
AMPEX

AUDIO-VIDEO
SYSTEMS DIVISION

TS-40

**TAPÉ TENSION
SERVO ACCESSORY**

**FOR THE AG-440C RECORDER/
REPRODUCER AND THE
AG-445C REPRODUCER**

**OPERATION
AND
MAINTENANCE**

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GENERAL INFORMATION

DESCRIPTION AND USE

This manual contains operation and maintenance information for the TS-40 Tape Tension Servo Accessory Kit, Ampex Part No. 4010245-01, which is designed for use with any 1-, 2-, or 4-channel Ampex AG-440C Recorder/Reproducer or AG-445C Reproducer. The kit is shown in Figure 1, and includes a control module, inter-

connecting cable, mounting brackets, a power rectifier diode, and a dummy plug.

- The TS-40 insures that tape holdback tension remains constant within ± 0.5 ounce on the supply reel in the play or record modes. A switch on the control module allows selection of either constant tension or constant torque. In the fast wind modes, the TS-40 is inactive. It may be completely

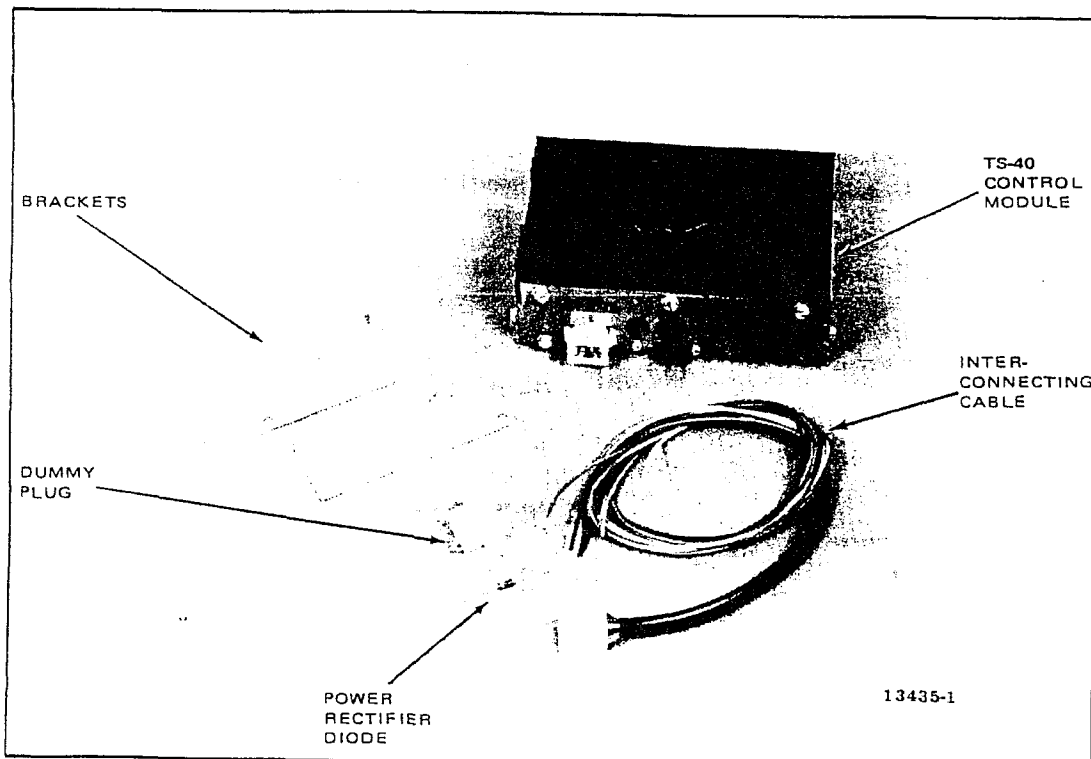


Figure 1. TS-40 Tape Tension Servo Accessory Kit

bypassed in all modes by use of the dummy plug included in the kit.

When the TS-40 is to be used in an environment where the ambient temperature could exceed 45°C (113°F), it is recommended that an Ampex fan kit be installed in the recorder/reproducer. For portable model recorder/reproducers, the fan kit part number is 4850196-01. For all other models, Console Fan Kit 4850172-01 is applicable.

No external power connections are required by the TS-40, which obtains its 50 or 60-Hz operating power directly from the recorder/reproducer.

SPECIFICATIONS

Table 1 lists the specifications for the TS-40 when used with an AG-440C or AG-445C. The specifications are subject to change without notice.

Table 1. TS-40 Tape Tension Servo Accessory Specifications

PARAMETER	SPECIFICATION
Tape Width	1/4 inch or 1/2 inch
Supply Reel Tape Pack Diameter	1-3/4 inches to 11-1/2 inches
Constant Tension Range	3 ounces to 6 ounces, measured at head input
Tension Variation	±0.5 ounce
Slow Tape Speed Tension (maximum)	3-3/4 in/s: 4 ounces 7-1/2 in/s: 6 ounces
Tension Variation for ±10%	
Line Voltage Variation	Less than 1/2 ounce
Starting Torque	Adjustable for optimum characteristics
Maximum Torque	85% of available motor torque
External Power Required	None
Dimensions (inches)	2-3/8 x 3-3/4 x 6
Weight	Approximately 2 pounds
Operating Environment:	
Temperature	0°C to 50°C
Humidity	10% to 90%, non-condensing
Altitude	Sea level to 10,000 feet

INSTALLATION

Installation of the TS-40 is accomplished in up to four steps, depending on the model recorder/reproducer involved. These four steps are:

- Installation of Jumper for 30 In/s Operation
- Transport Control Box Modification
- Installation of TS-40 Control Module
- Electrical Adjustment of the TS-40

INSTALLATION OF JUMPER FOR 30 IN/S OPERATION

Installation of the jumper is not necessary unless the recorder/reproducer is to be operated at 30 in/s, in which case the jumper is necessary to hold a fixed starting torque for approximately three seconds after startup. This is required to avoid tension buildup while the capstan accelerates to the 30-in/s tape speed. To install the jumper, proceed as follows:

1. Remove the bottom cover of the TS-40 control module, exposing the control module printed wiring assembly (PWA).
2. Locate terminals E1 and E2 near the center of the PWA, and solder a jumper wire between the two terminals.
3. Replace the bottom cover of the module.

TRANSPORT CONTROL BOX MODIFICATION

AG-440C and AG-445C are currently being manufactured with the TS-40 interconnect cable already installed, in which case the cable and the diode furnished with the TS-40 kit may be discarded. Recorder/reproducers of earlier manufacture, however, must have the kit cable installed and the recorder/reproducer's transport control box modified.

When installed, the TS-40 interconnect cable is a 10-conductor cable which passes through a hole near J607 in the transport control box chassis. It is terminated with a dummy plug in the connector, and is held in place by a cable clamp attached to the outside of the transport control box.

If the recorder/reproducer already has the TS-40 interconnect cable installed, remove the cable clamp so that the cable is free, and proceed to the paragraph covering installation of the TS-40 control module. If the interconnect cable is not already installed, proceed as follows:

1. Remove the recorder/reproducer transport control box cover.
2. Remove the transport control PWA by removing two screws and then unplugging the PWA.
3. Cut the jumper between K602-11 and K602-12.
4. Remove the wire connected to K602-12 and solder it to K602-11.
5. Locate the wire connecting R603 and K601-10. Remove the wire from R603 and connect it to K602-12.

6. Connect a wire between K602-4 and the end of R603 from which the wire was removed in step 5.
7. Connect the diode furnished with the kit between TB1-2 and TB2-2, with the cathode to TB1-2.
8. Remove the wire connected to K601-2.
9. Pass the TS-40 interconnect cable through the grommet next to J607. The connector on the end of the cable should be at least 6-1/2 inches from the transport control box chassis.
10. Connect the TS-40 interconnect cable wires in accordance with Table 2. See also Figure 2.
11. Secure the newly installed wires as necessary to prevent excessive movement or interference with other components.
12. Replace the transport control PWA and the cover to the transport control box.
13. Update the recorder/reproducer schematic diagram, and other pertinent documentation, to reflect the changes accomplished.

NOTE

The changes accomplished in the preceding steps do not result in a transport control box identical to the one containing the factory-installed interconnect cable. Therefore the schematic updated in step 13 should be used for user-modified boxes, instead of the schematic furnished in this manual.

INSTALLATION OF TS-40 CONTROL MODULE

Figure 3 shows the TS-40 control module installed in the recorder/reproducer. The installation is accomplished as follows:

1. Rotate the recorder/reproducer transport assembly to the maintenance position and remove the front panel.
2. Loosen the four nuts which mount the power transformer to the underside of the transport control box. Two of these nuts are shown in Figure 3.

Table 2. Cable Connections

COLOR	CONNECTION
Black	J607-3
Brown	K601-2
Red	TB3-2
Orange	Splice to the wire removed from K601-2 in step 8
Yellow	F603 tip
Green	TB2-2
Blue	Empty lug on S610
Violet	J606-5
Grey	J604-8
White	J607-5

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Between steps 2 and 3 of the Transport Control Box modification procedure, add the following additional step:

- 2a. Remove the wire from K602-8, and insulate the loose, exposed end with shrink tubing. If no tubing is available, double back the end and insulate it with electrical tape.

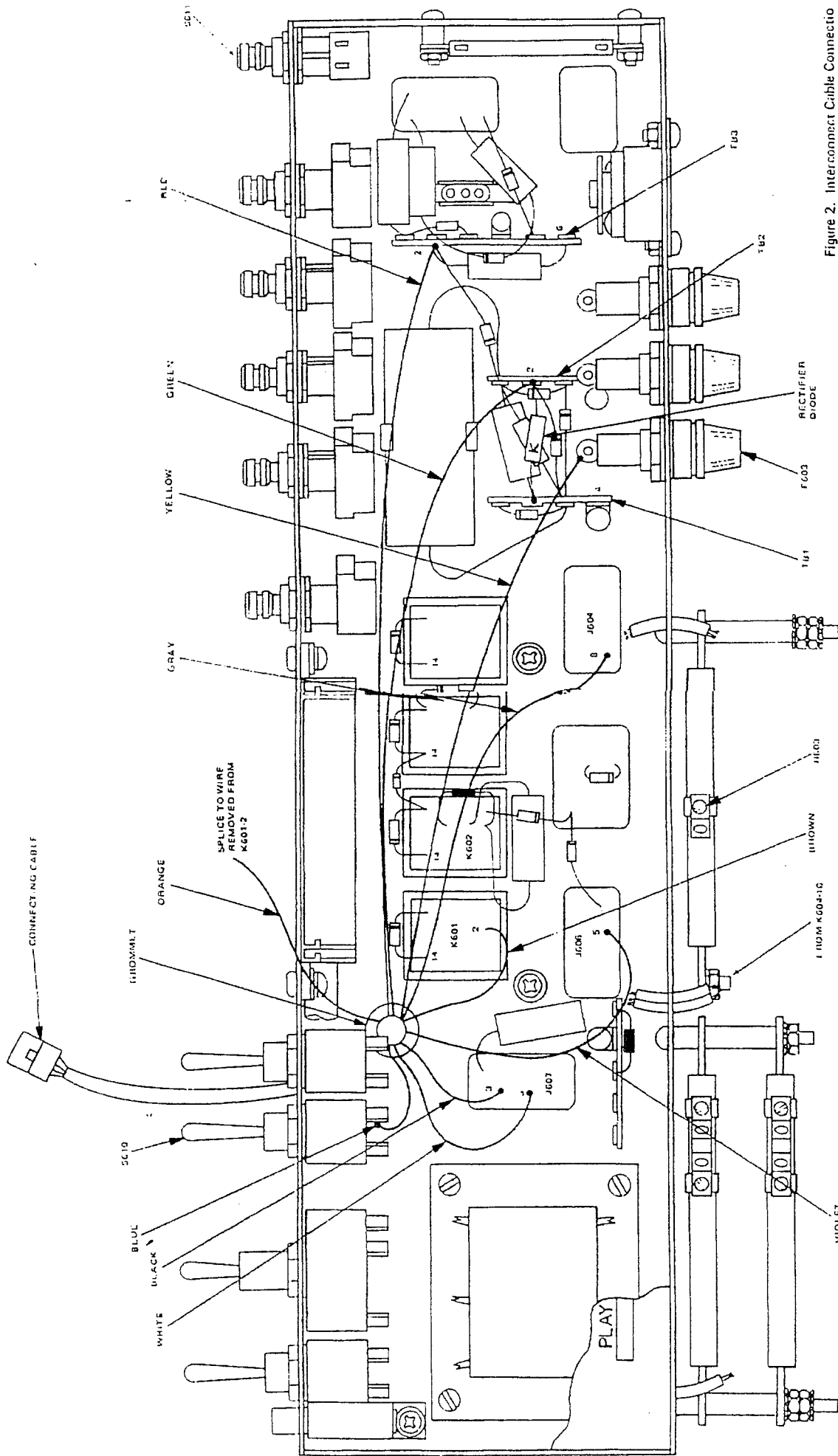


Figure 2. Interconnect Cable Connector

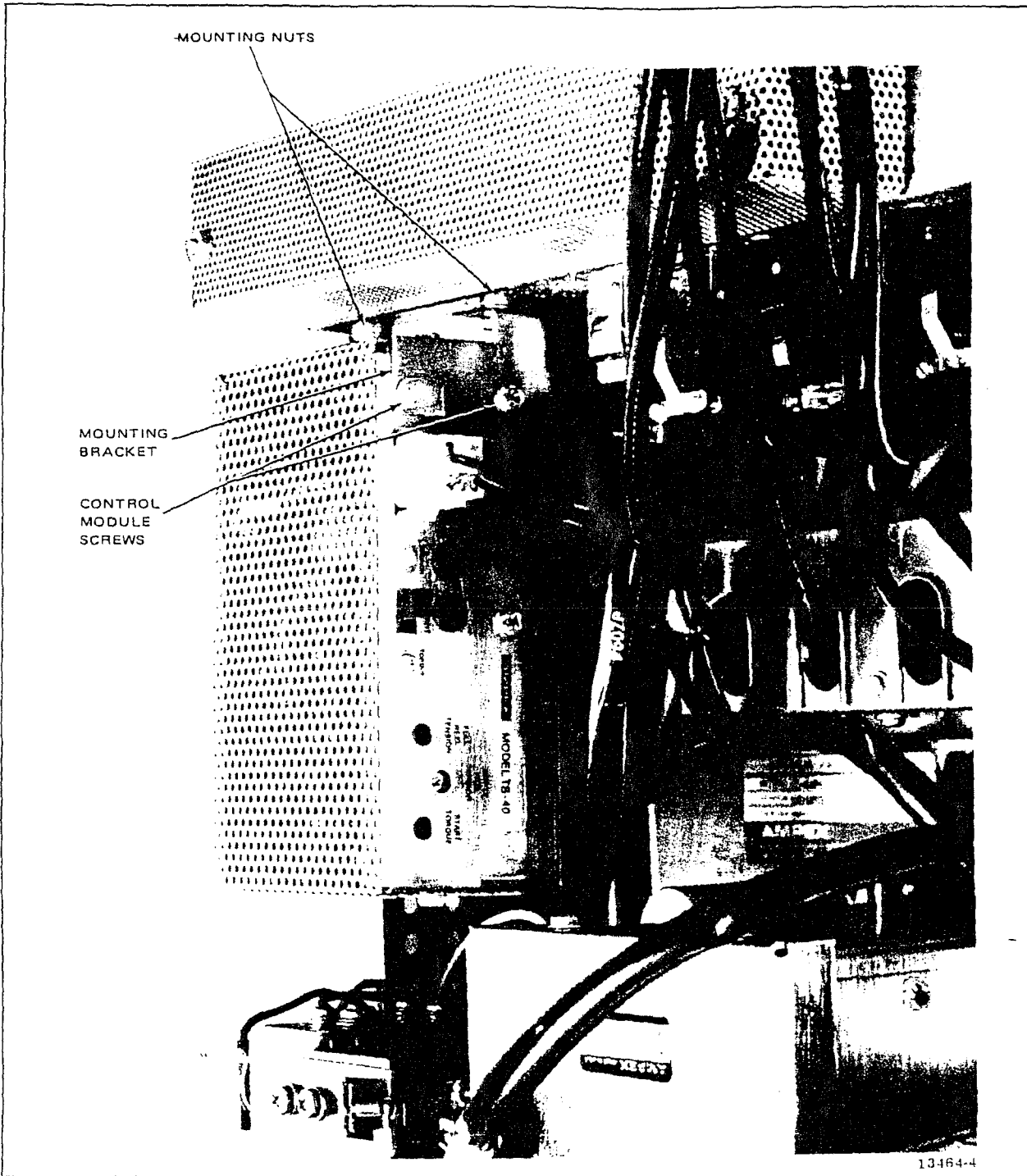


Figure 3. TS-40 Installed on the Transport Assembly

3. Slide the mounting brackets between the chassis and the nuts.
4. Remove two screws from each side of the control module near the connector end. Figure 3 shows two of these screws.
5. Slide the control module between the mounting brackets, with the heatsink facing the reel idler flywheel.
6. Reinstall the screws removed in step 4, and tighten the nuts loosened in step 2.

7. Remove the dummy plug from the TS-40 interconnect cable, and plug the cable into the connector on the control module.

ELECTRICAL ADJUSTMENT OF THE TS-40

Prior to use, the TS-40 must be adjusted to provide the proper tape operating tension and supply-reel starting torque. Recommended tape tensions and procedures for making the required adjustments are found in the Maintenance section of this manual.

OPERATION

OPERATING CONTROLS

Under normal recorder/reproducer operating modes, the TS-40 functions automatically, and operating controls are not required. For the special circumstances described in the remainder of this section, the following operating controls are found on the control module panel shown in Figure 4:

- a. **CONSTANT-TENSION/CONSTANT-TORQUE selector switch** — This switch allows the recorder/reproducer to operate with either a constant tape holdback tension or a constant supply-reel holdback torque.

- b. **START-TORQUE potentiometer** — This control varies the supply-reel holdback torque when the TS-40 is in the constant torque mode. (Note: This control also has alignment and maintenance functions as described in the Maintenance section of this manual.)

Other controls on the TS-40 control module panel are for maintenance purposes only.

VARIABLE SPEED MODE

When the recorder/reproducer is operated in a variable speed mode, as described in the appropriate Operation and Maintenance manual, the

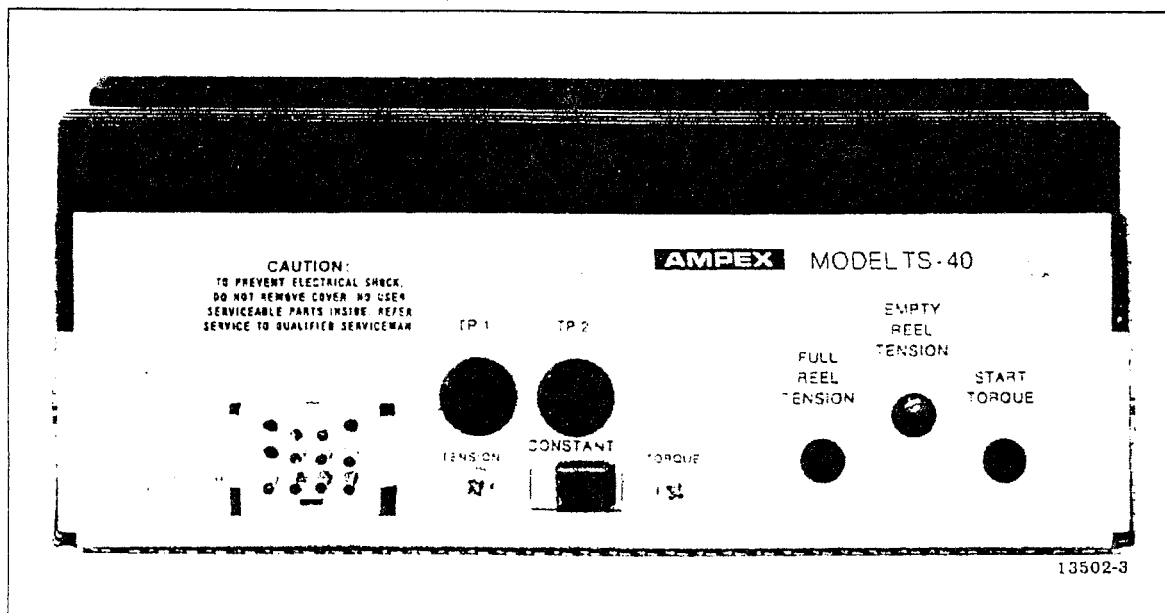


Figure 4. TS-40 Controls

tension will be inversely proportional to the tape speed, such that a 20% increase in tape speed will result in a 20% reduction in tension. If speed changes in excess of 20% are required, set the selector switch on the TS-40 control module to the CONSTANT TORQUE position. The tape will then run in the constant torque mode.

TAPES RECORDED AT CONSTANT TORQUE

When playback timing of a tape recorded on a constant torque transport is critical, reproducing this tape at constant tension can result in a timing error of 0.1% or more, depending upon the tape width and thickness and on the torque used in the record process. Setting the selector switch on the TS-40 control module to the CONSTANT TORQUE position and adjusting the torque to be the same as that used in the record process will restore the timing to the original record time. The

torque is adjusted with the START TORQUE control on the TS-40 control module. Adjustment procedures are found in the Maintenance section of this manual.

TAPE OPERATING TENSION

Recommended tape operating tension for various tape widths, and the procedures for obtaining the selected tension, are found in the Maintenance section of this manual.

CHANGE OF RECORDER/ REPRODUCER SPEED PAIR

When the speed pair of the recorder/reproducer is changed, the TS-40 tension controls must be readjusted as described in the Maintenance section of this manual.

THEORY OF OPERATION

The rotational velocity of the recorder/reproducer holdback reel is inversely proportional to the diameter of the tape pack when the tape is traveling at a constant velocity across the heads. The TS-40 Tape Tension Servo Accessory accepts reel velocity information from the recorder/reproducer, and converts it into a voltage which controls the torque of the reel motor. The result is that motor torque will be proportional to the reel-pack diameter, ensuring a constant tape tension.

FUNCTIONAL DESCRIPTION

Figure 5 is a functional block diagram of the TS-40. When not in a fast wind mode, the recorder/reproducer supply reel motor receives its drive through the TS-40 motor drive control. In the absence of a play or record command, the TS-40 play enable circuit holds the motor drive control cut off, and no power is furnished to the motor.

When a play/record command is received from the recorder/reproducer, the play enable circuit issues an enable command. In addition to turning on the motor drive control, the enable command actuates the start clamp, whose function will be discussed later.

As the supply reel motor turns, tachometer pulses are fed to the TS-40, where they are shaped into 1-ms pulses and applied to an optical coupler. The frequency of the 1-ms pulses is proportional to supply reel motor rotational velocity. It should be noted here that if the recorder/reproducer is operating at the lower of its two speeds, the TS-40's low-speed double circuit will double the frequency of the 1-ms pulses.

The 1-ms pulses are applied through the optical coupler to a frequency discriminator circuit. The discriminator output is a sawtooth wave whose amplitude and frequency are proportional to the input frequency. The sawtooth is filtered and shaped into a dc level whose amplitude is proportional to the tachometer pulse frequency. This level controls the power to the supply reel motor through the motor drive control circuit.

When the TS-40 selector switch is in the CONSTANT TORQUE position, the optical coupler is disabled, and the motor drive control circuit receives a steady dc voltage through the start clamp and the filtering-and-shaping circuit. This produces a constant level of drive to the motor, regardless of rotational velocity.

In the absence of an enable command, the start clamp is conducting, and establishes a level from which the motor drive will start upon receipt of an enable command. When a small reel is used on the recorder/reproducer, the TS-40 reel size switch detector reduces the clamp level being applied to the filtering-and-shaping circuit prior to the enable command. The initial drive to the motor is thereby reduced under small-reel conditions.

DETAILED CIRCUIT OPERATION

Referring to the control module schematic 4840420, dc power for operation of the TS-40 is obtained from a half-wave rectifier-filter power supply consisting of CR1, R1, VR1, CR4, and C9. The dc level of 12V is established by VR1.

When the recorder/reproducer is not in the play or record modes, the signal at J1-5 is a 60-Hz ac signal which is held negative with respect to circuit common by R4 and C1. Therefore, Q2 is cut off

and Q3 is conducting, being biased through R12 and R13. Transistor Q3 holds Q1 and Q10 cut off via CR9, so that no power can be supplied to the supply-reel motor through J1-1 and J1-4. Transistor Q3 also prevents any signal from reaching Q9 via CR8. With Q2 cut off, base current is supplied to start clamp Q7 via R13, R9, and CR7. This saturates Q7, and clamps the junction of R20 and R19 at approximately 0.7V above the setting of the START TORQUE control, R28.

When the recorder/reproducer is placed in the play mode, a 130-Vdc voltage is applied to J1-5. This signal saturates Q2, cutting off Q3 and Q7. The Darlington pair Q1/Q10, Q9, and Q5 are now enabled, and the motor starts to rotate. Current flow through the motor for the half cycle where J1-4 is positive with respect to J1-1 is as follows: J1-4, CR5, Q1/Q10, R2, CR2, J1-1. During the other half cycle, CR3 and CR4 conduct. Capacitors C2 and C3 filter the ac voltage across the bridge circuit formed by CR2 through CR5. Resistor R2 stabilizes the gain of the Darlington pair.

With the motor rotating, the tachometer pulses are coupled to A1-3 by C10. These pulses are approximately 8 Vp-p. The pulses are formed into a square wave by A1-3 and A1-4, with R38 providing hysteresis to avoid double edges caused by noise. The negative edges of the square waves are differentiated by C13 and R37 to form 1-ms positive pulses at A1-10. Doubling circuit A1-11 is enabled whenever 39 Vdc is supplied to R33 from the recorder/reproducer. This occurs whenever the tape speed switch on the recorder/reproducer is in the low-speed position. The doubling circuit inverts the square waves present at the output of A1-4, and the negative edges are differentiated by C12 and R36. In this manner, another positive pulse is applied to A1-10. NAND gate A1-10 drives optical coupler A2. The output of A2 is a series of positive pulses whenever S1 is in the CONSTANT TENSION position. These pulses are applied to the base of Q9.

Transistors Q8 and Q9 form a frequency discriminator circuit. Capacitor C8 is charged by a constant current through Q8, the magnitude of the current being determined by the setting of the EMPTY REEL TENSION control, R25. The positive pulses supplied by A2 can now pass to the

base of Q9, since CR8 is back biased. During the pulse period, C8 discharges through Q9. This action produces a sawtooth wave at the collector of Q9. The sawtooth starts from a level of about 1.5V, as established by CR13, CR14, and CR15. The positive excursion of the sawtooth wave is determined by the total charge delivered to C8 between pulses which, in turn, is determined by the pulse repetition rate and the setting of R25.

The sawtooth wave is filtered by active filter R20, R19, C7, C5, and Q5. The cut off frequency is 0.15 Hz to eliminate the sawtooth frequency from the signal. Components R15, CR10, R17, R24, and CR12 form a variable curve-shaping circuit that only becomes active when the base of Q4 is approximately 3.5V. This circuit attenuates a high level signal from Q5 in order to match the motor transfer characteristics. Transistor Q4 is an emitter follower which controls the base voltage of Q1. In this manner, the drive to the Darlington pair, Q1/Q10, is inversely proportional to the frequency of the tach pulses received by the TS-40.

Under high torque demands, capacitors C2 and C3 will no longer be able to hold the collector of Q10 above circuit common throughout the ac cycle. In this case, TP-2 will exhibit 120-Hz ripple. The circuit still performs its regulating function, but becomes increasingly sensitive to line voltage variations.

When there is no ac signal at J1-6, the reel-size switch detector Q6 is held cut off by R11. When the recorder/reproducer switch is in the small-reel position, an 85-Vac signal is applied to J1-6. It is rectified by CR6, filtered by R10 and C4, and causes Q6 to conduct. This effectively places R22 in parallel with the wiper arm of R28, reducing the clamp voltage of Q7.

When S1 is in the CONSTANT TORQUE position, Q7 is conducting even when the play/record command is received through J1-5, and Q2 is conducting. However, S1 has removed the operating voltage from A2, and no tach pulses pass to Q9. The collector of Q9 attempts to go positive to supply the current required by Q7. Under these conditions, the motor torque is determined by the setting of the START TORQUE control R28.

MAINTENANCE

Once the TS-40 is properly adjusted, no preventive or routine maintenance is required. However, the tension controls on the control module must be readjusted each time the speed pair of the recorder/reproducer is changed, or when a different tape holdback tension is desired. Procedures for such readjustment are found in this section. All *Electrical Adjustment* procedures must be performed when the TS-40 is first installed.

ELECTRICAL ADJUSTMENT OF THE TS-40

Required Test Equipment

The following test equipment is necessary for adjusting the TS-40:

- Spring scale (Chatillon 0-16 oz., or equivalent)
- Tension gauge (Tentel Model T2-H20-MS, or equivalent)

NOTE

If a tension gauge is unavailable, a 1-5-volt dc voltmeter can be used in conjunction with the spring scale.

Recommended Tensions

The following tape tensions at the input of the head assembly are recommended:

1/4 inch tape - 4 ounces

Combination 1/4 inch and 1/2 inch
tape - 5 ounces

1/2 inch tape - 6 ounces

The above tension values are nominal only, and can vary somewhat with no adverse effects. The important consideration is to keep the tension constant during playback or record.

Adjustments of the TS-40 include those for empty reel tension, full reel tension, and start torque. The empty reel tension control affects the tape tension throughout the entire tape pack, from full supply reel to empty (almost) supply reel. The full reel tension control will only be effective when the motor torque demand is high, such as at full supply reel with medium or high tensions. In addition to adjusting the starting torque, the start torque control is also used to adjust running torque under certain operating conditions as described in the Operation section of this manual.

Tension Controls Adjustment

Prior to making adjustments, it is advisable to verify proper operation of the recorder/reproducer by disconnecting the TS-40, inserting the dummy plug in the interconnect cable connector, and checking the transport's functioning in all operating modes.

For easier access to the TS-40 controls, the control module may be swung out from the recorder/reproducer by removing two of the four screws holding the module to the mounting brackets. The two screws to be removed are those nearest the reel idler flywheel.

Adjustment of the controls, shown in Figure 4, is as follows:

NOTE

This procedure involves use of a tension gauge. The procedure for adjusting tension with a spring scale and dc voltmeter is given at the end of this section.

1. Verify that the tension gauge is calibrated to the tape being used for the adjustments.
2. Thread a full 10-1/2 inch reel of tape on the recorder, and fast wind so that about 1/2 inch of tape pack remains on the supply reel.
3. Select the low speed of the speed pair designated for recording or reproducing.
4. Check that the FULL REEL TENSION control is fully clockwise, and place the selector switch in the CONSTANT TENSION position.
5. Place the recorder/reproducer in the PLAY mode. Wait approximately five seconds for the reel idler to come up to speed to allow the TS-40 to change from the constant torque start to the constant tension run condition.
6. When the reel idler comes up to speed, insert the tension gauge between the reel idler and the head assembly, and adjust the EMPTY REEL TENSION control for the recommended tension.
7. Fast wind the tape until the full tape pack is on the supply reel.
8. Place the recorder/reproducer in the PLAY mode and check the tape tension with the tension gauge. If the tension is too high, reduce the tension by adjusting the FULL REEL TENSION control.
9. Fast wind to the end of the reel, and readjust the EMPTY REEL TENSION control if necessary. Work back and forth until both the empty-reel and full-reel tensions are proper.
10. Check the tension at several places between minimum and maximum tape packs. Be sure that tensions are measured with the reel idler coupled to the tape. When small EIA reels are used, check the tension at various spots on

the small reel. When the tape type is not the same on the small reel, recalibrate the tension gauge.

NOTE

If tensions below 4 oz. are desired, a rising tension will be observed at the inside of an EIA reel. This can be corrected by shorting out diode CR15 on the control module PWA. However, this will adversely affect the tension linearity at high tensions. Additionally, very low tensions may result in erratic tensions and an increase in flutter.

Start Torque Adjustment

Since the optimum starting torque will vary with the mounting style (rack, console, or portable) and with the reel idler arm spring tension, no optimum value recommendation can be given in this manual. Starting torque should be kept low to avoid capstan slippage while the reel idler accelerates, but if it is too low, the tape will bounce off the heads during starts. The best method for making this adjustment is to reproduce a pre-recorded tape and adjust the START TORQUE control for the best sounding starts. Check at both ends of the reel and several points in between.

Adjustments Using a Spring Scale and a DC Voltmeter

When using a spring scale and a dc voltmeter to adjust the TS-40 tension controls, the dc control voltage required to produce the desired motor torque for a number of reel diameters is determined by static test, and then programmed into the TS-40 as the recorder/reproducer operates in the play mode.

Table 3 shows the holdback motor torque in ounces at the hub of an NAB reel for various tape pack diameters, and for the recommended constant tape tensions at the head, assuming a 4-1/2-inch reel hub diameter (NAB hub).

Table 3. Motor Torque Required for Specified Holdback Tape Tensions

TAPE TENSION	PACK DIAMETER	MOTOR TORQUE
4 oz.	5 inches	3.5 oz.
	9 inches	6.0 oz.
5 oz.	5 inches	4.5 oz.
	9 inches	7.5 oz.
6 oz.	5 inches	6.0 oz.
	9 inches	9.5 oz.

WARNING

WHEN PERFORMING TENSION CONTROL ADJUSTMENT USING A DC VOLTMETER, SHOCK HAZARD EXISTS. USE EXTREME CAUTION. TS-40 CIRCUITRY AND TEST POINTS 1 AND 2 ON THE TS-40 ARE AT AC POWER LINE POTENTIAL. IN ORDER TO AVOID SHOCK HAZARD, THE USE OF AN ISOLATION TRANSFORMER (115/115V, NOT LESS THAN 500W) BETWEEN THE RECORDER AND THE POWER LINE IS RECOMMENDED. SOME TEST EQUIPMENT WILL BE AT POWER LINE POTENTIAL IF THE ISOLATION TRANSFORMER IS NOT USED; ENSURE THAT ALL TEST INSTRUMENTS USED ARE FREE FROM GROUND. AN ACCIDENTAL SHORT BETWEEN THE TS-40 CIRCUIT AND CHASSIS GROUND IS THE SAME AS A SHORT CIRCUIT TO THE POWER LINE, AND ALL SEMI-CONDUCTORS IN THAT PATH WILL BE DESTROYED.

The following procedure is used to adjust the tension controls using a spring scale and a dc voltmeter:

1. Attach the spring scale to an NAB hub using twine, and place the hub on the recorder/reproducer supply turntable.

2. Connect a dc voltmeter to TP-2 (positive) and TP-1 (negative).
3. Place the TS-40 selector switch to the CONSTANT TORQUE position.
4. Set the FULL REEL TENSION control fully clockwise.
5. Tape the recorder/reproducer takeup tension arm in the actuated position, so that the transport will be enabled even in the absence of a complete tape path.
6. Referring to Table 3, select the torque that corresponds with the desired tape tension and a 5-inch pack diameter.
7. Place the transport in the PLAY mode. Holding the spring scale stationary, adjust the START TORQUE control to produce the selected reading on the spring scale.
8. Record the reading of the voltmeter.
9. Adjust the START TORQUE control so that the spring scale reading corresponds with the 9-inch pack diameter torque required for the selected tape tension. Record the reading of the voltmeter.

10. Place the transport in the STOP mode and remove the spring scale.
11. Mark the 5-inch and 9-inch diameter points on a full NAB reel of tape, and thread it onto the transport.
12. Place the TS-40 selector switch in the CONSTANT TENSION position.
13. Fast wind to the 5-inch diameter mark, set the tape speed control to 3-3/4 in/s or 7-1/2 in/s, and place the transport in the PLAY mode.
14. Observing the dc voltmeter, adjust the EMPTY REEL TENSION control so that the voltmeter reading is the same as that recorded in step 8.
15. Fast wind to the 9-inch diameter mark, and place the transport in the PLAY mode.
16. Observing the voltmeter, adjust the FULL REEL TENSION control so that the voltmeter reading is the same as that recorded in step 9.

CORRECTIVE MAINTENANCE

If a failure is suspected, only a qualified serviceman should attempt repairs. Normal electronic equipment troubleshooting techniques apply. As an aid in isolating problems, the TS-40 can be bypassed by disconnecting the control module and installing the dummy plug in the interconnect cable connector. This will determine if the recorder/reproducer is operating properly without the TS-40.

There are several sources of erratic tensions that can occur even when the TS-40 is operating properly. These sources include the following:

- a. Dragging brake causing high tension.
- b. Reel idler not coming up to speed.
- c. A sticky reel idler tape guide arm causing the wrap around the reel idler tape guide to vary. This can occur even though the tape pack is the same, and results in a small change in tension buildup around the guide. Another result is a change in tension at the head input, even though the reel output tension is constant.
- d. A dirty reel idler tape guide or extreme humidity variations causing the tension buildup around the guide to change.
- e. Tension selector switch on the TS-40 in the wrong position.
- f. A tension gauge used during adjustment not calibrated for the tape actually being used.
- g. If the tension varies at the once-around rate of the supply reel, it is an indication that the photocell is not properly aligned to the tachometer disk on the supply reel motor. In this case, readjust the photocell as described in the recorder/reproducer Maintenance manual. If trouble still persists due to an eccentric disk, drill out the holes in the disk to a diameter of 0.104 inch.

If corrective maintenance results in a significant parts replacement, performance of the *Electrical Adjustment* procedures found in this section is recommended. This is particularly applicable if parts have been replaced in the frequency discriminator, filtering and shaping, motor drive control, or start clamp circuits.

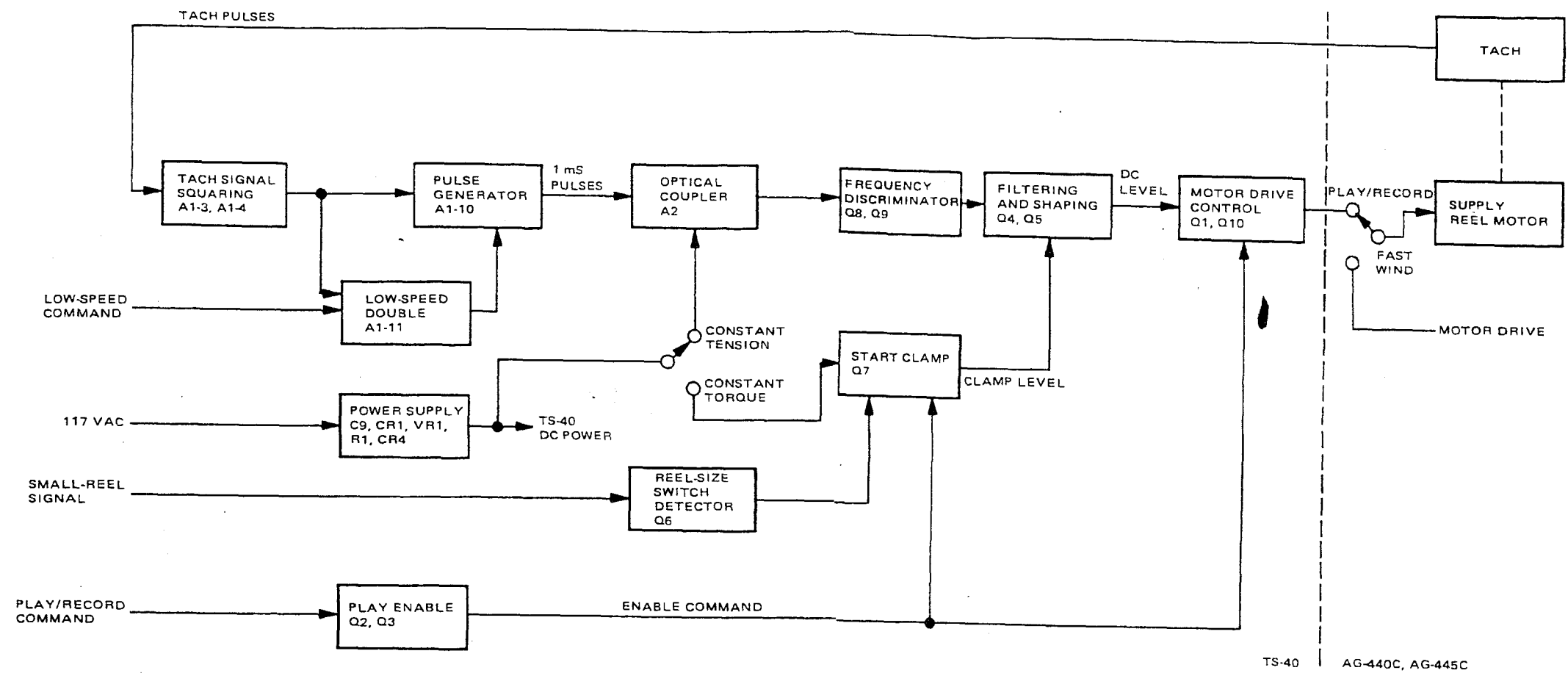
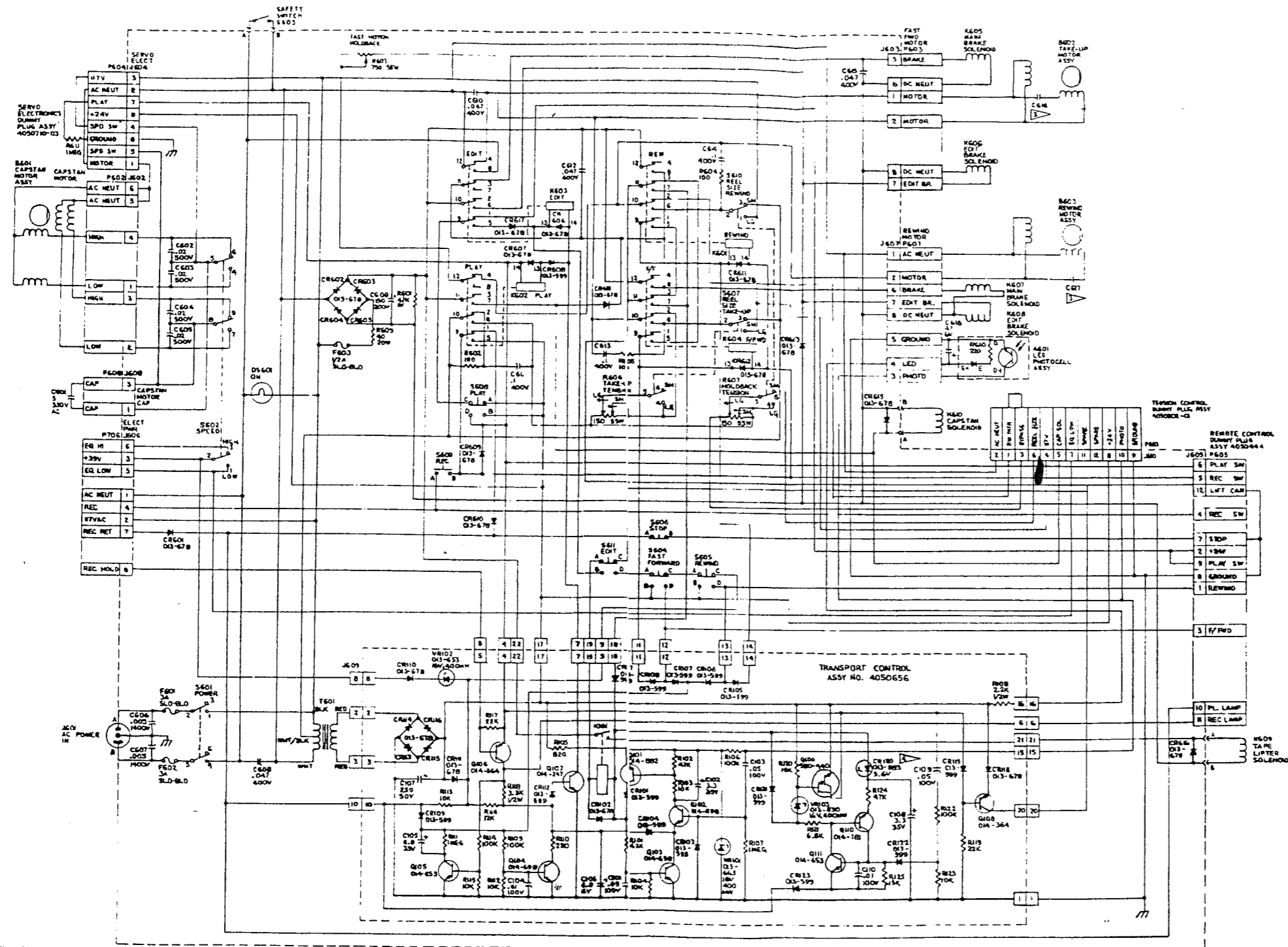


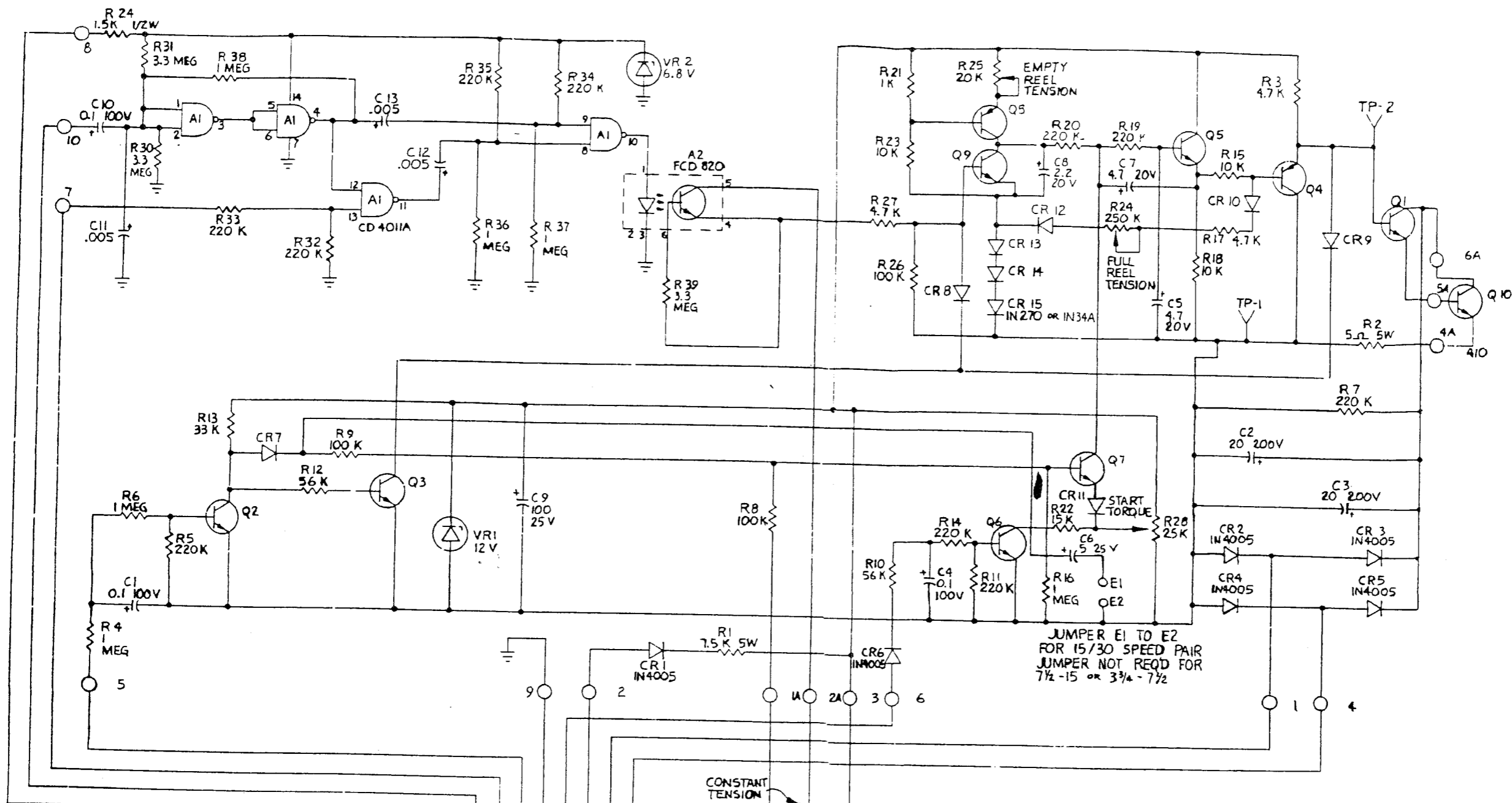
Figure 5. Functional Block Diagram – TS-40



NOTES: UNLESS OTHERWISE SPECIFIED
 1. ALL RESISTOR VALUES ARE IN OHMS, K Ω , M Ω , OR Ω .
 2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
 3. 10M Ω 250VAC EXCEPT 5M Ω 500VAC WITH
 4500M Ω 30 MOTOR.
 4. FUNCTIONS AS A FORWARD BIASED DIODE.

CAUTION
 USE THIS SCHEMATIC ONLY FOR THOSE
 RECORDER/REPRODUCERS WHICH WERE
 RECEIVED FROM THE MANUFACTURER
 WITH THE TS-40 INTERCONNECT AL
 READY INSTALLED. CONSULT THE
 "INSTALLATION" SECTION OF THIS
 MANUAL.

Schematic No. 4840413.
 Schematic Diagram, Transport, Mod



NOTES: UNLESS OTHERWISE SPECIFIED

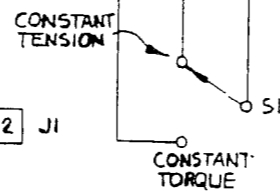
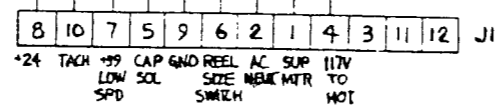
RESISTANCE VALUES ARE IN OHMS 1/4 W, 10%.

CAPACITANCE VALUES ARE IN MICROFARADS.

DIODES ARE TYPE IN4009.

FIELD SERVICE COMPONENT SUBSTITUTION:

REF. DES.	AMPEX P/N	NEAREST COML. EQUIV.
Q4, Q8	014-890	2N3645 OR 2N3638A
Q5	014-698	SE4010
Q2, Q3, Q6, Q7, Q9	014-698	MP55172



REFERENCE DESIGNATION	
LAST USED	NOT USED
A2	C13
Q10	R39
J1	VR2
	E2

Schematic No. 4840420.
Schematic Constant Tension