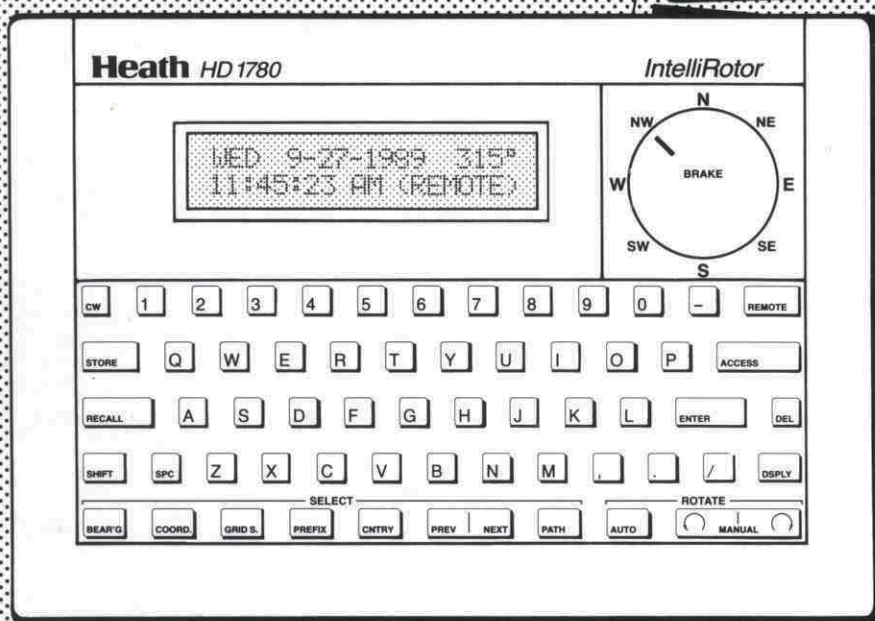


HD/HDW-1780

Heath®

IntelliRotor®

Operation Manual

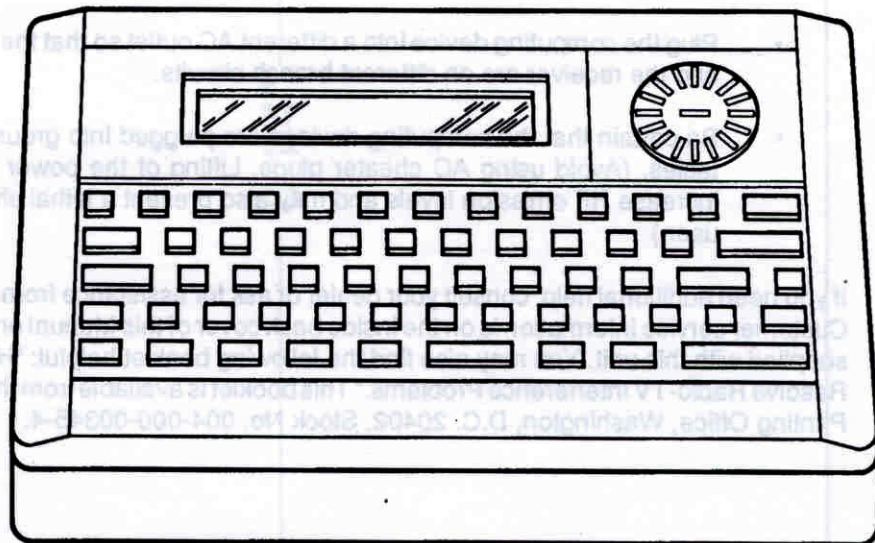


INTELLIROTOR™

Model HD/HDW-1780

OPERATION

595-4323



WARNING

Factory-assembled units have been certified to comply with the limits for a Class B computing device, pursuant to Subpart J of Part 15 of FCC Rules. Kits that were assembled in strict accordance with the Assembly Manual have also been found to comply with these limits. Only computers certified to comply with the Class B limits may be attached to this unit. Operation with non-certified computers is likely to result in interference to radio and TV reception.

This unit uses radio frequency energy for its operation; and if it is not installed and used properly, that is, in strict accordance with the instruction manual, may cause interference to radio and television reception. Factory-assembled units have been type tested and found to comply with the RF emission limits for a Class B computing device, which is intended to provide reasonable protection against such interference in a residential installation. There is no guarantee, however, that interference will not occur in a particular installation. If this equipment does cause interference to radio and television reception, which you can determine by turning the unit off and on, try to correct the interference by one or more of the following measures:

- Move the computing device away from the receiver being interfered with.
- Relocate the computing device with respect to the receiver.
- Reorient the receiving antenna.
- Plug the computing device into a different AC outlet so that the computing device and the receiver are on different branch circuits.
- Be certain that the computing devices are plugged into grounded outlet receptacles. (Avoid using AC cheater plugs. Lifting of the power cord ground may increase RF emission levels and may also present a lethal shock hazard to the user.)

If you need additional help, consult your dealer or ask for assistance from the manufacturer. Customer service information is on the inside back cover of this Manual or on an insert sheet supplied with this unit. You may also find the following booklet helpful: "How to Identify and Resolve Radio-TV Interference Problems." This booklet is available from the US Government Printing Office, Washington, D.C. 20402, Stock No. 004-000-00345-4.

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INTRODUCTION

The Heath Model HD/HDW-1780 IntelliRotor™ allows you to quickly obtain short or long path bearing and distance to any location on the globe and, if you wish, aim your beam toward the corresponding direction in the shortest possible time.

You can rotate your beam manually, or you can enter any of the following to specify a desired location or heading:

- Country name (or the first few letters)
- Amateur radio prefix (or partial prefix)
- Coordinates (latitude and longitude)
- Grid square
- Bearing in degrees.

You can also make a selection from one of ten user-defined names.

The IntelliRotor displays the date, day of week, local time (or UTC), and actual bearing. Additional "windows" also display as much of the following information about the destination as may be determined from the entry:

- Time*
- Distance in miles or kilometers*
- Bearing*
- Latitude and longitude*
- Grid square*
- Country (state or province) name
- Amateur radio prefix(es)
- User-defined name.

Although the internal database is permanent, you can edit it from the keyboard. Any changes made will remain in effect until you intentionally reset the unit.

You can, for example, optimize the IntelliRotor for your particular rotator/beam combination by pressing a few keys.

To help prevent jammed brake problems, the IntelliRotor first rotates your beam in a direction that is opposite to the correct direction. It then stops and rotates the beam in the proper direction until it reaches the bearing you desire. The beam rotation slows down prior to reaching the target bearing for better accuracy and to prevent damage near the ends of rotation.

A built-in serial interface allows you to remotely control the IntelliRotor from a terminal or computer. You can read the date, time, bearing, and select a new bearing through this interface. In addition, a List function allows you to print a listing, alphabetized by country name, of prefixes, latitudes and longitudes, grid squares, distances, bearings, and offsets from UTC. There is even a Dump function that allows you to make the edited database and setup entries permanent if you have access to an EPROM programmer.

A pop-up utility is included that allows you to completely control your IntelliRotor from a PC-compatible computer.

For sight-impaired users, the current bearing may be annunciated in Morse Code.

Built-in diagnostics test the program ROM, database ROM, RAM, serial port, LCD, and LEDs.

These and other thoughtful features will make the IntelliRotor a favorite operating accessory for many years.

SPECIFICATIONS

Displays	40-character (2 line x 20) liquid crystal; 16-point LED compass rose with 32-point resolution.
Bearing Resolution	LED compass rose: 11.25 degrees. LCD: 1 degree.
Bearing Selection	Manual or by keyboard entry of: bearing, country name*, prefix*, grid square, latitude and longitude, or user-defined bearing.
Database	Over 400 entries in ROM. Data is copied to battery-backed RAM, where you can edit it.
Clock/Calendar	24-hour or 12-hour (AM/PM) time format, automatic leap year correction, and day of week.
Keyboard	61 keys, with audible and/or tactile feedback.
Calibration	Implemented in software; no adjustment is required. Accommodates rotators capable of greater than 360 degree rotation.
Serial Interface Baud Rates	300, 600, 1200, 2400, 4800, and 9600 baud.
Compatible Rotators	Telex Models HAM-M (Series 3, 4, 5, & 6), HAM-II, HAM-III, HAM-IV, T2X, CDE TR-44, CD-45 (Series 2), M2, and HDR-300.
Beam Orientation	North- or south-centered.
Power Requirements	120/240 VAC, 50/60 Hz.
Dimensions	
Controller	5-1/2" H x 7-3/4" W x 1-3/8" D (13.8 x 19.7 x 3.5 cm).
Power Unit	3-3/4" H x 8-5/8" W x 5-3/8" D (9.5 x 21.9 x 13.7 cm).
Weight	
Controller	1-1/4 lbs.(570 g).
Power Unit	6-1/2 lbs. (3 kg).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

*You need to only enter enough characters to make the entry unique.

IMPORTANT SAFETY INSTRUCTIONS

Read all of the instructions before you try to operate this product, and keep the instructions for future reference. Pay particular attention to all warnings.

NOTE: If any of the following things happen, unplug the power unit from the wall outlet and correct the problem before you reapply power. If you need help, contact your nearest qualified service center.

- The power cord is damaged.
- The power unit is exposed to rain or something is spilled into it.
- The IntelliRotor does not operate properly.
- The IntelliRotor is dropped or damaged.
- You notice smoke, strong smells, or any other sign of overheating.

Be sure you operate your IntelliRotor from the correct line voltage. Factory-assembled units are wired for 120 VAC. If you modify the unit for use with 240 VAC, you must change the line cord. If you are unsure of the line voltage in your area, contact your local power company.

Use your IntelliRotor indoors only. Place the power unit in a dry location, away from plumbing fixtures and

damp basement floors. Route the power cord where it will not be pinched or stepped on. Inspect the cord periodically and replace it immediately if it is damaged.

The line cord is equipped with a 3-wire grounding plug. This plug will only fit a 3-hole grounded outlet. This feature is for your safety. If a 3-hole grounded outlet is not available, contact an electrician to have one installed. Do not use a "cheater plug" or other device to defeat the ground connection. (Also, do not overload the wall outlet with too many power cords. This can cause a fire hazard or electric shock.)

The slots on the power unit enclosure are for ventilation. To prevent overheating, make sure these slots are not blocked or covered. For example, do not place the power unit on thick carpeting, which could block air flow to the bottom slots. Also, do not place the power supply near a heat source, such as a radiator.

Never push anything through the openings in the power unit enclosure. This could damage the power supply, cause a fire, or give you a dangerous electric shock.

Unplug the line cord from the wall outlet before you clean the IntelliRotor. Use cloth dampened with water or a mild water-based cleaner. Do not let any moisture get into the enclosure.

INSTALLATION

The basic installation of your IntelliRotor is like a typical television rotor system. In addition to your IntelliRotor, you need a suitable rotator and the proper 8-wire control cable. The following rotators are known to be compatible with your IntelliRotor: HAM-M (Series 3, 4, 5, & 6), HAM-II, HAM-III, HAM-IV, T2X, CDE TR-44, CD-45 (Series 2), M2, and HDR-300. The control cable you need depends upon your particular rotator and the length of the cable. Generally, the brake wires in the cable must be larger than the other wires, due to the large current drawn by the brake-release solenoid. Refer to the Manual supplied with your rotator to determine the proper cable for your installation.

Connect the free end of the cable coming from the power unit to its mating connector on the control unit, if this has not already been done.

CONTROL CABLE CONNECTIONS

Figure 1 (on Page 8) shows a typical hookup to a Telex HAM IV rotator, using Belden #8448 cable. This cable contains two 18-gauge wires to operate the brake and six 22-gauge wires for other rotator functions, and is good for up to 125 feet. A heavier cable, Belden #9405, contains two 16-gauge wires and six 18-gauge wires and is usable up to 200 feet.

The power unit contains an 8-position terminal block for the control cable coming from your rotator. **Make sure you connect the cable correctly, or you could damage the IntelliRotor or your rotator (refer to the label near the terminal block).** To make connection to the terminal block, remove 1/4" of insulation from the end of each lead. Then twist the fine strands tightly together and apply a small amount of solder to hold the fine strands together. You may wish to use the chart on Figure 1 to keep track of your wire colors.

If you intend to use your IntelliRotor with a model HDR-300 rotator, skip the following information and proceed directly to "Alternate HDR-300 Connections".

NOTE: Generally, the wiper of the position potentiometer inside the rotator is connected to the brake solenoid and motor windings. To help avoid positioning errors that occur due to the voltage drop on the ground lead when the motor and brake solenoid are energized, we recommend that you use two ground wires. Since your IntelliRotor requires connection to only the wiper and counterclockwise end (as viewed from the top of the rotator) of the positioning potentiometer, the wire that is normally connected to the clockwise end can be used as a second ground wire. One way you can do this is to disconnect the wire from the clockwise terminal (normally #7) on the bottom of the rotator housing and connect it to the ground terminal (normally #1) along with the wire that is already connected to this terminal (see Figure 1).

If you are making a new installation, or if it is convenient to change an existing installation, we strongly recommend that you use two ground wires as described above. If your existing installation has a control cable with a heavy gauge ground wire, you may be able to use the single ground wire by connecting it to both the COM and GND pins of the terminal block in the power unit. To check this installation, perform the calibration procedure as described in the next section of this Manual. Then rotate your antenna to its fully counterclockwise position. The bearing indication on the display should be within 1 or 2 degrees of 0° (South centered) or 180° (North centered). When the brake LED extinguishes, press the DSP (DISPLAY) button to update the display. If the bearing indication changes by more than 2 or 3 degrees, you may want to rewire your rotator with two separate ground wires as described above.

NOTE: If the terminals on your rotator are too inconvenient to get to, you may want to try the following alternate procedure:

1. Determine which wire is connected to the clockwise potentiometer terminal.
2. At a convenient point near the rotator, break this wire and connect the end that comes from the IntelliRotor to a rotator mounting bolt, or to the leg of the tower. Be sure to weatherproof the connection.

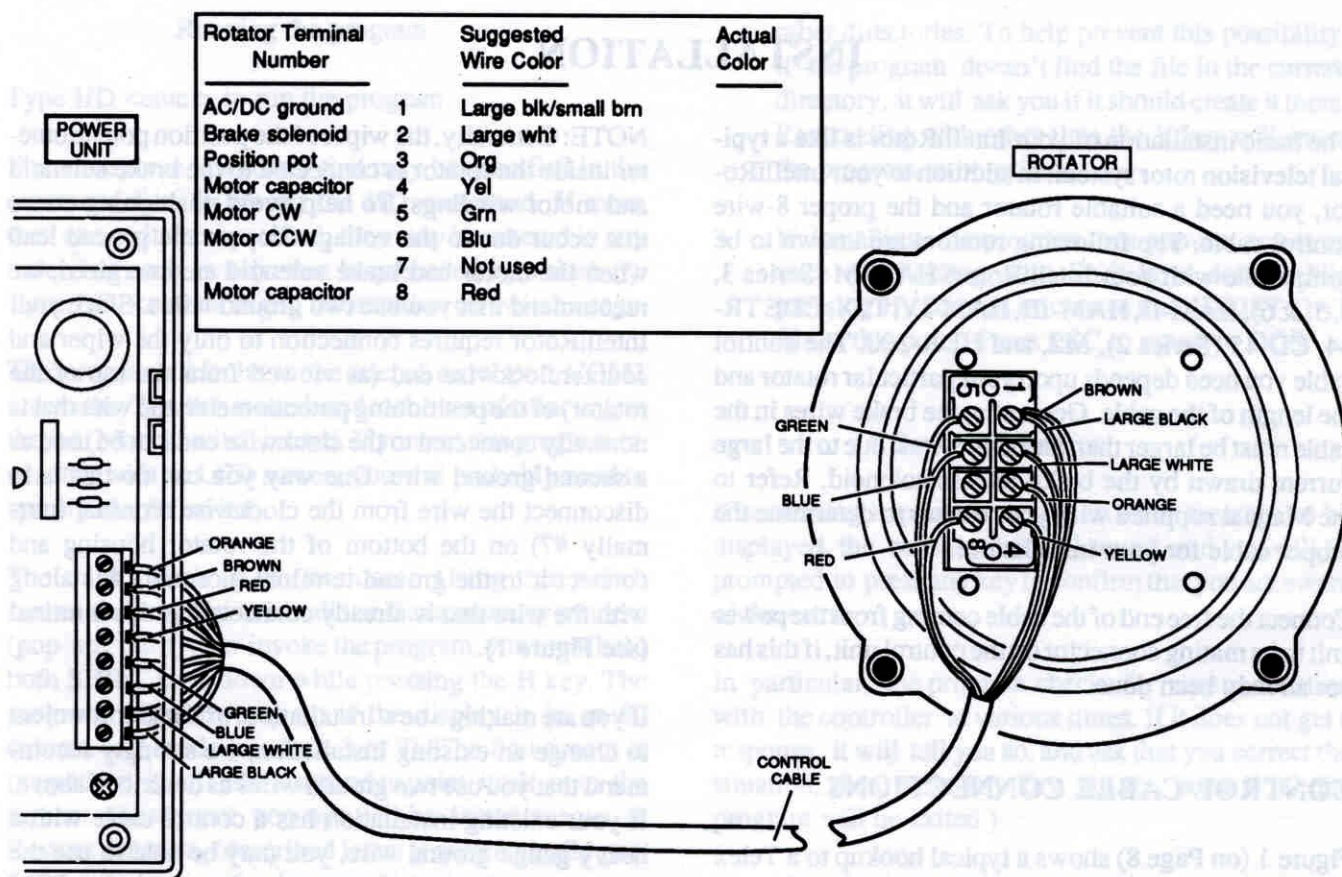


Figure 1

Alternate HDR-300 Connections

The following information assumes that one end of the cable (Belden #9405 is recommended) has already been connected to the rotator as described in its manual.

Connect the free end of the control cable to the 8-position terminal block on the IntelliRotor power unit as shown in the following chart.

Previous HDR-300 Control Connection	Function	IntelliRotor Power Unit Connection
1	Motor CCW	Motor CCW
2	Motor CW	Motor CW
3	Common	A.C. Ground
4	Brake solenoid	Brake Solenoid
8	Position Pot CCW	Not used
9	Position Pot wiper	Position Pot CCW
10	Position Pot CW	D.C. Ground

NOTES:

1. The motor phase-shift capacitor for this model is located inside the rotator housing. Therefore, no connections to the Motor Capacitor terminals on the power unit are required.
2. Check the value of resistor R125 on the main circuit board in the IntelliRotor control unit. If it is a 150 Ω resistor (brown-green-brown), replace it with a 220 Ω , 1/4-watt, 5% resistor (you can obtain one locally). The 220 Ω resistor will work with all compatible rotators, but resolution and noise rejection might be affected slightly.

ALTERNATE LINE VOLTAGE

Factory assembled units have been wired to operate from 120 VAC, which is most often used in the U.S.A. 240 VAC, however, may be more common in other countries. The following paragraphs show you how to modify your power unit to operate from the line voltage you desire.

Changing From 120 VAC to 240 VAC

Refer to Figure 2 while you perform the following steps.

1. Make sure the line cord is unplugged.
2. Remove the cover from the power unit.
3. Remove the hardware from the power supply circuit board so you can gain access to the foil side.
4. Remove the jumper wires in the circuit board at W501, W502, W504, and W505.
5. Install jumper wires at W503 and W506.
6. Reinstall the circuit board.

7. Replace fuse F502 with a 1/16-ampere, slow-blow 3AG type.

8. Replace fuse F501 with a 1-ampere, slow-blow 3AG type.

9. Reinstall the cover on the power unit.

NOTE: The plug on the power cord is for standard 120 VAC outlets. For 240 VAC operation in the U.S.A., cut off and replace the plug with a permanent plug that matches your 240 VAC receptacle so that your power connection conforms with section 210-21 (b) of the National Electric Code, which reads, in part:

“Receptacles connected to circuits having different voltages, frequencies, or types of current (AC or DC) on the same premises shall be of such design that attachment plugs used on such circuits are not interchangeable.”

When you install the new plug, make sure it is connected according to your local electrical code. Keep in mind that the green line cord wire is connected to the common side of the circuitry. In addition, black is “hot” and white is neutral.

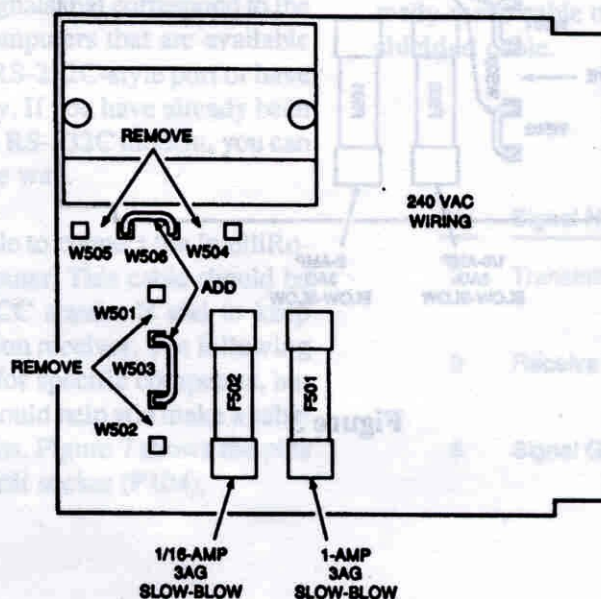


Figure 2

Changing from 240 VAC to 120 VAC

Refer to Figure 3 while you perform the following steps.

1. Make sure the line cord is unplugged.
2. Remove the cover from the power unit.
3. Remove the hardware from the power supply circuit board so you can gain access to the foil side.
4. Remove the jumper wires in the circuit board at W503 and W506.
5. Install jumper wires at W501, W502, W504, and W505.
6. Reinstall the circuit board.
7. Replace fuse F502 with a 1/8-ampere, slow-blow 3AG type.

8. Replace fuse F501 with a 2-ampere, slow-blow 3AG type.
9. Reinstall the cover on the power unit.

MOUNTING

The controller for your IntelliRotor is designed to be set directly on your desk. Two keyhole slots are included on the back of the controller, however, in case you prefer to mount it on the wall. Use standard #8 wood screws for mounting, and make sure their heads extend from the wall only enough so you can slip the controller snugly over them. A mounting template is included on Page 63.

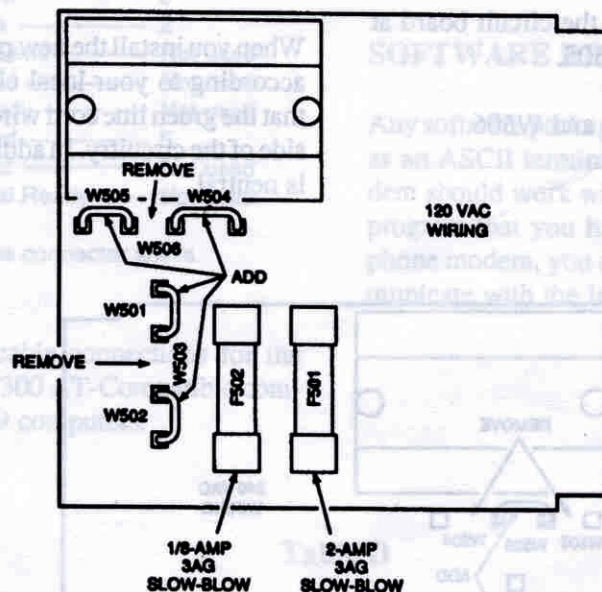


Figure 3

SETUP AND CALIBRATION

The information in this section is required the first time you use your IntelliRotor so it will work properly. You should not have to perform these steps again unless you replace the internal backup battery, or initialize the IntelliRotor (described later). In the event of a power failure, you will see the following display:

**Power was lost –
Press ENTER...**

When this appears, you only need to re-enter the date and time; the IntelliRotor will remember all of the other information.

SETUP

This section of the Manual requires you to enter some information about your particular station (local time, date, etc.) into the IntelliRotor's memory. You can also enter some personal preferences (12- or 24-hour clock format, etc.). Some of these parameters are used by the IntelliRotor to determine particulars about another station (direction, distance, and time). NOTE: The terms "target station" and "another station" are used interchangeably throughout this Manual.

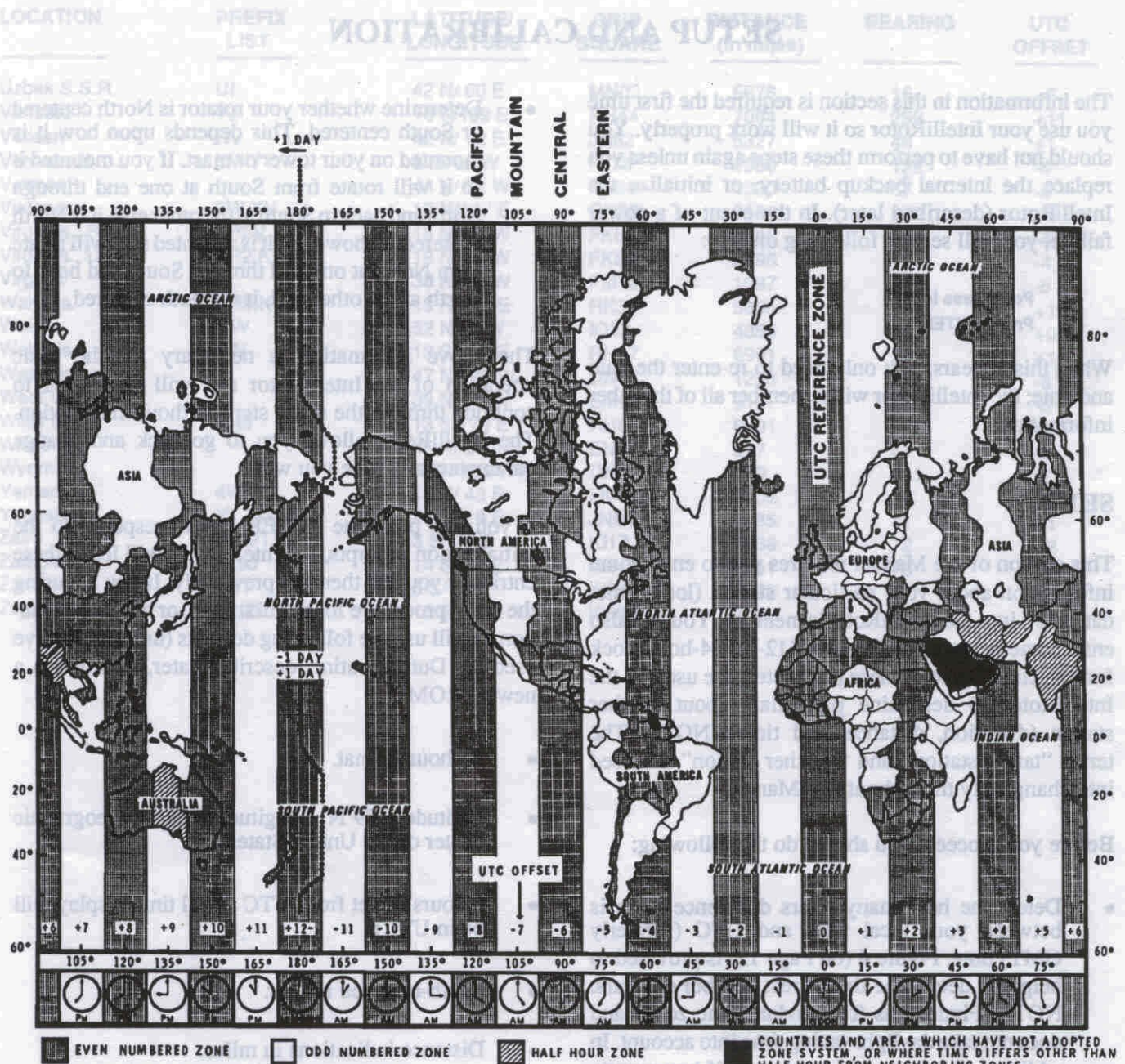
Before you proceed, you should do the following:

- Determine how many hours difference there is between your local time and UTC (formerly GMT) time. Figure 4 (on Page 12) is provided to help you determine the correct number of hours. NOTE: Figure 4 is for standard time zones and does not take daylight saving time into account. In addition, if you live in one of the half-hour zones, you will have to choose one of the nearby whole-hour time zones.
- Determine your latitude and longitude (rounded to the nearest degree). You can find this on some maps. You can also obtain this information from your local airport, police department, coast guard station, or librarian. A list of latitudes and longitudes for some selected U.S. cities is provided in Appendix A (beginning on Page 43).
- Determine whether your rotator is North centered or South centered. This depends upon how it is mounted on your tower or mast. If you mounted it so it will rotate from South at one end through North and back to South at the other end, it is North centered. If, however, it is mounted so it will rotate from North at one end through South and back to North at the other end, it is South centered.

The above information is necessary for the basic operation of the IntelliRotor and will allow you to continue through the setup steps without interruption. The IntelliRotor allows you to go back and change parameters any time you wish.

If you just press the ENTER key in response to the initialization prompts, the IntelliRotor will leave these entries as you had them set previously. If you are using the setup procedure for the first time, or after initialization, it will use the following defaults (unless you have used the Dump routine, described later, to program a new EPROM):

- 24-hour format.
- Latitude = 39°N, Longitude = 98°W (geographic center of the United States).
- 0 hours offset from UTC (local time display will be in UTC).
- North-centered rotator.
- Distance indications in miles.
- 5-second brake delay.
- Keyclick is on.
- Serial port baud rate = 9600.
- Auto-rotate parameters default as described under "Automatic Rotation" on Page 17.



STANDARD TIME ZONES OF THE WORLD REFERENCED TO UTC

Figure 4

Perform the following steps in the order shown to get your IntelliRotor ready for operation. Refer to the "In Case of Difficulty" section of this Manual if you do not obtain the correct results in any of these steps.

- () Temporarily insert a short bare wire between socket P104 pins 2 and 3. See Figure 5.

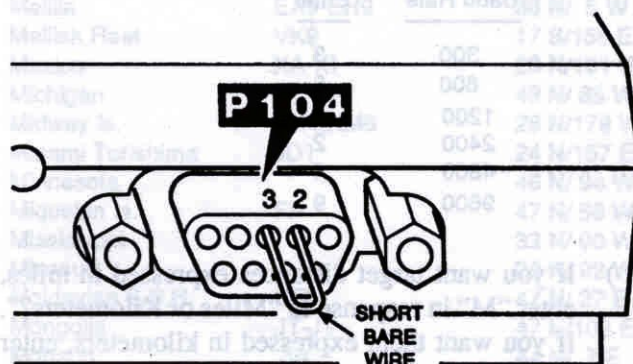


Figure 5

- () Be sure you have the control unit connected to its power unit and to your rotator as described in the "Installation" section.
- () Plug in the line cord. You may hear the relays in the power supply assembly click. If your rotator is nearby, you may also hear the brake solenoid briefly energize.
- () Press the ENTER key as many times as necessary until you obtain the date and time display. (The date and time will not be correct.) The number of times you have to press the ENTER key depends upon whether power has been previously applied, and whether or not a backup battery is installed in your control unit.
- () Press the ACCESS key. You will see the following display:

Setup, Edit or Misc?

- () Press the M key to obtain the Miscellaneous menu:

Dmp, Lst, Cal, Init?

- () Press the I key to select the Initialization routine. The display will indicate:

INITIALIZE (Y/N)?

- () Press the Y key. After a few seconds, the display will briefly indicate the ROM version (such as "Version A"). All 40 display segments will turn black briefly, followed by:

Tests passed:

PGM RAM ROM SER

SER will appear only if there is a jumper wire connected between socket P104 pins 2 and 3.

In addition, two opposite LEDs of the compass rose will light and rotate clockwise and then extinguish. The display will then indicate:

Month (1-12)?

- () Enter the number of the current month (1 for January, 12 for December) and press the ENTER key. NOTE: If you make a mistake, you can press the DEL (delete) key to backspace over the incorrect digit and re-enter it.
- () Enter the current date and press the ENTER key in response to "Day (1-31)?".
- () Enter the last two digits of the current year and press the ENTER key in response to "Year (0-99)?".
- () Enter the hour of the current UTC time in response to "UTC hours (0-23)?". You should have determined the difference between your time and UTC earlier. Be sure to express the hours in 24-hour format (1 PM is 13, 6 PM is 18, etc.). If you live in the Eastern time zone of the United States, for example, add five hours to your local time to determine UTC time (add only four hours if you are presently observing daylight saving time).
- () Enter the next minute in response to "UTC minutes (1-59)?", but do not press the ENTER key until the minute actually arrives (timekeeping does not start until you press the ENTER key).

- () Enter the number of hours that must be added to, or subtracted from, the UTC hours to produce your local hours in response to "Hours from UTC?" and press the ENTER key. This is the number that you obtained from Figure 4. Add 1 to the time offset shown in Figure 4 if your location is presently observing daylight saving time. Be sure to include the minus (-) sign where indicated. NOTE: Enter 0 if you want your IntelliRotor to display the time in UTC time instead of your local time.
- () Enter 1 or 2 in response to "12 or 24 hour clock?", depending upon whether you want the time displayed in 12-hour or 24-hour format. This entry does not require you to press the ENTER key.
- () Enter your latitude to the nearest degree in response to "Latitude (- for S)?" and press the ENTER key. If you live in the southern hemisphere, precede the number with a minus (-).
- () Enter your longitude to the nearest degree in response to "Longitude (- for E)?" and press the ENTER key. If you live in the eastern hemisphere, precede the number with a minus (-).
- () If your beam is aimed North at its center of rotation, enter "N" in response to "N or S centered?". If your beam is aimed South at its center of rotation, enter "S". This entry does not require you to press the ENTER key.
- () Enter the brake delay time you desire in response to "Brake delay (3-15)?" and press the ENTER key. This value, which is the number of seconds the IntelliRotor holds the brake released after rotation stops, depends upon the size of your beam(s). This delay makes sure the beam has stopped moving by the time the brake engages. In the automatic modes, the brake engages as soon as the IntelliRotor reaches the desired bearing (right after the beep), since the controller knows that the beam is not moving at this point. If the brake engages and disengages several times (the yellow LED turns off and on) before reaching the desired bearing, try increasing the brake delay. NOTE: If you are not sure what you should enter, simply press the ENTER key to enter the default brake time of 5 seconds.

- () Refer to the following chart to enter the serial baud rate you desire in response to "Baud Rate (300-9600)?" If you are not sure at this time what you should enter, or if you presently do not intend to use your IntelliRotor with a computer or terminal, simply press the ENTER key to enter the default baud rate of 9600.

Baud Rate	Enter
300	3
600	6
1200	1
2400	2
4800	4
9600	9

- () If you want target distances expressed in miles, enter "M" in response to "Miles or Kilometers?". If you want them expressed in kilometers, enter "K".
- () You may have noticed that when you pressed a key in the above steps, you heard an audible "beep". If you like this feature, enter "Y" in response to "Key click (Y/N)?" If you do not like this feature, enter an "N".

The display should now be indicating the correct date and time in the following format (the AM/PM indicator does not appear when the IntelliRotor is set for 24-hour format):

Mon 12-19-1988
11:45:24 AM

- () Remove the jumper wire that is connected between socket P104 pins 2 and 3, if this has not already been done.

CALIBRATION

NOTE: Make sure you have performed the above "Setup" procedure before you proceed with the following steps.

- () Make sure the date and time appear on the display. Press the ENTER key as many times as necessary until you obtain this display.

- () Press the ACCESS key. Then press the M key to obtain the Miscellaneous menu:

Dmp, Lst, Cal, Init?

- () Press the C key to select the Calibration routine. The display will indicate:

Rotate to CCW limit,
then press ENTER

NOTES:

1. You may find it easier to perform the next two steps if you have a friend watch your antenna while you rotate it, especially if your rotator is capable of more than 360-degree rotation. If your rotator is not capable of rotating more than 360 degrees, you can just rotate it until you are sure it has reached its end of rotation.
 2. The brake indicator in the center of the compass rose will light while you perform the next two steps, but the compass rose itself will not produce any indication.
 3. If you see a "Calib error - Press ENTER" message when you perform the next two steps, it indicates that the CCW and CW control wires at your power unit or rotator are interchanged. These wires must be connected so the position potentiometer inside the rotator increases in resistance as the rotator turns clockwise. (This message could also appear if there is a dirty spot on the potentiometer near the counterclockwise end of travel). Try this "Calibration" procedure again if you are sure it is wired correctly.
- () Press and hold the (↺) end of the MANUAL button until your rotator reaches due North or due South at its counterclockwise end of travel, depending upon how you have it mounted. If your rotator is capable of rotating more than 360°, and you rotate it too far, press the other end of the

MANUAL button to back up. Then press the ENTER key. The display will indicate:

Rotate to CW limit,
then press ENTER

- () Press and hold the (↻) end of the MANUAL button until your rotator reaches due North or due South at its clockwise end of travel. Then press the ENTER key. The display will return to its date and time display, but will now also indicate the antenna direction (your display will indicate the correct date, time, and antenna direction):

Tues 3-14-1989 180°
1:53:34 PM

If your rotator is South-centered, the display will indicate 359° or 0° instead of 180°.

NOTE: If you see a small "x" instead of a degree symbol when the rotator is near its ends of rotation, it indicates that the rotator has turned beyond its normal 360-degree range. The bearing, however, will still indicate the correct number of degrees. This feature accommodates rotators that are capable of extended rotation range. If this symbol occasionally appears within normal range, it indicates a dirty spot on the rotator's potentiometer. (It is normal for it to occasionally appear near due North (for South centered beams) or due South (for North centered beams).)

The IntelliRotor is now calibrated to your rotator and does not need to be recalibrated unless you use the Init function to clear the RAM (random-access memory), replace the rotator or its internal position potentiometer, change the length of your control cable, replace the RAM (integrated circuit U106), or replace the battery (B101).

- () Operate the rotator through its full range while you watch the bearing indication. Any skips indicate that the rotator's potentiometer is dirty, and should be cleaned. This will provide you with the best performance from your IntelliRotor.

This completes the "Calibration."

OPERATION

GENERAL

Your IntelliRotor has up to three different "windows" of available information. The DSPLY key enables you to rotate through these windows. NOTE: Unless the third window contains information, you will not be able to access it.

The first window shows your local day of the week, date, time, and the current antenna bearing (the bearing will not appear if you have not run the Calibration routine). Some keys automatically return the display to this window, which is the one normally displayed. It also displays "(Remote)" when the IntelliRotor is in the remote mode. The entire display looks like this:

```
Wed 1-4-1989 90°
1:44:46 PM (Remote)
```

Press the DSPLY key to see the second window, which displays the target bearing. Any other information in this window depends upon how you specify the target bearing. If you use the BEAR'G key to enter it in degrees, the bearing is all that will appear. If you use the COORD key to enter the latitude and longitude or the GRID S key to enter the grid square, the latitude, longitude, grid square, and distance are displayed in addition to the bearing. If you use the RECALL key to recall a previously stored and named bearing, the bearing reference name will appear. And lastly, if you use the CNTRY key to enter the country name or the PREFIX key to enter the call sign prefix, the bearing, latitude, longitude, grid square, distance to, and time at the target location* will appear.

Press the DSPLY key again to see the third window (if it is currently available) which shows the country name and its known call sign prefixes. Any information that the IntelliRotor cannot obtain will not appear in the window. If the window is entirely blank, you will not be able to select it with the DSPLY key. If you enter degrees to automatically rotate your antenna to a desired bearing, for example, this third window will be blank and cannot be displayed.

When you enter information, such as a country name, bearing, etc., the top line of the display will prompt you for the required data while the bottom line will show your input. If the prompt requests you to select between two or more options, such as "12 or 24 hour clock", or "Miles or Kilometers", you only need to press the first key of your selection. To select 24-hour clock time format, for example, just press the 2 key and the next prompt will automatically appear. If several characters are required, such as for a country name, you must press the ENTER key to terminate your entry. A cursor will appear on the bottom line of the display to indicate this condition. You can press the DEL (delete) key to correct mistakes before you press the ENTER key.

If you change your mind after you have made an entry or entered a menu, you can generally press the DEL key as necessary to clear the bottom line, and then press the ENTER key to return to the normal display without changing the selection.

NOTE: The SHIFT and SPC (space) keys work just like the corresponding keys on a standard typewriter.

MANUAL ROTATION

Like many rotor systems, the ⤿ (CCW) and ⤵ (CW) ends of the MANUAL button are momentary functions; you have to hold the key down to rotate your antenna to the bearing you desire. If the brake is engaged (the yellow LED indicator is not lit), the following sequence will occur:

1. The brake is released (the yellow LED will light).
2. After a brief pause, the rotator begins to rotate in the opposite direction for 1/2 second. This makes sure the brake is released in the event that wind loading is holding it engaged.
3. After a 1-second pause, the rotator begins to move in the proper direction.

* The approximate center of the country (or state) is used for the distance calculation, while the target time is referenced to the center of the selected area and does not take daylight saving time into account.

If the brake is already released when you press one of these keys, normal rotation will begin immediately.

Several seconds after the rotator stops, the brake will re-engage. NOTE: The Brake Delay (3-15) parameter in the setup routine (refer to the "Setup and Calibration" section) allows you to change this delay time.

AUTOMATIC ROTATION

In addition to manually rotating your antenna, you can choose one of six different ways to automatically rotate the antenna to a bearing you desire. You can recall a named bearing, enter an actual bearing in degrees, or select a target by latitude/longitude, grid square, country name, or call sign prefix. These functions are described separately in the following sections. After you specify a desired beam heading by one of these means, rotation does not occur until you press the AUTO key. This allows you to just get information, choose a different heading or even abort the operation completely. NOTE: If you have not already calibrated your IntelliRotor, the rotator will not turn when you press the AUTO key. Refer to the "Setup and Calibration" section of this Manual for calibration information.

If the brake is engaged when you press the AUTO key (or rotation is requested under remote control), the same operational sequence occurs as occurs under manual rotation. In addition, when the rotator is within 12 degrees* of its target bearing, the motor is pulsed to slow it down. This helps avoid overshooting the desired bearing or running into the stops if the target is near one of the mechanical limits of the rotator. Following each pulse, the position is checked to make sure the antenna has stopped moving sufficiently before its resting position is compared against the target bearing. (In gusty winds, the antenna may not come to enough of a stop until the brake delay times out.) When the rotator is within 2 degrees* of the desired bearing, or if the process has been attempted unsuccessfully several times, rotation ceases and a half-second beep indicates that the rotator has reached its target, or done its best trying. When the brake engages, the yellow LED extinguishes and both bearing displays (LCD and LED) are frozen to prevent any undesirable flicker.

You can make entries in upper case or lower case, but prefixes are always stored in upper case and country names may be a combination.

Once you have made a selection or typed in a bearing, press the ENTER key to update the information in the various windows. As indicated earlier, this does not turn the rotator; it allows you to use the IntelliRotor to simply obtain information or prepare for subsequent rotation. After you press the AUTO key, the rotator will rotate to the corresponding heading (displayed in window 2). If you wish, you can press the AUTO key instead of the ENTER key after you make your selection to begin rotation immediately. NOTE: If you enter a country name or call sign prefix, you will have to press the ENTER (or AUTO) key to verify the selection, and then press the ENTER or AUTO key again to confirm the entry or begin rotation, respectively.

NOTES:

1. If you know in advance that you want to use the long-path bearing, you must press the ENTER, PATH, and AUTO keys in that order. Refer to "Selecting Short or Long Path" described later.
2. Press any key to stop rotation prematurely when the antenna is rotating under automatic control. Press the AUTO key again to continue rotation to the target bearing.

Altering the AUTO Mode Parameters

As described above, the IntelliRotor normally begins to pulse the rotator when the rotator is within 12 degrees of its destination, and tries to stop within 2 degrees of the desired bearing. These are the default settings that were chosen for an average-size beam/rotator combination.

If you have a small beam, or a husky rotator, you may wish to start the pulsing at a point that is closer than 12 degrees and stop within 1 degree of its target. This will result in slightly faster operation and better accuracy. A large antenna array, however, may tend to coast farther after the rotator stops and require the pulsing to start earlier. Excessive coasting may make it harder for the IntelliRotor to achieve the normal ± 2 -degree accuracy.

* This number can be changed. Refer to "Altering the AUTO Mode Parameters."

In order to accommodate a wide range of rotator/antenna systems, the IntelliRotor allows you to choose one of the combinations of values listed in the table below. To make a selection, simply hold down the SHIFT key while you press one of the digit keys (0-9). There will be no indication that anything has happened, except for the normal key click (if it is enabled). The new setting, however, will be saved in the battery-backed RAM.

Digit key	Degrees from target before pulsing begins	Attempted accuracy (deg)*	Pulse width (sec)
0	8	1	.2
1	8	2	.4
2	8	3	.6
3	12	1	.2
4	12	2	.4 (default)
5	12	3	.6
6	16	1	.2
7	16	2	.4
8	16	3	.6
9	20	4	.8

You may wish to experiment to find the setting that works best for your particular installation. In general, you will want to choose a number in the second column that is greater than the "coasting range" of your antenna.

Recalling a Named Bearing

Press the RECALL key to recall a bearing that is stored in one of the 10 memory locations. The display will prompt you with "Memory (0-9 or -)?" Unless you have changed the contents of one or more of these memory locations (refer to "Storing a Named Bearing"), they default to the following settings:

Memory	Name	Bearing
0	North	(0°)
1	North	(0°)
2	Northeast	(45°)
3	East	(90°)
4	Southeast	(135°)
5	South	(180°)
6	Southwest	(225°)
7	West	(270°)
8	Northwest	(315°)
9	North	(0°)

*After the controller finishes positioning the beam, the combined action of the wind and the re-engaging of the brake wedge may cause the actual accuracy to be less than that shown.

Press the number key that corresponds to the stored bearing you desire. The name of the stored bearing will appear on the second line of the display. You now have three options:

1. If you see the desired reference name, you can press the ENTER key to copy the bearing and its name into the second display window, followed by the AUTO key to make the rotator turn to that bearing.
2. Press one of the other number keys to select a different stored bearing (followed by the ENTER and AUTO keys as in option 1).
3. Press the "-" key to abort the function.
4. Immediately press the AUTO key after you make your selection to make the rotator immediately begin turning to that bearing.

NOTE: Refer to "Storing a Named Bearing" to change the contents of one or more of these memory locations.

Rotation by Bearing, Latitude/Longitude, or Grid Square

To turn your antenna to a specific heading in degrees, press the BEAR'G key. The display will prompt you with "Bearing (0-359)?" Enter the bearing you desire in degrees and either press the ENTER key followed by the AUTO key, or just press the AUTO key to make the rotator turn to that bearing.

To turn your antenna to a specific latitude and longitude, press the COORD key. The display will prompt you for the latitude and longitude you desire. Enter each of these parameters followed by the ENTER key. Then press the AUTO key to make the rotator turn to those coordinates.

To turn your antenna to a specific grid square, press the GRID S key. The display will prompt you for the grid square you desire. Type in the grid square you desire (such as "EN77") and press the ENTER key followed by the AUTO key, or just press the AUTO key to make the rotator turn to that grid square. NOTE: You can obtain more information about grid squares from the ARRL, Newington, Conn. 06111.

Rotation by Prefix

If you wish to turn your antenna to a specific amateur radio call sign prefix, press the PREFIX key. The display will prompt you with "Prefix?". Type in the prefix (such as UA for Soviet Union) and press the ENTER key. The first prefix that the IntelliRotor finds that matches your entry or prefix range* will appear on the bottom line of the display followed by the country name (or as much of it as will fit in the display). The top line will prompt you with "NEXT, ENTER, or AUTO?". If the country is not the one you desire, press the NEXT key to see the next country that matches your entry.

When you enter a prefix, the IntelliRotor first makes an explicit search for it. If it cannot find anything that exactly matches your entry, it makes a second, implicit, search. What this means is that you can enter anything from the first character of the prefix to the entire call sign, and a match will be found. You may have to use the NEXT key if you enter something that is less than the entire prefix.

Rotation by Country Name

If you wish to turn your antenna to a specific country, press the CNTRY key. The display will prompt you with "Country?". Type in only enough characters to make the entry unique, such as "AZO" for Azores, and press the ENTER key. The first country that the IntelliRotor finds that alphabetically matches your entry will appear on the bottom line of the display, and the top line will prompt you with "PRV, NXT, ENTER, AUTO?". The PRV (previous) and NXT (next) keys allow you to step alphabetically through the list of matching countries. Once you see the desired country, press the ENTER followed by the AUTO key (or just press the AUTO key).

NOTE: This function is normally intended to let you select countries. The fifty states, however, are also included in the database for your convenience (but with a single space character for a prefix, except for Alaska and Hawaii).

* If the prefix list contains more than one part, only the part that matches your entry will be shown at this time. After you press the ENTER or AUTO key, window three will display the complete list.

STORING A NAMED BEARING

Your IntelliRotor allows you to save up to ten bearings. For your convenience, you can give each bearing a reference name.

Press the STORE key to display the "Brg (ENTER=current)?" prompt.

If you wish to store the current bearing, just press the ENTER key. If you wish to store some other bearing, type in the bearing in degrees and then press the ENTER key.

NOTE: The Store function will not work if the IntelliRotor has not been calibrated (refer to "Setup and Calibration").

You will now see the "Memory (0-9 or -)?" prompt. Press the digit key that matches the memory location where you wish to store your bearing, followed by the ENTER key. If you press the ENTER key by itself, the bearing will be stored in position 0 (default). NOTE: Before you press the ENTER key, pressing one of the digit keys will allow you to see the name of any bearing that is already saved at that position. This feature allows you to select an empty position, or one you wish to change.

The "-" key allows you to abort the Store function, if you change your mind and do not wish to save the bearing.

If you have not stored anything in a particular location, the number of that location appears in the display followed by one of eight compass rose bearing names:

Memory	Default Name
0	North
1	North
2	Northeast
3	East
4	Southeast
5	South
6	Southwest
7	West
8	Northwest
9	North

The last prompt you will see is "Reference name?". You can type in a name of up to 20 characters and spaces. You could enter, for example, "My friend in Germany" (you must enter something). After you type in the reference name, press the ENTER key.

Recalling a named bearing is explained above under "Automatic Rotation."

SELECTING SHORT OR LONG PATH

The IntelliRotor normally uses the short-path bearing. If you wish to use the long path, press the PATH key after you have used one of the normal methods to determine the short-path bearing. Then press the ENTER or AUTO key. The display will indicate that the bearing is long path by lowering the degree symbol, located next to the target bearing, from its normal upward position. If the distance appears on the display, it will change to the long-path distance.

AUDIBLE CW BEARING

When you press the CW key, an internal transducer will announce the bearing in Morse code. This key operates only while the rotator is not turning. NOTE: The time indication, if it is present on the display, does not update while the code is being sent, but will "catch up" upon completion. The code speed is fixed at 20 wpm.

REMOTE MODE

NOTE: To use this function, make sure you have your computer or terminal connected to plug P104 as described in Appendix C of this Manual.

If you are using a computer with this function, you will need a terminal emulation or modem program to provide the proper communications.

Press the REMOTE key to allow access to the IntelliRotor through its RS-232 serial port. A "Remote" indicator will appear on the normal display window. The current date, time, and bearing are obtainable, and you can select a new bearing. The protocol is shown below. NOTE: <CR> refers to the carriage return key on your computer or terminal, and CRLF refers to a carriage-return, line feed.

<u>Command</u>	<u>Operation</u>
D <CR>	Returns the date, followed by a CRLF.
T <CR>	Returns the time (in the format you have selected), followed by a CRLF.
B <CR>	Returns the current bearing in degrees, followed by a CRLF.
nnn <CR>	Selects a new bearing (you do not need to enter leading zeroes). When the rotator reaches the bearing you have requested, a CRLF is returned to the computer or terminal.

If the rotator is turning due to an nnn<CR> command, any additional character that passes through the serial port will abort the rotation.

The next two functions are specifically intended to be used by a computer program.

<u>Command</u>	<u>Operation</u>
L<CR>	Returns a list of country information. The format is similar to the List function from the MISC menu, except the leading zeros are not blanked and spaces are not used between fields. Instead, the high bit of the last character of a field is set. A formfeed character signals the end of the data. This function allows a computer program to obtain information based on the current database.
I<CR>	Returns a block of information from RAM that includes named bearings, currently selected country data, configuration status, and more. The information contained in the 388 (184 hex) bytes that are returned by this command is outlined in Table A on Page 21.

Table A

Bytes	Use
000H — 0EFH	Ten user-named bearings. Each entry is 24 bytes long. The first two bytes of each entry contain the binary bearing; this is followed by the ASCIIZ name. If the name is less than 20 characters long, ignore characters beyond the ASCIIZ null.
0F0H — 104H	Country name. (ASCIIZ string)
105H — 119H	Prefix list. (ASCIIZ string)
11AH — 124H	Local date. (ASCIIZ string)
125H — 130H	Local time. (ASCIIZ string)
131H — 13CH	Target time
13DH — 142H	Target distance
143H — 145H	Also used for bearing name. (ASCIIZ string)
146H — 14AH	Current bearing*. (ASCIIZ string)
14BH — 14FH	Target bearing*. (ASCIIZ string)
150H — 15AH	Target latitude/longitude. (ASCIIZ string)
15BH — 15FH	Grid square. (ASCIIZ string)
160H	System configuration byte:
	Bit 7 = North centered.
	Bit 6 = 12-hour clock format.
	Bit 5 = Distances in kilometers.
	Bit 4 = Key click on.
	Bit 3 = Set when calibrated.
	Bits 2-0 = Baud rate:
	000 = 300
	001 = 600
	010 = 1200
	011 = 2400
	100 = 4800
	101 = 9600
161H	Brake delay.
162H	AUTO mode parameter (0-9).
163H	Local hemisphere and time zone:
	Bit 6 = South.
	Bit 5 = East.
	Bits 4-0 = Hours relative to UTC (signed).
164H	Local latitude (absolute value, binary).
165H	Local longitude (absolute value, binary).
166H	Target hemisphere and time zone:
	Bit 7 = Entered by user.
	Bit 6 = South.
	Bit 5 = East.
	Bits 4-0 = Hours relative to UTC (signed).
167H	Target latitude (absolute value, binary).
168H	Target longitude (absolute value, binary).
169H — 172H	Count-to-bearing conversion constants.
173H	Reserved.
174H	EPROM (database) version.
175H — 182H	Reserved.
183H	55H indicates valid RAM contents.

* The normal degree symbol is 0DFH, the degree symbol for long path is 0A1H, and the degree symbol for "past limit" is 0EBH.

When the IntelliRotor enters the Remote mode, a CRLF is sent to the serial port. Any unrecognized or invalid commands will return a "?" followed by a CRLF. You will also see a "?" followed by a CRLF if you try to set or read a bearing when the IntelliRotor has not yet been calibrated. Except for leading zeroes in the date, time, and bearing (to force right-justification), the format is the same as on the IntelliRotor's display.

To disable the serial port and return to normal operation, press any key on the IntelliRotor other than the REMOTE or SHIFT key. The key you press will perform its normal operation, if any.

NOTE: The serial port responds to XON and XOFF (control-Q/control-S) characters whenever it is outputting data.

THE DATABASE

EPROM integrated circuit U105 in the IntelliRotor contains the country and state names, prefixes, latitudes and longitudes, and time zone information. When you initialize the IntelliRotor, like you did in the "Setup and Calibration" section, the EPROM data is copied into RAM integrated circuit U106. The data in RAM can be modified by adding or deleting countries. This RAM also retains any named bearings that you saved with the Store function, as well as the settings and selections you make when you use the Setup function.

The Edit function allows you to modify the RAM contents. To make changes to the RAM contents, first press the ACCESS key. You will see the "Setup, Edit, or Misc?" prompt. Press the E key to select the Edit function (it is not necessary to press the ENTER key). You will see the "Add or Remove?" prompt. Press the A key to add a country or the R key to remove a country. The display will prompt you for the required information.

If you add a country, it will be placed in alphanumeric order in the list. Depending upon the length of the country name and prefix list, there is room for several dozen new countries. In the unlikely event that there is not enough room left for your entry, the message "No room - press ENTER" will appear on the display.

If you wish to change an existing country entry (such as its spelling, prefix list, time zone, or coordinates), you must first use the Remove function from the Edit menu to remove the country from the list. You can then use the Add function to add it back into the list, making the changes you wish. The Remove function allows you to choose the country in the same way you do with the CNTRY key. If you change your mind about removing a country after you have selected it, press any key except the PREV, NEXT, ENTER, or AUTO keys. **NOTE:** The AUTO key operates just like the ENTER key in this function.

When you enter a new country name, you can use any combination of upper and lower case characters. Database searches always disregard letter cases.

Prefixes may also be entered in either upper or lower case, but are stored in upper case. A prefix list may contain a single prefix, or it may be a combination of separate prefixes and prefix ranges (which are indicated with a "-"). Prefixes and prefix ranges must be separated by commas. "B,A,CD1-CD5,E", for example, would be a valid prefix list.

You must enter something when the IntelliRotor prompts you for a prefix list. If you want the prefix field to be blank, just enter a space. This allows you to use the PREFIX key to locate the entry by pressing the SPACE key when the IntelliRotor prompts you for a prefix. (This also locates U.S. state names, which have a space in place of the prefix in the database; except Alaska and Hawaii). Any countries you add to the database are flagged so that if you use the List function from the MISC menu, they are preceded with an asterisk (*). This helps you determine which entries have been added or edited.

If you have made several changes to the country data and wish to make them permanent, you can do so with the Dump function from the MISC menu. To do so, however, you must have access to an EPROM programmer. The Dump function performs an Intel Hex dump of all of the data in RAM. This dump can be used to program a new EPROM if you want to make all of the entries permanent. Dump removes all of the "user-added" flags from the entries you have added, so the List function will only print an asterisk in front of countries that you add or edit after you program the new EPROM.

If you program a new EPROM, we recommend that you store the original in a safe place in the event you wish to use it later. The new EPROM also contains any named bearing information that you saved with the Store function, as well as the Setup data (your latitude and longitude, preferred clock format, etc.). As before, you can still use the Setup function to change these parameters.

The calibration constants at the time of a dump are also saved. Therefore, if the IntelliRotor was calibrated prior to the dump, using the new EPROM will cause the controller to automatically be in a calibrated condition, even after a full reset. You can, however, still recalibrate the IntelliRotor if necessary.

You can use the Init function from the MISC menu if you ever wish to start from scratch by copying the EPROM database to RAM. The display will request verification to help prevent you from losing any changes you have made to the database. Press any key except the Y key to abort the Init function.

LISTING THE DATABASE

When you choose the List function from the MISC menu, the IntelliRotor sends the contents of the database (Refer to Appendix B for a sample listing) to the serial port in a format that may be displayed on a computer terminal or printer. The country names are in alphabetical order and each name is followed by a prefix list, latitude and longitude, grid square, distance, bearing, and time offset from UTC. Press any key if you wish to stop the listing before it finishes. The list will stop as soon as it finishes printing the current line.

NOTE: When an XOFF character has been sent to the controller while it is in the Remote mode or outputting data, the controller's keyboard is disabled. It must receive an XON before you can regain control.

ROTATOR PROTECTION

Since rotators are not designed for continuous use, we have included a routine in the IntelliRotor's programming that helps protect the rotator from overheating.

This routine estimates the motor and solenoid temperatures by monitoring the on and off periods. When the temperature is likely to be approaching an unsafe value, the controller will not allow rotation until sufficient time for cool-down has passed.

From a "cold start", continuous rotation is possible for just over 4 minutes. At that point, it will take 15 to 16 minutes to fully recover. Shorter off times will allow proportionately shorter periods of use.

CONTRAST CONTROL

The 40-character liquid crystal display has a relatively narrow viewing angle. An internal contrast control allows you to make adjustments for your particular viewing angle. You may also have to use this control to compensate for large changes in ambient temperature.

To adjust the contrast for the viewing angle, set the IntelliRotor controller in its normal position. Then insert a small-blade screwdriver through the small hole in the rear of the controller to adjust the control as desired.

IN CASE OF DIFFICULTY

This section of the Manual is divided into two parts. The first part, titled "Troubleshooting and Repair Precautions," points out the care that you should use when you service the unit to prevent damaging components.

The second part, titled "Troubleshooting Chart," shows some difficulties and likely causes.

If the "Troubleshooting Chart" does not help you locate a problem, read the "Circuit Description" and refer to the Schematic Diagram (fold-in) to help you determine where the trouble is.

Refer to the "Circuit Board X-Ray Views", beginning on Page 33, for the locations of parts on the circuit boards.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to "Customer Service" inside the rear cover of this Manual. Your Warranty is located inside the front cover.

Troubleshooting and Repair Precautions

WARNING: When the line cord is connected to an AC outlet, hazardous voltages are present inside the power unit of your IntelliRotor. (see Figure 6). Be sure you disconnect the line cord before you remove the cover from the power unit.

1. Make sure you do not short any adjacent terminals or foils when you make tests or voltage measurements. If a probe or test lead slips, for example, and shorts two adjacent connections, it is very likely to damage one or more of the transistors, diodes, or integrated circuits (ICs).
2. Be especially careful when you test any circuit that contains an IC or a transistor. Although these components have an almost unlimited life when they are used properly, they are much more vulnerable to damage from excess voltage and current than many other parts.
3. Do not remove any components while the unit is connected to an AC outlet.
4. Use a voltmeter with a high-impedance input when you measure voltages.

5. When you make repairs, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, be sure you find what damaged the resistor. If you do not eliminate the cause, the replacement resistor may also become damaged when you put the unit back into operation.
6. In several areas of the circuit boards, the foil patterns are quite narrow. When you unsolder a part to check or remove it, avoid excessive heat while you remove the part. A suction-type desoldering tool makes part removal easier.

COMPONENTS

To remove faulty resistors or capacitors, first clip them from their leads; then heat the solder on the foil and allow each lead to fall out of its hole. Preshape the leads of the replacement part and insert them into the circuit board holes. Solder the leads to the foil and cut off the excess lead lengths.

You can remove transistors in the same manner as resistors and capacitors. Make sure you install the replacement transistor with its leads in the proper holes. Then solder the leads quickly to avoid heat damage. Cut off the excess lead lengths.

FOIL REPAIR

To repair a break in a circuit board foil, bridge solder across the break. Bridge large gaps in the foil with bare wire. Lay the wire across the gap and solder each end to the foil. Carefully trim off any excess bare wire.

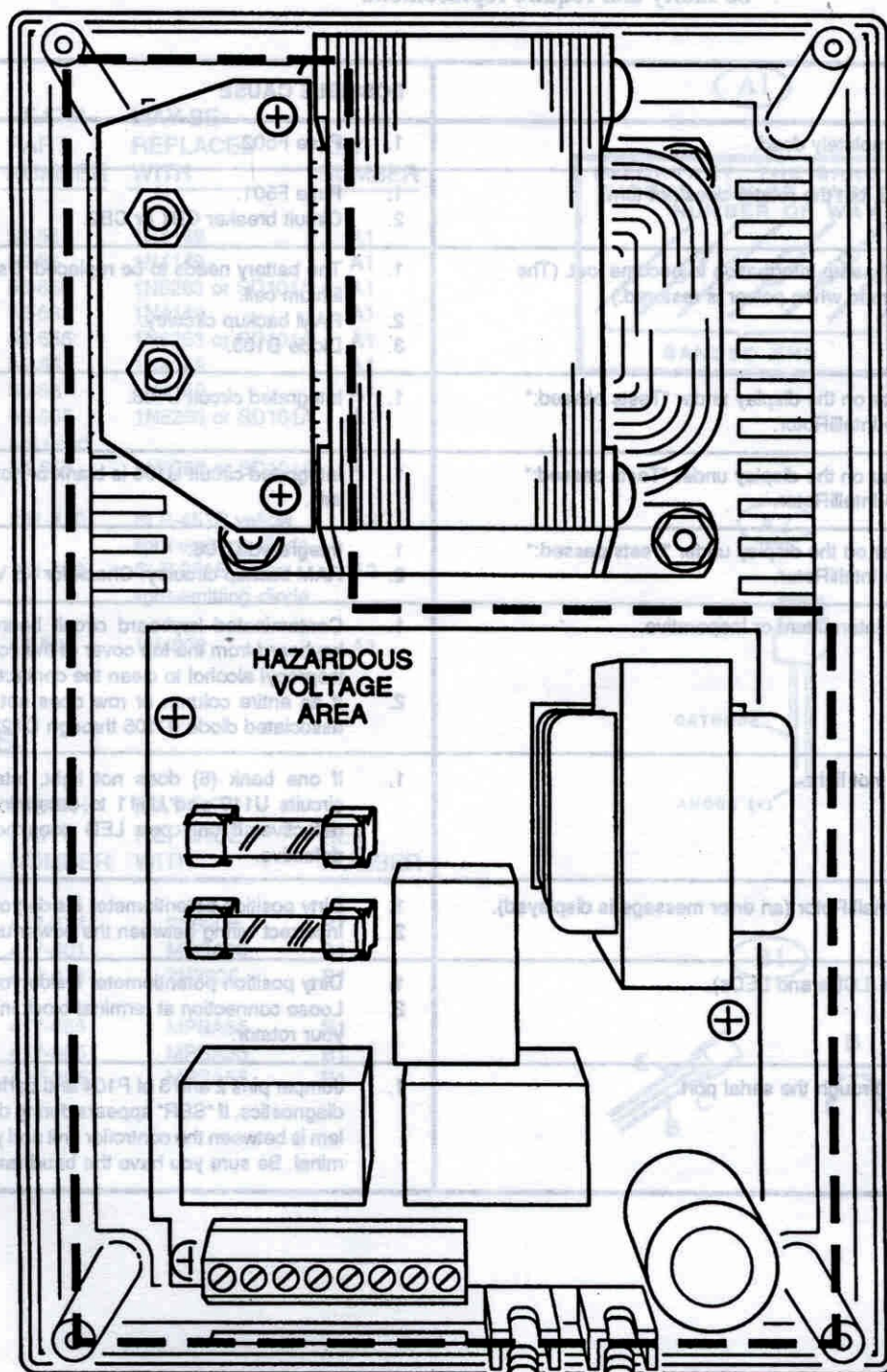


Figure 6

Troubleshooting Chart

The following chart lists the "Condition" of several specific malfunctions and some "Possible Causes." If a particular part or area is mentioned (U103, D114, etc.) as a possible cause, check the parts associated with that circuit. It is also possible, on rare occasions, for a part to be faulty and require replacement.

CONDITION	POSSIBLE CAUSE
Unit appears to be completely dead.	1. Fuse F502.
Displays are functional, but the rotator does not turn.	1. Fuse F501. 2. Circuit breaker CB1 or CB2.
Power loss causes the setup information to become lost. (The diagnostics are performed when power is restored.)	1. The battery needs to be replaced. Use a type CR-2025 lithium cell. 2. RAM backup circuitry. 3. Diode D103.
"PGM" does not appear on the display under "Tests passed:" when you initialize the IntelliRotor.	1. Integrated circuit U108.
"ROM" does not appear on the display under "Tests passed:" when you initialize the IntelliRotor.	1. Integrated circuit U105 is blank or not programmed properly.
"RAM" does not appear on the display under "Tests passed:" when you initialize the IntelliRotor.	1. Integrated U106. 2. RAM backup circuitry. Check for +5 VDC at U106 pin 26.
One or more keys are intermittent or inoperative.	1. Contaminated keyboard circuit board. Disassemble the keyboard from the top cover of the controller unit and use isopropyl alcohol to clean the contacts. 2. If an entire column or row does not operate, check the associated diode (D105 through D123).
One or more LEDs do not light.	1. If one bank (8) does not light, interchange integrated circuits U110 and U111 to determine if one of them is defective. If only one LED does not light, the LED is defective.
Cannot calibrate the IntelliRotor (an error message is displayed).	1. Dirty position potentiometer inside your rotator. 2. Incorrect wiring between the power unit and your rotator.
Erratic bearing display (LCDs and LEDs).	1. Dirty position potentiometer inside your rotator. 2. Loose connection at terminal block in the power unit or at your rotator.
Cannot communicate through the serial port.	1. Jumper pins 2 and 3 of P104 and perform initialization and diagnostics. If "SER" appears during diagnostics, the problem is between the controller unit and your computer or terminal. Be sure you have the baud rate set correctly.

CIRCUIT DESCRIPTION

Refer to the Schematic (fold-in) while you read the following paragraphs. The component numbers are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and cabinet:

1 — 99	Parts mounted on the cabinet.
101 — 199	Parts mounted on the controller circuit board.
201 — 299	Parts mounted on the display circuit board.
301 — 399	Parts mounted on the keyboard circuit board.
401 — 499	Parts mounted on the LED circuit board.
501 — 599	Parts mounted on the power supply circuit board.

The major parts of the IntelliRotor are the controller, displays, keyboard, and power supply. These parts are described below.

CONTROLLER

The heart of your IntelliRotor is 8-bit microprocessor U108, which controls all of the IntelliRotor's functions. An internal 8K ROM (read-only memory) contains the program instructions and display prompts. In addition to the ROM, an internal 256-byte scratchpad RAM (random-access memory) is used for mathematical calculations and keeps track of time, date, bearing, etc. Integrated circuit U108 also decodes the keyboard, communicates with the serial port, reads the V-F (voltage-to-frequency) converter, sends information to the LCD and LED displays, moves data to and from the external 8K RAM (U106), and activates the motor and brake relays.

Integrated circuit U108 port P0 is used as a bidirectional data port. It also supplies the low byte of the address bus when it accesses external devices. The ALE output of U108 latches this address into U103, while the high byte of the address appears at port P2.

Integrated circuit U107 performs address decoding, which results in the following memory map:

External ROM (U105)	000H—1FFFFH
External RAM (U106)	4000H—5FFFFH
Keyboard	8000H—8007H

Capacitor C110 and resistor R107 reset U108, by causing RST (reset) pin 9 to first go high briefly, and then low. Diode D113 allows C110 to quickly discharge during a brief power loss to ensure a proper reset.

TIME KEEPING

Transistor Q106 and inverter U109D provide a 60 Hz square wave for U108, which is used to keep time. U108 divides this square wave signal into seconds, minutes, hours, etc., as required for the clock and calendar displays. Since this signal comes from the AC power source, there is no cumulative error.

BEARING DETERMINATION

Regulator integrated circuit U115 is configured as a constant-current source, and delivers approximately 10 milliamperes to the 500-ohm position potentiometer inside the rotator. This produces a voltage that varies from near zero to approximately 5 volts, depending upon the current bearing.

Timer U113 and operational amplifier U114 convert the potentiometer voltage to a frequency that may be counted by U108 and translated into a bearing. Resistors R126 and R127 bias the negative input of U114 so that a minimum frequency (not zero Hz) corresponds to an input voltage of zero. This ensures linearity near the counterclockwise limit of rotation.

The output of U113 is a very narrow negative pulse that would be too narrow for U108 to recognize as an interrupt. Transistor Q108 and inverter U109A stretch this pulse to a duration that can be recognized.

During the calibration routine, U108 determines the slope and intercept of the straight line function that relates the bearing to frequency and stores these in external RAM U106, which retains them if power is lost.

SERIAL PORT

U108 contains a full-duplex serial port. It is configured so that it uses the 11.059 MHz crystal time base as its reference and allows you to select a standard baud rate between 300 and 9600.

U112 translates the TTL levels of U108 to RS-232-compatible levels and vice versa. This device also uses internal charge pumps to provide the positive and negative voltages that are required by RS-232. These voltages are also used by the V-F converter.

DISPLAYS

LCD (liquid-crystal display) module V201 receives its commands and ASCII characters from microprocessor port P0, but separate pins on U108 are used for its enable, read/write, and register select lines to accommodate the module's slower timing requirements.

Appropriate levels are latched into U110 and U111 to light LEDs D401 through D417.

KEYBOARD

When the keyboard is being addressed, address lines A0, A1, and A2 select, through U104, the column that is to be read into data port P0. Any row in that column that has a key closure will result in a low level on the corresponding input. Diodes D105 through D112 prevent logically different outputs of U104 from being shorted together in the event that two or more keys in the same row are pressed at the same time. Diodes D115 through D119 and D121 through D123 perform the same function for the data lines in case two or more keys in the same column are pressed at the same time.

BATTERY BACKUP

The data that is contained in external RAM U106 includes the database that was copied from ROM U105 (and possibly edited by the user). It also includes all setup selections, except date and time. The battery backup system prevents this data from being lost during power outages.

To protect the contents of RAM U106, its CS2 pin must go low to deselect the integrated circuit before its supply voltage drops. After this takes place, VDD may fall to 2 volts without losing data.

When power is lost, capacitor C501 begins to discharge and causes the +12-volt supply to fall. Transistor Q102 is normally turned on by this supply through the voltage divider formed by resistors R104, R105, and R106. This keeps transistor Q101 turned on, which keeps the CS2 pin at VDD.

As the +12-volt supply falls, capacitor C104 discharges through D104. Before U101 and U102 can go out of regulation, Q102 turns off, which turns off Q101 and allows resistor R101 to pull the CS2 pin low. A short time later, U101 and U102 go out of regulation, D101 becomes forward biased, and D102 becomes reverse biased. At this point, the RAM obtains its power from the battery. The RAM requires very little current under these conditions.

When power is restored, VDD returns to +5 volts and capacitor C104 begins to charge through resistor R106. When VDD stabilizes, transistor Q102 turns on, which turns Q101 on and takes the CS2 pin high again.

Diode D101 sets the ground terminal of U102 to a level that is one diode drop above circuit ground to compensate for the diode drop across D102.

TONE SOURCE

NAND gate U109C is connected as a gated astable multivibrator that, together with transistor Q107, drives piezo-electric transducer A101. This circuit produces the keyclick when you press a key (if you have the keyclick feature turned on), sounds the bearing in Morse code, and beeps when the target bearing is reached.

POWER SUPPLY AND SWITCHING

The IntelliRotor uses two power transformers. One of them supplies power for the logic circuitry, while the other supplies power for the brake solenoid and motor. To reduce current drain when the IntelliRotor is at rest, the brake and motor transformer is turned on only when it is needed.

Logic power transformer T501 supplies power to a fullwave rectifier formed by diodes D501 and D502, which supplies a nominal +12-volts DC that is filtered by capacitor C501. One side of the secondary winding supplies the 50/60 Hz signal that is used for time-keeping. Transistor Q106 and U109D convert this signal to a TTL-compatible square wave.

Relay K501 switches power transformer T1 on to turn the rotator. Microcontroller U108 turns on transistor Q501, which causes the relay to energize. Diode D503 protects Q501 from the reverse EMF produced by the relay coil when it de-energizes.

Relays K502 and K503 cause the motor to turn clockwise or counterclockwise, respectively. Their associated components operate the same as their counterparts in the K501 circuit described above.

Protection Devices

As is described in the "Operation" section of this Manual, a software routine prevents excessive heat buildup in the rotator itself. This also helps make sure that rotator power transformer T1 does not overheat.

In addition to the software protection, the primary windings of the rotator and logic power transformers are individually fused. In the event the other protection devices should fail, a thermal fuse located inside the rotator power transformer (near its core) will open before the transformer could become dangerously hot.

Circuit breakers CB1 and CB2 protect against excessive current in case a short circuit occurs in the rotator or rotator cable.

Chokes

L101	330-550	30 H
L102	330-550	30 H
L103	330-550	30 H
L104	330-550	30 H
L105	330-550	30 H

Socket — Plugs

P101	251-418	14-pin socket
P102		Location for keyboard cable
P103	Not used	
P104	438-1710	8-pin "D" plug
P105	281-418	20-pin socket
P106	438-1822	9-pin "D" socket
	404-230	8-pin "C" socket
	434-288	14-pin IC socket

Capacitors

C101	21-788	1 Hf (104) axial-lead ceramic
C102	21-788	1 Hf (104) axial-lead ceramic
C103	32-800-1	1 Hf electrolytic
C104	32-804-1	2.5 Hf electrolytic
C105	21-788	1 Hf (104) axial-lead ceramic

REPLACEMENT PARTS LIST

To order a replacement part, use the Parts Order Form supplied with your IntelliRotor. If a Parts Order Form is not available refer to "Replacement Parts" inside the rear cover of this Manual.

MAIN CIRCUIT BOARD

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
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Resistors

NOTE: All resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise noted.

R101	6-103-12	10 k Ω
R102	6-103-12	10 k Ω
R103	6-103-12	10 k Ω
R104	6-102-12	1000 Ω
R105	6-103-12	10 k Ω
R106	6-222-12	2200 Ω
R107	6-822-12	8200 Ω
R108	6-273-12	27 k Ω
R109	See "Miscellaneous"	
R110	6-332-12	3300 Ω
R111	6-151-12	150 Ω
R112	6-471-12	470 Ω
R113	6-103-12	10 k Ω
R114	6-103-12	10 k Ω
R115	Not used	
R116	6-471-12	470 Ω
R117	6-103-12	10 k Ω
R118	6-332-12	3300 Ω
R119	6-103-12	10 k Ω
R120	6-332-12	3300 Ω
R121	6-1003-12	100 k Ω , 1%
R122	6-1003-12	100 k Ω , 1%
R123	6-1003-12	100 k Ω , 1%
R124	6-1003-12	100 k Ω , 1%
R125	6-151-12	150 Ω
R126	6-273-12	27 k Ω
R127	6-271-12	270 Ω
R128	6-102-12	1000 Ω
R129	6-103-12	10 k Ω
R130	6-103-12	10 k Ω
R131	6-103-12	10 k Ω

Capacitors

C101	21-786	.1 μ F (104) axial-lead ceramic
C102	21-786	.1 μ F (104) axial-lead ceramic
C103	25-900-1	1 μ F electrolytic
C104	25-924-1	2.2 μ F electrolytic
C105	21-786	.1 μ F (104) axial-lead ceramic

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
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Capacitors (cont'd)

C106	21-786	.1 μ F (104) axial-lead ceramic
C107	21-786	.1 μ F (104) axial-lead ceramic
C108	21-786	.1 μ F (104) axial-lead ceramic
C109	21-786	.1 μ F (104) axial-lead ceramic
C110	25-917-1	10 μ F electrolytic
C111	20-100	30 pF (300J) mica
C112	20-100	30 pF (300J) mica
C113	21-786	.1 μ F (104) axial-lead ceramic
C114	21-786	.1 μ F (104) axial-lead ceramic
C115	25-915-1	47 μ F electrolytic
C116	25-915-1	47 μ F electrolytic
C117	25-915-1	47 μ F electrolytic
C118	25-915-1	47 μ F electrolytic
C119	21-786	.1 μ F (104) axial-lead ceramic
C120	25-900-1	1 μ F electrolytic
C121	21-784	.001 μ F (102) axial-lead ceramic
C122	21-786	.1 μ F (104) axial-lead ceramic
C123	21-786	.1 μ F (104) axial-lead ceramic
C124	21-769	.01 μ F (103) axial-lead ceramic
C125	21-786	.1 μ F (104) axial-lead ceramic
C126	21-786	.1 μ F (104) axial-lead ceramic
C127	21-786	.1 μ F (104) axial-lead ceramic
C128	25-887	220 μ F electrolytic
C129	21-786	.1 μ F (104) axial-lead ceramic

Chokes

L101	235-229	35 μ H
L102	235-229	35 μ H
L103	235-229	35 μ H
L104	235-229	35 μ H
L105	235-229	35 μ H

Socket — Plugs

P101	231-415	14-pin socket
P102	Location for keyboard cable	
P103	Not used	
P104	432-1710	9-pin "D" plug
P105	231-413	20-pin socket
P106	432-1855	9-pin "D" socket
	434-230	8-pin IC socket
	434-298	14-pin IC socket

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
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Sockets — Plugs (cont'd)

434-299	16-pin IC socket
434-311	20-pin IC socket
434-312	28-pin IC socket
434-253	40-pin IC socket

Diodes — Transistors — Integrated Circuits

Refer to "Semiconductor Identification" (Page 39).

Miscellaneous

A101	231-407	Piezo-electric transducer
B101	230-8403	3-volt lithium battery
R109	10-311	5000 Ω (5 k Ω) control
RP-101	231-401	4700 Ω (x8) resistor pack
Y101	231-408	11.059 MHz crystal
	230-8412	Battery holder
	85-3463	Circuit board

DISPLAY CIRCUIT BOARD

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
V201	150-412	LCD module
P201	231-414	14-pin plug

KEYBOARD CIRCUIT BOARD

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
	85-3644	Circuit board
P301	231-406	Ribbon cable

LED CIRCUIT BOARD

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
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Diodes

Refer to "Semiconductor Identification" (Page 39).

Miscellaneous

P401	231-412	20-pin plug
	85-3466	Circuit board
	255-896	LED spacer

POWER UNIT

CIRCUIT Comp No.	HEATH Part No.	DESCRIPTION
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Resistors

NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise noted.

R501	6-225-12	2.2 M Ω
R502	6-102-12	1000 Ω
R503	6-103-12	10 k Ω
R504	6-102-12	1000 Ω
R505	6-103-12	10 k Ω
R506	6-102-12	1000 Ω
R507	6-103-12	10 k Ω
R508	6-103-12	10 k Ω

Capacitors

C501	25-947	6800 μ F electrolytic
C502	231-402	120-160 μ F 125 VAC non-polarized electrolytic
C503	21-786	.1 μ F (104) axial-lead ceramic
C504	21-786	.1 μ F (104) axial-lead ceramic
C505	21-786	.1 μ F (104) axial-lead ceramic

Circuit Breakers — Fuses

CB1	65-85	Circuit breaker
CB2	65-85	Circuit breaker
F501	421-3	2-ampere slow-blow fuse (for 120 VAC)
F501	421-23	1-ampere slow-blow fuse (for 220 VAC)
F502	421-26	1/8-ampere slow-blow fuse (for 120 VAC)
F502	421-27	1/16-ampere slow-blow fuse (for 220 VAC)

Power Transformers

T1	54-1067	Rotator
T501	54-1066	Logic

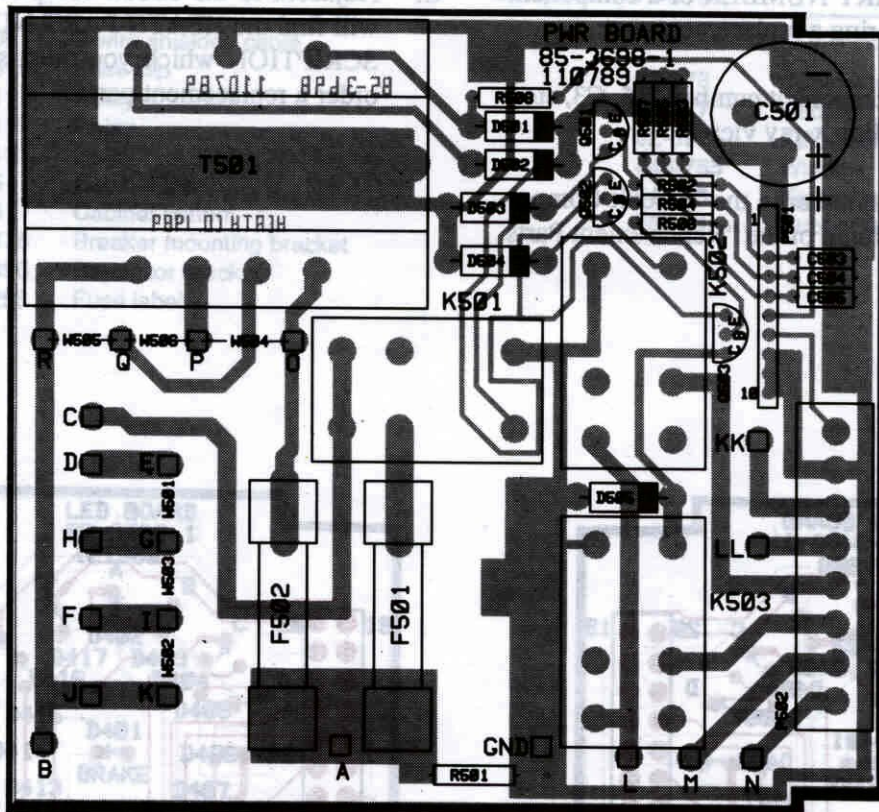
Diodes — Transistors

Refer to "Semiconductor Identification" (Page 39).

Miscellaneous

P501	432-1450	10-pin plug
P502	432-1806	8-screw terminal block
	85-3698-1	Circuit board
	89-54	Line cord

(Shown from the foil side. The foil on the component side is not shown.)

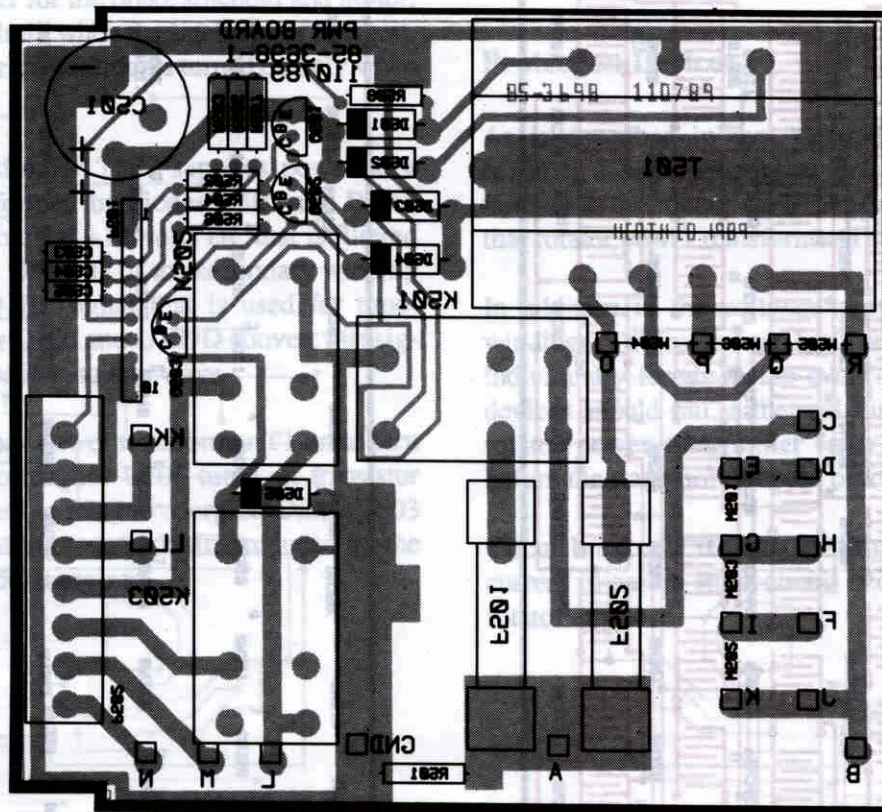


POWER SUPPLY CIRCUIT BOARD
(Shown from the component side.)

POWER SUPPLY AND SWITCHING

The logic power supply is a separate power source. One of these supplies power for the logic circuitry, while the other supplies power for the motor control and motor. To reduce current draw, the motor control and motor are switched on only when needed.

Relays K502 and K503 cause the motor to turn clockwise or counterclockwise, respectively. Their associated components operate the same as their counterparts in the K501 circuit described above.



POWER SUPPLY CIRCUIT BOARD
(Shown from the foil side.)

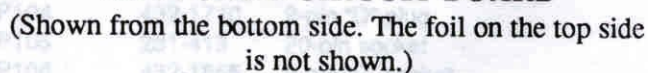
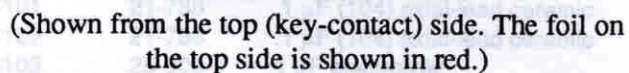
KEYBOARD CIRCUIT BOARD

(Shown from the bottom side. The foil on the top side is not shown.)

KEYBOARD CIRCUIT BOARD

(Shown from the top (key-connect) side. The foil on the top side is shown in red.)

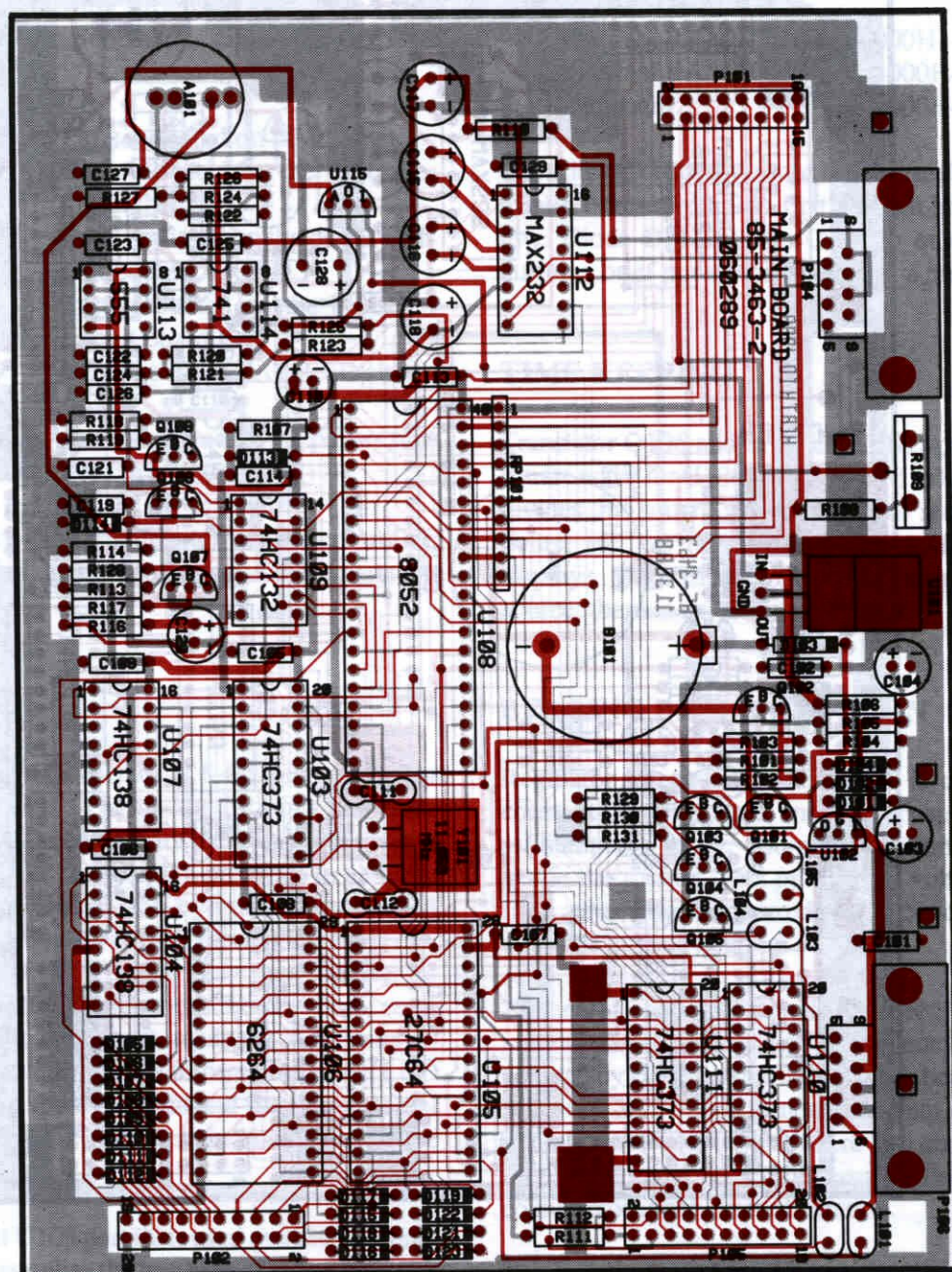
To order a replacement part, use the Parts Order Form supplied with your IntelliRotor. If a Parts Order Form is



MAIN CIRCUIT

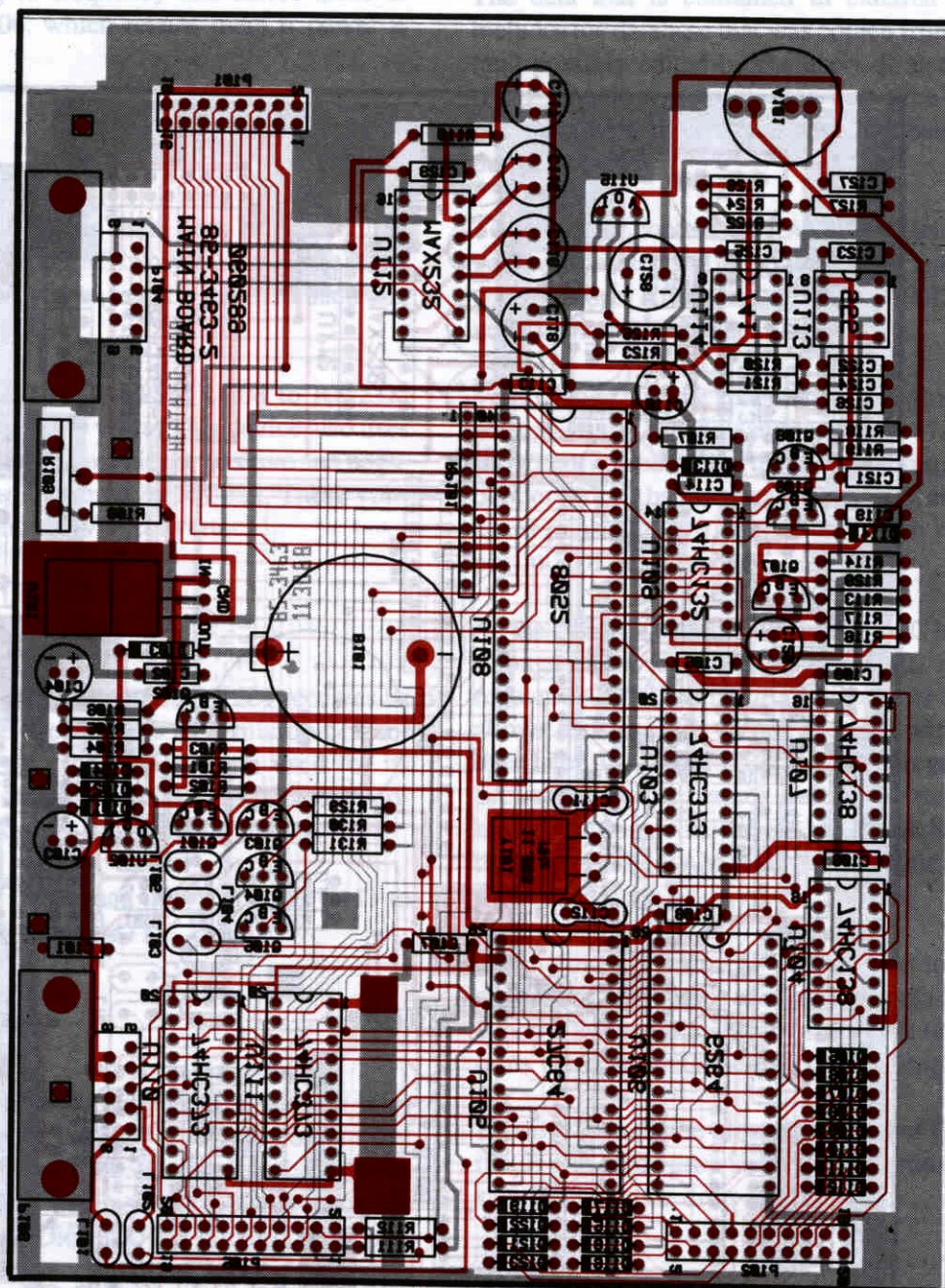
(Shown from the component side)

T BOARD



MAIN CIRCUIT BOARD

(Shown from the component side. The foil on the component side is shown in red.)



MAIN CIRCUIT BOARD

(Shown from the foil side. The foil on the component side is shown in red.)

SEMICONDUCTOR IDENTIFICATION

DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
D101	56-56	1N4149	A1
D102	56-56	1N4149	A1
D103	56-655	1N6263 or SD101A	A1
D104	56-56	1N4149	A1
D105 — D112	56-655	1N6263 or SD101A	A1
D113	56-56	1N4149	A1
D114	56-56	1N4149	A1
D115 — D119	56-655	1N6263 or SD101A	A1
D120	not used		
D121-D123	56-655	1N6263 or SD101A	A1
D401	231-410	SLP-451B yellow light-emitting diode	A2
D402 — D417	231-409	SLP-251B green light-emitting diode	A2
D501 — D505	57-65	1N4002	A1

TRANSISTORS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
Q101	417-874	2N3906	B1
Q102 — Q107	417-801	MPSA20	B1
Q108	417-874	2N3906	B1
Q501	417-865	MPSA55	B1
Q502	417-865	MPSA55	B1
Q503	417-865	MPSA55	B1



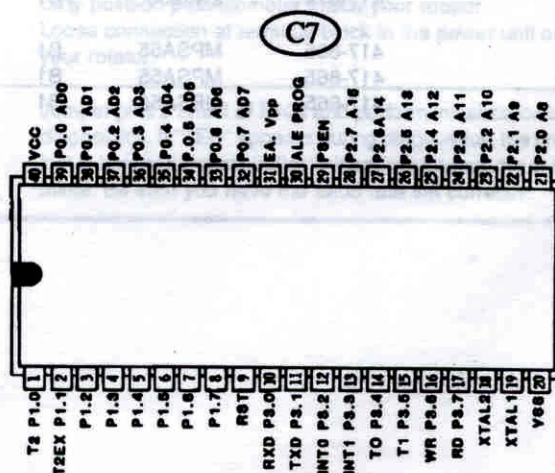
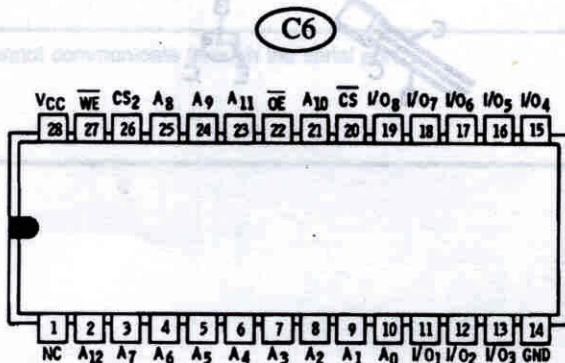
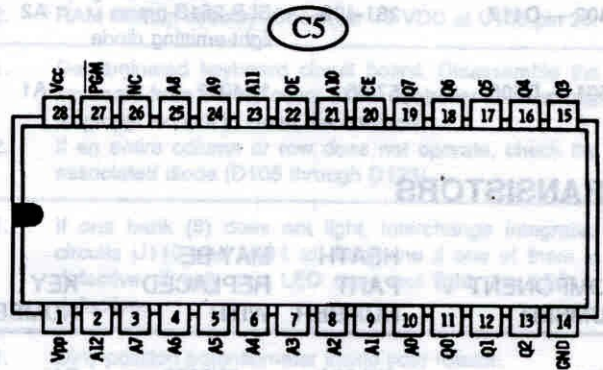
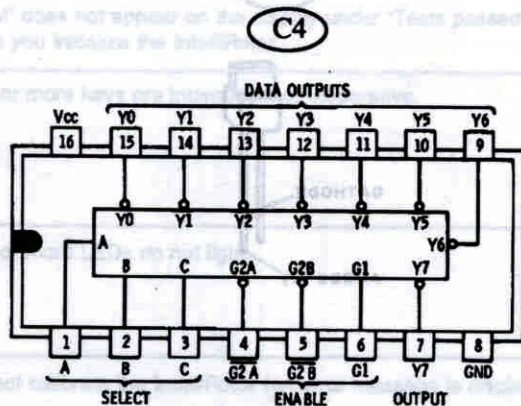
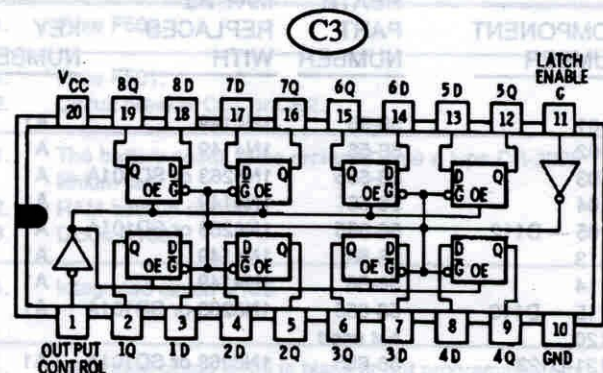
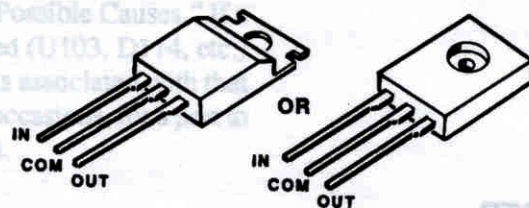
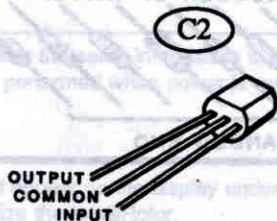
CATHODE
ANODE (+)

B1



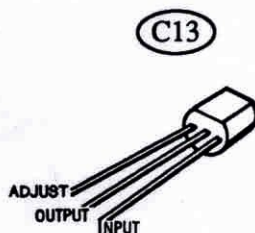
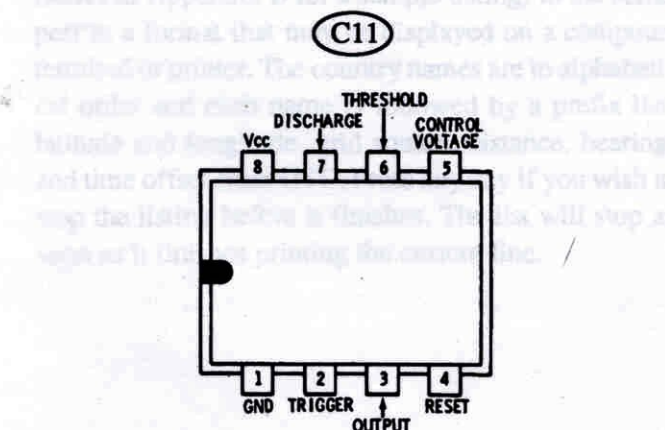
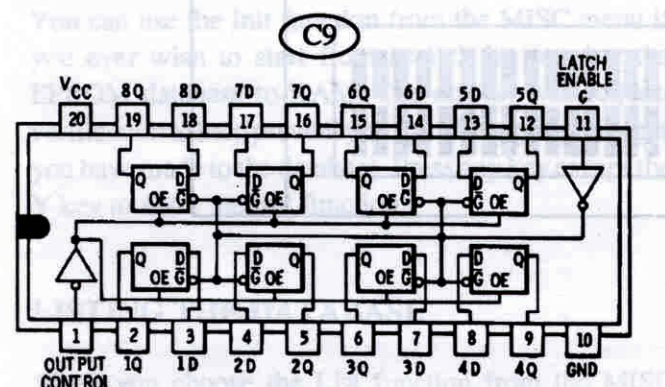
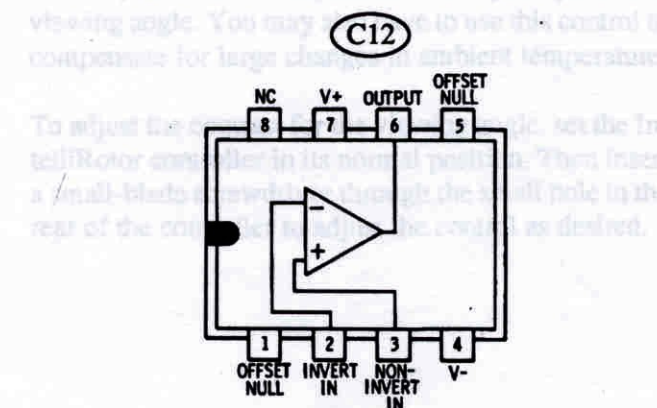
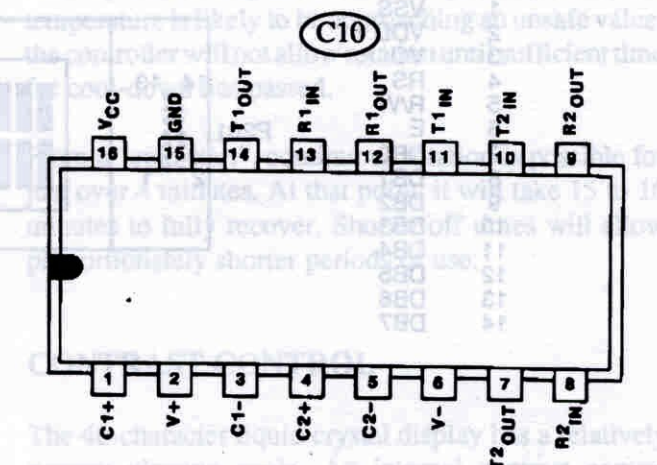
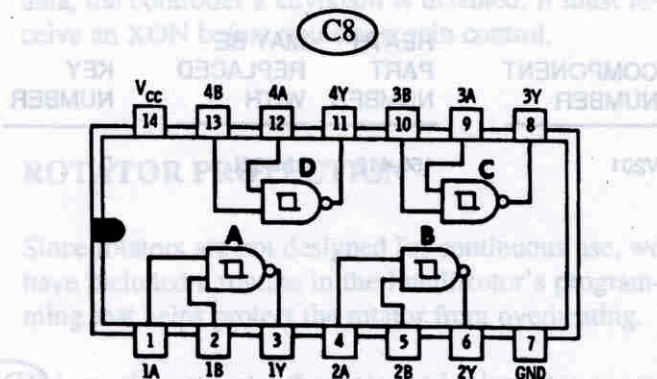
INTEGRATED CIRCUITS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U101	442-54	7805	C1
U102	442-627	78L05	C2
U103	443-1331	74HC373	C3
U104	443-1311	74HC138	C4
U105	231-417	27C64	C5
U106	443-1553	6264LP-15	C6
U107	443-1311	74HC138	C4
U108	231-416	8052	C7



Integrated Circuits (cont'd)

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U109	443-1301	74HC132	C8
U110	443-1331	74HC373	C9
U111	443-1331	74HC373	C9
U112	443-1576	MAX232CPE	C10
U113	442-801	TLC555	C11
U114	442-22	741	C12
U115	442-772	LM317L	C13



IN CASE OF DIFFICULTY

DISPLAY

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
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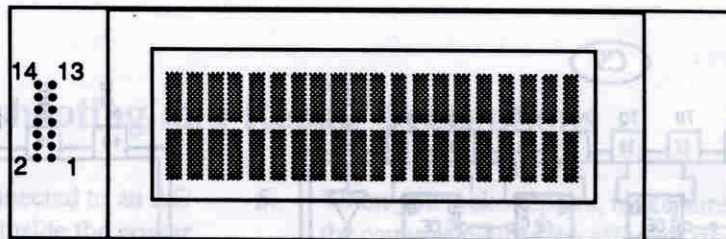
V201 150-412 LM032L D1

PIN # DESCRIPTION

1	VSS
2	VDD
3	VO
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7

P201

D1



Refer to the "Circuit Board X-Ray Views" beginning on Page 35. For more information on the display, refer to the "Component Replacement" section on the display.

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
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NOTE: In an extreme case where you are unable to replace the display, you may wish to contact the manufacturer for a replacement. The manufacturer's name and address are listed in the "Component Replacement" section on the display.

WARNING: When you are working on the circuit board, be sure that the power is off. If the power is on, you may damage the circuit board or the components. Be sure that the power is off before you remove the cover. Also, the power unit.

1. Make sure you do not short any adjacent connections or pins when you make tests or voltage measurements. If a probe or test lead slips, for example, and shorts two adjacent connections, it is very likely to damage one or more of the transistors, diodes, or integrated circuits (IC's).

2. Be especially careful when working on any circuit that contains an IC or a transistor. Although these components have an almost unlimited life when they are used properly, they are much more vulnerable to damage from excess voltage and current than many other parts.

3. Do not remove or replace any component while the unit is connected to an AC outlet.

4. Use a voltmeter with a high-impedance input when you measure voltage.

5. In several areas of the circuit board, the full patterns are quite complex. When you monitor a part to check or adjust it, avoid excessive heat while you remove a part. A section-type desoldering tool is the best tool to use for this purpose.

COMPONENTS

To remove faulty resistors or capacitors, first clip them from their leads, then heat the solder on the foil and allow each lead to fall away. Push the leads of the replacement part into the circuit board holes. Solder the leads to the foil and cut off any excess lead lengths.



APPENDIX A

Selected U.S. Latitudes and Longitudes

LOCATION	LATITUDE (°N)	LONGITUDE (°W)	LOCATION	LATITUDE (°N)	LONGITUDE (°W)
ALABAMA			DELAWARE		
Birmingham	34	87	Wilmington	40	76
Mobile	31	88	Dover	39	76
Montgomery	32	86			
ALASKA			FLORIDA		
Anchorage	61	150	Miami	26	80
Fairbanks	65	147	Tampa	28	82
Juneau	58	134	Jacksonville	30	82
ARIZONA			GEORGIA		
Phoenix	33	112	Atlanta	34	84
Tucson	32	111	Macon	33	84
Flagstaff	35	112	Albany	32	84
ARKANSAS			HAWAII		
Little Rock	35	92	Honolulu	21	158
Fayetteville	36	94			
Pine Bluff	34	92	IDAHO		
CALIFORNIA			Boise	44	116
Los Angeles	34	118	Pocatello	43	112
Oakland	38	122	Twin Falls	43	114
San Diego	33	117	ILLINOIS		
COLORADO			Chicago	42	88
Denver	40	105	Springfield	40	90
Colorado Springs	39	105	Rockford	42	89
Longmont	40	105	INDIANA		
CONNECTICUT			Indianapolis	40	86
New Haven	41	73	Gary	42	87
Hartford	42	73	Ft. Wayne	41	85
Stamford	41	73	So. Bend	41	86

LOCATION	LATITUDE (°N)	LONGITUDE (°W)
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IOWA

Des Moines	42	94
Cedar Rapids	42	92
Waterloo	43	92

KANSAS

Kansas City	39	95
Wichita	38	97
Topeka	39	96

KENTUCKY

Louisville	38	86
Lexington	38	85
Bowling Green	37	86

LOUISIANA

New Orleans	30	90
Baton Rouge	30	91
Lafayette	30	92

MAINE

Portland	44	70
Auburn	44	70
Bangor	45	69

MARYLAND

Baltimore	39	77
Prince Georges	39	77
Frederick	39	77

MASSACHUSETTS

Boston	42	71
Springfield	42	73
Worcester	42	72

MICHIGAN

Detroit	42	83
Grand Rapids	43	86
Kalamazoo	42	86

LOCATION	LATITUDE (°N)	LONGITUDE (°W)
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MINNESOTA

Minneapolis	45	93
St. Paul	45	93
Duluth	47	92

MISSISSIPPI

Jackson	32	90
Gulfport	30	89
Laurel	32	89

MISSOURI

St. Louis	39	90
Kansas City	39	95
Springfield	37	93

MONTANA

Billings	46	109
Missoula	47	114
Great Falls	48	111

NEBRASKA

Omaha	41	96
Lincoln	41	97
Grand Island	41	98

NEVADA

Las Vegas	36	115
Reno	40	120
Elko	41	116

NEW HAMPSHIRE

Manchester	43	71
Portsmouth	43	71
Concord	43	72

NEW JERSEY

Newark	41	74
New Brunswick	41	74
Red Bank	40	74

LOCATION	LATITUDE (°N)	LONGITUDE (°W)
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NEW MEXICO

Albuquerque	35	107
Roswell	33	105
Las Cruces	32	107

NEW YORK

Long Island City	41	74
Long Island	41	73
New York City	41	74
Hicksville	41	74

NORTH CAROLINA

Greensboro	36	80
Charlotte	35	81
Raleigh	36	79

NORTH DAKOTA

Fargo	47	97
Bismarck	47	101
Grand Forks	48	97

OHIO

Cleveland	42	82
Cincinnati	39	85
Columbus	40	83

OKLAHOMA

Oklahoma City	36	98
Tulsa	36	96
Muskogee	36	95

OREGON

Portland	46	123
Eugene	44	123
Salem	45	123

PENNSYLVANIA

Philadelphia	40	75
Pittsburgh	40	80
Harrisburg	40	77

LOCATION	LATITUDE (°N)	LONGITUDE (°W)
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RHODE ISLAND

Providence	42	71
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SOUTH CAROLINA

Columbia	34	81
Greenville	35	82
Charleston	33	80

SOUTH DAKOTA

Sioux Falls	44	97
Rapid City	44	103
Mitchell	44	98

TENNESSEE

Nashville	36	87
Memphis	35	90
Knoxville	36	84

TEXAS

Houston	30	95
Dallas	33	97
San Antonio	29	99

UTAH

Salt Lake City	41	112
Provo	40	112
Ogden	41	112

VERMONT

Burlington	44	73
Rutland	44	73
Montpelier	44	73

VIRGINIA

Norfolk	37	76
Richmond	38	77

LOCATION	LATITUDE (°N)	LONGITUDE (°W)
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WASHINGTON

Seattle	48	122
Tacoma	47	122
Everett	48	122

WEST VIRGINIA

Charleston	38	82
Huntington	38	82
Wheeling	40	81

AUDIBLE W BEARING

When you press the CW key, an internal transceiver will announce the bearing in Morse code. This key operates only while the transceiver is on. NOTE: The distance between the transceiver and the bearing station is not used. If the distance is not used, the bearing will be the same as the bearing station. The code speed is 20 wpm.

REMOTEMODE

NOTE: If you are using the function, make sure you have a computer or terminal connected to the port. The function will not work if the computer or terminal is not connected.

If you are using the function, make sure you have a computer or terminal connected to the port. The function will not work if the computer or terminal is not connected.

NOTE: If you are using the function, make sure you have a computer or terminal connected to the port. The function will not work if the computer or terminal is not connected.

LOCATION	LATITUDE (°N)	LONGITUDE (°W)
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WISCONSIN

Milwaukee	43	88
Madison	43	89
Green Bay	45	88

WYOMING

Cheyenne	41	105
Rock Springs	42	109
Casper	43	106

If the totator is bearing due to an error, the bearing will be the same as the bearing station. The code speed is 20 wpm.

Command

LeCR

LeCR

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APPENDIX B

Database Listing

This list is for ROM Version C. Distances and bearings are based on 39° North and 98° West.

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
Afghanistan	YA	33 N/ 66 E	MM33	7356	14	+4
Agalega Is.	3B6	10 S/ 57 E	LI80	9907	44	+4
Alabama		33 N/ 87 W	EM63	735	121	-6
Aland Is.	OH0	60 N/ 20 E	KP00	4756	28	+2
Alaska	KL7	65 N/153 W	BP35	2812	328	-10
Albania	ZA	41 N/ 20 E	KN01	5679	42	+1
Alberta	VE6	53 N/113 W	DO33	1197	329	-7
Algeria	7T-7Y	29 N/ 3 E	JL19	5521	61	+0
America	A,K,N,W	35 N/ 97 W	EM15	285	165	-6
Amsterdam Is.	FT8Z	37 S/ 78 E	MF93	12179	59	+5
Andaman Is.	VU7	12 N/ 92 E	NK62	8862	348	+5
Andorra	C3	42 N/ 1 E	JN02	4890	51	+1
Angola	D2,D3	12 S/ 18 E	JH98	8133	83	+1
Anguilla	VP2E	18 N/ 63 W	FK88	2545	115	-4
Antarctica	CE9,FT8Y,KC4,ZL5	85 S/ 75 E	MA75	9263	180	+0
Antigua	V2	17 N/ 61 W	FK97	2691	114	-4
Argentina	LO-LW	34 S/ 64 W	FF86	5497	152	-3
Arizona		34 N/111 W	DM44	796	248	-7
Arkansas		35 N/ 92 W	EM45	431	128	-6
Armenian S.S.R.	UG	41 N/ 44 E	LN21	6420	28	+4
Aruba	P4	12 N/ 70 W	FK52	2533	130	-4
Ascension Is.	ZD8	8 S/ 14 W	II32	6250	100	+0
Auckland Is.	ZL9	50 S/166 E	RE30	8449	229	+12
Australia	VK	23 S/135 E	PG77	9166	273	+9
Austria	OE	47 N/ 14 E	JN77	5169	41	+1
Aves Is.	YV0	15 N/ 64 W	FK85	2642	119	-4
Azerbaijan S.S.R.	UD	40 N/ 47 E	LN30	6554	26	+4
Azores Is.	CU,CT2	39 N/ 28 W	HM69	3663	66	-1
Bahama Is.	C6	26 N/ 76 W	FL26	1561	119	-5
Bahrain	A9	26 N/ 51 E	LL56	7526	29	+3
Baker Is.	KH1,KB6	0 N/176 W	AJ20	5582	262	-11
Balearic Is.	EA6-EH6	39 N/ 3 E	JM19	5096	53	+1
Banaba Is.	T33	1 S/169 E	RI49	6420	271	-11
Bangladesh	S2,S3	24 N/ 90 E	NL54	8060	352	+6
Barbados	8P	13 N/ 59 W	GK03	2982	11	-4
Barbuda	V2	18 N/ 62 W	FK98	2594	114	-4
Belgium	ON-OT	51 N/ 5 E	JO21	4683	42	+1
Belize	V3	17 N/ 88 W	EK67	1634	156	-6
Benin	TY	9 N/ 2 E	JJ19	6360	77	+1
Bermuda	VP9	32 N/ 65 W	FM72	1901	94	-4
Bhutan	A5	28 N/ 90 E	NL58	7781	352	+7
Bolivia	CP	17 S/ 64 W	FH83	4452	144	-4
Bonaire	PJ	12 N/ 68 W	FK62	2618	127	-4
Botswana	A2	22 S/ 24 E	KG28	8850	89	+2
Bouvet Is.	3Y	54 S/ 3 E	JD16	8753	134	+0
Brazil	PP-PY	9 S/ 53 W	GI31	4392	129	-4
British Columbia	VE7	46 N/123 W	CN86	1355	299	-8

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
Brunei	V8	5 N/115 E	OJ75	8741	318	+8
Bulgaria	LZ	43 N/ 25 E	KN23	5740	38	+2
Burkina Faso	XT	11 N/ 3 E	JK11	6323	75	+0
Burma	XY,XZ	22 N/ 96 E	NL82	8133	345	+7
Burundi	9U	3 S/ 30 E	KI57	8340	66	+2
Byelorussian S.S.R.	UC	53 N/ 27 E	KO33	5278	30	+3
Caicos Is.	VP5	21 N/ 71 W	FL41	2023	120	-4
California		37 N/120 W	DM07	1209	270	-8
Cambodia	XU	12 N/105 E	OK22	8619	332	+7
Cameroon	TJ	6 N/ 13 E	JJ66	7064	72	+1
Campbell Is.	ZL9	52 S/168 E	RD48	8425	226	+12
Canada	VE,VO,VY	50 N/100 W	EO00	771	351	-6
Canary Is.	EA8-EH8	28 N/ 16 W	IL28	4635	72	+0
Cape Verde	D4	15 N/ 24 W	HK85	4720	88	-1
Capri Is.	IC	42 N/ 14 E	JN72	5400	45	+1
Caroline Is.	KC6	9 N/143 E	QJ19	7319	296	+10
Cayman Is.	ZF	19 N/ 80 W	FK09	1755	137	-5
Central African Rep.	TL	8 N/ 21 E	KJ08	7368	65	+1
Ceuta	EA9-EH9	36 N/ 5 W	IM76	4853	59	+1
Chad	TT	17 N/ 15 E	JK77	6639	62	+1
Chagos	VQ9	8 S/ 72 E	MI62	10211	19	+5
Chatham Is.	ZL7	44 S/177 W	AE16	7550	228	-12
Chile	CA-CE	35 S/ 72 W	FF45	5376	158	-4
China	BY,BT	36 N/105 E	OM26	7052	341	+8
Christmas Is.	VK9	10 S/105 E	OI20	9980	318	+7
Clipperton Is.	FO	10 N/108 W	DK60	2096	200	-7
Cocos Is.	TI9	5 N/ 87 W	EJ65	2448	161	-6
Cocos-Keeling Is.	VK9	12 S/ 97 E	NH88	10357	330	+7
Colombia	HJ,HK	4 N/ 73 W	FJ34	2885	141	-5
Colorado		39 N/105 W	DM79	371	272	-7
Comoros	D6	12 S/ 44 E	LH28	9458	62	+3
Congo	TN	1 S/ 15 E	JI79	7489	76	+1
Connecticut		41 N/ 73 W	FN31	1330	76	-5
Conway Reef	3D2	21 S/174 E	RG79	7222	255	+12
Cook Is.	ZK1	19 S/158 W	BH11	5570	236	-10
Corsica	TK	42 N/ 9 E	JN42	5206	47	+1
Costa Rica	TI,TE	10 N/ 84 W	EK80	2181	153	-6
Crete	SV9	35 N/ 25 E	KM25	6165	43	+2
Crozet Is.	FT8W	46 S/ 51 E	LE54	10806	117	+3
Cuba	CM,CO	22 N/ 79 W	FL02	1622	131	-5
Curacao	PJ	12 N/ 69 W	FK52	2582	128	-4
Cyprus	5B,ZC	35 N/ 33 E	KM65	6445	38	+2
Czechoslovakia	OK-OM	49 N/ 17 E	JN89	5181	38	+1
Delaware		39 N/ 75 W	FM29	1233	83	-5
Denmark	OZ	56 N/ 10 E	JO56	4647	35	+1
Desecheo Is.	KP5	18 N/ 68 W	FK68	2314	120	-4
Djibouti	J2	12 N/ 43 E	LK12	8109	44	+3
Dodecanese Is.	SV5	38 N/ 26 E	KM38	6044	41	+2
Dominica	J7	15 N/ 61 W	FK95	2788	116	-4
Dominican Republic	HI	19 N/ 70 W	FK59	2168	122	-4
Easter Is.	CE0A	27 S/109 W	DG53	4622	191	-7
Ecuador	HC,HD	2 S/ 78 W	FI18	3104	151	-5
Egypt	SU	27 N/ 30 E	KL57	6773	45	+2
El Salvador	YS	13 N/ 89 W	EK53	1877	161	-6
England	G	51 N/ 1 W	IO91	4465	44	+0
Equatorial Guinea	3C	2 N/ 11 E	JJ52	7137	76	+1
Estonian S.S.R.	UR	59 N/ 25 E	KO29	4926	27	+3
Ethiopia	ET	10 N/ 39 E	KK90	8073	49	+3

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
Europa Is.	FR	22 S/ 40 E	LG08	9713	77	+3
Falkland Is.	VP8	52 S/ 59 W	GD08	6712	157	-4
Faroe Is.	OY	63 N/ 7 W	IP63	3894	33	+0
Fernando de Noronha	PP-PY	4 S/ 33 W	HI36	5084	109	-2
Fiji Is.	3D2	19 S/175 E	RH71	7198	257	+12
Finland	OF-OI	65 N/ 26 E	KP35	4647	22	+2
Florida		28 N/ 82 W	EL98	1197	125	-5
France	F	46 N/ 2 E	JN16	4768	47	+1
French Guiana	FY	4 N/ 53 W	GJ34	3711	119	-3
French Polynesia	FO	25 S/145 W	BG75	5364	223	-10
Futuna Is.	FW	13 S/176 E	RH87	6991	262	+12
Gabon	TR	1 S/ 12 E	JI69	7332	78	+1
Galapagos Is.	HC8-HD8	0 N/ 87 W	EJ60	2788	163	-5
Gambia	C5	13 N/ 16 W	IK23	5230	85	+0
Georgia		33 N/ 83 W	EM83	929	112	-5
Georgian S.S.R.	UF	42 N/ 43 E	LN12	6335	28	+4
Germany, East	DM,DT,Y2-Y9	53 N/ 12 E	JO63	4841	37	+1
Germany, West	DA-DP	51 N/ 8 E	JO41	4780	40	+1
Ghana	9G	8 N/ 2 W	IJ98	6190	80	+0
Gibraltar	ZB	36 N/ 5 W	IM76	4853	59	+1
Gilbert Is.	T30	0 N/173 E	RJ60	6275	271	+12
Glorioso Is.	FR	12 S/ 48 E	LH48	9640	58	+3
Gough Is.	ZD9	35 S/ 12 W	IF45	7489	120	+0
Gozo	9H4	36 N/ 13 E	JM66	5643	50	+1
Greece	SV-SZ	39 N/ 22 E	KM19	5849	42	+2
Greenland	OX,XP	74 N/ 40 W	HQ04	3043	20	-3
Grenada	J3	12 N/ 62 W	FK92	2885	120	-4
Guadeloupe	FG	16 N/ 61 W	FK96	2739	115	-4
Guam	KG6,KH2	15 N/143 E	QK15	7016	300	+10
Guantanamo Bay	KG4	19 N/ 75 W	FK29	1950	129	-5
Guatemala	TD,TG	16 N/ 91 W	EK46	1646	163	-6
Guernsey	GC,GU	49 N/ 3 W	IN89	4452	46	+1
Guinea	3X	11 N/ 11 W	IK41	5582	83	+0
Guinea-Bissau	J5	12 N/ 15 W	IK22	5327	85	+0
Guyana	8R	5 N/ 59 W	GJ05	3383	124	-3
Haiti	HH	19 N/ 73 W	FK39	2035	126	-5
Hawaii	KH6	21 N/158 W	BL11	3723	269	-10
Heard Is.	VK0	53 S/ 74 E	MD77	11401	161	+5
Honduras	HQ,HR	14 N/ 87 W	EK64	1853	156	-6
Hong Kong	VS6	22 N/114 E	OL72	7745	328	+8
Howland Is.	KB6,KH1	1 N/176 W	AJ21	5534	263	-11
Hungary	HA,HG	47 N/ 19 E	JN97	5339	39	+1
Iceland	TF	65 N/ 19 W	IP05	3505	32	+0
Idaho		45 N/115 W	DN25	966	301	-7
Illinois		40 N/ 89 W	EN50	480	79	-6
India	VU	23 N/ 77 E	ML83	8146	5	+6
Indiana		40 N/ 86 W	EN70	638	80	-5
Indonesia	YB-YH	4 S/118 E	OI96	9130	308	+8
Iowa		42 N/ 93 W	EN32	334	50	-6
Iran	EP,EQ	31 N/ 54 E	LM71	7283	25	+4
Iraq	YI	32 N/ 43 E	LM12	6931	33	+3
Ireland	EI,EJ	53 N/ 8 W	IO63	4137	44	+0
Isle of Man	GD	54 N/ 5 W	IO74	4209	42	+0
Israel	4X,4Z	32 N/ 35 E	KM72	6676	39	+2
Italy	I	43 N/ 12 E	JN63	5278	45	+1
ITU Geneva	4U	46 N/ 6 E	JN36	4926	45	+1
Ivory Coast	TU	7 N/ 6 W	IJ77	6020	83	+0
Jamaica	6Y	17 N/ 78 W	FK17	1938	136	-5

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
Jan Mayen Is.	JX	71 N/ 9 W	IQ51	3675	24	-1
Japan	7J,8J,JA-JS,KA	36 N/137 E	PM86	6177	318	+9
Jarvis Is.	KH5,KP6	0 N/160 W	BJ00	4744	251	-10
Jersey	GC,GJ	49 N/ 2 W	IN99	4501	46	+1
Johnston Is.	KH3,KJ6	17 N/168 W	AK67	4428	271	-10
Jordan	JY	31 N/37 E	KM81	6809	38	+2
Juan de Nova Is.	FR	17 S/ 43 E	LH13	9652	68	+3
Juan Fernandez Is.	CE0Z	33 S/ 79 W	FF07	5121	164	-4
Kampuchea	XU	12 N/105 E	OK22	8619	332	+7
Kansas		39 N/ 98 W	EM19	6	269	-6
Kazakh S.S.R.	UL	48 N/ 59 E	LN98	6263	15	+5
Kentucky		38 N/ 85 W	EM78	711	91	-5
Kenya	5Y,5Z	1 N/ 37 E	KJ81	8474	57	+3
Kerguelen Is.	FT8X	49 S/ 70 E	ME51	11535	144	+5
Kermadec Is.	ZL8	30 S/177 W	AG10	6967	240	+12
Kingman Reef	KH5K	7 N/163 W	AJ87	4574	259	-10
Kirghiz S.S.R.	UM	41 N/ 74 E	MN71	6882	6	+6
Kiribati, Central	T31	5 S/172 W	AI45	5594	256	-11
Kiribati, East	T32	5 N/157 W	BJ15	4355	253	-11
Kiribati, West	T30	0 N/173 E	RJ60	6275	271	+12
Korea	HL,HM	38 N/127 E	PM38	6396	326	+9
Kure Is.	KH7	34 N/133 E	PM64	6433	320	+12
Kuwait	9K	29 N/ 48 E	LL49	7259	30	+3
Labrador	VO2	54 N/ 62 W	FO94	1974	46	-4
Laccadive Is.	VU7	12 N/ 72 E	MK62	8862	12	+6
Lampedusa Is.	IG	35 N/ 14 E	JM75	5728	50	+1
Laos	XW	18 N/104 E	OK28	8255	336	+7
Latvian S.S.R.	UQ	57 N/ 24 E	KO27	4999	29	+3
Lebanon	OD	34 N/ 36 E	KM84	6603	37	+2
Lesotho	7P	29 S/ 28 E	KG41	9312	94	+2
Liberia	5L,EL	6 N/ 10 W	IJ56	5849	87	+0
Libya	5A	27 N/ 17 E	JL87	6250	54	+2
Liechtenstein	HB0	47 N/ 10 E	JN57	5023	43	+1
Line Is.	T32	5 N/157 W	BJ15	4355	253	-11
Lithuanian S.S.R.	UP	55 N/ 24 E	KO25	5096	30	+3
Lord Howe Is.	VK	31 S/158 E	QF99	8231	252	+11
Louisiana		31 N/ 92 W	EM41	650	147	-6
Luxembourg	LX	49 N/ 6 E	JN39	4793	43	+1
Macao	XX	22 N/113 E	OL62	7769	329	+8
Macquarie Is.	VK0	54 S/159 E	QD96	8826	226	+11
Madagascar	5R,5S	19 S/ 47 E	LH31	9943	67	+3
Maddelena Is.	IM	41 N/ 9 E	JN41	5254	48	+1
Madeira Is.	CT3	32 N/ 16 W	IM22	4477	68	+0
Maine		45 N/ 69 W	FN55	1537	65	-5
Malawi	7Q	13 S/ 34 E	KH77	9008	72	+2
Malaysia	9M	4 N/110 E	OJ54	8972	322	+8
Maldives Is.	8Q	4 N/ 73 E	MJ64	9409	13	+5
Mali	TZ	17 N/ 3 W	IK87	5752	74	+0
Malpelo	HK0	4 N/ 81 W	EJ94	2642	152	-5
Malta	1A0,9H	36 N/ 13 E	JM66	5643	50	+1
Malyj Vysotskij Is.	4J1	61 N/ 29 E	KP41	4914	24	+2
Manihiki	ZK1	10 S/161 W	AI90	5266	245	-11
Manitoba	VE4	50 N/ 97 W	EO10	759	0	-6
Mariana Is.	KG6,KH0	17 N/145 E	QK27	6833	300	+10
Marquesas Is.	FO0	10 S/140 W	CI00	4331	228	-9
Marion Is.	ZR2-ZU2	46 S/ 38 E	KE94	10174	117	+3
Market Reef	OJ0	65 N/ 22 W	HP95	3420	33	+0
Marshall Is.	KX6	10 N/165 E	RK20	6153	282	+12

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (in miles)	BEARING	UTC OFFSET
Martin Vaz Is.	PP-PY	21 S/ 29 W	HG59	6080	119	-2
Martinique	FM	15 N/ 61 W	FK95	2788	116	-4
Maryland		39 N/ 77 W	FM19	1124	83	-5
Massachusetts		42 N/ 72 W	FN42	1379	73	-5
Mauritania	5T	22 N/ 11 W	IL42	5121	74	+0
Mauritius Is.	3B8	20 S/ 57 E	LH80	10454	56	+4
Mayotte	FH	13 S/ 45 E	LH27	9555	62	+3
Melilla	EA9-EH9	36 N/ 5 W	IM76	4853	59	+1
Mellish Reef	VK9	17 S/156 E	QH83	7805	266	+11
Mexico	XA-XI	23 N/101 W	DL93	1124	191	-7
Michigan		43 N/ 85 W	EN73	735	64	-5
Midway Is.	KH4,KM6	28 N/179 W	AL08	4574	288	-11
Minami Torishima	JD1	24 N/157 E	QL84	5935	298	+10
Minnesota		46 N/ 94 W	EN36	528	23	-6
Miquelon Is.	FP	47 N/ 56 W	GN27	2168	61	-3
Mississippi		33 N/ 90 W	EM53	613	130	-6
Missouri		38 N/ 92 W	EM48	334	100	-6
Moldavian S.S.R.	UO	47 N/ 27 E	KN37	5594	34	+3
Mongolia	JT-JV	47 N/103 E	ON17	6360	346	+8
Monaco	3A	44 N/ 7 E	JN34	5048	47	+1
Montana		47 N/110 W	DN57	820	316	-7
Montserrat	VP2M	17 N/ 62 W	FK97	2642	115	-4
Morocco	CN	32 N/ 7 W	IM62	4926	64	+0
Mount Athos	SV/A	40 N/ 24 E	KN20	5862	41	+2
Mozambique	C8,C9	17 S/ 36 E	KH83	9287	74	+2
Namibia	ZR3-ZU3	22 S/ 17 E	JG88	8486	93	+2
Nauru	C2	1 S/167 E	RI39	6530	272	+12
Navassa Is.	KC4,KP1	18 N/ 75 W	FK28	1998	130	-5
Nebraska		41 N/100 W	EN01	176	322	-6
Nepal	9N	28 N/ 85 E	NL28	7805	357	+6
Netherlands	PA-PI	53 N/ 6 E	JO33	4635	39	+1
Netherlands Antilles	PJ,P4	12 N/ 68 W	FK62	2618	127	-4
Nevada		39 N/117 W	DM19	1014	276	-8
Nevis	V4	17 N/ 63 W	FK87	2594	116	-4
New Brunswick	VE1	45 N/ 66 W	FN75	1683	65	-4
New Caledonia	FK	22 S/164 E	RG28	7575	257	+11
New Hampshire		44 N/ 72 W	FN44	1379	67	-5
New Jersey		40 N/ 75 W	FN20	1221	79	-5
New Mexico		34 N/106 W	DM74	565	235	-7
New York		43 N/ 76 W	FN23	1172	69	-5
New Zealand	ZL,ZM	42 S/174 E	RE78	8024	236	+12
Newfoundland	VO1	49 N/ 57 W	GN19	2120	57	-3
Nicaragua	HT,YN	13 N/ 86 W	EK73	1938	155	-6
Nicobar Is.	VU7	11 N/ 92 E	NK61	8923	347	+6
Niger	5U	18 N/ 9 E	JK48	6311	65	+1
Nigeria	5N,5O	9 N/ 8 E	JJ49	6663	73	+1
Niue	ZK2	20 S/167 W	AH60	6032	241	-11
Norfolk Is.	VK9	29 S/168 E	RG41	7647	249	+12
North Carolina		35 N/ 79 W	FM05	1087	99	-5
North Dakota		47 N/100 W	EN07	565	348	-6
Northern Ireland	GI	54 N/ 7 W	IO64	4137	43	+0
Northwest Terr.	VE8	63 N/114 W	DP33	1792	343	-7
Norway	LA-LN	64 N/ 12 E	JP64	4380	28	+1
Nova Scotia	VE1	45 N/ 63 W	FN85	1828	65	-4
Nuvu Hiva Is.	F05	14 S/145 W	BH76	4756	230	-10
Ogasawara Is.	JD1	25 N/140 E	QL05	6651	309	+9
Ohio		40 N/ 83 W	EN80	796	80	-5
Okinawa	JR6	26 N/128 E	PL46	7052	319	+9

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
Oklahoma		35 N/ 97 W	EM15	285	165	-6
Oman	A4	20 N/ 57 E	LL80	8048	26	+4
Ontario	VE3	45 N/ 79 W	FN05	1051	61	-6
Oregon		44 N/121 W	CN94	1233	294	-8
Pagalu Is.	3C0	2 S/ 5 E	J128	7004	83	+0
Pakistan	AP-AS	31 N/ 70 E	MM51	7538	11	+5
Palmyra Is.	KH5,KP6	6 N/162 W	AJ96	4574	258	-10
Panama	HO,HP	8 N/ 80 W	FJ08	2411	148	-5
Pantelleria Is.	IH	37 N/ 12 E	JM67	5558	49	+1
Papua New Guinea	P2	6 S/142 E	QI14	8073	285	+10
Paraguay	ZP	23 S/ 58 W	GG17	4999	142	-4
Pennsylvania		41 N/ 78 W	FN11	1063	76	-5
Peru	OA-OC	9 S/ 75 W	F121	3626	151	-5
Peter 1 Is.	3Y	69 S/ 91 W	EC41	7477	178	-7
Philippines	DU-DZ	12 N/123 E	PK12	8036	314	+8
Phoenix Is.	T31	5 S/172 W	AI45	5594	256	-11
Pitcairn Is.	VR6	24 S/133 W	CG36	4902	214	-8
Poland	SN-SR	52 N/ 19 E	JO92	5096	35	+1
Portugal	CT	40 N/ 8 W	IN60	4574	57	+0
Prince Edward Is.	VE1,ZR2-ZU2	46 N/ 63 W	FN86	1828	63	-4
Princepe	S9	0 N/ 6 E	JJ30	6967	81	+0
Providencia Is.	HK0	12 N/ 81 W	EK92	2132	146	-5
Puerto Rico	KP4	18 N/ 66 W	FK78	2399	118	-4
Qatar	A7	25 N/ 52 E	LL65	7611	29	+3
Quebec	VE2	45 N/ 73 W	FN35	1342	64	-4
Reunion Is.	FR	22 S/ 55 E	LG78	10466	61	+4
Revilla Ggedo	XA4-X14	18 N/111 W	DK48	1646	212	-7
Rhode Island		41 N/ 71 W	FN41	1427	76	-5
Rodriguez Is.	3B9	20 S/ 63 E	MH10	10709	46	+4
Romania	YO-YR	46 N/ 25 E	KN26	5594	36	+2
Rotuma Is.	3D2	19 S/175 E	RH71	7198	257	+12
Russian S.F.S.R.	UA,UN,UV,UW,UZ	56 N/ 37 E	KO86	5364	24	+3
Rwanda	9X	2 S/ 30 E	K158	8291	65	+2
Ryukyu Is.	JR6	24 N/125 E	PL24	7271	320	+9
Saba Is.	PJ	19 N/ 63 W	FK89	2496	113	-4
Sabah	9M6	5 N/117 E	OJ85	8668	315	+8
Sable Is.	CY0,VE1	44 N/ 60 W	GN04	1974	67	-4
Sahara, Western	S0	25 N/ 14 W	IL35	4853	73	+0
Samoa, American	KH8,KS6	12 S/170 W	AH58	5813	249	-11
Samoa, Western	5W	12 S/170 W	AH58	5813	249	-11
San Andreas Is.	HK0	12 N/ 81 W	EK92	2132	146	-5
San Felix Is.	CE0X	26 S/ 80 W	FG04	4647	162	-4
San Marino	T7	44 N/ 12 E	JN64	5242	44	+1
Sao Tome	S9	0 N/ 7 E	JJ30	7016	80	+0
Sarawak	9M8	3 N/113 E	OJ63	8935	318	+8
Sardinia	IS,IM	40 N/ 9 E	JN40	5303	49	+1
Saskatchewan	VE5	50 N/104 W	DO80	820	340	-7
Saudi Arabia	7Z,HZ	24 N/ 45 E	LL24	7477	35	+3
Scotland	GM	57 N/ 4 W	IO87	4149	39	+0
Senegal	6V,6W	14 N/ 14 W	IK34	5291	83	+0
Seychelles	S7	5 S/ 55 E	LI75	9543	43	+4
Sicily	IT	38 N/ 14 E	JM78	5594	48	+1
Sierra Leone	9L	8 N/ 12 W	IJ48	5655	86	+0
Singapore	9V	2 N/104 E	OJ22	9275	328	+8
Sint Eustatius	PJ	19 N/ 63 W	FK89	2496	113	-4
Sint Maarten	PJ	19 N/ 63 W	FK89	2496	113	-4
Solomon Is.	H4	7 S/160 E	RI03	7174	272	+11
Somalia	T5	5 N/ 46 E	LJ35	8631	45	+3

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
South Africa	ZR-ZU	28 S/ 25 E	KG22	9117	95	+2
South Carolina		34 N/ 81 W	EM94	1002	105	-5
South Dakota		44 N/100 W	EN04	358	345	-6
South Georgia Is.	LU,VP8	54 S/ 37 W	HD16	7380	148	-2
South Orkney Is.	LU,VP8	61 S/ 45 W	GC79	7526	156	+3
South Sandwich Is.	LU,VP8	58 S/ 27 W	HD62	7842	147	-2
South Shetland Is.	CE9,HF0,LU,VP8, 4K1	60 S/ 63 W	FD80	7125	163	+3
Spain	EA-EH	40 N/ 4 W	IN80	4744	55	+1
Spratly Is.	1S	9 N/112 E	OJ69	8607	323	+8
Sri Lanka	4P-4S	8 N/ 81 E	NJ08	9190	2	+6
St. Brandon Is.	3B7	16 S/ 59 E	LH94	10332	48	+4
St. Christopher	V4	17 N/ 63 W	FK87	2594	116	-4
St. Helena Is.	ZD7	16 S/ 5 W	IH74	7064	101	+0
St. Kitts	V4	17 N/ 63 W	FK87	2594	116	-4
St. Lucia	J6	14 N/ 61 W	FK94	2837	117	-4
St. Martin Is.	FG,FS	19 N/ 63 W	FK89	2496	113	-4
St. Paul Is.	CY0,VE1	47 N/ 60 W	GN07	1974	61	-4
St. Paul Is. (Fr.)	FT8Z	37 S/ 78 E	MF93	12179	59	+5
St. Pauls Is.	PP-PY	5 N/ 35 W	HJ25	4562	104	-2
St. Peter Is.	PP-PY	5 N/ 35 W	HJ25	4562	104	-2
St. Pierre Is.	FP	47 N/ 56 W	GN27	2168	61	-3
St. Vincent	J8	13 N/ 61 W	FK93	2885	118	-4
Sudan	ST	14 N/ 30 E	KK54	7477	54	+2
Suriname	PZ	4 N/ 56 W	GJ24	3578	122	-3
Svalbard Is.	JW	77 N/ 20 E	KQ07	4003	14	+1
Swan Is.	HR0	14 N/ 88 W	EK64	1828	158	-6
Swaziland	3D6	27 S/ 32 E	KG63	9470	89	+2
Sweden	SA-SM	63 N/ 16 E	JP83	4513	27	+1
Switzerland	HB	47 N/ 8 E	JN47	4950	44	+1
Syria	YK	35 N/ 37 E	KM85	6578	36	+2
Tadzhik S.S.R.	UJ	39 N/ 69 E	MM49	6991	10	+5
Taiwan	BV	23 N/122 E	PL13	7441	322	+8
Tanzania	5H,5I	6 S/ 35 E	KI74	8729	65	+3
Tennessee		36 N/ 86 W	EM76	686	104	-5
Texas		31 N/ 99 W	EM01	553	182	-6
Thailand	HS	17 N/102 E	OK17	8364	338	+7
Tobago	9Y	11 N/ 61 W	FK91	2982	120	-4
Togo	5V	8 N/ 1 E	JJ08	6348	78	+0
Tokelau Is.	ZK3	8 S/176 W	AI22	5935	256	-11
Tonga	A3	19 S/175 W	AH21	6372	247	-12
Transkei	S8	32 S/ 28 E	KF48	9409	98	+2
Trinidad Is.	PP-PY	21 S/ 29 W	HG59	6080	119	-2
Trinidad	9Y-9Z	11 N/ 61 W	FK91	2982	120	-4
Tristan da Cunha	ZD9	35 S/ 12 W	IF45	7489	120	+0
Tromelin Is.	FR	10 S/ 50 E	LI50	9628	53	+4
Tunisia	3V	35 N/ 10 E	JM55	5570	52	+1
Turkey	TA-TC	39 N/ 36 E	KM89	6311	34	+3
Turkoman S.S.R.	UH	40 N/ 56 E	LN80	6736	20	+5
Turks Is.	VP5	21 N/ 71 W	FL41	2023	120	-4
Tuvalu	T2	8 S/178 E	RI92	6894	267	+12
Uganda	5X	2 N/ 32 E	KJ62	8194	61	+3
Ukrainian S.S.R.	UB,UT,UY	49 N/ 30 E	KN59	5582	32	+3
United Arab Emirates	A6	24 N/ 54 E	LL74	7720	28	+4
United Nations HQ	4U	41 N/ 74 W	FN31	1270	76	-5
Uruguay	CV-CX	33 S/ 56 W	GF27	5655	145	-3
USA	A,K,N,W	35 N/ 97 W	EM15	285	165	-6
Utah		39 N/111 W	DM49	699	274	-7

LOCATION	PREFIX LIST	LATITUDE/ LONGITUDE	GRID SQUARE	DISTANCE (In miles)	BEARING	UTC OFFSET
Uzbek S.S.R.	UI	42 N/ 60 E	MN02	6676	16	+5
Vanuatu	YJ	16 S/169 E	RH44	7064	259	+11
Vatican	HV	42 N/ 12 E	JN62	5327	46	+1
Venezuela	YV-YY	8 N/ 65 W	FJ78	2958	128	-4
Vermont		44 N/ 73 W	FN34	1330	67	-5
Vietnam	3W,XV	18 N/107 E	OK38	8182	333	+7
Virgin Is., Br.	VP2V	18 N/ 64 W	FK88	2496	116	-4
Virgin Is., U.S.	KP2,KV4	18 N/ 64 W	FK88	2496	116	-4
Virginia		38 N/ 78 W	FM18	1087	87	-5
Wake Is.	KH9,KW6	19 N/167 E	RK39	5655	288	+12
Wales	GW	52 N/ 3 W	IO82	4355	44	+0
Wallis Is.	FW	13 S/176 E	RH87	6991	262	+12
Washington		47 N/120 W	DN07	1233	304	-8
West Virginia		39 N/ 81 W	EM99	917	85	-5
Willis Is.	VK9	13 S/176 E	RH87	6991	262	+12
Wisconsin		45 N/ 90 W	EN55	577	41	-6
Wyoming		43 N/108 W	DN63	589	301	-7
Yemen	4W,7O	15 N/ 48 E	LK45	8109	38	+3
Yugoslavia	YT,YU,YZ	44 N/ 19 E	JN94	5485	41	+1
Zaire	9Q-9T	3 S/ 23 E	KI17	7988	72	+2
Zambia	9I,9J	14 S/ 28 E	KH46	8741	78	+2
Zanzibar	5H1	6 S/ 39 E	KI94	8923	61	+3
Zimbabwe	Z2,ZE	18 S/ 30 E	KH52	9020	80	+2

APPENDIX C

Computer Connections

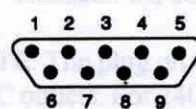
Before you can use the "Remote Mode" or "Software Program Control", you will have to properly connect your IntelliRotor to a terminal or to a computer with the proper terminal emulation or a communications program, such as CPS, HUG MCP, ZSTEM, PROCOMM, PIBTERM, etc.. Read and comply with the information that pertains to your situation under "Interconnection" and "Software Requirements".

NOTE: Since these programs allow a computer to operate like a terminal, the following information will use the term "computer" to refer to a computer or a terminal.

If you wish, you can write your own custom program to read information from the IntelliRotor. You could, for example, integrate your IntelliRotor with a logging program. A utility program for IBM PC-compatible computers is included with your IntelliRotor (documentation is included on the disk and duplicated in Appendix D).

The IntelliRotor communicates with your computer through a serial port using signals that correspond to the RS-232C standard. Most computers that are available today either incorporate an RS-232C-style port or have one available as an accessory. If you have already been using your computer with an RS-232C modem, you can use the IntelliRotor the same way.

You will need a suitable cable to connect the IntelliRotor to your terminal or computer. This cable should be shielded to comply with FCC standards and to keep digital noise out of your station receiver. The following paragraphs describe cables for specific computers, but the information presented should help you make a cable that will work with other units. Figure 7 shows the pins connections to the control unit socket (P104).



VIEWED FROM
THE PIN SIDE

1	No connection
2	Output
3	Input
4	No connection
5	Ground
6	No connection
7	Positive level output
8	Positive level output
9	No connection

Figure 7

INTERCONNECTION

Table B shows the minimum connections that are required between socket P104 on the rear of the IntelliRotor and your computer. Hardware flow control is not required. **NOTE:** Using a full 25-wire cable will cause your IntelliRotor to operate improperly. You may find that one of the ready-made cables that is available from your computer or electronics store will suit your particular needs. **IMPORTANT:** Whether you purchase a ready-made cable or make your own, make sure it is a shielded cable.

Table B

Pin	Signal Name	Description
2	Transmit Data	Serial data from the IntelliRotor to the computer.
3	Receive Data	Serial data from the computer to the IntelliRotor.
5	Signal Ground	Common ground for both data lines.

It is beyond the scope of this Manual to show you how to connect your IntelliRotor to every brand and model of computer. It does, however, provide you with information for several common computers. If your particular computer is not listed, you can probably adapt the information that is presented to suit your needs.

Heath/Zenith

Table C shows the proper cable connections for Heath/Zenith Series 89, 90, 130, 140, 150 (except 157 and 159), and 160 computers.

Table C

Computer 25-pin connector	IntelliRotor 9-pin connector
1* — Chassis Ground	1*
2 — Transmit Data	3
3 — Receive Data	2
4 — Request To Send	Not used
5 — Clear To Send	Not used
6 — Data Set Ready	Not used
7 — Signal Ground	5
8 — Carrier Detect	Not used
20 — Data Terminal Ready	Not used

*Connect this drain wire to the connector shells.

Table D shows the proper cable connections for the Heath/Zenith Series 200 and 300 AT-Compatible computers as well as 157 and 159 computers.

Table D

Computer 9-pin connector	IntelliRotor 9-pin connector
1 — Carrier Detect	Not used
2 — Receive Data	2
3 — Transmit Data	3
4 — Data Terminal Ready	Not used
5 — Ground	5
6 — Data Set Ready	Not used
7 — Request To Send	Not used
8 — Clear To Send	Not used

*Connect the shield or drain wire to the connector shells.

Other Computers With Nonstandard Serial Ports

Computers with nonstandard serial ports must be RS-232C compatible.

Make or purchase a cable that provides the necessary connections. The serial port common pin must be connected to the IntelliRotor's serial port connector at pin 5. The data line that sends data from the computer must be connected to the IntelliRotor's connector at pin 3. The line that your computer uses to receive data must be connected to the IntelliRotor's connector at pin 2.

If your computer requires any other signals, you must find ways of providing them. The documentation provided with your computer or its accessory serial port should specify any special requirements of your particular port. Positive RS-232C levels are available on P104 pins 7 and 8.

SOFTWARE REQUIREMENTS

Any software package that enables your computer to act as an ASCII terminal with an ordinary telephone modem should work with your IntelliRotor. If you have a program that you have successfully used with a telephone modem, you can use that same program to communicate with the IntelliRotor.

APPENDIX D

Software Utility Program

Heath HD-1780 Controller Ver. 1.05			Friday Jan. 12, 1990 10:21:29		
Target	Grid Sq	Dist	Path	Brg	Time
33° N/ 66° E	MM33	6955 mi.	Short	24°	19:21:29
LOCAL	Center	Brk Delay	# Pls@ Acc PW	BRG	ROM
42° N/ 86° W	North	5 Seconds	4 12' 2' 4	29°	B STOP

Afgghanistan	YA
Agalega Is.	3B6
Alabama	
Aland Is.	OH0
Alaska	KL7
Albania	ZA
Alberta	VE6

Mem	Name	Brg	Mem	Name	Brg
0	North	51°	1	North	0°
2	Northeast	45°	3	East	90°
4	Southeast	135°	5	South	180°
6	Southwest	225°	7	West	270°
8	Northwest	315°	9	North	0°

Ready!									
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Voice	Speak	NewName	Restore	Title	Colors	Named	Bearing	Cntry	Prefix

Typical Program Display

UTILITY PROGRAM INFORMATION

The following paragraphs contain the same information as the "README.DOC" file that is supplied on the disk.

Features

- * Transient or memory-resident (pop-up) operation
- * HV-2000 Voice Card support
- * User-selectable color combinations
- * On-screen date and time
- * Ability to see most internal settings
- * Display of all ten named bearings

Introduction

This program allows you to take full advantage of the serial interface in your HD-1780 IntelliRotor.

Most functions are activated by use of the computer's function keys and keypad keys, and menus appear at the bottom of the screen to define the action of the function keys. In addition, a PROMPTS window provides useful information on the use of many functions, and displays error messages.

You can scroll through the countries database and see all pertinent information conveniently displayed instantly.

The program may be run as a transient or installed to be memory resident, allowing it to be popped up over a logging program, for example.

Running the program

Type **HD <enter>** to run the program.

There are three 'switches' that may be specified in the command line following the HD command. If more than one switch is specified, they may be entered in any order, but each switch must be preceded by a slash (/). Type **HD/ <enter>** to get information on switch usage.

The program defaults to the use of serial port COM1 unless the /2 switch is used, and to the use of color unless the /M (Mono) switch is used. If you run this program on a laptop with an LCD screen, you will probably need to specify the /M switch.

The third switch is /R (Resident). Using this switch causes the program to install itself as a memory resident (pop-up) utility. To invoke the program, you must hold both SHIFT keys down while pressing the H key. The program will only pop up if the display is in an 80 column text mode (mode 2, 3 or 7). The first time it is popped up it will take a second to paint itself onto the screen; subsequent pop-ups will be instantaneous. A Restore function (described later) is automatically performed each time the program is popped up.

When the program is first run or installed, it looks for a file named HDLIST.DAT in the current directory. This file contains the country database in a particular format. If the file is not found, the program will read the data from the HD-1780, and create the file. Once created, the program will be able to simply read the file into memory.

NOTES:

1. If you make any changes to the country list in the HD-1780 using the EDIT function, you should delete HDLIST.DAT so that the program will create a new file that includes the changes you've made.
2. Since the program looks for HDLIST.DAT in the directory you are logged onto when you run or install the program, always make sure that you are in the proper directory at that time, so that the program won't create extra copies of the file in other directories. To help prevent this possibility, if the program doesn't find the file in the current directory, it will ask you if it should create it there. Responding with other than the Y key will cause the program to be exited.
3. If installing the program as a pop-up, pop it up once (by holding both Shift keys down while pressing H). It reads or creates the HDLIST.DAT file at this point. Press ESC to return to DOS.

General Operation

If something happens to cause an error message to be displayed, the console bell will sound, and you will be prompted to press any key to confirm that you are aware of the error.

In particular, the program checks for communication with the controller at various times. If it does not get a response, it will tell you so, and ask that you correct the situation, then press any key. (If you press ESC, the program will be exited.)

Most functions described below allow you to use the ESC key to change your mind if you make a mistake.

Information displays

The screen displays the title block and local clock/calendar on the top line. Note that the time and date are read from the computer, not the controller.

The second area from the top of the screen contains information relating to the target country or bearing. These items are self-explanatory, but two things may need to be clarified.

1. The distances shown are those read from the controller when the disk file HDLIST.DAT was created, and are in the unit of distance selected at that time. Therefore, if you select the other unit of measure, you will need to delete HDLIST.DAT, and let the program re-create it. (If you have the program installed as a pop-up, you must also reboot and re-install it.)

2. The target time will only be correct if your HD-1780 is set to display the same time as your computer. If you selected 0 at the Hours from UTC? prompt in the Setup menu, so your HD-1780 would read out in UTC time, then your computer must be set for UTC also.

The next section from the top contains information on internal settings and current status. Most of these are also self-explanatory. The window labeled #Pls@ ACC PW relates to the 'auto-rotate parameters' described in the HD-1780 manual. The first number is the selected setting (the shifted digit key pressed to make the selection). This is followed by the number of degrees from target at which the rotor motor is pulsed to slow it down. The next number is the attempted accuracy, and the last number is the pulse width used to slow the motor.

The local bearing (BRG) will go blank when the rotator is turning, since the bearing cannot be read from the controller during this time. As soon as rotation stops, this will be updated.

Automatic selection

When you make a selection by one of the following means, the path will default to SHORT. To begin rotation to the short bearing, press ENTER. If you want the long path heading, press the TAB key first. It toggles between short and long path bearings, and the distance (if displayed) and bearing are updated. When rotating, pressing the SPACE bar will stop rotation; pressing ENTER again will resume.

The area near the center of the screen displays up to seven countries and their prefixes. You can use the up- and down-arrow keys to scroll through the list. As you do so, the target information is updated.

Pressing ENTER will cause the controller to begin rotating to the currently highlighted country. The PgUp and PgDn keys scroll by seven entries at a time, and the Home and End keys go to the top and bottom of the list, respectively.

To select a named bearing, press F7. You will be asked to press a digit key to select one of the ten named bear-

ings shown near the bottom of the screen. If a country was highlighted in the list, it will be unselected, and the only information displayed in the Target area will be the bearing you entered. Press ENTER again to begin rotation.

To select a particular bearing in degrees, press F8. Enter the bearing, and press ENTER. If a country was highlighted in the list, it will be unselected, and the only information displayed in the Target area will be the bearing you entered. Press ENTER again to begin rotation.

To select by country name, press F9. Enter the country name or the first few letters of it, and press ENTER. The first match will be positioned to the top of the list, and highlighted. Pressing ENTER again starts rotation.

To select by prefix, press F10. As in the HD-1780, an explicit search is made first, and if it fails, an implicit search is made. So you may enter a prefix, partial prefix, or entire call sign. The first country that matches your entry will be displayed with its prefix list. If it is the one you want, press ENTER. If not, press SPACE to search for the next match. To begin rotation, press ENTER.

Manual rotation

The left- and right-arrow keys may be used for manual rotation. (If your keyboard has an auto-repeat feature, you may want to turn the keyboard click off if the repeated clicks are annoying.)

NOTE: There is a possibility of a problem using the left-arrow key IF your IntelliRotor is configured for North-centered operation, AND the rotor is at its CW limit. This is due to the way the left- and right-arrow keys operate the controller. They do so by sending a 'go to bearing' command, a 180 <CR> to turn counter-clockwise, and a 179 <CR> to turn clockwise. If the rotor is at its CW limit, it should read 179 degrees, but due to tolerances, even right after calibration, may read 180 or 181. If so, sending a command to rotate to 180 will cause it to respond with a beep to say "I'm already there!". It is unlikely that this will occur often, but if it does, press the CCW manual rotate button on the HD-1780 briefly, then press REMOTE.

Entering new named bearings

While the ten named bearings in the controller may only be changed using the controller's STORE key, you may change any of the ten named bearings shown on the screen. Press F3, enter the number of the memory you wish to change, enter the new name, and press ENTER. You will be asked to enter a new bearing, or press ENTER to use the current bearing (in the BRG window). (You may also press ESC to leave the bearing unchanged.)

NOTE: The new named bearings will be lost if you exit the program if it is being run as a transient. If installed as a memory-resident 'pop-up', they will be lost when you turn your computer off or reboot, or if you use the F4 Restore key.

Restoring information

Pressing F4 causes the program to read information from the HD-1780 concerning its current settings, and update the display. This information includes the named bearings.

Color selection

If you have a color monitor, you will appreciate the ability to customize the colors to your liking. Temporary changes may be made during an operating session to relieve eyestrain, or changes may be made permanent.

Press F6 and a new menu will appear, defining sections of the screen, and you will be prompted to make a selection. After doing so, the selection begins blinking in the menu line, and you are prompted to use the arrow keys to select colors. The Up Arrow and Down Arrow keys change background colors, while the Left Arrow and Right Arrow keys change foreground colors.

NOTE: The program automatically prevents any selections that would cause any part of the screen to become invisible. For example, the program won't allow the choice of a foreground (background) color of brown until the background (foreground) color is changed to something other than brown.

After changing a section, press ESC. The selection stops blinking, and you can choose another section to change, or press ESC again to leave the color selection mode.

If you hold either SHIFT key down while pressing ESC to return to the Ready! prompt, the changes will be made permanent. *

Entering a custom Title

F5 is labeled Title. Press F5, and enter a new title. If you press ESC, the old title will return; pressing ENTER accepts the new one. If you want to make this title permanent, hold either SHIFT key down while pressing ENTER.* (Note that the current color selections will also be saved by this action.)

Exiting the program

Press the ESC key to leave the program. If it was being run as a transient program, you will be asked to confirm this action by pressing 'Y'.

HV-2000 Voice Card Support

The controller program supports the Heath HV-2000 voice card, allowing use of the HD-1780 by blind operators. Refer to the HV-2000 manual for installation of the VOICE.SYS device driver, and note that, for the controller program to speak properly, the WORDS.EXC file included on this disk must be copied to the root directory, so that it will be loaded at boot-up with the device driver. (If you have already created your own WORDS.EXC file with the NEWWORDS utility, make sure to rename it first so it won't be written over.)

The voice may be turned on and off by the use of the F1 key. The voice will say 'Voice on' or 'Voice off'. When on, pressing F2 (Speak) will cause a voice menu to appear, and you will be asked what information you want spoken. Press the corresponding function key. After the information is spoken, the normal function menu will return.

* **IMPORTANT:** The program will be saved in the current directory under the name FM.COM.

When the voice is on, all prompts that appear in the Prompts window will be spoken, with the exception of those relating to color selection. In addition, some other actions will be spoken.

The voice parameters are initialized when the program is invoked (transient mode) or installed (resident mode). When in resident mode, but not popped up, you can change the voice parameters from the DOS prompt by using the SPEAK command furnished on the HV-2000 Utility Disk.

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Miscellaneous Notes

If you have only a single serial port, and need to share it with a printer or other device using an A-B switchbox, note that the program fully restores the selected serial port upon exiting.

If you experience problems with this program, either in transient or pop-up modes, it may be due to other, memory-resident programs. Uninstall them and try installing them one at a time to determine which one is causing the problem.

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MOUNTING TEMPLATE

