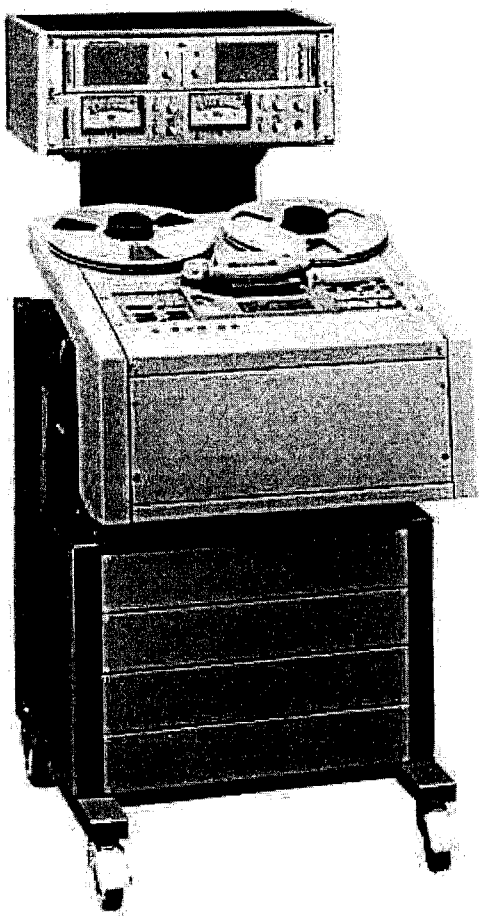
TASCAM

TEAC Professional Division

ATR-60-2

(-T, -N, -D, -HS)

2-Track Recorder/Reproducer



OPERATION/MAINTENANCE

5700079800

The guarantee of performance that we provide for the ATR-60-2 must have several restrictions. We say that the recorder will perform properly only if it is adjusted properly and the guarantee is that such adjustment will be possible. However, we cannot guarantee your skill in adjustment or your technical comprehension of this manual. Therefore, Basic Daily Setup is not covered by the Warranty. If your attempts at internal adjustments such as rebias and record EQ trim are unsuccessful, we must make a service charge to correct your mistakes.

Recording is an art as well as a science. A successful recording is often judged primarily on the quality of sound as art, and we obviously cannot guarantee that. A company that makes paint and brushes for artists cannot say that the paintings made with their products will be well received critically. The art is the provice of the artist. TASCAM can make no guarantee that the ATR-60-2 *by itself* will assure the quality of the recordings you make. Your skill as a technician and your abilities as an artist will be significant factors in the results you achieve.

This recorder/reproducer has a serial number located on the rear panel. Please record the model number and serial number and retain them for your records.
Model Number _____
Serial Number _____

WARNING: TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

CAUTION RISK OF ELECTRIC SHOCK DO NOT OPEN	CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, DO NOT REMOVE COVER (OR BACK). NO USER-SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.
	The lightning flash with arrowhead symbol within an equilateral triangle, is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure, that may be of sufficient magnitude to constitute a risk of electric shock to persons.
	The exclamation point within an equilateral triangle is intended to alert the user of the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

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Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daß der/die/das

MAGNETTONBANDGERÄT TASCAM ATR-60-2

(Gerät: Typ, Bezeichnung)

in Übereinstimmung mit den Bestimmungen der

AMTSBLATT 163/1984, VFG 1045/1984

(Amtsblattverfügung)

funk-entstört ist.

Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Berechtigung zur Überprüfung der Serie auf Einhaltung der Bestimmungen eingeräumt.

TEAC CORPORATION

Name des Herstellers/Importeurs

SECTION I. GENERAL INFORMATION

1.1 INTRODUCTION

This manual includes information for the operation and maintenance of four different 2-track stereo tape machines. All begin with the designation of ATR-60-2 (Audio Tape Recorder, Series 60, 2-track). The distinguishing features of the four models are listed below:

ATR-60-2T 1/2 Track format with 0.3 mm IEC center stripe data track for time code, 1/4" wide tape at 7.5 ips or 15 ips (19 cm/sec or 38 cm/sec), EQ set for NAB (switchable for IEC), fluxivity set for 250 nWb/m (switchable for 320 nWb/m).

ATR-60-2N 1/2 Track NAB stereo head format, 1/4" wide tape at 7.5 ips or 15 isp, EQ set for NAB (switchable for IEC), fluxivity set for 250 nWb/m (switchable for 320 nWb/m).

ATR-60-2D 1/2 Track DIN stereo head format, 1/4" wide tape at 7.5 ips or 15 ips, EQ set for IEC (switchable for NAB), fluxivity set for 320 nWb/m (switchable for 250 nWb/m).

ATR-60-2HS 1/2 Track stereo format, 1/2" wide tape at 15 ips or 30 ips (38 cm/sec or 76 cm/sec), EQ set for IEC at 15 ips (switchable for NAB), and for AES at 30 ips, fluxivity set for 320 nWb/m (switchable for 250 nWb/m).

All models are built with the transport in one chassis, and the electronics in another. This modular design enables the tape transport and electronics to be mounted in a standard 19" wide EIA equipment rack, in a portable 19" rack case, in a roll-around console such as the TASCAM CS-65 with CS-62 overbridge kit that places the electronics in an overbridge configuration, or in a custom console. The TASCAM RC-65 Remote Transport Control unit may be used with any of the ATR-60-2 models, providing a convenient "long arm" to operate all transport functions, including pitch control. For even greater flexibility, the TASCAM AQ-65 Multi-Function Auto Locator can be connected, which provides 10 cue point memory, programmable pre-roll, and two-point repeat.

The ATR-60-2 transport is an exceptionally reliable, professional design. It is built on an extra heavy duty chassis that assures stable alignment and the utmost accuracy in tape motion. The hefty construction of the transport also minimizes maintenance. The microprocessor ensures smooth, fast, and accurate tape motion by commanding a pair of direct drive reel motors and a Phase Lock Loop servo capstan motor. Even in synchronized lock-up to other audio transports, film chains or video systems, the ATR-60-2 has plenty of torque and accuracy to keep in step with a busy work schedule. What's more, this transport's physical and electronic stability minimize stretch and wear on recording tape during long hours of high speed, start-stop shuttling.

Interface between the ATR-60-2 and any time code based equipment (synchronizer, resolver, etc) is accomplished via a single, rear panel "Accessory" connector. This connector carries all the necessary logic and tally signals for use with Adams Smith, Audio Kinetics, Cypher Digital, Convergence, EECO, TimeLine, United Media, Video Media and other similar systems.

The ATR-60-2 electronics are mounted on plug-in, printed circuit boards for ease of service. The VU meter panel swings out and down for immediate access to all the trimmers required for routine alignment. This method also makes it easy to observe the VU meters while making adjustments, and alignment is equally easy whether the unit is vertically or horizontally mounted.

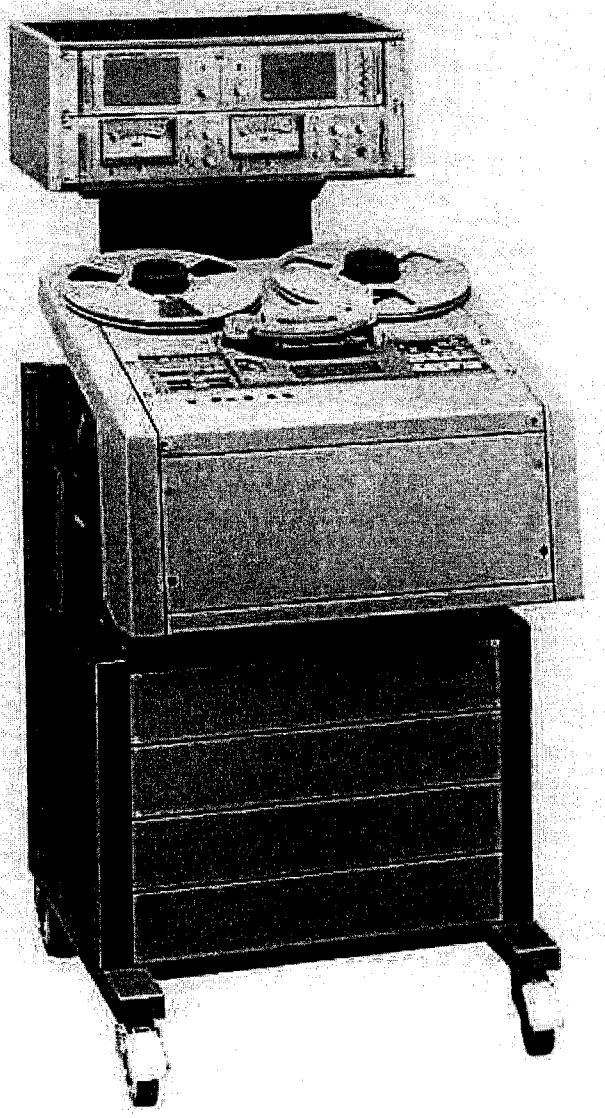


FIGURE 1-1. TYPICAL ATR-60-2 SYSTEM CONFIGURATION.

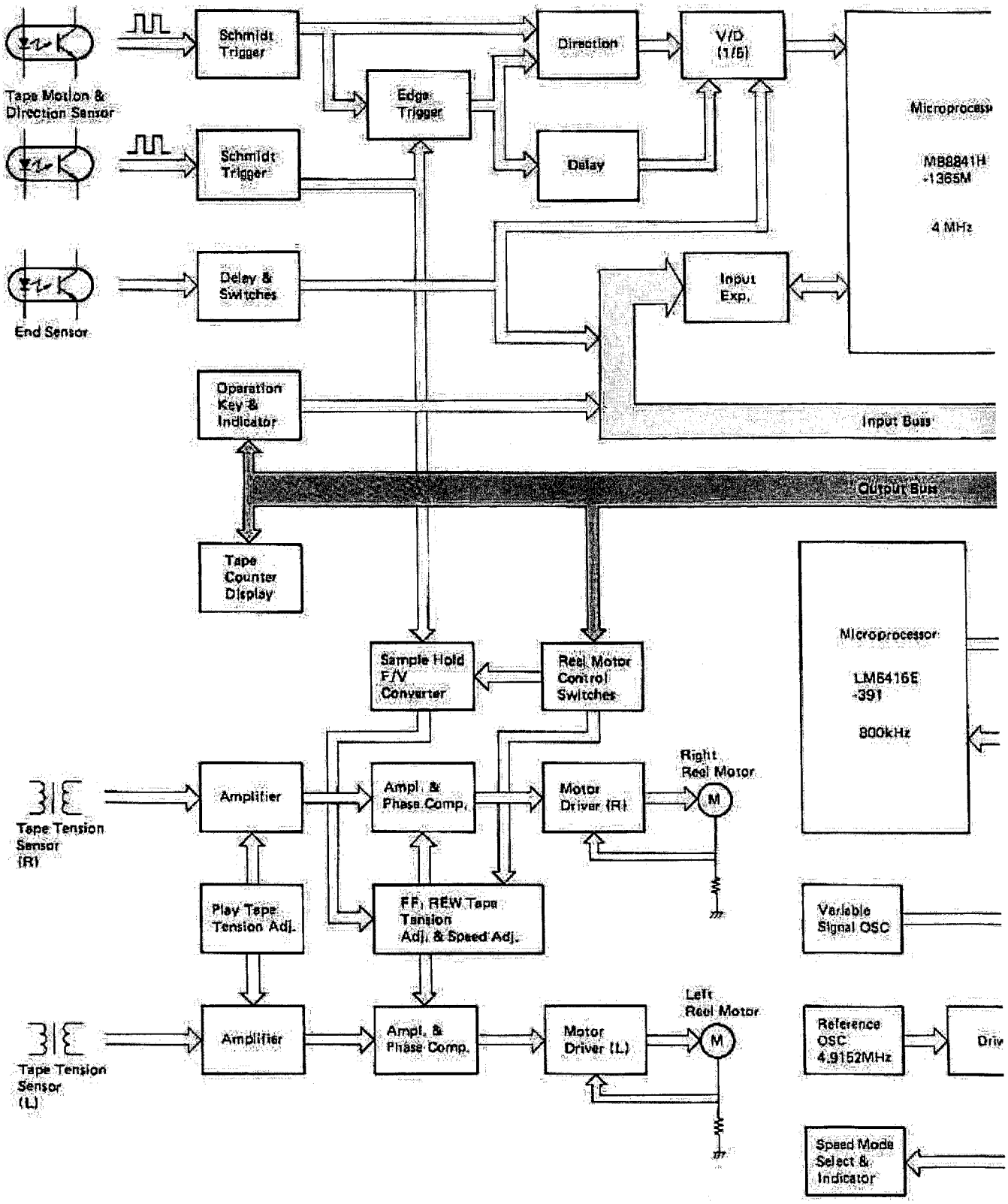
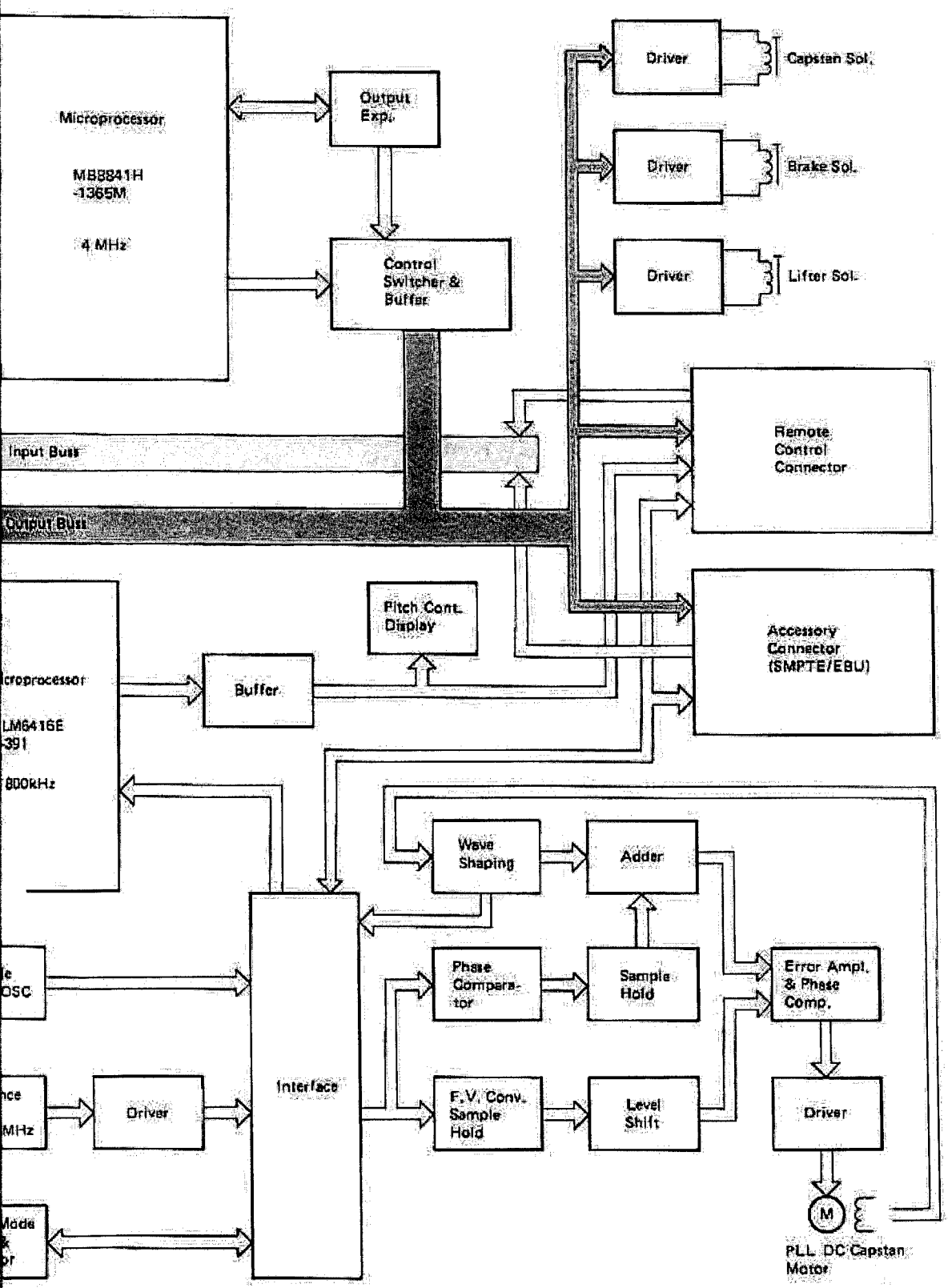


FIGURE 1-2. ATR-60-2 TRANSPORT LOGIC DIAGRAM.


Microprocessor
MB8841H
-1365M
4 MHz
Output Exp.
Control Switcher & Buffer
Driver
Capstan Sol.
Driver
Brake Sol.
Driver
Lifter Sol.
Input Buss
Output Buss
Remote Control Connector
Accessory Connector (SMPTE/EBU)
Pitch Cont. Display
Buffer
Wave Shaping
Adder
Phase Compara-tor
Sample Hold
Error Ampl. & Phase Comp.
Interface
F.V. Conv. Sample Hold
Level Shift
Driver
Driver
M
PLL DC Capstan Motor

1.2 THE TAPE TRANSPORT

The main transport components are all mounted on a rigid, precision-machined aluminum base plate. This provides an exceptionally stable platform for the supply and takeup reel motors, capstan motor, impedance roller, pinch roller, tachometer roller, digital counter, tape tension arms and guide rollers. A stable platform is essential for smooth, stable tape motion, but alone does not assure good tape handling.

In order to handle tape in the best possible manner, the ATR-60-2 transport is fully microprocessor controlled, including fast forward, rewind, play, and spooling modes. The microprocessor (μP) is specifically programmed for this series of transports (refer to Figure 1-2 for a block diagram of μP functions) to further optimize tape motion. A full servo reel system keeps tape tension within carefully regulated limits to avoid stretching. The capstan motor is strictly regulated by a phase-lock loop (PLL) servo system. The capstan motor's large size, brushless DC design, and ceramic direct-drive capstan shaft all work together to minimize cogging and other speed variations while providing extended service life.

The tension servo employs a "non-contacting" detector that utilizes the principle of mutual inductance to sense the actual tape tension. There are two coils on either side of an aluminum plate that moves in and out of a field between the coils in proportion to tension arm position. This approach is more stable, and less prone to aging effects than is the more common LED/LDR arrangement (and is vastly better than mechanical rheostat-based systems).

Major rotating components, including the tension arm guides and the pinch roller, are supported by ball bearings to provide minimum friction while retaining close tolerances. In fact, the tension arm itself is ball-bearing supported for more sensitive response and greater durability.

The tachometer roller measures linear tape footage. The readout, however, is converted to elapsed time from whatever zero point is entered into memory. As the tape moves, it drives the tach roller, causing a radially marked disk on the roller shaft to interrupt a photo sensor, which drives the digital counter circuitry. A thin rubber coating on the tach roller prevents tape slippage (for the most accurate results), and also protects the surface of the tape.

1.3 THE HEAD ASSEMBLY

The head assembly includes two fixed guides, a scrape flutter filter (idler roller) and three heads: erase, record/sync and reproduce (repro). A flip-up cover and a latching, push-down head shield (gate) provide full access to the heads for cleaning and editing.

Both the record/sync head and the repro head yield the same high-quality, full frequency range reproduction upon playback. Because no quality is sacrificed by synchronous reproduction from the record/sync head, artistic performance judgements and mixing decisions which are made during an overdub or insert will be based upon the correct frequency balance and phase response — something not always true on machines with inferior sync reproduction, or if the sync head output must be specially equalized.

A solenoid-actuated tape lifter automatically pushes the tape away from the heads during any of the fast winding modes (fast forward, rewind or spooling). This prevents unnecessary wear on the heads and tape, and the disturbing, loud, high-frequency sound that might otherwise damage monitor speakers. For added protection, the ATR-60-2 line outputs are also electronically muted. However, for editing (or readout of the time code on the ATR-60-2T), progressive engagement of the cue lever defeats the tape lifter so cues can be monitored while fast winding.

1.4 THE ELECTRONICS

The ATR-60-2 Series features direct-coupled amplifiers for low distortion and optimum low frequency response. The first stage of the reproduce amplifier consists of a pair of very-low noise FETs (field effect transistors). This differential amplifier eliminates the need to insert a coupling capacitor between the heads and the first stage amp; instead, the direct coupled servo amplifier brings the DC offset voltage to zero. The result is a smoother, wider frequency response with better transient and phase characteristics.

The amplifier section is constructed on plug-in printed circuit boards. Connections between boards are made via the mother board. Just four front panel screws need be removed to slide out the meter panel for electronic adjustments. The usual bias, audio level and EQ trimmers for both standards are provided (NAB/IEC or IEC/AES, depending on the ATR-60-2 model), including separate controls for the SYNC and REPRO playback. Selection between the NAB and IEC standards, and the 250 nWb/m or 320 nWb/m levels on the ATR-60-2 is a matter of moving the respective switches on the amplifier PC board. The ATR-60-2HS EQ is set for IEC standards at 15 ips (switchable for NAB), and fixed to AES standards at 30 ips, while the fluxivity level is switch-selectable between 320 nWb/m and 250 nWb/m. All trimmers are metal glazed for better mechanical durability, and to reduce susceptibility to value changes or deterioration induced by aging or the environment.

The ATR-60-2 series are equipped with a master bias oscillator, plus a separate bias amplifier for each track. This extra circuitry avoids inter-track interactions via the bias circuit for quieter punch-in and punch-out, while establishing phases matched bias signals which avoid beating.

Audio levels can be monitored on 2 large VU meters which include peak indicating LEDs. The VU meters provide a familiar "average" level reference, while the peak LEDs respond to brief transients that often are not accurately portrayed by the meters. The operator is thus able to avoid unwanted distortion (tape saturation) without being overly conservative and sacrificing too much average level (hence achieving the optimum signal-to-noise performance consistent with the lowest possible distortion).

On the ATR-60-2T, the input level for the center "time code" or "memo" track is displayed by a set of three LEDs. These "under," "norm," and "over" LEDs indicate whether the input is within the normal range, within which the automatic level control circuitry can adjust the signal so it is recorded at optimum fluxivity.

1.5 THE POWER SUPPLY

The power supply for the transport motors, logic and record/reproduce electronics is housed in the same chassis with the transport. An "umbilical" cable conveys power to the electronics module. The ATR-60-2's power transformer is factory set for one of several possible line voltages prior to shipment, in accordance with the destination country where the equipment is to be sold. The factory adheres to the following standards:

European models:	220 V, 50 Hz.
U.K./Australian models:	240 V, 50 Hz.
U.S.A./Canadian models:	120 V, 60 Hz.
General Export models: (switchable voltage)	100/120/220/240 V, 50 or 60 Hz.

The following supply voltages are available to the transport and audio electronics:

1. Regulated, bipolar 15 volt DC for audio amplifiers. This supply includes an exclusive tracking filter circuit to eliminate AC ripple.

2. Regulated bipolar 20 volt DC for the operational status indicators.

3. +5 volt DC for the microprocessor and related logic circuitry.

4. +24 volt DC for the reel motors.

5. +24 volt DC for the capstan motor and the relay that switches the amplifiers. This supply is independent of the reel motor 24 volt supply.

6. +15 volt DC and +24 volt DC for the capstan servo system.

7. Two DC voltages for the pinch roller solenoid: a higher voltage (+24 V) is used initially to ensure the strong, positive actuation of the solenoid. Once triggered, the solenoid is held in place by a lower voltage (+12 V) which thereby avoids generation of excessive heat. Both supplies include a ripple filter to avoid mechanical buzz, or any chance of hum leaking into the audio amplifiers.

8. 6 volt AC for illumination of the VU meters. The microprocessor also senses this AC voltage to detect when the power is turned on or off, and to thus activate the muting circuit. If the central processing unit should erroneously function, or if the power is cut off during the rewind or fast-forward modes, this circuit acts as a power loss sensor, automatically applying the reel brakes and putting the transport in the STOP mode as a safety precaution. This prevents tape spillage or breakage in the event of power interruption during tape winding.

1.6 REMOTE CONTROL AND AUTO LOCATOR FUNCTIONS

With the optional RC-65 Remote Transport Control unit interface via the ATR-60-2's rear-panel REMOTE CONTROL connector, nearly all transport functions (except EDIT) can be controlled at a distance from the tape machine. These functions include F. FWD, REW, PLAY, RECORD, CUE, STC, RTZ, the digital counter, and the PITCH CONTROL.

NOTE: When using the RC-65 Remote Transport Control unit, its PITCH CONTROL will not function unless the ATR-60-2 SPEED MODE selector is set to the "EXT" position.

The optional AQ-65 Auto Locator can be used with the ATR-60-2. The Auto Locator has been designed to increase the ATR-60-2's versatility, and to meet the tight working schedules of modern production facilities. For details concerning the AQ-65, refer to Section VII, Accessories.

1.7 TRANSPORT CONTROL FUNCTIONS

1.7.1 Auto Locator Functions (STC, RTZ)

A built-in "auto locator" function enables the transport to search automatically to a precise location on the tape for convenient replay, copying, overdubbing, editing, etc. The auto locator relies upon the tape counter, and provides two search points: one is the zero point, and the other is a user defined cue point. Pressing the RTZ button (Return-to-Zero) causes the transport to rewind or fast forward to the 00:00 point (zero minutes, zero seconds). Pressing the STC (Search-to-Cue) button causes the transport to rewind or fast forward the tape to whatever point was designated as the cue, and to then park (stop) the tape. Either function can be "pre programmed" by pressing RTZ or STC and then PLAY; in that case, the transport fast winds to the zero or cue point, then enters play mode.

NOTE: The cue point is originally designated by pressing the CUE button when the tape is stopped at or moving past the desired location. Thus, cues may be entered "on the fly" while listening to program material. The cue point memory register is independent of the tape counter "zero" so that a new "zero" for RTZ can be established without changing the previously established cue point.

1.7.2 Dynamic Braking

When the tape enters stop mode at the end of an RTZ or STC search, or after rewinding or fast forward winding, the reels are slowed to a stop by means of dynamic braking. This application of opposite electrical torque to the reel motors stops the tape more gently than mechanical braking; it avoids slippage and stretching by maintaining a more constant torque throughout the tape deceleration.

1.7.3 Fast Forward, Rewind and Spooling Modes

Pressing either the F.FWD or REW button from stop mode causes the tape to move rapidly in the designated direction. Pressing the F.FWD or REW button a second time causes the transport to enter the spooling mode, wherein tape runs at an intermediate speed for a tighter, more uniform pack.

1.7.4 Play and Related Modes

Pressing the PLAY button from stop mode causes the transport to run forward at the selected fixed speed (7.5 ips or 15 ips on the ATR-60-2T, -2N or -2D; 15 ips or 30 ips on the ATR-60-2HS), or at whatever speed has been selected with the PITCH CONTROL.

Pressing the PLAY button from a fast forward or rewind mode causes the tape to stop, and then immediately enter play mode. Pressing PLAY while the machine is recording does not interrupt tape motion, but does terminate recording.

1.7.5 Record Mode

Pressing the PLAY and RECORD buttons at the same time places the transport in record mode (or record-ready mode). Audio recording and erasure of any previous material does not actually occur unless one or both FUNCTION switches has also been set to record-ready status. On the ATR-60-2T, center track time code or memo recording does not actually occur unless the "TIME CODE CH REC MODE" switch has also been set to record-ready status.

If the transport is already in play mode, pressing RECORD accomplishes a punch-in (commencement of recording "on-the-fly"). Punch-out (ending the recording while tape is still rolling) is accomplished by pressing the PLAY button. Alternately, recording can be stopped by pressing STOP, F.FWD, REW, STC or RTZ.

1.7.6 Edit Modes

Pressing the EDIT button releases the reel brakes and resets the reel servo system so that very little tension is held. This permits reels to be manually turned in either direction while listening (or looking) for a precise cue point on the tape. Tape can be "dump edited" by simultaneously pressing the PLAY and EDIT buttons. In this mode, the capstan pulls tape past the heads at the set play speed, but the takeup reel motor does not operate, so tape spills from the transport. The "dump edit" mode is canceled by pressing STOP.

1.7.7 REMOTE CONTROL Connections

The 60-pin REMOTE CONTROL connector on the ATR-60-2 transport rear panel is for use with the optional RC-65 Remote Transport Control unit. For more information on this device, refer to Section VII, Accessories, and to Section 8.8.10.

1.7.8 ACCESSORY Connector

The 38-pin ACCESSORY connector on the ATR-60-2 transport rear panel is for use with the optional AQ-65 Auto Locator/Session Controller, or with most any time code based synchronizer/editing system. This connector carries the necessary logic/tally lines for direct plug-in interface to systems made by Adams Smith, Audio Kinetics, Cypher Digital, Convergence, EECO, TimeLine, United Media, Video Media and other similar systems. Additional details on the AQ-65 may be found in Section VII, Accessories, and detailed connector and interface information may be found in Section 8.8.9.

1.8 MOTOR DRIVE CIRCUIT

The ATR-60-2 servo system maintains proportional tape tension on both reels while the system is in play mode, with the capstan motor circuit determining the tape speed. During the fast winding modes, back tension is held to a constant value, and the servo control system regulates the reel motors to maintain a constant tape speed as well.

1.9 TIME CODE TRACK & OTHER FEATURES OF THE ATR-60-2T

The ATR-60-2T is nearly identical to the ATR-60-2N except that there is an extra track. This narrow (0.3 mm wide) track is centered in the 2 mm area between the two normal-width NAB audio head gaps, and is reserved primarily for data. Specifically, it is intended for the recording and playback of SMPTE/EBU time code, and other synchronizer time codes.

This makes it possible to synchronize the transport with video tape recorders, sprocketed film dubbers, video editors, or other audio tape recorders... without sacrificing or compromising the two audio tracks in any way. Complex editing functions become possible when the ATR-60-2 is "servoed" (remotely controlled in sync with its time code track) via a remote time code synchronization system. For more information, see Section 3.3 on Time Code Connector wiring, Section 8.10 on Theory of Operation for the Time Code Amplifier System, and Section 9.6 on Additional Checks and Adjustments for the ATR-60-2T.

In addition, a single switch alters the center track input/output circuitry to instead accommodate voice "memos" (cues) or slate tones. The center track is not suitable for use as a full bandwidth, wide dynamic range audio track.

The ATR-60-2T utilizes a special set of heads. A combination head handles erase and rec/sync functions. The erase portion of the head has separate gaps for each of the two main audio tracks and for the center "time code" track. The rec/sync head also has separate gaps for each track, all three of which are vertically aligned to ensure that the time code data is perfectly synchronized with the audio program. This offers a major benefit over tape machines which use a separate head for a center time code track. Because the time code and program signals are synchronous, no costly time code delay circuitry is necessary, there is less to go wrong, and the time code output from the recorder stops the instant tape stops, which lets any controlling, time-code based equipment do a better job.

The input signal to the "time code" track is automatically controlled to accommodate a wide signal level range. Three front-panel LEDs indicate the approximate range of the input signal (under, normal, over); because two of these LEDs turn on when the signal is in between their 3 primary ranges, they actually display five different signal level ranges. The "time code" output signal is specially processed to preserve sharp transitions, thereby minimizing data read errors; this processing is what is defeated when the system is switched to handle voice "memo" information or slate tones rather than "time code."

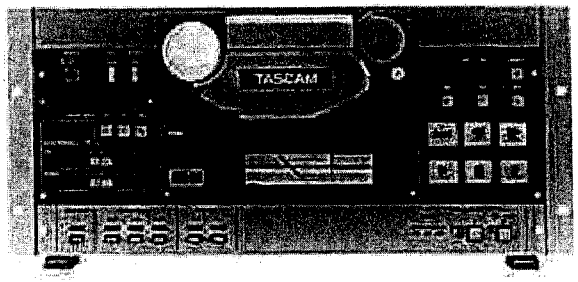


FIGURE 1-3. FRONT PANEL FEATURES UNIQUE TO ATR-60-2T.

SECTION II. SPECIFICATIONS

ATR-60-2T, ATR-60-2N, ATR-60-2D, and ATR-60-2HS are referred to as T, N, D, and HS, respectively.

MECHANICAL CHARACTERISTICS

Tape:	T, N, D	1/4 inch and
	HS	1/2 inch,
		1.5 mil, low noise high output tape
Track Format:		2-track, 2-channel
	T	2-audio tracks plus IEC standard center track for time code
Track Width:	T	Audio: 0.079 inch (2.0 mm)/NAB
		Time Code: 0.012 inch (0.3 mm)/IEC
	N	0.079 inch (2.0 mm)/NAB
	D	0.106 inch (2.7 mm)/DIN
	HS	0.2 inch (5.1 mm)/
Max. Reel Size:		10-1/2 inch NAB (large) hub
Tape Speed:	T, N, D	15/7-1/2 ips (38/19 cm/sec.)
	HS	30/15 ips (76/38 cm/sec.)
Speed Accuracy[1]:		±0.3 % deviation
Pitch Control:		
Coarse:		±15 %
Fine:		±0.7 %
Wow and Flutter[1]:		
30 ips (76 cm/sec.):	HS	±0.06 % peak (DIN/IEC/ANSI weighted)
		±0.09 % peak (DIN/IEC/ANSI unweighted)
		0.03 % RMS (NAB weighted)
		0.06 % RMS (NAB unweighted)
15 ips (38 cm/sec.):	T, N, D	±0.08 % peak (DIN/IEC/ANSI weighted)
		±0.12 % peak (DIN/IEC/ANSI unweighted)
		0.05 % RMS (NAB weighted)
		0.07 % RMS (NAB unweighted)
	HS	±0.08 % peak (DIN/IEC/ANSI weighted)
		±0.12 % peak (DIN/IEC/ANSI unweighted)
		0.04 % RMS (NAB weighted)
		0.07 % RMS (NAB unweighted)
7-1/2 ips (19 cm/sec.):	T, N, D	±0.09 % peak (DIN/IEC/ANSI weighted)
		±0.14 % peak (DIN/IEC/ANSI unweighted)
		0.06 % RMS (NAB weighted)
		0.09 % RMS (NAB unweighted)
Fast Wind Time:		130 seconds for 10-1/2 inch reel, 2,400 feet
Spooling Wind Time:		370 seconds for 10-1/2 inch reel, 2,400 feet
Start Time:		Less than 0.8 second to reach standard Wow and Flutter
Tape Drive System:		
Capstan Motor:		PLL (Phase-Locked Loop), DC, direct drive capstan motor x 2
Reel Motor:	T, N, D	Slotless, DC reel motor x 2
	HS	DC reel motor x 2
Head Configuration:		3 heads: erase, record/sync, and reproduce
Tape Cue:		Manual and automatic (RTZ and STC)
Dimensions (W x H x D):		
Transport Unit:	T, N, D	482 x 461 x 310 mm
		(19" x 18-1/8" x 12-3/16")
	HS	482 x 461 x 313 mm
		(19" x 18-1/8" x 12-5/16")
Amplifier Unit:		482 x 105 x 268 mm
		(19" x 4-1/8" x 10-9/16")
Weight (Net):		
Transport Unit:		38 kg (83.75 lbs)
Amplifier Unit:		7.5 kg (16.56 lbs)
Connectors:		
Line Inputs and Outputs:		XLR type connectors
Remote Control Unit:		Multi-pin type connector (refer to page 3-6 for details)
Accessory:		Multi-pin type connector (refer to page 3-4 for details)
Monitor System:		Multi-pin type connector (refer to page 7-6 for details)

ELECTRICAL CHARACTERISTICS

Line Input (Balanced):		
Input Impedance:		10 k ohms
Maximum Source Impedance:		600 ohms
Nominal Input Level:		+4 dBm (1.23 V)
Maximum Input Level:		+28 dBm (19.5 V)
Line Output (Balanced):		
Output Impedance:		20 ohms
Minimum Load Impedance:		200 ohms
Nominal Load Impedance:		600 ohms
Nominal Output Level:		+4 dBm (1.23 V)
Maximum Output Level:		+28 dBm (19.5 V)
Headphones Output Level:		100 mW maximum at 8-ohm stereophones
Bias Frequency:		150 kHz
Equalization:	T, N	NAB: 3,180 +50 μsec. at 15 ips (38 cm/sec.) and 7-1/2 ips (19 cm/sec.); or IEC/CCIR: ∞+35 μsec. at 15 ips (38 cm/sec.) and ∞+70 μsec. at 7-1/2 ips (19 cm/sec.), switchable
	D	IEC/CCIR: ∞+35 μsec. at 15 ips (38 cm/sec.) and ∞+70 μsec. at 7-1/2 ips (19 cm/sec.); or NAB: 3,180 +50 μsec. at both speeds, switchable
	HS	AES: ∞+17.5 μsec. at 30 ips (76 cm/sec.) and IEC: ∞+35 μsec. at 15 ips (38 cm/sec.); or NAB: 3,180 +50 μsec. at 15 ips (38 cm/sec.), switchable
Record Level (0 VU Reference):	T, N	250 nWb/m tape flux level (or 320 nWb/m, switchable)
	D, HS	320 nWb/m tape flux level (or 250 nWb/m, switchable)
Time Code Channel (ATR-60-2T Only):		
Input:		
Input Impedance:		10 k ohms
Maximum Source Impedance:		600 ohms
Nominal Input level:		TIME CODE: 2 Vp-p MEMO: +4 dBm (1.23 V)
Minimum Input Level:		0.2 Vp-p (TIME CODE)
Maximum Input Level:		15 Vp-p (TIME CODE)
Output:		
Output Impedance:		20 ohms
Minimum Load Impedance:		600 ohms
Nominal Output Level:		TIME CODE: 2 Vp-p (sustained) MEMO: +4 dBm (1.23 V)
Record Level:		TIME CODE: 707 nWb/m tape flux level MEMO: 79 nWb/m tape flux level
Power Requirements:		
USA/CANADA		120 V AC, 60 Hz
EUROPE		220 V AC, 50 Hz
UK/AUS		240 V AC, 50 Hz
GENERAL EXPORT		100/120/220/240 V AC, 50/60 Hz
Power Consumption:	T, N, D	110 W
	HS	130 W

TYPICAL PERFORMANCE

Frequency Response:		
Record/Reproduce[3]:		
30 ips (76 cm/sec.):	HS	30 Hz – 26 kHz, ±2 dB at 0 VU 30 Hz – 28 kHz, ±2 dB at -10 VU
15 ips (38 cm/sec.):	T, N	40 Hz – 22 kHz, ±2 dB at 0 VU 30 Hz – 24 kHz, ±2 dB at -10 VU
	D	30 Hz – 22 kHz, ±2 dB at 0 VU 30 Hz – 24 kHz, ±2 dB at -10 VU
	HS	20 Hz – 22 kHz, ±2 dB at 0 VU 20 Hz – 24 kHz, ±2 dB at -10 VU
7-1/2 ips (19 cm/sec.):	T, N	30 Hz – 16 kHz, ±2 dB at 0 VU 30 Hz – 20 kHz, ±2 dB at -10 VU
	D	20 Hz – 16 kHz, ±2 dB at 0 VU 20 Hz – 20 kHz, ±2 dB at -10 VU

Reproduce (Sync and Repro. Heads)[2]:		
30 ips (76 cm/sec.):	HS	30 Hz – 28 kHz, ±2 dB
15 ips (38 cm/sec.):	T, N, D	30 Hz – 22 kHz, ±2 dB
	HS	30 Hz – 20 kHz, ±2 dB
7-1/2 ips (19 cm/sec.):	T, N, D	30 Hz – 20 kHz, ±2 dB
Total Harmonic Distortion (THD)[3]:		0.6 % at 0 VU, 1,000 Hz, 250 nWb/m
		0.6 % at 0 VU, 1,000 Hz, 320 nWb/m
		3 % at 1,000 Hz, 1, 120 nWb/m, 15 ips
Signal-to-Noise Ratio[3]:		NAB "A" WTD/UNWTD
(Reference 3 % THD at 1 kHz)		
30 ips (76 cm/sec.):	HS	78 dB/72 dB
15 ips (38 cm/sec.):	T, N	72 dB/67 dB
	D	73/dB/68 dB
	HS	77 dB/71 dB
7-1/2 ips (19 cm/sec.):	T, N	72 dB/67 dB
	D	71 dB/66 dB
Adjacent Channel Crosstalk[3]:	T, N	Better than 57 dB,
	D	Better than 55 dB, and
	HS	Better than 58 dB
		down at 1,000 Hz, 0 VU
Erasure[3]:		Better than 75 dB at 1,000 Hz, +10 VU reference
Time Code Channel (ATR-60-2T Only):		
Frequency Response (Overall):		300 Hz – 10 kHz (MEMO)
Crosstalk (to Audio Tracks):		Better than 74 dB (TIME CODE signal)

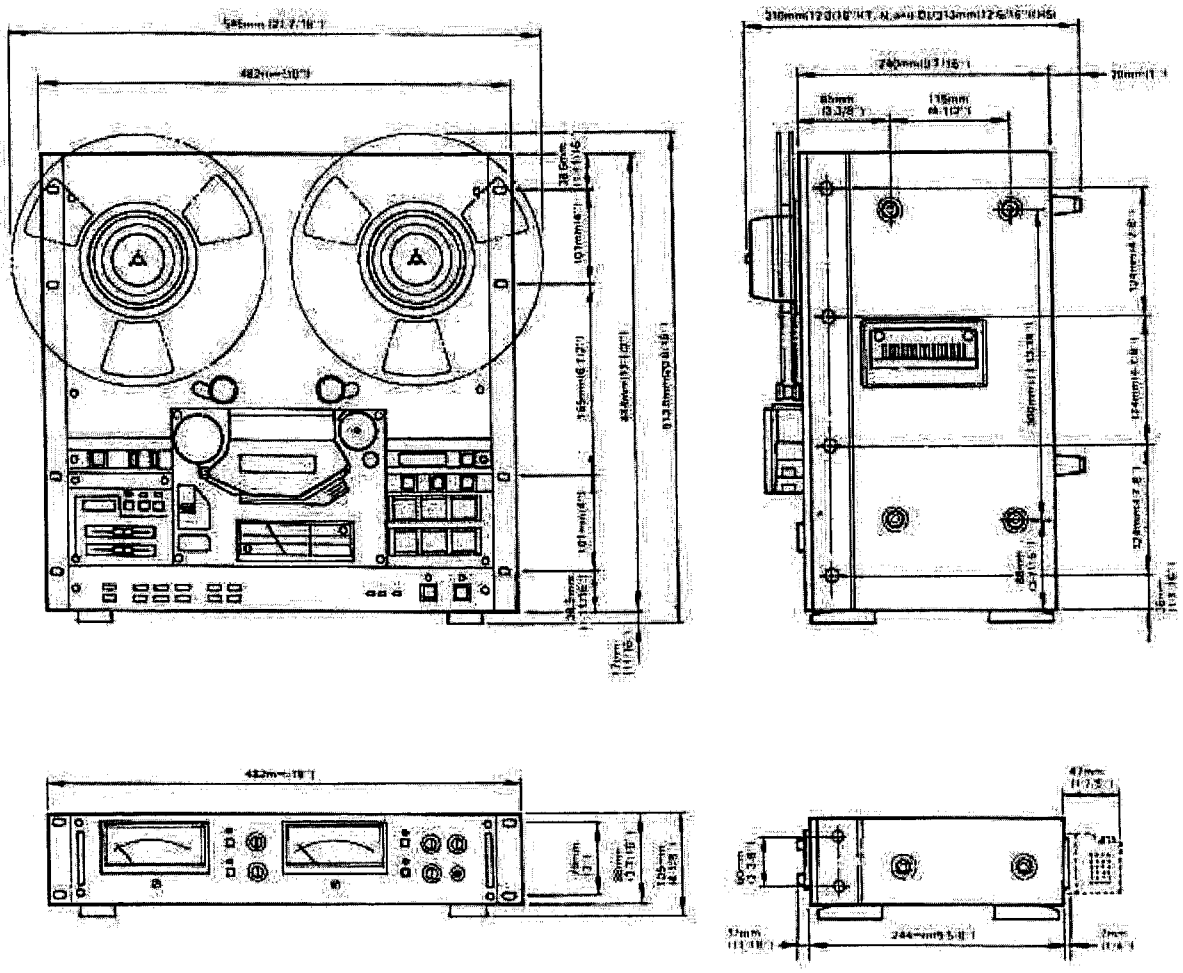
Specifications were determined using TEAC Test Tapes (at factory-set equalization and reference fluxivity):

1) Tape Speed/Wow-Flutter Measurement Tape
   T, N, and D: YTT-2004 (15 ips)/YTT-2003 (7-1/2 ips)
   HS: YTT-2165 (30 ips)/YTT-2104 (15 ips)
2) Reproduce Alignment Tape
   T, N, and D: YTT-1004 (15 ips)/YTT-1003 (7-1/2 ips) (NAB EQ)
   YTT-1064 (15 ips)/YTT-1063 (7-1/2 ips) (IEC EQ)
   HS: YTT-1165 (30 ips)/YTT-11441 (15 ips)
3) Blank Tape for Recording
   T, N, and D: YTT-8063
   HS: YTT-8163

In these specifications 0 dBm is referenced to 0.775 Volt. Actual voltage levels are also given in parenthesis.
Changes in specifications and features may be made without notice or obligation.

Options for:

Mounting (EIA standard 19-inch rack):	CS-65 Console Rack and CS-62 Overbridge Kit
Remote Control:	RC-65 Remote Control Unit, AC-65 Auto Locator, and CS-64 Roll-around Stand
Monitoring:	MA-650 Monitor System
Others:	E-3 Head Demagnetizer, PB-64 Patch Bay, PB-32 Series Patch Bays, and TASCAM Professional Cables



FIGUQUE 2-1. ATR-60-2 TRANSPORT AND AMPLIFIER DIMENSIONS.

SECTION III. INSTALLATION

NOTE: Since the ATR-60-2 amplifier module is packaged separately from the transport, the mounting configuration may be determined by the user. However, for ease of operation, we strongly recommend the use of the optional CS-65 Console Rack and CS-62 Overbridge Kit.

3.1 RACK MOUNTING

Figure 3-1 illustrates the ATR-60-2 installed in the CS-65 Console. The mounting procedure is detailed in a brochure provided with the CS-65.

FIGURE 3-1. ATR-60-2 TRANSPORT, MOUNTED IN OPTIONAL CS-65 CONSOLE RACK, WITH AMPLIFIER MODULE MOUNTED IN OPTIONAL CS-62 OVERBRIDGE. ALSO PICTURED: OPTIONAL RC-65 TRANSPORT REMOTE CONTROL, AO-65 AUTO LOCATOR AND MA-650 MONITOR SYSTEM.

3.2 CONNECTION BETWEEN THE TRANSPORT AND THE AMPLIFIER MODULE

Three head cables plus one power/logic cable are required to interconnect the transport and amplifier module. Connections are made on the rear panels, as illustrated in Figure 3-2. Use care to ensure that the sync head and repro head cables are connected properly, and are not inadvertently crossed.

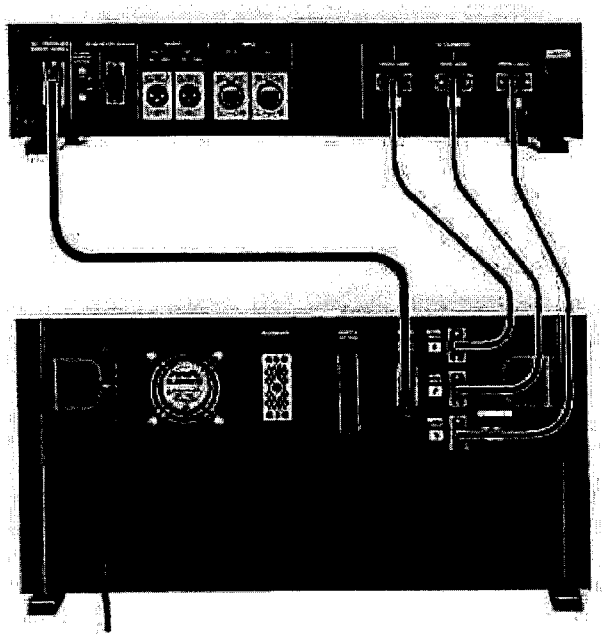


FIGURE 3-2. ELECTRICAL CONNECTIONS BETWEEN THE ATR-60-2 TRANSPORT AND THE ATR-60-2 AMPLIFIER MODULE.

3.3 REMOTE CONTROL AND TIME CODE BASED SYSTEM CONNECTIONS

The REMOTE CONTROL connector on the transport rear panel can be connected to the optional RC-65 to establish complete remote control of nearly all transport functions. The ACCESSORY connector on the transport rear panel can be connected to the optional AQ-65 Auto Locator/Tape Transport Controller to establish more extensive cue point manipulation than is provided within the transport itself. Alternatively, the ACCESSORY connector can be used to interface with time code synchronization or editing systems (ATR-60-2T).

3.3.1 An Introduction to SMPTE Time Code

SMPTE is an acronym for the Society of Motion Picture and Television Engineers. The SMPTE Time Code was defined in 1970 (C98.12: time and control code for video and audio tape for 525/30 television system). This specification has now become accepted as a universal standard, although additional practices have been informally added over the years (i.e., drop frame), as explained below.

The 1970 SMPTE code is an 80-bit digital code which designates the exact location in hours, minutes, seconds, and frames. There are 24 frames/second in film time code, and 30 frames/second on television time code. Some of the bits in the time code are undefined "user bits," and are often used to identify takes or production sequences, or for special functions (opening and closing automated theatre curtains, for example).

3.3.2 Drop Frame Time Code

It used to be true that U.S. television operated at 30 frames/second, but that was in a monochrome ("black and white") world, and current NTSC (National Television Standards Committee) standards utilize 29.97 frames/second for color TV broadcast. This means that an hour of 30 frame/second code is about 3.6 seconds too long when run at 29.97 frames/second. In order to remedy the problem, a slightly different time code format known as "DROP FRAME" was developed. In drop frame, one frame is dropped (skipped) every 108 frames, except that every tenth minute the frames are not dropped. In some cases, the difference between drop frame and standard TV time code is not significant. However, it is important to know what type of code is being utilized, and to set up the synchronization system accordingly.

3.3.3 EBU Time Code

The European TV time code equivalent of SMPTE code is known as EBU (European Broadcasting Union) code. It is very similar to SMPTE monochrome TV code, except that it runs at 25 frames per second, not 30. No drop frame format is required with EBU code.

3.3.4 VITC Time Code

A new format is the Vertical Interval Time Code (VITC). Basically, this is SMPTE TV time code, with a few extra bits for special control codes and error correction. The difference, however, is that instead of recording it in a continuous longitudinal track (recorded in a stripe along the edge of the video tape by a fixed audio head), the VITC is recorded in vertical bursts, during the vertical retrace interval, by the rotating video head. This method enables time code to be read while the video image is in "still frame" mode.

3.3.5 Time Code Equipment and Interface to the ATR-60

A *time code generator* is used to record SMPTE (or EBU) code onto one track of the tape. With the ATR-60-2T, this track is the center track, not one of the two audio tracks. With larger, multitrack recorders, typically one of the normal audio tracks is reserved for time code. A *time code controller* can then read the code from two or more tape machines (audio, film dubber, and/or video); the controller can also servo-control the reel motors of those machines to bring them to specific cue points. A *time code synchronizer* goes beyond the function of a time code controller by also controlling the capstan motors to keep the tape (and film) machines running synchronously in the play or record mode. This technology can be used to obtain more tracks (by "locking up" two or more audio machines), to mix audio signals in sync with video or film images, to make complex edits by transferring material from one or more audio machines to another, and so forth.

Generally speaking, the manufacturer of a SMPTE time code synchronizer or controller will provide interface information for use with the TASCAM ATR-60 series transports. We work closely with those manufacturers to ensure that our equipment will operate satisfactorily with the widest possible variety of equipment. Some of the more popular systems with which the ATR-60-2 transports have been tested are manufactured by Adams Smith, Audio Kinetics, Cypher Digital, Convergence, EECO, TimeLine, United Media, and Video Media.

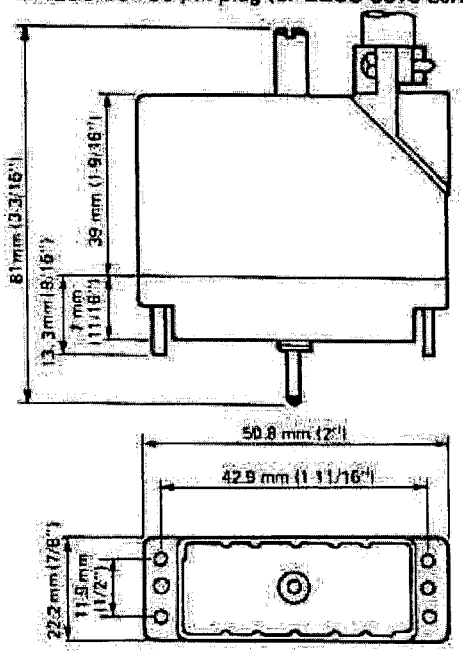
The TASCAM ATR-60-2 provides signals to the controller or synchronizer, via the ACCESSORY connector, which indicate the transport's speed, the direction of tape travel, and a reference power supply voltage. Also, tally signals are output to indicate the ATR-60-2's operating mode (PLAY, F.FWD, REW, STOP). Inputs on the same ACCESSORY connector accept commands from the controller/synchronizer (PLAY, F.FWD, REW, STOP, REC, LIFTER CONT). Also, there is an input for a capstan drive reference frequency signal so that the actual record/play speed can be precisely varied to maintain synchronization.

Given the ACCESSORY connector pin assignments in this section, the manual for the controller or synchronizer should provide you with sufficient information to connect that equipment to the ATR-60-2. If not, please contact the controller or synchronizer manufacturer or representative for further details on interface to this TASCAM equipment.

1 x 1910004500 Con. 38 Pin
1 x 191000 4600 Gehäuse

ACCESSORY Connector and Signals

MALCO 354-38 pin plug (or ELCO 8016 Series)



Pin #	IN(put)–OUT(put) signals		Function
A	PLAY	IN	Inputs PLAY signal at L level.
B	$\overline{FF}$	IN	Inputs FF signal at L level.
C	$\overline{REW}$	IN	Inputs REW signal at L level.
D	open terminal		
E	$\overline{STOP}$	IN	Inputs STOP signal at L level.
F	$\overline{REC}$	IN	Inputs REC signal at L level.
H	$\overline{LIFTER\ CONT}$	IN	Inputs LIFTER shift cancellation signal at L level.
J	open terminal		
K	UP/DOWN	OUT	Outputs tape running control signal at H or L level.
L	CP	OUT	Outputs open-collector signal (12 Hz pulse at 15 ips.)
M	$\overline{PLAY\ TALLY}$	OUT	Outputs open-collector signal (Low level during PLAY mode.)
N	$\overline{FF\ TALLY}$	OUT	Outputs open-collector signal (Low level during FF mode.)
P	$\overline{REW\ TALLY}$	OUT	Outputs open-collector signal (Low level during REW mode.)
R	$\overline{STOP\ TALLY}$	OUT	Outputs open-collector signal (Low level during STOP mode.)

Pin #	IN(put)–OUT(put) signals		Function
S	$\overline{REC\ TALLY}$	OUT	Outputs open-collector signal (Low level during record mode)
T	$\overline{SHUT\ OFF\ TALLY}$	OUT	Outputs open-collector signal (Low level during tape stop)
U	$\overline{RESET}$	SW IN	Inputs electronic counter reset signal low level.
V	$\overline{LOW}$	IN	Reduces tape speed to "Low" during fast winding.
W	$\overline{REW}$ COMMAND	OUT	Outputs open-collector signal (Low level when REW is pressed)
X	$\overline{FF}$ COMMAND	OUT	Outputs open-collector signal (Low level when F. FWD is pressed)
Y	$\overline{PLAY}$ COMMAND	OUT	Outputs open-collector signal (Low level when PLAY is pressed
Z	$\overline{STOP}$ COMMAND	OUT	Outputs open-collector signal (Low level when STOP is pressed)
AA	$\overline{REC}$ COMMAND	OUT	Outputs open-collector signal (Low level when REC is pressed)
BB CC DD EE	open terminal		
FF	MOTOR FREQ (HOT)	OUT	Capstan motor F.G. out: 600 Hz at 15 ips
HH	MOTOR FREQ (COLD)	OUT	Capstan motor F.G. out: 600 Hz at 15 ips
JJ	open terminal		
KK	EXT FREQ (HOT)	IN	Inputs speed control signal at input signal of 3.0 V or more and of 4.8 k to 19.2 kHz (HOT side)
LL	EXT FREQ (COLD)	IN	Inputs speed control signal (COLD side)
MM	INT/EXT	IN	Inputs internal/external speed control select signal Internal: LOW level (0 V) External: HIGH level (3.0 V or more)
NN	open terminal		
PP	+15 V supply voltage	OUT	Maximum: 50 mA
RR	0 V terminal		
SS	+5 V supply voltage	OUT	Maximum: 50 mA
TT	Main unit GND		

FIGURE 3-3. ACCESSORY CONNECTOR DIAGRAM AND PIN ASSIGNMENTS.

ACCESSORY Connector Pins and External Signal Connections

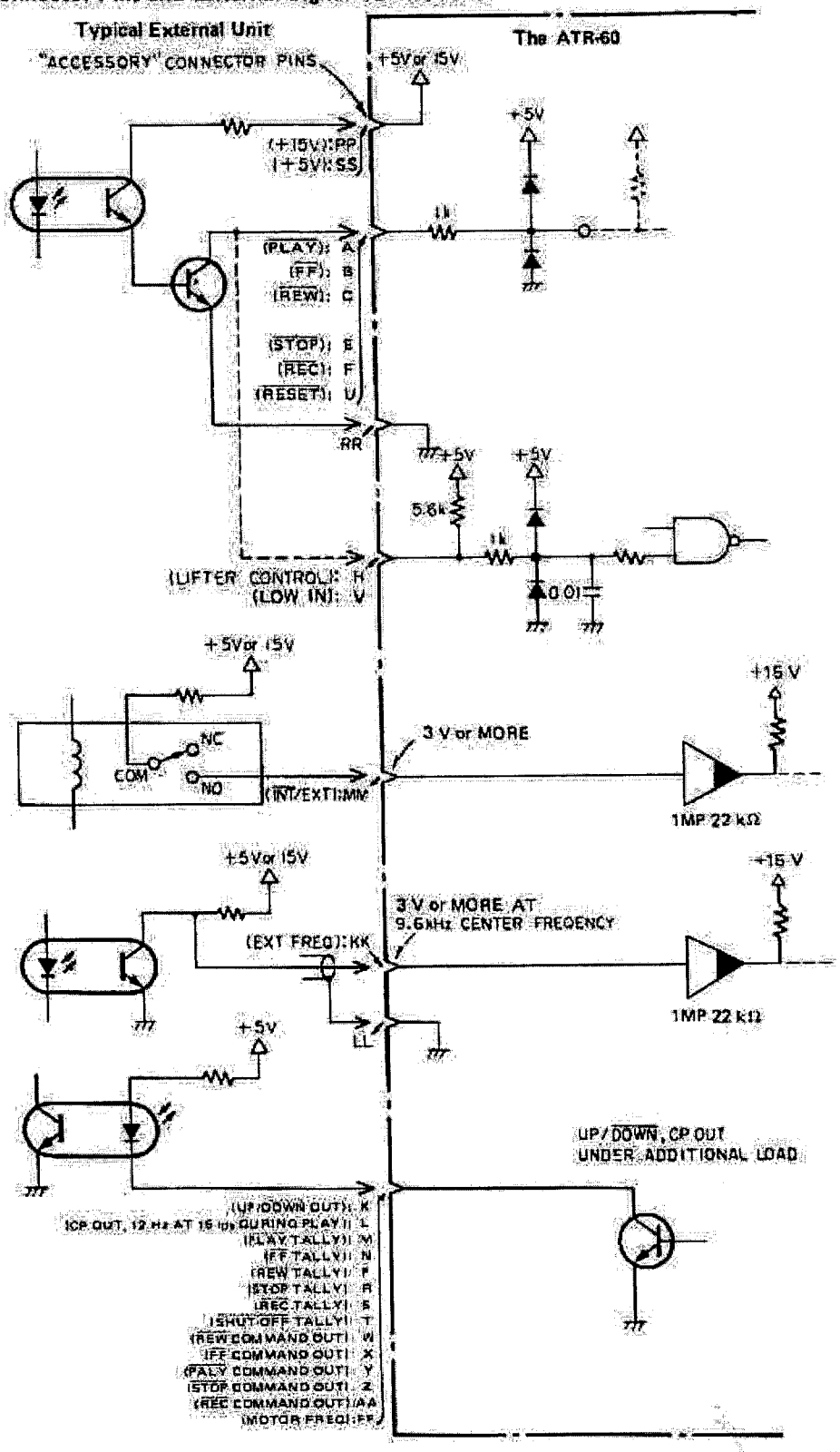


FIGURE 3-4. EXTERNAL SIGNAL CONNECTIONS FOR ACCESSORY CONNECTOR PINS.

Pin #	IN(put)–OUT(put)		Function
38	EDIT	OUT	High level when EDIT is pressed in STOP mode. (+5 V, 10 kΩ or more of load)
39	Open Terminal		
40	+5 V Supply		Counter display
41	$\overline{FF}$	IN	Inputs FF signal at L level.
42	↑		
43	Open Terminal		
44	↓		
45	+5 V Supply		
46	04	OUT	
47	03	OUT	
48	02	OUT	
49	01	OUT	>Speed display
50	$\overline{b}$	OUT	
51	$\overline{d}$	OUT	
52	$\overline{f}$	OUT	
53	$\overline{d\text{-}p}$	OUT	
54	Open Terminal		
55	GND		
56	Open Terminal		
57	EXT VARI	IN	Inputs speed control signal at input signal of 3.0 V or more and of 9.6 kHz ±15 %.
58	+15 V Supply		
59	+15 V Supply		
60	GND		

For REMOTE CONTROL connector's signal connections, refer to page 11-7.

3.4 MONITOR SPEAKERS

When the ATR-60-2 is utilized as a stereo mastering machine, it may be desirable to provide local monitor speakers at the tape machine. The optional TASCAM MA-650 Monitor System can be plugged into the "TO MONITOR SYSTEM" multi-pin connector on the ATR-60-2 amplifier module rear panel. A slide switch adjacent to that connector permits the ATR-60-2 to be set so that its monitor signals are, in fact, sent to the MA-650 rather than the built-in headphone jack.

The MA-650 provides channel selection and mono combine capabilities. It also has auxiliary inputs for monitoring external signals. Other features, and technical information on the MA-650, are provided in Section VII of this manual (Accessories).

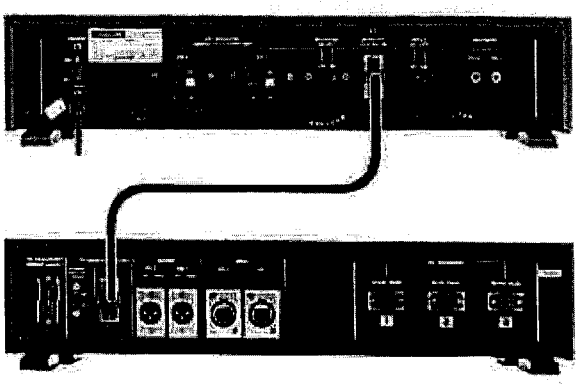


FIGURE 3-6. CONNECTION OF MA-650 MONITOR SPEAKER SYSTEM TO ATR-60-2 AMPLIFIER MODULE.

SECTION IV. FEATURES AND CONTROLS

4.1 TRANSPORT

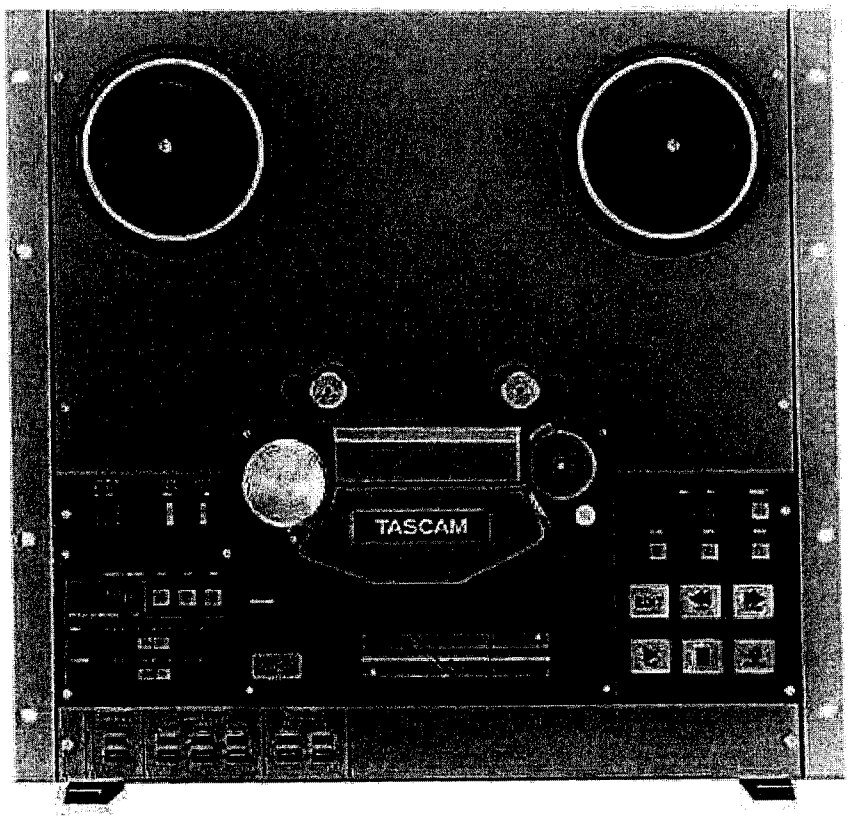


FIGURE 4-1. ATR-60-2 TRANSPORT FRONT PANEL.

4.1.1 NAB Hub Adaptors

These can be installed to allow use of 10-1/2" (26.7 cm) or 8" (20.3 cm) reels. Rotate the adaptor ring clockwise to fully tighten the reel. On the ATR-60-2HS, the "adaptors" are permanently mounted.

4.1.2 Reel Tables, REEL Size Selector

These support either 7" reels or hub adaptors for 10-1/2" or 8" reels. Always use the same size and kind of reels on the takeup and supply reel tables. The REEL selector switch should be set to the appropriate position for the size of reel in use – LARGE for 10-1/2", and SMALL for 7" (or 8" with the ATR-60-2HS) or smaller reels. See Section V for details.

4.1.3 POWER Button

This button turns on the AC power to the unit. As soon as power is turned on: the digital counter indicates "00.00", the pitch control indicator shows the amount of pitch adjustment, the STOP button begins flashing at a rate of 1 Hz and the VU meters on the amplifier module are illuminated. After about 3 seconds, the STOP button stops flashing and lights steadily, indicating the machine's logic circuitry has been initialized (i.e., all the control lines have achieved stand-by-status).

4.1.4 SPEED MODE/PITCH CONTROLs and Indicator, SPEED Selector

The SPEED selector button determines the basic record/play speed of the transport: on the ATR-60-2T, -2N and -2D, LOW selects 7-1/2 ips (19 cm/sec.) and HIGH selects 15 ips (38 cm/sec.). On the ATR-60-2HS, the choice is between 15 ips (38 cm/sec.) and 30 ips (76 cm/sec.). These set speeds are valid only when the nearby SPEED MODE "FIX" switch is engaged. The SPEED MODE controls may alter the speed, as explained below. One of the three LED's above the buttons is always on or flashing to show which speed has been selected.

FIX: indicates that the ATR-60-2 is in fixed speed/pitch mode. It will record or reproduce exactly at machine's nominal LOW or HIGH speed. In the FIX mode the indicator will always show: 00.0 %

VARI: is used to change the tape speed with the PITCH CONTROL. COARSE control is ± 15% and FINE control is ± 0.7%. Using these controls in conjunction with the indicator will ensure repeatable VARI(able) pitch settings (relative to the set LOW or HIGH speed).

EXT: assigns the ATR-60-2 speed control to external equipment. The external equipment can be the optional RC-65 Remote Transport Control or a SMPTE/EBU Synchronizer/Controller.

The EXT LED will remain on if the capstan is under external speed control or flash if external control is interrupted. The indicator will show the amount of speed change. The indicator display will flash on and off if the speed change is outside of the display range (-49.9%, +99.9%).

4.1.5 Tape Lifter Lever

Sliding this lever toward the reels (up), while the machine is in the fast forward or rewind mode, disables the muting circuit (i.e., the line outputs are no longer muted). Sliding the lever further up progressively retracts the tape lifters so the tape contacts the heads, allowing monitoring of the tape to find a cue (slate tone) or the end of a program during a high speed wind.

CAUTION: Sliding the Tape Lifter lever to monitor tape during a high speed wind will cause high-level, very high frequency audio signals to appear at the ATR-60-2 outputs. Be sure that you turn down the level of your monitor speaker prior to operating the Tape Lifter lever so that speaker components will not be damaged by excess high frequency energy. If you're wearing headphones, turn down the ATR-60-2 PHONES level control. It's your responsibility to protect your monitors... and ears!

4.1.6 Tension Arms

Both left and right tension arms have a built-in sensor which detects and compensates for any variation in tape tension. The tape tension is thus maintained at the appropriate value despite long hours and complex tape shuttling. Also provided on the right tension arm is a shut off mechanism which will cut power to the reel motor and put the transport into Stop mode if the tape slackens or spills from the reel.

4.1.7 Splicing Block

This precision aluminum splicing block has been provided to facilitate editing. Neat, uniform splices can be made by laying the magnetic tape in the slot, and using the block's pre-cut grooves to guide your razor blade.

4.1.8 Digital Counter Display

The counter displays the elapsed time of the tape, as wound from initial "00.00" point. The counter measures linear tape footage, then computes elapsed time based on the nominal play/record speed. Thus, even if the tape is actually wound to a cue point at high speed, the counter will indicate the correct running time. The maximum time displayed is 99 minutes, 59 seconds in either direction. (When counting prior to the "00.00" point, a minus(-) sign is displayed at the left of the counter.) The counter will indicate "00.00" when power is first turned on, or when the RESET button is pressed.

4.1.9 RESET Button

Pressing this button resets the tape counter to 00.00. The RESET button does not affect the stored (memorized) Cue point, which remains as previously set. Refer also to CUE Button, Section 4.1.10.

4.1.10 CUE Button

Press this button to set a cue point. The cue is not actually recorded on the tape; instead, the ATR-60-2 remembers the precise counter value at the moment the CUE button is pressed, and will return to that point whenever the STC button is subsequently pressed (Search-To-Cue). Until a "cue" is entered, the machine will assume a "00.00" cue point. Whatever cue point has been memorized remains valid until a new cue is established by again pressing the CUE button, or until power is turned off.

4.1.11 STC Button

Pressing the STC button activates the search-to-cue function, which winds tape rapidly forward (or rewinds) and stops at the established cue point (which must previously have been entered using the CUE button). The search-to-cue operation may be commanded from any tape motion status (i.e., from stop mode, or during play, rewind, etc.). If PLAY is pressed after pressing the STC button, the ATR-60-2 will go to the cue point and then enter the play mode. Pressing the counter RESET button does not affect the previously established CUE point... the tape counter (including the displayed zero or other time value) and the cue point actually utilize separate position memories, and the cue can only be changed by pressing CUE again, or by turning off power to the ATR-60-2.

4.1.12 RTZ Button

Pressing the RTZ button activates the return-to-zero function, which causes the transport to fast wind to "00.00" on the tape counter. The RTZ function, like the STC function, can be activated from any tape motion status, and can be pre-programmed to enter play on reaching "00.00" by depressing PLAY after RTZ.

4.1.13 EDIT Button

The EDIT button has no effect unless pressed when the machine is in stop mode. Then the EDIT button is illuminated to indicate the unit is in edit mode.

If EDIT is pressed when tape is stopped, the reel motor brakes are disengaged and a small, proportional amount of back tension is held by each reel motor so that the reels may be moved easily by hand for editing purposes, yet slack will be eliminated.

If EDIT and PLAY are pressed simultaneously, the transport enters Dump Edit mode. The capstan and pinch roller pull tape past the heads at the nominal speed, or at the adjusted pitch, allowing the operator to listen to playback for a particular edit point. However, the take-up reel does not turn, allowing tape to spill off the machine until the edit point is reached (take-up tension arm position is "ignored" by the shut off sensing logic). Upon reaching the desired point, pressing the STOP button stops the tape and cancels edit mode.

NOTE: If the EDIT button has been pressed (the EDIT button is illuminated) to place the machine in edit mode, and the PLAY button is pressed subsequently, the machine will not enter dump edit mode (the two buttons must be pressed simultaneously). Instead, edit mode will be cancelled, and tape will begin moving normally as the machine enters reproduce (play mode).

4.1.14 REWind Button

Pressing this button selects the rewind mode, which may be entered from any other mode. Pressing it a second time after the machine is placed in rewind mode causes the tape to slow to an intermediate winding speed (the reverse spooling mode), and the rewind button begins flashing on and off. Spooling is used for a rapid yet extremely uniform, tight tape pack. The third pressing of this button returns the machine to rewind mode (the rewind button lights up steadily). The approximate tape speeds are: for rewind, 240 ips (610 cm/sec), and for spooling, 80 ips (203 cm/sec).

4.1.15 F.FWD (Fast Forward) Button

Pressing this button selects the fast-forward mode. The button functions similarly to the rewind button in that pressing it a second time causes the machine to enter forward spooling mode.

4.1.16 PLAY Button

Pressing the PLAY button places the machine in play mode. When PLAY is pressed during fast-forward, rewind or spooling mode, the machine will enter play mode after tape has stopped. If PLAY is pressed during a search operation (using STC or RTZ), the machine will enter play after the cue or "00.00" point has been reached.

CAUTION: To enter record mode from play mode, press only the RECORD button (It is not necessary to press both PLAY and RECORD). To punch out of record mode, while keeping tape rolling at play speed, press the PLAY button.

4.1.17 STOP Button

Pressing this button stops tape motion and cancels any other mode of operation. The STOP button flashes for about three seconds when the AC power is first turned on, indicating the machine is not yet ready to operate while the logic is being initialized. In stop mode with the STOP MUTE switch OFF, the stop edit mode can be entered.

4.1.18 OUTPUT SELECT Switches

These three switches determine the source of the signal which is fed to the output connectors and the VU meters, as follows:

INPUT Selects the input to the track (primarily for alignment). This is the same as the E-to-E function on a video tape recorder.

SYNC Selects the record/sync head signal for synchronous reproduction, or the input signal, depending on the setting of the track's FUNCTION switch, as explained in Section 4.1.19. This setting is the one used most often during production.

NOTE: Synchronous reproduction is not possible unless both FUNCTION switches are released.

REPRO Selects signal from the repro head. This is used primarily during alignment, although it can be used for mixdown. Actually, the SYNC and REPRO head performance is equivalent, so there is no need to use REPRO for mixdown.

4.1.19 FUNCTION Switches and LEDs

These 2 switches determine whether the associated track can enter record mode. There are two ways to cause a track to record:

a) Press the RECORD (●) and PLAY (▶) buttons. If the track's FUNCTION switch is not engaged, the LED above it will flash to indicate that the track is Record Ready and will enter record mode as soon as that FUNCTION switch is pressed. When the FUNCTION switch is engaged to commence recording, the LED above it will remain on steadily.

b) Engage the track's FUNCTION switch with tape stopped, or in the play mode. The LED above it will flash to indicate that the track is ready to enter record mode. If tape is stopped, press the RECORD (●) and PLAY (▶) buttons to commence recording; if tape is playing, just press RECORD (●) to commence recording. The LED above the FUNCTION switch will remain on steadily to indicate the track is recording.

In either of the above instances, recording can be stopped on all tracks by pressing the PLAY (▶) button or the STOP button, or, for individual tracks, by disengaging the corresponding FUNCTION switch.

When the FUNCTION switch is released, no recording is possible on the track, and the track's LED indicator is off.

Assuming the OUTPUT SELECT — SYNC switch is engaged, whenever a track's FUNCTION switch is off, that channel's output will come from the record/sync head regardless of the transport's record or play status. This permits safe synchronous playback during inserts or overdubs.

4.1.20 STOP MUTE Switch

When the STOP MUTE switch is engaged, the ATR-60-2 audio output is momentarily muted as the transport starts, or as tape comes to a stop. This eliminates the "dragging" sound which is otherwise heard as tape is moving up to or down from normal play speed.

NOTE: When using the Stop Edit mode, be sure to disengage STOP MUTE. Otherwise, audio cueing is not possible.

4.1.21 RECORD (●) Button

Pressing this button at the same time the PLAY button is pressed initiates record (or record ready) mode. Recording actually occurs only on the track or tracks whose FUNCTION switches are engaged. On those channels, the FUNCTION LEDs will cease flashing, and will stay ON, indicating recording is taking place. Pressing the PLAY (▶) button cancels record mode, but allows tape to continue playing. The RECORD button flashes in the record ready mode, and lights steadily in the record mode.

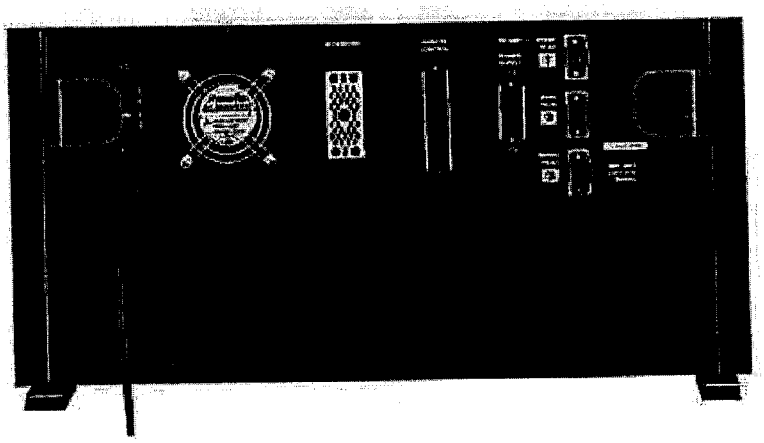


FIGURE 4-2. ATR-60-2 TRANSPORT REAR PANEL.

4.1.22 ACCESSORY Connector

This 38-pin connector has the necessary inputs and outputs for direct interface with SMPTE/EBU time code synchronizers, controllers or editors. Signals at the connector include capstan motor tachometer, logic and tally lines. This connector is plug-to-plug compatible with equipment made by Adams Smith, Audio Kinetics, Cypher Digital, Convergence, EECO, TimeLine, United Media, Video Media, and others.

Alternatively, the ACCESSORY connector may be used for interface of the ATR-60-2 with the optional AC-65 Auto Locator/Tape Transport Controller. Detailed physical dimensions and pin assignments, as well as a description of time code editing systems, are given in Section 3.3.

4.1.23 REMOTE CONTROL Connector

This 60-pin connector is used with the optional RC-65 Transport Remote Control Unit. Be sure the power is off when connecting or disconnecting the RC-65.

4.1.24 TO AMP – POWER SUPPLY Connector

This 33-pin connector accepts a cable from the TO TRANSPORT – POWER SUPPLY connector on the amplifier module rear panel. This connector thereby provides power and control signals to the amplifier module.

4.1.25 TO AMP – ERASE HEAD, SYNC HEAD & REPRO HEAD Connectors

These three connectors accept cables which mate the respective audio heads with the corresponding TO TRANSPORT – ERASE HEAD, SYNC HEAD, & REPRO HEAD connectors on the amplifier module rear panel.

4.2 AMPLIFIER MODULE

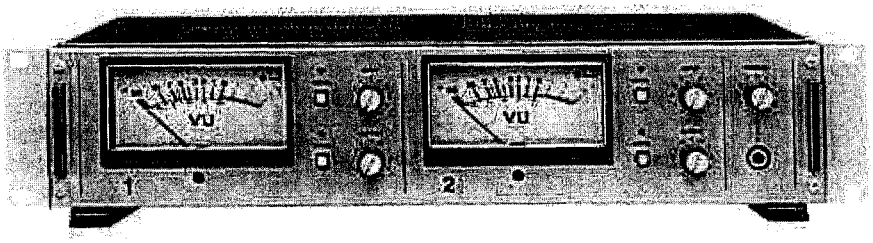


FIGURE 4-3. ATR-60-2 AMPLIFIER MODULE FRONT PANEL.

4.2.1 VU Meters with PEAK Indicators

The meters indicate signal levels appearing at the ATR-60-2 line outputs. 0 VU indicates the average, nominal output level is present (+4 dBm). The PEAK LEDs turn on when the instantaneous output level is 3 dB below clipping. Depending on the setting of the OUTPUT SELECT and FUNCTION switches, the output signal displayed will be derived from the input to the record/sync head, output from that head, or output from the repro head.

4.2.2 INPUT Level Controls (CH1, CH2)

These controls set the level of their respective channel's line inputs. They are used for recording level adjustment. Note that each INPUT level control is activated only when the adjacent UNCAL switch is engaged (down).

4.2.3 PHONES Volume Control

This control adjusts the volume of the signal at the headphone jack. This control does not affect the optional MA-650 monitor speaker output.

4.2.4 PHONES Jack

This 1/4" (6.3 mm) Tip/Ring/Sleeve jack accommodates 8-ohm or higher impedance stereo headphones. It permits the ATR-60-2 operator to listen to a tape directly, without using an external power amplifier. Maximum output is 100 milliwatts into 8-ohm headphones.

With the optional MA-650 Monitor System connected to the TO MONITOR SYSTEM connector and with the adjacent INT/EXT select switch set to EXT, the PHONES monitor source will follow the selection made on the MA-650, so that CH1, CH2, MONO (CH1 + CH2) or normal STEREO headphone monitoring is possible.

NOTE: Mono headphones are not compatible with this circuit. Headphone plugs should have 3 sections (tip/ring/sleeve). Moreover, it is a good idea to remove the shell on the headphone connector and to make sure that there are actually two different lead wires connected to the tip and sleeve terminals. If the terminals have been jumpered together to convert the stereo headphones into mono headphones, or if a mono plug is used, damage may be done to the ATR-60-2.

4.2.5 OUTPUT Level Controls (CH1, CH2)

These controls set the level of their respective channel's line output, and are used for reproduce level adjustments. As with the INPUT controls, each OUTPUT level control is activated only when the adjacent UNCAL button is engaged (down).

4.2.6 UNCAL Buttons (CH1, CH2) for Input and Output Signals

One UNCAL (uncalibrated) button is associated with each INPUT and OUTPUT level control. When the UNCAL button is disengaged (up), the associated level control is bypassed and

the +4 dBm nominal input signal can be passed on to the outputs without receiving any level alteration. When this button is engaged (down), the LED above it turns on, and each level control may be used to adjust the level of input or output signals.

CAUTION: This button should be left in the up position (LED off) when level control adjustments are not required. In this case, input or output levels are fixed.

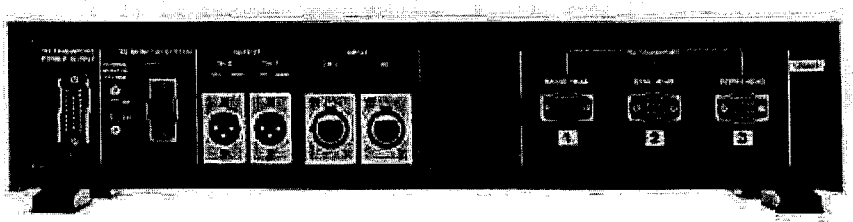


FIGURE 4-4. ATR-60-2 AMPLIFIER MODULE REAR PANEL.

4.2.7 TO TRANSPORT-POWER SUPPLY Connector

AC power is fed from the TO AMP-POWER SUPPLY connector on the transport section rear panel to the amplifier through this connection.

4.2.8 TO MONITOR SYSTEM Connection and INT/EXT Select Switch

This multi-pin connector is used for interface to the optional MA-650 Monitor System. When the MA-650 is used, set the switch to EXT. When the MA-650 is not used, be sure to set the switch to the INT position. If the switch is in the EXT position with the TO MONITOR SYSTEM connector unplugged, no sound can be monitored via the ATR-60-2 headphone jack.

4.2.9 TO TRANSPORT-ERASE HEAD/SYNC HEAD/REPRO HEAD Connection

Using the provided cables, link these connectors to the Head Connectors on the rear of the transport chassis.

4.2.10 CH 1 and CH 2 INPUTs

These XLR-3 type connectors accept a balanced line input to the ATR-60. Input impedance is 10k ohms, nominal input level is +4 dBm (1.23 V), and the maximum source impedance is 600 ohms.

4.2.11 CH 1 and CH 2 OUTPUTs

These XLR-3 type connectors provide a balanced line output from the ATR-60. The nominal level is +4 dBm (1.23 V), the output impedance is 20 ohms, and the minimum load impedance is 200 ohms. Above each of the XLR-3 type OUTPUT connectors is a two position slide switch which allows the signal to be selected as aither balanced or unbalanced, as required. When in the balanced position, pin 3 is hot, pin 2 cold, and pin 1 ground. In the unbalanced position, the output remains at +4 dBm; however, the pin outs change as follows: pin 3 hot, and pin 2 and pin 1 ground.

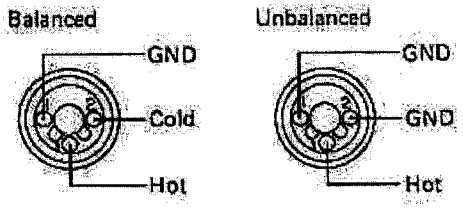


FIGURE 4-5. PIN OUTS IN BALANCED AND UNBALANCED POSITIONS.

4.3 TIME CODE CHANNEL (ATR-60-2T Only)

The ATR-60-2T is provided with the capability of printing and reading SMPTE/EBU time code or other data code on an IEC 0.3 mm wide track centered on the Sync/Repro head. The same track spacing is used on the Erase head, as shown in Figure 4-6.

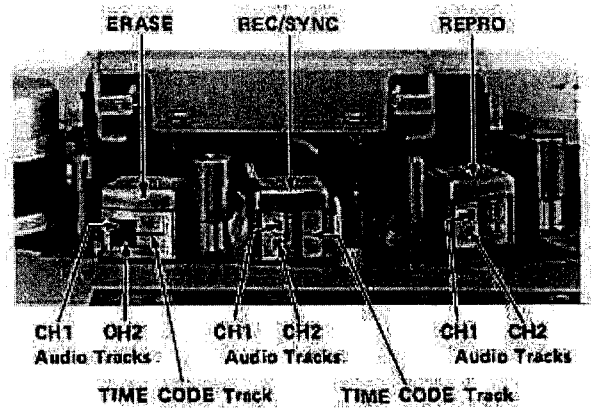


FIGURE 4-6. ATR-60-2T TRACK SPACING & CONFIGURATION.

The TIME CODE CH (channel) Section consists of the time code (or "memo" announcement) recording and reproducing control switches, and the LED indicators that display the status of the TIME CODE Channel.

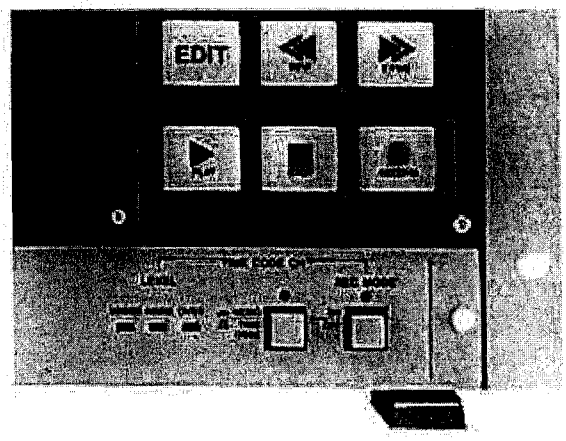


FIGURE 4-7. ATR-60-2T TIME CODE CHANNEL CONTROLS AND INDICATORS.

4.3.1 REC MODE Switch

Just as the FUNCTION Switch does in the audio channels, this switch determines the time code track status:

OFF With the switch up (OFF), no recording is possible on the Time Code/Memo track, and the REC MODE LED is off. For reading the time code track, the REC MODE should be in this position.

ON With the switch down (ON),
(1) the Time Code/Memo track starts recording and the REC MODE LED stays on if the machine is already set to Record Ready (with RECORD and PLAY pressed), or
(2) the Time Code/Memo track enters Record Ready mode and the REC MODE LED flashes on and off if the transport is in any mode other than Record Ready.

Sources plugged into the INPUT connector in the TIME CODE CH reach the OUTPUT connector of that channel regardless of the transport mode.

NOTE: If the TIME CODE CH REC MODE switch is used to punch-in or punch-out of record for slate tones or other announcements, "clicks" may appear at the TIME CODE CH OUTPUT. Instead, leave the switch engaged, disengage both of the main audio channel FUNCTION switches (buttons up) to prevent the audio tracks from entering the record mode), and use the transport RECORD and PLAY buttons to accomplish the time code channel punch-in/punch-out.

4.3.2 MEMO/TIME CODE Select Switch

The record and reproduce amplifiers are switched either to the MEMO function (with the switch up) or to the TIME CODE function (with the switch down). The MEMO setting provides best results with voice or slate tones, whereas the TIME CODE function is optimized for digitized data signals.

4.3.3 LEVEL LEDs

These three LEDs act as a level meter for the Time Code channel. The LEDs display the output level, or the input level, and are therefore useful when recording or reproducing a signal from the channel.

In Time Code mode, when in Record Ready, given an input signal within the nominal range the LEDs will light as follows: UNDER and NORM; NORM; NORM and OVER. With either of these three LED indications the time code record level is internally held at a specific level so that on reproduce only the NORM LED will be on. If, in Record Ready, only the UNDER or OVER LED lights, you may not get a satisfactory time code recording. If this should occur, the level of the time code source should be adjusted.

In Memo mode, the NORM LED should stay on, with the OVER and UNDER LEDs flashing occasionally as the record/reproduce level changes.

Although there are three LEDs, five different level ranges can be displayed because two adjacent LEDs will turn on when signals are at intermediate levels. As signal level is increased from a very low level, the approximate input/output levels present when the associated LEVEL LEDs first turn on are as follows:

LED	LEVEL RANGE (APPROX.) at 1 kHz
UNDER	-10 dBm and below
NORM & UNDER	-2 dBm to -3 dBm
NORM	+4 dBm
NORM & OVER	+8 dBm to +9 dBm
OVER	+14 dBm

TABLE 4-1. MEMO LEVEL RANGES

SECTION V. OPERATION

5.1 GENERAL INFORMATION

5.1.1 Reel Installation

The ATR-60-2T, -2N, and -2D accept small (EIA standard) reel hubs for 7 inch (17.8 cm) and smaller metal or plastic reels. By placing reel adaptors and metal spacers over the reel tables, larger (NAB standard) 10-1/2 inch (26.7 cm) metal reels may be used. A metal spacer is mounted on the back of each NAB reel adaptor, and must be in place when the NAB adaptor is in use. The reel spindles are keyed, and are split into outer (upper) and inner (lower) sections. The upper section is spring-loaded, and may be lifted and twisted 30 degrees in order to lock a reel in place. In order to ensure proper seating, be sure the key flanges are aligned on the outer and inner portions of the spindle when installing a reel or an NAB adaptor. (On the ATR-60-2HS which accepts 10-1/2" or 8" large hub reels only, the "adaptors" are permanently mounted.)

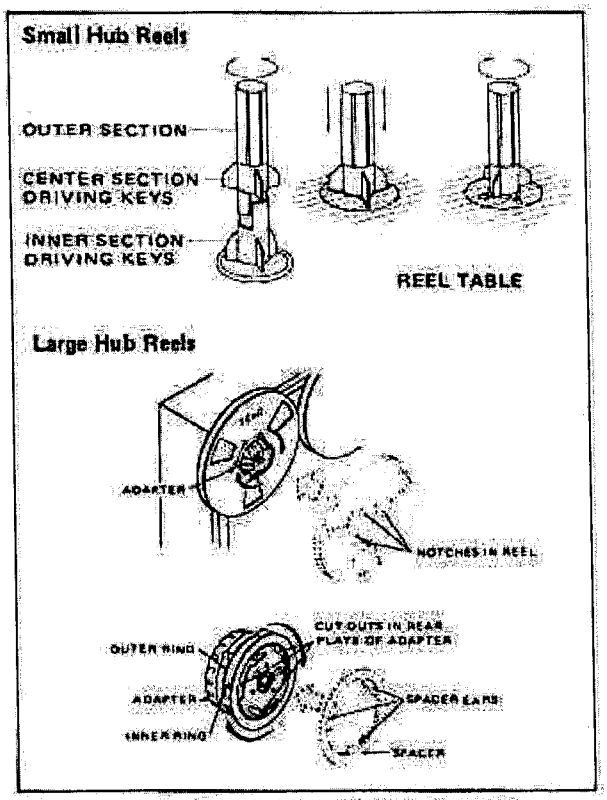


FIGURE 5-1. SMALL AND LARGE REEL INSTALLATION.

CAUTION (except the -HS model): Rubber retaining bands are placed over the reel spindles to protect them against damage in transit. These must be removed prior to operation of the transport.

NOTE: Optimum tension and tape handling will be obtained when the supply and takeup reels are the same size and type.

5.1.2 Threading Tape

Lift the head access cover and press the head shield (head gate) into the top plate to gain free access to the heads for threading tape. The tape should be threaded along the path illustrated in Figure 5-2.

NOTE: If the tape has been stored "tails out," which is a recommended practice, remember to place it on the takeup reel table, and to rewind it onto the supply reel prior to further use.

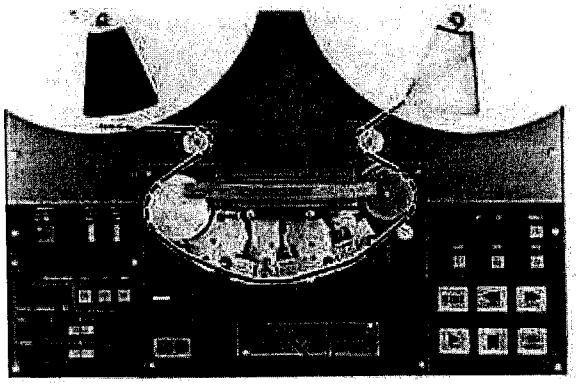
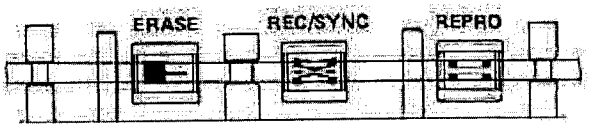


FIGURE 5-2. TAPE THREADING PATH.



(Illust. shows ATR-60-2T heads.)

FIGURE 5-3. HEAD ASSEMBLY LAYOUT (FOR REFERENCE).

5.1.3 Erasing a Tape

A previously recorded track is automatically erased when you make a new recording on it. However, if an entire tape is to be erased, or if you are using a brand new tape, we recommend using a bulk eraser such as the TEAC E-2A. This is faster and more convenient than erasure in real time. If a tape is to be reused, the initial bulk erasure combines with the track-by-track erasure which occurs during the subsequent recording to provide a more thorough erasure for optimum signal-to-noise performance.

5.1.4 Cleaning the Transport

NOTE: Do not overlook the importance of cleaning. Insufficient cleaning is the number one cause of tape machine performance degradation.

The first thing you will need for maintenance is the least expensive — cleaning fluids and swabs. The whole outfit, 2 fluids and all the cotton swabs you'll need for months, costs less than one roll of high quality tape. We can't stress the importance of cleaning too much. Clean up before every session. Clean up every time you take a break in the middle of a session (we're serious). Here's why:

a) Any dirt or oxide build-up on the heads will force the tape away from the gaps that record and play back. This will drastically affect the response. Even so small a layer of dirt as thin as one ten-thousandth of an inch will result in degraded performance. The thickness of a bit of oxide can rob the performance for which you have paid a lot of money. Wipe it off with head cleaner, and get back normal performance.

b) Tape and tape oxide act very much the same as fine sandpaper. Over time, these will grind down the heads and other parts in the tape path. If you don't clean off this abrasive material on a regular basis, the wear will be much more rapid and, what's worse, it will become irregular. Uniform wear on heads can be compensated for by electronic adjustments for a while, but uneven wear can produce notches on heads and guides that will cause the tape to "skew" and skip around from one path to another, making adjustment impossible. This ragged pathway chews up the tape, producing more abrasive material, thus causing more uneven wear . . . so begins a vicious cycle that can't be stopped once it gets a good start. The only solution then will be to replace not only the heads, but also the tape guides. Being conscientious about cleaning the tape path of the ATR-60-2 will more than double the service life of the head assembly.

Heads and Tape Guides

All heads and metal parts in the tape path must be cleaned after every 6 hours of operation, and before starting or after ending a recording session. Use a good head cleaner such as TASCAM HC Series or TZ-261.

Pinch Roller

Clean this part at least once each day the transport is used. Use a good rubber cleaner such as TASCAM RC Series or TZ-261.

1. Unthread the tape from the head area.
2. Apply a small amount of cleaner to the end of a cotton swab.
3. Press in the EDIT button, and then the PLAY button to place the transport in Dump Edit mode so that the pinch roller will turn.
4. Lightly press the cotton swab onto the pinch roller, and move it up and down. Use care to prevent the swab from becoming entangled. Clean until there is no more visible residue on the pinch roller.
5. Press the STOP button.
6. Using a clean cotton swab, wipe off all excess rubber cleaner from the pinch roller. Make certain that there is no foreign matter remaining on either the pinch roller or capstan shaft.

Capstan Shaft

After cleaning the pinch roller, it is necessary to clean the capstan shaft. TASCAM HC Series or TZ-261 head cleaner is recommended.

1. Apply head cleaner to the end of a cotton swab.

2. Lightly press the cotton swab onto the rotating capstan shaft, and move it up and down to clean the entire height of the turning shaft.

3. Make sure there is no visible residue on the capstan.

Tape Guides

Use a swab moistened in head cleaner to remove all oxide and other contaminants from any fixed or rotating guides which the tape contacts, including the tension arm guides, and the scrape flutter idler.

5.1.5 Degaussing (Demagnetizing)

NOTE: Do not overlook the importance of degaussing. Magnetism is the means by which the tape stores the audio signal. Even a small amount of residual magnetism on tape path components can significantly degrade record/reproduce performance, and can permanently alter the quality of a tape which is played on the magnetized transport.

CAUTION: If the degaussar is accidentally unplugged or turned off while it is near the tape heads or guides, it can place a strong, permanent magnetic charge on these components that no amount of subsequent degaussing will remove. That could require costly replacement of heads, etc.

CAUTION: A degausser can erase a tape, so keep it at least three feet (1 meter) away from any recorded tapes.

CAUTION: The powerful magnetic field created by a degausser can overload the head preamplifier circuits in the tape machine. It can create a signal that is roughly equal to 10,000 VU at 60 Hz! This could seriously damage the ATR-60-2 electronics and meters. Therefore, MAKE SURE AC POWER IS TURNED OFF ON THE TAPE MACHINE DURING ALL DEGAUSSING ACTIVITY. Do not turn on power to the tape machine until after the degausser is turned off.

Due to the potential for costly errors, it is a good idea to concentrate when you are degaussing any tape machine. Don't try to hold a conversation or think of anything else but the job you are doing. Make sure you are wide awake.

A little stray magnetism can cause a lot of touble. About 0.2 gauss residual charge can be developed on the heads and other ferrous tape path components after recording and playing 10 reels of tape, which causes increased distortion. A little more than that (0.7 gauss) will start to erase the high frequency signals on previously recordad tapes. For this reason, we recommend demagnetizing the entire tape path, including the tips of the tension arms, after fully playing six 10-1/2 inch reels. Fast motion is not as significant, so just keep track of record/play time.

The actual procedure is simple, provided you follow the precautions noted above:

1. Turn OFF the tape machine.

2. With the degausser located at least 3 feet away from the transport (and from any tapes), plug it in. If the degausser has an on/off switch, turn it on while it is still 3 feet away from the transport.

3. Slowly move the degausser toward the tape path. When it is nearly touching the heads, gradually move it in and out about 6 inches (15 cm). Slowly move it adjacent to each head, each guide roller, tension arm, and so forth until all ferrous parts (including bearings and rollers) have been subject to the varying magnetic field.

4. Slowly withdraw the degausser until it is at least 3 feet away from the transport.

5. After the degausser is at least 3 feet away from the transport, turn it off (if applicable) and unplug it. Now the tape machine can be returned to normal service.

5.2 MONITORING THE LINE OUTPUTS

The OUTPUT SELECT switches determine the source of those signals that are present at the amplifier module's CH1 and CH2 OUTPUT connectors. When the INPUT switch is engaged, the signal at the input connectors appears at the output connectors, regardless of transport mode. When the REPRO switch is engaged, playback from the Reproduce head appears at the output connectors. When the SYNC switch is engaged, the output may be derived from either the input connectors or the Record/Sync head, depending on the setting of the FUNCTION switches. Table 5-1 illustrates these functions.

OUTPUT SELECT Switch	FUNCTION Switch	RECORD Button	LINE OUTPUT Source
REPRO*	N/A	N/A	Repro Head
INPUT*	N/A	N/A	Line Input
SYNC*	OFF (up)	N/A	Sync Repro
	ON (down)	N/A	Line Input
*LED is ON above the engaged switch	LED flashes with RECORD switch off, & stays on with RECORD switch on.	The button flashes with FUNCTION switch off, & stays on with FUNCTION switch on.	

N/A = Not applicable; the setting of this switch or operating mode has no effect on the line output source.

TABLE 5-1. DETERMINATION OF LINE OUTPUT SOURCE.

5.3 RECORDING

Prior to recording, make sure the ATR-60-2 is properly wired to the associated sound equipment (mixing console, etc).

5.3.1 Initiating Recording

There are a number of ways to initiate recording. The settings in Table 5-2 are one reasonable suggestion:

SWITCH	SETTING	INDICATOR
OUTPUT SELECT	INPUT (to preset the record level) or SYNC (to monitor playback until recording begins)	LED turns on above the corresponding switch
FUNCTION	Engage for the track or tracks to be recorded	LED(s) flash on those tracks to be recorded (while tape is stopped or in play mode), or remain on (during actual recording)

TABLE 5-2. SUGGESTED SWITCH SETTINGS FOR INITIAL RECORDING.

Recording can be initiated by pressing the RECORD (●) and PLAY (▶) buttons simultaneously, or by pressing PLAY first, and then pressing RECORD at the moment you wish to punch in to record mode. To end recording, press the PLAY or STOP button.

5.3.2 Recording Levels

Observe the VU meter corresponding to each track. The meters monitor the output connectors, and hence the signals depicted in Table 5-1. The meters should peak around 0 VU, and the PEAK LEDs should flash on no more than occasionally. If the meters indicate the level is too high or too low, make appropriate adjustments.

The mixing console output level can be adjusted so that the proper signal level reaches the ATR-60-2 input connectors. Alternatively, engage the ATR-60-2 UNCAL button(s) adjacent to the INPUT control(s) and adjust those control(s). Once a program is recorded at the correct levels, the reproduce level should

be correct with the output UNCAL buttons disengaged (i.e., at calibrated level). If not, alignment may be necessary. However, the ATR-60-2 OUTPUT control(s) can be adjusted for temporary output level corrections after first disengaging the adjacent UNCAL button(s).

5.4 BUILT-IN AUTO LOCATOR FUNCTIONS

The ATR-60-2 has two digital tape position memories. One memory is associated with the digital counter on the transport that indicates elapsed running time from 00 minutes, 00 seconds (00.00) up to 99 minutes, 59 seconds (99.59) — which is an ample range because a 100 minute long tape will not actually fit on the transport. The second memory is reserved for a "cue" point, which the user can enter at any time by pressing the CUE button; this position is remembered but is not displayed.

From any mode, the ATR-60-2 can be made to fast forward or reverse wind to the "00.00" point by pressing the RTZ button (Return-To-Zero). If the tape is wound to a non-zero point, and the RESET button is pressed, that point becomes the new "00.00" reference at which RTZ will subsequently park the tape.

By pressing the STC button (Search-To-Cue), the tape will fast forward or reverse wind to whatever cue point had previously been memorized by pressing the CUE button. This cue point is not altered when the RESET button is pressed so that a different RTZ "zero" point can be established while retaining the same STC "cue" point. Similarly, a different "cue" point can be established without affecting the "zero" point.

There is a presettable function associated with STC and RTZ; if you press PLAY after pressing one of these buttons, the tape will fast wind to the cue or zero point, then enter the play mode.

When the RESET button is pressed, not only does the ATR-60-2 digital counter indicate "00.00," so, too, does the counter display on the RC-65 remote control unit if one is plugged into the ATR-60-2.

5.5 FAST WINDING

5.5.1 Fast Forward or Rewind

To fast wind in the forward direction (onto the takeup reel), press the Fast Forward button (F.FWD ▶▶); in the reverse direction (onto the supply reel), press the Rewind button (REW ◀◀). These fast winding modes can be initiated from the stop, play or record modes. The tape lifter arms pull tape away from the heads as soon as fast winding is initiated, and the line outputs are electrically muted (with the ATR-60-2T, the time code output is also muted).

5.5.2 Spooling

The spooling mode is used to transfer tape from one reel to the other at a constant speed of approximately 80 ips (203 cm/sec). This is about 1/3 the speed of fast forward or rewind, which moves tape at approximately 240 ips (610 cm/sec). By moving the tape more slowly, spooling mode makes it possible to obtain a tight, uniform tape pack that is almost the same as winding at play speed . . . but many times faster.

Generally, spooling will be done onto the takeup reel at the end of a recording or editing session so that tape can be stored "tails out," which reduces audible print-through effects (pre-echoes). Fast winding is not used here because the tape pack is less uniform, and edge damage to the tape would be more likely during storage. When tape is again to be used, it is first rewound onto the supply reel at normal rewind speed. It may be helpful to use a white or red leader tape at the head (beginning) of the tape, and a blue leader tape at the tail (end) of the tape to avoid any possible confusion as to which end is which.

To select the forward spooling mode, press the F.FWD (▶▶) button twice: once to begin fast forward winding, and again immediately to initiate spooling. The F.FWD button will flash to signal the transport is in forward spooling mode. Pressing F.FWD a third time will return the transport to normal fast forward winding (F.FWD button is steadily illuminated), or pressing STOP will stop all tape motion.

To select the reverse spooling mode, press

the REW (◀◀) button twice consecutively. As with forward spooling, the REW button will flash, and pressing it a third time will cause the transport to enter full-speed rewind mode. Pressing STOP stops all tape motion.

5.6 DUMP EDITING

Once the initial cue point is marked, pull tape forward, lay it onto the splicing block (oxide down), and cut the tape diagonally at the mark. Use a sharp, non-magnetic, single-edged industrial razor blade. If a substantial length of tape is to be removed, rethread the tape from the supply reel, through the heads, capstan and pinch roller, and let the "takeup" end hang off the right edge of the transport. Then, press the EDIT button and the PLAY button (▶) simultaneously. Tape will begin unthreading itself (dumping) from the supply reel as you listen to it play, and the takeup reel will not turn; tension arm position is disregarded by the transport logic.

When you reach the next edit point, press STOP (■). Once again, press EDIT, and manually move the tape so the splice point is opposite the head being used for reproduction, and mark that point. Lay the tape onto the splicing block, and make the second diagonal cut. Then butt the two cut ends from the supply and takeup reels, apply a small piece of splicing tape or splicing tab.

NOTES:

1. If the PLAY button is pressed alone, after the EDIT button lights, the transport will go into play mode, and the EDIT button light will turn off. To enter dump edit mode, both the EDIT and PLAY buttons must be pressed at the same time.

2. If the STOP button is pressed during dump edit mode, the edit mode will be disengaged, and tape will stop.

5.7 PRINTING AND READING ON THE ATR-60-2T TIME CODE TRACK

When the ATR-60-2T center track is utilized for time code, that code is independent of the audio program on the two primary tracks (CH1 and CH2). The sequence in which time code and audio program are recorded will depend on the particular application, and may be as follows:

1. First record time code, then record audio program with the ATR-60-2T synchronized to other time code based equipment, or . . .

2. Record time code and audio simultaneously.

NOTE: When the time center track is used for "memos" rather than time code, the same input and output connections are utilized, but the signal electronics are switched (with the MEMO/TIME CODE switch) to do a better job with voice than with digital data. While this section primarily deals with time code information, much of it is equally applicable to voice memos or slate tones which alternately may be recorded on this track.

5.7.1 Printing Time Code

The term "printing" means "initially recording" in this context. Follow this procedure to record time code on the ATR-60-2T center track:

1. Plug a time code generator (or a "memo" audio source) into the TIME CODE CH INPUT connector.

2. Press the TIME CODE CH "REC MODE" switch so it is on (engaged, LED on). Set the MEMO/TIME CODE select switch to the appropriate position (out for time code, engaged for memo).

3. Observe the LEVEL LEDs and adjust the level of the signal source applied to the TIME CODE CH INPUT.

With a time code generator, the signal level should not be so high or low that only the OVER or UNDER LEDs light steadly (and not the NORM LED).

The acceptable range for time code is 0.2 V to 15 V peak-to-peak; 2 V p-p nominal.

With a "memo" audio source also, the NORM LED should be on, and the OVER and UNDER LEDs should flash on only occasionally. The nominal MEMO level is +4 dBm.

NOTE: To avoid crosstalk between the center track and the audio channels, be sure to record the audio material at the correct level. This will also provide optimum fidelity and S/N ratio on that track.

4. When ready to record, press the transport RECORD and PLAY buttons (or PLAY then RECORD), just as you would for recording on the primary audio tracks.

CAUTION: Unless you specifically wish to record (or erase) material on the primary audio tracks (CH1 and CH2), be sure the FUNCTION select switches are not engaged prior to initiating recording of the time code track.

NOTE: If the OUTPUT SELECT "REPRO" switch is engaged (instead of SYNC), the REPRO LED will flash to show that the audio and the time code outputs are not being reproduced in synchronization. Press SYNC to ensure that the primary audio tracks and the time code track are synchronously reproduced.

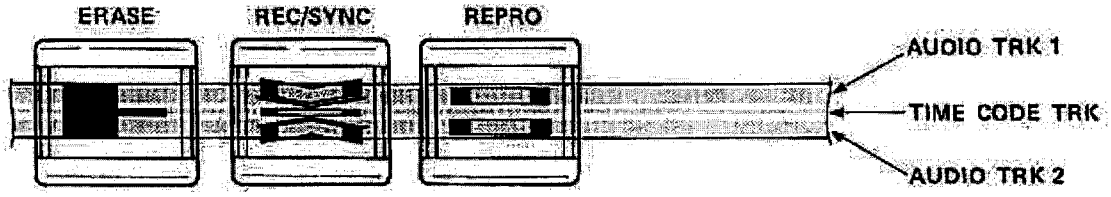


FIGURE 5-4. LAYOUT OF ATR-60-2T HEADS AND TRACKS.

SECTION VI. OPTIONAL ALIGNMENTS AND MODIFICATIONS

6.1 REFERENCE FLUXIVITY AND EQUALIZATION

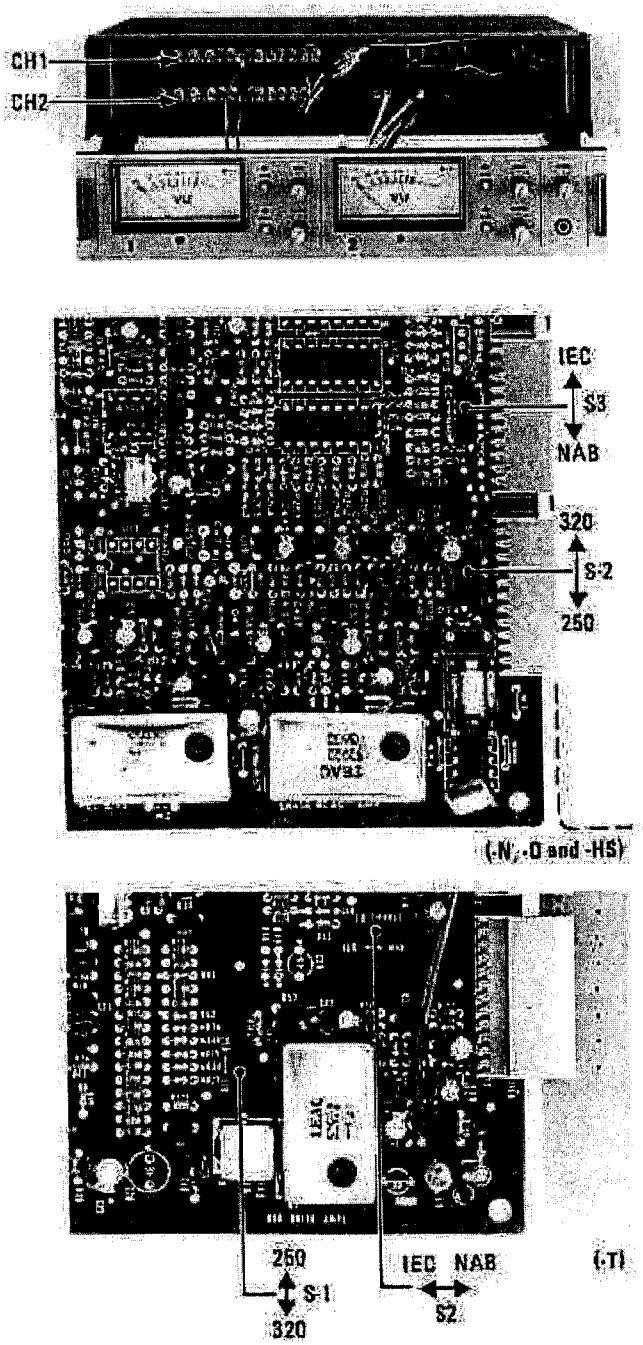


FIGURE 6-1. RECORD/REPRODUCE PCB ASSEMBLY.

The record and reproduce amplifiers on each ATR-60-2 model (-N, -D, -HS, or -T) may be set to one of two basic standards. A pair of switches (S2 and S3 on -N, -D, and -HS models; S1 and S2 on -T model) on the Record/Reproduce Amplifier PCB Assembly determine the basic reference fluxivity and record/repro equalization, as outlined in Table 6-1. Switch S2 (or S1 on -T model) sets the reference fluxivity level, in nanoWebers per meter. Switch S3 (or S2 on -T model) sets the equalization. The factory settings are indicated in bold type.

Model	S2 (Level) S1 on -T	S3 (EQ) S2 on -T
ATR-60-2T	**250** 320	**NAB** IEC
ATR-60-2N	**250** 320	**NAB** IEC
ATR-60-2D	**250** 320	**NAB** IEC
ATR-60-2HS	**250** 320	**IEC*** **NAB** **AES**

*On the -HS model, IEC or NAB is automatically selected at 15 ips, depending on switch S3's setting. AES is automatically selected at 30 ips, and this is not affected by switch S3.

TABLE 6-1. RECORD/REPRODUCE PCB SWITCH SETTINGS FOR DIFFERENT REFERENCE FLUXIVITY AND EQ STANDARDS.

When the NAB standard is selected, the equalization at the reproduce amplifier becomes 3180 + 50 microseconds (μsec) at both 7-1/2 ips and 15 ips (19 & 38 cm/sec).

When the IEC standard is selected, the reproduce amplifier equalization becomes infinity +70 μsec at 7-1/2 ips (19 cm/sec) or infinity +35 μsec at 15 ips (38 cm/sec).

The AES standard which is automatically set when the ATR-60-2HS is set for 30 ips means that the reproduce amplifier equalization becomes infinity +17.5 μsec.

With 320 nWb/m fluxivity (open circuit), the reproduce output level will be 1.3 dB higher than at 250 nWb/m (short-circuit), and 3.9 dB higher than the older 185 nWb/m reference fluxivity (short-circuit). These variations should be considered whenever making level adjustments or checks.

6.2 OUTPUT LEVEL

The nominal output level at the XLR connectors can be changed from +4 dBm (1.23 V) to +8 dBm (1.96 V). Figure 6-2 illustrates switches S-102 and S-202 (corresponding to CH1 and CH2) on the Input/Output PCB Assembly. By resetting these switches, the output amplifier gain is boosted 4 dB to change from the +4 dBm nominal factory output level to +8 dBm.

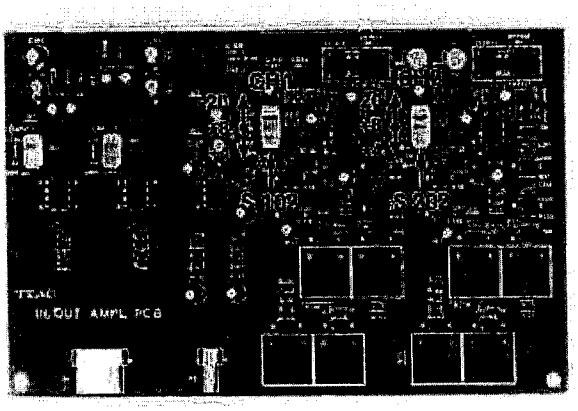


FIGURE 6-2. INPUT/OUTPUT AMPLIFIER PCB ASSEMBLY.

6.3 VOLTAGE CONVERSION AND POWER CORDS

6.3.1 Voltage Conversion

The ATR-60-2 is adjusted to operate on the electric voltage specified on the unit, power cord tag, and packing carton.

NOTE: Field conversion of this line voltage is not possible on models sold in the U.S.A., Canada, the U.K., Australia, or Europe. If your ATR-60-2 is a "general export" model, and if it becomes necessary to change the voltage requirements to suit local AC power mains, use the following procedures.

WARNING: Always disconnect the Power Cord before making these changes.

1. Locate the voltage selector on the left side of the transport rear panel. It consists of a plug which can be inserted in different positions.
2. Remove the plug by pulling it out; then reinsert it so that the arrow on the plug points to the white line indicating the desired line voltage.
3. We suggest you label the power cord with the set AC line voltage.

6.3.2 Power Cords – U.K. Customers

Due to the variety of plugs being used in the U.K., the ATR-60-2 is sold without an AC power plug. Please request your dealer to install the correct plug to match the power outlet in the location where the unit will be used.

CAUTION: The wire in the mains lead are coloured in accordance with the following code:

BLUE = NEUTRAL
BROWN = LIVE

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals of your plug, proceed as follows:

1. The wire which is coloured BLUE must be connected to the terminal which is marked with the letter "N" or coloured BLACK.
2. The wire which is coloured BROWN must be connected to the terminal which is marked with the letter "L" or coloured RED.

This product is manufactured to comply with the radio interference of EEC directive "82/499/EEC."

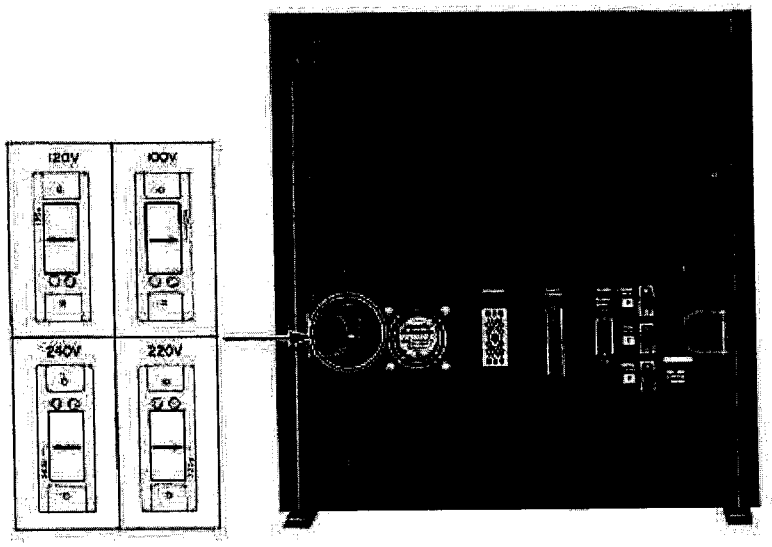


FIGURE 6.3. CHANGING THE AC LINE VOLTAGE ON "GENERAL EXPORT" MODELS.

SECTION VII. ACCESSORIES

A number of useful accessories are available as options from your TASCAM dealer.

7.1 AQ-65 AUTO LOCATOR

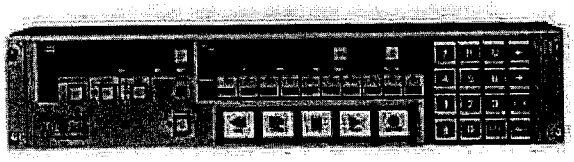


FIGURE 7-1. AQ-65 AUTO LOCATOR.

The TASCAM AQ-65 is a microprocessor controlled, multifunction Auto Locator that provides fast, exact transport control capabilities. It can be particularly helpful in sophisticated production, where the transport can be precisely controlled from the mixing position.

A broad range of feature includes 10 point memory, programmable duration pre-roll, two-point repeat, and duplication of basic transport functions. With the AQ-65 plugged in, the ATR-60-2 can be commanded to:

- Locate a specific location stored in the ten memory registers via the numeric keys or the Direct Store Button.
- Start playback at a preset time prior to the stored cue points. This "pre-roll" time is programmable between 1 and 19 seconds.
- Repeat playback of a selected portion of a tape.
- Return to Zero (RTZ) from any point of the tape. Zero can be used to mark the beginning of the tape, or as the start of a program segment.

AQ-65 SPECIFICATIONS

Description	Auto locator
Function	
Transport:	PLAY, STOP, F.FWD, REW, spooling and RECORD
Cue programming and location:	Ten-point (0 – 9) memory, cue point setting with ten digit keys RTZ, Return-To-Zero
Counters:	2-Tape Time, Locate Time 5 digit, hour, minute and second read-out, with RESET button
Others	
Connecting Cable:	6 m, 34-core shielded, with 38 pin (MALCO 354 or ELCO 8016 Series)
Dimensions (W x H x D)	432 x 88 x 125 mm (17" x 3-7/16" x 4-15/16")
Weight	5 kg (11 lbs), including cable

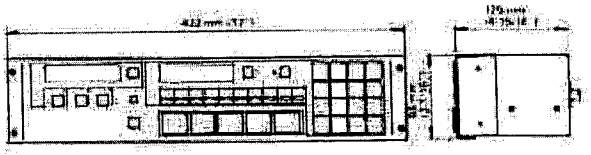


FIGURE 7-2. AQ-65 DIMENSIONS.

7.2 RC-65 REMOTE CONTROL UNIT

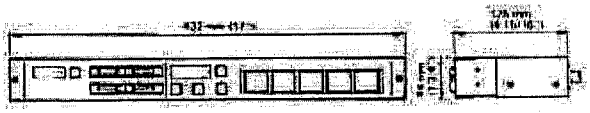
FIGURE 7-3. RC-65 REMOTE CONTROL UNIT.

The TASCAM RC-65 is a remote control unit which allows operation of the ATR-60-2 from as far away as 8 meters (25 feet). All transport controls (except EDIT), including RTZ/STC, counter readout, and pitch control can be remotely controlled with this unit. Use of the RC-65, which includes record functions, enhances the utility of the ATR-60-2.

RC-65 SPECIFICATIONS

Description	Remote Control Unit
Function	
Transport:	PLAY, STOP, F.FWD, REW, spooling and RECORD
Pitch Control:	FINE ±0.7%, COARSE ±15% with ON/OFF switch and 3-digit indicator

Tape Counter:	4-digit, minute and second read-out, single-point memory	**Dimensions (W x H x D)**	432 x 44 x 125 mm (17" x 1-3/4" x 4-15/16")
Auto Locator:	CUE, single-point memory RTZ, Return-To-Zero STC, Search-To-Cue	**Weight**	4.0 kg (8-13/16 lbs), including cable
Others			
Connecting cable:	8 m, 51-core shielded, with 60 pin connector (HIROSE P-1660 BA-CA)		



FUGURE 7-4. RC-65 DIMENSIONS.

7.3 CS-64 ROLL-AROUND STAND

The CS-64 is a roll-around stand for the RC-65 Remote Control Unit and the AQ-65 Auto Locator. The stand includes two sets of side panel adaptors: one measures the height of two standard EIA rack units, and the other 4 units.

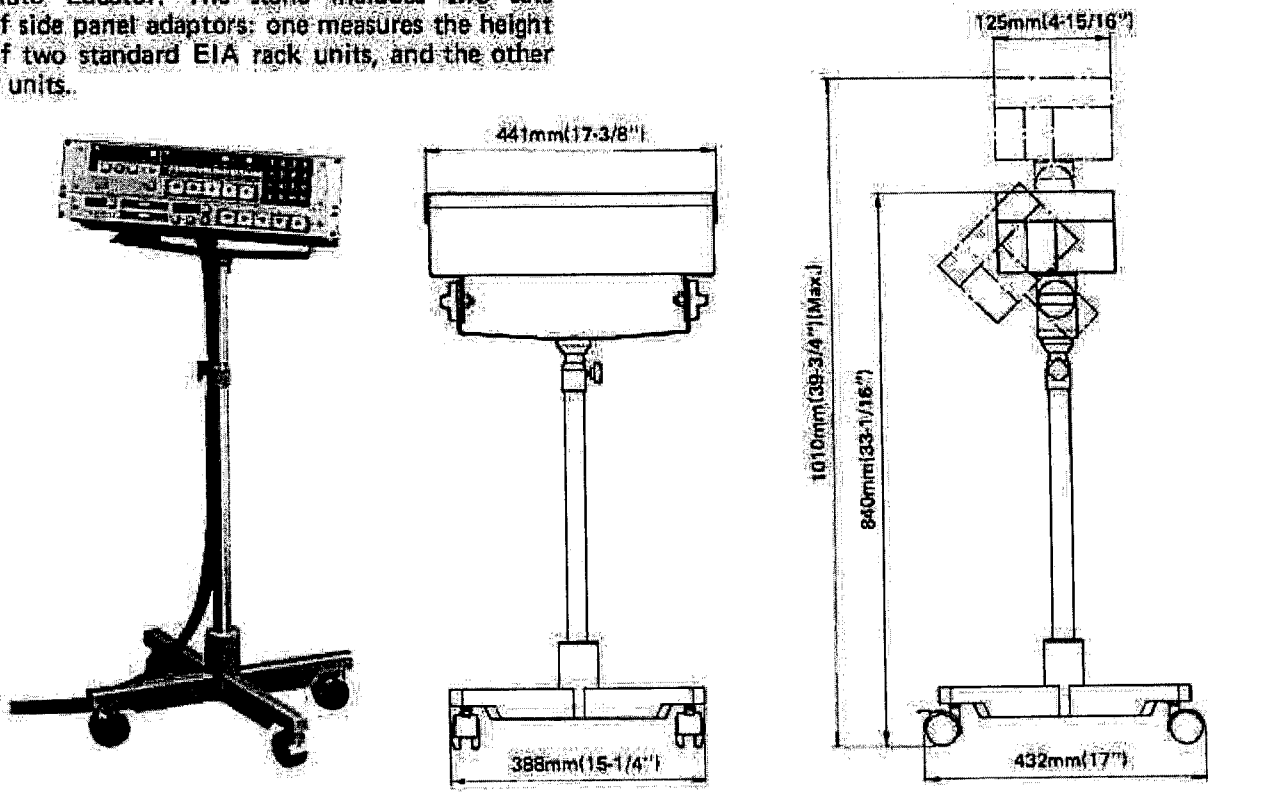
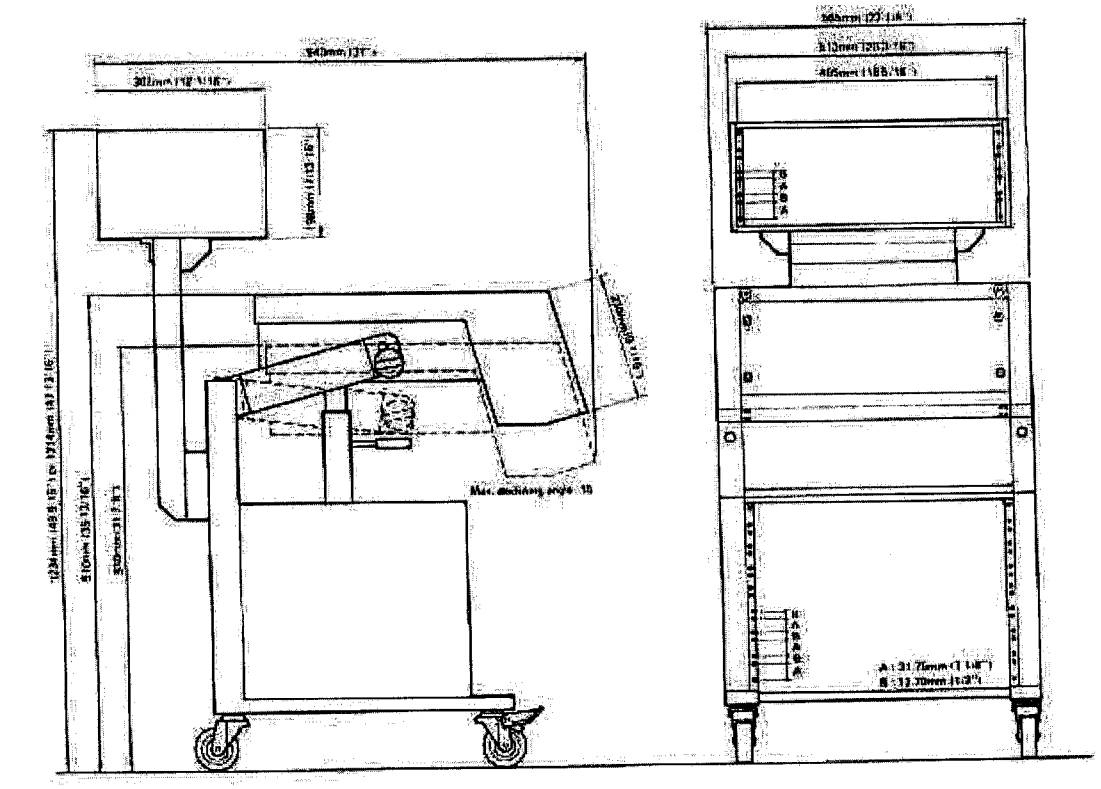


FIGURE 7-5. CS-64 ROLL-AROUND STAND PHOTOGRAPH AND DIMENSIONS.

7.4 CS-65 CONSOLE RACK (EIA 19-INCH) AND CS-62 OVERBRIDGE KIT

The CS-65 is a standard 19-inch console rack to be used for mounting of the ATR-60. The CS-62 allows the amplifier module to be mounted in an overbridge configuration.



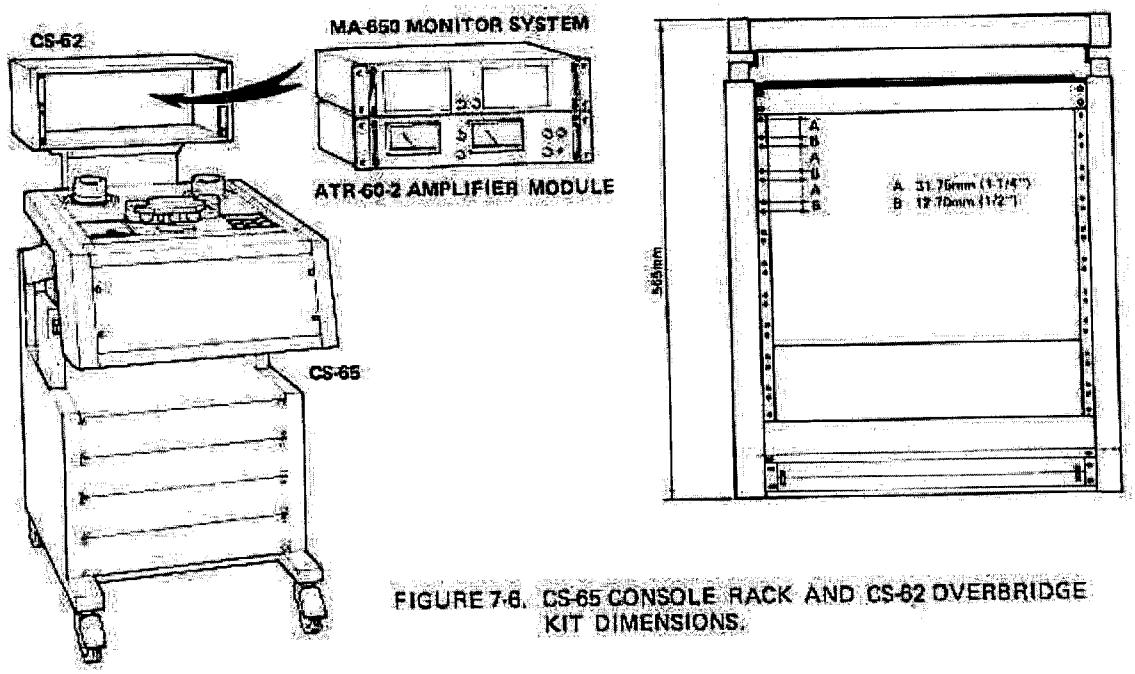


FIGURE 7-8. CS-65 CONSOLE RACK AND CS-62 OVERBRIDGE KIT DIMENSIONS.

7.5 MA-650 MONITOR SYSTEM

7.5.1 General Description

The MA-650 is a two-channel monitor system designed for use with the ATR-60-2 series tape recorder/reproducers. It provides loudspeaker munitor capabillty to augment or replace the built-in headphone monitor in the tapa machine. The MA-650 is packaged for stand-alone mounting or will occupy 3-1/2 inches (88 mm) vertically in a standerd 19 inch wide equipment rack. Built into the unit are a 20 Watt stereo power amplifier and two oval speakers measuring approximately 4-3/4 x 2-3/4 inches (120 x 70 mm).

Pushbutton switches permit the unit to be set to monitor channel 1 only, channel 2 only, both channels combined to mono, or both channels in stereo. Two auxiliary input jacks are provided, end front panel switching enables these inputs to replace the signal from the tape machine; the 1-2-both monitor switching also applies to the aux inputs. Separate channel 1 and 2 level controls adjust the power amplifier output, and connections for external 8-ohm speakers are provided for those installations where the internal speakers are inconvenient, or where a different type of speaker is preferred. Only one set of speakers, internal or external, can be heard at a time, as determined by the front panel Monitor On/Off switch.

Connection to the tape machine is made via a single, multi-conductor cable provided with the MA-650. No modification or internal wiring is required. The MA-650 normally operates instead of the tape machine's headphone output, which is disabled by selecting the "External" position on the tape machine's Phones Monitor switch. However, the tape machine Phones output can be reactivated by selecting the "Internal" position, in which case the audio output from the tape machine to the MA-650 will be interrupted.

7.5.2 Specifications

Input Impedance	10 k ohms, unbalanced
Nominal Input Level	-10 dBV (0.3 V RMS)
Maximum Output Power	Over 20 Watts (1 kHz, 0.1 % T.H.D., 8 ohm load)
Frequency Response (Amplifier)	20 Hz to 20 kHz, ±1 dB
Distortion (Amplifier)	Less than 0.03 % T.H.D. at 1 kHz, 20 Watts output
Signal-to-Noise Ratio	Over 100 dB; input shorted, IHF A-weighted
Built-In Speakers	4-3/4 x 2-3/4 inch (120 x 70 mm) oval (x 2); rated at 3 Watts
External Speakers	20 Watts maximum output, 8 ohm minimum load impedance (per channel)
Power Requirements	100/120/220/240 V AC, 50/60 Hz, switchable
Power Consumption	
USA/GENERAL EXPORT	50 W
CANADA	70 W
EUROPE/UK/AUS	120 W
Net Weight	7.5 kg (16.5 lbs)
Nominal Dimensions (W x H x D)	88 x 465 x 275 mm (3-1/2" x 19" x 10-3/4"); see drawing

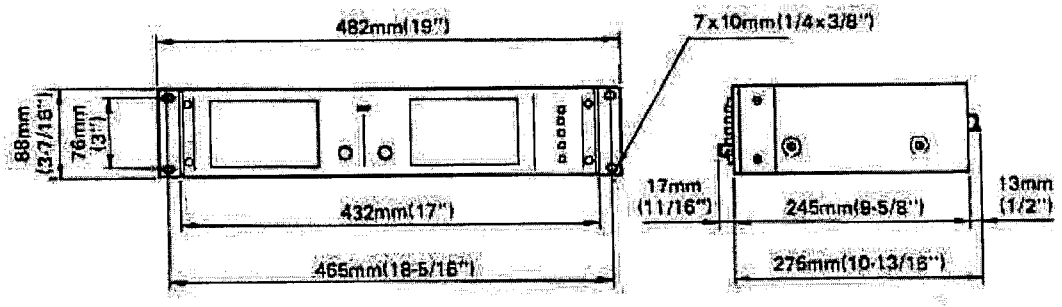


FIGURE 7-7. MA-650 MONITOR SYSTEM DIMENSIONS.

7.5.3 Features and Operation

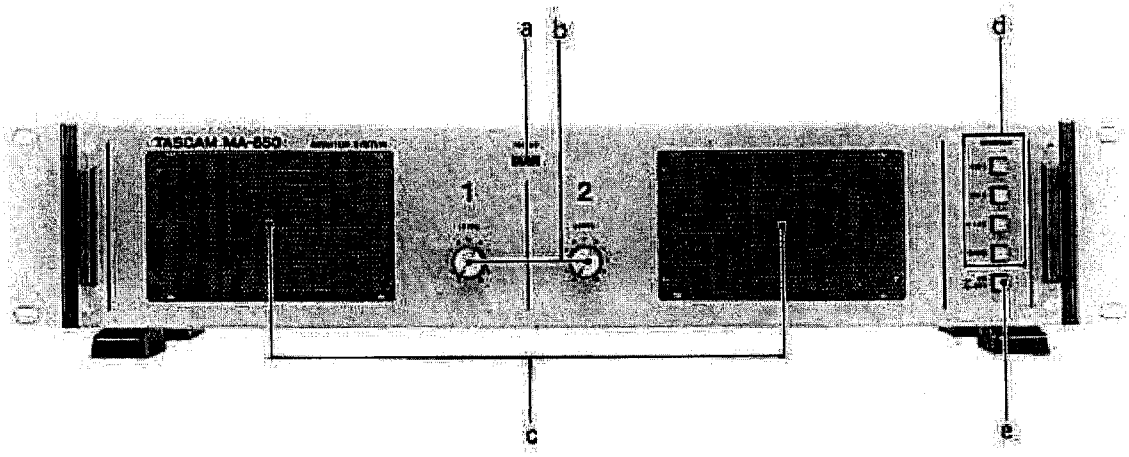


FIGURE 7-8. MA-650 FRONT PANEL.

a) POWER INDICATOR:

This LED lights when the rear-panel power switch is on.

b) LEVEL CONTROLS:

These two controls adjust the MA-650 power amplifier output level. They affect the built-in speakers and/or external speakers connected to the MA-650. These controls do not affect the headphone output level in the tape machine, nor does the tape machine Phones level control affect the MA-650 speaker output level.

c) BUILT-IN SPEAKERS:

These two wide-range loudspeakers reproduce the stereo (or dual mono) signal selected with the Monitor switches (d) provided the Monitor On/Off switch (e) is On.

d) MONITOR SELECTOR (CH1, CH2, CH1 + 2, STEREO):

These switches determine how the Channel 1 and 2 signals (from the tape machine or auxiliary inputs) will be fed to the internal speakers (or external speaker output):

"CH1" position feeds the channel 1 input to both the "left" and "right" speakers.

"CH2" position feeds the channel 2 input to both speaker outputs.

"CH1 + 2" position combines the channel 1 and channel 2 signals to mono, then feeds that combined signal to both speakers (this is good for a mono compatibility check).

"STEREO" position feeds the channel 1 input to the left speaker, and the channel 2 input to the right speaker.

e) MONITOR (ON ▬ / OFF □) SELECTOR SWITCH:

When this switch is engaged (button in), the internal speakers are activated (ON), and the EXTERNAL SPEAKER outputs are OFF.

When this switch is disengaged (button out), the internal speakers are OFF, and the EXTERNAL SPEAKER outputs are ON.

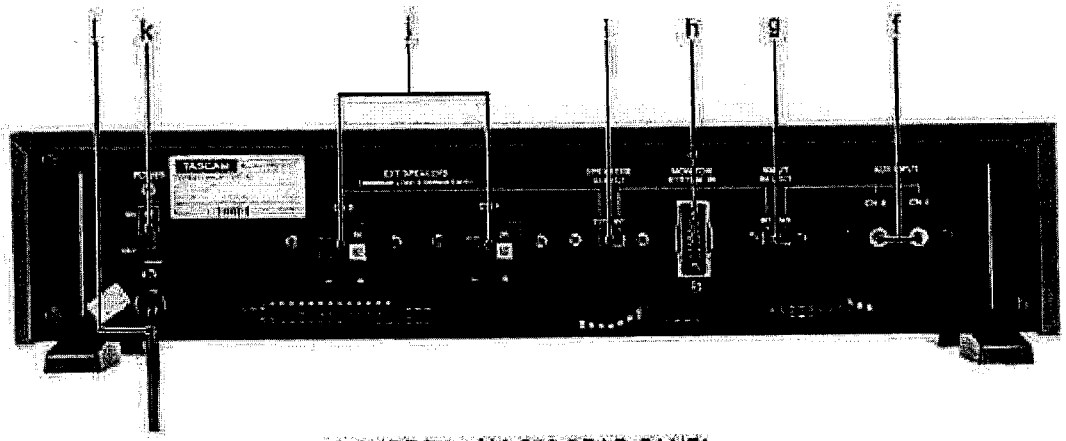


FIGURE 7-9. MA-650 REAR PANEL.

f) AUX INPUT (CH1, CH2) JACKS:

These two RCA phono jacks can be used to bring an external, –10 dBV nominal, line level signal into the MA-650. These inputs are activated by the Input Select switch (g).

g) INPUT SELECT (AUX-INT) SWITCH:

Placing this switch in INT position selects the CH1 and CH2 inputs from the tape machine (via the multi-pin connector) to drive the MA-650 power amplifier and speakers. AUX position selects the AUX INPUT jacks to instead drive the MA-650.

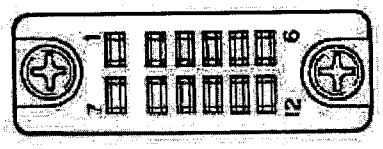
h) MONITOR SYSTEM IN (multi-pin) CONNECTOR:

This 12-pin connector accommodates a special interconnect cable (provided with the MA-650) which is used to link the channel 1 and channel 2 outputs from the TASCAM tape machine to the MA-650. Only audio and ground signals are carried by this cable, not power.

i) SPEAKER SELECTOR (INT-EXT) SWITCH:

When this switch is set to "INT," the internal speakers in the MA-650 are activated. When it is set to "EXT," the internal speakers are muted, and the external speaker output terminals are activated.

HIROSE P-1612-BA-C



Pin #	IN(put) – OUT(put)	Function
1	OUT	Sends out Ch.1 signal
2	GND, Ch.1	
3		
4	Open terminal	
5		
6	IN	Receives external monitor signals (Ch.1)*
7	OUT	Sends out Ch.2 signal
8	GND, Ch.2	
9		
10	Open terminal	
11		
12	IN	Receives external monitor signals (Ch.2)*

*With the INT/EXT select switch set to EXT, signals directly fed into the MA-650 are monitored in the headphones plugged into the PHONES jack on the ATR-60-2.

FIGURE 7-10. MONITOR SYSTEM IN CONNECTOR DIAGRAM AND PIN ASSIGNMENTS.

j) EXT SPEAKERS TERMINALS:

These terminals are provided for connection of external speakers. They will drive speakers only when the SPEAKER SELECTOR (i) is set to "EXT" position. The minimum load impedance is 8 ohms (per channel).

k) POWER SWITCH:

This switch turns on AC power, as indicated by the front panel POWER LED. The amplifier will remain muted, however, for about 7 seconds after power is turned on. This allows circuitry to stabilize and prevents turn-on "thumps" from reaching the speakers.

l) POWER CORD:

Plug this cord into a suitable AC outlet.

VOLTAGE CONVERSION

The MA-650 Monitor System is equipped to operate on any of four input voltages (100, 120, 220, or 240 V AC). If it becomes necessary to change the voltage requirements to suit local AC power mains, use the following procedures.

WARNING: Always disconnect the Power Cord before making these changes.

1. Remove the top side panel by removing two screws on each side and three screws on the top.
2. Locate the voltage selector near the transformer inside the unit.
3. Using a slot-blade screwdriver, turn the selector so that the required voltage is indicated in the cut-off section of the selector.
4. We suggest you label the power cord with the set AC line voltage.

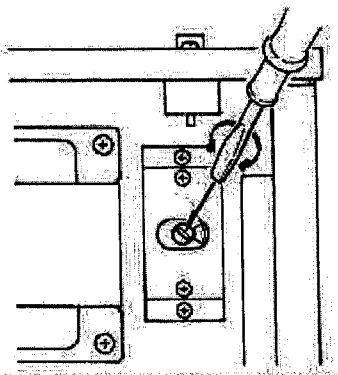


FIGURE 7-11. MA-650 VOLTAGE SELECTOR.

NOTE FOR U.K. CUSTOMERS

Due to the variety of plugs being used in the U.K., the MA-650 is sold without an AC power plug. Please request your dealer to install the correct plug to match the power outlet in the location where the unit will be used.

CAUTION: The wire in the mains lead are coloured in accordance with the following code:

BLUE = NEUTRAL
BROWN = LIVE

As the colours of the wires in the mains lead of this apparatus may not correspond with the coloured markings identifying the terminals of your plug, proceed as follows:

1. The wire which is coloured BLUE must be connected to the terminal which is marked with the letter "N" or coloured BLACK.
2. The wire which is coloured BROWN must be connected to the terminal which is marked with the letter "L" or coloured RED.

This product is manufactured to comply with the radio interference of EEC directive "82/499/EEC."

7.5.4 Block Diagram

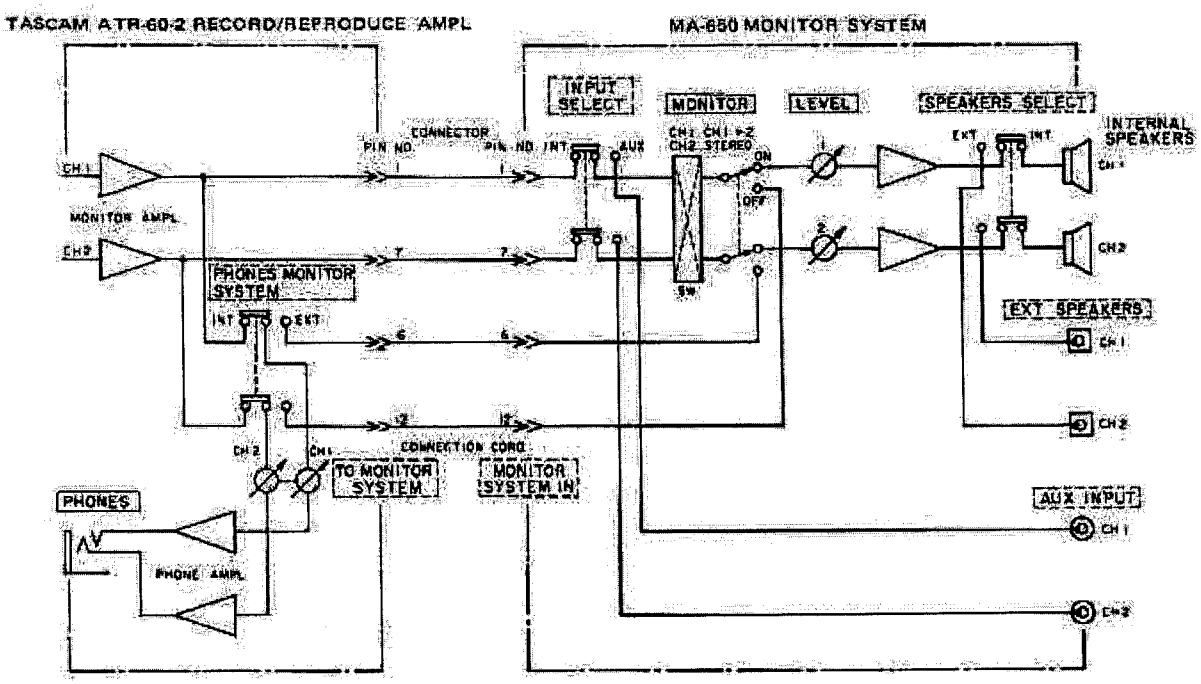


FIGURE 7-12. MA-650 BLOCK DIAGRAM.

7.6 E-3 HEAD DEMAGNETIZER

The E-3 is essential for eliminating the residual magnetism that builds up on the recording heads, as well as certain other metal parts along the tape path. Demagnetization is part of regular recorder maintenance, and the TEAC E-3 is the right tool for the job.

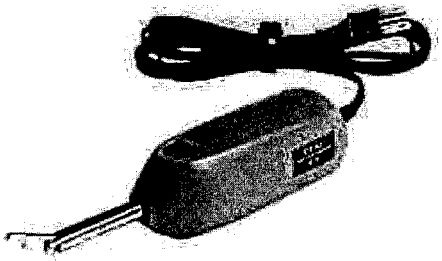


FIGURE 7-13. E-3 HEAD DEMAGNETIZER.

7.7 PATCH BAYS

7.7.1 PB-64

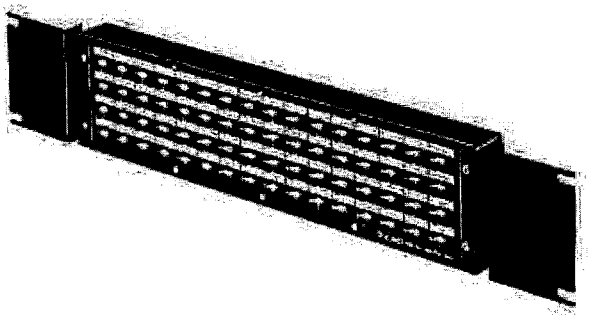


FIGURE 7-14. PB-64 PATCH BAY.

When your system begins to expand beyond the basic, sorting out where things go can take much time away from the recording process. This accessory will allow you to speed things up and get back to what you really want to do. Sixty-four RCA pins on a panel. So you can bring all those jacks to where you are. It will get you off the floor and back to recording. Connect all your inputs and outputs to the back, and you can reroute your signals with short jumpers quickly.

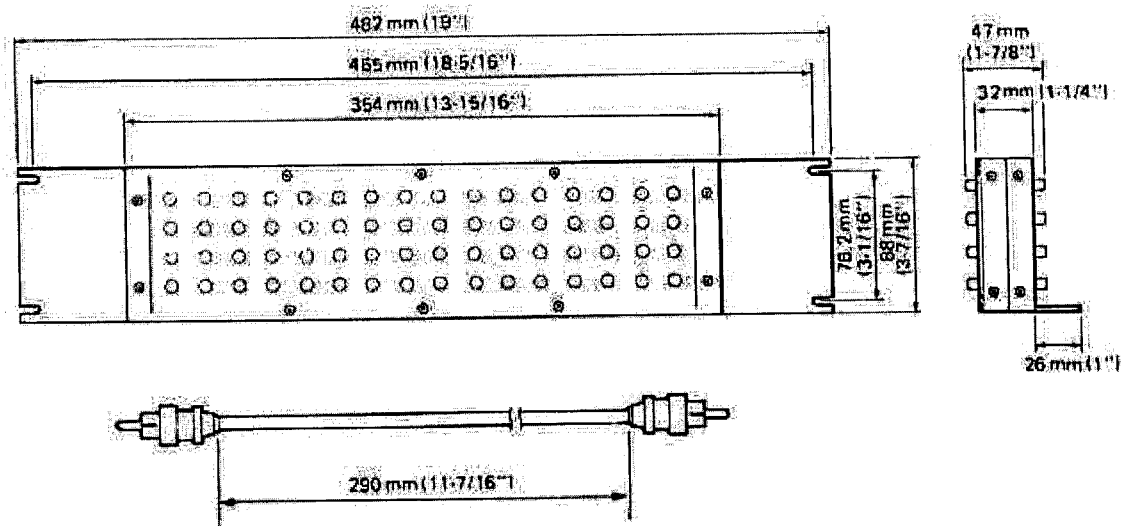


FIGURE 7-15. PB-64 DIMENSIONS.

7.7.2 PB-32 Series

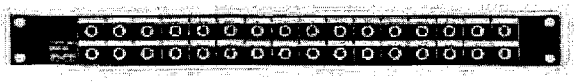


FIGURE 7-16. PB-32P PATCH BAY.

The PB-32 Series Patch Bays are ideal for any application in multitack recording process. They are available in four basic configurations, and can be mounted in 19" EIA rack. They also feature "normalled" connections to provide the maximum in patching convenience without the need to patch through unused circuits.

Specifications

Number of circuits:	16
Type of jacks:	RCA jacks and/or 1/4" phone jacks Front jacks with switches (white) Rear jacks without switches (red)
Dimensions: (W x H x D)	482 x 44 x 75 mm (19" x 1-3/4" x 3")
Weight:	1.3 kg (2-14/16 lbs.)

Model name	Type of jacks	Internal circuit connection (FRONT) (REAR)
PB-32P	1/4" phone jack (front and rear)	Upper / Lower
PB-32R	RCA jack (front and rear)	Upper / Lower
PB-32H	1/4" phone jack (front) RCA jack (rear)	Upper / Lower
PB-32W	1/4" phone jack (leftmost 12 jacks, front and rear) RCA jack (rightmost 20 jacks, front and rear)	Leftmost 12 jacks (same as PB-32P): Upper / Lower Rightmost 20 jacks (same as PB-32R): Upper / Lower

TABLE 7-1. PB-32 VERSIONS.

External Dimensions

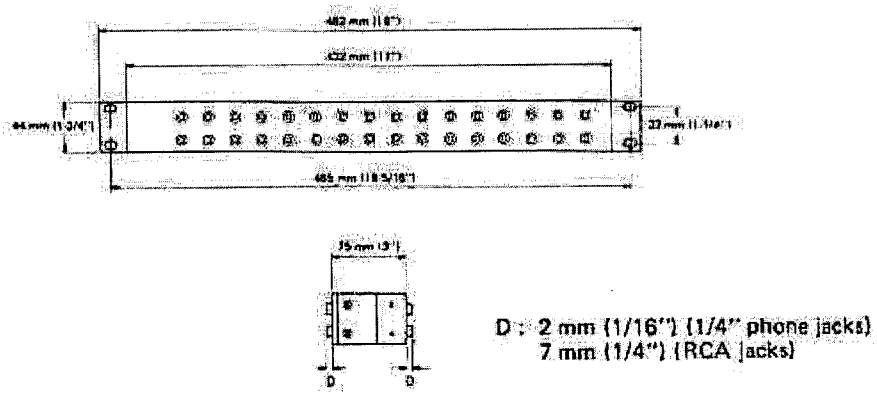


FIGURE 7-17. PB-32 DIMENSIONS.

7.8 TASCAM CABLES

Cable, because of its inherent capacitance and resistance, is an active component in an audio system. There are vast differences in cable design and performance that have significant effect on the sound quality you'll get from your equipment. TASCAM Professional Audio Cables are the best available.

Our cables feature very low capacitance (under 15 picofarads/foot) so they don't act as low pass filters and roll off high frequencies. The capacitance is also consistent; it doesn't change when the cable is bent or compressed. You don't get noise or degraded results when the cable has been used a while. Our cable's long term stability is provided by a special insulator that is as flexible as foam core dielectrics, but far more resistant to extreme cold or heat, and it doesn't let the center strands migrate. It also avoids the possibility of shearing the center conductor when the cable is crushed, so the cable does not suddenly fail.

Rather than loosely braided shield or spiral wrapped shield that can open up, we use bare copper braided shield with 97% coverage. This excludes electrostatic noise (buzz) and RFI (CB interference, etc.). We also use a 7-strand center conductor: 4 pure copper strands for minimum resistance and 3 copper weld stainless steel strands for strength. The multiple strands increase flexibility and strength while offering less resistance at ultra high frequencies due to increased surface area for the "skin effect." This improves transient response.

The outer PVC insulating jacket resists abrasion, and is tightly fitted to the shield so it will not elongate. The connectors are special, too. Their nickel-plated brass center pins are a bit longer than most to establish good contact in all RCA jacks. The cadmium plated steel outer shell includes a gentle ridge which burnishes the mating jack when the connector is twisted to ensure good contact. For maximum RF shielding, the braid is terminated inside the shell and 2-radian soldered, not just spot soldered, for maximum strength. The plugs are clad with an oval jacket of molded plastic to further increase strength and make the ends easier to handle. TASCAM cable is available in lengths from 6 inches to 20 feet, or in color-coded sets of 8 for fast channel or function identification. TASCAM cable is also available in 500 foot spools.

If TASCAM professional cables are not available in your area, please try to find the next best cables. It really does make a difference in system performance.

SECTION VIII. THEORY OF OPERATION

This section of the manual provides a functional description of the basic operations, followed by a detailed explanation of the circuit operation with the recorder/reproducer in a specific operating mode. The unit, with its easy-to-use operating controls provides a host of professional functions, and incorporates a microprocessor to control the tape transport and the record/reproduce amplifiers for improved reliability. Also incorporated are various ICs which are employed for the interfacing of the microprocessor and its associated devices.

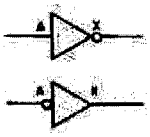
All operating conditions such as switching the tape operation modes and display operation modes, conditions of tape travel, etc. are under the control of a microprocessor. The microprocessor requires various inputs to control these conditions and output instruction signals according to a predetermined program which tests the input conditions, thus controlling operating conditions of the deck according to the instruction signals.

8-1. LOGIC SYMBOLS

The logic operation elements used in this unit and their definitions are as follows:

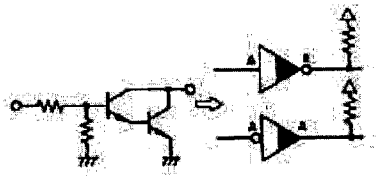
(1) INVERTER

a. TC4049BP



A	X
H	L
L	H

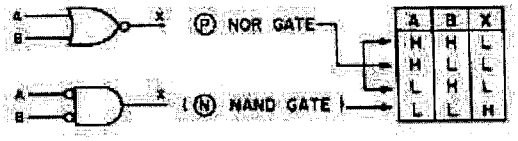
b. M54517P



A	X
H	L
L	H

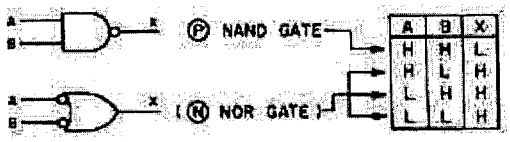
(2) NOR or NAND GATE

a. TC4001BP



A	B	X
H	H	L
H	L	L
L	H	L
L	L	H

b. TC4011BP

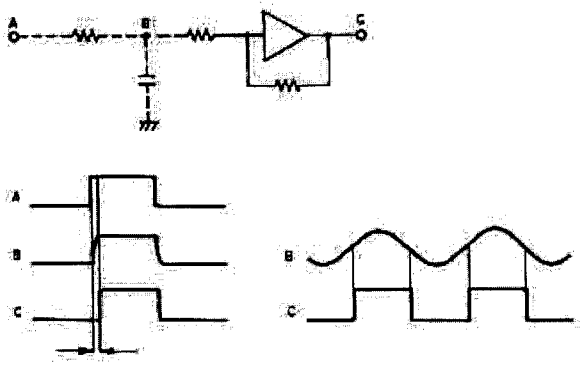


A	B	X
H	H	L
H	L	H
L	H	H
L	L	H

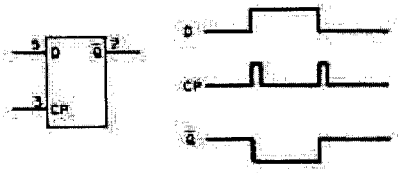
(3) EX-OR GATE (TC4030BP)

A	B	X
H	H	L
H	L	H
L	H	H
L	L	L

(4) BUFFER (TC4050BP)



(5) D-FF (TC4013BP)



(6) TC4510BP
UP/DOWN decimal counter controlled as Quintary counter

Fig. 8-1-1. Logic Symbol Chart

8-2. MICROPROCESSOR INPUT CIRCUIT

The microprocessor U9 provides four scanning pulses with different phases from terminals P0, P1, P2, and P3 to terminals SA, SB, SC, and SD of the interface IC U20 as shown in Fig. 8-2-1. These pulse input terminals and the terminals A0 – A3, B0 – B3, C0 – C3, D0 – D3 of U20 (each of which is connected to a keyboard switch) are connected inside the IC and form a matrix circuit. The matrix circuit outputs are fed to terminels K0 – K3 of microprocessor U9 through terminals Q0 – Q3 of U20.

Thus, the microprocessor will know which mode key is pressed from one of scanning pulses (t0, t1, t2, t3). However, two keys may possibly be pressed simultaneously. In such a case, operation priority, depending upon the combination of keys pressed, is determined as shown in Table 8-2-1. For example, if both keys FF and REC are pressed simultaneously, the microprocessor will judge that the FF key has been pressed. That is, the microprocessor will judge the operation mode requested by testing which of terminals K0, K1, K2, and K3 is "H" or "L" at times t0, t1, t2, and t3.

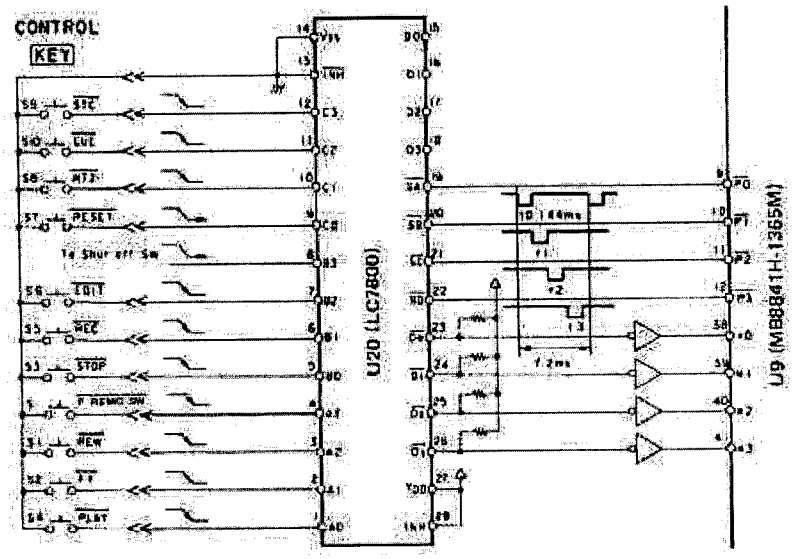


Fig. 8-2-1. Operation Instruction Input Circuit

TABLE 8-2-1. KEY SW PRIORITIES

KEY SW

KEY SW \ INPUT	STOP	PLAY	F.F	REW	REC	EDIT	STC	CUE	RTZ	RESET
STOP										
PLAY	STOP									
F.F	STOP	PLAY								
REW	STOP	PLAY	F.F							
REC	STOP	REC. PLAY	F.F	REW						
EDIT	STOP	DUMP EDIT	F.F	REW	M. EDIT					
STC	STOP	STC (STOP) PLAY	F.F	REW	STC	STC				
CUE	PLAY CUE MEMORY	PLAY CUE MEMORY	F.F CUE MEMORY	REW CUE MEMORY	STOP CUE MEMORY	M. EDIT CUE MEMORY	STC CUE MEMORY			
RTZ	STOP	RTZ (STOP) PLAY	F.F	REW	RTZ	RTZ	RTZ	RTZ CUE MEMORY		
RESET	STOP 00.00	PLAY 00.00	F.F 00.00	REW 00.00	STOP 00.00	M. EDIT 00.00	STC 00.00	STOP 0.00 CUE MEMORY	RTZ 00.00	

8-3. ENTRY OF TAPE SPEED AND DIRECTION INFORMATION

To control tape speed and tape travel direction, the microprocessor needs information on the tape speed and direction. Two photo sensors are provided to detect the speed and direction. Each sensor consists of an LED, a photo-transistor and a toothed disc inserted between the LED and photo-transistor which is rotated at a speed proportional to the tape speed. The teeth of the disc interrupt the light beam from the LED entering the photo transistor as the disc rotates, thus the photo-transistor develops a pulse output proportional to the tape speed. Fig. 8-3-1 shows a symbolic diagram of the sensor. Two photo transistors are provided and positioned so that their pulse output has a 90° phase difference each other. In this way, the microprocessor is able to judge the derection of tape travel by testing the relative phase relationship.

Furthermore, the microprocessor judges the tape speed by counting the number of pulses for a specified period. The circuit shown in Fig. 8-3-1 operates as follows:

Outputs from S1 and S2 are wave-shaped by U23 (3, 2) and U23 (14, 15) and the output of pin 2 of U23 is applied to input terminal D of U3 (flip-flop IC).

At the same time, pulses developed at TP3 and TP4 are logically processed by gates U2 (4, 5, 6), U4 (8, 9, 10), and U14 (9, 10) to create a train of narrow pulses that are fed to the CP (clock) terminal of U3. As a result, the flip-flop's Q terminal develops an "L" output when the tape is running in the forward direction and an "H" output when it is running in the reverse direction. (Terminal $\overline{Q}$ develops the opposite output to that of terminal Q). The terminal Q output indicating the tape travel direction is applied to input terminal R8 of the microprocessor, thus the microprocessor can judge the tape direction.

The clock pulses entering terminal CP of U3 are fed to the divider U13 and counted down to one fifth, and the resultant output is applied to the $\overline{IRQ}$ input of the microprocessor. The microprocessor counts the pulses, calculates the tape speed and tape running time, and uses the results for the required control. For further details, refer to the counter timing chart shown in Fig. 8-3-2.

8-4. ENTRY OF TAPE END INFORMATION

To detect the tape end, an end sensor which works in the same way as the speed sensors is provided. As long as the tension arm is enabled, the photo transistor is on and its output is L. This output enters the CARRY IN terminal of U13 passing through U12 (11, 12, 13) and U14 (11, 12). When the tape reaches its end and stops, the output of pin 11 of U12 changes to L, then the CARRY IN (U13) terminal goes H, thereby entering the counter stop mode. The L signal at pin 11 also enters terminal B3 of the interface U20 to signal that the tape has stopped.

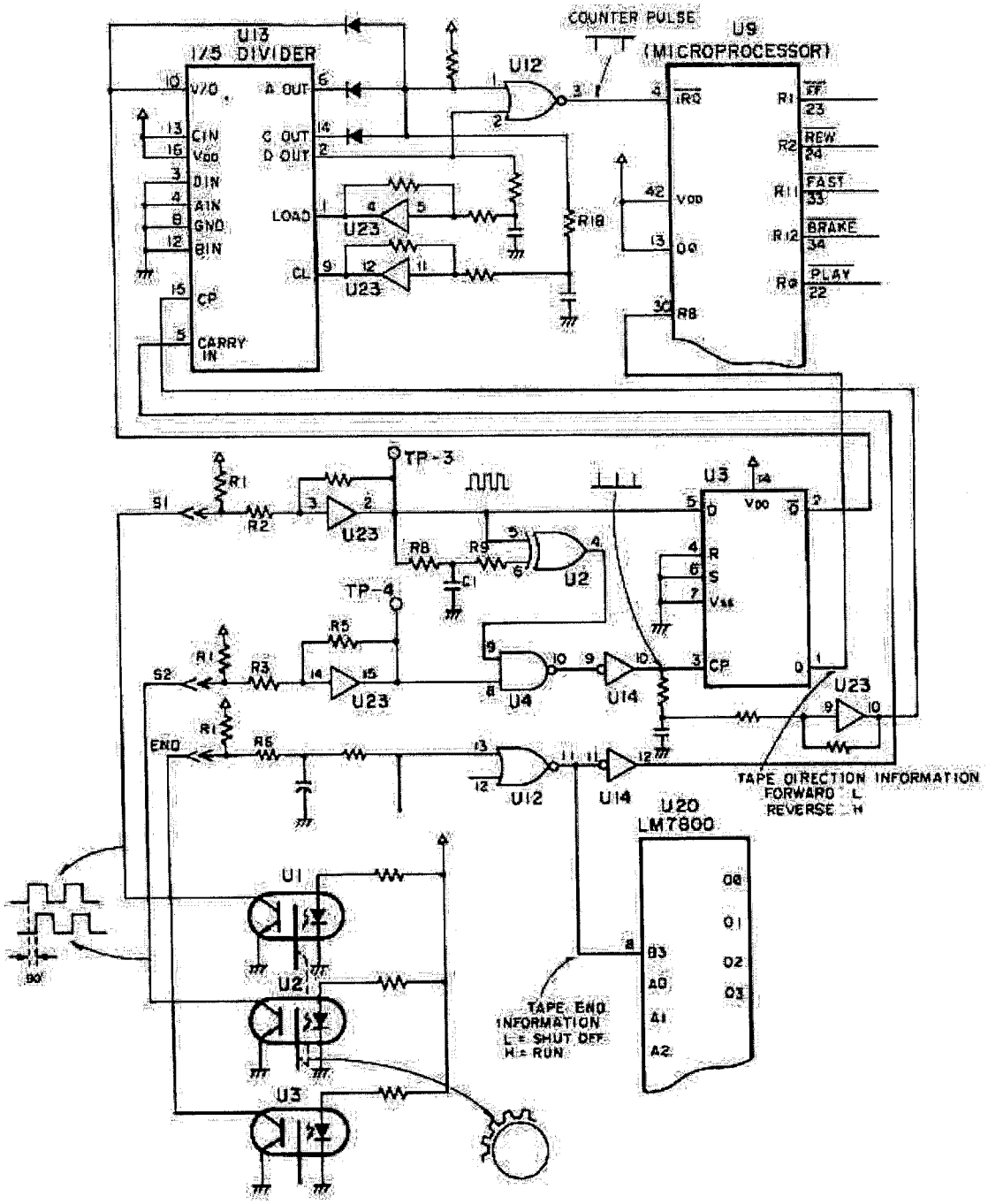


Fig. 8-3-1. Tape Direction Information

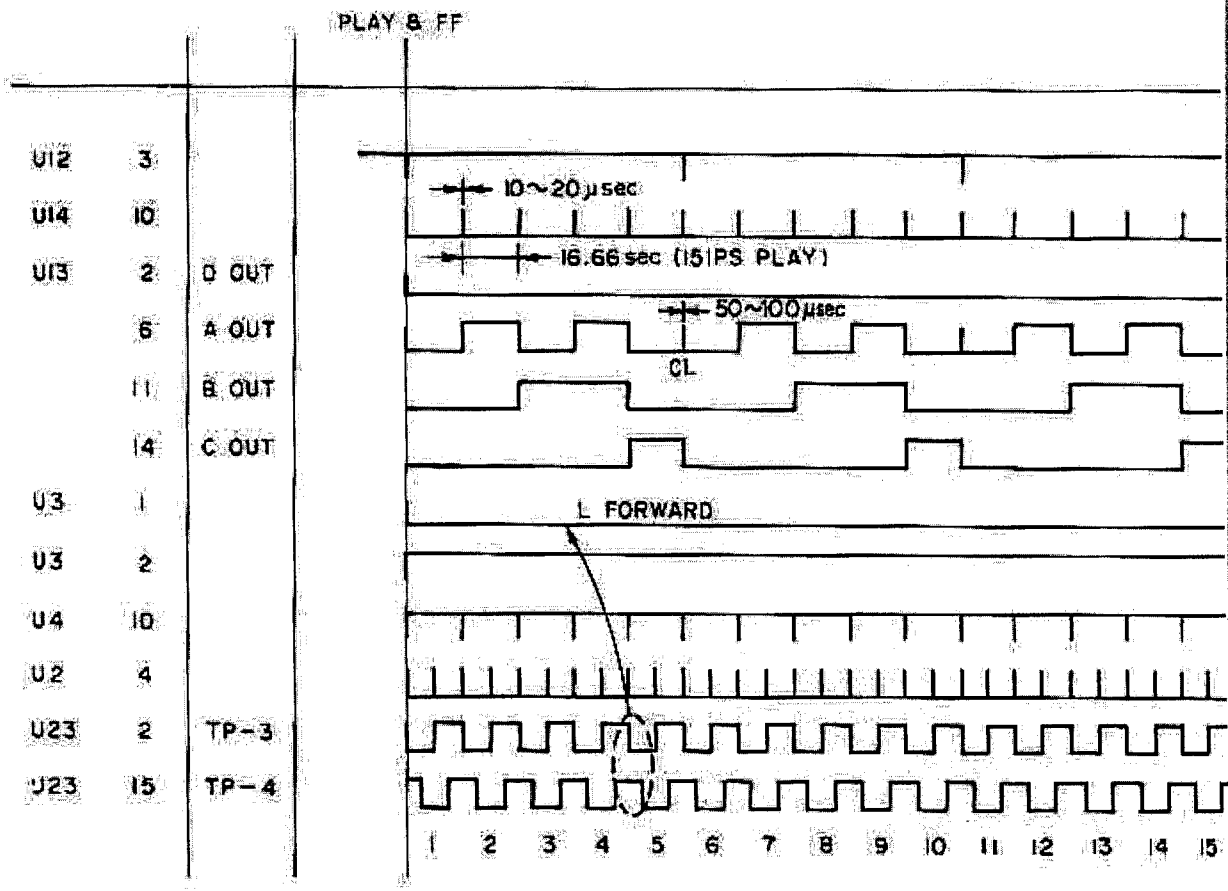
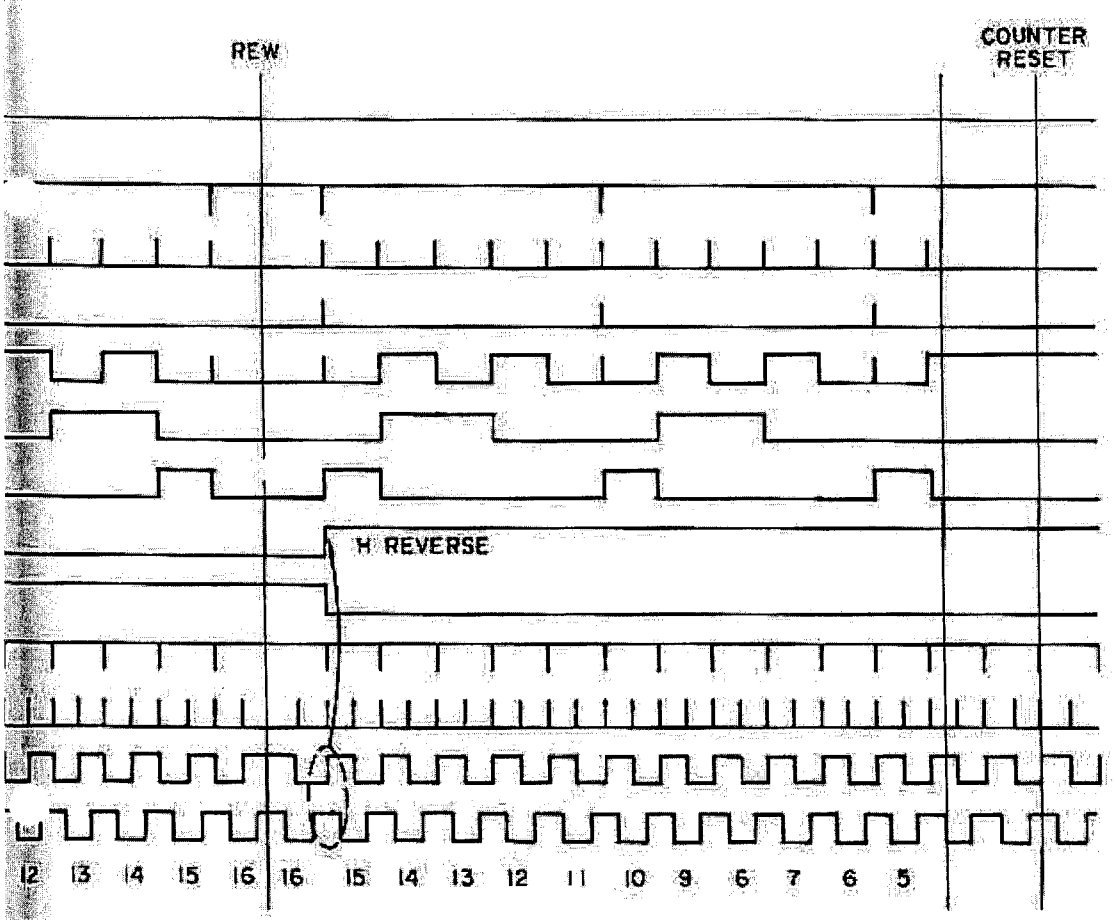


Fig. 8-3-2. Counter Timing



2. Counter Timing Chart

8-5. ENTRY OF POWER ON/OFF INFORMATION

The microprocessor and the various associated operation circuits, etc. will work as expected as long as their power supply voltage is at the specified steady state, but may possibly work erroneously during transient periods of the power supply voltage when it is turned on or off. To prevent this erroneous operation, a power on-off reset circuit is provided and is connected to the RESET terminal of the microprocessor. (Refer to Fig. 8-5-1.)

AC 6 V is applied to D10 immediately after power on and the rectified positive voltage flows to the cathode of D17, thus cutting off D17. Accordingly, the +5 V line voltage is applied to C13 and the voltage across C13 increases gradually because of its relatively large capacitance. Since the RESET terminal of the microprocessor maintains "L" level during this period, the microprocessor is set to its reset condition or the specified initial condition, so no erroneous operation will result.

Next, when power is turned off, the AC 6 V immediately becomes zero, so D17 conducts. That is, the electric charge stored in capacitor C13 is rapidly discharged through D17. Since the discharging time constant is set at a value shorter than the discharging time constants of the general power lines, the RESET terminal voltage of the microprocessor drops to "L" before the general power line voltages fall to low level.

That is, erroneous operation is prevented since the microprocessor is reset before any erroneous operation could occur due to the decreased line voltages.

As can be seen from Fig. 8-5-1, AC 6 V is also rectified by half-wave rectifier diode D9, wave-shaped by U25, and then fed to terminal R10 of the microprocessor. The microprocessor judges the power condition by referring to the pulses continuously entering this terminal. That is, if the pulses do not enter continuously, the microprocessor judges that a failure could be caused in the output amplifier line and sets the deck to the power off mode.

When the microprocessor is reset, terminal R15 develops an H level signal for approx. 3.3 sec, and the H level signal is used for OUTPUT signal muting and to make an LED blink to show the user that the deck is in its initial condition.

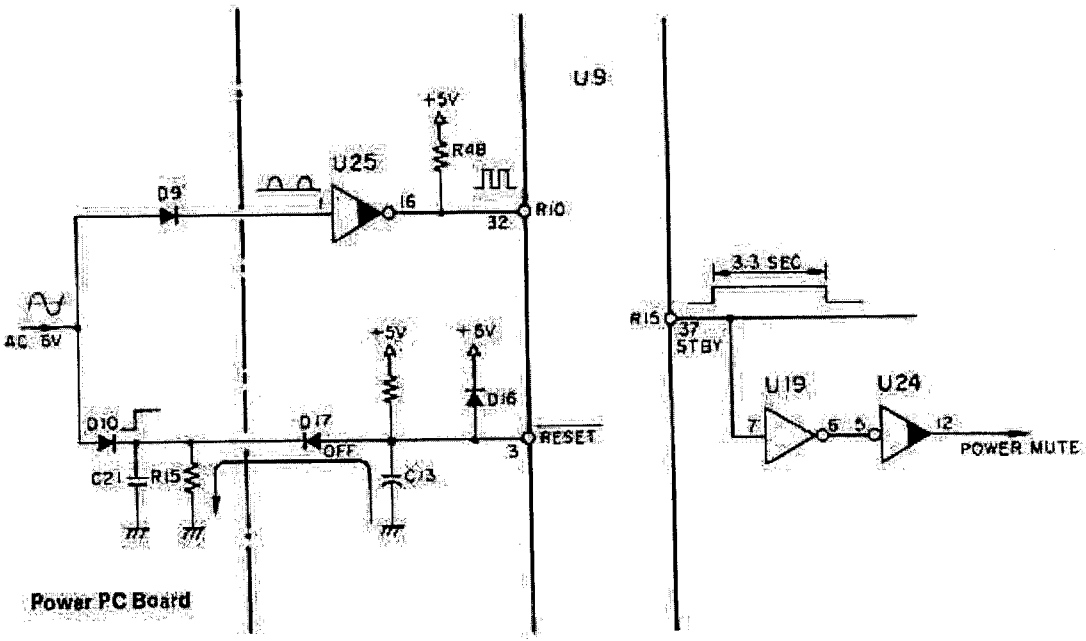


Fig. 8-5-1. Power On/Off Reset Circuit

8-6. MICROPROCESSOR OUTPUT CIRCUIT

When the microprocessor receives the various input signals described above, it develops the outputs shown in Fig. 8-6-1 according to its internal program. U8 is an interface IC to extend operation and creates the outputs shown when it receives the signals from terminals R3 – R7 of the microprocessor. For further details, also refer to Fig. 8-7-2 "Control Signal Timing Chart".

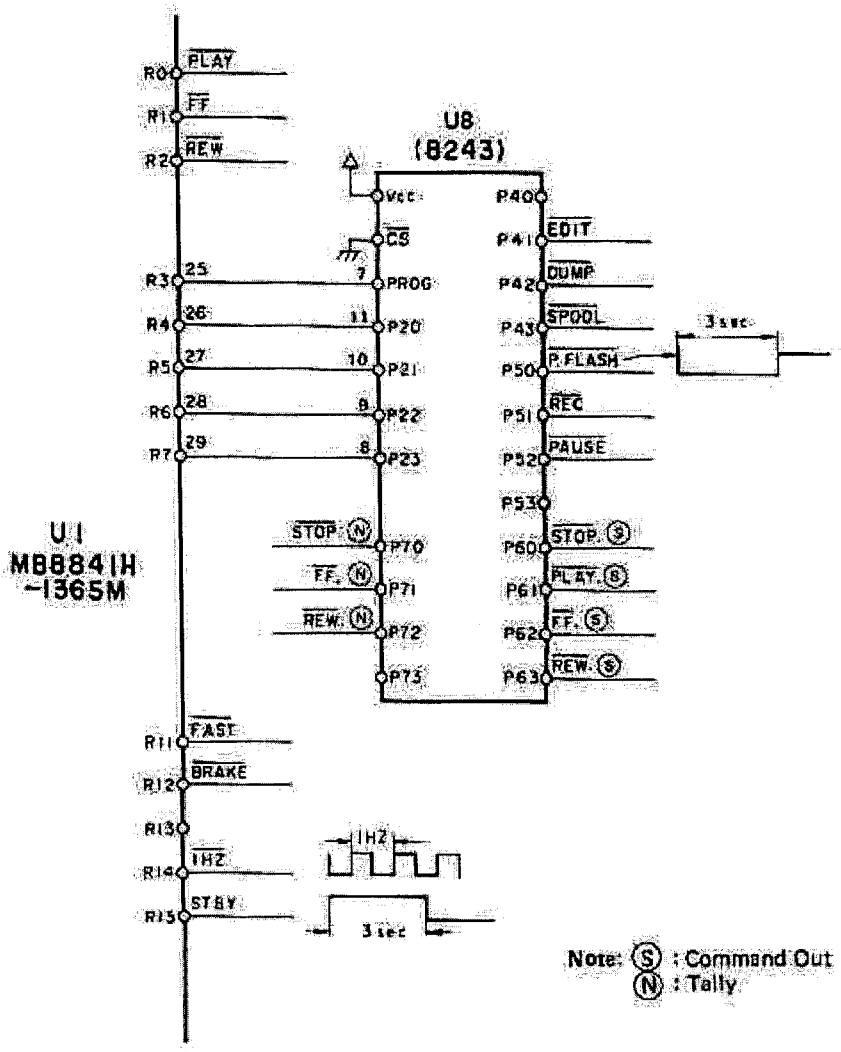


Fig. 8-6-1. Microprocessor Output Signals

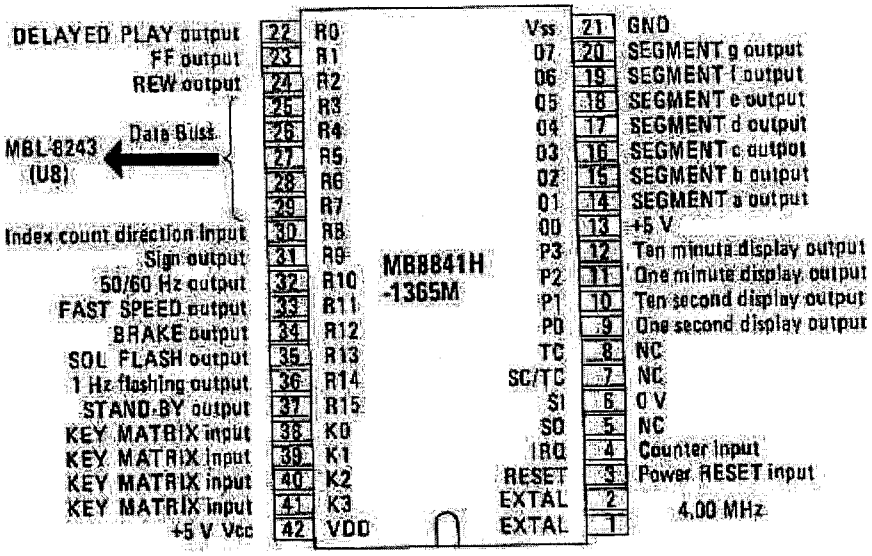
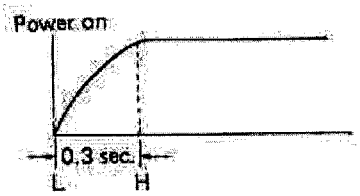
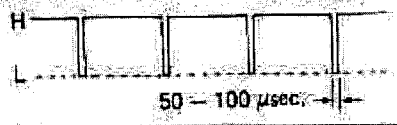


Fig. 8-6-2. U9 (MB8841H-1365M) Pin Assignments

TABLE 8-6-1. MB8841H FUNCTIONS

PINS NO	FUNCTIONS
1. ~ 2.	Connects 4-MHz ceramic oscillator.
3.	Microprocessor reset terminal (L H) L — operation level L — start level before power on Goes H 0.3 sec. later when power turns on. 
4.	Receives counter display pulses (12 Hz in PLAY at 38 cm/sec.). 
5. ~ 8.	NC
9. ~ 12.	Send out keymatrix & counter display driver output control sig.
13.	+5 V
14. ~ 20.	Counter display segments (a) ~ (g) output
21.	GND
22.	PLAY output (H ⟶ L) Goes L when PLAY is pressed and pinch roller is activated. When PLAY is pressed during F. FWD, REW or RTZ/STC and tape speed drops to 100 cm/sec., it goes L 0.5 sec. later.
23.	F. FWD output (H ⟶ L) Goes L when F. FWD is pressed, or when electrical brake is activated if F. FWD is pressed during fast-reverse winding at a speed higher than 100 cm/sec.
24.	REW output (H ⟶ L) Goes L when REW is pressed (and electrical brake is activated).
25. ~ 29.	Feed output expander.
30.	Receives counter display counting direction information. L — counting-up (PLAY and fast-forward winding) H — counting-down (fast-reverse winding)
31.	Outputs counter display driver output control sig.
32.	50/60 Hz input While power is on, the same square wave frequency of sig. as that of AC line enters.

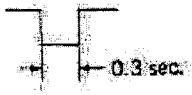
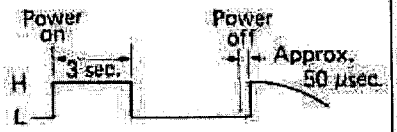
33.	FAST output (H → L) Goes L when F. FWD or REW is pressed or RTZ/STC is initiated. In RTZ/STC, it returns to H when a point 7 m apart from zero/cue points (18 sec. distance on counter) is attained.
34.	BRAKE output (H → L) Goes L when EDIT, PLAY, F. FWD or REW is pressed.
35.	SOL FLASH output (H → L) Goes L for 0.3 sec. when EDIT, PLAY, F. FWD or REW is pressed. 
36.	1-Hz output 
37.	STB output (L → H) Goes H for 3 sec. when power is applied. When power is turned off also it goes H instantaneously (50 msec. later). 
38. ~ 44.	Keymatrix inputs.
42.	Vcc +5 V

TABLE 8-6-2. MBL8243 FUNCTIONS

PINS NO	FUNCTIONS
1.	P. FLASH (H → L → H) Goes L for 3 sec. when PLAY is pressed (DUMP EDIT engagement included).
2.	LIFT SOL unused
3.	EDIT output (H → L) Goes L when EDIT only is pressed (in STOP)
4.	DUMP output (H → L) Goes L when PLAY and EDIT are pressed simultaneously. (DUMP is accessible from STOP, PLAY or EDIT, or by manually disengaging the right tension arm.)
5.	SPOOLING output (H → L) Goes L when F. FWD is pressed during fast-forward winding or REW during rewinding. Returns to H when F. FWD is pressed during forward SPOOLING or REW during reverse SPOOLING. Does not go L if F. FWD or REW is pressed opposing to the tape running direction.
6.	Chip Select "L"
7. ~ 11.	DATA BUSS
12.	GND
13.	Ⓝ STOP (H → L) Goes L when transport enters STOP.
14.	Ⓝ F. FWD (H → L) Goes L when F. FWD is pressed and the tape starts running in forward direction (forward SPOOLING mode included).
15.	Ⓝ REW (H → L) Goes L when REW is pressed and the tape starts running in reverse direction (reverse SPOOLING mode included).
16.	Ⓢ EDIT (H → L) unused
17.	Ⓢ REW (H → L) Goes L when REW is pressed.
18.	Ⓢ F. FWD (H → L) Goes L when F. FWD is pressed.
19.	Ⓢ PLAY (H → L) Goes L when PLAY is pressed.
20.	Ⓢ STOP (H → L) Goes L when STOP is pressed or end sensor is activated.
21. ~ 22.	NC
23.	RECORD (H → L) Goes L when recording (Punch-In included) is initiated. RECORD indicator turns on.
24.	+5 V

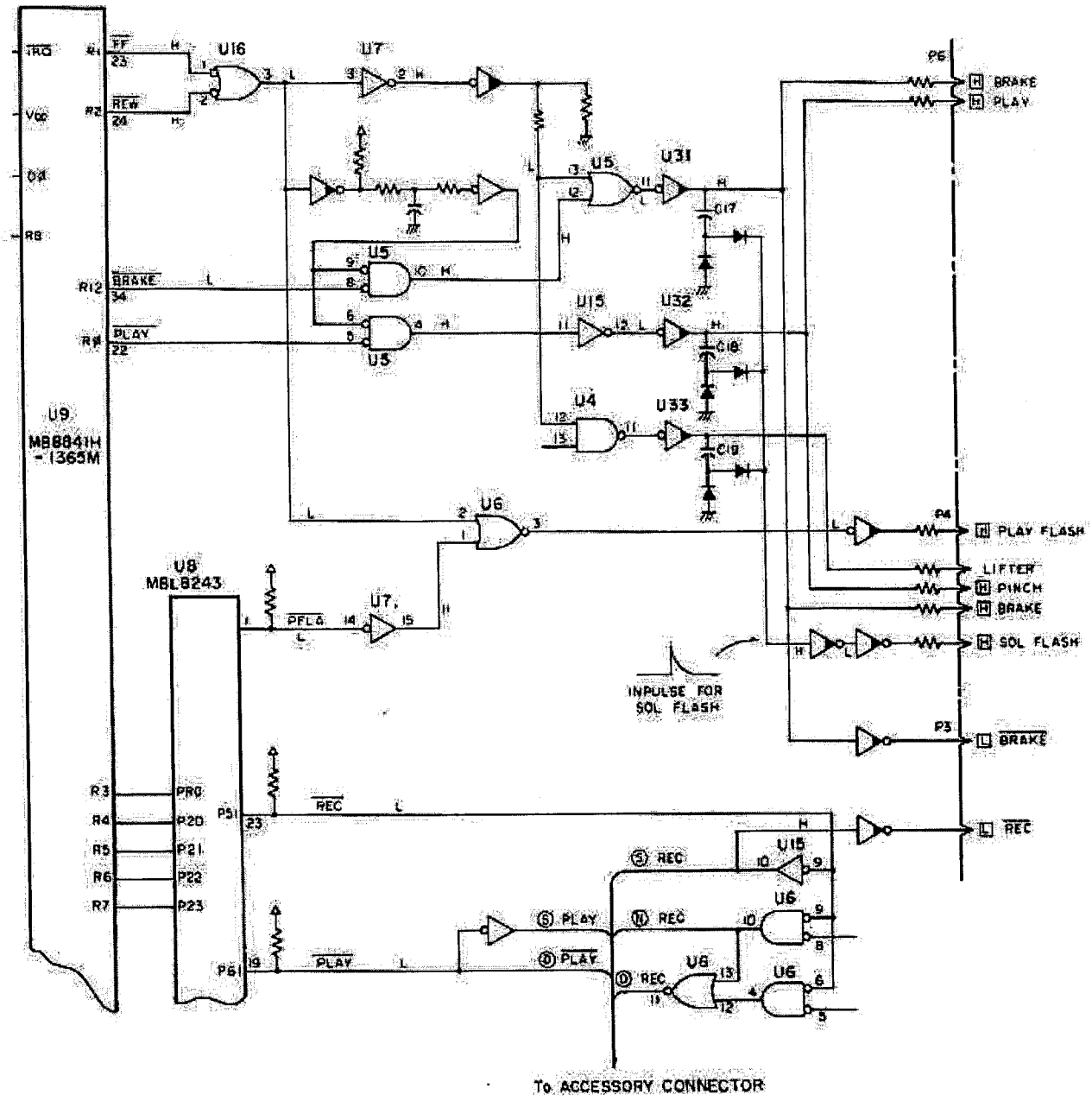


Fig. 8-7-1. Play and Rec Mode Control Signals

8-7. TAPE TRANSPORT CONTROL CIRCUIT OUTPUT

8-7-1. Play Mode

When the PLAY button is pressed the microprocessor decodes its instruction as described, previously and develops outputs from U9 and U8 as shown in the timing chart (Fig. 8-7-2) according to its internal program.

That is:

U9 $\overline{\text{PLAY}}$ terminal goes L
U9 $\overline{\text{BRAKE}}$ terminal goes L
While U9 $\overline{\text{FF}}$ terminal is H
U9 $\overline{\text{REW}}$ terminal is H
U8 $\overline{\text{P. FLA}}$ terminal goes L for 3 sec. only.
PLAY Ⓢ terminal goes L.

From the above conditions, U16 (1, 2, 3), U5 (11, 12, 13), U5 (8, 9, 10), U5 (4, 5, 6), etc. perform the logical operations shown in Fig. 8-7-1, resulting in the control outputs shown below:

P-6	BRAKE	output goes H
	PLAY	output goes H
P-4	PLAY FLASH	output goes H for only 3 sec.
	PINCH	output goes H
	BRAKE	output goes H
	SOL FLASH	output goes H
P-3	$\overline{\text{BRAKE}}$	output goes L

These control outputs are fed to the motor drive circuit, amplifier function circuit, etc. and control associated functions in playback operation.

Capacitors C17, C18 and C19 connected to U31, U32, and U33 respectively, develop a control signal that generates flashing current with a short period to start the solenoid when it is actuated, and the SOL FLASH terminal goes H until the charging of the capacitors is completed.

8-7-2. Record Mode

The record mode is the same as the play mode in terms of the mechanism, so the same control outputs as those for the play mode are developed except for the following. As the RECORD button is pressed, the $\overline{\text{REC}}$ output of U8 goes L. As a result, the $\overline{\text{REC}}$ terminal of P-3 goes L and this is used to make the amplifier circuit change to the record mode.

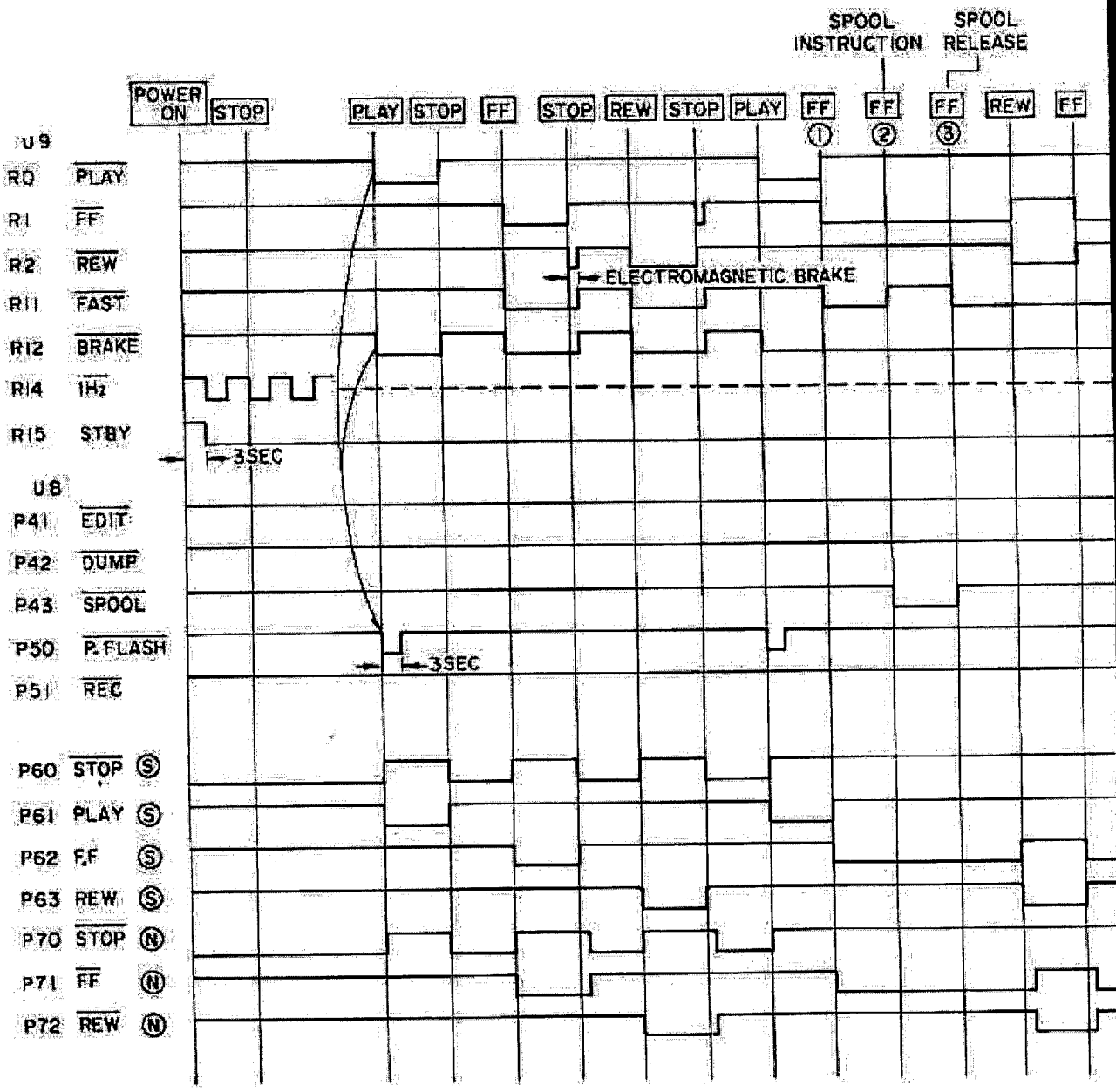
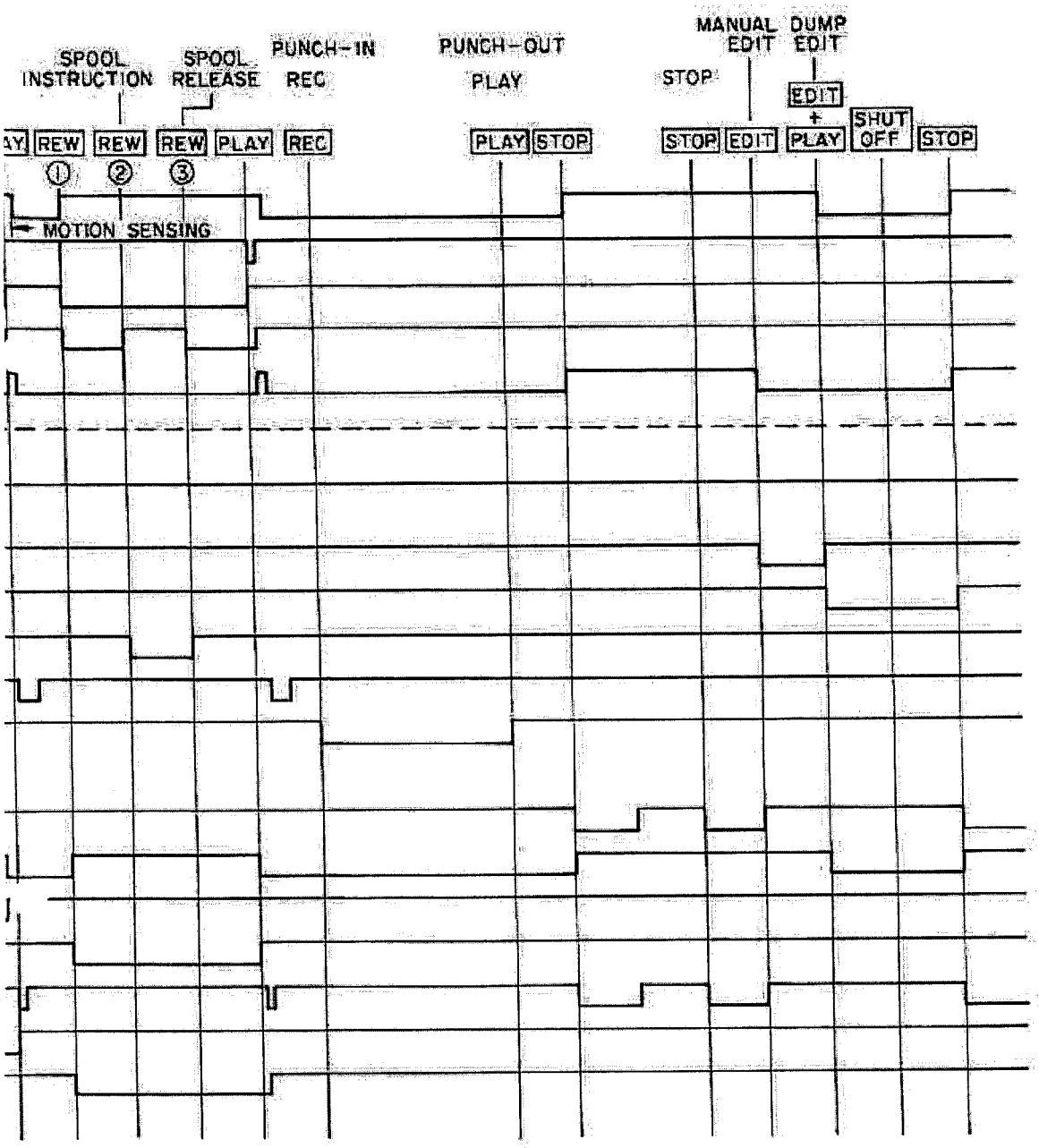


Fig. 8-7-2. Control Signal Timing Chart



Note: (S) ..... COMMAND OUT
(N) ..... TALLY

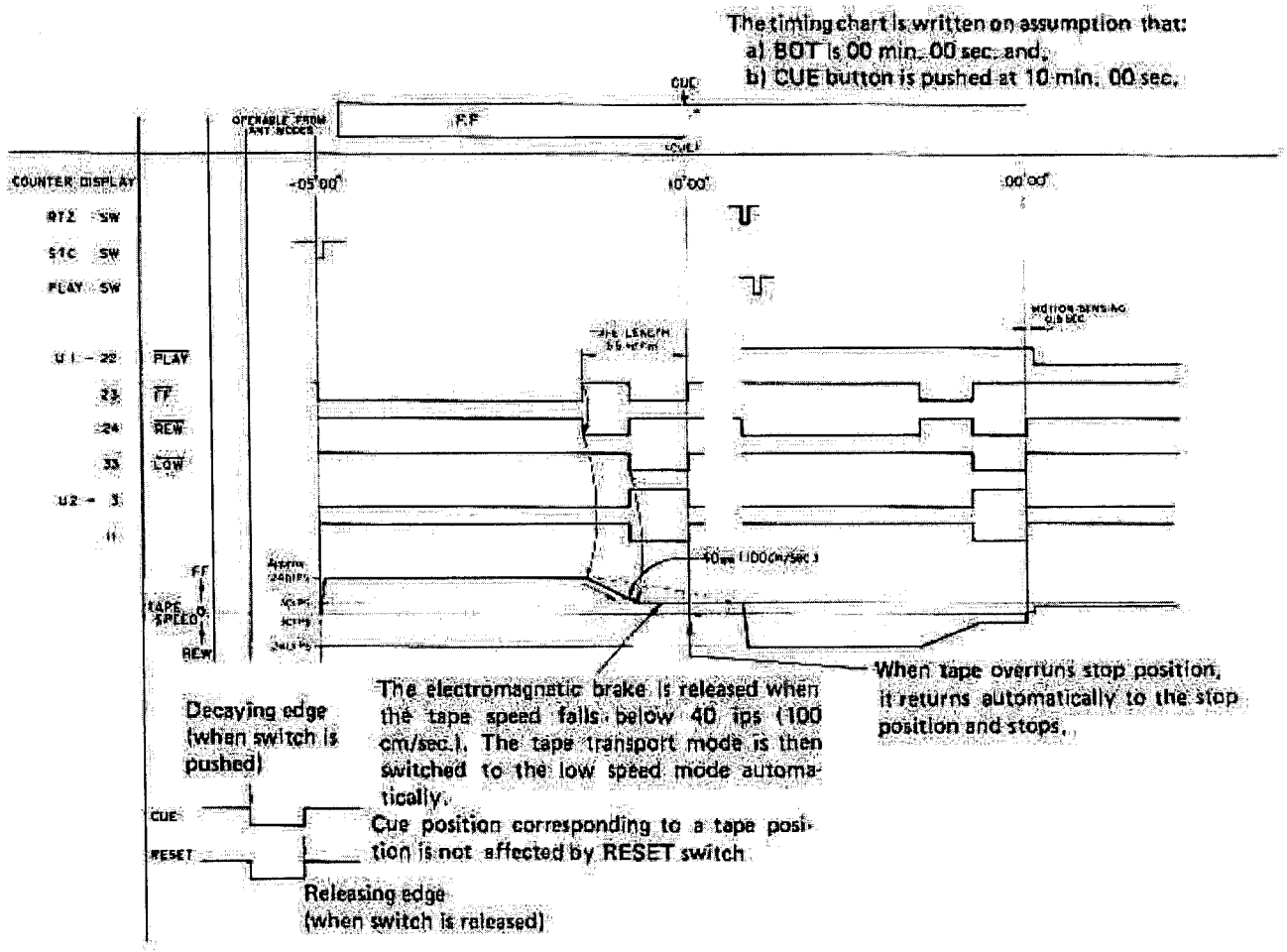


Fig. 8-7-3. Timing Chart for Search Mode

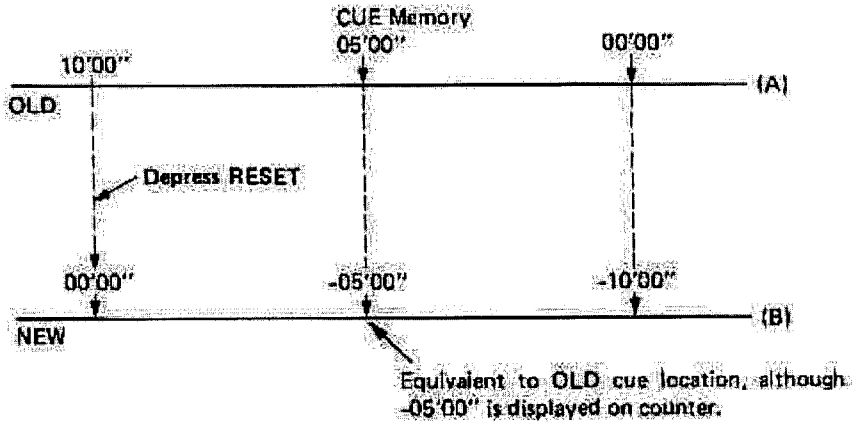


Fig. 8-7-4. Cue Point and Counter Reset

8-7-3. Fast Forward Mode

When FF mode button is pressed

U9 $\overline{\text{FF}}$ terminal goes L
$\overline{\text{FAST}}$ terminal goes L
$\overline{\text{BRAKE}}$ terminal goes L
U8 $\overline{\text{STOP}}$ Ⓢ terminal goes H
$\overline{\text{FF}}$ Ⓢ terminal goes L
$\overline{\text{STOP}}$ Ⓝ terminal goes H
$\overline{\text{FF}}$ Ⓝ terminal goes L

As the result, logical operations are performed in the same way as in the PLAY mode and result in following outputs on the control PCB.

P6 FF terminal goes H
FAST terminal goes H
BRAKE terminal goes H
P4 $\overline{\text{BRAKE}}$ terminal goes H
P3 $\overline{\text{BRAKE}}$ terminal goes L

(Refer to Fig. 8-7-5)

8-7-4. Rewind Mode

In the same way, when the REW mode button is pressed.

U9 $\overline{\text{REW}}$ terminal goes L
$\overline{\text{FAST}}$ terminal goes L
$\overline{\text{BRAKE}}$ terminal goes L
U8 $\overline{\text{STOP}}$ Ⓢ terminal goes H
$\overline{\text{REW}}$ Ⓢ terminal goes L
$\overline{\text{REW}}$ Ⓝ terminal goes L
$\overline{\text{STOP}}$ Ⓝ terminal goes H

As a result, P6 REW terminal goes H
FAST terminal goes H
BRAKE terminal goes H
P4 $\overline{\text{BRAKE}}$ terminal goes H
P3 $\overline{\text{BRAKE}}$ terminal goes L

(Refer to Fig. 8-7-6)

8-7-5. STC (Search-To-Cue) Mode

The function of the STC is to automatically detect arbitary index points on the tape and to stop the tape at these points.

For example, if the tape is run with the tape counter set to "00:00" and the "CUE" button is pressed when the point to be referenced later is found (assume the counter reading is "10:00" at this point). The tape is then run for more than 5 minutes in the same direction, then the STC button is pressed. The tape is then rewound in the forward direction and stops at the position at which "CUE" button was pressed 5 minutes earlier. This operation is shown by the timing chart shown in Fig. 8-7-3. In the above example, the cue point is searched during tape travel in the FF mode, but the search will be made in a similar way in the rewind direction.

When the STC button is pressed in above example, the transport mode of the tape is changed to fast-forward and the tape is rewound up to the position 7 m (23 ft) from the cue point in the FF mode and the electromagnetic brake is automatically applied (electrically, the FF mode is changed to the REW mode as illustrated in the timing chart) to reduce the tape speed temporarily. When the tape speed is reduced to 100 cm/sec (40 ips), the electromagnetic brake is released. The FAST signal goes H and the FF signal goes L again; in this way the tape is also rewound in the FF mode and it reaches the cue point, then the mechanical brake is actuated and this makes the tape stop completely.

* If the STC button is pressed within 7 m (23 ft) from the cue point, the tape is driven at a lower tape speed and stops in the same way as explained above.
* If the tape speed is not reduced to a value lower than 100 cm/sec, the tape may overrun the cue point depending upon the amount of tape wound on each reel, but the tape will return and stop precisely at the cue position. The stop error is approx. 1 second.
* If the CUE button is not pressed in the STC mode, the counter reading of "00:00" is automatically registered as the CUE position. Once the cue point has been registered, it is held until the CUE button is set again, and is not affected by the counter reset button because the relative CUE position is not altered as shown in Fig. 8-7-4 when the counter reading is changed.

8-7-6. RTZ (Return-To-Zero) Mode

The RTZ mode is the same as the STC mode except that the search is carried out to find the tape position at which the counter was set to "00:00".

8-7-7. Other Modes

For any other mode, the status of the output at each terminal can be found by following the logical process from the outputs developed by U9 and U8 as shown in Fig. 8-7-2. The actual output states for the remaining modes are not shown.

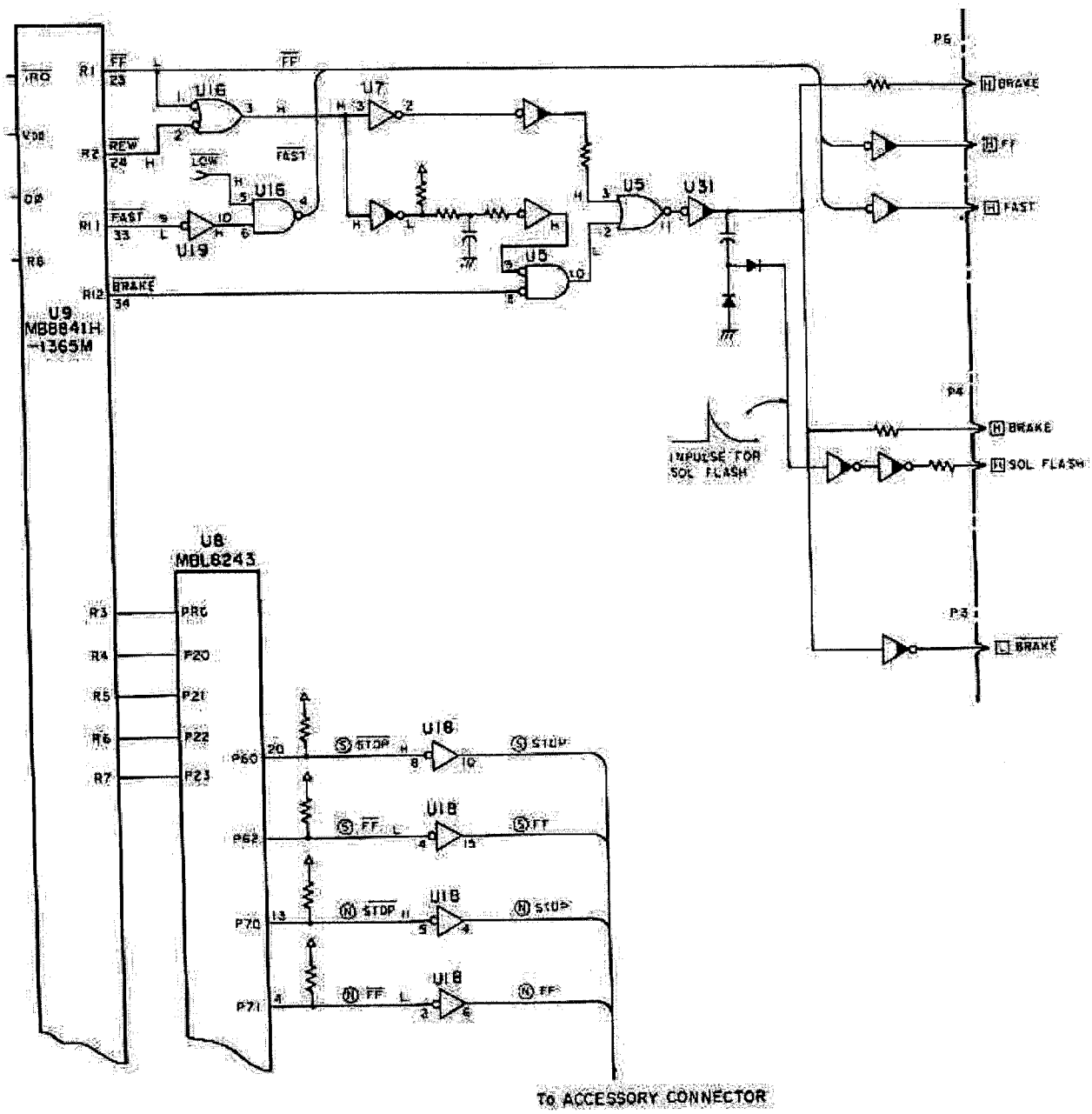


Fig. 8-7-5. FF Mode Control Signal

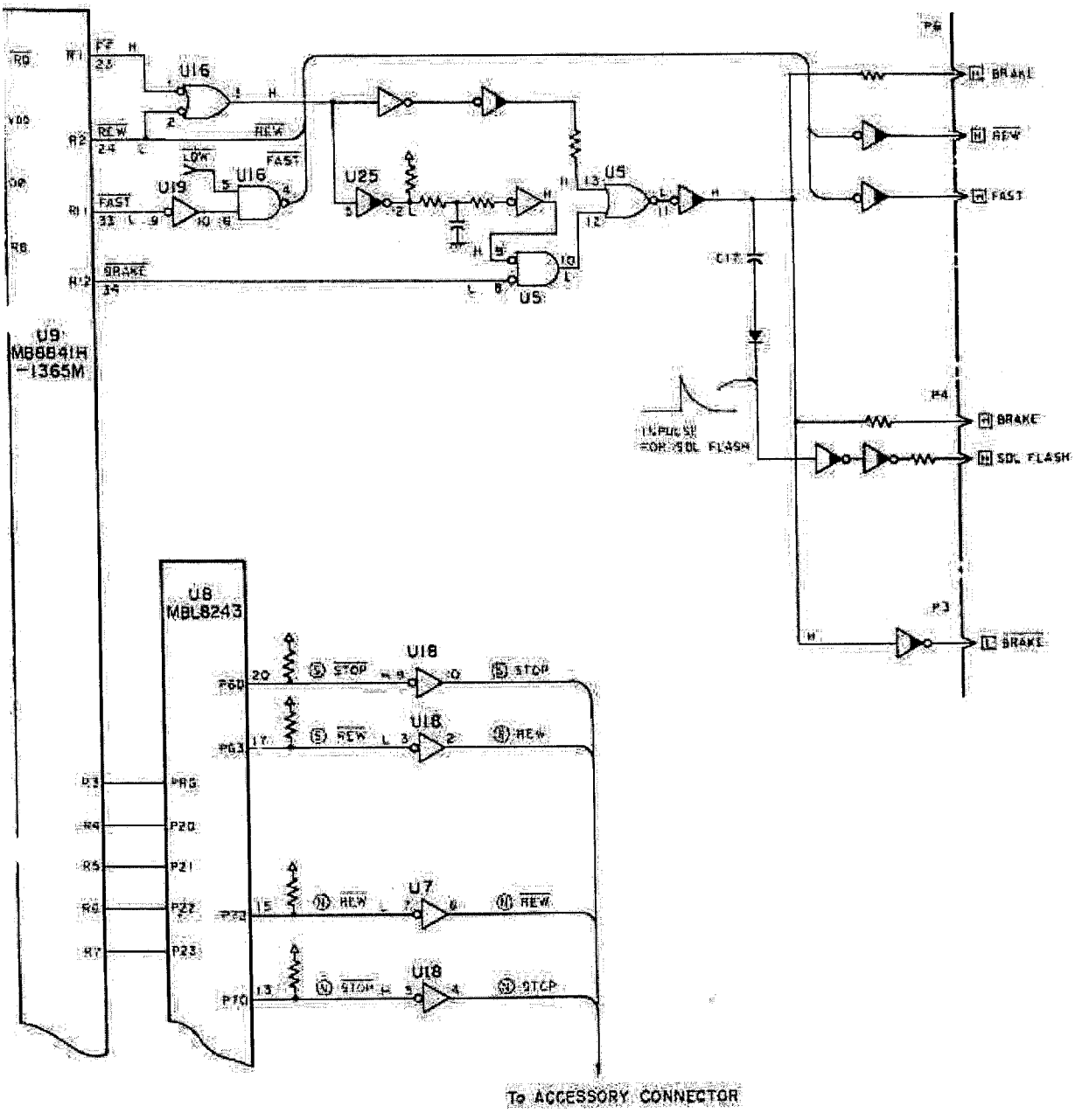


Fig. 8-7-6. REW Mode Control Signal

motor. When power is initially turned on, the H signal applied to STBY input terminal of P-10 keeps its H level for three seconds. The H level signal passes through D29 and D32 and enters pins 3 and 4 of U18 respectively and makes each output low (L), thus disabling the reel motor drive circuits. That is, both the left and right reel motor cannot rotate for the first 3 seconds.

When the STBY input becomes L after the three seconds have elapsed and the BRAKE signal which releases the brakes becomes H, the circuit operates logically as illustrated, and both pins 14 and 13 of U18 become H. Then the motor drive circuits start to function and motors rotate.

* In the DUMP mode, as the DUMP terminal of P-10 goes H, pin 1 of U18 (1, 16) goes H, then pin 13 of U18 (4, 13) goes L and makes the take-up side motor stop.

At the same time, pin 1 of U18 goes H and pin 16 goes L, but as pin 2 of U18 is being set to H by the BRAKE signal, pin 14 or U18 is kept at H, thus turning the supply reel motor.

8-7-8. Reel Servo Circuit

Fig. 8-7-7 shows the reel servo circuit.

Two identical circuits, each of which consists of Q1, T1, D1, etc. operate as tape tension detector circuits for the left and right reels. Q1 functions as an oscillator and its oscillation voltage passes through T1 and is rectified by D1. Since a metal piece is inserted between the primary and secondary windings of T1, the coupling factor of the transformer will change as the metal piece moves in response to tape tension, thus varying the voltage input to the diode. That is, the output voltage rectified by the diode will change as the tape tension changes. This tape tension voltage is applied to the inverted terminal 9 of comparator U24.

The non-inverted terminal 10 of the comparator is connected to an external variable resistor. This functions to adjust the reference voltage at pin 10 of the comparator and to set tape tension threshold (voltage) for the left reel. The output of pin 8 of U24 is further applied to the inverted terminal of U24 (12, 13, 14). Another reference voltage which varies according to a mode (FF, REW, etc) is applied to the non-inverted terminal in this stage. For example, in the FF mode, the "H" level voltage from the control PCB is applied to the FF terminal of P10, and this closes analog switch U16 (8-9).

In this condition, as the REW terminal of P-10 is at L, U16 (10-11) is open and this allows the output from D21 to enter the non-inverted terminal of comparator U24. As can be seen from the schematic diagram, the input voltage depends upon the conditions of the following three inputs:

a. Whether the FAST signal from the control circuit is H or L.
b. Whether the SPOOL signal from the control circuit is H or L.
c. Status of PG pulse,

and controls the tension to the optimum condition matching to each mode.

For example, when the FF or REW mode is selected, the FAST signal becomes H, and this makes the analog switch U6 (1-2) close, connecting R146 and R149 in series to R145.

When the SPOOL mode is selected, U6 (4-3) closes and R147 and R150 are connected in series to R145.

At the same time, the PG pulse entering pin 1 of P-10 is wave-shaped and inverted by U17 (7-6), and the resultant output is split into two, each of which is rectified by D23 and D24. Since the rectified output is inversely proportional to the tape speed, the output from pin 12 of buffer U18 decreases as the tape speed increases. At the same time, the output D24 goes H and L alternately and opens or closes the sampling switch U6 (8-9). The voltage output determined in this way by the tape speed and operation mode changes the sampling and hold capacitor C55, the voltage across C55 enters pin 5 of operational amplifier U5, and the pin 7 output is applied to the inverted terminal 2 of operational amplifier U5.

That is, the output of pin 1 of U5 increases as the tape speed increases, and the voltage is applied to pin 12 of U24 through D21. Since the tape tension is arranged to increase as the voltage at pin 12 of U24 increases, the back tension of the supply reel motor is increased in this case (FF mode), thus reducing the rotational speed of the take-up reel.

* In the REW mode, analog switch U16 (8-9) is opened and U16 (11-10) is closed, so the output of D21 enters pin 3 of U24 and controls the back tension of the take-up reel motor in a similar way.

  U23 (5, 6, 7), Q11 and the external transistor connected to the Q11 form the drive circuit for the left reel motor, and the tension control voltage described just above is applied to pin 5 of U23. Feedback is applied from the emitter of the external transistor to the inverted terminal 6 of U23 to drive the motor in the constant current mode. The same drive circuit is also used to drive the right reel motor.

* The flashing voltage which allows starting of the take-up motor in the playback mode is created as follows:

  The H pulse supplied to the PLAY terminal of P-10 is fed to U18 through C60 and its output is applied through U28 to pin 3 of comparator U24 which controls the take-up reel

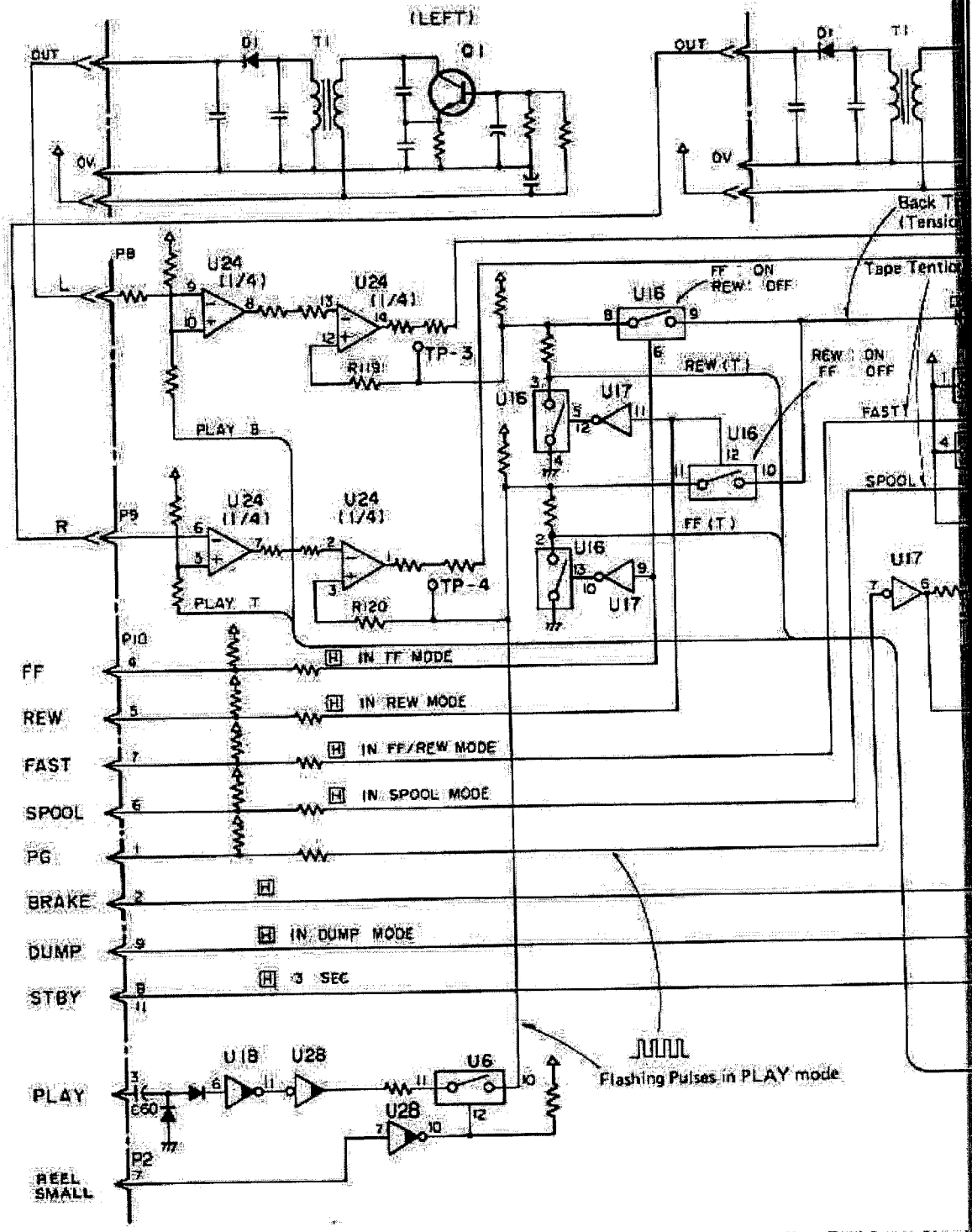
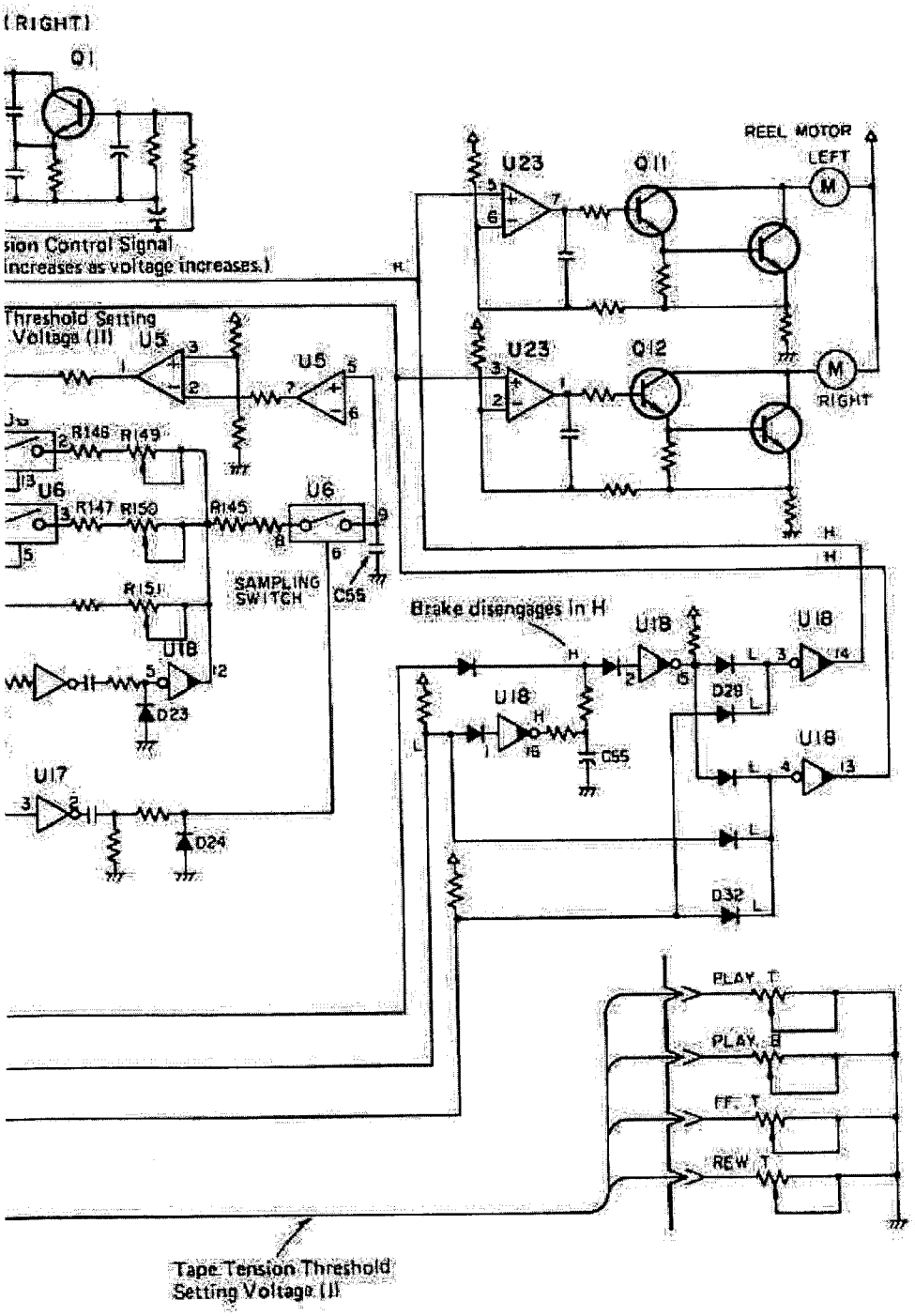
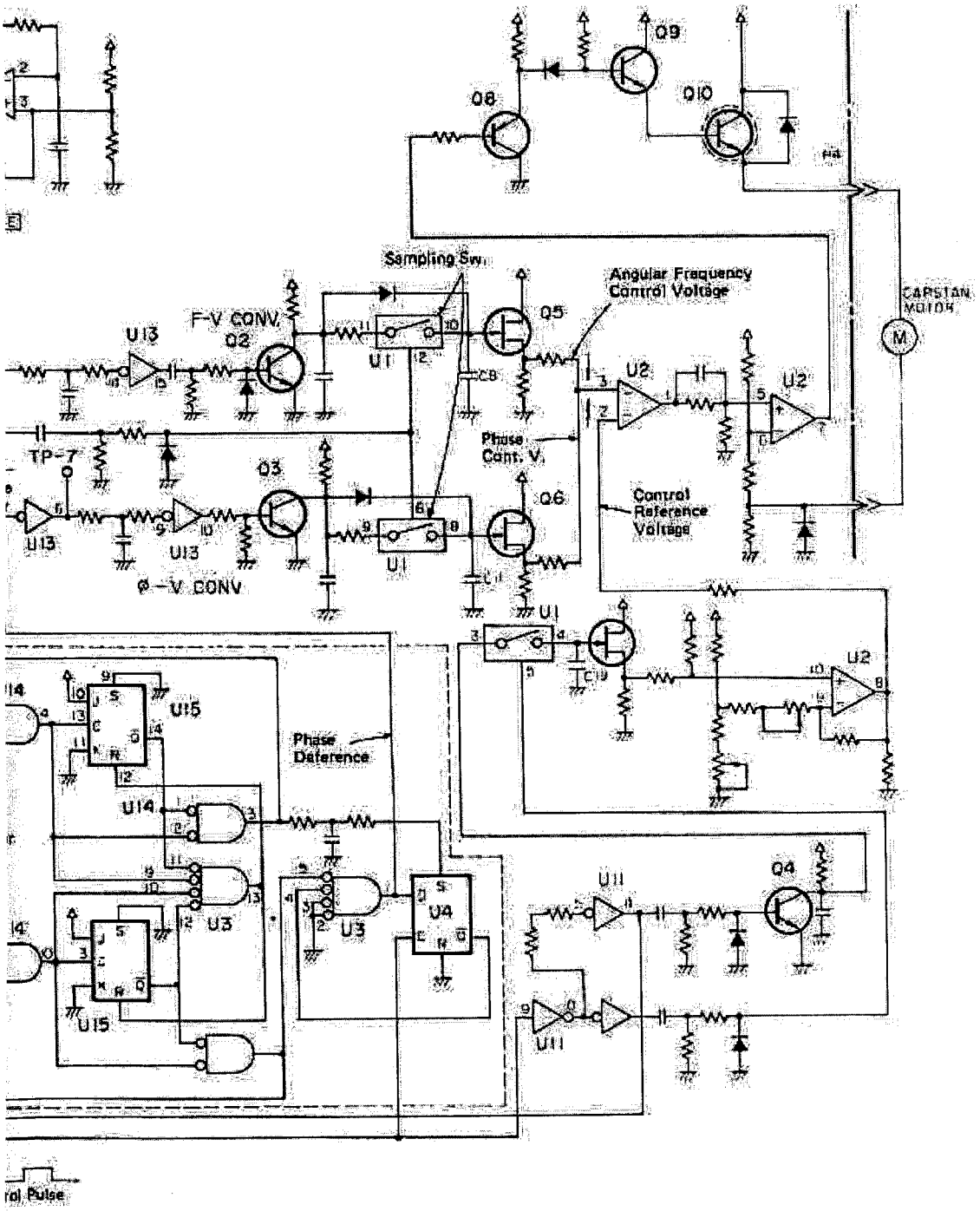


Fig. 8-7-7. Reel Servo Circu


(RIGHT)
Q1
REEL MOTOR
LEFT
U23
Q11
M
RIGHT
U23
Q12
M
sion Control Signal
increases as voltage increases.)
H
Threshold Setting
Voltage (II)
U5
U5
R146
R149
U6
R147
R150
R145
U6
SAMPLING
SWITCH
C55
R151
U18
D23
U17
D24
Brake disengages in H
U18
U18
U18
U18
D28
D32
C55
PLAY T
PLAY B
FF T
REW T
Tape Tension Threshold
Setting Voltage (I)



8. Capstan Motor Servo Circuit

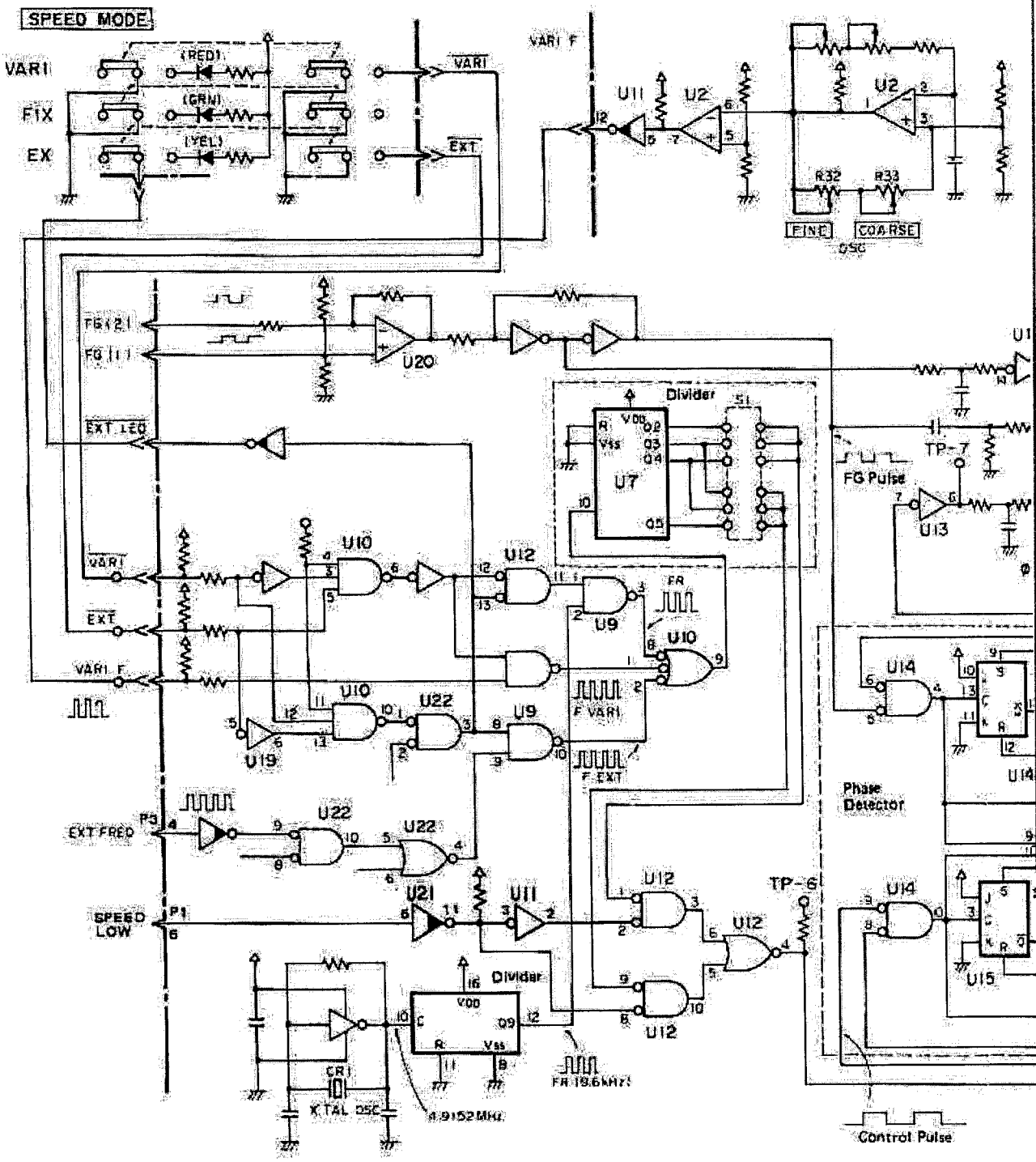


Fig. 8-7-8. Capstan Motor

8-7-9. Capstan Motor Servo Circuit

The capstan motor servo circuit consists of a crystal oscillator which functions as the reference for control, gate processing circuits which determine whether the control is carried out by means of a) the reference frequency, b) pitch control, or c) synchronization with an external frequency, F-V converter (I) which converts the fluctuations of the capstan motor (or variations of the FG frequency) into a voltage, a phase detector circuit which detects phase differences between the FG frequency of the capstan motor and the control frequency (either the reference frequency, variable frequency for pitch control, or external synchronization frequency), a ϕ-V converter which converts the phase difference into a control voltage, F-V converter (II) which converts the control frequency into the control reference voltage, an adder which mixes the above three control voltages, and the drive circuit which receives the adder output and drives the capstan motor.

Fig. 8-7-9 shows the block diagram of the capstan servo circuit.

1. When the speed mode switch on the pitch control display PC board is set to the VARI, FIX or EXT positions, the selected circuit becomes L (Refer to Fig. 8-7-8).
2. Since capstan motor speed control is carried out by varying the control frequency, a variable oscillator is needed to control the pitch continuously. U2 (1, 2, 3), U2 (5, 6, 7) and U1 (5, 12) constitute the variable frequency oscillator, and R33 functions as a coarse frequency control and R32 as a fine frequency control. The frequency output adjusted by these controls is applied to the gate processing circuit (pin 6 of U9) on the motor drive PC board as the control frequency (VARI-F) for the pitch control, and then the output of U9 (4, 5, 6) is fed to pin 1 of U10 (1, 2, 8, 9).
3. On the other hand, the external frequency for the external pitch control enters pin 2 of U10 (1, 2, 8, 9) through terminal 4 of connector P3.
4. Pitch control reference frequency of 9.6 kHz is applied to pin 8 of U10 through gate circuit

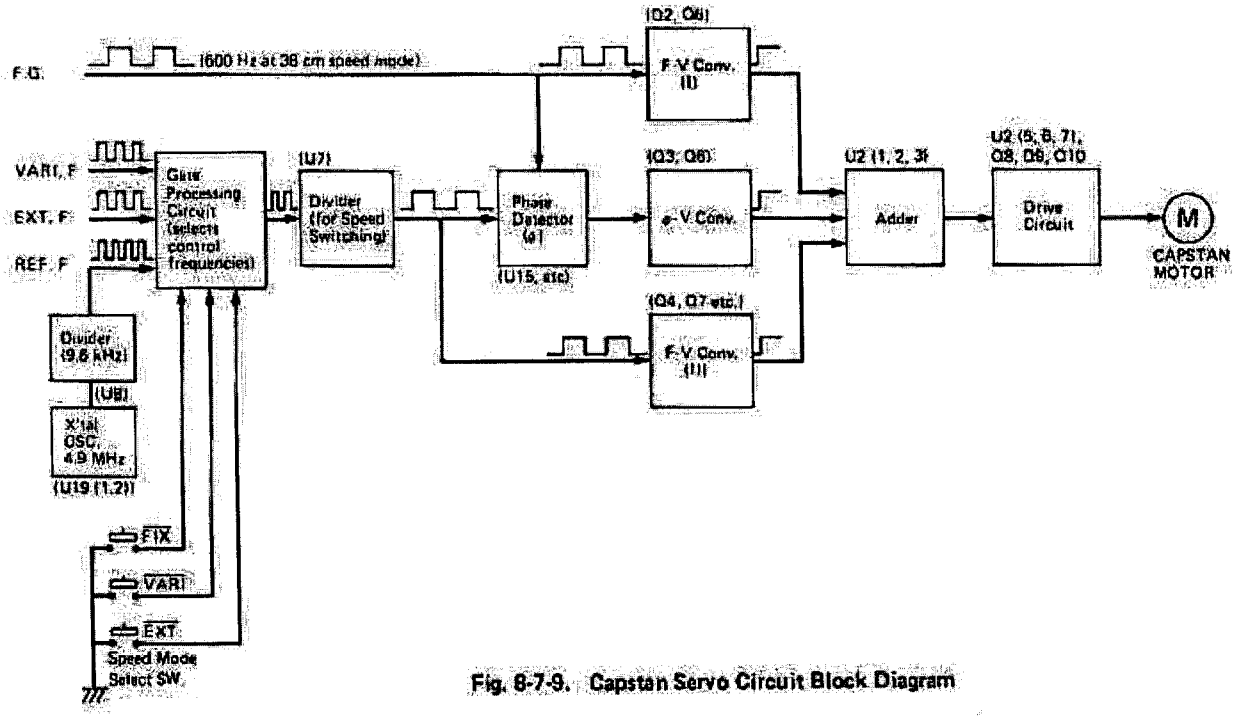


Fig. 8-7-9. Capstan Servo Circuit Block Diagram

U9 (1, 2, 3).

5. One of above three control frequencies is selected by the signal (FIX, VAR1, EXT) from the speed mode switch, and the selected output is obtained at pin 9 of U10. Since the output frequency is around 9.6 kHz (depending upon the selected mode) and is much higher than the FG frequency (approx. 600 Hz in 38 cm speed mode), it cannot be compared with the FG frequency directly. That is, the control frequency at pin 9 of U10 must be counted down to the level of the FG frequency. This counted-down control frequency enters pins 1 and 9 of U12 and is output from pin 4 of U12. The signal developed at pin 4 of U12 has the frequency to be compared with the PG frequency in their phases, and is 600 Hz.
6. The control reference frequency obtained in this way is applied to pin 9 of U14 through U11 (9, 10) and U11 (5, 4), and to pin 3 of U15. At the same time, the FG pulse enters pin 5 of U14 and pin 13 of U15. The phases of both signals entering pins 3 and 13 of U15 are compared and the phase difference is detected in U3 and U14.
   U3 pin 1 develops an error voltage proportional to the phase difference. The error voltage passes U13 (7, 6), U13 (9, 10), and Q3 and is sampled by the analog switch U1 (9, 8) which is actuated to be synchronized with the PG pulse. The sampled or charged voltage across C11 is fed to pin 3 of adder U2 through buffer Q6.
7. In a similar way, the FG signal applied to the other analog switch U1 (10, 11) passing through U13 (14, 15) and Q2 is also sampled by the switch and charges capacitor C8.
   The charged voltage is also applied to pin 3 of U2 (adder) through buffer Q5.
   Since the FG frequency increases as the capstan motor speed increases, the output of Q5 will be reduced as the speed increases.
8. At the same time, the control reference frequency developed at pin 4 of U12 passes U11 (9, 10), U11 (5, 4) and Q4, enters the sampling switch U1 (3, 4), and is sampled.
   The sampled voltage charges C19 and the charged voltage is also applied to pin 2 of adder U2 through buffer Q7 and operational amplifier U2 (8, 9, 10) as the reference voltage of the speed.
   As a result, pin 1 of adder U2 develops a capstan motor control voltage depending upon the three input signals described above.
9. Since the output signal developed at pin 1 of U2 will reduce as the speed increases, the output at pin 7 of U2 also reduces. Consequently, Q8 collector current will increase, and Q9 emitter current or Q10 emitter current decreases, thus lowering the speed of the motor. In this way, the capstan motor is controlled to rotate at the specified speed.

8-8. AMPLIFIER CONTROL CIRCUIT (ATR-60-2T ONLY)

The description will be made on the REC/PLAY AMPL, FUNCTION PCB ASSY circuits shown in Fig. 8-8-3, on page 8-33, so fold out this page and refer to it while following this description.

8-8-1. Input Mode

When the OUTPUT SELECT switch on the FUNCTION PCB is placed in the INPUT position, Input terminal 3 of the connector P-1 becomes L. The L level output is then fed to terminal 6 of the connector J103 on the REC/PLAY AMPL PCB ASSY.
The L level signal sent to the INPUT terminal is fed through U5 (2, 3) to D70, and then sent back to the inverter U5 (11, 12) for voltage shifting to approx. -5 V via a resistor network consisting of R201, R200 and R202. The negative voltage is applied to the FET switch Q23 through D45, making it turn off.
On the other hand, the output voltage from pin 12 of U5 (11, 12) inverter is also fed to pin 15 of another U5 (14, 15) inverter, and its output voltage is fed to Q32 gate after the voltage is shifted to approx. +5 V via a resistor network consisting of R204, R205 and R203, thus making Q32 conductive. The INPUT signals ere accordingly output to the OUTPUT terminals after passing through C21, R313, Q32, U2 (1, 2, 3) — an output amplifier, and C19 and R43. In other words, input signals are output via an OUTPUT terminal regardless of operations such as REC, PLAY, etc.

8-8-2. Reproduce Mode

When the OUTPUT SELECT switch is placed in the REPRO position with the transport in the reproduce mode, as the SYNC switch is turned off, output pin 10 of U2 (8, 9, 10) on the FUNCTION PCB ASSY goes L. Consequently terminal 7 of the connector P-1 becomes H. The H level output is connected to terminal 5 of the connector J103 on the REC/PLAY AMPL PCB ASSY to turn Q50 on. This in turn, turns on PLAY MUTE transistor Q20 to release the muting circuit. With the reproduce mode selected, U5 (2, 3) input is supplied from the +15 V line, causing it to go H as terminal 6 of the connector J103 is opened. Therefore, U5 (2, 3), U5 (11, 12) and U5 (14, 15) are inverted from as originally described under the INPUT mode of operation which causes Q32 to turn off and Q23 to turn on. In other words, reproduce signals are now obtainable from the OUTPUT terminals.
Furthermore, because the SYNC signal is in a non-SYNC state (H), Q54 is turned off and relay K1 is switched to the REPRO side, causing Q22 to turn on. This means that the reproduce circuit is able to function normally.

8-8-3. Sync Mode

Output mute when switching the OUTPUT SELECT SYNC switch on and off:

a) When the SYNC switch is operated, levels at each input pin of the EX-OR gate U2 (11, 12, 13) become as shown in Fig. 8-8-1. Pulse ⓐ appears at output pin 11 of U2 (11, 12, 13) for a period equal to the time constant of C1-R18. This pulse causes C3 installed ahead of pin 9 of U2 (8, 9, 10) to store and release the charge through R24 as the SYNC switches on and off.
Output from pin 10 of U2 (8, 9, 10) goes H while its input pin 9 is L (during the C3 discharging time or time period determined by C3-R20 time constant; i.e. 450 msec.), which allows output pin 10 of U4 (9, 10) to generate $\overline{\text{PLAY MUTE}}$ sig., and outputs are muted.

b) When the OUTPUT SELECT SYNC switch is turned on, the REC/SYNC head is switched to the reproduce function, and when the SYNC switch is turned off, the REPRO head is connected to the reproduce amplifier.
This head selection is accomplished by the $\overline{\text{SYNC}}$ sig. With SYNC engaged, the $\overline{\text{SYNC}}$ sig. is generated after being delayed for 60 msec (time determined by time constant of C2-R21) and the reproduce amplifier is connected to the REC/SYNC head. With SYNC disengaged, the $\overline{\text{SYNC}}$ sig. is interrupted with the same delay of 60 msec. and the reproduce amplifier is disconnected from the REC/SYNC head and connected to the REPRO head.

Monitor signal switching operations are made as shown in Table 8-8-1 Ⓐ when RECORD (record-in and record-out) operations are conducted.
When the OUTPUT SELECT switch is placed in the SYNC position during the record mode, output pin 3 goes H because input pins 1 and 2 of U6 (1, 2, 3) in the Record/Playback Amp. PCB

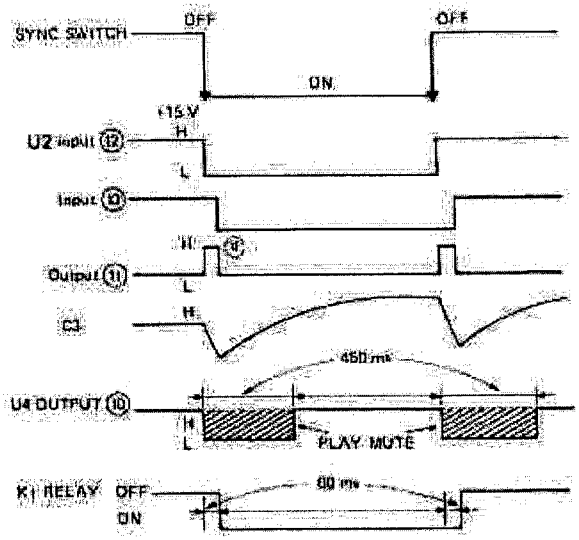


Fig. 8-8-1. Sync On/Off Mute Timing Chart

TABLE 8-8-1. DETERMINATION OF LINE OUT SOURCE

OUTPUT SELECT Switch	FUNCTION Switch	RECORD Switch	LINE OUTPUT Source
REPRO (▭)	—	—	Repro Head
INPUT (▭)	—	—	Line Input
SYNC (▭)	Released	—	Sync Repro
	Depressed	—	Line Input
LED on above the switch pressed.	LED flashes with RECORD switch off, and stays on with RECORD switch on.	The switch flashes with FUNCTION switch off, and lights steadily with FUNCTION on.	

Ⓐ

* "—" signifies that the setting of this switch or the operating mode has no effect on the line output source.

are being set to L, and an H level signal is applied to input pin 11 of U5 (11, 12) through D69. Since the above condition is the same as that of the previously described INPUT mode, the INPUT signals are output and monitored.
When the FUNCTION switch is placed in the OFF position, input pin 2 of U6 (1, 2, 3) goes H and this makes output pin 3 L. Consequently, the amplifier circuit is switched to the SYNC reproduction mode and the SYNC signals are monitored.
When the OUTPUT SELECT switch set to SYNC and the FUNCTION switch ON, output pin 11 of U6 (11, 12, 13) goes H, because input pins 13 and 12 are both in L. Namely, the same condition as that of the INPUT mode is established, and the INPUT signals are monitored.
On the other hand, when the FUNCTION switch is placed in "off" position, input pin 12 of U6 (11, 12, 13) in the Record/Playback Amp. PCB are changed to H. Then, output pin 11 is changed from H to L which in turn, makes the operating mode of the amplifier change from INPUT to SYNC, and thus the SYNC signals are monitored.

4. Since Q42 base bias decreases as Q43 is turned on, Q42 is cut off, and this turns input pin 7 of U5 to H and output pin 6 to L. Then input pin 2 of U6 (1, 2, 3) goes L. Pin 1 of U6 (1, 2, 3) is in L because SYNC terminal 7 is L (as the SYNC switch has been set to ON). Thus output pin 3 of U6 (1, 2, 3) becomes H.
5. Then output pin 12 of U5 (11, 12) goes L and output pin 15 of U5 (14, 15) goes H. Consequently, the 5 V positive voltage developed by the dividing network, which consists of R204 and R205, is applied to the cathode side of diode D46 through R203, and transistor Q32 is turned on. In this operation Q32 is gradually turned on because of a large time constant provided by R203 and C50. Therefore, the INPUT signal being applied to the drain side of Q32 is transferred to the output side gradually, thus suppressing switching noises in the monitor signals.
6. On the other hand, another voltage dividing network R201 and R202 develops -5 V, as input pin 14 of U5 (14, 15) is in L, and the negative voltage is applied to D45 cathode via R200, cutting Q23 off. In this case also, the cut off operation is accomplished gradually because of a large time constant provided by R200 and C49.
7. In this way, switching operations for both Q32 and Q23 are made under influence of four time constants, each relating to capacitors C54, C53, C52 & C49, and C54, C53, C52 & C50 (as stated in 4, 5 and 6 above). Accordingly, their total time required for switching operation becomes considerably long as shown in Fig. 8-8-2 (A).
8. When Q38 is cut off, Q39 is turned on until C44 is charged; thereby, discharging the residual charges stored in C43. Then C43 is recharged through R144, R145, R146 and, when recharging is completed, Q40 is turned on. After this, charging to C42 begins through R143, R147 and the charged voltage reaches approx. 0.6 V, which causes Q41 to turn on to actuate the bias oscillator amp. In this way, the operation of bais amp is influenced by the corresponding C44, C43, and C42 time constants, causing the bias driver oscillator to start functioning at approx. 75 msec, after the record-in operation has been set, to gradually increase the bias amplitude as shown in Fig. 8-8-2 ⓒ. Accordingly, the amplitude of the signal being recorded on the tape is also gradually changed to the steady state, thus eliminating switching noises.
9. Next, when record-out operation is made, the microcomputer outputs PLAY instructions to make the PLAY MUTE terminal 5 of the connector J103 and also the REC MODE terminal 9 of the connector J103 change to H. Accordingly, output pin 10 of U6 (9, 10, 11) goes L, output pin 4 of U5 (4, 5) goes H, and both Q38 and Q45 are turned on.
10. The charges stored in C43 is discharged through D56, R145, Q38 (emitter-collector path) as Q38 is turned on. Then Q40 is cut off, followed by Q41 cutting off. The time required to cut Q41 off depends upon the sum of the discharging time constants of C43 and C42, and is set to approx. 205 msec, as shown in Fig. 8-8-2 ⓓ. As the result, the bias oscillator voltage amplitude of the bias driver amplifier is gradually attenuated as illustrated, and the amplitude of signals being recorded is also attenuated gradually.
11. When Q45 is turned on, the charges stored in C53 is discharged through R162 and Q45 (emitter-collector path), cutting off Q43 as the discharging potential is decreased. Then the REC relay is switched in to the Repro side. The time required to actuate the REC relay is set to approx. 270 msec, completely after the bias oscillator voltage amplitude has been attenuated to zero. Refer to Fig. 8-8-2 ⓔ.
12. When Q43 is cut off, Q42 is turned on after the time period, determined by the charging time constant of R158, R159, C52 and this makes input pin 7 of U5 (7, 6) change to L. Then, output pin 6 of U5 or input pin 2 of U6 (1, 2, 3) changes to H. (These pins are in L until C52 is charged.)
13. Accordingly, output pin 3 of U6 goes L, and output pin 12 of U6 (11, 12) goes H. As a result, +5 V developed by the dividing network, consisting of R201 and R202, is applied to D45 cathode through R200 and this makes Q23 turn on. Because of the large charging time value constant of C49, Q23 is gradually turned on.

8-8-4. Racord Mode

When the RECROD button is pressed, the REC MODE Sig. terminal goes L, and if a recording channel is designated by the selection of the FUNCTION switch, the REC READY Sig. corresponding to the chennel selected also goes L. Then, input pins 8 and 9 of U6 (8, 9, 10) on the Record/Playback Amp. PCB go L and output pin 10 goes H, and transistors Q38 and Q45 on the Record/Playback Amp. PCB turn off because their bases are lowered to L. When Q45 turns off, Q43 goes on and the record relay K_2 actuates to switch on the record circuit.

When Q43 turns on, Q42 goes off and input pin 7 of U5 (7, 6) on the Record/Playback Amp. PCB goes H, and this causes input pin 2 of U6 (1, 2, 3) on the Record/Playback Amp. PCB to decrease to an L level. If the OUTPUT SELECT switch set to SYNC, input pin 1 of U6 (1,2,3) also goes L, so output pin 3 goes H and Q23 goes off, causing Q32 to go on as described in the Input mode of operation to enable monitoring of the Input signals via the OUTPUT terminals.

When Q38 on the Record/Playback Amp. PCB is turned off, Q38 collector voltage is applied to the base of Q40, causing it to turn on, followed by Q41 also turning on. Then, the Bais Amplifier module U7 on the Record/Playback Amp. PCB starts to function and supplies bias voltage to the recording and erase heads.

Transistors Q39 and Q44 are turned on by the charging currents being respectively applied through C44 and C54 on the Record/Playback Amp. PCB. Immediately after this, Q39 and Q44 are turned off, causing rapid discharge of the charges stored in C43 and C53 through C43 — R149 and C53 — R161.

That is, without Q39 and Q44, the charges that were stored in C43 and C53 could not be discharged so rapidly, and possibly resulting in Q41 staying on when FUNCTION (record-in and -out) operations are repeated quickly. Transistors Q39 and Q44 function to prevent this erroneous operation.

8-8-5. Record/Reproduction Switching Noise Protection Circuit

Eliminating switching noises caused during record and reproduction switching is very important to enhance operationability of the unit. This section describes how the switching noises are eliminated in this unit. To simplify the description, first suppose that the SYNC and FUNCTION switches are set to ON and the unit is being operated in the sync reproduction mode. For SYNC switch noise protection (generation of muting signals) refer to 8-8-3 "SYNC Mode".

1. When a record-in operation is conducted (or RECORD and PLAY buttons are pressed at the same time), REC MODE terminal 9 on Record/Reproduce Circuit goes L; then output pin 10 of U6 (8, 9, 10) goes H and output pin 4 of U5 (5, 4) goes L, and the MUTE terminal 5 of the connector J103 on the same circuit schematic also changes from H to L.
2. Since Q50 base bias falls as the MUTE terminal goes L, Q50 is cut off and the voltage at junction R195 and C48 rises for the time period determined by R194/R195 and C48 time constant. Since voltage is applied to the base of Q20, Q20 is turned on after the time constant time (approx. 25 msec), and the sync reproduction signal is shorted at ground through the emitter-collector path of Q20, thus disconnecting sync output from the OUTPUT terminals. Refer to Fig. 8-8-2 ⓐ.
3. Q45 is cut off as output pin 4 of U5 goes L. Then, +15 V voltage is applied to Q44 base for a brief period of time through C54 to make Q44 turn on to discharge the residual electric charges stored in capacitor C53. When the charging to C54 is completed, Q44 is again cut off, and C53 charging starts. When this charging to C53 is completed, Q43 is turned on and the REC relay K2 is actuated and the record/sync head is switched in the recrod circuit.

   The time required for this switching has been adjusted to approx. 50 msec through the time constant circuits including C53, R162, C54, R164, etc. Refer to Fig. 8-8-2 ⓑ.

14. On the other hand, as output pin 15 of U5 (14, 15) goes L, -15 V voltage is applied across R204 and R205, and the resultant divided voltage (-5 V) is applied to D46 cathode through R203, making Q32 cut off. Since the charging time constant of C50 is also of a considerably large value, the gradual cut off operation is made similarly as that of Q23.
15. When record-out operation is made, when the FUNCTION switch is set to OFF, REC READY terminal 8 on Record/Playback Amp. PCB goes H, and this makes outputpin 11 of U6 (11, 12, 13) and input pin 6 of the NOR gate U6 (4, 5, 6) change to L.
As previously stated, input pin 2 of U6 (1, 2, 3) is not changed to H immediately after the record-out operation has been made, but goas to H after Q42 is turned on for a brief time period that is determined by C52, C53, etc. charging time constants. Namely, input pin 2 of U6 (1, 2, 3) is L until Q42 is turned on. Accordingly, output pin 3 of U6 (1, 2, 3) is H, and output pin 4 of U6 (4, 5, 6) is L because of input pin 6 being L.
On the other hand, PLAY MUTE terminal 5 of the connector P103 goes H immediately after the record-out operation, but Q50 base bias voltage is unable to rise because, at this time, output pin 4 of U6 (4, 5, 6) is being set to L. Therefore, Q50 is maintained cut off and Q20 is also held in its conductive state. Next, when Q42 is turned on, input pin 2 of U6 (1, 2, 3) goes H and output pin 3 and input pin 5 of U6 (4, 5, 6) go L, causing output pin 4 to go H. Accordingly, Q50 is turned on, and this makes Q20 cut off, thus releasing the shortout circuit for SYNC reproduction signals. In other words, Q20 can not be turned off until the REC relay completes switching in to the SYNC position. Thus no switching noise is developed in the monitor output circuit. Refer to Fig. 8-8-2 ⓕ.

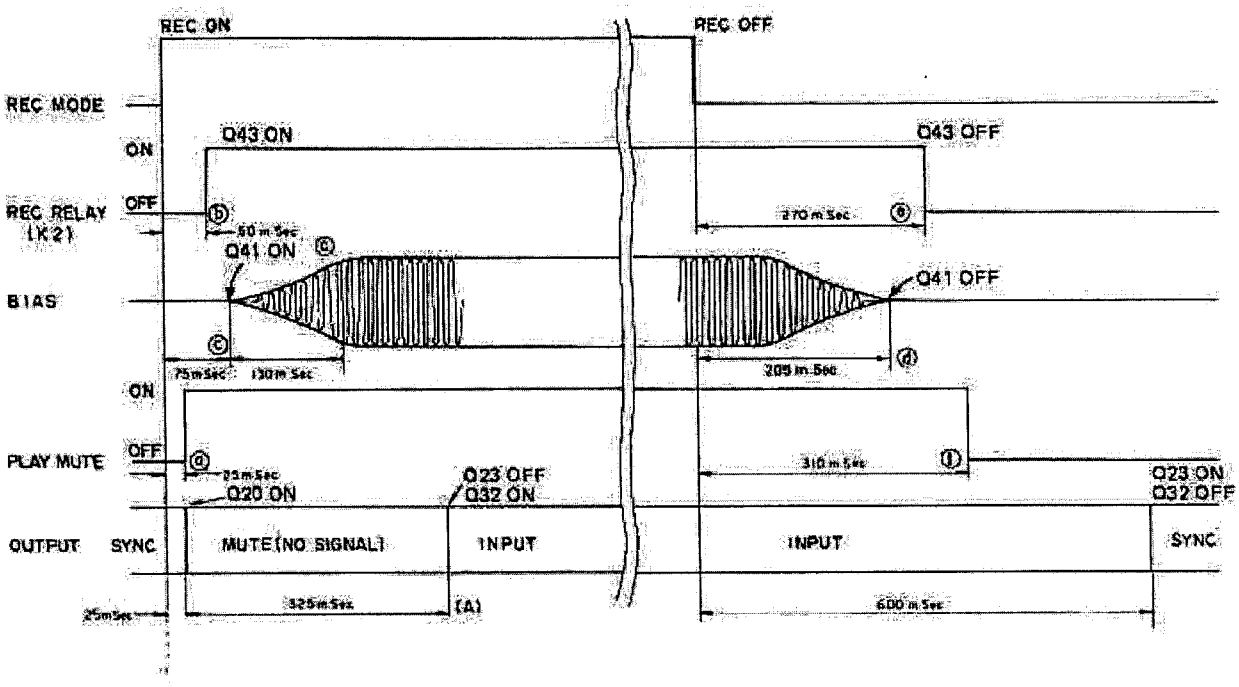


Fig. 8-8-2. Record On/Off Mute Timing Chart

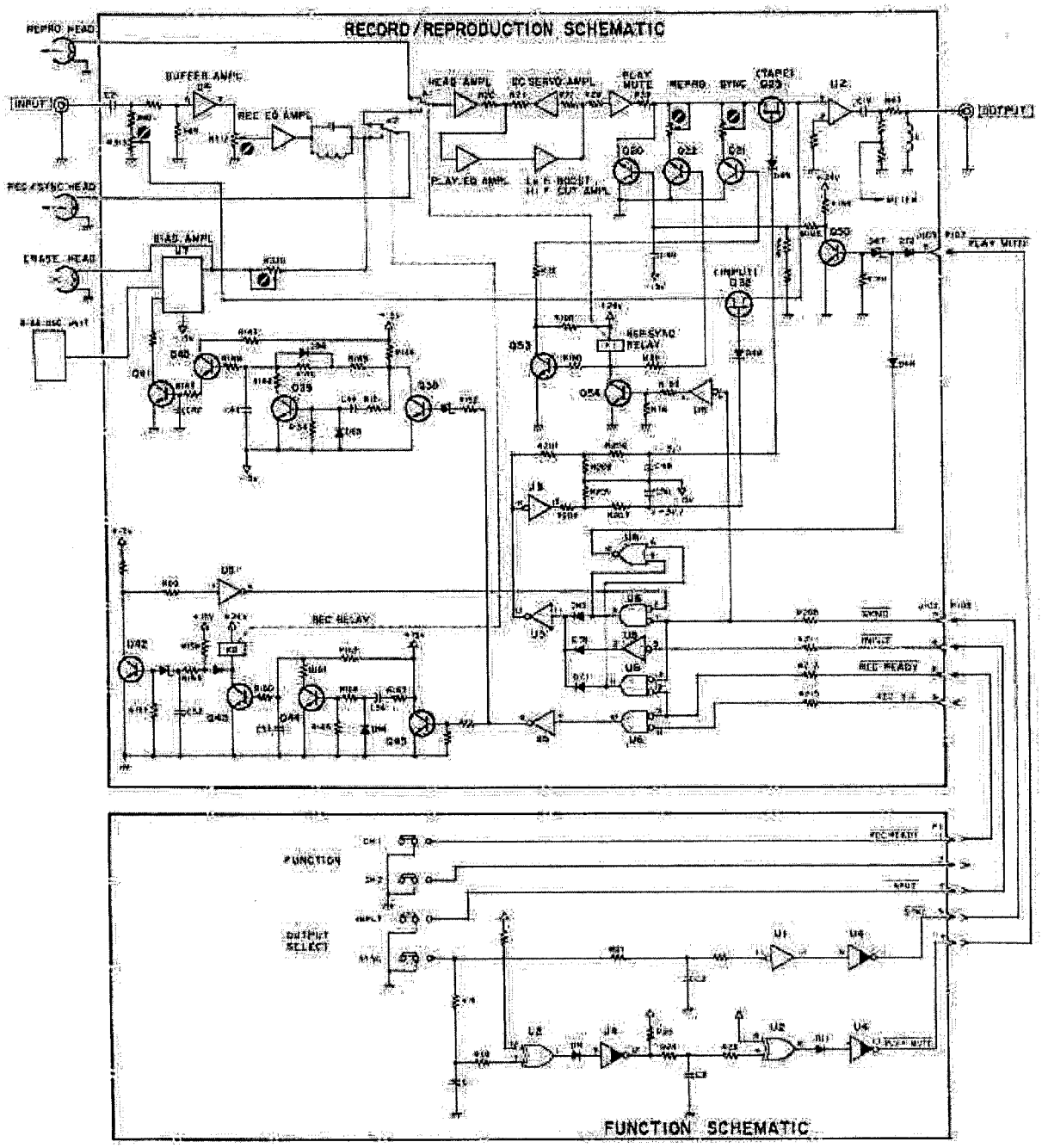


Fig. 8-8-3. Rec/Play Amp. and Function Circuits

8-9. TIME CODE AMPLIFIER SYSTEM (ATR-60-2T ONLY)

This system works to ensure fidelity printing and reading of the TIME CODE CH signals. The time code reproduce amplifier comprises a band-pass filter which prevents the time code channel signals from being affected by the audio channel signal's leaking into the time code reproduce amplifier. Also, provided between the time code reproduce amplifier and the time code record amplifier is a cancel circuit, which suppresses any mutual influence between the time code channel and the audio channels. Furthermore, provision is made in the time code amplifier system for switching the system to the "Memo" announcement record/reproduce function. See Fig. 8-9-1.

8-9-1. Reproduce Circuit

The signal from the sync or repro head is fed to the TIME CODE CH OUTPUT through amplifiers U101 and U102 (which has a band-pass filter), ICs U103, U3, and U104, FET switches Q105 and Q111, and balanced amplifier U110.
FET switches Q101, Q102, Q104, Q106, and Q111 in the time code reproduce circuit work to modify characteristics of the time code reproduce amplifier so as to prevent any audio channel signal from leaking into the amplifier.
When the TIME CODE CH is in MEMO mode, the reproduce signal is sent from the output pin of U101 (pin 1, 2, 3) to FET Q103, then goes on to the XLR-type TIME CODE CH OUTPUT connector.

8-9-2. Record Circuit

Input signal at balanced amplifier U106 (pin 1, 2, 3) comes out at pin 7 of U106 (pin 5, 6, 7). Then, the TIME CODE signal is fed into clipper amplifier U107 (pin 5, 6, 7) and the resultant constant level signal comes out at its pin 7. The MEMO signal is fed into limiting amplifier U107 (pin 1, 2, 3) (which has FET Q107), and is sent out from pin 7 of the limiting amplifier. The TIME CODE signal goes on through FET Q109 (MEMO signal, through FET Q108) to U108. Then, the signal (regardless of its being TIME CODE or MEMO) is fed through record relay K104 and a bias trap formed by L103 and C149 to the rec/sync head.
The record level (fluxivity) for both the time code and memo signals is selected by FET Q113.

8-9-3. Cancel System

This cancel system is designed to suppress crosstalk between the time code channel and the audio channels when these are in the following conditions:

1. Time code channel and audio channel(s) in sync reproduce mode (prohibition of the time code track signal from leaking onto the audio tracks).
2. Time code channel and audio channel(s) in record mode (prohibition of the time code track signal from leaking onto the audio tracks).
3. Time code channel in record mode, and audio channel(s) in reproduce mode (prohibition of the time code track signal from leaking onto the audio track).
4. Time code channel in reproduce mode, and audio channel(s) in record mode (prohibition of the audio track signal from leaking onto the time code track).

In each of the above instances, a circuit which provides a signal whose phase is opposite to that of the leakage signal is formed. In case 1, the circuit is formed by R307 and U109 (pin 5, 6, 7). In case 2, it is formed by R304 and U109 (pin 1, 2, 3). In case 3, it is formed by R308 and its relative CRs for CH1, and R309 and its relative CRs for CH2. In case 4, it is formed by R315 and U105 (pin 5, 6, 7) for CH1, and R316 and U105 (pin 1, 2, 3) for CH2.

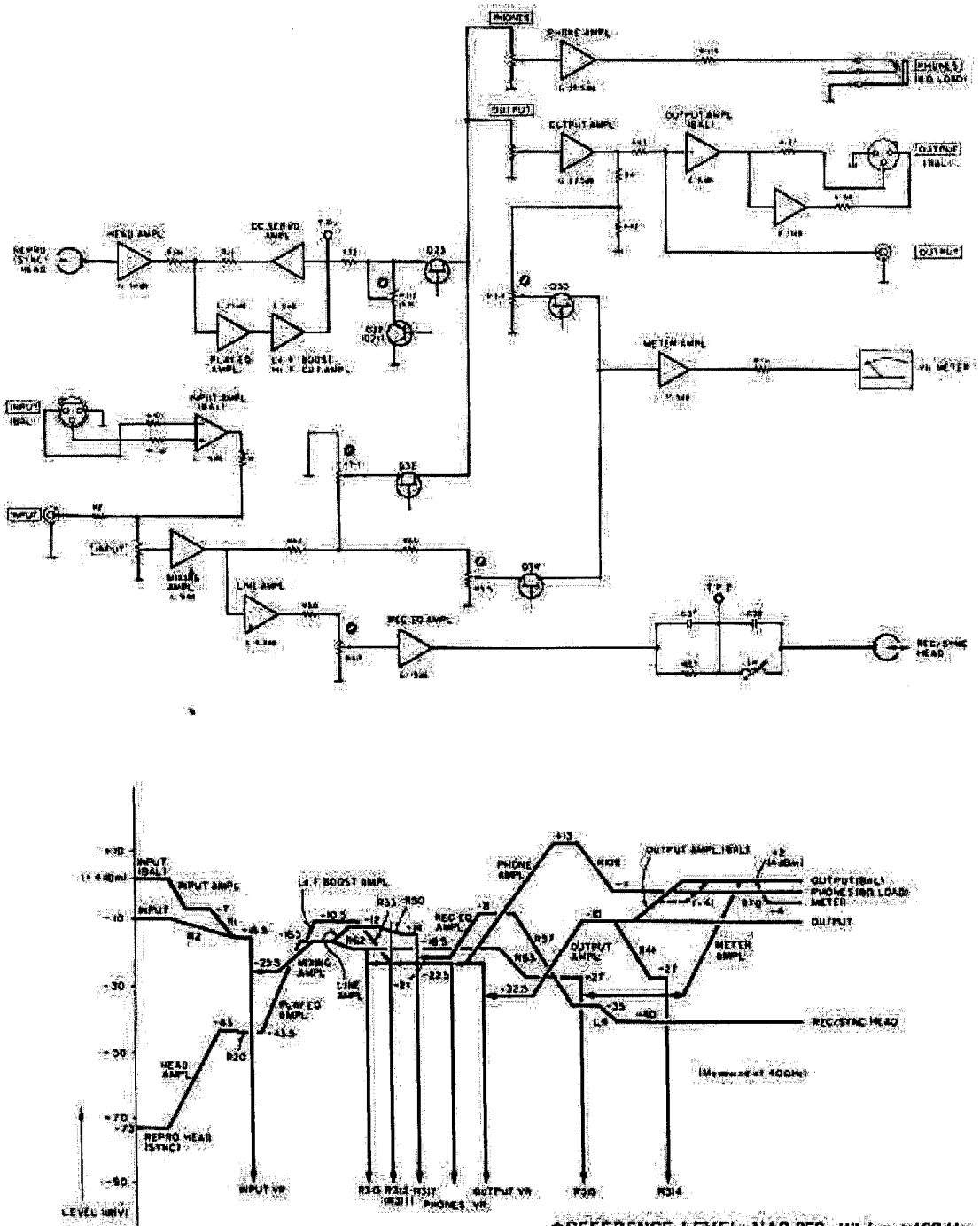


Fig. 8-8-4. Amplifier Level Diagram

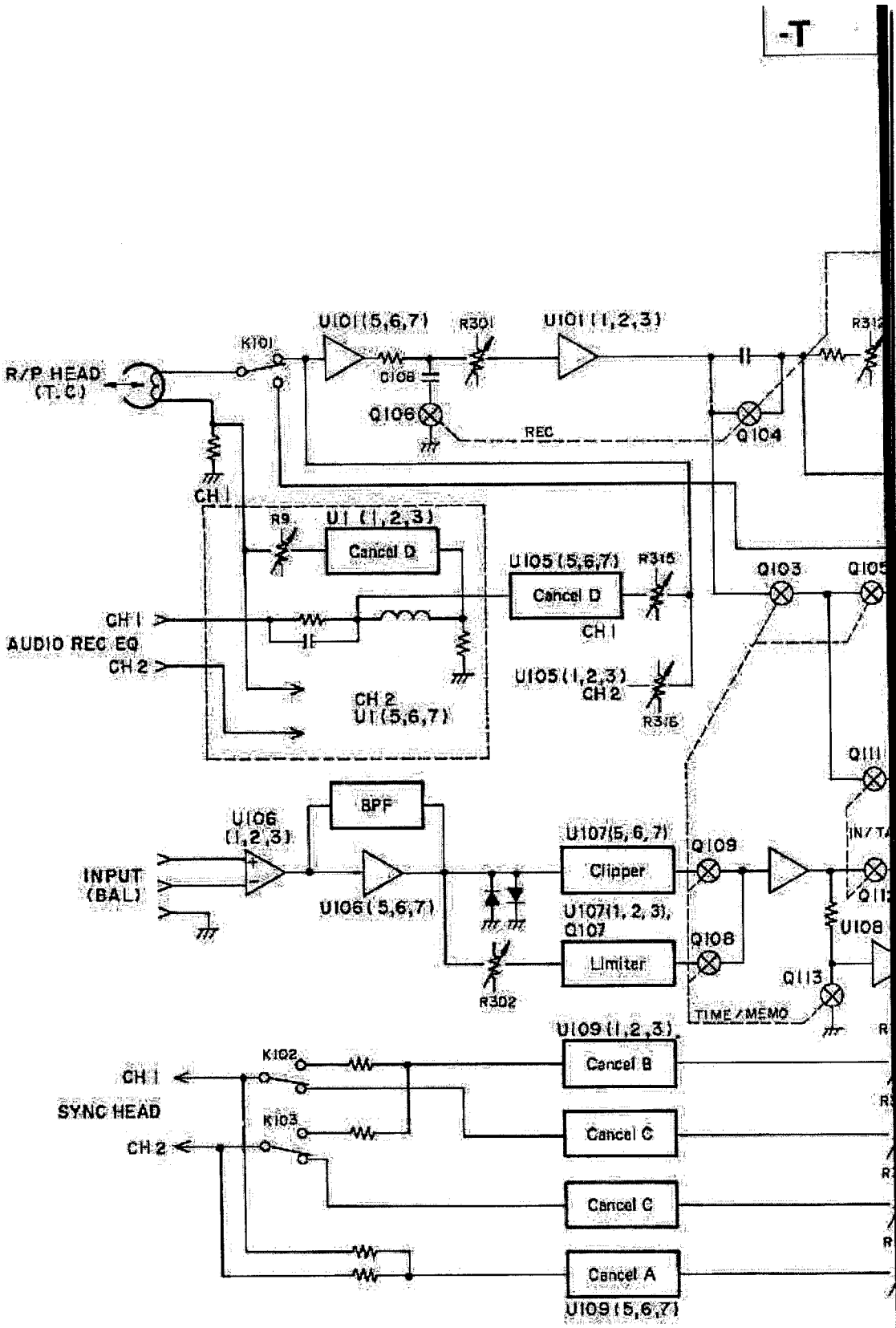
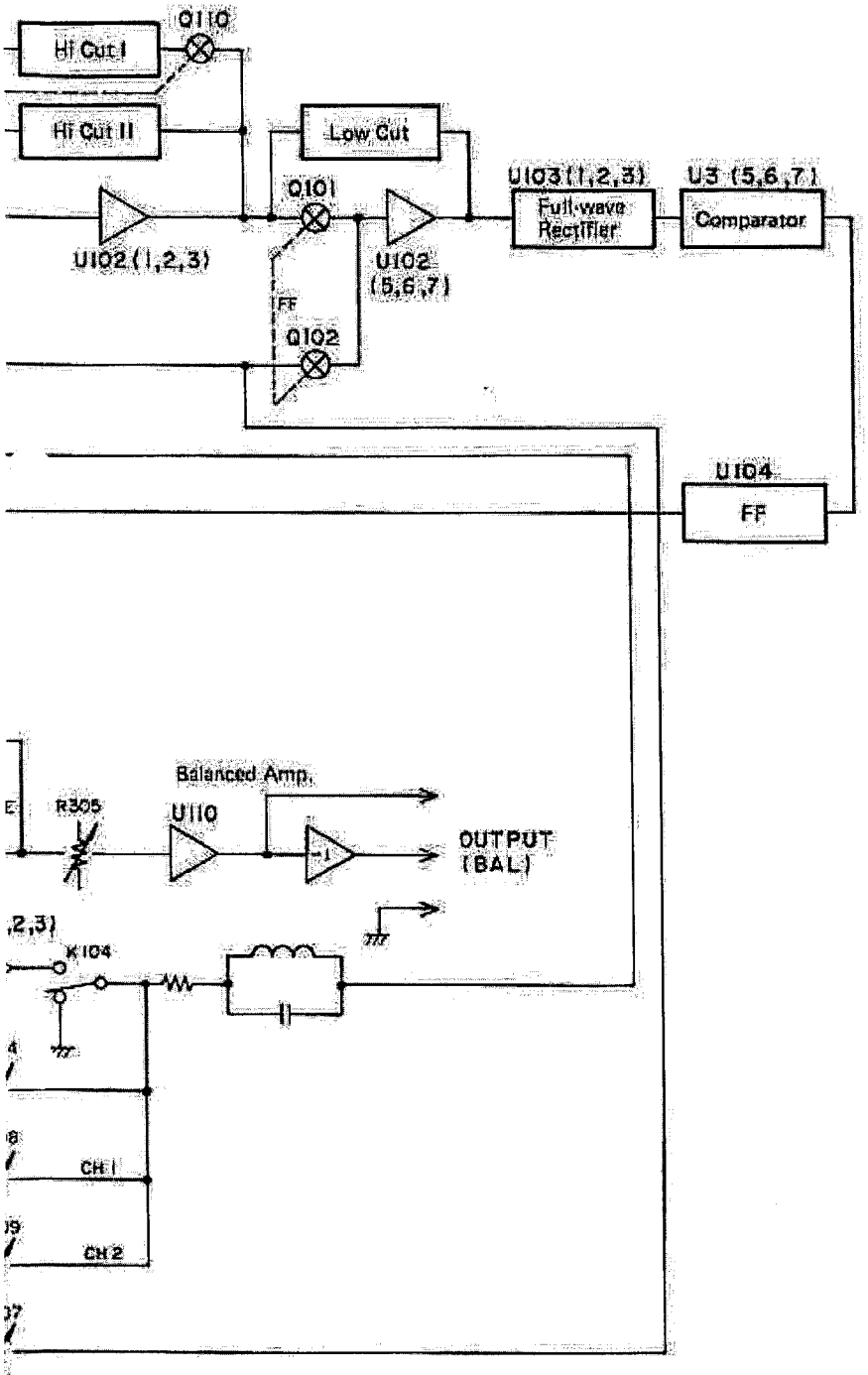


Fig. 8-9-1. Time Code Amplifier Block Diagram



⊗ = Elect. SW
Cancel A = TC leakage onto AUDIO (both TC and AUDIO in reproduce).
Cancel B = TC leakage onto AUDIO (both TC and AUDIO in record).
Cancel C = TC leakage onto AUDIO (TC in record and AUDIO in reproduce).
Cancel D = AUDIO leakage onto TC (AUDIO in record and TC in reproduce).

causes Q19 to turn off and Q20 to turn on, and increases the gain of U1 (pin 1, 2, 3).
Semi-fixed resistors R303 and R304 are used to compensate for differences in the low-frequency characteristics of the head. They become connected depending on the condition of Q26 and Q27: at high tape speed, control logic signal [A] goes low. This turns Q26 on and Q27 off.
Each pair of C21/R47 (-N & -D only) and C22/R48 is used to determine the upper value of the repro EQ time constant, i.e., 50 μsec for NAB, 35 μsec. for IEC (CCIR). Transistors Q14 (-N & -D only) and Q15 serve to connect and disconnect each pair of the capacitors and resistors under the action of control logic signals [I] and [J] whose state of logic depends on the equalization standard setting (NAB or IEC) and on the tape speed selection (HIGH or LOW).

Transistor Q16 acts as a muting transistor when STOP MUTE is engaged or during tape speed changes.
Signals output from the equalizer amplifier U2 (pin 5, 6, 7) in the final stage go through R54, C24, REPRO or SYNC head reproduce signal on/off switch Q17, OUTPUT VRs, and line output amplifier U2 (pin 1, 2, 3), and are sent to the output connectors.
Transistors Q17 and Q18 are the output source select switches. When control logic signal [K] is high, Q17 is on and Q18 is off, and the REPRO or SYNC head signal is selected. When signal [K] is low, Q17 is off and Q18 is on, making the INPUT signals available at the output connectors.

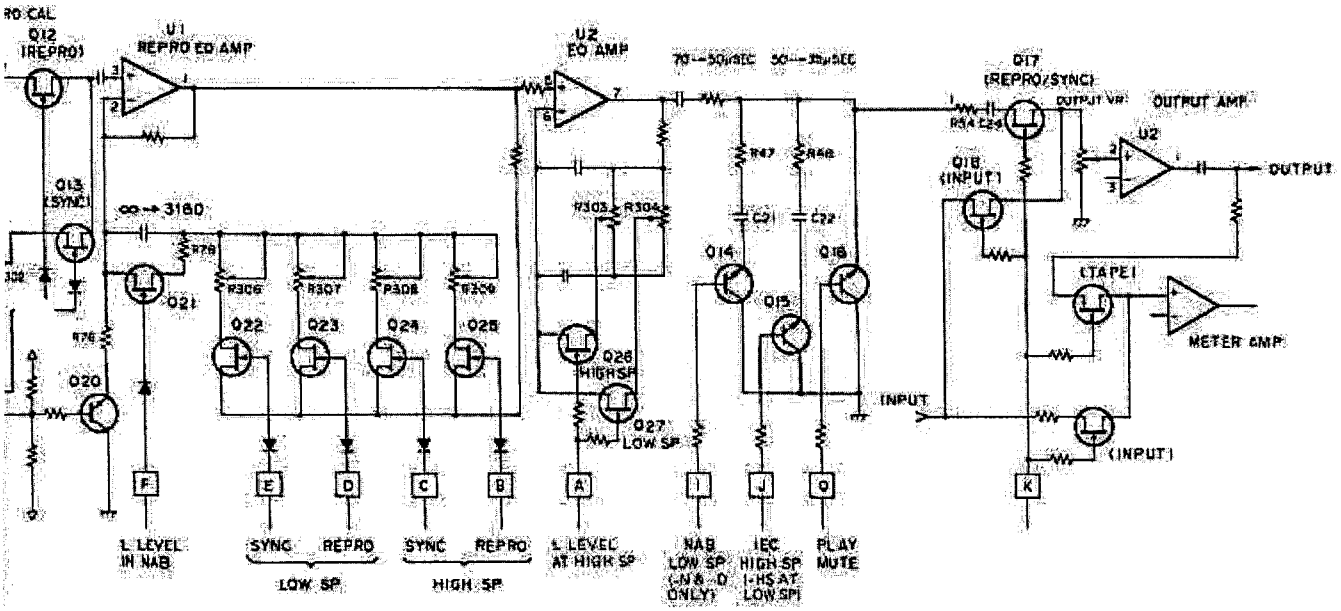


Fig. 8-10-1. Reproduce Amplifier Circuit

8-10. RECORD/REPRODUCE AMPLIFIERS (ATR-60-2N, -2D, AND -2HS ONLY)

The reproduce amplifier includes an equalizer circuit for REPRO and SYNC head signals, high and low tape speeds, and for NAB, IEC, and AES (AES on the -HS only) equalization curves. The record amplifier has an audio signal phase compensator. The record bias amplifier circuit is separate from the erase amplifier.
The monitor section includes a meter amplifier with a PEAK LED circuit.
There is also a logic circuit that controls the record and reproduce amplifier functions. The following paragraphs explain each of these circuit functions.

8-10-1. Reproduce Amplifier

Refer to Fig. 8-10-1, Reproduce Amplifier Circuit.

The head amplifier is provided for each of the REPRO and SYNC modes of operation, independently. Reproduced signals from the REPRO head are fed to the FET Q2 gate and pass through the head amplifier U1 (pin 5, 6, 7), REPRO CAL potentiometer R301, and REPRO signal on/off switching FET Q12, and are applied to input pin 3 of the equalizer amplifier U1 (pin 1, 2, 3) in the first stage of amplification.
Reproduced signals from the REC/SYNC head go through record relay K1 to the FET Q6 gate and then, after passing through the complementary amplifiers Q7 – Q11, SYNC CAL potentiometer R302, and SYNC signal on/off switching FET Q13, are fed into the equalizer amplifier U1 (pin 1, 2, 3).
Capacitors C1 and C8 are connected to the head amplifier terminals. At low tape speed, logic control signal [A] is high. This puts the source and drain terminals of FET Q1 or Q4 (depending on the head selection) into a state equivalent to their being short-circuited, thus conducting C1 or C8 to compensate for differences in the high-frequency characteristics of the head during low tape speed reproduction.
U1 (pin 1, 2, 3) is the reproduce equalizer amplifier in the first stage. Semi-fixed resistors R306 to R309 are the high-frequency compensation potentiometers and are connected when the corresponding transistors of Q22 to Q25 are turned on because control logic signals [B] to [E] go high depending on the tape speed and SYNC or REPRO mode selections.
R78 is a resistor used to select the lower factor of the reproduce EQ time constant, choosing between infinity and 3180. The NAB, IEC (CCIR), or AES standard selection is assumed by FET Q21 (P-channel type), which turns on when control logic signal [F] goes low and connects R78, thus switching the factor from infinity to 3180.
Q20 changes the reproduce level depending on the selected record level (250 or 320 nWb/m). When the switch S2 is set to the 250 nWb/m position, control logic signal [G] goes low. This

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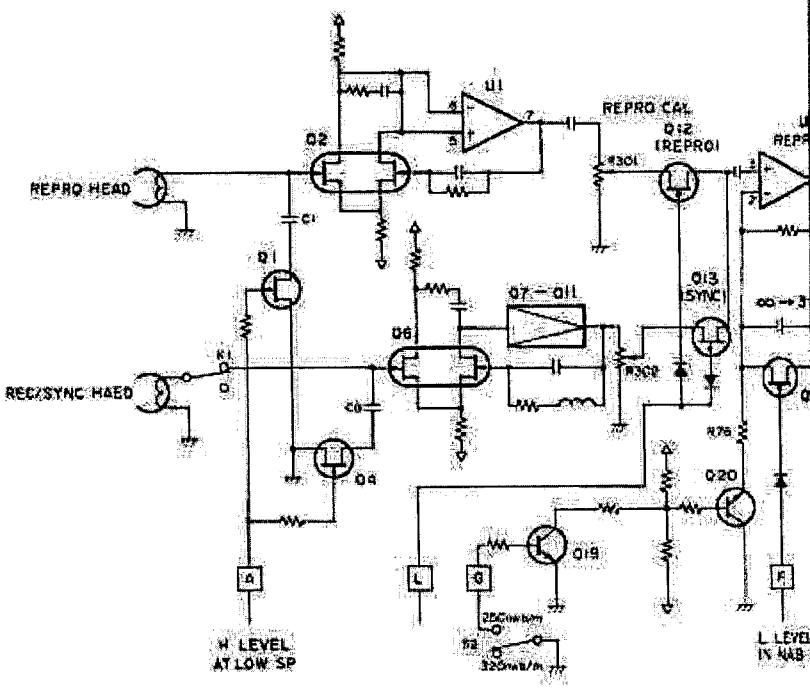


Fig. 8-10-

8-10-2. Record Amplifier

Refer to Fig. 8-10-2. Record Amplifier Circuit.

In addition to the record equalizer amplifier, a record signal phase correction circuit is provided. The bias amplifier section contains the record bias amplifier and a separate erase bias amplifier. Audio signals feeding the INPUT connectors pass through the input amplifier U4 (pin 1, 2, 3) and are fed to the record equalizer amplifier U4 (pin 5, 6, 7) in the first stage of amplification. Semi-fixed resistors R316 and R317 are used to assist the high-frequency characteristics correction assumed to be made in the final stage. When speed control logic signal [A] is low (at high tape speed), Q33 turns on and Q34 is out off, thus connecting R317. When the low tape speed is selected and thus logic signal [A] is high, Q33 is out off and Q34 turns on, thus making R316 effective.

C38 and R125 are used to compensate for the high-frequency characteristics for obtaining a flat record/reproduce response at high tape speed in NAB standard (i.e.; at 50 μsec EQ time constant), while C39 and R126 are for use at low tape speed in IEC standard (i.e.; 70 μsec EQ time constant). These correction circuits are triggered by switching Q35 and Q36 on and off under the action of control logic signals [R] and [M].

Record signals which have passed through the first stage amplifier U4 (pin 5, 6, 7) are fed to the final stage equalizer amplifier U5 (pin 5, 6,

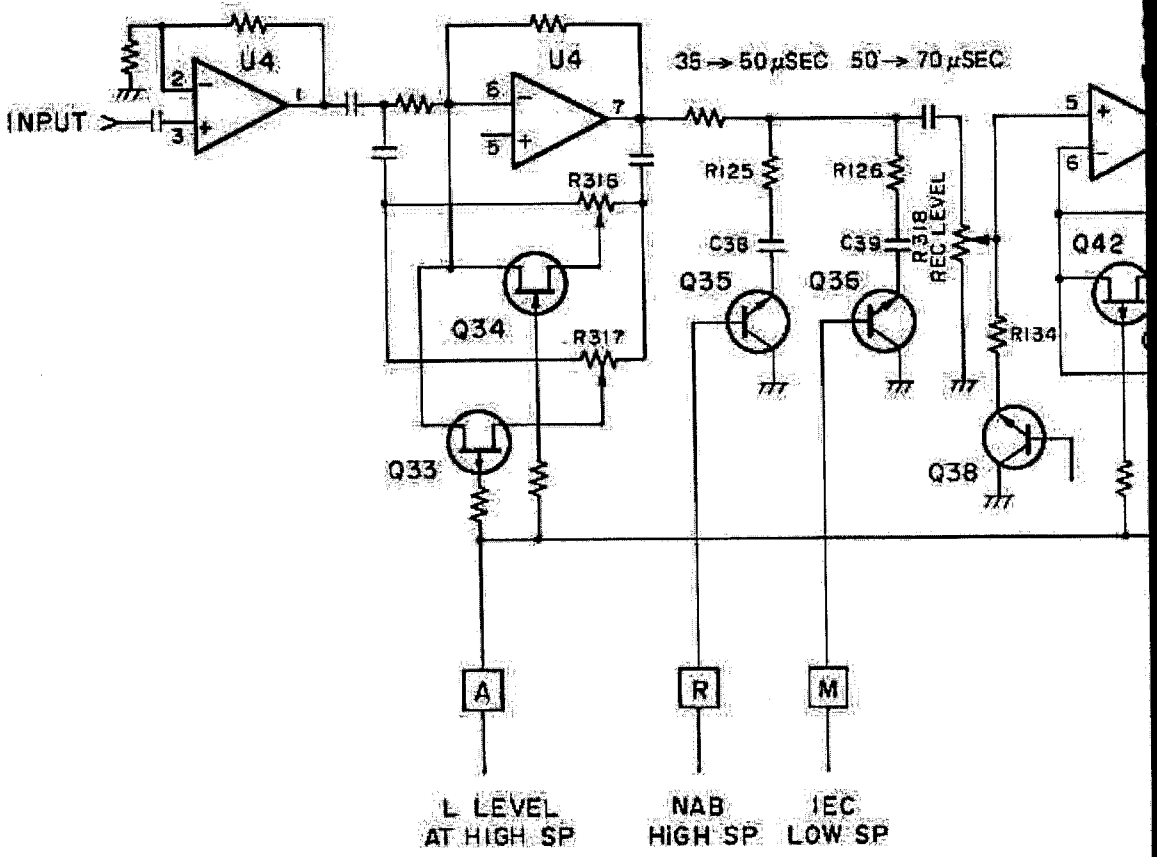
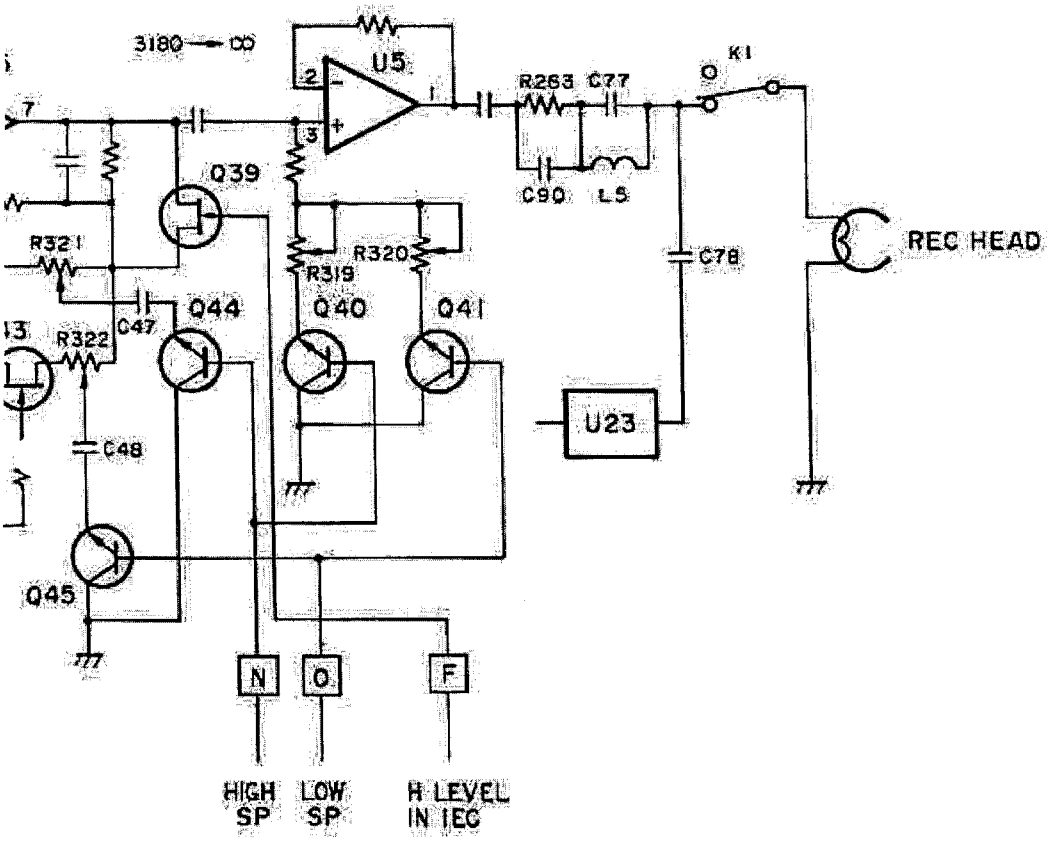


Fig. 8-10-2. Record Amplifier Circuit

7) through the REC LEVEL potentiometer R318.
Semi-fixed resistors R321 and R322 are the resistors used to compensate for differences in the high-frequency characteristics of the head. When tape speed control logic signal [N] is high (at high tape speed), Q42 and Q44 turn on and R321 is connected. When logic signal [O] is high (at low tape speed), Q43 and Q45 turn on and R322 is connected.
Q38 is the transistor used to determine the reference level (250 or 320 nWb/m) by connecting and disconnecting R134. When the level select switch S2 is set to the 250 nWb/m position, Q38 base goes logically high, turning Q38 on. This connects R134 to ground and the reference level is reduced by 1.3 dB from its level when level select switch S2 in the 320 nWb/m position.
The U5 (pin 1, 2, 3) amplifier circuit compensates for differences in the high-frequency audio signal phases induced in any of the amplifiers. The resistors used for this compensation are R319 and R320, which are controlled by Q40 and Q41, as they are switched on and off by control logic signals [N] and [O].
The record signals which have passed through the phase compensation circuit go on to the record head through R263·C90, the bias trap C77·L5, and record relay K1. At the same time, the bias signal from the bias driver amplifier U23 is fed through C78 to the record head to optimize the audio signal level.



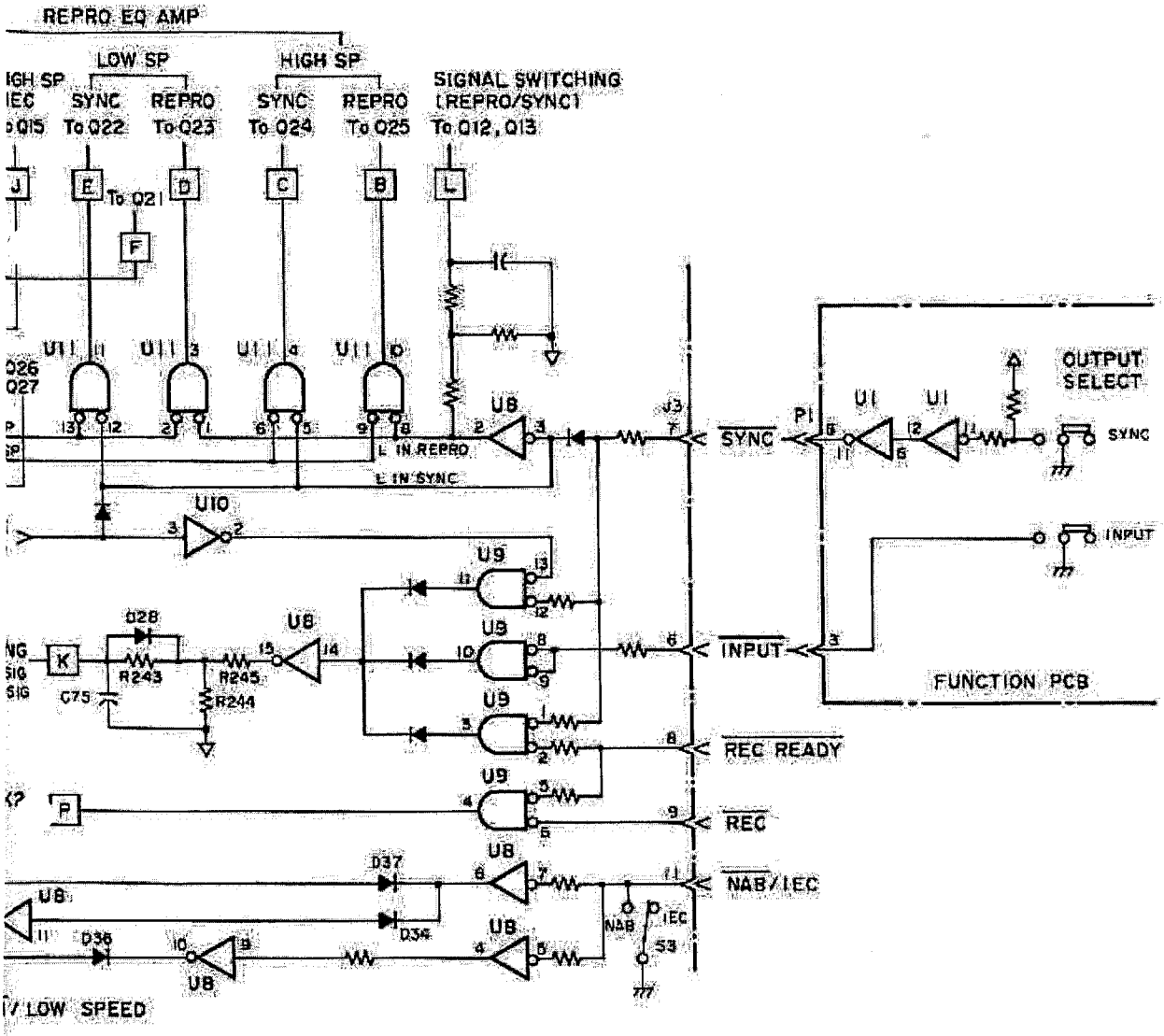


Fig. 8-10-3. Amplifier Control Circuit

8-10-3. Amplifier Function Control Circuit

Refer to Fig. 8-10-3, Amplifier Control Circuit.

1) OUTPUT SELECT in INPUT
When the OUTPUT SELECT "INPUT" switch is on, terminal 3 of connector P1 (in the FUNCTION PCB Ass'y) goes low and the control logic signal INPUT is developed. This signal is applied to input pins 8 and 9 of U9 (pin 8, 9, 10) in the Record/Reproduce Amplifier system. This makes output pin 10 of the same U9 go high. This high level output is inverted to low by the inverter U8 (pin 14, 15), passes through R245 and R243, and is applied to the gate of Q18 (FET of P-channel type), thereby turning Q18 on.
When Q18 turns on, if the signals from the INPUT connectors are present at the drain terminal of Q18 (see Fig. 8-10-1), they are sent to the output connectors through VRs and output amplifiers. At the same time, the high level control signal INPUT is applied to the gate of Q17 (FET of N-channel type), thus switching Q17 from on to off, which cuts the REPRO/SYNC head signal off.

2) OUTPUT SELECT in SYNC or REPRO
When the OUTPUT SELECT "SYNC" switch is on, terminal 8 of connector P1 in the FUNCTION PCB Ass'y goes low and the control logic signal SYNC is developped. The SYNC signal is applied to pin 5 of the NAND gate U11 (pin 4, 5, 6), pin 12 of U11 (pin 11, 12, 13) and to pin 12 of U9 (pin 11, 12, 13) in the record/reproduce amplifier system.
Control logic signal [L] makes output pin 2 of U8 (pin 2, 3) high, turning the FET switch Q13 on. This allows the audio signal comming from the SYNC head through Q6 to Q11 to reach input pin 3 of the repro equalizer amplifier U1 (pin 1, 2, 3) in Fig. 8-10-1.
On the other hand, when the [L] signal is low, Q13 is off (the SYNC amplifier disconnected) and Q12 is on thus connecting the REPRO head signal to the reproduce equalizer amplifier (Fig. 8-10-1).
Control logic signal [C] from output pin 4 of U11 (pin 4, 5, 6) is assumed to be high in the SYNC reproduce mode at high tape speed.
Signal [E] from output pin 11 of U11 (pin 11, 12, 13) is high during the SYNC reproduce mode at low tape speed.
When the OUTPUT SELECT "REPRO"

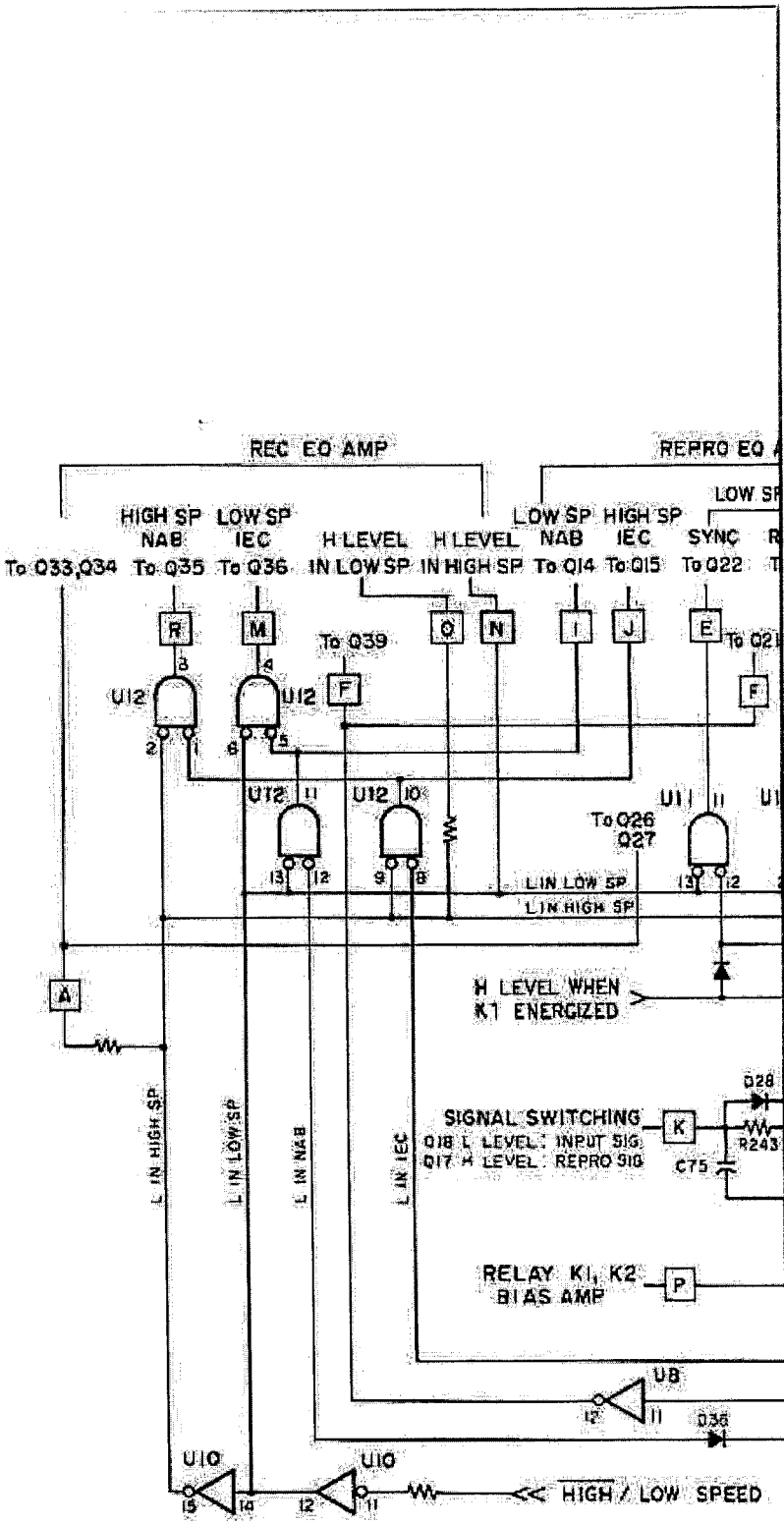


Fig. 8-10-3

switch is engaged, output pin 2 of U8 (pin 2, 3) is low, determining the output logic level of U11 (pin 8, 9, 10) and U11 (pin 1, 2, 3), so that the former develops control signal [B] in the REPRO mode at high tape speed and the latter develops signal [D] at low tape speed.
These sets of control signals, [C]/[E] and [B]/[D], condition the function of Q22 to Q25, all included in the REPRO EQ amplifier in the first stage, thus providing the necessary amplification characteristics depending on selection of the SYNC or REPRO mode and the high or low tape speed.
The reproduce equalizer amplifier characteristics are made to comply with NAB, IEC, or AES standards under the action of the logic control signals [I], [J] and [F].
The [I] signal goes high at low tape speed in the NAB position, and turns Q14 on. To select NAB standard, switch S3 should be on. When S3 is switched on, input pin 5 of U8 (pin 4, 5) goes low and output pin 10 of U8 (pin 9, 10) also goes low, causing, through D36, input pin 12 of U12 (pin 11, 12, 13) to go low. Since output pin 13 of the same U12 is assumed to be low at low tape speed, its output pin 11 goes high, turning Q14 on as a result.
The [J] signal goes high at high tape speed in the IEC position and turns Q15 on. To select IEC standard, switch S3 should be off. When S3 is switched off, input pin 7 of U8 (pin 6, 7) goes high, and therefore its output pin 6 goes low, causing, through D37, input pin 8 of U12 (pin 8, 9, 10) to go low. Since input pin 9 of the same U12 is assumed to be low at high tape speed, its output pin 10 goes high, turning Q15 on as a result.
The [F] signal goes low in the NAB position regardless of the tape speed and turns Q21 on (in the reproduce equalizer amplifier) and Q39 off (in the record equalizer amplifier). This is because output pin 6 of U8 (pin 6, 7) goes high and therefore input pin 11 of U8 (pin 11, 12) also goes high, which causes its output pin 12 to go low, thus turning Q21 on and Q39 off.

3) RECORD Mode

The record amplifier function is controlled by logic control signals [A], [R], [M], [F], [N], [O], and [P].
Signal [R] goes high at high tape speed in the NAB position and turns Q35 on. The [R] signal, as suggested in the preceeding paragraph, goes low in the NAB position and therefore input pin 1 of U12 (pin 1, 2, 3) is also low. Since, at high tape speed, input pin 2 of U12 (pin 1, 2, 3) is assumed to be low, its output pin 3 goes high, turning Q35 on as a result.
Signal [M] is high at low tape speed in the IEC standard position and turns Q36 on. At low tape speed in the IEC position, input pins 5 and 6 of U12 (pin 4, 5, 6) go low and therefore its output pin 4 goes high, thus turning Q36 on.
Signal [O] is high at low tape speed regardless of the EQ standard selection and turns Q41 and Q45 on.
Signal [N] is high at high tape speed regardless of the EQ standard selection and turns Q40 and Q44 on.
Signal [P] goes high when the record mode is entered, thus activating the bias amplifier and energizing the record relay K1 and the erase relay K2.
Upon entering the record mode, $\overline{\text{REC}}$ SIG is developed. This makes input pin 6 of U9 (pin 4, 5, 6) low while its other input pin 5 also goes low under the action of $\overline{\text{REC}}$ READY SIG. This, in turn, makes output pin 4 of the same U9 high.

8-10-4. Switching Noise Protection Circuit

A recorder's efficiency in preventing switching noises during operation mode changes is one of the determining factors for quality recording. The following paragraphs explain the main functions of the circuit provided for this purpose.

1. Noise Suppression During Record Mode On/Off Operations

Refer to Fig. 8-10-4, Record On/Off Noise Protection Circuit.

a) When the record mode is entered, logic control signal [P] goes high and output pin 6 of U10 (pin 6, 7) and output pin 1 of U10 (pin 1, 2) both go low. This cuts off U14, U17, U19 and U20. As U20 is cut off, +15 V voltage begins to be charged to C63 through R185 and R184. And when, because of this charge, the base potential of Q53 increases to the determined level, Q53 turns on, thus activating the record relay K1. At the same time the charge stored in C62 is released through R181, D22 and Q53 (emitter-collector path). As the record relay K1 is energized, the REC/SYNC head is connected to the record amplifier system. The time requird for energizing K1 after the record mode has been entered is determined by the time constant of R184, R185, and C63. Cutting-off of U20 causes in the similar manner erase relay K2 to be energized.

b) On the other hand, when U17 is cut off, U18 momentarily turns on, releasing the charge stored in C59. Then, when U18 turns back to off, C59 is recharged with +15 V through R171, R173, and R174, and, when the base potential of Q50 reaches the determined level, Q50 turns on. Almost at the same time as Q50 turns on, Q51 also turns on, thus switching the bias amplifier on. The bias amplifier reaches its set bias amplitude but only after the determined period of time, which nulls switching noise.

   Similarily, the erase bias amplifier also reaches its operating state with a delay of the determined period of time after U14 has been cut off.

c) Next, when the record mode is released, the REC SIG applied to input pin 6 of U9 (pin 4, 5, 6) (see Fig. 8-10-3) goes high and logic control signal [P] goes low. This causes U14, U17, U19, and U20 to be switched on (they had been cut off when entering the record mode).

d) When U17 turns on, the charge stored in C59 is released through R174, D17, and U17 (collector-emitter path), causing Q50 to turn off and then Q51 to also turn off. This switches the bias amplifier off.

e) When U20 turns on, the charge stored in C63 is released through R183, R184, and U20 (emitter-collector path). This switches Q53 off, thus de-energizing record relay K1 and switching the REC/SYNC head connection from the record amplifier to the reproduce amplifier. The timing of the record relay switching is set to occur when the bias voltage has decreased to zero. This is about 200 μsec after the entering of record operation has been made.

In the following two paragraphs, f) and g), the theory of monitor source switching is discussed, although the subject is not directly related to the noise suppression theory.

f) When, in the SYNC output mode, the FUNCTION switch is used to start recording (assuming the RECORD and PLAY buttons have been pressed already), the monitor source changes as follows.

   Refer to Fig. 8-10-3, Amplifier Control Circuit.

   When the FUNCTION switch is pressed on, output pin 3 of U9 (pin 1, 2, 3) goes high, and output pin 15 of U8 (pin 14, 15) goes low. Therefore, the charge stored in C75 is released through D28 and R245, and control signal [K] goes low, switching the monitor source from the SYNC head to the INPUT connectors.

g) When the record mode (with OUTPUT SELECT in the SYNC position) is released by disengaging the FUNCTION switch, the monitor source changes from INPUT to SYNC as follows:
   When the FUNCTION switch is pressed off, record relay K1 in the bias amplifier circuit (Fig. 8-10-4) is de-energized, and +15 V voltage is charged to C62 through R181 and R182. Then, when the bias potential of Q52 increases to the determined level, Q52 turns on, input in 3 of U10 (pin 2, 3) goes low, and in-

put pin 13 of U9 (pin 11, 12, 13) goes high. As input pin 13 of U9 goes high, its output pin 11 goes low, and, consequently, output pin 15 of U8 (pin 14, 15) (shown in Fig. 8-10-3) goes high. This starts the charging to C75, and, after completion of the charging, control logic signal [K] becomes high.

In fact, the monitor source switching from INPUT to SYNC is assumed to occur with a delay determined by the charging time of C62 and C75, that is, the time required for the reproduce amplifier to reach a stabilized state of functioning after the record relay has been de-energized.

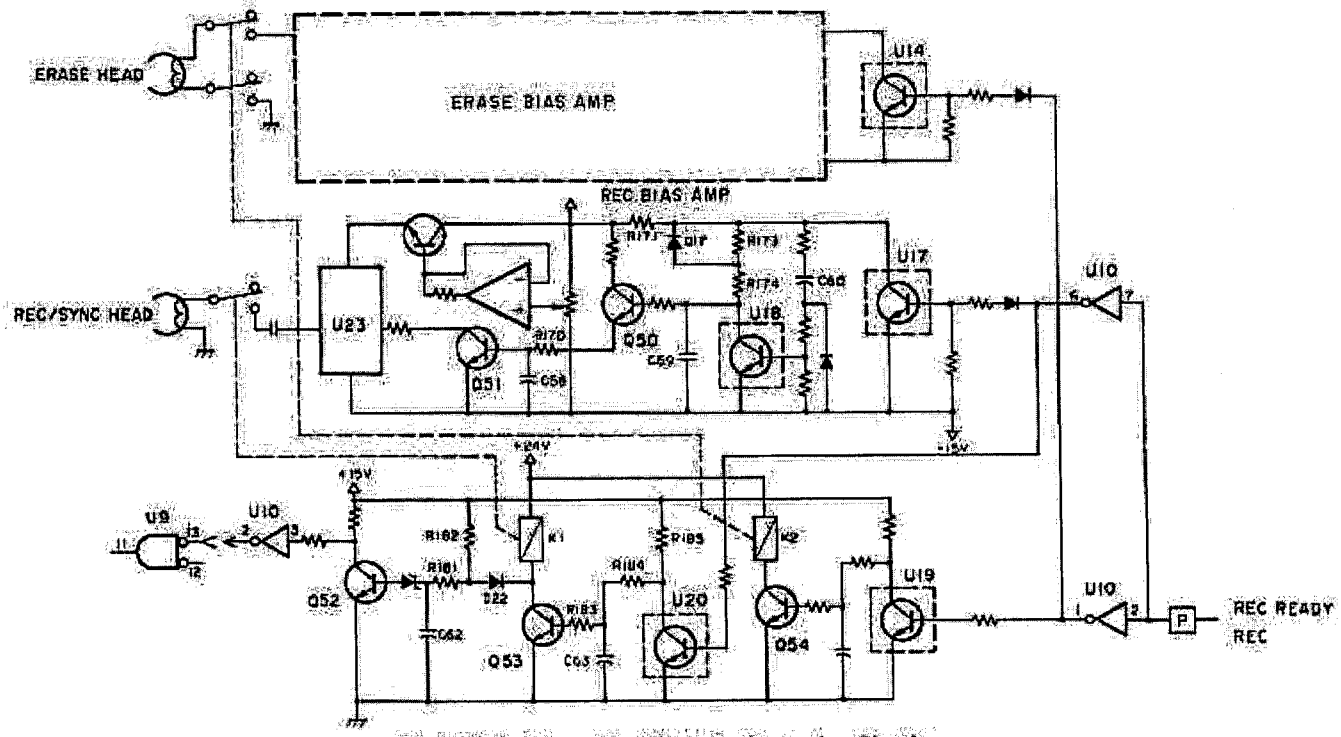


Fig. 8-10-4. Record On/Off Noise Protection Circuit

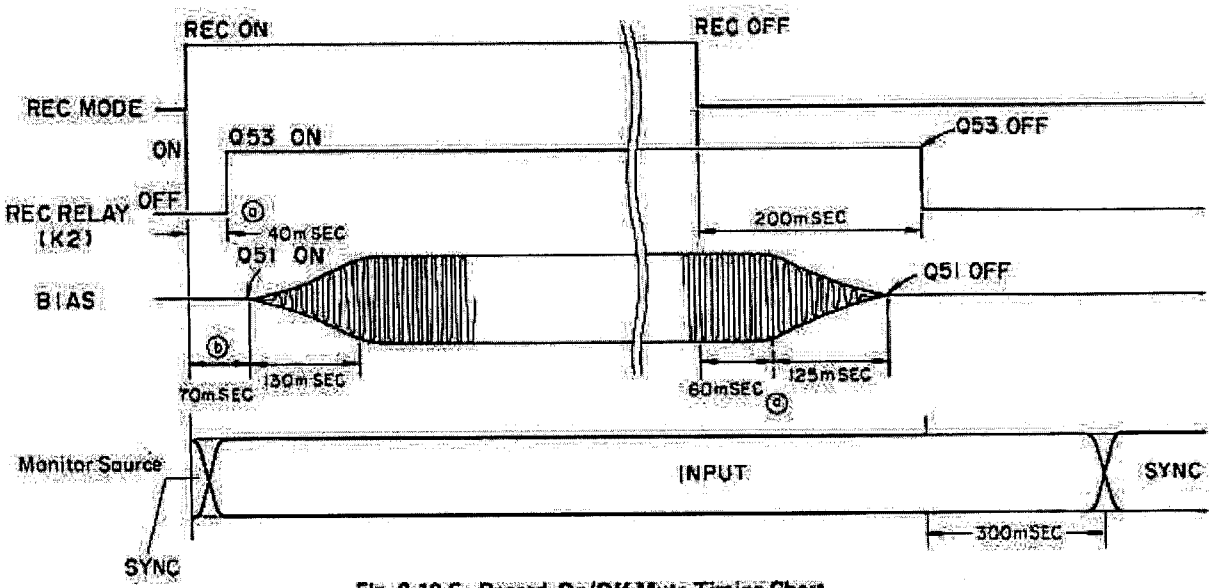


Fig. 8-10-5. Record On/Off Mute Timing Chart

2. Noise Suppression During Tape Speed Changes

Refer to Fig. 8-10-6, Tape Speed Switching Noise Protection Circuit.

a) When the SPEED selector is switched from HIGH to LOW, output pin 15 of U4 (pin 2, 15) in the Function circuit goes low immediately while its other input, pin 1, remains high for a short period of time during which the charge stored in C4 is released. This causes output pin 3 of U2 (pin 1, 2, 3) to develop a positive pulse voltage which now causes output pin 12 of U4 (pin 5, 12) to go momentarily low, thus releasing the charge stored in C3. Once C3 is discharged, it is recharged with +15 V through R20 and R24. As long as the charging to C3 is taking place (the charging time is determined by the time constant of C3 and R20), input pin 9 of U2 (pin 8, 9, 10) remains low and therefore its output pin 10 is high, thus making output pin 10 of U4 (pin 7, 10) develop a low level signal, that is, PLAY MUTE SIG.

b) On the other hand, when the SPEED selector is switched from LOW to HIGH, output pin 15 of U4 (pin 2, 15) goes high and input pin 2 of the EX-OR gate U2 (pin 1, 2, 3) goes high while its other input pin 1 remains low for a short period of time, until C4 is charged. This causes a positive pulse voltage to appear at output pin 3 of U2 (pin 1,2, 3), thus developing the PLAY MUTE SIG just es when switching the SPEED selector from HIGH to LOW.

c) The PLAY MUTE SIG thus developed is sent on through terminal 7 of connector P1 to terminal 5 of connector J3 of the record/reproduce amplifiers.
When this low-level mute signal is applied to the Q56 base, this transistor turns off and +15 V voltage is charged to C74 through R241 and R240. Then, when the base potential of mute transistor Q16 increases to the determined level, Q16 turns on, thus stopping the reproduce audio signal from going on through the reproduce amplifier. And, when the PLAY MUTE SIG ceases and the base potential of Q56 increases, the charge stored in C74 is released through R240 and Q56 (collector-emitter path). This turns Q16 off, thus canceling the muting function.

8-10-5. PLAY MUTE SIG in Other Modes of Operation

The NOR gate transistor U3 (pin 4, 5, 6) shown in Fig. 8-10-6 works to mute, and release from muting, the reproduce signal the moment it is made necessary in various modes of the recorder's operation other than those the preceeding sections referred to.
In the modes in which input pins 5 and 6 of the NOR gate are assumed to go high, its output pin 4 goes low. Consequently, output pin 10 of U4 (pin 7, 10) is made to go high, which turns Q16 off, thus releasing the reproduce signal from the action of PLAY MUTE SIG.
In the modes in which either or both of input pins 5 and 6 of the NOR gate are assumed to go low, its output pin 4 goes high, thus turning Q16 on. As a result, the reproduce signal is muted.

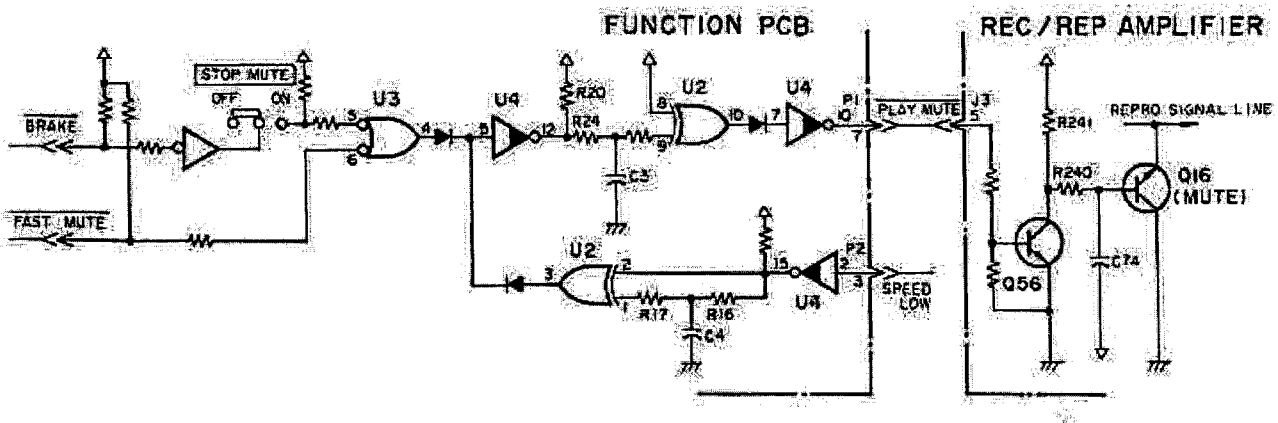


Fig. 8-10-6. Tape Speed Switching Noise Protection Circuit

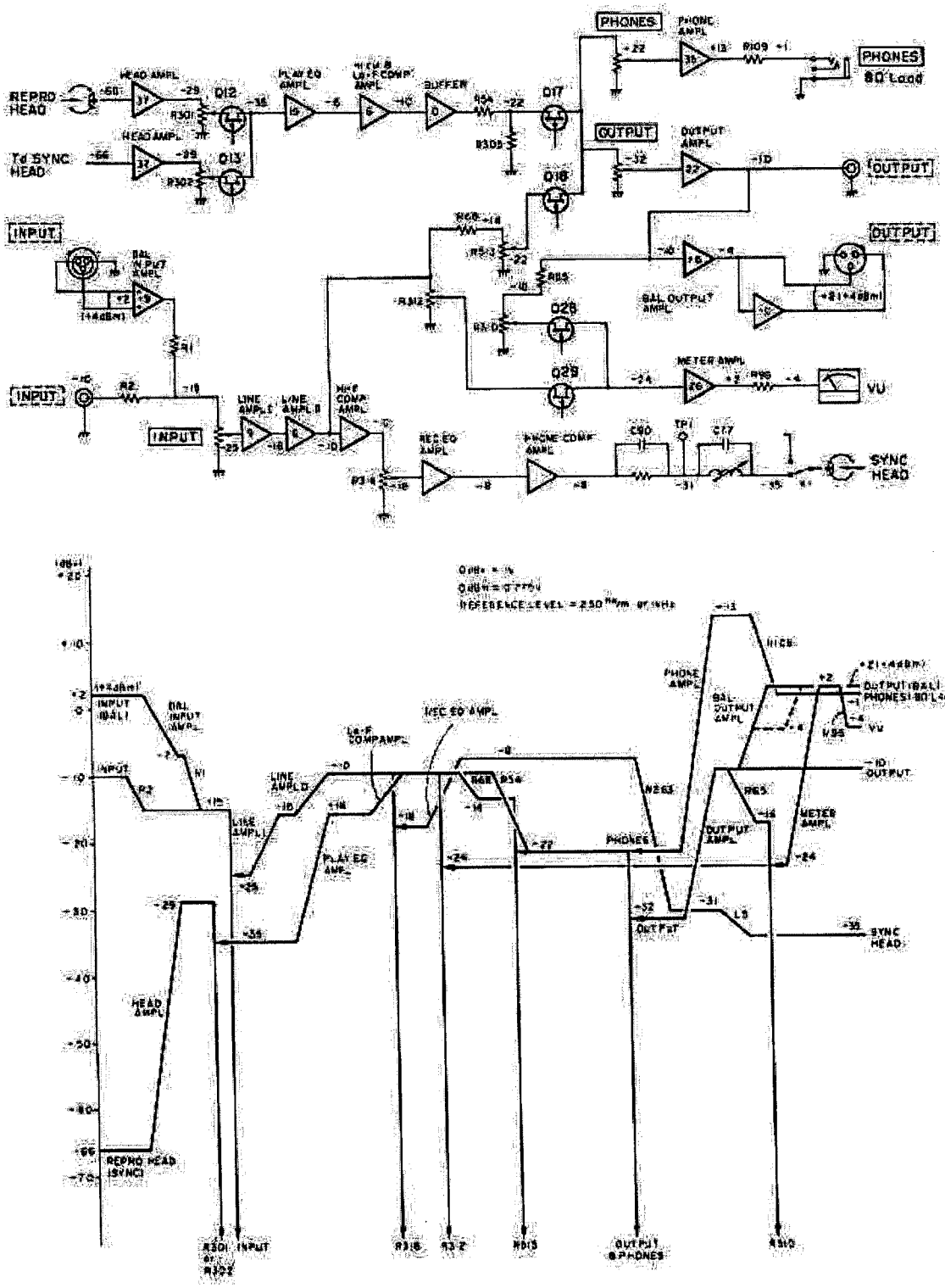


Fig. 8-10-7, Amplifier Level Diagram (-N and -D Models)

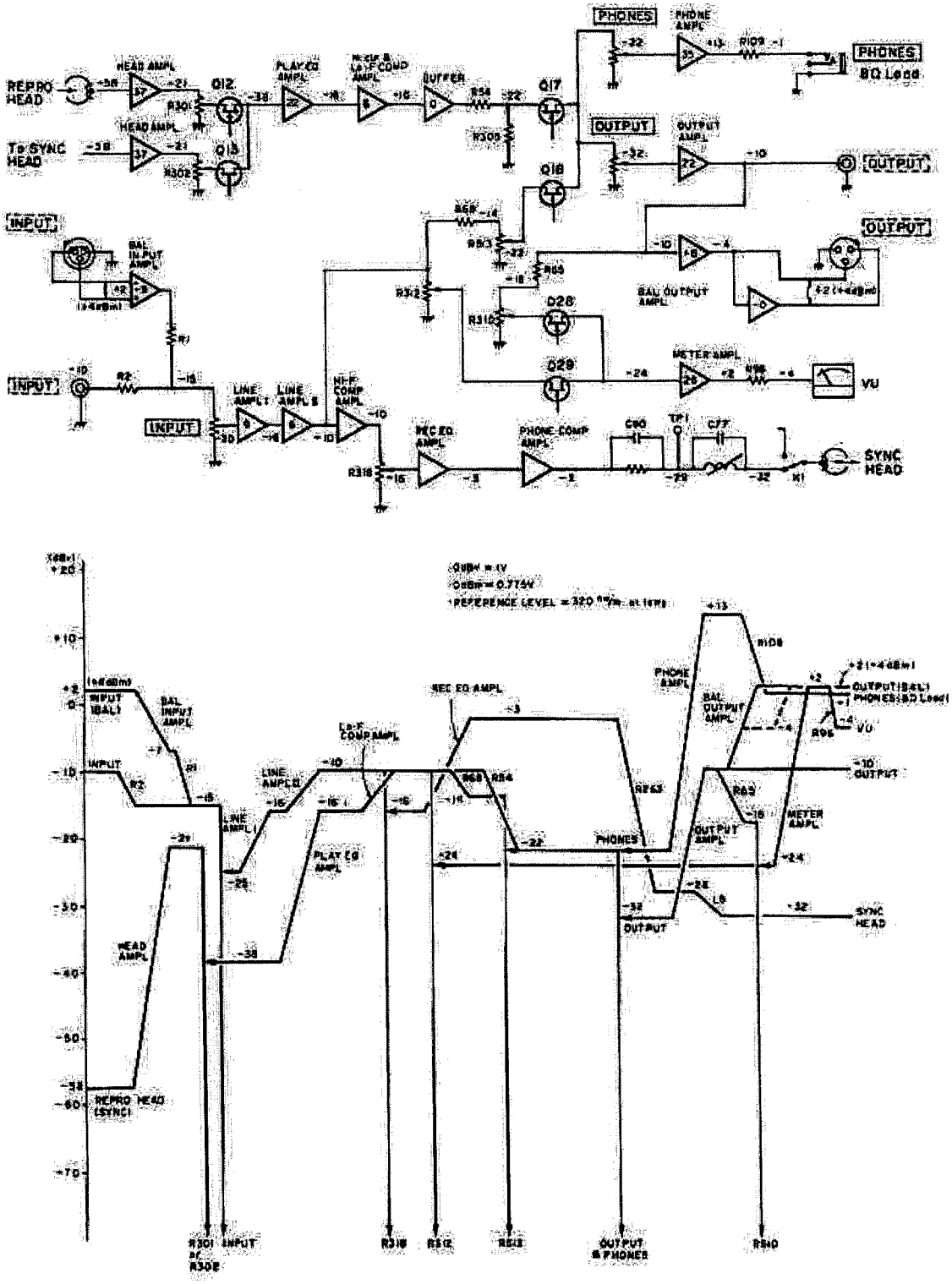


Fig. 8-10-8. Amplifier Level Diagram (-HS Model)

SECTION IX. MAINTENANCE

9-1. PARTS LOCATION DIAGRAMS

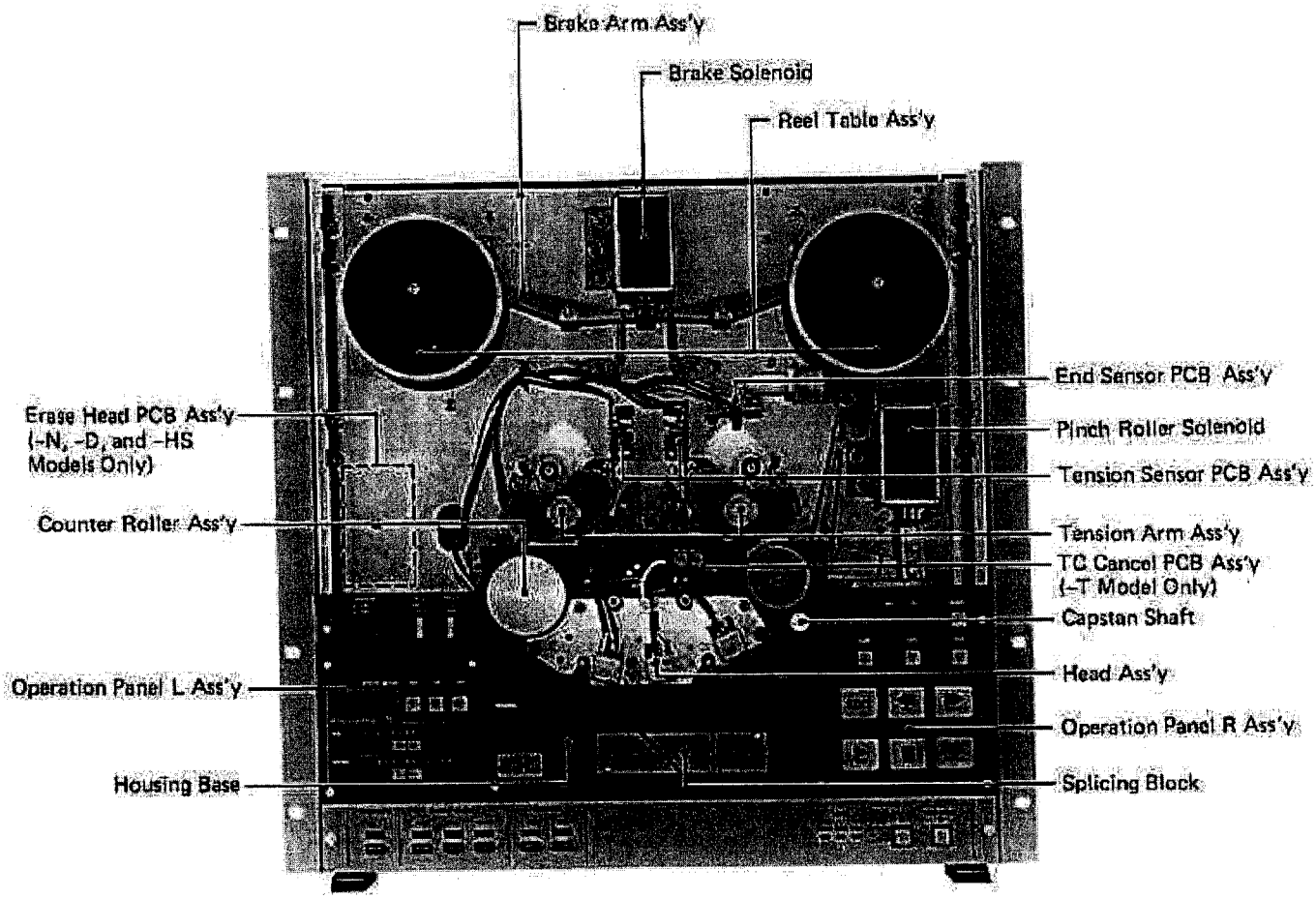
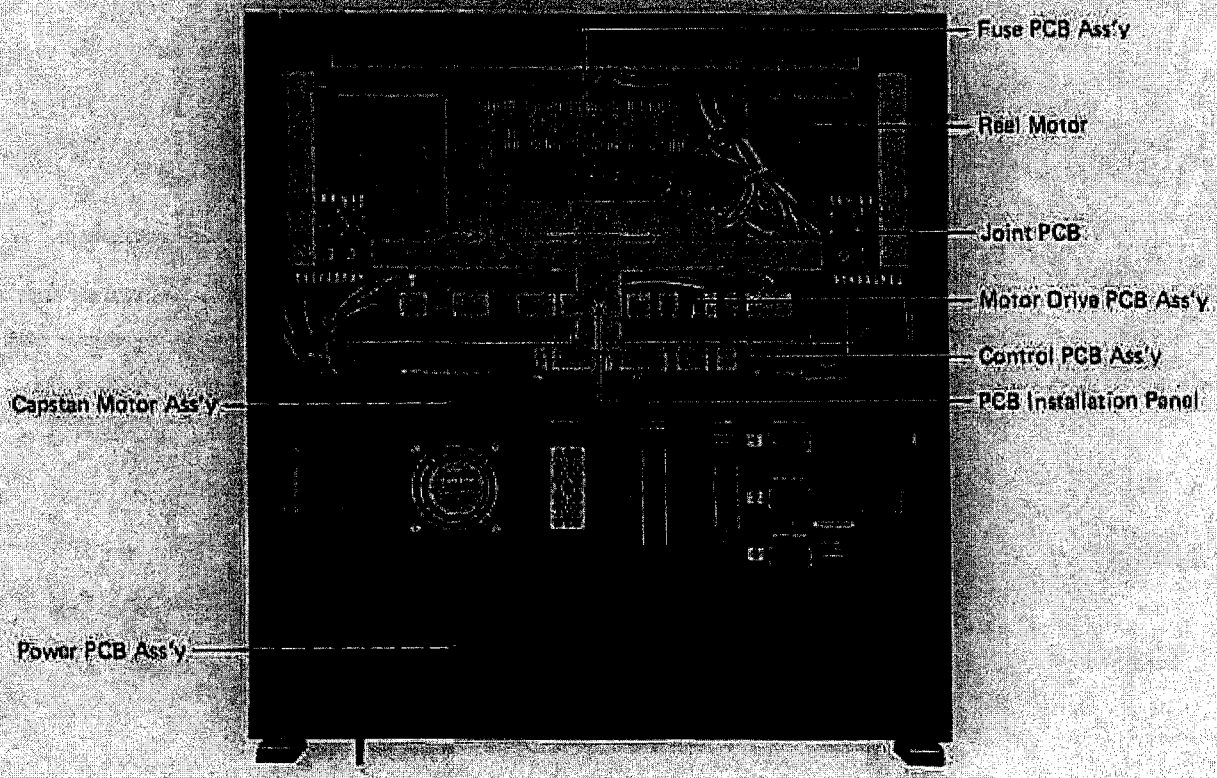


Fig. 9-1.1. Front Parts Location



TRANSPORT
(-T Model)

Fig. 9-1.2. Rear Parts Location

9-2. ESSENTIAL TEST EQUIPMENT REQUIRED

Wow & Flutter Meter	Meguro Denpa Sokki K.K., Model MK-669 (JAPAN), or Mincom Division, 3M Co., Model 8155 (U.S.A.)
Audio Oscillator	Hewlett Packard, Model 204C or equivalent
Digital Frequency Counter	Range: 10 Hz ~ 1 MHz; sensitivity; 0.1 Vrms; imp.: > 1 MΩ, < 25 pF
Band-Pass-Filter	1 kHz narrow band pass type
AF Level Meter	Range; -80 dB ~ +40 dB; imp.: > 1 MΩ, < 25 pF (example—HP 400GL)
Distortion Meter	General purpose (400 Hz, 1 kHz)
Oscilloscope	General purpose
Attenuator	General purpose
Tools	Spring scale: 0 ~ 8 lbs (0 ~ 4 kg) 0 ~ 2.2 lbs (0 ~ 1 kg) Tentelometer, Model T2-H20-1 or T2-H20-M2 Hex head Allen wrenches, Plastic alignment tool
Cleaning Fluid:	TEAC TZ-261 or equivalent
Head Demagnetizer	TEAC E-3 or equivalent
1/4" Test Tapes [for -T, -N and -D Models]	Tape Speed/Wow-Flutter Test Tape TEAC YTT-2004 (for tape speed 15 ips) TEAC YTT-2003 (for tape speed 7-1/2 ips) Reproduce Alignment Test Tape NAB Equalization: TEAC YTT-1004 (for tape speed 15 ips) TEAC YTT-1003 (for tape speed 7-1/2 ips) Reference fluxivity: 185 nWb/m Time constant: 3,180 +50 μsec. IEC Equalization TEAC YTT-1064 (for tape speed 15 ips) Reference fluxivity: 320 nWb/m Time constant: ∞ +35 μsec. TEAC YTT-1063 (for tape speed 7-1/2 ips) Reference fluxivity:320 nWb/m Time constant: ∞ +70 μsec Blank Test Tape (Recording) TEAC YTT-8063
1/2" Test Tapes [for -HS Model]	Tape Speed/Wow-Flutter Test Tape TEAC YTT-2165 (for tape speed 30 ips) TEAC YTT-2104 (for tape speed 15 ips) Reproduce Alignment Test Tepe TEAC YTT-1165 (for tape speed 30 ips) Reference fluxivity: 320 nWb/m Time constant: ∞ +17.5 μsec TEAC YTT-11441 (for tape speed 15 ips) Reference fluxivity:250 nWb/m Time constant: ∞ +35 μsec Blank Test Tape (Recording) TEAC YTT-8163

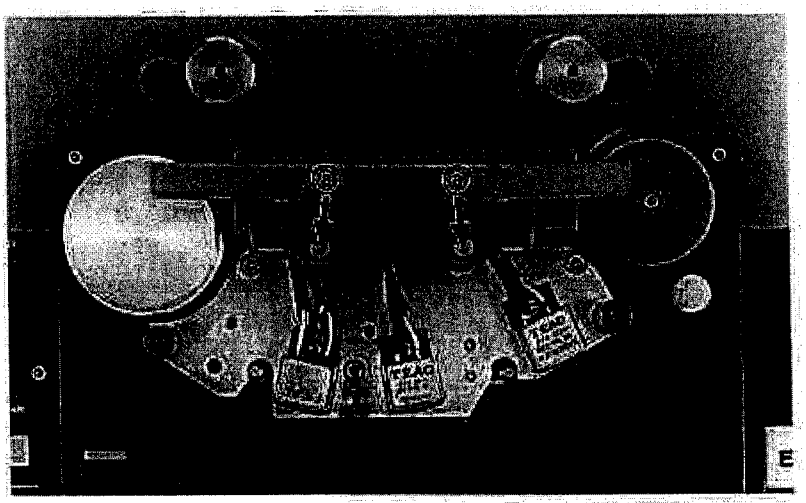
With 185 nWb/m reference fluxivity (short circuit), the reproduce output level will be 2.6 dB lower than at 250 nWb/m fluxivity (short circuit); and 3.9 dB lower than at 320 nWb/m (open circuit).

9-3. REMOVAL OF THE MAIN PARTS

9-3-1. External Parts

A. Head Housing

The head housing can be removed by simply removing the two screws marked ⓐ in Fig. 9-3-1.



(-T Model)

Fig. 9-3-1. Screw Locations for Head Housing Removal

B. Housing Base

1. To remove this base, the head housing and pinch roller should be removed first by using a 2.5 mm Allen wrench. The pinch roller can be removed by removing the retaining screw from the top of the pinch roller.
   (Allen wrench sizes are identified by cross-sectional side-to-side measurement of the end of the wrench)
2. Next, remove the screws ⓐ ⓑ located on the housing base, shown in Fig. 9-3-2.

C. Front Panel Ass'y

1. The front panel ass'y can not be removed without first removing the housing base (see "B. Housing Base" above).
2. Remove the four Allen screws ⓒ from both the left and right sides of the front panel, as shown in Fig. 9-3-2.
3. The front panel ass'y can now be separated from the unit by lifting upwards on it. It is also advisable to remove the reel clamper at this time.

D. Operation Panel R & L Assemblies

1. Remove the housing base before taking off these assemblies.
2. Remove the screws ⓓ to remove the operation panel R ass'y, or the screws ⓔ to remove its L ass'y.

E. Side Panels

As shown in Fig. 9-3-3, loosen the four retaining screws ⓐ from the feet of the deck, then remove the two screws ⓑ and the remaining four screws ⓒ to enable removal of the side panels.

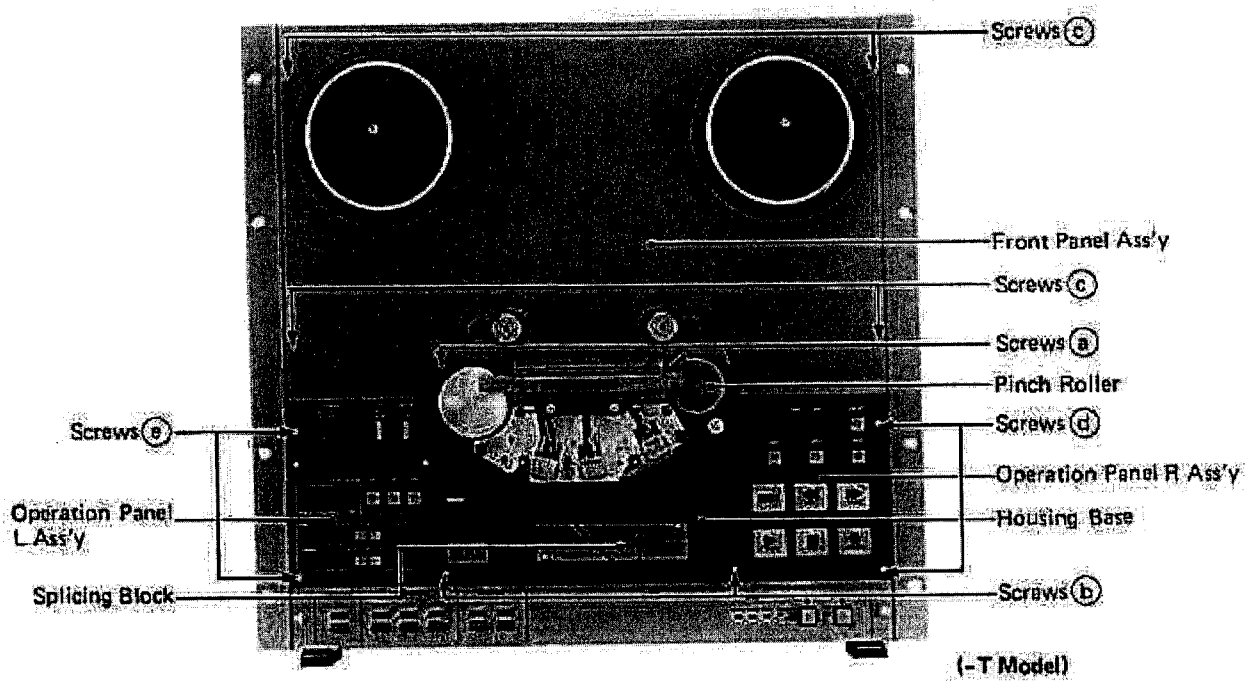


Fig. 9-3-2. Screw Locations for Front Panel Removal

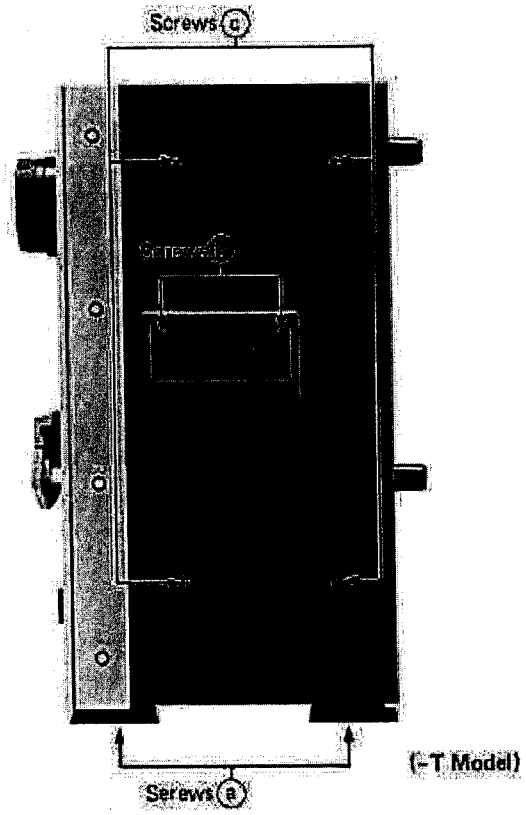


Fig. 9-3-3. Screw Locations for Side Panel Removal

9-3-2. Head Ass'y

1. First, remove the head housing as described in 9-3-1 (A).
2. Using a 3 mm Allen wrench, remove the three Allen screws ⓐ holding the head es shown in Fig. 9-3-4.
3. The head can be removed by first removing Allen screws ⓑ located on the rear of the head and then removing the other screws ⓒ from the rear of the head base.

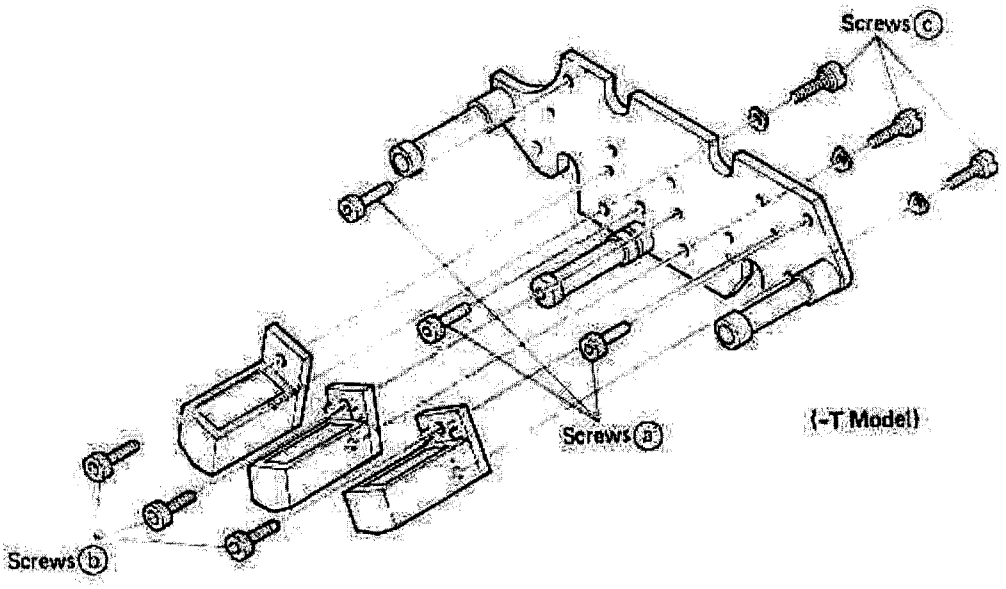


Fig. 9-3-4. Head Ass'y Removal

9-3-3. Reel Motor Ass'y

1. After removing the front panel as described in 9-3-1(C), remove the reel table assembly and as shown in Fig. 9-3-5, remove the three screws holding the reel motor.
2. Finally, undo the wire running to the JOINT PCB with the use of a soldering iron.

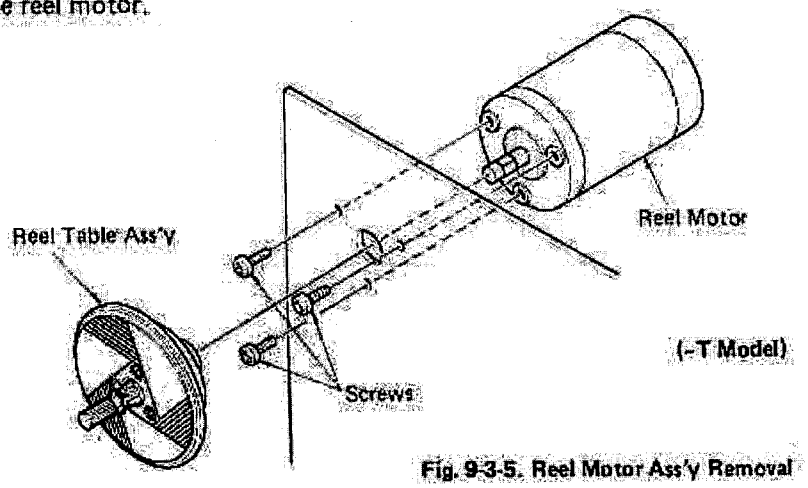


Fig. 9-3-5. Reel Motor Ass'y Removal

9-3-4. Capstan Motor Ass'y

1. Refer to 9-3-1 and remove the head housing, front panel assembly, pinch roller, housing base, operation panel R assembly and rear panel.
2. Remove the three screws ⓐ that are holding the motor section onto the capstan motor assembly as shown in Fig. 9-3-6. Next, unplug the connector to completely remove the capstan motor assembly.

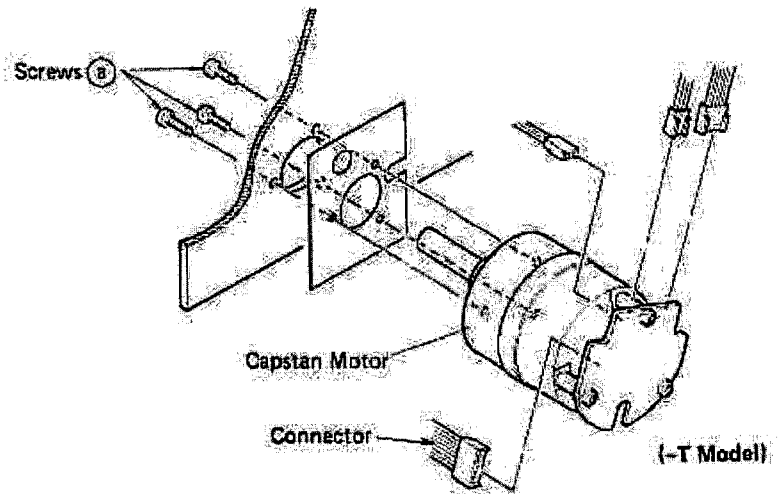


Fig. 9-3-6. Capstan Motor Ass'y Removal

9-3-5. Fuses

All together ten fuses will be visibly noticeable when the rear panel is taken off.

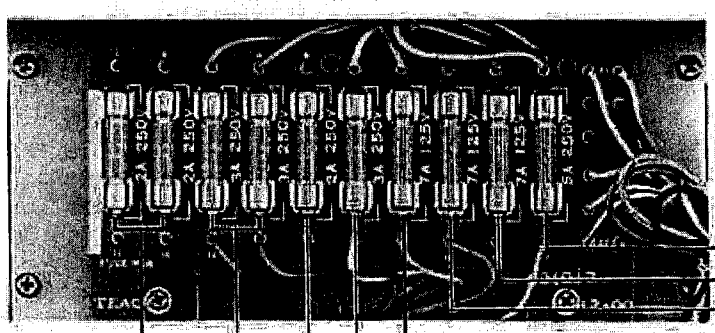


Fig. 9-3-7. Fuse PCB Ass'y

F10 (+11 V Reel Motor, Regulated +5 V)
F9 (+22 V Reel Motor Flash V., Regulated +15 V)
F8 (+12 V Solenoid)
F7 (+24 V, Solenoid Flash V.)
F6 (Regulated +24 V Relay, Capstan Motor)
F5 (AC 6 V Lamp)
F3, F4 (Regulated ±15 V Rec/Rep Amp)
F1, F2 (Regulated ±20 V Balanced Amp)

9-4. TAPE TRANSPORT CHECKS AND ADJUSTMENTS

9-4-1. Brake Mechanism

Note: Be sure that the power is turned off prior to making any adjustments to the brakes.

1. Make sure that the tip (A) of the brake arm assembly does not come into contact with the upper and lower sides of the recessed part of the brake plunger. If contact is noticeable, adjust the screws ⓐ of the hanger until tip (A) retains a centered position between the recessed part of the brake plunger.
   Note: Take care that the brake band is not twisted in any way when making this adjustment.
2. Manually operate the brake plunger to be sure that the brake band is separated from the brake drum. Then turn the left and right reels motors by hand and check that they move freely.
   If the brake band is still making contact with the brake drum at this point, adjust the position of the brake solenoid by loosening screws ⓑ.

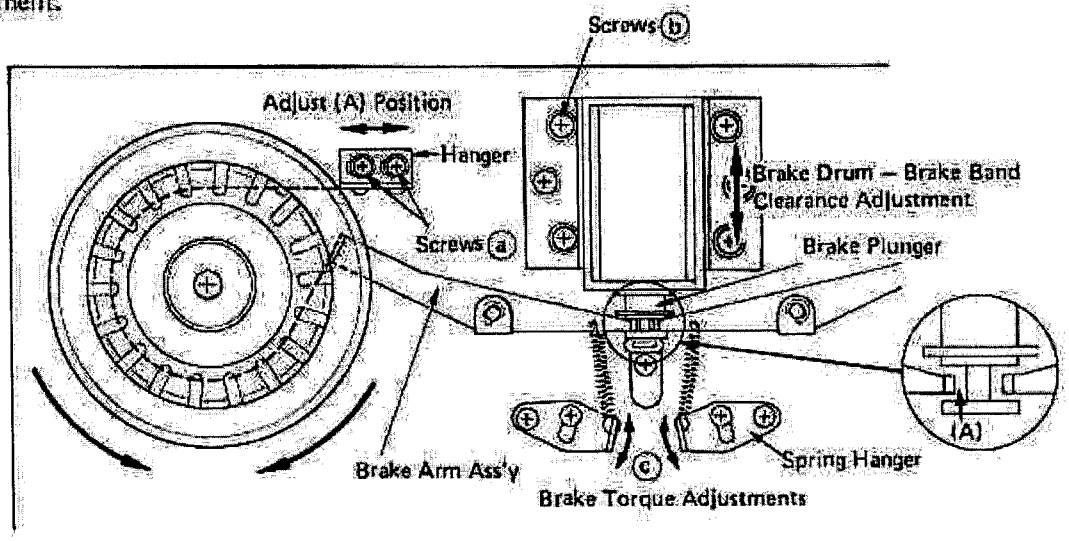


Fig. 9-4-1. Brake Mechanism Adjustments

9-4-2. Brake Torque

Note: Before making any brake adjustments or measurements, make sure the power is off.

1. Mount an empty 10-1/2" reel onto either reel table and attach a spring scale to the reel with a string. See Fig. 9-4-2.
2. Smoothly pull the scale away from the reel under test and note the torque value when the reading on the scale is steady. The proper torque values are given in the chart on the next page.
3. Follow steps 1 and 2 for each measuring condition; i.e., (A) and (B) in Fig. 9-4-2.
4. If the forward-direction torque is not correct, change the hooking position of the spring hanger (reference ⓒ in Fig. 9-4-1) for the corresponding brake requiring adjustment. If, the torque is still not correct, replace the brake felt pad with a new one after cleaning the inner-side of the brake belt with an alcohol cleaning solution, and also check that the brake mechanism is properly aligned as explained in Section 9-4-1, "Brake Mechanism". If necessary, replace the entire reel table.

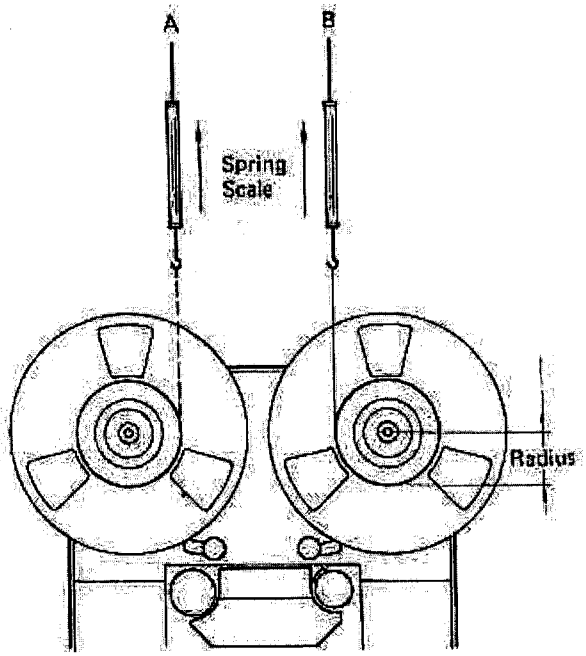


Fig. 9-4-2. Brake Torque Measurement

TABLE 9-4-1. BRAKE TORQUE VALUES

Forward direction (in which brake becomes in effect) (A) (B)

[-T, -N and -D models]	1,700 – 1,900 g-cm (23.6 – 26.4 oz-inch)
[-HS model]	2,300 – 2,700 g-cm (32 – 37.5 oz-inch)

Torque calculating formulas:

1. Torque (in g-cm or oz-inch)
   = Force or Weight (in g or oz) x Radius (in cm or inch)
2. Conversion of g-cm to oz-inch:
   g-cm x 0.0139 = oz-inch

9-4-3. Pinch Roller Pressure

Note: Pinch roller pressure is supplied by the pinch roller spring arm, and it is most important that the solenoid plunger be fully bottomed before taking pressure measurements.

1. Insert something soft or foldable between the tension arm and the opening on the front panel (A) so that the unit will be operative.
2. Attatch string to the pinch roller shaft and a spring scale to the string, as shown in Fig. 9-4-4.
3. Place the deck in the reproduce mode without threading the tape.
4. Pull the pinch roller away from the capstan shaft (on a plane intersecting the center of the capstan shaft and the pinch roller) until the capstan shaft and the pinch roller are separated.
5. Ease pressure on the scale until the pinch roller just begins to turn. The scale should then read:
   -T, -N and -D models 1.5 ±0.1 kg (3-1/16 lbs to 3-8/16 lbs)
   -HS model 2.1 ±0.1 kg (4-7/16 lbs to 4-14/16 lbs)
6. If you don't get this reading on the scale, adjust the position of the capstan solenoid by loosening the three screws.

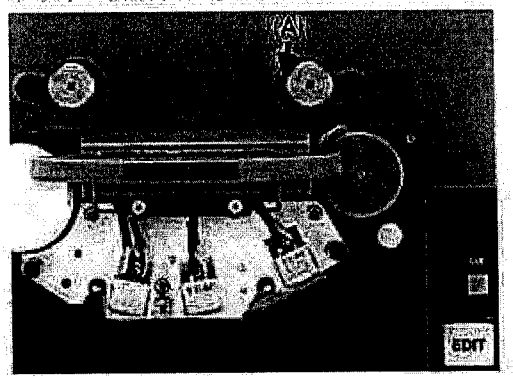


Fig. 9-4-3. Right Tension Arm

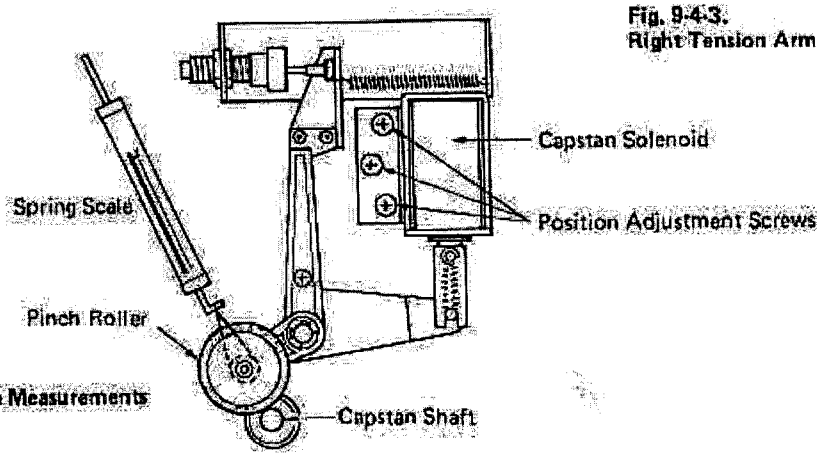


Fig. 9-4-4. Pinch Roller Pressure Measurements and Adjustments

9-4-4. Tape Tension Servo: Tension Arm Positions and Detection Characteristics

The tape tension servo detects and controls the tape tension through either left or right tension sensor assemblies located under the front transport panel and each function exactly the same. The assembly includes two coils with an aluminum plate inserted between them. The aluminum plate moves as tape tension varies and, accordingly, mutual inductance between the coils varies. This causes the sensor oscillation frequency and output voltage to vary proportionately. The variation of the output voltage is used to detect the movement of the tension arm.

The movement of the tension arm between A — C in Fig. 9-4-5 develops voltage at TP-1 (left tension sensor output voltage) and TP-2 (right tension sensor output voltage). (Refer to Fig. 9-4-8 for the test point locations.)

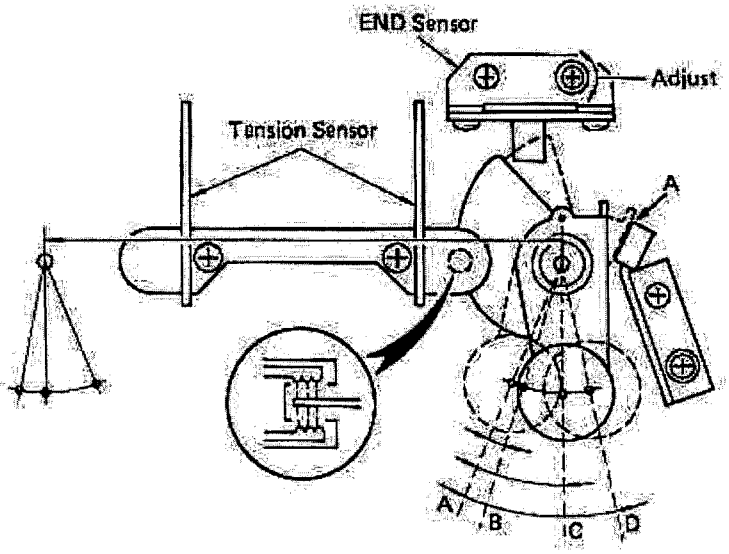


Fig. 9-4-5. Moving Position of The Tension Arm Ass'y

A : Stopper position of the tension arm.
A — D: Variable range of the arm
A — B: Detection range of END sensor
C : Position of arm setting while in the edit mode

A. Position of the tension arms while in the reproduce/edit mode.

1. Remove the front panel assembly as described in 9-3-1 (C).
2. Thread a blank tape onto the deck and wind half of the tape onto the take-up reel so that there is an equal amount of tape on both reels. Then set the deck into the edit mode of operation.
3. With the deck in the edit mode, confirm that both tension arms are near the C position shown in Fig. 9-4-5 – about 22.5° from the free position A.
4. If adjustment of the angle is necessary, adjust by adjusting the trimmer resistor located on the upper part of the Operation Panel L assembly. Refer to Fig. 9-4-6.

   REPRO (T) R38: Right tension arm (Take up reel)

   REPRO (B) R39: Left tension arm (Supply reel)

B. Tape tension while in the edit mode.

If proper tension arm positions have been obtained as described in A, proceed with the tape tension measurements.

Thread a blank tape onto the deck in the same manner as described in A (2) and set the deck into the edit mode. Measure the tape tension at both the take-up side and supply reel side with a tension analyzer or a tentelo meter. The measurement should be made at both the supply side and take-up side at points A and B as shown in Fig. 9-4-7.

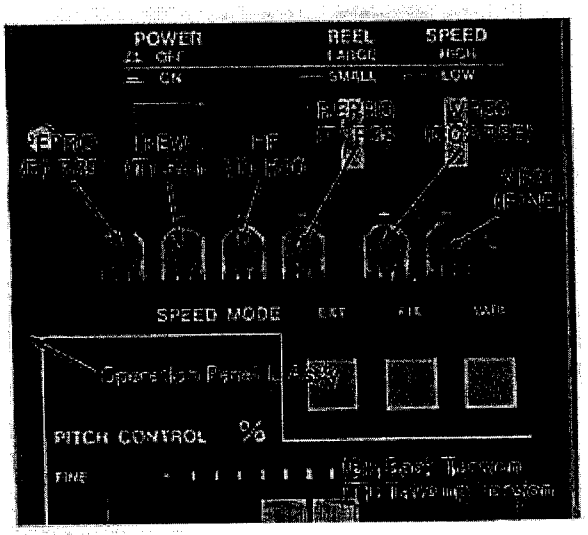


Fig. 9-4-6. Tape Tension Servo and Tape Speed Adjustment Pots

Tension values should be as follows:

-T, -N and -D models	40 ±10 g
-HS model	50 ±10 g

If you can't get this reading on your analyzer, adjust the tension strength of the spring by changing the position of the spring hook: Ⓐ and Ⓑ.

Note (-HS Only): As 10-1/2" reels cover more area than 8" reels, we suggest that you use the smaller 8" reels to ensure sufficient working room to get at the A and B points with the tentelometer probes.

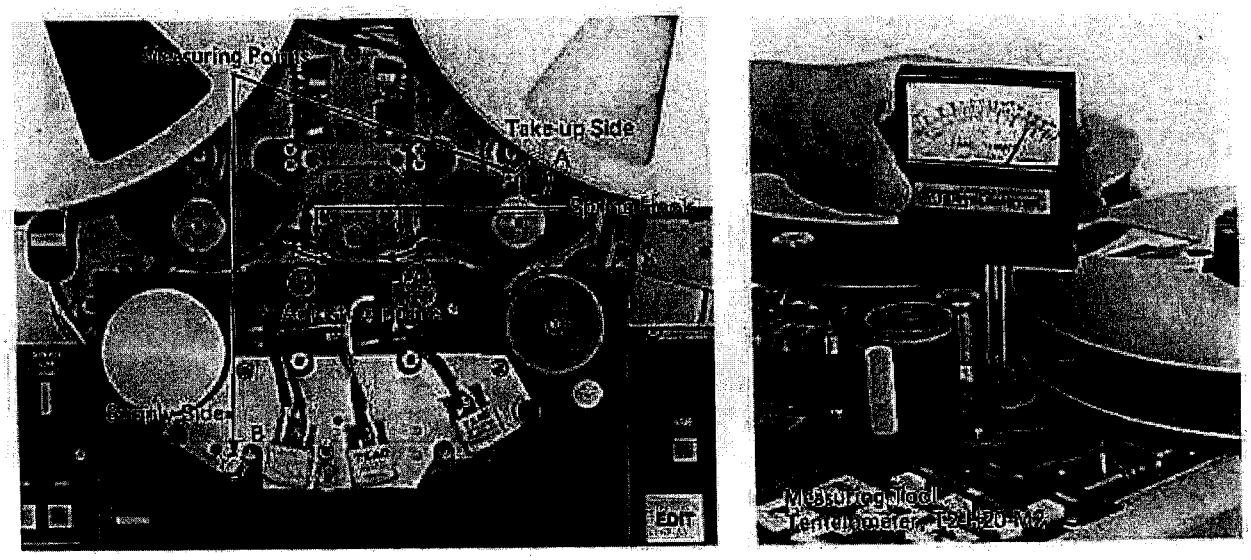


Fig. 9-4-7. Tape Tension Measurement and Adjustment Points

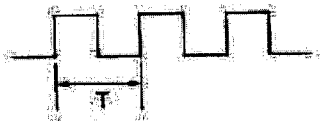
C. Tape tension while in the fast forward and rewind modes.

1. Load a tape and run it in fast forward. Check that the tension arm on the take-up side stabilizes at the C position shown in Fig. 9-4-5. If it does not, correct it by adjusting FF(T), R40 shown in Fig. 9-4-6. Then, run the tape in rewind and check, as in fast forward, that the tension arm on the take-up side stabilizes at C. If it does not, adjust REW(T), R41.
   If a tentelometer is used to measure tape tension, run tape in the Spooling mode, then stop the supply reel by hand and read the meter at A (in forward spooling) and B (in reverse spooling) shown in Fig. 3-4-7. The measurement should be read at both points. Adjustment pots to be used are the same as in the fast forward and rewind modes.
   Tension values should be as follows:
   -T, -N and -D models 110 ±10 g
   -HS model 170 ±15 g
   FF (T), R40 (forward)
   REW (T), R41 (reverse)

D. Motor Drive Adjustment
   This adjustment must be performed when:
* Motor drive PCB assembly has been replaced, or
* Irregular tape speed is observed.

1) Fast-winding "low" speed (40 ips, 100 cm/sec.) — the speed at which the tape runs at approaching the zero/cue points during the RTZ/STC modes.

1. Connect an oscilloscope between TP3 and GND on the Control PCB Ass'y, Fig. 9-4-8.
2. Short-circuit TP1 and GND on the same Control PCB Ass'y. (This allows the tape to run at the "low" speed when F. FWD or REW is engaged.)
3. Thread a blank tape on the recorder/reproducer, fast-wind the tape and stop when the middle portion of the tape is reached.
4. Engage the F. FWD mode and adjust LOW (R151) on the Motor Drive PCB Ass'y so that the square wave cycle time "T" becomes 8 msec.



2) FAST speed adjustment

5. Disconnect the shorting wire from TP1 and GND that was connected in step 1) -2.
6. Run the tape in the F. FWD mode.
7. Adjust FAST (R149) on the Motor Drive PCB Ass'y so that the square wave cycle time "T" becomes 0.9 msec.

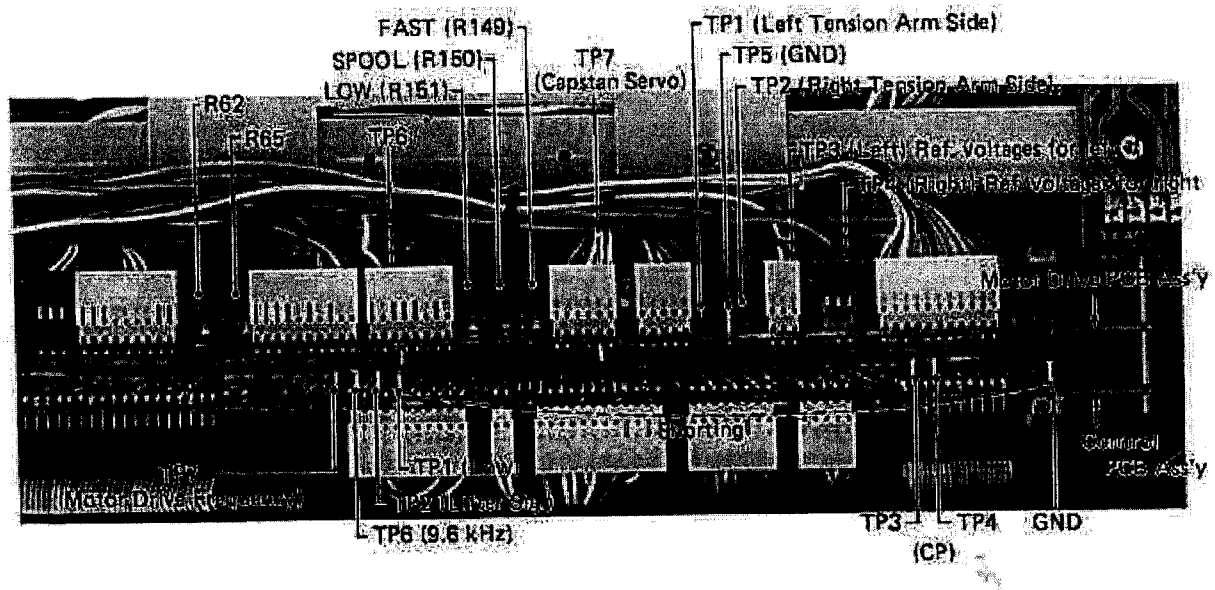


Fig. 9-4-8. Tape Tension Adjustment Pots and Test Points

3) Spooling speed adjustment

8. Run the tape in the spooling mode.
9. Adjust SPOOL (R150) so that the square wave cycle time "T" becomes 3 msec.

9-4-5. Re-installation of the Arm Stopper

Adjust the mounting position of the arm stopper so that it reaches point Ⓐ in Fig. 9-4-9 with tape unloaded (no tension applied to the tension arm: i.e., the right tension arm rests at point A in Fig. 9-4-5.).

9-4-6. Adjustment and Re-installation of the End Sensor Assembly

1. First loosen the adjustment screw on the end sensor assembly, lift the assembly upwards and temporarily secure; this will disable the end sensor.
2. Set the deck into the play mode without loading a tape.
3. Gradually move the end sensor assembly downwards, and tighten the adjustment screw at the point where the end sensor is activated.

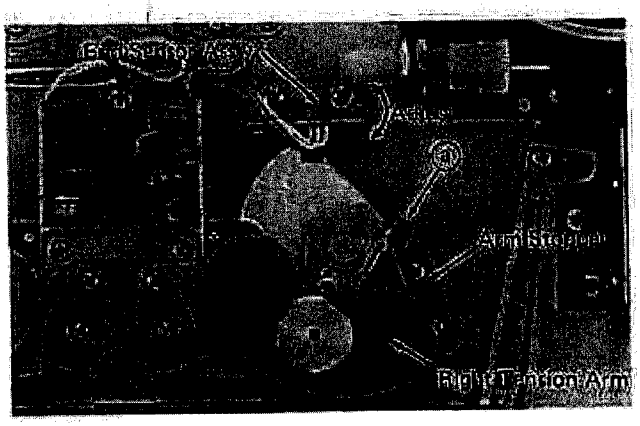


Fig. 9-4-9. Arm Stopper and End Sensor Ass'y Position Adjustments

9-4-7. Adjustment after Replacement of the Speed Sensor Assembly

After replacement of the speed sensor assembly which requires removal and reinstallation of the footage roller, it is necessary to check if the tape runs at stable speeds. Proceed as follows:

1. Connect an oscilloscope (double trace type) to two sets of test points; TP3 and GND, and TP4 and GND, on the Control PCB Ass'y, Fig. 9-4-8.
2. Thread a tape on the recorder/reproducer and run in the Repro mode.
3. Adjust the mounting position of the speed sensor assembly by loosening two mounting screws so that phase shift of the two inputs becomes 90°.
4. After adjustment, repeat switching between F. FWD and REW to confirm that the oscilloscope display remains stable.

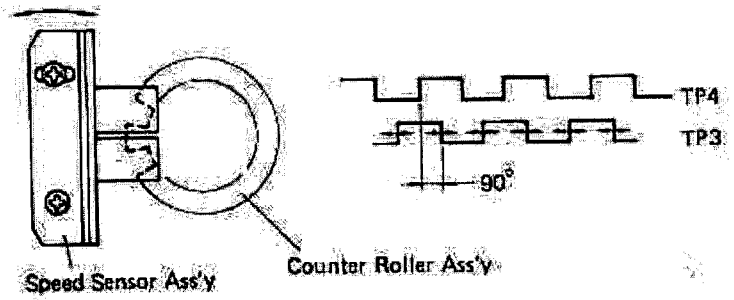


Fig. 9-4-10. Speed Sensor Ass'y Position Adjustment

9-4-8. Reel Table Height

Reel height adjustment is required only if a motor has been replaced or if tape rubs excessively against the reel flanges.
Adjustment is accomplished by loosening the reel set screws and moving the reel table on the motor shaft, so that the distance from the transport base surface to the rubber sheet upper surface meets the specifications given in Fig. 9-4-11. Remove the front panel assembly for access to the set screws in the reel motor shaft. Refer to paragraph 9-3-1(C). The reel table should be adjusted using standard NAB 10-1/2" reels. With a tape located on the machine, position the reel table height for smooth tape travel. Be sure to tighten the set screws after adjustment made.

A: 40.3 mm . . . . . (-T, -N and -D models)
41.3 mm . . . . . (-HS model)

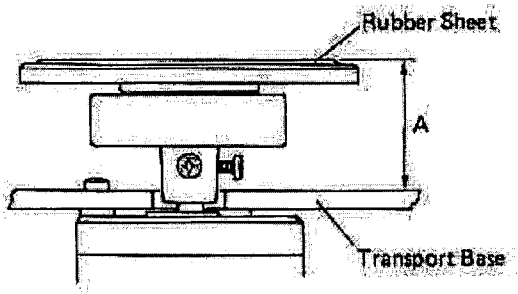


Fig. 9-4-11. Reel Tabel Height

9-4-9. Tape Speed

Tape speed is measured by using Flutter Test Tape which contains a highly accurate, continuous 3 kHz tone.

A. "FIX" Tape Speed
1. Connect a digital frequency counter to any OUTPUT, set the SPEED MODE switch on the deck to FIX.
2. Playing the tape at both the beginning and the end, check that the tape speed does not vary any more than the limits prescribed in the specifications. This is to assure that there will not be a total deviation of more than ±0.3 % from the 3000 Hz test tone.
3. If tape speed has greatly diverged from specification, check pinch roller pressure and takeup tension for correct values, and check to see that the tape path is clean.

B. "VARI" Tape Speed
1. Connect a digital frequency counter to any OUTPUT connector, and set the SPEED MODE switch to VARI, and the PITCH CONTROL sliders (FINE and COARSE) to the center position.
2. Play the middle portion of the test tape. Then, with the PITCH CONTROL sliders set fully left and right, take the necessary measurements. The measured results should be approx. 2,550 Hz or less with the PITCH CONTROL sliders set fully left (minimum speed), and 3,450 Hz or more with the PITCH CONTROL sliders set fully right (maximum speed).
3. If the obtained values differ from the above suggested values, adjust as follows:
   a. Set the SPEED MODE switch to VARI and the PITCH CONTROL sliders to the center position.
   b. Connect the frequency counter to TP6 and GND on the Control PCB Ass'y, Fig. 9-4-8. Then, while keeping an eye on the frequency counter, adjust VR33 (COARSE) shown in Fig. 9-4-6 until a 9,600 Hz ± 15 Hz reading is obtained, and then fine-adjust VR31 (FINE) to 9,600 Hz.

9-4-10. Wow and Flutter (Reproduce Method)

1. Connect a wow and flutter meter to any OUTPUT connector on the deck.
   These meters will measure the DIN/IEC/ANSI peak value or the NAB rms value, depending on the switch selection on the meter.
2. Playback the appropriate wow and flutter test tape, at nominal "FIX" speed.
3. If the peak or rms weighted value is to be read, set the wow and flutter meter for "weighted" readings and make sure that it is properly calibrated.
4. As the measured results may vary with respect to the location on the tape at which the measurement is taken, at least two locations — the beginning and end of the tape — should be checked. There may also be a slight difference in measured absolute values, depending on the brand of the meter being used.

Values should be as shown:

TABLE 9-4-2. WOW AND FLUTTER SPECIFICATIONS

(-T, -N and -D models)

Tape Speed	DIN/IEC/ANSI (peak value)		NAB	
	Weighted	Unweighted	Weighted	Unweighted
HIGH	±0.08 %	±0.12 %	0.05 %	0.07 %
LOW	±0.09 %	±0.14 %	0.06 %	0.09 %

(-HS model)

Tape Speed	DIN/IEC/ANSI (peak value)		NAB	
	Weighted	Unweighted	Weighted	Unweighted
HIGH	±0.06 %	±0.09 %	0.03 %	0.05 %
LOW	±0.08 %	±0.12 %	0.04 %	0.07 %

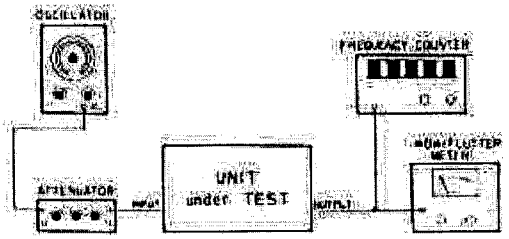
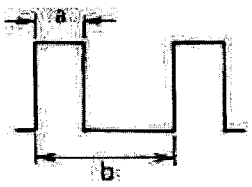


Fig. 9-4-12. Wow and Flutter Measurement Set-Up

9-4-11. Capstan Servo

The capstan servo will only require adjustment when the motor drive PCB has been replaced, or when the wow and flutter characteristics have greatly degraded because of the capstan servo itself.

1. Prior to making any adjustments to the capstan servo, connect an oscilloscope between test point TP7 and GND on the Motor Drive PCB Ass'y, Fig. 9-4-8; set R65 and R62 to their center positions and place the deck in play mode with a tape loaded.
2. While the tape is running at the fixed high speed, adjust R62 for an output duty factor of approx. 35 % (a/b) at TP7.



3. Next, with the SPEED MODE switch set to VARI, check that the PLL does not become unlocked when tape speed is changed by moving the PITCH CONTROL sliders fully left and right. If an unlock is detected with the PITCH CONTROL sliders set fully right (maximum), rotate R65 clockwise to lock the loop. If the loop becomes unlocked when the PITCH CONTROL sliders is set fully left (minimum), repeat steps 2 and 3.
4. Repeat steps 2 and 3 for low tape speed.

TABLE 9-5-1. AMPLIFIER ADJUSTMENT POTS AND CHOKES

TRIM POT NUMBER	REFERENCE NUMBER				FUNCTION
	HIGH Speed (15 ips)		LOW Speed (7-1/2 ips)		
#1	R313	5k ohms			INPUT LEVEL (LINE IN)
2-1	R314	50k ohms			METER LEVEL (TAPE)
2-2	R315	50k ohms			METER LEVEL (SOURCE) Model 52-NB, -DB only
3	R316	500k ohms	—		PEAK LED
4	—		R312	5k ohms	REPRO CAL
5	—		R311	5k ohms	SYNC CAL
6	R301	3.3k ohms	R303	3.3k ohms	NAB EQ REPRO
7	R302	3.3k ohms	R304	3.3k ohms	NAB EQ SYNC
8	R305	3.3k ohms	R307	3.3k ohms	IEC EQ REPRO
9	R306	3.3k ohms	R308	3.3k ohms	IEC EQ SYNC
10	R309	50k ohms	R310	50k ohms	REPRO, SYNC EQ (LOW-FREQ)
11	—		R320	100k ohms	BIAS LEVEL
12	—		R317	20k ohms	REC LEVEL
13	R318	6.8 k ohms	R319	6.8 k ohms	REC EQ (HIGH-FREQ)
—	L1	3 mH			BIAS TRAP (REPRO)
—	L4	3 mH			BIAS TRAP (RECORD)
—	L6	1.3 mH			BIAS TUNING

9-5-1. Before Making any Checks or Adjustments

This section contains the general descriptions and cautions required for the record/reproduce amplifier checks and adjustments.

Before going ahead with any of the electrical performance checks or adjustments, make sure the tape transport mechanism has been completely aligned as mentioned in the preceeding section, or at least make sure that the tape path and head contact are aligned correctly as mentioned later.

A. INPUT/OUTPUT

1. INPUT/OUTPUT Level

The nominal level at the XLR-type connectors is +4 dBm (1.23 V). The UNCAL switches on the amplifier module should be in the OFF position when performing electrical adjustments.

2. Connections to the Output Connectors

The nominal impedance at the XLR-type output connectors is 600 ohms.

CAUTION:

Be careful not to short-circuit pin 1 (GND) and pin 2 or pin 3 of the XLR-type output connectors.

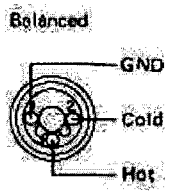
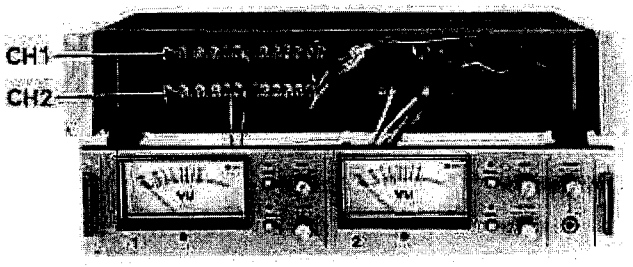


Fig. 9-5-2. XLR-type Connector Pin Outs

9-5. RECORD/REPRODUCE AMPLIFIER CHECKS AND ADJUSTMENTS (ATR-60-2T ONLY)

AUDIO CHANNELS



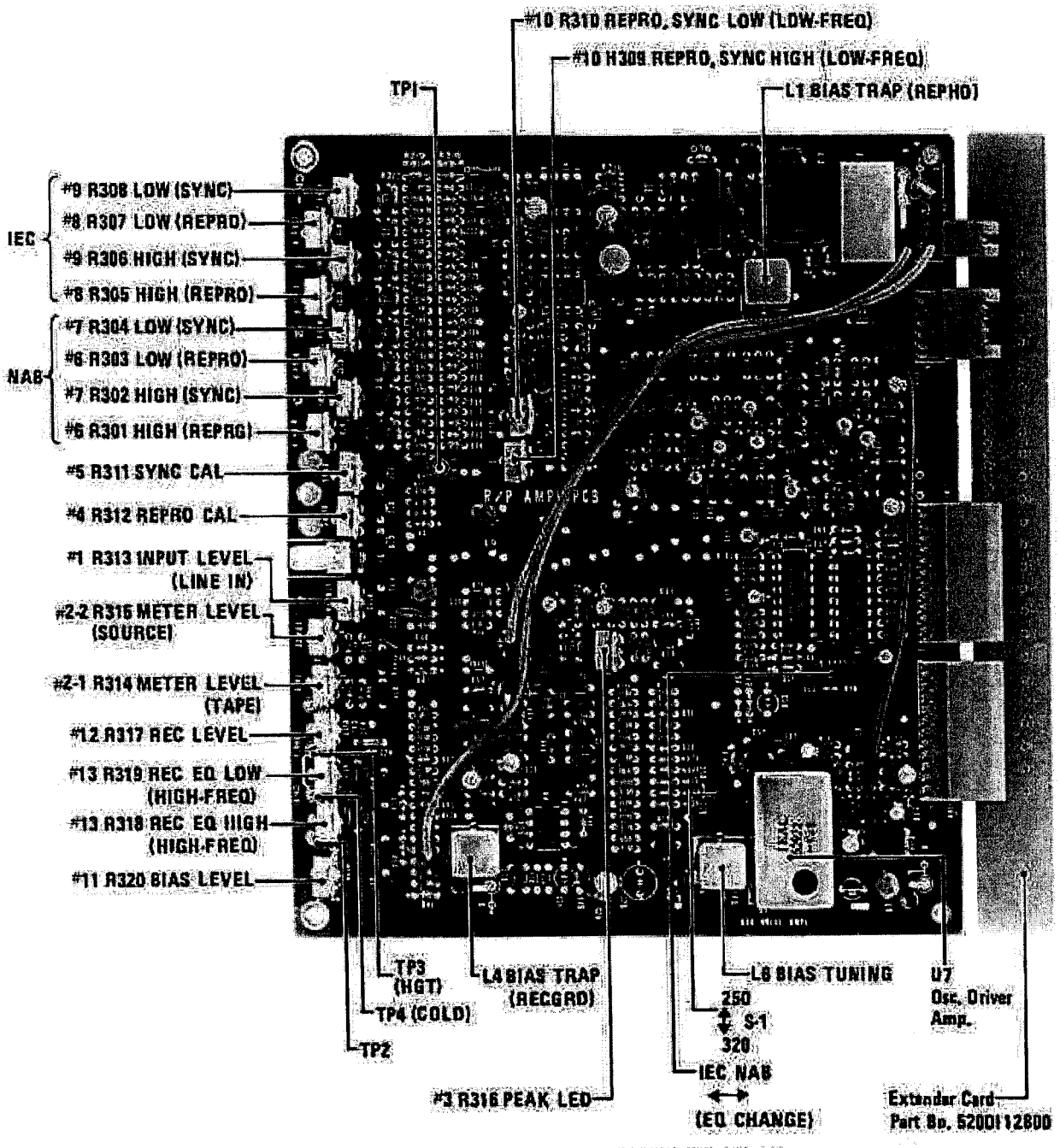


Fig. 9-5-1. Record/Reproduce Amplifier Adjustment Points

B. Tape path

The height of the tape guide ② and tension rollers should be so adjusted that the tape travels along the center width of the three heads (Erase, Rec/Sync, and Repro).

Check and adjust as follows:

1. Load a tape and run it in repro mode. Check that the upper edge of the tape is just touching the upper flange of the tape guide ②, and the lower edge of the tape the lower flange of the tape guides ① and ③ (see Fig. 9-5-4).

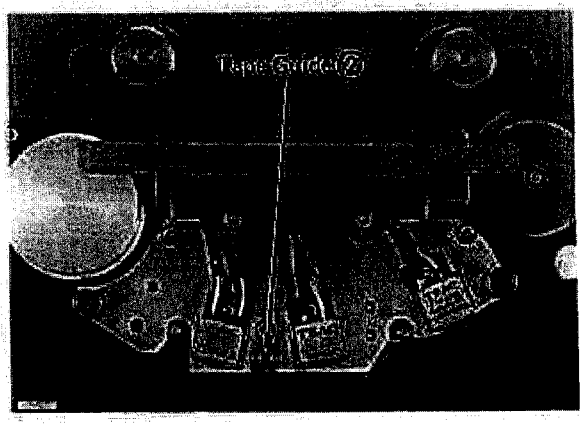


Fig. 9-5-3. Tape Guide Adjustment Point

2. If it does not and curling is observed at:
   a. Tape guide ②
      1. Loosen the screw located in the top center of the tape guide ②.
      2. Rotate the upper flange part of the tape guide ② in or out.
   b. Tape guide ①
      1. Loosen the screw located in the top center of the left tension roller.
      2. – To remove curling of the upper edge of the tape:
         Rotate clockwise the upper flange part of the left tension roller.
         – To remove curling of the lower edge of the tape:
         Rotate counterclockwise the upper flange part of the left tension roller.
   c. Tape guide ③
      1. Loosen the screw located in the top center of the right tension roller.
      2. – To remove curling of the upper edge of the tape:
         Rotate clockwise the upper flange part of the right tension roller.
         – To remove curling of the lower edge of the tape:
         Rotate counterclockwise the upper flange part of the right tension roller.
3. Check the adjustment. If curling persists, repeat necessary adjustments.

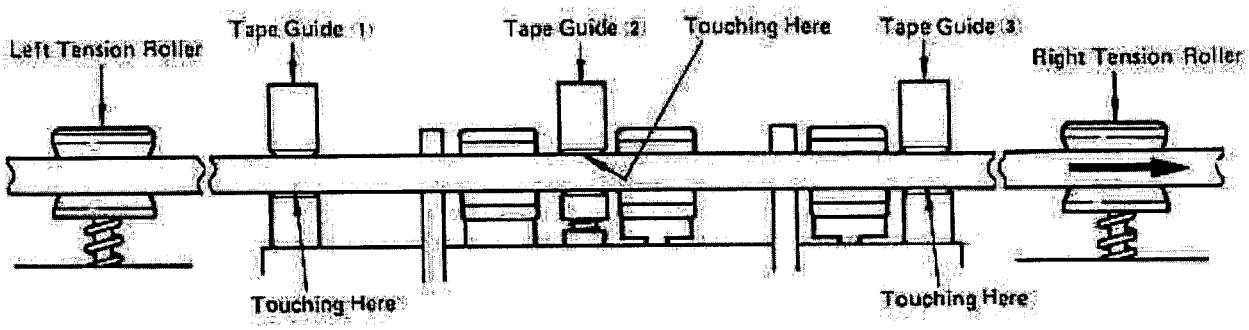


Fig. 9-5-4. Correct Tape Travel

C. Head contact

Contact of the record/sync head and the reproduce head is properly aligned by following the below methods.

1. Set the OUTPUT SELECT switch to REPRO or SYNC and load a reproduce alignment test tape, or a prerecorded tape with a constant 16 kHz level tone, and reproduce at a high speed of 15 ips. (38 cm/sec.).
2. While observing the VU meters, temporarily increase the back tension to the left reel by lightly applying pressure by hand. If sufficient contact pressure is applied to the head while the tape is running, no change will be noticed on the meter when the back tension is increased. However, if insufficient pressure is applied to the head, the deflection needle will show increased deflection due to contact pressure caused by the back tension. To adjust, loosen the retaining screw (A), that'll be the center screw at the rear of the head as shown in Fig. 9-5-5. Then, change the direction of the head for proper alignment.
3. With the test tape signal at 16 kHz, determine the point where maximum level of each channel is obtained and retighten the retaining screws (A) at that position.
4. For proper head contact, adjust the record/sync head as necessary.

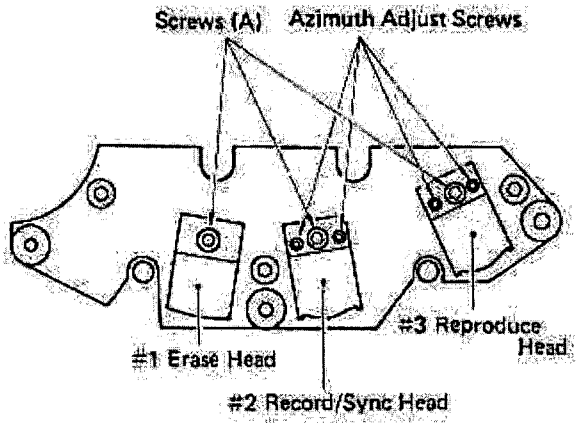


Fig. 9-5-5. Head Adjustment Screws

D. Head azimuth adjustment

1. Connect the CH1 OUTPUT connector of the deck to the vertical input terminal of an oscilloscope.
2. Connect the CH2 OUTPUT connector of the deck to the horizontal input terminal of the oscilloscope.
3. Connect an AF level meter to the OUTPUT connector as shown in Fig. 9-5-6.
4. Switch the OUTPUT SELECT switch to REPRO.
5. Load the reproduce alignment test tape to reproduce at a low speed of 7-1/2 ips. (19 cm/sec.). A scope display showing phase relations between both channels will be obtained as shown in Fig. 9-5-7.
6. Adjust the reproduce head azimuth screw until the scope display shows less than 90 degree out of phase at 12.5 kHz, with the AF level meter showing approximately maximum value for both channels.
7. Switch the OUTPUT SELECT switch to SYNC, and adjust the record/sync head azimuth screw the same way.

E. Others

* To get at the trim pots for record/reproduce amplifier circuit adjustments, open the meter panel by removing the four set screws, two on each side of the panel. (Refer to Fig. 9-5-8.) With the panel removed, you will see the amplifier boards to which the trim pots are mounted as shown in Fig. 9-5-8. The boards are identical and are exclusively used for their respective channels.
* 0 dBm = 0.775 V (600 ohms)
* The power should always be off when inserting or removing the record/reproduce amplifier PCB assembly.
* Be careful not to touch any trim pots while removing or replacing the record/reproduce amplifier PCB assembly.

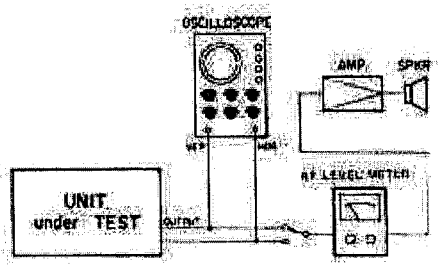


Fig. 9-5-6. Head Azimuth Test Set-Up

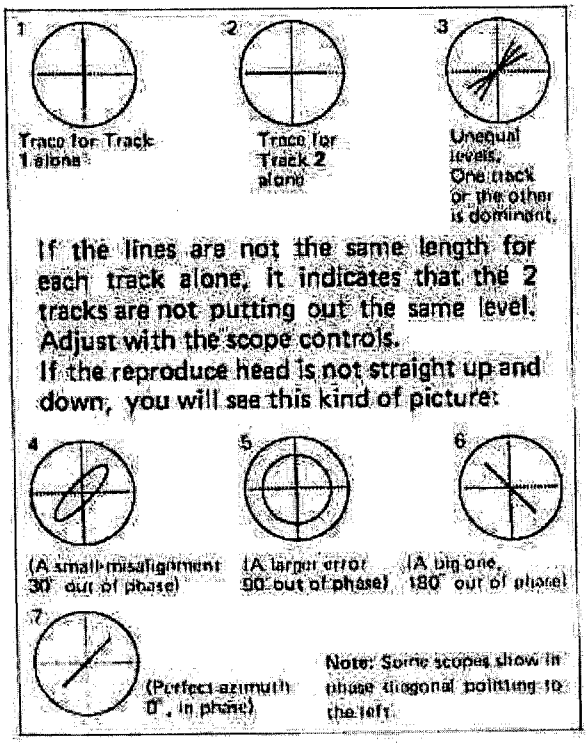


Fig. 9-5-7. Phase Shift

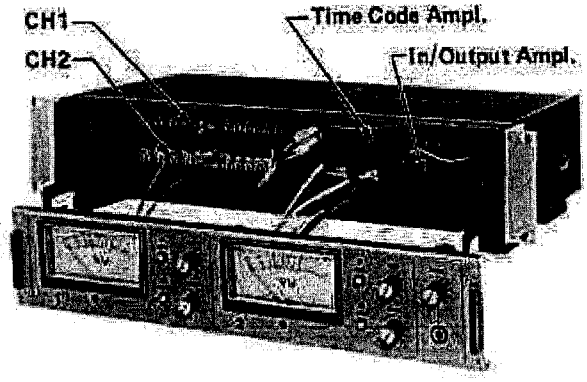


Fig. 9-5-8. Opening the Amplifier Module Front Panel

9-5-2. Input Level Calibration

1. Connect the test equipment to CH1 INPUT and CH1 OUTPUT as shown in Fig. 9-5-9.
2. Apply a 400 Hz, +4 dBm (1.23 V) test signal to the CH1 INPUT connector on the rear panel, and switch the OUTPUT SELECT switch to INPUT.
3. Make sure the AF level meter reads +4 dBm (1.23 V) output. If it doesn't, adjust R313, 5 k ohm trim pot on the record/reproduce amplifier PCB.
4. Adjust channel 2 in the same way.

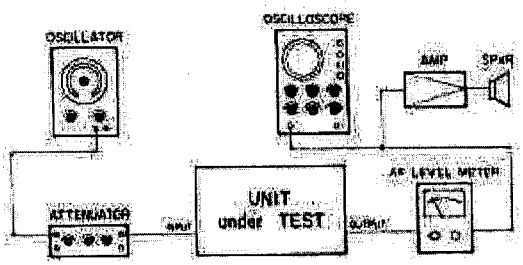


Fig. 9-5-9. Level or Frequency Response Measurement Set-up

9-5-3. Meter

1. Make sure that the meter indicates 0 VU after completion of the above steps 2-3, or after setting the input level to read +4 dBm output. If the meter does not indicate 0 VU, adjust the following trimmers on the record/reproduce amplifier PCB.
   R314 (TAPE signal)
   R315 (INPUT signal)
2. Check and adjust channel 2 in the same way.

9-5-4. Peak LED

1. Set the tape speed to high and with the conditions the same as described in 9-5-2, adjust R316, 400 k ohms so that the peak LED lights when the input level is raised 12 dB (input level +16 dBm) and turns off when reduced 1.5 dB (+15.5 dBm).
2. Check and adjust channel 2 in the same way.

9-5-5. Reproduce Level Calibration

1. Connect the AF level meter (and oscilloscope), to the CH1 OUTPUT connector on the rear panel.
2. Switch the OUTPUT SELECT switch to REPRO.
3. Load the reproduce alignment test tape for low 7-1/2 ips (19 cm/sec.) speed and reproduce the 400 Hz test tone. Observe the AF level meter, it should indicate +4 dBm (1.23 V), if not, adjust trim pot R312, 5 k ohms on the record/reproduce amplifier PCB.
4. Switch the OUTPUT SELECT switch to SYNC and reproduce the same tape. Check the AF level meter, it should read +4 dBm. If not, adjust trim pot R311, 5 k ohms on the record/reproduce amplifier PCB.
5. Check and adjust channel 2 in the same way. For reproduce alignment tapes and calibration level, refer to page 9-3.

9-5-6. Reproduce Frequency Response

1. Connect the AF level meter (and oscilloscope), to the CH1 OUTPUT connector.
2. Load the reproduce alignment test tape onto the tape deck and switch OUTPUT SELECT to REPRO.
3. Run the tape, then check the frequency response while noting the output level.

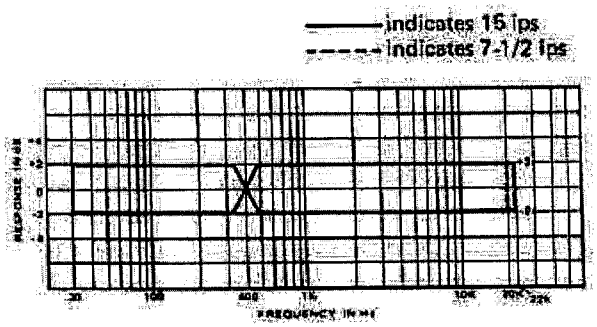


Fig. 9-5-10. Reproduce Frequency Response

4. If the AF level meter reading is not within the specified range, adjust the necessary trim pots by referring to Table 9-5-2 below.
5. Switch OUTPUT SELECT to SYNC.
6. Reproduce the same tape and read the output levels in the same manner as before to learn whether the frequency response is within the above specified limit. If it isn't, adjust the necessary trim pots by referring to Table 9-5-1.
7. Adjust channel 2 in the same way.
8. If the specified frequency response cannot be obtained with the trim pot(s) adjusted;
   * Check and compare the measurements of both channels. If they stand up to spec, correct or replace the off-spec channel's record/reproduce amplifier PCB.
   * If both channels are off spec, check power line, incorrect head adjustment, or whether heads should be cleaned.
   * Demagnetize the heads.
   * Finally, if all else fails, replace the heads.

9-5-7. Bias Tuning and Bias Trap Adjustments

These adjustments have been made at the factory and realignment will not be necessary except for the following circumstances:

* When the sync head, erase head and/or bias amplifier is replaced.
* When the MASTER BIAS unit is replaced.

Use the following procedures to adjust.

Note

* Be sure to use a non-conductive screwdriver (i.e. wood, plastic).
* For bias level measurements, use an AC level meter whose input terminal has a floating capacitance of 100 pF or lower.

TABLE 9-5-2. REPRODUCE FREQUENCY RESPONSE ADJUSTMENT POTS

	Tape Speed	Trim Pot		Adjust so that:
		REPRO	SYNC	
NAB EQ	HIGH	R301	R302	Level at 16 kHz becomes the same as the level at 400 Hz.
	LOW	R303	R304	Level at 12.5 kHz becomes the same as the level at 400 Hz.

A. BIAS TUNING (L6)

1. Place both channel FUNCTION (CH1 & CH2) switches to ON and set the tape deck into the record mode.
2. Connect a DC voltmeter between TP-3 (Hot) and TP-4 (Cold). By using an insulated screwdriver, adjust L6 so that a minimum reading is obtained on the DC meter. The minimum reading should be approximately 0.35 V if the bias level trim pot R320 is correctly set to the 3 o'clock position. The voltage at pin 4 of IC U7 of the OSC driver amplifier should be AC 70 V ±5 V.
   An extender card is required for the adjustment of the bias tuning coil L6. Pull out the PCB assembly of the channel that's to be adjusted and insert the extender card.
   Extender Card: TEAC part No. 5200112800

CAUTION: Do not try to obtain maximum reading on the DC voltmenter. This could occasion an extreme amount of bias amplifier output load.

B. BIAS TRAP (L4, L1)

1. Connect an AC level meter between TP-2 and chassis (ground).
2. Place both FUNCTION (CH1 & CH2) switches to ON and set the deck into the record mode.
3. Adjust L4 so that a minimum reading is obtained on the level meter.
4. Connect an oscilloscope to the OUTPUT connector.
5. Set the OUTPUT SELECT switch to REPRO.
6. With the deck set in the record mode, check the amount of bias signal leaking into the reproduce amplifier.
7. Adjust trim conductor L1 so that the amount of bias leakage is minimized.

9-5-8. Bias Level

This adjustment is made while you are recording a tone on the type of tape you'll be using for the session. It will be different for each brand of tape. Before proceeding with this adjustment, make sure that the tape path and head contact have been adjusted correctly as mentioned earlier and that no tape curling is noticed.

1. Connect an AF oscillator to CH1 INPUT connector, and an AF level meter to CH1 OUTPUT connector.
2. Adjust the AF oscillator to apply a 10 kHz, -6 dBm (388 mV, -10 VU) signal to CH1 INPUT connector on the rear panel.
3. Switch the OUTPUT SELECT switch to REPRO and set both FUNCTION (CH1 & CH2) switches to ON.
4. Begin recording channel 1 at low speed 7-1/2 ips (19 cm/s). Now adjustments can be made while recording a 10 kHz tone.

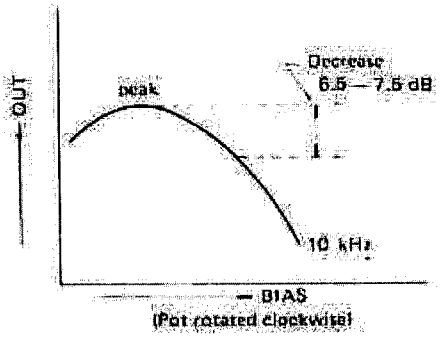


Fig. 9-5-11. Bias Level Adjustment

5. Begin the adjustments by turning trim pot R320, 100 k ohms completely counterclockwise. Next, turn the trim pot itself clockwise and the AF level meter will rise to give peak reading. Slowly continue the clockwise rotation until the reading on the level meter drops 6.5 — 7.5 dB from the peak reading as shown in Fig. 9-5-11.
6. Repeat the same procedures on channel 2.

9-5-9. Recording Level

Recording level adjustments should be done only after the reproduce level and recording bias have been properly set as specified above.

1. Connect the test equipment to the tape deck in the same manner as described in 9-5-8.
2. Apply a 400 Hz, +4 dBm (1.23 V) signal to the CH1 INPUT connector.
3. Switch the OUTPUT SELECT switch to REPRO and record the 400 Hz input signal on the specified recording test tape at a low speed of 7-1/2 ips (19 cm/sec.).
4. Check the AF level meter, it should indicate +4 dBm (1.23 V). If it doesn't, adjust trim pot R317, 20 k ohms to obtain the +4 dBm indication. At this time, make sure that the front panel VU meter indicates 0 VU.
5. Switch the OUTPUT SELECT switch to SYNC and record the 400 Hz input signal for a brief period of time. Then, rewind the tape just recorded and reproduce it. Make sure that both the AF level meter and the VU meter indicate +4 dBm and 0 VU, respectively.
6. If it's impossible to obtain a VU meter reading of 0 VU in steps 4 and 5 above, check to

see whether the reproduce meter is set as described under 9-5-3. "Meter".
7. Check and adjust channel 2 in the same way.

9-5-10. Frequency Response (OVERALL)

After completing the recording level check and adjustments, proceed onto the overall frequency response checks.

1. Connect the test equipment to the tape deck the same as described in 9-5-8 and load a blank test tape onto the tape deck.
   TEAC Blank Test Tape: YTT-8063.
2. Set the OUTPUT SELECT switches to REPRO and the "CH1" FUNCTION switch to ON.
3. Record and reproduce an input signal of 400 Hz, +4 dBm (1.23 V) at 15 ips (38 cm/sec.), then change the frequency and check that the output is still within specification. If not, adjust REC EQ, R318, 6.8 k ohms using a frequency higher than 20 kHz.
4. For a tape speed of 7-1/2 ips (19 cm/sec.), record and reproduce an input signal of 400 Hz, -8 dBm (388 mV), then change the frequency and check that the output is still within specification. If not, adjust REC EQ, R319, 6.8 k ohms using a frequency higher than 20 kHz.
5. Switch the OUTPUT SELECT switch to SYNC and record the test signals the same as before. When the recording is finished, rewind the tape just recorded and reproduce it. Measure the reproduced output levels at the proper test frequencies, and make sure that the frequency response is within the specified limit shown.
6. If the frequency response reading is not within the specified limit, readjust the bias level setting within its specified range by referring to 9-5-8 "Bias Level". When the frequency response in the lower frequency spectrum is not within the specified limits, adjust trim pot R309, 50 k ohms at high speed; R310, 50 k ohms at low speed. If the bias level is readjusted, the recording level adjustment will be upset, so repeat the recording level adjustments again as described in 9-5-9 "Recording Level".

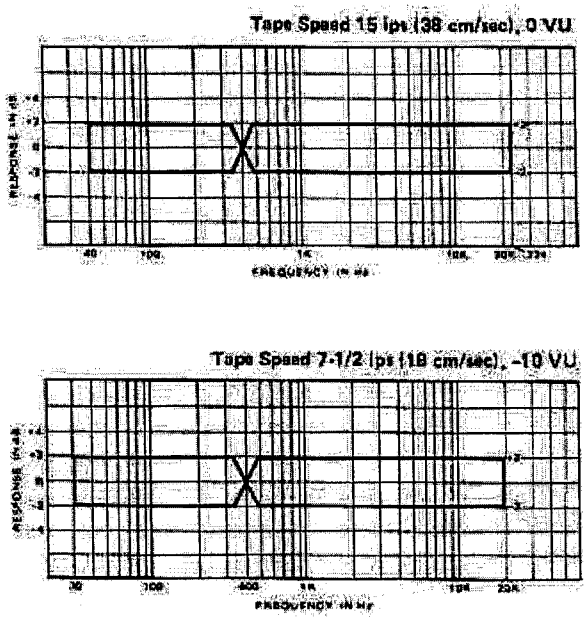


Fig. 9-5-12. Overall Frequency Response

9-5-11. Signal-to-Noise Ratio (OVERALL)

Before going ahead with any measurements, demagnetize all heads and tape guides.

1. Connect test equipment the same as described in paragraph 9-5-8.
2. Apply a 400 Hz, +4 dBm (1.23 V = 0 VU) input signal to CH1 INPUT connector on the rear panel.
3. Switch the OUTPUT SELECT switch to SYNC and record a short length of the input signal. Then, while still in the recording mode, unplug the AF oscillator connected to the CH1 INPUT connector, and make another length of no-signal recording.
4. Rewind the recording made in step 3 to the beginning and reproduce.
5. While making sure the reproduce output of the previously recorded 400 Hz 0 VU signal is +4 dBm, raise the sensitivity of the AF level meter and measure the level of the no-signal portion of the tape.
6. With +4 dBm (0 VU) as the reference level, the signal-to-noise ratio, as measured by the AF level meter, should be better than 50 dB.
7. If it is off spec,
   * Check and compare the measurement of the other channel. If they stand up to spec, correct or replace the off spec channel record/reproduce amplifier PCB.
   * Demagnetize the heads.
   * Check erasure, refer to 9-5-12.
   * Check for proper adjustment of the bias trap.

9-5-12. Erase Ratio

1. Connect test equipment to the tape deck as shown in Fig. 9-5-13. The filter to be used should be a 1 kHz bandpass filter.
2. Switch the OUTPUT SELECT switch to SYNC and record a short length of the 1 kHz, +14 dBm (3.88 V) signal on channel 1 and unplug the AF oscillator connected to the CH1 INPUT connector on the rear panel.
3. Rewind the tape to the beginning of the recorded section.
4. Record a no-signal portion over the recording of the 1 kHz signal.
5. Play the tape and compare the level from the 1 kHz signal recording with the level from the no-signal recording. The level difference should be 70 dB or greater.
6. Check channel 2 in the same way.

If the level difference is below the specified value, check erase head output voltage for 65 – 75 V using an AC voltmeter, and, if necessary, adjust the erase head position by loosening the screw located behind the erase head.

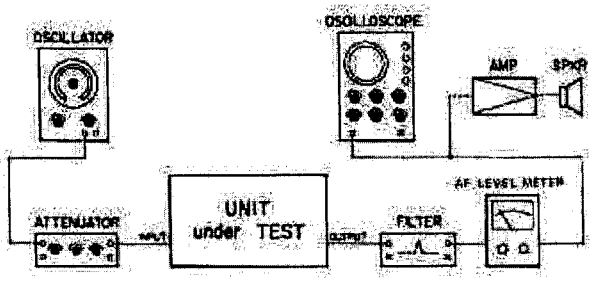


Fig. 9-5-13. Erase Ratio Test Set-Up

9-5-13. Adjacent Channel Crosstalk

1. Connect test equipment as shown in Fig. 9-5-14.
2. While making a no-signal recording on one of the channels, record a 1 kHz, +4 dBm (1.23 V) test signal on the adjacent channel.
3. Rewind the tape to the beginning of the recording.
4. Reproduce the tape with the OUTPUT SELECT switch set to SYNC. Then, measure the output (signal leakage) of the no-signal recorded channel.
5. Compare the level from the no-signal recording channel with the level from the 1 kHz recording channel. The difference should be 50 dB or greater.

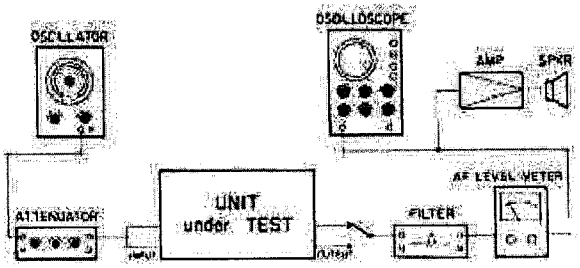


Fig. 9-5-14. Crosstalk Measurement Set-Up

9-5-14. Distortion

1. Connect test equipment as shown in Fig. 9-5-15.

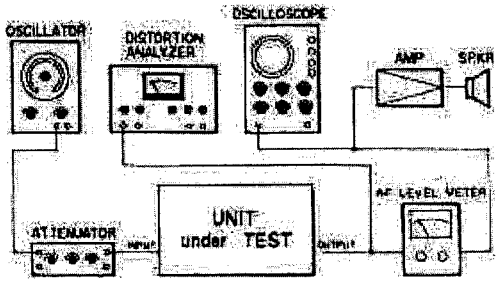


Fig. 9-5-15. Distortion Measurement Set-Up

2. Switch the OUTPUT SELECT switch to REPRO.
3. Apply a 1 kHz, +4 dBm (1.23 V) test signal to the INPUT connector and record.
4. Stop the recording and switch the OUTPUT SELECT switch to SYNC.
5. Rewind the tape to its beginning and reproduce. Measure the distortion of the reproduced output with a distortion analyzer connected to the OUTPUT connector.
6. The distortion measured should be less than 0.6 % for a +4 dBm recording.
7. If the distortion is off spec:
   * Check and compare the measurements of the other channel. If it stands up to spec, correct or replace the off-spec channel's record/reproduce amplifier PCB.
   * Check bias level setting and re-adjust if necessary.
   * Demagnetize the heads.
   * If all else fails, replace the heads.

9-5-15. Headphones

1. Connect an 8-ohm dummy load, a level meter and an oscilloscope to the headphone terminal.
2. Switch the OUTPUT SELECT switch to INPUT.
3. Connect a 400 Hz, +4 dBm (1.23 V) test signal to the CH-1 or CH-2 INPUT connector.
4. Turn up the headphone volume control until the waveform of the output signal starts to distort; measure the level at this point for a reading of 0.9 V or more.

9-5-16. Output Level Switching

The nominal output level at the XLR connectors can be changed from +4 dBm (1.23 V) to +8 dBm (1.95 V). Fig. 9-5-16 shows switches S102/S202 (CH-1/CH-2) on the Input/Output Amplifier PCB Ass'y. By resetting these switches, the gain of the output amplifier is boosted 4 dB to achieve the nominal output level of +8 dBm (1.95 V).

The output level can also be set to −20 dBm by switching S102/S202 to the −20 position.

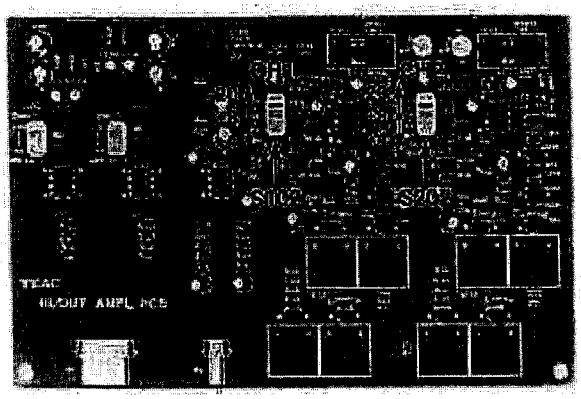


Fig. 9-5-16. Input/Output Amplifier PCB Ass'y

TABLE 9-5-3. CHECKS AND ADJUSTMENTS CHART

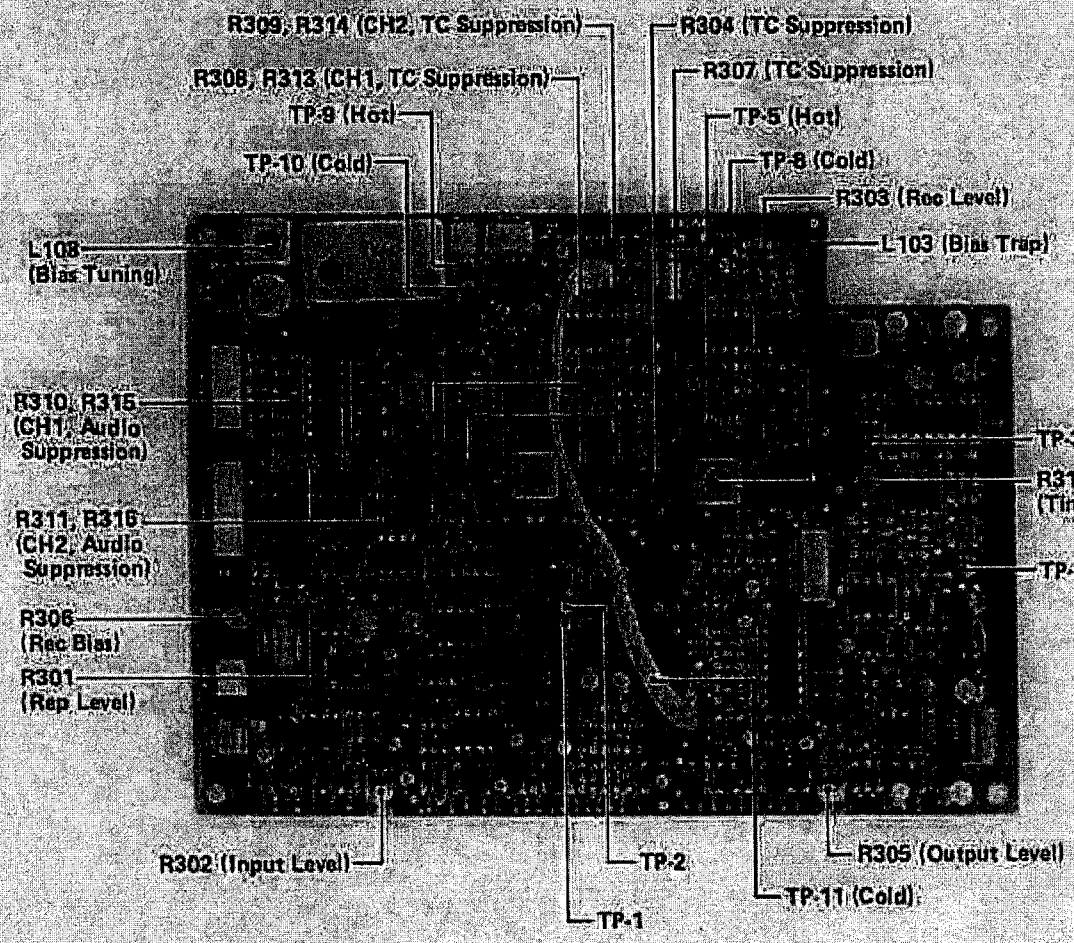
ADJUST STEP	WHAT IS IT CALLED	SIGNAL SOURCE AND AMOUNT	WHAT TEST GEAR TO USE	WHAT IS THE RECORDER DOING	POINT TO ADJUST	WHAT READING TO ADJUST FOR
1	Input Level	400 Hz signal at +4 dBm from oscillator connected to INPUT connector.	VTVM connected to OUTPUT connector or VU meters.	Stop mode. OUTPUT SELECT at INPUT.	Trim pot #1 R313	+4 dBm (1.23 V) on VTVM or 0 VU on VU meters.
2	Meter Adjustment *Refer to 9-5-3 Meter	*Same as above. Play reference level.	VU Meter	*Same as above. at SYNC.	*Trim pot #2-1 R314, #2-2 R315.	Adjust to read 0 VU on VU meters.
3	PEAK LED	400 Hz signal at +16 dBm.	PEAK LED	Tape speed at HIGH.	Trim pot #3 R316	Adjust to light PEAK LED.
4	Reproduce Head Alignment	Reproduce alignment test tape. (7-1/2 ips) Refer to page 9-3.	VTVM and oscilloscope with vertical and horizontal inputs connected to OUTPUT tracks 1 and 2.	Reproduce at 7-1/2 ips speed. OUTPUT SELECT at REPRO.	Repro head azimuth adjusting screw.	Adjust for maximum output and for output of tracks 1 and 2 less than 90° out of phase. (at 12.5 KHz)
5	Record/SYNC Head Alignment	Same as above	Same as above	Reproduce at 7-1/2 ips speed. OUTPUT SELECT at SYNC.	Record/SYNC head azimuth adjusting screw.	Same as above
6	Reproduce Level (Repro head)	Reproduce alignment test tape. (7-1/2 ips) Play 400 Hz reference level signal.	VTVM connected to OUTPUT connector.	Reproduce at 7-1/2 ips speed. OUTPUT SELECT at REPRO.	Trim pot #4 R312	+4 dBm (1.23 V) on VTVM.
7	Reproduce Level (Record/SYNC head)	Reproduce alignment test tape. Play 400 Hz reference level signal.	Same as above	Reproduce tape at 7-1/2 ips. OUTPUT SELECT at SYNC.	Trim pot #5 R311	+4 dBm (1.23 V) on VTVM.
8	Reproduce EQ at 15 ips speed. (Repro head)	Play 16 kHz signal on test tape.	VTVM connected to OUTPUT connector.	Reproduce at 15 ips speed. OUTPUT at REPRO.	NAB: Trim pot #6 R301	Adjust to read +4 dBm on VTVM, same level as 400 Hz signal.
9	Reproduce EQ at 15 ips speed. (Record/SYNC head)	Same as above	Same as above	Reproduce at 15 ips speed. OUTPUT SELECT at SYNC.	NAB: Trim pot #7 R302	Same as above
10	Reproduce EQ at 7-1/2 ips speed. (Repro head)	Play 12.5 kHz signal on test tape.	Same as above	Reproduce at 7-1/2 ips. OUTPUT SELECT at REPRO.	NAB: Trim pot #8 R303	Same as above
11	Reproduce EQ at 7-1/2 ips speed. (Record/SYNC head)	Same as above	Same as above	Reproduce at 7-1/2 ips. OUTPUT SELECT at SYNC.	NAB: Trim pot #7 R304	Same as above
12	Bias Tuning	No input signal	VTVM connected to Bias Tuning test point, negative lead to TP-4, positive lead to TP-3	Record mode, no input signal.	Inductor L6	Adjust inductor for minimum output at test point.
13	Bias Trap Adjustment	Same as above	VTVM connected to Bias Trap test point TP-2. VTVM connected to OUTPUT connectors.	Record mode, no input signal. OUTPUT SELECT at REPRO.	Inductor L4 Inductor L1	Adjust inductor for minimum output at Bias Trap test point or OUTPUT jacks. *See page 9-17 for test point location.

AD-JUST STEP	WHAT IS IT CALLED	SIGNAL SOURCE AND AMOUNT	WHAT TEST GEAR TO USE	WHAT IS THE RECORDER DOING	POINT TO ADJUST	WHAT READING TO ADJUST FOR
14	Bias Level Adjustment	10 kHz, -6 dBm oscillator signal connected to INPUT connector.	VTVM connected to OUTPUT connector.	Record signal on type of tape that will be used for actual recording at 7-1/2 ips. OUTPUT SELECT at REPRO.	Trim pot #11 R320	While recording adjust trim pot until VTVM indication rises to peak value, then turn pot further clockwise until signal drops off by 6.5–7.5dB from -6 dBm (over-bias)
15	Recording Level	400 Hz signal at +4 dBm (0 VU on VU meters) connected to INPUT connector.	VTVM connected to OUTPUT connector or use VU meters.	Same as above	Trim pot #12 R317	Set for +4 dBm (0.3 V) at OUTPUT connectors or 0 VU on VU meters.
16	Overall Frequency at 15 ips speed. (HIGH-FREQ)	20 kHz or higher signal connected to INPUT connector.	Same as above	Record on selected tape at 15 ips. OUTPUT SELECT at REPRO or SYNC.	Trim pot #13 R318	Check that frequency response matches limits given in Fig. 9-5-12 on page 9-24.
17	Overall Frequency at 7-1/2 ips speed. (HIGH-FREQ)	20 kHz or higher signal connected to INPUT connector (at -6 dBm).	Same as above	Record on selected tape at 7-1/2 ips. OUTPUT SELECT at REPRO or SYNC.	Trim pot #13 R319	Same as above
18	Low Frequency at 15 ips speed	40 Hz signal connected to INPUT connectors (at +4 dBm).	Same as above	Record on selected tape at 15 ips. Other conditions the same as above.	Trim pot #10 R309	Same as above
19	Low Frequency at 7-1/2 ips speed.	40 Hz signal connected to INPUT connectors (at -6 dBm).	Same as above	Record on selected tape at 7-1/2 ips. Other conditions the same as above.	Trim pot #10 R310	Same as above
20	Overall Signal-to-Noise Ratio	No input signal	VTVM connected to OUTPUT connectors.	Record mode at 15 or 7-1/2 ips speed. OUTPUT SELECT at SYNC.		Check for 50 dB or better.
21	Erase	1 kHz signal at +14 dBm connected to INPUT connectors. This is +10 VU on meters. Apply signal for short time only.	VTVM and 1 kHz band pass filter connected to OUTPUT.	Record 1 kHz signal, rewind, remove input. Record no-input signal over 1 kHz signal recording. OUTPUT SELECT at SYNC.	Check only	Check for 70 dB or greater (through a 1 kHz filter)

9-6. ADDITIONAL CHECKS AND ADJUSTMENTS FOR THE ATR-60-2T

The following adjustments have been made at the factory and any realignment will not be necessary except when:

— a head or heads are replaced;
— the time code amplifier PCB ass'y is replaced; or
— any error is detected in time code recording and/or reproducing.



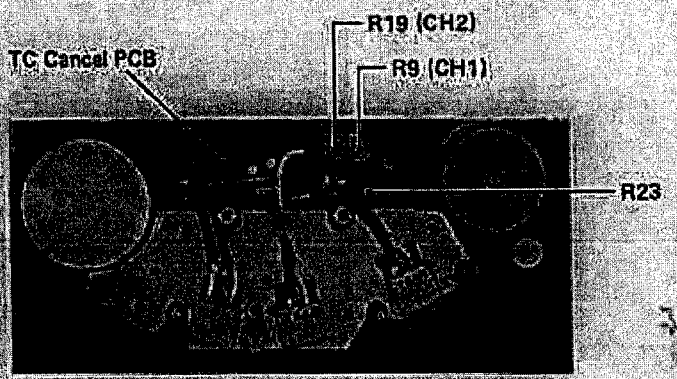


Fig. 9-6-1. Time Code Amplifier Adjustment Points

9-6-1. MEMO Signal

A. Reproduce Level Set

1. Make the following switch settings for the TIME CODE CH:

   MEMO/TIME CODE select switch to MEMO; REC MODE switch to OFF.

2. Reproduce a frequency response test tape (record level 250 nWb/m, 1 kHz) at LOW speed.
3. Check the time code amplifier output level at TP-1. The level reading should be -6 dBV (0.5 V) ±0.5. Adjust semi-fixed resistor R301 if necessary.

B. Output Level Set

1. With the same conditions as in paragraph A, check for +14 dBm (3.88 V) ±0.5 at the XLR-type TIME CODE CH OUTPUT connector. If the level is out of the specified range, adjust semi-fixed resistor R305.
2. Switch the MEMO/TIME CODE select switch to the TIME CODE (up) position and check output waveform (1 kHz). It should be of 2 Vp-p (±0.4 Vp-p) squarewave form.

* If, when the time code PCB ass'y is replaced, any output is not obtainable, resort to semi-fixed resistor R312.

C. Input Level Set

1. Make the following switch settings for the TIME CODE CH:

   MEMO/TIME CODE select switch to MEMO; REC MODE switch to ON.

2. Connect a 1 kHz, +4 dBm (1.23 V) signal to the XLR-type TIME CODE CH INPUT connector.

* Check for +4 dBm ±0.5 at the XLR-type TIME CODE CH OUTPUT connector. If necessary, adjust semi-fixed resistor R302.

D. Input Limiter

With the same conditions as in paragraph C, raise the input level 10 dB up to +14 dBm (3.88 V) and check for an output level of +9 dBm (2.18 V). Then, decrease the input level 10 dB down to -6 dBm (388 mV) and check for an output level of -6 dBm ±2.

E. Bias Tuning (L108)

1. Connect a DC voltmeter to Time Code Amp test points, TP-9 (hot) and TP-10 (cold).
2. Set the TIME CODE CH to REC mode.
3. Adjust L108 for minimum reading on the DC voltmeter. The reading should be approx 0.3 V.

Note: After adjustment of L108, waite one minute or so on and check that the reading on the DC voltmeter remains unvaried.

CAUTION: Do not try to obtain maximum reading on the DC voltmeter. If you do, excessively so high an electrical strain will be applied to the bias driva amplifer that this will be damaged.
Be sure to use a non-conductive screwdriver (i.e., wood, plastic).

F. Bias Trap Adjustment (L103)

1. Connect an oscilloscope to the Time Code Amp test points, TP-5 (Hot) and TP-11 (Cold).
2. With the same conditions as in paragraph E (TIME CODE CH in REC mode), adjust L103 so that leakage at TP-5 becomes minimum.

G. Record Bias Adjustment

Before performing the record bias adjustment procedure that follows, perform the bias trap adjustment, paragraphs E and F.
The Record Bias Adjustment will be necessary only when:

— it is necessary to fine-adjust the record bias corresponding to type of tape you'll use for the actual recording session; or
— the Record/Sync head and/or Erase head are replaced.

1. Connect a DC voltmeter to both ends of R23 (1 ohm) on the TC Cancel PCB.
2. Put the recorder/reproducer into REC mode and previously set record bias by adjusting semi-fixed resistor R306 so that the DC voltmeter shows a reading of 2.5 mV (0.25 mA) at both ends of R23.
3. Then connect an AC level meter between TP-8 (hot) on the time code amp and GND terminal and apply a +4 dBm, 1 kHz signal to TIME CODE CH INPUT.
4. With the transport in REC mode, adjust semi-fixed resistor R303 for 0 dBV (1 V) at TP-8.
5. Load a blank tape, record a 1 kHz signal and then a 6 kHz signal at LOW speed. Then reproduce the two recordings (at LOW) and note the level reading at TP-8. Level difference between the 1 kHz and 6 kHz portions should be within 1 dB. If not, readjust R306.

H. Record Level Set

With the same conditions as in paragraph G, set the input signal frequency to 1 kHz (+4 dBm), record it and reproduce the recording. Readjust R303 so that the reproduce output level becomes +4 dBm (±0.5).

I. Overall Frequency Response

With the same conditions as in paragraph H, sweep the input signal frequency from 400 Hz

shown here for minimum reading at the level meter.

CH1	R308, R313
CH2	R309, R314

D-4. Audio signal leakage suppression (Time Code channel in reproduce mode and Audio channel in record mode)

Adjustment is made so that audio signal leakage level appearing at TP-3 becomes minimum (over 100 Hz to 20 kHz) and must be repeated for each of the audio channels.

1. Make the following switch settings:
   TAPE SPEED to LOW;
   OUTPUT SELECT to INPUT;
   REC MODE (TIME CODE CH) to OFF.
2. Adjustment is made while recording a +10 VU audio signal connected to INPUT of the audio channel to be checked.
   a) Adjust for a minimum level at TP-3 the semi-fixed resistors shown in chart while changing the input signal frequency as shown.

TABLE 9-6-1. AUDIO SIGNAL LEAKAGE ADJUSTMENT POTS

	f	CH1	CH2
①	1 kHz	R9 (TC Cancel PCB)	R19 (TC Cancel PCB)
②	7 – 8 kHz	R310, R315	R311, R316
③	15 kHz	Confirm that leakage level is minimized thanks to adjustments ① and ② made with the above resistors.	

   b) Repeat adjustment in step a) several times, then, the audio level at TP-3 will become approx. 20 dB lower than the time code signal level obtainable at the same test point, TP-3, under the same conditions as in D-1, presenting a peak around at 1 kHz and 20 kHz. Level at 2 – 3 kHz will be approx. 5 dB lower than at 1 kHz. See Fig. 9-6-3.
   c) When both audio channels have been checked individually, feed them simultaneously and again measure leakage level at TP-3. It should be approx. -15 dB or lower at 1 kHz and 20 kHz and, -20 dB or lower around at 2 – 3 kHz.

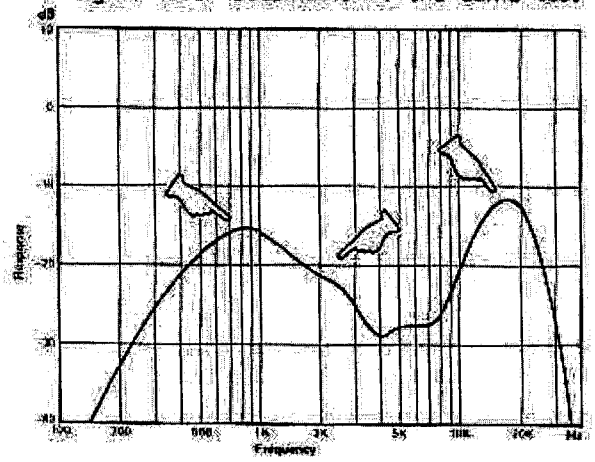


Fig. 9-6-3. Crosstalk from AUDIO CH1 & 2 to TIME CODE CH

D-5. LEVEL LEDs

1. Make the following switch settings:
   MEMO/TIME CODE to MEMO;
   REC MODE to ON.
2. Apply a 1 kHz signal to the TIME CODE CH INPUT connector and check that the LEDs light as the output level is varied as shown.

OUTPUT LEVEL (approx.)	LED(s)
+14 dBm	OVER*
+8 to +9 dBm	NORM and OVER
+4 dBm	NORM
-2 to -3 dBm	UNDER and NORM
-10 dBm	UNDER

*"OVER" LED condition must be checked using a time code signal (record it, then reproduce it in MEMO position).

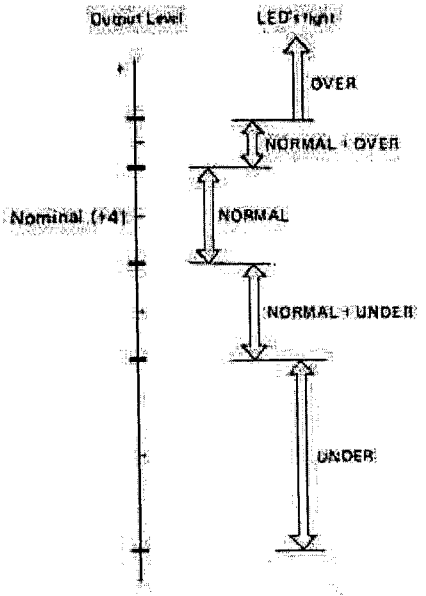


Fig. 9-6-4. Memo Level LED Lighting Condition

to 10 kHz to record it. Then by reproducing the recording, check for −4 dB ±4 at 400 Hz and -5 dB ±3 at 10 kHz with reference to level at 1 kHz.

J. Overall Signal-To-Noise Ratio

With the same conditions as in paragraph H, perform "no-signal" recording and its reproducing. Ratio should be 33 dB or greater (linear).

9-6-2. TIME CODE Signal

A. Input Level Setting

1. Make the following switch settings for the TIME CODE CH:
   MEMO/TIME CODE select switch to TIME CODE;
   REC MODE switch to ON.
2. Connect a square-wave signal generator to the XLR-type TIME CODE CH INPUT connector on the rear panel and an oscilloscope to TIME CODE CH OUTPUT.
3. Change the level of a 1 kHz input signal from 0.2 Vp-p to 6 Vp-p (nominal is 2 Vp-p) and check that the oscilloscope always shows a 2 Vp-p (±0.5 Vp-p) reading.

B. Record Level Setting

With the same conditions as in paragraph A above, record the square-wave signal, and then, reproduce it with the REC MODE switch reset to OFF. While reproducing, check the time code amplifier output level at TP-1. The level reading should be −3 dBV ±2. (Remember the signal waveform at TP-1 is not a sine-wave.)

C. Time Code Level

1. Connect a time code signal to the XLR-type TIME CODE CH INPUT connector.
2. Record a time code signal at HIGH speed, and reproduce it at LOW speed. While reproducing check the waveform obtainable at time code amplifier test point TP-4. The signal should drop to 5 V or a slightly higher level. If it drops beyond 5 V adjust semi-fixed resistor R312.

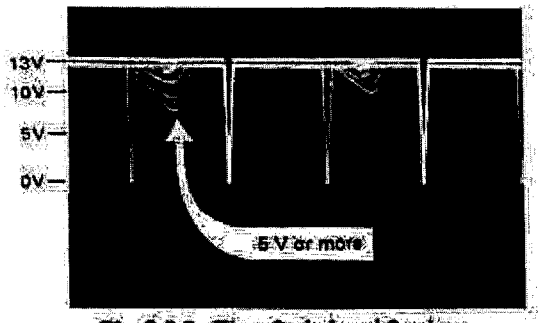


Fig. 9-6-2. Time Code Level Setting

D. Crosstalk Suppression

D-1. Time code signal leakage suppression (Time Code and Audio channels in reproduce mode)

1. Connect a level meter to an audio OUTPUT (CH 1 or CH2) connector, or plug headphones into PHONES. Then press the OUTPUT SELECT "SYNC".
2. With the TIME CODE CH set as in paragraphs A and B, record a nominal level time code signal on the time code track.
3. While reproducing the time code recording, adjust semi-fixed resistor R307 for minimum reading at the level meter. (i.e., leakage level onto the audio track). If headphones are used, adjust the same resistor R307 so that a minimum leakage signal from the time code track is heard.

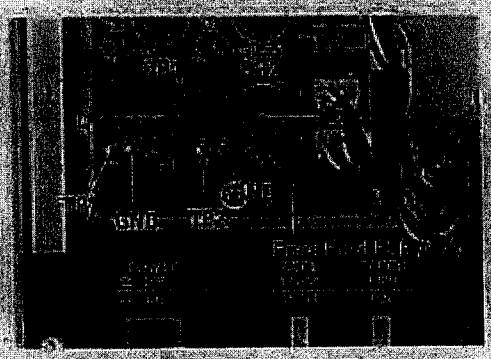
D-2. Time code signal leakage suppression (Time Code channel in record mode and Audio channels in record-reproduce mode)

1. As in paragraph D-1, connect the level meter and headphones.
2. With the TIME CODE CH set as in paragraphs A and B, connect a nominal level time code signal to the time code channel and "no-signal" to the audio channels.
3. While recording the time code signal and "no-signal" audio, set the OUTPUT SELECT to REPRO. Slowly turn semi-fixed resistor R304 clockwise from the leftmost position until the level meter (connected to an audio output connector) shows a minimum reading, or a minimum level of noise is heard in the headphones, then slightly turn R304 back (preferably to a point where the level meter shows a reading obtainable in step D-1-3 with the OUTPUT SELECT set to "REPRO" instead of "SYNC" as said in D-1-1).
4. Rewind the tape to the beginning of the recording, set the OUTPUT SELECT to SYNC, and reproduce the tape. Check for the same output level as in the previous step. If necessary, repeat adjustment by returning to step 3 above.

D-3. Time code signal leakage suppression (Time Code channel in record mode and Audio channel in reproduce mode)

With the same conditions as in paragraphs D-2-1 and -2, set the OUTPUT SELECT to SYNC and, while recording a time code signal on the time code track and reproducing the "no-signal" on the audio track, adjust the semi-fixed resistors

9-7. RECORD/REPRODUCE AMPLIFIER CHECKS AND ADJUSTMENTS (ATR-60-2N, -2D, AND -2HS ONLY)



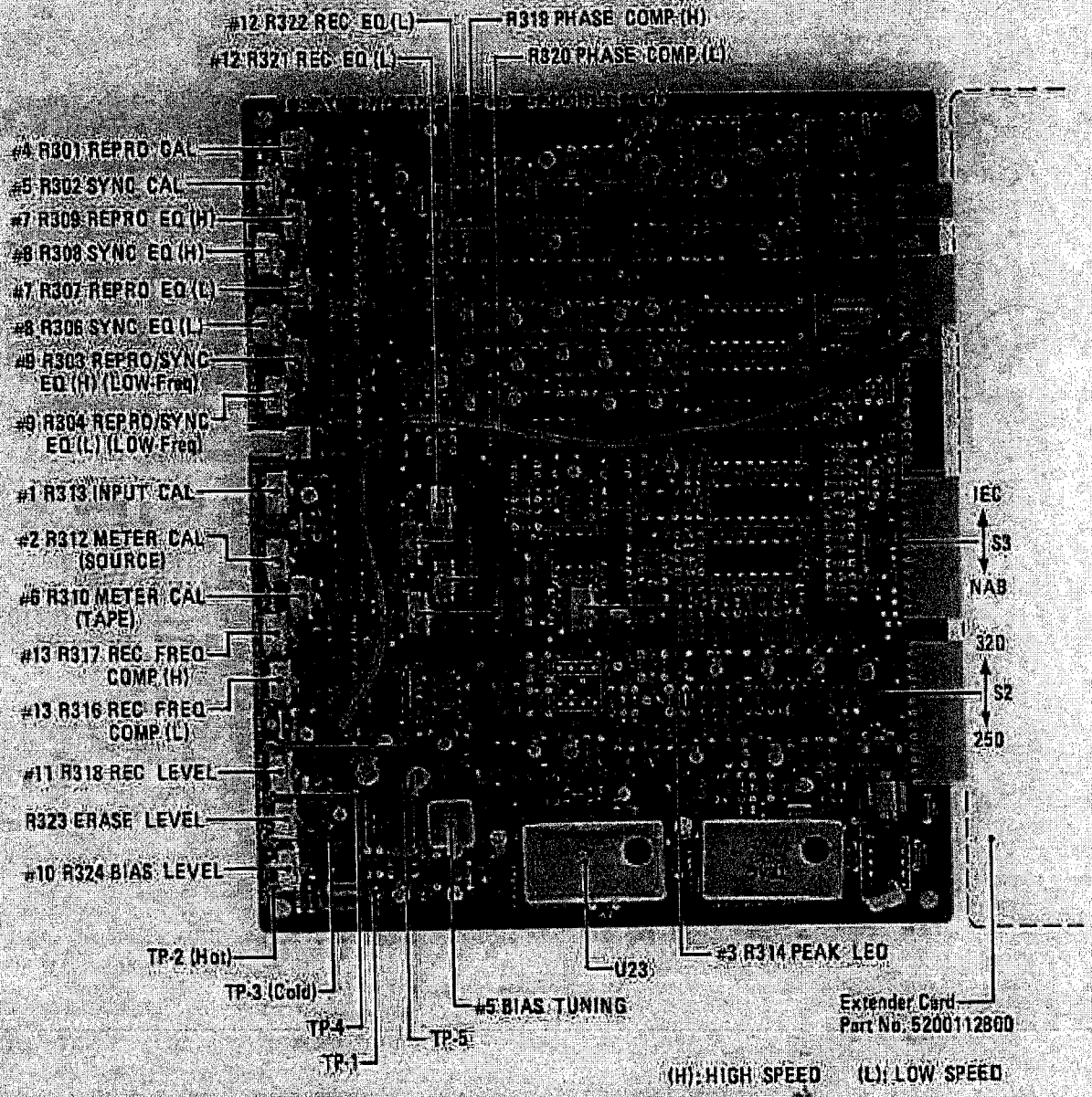


Fig. 9-7-1. Erase Head PCB and Record/Reproduce Amplifier Adjustment Points

TABLE 9-7-1. AMPLIFIER ADJUSTMENT POTS AND CHOKES

TRIM POT NUMBER	REFERENCE NUMBER		FUNCTION
	Tape Speed HIGH	Tape Speed LOW	
#1	R313		INPUT CAL
2	R312		METER CAL (INPUT)
3	R314	—	PEAK LED
4	—	R301	REPRO CAL
5	—	R302	SYNC CAL
6	R310		METER LEVEL (TAPE)
7	R309	R307 3.3k ohms	REPRO EQ
8	R308	R306 3.3k ohms	SYNC EQ
9	R303	R304	EQ Compensation (LOW FREQ)
10	—	R324	BIAS LEVEL
11	—	R318	REC LEVEL
12	R321 6.8k ohms	R322 6.8k ohms	REC EQ
13	R317	R316	REC FREQ Compensation
—	L1 (on the Erase Head PCB)		ERASE BIAS TUNING
—	L5		RECORD BIAS TRAP
—	R319	R320	PHASE Compensation
—	R323		Erase level

9-7-1. Before Making any Checks or Adjustments

This section contains the general descriptions and cautions required for the record/reproduce amplifier checks and adjustments.

Before going ahead with any of the electrical performance checks or adjustments, make sure the tape transport mechanism has been completely aligned as mentioned in section 9-4, or at least make sure that the tape path and head contact are aligned correctly as mentioned later.

A. INPUT/OUTPUT

1. INPUT/OUTPUT Level

The nominal level at the XLR-type connectors is +4 dBm (1.23 V). The UNCAL switches on the amplifier module should be in the OFF position when performing electrical adjustments.

2. Connections to the Output Connectors

The nominal impedance at the XLR-type output connectors is 600 ohms.

CAUTION:

Be careful not to short-circuit pin 1 (GND) and pin 2 or pin 3 of the XLR-type output connectors.

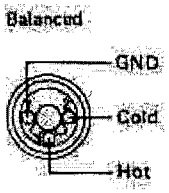


Fig. 9-7-2. XLR-type Connector Pin Outs

C. Head contact

Contact of the record/sync head and the reproduce head is properly aligned by following the below methods.

1. Set the OUTPUT SELECT switch to REPRO or SYNC and load a reproduce alignment test tape, or a prerecorded tape with a constant 16 kHz level tone, and reproduce at a high speed.
2. While observing the VU meters, temporarily increase the back tension to the left reel by lightly applying pressure by hand. If sufficient contact pressure is applied to the head while the tape is running, no change will be noticed on the meter when the back tension is increased. However, if insufficient pressure is applied to the head, the deflection needle will show increased deflection due to contact pressure caused by the back tension. To adjust, loosen the retaining screw (A); that'll be the center screw at the rear of the head as shown in Fig. 9-7-5. Then, change the direction of the head for proper alignment.
3. With the test tape signal at 16 kHz, determine the point where maximum level of each channel is obtained and retighten the retaining screws (A) at that position.
4. For proper head contact, adjust the record/sync head as necessary.

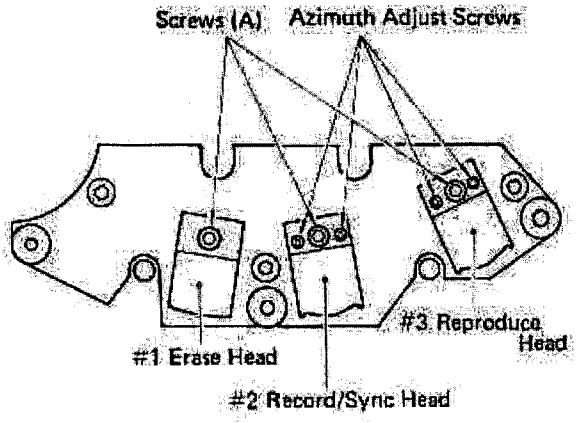


Fig. 9-7-5. Head Adjustment Screws

D. Head azimuth adjustment

1. Connect the CH1 OUTPUT connector of the deck to the vertical input terminal of an oscilloscope.
2. Connect the CH2 OUPUT connector of the deck to the horizontal input terminal of the oscilloscope.
3. Connect an AF level meter to the OUTPUT connectors as shown in Fig. 9-7-6.
4. Switch the OUTPUT SELECT switch to REPRO.
5. Load the reproduce alignment test tape to reproduce at low speed. A scope display showing phase relations between both channels will be obtained as shown in Fig. 9-7-7.
6. Adjust the reproduce head azimuth screw until the scope display shows less than 45 degree out of phase at 10 kHz, with the AF level meter showing approximately maximum value for both channels.
7. Switch the OUTPUT SELECT switch to SYNC, and adjust the record/sync head azimuth screw the same way.

E. Others

* To get at the trim pots for record/reproduce amplifier circuit adjustments, open the meter panel by removing the four set screws, two on each side of the panel. (Refer to Fig. 9-7-8.) With the panel removed, you will see the amplifier boards to which the trim pots are mounted as shown in Fig. 9-7-8. The boards are identical and are exclusively used for their respective channels.
* 0 dBm = 0.755 V (600 ohms)
* The power should always be off when inserting or removing the record/reproduce amplifier PCB assembly.
* Be careful not to touch any trim pots while removing or replacing the record/reproduce PCB assembly.

B. Tape path
The height of the tape guide ② and tension rollers should be so adjusted that the tape travels along the center width of the three heads (Erase, Rec/Sync, and Repro).
Check and adjust as follows:
1. Load a tape and run it in repro mode. Check that the upper edge of the tape is just touching the upper flange of the tape guide ②, and the lower edge of the tape the lower flange of the tape guides ① and ③ (see Fig. 9-7-4).

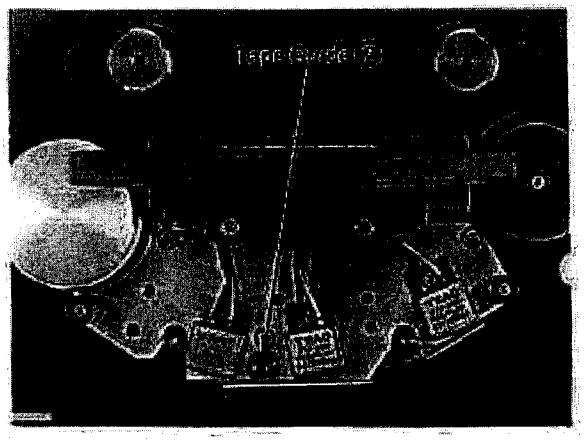


Fig. 9-7-3. Tape Guide Adjustment Point

2. If it does not and curling is observed at:
   a. Tape guide ②
      1. Loosen the screw located in the top center of the tape guide ②.
      2. Rotate the upper flange part of the tape guide ② in or out.
   b. Tape guide ①
      1. Loosen the screw located in the top center of the left tension roller.
      2. – To remove curling of the upper edge of the tape:
         Rotate clockwise the upper flange part of the left tension roller.
         – To remove curling of the lower edge of the tape:
         Rotate counterclockwise the upper flange part of the left tension roller.
   c. Tape guide ③
      1. Loosen the screw located in the top center of the right tension roller.
      2. – To remove curling of the upper edge of the tape:
         Rotate clockwise the upper flange part of the right tension roller.
         – To remove curling of the lower edge of the tape:
         Rotate counterclockwise the upper flange part of the right tension roller.
3. Check the adjustment. If curling persists, repeat necessary adjustments.

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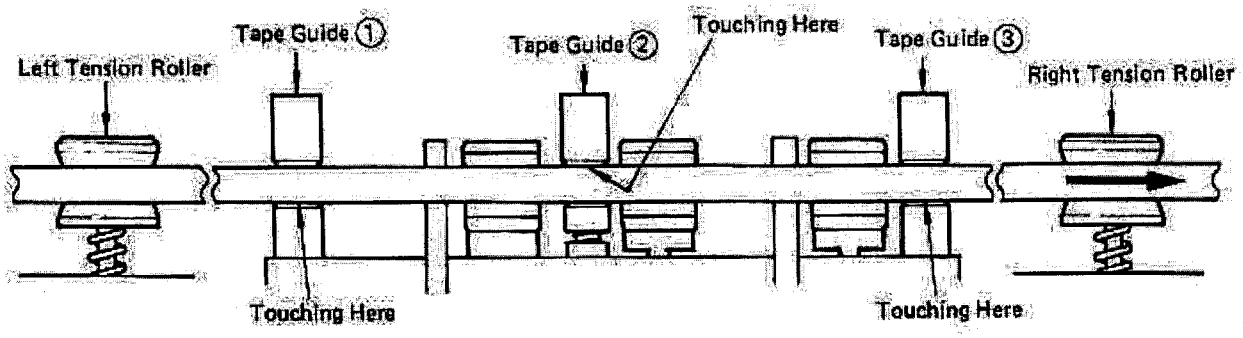


Fig. 9-7-4. Correct Tape Travel

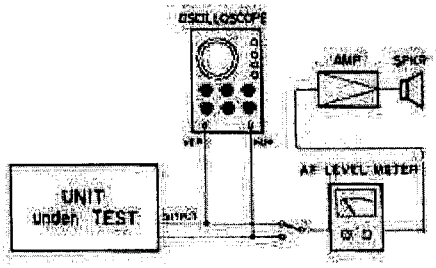


Fig. 9-7-6. Head Azimuth Test Set-Up

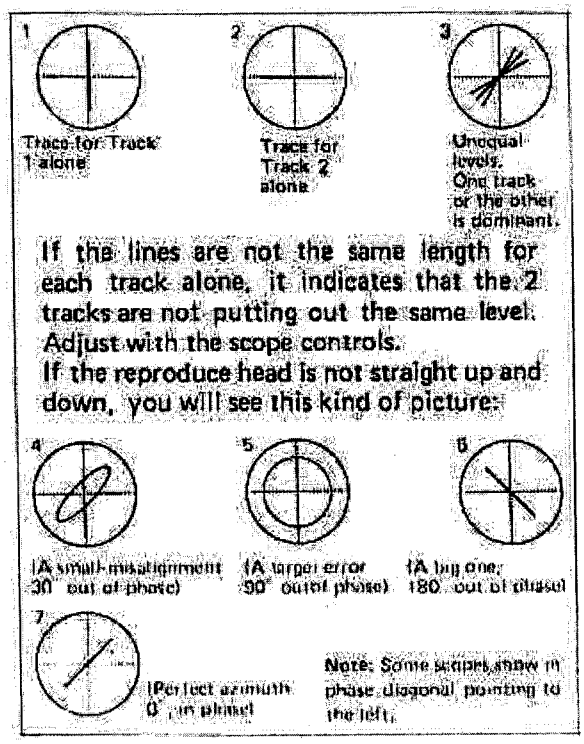


Fig. 9-7-7. Phase Shift

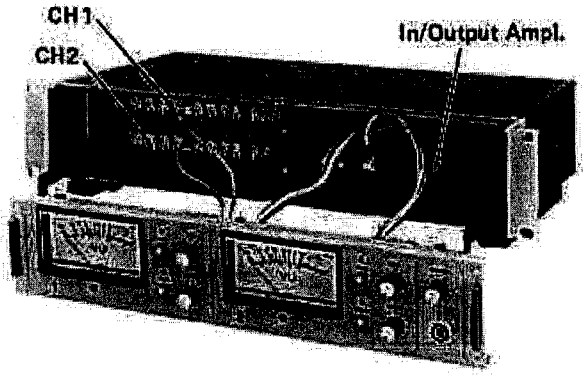


Fig. 9-7-8. Opening the Amplifier Module Front Panel

9-7-2. Input Level Calibration

1. Connect the test equipment to CH1 INPUT and CH1 OUTPUT as shown in Fig. 9-7-9.
2. Apply a 400 Hz (1 kHz for -HS model), +4 dBm (1.23 V) test signal to the CH1 INPUT connector on the rear panel, and switch the OUTPUT SELECT switch to INPUT.
3. Make sure the AF level meter reads +4 dBm (1.23 V) output. If it doesn't, adjust R313 on the record/reproduce amplifier PCB.
4. Adjust channel 2 in the same way.

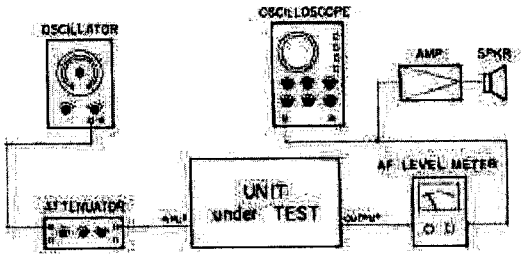


Fig. 9-7-9. Level or Frequency Response Measurement Set-up

9-7-3. Meter (Input Signal)

1. Make sure that the meter indicates 0 VU after completion of the above steps 2 and 3, or after setting the input level to read +4 dBm output. If the meter does not indicate 0 VU, adjust R312 on the record/reproduce amplifier PCB.
2. Check and adjust channel 2 in the same way.

9-7-4. Peak LED

1. Set the tape speed to high and with the same conditions as in 9-7-2, adjust R314, so that the peak LED lights when the input level is raised 12 dB (input level +16 dBm) on -N model and 10 dB (input level +14 dBm) on -D and -HS models, and turns off when reduced 1 dB.
2. Check and adjust channel 2 in the same way.

9-7-5. Reproduce Level and Meter Calibrations

1. Connect the AF level meter (and oscilloscope) to the CH1 OUTPUT connector on the rear panel.
2. Switch the OUTPUT SELECT switch to REPRO.
3. Load the reproduce alignment test tape for low speed and reproduce the 400 Hz test tone for -N and -D models and the 1 kHz signal for -HS model. Observe the AF level meter, it should indicate +4 dBm (1.23 V), if not, adjust trim pot R301 on the record/reproduca amplifier PCB.
4. Check that the VU meters read 0VU when the level meter reads +4 dBm. If not, adjust trim pot R310.
5. Switch the OUTPUT SELECT switch to SYNC and reproduce the same tape. Check the AF level meter, it should read +4 dBm. If not, adjust trim pot R302 on the record/reproduce amplifier PCB.
6. Check and adjust channel 2 in the same way. For reproduce allgnment tapes and calibration level, refer to page 9-3.

9-7-6. Reproduce Frequency Response

1. Connect the AF level meter (and oscilloscope) to the OUTPUT CH1 connector.
2. Load the reproduce alignment test tape onto the tape deck and switch OUTPUT SELECT to REPRO.
3. Run the reproduce alignment tape, then check the frequency response whila noting the output level.

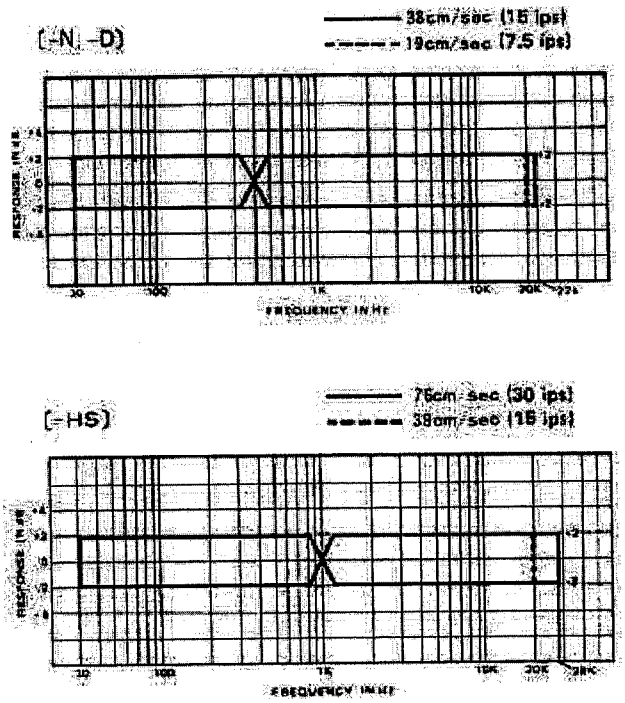


Fig. 9-7-10. Reproduce Frequency Response

4. If the AF level meters are not within the specified range, adjust the necessary trim pots by referring to Table 9-7-2 below.
5. Switch OUTPUT SELECT to SYNC.
6. Reproduce the same tape and read the output levels in the same manner as before to learn whether the frequency response is within the above specified limit. If it isn't, adjust the necessary trim pots by referring to Table 9-7-2.
7. Adjust channel 2 in the same way.

TABLE 9-7-2. REPRODUCE FREQUENCY RESPONSE ADJUSTMENT POTS

Trim Pot		Tape Speed	Adjust so that:
REPRO	SYNC		
R309	R308	HIGH	Level at 16–20 kHz becomes the same as at 400 Hz or 1 kHz.
R307	R306	LOW	
R303		HIGH	Low frequency response at around 40 Hz meets spec, taking account of the overall record/reproduce frequency response.
R304		LOW	

8. If the specified frequency response cannot be obtained with the trim pot(s) adjusted;

   * Check and compare the measurements of both channels. If they stand up to spec, correct or replace the off-spec channel's record/reproduce amplifier PCB.
   * If both channels are off spec, check power line, incorrect head adjustment, or whether heads should be cleaned.
   * Demagnetize the heads.
   * Finally, if all else fails, replece the heads.

9-7-7. Bias Tuning and Bias Trap Adjustments

These adjustments have been made at the factory and realignment will not be necessary except for the following circumstances:

* When the erase head is replaced (Erase Bias tuning is required).
* When the record/reproduce amp PCB ass'y or the rec/sync head is replaced (Record Bias tuning is required).

Use the following procedures to adjust.

Note

* Be sure to use a non-conductive screwdriver (i.e. wood, plastic).
* For bias level measurements, use an AC level meter whose input terminal has a floating capacitance of 100 pF or lower.

A. ERASE BIAS TUNING (L1)

1. Place both channel FUNCTION (CH1 & CH2) switches to ON and set the tape deck into the record mode.
2. Connect a DC voltmeter between TP-2 (Hot) and TP-3 (Cold) on the CH1 record/reproduce amp PCB ass'y. By using an insulated screwdriver, adjust L1 on the Erase Head PCB so that a minimum reading is obtained on the DC meter. The minimum reading should be approximately 200 mV if the bias level trim pot R323 on the record/reproduce amp PCB is set to the middle position.
3. Adjust channel 2 in the same way.

CAUTION: Be careful not to short-circuit TP-3 and GND.

B. RECORD BIAS TRAP (L5)

1. Connect an AC level meter between TP-1 and chassis (ground).
2. Place both FUNCTION (CH1 & CH2) switches to ON and set the deck into the record mode.
3. Adjust L5 on the CH1 rec/repro amp. PCB ass'y so that a minimum reading is obtained on the level meter.
4. Adjust channal 2 in the same way.

9-7-8. Bias Level

This adjustment is made while you are recording a tone on the type of tape you'll be using for the session.

1. Connect an AF oscillator to CH1 INPUT connector.
2. Adjust the AF oscillator to apply a 10 kHz, -6 dBm (388 mV, -10 VU) signal to CH1 INPUT connector on the rear panel.
3. Switch the OUTPUT SELECT switch to REPRO and set both FUNCTION (CH1 & CH2) switches to ON.
4. Begin recording channel 1 at low speed. Now adjustments can be made while recording a 10 kHz tone, -10 VU.

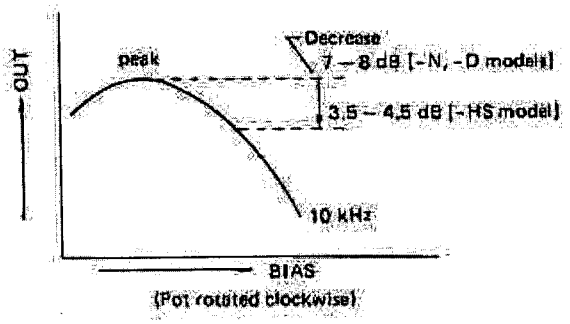


Fig. 9-7-11. Bias Level Adjustment

5. Begin the adjustments by turning trim pot R324 completely counterclockwise. Next, turn the trim pot clockwise and the AF level meter will rise to give peak reading. Slowly continue the clockwise rotation until the reading on the level meter drops 7 – 8 dB on the -N and -D and 3.5 – 4.5 dB on the -HS, from the peak reading as shown in Fig. 9-7-11.
6. Repeat the same procedures on channel 2.

When the record/reproduce amplifier PCB ass'y or the bias amplifier module U23 is replaced, check that when the bias trim pot R324 is turned fully clockwise the DC voltage between TP-4 (Hot) and TP-5 (Cold) is 250 mV or lower. If not, adjust U23 coil for a minimum voltage. Use an Extender Card (TEAC Part No. 520011280). (CAUTION: NOT SHORT-CIRCUIT TP-5 and GND.)

9-7-9. Recording Level

Recording level adjustments should be done only after the reproduce level and recording bias have been properly set as specified above.

1. Connect the test equipment to the tape deck in the same manner as described in 9-7-8.
2. Apply a 400 Hz, +4 dBm signal for -N and -D models or a 1 kHz, +4 dBm signal for -HS model, to the CH1 INPUT connector.
3. Switch the OUTPUT SELECT switch to REPRO and record the input signal on the specified recording test tape at low speed.
4. Check the AF level meter, it should indicate +4 dBm (1.23 V). If it doesn't, adjust trim pot R318 to obtain a +4 dBm indication. At this time, make sure that the front panel VU meter indicates 0 VU.
5. Switch the OUTPUT SELECT switch to SYNC and record the input signal for a brief period of time. Then, rewind the tape just recorded and reproduce it. Make sure that both the AF level meter and the VU meter indicate +4 dBm and 0 VU, respectively.
6. If it's impossible to obtain a VU meter reading of 0 VU in steps 4 and 5 above, check to see whether the reproduce meter is set as described under 9-7-5.
7. Check and adjust channel 2 in the same way.

9-7-10. Frequency Response (OVERALL)

After completing the recording level check and adjustments, proceed onto the overall frequency response checks.

1. Connect the test equipment to the tape deck the same as described in 9-7-8 and load a blank test tape onto the tape deck.
2. Turn R316 and R317 to the middle position and set the input level to -10 VU for 76 cm/sec. or 38 cm/sec. of tape speed and -20 VU for 19 cm/sec.
3. Set the OUTPUT SELECT switch to REPRO and the "CH1" FUNCTION switch to ON.
4. Record and reproduce the input signal, then change the frequency and check that the output is still within specification. If not, adjust REC EQ, R321 (High Speed), R322 (Low Speed) usig a frequency higher than 20 kHz.
5. Switch the OUTPUT SELECT switch to SYNC and record the test signals the same as before. When the recording is finished, rewind the tape just recorded and reproduce it. Measure the reproduced output levels at the proper test frequencies, and make sure that the frequency response is within the specified limit shown.
6. When the frequency response in the lower frequency spectrum is not within the specified limits, adjust trim pot R303 at high speed R304 at low speed. The high-frequency response can be fine-adjusted by using R316 (High Speed) and R317 (Low Speed), taking account of the reproduce frequency response.
7. Adjust channel 2 in the same way.

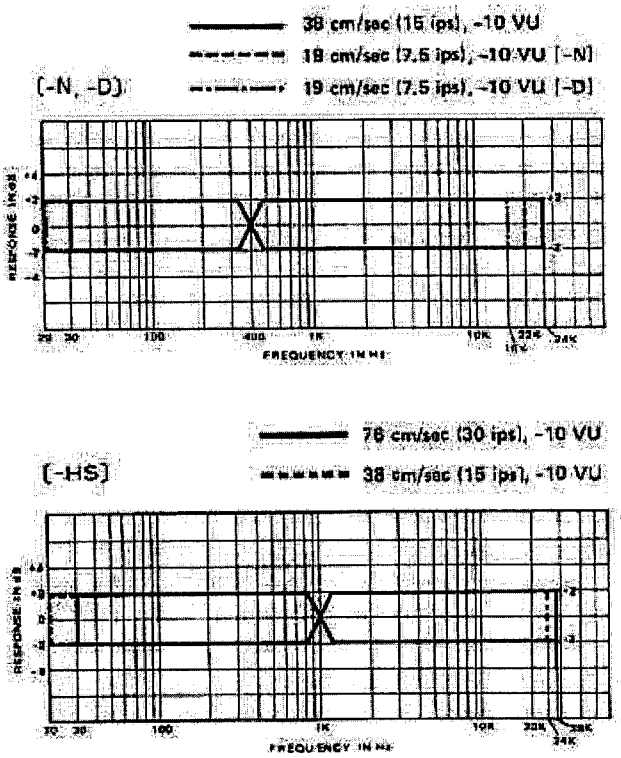


Fig. 9-7-12. Overall Frequency Response

9-7-11. Record/Reproduce Signal Phase Checks and Adjustments

1. With the same set-up as in paragraph 9-7-10, connect the oscilloscope to the OUTPUT connector and the scare-wave signal oscillator to the INPUT connector.
2. Set the oscillator to produce a scare-wave signal whose level is 20 dB lower than the nominal level of +4 dBm, and set the fre-

quency to 10 kHz for 76 or 38 cm/sec. of tape speed (7 kHz for 19 cm/sec.).

3. Set the OUTPUT SELECT to the REPRO position. Put the tape machine into the record mode and check that the output waveform is as square as shown below. If need be, adjust R319 for high tape speed and R320 for low tape speed.

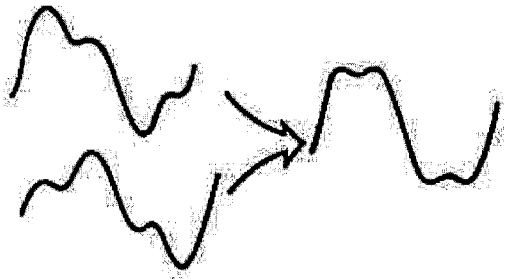


Fig. 9-7-13. Signal Phase Check

Check also that when the input frequency is changed to 1 kHz the output does not present a ridging deterioration.

9-7-12. Signal-to-Noise Ratio (OVERALL)

Before going ahead with any measurements, demagnetize all heads and tape guides.

1. Connect test equipment as in paragraph 9-7-8.
2. Apply a 400 Hz (1 kHz for -HS model), +4 dBm (1.23 V = 0 VU) input signal to CH1 INPUT connector on the rear panel.
3. Switch the OUTPUT SELECT switch to SYNC and record a short length of the input signal. Then, while still in the recording mode, unplug the AF oscillator connected to the CH1 INPUT connector, and make another length of no-signal recording.
4. Rewind the recording made in step 3 to the beginning and reproduce.
5. While making sure the reproduce output of the previously recorded signal is +4 dBm, raise the sensitivity of the AF level meter and measure the level of the no-signal portion of the tape.
6. With +4 dBm (0 VU) as the reference level, the signal-to-noise ratio, as measured by the AF level meter, should be better than 50 dB.
7. Check channel 2 in the same way.
8. If it is off spec,
   * Check and compare the measurement of the other channel. If they stand up to spec, correct or replace the off spec channel record/reproduce amplifier PCB.
   * Demagnetize the heads.
   * Check erasure, refer to 9-7-14.
   * Check for proper adjustment of the bias trap.

9-7-13. Erase Ratio

1. Connect test equipment to the tape deck as shown in Fig. 9-7-14. The filter to be connected should be a 1 kHz bandpass filter.
2. Switch the OUTPUT SELECT switch to SYNC and record a short length of the 1 kHz, +14 dBm (3.88 V) signal on channel 1 and unplug the AF oscillator connected to the CH1 INPUT connector on the rear panel.
3. Rewind the tape to the beginning of the recorded section.
4. Record a no-signal portion over tha recording of the 1 kHz signal.
5. Measure the level difference between the 1 kHz signal and the no-signal portions. The difference should be 70 dB or greater.
6. If the level difference is bebow this specification, check TP-1 voltage on the erase head PCB for 50 mV using an AC voltmeter, and adjust R323 on the record/reproduce amp PCB, if necessary. Also adjust, if required, the erase head position by loosening the screw located behind the erase head.
7. Check channel 2 in the same way.

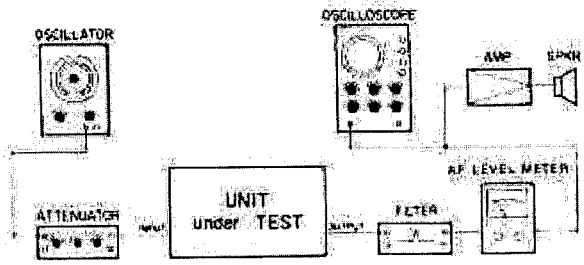


Fig. 9-7-14. Erase Ratio Test Set-Up

9-7-14. Adjacent Channel Crosstalk

1. Connect test equipment as shown in Fig. 9-7-15.
2. While making a no-signal recording on one of the channels, apply a 1 kHz, +4 dBm (1.23 V) test signal to the adjacent channel.
3. Rewind the tape to the beginning of the recording.

4. Reproduce the tape with the OUTPUT SELECT switch set to SYNC. Then, measure the output (signal leakage) of the no-signal recorded channel.
5. Measure the difference between the 1 kHz output level and the no-signal portions. The difference should be 50 dB or greater.

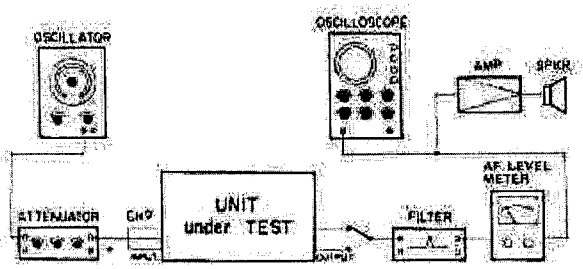


Fig. 9-7-15. Crosstalk Measurement Set-Up

9-7-15. Distortion

1. Connect test equipment as shown in Fig. 9-7-16.

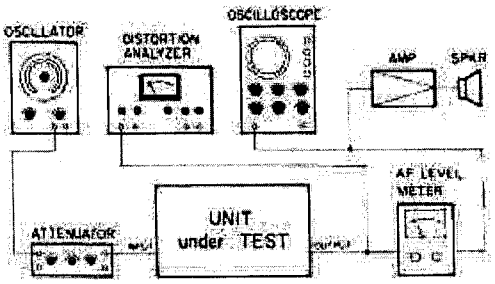


Fig. 9-7-16. Distortion Measurement Set-Up

2. Switch the OUTPUT SELECT switch to REPRO.
3. Apply a 1 kHz, +4 dBm (1.23 V) test signal to the INPUT connector and record.
4. Stop the recording and switch the OUTPUT SELECT switch to SYNC.
5. Rewind the tape to its beginning and reproduce. Measure the distortion of the reproduced output with a distortion analyzer connected to the OUTPUT connector.
6. The distortion measured should be less than 0.6 % for a +4 dBm recording.
7. If the distortion is off spec;
   * Check and compare the measurements of the other channel. If it stands up to spec, correct or replace the off-spec channel's record/reproduce amplifier PCB.
   * Check bias level setting and re-adjust if necessary.
   * Demagnetize the heads.
   * If all else fails, replace the heads.

9-7-16. Headphones

1. Connect an 8-ohm dummy load, a level meter and an oscilloscope to the headphone terminal.
2. Switch the OUTPUT SELECT switch to INPUT and the PHONES MONITOR SYSTEM switch to INT.
3. Connect a 1 kHz, +4 dBm (1.23 V) test signal to the CH-1 or CH-2 INPUT connector.
4. Turn up the headphone volume control until the waveform of the output signal starts to distort; measure the level at this point for a reading of 0.9 V or more.

9-7-17. Output Level Switching

The nominal output level at the XLR connectors can be changed from +4 dBm (1.23 V) to +8 dBm (1.95 V). Fig. 9-7-17 shows switches S102/S202 (CH-1/CH-2) on the Input/Output Amplifier PCB Ass'y. By resetting these switches, the gain of the output amplifier is boosted 4 dB to achieve the nominal output level of +8 dBm (1.95 V).
The output level can also be set to -20 dBm by switching S102/S202 to the -20 position.

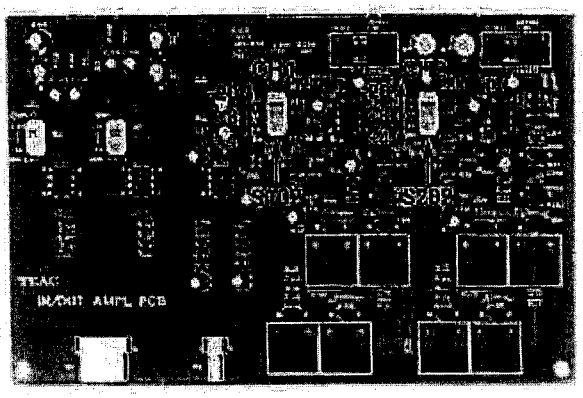


Fig. 9-7-17. Input/Output Amplifier PCB Ass'y

TABLE 9-7-3. CHECKS AND ADJUSTMENTS CHART

ADJUST STEP	WHAT IS IT CALLED	SIGNAL SOURCE AND AMOUNT	WHAT TEST GEAR TO USE	WHAT IS THE RECORDER DOING	POINT TO ADJUST	WHAT READING TO ADJUST FOR
1	Input Level	400 Hz/1 kHz signal at +4 dBm from oscillator connected to INPUT connector.	VTVM connected to OUTPUT connector	Stop mode OUTPUT SELECT at INPUT.	Trim pot #1 R313	+4 dBm (1.23 V) on VTVM.
2	Meter (Input)	*Same as above	VU Meter	*Same as above	*Trim pot #2 R312	Adjust to read 0 VU on VU meters.
3	PEAK LED	400 Hz/1 kHz signal at +16 dBm [-N]/ +14 dBm [-D/-HS]	PEAK LED	Tape speed at HIGH.	Trim pot #3 R314	Adjust to light PEAK LED.
4	Reproduce Head Alignment	Reproduce alignment tett tape for Low speed Refer to page 9-3.	VTVM and oscilloscope with vertical and horizontal inputs connected to OUTPUT CH1 and 2.	Reproduce at Low speed. OUTPUT SELECT at REPRO.	Repro head azimuth adjusting screw.	Adjust for maximum output and for output of tracks 1 and 2 less than 45° out of phase. (at 10 kHz)
5	Record/SYNC Head Alignment	Same as above	Same as above	Reproduce at Low speed. OUTPUT SELECT at SYNC.	Record/SYNC head azimuth adjusting screw.	Same as above
6	Reproduce Level (Repro head)	Reproduce alignment test tape for Low speed. Play reference level signal.	VTVM connected to OUTPUT connector.	Reproduce at Low speed. OUTPUT SELECT at REPRO.	Trim pot #4 R301	+4 dBm (1.23 V) on VTVM.
7	Reproduce Level (Record/SYNC head)	Same as above	Same as above	Reproduce tape at Low speed. OUTPUT SELECT at SYNC.	Trim pot #5 R302	+4 dBm (1.23 V) on VTVM.
8	Meter (Tape)	Play reference level	VU meter	Same as above	Trim pot #6 R310	Adjust to read 0 VU.
9	Reproduce EQ (High frequency) at High speed. (Repro head)	Play 16-20 kHz signal on test tape.	VTVM connected to OUTPUT connector.	Reproduce at High speed. OUTPUT at REPRO.	Trim pot #7 R309	Same reading on VTVM as at 400 Hz/1 kHz signal.
10	Reproduce EQ (High frequency) at High speed. (Record/SYNC head)	Same as above	Same as above	Reproduce at High speed. OUTPUT SELECT at SYNC.	Trim pot #8 R308	Same as above
11	Reproduce EQ (High frequency) at Low speed. (Repro head)	Play 10-20 kHz signal on test tape.	Same as above	Reproduce at Low. OUTPUT SELECT at REPRO.	Trim pot #7 R307	Same as above
12	Reproduce EQ (High frequency) at Low speed. (Record/SYNC head)	Same as above	Same as above	Reproduce at Low. OUTPUT SELECT at SYNC.	Trim pot #8 R306	Same as above
13	Reproduce EQ (Low frequency) at High speed.	Play approx. 40 Hz signal on test tape.	Same as above	Reproduce at High speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #9 R303	Adjust to meet specs.

ADJUST STEP	WHAT IS IT CALLED	SIGNAL SOURCE AND AMOUNT	WHAT TEST GEAR TO USE	WHAT IS THE RECORDER DOING	POINT TO ADJUST	WHAT READING TO ADJUST FOR
14	Reproduce EQ (Low frequency) at Low speed.	Same as above	Same as above	Reproduce at Low speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #9 R304	Same as above
15	Bias Trap Adjustment	No input signal	VTVM connected to Bias Trap test point TP-1 and GND.	Record mode, no input signal.	Inductor L5	Adjust inductor for minimum output at Bias Trap test point.
16	Bias Level Adjustment	10 kHz, -6 dBm oscillator signal connected to INPUT connector.	VTVM connected to OUTPUT connector.	Record signal at LOW on type of tape that will be used for actual recording. OUTPUT SELECT at REPRO.	Trim pot #10 R324	While recording adjust trim pot until VTVM indication rises to peak value, then turn pot further clockwise until signal drops off by 7-8 dB (19 cm/sec with -N & -D), 3.5-4.5 dB (38 cm/sec with -HS).
17	Recording Level	400 Hz/1 kHz signal at +4 dBm (0 VU on VU meters) connected to INPUT connector.	VTVM connected to OUTPUT connector or use VU meters.	Same as above	Trim pot #11 R318	Set for +4 dBm (1.23 V) at OUTPUT connectors or 0 VU on VU meters.
18	Overall Frequency at High speed. (HIGH-FREQ)	20 kHz or higher signal connected to INPUT connector (at -6 dBm).	Same as above	Record on selected tape at High speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #12 R321 Trim pot #13 R317 for fine-adjust	Check that frequency response matches limits given in Fig. 9-7-12, page 9-40.
19	Overall Frequency at Low speed. (HIGH-FREQ)	20 kHz or higher signal connected to INPUT connector (at -16 dBm).	Same as above	Record on selected tape at Low speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #12 R322 Trim pot #13 R316 for fine-adjust	Same as above
20	Low Frequency at High speed.	40 Hz signal connected to INPUT connectors (at -6 dBm).	Same as above	Record on selected tape at High speed. Other conditions the same as above.	Trim pot #9 R303	Same as above
21	Low Frequency at Low speed.	40 Hz signal connected to INPUT connectors (at -16 dBm).	Same as above	Record on selected tape at Low speed. Other conditions the same as above.	Trim pot #9 R304	Same as above
22	Overall Signal-to-Noise Ratio	No input signal	VTVM connected to OUTPUT connectors.	Record mode at High or Low speed. OUTPUT SELECT at SYNC.		Check for 50 dB or better.
23	Erase	1 kHz signal at +14 dB connected to INPUT connectors. This is +10 VU on meters. Apply signal for short time only.	VTVM and 1 kHz band pass filter connected to OUTPUT.	Record 1 kHz signal, rewind, remove input. Record no-input signal over 1 kHz signal recording. OUTPUT SELECT at SYNC.	Trim pot R323	Check or adjust for 70 dB or greater (through 1 kHz filter). Refer to Item Erase Ratio.

ADJUST STEP	WHAT IS IT CALLED	SIGNAL SOURCE AND AMOUNT	WHAT TEST GEAR TO USE	WHAT IS THE RECORDER DOING	POINT TO ADJUST	WHAT READING TO ADJUST FOR
14	Reproduce EQ (Low frequency) at Low speed.	Same as above	Same as above	Reproduce at Low speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #9 R304	Same as above
15	Bias Trap Adjustment	No input signal	VTVM connected to Bias Trap test point TP-1 and GND.	Record mode, no input signal.	Inductor L5	Adjust inductor for minimum output at Bias Trap test point.
16	Bias Level Adjustment	10 kHz, -6 dBm oscillator signal connected to INPUT connector.	VTVM connected to OUTPUT connector.	Record signal at LOW on type of tape that will be used for actual recording. OUTPUT SELECT at REPRO.	Trim pot #10 R324	While recording adjust trim pot until VTVM indication rises to peak value, then turn pot further clockwise until signal drops off by 7-8 dB (19 cm/sec with -N & -D), 3.5-4.5 dB (38 cm/sec with -HS).
17	Recording Level	400 Hz/1 kHz signal at +4 dBm (0 VU on VU meters) connected to INPUT connector.	VTVM connected to OUTPUT connector or use VU meters.	Same as above	Trim pot #11 R318	Set for +4 dBm (1.23 V) at OUTPUT connectors or 0 VU on VU meters.
18	Overall Frequency at High speed. (HIGH-FREQ)	20 kHz or higher signal connected to INPUT connector (at -6 dBm).	Same as above	Record on selected tape at High speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #12 R321 Trim pot #13 R317 for fine-adjust.	Check that frequency response matches limits given in Fig. 9-7-12, page 9-40.
19	Overall Frequency at Low speed. (HIGH-FREQ)	20 kHz or higher signal connected to INPUT connector (at -16 dBm).	Same as above	Record on selected tape at Low speed. OUTPUT SELECT at REPRO or SYNC.	Trim pot #12 R322 Trim pot #13 R316 for fine-adjust.	Same as above
20	Low Frequency at High speed.	40 Hz signal connected to INPUT connectors (at -6 dBm).	Same as above	Record on selected tape at High speed. Other conditions the same as above.	Trim pot #9 R303	Same as above
21	Low Frequency at Low speed.	40 Hz signal connected to INPUT connectors (at -16 dBm).	Same as above	Record on selected tape at Low speed. Other conditions the same as above.	Trim pot #9 R304	Same as above
22	Overall Signal-to-Noise Ratio	No input signal	VTVM connected to OUTPUT connectors.	Record mode at High or Low speed. OUTPUT SELECT at SYNC.		Check for 50 dB or better.
23	Erase	1 kHz signal at +14 dB connected to INPUT connectors. This is +10 VU on meters. Apply signal for short time only.	VTVM and 1 kHz band pass filter connected to OUTPUT.	Record 1 kHz signal, rewind, remove input. Record no-input signal over 1 kHz signal recording. OUTPUT SELECT at SYNC.	Trim pot R323	Check or adjust for 70 dB or greater (through 1 kHz filter). Refer to Item Erase Ratio.

LIST OF EXPLODED VIEWS AND PCB ASS'Y DRAWINGS

INSTRUCTIONS FOR SERVICE PERSONNEL

BEFORE RETURNING APPLIANCE TO THE CUSTOMER, MAKE LEAKAGE-CURRENT OR RESISTANCE MEASUREMENTS TO DETERMINE THAT EXPOSED PARTS ARE ACCEPTABLY INSULATED FROM THE SUPPLY CIRCUIT.

NOTES

- ★ Parts marked with ▸ require longer delivery time.
- ★ All capacitor values are in microfarads (UF) (PF = picofarads).
- ★ ⚠ Parts marked with this sign are safety critical components. They must always be replaced with identical components — refer to the TEAC Parts List and ensure exact replacement.
- ★ PC boards shown viewed from foil side.

Effective: November, 1985 Q50239

EXPLODED VIEW-1

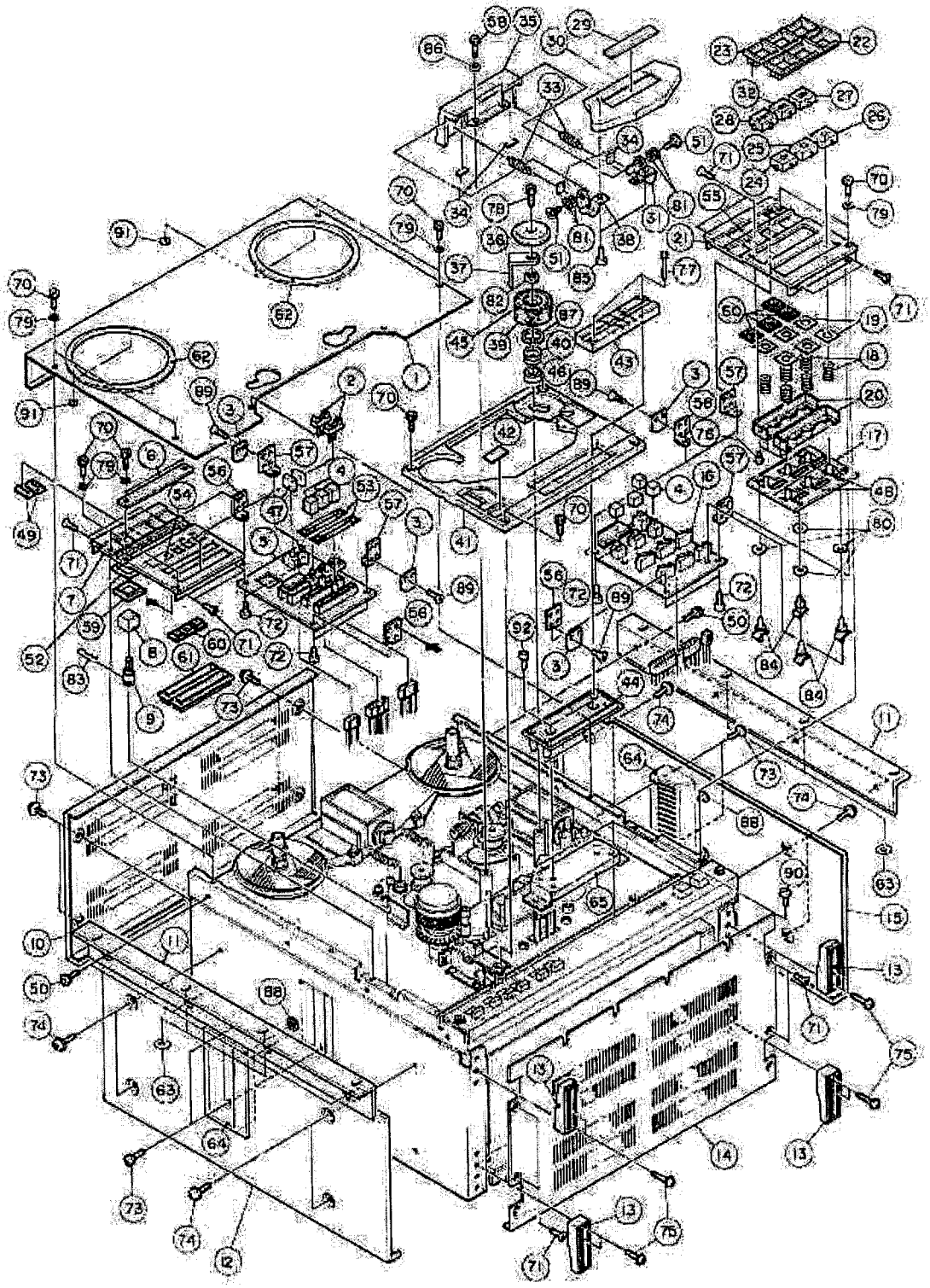
Parts marked with *require longer delivery time.

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
1- 1	*5800656900	PANEL,FRONT	
1- 2	5800341701	KNOB,FADER	
1- 3	*5800687300	PANEL STOPPER	
1- 4	5800657700	BUTTON,SQUARE	
1- 5	*5200161210	PITCH CONTROL PCB ASSY A (ATR-60-2T)	
	*5200161220	PITCH CONTROL PCB ASSY A (ATR-60-2N,2D,2HS)	
1- 6	*5800658000	COVER	
1- 7	*5800745400	PANEL,CONTROL L (ATR-60-2T)	
	*5800768900	PANEL,CONTROL L (ATR-60-2N,2D,2HS)	
1- 8	5800173100	BUTTON,POWER	
1- 9	5534713000	LINK,C	
1-10	*5800639900	COVER,TOP	
1-11	*5800639700	ANGLE, RACK MOUNT	
1-12	*5800653301	PANEL,SIDE L	
1-13	*5800288502	FOOT	
1-14	*5800639801	PLATE, BOTTOM	
1-15	*5800653201	PANEL,SIDE R	
1-16	*5200161000	KEY BOARD A PCB ASSY	
1-17	*5200161100	KEY BOARD B PCB ASSY	
1-18	5800778200	SPRING,BUTTON	
1-19	5800658201	GUIDE, SPRING	
1-20	*5800778100	PLATE, ESCUTCHEON	
1-21	*5800658601	CONTROL PANEL R	
1-22	*5800778500	ESCUTCHEON, BUTTON B	
1-23	*5800778400	ESCUTCHEON, BUTTON A	
1-24	5800778300	BUTTON A	
1-25	5800778600	BUTTON B	
1-26	5800778700	BUTTON C	
1-27	5800778900	BUTTON E	
1-28	5800779000	BUTTON F	
1-29	*5800482300	NAME PLATE,TASCAM	
1-30	*5800656100	HOUSING, HEAD A	
1-31	*5800656002	ARM, HOUSING R	
1-32	5800778800	BUTTON D	
1-33	5800396800	SPRING,A	
1-34	*5800476300	CUSHION, HOUSING	
1-35	*5800711900	HOUSING HEAD C	
1-36	5800758400	CAP,PINCH ROLLER S	
1-37	5800723801	PROTECTOR S	
1-38	*5800655902	ARM, HOUSING L	
1-39	5800347601	PINCH ROLLER	
1-40	5800380600	SPRING,PINCH ROLLER	
1-41	*5800656802	BASE, HOUSING	
1-42	*5800731100	NAME PLATE	
1-43	*5800400301	BLOCK,SPLICING (ATR-60-2T,2N,2D)	
	*5800383501	BLOCK,SPLISING (ATR-60-2HS)	
1-44	*5800382500	BASE,SPLICING	
1-45	5730003900	BEARING 626ZZ	
1-46	5730004200	BEARING,NIN626	
1-47	5800731200	BUTTON,SQUARE	
1-48	*5800778000	CUSHION, BUTTON	
1-49	*5800482000	BUTTON ESCUTCHEON	
1-50	5800509700	SCREW, CAP	
1-51	5800404400	SCREW,SHOULDER B	
1-52	*5800365300	SPACER A	
1-53	*5800609301	SCREEN (A)	

SECTION X. PARTS LISTS

10-1. MECHANICS

10-1-1. Exploded View-1 (External Parts Section)



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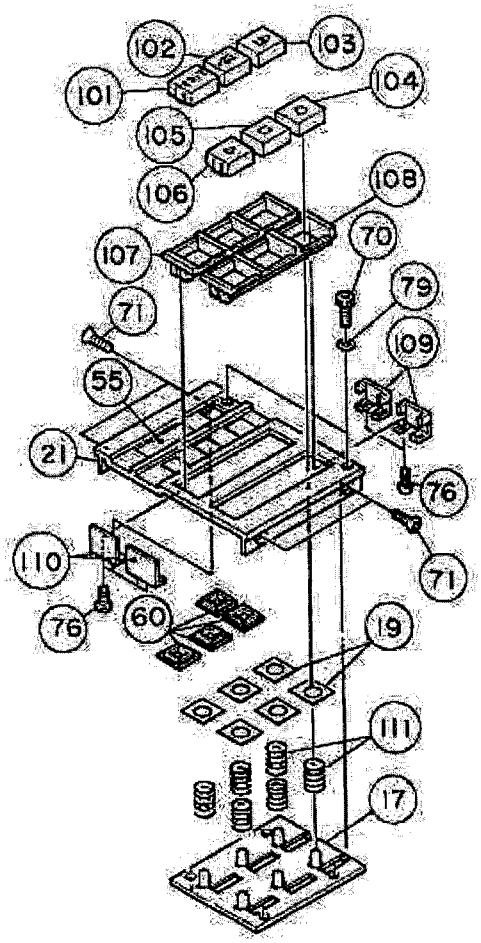
EXPLODED VIEW-1

Parts marked with *require longer delivery time.

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
1-54	*5800302200	COVER, COUNTER	
1-55	*5800474900	LENS,COUNTER	
1-56	*5800686200	HOLDER, PCB L	
1-57	*5800686300	HOLDER, PCB R	
1-58	5800509700	SCREW, CAP	
1-59	*5800173000	ESCUTCHEON,POWER SW	
1-60	*5800657800	ESCUTCHEON B	
1-61	*5800657900	ESCUTCHEON A	
1-62	*5800340300	REEL PROTECTOR	
1-63	*5800711400	CUSHION	
1-64	*5800344900	HANDLE	
1-65	*5800731001	BRACKET BASE	
1-70	*5781703008	SCREW,CAP M3X8 (NI)	
1-71	*5780203006	SCREW,COUNTER SUNK M3X6	
1-72	*5780003006	SCREW,BIND M3X6	
1-73	*5780023006	SCREW,BIND M3X6 (BK NI)	
1-74	*5783114006	SCREW,WASHER M4X6(BK NI)	
1-75	*57835830l4	SCREW,WASHER M3X14(BK NI)	
1-76	*5781002008	SCREW,PAN TAPPING M2X8	
1-77	*5781703030	SCREW,CAP M3X30 NI	
1-78	*5781703012	SCREW,CAP M3X12 (NI)	
1-79	*5785213200	WASHER,FIBER 3X5.5X0.25T	
1-80	*5785214100	WASHER,FIBER WHT 4X8X1T	
1-81	*5785150500	WAVE WASHER WW-05	
1-82	*5781851000	NUT, M1.0	
1-83	*5786360500	SNAP PIN,R 5F	
1-84	*5787010400	SUPPORT, PCB CBS-4N	
1-85	*5781703006	SCREW,CAP M3X6 (NI)	
1-86	*5785214200	WASHER,FIBER 4X6.5X0.5T	
1-87	*5786131900	RING,C 19F	
1-88	*5781880500	NUT,PUSH M3	
1-89	*5783043006	SCREW,C.SUNK S TITE M3X6	
1-90	*5780133008	SCREW,PAN SEMS A M3X8	
1-91	*5781880400	PUSH NUT M2.4	
1-92	*5780003018	SCREW,BIND M3X18	
1-101	5800671300	BUTTON,F	-T, -N, & -D : Serial No. 100001 or higher -HS : Serial No. 80001 or higher
1-102	5800657300	BUTTON,D	
1-103	5800657400	BUTTON,E	
1-104	5800657200	BUTTON,C	
1-105	5800657100	BUTTON,B	
1-106	5800657000	BUTTON,A	
1-107	*5800657502	ESCUTCHEON,BUTTON A	
1-108	*5800657602	ESCUTCHEON,BUTTON B	
1-109	*5800684900	HOLDER, BUTTON A	
1-110	*5800659500	HOLDER, BUTTON	
1-111	5800658400	SPRING,BUTTON	



Parts marked with *require longer delivery time.

INCLUDED ACCSESORY

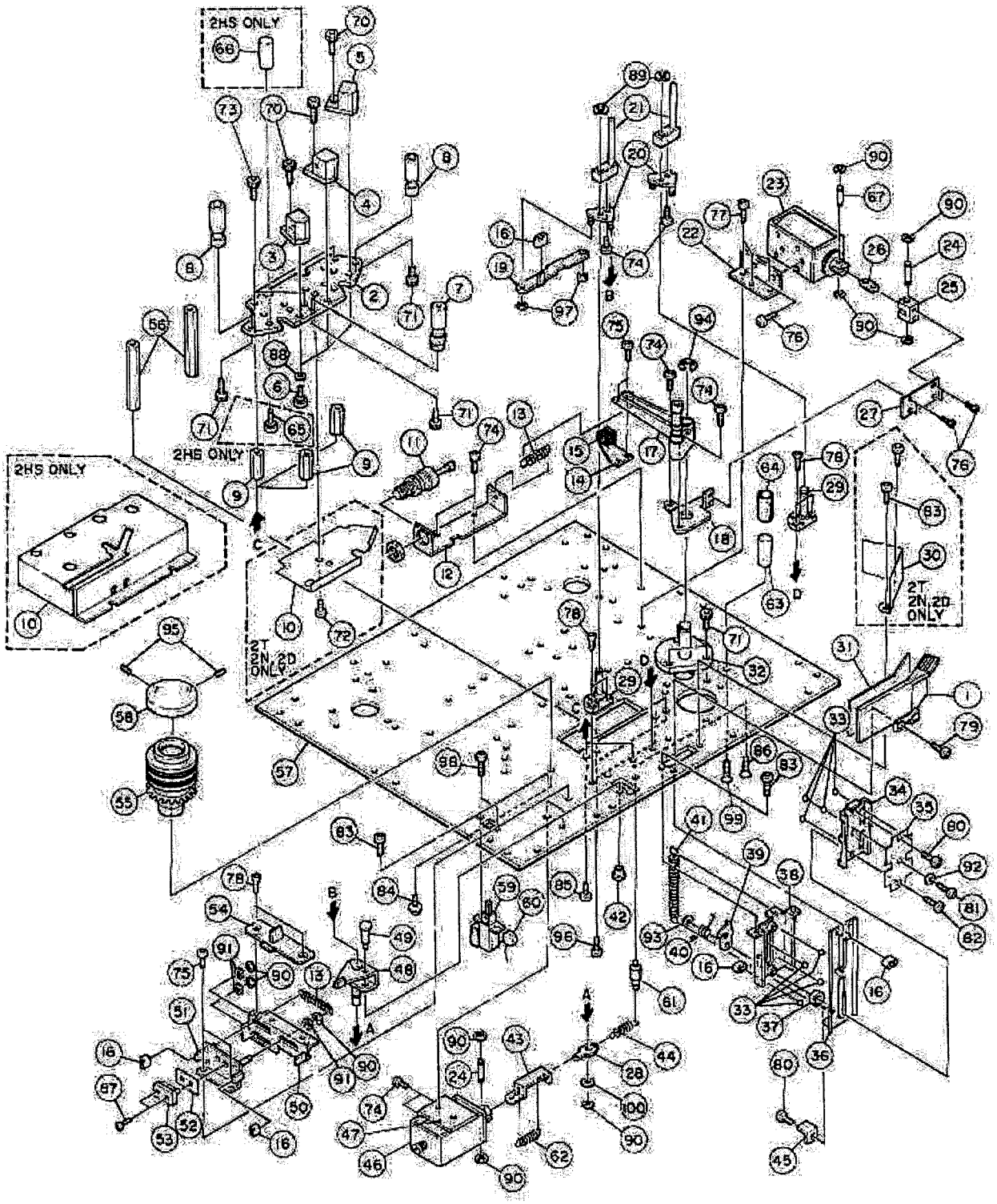
REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
	*5700075900	OWNER'S MANUAL [J]	
	*5700079800	OWNER'S MANUAL [ALL except J]	
	*5200112800	PCB ASSY,EXTENSION	
	*5800505100	PROTECTOR,PCB B	
	*5744023200	CRAMPER,REEL;B (ATR-60-2T,2N,2D)	
	*5032301100	RUBBER, CUSHION	
	*5062962000	TAPE,SPLICING	
	*5355122000	CABLE ASSY, HEAD (ATR-60-2T)	
	*5355087900	CABLE ASSY, HEAD (ATR-60-2N,2D,2HS)	
	*5355121900	CABLE ASSY, AMP (ATR-60-2T)	
	*5355088000	CABLE ASSY, AMP (ATR-60-2N,2D,2HS)	
	*5534659000	SPACER	
	*5740002700	EMPTY REEL, RE-1004 (ATR-60-2T,2N,2D)	
	*5740002800	EMPTY REEL, RE-1013 (ATR-60-2HS)	
	*5544995000	WASHER	

EXPLODED VIEW-2

Parts marked with *require longer delivery time.

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
2- 1	*5800638501	COVER, HEAD SHIELD	
2- 2	*5800637402	BASE HEAD (ATR-60-2T,2N,2D)	
	*5800763200	BASE,HEAD (ATR-60-2HS)	
2- 3	5378305900	HEAD,ERASE 3T3CH (ATR-60-2T)	
	5378302500	HEAD,ERASE 2T2CH NAB (ATR-60-2N)	
	5378302600	HEAD,ERASE 2T2CH DIN (ATR-60-2D)	
	5378306500	HEAD,ERASE 2T2CH (ATR-60-2HS)	
2- 4	5378305800	HEAD,REC/REP 3T3CH (ATR-60-2T)	
	5378302300	HEAD,REC/REP 2T2CH NAB (ATR-60-2N)	
	5378302400	HEAD,REC/REP 2T2CH DIN (ATR-60-2D)	
	5378306400	HEAD,REC/REP 2T2CH (ATR-60-2HS)	
2- 5	5378302300	HEAD,REC/REP 2T2CH NAB (ATR-60-2T,2N)	
	5378302400	HEAD,REC/REP 2T2CH DIN (ATR-60-2D)	
	5378306400	HEAD,REC/REP 2T2CH (ATR-60-2HS)	
2- 6	5781733008	SCREW, CAP M3X8 (SUS)	
2- 7	5800759300	TAPE GUIDE 1/4 ASSY A (ATR-60-2T,2N,2D)	
	5800759000	TAPE GUIDE 1/2 ASSY A (ATR-60-2HS)	
2- 8	5800759700	TAPE GUIDE 1/4 ASSY F (ATR-60-2T,2N,2D)	
	5800758600	TAPE GUIDE 1/2 ASSY F (ATR-60-2HS)	
2- 9	*5800454300	STUD,HEAD BASE (ATR-60-2T,2N,2D)	
	*5800337700	STUD,HEAD BASE (ATR-60-2HS)	
2-10	*5800763300	PLATE, SHIELD (ATR-60-2T,2N,2D)	
	*5800804600	PLATE, SHIELD (ATR-60-2HS)	
2-11	5730006100	ABSORBER,SOFT FA-0712G2	
2-12	*5800636100	HOLDER,DAMPER	
2-13	5800674800	SPRING,P.R.RETURN	
2-14	*5800780700	ARM,DUMPER	
2-15	*5534851000	DAMPER,ARM	
2-16	5027569000	RUBBER,CUSHION	
2-17	5800332301	ARM ASSY, PINCH ROLLER	
2-18	*5800780600	ARM, PRESSURE	
2-19	*5800636800	ARM,LINK	
2-20	*5800633600	PLATE ASSY,LIFTER	
2-21	5800724400	LIFTER ASSY	
2-22	*5800636200	BRACKET,SOLENOID	
2-23	5313001800	SOLENOID,PINCH ROLLER	
2-24	5800781100	PIN, SOLENOID	
2-25	*5800780800	BRACKET, LEAF SPRING	
2-26	*5800780900	JOINT	
2-27	5800188600	SPRING,PINCH ROLLER	
2-28	*5800782000	SLIDE BASE, ARM	
2-29	*5800689201	SHAFT ASSY,LIFTER ARM	
2-30	*5800679200	PLATE,SHIELD D (ATR-60-2T,2N,2D)	
2-31	*5800637700	PLATE,SHIELD C	
2-32	*5800687000	SHAFT ASSY,ARM	
2-33	5540056000	STEEL BALL 3OF	
2-34	*5800635801	RETAINER,BALL	
2-35	*5800635900	PALTE,BALL PRESSURE	
2-36	*5800635501	PLATE ASSY, SLIDE, A	
2-37	5800680700	SPACER	
2-38	*5800635101	BASE ASSY, SHIELD	
2-39	*5084643200	PLATE,LOCK	
2-40	5800380000	SPRING,LOCK	
2-41	5800674800	SPRING,P.R.RETURN	

10-1-2. Exploded View-2 (Head, Pinch Roller, and Lifter Sections)



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Parts marked with *require longer delivery time.

EXPLODED VIEW-2

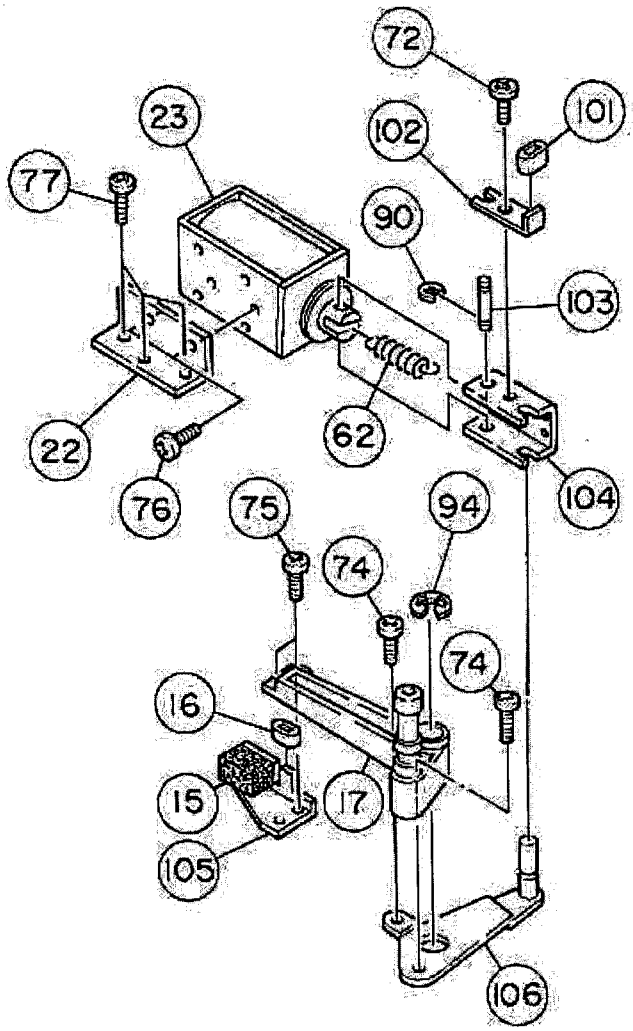
REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
2-42	*5800636500	SHAFT, KICK LEVER A	
2-43	*5800781900	BASE, ARM	
2-44	5800782100	SPRING, P RETURN	
2-45	*5800729000	STOPPER	
2-46	5313003400	SOLENOID,DAMP. G1564LTT81	
2-47	*5800675301	BRACKET, SOLENOID B	
2-48	*5800781600	LEVER ASSY, KICK	
2-49	*5800636600	SHAFT, KICK LEVER B	
2-50	*5800633901	SLIDER ASSY	
2-51	*5800632900	BASE ASSY	
2-52	*5550025100	PLATE,INSULATOR	
2-53	5301455500	SW.,MICRO SS5GL13-F	
2-54	5800640300	KNOB,CUE	
2-55	5800721601	ROLLER ASSY,COUNTER	
	(5730004200	BEARING,NTN626)	
2-56	*5800723900	POLE,HOUSING	
2-57	*5800640202	BASE,TRANSPORT	
2-58	5800757500	CAP, COUNTER ROLLER	
2-59	⚠ 5300040100	SW.,POWER TV-5	
2-60	⚠ 5052907000	CR.,0.01+300 400V	[J,GE]
	⚠ 5052910000	CR.,0.033+120	[US]
	⚠ 5292002600	CR, 0.033+120	[C]
	⚠ 5267703800	C.,4700PF 400V	[E,UK,A]
2-61	*5800781800	HOOK,SPRING	
2-62	5800674600	SPRING,PINCH ROLLER	
2-63	*5800781000	SHAFT,STOPPER	
2-64	5800354100	STOPPER,RUBBER	
2-65	5581057000	SHAFT,B (ATR-60-2HS)	
2-66	5800763000	HEAD, DUMMY (ATR-60-2HS)	
2-67	5545022000	PIN, SOLENOID	
2-70	*5800348701	SCREW,CAP	
2-71	*5781703006	SCREW,CAP;M3X6 (NI)	
2-72	*5780133006	SCREW,PAN SEMS A M3X6	
2-73	*5781704012	SCREW,CAP M4X12 (NI)	
2-74	*5780033006	SCREW,BIND SEMS A M3X6	
2-75	*5780003006	SCREW,BIND M3X6	
2-76	*5780033005	SCREW,BIND SEMS A M3X5	
2-77	*5780054008	SCREW,BIND SEMS F M4X8	
2-78	*5780203006	SCREW,FLAT;M3X6	
2-79	*5780023006	SCREW,BIND M3X6 (BK NI)	
2-80	*5780003004	SCREW,BIND M3X4	
2-81	*5780002003	SCREW,BIND M2X3	
2-82	*5780002004	SCREW,BIND M2X4	
2-83	*5780033010	SCREW,BIND SEMS A M3X10	
2-84	*5780004010	SCREW,BIND M4X10	
2-85	*5780034010	SCREW,BIND SEMS A M4X10	
2-86	*5780204010	SCREW,FLAT C.SUNK M4X10	
2-87	*5780002010	SCREW,BIND M2X10	
2-88	*5785150400	WASHER,WAVE WW-04	
2-89	*5786004000	RING, E E-4 (JIS)	
2-90	*5786003000	RING, E E-3 (JIS)	
2-91	*5785003000	FLAT WASHER, 0.5T	
2-92	*5785012000	WASHER,FLAT M2 (0.4T)	
2-93	*5786102400	RING, CS 2.4F	
2-94	*5786007000	RING, E E-7 (JIS)	

[US]:U.S.A. [E]:EUROPE [UK]:U.K. [C]:CANADA
[A]:AUSTRALIA [GE]:GENERAL EXPORT [J]:JAPAN

EXPLODED VIEW-2

Parts marked with *require longer delivery time.

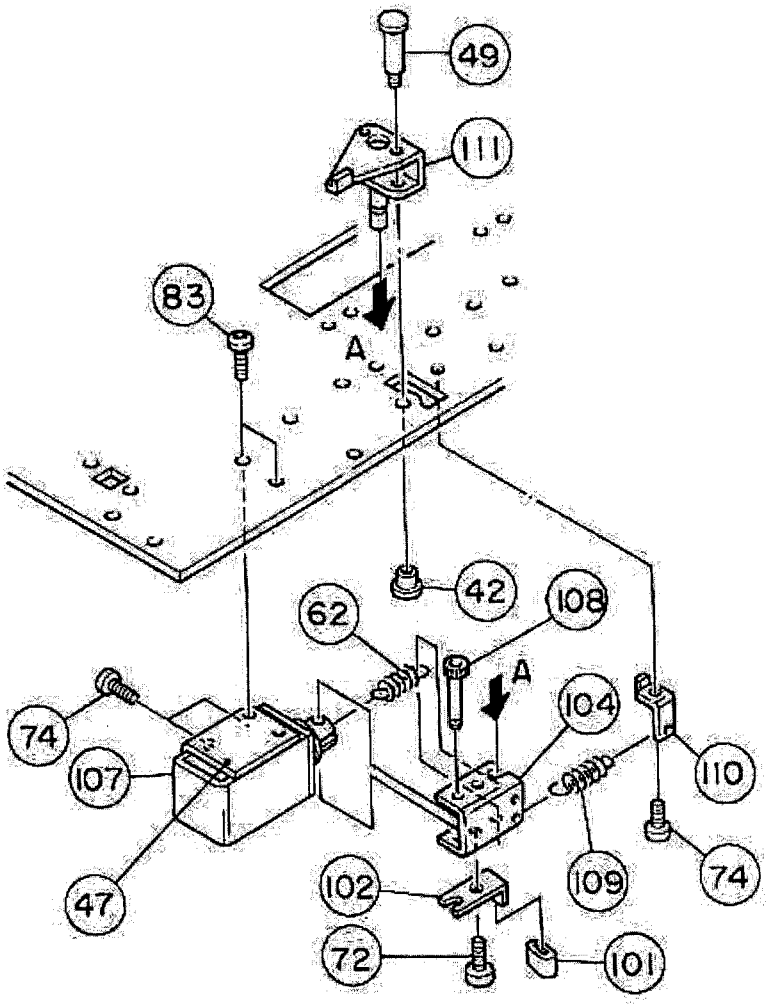
REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
2-95	*5782003003	SCREW,SET M3X3	
2-96	*5780004008	SCREW,BIND SEMS A M4X8	
2-97	*5786002500	RING, E E-2.5 (JIS)	
2-98	*5780133012	SCREW,PAN SEMS A M3X12	
2-99	*5780204006	SCREW,FLAT M4X6	
2-100	*5785004000	WASHER, FLAT M4(0.5T)	



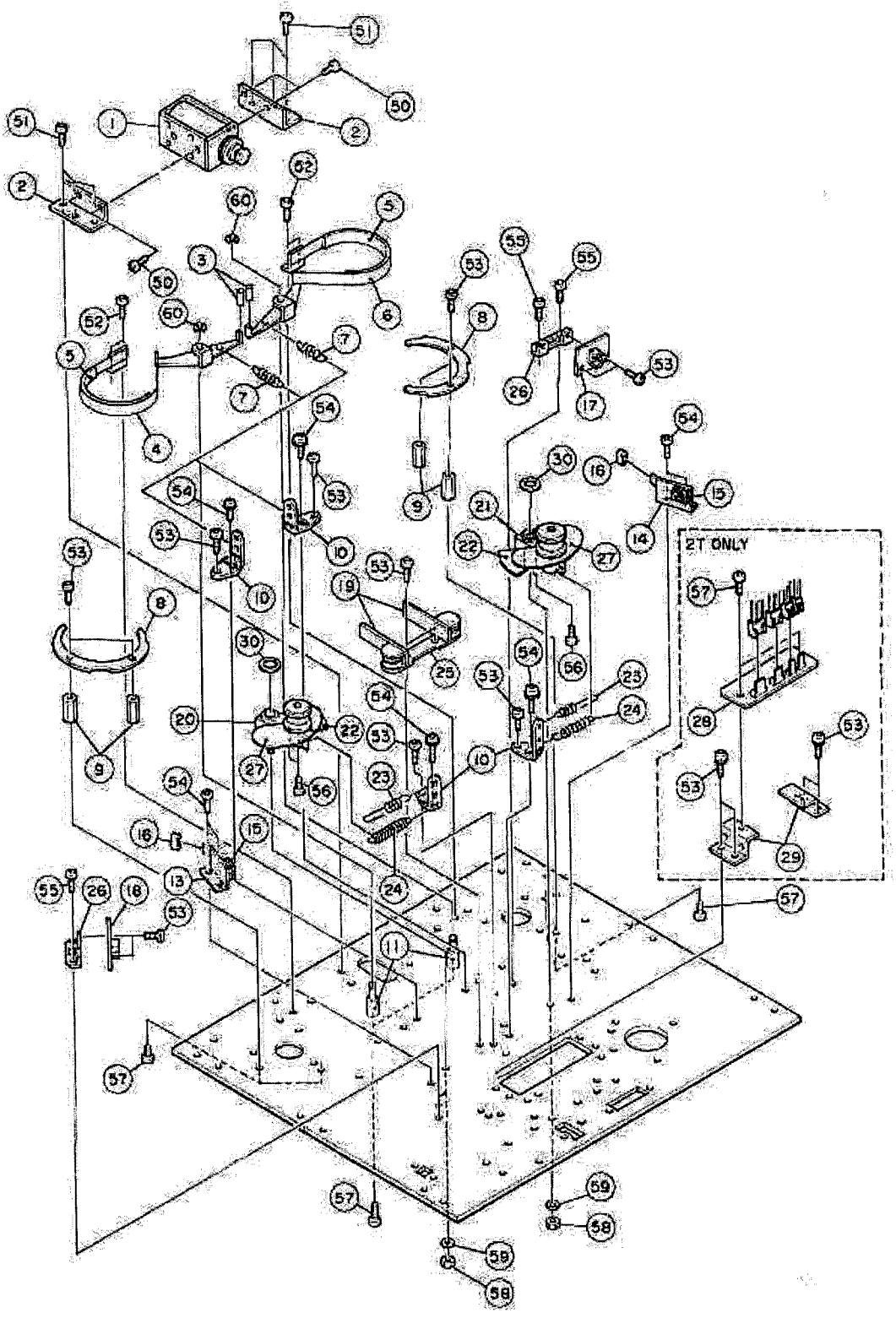
Parts marked with *require longer delivery time.

EXPLODED VIEW-2

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
2-101	5800689500	CUSHION	
2-102	*5800686500	PLATE,CUSHION	
2-103	5800636700	PIN,SOLENOID M	
2-104	*5800636301	ARM,BIAS	
2-105	*5800652100	ARM,DAMPER	-T : Serial No. 120001 or higher
2-106	*5800632300	ARM ASSY, SUB	-N & -D : Serial No. 70001 or higher
2-107	5313003300	SOLENOID C1264TT79	-H : Serial No. 80001 or higher
2-108	5800636700	PIN,SOLENOID M	
2-109	5800674400	SPRING,CUE RETURN	
2-110	*5800634500	STOPPER, SPRING	
2-111	*5800632600	KICK LEVER ASSY	



10-1-3. Exploded View-3 (Brake Tension Mechanism Section)

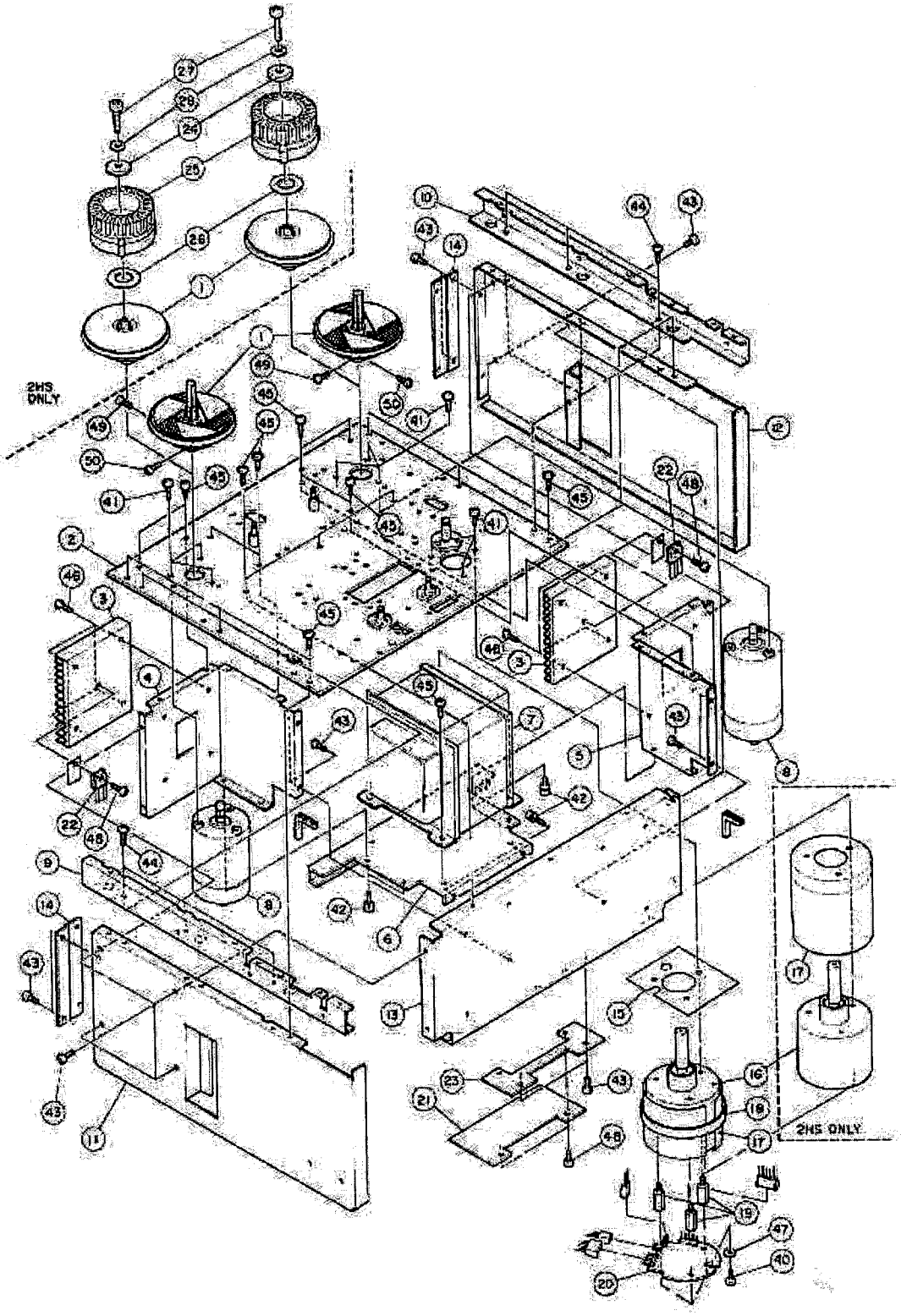


EXPLODED VIEW-3

Parts marked with *require longer delivery time.

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
3- 1	5313002900	SOLENOID,BRAKE	
3- 2	*5800636200	BRACKET,SOLENOID	
3- 3	5800532600	RUBBER, CUSHION A	
3- 4	5800634900	ARM ASSY,BRAKE L	
3- 5	5555274000	FELT,BRAKE (ATR-60-2T,2N,2D)	
	6012041000	SHOE,BRAKE (ATR-60-2HS)	
3- 6	5800634800	ARM ASSY,BRAKE R	
3- 7	5800674900	SPRING,BRAKE	
3- 8	*5555272000	RETAINER,BAND	
3- 9	*5800335401	STUD, BAND	
3-10	*5800670700	HOOK,SPRING B	
3-11	*5800335300	SHAFT, BRAKE ARM	
3-12		not used	
3-13	*5800336300	STOPPER, L	
3-14	*5800336400	STOPPER, R	
3-15	*5534851000	DAMPER,ARM	
3-16	5027569000	RUBBER,CUSHION	
3-17	*5200160900	END SENSOR PCB ASSY	
3-18	*5200160800	SPEED SENSOR PCB ASSY	
3-19	*5200185900	TENSION SENSOR PCB ASSY	
3-20	5800757602	ARM ASSY, TENSION, LB (ATR-60-2T,2N,2D)	
	(5730002100	BEARING 626HZ) (ATR-60-2T,2N,2D)	
	5800760100	ARM ASSY, TENSION 1/2 (ATR-60-2HS)	
	(5730004500	BEARING,WBC5-10ZZA/5K) ATR-60-2HS)	
	(5730005900	BALL BEARING,NTN 696ZZ-P5) ATR-60-2HS)	
3-21	5800757702	ARM ASSY, TENSION RB (ATR-60-2T,2N,2D)	
	(5730002100	BEARING 626HZ) (ATR-60-2T,2N,2D)	
	5800760100	ARM ASSY, TENSION 1/2 (ATR-60-2HS)	
	(5730004500	BEARING,WBC5-10ZZA/5K) ATR-60-2HS)	
	(5730005900	BALL BEARING,NTN 696ZZ-P5) ATR-60-2HS)	
3-22	*5800631502	SHUTTER	
3-23	5800761000	SPRING, TENSION 1/4 (ATR-60-2T,2N,2D)	
	5800763100	SPRING, TENSION 1/2 (ATR-60-2HS)	
3-24	5800728000	SPRING	
3-25	*5800634201	BASE, SENSOR	
3-26	*5800336201	HOLDER, SENSOR PCB	
3-27	*5800331400	PLATE, MASK	
3-28	*5200185200	TC CANCEL PCB ASSY (ATR-60-2T)	
3-29	*5800755600	BRACKET (ATR-60-2T)	
3-30	5800685800	CUSHION, PANEL	
3-50	*5780003005	SCREW, BIND M3X5	
3-51	*5780054008	SCREW, BIND SEMS F M4X8	
3-52	*5780003006	SCREW,BIND M3X6	
3-53	*5780033006	SCREW,BIND SEMS A M3X6	
3-54	*5780043006	SCREW,BIND SEMS B M3X6	
3-55	*5780133006	SCREW,PAN SEMS A M3X6	
3-56	*5780012004	SCREW, BIND M2X4 (NI)	
3-57	*5780033010	SCREW, BIND SEMS A M3X10	
3-58	*5781824000	NUT M4	
3-59	*5785104000	WASHER,SPRING,4MM	
3-60	*5786004000	RING,E E-4 (JIS)	

10-1-4. Exploded View-4 (Motor, Transport, and Reel Table Sections)



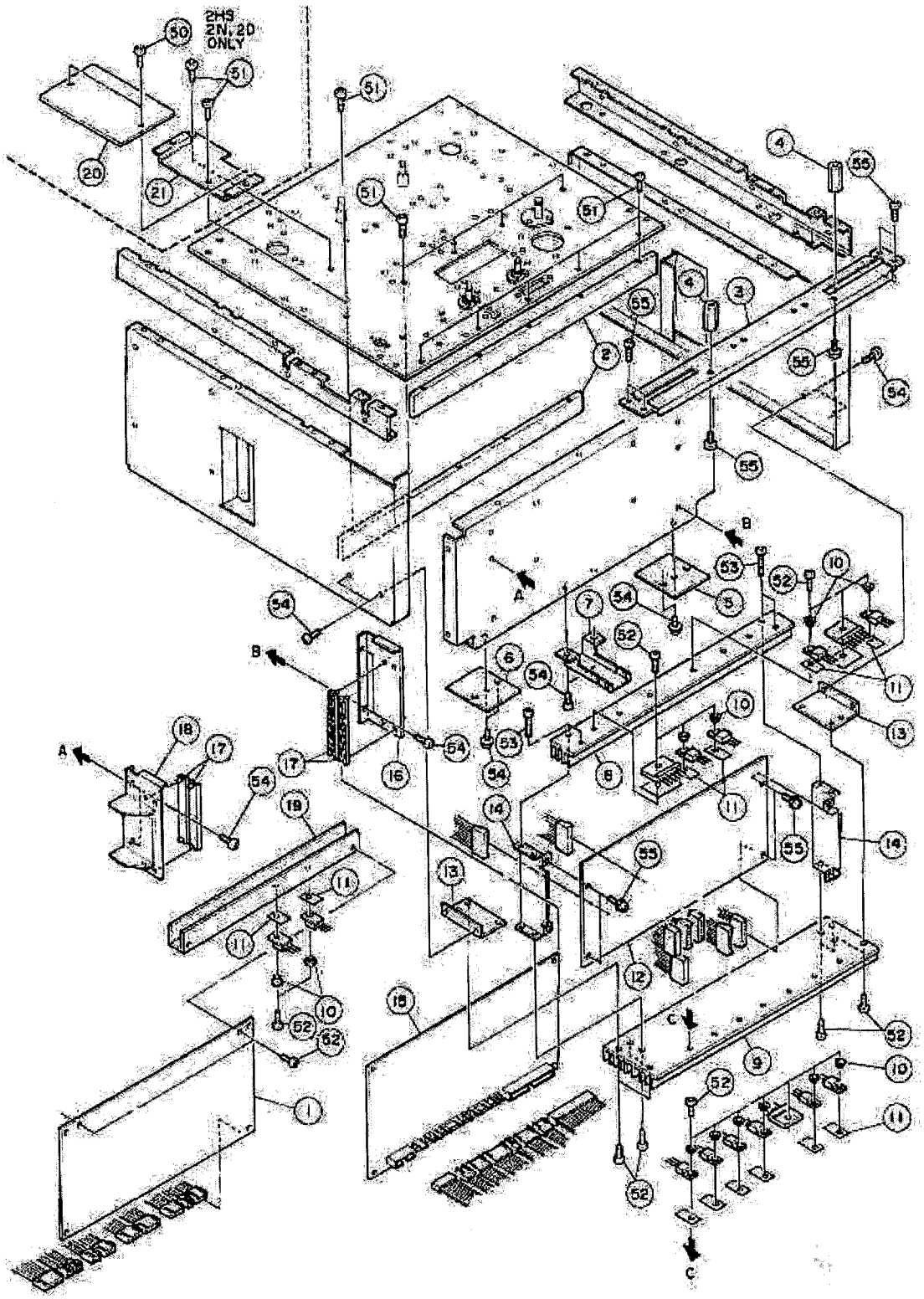
EXPLODED VIEW-4

Parts marked with *require longer delivery time.

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
4-1	5800400102	TABLE ASSY,REEL (ATR-60-2T,2N,2D)	
	5800637501	TABLE ASSY,REEL (ATR-60-2HS)	
4-2	*5800640202	BASE,TRANSPORT	
4-3	*5800525900	HEAT SINK B	
4-4	*5800639101	BRACKET, HEAT SINK L	
4-5	*5800639001	BRACKET, HEAT SINK R	
4-6	*5800653103	BRACKET, TRANSFORMER	
4-7	⚠ 5320034601	TRANSFORMER (ATR-60-2T,2N,2D) [J]	
	⚠ 5320034701	TRANSFORMER (ATR-60-2T,2N,2D) [US,C]	
	⚠ 5320034801	TRANSFORMER (ATR-60-2T,2N,2D) [GE]	
	⚠ 5320034901	TRANSFORMER (ATR-60-2T,2N,2D) [E,UK,A]	
	⚠ 5320032201	TRANSFORMER (ATR-60-2HS) [J]	
	⚠ 5320032301	TRANSFORMER (ATR-60-2HS) [US,C]	
	⚠ 5320032401	TRANSFORMER (ATR-60-2HS) [GE]	
	⚠ 5320032501	TRANSFORMER (ATR-60-2HS) [E,UK,A]	
4-8	5370002702	MOTOR,R.DC(1/2) (ATR-60-2T,2N,2D)	
	5370005300	MOTOR,REEL DC (ATR-60-2HS)	
4-9	*5800639601	ANGLE, SIDE L	
4-10	*5800639501	ANGLE, SIDE R	
4-11	*5800639403	CHASSIS, SIDE L	
4-12	*5800639303	CHASSIS, SIDE R	
4-13	*5800639200	CHASSIS, MIDDLE	
4-14	*5800638100	STAY, TOP COVER	
4-15	*5800679101	PLATE, SHIELD B (ATR-60-2T,2N,2D)	
4-16	5370006200	DC CAPSTAN MOTOR ASSY	
4-17	*5800679000	PLATE, SHIELD A (ATR-60-2T,2N,2D)	
	*5800804500	COVER, SHIELD CAPSTAN MOTOR (ATR-60-2HS)	
4-18	*5800637800	BAND,CORD (ATR-60-2T,2N,2D)	
4-19	*5800660300	STAY,CM DRIVE PCB	
4-20	*5200162200	CM DRIVE PCB ASSY	
4-21	*5200178200	FUSE PCB ASSY [J,US,C,GE]	
	*5200178300	FUSE PCB ASSY [E,UK,A]	
4-22	5231758800	SI.TR.2SD1047-E	
4-23	*5800652700	HOLDER, FUSE PCB	
4-24	5800324901	WASHER,A (ATR-60-2HS)	
4-25	5740003400	CRAMPER,REEL;D 1/2" (ATR-60-2HS)	
4-26	5800326600	SPACER,REEL (ATR-60-2HS)	
4-27	5780005025	SCREW, BIND M5X25 (ATR-60-2HS)	
4-28	5785225000	WASHER,FIBER 5X10X0.5T (ATR-60-2HS)	
4-40	*5780013006	SCREW,BIND M3X6 (NI)	
4-41	*5780034012	SCREW,BIND SEMS A; M4X12	
4-42	*5780004006	SCREW,BD M4X6 B/CZN-14	
4-43	*5780034006	SCREW,BIND SEMS A M4X6	
4-44	*5780034008	SCREW,BIND SEMS A M4X8	
4-45	*5780034010	SCREW,BIND SEMS A M4X10	
4-46	*5783003006	SCREW,PAN S TITE M3X6	
4-47	*5785213000	WASHER,FIBER;3X6X0.5T	
4-48	*5780003010	SCREW,BIND M3X10	
4-49	*5781704010	SCREW,CAP M4X10 (NI)	
4-50	*5800678500	SCREW;BALL POINT	

[US]:U.S.A. [E]:EUROPE [UK]:U.K. [C]:CANADA
[A]:AUSTRALIA [GE]:GENERAL EXPORT [J]:JAPAN

10-1-5. Exploded View-5 (Transport Main PCB Section)

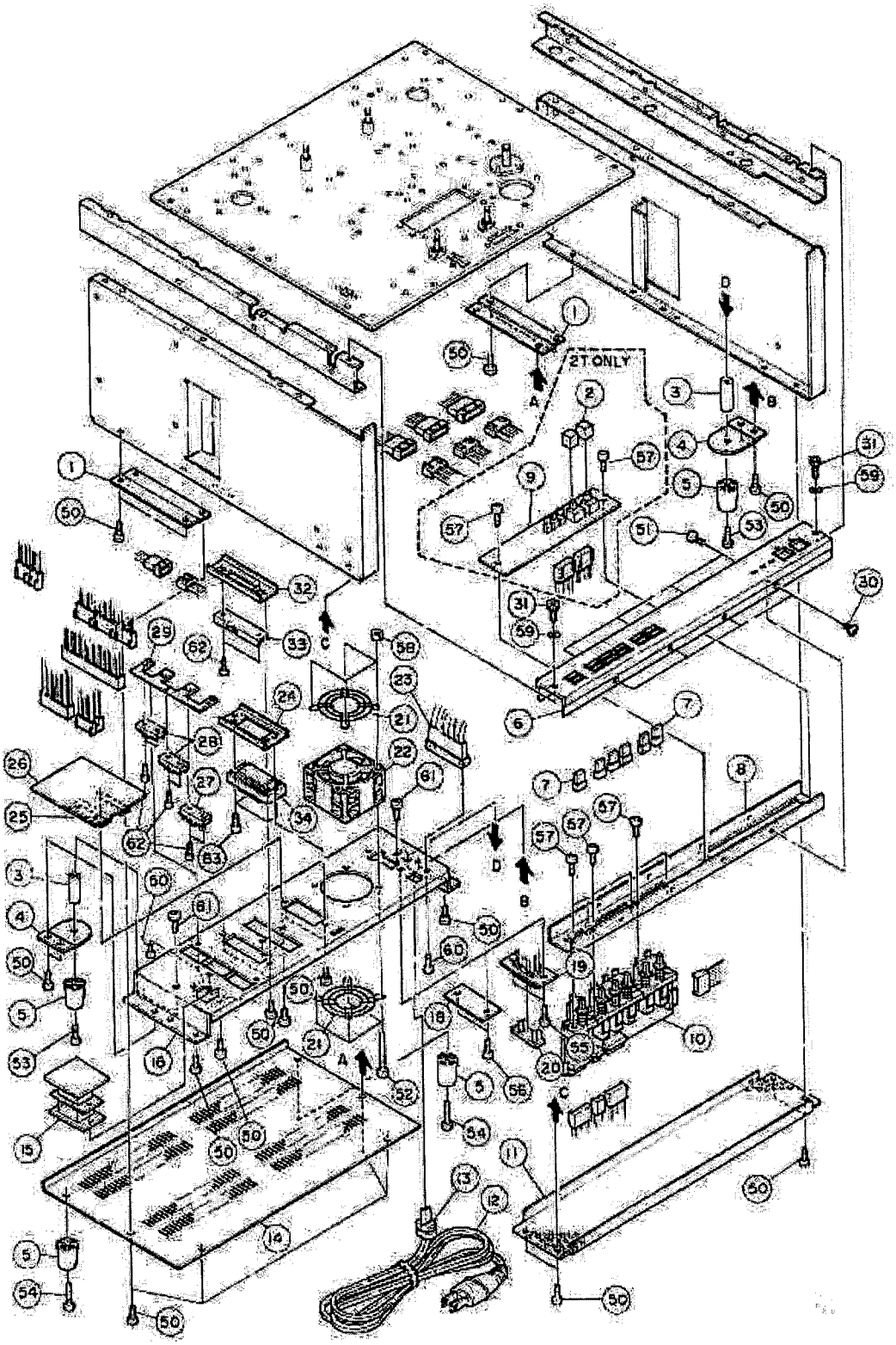


Parts marked with *require longer delivery time.

EXPLODED VIEW-5

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
5- 1	*5200160610	MOTOR DRIVE PCB ASSY (ATR-60-2T,2N,2D)	
	*5200160620	MOTER DRIVE PCB ASSY (ATR-60-2HS)	
5- 2	*5800686600	PLATE	
5- 3	*5800658801	BRACKET, BASE	
5- 4	*5800658300	STUD,HOUSING BASE	
5- 5	*5200160730	JOINT PCB ASSY R (ATR-60-2T,2N,2D)	
	*5200160710	JOINT PCB ASSY R (ATR-60-2HS)	
5- 6	*5200160720	JOINT PCB ASSY L (ATR-60-2T,2N,2D)	
	*5200160700	JOINT PCB ASSY L (ATR-60-2HS)	
5- 7	*5800637900	CLAMPER, PCB	
5- 8	*5800652900	HEAT SINK B	
5- 9	*5800652801	HEAT SINK A	
5-10	5033295000	TUBE,INSULATOR	
5-11	5033291000	PLATE,INSULATOR	
5-12	*5200160300	POWER SUPPLY PCB ASSY	
5-13	*5800652300	ANGLE, PS UNIT	
5-14	*5800652402	HOLDER, POWER SUPPLY PCB	
5-15	*5200160510	CONTROL PCB ASSY (ATR-60-2T,2N,2D)	
	*5200160520	CONTROL PCB ASSY (ATR-60-2HS)	
5-16	*5800656601	GUIDE, PCB R	
5-17	*5730003200	GUIDE, PCB (TROG-3925)	
5-18	*5800656701	GUIDE, PCB L	
5-19	*5800638001	HEAT SINK	
5-20	*5200185700	HEAD PCB ASSY,ERASE (ATR-60-2N,2D,2HS)	
5-21	*5800772100	BRACKET (ATR-60-2N,2D,2HS)	
5-50	*5780134006	SCREW,PAN SEMS A M4X6	
5-51	*5780134012	SCREW,PAN SEMS A M4X12	
5-52	*5780003008	SCREW,BIND M3X8	
5-53	*5780003025	SCREW,BIND M3X25	
5-54	*5780033006	SCREW,BIND SEMS A M3X6	
5-55	*5780133008	SCREW,PAN SEMS A M3X8	

10-1-6. Exploded View-6 (Rear Panel and Function Panel Sections)



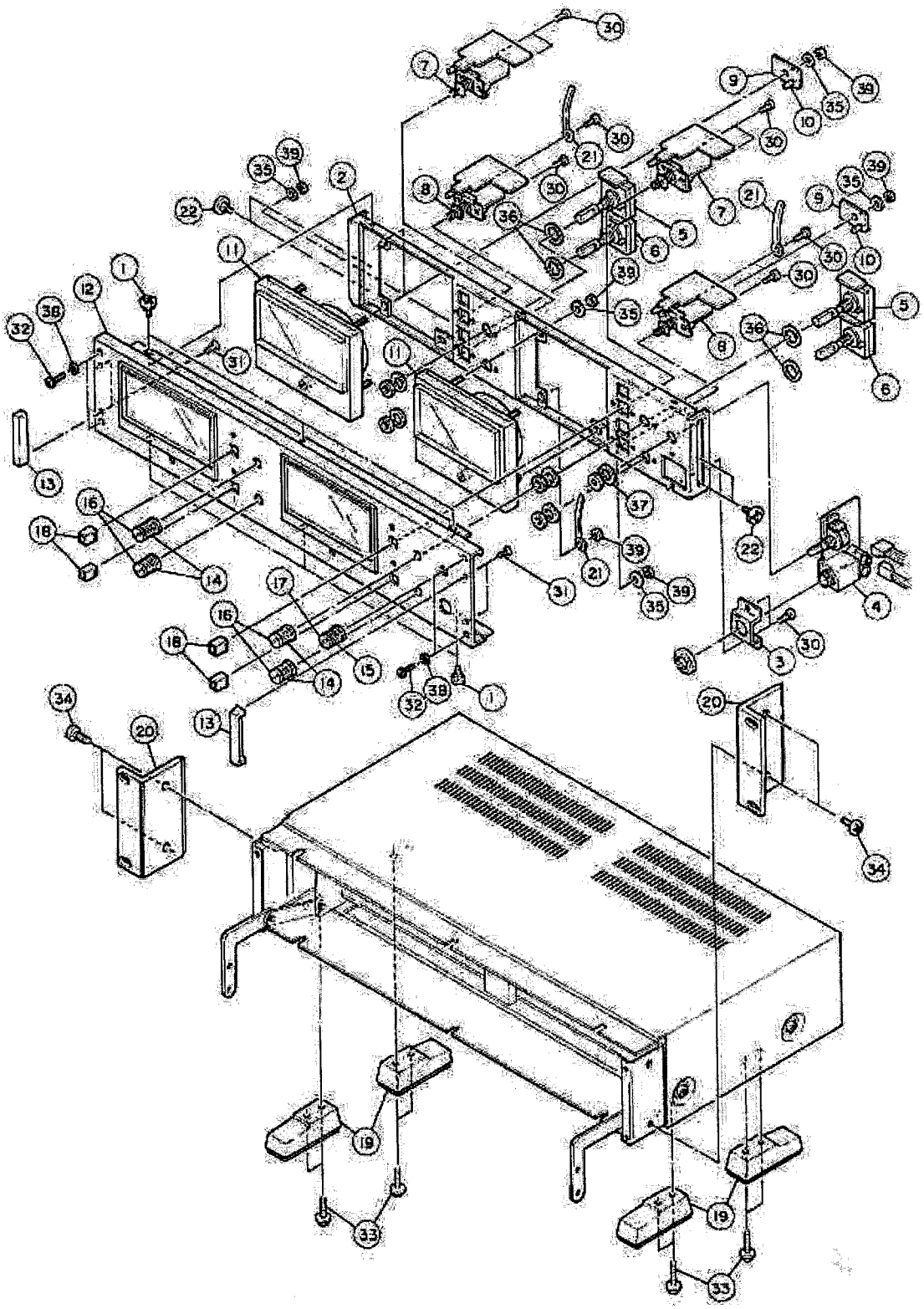
EXPLODED VIEW-6

Parts marked with *require longer delivery time.

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
6- 1	*5800638400	STAY, REAR COVER	
6- 2	5800657700	BUTTON,SQUARE (ATR-60-2T)	
6- 3	*5800675101	POLE, FOOT	
6- 4	*5800660600	PLATE, CABLE HOLD	
6- 5	*5504552000	FOOT	
6- 6	*5800730600	FUNCTION PANEL ASSY (ATR-60-2T)	
	*5800760700	FUNCTION PANEL ASSY (ATR-60-2N,2D,2HS)	
6- 7	5800378900	BUTTON	
6- 8	*5800693601	FUNCTION CHASSIS	
6- 9	*5200178000	FUNCTION PCB ASSY(T) (ATR-60-2T)	
6-10	*5200177900	FUNCTION PCB ASSY (ATR-60-2T)	
	*5200177910	FUNCTION PCB ASSY (ATR-60-2N,2D,2HS)	
6-11	*5800653000	COVER, HEAT SINK	
6-12	⚠ *5128027000	CORD,AC [J]	
	⚠ *5350010700	CORD,AC [US]	
	⚠ *5350012200	CORD,AC [C]	
	⚠ *5350010800	CORD,AC [GE]	
	⚠ *5350008200	CORD,AC [E]	
	⚠ *5128047000	CORD,AC [UK]	
	⚠ *5350008300	CORD,AC [A]	
6-13	⚠ *5534660000	STRAIN RELIEF [J,GE,E,A]	
	⚠ *5317001700	STRAIN RELIEF [US,UK]	
	⚠ *5534663000	STRAIN RELIEF [C]	
6-14	*5800640000	COVER,REAR	
6-15	*5200100000	CONNECTOR PCB ASSY	
6-16	*5800693701	PANEL, REAR	
6-17		not used	
6-18	*5800676700	PLATE, SELECTOR MASK	
6-19	*5133015001	PLUG,VOLT. SELECTOR [GE]	
6-20	*5133014000	PLUG,VOLT. SELECTOR [GE]	
6-21	*5730006300	GUARD, FINGER	
6-22	5370005600	MOTOR,DC FAN 0.09 2.16	
6-23	*5043849000	TERMINAL,3P	
6-24	*5800194101	BRACKET, CONNECTOR (C)	
6-25	*5800640901	BRACKET, CONNECTOR B	
6-26	*5200161310	REMOTE CONNECTOR PCB ASSY	
6-27	*5334035200	CONN. PLUG 08P P1608G-ST	
6-28	*5334033500	CONN.SOCKET 08P S1608G-ST	
6-29	*5800762900	PLATE, CONNECTOR	
6-30	5800400900	SCREW,SHOULDER	
6-31	5800509700	SCREW, CAP	
6-32	*5800653501	PLATE,CONNECTOR;34P	
6-33	*6052400004	CONN.SOCKET;34P	
6-34	*5334012900	CONN.SOCKET;38P	
6-50	*5780023006	SCREW, BIND M3X6 (BK NI)	
6-51	*5780003008	SCREW,BIND M3X8	
6-52	*5780013045	SCREW, BIND M3X45(NI)	
6-53	*5780133010	SCREW,PAN SEMS M3X10	
6-54	*5780134010	SCREW,PAN SEMS A M4X10	
6-55	*5780143008	SCREW,PAN SEMS B M3X8	
6-56	*5780123006	SCREW,PAN M3X6 BK (NI)	
6-57	*5780133008	SCREW, PAN SEMS A M3X8	
6-58	*5781813000	NUT M3	
6-59	*5785214200	WASHER, FIBER 4X6.5X0.5T	
6-60	*5780013006	SCREW,BIND M3X6 (NI)	
6-61	*5780004008	SCREW,BIND M4X8	
6-62	*5780102610	SCREW,PAN M2.6X10	
6-63	*5780033006	SCREW,BIND SEMS A M3X6	

[US]:U.S.A. [E]:EUROPE
[UK]:U.K. [C]:CANADA
[A]:AUSTRALIA
[GE]:GENERAL EXPORT [J]:JAPAN

10-1-7. Exploded View-7 (Amplifier Front Mechanism)

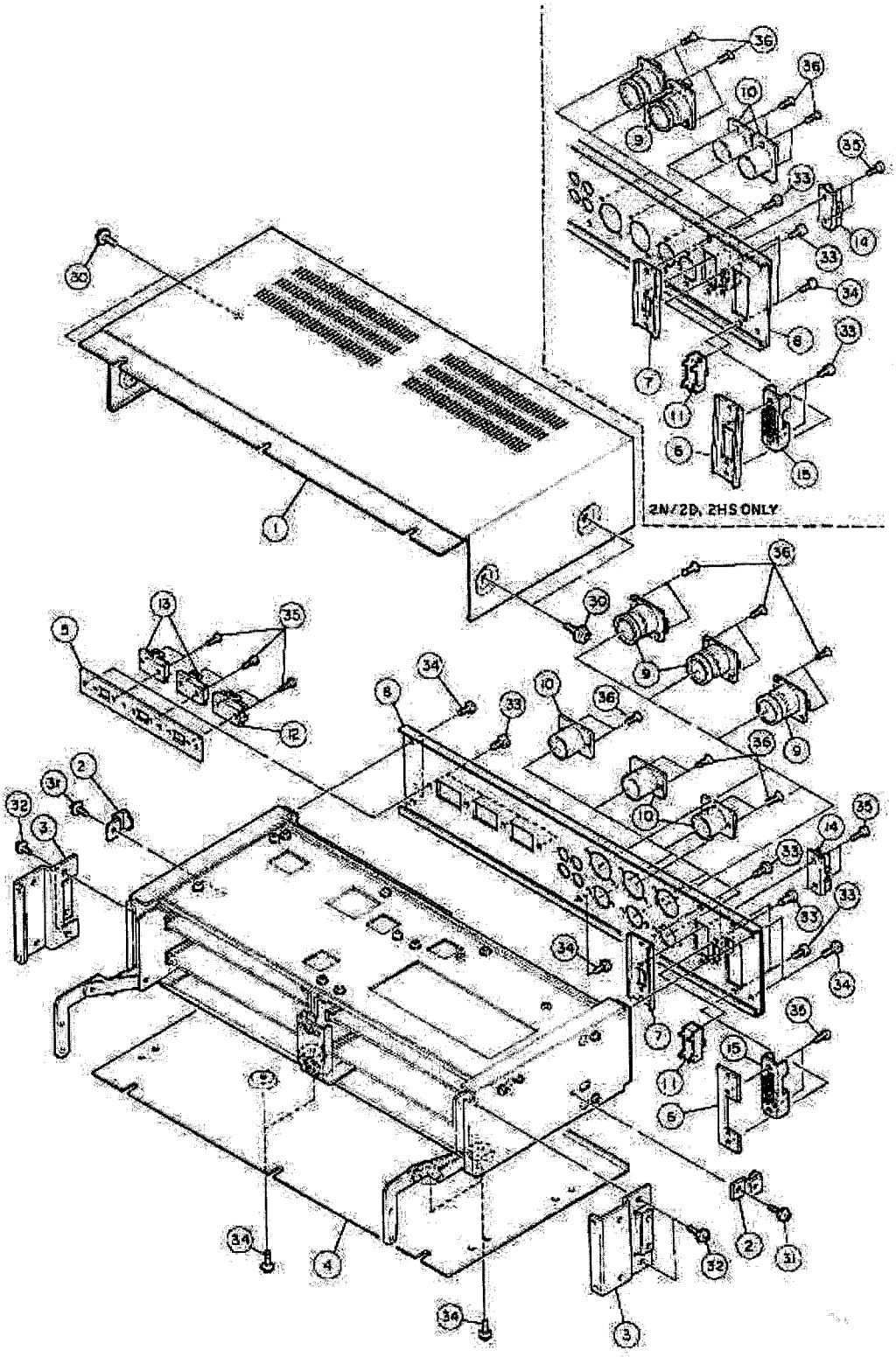


Parts marked with *require longer delivery time.

EXPLODED VIEW-7

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
7- 1	5800400900	SCREW,	
7- 2	*5800510200	CHASSIS AMP C ASSY	
7- 3	*5800505300	BRACKET, JACK	
7- 4	*5200128201	PHONE AMP PCB ASSY	
7- 5	*5200128600	VR(1) PCB ASSY	
7- 6	*5200129100	VR(2) PCB ASSY	
7- 7	*5200128700	SW(1) PCB ASSY	
7- 8	*5200129200	SW(2) PCB ASSY	
7- 9	*5210097600	LED PCB	
7-10	5225006900	LED,PR3432S RED	
7-11	5296006000	METER ASSY,VU	
7-12	*5800730800	PANEL ASSY(E), AMP	
	(*5800483100	COVER ASSY,METER)	
7-13	*5800349700	HANDLE ASSY	
7-14	5800173500	KNOB	
7-15	5800382900	KNOB,B-15	
7-16	6006054100	CAP,KNOB;IVORY	
7-17	6006055100	CAP,KNOB;ORANGE	
7-18	5800429200	BUTTON,PUSH A	
7-19	*5800288502	FOOT	
7-20	*5800565900	ANGLE,RACK MOUNT 2U	
7-21	*5581038000	HARNESS CLIP A	
7-22	5581055000	ROD,D	
7-30	*5783073006	SCREW,PAN CUP S TITE M3X6	
7-31	*5781212606	SCREW,C.SUNK TAP M2.6X6	
7-32	*5781703006	SCREW,CAP M3X6 (NI)	
7-33	*5783583014	SCREW,WASHER M3X14(BK NI)	
7-34	*5783144016	SCREW, WASHER M4X16 (NI)	
7-35	*5785103000	WASHER,SPRING 3F	
7-36	*5785008000	WASHER,FLAT M8 (1.2T)	
7-37	*5785027100	WASHER,FLAT 7.5X13X1T	
7-38	*5785213200	WASHER,FIBER 3X5.5X0.25T	
7-39	*5781813000	NUT M3	

10-1-8. Exploded View-8 (Amplifier Rear Mechenism)

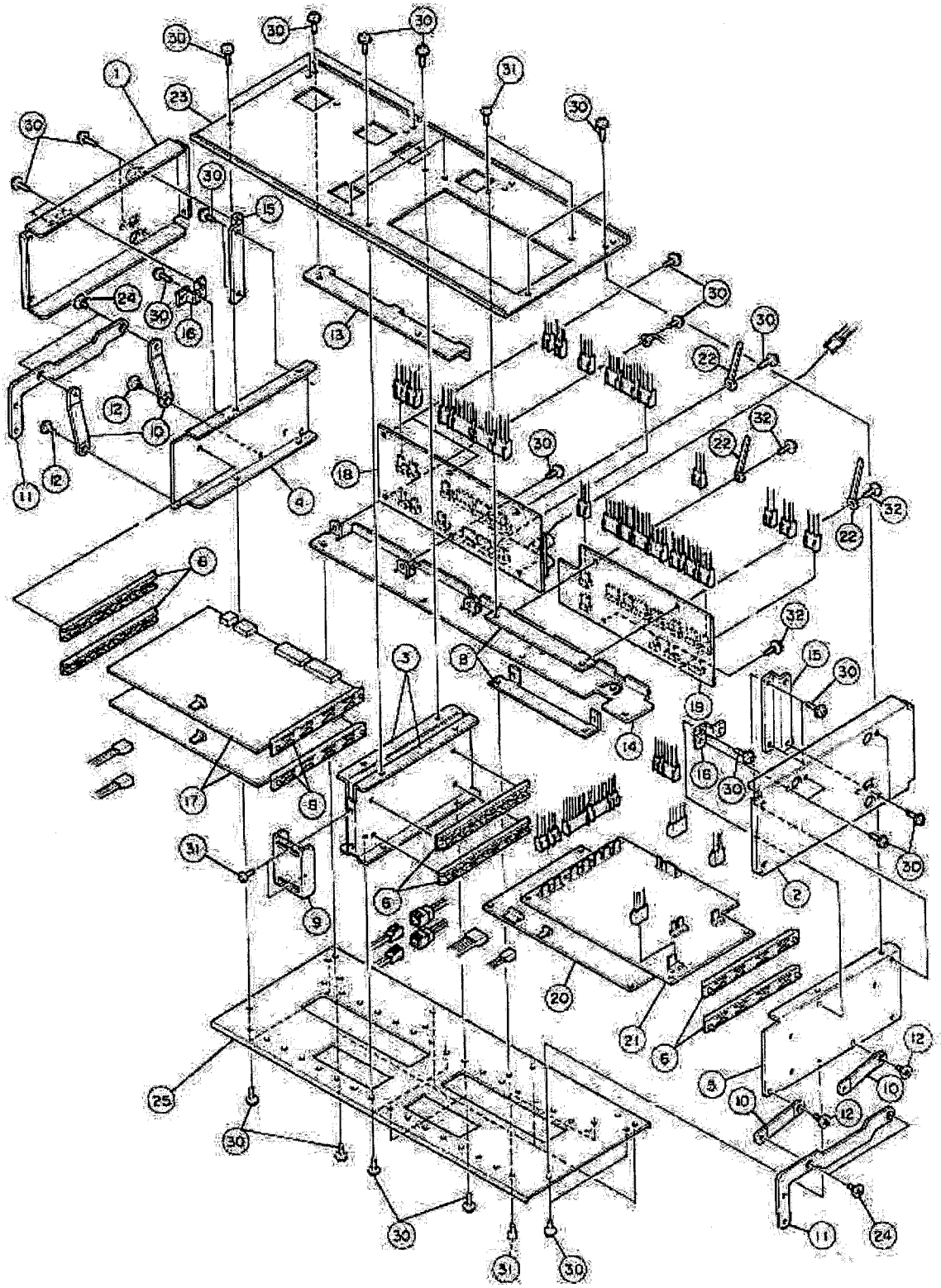


Parts marked with *require longer delivery time.

EXPLODED VIEW-8

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
8-1	*5800693800	BONNET	
8-2	*5800339900	HOLDER, COVER (C)	
8-3	*5800693100	BRACKET, AMP SIDE	
8-4	*5800562100	COVER, BOTTOM (A)	
8-5	*5800560800	BRACKET, H CONNECTOR	
8-6	*5800755500	PLATE,CONNECTOR (34P) (ATR-60-2T)	
	*5800561000	PLATE,CONNECTOR C (24P) (ATR-60-2N,2H,2HS)	
8-7	*5800560900	BRACKET, CONNECTOR (B)	
8-8	*5800693400	PANEL,REAR (ATR-60-2T)	
	*5800562000	PANEL,REAR (ATR-60-2N,2D,2HS)	
8-9	5334027200	CONNECTOR,CANNON XLB-3-32	
8-10	5334027300	CONNECTOR,CANNON XLB-3-31	
8-11	6051604000	SW.,SLIDE	
8-12	*5334033500	CONN.SOCKET 08P S1608C-ST	
8-13	*5334035200	CONN.PLUG 08P P1608C-ST	
8-14	*5334037300	CONN.SOCKET 12P S1612A-ST	
8-15	*5334032800	CONN.PLUG,34P (ATR-60-2T)	
	*5334032400	CONN.PLUG,24P (ATR-60-2N,2D,2HS)	
8-30	*5783114006	SCREW,WASHER M4X6(BK NI)	
8-31	*5783073006	SCREW,PAN CUP S TITE M3X6	
8-32	*5780004006	SCREW,BD M4X6 B/CZN-14	
8-33	*5780023006	SCREW,BIND M3X6 (BK NI)	
8-34	*5783583006	SCREW,WASHER M3X6 (BK NI)	
8-35	*5780102610	SCREW,PAN M2.6X10	
8-36	*5780203006	SCREW,C SUNK M3X6	

10-1-9. Exploded View-9 (Amplifier Internal Mechanism)



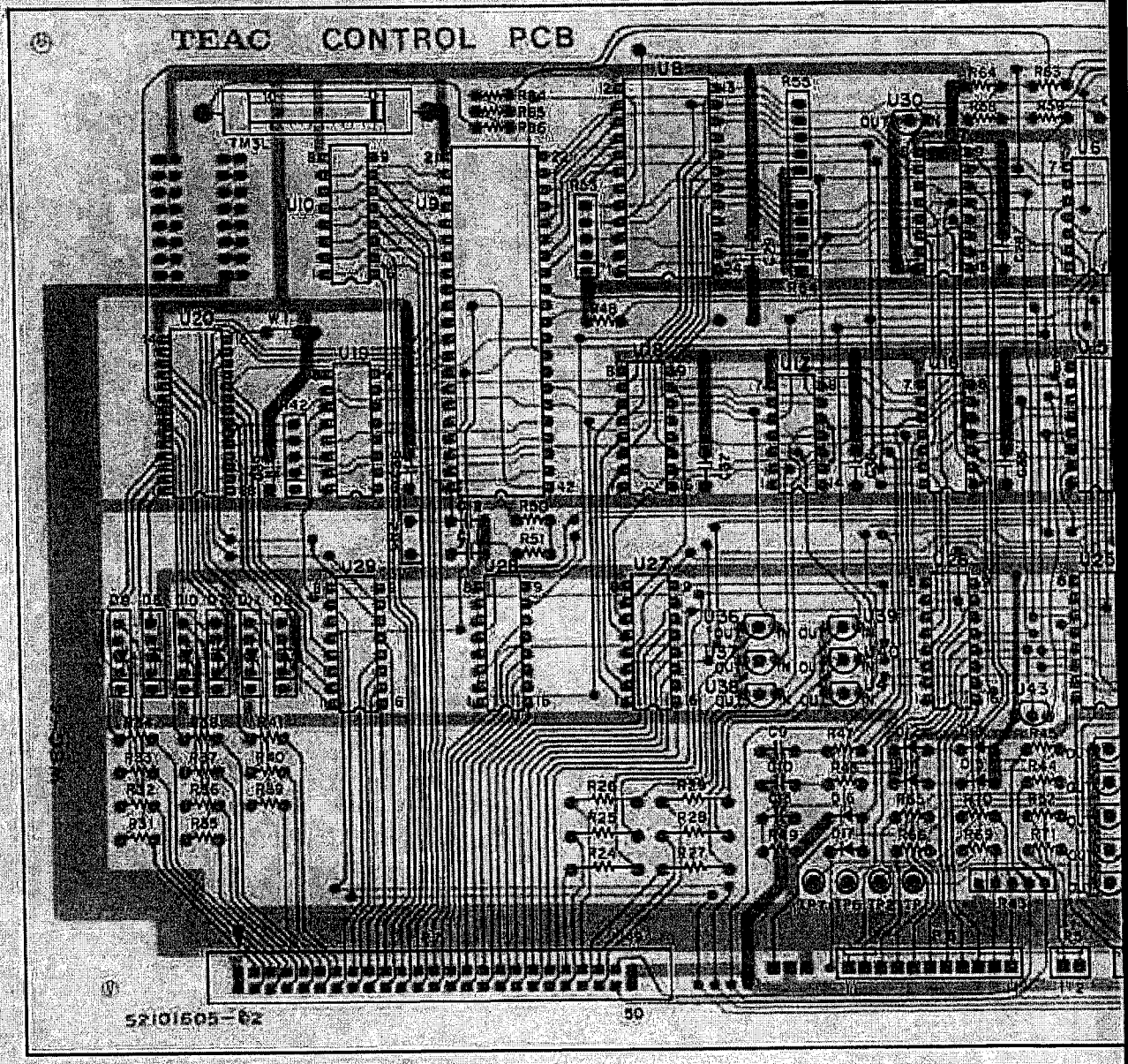
Parts marked with *require longer delivery time.

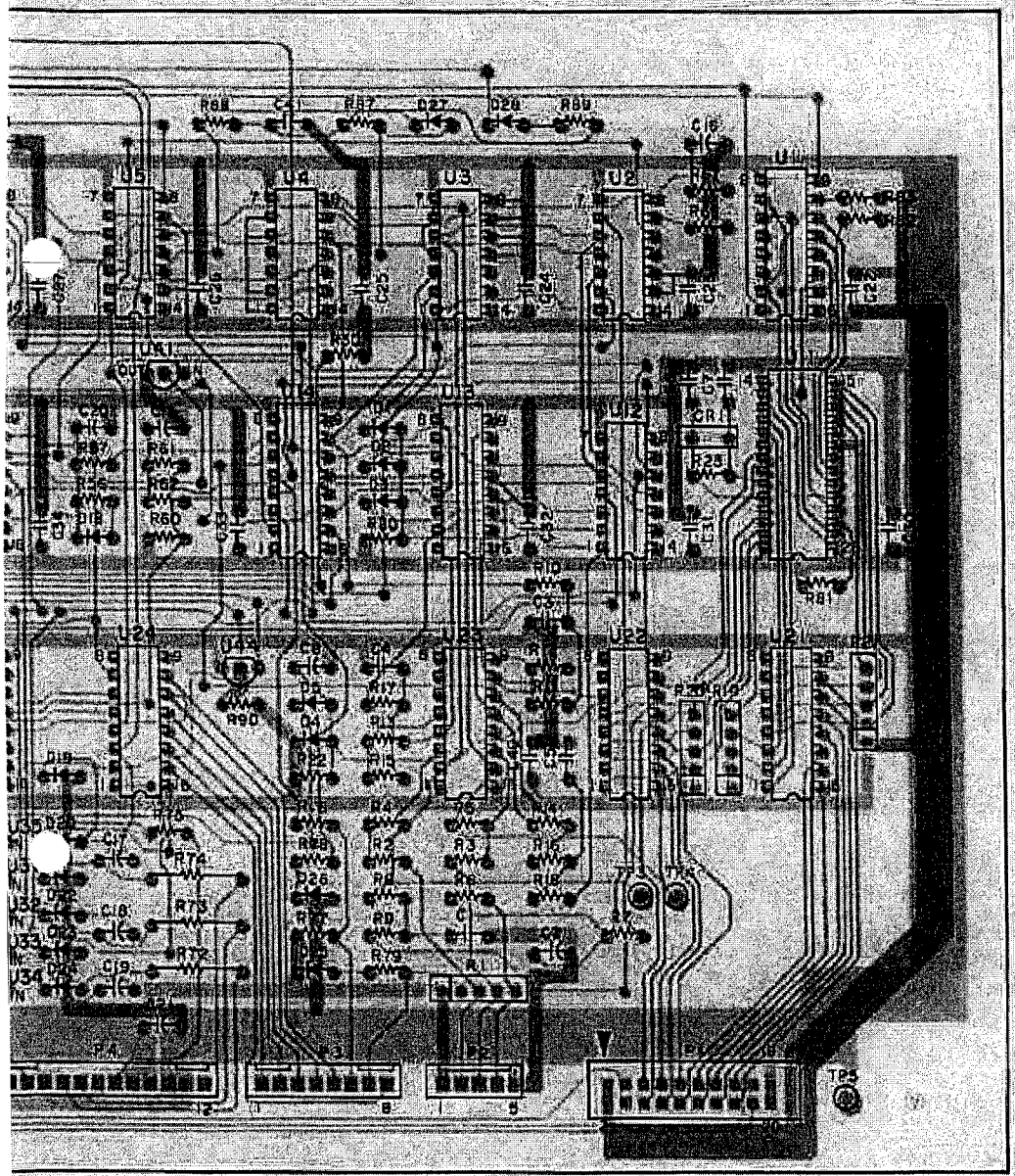
EXPLODED VIEW-9

REF.NO.	PARTS NO.	DESCRIPTION	REMARKS
9- 1	*5800561700	CHASSIS,AMP SIDE (L)	
9- 2	*5800561800	CHASSIS,AMP SIDE (R)	
9- 3	*5800561400	BRACKET, PCB GUIDE	
9- 4	*5800561500	CHASSIS, SIDE(L)	
9- 5	*5800561600	CHASSIS, SIDE(R)	
9- 6	*5730003200	GUIDE,PCB (TROG-3925)	
9- 7		not used	
9- 8	*5800561100	BRACKET PCB	
9- 9	*5800561300	HOLDER, PCB	
9-10	*5800339001	ARM (B)	
9-11	*5800339500	PLATE, JOINT	
9-12	5581056000	SHAFT,A	
9-13	*5800762800	BRACKET,PCB	
9-14	*5800561900	BRACKET, PCB(E)	
9-15	*5800339101	BRACKET, AMP(A)	
9-16	*5800339200	BRACKET, AMP(B)	
9-17	*5200097220	REC/PLAY PCB ASSY (AIR-60-2T)	
	*5200185800	AMP PCB ASSY, R/P (AIR-60-2N,2D)	
	*5200185810	AMP PCB ASSY, R/P (AIR-60-2HS)	
9-18	*5200138800	MOTHER A PCB ASSY	
9-19	*5200138900	MOTHER B PCB ASSY	
9-20	*5200139000	IN/OUT PCB ASSY	
9-21	*5200177800	TIME CODE AMP PCB ASSY (AIR-60-2T)	
9-22	*5581038000	HARNESS CLIP A	
9-23	*5800762702	BRACKET, PCB GUIDE	
9-24	5800404400	SCREW,SHOULDER B	
9-25	*5800343901	BRACKET,PCB GUIDE A	
9-30	*5783073006	SCREW,PAN CUP S TITE M3X6	
9-31	*5780023006	SCREW,BIND M3X6 (BK NI)	
9-32	*5780003006	SCREW,BIND M3X6	

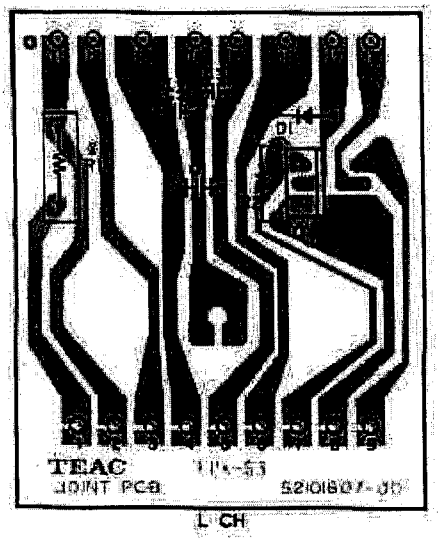
10-2. ELECTRONICS

10-2-1. Control PCB Ass'y



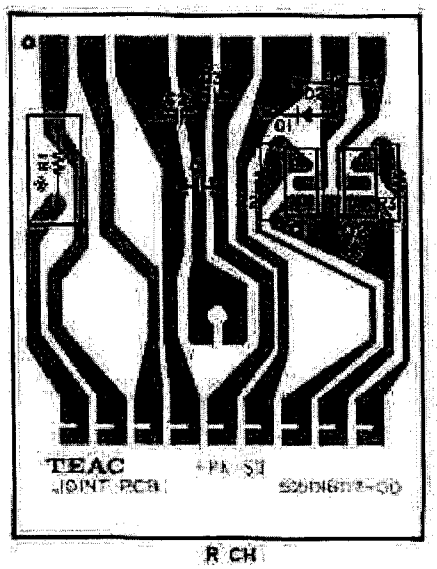

U5
U4
U3
U2
U1
TP3
TP4
TP5

10-2-3. Joint PCB Ass'y L



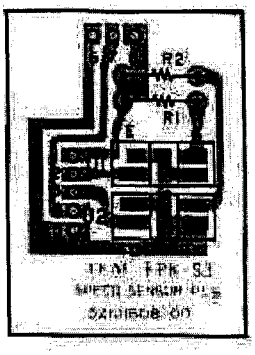
L CH

10-2-4. Joint PCB Ass'y R

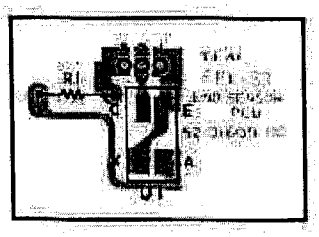


R CH

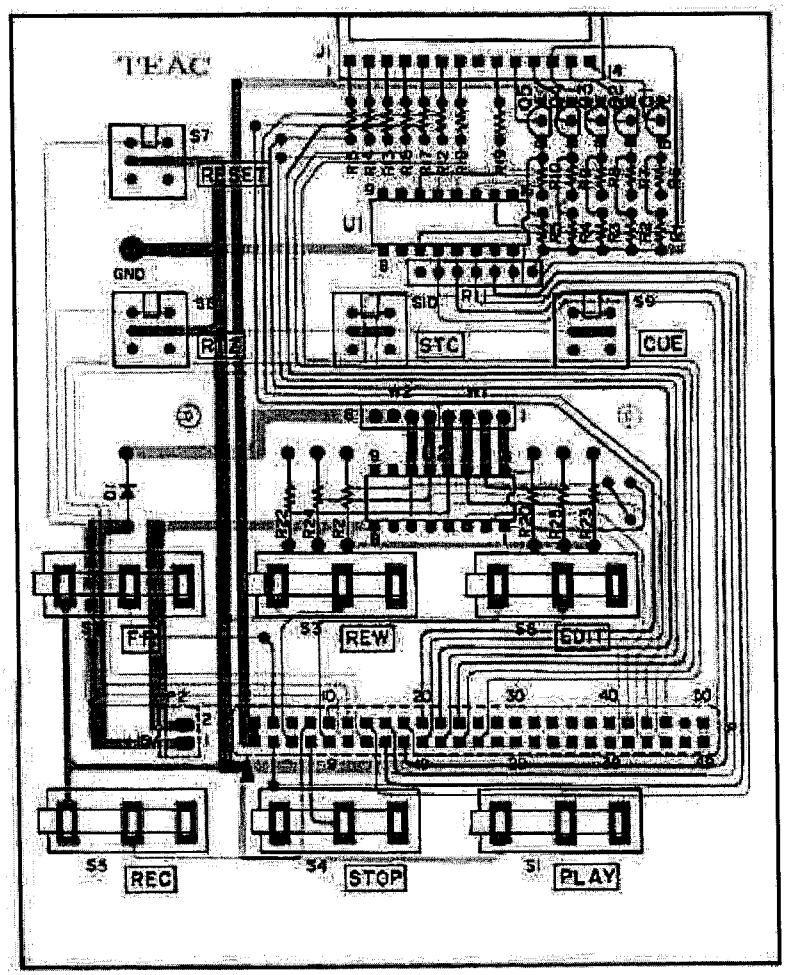
10-2-5. Speed Sensor PCB Ass'y



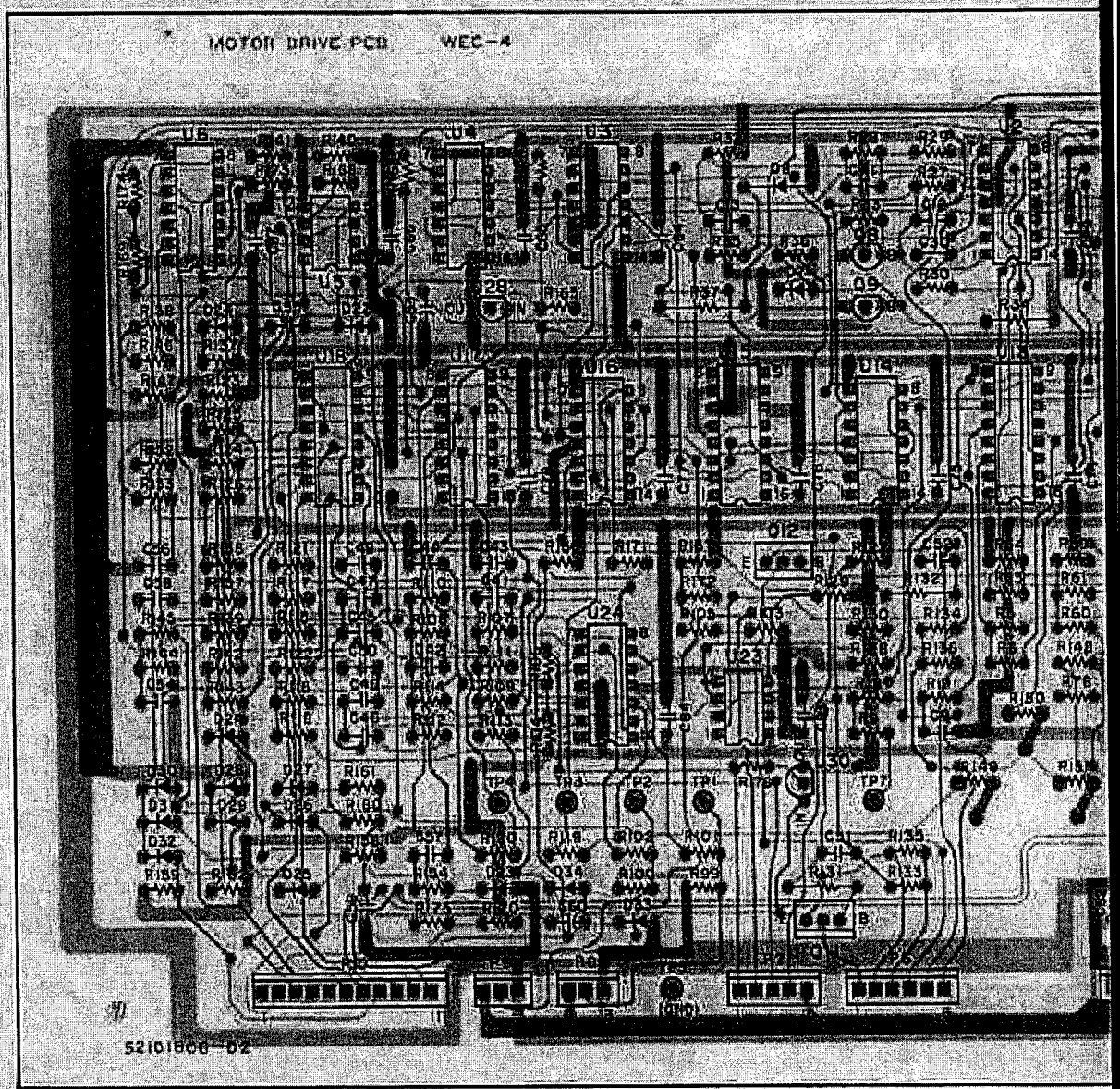
10-2-6. End Sensor PCB Ass'y

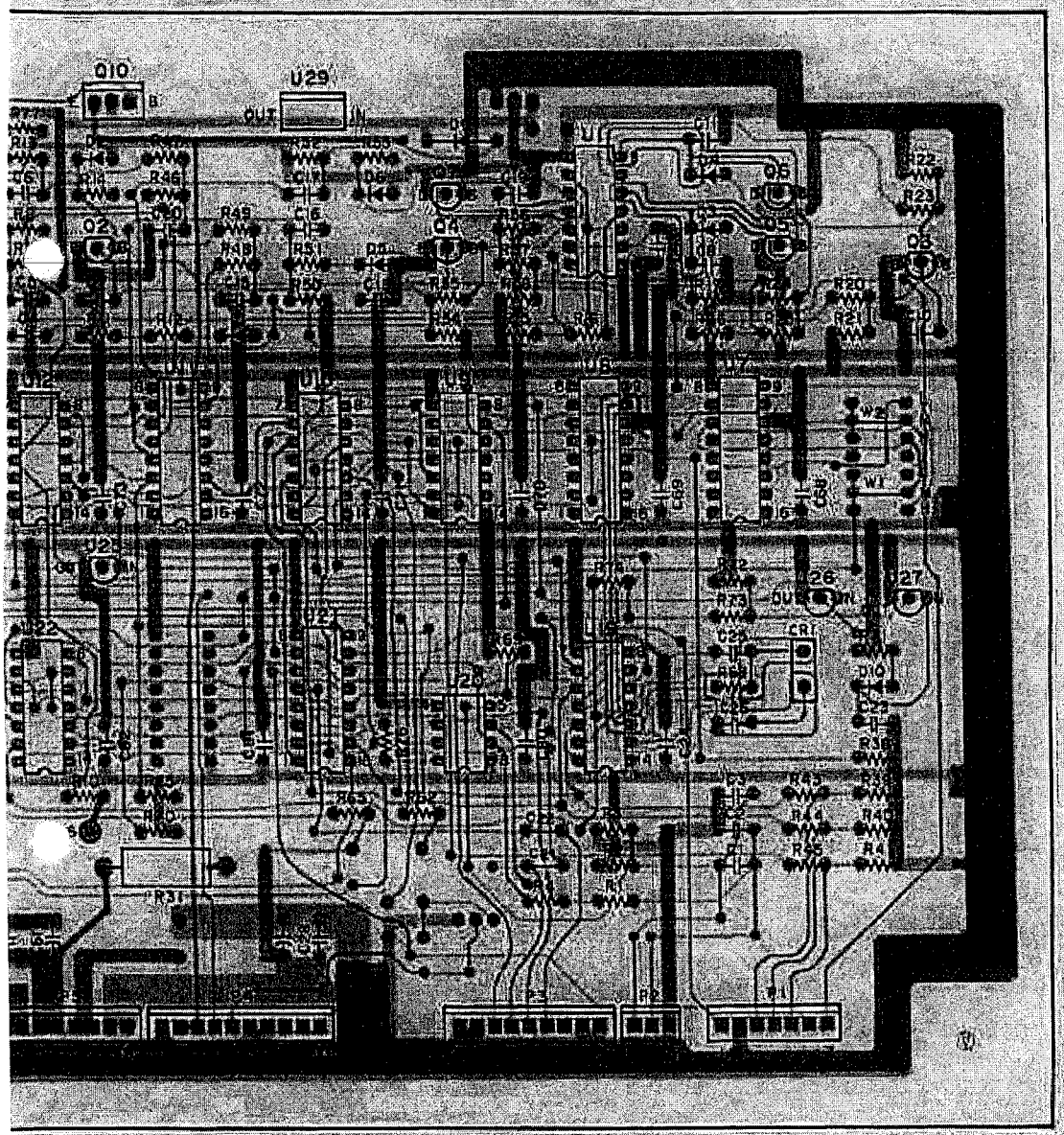


10-2-2. Key Board PCB A Ass'y



10-2-7. Motor Drive PCB Ass'y

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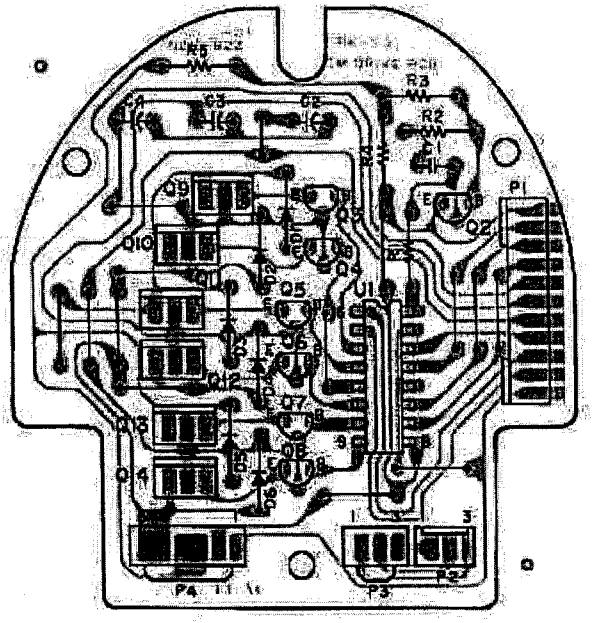
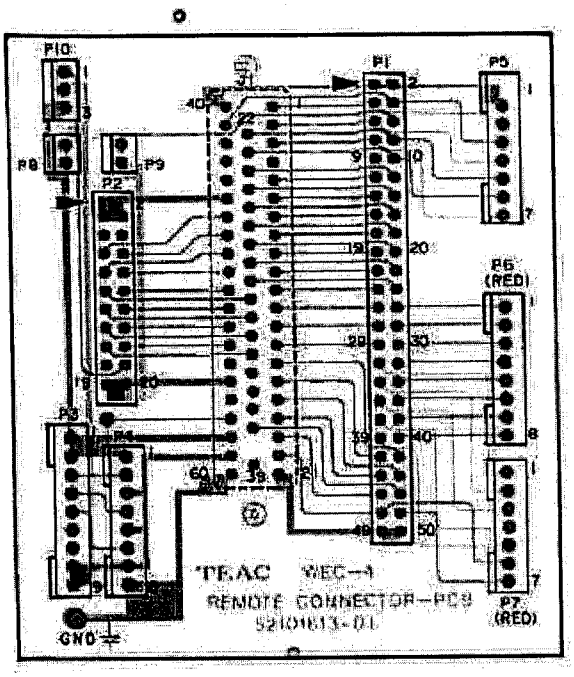
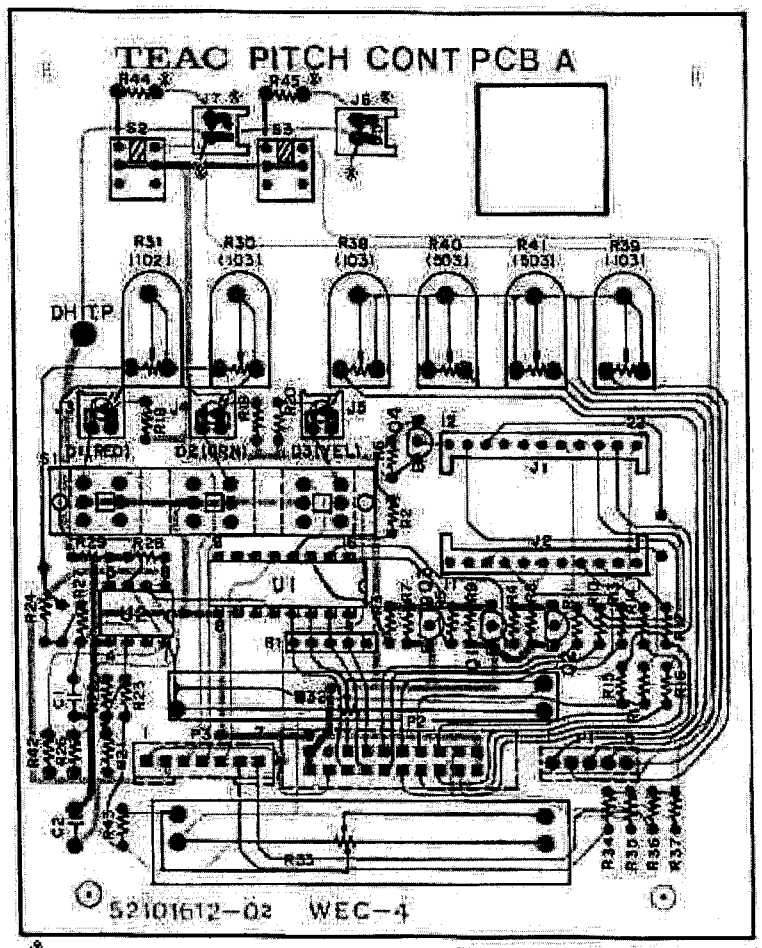
10-2-9. CM Drive PCB Ass'y



10-2-10. Remote Connector PCB Ass'y

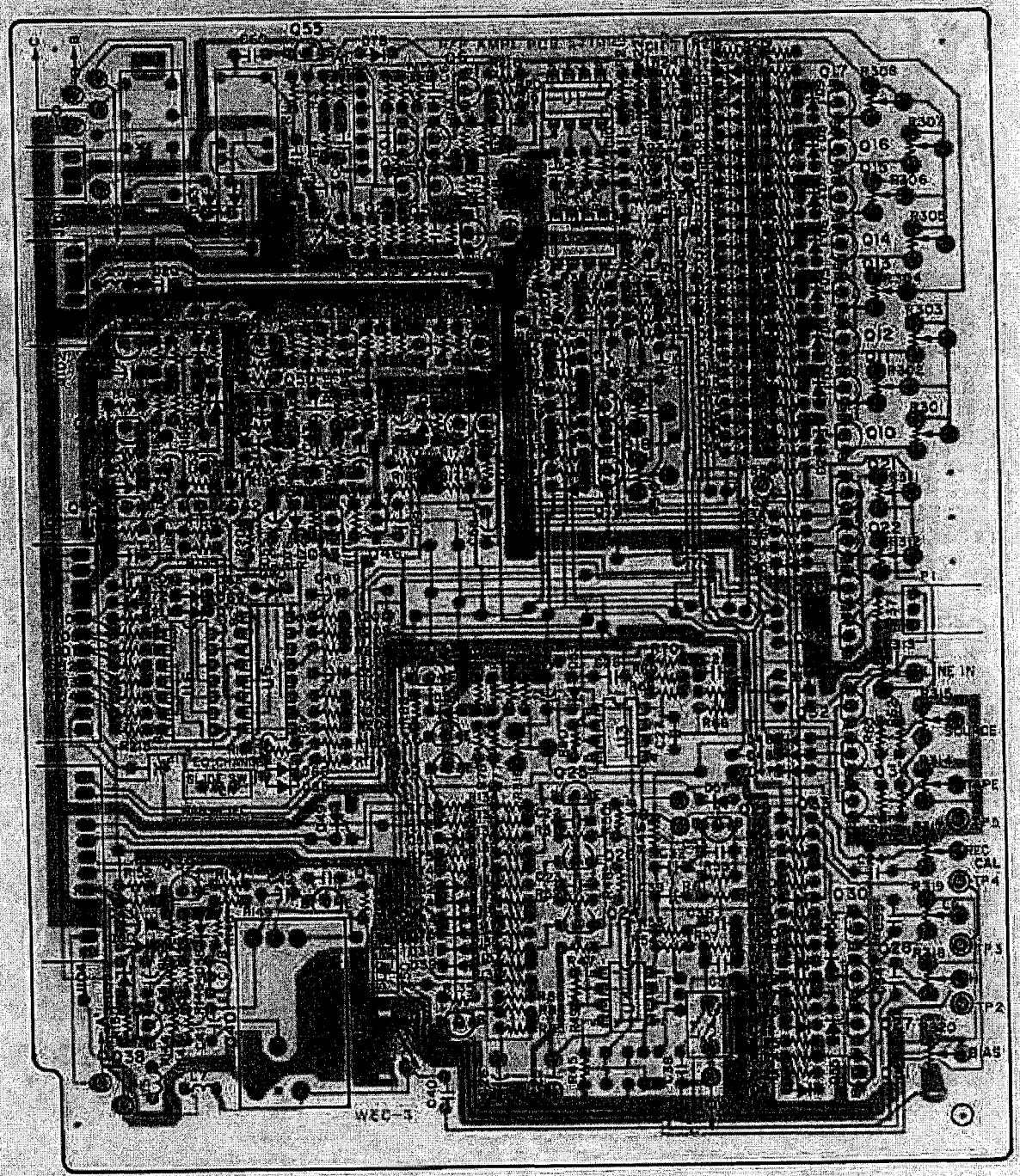


10-2-8. Pitch Control A PCB Ass'y

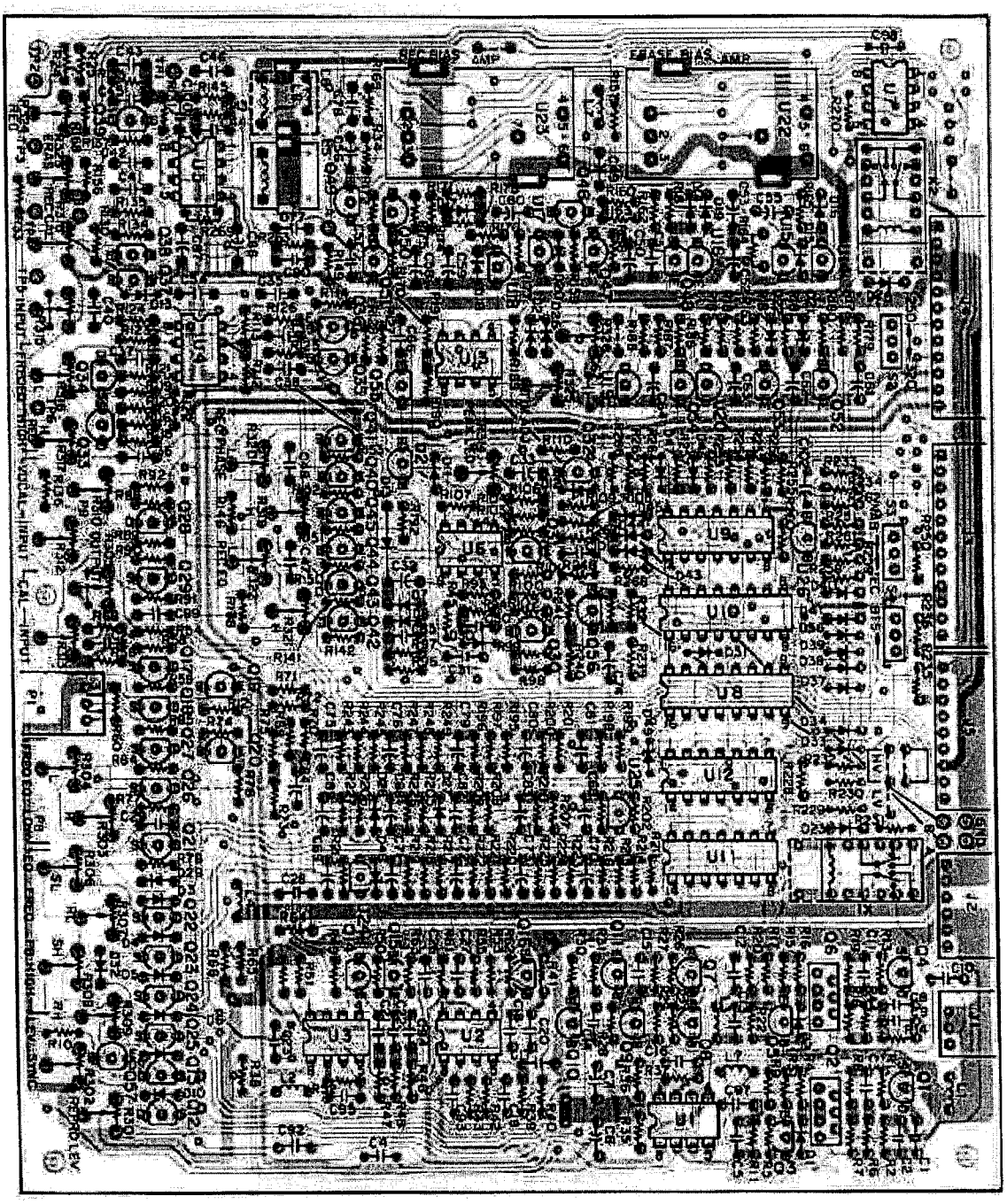


※	J6, J7	R34~R37	R44, R45	D4, D5
2T	—		—	—
2N/2D/2HS	○		○	○

10-2-11. Rec/Play PCB Ass'y (ATR-60-2T)



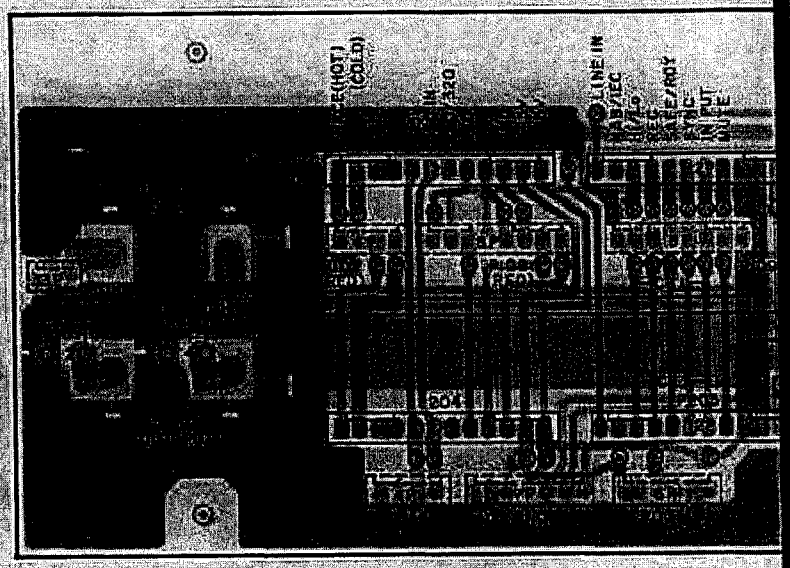
10-2-12. Rec/Play PCB Ass'y (ATR-60-2N, -2D, and -2HS)



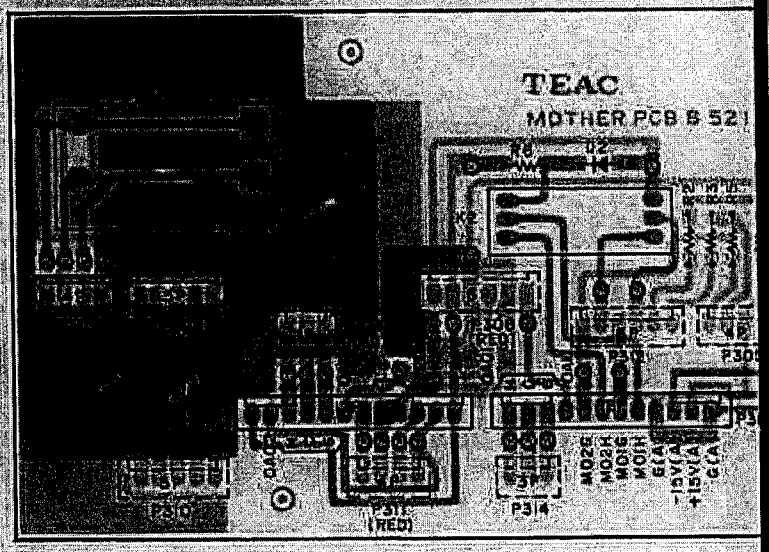
	C21	C32	C39	C80	C88	Q14	Q31	Q36	R38	R47	R49	R77	R100	R101
ATR-60-2N,2D	○	—	○	○	○	○	○	○	○	○	○	○	○	○
ATR-60-2HS	—	—	—	—	—	—	—	—	JUMPER	—	—	—	—	—

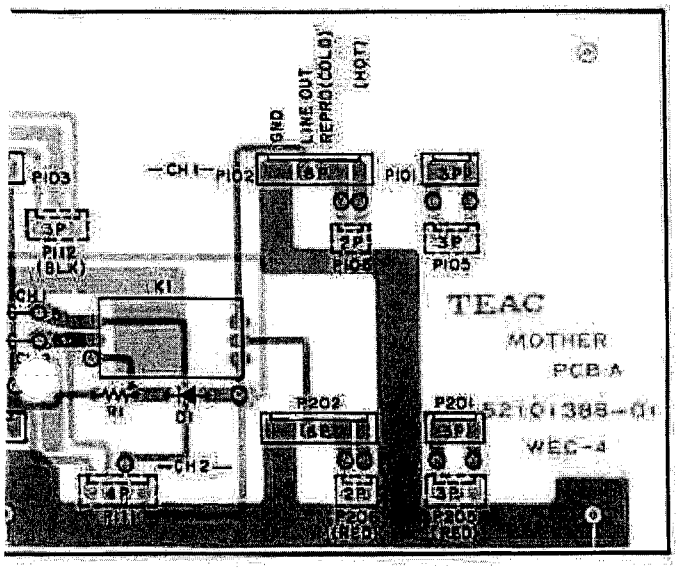
	R103	R126	R200	R201	R205	R226	D7	D8	D33	W7,W8	W9	U3
ATR-60-2N,2D	○	○	○	○	○	○	JUMPER	—	—	—	○	—
ATR-60-2HS	—	—	—	—	—	—	JUMPER	—	○	○	—	—

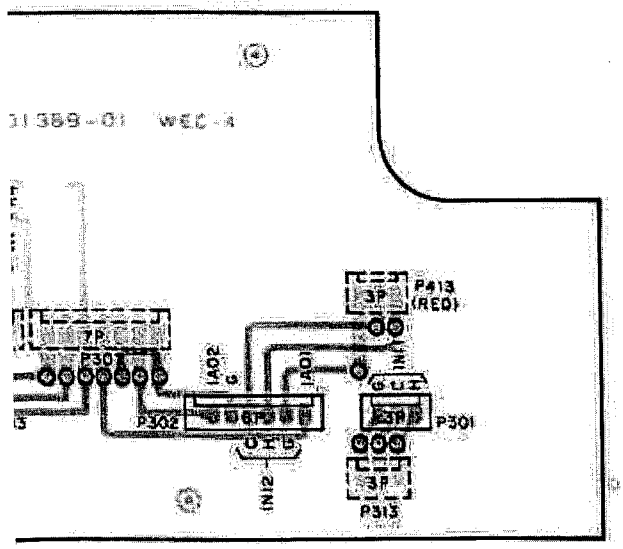
10-2-13. Mother A PCB Ass'y



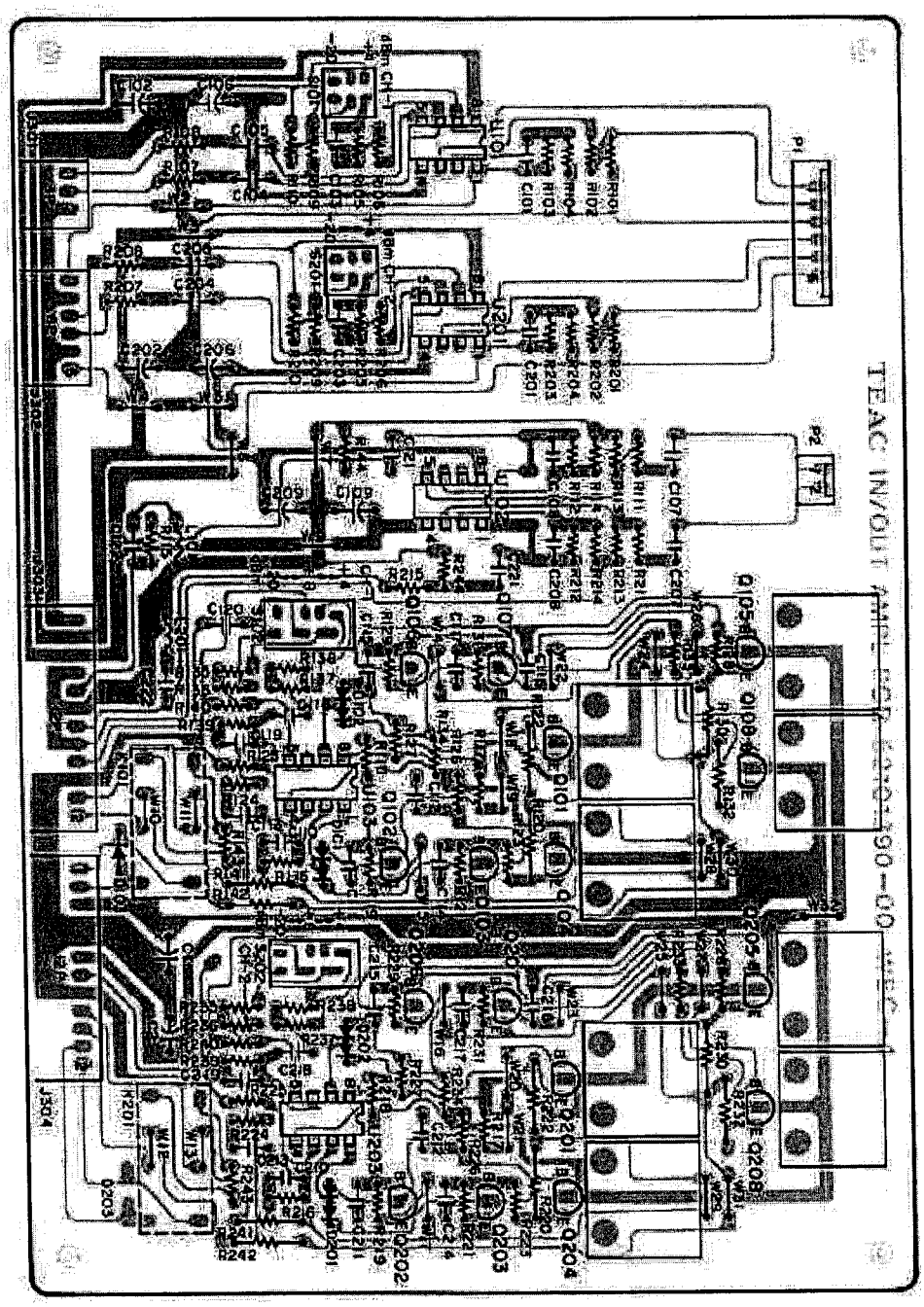
10-2-14. Mother B PCB Ass'y



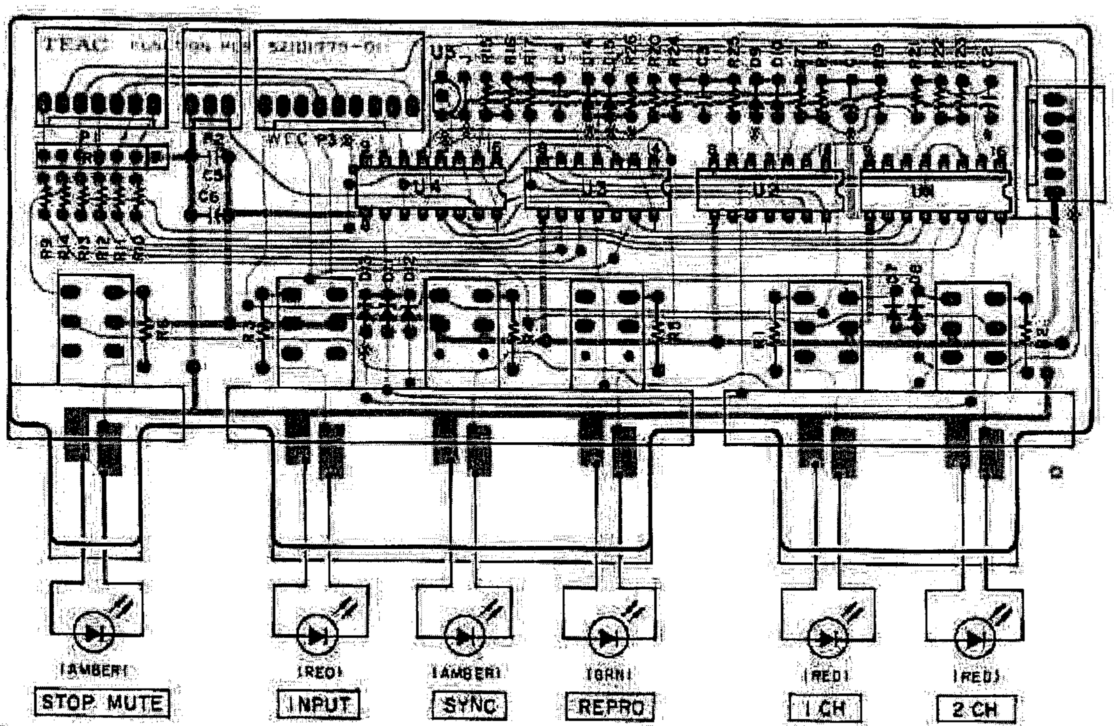

GND
LINE OUT REPRO(COLD)
(HOT)
P103
CH1
P102
P101
3P
2P
P112 (BLK)
P104
P105
K1
TEAC
MOTHER
PCB A
P202
P201
5210138B-01
WEC-4
R1
D1
CH2
4P
P111
P203
P204


WEC-4
P413 (RED)
7P
P302
P301
IN02
IN01
IN11
IN12
P313

10-2-17. In/Out PCB Ass'y



10-2-15. Function PCB Ass'y



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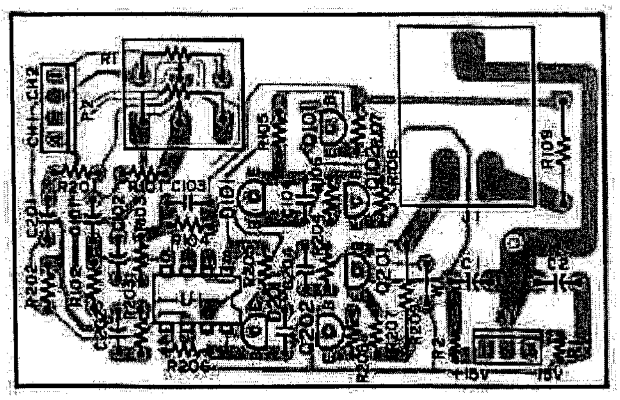
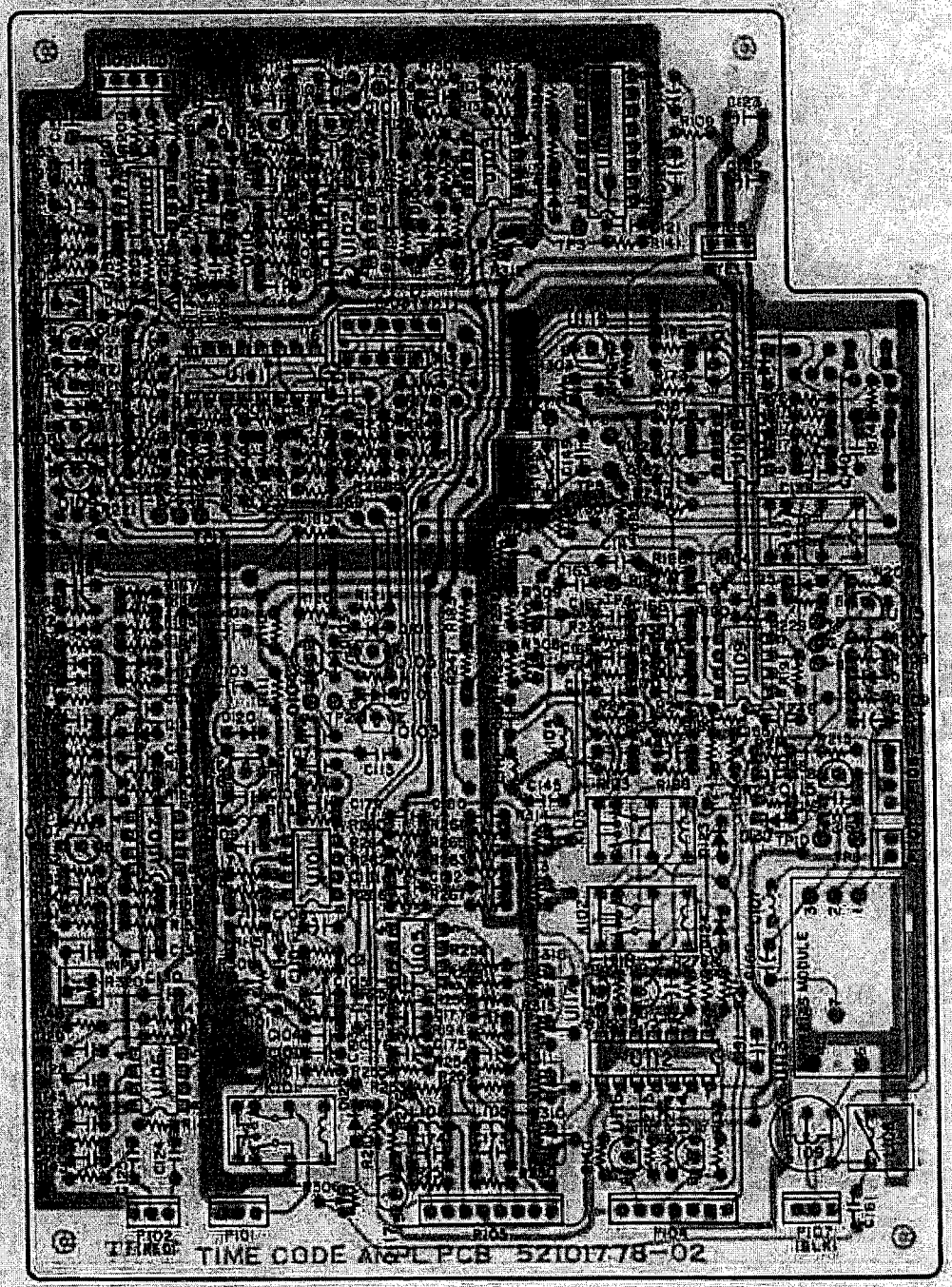
	C1, C2	D14, D15	D13	J	U5	P4	R26	D8
ATR-60-2T	○	○	○	—	○	○	○	○
ATR-60-2N,2D,2HS	—	—	—	○	—	—	—	—

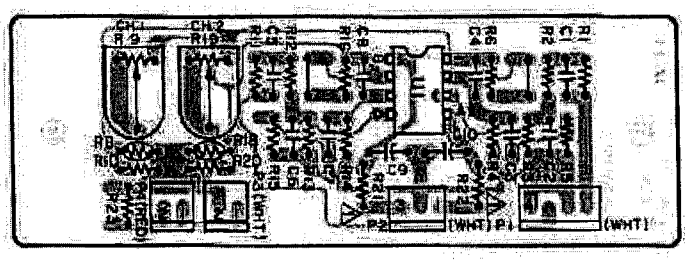
10-2-16. Phone AMP PCB Ass'y



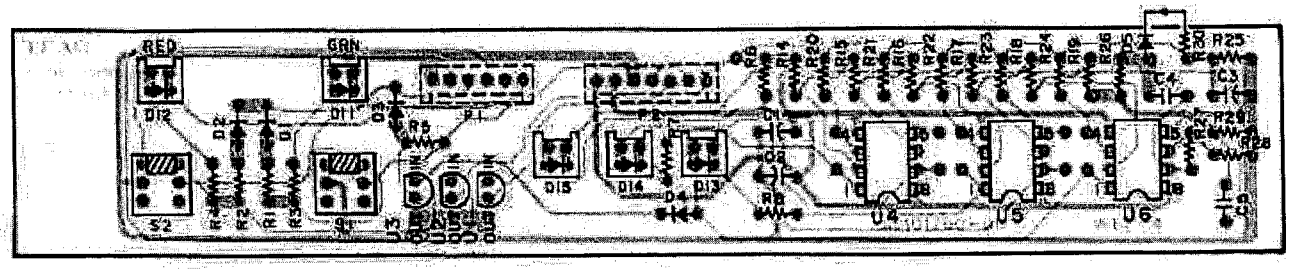
10-2-18. Time Code Amp PCB Ass'y (ATR-60-2T)



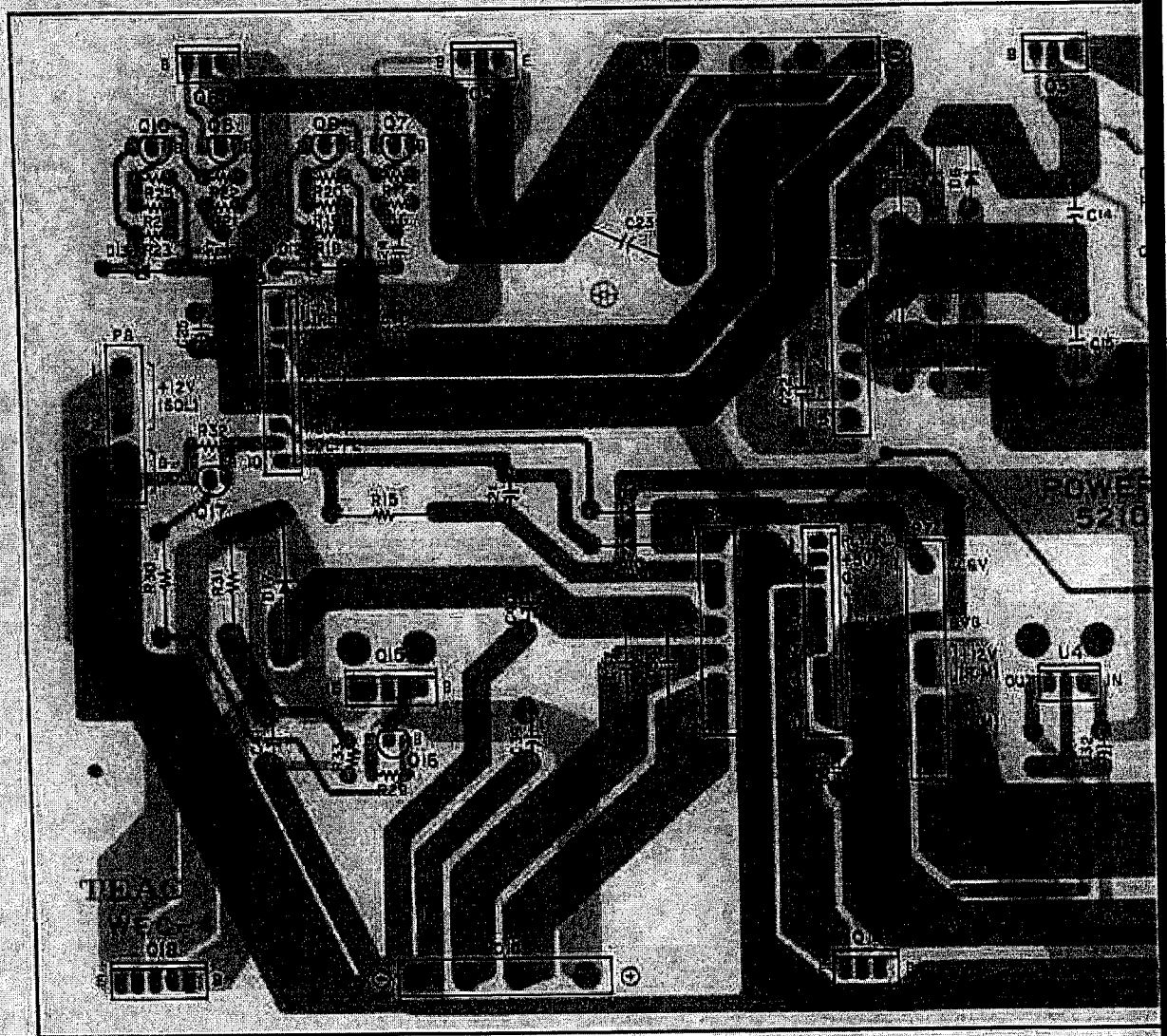
10-2-19. TC Cancel PCB Ass'y (ATR-60-2T)

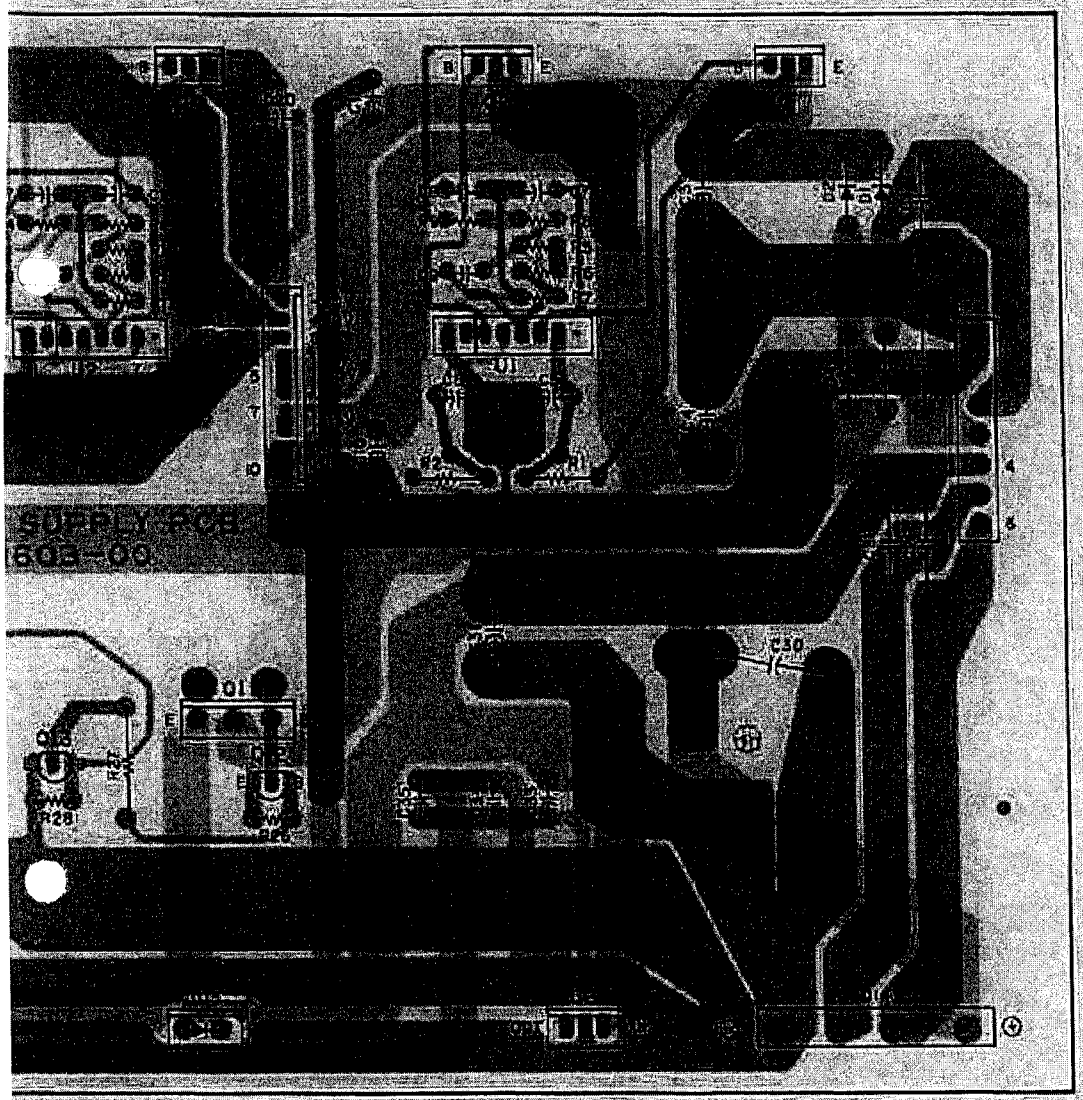


10-2-20. Function PCB Ass'y (T) (ATR-60-2T)



10-2-21. Power Supply PCB Ass'y




SUPPLY PCB
605-00

KEY BOARD PCB A ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200161000	KEY BOARD PCB A ASSY
	*5210161000	KEY BOARD PCB A
	5225009600	LED,DISPLAY
	*5317002100	DH CHECK PIN IPS-1136
D1	5143243000	DIODE,ERB12-02G1
J1	5336116400	CONN. SOCKET 3024-14GU
P1	5336213900	CONN. SOCKET 5332-50GS1
P2	5122126000	CONNECTOR,PLUG 3P W
P3	5122366000	PLUG,CONNECTOR 3022-14AD
Q1 -Q5	5230016100	SI.TR.2SA950-Y
R1 -R5	5240032220	R.,CARBON R20 47K J
R6 -R10	5240028220	R.,CARBON R20 1.0K J
R11	5242110400	R.,ARRAY 4.7KX6
R12 -R19	5240025620	R.,CARBON R20 82 J
R20 -R25	5180076000	R.,CARBON R50 560 J
S01 -S06	5301455200	SW.,MICRO SS-5GL13 N
S07 -S10	5300028100	SW.,PUSH SPH122A 2-2
U1 U2	6048661000	IC,M54517P

KEY BOARD PCB B ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200161100	KEY BOARD PCB B ASSY
	*5210161100	KEY BOARD PCB B
DS1	5310007100	LAMP,MINI 80MA/14V RED
DS2 -DS5	5310007200	LAMP,80MA/14V YLW
DS6	5310007300	LAMP,80MA/14V GREEN

JOINT PCB ASSY L & JOINT PCB ASSY R

REF.NO.	PARTS NO.	DESCRIPTION
	*5200160700	JOINT PCB ASSY L (AIR-60-2HS)
	*5200160710	JOINT PCB ASSY R (AIR-60-2HS)
	*5200160720	JOINT PCB ASSY L (AIR-60-2T,2N,2D)
	*5200160730	JOINT PCB ASSY R (AIR-60-2T,2N,2D)
—	*5210160700	JOINT PCB
C1	5260067610	C.,ELEC. 10UF100V M SMBP
C2 C3	5173433000	C.,CERAMIC 0.010UF 50V Z
D1	5143243000	DIODE,ERB12-02G1
D2	5143243000	DIODE,ERB12-02G1 (R only)
Q1	5145087000	SI.TR.2SD-313E
Q2	5145087000	SI.TR.2SD-313E (R only)
R1	5185202000	R.,METAL 0.47 5W (AIR-60-2T,2N,2D)
R1	5241262100	R.,METAL 0.15 5W (AIR-60-2HS)
R2	5181490000	R.,CARBON R25 2.2K J
R3	5181490000	R.,CARBON R25 2.2K J(R Only)

SPEED SENSOR PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200160800	SPEED SENSOR PCB ASSY
	*5210160800	SPEED SENSOR PCB
R1 R2	5181462000	R.,CARBON R25 150 J
U1 U2	5228008200	PHOTO INTERRUPTER EE-SJBB

END SENSOR PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200160900	END SENSOR PCB ASSY
	*5210160900	END SENSOR PCB
R1	5181462000	R.,CARBON R25 150 J
U1	5228007500	PHOTO INTERRUPTER EE-SJ3W

TENSION SENSOR PCB ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200185900	TENSION SENSOR PCB ASSY
	*6050556000	TENSION SENSOR PCB
C1 C2	5260160750	C.,ELEC. 1UF50V SM T-N
C3	6043571000	C.,POLYSTY. 150PF 50V J
C4	5170352000	C.,MYLAR 0.001UF/100V JT
C5	5054382000	C.,HIGH Q 22PF 50V
C6	5171878000	C.,MYLAR 0.1UF/100V J T
D1	5042517000	DIODE,1S2473VE
L1 L2	5160038000	COIL,DETECTOR
Q1	5145036000	SI.TR.2SC-945LK
R1	5240172000	R.,CARBON ELR25 39K J
R2	5240170400	R.,CARBON ELR25 8.2K J
R3	5240168200	R.,CARBON ELR25 1.0K J

CONTROL PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200160510	CONTROL PCB ASSY (AIR-60-2T,2N,2D)
	*5200160520	CONTROL PCB ASSY (AIR-60-2HS)
	*5210160502	CONTROL PCB
	*5347002900	TIMER,TM3L
C1	5054896500	C.,MYLAR 0.0015UF 50V
C2	5260165952	C.,ELEC.100UF/10V M USM
C3	5054878500	C.,MYLAR 0.0010UF 100V J
C4 C5	5054891500	C.,MYLAR 0.0047UF,50V
C6 C7	5172216000	C.,CERAMIC 220PF/50V T
C8	5260162050	C.,ELEC. 4.7UF 35V M SM
C9 C10	5173433000	C.,CERAMIC 0.010UF 50V Z
C11 C12	5172206000	C.,CERAMIC 33PF/50V K VFT
C13	5260162050	C.,ELEC. 4.7UF 35V M SM
C14	5260162650	C.,ELEC. 10UF25V (AIR-60-2T 2N 2D)
C14	5260164242	C.,ELEC. 33UF16V (AIR-60-2HS)
C15	5260165252	C.,ELEC.47UF/25V M USM VT
C16	5260162050	C.,ELEC. 4.7UF 35V M SM
C17 -C19	5260162650	C.,ELEC. 10UF25V M SM VT
C20	5260162050	C.,ELEC. 4.7UF 35V M SM
C21	5260165252	C.,ELEC.47UF/25V M USM VT
C22 -C40	5173433000	C.,CERAMIC 0.010UF 50V Z
C41	5260162050	C.,ELEC. 4.7UF 35V M SM
CR1	5347000900	CERAMIC OSC KBR-800H
CR2	5347001000	CERAMIC OSC KBR-4.0H
D01 -D5	5224015010	DIODE,1SS133HV
D06 -D8	5228009200	DIODE,ALLEY DAP401
D09 -D11	5228009100	DIODE,ALLEY DAN401
D12 -D28	5224015010	DIODE,1SS133HV
P1	5336213500	CONN.,SOCKET 5332-20GS1
P2	5122129000	CONNECTOR,PLUG 5045-05A W
P3	5122132000	CONNECTOR,PLUG 8P
P4	5122136000	CONNECTOR,PLUG 12P W
P5	5122126000	CONNECTOR,PLUG 3P W
P6	5122135000	CONNECTOR,PLUG 5045-11A
P7	5336213900	CONN.,SOCKET 5332-50GS1
P8	5122127000	CONNECTOR,PLUG 3P
R1	5242110200	R.,ARRAY 4.7KX4
R2 R3	5240031420	R.,CARBON R10 22K
R4 R5	5240035420	R.,CARBON R20 1.0M J
R6	5240027020	R.,CARBON R20 330 J
R7	5240030020	R.,CARBON R20 5.6K J
R8	5240031020	R.,CARBON R10 15K
R9 -R11	5240030020	R.,CARBON R20 5.6K J
R12 -R14	5240035420	R.,CARBON R20 1.0M J
R15 R16	5240030020	R.,CARBON R20 5.6K J
R17 R18	5240031020	R.,CARBON R10 15K
R19 -R21	5242110200	R.,ARRAY 4.7KX4
R22	5240032220	R.,CARBON R20 47K J
R23	5240035420	R.,CARBON R20 1.0M J
R24 -R29	5184908000	R.,CARBON R25 100 G
R30	5240029820	R.,CARBON R20 4.7K J

CONTROL PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
R31 -R41	5240028220	R.,CARBON R20 1.0K J
R42	5242110200	R.,ARRAY 4.7KX4
R43	5242108000	R.,ARRAY 1KX4
R44 R45	5240028220	R.,CARBON R20 1.0K J
R46 R47	5240030020	R.,CARBON R20 5.6K J
R48	5240030620	R.,CARBON R10 10K
R49	5240032220	R.,CARBON R20 47K J
R50 R51	5240028420	R.,CARBON R20 1.2K J
R52	5240030620	R.,CARBON R10 10K
R53 -R55	5242110200	R.,ARRAY 4.7KX4
R56	5240025020	R.,CARBON R20 47 J
R57	5240030020	R.,CARBON R20 5.6K J
R58	5240028220	R.,CARBON R20 1.0K J
R59	5240025820	R.,CARBON 100 OHM R10 T.
R60	5240031820	R.,CARBON R20 33K J
R61	5240025820	R.,CARBON 100 OHM R10 T.
R62 R63	5240030020	R.,CARBON R20 5.6K J
R64	5240031820	R.,CARBON R20 33K J
R65 R66	5240025020	R.,CARBON R20 47 J
R67	5240032220	R.,CARBON R20 47K J
R68 -R70	5240030020	R.,CARBON R20 5.6K J
R71	5240028220	R.,CARBON R20 1.0K J
R72 -R74	5180062000	R.,CARBON R50 150 J
R75	5240028220	R.,CARBON R20 1.0K J
R76	5240030020	R.,CARBON R20 5.6K J
R77	5240029820	R.,CARBON R20 4.7K J
R78	5240030020	R.,CARBON R20 5.6K J
R79	5240028220	R.,CARBON R20 1.0K J
R80 -R83	5240030620	R.,CARBON R10 10K
R84	5240031220	R.,CARBON R20 18K J
R85	5240034420	R.,CARBON R20 390K J
R86	5240035420	R.,CARBON R20 1.0M J
R87	5240031420	R.,CARBON R10 22K
R88	5240030020	R.,CARBON R20 5.6K J
R89	5240028220	R.,CARBON R20 1.0K J
R90	5240029820	R.,CARBON R20 4.7K J
TP1 -TP7	5317002100	DH CHECK PIN, IPS-1136
U1	5220036400	IC,TC4518BP
U2	5220020200	IC,TC4030BP
U3	5220019200	IC,TC4013BP
U4	5220019100	IC,TC4011BP
U5 U6	5220019000	IC,TC4001BP
U7	5220020000	IC,TC4049BP
U8	5220021800	IC,MB8243
U9	5220805200	IC,MB8841
U10	6048661000	IC,M54517P
U11	5220805100	IC,LM6416E-391
U12	5220019000	IC,TC4001BP
U13	5220020300	IC,TC4510BP
U14 U15	5220020000	IC,TC4049BP
U16 U17	5220019100	IC,TC4011BP
U18 U19	5220020000	IC,TC4049BP
U20	5220019700	IC,LC7800
U21 U22	6048661000	IC,M54517P
U23	5220020100	IC,TC4050BP
U24 -U29	6048661000	IC,M54517P
U30 -U41	5232251620	SI.TR.2SA1346
U42 -U44	5232252020	SI.TR.2SC3400

KEY BO

REF.NO.
D1
J1
P1
P2
P3
Q1 -Q
R1 -R
R6 -R
R11
R12 -R
R20 -R
S01 -S
S07 -S
U1 U

KEY BO

REF.NO.
DS1
DS2 -D
DS6

JOINT B

REF.NO.
C1
C2 C
D1
D2
Q1
Q2
R1
R1
R2
R3

MOTOR DRIVE PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200160610	MOTOR DRIVE PCB ASSY (ATR-60-2T,2N,2D)
	*5200160620	MOTOR DRIVE PCB ASSY (ATR-60-2HS)
	*5210160602	MOTOR DRIVE PCB
C1	5170352000	C.,MYLAR 0.001UF/100V JT
C2 C3	5173433000	C.,CERAMIC 0.010UF 50V Z
C4	5263106420	C.,POLYPRO. 270PF 100V J
C5 C6	5263107220	C.,POLYPRO. 560PF 100V J
C7	5263103720	C.,POLYPRO. 0.022UF 100V (ATR-60-2T,2N,2D)
C7	5263102920	C.,POLYPRO. 0.010UF 100V (ATR-60-2HS)
C8	5170364000	C.,MYLAR 0.0033UF/100V JT
C9	5263107220	C.,POLYPRO. 560PF 100V J
C10	5263103720	C.,POLYPRO. 0.022UF 100V (ATR-60-2T,2N,2D)
C10	5263102920	C.,POLYPRO. 0.010UF 100V (ATR-60-2HS)
C11	5170364000	C.,MYLAR 0.0033UF/100V JT
C12	5263107220	C.,POLYPRO. 560PF 100V J
C13	5170352000	C.,MYLAR 0.001UF/100V JT
C14	5170453000	C.,MYLAR 0.15UF 100V J
C15 C16	5263107220	C.,POLYPRO. 560PF 100V J
C17	5263106420	C.,POLYPRO. 270PF 100V J
C18	5263103720	C.,POLYPRO. 0.022UF 100V (ATR-60-2T,2N,2D)
C18	5263102920	C.,POLYPRO. 0.010UF 100V (ATR-60-2HS)
C19	5170364000	C.,MYLAR 0.0033UF/100V JT
C20	5263107220	C.,POLYPRO. 560PF 100V J
C23	5171864000	C.,MYLAR 0.022UF/100V J T
C24	5173434000	C.,CERAMIC 0.022UF 50V
C25 C26	5054741000	C.,DIP.MICA 22P,50V
C27	5260165352	C.,ELLEC. 47UF 35V M USM
C28	5173433000	C.,CERAMIC 0.010UF 50V Z
C41 C42	5171864000	C.,MYLAR 0.022UF/100V JT
C43 C44	5263167923	C.,METAL 0.1UF/50V J VT
C45 C46	5263168523	C.,METAL 0.33UF 50V J VT
C47 C48	5171856000	C.,MYLAR 0.01UF/100V J T
C49 C50	5263167923	C.,METAL 0.1UF/50V J VT
C51 C52	5171856000	C.,MYLAR 0.01UF/100V J T
C53	5260162650	C.,ELEC. 100UF25V M SM VT
C54	5263168123	C.,METAL 0.15UF/50V J VT
C55	5170364000	C.,MYLAR 0.0033UF/100V JT
C56 C58	5263107220	C.,POLYPRO 560PF 100V J
C57	5263100520	C.,POLYPRO.0.0010UF 100V J
C59	5260163452	C.,ELEC. 22UF 25V
C60	5260162050	C.,ELEC. 4.7UF 35V M SM
C61	5260165352	C.,ELLEC. 47UF 35V M USM
C62 -C84	5173433000	C.,CERAMIC 0.010UF 50V Z
CB5	5260160750	C.,ELEC. 1UF50V SM T-N
CR1	5347001600	OSC,CRYSTAL 4.9152MHZ
D01 -D07	5224015010	DIODE,1SS133HV
D08 D09	5143243000	DIODE,ERB12-02G1

MOTOR DRIVE PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
D10	5224015010	DIODE,1SS133HV
D21 -D34	5224015010	DIODE,1SS133HV
D35	5224015010	DIODE,1SS133HV (ATR-60-2HS)
P1	5122131000	CONN. PLUG 5045-07A WHT
P2	5122184000	CONN. PLUG 5045-03A BLK
P3	5122133000	CONN. PLUG 5045-09A WHT
P4	5122134000	CONNECTOR,PLUG 10P WHITE
P5	5122132000	CONNECTOR,PLUG 8P
P6	5122130000	CONNECTOR,PLUG 6P W
P7	5122129000	CONNECTOR,PLUG 5045-05A W
P8	5122127000	CONNECTOR,PLUG 3P
P9	5122300000	CONNECTOR,PLUG 5045-03A R
P10	5122135000	CONNECTOR,PLUG 5045-11A
Q2 -Q4	5145151000	SI.TR.2SC-1815GR
Q5 -Q7	5145102000	FET,2SK-68A-L
Q8	5145150000	SI.TR.2SA-1015GR
Q9	5230773800	SI.TR.2SC2655-Y
Q10	△5231755100	SI.TR.2SD880-Y
Q11 Q12	△5145077000	SI.TR.2SD-600
R1	5240028220	R.,CARBON R20 1.0K J
R2 R3	5240030620	R.,CARBON R10 10K
R4	5240035420	R.,CARBON R20 1.0M J
R5	5240030620	R.,CARBON R10 10K
R6	5240033020	R.,CARBON 100K R10 T.
R7 R8	5240031420	R.,CARBON R10 22K
R9 R10	5240033020	R.,CARBON 100K R10 T.
R11	5240030620	R.,CARBON R10 10K
R12	5240028220	R.,CARBON R20 1.0K J
R13	5240030620	R.,CARBON R10 10K
R14	5240028220	R.,CARBON R20 1.0K J
R15	5240033820	R.,CARBON R10 220K
R16	5240027820	R.,CARBON R20 680 J
R17	5240030620	R.,CARBON R10 10K
R18 R19	5240031420	R.,CARBON R10 22K
R20	5240032220	R.,CARBON R20 47K J
R21	5240030620	R.,CARBON R10 10K
R22	5240033020	R.,CARBON 100K R10 T.
R23	5240027820	R.,CARBON R20 680 J
R24	5240030620	R.,CARBON R10 10K
R25	5240033820	R.,CARBON R10 220K
R26	5240032220	R.,CARBON R20 47K J
R27	5240034620	R.,CARBON R20 470K (ATR-60-2T,2N,2D)
R27	5240034820	R.,CARBON R20 560K (ATR-60-2HS)
R28	5240033820	R.,CARBON R10 220K
R29	5240032220	R.,CARBON R20 47K J
R30	5240032020	R.,CARBON R20 39K J
R31	△5184550000	R.,INCOMBUSTIBLE 1/1W J
R32	5240032220	R.,CARBON R20 47K J
R33	5240030620	R.,CARBON R10 10K
R34	5181482000	R.,CARBON R25 1.0K J FT
R35	5240029420	R.,CARBON R20 3.3K J

MOTOR DRIVE PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
R36	5240030620	R.,CARBON R10 10K
R37	5180050000	R.,CARBON R50 47 J
R38 -R41	5240029820	R.,CARBON R20 4.7K J
R42 -R45	5240031020	R.,CARBON R10 15K
R46 R47	5240030620	R.,CARBON R10 10K
R48 R49	5240031420	R.,CARBON R10 22K
R50	5240030620	R.,CARBON R10 10K
R51	5240028220	R.,CARBON R20 1.0K J
R52	5240030620	R.,CARBON R10 10K
R53	5240028220	R.,CARBON R20 1.0K J
R54	5240033820	R.,CARBON R10 220K
R55	5240027820	R.,CARBON R20 680 J
R56	5240028220	R.,CARBON R20 1.0K J
R57	5240030620	R.,CARBON R10 10K
R58	5240030420	R.,CARBON 8.2K R10 T.
R59	5240026620	R.,CARBON R20 220 J
R60	5240029020	R.,CARBON R10 2.2K
R61	5240032420	R.,CARBON R20 56K J
R62	5280132702	R.,TRIMMER 50KB V. METAL
R63	5240033020	R.,CARBON 100K R10 T.
R64	5240028220	R.,CARBON R20 1.0K J
R65	5280131602	R.,TRIMMER 2.0KB V METAL
R68	5240035420	R.,CARBON R20 1.0M J
R69 R70	5240031020	R.,CARBON R10 15K
R71	5240029820	R.,CARBON R20 4.7K J
R72	5240030620	R.,CARBON R10 10K
R73	5240031420	R.,CARBON R10 22K
R74	5240035420	R.,CARBON R20 1.0M J
R75	5240031020	R.,CARBON R10 15K
R76 R77	5240030620	R.,CARBON R10 10K
R78	5240031020	R.,CARBON R10 15K
R99 R100	5240032220	R.,CARBON R20 47K J
R101 R102	5240033020	R.,CARBON 100K R10 T.
R103 R104	5240031620	R.,CARBON R20 27K J
R105 R106	5240029820	R.,CARBON R20 4.7K J
R107 R108	5240033620	R.,CARBON R20 180K J
R109 R110	5240028220	R.,CARBON R20 1.0K J
R111 R112	5240030620	R.,CARBON R10 10K
R113 R114	5240033020	R.,CARBON 100K R10 T.
R115 R116	5240033820	R.,CARBON R10 220K
R117 R118	5240028220	R.,CARBON R20 1.0K J
R119-R124	5240033020	R.,CARBON 100K R10 T.
R125 R126	5240031820	R.,CARBON R20 33K J
R127 R128	5240031820	R.,CARBON 33K J
R129 R130	5240032220	R.,CARBON 47K J
R131 R132	5181482000	R.,CARBON R25 1.0K J
R133 R134	5240029020	R.,CARBON R10 2.2K
R135 R136	5240028220	R.,CARBON R20 1.0K J
R137	5240032620	R.,CARBON R20 68K J
R138	5240030620	R.,CARBON R10 10K
R139 R140	5240033020	R.,CARBON 100K R10 T.
R141	5240032420	R.,CARBON R20 56K J
R142	5240032220	R.,CARBON R20 47K J
R143	5240029820	R.,CARBON R20 4.7K J
R144	5240025820	R.,CARBON 100 R10 T.

MOTOR DRIVE PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
R145	5240025020	R.,CARBON R20 47 J
R146	5240030620	R.,CARBON R10 10K
R147	5240031820	R.,CARBON R20 33K J
R148	5240033020	R.,CARBON 100K R10 T.
R149	5280132702	R.,TRIMMER 50KB V. METAL
R150	5280132902	R.,TRIMMER 100KB V. METAL
R151	5280133002	R.,TRIMMER 200KB H METAL
R152 R153	5240031420	R.,CARBON R10 22K
R154	5240028220	R.,CARBON R20 1.0K J
R156	5240030620	R.,CARBON R10 10K
R157	5240028220	R.,CARBON R20 1.0K J
R158 R159	5240029820	R.,CARBON R20 4.7K J
R160	5240025820	R.,CARBON 100 OHM R10 T.
R161	5240028220	R.,CARBON R20 1.0K J
R162	5240029820	R.,CARBON R20 4.7K J
R163	5240031020	R.,CARBON R10 15K
R164	5240032420	R.,CARBON R20 56K (AIR-60-2T,2N,2D)
R164	5240033820	R.,CARBON R20 220K (AIR-60-2HS)
R166-R170	5240029820	R.,CARBON R20 4.7K J
R171-R175	5240031020	R.,CARBON R10 15K
R176	5240032220	R.,CARBON R20 47K J
TP1 -TP7	5317002100	DH CHECK PIN IPS-1136
U1	5220013400	IC,TC4066BP
U2 U24	6048609000	IC,LM2902N
U3	5220015800	IC,HD14002BP
U4	5220019200	IC,TC4013BP
U5 U23	5220407200	IC,LM2904
U6	5220013400	IC,TC4066BP
U7 U8	5220016600	IC,HD14040BP
U9	5220019100	IC,TC4011BP
U10	5220016300	IC,HD14023BP
U11 U13	5220020000	IC,TC4049BP
U12 U14	5220019000	IC,TC4001BP
U15	5220016400	IC,HD14027BP
U16	5220013400	IC,TC4066BP
U17	5220020000	IC,TC4049BP
U18	6048661000	IC,M54517P
U19	6048937000	IC,MC14069B
U20	5220407200	IC,LM2904
U21	6048661000	IC,M54517P
U22	5220019000	IC,TC4001BP
U25 -U27	5232252020	SI.TR.2SC3400
U28	5232251620	SI.TR.2SA1346
U29	5220415600	IC,NJM7815A
U30	5232252020	SI.TR.2SC3400

PITCH CONTROL A PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200161210	PITCH CONTROL PCB A ASSY (AIR-60-2T)
	*5200161220	PITCH CONTROL PCB A ASSY (AIR-60-2N,2D,2HS)
	*5210161202	PITCH CONTROL PCB A
	*5317002100	DH CHECK PIN IPS-1136
C1	5171156000	C.,POLYSTY. 820PF 125V J
C2	5260165352	C.,ELLEC. 47UF 35V M USM
D1	5225007900	LED,GL-9PR2 RED
D2	5225007100	LED,GL-9NG2 GRN
D3	5225010600	LED,GL-9HY2
D4 D5	5225007900	LED,GL-9PR2 RED (AIR-60-2N,2D,2HS)
J1 J2	5336116100	CONN. SOCKET 3024-11CH
J3 -J5	5336115200	CONN. SOCKET 3024-02CH
J6 J7	5336115200	CONN. SOCKET 3024-02CH (AIR-60-2N,2D,2HS)
P1	5122129000	CONNECTOR,PLUG 5045-05A W
P2	5336213500	CONN. SOCKET 5332-20GS1
P3	5122131000	CONNECTOR,PLUG 5045-07A W
Q1 -Q4	5230016100	SI.TR.2SA950-Y
R1	5242110200	R.,ARRAY 4.7KX4
R2 -R5	5240028220	R.,CARBON R20 1.0K J
R6 -R9	5240030620	R.,CARBON R10 10K
R10 -R17	5240025620	R.,CARBON R20 82 J
R18	5240027420	R.,CARBON 470 OHM R10 T.
R19	5240026620	R.,CARBON R20 220 J
R20	5240026620	R.,CARBON R20 220 J
R21 R22	5240033020	R.,CARBON 10CK R10 T.
R23	5240031420	R.,CARBON R10 22K
R24	5241426602	R.,METAL FILM LT 1/8 5.1K
R26	5240030020	R.,CARBON R20 5.6K J
R27	5240031820	R.,CARBON R20 33K J
R28 R29	5240033020	R.,CARBON 10CK R10 T.
R30	5150274000	R.,TRIMMER 10KB
R31	5150267000	R.,TRIMMER 1 KB
R32	5284006100	VR,SLIDE 1KB
R33	5284008800	VR,SLIDE 20KB L45
R34 -R37	5240025020	R.,CARBON R20 47 J
R38 R39	5150274000	R.,TRIMMER 10KB
R40 R41	5150279000	R.,TRIMMER 50KB
R42	5240029820	R.,CARBON R20 4.7K J
R43	5240033420	R.,CARBON R10 150K
R44 R45	5240027420	R.,CARBON 470 OHM R10 T. (AIR-60-2N,2D,2HS)
S1	5300038800	SW.,PUSH 3G. SUZ 2-2
S2 S3	5300025700	SW.,PUSH SPH121A
U1	6048661000	IC,M54517P
U2	5220012500	IC,UPC393C,DIGITAL

PITCH CONTROL PCB B ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200162100	PITCH CONTROL PCB B ASSY
	*5210162100	PITCH CONTROL PCB B
	*5225012300	LED,SL-2405-05C
P1 P2	5122363000	CONNECTOR,M 11P

QM DRIVE PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200162200	QM DRIVE PCB ASSY
	*5210162201	QM DRIVE PCB
C1	5171856000	C.,MYLAR 0.01UF/100V J T
C2 -C3	5260165452	C.,ELEC. 47UF/50V M USM V
D1 -D6	5143243000	DIODE,ERB12-02G1
P1	5122135000	CONNECTOR,PLUG 5045-11A
P2	5122127000	CONNECTOR,PLUG 3P
P3	5122203000	CONNECTOR,PLUG 5046-03A B
P4	5122149000	CONNECTOR,PLUG 5046-06A W
Q2	5145151000	SI.TR.2SC-1815GR
Q3 Q5	5230014000	SI.TR.2SA1020-Y
Q4 Q6	5230773800	SI.TR.2SC2655-Y
Q7	5230014000	SI.TR.2SA1020-Y
Q8	5230773800	SI.TR.2SC2655-Y
Q9 Q11	5230505700	SI.TR.2SB834-Y
Q10 Q12	5231755100	SI.TR.2SD880-Y
Q13	5230505700	SI.TR.2SB834-Y
Q14	5231755100	SI.TR.2SD880-Y
R1	5181524000	R.,CARBON R25 56K
R2	5181502000	R.,CARBON R25 6.8K J
R3	5181506000	R.,CARBON R25 10K J
R4	5181498000	R.,CARBON R25 4.7K J
R5	5181502000	R.,CARBON R25 6.8K J
U1	5220036500	IC,M51724P

CONNECTOR PCB ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200100000	CONNECTOR PCB ASSY
	*5210100000	CONNECTOR PCB
	*5122339000	CONNECTOR,SOCKET 6P
C001 C002	5260162050	C.,ELEC. 4.7UF 35V M SM
D001	5143118000	DIODE,1S2473HJ
Q001	5145151000	SI.TR.2SC-1815GR
R001 R002	5181506000	R.,CARBON R25 10K J
R003	5181482000	R.,CARBON R25 1.0K J
R004 R005	5181498000	R.,CARBON R25 4.7K J

REMOTE CONNECTOR PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200161310	REMOTE CONNECTOR PCB ASSY
	*5210161301	REMOTE CONNECTOR PCB
J1	5336217700	CONN. SOCKET SD-1660A-8TA
P1	5336213900	CONN. SOCKET 5332-50GS1
P2	5336213500	CONN. SOCKET 5332-20GS1
P3	5122133000	CONNECTOR,PLUG 5045-09A W
P4	5122132000	CONNECTOR,PLUG 8P
P5	5122131000	CONNECTOR,PLUG 5045-07A W
P6	5122309000	CONNECTOR,PLUG 5045-08A R
P7	5122304000	CONNECTOR,PLUG 5045-07A R
P8	5122126000	CONNECTOR,PLUG 3P W
P9	5122127000	CONNECTOR,PLUG 3P

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REC/PLAY PCB ASSY (AIR-60-ZT)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200097220	REC/PLAY PCB ASSY
	*5210097204	REC/PLAY PCB
C1	5054876500	C.,MYLAR 0.0022UF 50V J
C3	5263106820	C.,POLYPRO. 390PF 100V J
C4	5172218000	C.,CERAMIC 330PF/50V T
C5 C6	5172204000	C.,CERAMIC 22PF/50V T
C7	5263107620	C.,POLYPRO. 820PF 100V J
C8	5260166052	C.,ELEC. 100UF/16V M USM
C9	5173063000	C.,ELEC. 330UF 16V (SM)
C10	5260254210	C.,ELEC. 6.8UF 16V M LIBP
C11 C12	5054899500	C.,MYLAR 0.027UF 100V J
C13 C14	5054878500	C.,MYLAR 0.0010UF 100V J
C15 C16	5263167923	C.,METAL 0.1UF/50V J VT
C18	5263106720	C.,POLYPRO. 360PF 100V J
C19	5260067050	C.,ELEC. 10UF 16V
C20	5054892500	C.,MYLAR 0.0056UF 100V J
C21	5260067050	C.,ELEC. 10UF 16V
C22	5054891500	C.,MYLAR 0.0047UF,50V
C23	5054881500	C.,MYLAR 0.0033UF 100V J
C25	5260166052	C.,ELEC. 100UF/16V M USM
C26	5173063000	C.,ELEC. 330UF 16V (SM)
C28	5260067050	C.,ELEC. 10UF 16V
C29	5054878500	C.,MYLAR 0.0010UF 100V J
C32	5263106220	C.,POLYPRO. 220PF 100V J
C33	5263168323	C.,METAL 0.22UF 50V J
C34	5054876500	C.,MYLAR 0.0022UF 50V J
C35	5054893500	C.,MYLAR 0.0068UF 100V
C36	5260067850	C.,ELEC. 22UF 16V M SMBP
C37	5054889500	C.,MYLAR 0.0027UF 100V J
C38	5263106820	C.,POLYPRO. 390PF 100V J
C39	5260165252	C.,ELEC.47UF/25V M USM VI
C40	5263106020	C.,POLYPRO. 180PF 100V J
C41	5260164452	C.,ELEC. 33UF 35V M USM
C42	5260160750	C.,ELEC. 1UF50V SM T-N
C43	5260163652	C.,ELEC. 22UF 50V M USM
C44	5171912000	C.,ELEC. 0.22UF 50V M KA
C45	5260160750	C.,ELEC. 1UF50V SM T-N
C46 -C50	5260162050	C.,ELEC. 4.7UF 35V M SM
C51	5260165252	C.,ELEC.47UF/25V M USM VI
C52 C53	5260163452	C.,ELEC. 22UF 25V
C54	5171912000	C.,ELEC. 0.22UF 50V M KA
C55 C56	5260163452	C.,ELEC. 22UF 25V
C57	5054878500	C.,MYLAR 0.0010UF 100V J
C58 C59	5260161150	C.,ELEC.2.2UF 50V
C60	5054888500	C.,MYLAR 0.0018UF 50V J
C61 C62	5170354000	C.,MYLAR 0.0012UF/100V JT
D01 -D48	5224015010	DIODE,1SS133HV
D51 -D58	5224015010	DIODE,1SS133HV
D59	5143174000	DIODE,ZENER EQA01-19R
D60	5224015010	DIODE,1SS133HV
D61	5143154000	DIODE,ZENER EQA01-06S
D62 -D66	5224015010	DIODE,1SS133HV
D67	5143154000	DIODE,ZENER EQA01-06S
D68 -D79	5224015010	DIODE,1SS133HV
J1	5336164300	CONN.SOCKET IL-D-03S

REC/PLAY PCB ASSY (AIR-60-ZT)

REF.NO.	PARTS NO.	DESCRIPTION
J2	5336164600	CONNECTOR
J3 J4	5336165200	CONN.SOCKET IL-D-12S
K1	5290010400	RELAY, MR62-24S 24V
K2	5290009500	RELAY,G2E-182P-H DC24V
L1	5160044000	COIL,TRAP.3MH
L2	5286007700	COIL,CHOKE 3.3MH
L4	5160044000	COIL,TRAP.3MH
L5	5286021100	COIL,CHOKE 1200UH M VR
L6	5286011400	COIL,CHOKE 1.3MH
L8 L9	5286021000	COIL,CHOKE 1000UH M VR
P1	5122146000	CONNECTOR,PLUG 3P
Q1	5232006200	FET,2SK270BL
Q2	5145151000	SI.TR.2SC-1815GR
Q3 Q4	5145149000	SI.TR.2SA-970GR
Q5 Q6	5145151000	SI.TR.2SC-1815GR
Q7	5145150000	SI.TR.2SA-1015GR
Q8 Q9	5145151000	SI.TR.2SC-1815GR
Q10 -Q19	5145103000	FET,2SK-68A-M
Q20	5145185000	SI.TR.2SD-655E
Q21 Q22	5145151000	SI.TR.2SC-1815GR
Q23	5145103000	FET,2SK-68A-M
Q24 -Q26	5145151000	SI.TR.2SC-1815GR
Q27 -Q29	5145103000	FET,2SK-68A-M
Q30 Q31	5145151000	SI.TR.2SC-1815GR
Q32 -Q34	5145103000	FET,2SK-68A-M
Q35 -Q40	5145151000	SI.TR.2SC-1815GR
Q41	5230771000	SI.TR.2SC2274-KE
Q42 -Q54	5145151000	SI.TR.2SC-1815GR
Q55	5145103000	FET,2SK-68A-M
R1	5240023420	R.,CARBON 10 OHM
R2	5240030620	R.,CARBON R10 10K
R3 R4	5241318200	R.,METAL FILM 1K F
R5	5240025420	R.,CARBON R20 68 J
R6	5240025020	R.,CARBON R20 47 J
R7	5240028620	R.,CARBON R20 1.5K J
R8 R9	5240027020	R.,CARBON R20 330 J
R10	5240030320	R.,CARBON R20 7.5K J
R11 R12	5240025420	R.,CARBON R20 68 J
R13	5240028020	R.,CARBON 820 OHM R10 T.
R14	5240029220	R.,CARBON R20 2.7K J
R15	5240028820	R.,CARBON R20 1.8K J
R16	5240030320	R.,CARBON R20 7.5K J
R17 -R18	5240024620	R.,CARBON R20 33 J
R19	5240028620	R.,CARBON R20 1.5K J
R20	5240028220	R.,CARBON R20 1.0K J
R21	5240031020	R.,CARBON R10 15K
R22	5240028020	R.,CARBON 820 OHM R10 T.
R23	5240029220	R.,CARBON R20 2.7K J
R24	5240033020	R.,CARBON 100K R10 T.
R25	5240034420	R.,CARBON R20 390K J
R26 -R27	5240032820	R.,CARBON R20 82K J
R28	5240029220	R.,CARBON R20 2.7K J
R29	5240029620	R.,CARBON R20 3.9K J
R30 -R31	5240030620	R.,CARBON R10 10K
R32	5240034420	R.,CARBON R20 390K J

REC/PLAY PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R33	5240029020	R.,CARBON R10 2.2K
R34 -R36	5240029820	R.,CARBON R20 4.7K J
R37 -R38	5240033820	R.,CARBON R10 220K
R39	5240026820	R.,CARBON R20 270 J
R40	5240029420	R.,CARBON R20 3.3K J
R41	5240029020	R.,CARBON R10 2.2K
R42	5240027420	R.,CARBON 470 OHM R10 T.
R43	5240026620	R.,CARBON R20 220 J
R45	5240032220	R.,CARBON R20 47K J
R46	5240028220	R.,CARBON R20 1.0K J
R47	5240031220	R.,CARBON R20 18K J
R48	5240031620	R.,CARBON R20 27K J
R49	5240030820	R.,CARBON R20 12K J
R50	5240029820	R.,CARBON R20 4.7K J
R51 -R52	5240030620	R.,CARBON R10 10K
R53	5240034420	R.,CARBON R20 390K J
R54	5240025820	R.,CARBON 100 OHM R10 T.
R55	5240032020	R.,CARBON R20 39K J
R56	5240028220	R.,CARBON R20 1.0K J
R57	5240028420	R.,CARBON R20 1.2K J
R61	5240029820	R.,CARBON R20 4.7K J
R62	5240028420	R.,CARBON R20 1.2K J
R63	5240032820	R.,CARBON R20 82K J
R64 R65	5240029820	R.,CARBON R20 4.7K J
R66	5240033820	R.,CARBON R10 220K
R67	5240029420	R.,CARBON R20 3.3K J
R68	5240033420	R.,CARBON R10 150K
R69	5240025820	R.,CARBON 100 OHM R10 T.
R70	5240029620	R.,CARBON R20 3.9K J
R72	5240031620	R.,CARBON R20 27K J
R73	5240033020	R.,CARBON 100K R10 T.
R74	5240031620	R.,CARBON R20 27K J
R75	5240033020	R.,CARBON 100K R10 T.
R76	5240034620	R.,CARBON R20 470K J
R77	5240032320	R.,CARBON R20 51K J
R78	5240031220	R.,CARBON R20 18K J
R79 -R80	5240032420	R.,CARBON R20 56K J
R81	5240030620	R.,CARBON R10 10K
R82	5240028820	R.,CARBON R20 1.8K J
R83	5240028420	R.,CARBON R20 1.2K J
R84	5240032020	R.,CARBON R20 39K J
R85	5240033020	R.,CARBON 100K R10 T.
R86	5240030620	R.,CARBON R10 10K
R87	5240031820	R.,CARBON R20 33K J
R88	5240032020	R.,CARBON R20 39K J
R89	5240033020	R.,CARBON 100K R10 T.
R90	5240031820	R.,CARBON R20 33K J
R91	5240032020	R.,CARBON R20 39K J
R92	5240033020	R.,CARBON 100K R10 T.
R93	5240031820	R.,CARBON R20 33K J
R94	5240032020	R.,CARBON R20 39K J
R95	5240033020	R.,CARBON 100K R10 T.
R96	5240031820	R.,CARBON R20 33K J
R97	5240032020	R.,CARBON R20 39K J
R98	5240033020	R.,CARBON 100K R10 T.

REC/PLAY PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R99	5240031820	R.,CARBON R20 33K J
R100	5240032020	R.,CARBON R20 39K J
R101	5240033020	R.,CARBON 100K R10 T.
R102	5240031820	R.,CARBON R20 33K J
R103	5240032020	R.,CARBON R20 39K J
R104	5240033020	R.,CARBON 100K R10 T.
R105	5240031820	R.,CARBON R20 33K J
R106	5240032020	R.,CARBON R20 39K J
R107	5240033020	R.,CARBON 100K R10 T.
R108	5240031820	R.,CARBON R20 33K J
R109	5240032020	R.,CARBON R20 39K J
R110	5240033020	R.,CARBON 100K R10 T.
R111	5240031820	R.,CARBON R20 33K J
R112	5240032020	R.,CARBON R20 39K J
R113	5240033020	R.,CARBON 100K R10 T.
R114	5240031820	R.,CARBON R20 33K J
R115	5240032020	R.,CARBON R20 39K J
R116	5240033020	R.,CARBON 100K R10 T.
R117	5240031820	R.,CARBON R20 33K J
R118	5240032020	R.,CARBON R20 39K J
R119	5240033020	R.,CARBON 100K R10 T.
R120 R121	5240030620	R.,CARBON R10 10K
R122	5240033020	R.,CARBON 100K R10 T.
R123 R124	5240030620	R.,CARBON R10 10K
R125	5240033020	R.,CARBON 100K R10 T.
R126	5240031820	R.,CARBON R20 33K J
R127	5240032020	R.,CARBON R20 39K J
R128	5240033020	R.,CARBON 100K R10 T.
R129	5240031820	R.,CARBON R20 33K J
R130	5240032020	R.,CARBON R20 39K J
R131	5240033020	R.,CARBON 100K R10 T.
R132	5240031820	R.,CARBON R20 33K J
R133	5240032020	R.,CARBON R20 39K J
R134	5240033020	R.,CARBON 100K R10 T.
R135	5240032020	R.,CARBON R20 39K J
R136 R137	5240031620	R.,CARBON R20 27K J
R138 R139	5240033020	R.,CARBON 100K R10 T.
R140	5240031820	R.,CARBON R20 33K J
R141	5240031620	R.,CARBON R20 27K J
R142	5240023220	R.,CARBON R20 8.2 J
R143 R144	5240030620	R.,CARBON R10 10K
R145	5240028220	R.,CARBON R20 1.0K J
R146	5240032220	R.,CARBON R20 47K J
R147	5240029020	R.,CARBON R10 2.2K
R148	5240030620	R.,CARBON R10 10K
R149	5240026620	R.,CARBON R20 220 J
R150	5240032220	R.,CARBON R20 47K J
R151	5240026620	R.,CARBON R20 220 J
R152	5240030620	R.,CARBON R10 10K
R153	5240030620	R.,CARBON R10 10K
R154	5240032220	R.,CARBON R20 47K J
R155	5240031020	R.,CARBON R10 15K
R156	5240031620	R.,CARBON R20 27K J
R157	5240029820	R.,CARBON R20 4.7K J
R158	5240031820	R.,CARBON R20 33K J

REC/PLAY PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R159	5240026620	R.,CARBON R20 220 J
R160	5240030020	R.,CARBON R20 5.6K J
R161	5240026620	R.,CARBON R20 220 J
R162	5240030820	R.,CARBON R20 12K J
R163	5240026620	R.,CARBON R20 220 J
R164	5240030620	R.,CARBON R10 10K
R165	5240032220	R.,CARBON R20 47K J
R166	5240030420	R.,CARBON 8.2K R10 T.
R167	5240032220	R.,CARBON R20 47K J
R168	5240031620	R.,CARBON R20 27K J
R169 R170	5240028620	R.,CARBON R20 1.5K J
R171	5240031420	R.,CARBON R10 22K
R172	5240031820	R.,CARBON R20 33K J
R174	5240031420	R.,CARBON R10 22K
R175	5240028620	R.,CARBON R20 1.5K J
R176	5240031420	R.,CARBON R10 22K
R177	5240028620	R.,CARBON R20 1.5K J
R179	5240031820	R.,CARBON R20 33K J
R180	5240031420	R.,CARBON R10 22K
R181	5240029820	R.,CARBON R20 4.7K J
R182	5240030620	R.,CARBON R10 10K
R183	5240031620	R.,CARBON R20 27K J
R184	5240032220	R.,CARBON R20 47K J
R185	5240031620	R.,CARBON R20 27K J
R186	5240032220	R.,CARBON R20 47K J
R187	5240031620	R.,CARBON R20 27K J
R188	5240030620	R.,CARBON R10 10K
R189	5240032220	R.,CARBON R20 47K J
R190	5240031620	R.,CARBON R20 27K J
R191	5240031620	R.,CARBON R20 27K J
R192	5240032220	R.,CARBON R20 47K J
R193	5240031620	R.,CARBON R20 27K J
R194	5240030620	R.,CARBON R10 10K
R195	5240031620	R.,CARBON R20 27K J
R196	5240032220	R.,CARBON R20 47K J
R197	5240029420	R.,CARBON R20 3.3K J
R198	5240029020	R.,CARBON R10 2.2K
R199	5240032220	R.,CARBON R20 47K J
R200	5240032420	R.,CARBON R20 56K J
R201	5240031620	R.,CARBON R20 27K J
R202	5240032420	R.,CARBON R20 56K J
R203	5240032420	R.,CARBON R20 56K J
R204	5240031620	R.,CARBON R20 27K J
R205	5240032420	R.,CARBON R20 56K J
R206 R207	5240031620	R.,CARBON R20 27K J
R208	5240031020	R.,CARBON R10 15K
R209 R210	5240031620	R.,CARBON R20 27K J
R211	5240031020	R.,CARBON R10 15K
R212	5240031620	R.,CARBON R20 27K J
R213	5240031020	R.,CARBON R10 15K
R214	5240031620	R.,CARBON R20 27K J
R215	5240031020	R.,CARBON R10 15K
R216	5240034220	R.,CARBON R20 330K J
R217	5240031820	R.,CARBON R20 33K J
R218	5240032020	R.,CARBON R20 39K J

REC/PLAY PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R219	5240033020	R.,CARBON 100K R10 T.
R220	5240025820	R.,CARBON 100 OHM R10 T.
R301-R308	5280131802	R.,TRIMMER 3.3KB V METAL
R309 R310	5280132902	R.,TRIMMER 100KB V. METAL
R311-R313	5280132002	R.,TRIMMER 5.0KB V METAL
R314 R315	5280132702	R.,TRIMMER 50KB V. METAL
R316	5280133402	R.,TRIMMER 500KB V METAL
R317	5280132302	R.,TRIMMER 20KB METAL
R318 R319	5280132202	R.,TRIMMER 10KB METAL
R320	5280132902	R.,TRIMMER 100KB V. METAL
S1 S2	5300908100	SW.,SLIDE 1-2N
TP1 -TP5	5317001200	PIN HEADER 0.7P
U1 U3	5220411600	IC,TL4558P
U2	5220416600	IC,NJM2041D-D
U4	5220411600	IC,TL4558P
U5	6048940000	IC,MC14001CP
U6	6048945000	IC,MC14049UBCP
U7	5292202400	MODULE,BIAS 70V

Note: Models using the PCB marked "#1" do not use #2 parts, additionally use #3 parts, and their #4 parts have unique electrical values.

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200185800	REC/PLAY PCB ASSY (ATR-60-2N,2D)
	*5200185810	REC/PLAY PCB ASSY (ATR-60-2HS)
	*5210185800	REC/PLAY PCB
#1	*5210185801	REC/PLAY PCB
C1	5170358000	C.,MYLAR 0.0018UF/100V JT
C2	5170354000	C.,MYLAR 0.0012UF/100V JT
C3	5172218000	C.,CERAMIC 330PF/50V T
C4	5260067850	C.,ELEC. 22UF 16V M SMBP
C5	5170352000	C.,MYLAR 0.001UF/100V JT
C6	5260164252	C.,ELEC. 33UF 16V M USM
C7	5260166052	C.,ELEC. 100UF/16V M USM
C8	5170358000	C.,MYLAR 0.0018UF/100V JT
C9	5269107220	C.,POLYST.560PF/100V J VT
C10	5170352000	C.,MYLAR 0.001UF/100V JT
C11	5172218000	C.,CERAMIC 330PF/50V T
C12	5260067850	C.,ELEC. 22UF 16V M SMBP
C13	5170352000	C.,MYLAR 0.001UF/100V JT
C14 C15	5172204000	C.,CERAMIC 22PF/50V T
C16	5260067850	C.,ELEC. 22UF 16V M SMBP
C17 C18	5170352000	C.,MYLAR 0.001UF/100V JT
C19 C20	5263167923	C.,METAL 0.1UF/50V J VT
C21	5171857000	C.,MYLAR 0.01UF/100V (ATR-60-2N,2D)
C22	5170372000	C.,MYLAR 0.0068UF/100V JT
C23 #2	5260067050	C.,ELEC. 10UF 16V
C24 #2	5260067850	C.,ELEC. 22UF 16V M SMBP
C26	5263106820	C.,POLYPRO. 390PF 100V J
C27	5260067050	C.,ELEC. 10UF 16V
C28	5170352000	C.,MYLAR 0.001UF/100V JT
C29	5171862000	C.,MYLAR 0.018UF/100V (ATR-60-2HS)
C29	5171866000	C.,MYLAR 0.027UF/100V (ATR-60-2N,2D)
C30	5172216000	C.,CERAMIC 220PF/50V T
C31	5260065850	C.,ELEC. 2.2UF 50V M SMBP
C33	5260160750	C.,ELEC. 1UF50V SM T-N
C34 C35	5260067050	C.,ELEC. 10UF 16V
C36 C37	5170364000	C.,MYLAR 0.0033UF/100V JT
C38	5170372000	C.,MYLAR 0.0068UF/100V JT
C39	5171857000	C.,MYLAR 0.01UF/100V (ATR-60-2N,2D)
C40 C41	5260067050	C.,ELEC. 10UF 16V
C42	5172216000	C.,CERAMIC 220PF/50V T
C43	5263168323	C.,METAL 0.22UF 50V (ATR-60-2HS)
C43	5263168223	C.,METAL 0.18UF 50V (ATR-60-2N,2D)
C44	5170366000	C.,MYLAR 0.0039UF/100V JT
C45 #2	5263168723	C.,METAL 0.47UF 50V (ATR-60-2N,2D)
C46	5260067850	C.,ELEC. 22UF 16V M SMBP
C47	5170360000	C.,MYLAR 0.0022UF/100V JT
C48	5170368000	C.,MYLAR 0.0047UF/100V (ATR-60-2HS)

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
C48	5170372000	C.,MYLAR 0.0068UF/100V (ATR-60-2N,2D)
C49	5260164452	C.,ELEC. 33UF 35V M USM
C50	5260160750	C.,ELEC. 1UF50V SM T-N
C51	5170352000	C.,MYLAR 0.001UF/100V JT
C53	5260163552	C.,ELEC. 22UF/35V M USM V
C55	5171912000	C.,ELEC. 0.22UF 50V M KA
C56	5260164452	C.,ELEC. 33UF 35V M USM
C57	5170352000	C.,MYLAR 0.001UF/100V JT
C58	5260160550	C.,ELEC. 0.47UF 50V M SM
C59	5260163552	C.,ELEC. 22UF/35V M USM V
C60	5171912000	C.,ELEC. 0.22UF 50V M KA
C61	5260165252	C.,ELEC.47UF/25V M USM VT
C62 -C64	5260163452	C.,ELEC. 22UF 25V
C68 C69	5260160550	C.,ELEC. 0.47UF 50V M SM
C69 #4	5260161150	C.,ELEC.2.2UF 50V
C70 -C73	5260160550	C.,ELEC. 0.47UF 50V M SM
C74	5171912000	C.,ELEC. 0.22UF 50V M KA
C75 C76	5260160550	C.,ELEC. 0.47UF 50V M SM
C76 #4	5260160750	C.,ELEC. 1UF50V SM T-N
C77	5263106820	C.,POLYPRO. 390PF 100V J
C78	5263106020	C.,POLYPRO. 180PF 100V J
C80	5260160550	C.,ELEC. 0.47UF 50V M SM (ATR-60-2N,2D)
C81 -C84	5260160550	C.,ELEC. 0.47UF 50V M SM
C85	5170352000	C.,MYLAR 0.001UF/100V JT
C86 C87	5260166052	C.,ELEC. 100UF/16V M USM
C88	5260160550	C.,ELEC. 0.47UF 50V M SM (ATR-60-2N,2D)
C89	5260160550	C.,ELEC. 0.47UF 50V M SM
C90	5170362000	C.,MYLAR 0.0027UF/100V (ATR-60-2HS)
C90	5170372000	C.,MYLAR 0.0068UF/100V (ATR-60-2N,2D)
C92	5260067050	C.,ELEC. 10UF 16V
C93	5260066550	C.,ELEC. 4.7UF 35V M SMBP
C94	5263106820	C.,POLYPRO. 390PF 100V J
C95 #2	5170352000	C.,MYLAR 0.001UF/100V JT
C96	5171856000	C.,MYLAR 0.01UF/100V J T
C97	5263106820	C.,POLYPRO. 390PF 100V J
C98	5263167923	C.,METAL 0.1UF/50V J VT
C101 #3	5260160750	C.,ELEC. 1UF50V SM T-N
D1 -D6	5224015010	DIODE,1SS133HV
D9 D10	5224015010	DIODE,1SS133HV
D11 D12	5224015010	DIODE,1SS133HV
D14 D15	5224015010	DIODE,1SS133HV
D16	5143174000	DIODE,ZENER EQA01-19R
D17 D18	5224015010	DIODE,1SS133HV
D20	5143174000	DIODE,ZENER EQA01-19R
D21	5143154000	DIODE,ZENER EQA01-06S
D22 -D24	5224015010	DIODE,1SS133HV
D27 #2	5224015010	DIODE,1SS133HV
D28	5224015010	DIODE,1SS133HV
D29	5224015010	DIODE,1SS133HV
D31	5224015010	DIODE,1SS133HV

Note: Models using the PCB marked "#1" do not use #2 parts, additionally use #3 parts, and their #4 parts have unique electrical values.

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
D32 #2	5224015010	DIODE,1SS133HV
D33	5224015010	DIODE,1SS133HV (ATR-60-2HS)
D34	5224015010	DIODE,1SS133HV
D36 -D41	5224015010	DIODE,1SS133HV
D43 -D47	5224015010	DIODE,1SS133HV
D48 D49 #3	5143174000	DIODE,ZENER EQA01-19R
J1	5336164300	CONNECTOR SOCKET,
J2	5336164600	CONNECTOR,
J3 J4	5336165200	CONNECTOR SOCKET,
K1 K2	5290011700	RELAY 24V G5A237P
L1	5286006700	COIL,CHOKE 1.2MH
L2	5286007600	COIL, CHOKE 3.0MH J
L3	5286021100	COIL,CHOKE 1200UH M VR
L4	5286006700	COIL,CHOKE 1.2MH
L5	5160044000	COIL,TRAP,3MH
L7	5286007600	COIL, CHOKE 3.0MH J
P1	5122146000	CONNECTOR,PLUG 3P
Q1 Q4	5232005200	FET,2SK246GR
Q2 Q6	5232008600	FET.,2SK389BL
Q3 Q5	5145151000	SI.TR.2SC-1815GR
Q7 Q8	5145149000	SI.TR.2SA-970GR
Q9 Q10	5145151000	SI.TR.2SC-1815GR
Q11	5145150000	SI.TR.2SA-1015GR
Q12	5232008100	FET 2SJ-103(GR)
Q13	5232005200	FET,2SK246GR
Q14	5145151000	SI.TR.2SC-1815GR (ATR-60-2N,2D)
Q15	5145151000	SI.TR.2SC-1815GR
Q16	5230775000	SI.TR.2SC2878-B
Q17	5232005200	FET,2SK246GR
Q18	5232008100	FET 2SJ-103(GR)
Q19 Q20	5145151000	SI.TR.2SC-1815GR
Q21	5232008100	FET 2SJ-103(GR)
Q22 -Q25	5232005200	FET,2SK246GR
Q26 Q29	5232008100	FET 2SJ-103(GR)
Q27 Q28	5232005200	FET,2SK246GR
Q30	5145151000	SI.TR.2SC-1815GR
Q31	5145151000	SI.TR.2SC-1815GR (ATR-60-2N,2D)
Q32	5145151000	SI.TR.2SC-1815GR
Q33	5232008100	FET 2SJ-103(GR)
Q34	5232005200	FET,2SK246GR
Q35	5145151000	SI.TR.2SC-1815GR
Q36	5145151000	SI.TR.2SC-1815GR (ATR-60-2N,2D)
Q38	5145151000	SI.TR.2SC-1815GR
Q39	5232005200	FET,2SK246GR
Q40 Q41	5145151000	SI.TR.2SC-1815GR
Q42	5232008100	FET 2SJ-103(GR)
Q43	5232005200	FET,2SK246GR
Q44 Q45	5145151000	SI.TR.2SC-1815GR
Q46 Q49	5230771000	SI.TR.2SC2274-KE
Q47 Q50	5145151000	SI.TR.2SC-1815GR
Q48 Q51	5230771000	SI.TR.2SC2274-KE

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
Q52 -Q54	5145151000	SI.TR.2SC-1815GR
Q56	5145151000	SI.TR.2SC-1815GR
Q57	5232007500	FET,2SJ-104GR
R1	5240177800	R.,CARBON EIR25 10M J VF
R2	5240030620	R.,CARBON R10 10K
R3 R4	5240027020	R.,CARBON R20 330 J FT
R5	5240028620	R.,CARBON R20 1.5K J FT
R6	5240025420	R.,CARBON R20 68 J FT
R7 R8	5241318200	R.,METAL FILM 1K F
R9	5240024220	R.,CARBON R20 22 J FT
R10	5240029820	R.,CARBON R20 4.7K J FT
R11	5240028620	R.,CARBON R20 1.5K J FT
R12	5240029820	R.,CARBON R20 4.7K J FT
R13	5240177800	R.,CARBON EIR25 10M J VF
R14	5240030620	R.,CARBON R10 10K
R15 R16	5240027020	R.,CARBON R20 330 J FT
R17	5240028620	R.,CARBON R20 1.5K J FT
R18 R19	5241318200	R.,METAL FILM 1K F
R20	5240024220	R.,CARBON R20 22 J FT
R22	5240028620	R.,CARBON R20 1.5K J FT
R23	5240028020	R.,CARBON 820 OHM R10 T.
R24 R25	5240028220	R.,CARBON R20 1.0K J FT
R26 R27	5240030320	R.,CARBON R20 7.5K J FT
R28	5240028820	R.,CARBON R20 1.8K J FT
R29	5240029220	R.,CARBON R20 2.7K J FT
R30 R31	5240024620	R.,CARBON R20 33 J FT
R32	5240031020	R.,CARBON R10 15K
R33 R34	5240028220	R.,CARBON R20 1.0K J FT
R35	5240032220	R.,CARBON R20 47K J FT
R36	5240027820	R.,CARBON R20 680 J FT (ATR-60-2HS)
R36	5240028020	R.,CARBON R20 820 J FT (ATR-60-2N,2D)
R37	5240034620	R.,CARBON R20 470K J FT
R38	5240026420	R.,CARBON R20 180K (ATR-60-2N,2D)
R39	5240029620	R.,CARBON R20 3.9K J FT
R40	5240029220	R.,CARBON R20 2.7K J FT
R41	5240030620	R.,CARBON R10 10K
R43	5240030620	R.,CARBON R10 10K
R44	5240025420	R.,CARBON R20 68 J FT
R46	5240029020	R.,CARBON R10 2.2K
R47	5240029920	R.,CARBON R20 5.1K (ATR-60-2N,2D)
R48	5240029920	R.,CARBON R20 5.1K J FT
R49	5240029820	R.,CARBON R20 4.7K J FT (ATR-60-2N,2D)
R50	5240029820	R.,CARBON R20 4.7K J FT
R51 R52 #2	5240032020	R.,CARBON R20 39K
R53	5240029820	R.,CARBON R20 4.7K J FT
R54	5240030420	R.,CARBON 8.2K R10 T.
R54 #4	5240031020	R.,CARBON R10 15K
R55	5240032020	R.,CARBON 39K R10 T.
R56 R57	5240032220	R.,CARBON R20 47K J FT
R58 R59	5240177800	R.,CARBON EIR25 10M J VF

Note: Models using the PCB marked "#1" do not use #2 parts, additionally use #3 parts, and their #4 parts have unique electrical values.

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
R60	5240030620	R.,CARBON R10 10K
R61	5240033020	R.,CARBON 100K R10 T.
R62	5240026820	R.,CARBON R20 270 J FT
R63	5240029420	R.,CARBON R20 3.3K J FT
R64	5240027420	R.,CARBON 470 OHM R10 T.
R65 R66	5240029820	R.,CARBON R20 4.7K J FT
R68	5240029620	R.,CARBON R20 3.9K J FT
R69	5240033020	R.,CARBON 100K R10 T.
R70	5240031220	R.,CARBON R20 18K J FT
R71	5240030620	R.,CARBON R10 10K
R72	5240029020	R.,CARBON R10 2.2K
R73	5240031620	R.,CARBON R20 27K J FT
R74	5240029820	R.,CARBON R20 4.7K J FT
R75	5240030420	R.,CARBON 8.2K R10 T.
R76	5240029420	R.,CARBON R20 3.3K J FT
R77	5240034820	R.,CARBON R10 560K (ATR-60-2N,2D)
R78	5240033820	R.,CARBON R10 220K (ATR-60-2HS)
R78	5240033420	R.,CARBON R10 150K (ATR-60-2N,2D)
R84 R85	5240177800	R.,CARBON ELR25 10M J VF
R88	5240030620	R.,CARBON R10 10K
R89	5240177800	R.,CARBON ELR25 10M J VF
R90	5240030620	R.,CARBON R10 10K
R91	5240177800	R.,CARBON ELR25 10M J VF
R92	5240033020	R.,CARBON 100K R10 T.
R93	5240028020	R.,CARBON 820 OHM R10 T.
R94	5240031020	R.,CARBON R10 15K
R96	5240029620	R.,CARBON R20 3.9K J FT
R98	5240031620	R.,CARBON R20 27K J FT
R99	5240033020	R.,CARBON 100K R10 T.
R100	5240031620	R.,CARBON R20 27K (ATR-60-2N,2D)
R101	5240033020	R.,CARBON 100K R10 (ATR-60-2N,2D)
R102	5240034620	R.,CARBON R20 470K J FT
R103	5240032320	R.,CARBON R20 51K J FT (ATR-60-2N,2D)
R104	5240031220	R.,CARBON R20 18K J FT
R106 R107	5240032420	R.,CARBON R20 56K J FT
R108	5240030620	R.,CARBON R10 10K
R109	5240028220	R.,CARBON R20 1.0K J FT
R110	5240028420	R.,CARBON R20 1.2K J FT
R112 R113	5240030620	R.,CARBON R10 10K
R115	5240033020	R.,CARBON 100K R10 T.
R116	5240031820	R.,CARBON R20 33K J FT
R119	5240030220	R.,CARBON R20 6.8K J FT
R120 R121	5240177800	R.,CARBON ELR25 10M J VF
R122	5240031020	R.,CARBON R10 15K
R123	5240031820	R.,CARBON R20 33K J FT
R124	5240029020	R.,CARBON R10 2.2K
R125	5240029920	R.,CARBON R20 5.1K J FT
R126	5240029920	R.,CARBON R20 5.1K (ATR-60-2N,2D)

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
R127	5240029820	R.,CARBON R20 4.7K J FT
R128	5240029820	R.,CARBON R20 4.7K J FT (ATR-60-2N,2D)
R130	5240032220	R.,CARBON R20 47K J FT
R133	5240032820	R.,CARBON R20 82K J FT
R134	5240034020	R.,CARBON R20 270K J FT
R135	5240029420	R.,CARBON R20 3.3K J FT (ATR-60-2HS)
R135	5240029820	R.,CARBON R20 4.7K (ATR-60-2N,2D)
R136	5240029820	R.,CARBON R20 4.7K J FT
R137	5240177800	R.,CARBON ELR25 10M J VF
R138	5240028220	R.,CARBON R20 1.0K J FT
R141 R142	5240177800	R.,CARBON ELR25 10M J VF
R143	5240030620	R.,CARBON R10 10K
R145	5240030620	R.,CARBON R10 10K
R146	5240028220	R.,CARBON R20 1.0K J FT
R148	5240028420	R.,CARBON R20 1.2K J FT
R149	5240033020	R.,CARBON 100K R10 T.
R150-R153	5240029820	R.,CARBON R20 4.7K J FT
R156	5240030620	R.,CARBON R10 10K
R157	5240022820	R.,CARBON R20 5.6 J FT
R158	5240029020	R.,CARBON R10 2.2K (ATR-60-2N,2D)
R158 #4	5240030420	R.,CARBON R10 8.2K (ATR-60-2HS)
R159 R160	5240030620	R.,CARBON R10 10K
R161	5240032220	R.,CARBON R20 47K J FT (ATR-60-2N,2D)
R161 #4	5240031420	R.,CARBON R20 22K J FT (ATR-60-2HS)
R162	5240028820	R.,CARBON R20 1.8K J FT
R162 #4	5240029320	R.,CARBON R20 3K (ATR-60-2HS)
R163	5240030620	R.,CARBON R10 10K
R164 R165	5240026620	R.,CARBON R20 220 J FT
R168	5240028420	R.,CARBON R20 1.2K (ATR-60-2HS)
R168	5240028020	R.,CARBON R20 820 (ATR-60-2N,2D)
R169	5240023620	R.,CARBON R20 12 J FT
R170	5240030420	R.,CARBON 8.2K R10 T.
R171	5240030620	R.,CARBON R10 10K
R172	5240029820	R.,CARBON R20 4.7K J FT
R173	5240031820	R.,CARBON R20 33K J FT
R174	5240028620	R.,CARBON R20 1.5K J FT
R175	5240030620	R.,CARBON R10 10K
R176 R177	5240026620	R.,CARBON R20 220 J FT
R178	5240031020	R.,CARBON R10 15K
R179	5240029020	R.,CARBON R10 2.2K
R180	5240029820	R.,CARBON R20 4.7K J FT
R181	5240026620	R.,CARBON R20 220 J FT
R182	5240031220	R.,CARBON R20 18K J FT
R183	5240030020	R.,CARBON R20 5.6K J FT
R184	5240030420	R.,CARBON 8.2K R10 T.

Note: Models using the PCB marked "#1" do not use #2 parts, additionally use #3 parts, and their #4 parts have unique electrical values.

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
R185	5240031220	R.,CARBON R20 18K J FT
R186	5240030020	R.,CARBON R20 5.6K J FT
R187	5240030420	R.,CARBON 8.2K R10 T.
R187 #4	5240031020	R.,CARBON R10 15K
R188	5240031220	R.,CARBON R20 18K J FT
R188 #4	5240030820	R.,CARBON R20 12K J FT
R189	5240031020	R.,CARBON R10 15K
R198	5240033020	R.,CARBON 100K R10 T.
R199	5240031620	R.,CARBON R20 27K J FT
R200	5240033020	R.,CARBON 100K R10 T. (ATR-60-2N,2D)
R201	5240031620	R.,CARBON R20 27K J FT (ATR-60-2N,2D)
R202	5240031620	R.,CARBON R20 27K J FT
R203	5240032420	R.,CARBON R20 56K (ATR-60-2N,2D)
R204	5240032420	R.,CARBON R20 56K J FT
R205	5240031620	R.,CARBON R20 27K J FT (ATR-60-2N,2D)
R206	5240031620	R.,CARBON R20 27K J FT
R207 R208	5240030820	R.,CARBON R20 12K J FT
R209 R210	5240032220	R.,CARBON R20 47K J FT
R211 #3	5240031620	R.,CARBON R20 27K J FT
R212 #2	5240032420	R.,CARBON R20 56K (ATR-60-2N,2D)
R213	5240032420	R.,CARBON R20 56K J FT
R214	5240031620	R.,CARBON R20 27K J FT
R215 R216	5240032420	R.,CARBON R20 56K J FT
R217	5240031620	R.,CARBON R20 27K J FT
R218 R219	5240032420	R.,CARBON R20 56K J FT
R220	5240031620	R.,CARBON R20 27K J FT
R221 R222	5240032420	R.,CARBON R20 56K J FT
R223	5240031620	R.,CARBON R20 27K J FT
R224 R225	5240032420	R.,CARBON R20 56K J FT
R226	5240033020	R.,CARBON 100K R10 T. (ATR-60-2N,2D)
R227	5240033020	R.,CARBON 100K R10 T.
R228 R229	5240031020	R.,CARBON R10 15K
R230-R232	5240031620	R.,CARBON R20 27K J FT
R233	5240031020	R.,CARBON R10 15K
R234	5240031620	R.,CARBON R20 27K J FT
R235	5240031020	R.,CARBON R10 15K
R236	5240031620	R.,CARBON R20 27K J FT
R239	5240032220	R.,CARBON R20 47K J FT
R240	5240031620	R.,CARBON R20 27K J FT
R241	5240030620	R.,CARBON R10 10K
R242	5240032220	R.,CARBON R20 47K J FT
R243	5240034620	R.,CARBON R20 470K J FT
R243 #4	5240032820	R.,CARBON R20 82K J FT
R244	5240032420	R.,CARBON R20 56K J FT
R245	5240031620	R.,CARBON R20 27K J FT
R246	5240033020	R.,CARBON R20 100K J FT
R247 R248	5240032420	R.,CARBON R20 56K J FT
R249 R250	5240031620	R.,CARBON R20 27K J FT
R251	5240031020	R.,CARBON R10 15K
R252	5240032220	R.,CARBON R20 47K J FT
R253 R254	5240031020	R.,CARBON R10 15K
R255	5240032220	R.,CARBON R20 47K J FT
R256	5240031020	R.,CARBON R10 15K
R257	5240032420	R.,CARBON R20 56K J FT

REC/PLAY PCB ASSY (ATR-60-2N,2D,2HS)

REF.NO.	PARTS NO.	DESCRIPTION
R258	5240030620	R.,CARBON R10 10K
R259 R260	5240031020	R.,CARBON R10 15K
R261 R262	5240031620	R.,CARBON R20 27K J FT
R263	5240028420	R.,CARBON R20 1.2K J FT (ATR-60-2HS)
R263	5240028020	R.,CARBON R20 820 J FT (ATR-60-2N,2D)
R264	5240031620	R.,CARBON R20 27K J FT
R265	5240030620	R.,CARBON R10 10K
R266	5240031020	R.,CARBON R10 15K
R267 #3	5240029820	R.,CARBON R20 4.7K J FT
R268 #3	5240031020	R.,CARBON R10 15K
R301 R302	5280132002	R.,TRIMMER 5.0KB V METAL
R303 R304	5280132902	R.,TRIMMER 100KB V. METAL
R305 #2	5240030620	R.,CARBON R10 10K
R306 R307	5280132002	R.,TRIMMER 5.0KB V METAL (ATR-60-2HS)
R306 R307	5280131802	R.,TRIMMER 3.3KB V METAL (ATR-60-2N,2D)
R308 R309	5280131602	R.,TRIMMER 2.0KB V METAL (ATR-60-2HS)
R308 R309	5280131802	R.,TRIMMER 3.3KB V METAL (ATR-60-2N,2D)
R310	5280132702	R.,TRIMMER 50KB V. METAL
R312	5280132702	R.,TRIMMER 50KB V. METAL
R313	5280132202	R.,TRIMMER 10KB METAL
R314	5280133402	R.,TRIMMER 500KB V METAL
R315	5240030620	R.,CARBON R10 10K
R316 R317	5280132502	R.,RIMMER 33KB V METAL
R318	5280132302	R.,TRIMMER 20KB METAL
R319 -324	5280132202	R.,TRIMMER 10KB METAL
S2 S3	5300908100	SW.,SLIDE 1-2N
TP1 -6	5317001200	HEADER PIN, 0.7F
U01 -U05	5220416600	IC,NJM2041D-D
U06 U07	5220418800	IC,M5218P
U08	5220020000	IC,TC4049BP
U09	5220019000	IC,TC4001BP
U10	5220020000	IC,TC4049BP
U11 U12	5220019000	IC,TC4001BP
U14 U15	5232252020	SI.TR.2SC3400
U17 -U20	5232252020	SI.TR.2SC3400
U22	5292205600	AMP MODULE, BIAS E
U23	5292205700	AMP MODULE, BIAS R
U24 U25 #3	5232252020	SI.TR.2SC3400

ERASE HEAD PCB ASSY (ATR-60-2N,2D,2HS)
(PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200185700	ERASE HEAD PCB ASSY
	*5210185700	ERASE HEAD PCB
	*5317002100	DH CHECK PIN LPS-1136
C1 C2	5265074400	C.,POLYSTY. 2700PF 250V
L1 L2	5286025000	COIL,STEP UP
P1	5336126500	CONNECTOR PLUG, WHT
P2	5336126400	CONNECTOR PLUG, WHT
R1 R2	5240023420	R.,CARBON 10 OHM

MOTHER A PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200138800	MOTHER A PCB ASSY
	*5210138801	MOTHER A PCB
D1	5042517000	DIODE,1S2473VE
J1	5330507700	PIN JACK 4P
K1	5061137000	RELAY REED LA82L
P101 P201	5336166300	CONNECTOR,PLUG IL-03P
P102 P201	5336166600	CONNECTOR,PLUG IL-06P
P103 P203	5336167200	CONNECTOR,PLUG IL-12P
P104 P204	5336167200	CONNECTOR,PLUG IL-12P
P105 P115	5122146000	CONNECTOR,PLUG 3P
P106	5122145000	CONNECTOR,PLUG 5046-02A W
P107	5122455000	CONNECTOR,PLUG 5046-04A R
P108	5122459000	CONNECTOR,PLUG 5046-08A R
P109	5122151000	CONNECTOR,PLUG 5046-08A W
P110	5122150000	CONNECTOR,PLUG 5046-07A
P111 P114	5122147000	CONNECTOR,PLUG 5046-04A W
P112	5122203000	CONNECTOR,PLUG 5046-03A B
P113	5122149000	CONNECTOR,PLUG 5046-06A W
P205	5122454000	CONNECTOR,PLUG 5046-03A R
P206	5122453000	CONN.PLUG 5046-02A RD
R1	5240168400	R.,CARBON ELR25 1.2K J

MOTHER B PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200138900	MOTHER B PCB ASSY
	*5210138901	MOTHER B PCB
D2	5224015010	DIODE,1SS133HV
K2	5061137000	RELAY REED LA82L
P301	5336166300	CONNECTOR,PLUG IL-03P
P302	5336166600	CONNECTOR, PLUG IL-06P
P303 P304	5336167200	CONNECTOR,PLUG IL-12P
P305 P309	5122147000	CONNECTOR,PLUG 5046-04A W
P306	5122457000	CONNECTOR,PLUG 5046-06A R
P307	5122150000	CONNECTOR,PLUG 5046-07A
P308 P310	5122148000	CONNECTOR,PLUG 5P
P311	5122455000	CONNECTOR,PLUG 5046-04A R
P312	5122149000	CONNECTOR,PLUG 5046-06A W
P313 P314	5122146000	CONNECTOR,PLUG 3P
P413 P414	5122454000	CONNECTOR,PLUG 5046-03A R
R2 R3	5240031220	R.,CARBON R20 18K J
R4 R5	5240030220	R.,CARBON R20 6.8K J
R6	5240028420	R.,CARBON R20 1.2K J
U1	5292201900	OSC UNIT 145KHZ

FUNCTION PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200177900	FUNCTION PCB ASSY (ATR-60-2T)
	*5200177910	FUNCTION PCB ASSY (ATR-60-2N,2D,2HS)
	*5210177901	FUNCTION PCB
	*5300028000	SW.,PUSH 3GANG SUN341A
	*5300028300	SW.,PUSH SUN241A
	*5300029000	SW.,PUSH 2-2 N
C1 C2	5260160750	C.,ELEC. 1UF50V (ATR-60-2T)
C3 C4	5260162650	C.,ELEC. 10UF25V M SM VT
C5	5267010400	C.,CERAMIC 0.1UF/50V Z VR
C6	5260165252	C.,ELEC,47UF/25V M USM VT
D1 -D3	5225010100	LED,SLP-155B RED
D4 D6	5225011300	LED,SLP445B
D5	5225010200	LED,SLP-255B GRN
D7 D8	5224015010	DIODE,1SS133HV
D9	5224015010	DIODE,1SS133HV (ATR-60-2T)
D10 -D12	5224015010	DIODE,1SS133HV
D13 -D15	5224015010	DIODE,1SS133HV (ATR-60-2T)
P1	5122152000	CONNECTOR,PLUG 9P (ATR-60-2T)
P1	5122151000	CONNECTOR,PLUG 8P (ATR-60-2N,2D,2HS)
P2	5122146000	CONNECTOR,PLUG 3P
P3	5122150000	CONNECTOR,PLUG 5046-07A
P4	5122149000	CONNECTOR,PLUG 5046-06A W (ATR-60-2T)
R1 -D3	5181492000	R.,CARBON R25 2.7K J
R4	5181484000	R.,CARBON R25 1.2K J
R5 R6	5181484000	R.,CARBON R25 1.2K J
R7	5240029820	R.,CARBON R20 4.7K J
R8	5242110400	R.,ARRAY 4.7KX6
R9 -R14	5240031020	R.,CARBON R10 15K
R15	5240029020	R.,CARBON R10 2.2K
R16	5240032220	R.,CARBON R20 47K J
R17	5240031020	R.,CARBON R10 15K
R18	5240032220	R.,CARBON R20 47K J
R19	5240031020	R.,CARBON R10 15K
R20	5240032820	R.,CARBON R20 82K J
R21	5240032620	R.,CARBON R20 68K J
R22	5240031020	R.,CARBON R10 15K
R23	5240035420	R.,CARBON R20 1.0M J
R24	5240026620	R.,CARBON R20 220 J
R25	5240031020	R.,CARBON R10 15K
R26	5240029820	R.,CARBON R20 4.7K (ATR-60-2T)
U1	5220020000	IC,TC4049BP
U2	5220020200	IC,TC4030BP
U3	5220019100	IC,TC4011BP
U4	6048661000	IC,M54517P
U5	5232252020	S1.1R.2SC3400 (ATR-60-2T)

IN/OUT PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200139000	IN/OUT PCB ASSY
	*5210139000	IN/OUT PCB
C1 C2	5173065800	C.,ELEC. 220UF/25V USM F
C101 C201	5172218000	C.,CERAMIC 330PF/50V T
C102 C202	5260165252	C.,ELEC.47UF/25V M USM VT
C103 C203	5172206000	C.,CERAMIC 33PF/50V K VFT
C104 C204	5260067050	C.,ELEC. 10UF 16V
C105 C205	5260067050	C.,ELEC. 10UF 16V
C106 C206	5260165252	C.,ELEC.47UF/25V M USM VT
C107 C207	5260067050	C.,ELEC. 10UF 16V
C108 C208	5172206000	C.,CERAMIC 33PF/50V K VFT
C109 C209	5260165252	C.,ELEC.47UF/25V M USM VT
C110 C210	5172206000	C.,CERAMIC 33PF/50V K VFT
C111 C211	5172204000	C.,CERAMIC 22PF/50V T
C112 C212	5260067050	C.,ELEC. 10UF 16V
C113 C213	5260067050	C.,ELEC. 10UF 16V
C114 C214	5172204000	C.,CERAMIC 22PF/50V T
C115 C215	5172204000	C.,CERAMIC 22PF/50V T
C116 C216	5260067050	C.,ELEC. 10UF 16V
C117 C217	5172204000	C.,CERAMIC 22PF/50V T
C118 C218	5260067050	C.,ELEC. 10UF 16V
C119 C219	5172206000	C.,CERAMIC 33PF/50V K VFT
C120 C220	5260067050	C.,ELEC. 10UF 16V
C121 C221	5260067050	C.,ELEC. 10UF 16V
D101 D201	5224015300	DIODE,MC931
D102 D202	5224015300	DIODE,MC931
J1	5336164300	CONN. SOCKET IL-D-03S
J2	5336164600	CONNECTOR,
J3 J4	5336165200	CONN.SOCKET IL-D-12S
P1	5122149000	CONNECTOR,PLUG 5046-06A W
P2	5122145000	CONNECTOR,PLUG 5046-02A W
Q101 Q201	5230773800	SI.TR.2SC2655-Y
Q102 Q202	5145151000	SI.TR.2SC-1815GR
Q103 Q203	5145150000	SI.TR.2SA-1015GR
Q104 Q204	5230014000	SI.TR.2SA1020-Y
Q105 Q205	5230773800	SI.TR.2SC2655-Y
Q106 Q206	5145151000	SI.TR.2SC-1815GR
Q107 Q207	5145150000	SI.TR.2SA-1015GR
Q108 Q208	5230014000	SI.TR.2SA1020-Y
R101 R201	5240033820	R.,CARBON R10 220K
R102 R202	5240025820	R.,CARBON 100 OHM R10 T.
R103 R203	5240028820	R.,CARBON R20 1.8K J
R104 R204	5240028220	R.,CARBON R20 1.0K J
R105 R205	5241321600	R.,METAL FILM 27K F
R106 R206	5241318800	R.,METAL FILM RE35 1.8K
R107 R207	5241319900	R.,METAL FILM RE35 5.1K
R108 R208	5241319900	R.,METAL FILM RE35 5.1K
R109 R209	5241318800	R.,METAL FILM RE35 1.8K
R110 R210	5241321600	R.,METAL FILM 27K F
R111 R211	5240025820	R.,CARBON 100 OHM R10 T.
R112 R212	5240032220	R.,CARBON R20 47K J
R113 R213	5240032220	R.,CARBON R20 47K J
R114 R214	5240031020	R.,CARBON R10 15K
R115 R215	5240027420	R.,CARBON 470 OHM R10 T.
R116 R216	5241320600	R.,METAL FILM 10K F

IN/OUT PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
R117 R217	5240031020	R.,CARBON R10 15K
R118 R218	5240028220	R.,CARBON R20 1.0K J
R119 R219	5240029820	R.,CARBON R20 4.7K J
R120 R220	5183546000	R.,INCOMBUSTIBLE F25 4.7J
R121 R221	5240029820	R.,CARBON R20 4.7K J
R122 R222	5183546000	R.,INCOMBUSTIBLE F25 4.7J
R123 R223	5240028220	R.,CARBON R20 1.0K J
R124 R224	5241320600	R.,METAL FILM 10K F
R125 R225	5240030620	R.,CARBON R10 10K
R126 R226	5240031020	R.,CARBON R10 15K
R127 R227	5240031020	R.,CARBON R10 15K
R128 R228	5240028220	R.,CARBON R20 1.0K J
R129 R229	5240029820	R.,CARBON R20 4.7K J
R130 R230	5183546000	R.,INCOMBUSTIBLE F25 4.7J
R131 R231	5240029820	R.,CARBON R20 4.7K J
R132 R232	5183546000	R.,INCOMBUSTIBLE F25 4.7J
R133 R233	5240028220	R.,CARBON R20 1.0K J
R134 R234	5240031020	R.,CARBON R10 15K
R135 R235	5240025820	R.,CARBON 100 OHM R10 T.
R136 R236	5240032620	R.,CARBON R20 68K J
R137 R237	5240029820	R.,CARBON R20 4.7K J
R138 R238	5240030620	R.,CARBON R10 10K
R139 R239	5240030620	R.,CARBON R10 10K
R140 R240	5240030620	R.,CARBON R10 10K
R141 R241	5183554000	R.,INCOMB.1/4 10 OHM R25
R142 R242	5183554000	R.,INCOMB.1/4 10 OHM R25
R143 R243	5240032220	R.,CARBON R20 47K J
S101 S201	5300910100	SW.,SLIDE 2-2 N SSS322
S102 S202	5300910300	SW.,SLIDE 2-3 N SSS323
U101 U201	5220416600	IC,NJM2041D-D
U102	5220416600	IC,NJM2041D-D
U103 U203	5220416600	IC,NJM2041D-D

PHONE AMP PCB ASSY

REF.NO.	PARTS NO.	DESCRIPTION
	*5200128201	PHONE AMP PCB ASSY
	*5210128200	PHONE AMP PCB
C1	5173063000	C.,ELEC. 330UF 16V (SM)
C101 C201	5260160750	C.,ELEC. 1UF50V SM T-N
C102 C202	5260163252	C.,ELEC. 22UF 10V M USM
C103 C203	5172209000	C.,CERAMIC 56PF 50V K
C104 C204	5260067050	C.,ELEC. 10UF 16V
C2	5173063000	C.,ELEC. 330UF 16V (SM)
D101 D102	5224015300	DIODE,MC931
J1	5124046000	JACK,HEADPHONE
P1	5122127000	CONNECTOR,PLUG 3P
P2	5122128000	CONNECTOR,PLUG 4P
Q101 Q201	5230773800	SI.TR.2SC2655-Y
Q102 Q202	5230014000	SI.TR.2SA1020-Y
R1	5282409300	VR.,50KAX2
R101 R201	5240030620	R.,CARBON R10 10K
R102 R202	5240033020	R.,CARBON 100K R10 T.
R103 R203	5240028620	R.,CARBON R20 1.5K J
R104 R204	5240033020	R.,CARBON 100K R10 T.
R105 R205	5240030820	R.,CARBON R20 12K J
R106 R206	5240030820	R.,CARBON R20 12K J
R107 R207	5240022220	R.,CARBON R20 3.3 J
R108 R208	5240022220	R.,CARBON R20 3.3 J
R109 R209	5185676000	R.,INCOMBUSTIBLE F50 33J
R2 R3	5184217000	R.,INCOMBUSTIBLE 4.7 OHM
U1	5220411600	IC,TL4558P

SW(1) PCB ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200128700	SW(1) PCB ASSY
	*5210128700	SW PCB
C1	5260162550	C.,ELEC.10UF 16V
C2	5260162550	C.,ELEC.10UF 16V
C3	5260162550	C.,ELEC.10UF 16V
D1	5225012800	LED,AA3432F
R1	5240032620	R.,CARBON R20 68K J
R2	5240031420	R.,CARBON R10 22K
R3	5240031020	R.,CARBON R10 15K
R4	5240031820	R.,CARBON R20 33K J
R5	5240028620	R.,CARBON R20 1.5K J
S1	5300034400	SW.,PUSH 4-2 SUN

SW(2) PCB ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200129200	SW(2) PCB ASSY
	*5210128700	SW PCB
C2 C3	5260162550	C.,ELEC.10UF 16V
D1	5225012800	LED,AA3432F
R3	5240029420	R.,CARBON R20 3.3K J
R4	5240030220	R.,CARBON R20 6.8K J
R5	5240028620	R.,CARBON R20 1.5K J
S1	5300034400	SW.,PUSH 4-2 SUN

VR (1) PCB ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200128600	VR (1) PCB ASSY
	*5210128600	VR PCB
R101	5285000200	VR,50KA PBC 1S1U 27

VR (2) PCB ASSY (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200129100	VR (2) PCB ASSY
	*5210128600	VR PCB
R101	5285000100	VR,10KA PBC 1S1U 27

-T

TIME CODE AMP PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200177800	TIME CODE AMP PCB ASSY
	*5210177801	TIME CODE AMP PCB
C101	5170364000	C.,MYLAR 0.0033UF/100V JT
C102 C103	5260165252	C.,ELEC.47UF/25V M USM VT
C104	5263106820	C.,POLYPRO. 390PF 100V J
C105	5260255000	C.,ELEC. 10UF 16V M LLBP
C106	5171856000	C.,MYLAR 0.01UF/100V J T
C107	5171864000	C.,MYLAR 0.022UF/100V J T
C108	5260165252	C.,ELEC.47UF/25V M USM VT
C109	5170352000	C.,MYLAR 0.001UF/100V JT
C110	5260067050	C.,ELEC. 10UF 16V
C111	5172212000	C.,CERAMIC 100PF/50V T
C112	5263168623	C.,METAL 0.39UF 50V J
C113	5263168523	C.,METAL 0.33UF 50V J
C114 C115	5171866000	C.,MYLAR 0.027UF/100V J T
C116	5172207000	C.,CERAMIC 39PF/50V K VFT
C117	5171868000	C.,MYLAR 0.033UF 100V J T
C118	5170370000	C.,MYLAR 0.0056UF/100V JT
C119	5260165252	C.,ELEC.47UF/25V M USM VT
C120	5260166052	C.,ELEC. 100UF/16V M USM
C121	5172212000	C.,CERAMIC 100PF/50V T
C122 C123	5260166052	C.,ELEC. 100UF/16V M USM
C124 C125	5260067050	C.,ELEC. 10UF 16V
C126 C127	5172208000	C.,CERAMIC 47PF/50V T
C128 C129	5263167923	C.,METAL 0.1UF/50V J VT
C130	5172212000	C.,CERAMIC 100PF/50V T
C131	5260067050	C.,ELEC. 10UF 16V
C132	5171872000	C.,MYLAR 0.047UF/100V J T
C133	5260162650	C.,ELEC. 10UF25V M SM VT
C134	5260065650	C.,ELEC. 1.0UF50V M SMBP
C135	5263168723	C.,METAL 0.47UF/50V J VT
C136	5260065650	C.,ELEC. 1.0UF50V M SMBP
C137	5260067050	C.,ELEC. 10UF 16V
C138	5260065650	C.,ELEC. 1.0UF50V M SMBP
C139	5172212000	C.,CERAMIC 100PF/50V T
C143	5263167923	C.,METAL 0.1UF/50V J VT
C144	5263107020	C.,POLYPRO. 470PF 100V J
C145	5263106820	C.,POLYPRO. 390PF 100V J
C147	5263107020	C.,POLYPRO. 470PF 100V J
C148	5260067050	C.,ELEC. 10UF 16V
C149	5263106820	C.,POLYPRO. 390PF 100V J
C152	5260165952	C.,ELEC.100UF/10V M USM
C153 C154	5172214000	C.,CERAMIC 150PF/50V K
C155 C156	5260166052	C.,ELEC. 100UF/16V M USM
C157	5260162550	C.,ELEC.10UF 16V
C158	5260162050	C.,ELEC. 4.7UF 35V M SM
C159	5170352000	C.,MYLAR 0.001UF/100V JT
C160	5260164452	C.,ELEC. 33UF 35V M USM
C161	5263105420	C.,POLYPRO. 100PF 100V J
C162 C163	5260067050	C.,ELEC. 10UF 16V
C164	5171864000	C.,MYLAR 0.022UF/100V J T
C165	5260067050	C.,ELEC. 10UF 16V
C166 C167	5171858000	C.,MYLAR 0.012UF/100V J T
C168 C169	5170358000	C.,MYLAR 0.0018UF/100V JT
C170 C171	5170364000	C.,MYLAR 0.0033UF/100V JT

TIME CODE AMP PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
C172	5260067050	C.,ELEC. 10UF 16V
C173 C174	5171860000	C.,MYLAR 0.015UF/100V J T
C175 C176	5170366000	C.,MYLAR 0.0039UF/100V JT
C177 C178	5171864000	C.,MYLAR 0.022UF/100V J T
C179 C180	5170366000	C.,MYLAR 0.0039UF/100V JT
C181 C182	5171866000	C.,MYLAR 0.027UF/100V J T
C183 C184	5170368000	C.,MYLAR 0.0047UF/100V JT
C185	5263107420	C.,POLYPRO. 680PF 100V J
C186-C189	5260162050	C.,ELEC. 4.7UF 35V M SM
C190	5263106820	C.,POLYPRO. 390PF 100V J
C191 C192	5260164252	C.,ELEC. 33UF 16V M USM
C193	5260065650	C.,ELEC. 1.0UF50V M SMBP
D101-D116	5224015010	DIODE,1SS133HV
D118-D125	5224015010	DIODE,1SS133HV
D130	5143174000	DIODE,ZENER EQA01-19R
D131	5224015400	DIODE,1K60
K101-K104	5290011500	RELAY,G5A-237P DC12V
L101	5286007600	COIL,CHOKE 3.0MH J
L102	5286021100	COIL,CHOKE 1200UH M VR
L103	5056659000	COIL, TRAP 3MH
L104	5286007600	COIL, CHOKE 3.0MH J
L105 L106	5286008500	COIL, CHOKE 6.8MH J
L107	5286021100	COIL,CHOKE 1200UH M VR
L108	5286024600	COIL,TINING 1.3MH
L109	5286024000	COIL,MATCHING 1.9MH
L110	5286007600	COIL,CHOKE 3.0MH J
P101	5336126300	CONNECTOR,PLUG 8263-0312
P102	5336135300	CONNECTOR,PLUG 8263-0312
P103	5336126600	CONNECTOR,PLUG 8263-0612
P104	5336126700	CONNECTOR,PLUG 8263-0712
P105	5336126800	CONNECTOR,PLUG 8263-0812
P106	5336145300	CONNECTOR,PLUG 8263-0312
P107	5336137300	CONNECTOR,PLUG 8263-0312
P108	5336126400	CONNECTOR,PLUG 8263-0412
P109	5336135500	CONNECTOR,PLUG 8263-0512
P110	5336126200	CONNECTOR,PLUG 8263-0212
Q101-Q103	5145103000	FET,2SK-68A-M
Q104	5232007200	FET,2SK364BL
Q105	5145103000	FET,2SK-68A-M
Q106	5232007500	FET,2SJ-104GR
Q107	5232008800	FET 2SK30GR
Q108 Q109	5145103000	FET,2SK-68A-M
Q110	5232007500	FET,2SJ-104GR
Q111 Q112	5145103000	FET,2SK-68A-M
Q113	5145103000	FET,2SK-68A-M
Q115	5230771000	SI.TR.2SC2274-KE
Q117	5145151000	SI.TR.2SC-1815GR
R101	5240027620	R.,CARBON R20 560 J
R102	5240031020	R.,CARBON R10 15K
R103	5240032220	R.,CARBON R20 47K J
R104	5240028420	R.,CARBON R20 1.2K J
R105	5240031220	R.,CARBON R20 18K J
R106	5240032020	R.,CARBON R20 39K J
R107	5240029620	R.,CARBON R20 3.9K J
R108	5240028220	R.,CARBON R20 1.0K J

TIME CODE AMP PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R109	5183578000	R.,INCOMBUSTIBLE 1/4W 100
R110 R111	5183586000	R.,INCOMBUSTIBLE 220 F25
R112	5240024420	R.,CARBON R20 27 J
R113	5240032220	R.,CARBON R20 47K J
R114	5240029220	R.,CARBON R20 2.7K J
R115	5240029820	R.,CARBON R20 4.7K J
R117	5240026620	R.,CARBON R20 220 J
R118	5240031220	R.,CARBON R20 18K J
R119	5240028220	R.,CARBON R20 1.0K J
R120 R121	5240031420	R.,CARBON R10 22K
R122	5240028220	R.,CARBON R20 1.0K J
R123 R124	5240032020	R.,CARBON R20 39K J
R125	5240027620	R.,CARBON R20 560 J
R126	5242111300	R.,ARRAY 10KX4
R127 R128	5240031420	R.,CARBON R10 22K
R129	5240030620	R.,CARBON R10 10K
R130	5240027820	R.,CARBON R20 680 J
R131	5240031420	R.,CARBON R10 22K
R132	5240029420	R.,CARBON R20 3.3K J
R133	5240030620	R.,CARBON R10 10K
R134	5240031020	R.,CARBON R10 15K
R135 R136	5240026620	R.,CARBON R20 220 J
R137	5240029220	R.,CARBON R20 2.7K J
R138	5240028220	R.,CARBON R20 1.0K J
R139	5240031420	R.,CARBON R10 22K
R140	5240029220	R.,CARBON R20 2.7K J
R141	5240032220	R.,CARBON R20 47K J
R142-R145	5241319900	R.,METAL FILM RE35 5.1K
R146	5240031020	R.,CARBON R10 15K
R147	5240032220	R.,CARBON R20 47K J
R148	5240032020	R.,CARBON R20 39K J
R150	5240032220	R.,CARBON R20 47K J
R151	5240028220	R.,CARBON R20 1.0K J
R152	5240033820	R.,CARBON R10 220K
R153	5240029020	R.,CARBON R10 2.2K
R154	5240030420	R.,CARBON 8.2K R10 T.
R155	5240035220	R.,CARBON R20 820K J
R156	5240028220	R.,CARBON R20 1.0K J
R157	5240030620	R.,CARBON R10 10K
R158	5240034220	R.,CARBON R20 330K J
R159	5240032220	R.,CARBON R20 47K J
R160	5240028220	R.,CARBON R20 1.0K J
R161	5240030620	R.,CARBON R10 10K
R162	5240028220	R.,CARBON R20 1.0K J
R163	5240033820	R.,CARBON R10 220K
R164	5240030620	R.,CARBON R10 10K
R165 R166	5240028220	R.,CARBON R20 1.0K J
R167	5240030620	R.,CARBON R10 10K
R168 R169	5240033820	R.,CARBON R10 220K
R170	5240031820	R.,CARBON R20 33K J
R171	5240029220	R.,CARBON R20 2.7K J
R172	5240030820	R.,CARBON R20 12K J
R173	5240029420	R.,CARBON R20 3.3K J
R174	5240032620	R.,CARBON R20 68K J
R176	5240033020	R.,CARBON 100K R10 T.

TIME CODE AMP PCB ASSY (AIR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R177	5240031020	R.,CARBON R10 15K
R178	5240027620	R.,CARBON R20 560 J
R179	5240031620	R.,CARBON R20 27K J
R180	5240031420	R.,CARBON R10 22K
R181	5240029620	R.,CARBON R20 3.9K J
R182	5240030620	R.,CARBON R10 10K
R183	5240031820	R.,CARBON R20 33K J
R184	5240030620	R.,CARBON R10 10K
R185	5240030420	R.,CARBON 8.2K R10 T.
R186 R187	5240030620	R.,CARBON R10 10K
R188	5240033020	R.,CARBON 100K R10 T.
R189-R192	5240030620	R.,CARBON R10 10K
R193	5240033020	R.,CARBON 100K R10 T.
R194 R195	5240030420	R.,CARBON 8.2K R10 T.
R196	5240028220	R.,CARBON R20 1.0K J
R197-R199	5240030620	R.,CARBON R10 10K
R200 R201	5240023420	R.,CARBON 10 OHM
R202 R203	5183586000	R.,INCOMBUSTIBLE 220 F25
R204	5240030620	R.,CARBON R10 10K
R205	5240031420	R.,CARBON R10 22K
R206 R207	5240028620	R.,CARBON R20 1.5K J
R208 R209	5240032220	R.,CARBON R20 47K J
R210-R212	5240026420	R.,CARBON R20 180 J
R213	5240029820	R.,CARBON R20 4.7K J
R214	5240032220	R.,CARBON R20 47K J
R215	5240029020	R.,CARBON R10 2.2K
R216	5240023220	R.,CARBON R20 8.2 J
R217	5240032420	R.,CARBON R20 56K J
R218	5240031620	R.,CARBON R20 27K J
R219 R220	5240032420	R.,CARBON R20 56K J
R221	5240031620	R.,CARBON R20 27K J
R222	5240032420	R.,CARBON R20 56K J
R223	5240032220	R.,CARBON R20 47K J
R224	5240032020	R.,CARBON R20 39K J
R225	5240033020	R.,CARBON 100K R10 T.
R226	5240032220	R.,CARBON R20 47K J
R227	5240032020	R.,CARBON R20 39K J
R228	5240033020	R.,CARBON 100K R10 T.
R229	5240026420	R.,CARBON R20 180 J
R230 R232	5240031020	R.,CARBON R10 15K
R235	5240033020	R.,CARBON 100K R10 T.
R236 R237	5240026620	R.,CARBON R20 220 J
R238 R239	5240032020	R.,CARBON R20 39K J
R240-R243	5240031020	R.,CARBON R10 15K
R244 R245	5240035420	R.,CARBON R20 1.0M J
R246	5240029020	R.,CARBON R10 2.2K
R247	5240031820	R.,CARBON R20 33K J
R248	5240032020	R.,CARBON R20 39K J
R249	5240033020	R.,CARBON 100K R10 T.
R250 R251	5240028420	R.,CARBON R20 1.2K J
R252 R253	5240023420	R.,CARBON 10 OHM
R254-R257	5240030620	R.,CARBON R10 10K
R258 R259	5240028220	R.,CARBON R20 1.0K J
R260 R261	5240033420	R.,CARBON R10 150K
R262 R263	5240029620	R.,CARBON R20 3.9K J

-T

TIME CODE AMP PCB ASSY (ATR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R264 R265	5240033020	R.,CARBON 100K R10 T.
R266 R267	5240030020	R.,CARBON R20 5.6K J
R268 R269	5240031620	R.,CARBON R20 27K J
R270-R273	5240032420	R.,CARBON R20 56K J
R274 R275	5240031620	R.,CARBON R20 27K J
R276	5240029420	R.,CARBON R20 3.3K J
R277	5240029220	R.,CARBON R20 2.7K J
R278 R279	5240030420	R.,CARBON 8.2K R10 T.
R301-R303	5280181700	R.,TRIMMER 10KB H, METAL
R304	5280181100	R.,TRIMMER 1.0KB H, METAL
R305	5280191500	R.,TRIMMER 4.7KB V, METAL
R306	5280182300	R.,TRIMMER 100KB H, METAL
R307	5280181300	R.,TRIMMER 2.2KB H,METAL
R308 R309	5280180900	R.,TRIMMER 470 B H,METAL
R310 R311	5280181500	R.,TRIMMER 4.7KB H,METAL
R312	5280180900	R.,TRIMMER 470 B H,METAL
R313 R314	5280182300	R.,TRIMMER 100KB H,METAL
R315 R316	5280181400	R.,TRIMMER 3.3KB H,METAL
TP1 -TP11	5544750000	PIN,CONBINATION
U101	5220416600	IC,NJM2041D-D
U102	5220418800	IC,M5218P
U103	5220415000	IC,NJM072D
U104	5220039000	IC M4027BP
U105	5220411600	IC,TL4558P
U106	5220416600	IC,NJM2041D-D
U107-U109	5220411600	IC,TL4558P
U110	5220416600	IC,NJM2041D-D
U111	6048945000	IC,MC14049UBCP
U112	5220036600	IC,M4081BP
U113	5292202400	MODULE,BIAS 70V
U114-U119	5232252020	SI.TR.2SC3400

TC CANCEL PCB ASSY (ATR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200185200	TC CANCEL PCB ASSY
	*5210185200	TC CANCEL PCB
C1 C5	5170368000	C.,MYLAR 0.0047UF/100V VT
C2 C6	5263106620	C.,POLYPRO. 330PF 100V J
C3 C7	5170447000	C.,MYLAR 0.082UF 100V J F
C4 C8	5172800000	C.,POLYSTY. 68PF 50V J VR
C9 C10	5260165252	C.,ELEC.47UF/25V M USM VT
P1	5122128000	CONNECTOR,PLUG 4P
P2	5122127000	CONNECTOR,PLUG 3P
P3	5122126000	CONNECTOR,PLUG 3P W
P4	5122299000	CONNECTOR,PLUG 5045-02A R
R01 R11	5240034020	R.,CARBON R20 270K J
R02 R12	5240032220	R.,CARBON R20 47K J
R03 R13	5240030620	R.,CARBON R10 10K
R04 R14	5240029820	R.,CARBON R20 4.7K J

TC CANCEL PCB ASSY (ATR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
R05 R15	5240025220	R.,CARBON R20 56 J
R06 R16	5240032220	R.,CARBON R20 47K J
R08 R18	5143127000	THERMISTOR,S5C-14
R09 R19	5150265000	R.,TRIMMER 500B METAL
R10 R20	5240025820	R.,CARBON 100 OHM R10 T.
R21 R22	5183578000	R.,INCOMBUSTIBLE 1/4W 100
R23	5240021020	R.,CARBON R20 1.0 J
U1	5220416600	IC,NJM2041D-D

FUNCTION PCB ASSY (T) (ATR-60-2T)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200178000	FUNCTION PCB ASSY(T)
	*5210178000	FUNCTION PCB(T)
C1 C2	5260163452	C.,ELEC. 22UF 25V
C3	5260160550	C.,ELEC. 0.47UF 50V M SM
C4 C5	5260067050	C.,ELEC. 10UF 16V
D1 -D4	5224015010	DIODE,1SS133HV
D5	5224015400	DIODE,1K60
D11	5225014400	LED,PG3432SY GRN
D12	5225006900	LED,PR3432S RED
D13 -D15	5225007900	LED,GL-9PR2 RED
P1	5122130000	CONNECTOR,PLUG 6P W
P2	5122131000	CONNECTOR,PLUG 5045-07A W
P4 -P8	5336115200	CONN. SOCKET 3024-02CH
R1 R2	5240030620	R.,CARBON R10 10K
R3	5240028020	R.,CARBON 820 OHM R10 T.
R4	5240029220	R.,CARBON R20 2.7K J
R5	5240030620	R.,CARBON R10 10K
R6 -R8	5240030020	R.,CARBON R20 5.6K J
R14	5240029820	R.,CARBON R20 4.7K J
R15	5240029220	R.,CARBON R20 2.7K J
R16	5240029620	R.,CARBON R20 3.9K J
R17	5240028820	R.,CARBON R20 1.8K J
R18	5240028420	R.,CARBON R20 1.2K J
R19	5240027020	R.,CARBON R20 330 J
R20 -R24	5240029820	R.,CARBON R20 4.7K J
R25	5240033820	R.,CARBON R10 220K
R26	5240030620	R.,CARBON R10 10K
R27	5240032420	R.,CARBON R20 56K J
R28	5240028220	R.,CARBON R20 1.0K J
R29	5240033020	R.,CARBON 100K R10 T.
R30	5240029820	R.,CARBON R20 4.7K J
S1 S2	5300025700	SW.,PUSH SPH121A
U1 -U3	5232252020	SI.TR.2SC3400
U4 -U6	5220418800	IC,M5218P

POWER SUPPLY PCB ASSY

REF.NO.		PARTS NO.	DESCRIPTION
		*5200160300	POWER SUPPLY PCB ASSY
		*5210160300	POWER SUPPLY PCB
C1	C2	△5263164500	C.,POLYST 0.047UF 250V
C3	C4	△5262001500	C.,ELEC. 4700UF35V
C5	C6	△5173047800	C.,ELEC 100UF/35V USM F
C7	C8	5260160550	C.,ELEC. 0.47UF 50V M SM
C9	-C11	5260165252	C.,ELEC.47UF/25V M USM VT
C12	C13	△5263164500	C.,POLYST 0.047UF 250V
C14	C15	△5173090000	C.,ELEC. 2200UF/35V SM VF
C16	C17	5260160550	C.,ELEC. 0.47UF 50V M SM
C18		5260166152	C.,ELEC. 100UF 25V
C19	C20	5260165252	C.,ELEC.47UF/25V M USM VT
C21		△5260166852	C.,ELEC. 220UF 10V M USM
C22		△5263164500	C.,POLYST 0.047UF 250V
C23		△5262001600	C.,ELEC. 4700UF50V
C24	C27	5173047800	C.,ELEC 100UF/35V USM F
C25	C26	5173056800	C.,ELEC.220UF 35V USM F
C28	C29	5263164500	C.,POLYST 0.047UF 250V
C30		5262006600	C.,ELEC. 6800UF 35V(LISN)
C31		5262006500	C.,ELEC. 6800UF 25V(VNSN)
C32	C33	5172882000	C.,ELEC. 1.0UF 50V (SM)
C34	C36	5054928500	C.,MYLAR 0.10UF 100V J
C35		5173071000	C.,ELEC.SM 470UF/10V SNAP
C37	C38	△5263164500	C.,POLYST 0.047UF 250V
C39		△5260271810	C.,ELEC. 2200UF 50V M SME
C40		△5173094000	C.,ELEC. 3300UF 25V (SM)
C41		△5173090000	C.,ELEC. 2200UF/35V SM VF
D1	-D10	△5143243000	DIODE,ERB12-02G1
D11		△5228010000	SILICON STACK,D5SB20
D12	D13	5143154000	DIODE,ZENER EQA01-06S
D14		5228010000	SILICON STACK,D5SB20
D15		5224016200	DIODE,S5S4M
D16		5228010000	SILICON STACK,D5SB20
D17		5224014700	DIODE,S3V20H
P1		5336172600	CONNECTOR,PLUG 5275-06A
P2		5336172500	CONNECTOR,PLUG 5275-05A
P3		5336172600	CONNECTOR,PLUG 5275-06A
P4	P5	5122134000	CONNECTOR,PLUG 10P WHITE
P6		5122135000	CONNECTOR,PLUG 5045-11A
P7		5336172700	CONNECTOR,PLUG 5275-07A
P8		5336172400	CONNECTOR PLUG,5275-04A
Q1		△5145087000	SI.TR.2SD-313E
Q2		△5145129000	SI.TR.2SB-507
Q3		△5145087000	SI.TR.2SD-313E
Q4		△5145129000	SI.TR.2SB-507
Q5	Q6	△5145087000	SI.TR.2SD-313E
Q7	Q8	5230771000	SI.TR.2SC2274-KE
Q9	Q10	5145151000	SI.TR.2SC-1815GR
Q11		△5145165000	SI.TR.2SD-716O
Q12		5230016000	SI.TR.2SA950 O
Q13		5230771000	SI.TR.2SC2274-KE
Q14	Q15	△5145087000	SI.TR.2SD-313E
Q16		5230016000	SI.TR.2SA950 O
Q17		5230771000	SI.TR.2SC2274-KE
Q18		△5145087000	SI.TR.2SD-313E

POWER SUPPLY PCB ASSY

REF.NO.		PARTS NO.	DESCRIPTION
R1	R2	△5184237000	R.,INCOMBUSTIBLE 33 OHM
R5		5240031420	R.,CARBON R10 2.2K
R6		5240029020	R.,CARBON R10 2.2K
R7		5240029420	R.,CARBON R20 3.3K J
R8	R9	5240031020	R.,CARBON R10 15K
R10		5240031820	R.,CARBON R20 33K J
R11		5240027220	R.,CARBON R20 390 J
R12		5240029420	R.,CARBON R20 3.3K J
R13	R14	5240031020	R.,CARBON R10 15K
R15		△5184755000	R.,FILM 100 1W
R16		5240030220	R.,CARBON R20 6.8K J
R17		5240030620	R.,CARBON R10 10K
R18		5240029620	R.,CARBON R20 3.9K J
R19		5240031220	R.,CARBON R20 18K J
R20	R21	5240030220	R.,CARBON R20 6.8K J
R22		5240030620	R.,CARBON R10 10K
R23		5240029620	R.,CARBON R20 3.9K J
R24		5240031220	R.,CARBON R20 18K J
R25		5240030220	R.,CARBON R20 6.8K J
R26		5240029420	R.,CARBON R20 3.3K J
R27		△5184763000	R.,FILM 220 1W
R28		5240032220	R.,CARBON R20 47K J
R29		5240029420	R.,CARBON R20 3.3K J
R30		△5184763000	R.,FILM 220 1W
R31		△5184688000	R.,METAL 15 1W RNX1
R32		5240032220	R.,CARBON R20 47K J
R33		5240029020	R.,CARBON R10 2.2K
U1	U2	5220416400	IC,M5230L,
U3		△5220415100	IC,NJM7805A
U4		5220415600	IC,NJM7815A

FUSE PCB ASSY [J,US,C,GE] (PCB Omitted)

REF.NO.	PARTS NO.	DESCRIPTION
	*5200178200	FUSE PCB ASSY
	*5210178201	FUSE PCB
	*5041237000	HOLDER,FUSE PCB
F1 F2	⚠5307004100	FUSE,2A-250V UL
F3 F4	⚠5307004300	FUSE,3A-250V UL
F5	⚠5307004100	FUSE,2A-250V UL
F6	⚠5307004300	FUSE,3A-250V UL
F7 F8	⚠5307004700	FUSE,7A-125V UL
F9	⚠5307004900	FUSE 10A 125V UL T
F10	⚠5307004700	FUSE,7A-125V UL

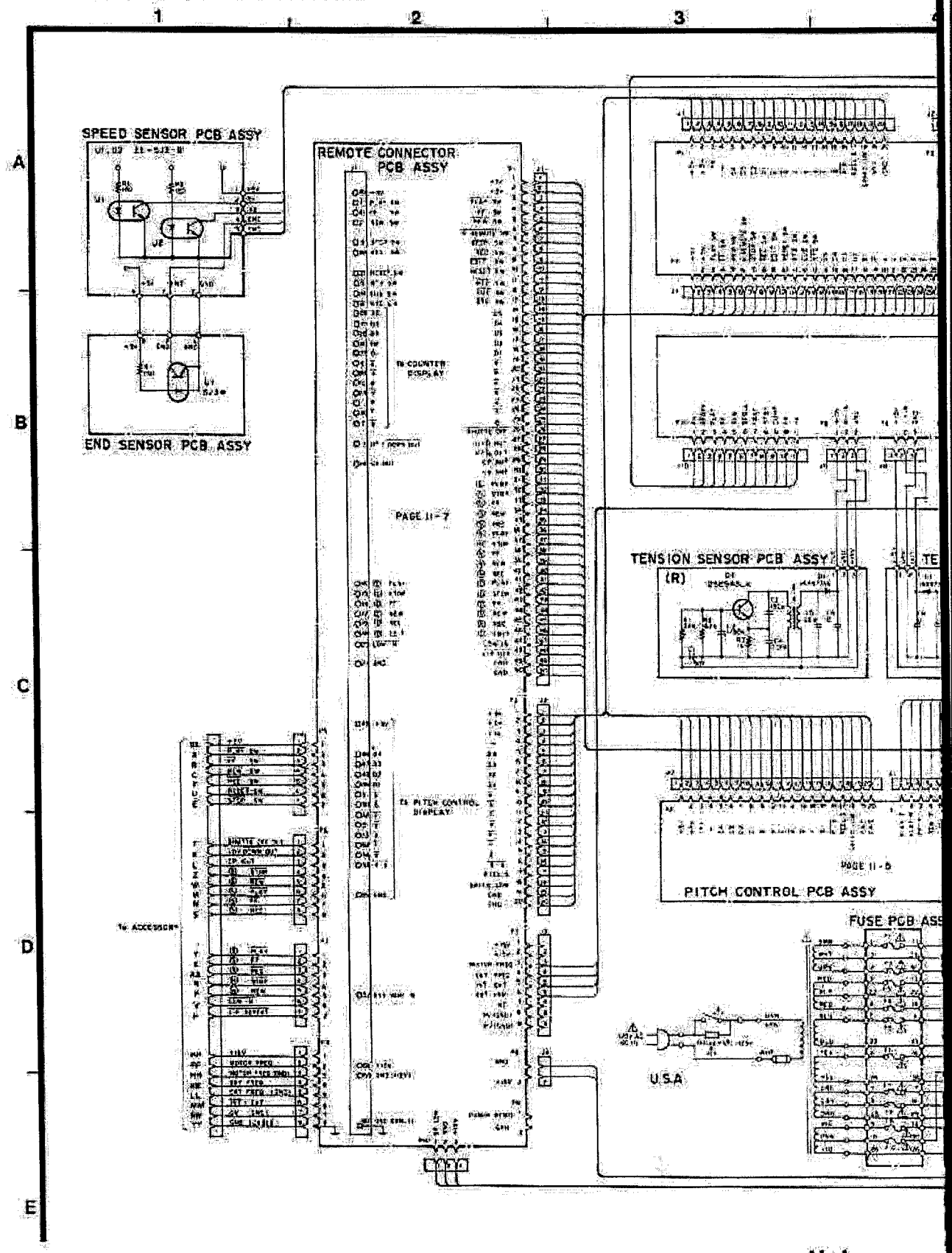
FUSE PCB ASSY [E,UK,A] (PCB Omitted)

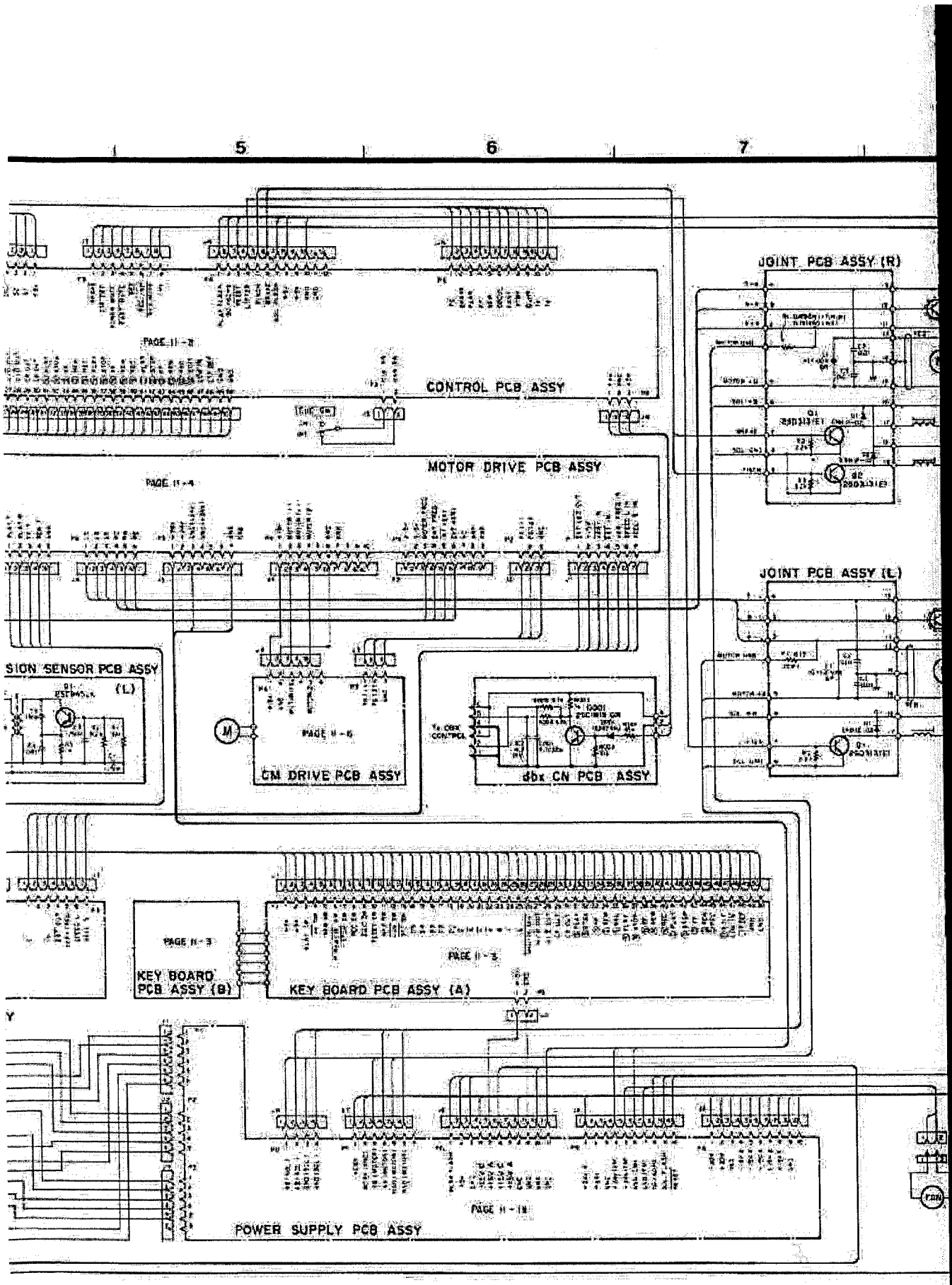
REF.NO.	PARTS NO.	DESCRIPTION
	*5200178300	FUSE PCB ASSY
	*5210178301	FUSE PCB
	*5332014200	HOLDER,FUSE
F1 F2	⚠5142188000	FUSE,1.6A-250V (T)
F3 F4	⚠5142190000	FUSE,2.5A-250V (T)
F5	⚠5142188000	FUSE,1.6A-250V (T)
F6	⚠5142190000	FUSE,2.5A-250V (T)
F7 F8	⚠5142193000	FUSE,5A-250V SLOW B.
F9	⚠5142194000	FUSE,6.3A-250V SLOW B
F10	⚠5142193000	FUSE,5A-250V SLOW B.

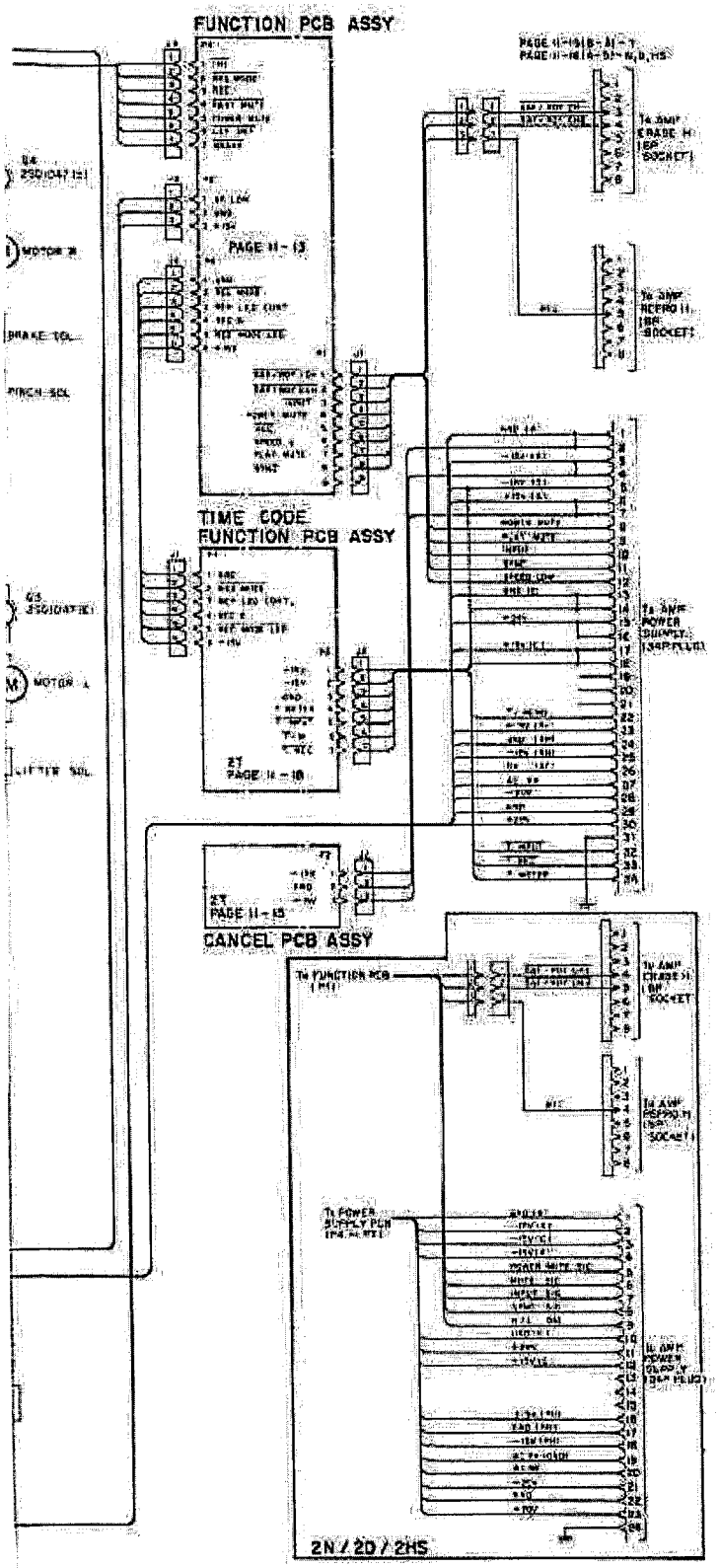
LIST OF SCHEMATICS

SECTION XI. SCHEMATICS

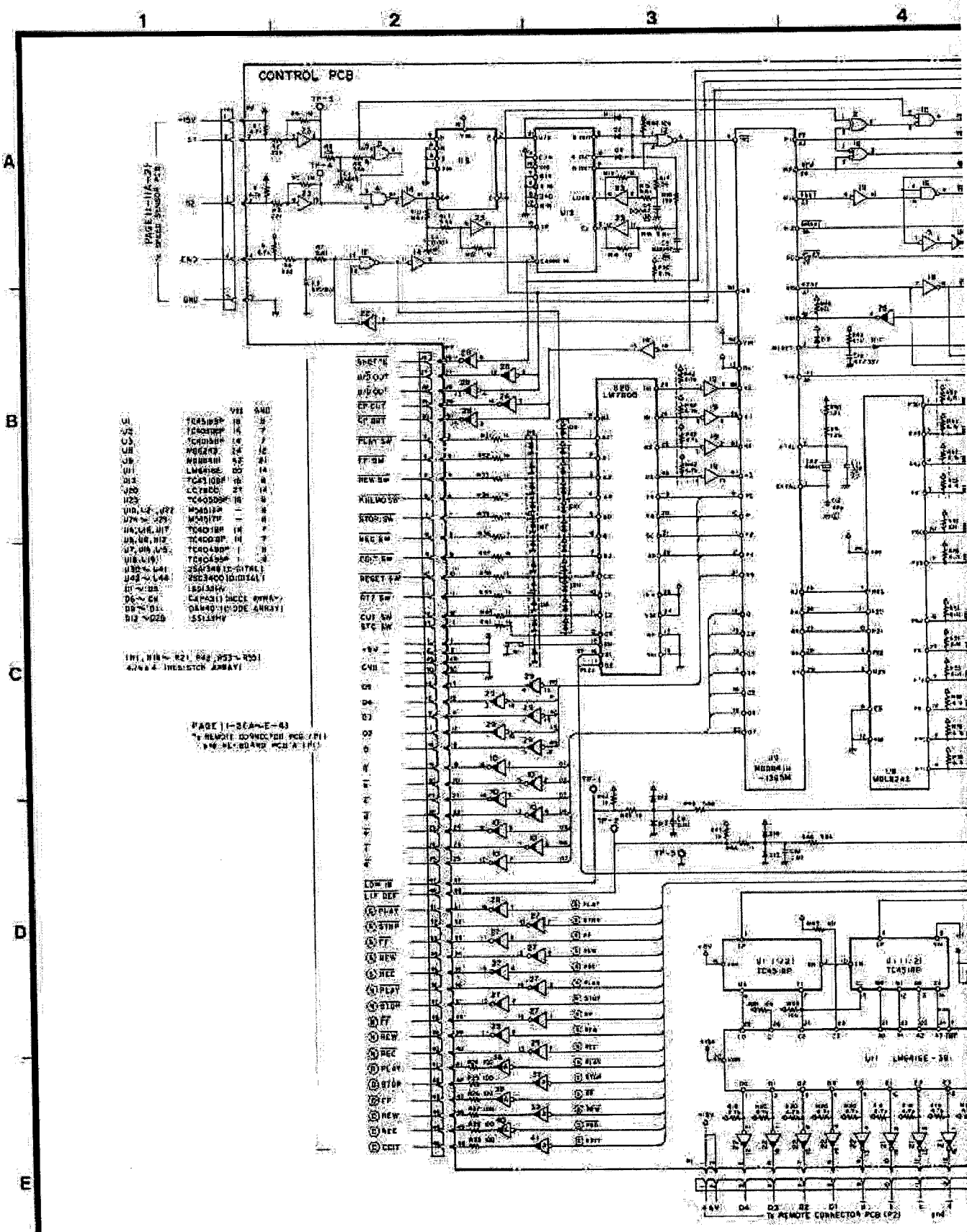
11-1. WIRING DIAGRAM (CONTROL)

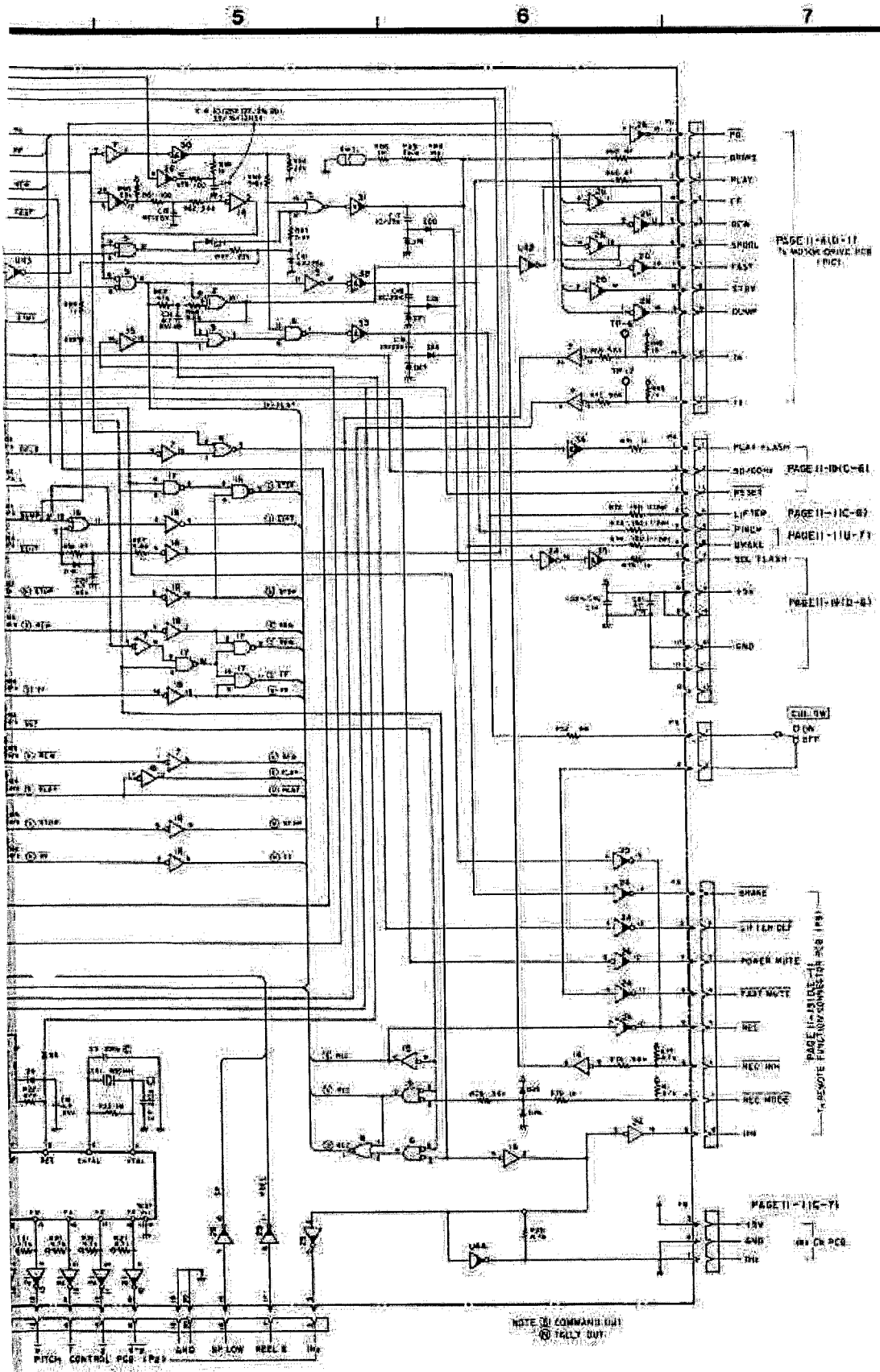



5
6
7
JOINT PCB ASSY (R)
CONTROL PCB ASSY
MOTOR DRIVE PCB ASSY
JOINT PCB ASSY (L)
SION SENSOR PCB ASSY
(L)
CM DRIVE PCB ASSY
dbx CN PCB ASSY
KEY BOARD
PCB ASSY (B)
KEY BOARD PCB ASSY (A)
POWER SUPPLY PCB ASSY

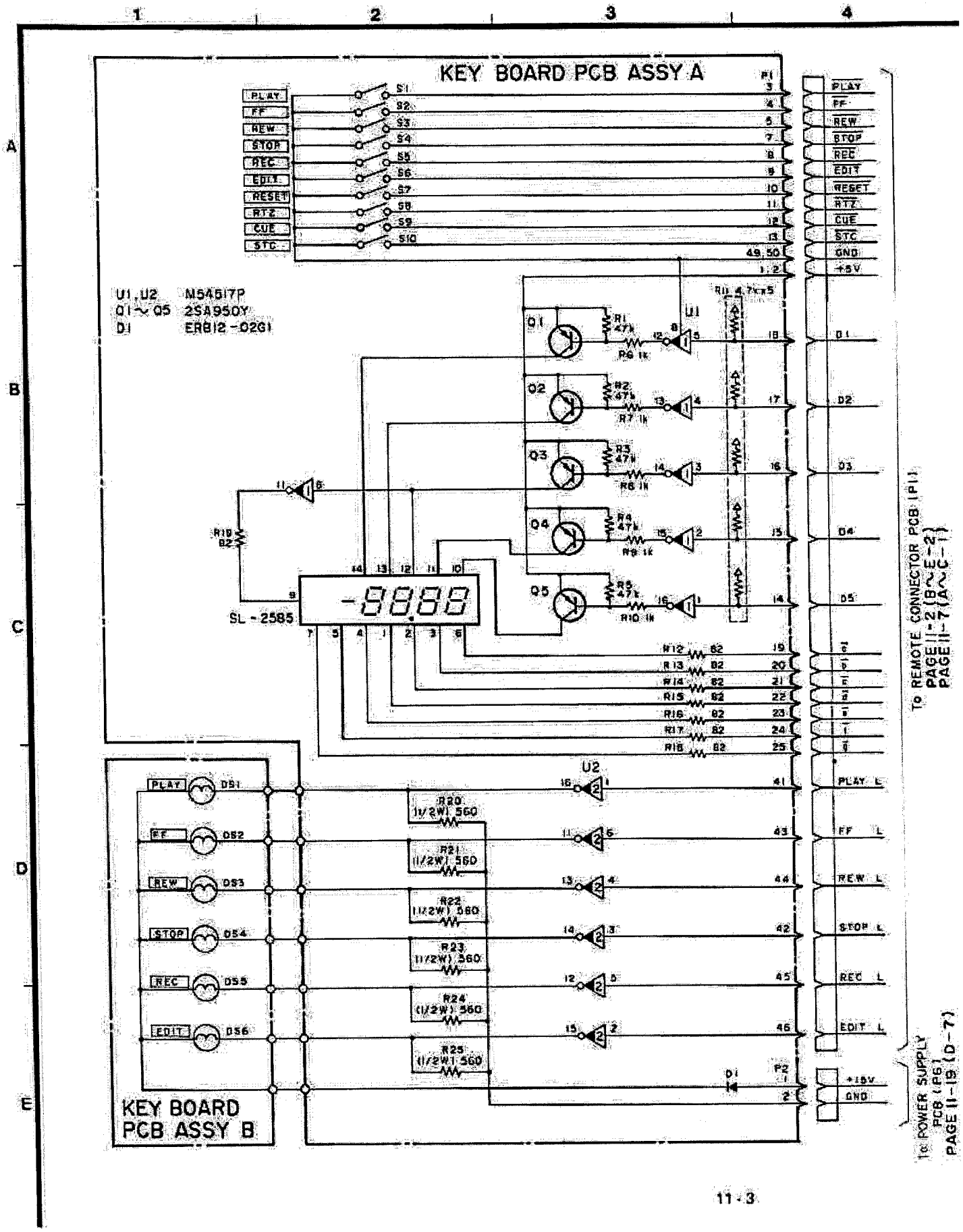

FUNCTION PCB ASSY
TIME CODE
FUNCTION PCB ASSY
CANCEL PCB ASSY
2N / 2D / 2HS

11-2. CONTROL PCB ASS'Y

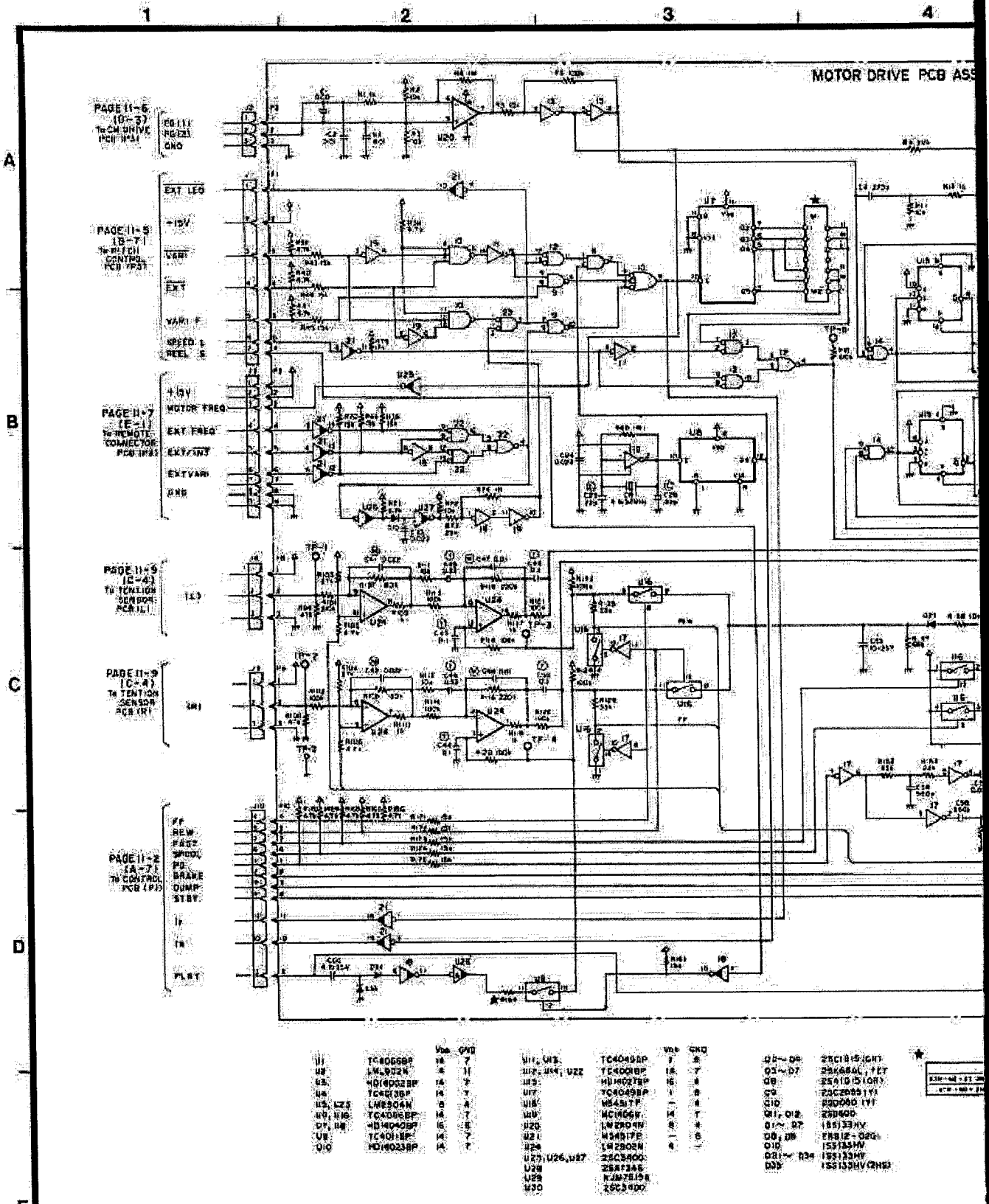



5
6
7
PG
DRIVE
PLAY
FF
REW
SPOOL
FLASH
STBY
DOWN
TP-6
TP-7
TP-8
PLAY FLASH
30/60Hz
PAGE II-1B(C-6)
RESET
LIFTER
PAGE II-1IC-6)
PINCH
BRAKE
PAGE II-1IU-7)
REC FLASH
+5V
PAGE II-1H(D-6)
GND
CAP. SW
ON
OFF
BRAKE
LIFTER OUT
POWER MUTE
FAST MUTE
REC
REC INH
REC MODE
INH
PAGE II-1IC-7)
+12V
GND
INH
PAGE II-1IS-7)
TO REMOTE FUNCTION CONNECTOR PCB
TO MOTOR DRIVE PCB
PITCH CONTROL PCB
GND
SP LOW
REEL K
INH
NOTE ① COMMAND OUT
② TALLY OUT

11-3. KEY BOARD PCB ASS'Y



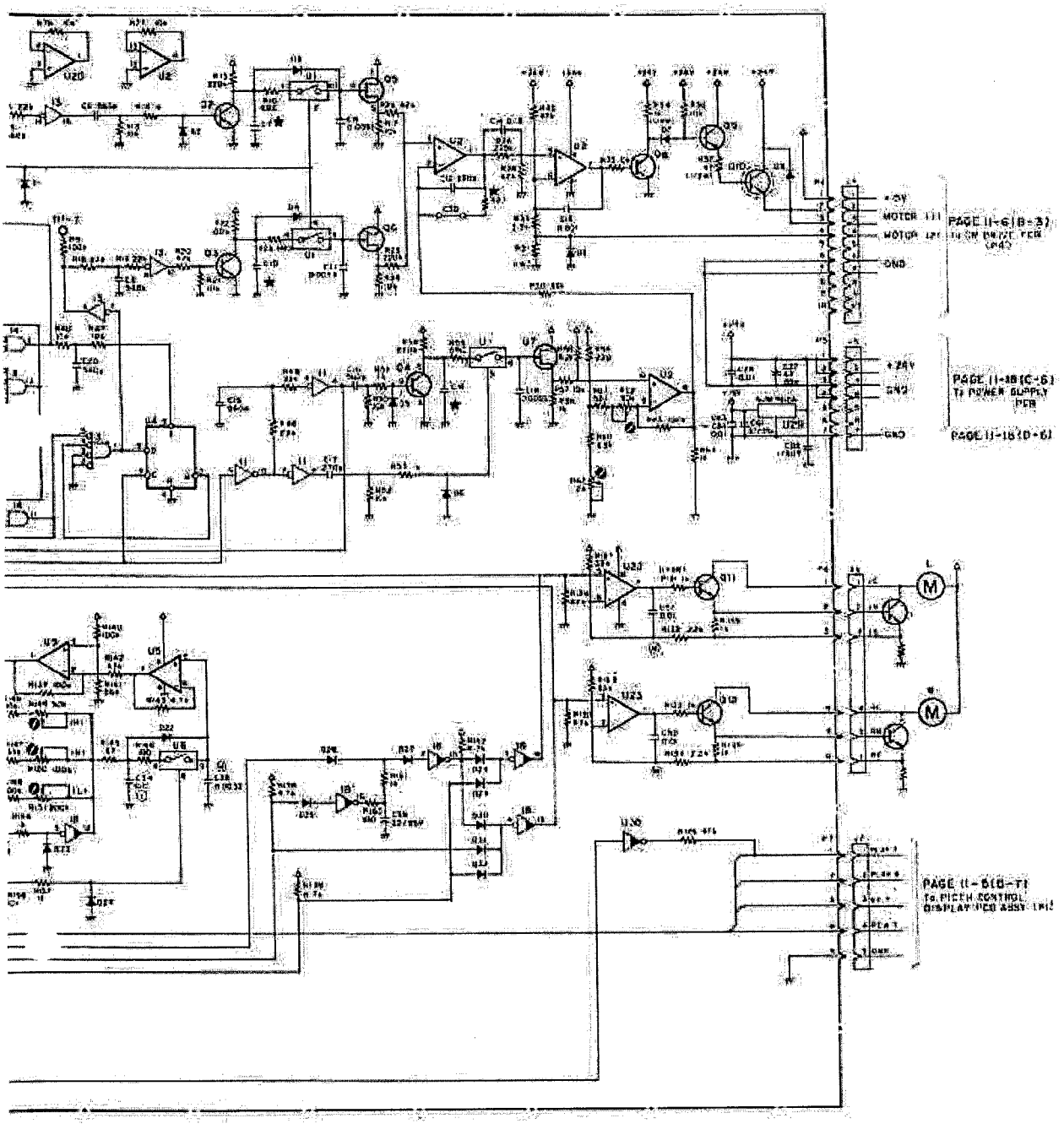
11-4. MOTOR DRIVE PCB ASS'Y

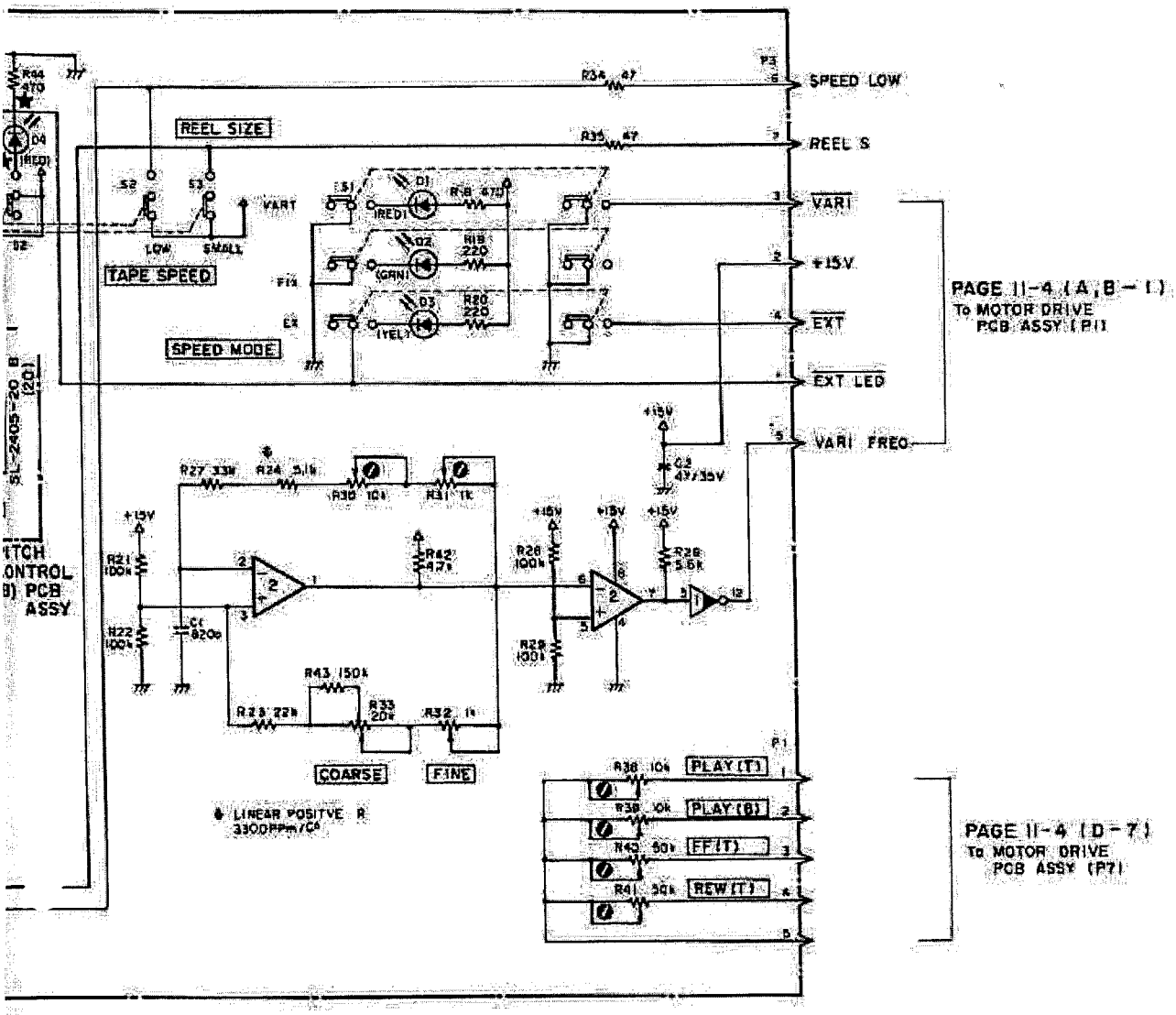


		Vdd	GND
U1	TC40G68P	16	7
U2	LML902N	4	11
U3	HD14002BP	14	7
U4	TC4013BP	14	7
U5, U23	LM2904N	8	4
U6, U16	TC4066BP	14	7
U7, U8	HD14040BP	16	8
U9	TC4011BP	14	7
U10	HD14023BP	14	7

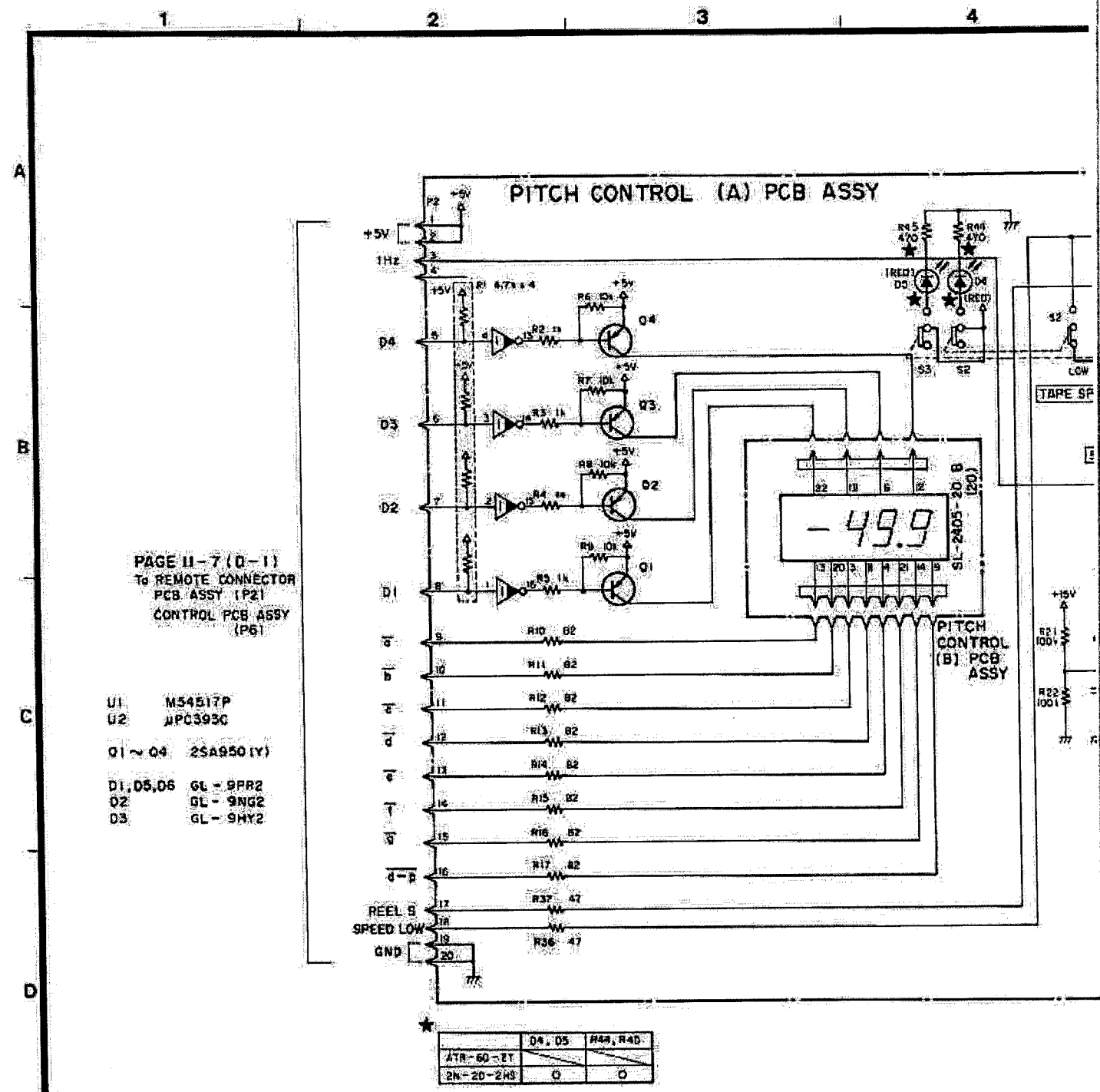
		Vdd	GND
U11, U13	TC4049BP	1	8
U12, U14, U22	TC4001BP	14	7
U15	HD14027BP	16	8
U17	TC4049BP	1	8
U18	M5451FP	—	8
U19	MC14066B	14	7
U20	LM2904N	8	4
U21	M5451FP	—	8
U24	LM2902N	4	—
U27, U26, U27	2SC3400		
U28	2SA1346		
U29	KIA78L05		
U30	2SC3400		

Q5 ~ Q6	2SC1815(GR)
Q3 ~ Q7	2SK68A(L), (YE)
Q8	2SA1015(GR)
Q9	2SC2655(Y)
Q10	2SD000 (Y)
Q11, Q12	2SB400
Q1 ~ Q2	1SS133HV
Q3, Q6	2SB12-02G
Q10	1SS133HV
Q31 ~ Q34	1SS133HV
Q35	1SS133HV(2HS)

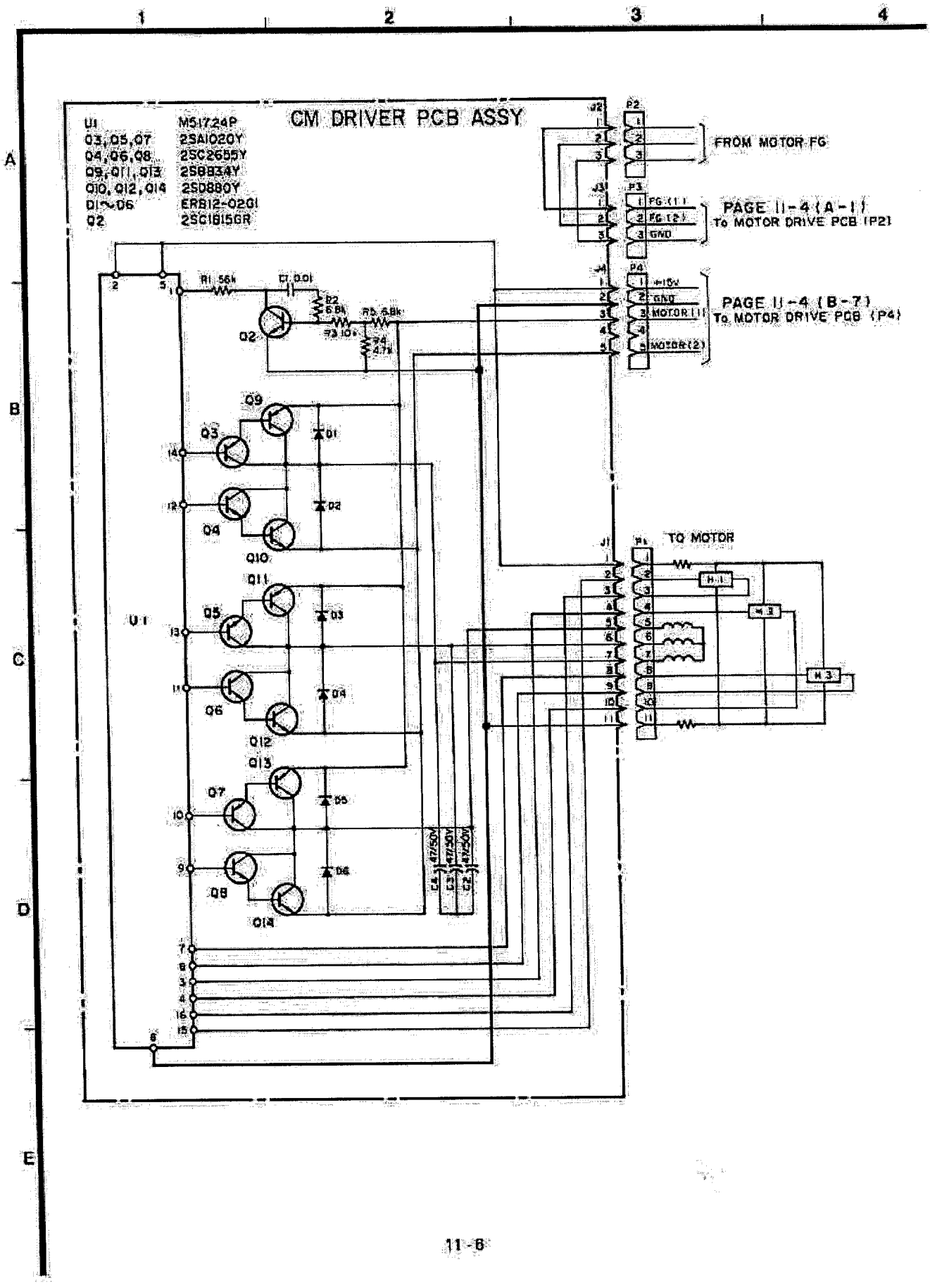

+5V
MOTOR
MOTOR
GND
PAGE II-6 (B-3)
+28V
GND
GND
PAGE II-18 (C-6)
PAGE II-18 (D-6)
PAGE II-6 (D-7)
M
M


SPEED LOW
REEL S
VARI
+15V
EXT
EXT LED
VARI FREQ
REEL SIZE
TAPE SPEED
SPEED MODE
COARSE
FINE
PLAY (T)
PLAY (B)
FF (T)
REW (T)
PAGE II-4 (A, B - 1)
To MOTOR DRIVE PCB ASSY (P1)
PAGE II-4 (D - 7)
To MOTOR DRIVE PCB ASSY (P7)
LINEAR POSITVE R
3300PPm/C°

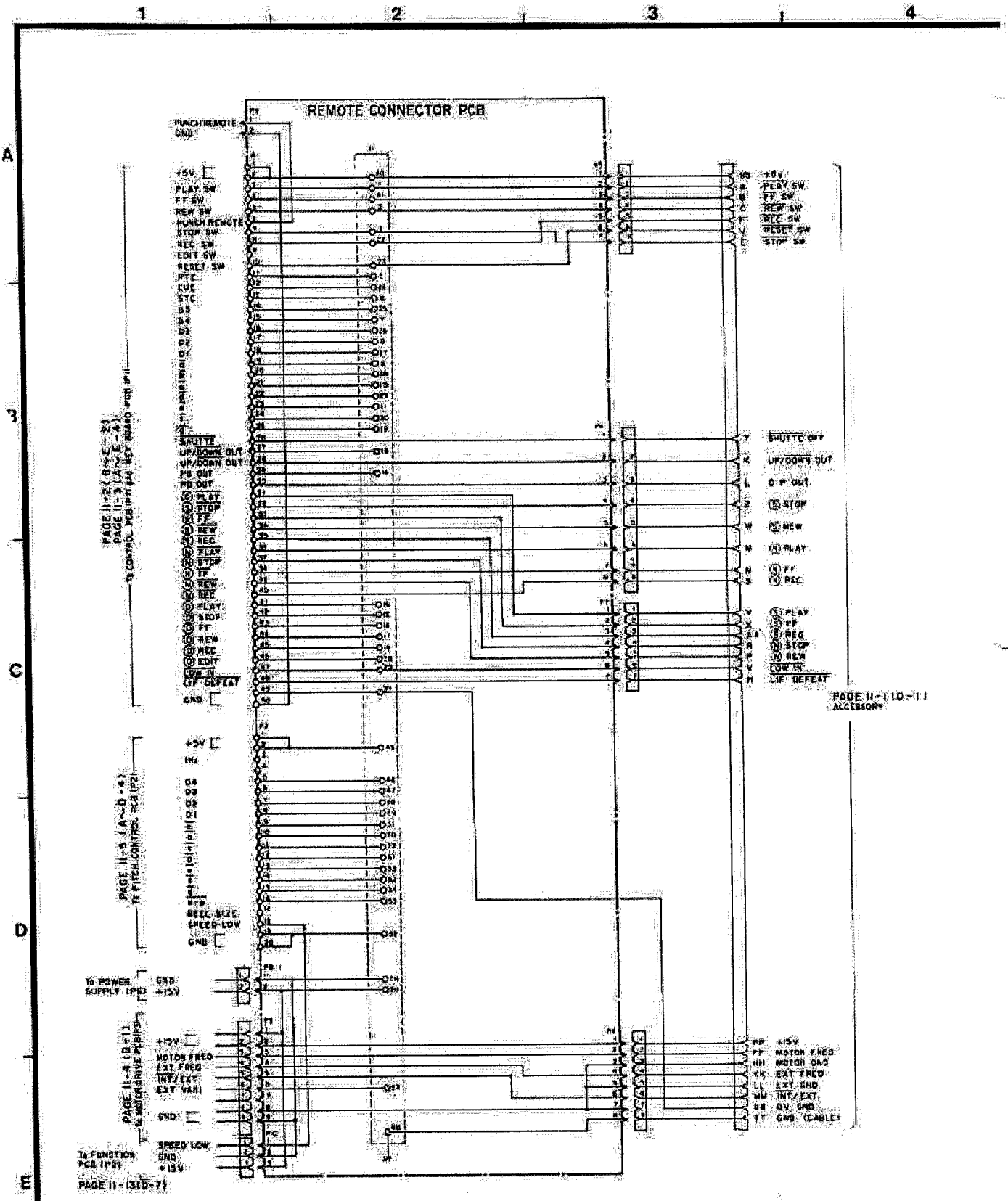
11-5. PITCH CONTROL A PCB ASS'Y AND PITCH CONTROL B PCB ASS'Y



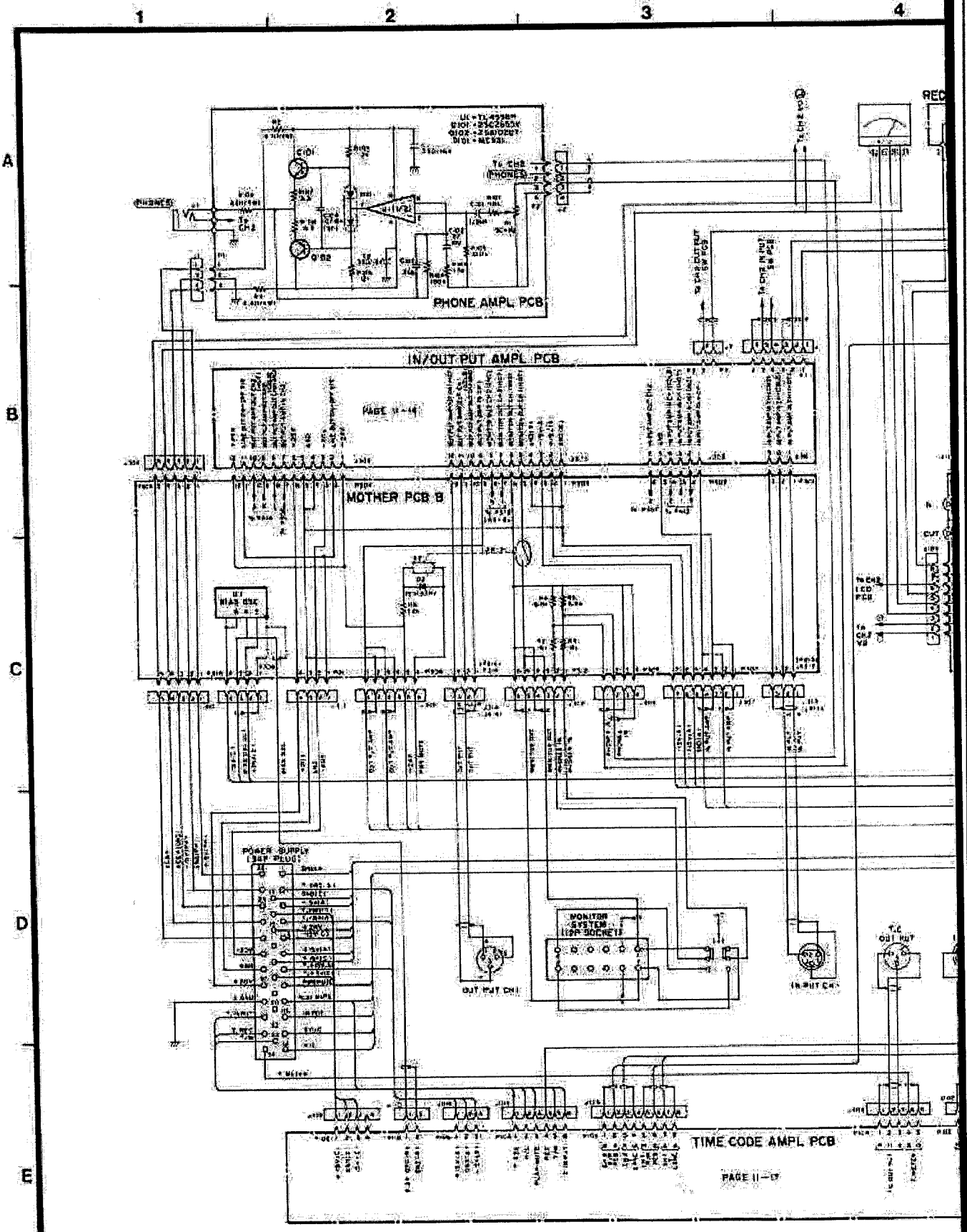
11-6. CAPSTAN MOTOR DRIVE PCB ASS'Y

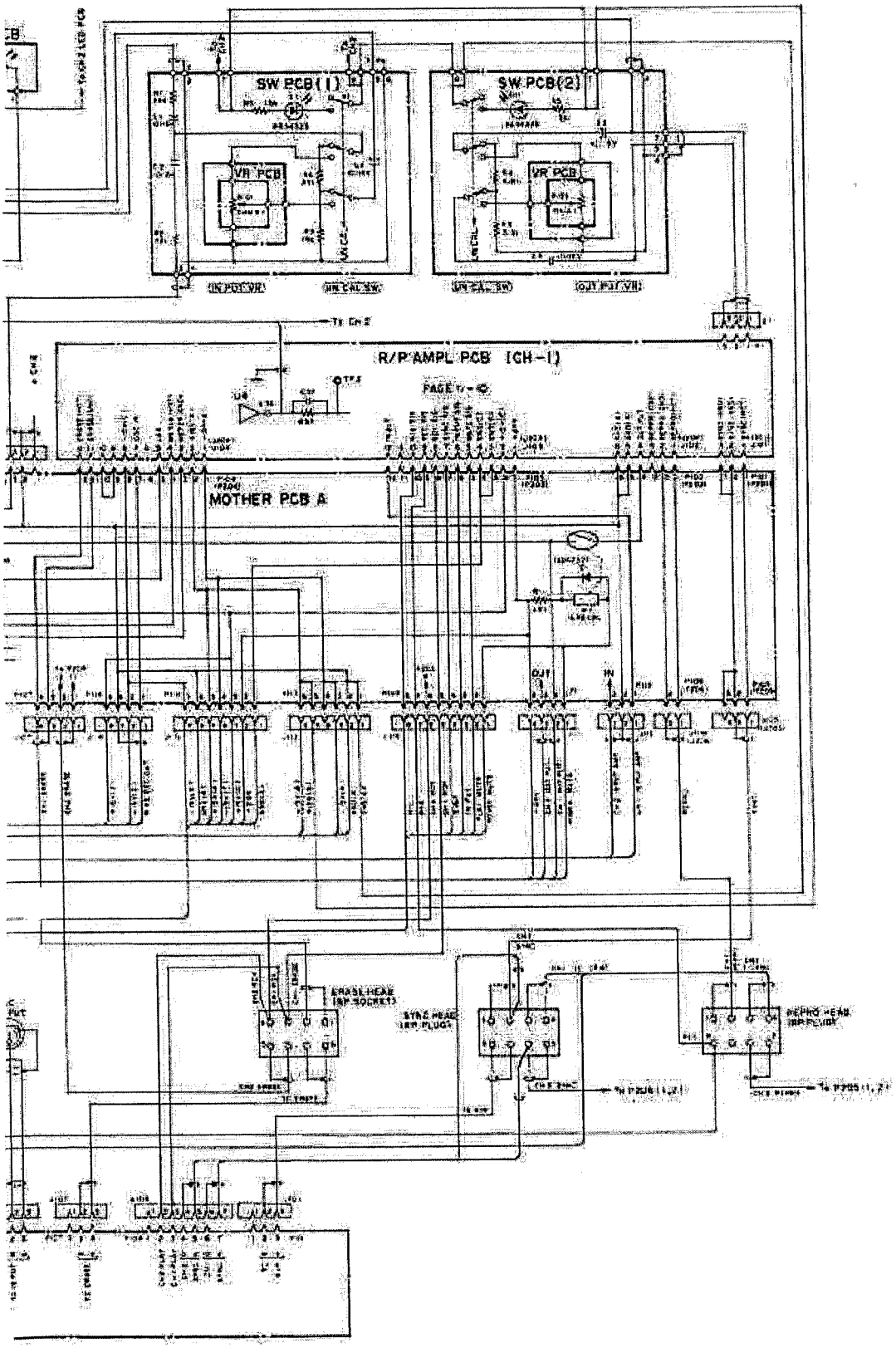


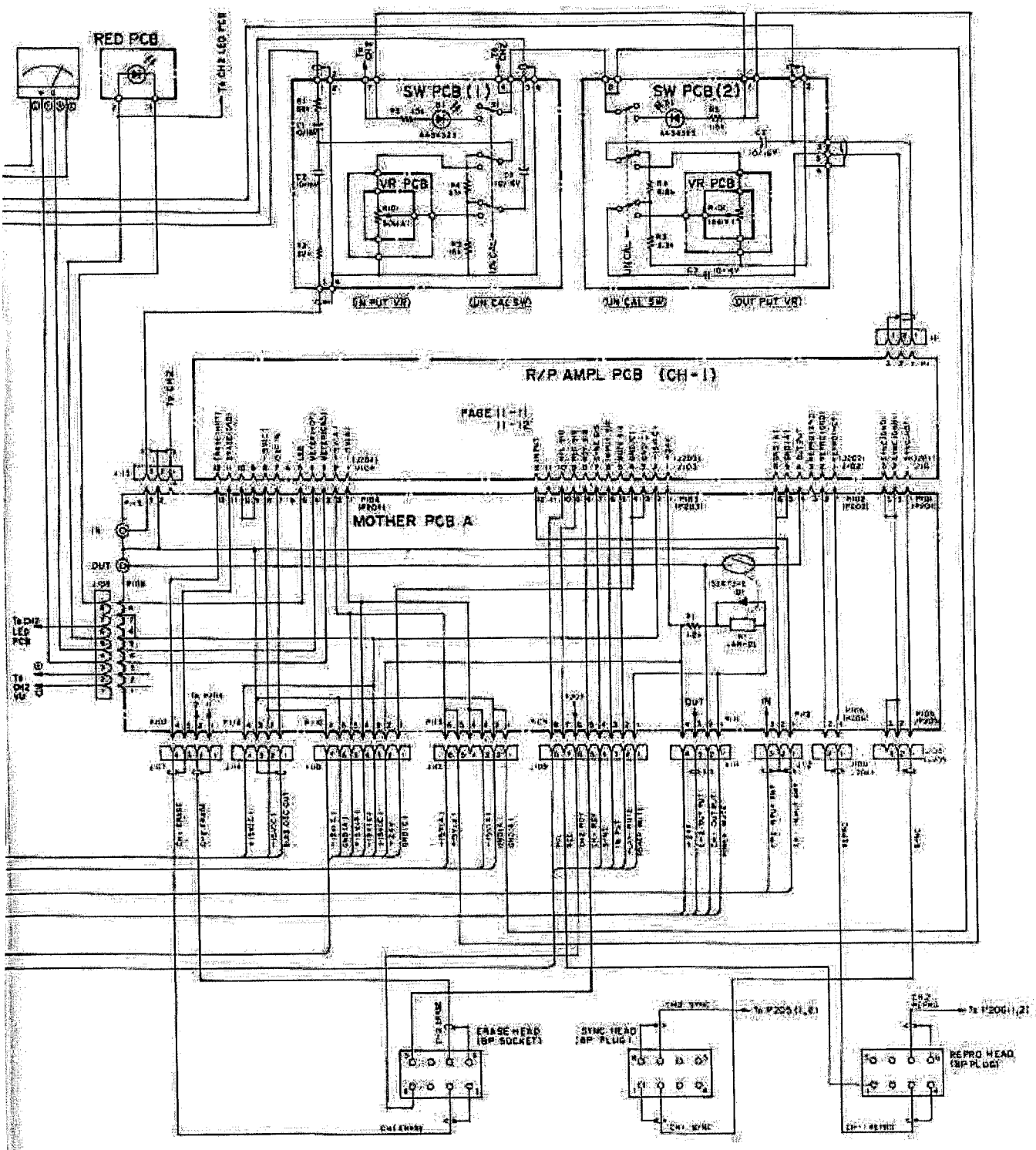
11-7. REMOTE CONTROL PCB ASS'Y



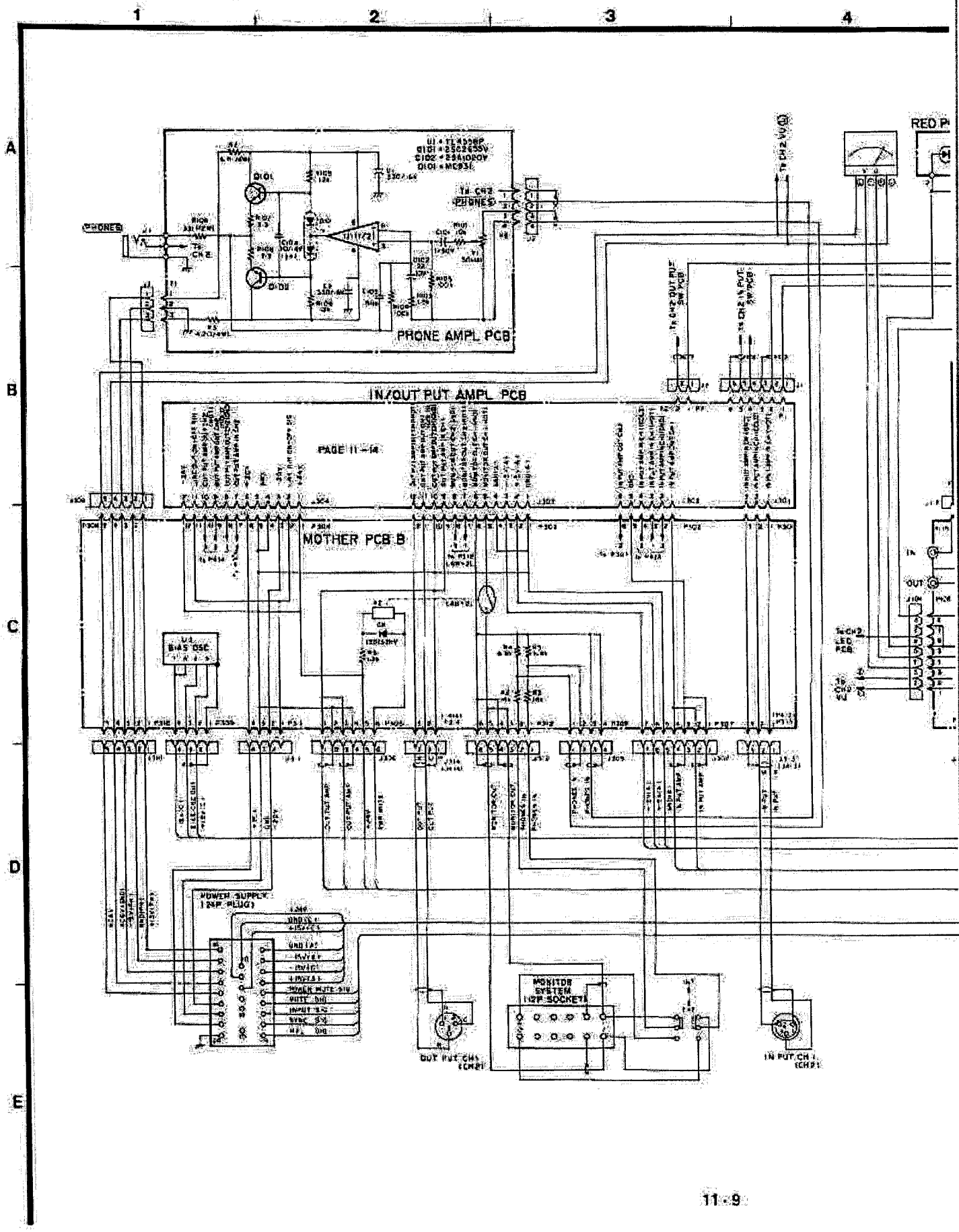
11-8. WIRING DIAGRAM (AMPLIFIER) (ATR-60-2T)



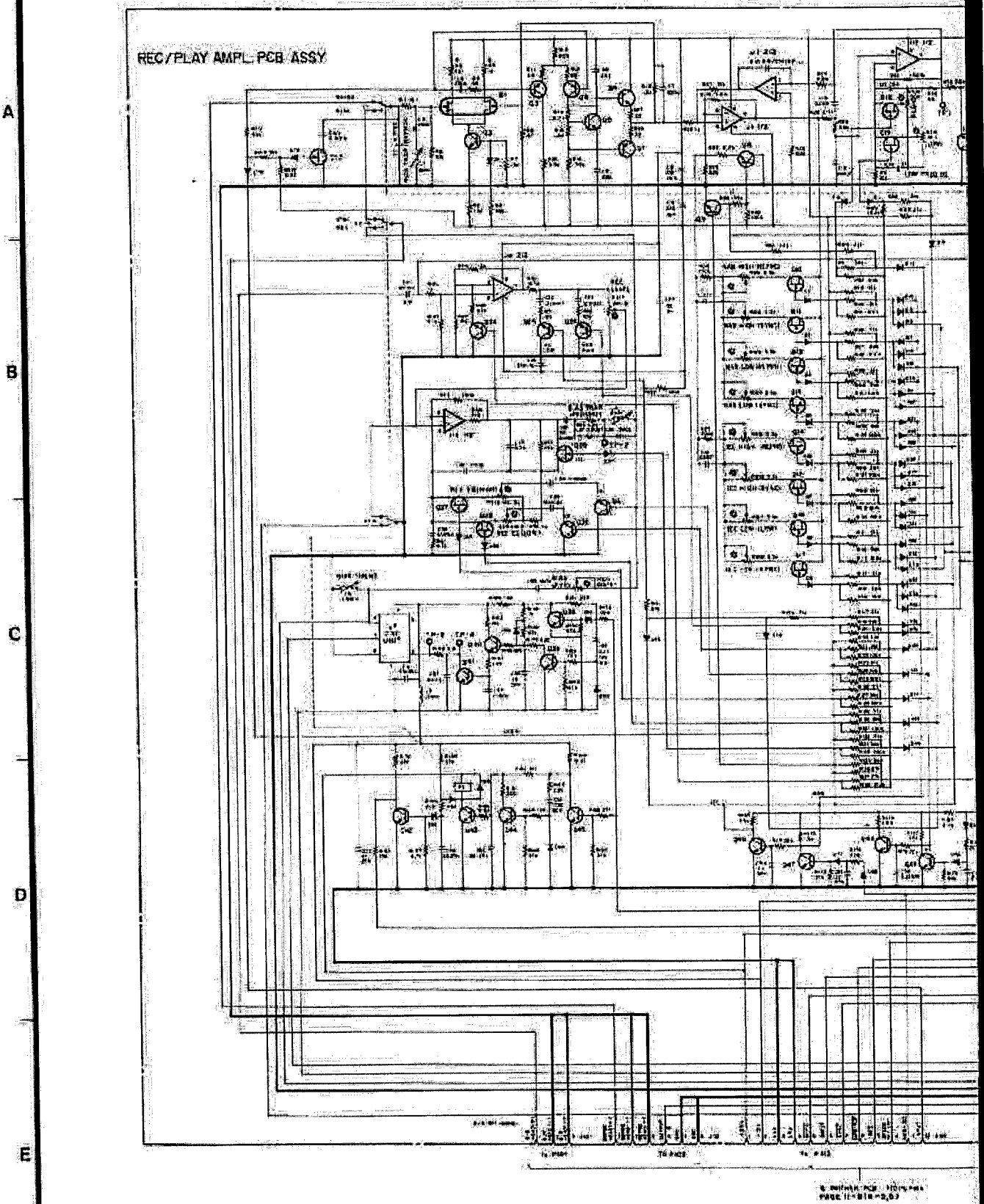

SW PCB(1)
SW PCB(2)
VR PCB
VR PCB
R/P AMPL PCB (CH-1)
MOTHER PCB A

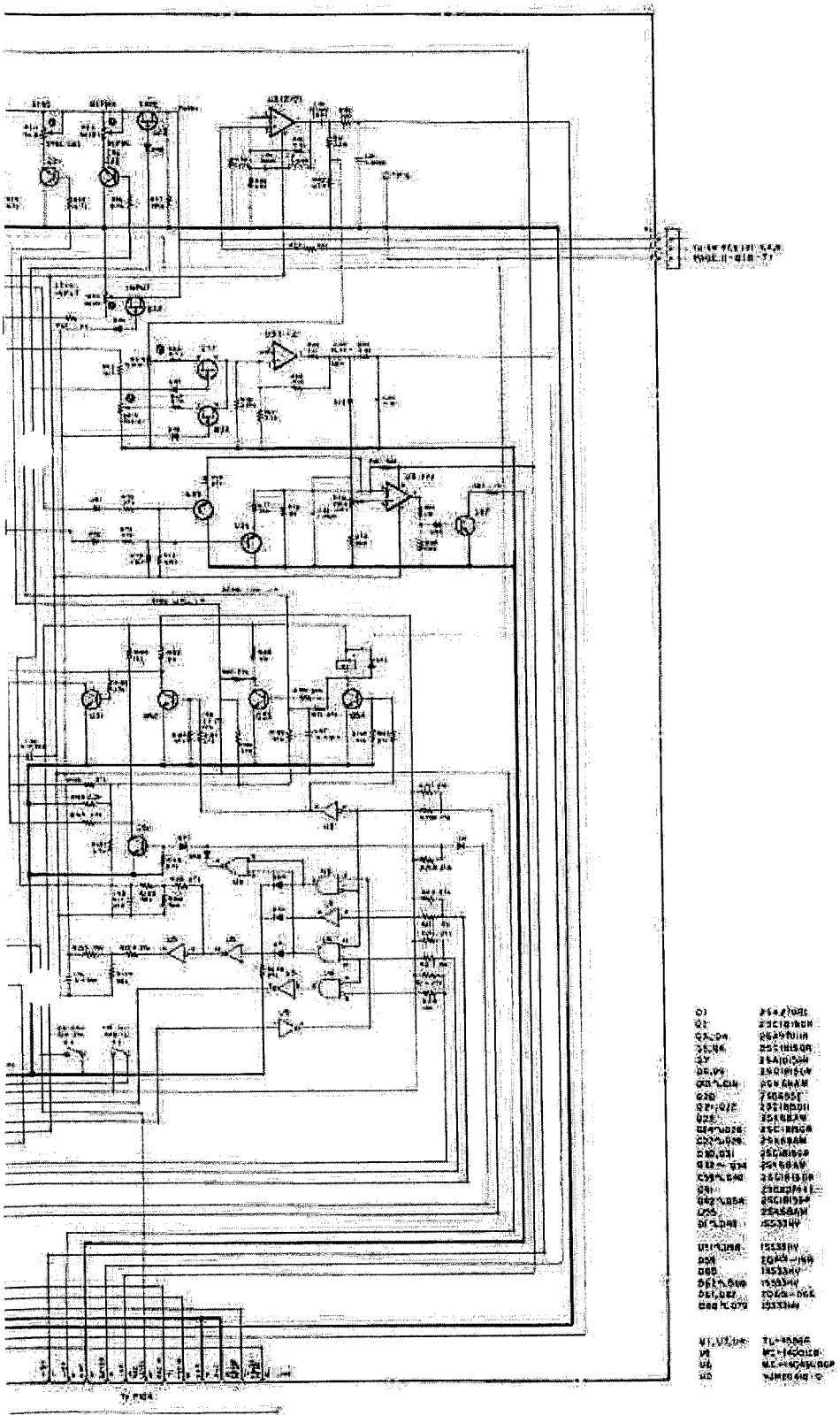

RED PCB
SW PCB (1)
SW PCB (2)
VR PCB
VR PCB
R/P AMPL PCB (CH-1)
MOTHER PCB A
ERASE HEAD (8P SOCKET)
SYNC HEAD (8P PLUG)
REPRO HEAD (8P PLUG)

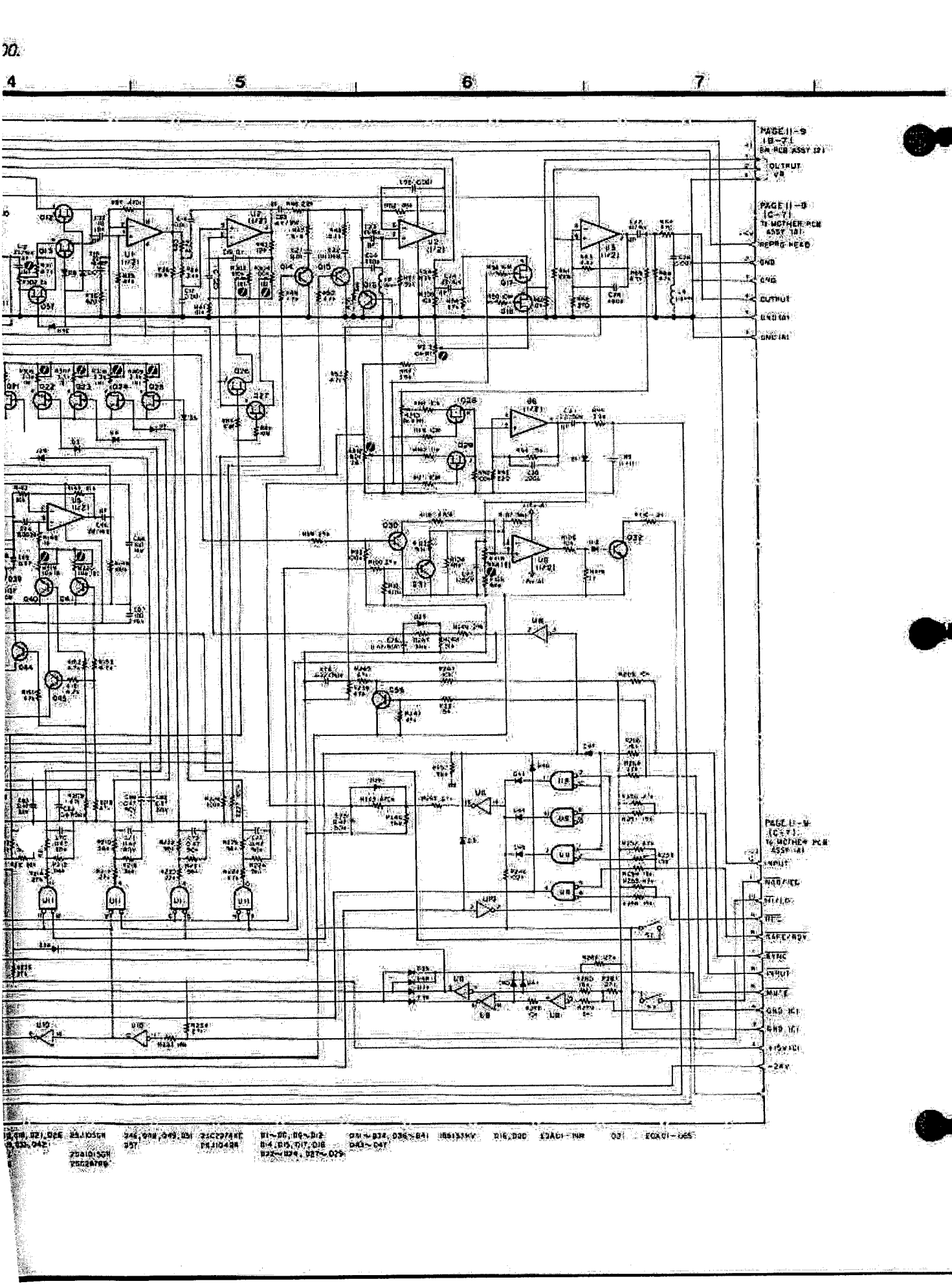
11-9. WIRING DIAGRAM (AMPLIFIER) (ATR-60-2N, -2D, AND -2HS)



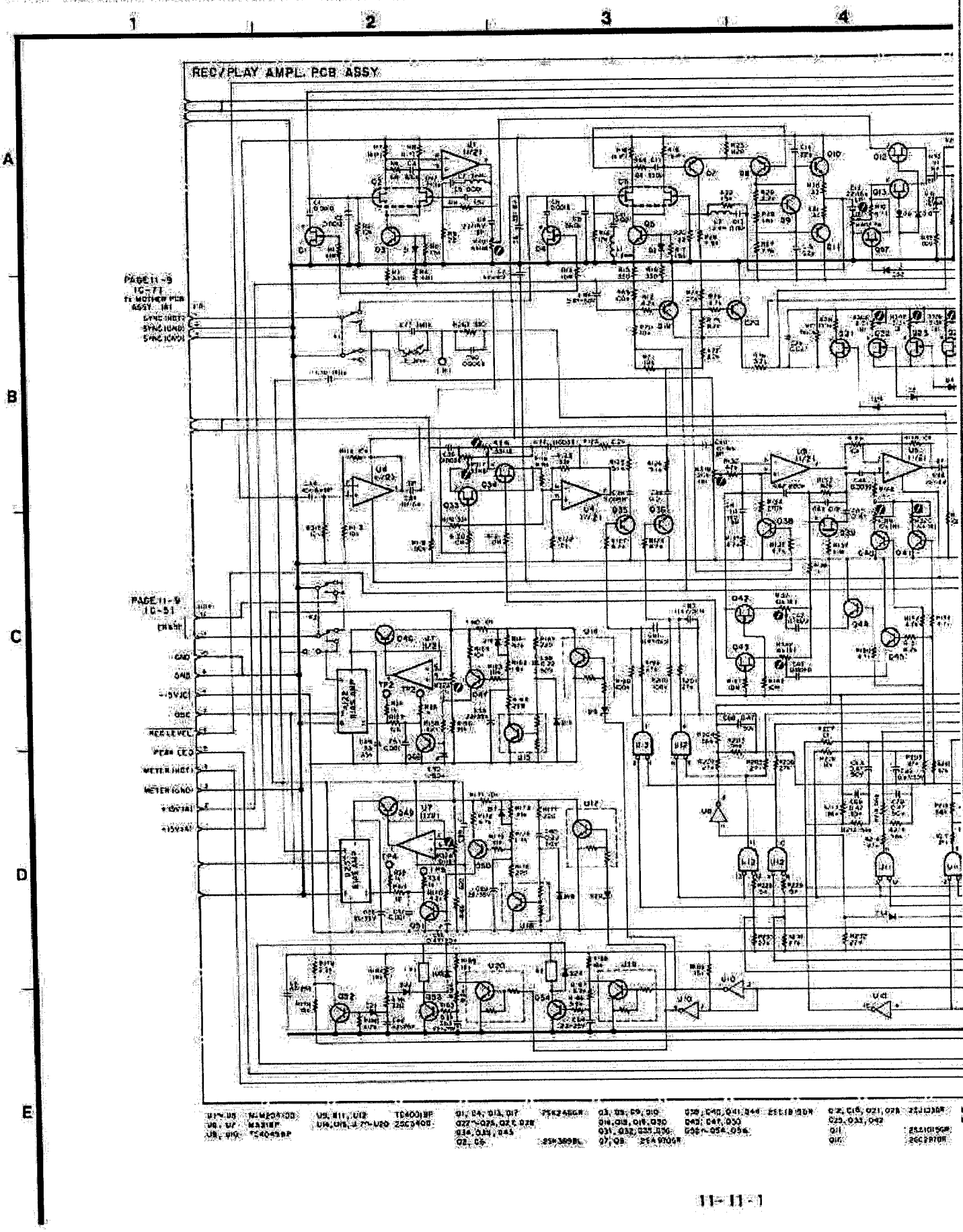
11-10. REC/PLAY AMPL. PCB ASS'Y (ATR-602T)



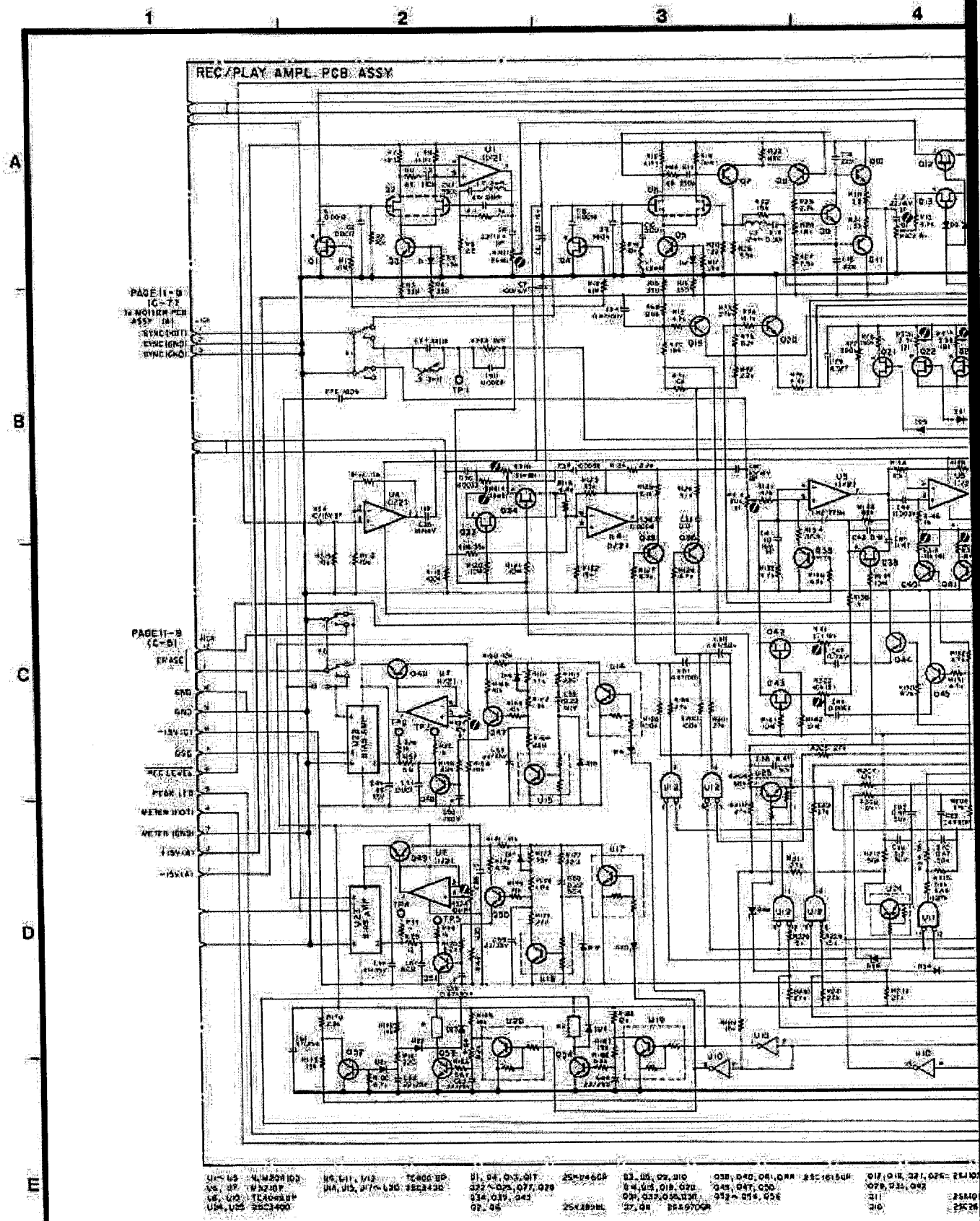


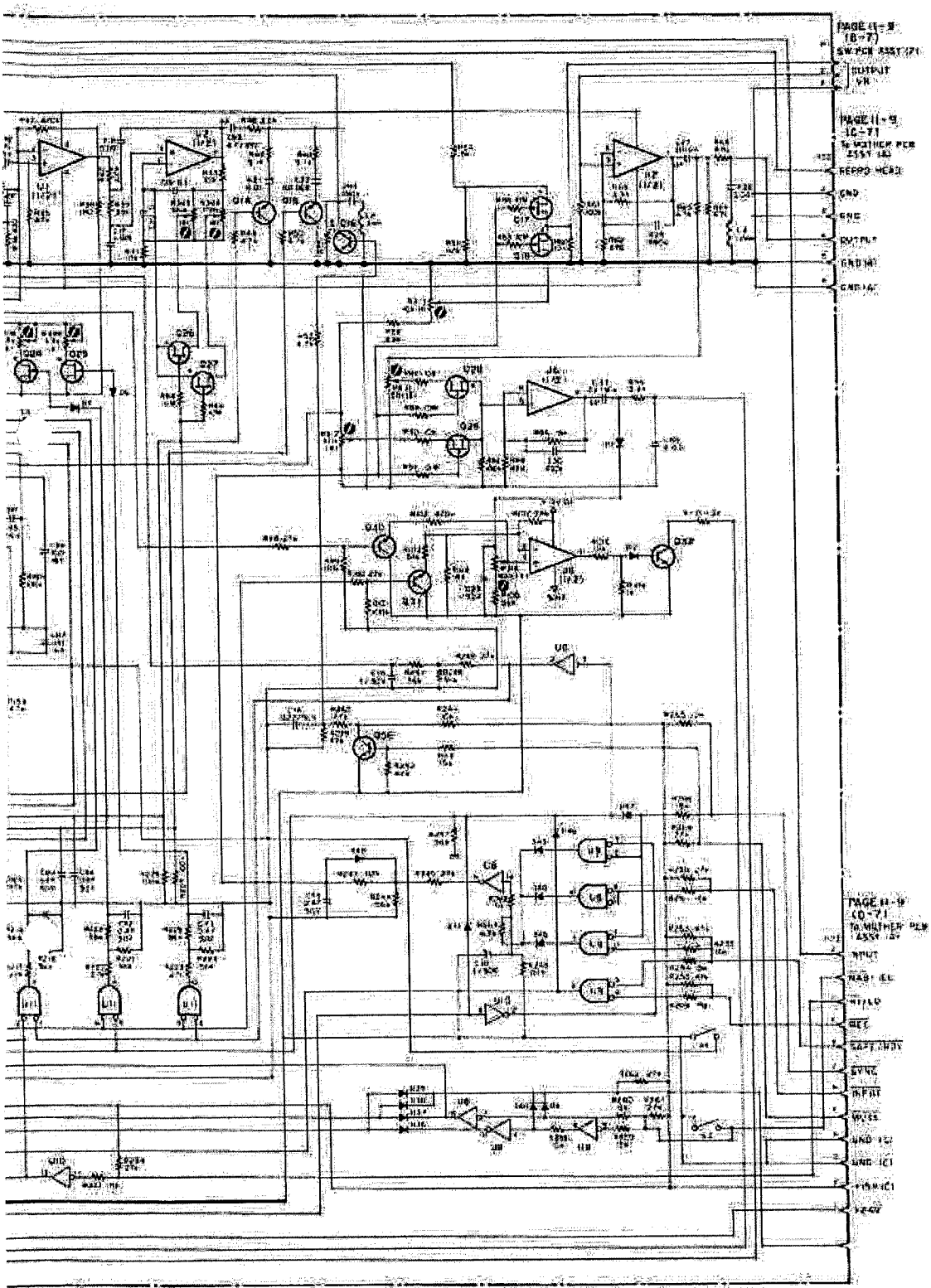

4
5
6
7
PAGE II-9 (B-7)
PAGE II-8 (C-7)
PAGE II-10 (C-7)

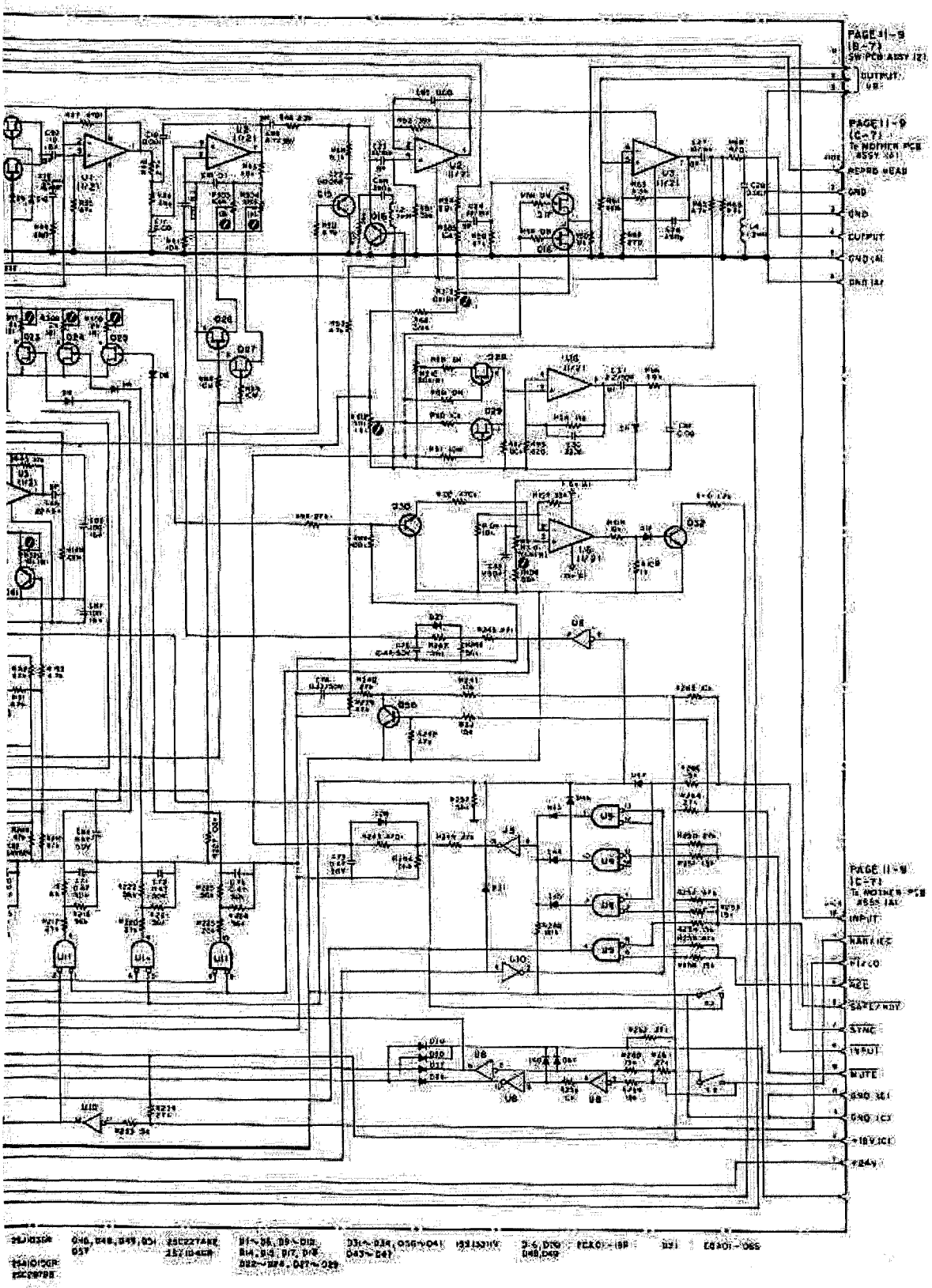
11-11. REC/PLAY AMPL. PCB ASS'Y (ATR-60-2N AND -2D) *Ass'y using PCB part No. 5210185800.*



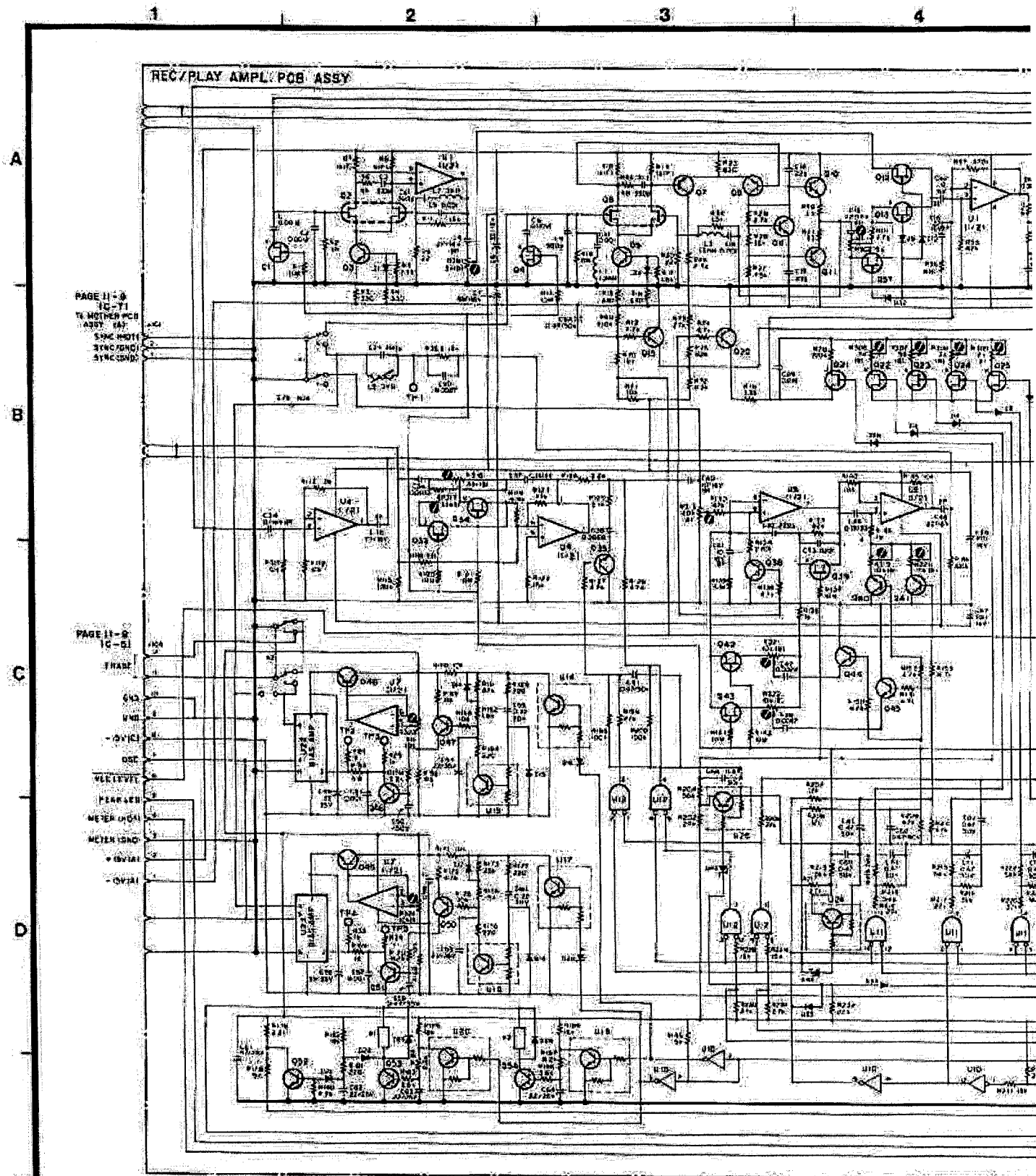
Ass'y using PCB part No. 5210185801.



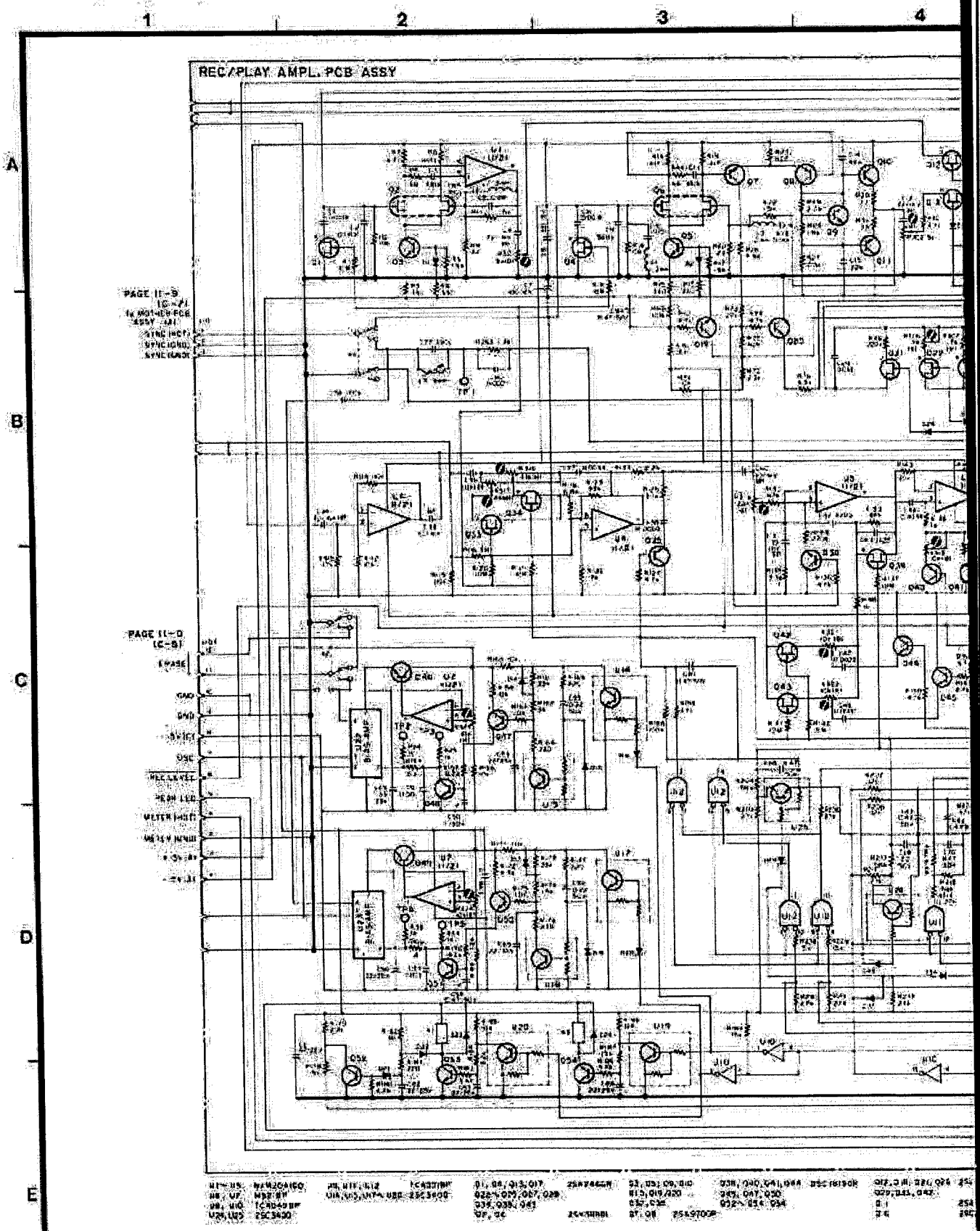

PAGE II-9
(B-7)
OUTPUT
PAGE II-9
(C-7)
PAGE II-9
(D-7)

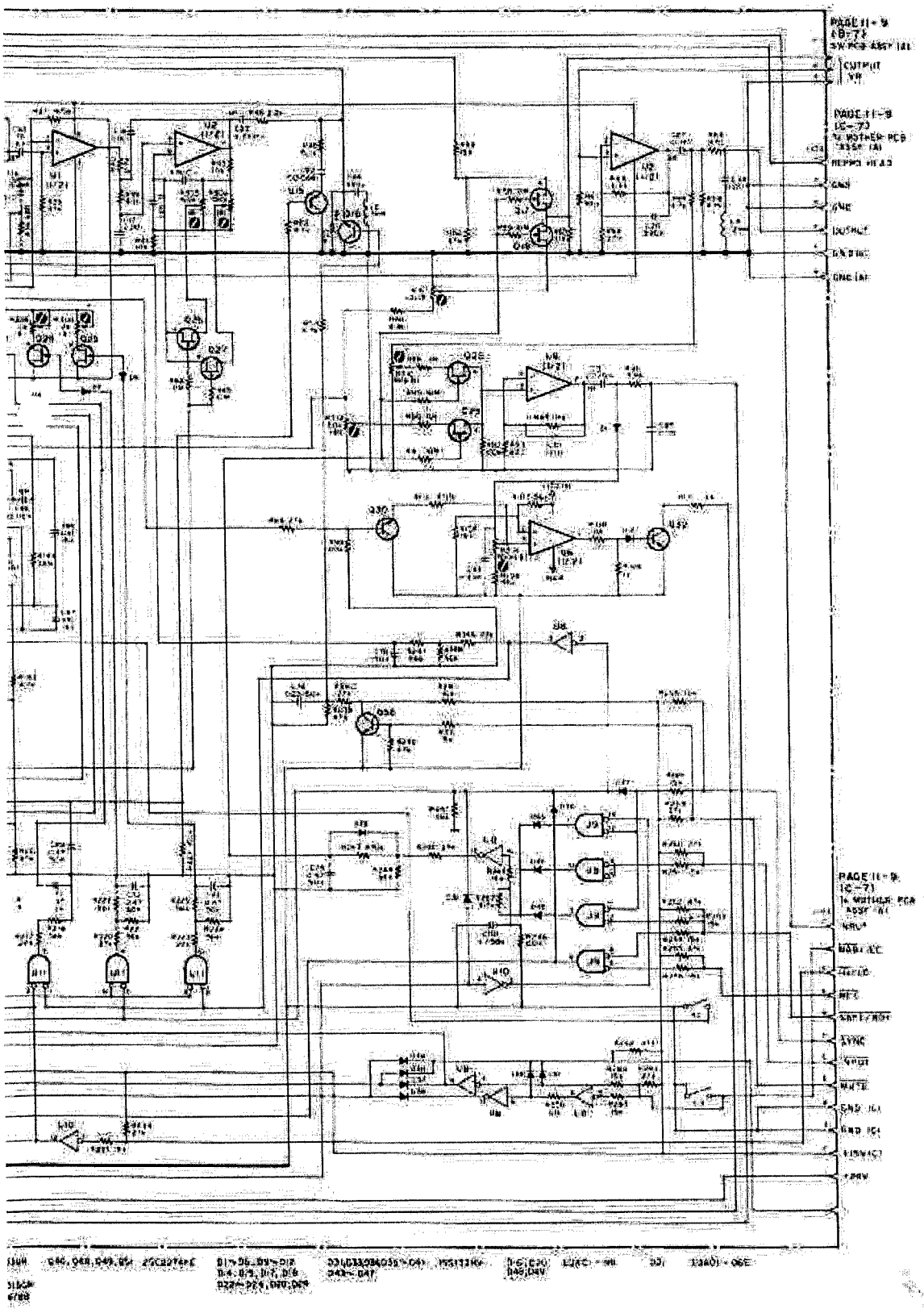

PAGE 11-9 (B-7) SW PCB ASSY (2)
OUTPUT
PAGE 11-9 (C-7) TO MOTHER PCB ASSY (6)
GND
GND
OUTPUT
PAGE 11-9 (C-7) TO MOTHER PCB ASSY (6)
INPUT
SYNC
INPUT
MUTE
+18V (C)
+24V

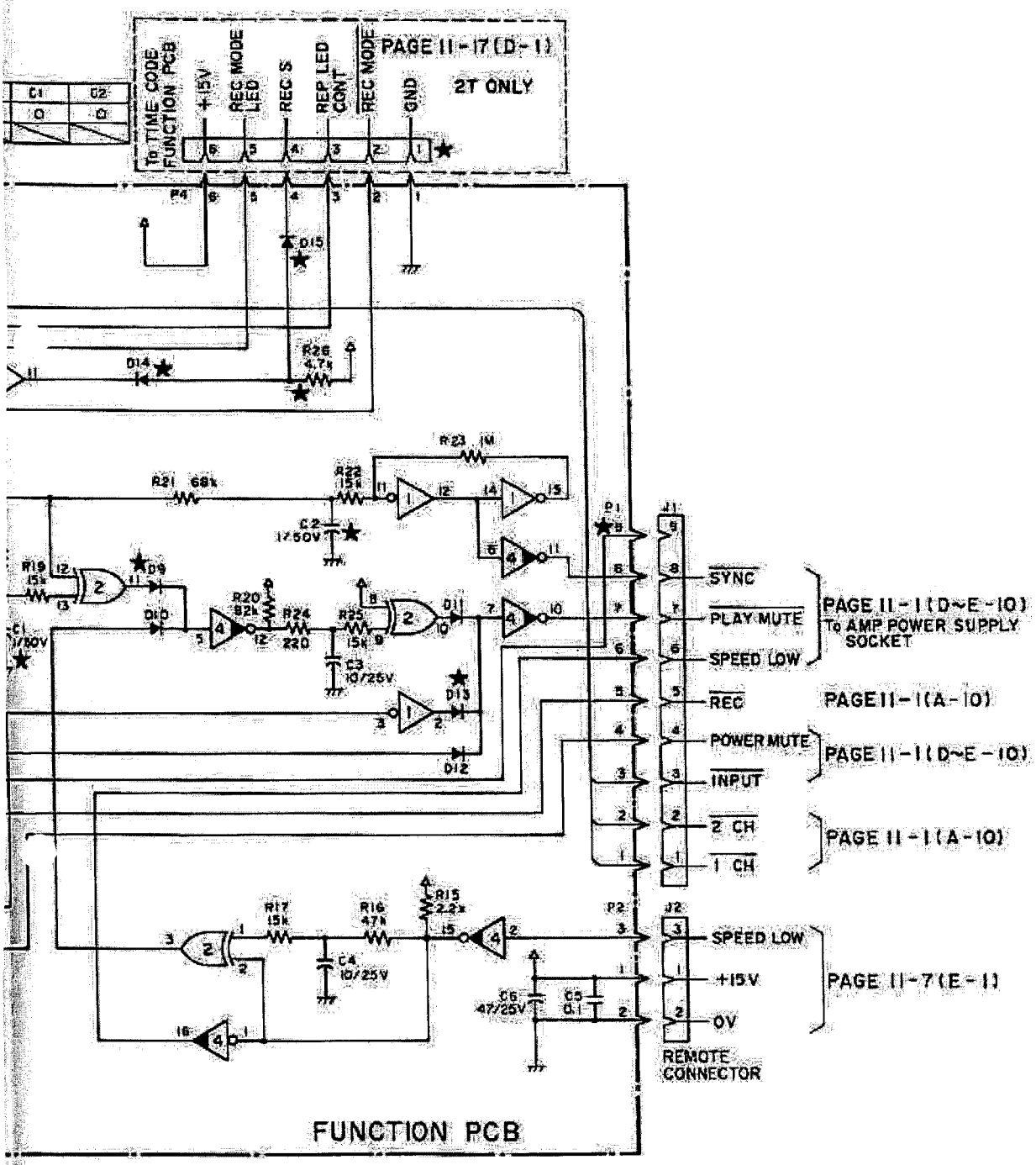
11-12. REC/PLAY AMPL. PCB ASS'Y (ATR-60-2HS) *Ass'y using PCB part No. 6210185800.*



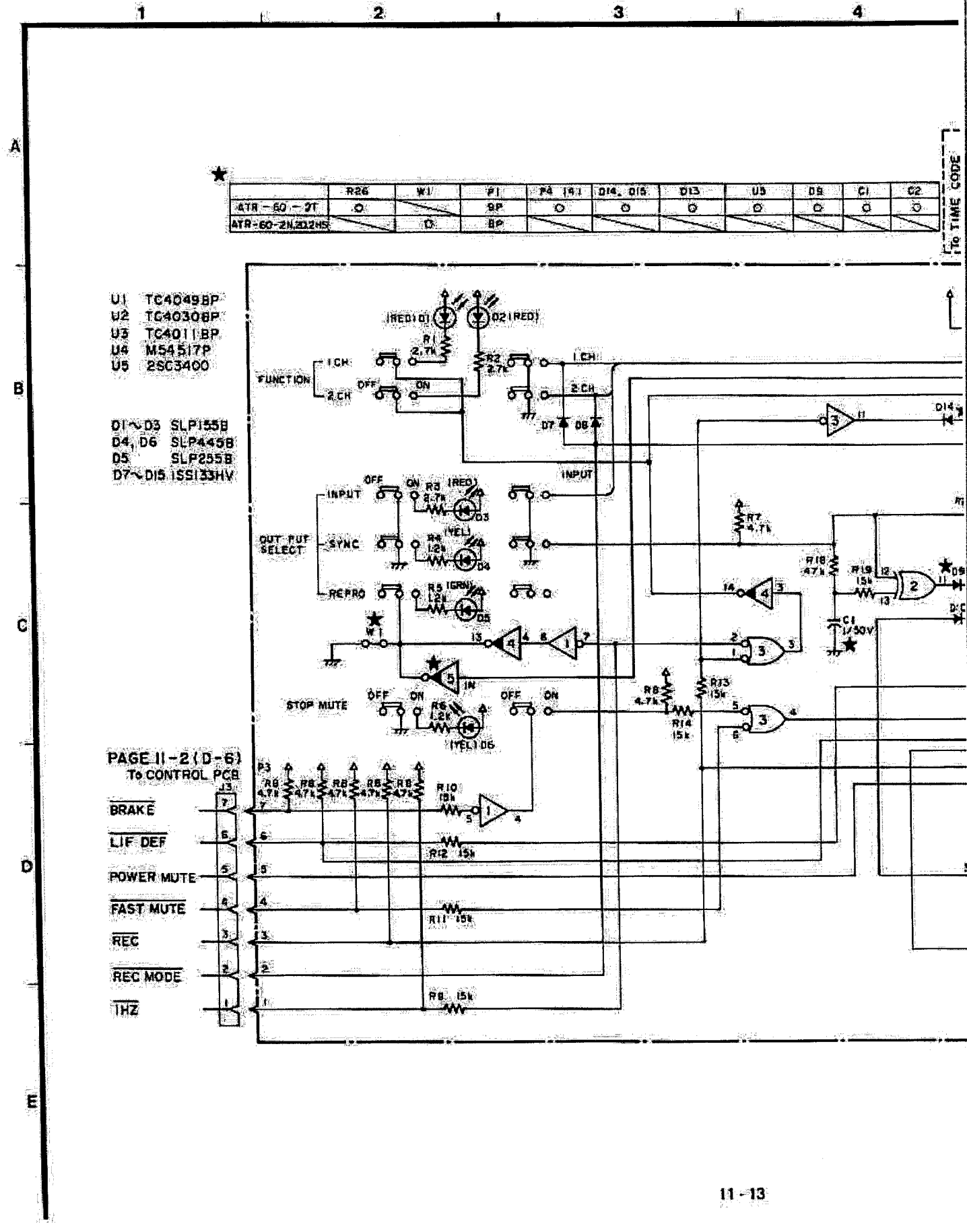
Ass'y using PCB part No. 5210185801.





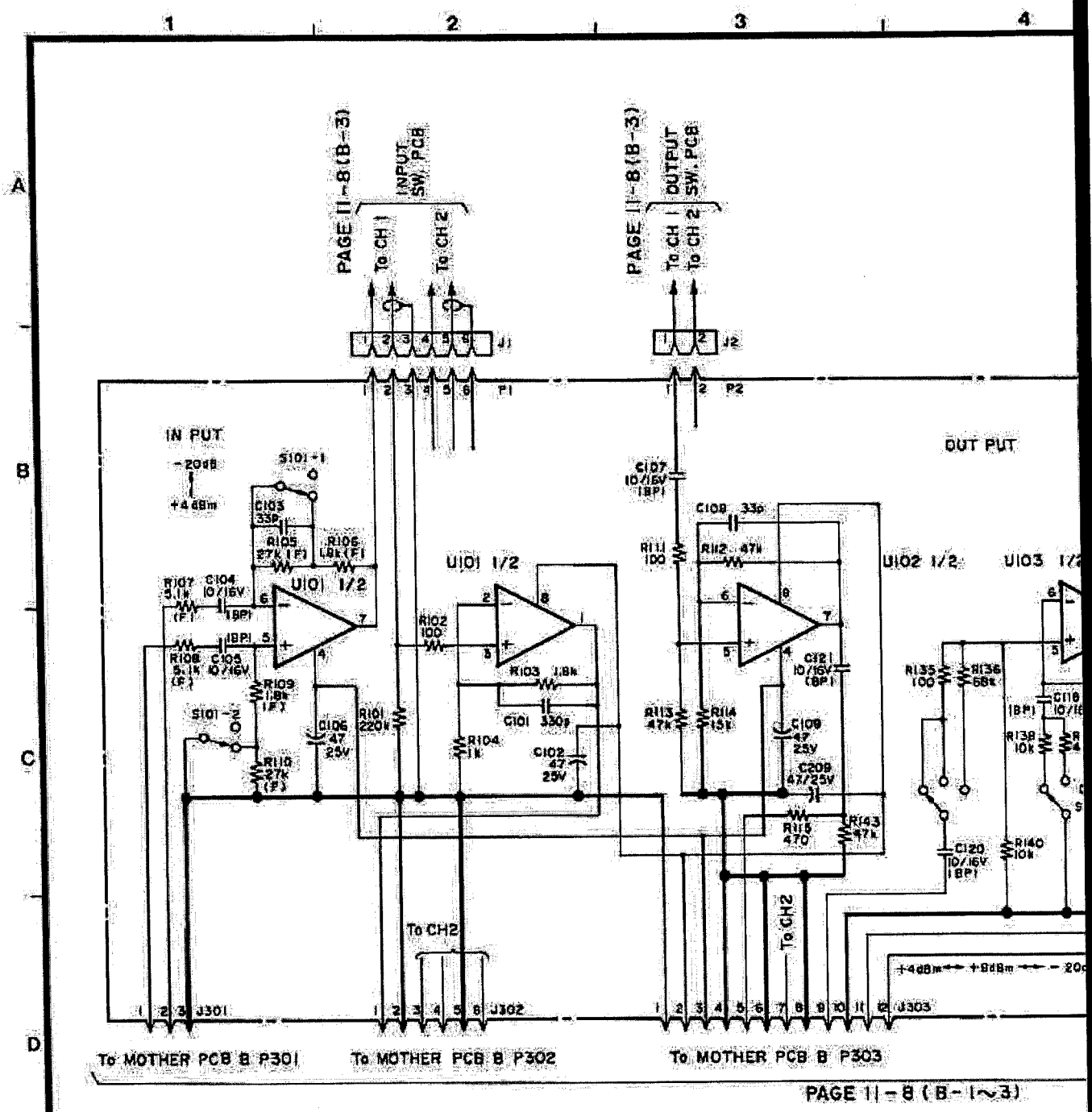

PAGE 11-17 (D-1)
2T ONLY
To TIME CODE FUNCTION PCB
+15V
REC MODE LED
REC'S
REP LED CONT
REC MODE
GND
C1
C2
P4
D15
D14
R26 4.7k
R23 1M
R21 68k
R22 15k
C2 1/50V
R19 15k
D9
D10
R20 82k
R24 220
R25 15k
C3 10/25V
D11
D13
D12
P1
J1
SYNC
PLAY MUTE
SPEED LOW
REC
POWER MUTE
INPUT
2 CH
1 CH
PAGE 11-1 (D~E-10)
To AMP POWER SUPPLY SOCKET
PAGE 11-1 (A-10)
R17 15k
R16 47k
R15 2.2k
C4 10/25V
C6 47/25V
C5 0.1
P2
J2
SPEED LOW
+15V
0V
PAGE 11-7 (E-1)
REMOTE CONNECTOR
FUNCTION PCB

11-13. FUNCTION PCB ASS'Y



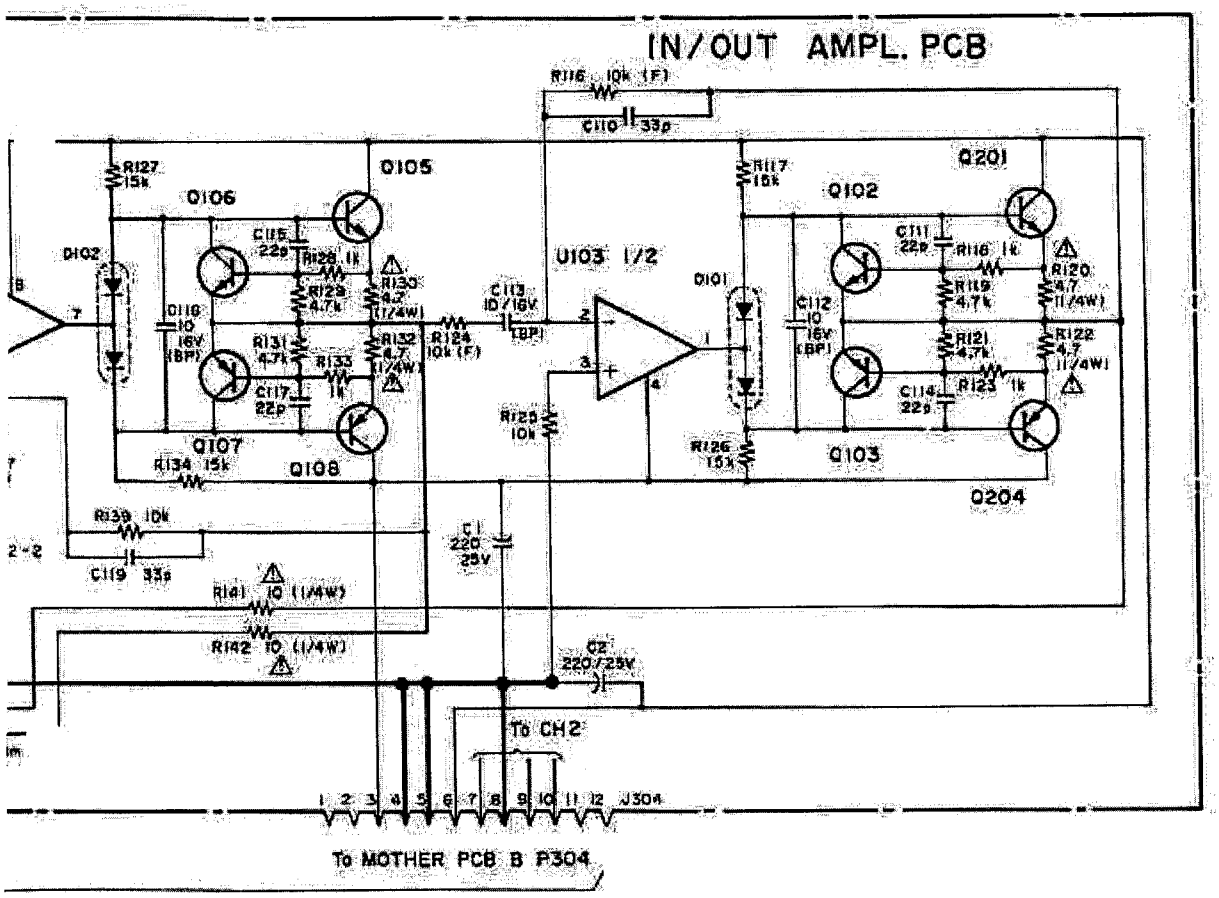
	R26	W1	P1	P4 (9)	D14, D15	D13	U5	D9	C1	C2
ATR-60-2T	○		9P	○	○	○	○	○	○	○
ATR-60-2N,2H,2HS		○	8P							

11-14. IN/OUT AMPL. PCB ASS'Y

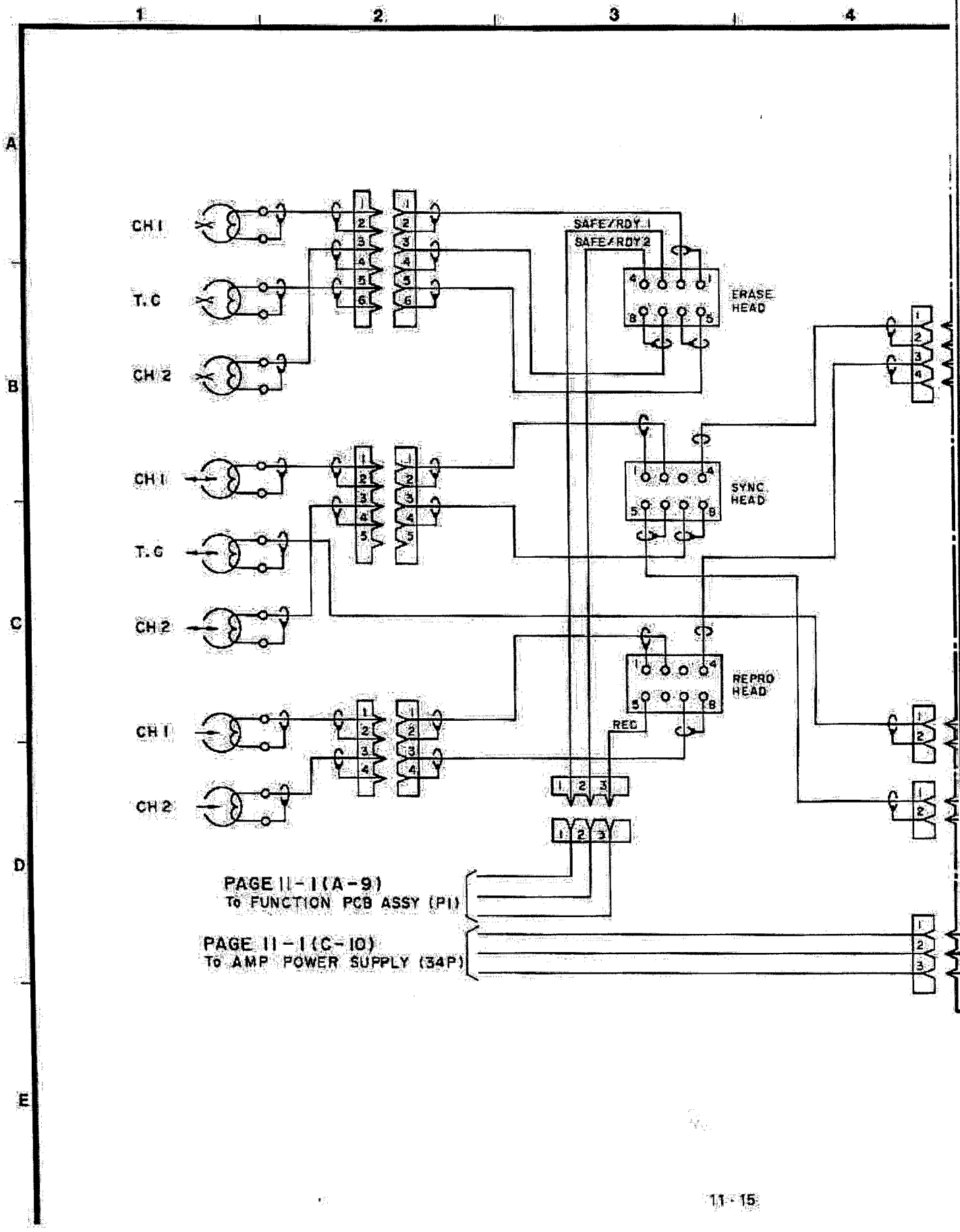


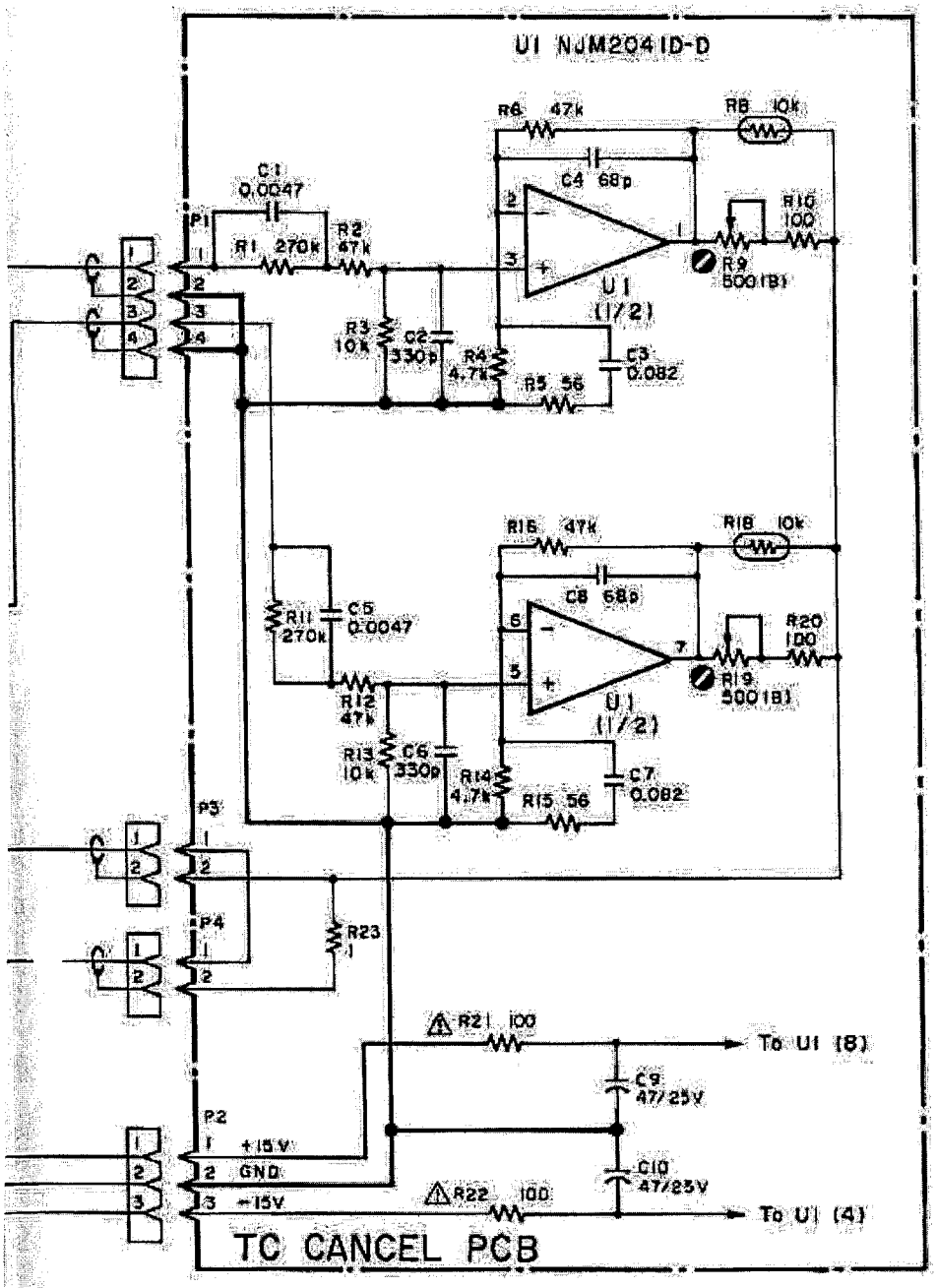
IN/OUTPUT AMPL. PCB

U101 ~ U103, U201, U203	: NJM2041DD
Q101, Q105, Q201, Q205	: 2SC2655Y
Q102, Q106, Q202, Q206	: 2SC1815GR
Q103, Q107, Q203, Q207	: 2SA1015GR
Q104, Q108, Q204, Q208	: 2SA1020Y
D101, D102, D201, D202	: MC931

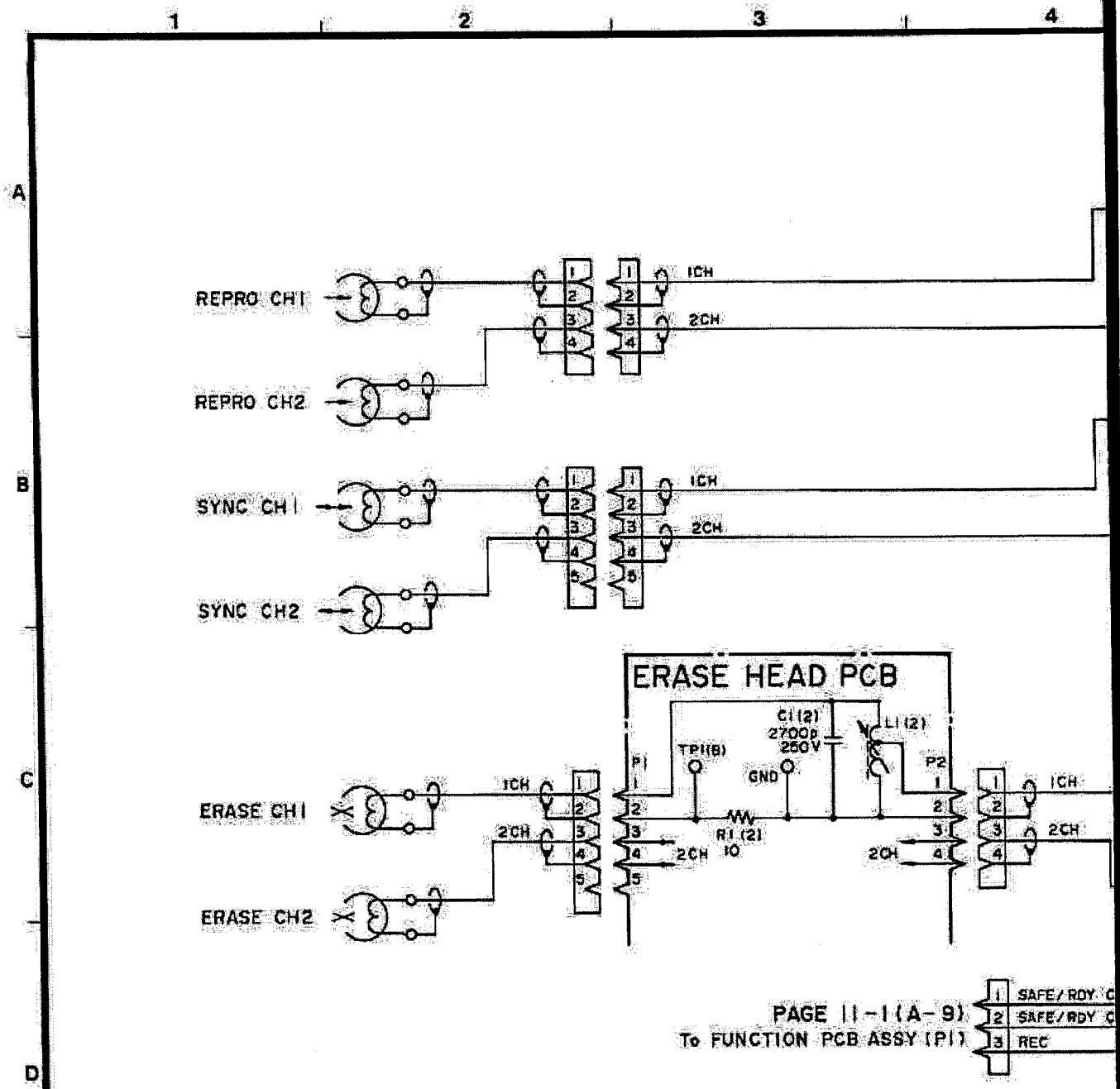

IN/OUT AMPL. PCB
R116 10k (F)
C110 33p
R127 15k
Q106
Q105
R117 15k
Q102
Q201
D102
C115 22p
R128 1k
R129 4.7k
R130 4.7 (1/4W)
U103 1/2
C111 22p
R118 1k
R119 4.7k
R120 4.7 (1/4W)
D110 10 16V (BP)
R131 4.7k
R133 1k
R132 4.7 (1/4W)
R124 10k (F)
C113 10/16V (BP)
D101
C112 10 16V (BP)
R121 4.7k
R123 1k
R122 4.7 (1/4W)
C117 22p
C114 22p
R125 10k
R126 15k
Q107
Q108
R134 15k
Q103
Q204
R139 10k
C119 33p
C1 220 25V
R141 10 (1/4W)
R142 10 (1/4W)
C2 220/25V
To CH2
1 2 3 4 5 6 7 8 9 10 11 12 J304
To MOTHER PCB B P304

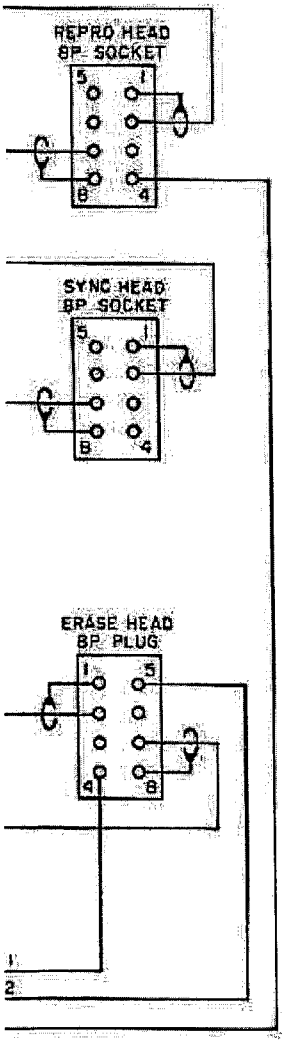
11-15. WIRING DIAGRAM (REC AND PLAY HEADS) AND TIME CODE CANCEL PCB ASS'Y



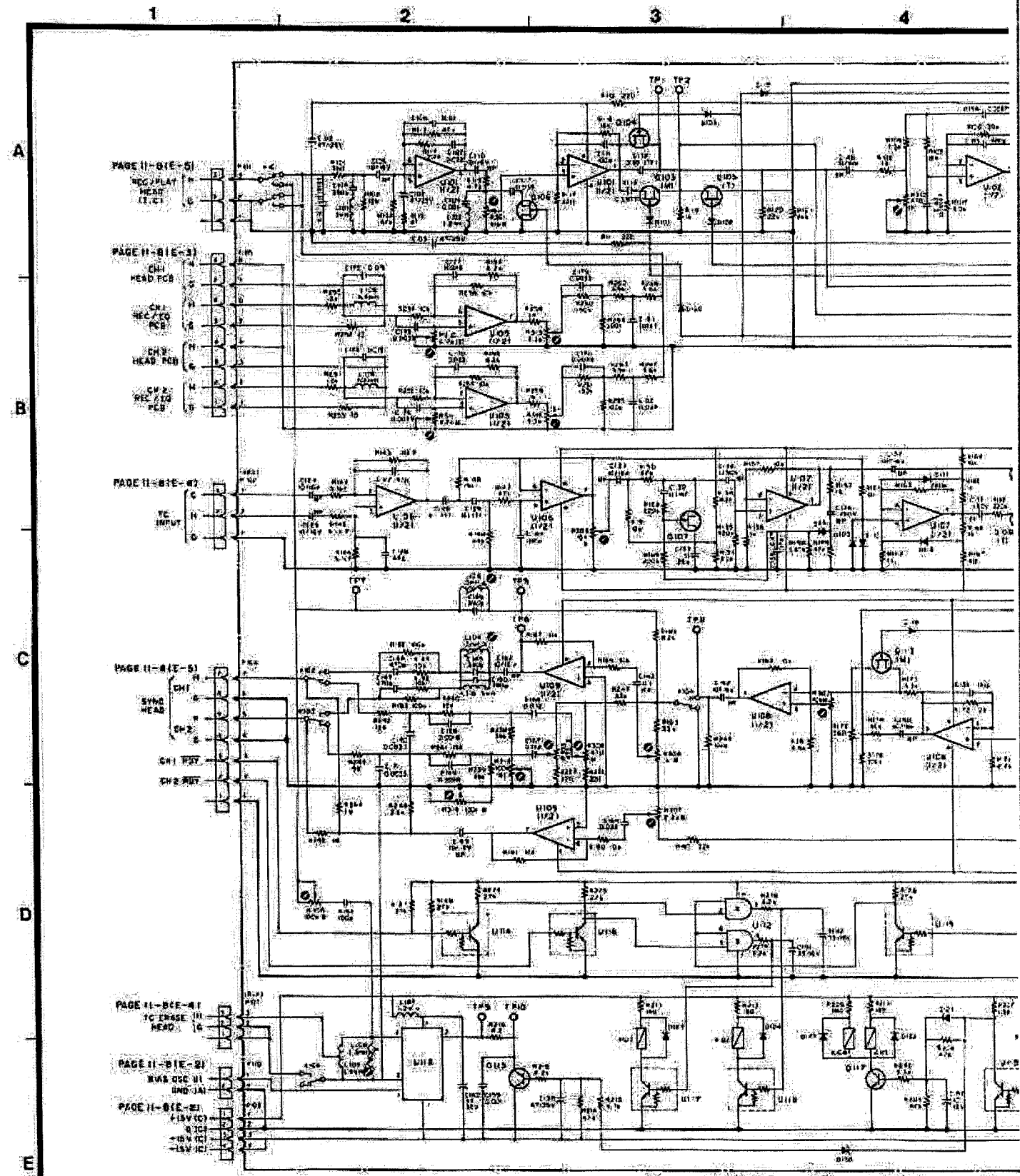

U1 NJM2041D-D
R6 47k
R8 10k
C4 68p
C1 0.0047
P1
R1 270k
R2 47k
R10 100
R9 500(B)
U1 (1/2)
R3 10k
C2 330p
R4 4.7k
R5 56
C3 0.082
R16 47k
R18 10k
C8 68p
R11 270k
C5 0.0047
R20 100
R19 500(B)
U1 (1/2)
R12 47k
R13 10k
C6 330p
R14 4.7k
R15 56
C7 0.082
P3
P4
R23 1
R21 100
To U1 (8)
C9 47/25V
P2
1 +15V
2 GND
3 -15V
C10 47/25V
R22 100
To U1 (4)
TC CANCEL PCB

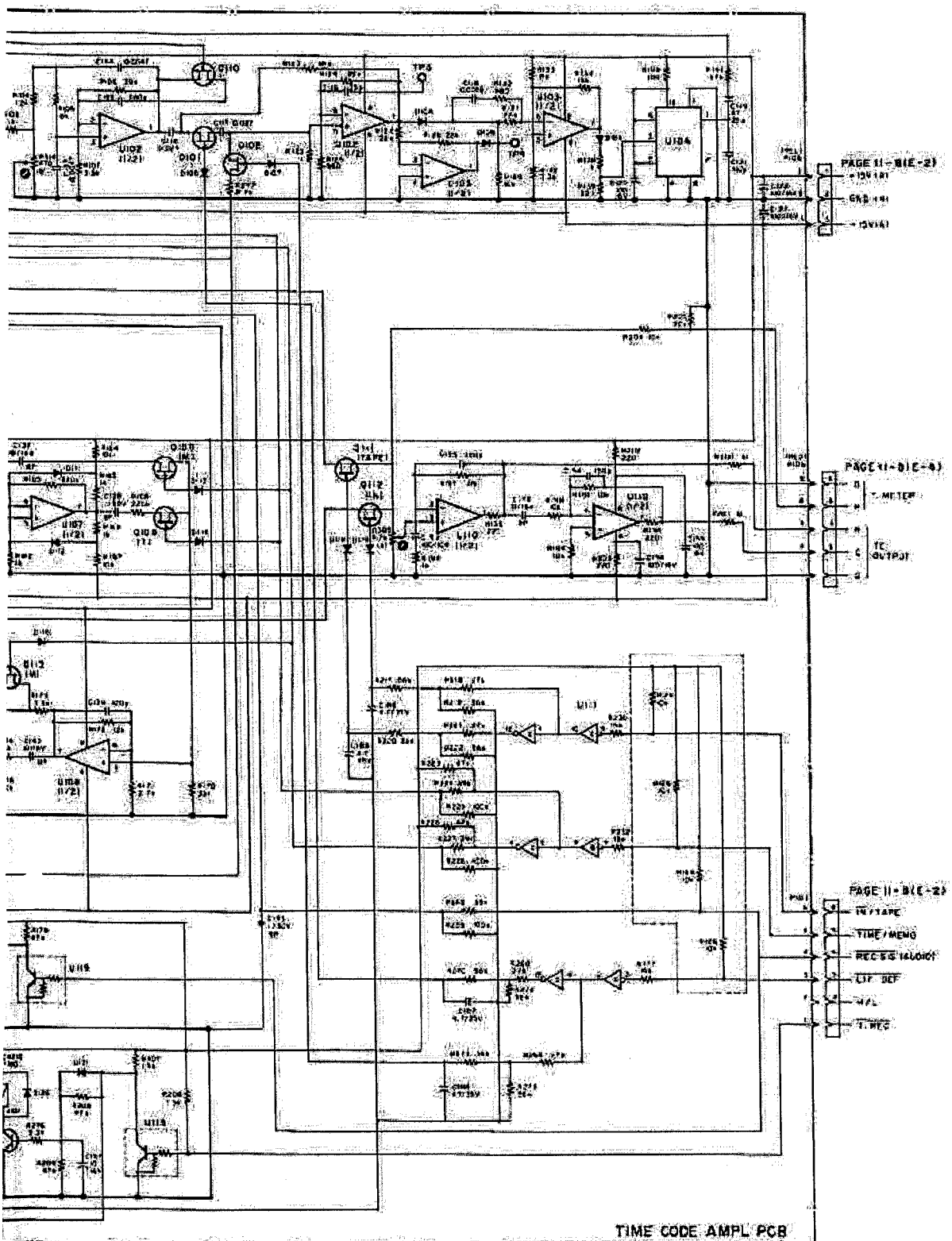
11-16. WIRING DIAGRAM (REC AND PLAY HEADS) AND ERASE HEAD PCB ASS'Y



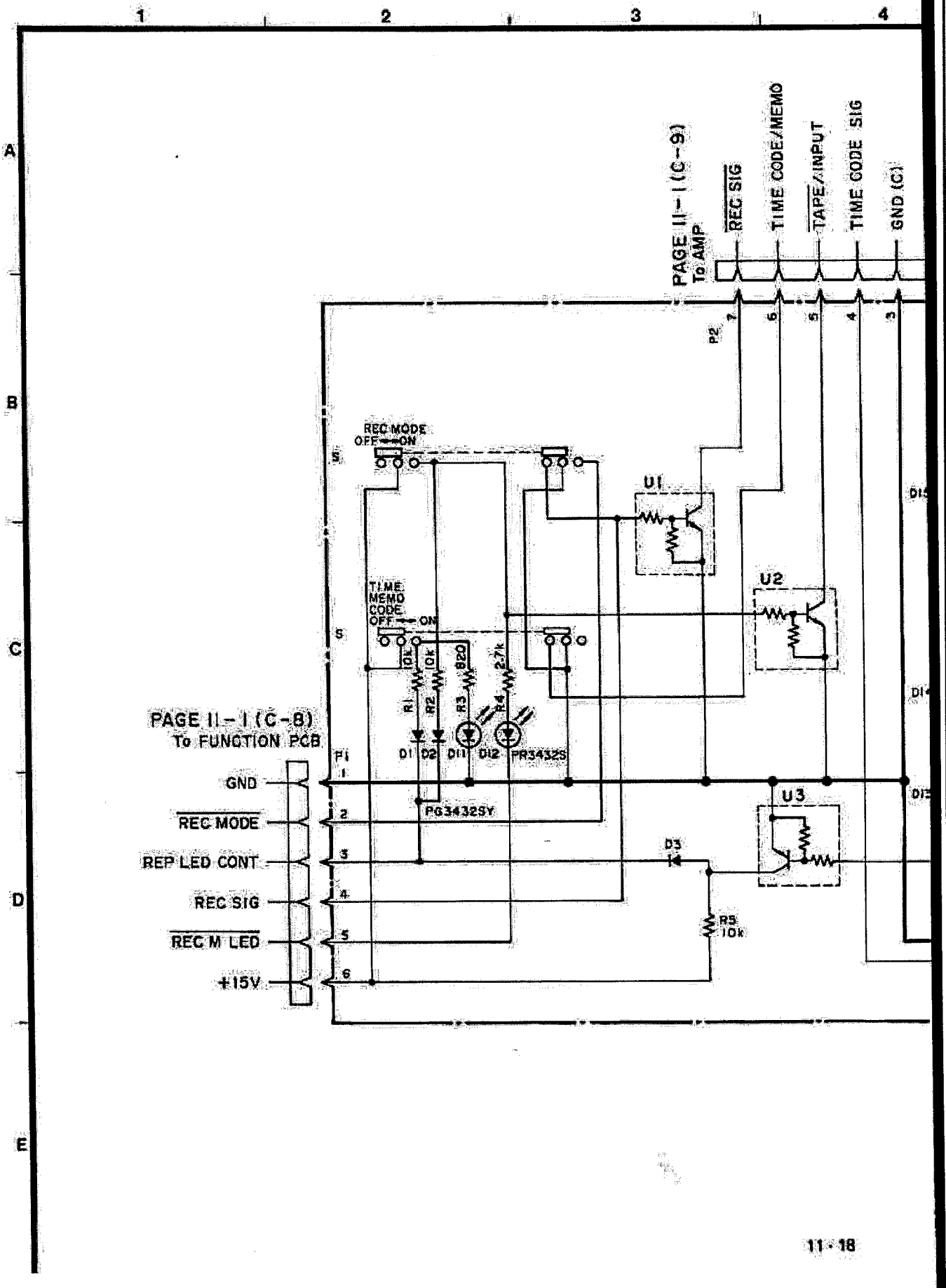

REPRO HEAD
8P. SOCKET
5
1
8
4
SYNC HEAD
8P. SOCKET
5
1
8
4
ERASE HEAD
8P. PLUG
1
5
4
8
1
2

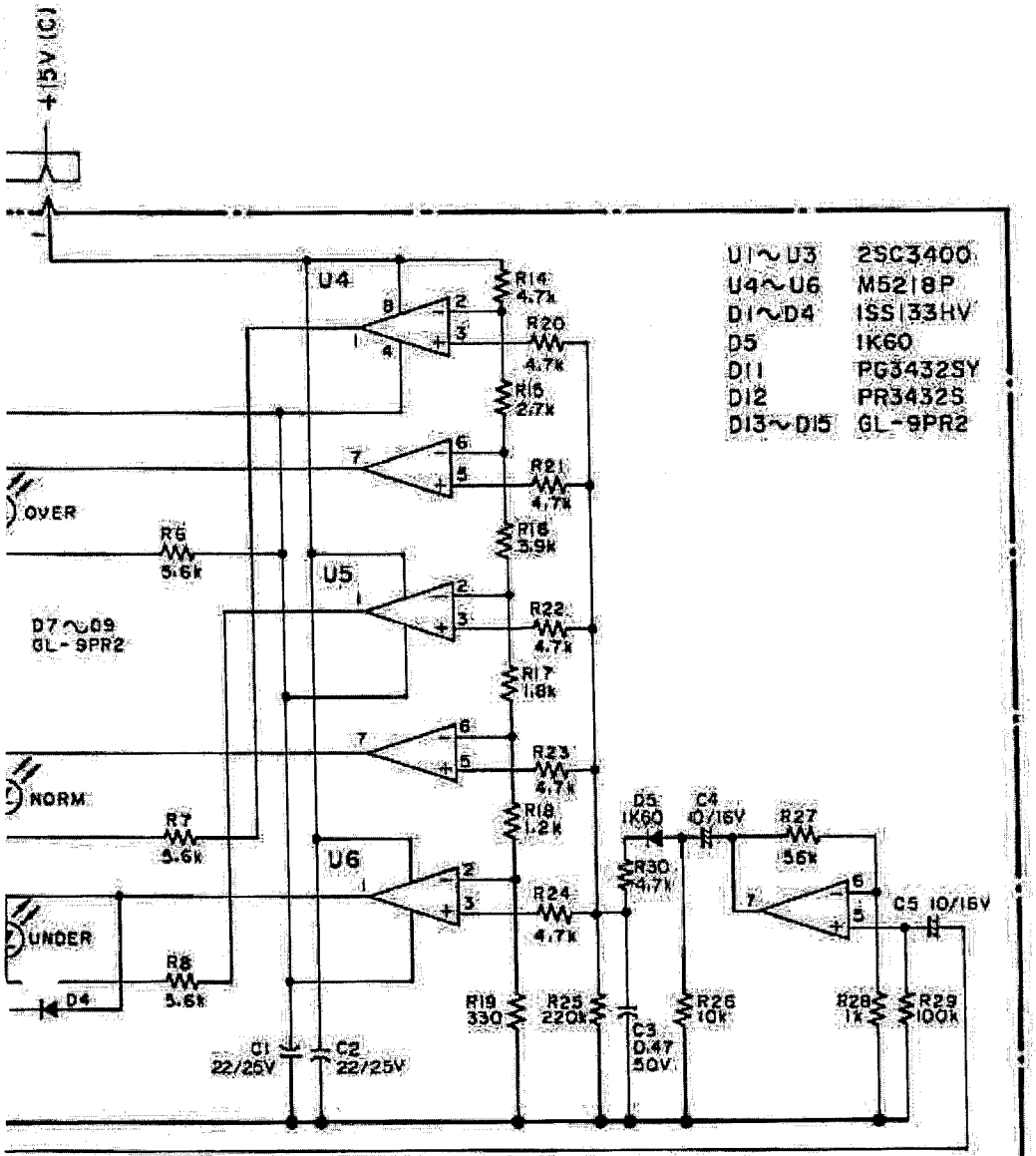
11-17. TIME CODE AMPL. PCB ASS'Y




PAGE 11-B(E-2)
PAGE 11-B(E-4)
PAGE 11-B(E-2)
TIME CODE AMPL PCB

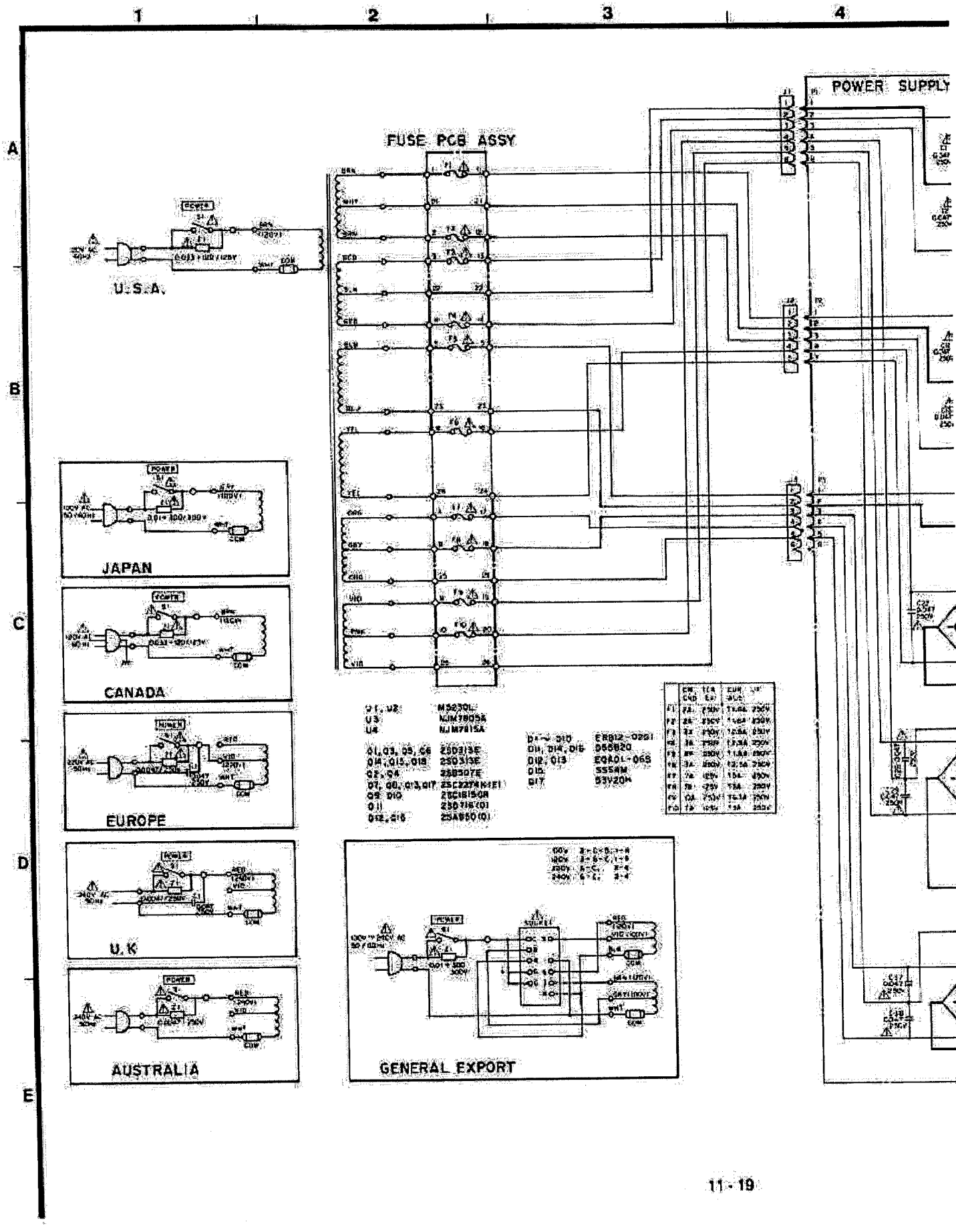
11-18. TIME CODE FUNCTION PCB ASS'Y

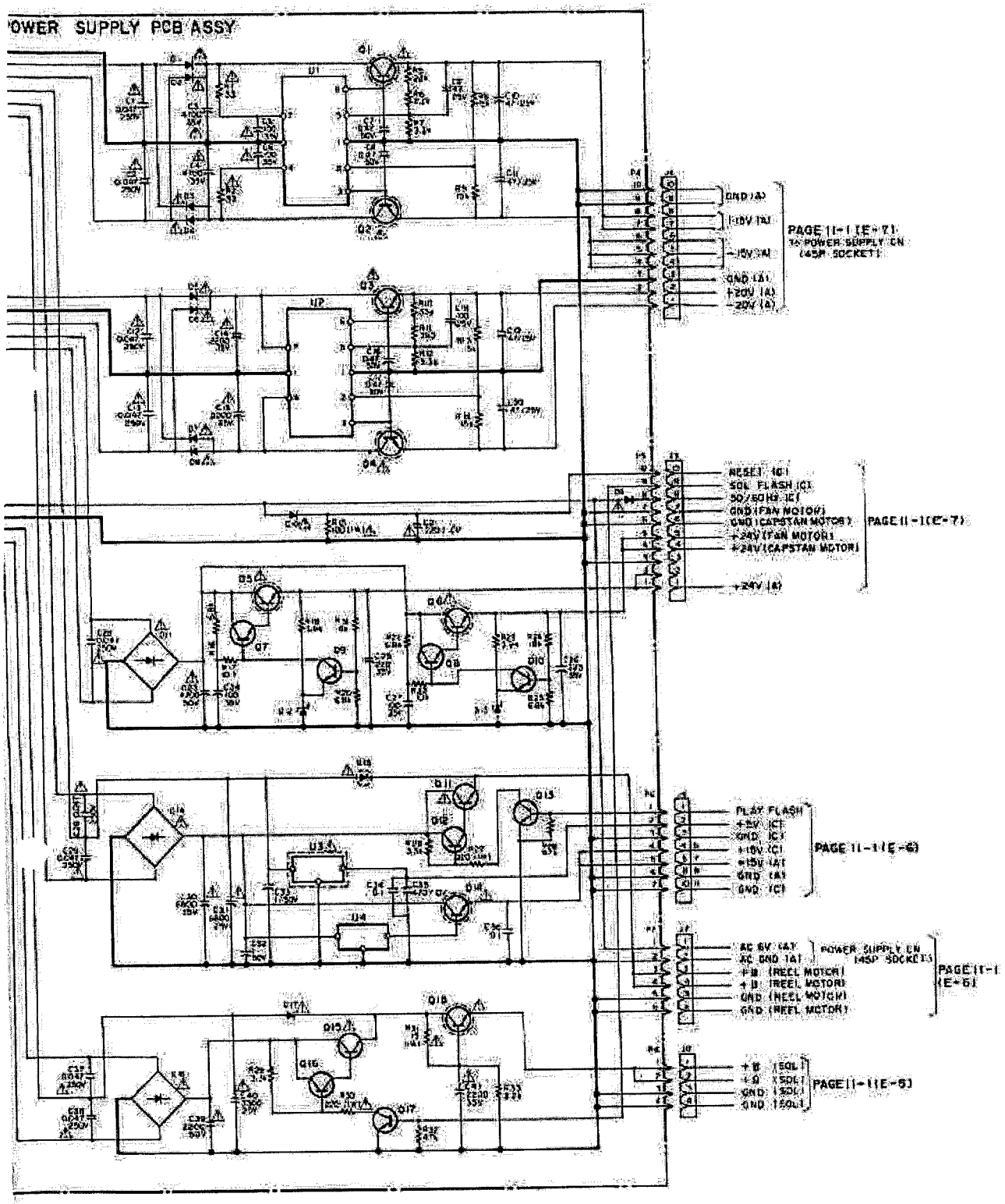




TIME CODE FUNCTION PCB (T)

11-19. POWER SUPPLY PCB ASS'Y




OWER SUPPLY PCB ASSY
GND (A)
-10V (A)
-15V (A)
GND (A)
+20V (A)
-20V (A)
PAGE 1-1 (E-7)
TO POWER SUPPLY CN
(45P SOCKET)
RESET (C)
SOL FLASH (C)
50/60Hz (C)
GND (FAN MOTOR)
GND (CAPSTAN MOTOR)
+24V (FAN MOTOR)
+24V (CAPSTAN MOTOR)
+24V (A)
PAGE 1-1 (E-7)
PLAY FLASH
+5V (C)
GND (C)
-15V (C)
+15V (A)
GND (A)
GND (C)
PAGE 1-1 (E-6)
AC 6V (A)
AC GND (A)
+B (REEL MOTOR)
+B (REEL MOTOR)
GND (REEL MOTOR)
GND (REEL MOTOR)
POWER SUPPLY CN
(4SP SOCKET)
PAGE 1-1
(E-5)
+B (SOL)
+B (SOL)
GND (SOL)
GND (SOL)
PAGE 1-1 (E-5)