NIKKO TIME DELAY

ATD-I

TIME DELAY SYNTHESIZER

TYPE AND VOLTAGE

W-TYPE UL and CSA type	120V AC
E-TYPE NK-STD type	220/240V AC
N-TYPE DEMKO and SEMKO type	

SERVICE MANUAL

CONTENTS

SPECIFICATIONS

Delay Section

	T1	T2	T3	T4	T5
Initial Delay Time					
Large	27mS,	78mS,	99mS,	114mS,	135mS
Mid	18mS,	51mS,	65mS,	75mS,	88mS
Small	13mS,	37mS,	47mS,	54mS,	64mS

Combinations of HALL CHARACTOR and INITIAL DELAY.

HALL CHARACTOR 1	T1, T5
2	T1, T4, T5
3	T1, T2, T3, T4, T5

REVERBERATION (at 500 Hz)

Large	0.2 ~ 2 sec
Mid	0.2 ~ 1.5 sec
Small	0.1 ~ 1 sec

Audio Section

Rated Output:	2V ~ 3V
Minimum Input:	0.1V
Frequency Response	
MAIN	20Hz ~ 20kHz, ±0.1dB
DELAYED:	20Hz ~ 5kHz, ±3dB T1 20Hz ~ 2.5kHz, ±3dB T2, T3, T4
T. H. Distortion	
MAIN	0.02% (20Hz ~ 20kHz)
DELAYED	0.6% (500Hz)
Signal to Noise Ratio (not weighted)	
MAIN	80dB
DELAYED	60dB

General

Power Requirement	AC 120V, 60Hz (W;TYPE) AC 220/240V, 50Hz (E & N-TYPE)
Power Consumption	12W
Dimensions	19 x 2-1/2 x 13 inches 482 x 63.5 x 331 mm
Weight, without packages	5 kg (11 lbs)

*Specifications are subject to modification without notice.

BLOCK DIAGRAM

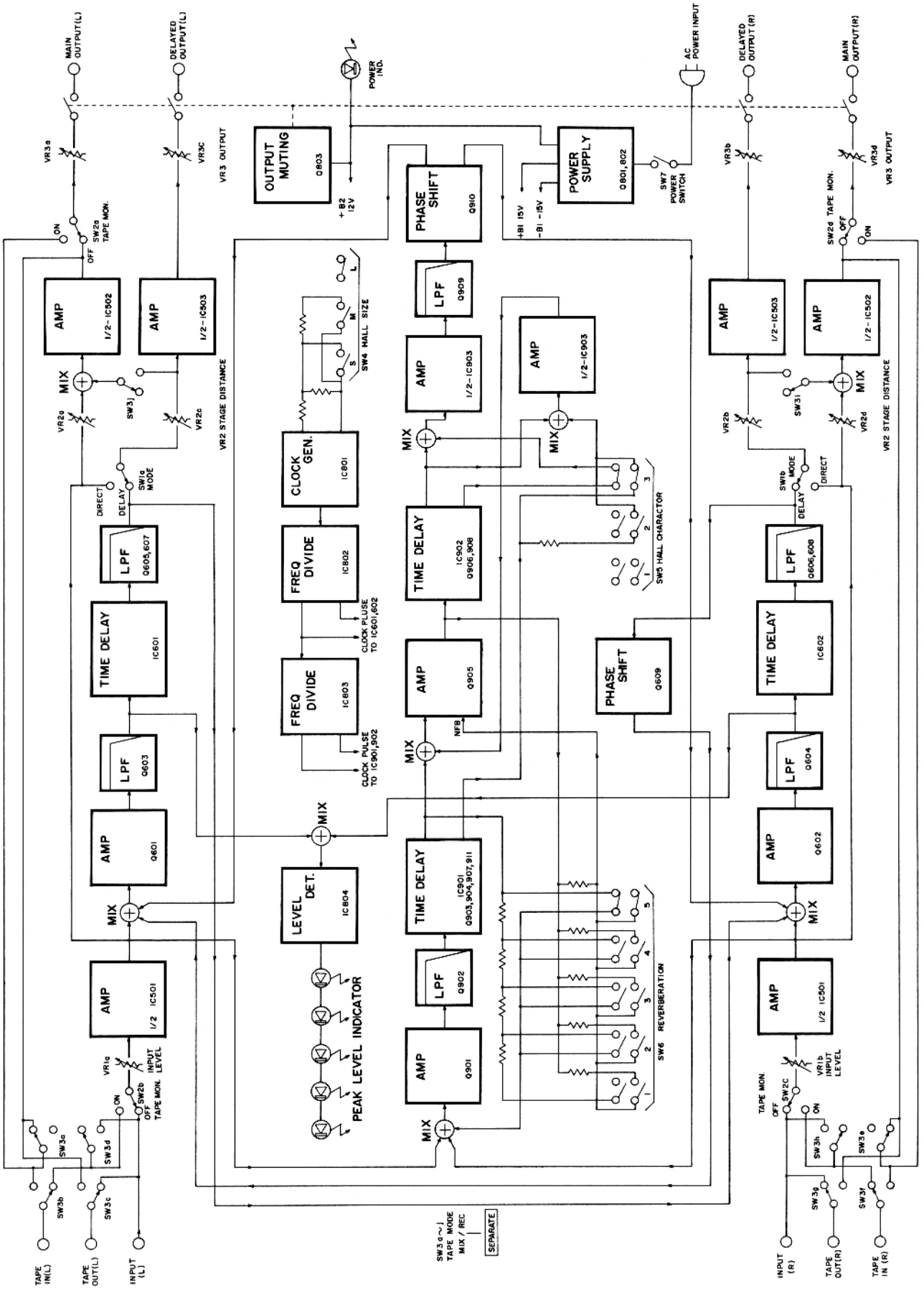


Fig. 1

DEVICE DESCRIPTION

BBD (Bucket Brigade Device)

The signal delay element adopted in ATD-I is the BBD (Bucket Brigade Device). As is commonly known, BBD is a device developed recently, and it is essentially a number of MOS-FETs and capacitors connected in series. Several BBD types having a different number of stages, for example, 64 stages to 4096 stages at present, have been developed corresponding to application purposes, and these BBDs are all fabricated as IC.

BBD is driven by the externally applied two-phase clock pulse. As the frequency of this clock pulse becomes lower, or as the number of stages of BBD becomes larger, the signal delay time will become longer. Owing to these characteristics, BBD can be utilized in various circuit configurations to create audio equipment having a variety of functions.

Operating Principle

As shown in Figure 2, the basic BBD circuit consists of one MOS-FET and one capacitor. When a number of these unit BBD circuits are connected in series, as shown in Figure 3, analog signals can be transferred in turn toward latter stages.

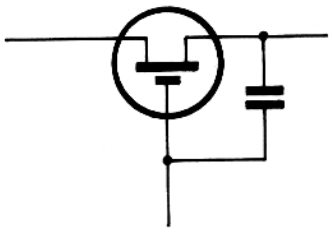


Fig. 2

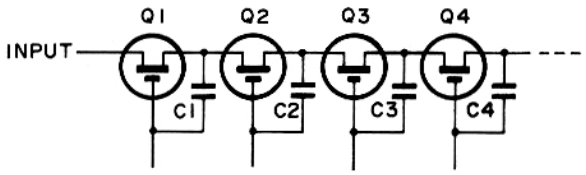


Fig. 3

Refer to Figure 3. Assume that Q1 is turned ON for a certain period. The input signal is then sent through Q1, and stored in the capacitor C1. Next, when Q2 is turned ON for a certain period, the signal stored in the capacitor C1 is then sent through Q2, and transferred to the capacitor C2 and stored. In this manner, the input signal can be transferred in turn from C2 → C3 → C4 →····· As the signal repeats storage and transfer, it is delayed compared to the original signal. This operation of BBD can be understood more easily when regarding the capacitors as buckets and the input signal as water. In a fire extinguishing operation, the water pumped into the first bucket is in turn transferred to the subsequent buckets, and this is known as a bucket brigade. The name "Bucket Brigade Device" is given in relation to such an operation.

BBD accepts the input signal only for a certain period, and this input signal accepting time is called the sampling time. Accordingly, the input signal level which is present during this sampling time period is stored in the capacitor of BBD. The input signal level is changing every moment, and sometimes it may fall to zero level. So, the capacitor in BBD is not always kept in the fully charged state. Moreover, since the capacitor can not store an electrical charge exceeding a certain fixed level, the BBD output will be saturated as the input signal level goes higher, and as a result, the final output signal is clipped. Details of signal storage and transfer in BBD are as follows. The ATD-I uses two types of BBDs; IC601 and IC602 (MN3007) are of 1024 stages configuration, and IC901 and IC902 (CX-766) are also of 1024 stages configuration, permitting the output to be taken out also at the 614th stage and 346th stage.

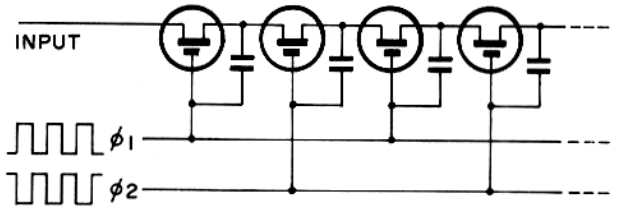


Fig. 4

Figure 4 shows the equivalent circuit. The gate of MOS-FET of each stage is connected every other stage, and is driven by two external two-phase clock pulses and which are reverse in phase each other. Figure 5 shows a schematic drawing for the operation of the P-channel MOS-BBD. As mentioned above, BBD transfers signals by repeating storage and transfer. In the storage mode, all MOS-FETs are in the cut-off state, and no signal is transferred.

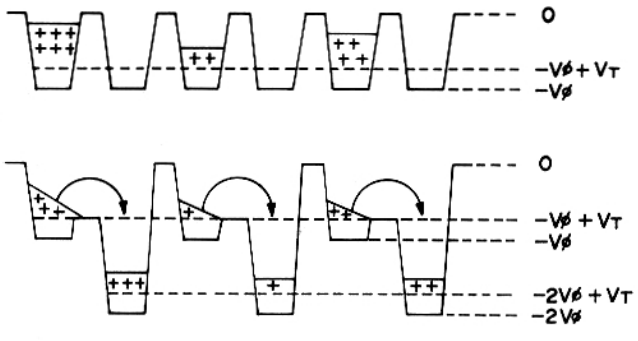


Fig. 5

As shown in Figure 5, the charged capacitor and empty capacitor are arranged alternately. Now, assume that the clock pulse $\phi 1$ is connected to the charged capacitor (whose potential is $-V\phi + VT + Vs$), and the clock pulse $\phi 2$ to the empty capacitor (whose potential is $-V\phi + VT$). In this expression, VT is the threshold voltage of MOS-FET and Vs is the signal voltage. In the next place, when $\phi 2$ turns to negative potential ($-V\phi$), the MOS-FET connected to this signal is turned ON, and its drain potential is deepened to $-2V\phi + VT$ from $-V\phi + VT$ by the bootstrap effect. Because of this change, the signal stored in the preceding stage is transferred to the next stage. This is called the transfer mode. Movement of signal is completed just before termination of the transfer mode, and the gate-to-source voltage of MOS-FET becomes $-VT$. In other word, the source voltage settles down at $-V\phi + VT$. In the storage mode which occurs after this transfer mode, the empty capacitor is connected to $\phi 1$ and the charged capacitor to $\phi 2$. After this state, the transfer mode occurs again in which the signal $\phi 1$ turns to negative potential ($-V\phi$). In this manner, the signal is in turn transferred. In the actual BBD, the signals $\phi 1$ and $\phi 2$ are reverse in phase each other, and the storage mode period is limited to a very short time which occurs upon switchover of $\phi 1$ and $\phi 2$.

As may be understood in the above explanation, the delay time corresponds to the number of stages of BBD and the clock pulse frequency. If the number of stages of BBD is S and the clock pulse frequency is fc (Hz), the delay time Td (second) can be expressed as follows.

$$Td = S/2fc \text{ (second)}$$

It seems from this equation that the delay time can be extended limitlessly by reducing the clock pulse frequency.

However, if the clock pulse frequency is lowered, the frequency band which BBD can transmit becomes narrow, in particular, transmission of higher frequency signals becomes impossible. BBD accepts the input signal only during the sampling time (the time period equivalent to the time length of transfer mode), so the signal that enters the capacitor represents a momentary segment of the whole input signal.

See the portion ① in Figure 6. After transferring this segment signal to the subsequent stage, the capacitor stores again the portion ② at its next sampling time. This operation is repeated again and again. As a result, the waveform Vo shown in Figure 6 can be obtained as the output of BBD. By passing this output waveform through a low-pass filter, the original waveform can be restored. Next, let us consider that the clock pulse frequency is lowered (or the input signal frequency is higher). In this case, the input signal is varying largely even during the sampling time, and it is impossible to say how the capacitor can be charged at the end of the sampling time. BBD transfers segments of the input signal, and the original signal is restored afterward. Accordingly, if the signal varies largely within one sampling time, it is impossible to restore the original signal from the sampled segment signals. When transferring a higher frequency signal, therefore, it is necessary to increase the clock pulse frequency.

For correct transferring of waveform, the clock pulse frequency must be higher than four times the frequency of the input signal to be transferred. The clock pulse frequency is determined in regard to the frequency response and delay time, corresponding to the purpose of a unit in which BBD is adopted.

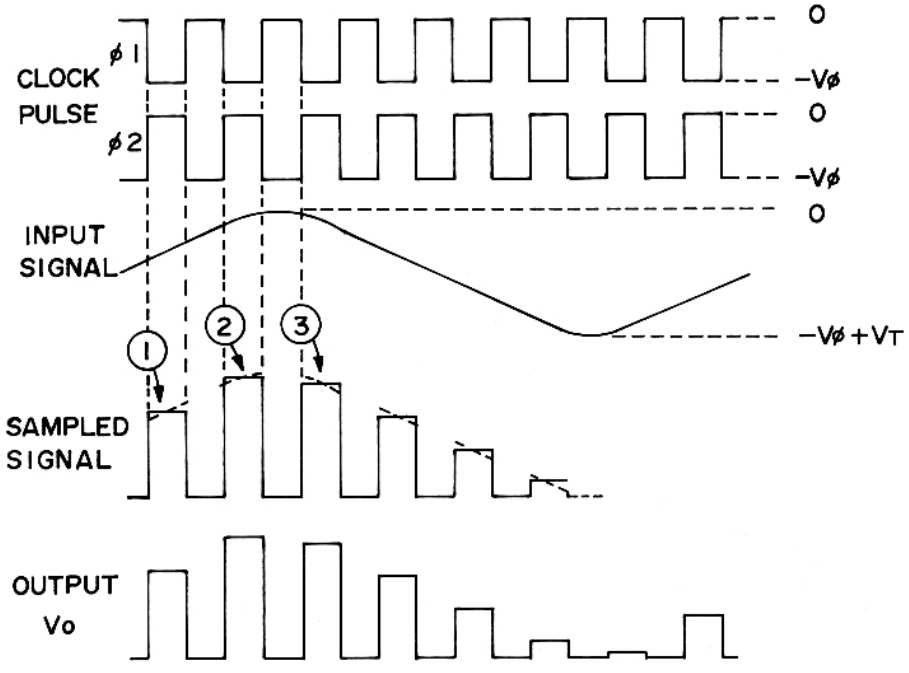


Fig. 6

DISASSEMBLY

CABINET COVER REMOVAL

a. Remove four tapping screws from the top of the metal cover.
b. Remove four screws from both sides of the metal cover.

BOTTOM PLATE REMOVAL

Remove nine tapping screws (#1 ~ #9) as shown in Photo 1.

FRONT PANEL REMOVAL

a. Remove the metal cover and the bottom plate.
b. Remove the tab-type knob (#1 in Photo 2, POWER) from the front panel by pulling it forward.
c. Using a hexagonal wrench, remove two knobs (#2 and #3 in Photo 2, STAGE DISTANCE and OUTPUT LEVEL).
d. Push the center of the push rivet by a small screw driver as shown in Figure 6, and remove two push rivets from the top of the front panel (Photo 2).
e. Similarly remove one push rivet (#1) as shown in Photo 3.
f. Remove six tapping screws (#6 ~ #8, in Photo 2 and #2 ~ #4, in Photo 3).
g. Lift the front panel away from the unit.

POWER TRANSFORMER REMOVAL

a. Disconnect all the wires from the power transformer.
b. Remove two screws (#9 and #10) as shown in Photo 2 and lift the power transformer away from the unit.

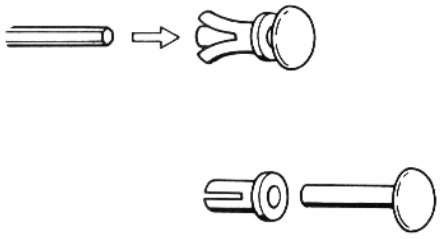


Fig. 7 PUSH RIVET

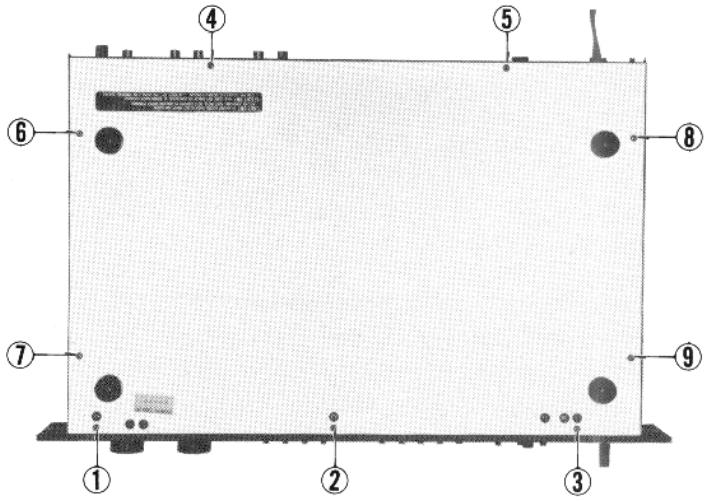


Photo 1

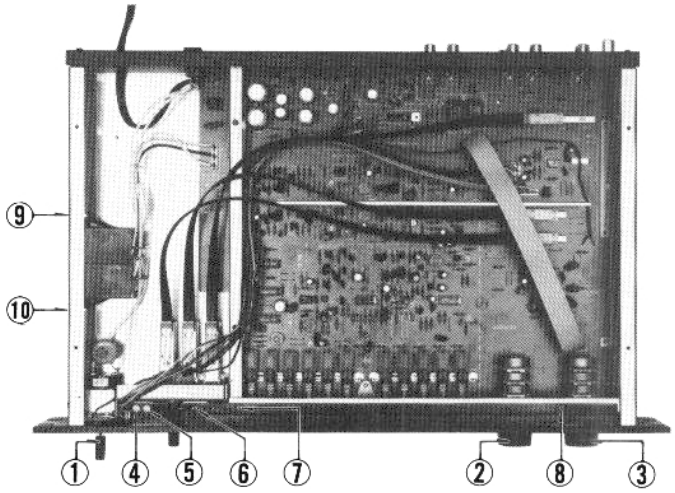


Photo 2

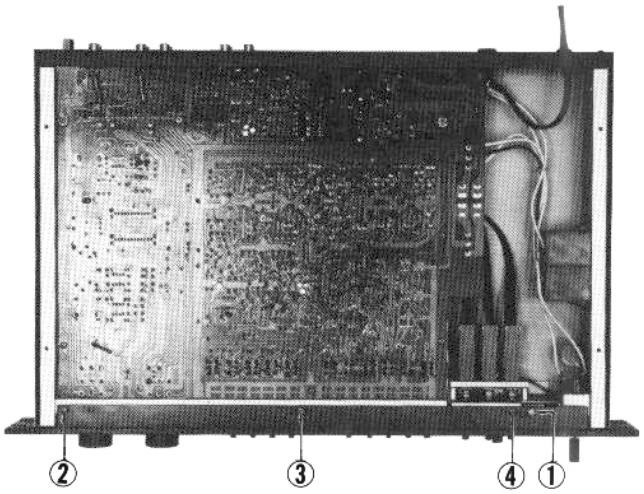


Photo 3

ALIGNMENT

Note: Before adjustment, the jumper wire which has been cut on the DELAY PCB must be connected. This jumper wire is located on the PCB at the portion indicated by a scissors mark. (Two places)
Adjustment of ATD-I cannot be done if this jumper wire is not connected. (See PC board on page 10, 11)

TEST EQUIPMENT

Allow a minimum of 10 minutes warm-up for test equipment. Maintain rated line voltage.

Audio Signal Generator.
Vacuum Tube Voltmeter. (VTVM)
Distortion Meter
Oscilloscope
Low Pass Filter. (Cut off frequency: 1 KHz)
Frequency Counter

ADJUSTMENT OF THE CLOCK PULSE FREQUENCY

1. Connect the frequency counter across the test point TP2 of the DELAY PCB and the chassis ground. There are two TP2 terminals, and connection may be made either of them.
2. Set the hall size selector of the ATD-I to "LARGE" position.
   Adjust the semi-fixed resistor HVR801 so that the frequency counter indicates 9.5 KHz.
3. Set the hall size selector to "MID" position. Make sure that the frequency counter indication is 15 KHz ±10%.
4. Set the hall size selector to "SMALL" position. Make sure that the frequency counter indication is 20 KHz ±10%.
5. Remove frequency counter.

DISTORTION ADJUSTMENT

See illustration, Figure 8, for test equipment hook-up.

1. Set the switches and the volume controls of the ATD-I as follows.

   MODE: "DELAY"
   TAPE MON.: "OFF"
   TAPE MODE: "SEPARATE"
   HALL SIZE: "LARGE"
   HALL CHARACTER: " 1 "
   REVERBERATION: " 1 "
   STAGE DISTANCE: " MAX "
   OUTPUT LEVEL: " MAX "
   INPUT LEVEL: " MAX "

2. Apply a 400 Hz signal of 30 mV to the input terminals.
3. Adjust the semi-fixed resistors HVR601 and HVR602 so that the waveform of both left and right channels will appear on the screen.
4. Readjust the semi-fixed resistor HVR601 so that the distortion meter indicates minimum. (Left channel output)
5. Readjust the semi-fixed resistor HVR602 so that the distortion meter indicates minimum. (Right channel output)
6. Repeat steps 4 and 5 for several times.
7. At the minimum distortion point, there may be large difference between the left and right output levels, or the red lamp of the peak level indicator may light up. In such a case, make adjustment again by changing the frequency of the audio signal generator within the range of ±20%.
8. Remove test equipments.

ADJUSTMENT OF THE CLOCK PULSE LEVEL BALANCE

1. Connect the oscilloscope across the test point TP3 (TP4 for right channel) of the DELAY PCB and the chassis ground.
2. Turn the INPUT LEVEL volume control down to the fully counter clockwise.
3. Observe the waveform. Make the peak of the pulse waveform uniform by adjusting the semi-fixed resistor HVR603. (HVR604 for right channel) (See Figure 9)
4. Remove oscilloscope.

ADJUSTMENT OF THE REVERBERATION

See illustration, Figure 10, for test equipment hook-up.

1. Set the switches and the volume controls of the ATD-I as follows.

   INPUT LEVEL: " MAX "
   HALL SIZE: " LARGE "
   HALL CHARACTOR: " 1 "
   REVERBERATION: " 5 "

2. Set the TP SW (See Figure 10) to the test point TP5 position.
3. Set the frequency of the audio signal generator to 500 Hz. Adjust the generator output so that the VTVM indicates 0.5V.
4. Turn the TP SW to the test point TP6 position.
5. Adjust the semi-fixed resistor HVR901 so that the VTVM indicates 0.375V.
6. Turn the TP SW to the test point TP7 position.
7. Adjust the semi-fixed resistor HVR902 so that the VTVM indicates 0.224V.
8. Press the reverberation switches 1, 2, 3, 4 and 5, in this order, and check whether the VTVM indication increases correspondingly.
9. During the above-mentioned adjustment, observe the waveform, and make sure there is no distortion in the waveform.
10. Remove test equipments.

Note: After completing the above-mentioned adjustment, cut off the jumper wire that has been connected for adjustment. (Two places)

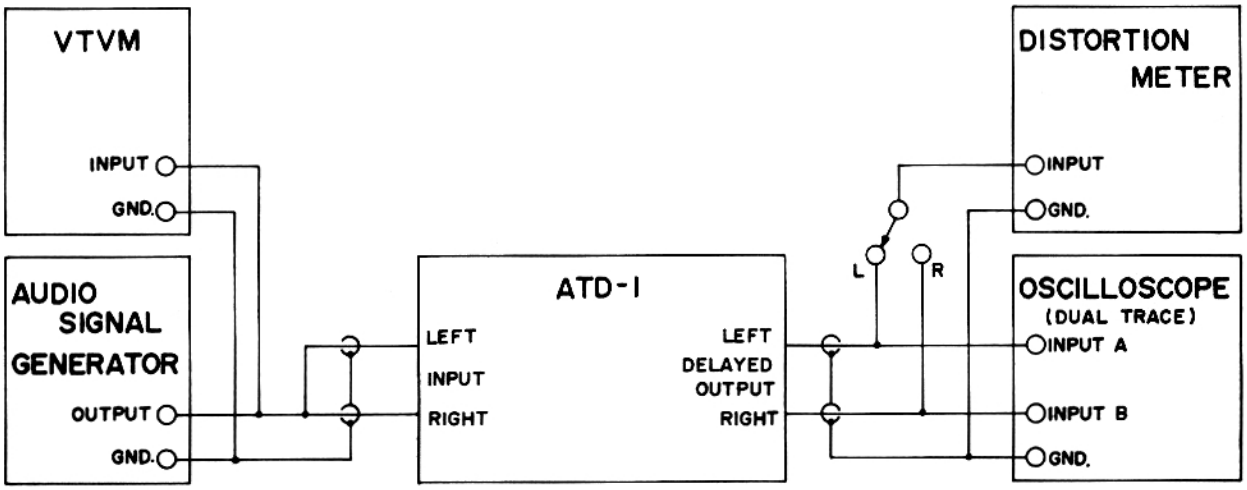


Fig. 8

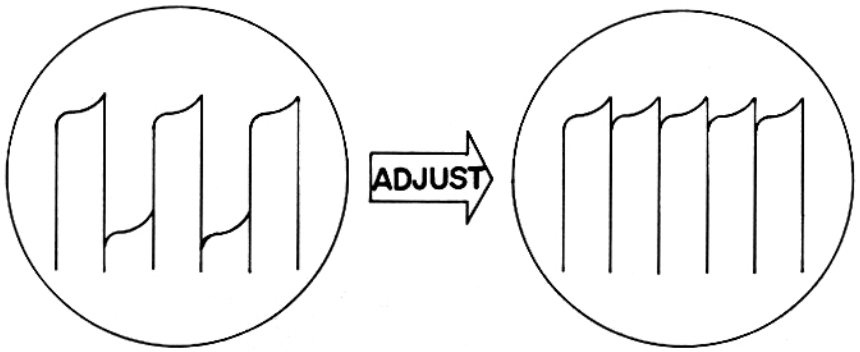


Fig. 9

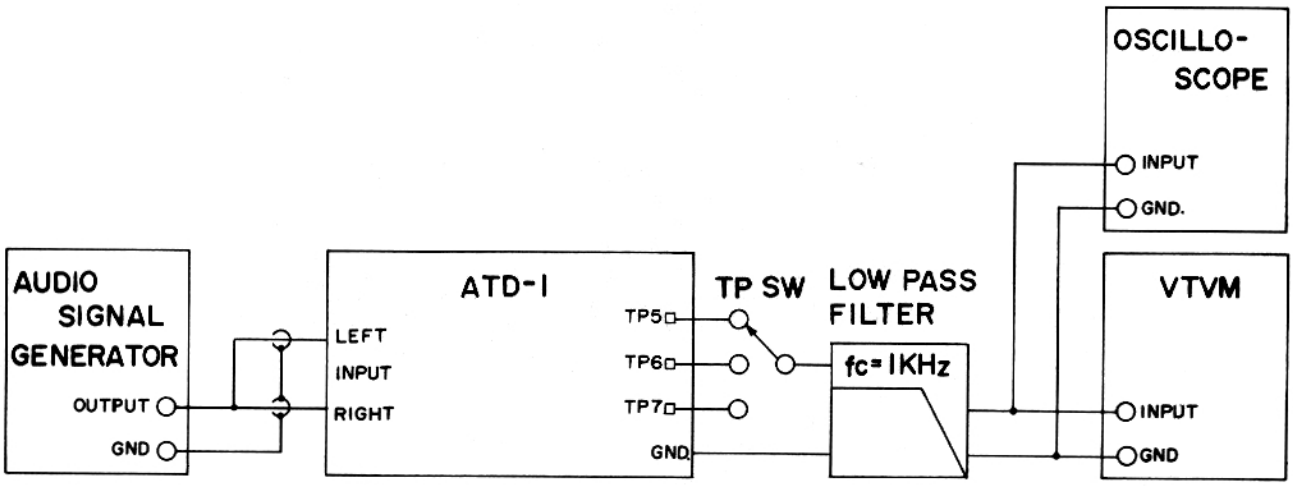
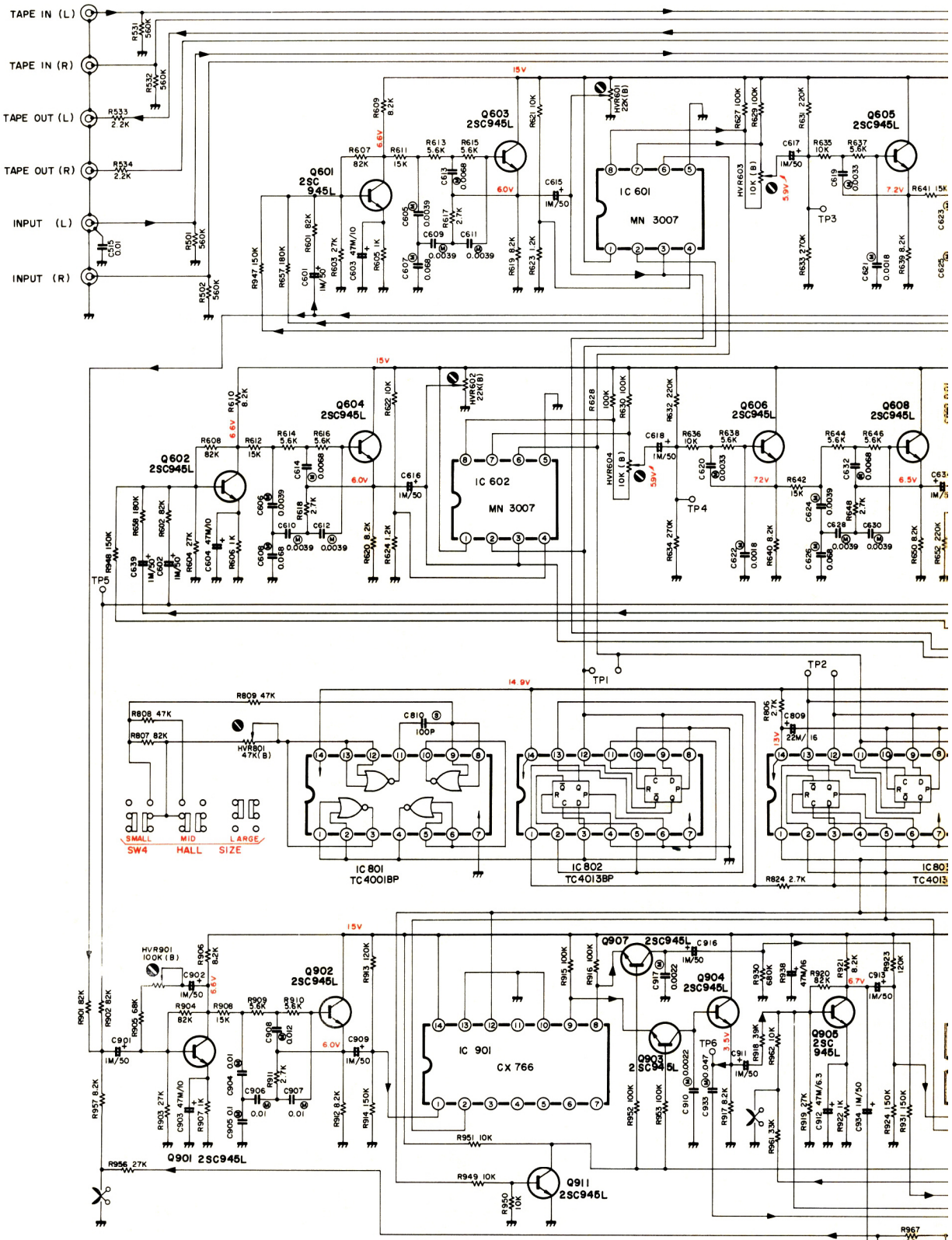


Fig. 10

SCHEMATIC DIAGRAM



NOTES:

1. SCHEMATIC IS SUBJECT TO CHANGE WITHOUT NOTICE.

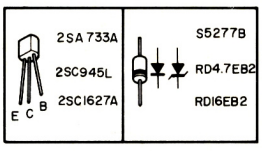
UNLESS OTHERWISE SPECIFIED:

2. RESISTANCE VALUES ARE IN OHMS. K = 1,000: M = 1,000,000
3. CAPACITANCE VALUES 1.0 AND ABOVE ARE IN pF OR uF (P = pF, M = uF), LESS THAN 1.0 ARE IN uF (ELECTROLYTIC CAPACITANCE VALUES ARE IN uF/WV.)
4. VOLTAGES ARE MEASURED TO CHASSIS GROUND WITH A "DC VOLTMETER"

V : VOLTAGES MEASURED WITH NO SIGNAL APPLIED.

SCHEMATIC SYMBOLS:

Ⓜ POLYESTER FILM CAPACITOR
Ⓢ POLYSTYRENE FILM CAPACITOR
• NONFLAMMABLE RESISTOR



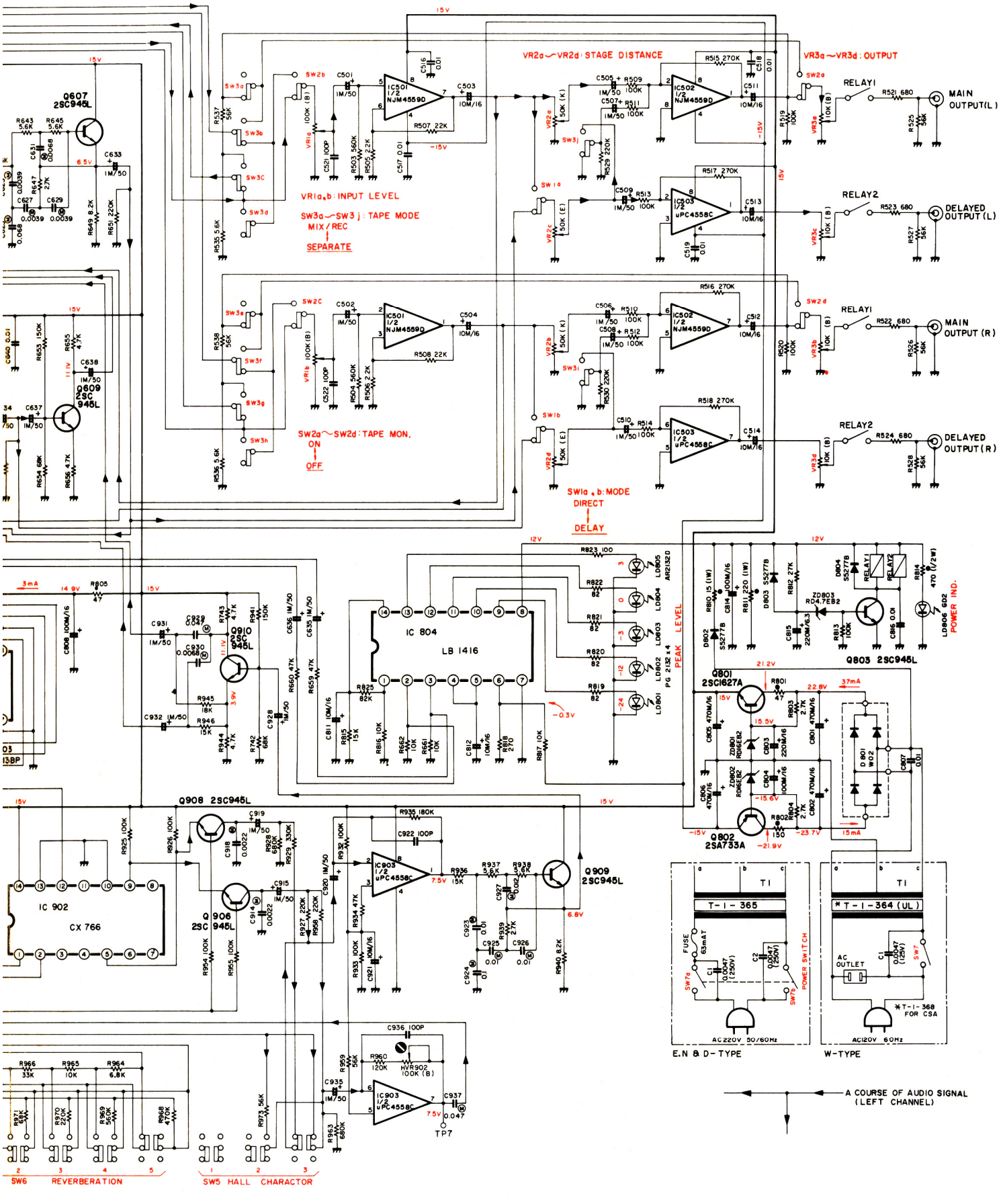
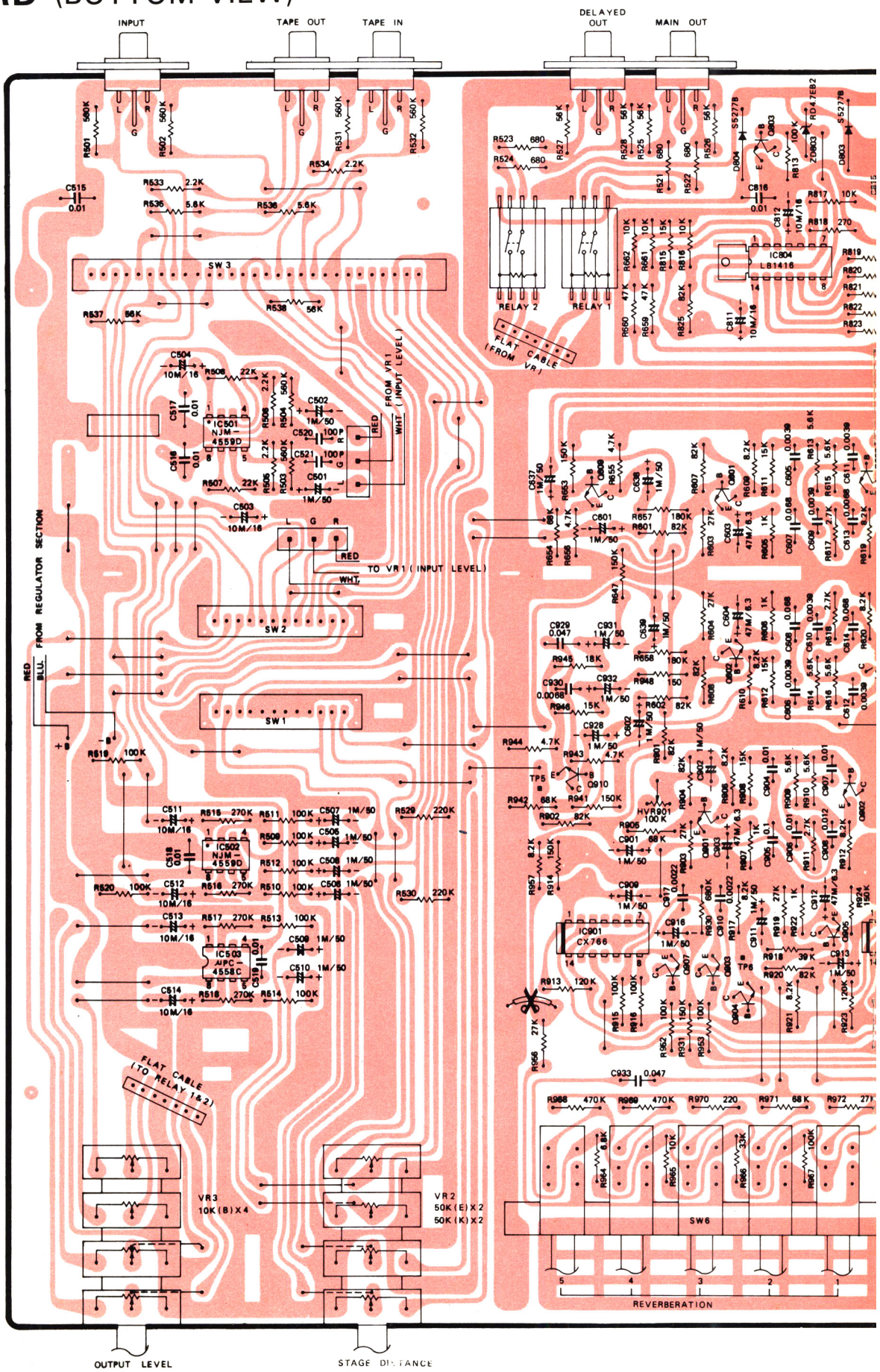

VR2a~VR2d : STAGE DISTANCE
VR3a~VR3d : OUTPUT
VR1a,b : INPUT LEVEL
SW3a~SW3j : TAPE MODE
MIX / REC
SEPARATE
SW2a~SW2d : TAPE MON.
ON
OFF
SW1a,b : MODE
DIRECT
DELAY
RELAY1
RELAY2
MAIN OUTPUT(L)
DELAYED OUTPUT(L)
MAIN OUTPUT (R)
DELAYED OUTPUT(R)
PEAK LEVEL
POWER IND.
IC 804
LB 1416
IC 902
CX 766
Q607 2SC945L
Q609 2SC 945L
Q610 2SC 945L
Q908 2SC945L
Q906 2SC 945L
Q909 2SC945L
Q801 2SC1627A
Q802 2SA733A
Q803 2SC945L
IC501 1/2 NJM4559D
IC502 1/2 NJM4559D
IC503 1/2 uPC4558C
IC903 1/2 uPC4558C
T-I-365
*T-I-364 (UL)
*T-I-368 FOR CSA
AC OUTLET
FUSE
POWER SWITCH
AC220V 50/60Hz
AC120V 60Hz
E.N & D-TYPE
W-TYPE
SW6 REVERBERATION
SW5 HALL CHARACTOR
A COURSE OF AUDIO SIGNAL (LEFT CHANNEL)

Fig. 11

P. C. BOARD (BOTTOM VIEW)



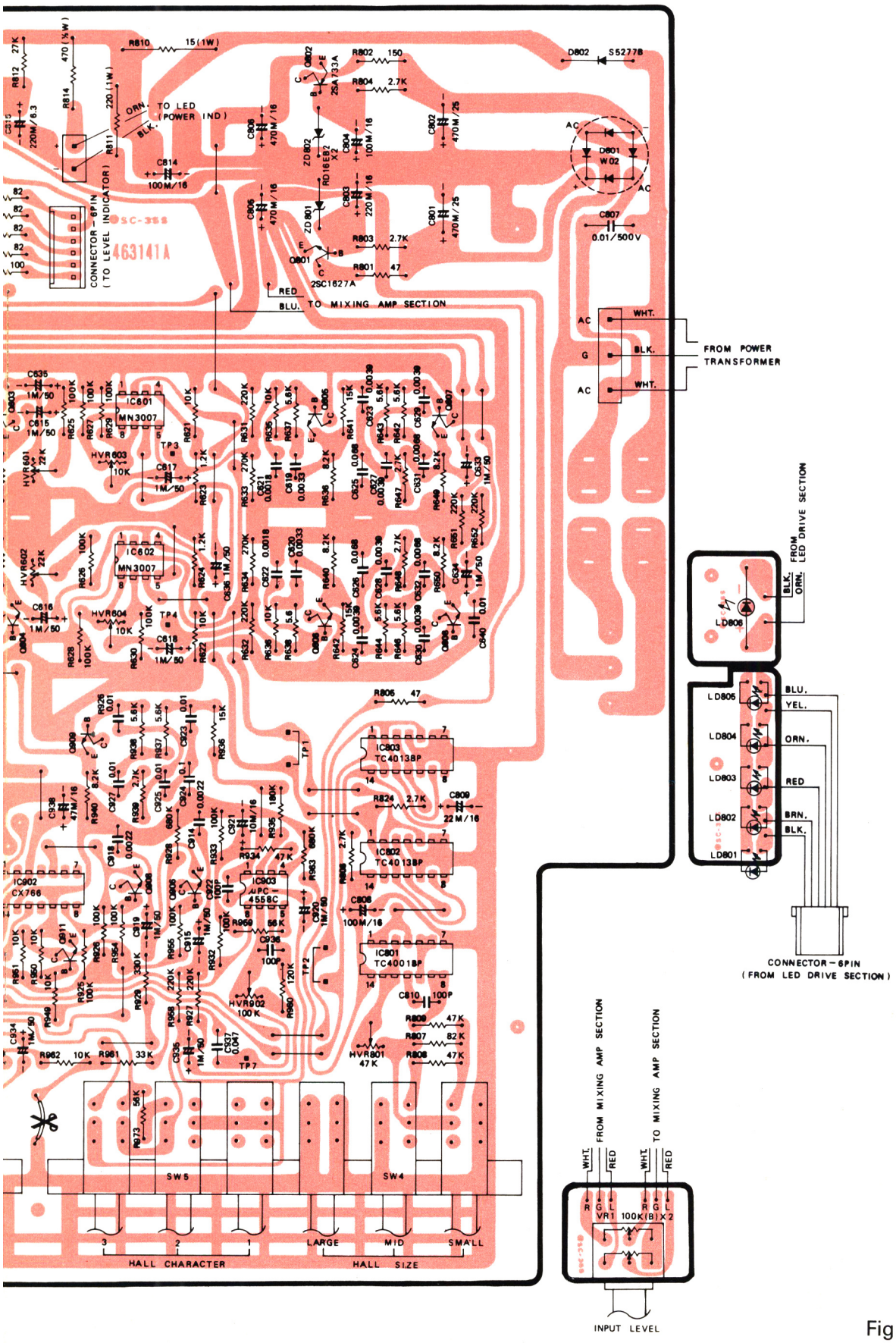

TO LED (POWER IND)
CONNECTOR – 6PIN (TO LEVEL INDICATOR)
TO MIXING AMP SECTION
FROM POWER TRANSFORMER
FROM LED DRIVE SECTION
CONNECTOR – 6PIN (FROM LED DRIVE SECTION)
FROM MIXING AMP SECTION
TO MIXING AMP SECTION
INPUT LEVEL
HALL CHARACTER
HALL SIZE
LARGE
MID
SMALL

Fig. 12

PARTS LOCATION

NOTE: Numbers of three digits with a ◯ are related to the KEY NUMBERS on parts list.

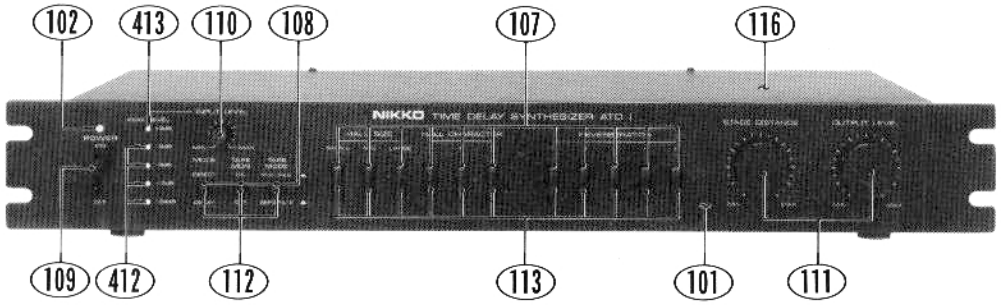


Photo 4

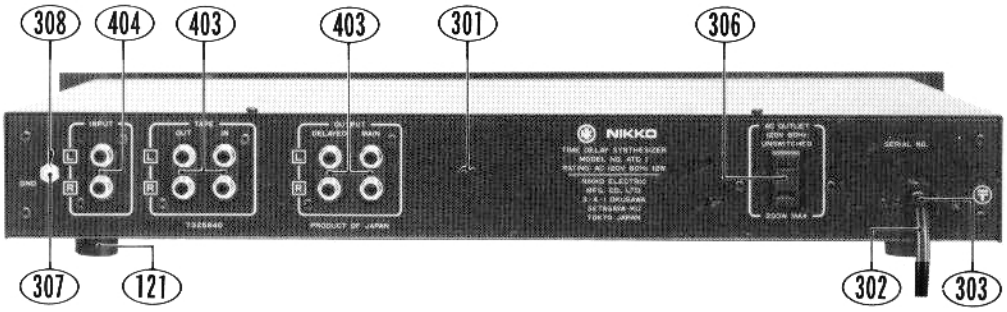


Photo 5

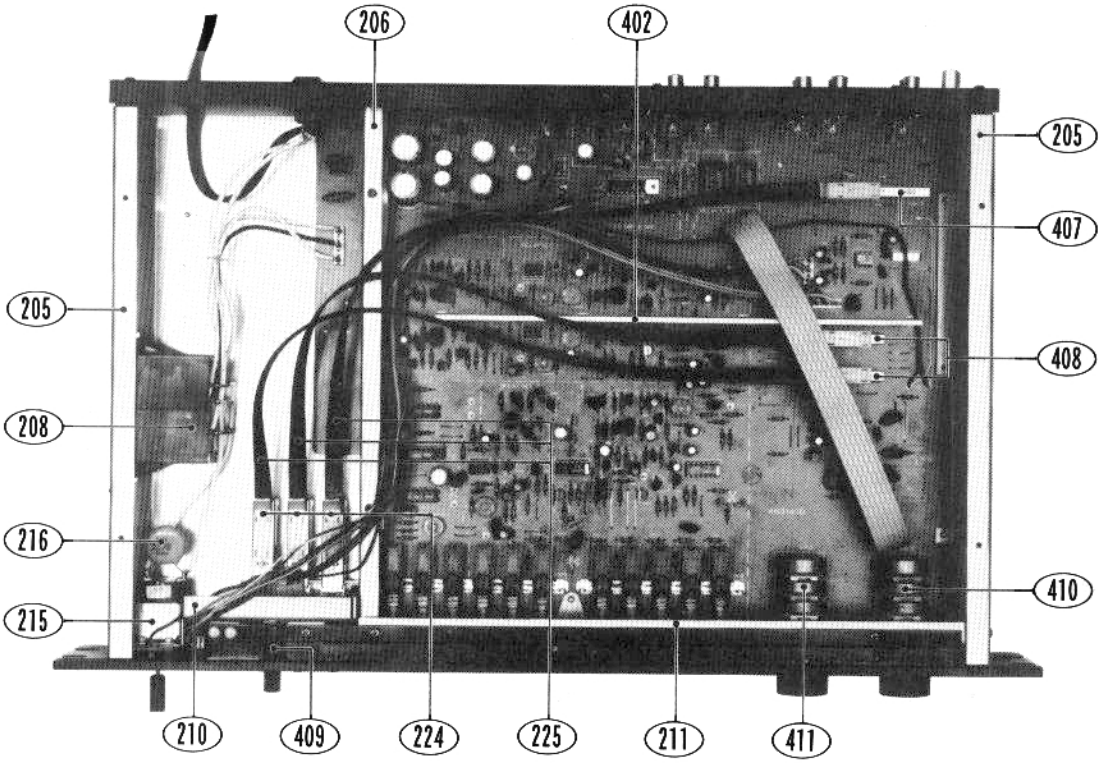


Photo 6

PARTS LIST

NOTES:

1. The KEY NUMBER (#) marked with a (★) on parts list relate to number of three digits with a (◯). (Photo 4 ~ 6)
2. \+ Numberals in file indicate the quantity of parts used in one type.
3. ++ TR : Transistor
   FET . Field effect transistor
   VR . Volume control (Variable resistor)
   RES : Carbon film fixed resistor
   MO-RES : Metal oxide film fixed resistor
   CEM-RES : Cemented wirewound fixed resistor
   FP : Flame proof
   C-CAP : Ceramic capacitor
   E-CAP : Aluminum electrolytic capacitor
   M-CAP : Polyester film capacitor
   S-CAP : Polystyrene film capacitor
   T-CAP : Tantalum electrolytic capacitor
   BP-CAP : Bipolar electrolytic capacitor
   LC-CAP : Low current leakage electrolytic capacitor.
4. Assemblies and parts are subject to change without notice.
5. Parts ordering procedure:
   A. DO NOT USE THE "KEY" NUMBER AND "SYMBOL" NUMBER. (these are control #for the factory only)
   B. Include in any order
      a. Part number.
      b. Part description.
      c. Model number.

      (any of the above lacking from an order may delay shipment of that order.)

KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
			PACKING MATERIALS & ACCESSORIES	
001		1 1 1	Carton box	9825590
002		1 1 1	Pad, left	9840750
003		1 1 1	Pad, right	9840760
004		1 1 1	Sack, polyethylen cloth	9640650
005		1 1 1	Cloth, polishing	9690040
006		1 1 1	Sack, polyethylen cloth – #13	9640320
007a		1 – –	Manual, instruction – E	960294E
007b		– 1 1	Manual, instruction – K	960295K
008		1 – –	List, service stations	9690180
009		1 – –	Card, warranty	967007A
010		1 – –	Post card	967008A
011		1 1 1	Drier – Silica gel	9690010
012		2 2 2	Cord, RCA phono pin plug – 2T-1 (NK)	962014A
			CABINET ASSEMBLY	
★101		1 1 1	Panel, front	7884610
102		1 1 1	Light guide, for power indicator	7402120
103		3 3 3	Rivet, push – 3φx4.5	7401240
104		3 3 3	Rivet, push – 3φx5.5	7400840
105		1 1 1	Bracket, LED	7032930
106		1 1 1	Dust cover	7001980
★107		11 11 11	Guide – GSB, for push button – hall size/ hall charactor/reverberation	7401520
★108		3 3 3	Guide, for push buttons – mode/tape mon./ tape mode	7401560
★109		1 1 1	Knob – 15BK-8LS – power	7841120
★110		1 1 1	Knob – 12BK-8D – input level	7841100
★111		2 2 2	Knob – 2BK-26D – stage distance/ output level	7851760
★112		3 3 3	Button, push – P5 – mode/tape mon./ tape mode	7401550
★113		11 11 11	Button, push – P416BK-4SQ – others	7852010
114		14 14 14	Stopper, button	7401460
115		3 3 3	Spring – (V)	7440400
★116a		1 – –	Cover, metal – (G)	7820850
★116b		– 1 1	Cover, metal – (DG)	7820860
117		4 4 4	Screw – TFTS 4φx10	887104W
118		4 4 4	Washer – 4φ	893104W
119		4 4 4	Screw – PTS 3φx6	814306W
120		1 1 1	Plate, bottom	7325120
★121		4 4 4	Foot, polyethylen – (TG)	7401350
122		4 4 4	Screw – PTS 3φx8	814308S
123		15 15 15	Screw – PTS 3φx6	814306S
124		3 3 3	Tye, nylon	7401880

KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
			CHASSIS ASSEMBLY	
201		1 1 1	(BACK PLATE ASSEMBLY)	
202		6 6 6	Screw – PTS 3φx6	814306W
203		6 6 6	Screw – PTS 3φx8	814308W
204		1 1 1	Holder, PCB	7226650
★205		2 2 2	Angle, both sides	7226630
★206		1 1 1	Angle, chassis	7227140
207		2 2 2	Screw – PTS 3φx6	814306S
★208a		1 – –	Transformer, power – T-1-364 – 120V only	1103640
★208b		– 1 1	Transformer, power – T-1-365 – 220/240V class II	1103650
209		2 2 2	Screw – PMS 4φx12	8104120
★210		1 1 1	Plate, front – L	7227150
★211		1 1 1	Plate, front – R	7227160
212		1 1 1	Bracket, panel	7031800
213		12 12 12	Screw – PTS 3φx6	814306S
214		1 1 1	Holder, PCB	7031140
★215a		1 – –	Switch, lever – PJ4AA TV-5 – power	4025410
★215b		– 1 1	Switch, lever – SY02 80DV – power	4025150
★216a		1 – –	C-CAP 0.0047μf AC125V	239472C
★216b		– 2 2	C-CAP 0.0047μf AC250V	239472E
217		– 2 2	Cover, C-CAP – (M)	7400980
218		– 1 1	Midget fuse – (S) 63mAT 250V	4720470
219		– 1 1	Holder, midget fuse	4581430
220		– 1 1	Screw – PTS 3φx8	814308S
221		2 2 2	Screw, stud – 9.5φ	7152470
222		2 2 2	Washer – TW(I) 3φ	893403U
223		4 4 4	Screw – PMS 3φx5	810305S
★224		1 1 1	Switch, tri push – mode/tape mon./ tape mode	4041420
★225		3 3 3	Wire, remote control	4582580
226		1 1 1	(DELAY PCB ASSEMBLY)	
227		5 5 5	Screw – PTS 3φx6	814306S
			BACK PLATE ASSEMBLY	
★301a		1 – –	Plate, back – W	7325840
★301b		– 1 1	Plate, back – E	7325850
★302a		1 – –	Plug/Cord – DP-70	606007A
★302b		– 1 1	Plug/Cord – CEE-2T	600510A
★303a		1 – –	Stopper, cord – SR-3P-4	7400620
★303b		– 1 1	Stopper, cord – SR-4N-4	7400690
304a		1 – –	Bracket, cord – UL	7029300

PART ORDERING PROCEDURE ----- DO NOT USE THE "KEY" NUMBER AND "SYMBOL" NUMBER. (these are control #for the factory only.) Include in any order: a. Part number, b. Part description, c. Model number. (any of the above lacking from an order may delay shipment of the order.)

KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
304b		– 1 1	Bracket, cord – EH	7029800
305		2 4 4	Screw – PTS 3φx6	814306W
*306		1 – –	Socket, AC outlet	4500150
*307		1 1 1	Shaft, GND terminal – MK-3	7152050
*308		1 1 1	Nut, GND terminal – MK-2	7152060
309		1 1 1	Washer – 3φ	8932030
310		1 1 1	Washer – IN 3φ	892013S
311		1 1 1	Washer – TW(I) 3φ	893403U
			DELAY PC BOARD ASSEMBLY	
401a		1 – –	DELAY PCB ASSEMBLY	9493090
401b		– 1 1	DELAY PCB ASSEMBLY	9492930
*402		1 1 1	Stay, PCB	7031280
*403		2 2 2	Terminal, RCA phono pin jack – 2Px2 – tape in/out, output	4444070
*404		1 1 1	Terminal, RCA phono pin jack – 1Px2 – input	4442050
405		1 1 1	Switch, hexa push – SUF62 – hall size/ hall character	4041400
406		1 1 1	Switch, penta push – SUF52 – reverberation	4041410
*407		1 1 1	Switch, slide – ESD801253 – tape mode	4020610
*408		2 2 2	Switch, slide – ESD801003 – mode/ tape mon.	4020600
*409		1 1 1	VR GM80 723F – 100kohm(B)x2 – input level	4321050
*410		1 1 1	VR JJ30E 560A – 10kohm(B)x4 – output level	4350030
*411		1 1 1	VR JJ30R 559A – 50k(K)x2, 50k(E)x2 – stage distance	4350040
			(MIXING AMP SECTION)	
	IC501,502	2 2 2	IC NJM4559D	518081S
	IC503	1 1 1	IC uPC4558C	518074S
	C501,502	2 2 2	E-CAP 1uf 50V	211510Q
	C503,504	2 2 2	E-CAP 10uf 16V	211220Q
	C505 ~C510	6 6 6	E-CAP 1uf 50V	211510Q
	C511,512	2 2 2	E-CAP 10uf 16V	211220Q
	C513,514	2 2 2	E-CAP 10uf 16V	211220Q
	C515 ~C519	5 5 5	C-CAP 0.01uf +80, –20% 50V YG	231103Z
	C520,521	2 2 2	C-CAP 100pf 10% 50V SL	232101K
	R501 ~R504	4 4 4	RES 560kohm 5% ¼W	328564J
	R505,506	2 2 2	RES 2.2kohm 5% ¼W	328222J
	R507,508	2 2 2	RES 22kohm 5% ¼W	328223J
	R509 ~R514	6 6 6	RES 100kohm 5% ¼W	328104J
	R515 ~R518	4 4 4	RES 270kohm 5% ¼W	328274J
	R519,520	2 2 2	RES 100kohm 5% ¼W	328104J
	R521 ~R524	4 4 4	RES 680ohm 5% ¼W	328681J
	R525 ~R528	4 4 4	RES 56kohm 5% ¼W	328563J
	R529,530	2 2 2	RES 220kohm 5% ¼W	328224J
	R531,532	2 2 2	RES 560kohm 5% ¼W	328564J
	R533,534	2 2 2	RES 2.2kohm 5% ¼W	328222J
	R535,536	2 2 2	RES 5.6kohm 5% ¼W	328562J
	R537,538	2 2 2	RES 56kohm 5% ¼W	328563J
			(MUTING SECTION)	
	RY1,2	2 2 2	Reed relay – FRL644D12-2AS	1700140
	Q803	1 1 1	TR 2SC945L (P or Q)	515077S
	D803,804	2 2 2	Diode S5277B	560046S
	ZD803	1 1 1	Zener diode RD4.7EB2	502051S
	C815	1 1 1	E-CAP 220uf 6.3V	211032Q
	C816	1 1 1	C-CAP 0.01uf +80, –20% 50V YG	231103Z
	R812	1 1 1	RES 27kohm 5% ¼W	328273J
	R813	1 1 1	RES 100kohm 5% ¼W	328104J
			(LED DRIVER SECTION)	
	IC804	1 1 1	IC LB1416	518075S
	C811,812	2 2 2	E-CAP 10uf 16V	211220Q
	R814	1 1 1	FP-RES 470ohm 5% ½W	329471L
	R815	1 1 1	RES 15kohm 5% ¼W	328153J
	R816,817	2 2 2	RES 10kohm 5% ¼W	328103J
	R818	1 1 1	RES 270ohm 5% ¼W	328271J
	R819 ~ R822	4 4 4	RES 82ohm 5% ¼W	328820J
	R823	1 1 1	RES 100ohm 5% ¼W	328101J
	R824		– DELETED –	
	R825	1 1 1	RES 82kohm 5% ¼W	328823J
			(CLOCK PULSE GENERATOR SECTION)	
	IC801	1 1 1	IC TC4001BP	518079S
	IC802,803	2 2 2	IC TC4013BP	518080S
	C808	1 1 1	E-CAP 100uf 16V	211230Q
	C809	1 1 1	E-CAP 22uf 16V	211222Q
	C810	1 1 1	S-CAP 100pf 5% 50V	223101V
	HVR801	1 1 1	Potentiometer – HVR SR19R B47kohm	4300730
	R805	1 1 1	FP-RES 47ohm 5% ¼W	328470L
	R806	1 1 1	RES 2.7kohm 5% ¼W	328272J
	R807	1 1 1	RES 82kohm 5% ¼W	328823J
	R808,809	2 2 2	RES 47kohm 5% ¼W	328473J
	R824	1 1 1	RES 2.7kohm 5% ¼W	328272J
			(REGULATOR SECTION)	
	Q801	1 1 1	TR 2SC1627A (O or Y)	512101S
	Q802	1 1 1	TR 2SA733A (P or Q)	514074S
	D801	1 1 1	Diode W02	560061S
	D802	1 1 1	Diode S5277B	560046S
	ZD801,802	2 2 2	Zener diode RD16EB2	502071S
	C801,802	2 2 2	E-CAP 470uf 25V	211335Q
	C803	1 1 1	E-CAP 220uf 16V	211232Q
	C804	1 1 1	E-CAP 100uf 16V	211230Q
	C805,806	2 2 2	E-CAP 470uf 16V	211235Q
	C807	1 1 1	C-CAP 0.01uf 500V YG	238103P
	C814	1 1 1	E-CAP 100uf 16V	211230Q
	R801	1 1 1	FP-RES 47ohm 5% ¼W	328470L
	R802	1 1 1	FP-RES 150ohm 5% ¼W	328151L
	R803,804	2 2 2	RES 2.7kohm 5% ¼W	328272J
	R810	1 1 1	FP-MO-RES 15ohm 5% 1W	361150L
	R811	1 1 1	FP-MO-RES 220ohm 5% 1W	361221L
			(DELAY SECTION 1)	
	IC601, 602	2 2 2	IC MN3007	518078S
	Q601 ~Q609	9 9 9	TR 2SC945L (P or Q)	515077S

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KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
	C601,602	2 2 2	E-CAP 1uf 50V	211510Q
	C603,604	2 2 2	E-CAP 47uf 10V	211025Q
	C605,606	2 2 2	M-CAP 0.0039uf 5% 50V	222392J
	C607,608	2 2 2	M-CAP 0.068uf 5% 50V	222683J
	C609			
	~C612	4 4 4	M-CAP 0.0039uf 5% 50V	222392J
	C613,614	2 2 2	M-CAP 0.0068uf 5% 50V	222682J
	C615			
	~C618	4 4 4	E-CAP 1uf 50V	211510Q
	C619,620	2 2 2	M-CAP 0.0033uf 5% 50V	222332J
	C621,622	2 2 2	M-CAP 0.0018uf 5% 50V	222182J
	C623,624	2 2 2	M-CAP 0.0039uf 5% 50V	222392J
	C625,626	2 2 2	M-CAP 0.068uf 5% 50V	222683J
	C627			
	~C630	4 4 4	M-CAP 0.0039uf 5% 50V	222392J
	C631,632	2 2 2	M-CAP 0.0068uf 5% 50V	222682J
	C633			
	~C639	7 7 7	E-CAP 1uf 50V	211510Q
	C640	1 1 1	C-CAP 0.01uf +80, -20% 50V YG	231103Z
	HVR601, 602	2 2 2	Potentiometer – HVR SR19R B22kohm	4301170
	HVR603, 604	2 2 2	Potentiometer – HVR SR19R B10kohm	4300510
	R601,602	2 2 2	RES 82kohm 5% ¼W	328823J
	R603,604	2 2 2	RES 27kohm 5% ¼W	328273J
	R605,606	2 2 2	RES 1kohm 5% ¼W	328102J
	R607,608	2 2 2	RES 82kohm 5% ¼W	328823J
	R609,610	2 2 2	RES 8.2kohm 5% ¼W	328822J
	R611,612	2 2 2	RES 15kohm 5% ¼W	328153J
	R613			
	~R616	4 4 4	RES 5.6kohm 5% ¼W	328562J
	R617,618	2 2 2	RES 2.7kohm 5% ¼W	328272J
	R619,620	2 2 2	RES 8.2kohm 5% ¼W	328822J
	R621,622	2 2 2	RES 10kohm 5% ¼W	328103J
	R623,624	2 2 2	RES 1.2kohm 5% ¼W	328122J
	R625			
	~R630	6 6 6	RES 100kohm 5% ¼W	328104J
	R631,632	2 2 2	RES 220kohm 5% ¼W	328224J
	R633,634	2 2 2	RES 270kohm 5% ¼W	328274J
	R635,636	2 2 2	RES 10kohm 5% ¼W	328103J
	R637,638	2 2 2	RES 5.6kohm 5% ¼W	328562J
	R639,640	2 222	RES 8.2kohm 5% ¼W	328822J
	R641,642	2 2 2	RES 15kohm 5% ¼W	328153J
	R643			
	~R646	4 4 4	RES 5.6kohm 5% ¼W	328562J
	R647,648	2 2 2	RES 2.7kohm 5% ¼W	328272J
	R649,650	2 2 2	RES 8.2kohm 5% ¼W	328822J
	R651,652	2 2 2	RES 220kohm 5% ¼W	328224J
	R653	1 1 1	RES 150kohm 5% ¼W	328154J
	R654	1 1 1	RES 68kohm 5% ¼W	328683J
	R655,656	2 2 2	RES 4.7kohm 5% ¼W	328472J
	R657,658	2 2 2	RES 180kohm 5% ¼W	328184J
	R659,660	2 2 2	RES 47kohm 5% ¼W	328473J
	R661,662	2 2 2	RES 10kohm 5% ¼W	328103J
			(DELAY SECTION 2)	
	IC901,902	2 2 2	IC CX766	518077S
	IC903	1 1 1	IC uPC4558C	518074S
	Q901			
	~Q911	11111	TR 2SC945L (P or Q)	515077S
	C901,902	2 2 2	E-CAP 1uf 50V	211510Q
	C903	1 1 1	E-CAP 47uf 10V	211125Q
	C904	1 1 1	M-CAP 0.01uf 5% 50V	222103J
	C905	1 1 1	M-CAP 0.1uf 5% 50V	222104J
	C906,907	2 2 2	M-CAP 0.01uf 5% 50V	222103J
	C908	1 1 1	M-CAP 0.012uf 5% 50V	222123J
	C909	1 1 1	E-CAP 1uf 50V	211510Q
	C910	1 1 1	M-CAP 0.0022uf 5% 50V	222222J
	C911	1 1 1	E-CAP 1uf 50V	211510Q
	C912	1 1 1	E-CAP 47uf 10V	211125Q

KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
	C913	1 1 1	E-CAP 1uf 50V	211510Q
	C914	1 1 1	M-CAP 0.0022uf 5% 50V	222222J
	C915,916	2 2 2	E-CAP 1uf 50V	211510Q
	C917,918	2 2 2	M-CAP 0.0022uf 5% 50V	222222J
	C919,920	2 2 2	E-CAP 1uf 50V	211510Q
	C921	1 1 1	E-CAP 10uf 16V	211220Q
	C922	1 1 1	C-CAP 100pf 10% 50V SL	232101K
	C923	1 1 1	M-CAP 0.01uf 5% 50V	222103J
	C924	1 1 1	M-CAP 0.1uf 5% 50V	222104J
	C925,926	2 2 2	M-CAP 0.01uf 5% 50V	222103J
	C927	1 1 1	M-CAP 0.012uf 5% 50V	222123J
	C928	1 1 1	E-CAP 1uf 50V	211510Q
	C929	1 1 1	M-CAP 0.047uf 5% 50V	222473J
	C930	1 1 1	M-CAP 0.0068uf 5% 50V	222682J
	C931,932	2 2 2	E-CAP 1uf 50V	211510Q
	C933	1 1 1	M-CAP 0.047uf 5% 50V	222473J
	C934,935	2 2 2	E-CAP 1uf 50V	211510Q
	C936	1 1 1	C-CAP 100pf 10% 50V SL	232101K
	C937	1 1 1	M-CAP 0.047uf 5% 50V	222473J
	C938	1 1 1	E-CAP 47uf 16V	211225Q
	HV901, 902	2 2 2	Potentiometer – HVR SR19R B100kohm	4301140
	R901,902	2 2 2	RES 82kohm 5% ¼W	328823J
	R903	1 1 1	RES 27kohm 5% ¼W	328273J
	R904	1 1 1	RES 82kohm 5% ¼W	328823J
	R905	1 1 1	RES 68kohm 5% ¼W	328683J
	R906	1 1 1	RES 8.2kohm 5% ¼W	328822J
	R907	1 1 1	RES 1kohm 5% ¼W	328102J
	R908	1 1 1	RES 15kohm 5% ¼W	328153J
	R909,910	2 2 2	RES 5.6kohm 5% ¼W	328562J
	R911	1 1 1	RES 2.7kohm 5% ¼W	328272J
	R912	1 1 1	RES 8.2kohm 5% ¼W	328822J
	R913	1 1 1	RES 120kohm 5% ¼W	328124J
	R914	1 1 1	RES 150kohm 5% ¼W	328154J
	R915,916	2 2 2	RES 100kohm 5% ¼W	328104J
	R917	1 1 1	RES 8.2kohm 5% ¼W	328822J
	R918	1 1 1	RES 39kohm 5% ¼W	328393J
	R919	1 1 1	RES 27kohm 5% ¼W	328273J
	R920	1 1 1	RES 82kohm 5% ¼W	328823J
	R921	1 1 1	RES 8.2kohm 5% ¼W	328822J
	R922	1 1 1	RES 1kohm 5% ¼W	328102J
	R923	1 1 1	RES 120kohm 5% ¼W	328124J
	R924	1 1 1	RES 150kohm 5% ¼W	328154J
	R925,926	2 2 2	RES 100kohm 5% ¼W	328104J
	R927	1 1 1	RES 220kohm 5% ¼W	328224J
	R928	1 1 1	RES 680kohm 5% ¼W	328684J
	R929	1 1 1	RES 330kohm 5% ¼W	328334J
	R930	1 1 1	RES 680kohm 5% ¼W	328684J
	R931	1 1 1	RES 150kohm 5% ¼W	328154J
	R932,933	2 2 2	RES 100kohm 5% ¼W	328104J
	R934	1 1 1	RES 47kohm 5% ¼W	328473J
	R935	1 1 1	RES 180kohm 5% ¼W	328184J
	R936	1 1 1	RES 15kohm 5% ¼W	328153J
	R937,938	2 2 2	RES 5.6kohm 5% ¼W	328562J
	R939	1 1 1	RES 2.7kohm 5% ¼W	328272J
	R940	1 1 1	RES 8.2kohm 5% ¼W	328822J
	R941	1 1 1	RES 150kohm 5% ¼W	328154J
	R942	1 1 1	RES 68kohm 5% ¼W	328683J
	R943,944	2 2 2	RES 4.7kohm 5% ¼W	328472J
	R945	1 1 1	RES 18kohm 5% ¼W	328183J
	R946	1 1 1	RES 15kohm 5% ¼W	328153J
	R947,948	2 2 2	RES 150kohm 5% ¼W	328154J
	R949,950	2 2 2	RES 10kohm 5% ¼W	328103J
	R951	1 1 1	RES 10kohm 5% ¼W	328103J
	R952			
	~R955	4 4 4	RES 100kohm 5% ¼W	328104J
	R956	1 1 1	RES 27kohm 5% ¼W	328273J
	R957	1 1 1	RES 8.2kohm 5% ¼W	328822J
	R958	1 1 1	RES 220kohm 5% ¼W	328224J
	R959	1 1 1	RES 56kohm 5% ¼W	328563J
	R960	1 1 1	RES 120kohm 5% ¼W	328124J
	R961	1 1 1	RES 33kohm 5% ¼W	328333J
	R962	1 1 1	RES 10kohm 5% ¼W	328103J

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KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
	R963	1 1 1	RES 680kohm 5% ¼W	328684J
	R964	1 1 1	RES 6.8kohm 5% ¼W	328682J
	R965	1 1 1	RES 10kohm 5% ¼W	328103J
	R966	1 1 1	RES 33kohm 5% ¼W	328333J
	R967	1 1 1	RES 100kohm 5% ¼W	328104J
	R968,969	2 2 2	RES 470kohm 5% ¼W	328474J
	R970	1 1 1	RES 220kohm 5% ¼W	328224J
	R971	1 1 1	RES 68kohm 5% ¼W	328683J
	R972	1 1 1	RES 27kohm 5% ¼W	328273J
	R973	1 1 1	RES 56kohm 5% ¼W	328563J

KEY NO.	SYMBOL NO.	TYPE + W E N	DESCRIPTION ++	PART NO.
			(LED SECTION 1)	
412	LD801 ~LD804	4 4 4	LED PG2132 – green	5060190
413	LD805	1 1 1	LED AR2132D – red	5060180
		1 1 1	Connector assembly – 6P	4570370
			(LED SECTION 2)	
414	LD806	1 1 1	LED GD2 – red – power indicator	5060200

SEMICONDUCTOR DATA

TRANSISTORS

† NOTES Ge: Germanium, Si: Sillicon; A: Alloy, B: Base, D: Diffused, Dd: Double-diffused; Df: Drift-field, E: Epitaxial, G: Grown, J: Junction; M: Mesa, P: Planer, Pc: Point-contact, Td: Triple-diffused

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute-Maximum Values: (T_A = 25°C unless otherwise specified)					ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)													MANUFACTURER
			Collector-to-Base Voltage V_{CBO} (V)	Emitter-to-Base Voltage V_{EBO} (V)	Collector Current I_C (mA)	Collector Dissipation P_C (mW)	Junction Temperature T_J (°C)	Collector Cutoff Current I_{CBO} (uA)	V_{CB} (V)	Static Forward-Current Transfer Ratio h_{FE}	V_{CE} (V)	I_C (mA)	Collector-Emitter Saturation Voltage $V_{CE(sat)}$ (V)	I_C (mA)	I_B (mA)	Gain-Bandwidth Product f_T f_{ob}* (MHz)	V_{CE} V_{CB}* (V)	I_E I_C* (mA)	Output Capacitance C_{ob} (pF)	Others	
2SA733A (P, Q)	AF	PNP Si-E	−60	−5	−100	250	125	−0.1 max.	−60	135 ~ 400	−6	−1	−0.3 max.	−100	−10	450 max.	−6	10	6 max.		NEC
2SC945L (P, Q)	AF	NPN Si-E	60	5	100	250	125	0.1 max.	60	135 ~ 400	6	1	0.3 max.	100	10	450 max.	6	10	5 max.		NEC
2SC1627A (O, Y)	AF, Driver	NPN Si-E	80	5	400	800	150	0.1 max.	50	70 ~ 240	2	50	0.4 max.	200	20						TOSHIBA

DIODES, LED'S

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute-Maximum Values: (T_A = 25°C unless otherwise specified)								ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)							MANUFACTURER
			Reverse Surge Voltage V_{Rsurge} (V)	Peak Reverse Voltage V_{RM} (V)	Reverse Voltage V_R (V)	Peak Forward Voltage V_{FM} (V)	Peak Forward Current I_{FM} (mA)	Average Rectified Current I_O (mA)	Forward Surge Current $I_{F\,surge}$ (A)	Junction Temperature T_J (°C)	Total Power Dissipation P_D (mW)	Forward Current I_{Fmin} (mA)	Test Condition V_F (V)	Forward Voltage V_{Fmax} (V)	Test Condition I_F (mA)	Reverse Current I_{Rmax} (uA)	Test Condition V_R (V)	Others	
W02	Rectifier	Si-DJ Bridge			200	200		1.5A	50	125				1.0	1.0A	10		Rth = 50°C/W	GENERAL INSTRUMENT
S5277B	Rectifier	Si-DJ		100			2.0A	1.0A	50	150				1.2	1.0A	10	100		TOSHIBA
PG2132	Lamp (GREEN)	GaP			4		100	I_F = 50 mA		85	125			2.5	20	100	4	I_V = 0.4 mcd (I_F = 20 mA)	STANLEY
AR2132D	Lamp (RED)	GaAsP			4		300	I_F = 50 mA		85	100			2.0	20	100	4	I_V = 0.6 mcd (I_F = 20 mA)	STANLEY
GD2	Lamp (RED)	GaAsP			3			I_F = 40 mA		75	80			2.0	20	100	3		STANLEY

ZENER DIODES

DEVICE TYPE	APPLICATIONS	STRUCTURE†	MAXIMUM RATINGS Absolute-Maximum Values: (T_A = 25°C unless otherwise specified)			ELECTRICAL CHARACTERISTICS Typical Values: (T_A = 25°C unless otherwise specified)														MANUFACTURER
			Total Power Dissipation P_D (mW)	Zener Current I_Z (A)	Junction Temperature T_J (°C)	Zener Voltage V_Z MIN (V)	V_Z TYP (V)	V_Z MAX (V)	Test Conditions I_Z (mA)	Differential Resistance r_Z TYP (Ω)	r_Z MAX (Ω)	Test Conditions I_Z (mA)	Temperature Coefficient γ_Z TYP (%/°C)	γ_Z MAX (%/°C)	Test Conditions I_Z (mA)	Reverse Current I_Z MAX (uA)	Test Conditions V_R (V)	Others	
RD4.7-E82	Regulator	Si-J	400		175	4.55		4.80	20		35	20				10	1		NEC
RD16-E82	Regulator	Si-J	400		175	15.25		16.04	10		35	10				2	12		NEC

INTEGRATED CIRCUITS μPC4558C/NJM4559D

- **APPLICATION: DUAL OPERATIONAL AMPLIFIER**
- **MANUFACTURER: NEC (μPC4558C) / JRC (NJM4559D)**

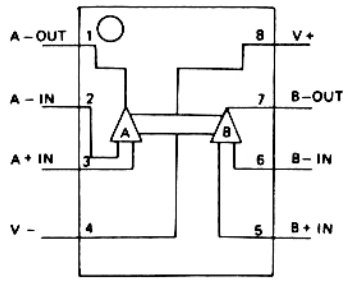
ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	μPC4558C	NJM4559D	UNITS
Supply Voltage	V_S	±18	±18	V
Total Power Dissipation	P_T	350	500	mW
Differential Input Voltage	V_{ID}	±30	±30	V
Input Voltage	V_{ICM}	±15	±15	V
Storage Temperature	Tsrg	−55 ~ +125	−40 ~ +120	°C
Operating Temperature	Topt	0 ~ +70	−20 ~ +75	°C

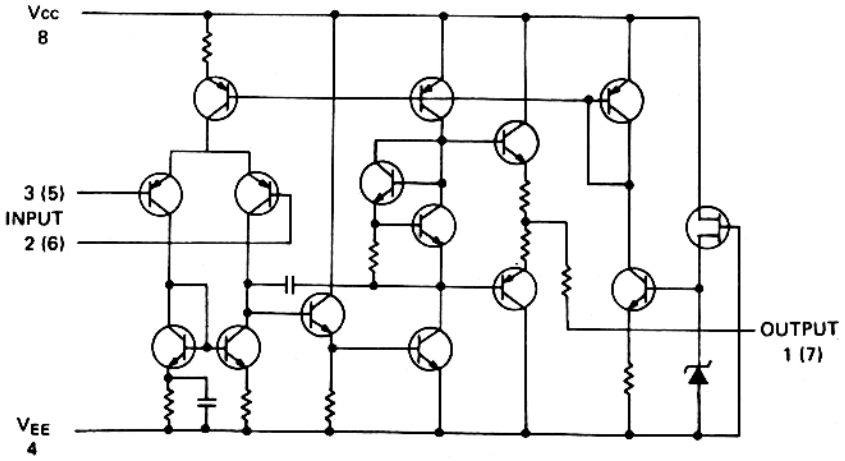
ELECTRICAL CHARACTERISTICS (T_a = 25°C, V_S = ±15V)

ITEM	SYMBOL	CONDITIONS	μPC4558C			NJM4559D			UNITS
			MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Input Offset Voltage	V_{IO}	$R_S \leqq 10k\Omega$		0.5	6.0			6.0	mV
Input Offset Current	I_{IO}			5	200			200	nA
Input Bias Current	I_B			60	500			500	nA
Large-Signal Voltage Gain	A_V	$R_L \geqq 2k\Omega, V_O = \pm 10V$	86	100		86			dB
Output Voltage Swing	V_{om}	$R_L \geqq 10k\Omega$	±12	±14		±12			V
Common Mode Rejection Ratio	CMR	$R_S \leqq 10k\Omega$	70	90		70			dB
Supply Voltage Rejection Ratio	SVR	$R_S \leqq 10k\Omega$		30	150			150	μV/V
Power Consumption	P_d	both channel		90	170			170	mW
Slew Rate	SR	$R_L \geqq 2k\Omega$		1.0			2.0		V/μS

TERMINAL GUIDE (TOP VIEW)



EQUIVALENT CIRCUIT (1/2 CIRCUIT)



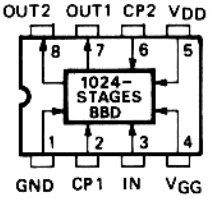
INTEGRATED CIRCUITS MN3007

- **APPLICATION: 1024 STAGES BBD**
- **STRUCTURE: P-MOS**
- **MANUFACTURER: MATSUSHITA**

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

ITEM	SYMBOL	RATINGS	UNITS
Terminal Voltage	Vpin	−18 ~ +0.3	V
Output Voltage	Vo	−18 ~ +0.3	V
Operating Temperature	Topt	−20 ~ +60	°C
Storage Temperature	Tstg	−55 ~ +125	°C

TERMINAL GUIDE (TOP VIEW)



ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{DD}=V_{CPL}=−15V, V_{CPH}=0V, V_{GG}=−14V, R_L=100kΩ)

ITEM	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Signal Delay Time	t_D		5.12		51.2	msec.
Input Frequency	fi	f_{cp} = 40kHz, V_i = 1.5Vrms			12	kHz
Input Voltage Swing	Vi	f_{cp} = 40kHz, f_i = 1kHz, THD = 2.5%			1.5	Vrms
Insertion Loss	Li	f_{cp} = 40kHz, f_i = 1kHz, V_i = 1.5Vrms	−4	0	4	dB
Total Harmonic Distortion	THD	f_{cp} = 40kHz, f_i = 1kHz, V_i = 0.78Vrms		0.5	2.5	%
Noise Voltage	Vno	f_{cp} = 100kHz, IHF-A curve			0.3	mVrms
Signal to Noise Ratio	S/N			80		dB

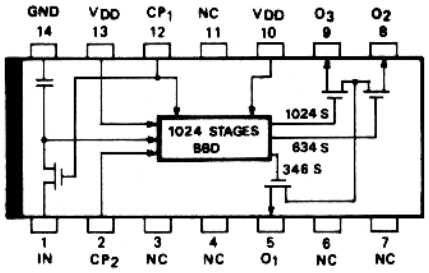
INTEGRATED CIRCUITS CX766

- **APPLICATION: 1024 STAGES BBD**
- **STRUCTURE: P-MOS**
- **MANUFACTURER: SONY**

ABSOLUTE MAXIMUM RATINGS (Ta = 25°C)

ITEM	SYMBOL	RATINGS	UNITS
Terminal Voltage	Vpin	−25 ~ +0.5	V
Power Dissipation	Pd	200 (Ta=60°C)	mW
Operating Temperature	Topt	−10 ~ +60	°C
Storage Temperature	Tstg	−50 ~ +120	°C

TERMINAL GUIDE (TOP VIEW)



ELECTRICAL CHARACTERISTICS (Ta = 25°C, V_{DD}=V_{CPL}=−12V, V_{CPH}=−1.5V, f_{CPL}=8kHz)

ITEM	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Signal Delay Time O_1	D_1			21.6		msec.
Signal Delay Time O_2	D_2			39.6		msec.
Signal Delay Time O_3	D_3			64.0		msec.
Insertion Loss	Li	f_i = 400Hz, V_i = 0dBs	4.5	5.3	6.0	dB
Total Harmonic Distortion	THD	f_i = 400Hz, V_i = 0dBs		0.9	1.5	%
Noise Level	NL	70dB amp.		0.2	0.3	Vrms

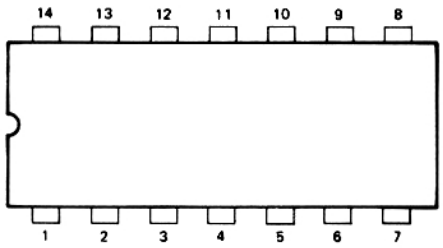
INTEGRATED CIRCUITS TC4001BP

- **APPLICATION: QUAD 2-INPUT NOR GATE**
- **STRUCTURE: C-MOS**
- **MANUFACTURER: TOSHIBA**

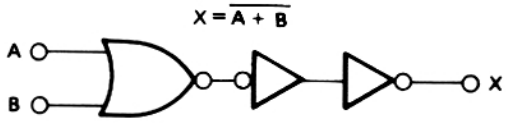
ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATINGS	UNITS
Supply Voltage	V_{DD}	$V_{SS}-0.5 \sim V_{SS}+20$	V
Input Voltage	V_{IN}	$V_{SS}-0.5 \sim V_{DD}+05$	V
Output Voltage	V_{OUT}	$V_{SS}-0.5 \sim V_{DD}+0.5$	V
Input Current	I_{IN}	±10	mA
Power Dissipation	P_D	300	mW
Storage Temperature	Tstg	−65 ~ 150	°C

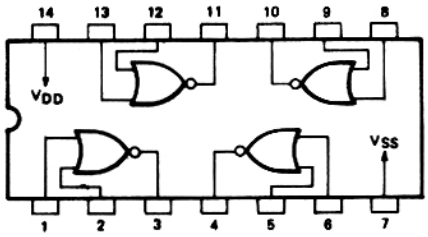
TERMINAL GUIDE (TOP VIEW)



LOGIC DIAGRAM



BLOCK DIAGRAM



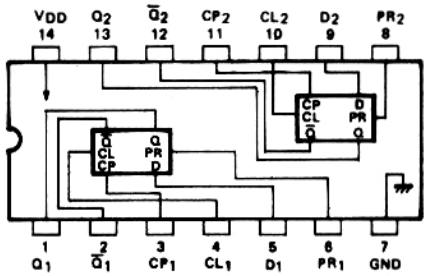
INTEGRATED CIRCUITS TC4013BP

- **APPLICATION: DUAL D-TYPE FLIP-FLOP**
- **STRUCTURE: C-MOS**
- **MANUFACTURER: TOSHIBA**

ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATINGS	UNITS
Supply Voltage	V_{DD}	$V_{SS}-0.5 \sim V_{SS}+20$	V
Input Voltage	V_{IN}	$V_{SS}-0.5 \sim V_{DD}+05$	V
Output Voltage	V_{OUT}	$V_{SS}-0.5 \sim V_{DD}+05$	V
Input Current	I_{IN}	±10	mA
Power Dissipation	P_D	300	mW
Storage Temperature	Tstg	−65 ~ 150	°C

TERMINAL GUIDE & BLOCK DIAGRAM (TOP VIEW)

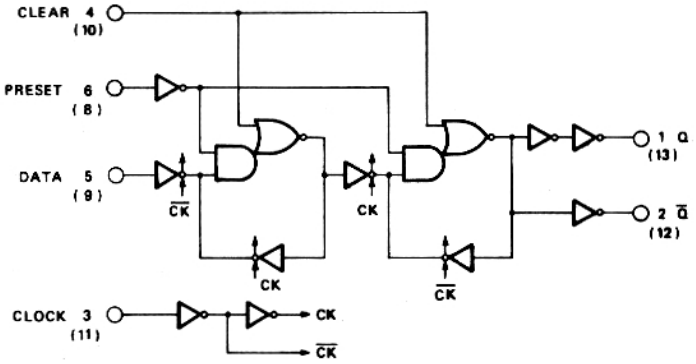


TRUTH TABLE

INPUTS				OUTPUT	
CL	PR	D	CP△	Q	$\overline{Q}$
L	H	X	X	H	L
H	L	X	X	L	H
H	H	X	X	L	H
L	L	L	↑	L	H
L	L	H	↑	H	L
L	L	X	↓	Q·	$\overline{Q}$·

NOTE:
X: Don't Care
△: Level Change
•: No Change

LOGIC DIAGRAM



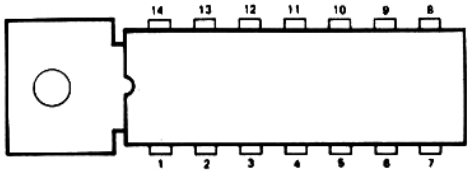
INTEGRATED CIRCUITS LB1416

- **APPLICATION: LEVEL METER DRIVER**
- **MANUFACTURER: SANYO**

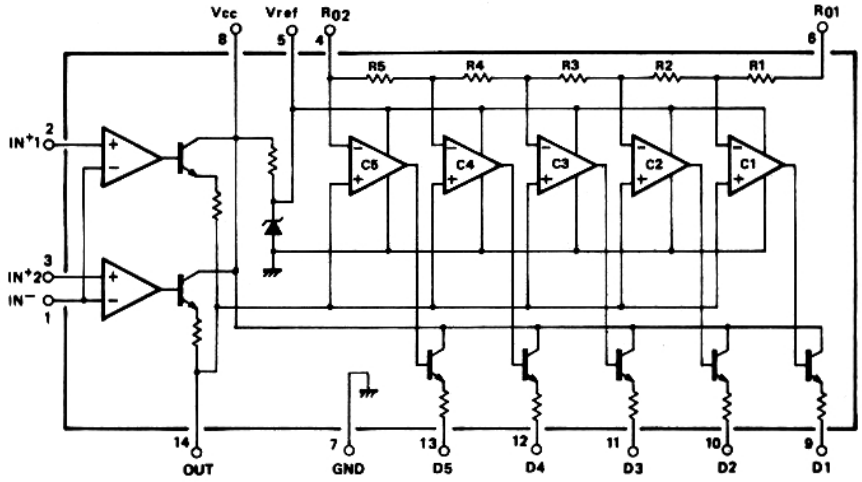
ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	RATINGS	UNITS
Supply Voltage	Vcc	−0.3 ~ +18	V
Input Voltage	VIN	−0.3 ~ Vcc	V
Output Voltage	VOUT	−0.3 ~ +8	V
"D" Terminal Output Voltage	VOUT(D)	−0.3 ~ +10	V
Power Dissipation (Ta ≦ 35°C)	PD	1150	mW
Storage Temperature	Tstg	−40 ~ +125	°C

TERMINAL GUIDE (TOP VIEW)



BLOCK DIAGRAM



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965187E 80. January 1,200 Printed in Japan