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T-2X / T-2XX TAILTWISTER™ Rotator

T-2X has 110 VAC Controller
T-2XX has 220 VAC Controller

INSTRUCTION MANUAL

GENERAL DESCRIPTION

The Tailtwister rotator consists of an extra heavy duty rotator and the control unit. The rotator is designed to be mounted on a plate inside a tower. A mast to support and turn large communications beams is then attached to the top of the rotator. However, in some instances, mast mounting is desired. The Lower Mast Support Kit, PN 5146710, contains a lower mast support and the necessary hardware to facilitate mounting the Tailtwister rotator on top of a mast.

New features in the Tailtwister include an 8 pin Cinch® connector on the rear panel of the control, a chassis ground connection on the 120 VAC model, a high-strength drive gear, a weather proof AMP connector at the rotor unit, and RF beads on the potentiometer lines.

Cinch™ a Division of Labinal Components & Systems, Inc.

The rotator unit must be wired to the control unit with an 8-wire cable. The control unit must be placed inside the house or other protected location. Included in the shipping box are:

- A. Instruction Manual
- B. Rotator Unit
- C. Controller Unit
- D. Mounting Hardware Pack
- E. Connector Parts Pack

Due to the wide variety of towers available, each installation will have different requirements. The gauge of the 8-wire cable to connect the control unit to the rotator depends upon the distance between the rotator and control. The longer the distance, the larger the diameter of the wire required. Various antennas or beams require different installation methods. (See Table 1).

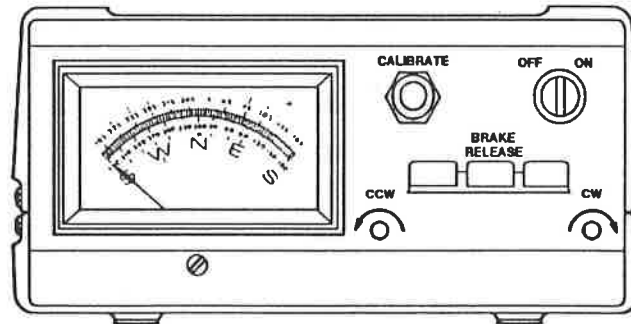


Figure 1
Control Unit - Front Panel

SPECIFICATIONS

Input Voltage	120 VAC 50/60 Hz
Optional	220 VAC 50/60 Hz
Motor	24 VAC 2.25 Amp, capacitor start, capacitor run
Brake Solenoid	24 VAC, 5.0 Amps
Power Transformer	120 VAC/26 VAC 10% duty, thermal switch protected
Optional	220 VAC/26 VAC 10% duty, thermal switch protected
Meter Transformer	120 VAC/13 VAC continuous duty
Optional	220 VAC/13 VAC continuous duty
Meter DC voltmeter	1000 ohms/volts, 1 MA full scale
Meter Scale	Direct Reading: North centered, 5° increments
Optional	Direct Reading: South centered, 5° increments
Maximum Antenna Size:	
A. Tower Mounted as per Figure 3	20 square feet (1.86 m ² or sq. m) of wind surface area
*Maximum Effective Moment (EM)	3400ft. lb. (470 Kg. m)
B. Outside Tower or Mast Mounted as per Figure 5 or 6	10 square feet (.93 m ² or sq. m)
	of wind surface area
Operational Temperature Range	-30°F to +210°F (-34°C to +99°C)
Maximum Interconnect Cable Resistance:	
A. Pins 1 and 28 ohm
B. Pins 3,4,5,6,7, and 8	2.0 ohms
Rotation Time	45-60 seconds with 60 Hz input
Brake	positive, electrically operated wedge, 60 segments spaced 6° apart
Rotator Size	9 inches (23.7) maximum diameter by 14.07 inches (35.7 cm) high
Recommended Antenna Mast Sizes	1 7/8 to 2 1/16" O.D. (48-52 mm)
Mounting Hardware	Stainless steel hardware and plated steel clamp plate
Control Unit Size	8.5 inches (21.6 cm) wide x 9.0 inches (22.8 cm) deep x
	4.3 inches (11.0 cm) high
Shipping Volume	2,280 cubic inches (37,350 ccms)
Shipping Weight	28 pounds (12.7 kg)

*Effective moment is defined as the product of antenna weight and turning radius and is more accurate when selecting a rotator for a particular antenna array.

CAUTIONS

- **Install properly and safely**
- **Towers, often the highest metal parts in the vicinity, require caution during erection and placement. Extreme care must be taken during erection so that metal towers and beams do not contact power lines even if the beams slip or rotate, towers fall or fracture or metal wires blow in the wind, etc.**
- **Metal towers or other position mechanisms must be placed so that if they fracture or blow over in high winds, they cannot contact power lines, be a hazard to individuals, or endanger property.**
- **When not mounted within a tower with a thrust bearing, as shown in Figures 6 and 7, the rotator must be DERATED.**

- **Metal towers must be grounded properly at the tower location before the tower is erected. This is to minimize electrical hazard and the possibility of lightning damage. DO NOT bury bare aluminum wires or stakes in the ground. Use copper ground stakes. The service entrance ground should be checked. The household convenience outlet should be the 3-prong type (grounded back to the service entrance).**
- **The Control Box is not weatherproof and must be located in the house, ham shack or other protected location.**
- **Read this manual completely before proceeding.**

The Tailtwister rotator has been carefully designed and manufactured to give many years of trouble-free service when carefully and professionally installed. It consists of the strongest and best commercially available components.

TYPES OF INSTALLATION

There are three general types of installations (see Figures 4, 5 and 6).

1. The recommended Installation is an "Inside" Tower Mount with a thrust bushing or bearing to provide support and resist high wind loads.

When the rotator is properly mounted this way, it can be rotated to turn an antenna or beam of 20 square feet (1.86 m²) wind surface area. The wind loading during storms, the rotational inertia of the beam and unbalanced weight are more important than the dead weight of the beam. It is important to minimize the height of the beam above the rotator to minimize the overturning force induced in a high wind (see "Unbalanced Weight" and "Wind Pressure").

2. An "outside" Tower Mount (see Figure 6) is optional. The rotator is not well protected but the installation is simpler. With an "Outside" Tower Mount, the rotator must be derated to 10 square feet (.93 m²).
3. A telescoping or other type mast (see Figure 7) can also be used. This installation is similar to Number 2 above and requires the optional Heavy Duty Lower Mast Support Kit and must be derated to 10 square feet (.93 m²).

UNBALANCED WEIGHT AND WIND PRESSURE

1. **Unbalanced Weight:** Weight should be as closely balanced as possible. Unbalanced weight creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the rotator. This moment tends to strain the mast at that point and also to bind the ball bearings by creating excessive downward pressure on one side and upward pressure on the other. Such unbalance places additional stress on the motor gear train. Unbalanced weight becomes critical as the distance from the antenna boom to the clamping point at the rotator is increased.
2. **Wind Pressure:** Wind pressure against the boom and elements produces a bending force on the mast which can cause the same stresses as unbalanced weight. To strengthen the installation to withstand unbalanced weight and wind pressure the top mast should be as short and as strong as possible. In multiple arrays the antenna with the most wind area should be closest to the rotator.

In order to distribute the bending stress and prevent fracture of the mast, the T2X rotator includes a specially designed steel clamping plate to clamp the mast to the rotator;

After procuring the type of tower or other positioning mechanism of the owner's choice, the next step is to wire the rotator to the control box and check out its operation prior to installation.

WIRING AND CHECK-OUT

A. Decide the wire gauge (size) required and procure the number of feet of the proper cable (see Table 1).

Maximum Length	Gauge for Terminals 1 & 2	Gauge for Terminals 3-8
125' (38 m)	# 18 (1.19 mm)	# 20 (.97 mm)
200' (61 m)	# 16 (1.42 mm)	# 18 (1.19 mm)
300' (91 m)	# 14 (1.75 mm)	# 16 (1.42 mm)

Table 1

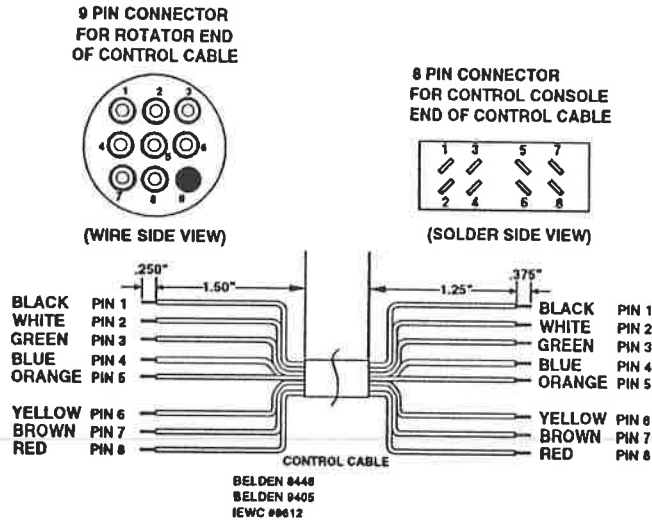


Figure 2

Control Cable Connector Attachments

NOTE: The specifications call for heavier gauge wire in two locations. Leads #1 and #2 must be heavier gauge and less total lead resistance.

B. Assemble the rotor cable as shown in Figure 1.

CAUTION

Shorts between terminals or grounded leads may damage the rotator. Pay strict attention to the pin numbers on the connectors!

C. Temporarily attach the 6 5/16"-18 x 1 5/8" screws (Item 140) to the bottom of the rotor unit.

D. With the rotator sitting in the upright position and connected to the control unit by the 8-wire cable, plug the control unit power cord into a receptacle.

E. Turn the power switch on. The meter should be illuminated.

F. Depress the "Brake Release" (center) lever, then release it. An audible click should be heard in the rotator. This is the solenoid operating the brake wedge.

G. Depress the "Brake Release" (center) lever, hold it, and simultaneously depress the CCW direction switch (left). The rotator should turn CCW (looking from the top). This is S-E-N-W-S. Release the CCW direction switch; the rotator will coast down and stop. Now release the brake switch. The rotator is now locked into position.

H. Repeat the previous step for CW direction by depressing the brake switch first, then the CW direction switch (right). The red lamps should indicate direction of rotation.

I. Return the rotator to full CW position.

CAUTION

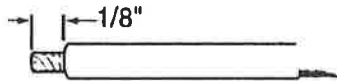
It is best to release the direction switch just prior to the end of rotation (extreme CW or CCW position) in order not to cause undue stress on the stop arm and/or the gears.

ATTACHING CONTACTS TO WIRES AND CONNECTOR

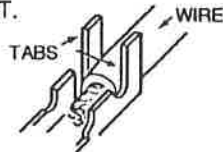
Since these contacts will be inserted into connector blocks, their tabs must be carefully rounded. Unless you have a crimping tool for installing connectors, use the following procedure.

Repeat for each contact. Pay close attention to the numbered holes in the connector! Pull back lightly on each conductor to be sure each contact is locked in each cavity. Once locked in place, the contacts may only be safely removed with an extraction tool. (Extraction tool not included). This tool consists of a tube with an O.D. of 0.129 and an I.D. of 0.115. When inserted over the contact from the front side, this tool compresses the locking tabs, permitting easy removal.

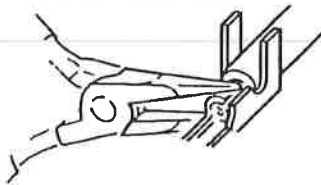
1. CUT WIRE TO SPECIFIED LENGTH. REMOVE 1/8" OF INSULATION FROM END.



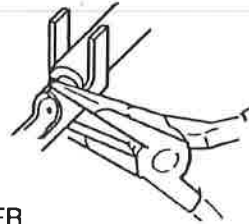
2. INSERT WIRE BETWEEN TABS IN CONTACT.



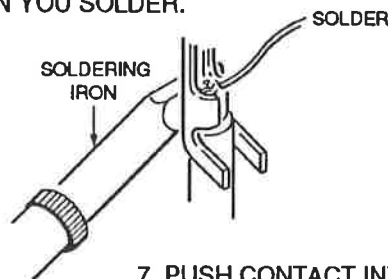
3. BEND TAB TIGHTLY AROUND BARE WIRE END.



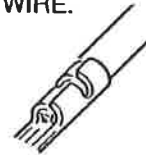
4. BEND OPPOSITE TAB AROUND FIRST TAB.



5. APPLY SOLDER. DO NOT ALLOW SOLDER TO FLOW INTO THE CONTACT END. HOLD THE CONTACT END UPWARD WHEN YOU SOLDER.



6. WHEN SOLDER COOLS, CAREFULLY SHAPE END TABS AROUND THE INSULATION ON THE WIRE.



7. PUSH CONTACT INTO HOLE IN CONNECTOR SHELL UNTIL CONTACT CLICKS INTO PLACE.

CONNECTOR SHELL



SOCKET CONTACT



Figure 3
Attaching Contacts to Wires and Connector

MOUNTING INSIDE TOWER

The rotator is mounted inside a tower (see Figure 4) to the flat tower plate by means of six (6) bolts furnished in the hardware kit. Use the following procedure:

1. Locate the rotator in the tower directly under the bushing. Note that the tower plate must be cut out to allow the connecting 8-wire cable to pass through the plate.

Use the template in the back of the manual.

2. Plug the cables together and secure the cable to the tower in such a manner that the cable will not be strained.
3. The rotator is attached to the tower plate by means of six (6) bolts and lockwashers (see Figure 4). The flat tower plate must be drilled in six (6) places using the template provided with this manual unless the tower plate is already properly drilled.

4. Tighten the six (6) bolts, but not to final tightness. Observe how the rotator turns. It must rotate in such a manner as to turn the mast concentrically in the thrust bearing.

5. Trial assemble the mast to the top of the rotator using the U-bolts, nuts and lockwashers through the rotator and clamp plate as shown in Figure 4. The maximum mast diameter that may be used is 2 1/16" O.D. We recommend 1 1/2" nominal steel pipe with 1.9" O.D. in standard wall thickness of .145". For stacked arrays or very large beams, we recommend extra heavy-duty wall thickness of .200". Both steel pipes can be purchased to specification ASTM-120.

NOTE: Apply a coating of heavy-duty motor oil or grease to the threads of the stainless steel bolts and U-bolts to prevent seizing.

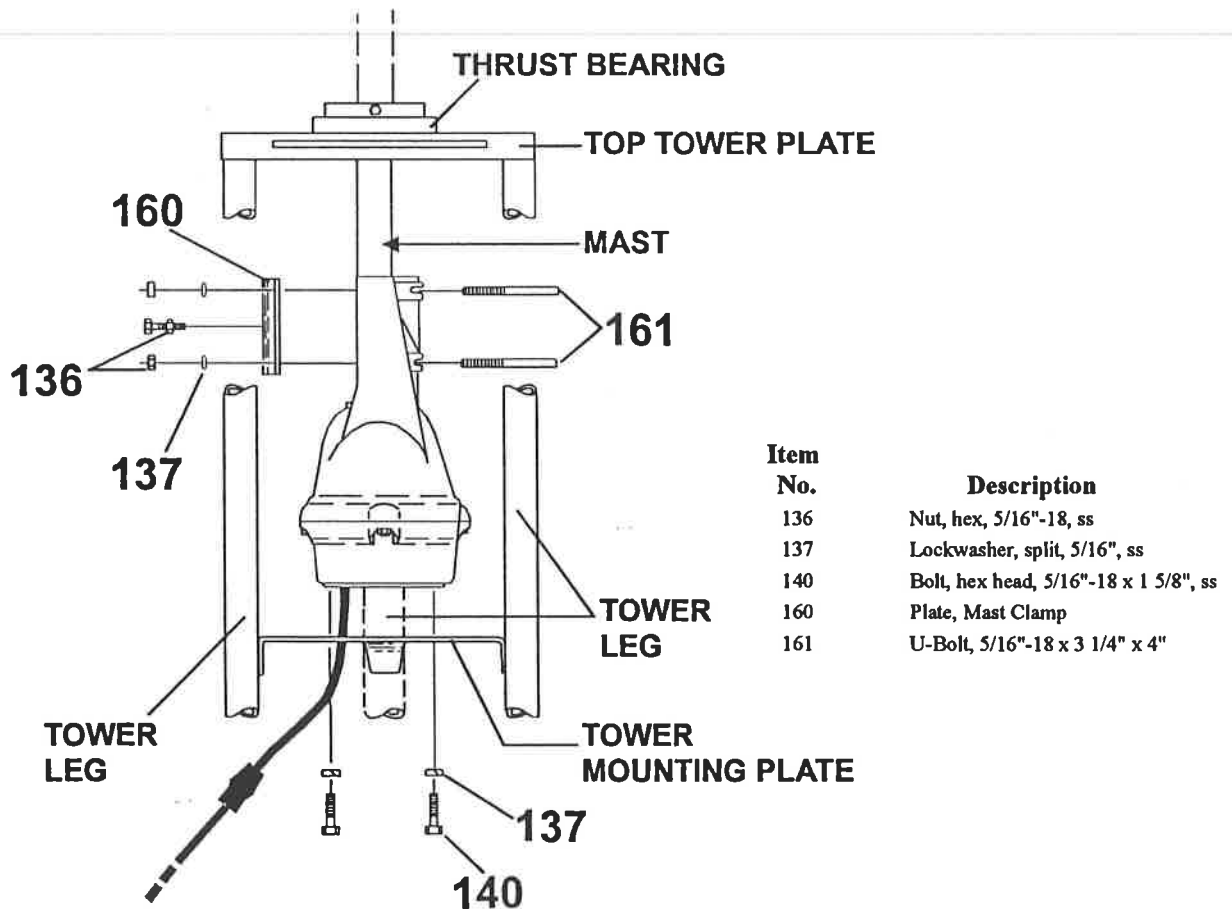


Figure 4
Rotator Mounting in a Tower

On any inside tower installation, care must be exercised to get the antenna mast shimmed to the exact rotational center of the rotator. The geometry is such that a mast of 2.062" (2 1/16" [52 mm]) O.D. pipe will be exactly centered. If the O.D. of your mast is less than this, you should shim out to these dimensions.

6. If the rotator, top bushing and mast are properly aligned, there should be unrestricted rotation through 360°. If not, the rotator may have to be moved slightly on the flat plate. If a high quality bearing is used in the top of the tower (recommended), the shimming procedure must be done more carefully as closer tolerances are required. It is important that the rotator does not try to turn the mast eccentrically with the top bushing or bearing.
7. Tighten the mounting bolts carefully - to approximately 175 inch-pounds of torque.
8. Drill through the antenna mast and rotator casting, using a 5/16" drill. Locate the hole in the clamp plate that is furnished. Insert the bolt through the clamp plate, mast, and rotator and tighten all bolts to 150 inch-pounds. Refer to Figure 4.

9. Return the rotator to the full CW "S" position. Mount the beam on the mast pointing South. The coaxial cable should be looped in such a manner that it will not foul or tangle when the beam turns around in a circle to the full 360° counterclockwise position.

OUTSIDE TOWER

Referring to Figures 5, 6, and 7, an outside tower or pole mount is made in the same manner except that the rotator is fastened by four (4) bolts only (not six) to the Lower Mast Support, PN 5146710. Since the eccentricity of the rotator turning in reference to the tower is no longer important, the shimming procedure is not necessary. The four (4) screws must be torqued to the same specification and the 8-wire cable securely fastened. The lower mast should be pinned with the 5/26"-18 x 4" bolt as shown in Figure 6.

CAUTION

The rotator is designed for vertical operation with the bell shaped housing in the up position. Water and other contamination will get into the motor unit if it's mounted horizontally or upside down.

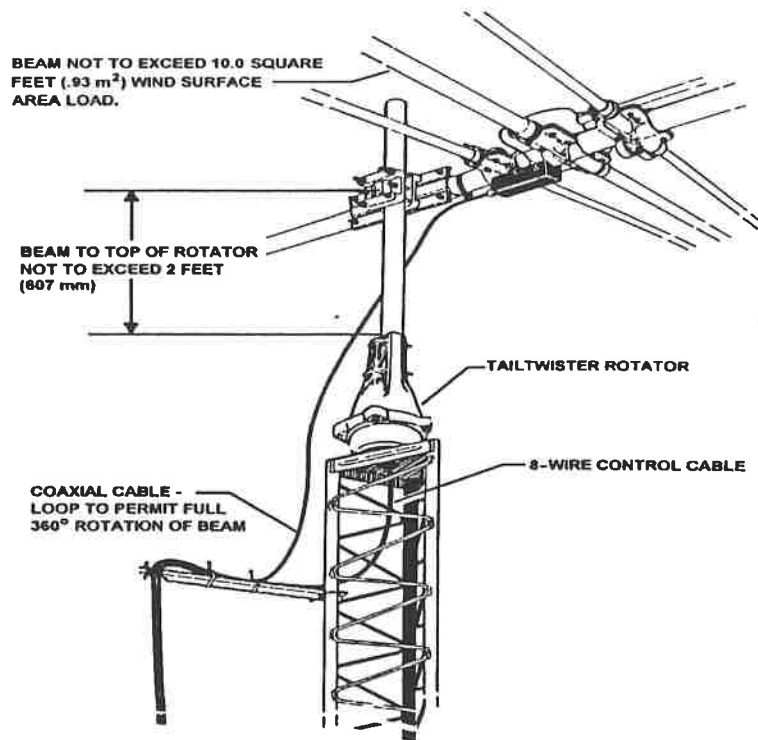


Figure 5
Rotator Mounted On Tower Top Plate

OPTIONAL KITS:

HEAVY-DUTY LOWER MAST SUPPORT KIT (51467-10) (Optional)

The stock Taitwister T2X is intended to mount on the base plate inside of the tower. However, in some instances, outside tower or mast mounting is desired as per Figures 5 and 6. This kit, P/N 5146710 contains a heavy-duty lower mast support and the necessary hardware to facilitate mounting the T2X on top of a tower stub or mast.

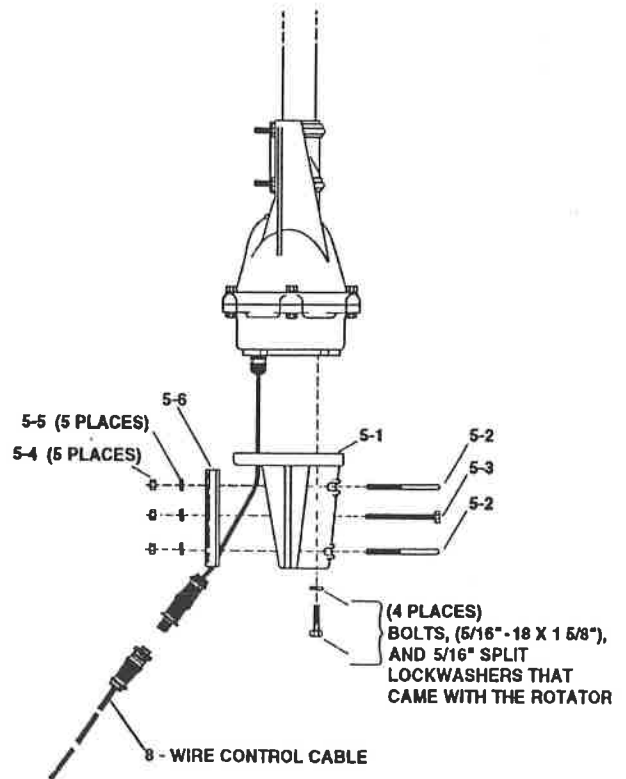
Item No.	Part No.	Description	Quantity
5-1	51423800	Clamp, lower mast	1
5-2	5142700	U-Bolt, 5/16"-18 x 3 1/4" x 4"	2
5-3	5142401	Bolt, 5/16"-18 x 4, hex head, ss	1
5-4	555747	nUT, 5/16"-18, hex, SS	5
5-5	564792	Lockwasher, 5/16", split, ss	5
5-6	5142602	Support, lower mast	1
5-7	107632061	Screw, #6-32 x 3/8", round head	2
5-8	5033900	Cover, terminal	1
5-9	5091400	Grommet	1

NOTE:

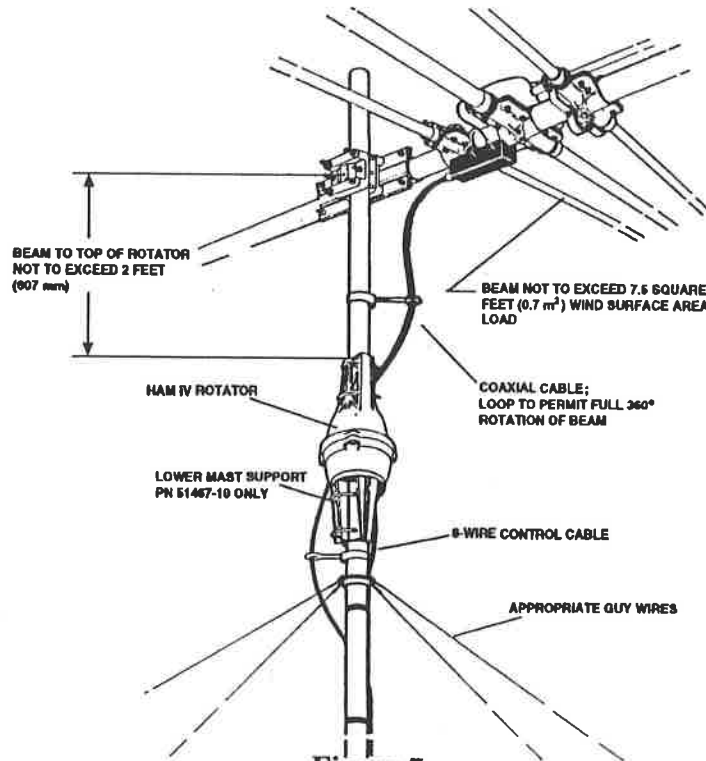
THIS IS AN ACCESSORY KIT AND SHOULD BE PURCHASED FROM YOUR DISTRIBUTOR/DEALER

CAUTION

When the rotator is installed using the lower mast support kit, the antenna size must be restricted to 10 square feet (.93 m²) of wind surface area.



**Figure 6
Rotator Mounting with Lower Mast Support**



**Figure 7
Pole Mounted Rotator**

PRELIMINARY CHECK AND CALIBRATION

IMPORTANT

THERMAL PROTECTION: If the rotator fails to turn after 4 or 5 minutes of continuous operation, the thermal switch has come into play. This protective device in the transformer automatically shuts off power if the rotator is used continuously for too long. It will automatically reset after 10 minutes.

1. Turn the Control Unit Power "ON" with the upper right "ON-OFF" switch. The meter should be illuminated and the needle should be to the right.
2. Depress the brake lever (center) and hold. Depress the CCW lever (left) and operate the rotator to its full CCW position. If the meter does not move from the right to the left hand position, press and release the "Calibrate" switch.
3. With the rotator in its full CCW position, if the meter is not at its full left position, carefully adjust the zero (CCW South) position with the screw directly under the meter to exactly South.
4. **Meter Calibration Procedure:** Operate the rotator to its full clockwise position. Adjust the calibration potentiometer until the meter indicates full scale to the right. The meter is now calibrated. Do not adjust the calibration potentiometer when the rotator is in any position other than full clockwise.

When the control unit is turned "OFF", the meter needle will fall to the left "S" position and return to indicate the rotator position as soon as the control unit is turned "ON" again. It will not damage the unit to leave it turned "ON" for extended periods.

NORMAL OPERATION

To operate the rotator, it is necessary to understand the T2X Brake Release Lever and its function. The brake lever (middle lever) on the Control Unit operates a brake wedge mechanism in the rotator which locks the rotator into position mechanically. The rotator cannot turn unless the wedge is retracted by depressing the middle lever. The normal operation is as follows:

1. Retract the brake wedge by holding down the "Brake Release", middle lever. (Green light on.) **NOTE:** The brake wedge will be retracted only while the Brake Release lever is held down.
2. Turn the rotator to the compass location by pushing down and releasing either the left hand or the right hand lever.

Allow a few seconds for the rotator to coast down. Then re-engage the brake wedge by releasing the "Brake Release" (middle) lever.

OPERATING PRACTICE

The rotator has several mechanisms to protect it from misuse, but the following precautions are advisable.

1. If you have a very large beam, the rotator can be "nudged" to exactly the desired position by alternately working the left and right control, allowing it to coast down before the brake wedge is allowed to engage.
2. It is advisable not to run it full speed into the end of rotation.
3. Upon completion of turning, always allow the rotator to coast down by keeping your finger on the "Brake Release" after you have released the rotation lever. This procedure will allow the rotator to stop before you re-engage the brake wedge. Observing this sequence prevents the rotator from stopping suddenly thus preventing undue stress on the rotator, beam, and tower.

The motor has an internal brake which controls the coast down time and deceleration. The internal motor brake is usually strong enough to prevent pin-wheeling during operation.

GROUNDING

The tower, or other metal support device, must be grounded to an earth ground at its location. Use heavy copper cable looped so that if the tower comes down for any reason, there will be adequate slack to prevent the ground wire from breaking. Use one or more 8 foot copper jacketed steel stakes driven into the moist earth and fasten the wire securely at the stake and at the tower.

As mentioned in the "Cautions" portion, the steel chassis of the control box should be either grounded to a metal cold water pipe in the house or back to the electric service entrance box where the power comes into the house. This normally is accomplished with the wire of the 3-prong plug which then depends on the wall outlet being adequately grounded back to the service entrance as to the utility ground. If there is any doubt, have this checked by a licensed electrician.

SOUTH-CENTER METER SCALE CONVERSION

The stock Tailtwister Control Unit is shipped with the meter scale installed for "North" center operation; ends of rotation are at the "South" position. Some geographic locations and/or popular working areas may favor having the meter "South" center; ends of rotation are at the "North" position. We have provided the Tailtwister with an interchangeable meter scale.

We recommend the following procedure:

1. Disconnect the power cord.
2. Remove the 8-wire control cable, carefully labeling each wire with its corresponding terminal number. This operation may be omitted if the control box can be worked on easily without removing the leads.
3. Remove the top and bottom covers.
4. Slip the lamp and holder off the lamp holder bracket. Loosen the hex nut on the transformer that is holding the lamp holder bracket and swing the bracket clear of the wires leading to the printed circuit board.

5. Carefully remove the hex nuts on the meter studs to free the printed circuit board. Slip the P.C. Board off the studs and pull it down under the chassis.

CAUTION

It is good practice to use a short test lead or jumper wire to short the meter studs when it is not in the circuit.

6. Loosen the meter retaining clips and remove the meter from the chassis.
7. Insert a small knife blade between the clear meter cover and black housing at either corner of the top edge and gently pry the cover loose from that corner. Repeat for the other corner. The meter cover should pop off.
8. Carefully slip a knife blade under each corner of the lower edge of the white meter scale and twist slightly until the scale clears the two small indexing pins. Remove the scale and install the new one. Make sure the scale fits over the indexing pins and that it is flush and tight against the black housing. This will assure free movement of the indicator needle.
9. Reinstall the meter (remove the temporary jumper), the P.C. Board and lamp hardware. Check for pinched, shorted end, or overstressed wires.
10. Reinstall the top and bottom covers.
11. Reconnect the 8-wire control cable in the exact sequence as they were removed.

If your beam was installed originally using the T2X with a "North" center scale, the antenna mast must be loosened and repositioned. In order for the meter to indicate properly, the front of your beam must point "North" when the rotator is at the ends of rotation.

Recalibrate the meter.

NOTE: In the past the South Centered meter scale was on the reverse side of the factory installed North Centered scale. The unit is now provided with a separate South Centered scale. This will help to avoid damage to the face of the meter scale during removal of the North Centered scale.

TROUBLESHOOTING

GENERAL DESCRIPTION

Most operational difficulties with rotators are traceable to broken, shorted or grounded wires usually at the rotor connections. Time spent in cutting the leads to exact lengths, tinning, and clamping to prevent strain on the control cable, will pay dividends.

CAUTION

This unit has been thoroughly tested and cycled before shipment. Follow the connector wiring carefully between Rotator and Control Box. Incorrect wiring will burn out the rotator potentiometer and void the warranty.

Be sure Rotator and Control Units are compatible. Do not intermix models with different operating voltages. This results in sluggish or non-operating performance, burned out motors, overheated transformers and burned out rotator potentiometer, etc.

MECHANICAL PLAY

Frequently the slight motion of the antenna array in gusts of wind is due more to the natural flexing of the elements and mast than it is due to actual play in the rotator mechanism. A slight amount of "play" is built into the rotator to avoid binding due to environmental changes.

ANTENNA ROTATES IN HEAVY WIND

This is usually a matter of the mast slipping in the support. For large arrays, it is often necessary to drill a 5/16" hole through the clamping plate, mast and mast supports and pin them together with the stainless steel bolt supplied.

If "slipping" or "turning" is suspected, return the rotator to the end of rotation and visually check to be sure that the antenna is in the original stop location as installed.

LACK OF POWER

If the antenna rotation is slow or sluggish or hard to start, check for proper voltages. If the voltages are correct, the 130-156 MFD motor start capacitor could be at fault. It is recommended that a new capacitor be tried before any other action is taken. Also, check proper wire size per Table 1, page 4.

If the electrical circuit is okay, then check for mechanical binding. Pay particular attention to bearings and alignment of the mast of an inside tower mount.

If the temperature is less than -30° F (-34° C), the rotator will be very sluggish and hard to start. This is normal. Hold down on the rotation switch until movement is seen on the meter.

If the capacitor is good, the temperature is well above -30°F, and there is no mechanical binding above the rotor, the rotor may not be receiving the proper voltage levels to achieve maximum torque. Check the cable resistances, and wire sizes. For cable runs over 300', move the motor capacitor to the tower.

IMPROPER METER INDICATION

The brake and motor operate independently of the indicating system. If the pilot light burns at proper brilliancy, the instrument transformer is okay and the output is not shorted. Check the 1/8 amp meter circuit fuse with the ohmmeter. Check for about 13 VDC across Terminals No. 3 and No. 7 with the switch operated. If the proper voltage is not obtained, check the individual components in the meter circuit. If the 13 VDC is present, check for 500 ohms across rotator leads No. 3 and No. 7. If 500 ohms is present from No. 3 and No. 7, see if the readings from No. 3 to ground and No. 7 to ground total 500 ohms.

NOTE: An intermittent condition in any component in the rectifier or meter circuits within the control box, as well as in the cable or potentiometer circuit in the rotator itself can cause meter fluctuation or error. Possible cause of such trouble may be localized by placing a test DC meter across Terminals No. 1 and No. 3 or No. 1 and No. 7 comparing the action of the test meter with the panel meter.

NO ROTATION - INDICATION OK

Either the thermal cut-out in the power transformer has opened or there is actually trouble in the motor circuit. After allowing time for the thermal cut-out to restore service, proceed to "Checking the Control Unit" and "Checking the Rotator from the Ground".

GROUND WIRES

Ground on cable leads can burn out either the line fuse or the small fuse in the meter circuit. If lead No. 3 or lead No. 7 is grounded, it shorts out part of the potentiometer so that as rotation progresses to the other end, the full DC voltage is applied across a decreasing portion until current becomes so high that the potentiometer burns out. Note also that any grounds may put an overload on the power transformer which could cause the line fuse to blow or overload the rectifier circuit so that the 1/8 amp fuse blows.

HELPFUL SUGGESTIONS

Be sure to check your rotator cable for shorting, open circuits, incorrect wiring, intermittent connections, shorted terminals, rodent damage, and mast support or thrust bearing binding.

CHECKING THE CONTROL UNIT

1. Voltages with Unit Plugged In.

To check the control unit, plug the line cord into AC power. With no connections to the terminals, turn the "ON-OFF" switch to the "ON" position, the meter light will illuminate. The meter needle will remain on the left hand "S".

Terminals 1 and 2 should show 30 volts AC (approximately) when the brake level is depressed.

Terminals 1 and 5 should show 30 volts AC with brake release lever depressed and CW lever depressed.

Terminals 1 and 6 should show 30 volts AC with brake release lever depressed and CW lever depressed.

Terminals 3 and 7 should show approximately 13 VDC.

2. Resistances with Unit Not Plugged In.

Disconnect the AC power source and disconnect the 8-wire control cable.

The control box can be checked without removing the cover by using a volt-ohmmeter to check values across terminals. Resistance across Terminals 1 and 2 should read 4 ohms. Read same value across Terminals 1 through 5 with clockwise switch lever (right hand) depressed and across Terminals 1 through 6 with counterclockwise switch lever (left hand) depressed. Resistance across input line cord with "ON-OFF" switch in the "ON" position and the brake lever depressed should read 3.8 ohms

CHECKING THE ROTATOR FROM THE GROUND

You may possibly avoid bringing the rotator down by making electrical checks from the control box position. This is done by disconnecting the eight wire control cable from the control unit. From the schematic diagram, it is apparent that the resistance of the lead wires will be added to the resistance of the motor windings and potentiometer strip in making the resistance checks as shown in Table 2.

Read To Check	Between Resistance	Terminals
Brake Solenoid	.75 ohms + leads	1-2
1/2 Motor Winding	2.5 ohms + leads	1-8
1/2 Motor Winding	2.5 ohms + leads	1-4
1/2 Motor + Switch	2.5 ohms + leads	1-6
1/2 Motor + Switch	2.5 ohms + leads	1-5
Entire Motor	5 ohms + leads	8-4
Right Limit Switch	0 ohms + leads	8-5
Left Limit Switch	0 ohms + leads	4-6
Entire Pot	500 ohms	3-7
Pot Arm to + End	0 to 500 ohms	3-1
Pot Arm to - End	0 to 500 ohms	7-1

Table 2

ADDITIONAL CHECKLIST

1. Check continuity of control wires for loose connections caused by wind.
2. Tape down control cable securely all the way to rotator.
3. Check motor winding through control cable as outlined in Table 2.
4. Check cable between leads. Static lightning charges or direct hits will cause carbon arcs in control cable at numerous spots along the cable that cannot be seen. This resistive path will break down with voltage applied to rotator. (Replace cable.)
5. Check both control and rotator connectors for shorts.
6. Rotation in one direction usually indicates a loose or broken cable wire, bad relay, and bad sensing transistors in some units.
7. Be sure cable is of proper size for length used. Refer to Table 1.
8. Substitute a 3 foot piece of new rotator cable to bench test unit. Proper operation will indicate a defective rotator cable on the mast or tower, or a cable not large enough to create proper turning torque.
9. Low line voltage and cold weather will slow rotation. Using an extra long or small wire extension cord can lower line voltage.

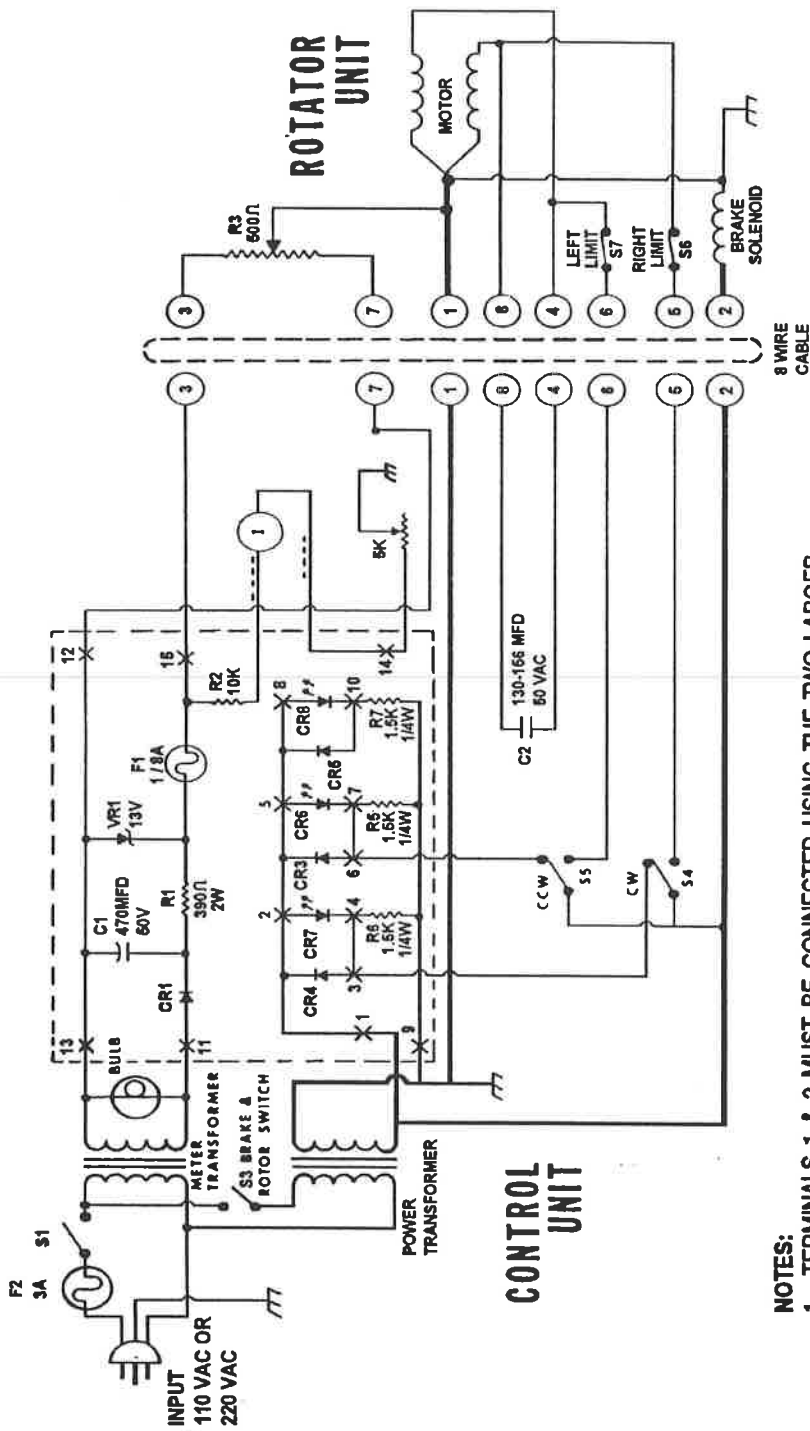
How To Get Factory Service

If service is required, the unit must be packed securely and sent prepaid to:

hy-gain
308 Industrial Park Road
Starkville, MS USA

For units that are in warranty, no charge will be made for any repair work required. Include a copy of your sales receipt. For out-of-warranty units, call the Warranty Service Department for prices.

The price includes rebuilding the unit, replacing all defective and/or worn parts, and return freight charges. Hy-Gain reserves the right to change prices at its option. When returning items for repair, a check, money order, Visa or Mastercard number for the repair charges must be included. Be sure to include your name, address, zip code, and telephone number. Also, give a brief description of the problem.



- NOTES:**
1. TERMINALS 1 & 2 MUST BE CONNECTED USING THE TWO LARGER GAUGE WIRES OF THE 8-WIRE CABLE.
 2. "X" DENOTES WIRING CONNECTION TO THE P.C. BOARD.
 3. "-.-.-" DENOTES MECHANICAL CONNECTION TO METER.

Figure 8
T2X Schematic

PARTS LIST

T2XControl Unit Replacement Parts

Item No.	Part No.	Description	Qty
1	5140302	Control Unit, 220 VAC, complete	1
2	5140300	Control Unit, 120 VAC, complete	1
3	5139200	Printed Circuit Board Assembly	1
10	5056300	Fuse, 1/8A, F-1	1
11	5143000	Diode, Light Emitting, Red, CR-6, CR-7	2
12	5143001	Diode, Light Emitting, Green CR-8	1
13	1034403	Fuse, 3A, F-2	2
14	5056300	Fuse, 1/8A, F-1	2
15	5089501	Bulb, meter	2
16	710053	Fuse, 1A, SLO-BLO, F-2	2
17	5138500	Switch, S-3, S-4, S-5	3
18	5140600	Diode, Light Emitting, Red	2
19	5140601	Diode, Light Emitting, Green	1
20	5018700	Knob, Calibration	1
21	640076	Socket, Cinch, S-308-AB	1
22	520057	Screw, #6-32 x 3/8", Pan Head	9
23	5088400	Lever, Switch for S-3, S-4, & S-5	3
24	450403	Strain Relief	1
25	560068	Washer, backup (for 220V ONLY)	1
26	5141100	Cover, Top	1
27	5141200	Cover, Bottom	1
28	5152700	Pads, Skid	4
29	1073301	Transformer (Power), 120 VAC	1
30	5017700	Transformer (Meter), 120 VAC	1
31	1073501	Transformer (Power), 220 VAC	1
32	5020200	Transformer (Meter), 220 VAC	1
33	5151500	Capacitor, Motor start, C-2, 130-156 MFD	1
34	5086100	Cord, Power, 3-wire, 120 VAC, U.S.	1
35	5079800	Cord, Power, 220 VAC, European	1
36	5147701	Meter (with Bezel & Hardware)	1
37	710061	Holder, Bulb	1
38	5103600	Bracket	1
39	5175200	Switch, On/Off (S-1)	1
40	723406	Potentiometer	1
41	10563000	Holder, Fuse (for F-2, 110V Version)	1
42	1034403	Fuse, 3A (3AG, LTLF, 312003)	1
43	710054	Holder, Fuse (for F-2, 220 Version)	1
44	5137300	Faceplate	1
45	5089102	Chassis	1
46	5105000	Flatwasher	1
47	10563205	Screw, #6-32 x 5/16", round head	2
48	450431	Strain relief, Heyco 1217	1
49	506325	Bolt, Hex Head, 1/4"-20 x 3/4"	1
50	550029	Wingnut, 1/4"-20	1
51	556960	Nut, Hex, 1/4"-20	1
52	567110	Lockwasher, internal, 1/4"	2
53	567120	Flatwasher	2
54	5140700	Plate, Logo	1

* :220V Version

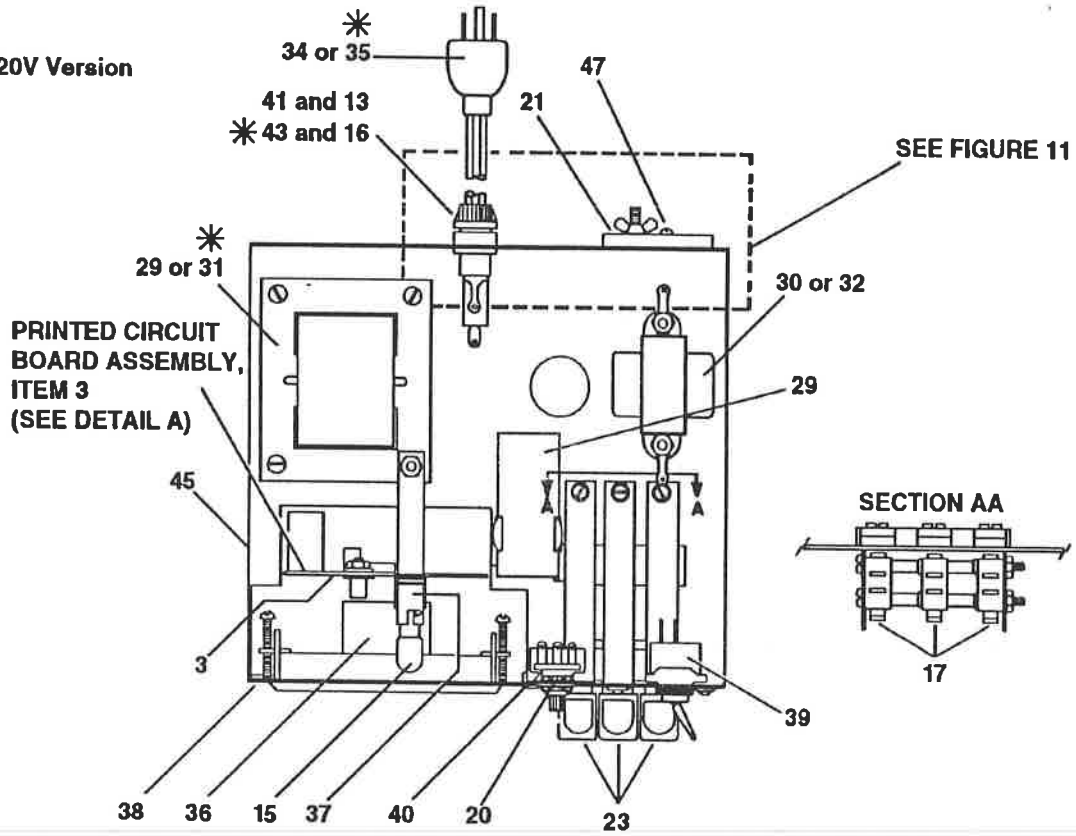
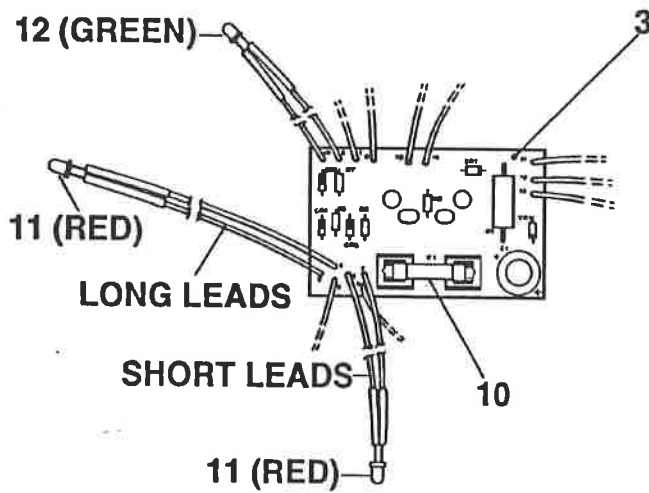


Figure 9
T2X Control Unit
Inside-Top View



Printed Circuit Board
Detail A

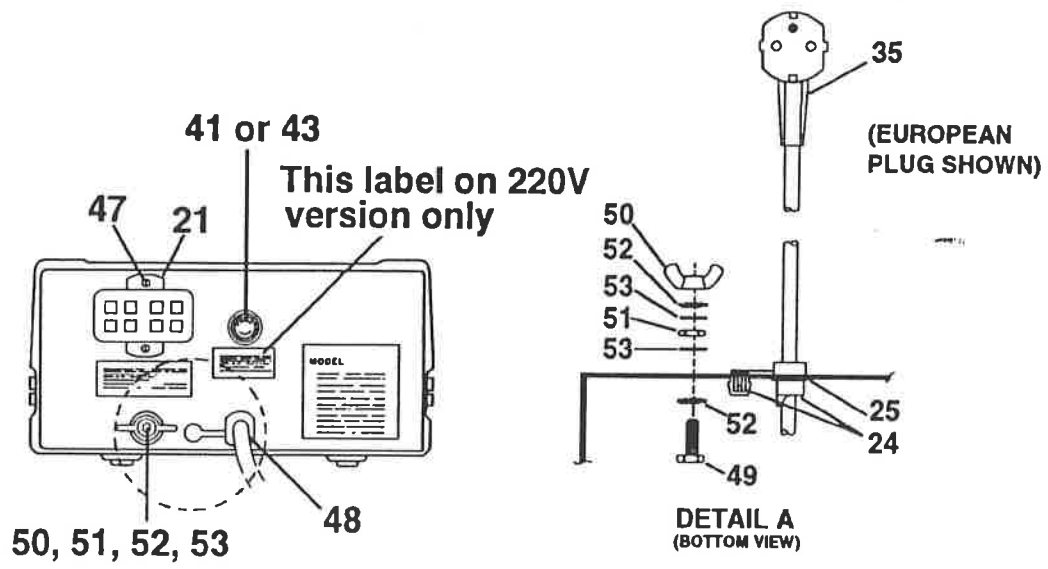


Figure 10
Rear View of T2X Control Unit

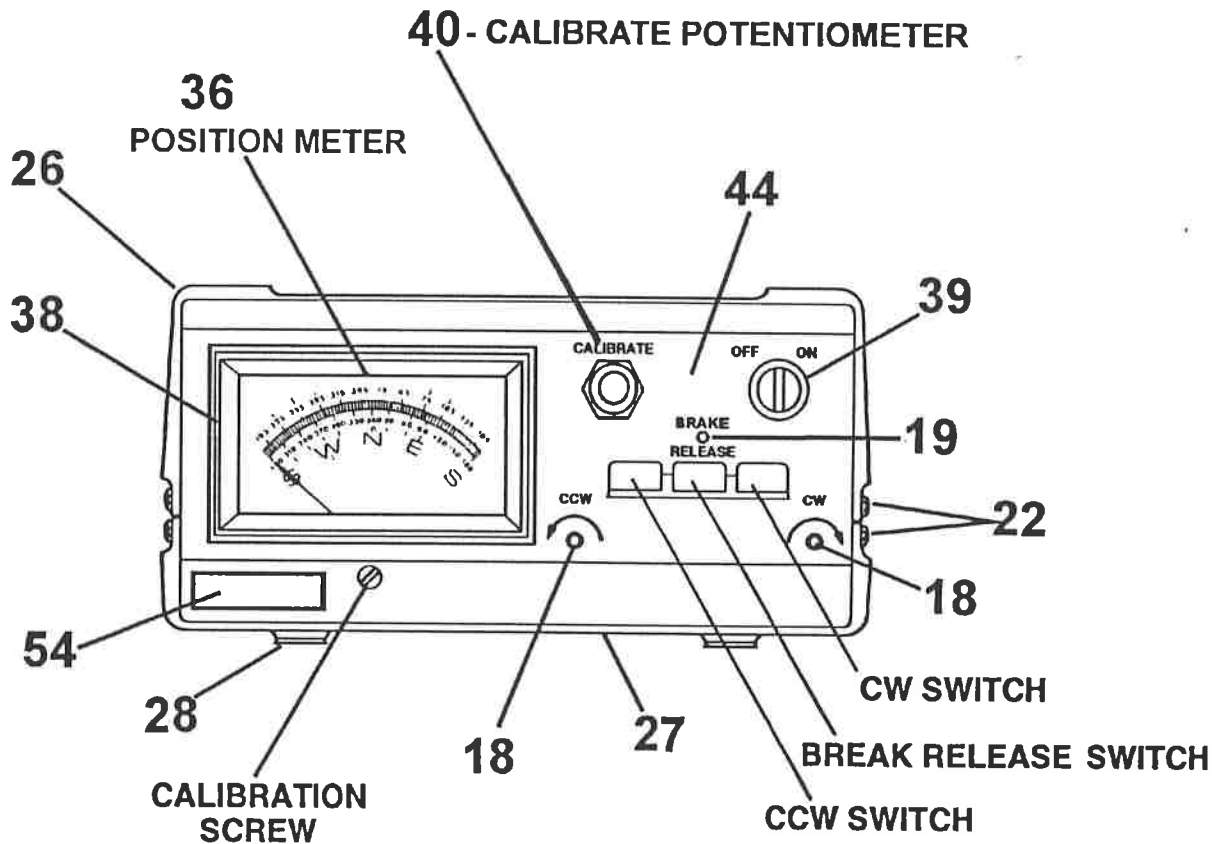


Figure 11
Front View of T2X Control Unit

T2X Rotator Replacement Parts

Item No.	Part No.	Description	Qty
101	5137700	Rotator	1
102	5136201	Upper Mast support (Bell Casting)	1
103	5136301	Brake Housing	1
104	5033501	Ball Bearings (Unit1)	98
		Ball Bearings (Unit 2)	40
105	5011300	Bearing Retainer (Unit 1)	1
		Bearing Retainer (Unit 2)	1
114	5136101	Gear, High-Strength Drive (Ring Gear)	1
117	5137600	Motor and Pinion (brass)	1
118	5023100	Potentiometer	1
119	5009900	Solenoid (Brake)	1
128	5151401	Wedge, Brake	1
135	509711	Bolt, 5/16-18 x 2", Hex Head, ss	6
136	555747	Nut, Hex, 5/16"-18, ss	6
137	564792	Lockwasher, Split, 5/16", ss	6
138	450590	Strain relief, Heyco	1
139	610215	Cable, 2 #16, 6 #18	A/R
141	650179	Receptacle, AMP	1
158	5146110	Assembly, End of Rotation	1
	5142210	Kit, Accessory	1
160	5137000	Plate, Mast Clamp	1
161	5136900	U-Bolt, 5/16"-18 x 3 1/4" X 4"	2
140	5149600	Bolt, hex head, 5/16"-18 x 1 5/8", ss	6
162	5142400	Bolt, hex head, 5/16"-18 x 3 1/2", ss	1
136	555747	Nut, hex, 5/16"-18, ss	11
	870598	Parts Pack, Connector	1
163	650181	Plug, 9 pin	1
164	650180	Receptacle Shell	1
165	650293	Contact	8
166	640077	Plug, 8 pin Cinch	1
167	890014	Ferrite bead, Type 73	4
168		Grease, Special Kit (Quantity for one overhaul)	1

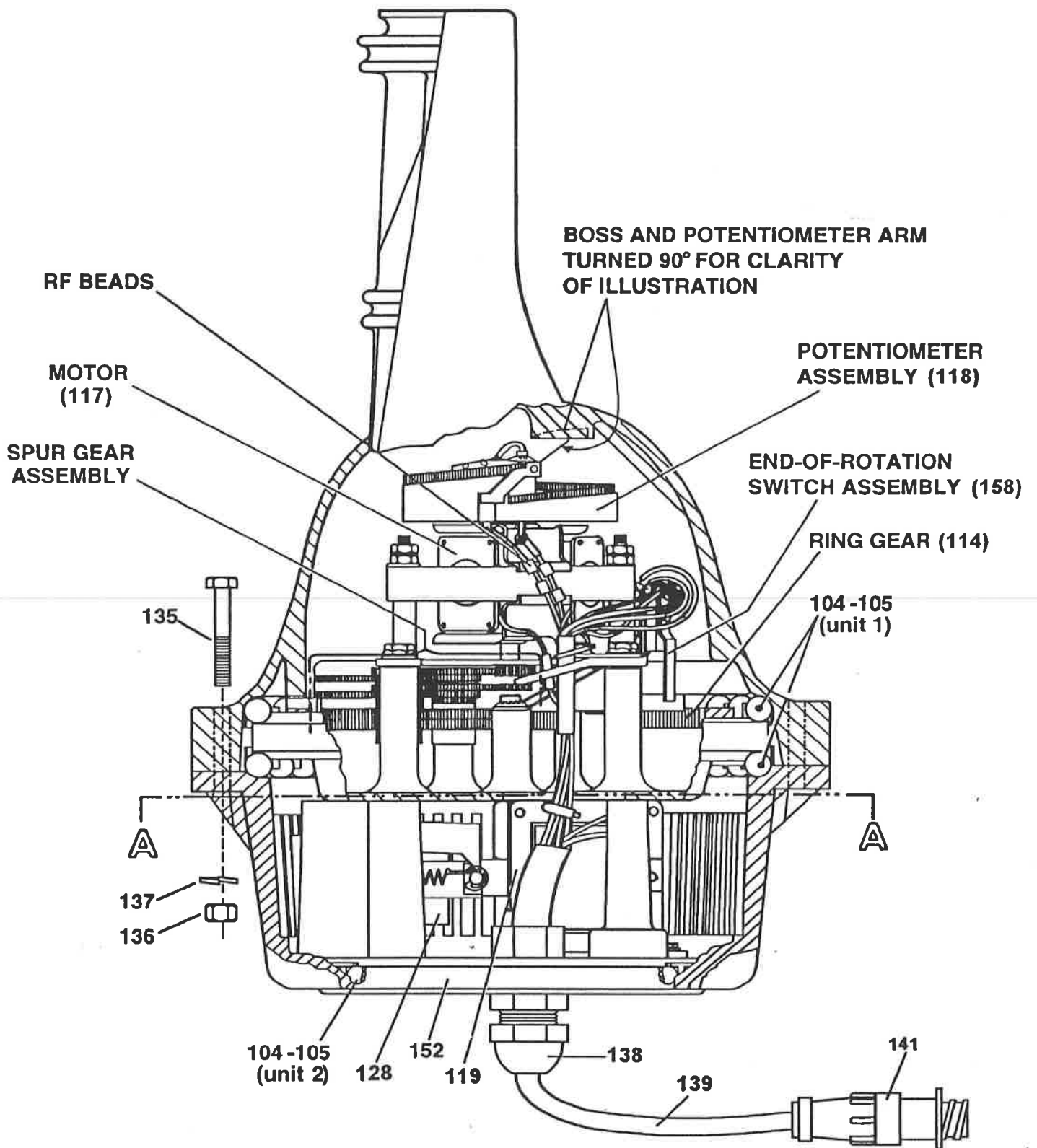


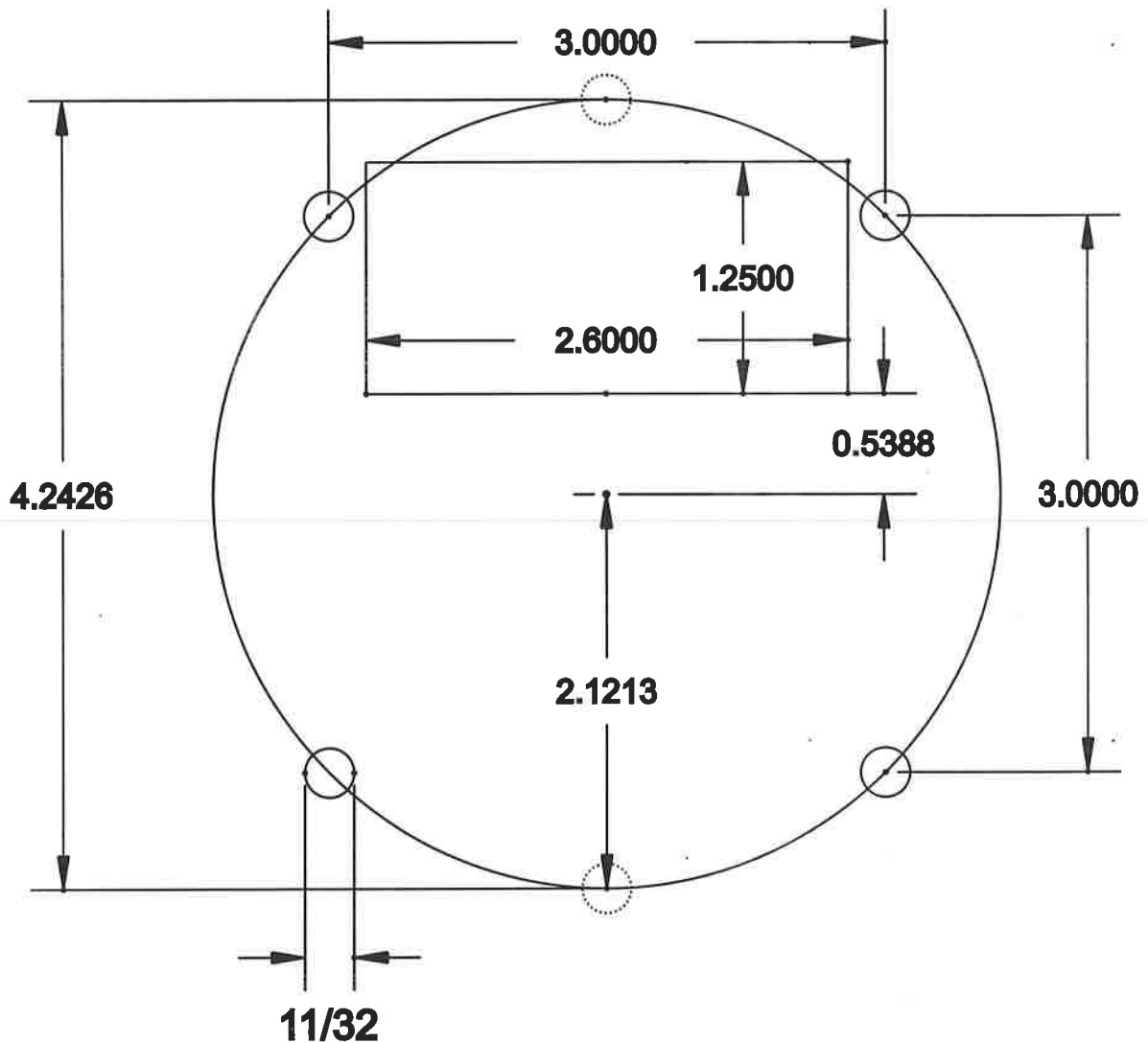
Figure 12
 Inside View of T-2X Rotator

hy-gain® LIMITED WARRANTY

hy-gain Warrants to the original owner of this product, if manufactured by *hy-gain* and purchased from an authorized dealer or directly from *hy-gain* to be free from defects in material and workmanship for a period of **12 months** for rotator products and **24 months** for antenna products from date of purchase provided the following terms of this warranty are satisfied.

1. The purchaser must retain the dated proof-of-purchase (bill of sale, canceled check, credit card or money order receipt, etc.) describing the product to establish the validity of the warranty claim and submit the original or machine reproduction of such proof-of-purchase to *hy-gain* at the time of warranty service. *hy-gain* shall have the discretion to deny warranty without dated proof-of-purchase. Any evidence of alteration, erasure, or forgery shall be cause to void any and all warranty terms immediately.
2. *hy-gain* agrees to repair or replace at *hy-gain's* option without charge to the original owner any defective product under warranty, provided the product is returned postage prepaid to *hy-gain* with a personal check, cashiers check, or money order for \$8.00 covering postage and handling.
3. Under no circumstances is *hy-gain* liable for consequential damages to person or property by the use of any *hy-gain* products.
4. Out-of-warranty Service: *hy-gain* will repair any out-of-warranty product provided the unit is shipped prepaid. All repaired units will be shipped COD to the owner. Repair charges will be added to the COD fee unless other arrangements are made.
5. This warranty is given in lieu of any other warranty expressed or implied.
6. *hy-gain* reserves the right to make changes or improvements in design or manufacture without incurring any obligation to install such changes upon any of the products previously manufactured.
7. All *hy-gain* products to be serviced in-warranty or out-of-warranty should be addressed to *hy-gain*, **308 Industrial Park Road, Starkville, Mississippi 39759, USA** and must be accompanied by a letter describing the problem in detail along with a copy of your dated proof-of-purchase.
8. This warranty gives you specific rights, and you may also have other rights which vary from state to state.

CLEARANCE HOLES TO BE 11/32"



Tower Drilling Template

This information is believed correct, but no warranty is given or implied and no liability is assumed by Hy-Gain as to its accuracy or completeness. Changes may be made from time to time so that the user should verify all factors that may be critical. This information is not to be construed as authorizing or advising use of any patented invention.

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