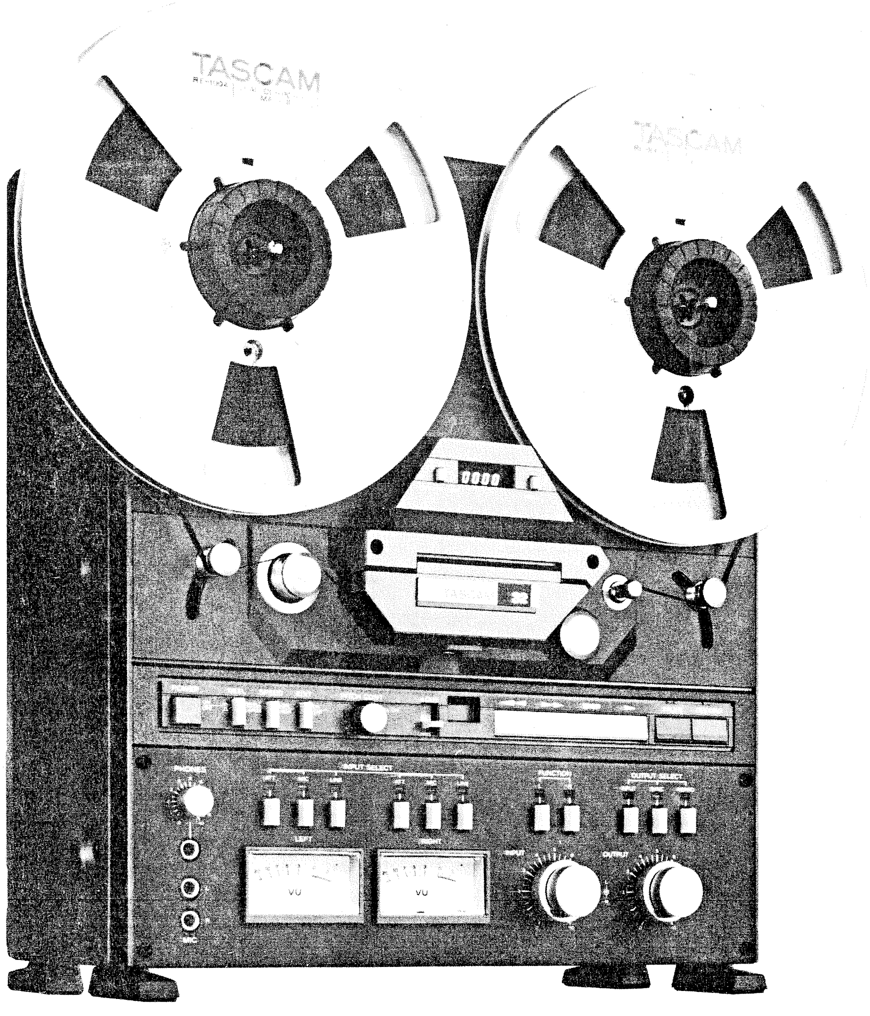
TASCAM
TEAC Production Products

32

2-Track Recorder/Reproducer



OPERATION/MAINTENANCE

5700029101

The guarantee of performance that we provide for the 32 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 of such things 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 province of the artist. TASCAM can make no guarantee that the 32 in 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.

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

TABLE OF CONTENTS

*dbx Noise Reduction Unit DX-2D and Recording Mixer M-30 are optional.

Introduction to the 32 and Its Design Philosophy

No matter how elaborate a multichannel tape recorder is, it doesn't do the job without help. A lot of equipment is involved, and a lot of talent as well. The recorder becomes the keystone in a system that involves microphones, mixers, loudspeakers, amplifiers and many sophisticated electronic devices. Everything contributes a part to the system of multichannel recording.

In this general purpose 2 channel recorder/reproducer we have included the features, circuits and controls necessary for a wide variety of applications. For example, true stereo remote recording with a minimum amount of extra equipment is made possible by the inclusion of microphone preamplifiers, pads and headphone amps.

Either channel may be recorded while auditioning the other in true "sync" (overdub capability) and a recording can commence while the tape is rolling (true multitrack "punch-in" is possible).

CUE and EDIT logics are both supported, and follow the generally accepted procedures that professional engineers have made "standard". Hand CUE. DUMP EDIT, and independent signal selection for the reproduce amplifiers regardless of record status make the 32 a useful tool in the business of recording, whatever that business is, multitrack, multimedia, remote stereo or fixed location studio operation.

It has long been our contention that professionalism is defined by people and what results they achieve. It's not something that automatically happens when you buy a tape machine with a lot of tracks, or at a very high price. It's what you do with the equipment and how well you do it that makes the point.

In designing the 32, we believe we have been guided by the multichannel system as it truly is. We are sure our recorder/reproducer can deliver the performance necessary to achieve solid results.

If you would like to comment on our design philosophy, please feel free to contact us. Criticism and comment from our owners has helped us improve our products and our business. We welcome all feedback.

Please send in the warranty card. Although it is not absolutely necessary to insure warranty protection, it will allow us to learn some things about who you are and what you do with tape. From time to time we mail out literature and information of interest to the multichannel recordist. Let us know where you are and we'll keep in touch.

*dbx noise reduction system made under license from dbx, Incorporated. The name "dbx" and the dbx symbol are trademarks of dbx, Incorporated.

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 ____________________

Note:

If you notice any differences, either on the outside or the inside of the unit from the illustrations and descriptions in this manual, talk to your dealer. He may have revision sheets that will show manufacturing changes, or notifications of how to deal with any changes in set-up or maintenance procedures.

Save this manual, refer to it when necessary, and good luck with your 32.

energy to be generated by the microphones.
This ATT button affects the MIC circuit only.

⑲ VU Meters
0 VU = .3 Volt. What signal will be shown on the meters will depend on the settings of the OUTPUT SELECT buttons. For a comprehensive list of the possible meter logic, see item 24, OUTPUT SELECT buttons.

⑳ FUNCTION LED Indicators
Indicates which FUNCTION buttons have been activated.

㉑ FUNCTION (L, R) Buttons
Determines the record/reproduce status of the corresponding channels.

Up – Safe, reproduce or source determined by OUTPUT SELECT buttons.

Down – Ready to record. If "Record" has been selected through the transport controls, depressing this button will begin recording immediately. Output of recorder switches to source.

㉒ INPUT Level Controls
For adjusting the MIC or LINE level signal. Setting has no effect on reproduce. This control is of a dual concentric type, so either channel can be adjusted independently.

㉓ OUTPUT Level Controls
For adjusting the levels of the signals sent to the OUTPUT (L & R) terminals. This control is of a dual concentric type, so either channel can be adjusted independently. Use this control to set optimum monitoring or listening levels.

㉔ OUTPUT SELECT Buttons
Select which of three possible sources to feed the output jacks (rear panel) and VU meter circuits. The LED's above the buttons show selection.

INPUT – Meter reads line input to recorder, input signal appears at output jacks. Tape signal will not be heard.

SYNC – Used for all normal operations, recording, sync/reproduce and reproduce. Meter reads input or head # 2 play output depending on setting of function buttons (L or/and R).

REPRO – Selects head # 3. Meter now reads tape playback. Does not prevent recording on head # 2. Used in to check performance and record/play monitoring of tape.

㉕ OUTPUT SELECT LED Indicators
Indicates which OUTPUT SELECT buttons have been activated.
INPUT LED : Red
SYNC LED : Yellow
REPRO LED : Green

㉖ Transport Controls
This group of buttons control the mechanical action of the transport, and the in/out switching of the record circuit. The RC-71 remote control unit (see rear panel for the connection point) will duplicate this control group. When the remote is connected, both sets of controls will be active at the same time.

(▶) Play Button
1. When depressed alone, the tape will advance at the speed selected by the # 10 SPEED switch and the # 12 PITCH CONTROL.
2. When depressed along with the RECORD button, any or all tracks that have their FUNCTION select buttons IN (record ready) will begin recording immediately.
3. This transport has a motion sensing circuit that allows the selection of PLAY directly from either fast forward or rewind. Press PLAY when fast winding and the transport will slow, come briefly to STOP and then enter PLAY by itself.

(▶▶) Fast Forward Button

(◀◀) Rewind Button
Rewind time is 90 seconds for a 10-1/2" reel, 1-1/2 mil tape.

STOP Button

RECORD Button
Depressing this button by itself will have no effect. To begin recording, several conditions must first be met.
1. One or more FUNCTION select buttons must be IN (record ready)
2. To enable the record logic, the PLAY button must be depressed simultaneously with the RECORD button. If the transport is in PLAY, press BOTH buttons together and the unit will go into record mode.
3. Since the PAUSE button can hold the record logic in an active condition (see next page, PAUSE button) if PAUSE is active, recording can start with a one button PLAY command.
4. Since depressing PLAY/RECORD will enable the record logic when the FUNCTION select buttons are NOT active, it is possible to begin recording with this sequence as well as the more usual ones. Do this;

1. Establish the record active condition by depressing PLAY and RECORD together, then—
2. Depress one or both FUNCTION select buttons and recording will commence. This additional logic is provided when it is necessary to hear a previously recorded signal up to the "punch-in" point. If the FUNCTION select buttons are OUT (safe) the tape signal CAN appear at the output. If the FUNCTION buttons are IN (record ready) only new INPUT signal can be auditioned and listening to the tape to find a "Cue" point for the punch-in will not be possible. When you must listen to the tape, pre-load the record logic and use the FUNCTION buttons to begin the recording.

PAUSE Button
This button will stop the tape and the recording process without disengaging the record logic, to continue recording, just press the play (▶) button alone. If a RECORD/PAUSE logic condition is in effect, allowing this "one key" return to record mode, the green and red LEDs above the PAUSE and RECORD buttons will light.

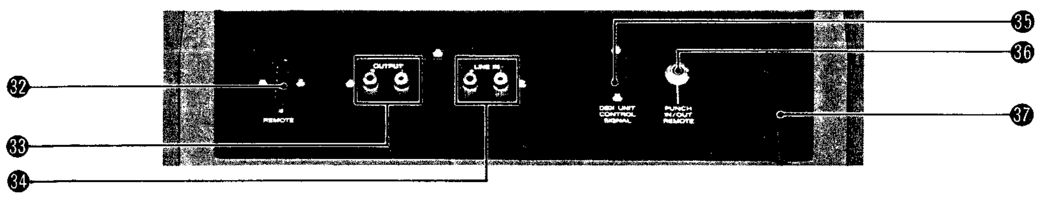
㉗ RECORD Status Indicator
The red LED lights up when the deck has been set into the record mode and begins blinking if the FUNCTION buttons are not depressed.

㉘ PAUSE Status Indicator
The green LED lights only when PAUSE and RECORD have been simultaneously pressed.

㉙ Shut Off Arm
The shut off arm will drop power to the capstan and reel motors if the tape breaks. It's a good idea to allow it to drop when you take a break in the middle of a session. Doing this will stop the constant rotation of the capstan, and will lengthen the life of the capstan motor bearings. It is not necessary to unthread the tape. Just allow it to become slack so that the shut off arm can drop.

㉚ Pinch Roller

㉛ Capstan Shaft



BACK PANEL

㉜ REMOTE Connector
Allows connection of the optional RC-71 Remote Control Unit.

㉝ Output Jacks
Output level is -10 dB (0.3 V). Minimum load impedance is 10k ohms (unbalanced).

㉞ LINE IN Jacks
Input level is -10 dB (0.3 V). Input impedance is 50k ohms (unbalanced).

㉟ DBX UNIT CONTROL SIGNAL Connector
This allows connection of the optional DX-2D Noise Reduction Unit and supplies control signal to the dbx unit to permit simultaneous encode/decode dbx operation. Because of this "dual process", no switching is required when you change function from recording to playback. The fact that there are separate sections for each function will also allow "off the tape" monitoring when the dbx is used.

㊱ PUNCH IN/OUT REMOTE Connector (RC-30P)
Allows connection of the optional RC-30P TASCAM PUNCH IN/OUT REMOTE PEDAL.

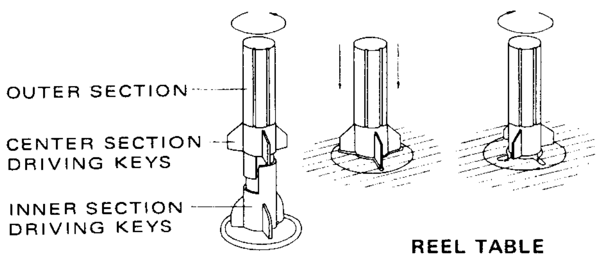
㊲ AC Cord

***INPUT and OUTPUT levels**
If you do not have access to any test equipment or test tapes, a good working position for the output controls would be position "7". From that position, careful monitoring and experimentation will help you determine the optimum setting. The loudest peaks may briefly register in the red zone, but the input levels should be reduced if the deflection needles seem to spend a lot of time in the red zone. For information on setting the correct input and output levels, see "Calibration" on page 29.

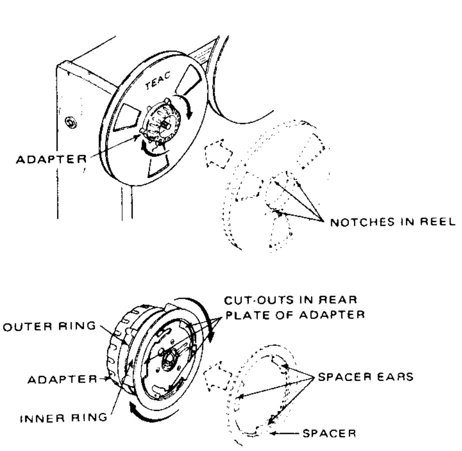
BASIC INFORMATION

Reel Installation

Small Hub Reels

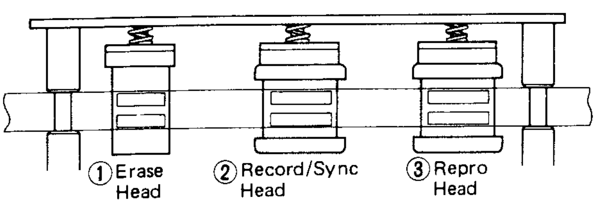


Large Hub Reels



NOTE:
A metal spacer is mounted on the back of the reel adaptors and it must be in place when the NAB standard 10-1/2" metal reels are used.

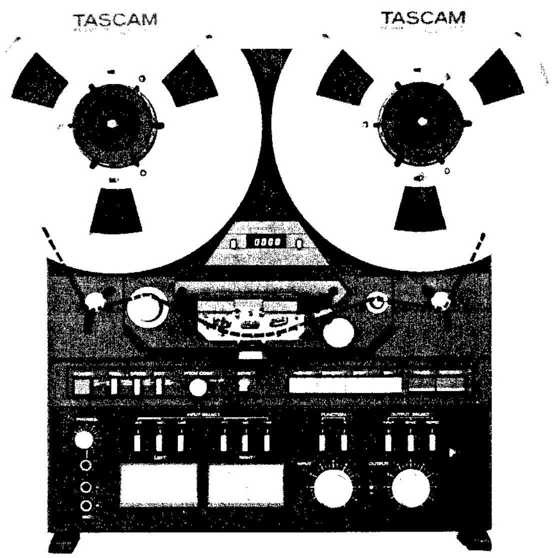
Head Configuration



Threading the Tape

Lift the head access cover and release the sync head shield to gain access for threading.

NOTE:
If you use a reel of tape that has been stored "tailed out" (See "Editing and Tape Storage"), it must be placed on the right reel table and rewound to the left.



Erasing the Tape

A previously recorded tape is automatically erased when you make a new recording on it. For the best-quality recordings, and for convenience, we recommend the TEAC E-2A bulk eraser. This will erase your tapes cleanly in one pass for the best signal-to-noise ratio. Another way to erase is to record with the input controls set to the minimum levels.

Editing and Tape Storage

Never use ordinary adhesive tape for this vital procedure. Use only the special tape made exclusively for tape editing.

Monitor with the CUE lever. When you have located the precise point to make the cut, stop the tape and mark the back of the tape with a Chinacraft type pencil at the center of the reproduce head, and then use the EDIT switch. With the EDIT switch and (▶) button depressed, the tape will begin unthreading itself (dumping) because the take up reel will not be moving to take up the slack. The use of non-magnetic tools is highly recommended. A good quality machine-milled tape-editing block will help ensure good edits.

Tape should be stored in a cool, dry place well away from the influence of magnetic fields. Print-through (the unwanted transfer of magnetic signals from one part of the tape to an adjacent part of the tape, causing "echos") may be reduced by winding (NOT fast winding) the tape onto the take up reel at normal playing speed for storage. When the tape is played again, it is first rewound at a high speed onto the supply reel. This is called storing the tape "tails out" and is a common practice in many studios. A helpful idea is to use white leader tape at the beginning and red leader tape at the tail end. The analogy with vehicle head and tail lights is then an easy way to remember which end is which.

ENTERING "RECORD"

In any tape recorder that offers "SYNC" or overdub capabilities (where a new part may be added to an already recorded part), many different methods for entering the record mode will be necessary. On the 32, there are four ways to cause the transport to begin recording. Although all of these different methods can be inferred by reading the descriptions that list the action of each group of controls, we'll review all four methods here. The title of each method is the LAST action you perform to make the process start.

1. PLAY/RECORD. Depress these two buttons together. Of course, a signal source must be selected (MIC, MIC ATT or LINE), and one or more FUNCTION select buttons must be depressed. This industry standard two button (interlock) method can be used for almost all recordings, but it has a drawback. The minute that you depress a FUNCTION select button, that track is switched to "source" and you can't hear a signal that is already on the tape, even if you press PLAY all by itself. If you don't need to hear the previously recorded signal to find the right place to begin your new part, this method is OK. If you must hear, use method 2.

2. FUNCTION select. To use this method, switch the OUTPUT select to SYNC, select a signal source and with all FUNCTION select buttons UP (inactive), press PLAY/RECORD together, this action will start the tape playing without actually recording. It WILL pre-load the record logic. It will NOT switch the output electronics to "source" (new signal instead of tape playback). You will still be able to hear the tape. When you hear the cue, depress the FUNCTION select button(s) and recording will commence.

3. PLAY. A single button return to the record mode is possible if a RECORD/PAUSE logic has been previously selected, see the paragraph on the PAUSE control on page 7 for a complete description of this logic. This method is useful when you wish to stop recording, wait for some undesired part to finish and then continue recording.

4. REMOTE PEDAL RC-30P. An accessory pedal is available that will allow you to start recording with a foot switch. This is extremely useful to the musician who must make a "tight" punch-in that requires both hands "on the instrument" at the exact moment of the "punch". The foot switch will NOT start the transport, you must do that, but it WILL start and stop recording. Here's How.
   Connect the TASCAM PUNCH IN/OUT REMOTE PEDAL to the rear of the 32. Now, even with both of your hands occupied, PUNCH OUT can still be performed by using the remote pedal. While in sync reproduce, pressing the pedal with your foot initiates punch-in of the channels for which record function has been selected. Punch-out is done by simply pressing the pedal again.

To conclude this section on entering record, here is a review of all the record related controls and what they do.

INPUT SELECT BUTTONS: The signal coming from MIC or LINE is controlled by the INPUT SELECT buttons.
LINE – Selects line input source signals.
MIC – Selects microphone signals.
ATT – Discards 20 dB of signal from the microphones.

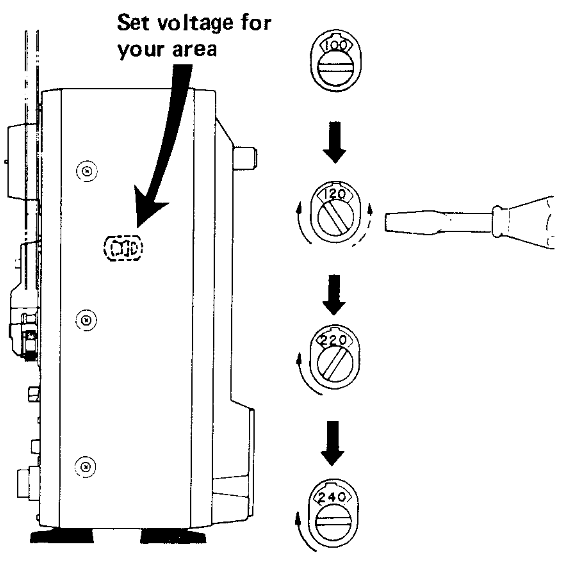
OUTPUT SELECT BUTTONS: The signal presented at the output terminals is controlled by the OUTPUT SELECT buttons.
INPUT – will typically be used for source calibrations during system interface and set-up procedures. When this button is depressed, the input signals are sent directly to the output terminals.
REPRO – will present the reproduce head signal to the output jacks to monitor the printed signal on the tape for reference during recording.
SYNC – will be used for most operations: recording, overdubbing (sync), and reproduce. The monitoring status is then determined by the FUNCTION buttons.

FUNCTION BUTTONS: When the OUTPUT SELECT is in either the INPUT or REPRO POSITION, the FUNCTION buttons have the single purpose of determining the record status. UP is safe. EOWN is ready-to-record.
When the OUTPUT SELECT is in the SYNC position, the FUNCTION buttons serve two purposes:
1) they determine the record status – **UP** is safe, DOWN is ready-to-record.
2) they determine the monitoring status – UP is sync/tape reproduce, DOWN is source.

VOLTAGE CONVERSION

This deck is adjusted to operate on the electric voltage specified on the reel tag and packing carton.
Note: This voltage conversion is not possible on models sold in the U.S.A., Canada, UK, Australia or Europe.
For general export units, if it is necessary to change the voltage requirements of this deck to match your area, use the following procedures.
Always disconnect power line cord before making these changes.

1. Disconnect the power cord of the deck from the source.
2. Remove the bonnet panel and locate the voltage selector on the side of the deck.
   Refer to "2-2 Removing the Panels of the Deck" on page 78.
3. To increase the selected voltage, turn the slotted center post clockwise using a screw-driver or another suitable tool.
4. To decrease the selected voltage, turn the slotted center post counter-clockwise.
5. The numerals that appear in the cut-out window of the voltage selector indicate the selected voltage.
6. If the desired voltage numerals do not appear in the cut-out window as you turn the slotted center post, your deck must be taken to an authorized TEAC Service Facility for voltage conversion.



NOTE FOR U.K. CUSTOMERS

U.K. Customers Only:
Due to the variety of plugs being used in the U.K., this unit is sold without an AC plug. Please request your dealer to install the correct plug to match the mains power outlet where your unit will be used as per these instructions.

IMPORTANT

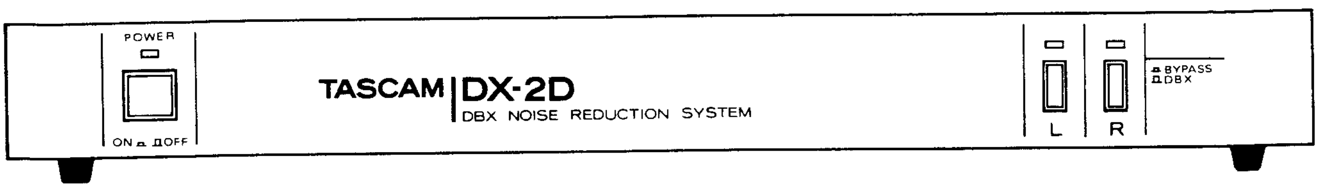
The wires in this mains lead are coloured in accordance with the following code:

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.

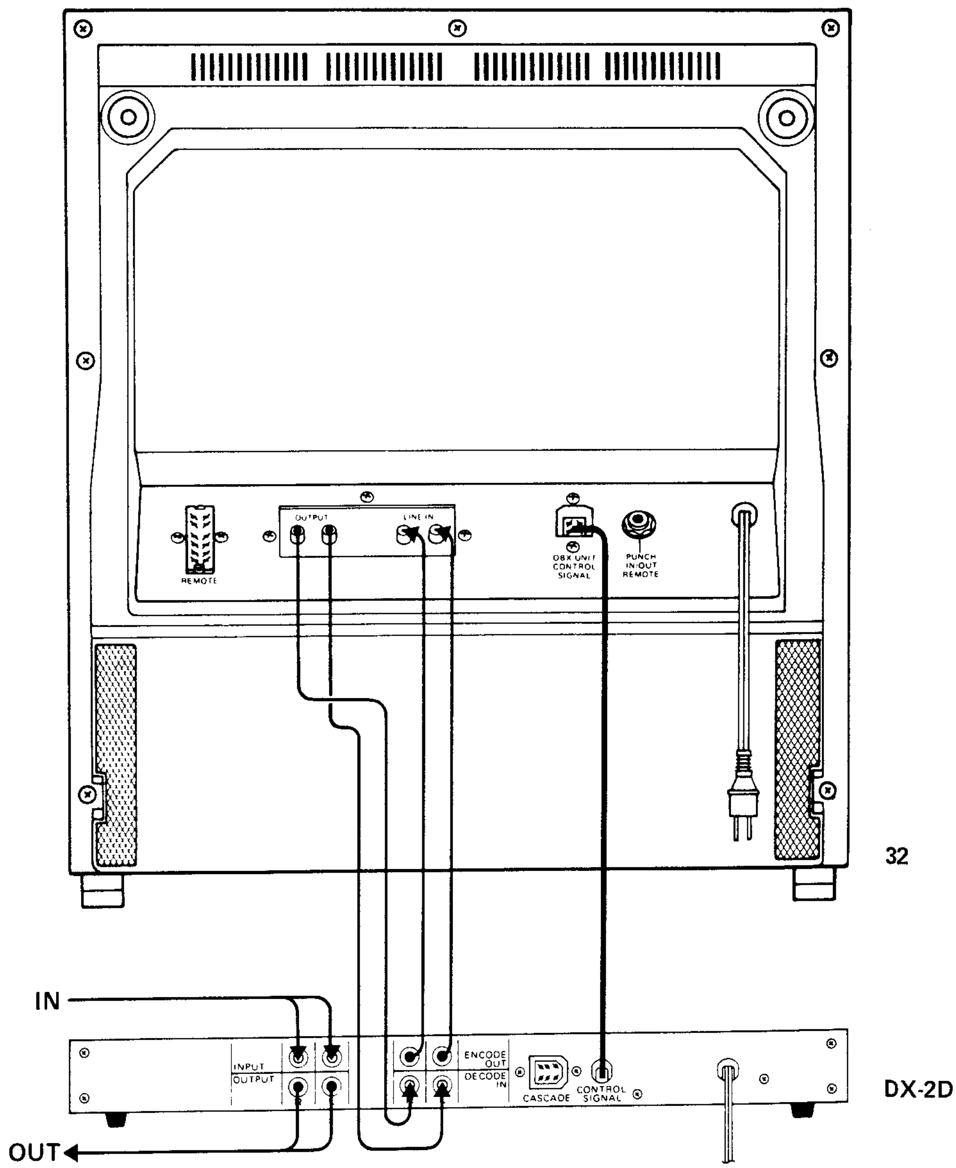
The wire which is coloured BLUE must be connected to the terminal which is marked with the letter N or coloured BLACK. The wire which is coloured BROWN must be connected to the terminal which is marked with the letter L or coloured RED.

CONNECTION AND OPERATION OF THE DX-2D



The DX-2D is an optional 2-channel DBX UNIT designed for integration with the 32 Recorder/ Reproducer.

Note: When the DX-2D is used together with the 32, encorded signal levels displayed on VU meters will be found to be of slightly less value (through compression) than non-encoded signal levels.



DBX Bypass Switch

1. With this DBX Noise Reduction system both ENCODE/DECODE are in operation while this switch is in the (◻ DBX) position. With this switch in the (⏏ BYPASS) position, the DBX circuit is bypassed, which deactivates the ENCODE/DECODE function. The switches for each channel (1 – 2) work independently to facilitate separate functioning.
2. With this switch in the (⏏ BYPASS) position, an LED lights to indicate that the DBX circuit has been bypassed. Keep this switch in this position when not using the dbx Noise Reduction system.

How the DX-2D functions

This DBX UNIT functions only when connected to the DBX UNIT CONTROL SIGNAL terminal of the 32.

Once the DX-2D has been connected, you may virtually ignore it. The unit is completely automatic. And, because of the design and nature of the DX-2D noise reduction unit, there is no need for record or reproduce level match adjustments – the level is non-critical within nominal tolerances; the circuit is stable.

Since decode and encode functions are actuated by the respective channels of the DX-2D, simultaneous dbx NR Coding/Decoding is possible without having to switch between ENCODE or DECODE.

Original Recording

Suppose you are going to record, with OUTPUT SELECT in the SYNC position, depress FUNCTION select buttons 1 and/or 2. LED indicators will light, signaling ready-to-record.

An encoded signal will be automatically reproduced when the 32 is started because of the DBX unit's ability to simultaneously code and decode while the DBX switch is in the (◻ DBX) position.

HOW THE DX-2D WORKS

The DX-2D is a wide-band compression-expansion system which provides a net noise reduction (broadband, not just hiss) of a little more than 30 dB. In addition, the compression during recording permits a net gain in tape headroom of about 10 dB.

A compression factor of 2:1 is used before recording; then, 1:2 expansion on reproduce. These compression and expansion factors are linear in decibels and allow the system to produce tape recordings with over a 100 dB dynamic range – an important feature, especially when you're making live recordings. The DX-2D employs RMS level sensors to eliminate compressor-expander tracking errors due to phase shifts in the tape recorder, and provides excellent transient tracking capabilities.

To achieve a large reduction in audible tape hiss, without danger of overload or high frequency self-erasure on the tape, frequency pre-emphasis and de-emphasis are added to the signal and RMS level sensors.

If you're an electronic engineer, all of the above gab may tell you the whole story of what's going on in the DBX, but if you're not, to make things a little easier to understand we'll ask you to use your imagination.

Imagine four little recording engineers in the box with each of their hands on a volume control. They are incredibly fast but very stupid, so you must give them a set of rules. You tell them to raise signals that are below "0 VU", and reduce signals that are higher than "0 VU".

The lower the signal is, the more they raise it, and the higher levels above "0 VU" get lowered more and more as they go up in level past "0". This is the 2:1 compression. You also tell them to call "0.316 V" "0 VU". Here they do nothing, no change except frequency pre-emphasis or boost. Since you know they are going to keep the high levels under control, you can raise the "top end" a bit and still not overload the tape. Just to keep it simple for them, the boost in highs is fixed. They put it in all the time, no matter what level changes they are making. Now we play tape back, and say OK, do everything backwards. Levels above "0.316 V" "0 VU" are raised and levels below "0.316 V" are lowered, and while you're at it, fellows, take off the extra top end as well. Follow the rules in reverse. As long as you don't confuse them by shifting the "0 VU" point, they work just great, but — don't put in more than "0.316 V" as zero VU, and don't make the tape playback zero anything other than "0.316 V" either. As we said they're very dumb and will follow instructions very precisely. Differing levels will produce decoding errors.

The reason these errors may not be objectionable is that people could have played or sung or whatever with a little more or less dynamics. A small change won't be as noticeable as a mistake, but it is not perfect. The tolerance here is not electronic, it's human. To get exactly what you put in, it is necessary to get an exact "0 VU", 0.316 V in and out. The system is level sensitive although it is realistic to say it is "artistically" forgiving.

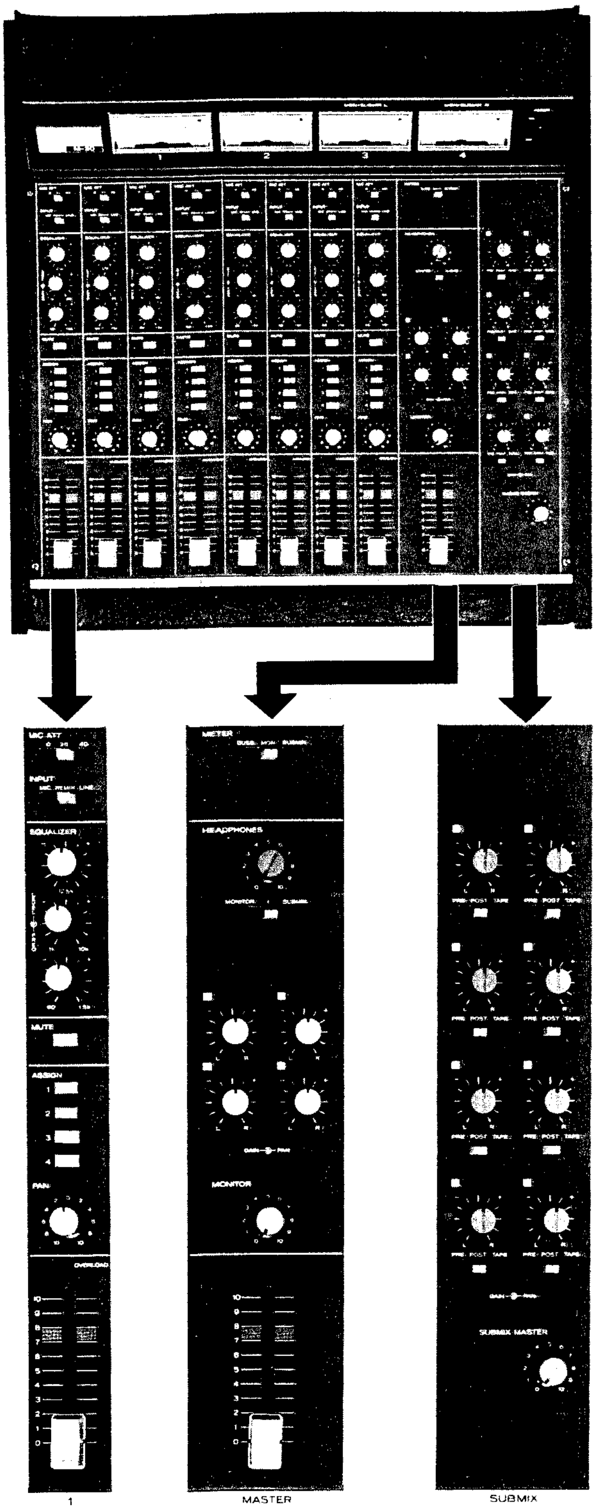
One common mistake we find, is that people don't check the OUTPUT voltage of the mixer or other device feeding the DX-2D, and don't remember that the DX-2D is the first item in the system (32/DX-2D). "Breathing" and "pumping" can result especially on instruments like piano and acoustic guitars, if the levels are seriously mismatched, because of the way the DX-2D works. If your mixer "0" VU is not 0.3 volt, (the DX-2D "standard zero") the code process will reflect the fact that all levels are higher (if the mixer "zero" is 1 volt.) Now, when you DECODE, the troubles start. The 32 playback electronics cannot safely be set to this "high" output level, and the decoder will not "see", the same levels in playback. Decode errors will occur.

Consider also the fact that the DX-2D will increase your signal to noise ratio by 30 dB. If you record at a generally lower level you will avoid dbx problems and still have quiet tapes. Try using -5 or -7 VU as a "zero".

Mixing
Program material must be in uncompressed form for mixing and sound-on-sound recording. You must first decode the program material which has been encoded by the DX-2D in order to mix it with any other material – compressed or uncompressed. Of course, mixed material may be compressed again for recording. If this precaution is not followed, you'll get cross-modulation of the separate signals or tracks.
The little guys in the box will look at their "chart" and give you some really entertaining level shifts, as we have said, they're fast but dumb.

Subsonics and Interference
The DX-2D incorporates an effective bandpass filter with -3 dB response at 20 Hz and 30 kHz. This filter suppresses undesirable sub- and supersonic frequencies to keep them from introducing errors into the encode or decode process. However, if rumble from trains or trucks is picked up by your microphone and fed to the DX-2D – filters are not perfect – modulation of the program material during low level passages may occur. This low frequency component will not itself be passed through the recorder and so, will not be present at reproduce for proper decoding. If this low level decoding error is encountered, and subsonics are suspected, we suggest the addition of a suitable high pass filter ahead of the DX-2D and after the mic preamplifier for further attenuation of these subsonic frequencies.

M-30 RECORDING MIXER



The M-30, a multi-function recording mixer, not only offers multi-microphone recordings, mixing and equalization functions, but also offers the possibility to draw out any desired signal throughout sound processing, and the ability to mixdown to obtain a master tape on a 2-track tape deck.
We recommend the TASCAM M-30 RECORDING MIXER as the ideal partner for the 32.

FEATURES

INPUT SECTION

- 8 mic inputs (6 low impedance balanced, and 2 high impedance unbalanced mic inputs)
- 8 tape inputs
- 8 line inputs
- Mic/line/remix(tape) input selector
- Mic ATT (0/20/40)
- 2 band parametric equalizer (60 — 1.5 k, 1 k — 10 kHz plus 12.5 kHz shelving type equalizer (±15 dB))
- Mute switches
- Direct out
- Cue out
- Accessory send/receive for each input
- Overload indicator for each input
- Buss assign buttons and pan pots

MASTER SECTION

- 4 main program mixing busses
- Buss input for each buss
- Accessory send/receive for each buss
- 4 buss out (line out)
- Monitor gain and pan controls for each program buss
- Master fader
- Meter input selector (buss/monitor/submix)
- Stereo monitor headphones with volume control and input selector (monitor/submix)

SUBMIX SECTION

- 8 x 2 submixer
- Pre/post/tape input selector
- Gain and pan controls
- Submix master gain control
- Stereo submix out
- Stereo submix in

OTHERS

- 2 sets of stereo phono in/out terminals (built-in phono RIAA EQ)

SPECIFICATIONS

8-Input/4-Line Output/2-Monitor Output/2-Submix Output

Input Selector
- 1 – 6 channel: MIC (Low impedance)/REMIX/LINE
- 7, 8 channel: MIC (High impedance)/REMIX/LINE

Mic Input (Low impedance) – channel 1 – 6:
- Mic impedance: 200 to 600 ohms nominal mics (matched for mics of 600 ohms or less)
- Input impedance: 600 ohms, balanced XLR type
- Nominal input level: -60 dBV (1 mV)
- Maximum input level: +10 dBV (3 V) – ATT to 40 dB

Mic Input (High impedance) – channel 7, 8:
- Mic impedance: 10k ohms nominal mics
- Input impedance: 100k ohms
- Nominal input level: -60 dBV (1 mV)
- Maximum input level: +10 dBV (3 V) – ATT to 40 dB

Line Input
- Input impedance: 20k ohms
- Nominal input level: -10 dBV (0.3 V)
- Maximum input level: +14 dBV (5 V)

Tape Input:
- Input impedance: 50k ohms
- Nominal input level: -10 dBV (0.3 V)
- Maximum input level: +14 dBV (5 V)

Line Output:
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -10 dBV (0.3 V)
- Maximum output level: +14 dBV (5 V)

Monitor Output:
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -2.2 dBV (0.775 V)
- Maximum output level: +14 dBV (5 V)

Submix Output:
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -10 dBV (0.3 V)
- Maximum output level: +14 dBV (5 V)

Cue Output:
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -10 dBV (0.3 V)

Direct Output:
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -10 dBV (0.3 V)

ACCESS SEND Output (Input/Master Section):
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -10 dBV (0.3 V)

ACCESS Receive Input (Input/Master Section):
- Input impedance: 200k ohms
- Nominal input level: -10 dBV (0.3 V)
- Minimum input level: -18 dBV (0.13 V)

Submix input – channel L,R (and PRE, POST, TAPE 1 – 8):
- Input impedance: 10k ohms
- Nominal input level: -10 dBV (0.3 V)
- Maximum input level: +14 dBV (5 V)

Buss Input
- Input impedance: 10k ohms
- Nominal input level: -10 dBV (0.3 V)
- Maximum input level: +14 dBV (5 V)

Headphones Output:
- Load impedance: 8 ohms
- Maximum output power: Greater than 100 mW – Output VR at max.

Phono Input
- Input impedance: 45k ohms
- Nominal input level: -54 dBV (2 mV) at 1 kHz
- Minimum input level: -60 dBV (1 mV) at 1 kHz
- Maximum input level: -30 dBV (31.6 mV) at 1 kHz

Phono Output:
- Minimum load impedance: 5k ohms
- Nominal load impedance: 10k ohms
- Nominal output level: -10 dBV (0.3 V) at 1 kHz

Frequency Responce:
- Line output: 30 to 20,000 Hz, ±2 dB
- monitor output: 30 to 20,000 Hz, ±2 dB
- Submix output: 30 to 20,000 Hz, ±2 dB

Equalizer:
- Type: Peak Parametric and Shelving
- Level: ±15 dB
- Frequency, low: 60 to 1,500 Hz
- Middle: 1,000 to 10,000 Hz
- High: 12,500 Hz

Signal to Noise Ratio (A weighted/unweighted)
- Equivalent Mic (Low impedance): 116 dB WTD; 114 dB UNWTD (20 to 20,000 Hz)
- Mic (Low impedance)
  - 1 channel: Better than 66/64 dB
  - 6 channel: Better than 57/55 dB
- Mic (High impedance)
  - 1 channel: Better than 58/57 dB
  - 2 channel: Better than 55/53 dB
- Mic (Low and high impedance) 8 channel: Better than 53/51 dB
- Phono input to phono output: Better than 57 dB UNWTD (20 to 20,000 Hz)

Cross Talk: Better than 60 dB (1 kHz, Nominal input level)

Total Harmonic Distortion: Less than 0.1 % at 1 kHz, Nominal input level

Fader Attenuation: 60 dB or more

Overload Indicator Level: 25 dB above nominal input level

Peak Indicator Level: 10 dB above nominal output level

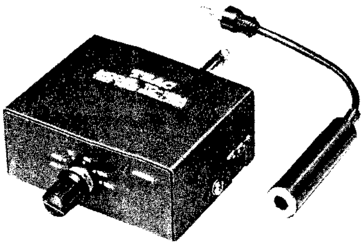
Dimensions (WxHxD): 465 x 160 x 520 mm (18-1/4" x 6-5/16" x 20-1/2")

Weight: 16 kg (35-5/16 lbs.)

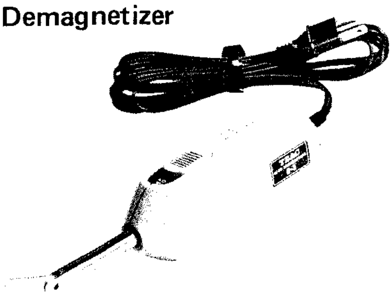
Power Requirement:
- 100/120/220/240 V AC, 50/60 Hz, 26 W (General Export Model)
- 120 V AC, 60 Hz, 26 W (U.S.A./Canada Model)
- 220 V AC, 50 Hz, 26 W (Europe Model)
- 240 V AC, 50 Hz, 26 W (UK/AUS Model)

ACCESSORY INFORMATION

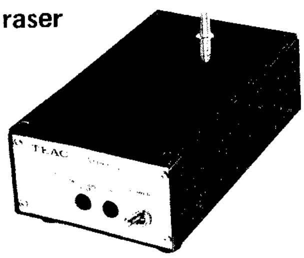
TO-122A Test Tone Oscillator
Checks input/output balance or other electric characteristics of the system chain. This unit is also useful for tape deck maintenance work.
*Output pin jack
*Output level -10 dB, -40 dB (0 dB/1 V)
*Selectable frequencies 40 Hz, 400 Hz,
1 kHz, 4 kHz, 10 kHz,
15 kHz



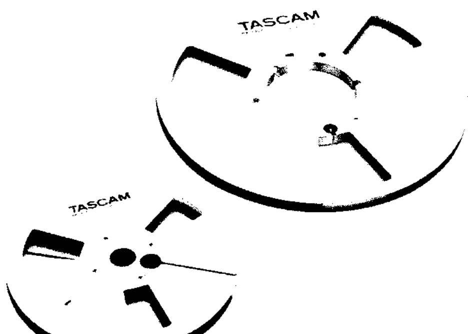
E-3 Head Demagnetizer



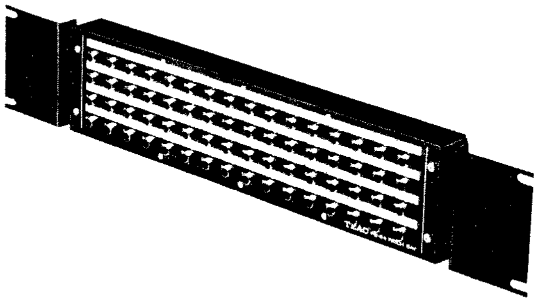
E-2A Bulk Eraser



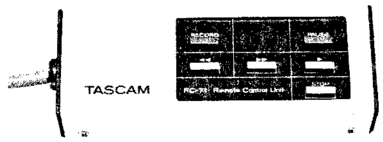
RE-1004 Reel (10-1/2", 1/4" tape)
RE-712 Reel (7", 1/4" tape)



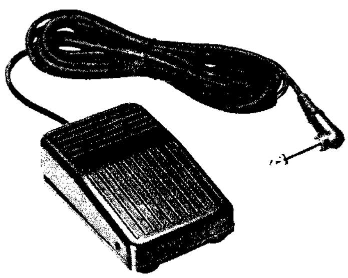
PB-64 Patch Bay
A tangle of cables is one of the growing vexations of any audio system. With all of the inputs and outputs plugged into the rear panel, jumper cables plugged into the front make any hookup you need neatly.



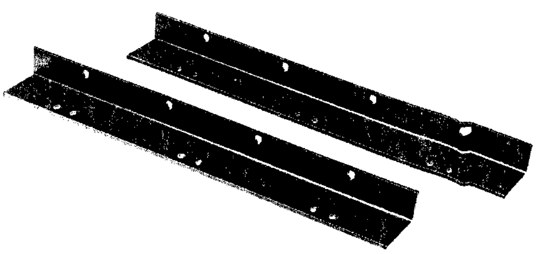
RC-71 Remote Control Unit



RC-30P Punch In/Out Remote Pedal

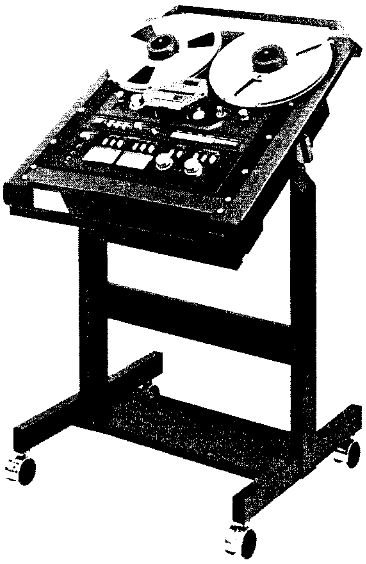


RM-300 Rack Mount Angle (EIA 19-inch)
The RM-300 is a rack mounting angle kit for the TASCAM recorder/reproducer 32 to enable mounting in the CS-607 or a standard 19-inch rack.



CS-607 Console Rack (EIA 19-inch)

The CS-607 is a standard 19-inch console rack to be used with the RM-300 for mounting of the TASCAM 32.



T-0804 Blank Panel (EIA 19-inch)

The T-0804 is designed to cover up the unavoidable blank spaces on the TASCAM CS-607 or equivalent EIA standard 19-inch rack.

Professional Low Loss Cable

There are vast differences in cable design and performance, and those differences can make or break an otherwise excellent sound system. When you're investing in the kind of high quality audio equipment represented by the TASCAM Studio Series, it makes sense to use TASCAM professional audio cables. Anyone who's switched to them will tell you they're worth every cent.

LOW CAPACITANCE

Our cables feature very low capacitance under 15 picofarads per foot, so they don't act as high-frequency roll-off filters as do typical cables of 100 or 300 pF/foot. In addition, our cables use an ultra-high density bare-copper braided shield (99 % coverage), so electrostatic noise (buzz or hum) and RFI (CB or broadcast signals) are kept out of your program.

Low capacitance is important, and so is consistent capacitance; that is, you want the electrical coupling of center conductor-to-shield to remain the same throughout the cable, even if it is sharply bent, crushed, flexed, or tugged. Should the local cable capacitance change, noise and/or signal losses often result. We utilize the unique dielectric known as Datalene. This special insulation keeps the stranded signal conductor perfectly centered within the shield. Datalene is about as flexible as foam core dielectrics but far more resistant to extreme heat or cold, and it has a "memory", so it retains its shape after flexing. Datalene also acts as a mechanical shock absorber, guarding against external impacts which, in other cables, might sever the center conductors and cause intermittent contact.

When we join the connector to the cable, we insert the cable's stranded center conductor all the way into the pin and then fill the pin with solder. The braid is wrapped and soldered a full 120° around the shell, not tacked at one spot, so you get maximum shielding and strength.

SPECIFICATIONS OF THE 32

MECHANICAL	
Tape:	1/4 inch, 1-1/2 mil, low noise, high output tape
Track Format:	2-track, 2-channel, track width, NAB 0.079 inch (2.0 mm), DIN 2.7 mm
Reel Size:	10-1/2" NAB (large) hub maximum
Tape Speeds:	15 inches per second (38 cm/sec.), 7-1/2 inches per second (19 cm/sec.); Variable, ±12 % relative to 15 ips/7-1/2 ips
Speed Accuracy:[1]	±0.8 % deviation
Wow and Flutter: [1]	
15 ips	±0.06 % peak (DIN/IEC/ANSI weighted) ±0.1 % peak (DIN/IEC/ANSI unweighted) 0.05 % RMS (JIS/NAB weighted) 0.07 % RMS (JIS/NAB unweighted)
7-1/2 ips	±0.09 % peak (DIN/IEC/ANSI weighted) ±0.12 % peak (DIN/IEC/ANSI unweighted) 0.07 % RMS (JIS/NAB weighted) 0.09 % RMS (JIS/NAB unweighted)
Fast Wind Time:	90 seconds for 10-1/2" reel 2,400 feet
Start Time:	Less than 0.8 sec. to reach standard Wow and Flutter
Capstan Motor:	FG (frequency generator) DC servo motor
Reel Motors:	2-slotless DC motors
Head Configuration:	3 heads; erase, record/reproduce x 2
Tape Cue:	Manual
Motion Sensing:	0.8 sec. ±0.15 sec. delay time, stop to next motion
Dimensions:	(W) 16-3/16" x (H) 18-3/16" x (D) 10-1/8" (410 x 461 x 256 mm)
Weight:	44.1 lbs (20 kg), net
ELECTRICAL	
Input Selector:	Line/Mic/Mic ATT (20 dB)
Line Input:	
Input impedance:	50k ohms, unbalanced
Maximum source impedance:	2.5k ohms
Nominal input level:	-10 dBV (0.3 V)
Maximum input level:	+18 dBV (8.0 V)
Mic Input:	
Source impedance:	10k ohms or less
Input impedance:	10k ohms, unbalanced
Nominal input level:	-60 dBV (1 mV)
Maximum input level:	-3 dBV (700 mV), with mic ATT (20 dB) engaged.
Line Output:	
Output impedance:	1 k ohms, unbalanced
Minimum load impedance:	10 kohms
Nominal load impedance:	50 k ohms
Nominal output level:	-10 dBV (0.3 V)
Maximum output level:	+18 dB (8.0 V)
Headphone output:	100 mW maximum at 8 ohms stereo headphones
Bias Frequency:	150 kHz
Equalization:	NAB (USA/Canada/General Export models): 3180 + 50 μsec. at 15 ips (38 cm/sec.), 7-1/2 ips (19 cm/sec.) IEC-1 (Europe/U.K./Australia models): ∞ + 35 μsec. at 15 ips (38 cm/sec.), ∞ + 70 μsec. at 7-1/2 ips (19 cm/sec.)
Record Level Calibration:	0 VU reference; 250 nWb/m tape flux level
Frequency Response:	
Record/Reproduce:[3]	
15 ips	40 Hz – 22 kHz, ±3 dB at 0 VU 40 Hz – 22 kHz, ±3 dB at -10 VU
7-1/2 ips	40 Hz – 16 kHz, ±3 dB at 0 VU 40 Hz – 20 kHz, ±3 dB at -10 VU
Sync and Reproduce:[2]	
15 ips	40 Hz – 22 kHz, ±3 dB
7-1/2 ips	40 Hz – 20 kHz, ±3 dB
Total Harmonic Distortion (THD):[3]	0.8 % at 0 VU, 1,000 Hz, 250 nWb/m 3 % at 13 dB above 0 VU, 1,000 Hz, 1,116 nWb/m

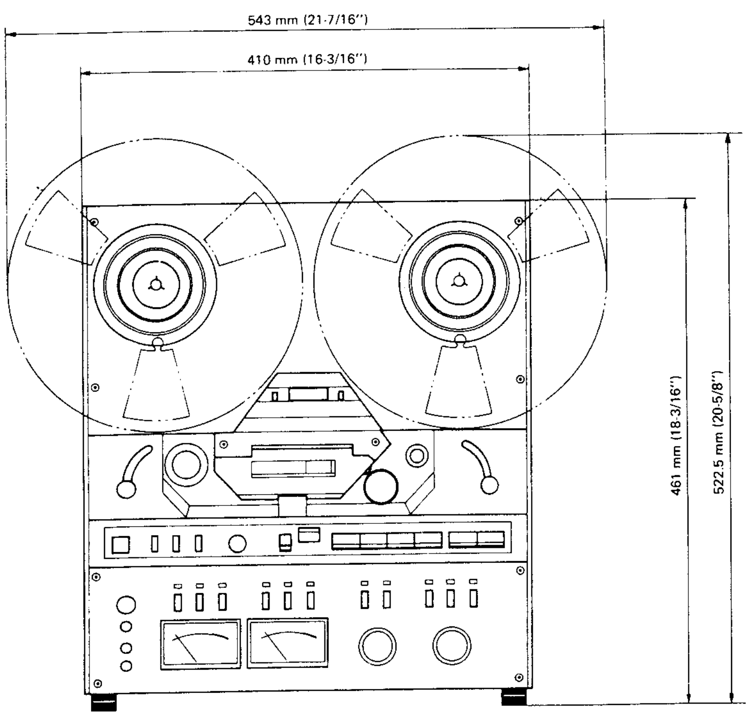
Signal-to-Noise Ratio:3)	At a reference of 1 kHz, at 13 dB above 0 VU, 1,116 nWb/m
15 ips	68 dB A weighted (NAB), 60 dB unweighted
7-2/2 ips	66 dB A weighted (NAB), 58 dB unweighted
	92 dB A weighted (NAB), with dbx*
	82 dB unweighted, with dbx
Adjacent Channel Crosstalk (Overall):3)	Better than 50 dB down at 1,000 Hz, 0 VU
Erasure:3)	Better than 65 dB at 1 kHz, +10 VU reference
Headroom:	Recording Amplifier – Better than 25 dB above 0 VU at 1 kHz
Connectors:	
Line inputs and outputs:	RCA jack
Mic input:	Phone jack (Tip-Sleeve)
Remote control:	Multi-Pin jack
Punch in/out remote:	Phone jack (Tip-Sleeve)
dbx unit:	Multi-Pin jack
Power Requirement:	100/120/220/240 V AC, 50/60 Hz, 70 W (General Export Model)
	120 V AC, 60 Hz, 70 W (USA/Canada Model)
	220 V AC, 50 Hz, 70 W (Europe Model)
	240 V AC, 50 Hz, 70 W (UK/AUS Model)

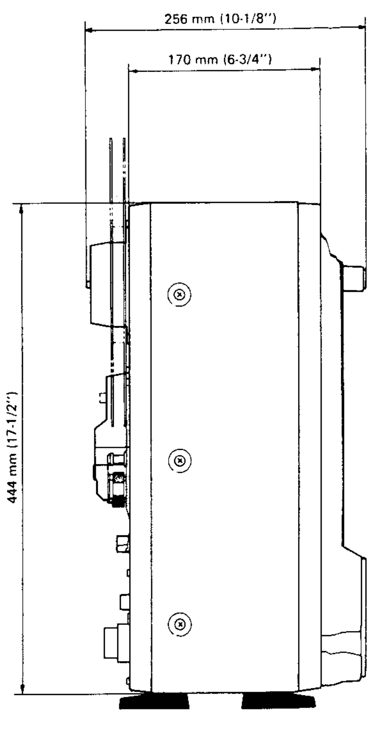
In these specifications, 0 dBV is referenced to 1.0 Volt. Actual voltage levels also are given in parenthesis. To calculate the 0 dB = 0.775 Volt reference level (i.e., 0 dBm in a 600-ohm circuit) add 2.2 dB to the listed dB value; i.e., –10 dB re: 1 V = –7.8 dB re: 0.775 V.

1) Specifications were determined using TEAC Test Tape YTT-2004/YTT-2003.
2) Specifications were determined using TEAC Test Tape YTT-1004/YTT-1003 (NAB Equalization), YTT-1044/YTT-10432 (IEC Equalization)
3) Specifications were determined using TEAC Test Tape YTT-8063.

Changes in specifications and features may be made without notice obligation.
*dbx is a trademarks of dbx Inc.

Options for:	
Mounting (Standard 19 inch rack):	RM-300 Rack Mount Angle, CS-607 Console Rack and T-0804 Blank Panel
Remote control:	Full transport function available with RC-71
Punch in/out remote control:	Punch in/out function available with RC-30P
DBX noise reduction:	DX-2D 2-channel DBX unit





THE dB; WHO, WHAT, WHY

No matter what happens to the signal while it is being processed, it will eventually be heard once again by a human ear. So the process of converting a sound to an electrical quantity and back to sound again must follow the logic of human hearing.

The first group of scientists and engineers to deal with the problems of understanding how the ear works were telephone company researchers, and the results of their investigations form the foundation of all the measurement systems we use in audio today. The folks at Bell Laboratories get the credit for finding out how we judge sound power, how quiet a sound an average person can hear, and almost all of the many other details about sound you must know before you can work with it successfully.

From this basic research, Bell Labs developed a system of units that could be applied to all phases of the system. Sound traveling on wires as electrical energy, sound on tape as magnetic energy, sound in air; anyplace that sound is, or has been stored as energy until some future time when it will again be sound, can be described by using the human ear-related system of numbers called "bels" named in honor of Alexander Graham Bell, the inventor of the telephone.

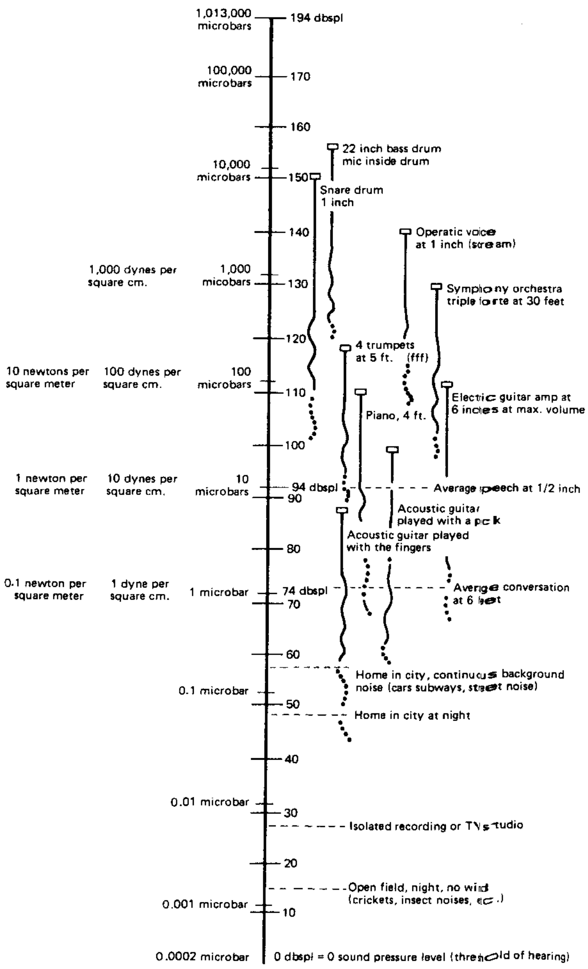
What is a bel and what does it stand for?

It means, very simply, twice as loud to the human ear. Twice as loud as what? An obvious question. The bel is always a comparison between two things. No matter what system of units of measure you are working with at the time, you must always state a value as a reference before you can compare another value to it by using bels, Volts, dynes, Webers — it doesn't matter, a bel, or ear-related statement of "twice as loud" is always a ratio, not an absolute number. Unless a zero, or "no difference" point is placed somewhere, no comparison is possible.

There are many positive and definite statements of reference in use today. But before we go over them, we should divide the "bel" into smaller units. "Twice as loud" will be a little crude to be used all the time. How about one tenth of a bel? Okay, the decibel it is, and 0 means "no difference, same as the reference". It seldom means "nothing". Now, if you double the power, is that twice as loud? No, it is only 3 dB more sound. If you double an electrical voltage, is it twice as loud? No, it is only 6 dB more sound. The unit quantities must follow nonlinear progressions to satisfy the ears' demand.

Remember, decibels follow the ears. All other quantities of measure must be increased in whatever units necessary to satisfy the human requirements, and may not be easy to visualize. Sound in air, our beginning reference, is the least sound the human ear (young men) can detect at 1000 to 4000 Hertz. Bell Labs measured this value to be .0002 microbar, so we say 0 dB = .0002 microbar and work our way up from the bottom, or from the point at which there is "no perceivable sound to humans". Here is a chart of sounds and their ratings in dB, using .0002 microbar pressure change in air as our reference for "0 dB spl" (Sound Pressure Level).

SOUND AND MUSIC REFERENCE



Since the reference is assumed to be the lowest possible audible value, dB spl (Sound Pressure Level) is almost always positive, and correctly written should have a + sign in front of the number. But it is frequently omitted. Negative dB spl would indicate so low an energy value as to be of interest to a scientist trying to record one cricket at 1,000 yds. distance, and is of no significance to the multichannel recordist. Far more to the point is the question "What is a microbar?" It is a unit of measurement related to atmospheric pressure and although it is extremely small, it must be divided down quite a lot before it will indicate the minimum pressure change in air that we consider minimum audible sound. This will give you a better idea of the sensitivity of the human ear.

One whole atmosphere, 14.70 pounds per square inch, equals 1.01325 bars. So one whole atmosphere in microbars comes out to be 1,013,250. One microbar of pressure change is slightly less than one millionth of an atmosphere, and you can find it on our chart as 74 dB spl. It is not terribly loud, but it is certainly not hard to hear. As a matter of fact, it represents the average power of conversational speech at 6 feet. This level is also used by the phone company to define normal earpiece volume on a standard telephone. Now think about that minimum audible threshold again:

.0002 microbar.

That's two ten-thousandths of a millionth part of one atmosphere!

This breakdown of one reference is not given just to amaze you, or even to provide a feel for the quantity of power that moderate levels of sound represent. Rather, it is intended to explain the reason we are saddled with a ratio/logarithm measurement system for audio. Adding and subtracting multi-digit numbers might be easy in this age of pocket calculators, but in the 1920's when the phone company began its research into sound and the human ear, a more easily-handled system of numbers became an absolute necessity. Convenience for the scientist and practical engineer, however, has left us with a system that requires a great deal of complex explanation before you can read and correctly interpret a "spec sheet" for almost any piece of gear.

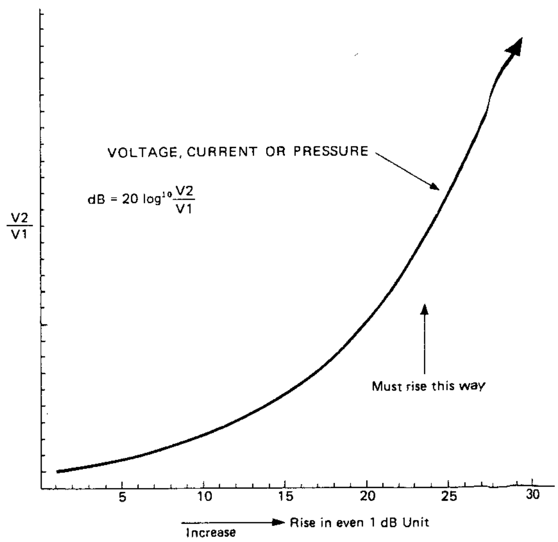
Here are the formulae for unit increment; but they are necessary only for designers, and unless you build your own gear, you won't have to deal with them. For power (watts) increase or loss, calculate by the following equation:

$$10 \text{ LOG}_{10} \frac{P2}{P1} = N \text{ (dB)}$$

For voltage, current or pressure calculations:

$$20 \text{ LOG}_{10} \frac{V2}{V1} = N \text{ (dB)}$$

Plotting the points resultant from using these equations we come up with the following chart. Once we have this chart, we can see the difference between the way humans perceive sound and the amount of force it takes to change air pressure. Unfortunately, the result is not a simple "twice as much pressure" of sound to be heard as "twice as loud". If you plot decibels as the even divisions on a graph, the unit increase you need is a very funny curve.



This is how the ear works, and we must adapt our system to it. We have no choice if we expect our loudspeaker to produce a sound that resembles the original sound we begin with. The high sensitivity to sound of the human ear produces a strong "energy" illusion that has confused listeners since early times. How powerful are the loudest sounds of music in real power? Can sound be used as a source of energy to do useful work, such as operating a car? For any normally "loud" sound the answer is, regrettably, no! perhaps not so regrettably, consider what would happen if one pound of pressure was applied not to your head, but directly to your inner ear. One pound of air pressure variation is 170 dB spl! This amount of "power" might do some useful work — but not much, it's still only one pound and to make use of it you will have to stand one mile away or you will go deaf immediately.

If we reduce our sound power to realistic musical values, we will not be injured, but we will have almost nothing (in real power terms) to run the mic with!

This low available energy is the reason that high gain amplifiers are required for microphones.

When we take a microphone and "pick up" the sound, we do have some leeway in deciding how much energy we must have in order to operate the electrical part of our system. If we can decide that we don't have to truly hear the signal while we are processing it from point to point and we can wait until the electronic devices have done all their routing and switching before we need audible sound, we can lower the power of the signal. What is a good value for a reference here? Well, we need to have enough energy so that the signal is not obscured by hiss, hum, buzz or other unpleasant things we don't want, but not so high that it costs a fortune in "juice" or electrical power. This was a big consideration for the telephone company.

They now have the world's biggest audio mixing system, and even when they started out, electricity was not free. They set their electrical power signal reference as low as was practical at the time, and it has lowered over the years as electronic equipment has gotten better. In 1939 the telephone company, radio broadcasting, and recording industry got together and standardized 1 milliwatt of power as 0 dBm, and this is still the standard of related industries. Thus, a 0 dBm signal into a 600 ohm-line impedance will present a voltage of 0.775 volts.

Once again, we owe you an explanation. Why does it say ZERO on the meter? What is an ohm? Why 600 of them and not some other value? What's a volt? Let's look at one thing at a time.

1. The logic of ZERO on the meter is another hangover from the telephone company practice. When you start a phone call in California, the significant information to a telephone company technician in Boston is — did the signal level drop? If so, how much? When the meter says ZERO it indicates (to the phone company) that there has been no loss in the transmission, and all is well. The reference level is one milliwatt of power, but the gain or loss is in the information the meter was supposed to display, so the logic of ZERO made good sense, and that's what they put on the dial. We still use it even though it's not logical for anything else, and the idea of a reference level described as a "no loss" ZERO, no matter what actual power is being measured, is so firmly set in the minds of everyone in the audio world that it is probably never going to change.

2. One ohm is a unit of resistance to the passage of electrical energy. The exact reasons for the choice of 600 ohms as a standard are connected to the demands of the circuits used for long distance transmission and are not simple or easy to explain. Suffice it to say that the worst possible thing you can do to a piece of electronic equipment is to lower the resistance it is expected to work into (the load). The lower the number of ohms, the harder it is to design a stable circuit. When you think about "load", the truth is just the opposite of what you might expect! 0 ohms is a "short circuit", not resistance to the passage of signal. If this condition occurs before your signal gets from California to Boston, you won't be able to talk — the circuit didn't "get there", it "shorted out". Once again, telephone company logic has entered the language on a permanent basis. Unless the value for ohms is infinity (no contact, no possible energy flow) you will be better off the higher the value, and many working electronic devices have input numbers in the millions or billions of ohms.

3. A volt is a unit of electrical pressure, and by itself is not enough to describe the electrical power available. To give you an analogy that may help, you can think of water in a hose. The pressure is not the amount of water, and fast flow will depend upon the size of the hose (impedance or resistance) as well. Increase the size of the pipe (lower the resistance, or Z) and pressure (volts) will drop unless you make more water (current) available to keep up the demand. This analogy works fairly well for DC current and voltage, but alternating current asks you to imagine

the water running in and out of the nozzle at whatever frequency your "circuit" is working at, and is harder to use as a mental aid. Water has never been known to flow out of a pipe at 10,000 cycles per second.

This reference level for a starting point has been used by radio, television, and many other groups in audio because the telephone company was the largest buyer for audio equipment. Most of the companies that built the gear started out working for the phone company and new audio industries, as they came along, found it economical to use as many off-the-shelf components as they could, even though they were not routing signals from one end of the world to the other.
Must we use this telephone standard for recording? Its use in audio has been so widespread that many people have assumed that it was the only choice for quality audio. Not so.

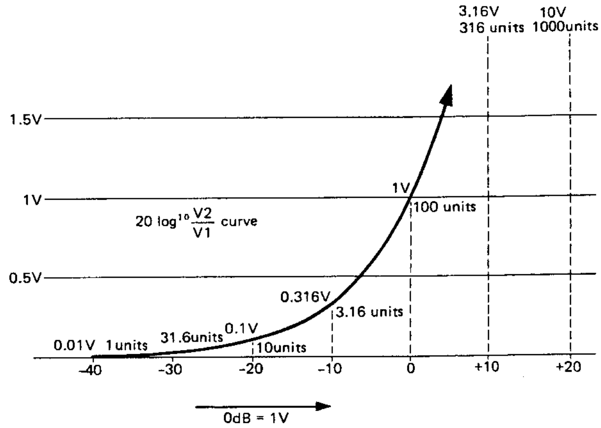
A 600-ohm, 3-wire transformer-isolated circuit is a necessity for the telephone company, but the primary reason it is used has nothing to do with audio quality. It is noise, hum and buzz rejection in really long line operation (hundreds and hundreds of miles).
Quality audio does not demand 600-ohm, 3-wire circuitry. In fact, when shielding and isolation are not the major consideration, there are big advantages in using the 2-wire system that go well beyond cost reduction. It is, as a system, inherently capable of much better performance than 3-wire transformer-isolated circuits.

Since TASCAM's mixers are designed to route a signal from a mic to a recorder, we think that the 2-wire system is a wise choice. The internationally accepted standard (IEC) for electronics of this kind uses a voltage reference without specifying the exact load it is expected to drive. The reference is this:

0 dB = 1 Volt

This is now the preferred reference for all electronic work except for the telephone company and some parts of the radio and television business. Long distance electronic transmission still requires the 600-ohm standard.

If your test gear has a provision for inserting a 600-ohm load, be sure the load is not used when working on TASCAM equipment.
Now that we have given a reference for our "0 dB" point, we can print the funny curve again, with numbers on it, and you can read voltages to go along with the changes in dB.



IMPEDANCE MATCHING AND LINE LEVELS

All electronic parts, including cables and non-powered devices (mics, passive maxiers and such), have impedance, measurable in ohms (symbol Ω or Z). Impedance is the total opposition a part presents to the flow of signal, and it's important to understand some things about this value when you are making connections in your mixing system. The outputs of circuits have an impedance rating and so do inputs. What's good? What values are best? It depends on the direction of signal flow, and in theory, it looks like this:

OUTPUTS —— Plug into ——→ INPUTS

It is generally said that the output impedance (Z) should be as low as possible. 100 ohms, 10 ohms. The lower, the better, in theory. A circuit with a low output impedance will offer a low resistance to the passage of signal, and thus will be able to supply many multiple connections without a loss in performance or a voltage drop in any part of the total signal pathway. Low impedance values can be achieved economically by using transistors and integrated circuits, but other considerations are still a problem in practice.

1. The practical power supply is not infinitely large. At some point, even if the circuit is capable of supplying more energy you will run out of "juice".
2. Long before this happens, you may burn out other parts of the circuit. The output impedance may be close to the theoretically ideal "ohms" but many parts in the practical circuit are not. Passing energy through a resistance generates heat and too much current will literally burn parts right off the circuit board if steps are not taken to prevent catastrophic failure.
3. Even if the circuit does not destroy itself, too high a demand for current may seriously affect the quality of the audio. Distortion will rise, frequency response will suffer, and you will get poor results.

Inputs should have very high impedance numbers, as high as possible (100,000 ohms, 1 million ohms, more, if it can be arranged). A high resistance to the flow of signal at first sounds bad, but you are not going to build the gear. If the designer tells you his input will work properly and has no need for a large amount of signal, you can assume that he means what he says. For you, a high input impedance is a virtue. It means that the circuit will do its job with a minimum of electrical energy at the beginning. The most "economical" electronic devices in use today have input impedances of many millions of ohms. Test gear, for example, voltmeters of good quality must not draw signal away from what they are measuring, or they will disturb the proper operation of the circuit. A design engineer needs to see what is going on in his design without destroying it, so he must have an "efficient" device to measure with.

SOURCE (output) —— Plugs into ——→ LOAD (input)

The classic procedure for measuring output impedance is to reduce the load's impedance until the output voltage drops 6 dB (half the original power) and note what the load value is. In theory, you now have a load impedance that is equal to the output impedance. If you gradually reduce the load (increase the input impedance), the dB reading will return slowly to its original value. How much drop is acceptable? What load will be left when an acceptable drop is read on the meter?

Traditionally, when the load value (input Z) is approximately seven times the output impedance, the needle is still a little more than 1 dB lower than the original reading.

Most technicians say, "1 dB, not bad, that's acceptable." We at TASCAM must say that we do not agree. We think that a seven-to-one ratio of input (7) to output (1) is not a high enough ratio, and here's why:

1. The measurement is usually made at a mid-range frequency and does not show true loss at the frequency extremes. What about the drop at 20 Hz or 30 kHz?
2. All outputs are not measured at the same time. Most people don't have twenty meters, we do. Remember, everybody plays together when you record and the circuit demands, in practice, are simultaneous. All draw power at the same time.

Because of the widely misunderstood rule of thumb — the seven-to-one ratio — we will give you the value for output impedance.

True Output Impedance
Even though the true output impedance may be low, say 100 ohms, it takes a lab to check the rule of thumb, so for the practical reasons we have explained, the use of the ratio method of impedance calculation must be changed to a higher ratio. We prefer 100:1 if possible and we consider 50:1 to be the minimum ratio that we think safe. Because of this, we will give you a number for ohms that you can match, Minimum Load Impedance. No calculations, we have made them already.

Minimum Load Impedance
MAKE CERTAIN THAT YOU CONNECT NO TOTAL LOAD IMPEDANCE LOWER (numerically) THAN THIS FIGURE.

LINE OUTPUT : 10k ohms

Nominal Load Impedance
Our specifications usually show 10,000 ohms as a Nominal Load Impedance. This load will assure optimum performance. Remember, any impedance lower than 10,000 ohms is more load.

Input Impedance
Input impedance is more straight forward and requires only one number. Here are the values for the 32.

LINE INPUT : 50k ohms
MIC INPUT : 10k ohms

If one output is to be "Y" connected to two inputs the total impedance of the two inputs must not be lower than the minimum load impedance, mentioned above, and if it becomes necessary to increase the number of inputs with slight reduction of the load specifications, you must check for a drop in level, a loss of headroom, low frequency response, or else suffer from a bad recording. If one input is 10,000 ohms, another of the same 10,000 ohms will give you a total input impedance (load) of 5,000 ohms. To avoid calculations you can do the following when you have two inputs to connect to one output.

Take the lower value of the two input impedance and divide it in half. If the number you have is greater than the minimum load impedance, you can connect both at the same time. Remember, we are not using the true output impedance we are using the adjusted number, the minimum output load impedance.

If you must have exact values here is the formula for dissimilar 2 loads or inputs:

$$Rx = \frac{R1 \times R2}{R1 + R2}$$

When you have more than two loads (inputs), just dividing the lowest impedance by the number of inputs will not be accurate unless they are all the same size. But if you still get a number that is higher than the minimum load impedance by this method, you can connect without worry.

If you must have exact values, here is the formula for more than 2 loads or inputs:

$$Rx = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \ldots\ldots + \frac{1}{Rn}}$$

Rx = Value of Total Load

Finding Impedance Values on Other Brands of Equipment

When you are reading an output impedance specification, you will occasionally see this kind of statement

Minimum load impedance = x ohms
or
Maximum load impedance = x ohms

These two statements are trying to say the same thing, and can be very confusing. The minimum load impedance says: please don't make the NUMBER of ohms you connect to this output any lower than x ohms. That's the lowest NUMBER. The second statement changes the logic, but says the exact same thing.

Maximum load impedance refers to the idea of the LOAD instead of the number, and says: please don't make the LOAD any heavier. How do you increase the load? Make the number lower for ohms. Maximum load means minimum ohms, so read carefully.

When the minimum/maximum statement is made, you can safely assume that the manufacturer has already done his calculations, and the number given in ohms does not have to be multiplied. You can MATCH the value of your input to this number of ohms successfully; but as always, higher ohms will be okay (less load).

Occasionally, a manufacturer will want to show you that 7 times the output Z is not quite the right idea and will give the output impedance and the correct load this way, they will call the output impedance the True Output Impedance and then will give the recommended minimum LOAD impedance. It may be a higher or lower ratio than 7 times and will be whatever the specific circuit in question requires.

REFERENCE LEVELS

We should talk about one more reference, a practical one.

Anyone who has ever watched a VU meter bounce around while recording knows that "real sound" is not a fixed value of energy. It varies with time and can range from "no reading" to "good grief" in less time than it takes to blink. In order to give you the numbers for gain, headroom and noise in our mixers, we must use a steady signal that will not jump around. We use a tone of 1000 Hz and start it out at a level of -60 dB at the mic input, our beginning reference level. All levels after the mic input will be higher than this, showing that they have been amplified, and eventually we will come to the last output of the mixer – the line-out and the reference signal there will be -10 dB, our "line level" reference.

From this you can see that if your sound is louder than 94 dB spl – your mic will produce more electricity from a sound of 94 dB spl than -60 dB, all these numbers will be changed. We have set this reference for mic level fairly low. If you examine the sound power or sound pressure level (spl) chart on page 21 you will see that most musical instruments are louder on the average than 94 dB spl, and most commercial mics will produce more electricity than the -60 dB for a sound pressure of 94 dB, so you should have no problems getting up to "0 VU" or your recorder.

We should also make a point of mentioning that the maximum number on the chart on page 21 represents "peak power" and not average power. The reason? Consider if even some momentary part of your recording is distorted, it will force a re-recording and it is wisest to be prepared for the highest values and pressure even if they only happen "once in a while". On this point, statistics are not going to be useful, the average sound pressure is not the whole story. The words themselves can be used as an example. Say the word "statistics" close to the mic while watching the meters and the peak LED level detector. Then say the word "average". What you are likely to see are two good examples of the problems encountered in the "real world" of recording. The strong peaks in the "s" and "t" sounds will probably cause the LED's to flash long before the VU meter reads anywhere near "zero" while the vowel sounds that make up the word "average" will cause no such drastic action.

To allow peaks to pass undistorted through a chain of audio parts, the individual gain stages must all have a large reserve capability. If the average is X, then X +20 dB is usually safe for speech, but extremely percussive sounds may require as much as 40 dB of "reserve" to insure good results. Woodblocks, castanets, latin percussion (guido, afuche) are good examples of this short term violence that will show a large difference between "LED flash" and actual meter movement. When you are dealing with this kind of sound, believe the LED, it is telling you the truth.

If you are going to record very loud sounds you may produce more electrical power from the mic than the mixer can handle as an input. How can you estimate this in advance? Well, the spl chart and the mic sensitivity are tied together on a one-to-one basis. If 94 dB spl in gives −60 dB (1 mV) out, 104 dB spl will give you −50 dB out, and so forth. Use the number, on our chart for sound power together with your mic sensitivity ratings to find out how much level, then check that against the maximum input levels for the various jacks on your mixer. If your mic is in fact producing −10 dB or line level, there is nothing wrong with plugging it into the line-level connections on the mixer. You will need an adaptor, but after that it will work!

Most mic manufacturers give the output of their mics as a minus-so-many-dB number, but they don't give the loudness of the test sound in dB, it's stated as a pressure reference (usually 10 microbars of pressure). This reference can be found on our sound chart. It is 94 dB spl, 10 microbars, 10 dynes per cm^2 or 1 Newton per square meter. For mics, the reference "0" is 1 volt (dB). So, if the sound is 94 dB spl the electrical output of the mic is given as −60 dB, meaning so many dB less than the reference 0 = 1 volt. In practice you will see levels of −60 dB for low level dynamics, up to about −40 dB or slightly higher for the better grade of condenser mics available today. TASCAM recorders and mixers work at a level of −10 dB referenced to 1 volt (.316 volt) so, for 94 dB spl, a mic with a reference output of −60 dB will need 50 dB of amplification from your mixer or recorder in order to see "0 VU" (−10 dB) on your meter. Now, if the sound you want to record is louder than 94 dB spl, the output from the mic will be more powerful and you will need less amplification from your mixer to make the needles on your recorder read "0 VU".

CALIBRATION

NOTE:
Peak meters may vary considerably in the values which are equivalent to 0 VU. If any of the equivalent in your system uses peak meters, make sure you match your peak meter levels to correspond to 0 VU; do not automatically assume a direct correlation between the readings on the two different types of meters.

"Calibration" simply means matching all the reference levels in your recording system to ensure that signals from one element in the system are equally interpreted by all the other elements in the system.
If you're really serious about making true professional-quality recordings, then a reliable tone generator is a necessity in order to accurately calibrate your system. We recommend the TEAC TO-122A test-tone oscillator. When using a tone generator, select a signal that will be equivalent to 0 VU when passed through the device to which you are calibrating the 32 . For example, if you are using a mixer with 0 dB referenced to 1 V (TASCAM mixers and recorders all use this reference level) and the mic input level is -60 dB and the line level (both input and output) is -10 dB, then, with the mixer's faders set to the shaded area, a 1 mV signal fed through the mic input or a 316 mV signal fed through the line input can be used to precisely establish the 0 VU level on the mixer. In this case (as with TASCAM line), -10 dB corresponds to 0 VU. If the equipment you are using references 0 dB to .775 V rather than 1 V, then a correction factor of 2.2 dB will have to be used to compensate for the diference.
The frequency of the tone used as the calibration signal has little effect on calibration, so any reasonable frequency may be used (400 Hz or 1 kHz is recommended). If you wish to calibrate your system without a tone generator, any source that produces a sustained tone, such as a musical instrument or even a vacuum cleaner, can be used to generate a reference signal; however, since there is no way to measure the reference level of such signal, experimentation with microphone placement and/or different volumes will be required to establish a reasonable recording reference level.

To calibrate, use a sustained tone and set the controls on your mixer and/or multitrack recorder so that their VU meters read 0 VU, and, passing the signal through the multitrack recorder and/or mixer, set the controls on the 32 so that its VU meters also read 0 VU. After calibrating your system, make all subsequent level adjustments from the mixer or the first unit receiving input in the recording chain; do not change the controls on the rest of your equipment.

When using an oscillator for system calibration, start with a frequency setting somewhere midpoint in the audio range. This ensure that frequency limitations of metering circuitry will not affect accuracy. The audio range is three decades wide so choose a frequency typically in the 200 to 2,000 Hz area of the audio range.

All TASCAM mixers and recorders use the IEC standard, 1 V = 0 dB or 0 dBV, as the reference to which all measurements are made. The input level (and output level) that TASCAM gear uses as its 0 VU reference, is -10 dBV, or 0.316 V. If any of the gears you use have a different reference (eg. 0 = .775 V/600 ohms) then use the appropriate correction factor as follows:

0 dBV = 1 V	Voltage	0 dBm = 0.775 V/ 600 ohms
+6 dB	2 V	+8.2 dB
+1.78 dB	1.228 V	+4 dB*2
0 dB	**1 V**	+2.2 dB
-2.2 dB	**0.775 V**	**0 dB**
-6 dB	0.5 V	-3.8 dB
-8.2 dB	0.388 V	-6 dB
*1 **-10 dB**	**0.316 V**	-7.8 dB
-12 dB	0.250 V	-9.8 dB
-12.2 dB	**0.245 V**	**-10 dB**
-20 dB	0.1 V	-17.8 dB

Note:
*1. TASCAM STANDARD LEVEL = 0 VU.
*2. Low Impedance System Level = 0 VU.

Peak meters read 3 dB or so higher than RMS or VU meters, so when calibrating your system make sure that any peak meters are reading properly to compensate the difference.

MORE INFORMATION IS AVAILABLE

We've tried to give you representative examples of some of the things you can do to get started, and you'll discover many more – some by way of happy coincidence, others after long hours of concentration. If you're just getting into recording and want to expand your knowledge, more information is available.

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ACOUSTICS
McGraw-Hill Book Co. Inc.
New York, New York
1954
More concerned with exact formulae, but still very readable. It is not necessary to do calculations to gain knowledge from this textbook.

Beranek, Leo L.
MUSIC, ACOUSTICS AND ARCHITECTURE
John Wiley & Sons, Inc.
New York, N.Y.
1962
A technical survey on concert halls with much documentation. Worth reading, this author has many useful stories to tell about the interface of science and art.

Clifford, Martin
MICROPHONES: HOW THEY WORK AND HOW TO USE THEM
Tab Books
Blue Ridge Summit, Pa.
1977
An excellent low cost book for the beginner on microphone types, history and construction. The explanations given assume no prior knowledge and are very complete. Recommended.

Everest F. Alton
ACOUSTIC TECHNIQUES FOR HOME AND STUDIO (3rd. Printing)
Tab Books
Blue Ridge Summit, Pa.
1978
Low cost basic book. This book on studio acoustics is the easiest to read and understand of all the textbooks on the subject, and comes closest to dealing with the actual problems encountered in the home studio.

Everest F. Alton
HANDBOOK OF MULTICHANNEL RECORDING
Tab Books
Blue Ridge Summit, Pa.
1976
A survey volume containing good information on all topics. Very clearly written and recommended for a beginner.

Nisbett, Alec
THE TECHNICS OF THE SOUND STUDIO FOR RADIO, TELEVISION AND FILM
Hastings House Publishers, Inc.
New York, N.Y.
1976
Although not specifically written for the tape recordist, this 500 page book is well worth its cost. Very useful practical advice if you are working with speech (drama, commercial announcing, etc.)

Nisbett, Alec
THE USE OF MICROPHONES
Hastings House
New York, N.Y.
1976
The authors point of view is basically radio, but has ability to communicate difficult concepts is very good. Well illustrated.

Olsen, Harry F.
ACOUSTICAL ENGINEERING
D. Van Nostrand Company
New York, N.Y.
1957

and

Olsen, Harry F.
MUSICAL ENGINEERING
D. Van Nostrand Company
New York, N.Y.
1959
Anything you can find by this writer is worthwhile, and the latter book in particular will give scientific answers to questions (what frequency is the note D♭ above middle C?) and can be used to translate one "language" into another. Extremely valuable.

Rettinger, Michael
ACOUSTIC DESIGN AND NOISE CONTROL, VOL. 1
Chemical Publishing Company
New York, N.Y.
1977
Although this book is highly technical, the writing is very lucid and many examples are given to go along with the math. This writer is not afraid to draw conclusions and give his reasons for doing so in simple language.

Runstein, Robert E.
MODERN RECORDING TECHNIQUES
Howard W. Sams and Co.
Indianapolis, Indiana
1974
The first low cost book on studio practice. The equipment dealt with is somewhat outdated, but the theory is still the same. Excellent basic survey.

Tremaine, Howard M.
THE AUDIO CYCLOPEDIA
Howard W. Sams and Co.
Indianapolis, Indiana
1976
This 1,700 page reference work is sure to contain the answer to almost any technical question you can think of. The writing assumes much prior knowledge and this book should be used with others that are more basic in their writing style if you are new to the field of scientific audio.

SOME MAGAZINES OF INTEREST:

"db" – THE SOUND ENGINEERING MAGAZINE
1120 Old Country Road
Plainview, N.Y. 11803

"MODERN RECORDING"
14 Vanderventer Avenue
Port Washington, N.Y. 11050

"RE/P" – RECORDING ENGINEER/PRODUCER
1850 Whitley Street, Suite 220
Hollywood, Ca. 90028

THEORY OF OPERAION–MAINTENANCE

If you are new to high quality sound recording equipment, you should become aware of the fact that high quality sound requires high quality maintenance.

Recording studios that rent time by the hour are very fussy about maintaining their equipment. Tape recorders and other electronic gear in the studio are checked out before every session. And, if necessary, adjusted to "spec" by an "in house" service technician. He is usually prepared to correct any problem from a minor shift in circuit performance to major breakdown in a motor. He has a full stock of spare parts and all the test equipment he needs.

Now that you are running your own "studio" you will have to make some decisions about maintaining it, and your 32. You will have to become your own "in house" service technician. Well, what about the test gear and the spare parts? A stock of spare parts and a super deluxe electronic test bench can easily cost many times the price of the recorder. Fortunately, the most frequently needed adjustments use the least expensive equipment, and the very costly devices are only needed for major parts replacements such as drive and rewind motors or head assemblies. Replacing parts cannot be considered "daily maintenance" by any means, so we suggest that you leave the major mechanical and electrical repair to the Dealer Service Center. That's what it's for.

Adjustments to the motors – back tension and brake torque are not required often and can safely be left to dealer service. The adjustments for wow and flutter require several thousands of dollars of test gear to perform. It's not practical to consider doing these adjustments yourself unless you have fifty machines to service. Then it might pay to buy the test gear.

In order to help you make plans about the more routine adjustments to your 32, we have made this section of the manual as easy to understand as technology will allow. It's a short course in tape recorder theory as well as a list of adjustments and will help you to understand what is going on inside when you record. Read the manual, decide what test equipment you can afford (although it is not violently expensive, it is not free) and determine what service you can do yourself.

CLEANING

IMPORTANT:

Do not overlook the importance of cleaning. Insuffıcent cleaning is the number one cause of the degradation of performance levels.

The first thing you will need for service is definitely the least expensive – Cleaning fluids and swabs. The whole outfit, 2 fluids and all the cotton swabs you'll need for months cost 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 after every session. Clean up every time you take a break in the middle of a session (we're serious).** How come? Well there are two good reasons we can think of right off the top:

1. Any dirt or oxide buildup on the heads will force the tape away from the gaps that record and playback. This will drastically affect the response. Even so small a layer of dirt as one thousandth of an inch will cause big trouble. All the money you have paid for high performance will be wiped out by a bit of oxide. Wipe it off with head cleaner and get back to normal.
2. Tape and tape oxide act very much the same as fine sandpaper. The combination will grind down the tape path in time. If you don't clean off this abrasive on a regular basis, the wear will be much more rapid and, what's worse, it will become irregular. Even wear on heads can be compensated for by electronic adjustments for a time, 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, thus dropping more abrasive, thus causing more uneven wear and so – a vicious spiral that can't be stopped once it gets a good start. The only solution will then be to replace not only the heads, but all the tape guides as well. Being conscientious about cleaning the tape path on the 32 will more than double the service life of the head assembly.

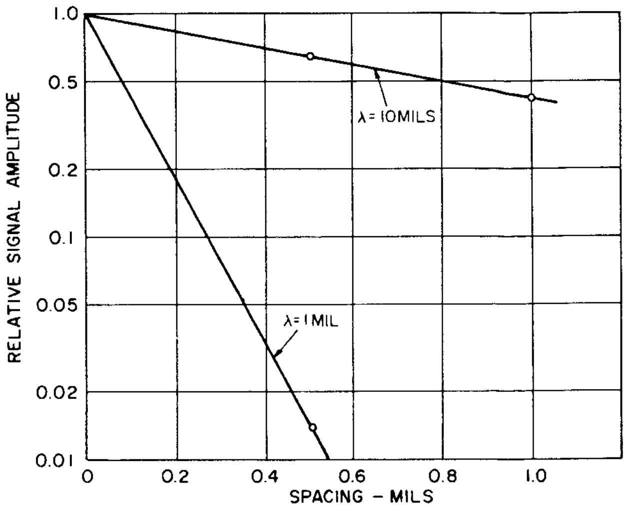


Fig. 2-7 Curves showing fall-off of reproduced signals versus spacing from reproducer head.
(Courtesy, Minnesota Mining and Manufacturing Co.)

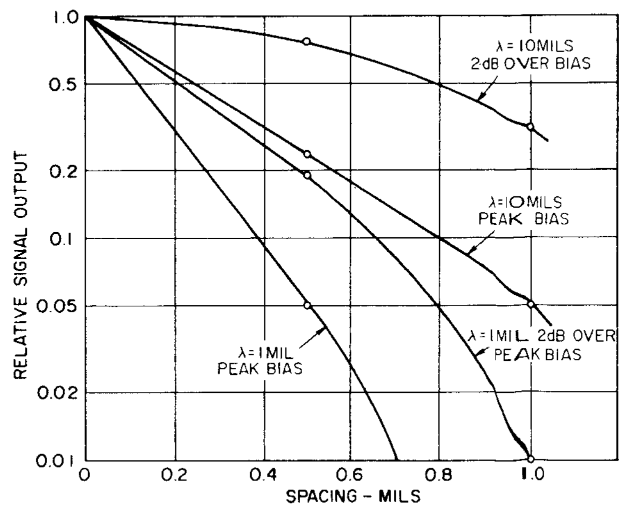


Fig. 2-8 Curves showing the fall-off of recorded signals versus spacing from recording head.
(Courtesy, Minnesota Mining and Manufacturing Co.)

DEGAUSSING (DEMAGNETIZING)

IMPORTANT:

1. **Do not overlook the importance of degaussing. Magnetism in the tape can significantly degrade performance. In extreme causes, the heads may not respond to signals at all.**
2. **Turn off the deck before degaussing.**
3. **Do not turn the degausser (E-3) off or on while it is in close proximity to the tape path.**
4. **Keep all recorded tape a safe distance from the degausser.**

A little stray magnetism goes a long way. A long way towards making trouble for your tapes. It only takes a small amount (0.2 gauss) to cause trouble on the record head and playing 10 rolls of tape will put about that much charge on the heads and other ferrous parts of the tape path. A little more than that (0.7 gauss) will start to erase high frequency signal on previously recorded tapes. Demagnetize the whole tape path, including the tips of the tension arms every six fully played 10-1/2" reels. This is a fair "rule of thumb" even though it may be a bit hard to keep track of. Fast motion isn't as significant to the heads, so we don't give an hourly reference. It's the record/play time that counts.

Degaussing is always done with the recorder turned off. If you try it with the electronics on, the 60 cycle current pulses produced by the degausser will look just like 60 Hz audio to the heads, at about 10,000 VU and will seriously damage the electronics and/or the meters. Turn off the machine, turn on the degausser at least 3 feet away from the recorder. Move slowly in to the tape path. Move the degausser slowly up and down in close proximity to all ferrous parts and, slowly move away to at least 3 feet before turning off.

It's a good idea to concentrate when you are degaussing. Don't try to hold a conversation or think of anything else but the job you are doing. If the degausser is turned off or on by accident while it is near the heads, you may put a permanent charge on them that no amount of careful degaussing will remove – head replacement time again, we're sorry to say. Make sure you are wide awake for this procedure.

A clean and properly demagnetized tape recorder will maintain its performance without any other attention for quite some time. Even if it does drift as a recorder, it won't ruin previously recorded material, and getting it back in good shape will not be too difficult.

TEST EQUIPMENT/MATERIALS

To make electronic adjustments, you need test gear, so let's go over what's necessary.

1) Alignment Tapes

You need one for each speed that the recorder operates at. For the 32 the specs are:

Reference fluxivity:	250 nWb/m
Equalization standard:	NAB
15 ips (38 cm/sec)	3180 μs + 50 μs
7-1/2 ips (19 cm/sec)	3180 μs + 50 μs
Equalization standard:	IEC – 1
15 ips (38 cm/sec)	∞ +35 μsec
7-1/2 ips (19 cm/sec)	∞ +70 μsec

These test tapes are made by several companies, but there are many different tape specs. Be sure you have the right one. See page 39.

Reference Fluxivity – How much magnetic energy is necessary on the tape to make the meter read "0 VU" in playback? This is the "benchmark", or standard you tune your playback electronics to. 250 nano Webers per meter is the correct value for the 32. If a lower or higher "Reference Fluxivity" is used to set up the playback, all your other measurements will be off.

NAB Equalization – Here we have a lot to talk about. The process of magnetic recording is far from "flat." Every circuit in a tape recorder will alter the level of signal with respect to its frequency – some deliberately, some unavoidably. The deliberate errors are used to overcome the unavoidable problems. Here is a selection of frequency response graphs at various points in the recording process:

1. The input signal starts this way in the beginning (FLAT).

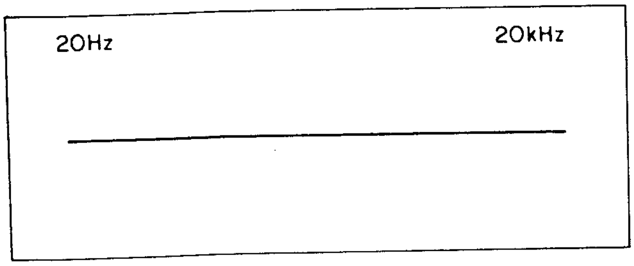


Fig. 2-9

2. EQ to overcome head loss at high frequency and bass anomalies (NAB)
Deliberate error

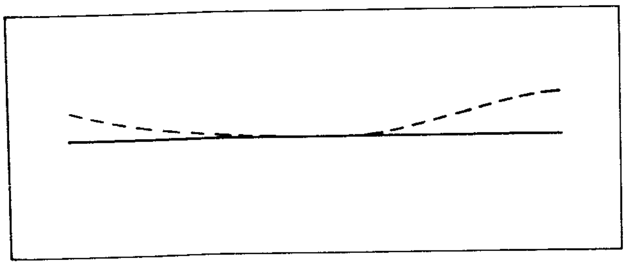


Fig. 2-10

3. Record Head Response
(6 dB per octave rise until gap in head approaches wavelength)
Unavoidable error
Small wavelengths (high frequencies) are partially erased as fast as they are recorded.

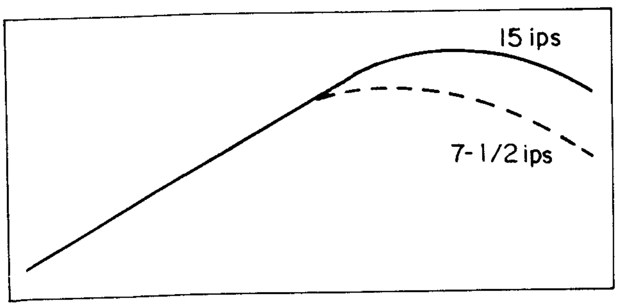


Fig. 2-11

We will assume something is recorded, but it's not flat on the tape either. Now we'll play it back.

4. Reproduce Head Response
(6 dB per octave rise again, same as record head).
Unavoidable error,
Small wavelengths are not picked up by gap.

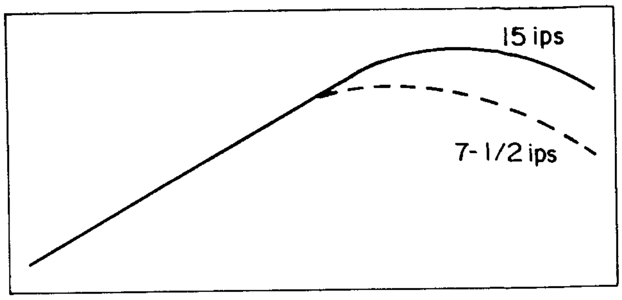


Fig. 2-12

5. Reproduce EQ
Now we must overcome the characteristic response of heads.
Big deliberate error
Helps lower tape hiss as well as restoring proper levels to high frequencies.

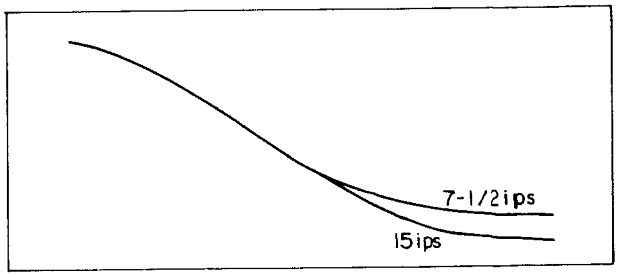


Fig. 2-13

6. The result of all this equalization is this (hopefully).

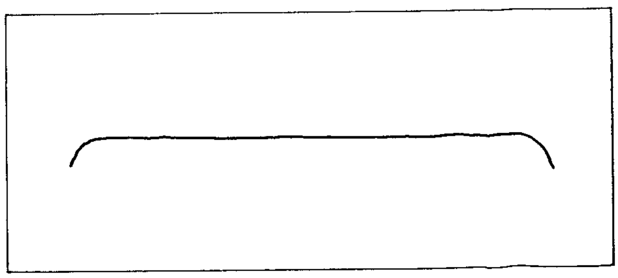


Fig. 2-14

The idea is to use the electronics that are adjustable to cope with the problems that are caused by the nature of the magnetic recording process. We can't change the basic laws of magnetic physics, so we change the record and reproduce equalization. Now comes the sticky part. How much EQ do we use in each stage? If every manufacturer of tape recorders used their own standard, their idea of what was best, there would be no compatibility. Tapes made on one recorder would not reproduce properly on another of different make. The standards for record and reproduce equalization are established by societies of scientists, engineers and users in the profession. They are:

- NAB National Association of Broadcasters
- IEC International Electrotechnical Commission
- CCIR International Radio Consultive Commission
- DIN Deutsche Industrie Normen

Unfortunately, they don't all agree. Each organization has a slightly different approach to solving the problems of tape recording. Scientists and engineers are human, as well, and have been known to disagree, sometimes violently about what ways are best. Advances in the manufacture of tape, improvements in head design, and the lowering of electronic circuit costs have made bizarre solutions quickly change into practical realities. The optimums have shifted and will probably continue to do so. Standards are set by man, not cast in stone.

But while the scientists are boxing in the conference room, we would like to be recording, so depending on the equalization requirements of its final destination, TASCAM has selected the NAB and IEC standards for record/reproduce equalization as the recommendation for the 32. See page 39 for details.

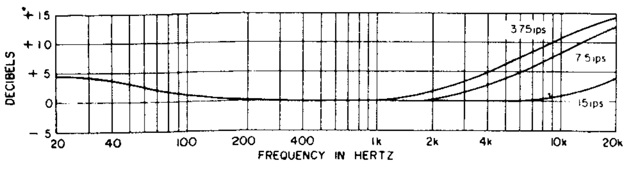


Fig. 2-15 Typical recording (pre-equalization) for 1/4-inch tape recorders using NAB characteristics.

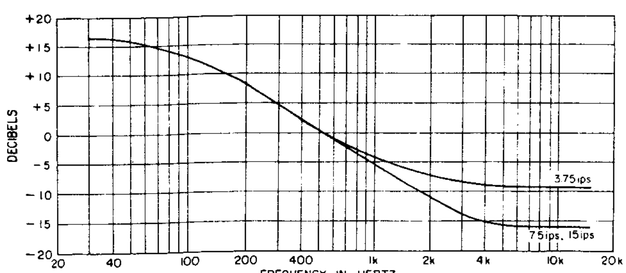


Fig. 2-16 Typical post-equalization for 1/4-inch tape recorders using NAB characteristics.

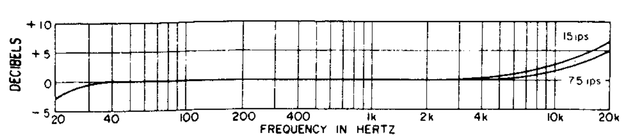


Fig. 2-17 Typical pre-equalization characteristics for 1/4-inch tape recorders running at 7.5 and 15 ips using the CCIR (DIN) standard.

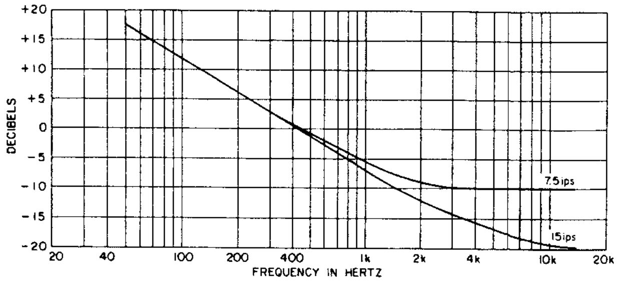


Fig. 2-18 Typical post-equalization curves for 1/4-inch recorders using CCIR characteristics, at 7.5 and 15 ips.

You will need a separate reference tape for each speed. The curves are not the same.

Since these Reference Standard tapes cost about 3 times the price of a big roll of the best blank tape, plan on storing them carefully in a place that will not encounter any magnetic fields that might damage them – away from loudspeakers, guitar pickup, tape recorder and record player motors, power amplifiers (magnetic field surges in big transformers when amps are turned on and off can be very powerful) or anything magnetic that might alter the quality of the reference standard. If you don't damage them physically or magnetically (don't play them on dirty or magnetized recorders, or loan them out to the careless) they will last for several years.

If it is not possible to obtain a tape that has both the NAB EQ and a fluxivity of 250 nWb/m, select the NAB EQ as the preferred single standard. A different reference fluxivity requires only that you make a level correction once. Just use a different mark on the meter instead of "zero." A different EQ curve requires a different amount of correction for each frequency and is much harder to use – especially for a beginner.

Level corrections for different reference fluxivity:

			Use this instead of "O" VU
15 ips	185 nWb/m	– (Ampex operating level)	–3 VU
	200 nWb/m	– (STL, MRL)	–2 VU
7-1/2 ips	185 nWb/m	operating	–3 VU
		sweep frequencies	–13 VU
	200 nWb/m	operating	–2 VU
		sweep frequencies	–12 VU

Below are tabulated some commonly encoutered flux levels along with their dB differences, and their differences in dB from 185 nWb/m.

	Flux Level nWb/m	Flux Level Difference in dB	Difference from 185 nWb/m in dB
	150		1.82
		0.56	
	160		1.26
		0.53	
	170		0.73
		0.50	
	180		0.24
		0.24	
Ampex operating level	185		0.00
		0.23	
	190		0.23
		0.45	
	200		0.68
		0.42	
	210		1.10
		0.40	
	220		1.51
		0.39	
	230		1.89
		0.37	
	240		2.26
		0.35	
	250		2.62
		0.34	
	260		2.96
		0.04	
3 dB above Ampex operating level	261.32		3.00
		0.28	
	270		3.28
		0.32	
	280		3.60
		0.30	
	290		3.90
		0.29	
	300		4.20
		0.28	
	310		4.48
		0.28	
DIN Standard	320		4.76
		0.27	
	330		5.03
		0.26	
	340		5.29
		0.25	
	350		5.54
		0.24	
	360		5.78
		0.22	
6 dB above Ampex operating level	369.12		6.00
		0.02	
	370		6.02
		0.23	
	380		6.25
		0.23	
	390		6.48
		0.22	
	400		6.70

Note:
Add 0.7 dB for European Measurement Method using Magnetometer.

IEC Correction Chart (illus.)

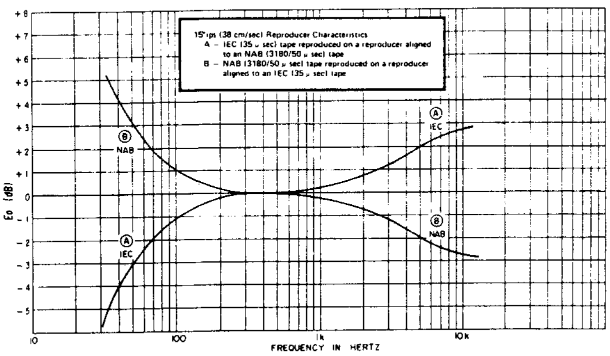


Fig. 2-19

If you must use IEC EQ tapes, these readings are correct. IEC has less boost in playback, the tape will read progressively higher as frequencies rise when played on a NAB adjusted recorder. At 250 nWb/m reference read these numbers to set IEC-1 EQ.

31.5	50	125	400	1K	3K	6.3K	8K	10K	16K	18K	20K
-5.4	-3.0	-0.6	0	+0.2	+1.2	+2.3	+2.6	+2.7	+2.9	+3.0	+3.0 dB

See "Test Tapes for the 32" on page 39.

Since the low frequency EQ on the 32 is fixed, the differences are academic. On to the next piece of test equipment.

2) VTVM or FET Multimeter

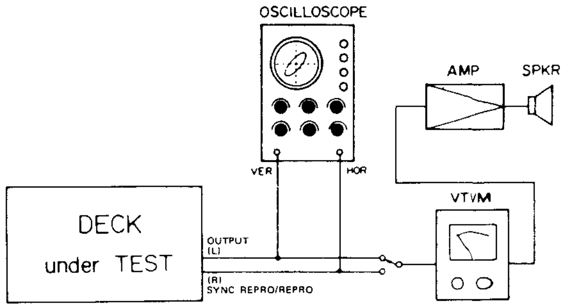


Fig. 2-20 Head Alignment Fine Adjustment Set-up and Test Connections (REPRODUCE)

Use a VTVM or FET multimeter with an input impedance of at least 1 megohm that can read levels down to –70 (full scale) you can think of this as a very accurate VU meter of very wide range. Meters with lower input impedances will draw power from the circuits to be measured and will affect the readings. Meters that have adequate input impedance but do not read below –40 (0.01 V) can be used for reference levels and frequency response measurements, but will not be capable of making signal-to-noise, erase efficiency or bias circuit measurements where the output of the circuit being adjusted is expected to be very low. Meter MUST have wide, flat frequency response (minimum = 10 Hz – 1 MHz).

This tool is not cheap and is just as important as the test tapes. Without a good reference meter, you can do very little in the way of accurate adjustment. Spend as much as you can here. It's worth it. Next. . . .

3) Signal Generator or Oscillator

Here you get a break. A simple oscillator will do all the work and won't send you to the poor house. There are several on the market for around $100. The local electronic surplus store can be a good source for test equipment that can be re-calibrated by the manufacturer for a reasonable cost. If you get one with a meter on it, you won't have to calibrate its output with the big meter as often. This device is very useful in a studio for troubleshooting – a good investment. It should have at least the following frequencies.

40 Hz — 100 Hz — 400 Hz — 1 kHz — 4 kHz — 10 kHz — 15 kHz — 18 kHz

Sine wave is all that is required, at a distortion of no more than 5 %. Most modern units do better than this easily. This unit is the workhorse on the equipment list. Whether you are reading the big meter (FET) or the meters on the recorder, you will need a signal to read, this instrument or the test tapes will provide you with signals.

Test tapes, tone generator, VTVM or FET meter. . . This is the basic package and will do almost every adjustment in the sequence – except the first one . . .

4) The Oscilloscope

Even a simple one is not cheap. Fortunately, a simple one is all you need. You can spend $6,000 and more for the big ones, but for this purpose $100 – $200 will be more than enough. It must have a "vertical" and a "horizontal" amplifier and an X–Y mode. That's all you use to do the one adjustment you need it for. Assuming that the motors are not in need of attention (that's for Dealer Service), Azimuth, or head alignment is the number one step in maintenance . . . . so let's begin.

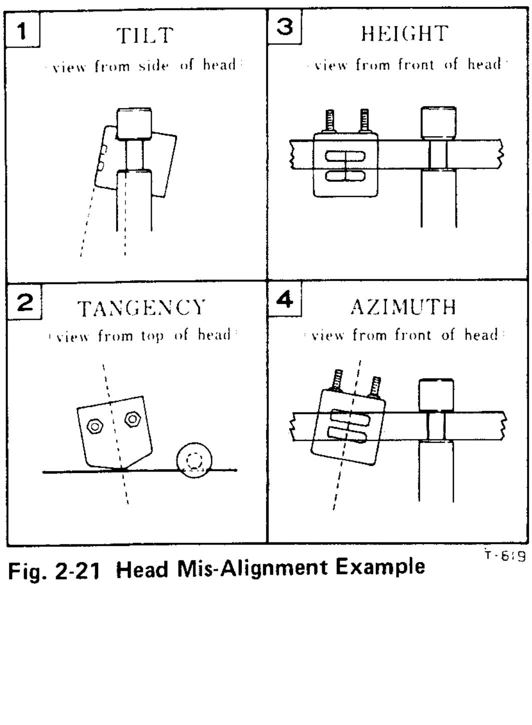


Fig. 2-21 Head Mis-Alignment Example

The gaps in the heads that do the erasing, recording, and reproducing must be precisely perpendicular to the tape. PRECISELY. Even a tiny error in alignment will make problems for the recorder. If the heads are not in alignment, both with the tape, and with respect to each other, tones recorded on one head will not play properly on the other. In the table below, the error is shown with the loss in dB. The amount of tilt is given in the fractions of a single degree called minutes, 60 minutes to a degree. As you can see, it only takes 1/4 degree to cause big trouble.

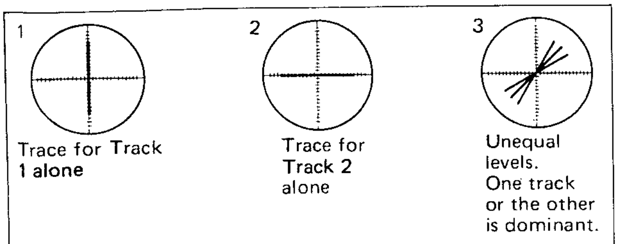
1-Mil Wavelength		½-Mil Wavelength		¼-Mil Wavelength	
Loss in dB	Azimuth Error in Minutes	Loss in dB	Azimuth Error in Minutes	Loss in dB	Azimuth Error in Minutes
0.5 dB	14.86	0.5 dB	7.43	0.5 dB	3.71
1.0 dB	20.90	1.0 dB	10.45	1.0 dB	5.22
2.0 dB	29.21	2.0 dB	14.60	2.0 dB	7.30
3.0 dB		3.0 dB	17.67	3.0 dB	8.83
4.0 dB		4.0 dB	20.16	4.0 dB	10.08
5.0 dB		5.0 dB	22.16	5.0 dB	11.13
6.0 dB		6.0 dB	24.08	6.0 dB	12.04
7.0 dB		7.0 dB	25.68	7.0 dB	12.84
8.0 dB		8.0 dB	27.09	8.0 dB	13.54
9.0 dB		9.0 dB	28.36	9.0 dB	14.18
10.0 dB		10.0 dB	29.50	10.0 dB	14.75

Fig. 2-22 Loss due to azimuth misalignment for 43-mil quartertrack. (Courtesy, Ampex Corp. Test Tape Laboratory)

Since the 32 can use a single head (head #2 in the stack) to perform all functions (recording, sync reproduce and reproduce) it won't hurt the recorder to use the "whizband studio alignment" procedure, which is to do nothing about alignment at all. You won't notice anything wrong with the sound you make, but there are drawbacks.

1. Your tapes won't play properly on any other recorder (whizbang standards are unique).
2. No accurate tune-up of the recorder will be possible, as most test procedures use one head as a reference for the other. To do this, they must be aligned perfectly.

Thread the 7-1/2 ips test tape on the recorder and find the operating level section of the tape. Connect the outputs for tracks 1 and 2 of the recorder to the 2 inputs of an oscilloscope, track 1 to the vertical input that makes the beam draw lines up and down and 2 to the horizontal input (draws lines left to right). Set the scope to the "Vector" or XY mode. You will have to consult the instruction book for the scope to determine how to do this. We don't know what brand of test gear you have. Play the tone, and this is what you should see:



If the lines are not the same length for each track alone, it indicates that the 2 tracks are not putting out the same level. Adjust with the scope controls.

If the playback head is not straight up and down, you will see this kind of picture:

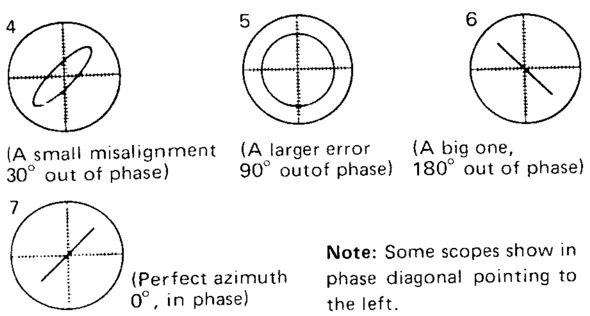


Fig. 2-23 Phase Shift

How much distance error is involved depends on the frequency or pitch of the tone and the speed of the tape. One "cycle" per second at 15 ips would be hard to misalign. To get scope picture No. 6, you would have to separate the gaps in the playback head by 7-1/2 inches, but one cycle per second is not audio. How about 1,000 cycles per second of tape travel? At 15 ips, the separation or tilt in the head for scope picture No. 6 becomes 0.0075 inch. And at 15,000 Hz at 15 ips it's 0.0005 inch. Not much tilt will produce a big error. Slower tape speeds mean even smaller spacings and good azimuth becomes even more important. The proper method of adjustment is to look first at a long wave, say 1000 cycles, and make a coarse adjustment. Then work up in frequency, adjusting shorter and shorter wavelengths smaller and smaller amounts. If you start adjusting with 10 kHz or 15 kHz, you can make a big mistake. Here's why. . . . Since the very short wavelengths are very close together on the tape, it is possible to get a good "picture" on the scope by adjusting one full cycle off. If you work up to 15K, checking and adjusting as you go, you will avoid this mistake.

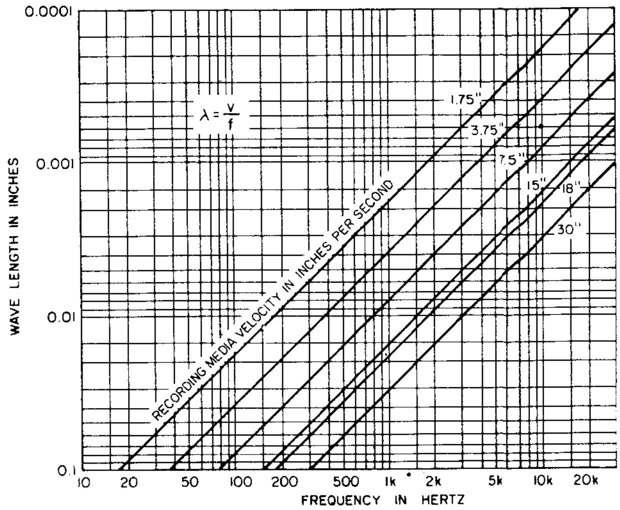
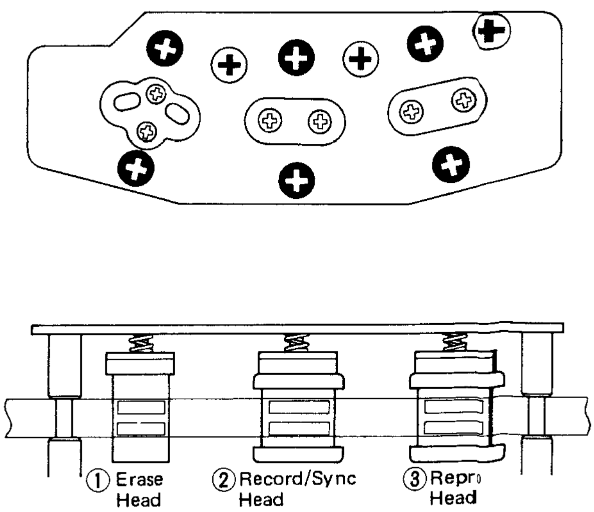


Fig. 2-24 Velocity of recording media versus recorded wavelength in inches for a given frequency.

Once you have everything set up – the reference tape is playing, the scope is running and showing the x-y display, you need a screwdriver and this diagram to find the right adjustment point. Adjusting the screw will rotate the head very slightly.



⊕ AZIMUTH ADJ. SCREWS
O HEIGHT AND TILT ADJ. SCREWS
⊕ TANGENCY ADJ. NUTS

Fig. 2-25 Head Adjustment Screws and Alignment

5) Test Tapes for 32 (reproduce alignment)

NAB Equalization:
STL 3 or MRL 21J205 = Tape speed 15 ips
STL 22 or MRL 21T204 = Tape speed 7.5 ips
Reference fluxivity; 250 nWb/m
Time constant; 3,180 + 50 μsec.
IEC-1 Equalization:
STL 3-IEC or MRL 21J103 = Tape speed 15 ips
Reference fluxivity; 200 mWb/m
Time constant; ∞ + 35 μsec.
STL 22-IEC or MRL 21T102 = Tape speed 7.5 ips
Reference fluxivity; 200 nWb/m
Time constant; ∞ + 70 μsec.

— or —

NAB Equalization:
TEAC YTT-1044 = Tape speed 15 ips
Reference fluxivity; 185 nWb/m
Time constant; ∞ + 35 μsec
IEC-1 Equalization:
TEAC YTT-10432 = Tape speed 7.5 ips
Reference fluxivity; 185 nWb/m
Time constant; ∞ + 70 μsec.

All specs are identical with STL or MRL tapes except for the reference fluxivity which is 185 nWb/m, and thus, its reproduce output level will be 3 dB lower compared with 250 nWb/m fluxivity. Calibration level under "Reproduce Calibration" refers 0 VU as 250 nWb/m.

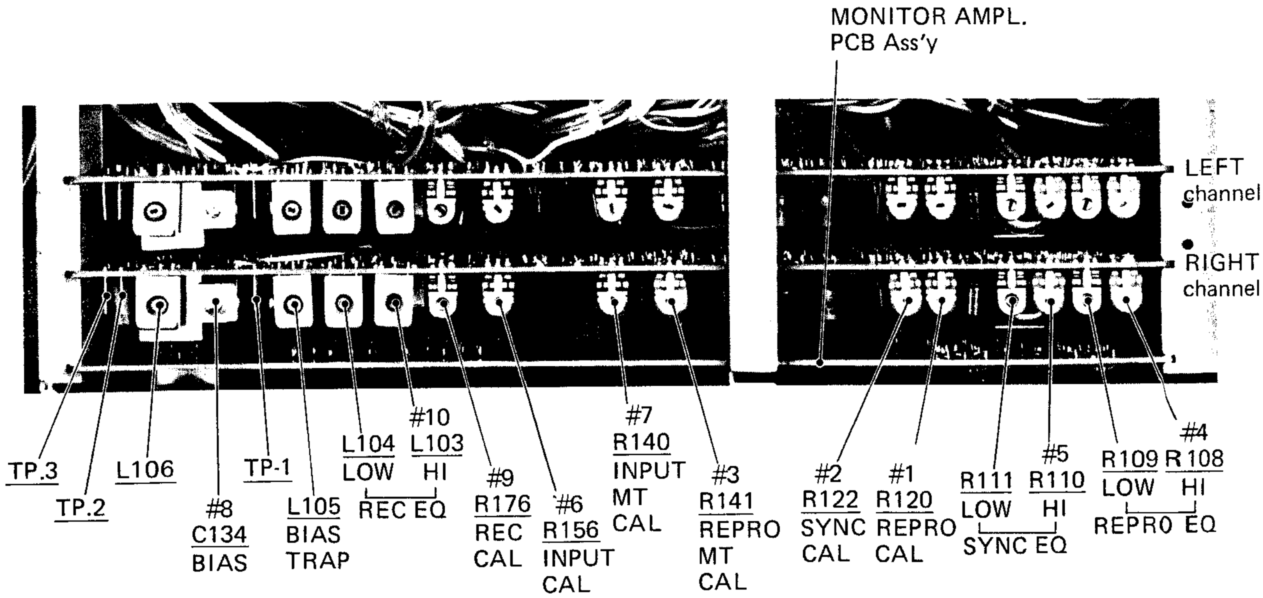
CAUTION: As mentioned before TASCAM has selected the NAB and IEC standards for record/reproduce EQ as the recommendation for the 32. The NAB standard is chosen for the models which are to be sold in the U.S.A. and Canada, or for General Export models, while the IEC standard chosen for the models designated for Europe, U.K. and Australia.

Note: If necessary, inter-switching between the NAB and IEC standards can be accomplished by simply removing and repatching the jumper wires on five points of the amplifier. The details are explained as a note in the inserted schematic of the amplifier section.

The next step is to play all the signals from the lowest frequency to the highest on the 7-1/2 ips alignment tape — one play for each head position (2—3), and DO NOTHING. Just have a look. It's not a good idea to turn knobs just to "see what happens." Just because an adjustment can be made doesn't mean it's necessary. The recorder is very solid and is well adjusted at the factory, so in all test and maintenance procedures, check first, then if something is not right, adjust. Taking your time will save endless grief. A new machine is very likely to be "on the money" when you get it and if you keep it clean and degaussed will drift away from top shape very slowly. It's not necessary to plan on a major overhaul when it comes out of the box.

ELECTRICAL ADJUSTMENT PROCEDURE

1) Location of Electrical Adjustments:



TRIM POT NUMBER	REFERENCE NUMBER				FUNCTION
	Tape Speed 15 ips		Tape Speed 7-1/2 ips		
#1	R120	2k ohms	–		REPRO CAL
2	R122	2k ohms	–		SYNC CAL
3	R141	50k	–		REPRO METER CAL
4	R108	10k	R109	10 kohms	REPRO EQ
5	R110	20kohms	R111	20 kohms	SYNC EQ
6	R156	2k	–		INPUT LEVEL
7	R140	50k	–		INPUT METER CAL
8	C134	100p Max.	–		BIAS LEVEL
9	R176	20k	–		REC LEVEL
10	L103	1.4 mH	L104	2.4 mH	REC EQ
–	L105		–		RECORD BIAS TRAP
–	L106		(BIAS TUNING)		CAUTION; Don't attempt any adjustments of L106 except for purposes described under the MAINTENANCE section.

2) Reproduce Calibration:

(DO NOT ATTEMPT TO CALIBRATE WITH DBX ENGAGED!)

When we're sure the reproduce and record head are properly aligned, we can move on to the electronic adjustments.

The first step here is to actually check your meter calibration. To open the bottom panel, remove the 8 binding screws. Rotate OUTPUT knob on the front panel to the position "7".

Connect the VTVM to the output terminal of left channel. Turn the machine ON, and thread the 15 ips alignment tape. Play the "operating level" portion (a voice on the tape identifies each section at the beginning).

Switch the OUTPUT SELECT on the 32 to REPRO. Adjust the playback or "reproduce" level with trim pot # 1 R120, 2k ohms (REPRO CAL), until the VTVM reads -10 dB (0.3 V).

Switch the OUTPUT SELECT to SYNC. Adjust the reproduce level with trim pot # 2 R122, 2k ohms (SYNC CAL), until the meter reads -10 dB (0.3 V). Now read the meter on the front panel of the 32. It should read "0 VU".

If it does not, adjusting trim pot # 3 R141 50k ohms (METER CAL) will allow you to set the meter on the 32. You adjust the 32 meter to read "0 VU", not -10, the reading on the VTVM. The meter will read 0 at any voltage you set it for, the correct one is 0.316 Volt. This is the right setting for the 32. You read -10 dB (0.3 V) on the VTVM and adjust the 32 meters to read 0 VU at this level.

Channel R still remains to be checked and adjusted, but as you can see, the adjustments are the same as for channel L. In brief:

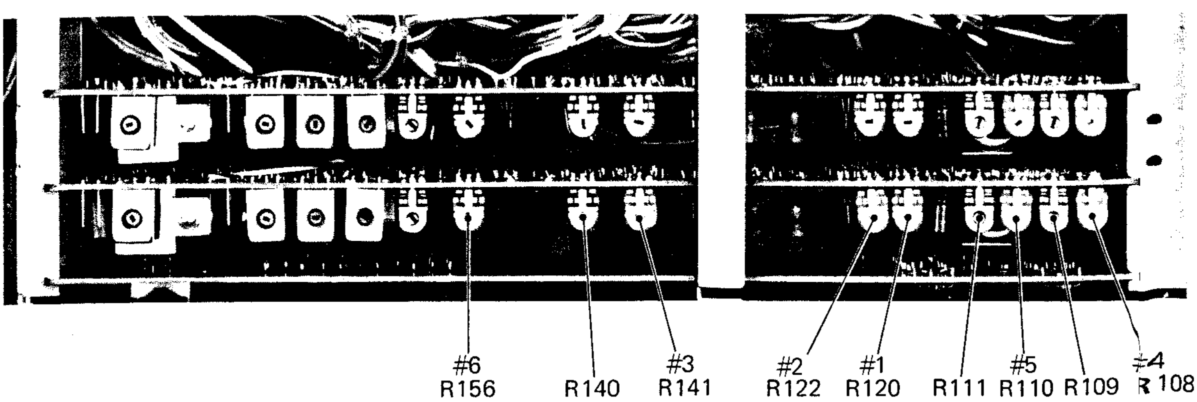
1. Play the tape "operating level"
2. Read the VTVM for head 3, REPRO.
3. Adjust for -10 dB (0.3 V) reading with trim pot # 1.
4. Switch to SYNC on OUTPUT SELECT.
5. Read the VTVM. Adjust trim pot # 2.
6. Read the meter on the 32 – it must read 0 VU.
7. Adjust the meter trim pot #3 R141, 50k ohms METER CAL.

One more word of encouragement. The circuits in the 32 are very stable. Most of the time you will make a reading and not have to adjust anything. When something does go wrong, you will be able to fix it very quickly, and get back to recording.

In summary, with the VTVM and test tape, you have adjusted the reproduce level on the 32 to the test tape. But your reproduce reference is not yet complete. You have only "zeroed" one point on a line of frequency response. To establish the rest of the line, you must measure and adjust one more frequency.

Advance the alignment tape for 15 ips to the section that is recorded at 16 kHz and adjust the trim pot marked REPRO EQ #4, R108, 10k ohms – switch to SYNC on the OUTPUT SELECT, and adjust trim pot #5, R110, 20k ohms SYNC EQ.

The reading for both positions should be 0 VU on the 32 meters. Since you have checked and adjusted the reproduce meter circuit, you now can use the meters on the 32 for the test readings.

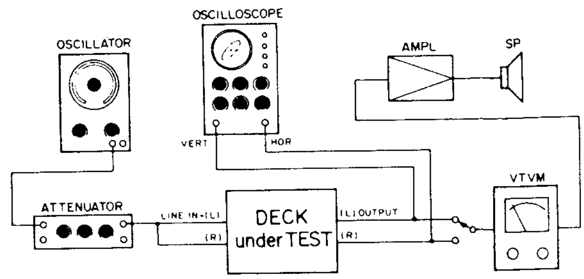


By adjusting all of the preceding trimmers, you have established two things: an operating playback level or "zero", and a playback frequency response reference. You know that both heads on the 32 are reproducing the test tape in an identical manner, at 15 ips.
You now repeat the frequency adjustments for both heads at 7-1/2 ips. Change test tapes and use trim pot #4 R109, 10k ohms and adjust the high frequency playback response for "REPRO". The reading on the meter should be "0 VU". If you are still using the VTVM, the reading will be -10 dB. The test frequency is 18 kHz.
Repeat the adjustment for "SYNC" trim pot #5 R111, 20k ohms at 18 kHz. The reproduce response section is now complete for both speeds.

3) Input Calibration:

It stands to reason that you should monitor the level of the signals which are going to be recorded, before actually making the recording itself. This monitoring signal can be fed to the VU meters and, at the same time to the output terminals. The required procedures are:
Connect the reference level, or signal generator to channel L input on the 32.
The correct level is -10 dB (0.3 V).
The frequency to use is 400 Hz. Rotate INPUT knob and OUTPUT knob on the front panel to the "7" position. It's a good idea to mark it. Check the OUTPUT SELECT. Make sure you have the button marked INPUT depressed. If you get a reading, use trim pot #6, R156, 2k ohms, INPUT LEVEL, and adjust the meter to read 0 VU. If you have a VTVM, connect it to the output terminals, and adjust the input level by using trim pot #6, R156, 2k ohms to obtain the correct -10 dB (0.3 V) level. Plugging and unplugging test equipment can be tedious. You can save some time by doing a reference check on your mixer. If you know that your console meter reads 0 VU accurately (check it with the VTVM), you can assign the reference oscillator signals to the 32 through the mixer connections to the inputs. Assign, read, adjust: next track, assign, read, adjust . . . no need to pull plugs.

Record Calibration



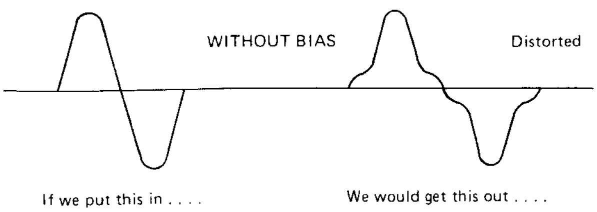
Test Connection for Recording Check

Now you can use the REPRO head as a test instrument to check and adjust the record circuits. Almost all of the following steps involve recording a tone on a tape and reading the reproduce output of the recorder. YOU WON'T ALTER THE REPRODUCE CONTROLS. They are all set. You will make all necessary adjustments by trimming the record electronics.
This way, you can be sure that the recordings you make, no matter what brand of tape you use (the brand of tape becomes part of the test tones on it), will reproduce properly on any 32.
The alignment tape can be put away. Before storing, the tape should be played all the way from front to back (not fast wound), and stored tails out, so it will last longer. Even if you decide not to attempt any major maintenance yourself, we strongly suggest that you purchase an alignment tape. An occasional playing will tell you when you need to call the "doctor". It's good insurance to know the truth.
The record adjustments begin with the INPUT LEVEL trim of the 32. The INPUT LEVEL controls the meter reading of the signal as it arrives at the electronics (before it is recorded). You must be sure you are sending the right amount of signal in before you can adjust record levels and equalization controls.

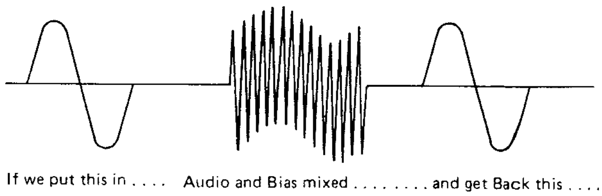
4) About the Bias

At this point in the adjustment procedure we'll stop for a time and talk about a major section of the recorder electronics: the oscillator and its related circuitry. The oscillator produces a very high frequency signal that does two big jobs in the 32. It supplies the 150 kHz (one hundred fifty thousand cycles per second) frequency to the bias amplifier in the 32. There is a bias amplifier on every card, one for both tracks. The bias amplifier provides power for the erase head and bias signal for the record head. Erasure is easy to explain, so we'll tackle that subject first. A lot of power is used to remove all signal from the tape just prior to its being recorded. The erase head has a rather large gap and completely cleans off any magnetic field on the tape by brute force. No new signal is recorded by this head. The gap is much too large to be effective as a recording device.

From the same amplifier, current is added to the record head circuit lead. This high frequency signal overcomes magnetic inertia in tape, and gets everything moving. If there were no "starter current" to help the record signal, we would see this kind of trouble on a scope.



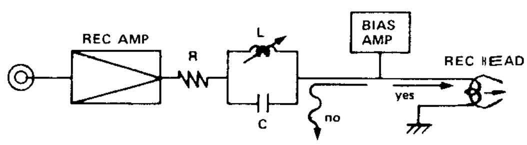
The beginning and ending points of the wave would be distorted by the reluctance of the iron bits to change their magnetic state from one polarity to the other. Crossing that zero line takes extra energy. The bias signal provides it. We put in this:

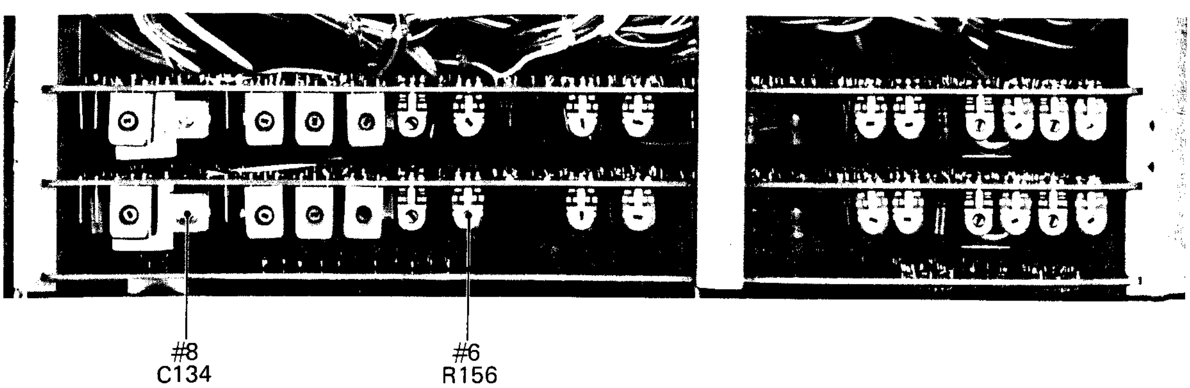


Where did the 150 kHz go? It disappears from the output because the head gap is too large to play it back. The individual changes of magnetic energy on the tape are smaller than the gap size so a plus and minus wave are both within the gap at the same time. They cancel out. Marvelous! On with the problem of alignment.

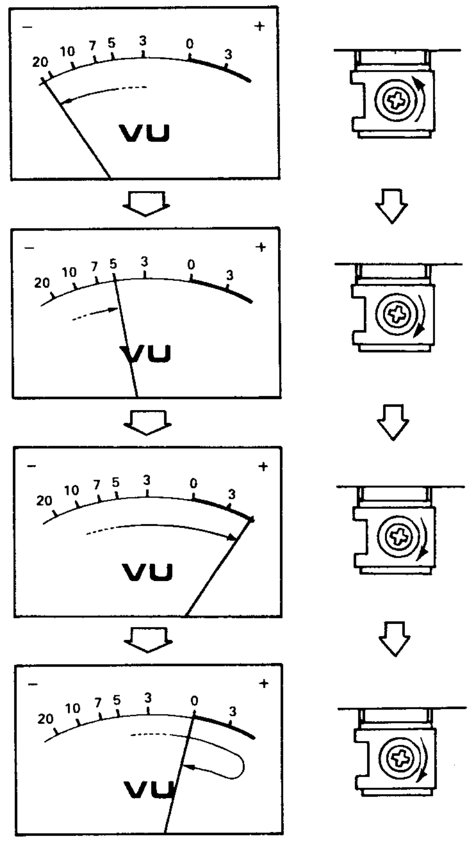
Well, maybe not so marvelous. Because of the fact that there is one amplifier dojing 2 separate jobs. The adjustments we make on one circuit will affect the other. In fact, the erase current fixed, but there are 2 interfacing circuits and life can get pretty tricky right here. The 2 adjustables are (in sequence):

1. The bias current (for the record head) trim capacitor C134 100P max. BIAS LEVEL.
2. The bias traps. Since there is a lot of power involved here, you have 2 problems.





We've give you the bad news (they interact). Now we'll give you the good news. Unless you adjust the erase current or the bias current by a very large amount, you won't need to check these circuits more than once every six months or so. The traps seldom need adjustment unless something is wrong with the master oscillator. The "traps" are expected to tune out the 150 kHz frequency that the bias oscillator is producing, and the range of adjustment that they have is not very good at filtering a much different frequency. If the master bias oscillator drifts, it must be re-adjusted to produce 150 kHz. Since this bias oscillator master circuit adjustment requires something expensive (very) called a frequency counter, it's wise to assume it's a dealer problem. Cart it in for this kind of service. There are also bias traps in the reproduce circuit to keep any stray leaks out of them as well, but they are not as touchy as the record-related circuit traps, and won't affect the load on the bias amplifier. They are tricky to adjust, but very stable. In sequence, you adjust them (if necessary) at the very end of the entire alignment procedure so we'll mention them again.

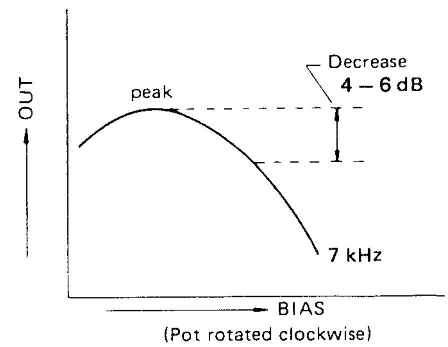


5) Bias Level Adjust:

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. Set up the signal generator (oscillator). The frequency is 7 kHz, -10 dB (0.3 V). Depress INPUT SELECT to LINE, and set both FUNCTION buttons to ON, then set INPUT and OUTPUT knobs to the "7" position. The level should be 0 VU on the meters of the 32 on INPUT. Start the machine at the tape speed 7-1/2 ips, record the signal, and switch to REPRO on the OUTPUT SELECT.

Begin the adjustment by making sure trim capacitor #8 C134 100P max. BIAS LEVEL is in the fully CCW position (off, no bias at all). Now, as you rotate the trim pot #8 CW, the VU meter will rise to some peak reading. CONTINUE THE CLOCKWISE ROTATION SLOWLY until the reading on the meter drops back 4 – 6 dB from the peak.

If, at peak the meter goes off scale, adjust the INPUT level controls to keep the reading on scale. What is important here is not the zero. It is the reduction of the peak by 4 – 6 dB. If you have moved the input level pot on the front panel of the 32 to keep your reading on scale, the next adjustment will correct your input reference.



Bias Limits Chart

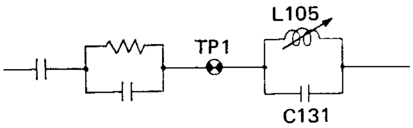
If there is insufficient CW rotation of #8 to achieve a peak, dealer service of the bias amplifier/oscillator system will be required. Many voltages in the circuit must be adjusted accurately and this type of problem is not considered to be "Daily Maintenance". Bring it in.

When doing bias adjustment, both channels should be recording at once, even though you are adjusting only one at a time.

With the oscillator running at 400 Hz, switch back to INPUT. Set INPUT and OUTPUT knobs on the front panel to the "7" position and adjust trim pot #6, R156 INPUT LEVEL for 0 VU indication on meters.

6) Bias Trap Adjust:

Now is the time to do the bias trap in the record circuit: with no input signal, adjust test point TP1 located on the PC Board. Positive side of the VTVM is connected to the test point, negative side to ground. Tune inductor L105 for minimum.



7) Record Level Adjust:

We give these adjustments just to be accurate and thorough, and remind you again that they are seldom needed. Unless you have made some really drastic change in your recorder, you should not worry about this adjustment for at least 6 months.

Again, to be thorough, at this point it would be wise to check erase and bias again before proceeding. Once you start a major overhaul it might be necessary to go through these 3 steps – erase, bias and record level adjustments – 3 or 4 times before finally moving on to the "record equalization" and then, once more from erase through to the end. Describing the way is probably giving the manufacturing setup, or head replacement sequence when all values of the record circuit must be re-qualified. If noise is heard, signals don't erase completely even after adjustment, or there is not enough rotation of the bias trim pot left to get a "drop" in bias, the whole adjustment should be considered, but only under these unusal circumstances.

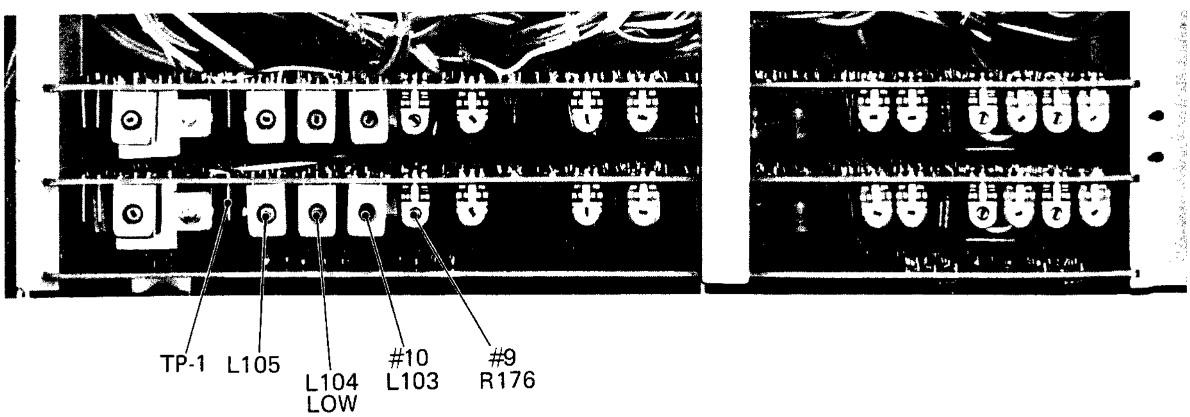
However, we do recommend that you select a brand of high quality tape and stick to it. Changing bias every day for different tapes will make the recorder cranky and a little harder to adjust. Constant messing with the controls is unwise It is a much better idea to do as little as possible and let the recorder "settle in" to one kind of tape.

We are now ready to adjust the record circuitry. We first check the low frequency input level at 400 Hz to get a reference. The steps are as follows:.

1. Adjust oscillator to 400 Hz.
2. Select "LINE" on INPUT SELECT buttons.
3. Set INPUT and OUTPUT knobs on the front panel to the "7" position.
4. Select "INPUT" on OUTPUT SELECT buttons.
5. Set both FUNCTION buttons to ON.
6. Send in 0.316 V, set "0 VU" on the 32 meter.
7. Record the tone at 15 ips.
8. Switch to "REPRO", read the 32 meter.
9. With trim pot #9 R176, 20k ohms (REC LEVEL), adjust to "0 VU".

With only a few adjustments remaining in the complete procedure, let's review all you have done up to this point. Step by step, you have:

1. Cleaned and degaussed the tape path.



2. Adjusted the head azimuth of both heads to 90° by checking and adjusting progressively higher and higher frequencies.
3. Checked the 32 meters against a precision meter and set 0.316 V output as "0 VU" reproduce.
4. Adjusted reproduce from both playhead positions to be "0 VU" at 400 Hz using the test tapes as an absolute reference of magnetic level.
5. Applied a reference level to the input of the 32 and adjusted the "0 VU" point to be 0.316 V, both in the circuit and on the meter.
6. Set bias level for the tape of choice.
7. If you have the equipment, make sure no bias is going to the record amplifiers.
8. If you have the equipment, set (after bias) the record "0 VU" and read it off reproduce. You now know that the tape you are making has the same level of magnetic flux recorded on it as the reference alignment tape, but only at 400 Hz, the basic adjustment frequency.

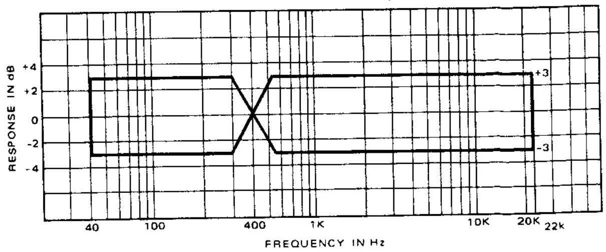
8) The Peak Adjust Circuit

The choke coil in this circuit only has a very small range, 1 dB at tape speed 15 ips. It is for final high end adjustment. The frequency to send in is 20 kHz, record the tone at "0 VU", switch to REPRO and read the result. Adjust choke coil #10 L103 to read "0 VU" in reproduce.

Both of the record equalization circuits have rather a small range of adjustment. The high frequency adjust is 3 dB, the peak adjust is 1 dB. If you can't seem to get a "good" reading because you run out of adjustment range, check these 3 points.

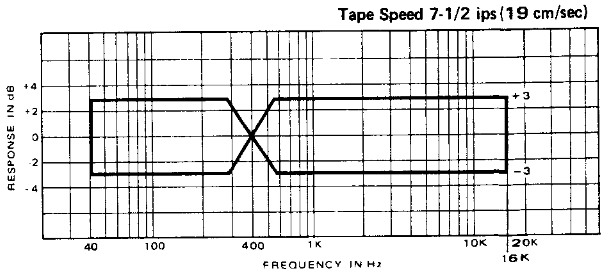
- The "record adjust" (point #8 in this review). Re-do, send in "0 VU" at 400 Hz. Record the tone and read reproduce. If it is low, it will be impossble to get 18 kHz or 20 kHz up to "0 VU". Reset and try again. Still no good? Re-check the bias. If the bias current is too high, the high frequency sensitivity is reduced in relation to the 400 Hz point. Check it out.

Tape Speed 15 ips (38 cm/sec)



7-1/2 ips tape speed adjustments still remain to be checked and adjusted. The procedures for adjustment are the same as the 15 ips adjustments, but the test tape has to be changed. Send in a 16 kHz frequency and record the tone at "0 VU." If you get a low reading, adjust the #10 choke coil, L104 to read "-3 VU," or higher as necessary.

Tape Speed 7-1/2 ips (19 cm/sec)



If all this fails to produce a reading that lives within the tolerances for frequency response on this graph, it is time to replace the heads. If more equalization were added to the record circuit to overcome wear, the boost needed would be large enough to make the signal-to-noise ratio specification impossible to achieve.

Let's assume everything is OK so far. You have sent in and read back good numbers for 15 ips, everything in spec at both frequencies. Now, as a check, record everything you have on your tone generator (If it is variable be reasonable, say 9 frequencies) 40 Hz, 100 Hz, 400 Hz, 1 kHz, 4 kHz, 10 kHz, 18 kHz, 20 kHz – compare with the graph above.

Fine tuning the bias against the frequency trim pots will allow you to get a little closer to perfectly flat. It's time consuming but worthwhile. Suit yourself.

With the bottom panel closed, you can now check the signal to noise of the whole system. You use the big test meter and a noise filter. Record with no input signal and read the result. The reading should be -50 dB or better (un-weighted).

That's it. The whole procedure for an electronic overhaul of the 32. Mechanical adjustments such as brake and holdback torque, reel height adjust and wow and flutter measurements must be done first, but they are major service and should not be necessary "out of the box". The transport logic control and switching system are described in the maintenance section. But digital I.C. theory is very complex and the necessary test equipment for repairs costs more than the recorder. The maintenance section is not written as a guide to the beginner, so be advised, it may not help your understanding of the 32. It is useful only to the experienced maintenance technician.

DAILY SETUP

It's obvious that this entire procedure is not something that can be completed quickly. You don't begin a "major" ten minutes before the musicians arrive. It is not likely to be necessary every day, but what is reasonable? Most good engineers make several quick tests. If nothing is amiss, they start setting up the rest of the session with confidence. If there is a problem, they go further. Here is what they do.

1. Clean and degauss. Obvious first step.
2. After the recorder has been on for 10 minutes and is nicely warmed up, they check the reproduce response with the test tape. A little trim? OK, no problem.
3. They then set up the signal generator and record several frequencies, say 100 Hz, 4k, 10k. Looks good? Then we can begin.
4. A very fussy engineer will take a look at the bias adjust to make sure everything is OK there as well, before he looks at the record EQ.

These several quick checks will usually uncover any serious trouble, and the idea is to work backwards up the chain of adjustments if anything shows an error. "Reproduce" is the first step in a major overhaul, and Record EQ is the last. If everything works OK, you can assume all is well. If you get something funny as a reading, you will have to track it down, but these tests will usually give you some idea of where the problem lies. Work backwards through the recorder (that's forward through the adjustments, by the way, they run from back to front in the procedure, don't get confused) until you uncover the problem. You always clean and degauss, and you should always check the reproduce response with the test tape. Again, reproduce, bias, record check, no problems, OK, go, and good luck with your tapes.

Speaking of tape, the 32 has been designed to use 1.5 mil tape, the use of 1 mil tape is not recommended, we strongly suggest that you buy good quality tape and stick to one kind. White box tape is cheap for a reason. It doesn't perform as well as the "good stuff", and will be hard to tune up to, and may even damage your recorder. Excessive shedding of oxide, uneven slitting and other defects too numerous to mention will make all your efforts go for very little. Tape is important, use the best.

GENERAL ADVICE ON MAINTENANCE

Don't attempt to adjust a stone cold machine. Turn it on and let it warm up for 30 minutes.

Don't adjust the "traps" with a metal screw driver or tool. The metal tip will affect the value of the part and will give false readings. Use a plastic T.V. adjustment tool, or cut a strip of rigid plastic to size. (Credit cards will work, if you have an old one you don't need.)
Suspect any large change in adjustment that happens all at once.
Stop and think, if you turn a pot and get no change in reading, have you adjusted the wrong control?
Always turn the machine "off" when installing the extender card.
Remove the alignment tape from the heads when switching power "on" or "off." A switching transient on a badly adjusted recorder can "print" on the tape.
Tape and electronic "hiss" should be smooth sounding. If, when recording, you detect popping, or sputtering noises, degauss the heads. If this doesn't change the sound, plan on a record bias trap adjustment.

If the oscilloscope picture is not stable when using the alignment tape (the trace opens and shuts like a mouth) suspect the holdback torque adjustment. When recording and playing test tones, suspect the tape slitting as well as the motor adjusts. If the reference tape doesn't do this, but the recording tape does, it's definitely not the recorder. It is the tape that is at fault.
At the end of a session, take the time to slow wind (play) the roll off the machine and store it "tails out." This is the best way.

Don't plan on recording over a splice. Any steady tone such as singing, or violins that you attempt to print over a cut in the tape may show a dropout, or momentary interruption. Even the best splice in the world is thicker than normal. The splicing tape adds quite a lot, and makes the tape "bump" when it goes by the head. This is especially important if you are using DBX. The dropout will be made much more noticeable by the action of the DBX.
It is a good idea to pad your master tapes by winding some blank tape on both ends, and adding leader tape.

Put a test tone (1 kHz) on each tape for reference level checks. Then it's easier to set up machines and mixers when recording sessions occur on different dates or different machines.

Keep a TRACK SHEET. Write down what happened during the session and what went on to the tape. You might list such things as mic placement; complete/incomplete takes; brand of tape used; speeds; noise reduction; comments (for example: a producer might have liked a particular bass part more than others, so you can save it and use it during overdubbing and mix-down).

Have the tools of the trade handy – leader tape, razor blades, splicing tape, masking tape, grease pencils, etc.

There's another old saying around studio circles: If it's not labeled, use it. So it's a very good idea to label all tape boxes and reels. And pack a track sheet in every box.

When you're not working on a tape, it's safest to put it in its box; don't leave it on the machine where an accident could wipe out weeks of work.

SERVICE 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	Reproduce head Alignment	TEAC YTT-1003 Playback Alignment Test Tape (7-1/2 ips)	VTVM and Oscilloscope with vertical and horizontal inputs connected to OUTPUT channels L and R.	Playback at 7-1/2 ips speed. OUTPUT SELECT at REPRO. OUTPUT knob at position "7"	Repro head #3 azimuth adjusting screw.	Adjust for maximum output and for output of tracks L and R less than 90° out of phase. (at 12.5 kHz)
2	Sync head Alignment	Same as above	Same as above	Playback at 7-1/2 ips speed. OUTPUT SELECT at SYNC. OUTPUT knob at position "7".	Record head #2 azimuth adjusting screw	Same as above (at 10 kHz)
3 *	Reproduce Level (head #3)	TEAC YTT-1004 Playback Alignment Test Tape (15 ips) Play 400 Hz reference level signal.	VTVM connected to OUTPUT terminal	Playback at 15 ips speed. OUTPUT SELECT at REPRO. OUTPUT knob at position "7".	Trim pot #1 R120 (REPRO CAL)	-10 dB (0.3 V) on VTVM
4 *	Sync Reproduce Level (head #2)	TEAC YTT-1004 Playback Alignment Test Tape. Play 400 Hz reference level signal.	Same as above	Playback tape at 15 ips. OUTPUT SELECT at SYNC. OUTPUT knob at position "7".	Trim pot #2 R122 (SYNC CAL)	-10 dB (0.3 V) on VTVM
5 *	REPRO Meter Adjustment	Same as above	VU Meter	Same as above	Trim pot #3 R141 (METER CAL)	Adjust to read 0 VU on VU meters
REPEAT STEP MARKED WITH AN ASTERISK FOR EACH CHANNEL. THE ADJUSTMENT NUMBERS ARE THE SAME BUT THE CIRCUIT BOARD LOCATION, INPUT/OUTPUT TERMINAL NUMBERS, VU METERS, ETC., WILL BE DIFFERENT DEPENDING ON THE CHANNEL.						
6 *	REPRO EQ at 15 ips speed (head #3)	Test Tape Play 16 kHz signal on the tape.	VTVM connected to OUTPUT terminal or VU meter	Playback at 15 ips speed. OUTPUT SELECT at REPRO. OUTPUT knob at position "7".	Trim pot #4 R108 (REPRO EQ)	Adjust to read 0 VU on VU meters or -10 dB on VTVM
7 *	Sync Reproduce EQ at 15 ips speed (head #2)	Same as above	Same as above	Playback at 15 ips speed. OUTPUT SELECT at SYNC. OUTPUT knob at position "7".	Trim pot #5 R110 (SYNC EQ)	Same as above
8 *	REPRO EQ at 7-1/2 ips speed (head #3)	Test Tape Play 10 kHz signal on the tape.	Same as above	Playback at 7-1/2 ips. OUTPUT SELECT at REPRO.	Trim pot #4 R109 (REPRO EQ)	Same as above
9 *	Sync Reproduce EQ at 7-1/2 ips speed (head #2)	Same as above	Same as above	Playback at 7-1/2 ips. OUTPUT SELECT at SYNC. OUTPUT knob at position "7".	Trim pot #5 R111 (SYNC EQ)	Same as above
10 *	Input Level	400 Hz signal at -10 dB from oscillator connected to LINE IN terminals.	Same as above	Stop mode INPUT SELECT at LINE. OUTPUT SELECT at INPUT. INPUT and OUTPUT knobs at position "7".	Trim pot #6 R156 (INPUT LEVEL)	Same as above
11 *	INPUT Meter Adjustment	Same as above	VU meters	Same as above	Trim pot #7 R140 (INPUT METER CAL)	Adjust for 0 VU on VU meter

AD-JUST STEP	WHAT IS IT CALLED	SIGNAL SOURCE AND AMOUNT	WHAT TEST GEAR TO USE	WAHT IS THE RE-CORDER DOING?	POINT TO ADJUST	WHAT READING TO ADJUST FOR
12 *	Bias Level Adjustment Refer to MAINTENANCE section for more precise adjustments.	7 kHz, -10 dB oscillator signal connected to line input jacks.	VTVM connected to OUTPUT jacks.	Record signal on type of tape that will be used for actual recording. FUNCTION at ON. INPUT SELECT at LINE. OUTPUT SELECT at REPRO. INPUT and OUTPUT knobs at position "7". Tape speed at 15 ips.	Trim capacitor #8 C134 (BIAS LEVEL)	While recording adjust trim pot until VU meter indication rises to peak value, then turn pot further clockwise until signal drops off by 4 – 6 VU (over-bias).
IF INPUT AND OUTPUT KNOB ARE MOVED, REPEAT STEP 10 CONDITIONS TO RESET.						
13 *	Bias Trap Adjustment	No input signal	VTVM connected to Bias Trap test point TP1, negative lead to ground, positive lead to test point.	Record mode, no input signal	Trim capacitor L105	Adjust capacitor for minimum output at Bias Trap test point TP1. See page 45 for test point location.
14 *	Record Level	400 Hz signal at -10 dB (0 VU on VU meters) connected to input terminals.	VTVM connected to OUTPUT jack or use VU meters.	Record signal on type that will be used for actual recording. INPUT SELECT at LINE. FUNCTION at ON. OUTPUT SELECT at REPRO. INPUT and OUTPUT knobs at position "7". Tape speed at 15 ips.	Trim pot #9 R176 (REC LEVEL)	Set for -10 dB (0.3 V) at OUTPUT jacks or 0 VU on VU meters.
15 *	Record Reproduce Frequency Response at 15 ips speed.	40 Hz to 22 kHz signal at -10 dB connected to input terminals.	Same as above	Same as above	Inductor #10 L103	Check that frequency response matches limits given in Chart. See page 46.
16 *	Record Reproduce Frequency Response at 7-1/2 ips speed	40 Hz to 16 kHz signal at -10 dB connected to input terminals.	Same as above	Record signal on type of tape that will be used for actual recording. INPUT SELECT at LINE. OUTPUT SELECT at REPRO. INPUT and OUTPUT knobs at position "7". Tape speed at 7-1/2 ips.	Inductor #10 L104	Same as above
17 *	Overall Signal-to-Noise Ratio	No input signal	VTVM connected to OUTPUT jacks.	Same as above tape speed at 15 ips or 7-1/2 ips.		Check for -50 dB or better.

MAINTENANCE

Note:
Parts reference numbers used in the circuit description may not always correspond to those of the Model 32, except for the following sections: 1-5 Reel Motor Drive Circuit, 1-9 F.F and REW Operation, 1-10 Electrical Brake System, 1-13 Edit Control Circuit and 1-16 Amplifier Circuit Description.

NOTES

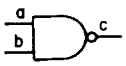
- ★ All resistors are 1/4 watts, 5 %, unless marked otherwise. Resistor values are in ohms (K=1,000-ohms, M=1,000,000 ohms).
- ★ All capacitor values are in microfarads (p=pico-farads).
- ★ ⚠ Parts marked with this sign are safety critical components. They must always be replaced with indentical components – refer to the TEAC Parts List and ensure exact replacement.
- ★ 0 dB is referenced to 1 V in this manual unless otherwise specified.
- ★ PC boards shown viewed from foil side.

1. CIRCUIT DESCRIPTION

Signal flow and functions of the various control circuits of the tape deck are explained in detail in this section. These should be of help in analyzing any trouble which may occur and in correcting the malfunctioning circuit.

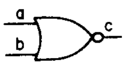
1-1. LOGIC USED IN THE TAPE DECK

(a) 2 INPUT NAND GATE



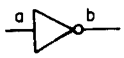
a	b	c
H	H	L
H	L	H
L	H	H
L	L	H

(b) 2 INPUT NOR GATE



a	b	c
H	H	L
H	L	H
L	H	H
L	L	H

(c) INVERTER



a	b
L	H
H	L

Note: H level = 3.4 V ~ 5 V
L level = 0 V ~ 0.6 V

1-2. SYSTEM CONTROL IC

1-2-1. Pin Assignments and Their Functions

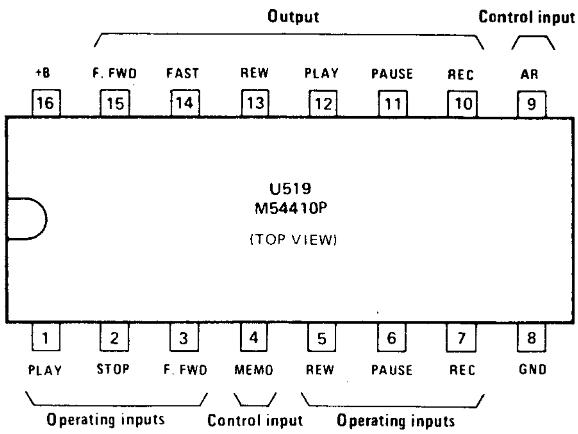


Fig. 1-1. Pin Assignments

	Pin No.	Pin name	Function
Operation inputs	1	PLAY	Reproduce start signal input terminal. Signal level: L
	2	STOP	Stop signal input terminal Signal level: L
	3	F.FWD	Fast-forward signal input terminal. Signal level: L
	5	REW	Rewind signal input terminal. Signal level: L
	6	PAUSE	Pause signal input terminal. Signal level: L
	7	REC	Record signal input terminal. Signal level: L
Control inputs	4	MEMO	Memory input terminal (resets rewind mode when at L level)
	9	AR	Record inhibit signal input terminal (L level: record inhibited, H level: record enabled)
Outputs power	10	REC	H-level signal output terminal during record/reproduce or record/pause mode
	11	PAUSE	H-level signal output terminal during pause mode
	12	PLAY	H-level signal output terminal during reproduce mode.
	13	REW	H-level signal output terminal during rewind mode.
	14	FAST	H-level signal output terminal during rewind or fast-forward mode.
	15	F.FWD	H-level signal output terminal during fast-forward mode.
Power	8	GND	Ground terminal.
	16	+B	Power supply terminal (standard: +5 V +/-10%, absolute maximum: +7.0 V)

1-2-2. Block Diagram

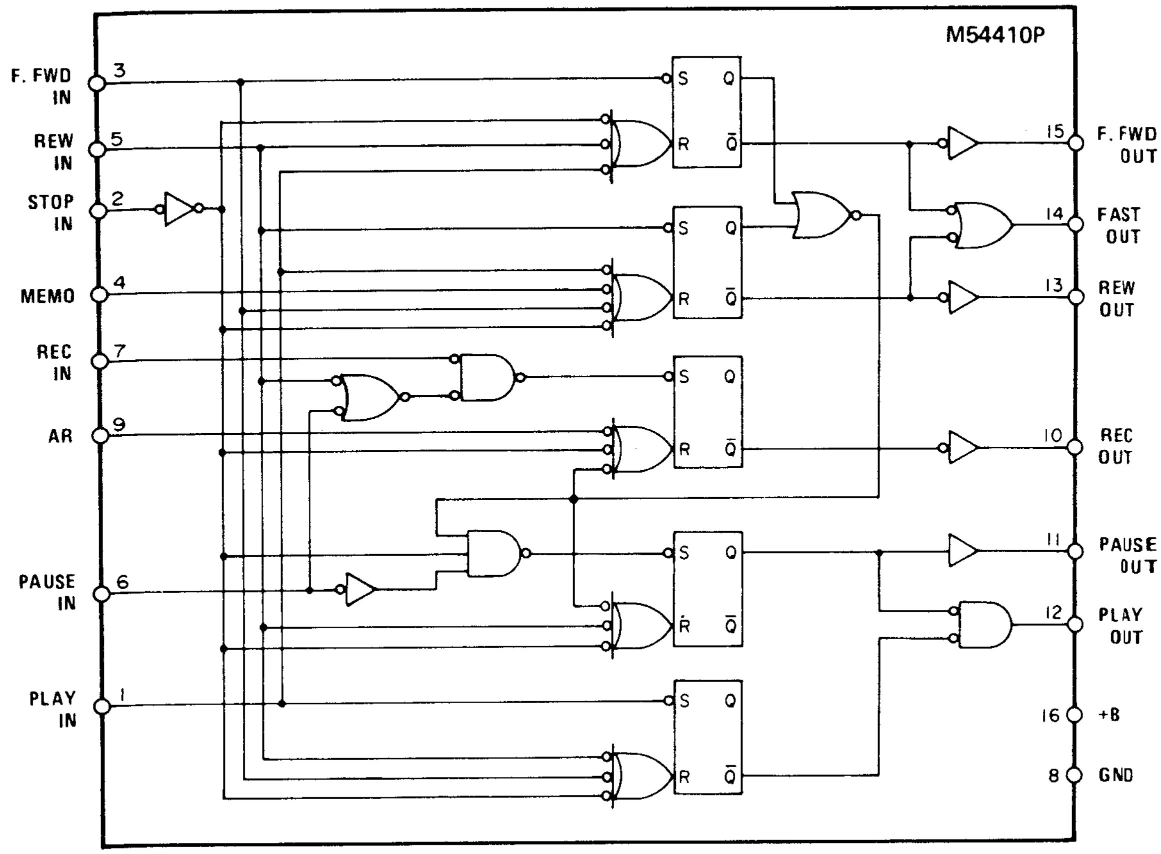


Fig. 1-2. Block Diagram

1-2-3. Input Signals and Resulting Modes

Output signal / Input signal	REC	PAUSE	PLAY	REW	FAST	F. FWD	Operating mode
PLAY	L	L	H	L	L	L	PLAY mode
STOP	L	L	L	L	L	L	STOP mode
F.FWD	L	L	L	L	H	H	F.FWD mode
REW	L	L	L	H	H	L	REW mode
PAUSE	L	H	L	L	L	L	PAUSE mode
REC and PLAY	H	L	H	L	L	L	REC/PLAY mode
REC and PAUSE	H	H	L	L	L	L	REC/PAUSE mode

Notes
1. The mode is set at the decaying edge of the input signal waveform.
2. The output retains the current mode until an input signal indicating a different mode is received.
3. Output REC remains at L as long as input AR is L.
4. Output REW remains at L as long as input MEMO is L.

1-2-4. Mode Transition

The table below summarizes transition from one to another due to an input signal.

Input signal \ Current Mode	STOP	F.FWD	REW	PLAY	PAUSE	REC/PLAY	REC/PAUSE
STOP		STOP	STOP	STOP	STOP	STOP	STOP
F.FWD	F.FWD		F.FWD	F.FWD	F.FWD	F.FWD	F.FWD
REW	REW	REW		REW	REW	REW	REW
PLAY	PLAY	PLAY	PLAY		PLAY		REC/PLAY
PAUSE	PAUSE			PAUSE		REC/PAUSE	
REC and PLAY	REC/PLAY	REC/PLAY	REC/PLAY	REC/PLAY	REC/PLAY		REC/PLAY
REC and PAUSE	REC/PAUSE			REC/PAUSE	REC/PAUSE	REC/PAUSE	

Note. A diagonal line indicates that the current mode remains unchanged.

1-2-5. Operation with more than One Input Signal

When more than one input signal is received simultaneously, the deck enters the mode indicated below. When input signals applied simultaneously are removed in sequence, the mode indicated by the last signal to be removed is normally enabled. If REC and PLAY or REC and PAUSE are combined, the record/reproduce or record/pause mode will be enabled regardless of the sequence in which the input signals are removed. If F.FWD (REW) and REC or PAUSE are combined, the fast-forward (rewind) mode will be enabled regardless of the sequence in which the input signals are removed.

Input signal A	Input signal B	Resulting mode
STOP	Any combination of F.FWD, REW, REC, PAUSE, and PLAY	STOP mode
F.FWD	REW	STOP mode
	REC and/or PAUSE	F.FWD mode
	PLAY	STOP mode
REW	REC and/or PAUSE	REW mode
	PLAY	STOP mode
REC	PAUSE	REC/PAUSE mode
	PLAY	REC/PLAY mode
	PAUSE and PLAY	REC/PAUSE mode
PAUSE	PLAY	REC/PLAY mode

1-2-6. Input/Output Levels

Input/output levels and voltages are given below.

Item	Minimum	Standard	Maximum	Absolute maximum
Maximum supply voltage	–	–	–	7.0 V
Maximum input voltage	–	–	–	5.5 V
Recommended supply voltage	4.5 V	5.0 V	5.5 V	–
H-level input voltage	2.0 V	–	–	–
L-level, input voltage	–	–	0.8 V	–
Open-input voltage	3.2 V	–	–	–
H-level output voltage	2.9 V	–	–	–
L-level output voltage	–	–	0.4 V	–

1-2-7. Initial Reset Circuit

See Fig. 1-3.

The initial reset circuit generates a signal which puts the deck in the stop mode as soon as the power is turned on, preventing incorrect operation during the time the DC supply voltage is unstable.

When power is turned on, current from the IC U519 charges the noise suppression capacitors (C502 ~ C507). It takes only about 20 msec to charge C502 ~ C507 because of their low capacity. When the capacitors are fully charged, the PLAY, PAUSE, F.F, REW, and REC input terminals become HIGH. However, it takes approximately 100 msec for the STOP input terminal to rise to HIGH because of the large capacity of C507. Since STOP takes longer to become HIGH than the other input terminals, a flip-flop is set in U519 when power is turned on and the deck enters the stop mode.

Unless C507 is fully charged and the STOP input terminal is HIGH, U519 does not switch from the stop mode to any other mode even if operation signals are input.

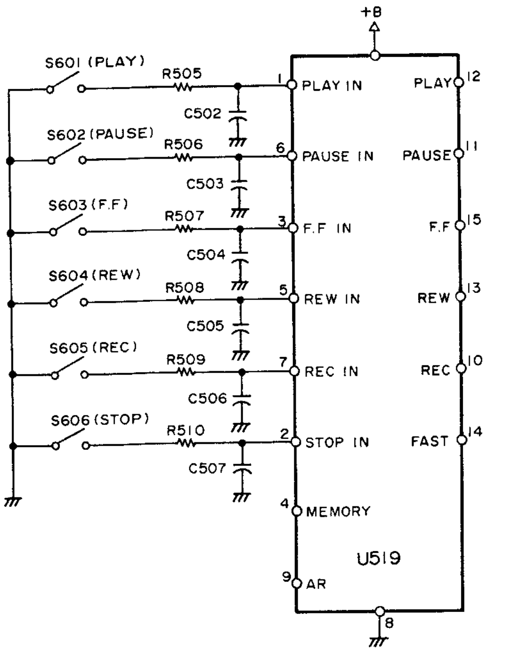


Fig. 1-3. System Control IC Input Circuit

1-3. POWER SHUT-OFF CIRCUIT

See Fig. 1-4.

A photo interruptor type shut-off switch is interlocked with the right tension arm.

1. When the tension arm deviates from its normal position, the light beam falling on the photo transistor is interrupted and the photo transistor output voltage drops, turning off Q516 and Q517. When Q516 is cut off, Q813 is also turned off and no power is supplied to terminal 6 of capstan motor assembly, and the capstan motor is deenergized.
2. When Q517 goes off, base bias current flows to the base of Q518 through R551 and R552 and Q518 goes on. Since the collector of Q518 is connected to the STOP mode switch, the tape deck is set to the STOP mode. Thus, the entire system stops when the tension arm is not set in its specified position due to tape slackness or other trouble.

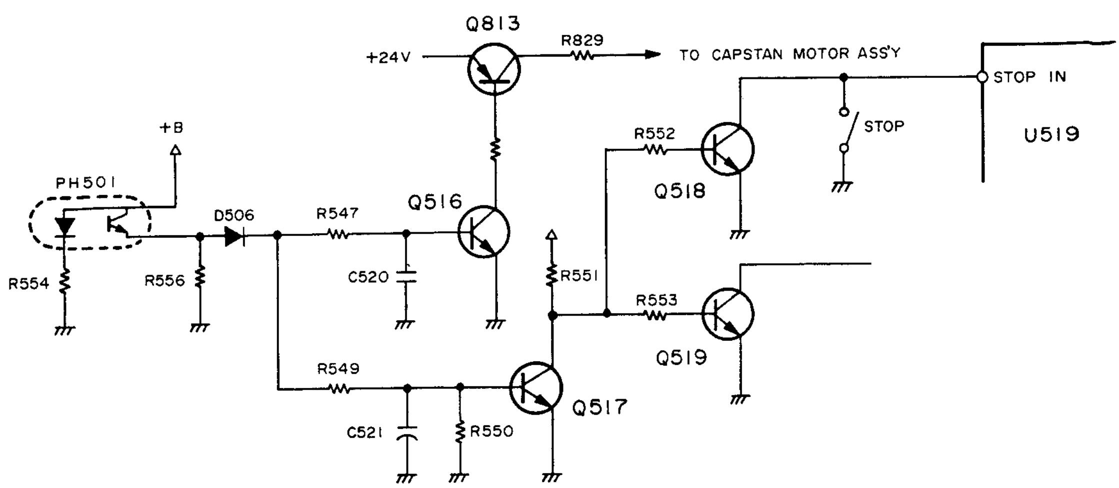


Fig. 1-4. Power Shut-Off Circuit

3. When the tension arm is in its normal position, the photo transistor receives the light beam and outputs a high level voltage to make Q516 and Q517 conduct.
4. When Q516 goes on, the Q813 base bias circuit is grounded and Q813 supplies current to the capstan motor.
5. When Q517 goes on, Q518 and Q519 are turned off, disconnecting Q518 from the stop mode switch and Q519 from the speed sensing circuit.

1-4. CAPSTAN AND BRAKE SOLENOID DRIVE CIRCUIT

The tape deck uses two solenoids; their drive circuits are shown in Fig. 1-5 (B).

1) Capstan solenoid
This solenoid operates in the PLAY mode to activate the pinch roller. The solenoid goes off in the PAUSE mode.
2) Brake solenoid
In the PLAY, F.F, and REW modes, this solenoid operates to release the reel motor brakes. The solenoid goes off in the PAUSE, STOP, F.F., and REWIND mode.

These solenoids operate as described below:

1. When the deck is in the STOP mode and the PLAY button is pressed, pin 12 of U519 goes HIGH.
2. When pin 12 goes HIGH, Q537 goes on and current flows to the base of Q538 and Q538 goes on.
3. When Q538 goes on, the ground side of the capstan solenoid coil is connected to the ground.
4. When pin 12 of U519 goes HIGH, Q539 goes on,followed by Q541 so that R614, C531 and the brake solenoid are grounded through the collector-emitter path of Q541.
5. When Q541 goes on, charging current flows to C531 through route (1) and Q535 goes on for approximately 200 msec. Then Q536 also goes on and supplies the capstan and brake solenoids with +24 V. A large solenoid current flows to ensure activation of the solenoids. Refer to Fig. 1-5(A)
6. When the charge current stops flowing, Q535 and Q536 go off, disconnecting +24 V supply. However, +12 V is supplied through D514 and solenoid activation is maintained with minimal voltage.
7. Thus, the solenoid voltage applied during activation is reduced for holding, maximizing the activation force to ensure positive action but minimizing heating of the solenoid during holding.

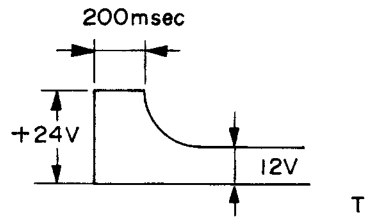


Fig. 1-5 (A). Flashing & Steady State Voltage

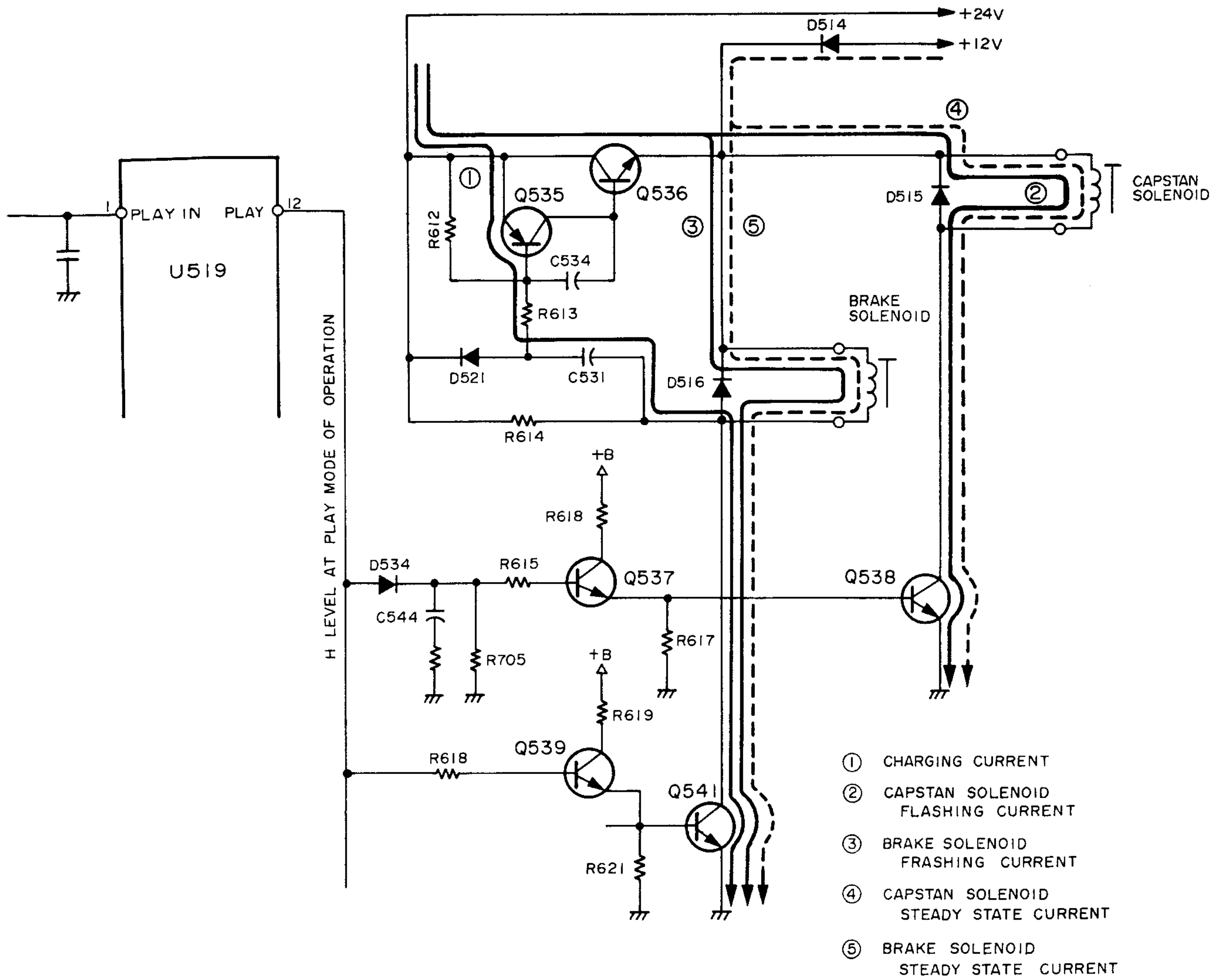


Fig. 1-5 (B). Solenoid Drive Circuit

1-5 REEL MOTOR DRIVE CIRCUIT

Reproduce (Record) Operation

See Fig. 1-6.

1. Before the PLAY button has been pushed, Q547 is cut off, and Q548, Q549 go on causing a 20 V line voltage to be applied to the hot sides of both reel motors through the collector-emitter paths of Q549 and D525. Since the opposite sides of the motor are not connected to the circuit ground through its corresponding drive circuit (Q556 and Q557, or Q560 and Q561), the motors are unable to be rotated.
2. When the PLAY button is pushed, the H level voltage is applied to the base of Q550 making it conductive. Q551 goes on and a charging current flows to the base of Q552 from the emitter-collector path of Q551, C535 and R671 for a short period (1 second) of which length is determined by the value of C535. Q552 then goes on, followed by Q553 which supplies +24 V to the hot sides of both motors until the charging current to C535 is stopped and the flashing current which is required to start the motors is provided.
3. At the same time, the H level voltage is also applied to the base of Q547 making it conductive, turning off Q548 and Q549, which in turn, cuts off the 20 V line voltage which was applied to the motor circuit.
4. Then the H level voltage is applied to the base of Q554 to turn it on, followed by Q555. When Q555 goes on, a base bias current is supplied to both right and left motor drive circuits (Q556, Q557, and Q560, Q561) through routes 1 and 2 causing the drive circuits to initiate motor driving.
5. Meanwhile, the H level voltage is differentiated by C536 and the resultant short impulse turns Q558 and Q559 on. Since the right reel motor is connected to the Q559 collector at time of PLAY start, it is driven with a higher current than that of the left, so it is able to develop more take-up torque, resulting in a smoother starting operation without tape slack.
6. The REEL size selector switch S611 determines the amount of bias current which is to be fed to both motor drive circuits by switching R680 and R698 on and off to enable proper reel drive torque.
7. After the transient or flashing current has stopped, a steady 12 V current is supplied to the motors through D524.

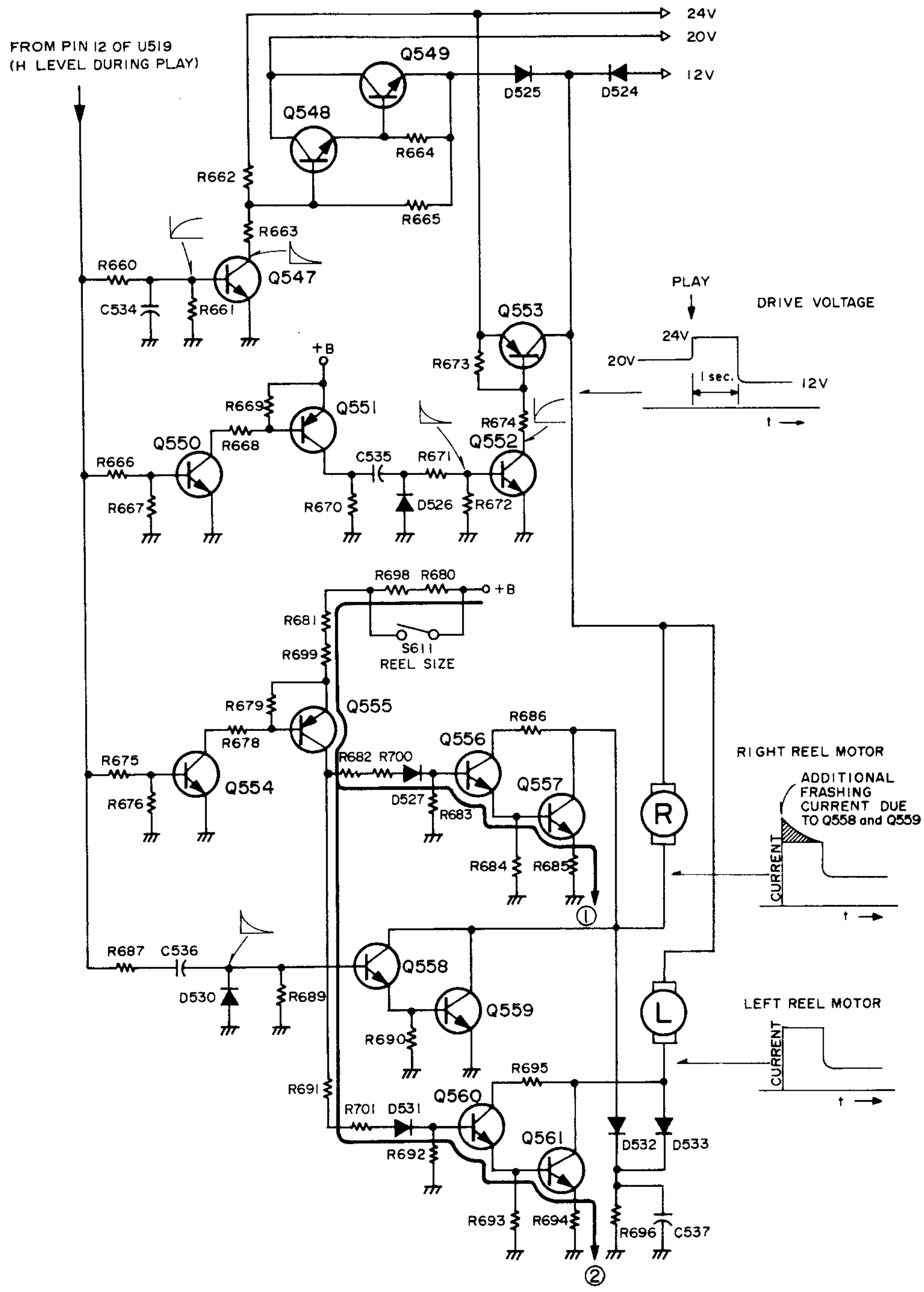


Fig. 1-6 Reel Motor Drive Circuit

1-6. TAPE DIRECTION SENSING AND COUNTER CLOCK GENERATION CIRCUIT

See Fig. 1-7.

This tape deck employs photo-sensing circuits which detect whether the tape is running or stationary and the direction in which it is running. This function is performed by two pairs of photo-interruptors, each consisting of an LED and a photo transistor. The LED and the photo transistor are respectively mounted on the upper and lower sides of a rotating disc which has four openings and is coupled to the right reel motor shaft. The second pair of photo-couplers is mounted in a similar manner, but in such a way that both output pulses produced by the two photo transistors are 90° out of phase when the disc rotates and the openings pass between each pair of LEDs and photo transistors. Thus, the pulses output represent tape speed, and the higher the pulse frequency, the higher the tape speed. The pulse output obtained from the first photo-transistor (PH502) is applied to pin 2 of U517 (an amplifier/wave shaper) and the wave-shaped pulse output developed at pin 1 of U517 is further applied to the base of Q530, then to pin 11 of U505 (the clock terminal of flip-flop U505). The pulse output by the second photo transistor is applied to pin 6 of U517, then to pin 12 of U505 after wave-shaped in the same way as the pulse applied to pin 11 of the same flip-flop. The flip-flop checks the phase (high, low) relationship between the two input pulses applied to pins 11 and 12 and produces a high level output at pin 9 when the tape is running in forward direction and a low level output when the tape is running in reverse direction. The high level signal produced at pin 9 of U505 turns on Q532, which in turn makes Q533 conductive so that the instruction required to increment the tape counter is issued to the counter UP/DOWN input terminal. In a similar way, when the tape is running in reverse direction, the low level output is applied to the UP/DOWN input terminal to decrement the tape counter.

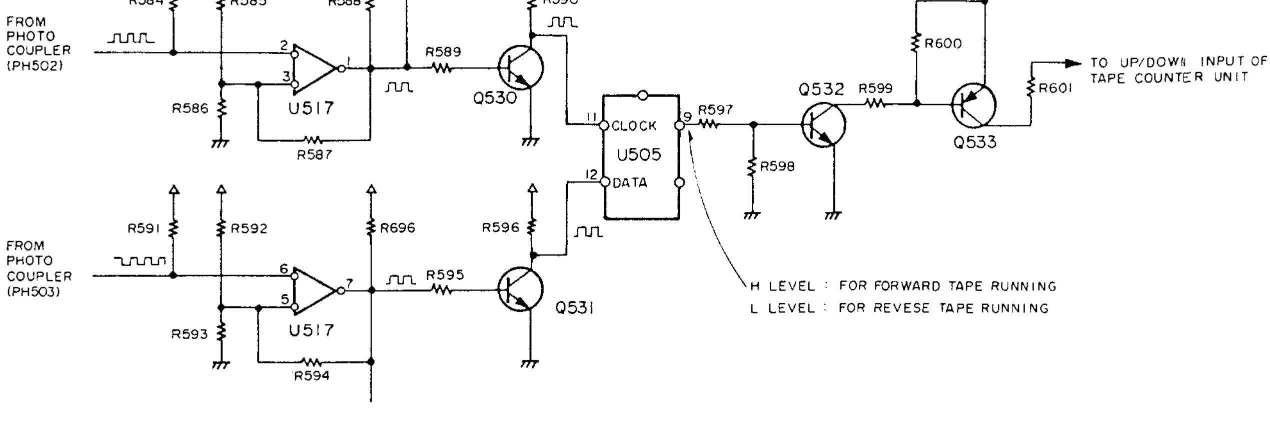


Fig. 1-7. Tape Direction Sensing and Tape Counter Clock Generation Circuit

1-7. COUNTER CLOCK PULSE

See Fig. 1-7.

The wave-shaped pulse output developed at pin 1 of U517 is also applied to the base of Q528 to turn Q528 on or off, along with Q529. The pulse output thus obtained at the Q529 collector is applied to the clock input terminal of the electronic tape counter as a clock pulse.

1-8. MOTION SENSING CIRCUIT

See Fig. 1-8.

1. The wave-shaped pulse output from pin 7 of U517 to represent the tape speed is differentiated by C525, then applied to the base of Q527 to turn it on and off at a frequency corresponding to the tape speed at that time. Thus, C523 is repeatedly charged and discharged. However, C523 does not charge when Q527 goes on and off repeatedly at high speed or when the tape is running at high speed, and pin 6 of U516 (comparator) goes HIGH so that pin 7 of U516 goes HIGH. On the other hand, pin 7 goes LOW when tape is running at low speed. (Pin 7 may develop HIGH and LOW output in alternation when the tape runs at a threshold speed.)
2. Since the voltage developed at pin 7 of U516 is applied to the base of Q521 through R566 and D507, Q521 goes on at high tape speeds and off at low speed. Consequently, pin 1 of U516 also outputs H at high speed and L at low speed as long as Q520 is off.
3. The two signals obtained at pins 7 and 1 of U516 are used as motion control signals, as described later.
4. The motion sensing circuit does not operate in the PLAY and PAUSE modes because pin 12 (PLAY OUT) and pin 11 (PAUSE) of U519 are connected to D508 and D509, respectively, and Q526 is forced to go on when the PLAY or PAUSE button is pushed.

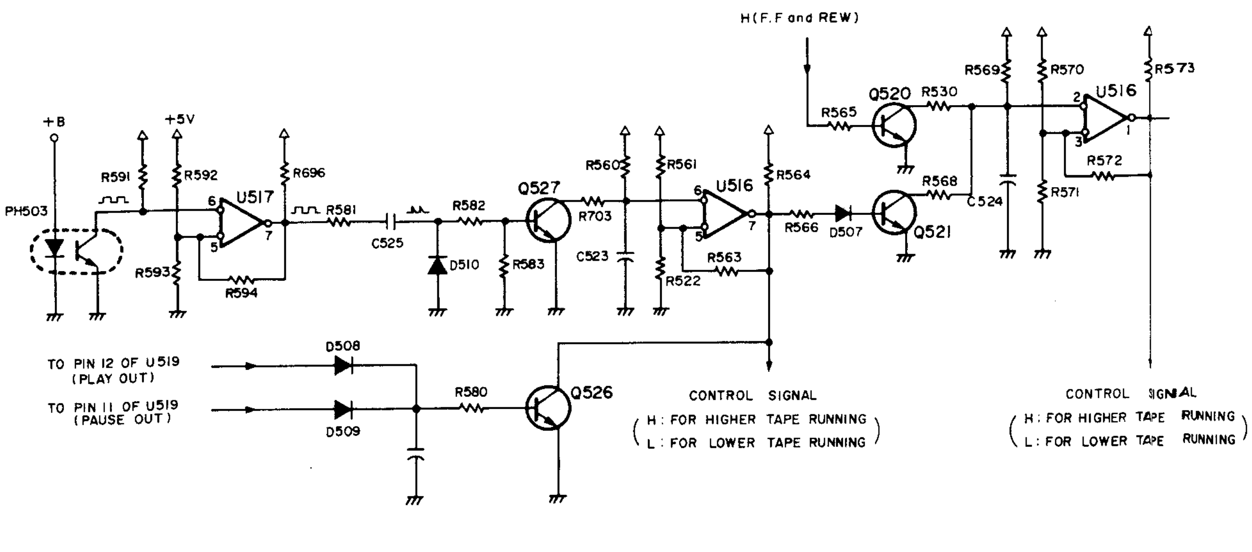


Fig. 1-8. Motion Sensing Circuit

1-9. F.F. AND REW OPERATION

See Fig. 1-9

1. As previously mentioned, both pin 3 and pin 6 of U514 develops an H level voltage during the F.F. and REW operations.
2. Q547 goes off during F.F. and REW operations, and Q548, Q549 go on supplying 20 V line voltage to the hot sides of both reel motors.
3. When the F.F. button is pushed, the H level voltage developed through pin 3 of U514 is applied to the base of Q543, turning it on, which in turn, makes Q544 go on. When Q544 goes on, 5 V is applied to the base of Q556 and Q557 through route 1 to enable the energizing of the right reel motor through its own drive circuit (Q556 and Q557).
4. At the same time, the base of Q560 and Q561 are also biased through route 2 to enable the energizing of the left reel motor through its drive circuit (Q560 and Q561).
5. As shown in the schematic diagram, the overall resistance of bias route 1 is lower than that of route 2, signifying that the right reel motor drive circuit is able to supply more current to the right motor. Consequently, the right reel motor rotates with higher torque than that of the left reel motor. The left reel motor is only driven to develop proper back tension torque.
6. When the REW button is pushed, the H level voltage is applied to the base of Q545 turning it on, followed by Q546. Then the manner which the bias current is applied above in the F.F. operation is reversed. The bias current is now applied to the base of Q556 through R659, R658, R656 and D522 while at the same time is fed to the base of Q560 through R657 and D523. This being the case, the left reel motor now rotates with higher torque than that of the right reel motor in this case.

1-10. ELECTRICAL BRAKE SYSTEM

See Fig. 1-9

The electrical braking system functions when a fast operation mode is changed to any other mode and continues to function until the tape speed drops to a predetermined speed and the motion sensing circuit develops an L level signal. The case in which the mode is changed from REW to STOP is described below.

1. When the STOP button is depressed in the REW mode of operation, pin 13 of U519 goes LOW, then pin 12 of U513 goes LOW to make pins 11, 5 and 10 of U513 and pin 4 of U514 go HIGH. When pin 4 of U514 goes HIGH, pin 6 of U514 goes LOW and Q545 and Q546 are turned off.
2. While the logic state at pin 6 of U513 is set to HIGH by the H level output from the motion sensing circuit during REW mode of operation, pin 8 of U513 (and thus, pin 2 of U514) goes LOW when the STOP button is depressed. Then pin 3 of U514 goes H.
3. Thus, the mode of operation is temporarily changed from REW to F.F and electrical braking is applied to the reel motors to reduce tape speed rapidly.
4. When tape speed has been considerably reduced by applying the electrical brake to the reel motors, the motion sensing circuit outputs an L level signal to the reset terminal (pin 1 of U513) and the flip-flop output (pin 6 of U513) goes L; then, pin 8 of U513 goes H and pin 3 of U514 goes L. Thus, both pins 3 and 6 of U514 are set to L (pin 6 of U514 is set to L when the REW mode is changed to the F.F mode).
5. When pin 3 of U514 goes L, Q541 base bias is cut, and Q541 and Q542 go off to disconnect the ground side of the brake solenoid and apply mechanical braking to the reel motors.

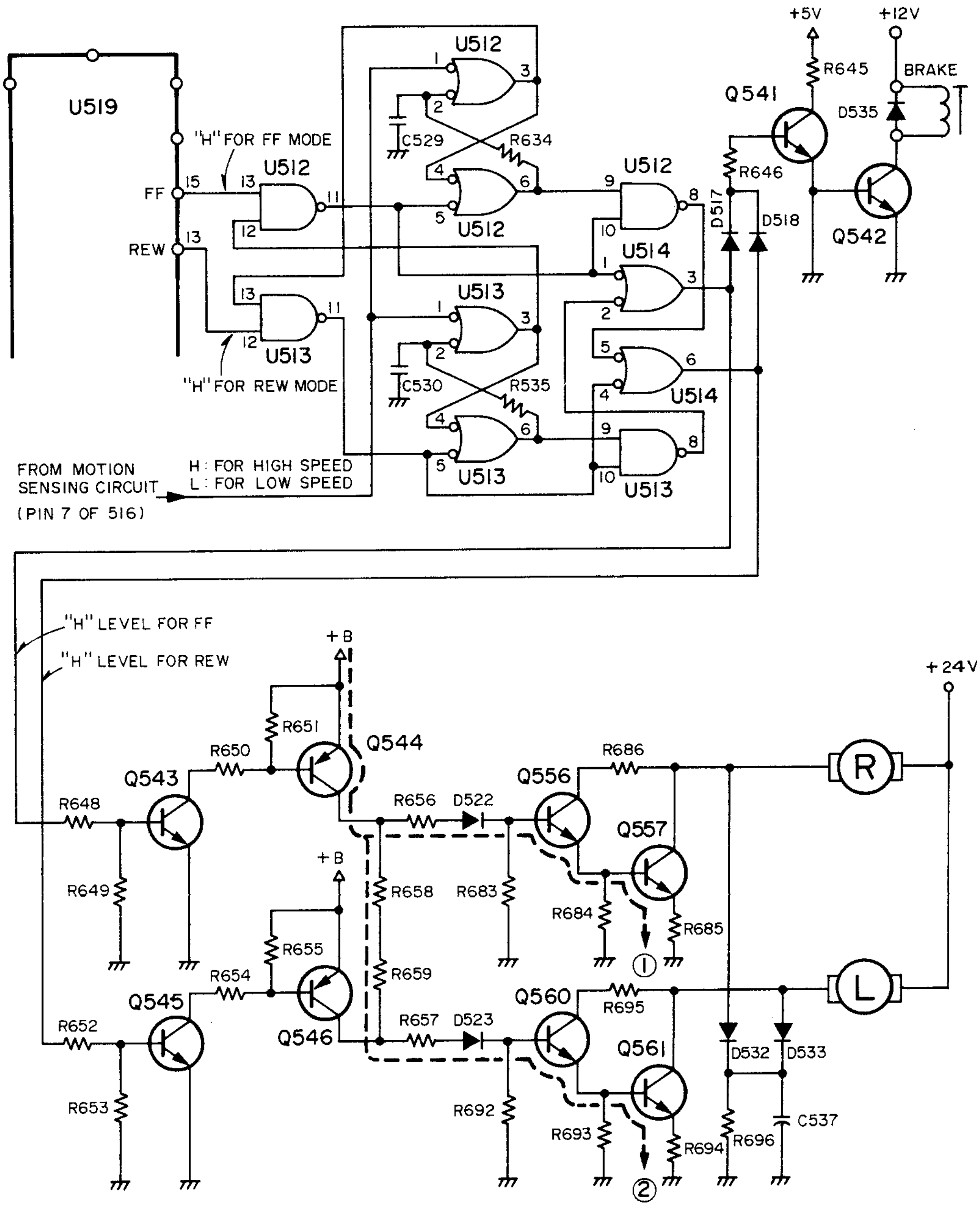


Fig. 1-9. FF and REW Mode Operation Control Circuits

1-11. COUNTER ZERO RETURN

See Fig. 1-10.

If ZERO RETURN switch S609 is set to ON, the tape stops automatically when the electronic counter reading reaches zero during the REW mode of operation. The electronic counter is designed to produce one H level pulse when its reading reaches zero. The zero return operation functions as follows:

1. When the REW mode is set, an H level voltage is applied to the base of Q509 to turn it on. Thus, pin 11 of U510, pin 10 of U510, and pin 12 of U506 are set to H. While the tape is running at high speed, the motion sensing circuit also outputs an H level signal, which is applied to pin 5 of U507 and pin 5 of U509. While in the REW mode, the electronic counter is decremented and, when it reaches zero, it generates one H level pulse. This pulse is applied to the base of Q507 to turn it on, which in turn makes pin 6 of U506 HIGH; this HIGH pulse is applied to pin 13 of U506. Since pin 12 of U506 has already been set to H, pin 11 of U506 goes L, then pin 8 of U506 goes H to turn on Q510. As Q510 collector is connected in parallel to the F.F button, the tape deck operation mode is changed from REW to F.F mode electronically.
2. When pin 11 of U506 goes L, the flip-flop is set, pin 3 of U507 goes H, pin 6 of U507 goes L, then pin 8 of U507 goes H and pin 12 of U507 is set to H.
3. When tape deck operation mode changes from REW to F.F, the electro-magnetic braking system starts to function but the tape does not stop immediately because of high rotational inertia and the tape counter continues to be decremented. When the inertia decreases the tape stops, then starts to run in the forward direction (the F.F mode is set at this time).
4. When the F.F mode is set, an H level signal is applied to the base of Q508 to turn it on, then pin 3 of U508 (pin 12 of U508) goes H. Now the tape counter is being incremented and, when the reading reaches zero, the counter outputs one H level pulse. This pulse is applied to pin 13 of U508 to make pin 11 of U508 go L. Pin 8 of U508 then goes H to set pin 13 of U507 to H. As pin 12 of U507 has already been set to H, pin 11 of U507 goes L and pin 6 of U508 goes H, turning Q511 on or changing the tape deck operation mode from F.F to REW.
5. On the other hand, when pin 11 of U507 goes L the flip-flop consisting of two U509 units is set and pin 3 of U509 is set to H and pin 6 of the same is set to L.
6. When the REW mode is set, pin 11 of U510 goes H again and pin 10 of U510 is set to H. Now the counter is being decremented and, when it reaches zero, one pulse is generated and applied to pin 9 of U510. Pin 8 of U510 then goes L, pin 3 of U510 goes H, and pin 8 of U509 goes L.
7. Meanwhile, when pin 3 of U511 is set to L (as started below), pin 6 of U510 goes H to turn on Q512, which in turn closes the STOP mode switch. Thus, the tape is stopped at a gradually decreasing speed when the counter reaches zero.
8. However, when the position in which the tape is to be stopped is within 3 or 4 seconds of that at which the REW mode is set, the tape can be directly stopped without repeating the REW/F.F./REW/STOP operation described above. This operation is conducted as follows: When the rewind mode is set, an H level signal is applied to C542 and a differentiated impulse is applied to the base of Q561 to turn it on, decreasing voltage at pin 2 of U515 and setting pin 1 of U515 to H for 3 ~ 4 seconds. When the tape counter reaches zero within this period, its zero pulse is applied to pin 2 of U511, setting pin 3 of U511 to L, causing pin 6 of U510 to go HIGH and to turn Q512 on. Thus, the REW mode is changed directly to the STOP mode if the counter zero pulse is generated within 3 ~ 4 seconds after the REW mode is set.

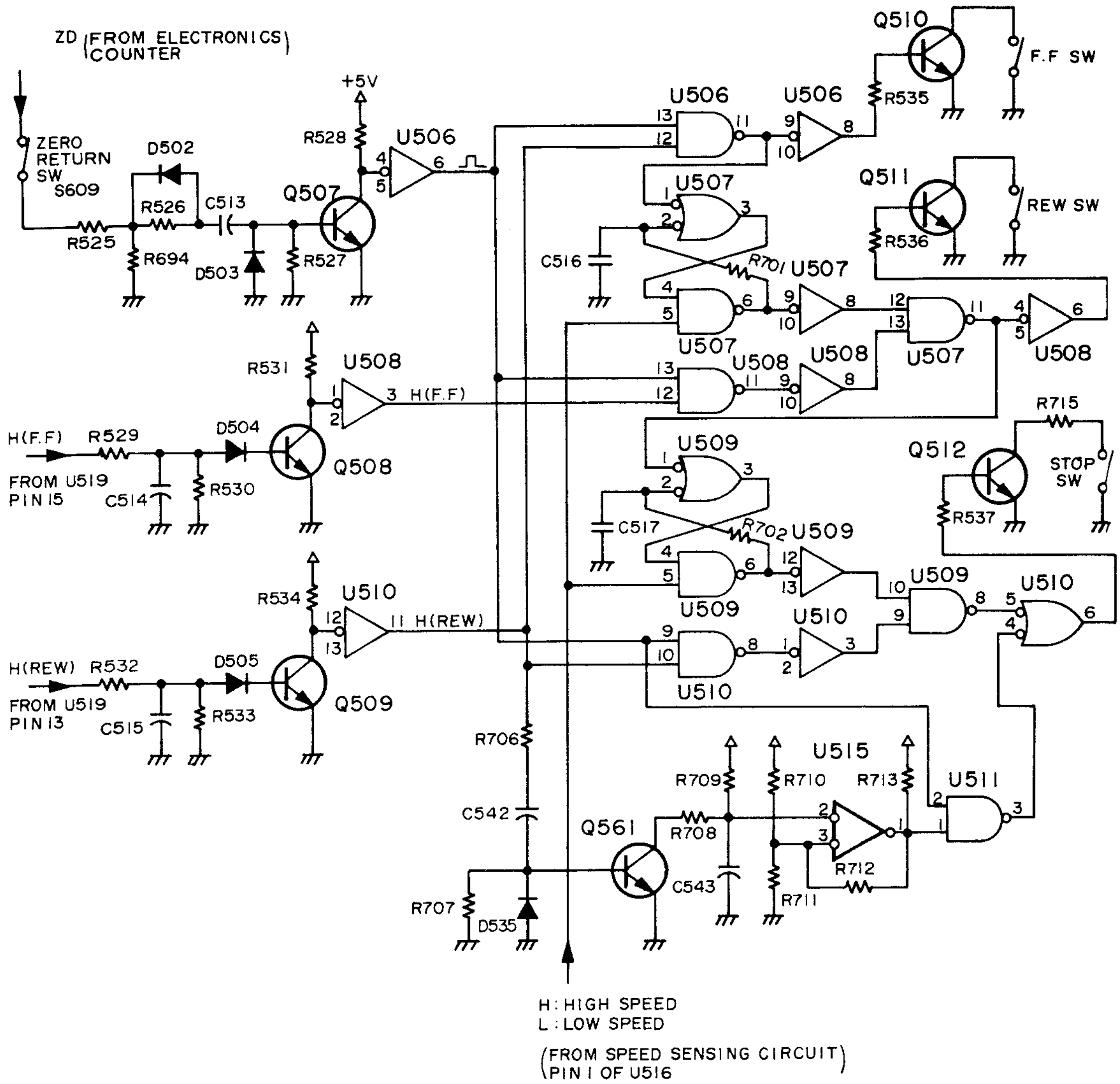


Fig. 1-10. Counter Zero Return Control Circuit

1-12. PUNCH IN/OUT CONTROL CIRCUIT

See Fig. 1-11

1. The PUNCH IN/OUT switching pulse circuit consists of Q901, Q902, U506 and a momentary switch. When the punch in/out switch is pushed once, Q901 goes off, Q902 goes on and U506 generates an H level pulse.
2. In the PLAY mode, pin 1/2 of U502 is L and pin 12 of U502 is H, so pin 2 of the U505 flip-flop is H. Under this condition, a H level pulse is applied to pin 3 of U505 if the punch in/out switch is pushed, then the flip-flop output (pin 5) changes from L to H, pin 6 of U502 goes L because pin 5 of U502 is set to H through pin 12 of U519, and pin 8 of U502 goes H so that Q505 goes on. Since the Q505 collector is connected to both the PLAY and REC mode switches, the operation mode is changed from PLAY to REC/PLAY.
3. At the same time, another flip-flop in U503 changes its logic state and outputs L at pin 6 of U503 . Then, pin 8 of U503 goes H and sets pin 13 of U503 to H. Further, pin 1/2 of U502 goes H, changing the logic state at pin 2 of U505 from H to L.
4. When the PUNCH IN/OUT switch is pushed once more, a positive pulse is applied to pin 3 of U505 which changes output from H to L because of pin 2 of U505 is at this time set to L. Then pin 1/2 of U504 goes L and pin 3 of U504 (and pin 12 of U503) goes H. Since pin 13 of U503 has already been set to H, pin 11 of U503 goes L and pin 6 of U504 goes H. Thus, the H level pulse obtained is finally applied to the base of Q506, turning it on and operating the AR circuit of U519 to inhibit recording.
5. Three diodes (D537-D539) connected to the CLEAR terminal of U505 are inserted to avoid erroneous PUNCH IN operation which would be caused during operation mode switching (F.F, REW & STOP).

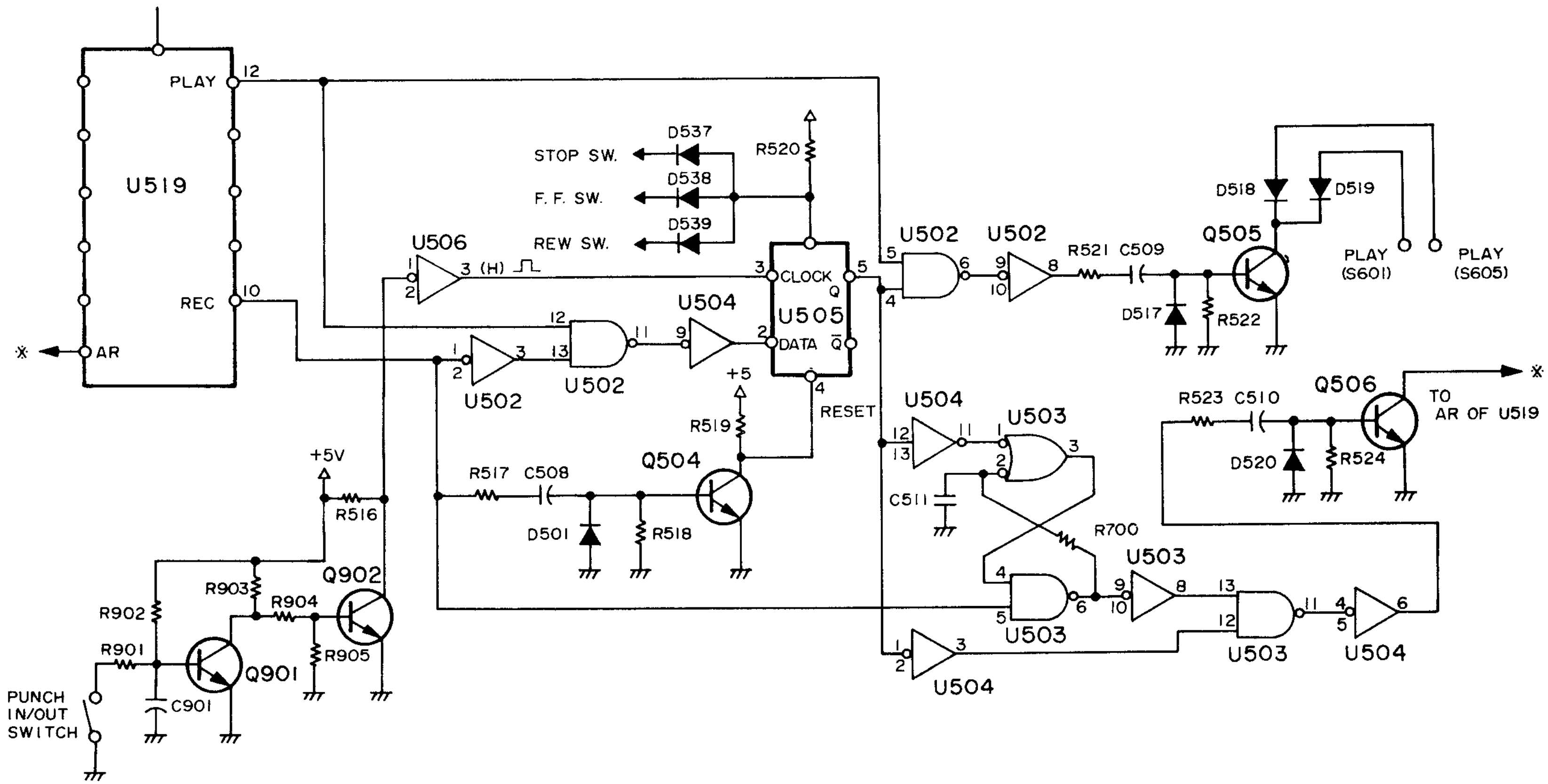


Fig. 1-11. Punch In/Out Control Circuit

1-13. EDIT CONTROL CIRCUIT

See control section of the inserted circuit diagrams.

1. When the EDIT switch is on, Q509 and Q510 go on, followed by Q512. With Q512 turned on, the Q813 base bias circuit on PCB assembly power supply is closed and Q813 supplies DC power to the capstan motor circuit to actuate the motor. At the same time, Q511 also goes on to turn off Q514 to release the STOP mode.
2. At the same time, when Q509 goes on, Q556, and Q558 are grounded through D528, D527, D529 and through the collector-emitter path of Q509, to stop the take-up reel motor.
3. During the EDIT mode of operation, no F.F or REW mode is available because the F.F IN and REW IN circuits are opened by the EDIT switch being set on.

1-14. REC AND PLAY MUTE SIGNALS

See Fig. 1-12.

1. REC signal
   When the REC button is depressed, pin 10 of U519 outputs an H level signal, which is applied to the base of Q524 to turn it on. When Q524 goes on, Q525 base current flows and Q525 also goes on. The +24 V line is then connected to R579 for use as a control voltage to actuate amplifier circuits associated with recording.
2. Play Mute Signal
   When the PLAY button is depressed, pin 12 of U519 outputs an H level signal, which is applied to the base of Q534 to turn it on, grounding the PLAY MUTE terminal. This low level state is also used to control the amplifier circuit (as described later). The CUE switch connected in parallel with Q534 serves the same function as the PLAY MUTE signal when it is closed.

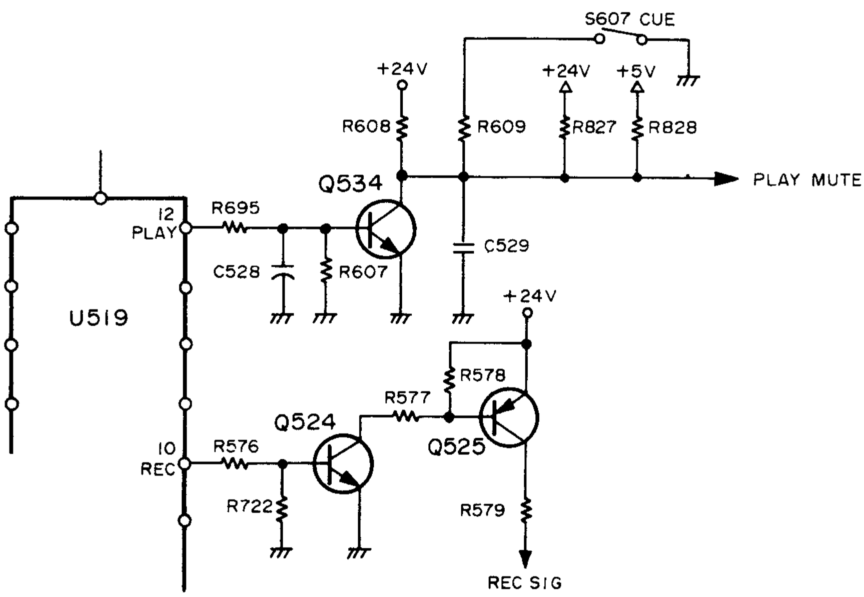


Fig. 1-12. Rec & Play Mute Circuit

1-15. DISPLAY CIRCUIT

See Fig. 1-13.

A. RECORD LED

1. The comparator of U515 with pins 5, 6, and 7 constitutes a square wave oscillator and outputs a pulse signal at pin 7. When the REC button is depressed, pin 9 of U511 is set to H and the pulse output is obtained at pin 8 of U511. The pulse signal is then fed to gate pin 5 of Q501. Meanwhile, as the REC button is on, pin 1 of U501 is set to H.
2. If one or more of the record function switches are switched on, a L level signal is applied to R511 as the REC MODE signal, causing pin 11 of U511 (pin 2 of U501) to go H. Then, pin 3 of U501 (pin 4 of U501) goes L, setting pin 6 of U501 to H and turning Q501 on. Thus, the REC LED (D601) lights.
3. Next, assume that none of the record function switches are on; an H level signal is then applied to pins 12/13 of U511 through R511 so that pin 11 of U511 (pin 2 of 501) goes L. Since pin 1 of U501 is set to H, pin 3 of U501 (pin 4 of U501) goes H and the output gate (pin 6 of U501) opens. Then, the pulse signal applied to pin 5 of U501 is output from pin 6 of U501, turning Q501 on and off and making the REC LED flash to indicate that the tape deck is in the REC mode but that no recording channel is designated.

B. PAUSE LED

When the REC and the PAUSE buttons are on, pins 12 and 13 of U501 are set to H and an L level signal is output at pin 11 of U501. Then, pin 8 of U501 goes H, turning on Q502 and lighting PAUSE LED D602.

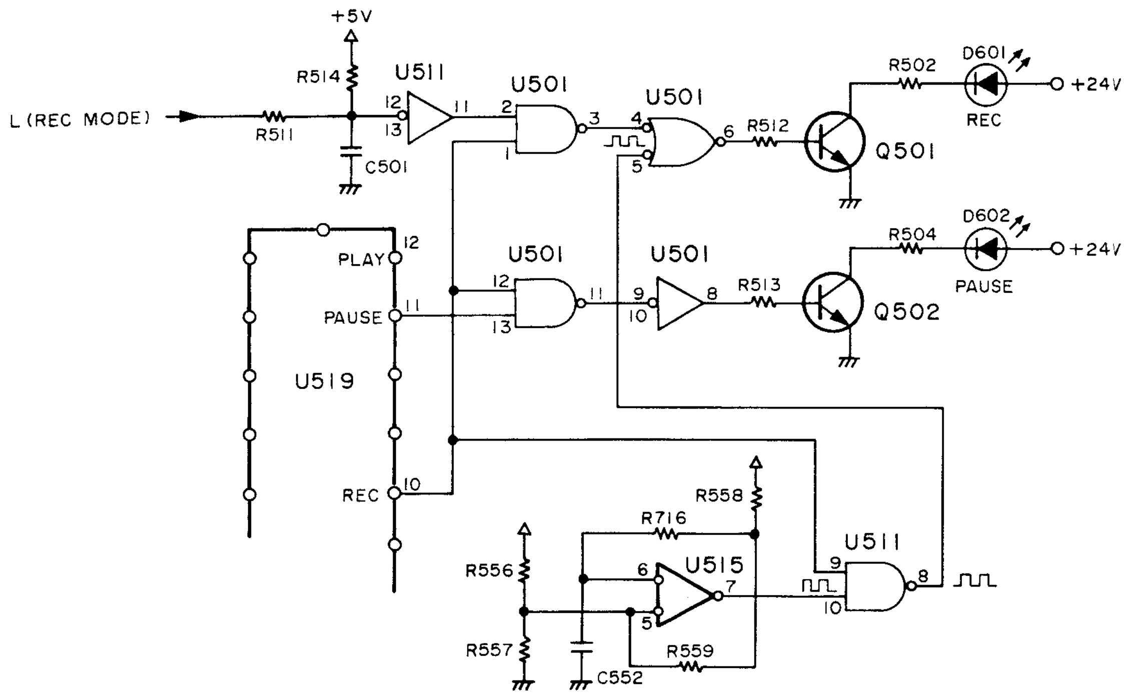


Fig. 1-13. Display Circuit

1-16. AMPLIFIER CIRCUIT DESCRIPTION

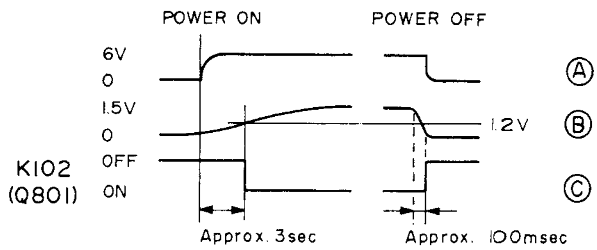
This description covers only one channel, with the exception of several switching circuits which are assembled on the FUNCTION PCB, MASTER OSC PCB, IN/OUT SELECT PCB, and LED indicators.

1-16-1. Power Muting Circuit

See Fig. 1-14.

K102 is a muting relay which protects the output line from impulse noise occurring when the power switch is turned on or off. When power supply starts, +6 V (VU meter lamp power) rises rapidly, charging C802 through R801. When the voltage across C802 reaches about 1.2 V, Q801 goes on and K102 operates to connect the OUTPUT terminal to the output circuit of the OUTPUT amplifier. It takes about 3 seconds for K102 to go on after power supply starts. The power lines of the deck's amplifier reach a steady state during this time. Thus, the audio output line is protected from transient noise.

When power is turned off, the +6 V applied to the VU meter lamp falls rapidly, and C802 quickly discharges through D805 and the meter lamp; Q801 and K102 go off immediately before the amplifier power line voltage falls. Thus, the output line is also protected from transient noise.



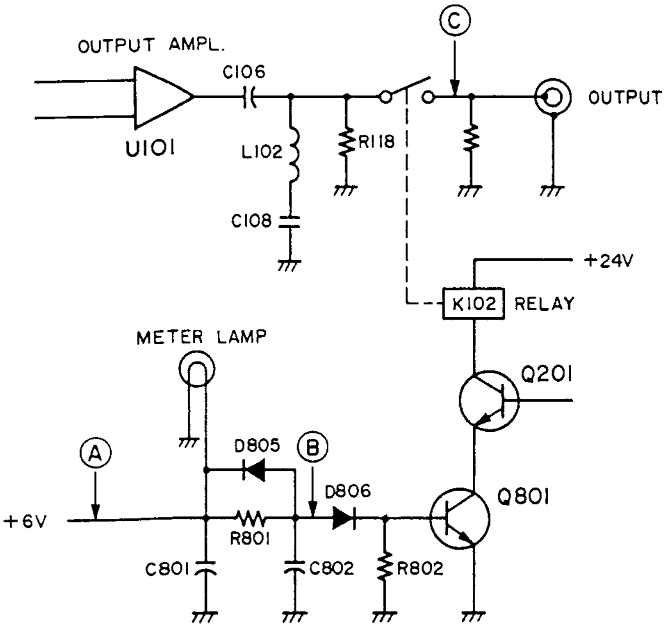


Fig. 1-14. Power Muting Circuit

1-16-2. Bias and Record Control Circuit

See Figs. 1-15(A) and 1-15(B).

1. As previously described, when the unit is in REC mode, REC SIG (+24 V) is produced at Q525 collector. This signal is applied to the FUNCTION switches. If any one (or more) of the switches (for example F) is set to ON or into the record mode: (1) the common terminal of Fa is connected to a +24 V line and voltage is supplied to D109, D117 and D115. Thus, Q108, Q109 and Q120 go on, and Q118, Q119 also go on. (2) The Fb common terminal is grounded, causing REC LED indicator to light continuously as described in section 1-15 "Display Circuit".

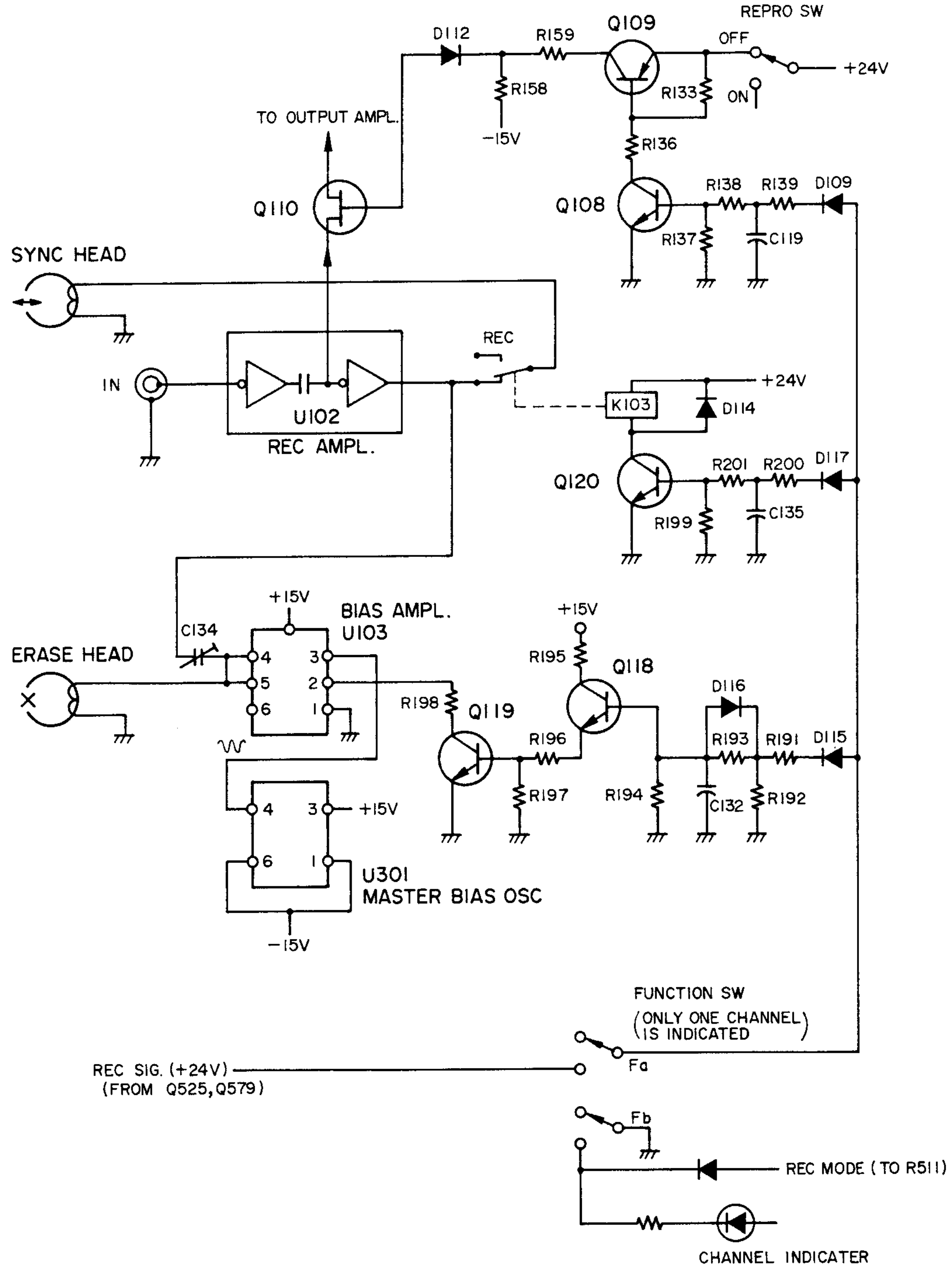


Fig. 1-15(A). Bias and Record Control Circuit

2. When Q109 is turned on, FET switching transistor Q110 is on and part of the recording signal is applied to the OUTPUT amplifier, allowing recording to be monitored. When Q120 goes on, REC relay K103 is energized, the record head is switched to the record amplifier, and the cold side of the erase head is grounded. Thus recording is made. On the other hand, when Q119 goes on, bias oscillator amplifier unit U103 starts to amplify the bias signal supplied from master bias oscillator U301 and the amplified output is supplied to both the record and erase heads.

3. The on and off switching timings for all above circuits (the bias switching circuit comprising Q118 & Q119, the REC relay switching circuits comprising Q120, and the OUTPUT (SYNC – INPUT) switching circuits comprising Q108 & Q109) are suitably fixed so that transient noise has no undesirable influence on recorded sound quality. The switching timings (delay time periods) of the circuits depend on the values of C132, C135 and C119, respectively. For details on the relationship between these, refer to Fig. 1-15(B).

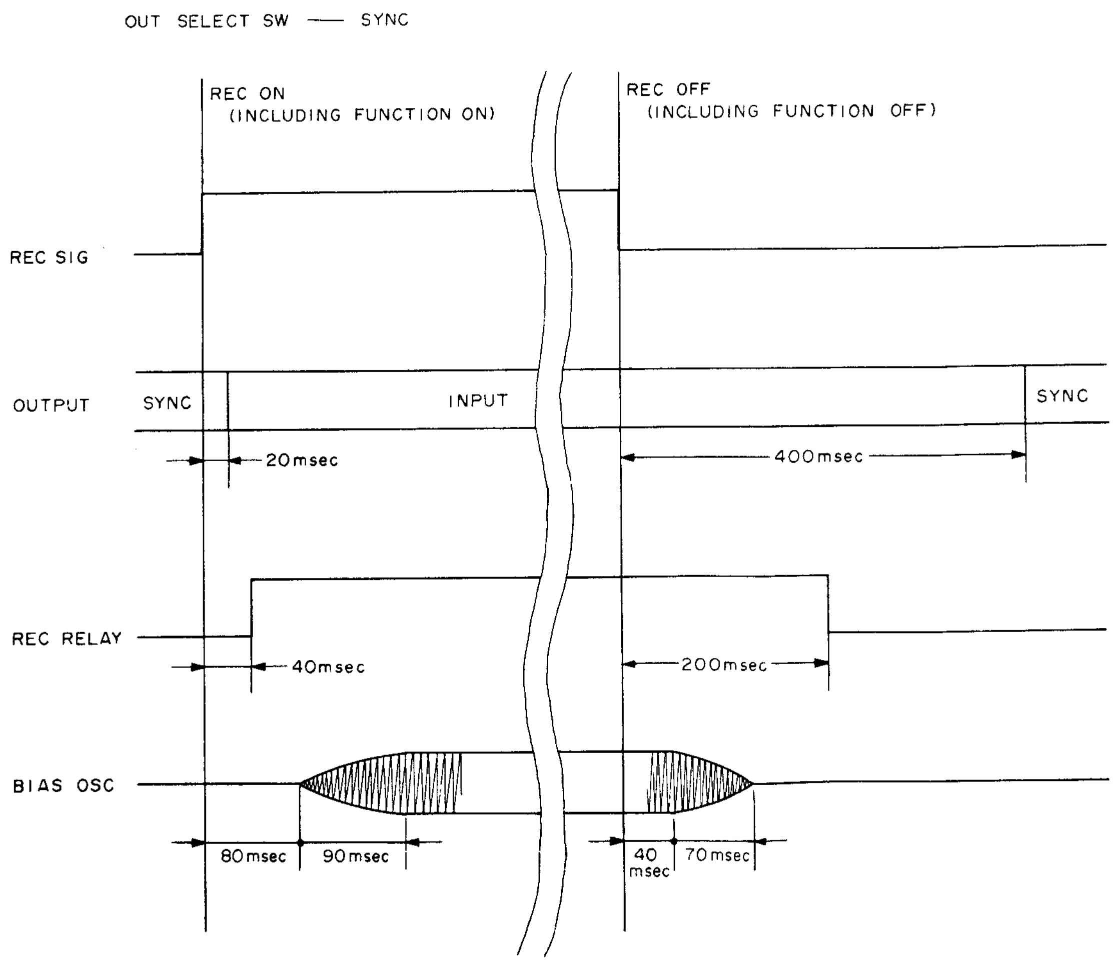


Fig. 1-15 (B). Record Circuit Switching Timing Diagram

1-16-3 Reproduce Amplifier Circuit

See Fig. 1-17 (A) and (B).

1. The reproduce amplifier consists of an 18 dB Step-up Transformer, a Reproduce EQ Amplifier, a Meter Amplifier and FET switching transistors which controls the function of the reproduce amplifier depending on the mode of operation and the tape speed selected.
2. Let's assume that the SPEED selector has been set to HIGH (15 ips – 38 cm/sec.) and that the play button is on.
3. When OUTPUT SELECT is set to INPUT, +24 V is applied to the base of Q201 through R358 and D356 to turn it on. The +24 V is applied to energize the POWER MUTE RELAY, K102. (This part of the circuit is not shown in Fig. 1-16(A)). The relay connects the amplifier output (pin 1) of U101(2/2) to the LINE OUT jack. When OUTPUT SELECT is set to REPRO or SYNC, Q201 and K102 go on in the same way.
4. At the same time, +24 V is also applied to the cathode side of D112 from a1 through D118, R204 and R159 to set the gate potential of Q110 to zero, turning it on. The input audio signals (previously selected through the INPUT switch) coming from the LINE IN jack are fed from the INPUT VR through pin 7 of U102(1/2) to R202, R156 and then sent to the OUTPUT VR to be amplified to pin 1 of U101 for routing to LINE OUT.
5. Meanwhile, the signals selected through the INPUT select switch are supplied to the motor circuits from pin 7 of U102(1/2) through R140 and a2 of the INPUT select switch.
6. Now, assume that the SPEED selector has been set to HIGH and that OUTPUT SELECT is set to REPRO.
7. When OUTPUT SELECT is set to REPRO, +24 V is supplied through c1 of REPRO to the cathode side of D102 to set the gate potential of Q101 to zero, turning it on. Switching Q101 on allows the reproduced frequency response to be modified to precisely match the tape speed and the reproduce head which is to be used. During the low speed (7-1/2 ips – 19 cm/sec.), this modifying is done by Q102 being turned on.
8. Meanwhile, when OUTPUT SELECT has been set to REPRO, Q105 is turned on to connect the EQ amplifier output signals to the input terminal (pin 3) of U101(2/2) through the OUTPUT VR for final routing to the LINE OUT jack.
9. Then, because the play mode operation has been selected, the muting inhibit-signal (ca. -6.5 V) is applied to the gate of Q107 from pin 8 of the power supply unit PC board, which in turn, cuts off Q107. By Q107 being cut off, muting is inhibited and the audio signals are transmitted to the next stage.
10. When OUTPUT SELECT has been set to SYNC, Q204 is turned on and the SYNC RELAY K101 is energized. (This part of the circuit is not shown in Fig. 1-16(A)). When this relay is activated, the input pin of the primary side of the step-up transformer (T101), is disconnected from the reproduce head and is connected to one of the terminals of the REC relay circuit on the K103 side. Under this condition, the SYNC head will be connected through K103 to the input terminal of the primary side of T101 and the audio signals which are picked up by the SYNC head are reproduced through the reproduce amplifier if the REC mode is not selected. However, if the REC mode is selected, the SYNC head will be connected through K103 to the record amplifier output circuit as described in "1-16-2 Bias and Record Control Circuit".
11. When the SPEED selector has been set to HIGH and OUTPUT SELECT is set to SYNC, +24 V is applied to the cathode side of D104 through b1 of the SYNC switch which sets the gate potential of Q103 to zero, turning it on. This allows the reproduced frequency response to be modified to precisely match the tape speed and the reproduce head used. When the low speed is selected, Q104 is turned on to obtain this modifying and matching result in the same way.
12. When OUTPUT SELECT has been set to SYNC, Q106 is turned on and the reproduce EQ amplifier output signals are fed to pin 3 of U101(2/2) through OUTPUT VR to be finally outputed through LINE OUT.
13. In the SYNC mode of operation, one channel may be operated in the PLAY mode while the other channel is in the REC mode of operation. In this situation, the recording bias signal may flow into the adjacent channel

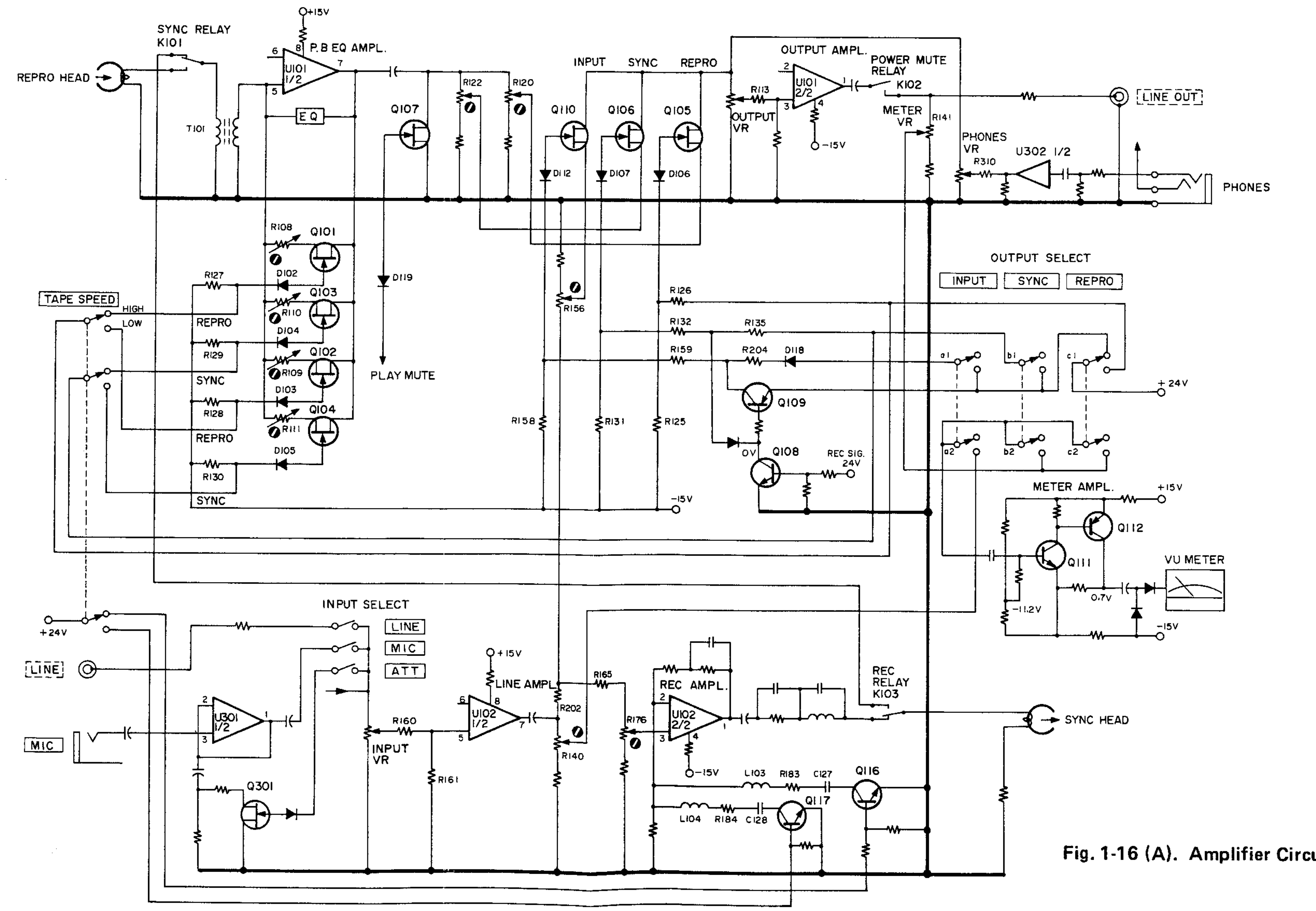


Fig. 1-16 (A). Amplifier Circuit Diagram

head which is operating as reproduce head and cause degrading of the sound quality (SN). To prevent this, three bias traps consisting of a choke coil and two capacitors (L101, C136, C101, etc.)

14. The on and off timings of the SYNC relay are so adjusted as to prevent switching noise during circuit muting as shown in Fig. 1-16(B). The SYNC relay on and off timing depends on R363, C354, and by C354, R361 respectively, of the SYNC relay drive circuits including Q202. (This part of the circuit is now shown in Fig. 1-16(A)).

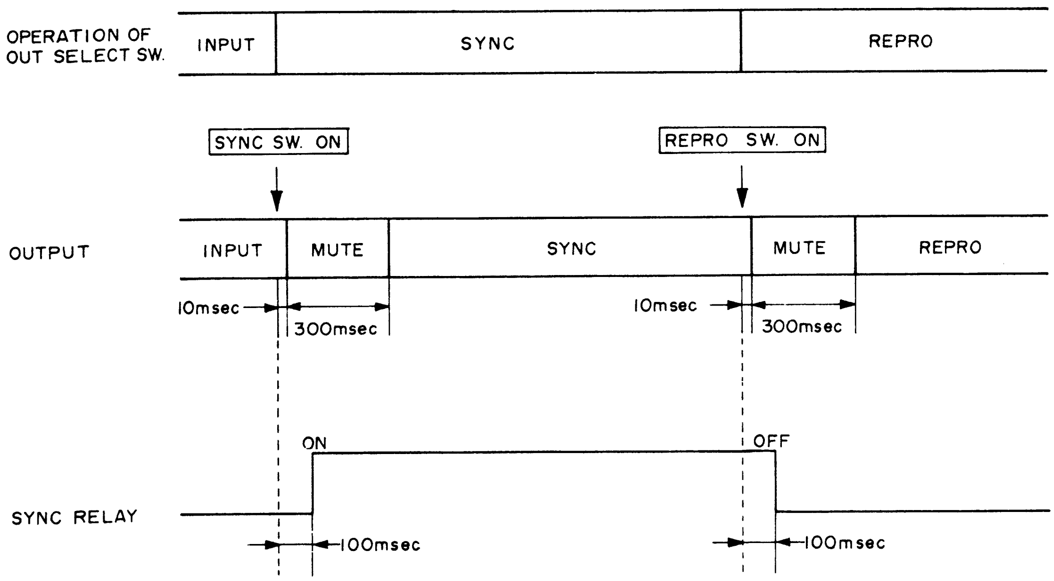


Fig. 1-16 (B). SYNC Relay Operation Timing Chart

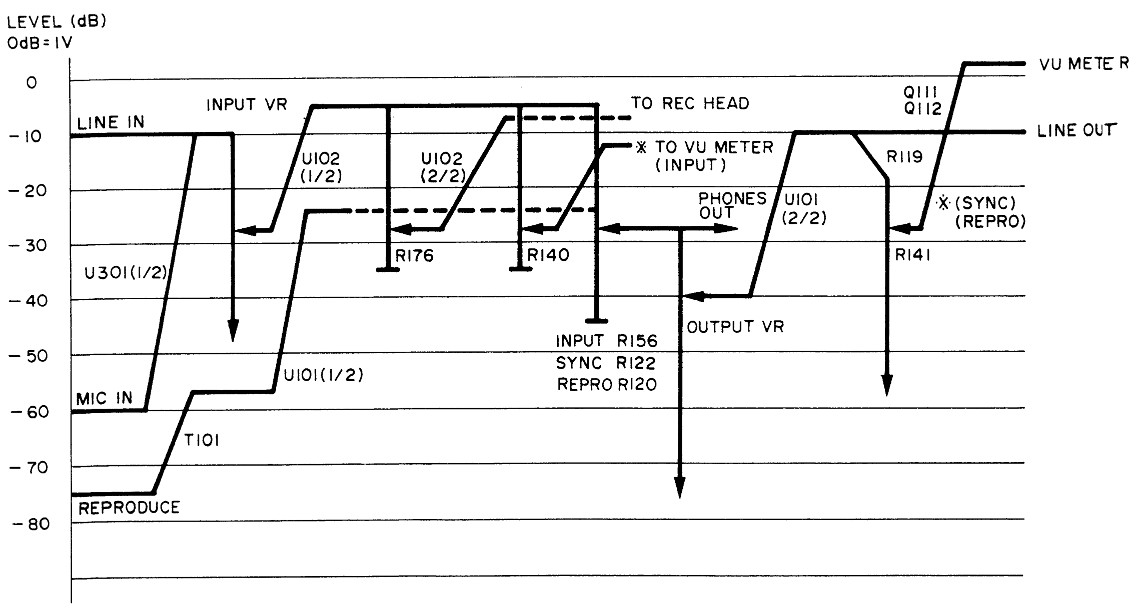


Fig. 1-17. Level Diagram

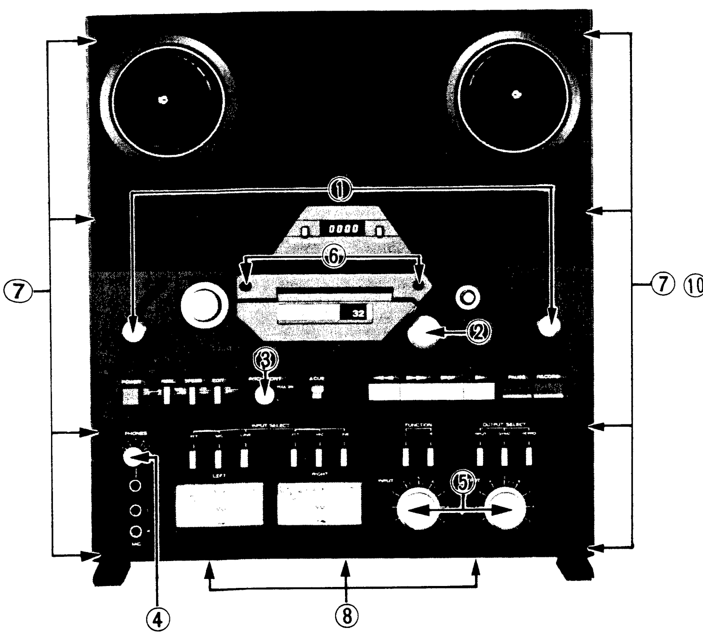
2. CHECKS AND ADJUSTMENTS

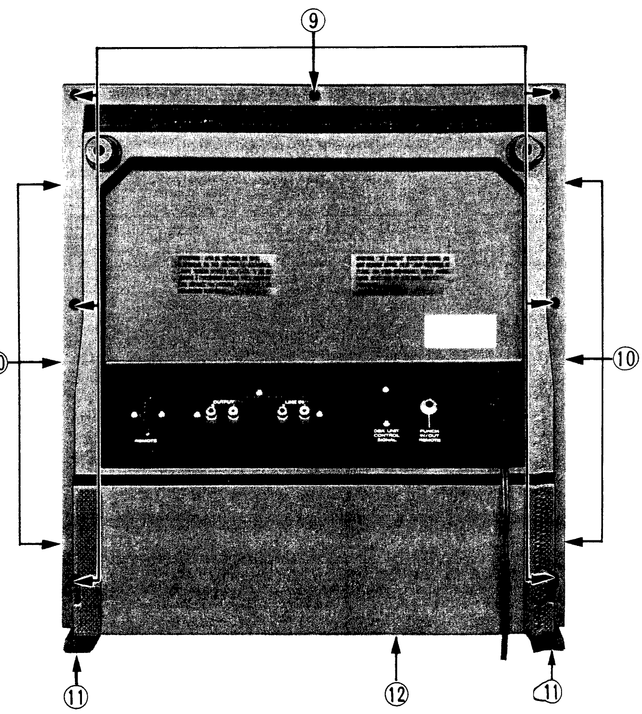
2-1. ESSENTIAL TEST EQUIPMENT REQUIRED

Wow & Flutter Meter	Meguro Denpa Sokki K.K., Model MK-668C (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 ~ 100 kHz; 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) Hex head Allen wrenches, Plastic alignment tool
Cleaning fluid:	TEAC TZ-261 or equivalent TEAC Spindle Oil TZ-255 or equivalent
Head Demagnetizer	TEAC E-3 or equivalent
Test Tapes	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 TEAC YTT-1004 (for tape speed 15 ips, NAB Equalization 3180 + 50 μsec) TEAC YTT-1003 (for tape speed 7-1/2 ips, NAB Equalization 3180 +50 μsec) TEAC YTT-1044 (for tape speed 15 ips, IEC Equalization ∞ + 35 μsec) TEAC YTT-10432 (for tape speed 7-1/2 ips, IEC Equalization ∞ + 70 μsec) Reference fluxivity is 185 nWb/m; reference output level is 3 dB lower compared with 250 nWb/m fluxivity. Calibration level under "Reproduce Calibration" refers 0 VU as 250 nWb/m. Blank Test Tape (Recording) TEAC YTT-8063

2-2. REMOVING THE PANELS OF THE DECK

1. Dress Panels
   1) Remove the left and right tension arm tape guides ① by turning the tape guide caps counterclockwise.
   2) Turn the pinch roller cap ② counterclockwise to remove the pinch roller.
   3) Remove the pitch control knob ③ with a 1.5 mm hex-head wrench and loosen to remove the nut directly behind it.
   4) Remove the headphone knob ④, INPUT and OUTPUT knobs ⑤ with a 1.5 mm hex-head wrench.
      Note: Pull out the inner knobs (left channel) of the INPUT and OUTPUT controls.
   5) Remove the housing by loosening the two hex screws ⑥ with a 3 mm hex-head wrench.
   6) Remove the eight hex screws ⑦ from both sides with a 2.5 mm hex-head wrench, and then remove the three screws ⑧ holding the dress panel. Remove the dress panel by pulling out in the direction of the bottom cover. To completely remove, disconnect the connector coupling the transport control assembly to the main assembly.
2. Rear Panel
   Remove the seven ⑨ holding screws from the rear panel.
3. Bonnet Panel
   1) After removing the rear panel, go on to removing the bonnet panel.
   2) Remove the six screws ⑩ (both sides) holding the bonnet panel.
4. Bottom Panel
   1) Remove the eight screws ⑪ from the feet attached to the bottom panel.
   2) Remove the screw ⑫ holding the bottom panel.





2-3. CAPSTAN THRUST CLEARANCE

1. There must be a clearance of 0.05 to 0.15 mm between the capstan shaft and the thrust plate. Check to see that the clearance is within this range. If not, loosen the two screws on the flywheel, adjust the clearance, and retighten the screws.

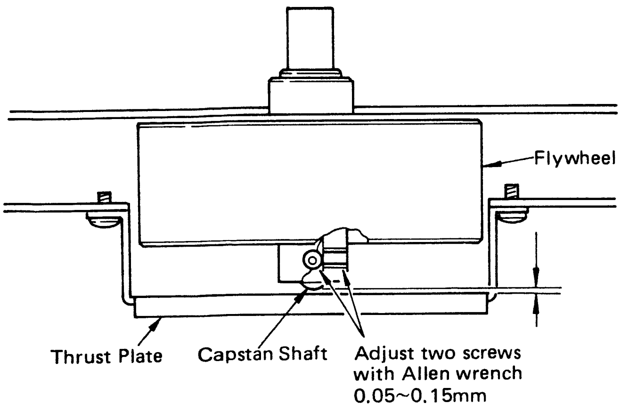


Fig. 2-1.

2-4. BRAKE MECHANISM

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

1. Screw (A) for the left brake (as viewed from the front) must be adjusted so that there is a clearance (a) of 1 mm between lever (C) and lever (E). Screw (A) for the right brake must then be adjusted so that lever (B) is parallel to lever (C). See Fig. 2-2.
2. When there is contact at (a), position the solenoid housing so that the gap at (f) (the distance between the plunger and solenoid washer) is 3 mm.

2-5. BRAKE TORQUE

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

1. Mount an empty 7" reel onto either reel table and attach a spring scale to the reel with a string. See Fig. 2-3.
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 below.

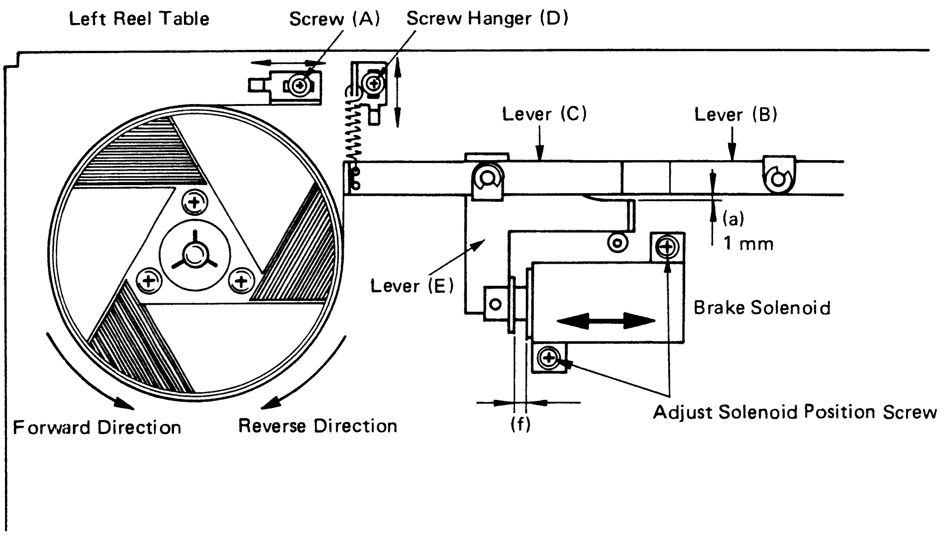


Fig. 2-2.

3. Follow steps 1 and 2 for each measuring condition; i.e., (A) through (D) in Fig. 2-3.
4. If the forward-direction torque is not correct, change the hooking position of the spring hanger (reference (D) in Fig. 2-2) for the corresponding brake requiring adjustment. If, after the forward-direction torque has been properly adjusted, the reverse-direction torque is not correct, or the forward-direction 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 2-4, "Brake Mechanism". If necessary, replace the entire reel table.

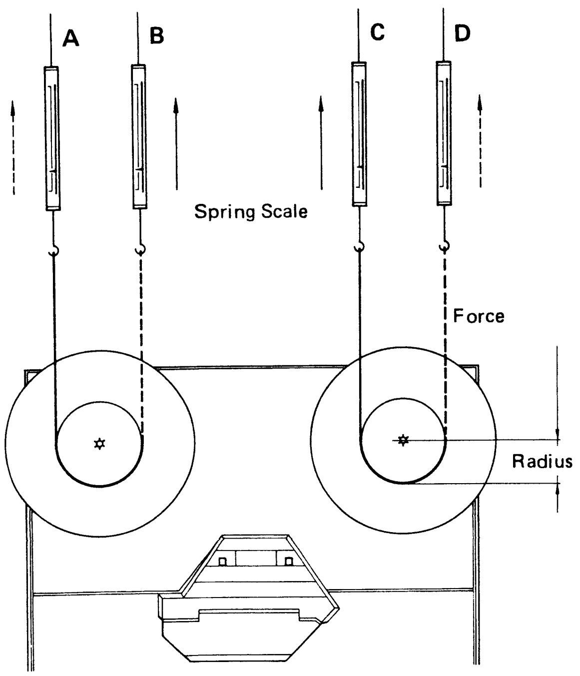


Fig. 2-3.

Forward direction (B) (C)	1700 – 2100 g-cm (23.6 – 29.2 oz-inch)
Reverse direction (A) (D) (Reference values)	650 – 800 g-cm (9.0 – 11.1 oz-inch)
Left/Right deviation	200 g-cm (2.78 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

2-6. REEL MOTOR TORQUE

Note: *For torque calculation, refer to the said formulas.
*There is no specially-provided adjustment for take-up torque, so if correction is needed, repair or replace the defective part and/or circuit.

2-6-1 Take-up Torque

1. Hold the right tension arm up with a rubber band.
2. Mount an empty 7" reel onto the take-up (right) reel table, and attach a spring scale to the reel with a string.
3. Place the deck in the reproduce mode.
4. Allow the rotation of the reel to slowly pull the scale toward the reel.
5. Hold the spring scale with enough force to allow steady reading. See Fig. 2-4.
6. The calculated value should be approx:

REEL SW	TAKE-UP TENSION
LARGE	550 to 650 g-cm (7.64 to 9.03 oz-in)
SMALL	300 to 400 g-cm (4.17 to 5.55 oz-in)

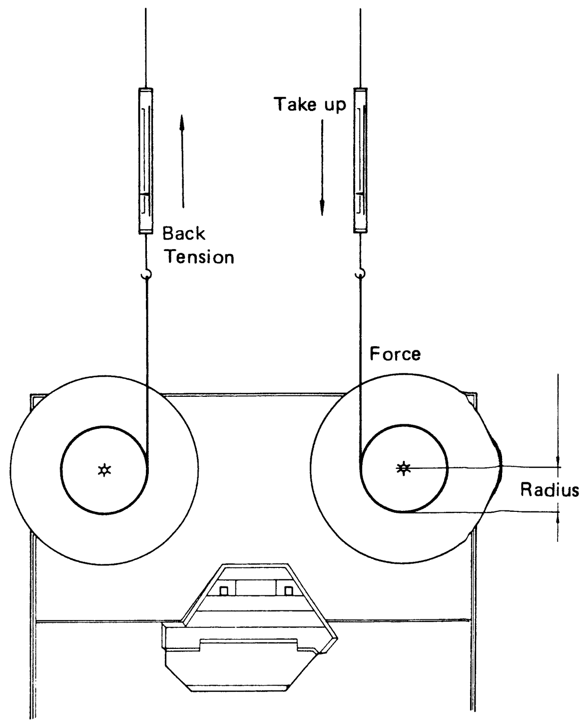


Fig. 2-4.

2-6-2 Back Tension

1. Hold the right tension arm up with a rubber band.
2. Mount an empty 7″ reel onto the supply (left) reel table, and attach a spring scale to the reel with a string.
3. Place the deck in the reproduce mode.
4. Using a steady, smooth motion, pull against the motor torque to draw the scale away from the reel.
5. After making sure that the reel motion is smooth (the string should not be rubbing against the reel flanges), note the value indicated on the scale. See Fig. 2-4.
6. The calculated value should be approx:

REEL SW	BACK TENSION
LARGE	350 to 400 g-cm (4.86 to 5.55 oz-in)
SMALL	200 to 250 g-cm (2.78 to 3.47 oz-in)

2-7. 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 measurement.

1. Hold the right tension arm up with a rubber band, string, etc.
2. Place the deck in the reproduce mode without threading the tape.
3. Attach a spring scale to the pinch roller as shown in Fig. 2-6.
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 be read 1.5 kg to 1.7 kg (3.3 lbs to 3.74 lbs).
6. If necessary, adjust the adjust screws for proper pressure.

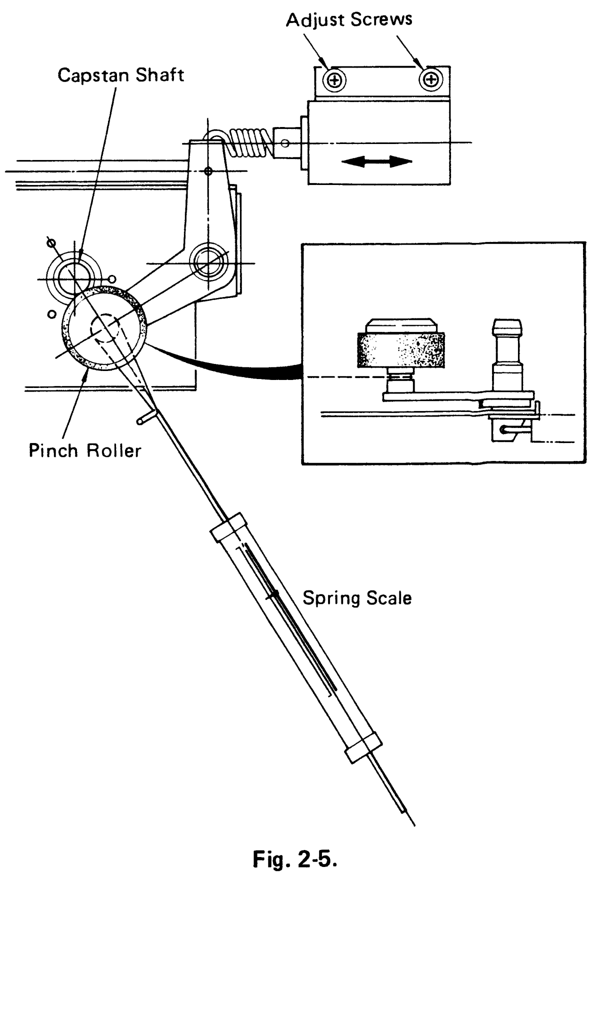


Fig. 2-5.

2-8. REEL TABLE HEIGHT ADJUSTMENT

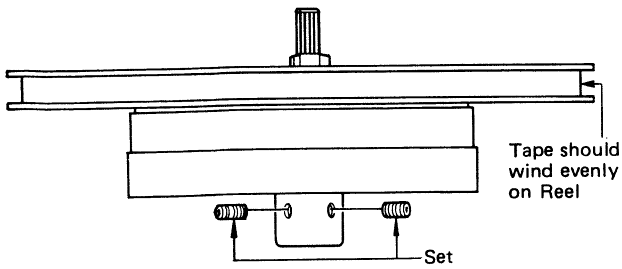


Fig. 2-6.

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 as shown in Fig. 2-6.
Remove the bonnet panel on the left or right of the unit for access to the set screws (2) in the reel motor shaft. Reel table should be adjusted using standard NAB 7" reels. With a tape loaded on the machine, position the reel table height for smooth tape travel. Be sure to tighten the set screws after each adjustment is made. Refer to page 78 (section 2-2).

2-9. TAPE SPEED

Tape speed is measured by using flutter test tape, which contain a highly accurate, continuous 3 kHz tone.

Test Tape: TEAC YTT-2004 (for tape speed 15 ips)
TEAC YTT-2003 (for tape speed 7-1/2 ips)

1. Connect a digital frequency counter to either OUTPUT.
2. The indicated frequency should be 3 kHz, ±0.8 % for all speeds.
3. Play the middle of the test tape at high speed 15 ips (38 cm/sec) and adjust the HIGH speed trimmer resistor until the frequency counter indicates a reading of 3000 Hz. Use the LOW speed trimmer resistor for low speed adjustment 7-1/2 ips (19 cm/sec). See Fig. 2-7. (CAUTION: Use an insulated screwdriver to prevent shorting.)
4. 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, so that there is never a total deviation of more than ±0.8 Hz from the 3000 Hz test tone.
5. If tape speed is greatly offset from the specification, check pinch roller pressure and takeup tension for correct values, and see that the tape path is clean.

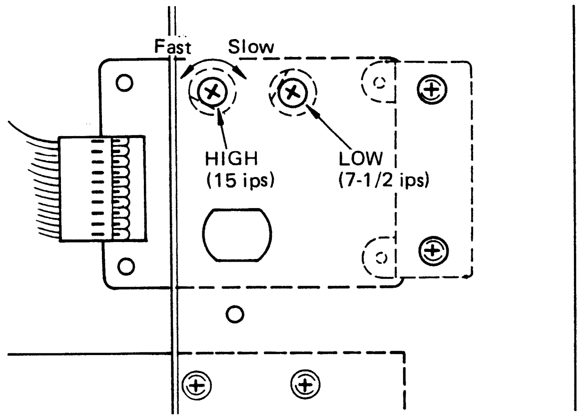


Fig. 2-7.

2-10. WOW AND FLUTTER CHECK (Reproduce Method)

1. Connect a Wow-and-Flutter Meter to the deck as shown in Fig. 2-8.
   These meters will measure the 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.
3. If the peak or rms weighted value is to be read, set the Wow-and-Flutter Meter for the "Weighted" readings and also make sure that the meter 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 – at the beginning and near the end of the tape – should be checked. There may also be slight differences in absolute values measured according to the brand of the meter being used.

Values should be as shown:

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

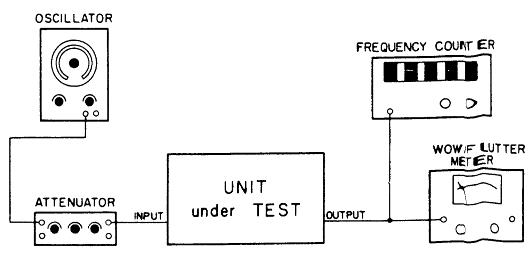


Fig. 2-8.

2-11. RECORD/REPRODUCE AMPLIFIER CHECKS AND ADJUSTMENTS

Preliminary Adjustments

A. Before proceeding with any 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 by the following methods:

TAPE PATH

1. Advance the tape in the play mode and check to see that the tape is not curled on the edges of the tape guide poles which are located on either side of the head assembly.
2. If curling at the left tape guide is evident, adjust the height of the guide by inserting a shim of appropriate thickness ($\phi 5 \times \phi 8 \times 0.5^t$ or 0.25^t) into "A" of the left tension arm. The same procedures should be followed for the right tension arm height adjustment. See Fig. 2-9.

HEAD CONTACT

1. Load a prerecorded tape with a constant level tone and reproduce at high speed 15 ips (38 cm/sec).
2. While observing the VU meter, temporarily increase 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 back tension is increased. However, if in sufficient pressure is applied to the head, the deflection needle will show increased deflection due to contact pressure caused by the back tension. This method will help determine whether head contact is properly adjusted or not. To adjust, loosen the retaining screws (A) for that head (Shown in Fig. 2-12) and change the direction of the head for proper alignment.

Note: The amount of pressure to be applied to the reel is very important; too strong of pressure lowers the speed of the tape, while too light of pressure does not ensure contact. However, by practicing a few times, you will be able to judge approximate pressure to be applied.

HEAD AZIMUTH ADJUSTMENT

1. Connect the OUTPUT jack for channel L of the deck to the vertical input terminals of an oscilloscope.
2. Connect the OUTPUT jack for channel R of the deck to the horizontal input terminals for the oscilloscope.
3. Connect an AF level meter and a 50k ohm load to the OUTPUT jack(s) as shown in Fig. 2-10.

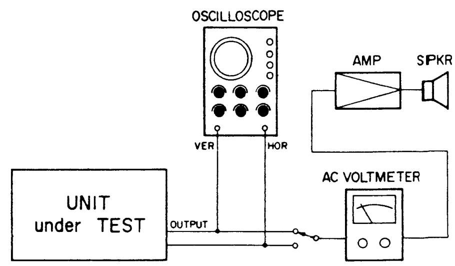


Fig. 2-10. Head Azimuth Test Set-Up

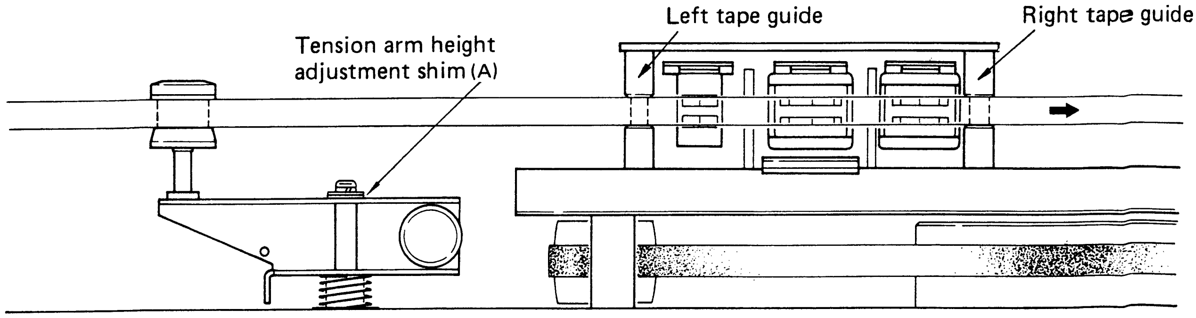


Fig. 2-9. Tape Path Adjustment

4. Switch OUTPUT SELECT to REPRO.
5. Load the reproduce alignment test tape to reproduce at high speed 15 ips (38 cm/sec). Then, a scope display reading showing phase relations between both channels will be obtained as shown in Fig. 2-11.
6. Adjust the REPRO head azimuth screw until the scope display shows less than 90 degree at 12.5 kHz out of phase with the AF level meter showing approximately maximum value for both channels.
7. Switch OUTPUT SELECT to SYNC, and adjust the RECORD SYNC head azimuth screw the same way.

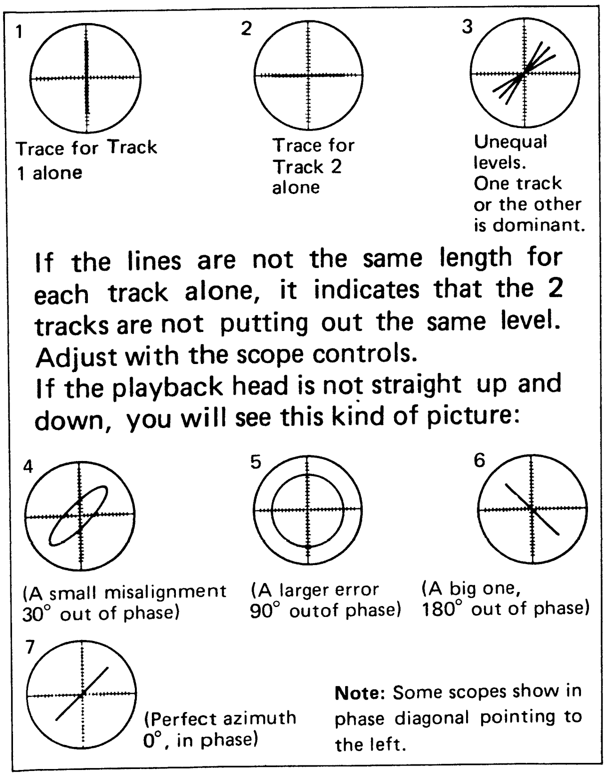
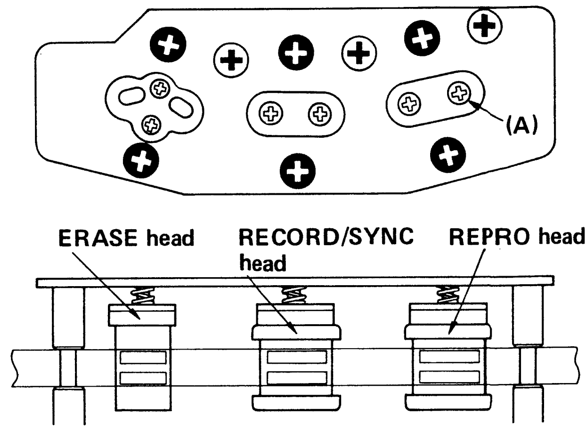


Fig. 2-11 Phase Shift



⊕ AZIMUTH ADJ. SCREWS

● HEIGHT AND TILT ADJ. SCREWS

⊛ TANGENCY ADJ. NUTS (A)

Fig. 2-12

B. To get at the trim pots for record/reproduce amplifier circuit adjustments, remove the bottom cover by removing the holding screws. With the cover removed, you will see the amplifier boards to which the trim pots are mounted as shown in the photograph. The boards are identical and are exclusively used for both channels. See page 85.
Record/reproduce amplifier checks and adjustments are given for only one of the channels but they should be applied for the other channel as well.
Before beginning any adjustments thoroughly demagnetize and clean the heads, tape guide, etc.

C. Line Output Load Impedance of the Deck: This deck has been preadjusted and set for a 50k ohm load, when switched from this adjustment, for example, to a 10k ohm load, the output level results in a 0.5 dB reduction. When connecting less than a 50k ohm load, readjust the deck to match the applied load.

D. The nominal input/output levels of this deck has been determined with the INPUT and OUTPUT control knobs set at position "7". The following checks and adjustments should be made with these controls in this position, unless otherwise noted.

2-11-1 Input Level Calibration

1. Connect the test equipment as shown in Fig. 2-13.
2. Apply a 400 Hz, -10 dB (0.3 V) test signal to the LINE IN jack on rear panel, switch INPUT SELECT to LINE and OUTPUT SELECT to INPUT, and set the INPUT and OUTPUT control knobs to position "7".
3. Make sure the AF level meter reads -10 dB (0.3 V) output. If it doesn't, adjust the (R156) trim pot until the -10 dB indication on the level meter is obtained.

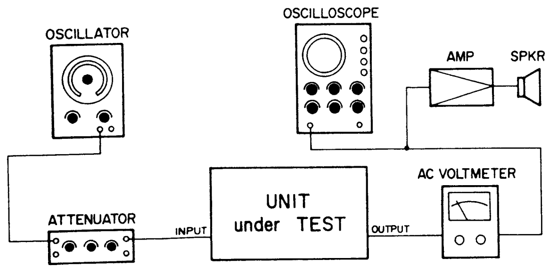


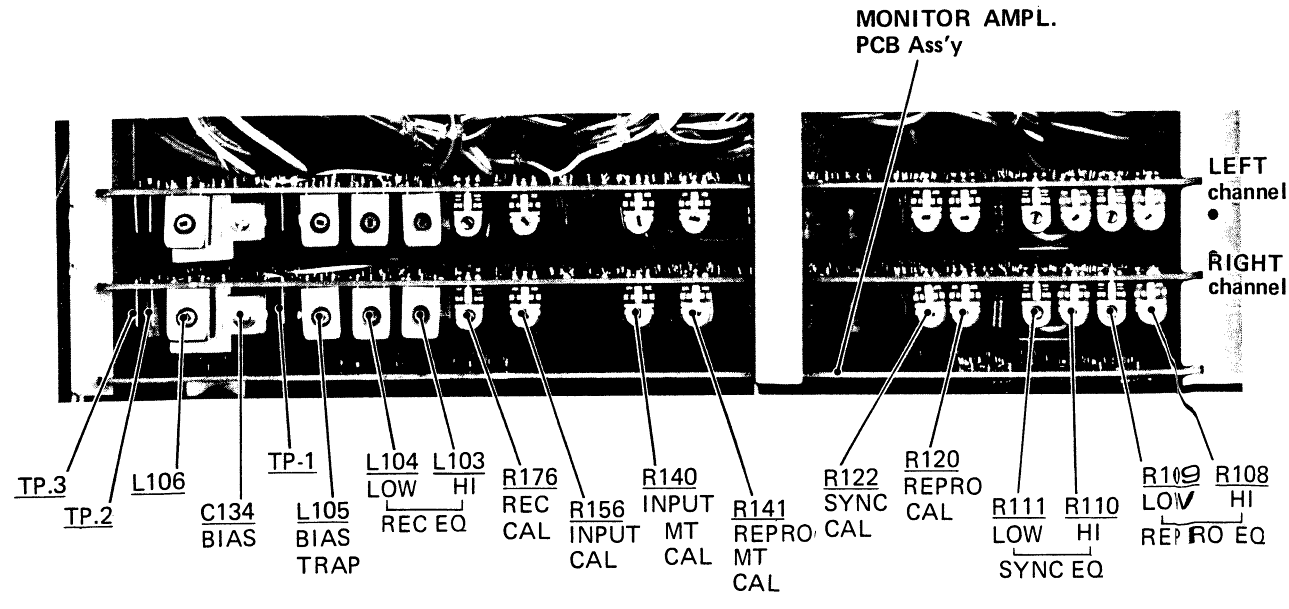
Fig. 2-13 Input Level Calibration

2-11-2 Input Meter Calibration

1. The meter is designed to indicate 0 VU when -10 dB signal is connected to the input terminals and the INPUT control knob is set to position "7".
2. Therefore, make sure that the meter indicates 0 VU after completion of the above 2-11-1 (2-3). If the meter does not indicate 0 VU, adjust R140 to obtain the 0 VU indication.

2-11-3 Reproduce Level Calibration

1. Connect the AF level meter (oscilloscope), and a 50k ohm load to the OUTPUT jack on the rear panel.
2. Switch OUTPUT SELECT to REPRO and set the OUTPUT control knob to position "7".
3. Load the reproduce alignment test tape for high speed 15 ips (38 cm/sec) and reproduce. Observe the AF level meter, it should indicate -10 dB, if not, adjust the (R120) trim pot to obtain the -10 dB output indication.
4. Switch OUTPUT SELECT to SYNC and reproduce the same tape. Check the AF level meter, it should read -10 dB. If not, adjust the (R122) trim pot.



2-11-4 Reproduce Meter Calibration

1. The meter is designed to indicate 0 VU when the reproduce amplifier produces -10 dB output into a 50k ohm load.
2. Therefore, make sure that the meter indicates 0 VU after completion of the above 2-11-3 (2-3). If the meter does not indicate 0 VU, adjust R141 to obtain the 0 VU indication.

2-11-5 Reproduce Frequency Response

1. Connect the AF level meter, (oscilloscope), and a 50k ohm load to the OUTPUT jack.
2. Load the reproduce alignment test tape onto the tape deck.
3. Switch OUTPUT SELECT to REPRO and set the OUTPUT control knob to position "7".
4. Run the tape, then check the frequency response while noting the output level.
   Test tapes: TEAC YTT-1004/YTT-1003 NAB standard 3180 + 50 μsec (Tape Speed 15 ips/7-1/2 ips).
   TEAC YTT-1044: IEC-1 standard ∞ + 35 μsec (Tape Speed 15 ips).
   TEAC YTT-10432: EQ IEC-1 standard ∞ + 70 μsec (Tape Speed 7-1/2 ips).
5. If the AF level meters are not within the specified range, adjust R108 for 15 ips (38 cm/sec) and R109 for 7-1/2 ips (19 cm/sec).

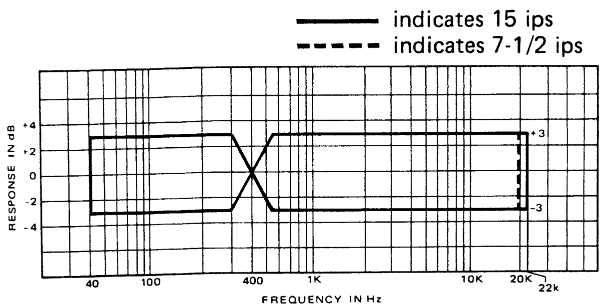


Fig. 2-14. Reproduce Frequency Response

6. Switch OUTPUT SELECT to SYNC.
7. Reproduce the same tape and also read the output levels the same way to learn whether the frequency response is within the above specified limit. If the frequency response is not within the specified limit, adjust the R110 for 15 ips (38 cm/sec), and R111 for 7-1/2 ips (19 cm/sec).
8. If the specifed frequency response cannot be obtained with the trim pot(s) adjusted;
   * Check and compare the measurements of the other channel. If they stand up to spec, correct or replace the off spec channel 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.

2-11-6 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 PC card or MASTER BIAS unit is replaced.

Use the following procedures to adjust.

A. BIAS TUNING

1. Place both channels FUNCTION switches to ON and set the tape deck into the REC PAUSE mode.
2. Connect a DC volt-meter between TP(2) and TP(3). Adjust L106 to obtain a minimum reading on the DC meter by using an insulate screwdriver. Be sure to use a non-conductive screwdriver (i.e. wood, plastic, etc.).

CAUTION: Do not try to obtain maximum reading on the DC volt-meter, which would occasion an extreme amount of Bias Amp output load.

B. BIAS TRAP

1. Connect an "AC" level meter between TP(1) and ground.
2. Place both FUNCTION switches to ON and set the deck into the REC PAUSE mode.
3. Adjust L105 to obtain a minimum reading on the level meter.

2-11-7 Recording Bias Adjustment

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 level meter and a 50k ohm-load to the OUTPUT jacks as shown in Fig. 2-13, then load a blank test tape.
2. Set the INPUT and OUTPUT control knobs to position "7", tape speed to LOW, switch INPUT SELECT to LINE.
3. Adjust the AF oscillator to apply a 7 kHz, -20 dB (0.1 V, -10 VU) signal to the LINE IN jack on rear panel.
4. Switch OUTPUT SELECT to REPRRO and set both FUNCTION switches to ON.
5. Begin recording. Now adjustments can be made while recording a 7 kHz tone.
6. Begin adjustment by turning the trimmer (C134) completely counterclockwise. Next, loosen and turn the trimmer 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 4 – 6 dB from the peak reading as shown in Fig. 2-15.

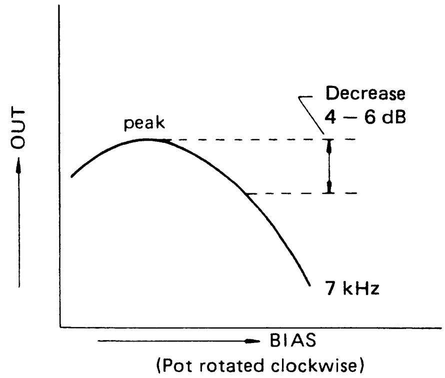


Fig. 2-15. Bias Limit Chart

2-11-8 Recording Level Adjustment

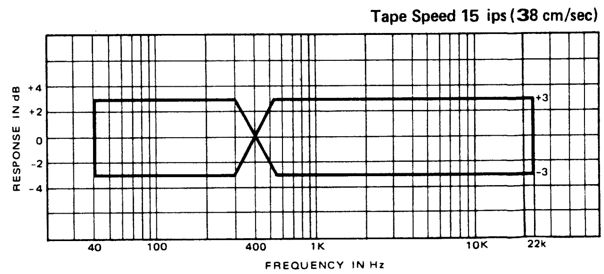
Recording level adjustments should be done only after the reproduce level and recording bias have been properly set as specified above.

1. Connect the AF oscillator, oscilloscope, AF level meter, and a 50k ohm load to the tape deck as shown in Fig. 2-13.
2. Apply a 400 Hz, -10 dB (0.3 V) signal to the LINE IN jack.
3. Switch INPUT SELECT to LINE, OUTPUT SELECT to REPRO, set both FUNCTION switches to ON, and the INPUT and OUTPUT knobs to position "7".
4. Record the 400 Hz input signal on the specified recording test tape.
5. Check the AF level meter, it should indicate -10 dB (0.3 V). If not, adjust the (R176) trim pot to obtain the -10 dB indication. At this time, make sure that the VU meter on the front panel indicates 0 VU.
6. Switch OUTPUT SELECT 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 -10 dB and 0 VU, respectively.
7. If it's impossible to obtain a VU meter reading of 0 VU in steps 5 and 6 above, check to see whether the reproduce meter is set properly as described under 2-11-2. "Input Meter Calibration".

2-11-9 Frequency Response (OVERALL)

After completion of the recording level check and adjustment, proceed to the overall frequency response check.

1. Connect the test equipment to the tape deck as shown in Fig. 2-13 and load a blank test tape onto the tape deck.
2. Set the INPUT and OUTPUT select control knobs and both FUNCTION switches to ON, then set the OUTPUT SELECT switches to REPRO.
3. Record and reproduce an input signal of 400 Hz, -10 dB (0.3 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 coil L103 using a frequency higher than 22 kHz.
4. For a tape speed of 7-1/2 ips (19 cm/sec), record and reproduce an input signal of 400 Hz, -20 dB (0.1 V), then change the frequency and check that the output is still within specification. If not, adjust REC EQ coil L104 using a frequency higher than 20 kHz.
   Blank test tape: YTT-8063.
5. Switch OUTPUT SELECT to SYNC and record the test signals the same as above. When the recording is finished, rewind the tape just recorded and reproduce it. Measure that 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 refering to 2-11-7 "Recording bias adjustment". If the bias level is readjusted, the recording level adjustment will be upset, so repeat the recording level adjustment again as described in 2-11-8. "Recording Level Adjustment".



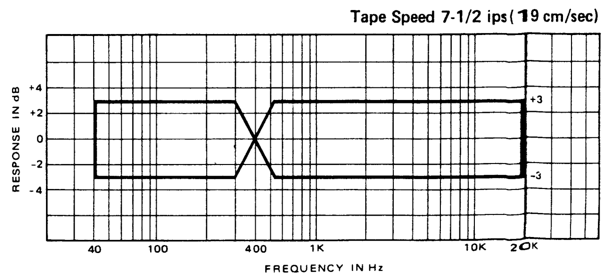


Fig. 2-16. Overall Frequency Response

2-11-10 Signal-to-Noise Ratio (OVERALL)

Prior to measurement, demagnetize all heads and tape guides.

1. Connect the AF oscillator, oscilloscope, AF level meter, and a 50k ohm load to the tape deck as shown in Fig. 2-13.
2. Apply a 400 Hz, -10 dB (0.3 V) signal to the LINE IN jack.
3. Switch OUTPUT SELECT to REPRO, INPUT SELECT to LINE. Set both FUNCTION switches to ON, INPUT and OUTPUT knob to "7" and record a short length of the input signal, then, while still in the recording mode, set INPUT knobs to minimum, and make another length of no-signal recording.
4. Rewind the recording made in step 3 (above) to the beginning and reproduce.
5. While making sure the reproduce output of the previously recorded 400 Hz 0 VU signal is -10 dB, raise the sensitivity of the AF level meter and measure the level of the no-signal portion of the tape.
6. With -10 dB (0 VU) as the reference level, the SN (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 this stands up to spec, correct or replace the off spec channel record/reproduce amplifier PCB.
   * Demagnetize the heads.
   * Check erasure, refer to item 2-11-11.
   * Check for proper adjustment of the bias trap.
   * Try another tape of the same type number.

2-11-11 Erase Ratio

1. Connect test equipment to the tape deck as shown in Fig. 2-17.
2. Use a 1 kHz bandpass filter to check the erasing ratio.
3. Switch OUTPUT SELECT to SYNC and record a short length of the 1 kHz, 0 dB (1 V) signal. Set INPUT knobs to minimum.
4. Rewind the tape to the beginning of the recorded section.
5. Record a no-signal portion over the recording of the 1 kHz signal.
6. Measure the difference between the 1 kHz signal level and the no-signal portion. The difference should be at least 65 dB.
7. If the level difference is below this specification, check erase head terminal voltage for 60 – 70 V using an AC volt-meter.

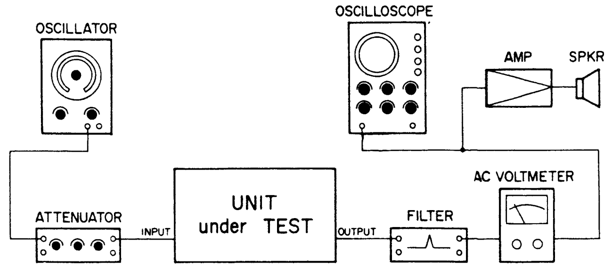


Fig. 2-17. Erase Ratio Test Set-Up

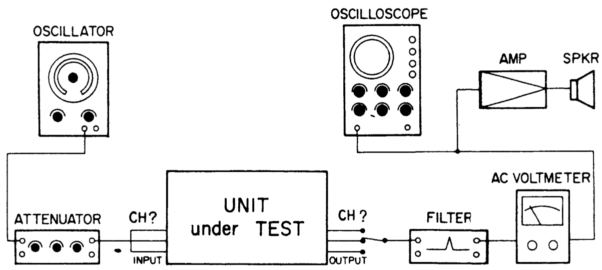


Fig. 2-18. Crosstalk Measurement Set-Up

2-11-12 Channel Crosstalk

1. Connect test equipment as shown in Fig. 2-18.
2. Switch INPUT SELECT to LINE and set both FUNCTION switches to ON.
3. Switch OUTPUT SELECT to REPRO and set the INPUT control knob to position "7".
4. While recording a "no-signal" recording on one of the channels, apply a 1 kHz, -10 dB (0.3 V) test signal to the other channel.
5. Reproduce the tape with REPRO (OUTPUT SELECT) button depressed, after which, measure the output of the "no signal" recorded channel.
6. Measure the output of the other channel. The difference should be 50 dB or greater.

2-11-13 Distortion

1. Connect test equipment as shown in Fig. 2-19.
2. Switch INPUT SELECT to LINE, OUTPUT SELECT to SYNC and set both channel FUNCTION switches to ON and the INPUT and OUTPUT control knobs to position "7".

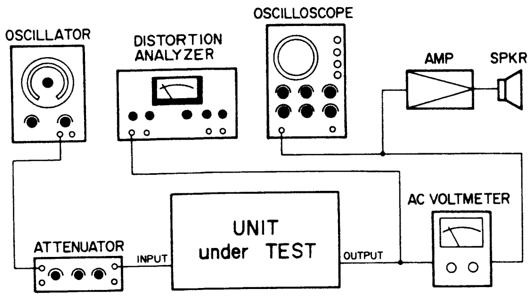


Fig. 2-19. Distortion Measurement Set-Up

3. Apply a 1 kHz, -10 dB (0.3 V) test signal to the LINE IN jack and record.
4. Stop the recording, rewind the tape to its beginning and reproduce. Measure the distortion of the reproduced output.
5. The distortion measured should be less than 0.8 %.
6. If the distortion is off spec;
   * Check and compare the measurement of the other channel. If it is off spec, correct or replace the off spec channel record/reproduce amplifier PCB.
   * Check bias level setting and readjust if necessary.
   * Demagnetize the heads.
   * Replace the heads.

2-11-14 Headphones Output Level

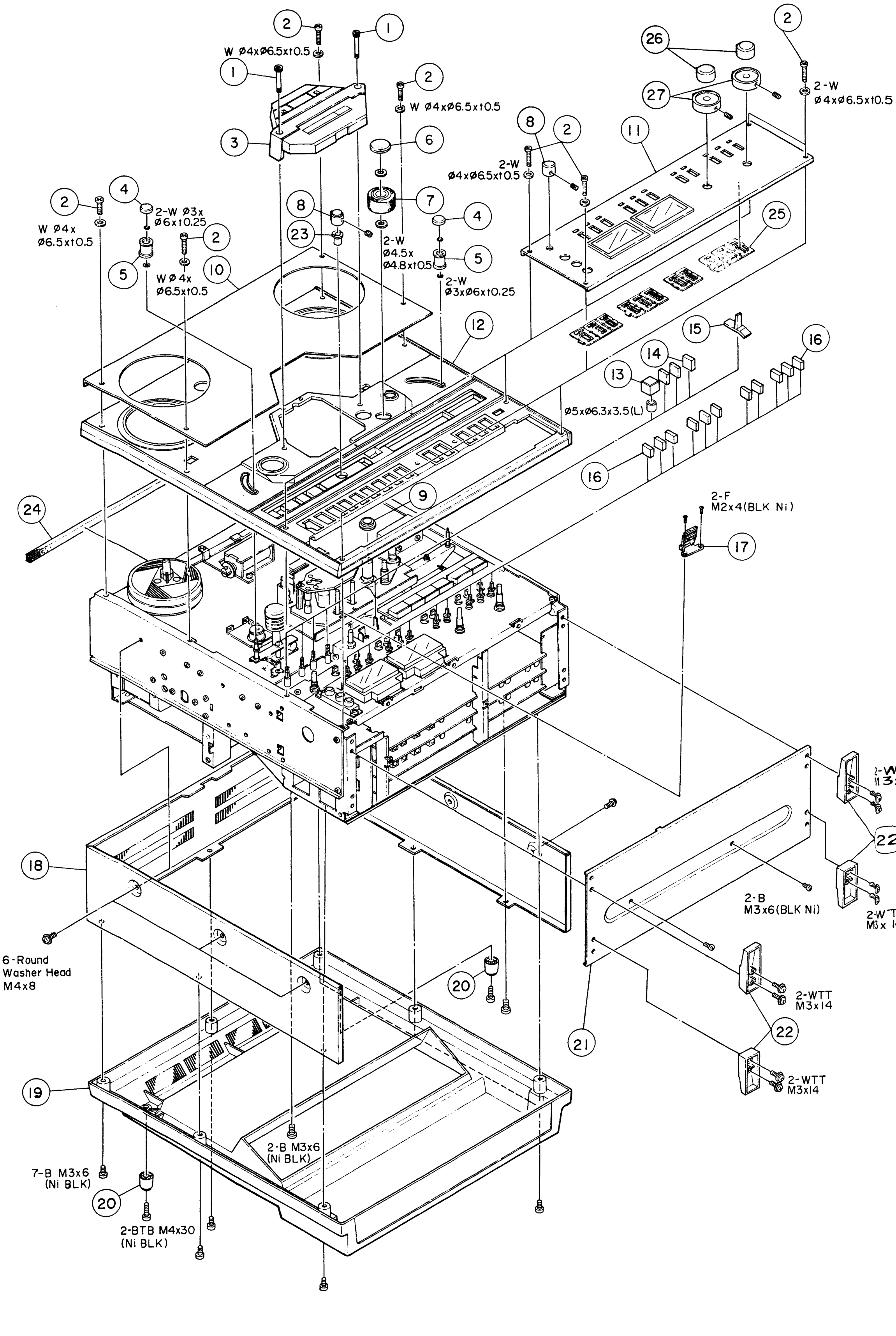
1. Connect an 8 Ω dummy resistor to the headphones terminal.
2. Set the INPUT SELECT switches to LINE, OUTPUT SELECT to INPUT.
3. Apply a 400 Hz, -10 dB (0.3 V) input signal through the LINE IN jacks with the INPUT control knob at position 7, and turn up (CW) the volume control knob for the headphones and measure the headphones output level just before the wave form begins to clip.
   Max. output level: More than 894 mV

2-11-15 Mic Level Check

1. Make sure that a correct input level calibration has been obtained (Step 2-11-1) before attempting MIC level check.
2. Apply a 400 Hz, -60 dB (1 mV) test signal to MIC L jack on front panel.
3. Change INPUT SELECT from LINE to MIC and set MIC ATT to OFF.
4. At this time, line out level should be -13 dB ~ -7 dB.
5. When MIC ATT is set to ON, the output level should be -20 dB lower than the reading obtained in step 4.

3. EXPLODED VIEWS AND PARTS LIST

EXPLODED VIEW–1



EXPLODED VIEW–1

Parts marked with * require longer delivery time.

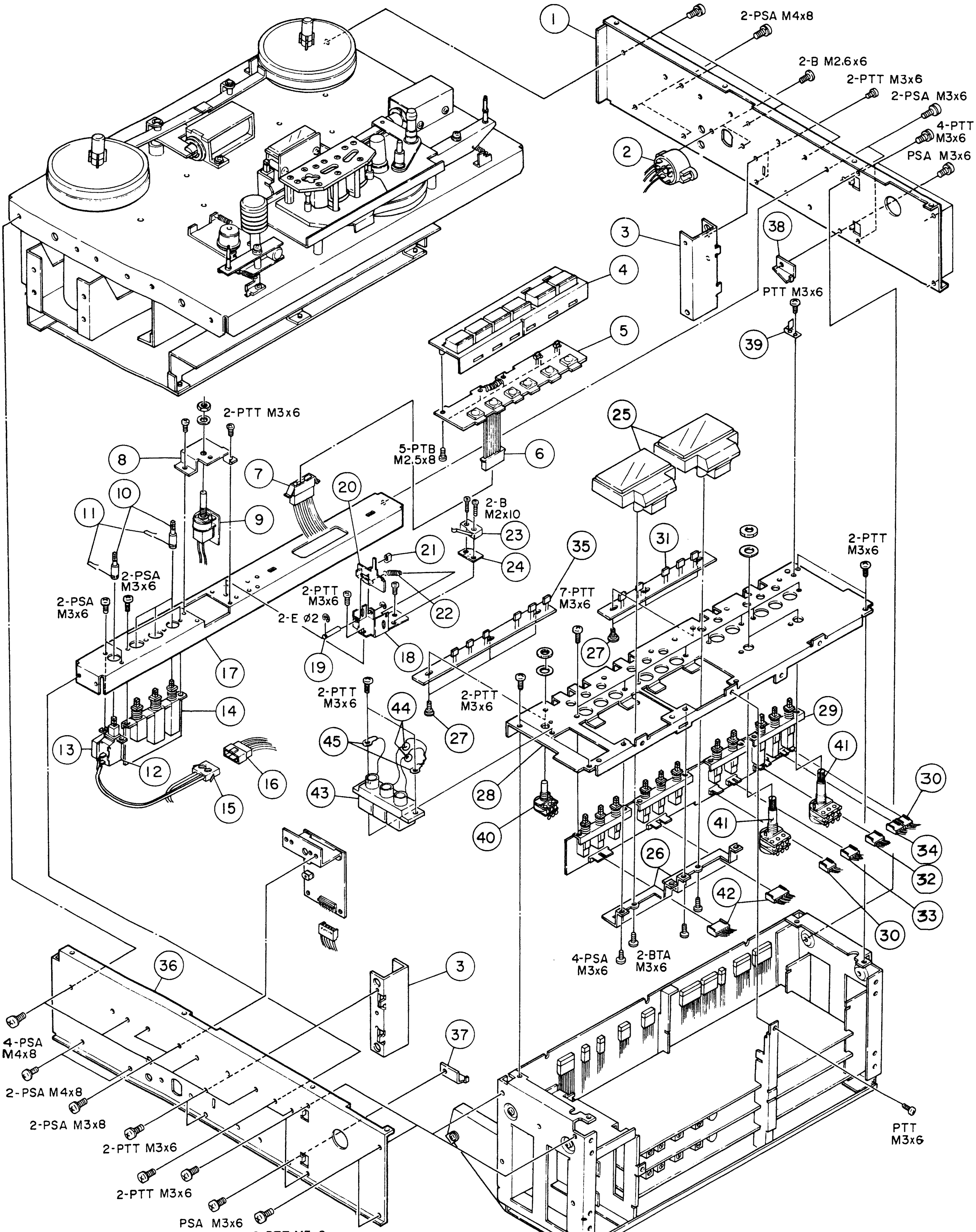
REF. NO.	PARTS NO.	DESCRIPTION	REMARKS
1 - 1	*5800307000	Screw, Head Housing	
1 - 2	*5800306900	Screw, Top Panel	
1 - 3	*5800312400	Housing Assy, Head; (5) [J]	
	*5800312500	Housing Assy, Head; (6) [All except J]	
1 - 4	5800311900	Cap, Tension Roller; (A)	
1 - 5	5504843000	Roller Assy, Tension	
1 - 6	*5800312100	Cap, Pinch Roller	
1 - 7	5800352900	Pinch Roller	
1 - 8	5800288000	Knob, Pitch Control	
1 - 9	*5800288600	Cap, Dust	
1 - 10	*5800293000	Panel, Transport	
1 - 11	*5800309600	Panel Assy, Ampl; (C)	
1 - 12	*5800309900	Panel Assy, Top; (4)	
1 - 13	5800173100	Button, Power Switch	
1 - 14	5800288200	Button, Switch	
1 - 15	5800288100	Knob, Cue	
1 - 16	5800288300	Button, Push	
1 - 17	*5800301200	Shield Assy, Front	
1 - 18	*5800308900	Bonnet, (A)	
1 - 19	*5800294300	Panel, Rear; (4)	
1 - 20	*5800307100	Collar, Foot; (A)	
1 - 21	*5800348200	Bottom Assy; (A)	
1 - 22	*5800288500	Foot	
1 - 23	*5800067700	Nut	
1 - 24	*5800289500	Cushion, Bonnet	
1 - 25	*5800287400	Escutcheon; BL	
1 - 26	*5800315500	Knob, (L)	
1 - 27	*5800315600	Knob, (R)	

INCLUDED ACCESSORY

PARTS NO.	DESCRIPTION	REMARKS
*5740002700	10-inche Reel Set	
*5101708000	Open Reel Supplement	
*5744023200	Clamper, Reel; B (TZ-613)	
*5032301100	Rubber, Cushion	
*5350008500	Cord, In-Output Connection [All except U]	

[U]: U.S.A. [C]: CANADA [GE]: GENERAL EXPORT
[A]: AUSTRALIA [E]: EUROPE [UK]: U.K.
[L]: LIMITED AREA

EXPLODED VIEW–2



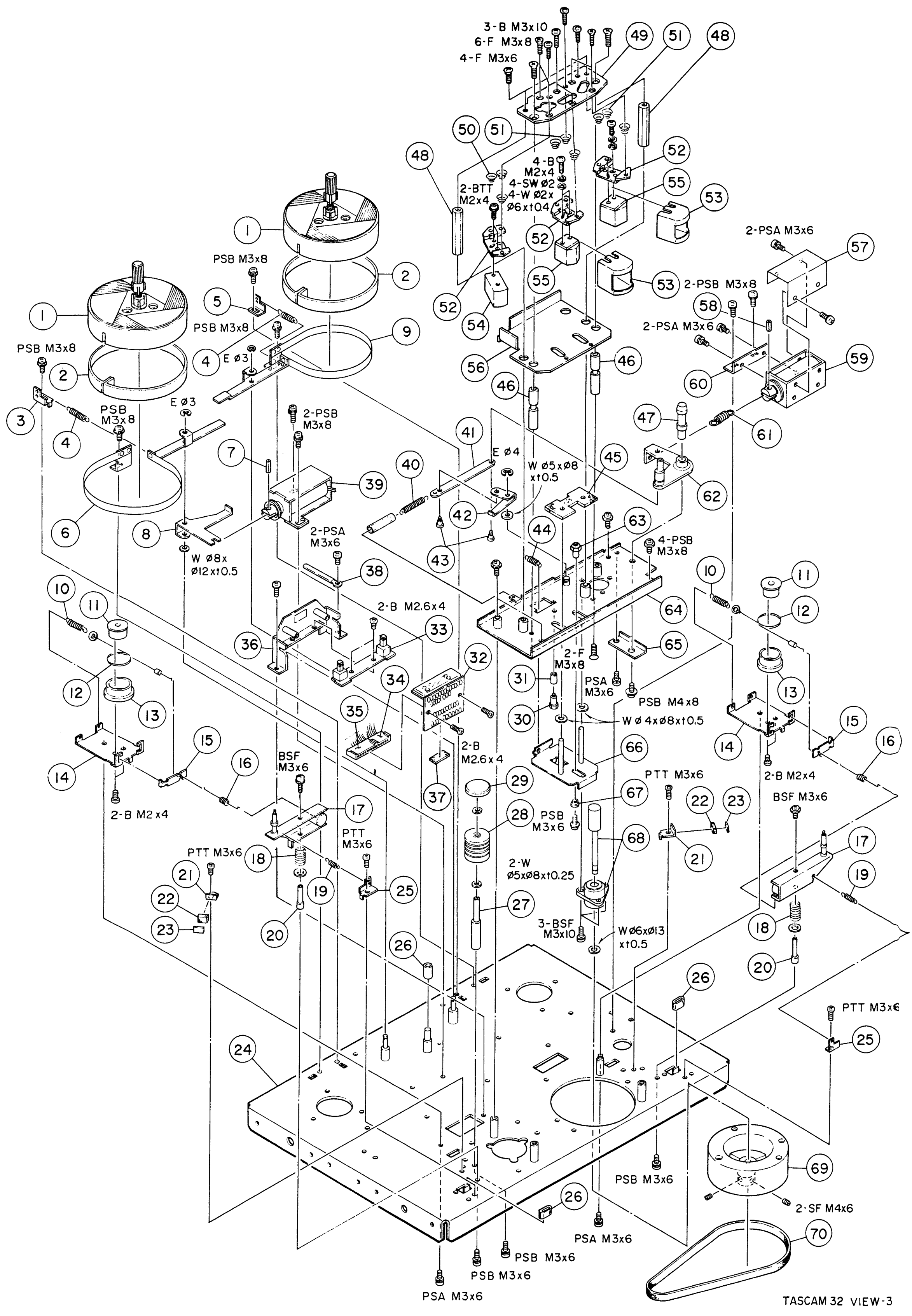
EXPLODED VIEW–2

Parts marked with * require longer delivery time.

REF. NO.	PARTS NO.	DESCRIPTION	REMARKS
2 - 1	*5800293900	Chassis, Side; R	
2 - 2	⚠ 5302101200	Switch, Voltage Selector [GE]	
2 - 3	*5800308100	Bracket, CONTROL PCB	
2 - 4	*5800287000	Button Assy, Control	
2 - 5	*5200073600	PCB Assy, Operation	
2 - 6	*5336112000	Connector Socket, 10P (WHT)	
2 - 7	*5336114000	Connector Plug, 10P (WHT)	
2 - 8	*5800288700	Bracket, PITCH CONTROL PCB	
2 - 9	*5168938000	PCB Assy, Pitch Control	
2 - 10	*5534713000	Rod, Switch; (C)	
2 - 11	*5786360500	Pin, Snap; ϕ5	
2 - 12	⚠ 5300027300	Switch, POWER [J]	
	⚠ 5300027400	Switch, POWER [U, C]	
	⚠ 5300027500	Switch, POWER [E, UK, A, GE]	
2 - 13	⚠ 5052907000	Spark Killer, 0.01μF + 300Ω/300V [J; GE]	
	⚠ 5052910000	Spark Killer, 0.033μF + 120Ω/125V [U]	
	⚠ 5292002600	Spark Killer, 0.033μF + 120Ω/125V [C]	
	⚠ 5267702500	Spark Killer, 0.0047μF 250V [E, UK, A]	
2 - 14	*5200074500	PCB Assy, SPEED SWITCH	
2 - 15	*5122261000	Connector Plug, 4P	
2 - 16	*5122262000	Connector Socket, 4P	
2 - 17	*5800069901	Chassis, Control	
2 - 18	*5800298800	Bracket, Cue	
2 - 19	*5800298600	Pin, Guide	
2 - 20	*5800298700	Lever, Cue	
2 - 21	*5534850000	Cushion, Stopper	
2 - 22	*5800303800	Spring, Cue	
2 - 23	5301456100	Switch, Micro; SS-5GL13-3	
2 - 24	*5800299200	Plate, Insulating	
2 - 25	5165068000	Meter, VU	
2 - 26	*5800308700	Escutcheon, Meter	
2 - 27	*5800002600	Screw, Shoulder; F	
2 - 28	*5800310200	Chassis, Ampl; 2	
2 - 29	*5200078000	PCB Assy, IN/OUT SELECTOR	
2 - 30	*5122166000	Connector Socket, 4P (WHT)	
2 - 31	*5200078400	PCB Assy, FUNCTION LED	
2 - 32	*5122169000	Connector Socket, 7P (WHT)	
2 - 33	*5122168000	Connector Socket, 6P (WHT)	
2 - 34	*5122167000	Connector Socket, 5P (WHT)	
2 - 35	*5200078300	PCB Assy, INPUT LED	
2 - 36	*5800293800	Chassis, Side; L	
2 - 37	*5800289200	Bracket, L	
2 - 38	*5800289300	Bracket, R	
2 - 39	*5800289800	Spring, Earth; (B)	
2 - 40	5282408300	Var. Res., 100kΩ x 2; 1-2	
2 - 41	5282706300	Var. Res., 100kΩ x 1; 2-2	
2 - 42	*5122172000	Connector Socket, 10P (WHT)	
2 - 43	5124063000	Jack, 3-gang	
2 - 44	5054204000	Ceramic Capacitor 0.01μF 50V	
2 - 45	*5786701100	Leg, GND ϕ3	

[U]: U.S.A. [C]: CANADA [GE]: GENERAL EXPORT
[A]: AUSTRALIA [E]: EUROPE [UK]: U.K.
[L]: LIMITED AREA

EXPLODED VIEW–3



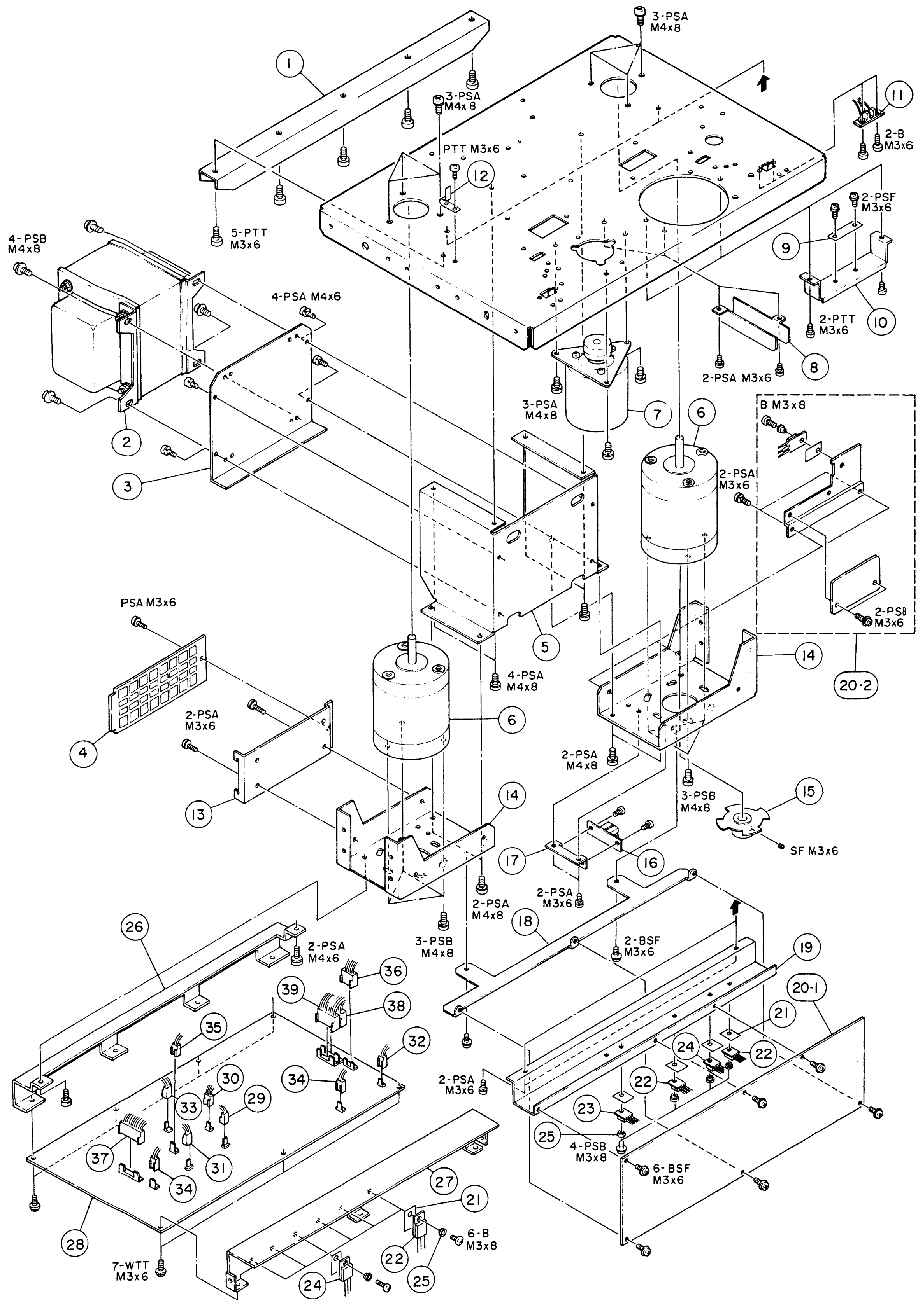
EXPLODED VIEW–3

Parts marked with * require longer delivery time.

REF. NO.	PARTS NO.	DESCRIPTION	REMARKS
3 - 1	5800311401	Table Assy, Reel	
3 - 2	5800295700	Felt, Brake	
3 - 3	*5555929000	Hook, Spring	
3 - 4	*5800301700	Spring, Brake; B	
3 - 5	*5800295801	Hook, Spring	
3 - 6	*5800295201	Band Assy, Brake; (L)	
3 - 7	*5786303012	Pin, Spring; ϕ3 x 12	
3 - 8	*5800299000	Lever, Brake Actuating	
3 - 9	*5800295301	Band Assy, Brake; (R)	
3 - 10	*5800301800	Spring, Damper	
3 - 11	*5800305600	Shaft, Damper	
3 - 12	*5800301000	String Assy, Damper	
3 - 13	*5800301100	Drum, Damper	
3 - 14	*5800300800	Base, Damper	
3 - 15	*5800300900	Arm, Damper	
3 - 16	*5800302000	Spring	
3 - 17	5504842001	Arm Assy, Tension	
3 - 18	*5524289000	Spring, Bias	
3 - 19	*5524106000	Spring, Hook Plate	
3 - 20	*5800299100	Shaft, Tension Arm	
3 - 21	*5555930000	Stopper, Arm	
3 - 22	*5800298400	Damper	
3 - 23	*5800298500	Plate, Damper	
3 - 24	*5800300300	Chassis Assy, Main	
3 - 25	*5555929000	Hook, Spring	
3 - 26	*5534850000	Cushion, Stopper	
3 - 27	*5545182000	Shaft, Guide Roller	
3 - 28	5504839000	Roller Assy, Lapping	
3 - 29	*5800312200	Cap, Guide Roller	
3 - 30	*5800290400	Stopper, Lifter	
3 - 31	*5800316000	Cushion, Stopper	
3 - 32	5312000100	Counter, FL4028	
3 - 33	*5200074000	PCB Assy, Counter	
3 - 34	*5122170000	Connector Socket, 8P	
3 - 35	*5122172000	Connector Socket, 10P	
3 - 36	*5800294900	Base Assy, Counter	
3 - 37	*5555570000	Cushion; B	
3 - 38	*5581038000	Clamper, Cord	
3 - 39	5313001500	Solenoid, Brake	
3 - 40	*5524288000	Spring, Return	
3 - 41	*5555926000	Arm, Joint; B	
3 - 42	*5555925000	Arm, Joint; A	
3 - 43	*5581056000	Screw, Shoulder; A	
3 - 44	*5800301900	Spring, Lifter	
3 - 45	*5800303600	Cover, Lifter	
3 - 46	5545181000	Guide, Tape	
3 - 47	*5800310900	Post, Guide (1/4")	
3 - 48	*5800311000	Post, Head Base	
3 - 49	*5800311100	Base, Head	
3 - 50	*5022050000	Spring (B)	
3 - 51	*5520182000	Spring (D)	
3 - 52	*5800311200	Bracket, Head	
3 - 53	*5800329200	Head Shield	
3 - 54	5378301900	Head, Erase (2Tr - 2ch)	
3 - 55	5378301800	Head, Rec/Play (2Tr-2ch)	

(Continued on page 100)

EXPLODED VIEW–4



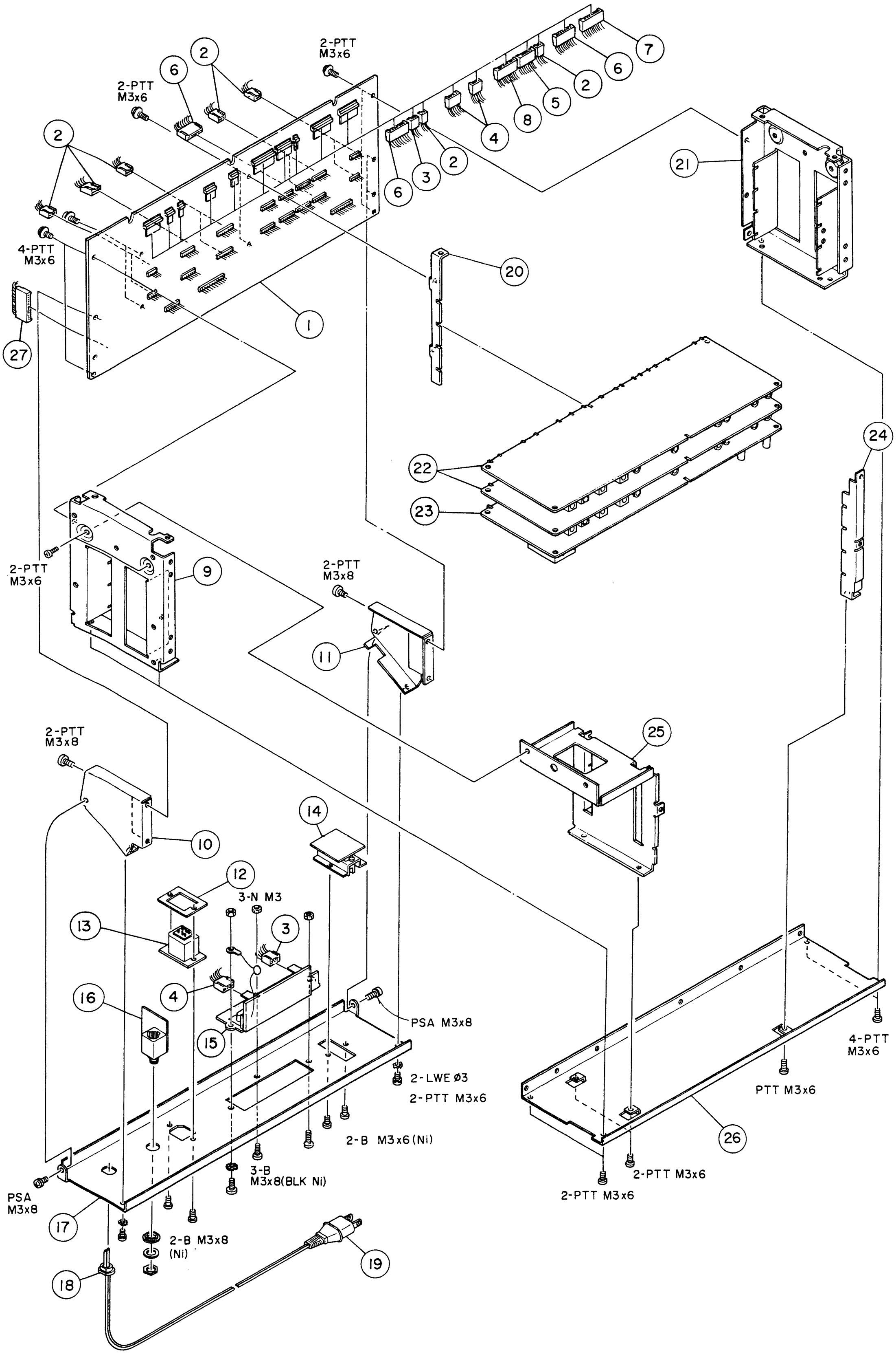
EXPLODED VIEW–4

Parts marked with * require longer delivery time.

REF. NO.	PARTS NO.	DESCRIPTION	REMARKS
4 - 1	*5800300200	Angle, Main Chassis	
4 - 2	*5320015100	Transformer, Power [J]	
	*5320015200	Transformer, Power [U, C]	
	*5320015300	Transformer, Power [GE]	
	*5320015400	Transformer, Power [E]	
	*5320015500	Transformer, Power [UK, A]	
4 - 3	*5800311700	Holder, Transformer; A	
4 - 4	*5200078510	PCB Assy, Fuse [J, GE, U, C]	
	*5200078520	PCB Assy, Fuse [E, UK, A]	
4 - 5	*5800311600	Holder, Transformer	
4 - 6	5370002800	DC Motor, Reel (1/4")	
4 - 7	5370002900	Motor Assy, DC Capstan	
4 - 8	*5800299700	Holder, Cord	
4 - 9	*5555921000	Plate, Thrust	
4 - 10	*5555920001	Angle, Thrust	
4 - 11	*5200073800	PCB Assy, SHUT OFF	
4 - 12	*5800289600	Spring, Earth; (A)	
4 - 13	*5800311800	Bracket, Fuse	
4 - 14	*5800300000	Holder, Motor	
4 - 15	*5800299400	Encoder Assy	
4 - 16	*5200073900	PCB Assy, SENSOR	
4 - 17	*5800299300	Bracket, SENSOR PCB	
4 - 18	*5800303400	Bracket, POWER SUPPLY PCB	
4 - 19	*5800303500	Heatsink	
4 - 20-1	*5200074301	PCB Assy, POWER SUPPLY	
4 - 20-2	*5200086000	PCB Assy, AUXILIARY POWER SUPPLY	
4 - 21	5033291000	Plate, Insulating	
4 - 22	5145087000	Transistor; 2SD313E	
4 - 23	5220405100	IC, µPC78M05H	
4 - 24	5145129000	Transistor; 2SB507E	
4 - 25	*5033295000	Tube, Insulating	
4 - 26	*5800294100	Bracket, CONTROL PCB	
4 - 27	*5800293500	Heatsink	
4 - 28	*5200074200	PCB Assy, CONTROL	
4 - 29	*5122280000	Connector Socket; 2P (RED)	
4 - 30	*5122164000	Connector Socket; 2P (WHT)	
4 - 31	*5336109200	Connector Socket; 2P (YEL)	
4 - 32	*5122165000	Connector Socket; 3P (WHT)	
4 - 33	*5336109300	Connector Socket; 3P (YEL)	
4 - 34	*5122166000	Connector Socket; 4P (WHT)	
4 - 35	*5122166000	Connector Socket; 4P (WHT)	
4 - 36	*5122168000	Connector Socket; 6P (WHT)	
4 - 37	*5122169000	Connector Socket, 7P (WHT)	
4 - 38	*5122288000	Connector Socket, 10P (RED)	
4 - 39	*5122172000	Connector Socket, 10P (WHT)	

[U]: U.S.A. [C]: CANADA [GE]: GENERAL EXPORT
[A]: AUSTRALIA [E]: EUROPE [UK]: U.K.
[L]: LIMITED AREA

EXPLODED VIEW–5



EXPLODED VIEW–5

Parts marked with * require longer delivery time.

REF. NO.	PART NO.	DESCRIPTION	REMARKS
5 - 1	*5200077900	PCB Assy, MOTHER AMPL.	
5 - 2	*5122164000	Connector Socket, 2P (WHT)	
5 - 3	*5122165000	Connector Socket, 3P (WHT)	
5 - 4	*5122166000	Connector Socket, 4P (WHT)	
5 - 5	*5122169000	Connector Socket, 7P (WHT)	
5 - 6	*5122170000	Connector Socket, 8P (WHT)	
5 - 7	*5122171000	Connector Socket, 9P (WHT)	
5 - 8	*5122173000	Connector Socket, 10P (WHT)	
5 - 9	*5800293100	Frame, Ampl; FL	
5 - 10	*5800288900	Bracket, MOTHER PCB; L	
5 - 11	*5500289000	Bracket, MOTHER PCB; R	
5 - 12	*5555700000	Plate, Nut	
5 - 13	*5122339000	Connector Socket, 6P	
5 - 14	*5200073700	PCB Assy, REMOTE	
5 - 15	*5200078100	PCB Assy, IN/OUT	
5 - 16	*5200077700	PUNCH IN/OUT PCB Assy	
5 - 17	*5800309200	Panel, Connector, 2	
5 - 18	*5534660000	Strain Relief, AC Power Cord [All except UK]	
	*5534661000	Strain Relief, AC Power Cord [UK]	
5 - 19	⚠*5127246000	Cord, AC Power [J]	
	⚠*5128083000	Cord, AC Power [U, C]	
	⚠*5128095000	Cord, AC Power [UK]	
	⚠*5350008200	Cord, AC Power [E]	
	⚠*5350008400	Cord, AC Power [A]	
5 - 20	*5800289900	Bracket, PCB; A	
5 - 21	*5800293200	Frame, Ampl; FR	
5 - 22	*5200074820	PCB Assy, REC/PLAY	
5 - 23	*5200078200	PCB Assy, MONITER AMPL.	
5 - 24	*5800290000	Bracket, PCB; B	
5 - 25	*5800309000	Holder, PCB	
5 - 26	*5800310400	Chassis, Back	

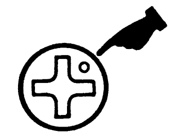
(Continued from page 96)

REF. NO.	PARTS NO.	DESCRIPTION	REMARKS
3 - 56	*5800311300	Base, Lower	
3 - 57	*5800317700	Plate, Shield; Solenoid	
3 - 58	*5786303012	Pin, Spring; ϕ3 x 12	
3 - 59	5313001600	Solenoid, Pinch Roller	
3 - 60	*5800171000	Bracket, Solenoid	
3 - 61	*5524286001	Spring, Pressure	
3 - 62	*5800310700	Arm Assy, Pinch Roller	
3 - 63	*5800290200	Collar, Head Base; A	
3 - 64	*5800310500	Base Assy, Capstan	
3 - 65	*5800302700	Plate, Pinch Roller Arm	
3 - 66	*5800290600	Base Assy, Lifter	
3 - 67	*5800290500	Collar, Lifter Base	
3 - 68	5800311500	Capstan Assy	
3 - 69	5534849000	Flywheel	
3 - 70	5534468000	Belt, Capstan	

[U]: U.S.A. [C]: CANADA [GE]: GENERAL EXPORT
[A]: AUSTRALIA [E]: EUROPE [UK]: U.K.
[L]: LIMITED AREA

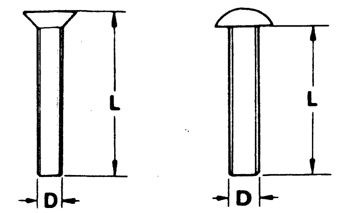
ASSEMBLING HARDWARE CODING LIST

All screws conform to ISO standards, and have crossrecessed heads, unless otherwise noted.
ISO screws have the head inscribed with a point as in the figure to the right.

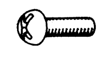
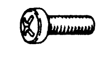
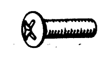
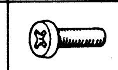
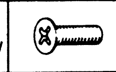
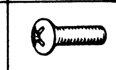
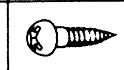
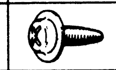
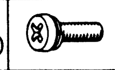
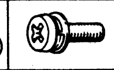
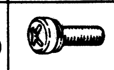
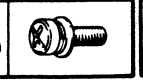


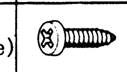
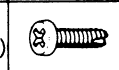
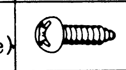
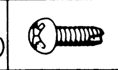
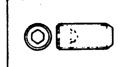
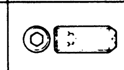
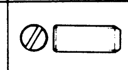
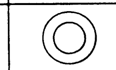
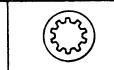
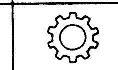
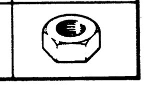
FOR EXAMPLE:

B M 3 x 6
- 6 – Length in mm (L)
- 3 – Diameter in mm (D) *
- M – Metric System
- B – Nomenclature



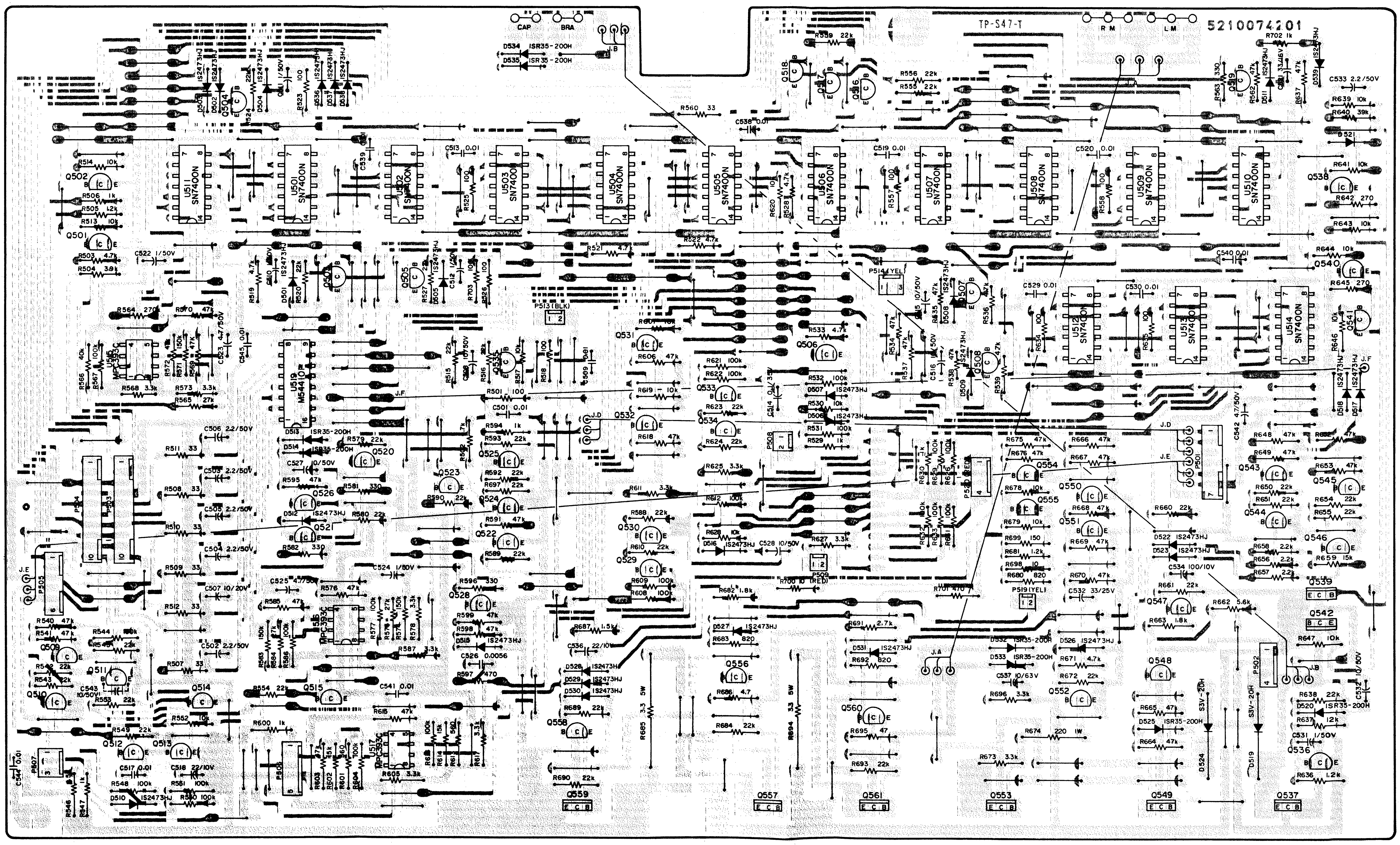
* Inner dia. for washers and nuts

	Code	Name	Type
MACHINE SCREW	R	Round Head Screw	
	P	Pan Head Screw	
	T	Stove Head Screw (Truss)	
	B	Binding Head Screw	
	F	Flat Countersunk Head Screw	
	O	Oval Countersunk Head Screw	
WOOD SCREW	RW	Round Head Wood Screw	
TAPTITE SCREW	PTT	Pan Head Taptite Screw	
	WTT	Washer Head Taptite Screw	
SEMS SCREW	BSA	Binding Head SEMS Screw(A Type)	
	BSB	Binding Head SEMS Screw(B Type)	
	BSF	Binding Head SEMS Screw(F Type)	
	PSA	Pan Head SEMS Screw(A Type)	
	PSB	Pan Head SEMS Screw(B Type)	

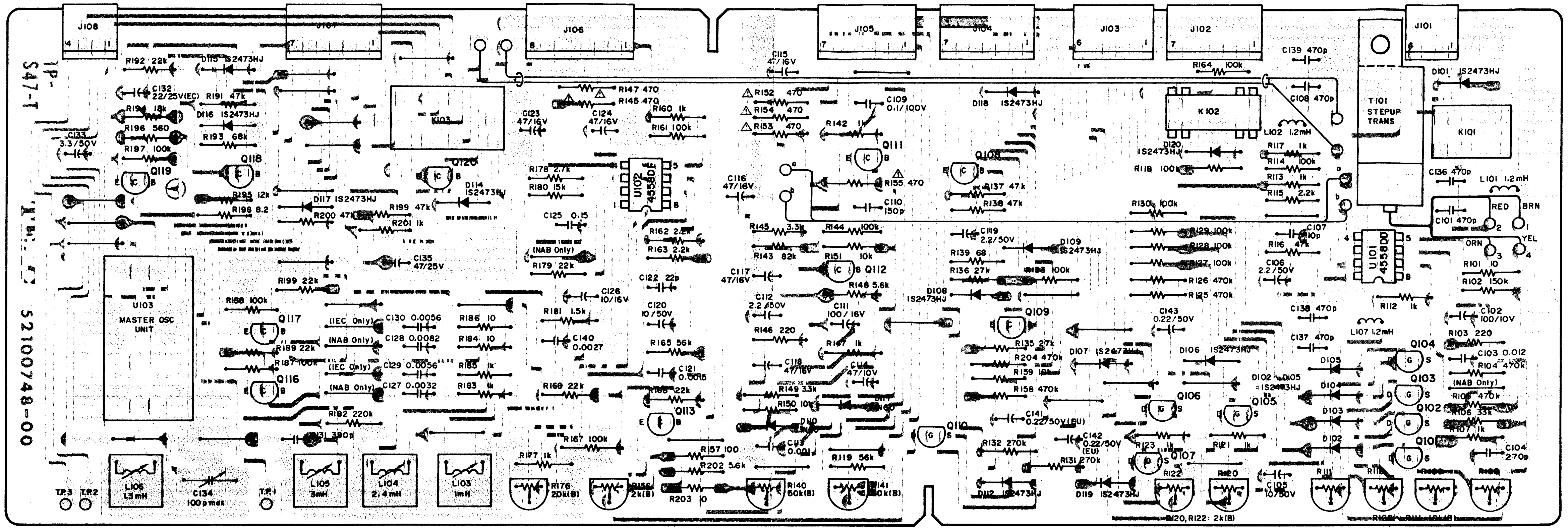
	Code	Name	Type
TAPPING SCREW	BTA	Binding Head Tapping Screw(A Type)	
	BTB	Binding Head Tapping Screw(B Type)	
	RTA	Round Head Tapping Screw(A Type)	
	RTB	Round Head Tapping Screw(B Type)	
SETSCREW	SF	Hex Socket Setscrew(Flat Point)	
	SC	Hex Socket Setscrew(Cup Point)	
	SS	Slotted Socket Setscrew(Flat Point)	
WASHER	E	E-Ring (Retaining Washer)	
	W	Flat Washer (Plain)	
	SW	Lock Washer (Spring)	
	LWI	Lock Washer (Internal Teeth)	
	LWE	Lock Washer (External Teeth)	
	TW	Trim Washer (Countersunk)	
NUT	N	Hex Nut	

4. PC BOARDS AND PARTS LIST

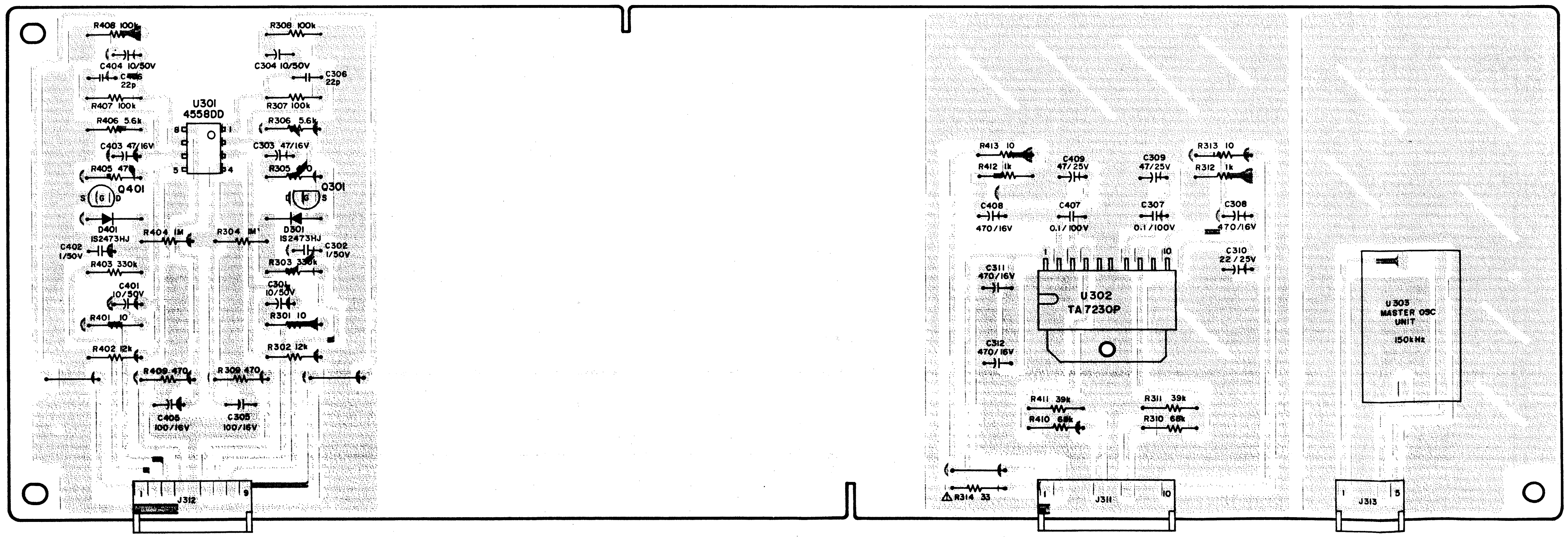
1. CONTROL PCB ASSY



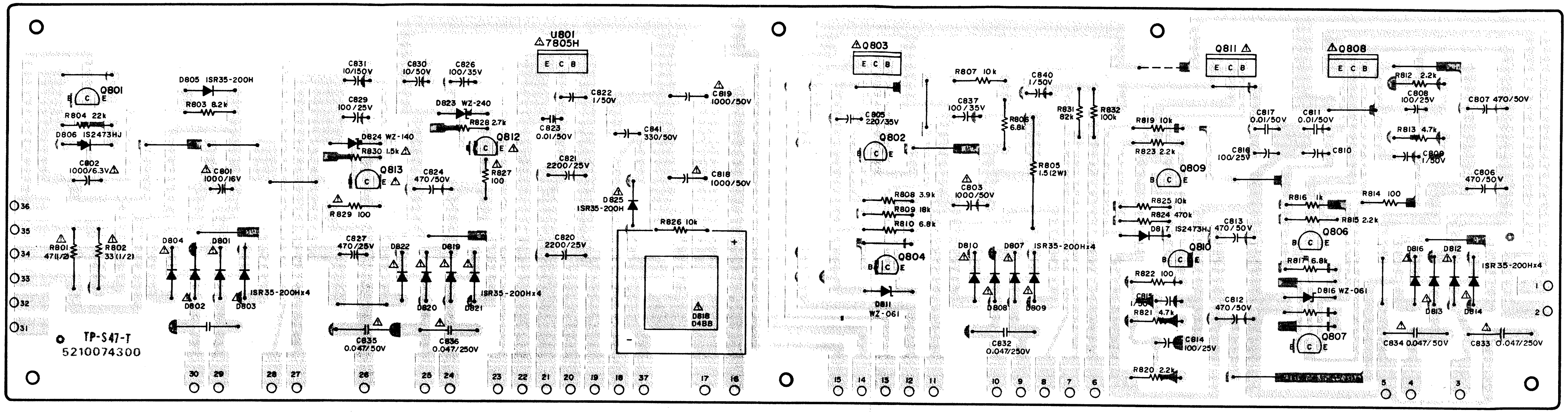
2. REC/PLAY PCB ASSY



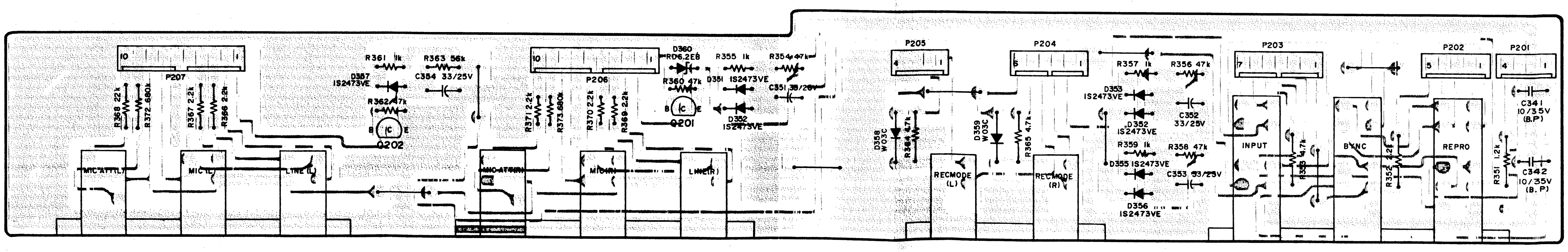
3. MONITOR AMPL. PCB ASSY



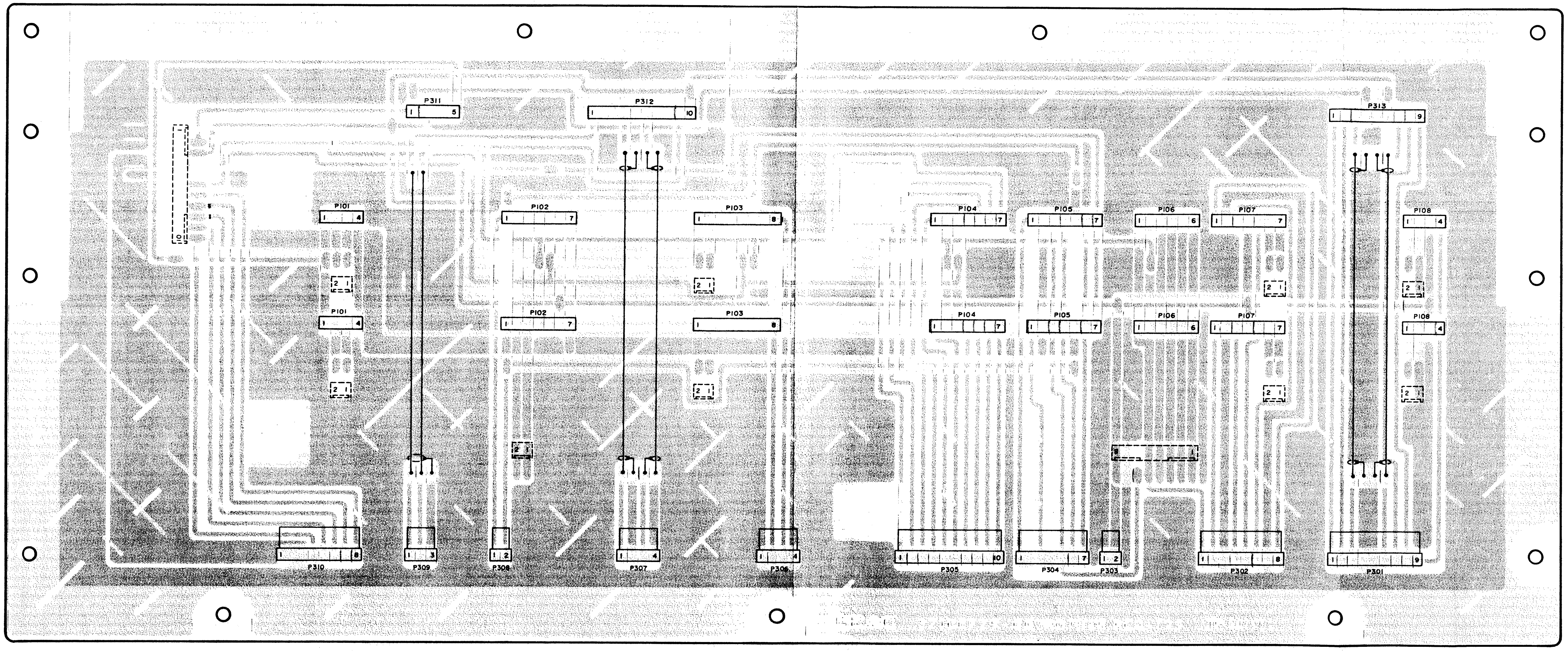
4. POWER SUPPLY PCB ASSY



5. IN/OUT SELECT PCB ASSY



6. MOTHER PCB ASSY



CONTROL PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200074201	PCB Assy, Control
	5210074201	PCB
	IC's	
U501~U504	5042712000	SN-7400N
U505	5220019900	SN-7474N
U506~U514	5042712000	SN-7400N
U515~U517	5220012500	μPC-393C
U519	5147047000	M-54410P
	TRANSISTORS	
Q501~Q509	5145178000	2SC-1684S
Q510	5042553000	2SA-733P
Q511	5145178000	2SC-1684S
Q512	5145091000	2SC-945AK
Q513~Q523	5145178000	2SC-1684S
Q524	5145091000	2SC-945AK
Q525	5042553000	2SA-733P
Q526	5145178000	2SC-1684S
Q528	5145178000	2SC-1684S
Q529	5145091000	2SC-945AK
Q530	5042553000	2SA-733P
Q531, Q532	5145178000	2SC-1684S
Q533	5145091000	2SC-945AK
Q534	5042553000	2SA-733P
Q535	5145091000	2SC-945AK
Q536	5145043000	2SA-720Q
Q537	5145087000	2SD-313E
Q538	5145178000	2SC-1684S
Q539	5231755400	2SD794Q
Q540, Q541	5145178000	2SC-1684S
Q542	5231755400	2SD794Q
Q543	5145091000	2SC-945AK
Q544	5042553000	2SA-733P
Q545	5145091000	2SC-945AK
Q546	5042553000	2SA-733P
Q547	5145091000	2SC-945AK
Q548	5042625000	2SC-1318S
Q549	5145087000	2SD-313E
Q550	5145091000	2SC-945AK
Q551	5042553000	2SA-733P
Q552	5042625000	2SC-1318S
Q553	5145129000	2SB-507E
Q554	5145091000	2SC-945AK
Q555	5042553000	2SA-733P
Q556	5042625000	2SC-1318S
Q557	⚠ 5145087000	2SD-313E
Q558	5042625000	2SC-1318S
Q559	5145087000	2SD-313E
Q560	5042625000	2SC-1318S
Q561	⚠ 5145087000	2SD-313E
	DIODES	
D501~D512	5143118000	1S2473HJ
D513, D514	5224014500	1SR35-200H
D515~D518	5143118000	1S2473HJ
D519	5224014700	S3V20H
D520	5224014500	1SR35-200H
D521~D523	5143118000	1S2473HJ
D524	5224014700	S3V20H
D525	5224014500	1SR35-200H
D526~D531	5143118000	1S2473HJ
D532~D535	5224014500	1SR35-200H
D536~D539	5143118000	1S2473HJ

REF. NO.	PARTS NO.	DESCRIPTION
	CARBON RESISTORS	
R501	5183058000	100Ω
R502, R503	5183098000	4.7kΩ
R504	5183096000	3.9kΩ
R505	5183084000	1.2kΩ
R506	5183082000	1.0kΩ
R507~R512	5183046000	33Ω
R513, R514	5183106000	10kΩ
R515, R516	5183114000	22kΩ
R517	5183106000	10kΩ
R518	5183058000	100Ω
R519	5183098000	4.7kΩ
R520	5183114000	22kΩ
R521, R522	5183098000	4.7kΩ
R523	5183058000	100Ω
R524	5183114000	22kΩ
R525, R526	5183058000	100Ω
R527	5183114000	22kΩ
R528	5183098000	4.7kΩ
R529	5183082000	1.0kΩ
R530	5183106000	10kΩ
R531, R532	5183130000	100kΩ
R533	5183098000	4.7kΩ
R534, R535	5183122000	47kΩ
R536	5183098000	4.7kΩ
R537, R538	5183122000	47kΩ
R539	5183098000	4.7kΩ
R540, R541	5183122000	47kΩ
R542, R543	5183114000	22kΩ
R544	5183130000	100kΩ
R545	5183114000	22kΩ
R546	5183086000	1.5kΩ
R547	5183082000	1.0kΩ
R548	5183130000	100kΩ
R549	5183114000	22kΩ
R550, R551	5183130000	100kΩ
R552	5183106000	10kΩ
R553~R556	5183114000	22kΩ
R557, R558	5183058000	100Ω
R559	5183114000	22kΩ
R560	5183046000	33Ω
R561, R562	5183122000	47kΩ
R563	5183070000	330Ω
R564	5183140000	270kΩ
R565	5183116000	27kΩ
R566	5183122000	47kΩ
R567	5183130000	100kΩ
R568	5183094000	3.3kΩ
R569, R570	5183122000	47kΩ
R571	5183134000	150kΩ
R572	5183122000	47kΩ
R573	5183094000	3.3kΩ
R574	5183134000	150kΩ
R575	5183116000	27kΩ
R576	5183122000	47kΩ
R577	5183130000	100kΩ
R578	5183094000	3.3kΩ
R579, R580	5183114000	22kΩ
R581, R582	5183070000	330Ω
R583	5183134000	150kΩ
R584	5183116000	27kΩ
R585	5183122000	47kΩ

REF. NO.	PARTS NO.	DESCRIPTION
R586	5183130000	100kΩ
R587	5183094000	3.3kΩ
R588~R590	5183114000	22k
R591	5183122000	47kΩ
R592, R593	5183114000	22kΩ
R594	5183082000	1.0kΩ
R595	5183122000	47kΩ
R596	5183070000	330Ω
R597	5183074000	470Ω
R598, R599	5183122000	47kΩ
R600	5183082000	1.0kΩ
R601	5183076000	560Ω
R602	5183110000	15kΩ
R603	5183122000	47kΩ
R604	5183130000	100kΩ
R605	5183094000	3.3kΩ
R606	5183122000	47kΩ
R607	5183106000	10kΩ
R608, R609	5183130000	100kΩ
R610	5183114000	22kΩ
R611	5183094000	3.3kΩ
R612	5183130000	100kΩ
R613	5183076000	560Ω
R614	5183110000	15kΩ
R615	5183122000	47kΩ
R616	5183130000	100kΩ
R617	5183094000	3.3kΩ
R618	5183122000	47kΩ
R619, R620	5183106000	10kΩ
R621, R622	5183130000	100kΩ
R623, R624	5183114000	22kΩ
R625	5183094000	3.3kΩ
R626	5183130000	100kΩ
R627	5183094000	3.3kΩ
R628	5183106000	10kΩ
R629	5183130000	100kΩ
R630	5183082000	1.0kΩ
R631~R633	5183130000	100kΩ
R634, R635	5183058000	100Ω
R636	5183084000	1.2kΩ
R637	5183108000	12kΩ
R638	5183114000	22kΩ
R639	5183106000	10kΩ
R640	5183120000	39kΩ
R641	5183106000	10kΩ
R642	5183068000	270Ω
R643, R644	5183106000	10kΩ
R645	5183068000	270Ω
R646, R647	5183106000	10kΩ
R648, R649	5183122000	47kΩ
R650, R651	5183114000	22kΩ
R652, R653	5183122000	47kΩ
R654, R655	5183114000	22kΩ
R656~R658	5183090000	2.2kΩ
R659	5183110000	15kΩ
R660, R661	5183114000	22kΩ
R662	5183100000	5.6kΩ
R663	5183088000	1.8kΩ
R664~R670	5183122000	47kΩ
R671	5183098000	4.7kΩ
R672	5183114000	22kΩ
R673	5183094000	3.3kΩ
R674	⚠ 5184763000	220Ω 1W Nonflammable
R675	5183122000	47kΩ
R676	5183122000	47kΩ

REF. NO.	PARTS NO.	DESCRIPTION
R678, R679	5183106000	10kΩ
R680	5183080000	820Ω
R681	5183084000	1.2kΩ
R682	5183088000	1.8kΩ
R683	5183080000	820Ω
R684	5183114000	22kΩ
R685	⚠ 5184410000	3.3Ω 5W
R686	5183050000	47Ω
R687	5183086000	1.5kΩ
R689, R690	5183114000	22kΩ
R691	5183092000	2.7kΩ
R692	5183080000	820Ω
R693	5183114000	22kΩ
R694	⚠ 5184410000	Cement 3.3Ω 5W 10%
R695	5183050000	47Ω
R696	5183094000	3.3kΩ
R697	5183114000	22kΩ
R698	5183034000	10Ω
R699	5183062000	150Ω
R700	5183034000	10Ω
R701	5183074000	470Ω
R702	5183082000	1kΩ
R703	5183058000	100Ω
	CAPACITORS	
C501	5054204000	Ceramic 0.01μF 50V ±10%
C502~C506	5172996000	Elec. 2.2μF 50V
C507, C508	5173013000	Elec. 10μF 50V
C509	5054204000	Ceramic 0.01μF 50V ±10%
C510~C512	5172992000	Elec. 1μF 50V
C513	5054204000	Ceramic 0.01μF 50V ±10%
C514	5054664100	Dip. Tant. 0.1μF 35V ±20%
C515, C516	5173013000	Elec. 10μF 50V
C517	5054204000	Ceramic 0.01μF 50V ±10%
C518	5173017000	Elec. 22μF 10V
C519, C520	5054204000	Ceramic 0.01μF 50V ±10%
C521	5260222800	Elec. (LL) 33μF 16V
C522	5172992000	Elec. 1μF 50V
C523	5173006000	Elec. 4.7μF 50V
C524	5172992000	Elec. 1μF 50V
C525	5173006000	Elec. 4.7μF 50V
C526	5170489000	Mylar 0.0056μF 100V ±10%
C527, C528	5173013000	Elec. 10μF 50V
C529, C530	5054204000	Ceramic 0.01μF 50V ±10%
C531	5172992000	Elec. 1μF 50V
C532	5173013000	Elec. 10μF 50V
C533	5172996000	Elec. 2.2μF 50V
C534	5172933000	Elec. 100μF 10V
C535	5172917000	Elec. 33μF 25V
C536	5173017000	Elec. 22μF 10V
C537	5172904000	Elec. 10μF 63V
C538~C541	5054204000	Ceramic 0.01μF 50V ±10%
C542	5173006000	Elec. 4.7μF 50V
C543	5173013000	Elec. 10μF 50V
C544, C545	5054204000	Ceramic 0.01μF 50V
	CONNECTOR PLUGS	
P501	5122131000	7P(WHT)
P502	5122128000	4P(WHT)
P503, P504	5122134000	10P(WHT)
P505	5122130000	6P(WHT)
P506	5122128000	4P(WHT)

REF. NO.	PARTS NO.	DESCRIPTION
P507	5122127000	3P(WHT)
P508	5122126000	2P(WHT)
P509	5122299000	2P(RED)
P513	5122183000	2P(BLK)
P514	5336107300	3P(YEL)
P519	5336107200	2P(YEL)
P520	5122301000	4P(RED)
	MISCELLANEOUS	
	5800293500	Heat Sink
	5800294100	Bracket, Control PCB
	5033291000	Plate, Insulating
	5033295000	Tube, Insulating

REC/PLAY PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION			
	5200074821	PCB Assy			
	5210074800	PCB			
	IC's				
U101	5147028000	JRC-4558D-D			
U102	5147064000	JRC-4559D-D			
	TRANSISTORS				
Q101~Q107	5145103000	FET, 2SK-68AM			
Q108	5147178000	2SC-1684S			
Q109	5042553000	2SA-733P			
Q110	5145103000	FET, 2SK-68AM			
Q111	5145178000	2SC-1684S			
Q112	5042553000	2SA-733P			
Q113	5145178000	2SC-1684S			
Q116~Q118	5143178000	2SC-1684S			
Q119	5042625000	2SC-1318S			
Q120	5145178000	2SC-1684S			
	DIODES				
D101~D109	5143118000	1S2473HJ			
D110, D111	5042213000	IN60			
D112	5143118000	1S2473HJ			
D114~D119	5143118000	1S2473HJ			
	CARBON RESISTORS				
R101	5183034000	10Ω			
R102	5183013800	220kΩ			
R103	5183072000	390Ω			
R104, R105	5183146000	470kΩ			
R106	5183118000	33kΩ			
R107	5183082000	1.0kΩ			
R112, R113	5183082000	1.0kΩ			
R114	5183130000	100kΩ			
R115	5183090000	2.2kΩ			
R116	5183122000	47kΩ			
R117	5183082000	1.0kΩ			
R118	5183030000	100kΩ			
R119	5183124000	56kΩ			
R121	5183082000	1.0kΩ			
R123	5183082000	1.0kΩ			
R125, R126	5183146000	470kΩ			
R127~R130	5183130000	100kΩ			
R131, R132	5183140000	270kΩ			
R133	5183130000	100kΩ			
R135, R136	5183116000	27kΩ			
R137, R138	5183122000	47kΩ			
R139	5183054000	68Ω			
R142	5183082000	1.0kΩ			
R143	5183128000	82kΩ			
R144	5183130000	100kΩ			
R145	5183094000	3.3kΩ			
R146	5183066000	220Ω			
R147	5183082000	1.0kΩ			
R148	5183100000	5.6kΩ			
R149	5183094000	3.3kΩ			
R150, R151	5183106000	10kΩ			
R152~R155 ⚠	5183074000	470Ω			
R157	5183058000	100Ω			
R158	5183146000	470kΩ			
R159	5183106000	10kΩ			
R160	5183082000	1.0kΩ			
R161	5183130000	100kΩ			
R162	5183090000	2.2kΩ			
R163	5183114000	22kΩ			
R164	5183130000	100kΩ			
R165	5183124000	56kΩ			
R166	5183108000	12kΩ			
R167	5183130000	100kΩ			
R168	5183114000	22kΩ			
R174, R175 ⚠	5183074000	470Ω			
R177	5183082000	1.0kΩ			
R178	5183092000	2.7kΩ			
R179	5183114000	22kΩ			
R180	5183110000	15kΩ			
R181	5183086000	1.5kΩ			
R182	5183138000	220kΩ			
R183	5183082000	100Ω			
R184	5183034000	10Ω			
R185	5183082000	1kΩ			
R186	5183034000	10Ω			
R187, R188	5183130000	100kΩ			
R189, R190	5183114000	22kΩ			
R191	5183122000	47kΩ			
R192	5183114000	22kΩ			
R193	5183126000	68kΩ			
R194	5183112000	18kΩ			
R195	5183108000	12kΩ			
R196	5183076000	560Ω			
R197	5183130000	100kΩ			
R198 ⚠	5184223000	8.2Ω Nonflammable			
R199, R200	5183122000	47kΩ			
R201	5183082000	1.0kΩ			
R202	5183100000	5.6kΩ			
R203	5183034000	10Ω			
R204	5183014600	470kΩ			
	CAPACITORS				
C101	5263107010	Polyst.	470pF	100V	±5%
C102	5173044000	Elec.	100μF	10V	
C103	5170427000	Mylar	0.012μF	100V	±5%
C104	5172317000	Ceramic	270pF	50V	±10%
C105	5173013000	Elec.	10μF	50V	

REF. NO.	PARTS NO.	DESCRIPTION
C106	5172996000	Elec. 2.2μF 50V
C107	5172300000	Ceramic 10pF 50V ±10%
C108	5173728000	Polyst. 470pF 100V ±5%
C109	5170449000	Mylar 0.1μF 100V ±5%
C110	5172314000	Ceramic 150pF 50V ±10%
C111	5173045000	Elec. 100μF 16V
C112	5172996000	Elec. 2.2μF 50V
C113	5170401000	Mylar 0.001μF 100V ±5%
C114	5173035000	Elec. 47μF 10V
C115~C118	5173036000	Elec. 47μF 16V
C119	5172996000	Elec. 2.2μF 50V
C120	5173013000	Elec. 10μF 50V
C121	5170405000	Mylar 0.0015μF 100V
C122	5172300000	Ceramic 10pF 50V
C123, C124	5173036000	Elec. 47μF 16V
C125	5170453000	Mylar 0.15μF 100V ±5%
C126	5171565000	Elec. 10μF 16V (LR)
C127	5170419000	0.0056μF 100V ±5%
C128	5170423000	0.0082μF 100V ±5%
C129	5170413000	0.0033μF 100V ±5%
C130	5170419000	Mylar 0.0056μF 100V ±5%
C131	5263106810	Polyst. 390pF 100V ±5%
C132	5260080800	Elec. (EU) 3.3μF 25V
C133	5173000000	Elec. 3.3μF 50V
C134	5267205800	TRIMMER M-291009
C135	5260082200	Elec. (EU) 22μF 25V
C136~C139	5263107010	Polyst. 470pF 100V ±5%
C140	5170411000	Mylar 0.0027μF 100V ±5%
C141~C143	5260080200	Elec. (EU) 0.22μF 50V ±10%
	VARIABLE RESISTORS	
R108	5150154000	Semi-fixed 10kΩ(B)
R109	5280001100	Semi-fixed 20kΩ(B)
R110	5150154000	Semi-fixed 10kΩ(B)
R111	5280001100	Semi-fixed 20kΩ(B)
R120	5150152000	Semi-fixed 2kΩ(B)
R122	5150152000	Semi-fixed 2kΩ(B)
R140	5150157000	Semi-fixed 100kΩ(B)
R141	5150156000	Semi-fixed 50kΩ(B)
R176	5280001102	Semi-fixed 20kΩ(B)
	COILS	
L101, L102	5160107000	Choke, 1.2 mH ±5%
L103	5286010900	Choke, 1.0mH
L104	5286011000	Choke, 2.4mH
L105	5160044000	Trap, 3mH
L106	5286011400	Choke, 1.3 mH
L107	5160107000	Choke, 1.2 mH ±5%
	MISCELLANEOUS	
K101	5290009500	Relay, 24V G2E-182P-H
K102	5290009600	Relay, Reed; RRD51A24
K103	5290008900	Relay, 24V G2V-2
U103	5292201600	BIAS Ampl. module
J101	5122375000	Connector Socket, 4P
J102	5122378000	Connector Socket, 7P
J103	5122377000	Connector Socket, 6P
J104, J105	5122378000	Connector Socket, 7P
J106	5122379000	Connector Socket, 8P
J107	5122378000	Connector Socket, 7P
J108	5122375000	Connector Socket, 4P
T101	5320200300	Step-up Transformer
	5800289400	Step-up Metal Fitting

MONITOR AMPL, PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200078200	PCB Assy
	5210078200	PCB
	IC's	
U301	5147064000	JRC-4559D-D
U302	5220406800	TA7230P
	TRANSISTORS	
Q301, Q401	5145103000	FET, 2SK-68AM
	DIODES	
D301, D401	5143118000	1S2473HJ
	CARBON RESISTORS	
R301, R401	5183034000	10Ω
R302, R402	5183108000	12kΩ
R303, R403	5183142000	330kΩ
R304, R404	5183154000	1.0MΩ
R305, R405	5183074000	470Ω
R306, R406	5183100000	5.6kΩ
R307, R407	5183130000	100kΩ
R308, R408	5183130000	100kΩ
R309, R409 ⚠	5183074000	470Ω
R310, R410	5183126000	68kΩ
R311, R411	5183120000	39kΩ
R312, R412	5183082000	1.0kΩ
R313, R413	5183034000	10Ω
R314 ⚠	5184237000	33Ω Nonflammable
	CAPACITORS	
C301, C401	5173013000	Elec. 10μF 50V
C302, C402	5260065610	Elec. (B.P) 1μF 50V
C303, C403	5173036000	Elec. 47μF 16V
C304, C404	5173013000	Elec. 10μF 50V
C305, C405	5173045000	Elec. 100μF 16V
C307, C407	5170449000	Mylar 0.1μF 100V ±5%
C308, C408	5173072000	Elec. 470μF 16V
C309, C409	5173037000	Elec. 47μF 25V
C311, C312	5173072000	Elec. 470μF 16V
	MISCELLANEOUS	
U303	5292201500	OSC Unit, 150kHz
	5122380000	Connector Socket, 9P
	5122381000	Connector Socket, 10P
	5122376000	Connector Socket, 5P

POWER SUPPLY PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION			
	5200074301	PCB Assy			
	5210074300	PCB			
	IC				
U801	⚠5220405100	UPC-78M05H			
	TRANSISTORS				
Q801	5145133000	2SC-1645B			
Q802	5042625000	2SC-1318S			
Q803	⚠5145087000	2SD-313E			
Q804	5145091000	2SC-945AK			
Q806, Q807	5145091000	2SC-945AK			
Q808	⚠5145087000	2SD-313E			
Q809, Q810	5042553000	2SA-733P			
Q811	⚠5145129000	2SB-507E			
Q812, Q813	⚠5145091000	2SC-945AK			
	DIODES				
D801~D805	⚠5224014500	1SR35-200H			
D806	5143118000	1S2473HJ			
D807~D810	⚠5224014500	1SR35-200H			
D811	5042514000	WZ-061, Zener			
D812~D815	⚠5224014500	1SR35-200H			
D816	5042514000	WZ-061, Zener			
D817	5143118000	1S2473HJ			
D818	⚠5228007200	D4BB, Silicon Stad			
D819~D822	⚠5224014500	1SR35-200H			
D823	⚠5143297000	WZ-240, Zener			
D824	5143283000	WZ-140, Zener			
D825	⚠5224014500	1SR35-200H			
	CARBON RESISTORS				
R801	⚠5180050000	47Ω	1/2W		
R802	⚠5180046000	33Ω	1/2W		
R803	5183104000	8.2kΩ			
R804	5183114000	22kΩ			
R805	⚠5184302000	1.5Ω	Cement	2W	±10%
R806	5183102000	6.8kΩ			
R807	5183106000	10kΩ			
R808	5183096000	3.9kΩ			
R809	5183112000	18kΩ			
R810	5183102000	6.8kΩ			
R812	5183090000	2.2kΩ			
R813	5183098000	4.7kΩ			
R814	5183058000	100Ω			
R815	5183090000	2.2kΩ			
R816	5183082000	1.0kΩ			
R817	5183102000	6.8kΩ			
R818	5183100000	5.6kΩ			
R819	5183106000	10kΩ			
R820	5183090000	2.2kΩ			
R821	5183098000	4.7kΩ			
R822	5183058000	100Ω			
R823	5183090000	2.2kΩ			
R824	5183146000	470kΩ			
R825, R826	5183106000	10kΩ			
R827	⚠5184249000	100Ω	Nonflammable		
R828	5183092000	2.7kΩ			
R829	⚠5184249000	100Ω	Nonflammable		
R830	5183086000	1.5kΩ			
R831	5183128000	82kΩ			
R832	5183130000	100kΩ			

REF. NO.	PARTS NO.	DESCRIPTION			
	CAPACITORS				
C801	⚠5173081000	Elec.	1000µF	16V	
C802	⚠5173079000	Elec.	1000µF	6.3V	
C803	⚠5173084000	Elec.	1000µF	50V	
C805	5173056000	Elec.	220µF	35V	
C806, C807	5173075000	Elec.	470µF	50V	
C808	5173046000	Elec.	100µF	25V	
C809	5172992000	Elec.	1µF	50V	
C810	5173046000	Elec.	100µF	25V	
C811	5054204000	Ceramic	0.01µF	50V	±10%
C812, C813	5173075000	Elec.	470µF	50V	
C814	5173046000	Elec.	100µF	25V	
C815	5172992000	Elec.	1µF	50V	
C816	5173046000	Elec.	100µF	25V	
C817	5054204000	Ceramic	0.01µF	50V	±10%
C818, C819	⚠5173084000	Elec.	1000µF	50V	
C820, C821	⚠5173089000	Elec.	2200µF		
C822	5172992000	Elec.	1µF	50V	
C823	5054204000	Ceramic	0.01µF	50V	±10%
C824	5173075000	Elec.	470µF	50V	
C826	⚠5173047000	Elec.	100µF	35V	
C827	5173073000	Elec.	470µF	25V	
C829	5173046000	Elec.	100µF	25V	
C830, C831	5173013000	Elec.	10µF	50V	
C832~C836	⚠5263164500	Metalized	0.047µF	250V	±10%
C837	⚠5173047000	Elec.	100µF	35V	
C838	⚠5263164500	Metalized	0.047µF	250V	±10%
C840	5172992000	Elec.	1µF	50V	
C841	5173066000	Elec.	330µF	50V	
	MISCELLANEOUS				
	5800303400	Bracket, Power Supply PCB			
	5800303500	Heat Sink			
	5033291000	Plate, Insulating; 1S-313D			
	5033295000	Tube, Insulating; P			

AUXILIARY POWER SUPPLY PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200086000	PCB Assy
	5210086000	PCB
	TRANSISTORS	
Q851	5145087000	2SD313E
	5033291000	Plate, insulate, A-18
	5033295000	Tube, insulate, A-24B
Q852	5145091000	2SC945AK
Q853	5145043000	2SA720Q
	DIODE	
D851	504251400	WZ-061, Zener

REF. NO.	PARTS NO.	DESCRIPTION
		CARBON RESISTORS
R851	5183084000	1.2kΩ
R852	5183092000	2.7kΩ
R853	5183082000	1kΩ
R854	⚠ 5183562000	22kΩ Nonflammable
		CAPACITORS
C851	5173013000	Elec. 10μF 50V
C852	5172992000	Elec. 1μF 50V
C853	5173047000	Elec. 100μF 35V
		MISCELLANEOUS
	5800369000	Holder, PCB assy

IN/OUT SELECT PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200078000	PCB, Assy
	5210078000	PCB
		TRANSISTORS
Q201, Q202	5145178000	2SC-1684S
		DIODES
D351~D357	5042517000	1S2473VE
D358, D359	5143315000	WO3C
D360	5042554000	RD6.2EB, 3%; Zener
		CARBON RESISTORS
R351	5183092000	4.7kΩ
R352	5183090000	2.2kΩ
R353	5183084000	1.2kΩ
R354	5240172200	47kΩ
R355	5240168200	1.0kΩ
R356	5240172200	47kΩ
R357	5240168200	1.0kΩ
R358	5240172200	47kΩ
R359	5240168200	1.0kΩ
R360	5240172200	47kΩ
R361	5240168200	1.0kΩ
R362	5240172200	47kΩ
R363	5240172400	56kΩ
R364, R365	5183092000	4.7kΩ
R366~R371	5240169000	2.2kΩ
R372, R373	5240175000	680kΩ
		CAPACITORS
C341, C342	5260067310	Elec. 10μF 50V ±20%
C351~C354	5173028000	Elec. 33μF 25V
		CONNECTOR PLUGS
P201	5122128000	4P(WHT)
P202	5122129000	5P(WHT)
P203	5122131000	7P(WHT)
P204	5122130000	6P(WHT)
P205	5122128000	4P(WHT)
P206, P207	5122134000	10P(WHT)

SPEED SW PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200074500	PCB Assy, Speed Switch
	5210074500	PCB
	5300027700	Push Switch, 3-gang

MOTHER PCB ASSY

REF. NO.	PARTS NO.	DESCRIPTION
	5200077900	PCB Assy
	5210077900	PCB
		CONNECTOR PLUGS
P101	5122356000	4P
P102	5122359000	7P
P103	5122358000	6P
P104, P105	5122359000	7P
P106	5122360000	8P
P107	5122359000	7P
P108	5122356000	4P
P111~P114	5122126000	2P(WHT)
P171	5122135000	11P(WHT)
P191	5122132000	8P(WHT)
P192	5122126000	2P(WHT)
P301	5122152000	9P(WHT)
P302	5122151000	8P(WHT)
P303	5122145000	2P(WHT)
P304	5122150000	7P(WHT)
P305	5122153000	10P(WHT)
P306, P307	5122147000	4P(WHT)
P308	5122145000	2P(WHT)
P309	5122146000	3P(WHT)
P310	5122151000	8P(WHT)
P311	5122361000	9P
P312	5122362000	10P
P313	5122357000	5P

PUNCH IN/OUT PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200077700	PCB Assy
	5210077700	PCB
Q901, Q902	5145178000	Transistor, 2SC-1684S
R901	5183034000	Resistor, Carbon 10Ω
R902	5183122000	Resistor, Carbon 47kΩ
R903	5183098000	Resistor, Carbon 4.7kΩ
R904	5183106000	Resistor, Carbon 10kΩ
R905	5183122000	Resistor, Carbon 47kΩ
C901	5172996000	Capacitor Elec. 2.2μF 50V
	5330008300	Jack, Mic

TASCAM 32
TEAC Production Products

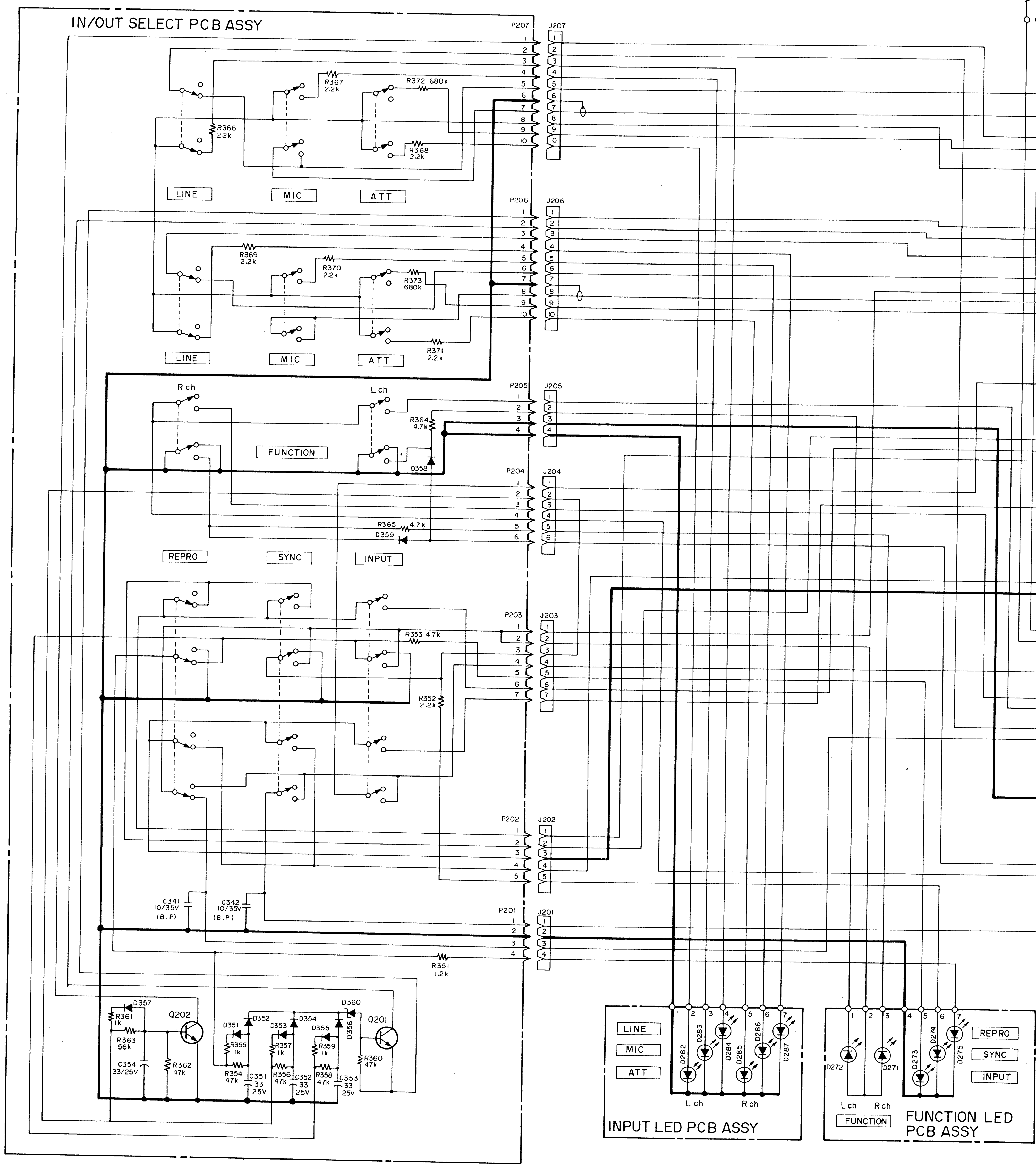
WIRING CIRCUIT DIAGRAM

IN/OUT SELECT PCB ASSY
Q201,Q202 2SC1684S

D351~D357 IS2473VE
D358, D359 W03C
D360 RD6.2EB

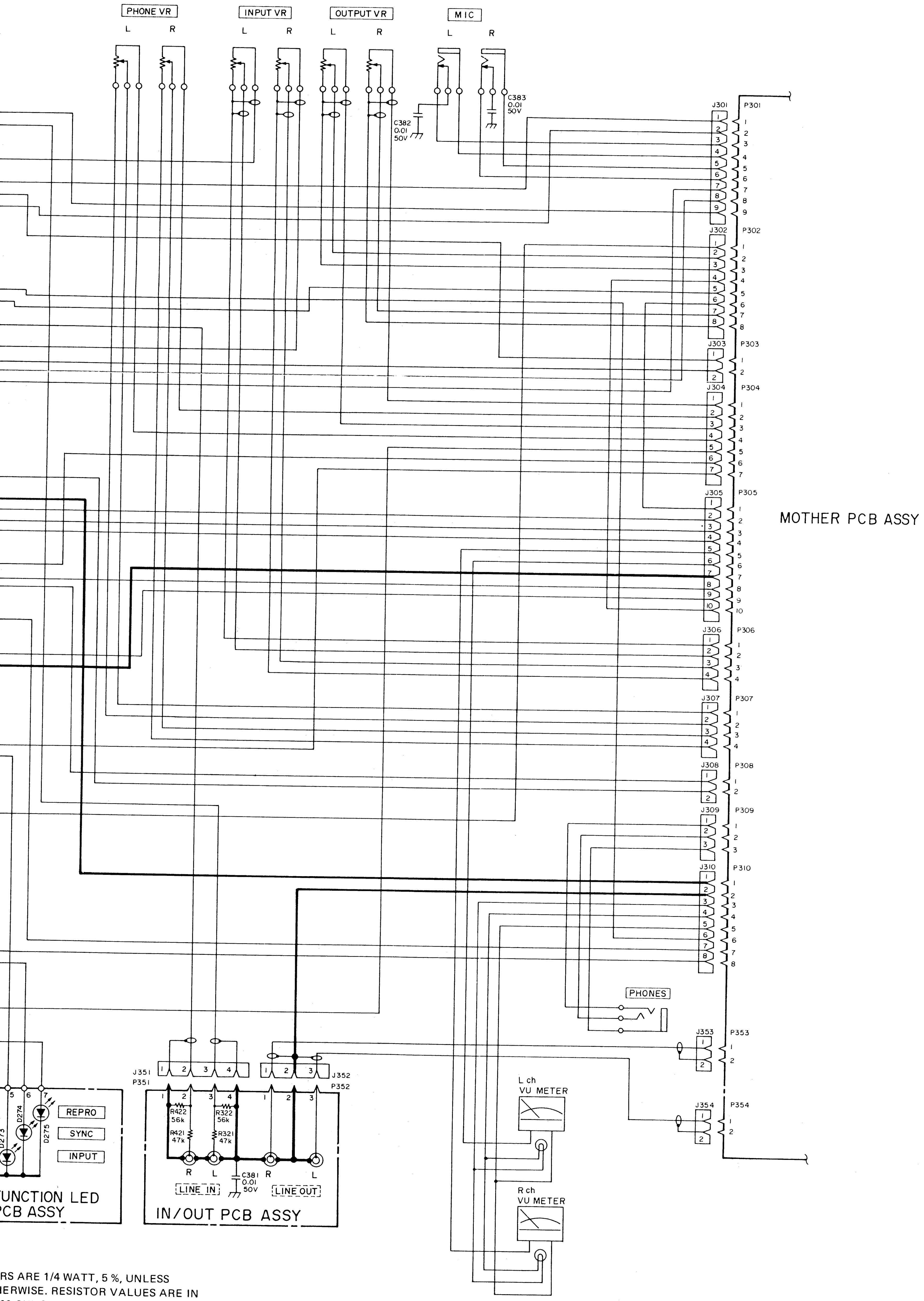
FUNCTION LED PCB ASSY
D271~D275 GL-9PR2

INPUT LED PCB ASSY
D282~D284, D286~D288 GL-9PR2



NOTES

1. ALL RESISTORS ARE 1/4 WATT, 5 %, MARKED OTHERWISE. RESISTOR VA OHMS (k = 1,000 OHMS, M = 1,000,000
2. ALL CAPACITOR VALUES ARE IN MI (p = PICOFARADS).
3. ⚠ PARTS MARKED WITH THIS SIGN CRITICAL COMPONENTS – REFER T PARTS LIST AND ENSURE EXACT RE



RS ARE 1/4 WATT, 5 %, UNLESS
IERWISE. RESISTOR VALUES ARE IN
00 OHMS, M = 1,000,000 OHMS).
OR VALUES ARE IN MICROFARADS
ADS).
RKED WITH THIS SIGN ARE SAFETY
MPONENTS – REFER TO THE TEAC
ND ENSURE EXACT REPLACEMENT.

TASCAM 32 AMPLIFIER SCHEMATIC DIAGRAM

TEAC Production Products

NOTES

1. ALL RESISTORS ARE 1/4 WATT, 5 %, UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (k = 1,000 OHMS, M = 1,000,000 OHMS).
2. ALL CAPACITOR VALUES ARE IN MICROFARADS (p = PICOFARADS).
3. SCHEMATIC DIAGRAM SHOWN FOR ONE CHANNEL EXCEPT FOR SOME OF THE COMPONENTS.
4. ⚠ 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.

* The NAB and IEC standard (equalization) wiring configuration of the record/reproduce amplifier.

NAB Standard : With the A, B, and C jumper connections being disregarded, jumper D is connected to terminal side of C129 and jumper E to the terminal side of C128.

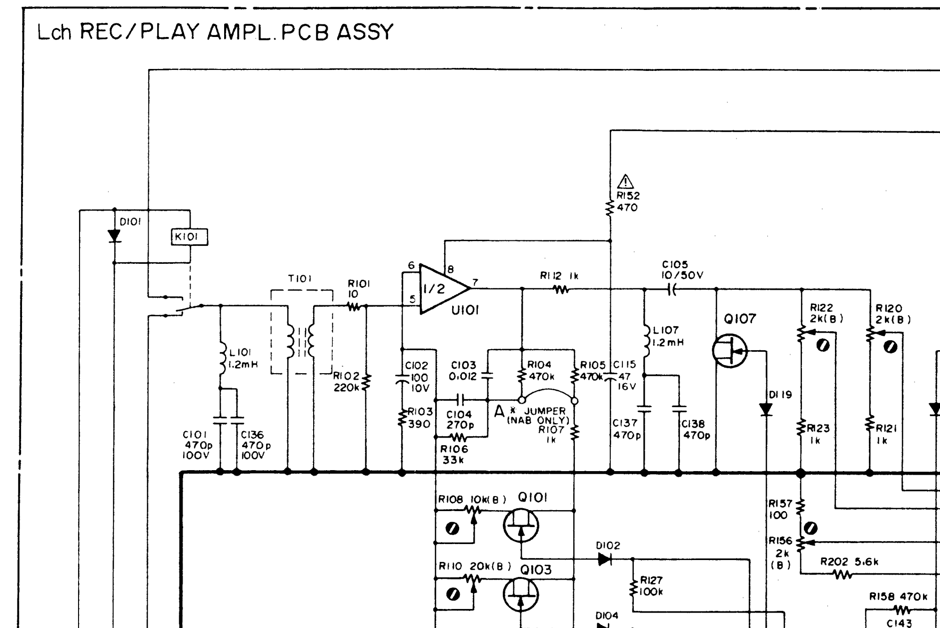
IEC Standard : With A, B, and C jumpers in place, jumper D is connected to terminal side of C127 and jumper E to terminal side of C130.

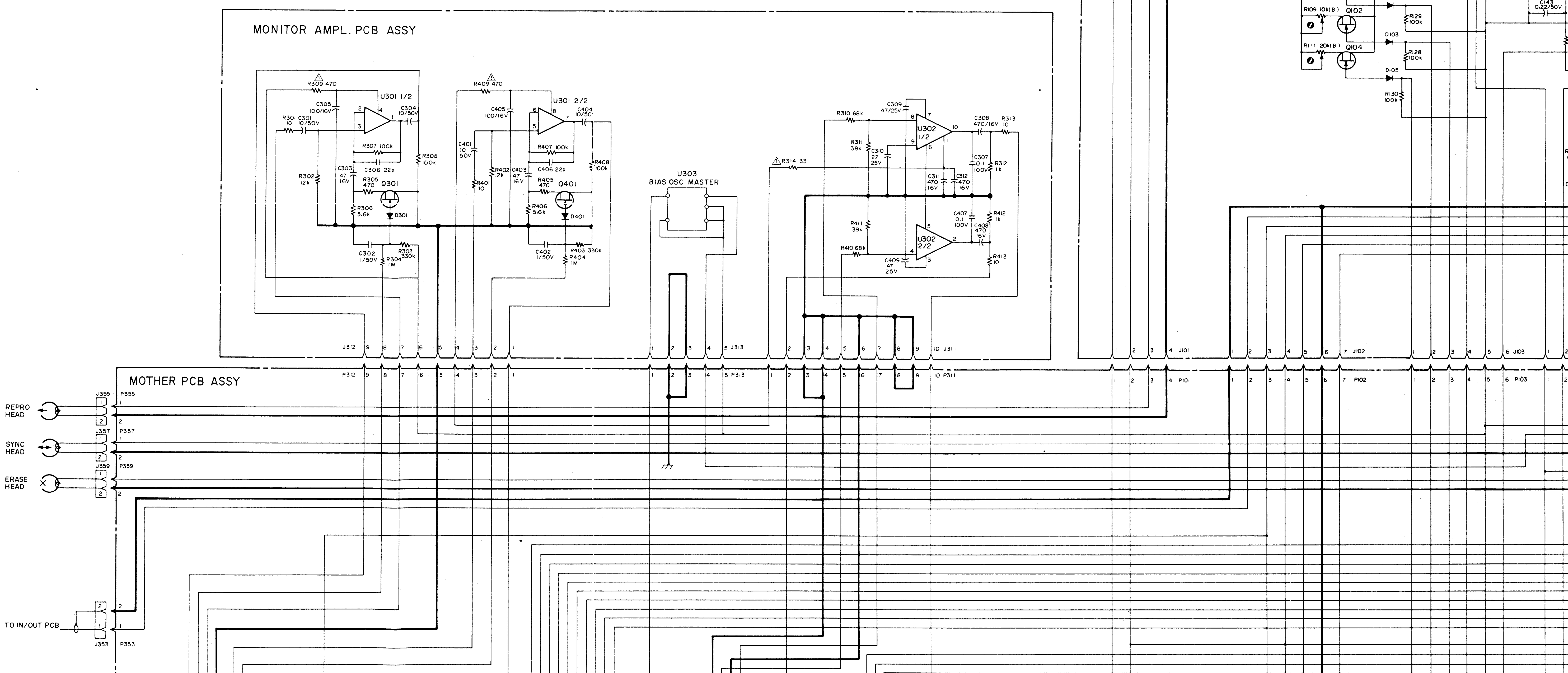
REC/PLAY AMPL. PCB ASSY

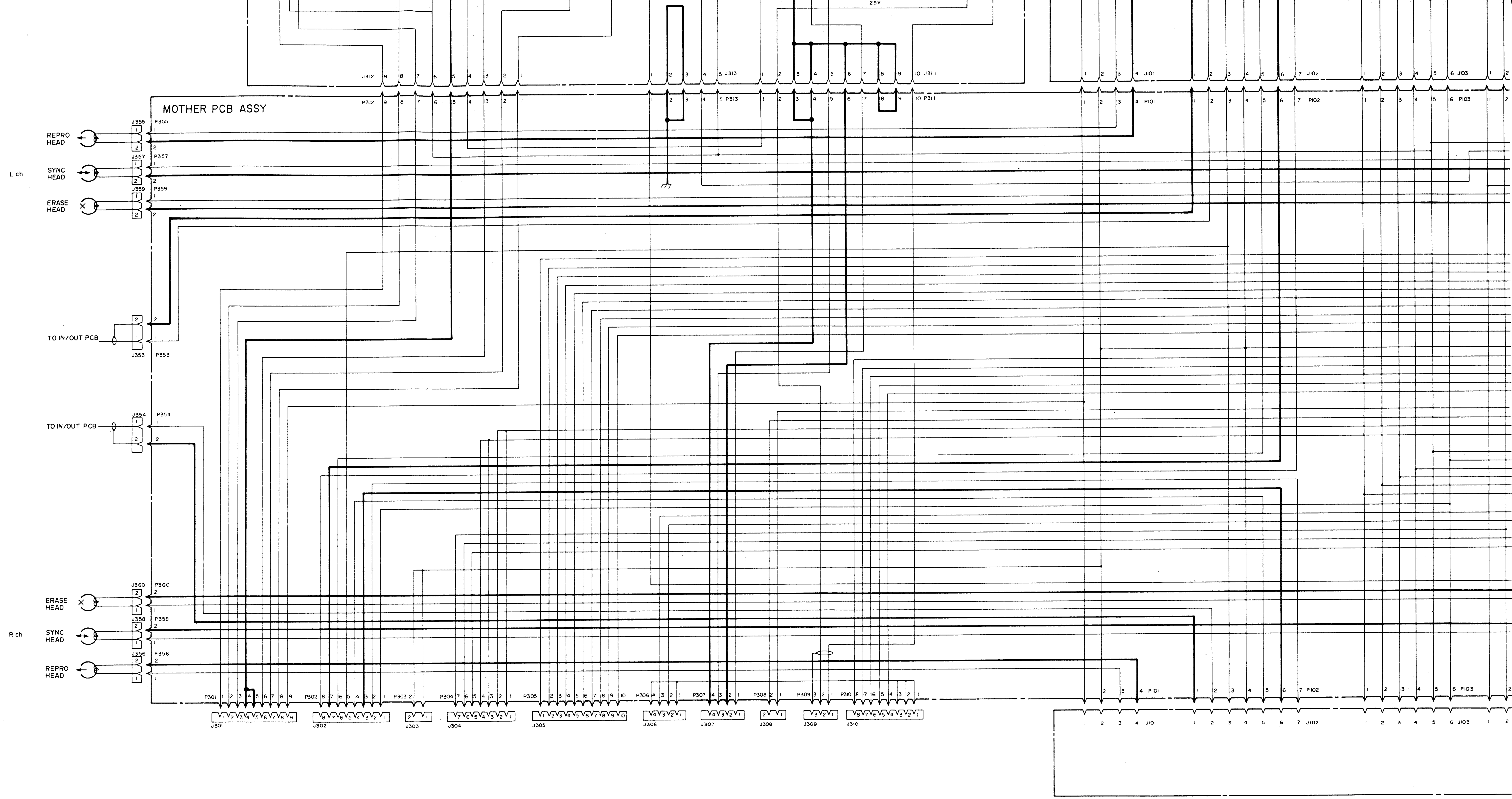
U101	JRC-4558D-D
U102	4559DD
U103	BIAS OSC AMPL
Q101～Q107	2SK68AM
Q108	2SC1684S
Q109	2SA733P
Q110	2SK68AM
Q112	2SA733P
Q113, Q116～Q118	2SC1684S
Q119	2SC1318S
Q120	2SC1684S
D101～D109	1S2473HJ
D110, D111	1N60
D114～D119	1S2473HJ

MONITOR AMPL. PCB ASSY

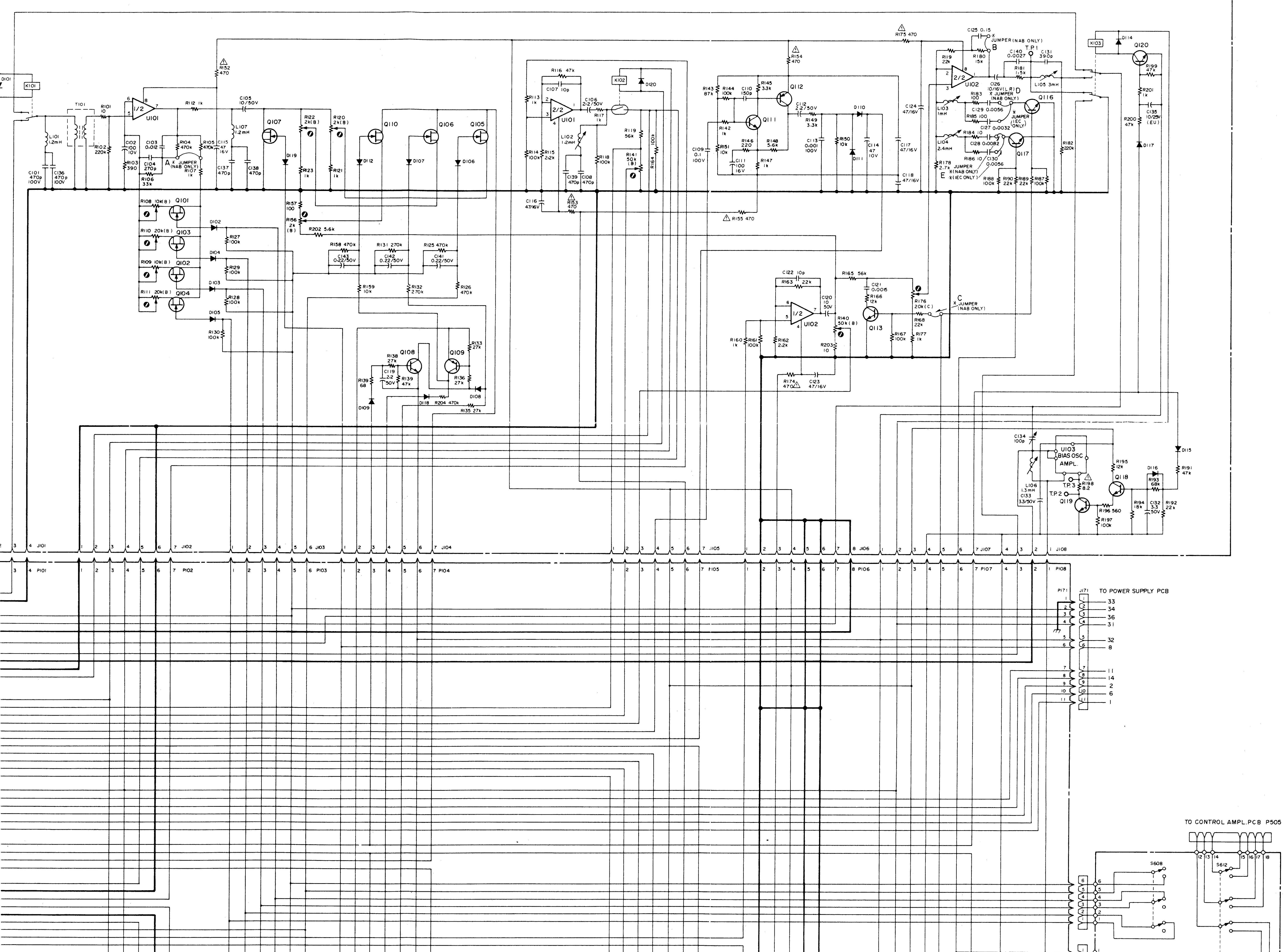
U301	4559DD
U302	TA7230P
U303	BIAS OSC MASTER
Q301, Q401	2SK68AM
D301, D401	1S2473HJ

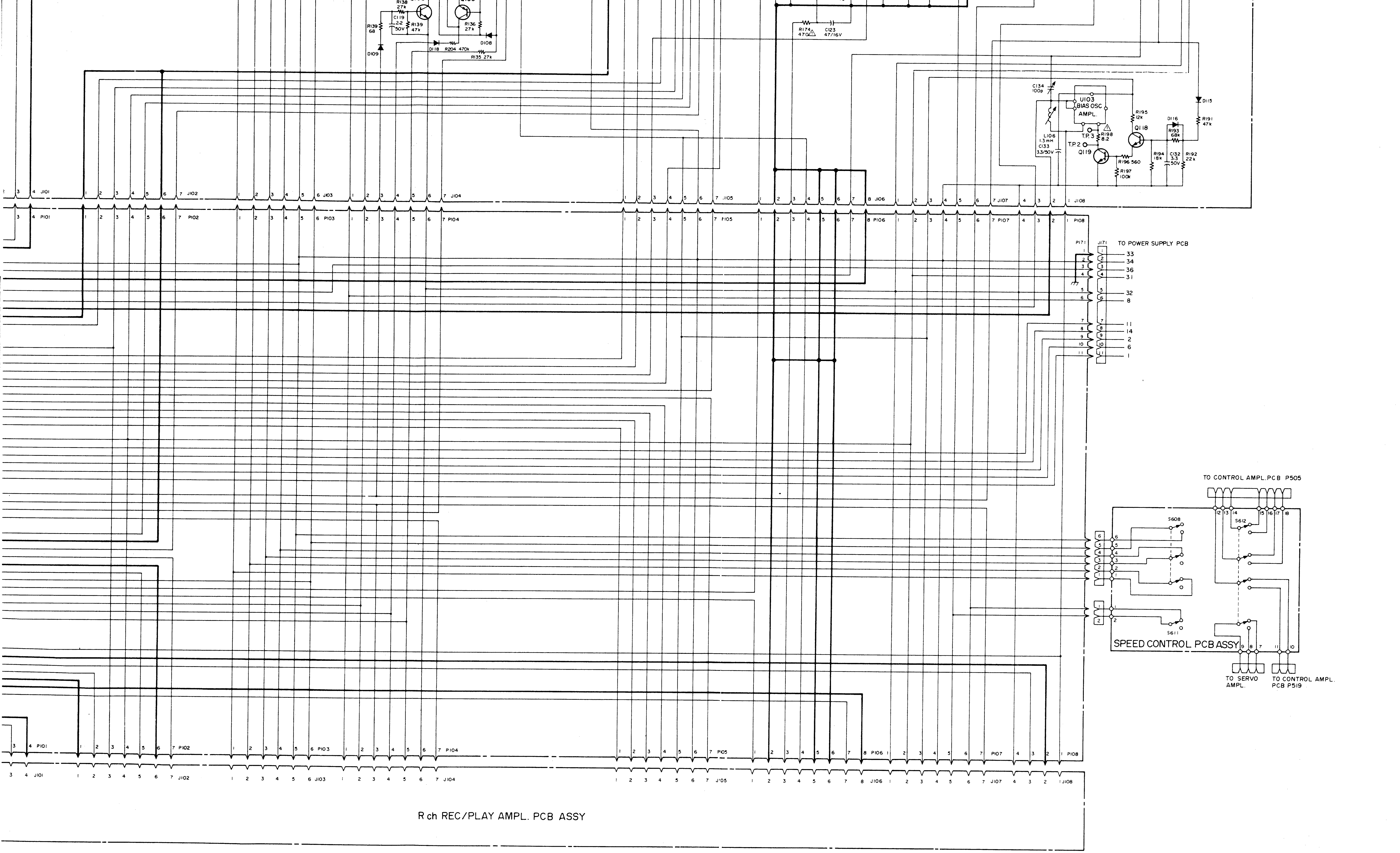





MOTHER PCB ASSY
25V
L ch
R ch
REPRO HEAD
SYNC HEAD
ERASE HEAD
TO IN/OUT PCB
J312 P312
J313 P313
J311 P311
J101 P101
J102 P102
J103 P103
J355 P355
J357 P357
J359 P359
J353 P353
J354 P354
J360 P360
J358 P358
J356 P356
P301 J301
P302 J302
P303 J303
P304 J304
P305 J305
P306 J306
P307 J307
P308 J308
P309 J309
P310 J310

C/PLAY AMPL. PCB ASSY




U103 BIAS OSC AMPL.
TO POWER SUPPLY PCB
TO CONTROL AMPL. PCB P505
SPEED CONTROL PCB ASSY
TO SERVO AMPL.
TO CONTROL AMPL. PCB P519
R ch REC/PLAY AMPL. PCB ASSY

TASCAM 32 TAPE TRANSPORT SCHEMATIC DIAGRAM

TEAC Production Products

CONTROL PCB

Q501~Q509	2SC1684S
Q510	2SA733P
Q511	2SC1684S
Q513~Q523	2SC1684S
Q524	2SC945AK
Q525	2SA733P
Q526	2SC1684S
Q528	2SC1684S
Q529	2SC945AK
Q530	2SA733P
Q531, Q532	2SC1684S
Q533	2SC945AK
Q534	2SA733P
Q535	2SC945AK
Q536	2SA720Q
Q537	2SD313E
Q538	2SC1684S
Q539	2SD794Q
Q540	2SC1684S
Q541	2SC1684S
Q542	2SD794Q
Q543	2SC945AK
Q544	2SA733P
Q545	2SC945AK
Q546	2SA733P
Q547	2SC945AK
Q548	2SC1318S
Q549	2SD313E
Q550	2SC945AK
Q551	2SA733P
Q552	2SC1318S
Q553	2SB507E
Q554	2SC945AK
Q555	2SA733P
Q556	2SC1318S
Q557	2SD313E
Q558	2SC1318S
Q559	2SD313E
Q560	2SC1318S
Q561	2SD313E
D501~D512	IS2473HJ
D513, D514	ISR35-200H
D515~D518	IS2473HJ
D519	S3V-20H
D520	ISR35-200H
D521~D523	IS2473HJ
D524	S3V-20H
D525	ISR35-200H
D526~D531	IS2473HJ
D532~D535	ISR35-200H
D536~D539	IS2473HJ
U501~U504	SN7400N
U506~U514	SN7400N
U505	SN7474N
U515~U517	µPC393
U519	M54410P

FUSES

U.S.A, CANADA, GENERAL EXPORT

F501~F504	2A 250V
F505, F506	7A 125 V
F507, F508	1A 250V

POWER SUPPLY PCB

Q801	2SC1645
Q802	2SC1318S
Q803	2SD313E
Q804	2SC945AK
Q806, Q807	2SC945AK
Q808	2SD313E
Q809, Q810	2SA733P
Q811	2SB507E
Q812, Q813	2SC945AK
D801~D804	ISR35-200H
D805	ISR35-200H
D806	IS2473HJ
D807~D810	ISR35-200H
D811	WZ-061
D812~D815	ISR35-200H
D816	WZ-061
D817	IS2473HJ
D818	D4BB
D819~D822	ISR35-200H
D823	WZ-240
D824	WZ-140
D825	ISR35-200H
U801	7805H
Q851	2SD313E
Q852	2SC945AK
Q853	2SA720Q
D851	WZ-061

PUNCH IN/OUT PCB

Q901, Q902	2SC1684S

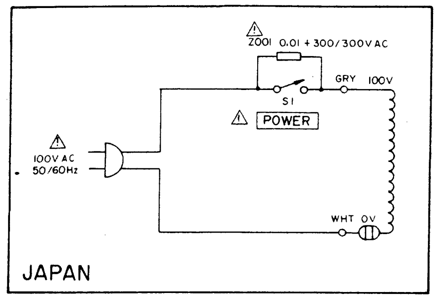
SENSER/SHUT OFF PCB

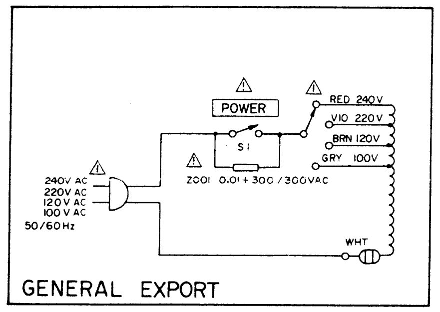
PH501	SM3B
PH502, PH503	SJ3W

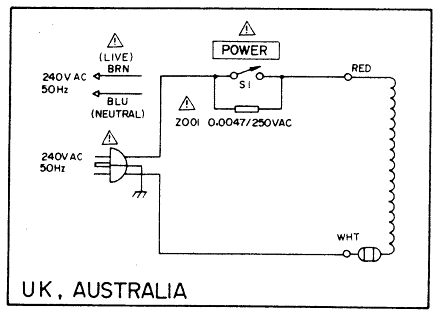
FUSES

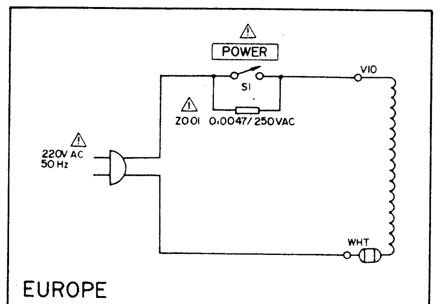
EUROPE, UK, AUSTRALIA

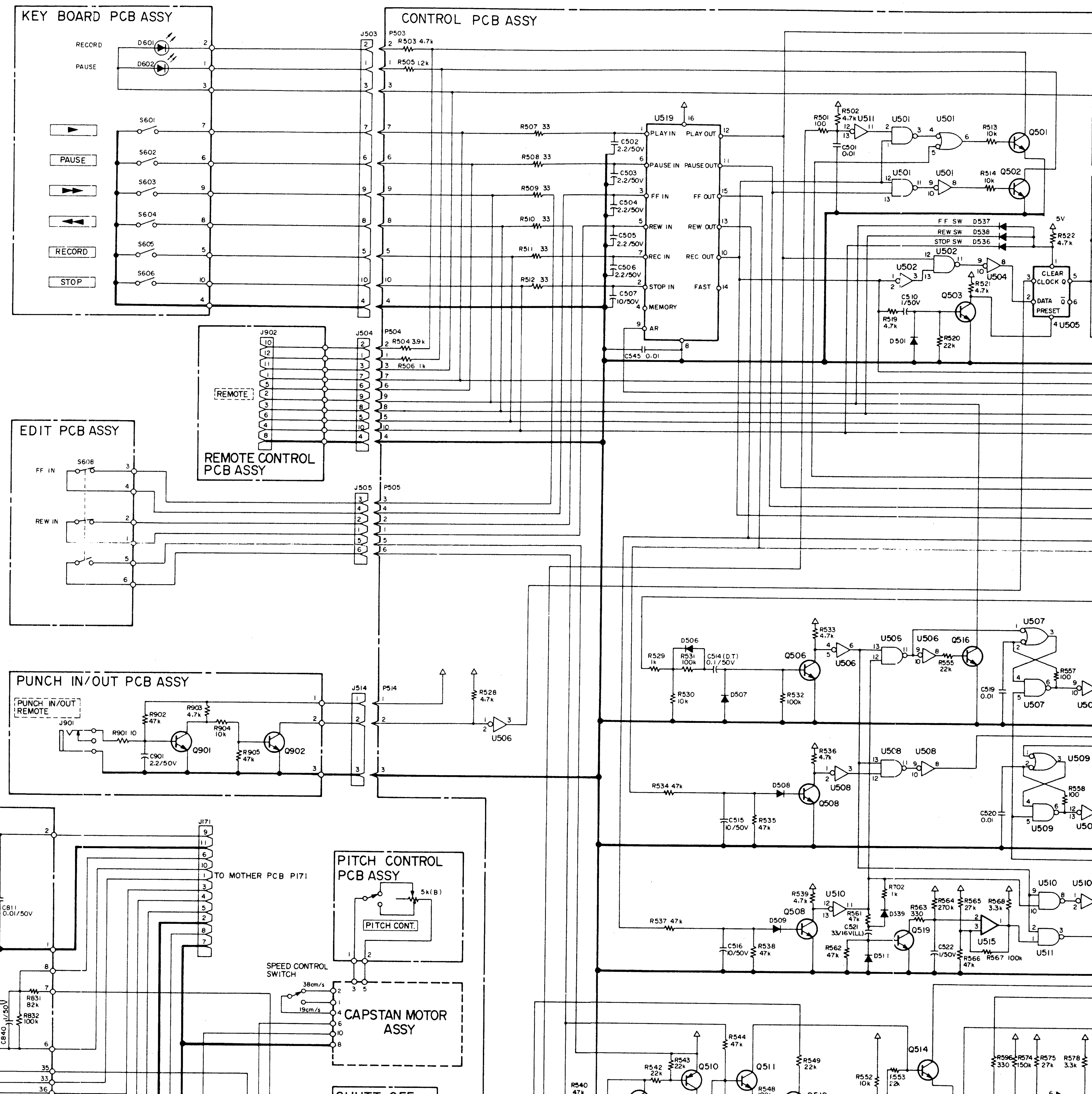
F501~F504	T2A 250V
F505, F506	T5A 250V
F507, F508	T1A 250V

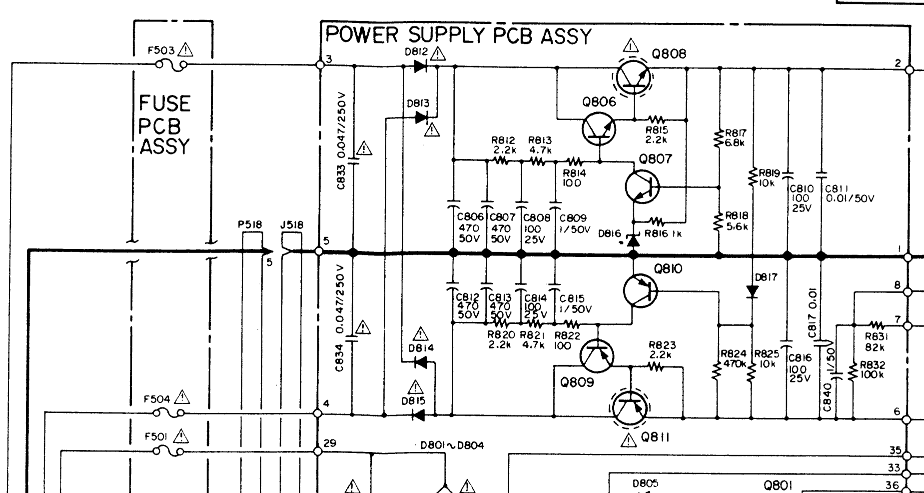


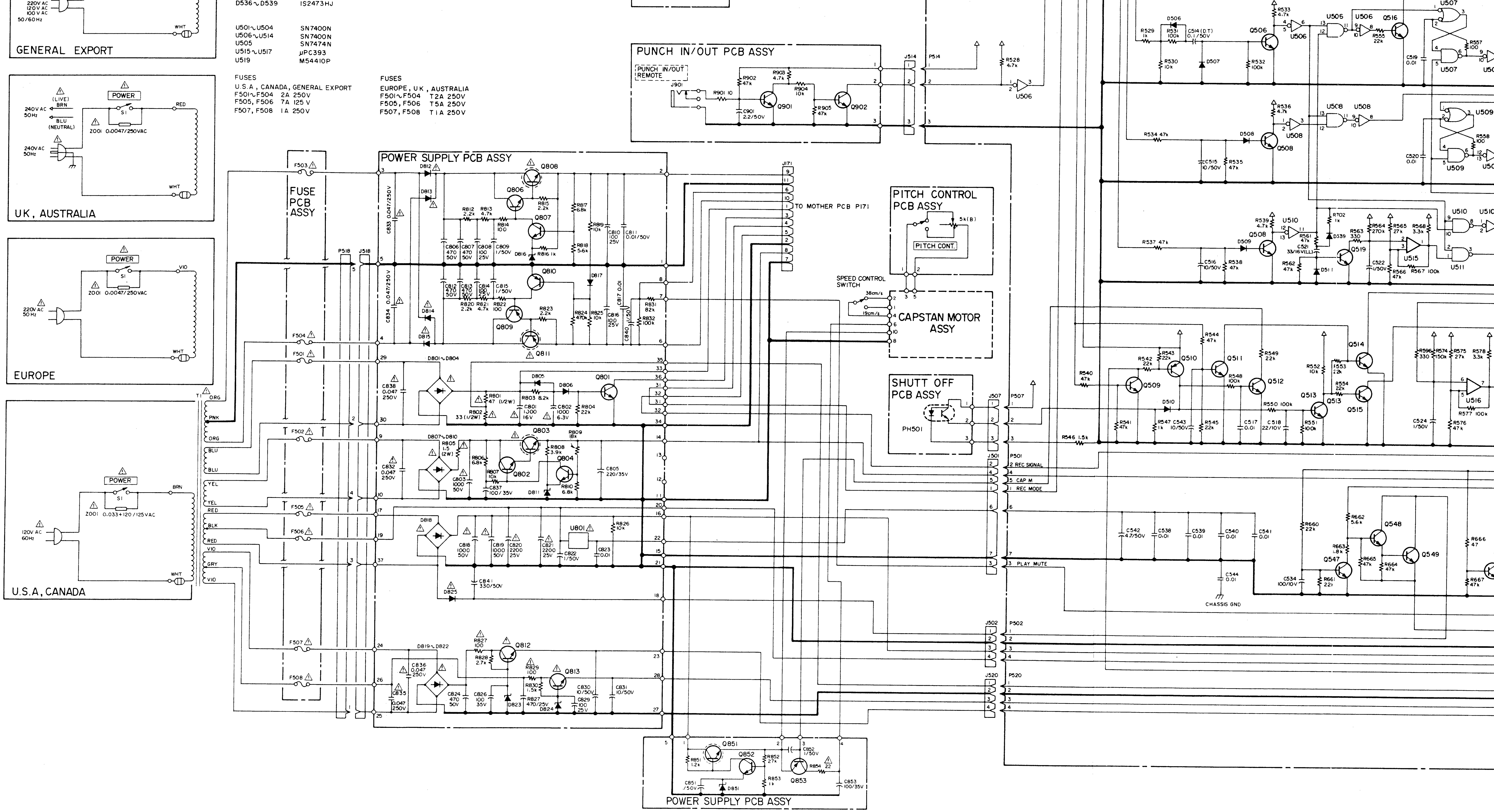


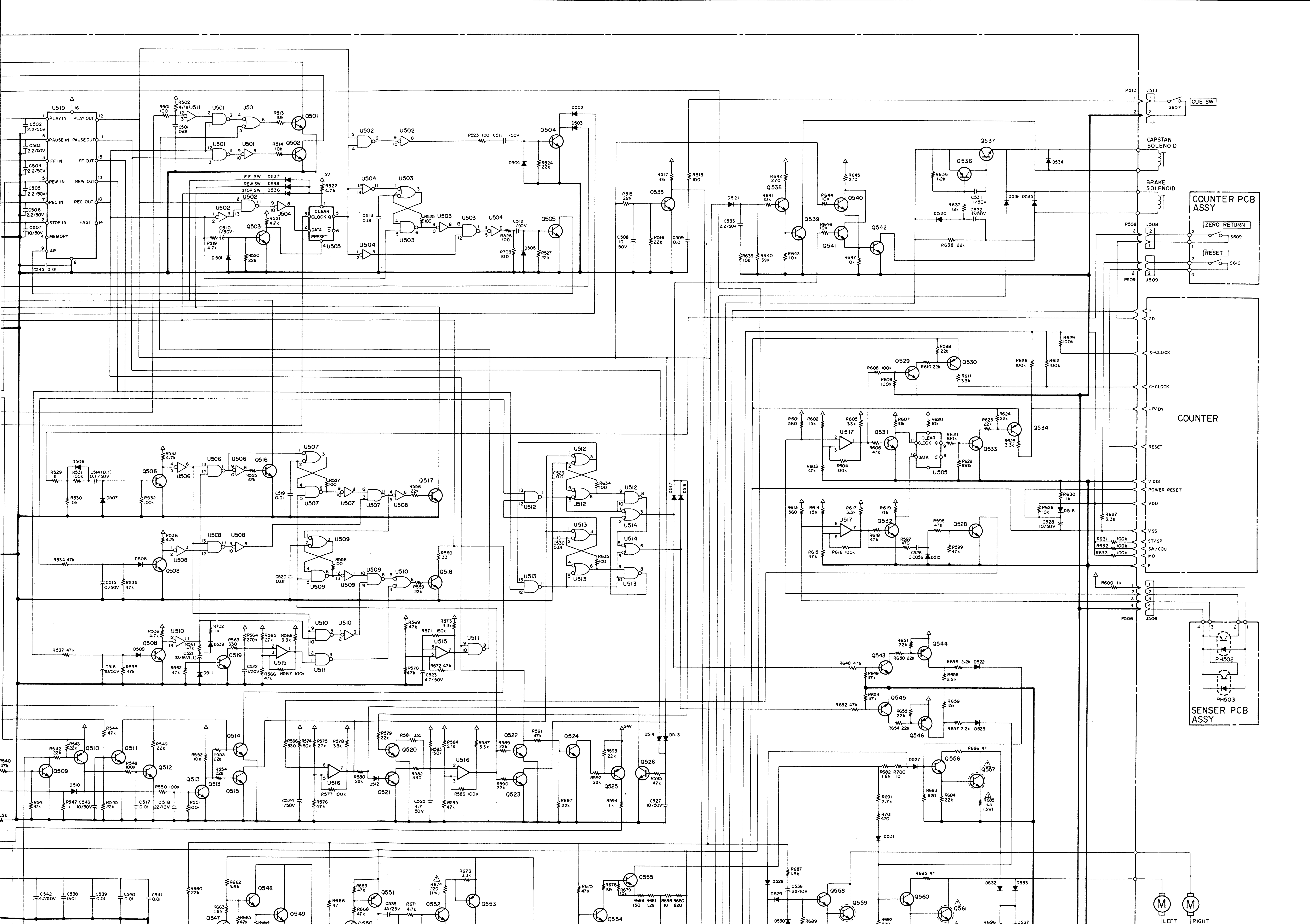




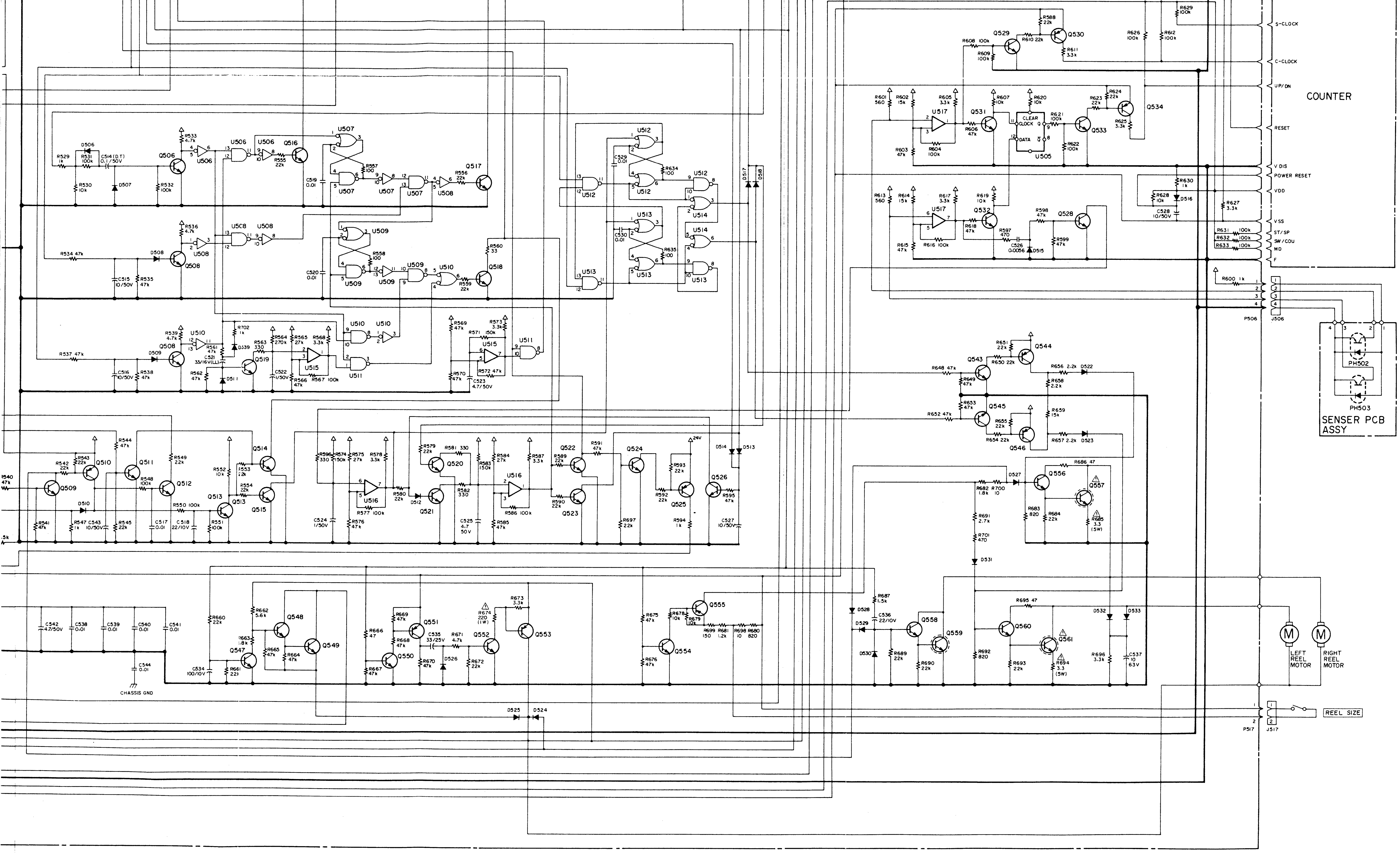





D536~D539 IS2473HJ
U501~U504 SN7400N
U506~U514 SN7400N
U505 SN7474N
U515~U517 μPC393
U519 M54410P
FUSES
U.S.A., CANADA, GENERAL EXPORT
F501~F504 2A 250V
F505, F506 7A 125V
F507, F508 1A 250V
FUSES
EUROPE, UK, AUSTRALIA
F501~F504 T2A 250V
F505, F506 T5A 250V
F507, F508 T1A 250V
GENERAL EXPORT
UK, AUSTRALIA
EUROPE
U.S.A., CANADA
POWER
PUNCH IN/OUT PCB ASSY
POWER SUPPLY PCB ASSY
FUSE PCB ASSY
TO MOTHER PCB P171
PITCH CONTROL PCB ASSY
PITCH CONT.
SPEED CONTROL SWITCH
CAPSTAN MOTOR ASSY
SHUTT OFF PCB ASSY
REC SIGNAL
CAP M
REC MODE
PLAY MUTE
CHASSIS GND
POWER SUPPLY PCB ASSY



CUE SW.
S607
P513
J513
CAPSTAN SOLENOID
BRAKE SOLENOID
COUNTER PCB ASSY
ZERO RETURN
S609
RESET
S610
P508
J508
P509
J509
COUNTER
S-CLOCK
C-CLOCK
UP/DN
RESET
V DIS
POWER RESET
VDD
VSS
ST/SP
SW/COU
MD
P506
J506
PH502
PH503
SENSER PCB ASSY
U519
PLAY IN
PLAY OUT
PAUSE IN
PAUSE OUT
FF IN
FF OUT
REW IN
REW OUT
REC IN
REC OUT
STOP IN
FAST
MEMORY
AR
FF SW
REW SW
STOP SW
CLEAR
CLOCK
DATA
PRESET
U505
LEFT
RIGHT



COUNTER
S-CLOCK
C-CLOCK
UP/DN
RESET
V DIS
POWER RESET
VDD
VSS
ST/SP
SW/COU
MD
F
P506
J506
SENSER PCB ASSY
PH502
PH503
LEFT REEL MOTOR
RIGHT REEL MOTOR
REEL SIZE
P517
J517
CHASSIS GND

REMOTE PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200073700	PCB Assy
	5210073700	PCB
J902	5334010100	Connector Socket, 12P
	5554099100	Bracket, Connector

SENSOR PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200073900	PCB Assy
	5210073900	PCB
PH502, PH503	5228007500	Photo Interrupter, SJ3W
	5800299300	Bracket, Photo Interrupter

SHUT OFF PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200073800	PCB Assy
	5210073800	PCB
PH501	5228007400	Photo Interrupter, SM3B

COUNTER PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200074000	PCB Assy, Counter
	5210074000	PCB
S609	5300025700	Push SW, 2-2
S610	5300028100	Push SW, 2-2 Non lock

PITCH CONTROL PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5168938000	PCB Assy, Pitch Control
	5167938000	PCB
	5150239000	Variable Resistor, Semi-fixed; 5kΩ(B)

INPUT LED PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200078300	PCB Assy
	5210075700	PCB, Function
D282~D284	5225007900	Diode, GL-9PR2
D286~D288	5225007900	Diode, GL-9PR2

FUSE PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200078510	PCB Assy [U, C, GE]
	5200078520	PCB Assy [E, UK, A]
	5210078500	PCB [U, C, GE]
	5210076400	PCB [E, UK, A]
	FUSES	
F501~F504	⚠5307004100	2A 250V [U, C, GE]
F505, F506	⚠5307004700	7A 125V [U, C, GE]
F507, F508	⚠5307003600	1A 250V [U, C, GE]
F501~F504	⚠5142189000	T2A 250V [E, UK, A]
F505, F506	⚠5142193000	T5A 250V [E, UK, A]
F507, F508	⚠5041140000	T1A 250V [E, UK, A]
	MISCELLANEOUS	
	5041237000	Fuse Holder [U, C, GE]
	5332014200	Fuse Holder [E, UK, A]

FUNCTION LED PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200078400	PCB Assy
	5210078400	PCB
D271~D275	5225007900	Diode, LED GL-9PR2

IN/OUT PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200078100	PCB Assy
	5210078100	PCB
R321, R421	5183122000	47kΩ
R322, R422	5183124000	56kΩ
C381	5054204000	Ceramic Capacitor 0.01μF 50V ±10%
P311	5122128000	Connector Plug 4P(WHT)
P312	5122127000	Connector Plug 3P(WHT)
	5126038000	Terminal, In/Out

OPERATION PCB ASSY (PC Board Omitted)

REF. NO.	PARTS NO.	DESCRIPTION
	5200073600	PCB Assy
	5210073600	PCB
S601~S606	5138011000	Takt Switch, AKC-8C
D601	5225007900	Diode, LED GL-9PR2 (RED)
D602	5225007100	Diode, LED GL-9NG2 (GRN)