2. Installation and Operation

In this chapter:

2.1 Board Configuration and External Connections

The following electrical interfacing signals represent those used by the RCP02:

- Wide-range status inputs for receiving most external status information.
- Control outputs for driving external devices and signals.
- Analog DC voltage signals for motor drive and tachometer measurement.
- RS232 and RS422 signals for serial communication.

2.1.1 Configuring the Wide-range Status Inputs

The wide-range status inputs have a fixed 2.5-volt threshold level and can accept any DC signal that toggles across this threshold (e.g., standard TTL, RS232, or a direct connection to a 28-volt lamp.) These status inputs are diode clamped to GND and +5V, following a 33K-Ohm series input resistor, and are unharmed by input voltages as large as ±70 Volts. These do not require configuration to set the input voltage span.

Each wide-range input can be internally jumpered to +5V through a 1K-Ohm resistor. This permits direct connection of switch closures to ground and may also be used as termination for TTL inputs.

The pull-up jumpers are listed below. The BC jumper position attaches the pull-up and the AB position leaves it disconnected.

Important: The pull-up resistor should not be used when the input is connected to high voltages.

Important: The "A" jumper position is indicated by the ">" on the board.

Status Input	Jumper
LOCAL MODE	JP5
STANDBY	JP6
INTERLOCK	JP7
MAGNETRON CURRENT	JP8
AIRFLOW	JP9
WAVEGUIDE PRESSURE	JP10
PULSE WIDTH (LSB)	JP11
PULSE WIDTH (MSB)	JP12
RADIATE ON	JP13
SERVO ON	JP14
EL LIM LO	JP15
EL LIM HI	JP16
TR CABINET POWER	JP17
RESET INDICATOR	JP18
SPARE	JP37

2.1.2 Configuring the Control Outputs

Jumpers select whether these outputs are standard TTL levels, or relay switch closures either to ground or as an isolated pair. The relay contacts can be wired for Normally Closed (NC) or Normally Open (NO) operation, meaning that the contacts default to Closed/Open when the RCP02 power is Off/On. There are seven such outputs and associated jumpers options:

Important: The "A" jumper position is indicated by the ">" on the board.

RADOUT– Jumper Wiring (Relay K1)

JP20A–JP20B			TTL Output
JP20B–JP20C	JP20A–JP19B	JP19A–GND	NC Switch to GND
JP20B–JP20C	JP20A–JP19B	JP19C–GND	NO Switch to GND
JP20B–JP20C	JP20A–JP19B	JP19A–Edge	NC Switched pair
JP20B–JP20C	JP20A–JP19B	JP19C–Edge	NO Switched pair

RADOUT+ Jumper Wiring (Relay K2)

JP22A–JP22B			TTL Output
JP22B–JP22C	JP22A–JP21B	JP21A–GND	NC Switch to GND
JP22B–JP22C	JP22A–JP21B	JP21C–GND	NO Switch to GND
JP22B–JP22C	JP22A–JP21B	JP21A–Edge	NC Switched pair
JP22B–JP22C	JP22A–JP21B	JP21C–Edge	NO Switched pair

PWOUT0 Jumper Wiring (Relay K3)

JP24A–JP24B			TTL Output
JP24B–JP24C	JP24A–JP23B	JP23A–GND	NC Switch to GND
JP24B–JP24C	JP24A–JP23B	JP23C–GND	NO Switch to GND
JP24B–JP24C	JP24A–JP23B	JP23A–Edge	NC Switched pair
JP24B–JP24C	JP24A–JP23B	JP23C–Edge	NO Switched pair

PWOUT1 Jumper Wiring (Relay K4)

JP26A–JP26B			TTL Output
JP26B–JP26C	JP26A–JP25B	JP25A–GND	NC Switch to GND
JP26B–JP26C	JP26A–JP25B	JP25C–GND	NO Switch to GND
JP26B–JP26C	JP26A–JP25B	JP25A–Edge	NC Switched pair
JP26B–JP26C	JP26A–JP25B	JP25C–Edge	NO Switched pair

SERVOUT Jumper Wiring (Relay K5)

JP28A–JP28B			TTL Output
JP28B–JP28C	JP28A–JP27B	JP27A–GND	NC Switch to GND
JP28B–JP28C	JP28A–JP27B	JP27C–GND	NO Switch to GND
JP28B–JP28C	JP28A–JP27B	JP27A–Edge	NC Switched pair
JP28B–JP28C	JP28A–JP27B	JP27C–Edge	NO Switched pair

TRPWROUT Jumper Wiring (Relay K6)

JP30A–JP30B			TTL Output
JP30B–JP30C	JP30A–JP29B	JP29A–GND	NC Switch to GND
JP30B–JP30C	JP30A–JP29B	JP29C–GND	NO Switch to GND
JP30B–JP30C	JP30A–JP29B	JP29A–Edge	NC Switched pair
JP30B–JP30C	JP30A–JP29B	JP29C–Edge	NO Switched pair

RESETOUT Jumper Wiring (Relay K7)

JP32A–JP32B			TTL Output
JP32B–JP32C	JP32A–JP31B	JP31A–GND	NC Switch to GND
JP32B–JP32C	JP32A–JP31B	JP31C–GND	NO Switch to GND
JP32B–JP32C	JP32A–JP31B	JP31A–Edge	NC Switched pair
JP32B–JP32C	JP32A–JP31B	JP31C–Edge	NO Switched pair

For each control signal, TTL output merely requires that a single "AB" jumper be installed on the even-numbered jumper. For relay output, install the "BC" jumper instead, and connect a wire-wrap wire from the remaining "A" pin to the "B" pin of the odd-numbered jumper. Then wire either the "A" or "C" odd-numbered pins to either GND or to an external connector as shown in the table. A convenient source of GND are pins A1,B1,C1 and A32,B32,C32 of 96-pin headers HP1 and HP2.

2.1.3 Motor Drive and Tachometer

The motor drive and tachometer analog signals connect to the DRV/TACH (J11) backpanel connector and are the only analog signals used by the RCP02. If the distances are long, they should be carried on a twisted pair or shielded cables.

The motor drive signals are single-ended voltage sources with a 10K-Ohm output impedance. The span of the drive signals may be adjusted to a ± 12V range using gain potentiometers R14 (azimuth) and R24 (elevation). The voltage span should be chosen to match the maximum drive that the antenna servo power amplifiers can accept.

The tachometer signals are received by separate amplifiers on the RCP02. This approach gives the best immunity to common mode noise interference. Single-ended tachometer signals may be connected directly to any none of these inputs, even if one of the leads is grounded. The coarse voltage span of the input amplifiers is set by jumpers and the fine span is set by gain potentiometers.

Important: Both jumpers, for each axis, must always remain in the same position.

Tach Max Voltage	Azimuth JP1&JP2	Elevation JP3&JP4
±150V	Open	Open
±36V	B–C	B–C
±10V	A–B	A–B

2.1.4 External Servo Drive Relay

The servo drive relay is a 12-volt DC signal from the RCP02 that is intended to drive the coil of an external relay in the antenna's servo cabinet. The drive relay will close whenever the RCP02 is in positive control of the antenna, and will open when computer control is removed or if a shutdown error occurs.

The drive relay signals are labeled in the following manner:

- RELAY +
- RELAY – .

2.1.5 Azimuth and Elevation Position Inputs

The digital antenna-position data are input on the J1 (Azimuth) and the J2 (Elevation) of the back panel. Up to 16 bits of binary angle information can be used. If fewer binary bits are available, the bits should be wired to the higher-numbered lines with a portion of the lower-numbered lines left unconnected.

When the BCD angle input is used, the four possible digits must be connected to the input lines in the following order:

- Hundreds digit: Bits 12–15
- Tens digit: Bits 8–11
- Ones digit: Bits 4–7
- Tenths digit: Bits 0–3

For example, if the tenths digits are not used, bits 3–0 would be left unconnected however, the wiring of the other BCD digits would remain unchanged.

Remember, the higher-order digits must all be wired, even though the elevation position may be constrained to a limited angle, for the elevation axis. If this is not done, the negative angles will be read incorrectly. An elevation of -0.1^{o} must be input as 359.9^{o}.

2.1.6 Elevation Limit Switches

The elevation limit switches are connected to wide-range inputs that can accept either switch closures to ground or DC input levels. The limit switch inputs are wired to the DRV/TACH back-panel connector. The RCP02 has protection circuitry that inhibits

elevation motor drive whenever either limit switch is encountered. The motor drive is inhibited only in the direction that would push the antenna further into the limit. The antenna may be manipulated away from the limit by applying reverse polarity drive.

The following settings represent the two sets of two jumpers used to configure the elevation protection circuitry:

- If the elevation axis is driven upwards by positive drive voltage, then jumper the BC pins of JP35 and JP36. If not, then jumper the AB pins.
- If the limit switch signals are active low, then jumper the BC pins of JP33 and JP34. If not, then jumper the AB pins. An active low signal is effectively produced if the limit switches make a contact closure to ground when encountered.
- To entirely disable the limiting of elevation drive, remove the jumpers on JP35 and JP36 (you can plug them in sideways on just one pin for storage), and install the AB jumpers on JP33 and JP34. The elevation limit switch inputs will still be monitored by the RCP02 software, and can still be configured to bring about a shutdown when they are encountered. The output drive, however, will no longer be limited directly by the switch inputs.

2.1.7 TTY and Host Computer Serial Lines

A serial 9600-Baud TTY can be attached to the RCP02 to carry out the initial configuration and checkout. The terminal plugs into either the J6 (SETUP TTY) on the back panel or the 6-pin modular MMJ connector on the front edge of the RCP02's main board. The terminal may also remain permanently attached as part of a remote status/control interface.

The RCP02 setup menus can also be accessed via the "chat" mode from the user's host computer. This special mode is supported by IRIS and uses spare bandwidth, on the existing host computer serial interface, to allow the user to converse with the RCP02 from an XTERM window. This is the most preferred method of communication since the "chat" mode can be started up remotely and does not require additional hardware or cabling.

2.1.8 Analog Voltage Input Lines

The RCP02 supports eight analog voltage input lines that can be used to directly monitor continuously varying waveforms within the user's environment. ***No additional hardware is required to use this new feature***; only the addition of a few wirewrap wires on the Main Board and Backplane to bring out the external connections.

The analog input lines can accept voltages in the range –12V to +12V, and their input impedance is 1MΩ. Channels 0 through 3 are single ended (a single input relative to ground), and channels 4 through 7 are differential (difference of two inputs). The

12-bit A/D convertor operates in the –5V to +5V range for all channels. Thus, the single ended inputs must stay within –5V to +5V to be sampled properly; and the difference voltage on the differential channels must be likewise constrained.

The analog signal inputs are available on the following pins of the RCP02/Main board.

Channel	+Input	–Input
0	H2,3	N/A
1	H2,7	N/A
2	H2,11	N/A
3	H2,15	N/A
4	H2,17	H2,19
5	H2,21	H2,23
6	H2,27	H2,29
7	H2,31	H2,33

2.2 The TTY Main Menu

The Main menu represents the top level of communication between the RCP02 and the user in the TTY Setups. All setup, monitor, and control functions can be accessed through this menu.

The example on the following page represents the Main menu as it appears on the TTY screen:

```
RCP> help
Available Commands:
     Axis <AZ><EL>                      General Axis Setup
  Control <Lines><Logic>                Control outputs
     Help <Support><Listall><View>      Help text (also '?')
      INU                               Inertial Navigation Unit
  Monitor <Ang><INU><SIO><Sta><Con>     Live TTY monitor
   Pservo <AZ><EL>                      Position Servo Variables
    Reset <#Seconds>                    Reset from Shutdown
  Restore <Factory><Saved><Undo>        Restore settings
     Save                               Save settings
     Site <Disp><Host><Custom><Misc>    Local Site setups
   Status                               Status Input Lines
   Vservo <AZ><EL>                      Velocity Servo Variables
```

To make a selection, type the appropriate command followed by any additional keywords or numerical values. Remember, many of the commands may require additional information.

The DELETE and BACKSPACE keys may be used to correct typographical errors however, all invalid selections will result in a diagnostic message followed by a beep. To simplify typing, all commands and keywords may be abbreviated to a short, unambiguous prefix.

Many of the commands relate to the setup and calibration of the RCP02, as described in Chapter 3. The TTY Setup interface can also perform a wide-variety of operational tasks via the "monitor" command described in the next section.

2.2.1 TTY "Help Support" Command

The following example demonstrates how the "HELP" command is invoked using "support" as the identifying keyword.

```
RCP> help support
   E-Mail: support@sigmet.com
  US-Mail: 2 Park Drive, Unit #1, Westford, MA 01886 USA
 Internet: www.sigmet.com, ftp.sigmet.com
    Phone: (978) 692-9234  (Monday-Friday, 9am-5pm EST)
      FAX: (978) 692-9575  (All hours)
```

2.2.2 TTY "Help View" Command

This version of "HELP" is used to view internal status and configuration that is not easily visible from other RCP02 commands.

```
RCP> help view
Rev.B board, ROM V09 from Tue Jun 23 16:00:07 1998
Values were last saved using ROM version V10
IP Module Inventory:
  IP-A : IP-Digital-48        IP-D : Empty Slot
  IP-B : IP-Digital-48        IP-E : IP-488
  IP-C : IP-Digital-48        IP-F : IP-Precision-ADC
Additive angle offsets   AZ: 0.00   EL: 0.00
```

The various sections of the listing include:

- The board and code revision levels, and the date and time that the code was compiled. The date is useful in distinguishing beta test versions that may be released from time to time.

  The support for intermediate minor releases of RCP02 code includes a minor version number for intermediate "unofficial" releases. The minor number starts from zero at the time of each "official" release, and then increments until the next "official" release. The RCP02 front panel and TTY startup messages will show the minor release number (if it is not zero). Likewise, the minor release number of the code that last saved the nonvolatile RAM will be shown in the "Help View" command.

- An inventory of all of the IP modules that are plugged in.

- Current angle offsets that are being added to the parallel or synchro angle inputs. This value generally comes from the "Axis" setup command; but in some cases it may be supplied by external equipment.

2.3 The TTY "MONITOR" Command

The "MONITOR" command provides a live display of changing parameters within the RCP02. Several different types of displays can be selected, but all consist of a line of information that is continually retyped on the same position of the TTY screen. For terminals operating at 2400 baud or faster, the effect is similar to that of a stationary format display where each value is kept up-to-date.

User commands may be input while the monitor display is running. The effect is as if the TTY cursor were located to the right of the text and the characters appeared in the usual manner. Since the entire status line is continually being retyped, the implementation of these echoed characters is somewhat more complicated. The DELETE and BACKSPACE keys can still be used to correct errors and the ENTER key terminates the input.

When a valid command is input, the screen will scroll up a line and the status display will continue to be printed on the following line. A history of the commands that have been typed is thereby preserved. With this in mind, a blank line is one of the more useful commands. This no-operation command allows the display to scroll in an upward motion. It also creates a sequential record of observations on the TTY screen, thus allowing the information to be written down at a later time. This is an important feature for calculating the initial measurements of the antenna dynamics as required for the position and velocity servos.

Invalid commands will erase all command characters; the TTY will beep, and no scrolling will occur.

After many commands are typed, the initial heading will eventually scroll off the top of the screen. Entering the "." command will automatically retype the heading line, and the status display will continue under it as before. The "." command can prevent the misinterpretation of an unlabeled line of numerical information.

To exit from the monitor command, use the ESC key or the "QUIT" command. Either one will cause an immediate return to the Main menu.

Alternate data displays are usually available within each monitor command. Use the "ALT" command to toggle through the different displays, and the "MAIN" command to quickly return to the default presentation. If you exit from a monitor while an alternate display was in use, you will automatically be returned to that display upon reentering.

2.3.1 TTY Antenna Monitor and Control

The RCP02 can display most of the important real-time antenna parameters on the local TTY screen and can request antenna motion through a simple command interface. This local control and monitoring capability is primarily intended for use during the initial installation and testing of the RCP02. The features, however, are so simple to use, it could also form the basis of a "front panel" for the manual antenna control.

The local antenna monitor is entered by typing "monitor angles" from the Main menu.

Note: The "MONITOR" command may be abbreviated to its unique first letter. The term "angles" is the default value of an optional keyword; typing a single letter "m" would also work.

An initial heading is printed, followed by repeated lines of numerical text in the following manner:

```
RCP> monitor angles
AZ–Pos AzTach Az–Vel AzDrv   EL–Pos ElTach El–Vel ElDrv   Time
------ ------ ------ -----   ------ ------ ------ -----   ----
141.21  34.81   8.37  32.7    12.01   0.00   0.00   0.0   3.42
```

The displayed values are interpreted as:

AZ-Pos / EL-Pos

The Azimuth (AZ) position is unsigned and displayed in a 0 to 360^{o} range. The Elevation (EL) position is signed and operates from -180 to $+180^{o}$.

AZTach / ELTach

The AZ and EL tachometer levels represent 12-bit, A/D converter samples scaled to a range from -100 to $+100$.

AZ-Vel / EL Vel

The AZ and EL velocity are computed as the end-product of the tachometer samples with a calibration slope for each axis.

AZDrv / ELDrv

The AZ and EL motor drive represents 12-bit, D/A converter values scaled to a range from -100 to $+100$.

Time

The seconds counter increments from zero to 10 with 0.01 second resolution. These values are included so the elapsed time, between displayed lines, can be easily measured. It is useful when manually calculating the antenna dynamic parameters.

2.3.1.1 Commands Recognized by the Angle Monitor

The following commands are available within the angle monitor:

```
Angle Monitor Commands:
   azd / eld <#>  Set AZ/EL drive (D-Units)
   azp / elp  #   Set AZ/EL position (degrees)
   azt / elt <#>  Set AZ/EL velocity (Tach-Units)
   azv / elv <#>  Set AZ/EL velocity (deg/sec)
         Alt      Switch among alternate presentations
        Main      Back to primary presentation
       Reset <#>  Reset from Shutdown (Unsafe sec)
           .      Reprint header labels
```

The following commands are used to set up particular drive levels, or alternatively to start up one of the internal servos, for both the azimuth and the elevation axes. The range of -100 to $+100$ represent the digital value that is applied to the output D/A converters.

- Use the "ad" or "ed" commands, followed by a number in the range of -100 to $+100$, to output a given motor drive.
- Use the "ap" or "ep" commands, followed by the desired angle in degrees (^{o}), to move the antenna to a fixed position.

The host computer serial interface will continue to control the RCP02 until a command that moves the antenna is typed on the TTY screen. The RCP02 will remain under the terminal's control until until the local monitor mode has been exited.

Important: The terminal may be used as a monitor however, do not input those commands that will seize control from the host computer.

If commands are used to move the antenna, checks are usually performed that restrict the antenna's travel to ensure the soft limits (lower and upper) are not exceeded. The checks are done by executing the position servo "silently" in the background using the two soft limits as target points. If the present motor drive does not rest in between the calculated drives, then the drive is automatically overridden by either one of those values. This is a safety measure designed to prevent the antenna from running into its stops.

2.3.1.2 Alternate Display for Shipboard Platforms

The following alternate format is useful when moving platform stabilization is performed. This allows the user to compare the Pedestal and the Earth angles as the orientation of the platform changes.

```
  Ped AZ/EL     Earth AZ/EL     Earth Vel     Roll   Pitch  Head
-------------  -------------  -------------  ------ ------ ------
294.70  -0.98  359.72   9.43   -0.01   4.00   -7.99  -7.76  65.88
```

The displayed values are interpreted as:

Ped AZ/EL

This represents the Pedestal position angles in degrees (^{o}).

Earth AZ/EL

This represents the Earth position angles in degrees (^{o}).

Earth Vel

This represents the Earth AZ and EL angular velocities in degrees/seconds (^{o}/sec).

Roll/Pitch/Head

This represents the Roll, Pitch, and Heading angles of the moving platform in degrees (^{o}).

2.3.1.3 Alternate Display of Antenna Dynamics

The following alternate format prints several derived parameters pertaining to the dynamic properties of each antenna axis. Only one axis is displayed at a time. The azimuth axis printout is shown below, but the alternate display for the elevation axis is identical.

```
AZ–Pos AzTach AzDrv     T–Cal/Vel/Ratio     T–Dot T–Err I–Mom  Time
------ ------ -----  -------------------  ------ ----- -----  ----
359.95 –11.67  –2.3  –13.72  –3.25  1.013    2.86  –1.0  2.81  5.29
```

The displayed values are interpreted as:

AZ-Pos

The represents the Pedestal position angle in degrees (^{o}).

AzTach

The represents the Pedestal tachometer levels, scaled to -100 to $+100$ T-Units

AzDrv

The represents the Pedestal drive signals, scaled to -100 to $+100$ D-Units.

T-Cal / Vel / Ratio

The tachometer calibration values consist of a one-second averaged tachometer calibration level (T-units) and a computed actual velocity based on various positions (^{o}/sec). Both of these numbers define the map from the tachometer T-units to velocities (^{o}/sec). The slope ratio, implied by the current values to the stored slope from the axis menu, is displayed. This ratio should be very close to 1.000 for all rates of rotation. The antenna must be in motion for these values to be valid.

T–Dot / T–Err / I-Mom

The time derivative of the tachometer (i.e. the acceleration) is displayed in T-units/sec followed by the extrapolated tachometer error in T-units, based on a 2.5-second integration of an internal antenna model. This tachometer error is the

basis of an unresponsive antenna check that is continually executed in the background. The antenna's instantaneous moment of inertia is displayed in D-units and T-units/sec. The antenna must be accelerating for these values to be valid.

Time

The seconds counter increments from 0 to 10 with 0.01 second resolution. These values are included in order to easily measure the elapsed time between display lines.

2.3.2 TTY Serial I/O Monitor

This display is provided as an aid to debug the serial interface with the host computer. The TTY screen displays the I/O activity and the interpretation of the commands being sent to the RCP02. The serial I/O monitor is entered by typing "monitor sio" from the Main menu.

```
RCP> monitor sio
  Ch/Rec In  Time Err  Ch/Rec Out   AZ-Pos  AZ-Vel  EL-Pos  EL-Vel
------------ ---- --- ------------  --------------  --------------
154867 11002  0.2   3 698660 11342    0.00 P  0.00    0.00 P  0.00
```

The displayed values are interpreted as:

Ch/Rec In

The character input count represents the total number of characters received. The valid record count represents the number of properly formatted packets received.

Time

The time represents the time since the last valid record was received (sec).

Err

The error count represents the total number of improperly formatted packets received.

Ch/Rec Out

The character output count represents the total number of characters and packets transmitted.

AZ-Pos/AZ-Vel

This represents the requested azimuth position and azimuth velocity and are always displayed regardless of the servo type. The letter "P," in the center of the two values, represents the position servo.

Other letters that may appear include:

- "V" — velocity servo,

- "D" — direct motor drive, and
- "X" — disabled.

EL-Pos/EL-Vel

This represents the requested elevation position and velocity and has the same format as for azimuth.

2.3.2.1 Commands Recognized by the Serial I/O Monitor

If command characters are typed by the user while the TTY screen displays the status text, these characters will be echoed at the right side of the screen. The commands that are available within the Serial I/O Monitor are:

```
SIO Monitor Commands:
    Alt    Switch among alternate presentations
   Ri/Ro   Host computer record In/Out monitor
   Main    Back to primary presentation
   Zero    Clear SIO counters
      .    Reprint header labels
```

2.3.2.2 Alternate Displays of Raw SIO Records

The "Ri" and "Ro" subcommands may be used to view the incoming and outgoing raw serial traffic with the host computer. This can be very helpful when debugging interface problems at either end. The data are shown in hexadecimal format, one (variable length) record per line. Note that the only data shown are character sequences that 1) begin with a byte with MSB set but not equal to 0xFF, 2) end with 0xFF, and 3) have MSBs clear in all intermediate bytes. Examples are shown below.

```
Incoming Records from Host Computer
-----------------------------------
80 00 00 00 00 00 0A 00 0F 00 00 00 00 FF
80 00 00 00 00 00 0A 00 0F 00 00 00 00 FF
C0 01 00 00 02 00 00 00 00 00 00 00 FF
80 00 00 00 00 00 0A 00 0F 00 00 00 00 FF
C0 4D FF
80 00 00 00 00 00 0A 00 0F 00 00 00 00 FF

Outgoing Records to Host Computer
---------------------------------
80 00 00 00 00 00 00 00 00 10 00 00 00 24 30 FF
80 00 00 00 00 7F 7F 00 00 10 00 00 00 34 33 FF
C0 00 00 00 00 00 00 00 00 10 00 00 FF
C0 01 7F 7F 7F 7F 7F 7F 3F 00 00 00 FF
80 00 00 00 00 00 00 00 00 10 00 00 00 4B 36 FF
C0 4D FF
80 00 00 00 00 00 00 00 00 10 00 00 00 34 65 FF
```

2.3.3 TTY Inertial Navigation Unit Monitor

This display provides a view of the data stream arriving from an optional Inertial Navigation Unit (INU). The INU monitor is entered by typing "monitor inu" from the Main menu.

```
RCP> monitor inu
  Roll   Pitch  Head   R.Dot P.Dot H.Dot    Time      Date
 ------ ------ ------  ----- ----- -----  -------- -----------
  -1.04   4.74 345.96    0.6   3.1   8.3  00:27:58  1-Jan-1998
```

The displayed values are interpreted as:

Roll / Pitch / Head

These represent the attitude angles in degrees (^{o}).

R.Dot / P.Dot / H.Dot

These represent the rates of change of attitude angles in degrees (^{o}) / second.

Time / Date

The time and date, using whatever time zone has been set for the INU.

2.3.3.1 Alternate INU Monitor Presentations

You may switch to the following alternate presentation by typing "alt":

```
 Latitude Longitude Height  N.Vel E.Vel Z.Vel  Char/Err  Rec/Err
--------- --------- ------  ----- ----- -----  --------  -------
 42 31.0N  71  2.4W   40.9   10.0   3.0   0.5     0   0  161   0
```

The displayed values are interpreted as:

Latitude / Longitude / Height

These represent the physical location. Latitude and Longitude are in degrees and minutes, with N/S and E/W indicating the sign. Height is in meters relative to sea level.

N.Vel / E.Vel / Z.Vel

These represent the linear velocities in meters/second the North, East, and Up directions.

Char/Err and Rec/Err

These are the counts of the number of characters and records received, and the number of character and record errors that have been detected. A character error is a framing or parity error, whereas a record error results from an invalid CRC checksum in a record of data. The record count should increase at a rate of approximately 100 records/second when INU data are being received correctly. You may use the "zero" subcommand to clear these counters so that changes are easier to spot.

2.3.4 TTY Status Line Monitor

This display provides a concise view of all of the status input lines that are sensed by the RCP02. The status line monitor is entered by typing "monitor status" from the Main menu.

```
RCP> monitor status
Hardware Electrical Inputs
Locl Pw1 Pw0 Rad Srv T/R Stby Intr Mag Air WGp Res ElLO ElHI IRIS
---- --- --- --- --- --- ---- ---- --- --- --- --- ---- ---- ----
 --   --  --  --  --  --  --   --       On  --  --  --   --   ---
```

The characters "—" will be printed under each status input that is not being used. For the used inputs, the word "ON" will be printed if the line is asserted, and blank space will appear if the line is not asserted.

You may switch to the following alternate presentation by typing "alt". Now, the internal status of each condition is displayed. This is different from the condition of the hardware input line in that the status may be coming from another source, or may be spoofed from the requested control.

```
RCP Internal Status
Locl Pw1 Pw0 Rad Srv T/R Stby Intr Mag Air WGp Res ElLO ElHI IRIS
---- --- --- --- --- --- ---- ---- --- --- --- --- ---- ---- ----
                  ON                                          000
```

Lastly, if auxiliary status lines have been enabled, then you may switch to the following bit presentation by typing "alt". In the following example, four bytes of optional status have been selected via the "site custom" menu. High inputs are shown as a "1", and low inputs are shown as a "." (rather than as "0", to make the string more readable at a glance).

```
Auxiliary Status Inputs
S[31:24] S[23:16] S[15:08] S[07:00]
-------- -------- -------- --------
11111111 11111111 11111111 1111111.
```

The "Monitor Status" command uses the "/" subcommand to toggle between the requested and qualified versions of the primary and auxiliary status bits, as well as the direct hardware inputs themselves. The distinction between requested and qualified status bits exists because the status bits can appear on the left side of logic equations (See Section 3.7.2).

2.3.5 TTY Control Request Monitor

This display provides a concise view of all of the control functions that might be handled by the RCP02. The control request monitor is entered by typing "monitor control" from the Main menu.

The primary control functions that have been externally requested (usually from the host computer) are shown in the following display:

```
Requested Primary Control Bits
Pw1 Pw0 Rad Srv T/R Res IRIS
--- --- --- --- --- --- ----
             ON          000
```

The qualified state of each control function can be viewed by the "/" subcommand. The display now shows the actual control state, which may be different from the requested state if any internal logic equations are overriding the request (See Section 3.7.2).

```
Qualified Primary Control Bits
Pw1 Pw0 Rad Srv T/R Res IRIS
--- --- --- --- --- --- ----
             ON  ON      000
```

Note that "/" works as a toggle between the requested and qualified states of whatever control variables are being shown. This makes it easy to compare the bits, and to verify that custom logic equations are implemented correctly. The "alt" subcommand may be used to switch to the following display of requested auxiliary control bits:

```
Requested Auxiliary Control Bits
C[63:56] C[55:48] C[47:40] C[39:32] C[31:24] C[23:16] C[15:08] C[07:00]
-------- -------- -------- -------- -------- -------- -------- --------
........ ........ ........ ........ ........ 11...... 1....... ........
```

from which the "/" subcommand can switch to the qualified states:

```
Qualified Auxiliary Control Bits
C[63:56] C[55:48] C[47:40] C[39:32] C[31:24] C[23:16] C[15:08] C[07:00]
-------- -------- -------- -------- -------- -------- -------- --------
........ ........ ........ ........ ........ ........ 1....... ........
```

Lastly, the sixteen local logic variables are shown in the following "alt" display.

```
Local Variables
V[15:08] V[07:00]
-------- --------
........ ........
```

2.3.6 TTY Internal LOG Monitor

This display allows you to view the RCP02's internal log of data and events. The control request monitor is entered by typing "monitor control" from the Main menu. If log entries already exist when the command is typed, you will see a message resembling:

```
RCP02 System and Event LOG
--------------------------
There are 27 saved entries – DELETE ?
```

You may type "Yes" to delete the old entries if they have already been seen, or if they are known to be unimportant. But beware — deleted entries can not be recovered and will never be seen again. In general, you should simply type <Enter> to view and preserve the saved entries. If you want a permanent record of the log, be sure that you can archive the printed lines from the X–Terminal that is running, for example, "antcheck –chat". After printing these old log entries you will see the message:

```
Flush this saved LOG and enter live update mode? n
```

Typing "Yes" will delete the entries that were just printed, and the monitor will enter its live update mode in which new log entries are printed (and discarded) immediately. Typing any key during live update mode will return to the top level "RCP>" prompt.

The depth of the log is eighty entries; when the log fills up, additional entries can not be added and are discarded. If this has happened, you will see an initial message such as:

```
WARNING: There have been 58 missed LOG entries
```

Each entry of the printed log begins with a banner such as:

```
----- # 27   Time: 4626.554 sec ----- (Angle Glitch)
```

This indicates that we have the twenty-seventh log entry, the time of the entry (in seconds since the RCP02 was booted), and the type of entry. One or more additional lines will follow with the specific data for this type of log entry.

2.3.7 TTY Analog Voltage Input Monitor

The command "Monitor ADC" may be used to view the sampled voltage on each of the eight analog input lines. An internal loop-back measurement of the AZ and EL drive output voltages is also included. A sample printout is shown below; all values are displayed in Volts.

```
RCP> monitor adc
Analog Input Lines (Volts relative to GND)
  0     1     2     3     4     5     6     7   AzRef ElRef
----- ----- ----- ----- ----- ----- ----- ----- ----- -----
 0.92  4.04 -3.12  0.00  0.00  0.00  0.00  0.00  1.22  0.00
```

2.4 TTY "RESET" and "REBOOT" Commands

The RCP02 continually performs antenna consistency checks to guard against faults that might damage the mechanical system. Whenever such conditions are detected, the RCP02 will immediately enter a shutdown state and a flashing error message will appear on the front panel display.

The following list represents the three ways a shutdown state can be exited:

- Turn the power on and off
- use a suitable command from the host computer, or
- type the local command "reset."

The "RESET" command provides a restore capability that is more graceful than cycling the power. This can also be executed remotely.

⚠ **Warning: The cause of the shutdown must be determined and corrected before attempting to restore system operation.**

The local "RESET" command may be followed by an optional numerical value between zero and 10. This value represents the number of seconds that a shutdown will be inhibited following the reset, with a default value of one second. This brief lockout period is designed to assist with the antenna's reposition so the shutdown condition can be remedied—rather than a repeat of the shutdown—immediately following the reset. For example, if the antenna has contacted a limit switch, the user can issue brief drive commands and attempt to move the antenna away from its limit.

The RCP02 will only shut down when it has control of the antenna. When the external LOCAL status input forces the RCP02 into local mode, it will not shutdown even if the velocity limits are exceeded or if the tachometer signals are inconsistent with angular positions. Once control is returned to the RCP02, the operator must ensure that no shutdown criteria is pending prior to the switch-over.

The ”RESET” command always places the controller into its momentary ”unsafe” condition regardless of whether the RCP02 is shutdown at the time the command is received. This allows the command to be useed when attempting to exit from stuck conditions; including those times when the RCP02 has not actually shutdown.

Note: The “local” status places no restrictions on exiting from the shutdown state — only on entering it. Therefore, the “reset” command is always effective.

The “RESET” command causes a soft internal reset, i.e., the shutdown state is cleared and the RCP02 continues running smoothly. In some cases, however, the RCP02 may require a more drastic restart that is equivalent to cycling the power. This function is available using the “REBOOT” command. You will be asked for confirmation prior to actually rebooting; answering “yes” will allow the reboot to proceed.

2.5 Suggested SETUP Sequence

After the initial power-up and cabling has been completed, configuration of the RCP02 must be carried out in a particular order. A suggested sequence is given below, which is based on the assumption that none of the parameters are yet correct. When changes are later made to one particular area, it is not always necessary to redo this entire sequence of steps. Detailed instructions for modifying parameter values are described in Chapter 3.

1. Install the jumpers for tachometer voltage range, then adjust the tachometer and drive gain potentiometers to match the requirements of the antenna electronics.
2. Use the “site display” command to choose the parameters you would like to show on the front panel display.
3. Define most of the fixed information for each axis — the number of bits and the polarity of angles, the coding format, the validation and start signals, and so forth. This is performed using the “axis” command.
4. For the elevation axis — temporarily set the shutdown limits short of mechanical stops, leaving enough distance for the antenna to coast to a stop in case of errors. Also, set the limit switch options and polarity.
5. Determine the motor starting drives, the nominal drive slope, and the maximum angular velocity. Determine the tachometer and drive signs, then set the tach and

the drive filter time constants fairly short (.03 second). Set the velocity feedback dead zone to 0.3, and the feedback slope to 25. The velocity servo should now be stable and optimized for best operation.

6. Set up the position servo parameters to achieve a stable motion between two positions that are separated by an angular distance.
7. Make absolute velocity calibration; set up the velocity check and the unresponsive–antenna check.
8. Set up the host computer's serial communications line.

It may be necessary to disable the soft limit protection, especially when the initial dynamic antenna measurements are performed or while setting up the velocity and position servos. If the servos are not properly set up, the computed safety limits may be incorrect and could actually cause damage rather than protect against it. A temporary measure to prevent this from occurring is to set the shutdown limits of travel to 15^{o} short of either extreme. If the antenna becomes unstable, this will ensure a shutdown of the RCP02 and allow the antenna to come to a stop under zero-drive conditions.