E470J	RES. CARBON		47	5%	1/4W	VR012	R12-5510-05	RES. SEMI FIXED			
	R002	RD14BB2E470J	RES. CARBON		47	5%	1/4W	VR013	R12-1511-05	RES. SEMI FIXED			
	R003	RN14BK2H9003F	RES. METAL FILM		900K	1%	1/2W	VR014	R12-5510-05	RES. SEMI FIXED			
	R004	RN14BK2E1113F	RES. METAL FILM		111K	1%	1/4W						
	R005	RN14BK2H9903F	RES. METAL FILM		990K	1%	1/2W						
	R006	RN14BK2E1012F	RES. METAL FILM		10.1K	1%	1/4W						
	R007	RN14BK2H9993F	RES. METAL FILM		999K	1%	1/2W						
	R008	RN14BK2E1001F	RES. METAL FILM		1K	1%	1/4W						
	R009	RN14BK2H1004F	RES. METAL FILM		1M	1%	1/2W						
	R010	RD14BY2H104J	RES. CARBON		100K	5%	1/2W						
	R011	RN14BK2E1001F	RES. METAL FILM		1K	1%	1/4W						
	R012	RN14BK2E2402F	RES. METAL FILM		24K	1%	1/4W						
	R013	RN14BK2E6201F	RES. METAL FILM		6.2K	1%	1/4W						
	R014	RN14BK2E6201F	RES. METAL FILM		6.2K	1%	1/4W						
	R015	RN14BK2E1502F	RES. METAL FILM		15K	1%	1/4W						
	R016	RN14BK2E7501F	RES. METAL FILM		7.5K	1%	1/4W						
	R017	RN14BK2E7501F	RES. METAL FILM		7.5K	1%	1/4W						
	R018	RN14BK2E4701F	RES. METAL FILM		4.7K	1%	1/4W						
	R019	RN14BK2E6801F	RES. METAL FILM		6.8K	1%	1/4W						
	R020	RN14BK2E6201F	RES. METAL FILM		6.2K	1%	1/4W						
	R021	RN14BK2E6201F	RES. METAL FILM		6.2K	1%	1/4W						
	R022	RN14BK2E1502F	RES. METAL FILM		15K	1%	1/4W						
	R023	RN14BK2E1002F	RES. METAL FILM		10K	1%	1/4W						

MEMORY UNIT (X81-1170-00)

REF. NO	PARTS NO	NAME & DESCRIPTION				
	E33-4027-00	WIRE ASSY				
	J25-2983-12	PCB (UNMOUNTED)				
	J61-0514-05					
	R92-0150-05	JUMPING RES. ZERO OHM				
	Z18-2983-09					
	Z19-2983-09					
	Z20-2983-09					
	Z21-2983-09					
	Z23-2983-09					
	Z83-0962-02					
	001-0004-05	COATING WIRE				
C001	CE04W1C100M	CAP.	ELECTRO	10	20%	16V
C002	C91-0456-05	CAP.	CERAMIC	0.047	10%	25V
C003	C91-0456-05	CAP.	CERAMIC	0.047	10%	25V
C004	CE04W1C100M	CAP.	ELECTRO	10	20%	16V
C005	C91-0456-05	CAP.	CERAMIC	0.047	10%	25V
C006	CE04W1C100M	CAP.	ELECTRO	10	20%	16V
C007	C91-0456-05	CAP.	CERAMIC	0.047	10%	25V

PARTS LIST; MU-1651(T)

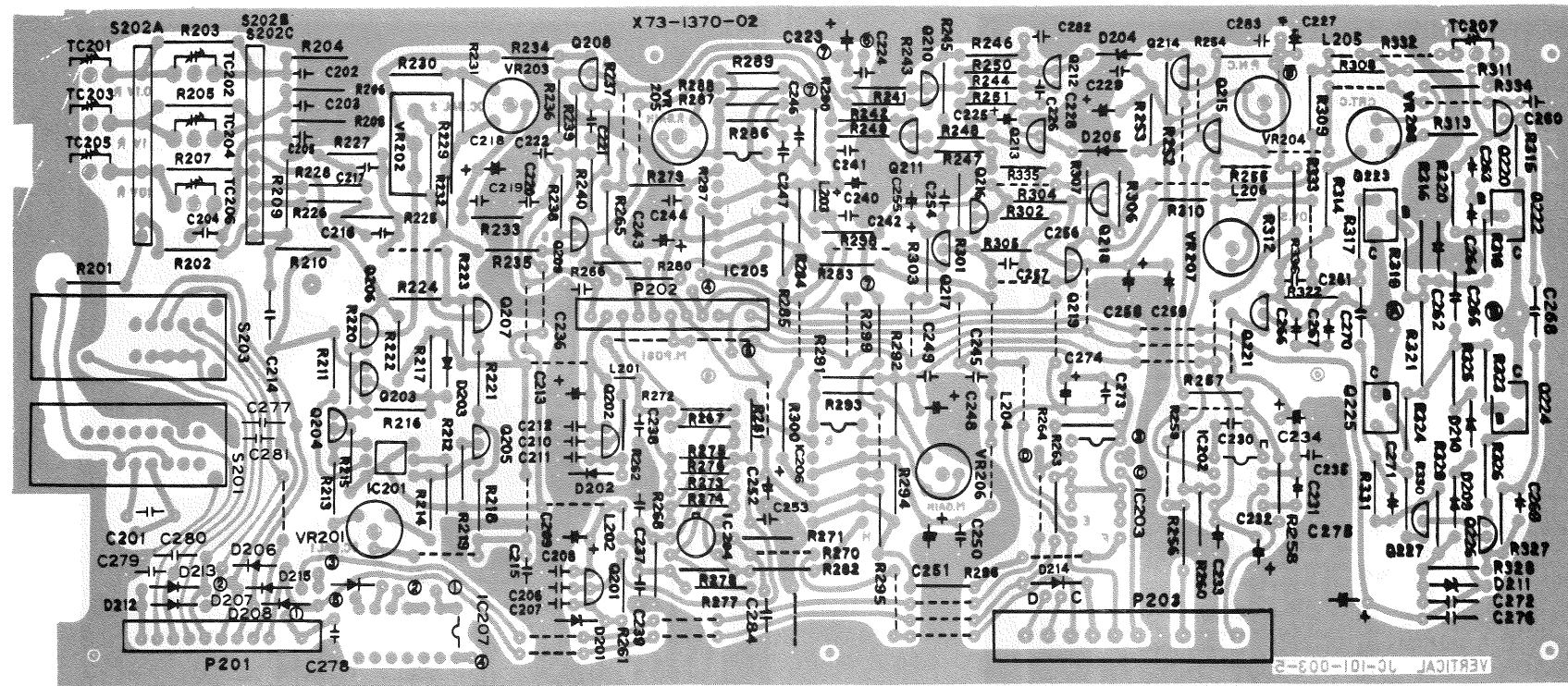
REF.NO	PARTS NO	NAME & DESCRIPTION	REF.NO	PARTS NO	NAME & DESCRIPTION
C008	CK45FB1H221K	CAP. CERAMIC 220P 10% 50V	IC011	SN7400N	IC
C009	CK45FB1H221K	CAP. CERAMIC 220P 10% 50V	IC012	SN74LS123N	IC
C010	CE04W1C101M	CAP. ELECTRO 100 20% 16V	IC013	SN7406N	IC
C011	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	IC014	SN7406N	IC
C012	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	IC015	SN74LS273N	IC
C013	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	IC016	SN74LS367N	IC
C014	CE04W1C101M	CAP. ELECTRO 100 20% 16V	IC017	SN74LS367N	IC
C015	CE04W1C100M	CAP. ELECTRO 10 20% 16V	IC018	UPD444C-0	IC
C016	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	IC019	UPD444C-0	IC
C017	CE04W1C470M	CAP. ELECTRO 47 20% 16V	IC020	SN74LS273N	IC
C018	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	IC021	SN7406N	IC
C019	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	IC022	SN7406N	IC
C020	CE04W1C100M	CAP. ELECTRO 10 20% 16V	IC023	SN7406N	IC
C021	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	IC024	MC1741CP	IC
C022	CE04W1C100M	CAP. ELECTRO 10 20% 16V	IC025	MC14013BCP	IC
C023	CE04W1C101M	CAP. ELECTRO 100 20% 16V	IC026	MC14011BCP	IC
C024	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	IC027	LM310N	IC
C025	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	IC028	LM310N	IC
C026	CK45FB1H221K	CAP. CERAMIC 220P 10% 50V	IC029	SN7404N	IC
C027	CE04W1C470M	CAP. ELECTRO 47 20% 16V	IC030	SN7408N	IC
C028	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	L001	L40-4701-03	FERRI INDUCTOR 47UH
C029	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	L002	L40-4701-03	FERRI INDUCTOR 47UH
C030	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	L003	L40-4701-03	FERRI INDUCTOR 47UH
C031	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	L004	L40-4701-03	FERRI INDUCTOR 47UH
C032	CK45FB1H472K	CAP. CERAMIC 4700P 10% 50V	L005	L40-4701-03	FERRI INDUCTOR 47UH
C033	CK45SL1H220J	CAP. CERAMIC 22P 5% 50V	L006	L40-4701-03	FERRI INDUCTOR 47UH
C034	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	L007	L40-4701-03	FERRI INDUCTOR 47UH
C035	CE04W1C101M	CAP. ELECTRO 100 20% 16V	L008	L40-4701-03	FERRI INDUCTOR 47UH
C036	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	L009	L40-4701-03	FERRI INDUCTOR 47UH
C037	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	L010	L40-4701-03	FERRI INDUCTOR 47UH
C038	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	L011	L40-4701-03	FERRI INDUCTOR 47UH
C039	CE04W1C101M	CAP. ELECTRO 100 20% 16V	L012	L40-4701-03	FERRI INDUCTOR 47UH
C040	CE04W1C101M	CAP. ELECTRO 100 20% 16V	P001	E40-1273-05	PIN CONNECTOR 12P
C041	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	P002	E40-0273-05	PIN CONNECTOR 2P
C042	C90-0298-05	CAP. CERAMIC 0.1 20% 12V	P003	E40-0673-05	PIN CONNECTOR 6P
C043	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	P004	E40-0473-05	PIN CONNECTOR 4P
C044	CE04W1C100M	CAP. ELECTRO 10 20% 16V	P005	E40-1373-05	PIN CONNECTOR 13P
C045	CE04W1C100M	CAP. ELECTRO 10 20% 16V	Q001	25C1815(Y)	TR. SI, NPN
C046	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q002	25C1815(Y)	TR. SI, NPN
C047	NO USE		Q003	25C1815(Y)	TR. SI, NPN
C048	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q004	2N5771-T	TR. SI, PNP
C049	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q005	2N5771-T	TR. SI, PNP
C050	CK45FB1H102K	CAP. CERAMIC 1000P 10% 50V	Q006	2N5771-T	TR. SI, PNP
C051	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q007	2N5771-T	TR. SI, PNP
C052	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q008	2N5771-T	TR. SI, PNP
C053	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q009	2N5771-T	TR. SI, PNP
C054	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q010	2N5771-T	TR. SI, PNP
C055	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q011	2N5771-T	TR. SI, PNP
C056	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q012	2N5771-T	TR. SI, PNP
C057	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q013	2N5771-T	TR. SI, PNP
C058	CE04W1C101M	CAP. ELECTRO 100 20% 16V	Q014	2N5771-T	TR. SI, PNP
C059	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q015	2N5771-T	TR. SI, PNP
C060	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q016	2N5771-T	TR. SI, PNP
C061	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q017	2N5771-T	TR. SI, PNP
C062	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q018	2N5771-T	TR. SI, PNP
C063	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q019	2N5771-T	TR. SI, PNP
C064	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	Q020	25J43(R)	FET. P-CHANNEL
C065	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	R001	RN14BK2E1000F	RES. METAL FILM 100 1% 1/4W
C066	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	R002	RN14BK2E5600F	RES. METAL FILM 560 1% 1/4W
C067	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	R003	RN14BK2E1001F	RES. METAL FILM 1K 1% 1/4W
C068	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	R004	RN14BK2E1003F	RES. METAL FILM 100K 1% 1/4W
C069	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	R005	RD14BB2B152J	RES. CARBON 1.5K 5% 1/8W
C070	C91-0456-05	CAP. CERAMIC 0.047 10% 25V	R006	RD14BB2B152J	RES. CARBON 1.5K 5% 1/8W
C071	CE04W1C100M	CAP. ELECTRO 10 20% 16V	R007	NO USE	
C075	C91-0566-05	CAP. GOLD 1F 20% 5.5V	R008	RD14BB2B221J	RES. CARBON 220 5% 1/8W
C076	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	R009	RN14BK2E8200F	RES. METAL FILM 820 1% 1/4W
C077	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	R010	R92-1030-05	RES. METAL FILM 910
C078	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	R011	R92-1030-05	RES. METAL FILM 910
C079	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	R012	R92-1030-05	RES. METAL FILM 910
C080	CK45FB1H101K	CAP. CERAMIC 100P 10% 50V	R013	R92-1030-05	RES. METAL FILM 910
D001	DS442X	DIODE	R014	R92-1030-05	RES. METAL FILM 910
D002	DS442X	DIODE	R015	R92-1030-05	RES. METAL FILM 910
D003	DS442X	DIODE	R016	R92-1030-05	RES. METAL FILM 910
D004	DS442X	DIODE	R017	R92-1030-05	RES. METAL FILM 910
D005	DS442X	DIODE	R018	R92-1028-05	RES. METAL FILM 180
D006	DS442X	DIODE	R019	R92-1028-05	RES. METAL FILM 180
D007	WZ-063	DIODE ZENER 6.3V	R020	R92-1028-05	RES. METAL FILM 180
D008	DS442X	DIODE	R021	R92-1028-05	RES. METAL FILM 180
IC001	MC14174BCP	IC	R022	R92-1028-05	RES. METAL FILM 180
IC002	SN7408N	IC	R023	R92-1028-05	RES. METAL FILM 180
IC003	SN7406N	IC	R024	R92-1029-05	RES. METAL FILM 360
IC004	NE529N	IC	R025	R92-1029-05	RES. METAL FILM 360
IC005	AM2503PC	IC	R026	R92-1029-05	RES. METAL FILM 360
IC006	SN74LS193N	IC	R027	R92-1029-05	RES. METAL FILM 360
IC007	SN74LS193N	IC	R028	R92-1029-05	RES. METAL FILM 360
IC008	MC14175BCP	IC	R029	R92-1029-05	RES. METAL FILM 360
IC009	SN74LS193N	IC	R030	R92-1029-05	RES. METAL FILM 360
IC010	SN7404N	IC			

PARTS LIST; MU-1651(T)

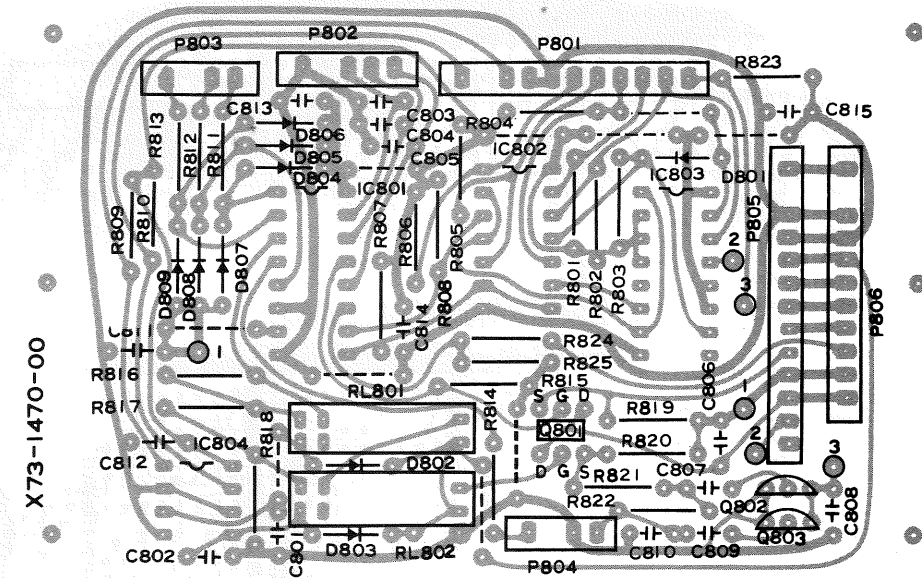
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R031	R92-1028-05	RES. METAL FILM 180			
R032	RN14BK2E2701F	RES. METAL FILM 2.7K	1%	1/4W	
R033	RN14BK2E1501F	RES. METAL FILM 1.5K	1%	1/4W	
R034	RD14BB2B102J	RES. CARBON	1K	5%	1/8W
R035	RD14BB2B471J	RES. CARBON	470	5%	1/8W
R036	RD14BB2B471J	RES. CARBON	470	5%	1/8W
R037	RD14BB2B363J	RES. CARBON	36K	5%	1/8W
R038	RD14BB2B223J	RES. CARBON	22K	5%	1/8W
R039	RD14BB2B104J	RES. CARBON	100K	5%	1/8W
R040	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R041	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R042	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R043	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R044	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R045	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R046	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R047	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R048	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R049	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R050	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R051	R92-1030-05	RES. METAL FILM 910			
R052	R92-1030-05	RES. METAL FILM 910			
R053	R92-1030-05	RES. METAL FILM 910			
R054	R92-1030-05	RES. METAL FILM 910			
R055	R92-1030-05	RES. METAL FILM 910			
R056	R92-1030-05	RES. METAL FILM 910			
R057	R92-1030-05	RES. METAL FILM 910			
R058	R92-1028-05	RES. METAL FILM 180			
R059	R92-1028-05	RES. METAL FILM 180			
R060	R92-1028-05	RES. METAL FILM 180			
R061	R92-1028-05	RES. METAL FILM 180			
R062	R92-1028-05	RES. METAL FILM 180			
R063	R92-1028-05	RES. METAL FILM 180			
R064	R92-1028-05	RES. METAL FILM 180			
R065	R92-1029-05	RES. METAL FILM 360			
R066	R92-1029-05	RES. METAL FILM 360			
R067	R92-1029-05	RES. METAL FILM 360			
R068	R92-1029-05	RES. METAL FILM 360			
R069	R92-1029-05	RES. METAL FILM 360			
R070	R92-1029-05	RES. METAL FILM 360			
R071	R92-1029-05	RES. METAL FILM 360			
R072	R92-1028-05	RES. METAL FILM 180			
R073	RN14BK2E8200F	RES. METAL FILM 820	1%	1/4W	
R074	RN14BK2E1001F	RES. METAL FILM 1K	1%	1/4W	
R075	RN14BK2E6801F	RES. METAL FILM 6.8K	1%	1/4W	
R076	RN14BK2E4701F	RES. METAL FILM 4.7K	1%	1/4W	
R077	RD14BB2B103J	RES. CARBON	10K	5%	1/8W
R078	RD14BB2B473J	RES. CARBON	47K	5%	1/8W
R079	RD14BB2B471J	RES. CARBON	470	5%	1/8W
R080	RD14BB2B221J	RES. CARBON	220	5%	1/8W
R081	RD14BB2B103J	RES. CARBON	10K	5%	1/8W
R082	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R083	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R084	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R085	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R086	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R087	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R088	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R089	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R090	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R091	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R092	RD14BY2H220J	RES. CARBON	22	5%	1/2W
R093	RD14BB2B222J	RES. CARBON	2.2K	5%	1/8W
R094	RD14BB2B221J	RES. CARBON	220	5%	1/8W
R095	RD14BB2B221J	RES. CARBON	220	5%	1/8W
R096	RD14BB2B221J	RES. CARBON	220	5%	1/8W
R097	RD14BB2B221J	RES. CARBON	220	5%	1/8W
R098	RD14BB2B221J	RES. CARBON	220	5%	1/8W
R099	RD14BB2B472J	RES. CARBON	4.7K	5%	1/8W
R100	NO USE				
R101	RD14BB2B473J	RES. CARBON	47K	5%	1/8W
VR001	R12-0511-05	RES. SEMI FIXED			
VR002	R12-1037-05	RES. SEMI FIXED			
VR003	R12-0511-05	RES. SEMI FIXED			
VR004	R12-0511-05	RES. SEMI FIXED			
VR005	R12-3041-05	RES. SEMI FIXED			
VR006	R12-3041-05	RES. SEMI FIXED			
X001	L77-1002-05	CRYSTAL RESONATOR			

P.C. BOARD; MS-1650B

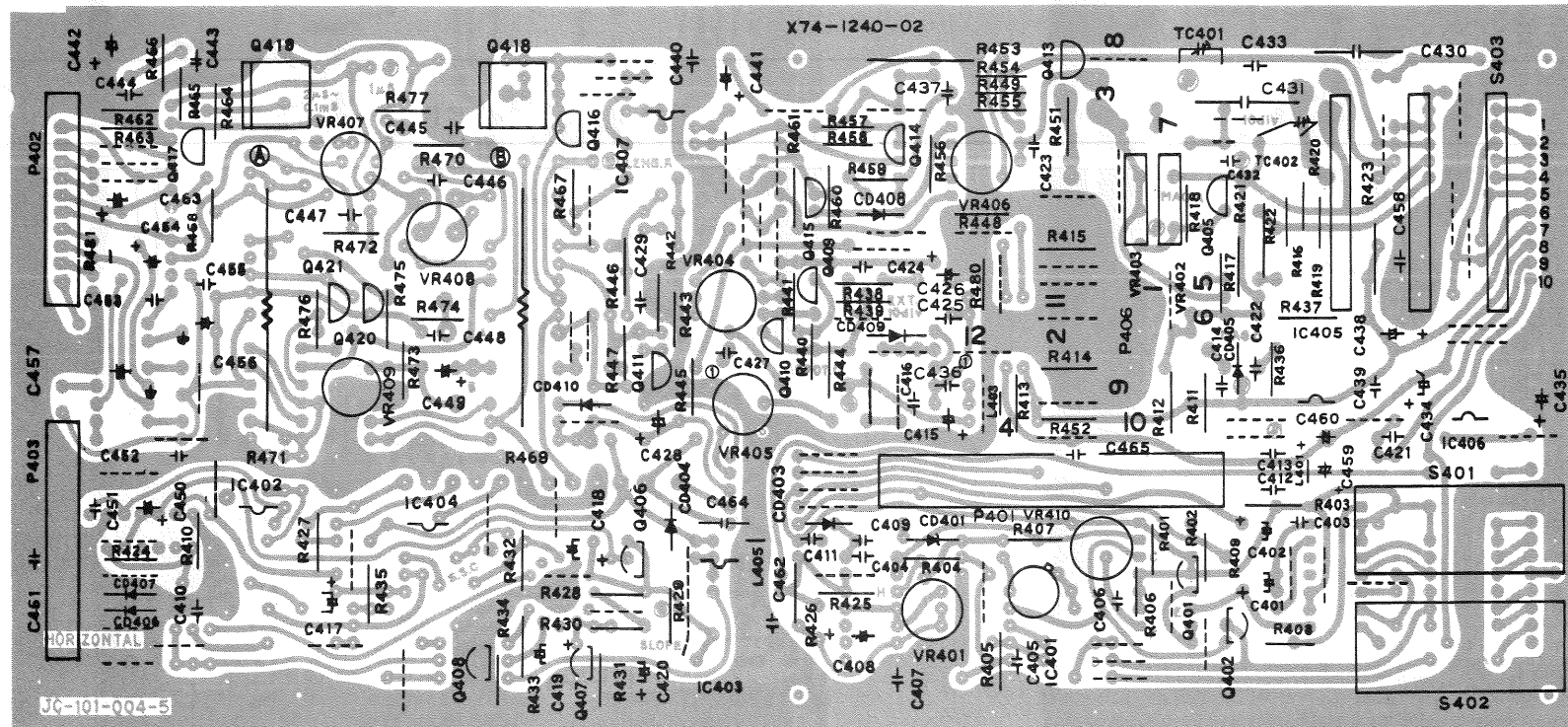
VERTICAL UNIT (X73-1370-02)



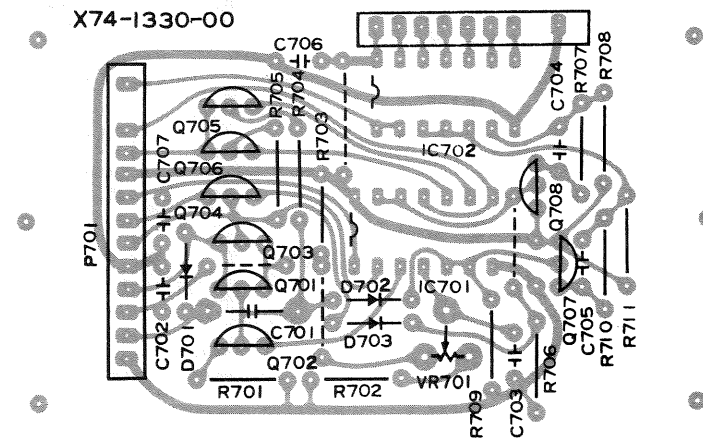
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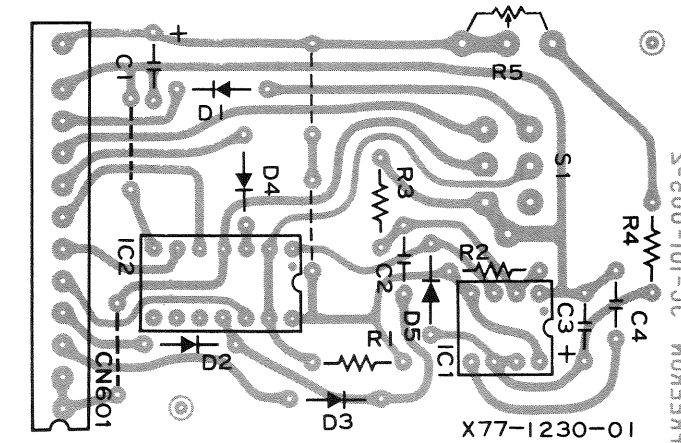
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HORIZONTAL SUB UNIT (X74-1330-00)

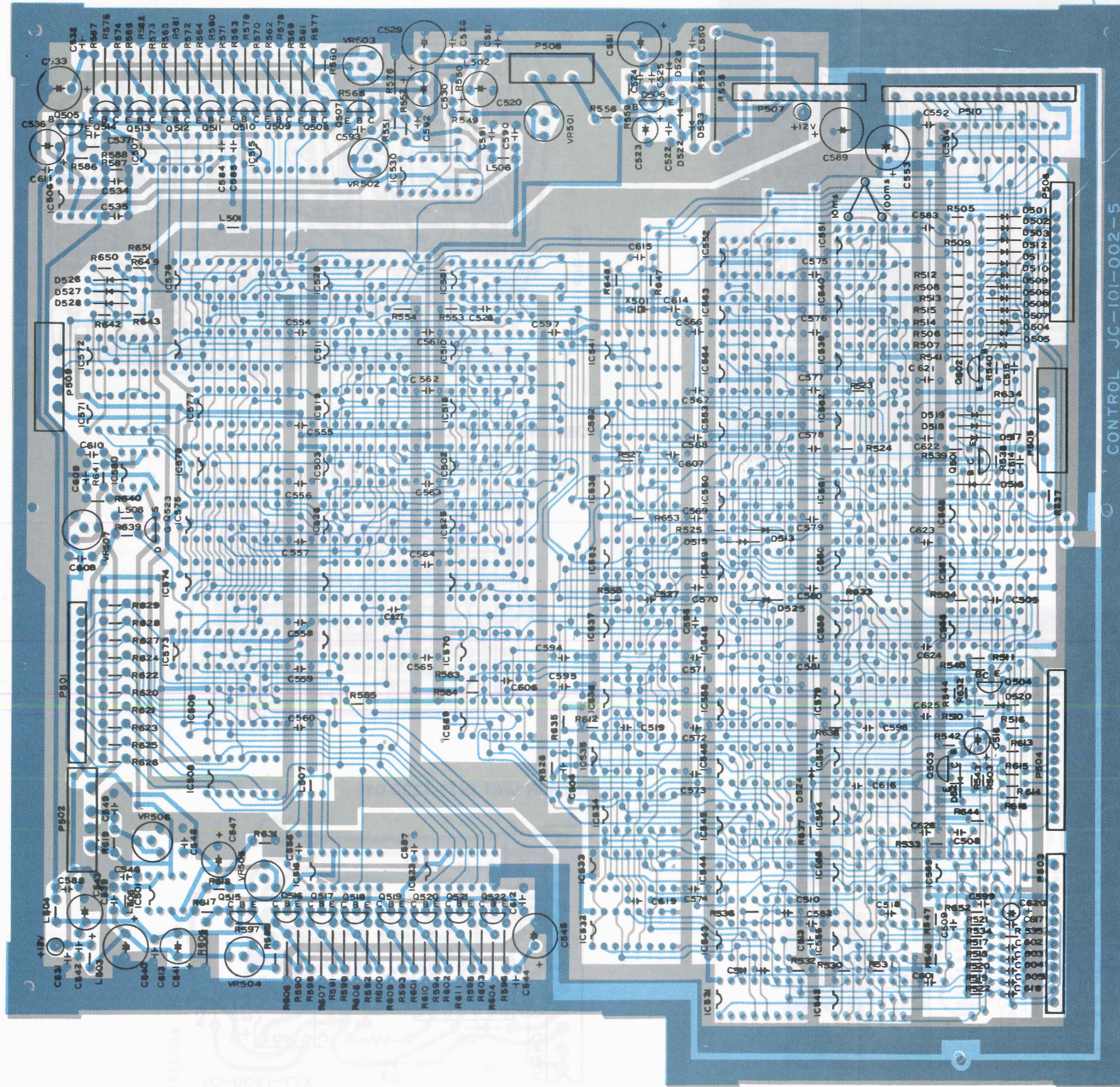


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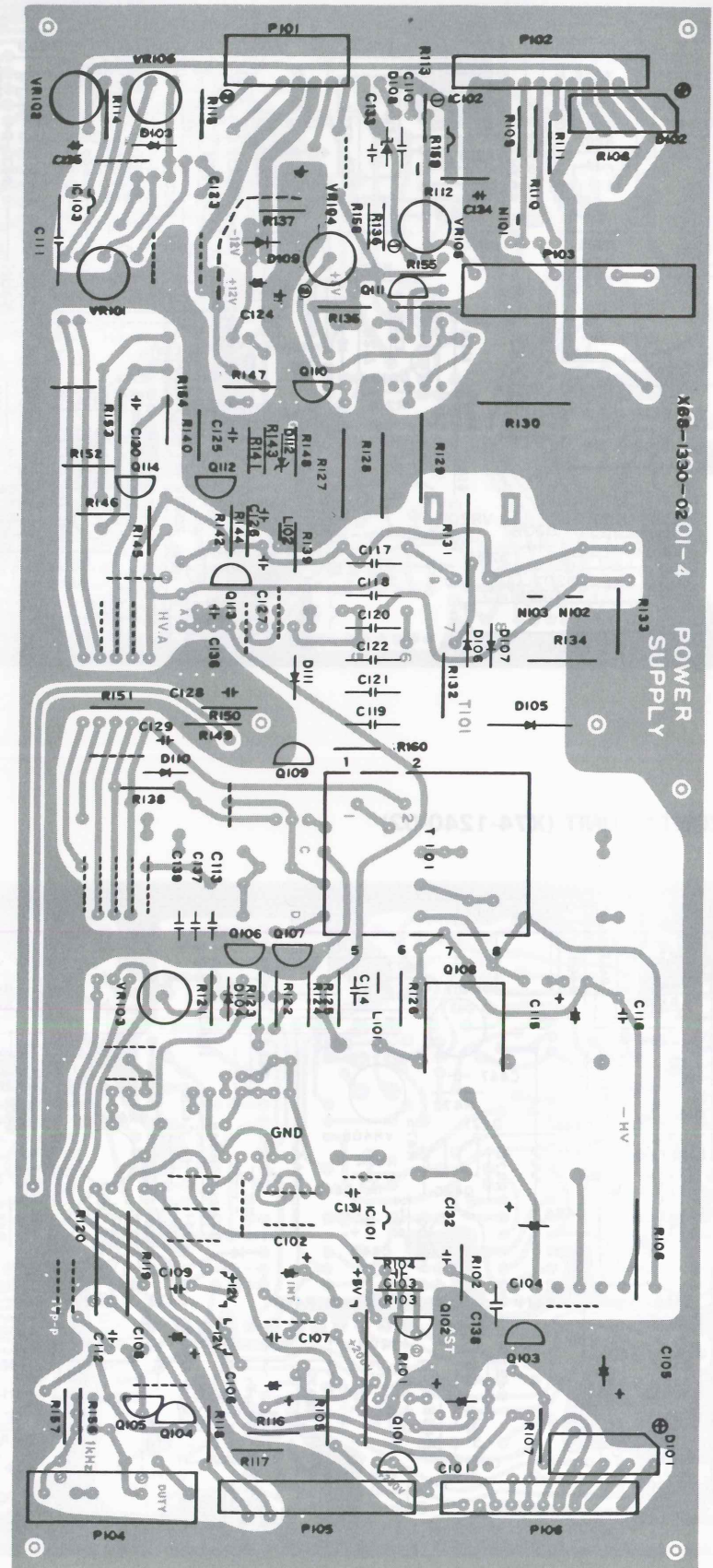


P.C. BOARD

CONTROL UNIT (X77-1170-02)

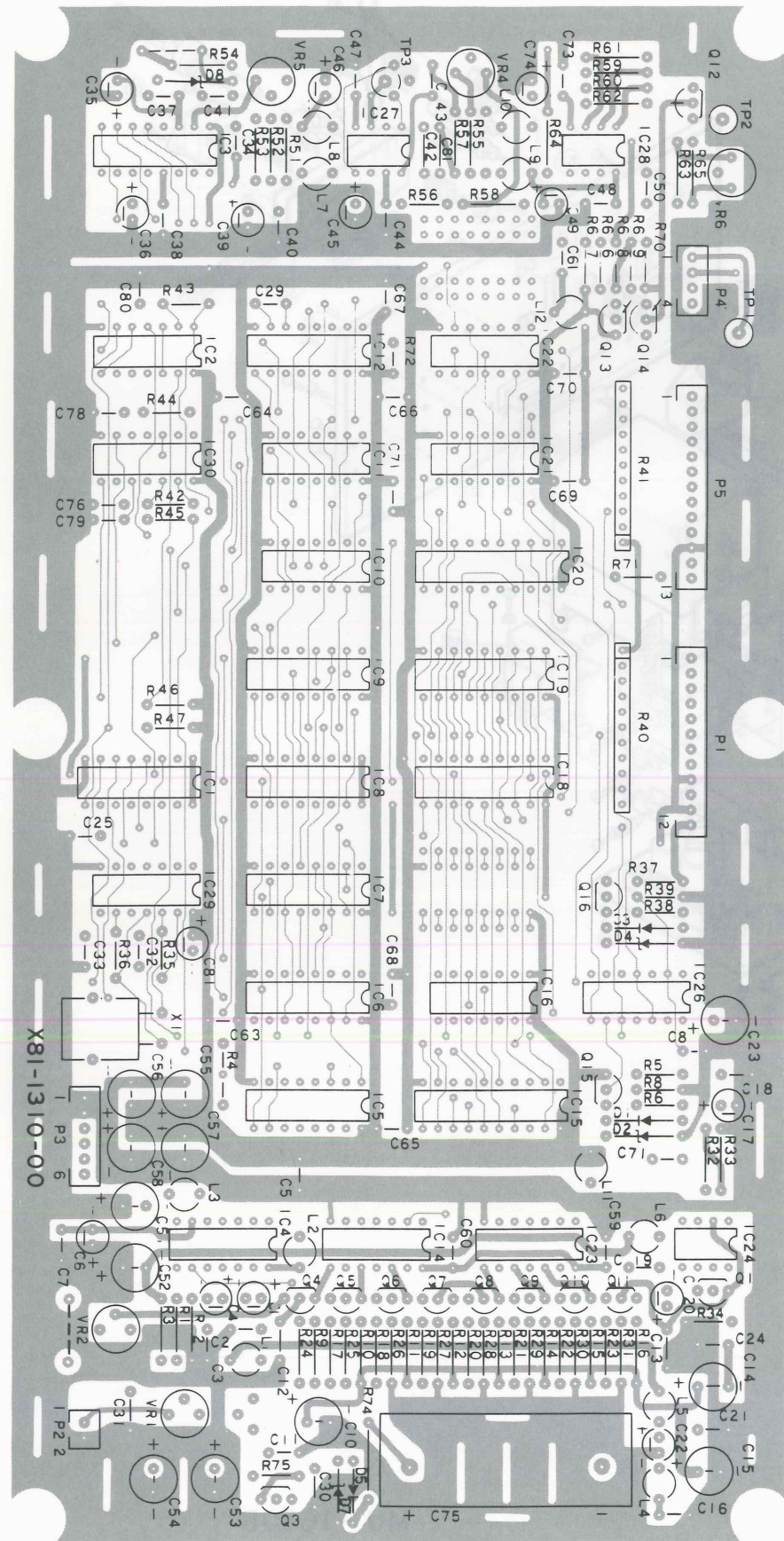


POWER SUPPLY UNIT (X68-1330-02)

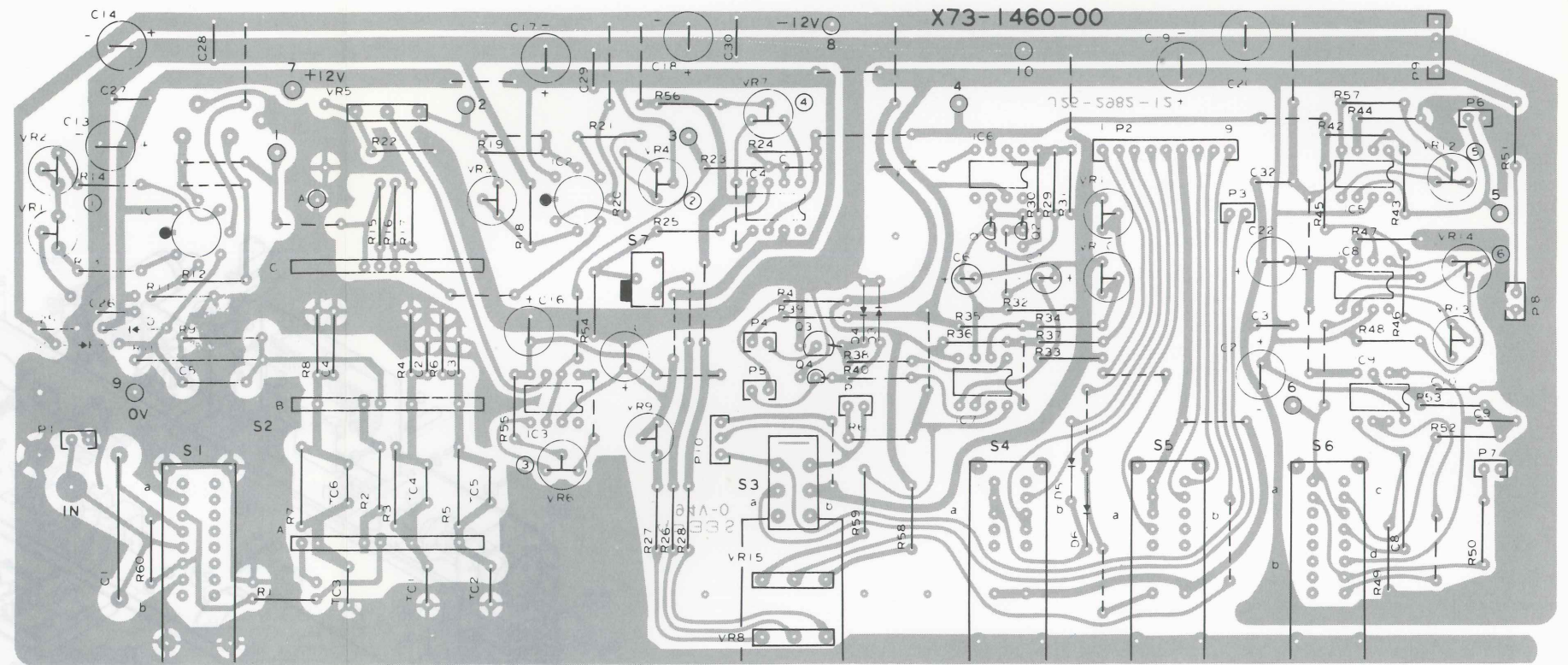


8-A0 P.C. BOARD; MU-1651

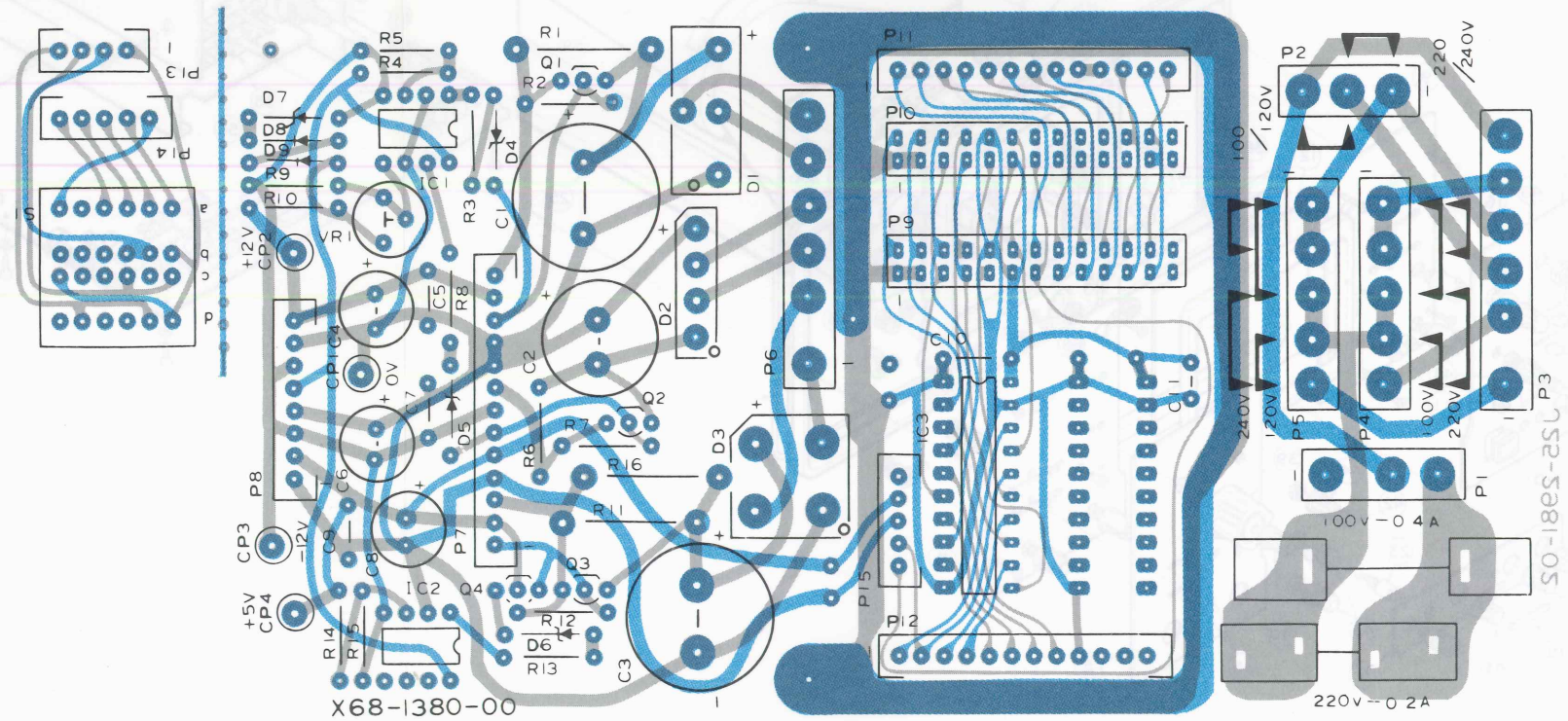
MEMORY UNIT (X81-1310-00)



AMP UNIT (X73-1460-00)



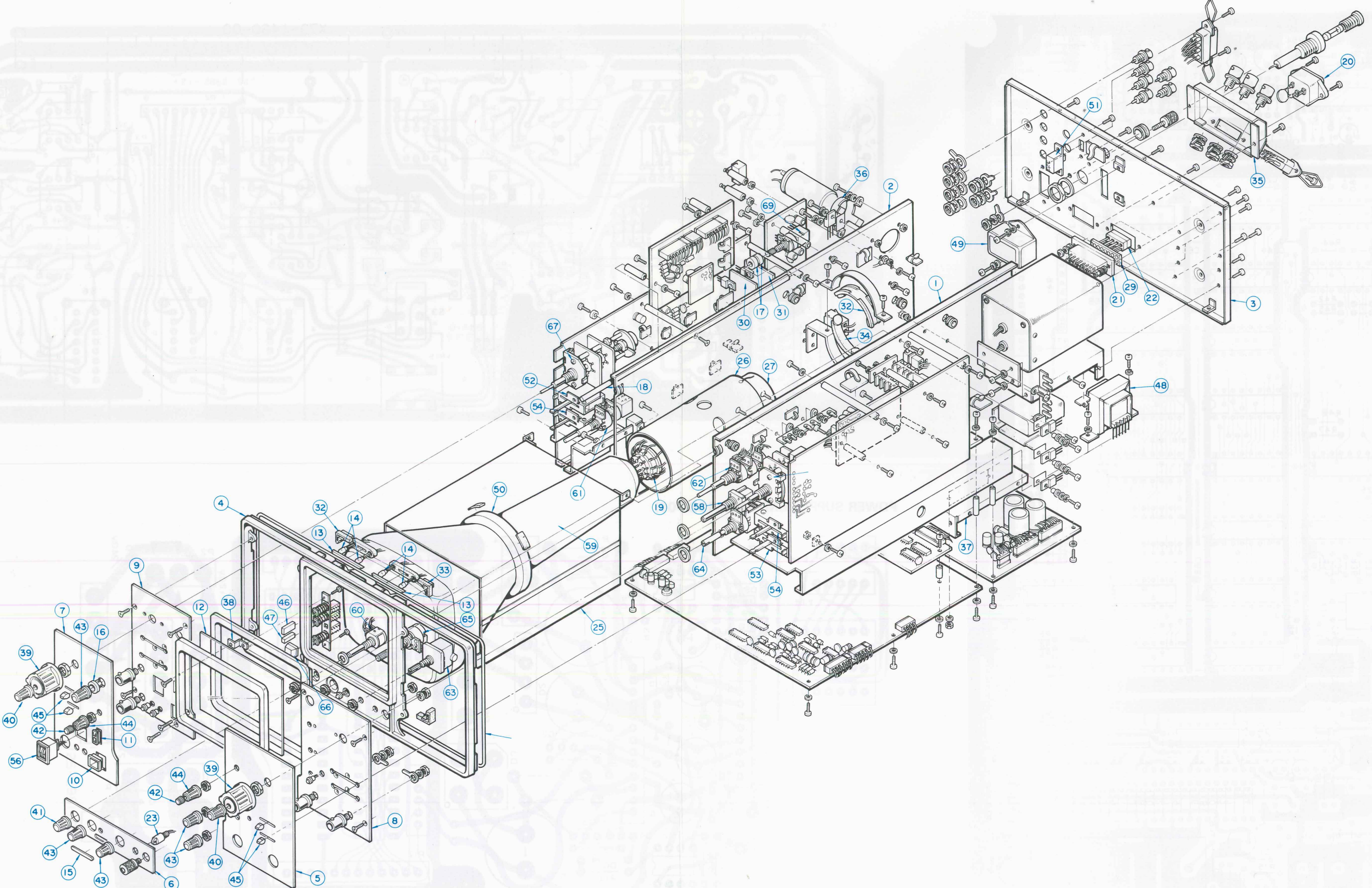
POWER SUPPLY UNIT (X68-1380-00)



DISASSEMBLY; MS-1650A-B

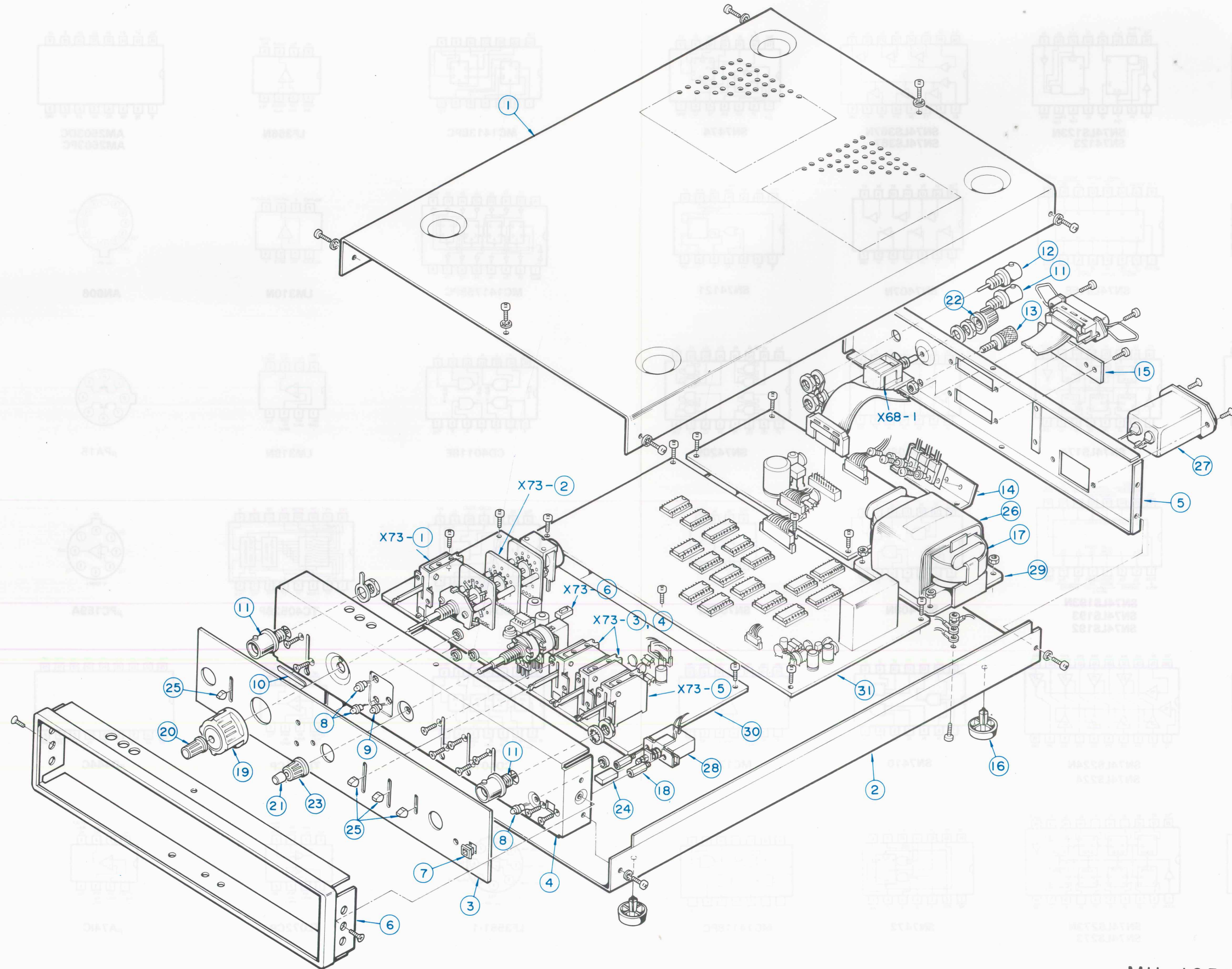
AMP UNIT (X3-1460-ETX) TIME 9MA

MEMORY UNIT (X3-1470-00)



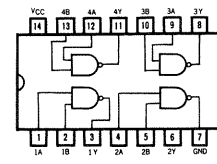
MU - 1650B

DISASSEMBLY; MU-1651

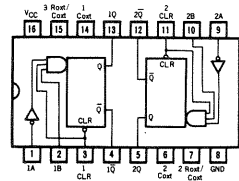


MU-1651

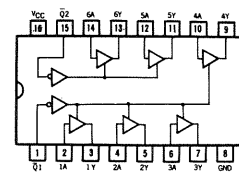
SEMICONDUCTORS



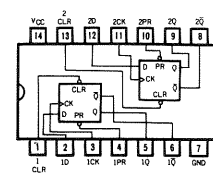
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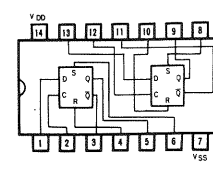
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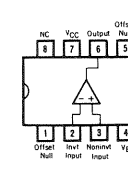
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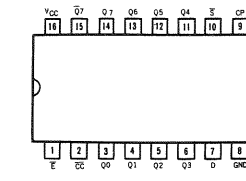
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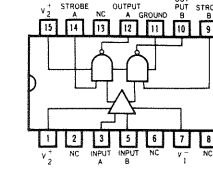
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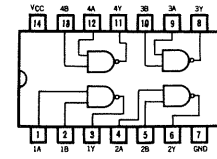
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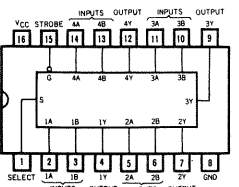
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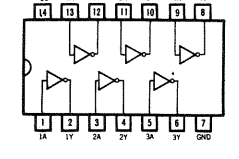
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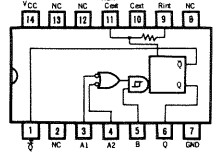
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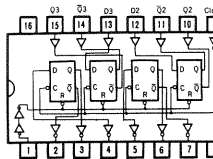
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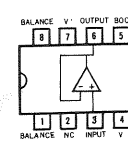
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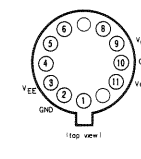
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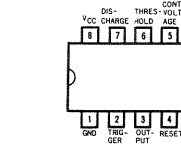
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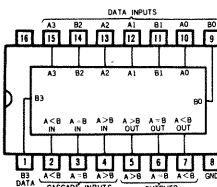
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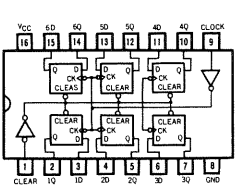
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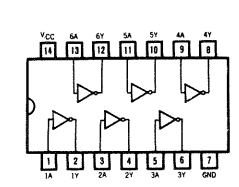
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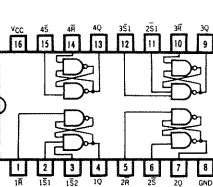
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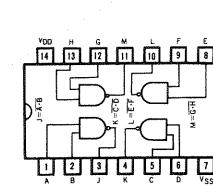
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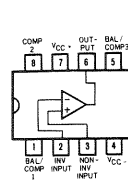
SN7406N
SN7406



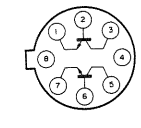
SN74209



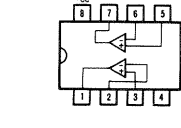
CD4011BE



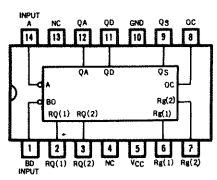
LM318N



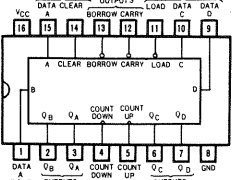
μPA15



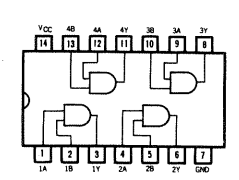
RC4558D



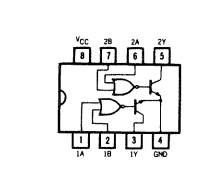
SN74LS90



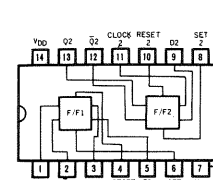
SN74LS193N
SN74LS193
SN74LS192



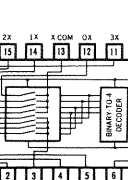
SN7408N



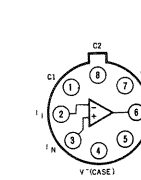
SN75453



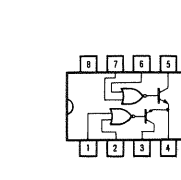
CD4013BE



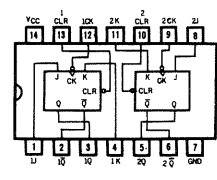
TC40528P



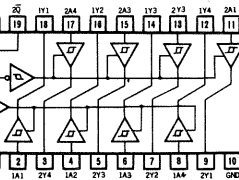
μPC159A



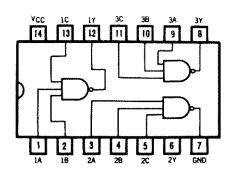
M54603



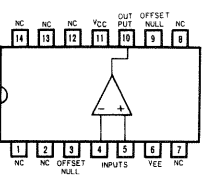
SN74LS107



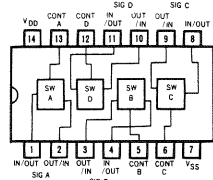
SN74LS224N
SN74LS224



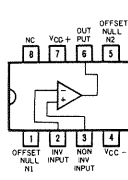
SN7410



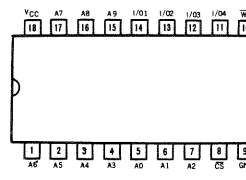
MC1741



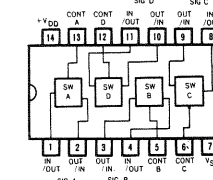
CD4016



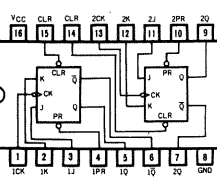
TL071CP



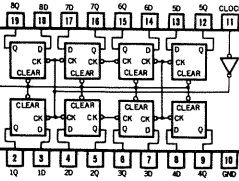
μD444C



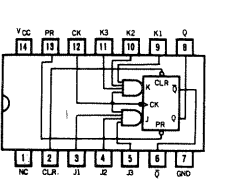
4066B



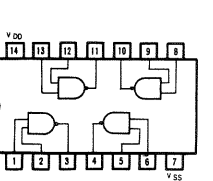
SN74LS112



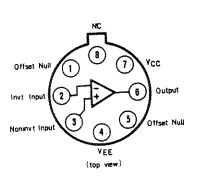
SN74LS273N
SN74LS273



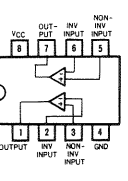
SN7472



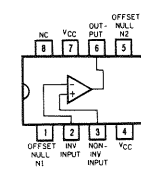
MC1411BPC



LF3561-1

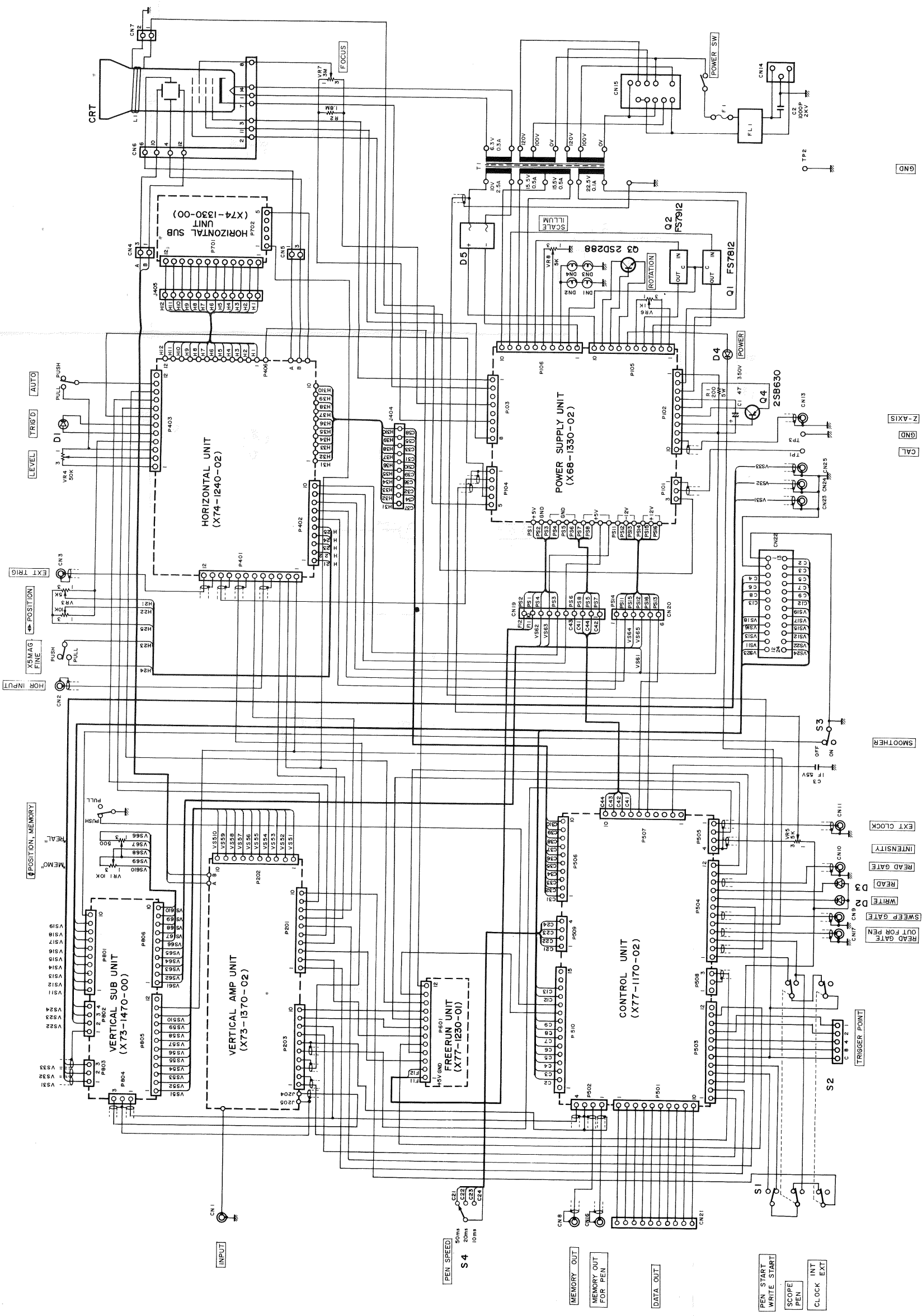


TL072CP

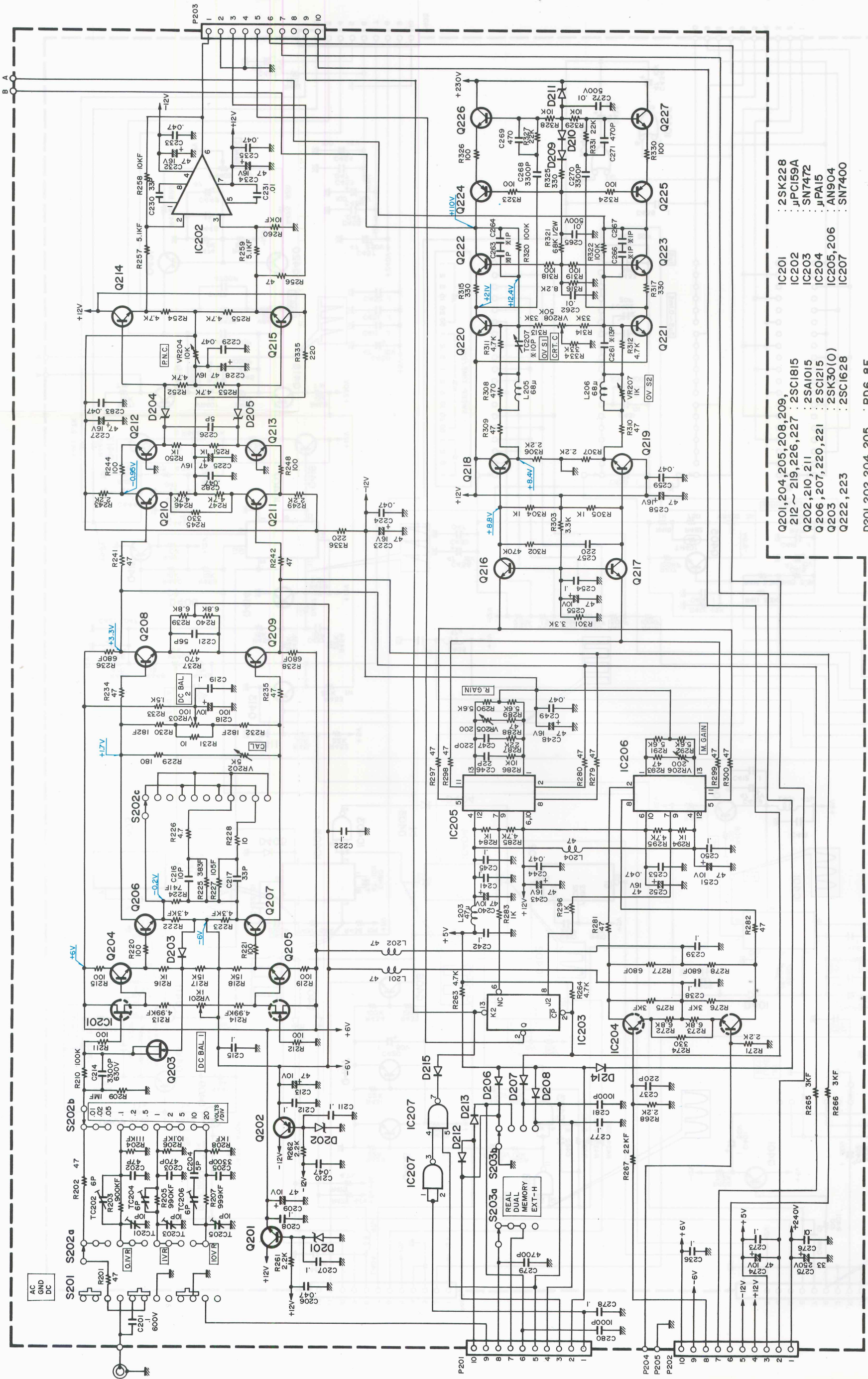


μA741C

TOTAL DIAGRAM

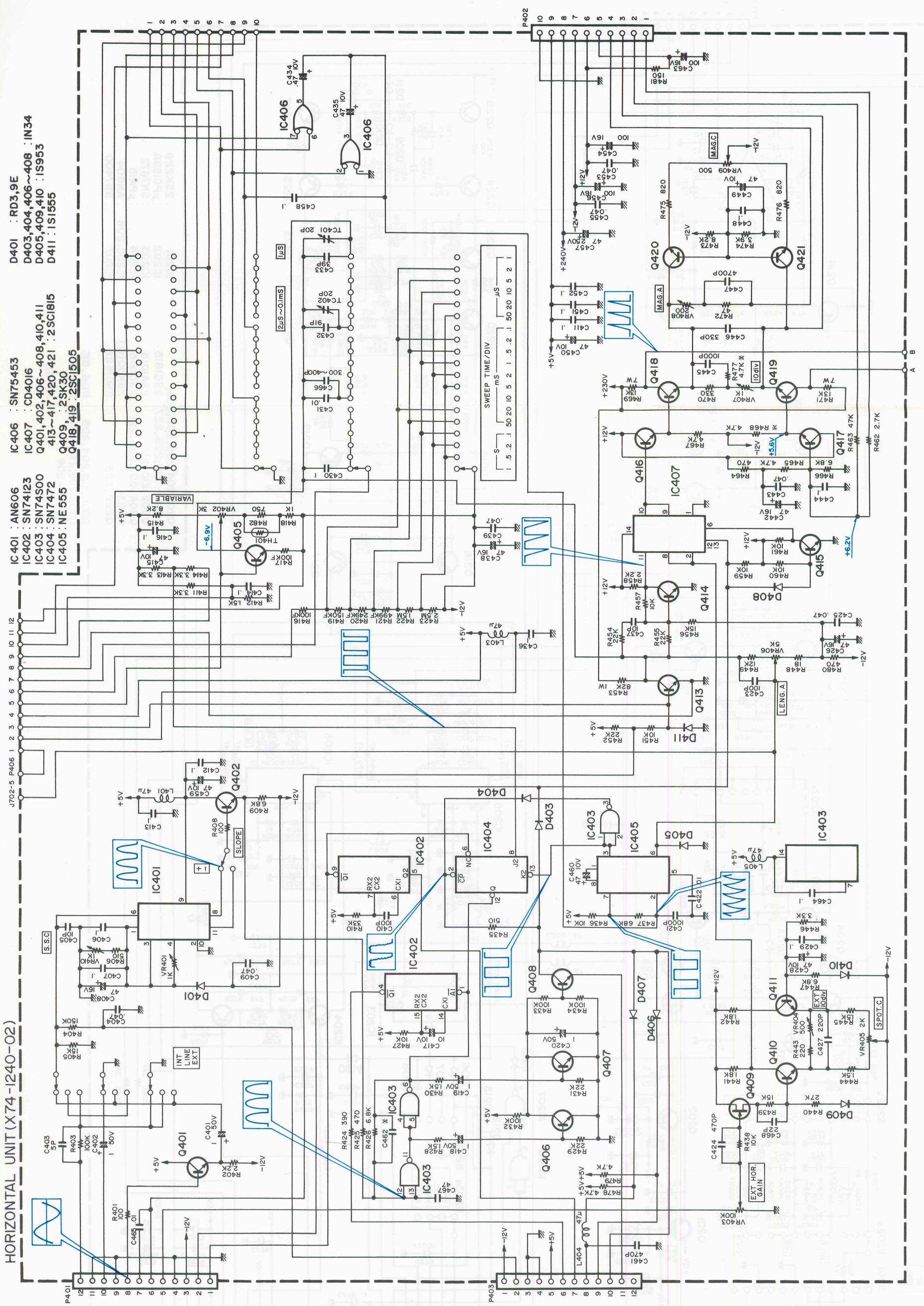


VERTICAL UNIT (X73-1370-02)



- IC201 : 2SK228
 - IC202 : μPCI59A
 - IC203 : SN7472
 - IC204 : μPA15
 - IC205, 206 : AN904
 - IC207 : SN7400
- Q201, 204, 205, 208, 209, 212 ~ 219, 226, 227 : 2SC1815
 - Q202, 210, 211 : 2SA1015
 - Q206, 207, 220, 221 : 2SC1215
 - Q203 : 2SK301(O)
 - Q222, 223 : 2SC1628
 - D201, 202, 204, 205 : RD6, 8E
 - D203, 209, 210, 214, 215 : IS953
 - D206 ~ 208 : IN34
 - D211 : RD10E

HORIZONTAL UNIT (X74-1240-02)

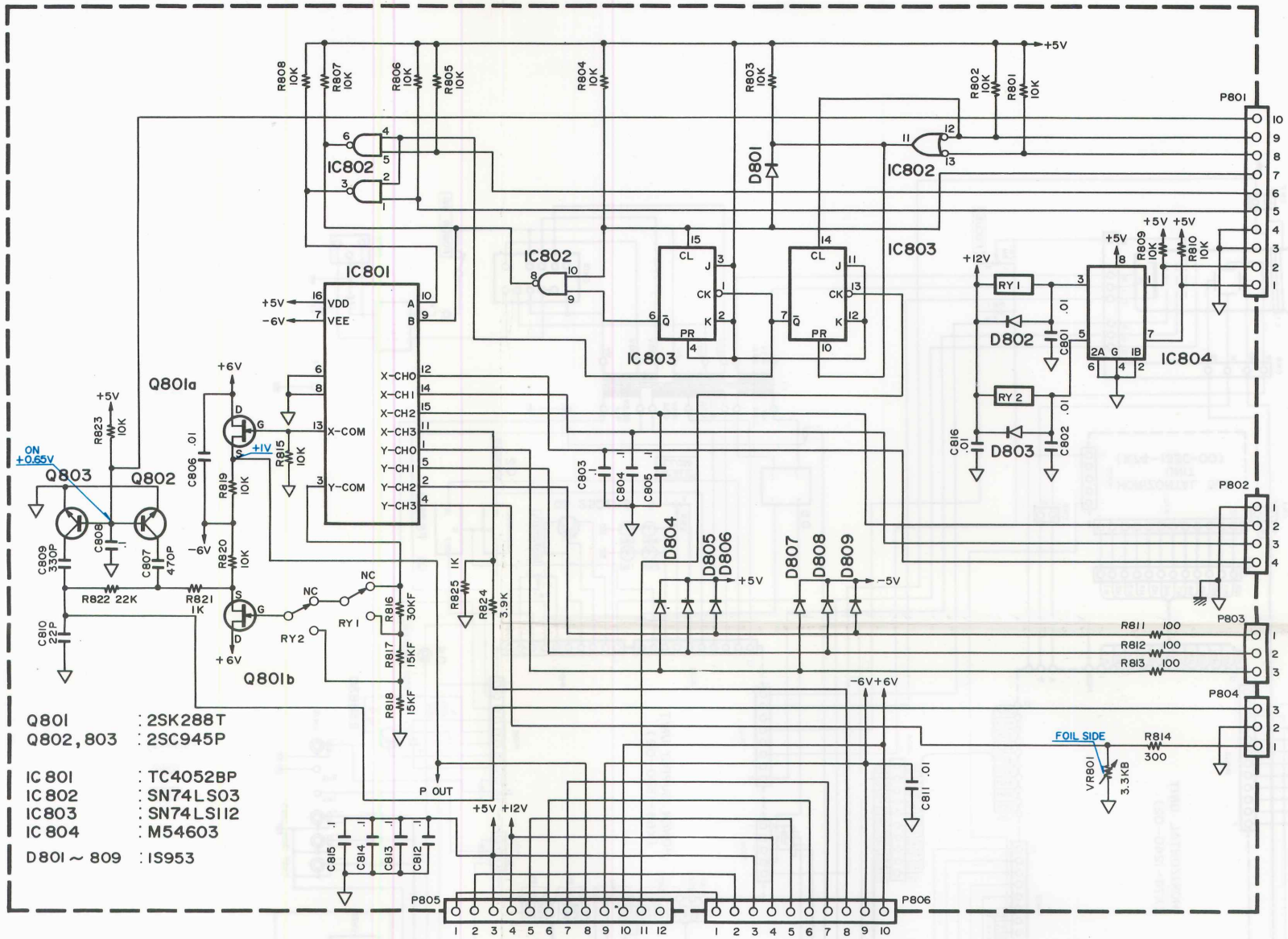


- D401 : RD3,9E
- D403,404,406~408 : IN34
- D405,409,410 : IS953
- D411 : IS1555
- IC401 : AN606
- IC402 : SN74123
- IC403 : SN74S00
- IC404 : SN7472
- IC405 : NE555
- IC406 : SN75453
- IC407 : CD4016
- Q401,402,406~408,410,411
- Q43~417,420,421 : 2SC1815
- Q409 : 2SK30
- Q418,419 : 2SC1505

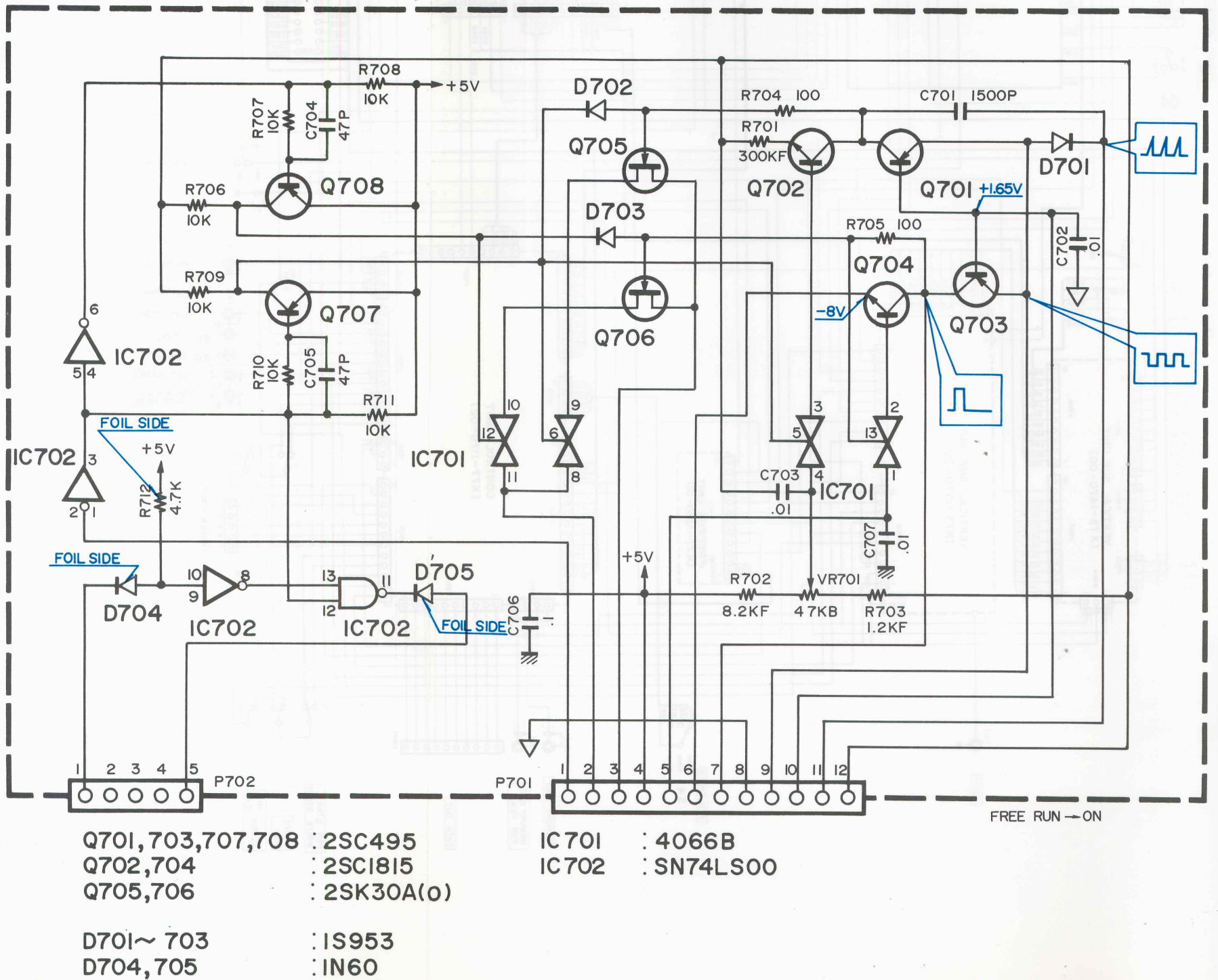
SCHEMATIC DIAGRAM (MS-1650B)

VERTICAL SUB UNIT (X73-1470-00)

TOTAL DIAGRAM

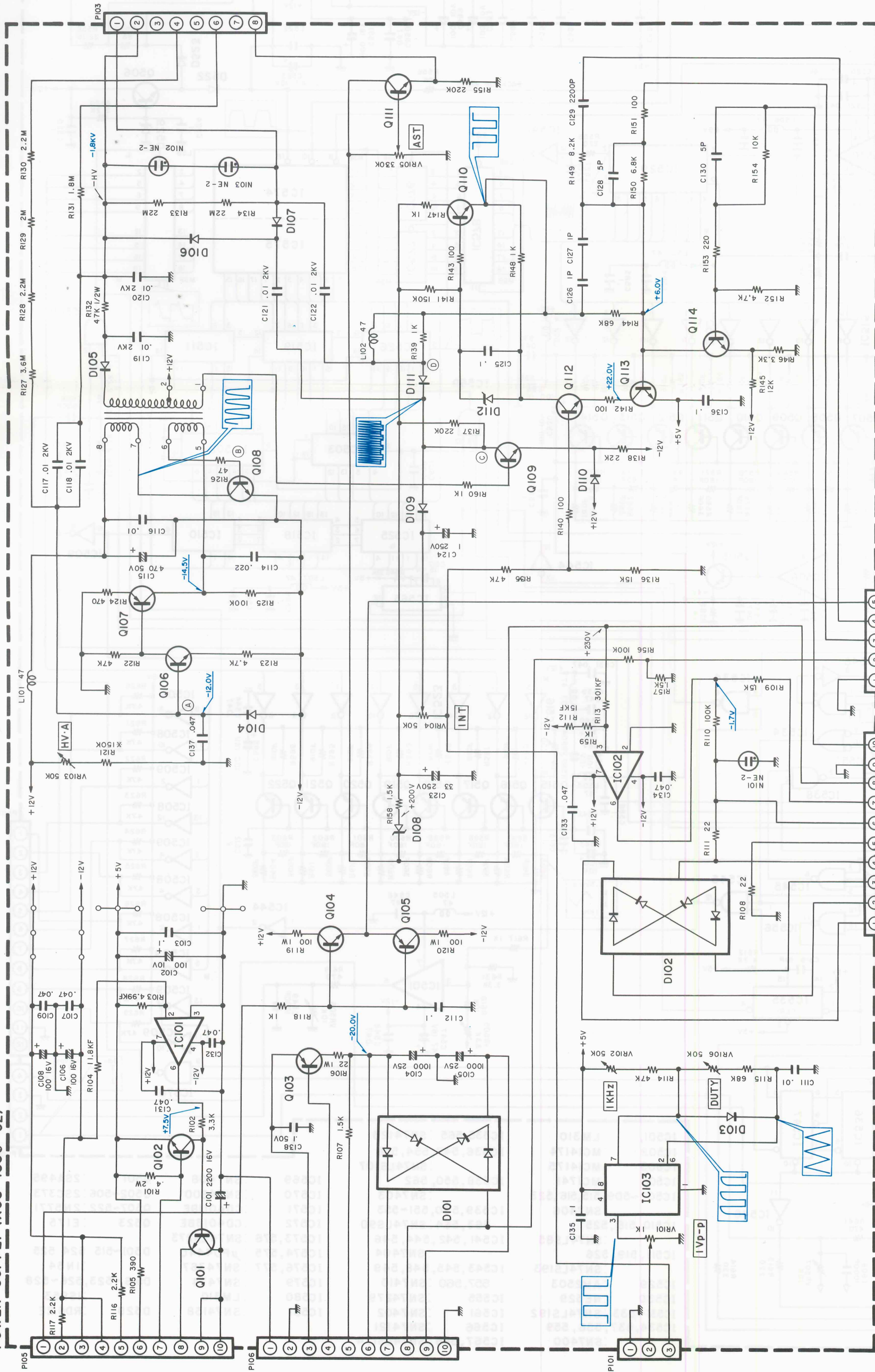


HORIZONTAL SUB UNIT (X73-1330-00)



POWER SUPPLY (X68-1330-01)
POWER SUPPLY (X68-1330-02)

POWER SUPPLY (X68-1330-01)
POWER SUPPLY (X68-1330-02)

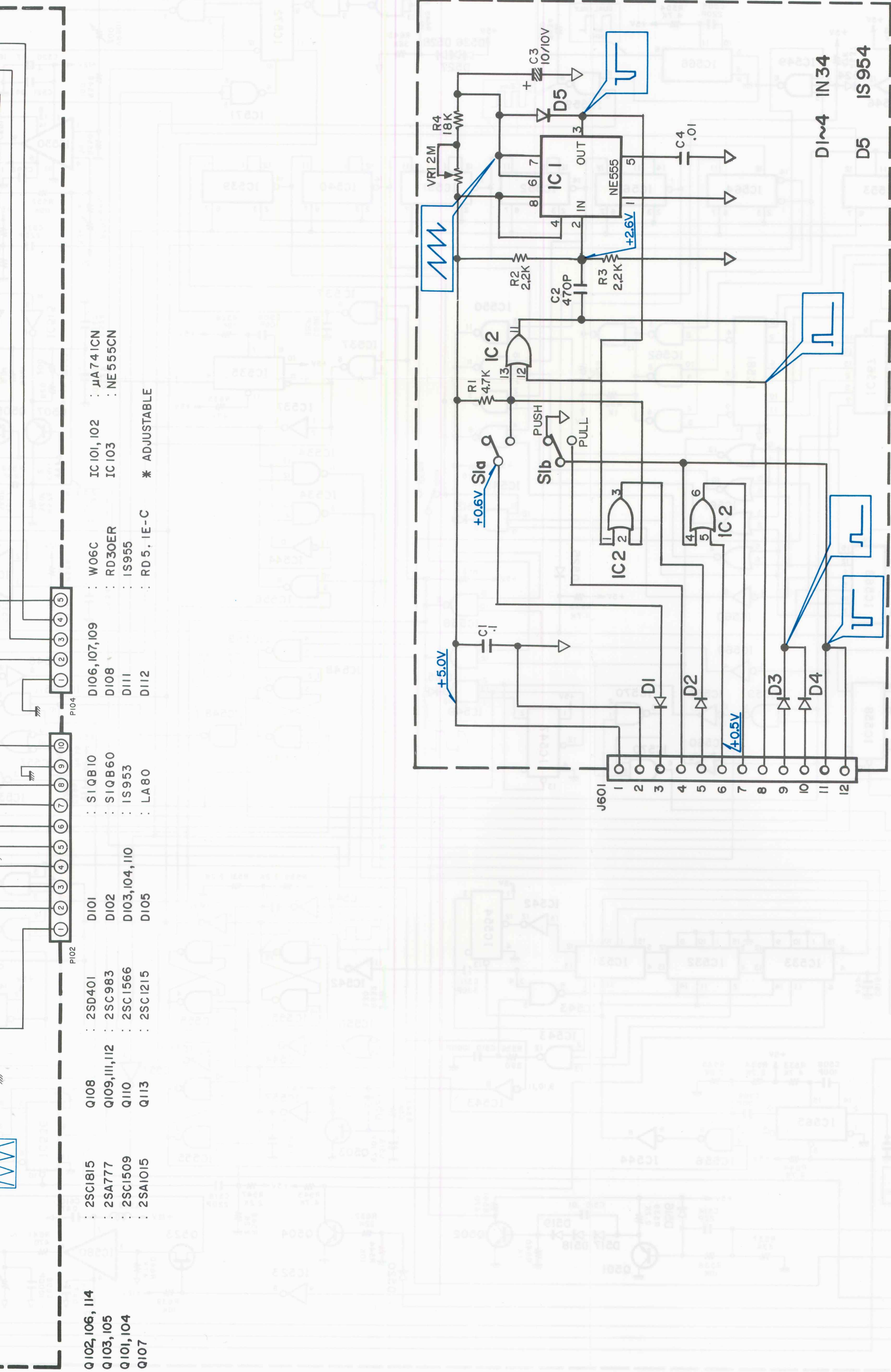


- Q102, 106, 114 : 2SC1815
- Q103, 105 : 2SA777
- Q101, 104 : 2SC1509
- Q107 : 2SA1015
- Q108 : 2SD401
- Q109, 111, 112 : 2SC983
- Q110 : 2SC1566
- Q113 : 2SC1215
- D101 : 1N4001
- D102 : 2SC983
- D103, 104, 110 : 1N4001
- D105 : 1N4001
- D106, 107, 109 : W06C
- D108 : RD30ER
- D111 : IS955
- D112 : RD5, 1E-C
- IC101, 102 : μ A741CN
- IC103 : NE555CN

* ADJUSTABLE

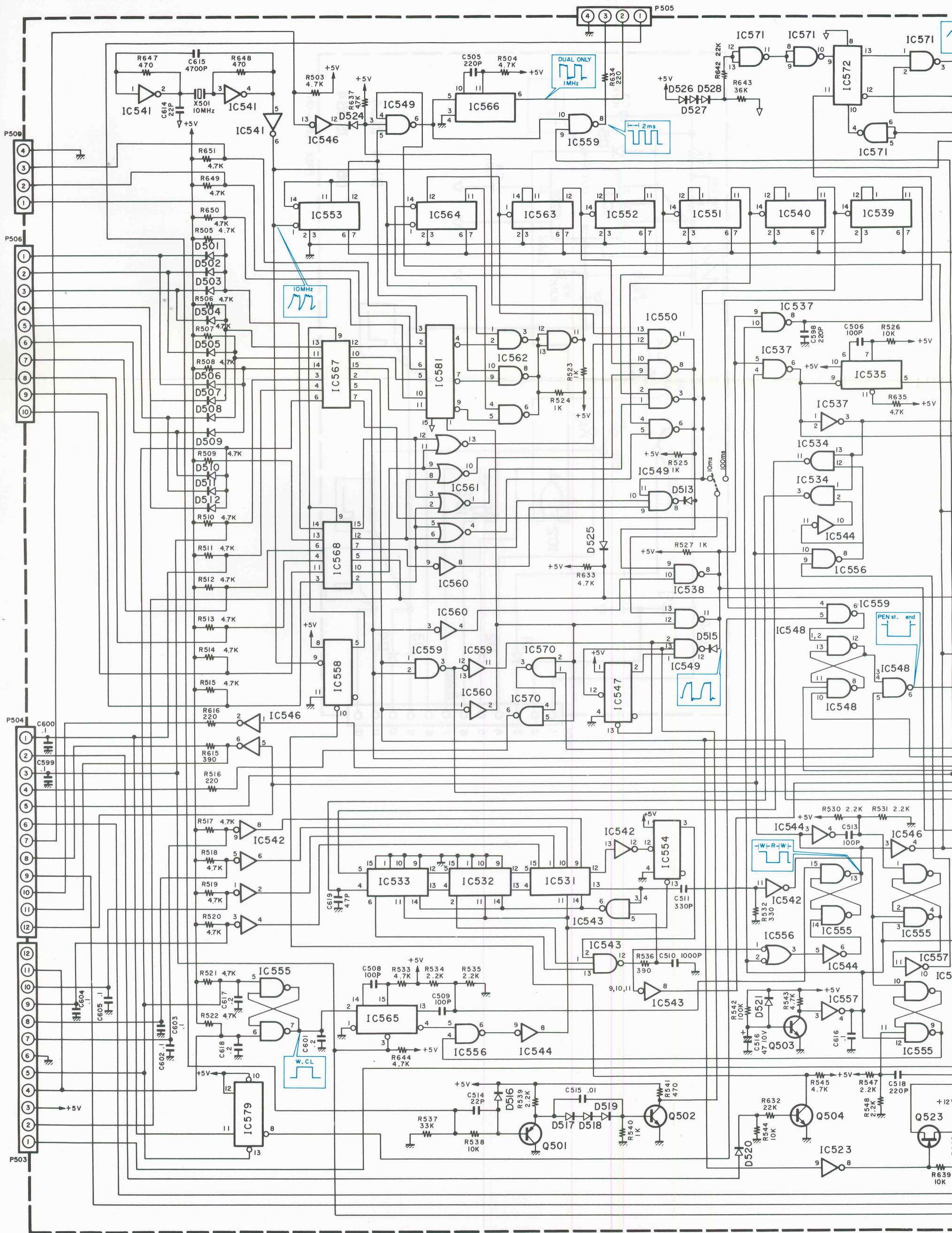
SCHEMATIC DIAGRAM (MS-1650B)

FREERUN UNIT (X77-1230-01)
 FREERUN UNIT (X77-1230-02)

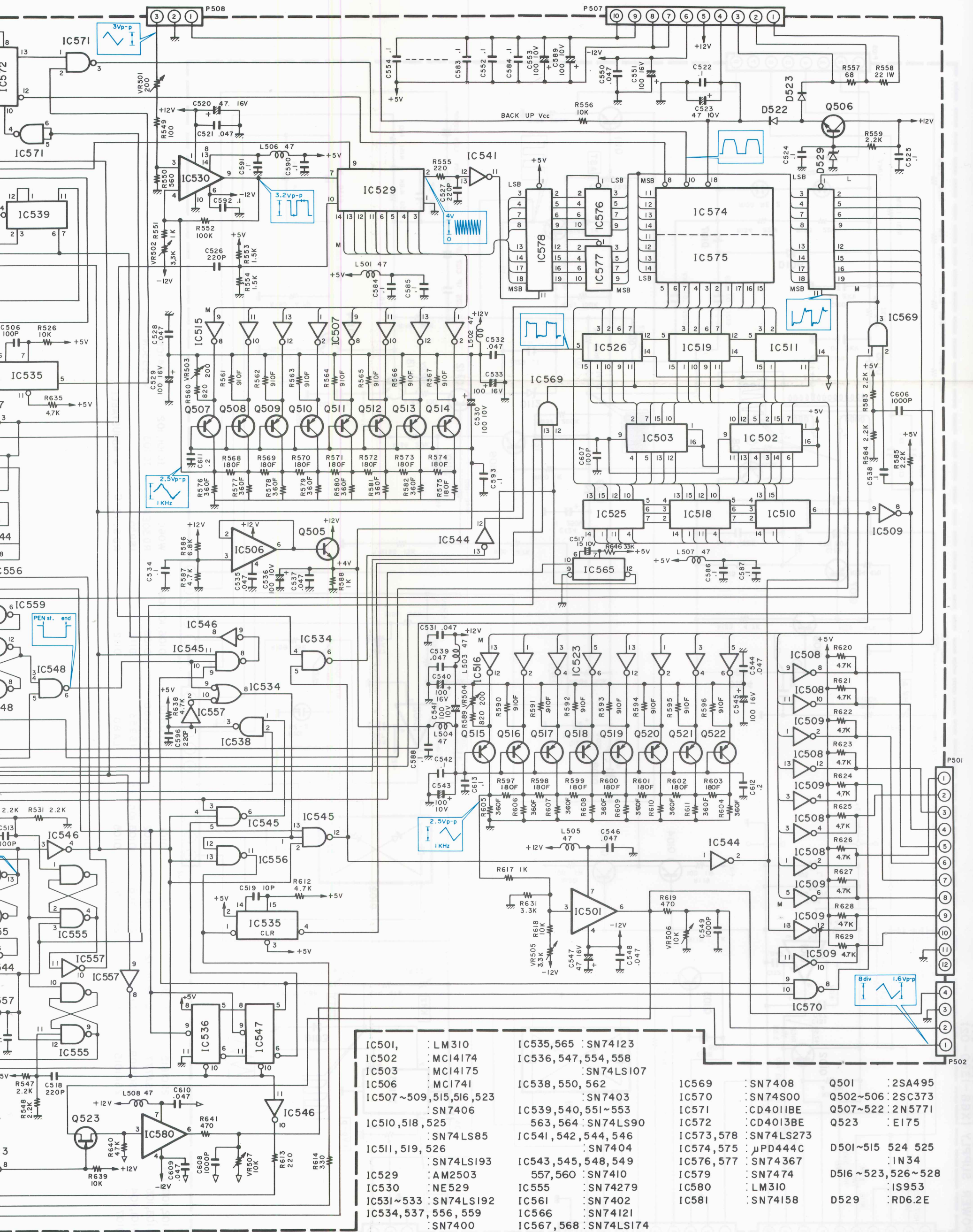


UNIT (X77-1230-02)

CONTROL UNIT (X77-1170-02)



LOGIC DIAGRAM (MS-1650B)

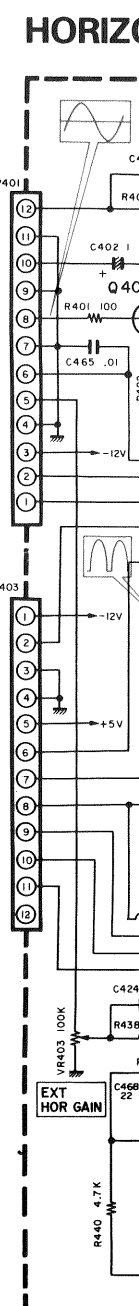
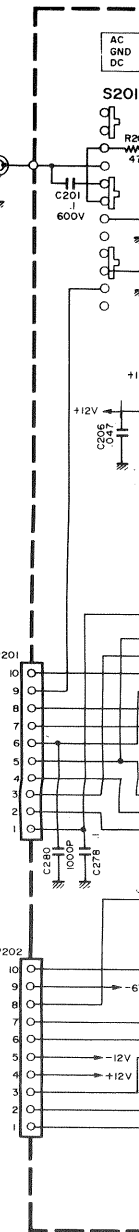
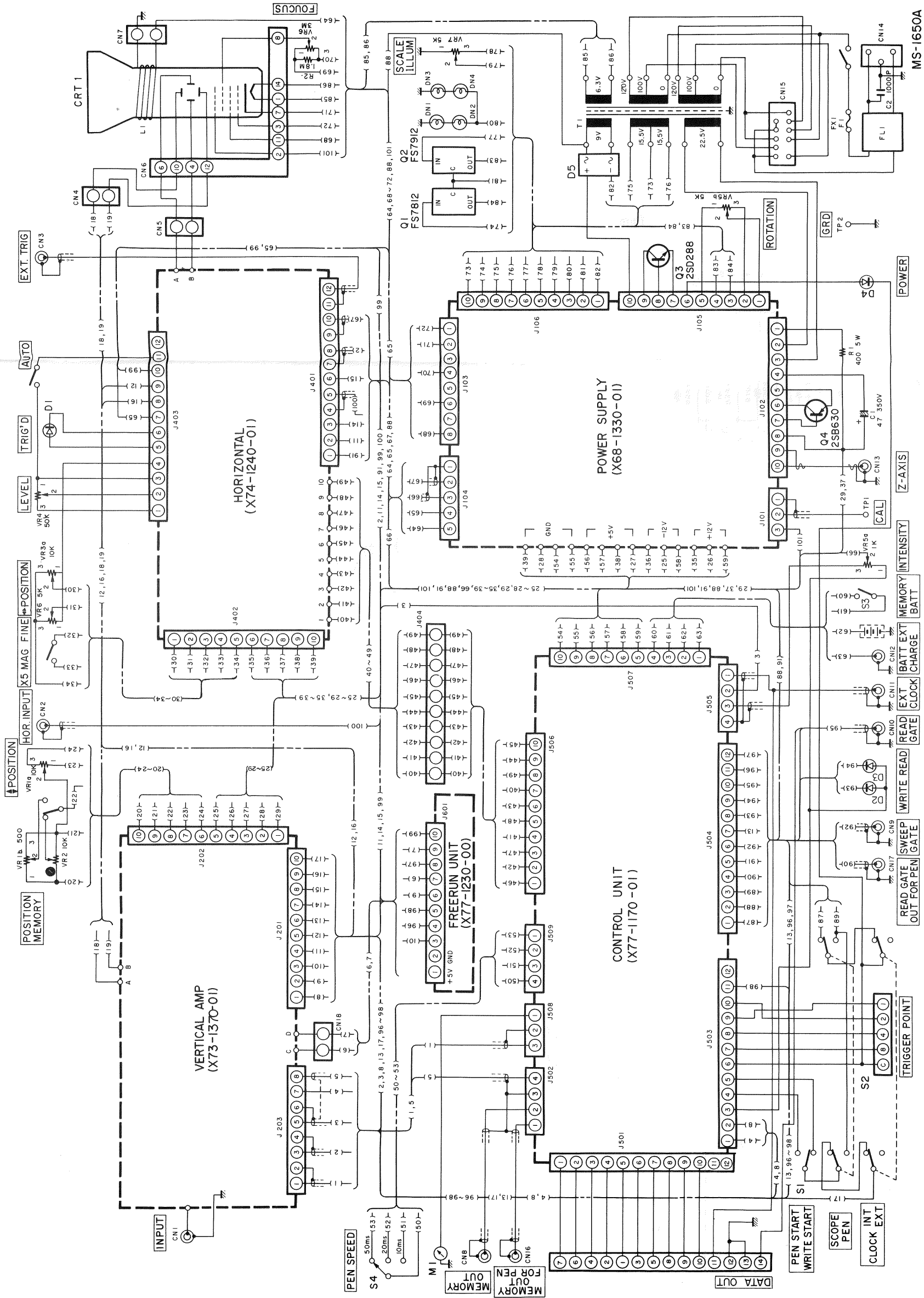


IC501, :	LM310	IC535, 565 :	SN74123	IC569 :	SN7408	Q501 :	2SA495
IC502 :	MC14174	IC536, 547, 554, 558 :	SN74LS107	IC570 :	SN74S00	Q502~506 :	2SC373
IC503 :	MC14175	IC538, 550, 562 :	SN7403	IC571 :	CD4011BE	Q507~522 :	2N5771
IC506 :	MC1741	IC539, 540, 551~553 :	SN74LS90	IC572 :	CD4013BE	Q523 :	E175
IC507~509, 515, 516, 523 :	SN7406	IC541, 542, 544, 546 :	SN7404	IC573, 578 :	SN74LS273	D501~515, 524, 525 :	IN34
IC510, 518, 525 :	SN7406	IC543, 545, 548, 549 :	SN7404	IC574, 575 :	μPD44C	D516~523, 526~528 :	IS953
IC511, 519, 526 :	SN74LS85	IC544 (LM310) :	LM310	IC576, 577 :	SN74367	D529 :	RD6.2E
IC529 :	AM2503	IC545, 546 (SN7404) :	SN7404	IC579 :	SN7474		
IC530 :	NE529	IC547 (SN7404) :	SN7404	IC580 :	LM310		
IC531~533 :	SN74LS192	IC548 (SN7404) :	SN7404	IC581 :	SN74158		
IC534, 537, 556, 559 :	SN7400	IC549 (SN7404) :	SN7404				
IC535, 565 :	SN74123	IC550 (SN7404) :	SN7404				
IC536, 547, 554, 558 :	SN74LS107	IC551 (SN7404) :	SN7404				
IC538, 550, 562 :	SN7403	IC552 (SN7404) :	SN7404				
IC539, 540, 551~553 :	SN74LS90	IC553 (SN7404) :	SN7404				
IC541, 542, 544, 546 :	SN7404	IC554 (SN7404) :	SN7404				
IC543, 545, 548, 549 :	SN7404	IC555 (SN74123) :	SN74123				
IC544 (LM310) :	LM310	IC556 (SN7404) :	SN7404				
IC545, 546 (SN7404) :	SN7404	IC557 (SN7404) :	SN7404				
IC547 (SN7404) :	SN7404	IC558 (SN7404) :	SN7404				
IC548 (SN7404) :	SN7404	IC559 (SN7404) :	SN7404				
IC549 (SN7404) :	SN7404	IC560 (SN7404) :	SN7404				
IC550 (SN7404) :	SN7404	IC561 (SN7402) :	SN7402				
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IC554 (SN7404) :	SN7404	IC565 (SN7402) :	SN7402				
IC555 (SN74123) :	SN74123	IC566 (SN74121) :	SN74121				
IC556 (SN7404) :	SN7404	IC567, 568 (SN74LS174) :	SN74LS174				
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IC558 (SN7404) :	SN7404						
IC559 (SN7404) :	SN7404						
IC560 (SN7404) :	SN7404						
IC561 (SN7402) :	SN7402						
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IC563 (SN7402) :	SN7402						
IC564 (SN7402) :	SN7402						
IC565 (SN7402) :	SN7402						
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IC567, 568 (SN74LS174) :	SN74LS174						

TOTAL DIAGRAM

SCHEMATIC DIAGRAM (M)

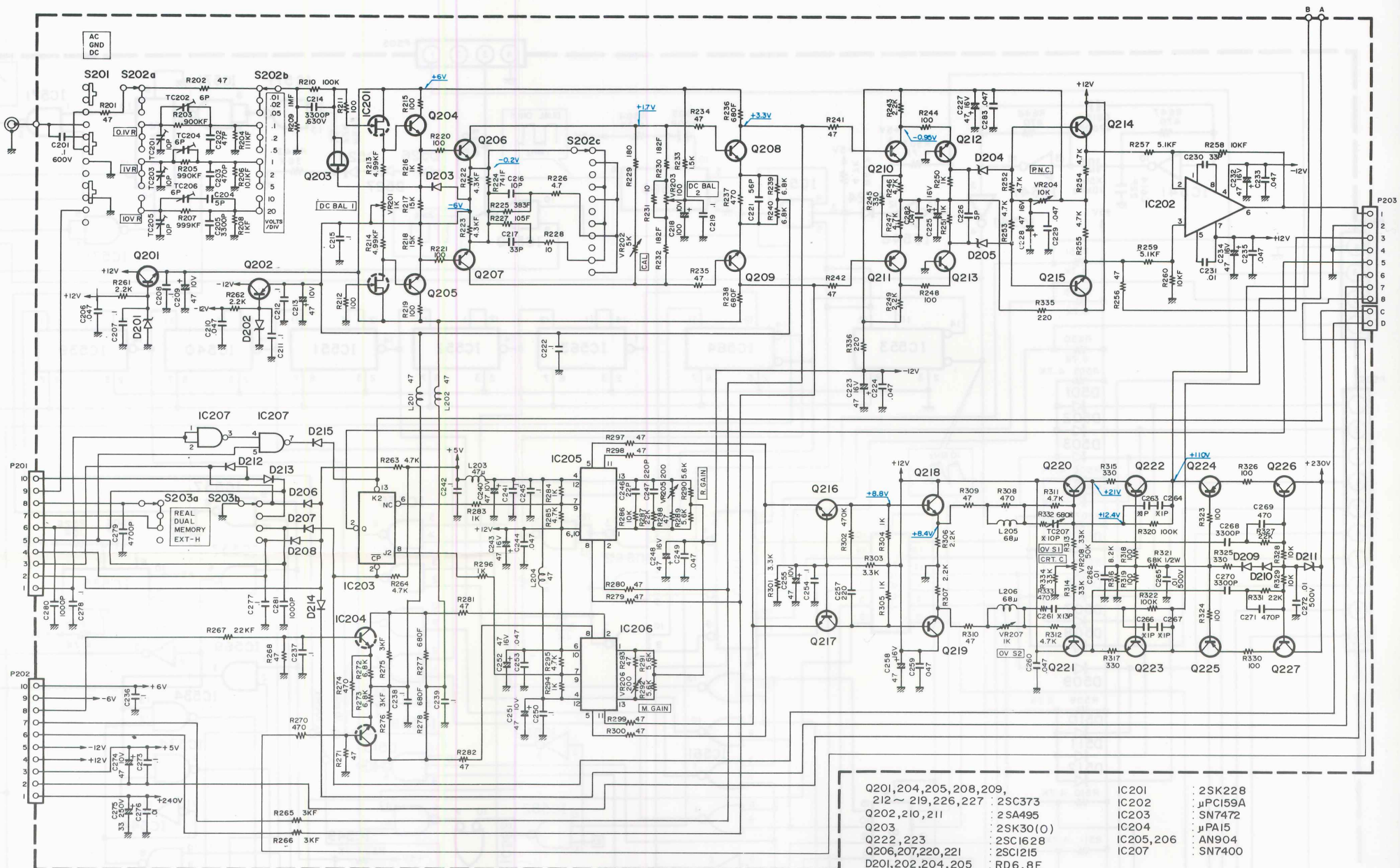
VERTIC



Q401, 402, 404, 411, 413-417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

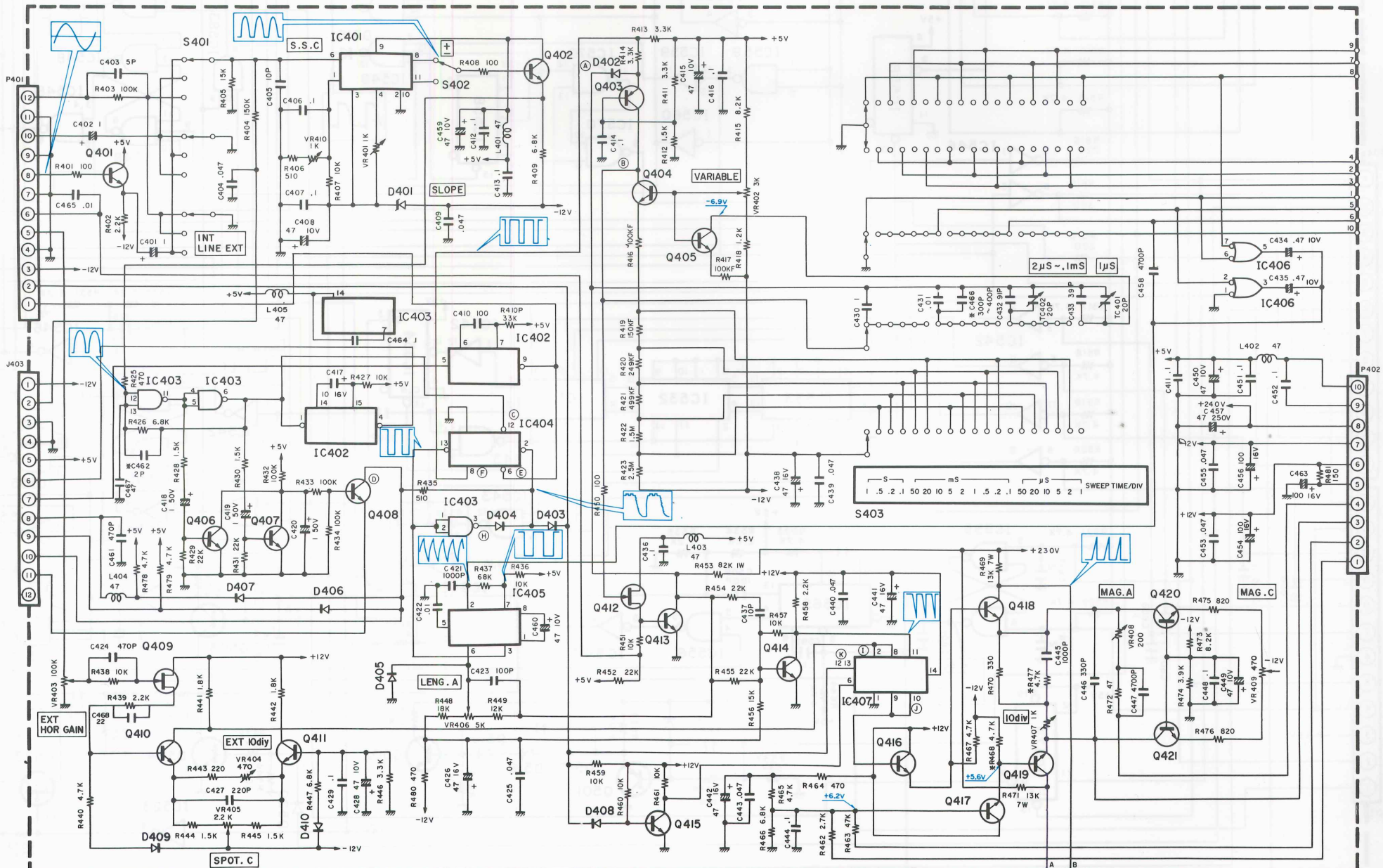
GRAM (MS-1650A)

VERTICAL AMP UNIT (X73-1370-01)



- | | | |
|---------------------------|------------|---------|
| Q201, 204, 205, 208, 209, | IC201 | 2SK228 |
| 212 ~ 219, 226, 227 | IC202 | μPC159A |
| Q202, 210, 211 | IC203 | 2SA495 |
| Q203 | IC204 | SN7472 |
| Q206, 207, 220, 221 | IC205, 206 | μPA15 |
| D201, 202, 204, 205 | IC207 | AN904 |
| D203, 209, 210, 214, 215 | | SN7400 |
| D206 ~ 208, 212, 213 | | |
| D211 | | |

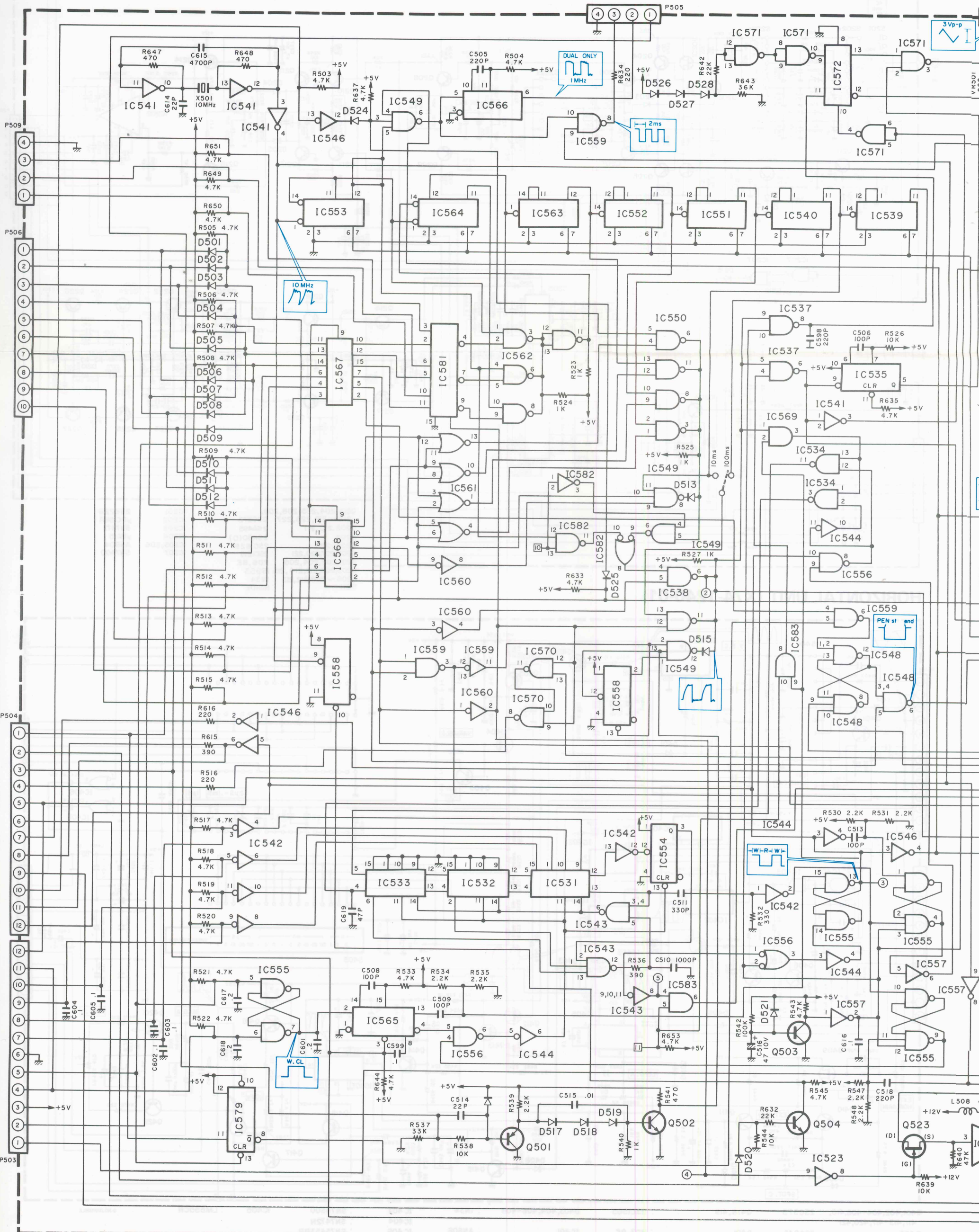
HORIZONTAL UNIT (X74-1240-01)



- | | | | | |
|--------------------------|-----------|---------------------|--------|--------|
| Q401, 402, 404-408, 410, | Q418, 419 | D403, 404, 406-408 | IC 403 | IC 405 |
| 411, 413-417, 420, 421 | | | | |
| Q403 | D401 | D402, 405, 409, 410 | IC 401 | IC 404 |
| Q409, 412 | | | IC 402 | IC 406 |
| | | | | IC 407 |

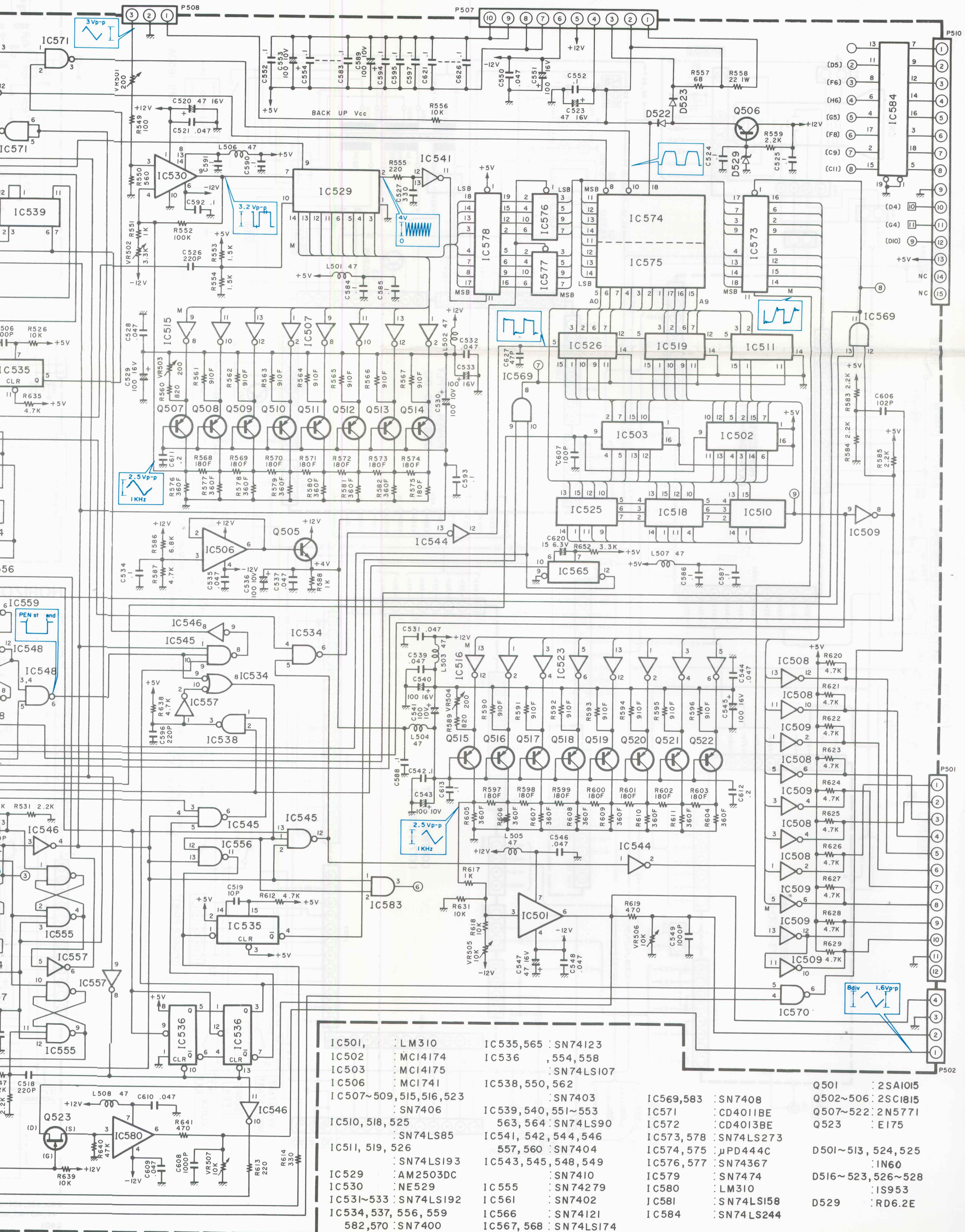
CONTROL UNIT (X77-1170-01)

VERTICAL AMP UNIT (X73-1370-01)



SCHEMATIC DIAGRAM (MS-1650A)

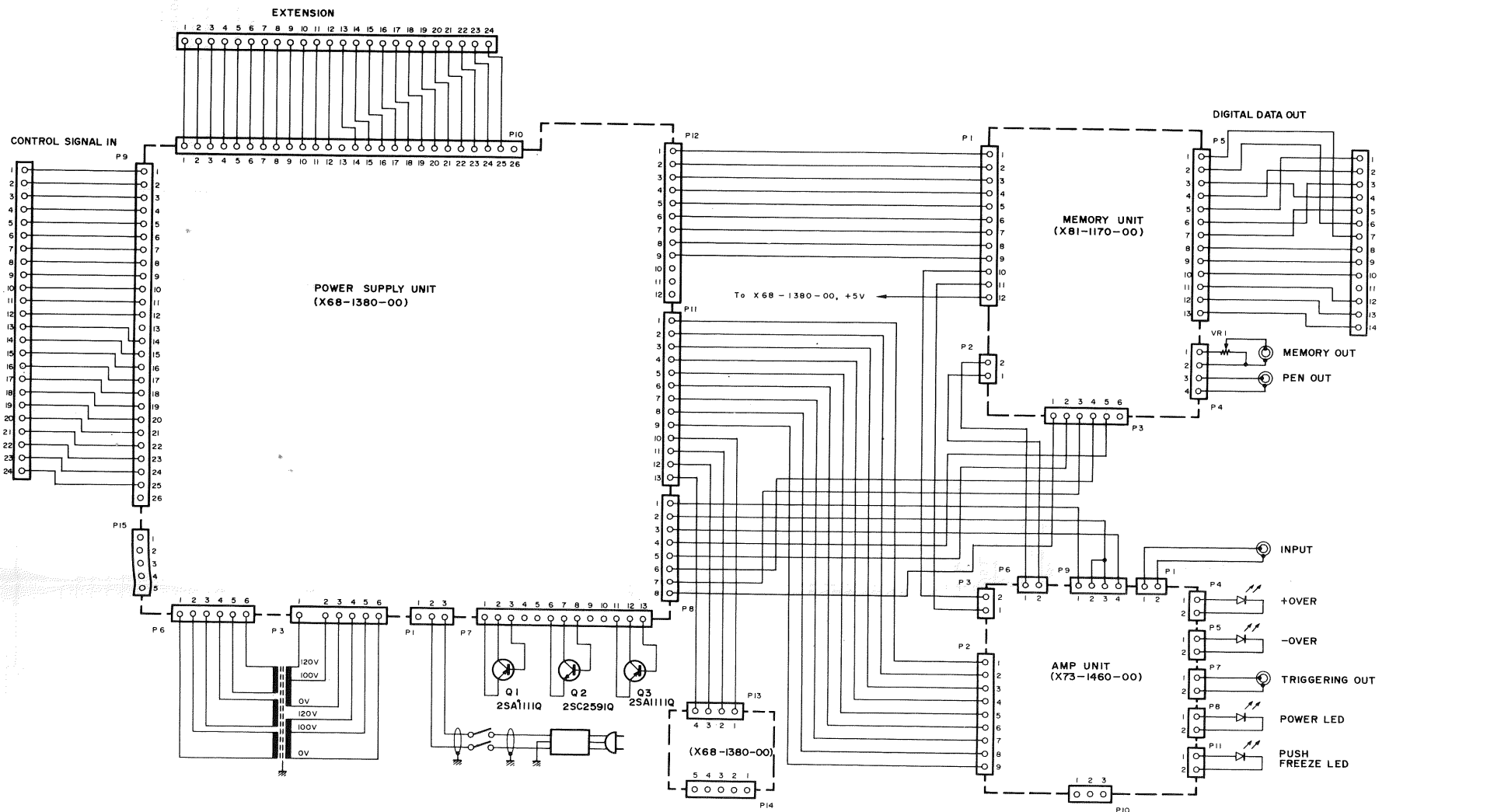
TOTAL DIAGRAM



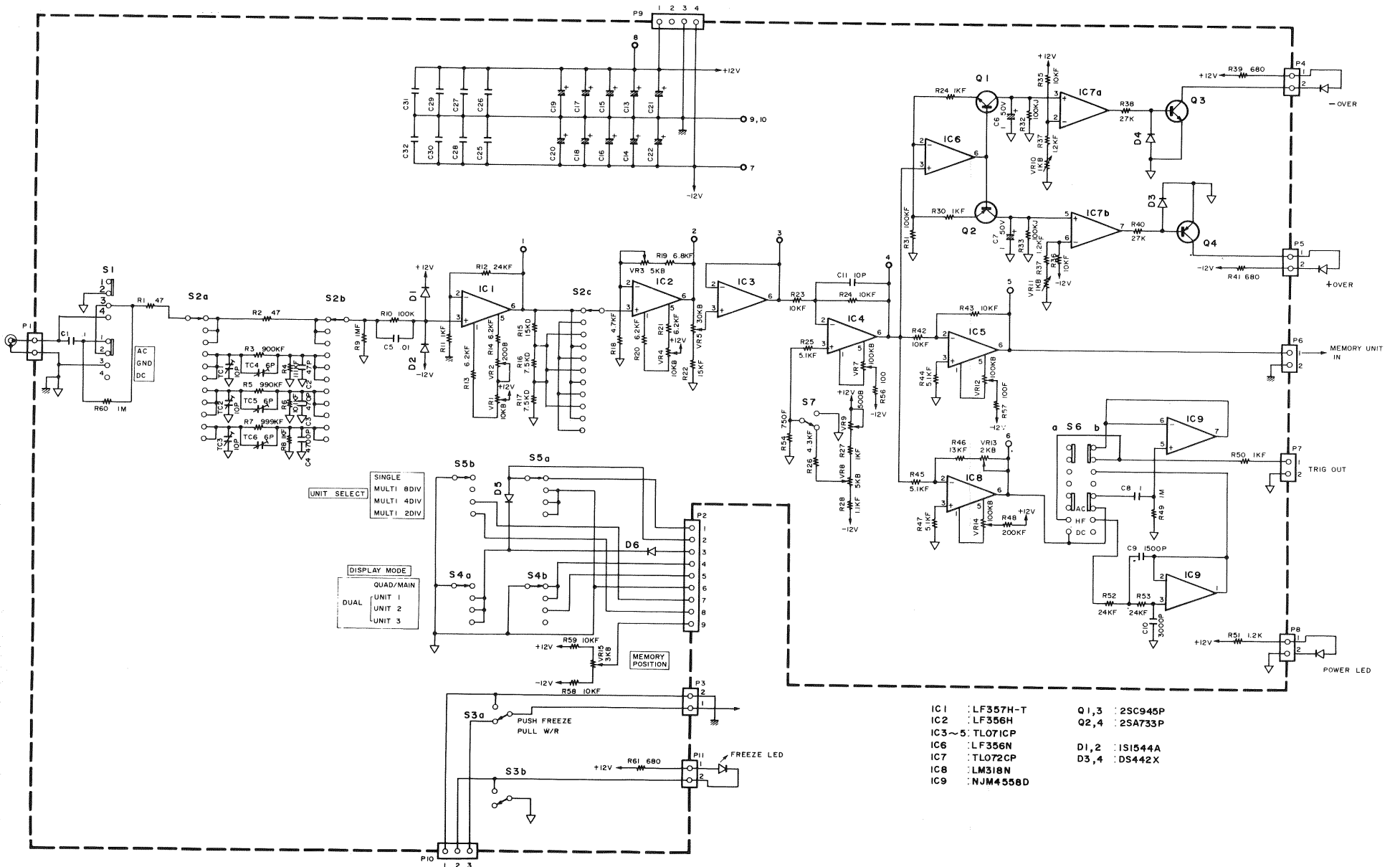
IC501, : LM310	IC535,565 : SN74123	IC569,583 : SN7408	Q501 : 2SA1015
IC502 : MC14174	IC536 : 554,558	IC571 : CD4011BE	Q502~506 : 2SC1815
IC503 : MC14175	: SN74LS107	IC572 : CD4013BE	Q507~522 : 2N5771
IC506 : MC1741	IC538,550,562 : SN7403	IC573,578 : SN74LS273	Q523 : E175
IC507~509,515,516,523 : SN7406	IC539,540,551~553 : SN74LS90	IC574,575 : μ PD444C	D501~513,524,525 : 1N60
IC510,518,525 : SN74LS85	IC541,542,544,546 : SN7404	IC576,577 : SN74367	D516~523,526~528 : 1S953
IC511,519,526 : SN74LS193	IC543,545,548,549 : SN7410	IC579 : SN7474	D529 : RD6.2E
IC529 : AM2503DC	IC555 : SN74279	IC580 : LM310	
IC530 : NE529	IC561 : SN7402	IC581 : SN74LS158	
IC531~533 : SN74LS192	IC566 : SN74121	IC584 : SN74LS244	
IC534,537,556,559 : SN7400	IC567,568 : SN74LS174		

TOTAL DIAGRAM

MEM

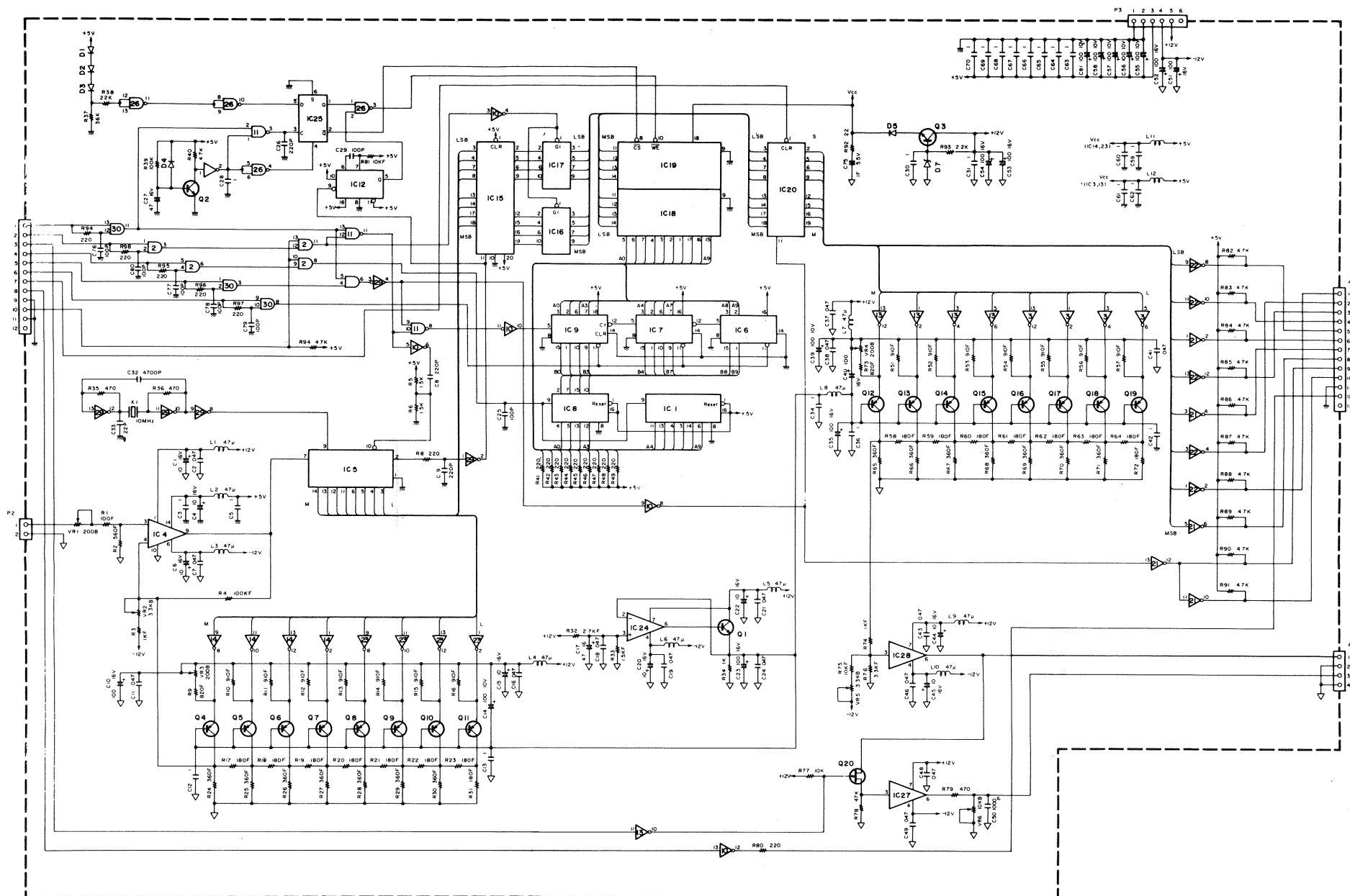


AMP UNIT (X73-1460-00) MU-1651, 1652



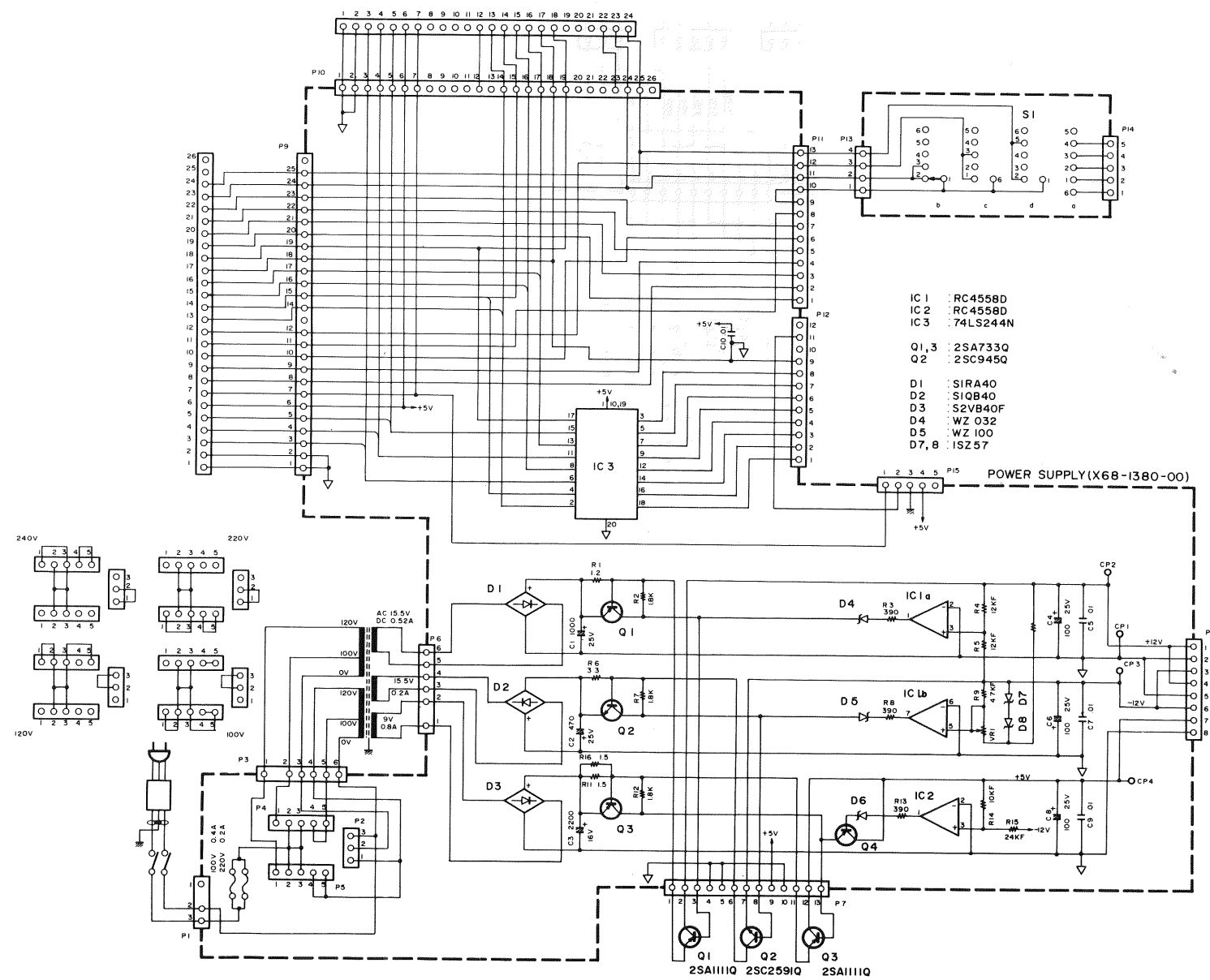
GRAM (MU-1651)

MEMORY UNIT (X81-1170-00)



- | | | | | |
|---------------|---------------------------|----------------------|------------------------|---------------------|
| D1~5 : DS442X | IC 1 : MCI4174BCP | IC 8 : MCI4175BCP | IC18,19 : μ PD444C | Q1 ~ 3 : 2SC1815(Y) |
| D7 : WZ-063 | IC 2, 30 : SN7408N | IC10, 29 : SN7404N | IC24 : MCI741CP | Q4 ~ 19 : DNS771 |
| | IC3,13,14,21~23 : SN7406N | IC11 : SN7400N | IC25 : MCI4013BCP | Q20 : 2SJ43(R) |
| | IC4 : NE529N | IC12 : SN74LS123N | IC26 : MCI4011BCP | |
| | IC5 : AM2503PC | IC15,20 : SN74LS273N | IC27,28 : LM310N | |
| | IC6,7,9 : SN74LS193N | IC16,17 : SN74LS367N | | |

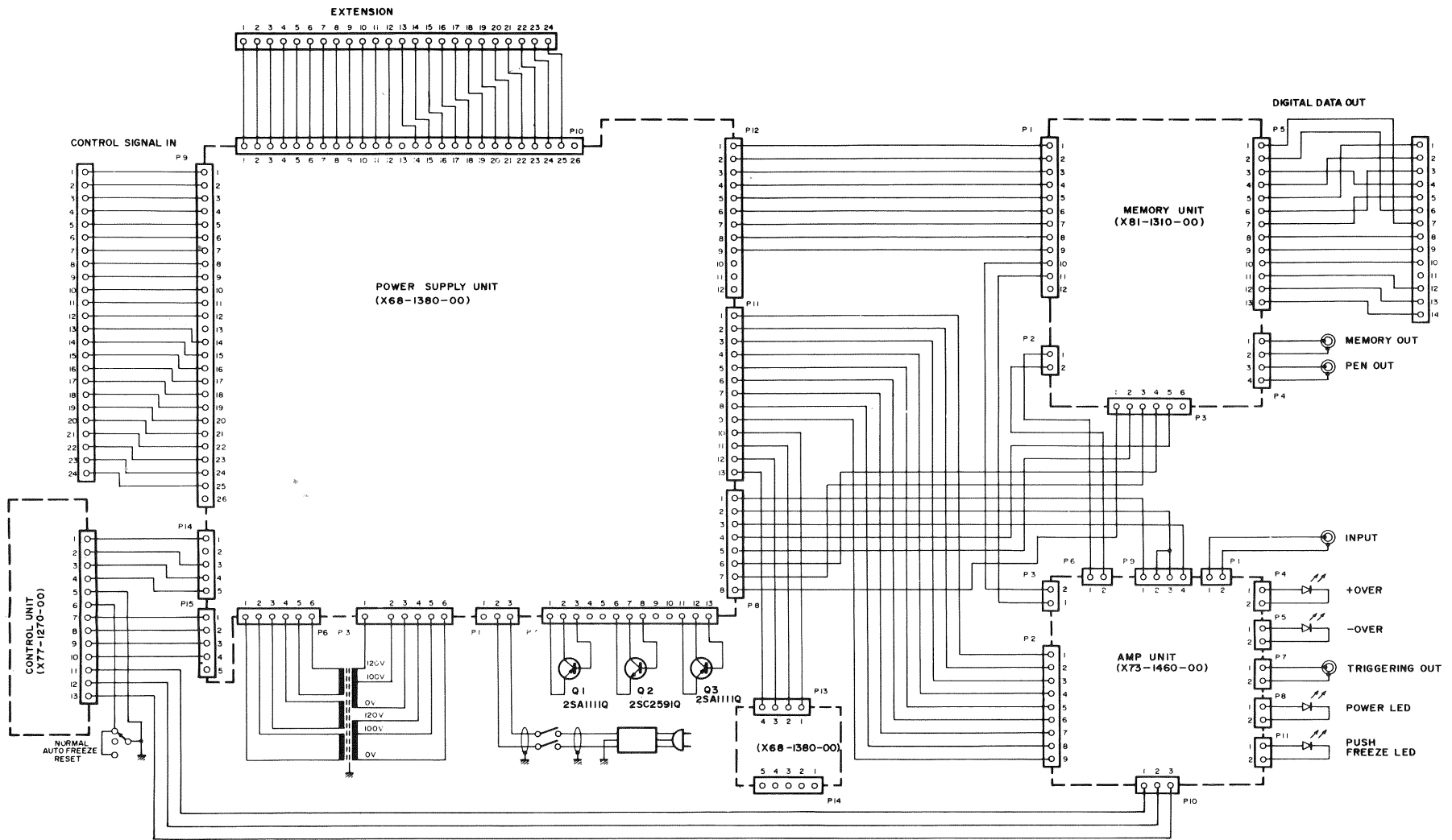
POWER SUPPLY (X68-1380-00) MU-1651, 1652



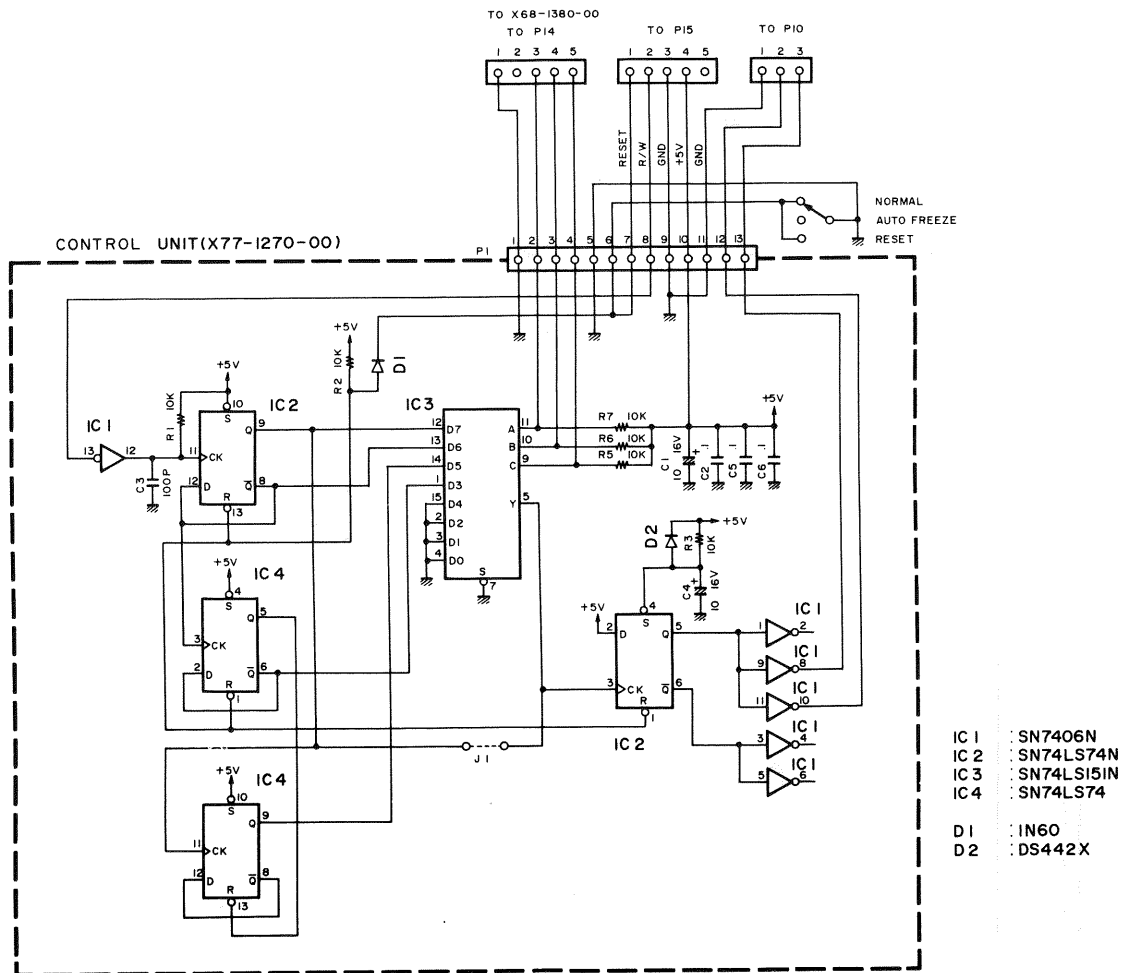
- | |
|-----------------|
| IC 1 : RC4558D |
| IC 2 : RC4558D |
| IC 3 : 74LS244N |
| Q1, 3 : 2SA7330 |
| Q2 : 2SC9450 |
| D1 : SIRA40 |
| D2 : SIQB40 |
| D3 : S2VB40F |
| D4 : WZ 032 |
| D5 : WZ 100 |
| D7, 8 : ISZ57 |

2SA1111Q 2SC2591Q 2SA1111Q

TOTAL DIAGRAM

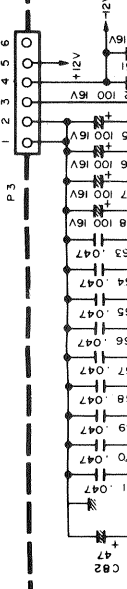


CONTROL UNIT (X77-1270-00)



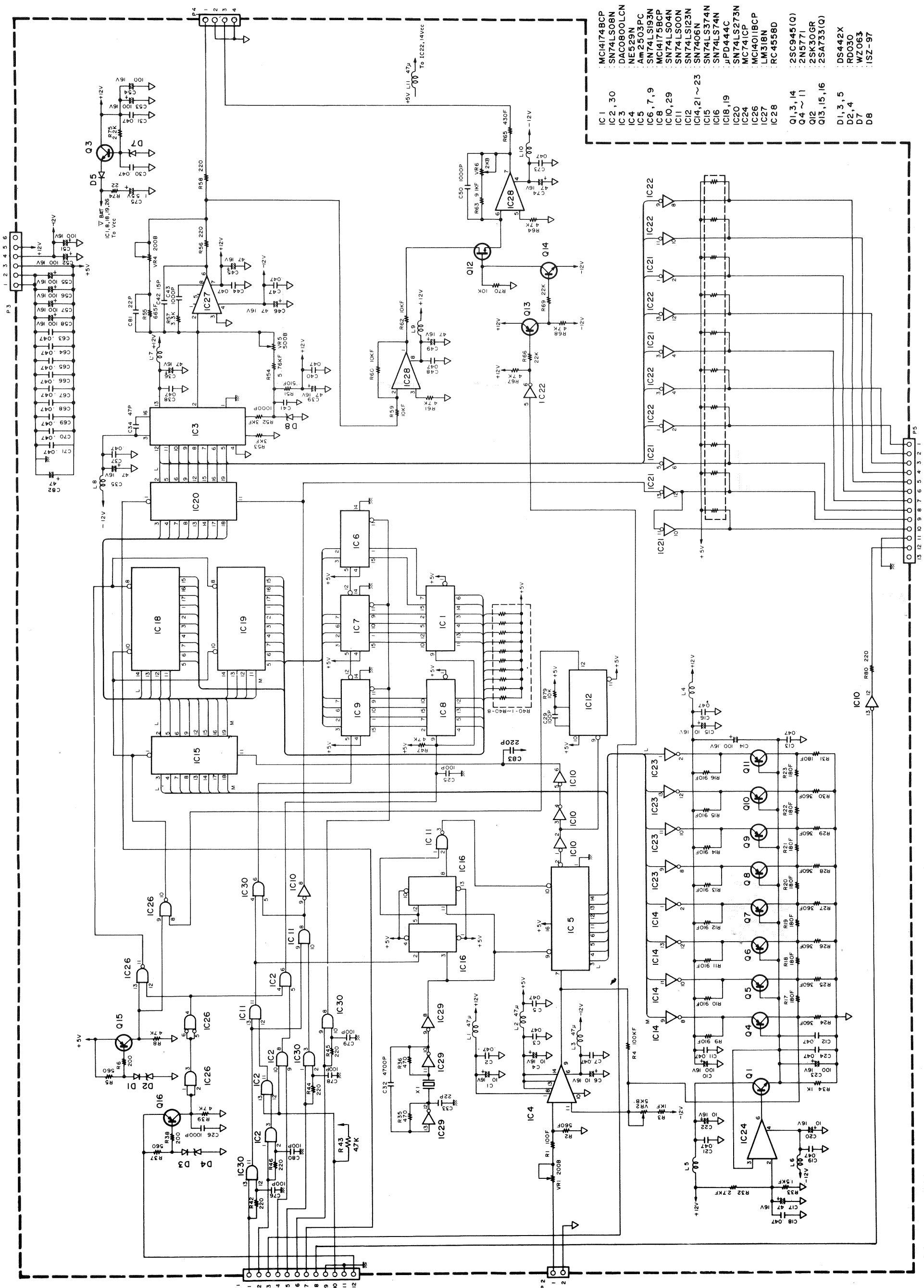
- IC 1 : SN7406N
- IC 2 : SN74LS74N
- IC 3 : SN74LS15N
- IC 4 : SN74LS74

- D 1 : 1N60
- D 2 : DS442X

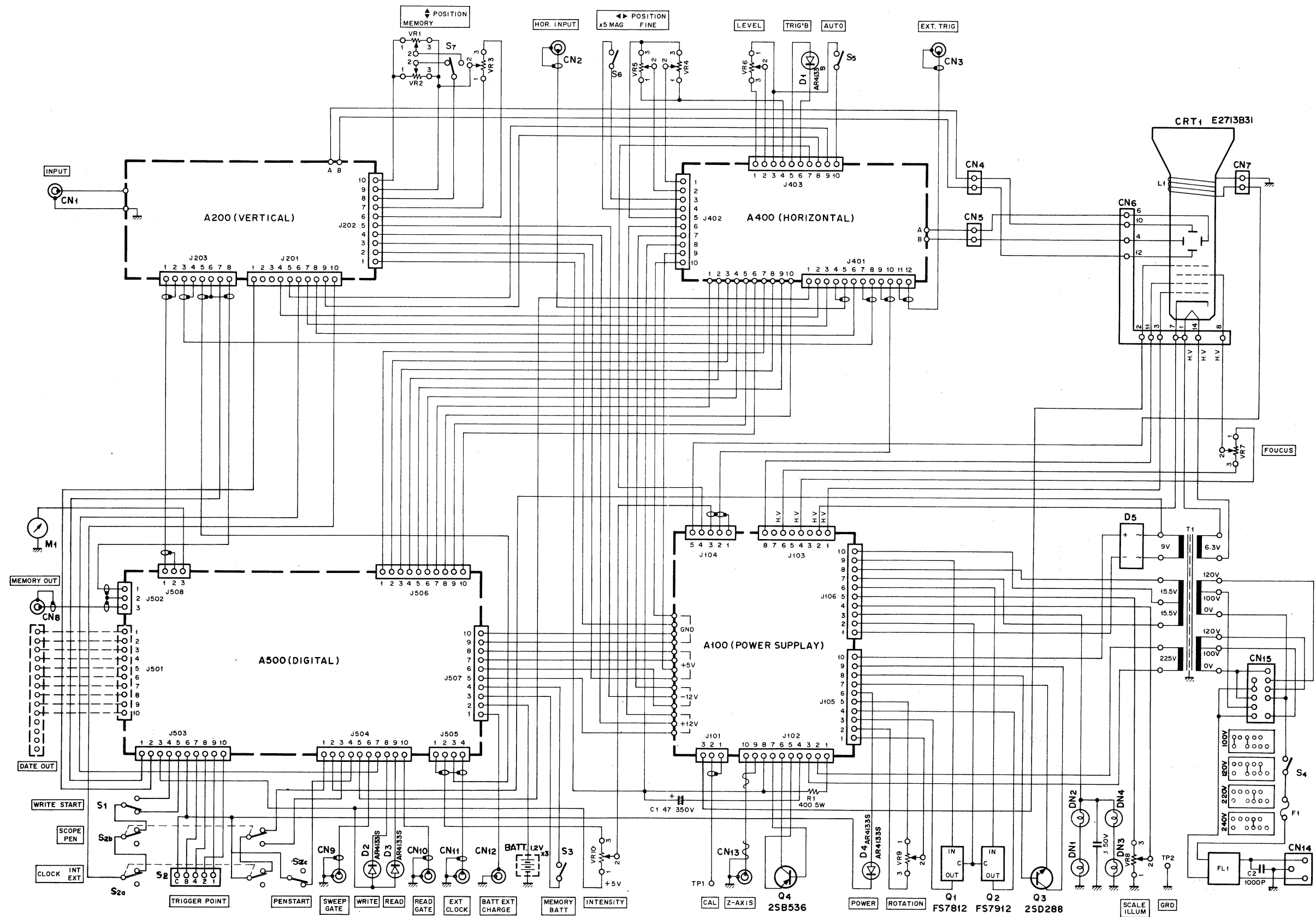


SCHEMATIC DIAGRAM (MU-1652)

MEMORY UNIT (X81-1310-00)

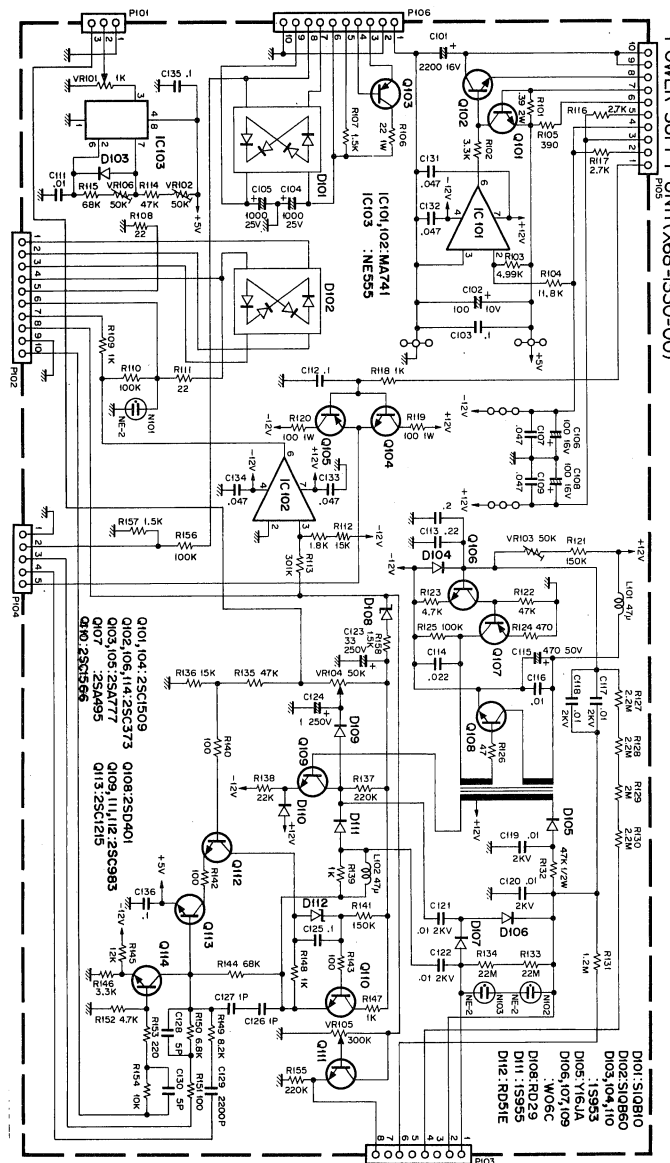


- | | |
|----------------|------------|
| IC 1 | MC1474BCP |
| IC 2, 30 | SN74LS08N |
| IC 3 | DAC0800LCN |
| IC 4 | NE529N |
| IC 5 | Am2503PC |
| IC 6, 7, 9 | SN74LS193N |
| IC 8 | MC14175BCP |
| IC 10, 29 | SN74LS04N |
| IC 11 | SN74LS00N |
| IC 12 | SN74LS123N |
| IC 14, 21 ~ 23 | SN7406N |
| IC 15 | SN74LS374N |
| IC 16 | SN74LS74N |
| IC 18, 19 | μPD4444C |
| IC 20 | SN74LS273N |
| IC 24 | MC741CP |
| IC 26 | MC14011BCP |
| IC 27 | LM318N |
| IC 28 | RC4558D |
| Q1, 3, 14 | 2SC945(Q) |
| Q4 ~ 11 | 2N5771 |
| Q12 | 2SK306R |
| Q15, 15, 16 | 2SA735(Q) |
| D1, 3, 5 | DS442X |
| D2, 4 | RD030 |
| D7 | WZ063 |
| D8 | ISZ-97 |



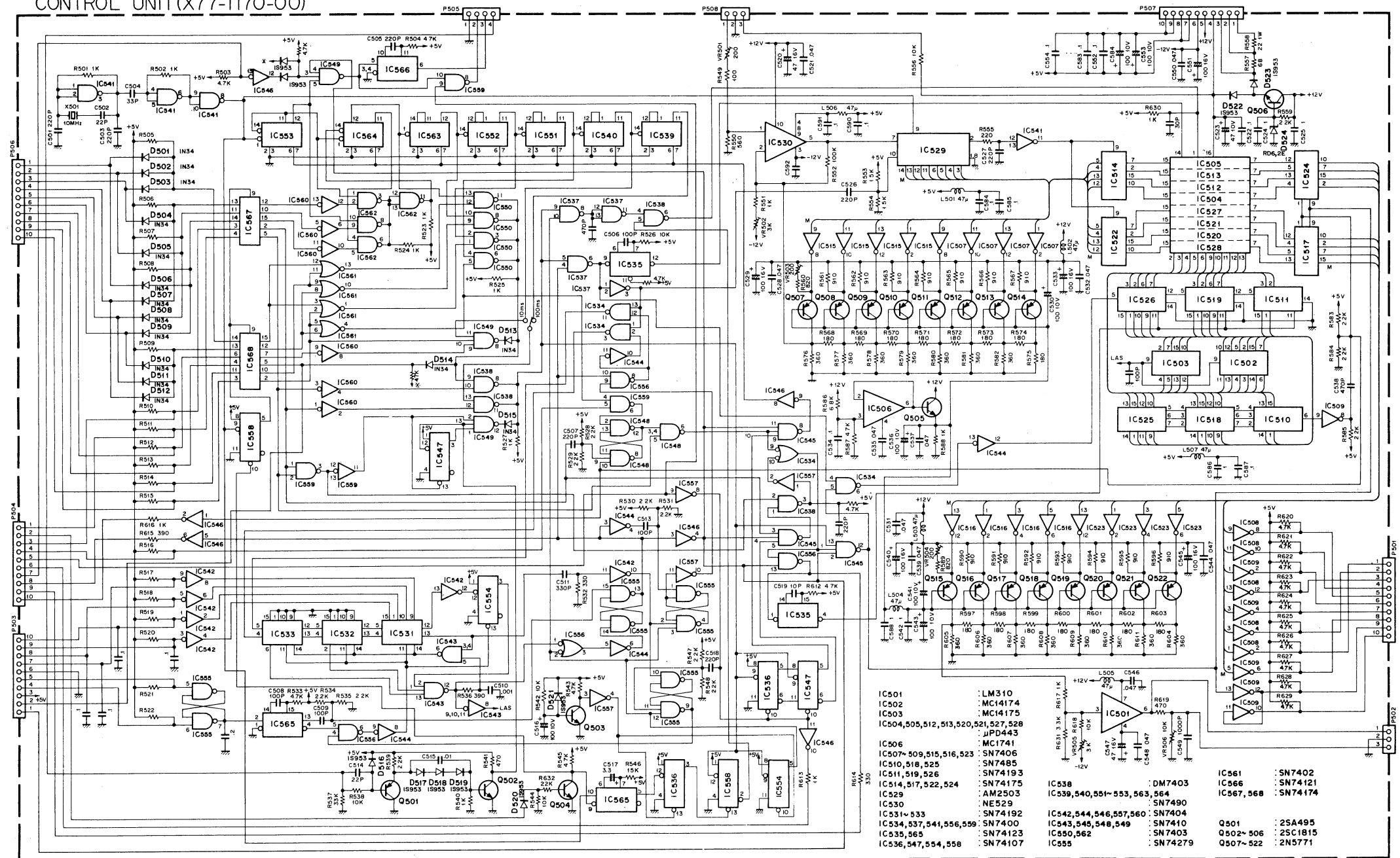
POWER SUPPLY UNIT (X68-1330-00)

CONTROL UNIT (X77-1170-00)



POWER SUPPLY UNIT(X68-1330-00)

CONTROL UNIT(X77-1170-00)



- | | | | |
|--|---------------|-------------------------------|-----------|
| IC501 | : LM310 | IC561 | : SN7402 |
| IC502 | : MC14174 | IC566 | : SN74121 |
| IC503 | : MC14175 | IC567, 568 | : SN74174 |
| IC504, 505, 512, 513, 520, 521, 527, 528 | : μ PD443 | | |
| IC506 | : MC1741 | | |
| IC507, 509, 515, 516, 523 | : SN7406 | | |
| IC510, 518, 525 | : SN7485 | | |
| IC511, 519, 526 | : SN74193 | | |
| IC514, 517, 522, 524 | : SN74175 | | |
| IC529 | : AM2503 | | |
| IC530 | : NE529 | | |
| IC531-533 | : SN74192 | | |
| IC534, 537, 541, 556, 559 | : SN7400 | | |
| IC535, 565 | : SN74123 | | |
| IC536, 547, 554, 558 | : SN74107 | | |
| | | IC538 | : DM7403 |
| | | IC539, 540, 551-553, 563, 564 | : SN7480 |
| | | IC542, 544, 546, 557, 560 | : SN7404 |
| | | IC543, 545, 548, 549 | : SN7410 |
| | | IC550, 562 | : SN7403 |
| | | IC555 | : SN74279 |
| | | Q501 | : 2SA495 |
| | | Q502-506 | : 2SC1815 |
| | | Q507-522 | : 2N5771 |