SECTION IV. AUDIO ALIGNMENT

4.1 GENERAL DESCRIPTION

Each audio circuit board has 4 groups of front panel controls: repro, sync, record, and bias. In addition to these adjustments for each channel, this section of the manual also deals with adjustments on the bias card (#7 in the lower card cage).

1. To make these adjustments, you will need the following items:

   A. A suitable test tape, preferably 320 nanoWebers per meter (nWb/m) reference level. The tape should be compensated for the head format (i.e., 8, 16 or 24 track).

   B. A test oscillator capable of generating the following frequencies: 125 Hz, 700 Hz or 1 kHz, 10 kHz, and 15 kHz at + 4 dBm or whatever standard operating level you have chosen for your studio. In addition, the 10 kHz output should be available at -30 dBm.

   C. A reel of 1" or 2" recording tape of the type you intend to use for the session (i.e., Scotch #226 or equivalent).

   D. A non-metallic alignment screwdriver whose blade is small enough to be inserted in the trimmers of the multi-turn potentiometers on the audio cards.

   E. A head demagnetizer (degausser).

   F. Pure isopropyl alcohol and cotton swabs for head cleaning.

      CAUTION: DO NOT USE RUBBING ALCOHOL, as this can leave water and oil residues, and DO NOT USE OTHER SOLVENTS, as they may delaminate the heads.

2. When you are performing these procedures for the first several times, proceed slowly and carefully. Soon you will be fully familiar with them, but initially it is truly "better safe than sorry," as the saying goes.

4.2 DEMAGNETIZING THE HEADS AND TAPE GUIDANCE PATH

Demagnetizing (sometimes called degaussing, although that term more often refers to bulk tape erasure) is a necessary procedure, and should be performed prior to every alignment and recording session. It should always be done with extreme care.

DEMAGNETIZING CAUTION: To avoid damage to the MTR-90, always make sure the POWER switch is off before proceeding. Also, remove all recording tape, especially alignment tapes, from the vicinity of the MTR-90. The AC field created by the demagnetizer is extremely powerful and could seriously damage electronics if they are powered up.

DEMAGNETIZING CAUTION: Never turn on or turn off the power to the demagnetizer unless it is at least 3 feet (1 meter) away from the MTR-90. This would create an especially strong moving magnetic field which could possibly place a permanent magnetic charge on parts of the tape machine. The demagnetizer would not be powerful enough to remove such charges under normal operating conditions, and the parts might therefore have to be discarded. USE ONLY A PROFESSIONAL DEMAGNETIZER OF HIGH FLUX DENSITY; INEXPENSIVE "HI-FI" TYPE DEMAGNETIZERS CAN LEAVE RESIDUAL FIELDS THAT WILL CAUSE MORE HARM THAN BENEFIT.

1. Turn OFF the MTR-90 POWER switch.

2. With the demagnetizer at least 3 feet (1 meter) away from the MTR-90, plug the demagnetizer into the power mains and turn it on.

3. Slowly move the demagnetizer toward the supply swing arm roller (on the left side of the transport) until the tip is about 1/8 inch (3 mm) away.

4. Slowly move the demagnetizer tip up and down along the roller, while simultaneously turning the roller with your other hand so that the entire roller surface is directly exposed to the demagnetizing field. DO NOT TOUCH ANY MTR-90 PARTS with the demagnetizer.

5. Slowly move the demagnetizer at least 3 feet (1 meter) away from the MTR-90.

6. Working from left to right, repeat steps 3, 4, and 5 for each additional metallic part in the tape path:

   A. Tachometer idler
   B. Guide roller
   C. Tape lifter (left)
   D. Erase head
   E. Record head
   F. Scrape flutter filter roller
   G. Tape lifter (right)
   H. Reproduce head
   I. Guide roller
   J. Capstan idler
   K. Takeup swing arm roller

7. When all the above parts have been demagnetized, draw the demagnetizer at least 3 feet (1 meter) away, turn it OFF and/or unplug it.

4.3 CLEANING THE TAPE PATH

It is important to regularly clean the route along which the tape travels. Oxide and dirt will shed from the tape and accumulate on these parts, causing a build-up that can create slippage, degrade frequency response, and accelerate tape wear.

CAUTION: Never use any metallic item or abrasive to clean the heads or other tape guidance parts. Never use MEK, spirits, lacquer thinner, acetone, or other solvents on the tape heads. Rubbing alcohol should be avoided since it contains oil that will leave a residue.

1. Moisten a cotton swab with pure isopropyl alcohol, and wipe the entire surface of the supply swing arm roller. Also clean the upper and lower flanges of the swing arm to keep oxide out of the roller's bearings. Allow the roller to dry by evaporation.

2. Moisten additional swabs, and clean the following parts:

A. Guide roller
B. Tape lifter (left)
C. Erase head
D. Record head
E. Scrape flutter filter roller
F. Tape lifter (right)
G. Reproduce head
H. Guide roller
I. Takeup swing arm roller

CAUTION: DO NOT USE ALCOHOL-MOISTENED SWABS TO CLEAN THE TACHOMETER OR CAPSTAN ROLLERS. In order to avoid fibers and dust particles embedding themselves in the surface of these rollers, a lint-free cloth should be moistened with alcohol and used to gently wipe the rollers.

This should be done as often as humanly possible, i.e., between sessions or approx. every 2 - 4 reels of tape.

NOTE: Additional maintenance information is in Section 10.

4.4 REPRO AMP ALIGNMENT

1. Check to make sure the LOW FREQ COMP switch on the bias circuit board (board #7 in the lower card cage) is in the OFF position.

2. Check the Remote Box to make sure the ALL SAFE and ALL REPRO buttons are engaged.

3. Thread the test tape on the transport, and press the STOP button to initialize the servos.

4. Set the TAPE SPEED switch to the desired speed, HI or LOW.

5. Set the SPEED MODE switch to the FIX position.

6. Press the PLAY button, and locate the 700 Hz or 1 kHz reference tone.

7. Observe the VU meters, which should indicate 0 VU. If any do not, adjust the REPRO GAIN control on the correspondingly numbered audio boards as required. (Refer to Figure 4-1.)

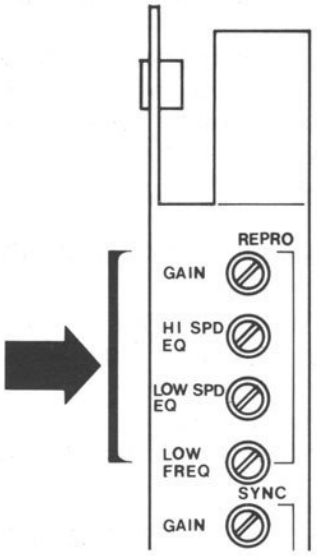


Figure 4-1. Repro section of audio circuit card (typical for channels 1-24)

8. Locate the 10 kHz reference tone.

9. On each channel's audio card, adjust the REPRO HI SPEED EQ or REPRO LOW SPEED EQ as required (in accordance with the tape speed selected) to obtain a 0 VU indication for that channel.

10. Locate the 15 kHz reference tone. The VU meters should be within 1 dB of 0 VU.

    NOTE: As a convenience, the MTR-90 is provided with a fixed low frequency equalization characteristic that suits most applications. If, however, your needs require a different characteristic (i.e., a tape supplied from another studio), the MTR-90 can be realigned with a custom-tailored low frequency EQ. This is done by moving the bias circuit card's LOW FREQ COMP switch to the ON position (the switch is located on card #7 in the lower card cage), and then adjusting the LOW FREQ controls on each audio circuit card.

11. If a test tape is being used for initial audio alignment the LOW FREQ COMP adjustments should be placed in the "OFF" mode. (They are to be ADJ. in only Record/Reproduce mode.) Otherwise turn "ON" the COMP switch if aligning to project tones.

4.5 SYNC AMP ALIGNMENT

1. Engage the ALL SEL-REP button on the Remote Box. ALL SAFE should still be engaged.

2. Rewind the test tape, press the PLAY button, and locate the 1 kHz reference tone.

3. Observe the VU meters, which should indicate 0 VU. If any do not, adjust the SYNC GAIN control on the correspondingly numbered audio cards as required. (Refer to Figure 4-2.)

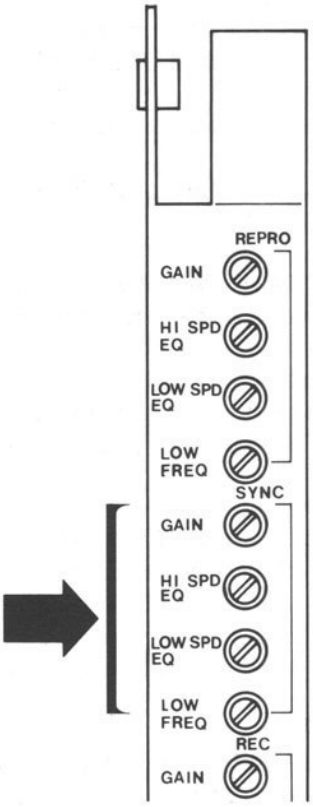


Figure 4-2. Sync section of audio circuit cards (typical for channels 1-24)

4. Locate the 10 kHz reference tone.

5. On each channel's audio card, adjust the SYNC HI SPEED EQ or SYNC LOW SPEED EQ as required (in accordance with the tape speed selected) to obtain a 0 VU indication for that channel.

6. If a test tape is being used for initial audio alignment the LOW FREQ COMP adjustments should be placed in the "OFF" mode. (They are to be adjusted in sync playback of a recorded 100 Hz tone on the MTR-90.) Otherwise, turn "ON" the COMP. switch if aligning to project tones.

4.6 BIAS ALIGNMENT

Bias need not be adjusted separately for both tape speeds; adjustment at low speed (15 ips = 38 cm/s) is recommended, and will also provide the desired results at high speed. Three master bias controls are switch-selectable so that once the individual channels have been brought into proper bias balance, a single control can reset the bias level to accommodate different tape formulations.

1. Thread a reel of blank tape on the machine.

2. Plug a test oscillator into the TEST SIGNAL input jack on the bias circuit card (#7 on the lower card cage). This jack accepts a tip-sleeve 1/4" (6 mm) phone plug.

3. Set the oscillator for +4 dBm output at 10 kHz.

4. Place the BIAS SELECT switch below the TEST SIGNAL jack in position #1.

5. On the Remote Box, engage the ALL INPUT switch so you can monitor the test input signal to check that it is actually present.

6. Now switch the Remote Box to ALL REPRO mode, disengage the ALL SAFE button, and set every READY/SAFE switch to Ready mode.

7. Press the RECORD and PLAY buttons to initiate recording of the 10 kHz test tone.

   NOTE: Perform the following 3 steps for all 8, 16 or 24 channels, one channel at a time. Refer to Figure 4-3, next page.

8. Turn the BIAS control on the audio circuit board counterclockwise until the indicated VU meter level begins to drop. If the control is already fully counterclockwise, go on to step 9.

9. Turn the BIAS control clockwise until the VU meter peaks; then continue clockwise rotation until the meter indication is 3 dB below whatever peak reading was obtained.

10. Turn down oscillator output if the peak indication is over "0" VU.

11. Repeat steps 8 and 9 to re-check the channel's bias alignment before proceeding to the next channel.

12. When all channels have been aligned for proper bias level, unplug the test oscillator from the TEST SIGNAL jack.

NOTE: For subsequent bias alignments where the only change is to a different tape formulation, you need not follow this entire procedure. Merely apply a 10 kHz signal to the TEST SIGNAL input on any one channel, choose the #2 or #3 BIAS SELECT switch position, and adjust the corresponding BIAS LEVEL control below the switch while the tape is recording. In this way, all channels are properly biased even though only a single bias adjustment is necessary.

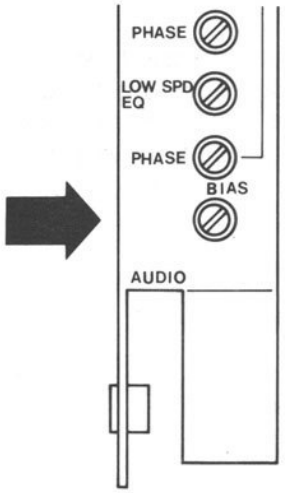


Figure 4-3. Bias section of audio circuit card (typical of channels 1-24)

4.7 RECORD ALIGNMENT

1. A reel of blank tape should be threaded on the machine.

2. Plug a test oscillator into the tape machine's XL Input jacks, either directly or via the mixing console bus outputs.

3. Set the oscillator or console for +4 dBm output (or your chosen zero VU level) at 700 Hz or 1 kHz.

4. Set the TAPE SPEED switch for the desired position (HI or LOW), and place the machine in FIX SPEED MODE.

5. The Remote Box should be switched to ALL REPRO mode, the ALL SAFE button should be disengaged, and all the READY/SAFE switches should be in Ready mode.

6. Press the RECORD and PLAY buttons to initiate recording of the 1 kHz test tone.

7. Observe the VU meters, which should indicate 0 VU. If any do not, adjust the RECORD GAIN control on the correspondingly numbered audio cards as required. (Refer to Figure 4-4.)

8. Switch the test oscillator to apply a 10 kHz + 4 dBm (or other zero VU level) tone to the inputs.

9. Observe the VU meters, which should indicate 0 VU. On each channel's audio card, adjust the RECORD HI SPEED EQ or RECORD LOW SPEED EQ as required (in accordance with the tape speed selected) to obtain a 0 VU indication for that channel.

10. Switch the oscillator to 15 kHz at +4 dBm (or your chosen zero VU reference level). The VU meters should be within 1 dB of 0 VU.

11. Press the STOP button and engage the Remote Box ALL INPUT pushbutton.

12. On each channel's audio card, adjust the MONI (monitor) control as required to obtain a 0 VU meter indication. This matches the input sensitivity and monitor level of the tape machine to the output level from the mixing console.

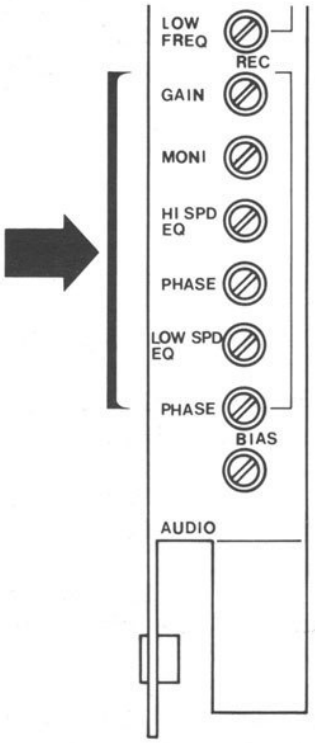


Figure 4-4. Record section of audio circuit card (typical of channels 1-24)

4.8 PHASE COMPENSATION

1. After completion of all adjustments, adjust the PHASE COMP for improving the rectangular wave transmission characteristics.

2. Apply a rectangular wave of 1 kHz 0 VU for 15 ips or 10 kHz 0 VU for 30 ips to the input.

3. Place the machine into record mode. Adjust the PHASE control for the operating speed so that such waveforms, as given in the following figures, may be obtained by observing the regenerative reproducing outputs with an oscilloscope.

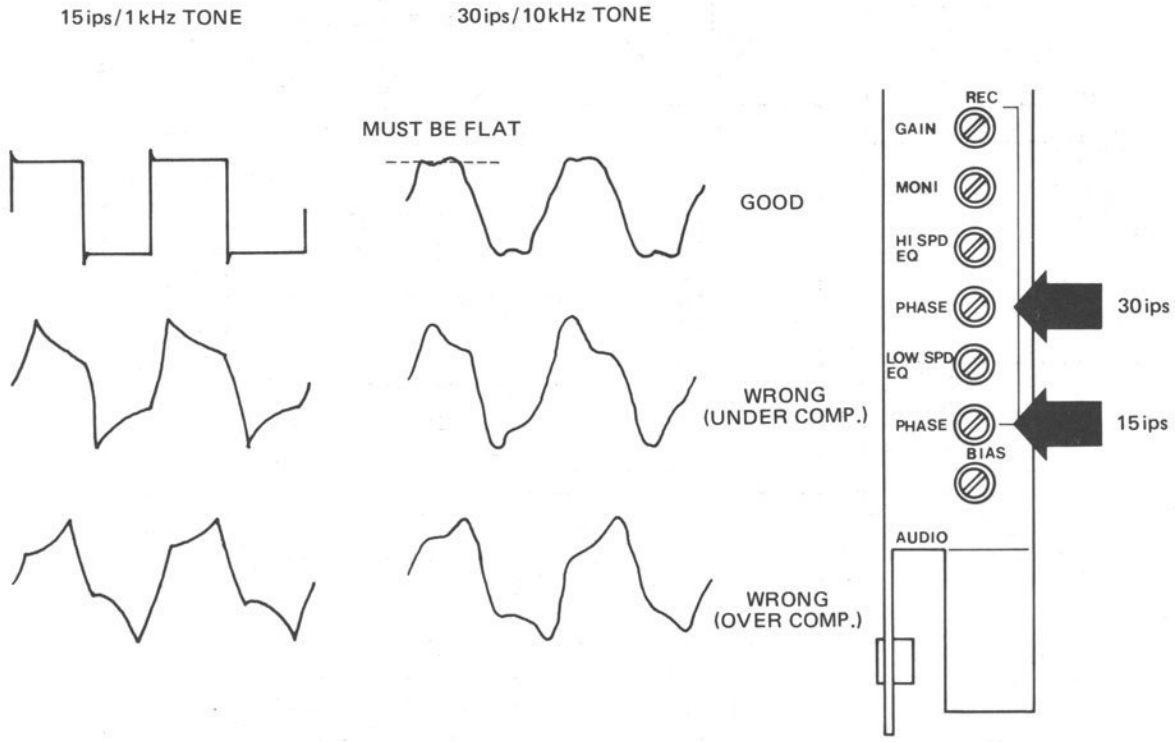


Figure 4-5 Phase compensation adjustment(s)

4.9 GAIN STRUCTURE

Figure 4-6 on the next page is a block diagram of the audio signal path for one channel of the 24-track MTR-90 (8 and 16 channel versions may differ slightly). On it are indicated the nominal signal levels in dBm (ref. 0 dB = 0.775 V RMS), given a 1 kHz signal with NAB EQ at 30 ips.

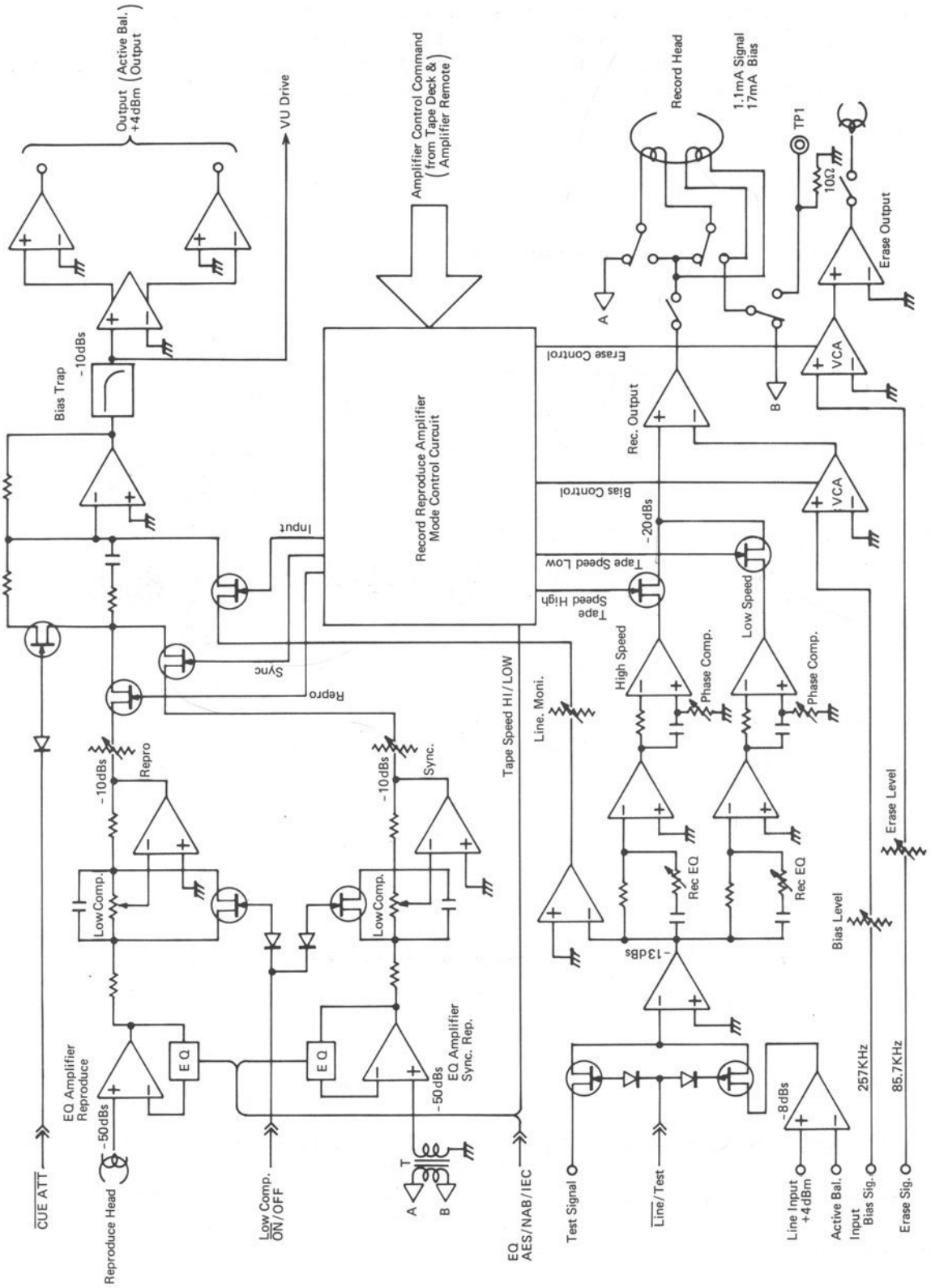


Figure 4-6. MTR-90 block diagram showing audio levels, 24-channel model. (Based on 1 kHz signal, NAB EQ, 30 ips speed.)

SECTION V. TRANSPORT ALIGNMENT

5.1 GENERAL DESCRIPTION

This section of the manual covers electronic and mechanical adjustments which affect MTR-90 performance. Many adjustments are seldom, if ever, necessary, such as those for the brakes, tape lifters, and servos. Other adjustments, such as head azimuth, will be necessary when playing tapes made on other machines. Whether or not maintenance seems to be needed, it is a good practice to check all adjustments periodically. The schedule will depend on the amount and type of use to which the MTR-90 is subjected, but we would recommend a minimum of once every 6 months or 1,000 hours of operation, whichever comes first.

5.2 HEAD GEOMETRY

The MTR-90 record and repro heads are mounted to the head assembly block via an ingenious system that permits a simple 2-screw adjustment for azimuth (left-right tilt), without affecting the zenith (forward-back tilt), wrap (penetration of the head into the tape path) or head height. This system makes it possible for OTARI to factory preset the zenith, wrap and height so that no further field adjustments are required. The only adjustment recommended is for azimuth, which maintains maximum phase coherency across the various tracks of the heads, and ensures optimum high frequency response between the record and repro heads.

Refer to Figure 5-1 for the location of the azimuth adjustment screws. Repro head azimuth must be checked and adjusted, as required, before record head azimuth can be checked.

REPRO HEAD AZIMUTH

1. Place a test tape on the transport and connect a dual-trace oscilloscope to the MTR-90's channel #2 and #23 outputs (or channels #2 and #15 on the 16 track head assembly, #2 and #7 on the 8 track head assembly).

2. Set the Remote box to All Repro mode.

3. Play the segment of the test tape containing an 8 kHz tone, which is used for the coarse adjustment.

4. Using an allen wrench, adjust the repro head for maximum phase coherence of the two traces. The head may be tilted by loosening the left-hand azimuth adjustment screw and tightening the right-hand azimuth adjustment screw an equivalent amount, or vice-versa.

5. For a fine adjustment, play the segment of the test tape containing a 16 kHz tone, and again carefully adjust tilt of the head as required for maximum phase coherence of the two traces.

RECORD HEAD AZIMUTH

1. Thread a test tape on the transport; a dual-trace oscilloscope should be connected to the MTR-90's channels #2 and #23 outputs (channels #2 and #15 on 16-track head assembly, #2 and #7 on 8-track head assembly).

2. The Remote Box should be set to All Sync mode.

3. Repeat Section 5.2, steps 3 through 5, but instead adjust the record head.

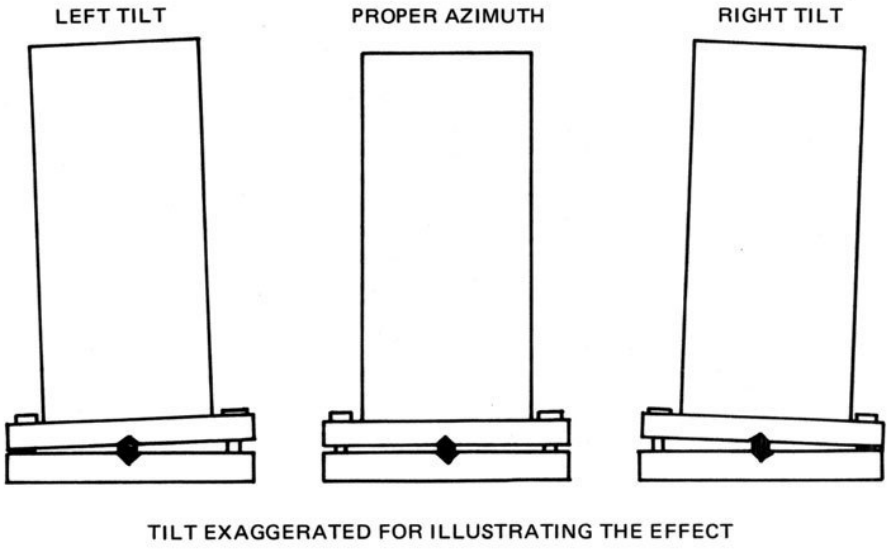


Figure 5-1. MTR-90 record and repro head azimuth adjustment.

5.3 TRANSPORT COVER PLATE REMOVAL & REPLACEMENT

The alignment/servicing procedures described in the following sub-sections of this manual require removal of the transport cover plate for access to various components.

REMOVAL:

1. Turn off the MTR-90 power switch.

2. Loosen the four cap head allen screws that secure the head assembly top cover, lift and set it aside.

3. Loosen the four cap head allen screws that secure the head assembly base cover, lift the cover up and forward so the cutout clears the head cables, and set it aside.

4. Loosen the two allen head cap screws and remove the splicing block and dress plate.

5. Loosen the 2 cap head allen screws that secure each of the swing arm guards, pushing the swing arms back to get clear access, lift the guards and set them aside.

6. Remove both reel turntable guard rings (not the turntables). This is done by removing the three cap head allen acres in each guard ring, and lifting the ring straight up.

7. Remove the two oval head phillips screws, dress washers, and nylon flat washers from the rear flange of the transport cover plate, lift the plate straight up and set it aside. Be careful not to scratch the tension arm rollers while removing this plate.

TRANSPORT DECK FLIP-UP:

The transport deck of the MTR-90 can be tilted up about 30° for very easy access to the inside of the transport. Remove the five screws (round head screws, flat washers) on each of the side panels. Remove the three screws on each side of the deck plate which are located underneath. The transport deck can now be tilted about 30° upward. Lift the transport deck until it is fully locked into position. It is dangerous to stop lifting on the way, because the deck will drop to its original position.

CAUTION: Do not lift transport deck while meter panel is folded up. This will cause damage to the shield assembly motor.

REPLACEMENT:

The transport cover plate should be reinstalled in the reverse order of its removal, with the following precautions:

1. Be sure that no loose parts, tools, wires, etc. have been left on the deck plate.

2. When putting back the head assembly base, be sure not to scrape the tacho-roller and capstan roller with the edges of the base.

3. To avoid stripped threads, do not overtighten the screws that secure the swing arm guards.

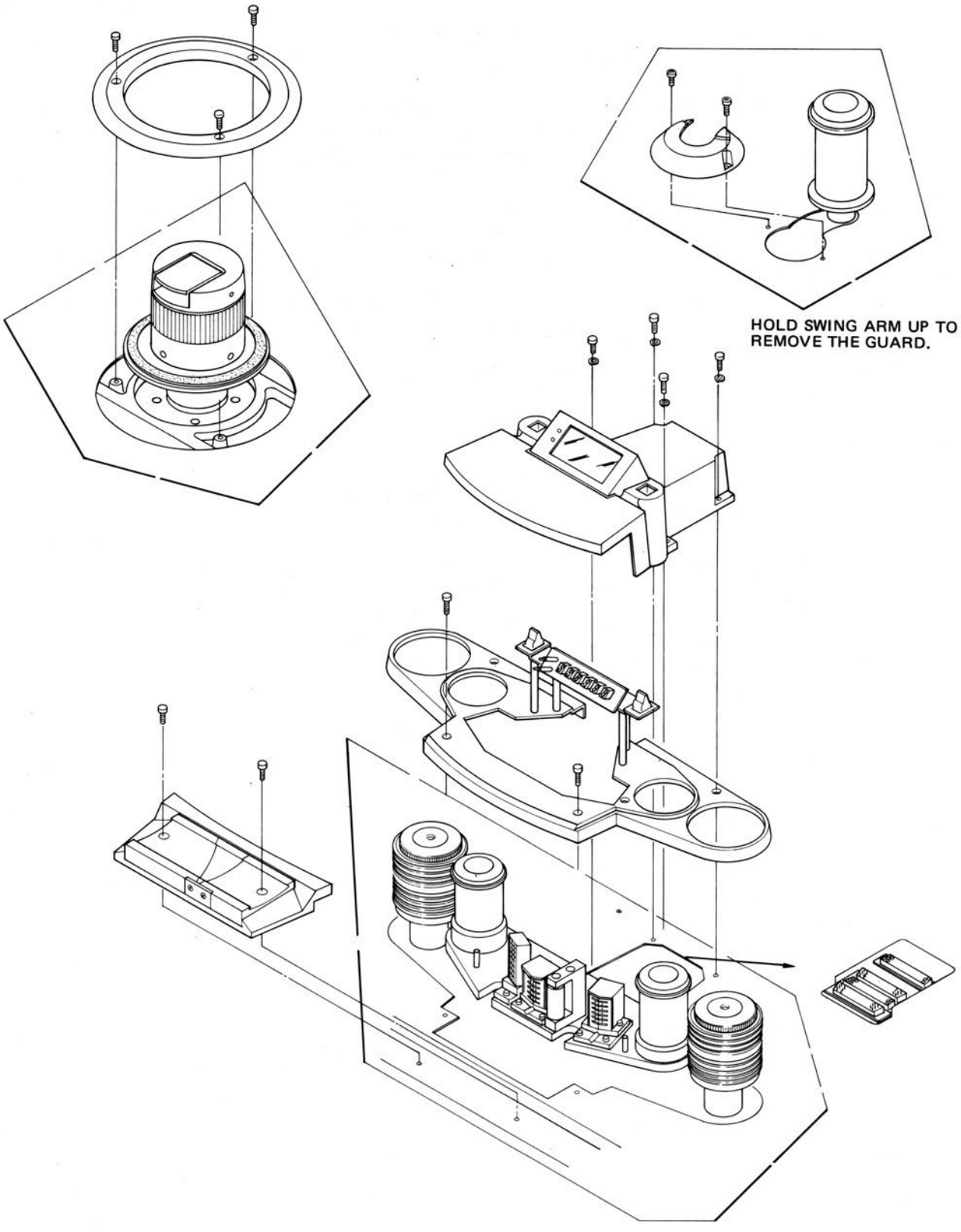


Figure 5-2. Transport cover plate removal.

5.4 SWING ARM TRAVEL (Ref. to Fig. 5-3)

Two fingers on the linkage of each swing arm restrict swing arm travel when they contact a rubber-padded post screwed to the deck plate. Two phillips screws secure each of two fingers to the linkage; the extremes of swing arm travel may be adjusted by loosening these screws and sliding the finger. Check the supply and takeup swing arms, and adjust as required.

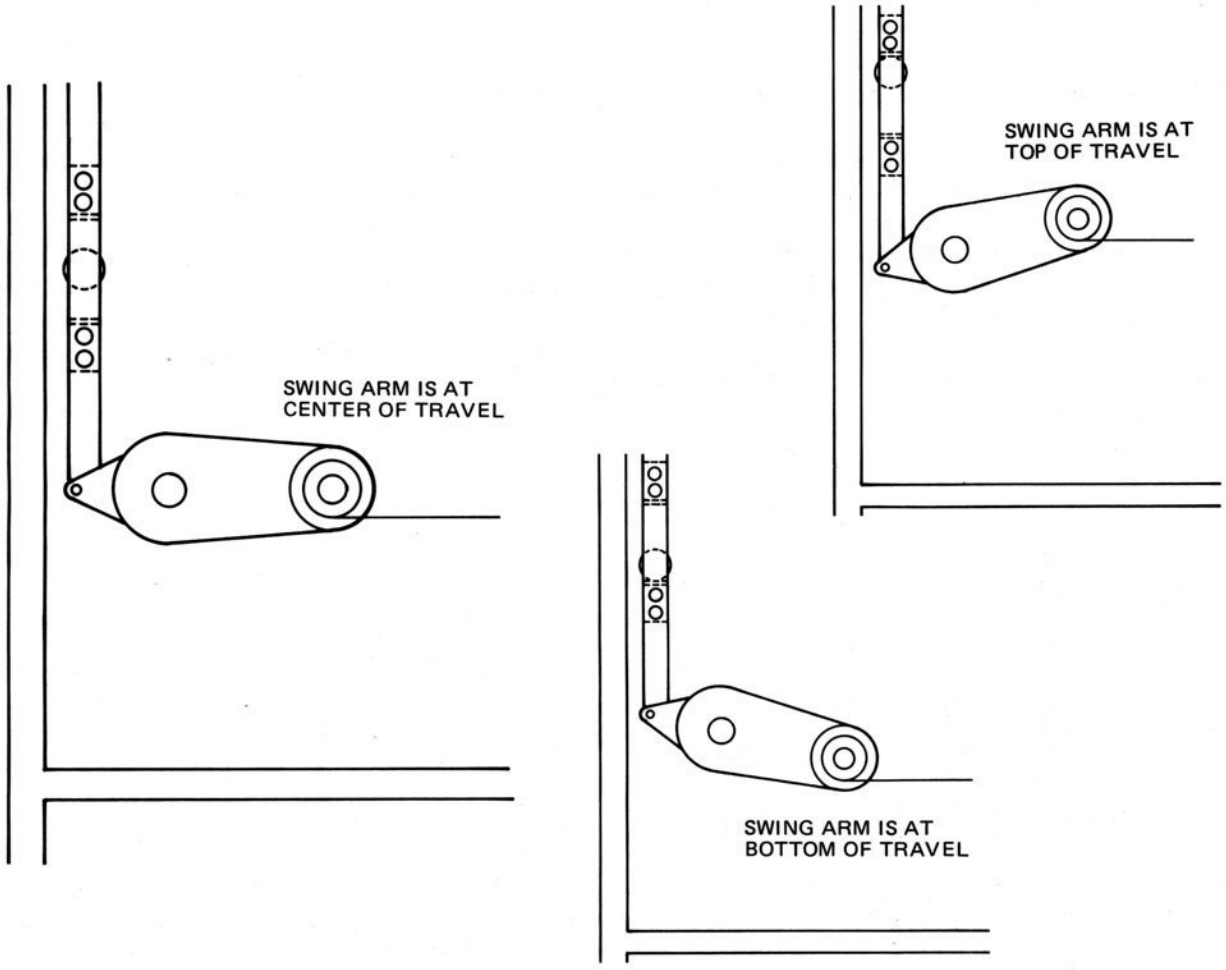


Figure 5-3. Swing arm travel limit adjustment

1. Make sure the power is off.

2. Adjust the L-bracket so that the distance from the outside of the swing arm roller guide shaft to the outside of the deck plate rib is approximately 65 mm (2-1/2 inches) when the swing arm is at the bottom of its travel (normal resting position with power off). Be sure to take-up some of the possible linkage play.

3. Loosen the tape arming solenoid (Fig. 5-4). So the next adjustment can be made properly.

4. Adjust the L-bracket so that the distance from the outside of the swing arm roller guide pin bushing and the outside of the deck plate rib is approximately 100 mm (4 inches) when the swing arm is at the top of its travel (pushed fully toward the rear of the deck plate). Recheck step '1' above to ensure that the bottom travel 65 mm dimension has not been changed.

5.5 TAPE ARMING SOLENOIDS (Ref. to Fig. 5-4)

NOTE: Before continuing, you should first have performed the procedures outlined in Section 5.4.

The tape arming solenoid is the smaller one (the solenoid nearest the front of the deck plate) of the pair associated with each swing arm. It can be moved back and forth after loosening the two phillips screws that secure it to the deck plate. Repeat the procedure below for the supply and takeup sides of the transport.

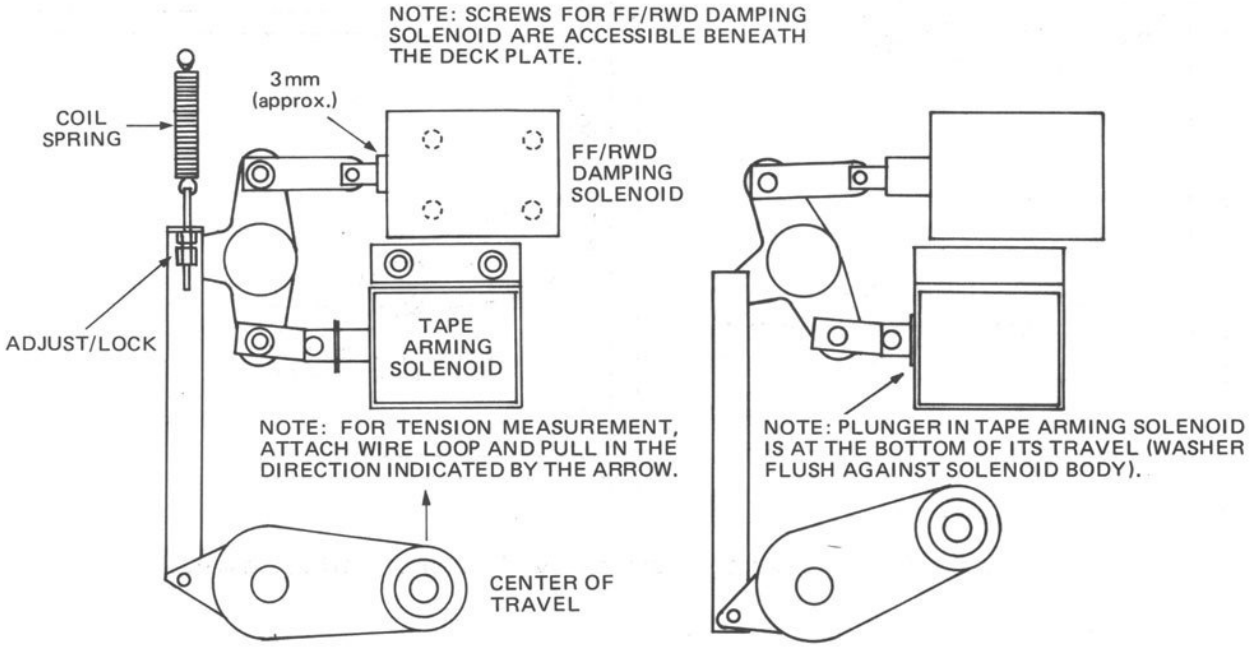


Figure 5-4. Tape arming and fast forward/rewind solenoid adjustments

1. Make sure the power is off.

2. Confirm the tape arming solenoid screws have been loosened

from Section 5.4, step 3.

3. Hold the swing arm at the top of its travel (nearest the back of the deck plate).

4. Slide the solenoid body toward the center of the deck plate. The E-retaining ring and rubber washer on the solenoid shaft should now be separated from the solenoid body.

5. Now slide the solenoid body in the opposite direction until it just contacts the retaining ring and washer. Tighten the screws to secure the solenoid, be sure to take-up some of the possible linkage play.

5.6 FAST FORWARD/REWIND DAMPING SOLENOIDS (Ref. to Figs. 5-3 & 5-4)

The fast forward/rewind damping solenoid is the larger one (the solenoid nearest the rear of the deck plate) of the pair associated with each swing arm. It can be moved back and forth after loosening six phillips screws beneath the deck plate. Repeat the procedure below for the supply and takeup sides of the transport.

1. Make sure the power is off.

2. Hold the swing arm at the middle of its range of travel (e.g., so the roller guide pin bushing is in line with the punch mark on the deck plate, per Figure 5-3).

3. Inspect the plunger in the damping solenoid. The plunger will protrude from the solenoid body toward the linkage. About 3 mm of the plunger should be visible between the body and the point where the plunger diameter is reduced for mating with the linkage (Refer to Figure 5-4). If necessary, loosen the solenoid mounting screws and adjust its position. Be sure to average this measurement, due to possible linkage play.

5.7 SWING ARM TENSION (Ref. to Fig. 5-4)

When the power is on and the swing arm solenoids have been armed, the swing arm tension is solenoid controlled (only in F.FWD and RWD modes). The tension of the coil spring on each swing arm assembly should be checked periodically, and adjusted as required to maintain accurate functioning. Repeat the procedure below for the supply and takeup sides of the transport.

1. Make sure the power is off.

2. Attach a spring scale to the swing arm post, using a loop of wire, as shown in Figure 5-4.

3. Pull the scale toward the rear of the deck plate until the swing arm is in the middle position. Then, the mark on the swing arm and that on the deck plate are horizontal (in-line) and of course parallel to the front of the machine. The scale should indicate between 410 and 450 (280 ∿ 320 for 1" tapes) grams; if not, go to step 4.

4. Loosen the double nut by holding the portion closest to the support bracket stationary, and unscrewing the other half. Then adjust the nut as required to obtain 410 ∿ 450 (or 280 ∿ 320 for 1" tapes) grams tension. It is a good practice to obtain the same measurement for both the take-up and supply swing arms, for smoother operation (approx. ±10 grams).

5. Retighten the double nut to lock it in place.

6. After completion of this adjustment, make sure that the spring is under some tension even with the swing arm in its lower position.

NOTE: When this adjustment is correct, the actual tape tension between the reel and swing arm should be from 200 to 240 grams, as measured with a Tentelometer or equivalent gauge.

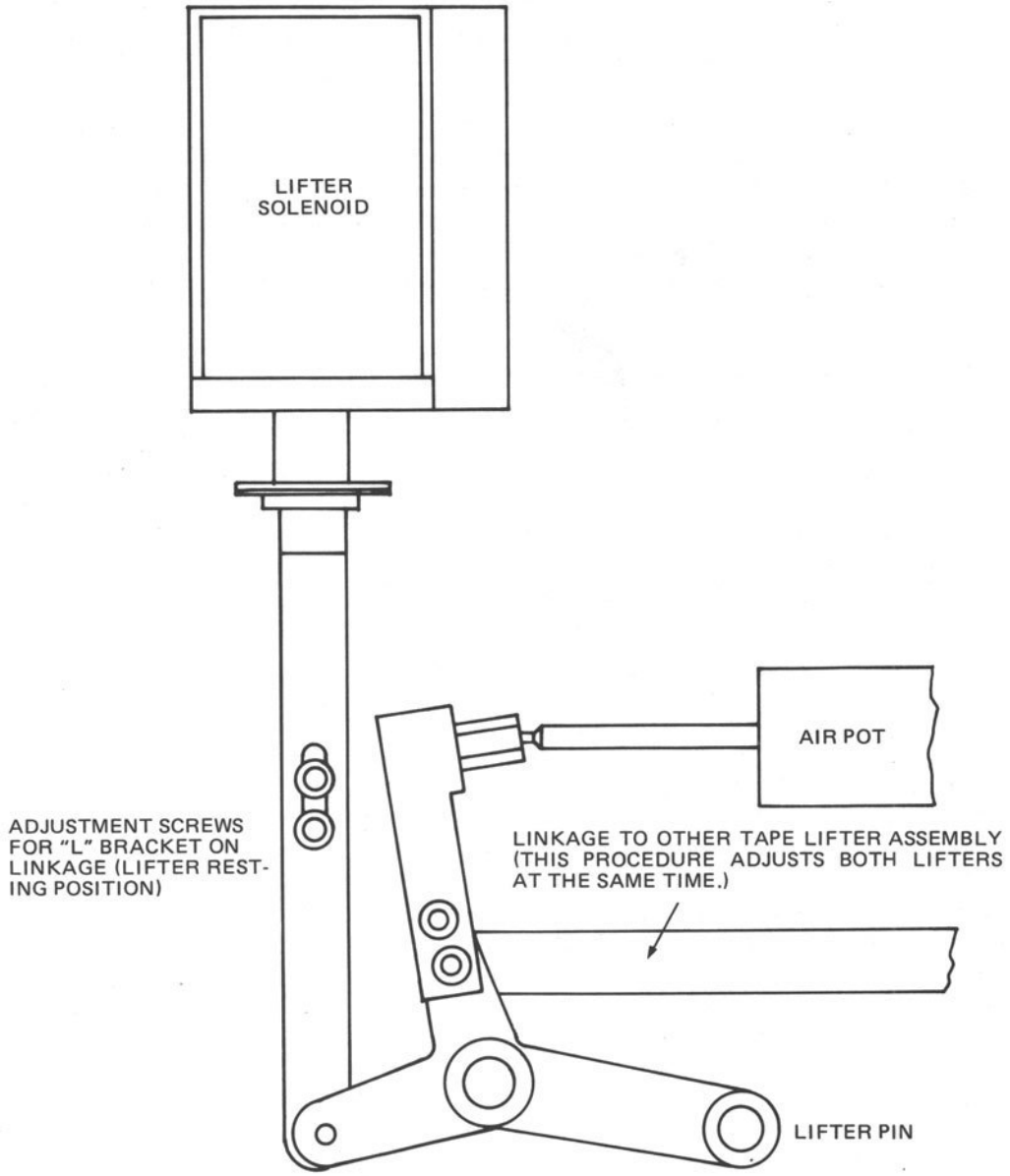
5.8 TAPE LIFTER MECHANISM (Ref. to Fig. 5-5)

The two tape lifters are linked together, and are thus adjusted at the same time. There are three different tape lifter adjustments, all of which require tape to be threaded on the transport. It makes no difference whether the deck cover plate is removed for these adjustments. Access to the lifter mechanism is obtained by opening the VU meter panel.

1. Thread a reel of tape on the transport, arm the solenoids, and place the transport in Stop mode. There should be between 2 mm and 3 mm clearance between the tape and the lifters. (If the clearance is correct, go on to Step 3.)

2. Locate the lifter solenoid beneath the deck plate. The resting position of the tape lifters can be reset by loosening the 2 phillips head screws that secure the L-bracket to the flat metal linkage, and sliding the L-bracket forward or back along this linkage.

CAUTION: You may be tempted to save time by making the following adjustments while the power is on. We urge you to use great care to avoid electrical shock. Also, avoid touching swing arm-related components which, if disturbed, could imbalance the servo system and cause tape spillage. It is faster to check a measurement with tape moving, then turn power off, make an adjustment, and recheck with power on.



NOTE: Components shown are an "x-ray" view, as though seen looking down on the top of the deck plate. In fact, only the airpot adjustment screw is accessible from the top (with deck cover plate removed), while all parts are accessible below the deck plate.

Figure 5-5. Tape lifter adjustment(s)

3. Place the transport in Fast Forward or Rewind mode. The lifters should push the tape about 2-3 mm away from the repro head. (If the clearance is correct, go on to Step 5.)

4. The L-shaped bracket securing the solenoid is screwed to the deck plate. The securing hole of this L-shaped bracket is elliptical, so the solenoid can move back and forth when the screw is loosened. Therefore, tighten the screws after moving the solenoid with the bracket back and forth once the correct outer clearance is obtained from the tape to repro. head.

5. Place the transport in Fast Forward mode and allow the tape to reach full winding speed. Then press the PLAY button and observe the tape lifters. The tape should be lowered gently onto the heads; if not, turn the damping adjustment screw clockwise to increase dampening (accessible beneath the deck plate). If when leaving fast wind and coming to a stop mode, the tape lifters require greater than 1.5 - 2 seconds, turn the damp adjustment screws counterclockwise to relieve the excessive lifter delay.

5.9 BRAKES (Ref. to Fig. 5-6)

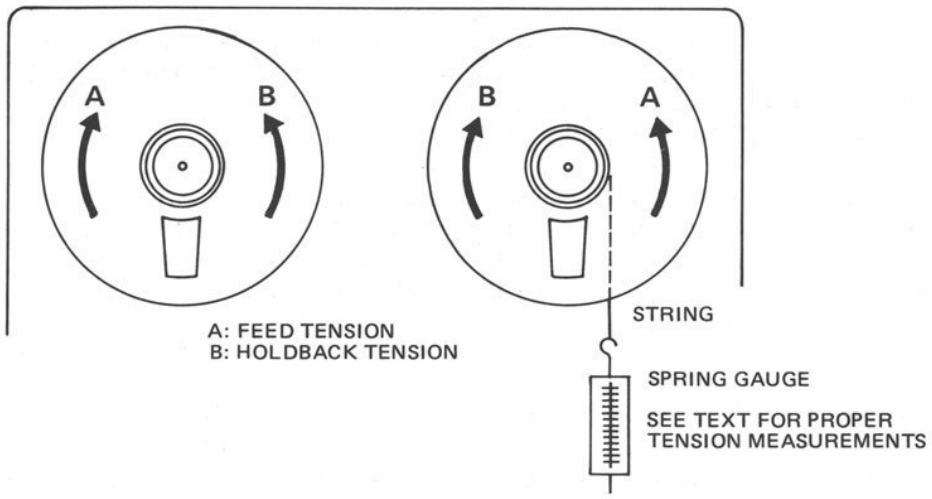
Braking is accomplished primarily through the servo control of the reel motors. However, additional braking, and a safety backup in the event of a loss of power, is provided by mechanical brakes on the reel motors. A padded felt band is spring loaded to close against a cylindrical disc attached to the motor shaft, and a solenoid holds the shoe away from the disc during Play, Record, Fast Forward, Rewind, Cue, and Stop modes. Only in Unload mode or when the power is off do the brakes engage. The mechanism is designed so that the holdback tension on each reel is greater than the feed tension (i.e., for the supply reel motor, counter-clockwise tension is greater than clockwise, and vice-versa for the takeup motor). Repeat the procedure below for both the supply and takeup reel brakes.

1. Turn power off.

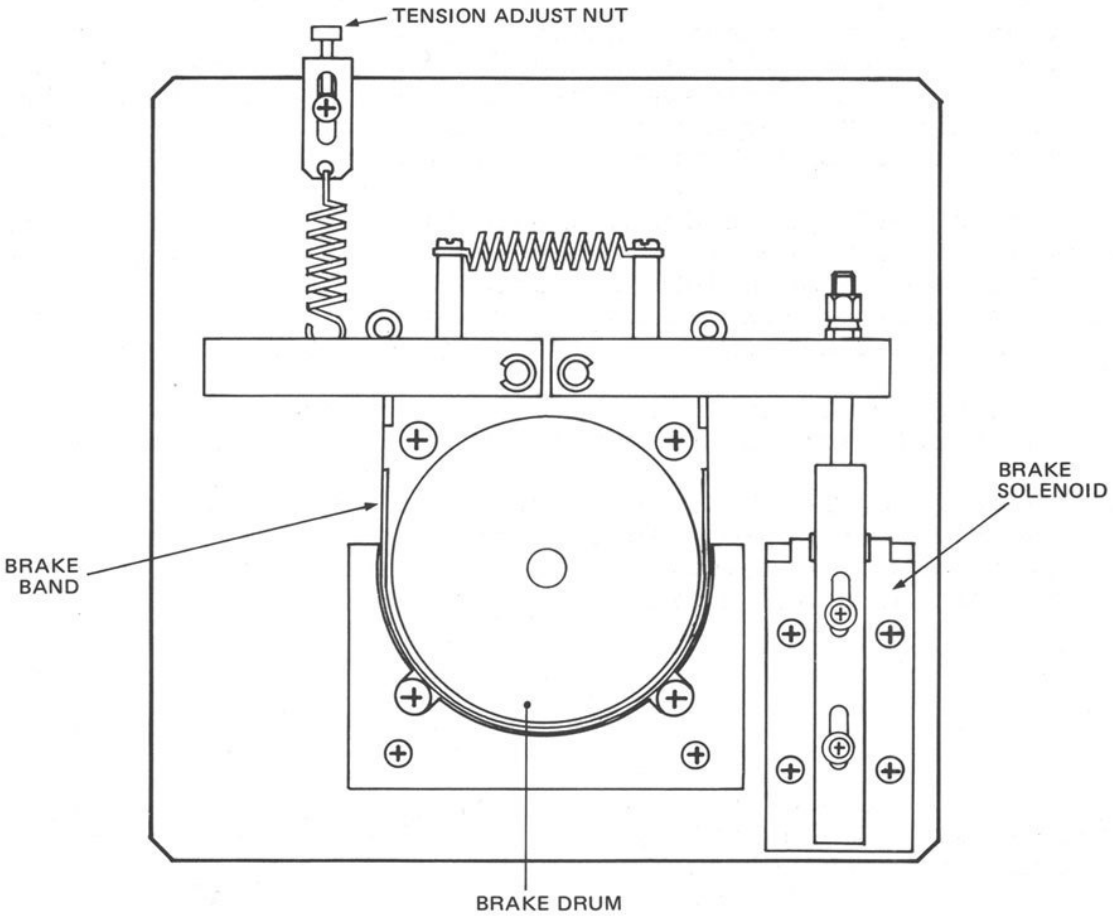
2. Seat an empty 10" reel on the reel turntable.

3. Attach a string of approximately 2 feet (70 cm) in length to a spring scale (spring gauge).

4. Holdback tension should be between 1.2 killograms and 1.5 kilograms; check it by looping the free end of the string from the spring scale around the reel hub and winding the string onto the hub,
   a) turning the supply reel clockwise or,
   b) turning the takeup reel counterclockwise. Then
   c) pull on the spring scale to "unwind" the reel, thus measuring the holdback tension (Figure 5-6, a).



a) Measuring brake tension



b) Brake tension adjustment nut

Figure 5-6. Brake tension adjustment.

5. Feed tension should be between 600 grams and 750 grams; check it by winding the free end of the string from the spring scale onto the reel hub in the opposite direction of that used to check holdback tension.

   NOTE: The tension adjustment is done with a single hex head screw on each brake spring slide bracket (Figure 5-6,b). These adjustment screws are accessible either by opening the meter panel, or by removing the two side cover panels from the MTR-90.

5.10 REEL TURNTABLE HEIGHT (Ref. to Fig. 5-7)

CAUTION: Each reel motor shaft has two flats ground in it, at 90° angles to one another. Two allen-head set-screws in the reel turntable seat against these flats. Whenever adjusting or replacing a reel turntable, IT MUST BE CAREFULLY ALIGNED SO THAT BOTH SET-SCREWS ARE DIRECTLY IN LINE WITH THE CORRESPONDING FLATS ON THE MOTOR SHAFT. If a set-screw is improperly tightened against the rounded portion of the shaft, the turntable will be unbalanced and a burr can form that will make it extremely difficult to subsequently remove the turntable and correct the situation. Costly damage to the motor shaft and turntable could result.

The following procedures should be performed for both the supply and takeup reel turntables. While nominal heights are indicated, some fine height adjustment may be necessary to avoid rubbing on reel or flanges swing arm guide rollers: both turntables should be within 0.5 mm (.02") of the same height.

1. Turn power off so that there is less chance the reel motor shaft will rotate inadvertently during turntable adjustment.

2. Measure the height from outside the rubber gasket on top of the reel turntable flange to the top of the turntable guard ring (as shown below). The height should be 2.5 mm (0.1") to the turntable guard ring.

DO NOT LOOSEN the protruding cap head phillips screw that engages the key slot in the reel hub.

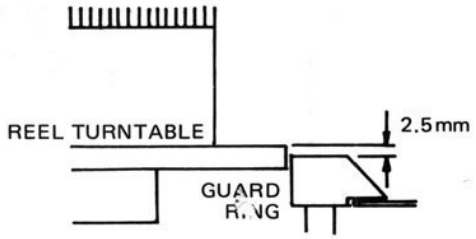


Figure 5-7. Reel turntable height adjustment

3. For adjustment, loosen both allen set-screws at least two full turns, and gently lift (or press down) the reel turntable as required. IF YOU HAVE ANY DOUBT AS TO WHETHER THE SET-SCREWS ARE STILL ALIGNED WITH THE FLATS ON THE MOTOR SHAFT, DO NOT TIGHTEN THE SCREWS; LIFT THE TURNTABLE COMPLETELY OFF THE SHAFT AND VISUALLY INSPECT THE ALIGNMENT.

4. When the correct turntable height is achieved, tighten both set-screws moderately and recheck the height. Then firmly tighten the screws.

5.11 REEL TENSION SERVO

The following adjustments are made with the deck plate installed, but without tape. Refer to Figure 5-8. Steps 1 and 2 are only necessary if either both swing assembly have been disassembled.

UPPER AND LOWER LIMIT ADJUSTMENT

1. Turn the power off, and remove the REEL CONTROL circuit card #1 from the lower card cage. Reinstall the reel card using the extender P.C.B. Turn the power on monitor TP-3 and TP-4 take-up and supply respectively with a DVM or VOM (DC voltmeter) with reference to a ground test point on the same card.

2. Mechanically adjust the swing arm potentiometer by loosening the 2 screws that secure the pot to its bracket. Adjust for "0" volt while securing the arms at their center positions (marks on dress base). When completed turn off power and reinstall the reel control card into its proper slot in the card cage.

3. Turn the power on.

4. Hold the takeup swing arm all the way to its uppermost position (e.g., toward the rear of the deck plate).

5. Use a small screwdriver to adjust the T.UP UPPER trimmer (third from the top of board #1) until the green LED beneath) it just turns on. This should place the swing arm about 1/4" from the uppermost position when the green LED turns off.

6. Allow the swing arm to return to its bottom-most position; make sure the guard ring does not interfere with the arm moving all the way down (toward the front of the deck plate).

7. Adjust the T.UP LOWER trimmer (fourth from the top of board #1) until the yellow LED beneath it just turns on. This should place the swing arm about 1/8 ∿ 1/4" from the lowermost position when the yellow LED turns off.

8. Repeat Steps 5 through 8 for the supply swing arm, adjusting the SUP UPPER and SUP LOWER trimmers (next to bottom and on bottom on the circuit board). It is a good practice to adjust the upper green LEDs as ballanced as possible between take-up and supply arms.

PRELIMINARY CENTER POSITION AND GAIN ADJUSTMENTS

1. Place a small piece of polystyrene foam in the bottom of each swing arm slot (at the guard ring) to prevent the arms from dropping into the disarm position.

2. Turn the power on, arm the solenoids by pushing both swing arms to their uppermost position, and press the STOP button. Both swing arms should drop against the foam, and the reel motors should spin.

3. Hold the takeup swing arm at the center position (marks on dress base), and adjust the T.UP POS (position) trimmer (top on circuit card #1) so the takeup reel motor stops spinning and just begins to reverse direction.

4. Repeat the procedure for the supply swing arm, adjusting the SUP POS trimmer on circuit card #1.

5. Hold the takeup swing arm all the way down to its lowermost position (toward the front of the deck plate), and adjust the T.UP GAIN trimmer (second from the top on circuit card #1) clockwise until maximum speed is obtained. Then turn counterclockwise to the point at which 1/2 of speed is obtained.

6. Repeat Step 5 for the supply swing arm, adjusting the SUP GAIN trimmer. This frequency can be heard by holding business card to the corrugated rubber edges on the reel hubs.

7. The same adjustment can be made much more accurately if a digital voltmeter is available. Turn off the machine and extend the reel control card. Turn power "ON" monitor TP-1 and TP-6 takeup and

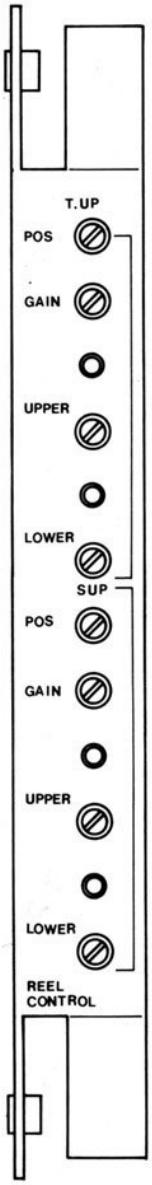


Figure 5-8. Reel control circuit card (card #1) front panel adjustments.

supply respectively with reference to a ground test point on this card. By moving the supply then takeup arms fully upward and downward, adjust the corresponding gain adjustments for a total deviation of 8 volts.

8. Now by continuing to monitor the same test points, secure the swing arms at their center positions, once again, and readjust the position adjustments for "0" volt (loading tape on the machine is not necessary for these last two adjustments).

TAPE TENSION CHECK

1. Load a 10 inch reel of Scotch 226 (or equivalent) tape onto the transport, with the tape evenly distributed between the supply and takeup reels.

2. As a visual check, the tension swing arms should be approx. 2 mm at their dress cover markings in Stop mode.

3. Use a Tentelometer or other tension gauge to check the tension on the portion of tape between each swing arm and its adjacent reel. The tension should be between 200 grams and 240 grams.

4. If the deviation from the above specification is less than ± 20 grams, you can use the POS (position) trimmer(s) to correct the tension.

5. If the tension is more than 20 grams out of spec, DO NOT RESET THE POSITION TRIMMERS. Instead, the swing arm spring (under the transport deck cover) must be readjusted (Refer to Section 5-7).

REEL MOTOR TRACKING OF CAPSTAN

The potentiometers for adjusting the motor torque is located on the transport control circuit card #3.

1. Turn the power off, remove the circuit card #3 and insert the extender card in its place. Then, mount the transport control circuit card #3 into the front of extender card.

2. Turn the power on and thread a reel of tape to an equal (balanced) tape pack between the two reels. Disconnect the capstan motor (unplug the UNIVERSAL MATE-N-LOCK connector to the left of the capstan motor beneath the deck plate).

3. Place the machine into Rewind mode.
Using your hand. Spin the capstan roller counterclockwise. Adjust the potentiometer VR1 on the transport control PCB assembly so that the tape moves very slowly onto the supply

reel (about 5 ips or 1 capstan rotation in 2 seconds). (Refer to Figure 5-9.)

4. Place the machine in Fast Forward mode, spin the capstan clockwise, and adjust the potentiometer VR2 on the transport control PCB assembly so that tape moves slowly onto the take-up reel. It is important to adjust the two positions as equal as possible. Do not adjust either adjustment for longer than 15 seconds at one time. This will cause invalid results.

5. Press the STOP button, turn the Power Off and reconnect the capstan motor, and reinstall transport card properly into card cage.

FINE ADJUSTMENT OF POSITION AND GAIN

1. Place the machine in Rewind mode. Capstan and tacho rollers should need no replacement for extensive periods of time if they are properly maintained. If there is any slippage of the tape on the capstan roller, temporarily adjust the SUP POS trimmer on circuit card #1, turning it slowly clockwise until the slippage is eliminated (Refer to Figure 5-8). Wind time for a 10 inch reel of 1.5 mil tape should be approx. 120 seconds.

2. Place the machine in Fast Forward mode. If there is any slippage of the tape on the capstan roller, adjust the T.UP POS trimmer on circuit board #1, turning it slowly counter-clockwise until the slippage is eliminated.

3. If any swing arm instability or jitter is noted at this time, slightly reduce that swing arm's GAIN trimmer (e.g., SUP GAIN or T.UP GAIN on circuit card #1) to eliminate the problem. If this problem persists, it is possible that the capstan roller may need replacement. (Contact OTARI or your local OTARI dealer for this part and technical assistance for proper installation.)

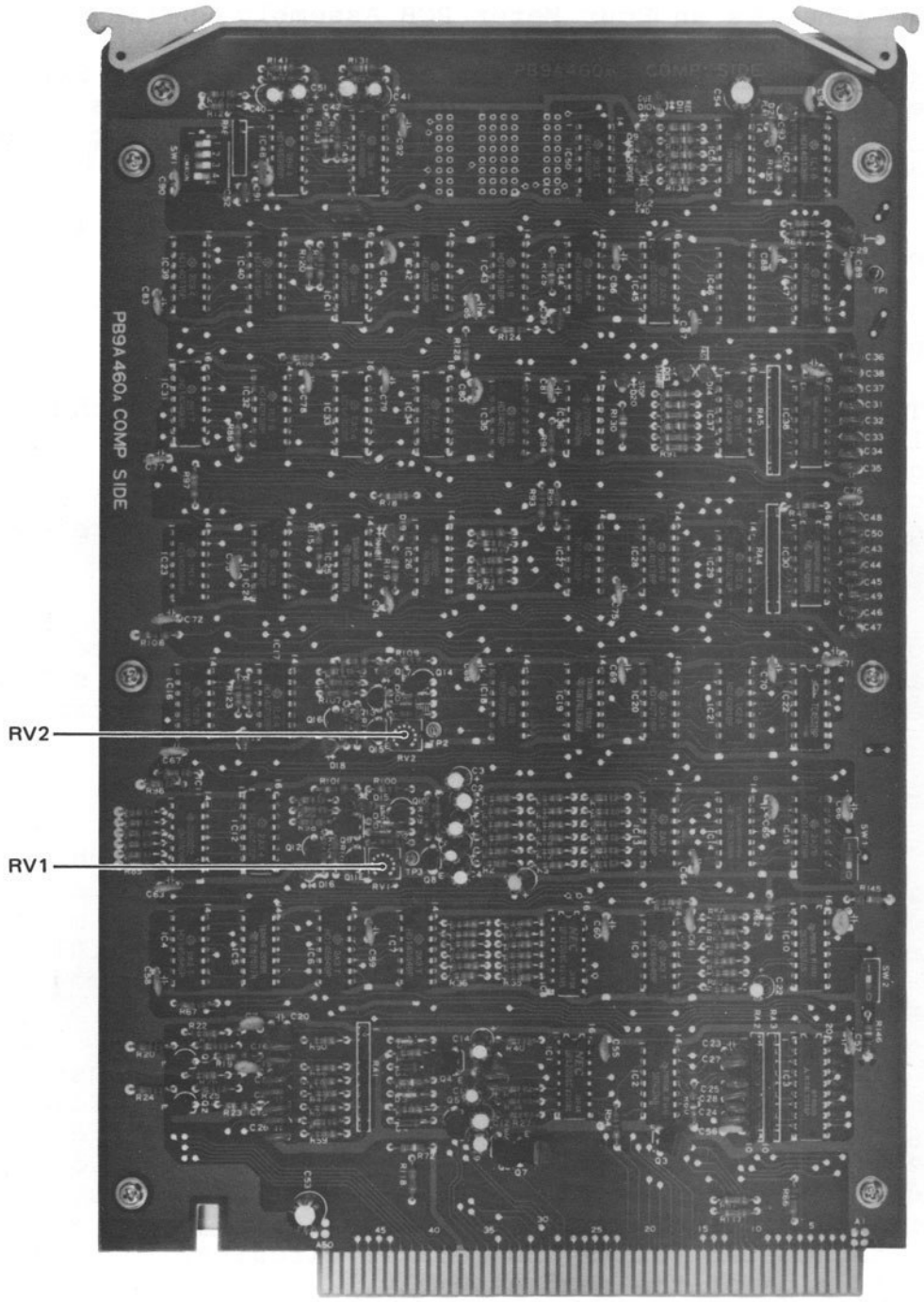


Figure 5-9. Transport control card (card slot #3) component side shown. VR-1 and VR-2 for rewind and fast forward respectively.

REEL SIZE DETECTOR ADJUSTMENT

1. Reel size detector PCB Assembly (PB-45D PB9A371A) is one of the two small PCB Assemblies beneath the transport assembly. (The other is an Hour Meter PCB Assembly PB-45R.)

2. Make adjustments of VR1 (for T.UP) and VR3 (for SUP) so that the LEDs on this PCB Assembly turn on. The LEDs should light up only with 14" reels, while they should go out with anything smaller.

3. If the decorative cover is reinstalled, confirm its correct operation (sensitivity).

5.12 CAPSTAN SERVO

NOTE: In this Section of the manual, refer to the following illustrations:
Figure 5-10 for capstan tachometer adjustment,
Figure 5-11 for capstan control circuit card adjustments,
Figure 5-13 for miscellaneous capstan waveform references.

1. Turn the power off.

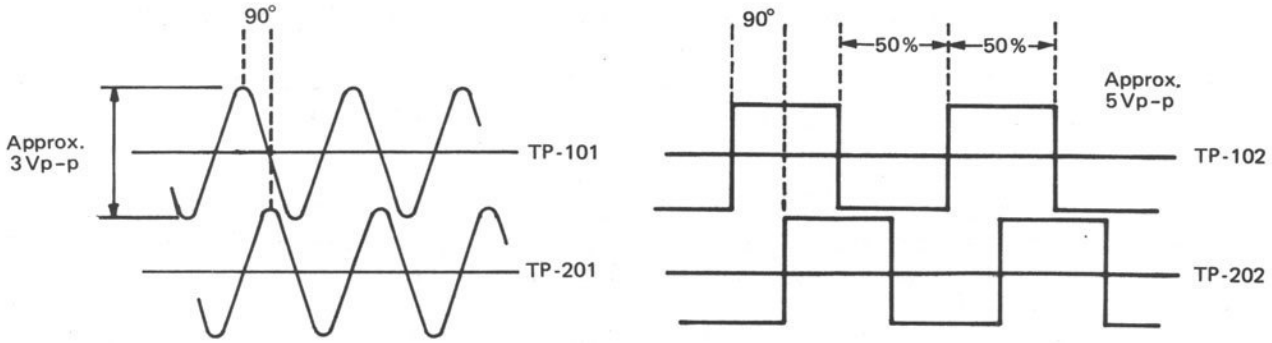
2. Unplug the Capstan Control card (#2), and replace it with the service extender board (plug the board into slot #2 in the lower card cage). Now plug the Capstan Control card onto the extender board.

3. Turn the power on.

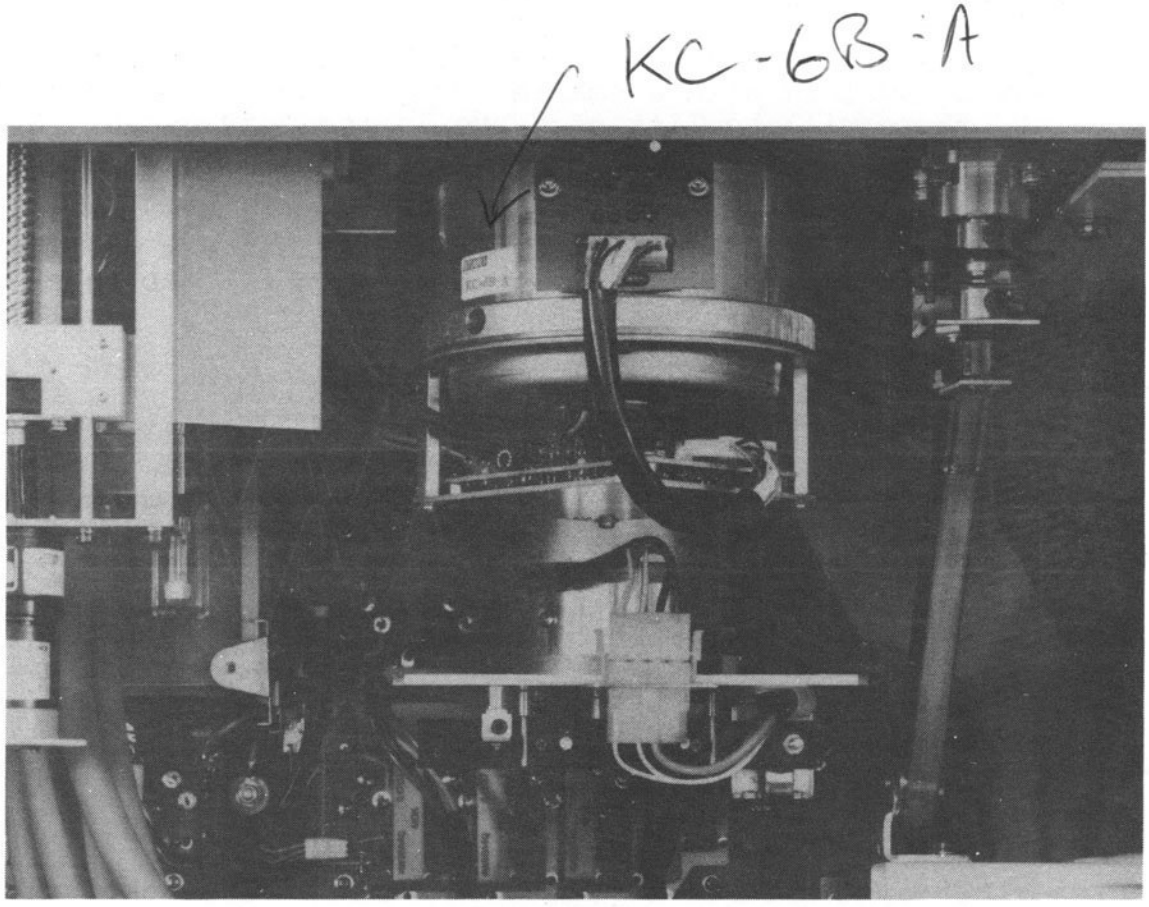
4. To check the output of the capstan photocell tach assembly, connect a dual-trace oscilloscope to pins TP101 and TP201 of the Tacho Sensor Amp. PCB mounted under capstan motor. (Refer to Figure 5-10,a.) The signal at pin TP101 should lead that at pin TP201 by 90° when the tape is moving forward. If it does, go on to Step 6.

5. If necessary, the position of the capstan tach assembly can be adjusted to meet the above specification. (Refer to Figure 5-10,b.) The tach assembly is accessible by opening the meter panel and removing the capstan motor, on the takeup side of the head assembly. (Do not confuse this small circuit board attached to the front of the capstan motor with the tachometer roller and related circuitry located on the supply side of the head assembly.)

6. Observe TP102 and TP202 on the top of TACHO SENSOR AMP PCB assembly. Adjust VR101 and VR201 so that the waveform of tachopulse has a 50% duty cycle (Fig. 5-10,a). Next, observe the check points TP1 and TP3 of CAPSTAN PCB assembly (TP11 or TP12 for GROUND) to see that a similar waveform is obtained.



a) Output waveform



b) Location of the capstan tachometer PC board

Figure 5-10. Capstan tachometer adjustment.

ADJUSTMENT OF CAPSTAN CONTROL PCB ASSEMBLY (PB-45V, PR9A459)

1. Observe TP1 and TP3 of PB-45V (the ground terminal in TP11 or 12) with a DUAL scope. (The servo circuit may be in operation.)

2. Make sure that a waveform observed at TP3 with the capstan motor roller being turned forward by hand has a 50% cycle and there should be a 90° phase shifted waveform at TP1.

3. Operate the servo circuit so the following observation can be made.

4. Adjust VR6 so that D.C. voltage at TP10 is 0 V in Stop mode (for B suffix serial numbered machines only).

Adjustment of PLAY GAIN (VR1) (Front panel)

1. Press the PLAY button. Turn VR1 either cw or ccw for an observed waveform with a smaller duty cycle. After a certain point, there will be little change in the duty cycle. Stop the adjustment at the point. (The duty cycle will be about 60% at this time.)

2. It is when the PLL circuit operates that a square wave is correctly observed at TP9. Make sure that the LED on PB-45V lights up.

Adjustment of PLAY DUMP (VR2) (Front panel)

1. Turn VR2 in PLAY mode, observing TP9.

2. At a certain point, an observed waveform (a square wave) once breaks. Keep on turning VR2 till a square wave can be observed again. Stop adjustment after making two revolutions from this point.

3. Repeat PLAY-STOP and make sure that the capstan motor operates smoothly.

Adjustment of FAST GAIN and DAMP (VR3 and VR4) (Front panel)

1. Set VR3 and VR4 at the middle of their movable range.

2. Load the capstan shaft in the fast wind mode to make sure that there is no big change in the duty for the waveform observed at TP9.

Adjustment of VR5

1. Connect the frequency counter to TP102 or TP202 on the Tach Sensor Amp. PCB Assembly (mounted under capstan motor).

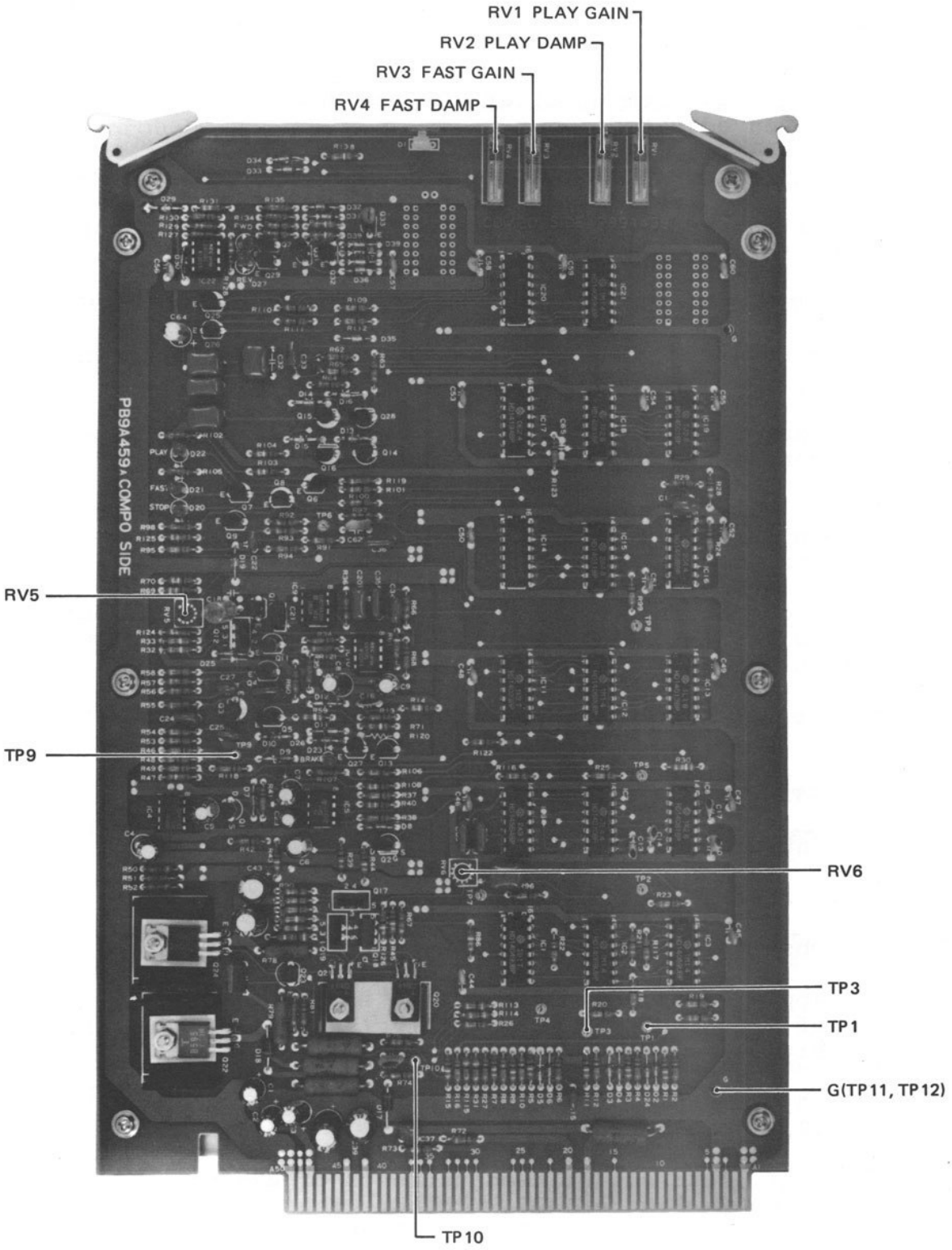


Figure 5-11. Capstan control circuit board, adjustments and check points.

2. Adjust VR5 both in F.FWD and RWD modes so that at top speed the frequency counter stabilizes near 42 kHz and the difference between the readouts in both modes is within ± 0.5 kHz.

3. Make this adjustment after VR1 and VR3 of I/O PCB Assembly have been adjusted.

5.13 ADJUSTMENT OF TRANSPORT PCB ASSEMBLY (PB-45W; PB 9A460)

As for the adjustment of VR1 and VR2 on the transport card, refer to Page 5-15.

5.14 ADJUSTMENT OF MASTER CPU PCB ASSEMBLY (PB-45X; PB 9A461)

1. Remove the CPU card and install the extender card in its place, then reinstall the extender.

2. Make sure that the LED on the front panel turns green about 3 seconds after turning the power on.

3. Adjust VR1 so that the output frequency at check terminal TP5 on PB-45X is 9606 Hz with the Remote Control Box (CB-113) disconnected.

4. After connecting the Remote Control Box (CB-113), put the remote box into Vari mode and select speed indication readout in percentage Reading mode.

5. Adjust VR1 on the CPU card for equal pitch adjustment ± 23 ∿ 24%.

5.15 ADJUSTMENT OF I/O PCB ASSEMBLY (PB-45Y; PB 9A463)

Adjustment of Cue Tone Filter

A Suffix Serial Numbered Machines

1. Observe the output waveform of TP6 with a scope.

2. Apply +4 dB, 800 Hz sinewave signal to Test Signal jack of Bias Control PCB Assembly (PB-15L; PB9A465) from the signal generator.

3. Adjust VR5 so that an output waveform shown in Figure 5-12, a) can be observed.

4. Next, make slight readjustments of VR5 so that a waveform shown in Figure 5-12, c) can be obtained when the frequency is changed to 1200 Hz. Then make sure that both waveforms shown in Figures 5-12, a) & c) can be obtained when signal frequency is set to 800 Hz and 1200 Hz alternately.

5. Adjust VR6 so that D14 turns ON when the input frequency

is 800 Hz and adjust VR7 so that D14 turns ON when the input frequency is 1200 Hz.

6. Make sure that D14 is turned ON at 800 Hz and turned OFF at 1200 Hz by adjusting the input frequency from 700 Hz through 1300 Hz.

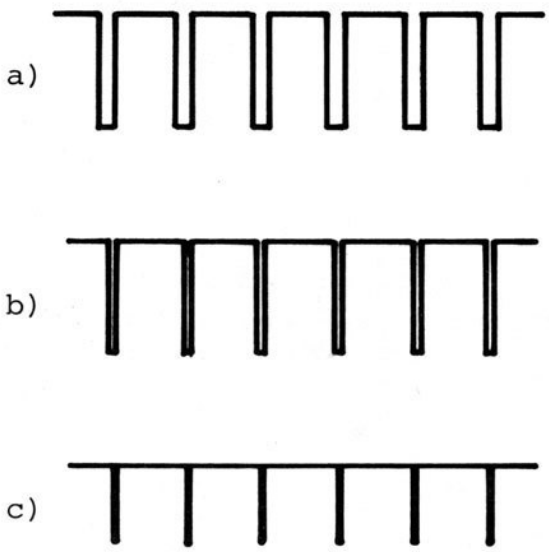


Figure 5-12. Output waveform at the test point.

B Suffix Serial Numbered Machines and Later

1. Observe TP2.

2. Adjust VR5 by changing the input signal frequency so that the output waveforms as are shown in Figure 5-12,b) can be obtained at 795 Hz and 1205 Hz, respectively.

3. Adjust VR6 so that D14 turns ON when the input signal frequency is 800 Hz and adjust VR7 so that D14 turns ON when the input signal frequency is 1200 Hz.

4. Make sure that D14 is turned ON at 800 Hz and turned OFF at 1200 Hz by adjusting the input signal frequency continuously from 700 Hz through 1300 Hz.

Adjustment of Fast Wind Speed

1. Read the output of a TP-102 or 202 (any terminal will do) on Tacho Sensor Amp PCB Assembly mounted under capstan motor by using the frequency counter.

2. Set front panel adjustment VR1 of PB-45Y on I/O PCB Assembly to maximum.

3. Put machine into fast wind and adjust VR3 so that the frequency counter reads 52 kHz.

4. Adjust VR1 so that the frequency in fast wind mode reaches approximately 42 kHz.

NOTE: If the speed in F.FWD mode is not the same as that in RWD mode, readjust the speed by VR5 on Capstan Control PCB Assembly.

Adjustment of Cue Speed

1. Measure the output of TP102 or 202 on Tacho Sensor Amp PCB Assembly by means of a frequency counter.

2. Adjust VR2 on PB-45Y so that the counter reads 550 - 640Hz when the tape is moving slowly in Cue mode at the beginning of a reel (take-reel almost empty). The capstan motor at very slow speed may groan or whine. If so adjust VR2 up to a higher frequency till this noise is gone.

3. After adjusting VR2 and reinserting back into its proper position, recheck the frequency obtained in Step "2". This may have changed when removing the extender board.

5.16 ADJUSTMENT OF BIAS CONTROL PCB ASSEMBLY (PB-15L; PB 9A465)

Adjustment of Bias Output

Measure TP1 output by means of a scope. Make adjustments so that the following output level can be obtained at each volume.

Bias switch	Front panel potentio-meter	TP1 output level	Output frequency
1	VR1	4.5 Vp-p *	257 kHz
2	VR2	5 Vp-p *	Sine wave
3	VR3	4 Vp-p *	

Adjustment of Erase Output

1. Adjust VR4 so that TP2 output is 5 Vp-p.

2. Make sure that the frequency is a sine wave of 85.7 kHz.

Adjustment of Test Signal Level

1. Apply a signal of 1 kHz, + 4 dBm from the Test jack.

2. Adjust VR5 so that the output of IC6 pin No. 1 is -3 dBm.

* TP1 output test point of record bias is an approx. adjustment with the assumption that all audio channels are set properly.

Although it is a good practice to set the adjustments per these voltages and to re-calibrated the indivisual audio channels for the proper bias settings only if there is any confusion as to where the master setting is.

SECTION VI. OPERATION

6.1 GENERAL

The following procedures are based on the assumption that the MTR-90 has been installed and checked for proper functions, as per Sections II and III, and that it has been properly aligned as per Sections IV and V of this manual. It is further assumed that a suitable mixing console, monitoring system, and any other auxiliary equipment are ready for recording and playback, and that the MTR-90 power is on.

We recommend situating the Remote Box (and the optional Auto Locator) in a convenient location near the mixing console. If you wish to review control functions and locations, refer to Figures 6-1 and 6-2.

CAUTION: The reel motors are capable of delivering substantial torque, and could present a danger if hands or clothing become entangled in the reels or tape path. It is imperative that you not press the swing arms directly when the tape is threaded. To shuttle the tape back and forth slowly, do not attempt to move the reels by hand. Instead, place the transport in STOP mode and turn the top of the capstan by hand, or press the MTR-90 CUE button and move the adjacent Cue knob.

NOTE: If your MTR-90 is set up with a 16-track head assembly or 8-track head assembly, disregard all Remote Box switches for channels 17-24 or 9-24 respectively.

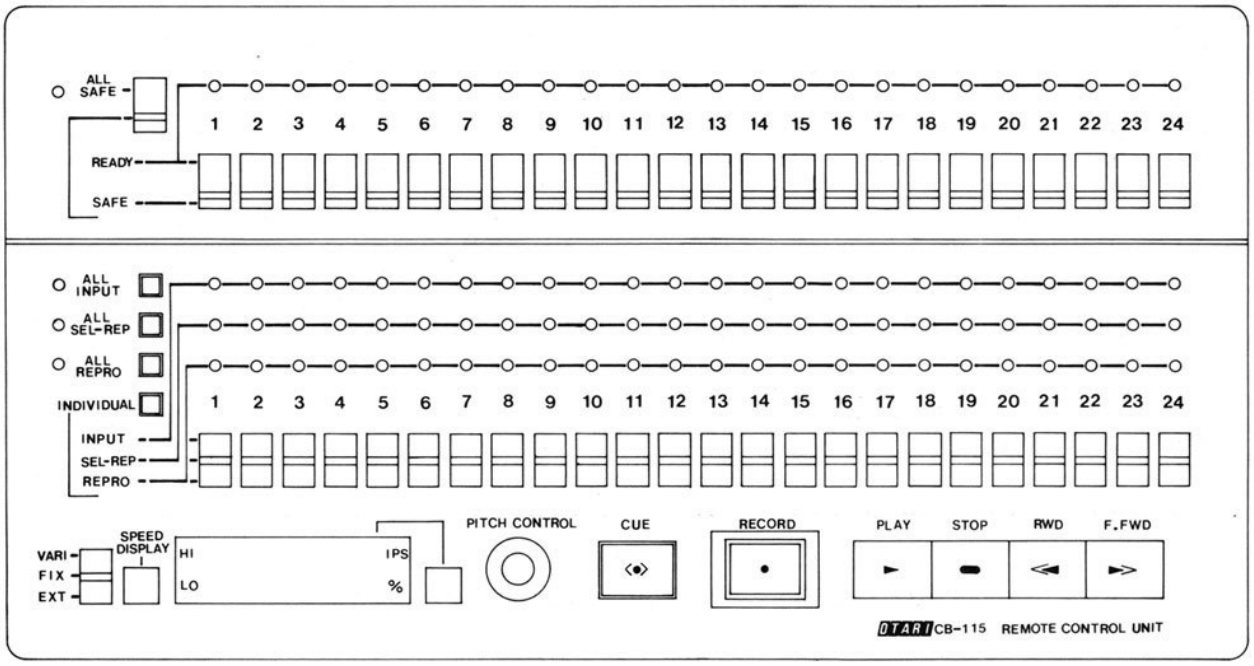


Figure 6-1. Remote Box features

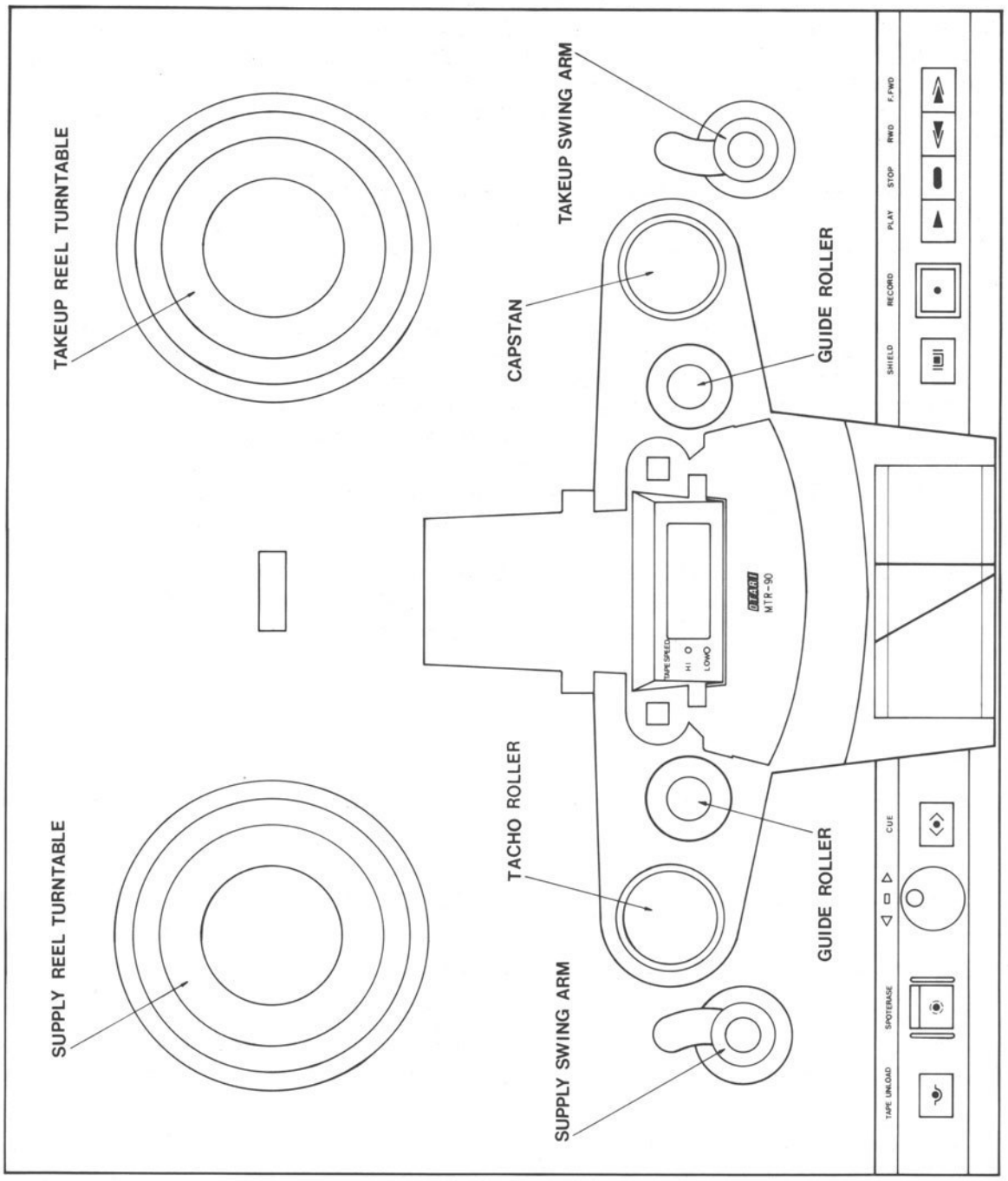


Figure 6-2. MTR-90 Transport Features.

6.2 RECORDING INITIAL TRACKS

1. Thread a blank 2" (or 1") tape on the transport.

2. To take up all slack and pull up the swing arms together to their "click" stops, hand rotate the supply reel clockwise and the takeup reel counterclockwise.

3. Press the STOP button to initialize the servos, place the tape under constant tension, and ready the machine for other functions.

4. Select the desired TAPE SPEED, HI or LOW. Unless there is some special application, you will probably choose the FIX(ed) SPEED MODE.

5. Zero the Tape Time Counter (or do this after step 10 below).

6. Apply a signal to those inputs of the MTR-90 corresponding to the tracks you wish to record.

7. On the Remote Box, press the ALL INPUT button.

8. On the Remote Box, disengage the ALL SAFE switch (adjacent LED off), and move the READY/SAFE levers up for those tracks you wish to record. The LEDs above these levers will flash.

9. Adjust the mixing console buss levels so the MTR-90 meters are peaking no higher than between -3 to 0 VU.

   NOTE: If a linear compander noise reduction system is in use (i.e., dbx or dolby) the meter deflection on the MTR-90 should be less than that on the console due to the noise reduction encoding.

10. Before recording a program, it is a good practice to record a series of reference test tones at the head of the tape for playback alignment. Use 700 or 1 kHz, 100 Hz and 10 kHz tones at the 0 VU reference level. Even if a noise reduction system is being used, record the test tones (the test tones should not be noise reduction encoded).

    NOTE: You should be monitoring the output of the tape machine (which will be the same as the input to the machine), rather than the buss output of the mixing console.

11. When you are ready to record, press the PLAY and RECORD buttons on the MTR-90 or the Remote Box. The Ready/Safe LEDs will stop flashing and instead remain on, indicating the selected tracks are recording.

12. To cease recording on all tracks, press the STOP button, the PLAY buttons, or the ALL SAFE switch. To cease recording on

only certain tracks and continue recording on others, move the corresponding READY/SAFE levers down to Safe position.

6.3 PLAYBACK OF INITIAL TRACKS

1. Rewind the tape.

2. On the Remote Box, engage the ALL SAFE switch to prevent any possibility of inadvertent erasure should the RECORD button be accidentally pressed.

3. On the Remote Box, engage the ALL REPRO switch. This saves time, but if you wish you can engage the INDIVIDUAL button and switch each individual track to Repro mode.

4. Press the PLAY button to roll tape. You should now be monitoring the previously recorded tracks.

5. Press the STOP button.

6. Assuming you wish to record additional tracks, rewind the tape.

6.4 SEL-REP RECORDING (OVERDUBBING)

The intent of Sel-Rep recording is to monitor previously recorded tracks while simultaneously recording one or more additional tracks. To avoid the time delay between the record head and the reproduce head, the previously recorded tracks must be played back from the record head.

A variation of this technique involves an insert (punch-in) of new recording to replace or add onto a previously recorded track. This method is discussed in Section 6.5, SEL-REP RECORDING (PUNCH-INS).

NOTE: For rehearsal of an overdub, see Section 6.6.

1. Press the ALL SEL-REP button.

2. Disengage the ALL SAFE switch (adjacent red LED off).

3. On those tracks you wish to add new material, to set the READY/SAFE switches to Ready mode (red LED above flashes).

4. On all other tracks (those you wish to protect from erasure), set the READY/SAFE switches to Safe mode (red LED above is off).

NOTE: When the tape is stopped, you will be monitoring the input of any tracks set to Ready mode. This is true unless

the optional STOP STAND BY switch on the transport control card, #3, is off. (See Section 2.2, 2D.)

5. Press the PLAY and RECORD buttons to begin the overdub. You will now be monitoring the input on those tracks being recorded, and the tape from the record head and sync amps on those tracks not being recorded.

6. To end the overdub, press the STOP button. As a further precaution, engage the ALL SAFE switch, preventing any accidental erasure of those individual tracks set to Ready mode.

6.5 SEL-REP RECORDING (PUNCH-INS)

This technique permits you to monitor the various tracks, including the track or tracks upon which you will be recording. At the instant you enter recording (punch-in), the monitoring of the tracks being recorded will switch from the record head to the input electronics.

NOTE: For rehearsal of a punch-in, see Section 6.6.

1. Press the ALL SEL-REP button.

2. Disengage the ALL SAFE switch (adjacent red LED off).

3. On those tracks you wish to do the punch-in (make an insert), on set the READY/SAFE switches to Ready mode (red LED above flashes).

4. On all other tracks (those you wish to protect from erasure), set the READY/SAFE switches to Safe mode (red LED above is off).

   NOTE: When the tape is stopped, you will be monitoring the input of any tracks set to Ready mode. This is true unless the optional STOP STAND BY switch on the transport control card, #3, is off. (See Section 2-2, 2D.)

5. Press the PLAY button and monitor the tape. You will now be listening to all tracks via the record head and sync amps.

6. At the instant you wish to make the punch-in, press the RECORD button. BEST RESULTS ARE OBTAINED BY PUNCHING-IN IN A PAUSE ON THE TRACKS YOU ARE RECORDING (on the off-beat). You will now be monitoring the input on those tracks being recorded, and the tape from the record head and sync amps on those tracks not being recorded.

   NOTE: There is a very short delay from the instant you press the RECORD button to the initiation of recording, due to the gapless punch-in feature.

7. To end the punch-in:

   A. If you wish to end the insert, but continue monitoring the tape for a second punch in, press the PLAY button.

   B. If you are done with all punch-ins for now, press the STOP button. As a further precaution, engage the ALL SAFE switch.

6.6 REHEARSAL OF OVERDUBS AND PUNCH-INS

In the overdub and punch-in procedures discussed in Sections 6.5 and 6.6, there was no way to monitor the new input signal unless and until the machine was actually recording. It may be desirable to do "dry runs." That is, rehearse the overdub or punch-in by playing previously recorded tracks through the record head and sync amps, and by monitoring the input of the tracks on which you will be recording. The method is explained below.

1. Press the INDIVIDUAL button so the individual track function selectors can be operated.

2. Engage the ALL SAFE switch (adjacent red LED On). The position of the individual READY/SAFE switches is not significant in this step (although they may be preset in accordance with the intended overdub or punch-in, if so desired).

3. For those channels on which you wish to monitor the input, move the INPUT/SEL-REP/REPRO selector switch to the Input position.

4. For all other channels, set the selector switch to the Sel-Rep position.

5. To rehearse an overdub, press the PLAY button. You will now be monitoring the input of all rehearsal tracks, and playback from the record head and sync amp on all other tracks. To end the overdub rehearsal, press the STOP button.

6. To rehearse a punch-in, press the PLAY button and the ALL SEL-REP button. You will now be monitoring playback of all tracks via the record head and sync amp. At the instant the punch-in would be initiated, press the INDIVIDUAL button, and the rehearsal tracks will switch to input.
   To end the punch-in rehearsal:

   A. If you wish to end the "insert," but continue monitoring the tape for a second punch-in rehearsal, press the PLAY button.

   B. If you are done with all punch-in rehearsals for now, press the STOP button.

6.7 MIXDOWN

The procedure for mixdown is the same as for playback of initial tracks (Section 6.3). Be sure to use the reproduce head (Repro mode), rather than the record head (Sel-Rep mode) for utmost quality.

6.8 USE OF THE CUE BUTTON AND KNOB

1. The CUE button performs several functions:

   A. When the machine is in Stop mode, pressing the CUE button on the MTR-90 (not on the Remote Box) activates the adjacent rotating Cue knob. The knob can then be rotated CW and CCW to shuttle the tape between the supply and takeup reels for locating cue points, matching edit points, and so forth. The actual tape speed is proportional to the degree of rotation.

   To exit this mode, press STOP.

   NOTE: If the head shields are up, and you wish to see the tape as it passes over the heads, press the SHIELD button on the MTR-90 Transport.

   B. The above mode can be used for very fast or slow playback of a tape, beyond the ± 20 % allowed by the Pitch control, as described in Section 6-10.

   C. When the machine is in FAST FORWARD or REWIND mode, pressing CUE on either the MTR-90 or the Remote Box retracts the tape lifters. It is then possible to audibly detect the beginning or end of a tape.

6.9 SPOT ERASE

The SPOT ERASE function is available for erasure of unwanted tracks on a tape.

1. First, search for the portion of tape which you want to erase by operating the Cue function or by rotating the top of the capstan motor by hand.

2. Mark with a grease pen the beginning and the end of the portion of the tape which you want to erase.

3. Place the machine in STOP mode for the spot erase operation.

4. Set the track, to be erased with the REC/READY switch to the REC position.

5. Press the SPOT ERASE button. (Lamps of SPOT ERASE and STOP will blink.)

6. Move tape slowly by rotating the top of the capstan motor by hand.

7. Press the CUE button just before the beginning of the portion to be erased reaches the erase head. (Keep pressing both the SPOT ERASE and CUE buttons. Both lamps will light up.)

8. Keep the tape moving until the end of the portion to be erased comes in front of the erase head, then you must release the buttons. (Continue moving the tape slowly for an instant.)

9. The erase current slowly diminishes, thus leaving no erase noise on the tape.

6.10 USE OF THE VARIABLE SPEED MODE

1. The SPEED MODE switch may be set in the VARIABLE position for either recording or playback, and the actual tape speed can then be adjusted with the PITCH CONTROL over a range of at least ± 20 % (± 2 tones, approximately). The actual tape speed can be calculated by multiplying the 15 ips or 30 ips (LOW or HIGH) base speed selected by the percentage of variation indicated on the PITCH CONTROL digital readout, and adding or subtracting that value from the base speed, or you can read it directly by using IPS DISPLAY when SPEED DISPLAY switch is set to IPS indication.

2. Variable speed can be used to "tune up" new or old tracks during overdubs, to change tempos, to bring a song into a vocalist's range, to squeeze or stretch a program to fit a particular time slot, etc.

6.11 USE OF AN EXTERNAL SPEED REFERENCE

An external clock (reference oscillator) can be used to control the speed of the MTR-90 capstan motor. When the SPEED MODE switch is set to EXT position, a suitable input signal must be connected to the EXT CLOCK input connector (9 pin D connector on the MTR-90 rear panel). The reference frequency is 9,600 Hz, and should be at TTL level (0 V low, +5 V high), approximately a 50% duty cycle; a sine wave source may be used, at a level of about 10 Vp-p.

When the external reference is in use, the MTR-90 HIGH/LOW SPEED SELECT switch still operates, although the two speeds selected will vary from 15 and 30 ips in proportion to deviations of the clock input from the reference frequency.

When using SMPTE time code synchronizers, the SMPTE-CUE slide switch (on the back of the upper card cage mother board near the #24 card connector) should be turned on. If the MTR-90 is being used for 16 track operation, a jumper cable will have to be installed to join the 3-pin Molex connector adjacent to this switch to a similar connector on the same circuit board, located between the #16 and #17 card connectors. If the MTR-90 is being used for 8 track operation, the jumper cable connector will be located between #8 and #9.

Detailed information on the use of time code synchronizers with the MTR-90 will be available from the manufacturer of that equipment, or you can contact OTARI.

ABOUT SMPTE LOCATION CONTROL AND SYNCHRONIZATION

SMPTE is an acronym for the Society of Motion Picture and Television Engineers. The SMPTE time code is a standard digital coding technique for identifying the location of an audio or video tape; coding is done in hours, minutes, seconds and frames (24 frames/sec for film or 30 frames/sec for video). A time code generator is used to record the code onto one track of the tape. A time code controller can then read the code from two or more tape machines, and, by also servo controlling the reel motors of those machines, bring them to specific cue points. A time code synchronizer further controls the capstan motors to keep both of the machines running synchronously. These techniques can be used to obtain more tracks of recording, to mix audio in sync with video or film images, to make complex edits per user-selected programs, etc.

Pin assignment for EXT. CLOCK

EXT CLOCK

$\overline{\text{REC}}$	T	1
$\overline{\text{PLAY}}$	T	2
$\overline{\text{STOP}}$	T	3
$\overline{\text{FF}}$	T	4
$\overline{\text{RWD}}$	T	5
LIFTER DEFEAT		6
SIMPTE CUE		7
SPD REF. VOLT.		8
SPD COM.		9
REC	C	10
PLAY	C	11
STOP	C	12
FF	C	13
RWD	C	14
TACHO OUT		15
9.6K REF.		16
GND		17
EXT CLOCK		18
CAPSTAN TACHO OUT		19
+5V		20
FWD/REV		21
N.C		22
N.C		23
N.C		24
N.C		25

T—TALLY (REPLY)
C—COMMAND

Contact OTARI or local OTARI dealers for the connector CN225221 (OTARI's part no.) necessary for the connection.

Synchronizers now available for the connection to the MTR-90 are as follows. For further details on newly developed synchronizers and interfaces, you can contact the manufacturer, OTARI or local OTARI dealers.

Manufacturers	Type of Synchronizer
ADAMS-SMITH	WIDE BAND
AUDIO KINETICS	TACH
CONVERGENCE	TACH
EECO	WIDE BAND
BTX	TACH
LEXICON 1200	TACH

6.12 VOLTAGE CONVERSION

1. When the machine is used at a different voltage, a connection plug for the power supply needs to be rewind.

2. Remove bottom section of the back panel.

3. When the panel is removed, a maintain lock connector will be found attached to the "L" shaped bracket fixed atop the right chassis frame.

4. Change the wiring of the connector in accordance with the power supply circuit diagram, or insert a new connector for new voltage.

6.13 FREQUENCY CONVERSION

1. When the machine is used at a different AC line frequency, the voltage supplied to the cooling fan must be changed.

2. This is because the efficiency of a cooling fan is determined by frequency. A switch provides this conversion.

3. Remove the left side panel of the machine, and this switch will be found on the side of the power supply box located at the top right.

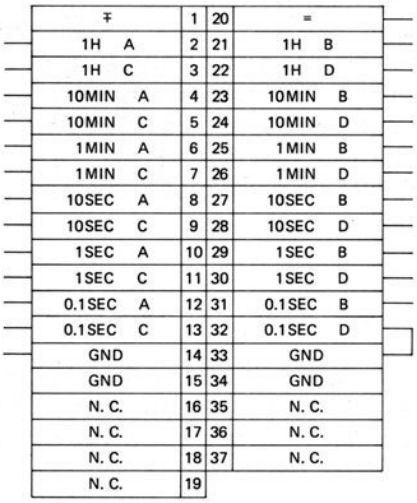
4. Set the switch adjusting to the line frequency to be used.

6.14 BCD OUT

The external output of the MTR-90 has an output terminal for

BCD signals of the tape time readout. Use this output terminal when another external tape timer readout is to be used. The connector should be connected as follows.

The necessary connector is DC-37P (TRW CINCH) or its equivalent.



CN1

6.15 SERIAL I/O

1. The MTR-90 is provided with an interface function which enables the direct conversation with a computer. This function (SERIAL I/O) has the following three capabilities.

   (1) RS-232C
   (2) CURRENT LOOP
   (3) TTL LEVEL

2. The baud rate can be selected by the DIP SWITCH (D-SWI) located on the I/O PCB Assembly as per the table given below.

D-SWI	ON/OFF	BAUD RATE
No. 1	ON	110 baud
No. 2	ON	1200 baud
No. 3	ON	2400 baud
No. 4	ON	4800 baud

* Make sure other switches have been set to OFF. Only SW No. 4 is set ON, when shipped.

3. A connector for SERIAL I/O should be connected as per the table shown in right side. This applies to later model machines (from C Lot on). As to machines other than the above (Lots A and B), refer to the circuit diagrams sent with the machine or contact OTARI or local OTARI dealers.

SERIAL I/O

FM GND	1	14	GND
TRANSMIT DATA	2	15	RD CNT
RECEIVE DATA	3	16	RD COM
RTS	4	17	TTY OUT
CTS	5	18	TTY IN
DSR	6	19	TTY COM
(sig)GND	7	20	DTR
GND	8	21	N. C.
RDR STA	9	22	N. C.
TXD	10	23	N. C.
RXD	11	24	N. C.
DATA BUSY	12	25	N. C.
DCD	13		

CN2

4. For technical information about ASCII COMMAND CHARACTERS LIST and others, you can also contact OTARI or local OTARI dealers. The necessary connector is DC-25P (TRW CINCH) or its equivalent.

SECTION VII. AUTO LOCATOR

7.1 GENERAL

The OTARI CB-115 Auto Locator is designed specifically for the MTR-90. It uses a microcomputer for sophisticated, precision control of tape motion without overshoot. A tape time memory stores up to 10 cue points (11 cues if zero search is also considered), which can be directly memorized by pressing only one button (STORE button), instead of being keyed in; and can be directly recalled instantly by pressing another button (SEARCH button). And there is an independent digital stop-watch built in. Each memory and readout can accommodate times of up to 9 hours 59 minutes, 59 seconds. In addition to special Auto Locator functions such as Search, Zero Search, Zero Set, Shuttle and Auto Rewind (described in subsequent paragraphs), there is a duplicate set of tape motion pushbuttons like those on the Remote Box and transport.

NOTE: The CB-115 Auto Locator should be installed as detailed in Sections 2.4 and 2.5. Bracketed numbers in this section (e.g., TAPE TIME [1] refer to the callouts in Figure 7-1, unless otherwise stated.

All function buttons [19 through 24] have 2-level illumination: dim normally, bright when selected. The 10 numeric buttons (0-9) and the adjacent buttons are not illuminated; when describing these features, we use the terms "key" and "button" interchangeably.

Sub-sections 7.2 through 7.17 are brief descriptions of the front panel features of the Auto Locator, intended to accompany Figure 7-1. Following this, some of the more common functions are discussed in greater detail, with examples.

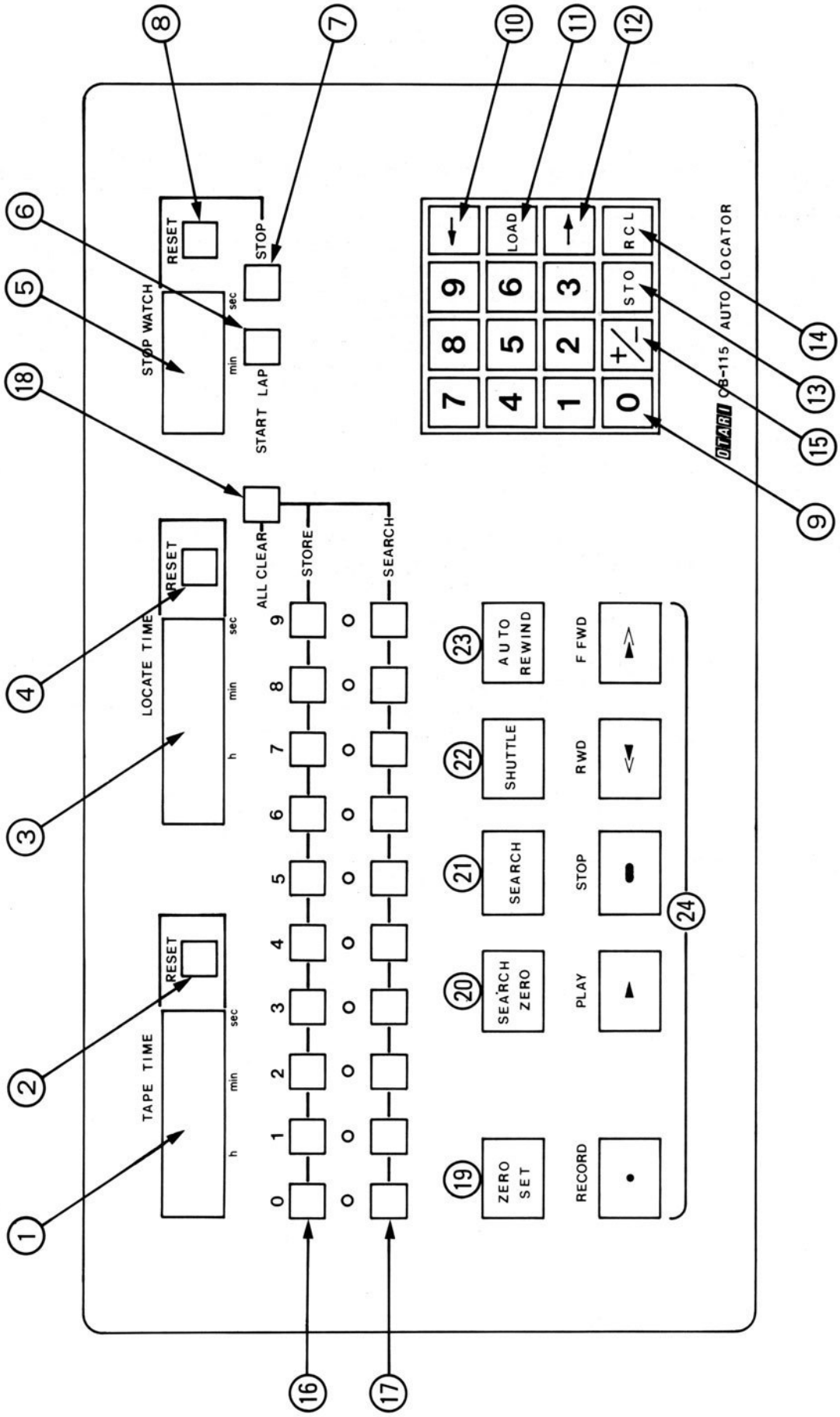


Figure 7-1. Auto Locator front panel features.
(Features are described on the following pages.)

7.2 TAPE TIME

The Tape Time readout [1] displays the elapsed time of the tape relative to the same zero point shown on the MTR-90 readout, or any other point on the tape, such as the beginning of a "take."

1. To Zero the Tape Time at the location of the tape currently in front of the heads, press the adjacent RESET button [2].

2. To offset the Auto Locator Tape Time readout from the MTR-90 readout, select a Locate Time [3] and press the Shift Left button [10].

3. To correlate the Tape Time with the MTR-90 readout, press the keyboard's LOAD button [11], or the SEARCH ZERO button [16].

4. This Tape Time readout is provided with a minus sign at the head of the digital readouts when the elapsed time diminishes from 0.00.00 , that is, a second before 0.00.00, -0.00.00 is displayed. The same applies to LOCATE TIME.

7.3 LOCATE TIME

The Locate Time readout [3] displays the location you wish to reach on the tape when you press the SEARCH [21], SHUTTLE [22] or AUTO REWIND [23] buttons.

1. Locate Time can be entered directly from the keyboard numerals [9], or ...

2. Locate Time can be recalled from previously stored cues using the RCL button [14] and any of the 10 numeric addresses [9], or ...

3. Locate Time can be "Copied" from the Tape Time readout by pressing the Shift Right key [12].

4 The adjacent RESET button [4] zeroes the Locate Time.

7.4 STOP WATCH

The Stop Watch is independent, and has no interaction with any other Auto Locator function or MTR-90 function. Its readout [5] displays up to 99 minutes, 59 seconds.

1. To start the watch from Stop mode, press START/LAP [6].

2. To take a "lap" time, press START/LAP again, freezing that interim time on the readout while the watch still counts internally. To return to the elapsed time count, press START/LAP once more.

3. To stop the counting and display the final time, press STOP [7]. If STOP is pressed while a lap time is displayed, the readout will change and display the final time.

4. To zero the watch, press RESET [8]; if pressed while the watch is counting, this also stops the count.

7.5 KEYBOARD NUMERALS

The keyboard buttons [9] numbered 0 through 9 have two functions: they can be used to enter a Locate Time or they can address the 10 memory registers. The keyboard is temporarily disabled while the machine is performing a Search, Zero Search, Shuttle or Auto Rewind function.

NOTE: It is impossible to enter a Locate Time with a numeral of 6 or higher in the second digit from the right of the readout, since this would indicate 60 or more seconds and should be entered in minutes.

7.6 SHIFT LEFT AND SHIFT RIGHT

The Shift Left button [10] copies whatever time is shown on the Locate Time readout and displays it in the Tape Time readout. Conversely, the Shift Right button [12] transfers the Tape Time to the Locate Time.

7.7 LOAD

The LOAD button [11] changes the Tape Time readout to display the same tape time shown on the MTR-90 readout. In other words, it resets the Auto Locator Tape Time to correspond to the actual time shown on the transport.

7.8 MEMORY STORE

The STO button [13] is used to memorize the time displayed in the Locate Time readout. Up to ten different times can be memorized at once. Memory is volatile, meaning it is not saved after the power is turned off.

1. To store a given cue, display the time in the Locate Time readout, either by direct entry with the numeric keys [9] or by using the SHIFT RIGHT button [12] to move the Tape Time to the Locate Time readout.

2. Press the STO button [13], and then press any one of the 10 numeric keys [9]. The number pressed, 0 through 9, becomes the "address" where the Locate Time is stored.

3. To store a second cue, repeat Steps 1 and 2 using a different numeric address. If the same address is re-used, the previously stored time will be replaced by the new entry.

   NOTE: Tape Time can be "captured" "on the fly," while the tape is playing or recording, by pressing SHIFT RIGHT at the exact instant you want to capture, then pressing STO followed by a numeric address.

7.9 MEMORY RECALL

The RCL button [14] is used to retrieve a time which was previously stored, and display it in the Locate Time readout. When the machine is first turned on, all addresses are initialized so they contain 00.00.

1. To recall a given cue, press the RCL button [14], and then press the numeric key (0 through 9) which identifies the "address" where the time was stored. The time will display on the Locate Time readout, and will also remain in memory.

2. To recall another cue, repeat Step 1; it is not necessary to first reset the readout since the recalled time will replace any previously displayed Locate Time.

7.10 +/- KEY

A minus(-) sign can be used to display a locate time readout. For example, in order to display the Locate Time 2 minutes before 0.00.00, display the Locate Time 0.02.00 on the readout. Then, press the +/- KEY [15] once and a minus(-) sign will appear at the head of the digital readout. (Another pressing provides a plus(+) sign.)

7.11 DIRECT STORE, DIRECT SEARCH AND ALL CLEAR

The tape time can be directly stored in MEMORY without using the ten keys. Up to ten memories can be stored just by pressing the buttons [16] under the LEDs which are not illuminated. When the LEDs are illuminated, the memories have already been stored, thus making this DIRECT STORE method unavailable. In this case, the memories have to be cancelled or they could be stored by using the ten keys.

When you want to move the tape direct to the memorized location, press SEARCH button [17] of the memory in which the location has been memorized. The tape moves automatically to the position.

HOW TO CANCEL MEMORIES

Several methods are available for the cancellation of memories.

1. Use of ten keys [9]
   Memory time in resistor 1 is cancelled by the sequence of inserting 0.00.00 into locate time and pressing STORE 1. (Actually, 0.00.00 is memorized.)

2. Press STORE button [16] for any memory twice within a second. Then, this memory is cancelled.

3. Similarly, press the ALL CLEAR button [18] twice within a second. Then, all memories are cancelled.

7.12 ZERO SET

The ZERO SET button [19] is used to automatically zero both the MTR-90 and the Auto Locator Tape Time readouts at a specific point on the tape.

1. To mark the point (or points) on the tape where you wish to have the Tape Time zero, record one or two seconds of a 1 kHz tone at 0 VU level on track 1 (Fixed speed at 15 ips or 30 ips).

2. Make sure channel 1 of the Remote Box is set to the Repro mode.

3. Press the ZERO SET button [15]; the transport will enter Play mode (or will continue if already in Play mode). Then, as soon as the Auto Locator detects the 1 kHz tone on track 1, the transport will stop, and both the Tape Time readouts on the MTR-90 and Auto Locator will both be zeroed.

7.13 SEARCH ZERO

Pressing the SEARCH ZERO button [20] causes the MTR-90 to return at fast winding (or rewinding) speed to the 0.0000 actual Tape Time shown on the transport readout. There are three variations of Zero Search mode.

NOTE: If the Auto Locator Tape Time readout has been changed to a zero different from the MTR-90, it will be reset to match the MTR-90 the moment SEARCH ZERO is pressed. Search Zero always looks for the zero of the MTR-90 Transport display.

1. Pressing SEARCH ZERO [20] will rewind the tape to zero Tape Time and then stop the transport.

2. Pressing SEARCH ZERO and then PLAY [24] causes the PLAY button to flash bright and dim, then the tape will rewind to the zero point of Tape Time and then to enter Play mode.

3. Pressing SEARCH ZERO [20] and then PLAY and RECORD [24] causes the PLAY and RECORD buttons to flash bright and dim; the tape to rewind to zero Tape Time and will enter the Record mode.

   NOTE: Search Zero/Play or Search Zero/Record modes only work when the Auto Locator's PLAY (or PLAY and RECORD) button is pressed. Pressing these buttons on the Remote Box or the MTR-90 ends the search and immediately causes the machine to enter the Play mode.

4. To end ("abort") a Search Zero, press STOP, REWIND, or FAST FORWARD on the Auto Locator [24], or their counterparts; the PLAY button on the Remote Box; or the MTR-90 Transport.

7.14 SEARCH

Pressing the SEARCH button [21] causes the MTR-90 to fast wind (or rewind) the tape until the Auto Locator Tape Time matches that shown on the Locate Time readout [3]. There are three variations of SEARCH mode:

1. Pressing SEARCH [21] will move the tape to the Locate Time and then stop the transport.

2. Pressing SEARCH [21] and then PLAY [24] causes the PLAY button to flash bright and dim; the tape will fast wind to the Locate Time and then will enter the Play mode.

3. Pressing SEARCH [21] and then PLAY and RECORD [24] causes the PLAY and RECORD buttons to flash bright and dim; the tape will fast wind to the Locate Time and then will enter the Record mode.

   NOTE: The Search/Play or Search/Record modes only work when the Auto Locator's PLAY (or PLAY and RECORD) button is pressed. Pressing these buttons on the Remote Box or the MTR-90 ends the search and immediately causes the machine to enter the Play mode.

4. To end ("abort") a Search, press STOP, REWIND, or FAST FORWARD on the Auto Locator [24], or their counterparts; PLAY button on the Remote Box; or the MTR-90 Transport.

7.15 SHUTTLE

Pressing the SHUTTLE button [22] causes the MTR-90 to "remember" the current Tape Time displayed on the readout, and to enter (or continue in) the Play mode until the Locate Time is reached. Then the tape automatically rewinds to the point where SHUTTLE was first pressed, and again plays. This cycle continues until you exit Shuttle mode, as explained below. Shuttle is helpful for replaying a section of an alignment tape, for rehearsing particular segments of a tune, and so forth.

NOTE: The above and following description assumes the Locate Time is greater than the displayed Tape Time. If not, the SHUTTLE will perform a reverse shuttle function, thus stopping the tape when the button is pushed and winding the tape back to the number displayed in the Locate Time window, then going into Play mode and repeating this function until cancelled. Make the machine shuttle ahead to a Locate Time that is actually behind the current Tape Time.

1. Enter the Locate Time (ahead in time) at which you want the shuttle to stop and rewind the tape.

2. Move the tape to the point where you want the shuttle operation to begin; the transport can be in Stop, Play or Record mode at this point.

3. Press SHUTTLE [22].

4. If you wish to enter Record mode at any time while the tape is playing in Shuttle mode, press the RECORD button on the Auto Locator. The machine will continue recording for the duration of this "pass," but will return to Play mode after it rewinds to the beginning of the shuttle segment.

   NOTE:
   A. Unlike Search or Search Zero modes, you cannot "preset" the machine to begin recording by pressing RECORD while the tape is rewinding in Shuttle mode.

   B. Shuttle/Record mode only works when the Auto Locator's RECORD button is pressed. Pressing the RECORD button on the Remote Box or MTR-90 ends the search and immediately causes the machine to enter normal Record mode.

5. To end ("abort") a Shuttle, press STOP, REWIND, or FAST FORWARD on the Auto Locator [24], or their counterparts on the Remote Box or MTR-90 Transport, or the PLAY buttons on the Remote Box or the MTR-90 Transport.

7.16 AUTO REWIND

AUTO REWIND [23] is similar to Shuttle, except the tape will play to the Locate Time, rewind, and stop at the point you first pressed AUTO REWIND rather than continue the play/rewind cycle.

7.17 TRANSPORT CONTROLS

The Auto Locator's RECORD, PLAY, STOP, REWIND and FAST FORWARD buttons [24] essentially duplicate the functions of their counterparts on the MTR-90 Transport and the Remote Box. The only difference is that when using Search, Search Zero, Shuttle, and Auto Rewind modes, you can press the Auto Locator PLAY and/or RECORD buttons without affecting the selected Auto Locator mode; pressing the RECORD or PLAY buttons on the MTR-90 or Remote Box will override the Auto Locator function.

7.18 EXAMPLES OF AUTO LOCATOR OPERATION

These examples are intended to help familiarize you with Auto Locator functions; they are by no means comprehensive. As you use the Auto Locator for actual recording and mixdown functions, you will undoubtedly devise useful techniques to accomplish your unique goals. Initially, it is assumed that the power is on, a reel of tape is threaded, and the transport is in Stop mode.

1. MANUALLY ZERO THE TRANSPORT AND AUTO LOCATOR AT THE END OF THE LEADER TAPE.

   When the power is first turned on, the displays of both units are zeroed. However, this is generally not the zero point you want to use because on a Zero Search function, the tape may unthread itself, and because there is no absolute reference point for logging cues. Therefore, do the following.

   A. Play or fast wind the tape ahead to the end of the leader, or approximately 10 to 20 seconds if there is none or if the leader is short.

   B. Pull the RESET lever adjacent to the Tape Time readout on the MTR-90 head cover. That readout will now display 00.00.0 (00 minutes, 00 seconds, 0 tenths).

   C. Press the LOAD button [11] on the Auto Locator so its Tape Time readout also displays 0.00.00 (tenths of seconds are not shown on the Auto Locator).

2. ENTER A LOCATE TIME AND SEARCH AHEAD TO IT.

   A. With the tape stopped at zero Tape Time, use the keyboard [9] to enter a Locate Time of 1 minute, 35 seconds (press

1 then 3 then 5).

B. Press the SEARCH button [20]. It and the FAST FORWARD button will light up brightly, and the tape will wind ahead fast, begin slowing at about 1 minute on the Tape Time readout, and stop when the Tape Time displays 0.01.35. The STOP button will then light up and the others will return to their dim state.

3. STORE A CUE FOR FUTURE RECALL.

A. To memorize the locate time of 01.35, now displayed on the Locate Time readout, press the STO button [13] and the "0" key on the keyboard, or you can use STORE button [16] for memory "0".

B. The cue is now stored in memory address "0".

C. If you want to check that the cue is stored, first clear the Locate Time by pressing its RESET button [4]; the readout should change to 0.00.00.

D. Now press RCL [14] and number "0"; the Locate Time Readout should again display 0.01.35.

4. SEARCH AHEAD AND ENTER PLAY MODE WHEN THE CUE IS REACHED

A. Clear the Locate Time by pressing the RESET button [4].

B. Use the keyboard [9] to enter a locate time of 6 minutes, 13 seconds (press 6 then 1 then 3).

NOTE: When you press the "1" key, the 6 temporarily disappears, then reappears when you press the "3" key. This is because the readout will not display a 6 in the tens of seconds column (it will display the number you pressed minus 6, or zero in this case).

C. Press the SEARCH button, and tape will begin fast winding.

D. While the tape is winding, press the PLAY button on the Auto Locator. It will begin flashing.

E. When the Tape Time reaches 0.06.13,
(1) The STOP button brightens for an instant,
(2) The PLAY button stops flashing and stays brighter,
(3) The transport enters Play mode,
(4) The SEARCH button returns to its dim state.

F. If you want to save the 0.06.13 cue point (do so for now), press the STO button and number "1" on the keyboard.[9]. Or use the STORE button [16] for memory "1".

5. SEARCH BACK TO THE FIRST CUE AND THEN BEGIN RECORDING

   A. Press the RCL button followed by number "0" to recall the first cue saved; the locate time should now read 0.01.35.

   B. Press SEARCH and the tape will begin rewinding to the cue; the SEARCH and REWIND buttons will be brightly illuminated.

   C. While the tape is winding, press the PLAY button and the RECORD button on the auto locator. The will begin flashing.

   D. When the Tape Time reaches 0.01.35,
      (1) The STOP button will brighten for an instant, and the tape momentarily stops,
      (2) The PLAY and RECORD buttons will stop flashing and stay brighter,
      (3) The transport will enter Record mode,
      (4) The SEARCH button will return to its dim state.

      NOTE: You can also use the SEARCH button [17] for memory "0" above and then proceed with step C.

6. SEARCH TO ZERO

   A. With the tape still recording, or stopped somewhere past the previous 0.01.35 cue, press the ZERO SEARCH button; the tape will begin rewinding and the ZERO SEARCH and REWIND buttons will be brightly illuminated.

   B. When the Tape Time reaches 0.00.00, the transport will stop, the STOP button will light up and the others will dim.

7. AUTO REWIND

   A. Recall the 1 minute 35 second cue by pressing RCL and number "0".

   B. Press the PLAY button.

   C. When the Tape Time reaches about 20 seconds, press the AUTO REWIND button [19], which will brighten.

   D. The tape will continue playing until it reaches the 01.35 cue; it will then rewind to the same Tape Time as when you pressed AUTO REWIND (i.e., about 20 seconds) and stop. The STOP button will light up, and the others will dim.

   E. By pushing the AUTO REWIND button with a Locate Time less than the Tape Time the machine will do the inverse function of the above.

8. SHUTTLE

A. Clear the Locate Time by pressing RESET, and enter a new time of about 20 seconds ahead of the current Tape Time (i.e., if you are at 20 seconds, enter 40 seconds).

B. Press the SHUTTLE button [18]; the tape will begin to play and the SHUTTLE and PLAY buttons will brighten.

C. When the Locate Time is reached, the PLAY button will dim, REWIND will brighten, and the tape will rewind to the same Tape Time as when you pressed SHUTTLE.

D. The PLAY button will then brighten (SHUTTLE is still bright), and the tape will play ahead to the Locate Time. This cycle will continue indefinitely until you press STOP, REWIND, or FAST FORWARD.

E. By pushing the SHUTTLE button with a Locate Time less than the Tape Time the machine will do the inverse function of the above.

9. "ILLEGAL" COMMANDS

Enter a Locate Time that is a few minutes ahead of the currently displayed Tape Time. Press SEARCH. While the tape is winding ahead, try to enter a new Locate Time, or try to use RCL to recall a previously stored time. Press RESET on the Tape Time or Locate Time. Notice that these functions are temporarily disabled (do not have any effect) until the search is completed and the machine returns to Stop mode.

SECTION VIII. 16/24 TRACK CONVERSIONS

8.1 GENERAL

The OTARI MTR-90 may be ordered in any of four configurations, 16 track only, 16 track wired to accommodate 24 tracks (16 track convertible), 24 track or 1" 8 track; this section of the manual deals only with changing between the 16 and 24 track formats.

To change a 16 track convertable model to a 24 track machine, you perform only 4 steps: (1) remove the heads and head cables as an entire assembly, (2) install the 24 track head assembly, (3) plug in 8 additional circuit cards, and (4) align the azimuth and record/reproduce/bias circuits. Changing a 24 track model to a 16 track machine is even simpler – you don't have to remove the extra 8 circuit cards.

NOTE: If an external controller or synchronizer is to be used, the jumper cable for the SMPTE CUE switch on the rear of the upper card cage's mother board will need to be removed (for 16 to 24 conversion) or installed (for 24 to 16 conversion). Refer to Section 6.10. If not, that switch should be in the off position, and will therefore have no effect. (This is not critical since not all controllers require this feature.)

8.2 16 TO 24 TRACK, OR 24 TO 16 TRACK CONVERSION PROCEDURE

(Refer to Figures 5-2 and 8-1.)

1. Turn off the MTR-90 power switch.

2. Loosen the four cap head allen screws that secure the head top cover, lift and set it aside.

3. Unplug the speed select/tape timer readout/reset switch flat connector under the readout P.C.B. card. (It may be necessary to remove the head base cover (Step 4) before completing this step.)

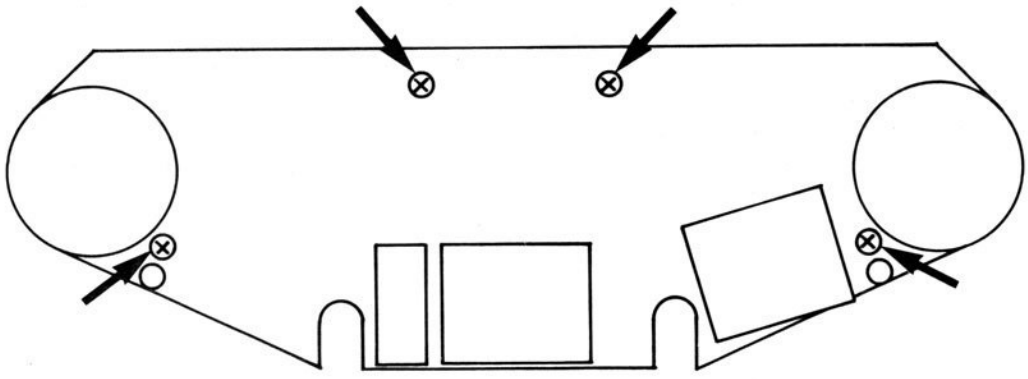


Figure 8-1. Remove these 4 screws to exchange head assemblies.

4. Loosen the four cap head allen screws that secure the head assembly base cover, lift the cover up and forward so the cutout clears the head cables, and set it aside.

5. Unplug the four head cables (1 erase, 2 record/sync, 1 repro).

6. Unscrew the four round head phillips screws that secure the head assembly base plate to the transport deck plate; two are located directly behind and to each side the record/sync head, and one next to each roller toward the front of the base plate.

   1" to 2" TRACK CONVERSION:
   The MTR-90 1" 8 track model can be converted into a 2" 16 track or 24 track machine. The conversion can easily be achieved by exchanging various parts on the transport for those for 2" operation and by adding 8 (or 16) audio circuit cards, followed by necessary adjustments.
   All the necessary parts are included in the conversion parts kit. For further details on the price of the parts kit and the changing procedures, you can contact OTARI or local OTARI dealers.

   ZA-31G (8 to 24 track conversion kit)
   ZA-31H (8 to 16 track conversion kit)

   CAUTION: Do not disturb any of the allen screws that secure the heads to the head assembly base plate.

7. Remove the head assembly, and set it aside.

8. Install the new head assembly by following the preceding steps 2 through 8 in reverse order.

9. If converting from 16 to 24 tracks for the first time, install 8 additional circuit cards in slots 17 through 24 of the upper card cage.

10. Turn the power on, thread an alignment tape on the transport, and proceed to align the head azimuth, and the various record and repro levels, EQ and bias adjustments, as detailed in Sections 4 and 5 of this manual.

    NOTE: Once both head assemblies' azimuths have been aligned for a particular MTR-90 transport, further conversions between 16 and 24 track configurations do not necessarily require further azimuth adjustment.

SECTION IX. CIRCUIT DESCRIPTIONS

NOTES: 1. Pertinent schematic diagrams in the drawing package accompanying this manual are referred to after each subtitle (alternate drawing numbers are also given).

2. Each circuit board has its own individual power supply regulation to provide the necessary voltages.

9.1 PLAYBACK HEAD AND PREAMP

[Drawing Ref. PB-15KOA (PB-9A455)]

The playback (repro) head has a high impedance output (2 k-ohms @ 1 kHz). Its output is fed via a low capacitance coax cable into each channel's electronics module. The signal is AC coupled to a set of matched transistors Q101. These provide the initial gain stage. The output of this stage is fed to an operational amplifier which provides a low impedance output to drive the EQ and other stages (IC101).

9.2 SPEED SELECTION AND HIGH FREQUENCY PLAYBACK EQUALIZATION

[Drawing Ref. PB-15KOA (PB-9A455)]

Equalization for 15 ips is switched ON when FET Q104 is gated ON by the logic circuitry. Similarly, 30 ips EQ is switched ON when FET Q105 is gated ON by the logic. Additionally, one has a choice between two different equalization curves at each speed. Two miniature switches on the Bias Control master circuit board allows the pre-selection of either a 35 µS time constant (IEC curve) or 50 µS (NAB curve) at 15 ips. The shorter time constant is toggled between 17.5 and 35 µS by FET Q102, and the longer is toggled between 30 µS and 50 µS by FET Q103.

9.3 LOW FREQUENCY PLAYBACK EQUALIZATION

[Drawing Ref. PB-15KOA (PB-9A455)]

A standard low-frequency compensation is normally fixed at both 15 and 30 ips. Optionally, one may individually adjust the low frequency response of each channel (using trimmers on each channel's electronics) by moving the "LF COMP" switch on the Bias Control master board front panel from OFF to ON position. (OFF position selects the fixed compensation.) When the LF COMP switch is ON, FET Q107 is turned OFF, enabling trimmer VR104 to adjust the amount of the channel's low frequency equalization (the knee of the curve remains at 50 Hz).

9.4 SYNC PLAYBACK

[Drawing Ref. PB-15KOA (PB-9A455)]

Sync playback utilizes a circuit that is separate from, but almost identical to, normal playback electronics. The circuitry operates in nearly the same manner, with logic controlled selection of high frequency equalization, and the choice of fixed or variable low frequency EQ.

Transformer T101 steps up the head's output signal and feeds the signal to a set of matched transistors Q109 for preamplification. Second stage is provided by half of IC102, and a low impedance output is given by the other half of IC102.

15 ips EQ is switched ON by Q112, and 30 ips EQ is switched ON by Q113. The 15 ips time constant is selected by Q111, Q114 and 30 ips time constant is selected by Q110, Q114, Q115 plus VR108 provides the adjustable low frequency EQ.

9.5 OUTPUT STAGE

[Drawing Ref. PB-15KOA (PB-9A455)]

Three FETs select the signal source to the output amplifier: the repro head (Q120), sync repro (Q122), or the input to the record electronics (Q118). The logic-selected signal is fed to the first stage of a dual Op Amp (Operational Amplifier) (IC103A) and then to a bias trap, the second half of the Op Amp (IC102B) and another bias trap. The output of the second bias trap is fed to an Op Amp (IC104). Here the signal is divided into two, the one being sent to IC104A and the other to IC105B, i.e., ACTIVE BALANCE OUTPUT circuit. SW101 is a switch selecting between BAL and UNBAL. Output to the VU meter is fed to the VU meter assembly through Q124 behind the second bias trap.

9.6 INPUT CIRCUITRY

[Drawing Ref. PB-15KOA (PB-9A455)]

A test signal input is provided on the Bias Control board. When a 1/4" (6.3 mm) phone plug is inserted in this jack, the signal is bussed to the TEST SIG. input of every channel, and a DC voltage is applied to the TEST/LINE input. FET Q202 then passes the test signal; FET Q201 is simultaneously turned OFF, blocking the normal input signal. When a test signal is not plugged into the Bias Control board, the normal signal path is as follows.

The channel input circuit adopts an ACTIVE BALANCE INPUT circuit in which a transformer is not used. The signal applied to each channel receives unbalanced conversion at IC201 and is fed to

IC201B where the first stage of amplification is carried out by FET Q201. One of the outputs goes through RV202 (the Monitor Level Calibration) to a Line Output Amp, while the other proceeds through RV201 to the output stage of the recording amplifier. IC203A and IC204A form the High speed EQ recording amplifier, where as IC203B and IC204B from the Low speed EQ recording amplifier. Adjustment of each EQ is provided at VR203 and VR205. IC205A and IC205B form the PHASE COMP. circuit at their own respective speeds.

NOTE: EQ circuit constant for the recording system is switchable. Conversion of the constant for the change from NAB to IEC specification or vice versa is accomplished by switching a miniature switch mounted on the Bias Control P.C.B. card. The signal supplied from EQ stage is fed to the last stage of recording through Q205 or Q204 (Speed Select Gate). IC301 is MIX circuit for the mixed bias and audio signal. The bias current is supplied to this MIX circuit after receiving adjustment of its waveshape at IC301.

15 ips high frequency pre-emphasis is provided by IC205A, and adjusted by a 10-turn 10 kohm potentiometer VR204. IC205B serves as a differential mixer for 15 ips EQ. A 30 ips high frequency pre-emphasis is provided by IC204A, and adjusted by a 10-turn 10 kohm potentiometer VR203. IC204B serves as a differential mixer for 30 ips EQ. 15 ips EQ is selected when the logic turns ON FET Q204, and 30 ips is selected when the logic turns off Q204 and turns ON Q203.

The pre-emphasized audio from Q203 or Q204 feeds the audio/bias mixing circuitry.

9.7 AUDIO/BIAS MIXING CIRCUITRY

[Drawing Ref. PB-15KOA (PB-9A455)]

A master bias signal is generated in the Bias Control board and distributed to each channel's electronics, where it is amplified and mixed with the pre-conditioned audio input. A 10-turn 10 kohm potentiometer (VR301) serves as the channel's Bias Level adjustment. The bias current is applied to IC302, the amplification stage, through R301 and C302. L301 and C301 are wave shapers. IC302 is provided with controls for the record mode and lamp voltage in Control circuit by IC516 and Q206. All the controls for the record mode are carried out by clock pulse to provide gap-free punch-in at both high and low speeds. At 30 ips, it takes about 30 mS for the bias to turn ON. The clock pulse provides an additional delay of approximately 45 mS to compensate for the distance between the erase and records heads. The TPI is a check terminal for record and bias currents. This carefully synchronized turn-on not only provides gap-free punch in, it permits the machine to enter record mode without "pops" or other

noises. Once in record mode, the bias and erase current ramp down in the inverse sequence.

The bias signal enters a high speed Op Amp (IC302) which mixes the audio and bias signals. Q302 and Q303 form class AB output amplifier that mixes the audio and bias (the head driver amp). The mixed bias and audio signal is applied to the record head through C308, parasitic trap L303/R317 and relay RL510. Each track on the Record Head has two identical windings. RL510 switches the windings into series for Sync Repro mode, and into parallel for Record mode to provide a low impedance load for increased bias current cap-capability.

9.8 ERASE HEAD DRIVER

[Drawing Ref. PB-15KOA (PB-9A455)]

The erase current is also generated in the Bias PCB Assembly and distributed to each Amp PCB Assembly. RV401 mounted atop PCB Assembly, is a gain adjustment for the erase current. The erase current is then fed to IC401. IC515(A & B) provides ON-OFF operation of IC401. The clock pulse provides all the rise and fall times of the erase current. L402 and C404 are wave shapers.

The erase current is amplified at IC402 and CLASS AB AMP (Q402 and Q403) and supplied to the erase head through RL-502. TP2 is a check terminal for the measurement of the erase current.

9.9 REEL CONTROL BOARD

[Drawing Ref. PB-43J (PB-9A268)]

As a system, the Reel Control board, swing arm potentiometers, motor drive amp output, and reel motors, all maintain constant tape tension. In addition, the Reel Control board senses whether the swing arms are in the correct position to allow arming of the reel servos, or in a position that would require disarming of the servos. (Refer to the upper left hand corner of the schematic). One half of IC8 and half of IC7 serve as comparators that receive DC voltages from the center wipers of the supply and takeup swing arm pots. IC8's reference voltage input comes from VR1 (the takeup arm POS trimmer), and IC7's reference voltage comes from VR3 (the supply arm POS trimmer). Later models have test points TP2 and TP5 for checking the supply and takeup position voltages, respectively.

The other halves of IC8 and IC7 are variable-gain inverting amplifiers, whose gain is set by trimmers VR2 and VR4 which thus set the gain for the entire servo system. IC8's output proceeds to the base of Q3 through a DC discrete component Op Amp, and differentially drives the takeup motor drive amp output stage after leaving the Reel Control board via card edge connector points AB.

R89 provides a negative feedback path from the take-up reel motor ground return. The supply motor drive system is fed similarly from IC7, and output from AB18. R107 provides the negative feedback paths from the supply reel motor ground return.

The DC output from each swing arm pot center-wiper, in addition to providing constant tension information, feeds a pair of comparators which are adjusted to indicate when the swing arm is at either extreme of its travel. Specifically, the takeup swing arm output goes through inverting buffer IC6B to comparators IC6A and IC5A. VR5 provides the reference voltage to IC6A, and is trimmed so that D27 lights up when the swing arm is fully up (toward the rear of the deck); VR6 adjusts the reference voltage to IC5A so that D28 lights with the arm fully down. The supply swing arm circuit operates similarly, with VR7 adjusting the reference voltage to IC4A for the upper limit (D30), and VR8 adjusting the reference to IC3A for the lower limit (D20). The same voltage which lights the LEDs is fed through a hex inverter IC2 to the AND gates in IC1. When both upper-limit LEDs are on, then the upper AND gate's output goes negative, allowing the servos to be energized if the STOP button is pressed. Conversely, if both lower-limit LEDs are on, then the lower AND gate's output will go negative and shuts off the servo system for safety.

SECTION X. MAINTENANCE

10.1 GENERAL

The OTARI MTR-90 requires very little maintenance, other than routine electronic alignment to different tape batches, cleaning, and demagnetization. In addition to these day-to-day maintenance procedures, there are a few items that will benefit from occasional cleaning and/or lubrication. Such items, plus a few parts replacement procedures, are covered in this section of the manual. The maintenance items which are primarily covered elsewhere in this manual are listed below:

1. AUDIO ALIGNMENT

   A. Repro alignment (Section 4.4)
   B. Sync amp alignment (Section 4.5)
   C. Bias alignment (Section 4.6)
   D. Record alignment (Section 4.7)
   E. Phase compensation (Section 4.8)

2. TRANSPORT MECHANICAL & ELECTRO-MECHANICAL

   A. Head geometry (Section 5.2)
   B. Transport cover plate removal and replacement (Section 5.3)
   C. Swing arm travel (Section 5.4)
   D. Tape arming solenoids (Section 5.5)
   E. Fast forward/rewind damping solenoids (Section 5.6)
   F. Swing arm tension (Section 5.7)
   G. Tape lifter mechanism (Section 5.8)
   H. Brakes (Section 5.9)
   I. Reel turntable height (Section 5.10)
   J. Reel tension servo (Section 5.11)
   K. Capstan servo (Section 5.12)
   L. Adjustment of transport PCB assembly (Section 5.13)
   M. Adjustment of master CPU PCB assembly (Section 5.14)
   N. Adjustment of I/O PCB assembly (Section 5.15)
   O. Adjustment of bias control PCB assembly (Section 5.16)
   P. 16/24 track conversions (Section 8)

10.2 REMOVING AND REINSERTING PRINTED CIRCUIT BOARDS

The printed circuit boards, alternately referred to in this manual as circuit cards, in the MTR-90's upper and lower card cages are equipped with convenient levers that uniformly distribute pressure when withdrawing the cards. Be sure to use the levers rather than pulling on the front lip of the PC board's shield plate; grasp the end closest to the middle of the card on both of its levers, and pull forward.

CAUTION: Before replacing board into machine, TURN OFF the power FIRST.

When replacing a circuit board, observe that the PC board itself protrudes beyond the metal shield plate. It is the board, not the metal plate, that must be aligned with the upper and lower guides in the card cage. Slide the board in carefully, and then press firmly on both levers to seat the board fully home into its mating connector.

It makes no difference whether any of the circuit boards in the upper card cage (1-24) are exchanged with one another; they are numbered for convenience so that once aligned to a given head assembly, several boards can be removed and reinstalled without necessarily having to realign the machine.

10.3 REEL MOTOR REPLACEMENT

1. Turn the power off and unplug the AC power cable.

2. Remove the guard ring around the reel turntable of the motor to be replaced, and then loosen the two recessed allen screws in the turntable hub and lift it off the motor shaft.

3. Remove the four phillips screws that secure the upper back panel of the chassis, and fold it down carefully.

4. Unplug the 4-pin UNIVERSAL MATE-N-LOK™ connector on the brake bracket that is attached to the reel motor.

5. Loosen the four cap head allen screws around the motor shaft on the top of the deck plate.

   CAUTION: Be sure to support the motor from beneath so it does not fall into the chassis.

6. Remove the four motor mount screws completely, and withdraw the motor.

7. Reinstall the replacement motor by following above steps 2 through 6 in reverse order.

   CAUTION: Before reinstalling the reel turntable(s), refer to Section 5.10. Improper installation can result in costly damage to the turntable and/or reel motor shaft.

8. Set the reel turntable height as described in Section 5.10.

9. Check and adjust the reel tension servo, if necessary, as described in Section 5.11.

10. Check and adjust the brake tension, if necessary, as described in Section 5.9.

10.4 BRAKE PAD REPLACEMENT

Brake pads receive very little wear and seldom require replacement. If a pad does wear out, perform the following pro procedure.

1. Brake pad can be easily replaced. Easy replacement can be carried out by lowering the upper back panel and the panels on both sides, or by flipping up the transport after pulling down the VU meter panel toward you.

2. A brake pad can be taken out by removing the four screws that secure the brake band (two for each side) as per the Figure 5-6,b).

3. After installing a new brake pad, make sure that the brake pad is uniformly distant from the brake drum by moving the plunger of the brake solenoid by hand. Make adjustments by loosening screws marked "H" in the figure.

4. Check and adjust the brake tension as described in Section 5.9.

10.5 METER OR METER LAMP REPLACEMENT

The VU meter lamps are operated at less than their rated voltage, and should therefore have a very long life. If a lamp does burn out, a replacement lamp may be obtained from OTARI.

1. Remove the four phillips head screws, dress washers, and flat washers that hold the meter cover panel to the front of the chassis.

2. Remove the three allen screws that secure the top of the meter panel, and swing the panel open (down).

3. Locate the meter whose lamp you wish to replace; notice that four screw posts from the meter protrude through the metal chassis panel, but only two of these posts are secured with nuts. Insert a suitable nut driver through the holes provided in the meter circuit board, and loosen the nuts and lock-washers, but do not remove completely unless you are replacing the meter.

4. Unscrew the 4 round head phillips screws that secure the meter to the meter circuit board, removing the screws and lock-washers.

5. Pull the meter partially out of the front of the meter panel, and remove the meter bezel (for lamp replacement), or pull the meter completely out of the panel (for meter replacement).

6. (For lamp replacement only) Unsolder the old meter lamp(s) and solder in the new one.

7. Reinstall the meter bezel (or a new meter) by following above steps 1 through 5 in reverse order (first see the note below).

   NOTE: If the meter pointer does not rest exactly on the last line of its scale, do not yet replace the meter cover panel. First adjust the meter zero screw (centered below the scale on the front of the meter) so the pointer rests at the line just below -20 VU. This of course is a good time to be sure if any other meters require this same static adjustment.

10.6 CAPSTAN AND TACHO ROLLER REPLACEMENT

Field replacement of the rollers is not recommended. We strongly urge you to contact OTARI before attempting to service the rollers (other than cleaning them with pure isopropyl alcohol).

10.7 HEAD SHIELD POSITION ADJUSTMENT

Refer to Figure 10.1. The upper and lower sensor assembly positions can be adjusted slightly after loosening the respective phillips head screws.

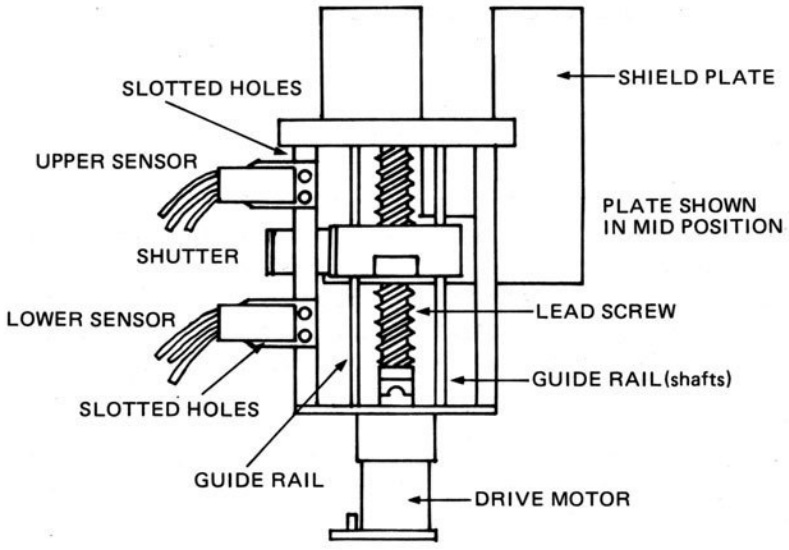


Figure 10-1. Head shield position adjustment.

The lower sensor should be adjusted so that the top of the shield plate lowers to approximately 1 mm above the head assembly base cover. The upper sensor should be adjusted so the shield plate raises to approximately 3 mm from the bottom lip of the head assembly cover plate.

10.8 CLEANING AND LUBRICATION

Refer to Section 4.3 for cleaning the tape path. There are only a few other areas that should be checked periodically for dirt. The MTR-90 motor and guide roller bearings are permanently lubricated so they do not require oiling.

HEAD SHIELD SCREW (WORM)

Perform this procedure once every 6 months, or if the shields become noisy or move erratically.

1. Remove the 3 allen head screws that secure the top of the meter panel, and swing the panel open.

2. Using a lint-free cloth, wipe off the screw (worm) shaft in the center of the head shield mechanism, and the two smaller guide shafts on either side of that screw (Figure 10-1). To again access to all areas of these parts, turn the power on, place the transport in Stop mode, and operate the SHIELD button.

3. Wipe a light coating of utility oil onto the two shafts and the screw (worm).

SECTION XI. SPECIFICATIONS

11.1 TAPE TRANSPORT

TAPE WIDTH AND TRACKS:	1-inch (25.4 mm) 8-tracks 2-inch (50.8 mm) 16-tracks 2-inch 24-tracks
REELS SIZE:	Up to 14 inches diameter (35.6 cm) NAB hub with reel size auto sensing.
HEADS:	Plug-in head blocks with full access to independent head azimuth adjustment.
DRIVE SYSTEM:	Pinch-rollerless direct drive capstan system with ±20% speed control. Constant tension servo-controlled reel motors.
MOTORS:	1 DC capstan motor; 2 fully servoed DC reel motors.
TAPE SPEED DEVIATION:	Less than ±0.05% from beginning to end of reel.
START TIME:	Less than 1.0 second.
FAST FORWARD/REWIND TIME:	120 seconds maximum for 2400 feet (760 m)
WOW AND FLUTTER: (Peak wtd. per DIN 45507)	Less than 0.04% at 30 ips; Less than 0.05% at 15 ips
PITCH CONTROL:	±20% continuously variable control, percentage or ips readout with 0.1% precision.
CUE CONTROL:	Rotating Cue knob for variable speed tape winding (bidirectional) proportional to cue knob rotating; button also defeats tape lifters in fast wind and rewind modes.
TAPE TIME COUNTER:	Five digit LED readout from tachometer/logic measurement circuit; indicates hours, minutes, seconds, and tenths of seconds.
TAPE SPEEDS:	30 ips (76.2 cm/s), and 15 ips (38.1 cm/s)

11.2 ELECTRONICS (Measured with 3M #226 tape)

LINE INPUT:	+4 dBm nominal level, 10 kohm active balance.
LINE OUTPUT:	+4 dBm nominal level, 5 ohm active balance, BALANCE-UNBALANCE switch. Minimum load impedance: 150 ohm
AMPLIFIER CLIPPING:	+28 dBm
HEADROOM:	24 dB
EQUALIZATION:	@ 30 ips, AES or IEC (CCIR), switchable. @ 15 ips, NAB or IEC (CCIR). Record EQ to be specified at time of order.
BIAS FREQUENCY:	Record, 257 kHz; Erase, 86 kHz
PUNCH-IN/PUNCH-OUT:	Gapless and noiseless inserts with automatic monitor switching.
STANDARD RECORD LEVEL:	320 nanoWebers per meter (nWb/m).
FREQUENCY RESPONSE: (Overall Record/Repro, measured @ 250 nWb/m)	Record/Reproduce @ 30 ips, 50 Hz ∿ 25 kHz +2 dB, -2 dB @ 15 ips, 30 Hz ∿ 20 kHz +2 dB, -2 dB Synchronous Reproduce (Sel-Rep) @ 30 ips, 50 Hz ∿ 18 kHz ± 2 dB @ 15 ips, 30 Hz ∿ 18 kHz ± 2 dB
DISTORTION:	Less than 0.5% THD at 1 kHz, 320 nWb/m
CROSSTALK:	24 track @ 2 kHz, greater than 55 dB 16 track @ 2 kHz, greater than 58 dB 8 track @ 2 kHz, greater than 58 dB 16 and 24 track, 200 Hz ∿ 16 kHz, greater than 43 dB
ERASE EFFECT:	Greater than 75 dB

SIGNAL-TO-NOISE RATIO:

Unweighted	@ 520 nWb/m
24 Track @ 30 ips	Greater than 68 dB
24 Track @ 15 ips	Greater than 66 dB
16 Track @ 30 ips	Greater than 70 dB
16 Track @ 15 ips	Greater than 68 dB
8 Track @ 30 ips	Greater than 70 dB
8 Track @ 15 ips	Greater than 68 dB

(Measured through 30 Hz ∿ 18 kHz audio filter)

11.3 PHYSICAL

WEIGHT:	440 pounds (200 kg)
DIMENSIONS:	43 inches high (1,100 mm), 30 inches wide (770 mm), 24-1/2 inches deep (620 mm)
FINISH:	Light beige and gray pebble finished steel chassis, black cover panels.
POWER REQUIREMENTS:	100/117/220/240 volts single phase AC, 50 Hz or 60 Hz; 720 VA operating, 2,000 VA starting.

11.4 ACCESSORIES

STANDARD:

- Model CB-113 Remote Box features separate record, ready, and monitor functions, vari-speed control, master switching, cue, full transport controls, and LED status indicators.
- Accessory box
- Operation and maintenance manual (OS3-039)

OPTIONAL:

- Model CB-115 Auto Locator features ten assignable memories, using stroken and/or keyboard access; varispeed control, electronic stopwatch, dual LED displays for tape and locate timing, shuttle, and search to cue capabilities.
- 16/24 track conversion kit (ZA-53G)
- Acryl resin dust cover (ZA-52M)
- Round-roll stand (ZA-52L)
- 1" 8 track to 2" 16 or 24 track conversion kits. ZA-31G (to 24CH)
ZA-31H (to 16CH)
- Input Transformer Ass'y (ZA-53C)
- Output Transformer Ass'y(ZA-53D)
- 1" 8CH conversion kit (to 2" 16CH)(ZA-31H)
- 1" 8CH conversion kit (to 2" 24CH)(ZA-31G)
- Emergency P.C.B. kit ZA-53J
- Extender P.C.B. Ass'y PB-78A

In the interest of product improvement, OTARI reserves the right to change specifications without notice or obligation.