

Catalog No. 4890429-01
Issued: September 1981

MM-1200 TAKE-UP TENSION CONTROLLER KIT

INSTALLATION AND THEORY OF OPERATION

AMPEX CORPORATION
AUDIO-VIDEO SYSTEMS DIVISION

FOR ADDITIONAL TECHNICAL INFORMATION

FIELD ENGINEERING BULLETIN SERVICE

AMPEX	REF NO	6-71
FIELD ENGINEERING BULLETIN	SHEET NO	4-71-001
TITLE ACR-25 SPARE PARTS INFORMATION	MODEL NO	ACR-25
	DATE OF ISSUE	1-77
	DISTRIBUTION	

1. APPLICABILITY
All ACR-25 Cassette Recorders. This also applies to SR-6020.

2. PURPOSE
A listing of the following items used in the ACR-25 for spare parts: inventory and parts ordering information; diodes, transistors, integrated circuits, relays, lamps and switches.

3. DISCUSSION
Parts are listed, as much as possible, in numerical order by Ampeg part number. Parts for all accessories, except IDA (Identification Data Accessory) and ADA (Automatic Data Accessory) are included in this listing. The total quantity of each item in the ACR-25 is given. This list is for reference only.

NOTES:

- Some items are not used in all SER-25's. Refer to the notes on the last page of this FEB.
- A spare parts kit for the ACR-25 is available from Ampeg. The part number is 1-982256-000.

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SECTION 1

GENERAL INFORMATION

1-1. PURPOSE AND SCOPE OF MANUAL

This manual provides general information, installation instructions and theory of operation for the MM-1200 Take-up Tension Controller Kit, Ampex Part Number 4051099. Parts lists and schematics have also been included, and can be found in Section 4.

1-2. RELATED PUBLICATIONS

For information pertinent to both the MM-1200 Multichannel Recorder and the Take-up Tension Controller Kit, refer to *MM-1200 Multichannel Recorder/Reproducer Operation and Maintenance Manual*, Catalog No. 4890400-02.

1-3. CAPABILITIES OF EQUIPMENT

The MM-1200 Take-up Tension Controller Kit (TTC) provides for automatically-regulated tape tension between the take-up reel and capstan on the MM-1200 Audio Recorder/Reproducer when in PLAY mode. The need for a tape tension sensor is precluded because information necessary to

regulate tension is determined as a function of tape speed and reel rotation.

1-4. PHYSICAL DESCRIPTION

Electronics for the TTC are contained on four PWAs; three of which are mounted on brackets and one in a "piggyback" configuration. All PWAs are installed internal to the MM-1200 enclosure. Interconnection of the various PWAs is made possible via multi-pin connectors which already exist in the MM-1200, or are supplied in the kit. For a complete listing of all parts and assemblies contained in the TTC kit, refer to Parts Lists and Schematics, Section 4, of this manual.

1-5. SPECIFICATIONS

Nominal operating temperature for the TTC ranges from 0° C to 40° C. Any tape reel having a 4-1/2 inch diameter hub can be used on an MM-1200 equipped with a TTC up to a maximum reel diameter of 16 inches. Tape tension tolerance is approximately ± 1.5 ounce. All specifications are subject to change without notice.

SECTION 2 INSTALLATION

2-1. INTRODUCTION

This section contains information for unpacking, inspection and system interconnection to the MM-1200 Take-up Tension Controller Kit.

2-2. UNPACKING

Use care when unpacking the equipment to prevent damage. Check the equipment received against the packing list. Examine the equipment carefully for damage that may have occurred during shipping. Notify the carrier and the Ampex representative in case of shortage or damage.

2-3. INSTALLATION

Before beginning installation disconnect power from MM-1200 and remove side panels.

2-4. Motor Drive Amplifier PWA 4050771 Modification

See Figure 2-1.

1. Remove Motor Drive Amplifier PWA from its slot in rear of MM-1200.
2. Remove R19 and discard.
3. Remove R15 and R16 and replace with jumper wires.
4. Remove and replace selected parts per the following chart: NOTE: All replacement resistors 1% tolerance.

REMOVE:		REPLACE WITH:
REF. NO.	VALUE (OHMS)	VALUE (OHMS)
R20	330	681, 1W
R8, 9, 34, 35	30k	30.1k
R3, R29	13k	13k
R4, R30	1M	1M
R6, R27	22k	35.7k

5. Re-install the motor drive amplifier in its slot.

2-5. Capstan Servo PWA 4050692 Modification

1. Remove Capstan Servo PWA from transport control chassis.
2. Place piggyback board 4051106 on blank area of Capstan Servo PWA (component side). (See Figure 2-2.)
3. Using threaded holes of piggyback board as a guide, mark screw hole locations on Capstan Servo PWA.
4. Drill screw holes in Capstan Servo PWA using a 1/8-inch drill.
5. Cut a wire into six segments of about five inches in length and prepare one end of each.
6. Solder the five wires onto circuit pads E7 through E12 of piggyback board.
7. Attach piggyback board to Capstan Servo PWA using two 4.40 x 0.250-inch machine screws with associated washers (Part No. 473-324).

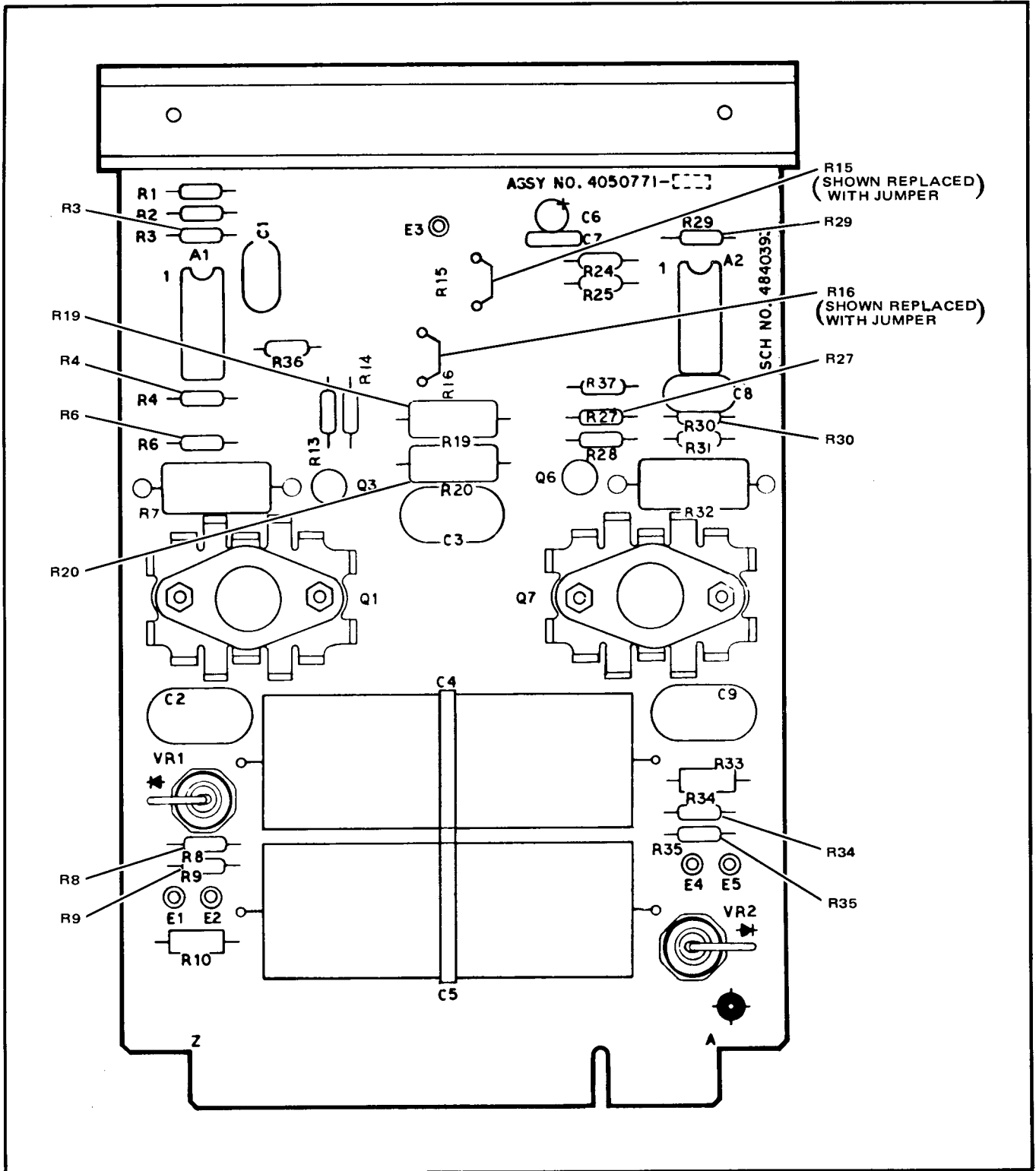


Figure 2-1. Motor Drive Amplifier PWA Parts Location

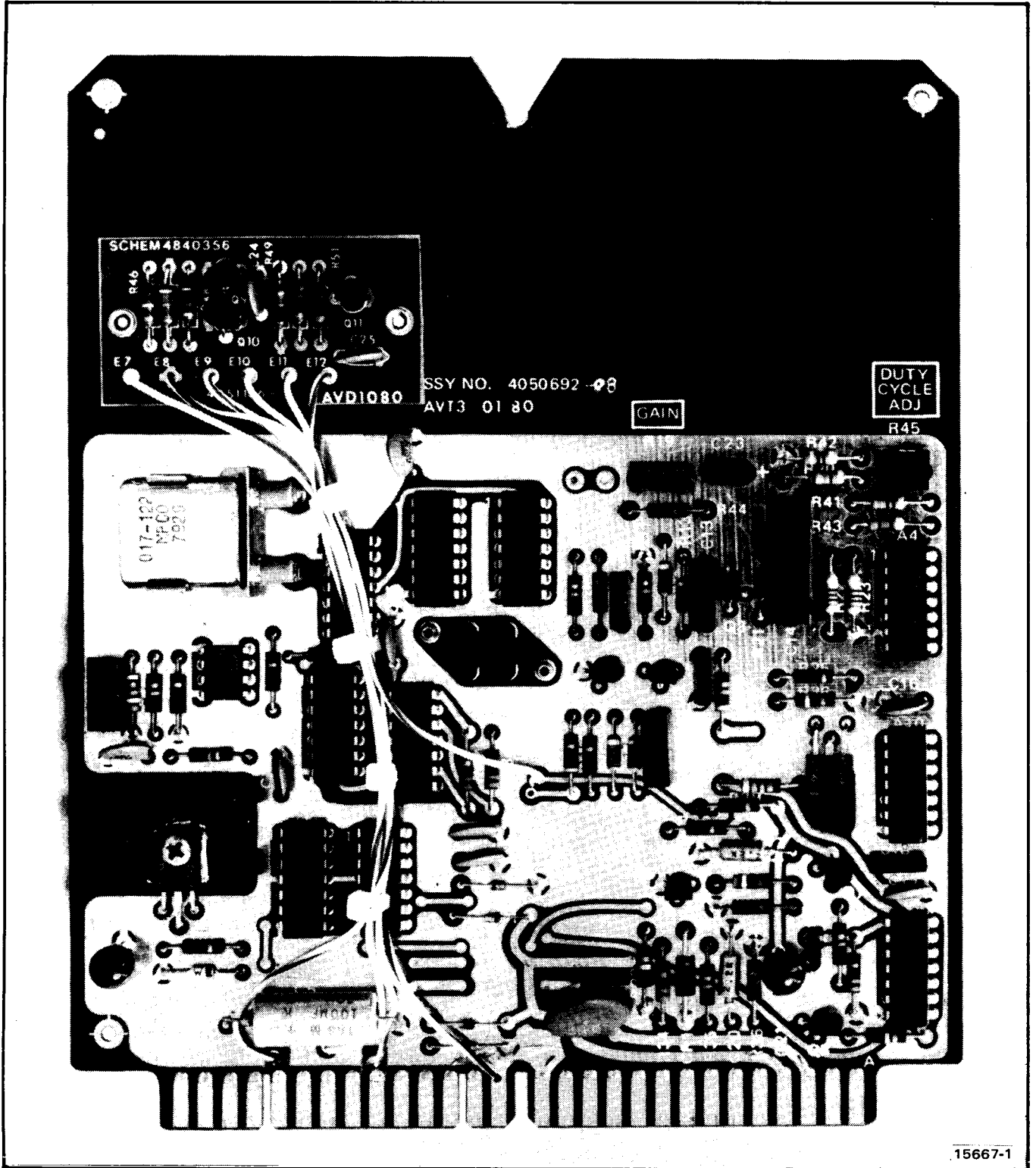


Figure 2-2. Piggyback Board 4051106 Mounted on Capstan Servo PWA

SUGGESTION:

Before soldering wires to Capstan Servo PWA, cut ground plane away from edge fingers BB and X as shown in Figure 2-3, to preclude accidental short circuits. To remove circuit path place tip of hot soldering iron in the middle of cut section while removing.

8. Trim wires to appropriate lengths, strip insulation from ends and solder onto locations designated in Figure 2-3. DO NOT REINSTALL MODIFIED PWA AT THIS TIME.

2-6. Transport Control PWA 4050706 Modification

1. Remove Transport Control PWA from transport control chassis.
2. (See Figure 2-4.) Remove and discard R18 and R20. DO NOT REINSTALL MODIFIED PWA AT THIS TIME.

2-7. Installation of Tension Controller PWA Bracket No. 4260672.

1. Pull the armrest and meter panel out as far as the slots in the adjustable side-arms will allow, or remove completely by unfastening the four screws and associated washers, and self-locking nuts, holding panel on brackets.
2. Remove the control box from the MM-1200 by lifting it away from its plastic retainers, and disconnect the electrical connector.
3. Unfasten four 8-32 screws and remove shelf that supports transport control box. (See Figure 2-5.)
4. Drill two 0.2 inch diameter holes on a line 0.87 inches from the front edge of the shelf. Space the holes 5.2 inches apart with the first hole placed 2.5 inches from the left edge of the shelf. (See Figure 2-6.)

CAUTION

WHILE DRILLING HOLES IN SHELF, SOME MEANS FOR CATCHING STRAY METAL

CHIPS SHOULD BE PROVIDED, AS THESE COULD CAUSE SERIOUS DISRUPTION SHOULD THEY FALL INTO THE MACHINE.

5. Affix Tension Controller PWA mounting bracket to shelf using two 8-32 inch screws (part No. 475-061) and associated washers. Orient bracket such that it extends downward when the shelf is installed in MM-1200. Ensure that slots for PWA edge connector are situated left.
6. Cut the long, nylon "caterpillar" grommet to appropriate lengths and press over the two exposed edges (bottom and right side) of the mounting bracket.

DO NOT REINSTALL COMPLETED ASSEMBLY AT THIS TIME.

2-8. Installation of Motor Control Indicator No. 4051088.

1. Using a No. 2 Phillips screwdriver unfasten two mounting screws of black spacer panel located between transport control chassis and transport control box. Remove spacer panel. (See Figure 2-5.)
2. Drill three 0.140 inch diameter holes in the spacer panel as shown in Figure 2-7A.
3. Using standoffs (part No. 280-664), mount the Motor Control Indicator PWA to the underside of spacer panel so that indicator LED centers in middle hole. (See Figure 2-7B.) Affix PWA using two 4-40 x 0.500 inch black button-head screws (part No. 470-476), and locking nuts (part No. 496-004).

DO NOT REINSTALL MODIFIED SPACER PANEL AT THIS TIME.

2-9. Installation of Harness Assembly No. 4051107.

1. Examine Figure 2-8. Locate J5 on the operator side of the transport control chassis, and disconnect P5 (on opposite side of chassis).

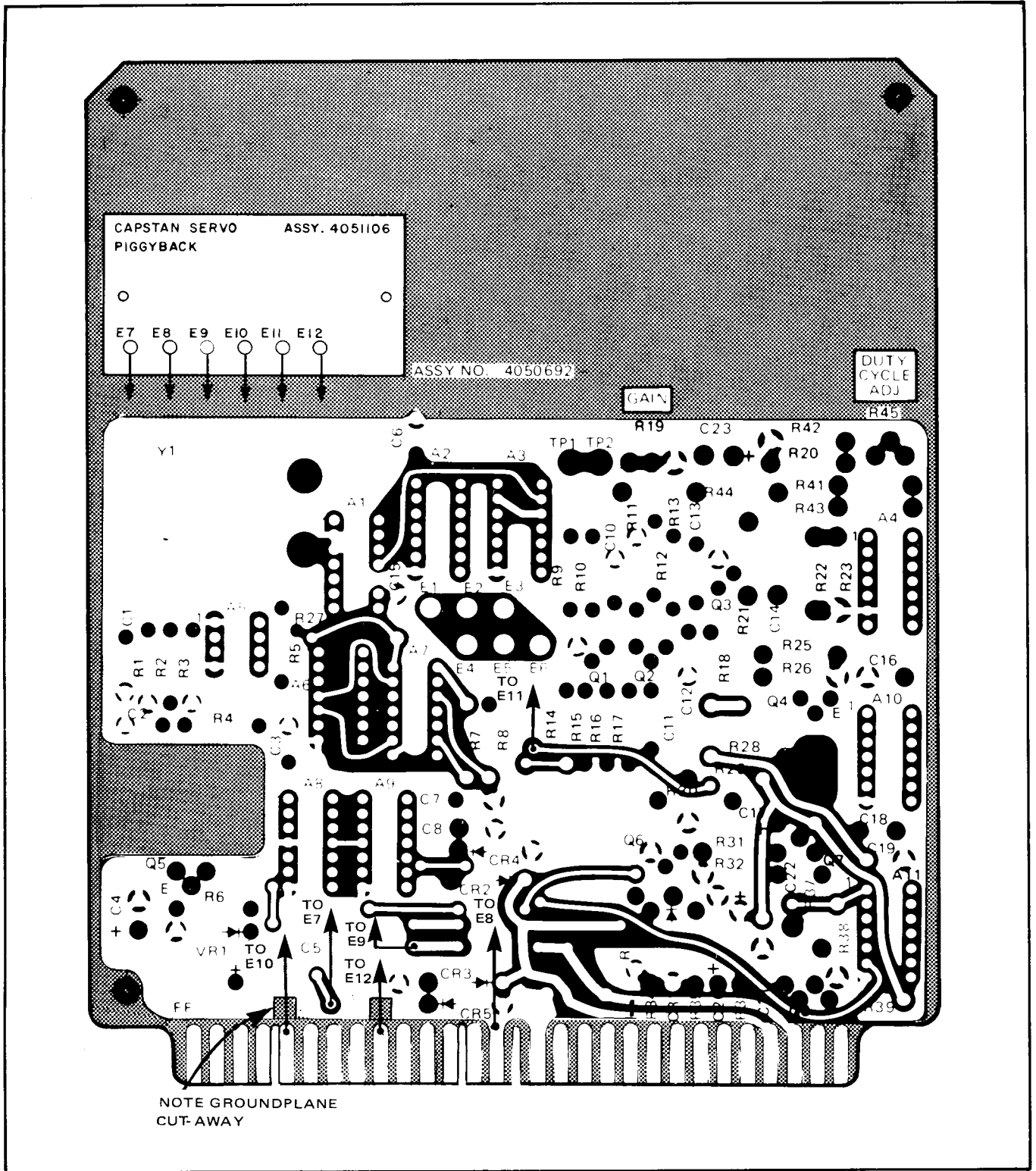


Figure 2-3. Capstan Servo Piggyback Soldering Guide

SCHEMATIC NO. 4840438

ASSY NO. 4050864 -

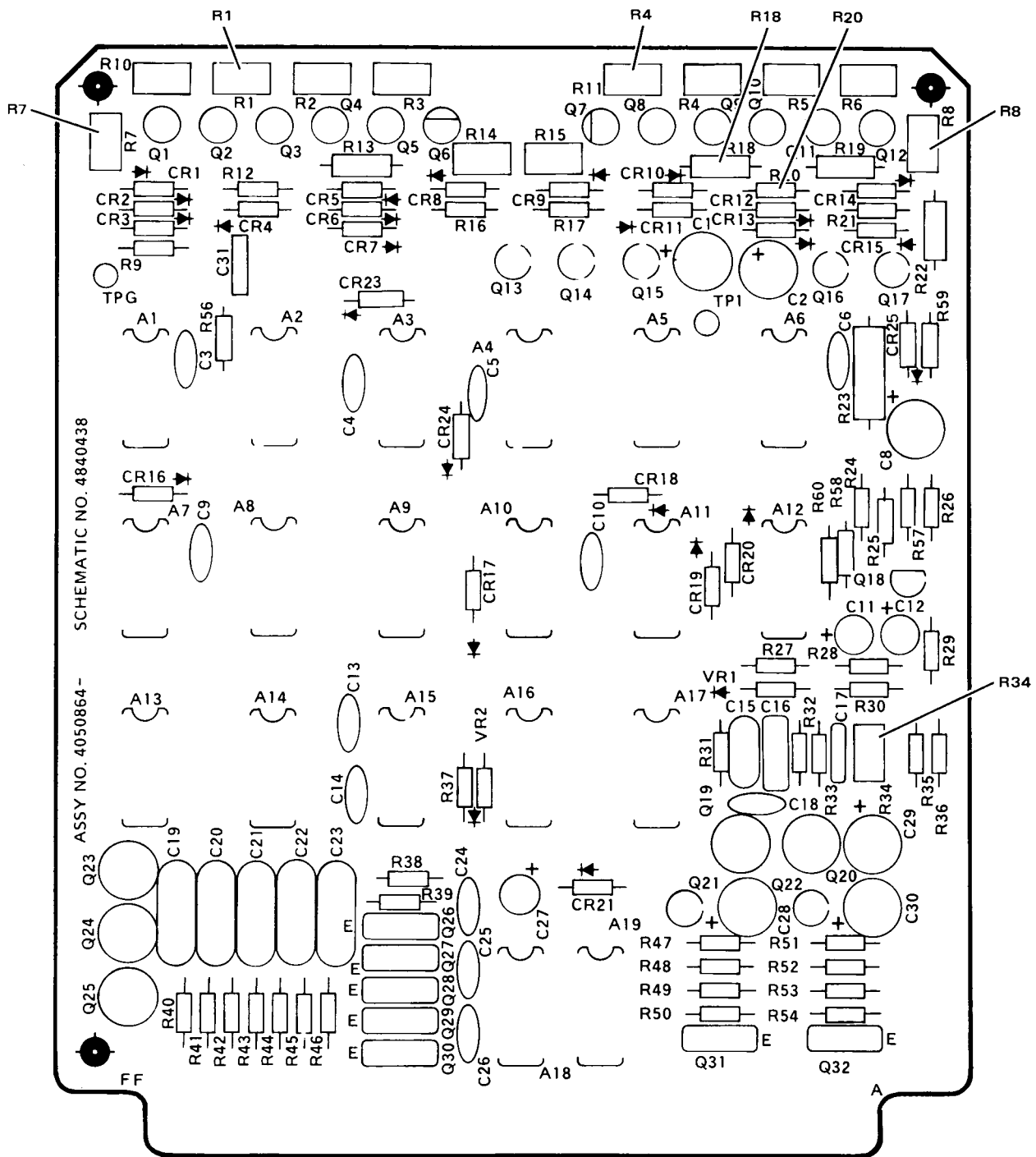
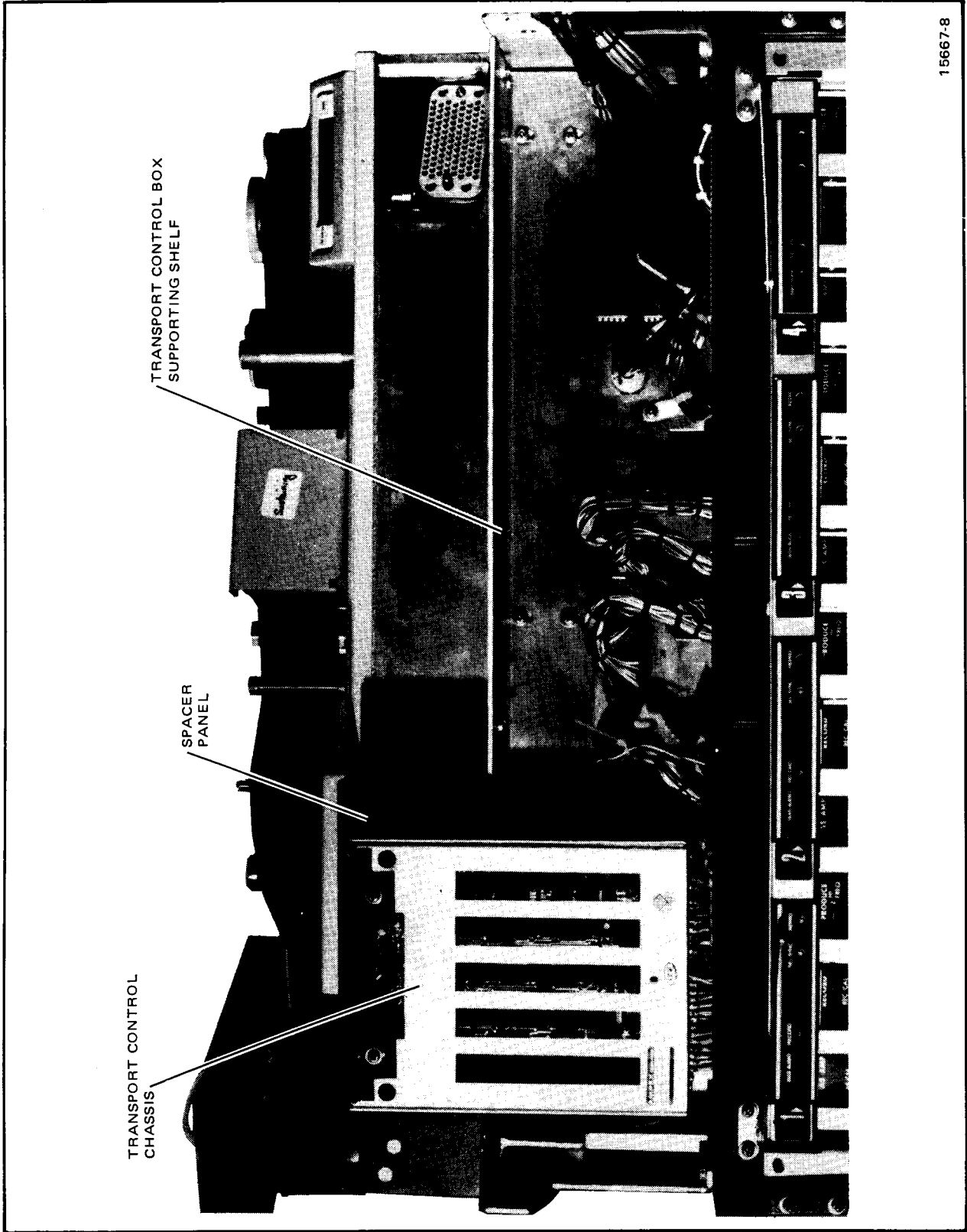


Figure 2-4. Transport Control PWA Parts Location



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Figure 2-5. Transport Control Chassis, Spacer Panel and Supporting Shelf Locations

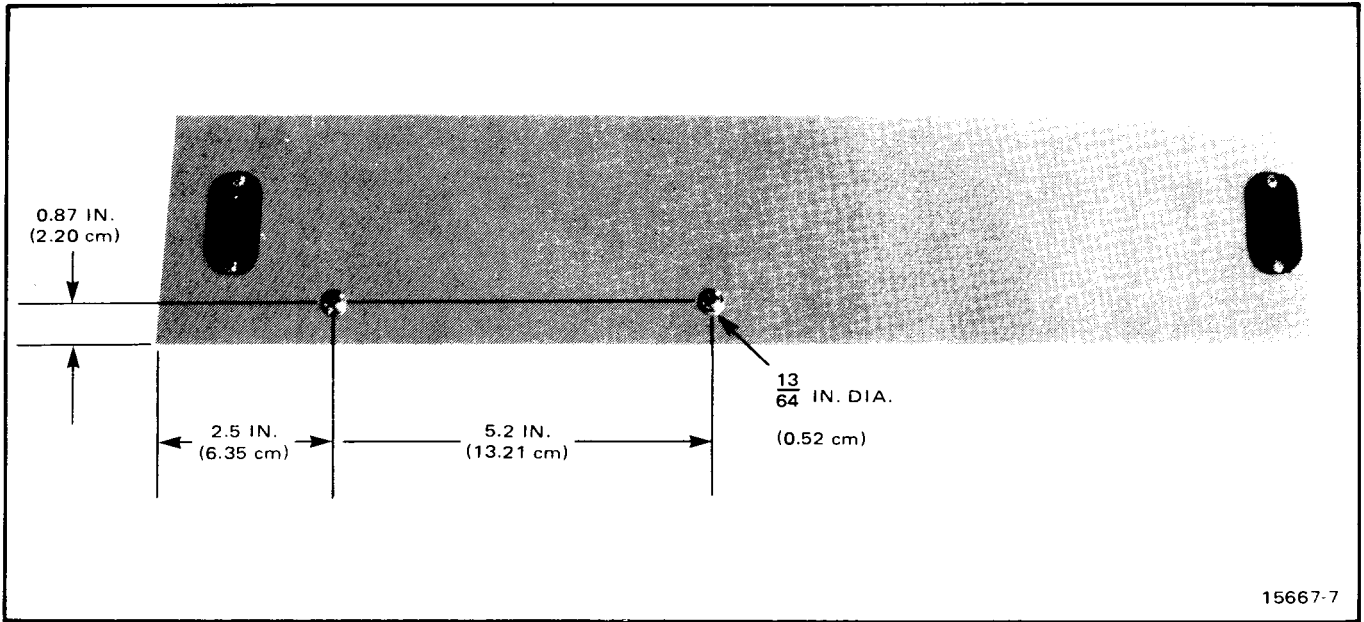
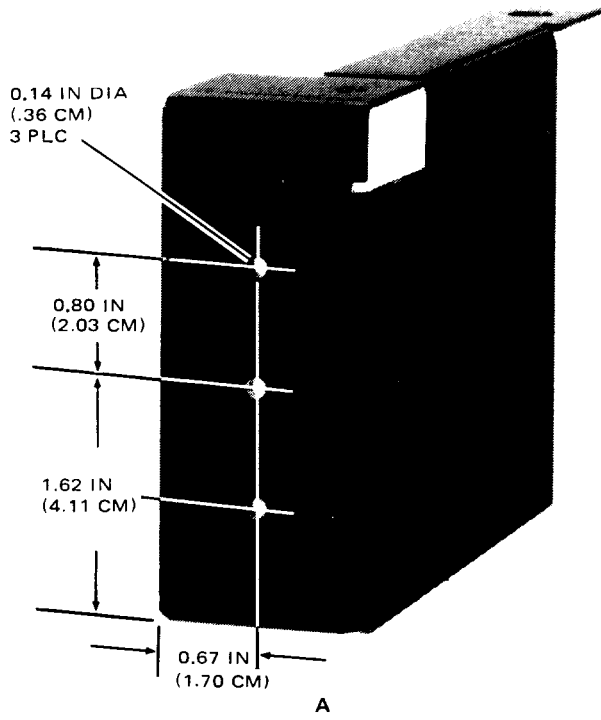


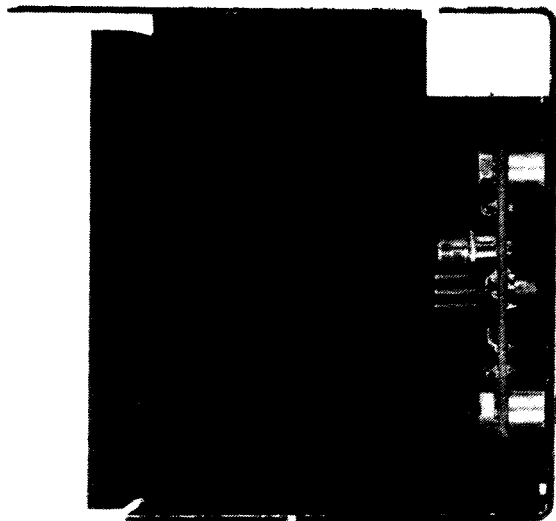
Figure 2-6. Transport Control Box Supporting Shelf. Hole Placement for Tension Controller Bracket Shown

2. To release J5 from transport control panel: Pinch together plastic catches which are above and below the connector while pulling connector straight out. This step is performed to allow greater freedom of movement.
3. Remove the Search to Cue/Timer PWA from the transport control chassis.
4. Referring to Figure 2-8 and to Cable Diagram 4840561 in Section 4, orient the branches of Harness Assembly 4051107 in the following manner:
 - a. Situate J15 so that it rests beneath the location for the transport control box shelf.
 - b. Lay the connectorless lead containing the shielded wire and marked J2 towards the center edge connector in the transport control chassis, also designated J2.
 - c. Run the remaining connectorless lead (marked P5) under the transport control panel via the U-shaped opening.
 - d. Run the longest branch, marked J16, along the existing machine harness toward the take-up motor.
 - e. Remove two screws near top of transport control chassis, securing it to main frame.
 - f. Carefully lay the transport control chassis on its side, so as to expose the edge connectors, and solder the harness leads to J2 as directed by Cable Diagram 4840561 in Section 4. As a convenience, the following table may be used:

J15		J2	
TENSION CONTROLLER		CAPSTAN SERVO	
Wire Color	Soldered To:	Pin	
WHITE/GREEN		BB and 24	
WHITE/YELLOW (center)		X and 20	
WHITE/YELLOW (shield)		R	
WHITE/BLACK		S ⁽¹⁾	
(1) Solder a jumper wire between pins R and S.			



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15667-5R

Figure 2-7. Spacer Panel Hole and PWA Locations

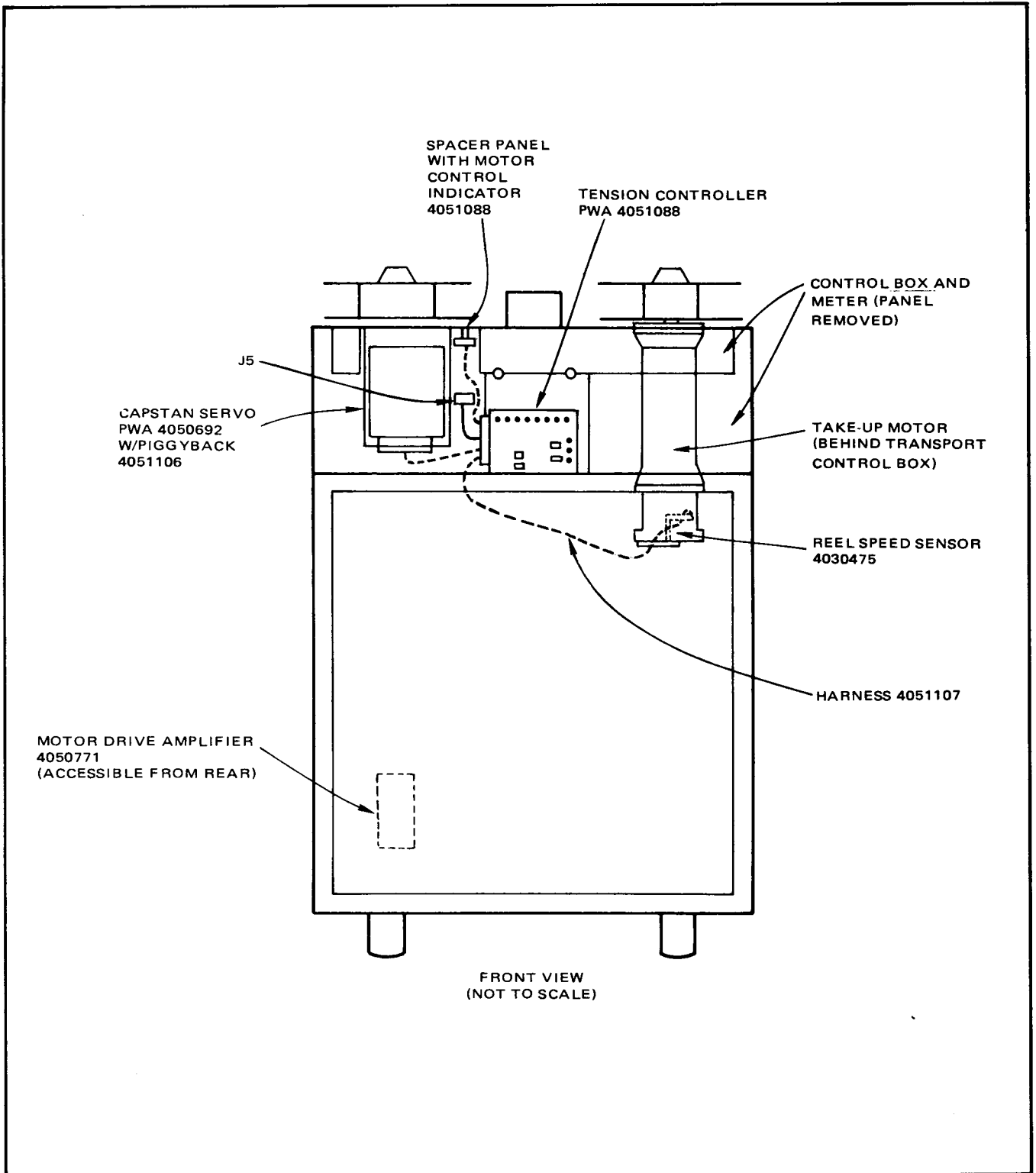


Figure 2-8. TTC Component Locations in MM-1200

g. Return the transport control chassis to its upright position and replace fastening screws.

h. Replace the Search to Cue/Timer PWA and the newly modified Capstan Servo and Transport Control PWA's.

i. Reattach J5 to the transport control panel but do not reconnect it to P5 at this time.

j. Reach behind the transport control panel from the left side of the MM-1200 and grasp connector P5. Pull out as far as necessary for easy access to all pins.

k. Prepare ends of four wires on transport control harness, sharing designation "P5" and solder as directed by cable diagram 4840561 in Section 4. Because the pins of connector P5 in the MM-1200 are recessed, it will be necessary to use a pin extractor (Burndy RX-16 D11, or equivalent). If such an extractor is available, remove pin of interest, solder appropriate wire to it and reinsert. Ensure that pin LOCKS back in place. If an extractor is *not* available, remove a section of insulation from existing wire on pin, solder harness wire to exposed portion of existing wire and cover splice with electrical tape.

Use the following table for convenience:

WIRE COLOR	P5	
	Solder To:	Pin No.
WHITE/VIOLET		23
BLUE		6
WHITE/RED		15
WHITE/BROWN		12

When all four wires are soldered to P5, reconnect P5 to J5, making sure that plastic catches lock into panel.

2-10. Installation of Reel Speed Sensor Assembly No. 4030475.

NOTE

It is not necessary to remove the take-up motor when installing the reel speed sensor bracket assembly. (See Figure 2-9.)

1. Attach harness branch routed in step 4d to Reel Speed Sensor PWA mounted on bracket. If plug is equipped with flat, black handle, orient plug handle-side-towards-bracket. Should plug *not* be equipped with handle, orientation cannot be determined at this time, and plug is inserted, regardless. No damage to the circuitry will result from plugging P16 in backwards.
2. Attach cable to bracket with No. 6-32 screw, loop-clamp and "D" washer provided.
3. Install reel speed sensor assembly on take-up motor so that PWA is up inside motor brake housing. Fasten bracket to brake housing with two No. 10-32 cap screws, lockwashers and flat washers.
4. Into remaining threaded holes on bottom of brake housing, add two 10-32 cap screws along with two flat washers and one lock-washer for each screw. These screws, in conjunction with the screws adjoining the bracket and brake housing, will act as "feet" should it be necessary to remove the motor from the MM-1200.

2-11. Final Harness Attachment

1. Locate harness branch marked P17. Examine the plug terminating the branch and identify the white/red striped wire. This wire is associated with Pin 1 of P17.
2. Connect P17 to Motor Control Indicator PWA, mounted to spacer panel in step 5c. Orient plug so that pin 1 (determined in step 1) mates with pin marked "1" of J17 on PWA.

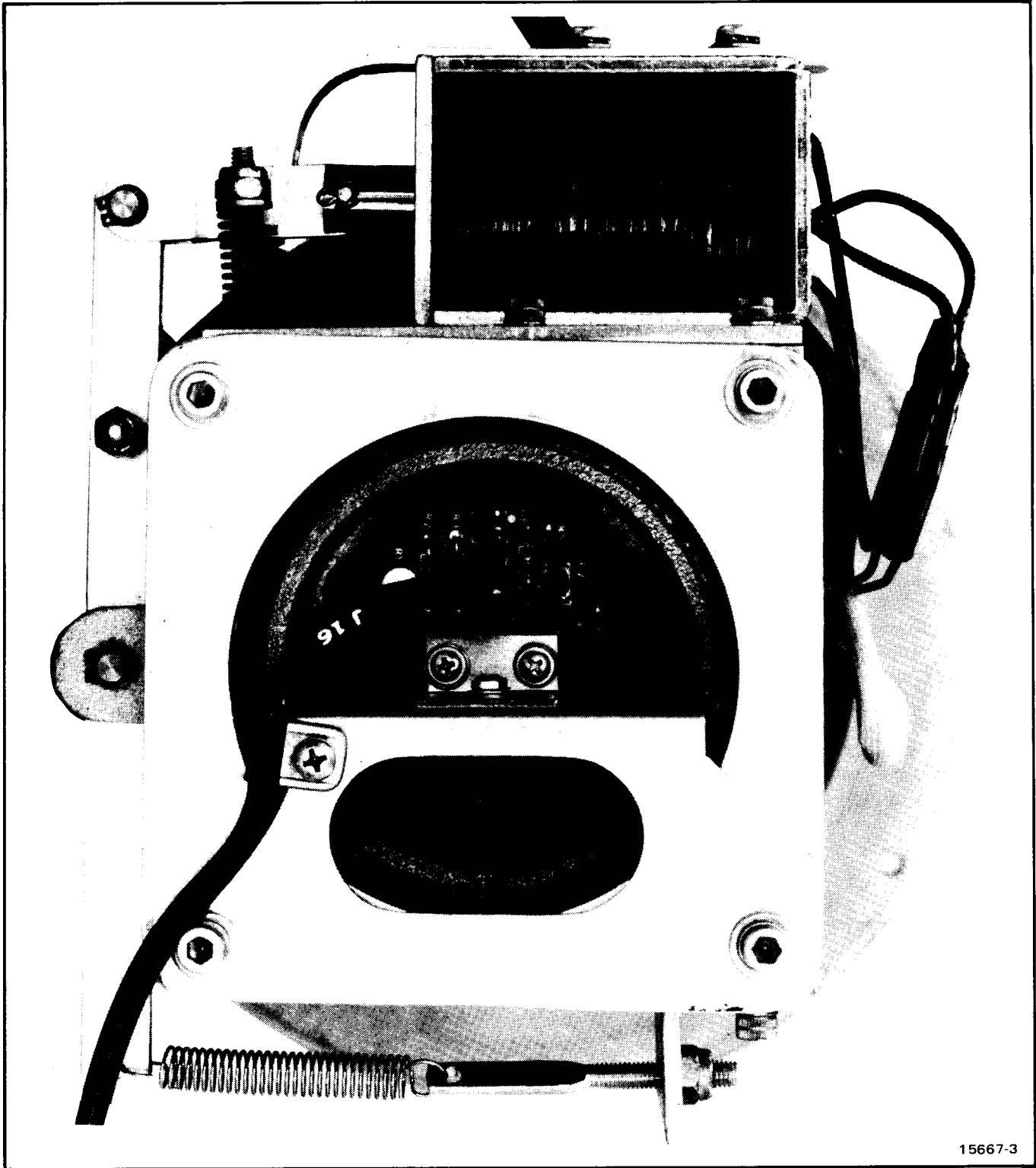


Figure 2-9. Reel Speed Sensor/Bracket Assembly Mounted in Motor Housing

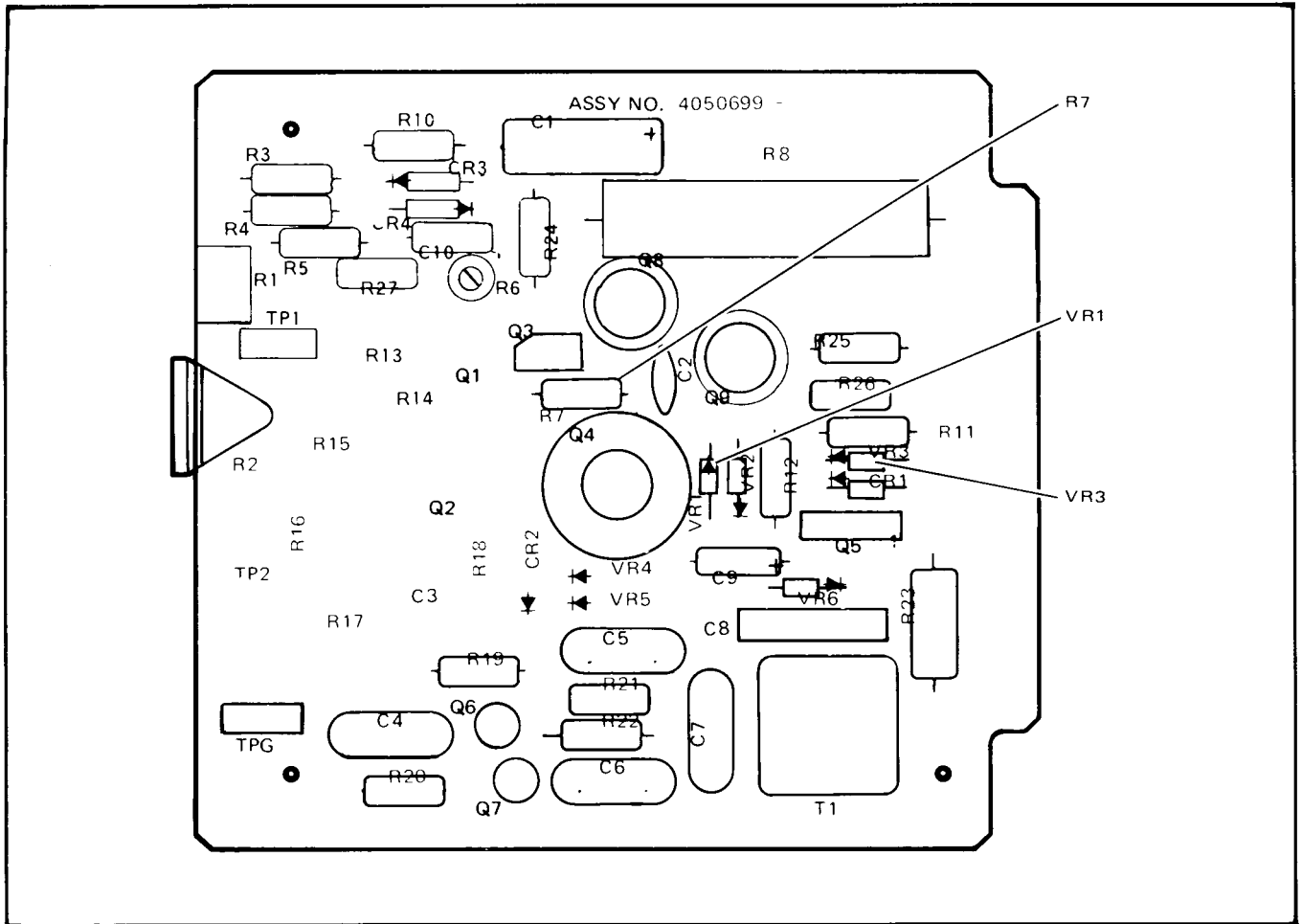


Figure 2-10. 27-Volt Regulator PWA Parts Location

3. Reinstall the spacer panel/motor control indicator assembly (with harness attached) on machine.
 4. Mount tension control edge connector J15, on Tension Controller PWA bracket (installed in step 5 of paragraph 2-7), using two 4-40 x 0.250 inch machine screws with associated washers. Position J15 such that Pin 1 is at the top.
 5. Plug Tension Controller PWA into edge connector and fasten to bracket using three 4-40 x 0.250 machine screws and washers. Do not use a screw in hole nearest pin 1 of edge connector as this might short a trace to ground.
 6. Mount the transport control shelf on the machine in its original position.
 7. Reconnect and install the transport control box on the shelf. This completes the installation procedure.
- 2-12. 15/27 Volt Regulator Modification**
- To insure smooth operation of the take-up tension kit, it is necessary to modify the 15/27 Volt Regulator PWA No. 4050694-10 as directed. (Refer to Figures 2-10 and 2-11.)

1. Remove power supply cover protecting 15/27 Volt Regulator PWA on lower back of MM-1200 and pull PWA from its slot.
2. Replace VR1 on Regulator PWA with one 5.1 volt, 5% Zener (1N751 A) supplied in kit.
3. Replace VR3 on Regulator PWA with two 5.1V 5% Zeners (1N751A), soldered in series.
4. Replace R7 (2K ohm) with 510 ohm, 5%, 1/2W resistor.
5. Reinstall regulator PWA and replace power supply cover.

2-13. 15/27 Volt Regulator Adjustment.

1. Apply power to MM-1200.
2. Connect a multimeter to 27V-TP1 (positive) and TPG (common) points. (See Figure 2-12.)
3. Observe that the voltage is 27 ± 0.5 Vdc.

4. If the voltage at 27V-TP1 is not within the limits stated in step 3, adjust 27V-R1 as necessary to obtain the correct indication.
5. Connect multimeter positive lead to 15V-TP2. Leave negative lead at TPG.
6. Observe that the voltage is 15 ± 0.5 Vdc.
7. If the voltage at 15V-TP2 is not within the limits stated in step 6, adjust 15V-R2 as necessary.

2-14. Tension Controller PWA Operation Verification

1. Apply power to MM-1200 and thread tape onto 14-inch reel.
2. Press PLAY and verify that top indicator on Tension Controller PWA is lit.
3. Shuttle tape until tape pack of equal diameter is achieved on both reels.

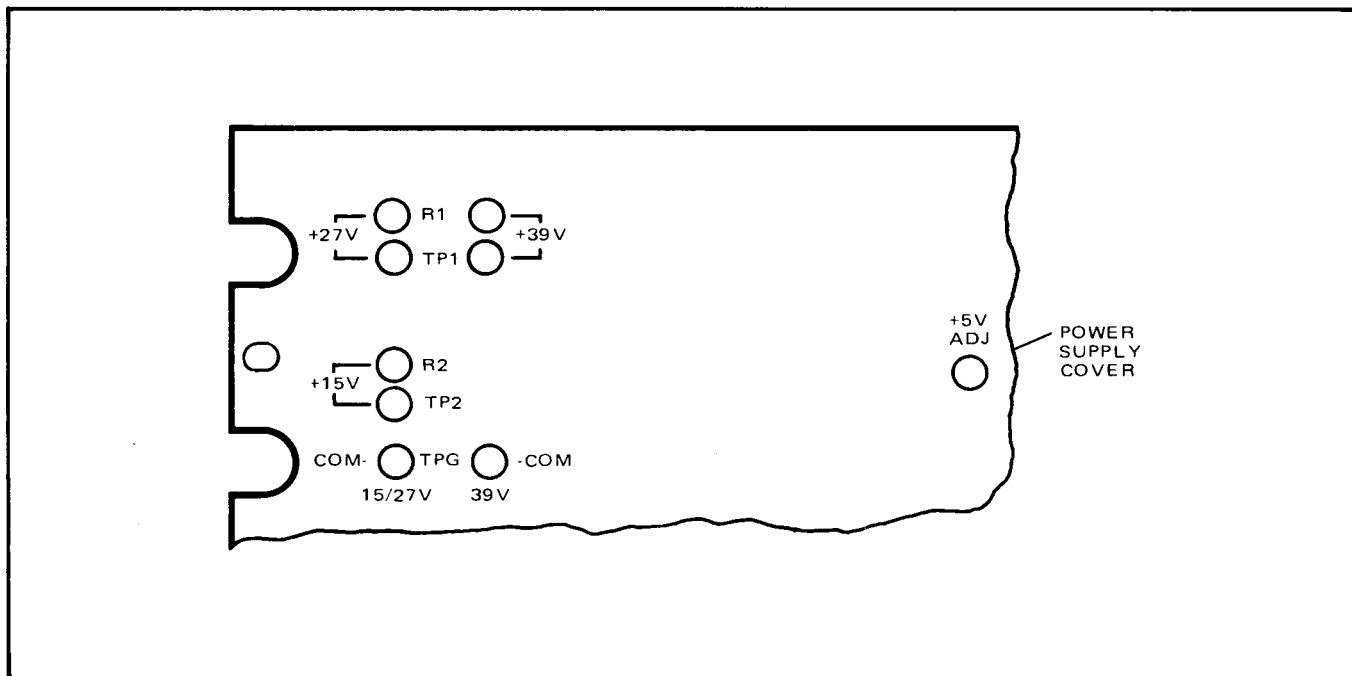


Figure 2-12. Power Supply Test Points and Adjustments

4. Place machine in PLAY and verify that center indicator on PWA is lit. Top and center indicators will alternately light at approximately nine inches, tape pack diameter.
5. Shuttle tape nearly to end of reel, and enter PLAY mode. At approximately 14 inches tape pack diameter, the center and lowest indicators will alternately light. As the pack diameter increases toward 16 inches, only the lowest indicator will be lit.

2-15. Take-up Tension Controller Operation Verification

1. Rewind tape wound onto take-up reel in paragraph 2-14, step 5.
2. With tape threaded and machine in STOP mode, verify that motor control indicator glows dimly.
3. Place machine in FAST FORWARD. Indicator should glow with maximal brightness.
4. Switch to REWIND. Verify that indicator is either off, or faintly glows. Continue rewinding to beginning of reel.
5. Press PLAY. Indicator will briefly flash to full brightness, becoming dim within approximately one revolution of the take-up reel. This signifies correct installation of kit. Proceed to paragraph 2-16.

NOTE

If indicator remains at full intensity after entering PLAY mode, press STOP, remove power from MM-1200 and proceed to the next step.

6. Unfasten two screws securing reel speed sensor assembly to brake housing of take-up motor (installed in step 3 paragraph 2-10) and remove assembly from motor.
7. Unplug P16 from Reel Speed Sensor PWA, reverse and reinsert.
8. Reinstall reel speed sensor assembly in motor.

9. Apply power to MM-1200 and perform step 5 again. When satisfied that kit is correctly installed, proceed to paragraph 2-16.

2-16. Tension Adjustments

Follow this procedure only after it has been ascertained that TTC is functioning satisfactorily. For further information refer to tension setting procedures given in MM-1200 Operation and Maintenance Manual 4890400-02.

If a tape tension meter (Tentel Model T2-H20-2 or equivalent) is available, the following procedure may be used to establish proper tension levels:

1. Remove power from MM-1200 and place Transport Control PWA on extender No. 4050695-04. Reapply power.
2. Rewind entire tape onto supply reel.
3. Block end-of-tape arm in tape threaded position.
4. Refer to Figure 2-4. Turn potentiometers R1 (FF) and R4 (REW) fully counterclockwise.

NOTE

All potentiometers except R34 are four-turn devices with clutched end stops.

5. Place machine in REWIND mode and adjust R8 (take-up gain) until motor just ceases turning.
6. Place machine in FAST FORWARD and similarly adjust supply gain potentiometer R7.
7. Free end-of-tape arm and thread a tape.
8. Put machine in FF and adjust FAST FORWARD supply potentiometer R1 such that after acceleration, the tension stabilizes just short of the alignment mark (2-inch mark if 2-inch tape threaded and 1-inch mark for 1-inch tape), on label under tension sensor arm.

9. Put machine in REWIND mode and adjust rewind potentiometer R4 in the same manner.
10. Put machine in FAST FORWARD mode and check that voltage at TP1 on Tension Controller PWA is $27V \pm 5\%$. (See Figure 2-13.)
11. Put machine in PLAY mode. With tension meter at flange of takeup reel, adjust R60 for a reading of 13 ± 1 ounce of take-up tension. If reading falls outside of this tolerance carefully readjust R60 for the correct reading.
12. If 1-inch tape is to be used, replace 2-inch head assembly with assembly for 1-inch tape, and adjust R61 (1-inch tape) for a reading of 27V at TP1. (See Figure 2-13.)
13. Wind tape for equal pack on both reels and check tensions for 6 ± 1 ounce at supply reel and 13 ± 1.5 ounce at takeup reel for 2-inch tape in PLAY mode. Tension readings for 1-inch tape should be half of those stated for 2-inch tape.
14. Wind tape almost to end of supply reel, press PLAY and take measurements of step 13 again. On larger reels of 14-inches and 16-inches the supply tension should be able to maintain 6 ± 2 ounce for 2-inch and 3 ± 1 ounce for 1-inch tape regardless of tape pack diameter. The take-up reel should be able to maintain 13 ± 2 ounce tension for 2-inch tape or 6.5 ± 2 ounce for 1-inch tape, to the end of a 14-inch reel and nearly to the end of a 16-inch reel.
15. Replace side panels on MM-1200 and restore meter panel/armrest to original position.

This completes testing and adjustment procedures for the Take-up Tension Controller Kit.

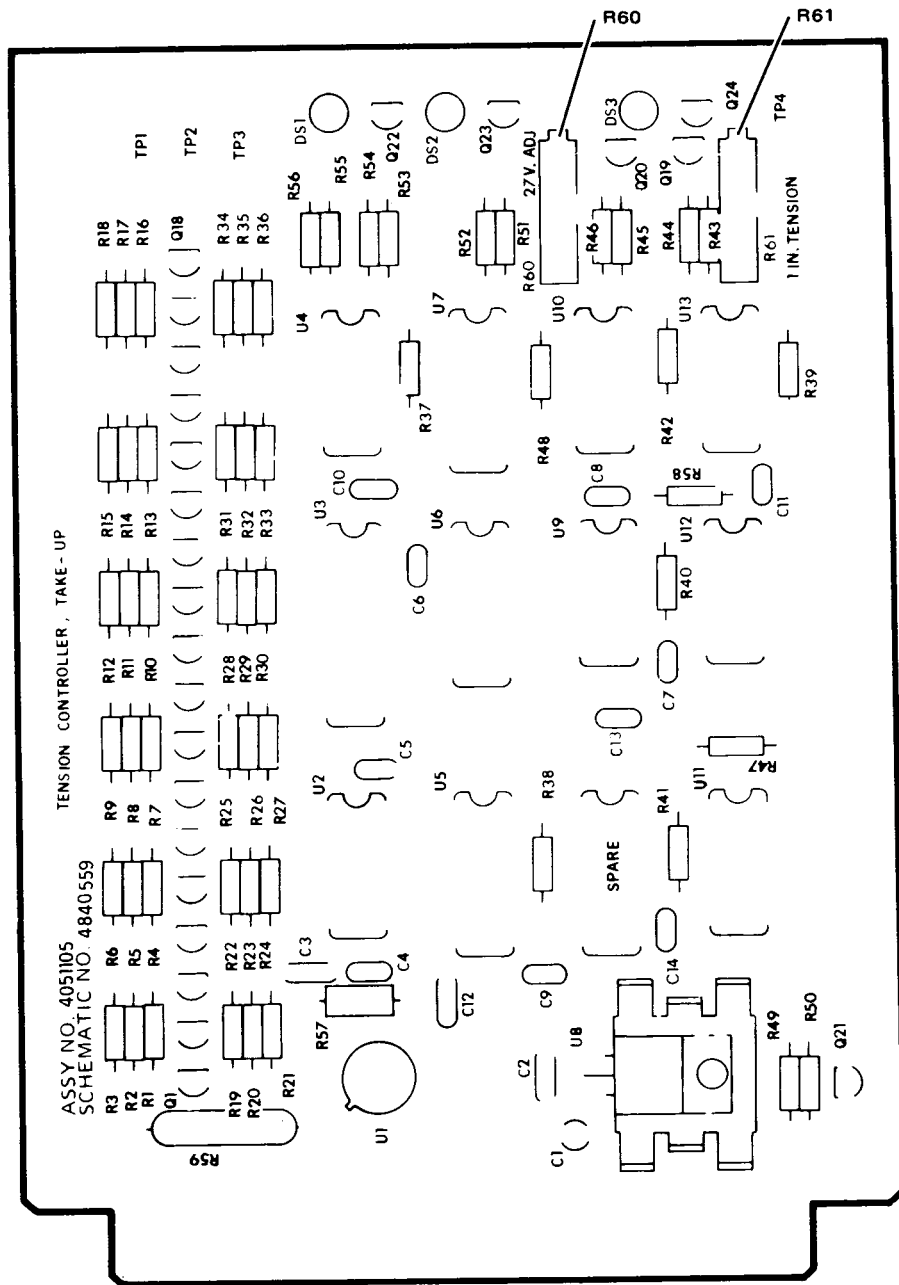


Figure 2-13. Tension Controller PWA 4051105 Adjustment Locations

SECTION 3

THEORY OF OPERATION

3-1. INTRODUCTION

The MM-1200 Recorder/Reproducer, does not provide a means of controlling tape tension between the capstan and the take-up reel. The Take-up Tension Controller Kit is a predominately digital device that offers such control without the addition of external, mechanical tape tension sensors. This is accomplished by taking pulses from beneath the take-up reel along with pulses from the Capstan Servo PWA and introducing them to a counter. The counter generates a binary number which is indicative of the tape pack diameter as tape is pulled onto the reel. The number is supplied to a digital-to-analog converter, formed by a precision resistor array. The resistors are selectively switched in parallel in predetermined combinations, as dictated by a converter control which responds to the size of the binary number and/or the logic states of respective bits of the number.

The resistor combinations form the lower portion of a voltage divider that supplies a control voltage to the motor drive amplifier. The motor drive amplifier in response, supplies directly proportional variations in current to the take-up motor, varying the torque required to maintain constant tape tension.

Theory of operation is divided into three discussions. Overall system operation is covered with the aid of a simplified block diagram. A more involved discussion at a detailed block diagram level is included and should be used in conjunction with the schematic appearing in the Parts Lists and Schematics Section. Lastly, a functional description details circuit operation strictly from a schematic diagram level.

3-2. SIMPLIFIED BLOCK DIAGRAM DISCUSSION

As indicated in Figure 3-1, a reel tach pulse train indicative of the take-up reel speed is supplied to the counter/latch and to the servo control circuit, from the reel tach input. A capstan reference pulse train, representing the speed of the tape, is also supplied to the counter/latch and to the servo control via the capstan reference input. The servo control provides various clock, clear and inhibit commands to the counter/latch and converter control.

The counter/latch counts the number of capstan reference pulses which occur between reel tach pulses, and generates an 8-bit binary number, indicative of the instantaneous tape pack diameter. This number is fed to a non-linear digital-to-analog (D/A) converter formed by selected arrays of parallel precision resistors. A portion of the number is introduced to the converter control circuit. This determines which of the resistor arrays is to receive the binary number, dependent on the size of the number (different numerical values representing different tape pack diameters).

The logic states of the respective bits select the actual resistors in the parallel combinations of each array, as the pack diameter changes. The parallel combination of resistors forms the lower portion of a resistive voltage divider which supplies a tension control voltage at the output. This voltage is sent to the Motor Drive Amplifier (MDA) which drives the reel motor in conventional manner.

3-3. DETAILED BLOCK DIAGRAM/ SCHEMATIC DISCUSSION

Examine block diagram, Figure 3-2 and schematic 4840559 of Parts Lists and Schematics Section 4.

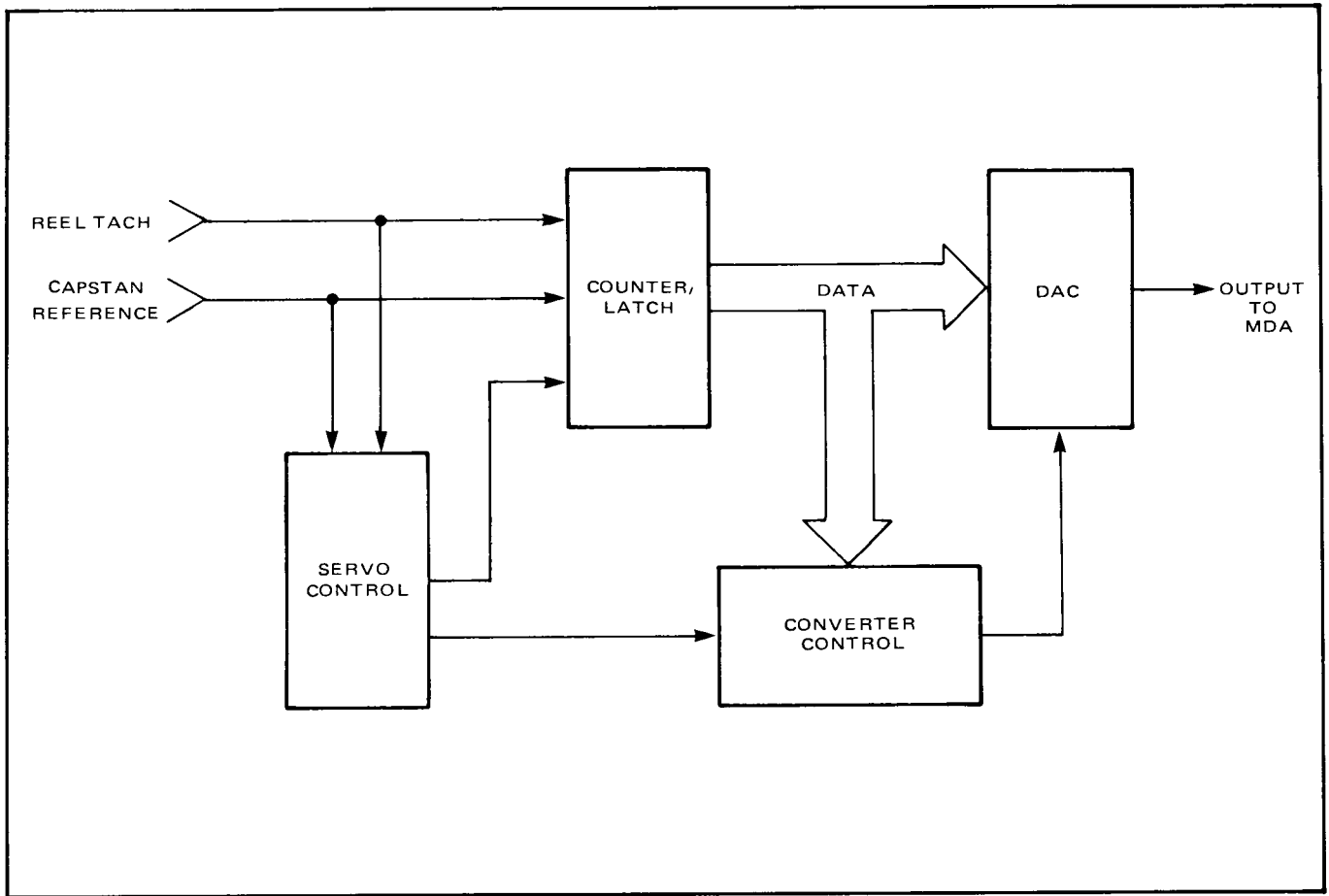


Figure 3-1. TTC Simplified Block Diagram

3-4. Tach Pulse Generator

Tach pulses are generated by optical sensor U1 which detects six holes in the take-up reel brake drum and generates six tach pulses during one revolution of the reel. The pulses, with symmetry adjusted at the factory by R1, are applied to the base of Q1 and appear as a 5-Volt peak level on Pin 1 of Reel Speed Sensor PWA.

3-5. Tach Processor

The Tach Processor improves the symmetry of pulses arriving from pin 1 of the Reel Speed Sensor PWA. The pulses are squared by a pair of Schmitt triggers (U3, U9) and are then halved by a D-type flip-flop U10 to improve their accuracy.

The resulting gate and inverse gate commands (now at one-half the initial tach pulse frequency) are fed to the counter (U5, U6) and servo control circuits U10, U13.

3-6. Clock Divider

Capstan reference pulses generated by a crystal oscillator on the Capstan Servo PWA are fed via buffer Q21 to the clock input of U11, where they are divided by two. The pulses are further divided by the two stages of U12. The capstan reference, having undergone a total division of 6, is supplied from \bar{Q} of flip-flop U12 to the clock input of the counter U5, U6. Thus the counter counts the number of pulses which occur during one-third revolution of the tape reel.

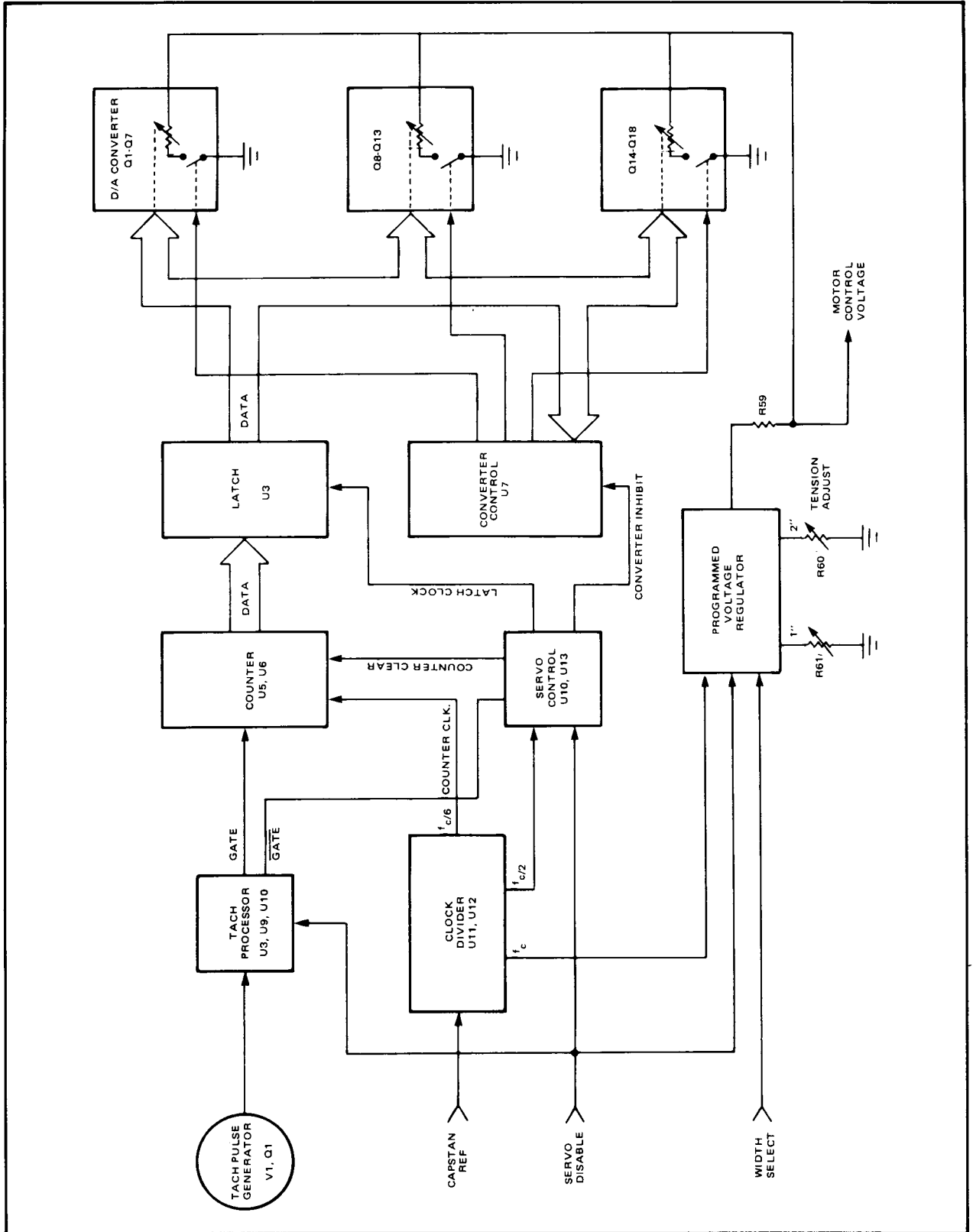


Figure 3-2. TTC Detailed Block Diagram

3-7. Servo Control

The servo control includes two intercoupled D-type flip-flops U13 clocked by the capstan reference on the collector of Q21 and a third flip-flop U10, clocked by the output of flip-flop U13. In response to the capstan reference and the inverse gate command from tach processor U10, the servo control generates COUNTER CLEAR and LATCH commands via flip-flops U13-5¹ and U13-9, respectively. The flip-flop U10-5 supplies the INHIBIT command to the inhibit input of converter control U7.

3-8. Counter and Latch

The counter U5, U6 provides an 8-bit binary number on its output data bus Q_A-Q_D which is indicative of the tape pack diameter. The number is stored in latch U3 upon receipt of the LATCH CLOCK command from servo control U13-9. The seven most significant bits of the binary number in the latch are supplied to open-collector NAND gates U2, U4, serving as inverters. The least significant bit (U-2) is unstable due to tape pack eccentricity, and is not used.

3-9. Converter Control and D/A Converter

The three most significant bits of the binary number on the output bus of latch U3 are coupled to a one-by-eight multiplexer/demultiplexer, U7. This circuit forms the converter control which acts as a rotary switch to provide a converter select command on one of the select lines (U7-13, 1, 2) to the D/A converter Q₁-Q₁₈. This happens whenever a TRUE logic state is detected on any line in the data bus from latch U3. The CONVERTER SELECT command enables one of three groups of transistors, with each transistor simultaneously responding to commands from latch U3 via inverters U2, U4.

3-10. Programmed Voltage Regulator

The programmed voltage regulator dictates how much voltage is sent to the resistive divider of the D/A converter and has the ability to shift overall

(1) The designation "U13-5" means, "Integrated circuit 13, Pin 5".

motor torque either up (for 2-inch tape) or down (for one-inch tape). This is determined by control voltage levels sent to U1 via potentiometers R60 and 61, with their associated transistors. Voltage levels to the potentiometers are sourced from the Q and \bar{Q} outputs of flip-flop U11, the states of which are dependent upon conditions present at the D, Clock and clear inputs.

3-11. FUNCTIONAL DESCRIPTION

The following is a detailed description of the Take-up Tension Controller Circuits, under operation.

When the GATE command from U10-9 to the counter U6 goes to a HIGH logic state, the counter is enabled and it counts the incoming capstan reference pulses from U12-8, which are one-sixth the initial capstan reference frequency. When the GATE command goes LOW, the counter is disabled, stopping the count and providing the resulting binary number. When there is a LOW GATE command, the \bar{GATE} command from U10-8 goes HIGH, and the servo control flip-flop U13 delivers a LATCH CLOCK command to latch U3-11. The number in the counter U6 thus is held in latch U3. Immediately thereafter, flip-flop U13 clears the counter back to zero, and the counter is ready for the next cycle. If the number fills the counter, then carryouts are recirculated via NAND gate U9. This action locks the counter (to prevent overflowing) until a CLEAR command is received from flip-flop U13-5.

The SERVO DISABLE command from the Capstan Servo PWA holds the tension control circuit inactive during the STOP, REWIND and FAST FORWARD modes, when the capstan is not running. When a SERVO DISABLE command is received on pin 13, flip-flop U10 is preset via pin 4, which inhibits Multiplexer/Demultiplexer U7 and disables the converter select lines from pins 13, 1 and 2. The SERVO DISABLE command also clears flip-flop U11, providing +5 Volts at pin 6. At the same time, Q19 and Q20 are pulled low by the diode on each transistor's base (CR1 and CR2, respectively). This causes 27V Zener VR2 and the output of U1 to provide full voltage to the reel motor via resistor R59.

When the MM-1200 is switched to RECORD or PLAY mode, the fact that the flip-flop U10 has been held clear by the SERVO DISABLE command, means the GATE command on U6-10 is low. At the same time, flip-flop U10 is still holding the INHIBIT command on U7-6 HIGH, whereby the converter select lines are disabled to allow the tension control circuit to deliver full torque to the take-up motor while accelerating the reel. Then, after the reel has attained operating speed, the occurrence of the first reel tach pulse causes a high logic state at U6-10—initiating a count cycle. A valid number is generated in the counter and is clocked into the latch. Simultaneously, flip-flop U10 is clocked, generating a low on U7-6, which immediately allows the multiplexer/demultiplexer to select the appropriate converter resistor array, as determined by the size of the number present on pins 9, 10, and 11. Thus the reel motor accelerates at full torque until the counter generates a valid number (in accordance with the tape pack diameter), at which time the tension control circuit takes over and begins to regulate the motor torque.

Once the tape has been accelerated to the proper steady-state speed, the seven bits of the binary word on gates U4-U2 are selectively coupled to the emitters of switch transistors Q1-Q18 of the selected precision resistor array. Meanwhile, the bases of the transistors are coupled to the SELECT command line from the multiplexer/demultiplexer, U7. The collectors are coupled to respective precision resistors; forming the lower portion of the resistive voltage divider. If the SELECT command from U7-13 is high, it applies base current to all the transistors in the array. The emitters of each transistor are floating until grounded by a LOW logic state at the output of respective inverting NAND gates U4-U2. This pulls the corresponding precision resistors to ground, inserting them in parallel into the lower portion of the voltage divider.

Since the upper portion of the voltage divider (resistor R59) is a fixed value, it is necessary to

change the supply voltage to provide full motor torque for different tape widths without changing the resistor values of the array. This is done using the WIDTH SELECT signal from the Transport Control PWA indicative of whether a two or a one-inch tape is being pulled. The signal is fed to flip-flop U11, which is clocked by the capstan reference F/2 arriving on pin 3. The Q and \bar{Q} outputs of the flip-flop are coupled to the one-inch and two-inch potentiometers R61 and R60, respectively, via Q19 and Q20. The output of the potentiometer which is enabled is coupled to the ADJ input of voltage regulator U1 and also to the fixed resistor R59. A selected driving voltage (39 volts) is fed to the regulator from Transport Control PWA, pin 6. When two-inch tape is used, the potentiometer R60 provides the full 27 volts. When one-inch tape is used, the potentiometer R61 provides a given smaller voltage (around 25.5V) resulting in the reel motor generating one-half the torque required for two-inch tape.

When a different tape speed is selected, the capstan reference clock changes frequency accordingly, so the basic reference for generating the binary number is changed and the correct tension is automatically maintained even at different tape speeds.

Since the digital tension control circuit is open loop, a malfunction may not be immediately detected. Because of this, three transistor/LED pairs are coupled to converter select lines U7-13, 1, 2 to indicate when a line goes to a HIGH logic state, selecting one of three sections in the resistor array. Hence, at the start of operation, DS1 lights to indicate the tape pack is at its smallest diameter. When the tape pack diameter increases, (—say ten inches), DS1 is disabled and DS2 is enabled. When the diameter reaches fourteen inches, DS2 is disabled and DS3 is turned on. Any variation from the proper lighting sequence is a visual indication of malfunction in the digital tension control circuit.












SECTION 4

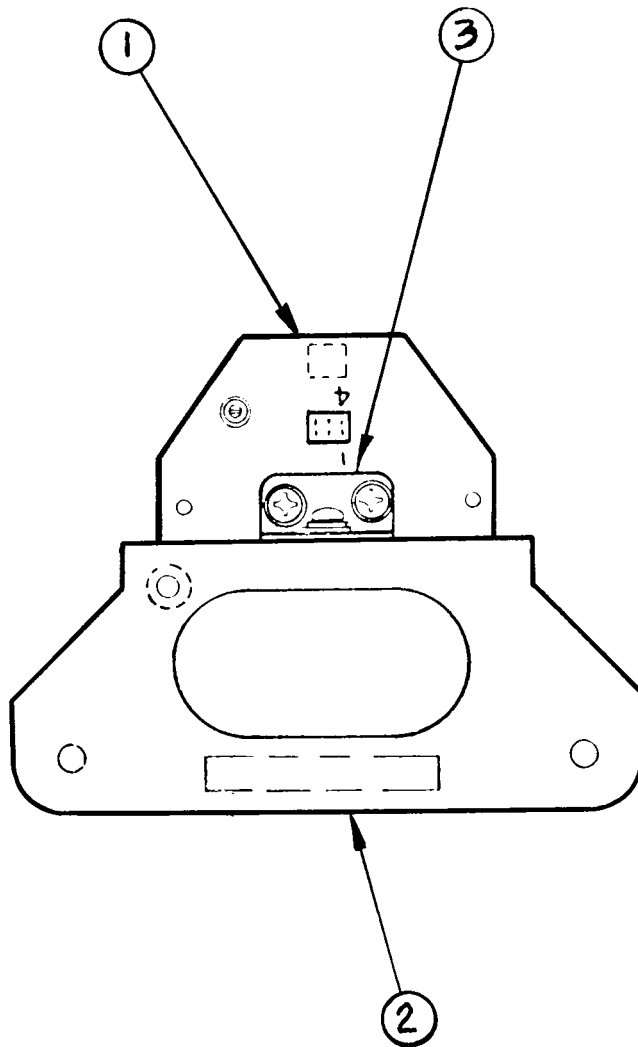
PARTS LISTS AND SCHEMATICS

This section of the manual provides parts lists, assembly drawings, and schematic diagrams for the MM-1200, Take-Up Tension Controller Kit, Ampex part number 4051099.

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TITLE	ASSEMBLY NO.	PAGE NO.
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ITEM NO.	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER																
				-04																
1	4030475-01	REEL SPEED SENSOR AND BRACKET ASSEMBLY	1																	
2	4890429-01	INSTALLATION AND OPERATION	1																	
3	4051088-02	MOTOR CONTROL INDICATOR PWA	1																	
4	4051105-01	TENSION CONTROLLER PWA, TAKE-UP	-																	
5	4051106-01	TENSION CONTROL CAPSTAN SERVO PIGGYBACK PWA	1																	
6	4051107-01	HARNES ASSEMBLY, PLAY TAKE-UP TENSION CONTROL	1																	
8	4260672-01	BRACKET, MOUNTING, TENSION CONTROLLER	1																	
10	4840554	SCHEMATIC, CAPSTAN SERVO	REF																	
11	4840559	SCHEMATIC, TENSION CONTROLLER 	REF																	
12	4840561	KIT, HARNES DIAGRAM, PLAY, T-U TENSION CONTROL	REF																	
14	048-136	RESISTOR, M.F., 681 OHMS, 1W, 1% 	R20	1																
15	066-061	13K 1W, 1% 	R3,9	2																
16	066-450	1M 	R4,30	2																
17	066-656	30.1K 	RE,9,34,35	4																
18	066-714	RESISTOR, M.F., 35.7K OHMS, 1W, 1% 	R6,27	2																
20	260-058	GROMMET, NYLON, CATERPILLAR, .053/.085 INSIDE WD	A/R																	
21	280-664	SPACER, PLAIN, .119 I.D., .250 O.D., .250 LG	2																	
22	302-120	CLAMP, LOOP OFFSET, .125 I.D.	1																	
24	496-004	NUT, LOCKING ASSEM. WSHR, #4	2																	
26	470-036	SCREW, CAP, HEX SOC, #10-32 X .375 LG	4																	
27	470-476	SCREW, CAP, BUTON HD, 4-40 X .500 LG., BLK	2																	
28	473-324	SCREW, PAN HD, ASSEM. WSHR, 4-40 X .250 LG	8																	
29	475-053	SCREW, PAN HD, ASSEM. WSHR, 6-32 X .375 LG	1																	
30	475-061	SCREW, MACH, PAN HD ASSEM. WSHR, 8-32 X .500 LG	2																	
31	041-504	RESISTOR, CARBON, 510 OHM, 5% 	REF R7 (1N751A)	1																
32	013-358	DIODE, ZENER, 5.1V, 5%, .4W 	REF VR1, VR3, VRX	3																
33	502-005	WASHER, LOCK, HELICAL SPRING, #10	4																	
34	501-008	WASHER, PLAIN, #4	10																	
35	501-070	WASHER, PLAIN, #10	6																	
36	501-205	WASHER, PLAIN, #8	2																	
39	506-027	WASHER, "D", #6	1																	
		 REFERENCE MDA 4050771																		
		 REFERENCE 27V REGULATOR SCH 4840339																		
		 STATIC SENSITIVE, SPECIAL HANDLING REQD																		
40	4051105-03	TAKE-UP TENSION CONTROLLER PWA	1																	



4	5	501-008	WASHER, PLAIN #4
4	4	473-324	SCREW, PANHD, ASSEM, WSHR, 4-40X .250 LG.
1	3	4260670-01	BRACKET, SUPPORT, REEL SPEED SENSOR
1	2	4260671-01	BRACKET, MOUNTING, REEL SPEED SENSOR
1	1	4051100-01	P.W.A., REEL SPEED SENSOR TACH
01	ITEM NO	PART NUMBER	DESCRIPTION

Assembly No. 4030475. Reel Speed Sensor and Bracket Assembly

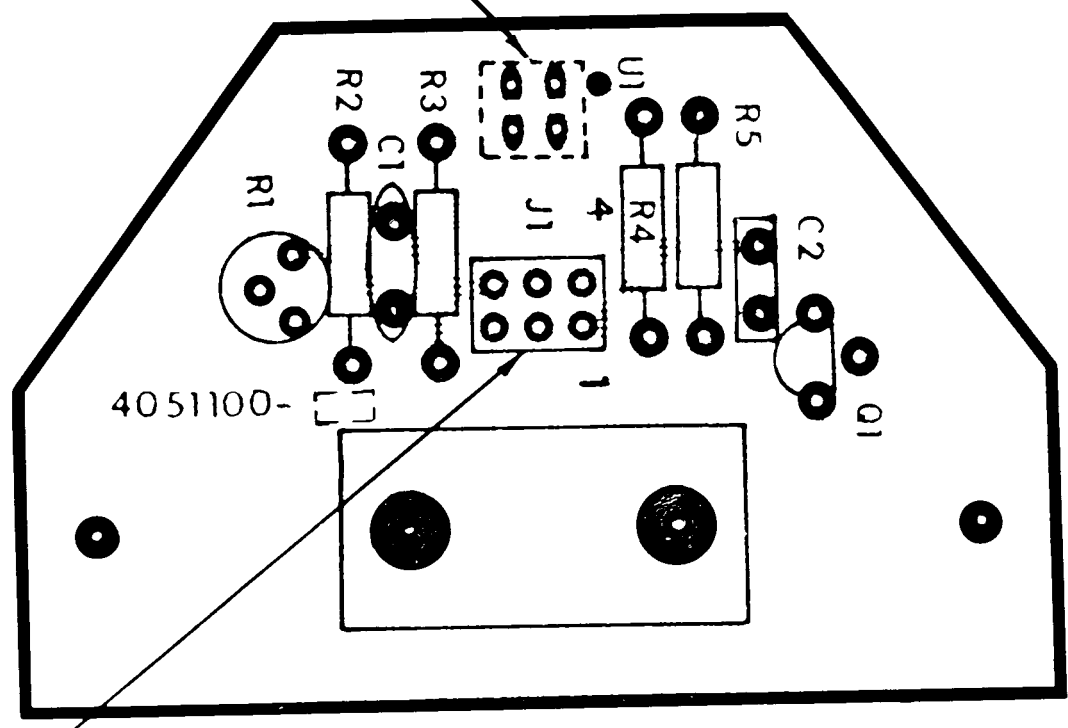
4051100-01

REEL SPEED SENSOR TACH PWA
NEXT HIGHER ASSEMBLY 4030475

REV. A

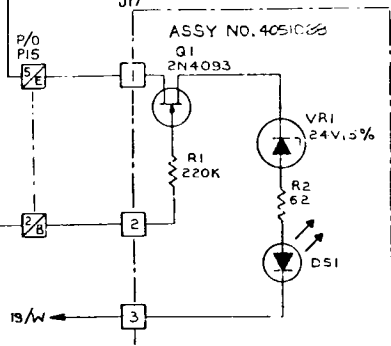
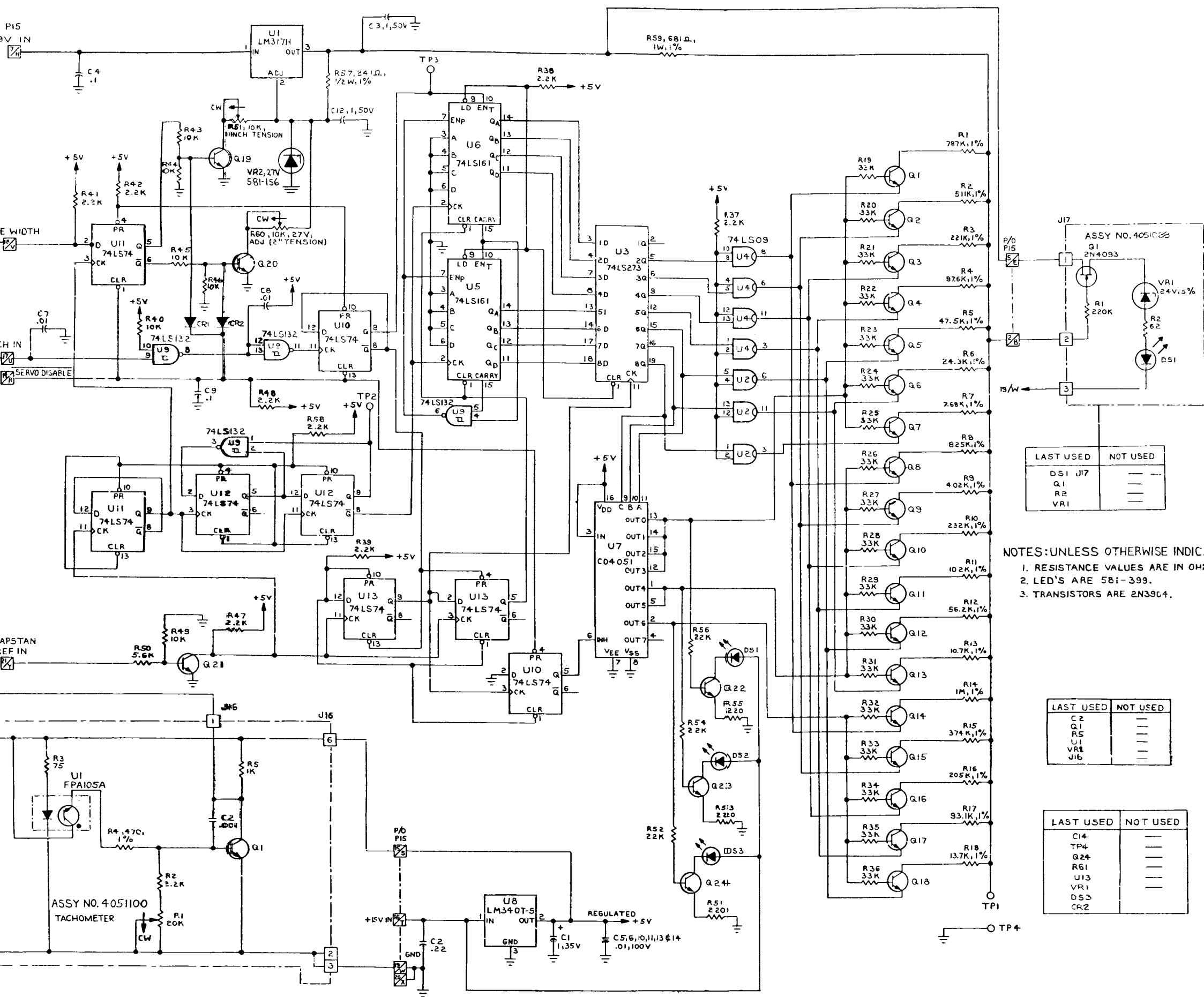
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2																				
3	4840559	SCHEMATIC, TENSION CONTROLLER	REF																	
4	580-647	TRANSISTOR, SILICON NPN(2N3904)	Q1	1																
5	581-749	OPTICAL COUPLER, REFLECTION INTERRUPTER	U1	1																
6																				
7	135-045	CONNECTOR PART, HEADER, VERT. MTG., 6 POSITION	J16	1																
8																				
9	030-057	CAPACITOR, CER. DIP, .01UF, 100V	C1	1																
10	069-090	CAPACITOR, POLY, .001UF, 50V	C2	1																
11																				
12	058-610	RESISTOR, VAR, 1 TURN, 20K OHMS	R1	1																
13	066-665	RESISTOR, C.F., 1K OHMS, 1/4W, 5%	R5	1																
14	076-045	RESISTOR, C.F., 75 OHMS, 1/4W, 5%	R3	1																
15	066-818	RESISTOR, C.F., 470 OHMS, 1/4W, 5%	R4	1																
16	066-689	RESISTOR, C.F., 22K OHMS, 1/4W, 5%	R2	1																
17																				
18																				
19																				
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FAR SIDE (5)



(7)

Assembly No. 4051100. Reel Speed Sensor Tach PWA



LAST USED	NOT USED
DS1 J17	---
Q1	---
R2	---
VR1	---

NOTES: UNLESS OTHERWISE INDICATED:
 1. RESISTANCE VALUES ARE IN OHMS, 1/4W, ±5%.
 2. LED'S ARE 581-399.
 3. TRANSISTORS ARE 2N3904.

LAST USED	NOT USED
C2	---
Q1	---
R5	---
U1	---
VR1	---
J16	---

LAST USED	NOT USED
C14	---
TP4	---
Q24	---
R61	---
U13	---
VR1	---
DS3	---
CR2	---

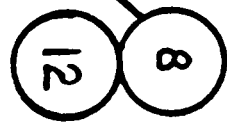
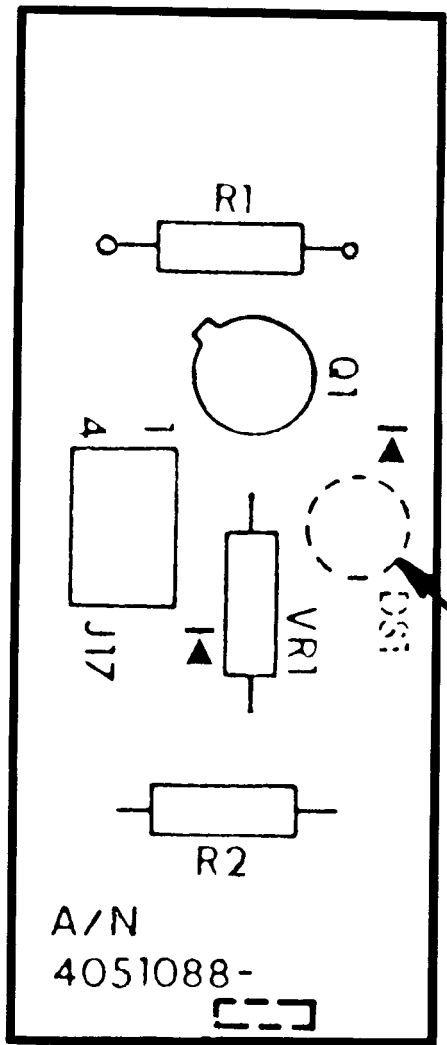
Schematic No. 484059C.
Tension Controller

4051088-01

MOTOR CONTROL INDICATOR PWA
NEXT HIGHER ASSEMBLY 4051099

REV. A

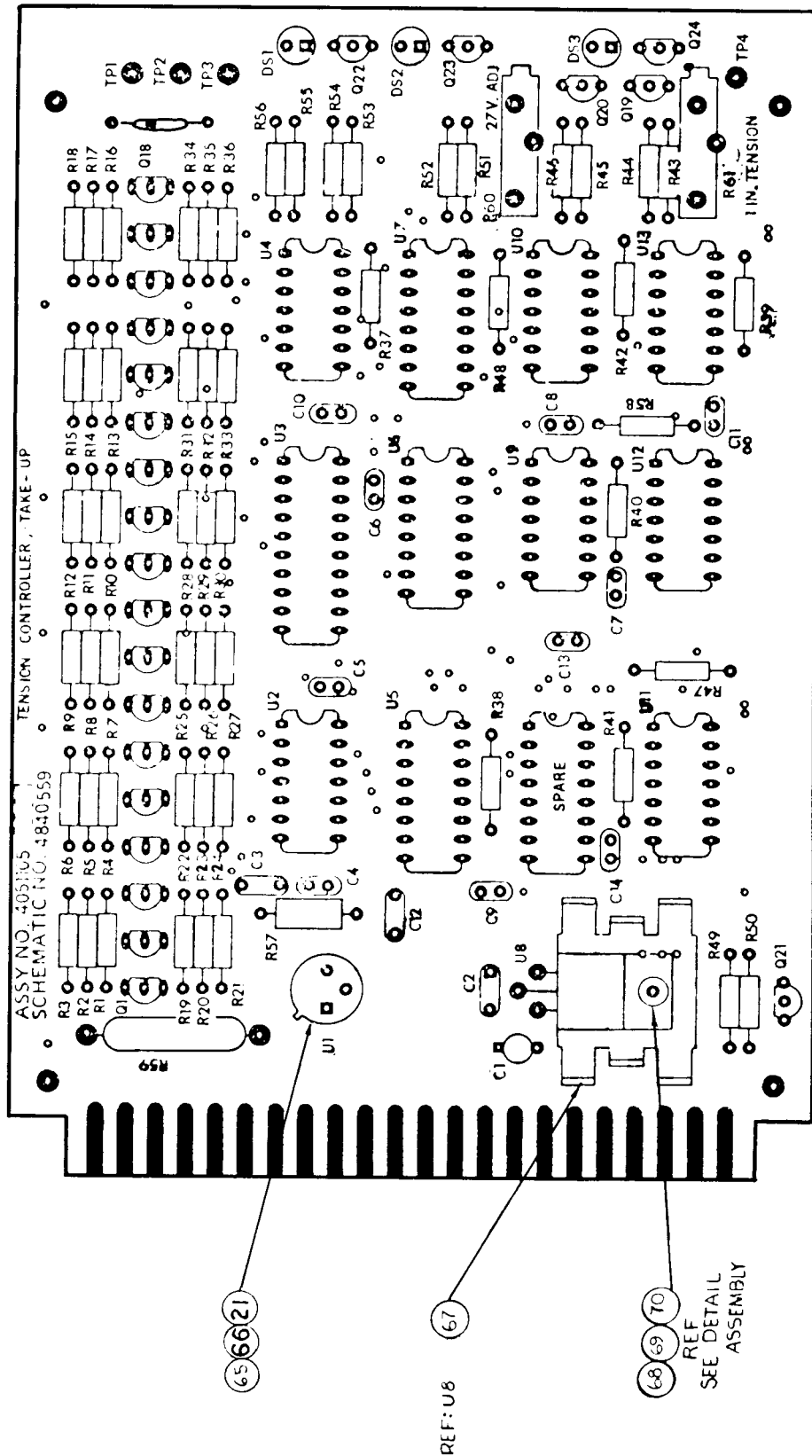
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1																
2																
3	4840559	SCHEMATIC, TENSION CONTROLLER	REF													
4																
5																
6	135-045	CONNECTOR, PART, HEADER, VERT.MTG,6POSITION J17		1												
7																
8	581-294	DIODE, ZENER 2AV, 5% (1N4749A)	VR1	1												
9																
10	581-399	L.E.D. VISIBLE, YELLOW, (HLMP 1401)	DS1	1												
11																
12	280-130	MTG. PAD, TRANSISTOR REF.: DSI		1												
13																
14	066-913	RESISTOR, C.F. 220K, OHMS, 1/4W, 5%	R1	1												
15	066-985	RESISTOR, C.F., 62 OHM, 1/4W, 5%	R2	1												
16																
17	580-133	TRANSISTOR, F.E.T. (2N4093)	Q1	1												
18																



Assembly No. 4051088. Motor Control Indicator PWA

ITEM NO.	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER																
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2																				
3	4840559	SCHEMATIC, TENSION CONTROLLER		REF	REF	REF														
4																				
5	037-591	CAPACITOR, TANT, 1.0UF, 35V	C1	1	1	1														
6																				
7	064-062	CAPACITOR, CER, MONO, 0.1UF, 100V	C4,9	2	2	2														
8	064-298	CAPACITOR, CER, MONO, 0.01UF, 100V	C5-8,10,11,13,14	8	8	8														
9	064-307	CAPACITOR, CER, MONO, 0.22UF, 100V	C2	1	1	1														
10	064-314	CAPACITOR, CER, MONO, 1.0UF, 50V	C3,12	2	2	2														
11	581-156	DIODE, ZENER, 27V, 5%	VR2			1														
12	013-650	DIODE GERMANIUM (1N270)	CR1,CR2	1	2	2														
13	013-968	DIODE, ZENER, 30V, ±5%, (1N4751A)	VR1	1	1	-														
14	587-387	INTEGRATED CIRCUIT, 74LS74	U10-13	4	4	4														
15	587-438		LM340T-5	U8	1	1	1													
16	587-470		CD4051B	U7	1	1	1													
17	587-772		74LS161	U5,6	2	2	2													
18	587-948		74LS09	U2,4	2	2	2													
19	589-331		74LS273	U3	1	1	1													
20	589-368		74LS132	U9	1	1	1													
21	589-956	INTEGRATED CIRCUIT, LM317H	U1	1	1	1														
22																				
23																				
24	581-399	LED, VISIBLE YELLOW, HLMP W401	DS1-3	3	3	3														
25																				
26	048-136	RESISTOR, FIXED, M.F., 68F OHMS, 1W, 1%	R59	1	1	1														
27																				
28	059-343	RESISTOR, VAR, 20 TURN, 10K OHMS	R60,61	2	2	2														
29																				
30	062-285	RESISTOR, FIXED, M.F., 243 OHMS, 1/2W, ±1%	R57	1	1	1														
31	062-796		1M	1/4W,	R14	1	1	1												
32	062-798		56.2K		R12	1	1	1												
33	062-799		102K		R11	1	1	1												
34	062-978		7.68K		R7	1	1	1												
35	062-985	RESISTOR, FIXED, M.F., 10.7K OHMS, 1/4W, ±1%	R13	1	1	1														
36																				
37																				

AMPEX		Amplex Corporation REDWOOD CITY, CALIFORNIA		CODE IDENT NO 92739	LIST OF MATERIALS	LM-4051105	SHEET 2 OF 2		C
ITEM NO	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER					
				01	02	03			
38									
39									
40	062-988	RESISTOR, FIXED, M.F., 13.7K OHMS, 1/4W, ±1%	R18	1		1			
41	066-004	24.3K	R6	1		1			
42	066-014	47.5K	R5	1		1			
43	066-042	511K	R2	1		1			
44	066-154	RESISTOR, FIXED, M.F., 205K OHMS, 1/4W, ±1%	R16	1		1			
45									
46	065-663	RESISTOR, FIXED, C.F., 220 OHMS, 1/4W, ±5%	R51,52,55	3		3			
47	066-689	2.2K	R37-39,41,42, 47,48,58	3		8			
48	066-712	22K	R52,54,56	3		3			
49	066-718	5.6K	R59	1		1			
50									
51	066-830	10K	R40,43-46,49	6		6			
52	066-847	RESISTOR, FIXED, C.F., 33K OHMS, 1/4W, ±5%	R19-36	18		18			
53									
54									
55	076-350	RESISTOR, FIXED, M.F., 97.6K OHMS, 1/4W, ±1%	R4	1		1			
56	076-363	232K	R10	1		1			
57	076-369	374K	R15	1		1			
58	076-370	402K	R9	1		1			
59	076-383	787K	R1	1		1			
60	076-385	825K	R8	1		1			
61	066-763	221K	R3	1		1			
62	069-942	RESISTOR, FIXED, M.F., 93.1K OHMS, 1/4W, ±1%	R17	1		1			
63									
64	580-647	TRANSISTOR, SILICON, NPN, (2N3904)	Q1-24	24		24			
65	014-070	HEATSINK, TRANSISTOR, TO-5	U1	1		1			
66	288-998	SPACER, TRANSISTOR, TO-5	U1	1		1			
67	582-190	HEATSINK, IERC PA1-1CB	U8	1		1			
68	471-109	SCREW, MACH, PAN HD, 4-40 X .185 LG				1			
69	496-004	NUT, LOCKING, HEX, ASSM. WSHR., #4				1			
70	501-008	WASHER, PLAIN, #4				1			
71									
72	087-388	SILICONE, HEAT XFR COMPOUND	REF U1,8			A/R			
73									
74		▷ STATIC SENSITIVE, SPECIAL HANDLING REQ'D							
75									
76									
77									
78									
79									
80									
81									
82									



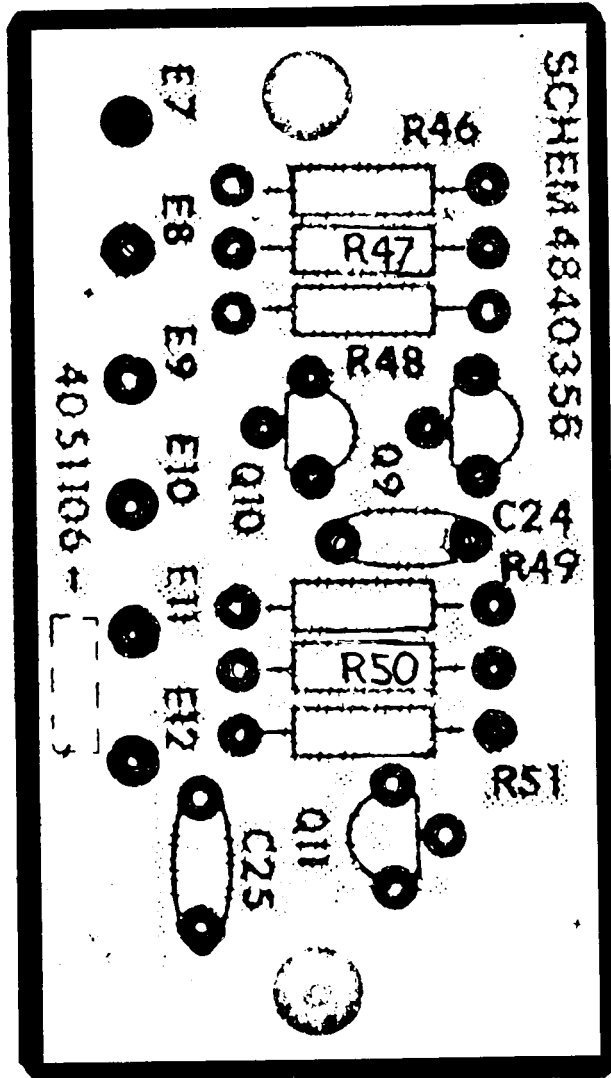
Assembly No. 4051105. Take-Up Tension Controller PWA

4051106-01

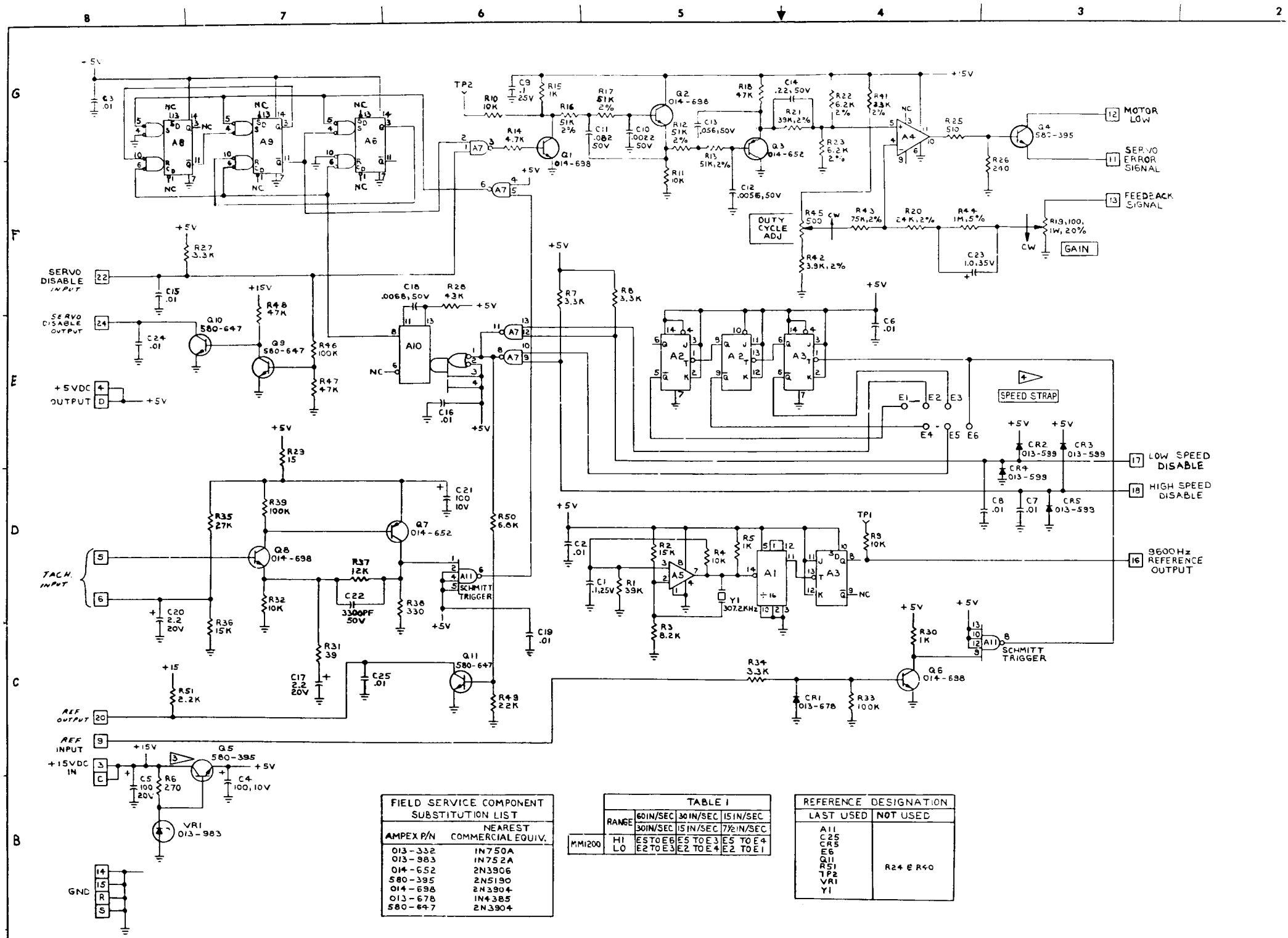
TENSION CONTROL CAPSTAN SERVO PIGGYBACK PWA
 NEXT HIGHER ASSEMBLY 4051099

REV. B

ITEM NO	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER																
				-01																
1																				
2																				
3	4840554	SCHEMATIC, CAPSTAN SERVO	REF																	
4																				
5	030-057	CAPACITOR, CER, DIP, .01UF, 100V, ±20%	C24,25	2																
6																				
7	066-689	RESISTOR, C.F., 2.2K OHMS, 1/4W, ±5%	R51	1																
8	066-712		22K					R49	1											
9	066-717		47K					R47,48	2											
10	066-829		6.8K					R50	1											
11	066-849	RESISTOR, C.F., 100K OHMS, 1/4W, ±5%	R46	1																
12																				
13																				
14	580-647	TRANSISTOR, SILICON, NPN, (2N3904)	Q9-11	3																
15																				
16																				
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Assembly No. 4051106. Tension Control Capstan Servo Piggyback PWA



FIELD SERVICE COMPONENT SUBSTITUTION LIST

AMPEX P/N	NEAREST COMMERCIAL EQUIV.
013-332	1N750A
013-983	1N752A
014-652	2N3906
580-395	2N5190
014-698	2N3904
013-678	1N4385
580-647	2N3904

TABLE I

RANGE	60IN/SEC	30IN/SEC	15IN/SEC	
	HI	LO	HI	LO
MM1200	E2 TO E6	E5 TO E3	E5 TO E4	E2 TO E1

REFERENCE DESIGNATION

LAST USED	NOT USED
A11	
C25	
CR5	
E6	
Q11	
R51	
TP2	
VR1	R24 & R40
Y1	

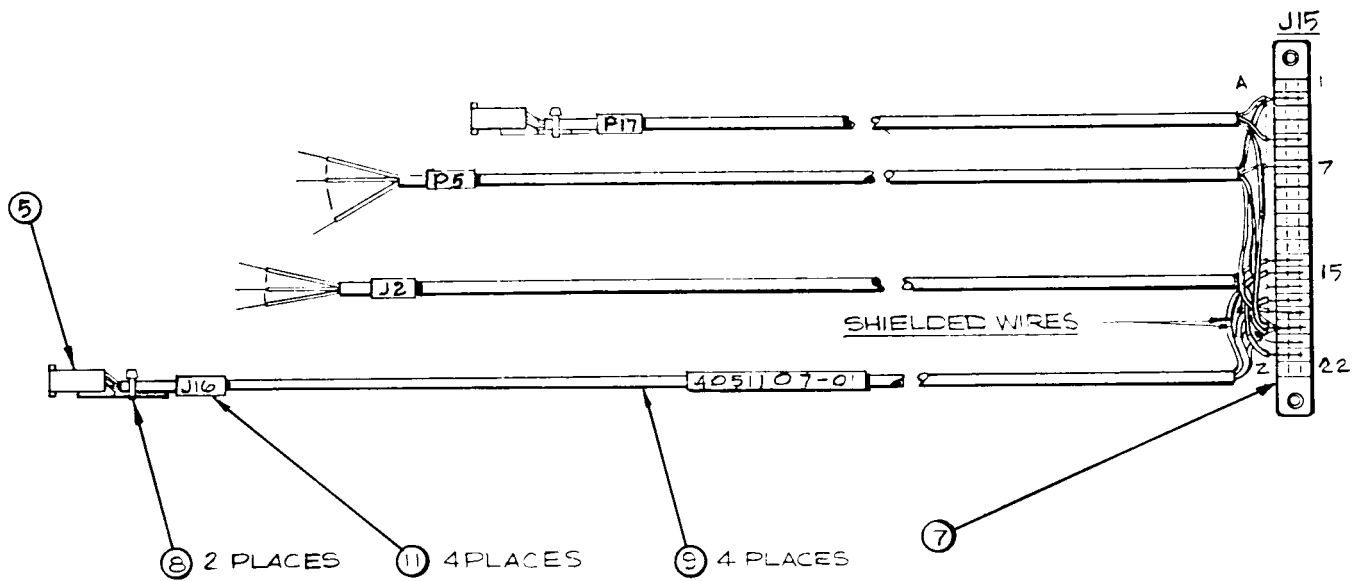
I. C. LIST

REFERENCE DESIGNATION	A11	A6,8,9	A7	A4	A1	A2,3	A5	A10
AMPEX P/N	586-680	536-698	596-153	586-268	586-283	586-425	597-086	586-309
VENDOR P/N	SN7413J	U6A935C	MC846P	LA741C	SN7493N	MC853P	LM311N	U6A960I
VOLTAGE PIN	14	14	14	11	5	14	8	14
GROUND PIN	7	7	7	6	10	7	4,1	7

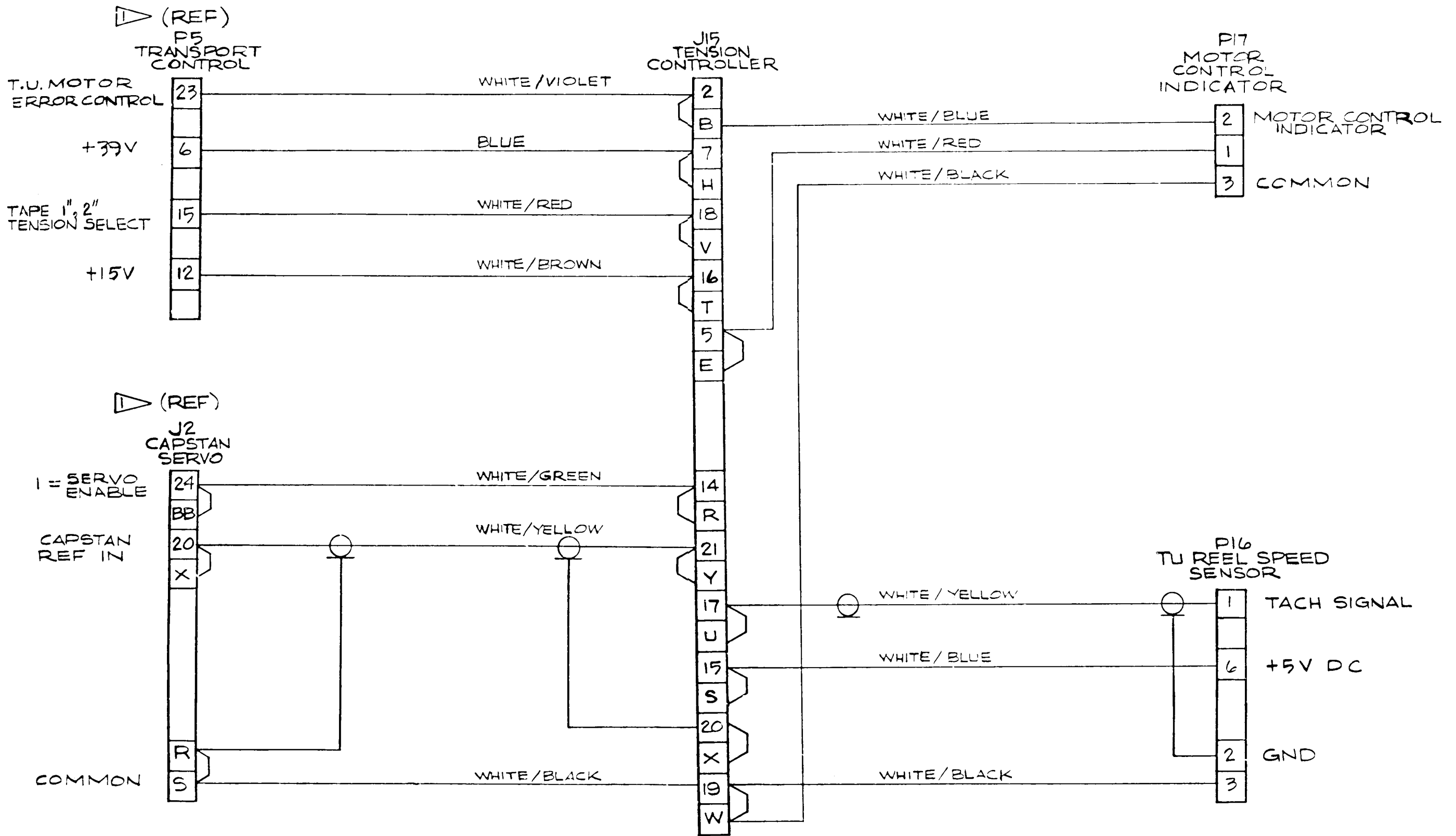
NOTES: UNLESS OTHERWISE SPECIFIED;
 1. CAPACITANCE VALUES ARE IN MICROFARADS, 100V.
 2. RESISTANCE VALUES ARE IN OHMS, 1/4W, 5%.
 ⚡ HEATSINK REQUIRED.
 ⚡ SEE TABLE I FOR SPEED STRAPPING.

Schematic No. 4840554A.
 Capstan Servo

ITEM NO.	PART NUMBER	DESCRIPTION	REF DESIG	QTY REQD PER DASH NUMBER														
				-01														
1	4840561	KIT. HARNESS DIAGRAM, PLAY T-U TENSION CONTROL	REF															
2																		
3		WIRE, STRANDED 24 AWG CD 569	A/R															
4																		
5	167-714	CONNECTOR, PLUG, 6 POSITION	P16, P17	2														
6	167-727	PINS		12														
7	168-140	CONNECTOR, BOARD 22 PIN	J15	1														
8	302-335	TIE WRAP		2														
9	600-011	SLEEVING .178 ID		A/R														
10	600-131	SLEEVING SHRINKABLE CLEAR		A/R														
11	600-255	SLEEVING, SHRINKABLE		A/R														
12	615-004	WIRE SOLID 24 AWG		A/R														
13	614-934	WIRE COAX 24 AWG		A/R														
14																		
15																		
16																		
17																		
18																		
19																		
20																		



Assembly No. 4051107. Play Take-Up Tension Control Harness Assembly



NOTES: UNLESS OTHERWISE SPECIFIED

▶ THESE CONNECTORS (P5 / J2) EXIST IN THE MM-1200.

Wiring Diagram 4840561A.
Play Take-Up Tension Control Harness