# TASCAM
## TEAC Production Products

# 38

## 8-Track Recorder/Reproducer


## OPERATION/MAINTENANCE

5700027000

The guarantee of performance that we provide for the 38 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 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 38 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.

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*dbx Noise Reduction Unit DX-4D and Recording Mixer M-30 are optional.

> **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 booklet, refer to it when necessary, and good luck with your 38.

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

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

This tape deck 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______________________________

)027000

## Introduction to the 38 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.

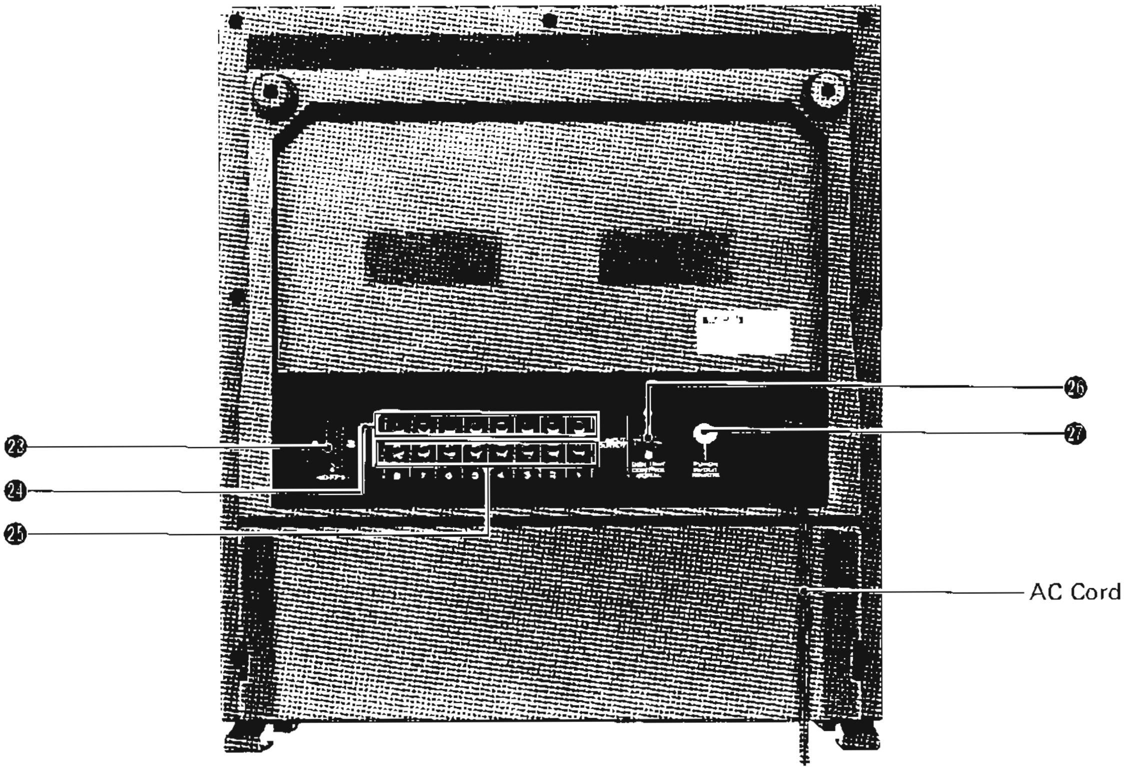
Because of what we have learned about multichannel recording systems in the past 10 years, TASCAM decided to concentrate on improving functions in the 38 that are strictly the province of the tape recorder and to remove features that we felt were best placed elsewhere in the system. The cost saved by eliminating features that are usually duplicated by our mixers, such as headphone amps and microphone inputs has been used to improve the overall quality of the recorder. The result, a better and more flexible recorder/reproducer for the system of multitrack recording. This logical growth now reflects the needs of the studio style or, if you will, the professional recordist.

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 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 38, 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.




CAUTION:
**Never try to activate the EDIT switch while the tape is being fast forwarded or rewounded or the sudden stoppage may cause the tape to snap. Another thing to remember is that the EDIT switch is to be in the ( □ OFF) position before attempting to reproduce.**

**⑩ PITCH CONTROL PULL ON Control**
Permits a ±12 % variation of the tape speed in the recording or reproducing modes.
Pull out and turn to the left (−) to decrease the speed of the tape transport; turn to the right (+) to increase the transport speed.
Push in to disengage.
NOTE:
**Be sure to keep this control pushed in for normal record/reproduce operations.**

**⑪ CUE Lever**
This control will defeat the fast motion tape lifters. The more pressure you apply, the closer the tape will come to the heads. This will allow the reproduce signal to be heard in fast motion for cueing. Use only enough pressure to hear the signal. Too much signal will damage the electronics, and if your monitor system is turned up, high frequency playback signal will damage your loudspeakers so be sure the cue lever is not engaged (locked) when in fast motion. The latch position is provided only for hand winding the tape to find an edit point. Push the lever all the way up a second time to release.
CAUTION:
**Use of the cue lever in fast forward or rewind will greatly accelerate head wear.**

**⑫ FUNCTION SELECT LED Indicators**
Off — Record mode cancelled.
Lit — Record/Reproduce Standby

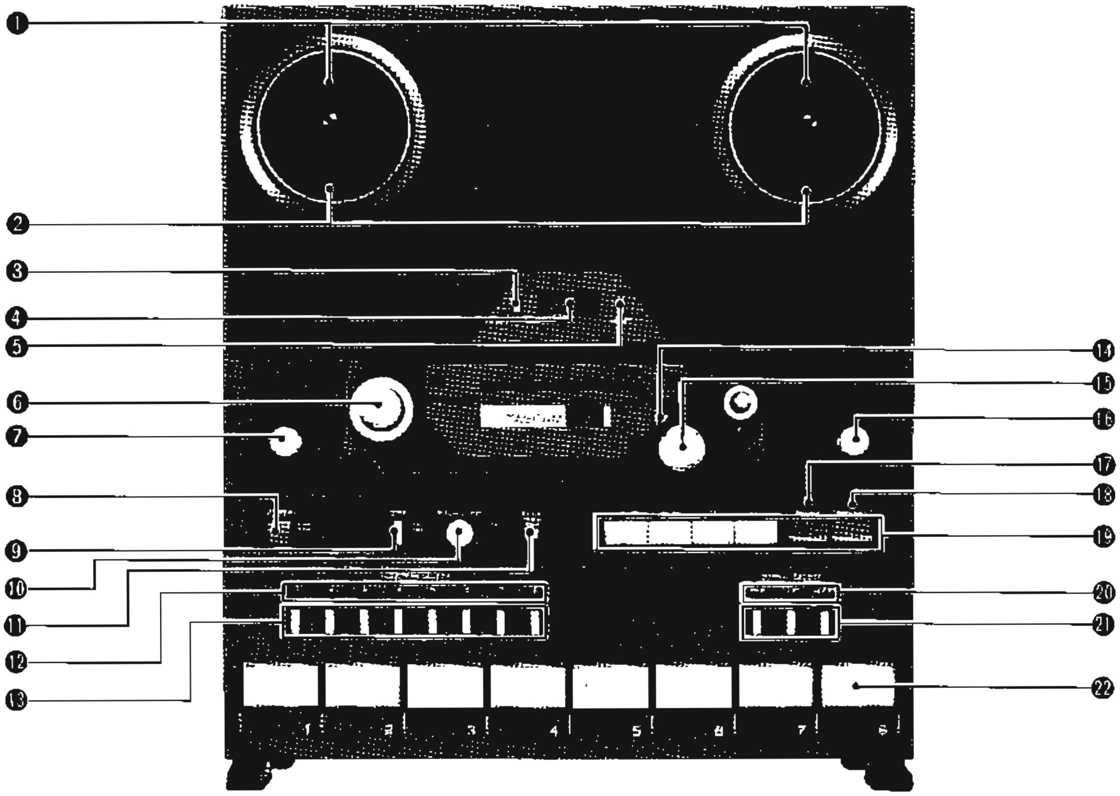
**⑬ FUNCTION SELECT Buttons**
Determine the record/reproduce status of the corresponding channels.
Up — Safe, reproduce or source determined by OUTPUT SELECT buttons.
Down — Ready to record. If "Record" has been selected through the transport controls, depressing this button will begin recording immediately. Output of recorder switches to source.

**⑭ Capstan Shaft**

**⑮ Pinch Roller**

**⑯ Shut Off Arm**
The shut off arm will drop power to the transport if the tape breaks. It's 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

# FEATURES AND CONTROLS




❶ **NAB Hub Adaptors**
Permanently mounted. Use 10-1/2" reel only. Rotate adaptor ring CW to fully tighten.

❷ **Reel Tables**
1/2" tapes are to be used. We recommend to always use the same size and kind of reels.

❸ **ZERO RETURN Button**
When depressed, counter 0000 may be considered a one position "autolocator" allowing rewind ( ◀◀ ) to find one spot (0000) on the tape without the use of the cue lever. You won't need an audible cue to find this location, and accidents to the tape or damage to the monitor system tweeters will be avoided.
This auto stop function is only possible in rewind ( ◀◀ ) and if you are using ( ▶▶ ) fast forward, the transport will not stop at 0000.

1. If the rewind time is short, the transport will stop at 999, not precisely on the "mark", but very close.
2. If the rewind time is long (half a reel of tape), the transport will cycle between ( ◀◀ ) and ( ▶▶ ) several times and finally come to rest at counter 999.

Tape slippage will lower the accuracy of the "stop" point, so, always check by listening before re-recording. You may not be exactly "on-cue". Take care.

CAUTION:
**Once the ZERO RETURN operations are completed, make sure to reset this button to ( ◻ OFF).**

❹ **Digital Counter** A 4-digit counter.

❺ **RESET Button**
Press this button to obtain "0000" to determine the record start or ZERO RETURN positions.

❻ **Tape Guide Roller**

❼ **Tension Arm**

❽ **POWER Switch**
When depressed ( ▭ ON), the digital counter and VU meters light. Press again ( ◻ OFF) to discontinue power to the deck.

❾ **EDIT Switch**
Depressed when editing becomes necessary.
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. When the tape is found in this condition (loose from the supply reel), recording, fast forwarding and rewinding becomes impossible. Leave this switch in the ( ◻ OFF) position except when editing.



**CAUT**
**Neve**
**tape**
**the**
**snap.**
**EDIT**
**befor**

❿ **PIT**
Permit
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speed
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**NOTE.**
**Be su**
**normal**

⓫ **CUE**
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life of the capstan motor bearings. It is not necessary to unthread the tape. Just allow it to become slack so that shut off arm can drop.

**⑰ PAUSE Status Indicator**
The green LED lights only when PAUSE and RECORD have been simultaneously pressed.

**⑱ RECORD Status Indicator**
The red LED lights up when the deck has been set into the record mode and begins blinking if the FUNCTION SELECT buttons are not depressed.

**Master Record Status LED**
Shows record state.
Off – Safe
Blinking – Record ready
On – Recording in progress (or RECORD/PAUSE)

**⑲ Transport Controls**
These buttons control the tape transport. The use of the RC-71 Remote Control Unit (when connected to the REMOTE connector on the rear panel) does not affect the functions of the front panel controls.

**( ▸ ) Play Button**
The tapes moves at a consistent speed of 15 ips (38 cm/sec). A motion sensing facility is adapted in this deck so that when the button is pressed, it will go into the reproduce mode even from fast forward or fast rewind after an instantaneous pause.

**STOP Button**

**( ▸▸ ) Fast Forward Button**

**( ◂◂ ) Rewind Button**

**RECORD Button**
After pressing the desired FUNCTION SELECT buttons corresponding to the tracks to be recorded on, simultaneously pressing RECORD and ( ▸ ) initiates recording of the selected tracks. The FUNCTION SELECT LED indicators of the selected tracks will light; the red (RECORD) LED will light, or if the FUNCTION SELECT button has not been pressed, it will begin blinking.

**CAUTION:**
**Be careful because pressing the FUNCTION SELECT buttons causes the selected tracks to go into the record mode.**

**PAUSE Button**
Pressing this button temporarily discontinues the record/reproduce functions. Press PAUSE and RECORD to obtain record-standby, in which case a green LED will light.

**⑳ OUTPUT SELECT LED Indicators**
Indicates which OUTPUT SELECT buttons have been activated.
INPUT LED : Red
SYNC LED : Yellow
REPRO LED : Green

**㉑ 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 playback. Meter reads input or head #2 play output depending on setting of FUNCTION SELECT buttons.

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

**㉒ VU Meters**
Depending on the FUNCTION SELECT and the OUTPUT SELECT button settings, these meters show the record input signal, the sync reproduce output signal or the reproduce output signal level while recording. 0 VU = –10 dB (0.3 V)

## BACK PANEL

**㉓ REMOTE Connector**
Allows connection of the optional RC-71 Remote Control Unit.

**㉔ Input Jacks**
Input level is –10 dB (0.3 V). Input impedance is 50K ohms (unbalanced).

**㉕ Output Jacks**
Output level is –10 dB (0.3 V). Minimum load impedance is 10K ohms (unbalanced).

**㉖ DBX UNIT CONTROL SIGNAL Connector**
This allows connection of the optional DX-4D Noise Reduction Unit and supplies control signal to the dbx unit to permit simultaneous NR Recording/Reproducing.

**㉗ PUNCH IN/OUT REMOTE Connector (RC-30P)**
Allows connection of the optional RC-30P TASCAM PUNCH IN/OUT REMOTE PEDAL.

# ENTERING "RECORD"

**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 for those situations where it is desirable to monitor the printed signal on the tape for reference during the recording.

**SYNC** will be used for most operations: recording, overdubbing (sync), and reproduce. The monitoring status is then determined by the FUNCTION SELECT buttons.

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

**There are 3 ways to enter record:**

1. With the OUTPUT SELECT in the SYNC position, depress the FUNCTION SELECT buttons for those tracks on which you wish to record. The LEDs will indicate ready-to-record on those particular tracks. Enter record with the TRANSPORT CONTROLS – depress RECORD (red LED lights) and PAUSE (green LED lights) together. Then push ( ▶ ) and the selected FUNCTION SELECT LEDs will remain lit until released.

2. To facilitate punch-ins, the logic can be reversed by first setting the FUNCTION SELECT button in the UP position and entering record with the RECORD and ( ▶ ) buttons. Now the record LED will blink, indicating ready-to-record, and you are monitoring sync/tape reproduce. At the appropriate time, depress the FUNCTION SELECT button(s) for the tracks you wish to punch-in, and you enter record while simultaneously switching the monitor to source. The record status indicator will now stay on instead of blinking.
Now, imagine two different occasions where it is desirable to punch-in a correction on a given track, instead of recording the entire part all over again.

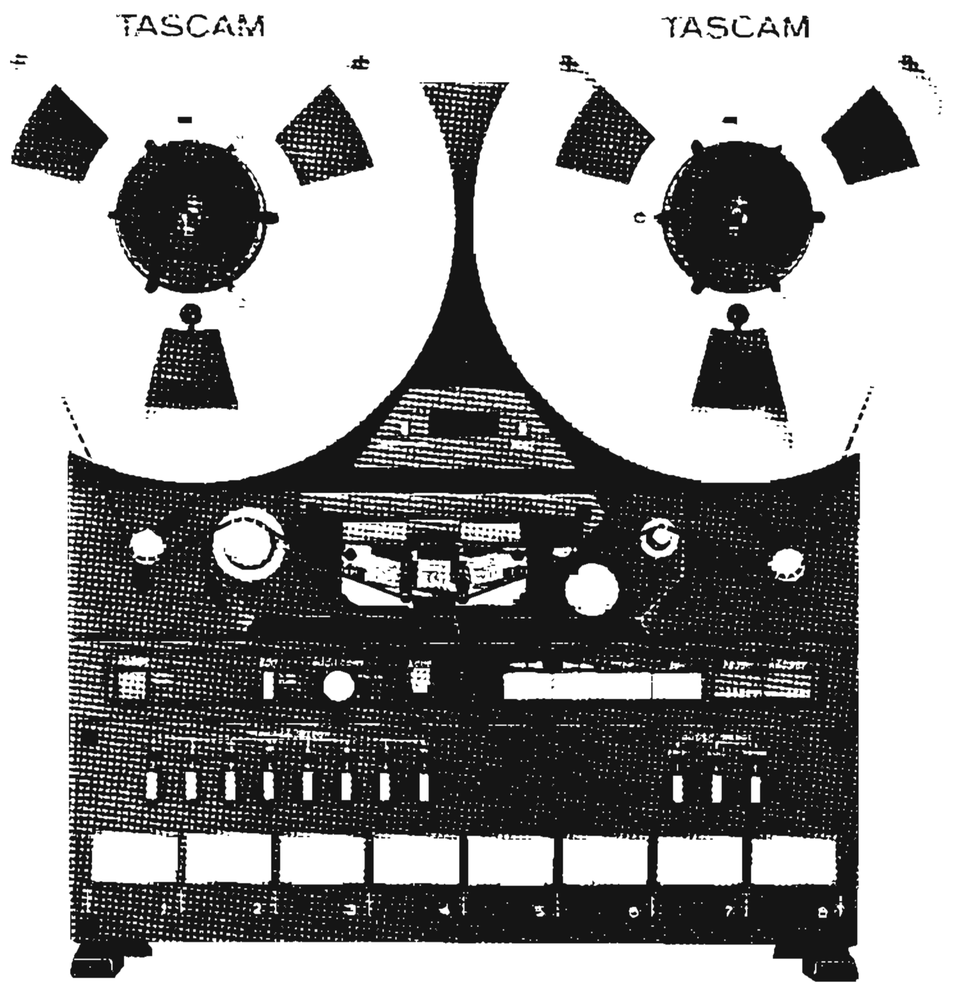
EXAMPLE 1:
If the correction needs to be made at the BEGINNING of the tune – say a hesitant start that is slightly out of sync with the downbeat – then there is no need to monitor reproduce (sync) since the bad start will only serve to confuse the musician. Indeed, that part of the track will be re-recorded.
So the punch-in is straightforward enough: enter the record mode on the appropriate track with the corresponding FUNCTION SELECT button. Press the record and ( ▶ ) button when the slate occurs – at the beginning of the tune – then enter stop at a convenient, appropriate time, after the punch-in is completed.

EXAMPLE 2:
In this situation, suppose an error has been made near the end of the tune – or in the middle – the example 1 is still valid. Now the musician will likely need to hear his performance up to that point so that the punch-in does not represent a different style or feel, and therefore, is consistent with the rest of the performance. In this case, enter record ready by pressing the record and play buttons simultaneously. The record mode will be activated when a FUNCTION SELECT button is depressed.
When the FUNCTION SELECT is in the UP position, the musician will be monitoring reproduce (sync) and probably play along with the previous performance until the time comes to punch-in the correction. When that moment occurs, simply press the appropriate FUNCTION SELECT button for the corresponding track that is ready to be recorded. Two things then happen. First, you instantly enter the record mode on that track, and the new part will replace the previous one, in sync of course. Second, the monitor is automatically switched from tape (UP position) – sync reproduce – to source (DOWN position) – so the musician can hear his new part as it is being added. The logic remains consistent.

**PUNCH IN/OUT Operation with the REMOTE PEDAL RC-30P:**

Connect the TASCAM PUNCH IN/OUT REMOTE PEDAL to the rear of the 38. Now, even with both of your hands occupied, PUNCH IN/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.

## THREADING THE TAPE




***Lift the head access cover and release the sync head shield to gain access for threading, maintenance purposes, etc.**

# 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 from 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 a 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" in honor of Alexander Graham Bell, the inventor of the telephone.

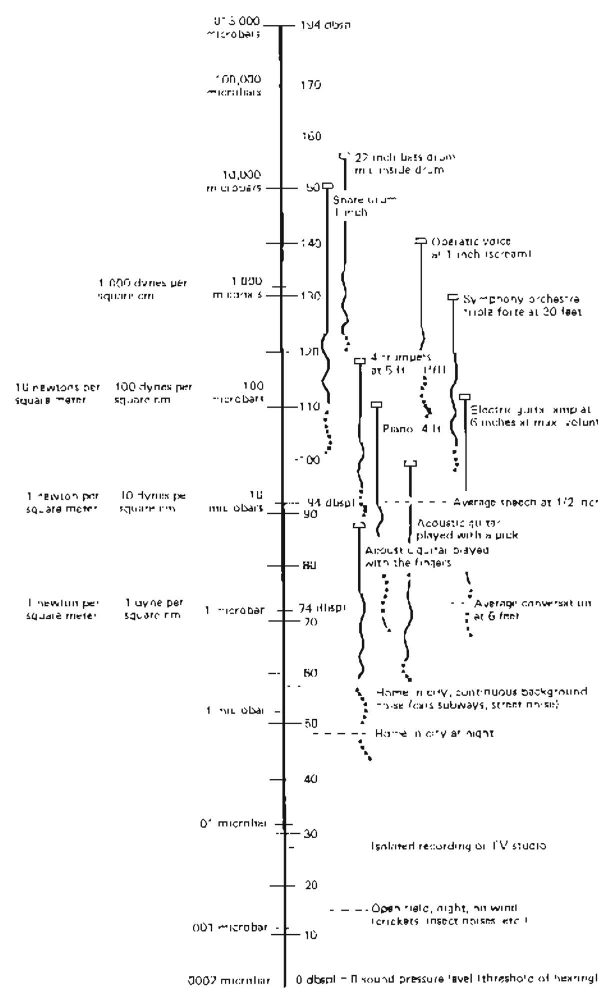
What is a bel and what does it stand for?

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 0.0002 microbar, so we say 0 dB = 0.0002 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 0.0002 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:

0.0002 microbar

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

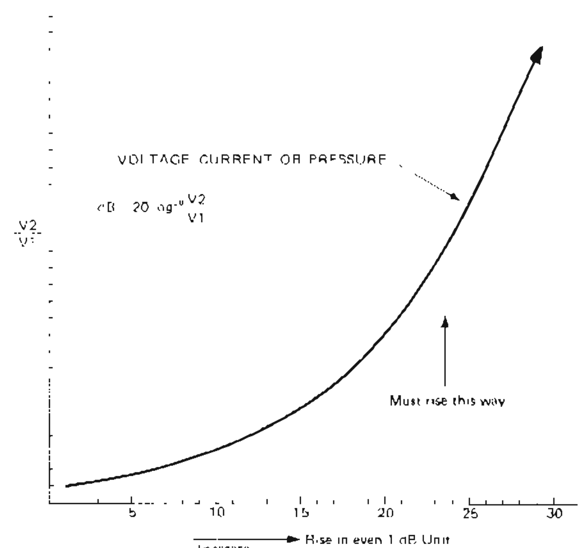
This breakdown of one reference is not given just to amaze you, or even to provide a feel for the quantity of power that moderate levels of sound represent. Rather, it is intended to explain the reason we are saddled with a ratio/logarithm measurement system for audio. Adding and subtracting multi-digit 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:

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

For voltage, current or pressure calculations:

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

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.

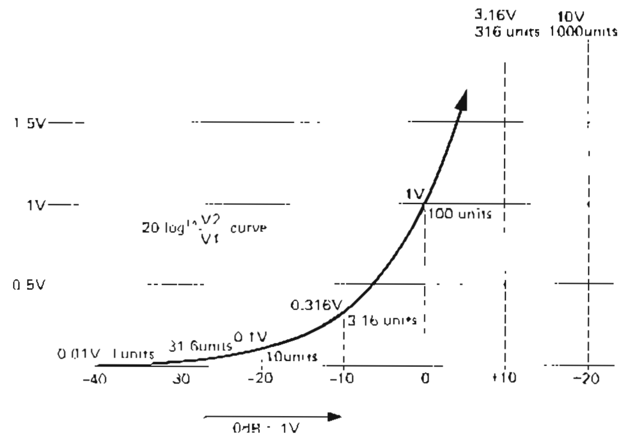
A 600-ohm, 3-wire transformer-isolated circuit is a necessity for the telephone company, but the primary reason it is used has nothing to do with audio quality. It is noise, hum and buzz rejection in really long line operation (hundreds and hundreds of miles).
Quality audio does not demand 600-ohm, 3-wire 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 is in need of the 600-ohm standard.
If your test gear 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 (G) 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 an unalloyed virtue. It means that the circuit will do its job with a minimum of electrical energy at a 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 values for outputs 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 straightforward and requires only one number. Here is the value for the 44.

LINE INPUT: 50k 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 safe load greater 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:

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

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 or – 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 9 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 of "0 VU" or your recorder.

We should also make a point of mentioning that the maximum number on the chart on page 9 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 work "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 <u>in</u> 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 (0.316 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".

## DAILY SETUP

It's obvious that an entire alignment 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 three 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, then 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, 4 k, 10 k. 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 three quick checks will usually uncover any serious troubles, 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 three 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, 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.

# 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 model sold in the U.S.A. and 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 56.
3. To increase the selected voltage, turn the slotted center post clockwise using a screwdriver 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.

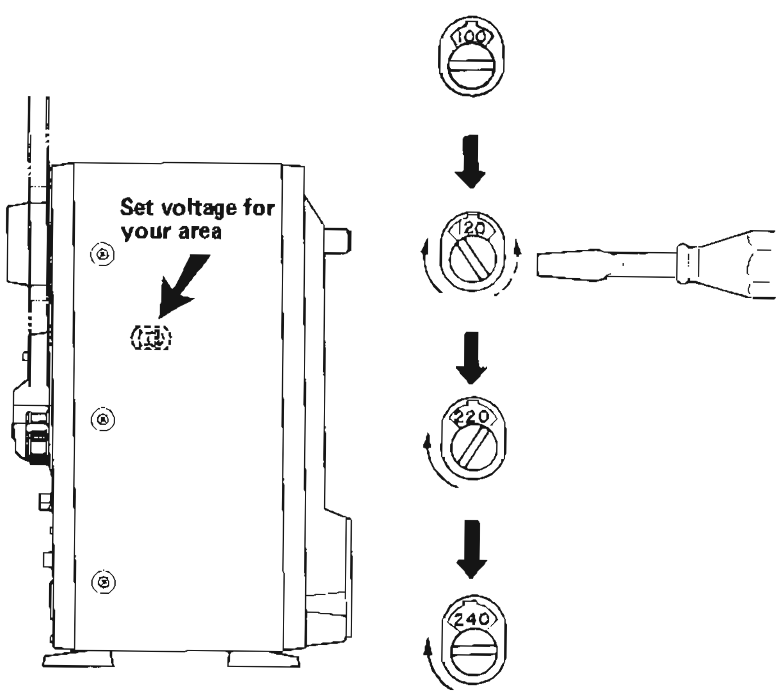
**IMPORTANT**

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

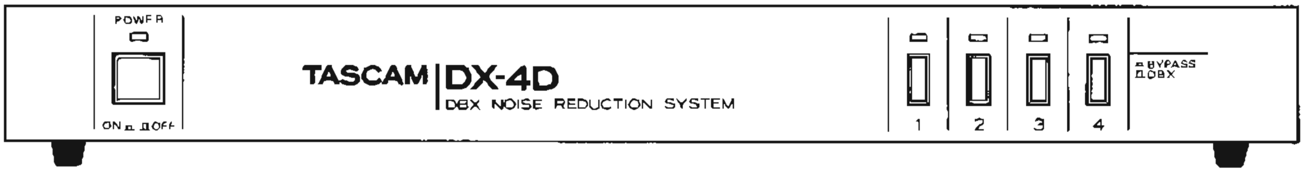
| | |
|---|---|
| **BLUE:** | **NEUTRAL** |
| **BROWN:** | **LIVE** |

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.

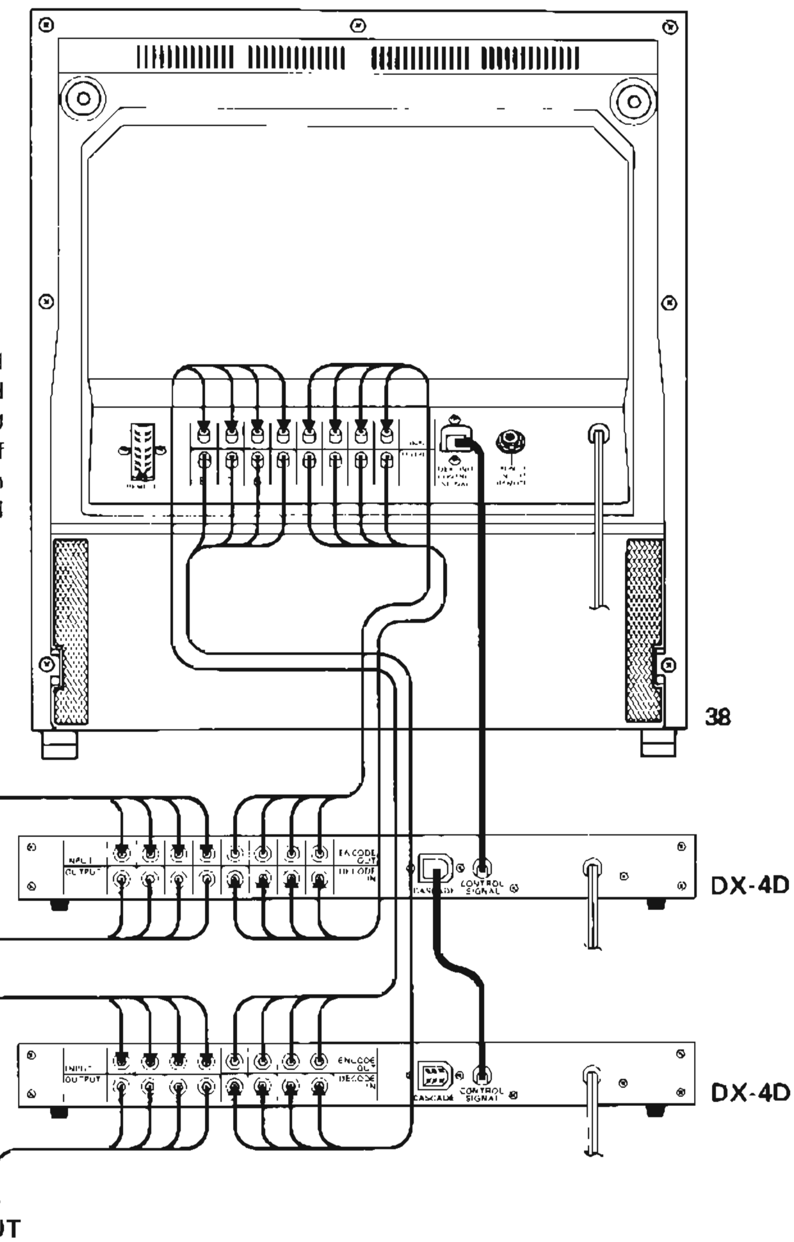


# CONNECTION AND OPERATION OF THE DX-4D




**Hook up**

Because the DX-4D is an optional 4-channel DBX UNIT, it is necessary to connect two of the DX-4D's to facilitate the 38's eight channel function. There is no specific order in which the two units are to be connected. But be consistent or you may become confused. Make sure that each track ENCODE/DECODE pair is connected to the same section, or your bypass switch functions will not work properly.




**Note:** When DX-4Ds are used together with the 38, encoded signal levels displayed on VU meters will be found to be of somewhat less value (through compression) than no-encoded signal levels.

**DBX Bypass Switch**

1. The DBX Noise Reduction system (both ENCODE/DECODE) is in operation while this switch is in the ( ◻ DBX) position. With this switch in the ( ▭ BYPASS) position, the DBX circuit is bypassed, which deactivates ENCODE/DECODE. The switches for each channel (1 – 4) 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-4D functions**

This DBX UNIT functions only when connected to the DBX UNIT CONTROL SIGNAL terminal of the 38.

Once the DX-4D has been connected, you may virtually ignore it. The unit is completely automatic. And, because of the design and nature of the DX-4D 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-4D, simultaneous dbx NR Coding/Decoding is possible without having to switch between ENCODE or DECODE.

**EXAMPLE 1.**

**Original Recording**

Suppose you are going to record, with OUTPUT SELECT in the SYNC position, depress FUNCTION SELECT buttons 1 thru 4. LED indicators will light, signaling ready-to-record on those tracks.

An encoded signal will be automatically reproduced when the 38 is started because of the DBX units ability to simultaneously code and decode while the DBX switch is in the ( ◻ DBX) position.

**EXAMPLE 2.**

**Overdubbing**

In this example, suppose you have recorded on tracks 1 thru 4, and now wish to record on tracks 5 thru 8, in sync.

Set up the OUTPUT and FUNCTION SELECT buttons the same manner as in Example 1. The DX-4D will automatically encode the signals going to tracks 5 thru 8, and decode the signals on tracks 1 thru 4.

The same process occurs when you punch-in during any recording session. When the 38 is in the record mode, the DX-4D is encoding; in reproduce (sync monitoring), it's decoding.

**HOW THE DX-4D WORKS**

The DX-4D 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-4D 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 sensers.

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 charge 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" foregiving.

One common mistake we find, is that people don't check the OUTPUT voltage of the mixer or other device feeding the DX-4D, and don't remember that the DX-4D is the first item in the system (38/DX-4D). "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-4D works. If your mixer "0" VU is not 0.3 volt, (the DX-4D "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 38 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-4D 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-4D in order to mix it with any other material – compressed or uncompressed. Of source, 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.

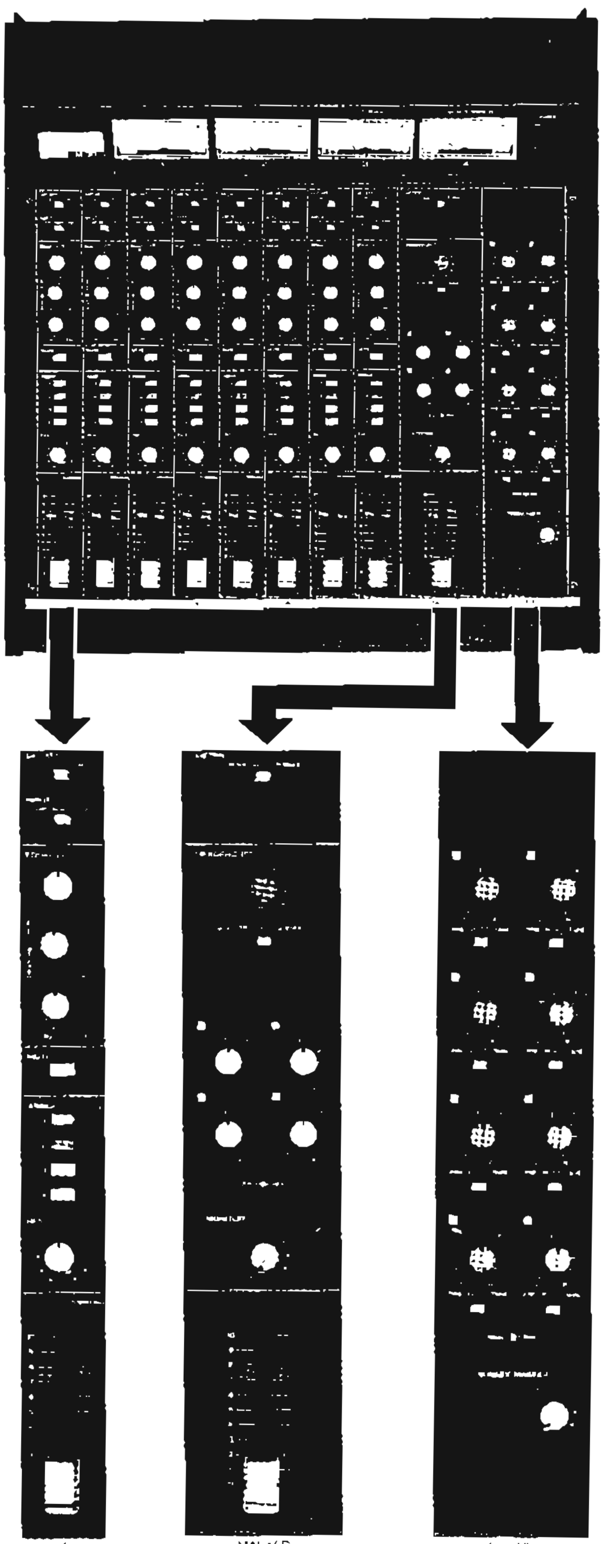
The little guys in the box will look at their "chart" and give you some really entertaining level shifts, as we have said, they're fast but dumb.

**Subsonics and Interference**

The DX-4D 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-4D – 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-4D and after the mic preamplifier for further attenuation of these subsonic frequencies.

# M-30 RECORDING MIXER

The 38 is designed to be used with a Recording Mixer and because of this reason, there are no input/output level controls on the deck; the commands of which are effectuated through a mixer. Thus, a Recording Mixer is a "must" for the 38



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 38.

## FEATURES OF THE M-30

### INPUT SECTION

- 8 mic inputs (6 low impedance balanced, and 2 high impedanced unbalanced mic input)
- 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
- 4 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 OF THE M-30

**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 levle: -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

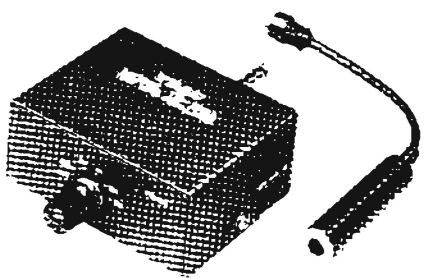
**Dimensions (WxHxD):** 465 x 160 x 520 mm (18-1/4" x 6-5/16" x 20-1/2")

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

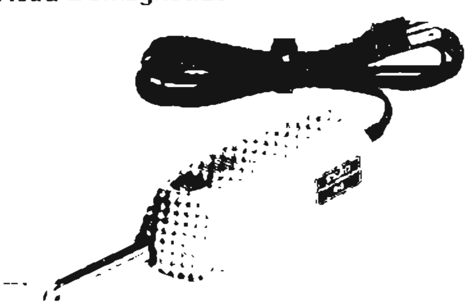
**Power Requirement** 100/120/220/240 V AC, 50/60 Hz, 26 W (General Export Model)
120 V AC, 60 Hz, 26 W (U.S.A./Canada Model)
220 V AC, 50 Hz, 26 W (Europe Model)
240 V AC, 50 Hz, 26 W (UK/AUS Model)

# ACCESSORY INFORMATION

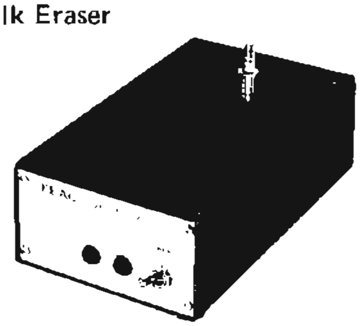
TO-122A Test Tone Oscillator
Checks input/output balance or other electric characteristics of the system chain. This unit is also useful for tape deck maintenance work.
*Output pin jack
*Output level -10 dB, -40 dB (0 dB/1 V)
*Selectable frequencies 40 Hz, 400 Hz,
1 kHz, 4 kHz, 10 kHz,
15 kHz



E-3 Head Demagnetizer

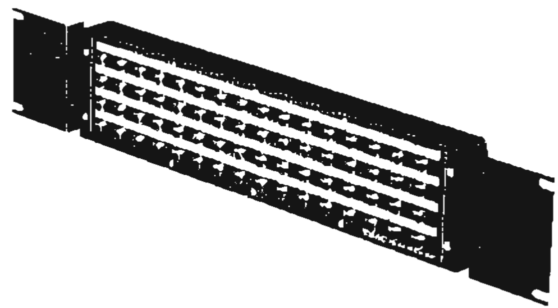


E-2A Bulk Eraser

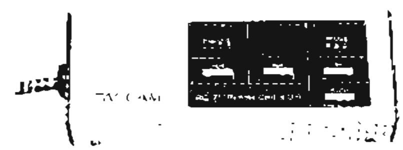


RE-1013 Reel (10-1/2", 1/2" tape)

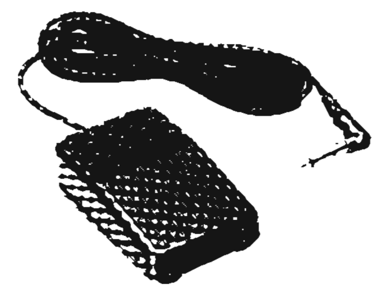

PB-64 Patch Bay
A tangle of cables is one of the growing vexations of any audio system. With all of the inputs and outputs plugged into the rear panel, jumper cables plugged into the front make any hookup you need neatly.



RC-71 Remote Control Unit



RC-30P Punch In/Out Remote Pedal



RC-1 Rubber Cleaner/HC-1 Head Cleaner

## Professional Low Loss Cable

| | | |
|---|---|---|
| WR-03S | Single | 30 cm |
| WR-1 | Dual | 100 cm |
| WR4C-05 | Quadruple | 50 cm |
| WR4C-15 | Quadruple | 150 cm |
| WR4C-25 | Quadruple | 250 cm |
| WR-5 | Dual | 5 m |
| WR-7S | Single | 7 m |

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.

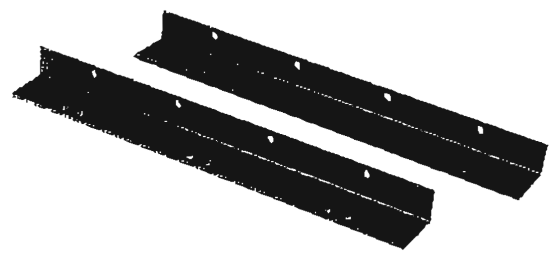
Low capacitance is important, and so is consistent capacitance; that is, you want the electrical coupling of center conductor-to-shield to remain the same throughout the cable, even if it is sharply bent, crushed, flexed, or tugged. Should the local cable capacitance change, noise and/or signal losses 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.

**Note:** If these TASCAM professional audio cables are not obtainable in your area, use an equivalent cable.

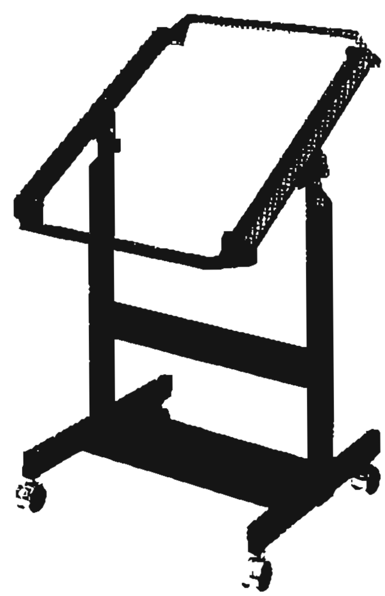
## RM-300 Rack Mount Kit

The RM-300 is a rack mounting kit for the TASCAM recorder/reproducer 38 to enable mounting in the CS-607 or a standard 19-inch rack.



## CS-607 Console Rack

The CS-607 is a standard 19-inch console rack to be used with the RM-300 for mounting of the TASCAM 38.



# SPECIFICATIONS OF THE 38

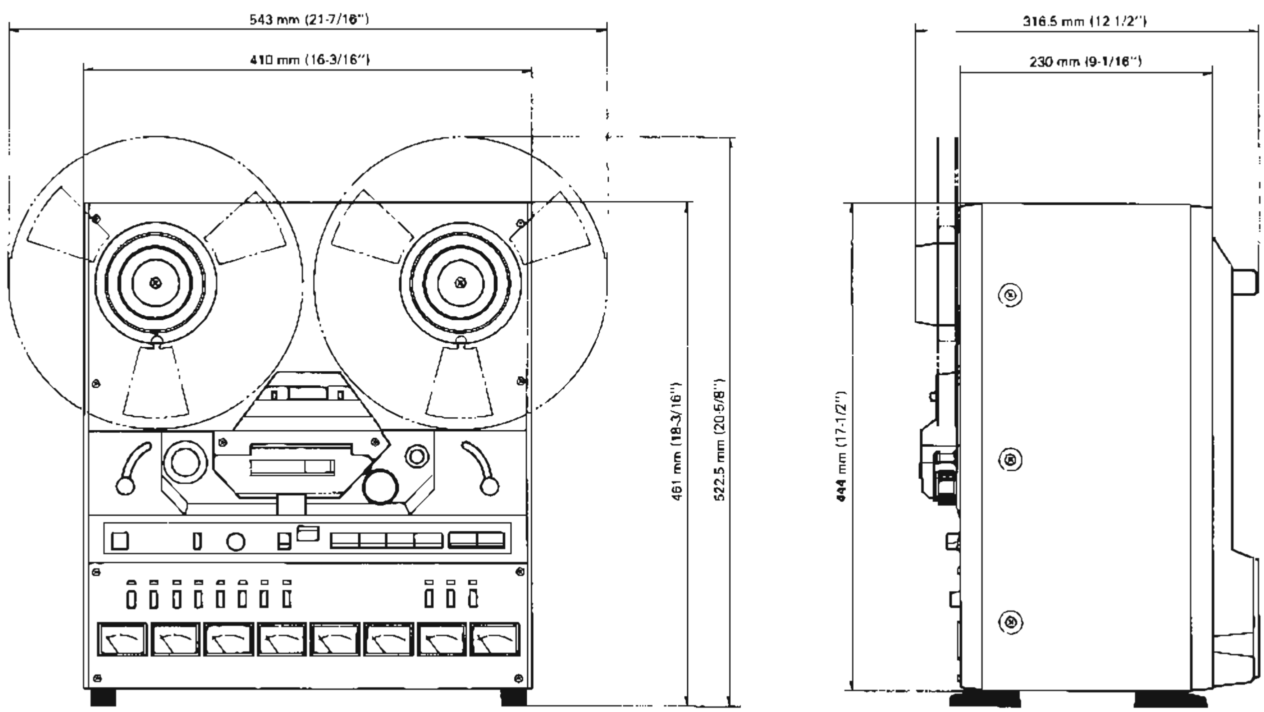
| | |
|---|---|
| **MECHANICAL** | |
| **Tape:** | 1/2 inch, 1.5 mil, low noise, high output tape |
| **Track Format:** | 8-track, 8-channel, track width 0.032 inch (0.8 mm) |
| **Reel Size:** | 10-1/2" NAB (large) Hub |
| **Tape Speeds:** | 15 inches per second (38 cm/s); Variable, ±12 % relative to 15 ips |
| **Speed Accuracy:** [1] | ±0.8 % deviation |
| **Wow and Flutter:** | |
| **15 ips** [1] | ±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) |
| **Fast Wind Time:** | 100 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 and reproduce |
| **Tape Cue:** | Manual |
| **Motion Sensing:** | 0.18 sec. ±0.15 sec. delay time, stop to next motion |
| **Dimensions:** | (W) 16-3/16" x (H) 17-1/2" x (D) 10-3/4" (410 x 444 x 273 mm) |
| **Weight:** | 59.6 lbs (27 kg), net |
| **ELECTRICAL** | |
| **Line Input:** | |
| **Input impedance:** | 50 k ohms, unbalanced |
| **Maximum source impedance:** | 2.5 k ohms |
| **Nominal input level:** | -10 dBV (0.3 V) |
| **Maximum input level:** | +18 dBV (8.0 V) |
| **Line Output:** | |
| **Output impedance:** | 1 k ohms, unbalanced |
| **Minimum load impedance:** | 10 k ohms |
| **Nominal load impedance:** | 50 k ohms |
| **Nominal output level:** | -10 dBV (0.3 V) |
| **Bias Frequency:** | 150 kHz |
| **Equalization:** | ∞ μsec + 35 μsec IEC standard (International Electrotechnical Commission), CCIR (International Radio Consultative Committee) |
| **Record Level Calibration:** | 0 VU reference; 250 nWb/m tape flux level |
| **Frequency Response:** | |
| **Record/Reproduce:** [3] | 40 Hz – 20 kHz, ±3 dB at 0 VU |
| | 40 Hz – 20 kHz, ±3 dB at -10 VU |
| **Sync and Reproduce:** [2] | 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 |
| | 68 dB A weighted (NAB), 60 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 |
| | Reproduce Amplifier – Better than 43 dB above 0 VU at 1 kHz |
| **Connectors:** | |
| **Line inputs and outputs:** | RCA jack |
| **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, 100 W (General Export Model) |
| | 120 V AC, 60 Hz, 100 W (USA/Canada Model) |
| | 220 V AC, 50 Hz, 100 W (Europe Model) |
| | 240 V AC, 50 Hz, 100 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 STL Test Tape 62 or equivalent.
2) Specifications were determined using TEAC Test Tape YTT-1144SP.
3) Specifications were determined using TEAC Test Tape YTT-8163.
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, CS-607 Console Rack |
| **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:** | 4-channel DBX unit with DX-4D x 2 ea. |



# 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.

## BIBLIOGRAPHY


Beranek, Leo L.
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 Bd 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

# MAINTENANCE

## NOTES

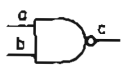
- ★ All resistors are 1/4 watts, 5 %, unless marked otherwise. Resistor values are in ohms (K=1,000-ohms, M=1,000,000 ohms).
- ★ All capacitor values are in microfarads (p=pico-farads).
- ★ ⚠ Parts marked with this sign are safety critical components. They must always be replaced with indentical components – 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. THEORY OF OPERATION

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 troubles which may occur and in correcting the malfunctioning circuit.

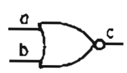
## 1-1. LOGIC USED IN THE TAPE DECK

(a) 2 INPUT NAND GATE



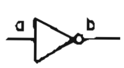

| a | b | c |
|---|---|---|
| H | H | L |
| H | L | H |
| L | H | H |
| L | L | H |

(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

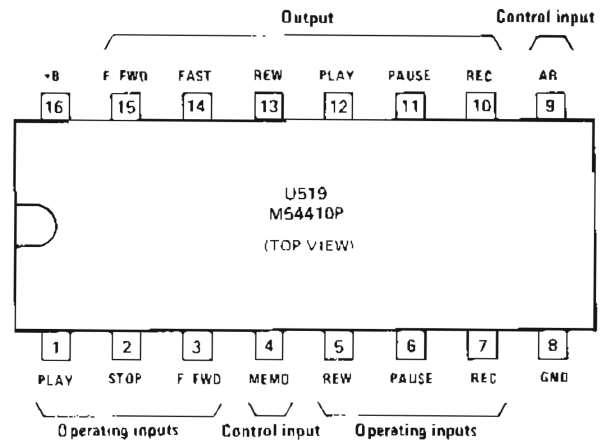



**Fig. 1-1. Pin Assignments**

| | 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

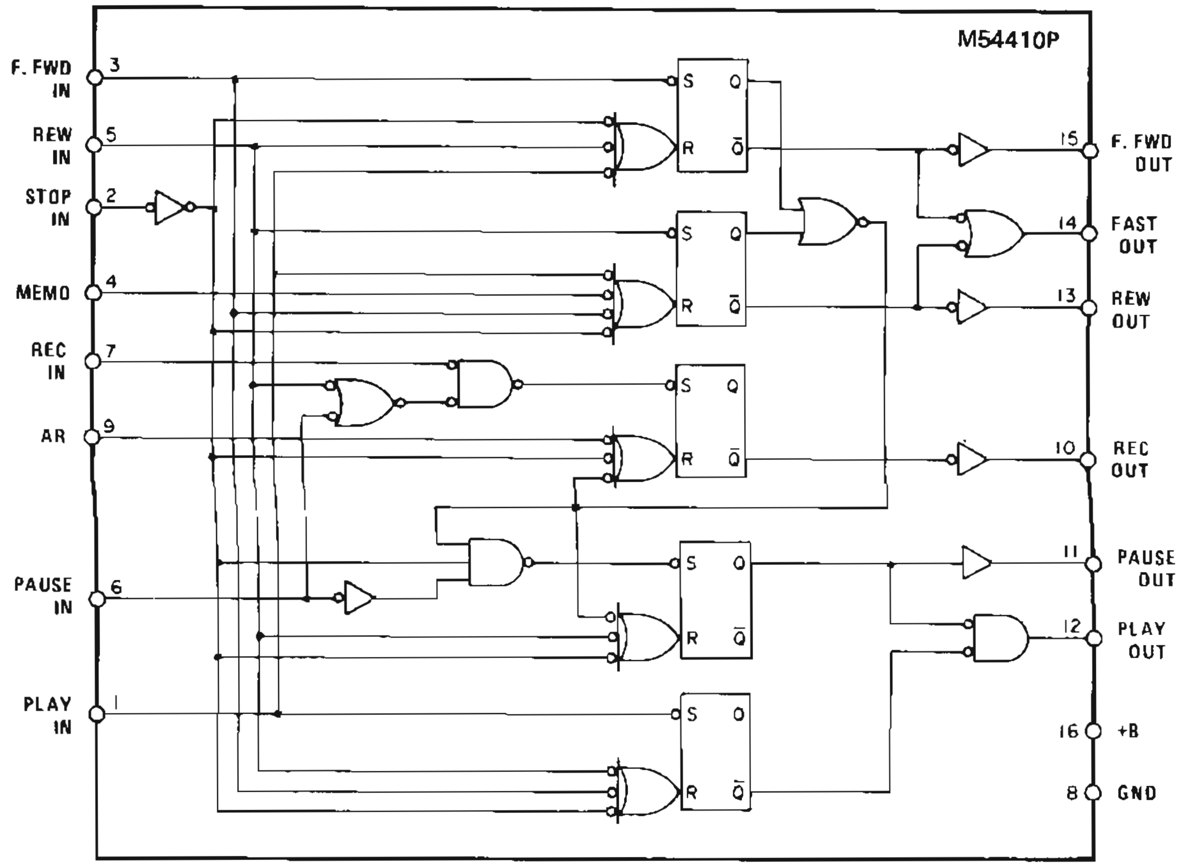



Fig. 1-2. Block Diagram

## 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 the power is turned, 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 C507 has large capacity. 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.

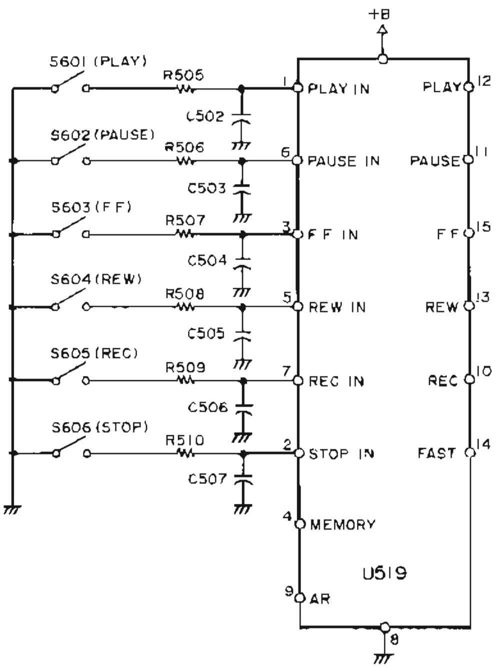



Fig. 1-3. **System Control IC Input Circuit**

### 1-3. 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, so that 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.

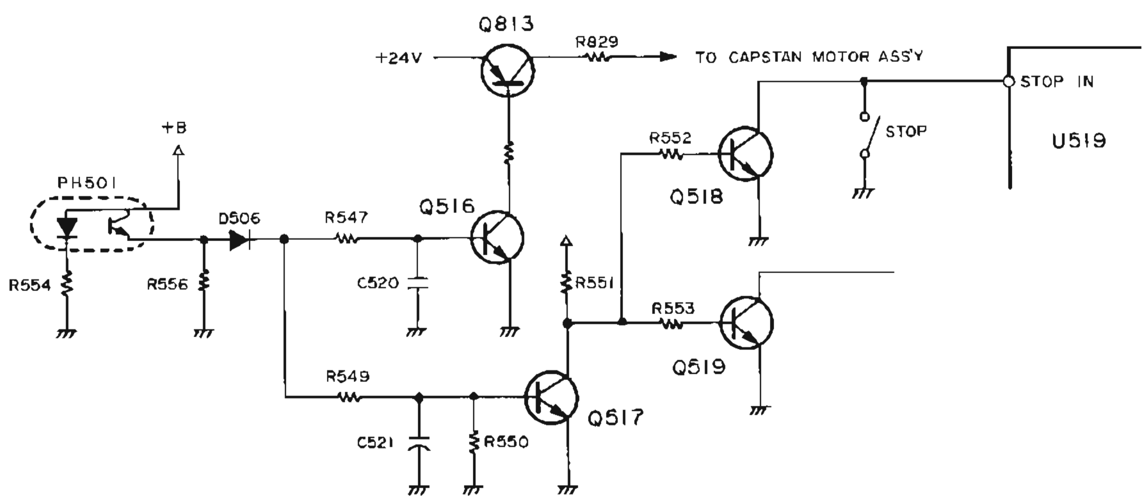



Fig. 1-4. **Power Shut-Off Circuit**

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 (A).

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 of U519 goes HIGH, Q537 goes on and current flows to the base of Q538 so that 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.
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.

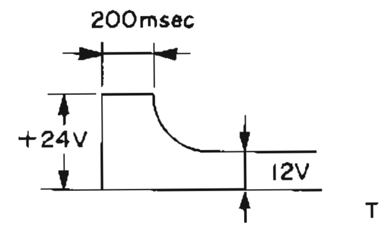



**Fig. 1-5 (A). Flashing & Steady State Voltage**

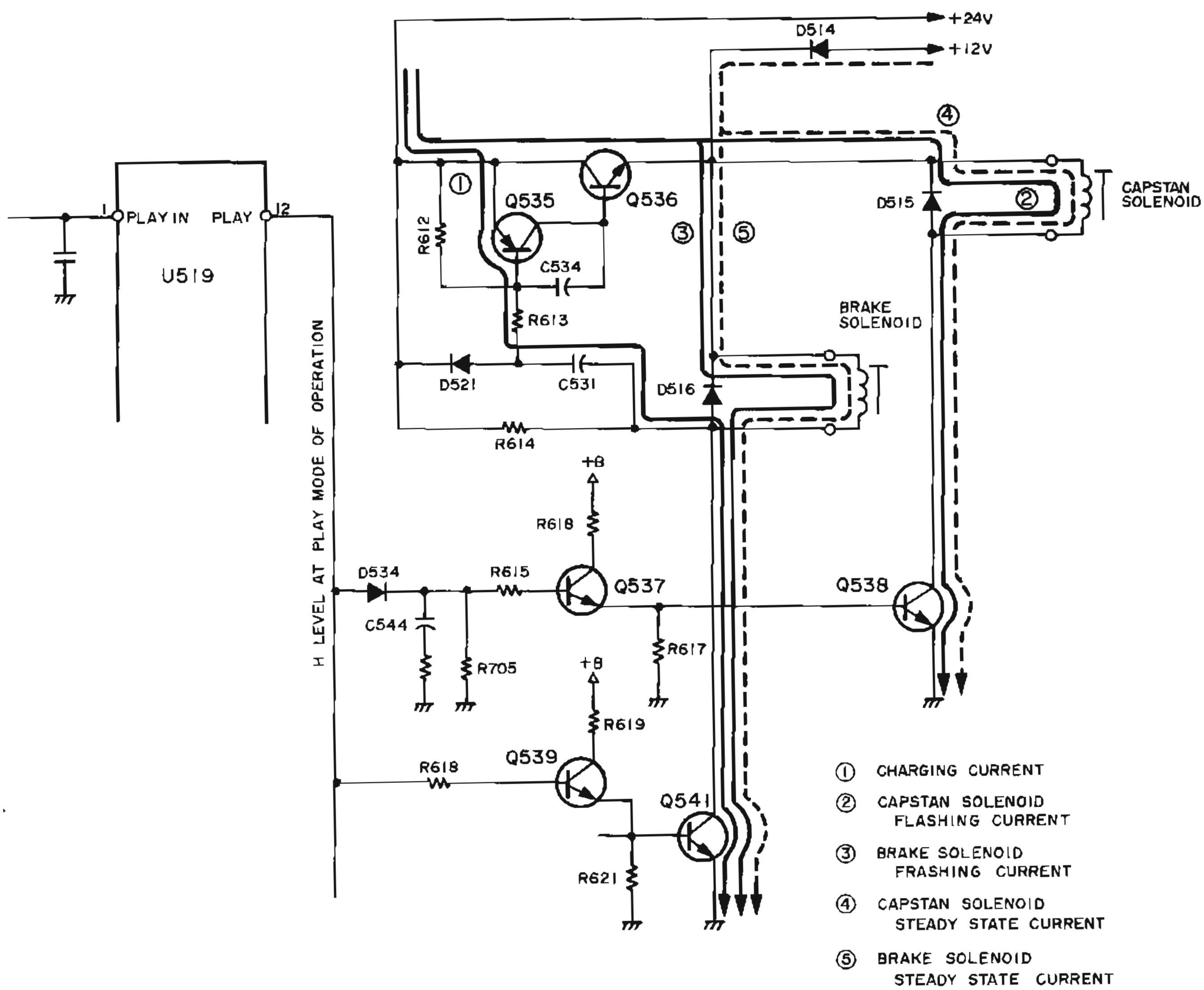



**Fig. 1-5 (B). Solenoid Drive Circuit**

### 1-5. REEL MOTOR DRIVE CIRCUIT

#### 1-5-1. Reproduce (record) operation

See Figs. 1-6 (A), (B).

1. Pushing the PLAY button sets U519 in the PLAY mode and sets pin 12 of U519 to HIGH.
2. When pin 12 of U519 goes HIGH, Q542 and Q543 go on and C532 charging current flows to the base of Q544 through the Q543 emitter-collector, R626 and C532, turning Q544 on. Q559 then goes on turning on 2SD 716 and +24 V is applied to the hot sides of both motors.
3. When charging ends after approximately 500 msec, Q544 goes off, and Q559 also goes off turning off 2SD 716 so that only +14 V voltage is applied to the motors.
4. The high voltage produced at pin 12 of U519 also makes Q548 conductive, so Q549 goes off. As Q549 goes off, the two diodes (D529 and D530) connected to ground through the collector-emitter path of Q549 are disconnected from ground so that normal bias is applied to each input (pins 3 and 12 of U518) of the first motor drive circuit stage. Next the comparator produces high voltage at pin 1 of U518, and the output is fed to pin 5 of U518. As a result, pin 7 of U518 outputs a high level DC voltage to drive Q554, which in turn drives motor drive power transistor 2SD 716. Thus, the right reel motor starts to rotate. Potentiometer R658 is adjusted to provide proper take-up torque.
5. In a similar manner, the left motor drive circuit drives the left motor at the same time. Potentiometer R675 is adjusted to provide proper back tension during the PLAY and REC modes of operation.
6. When Q545 goes on, Q546 goes off, causing charging current to flow to C533 through route (2). Then Q547 goes on, causing the input voltage at pin 2 of U518 drop. As the voltage drops, the output voltage at pin 1 of U518 increases because the voltage difference between pins 3 and 2 of U518 increases. Thus, the right reel motor drive voltage is increased, so that it temporarily develops more torque than the left reel motor to take up tape slack at play start.
7. When charging has ended after approximately 150 msec, Q547 goes off and the voltage at pin 2 of U518 returns to normal and the motor develops normal torque.
8. When the STOP button is depressed during the PLAY (or REC/PLAY) mode of operation, the high level control voltage applied to the base of Q548 drops to the low level and Q548 goes off. Then, charging current flows to capacitor C535, and the base voltage of Q549 gradually increases. When the capacitor has fully charged (after approximately 50 msec), Q549 goes on, dropping the voltage at pins 3 and 12 of U518 to 0.64 V, since both pins are grounded through D529 and D530 and the collector-emitter path of Q549. Consequently, the left and right motor drive power transistors (2SD716s) each go off approximately 50 msec after the STOP button is depressed so that tape slack is taken up.

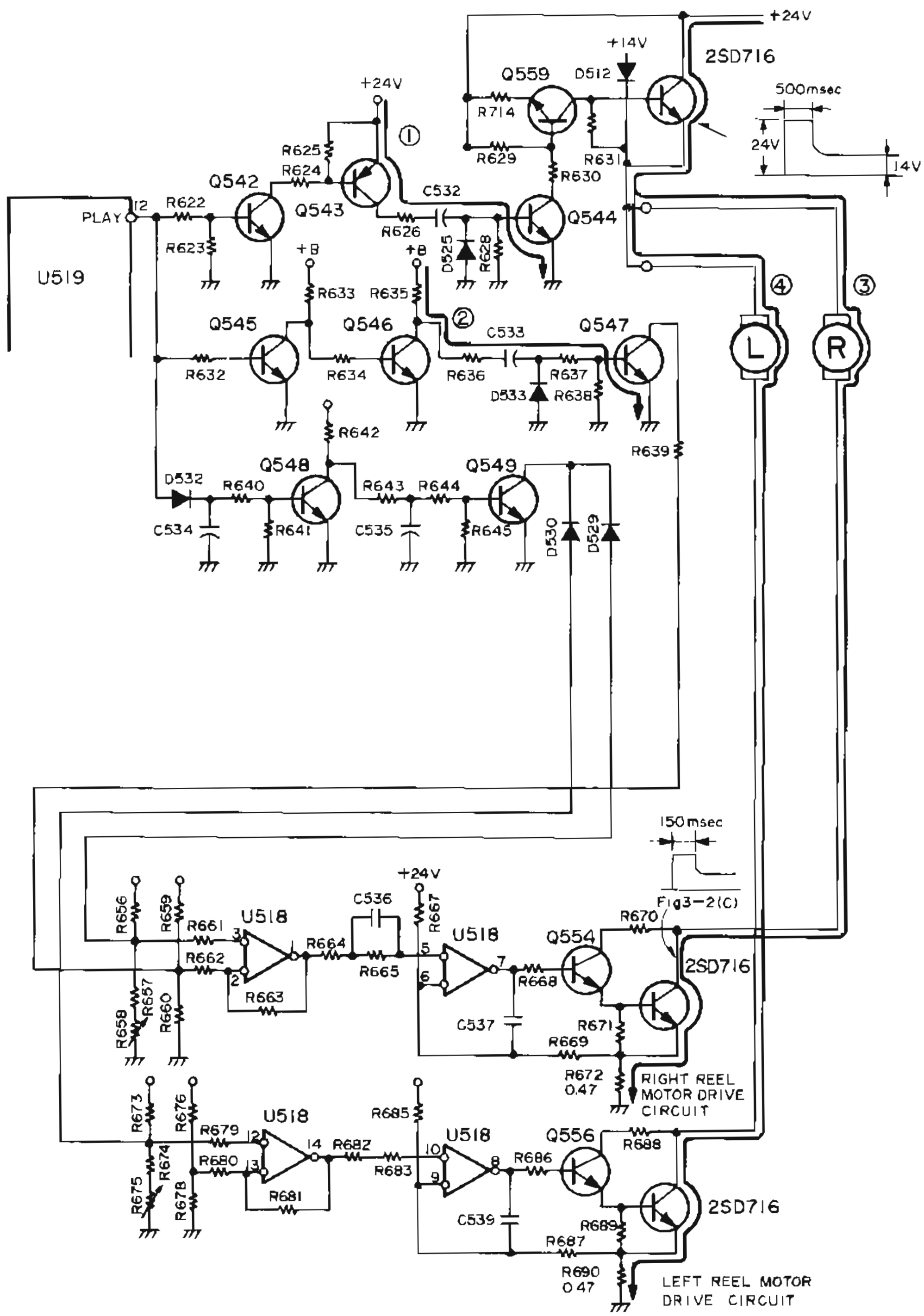



**Fig. 1-6 (A). Reel Motor Drive Circuit**

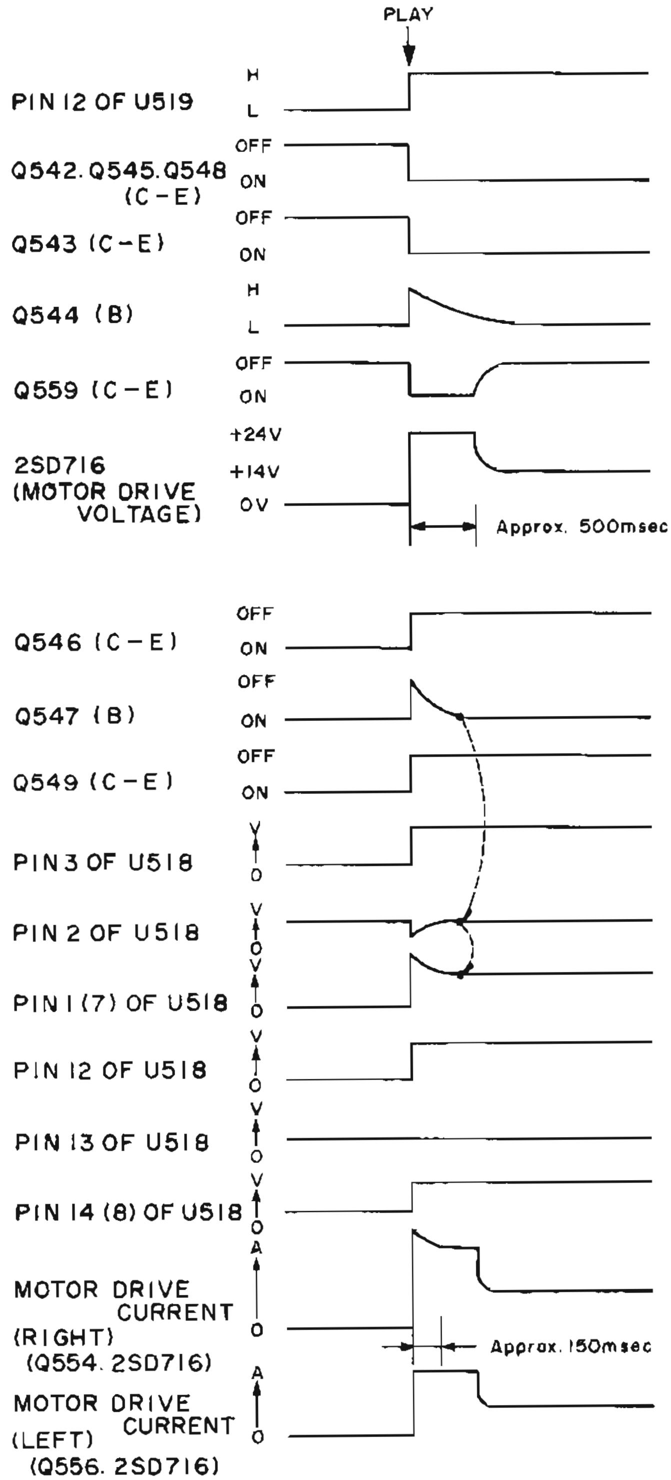



**Fig. 1-6 (B). Reel Motor Drive Circuit**

## 1-6. TAPE DIRECTION SENSING AND COUNTER CLOCK GENERATION CIRCUITS

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

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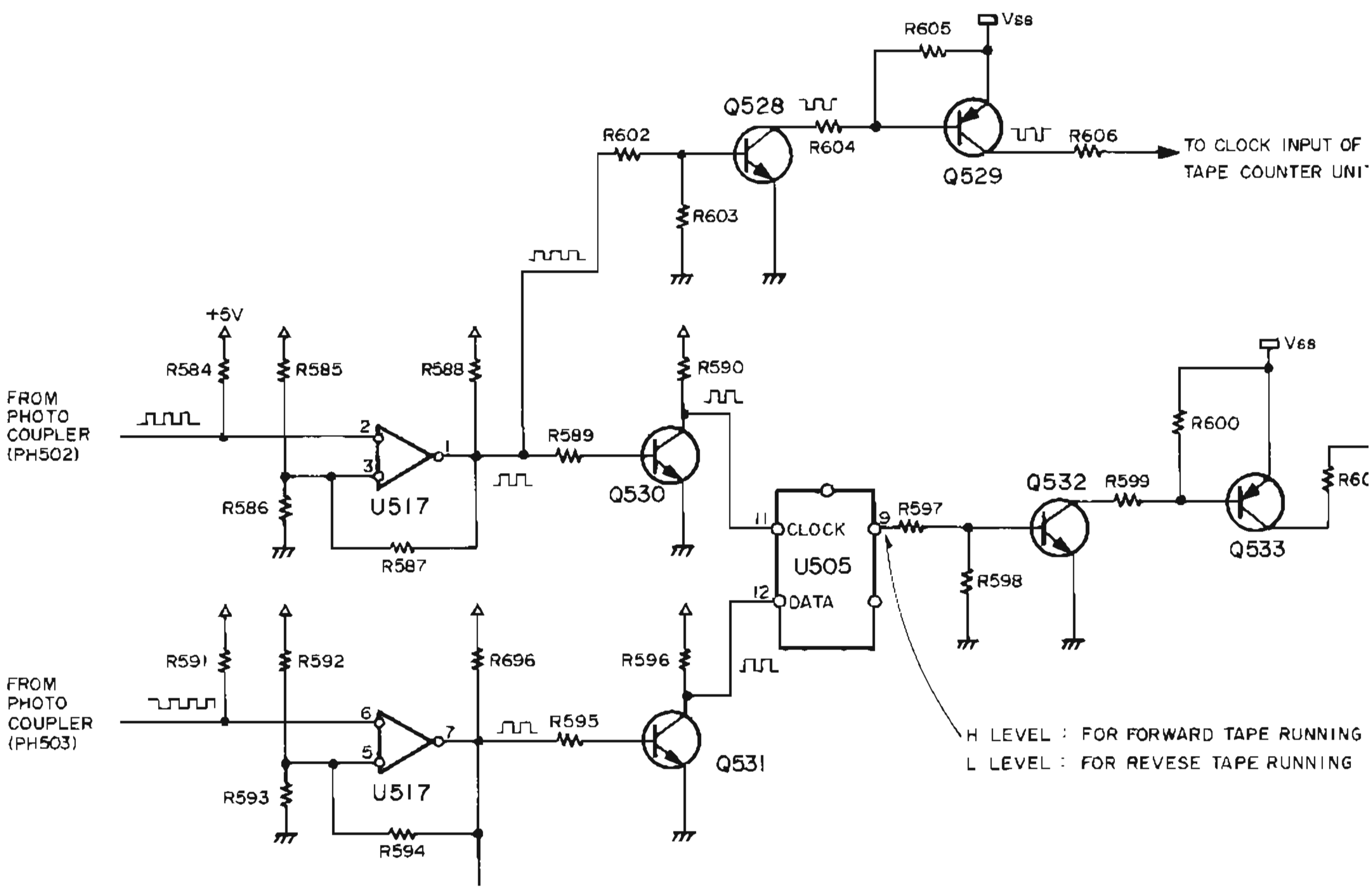
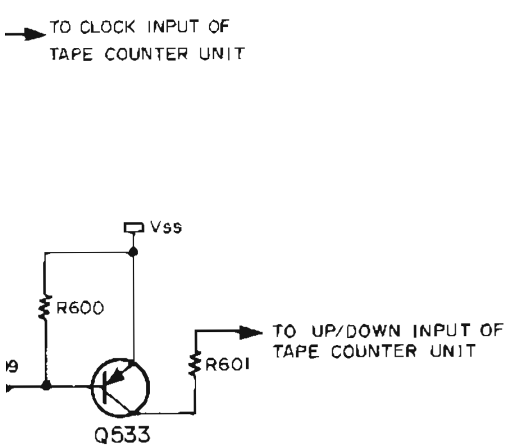



**Fig. 1-7. Tape Direction Sensing and Tape Counter Clock Generation Circuits**

(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.




ORWARD TAPE RUNNING
EVESE TAPE RUNNING

## 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.

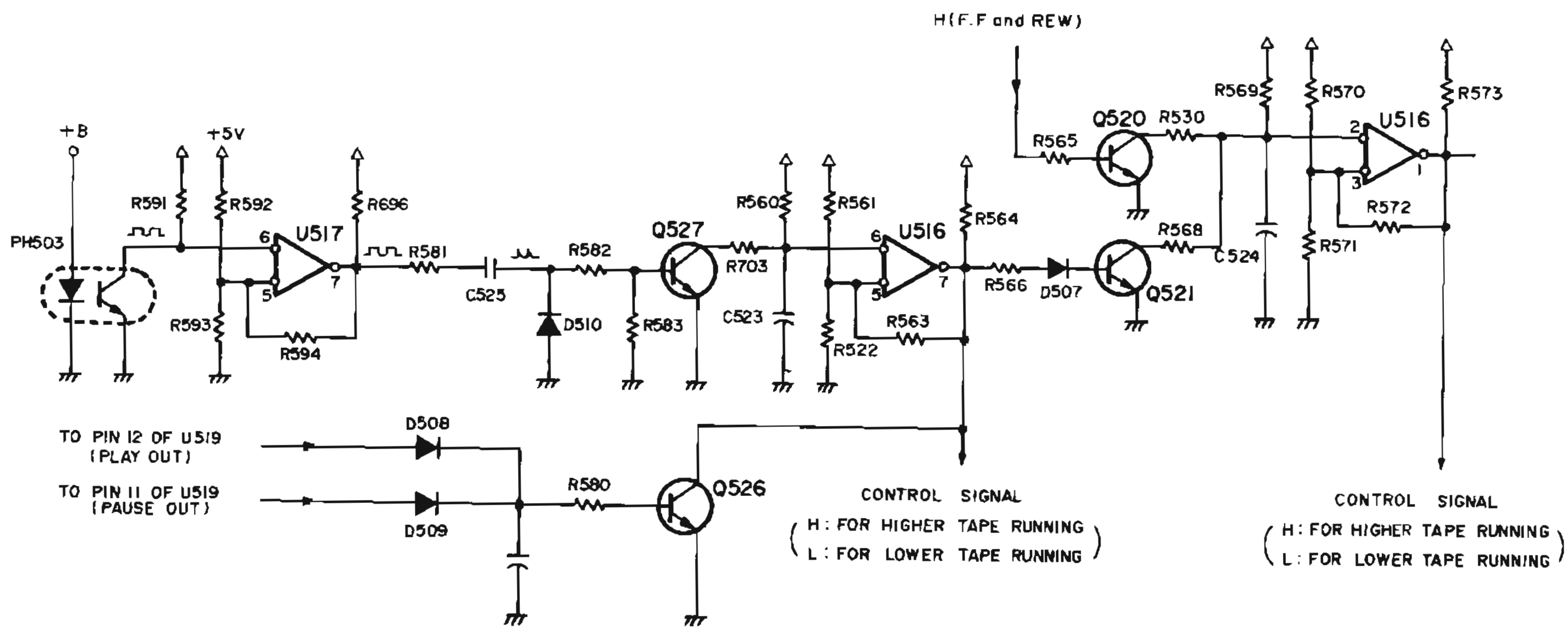



Fig. 1-8. Motion Sensing Circuit

## 1-9. F.F AND REW OPERATION

See Fig. 1-9.

1. As described above in 1-8 "Motion Sensing Circuit", pin 7 of U516 outputs a LOW level signal when the tape is running at low speed. Therefore, logic states at pin 1 of flip-flop U512 and pin 1 of flip-flop U513 are set to LOW. This means that pin 3 of U512 is set to HIGH and pin 6 of U512 to LOW. In the same way, pin 3 of U513 becomes HIGH and pin 6 of U513 becomes LOW.
2. When the F.F button is depressed, pin 15 of U519 and pin 13 of U512 go HIGH. Since pin 12 of U512 is connected to pin 3 of U513, pin 12 of U512 also goes HIGH. Then, pin 11 of U512 goes LOW, making pin 1 of U514 go LOW and pin 3 of U514 go HIGH. Thus, in the F.F mode, pin 3 of U514 becomes HIGH.
3. In a similar way, when the REW button is depressed, pin 13 of U519 goes H, pin 11 of U513 goes L, pin 4 of U514 goes L and pin 6 of U514 goes H. Thus, in the REW mode, pin 6 of U514 goes HIGH.
4. When either pin 3 or 6 of U514 goes HIGH, base current flows to Q540 to turn it on, which in turn makes Q541 go on. Then the brake solenoid is actuated as described in 1-4 "Capstan and Brake Solenoid Drive Circuit" and the brakes are released.
5. As described above, HIGH is produced at pin 3 of U514 and applied to the base of Q550 in the F.F mode, turning on Q550 and, in turn, Q551. Thus, +24 V is supplied to the junction of R652 and R655 through the emitter-collector path of Q551. The same voltage is applied to pin 5 of U518 through R562 and D526, and to pin 10 of U518 through R655, R654, R653 and D527. Since overall resistance of the current path to pin 5 of U518 is lower than that of the current path to pin 10 of U518, the voltage applied to pin 5 of U518 is larger than that applied to pin 10 of U518. Thus, a larger drive motor current flows to the right reel motor than to the left reel motor, so that the right motor develops take-up torque and the left motor develops back tension torque.
6. When the REW button is depressed, the H level voltage developed at pin 6 of U514 is applied to the base of Q552 and Q552 is turned on. Then Q553 also goes on and +24 V voltage is applied to the junction of R654 and R653. Voltage is then applied to pin 5 of U518 through R654, R655, R652 and D526, and to pin 10 of U518 through R653 and D527. At this time, a higher voltage is applied to pin 10 of U518 than to pin 5 of U518, so the left reel motor rotates with higher torque than the right reel motor.

## 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 Q552 and Q553 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, Q540 base bias is cut, and Q540 and Q541 go off to disconnect the ground side of the brake solenoid and apply mechanical braking to the reel motors.
6. When pin 3 of U514 goes L, Q552 goes off to disable the left and right reel motor drive circuits. Thus, no current flows to the motors.
7. When pin 6 of U514 goes L, Q558 goes off and C540 discharges through R693, R684 and

D531 so that the voltage at pin 10 of U518 is maintained for 100 msec or more. Consequently, the left motor drive circuit is actuated for this period even though the control voltage from D527 is disabled immediately when the STOP button is depressed; this prevents tape slack which would otherwise occur during a stop operation.

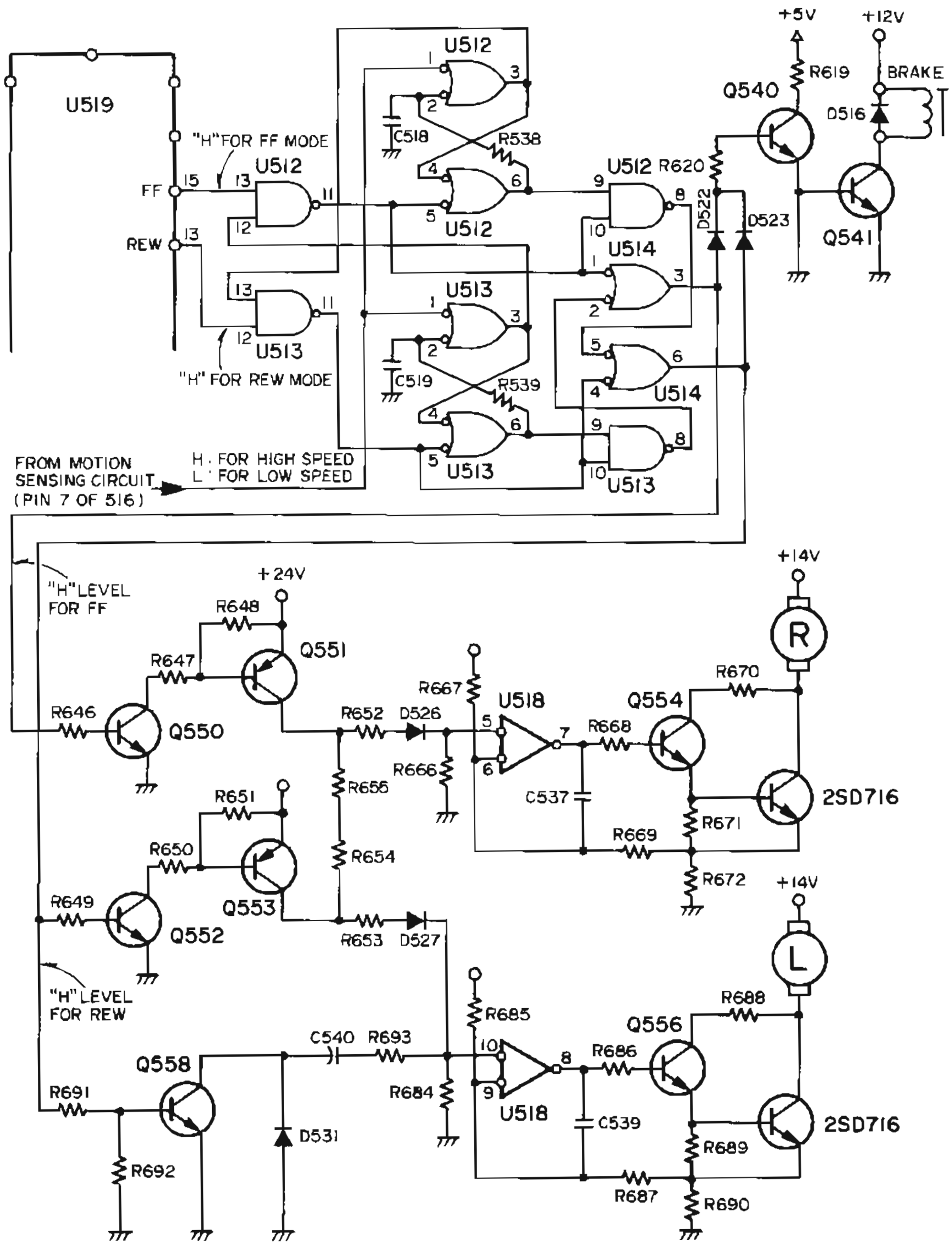


Fig. 1-9. FF and REW Mode Operation Control Circuits

## 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.

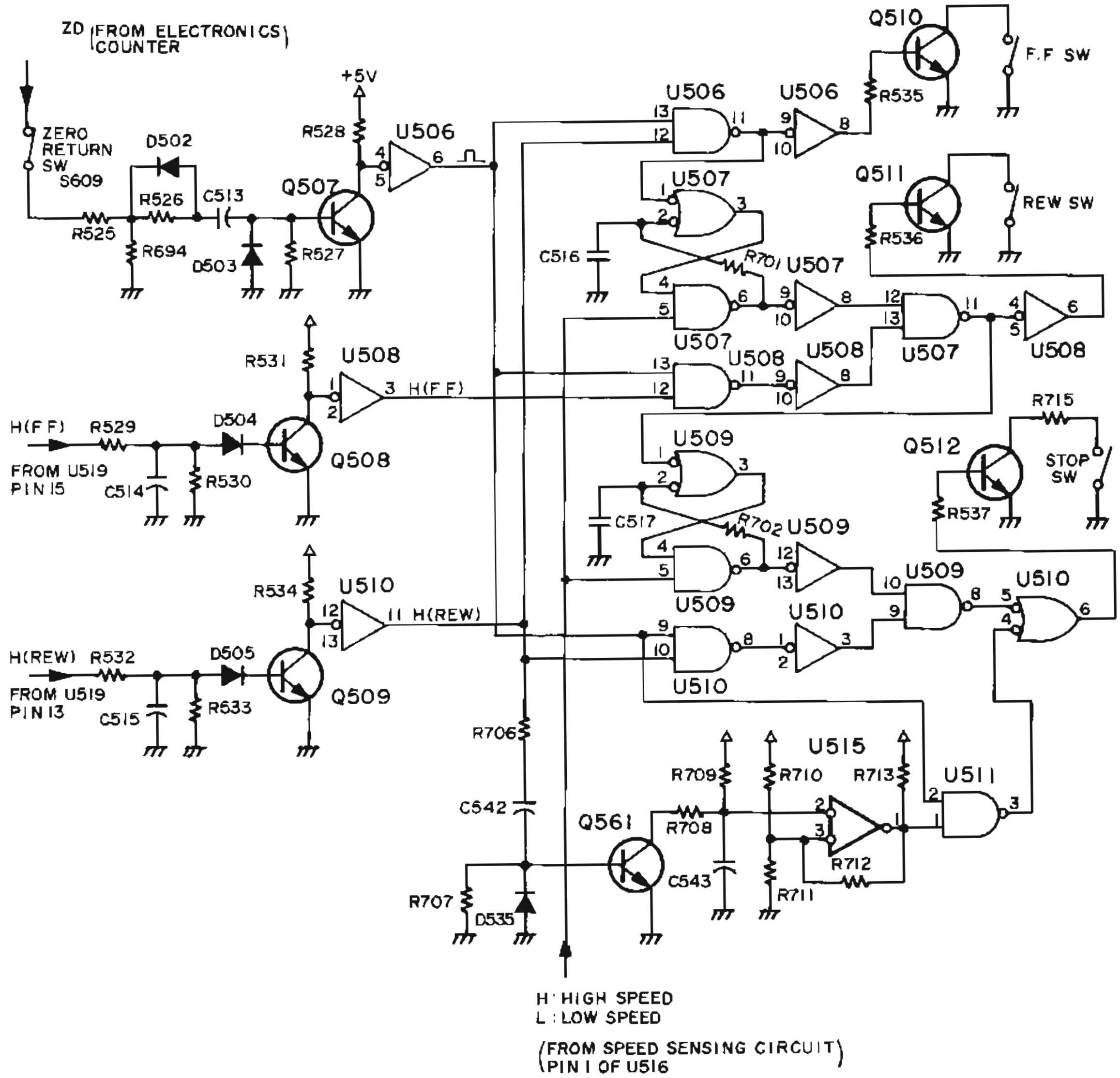



**Fig. 1-10. Counter Zero Return Control Circuit**

## 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).

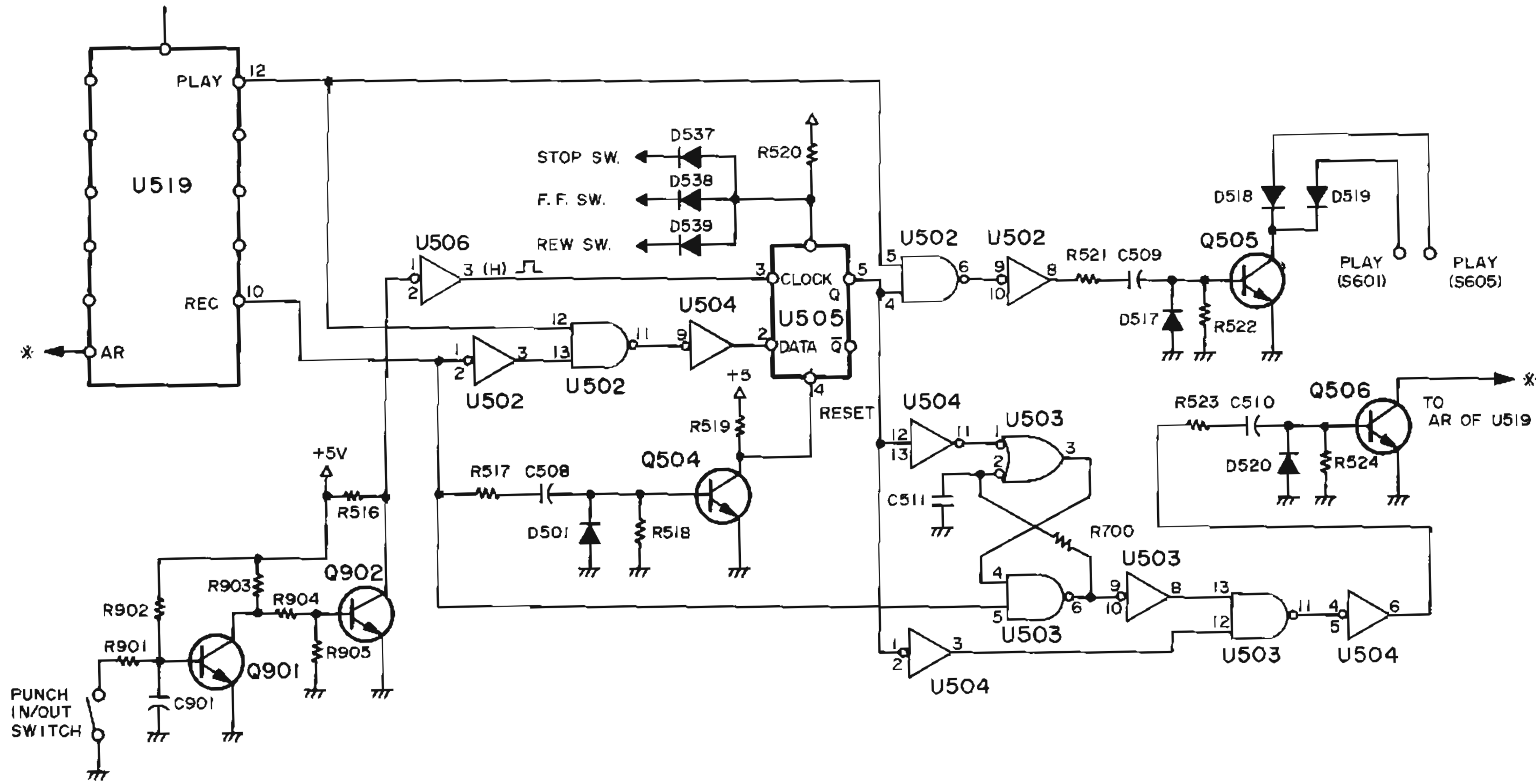



**Fig. 1-11. Punch In/Out Control Circuit**

## 1-13. EDIT CONTROL CIRCUIT

**See control section of the inserted circuit diagrams.**

1. When the EDIT switch is on, Q513 goes on, Q514 goes on followed by Q516. With Q516 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, Q515 also goes on to turn off Q518 to release the STOP mode.
2. At the same time, when Q513 goes on, pin 3 of U518 is grounded through R661, D528 and through the collector-emitter path of Q513, 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.

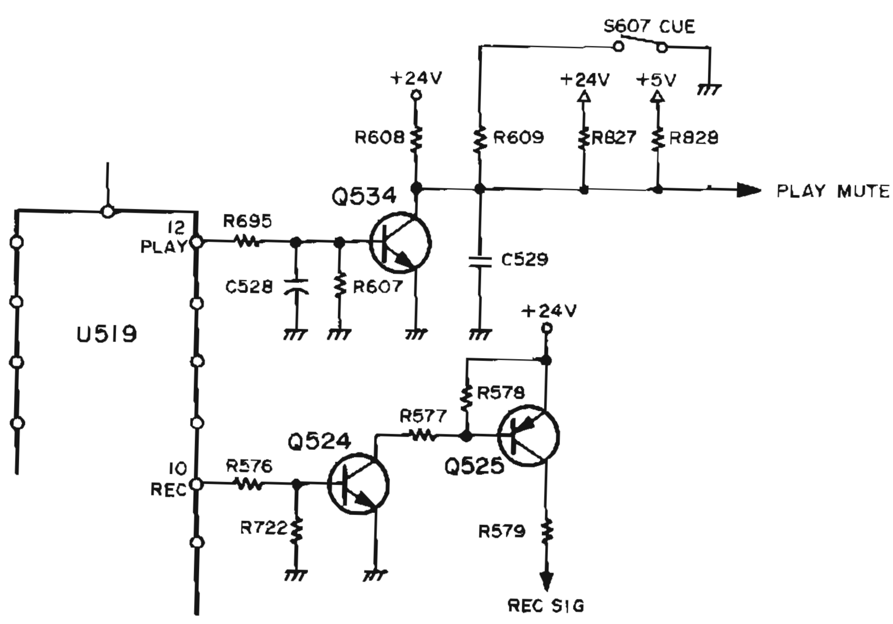



**Fig. 1-12. Rec & Play Mute Circuit**

## 1-15. DISPLAY CIRCUITS

**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 eight 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 eight 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.

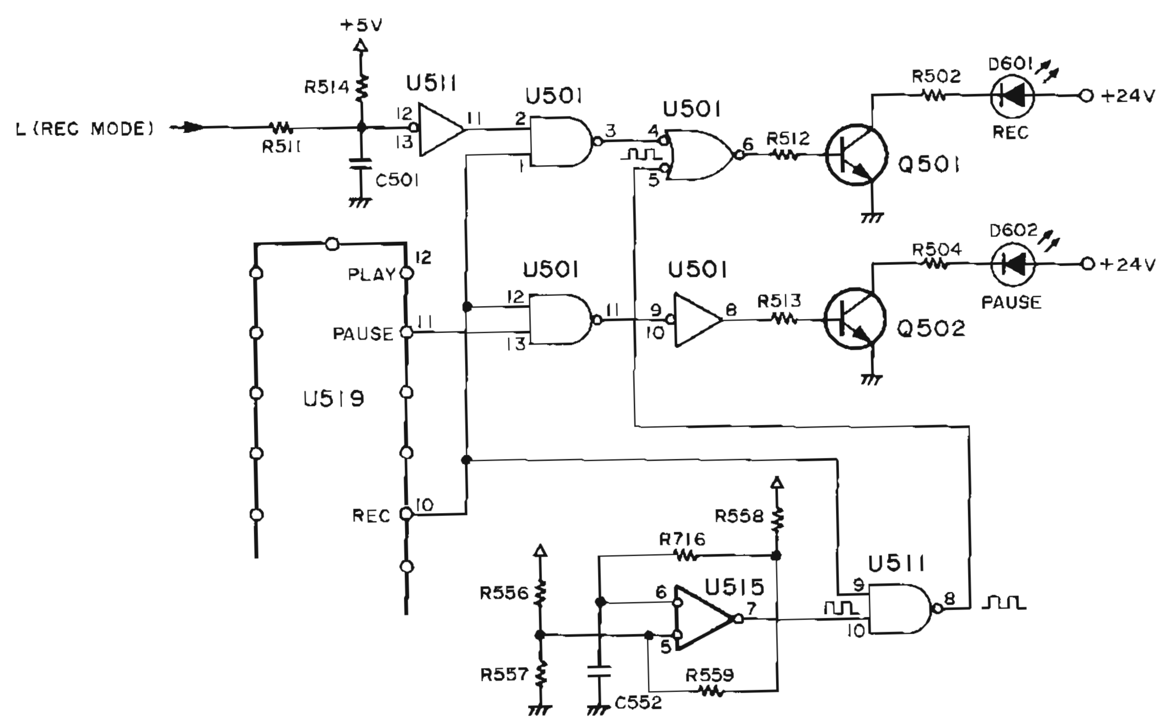



Fig. 1-13. Display Circuit

## 1-16. AMPLIFIER CIRCUIT DESCRIPTION

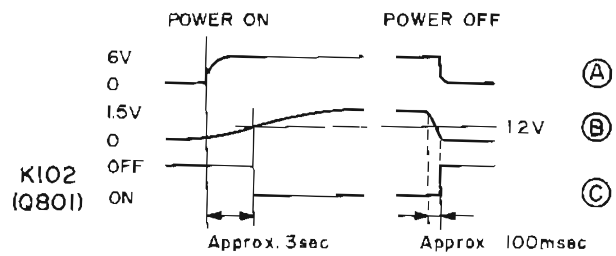
This description covers only one channel, with the exception of several switching circuits which are assembled on the FUNCTION PCB, MASTER OSC PCB, OUTSELECT PCB, and LED Indicators.

### 1-16-1. Power muting circuit

**See Fig. 1-16.**

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 the 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.



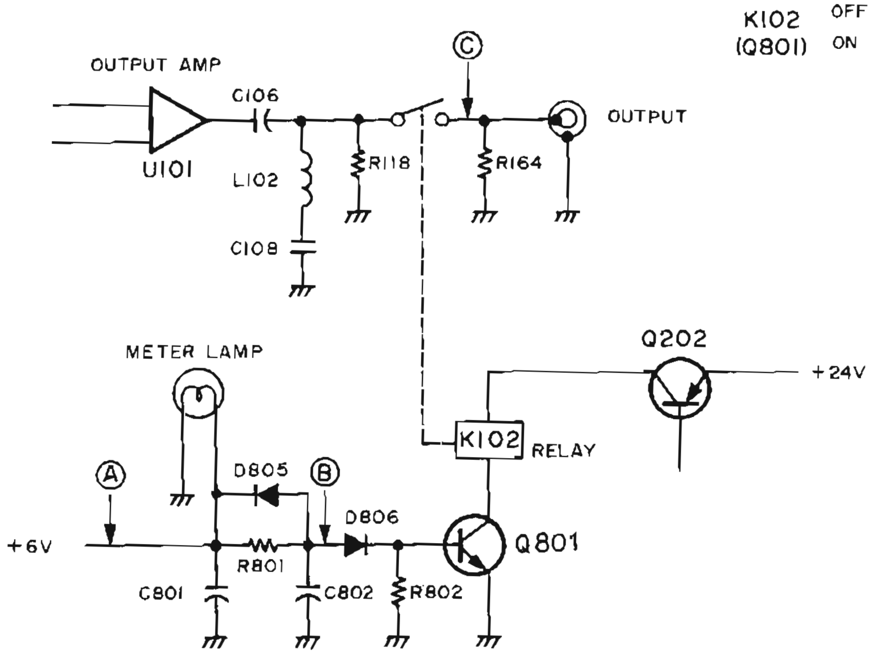




**Fig. 1-16. Power Muting Circuit**

### 1-16-2. Bias and record control circuit

**See Figs. 1-16(A) and 1-16(B).**

1. As previously described, when the unit is in REC mode, REC SIG is produced at the Q525 collector. This signal is applied to the base of Q301 to turn it on; Q302 then also goes on, supplying +24 V to the FUNCTION (eight channel) switches. If any one (or more) of the switches (for example F8) is set to ON or into the record mode: (1) the common terminal of F8a is connected to the +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 F8b common terminal is grounded, making REC LED indicator light continuously as described in section 1-15 "Display Circuits".

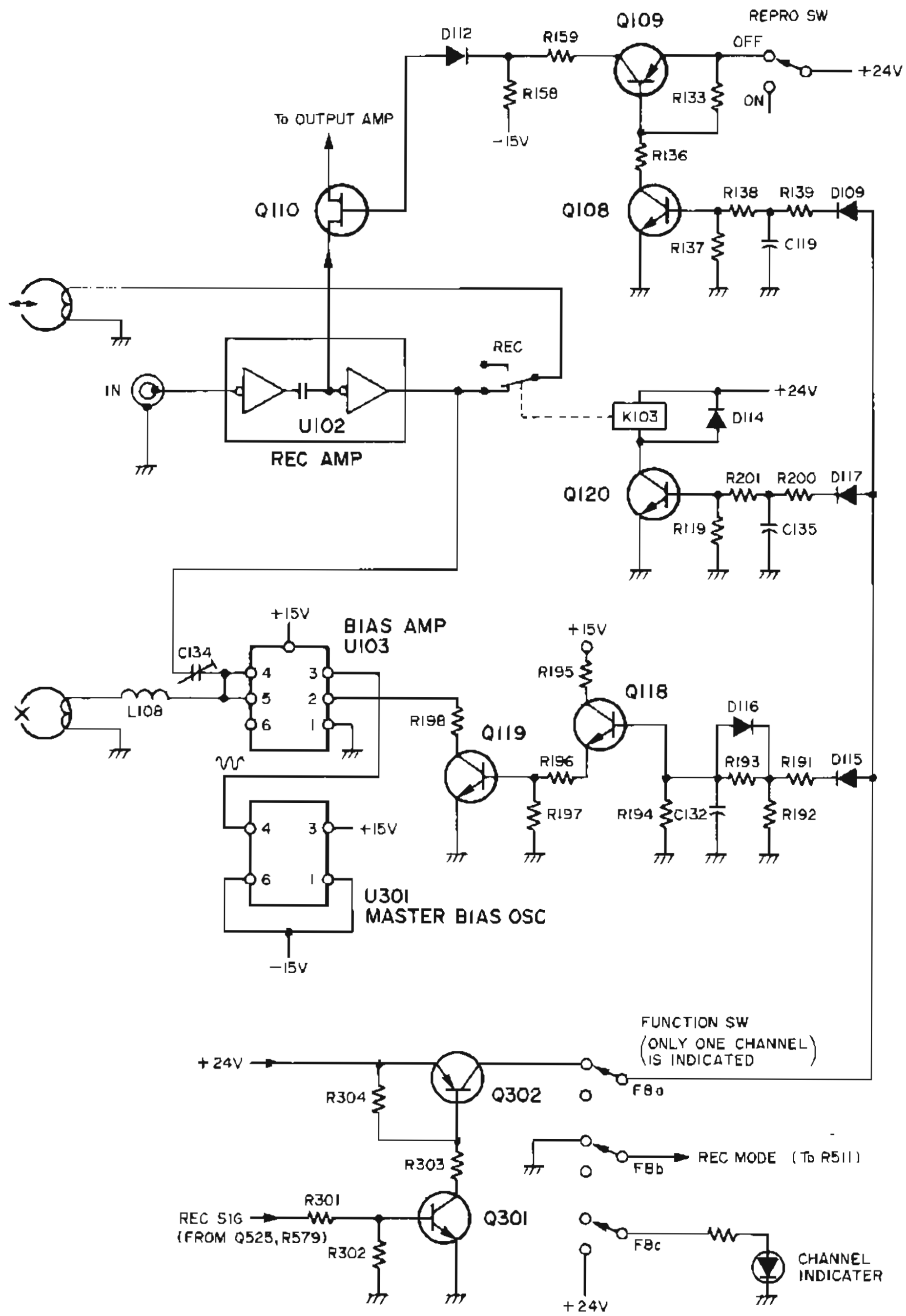



Fig. 1-16 (A). Bias and Record Control Circuit

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(3) The F8c contact is closed and the channel indicator LED lights up.

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. 1-16(B).

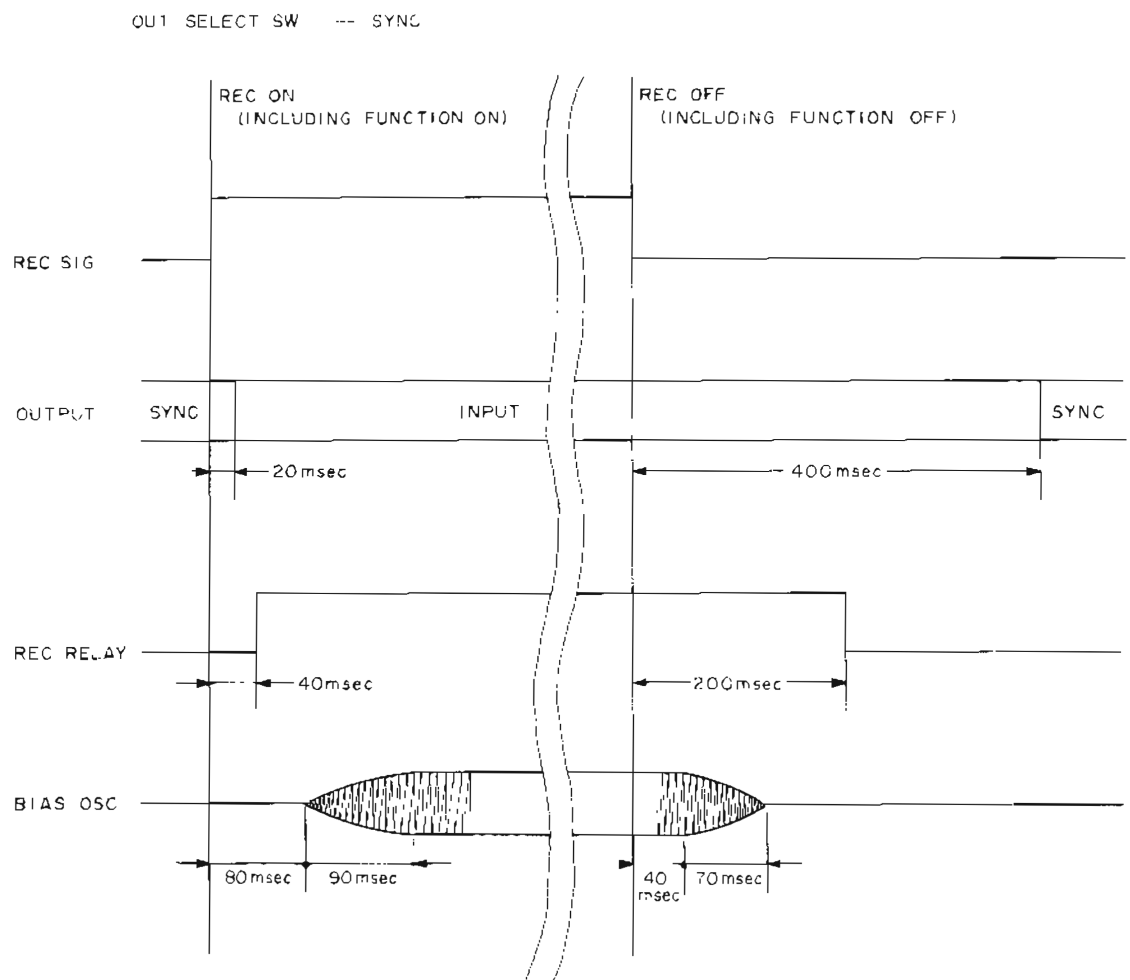


**Fig. 1-16 (B). Record Circuit Switching Timing Diagram**

### 1-16-3. Reproduce amplifier circuit

**See Figs. 1-16(A) (B) and the OUTPUT SELECT SECTION of the inserted Amp circuit diagram.**

1. The reproduce amplifier consists of an 18 dB step-up transformer, a P.B. EQ amplifier, an OUTPUT amplifier, a meter amplifier, and several FET switching transistors which are switched into or out of the amplifier circuits according to the operation mode selected. Three reproduce operation modes, INPUT, REPRO, and SYNC, are available by placing the OUTSELECT switch in the specified positions.
2. Now, assume that the PLAY button is on and FUNCTION switch is off.
3. When the INPUT (OUTSELECT) switch is pushed, +24 V is applied to the base of Q201 through R251 and D204 so that Q201 goes on. When Q201 goes on, Q202 also goes on to supply +24 V to relay K102 and actuates it. The relay connects the amplifier output to the OUTPUT jack.
4. At the same time, +24 V is also applied from another INPUT switch contact to the cathode side of D112 through D118, R204 and R159, setting the gate potential of Q110 to zero; Q110 then goes on, connecting the input audio signals amplified by U102(1/2) to pin 3 of U101 (1/2) OUTPUT amplifier, the input circuit. Thus, the input signals are selected and amplified.
5. When the INPUT switch is reset to off, the voltage stored in C201 flows out through D201 turning off Q201, Q202 and when the REPRO switch is pushed, +24 V is supplied to C203 through R255 turning Q201, Q202 on. The relay K102 is actuated in the same way as in the INPUT mode.
6. The REPRO signal (+24 V) is supplied to the cathode sides of D102 and D106 through the REPRO switch and R126 at this time, turning on Q101 and Q105.
7. When Q101 is turned on, R108 is connected and the frequency response is modified to precisely match the reproduce head used.
8. When Q105 goes on, the EQ amplifier output is connected to the input circuit of U101(1/2).
9. Meanwhile, when the reproduce mode is selected, the REPRODUCE MUTE releasing signal (approx. -6.5 V) is applied to the gate of Q107 from pin 8 of the power supply unit, cutting off Q107 and releasing the muting function.
10. Thus, the audio signal detected by the reproduce head is reproduced. (Of course, the reproduce head is connected to the input step-up transformer, since the SYNC mode is not selected.)
11. When the SYNC button is pushed, relay K102 is energized in the same way as described above.
12. Q203 base bias is applied through the SYNC switch, Q203 goes on, then Q204 goes on to supply power to SYNC relay K101. When the relay is actuated, input pin 1 of step-up transformer TR101 is disconnected from the reproduce head, but is connected to one terminal of the REC relay circuit. Under this condition, the record/reproduce head is connected to pin 1 of TR101 if the REC mode is not selected and audio signals

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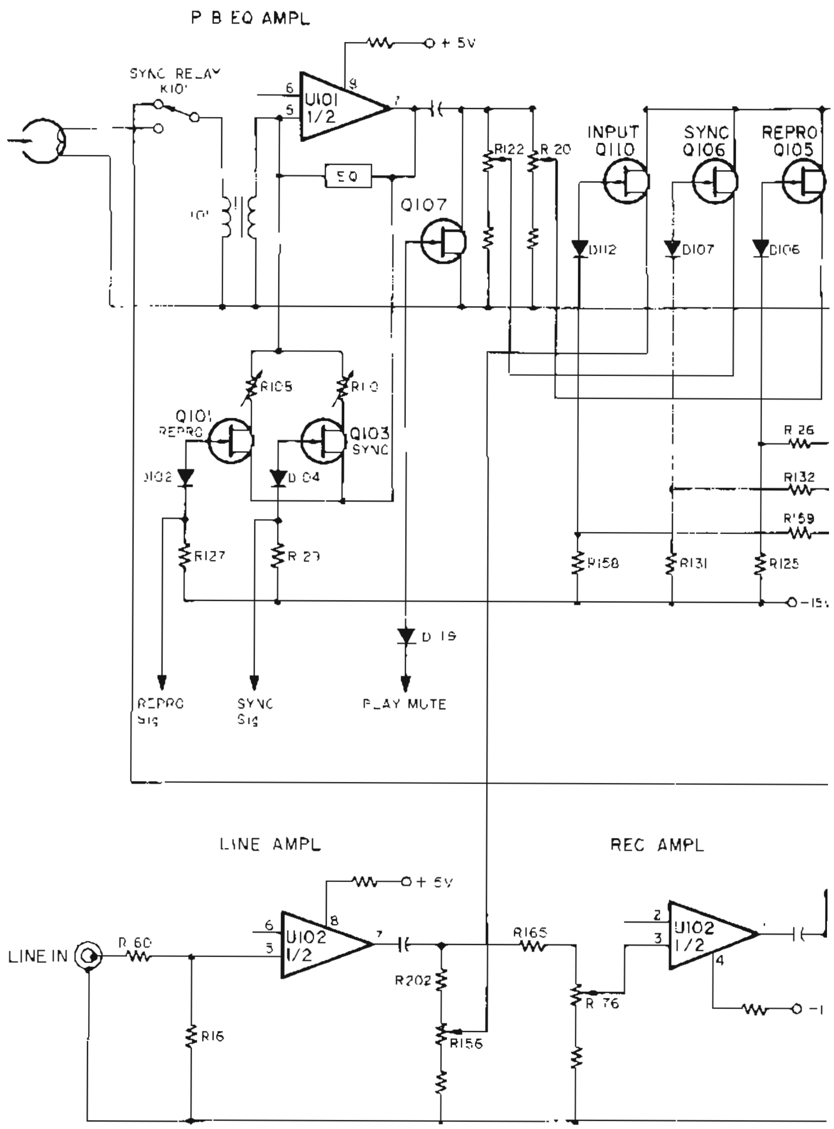
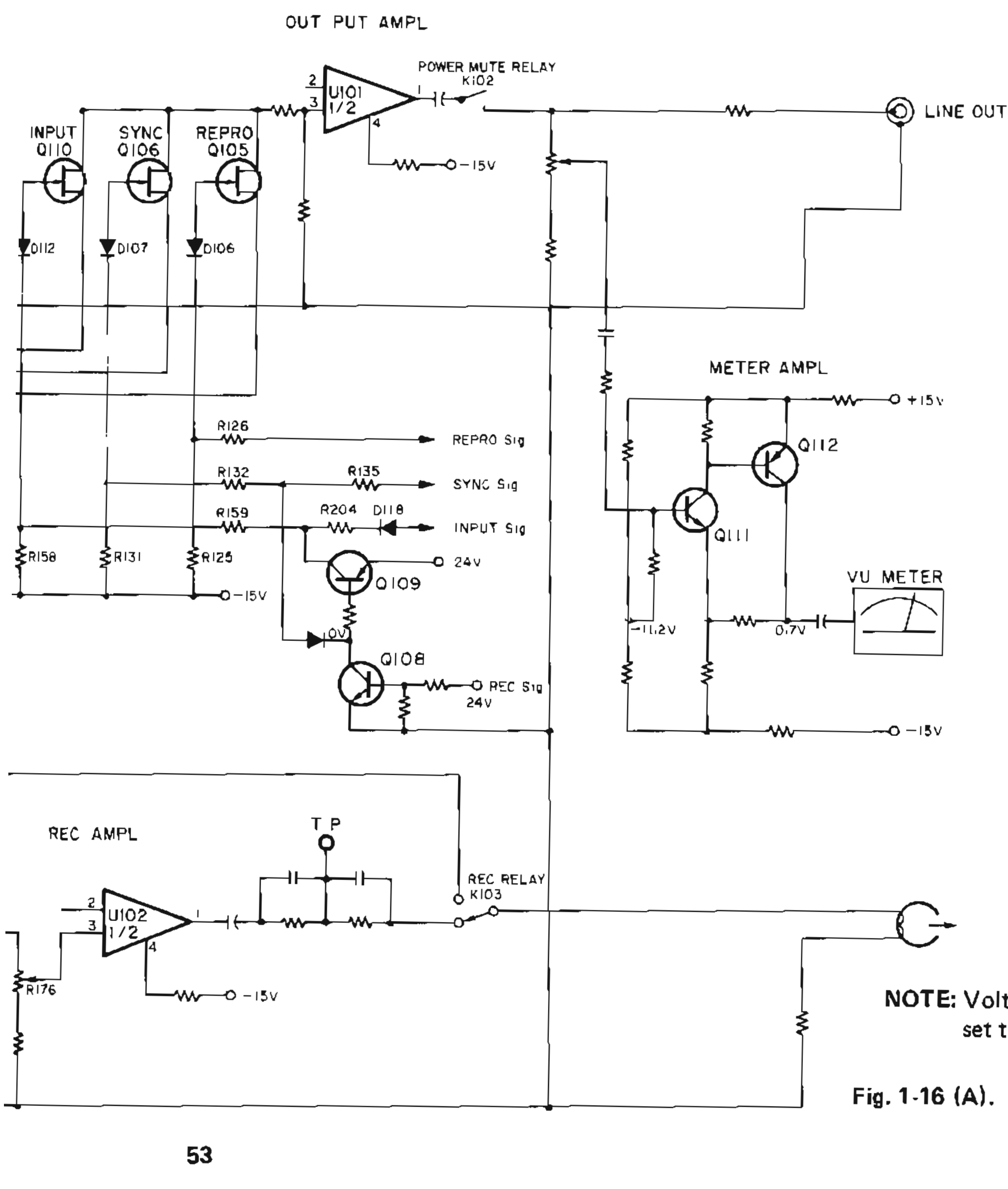


picked-up by the head are reproduced through the reproduce amplifier; however, if the REC mode is selected, the record/reproduce head is connected to the record amplifier output circuit as shown in 1-16(A) "Bias and record control circuit".

13. The SYNC signal (+24 V from the SYNC switch) is applied to D104 and D107, making Q103 and Q106 conductive. Q103 connects R110 to ground, correcting frequency response at the high end to match the characteristic of record/reproduce head selected; the EQ amplifier output is connected to the OUTPUT amplifier by Q106.
14. In the SYNC mode of operation, one or more channels may be operated in the PLAY mode with the remaining channels operated in the REC mode. In this situation, the recording bias signal may flow into a djacent channel heads operating as reproduce heads and lower sound quality (SN). To prevent this, three bias traps consisting of one choke coil and two capacitors (L101, C136, & C101,etc.) are provided in the amplifier circuit.
15. The on and off timings of the SYNC relay are adjusted so that each on or off operation is conducted during circuit muting to prevent undesirable switching noise (as shown in Fig. 1-16.(B)). On and off timing of the SYNC relay depends on R260 and C208, and C208 and R261, respectively, in the SYNC relay drive circuit comprising Q203 and Q204.




**NOTE:** Voltages measured with OUTPUT SELECTOR set to SYNC in REC-PAUSE mode.

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

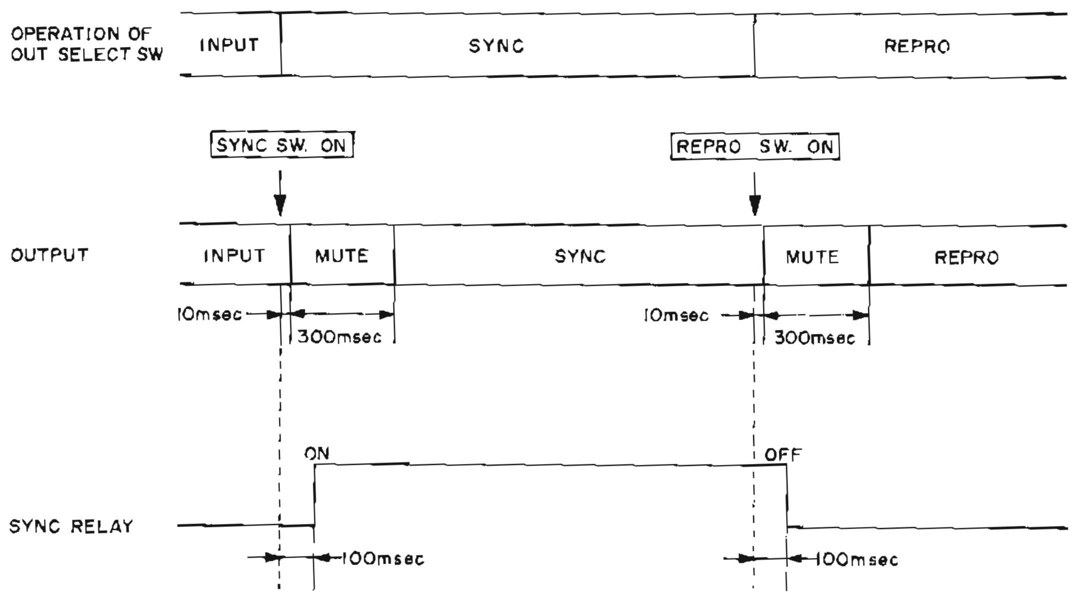



**Fig. 1-16 (B). SYNC Relay Operation Timing Chart**

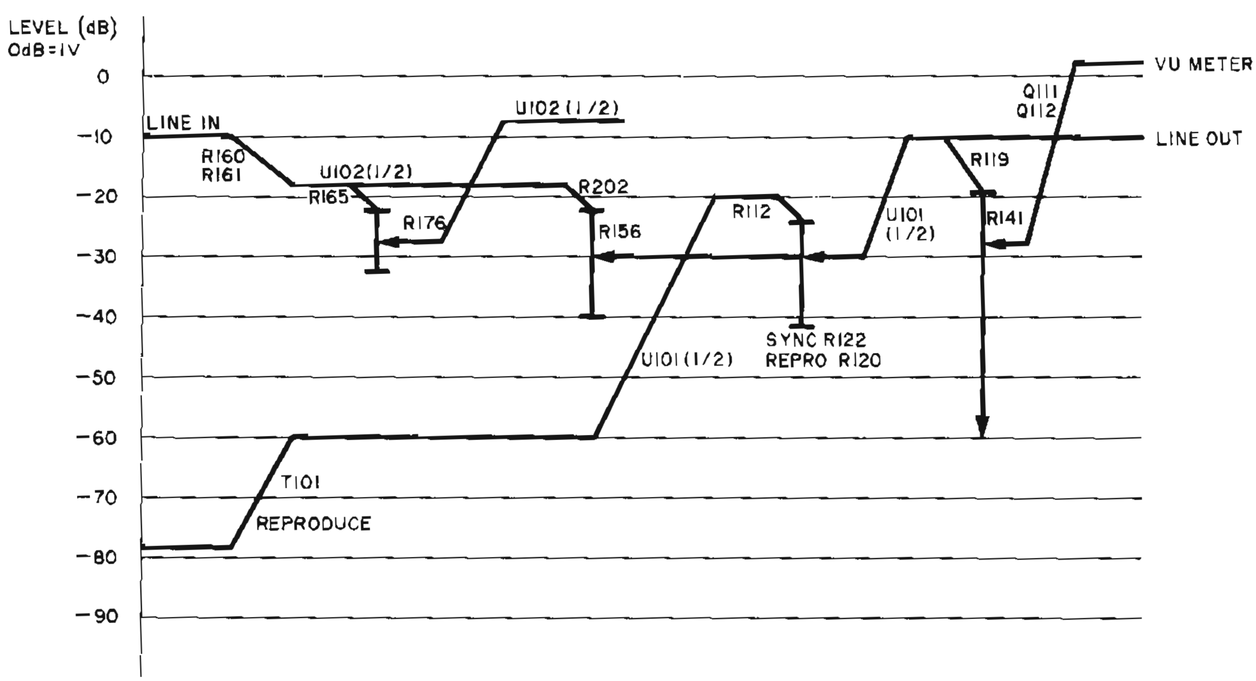



**Fig. 1-17. Level Diagram**

# 2. CHECKS AND ADJUSTMENTS

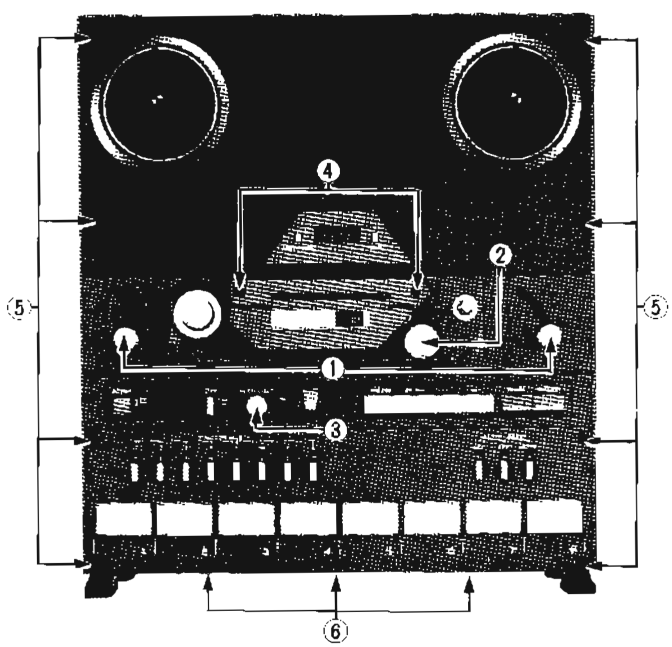
## 2-1. ESSENTIAL TEST EQUIPMENT REQUIRED

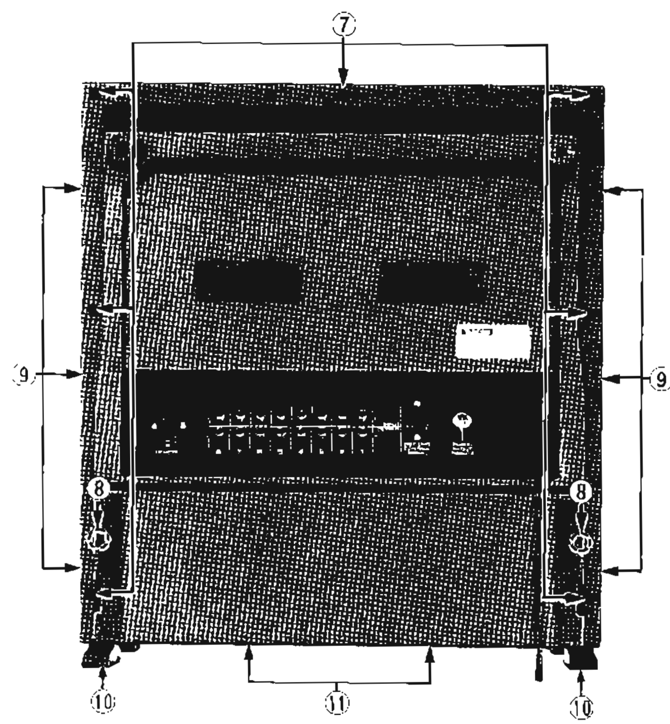
| | |
|---|---|
| **Wow & Flutter Meter** | Meguro Denpa Sokki K.K., Model MK-668C (JAPAN), or Mincom Division, 3M Co., Model 8155 (U.S.A) |
| **Audio Oscillator** | Hewlett Packard, Model 204C or equivalent |
| **Digital Frequency Counter** | Range: 10 Hz ~ 100 kHz; sensitivity; 0.1 Vrms; imp.: > 1 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)<br>0 ~2.2 lbs (0 ~ 1 kg)<br>Hex head Allen wrenches,<br>Plastic alignment tool |
| **Cleaning fluid:** | TEAC TZ-261 or equivalent<br>TEAC Spindle Oil TZ-255 or equivalent |
| **Head Demagnetizer** | TEAC E-3 or equivalent |
| **Test Tapes** | Reproduce Alignment Test Tape: TEAC YTT-1144SP<br>Equalization Standard: IEC, CCIR<br>Time Constant: 15 ips = ∞μs + 35 μs<br>Blank Test Tape (Recording):<br>TEAC Test Tape YTT-8163 |

## 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 housing by loosening the two hex screws ④ with a 3 mm hex-head wrench.
   5) Remove the eight hex screws ⑤ from both sides with a 2.5 mm hex-head wrench, and then remove the three screws ⑥ holding the bottom cover. 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 ⑦ 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 two screws ⑧ which are found inside the rear panel.
   3) Remove the six screws ⑨ (both sides) holding the bonnet panel.
4. Bottom Panel
   1) Remove the eight screws ⑩ from the feet attached to the bottom panel.
   2) Remove the six screws ⑪ 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.

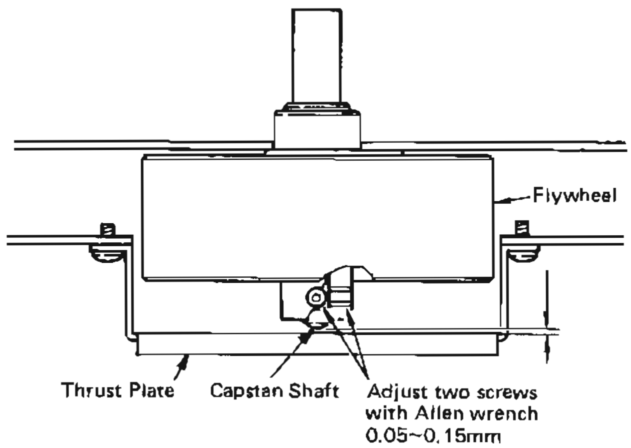



Fig. 2-1.

## 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 10-1/2" 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.

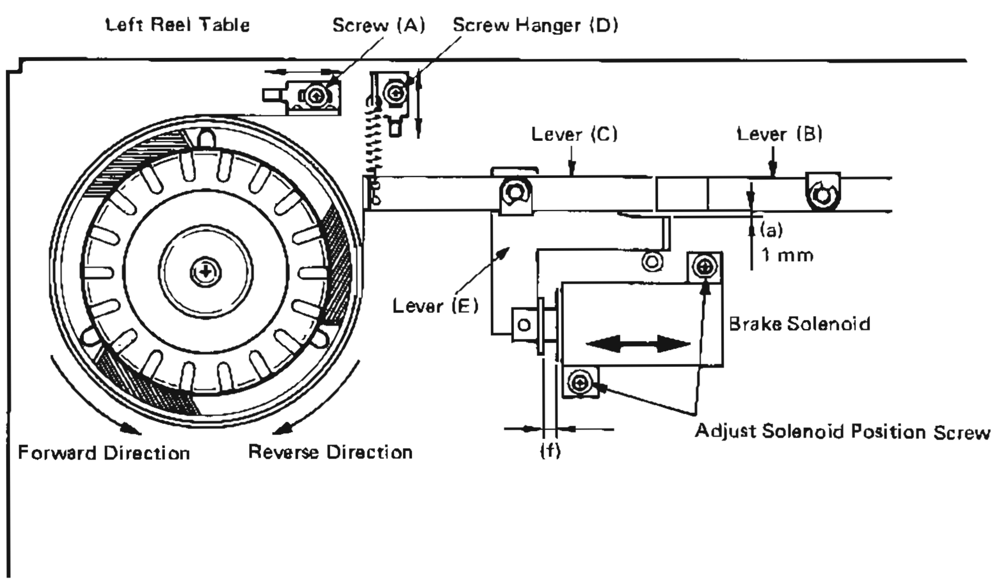



Fig. 2-2.

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, check to see if the brake felt pad is worn, 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.

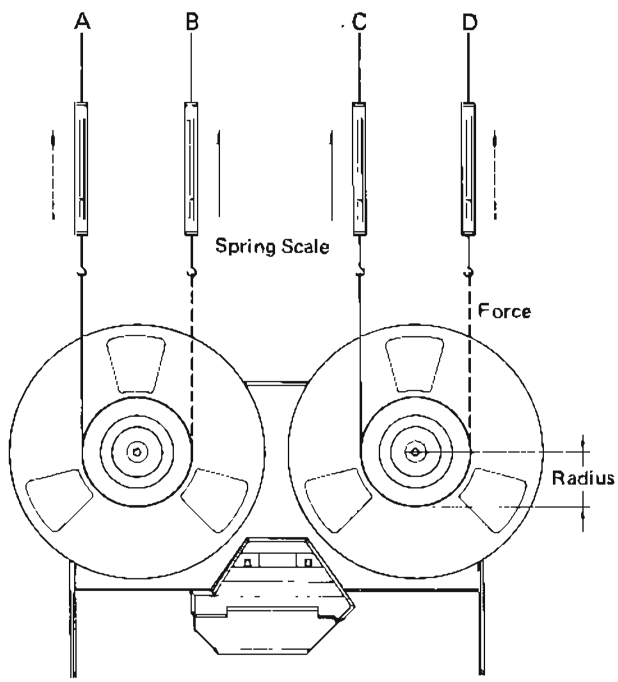



Fig. 2-3.

| Forward direction (B) (C) | 2300 – 2700 g-cm (31.9 – 37.5 oz-inch) |
|---|---|
| Reverse direction (A) (D) (Reference values) | 900 – 1000 g-cm (12.5 – 13.9 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.

### 2-6-1 Take-up torque

1. Hold the right tension arm up using a rubber band.
2. Mount an empty 10-1/2" 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 proper value is between 900 g-cm (12.5 oz-inch) and 1100 g-cm (15.3 oz-inch).
   Adjust the resistor (R658 on the control PC Board) to correct the take up torque. See Fig. 2-5 on page 59.

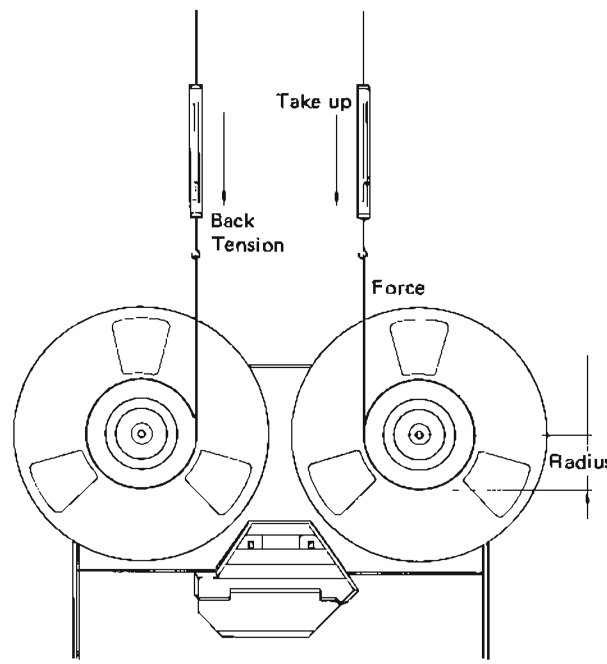



Fig. 2-4.

### 2-6-2 Back tension

1. Hold the right tension arm up using a rubber band.
2. Mount an empty 10-1/2" 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.
6. The proper value is between 650 g-cm (9.0 oz-inch) and 750 g-cm (10.5 oz-inch).
7. If necessary, adjust the resistor (R675) on the Control PC Board until the proper torque value is obtained.

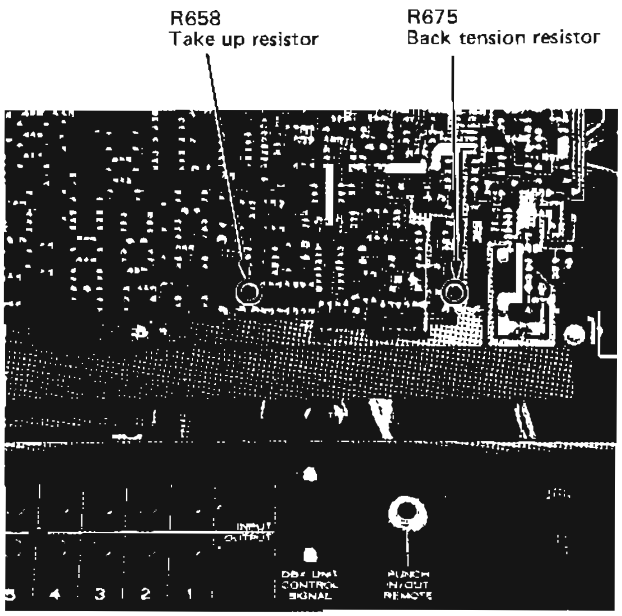



**Fig. 2-5. Resistors for Tension Adjustment on Control PC Board**

## 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 using 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 1.9 kg to 2.2 kg (4.19 lbs to 4.85 lbs).
   With the plunger pushed in by hand until the pinch roller makes contact with the capstan shaft, the distance between the leftmost edge of the plunger and the leftmost edge of the solenoid housing is normally about 3 mm.

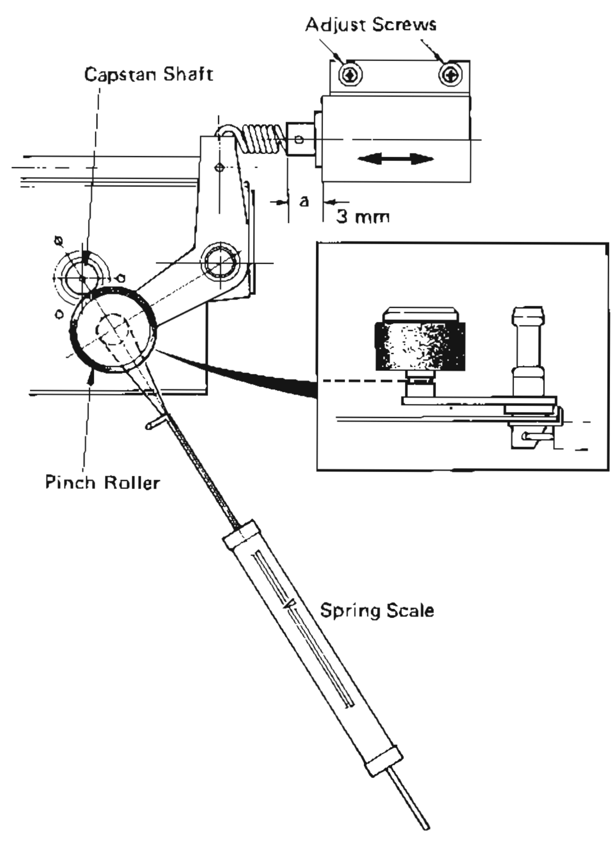



**Fig. 2-6.**

## 2-8. REEL TABLE HEIGHT ADJUSTMENT

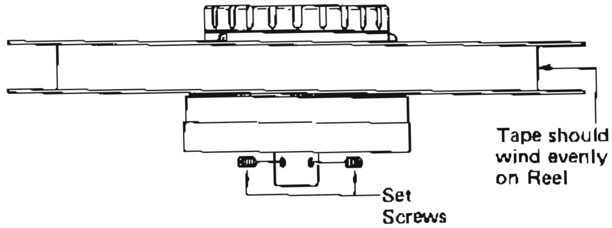



Fig. 2-7.

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. 2-7.
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 10-1/2" 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 56 (2-2).

## 2-9. TAPE SPEED

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

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 and adjust the HIGH speed trimmer resistor until the frequency counter indicates a reading of 3000 Hz. See Fig. 2-8. (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 taht the tape path is clean.

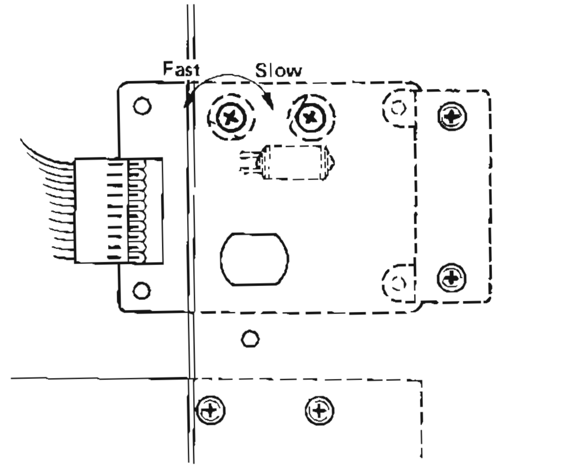



Fig. 2-8.

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

1. Connect a Wow-and-Flutter Meter to the deck as shown in Fig. 2-9.
   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:

| DIN/IEC/ANSI (peak value) | | NAB (rms value) | |
|---|---|---|---|
| Weighted | Unweighted | Weighted | Unweighted |
| ±0.06 % | ±0.10 % | 0.05 % | 0.07 % |

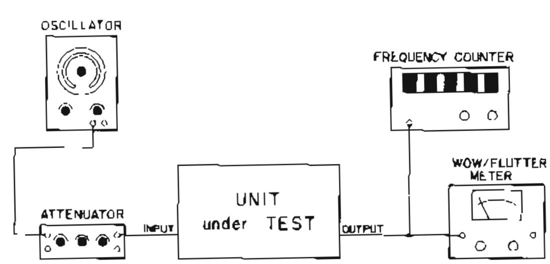



Fig. 2-9.

## 2-11. RECORD/REPRODUCE AMPLIFIER CHECKS AND 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. When irregular tape movement occurs, remove the nut fastened to the top of the left tape guide pin with an Allen wrench.
2. Thread and advance the tape, then check that the lower edge of the tape just touches the lower edge of the left tape guide pin. If it doesn't, adjust the tension arm height adjustment screw until the tape edge is just in contact with the lower edge of the guide pin.
3. Fasten the nut back onto the left tape guide.

### HEAD CONTACT

1. Load a prerecorded tape with a constant level tone and reproduce.
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 particular head (Shown in Fig. 2-13) 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.

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 their respective channels. See page 63.
Record/reproduce amplifier checks and adjustments are given for only one of the channels but they should be applied for all the other channels as well.
Before beginning any adjustments thoroughly demagnetize and clean the heads, tape guide, etc.

### HEAD AZIMUTH ADJUSTMENT

1. Connect the OUTPUT jack for channel 1 of the deck to the vertical input terminals of an oscilloscope.
2. Connect the OUTPUT jack for channel 8 of the deck to the horizontal input terminals of the oscilloscope.
3. Connect an AF level meter and a 50k ohm load to the OUTPUT jack(s) as shown in Fig. 2-11.

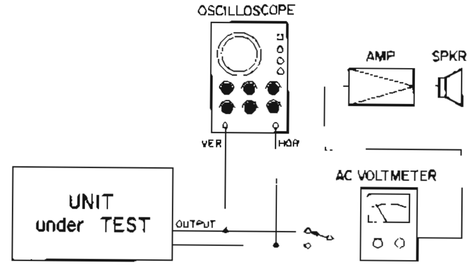



**Fig. 2-11. Head Azimuth Test Set-Up**

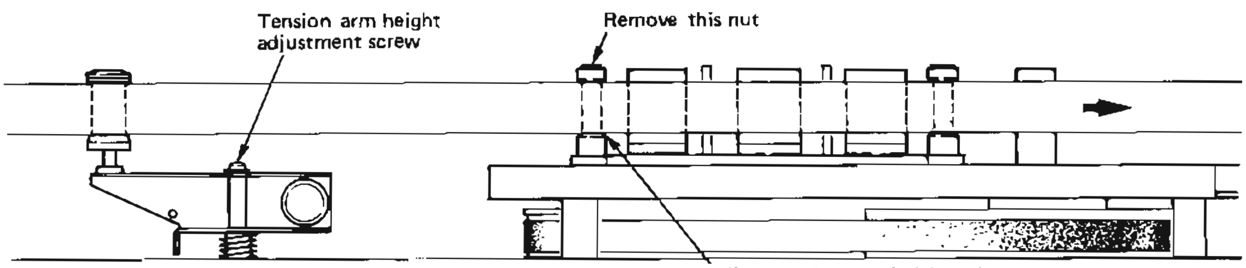



**Fig. 2-10. Tape Path Adjustment**

4. Switch OUTSELECT to REPRO.
5. Load the reproduce alignment test tape to reproduce. Then, a scope display reading showing phase relations between both channels will be obtained as shown in Fig. 2-12.
6. Adjust the REPRO head azimuth screw until the scope display shows less than 90 degree at 10 kHz out of phase with the AF level meter showing approximately maximum value for both channels.
7. Switch OUTSELECT to SYNC, and adjust the RECORD SYNC head azimuth screw the same way.

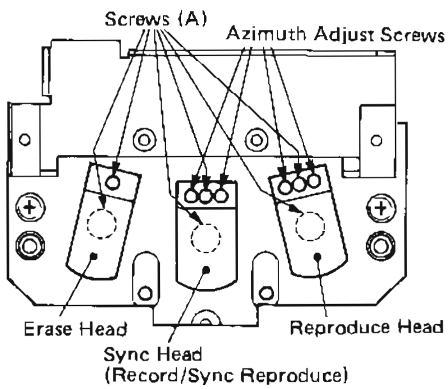
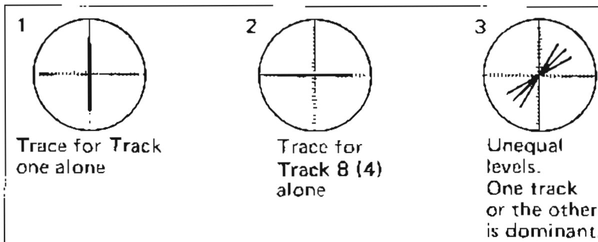


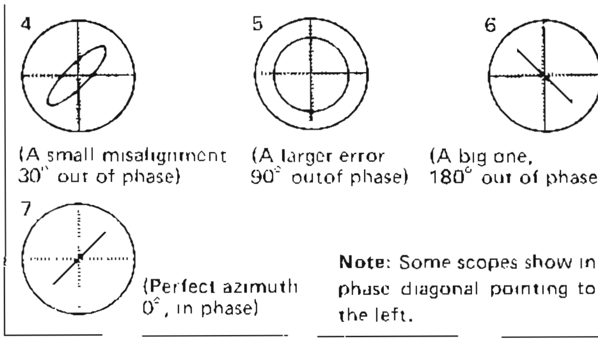

**Fig. 2-13. Head Contact and Azimuth Adjust Screws**

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.




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:




**Note:** Some scopes show in phase diagonal pointing to the left.

**Fig. 2-12. Phase Shift**

### 2-11-1 Input level calibration

1. Connect the test equipment as shown in Fig. 2-14.
2. Apply a 400 Hz, -10 dB (0.3 V) test signal to the INPUT jack on rear panel, and switch OUTSELECT to INPUT.
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.

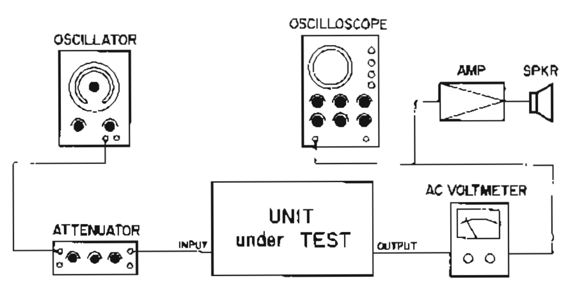



**Fig. 2-14. Input Level Calibration**

### 2-11-2 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 2-11-1 (2-3) or after setting the input level to read -10 dB output. If the meter does not indicate 0 VU, adjust R141 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 OUTSELECT to REPRO.
3. Load the reproduce alignment test tape 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 OUTSELECT 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 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 on to the tape deck.
3. Switch the OUTSELECT to REPRO.
4. Reproduce the test tape and take a reading of the output levels at the specified frequencies shown in Fig. 2-15. They should be within the limit shown below. If not, adjust the (R108) trim pot.

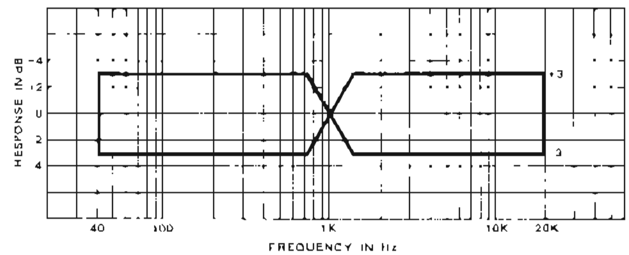
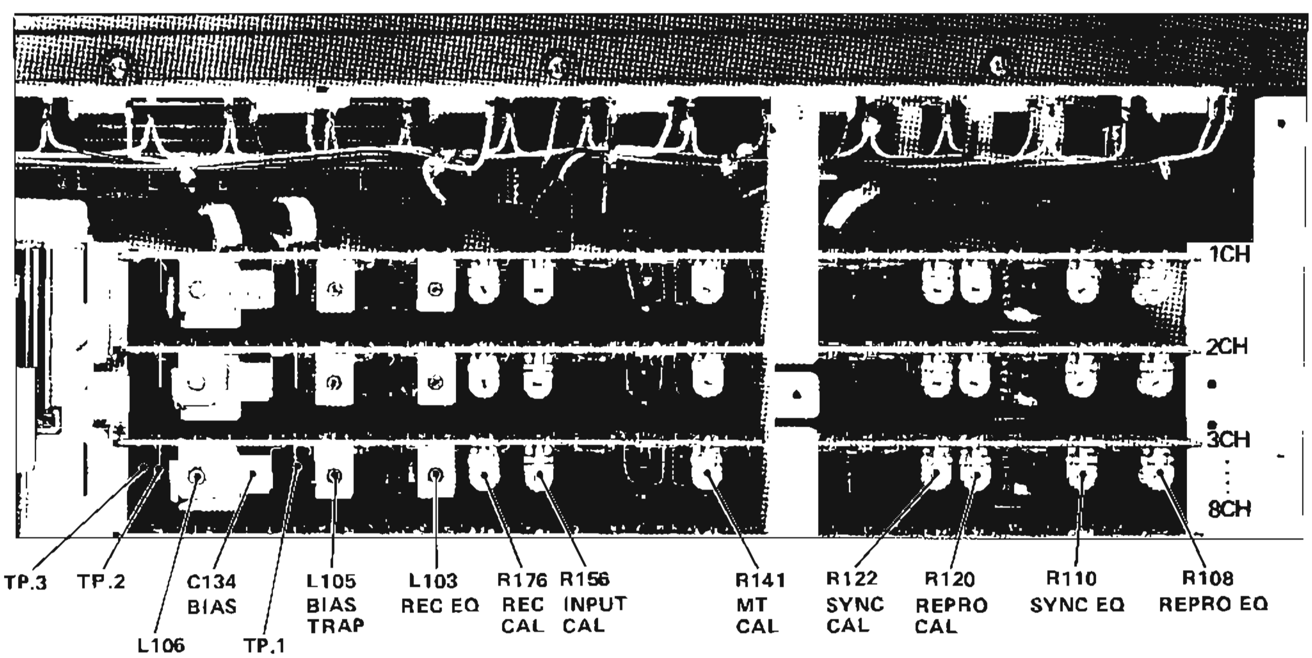



**Fig. 2-15. Reproduce Frequency Response**

5. Switch OUTSELECT to SYNC.
6. Reproduce the same tape and also read the output levels the same way to learn whether the frequency response is within the specified limit. If the frequency response is not within the specified limit, adjust the (R110) trim pot.
7. If the specifed frequency response cannot be obtained with the trim pot(s) adjusted;
   * Check and compare the measurements of the other channels. If they stand up to spec, correct or replace the off spec chan-



nel record/reproduce amplifier PCB.
* If all 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.

### 2-11-5 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 all channel 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) or across the resistor R198 by using an insulate screwdriver, adjust L106 to obtain a minimum reading on the DC meter. 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 all the 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.

### 2-11-6 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 oscillator, oscilloscope, AF level meter (adjusted to 1 V range) and a 50k ohm load to the tape deck as shown in Fig. 2-14.
2. Adjust the AF oscillator to apply a 10 kHz, -10 dB (0.3 V, 0 VU) signal to the INPUT jack on rear panel.
3. Switch OUTSELECT to REPRO and set all FUNCTION switches to ON.
4. Begin recording. Now adjustments can be made while recording a 10 kHz tone.
5. 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 – 5 dB from the peak reading as shown in Fig. 2-16.

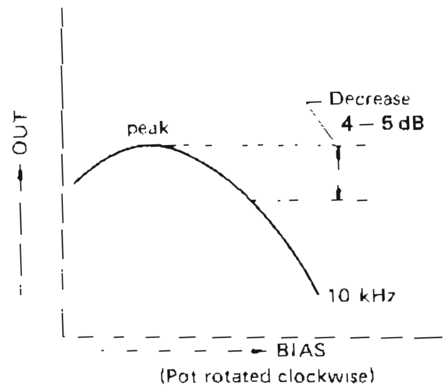



**Fig. 2-16. Bias Level Adjustment**

#### 2-11-7 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. 2-14.
2. Apply a 1 kHz, -10 dB (0.3 V) signal to the INPUT Jack.
3. Switch OUTSELECT to REPRO and record the 1 kHz input signal on the specified recording test tape.
4. 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 mounted on the front panel indicates 0 VU.
5. Switch OUTSELECT to SYNC and record the 1 kHz 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.
6. If it's impossible to obtain a VU meter reading of 0 VU in steps 4 and 5 above, check to see whether the reproduce meter is set properly as described under 2-11-2. "Meter calibration".

#### 2-11-8 Frequency response (OVERALL)

After completion of the Recording Level Check and Adjustment, preceed to the Overall Frequency Response Check.

1. Connect the test equipment to the tape deck as shown in Fig. 2-14 and load a blank test tape onto the tape deck.
2. Apply a -10 dB test signal to the INPUT jack on the rear panel.
3. Switch OUTSELECT to REPRO and record the test signal with the frequency varied from 40 Hz to 20 kHz. Read the reproduced output levels at the proper test frequencies during recording. Make sure the frequency response obtained is within the specified limit shown in Fig. 2-17.
4. Switch OUTSELECT 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 the reproduced output levels at the proper test frequencies, and make sure that the frequency response is within the specified limit shown.
5. If the frequency response reading is not within the specified limit, readjust the Bias Level Setting within its specified range by refering to 2-11-6 "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 2-11-7 "Recording level adjustment".

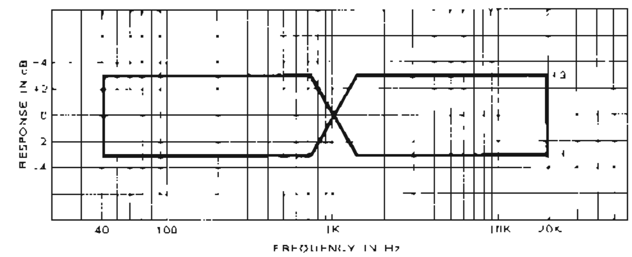



**Fig. 2-17. Overall Frequency Response**

#### 2-11-9 Signal-to-noise ratio (OVERALL)

Prior to measurement, demagnetize all heads and tape guides.

1. Connect test equipment as shown in Fig. 2-14.
2. Apply a 1 kHz -10 dB (0.3 V = 0 VU) input signal to the INPUT jack on the rear panel.
3. Switch OUTSELECT to SYNC and record a short length of the input signal, then, while still in the recording mode, unplug the AF oscillator connected to the INPUT jack, 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 1 kHz (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 channels. If they stand up to spec, correct or replace the off spec channel record/reproduce amplifier PCB.
   * Demagnetize the heads.
   * Check erasure, refer to item 2-11-10.
   * Check for proper adjustment of the bias trap.
   * Try another tape of the same type number.

### 2-11-10 Erase ratio

1. Connect test equipment to the tape deck as shown in Fig. 2-18.
2. Use a 1 kHz bandpass filter to check the erasing ratio.
3. Switch OUTSELECT to SYNC and record a short length of the 1 kHz, 0 dB (1 V) signal and unplug the AF oscillator connected to the INPUT jack on rear panel.
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 output voltage for 60 — 70 V using an AC volt-meter.

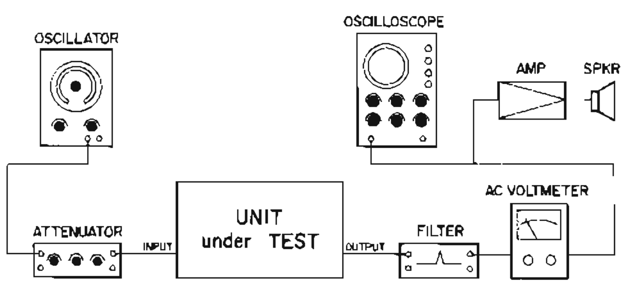



**Fig. 2-18. Erase Ratio Test Set-Up**

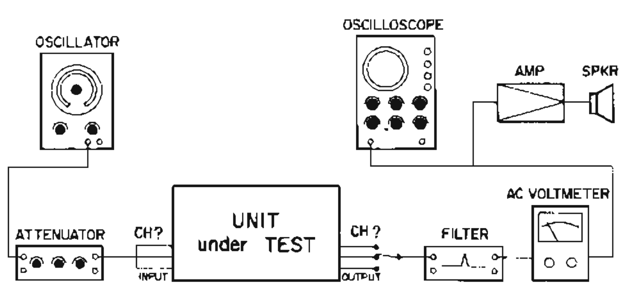



**Fig. 2-19. Crosstalk Measurement Set-Up**

### 2-11-11 Adjacent channel crosstalk

1. Connect test equipment as shown in Fig. 2-19.
2. While performing "no signal" recordings on one of the channels, apply a 1 kHz -10 dB (0.3 V) test signal to the adjacent channel.
3. Rewind the tape to the beginning of the recording.
4. Reproduce the tape with SYNC (OUTPUT SELECT) button depressed, after which, measure the output of the "no signal" recorded channel.
5. Measure the output of the adjacent channel. The difference should be 50 dB or greater.

### 2-11-12 Distortion

1. Connect test equipment as shown in Fig. 2-20.
2. Switch OUTSELECT to REPRO.

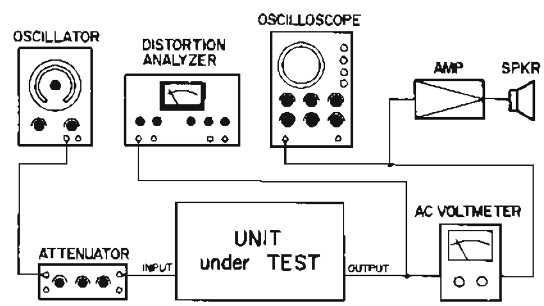


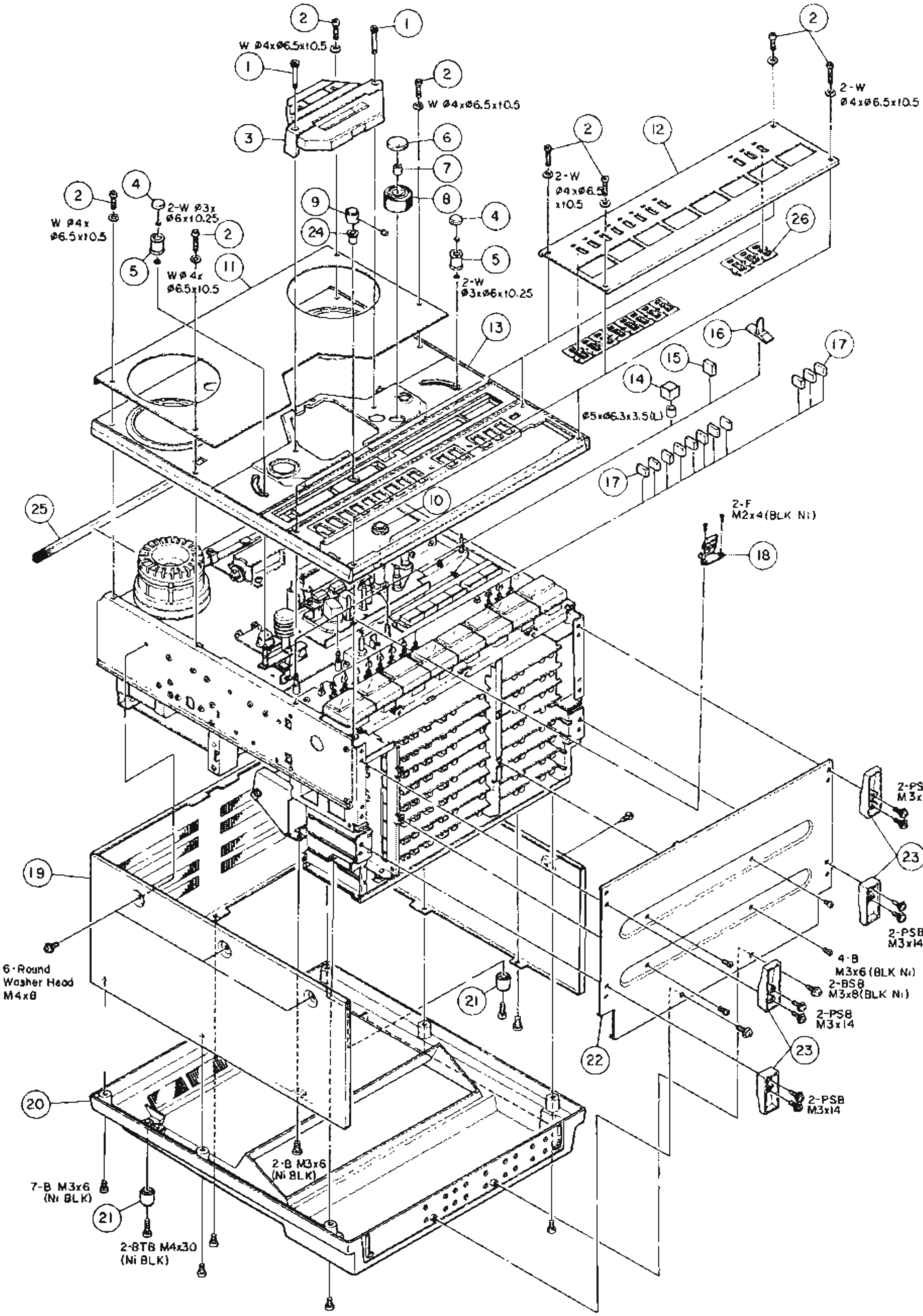

**Fig. 2-20. Distortion Measurement Set-Up**

3. Apply a 1 kHz, -10 dB (0.3 V) test signal to the INPUT jack and reproduce. Measure distortion of the reproduced output with a distortion analizer connected to the OUTPUT jack.
4. Change the input test signal level to 0 dB (1 V) and continue to measure the distortion of the reproduced output signal while recording.
5. Stop the recording and switch OUTSELECT to SYNC.
6. Rewind the tape to its beginning and reproduce. Measure the distortion of the two sections, each of which recorded with the input signal levels of -10 dB and 0 dB, respectively.
7. The distortion measured should be less than 0.8 % for a -10 dB recording.
8. If the distortion is off spec;
   * Check and compare the measurements of the other channels. If they are 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.

# 3. EXPLODED VIEWS AND PARTS LISTS

## 3-1 EXPLODED VIEWS AND PARTS LISTS OF 38

### EXPLODED VIEW–1



## EXPLODED VIEW—1

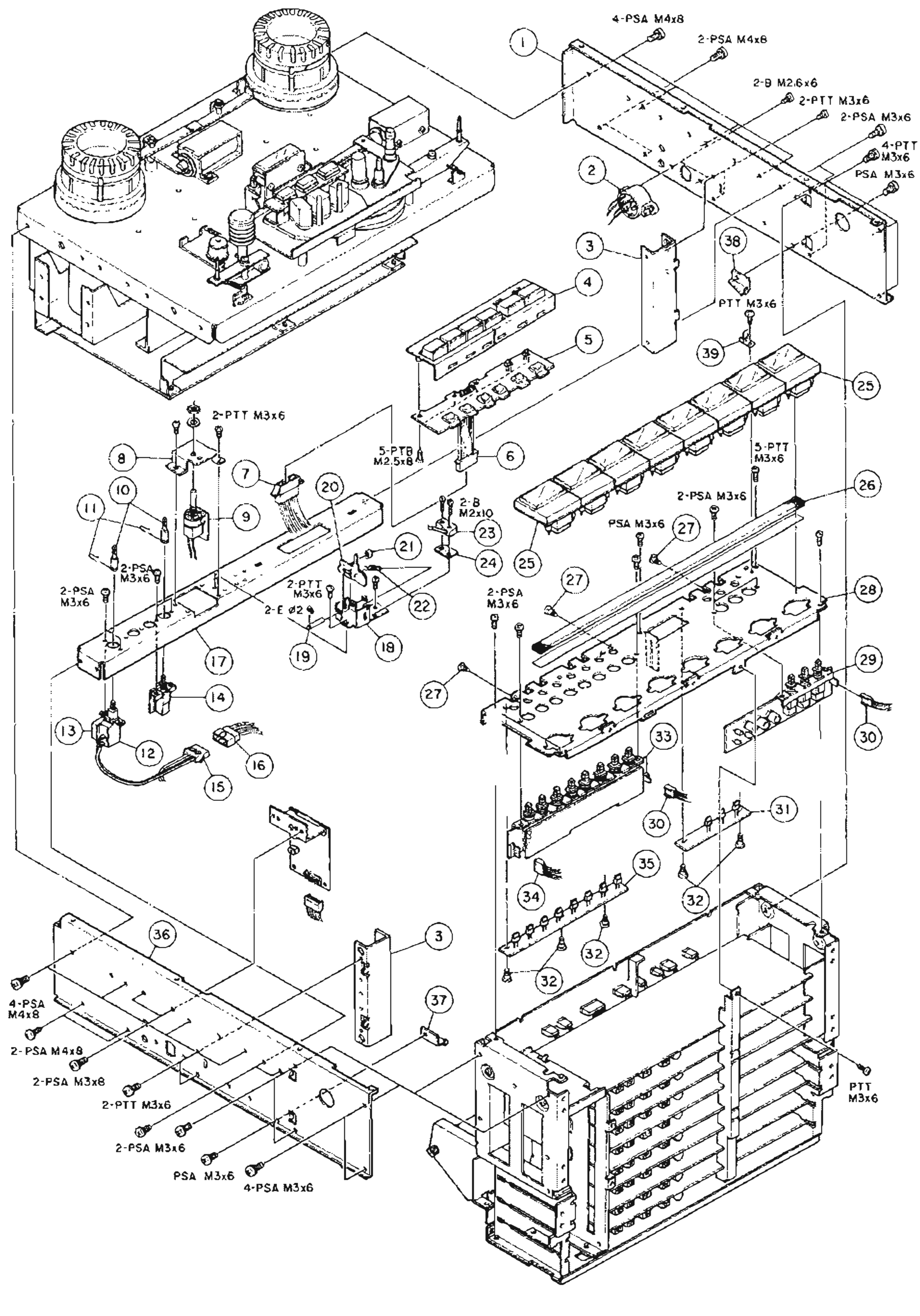
Parts marked with * require longer delivery time.

| REF. NO. | PARTS NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| 1 - 1 | *5800307000 | Screw, Head Housing | |
| 1 - 2 | *5800306900 | Screw, Top Panel | |
| 1 - 3 | *5800307300 | Housing Assy, Head; (2) | |
| 1 - 4 | *5800297500 | Cap, Tension Roller | |
| 1 - 5 | 5800297800 | Roller Assy, Tension | |
| 1 - 6 | *5800312100 | Cap, Pinch Roller | |
| 1 - 7 | *5011266000 | Collar, Bearing | |
| 1 - 8 | 5800291500 | Pinch Roller (1/2") | |
| 1 - 9 | 5800288000 | Knob, Pitch Control, (PH) | |
| 1 - 10 | *5800288600 | Cap, Dust | |
| 1 - 11 | *5800293000 | Panel, Transport | |
| 1 - 12 | *5800286900 | Panel Assy, Ampl; (A) | |
| 1 - 13 | *5800286800 | Panel Assy, Top, Dress; (B) | |
| 1 - 14 | 5800173100 | Button, Power Switch | |
| 1 - 15 | 5800288200 | Button, Switch | |
| 1 - 16 | 5800288100 | Knob, Cue | |
| 1 - 17 | 5800288300 | Button, Push | |
| 1 - 18 | *5800301200 | Shield Assy, Front | |
| 1 - 19 | *5800294400 | Bonnet; (B) | |
| 1 - 20 | *5800347900 | Case, Rear; (B) | |
| 1 - 21 | *5800307100 | Collar, Foot; (A) | |
| 1 - 22 | *5800348300 | Bottom Assy; (B) | |
| 1 - 23 | *5800288500 | Foot | |
| 1 - 24 | *5800067700 | Nut, Lock | |
| 1 - 25 | *5800289500 | Cushion, Bonnet | |
| 1 - 26 | *5800287400 | Escutcheon; BL | |

(Continued from page 72)

| REF. NO. | PART NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| 3 - 56 | *5534850000 | Cushion, Stopper | |
| 3 - 57 | *5534849000 | Flywheel | |
| 3 - 58 | 5534468000 | Belt, Capstan | |
| 3 - 59 | *5800300300 | Chassis Assy, Main | |
| 3 - 60 | *5534850000 | Cushion, Stopper | |
| 3 - 61 | *5800298200 | Shaft, Guide Roller | |
| 3 - 62 | 5800298100 | Roller Sub Assy, Guide | |
| 3 - 63 | *5800312200 | Cap, Guide Roller | |
| 3 - 64 | *5800297700 | Shaft, Tension Arm; (L) | |
| 3 - 65 | *5800297600 | Collar, Tension Arm | |
| 3 - 66 | *5800304000 | Screw, Lock | |
| 3 - 67 | *5122172000 | Connector Socket, 10P | |
| 3 - 68 | *5122170000 | Connector, Socket, 8P | |
| 3 - 69 | 5312000100 | Counter, FL4028 | |
| 3 - 70 | *5200074000 | PCB Assy, Counter | |
| 3 - 71 | *5800294900 | Base Assy, Counter | |
| 3 - 72 | *5581038000 | Clamper, Cord | |
| 3 - 73 | *5555570000 | Cushion, B | |
| 3 - 74 | *5800307200 | Bolt, Cap. M3 x 6 | |
| 3 - 75 | *5800326600 | Spacer, Reel | |
| 3 - 76 | *5785150400 | Washer, Wave; (W-W-4) | |
| 3 - 77 | *5800348700 | Screw, Head Hold | |
| 3 - 78 | *5781733010 | Bolt, Cap, M3 x 10 | |

## EXPLODED VIEW–2



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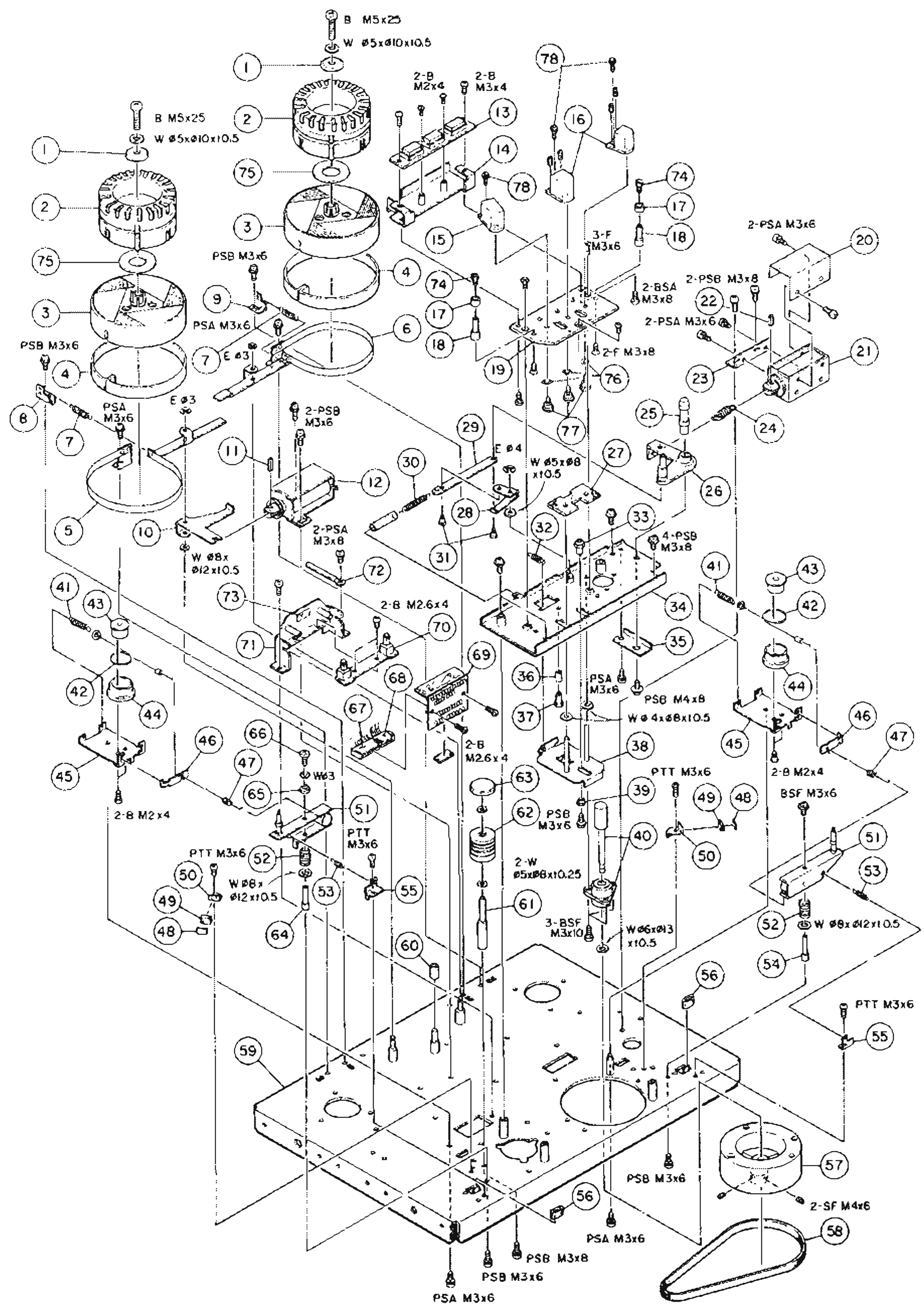
*dbx Noise Reduction Unit DX-4D and Recording Mixer M-30 are optional.

## 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 | |
| 2 - 3 | *5800289100 | Bracket, CONTROL PCB; B | |
| 2 - 4 | *5800287000 | Button Assy, Control | |
| 2 - 5 | *5200073600 | PCB Assy, Operation | |
| 2 - 6 | *5122172000 | Connector Socket, 10P (WHT) | |
| 2 - 7 | *5336114000 | Connector Plug 10P (WHT), Plug 524-10P | |
| 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 [JAPAN] | |
| | ⚠ 5300027400 | Switch, POWER [U, C] | |
| | ⚠ 5300027500 | Switch, POWER [E, A, GE, UK] | |
| 2 - 13 | ⚠ 5052907000 | Spark Killer, 0.01μF + 300Ω/300V [JAPAN, GE] | |
| | ⚠ 5052910000 | Spark Killer, 0.033μF + 120Ω/125V [U] | |
| | ⚠ 5292002600 | Spark Killer, 0.033μF + 120Ω/125V [C] | |
| | ⚠ 5267702500 | Spark Killer, 0.0047μF 250V [E, A, UK] | |
| 2 - 14 | *5200074100 | PCB Assy, EDIT | |
| 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 | 5296003300 | Meter, VU | |
| 2 - 26 | *5800288801 | Cushion, Meter | |
| 2 - 27 | *5800002600 | Screw, Shoulder; F | |
| 2 - 28 | *5800293300 | Chassis, Ampl.; 8 | |
| 2 - 29 | *5200075200 | PCB Assy, OUT SELECT | |
| 2 - 30 | *5122166000 | Connector Socket, 4P (WHT) | |
| 2 - 31 | *5200075900 | PCB Assy, OUT SELECT LED | |
| 2 - 32 | *5800002600 | Screw, Shoulder; F | X-10R |
| 2 - 33 | *5200075300 | PCB Assy, Function Select; A | |
| 2 - 34 | *5122167000 | Connector Socket, 5P (WHT) | |
| 2 - 35 | *5200075700 | PCB Assy, Function LED; | |
| 2 - 36 | *5800293800 | Chassis, Side; L | |
| 2 - 37 | *5800289200 | Bracket, L | |
| 2 - 38 | *5800289300 | Bracket, R | |
| 2 - 39 | *5800289800 | Spring, Earth; (B) | |

## EXPLODED VIEW–3



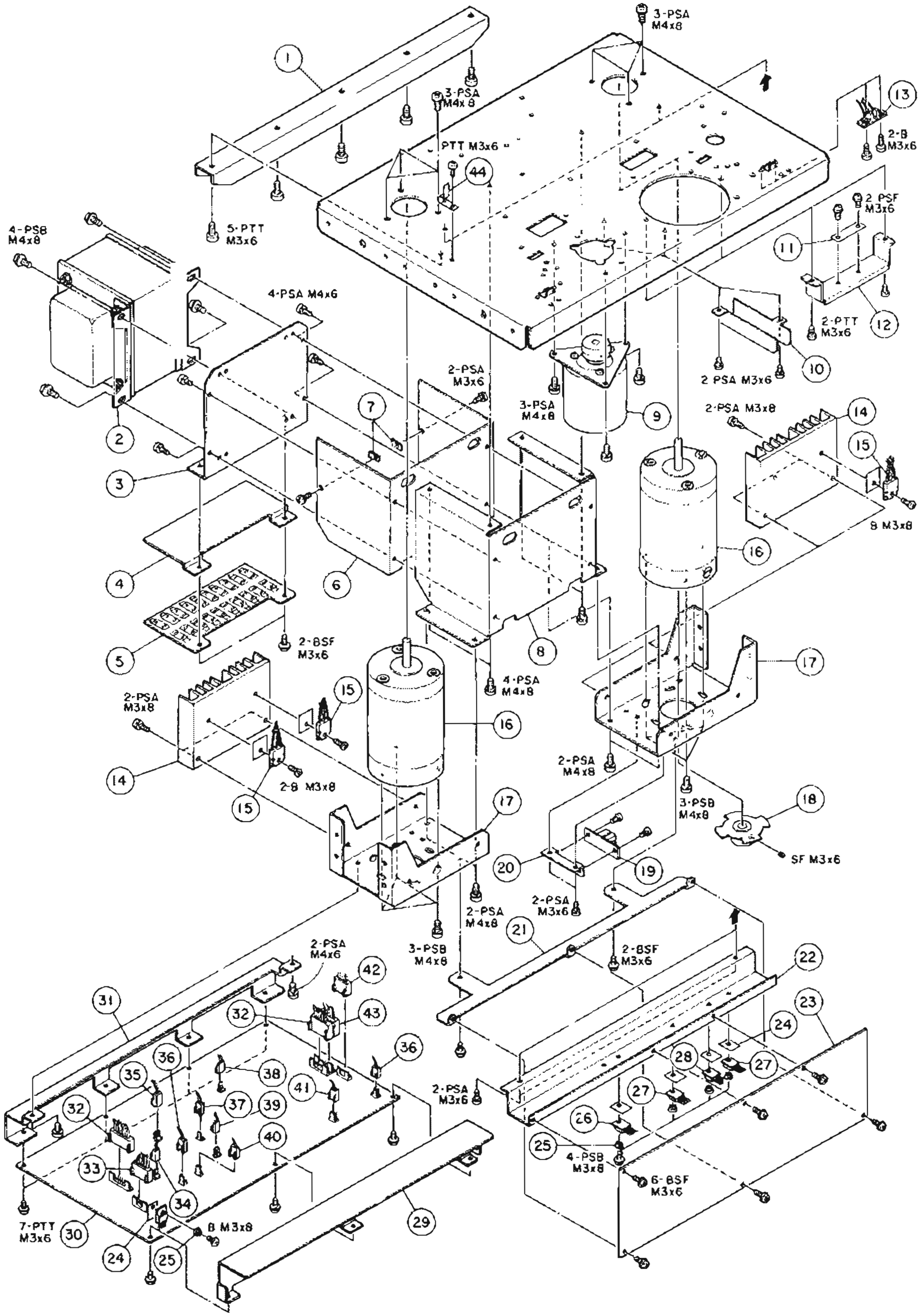
## EXPLODED VIEW–3

Parts marked with * require longer delivery time.

| REF. NO. | PARTS NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| 3 - 1 | *5800324900 | Washer, Clamper, (A) | |
| 3 - 2 | 5740003400 | Clamper, Reel, D, 1/2" | |
| 3 - 3 | 5800300500 | Table Assy, Reel | |
| 3 - 4 | 5800295700 | Felt, Washer | |
| 3 - 5 | *5800295200 | Band Assy, Brake; (L) | |
| 3 - 6 | *5800295301 | Band Assy, Brake; (R) | |
| 3 - 7 | *5800301700 | Spring, Brake; B | |
| 3 - 8 | *5555929000 | Hook, Spring; (L) | |
| 3 - 9 | *5800295800 | Hook, Spring; (R) | |
| 3 - 10 | *5800299000 | Lever, Brake Actuating | |
| 3 - 11 | *5786303012 | Pin, Spring; $\phi$3 x 12 | |
| 3 - 12 | 5313001500 | Solenoid, Brake | |
| 3 - 13 | *5200076100 | PCB Assy, Head | |
| 3 - 14 | *5800295900 | Base Assy, Head Connector | |
| 3 - 15 | 5378300200 | Head, ERASE | |
| 3 - 16 | 5378300400 | Head, REC/PLAY | |
| 3 - 17 | 5800296300 | Cap, Guide | |
| 3 - 18 | 5800296200 | Guide, Tape; 1/2 inch | |
| 3 - 19 | *5800300701 | Base, Head | |
| 3 - 20 | *5800317700 | Plate, Shield; Solenoid | |
| 3 - 21 | 5313001600 | Solenoid, Pinch Roller | |
| 3 - 22 | *5786303012 | Pin, Spring; $\phi$3 x 12 | |
| 3 - 23 | *5800171000 | Bracket, Solenoid | |
| 3 - 24 | *5524286001 | Spring, Pressure | |
| 3 - 25 | 5800291900 | Shaft, Guide; 1/2 inch | |
| 3 - 26 | *5800290900 | Arm Assy, Pinch Roller | |
| 3 - 27 | *5800303600 | Cover, Lifter | |
| 3 - 28 | *5555925000 | Arm, Joint; A | |
| 3 - 29 | *5555926000 | Arm, Joint; B | |
| 3 - 30 | *5524288000 | Spring, Return | |
| 3 - 31 | *5581056000 | Screw, Shoulder; A | |
| 3 - 32 | *5800301900 | Spring, Lifter | |
| 3 - 33 | *5800290200 | Collar, Head Base; A | |
| 3 - 34 | *5800296400 | Base Assy, Capstan | |
| 3 - 35 | *5800302700 | Plate, Pinch Roller Arm | |
| 3 - 36 | *5800316000 | Cushion, Stopper | |
| 3 - 37 | *5800290400 | Stopper, Lifter | |
| 3 - 38 | *5800290600 | Base Assy, Lifter | |
| 3 - 39 | *5800290500 | Collar, Lifter Base | |
| 3 - 40 | 5800291300 | Capstan Assy | |
| 3 - 41 | *5800301800 | Spring, Damper | |
| 3 - 42 | *5800301000 | String Assy, Damper | |
| 3 - 43 | *5800305600 | Shaft, Damper | |
| 3 - 44 | *5800301100 | Drum, Damper | |
| 3 - 45 | *5800300800 | Base, Damper | |
| 3 - 46 | *5800300900 | Arm, Damper | |
| 3 - 47 | *5800302000 | Spring | |
| 3 - 48 | *5800298500 | Plate, Damper | |
| 3 - 49 | *5800298400 | Damper | |
| 3 - 50 | *5555930000 | Stopper, Arm | |
| 3 - 51 | *5800297401 | Arm Assy, Tension | |
| 3 - 52 | *5524289000 | Spring, Bias | |
| 3 - 53 | *5524106000 | Spring, Hook Plate | |
| 3 - 54 | *5800299100 | Shaft, Tension Arm; (R) | |
| 3 - 55 | *5555929000 | Hook, Spring | |

(Continued on page 68)

# EXPLODED VIEW—4

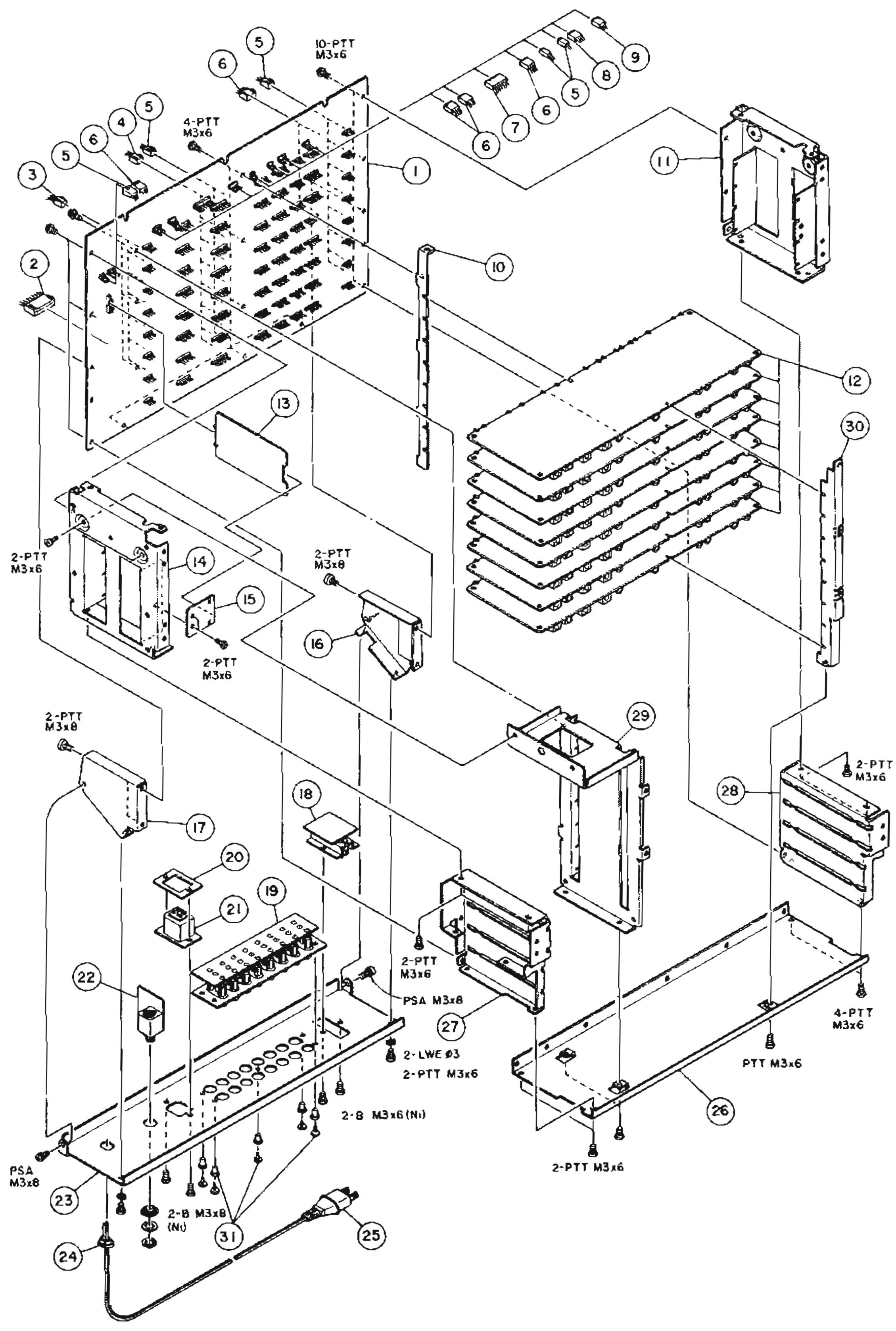


## EXPLODED VIEW—4

Parts marked with * require longer delivery time.

| REF. NO. | PARTS NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| 4 - 1 | *5800300200 | Angle, Main Chassis | |
| 4 - 2 | *5320014600 | Transformer, Power [JAPAN] | |
| | *5320014700 | Transformer, Power [U, C] | |
| | *5320014800 | Transformer, Power [GE] | |
| | *5320014900 | Transformer, Power [E] | |
| | *5320015000 | Transformer, Power [A, UK] | |
| 4 - 3 | *5800299801 | Holder, Transformer; B | |
| 4 - 4 | *5800305700 | Plate, Insulating; FUSE PCB | |
| 4 - 5 | *5200073500 | PCB Assy, FUSE [JAPAN, GE] | |
| | *5200073510 | PCB Assy, FUSE [U, C] | |
| | *5200073520 | PCB Assy, FUSE [A, E, UK] | |
| 4 - 6 | *5800300100 | Plate, Insulating; Transformer | |
| 4 - 7 | *5027737000 | Nut, Plate | |
| 4 - 8 | *5800299900 | Bracket, Transformer; B | |
| 4 - 9 | 5370002900 | Motor Assy, DC Capstan | |
| 4 - 10 | *5800299700 | Holder, Cord | |
| 4 - 11 | *5555921000 | Plate, Thrust | |
| 4 - 12 | *5555920001 | Angle, Thrust | |
| 4 - 13 | *5200073800 | PCB Assy, SHUTT OFF | |
| 4 - 14 | *5800296700 | Heatsink | |
| 4 - 15 | ⚠ 5145165000 | Transistor, 2SD716(O) | |
| 4 - 16 | 5370002700 | DC Motor, Reel | |
| 4 - 17 | *5800300000 | Holder, Motor | |
| 4 - 18 | *5800299400 | Encoder Assy | |
| 4 - 19 | *5200073900 | PCB Assy, SENSOR | |
| 4 - 20 | *5800299300 | Bracket, SENSOR PCB | |
| 4 - 21 | *5800303400 | Bracket, POWER SUPPLY PCB | |
| 4 - 22 | *5800303500 | Heatsink | |
| 4 - 23 | *5200073400 | PCB Assy, POWER SUPPLY | |
| 4 - 24 | *5033291000 | Plate, Insulating | |
| 4 - 25 | *5033295000 | Tube, Insulating | |
| 4 - 26 | 5220405100 | IC, MPC78M05H | |
| 4 - 27 | 5145087000 | Transistor, 2SD313E | |
| 4 - 28 | 5145129000 | Transistor, 2SB507E | |
| 4 - 29 | *5800293500 | Heatsink | |
| 4 - 30 | *5200073300 | PCB Assy, CONTROL | |
| 4 - 31 | *5800294100 | Bracket, CONTROL PCB | |
| 4 - 32 | *5122172000 | Connector Socket, 10P (WHT) | |
| 4 - 33 | *5122169000 | Connector Socket, 7P (WHT) | |
| 4 - 34 | *5122222000 | Connector Socket, 3P (BLK) | |
| 4 - 35 | *5336109300 | Connector Socket, 3P (YLW) | |
| 4 - 36 | *5122165000 | Connector Socket, 3P (WHT) | |
| 4 - 37 | *5122164000 | Connector Socket, 3P (WHT) | |
| 4 - 38 | *5122221000 | Connector Socket, 2P (BLK) | |
| 4 - 39 | *5122280000 | Connector Socket, 2P (RED) | |
| 4 - 40 | *5122281000 | Connector Socket, 3P (RED) | |
| 4 - 41 | *5122166000 | Connector Socket, 4P (WHT) | |
| 4 - 42 | *5122168000 | Connector Socket, 6P (WHT) | |
| 4 - 43 | *5122288000 | Connector Socket, 10P (RED) | |
| 4 - 44 | *5800289600 | Spring, Earth; (A) | |

# EXPLODED VIEW-5



## EXPLODED VIEW–5

Parts marked with * require longer delivery time.

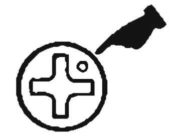
| REF. NO. | PARTS NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| 5 - 1 | *5200074600 | PCB Assy, MOTHER | |
| 5 - 2 | *5122173000 | Connector Socket, 11P (WHT) | |
| 5 - 3 | *5122221000 | Connector Socket, 2P (BLK) | |
| 5 - 4 | *5122280000 | Connector Socket, 2P (RED) | |
| 5 - 5 | *5122164000 | Connector Socket, 2P (WHT) | |
| 5 - 6 | *5122166000 | Connector Socket, 4P (WHT) | |
| 5 - 7 | *5122170000 | Connector Socket, 8P (WHT) | |
| 5 - 8 | *5122167000 | Connector Socket, 5P (WHT) | |
| 5 - 9 | *5122165000 | Connector Socket, 3P (WHT) | |
| 5 - 10 | *5800292100 | Bracket, PCB; C | |
| 5 - 11 | *5800293200 | Frame, Ampl; FR | |
| 5 - 12 | *5200074800 | PCB Assy, REC/PLAY AMPL | |
| 5 - 13 | *5200074900 | PCB Assy, MASTER OSC | |
| 5 - 14 | *5800293100 | Frame, Ampl; FL | |
| 5 - 15 | *5800289700 | Bracket, MASTER OSC PCB | |
| 5 - 16 | *5800289000 | Bracket, MOTHER PCB; R | |
| 5 - 17 | *5800288900 | Bracket, MOTHER PCB; L | |
| 5 - 18 | *5200073700 | PCB Assy, REMOTE | |
| 5 - 19 | *5200075000 | PCB Assy, IN/OUT | |
| 5 - 20 | *5555700000 | Plate, Nut | |
| 5 - 21 | *5122339000 | Connector Socket, 6P | |
| 5 - 22 | *5200077700 | PCB Assy, PUNCH IN/OUT | |
| 5 - 23 | *5800293700 | Panel, Connector; B | |
| 5 - 24 | *5534660000 | Strain Relief, AC Power Cord [All except UK] | |
| | *5534661000 | Strain Relief, AC Power Cord [UK] | |
| 5 - 25 | ⚠ *5127246000 | Cord, AC Power [JAPAN, GE] | |
| | ⚠ *5128083000 | Cord, AC Power [U, C] | |
| | ⚠ *5128095000 | Cord, AC Power [UK] | |
| | ⚠ *5350008200 | Cord, AC Power [E] | |
| | ⚠ *5350008400 | Cord, AC Power [A] | |
| 5 - 26 | *5800293400 | Chassis, Back; B | |
| 5 - 27 | *5800292300 | Chassis, Ampl.; BL | |
| 5 - 28 | *5800292400 | Chassis, Ampl.; BR | |
| 5 - 29 | *5800293600 | Holder, PCB; B | |
| 5 - 30 | *5800292200 | Bracket, PCB; D | |
| 5 - 31 | *5786610300 | Rivet, Push | |

## INCLUDED ACCESSORY

| REF. NO. | PARTS NO. | DESCRIPTION | REMARKS |
|---|---|---|---|
| | 5740002800 | 10-1/2" Reel | Except TCA |

# ASSEMBLING HARDWARE CODING LIST

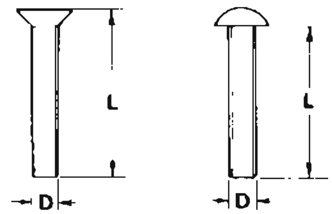
All screws conform to ISO standards, and have crossrecessed heads, unless otherwise noted.
ISO screws have the head inscribed with a point as in the figure to the right.



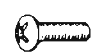
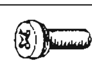
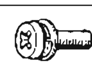
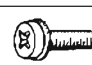
*FOR EXAMPLE:*

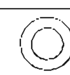
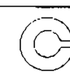
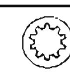
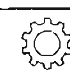
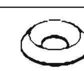
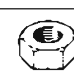
B M 3 x 6

- Length in mm (L)
- Diameter in mm (D) *
- Metric System
- Nomenclature




* Inner dia. for washers and nuts

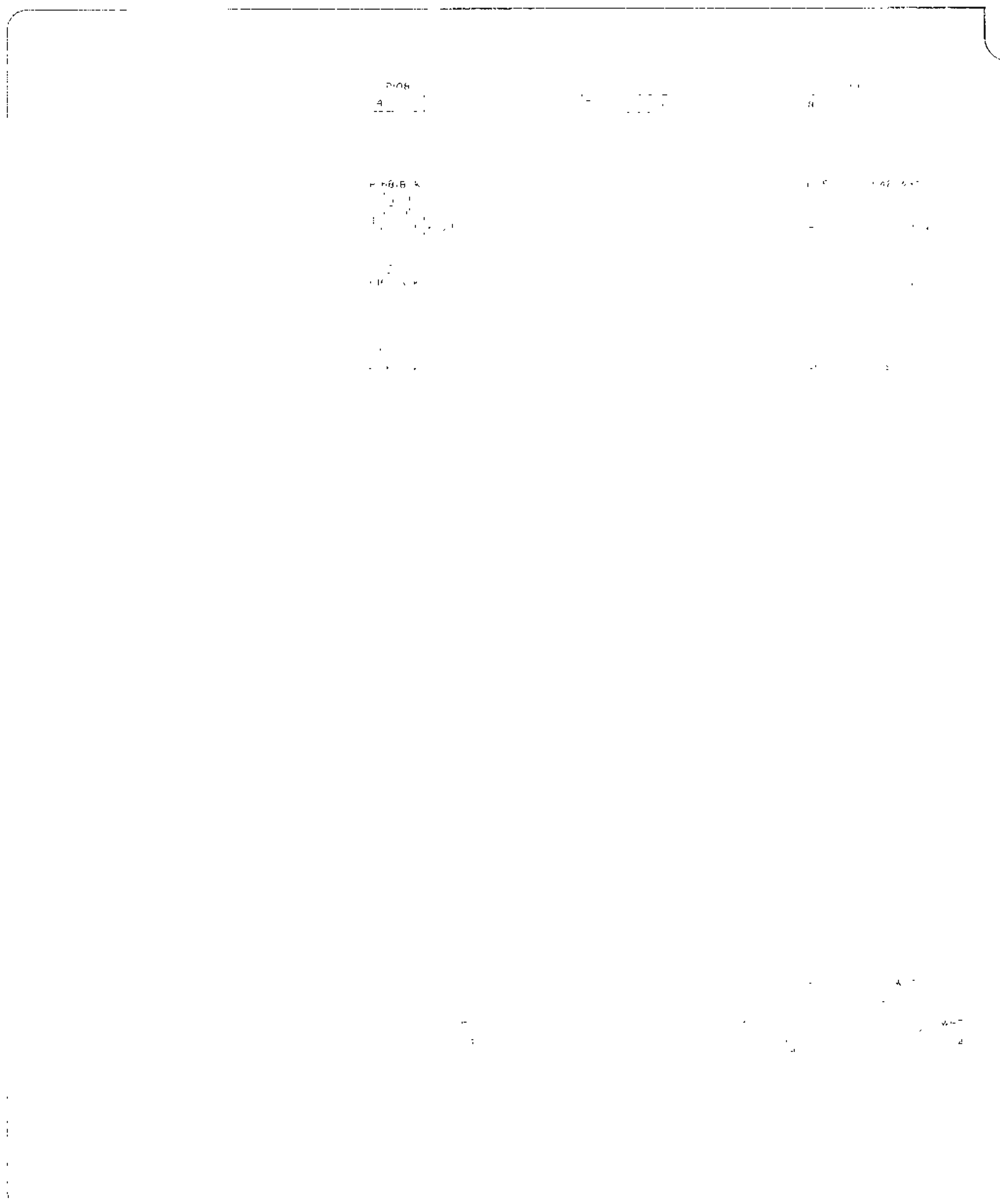
| | *Code* | *Name* | *Type* |
|---|---|---|---|
| MACHINE SCREW | **R** | Round Head Screw |  |
| | **P** | Pan Head Screw |  |
| | **T** | Stove Head Screw (Truss) |  |
| | **B** | Binding Head Screw |  |
| | **F** | Flat Countersunk Head Screw |  |
| | **O** | Oval Countersunk Head Screw |  |
| WOOD 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 LISTS

## 4-1 PC BOARDS AND PARTS LISTS OF 38

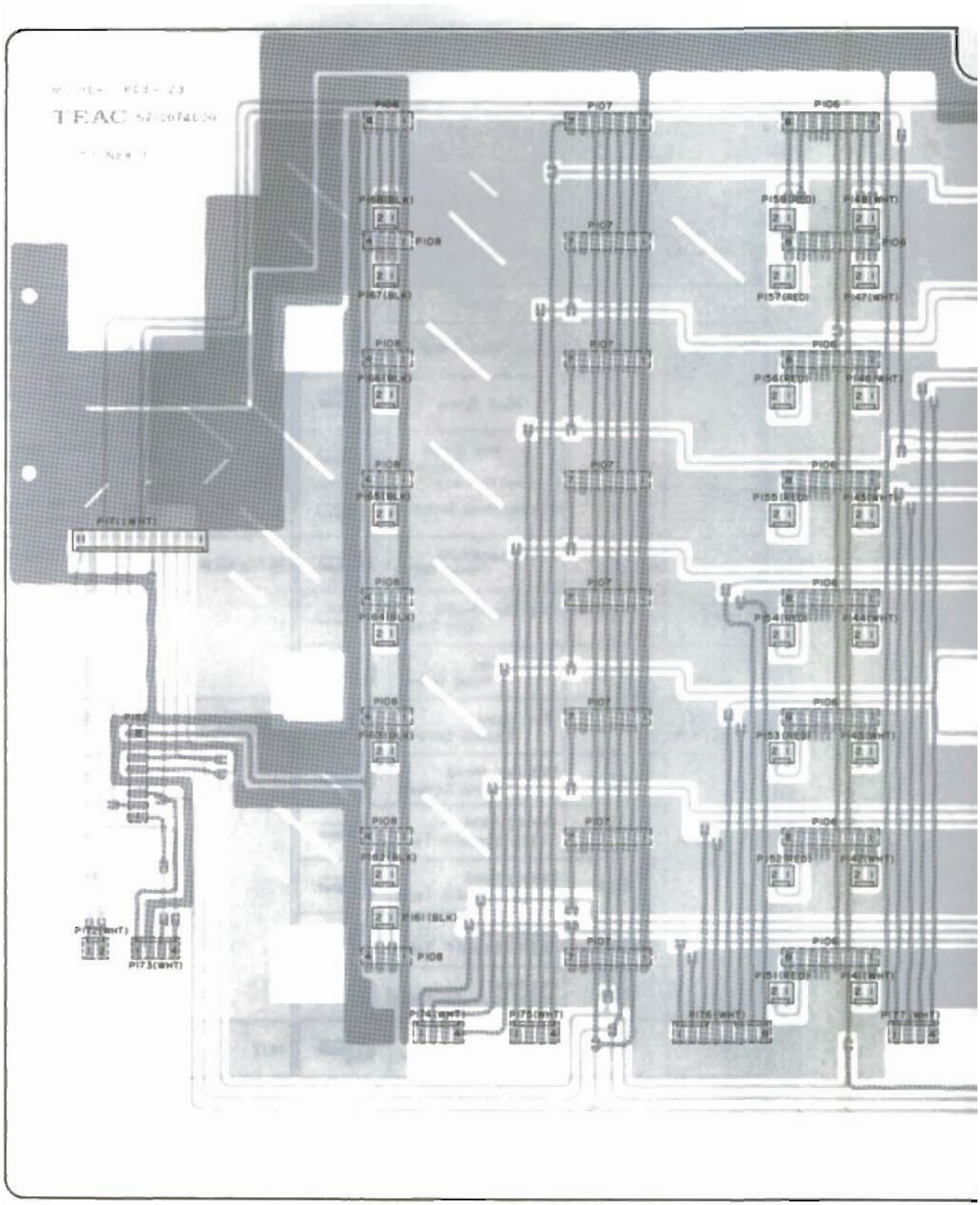
### 1. MOTHER PCB ASSY

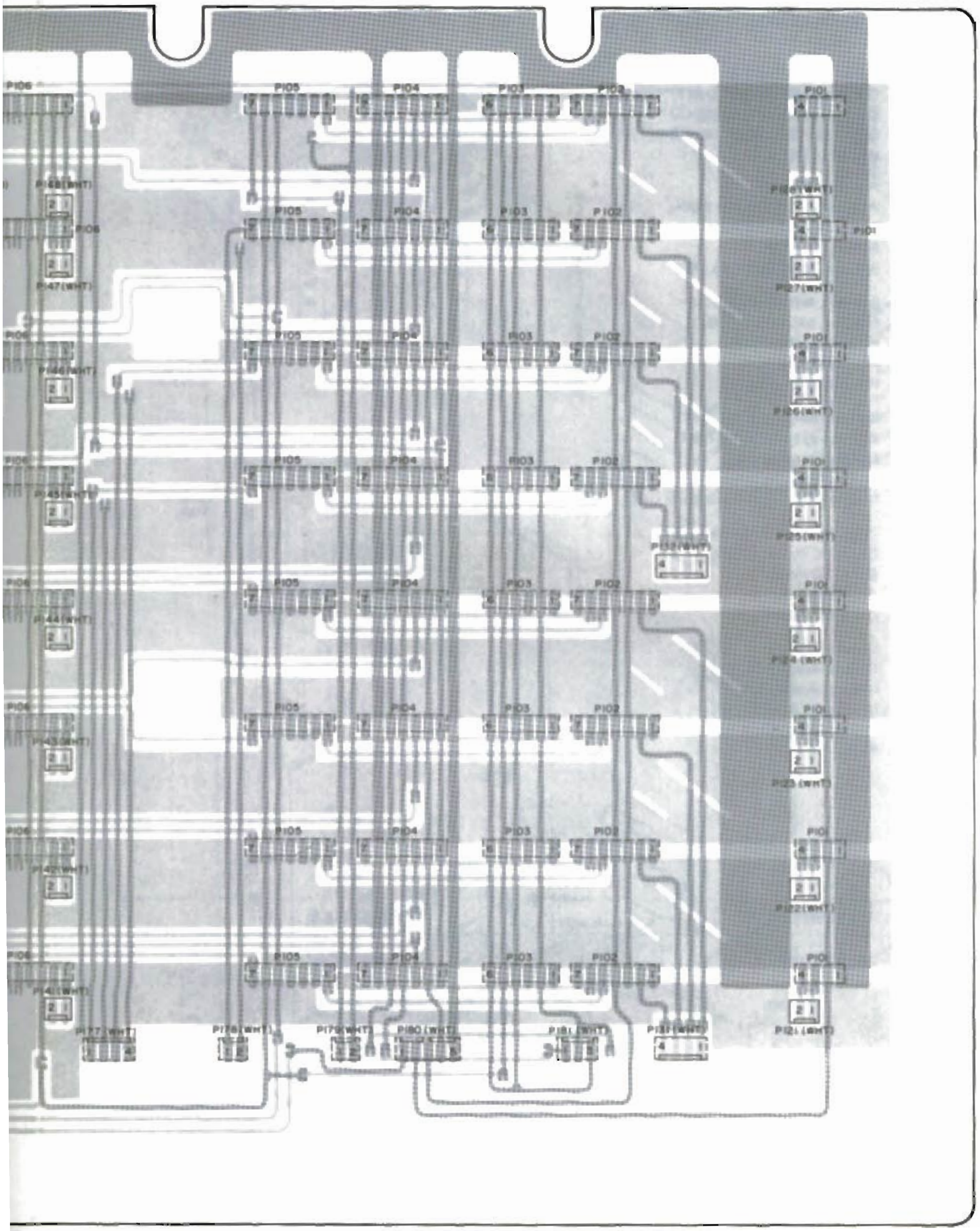


# 4. PC BOARDS AND PARTS LISTS

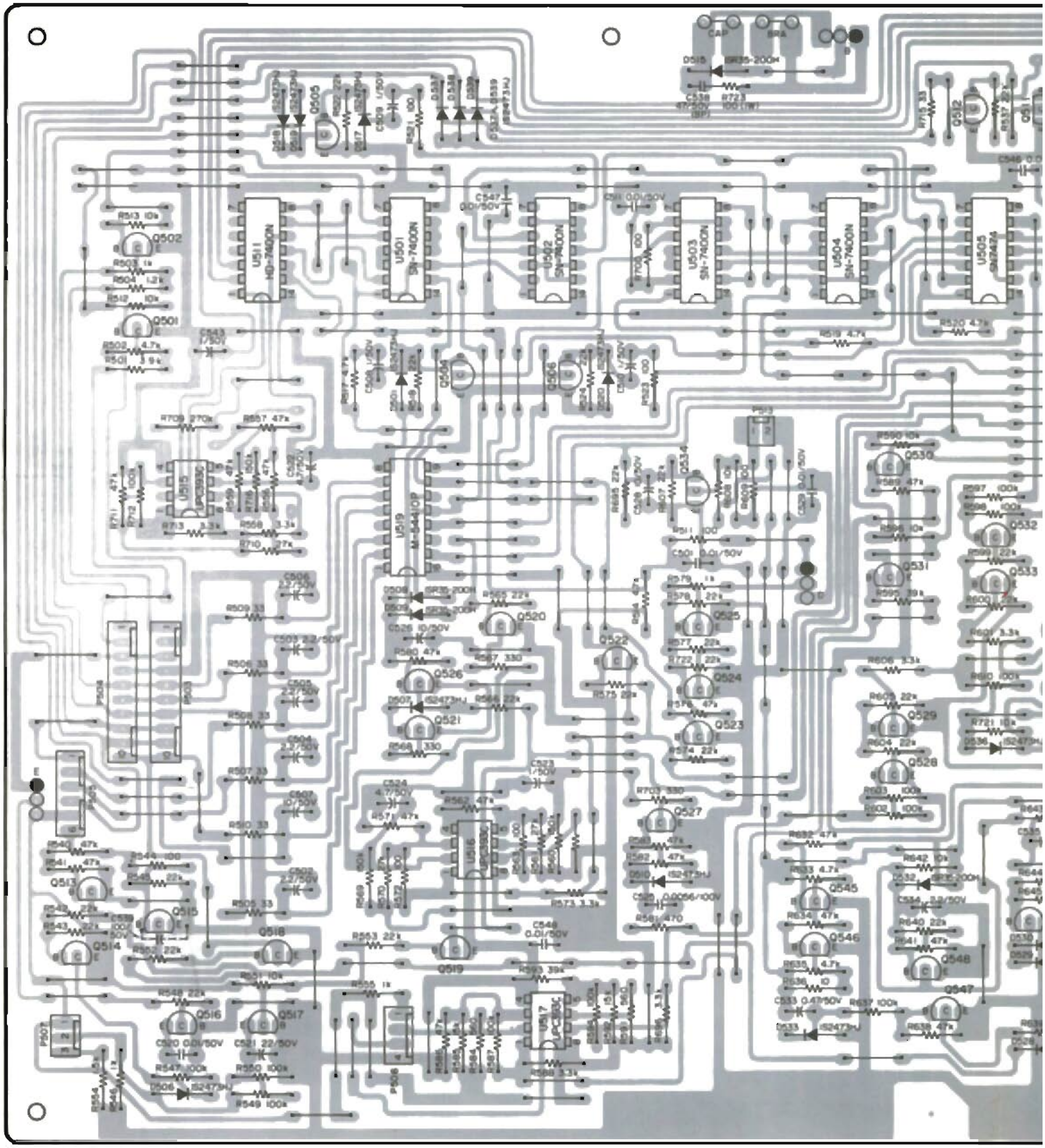
## 4-1 PC BOARDS AND PARTS LISTS OF 38

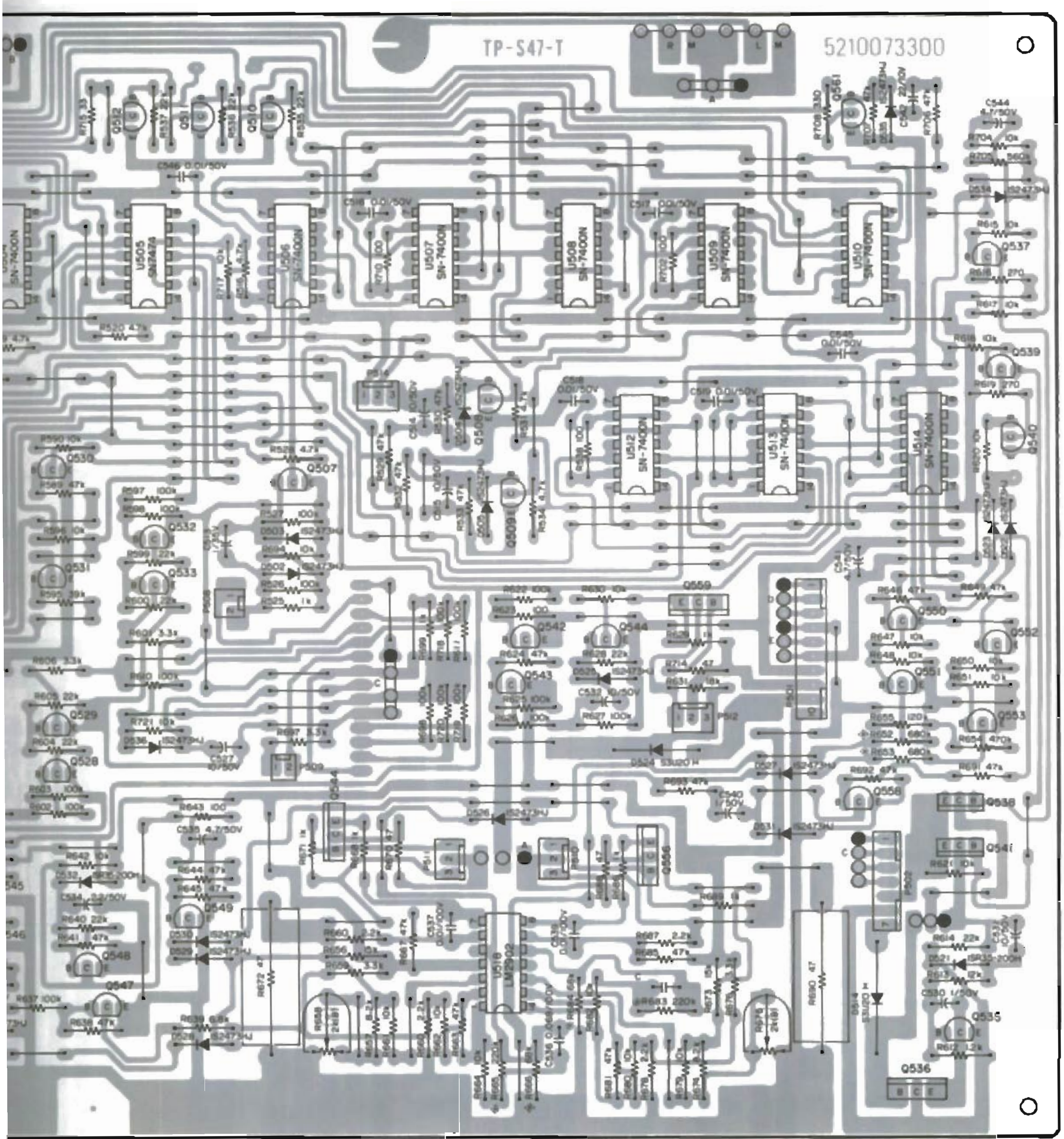
### 1. MOTHER PCB ASSY



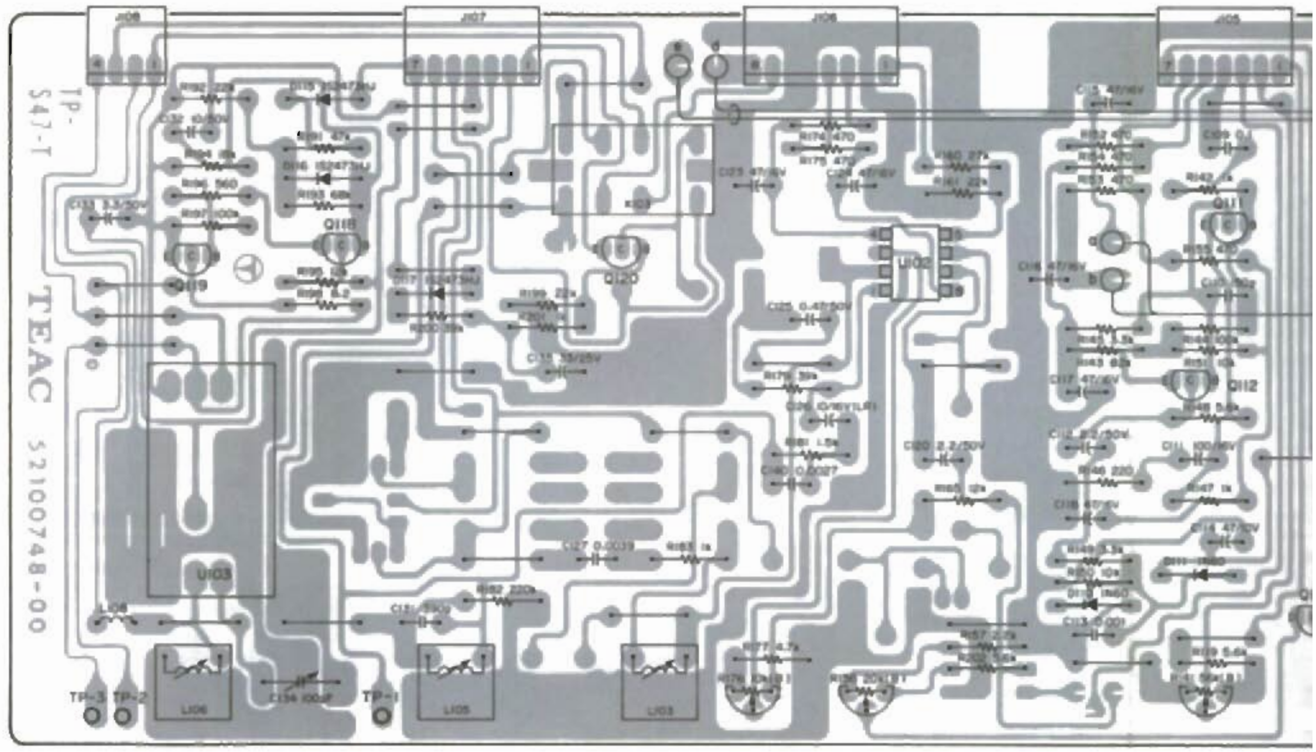


## 2. CONTROL PCB ASSY

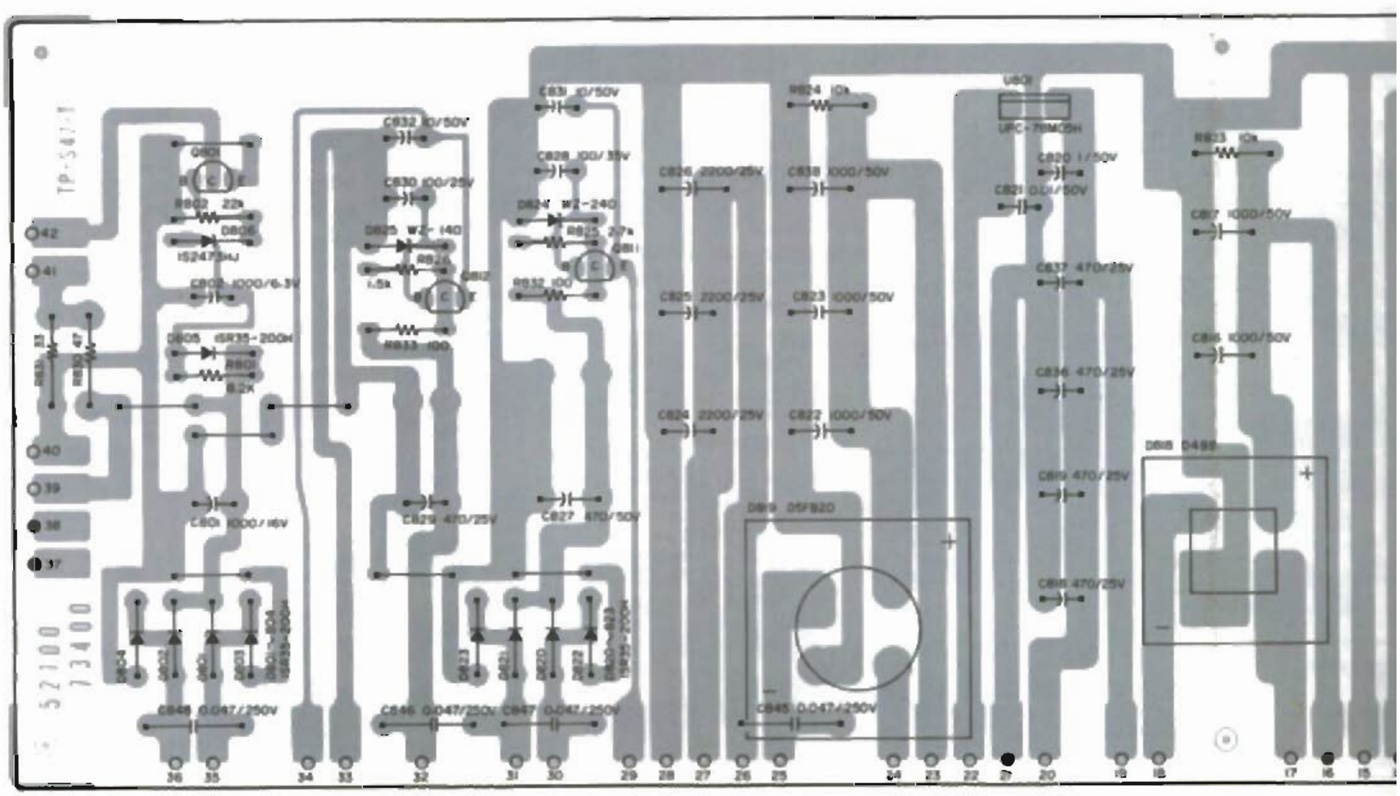


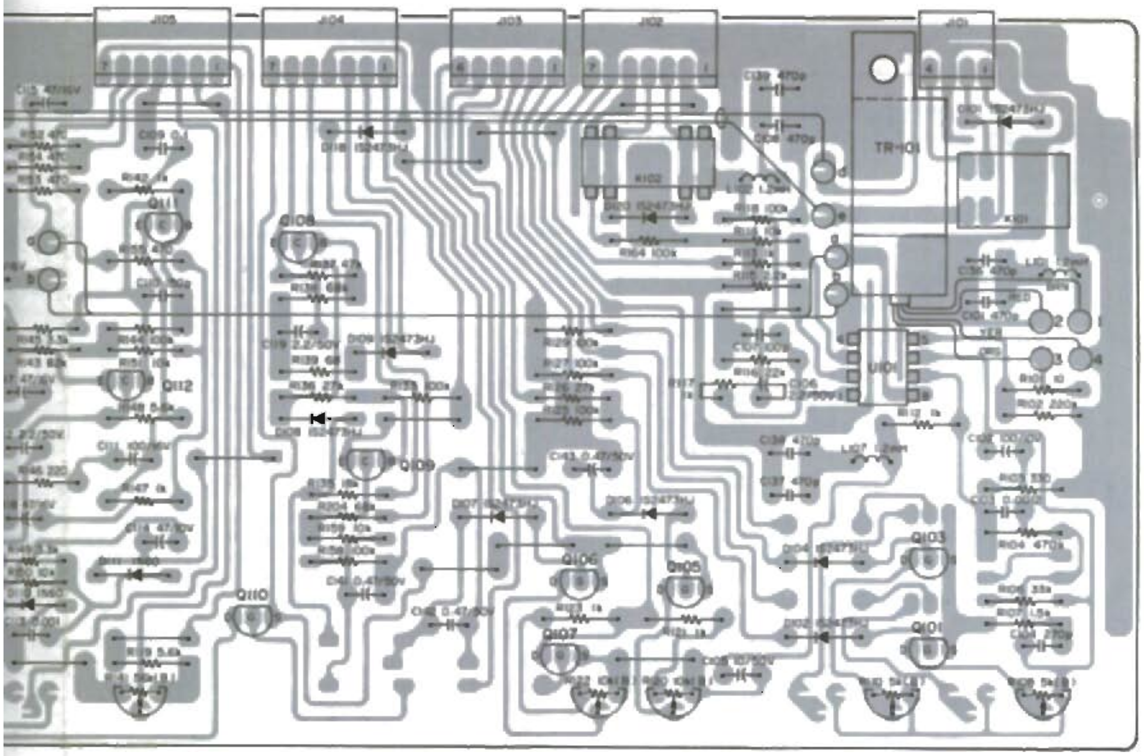

TP-S47-T
5210073300
U505 SN7474
U506 SN-7400N
U507 SN-7400N
U508 SN-7400N
U509 SN-7400N
U510 SN-7400N
U512 SN-7400N
U513 SN-7400N
U514 SN-7400N
U516 LM2902

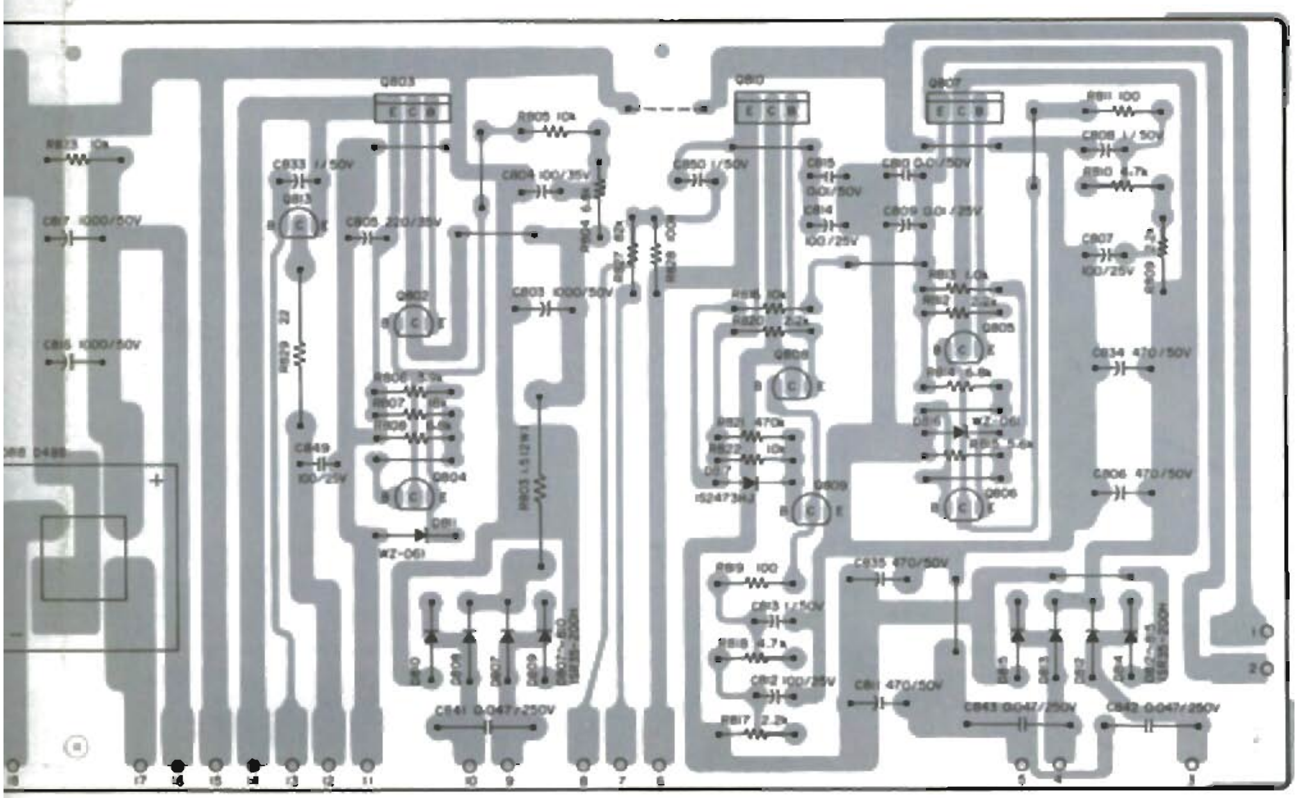
## 3. RECORD/REPRODUCE AMPL. PCB ASSY



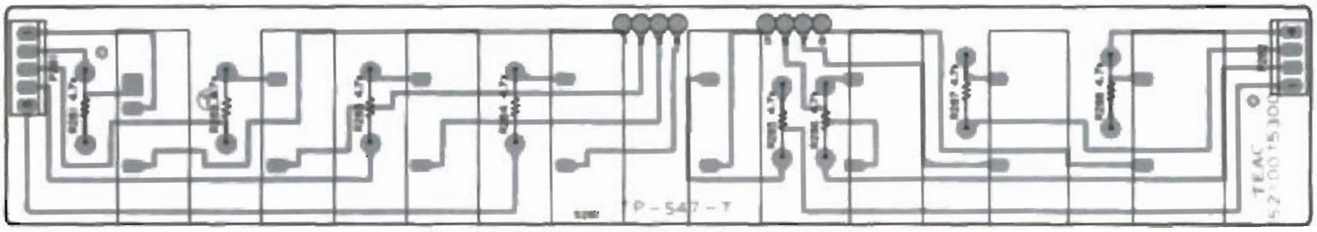
## 4. POWER SUPPLY PCB ASSY



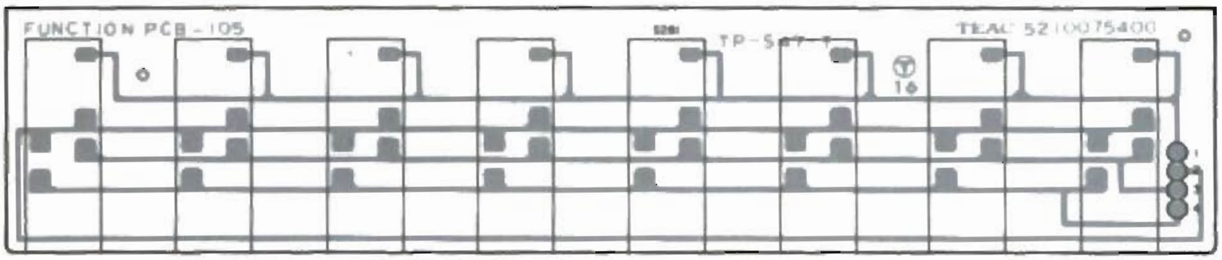

J105
J104
J103
J102
J101
TR-101
K102
K101
U101
Q111
Q108
Q112
Q109
Q110
Q106
Q105
Q107
Q103
Q101


Q803
Q810
Q807
R813 10k
C833 1/50V
Q813
C817 1000/50V
C805 220/35V
C804 100/35V
R805 10k
C850 1/50V
Q802
C803 1000/50V
C816 1000/50V
Q804
R811 100
C808 1/50V
R810 4.7k
Q805
Q808
Q809
Q806
C834 470/50V
C806 470/50V
C835 470/50V
R809 100
C813 1/50V
R818 4.7k
C812 100/25V
C811 470/50V
R817 2.2k
C841 0.047/250V
C843 0.047/250V
C842 0.047/250V

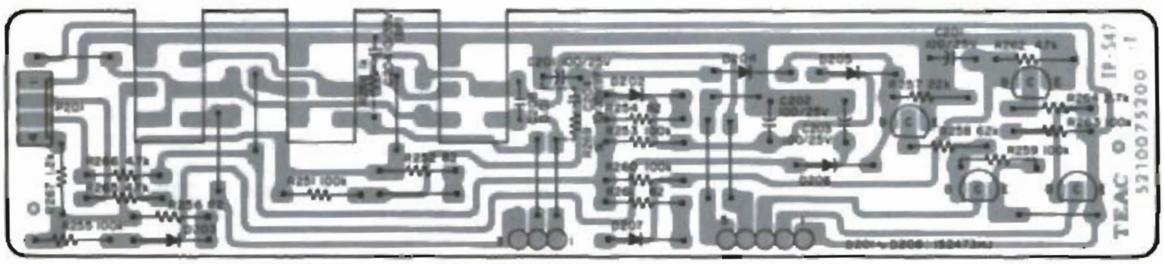
## 5. FUNCTION SELECT PCB A ASSY



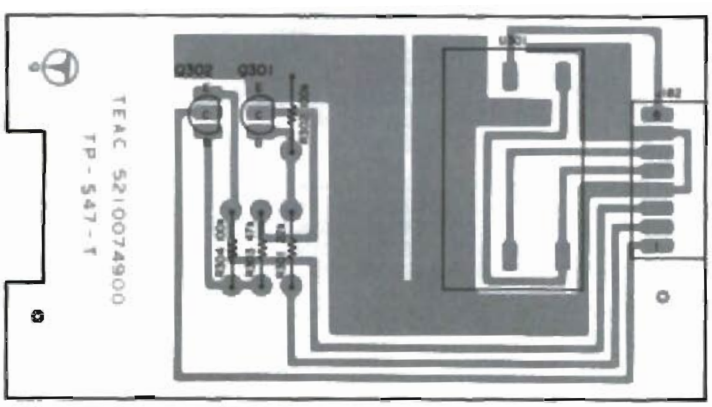
## 6. FUNCTION SELECT PCB B ASSY



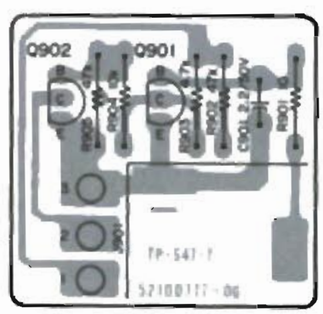
## 7. OUT SELECT PCB ASSY



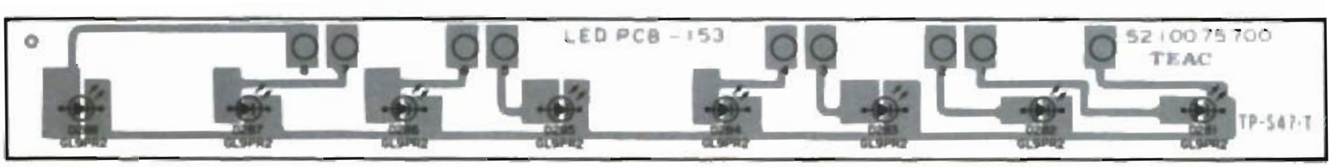
## 8. MASTER OSC PCB ASSY



## 9. PUNCH IN/OUT PCB ASSY



## 10. FUNCTION LED PCB ASSY



## MOTHER PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200074600 | PCB Assy, Mother |
| | 5210074600 | PCB, Mother |
| | | **CONNECTOR PLUGS** |
| P101 | 5122356000 | 4P |
| P102 | 5122359000 | 7P |
| P103 | 5122358000 | 6P |
| P104, P105 | 5122359000 | 7P |
| P106 | 5122360000 | 8P |
| P107 | 5122359000 | 7P |
| P108 | 5122356000 | 4P |
| P121 ~ P128 | 5122126000 | 2P (WHT) |
| P131, P132 | 5122128000 | 4P (WHT) |
| P141 ~ P148 | 5122126000 | 2P (WHT) |
| P151 ~ P158 | 5122299000 | 2P (RED) |
| P161 ~ P168 | 5122183000 | 2P (BLK) |
| P171 | 5122135000 | 11P (WHT) |
| P172 | 5122126000 | 2P (WHT) |
| P173 ~ P175 | 5122128000 | 4P (WHT) |
| P176 | 5122132000 | 8P (WHT) |
| P177 | 5122128000 | 4P (WHT) |
| P178, P179 | 5122126000 | 2P (WHT) |
| P180 | 5122129000 | 5P (WHT) |
| P181 | 5122127000 | 3P (WHT) |
| P182 | 5122360000 | 8P |

## CONTROL PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200073300 | PCB, Assy, Control |
| | 5210073300 | PCB, Control |
| | | **IC's** |
| U501 ~ U504 | 5042712000 | SN7400N |
| U505 | 5220019900 | SN7474N |
| U506 ~ U514 | 5142712000 | SN7400N |
| U515 ~ U517 | 5220012500 | μPC393C |
| U518 | 6048609000 | LM2902 |
| U519 | 5147047000 | M54410P |
| | | **TRANSISTORS** |
| Q501, Q502 | 5145178000 | 2SC1684S |
| Q504 ~ Q513 | 5145178000 | 2SC1684S |
| Q514 | 5042466000 | 2SA564R |
| Q515 | 5145178000 | 2SC1684S |
| Q516 | 5145091000 | 2SC945AK |
| Q517 ~ Q523 | 5145178000 | 2SC1684S |
| Q524 | 5145091000 | 2SC945AK |
| Q525 | 5042553000 | 2SA733P |
| Q526, Q527 | 5145178000 | 2SC1684S |
| Q528 | 5145091000 | 2SC945AK |
| Q529 | 5042553000 | 2SA733P |
| Q530, Q531 | 5145178000 | 2SC1684S |
| Q532 | 5145091000 | 2SC945AK |
| Q533 | 5042553000 | 2SA733P |
| Q534 | 5145091000 | 2SC945AK |
| Q535 | 5145043000 | 2SA720Q |
| Q536 | 5145087000 | 2SD313E |
| Q537 | 5145178000 | 2SC1684S |
| Q538 | 5231755400 | 2SD794Q |
| Q539, Q540 | 5145178000 | 2SC1684S |

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| Q541 | 5231755400 | 2SD794Q |
| Q542 | 5145091000 | 2SC945AK |
| Q543 | 5042553000 | 2SA733P |
| Q544 ~ Q550 | 5145091000 | 2SC945AK |
| Q551 | 5042553000 | 2SA733P |
| Q552 | 5145091000 | 2SC945AK |
| Q553 | 5042553000 | 2SA733P |
| Q554, Q556 | 5145087000 | 2SD313E |
| Q558 | 5145091000 | 2SC945AK |
| Q559 | 5145129000 | 2SB507E |
| Q561 | 5145178000 | 2SC1684S |
| | **DIODES** | |
| D501 ~ D507 | 5143118000 | 1S2473HJ |
| D508, D509 | 5224014500 | 1SR35-200H |
| D510 | 5143118000 | 1S2473HJ |
| D514 | 5224014700 | S3V20H |
| D515, | 5224014500 | 1SR35-200H |
| D517 ~ D520 | 5143118000 | 1S2473HJ |
| D521 | 5224014500 | 1SR35-200H |
| D522, D523 | 5143118000 | 1S2473HJ |
| D524 | 5224014700 | S3V20H |
| D525 ~ D531 | 5143118000 | 1S2473HJ |
| D532 | 5224014500 | 1SR35-200H |
| D533 ~ D539 | 5143118000 | 1S2473HJ |
| | **CARBON RESISTORS** | |
| R501 | 5183096000 | 3.9Ω |
| R502 | 5183098000 | 4.7kΩ |
| R503 | 5183082000 | 1kΩ |
| R504 | 5183084000 | 1.2kΩ |
| R505 ~ R510 | 5183046000 | 33Ω |
| R511 | 5183058000 | 100Ω |
| R512, R513 | 5183106000 | 10kΩ |
| R514 | 5183098000 | 4.7kΩ |
| R516, R517 | 5183098000 | 4.7kΩ |
| R518 | 5183114000 | 22kΩ |
| R519, R520 | 5183098000 | 4.7kΩ |
| R521 | 5183058000 | 100Ω |
| R522 | 5183114000 | 22kΩ |
| R523 | 5183058000 | 100Ω |
| R524 | 5183114000 | 22kΩ |
| R525 | 5183082000 | 1kΩ |
| R526, R527 | 5183130000 | 100kΩ |
| R528 | 5183098000 | 4.7kΩ |
| R529, R530 | 5183122000 | 47kΩ |
| R531 | 5183098000 | 4.7kΩ |
| R532, R533 | 5183122000 | 47kΩ |
| R534 | 5183098000 | 4.7kΩ |
| R535 ~ R537 | 5183114000 | 22kΩ |
| R538, R539 | 5183058000 | 100Ω |
| R540, R541 | 5183122000 | 47kΩ |
| R542, R543 | 5183114000 | 22kΩ |
| R544 | 5183130000 | 100kΩ |
| R545 | 5183114000 | 22kΩ |
| R546 | 5183082000 | 1kΩ |
| R547 | 5183130000 | 100kΩ |
| R548 | 5183114000 | 22kΩ |
| R549, R550 | 5183130000 | 100kΩ |
| R551 | 5183106000 | 10kΩ |
| R552, R553 | 5183114000 | 22kΩ |
| R554 | 5183086000 | 1.5kΩ |
| R555 | 5183082000 | 1kΩ |

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| R556, R557 | 5183122000 | 47kΩ |
| R558 | 5183094000 | 3.3kΩ |
| R559 | 5183122000 | 47kΩ |
| R560 | 5183134000 | 150kΩ |
| R561 | 5183116000 | 27kΩ |
| R562 | 5183122000 | 47kΩ |
| R563 | 5183130000 | 100kΩ |
| R564 | 5183094000 | 3.3kΩ |
| R565, R566 | 5183114000 | 22kΩ |
| R567, R568 | 5183070000 | 330Ω |
| R569 | 5183134000 | 150kΩ |
| R570 | 5183116000 | 27kΩ |
| R571 | 5183122000 | 47kΩ |
| R572 | 5183130000 | 100kΩ |
| R573 | 5183094000 | 3.3kΩ |
| R574, R575 | 5183114000 | 22kΩ |
| R576 | 5183122000 | 47kΩ |
| R577, R578 | 5183114000 | 22kΩ |
| R579 | 5183082000 | 1kΩ |
| R580 | 5183122000 | 47kΩ |
| R581 | 5183074000 | 470Ω |
| R582, R583 | 5183122000 | 47kΩ |
| R584 | 5183076000 | 560Ω |
| R585 | 5183110000 | 15kΩ |
| R586 | 5183122000 | 47kΩ |
| R587 | 5183130000 | 100kΩ |
| R588 | 5183094000 | 3.3kΩ |
| R589 | 5183122000 | 47kΩ |
| R590 | 5183106000 | 10kΩ |
| R591 | 5183076000 | 560Ω |
| R592 | 5183110000 | 15kΩ |
| R593 | 5183120000 | 39kΩ |
| R594 | 5183130000 | 100kΩ |
| R595 | 5183122000 | 47kΩ |
| R596 | 5183106000 | 10kΩ |
| R597, R598 | 5183130000 | 100kΩ |
| R599, R600 | 5183114000 | 22kΩ |
| R601 | 5183094000 | 3.3kΩ |
| R602, R603 | 5183130000 | 100kΩ |
| R604, R605 | 5183114000 | 22kΩ |
| R606 | 5183094000 | 3.3kΩ |
| R607 | 5183114000 | 22kΩ |
| R608 | 5183106000 | 10kΩ |
| R609 | 5183058000 | 100Ω |
| R610, R611 | 5183130000 | 100kΩ |
| R612 | 5183084000 | 1.2kΩ |
| R613 | 5183108000 | 12kΩ |
| R614 | 5183114000 | 22kΩ |
| R615 | 5183106000 | 10kΩ |
| R616 | 5183068000 | 270Ω |
| R617, R618 | 5183106000 | 10kΩ |
| R619 | 5183068000 | 270Ω |
| R620, R621 | 5183106000 | 10kΩ |
| R622, R623 | 5183130000 | 100kΩ |
| R624 | 5183122000 | 47kΩ |
| R625 ~ R627 | 5183130000 | 100kΩ |
| R628 | 5183114000 | 22kΩ |
| R629 | 5183082000 | 1kΩ |
| R630 | 5183106000 | 10kΩ |
| R631 | 5183112000 | 18kΩ |
| R632 | 5183122000 | 47kΩ |
| R633 | 5183098000 | 4.7kΩ |
| R634 | 5183122000 | 47kΩ |
| R635 | 5183098000 | 4.7kΩ |
| R636 | 5183034000 | 10Ω |

| REF. NO. | PARTS NO. | DESCRIPTION | | | |
|---|---|---|---|---|---|
| R637 | 5183130000 | 100kΩ | | | |
| R638 | 5183122000 | 47kΩ | | | |
| R639 | 5183102000 | 6.8kΩ | | | |
| R640 | 5183114000 | 22kΩ | | | |
| R641 | 5183122000 | 47kΩ | | | |
| R642 | 5183106000 | 10kΩ | | | |
| R643 | 5183058000 | 100Ω | | | |
| R644 ~ R646 | 5183122000 | 47kΩ | | | |
| R647, R648 | 5183106000 | 10kΩ | | | |
| R649 | 5183122000 | 47kΩ | | | |
| R650, R651 | 5183106000 | 10kΩ | | | |
| R652, R653 | 5185590000 | 680kΩ | ±2% | Metal Film | |
| R654 | 5183146000 | 470kΩ | | | |
| R655 | 5183132000 | 120kΩ | | | |
| R656 | 5183110000 | 15kΩ | | | |
| R657 | 5183104000 | 8.2kΩ | | | |
| R659 | 5183094000 | 3.3kΩ | | | |
| R660 | 5183090000 | 2.2kΩ | | | |
| R661, R662 | 5183106000 | 10kΩ | | | |
| R663 | 5183122000 | 47kΩ | | | |
| R664 | 5183106000 | 10kΩ | | | |
| R665 | 5185578000 | 220kΩ | ±2% | Metal Film | |
| R666 | 5185566000 | 68kΩ | ±2% | Metal Film | |
| R667 | 5183122000 | 47kΩ | | | |
| R668 | 5183082000 | 1kΩ | | | |
| R669 | 5183090000 | 2.2kΩ | | | |
| R670 | 5183050000 | 47Ω | | | |
| R671 | 5183082000 | 1kΩ | | | |
| R672 | ⚠ 5184402000 | 0.47Ω | ±10% | 5W | Cement |
| R673 | 5183110000 | 15kΩ | | | |
| R674 | 5183104000 | 8.2kΩ | | | |
| R676 | 5183094000 | 3.3kΩ | | | |
| R678 | 5183090000 | 2.2kΩ | | | |
| R679, R680 | 5183106000 | 10kΩ | | | |
| R681 | 5183122000 | 47kΩ | | | |
| R682 | 5183106000 | 10kΩ | | | |
| R683 | 5185578000 | 220kΩ | ±2% | Metal Film | |
| R684 | 5185566000 | 68kΩ | ±2% | Metal Film | |
| R685 | 5183122000 | 47kΩ | | | |
| R686 | 5183082000 | 1kΩ | | | |
| R687 | 5183090000 | 2.2kΩ | | | |
| R688 | 5183050000 | 47Ω | | | |
| R689 | 5183082000 | 1kΩ | | | |
| R690 | ⚠ 5184402000 | 0.47Ω | ±10% | 5W | Cement |
| R691 ~ R693 | 5183122000 | 47kΩ | | | |
| R694 | 5183106000 | 10kΩ | | | |
| R695 | 5183114000 | 22kΩ | | | |
| R696, R697 | 5183094000 | 3.3kΩ | | | |
| R698 | 5183130000 | 100kΩ | | | |
| R699 | 5183082000 | 1kΩ | | | |
| R700 ~ R702 | 5183058000 | 100Ω | | | |
| R703 | 5183070000 | 330Ω | | | |
| R704 | 5183106000 | 10kΩ | | | |
| R705 | 5183148000 | 39kΩ | | | |
| R706, R706 | 5183122000 | 47kΩ | | | |
| R708 | 5183070000 | 330Ω | | | |
| R709 | 5183140000 | 270kΩ | | | |
| R710 | 5183116000 | 27kΩ | | | |
| R711 | 5183122000 | 47kΩ | | | |
| R712 | 5183130000 | 100kΩ | | | |
| R713 | 5183094000 | 3.3kΩ | | | |
| R714 | 5183050000 | 47Ω | | | |
| R715 | 5183046000 | 33Ω | | | |
| R716 | 5183134000 | 150kΩ | | | |
| R717 | 5183106000 | 10kΩ | | | |
| R718 ~ R720 | 5183130000 | 100kΩ | | | |
| R721 | 5183106000 | 10kΩ | | | |
| R722 | 5183114000 | 22kΩ | | | |
| R723 | 4518475500 | 100Ω | 1W | Nonflammable | |

| REF. NO. | PARTS NO. | DESCRIPTION | | | |
|---|---|---|---|---|---|
| | | **CAPACITORS** | | | |
| C501 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C502~C506 | 5172996000 | Elec. | 2.2μF | 50V | |
| C507 | 5173013000 | Elec. | 10μF | 50V | |
| C508~C510 | 5172992000 | Elec. | 1μF | 50V | |
| C511 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C513 | 5054664100 | Dip. Tantal | 0.1μF | 50V | 20% |
| C514, C515 | 5173013000 | Elec. | 10μF | 50V | |
| C516~C520 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C521 | 5173017000 | Elec. | 22μF | 10V | |
| C522 | 5173006000 | Elec. | 4.7μF | 50V | |
| C523 | 5172992000 | Elec. | 1μF | 50V | |
| C524 | 5173006000 | Elec. | 4.7μF | 50V | |
| C525 | 5170489000 | Mylar | 5600pF | 100V | 10% |
| C526~C528 | 5173013000 | Elec. | 10μF | 50V | |
| C529 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C530 | 5172992000 | Elec. | 1μF | 50V | |
| C531, C532 | 5173013000 | Elec. | 10μF | 50V | |
| C533 | 5172990000 | Elec. | 0.47μF | 50V | |
| C534 | 5172996000 | Elec. | 2.2μF | 50V | |
| C535 | 5173006000 | Elec. | 4.7μF | 50V | |
| C536 | 5170515000 | Mylar | 0.068μF | 50V | 10% |
| C537, C539 | 5170495000 | Mylar | 0.01μF | 50V | 10% |
| C538 | 5055949000 | Elec. | 47μF | 50V(BP) | |
| C540 | 5172992000 | Elec. | 1μF | 50V | |
| C541 | 5173006000 | Elec. | 4.7μF | 50V | |
| C542 | 5173017000 | Elec. | 22μF | 10V | |
| C543 | 5172992000 | Elec. | 1μF | 50V | |
| C544 | 5173006000 | Elec. | 4.7μF | 50V | |
| C545~C548 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C549 | 5173013000 | Elec | 10μF | 50V | |
| | | **VARIABLE RESISTORS** | | | |
| R658 | 5280002902 | Semi-fixed | 2kΩ(B) | | |
| R675 | 5280002902 | Semi-fixed | 2kΩ(B) | | |
| | | **MISCELLANEOUS** | | | |
| J515 | 5122172000 | Connector Socket, 10P (WHT) | | | |
| J516 | 5122170000 | Connector Socket, 8P (WHT) | | | |
| P501 | 5122134000 | Connector Plug, 10P (WHT) | | | |
| P502 | 5122131000 | Connector Plug, 7P (WHT) | | | |
| P503, P504 | 5122134000 | Connector Plug, 10P (WHT) | | | |
| P505 | 5122130000 | Connector Plug, 6P (WHT) | | | |
| P506 | 5122128000 | Connector Plug, 4P (WHT) | | | |
| P507 | 5122127000 | Connector Plug, 3P (WHT) | | | |
| P508 | 5122126000 | Connector Plug, 2P (WHT) | | | |
| P509 | 5122299000 | Connector Plug, 2P (RED) | | | |
| P510 | 5122127000 | Connector Plug, 3P (WHT) | | | |
| P511 | 5122300000 | Connector Plug, 3P (RED) | | | |
| P512 | 5122184000 | Connector Plug, 3P (BLK) | | | |
| P513 | 5122183000 | Connector Plug, 2P (BLK) | | | |
| P514 | 5336107300 | Connector Plug, 3P (YEL) | | | |

## REC/REP AMPL. PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200074800 | PCB Assy, REC/PLAY Ampl. |
| | 5210074801 | PCB, REC/PLAY Ampl. |
| | **IC's** | |
| U101 | 5147028000 | JRC-4558D-D |
| U102 | 5220406700 | RC4558 |
| U103 | 5292210600 | BIAS Ampl. Module |
| | **TRANSISTORS** | |
| Q101, Q103 | 5145103000 | FET, 2SK-68AM |
| Q105~Q107 | 5145103000 | FET, 2SK-68AM |
| Q108 | 5145178000 | 2SC-1684S |
| Q109 | 5042553000 | 2SA-733P |
| Q110 | 5145103000 | FET, 2SK-68AM |
| Q111 | 5145178000 | 2SC-1684S |
| Q112 | 5042553000 | 2SA-733P |
| Q118 | 5145178000 | 2SC-1684S |
| Q119 | 5042625000 | 2SC-1318S |
| Q120 | 5145178000 | 2SC-1684S |
| | **DIODES** | |
| D101, D102 | 5143118000 | 1S2473HJ |
| D104 | 5143118000 | 1S2473HJ |
| D106~D109 | 5143118000 | 1S2473HJ |
| D110, D111 | 5042213000 | IN60 |
| D112 | 5143118000 | 1S2473HJ |
| D114~D120 | 5143118000 | 1S2473HJ |
| | **CARBON RESISTORS** | |
| R101 | 5183034000 | 10Ω |
| R102 | 5183138000 | 220kΩ |
| R103 | 5183070000 | 330Ω |
| R104 | 5183146000 | 470kΩ |
| R106 | 5183118000 | 33kΩ |
| R107 | 5183086000 | 1.5kΩ |
| R112, R113 | 5183082000 | 1.0kΩ |
| R114 | 5183106000 | 10kΩ |
| R115 | 5183090000 | 2.2kΩ |
| R116 | 5183114000 | 22kΩ |
| R117 | 5183082000 | 1.0kΩ |
| R118 | 5183130000 | 100kΩ |
| R119 | 5183124000 | 56kΩ |
| R121 | 5183082000 | 1.0kΩ |
| R123 | 5183082000 | 1.0kΩ |
| R125 | 5183130000 | 100kΩ |
| R126 | 5183128000 | 82kΩ |
| R127 | 5183130000 | 100kΩ |
| R129 | 5183130000 | 100kΩ |
| R131 | 5183130000 | 100kΩ |
| R132 | 5183126000 | 68kΩ |
| R133 | 5183130000 | 100kΩ |
| R135 | 5183112000 | 18kΩ |
| R136 | 5183116000 | 27kΩ |
| R137 | 5183122000 | 47kΩ |
| R138 | 5183126000 | 68kΩ |
| 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 |

| REF. NO. | PARTS NO. | DESCRIPTION | | | | |
|---|---|---|---|---|---|---|
| R152~R155⚠ | 5183074000 | 470Ω | Nonflammable | | | |
| R157 | 5183090000 | 2.2kΩ | | | | |
| R158 | 5183130000 | 100kΩ | | | | |
| R159 | 5183106000 | 10kΩ | | | | |
| R160 | 5183116000 | 27kΩ | | | | |
| R161 | 5183114000 | 22kΩ | | | | |
| R164 | 5183130000 | 100kΩ | | | | |
| R165 | 5183108000 | 12kΩ | | | | |
| R174, R175⚠ | 5183074000 | 470Ω | | | | |
| R177 | 5183098000 | 4.7kΩ | | | | |
| R178 | 5183098000 | 4.7kΩ | | | | |
| R179 | 5183120000 | 39kΩ | | | | |
| R180 | 5183110000 | 15kΩ | | | | |
| R181 | 5183086000 | 1.5kΩ | | | | |
| R182 | 5183138000 | 220kΩ | | | | |
| R183 | 5183082000 | 1.0kΩ | | | | |
| 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 | 5183114000 | 22kΩ | | | | |
| R200 | 5183120000 | 39kΩ | | | | |
| R201 | 5183082000 | 1.5kΩ | | | | |
| R202 | 5183100000 | 5.6kΩ | | | | |
| R204 | 5183126000 | 68kΩ | | | | |
| | **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 | |
| C106 | 5172996000 | Elec. | | 2.2μF | 50V | |
| C107 | 5172312000 | Ceramic | | 100pF | 50V | 10% |
| C108 | 5263107010 | 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, C120 | 5172996000 | Elec. | | 2.2μF | 50V | |
| C123, C124 | 5173036000 | Elec. | | 47μF | 16V | |
| C125 | 5172990000 | Elec. | | 0.47μF | 50V | |
| C126 | 5171565000 | Elec. | | 10μF | 16V | (LR) |
| C127 | 5170409000 | Mylar | | 0.0022μF | 100V | 5% |
| C131 | 5263106810 | Polyst. | | 390pF | 100V | 5% |
| C132 | 5173013000 | Elec. | | 10μF | 50V | |
| C133 | 5173000000 | Elec. | | 3.3μF | 50V | |
| C134 | 5267205800 | Trimmer-M-2P-7 | | 100pF | | |
| C135 | 5173028000 | Elec. | | 33μF | 25V | |
| C136~C139 | 5263107010 | Polyst. | | 470pF | 100V | 5% |
| C140 | 5170411000 | Mylar | | 0.0027μF | 100V | 5% |
| C141~C143 | 5172990000 | Elec. | | 0.47μF | 50V | |

| REF. NO. | PARTS NO. | DESCRIPTION | | |
|---|---|---|---|---|
| | **VARIABLE RESISTORS** | | | |
| R108 | 5150153000 | Semi-fixed | 5kΩ(B) | |
| R110 | 5150153000 | Semi-fixed | 5kΩ(B) | |
| R120 | 5150154000 | Semi-fixed | 10kΩ(B) | |
| R122 | 5150154000 | Semi-fixed | 10kΩ(B) | |
| R141 | 5150156000 | Semi-fixed | 50kΩ(B) | |
| R176 | 5150154000 | Semi-fixed | 10kΩ(B) | |
| R156 | 5280001102 | Semi-fixed | 20kΩ(B) | |
| | **COILS** | | | |
| L101, L102 | 5160107000 | Choke, 1.2 mH | 5% | TIE-UP |
| L103 | 5286011000 | Choke, 2.4mH Variable | | |
| L105 | 5160044000 | Trap, 3mH | 20% | |
| L106 | 5286011400 | Choke, 1.3mH Variable | | |
| L107 | 5160107000 | Choke, 1.2mH | 5% | TIE-UP |
| L108 | 5286011500 | Choke, 200μH | | |
| | **CONNECTOR SOCKETS** | | | |
| J101 | 5122375000 | 4P | | |
| J102 | 5122378000 | 7P | | |
| J103 | 5122377000 | 6P | | |
| J104, J105 | 5122378000 | 7P | | |
| J106 | 5122379000 | 8P | | |
| J107 | 5122378000 | 7P | | |
| J108 | 5122375000 | 4P | | |
| | **MISCELLANEOUS** | | | |
| T101 | 6046631000 | Step-up Transformer | | |
| | 5800289400 | Step-up Metal Fitting | | |
| K101 | 5290009500 | Relay, 2.4V G2E-182P-H | | |
| K102 | 5290009800 | Relay, Reed; RP1A24 | | |
| K103 | 5290008900 | Relay, 24V G2V-2 | | |
| | 5800303900 | Cover, Seald Relay | | |

## POWER SUPPLY PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION | | | |
|---|---|---|---|---|---|
| | 5200073400 | PCB Assy, Power Supply | | | |
| | 5210073400 | PCB, Power Supply | | | |
| | **IC's** | | | | |
| U801 | ⚠5220405100 | μPC 78M05H | | | |
| | **TRANSISTORS** | | | | |
| Q801 | 5145133000 | 2SC-1645B | | | |
| Q802 | 5042625000 | 2SC-1318S | | | |
| Q803 | ⚠5145087000 | 2SD-313E | | | |
| Q804～Q806 | 5145091000 | 2SC-945AK | | | |
| Q807 | ⚠5145087000 | 2SC-313E | | | |
| Q808, Q809 | 5042553000 | 2SA-733P | | | |
| Q810 | ⚠5145129000 | 2SB-507E | | | |
| Q811, Q812 | ⚠5145091000 | 2SC-945AK | | | |
| Q813 | 5145043000 | 2SA-720Q | | | |
| | **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 Stud | | | |
| D819 | ⚠5228007300 | D5FB20, Silicon Stud | | | |
| D820～D823 | ⚠5224014500 | 1SR35-200H | | | |
| D824 | 5143297000 | WZ-240, Zener | | | |
| D825 | 5143283000 | WZ-140, Zener | | | |
| | **CARBON RESISTORS** | | | | |
| R801 | 5183104000 | 8.2kΩ | | | |
| R802 | 5183114000 | 22kΩ | | | |
| R803 | ⚠5184302000 | 1.5Ω | Cement | 2W | 10% |
| R804 | 5183102000 | 6.8kΩ | | | |
| R805 | 5183106000 | 10kΩ | | | |
| R806 | 5183096000 | 3.9kΩ | | | |
| R807 | 5183112000 | 18kΩ | | | |
| R808 | 5183102000 | 6.8kΩ | | | |
| R809 | 5183090000 | 2.2kΩ | | | |
| R810 | 5183098000 | 4.7kΩ | | | |
| R811 | 5183058000 | 100Ω | | | |
| R812 | 5183090000 | 2.2kΩ | | | |
| R813 | 5183082000 | 1.0kΩ | | | |
| R814 | 5183102000 | 6.8kΩ | | | |
| R815 | 5183100000 | 5.6kΩ | | | |
| R816 | 5183106000 | 10kΩ | | | |
| R817 | 5183090000 | 2.2kΩ | | | |
| R818 | 5183098000 | 4.7kΩ | | | |
| R819 | 5183058000 | 100Ω | | | |
| R820 | 5183090000 | 2.2kΩ | | | |
| R821 | 5183146000 | 470kΩ | | | |
| R822～R824 | 5183106000 | 10kΩ | | | |
| R825 | 5183092000 | 2.7kΩ | | | |
| R826 | 5183086000 | 1.5kΩ | | | |
| R827 | 5183128000 | 82kΩ | | | |
| R828 | 5183130000 | 100kΩ | | | |
| R829 | 5183562000 | 22Ω | Nonflammable | | |
| R830 | ⚠5180050000 | 47Ω | 1/2W | | |
| R831 | ⚠5180046000 | 33Ω | 1/2W | | |
| R832, R833 | ⚠5184249000 | 100Ω | Nonflammable | | |

| REF. NO. | PARTS NO. | DESCRIPTION | | | |
|---|---|---|---|---|---|
| | **CAPACITORS** | | | | |
| C801 | ⚠5173081000 | Elec. | 1000μF | 16V | |
| C802 | ⚠5173079000 | Elec. | 1000μF | 6.3V | |
| C803 | ⚠5173084000 | Elec. | 1000μF | 50V | |
| C804 | 5173047000 | Elec. | 100μF | 35V | |
| C805 | 5173056000 | Elec. | 220μF | 35V | |
| C806 | 5173075000 | Elec. | 470μF | 50V | |
| C807 | 5173046000 | Elec. | 100μF | 25V | |
| C808 | 5172992000 | Elec. | 1μF | 50V | |
| C809 | 5173046000 | Elec. | 100μF | 25V | |
| C810 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C811 | 5173075000 | Elec. | 470μF | 50V | |
| C812 | 5173046000 | Elec. | 100μF | 25V | |
| C813 | 5172992000 | Elec. | 1μF | 50V | |
| C814 | 5173046000 | Elec. | 100μF | 25V | |
| C815 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C816, C817 | ⚠5173084000 | Elec. | 1000μF | 50V | |
| C818, C819 | 5173073000 | Elec. | 470μF | 25V | |
| C820 | 5172992000 | Elec. | 1μF | 50V | |
| C821 | 5054204000 | Ceramic | 0.01μF | 50V | 10% |
| C822, C823 | ⚠5173084000 | Elec. | 1000μF | 50V | |
| C824～C826 | ⚠5173089000 | Elec. | 2200μF | 25V | |
| C827 | 5173075000 | Elec. | 470μF | 50V | |
| C828 | ⚠5173047000 | Elec. | 100μF | 35V | |
| C829 | 5173073000 | Elec. | 470μF | 25V | |
| C830 | 5173046000 | Elec. | 100μF | 25V | |
| C831, C832 | 5173013000 | Elec. | 10μF | 50V | |
| C833 | 5172992000 | Elec. | 1μF | 50V | |
| C834, C835 | 5173075000 | Elec. | 470μF | 50V | |
| C836, C837 | 5173073000 | Elec. | 470μF | 25V | |
| C838 | ⚠5173084000 | Elec. | 1000μF | 50V | |
| C841～C848 | ⚠5263164500 | Metallized | 0.047μF | 250V | 10% |
| C849 | 5173046000 | Elec. | 100μF | 25V | |
| C850 | 5172992000 | Elec. | 1μF | 50V | |

## FUNCTION SELECT A(B) PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200075300 | PCB Assy, Function Select A |
| | 5210075300 | PCB, Function Select A |
| | 5210075400 | PCB, Function Select B |
| R281~R288 | 5183098000 | Carbon Resistor 4.7kΩ 5% 1/4W |
| P281 | 5122129000 | Connector Plug 5P(WHT) |
| P282 | 5122128000 | Connector Plug 4P(WHT) |
| S281 | 5300027800 | Push SW 4-2NS |

## OUT SELECT PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200075200 | PCB Assy, Out Select |
| | 5210075200 | PCB, Out Select |
| | | **TRANSISTORS** |
| Q201 | 5145178000 | 2SC-1684S |
| Q202 | 5145043000 | 2SC-720Q |
| Q203 | 5145178000 | 2SC-1684S |
| Q204 | 5145043000 | 2SA-720Q |
| | | **DIODES** |
| D201~D207 | 5143118000 | 1S2473HJ |
| | | **CARBON RESISTORS** |
| R251 | 5183130000 | 100kΩ |
| R252 | 5183056000 | 82Ω |
| R253 | 5183130000 | 100kΩ |
| R254 | 5183056000 | 82Ω |
| R255 | 5183130000 | 100kΩ |
| R256 | 5183056000 | 82Ω |
| R257 | 5183114000 | 22kΩ |
| R258 | 5183084000 | 1.2kΩ |
| R259, R260 | 5183130000 | 100kΩ |
| R261 | 5183092000 | 2.7kΩ |
| R262 | 5183122000 | 47kΩ |
| R263 | 5183092000 | 2.7kΩ |
| R264 | 5183130000 | 100kΩ |
| R265 | 5183098000 | 4.7kΩ |
| R266 | 5183090000 | 2.2kΩ |
| R267 | 5183084000 | 1.2kΩ |
| R268, R269 | 5183082000 | 1kΩ |
| | | **CAPACITORS** |
| C201~C203 | 5173046000 | Elec. 100μF 25V |
| C204~C206 | 5172344000 | Seramic 0.047μF |
| C208 | 5173037000 | Elec. 47μF 25V |
| | | **MISCELLANEOUS** |
| S201 | 5300028000 | Push SW, 3-gang |
| P201 | 5122128000 | Connector Plug 4P(WHT) |

## MASTER OSC PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200074900 | PCB Assy, Master OSC |
| | 5210074900 | PCB, Mastor OSC |
| | | **TRANSISTORS** |
| Q301 | 5145178000 | 2SC-1684S |
| Q302 | 5042466000 | 2SC-564R |
| | | **CARBON RESISTORS** |
| R301 | 5183114000 | 22kΩ 5% 1/4W |
| R302 | 5183130000 | 100kΩ 5% 1/4W |
| R303 | 5183122000 | 47kΩ 5% 1/4W |
| R304 | 5183130000 | 100kΩ 5% 1/4W |
| | | **MISCELLANEOUS** |
| J182 | 5122379000 | Connector, Socket 8P |
| U301 | 5292201500 | OSC Unit 150kHz |

## PUNCH IN/OUT PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200077700 | PCB Assy, Punch In/Out |
| | 5210077700 | PCB, Punch In/Out |
| Q901, Q902 | 5145178000 | Transistor, 2SC-1684S |
| R901 | 5183034000 | Carbon Resistor 10Ω 5% 1/4W |
| R902 | 5183122000 | Carbon Resistor 47kΩ 5% 1/4W |
| R903 | 5183098000 | Carbon Resistor 4.7kΩ 5% 1/4W |
| R904 | 5183106000 | Carbon Resistor 10kΩ 5% 1/4W |
| R905 | 5183122000 | Carbon Resistor 47kΩ 5% 1/4W |
| C901 | 5172996000 | Capacitor, Elec. 2.2μF 50V |

## FUSE PCB ASSY (PC Board Omitted)

| REF. NO. | PARTS NO. | DESCRIPTION | | |
|---|---|---|---|---|
| | 5200073510 | PCB Assy, Fuse | | U,C,GE |
| | 5200073520 | PCB Assy, Fuse | | E,UK,A |
| | 5210073500 | PCB, Fuse | | U,C,GE |
| | 5210074400 | PCB, Fuse | | E,UK,A |
| F501~F504 ⚠ | 5307004100 | Fuse 2A | 250V | U,C,GE |
| F505 ⚠ | 5307004300 | Fuse 3A | 250V | U,C,GE |
| F506 ⚠ | 5307004100 | Fuse 2A | 250V | U,C,GE |
| F507, F508 ⚠ | 5307004700 | Fuse 7A | 250V | U,C,GE |
| F509, F510 ⚠ | 5307003600 | Fuse 1A | 250V | U,C,GE |
| F501~F504 ⚠ | 5041155000 | Mini Fuse 2A | 250V | E,UK,A |
| F505 ⚠ | 5142172000 | Mini Fuse 3.15A | 250V | E,UK,A |
| F506 ⚠ | 5041155000 | Mini Fuse 2A | 250V | E,UK,A |
| F507, F508 ⚠ | 5142174000 | Mini Fuse 5A | 250V | E,UK,A |
| F509, F510 ⚠ | 5041141000 | Mini Fuse 1A | 250V | E,UK,A |
| | 5041237000 | Fuse Holder | | GE,U,C |
| | 5332014200 | Fuse Holder, Mini | | E,UK,A |
| | 5800305700 | Plate, Insulating | | |

## FUNCTION LED PCB ASSY

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200075700 | PCB Assy, Function LED A |
| | 5210075700 | PCB, Function LED A |
| D281~D288 | 5225007900 | LED, GL-9PR2 |

## OUT SELECT LED PCB ASSY (PC Board Omitted)

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200075900 | PCB Assy, Out Select LED B |
| | 5210075800 | PCB, Function LED B |
| D251~D253 | 5225007900 | LED, GL-9PR2 |
| D252 | 5225010600 | LED, GL-9HY2 |
| D253 | 5225007100 | LED, GL-9NG2 |

## OPERATION PCB ASSY (PC Board Omitted)

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

## HEAD PCB ASSY (PC Board Omitted)

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200076100 | PCB Assy, Head |
| | 5210076100 | PCB, Head |
| J401~J403 | 5332014000 | IC Socket, 16P |

## IN/OUT PCB ASSY (PC Board Omitted)

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200075000 | PCB Assy, IN/OUT |
| | 5210075000 | PCB, IN/OUT |
| | 5327007000 | Terminal Board, IN/OUT 16P |

## PITCH CONTROL PCB ASSY (PC Board Omitted)

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

## SENSOR PCB ASSY (PC Board Omitted)

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200073900 | PCB Assy, Sensor |
| | 5210073900 | PCB, Sensor |
| 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, Shut Off |
| | 5210073800 | PCB, Shut Off |
| PH501 | 5228007400 | Photo Interrupter SM3B |

## COUNTER PCB ASSY (PC Board Omitted)

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

## EDIT PCB ASSY (PC Board Omitted)

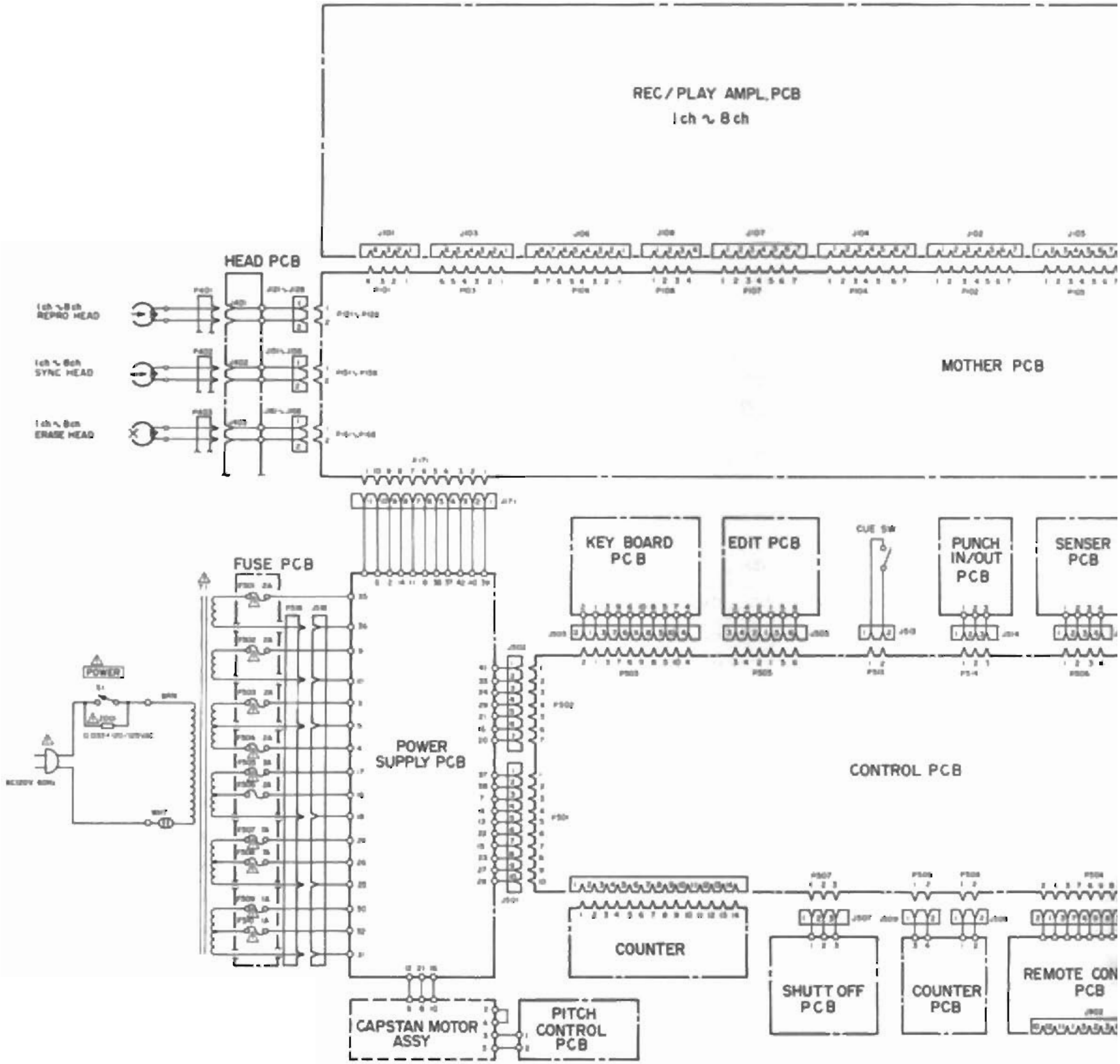
| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200074100 | PCB Assy, Edit |
| | 5210074100 | PCB, Edit |
| S608 | 5300027600 | Push SW, 4-2 NS |

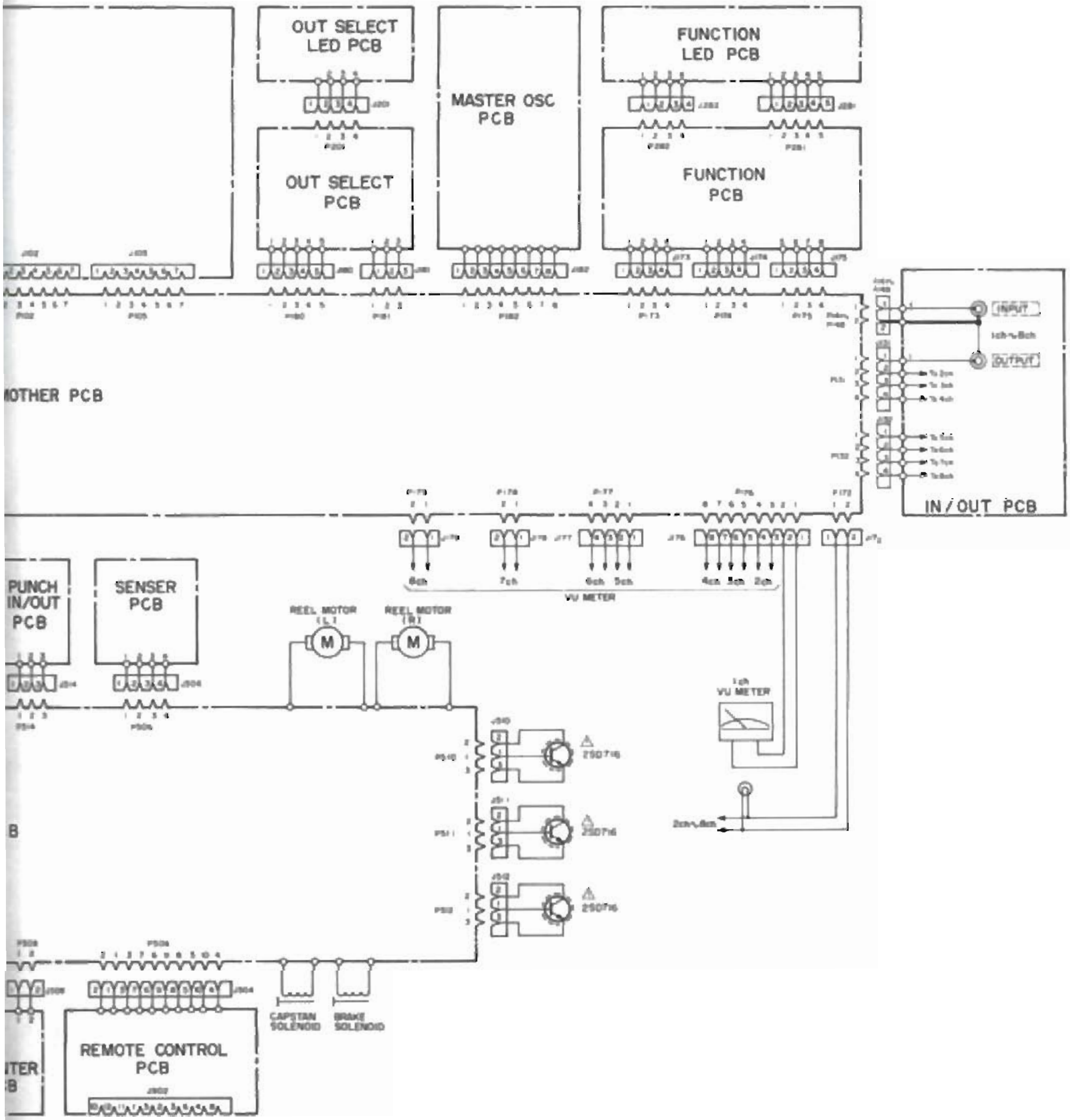
## REMOTE PCB ASSY (PC Board Omitted)

| REF. NO. | PARTS NO. | DESCRIPTION |
|---|---|---|
| | 5200073700 | PCB Assy, Remote |
| | 5210073700 | PCB, Remote |
| J902 | 5334010100 | Connector Socket |

# 5. SCHEMATICS

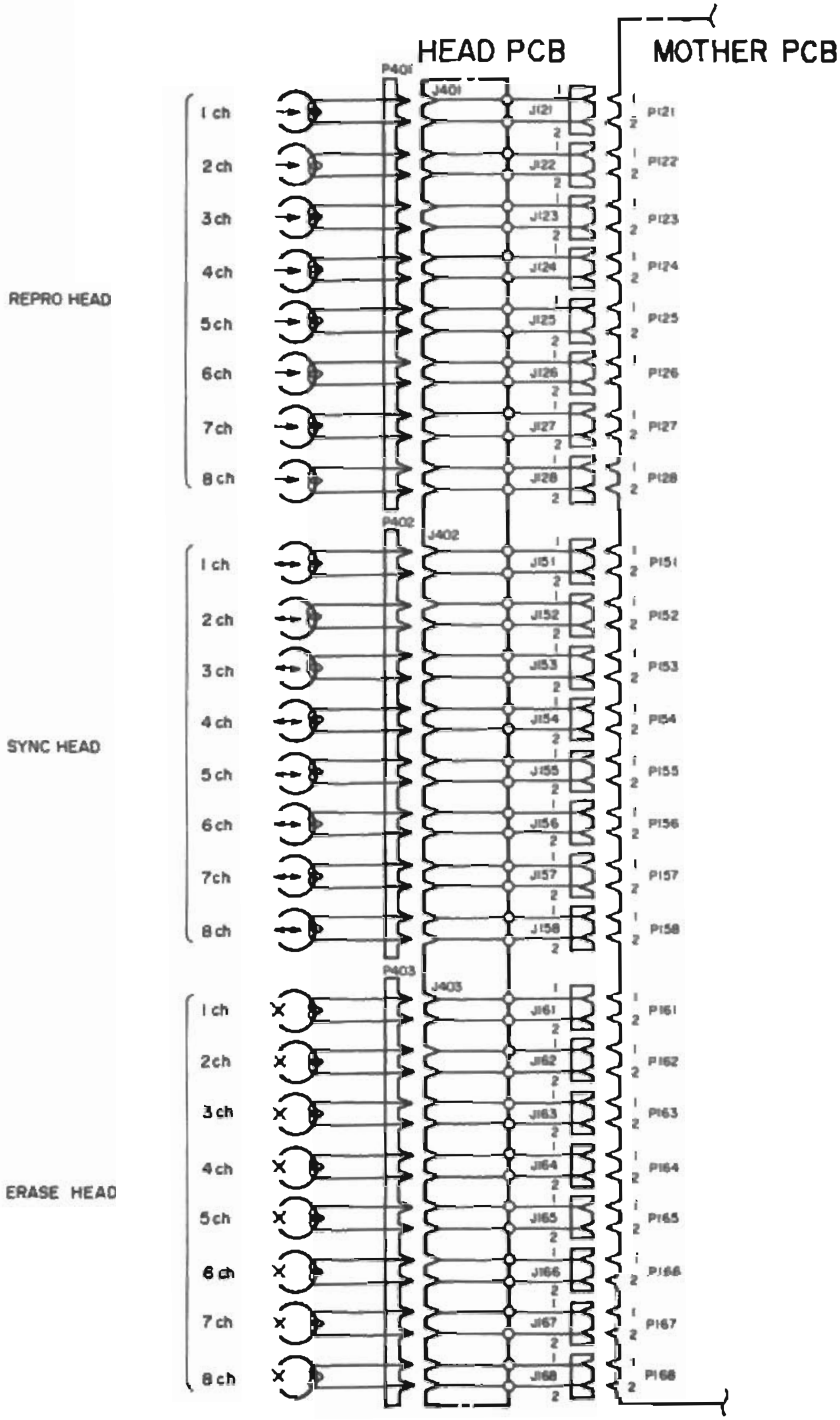
## 1. WIRING CIRCUIT DIAGRAM





OUT SELECT LED PCB
MASTER OSC PCB
FUNCTION LED PCB
OUT SELECT PCB
FUNCTION PCB
OTHER PCB
INPUT
1ch~8ch
OUTPUT
IN / OUT PCB
PUNCH IN/OUT PCB
SENSER PCB
REEL MOTOR (L)
REEL MOTOR (R)
M
8ch
7ch
6ch
5ch
4ch
3ch
2ch
VU METER
1ch VU METER
2SD716
2SD716
2SD716
2ch~8ch
CAPSTAN SOLENOID
BRAKE SOLENOID
REMOTE CONTROL PCB

## 2. HEAD ASSEMBLY CIRCUIT



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