

HAM V / HAM VX
Antenna Rotator System Including
DCU-1 Digital Controller

Instruction Manual

hy-gain[®]

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CHAPTER 1 INSTALLATION AND OPERATION

Section 1. Components of the Ham-V

General Description

The Ham-V rotator system consists of a heavy duty rotator and the new DCU-1 "Pathfinder" digital control unit. The rotator is designed to be mounted on a plate inside a communications tower, and is attached to a vertical steel mast. The DCU-1 control unit must be installed indoors and connected to the rotator by an 8 conductor cable.

The DCU-1 "Pathfinder" digital control unit features 6 memory presets, automatic brake delay (8 seconds), automatic motor slowdown (last 5 degrees), automatic motor control on startup, programmable center of rotation, full circle analog display of current and target bearings, digital display of current and target bearings, automatic display blanking of target bearings (30 seconds), automatic display blanking (30 minutes), RS-232 control with pass-through, and an 8 pin socket for the control cable.

The Ham-V rotator features low temperature operation (-30 deg. F/ -34 deg. C), a weatherproof AMP connector with gold-plated contacts, an improved high-strength steel drive gear, RF beads on the potentiometer lines, wedge brake, and safe 26 volt operation.

The Ham-V also features a rugged powder-coat finish on the rotator unit

The rotator unit must be connected to the control unit with an 8-wire cable. You may assemble your own cable from the information supplied in this manual.

The Ham-V rotator system consists of the following main components:

P/N 5137202	Ham-V Rotator Assembly
P/N 870804	DCU-1 Control Unit Assembly (110 VAC)
P/N 870842	DCU-1 Assembly Control Unit (220 VAC)

It is recommended that you use this rotator system with compatible antennas and towers. For example, the maximum antenna size for this system is 15 sq. ft. (1.4 sq. m). Therefore, if you anticipate using antennas near this limit, the tower system should also be rated for wind areas of this magnitude. If you are considering antennas with long booms and/or long elements, do not exceed the Effective Moment specification of 2800 ft. lb. (387 Kg m). EM is defined as the antenna turning radius times weight. Antennas with long booms and elements have much more angular momentum and exert more torque on rotator systems than antennas with shorter booms and

Options:

The optional heavy-duty lower mast support kit must be procured if you elect to use a mast mount (see Figure 5 and 9). The part number for this kit is 51467 10. When using the lower mast support, the antenna size is restricted to 7.5 square feet of wind area. The "inside tower mount" configuration is recommended (see Figure 3 and 8).

A 3 foot cable with a pre-assembled AMP connector may be ordered as product 307-3. The other end of the cable has bare wires. You must supply the connector for this end!

Section 2.

Specifications

Electrical:

Input voltage	120 VAC 60 Hz, 3 Amp max.
Motor	24 VAC, 2.25 Amp, capacitor start/run
Brake Solenoid.....	24 VAC, 5 Amp
Power Transformer	120 VAC/26 VAC 10% duty, thermal switch protected

Maximum Cable Resistances:

Pins 1 and 2.....	0.8 ohms
Pins 3 - 8	2.0 ohms

Rotator Mechanical:

Maximum Antenna Size:

Inside Tower Mount:

Wind Surface Area.....	15 sq. ft. (1.4 sq. m)
*Effective Moment.....	2800 ft. lb. (387 Kg. m)

Outside Tower Mount:

Wind Surface Area.....	7.5 sq. ft. (0.7 sq. m)
*Effective Moment.....	1125 ft. lb. (155 Kg. m)

Rotator Size	8" x 13.5" (O.D. x H) (20 x 34 cm)
--------------------	---

Antenna Mast Size	1.875 - 2.063" O.D. (48-52 mm)
-------------------------	--------------------------------

Operational Temperature Range	-30 deg F to +210 deg F (-34 deg C to +99 deg C)
-------------------------------------	---

Brake.....	positive, electrically operated wedge 75 segments, 4.8 degrees apart
------------	---

Rotation time	50-65 seconds for 360 degrees
---------------------	-------------------------------

Mounting Hardware.....	stainless steel bolts and nuts plated steel clamp
------------------------	--

* Effective Moment is defined as the antenna turning radius times the weight.

DCU-1 Digital Control Unit:

Size	8.5"x4.3"x9.0" (WxHxD) (21.6x 11.0 x22.8 cm)
Control Unit	Gas Plasma, Amber filter
Display: Type	
Scale	
Blankin	5 degree (Analog), 1 degree (Digital)
Display Life Memory	Target Bearing (8/60 seconds) Total (30 minutes after no activity)
Presets Rotation Center	30,000 to 40,000 hours
Brake Delay Automatic	6, independently programmable
Motor Control	User selectable, 0 - 360 degrees 8 seconds, fixed - momentary reverse direction on start-up
Front Panel	-automatic stop if no rotator movement detected in 8 seconds - motor pulse (half-cycle) on last 5 degrees before stop 1 Knob (36 pos. digital encoder) - sets target bearing - sets center of rotation in calibrate mode - increment of 1 degree (slow speed mode) and 7 degrees (high speed mode) 6 Memory Preset (pushbuttons) 1 Start Rotation (pushbutton) - also starts EPC (calibration) 1 Stop Rotation (pushbutton) 1 Display (pushbutton)
Rear Panel Items	- turns on display after blanking - enters calibration mode 1 8-pin socket (rotor

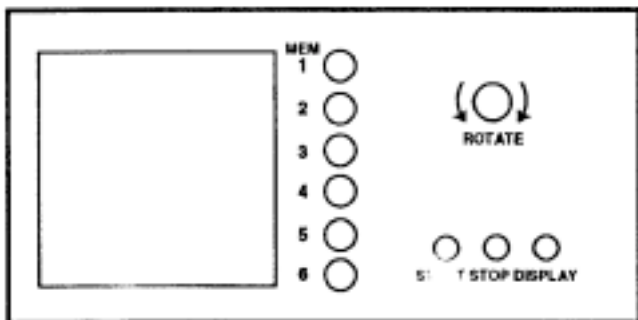


Figure 1 Front View

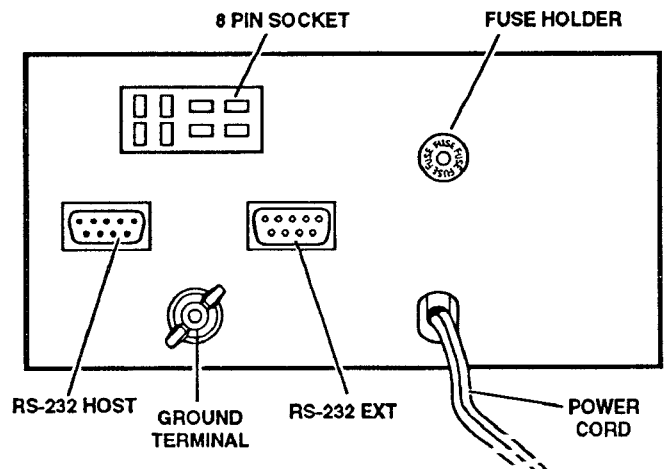


Figure 2 Back View

Section 3. Precautions

Towers and antennas require caution during erection and placement! Extreme care must be taken during erection so that metal tower and antenna parts DO NOT contact power lines, even if the parts slip, rotate, retract, fall or fracture!

Antenna position mechanisms (towers and rotators) must be placed so that if they fail, the parts of the antenna system cannot contact power lines, be a hazard to individuals, or endanger property.

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 or copper-clad 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).

It is recommended that you use a "daisy-chain" ground connection rather than connecting all units (DCU-1, radio, tuner, etc.) to the ground rod separately.

The DCU-1 Control Unit is not weatherproof and must be located in a house or other protected location. Connect a ground wire to the 1/4"-20 terminal on the back of the DCU-1.

NOTE:

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, "which can be determined by turning the equipment off and on, the user is encouraged

- Reorient or relocate the receiving
- Increase the separation between the
equipment and receiver
- Connect the equipment into an outlet on a
circuit different from that to which the
receiver is connected
- Consult the dealer or an experienced
radio/TV technician for help.

The Ham-V rotator system 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. This product is manufactured in the U.S.A.

Section 4. Installation Preparations

Types of installations:

There are three general types of rotator installations (see Figures 3, 4, and 5).

1. The recommended installation is an "inside" tower mount with a thrust bearing or bushing to provide vertical and horizontal support. The thrust bearing should mount on the top surface of the tower and should fit the size of mast you are using.

The rotator shelf should be at least three (3) feet below the thrust bearing. If a single antenna is mounted on the mast, it should be no more than one (1) foot above the thrust bearing. The thrust bearing should be of commercial manufacture and should properly fit the tower that it is attached to. If your installation follows these guidelines, this rotator system will easily handle an antenna system of 15 sq. ft. wind area or EM of 2800 ft.

**ANTENNA OR BEAM—NOT TO EXCEED
15.0 SQ. FT. (1.4 m²) WIND SURFACE
AREA LOAD**

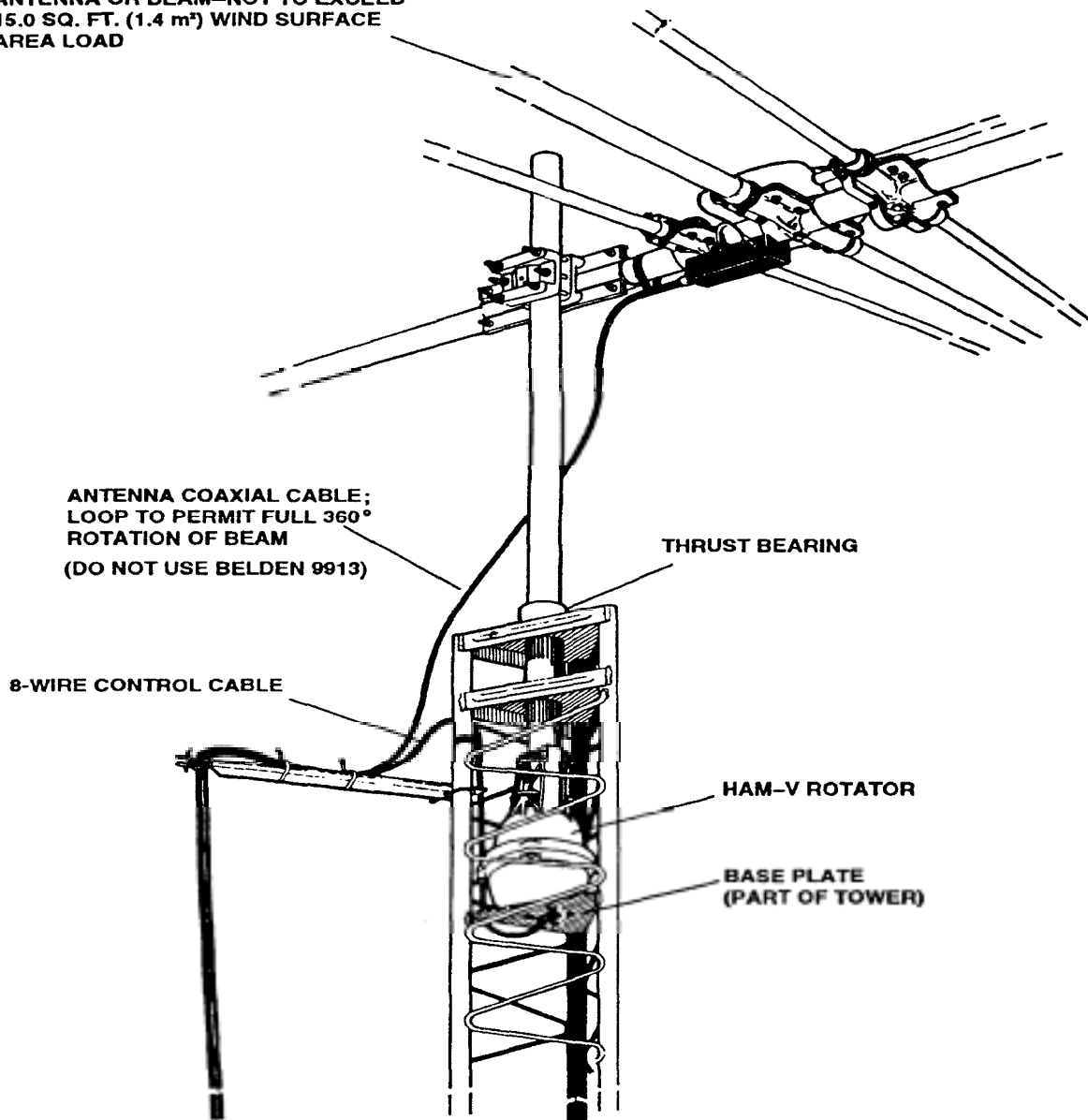


Figure 3 Rotator
Mounted Inside

2. An "outside" tower mount may be used when the rotator unit will not fit within the tower, or there is no rotator shelf provided. In this installation, the rotor mounts on a flat plate at the top of the tower. There is no thrust

In this application, it is extremely important that the antenna is mounted no more than six (6) inches above the top of the rotator. If these guidelines are followed, the rotator system will easily handle a single antenna with a 7.5 sq. ft. wind area or EM of 1125 ft. lb.

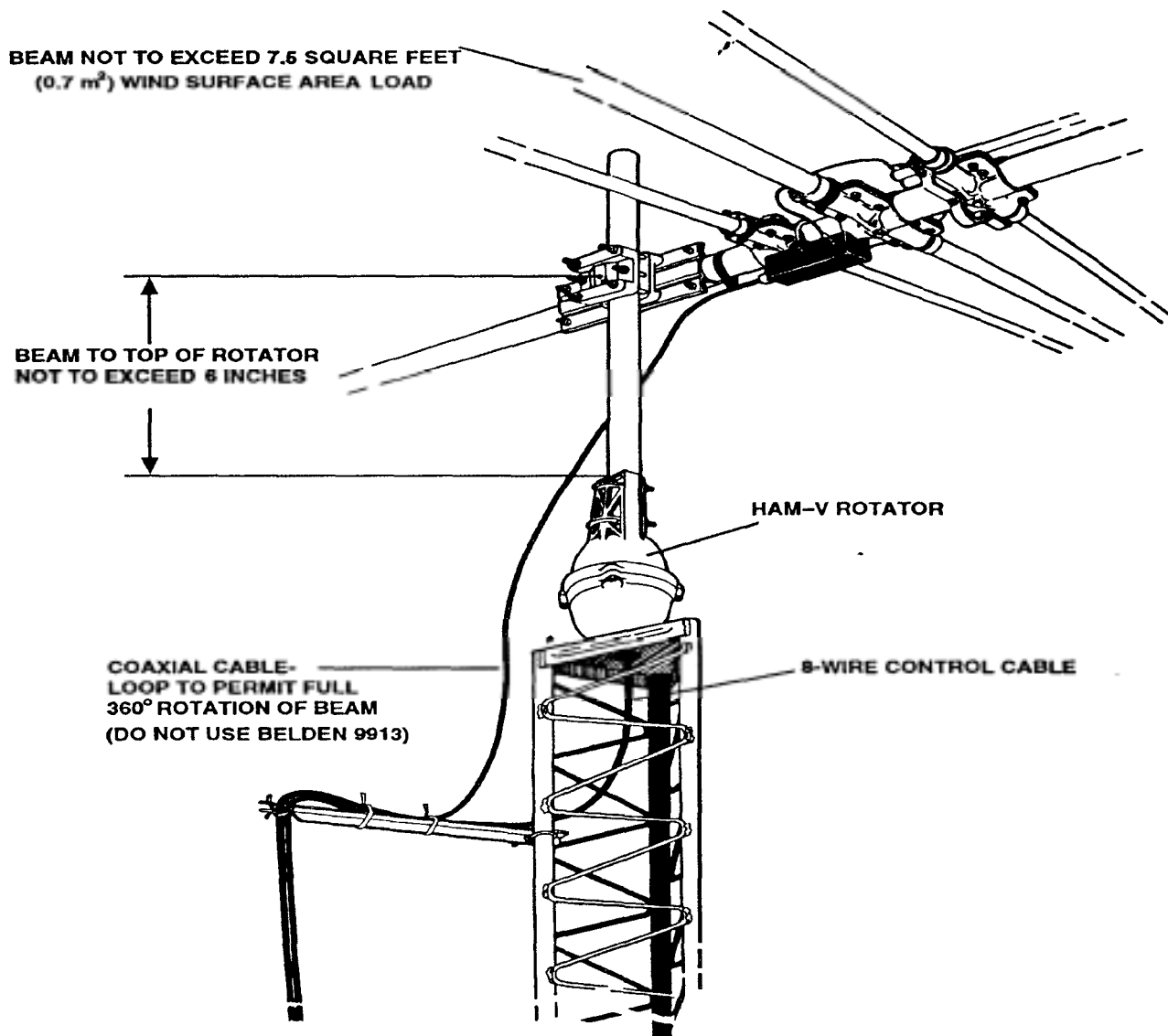


Figure 4 Rotator Mounted on Tower
Top Plate

3. A telescoping or other type mast may also be used. This installation requires the optional "Heavy Duty Lower Mast Support Kit". In this application, it is extremely important that the antenna is mounted no more than six (6) inches above the top of the rotator.

If these guidelines are followed, the rotator system will easily handle a single antenna with a 7.5 sq. ft. wind area or EM of 1125 [ft. lb.](#) Ensure that the mast is also rated for this load!

There are variations of mounting which fall generally into one of the above categories. For example, the rotator may be mounted much lower in the tower than described. In this case, more than one mast bearing may be required.

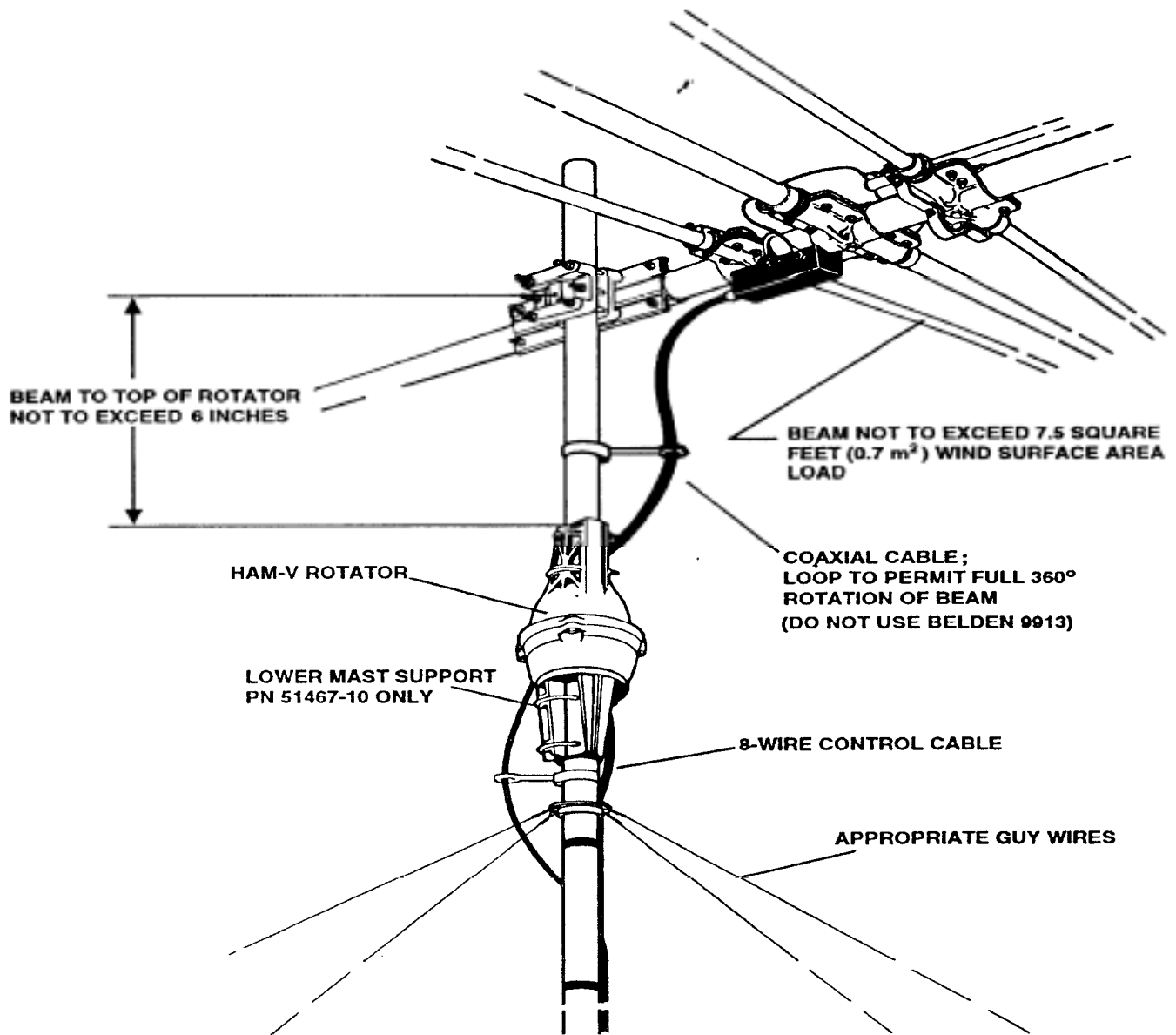


Figure 5 Pole Mounted
Rotator

Precautions

1. Unbalanced weight: Weight should be as closely balanced as possible. Unbalanced weight in an antenna creates a bending moment of force which is concentrated on the mast at the point where it is clamped to the
2. Wind Pressure: Balanced wind pressure against the antenna system produces a bending force on the mast which can cause the same stresses as unbalanced weight. To minimize these forces, a thrust bearing should be used where possible, the antenna should be as close to the top of the tower as possible and the rotator shelf should be as low as possible.
3. Unbalanced Wind: If the antenna has unequal wind areas and element spacings on each side of the mast attachment point, it could produce torque on the support mast. This is similar to the principle of a weather vane. If the unbalance is high enough or the wind velocity is high enough, this could prevent rotation or could damage the limit switches. To minimize this effect, the antenna should be designed for minimum mast torque or "torque compensators" added to produce minimum
4. Mast Binding: If the antenna support mast binds withig. the tower due to ice accumulation or other reasons, this could prevent rotation. The DCU-1 checks for rotator movement upon pressing "START", and if no movement is detected within 8
5. Extreme Cold: If the ambient temperature is at or below -30 degrees F, this could prevent rotation. If no movement is detected within 8 seconds of pressing "START", then the rotator

Section 5. Wiring and Check-

Wiring and Check-Out

1. Determine the length of control cable required and find the wire gauge (size) required from 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)

Recommended Cables:

Belden 8448
 Belden 9405
 IEWC #8612

TABLE 1

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

2. Assemble the rotator cable as shown in Figure 6, or purchase a pre-assembled cable.

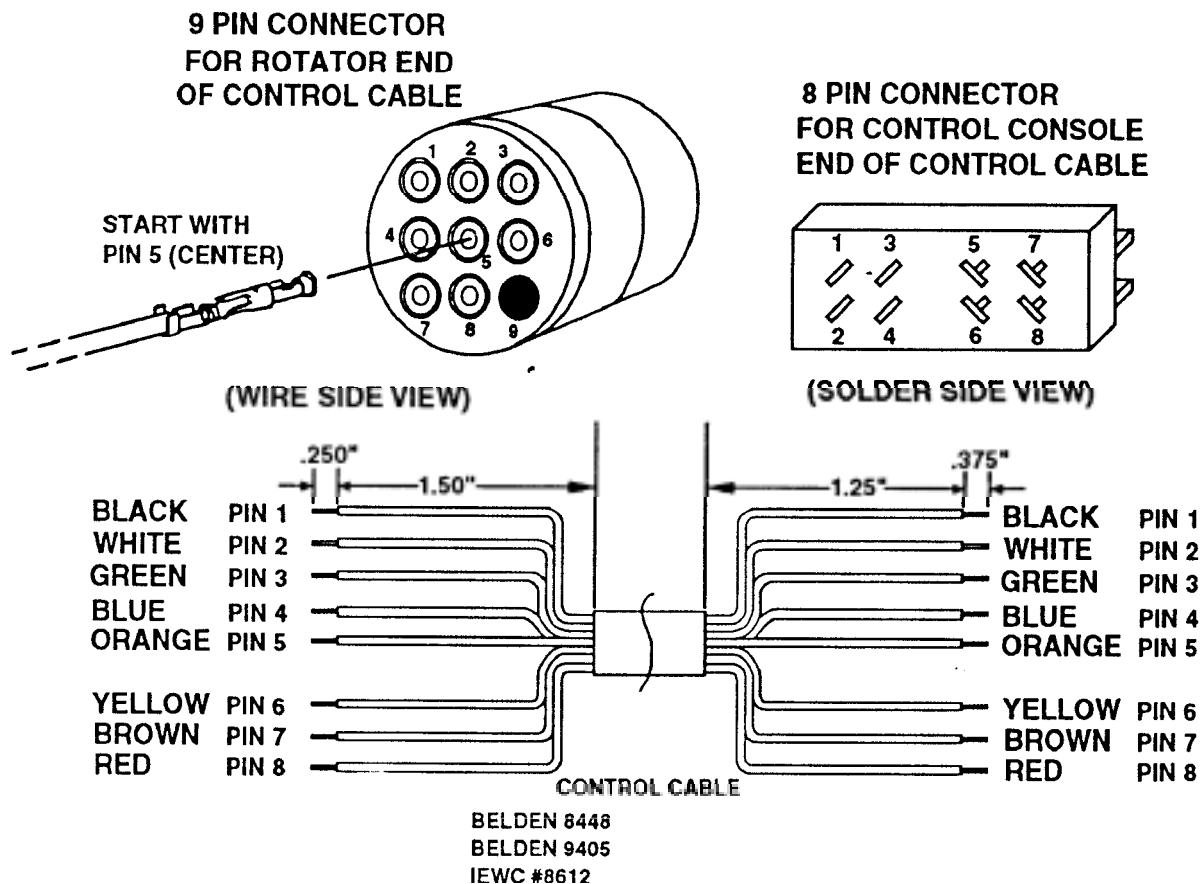


Figure 6 Control Cable Connector Attachments

CAUTION

Shorts between terminals or grounded leads may damage the rotator. Check the numbered pins on each connector with an

3. Temporarily attach the 4 screws, 1/4" - 20 x 1 1/4" (Item 147) to the bottom of the rotor unit. These will be used to support the rotator during bench-testing.
4. 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. At this time, the rotator brake wedge may momentarily release and re-engage. This is normal.

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

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. This tool consists of a tube with an OD of 0.129 and an ID of 0.115. When inserted over the contact from the front side, this tool compresses the locking tabs, permitting easy

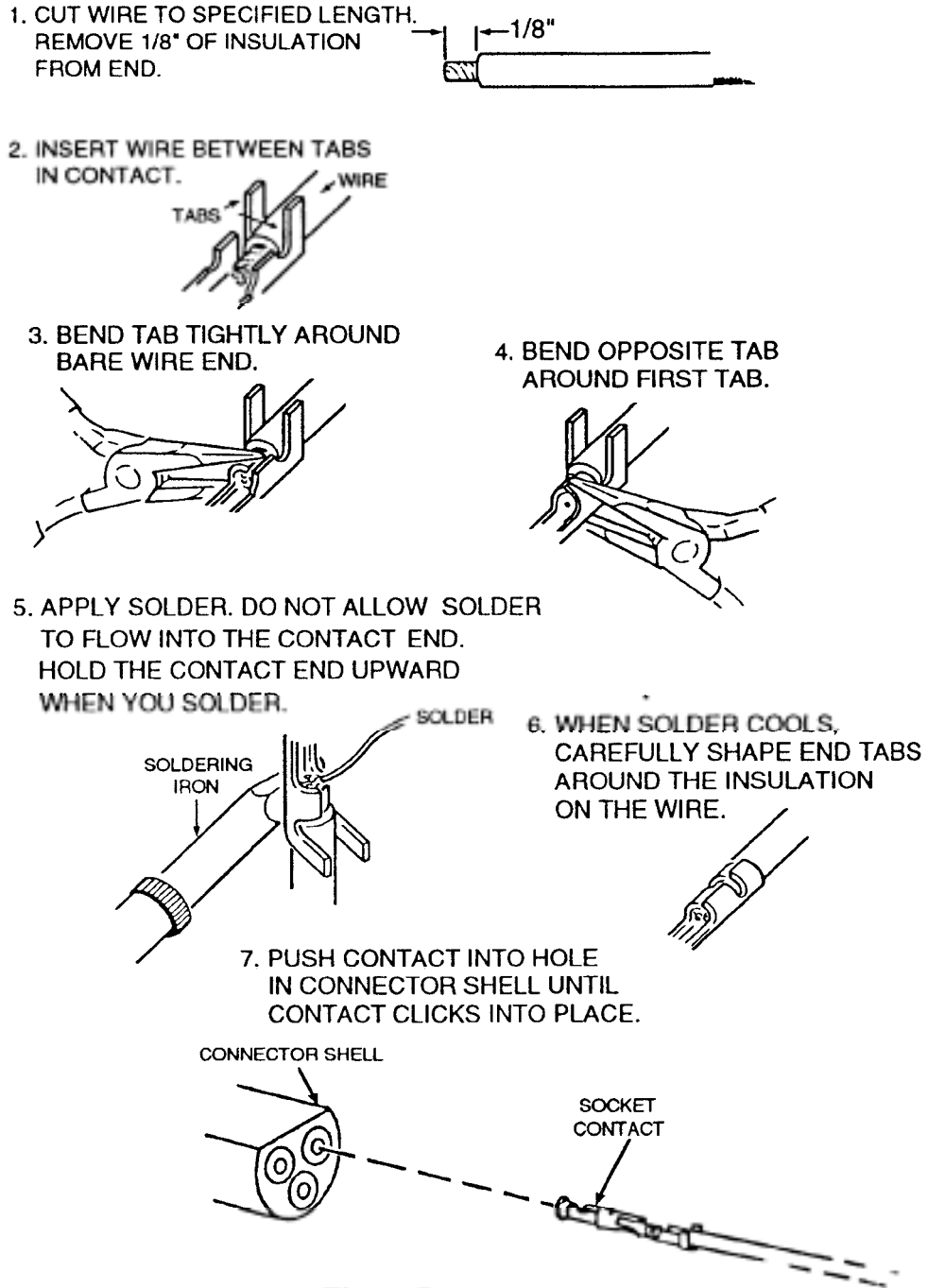


Figure 7
Attaching Contacts to Wires and Connector

5. The DCU-1 "Pathfinder" display should look similar to the display shown in Figure 7. The numeric display in the lower left corner indicates the current bearing of your rotator. The numeric display in the lower right corner indicates the target bearing. If both displays read a steady "000", disconnect your control cable and check the cable wiring with an ohmmeter. Proceed if the

NOTE: Push the "DISPLAY" button to return normal display. After approximately 60 seconds of inactivity, the target digital and analog displays will blank (disappear). After 30 minutes of inactivity, the entire display will blank.

6. If the current bearing display shows a number between "001" and "359", then proceed. Twist the knob marked with the two (2) arrows "W". The target bearing display should change along with the inner circle tick mark. The knob will increment at 1 degree per "click" at slow speeds and 7 degrees per "click" at faster speeds. Using the knob, select a target bearing at least 30 degrees from the current bearing. Push the "START" button. The brake in the rotator should release, the rotator will turn a few degrees in the opposite direction, reverse direction, then turn to the target bearing. During the last 5 degrees, the rotator will slow down to half speed, then stop on or close to the target bearing. The brake solenoid will "hum" for 8 seconds, then the brake will engage. Target display blanking will occur simultaneously with brake engagement. During

7. You may wish to repeat step 6 to confirm operation over a wide range of bearings. If the "STOP" button is depressed during rotation, rotation will stop and the brake will engage 8 seconds later. If the operation is consistent,

8. Decide on the mechanical center of rotation at this time. For example, if you would like to rotate from East to West through South, then South (180 degrees) is your center of rotation. The center of rotation can be selected as any bearing between "000" and "359". Press "DISPLAY" and hold until the letters "CAL" appear in the center of the display. The rotator should automatically turn to the mechanical center of rotation. When it has reached this position, the letters "SET" should appear in the center of the display. Twist the knob until the desired center of rotation is

The knob will increment 1 degree per "click" at slow speeds and 7 degrees per "click" at faster

Press the "START" button and hold until the rotator starts to turn. The rotator will automatically find both limit switches and set up the calibration for the center of rotation you selected. During this time, the letters "EPC" will be displayed for "End Point Calibration". When this process is finished, the "EPC" will disappear, and the rotator is ready for use. If you wish, you

9. You may set the memory presets at this time or at any time after the rotator system has been installed. To store a bearing into a memory location, select a target bearing with the knob then press and hold the appropriate memory location button until the letters "PRE" light up. You may use previously stored memory presets

10. Rotate the system to the center of rotation. You are now ready to install the rotator system in your tower or on your mast.

Hints:

Some users have labeled their memory buttons with the stick-on letters supplied with VCR tapes. Use EU for Europe, JA for Japan, AU for Australia, AF for Africa, etc.. Place the labels next to each of the 6 memory presets,

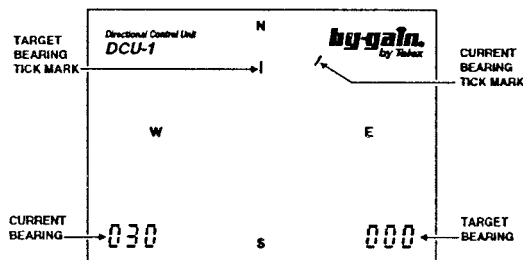


Figure 8 DCU-1
Display 1-11

Section 6. Installing the

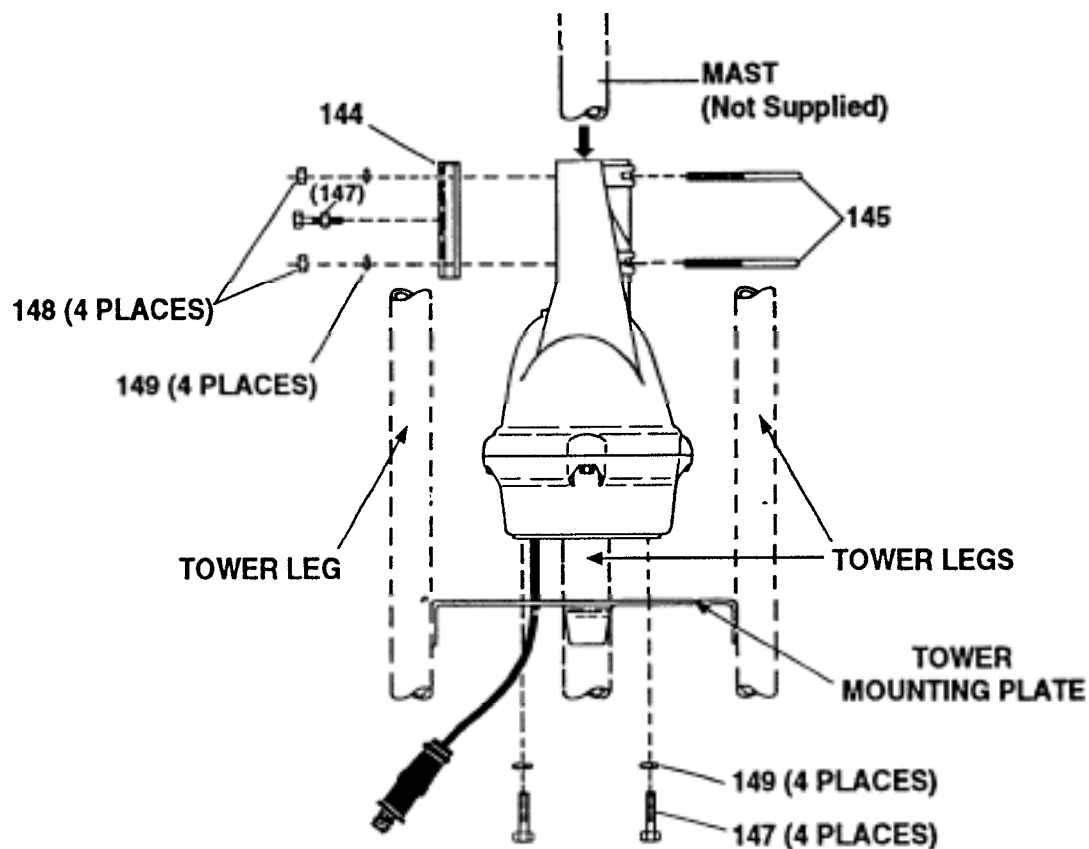
Installing the Rotator

Inside tower mount:

The rotator is mounted inside a tower, see Figure 3 and 8, to the flat tower plate by means of four (4) bolts furnished in the hardware kit. Use the following procedure:

1. Position the rotator in the tower directly under the thrust bearing. The tower plate must be cut out to allow the connecting 8-wire cable with connector to pass through the plate. If a new hole must be made, use the template in the back of this manual.

2. Attach the rotator to the tower plate by means of four (4) bolts and lockwashers (see Figure 3 and 8). The flat tower plate must be drilled in four (4) places using the template provided with this manual unless the tower plate is already properly drilled. Tighten the four (4)



Item No.	Description
144	Plate, Mast Clamp
145	U-Bolt, 1/4"-20, 2 1/4" x 3 7/8"
147	Bolt, 1/4"-20 x 1 1/4", Hex Head
148	Nut, 1/4"-20, Hex
149	Lockwasher, split, 1/4", stainless steel

Figure 9 Rotator Mounting in a Tower

3. Attach the control cable to the rotator connector as before. Using the DCU-1 control unit, turn the rotator and observe rotator movement. If everything works properly, secure the cable to the tower using proper strain-relief techniques.
 4. Assemble the mast to the rotator using the U-bolts, nuts, lockwashers, and clamp plate as shown in Figure 8. Apply a coating of heavy-duty motor oil or grease to the threads of the stainless steel U-bolts to prevent seizing. Do not tighten at this time.
 5. Center the mast within the tower thrust bearing and secure the thrust bearing to the mast. Turn the mast by hand to check for binding within the tower. Adjust the thrust bearing if required. If no binding occurs, then tighten the rotator U-bolts to secure the mast to the rotator. Install and tighten the center mast bolt at this time. See Figure 8.
 6. Turn the rotator using the DCU-1 control. Observe mast movement throughout full 360 degree rotation. If any binding occurs, reposition the rotator on the flat plate and retighten the mounting
- CAUTION:
- Do not use masts with an O.D. less than 17/8" with a thrust bearing! It is important that the rotator does not try to turn the mast**
7. Position the rotator to the center of rotation using the DCU-1 control unit. Attach the directional antenna so that it points the same direction. The coaxial cable should be attached to the mast and tower so that the rotator can freely move in both directions to the ends of rotation. The coaxial cable should be flexible enough to permit rotation without damage. Do NOT use Belden 9913 cable

Outside Tower

The rotator is mounted to the top surface of a tower, see Figure 4, by means of four (4) bolts furnished in the hardware kit. Use the following

1. Position the rotator on the top surface of the tower or other support structure and attach by means of four (4) bolts and lockwashers. The top of the tower must be cut out to allow the connecting 8-wire cable with connector to pass through the plate. If a new hole must be made, use the template in the back of this manual. Tighten the four (4) bolts.
2. Attach the control cable to the rotator connector as before. Using the DCU-1 control unit, turn the rotator and observe rotator movement. If everything works properly, secure the cable to the tower using proper
3. Assemble the mast to the rotator using the U-bolts, nuts, lockwashers, and clamp plate as shown in Figure 4. Apply a coating of heavy-duty motor oil or grease to the threads of the stainless steel U-bolts to prevent seizing. Tighten all bolts securely.
4. Position the rotator to the center of rotation using the DCU-1 control unit. Attach the directional antenna so that it points the same direction. The coaxial cable should be attached to the mast and tower so that the rotator can freely move in both directions to the ends of rotation. The coaxial cable should be flexible enough to permit rotation without damage. Do NOT use Belden 9913 cable in this rotation

CAUTION:

This rotator is designed for vertical operation with the bell-shaped housing pointing straight up. Do not mount this unit either horizontally

Mast mount

The rotator is mounted to a vertical mast, see Figure 5 and 9, by means of four (4) bolts and the optional lower mast support, P/N 5146710. Use the following procedure:

1. Attach the rotator to the lower mast support by means of four (4) bolts, nuts and lockwashers. Tighten the four (4) bolts. Attach this assembly to the top of the mast as shown in Figure 5. Tighten all bolts securely.
2. Attach the control cable to the rotator connector as before. Using the DCU-1 control unit, turn the rotator and observe rotator movement. If everything works properly, secure the cable to the mast using proper
3. Assemble the top mast to the rotator using the U-bolts, nuts, lockwashers, and clamp plate as shown in Figure 8. Apply a coating of heavy-duty motor oil or grease to the threads of the stainless steel U-bolts to prevent seizing. Tighten all bolts securely.
4. Position the rotator to the center of rotation using the DCU-1 control unit. Attach the directional antenna so that it points the same direction. The coaxial cable should be attached to the mast and tower so that the rotator can freely move in both directions to the ends of rotation. The coaxial cable should be flexible enough to permit rotation without damage. Do NOT use Belden 9913 cable in this rotation

NOTE: Belden 9913 Coax has a solid center conductor and an air-space dielectric. It is not flexible enough to use in a rotation loop.

Section 7. Optional Accessory

Optional Heavy-Duty Lower Mast Support Kit

DN 5116710

This kit contains a heavy-duty lower mast support and the necessary hardware to facilitate mounting the rotator on a mast.

CAUTION:

When the rotator is installed using the lower mast support kit, the antenna size must be restricted to 7.5 square feet (0.7 sq. m.) of

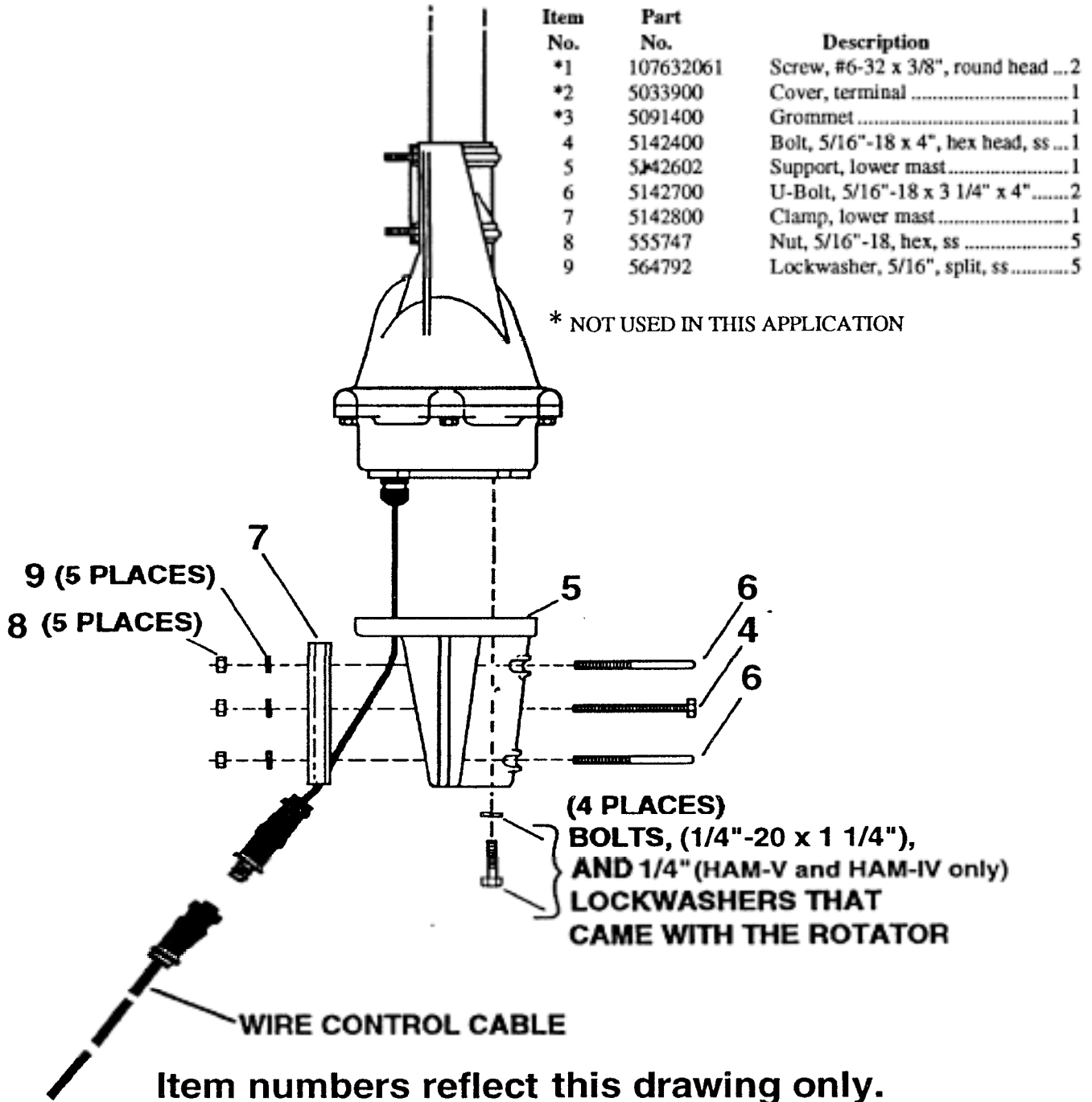


Figure 10 Rotator Mounting with (optional) Lower Mast Support 1-15

Section 8. Operation of DCU-1 "Pathfinder" Control

Operation of DCU-1 Control Unit

Precautions:

1. 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 assembly automatically shuts off power if the transformer becomes too hot. It will automatically reset after approximately 10
2. Display Protection: The gas-plasma display will be turned off during periods of inactivity to extend its useful life. After approximately 30 to 45 seconds of inactivity, the target digital and analog displays will blank (disappear). After 30 minutes of inactivity, the entire display will blank. Push the "DISPLAY" button to return normal display.
3. Brake Wedge Protection: The brake wedge will only engage after waiting eight seconds after removing power from the motor. This allows large antenna systems to coast to a complete stop before engaging the brake. Even if the "STOP" button is pressed, the system will still wait eight (8) seconds before dropping the brake. The brake will immediately engage if AC power is

-----CAUTION; -----
Do not reverse rotation direction during rotation! This will cause the system to hang with the brake released. Pressing "STOP" will reset the system.

Normal Operation

The numeric display in the lower left corner and the outer circle tick mark always indicates the current bearing of your rotator. The numeric display in the lower right corner and the inner circle tick mark indicates the target bearing. This display is also used during calibration to select the center of rotation. The center alpha-numeric display is used during the calibrate routine and to indicate memory preset selections. The tick marks may fluctuate between (two marks if the rotator is moving in the wind and the digital bearing ends

To move the rotator to a new bearing, either the knob, memory presets, or a combination of these may be used to select the new bearing. To start rotation to this new bearing, press "START". The brake in the rotator will release, the rotator will turn a few degrees in the opposite direction, reverse direction, then turn to the target bearing. During the last 5 degrees, the rotator will slow down to half speed, then stop on or close to the target bearing. The brake solenoid will stay on for 8 seconds, then the brake will engage. The target display will also blank simultaneously. During rotation, the outer circle tick mark will move to

If the "STOP" button is pressed during rotation, rotation will stop and the brake will engage 8 seconds later.

To store a bearing into a memory location, select a target bearing with the knob then press and hold the appropriate memory location button until the letters "PRE" light up. You may use previously stored memory presets and the knob to select new bearings to store.

NOTE: The rotator may end up a few degrees off the desired target bearing. This is because the brake wedge locks into place every five (5) degrees. This should not cause any problems in most HF and VHF installations.

Computer Operation

The DCU-1 may be controlled from your computer via a RS-232 cable connection. The rear panel has two (2) RS-232 connectors. The connector marked "HOST" is a DB9 female connector and should be directly connected to the host computer. Do not use a null-modem connection. The connector marked "EXT" is a DB9 male connector and should be connected to other ham equipment such as a modem, TNC, or radio interface unit. If the "EXT" connector is not attached to other equipment, it should be terminated with the supplied plug. The supplied termination plug shorts DTR, DSR and DCD (Pins 4,6, 1) together and RTS and CTS (Pins 7

The cable which is attached to the computer and to the DCU-1 should have a DB9 male connector at one end and either a DB9 female or DB25 female connector at the other end. The connections should be straight through, e.g. pin 1 to pin 1, pin 2 to pin 2, etc if both ends have 9 pin connectors. If a DB25 female connector is used to attach to the computer's COM 1 or COM2 port, use the wiring guide shown in Figure 10. You may also purchase a pre - assembled cable from Hy-Gain to connect your computer to the DCU-1. Order either DCU-9P or DCU-25P

Your other computer peripheral equipment should connect to the "EXT" connector as they would normally connect to your computer com-port.

	Signal Name	DB9 pin	DB25 pin
DCD	Data Carrier Detect	1	8
RX	Receive Data	2	3
TX	Transmit Data	3	2
DTR	Data Terminal Ready	4	20
GND	Signal Ground	5	7
DSR	Data Set Ready	6	6
RTS	Request to Send	7	4
CTS	Clear to Send	8	5
RI	Ring Indicator	9	22

Figure 11
Wiring Guide

Command:	Result:
AP1***;	Sets Target Bearing in DCU-1
(***is a three digit number between 000 and 359)	
AM1;	Starts Rotation to Target Bearing
AS1;	Stops Rotation
;	Resets system after any previous command

Figure 12
Command Set

A sample BASIC program is shown in Figure 12 which can be used to control operation of the DCU-1. Other software vendors may also include the ability to directly control the DCU-1 from within a logging or rig control program.

The commands are similar to those used by Kenwood in controlling radio operations. A summary of unique commands is shown in Figure 11. The COM port should be used at 4800 baud with no parity, 8 data bits, 1 stop bit and ASCII mode. This is usually shown as "4800,N,8,1,ASC".

After a command is sent to the DCU-1, all other motor and brake operation is automatic. There are no provisions at this time to send current bearing information back to the computer.

You may wish to check with our Customer Service Department from time to time in order to obtain the latest firmware upgrades. See Section 16, page 32. Phone (402) 467-5321 or (402) 465-

```
10 CLS
PRINT " "
PRINT " HY-GAIN DCU-1 ROTATOR CONTROL"
PRINT " REV. 1.5 12-02-94"
PRINT " "
PRINT " "
PRINT " "
INPUT " Press 'Enter' to continue: ",Z$
CLS
20 INPUT " Choose either COM1 or COM2: (Enter 1 or 2) ",COMPT
IF COMPT < 1.5 THEN 30 ELSE 40
30 OPEN "COM1:4800,N,8,1,ASC" FOR OUTPUT AS #1
PRINT #1,";"
PRINT " "
PRINT " Opening COM1 at 4800 baud "
PRINT " "
INPUT " Press 'Enter' to continue: ",Z$
GOTO 60
40 OPEN "COM2:4800,N,8,1,ASC" FOR OUTPUT AS #1
PRINT #1,";"
PRINT " "
PRINT " Opening COM2 at 4800 baud "
PRINT " "
INPUT " Press 'Enter' to continue: ",Z$
GOTO 60
50 PRINT " "
PRINT " ERROR - Enter Destination between 0 and 359 degrees "
PRINT " "
INPUT " Press 'Enter' to continue: ",Z$
60 CLS
PRINT #1,";"
PRINT " "
PRINT " North = 0, East = 90, South = 180, West = 270, ... "
PRINT " Enter '999' to exit program "
INPUT " Enter Destination Bearing ( 0 - 359 ): ",DEST
IF DEST >= 999 THEN 500
IF DEST < 0 THEN 50
IF DEST > 360.5 THEN 50
IF DEST > 359.5 AND DEST < 360.5 THEN DEST = 0
PRINT " "
PRINT " Destination Bearing = ";DEST;" Degrees "
DEST=DEST+1000
PRINT #1, USING "AP###";DEST
100 PRINT " "
INPUT " Press 'Enter' to execute rotation: ",Z$
PRINT #1,";"
PRINT #1,"AM1;"
PRINT " ROTATING !"
PRINT " "
PRINT " Wait for brake to engage before entering new destination."
PRINT " "
INPUT " Press 'Enter' to continue: ",Z$
GOTO 60
500 CLOSE #1
END
```

Figure 13
Sample Program

Section 9.
Troubleshooting

Troubleshooting

CAUTION: This unit has been thoroughly tested and cycled before shipment. Follow the connector wiring carefully between the rotator and the DCU-1 control box. Pin #1 must attach to Pin #1, etc... Incorrect wiring will burn out the rotator potentiometer and void the warranty.

The DCU-1 control box is designed to be used ONLY with Hy-Gain HAM-IV, HAM-V, and T2X rotator systems. Do not try to use this control on other systems!

Problem	Possible Cause
Antenna Bearing doesn't match display	Mast slipped in rotator clamp Antenna slipped on mast DCU-1 Calibration not performed
Current Bearing changes randomly, +/- 10 to 20 degrees or does not change at all	Potentiometer broken, burned-up, or dirty Shorts or opens in control cable Extremely high RF field near rotator DCU-1 MPU or A/D failure Tower or DCU-1 not grounded
Antenna Bearing changes by itself	Brake wedge failure DCU-1 MPU failure
Current Bearing changes +/- less than 3 degrees	Antenna rocking in high winds Potentiometer dirty or poor connection High RF field near rotator Long (200') control cable
Rotator unable to reach target bearing	Temperature less than -30 degrees F Broken teeth in gears Shorts or opens in control cable Thermal cut-out in power transformer Mast binding in tower Old motor-start capacitor High winds, high wind area Control cable wire size too small DCU-1 MPU failure
Rotator slow to reach target bearing	Temperature between -30 and 0 degrees F Broken teeth in gears Mast binding in tower Old motor-start capacitor High winds, high wind area

Table 2

Ground Wires

Most operational difficulties with rotators are traceable to broken, shorted, grounded or miswired control cables. Time spent on assembling, routing and protecting the control cable will lead to a long trouble-free rotator life.

Unintentional grounds on cable leads can burn out the line fuse in the DCU-1 control box, the A/D IC, or the potentiometer in the rotator. If pin #3 or pin #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 or the voltage regulator burns out. Note also that any grounds may put an overload on the power transformer which could cause the line fuse to blow.

Antenna Motion

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 to actual play in the rotator mechanism. A slight amount of "play" is built into the rotator to avoid binding due to environmental changes.

If the antenna actually rotates in high winds, this is usually just the mast slipping in the rotator or the antenna slipping on the mast. For large antennas,, it is often necessary to drill a 5/16" hole through the rotator clamping plate and mast and pin them together with the bolt provided. Also, if possible, pin the antenna to the mast with appropriate hardware. If slipping is suspected, return the rotator to an end of rotation limit and visually check antenna alignment.

Lack of Power

If the antenna rotation is slow or sluggish or hard to start, check for proper voltages on pins #2,5, and 6 (See Table 3). If the voltages are correct, the 130 - 156 MID capacitor may be old. If your unit is more than 5 years old, try replacing this capacitor. Also, if your cable run is over 200 feet, make sure that you are using the proper wire size. See Table 1. For cable runs over 300 feet, you may wish to move the motor capacitor to the tower. This allows you to run only 6 wires from the control to the rotator, so that you can reduce wire resistance by doubling up wires or using

If the electrical circuit is working, then check for mechanical problems. Look for mast binding or thrust bearing misalignment if you have experienced strong winds recently. If the temperature is less than -30 deg. F (-34 deg. C), the rotator will be very sluggish or may not run at all! This is normal. Do not try to rotate with the DCU-1 control if temperatures are below -30 deg. F !

Checking the Control Unit Voltages

To check the control unit voltages, first remove the rotator control cable from the DCU-1 control box, then plug the line cord into a 120 or 220 VAC outlet.

With no connections, the front panel display should read "000" on the current display and "000" on the target bearing display. Check for the following voltages on the 8 pin connector:

NOTE:

You have 8 seconds after pressing "STAR T" to make each measurement. The DCU-1 checks for movement, and after 8 seconds without movement, it stops trying to rotate. You may wish to make your meter connections with

Pin #'s	Ambient State	Press "START" (see note)
1 - 2	0	30 VAC
1 - 5	0	30 VAC
1 - 6	0	0
4 - 8	0	0
3 - 7	+ 5.0 VDC	+ 5.0 VDC

Table 3

Checking the Rotator Resistances from the ground

You may possibly avoid bringing the rotator down from the tower by making electrical resistance checks on the control cable. Disconnect the control cable from the control box. Check for the following resistances:

Description	Pin #'s	Approximate Resistance (ohms)
Brake Solenoid	1 - 2	0.75+ cable resistance
1/2 Motor Winding	1 - 8	2.5 +cable resistance
1/2 Motor Winding	1 - 4	2.5 +cable resistance
1/2 Motor Winding + switch	1 - 6	2.5 +cable resistance
Entire Motor	4 - 8	4.5 + cable resistance
Right Limit Switch	5 - 8	0 +cable resistance
Left Limit Switch	4 - 6	0 + cable resistance
Entire Pot	3 - 7	500 + cable resistance
Pot Arm to + End	1 - 3	0 to 500 (0 at full CCW)
Pot Arm to - End	1 - 7	0 to 500 (500 at full CCW)

Section 10. Disassembly of the Rotator Unit

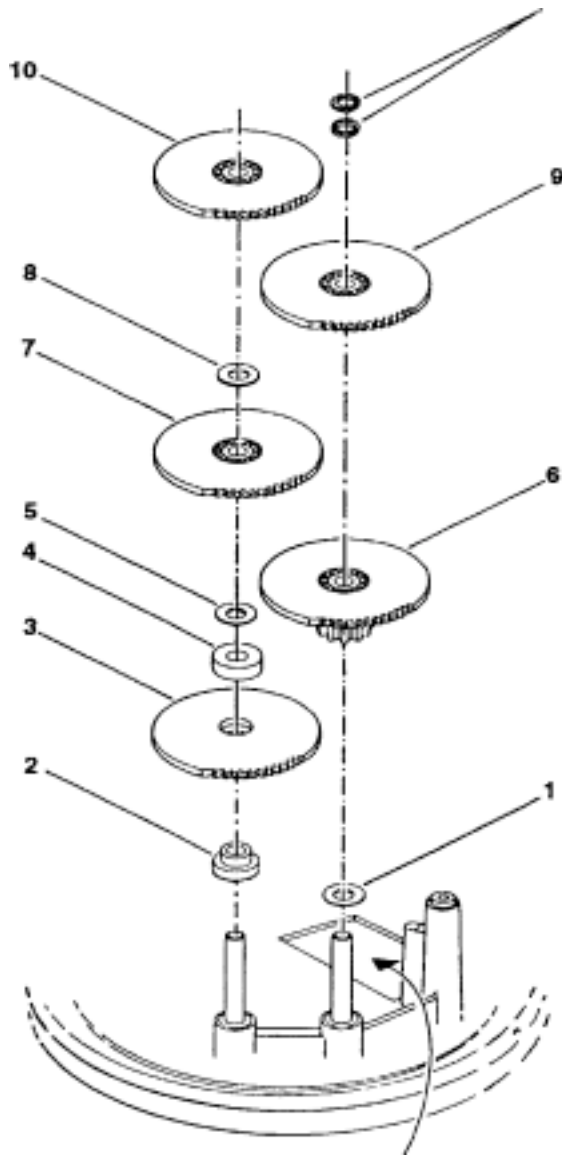
(This applies only to Out-of-Warranty Units.)

DISASSEMBLY OF THE ROTATOR

In order to service the rotator, the unit must be disassembled. We recommend the following procedure:

1. Set the rotator on a flat
2. Remove the four (4) screws and carefully raise the top casting to expose the potentiometer and drive mechanism.
3. Carefully remove upper ball bearing retaining ring. Keep it circular and lay it on
4. See that the potentiometer strip is clean and not burned at either end and that the arm is clean at the point of contact. Use only fine rouge cloth to polish the contact arm.
5. If the drive ring happens to be near the end of rotation, hold the unit horizontal, operate the spur gear to rotate the mechanical stop on the drive ring away from the area of the limit switch. See that the mechanical stop lever (which is positioned between the two limit switches) will open each electrical contact before it hits the corresponding mechanical stop. Also, see that the stop lever has not been Seformed and that the electrical contacts are clean and uncorroded. Rotate the top spur gear several revolutions to determine that the motor and its bearings are operating freely. Look for broken teeth in any of the gears.
6. Lift the motor and brake mechanism out of the brake housing. Carefully remove the ball bearing retainer and place it on a clean piece of paper.
7. Remove the ring gear from the motor base. This is accomplished by first pulling up on the side opposite the gear train. Then raise the entire ring slightly upward with the side away from the gear train so that it will slide out from under the gears.
8. Examine the teeth in the brake casting. Examine closely for evidence of broken or worn teeth.
9. To remove the potentiometer, remove the hex nuts and unsolder the leads. The mounting studs are integral to the motor and bell. In replacing the pot, be sure the connections are on the side which overhangs the motor.
10. To replace the motor, first remove the pot per step 9, then unsolder the black motor lead from the solder lug, the red lead from the inside left limit switch lug and the blue lead from inside the right switch lug. The fastenings holding the motor on the studs may then be removed and the motor pulled up and out. In replacing a motor, be sure to see that the round hole in the motor is next to the limit switch. Use a double locknut on this stud near the limit switch to provide clearance for the leads. Use special internal/external lockwasher over the stud that works in the slotted hole in the motor. Be sure that the pinion is snug against the spur gear before

SPUR GEAR ASSEMBLY



PLACE THE OPENING FOR
ELECTRICAL LEADS TO THE
RIGHT.

Figure 14 Spur Gear
Assembly

The numbers within circles on this illustration are sequence-of-assembly numbers; their only function is to indicate which part should be positioned on the gear shaft in a particular sequence.

Item Numbers are used to identify a particular item by Part Number and Description. The Item Numbers listed correspond to the Item Numbers used in the Rotator Parts List in the rear of the

Sequence Numbers 7, 9, and 10 (PN 5011200-1) are identical spur gears with rather small pinion gears attached to the bottom side.

Sequence Number 6 (PN 5011100-1) is a spur gear with a rather long pinion gear attached to the bottom side.

Sequence Number 3 consists of two (2) spur gears (PN 5010700-1) "sandwiched" together. There is no pinion gear on this spur gear.

Sequence Numbers 1 and 8 are identical flat washers

The pinion gears for this application are always orientated on the shafts with the pinion gear side "down".

When assembling the gears and their associated components on both shafts, follow the numerical sequence shown.

Sequence No.	Item No.	Part Number	Description
1	111	5112000	Flatwasher
2	113	5037900	Bushing
3	112	5010700-1	Spur Gear
4	110	5037800	Spacer
5	138	5112100	Flatwasher, brass
6	108	5011100-1	Gear & Pinion Assembly
7	107	5011200-1	Gear & Pinion Assembly
8	111	5112000	Flatwasher
9	107	5011200-1	Gear & Pinion Assembly
10	107	5011200-1	Gear & Pinion Assembly
11	109	560084	Spacer, small gear

Section 11. Reassembly of the

REASSEMBLY OF THE ROTATOR

It is assumed in the following instructions that the brake mechanism is assembled and operative. The motor and gear train along with the potentiometer and the limit switches are likewise assembled, wired and operative.

It is not likely that the brake wedge will be exactly positioned in relation to the teeth in the brake housing to permit proper assembly unless the brake mechanism is retracted. For this reason, it is necessary to operate the brake mechanism electrically during Step 8 of the assembly of the

1. See that a small amount of low temperature, high quality, light weight grease is conservatively distributed around the ball bearings, ring gear and spur gears. Only an even film of grease is desirable (approximately one thimbleful of grease should be used to lubricate a completely dry rotator). Excessive grease will only run out during high temperatures or cause power loss during
2. Rotate the upper spur gear until the inwardly protruding mechanical stop on the ring gear touches the channel shaped stop lever. This action will push it far enough to the left to just open the left hand limit switch contact (it is assumed that the rotator is viewed from the side of the limit switch). This situation represents the extreme clockwise end of rotation. The potentiometer arm must then be rotated to its extreme clockwise position against
3. Secure the upper bell housing upside down by the mast support in a vise with the open end of the "V" toward the bench. The boss, which drives the potentiometer arm that is located in the bottom part of the housing, will then be to the left of center.
4. Clean the inner portion of the housing and apply a small amount of grease to the ball race. Then, carefully insert one ball bearing assembly with the fringed rim up and against the outer edge of the casting.
5. Grasp the operating mechanism by the flat base, steady the ring gear, invert the mechanism and lower it into the housing. In doing this, note that the serrated portion of the potentiometer arm must engage the driving boss in the housing and that the three driving bosses on the ring gear must engage into the mating recesses in the top housing. This situation will result automatically if the previous instructions have been followed.
6. Clean the exposed bearing race and apply a film of grease. Then apply the top bearing assembly to the race with the rim downward.
7. Clean the brake housing. Lower the brake housing into place so that the assembly holes will approximately line up with the threaded holes in the bell housing. Do not mechanically force an exact alignment of these holes without electrically retracting the
8. Connect control unit pins 1 and 2 only to the corresponding pins on the rotator while it remains clamped in the vise. Momentarily operate the "Brake Release". This will permit the brake housing to freely rotate the exact alignment of the holes. With the brake retracted, secure the upper mast support (bell) to the lower brake housing. Tighten finger tight. With the brake retracted, tighten all four (4) bolts in an alternate pattern to approximately 85 inchpounds of torque. Recheck the brake to make sure that it

It is suggested that all eight wires be connected from the control box while the rotator is still on the bench and that its complete operation be checked.

Section 12. HAM-V Rotator Replacement Parts

Item No.	Part No.	Description	Qty
101	5137202	Rotator (complete with hardware)	1
102	5030400	Support, Upper Mast (bell casting)	1
103	5136502	Brake Housing (lower casting)	1
104	5033501	Bearings, Ball (49 per retainer).....	98
105	5011300	Retainer, Bearing (one per race)	2
106	5009700	Casting, Brake Support	1
107	5011200-1	Gear and Pinion (See Figure 13).....	3
108	5011100-1	Gear and Pinion (See Figure 13)	1
109	560084	Spacer, Small Gear (See Figure 13).....	2
110	5112100	Flatwasher, Brass (See Figure 13)	2
111	5037800	Spacer (See Figure 13).....,,.....	1
112	5136101	Gear, Steel Drive.....	1
113	5010700-1	Gear, Final Spur.....	2
114	5037900	Bushing	1
115	5067000	Arm, Pivot.....	1
116	5123900	Reinforcement, Pivot Arm	1
117	572264	Rivet, Steel, Cad plated, 1/8 x 3/16 Semi-Tubular	2
118	350885	Washer, Spring Grip, .241	1
119	5037000	Assembly, Base and Gear Shaft.....	1
120	5012200	Mounting Plate and Stud, Motor.....	1
121	5031100	Lug, Solder.....	2
122	5112000	Flatwasher (See Figure 13)	3
123	5105600	Screw, #10-24 x 1/2" thread cutting, Cad.....	6
124	5137600	Motor and Pinion	1
125	5023100	Potentiometer	1
126	5009900	Solenoid	1
127	5010000	Pin, Solenoid	1
128	5010101	Spacer, Solenoid Pin SS.....	3
129	5028206	Ring, Solenoid ketaining	2
130	5011400	Spring, Solenoid Retaining.....	2
131	5009600	Clip, Retracting Spring	2
132	380828	Wedge, Brake.....	1
133	5009800	Link, Connecting.....	1
134	380626	Pin, Connecting Link	1
135	5011700	Support, Brake Wedge.....	1
136	5010401	Latch, Brake.....	1
137	5010600	Pin, Latch	2
138	5028204	Retainer, Latch Pin.....	2
139	5010500	Spring, Latch.....	2
140	179894	Mounting Plate.....	1
141	510680	Screw, #6 x 3/8", torque.....	2
142	520057	Screw, #6-32 x 3/8", Pan Head	2
143	5105700	Screw, #12-24 x 3/4".....	4

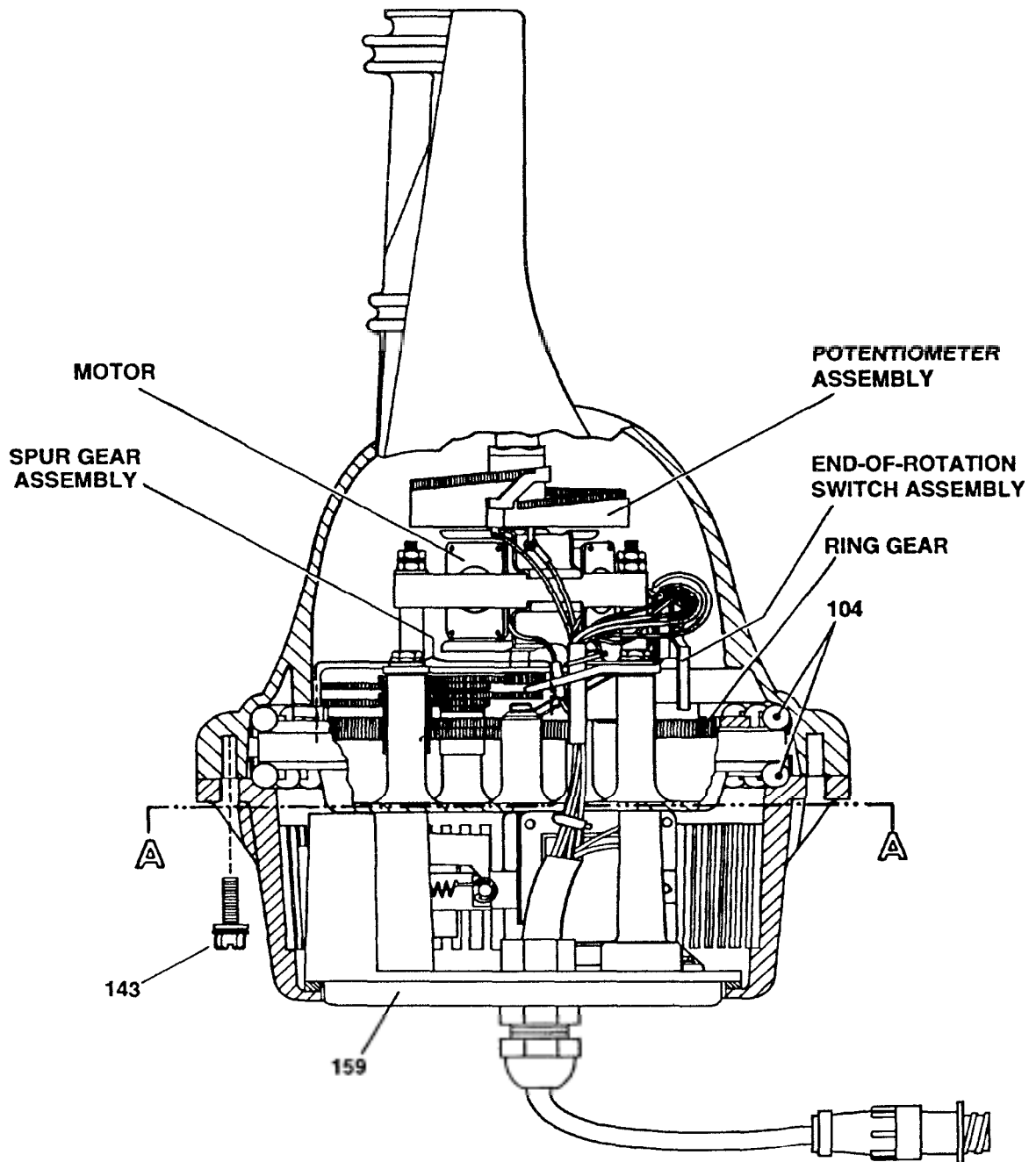
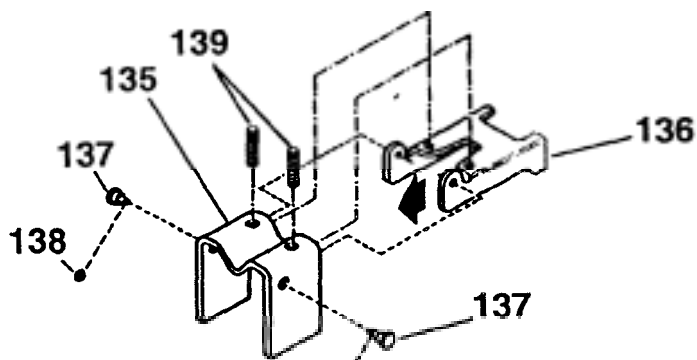
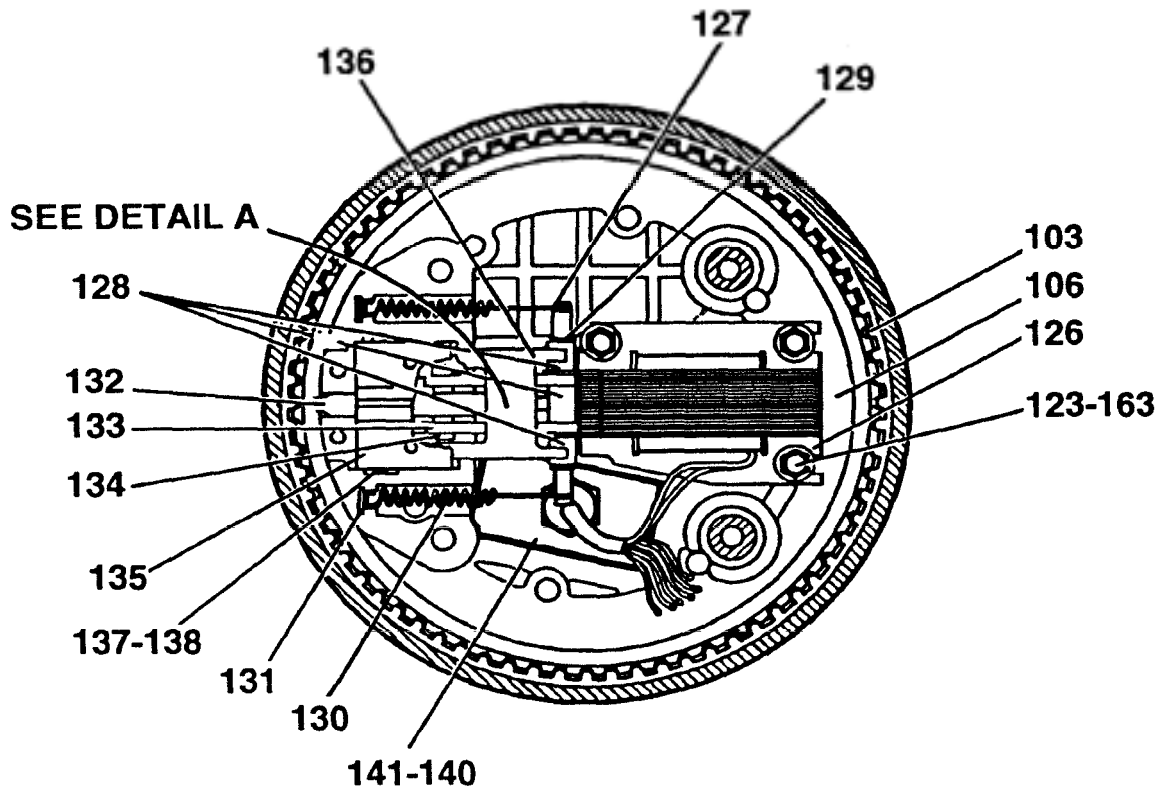


Figure 15 Inside View of
HAM-V Rotator



**•138; ATTACH AFTER ITEM 137
IS INTALLED THROUGH ITEMS 135
AND 136 (2 PLACES)**

Figure 16 Brake Assembly and Terminal Board
Wiring Detail

HAM-V Rotator Replacement Parts (continued)

Item No.	Part No.	Description	Qty
* 144	5011500	Plate, Mast Clamp	1
* 145	5038200	U-Bolt, 1/4"-20, 2 1/4" x 3 7/8"	3
* 146	5050200	Flatwasher, 5/16"	4
147	110820035	Bolt, 1/4"-20 x 1 1/4", Hex Head.....	5
* 148	554099	Nut, 1/4"-20, Hex.....	5
* 149	561177	Lockwasher, Split, 1/4", SS	9
150	5008000	Spacer, Switch, Part of Item 164.....	8
151	5009100	Bracket, Switch, Part of Item 164.....	1
152	5112400	Flatwasher, 1/8", Part of Item 164	4
153	5009200	Leaf, Contact, Part of Item 164.....	2
154	5011600	Rivet, Contact, Part of Item 1W.....	2
155	5009300	Leaf, Contact, Part of Item 164.....	2
156	5007601	Disc, Pulsing	2
157	5008900	Rivet, Contact	2
158	106004101	Screw, #4-40 x 5/8" Pan Head	4
159	5009700	Cover, Bottom.....	1
160	102720441	Bolt, 1/4"-20 x 2 3/4" Fil. Head.....	4
161	567115	Lockwasher, Split, 1/4".....	4
162	5112300	Flatwasher, 3/8"	3
163	5112200	Flatwasher, .203" ID, . 5" OD	4
164	5146110	Assembly, End of Rotation	1
165	567135	Lockwasher, Int. #8.....	3
166	556990	Nut, Hex #8-32.....	4
167	5104700	Lockwasher, Int./Ext. Tooth, #8	1
168	120006001	Lockwasher, External, #6.....	2
169	5113100	Nut, Hex, #6-32.....	2
170	5030400	Support, Upper Mast.....	1
171	450590	Strain Relief	1
172	610215	Cable, 8 conductor	1.67 ft.
173	650179	Receptacle, 9 pin.....	1
174	650291	Contact pin	8
175	650180	Receptacle shell.....	1
	870598	Parts Pack, Connector	1

*Contained in Mounting Hardware Kit PN

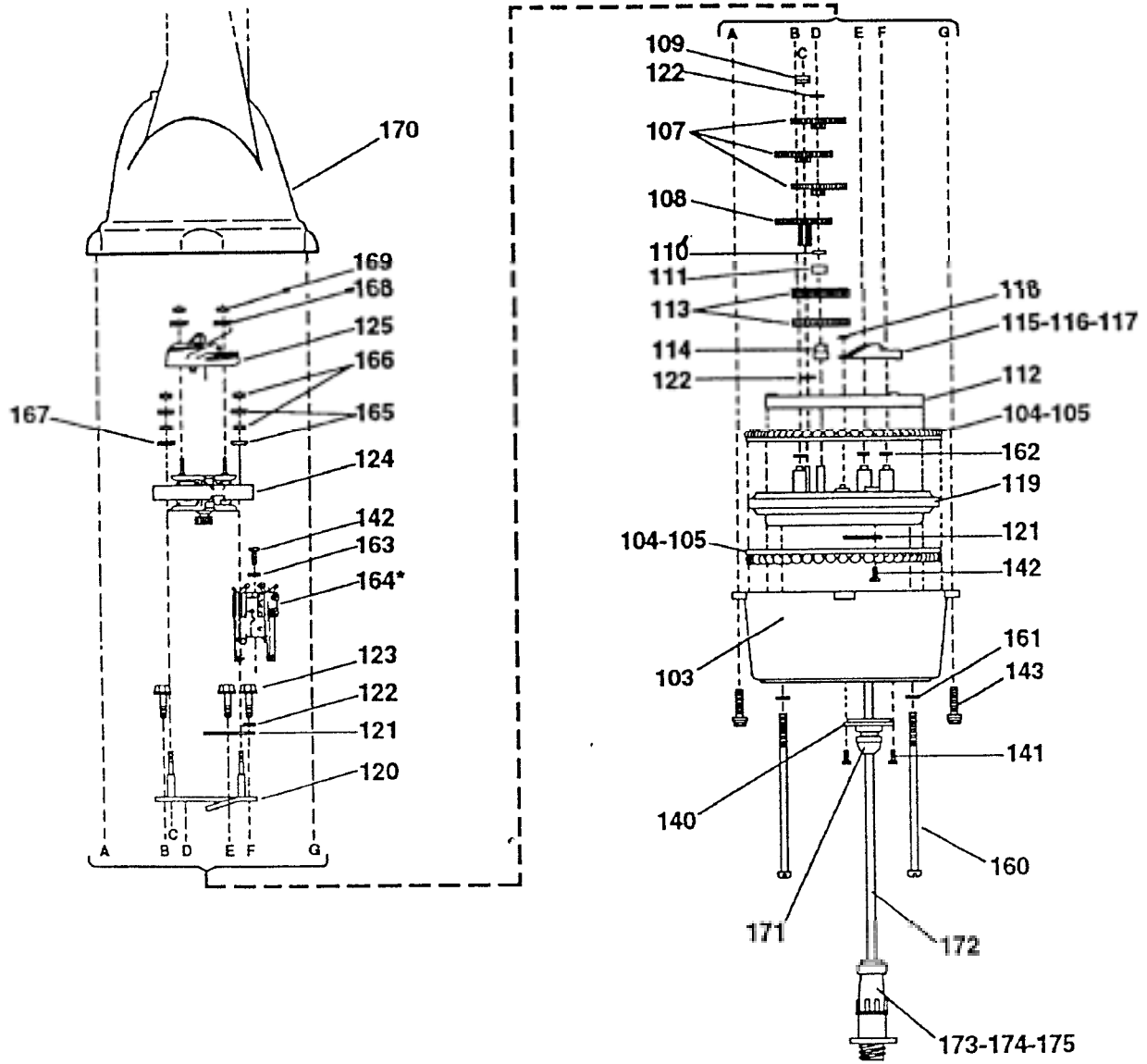


Figure 17 HAM-V Rotator - Illustrated Parts Breakdown

Section 13. DCU-1 Control Unit Block Diagrams

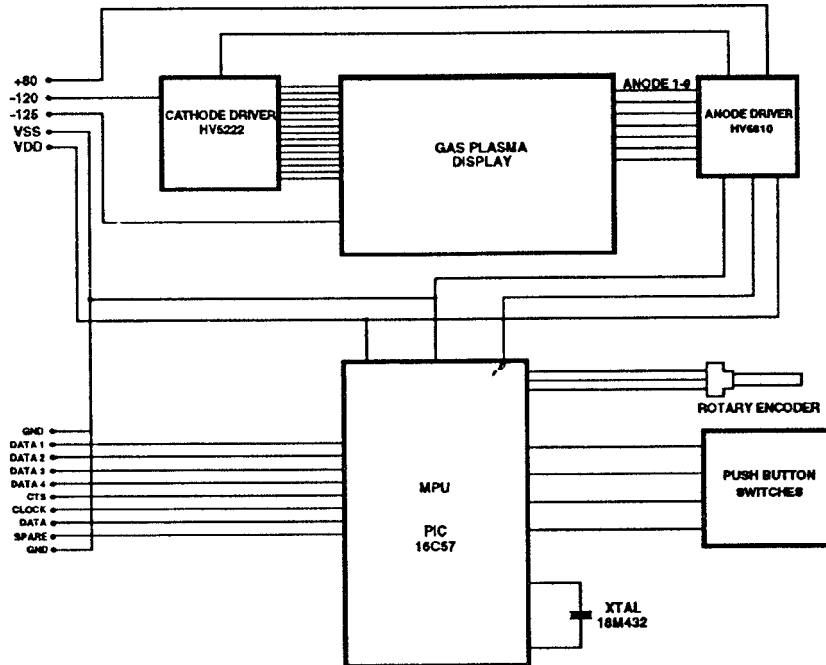


Figure 18 Front Panel PCB

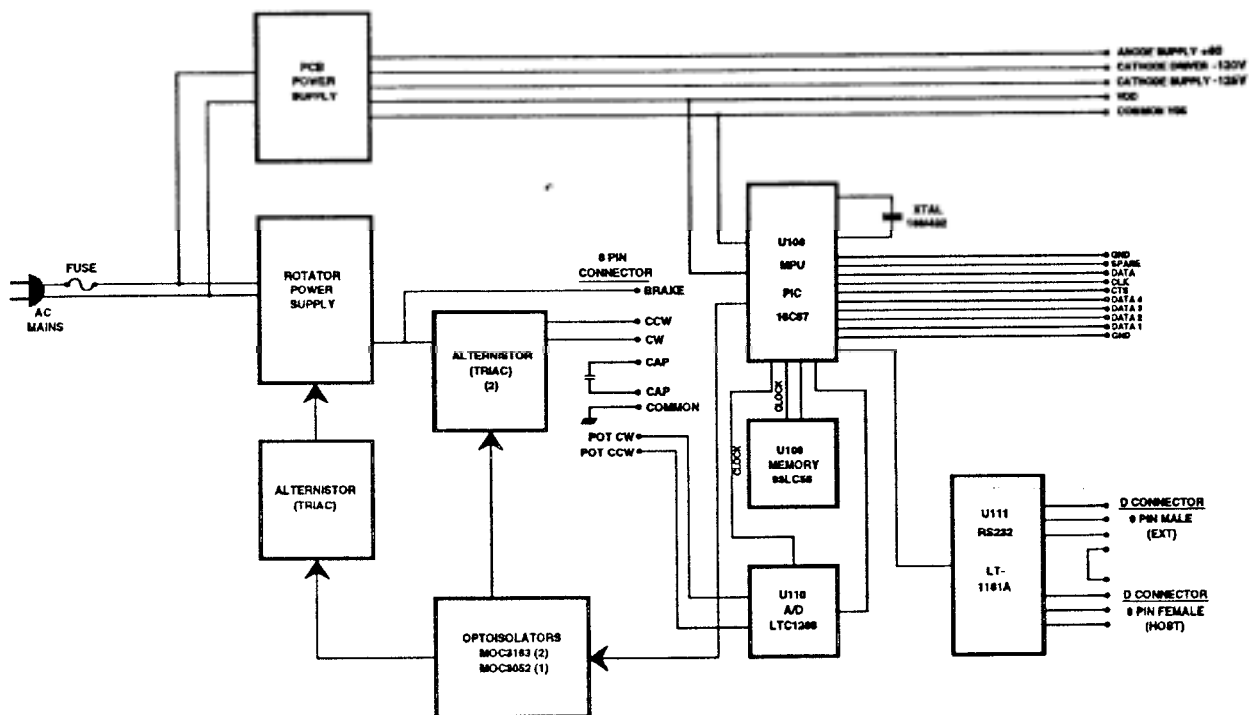


Figure 19 Control PCB and External Components

Section 14. DCU-1 Control Unit Replacement Parts List

Item No	Part No.	Description	Qty
870804		DCU-1 Assembly, 120 V.....	1
870842		DCU-1 Assembly, 220 V.....	1
1034403		Fuse 3 Amp 3 AG (120 VAC)	
(710053)		Fuse 1 AMP 5 x 20 mm (220 VAC).....	
1056300		Fuse Holder (120 VAC).....	1
(710054)		Fuse Holder 5/20 mm (220	
105632051		6-32 x 5/16 screw.....	2
150078		Front overlay, printed.....	
150624-3		Label, "TELE)C "	
171131		Spacer, transformer assy.	
350979		Clip, capacitor.....	1
450431		Strain Relief (120 VAC).....	1
(450403)		Strain Relief (220 VAC)	
450433		Hole plug (110 VAC only)	1
450614		Filter Display, printed	
470677		Backing plate, switch.....	3
46002 RD		Connector, 2 pin, red.....	2
47138P2		Contact, connector	
500157		Screw, 10-24 x	
500326		Screw, 4-40 x	
5022500		Terminal, solder	
506325		Screw, 1/4"-20 x 3/4"	
5086100		Power Cord (120 VAC)	
(5079800)		Power Cord (220 VAC)	
5112400		Flat Washer. 128 I.D.....	1
5113100		Nut, 6-32 hex	5
5141100		Rotator Housing, Top cover.....	1
5141200		Rotator Housing, bottom cover.....	1
5151501		Capacitor 13Q-156 MFD.....	
5152700		Bumper (rubber feet).....	
520057		Screw, 6-32 x 3/8", (black)	
53432116		Knob.....	1
53433015		Knob-cap.....	1
550029		Wing nut, 1/4"-20,	
554071		Nut, 10-24, hex	
556960		Nut, 1/4"-20, hex.....	1
567110		Lockwasher, 1/4", internal .. .	2
567120		Flatwasher, 1/4"	
567125		Lockwasher, No. 10, internal.....	8
640076		Socket, 8 pin (Part of 870849 Wire Assembly)	
640084		Cable Assembly, 10 wire, 7 inch	
640085		Cable Assembly, 6 wire, 7 inch	
810138		Key pad, 3 button.....	3
51401-031		Screw, 4-40 x 1/4", socket head.....	3

DCU-1 Control Unit Replacement Parts List

Item No.	Part No.	Description	Qty
	870806	Transformer Assembly, (120 VAC).....	1
	1073501	Transformer Assembly, (220 VAC).....	1
	870807	PCB Assembly, front panel.....	1
	870808	PCB Assembly, control.....	1
	8800102114	Connector D, 9 pin, male (Part of 870848 Wire Assembly).....	1
	8800102132	Connector D, 9 pin, female (Part of 870848 Wire Assembly).....	1
	8800102463	Hardware , D Connector	2
	880394	Chassis, Assembly	1

Section 15 Parts-Pack Parts List

Accessory Kit PN

Item No.	Part No.	Description	Qty
147	110820035	1/4"-20 x 1 1/4 Hex.....	5
144	5011500	Mast Clamp.....	1
145	5038200	U-type Bolt.....	3
145	5050200	Flatwasher	4
148	554099	1/4"-20 hex nut.....	5
149	561177	1/4", split lockwasher.....	9

Connector Parts Pack PN 870598

Item No.	Part No.	Description	Qty
176	650181	Plug, Amp.....	1
177	650180	Shell, Amp	1
178	650293	Contact, socket.....	8
179	640077	Plug, 8 pin.....	1

DCU-1 Parts Pack, 120V,

Item No.	Part No.	Description	Qty
	1034403	Fuse, 3 AMP, 3 AG.....	2
	640077	Plug, 8 pin.....	1
	870844	DCU Termination Assembly	1

DCU-1 Parts Pack, 220V,

Item No.	Part No.	Description	Qty
	710053	Fuse, 1 AMP, 5 x 20 mm	2
	640077	Plug, 8 pin.....	1
	870844	DCU Termination Assembly	1