VAISALA

USER'S MANUAL

Radar Control Processor
RCP8

M211320EN-C

PUBLISHED BY

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CHAPTER 1

GENERAL INFORMATION

This manual provides technical information on the Radar Control Processor (RCP8).

1.1 About This Manual

This manual is used primarily by engineers for troubleshooting or by users interested in understanding the use, the configuration, and the data formats used by the RCP8.

Chapter 2, Introduction and Specifications, on page 13, describes the major features of the RCP8 processor and gives its technical specifications.

Chapter 3, Hardware Installation, on page 33, describes the hardware installation and configuration of input and output signals, including the motor drive and tachometer signals.

Chapter 4, TTY Menu Control and Monitoring, on page 45, presents the operation of the RCP8 via its local TTY menus.

Chapter 5, TTY Setup Menus, on page 61, further describes the use of the local TTY menus to setup the complete software environment, including all parameters for the digital velocity and position antenna servos.

Chapter 6, Theory of Servo Operation, on page 135, is a mathematical description of the digital servos, including extensions to moving platform stabilization.

A.1 Serial Data Format on page 149, lists the serial line data formats normally used by the host computer to control the RCP8 and the antenna.

Appendix B, Antenna Stabilization Procedure, on page 175, gives an outline of the steps required to stablize a new antenna.

Appendix C, RVP8/RCP8 Packaging, on page 179, includes drawings and specifications for the chassis and the Pin–Assignments for a standard unit.

1.2 Version Information

Manual Code	Description
M211320EN-C	This manual. Third version. November 2013
M211320EN-B	Previous manual. Second version. March 2013
M211320EN-A	Previous manual. First version.

1.3 Related Manuals

Manual Code	Manual Name
M211315EN	Software Installation Manual
M211316EN	IRIS and RDA Utilities Manual
M211317EN	IRIS Radar Manual
M211318EN	IRIS Programmer’s Manual
M211319EN	IRIS Product and Display Manual
M211321EN	RVP8 User's Manual
M211322EN	RVP900 User's Manual
M211452EN	IRIS and RDA Dual Polarization User’s Manual

You can download the latest versions of the manuals from Vaisala product website, http://www.vaisala.com. They can be read online using by Adobe® Reader®, which is installed with IRIS.

Vaisala encourages you to send your comments and/or corrections to:

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1.4 Documentation Conventions

Throughout the manual, important safety considerations are highlighted as follows:

WARNING	Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION	Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

The following conventions are used throughout this manual:

`prompt`	Some features of the RCP8 operate by displaying questions and waiting for you to type an answer. The text of prompts is displayed in bold, monospaced type.
`command`	Commands are also printed in bold, monospaced type.

CHAPTER 2
INTRODUCTION AND SPECIFICATIONS

The RCP8™ provides a convenient interface between a modern weather radar system and advanced application software. All of the radar I/O and low–level antenna control are handled by the RCP8 which communicates with a host computer via an Ethernet interface or a standard RS232 serial line. The application software on the host computer monitors the serial line for status information and issues high–level commands for control. The flexibility of the RCP8 allows the unit to be connected to weather radar systems from different manufacturers. It is fully compatible with Vaisala's previous generation RCP02.

The RCP8 provides position and velocity servos for both the AZ and the EL axes of the antenna, the status monitoring of the transmitter/receiver/antenna servo systems and the control functions such as Radiate On/Off and Servo On/Off. Even synchro signals can be input into the RCP8 directly. The Ethernet or RS232C interface can be connected to virtually any workstation or PC and is fully compatible with Vaisala's RVP8 signal processor and IRIS software system.

The features of the RCP8 are summarized in on page 14. Of special note are the fail–safe features of the RCP8 which are designed to protect the radar and antenna system in the event of a failure. The flexibility of the I/O design is based on Vaisala's over 25 years of interfacing experience to different weather radar systems.

An optional feature is antenna stabilization for moving platforms, such as ships or airplanes. For shipboard use, the RCP8 accepts position, attitude and speed information from an inertial navigation unit (e.g., the Honeywell MAPS Hybrid system.) The antenna will then scan in Earth coordinates regardless of the platform pitch, roll, or heading.

The speed of modern processors and the flexibility of the Linux operating system allow the RCP8 and the Vaisala IRIS/Radar software to be installed on the same PC with no hardware changes. This is called an RCP8/RCW

(Radar Control Workstation). This saves the purchase and maintenance cost of an additional PC.

In this chapter:

2.1 General Architecture

The RCP8 is based on a standard PCI architecture under the open Linux operating system. A typical unit is supplied in Vaisala's standard 4U 19 EIA rackmount chassis. Unlike a standard PC, the chassis is ruggedly constructed with redundant power supplies, captive quick release fasteners, PCI card guides and security hold–down bar. A standard system contains the following components listed below and shown in on page 15:

- Motherboard or single–board Intel Pentium system with single or dual processors.
- Vaisala I/O–62 general purpose I/O board.
- Vaisala RCP8 Connector Panel (connects to I/O–62).

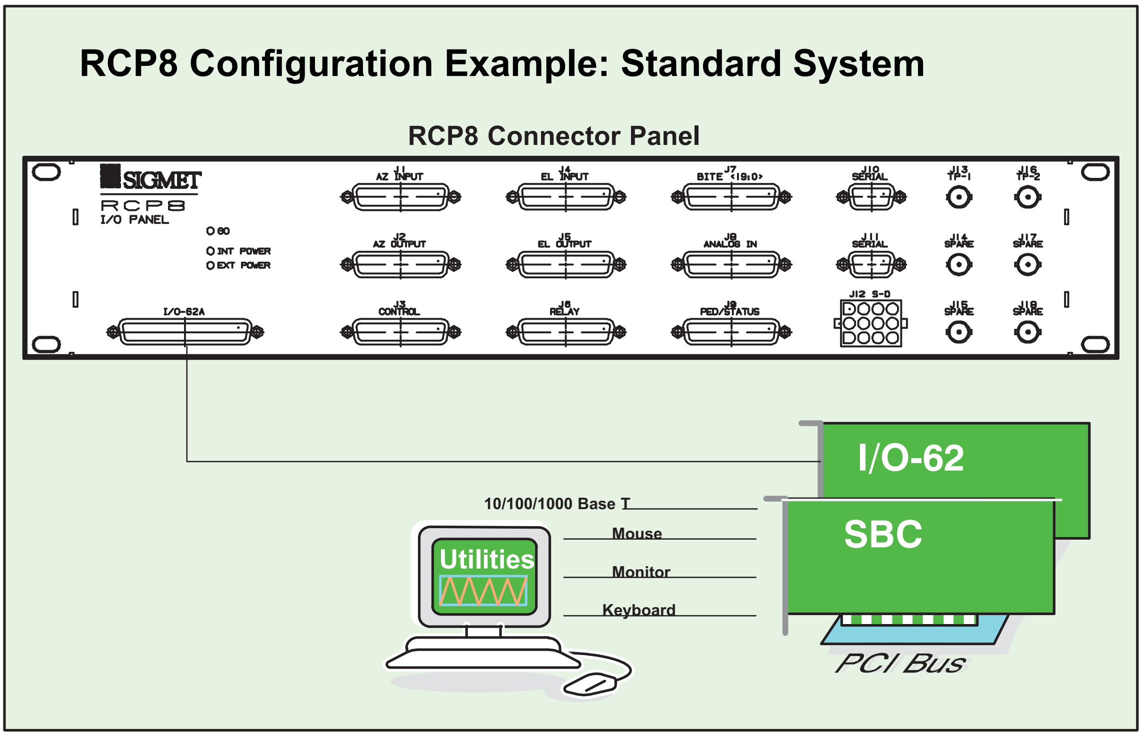


Figure 1 RCP8 Architecture

Depending on the application, other standard commercial PCI cards may be provided by Vaisala or added by the customer for additional I/O capability such as the following:

- 10/100–BaseT Ethernet card for additional network I/O (e.g., a backup network).
- RS–232/RS–422 serial cards for serial angles, remote TTY control, etc.
- Sound card to synthesize audio waveforms for alarm applications.
- GPS card for time synch.
- IEEE 488 GPIB card for control of test equipment.

The front panel of the RCP8 houses a bright, 2–line display that shows diagnostic and error messages as well as the position information. An example is shown below.

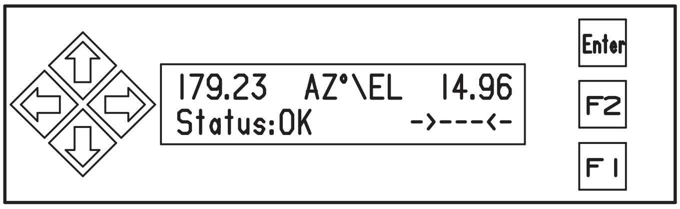


Figure 2 Front Panel Display

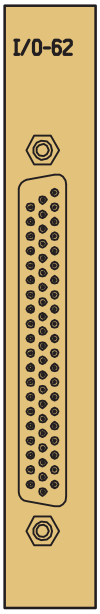
The front of the unit also contains a CDRW and 1.44 MB diskette for backup, software installation and maintenance.

The RCP8 is configured using a local keyboard, mouse and monitor or can be configured remotely over the network. The configuration menus are TTY text–based menus which allow the configuration of the antenna servos, host computer interface and the programmable control logics. The TTY menus also provide status and monitoring for diagnostic purposes and during the antenna stabilization process. Pin assignments to the Connector Panel are made in the softplane.conf file. This eliminates the need for jumpers and custom wiring.

The major hardware components are described in the sections below. 2.2.1 Antenna Control I/O and Features on page 23 contains detailed specifications of the RCP8.

2.1.1 Mother Board or Single–Board Computer (SBC)

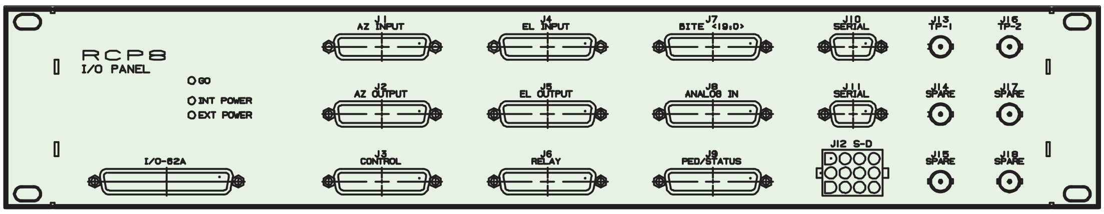
The dual–CPU Pentium mother board or single–board computer (SBC) acts as the host to the Linux operating system and provides all of the compute resources for performing the antenna servo control as well as the status and monitoring. Standard keyboard, mouse and monitor connections are on the SBC or motherboard backpanel, along with typically two 10/100/1000 BaseT Ethernet ports. The system does not require that a keyboard, mouse or monitor be connected which is typically the case at an unattended site. An SBC example is shown on the left.

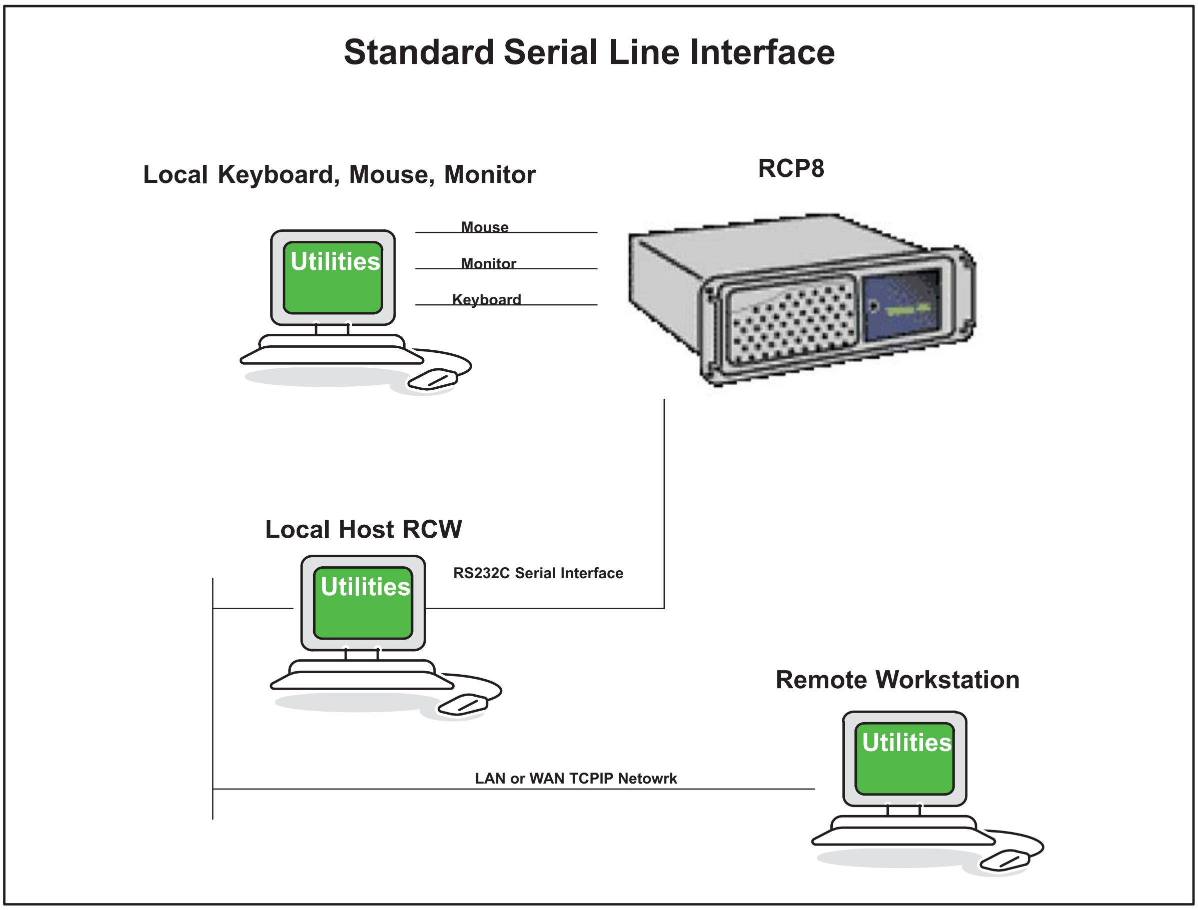


Motherboards and SBC's are available from many vendors, at various speeds Typically the SBC is equipped with 128 MB RAM. The RVP8 chassis has a front bay for a >20 GB hard disk. CDRW is also provided for backup and software maintenance. Note that the latest versions of the RVP8 software and documentation can always be downloaded from Vaisala's website for free.

The SBC also plays host for Vaisala's RCP8 Utilities which provide test, configuration, control and monitoring software as well as built–in on–line documentation.

2.1.2 I/O–62 PCI Card and I/O Connector Panel





The Vaisala I/O–62 is a short format PCI card that provides extensive I/O capabilities for the RCP8. Note that the identical card is used in the Vaisala RVP8 Digital Receiver and Signal Processor. A typical installation would have one I/O–62 and an RCP8 Connector Panel shown above. The I/O–62 has a single 62–position, high–density D connector. This is attached to the rackmount RVP8 Connector Panel via a standard 1.6 m (6 foot) 1:1 cable. Typically the Connector Panel is installed in the same rack as the RCP8.

The I/O–62 is configurable in software, i.e., there is no need to open the chassis to configure jumpers or switches. This means that when a spare board is added, there is no need to perform hardware configuration or custom wiring. The physical I/O lines are summarized in the system specifications, 2.2.1 Antenna Control I/O and Features on page 23.

If more I/O is required, then a second I/O–62 can be installed. This makes for easy expandability of the system.

ESD Protection Features

Since the I/O lines are connected to the radar system, there is a potential for lightning or other ESD type damage. This is addressed aggressively by the I/O–62 in two ways:

- Every wire is protected by a **Tranzorb** diode which transitions from an open to a full clamp between ±27 to ±35 VDC. Additionally, the Connector Panel uses **Tranzorb** diodes on every I/O line for double protection.
- High–voltage tolerant front–end receivers/drivers are used. All components connected to the external pins can tolerate up to ±40V. For example, the TTL and wide range inputs use protectors that normally look like 100 Ohm resistors, but open at high voltage.

These features make the RCP8 very robust to transient surges.

Run Time FPGA Configuration

The Vaisala I/O–62 card is built around a 100K—Gate FPGA which, in addition to driving the I/O signals on the 62–position connector, also coordinates the PCI traffic. These chips are SRAM—based, meaning that they are configured at run time. This allows the FPGA code to be automatically upgraded during each RVP8 code release without needing to physically reprogram any parts.

The board's basic I/O services use up only 40% of the complete FPGA. The leftover space makes it possible to add smart processing right on the I/O–62 board to handle custom needs. Some examples include generating custom serial formats, data debouncing, and signal transition detection. In general, I/O functions that would either be tedious or inappropriate for the host computer SBC can likely be moved onto the I/O–62 card itself.

The following two pages summarize the electrical characteristics of the I/O for both the the I/O–62 and the connector panel.

2.1.3 System Network Architecture Options

The RCP8 provides considerable flexibility for network operation. This allows remote control and monitoring of the system from virtually anywhere on the network, subject to the user's particular security restrictions.

There are three basic types of workstations/computers to consider:

- **RCP8** itself– this can be equipped with a local keyboard, mouse and monitor.

- **Host Computer Radar Control Workstation (RCW)–** this is running the user's application software (e.g., the Vaisala, Inc. IRIS/ Radar™ software and utilities).
- **Remote Workstation–** a networked workstation used for remote control and monitoring. This may be running only X—Windows or additionally the user's application software or the IRIS application software.

The RCP8 provides two types of physical interfaces:

- **RS232C serial line interface–** typically running at 9600 baud.
- **Ethernet socket interface–** at 10/100/1000 BaseT. The Vaisala AntExport software provides a socket interface to other workstations on the network.
- **Native connection–** here the RCP8 is used to run application software locally. The local connection is via a FIFO interface.

Combining the different types of workstations and the physical interfaces, Vaisala supports three different ways of connecting the RCP8 to a network:

- **Case 1: Standard Serial Line–** the connection. between the RCP8 and the Host RCW.
- **Case 2: Combined RCP8/RCW–** To eliminate the need for a separate host computer, the RCP8 and RCW can be run on the same computer. Note that Vaisala can only guarantee the performance of this configuration if the RCW is running the Vaisala IRIS software. However, user's are free to run their own application software directly on the RCP8.
- **Case 3: TCPIP Socket–** Ethernet connection between the RCP8 and the Host RCW. (Support is pending for this feature)

These three cases are discussed in the following sections.

2.1.4 Case 1: Standard Serial Line Interface

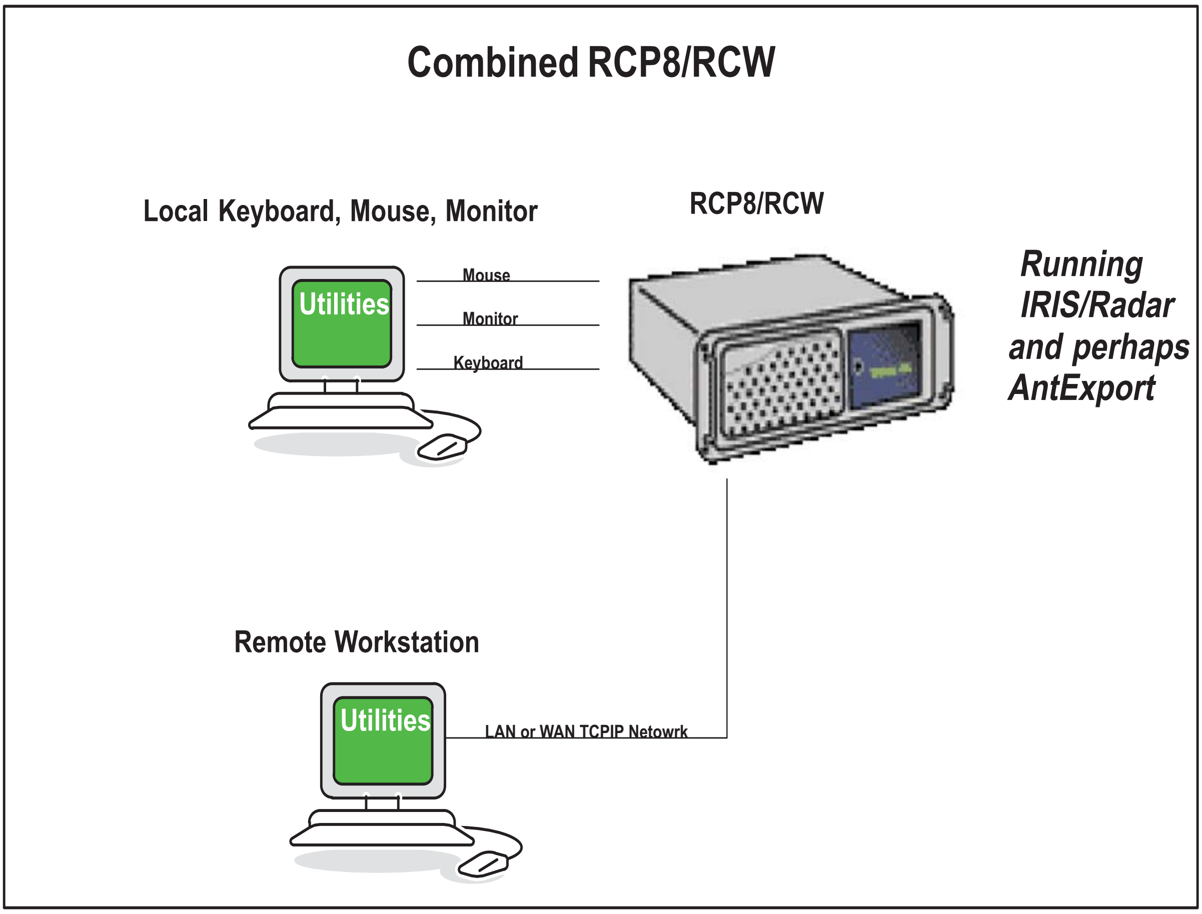


Figure 3 Network Architecture– Case 1: Standard Serial Interface

This architecture is used for most applications. Note that this is the identical architecture used for the previous generation RCP02. The access by the remote computer assumes that there is sufficient band–with to export an X—Window from the RCW. This typically requires at least 128 KBit/sec. Note that satellite links may have this band width, but their latency will lead to slow X—Window export. In this case, it is better to use the Case 3: Hybrid Serial/Socket approach.

2.1.5 Case 2: Combined RCP8/RCW

Figure 4 Network Architecture– Case 2: Combined RCP8/RCW

Because of the speed of modern computers, the RCP8 and IRIS/Radar software can be run on the same machine. In this case, access from a remote workstation is done by X—Window export. In the case of a slow link to the Remote Workstation, AntExport can be run on the RCP8/RCW to service a low–speed connection to a remote workstation.

2.1.6 Case 3: Socket Interface Using AntExport

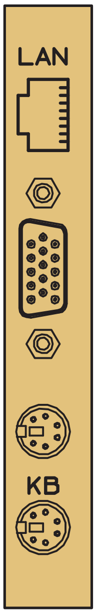


Figure 5 Network Architecture– Case 3: Socket with AntExport

In this architecture the RCP8 runs AntExport to provide a socket connection between the RCP8 and the Host computer. Note that any computer on the network can, in theory, function as a direct controller of the RCP8.

2.2 RCP8 Specifications

2.2.1 Antenna Control I/O and Features

- **Approach:** Digital position and velocity servos with interactive software parameter tuning.
- **AZ/EL Position Input:** TTL 16–bit binary angle, 14–bit BCD or 90V 60Hz synchro (nominal).
- **AZ/EL Position Output:** TTL 16–bit binary angle.
- **AZ/EL Tachometer Input (if available):** ± 70V signed analog input voltage.
- **Servo drive error:** ± 10V analog output to AZ/EL servo amplifiers
- **Servo Control/Status:** On/Off control via TTL or switch closure output. On/Off status via wide range input.

- **Antenna:** Local mode switch input, switch closure or TTL.
- **Alternate Control Relay Signal:** 12V output to external relays to switch to alternate control such as handwheels when the antenna is in local mode or shutdown state.

2.2.2 Fail–safe Antenna Protection Features

- **Elevation Soft Limits:** Automatic software override brings antenna to a gentle stop at the specified limits.
- **Elevation Shutdown Limits:** Antenna is placed in shutdown state if the upper or lower limit is exceeded.
- **Elevation Limit Switch Inputs:** EL Hi/Low TTL or switch closure. Antenna is placed in a shutdown state if a limit switch is encountered.
- **Tachometer Check Watchdog:** The calibrated tachometer is compared to the differenced position for consistency. Shutdown is invoked if the check fails. Protects against loss of tach or position sensors.
- **Antenna Response Watchdog:** Based on an internal model of the antenna inertia and damping moments, the response of the antenna to drive output requests is checked for consistency. Shutdown is invoked if the check fails. This protects the antenna from a jammed or broken gear, or if equipment such as a scaffold is inadvertently hit by the antenna.
- **Antenna Maximum Speed Watchdog:** Shutdown is invoked if the specified maximum speed of the antenna is exceeded.
- **Antenna Max Acceleration Limit:** Based on the internal antenna model, this check limits the drive output to stay within a specified acceleration limit.

2.2.3 Optional Shipboard Stabilization

- **Approach:** Stabilization algorithms scan the antenna in earth coordinates using AZ and EL velocity and position servos that are adjusted for the pitch, roll and heading (and rates of change) of the platform.
- **Platform Motion Sensor Input:** Pitch, roll heading and rates and absolute platform position and velocity from inertial navigation system such as the Honeywell MAPS system on SDLC serial line or Seatex, Inc. Seapath 200 system on RS232C serial line. GPS update and at–sea alignment are highly recommended for any INU system.

- **Range of Operation:** Typical 0 to 65ºelevation (earth relative) for up to 15º of attitude change. **Note:** Antenna pedestal should be capable of ~ -20º of elevation.
- **Typical Performance:** 0.1º of accuracy for elevation angles in the range 0 to 65º for inclinations, up 15º over 10 second periods. Exact performance depends on servo drive performance.
- **Built–in Display Features:** Selectable earth or pedestal relative AZ/EL position and/or velocity.

2.2.4 Radar Status/Control I/O and Features

- **I/O Configuration:** The softplane.conf file is used to configure the I/O pin assignments to the Connector Panel. This virtually eliminates the need for jumpers and custom wiring typical of legacy systems.
- **Standard Status Wide Range Inputs:** Servo Power, Antenna Local Mode, Lower and Upper EL Limit switches, T/R power, T/R Local Mode, Radiate Standby, Radiate on, Magnetron Current, Wave Guide Pressure, Airflow, Interlock, external Reset input signal, Trigger Blanking input signal and pulse width (up to four coded in two bits).
- **Standard Control Outputs:** These are wide range inputs or switch closures to ground. Standard parameters are Servo power, T/R power On/Off, Radiate On/Off (TTL or switch closure), Cabinet Relay, Trigger Blanking, equipment Reset signal, and pulse width (up to four bits).
- **BITE I/O:** Up to 60 TTL lines configurable in groups of 10 to be either input or output lines. These are used for BITE/IO. Note that 100 additional lines can be added by adding a second I/O-62 card.
- **Programmable Control Logics:** User programmable status/control logic actions in a flexible C–like programming interface. For example, if the antenna radome is opened, the system can automatically sound an alarm for a programmable time and immediately de–radiate and stop the antenna.

2.2.5 Application Software for Test/Monitoring

- **antenna Utility:** For control and monitoring of the antenna and standard status and control parameters. Includes sun tracking feature for antenna alignment check.

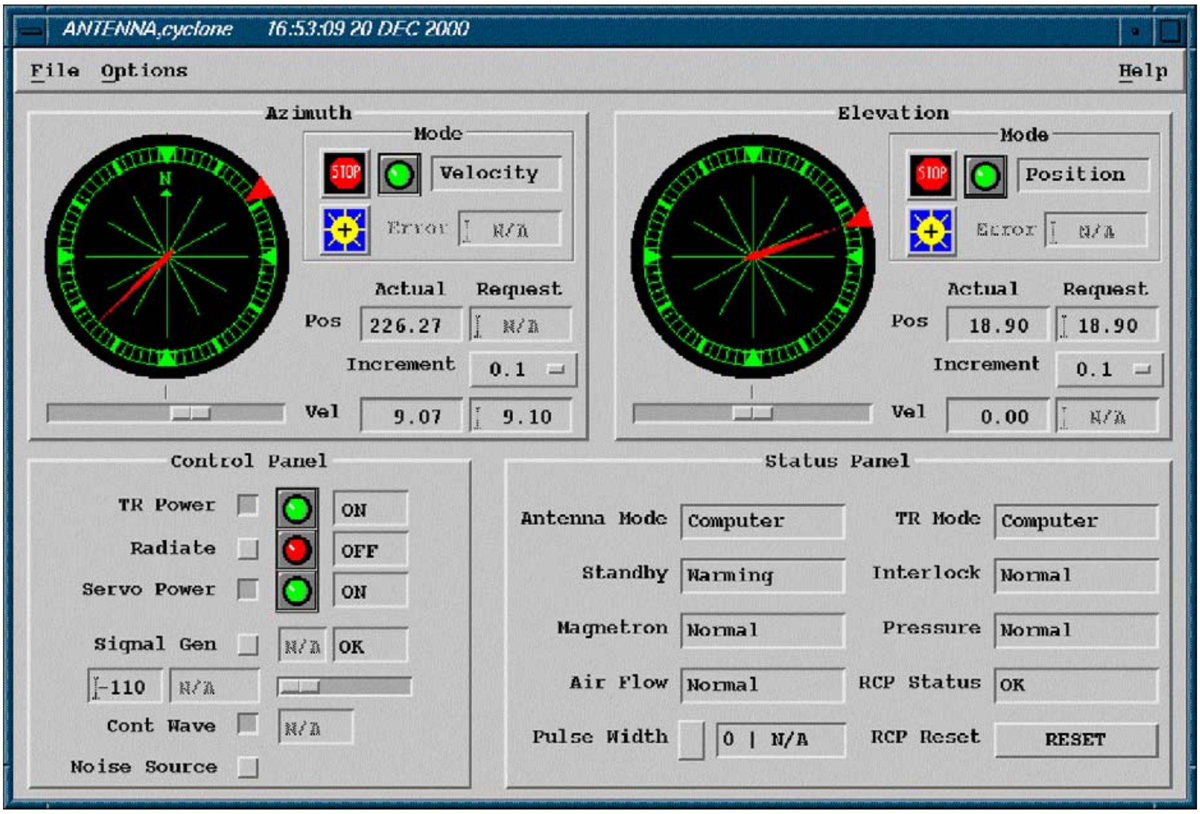
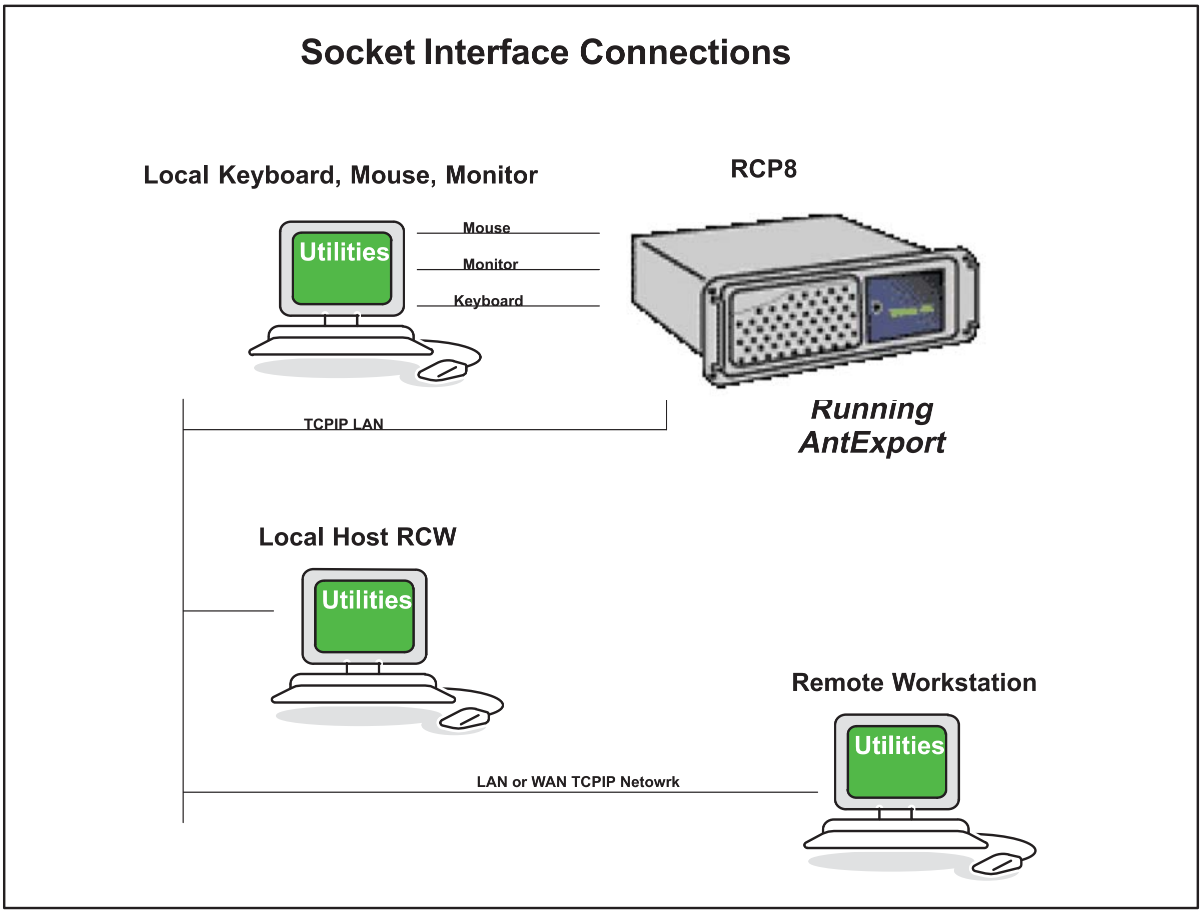


Figure 6 Antenna and Bitex utility examples Bitex utility, introduction

- **bitex BITE Examiner Utility:** For status monitoring and control of BITE (built-in test equipment). Graphical backgrounds and control/ status widgets can be customized by the user, including quantitative BITE from analog inputs.



2.2.6 Vaisala I/O-62 PCI Card

- Short format PCI card with 62-position D connector. Multiple cards may be installed.
- Includes D/A, A/D, discrete inputs and outputs (TTL, wide range, RS422, etc.) See summary table below.
- Expandable I/O allows the addition of a second I/O-62 and Connector Panel.
- I/O pin assignment mapping by **softplane.conf** file allows easy reconfiguration of the pin assignments without need for custom wiring.

- ESD protection using Tranzorb™ silicon avalanche diode surge suppression and high-voltage tolerant components.

	Vaisala I/O-62 Summary of Electrical Interfaces
Qty	**Description**
40	Lines configurable in groups of 8 to be either inputs or outputs. The electrical specifications are software defined within each group as follows: - Single-ended TTL input or output with software–configured pull-up or pull-down resistors for inputs. - Wide range inputs (±27VDC, threshold +2.5VDC), often used for lamp voltage status inputs. - RS-422/485 @ 10 MBit/sec (requires two lines each). RS-422 receivers can be configured in software to have 100-Ohm termination between each pair.
8	A/D convertors configurable as 0, 4, or 8 convertors, ±2V, 12 bits @ 10 MHz, These lines are shared with some of the 40 I/O lines listed above.
2	D/A convertors, ±10V 1 MHz update rate, output can drive a 75-Ohm load.
2	SPDT relays on the board. These are often used for switching high power relays. Contacts are diode protected.
2	RS-232C full duplex lines (Tx and Rx)
4	12V 75-Ohm trigger drivers.
2	Power/Ground pairs of 12V power (filtered, fused) for external equipment or remote backpanel use (up to 24 W total). Polyfuse technology acts like a circuit breaker with auto reset in the event of an overload.
8	Ground wires for signal grounds from the remote back panel.

2.2.7 RCP8 Standard Connector Panel

- Mounts on front or rear of standard 19 EIA rack and connects to I/O-62 via 1:1 62-pin 1.8-m cable (provided).
- 3 internal relays and 4 12V relay control signals for switching external devices.
- Programmable pin assignments made in **softplane.conf**.

- Diagnostic power supply and self test LED's for troubleshooting.

RVP8 Connector Panel Summary			
J-ID	**Label**	**Type**	**Description**
J1	AZ INPUT	DBF25	Up to 16–bits of parallel TTL binary or BCD angle
J2	AZ OUTPUT	DBF25	Up to 16–bits of parallel TTL binary angle in earth coordinates.
J3	CONTROL	DBF25	16 assignable digital control/status lines and two RS422 differential lines. Default control assignments are Pulse Width (2 bits) Radiate On, Radiate Off, Reset. Default status assignments are Pulse Width (2 bits), Radiate, Servo Power, Transmit Power, Reset.
J4	EL INPUT	DBF25	Up to 16–bits of parallel TTL binary or BCD angle
J5	EL OUTPUT	DBF25	Up to 16–bits of parallel TTL binary angle in earth coordinates.
J6	RELAY	DBF25	3 internal relays, contact rating 0.5 A continuous. The switching load is 0.25 A and 100V, with the additional constraint that the total power not exceed 4VA. 4, 12V relay control signals, up to 200mA. (Note that external relays should be equipped with proper diode protection to shunt the back EMF).
J7	BITE 19:0	DBF25	20 additional TTL I/O lines each configurable to be input or output. Used for BITE Status and Control
J8	ANALOG IN	DBF25	10 differential analog inputs, up to ±20V max multiplexed into A/D convertor sampling each at >1000 Hz.

RVP8 Connector Panel Summary			
J-ID	**Label**	**Type**	**Description**
J9	PED/STATUS	DBF25	AZ/EL Tachometer Differential inputs (±2 to 70 VDC) and AZ/ EL Drive outputs (±10 VDC). Additional status inputs: Wave Guide Pressure, Airflow, Interlock, Mag Current, Local Mode, Standby, El Upper and Lower Limit Switches.
J10	SERIAL	DBF9	RS232C
J11	SERIAL	DBF9	RS232C
J12	S–D	Modular	3 x 4 matrix connector for AZ and EL synchro and reference inputs (nominally 90V and 60 Hz).
J13	TP1	BNC	Programmable scope test point. 75 Ohms
J14/15	SPARE	BNC	
J16	TP2	BNC	Programmable scope test point. 75 Ohms
J17/18	SPARE	BNC	

2.2.8 Physical and Environmental Characteristics

Packaging

- Motherboard Configuration 4U rackmount with 6 PCI slots
- Single Board Computer Configuration 4U rackmount with 14 PCI slots
- Dimensions of standard 4U chassis

  43.2 wide x 43.2 long x 17.8 cm high

  17 wide x 17 long x 7.00 inch high
- Redundant Power Supplies. Three hot–swap modules with audio failure alarm.

Input Power

- Main Chassis 60/50 Hz 115/230 VAC Manual switches for voltage selection.

Power Consumption

- Standard RCP8 120 Watts

Environmental

- Temperature 0C (32F) to 50C (122F)
- Humidity 0 to 95% non–condensing

Reliability

- MTBF>50,000 hours (based on actual RCP02 field data).

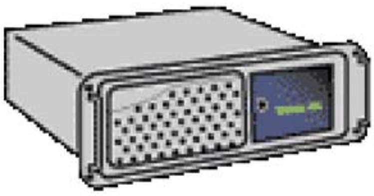
CHAPTER 3

HARDWARE INSTALLATION

In this chapter:

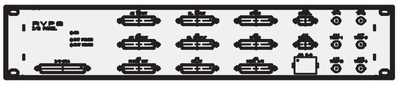
3.1 Overview and Input Power Requirements

This section describes how to install the RCP8 hardware. Topics include mechanical installation and siting, electrical specifications of the interface signals, system-level considerations and the standard connector panel that is provided. There are three major modules supplied with the RCP8. These are:



Main Chassis Usually mounted in 19 EIA rack.

Input Power 60/50 Hz 115/230 VAC Manual Switches



I/O-62 Connector Panel

Usually mounted in 19 EIA rack within 1 m of Main Chassis

Much of the RCP8 I/O is configured via software. This makes the unit very flexible. Also, since there is virtually no custom wiring, it is very easy to insert spare modules and circuit cards. The software configuration of the I/O is described in the softplane section of the *Software Installation Manual*. This section, in conjunction with Appendix C, RVP8/RCP8 Packaging, on page 179, describes the physical installation of the hardware.

WARNING The Main Chassis redundant power supplies are NOT auto-ranging like the IFD. These are factory configured for the expected voltage, but should be VERIFIED by the customer before power is applied to the system.

3.2 Initial Power–Up Prior to Connecting to Radar

WARNING The RCP8 initial power-up should be done with no connections to the radar to avoid possible damage to the antenna system before it has been configured with the various safety parameters.

The very first time that the RCP8 is powered–up, caution must be exercised to assure that no damage is done to the antenna system. The reason for this is that the RCP8 needs to go through an antenna stabilization procedure as described in Appendix B, Antenna Stabilization Procedure, on page 175 before the fail-safe features can be activated.

The initial power-up procedure is as follows:

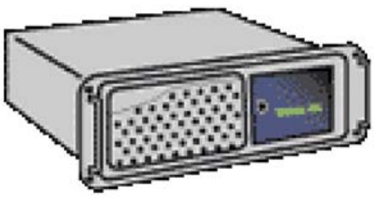
- Verify that the input line power to the RCP8 is correct as described in C.1.3 Main Chassis Back Panel Power Section on page 187.
- Install the RCP8 in its rack on the slides provided by Vaisala per 3.3.2 Power Requirements, Size and Physical Mounting on page 36.
- Install the Connector Panel in the rack and cable it to the I/O-62 card in the RCP8 using the 1.8 m (6 foot) cable provided by Vaisala per 3.4 RCP8 Connector Panel on page 38.

- mouse and monitor per 3.3.3 Main Chassis Direct Connections on page 37. These shall be used for local diagnostic and configuration work. They can be disconnected after the installation is completed.
- Disconnect *ALL* I/O from the connector panel for the initial power–up. The various connectors will be installed later, one-at-a-time, and then configured and tested using the procedure described in Appendix B, Antenna Stabilization Procedure, on page 175.
- Turn on the monitor.
- Push the power–on button on the lower right of the front panel.

When the RCP8 is powered-up, the Linux operating system will boot-up and the RCP8 software process will start automatically, first running a set of diagnostic self-tests.. The progress of the boot can be monitored on the local display. The front panel display will show the final results of the diagnostics with Status:OK and a moving arrow that indicates that the RCP8 is happily running.

At this point you you should prepare, but not connect the various cables described in the following sections, then you are ready to go through the alignment procedure described in Appendix B, Antenna Stabilization Procedure, on page 175. You should first review the various TTY control and monitoring commands in Chapter 4, TTY Menu Control and Monitoring, on page 45 setup commands described in Chapter 5, TTY Setup Menus, on page 61 since these will be used extensively in the alignment procedure.

3.3 RCP8 Chassis



3.3.1 RCP8 Chassis Overview

The RCP8 main chassis can assume a variety of forms depending on the customer requirements. Appendix C, RVP8/RCP8 Packaging, on page 179 describes a standard Vaisala system. A typical unit supplied by Vaisala contains at least the following:

- A dual CPU on either motherboard or SBC in a passive PCI backplane

- I/O-62 Card and Connector Panel

Note that additional I/O-62 cards and Connector Panels can be added to expand the I/O capabilities of the system, along with standard PCI cards.

The system is also shipped with an integrated hard disk drive (HDD), 1.44 MB floppy (FDD) and CDRW unit. There is an LED display panel on the front of the chassis that is used to report system status and display AZ and EL angle information. Redundant hot swap power supply modules are used.

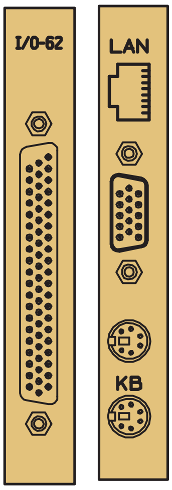
3.3.2 Power Requirements, Size and Physical Mounting

WARNING	WARNING: The Main Chassis redundant power supplies are NOT auto-ranging like the IFD. These are factory configured for the expected voltage, but should be VERIFIED by the customer before power is applied to the system.

There a three redundant power supplies

The standard Vaisala chassis is a 19 EIA 4U rackmount unit, 17 (43 cm) deep. The chassis is usually mounted in an equipment rack on rack slides (provided as standard). The Connector Panel is usually mounted on either the front or the rear of the same rack. The standard cable provided to connect the I/O-62 card in the main chassis to the connector panel is 6 feet long (1.8 m).

3.3.3 Main Chassis Direct Connections



The direct connections to the RCP8 chassis are made either to the back of the unit to PCI cards (e.g., left) or to the remote connector panel. The direct connections are summarized in the table below.

Note that the appearance of the system is different depending on whether an SBC or motherboard is used. The card at the right shows the typical appearance of the SBC version. C.1.4 Main Chassis Back Panel PC I/O Section on page 188 shows the typical appearance of the motherboard version

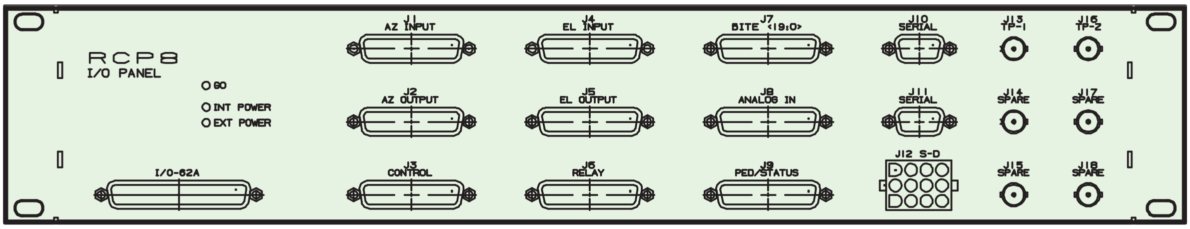
Table 1 Direct Connections to RCP8 Main Chassis

IFD I/O Summary		
Connector Label	**Style**	**Description**
SBC or Motherboard Connections		
Network	**RJ-45**	**10/100/1000 BaseT TCP/IP**
Keyboard	**PS/2**	**Standard PC Keyboard**
Mouse	**PS/2**	**Standard PC Mouse**
Monitor	**VGA**	**Standard PC Video Monitor**
Serial	**DBM9**	**Standard COM1 and COM2 connections are available on most systems. COM1 is typically used for connection to an external host computer. The default baud rate is 9600.**
I/O-62 Connections		

Table 1 Direct Connections to RCP8 Main Chassis (Continued)

IFD I/O Summary		
Connector Label	**Style**	**Description**
<no label>	DB-62F	Vaisala-supplied cable to IO62/CP remote panel

3.4 RCP8 Connector Panel



Most of the connections between the radar and the RCP8 are made using the RCP8 Connector Panel which connects to the I/O-62 by 1.8m (6 foot) cable. The panel is usually mounted on the front or the back of the same 19 EIA rack that contains the RCP8 chassis. The I/O-62 cable may be plugged into either the front or the back of the connector panel to optimize the cable run.

The Connector Panel uses a DC–DC converter to convert 12V unregulated input from the PCI card into regulated +5V, +3.3V, and ±12V to run the main electronics on the panel. The LEDs on the panel are described below:

- **EXT LED** indicates that the 12V input power is present
- **INT LED** indicates that +3.3V is present
- **GO LED** indicates that the panel is properly communicating with the PCI card. It will blink slowly when communication is absent and very rapidly during the BRIEF times that the backpanel firmware are being updated with an rdaflash command. It will be solid when the panel is being used by the RCP8 software.

The pin assignments to the panel are actually configured in software using the **softplane.conf** file. The labels reflect the default settings for the **softplane.conf** file which is described in the *Software Installation Manual*. The discussion in this section describes the default configuration as well as how the connector pin assignments can be re–mapped to serve other functions.

The specification table in 2.2.7 RCP8 Standard Connector Panel on page 28 provides a summary of the I/O for each connector. Detailed pin–out assignments for the default configuration are given in C.2 I/O-62 and Connector Panel on page 192. Descriptions of the various signals are provided below.

J1 & J4- AZ/EL Input: TTL parallel angles

This connector has 20 digital inputs or outputs. In the default **softplane.conf** file it is configured for input of 16–bit binary or 16–bit BCD angles. Whenever antenna angle data are required, the RCP8 reads the azimuth lines up to ten times in a row (spaced by 0.5 µsec) until two successive values compare as equal. This de-bouncing is done so that unsynchronized input data will be latched in a valid state. If after ten retries, the lines were never observed in a consistent state, then the last observed state is used. Sampling for elevation is identical.

If fewer than 16 bits are used for the binary angles, then the high order bits should be connected (LSB on pin 1). If a wiring error is made, it is fairly simple to correct it in the **softplane.conf** file (e.g., LSB and MSB reversed).

The BCD format is as follows.

- 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 -0.1º must be input as 359.9º.

J2 & J5- AZ/EL Output: TTL parallel angles Angle: TTL output

This connector has 20 digital inputs or outputs. In the default **softplane.conf** file it is configured for output of a 16–bit TTL binary angle. Detailed pin assignments are given in C.2 I/O-62 and Connector Panel on page 192 This feature could output the parallel angles to a signal processor such as the RVP7 or RVP8.

J3- Control:

16 lines can be used as differential RS422 or as single–ended TTL input or output. In the default **softplane.conf** file it is configured for various

standard Status and Control I/O. Configuration can be made in groups of 4 with regard to RS422 vs Single–ended, I/O sense and input termination of single–ended lines. See the pin assignments in Appendix B, Antenna Stabilization Procedure, on page 175 for details.

J6-RELAY: Control for external equipment

Note that the default **softplane.conf** file makes no assignments to this connector. Often, external equipment in the radar will require relay control (e.g., power on, radiate on, environmental systems, reset lines, slow polarization switch). This connector has connections for 3 internal relays that are on the connector panel itself. The maximum current through the relay contacts is 0.5 A continuous. The switching load is 0.25 A and 100V, with the additional constraint that the total power not exceed 4VA.

If larger current and voltage loads are required, then the connector panel relays can be used to switch external relays provided by the customer. Another alternative to power external relays is to use the additional 4, 12V relay signals (up to 200mA) that are also supported on this connector.

WARNING	Hazard: External relays must be equipped with proper diode protection against back-EMF or damage to the I/O-62 and or the connector panel might result.

J7 BITE: Configurable 20 lines of TTL I/O

This connector supports 20 lines of TTL each of which can be configured as either input or output. The default softplane.conf file configures these to be inputs. The inputs are multiplexed into the BITE message to the host computer and can be used internally by the RCP8 in control logic equations.

J8 SPARE: Analog Inputs

Note that the default **softplane.conf** file makes no assignments to this connector. Ten differential analog inputs, up to ±20V max multiplexed into a single A/D convertor sampling each at >1000 Hz. This can be used for monitoring environmental systems at the radar site. Results are put into the Q–BITE (quantitative BITE) message to the host computer. In addition, the RCP8 can threshold the Q–BITE numerical values and use the logical results in control logic equations.

J9- PED/STATUS: RS422 I/O, D/A and A/D

14/7 additional I/O-62 digital lines, 2 each dedicated (non–multiplexed) A/D inputs (±70 V with pot adjust) and D/A outputs (±10V). For the digital lines, configuration can be made in groups of 4 with regard to RS422 vs single-ended, I/O sense and input termination of single-ended lines. In the default **softplane.conf** file, this connector is configured for the differential AZ/EL tachometer inputs, AZ/EL drive outputs and several status variables.

J10-11: RS232C I/O

In the default **softplane.conf** file, these are not used. The two connectors can be used for serial angle input. The most common format is the RCV01 format (see A.1 Serial Data Format on page 149), although custom formats from antenna/pedestal manufacturers such as Orbit, Andrew and Scientific Atlanta can also be supported. Note that J11 also has +12 V, -12 V and +5 V regulated power supply outputs for external equipment.

J12: S-D- AZ and EL synchro input

For systems that have AZ/EL synchro position sensors, the RCP8 can accept direct synchro inputs. The nominal voltage and frequency are 90V @ 60 Hz. S/D conversion is performed in the I/O-62.

J13,J16: TP1 & TP2- Programmable test point scope outputs

The default **softplane.conf** file makes no assignments to the test points and other BNC connectors.

An exciting feature of the RCP8 is the programmable test points. These are usually used to connect to an oscilloscope. The user can then specify what is output to the test points in the form of an analog voltage for display on the scope. This can be useful for example to observe the results of logic equations.

The advantage of using the test points is that technicians can leave them permanently connected to a rackmount oscilloscope and then select what is displayed. This saves time and reduces cabling errors when switching test cables.

J14, J15, J17, J18: SPARE- spare BNC connections

The default **softplane.conf** file makes no assignments to the test points and other BNC connectors.

3.5 Host Computer Serial Interface

The RCP8 typically connects to a host computer via the COM1 RS232C serial line. The default baud rate is 9600. The connector on the RCP8 is located on the main chassis. On some systems, a null modem may be required to connect to the host computer. On most systems, this is referred to as /dev/ttyS0.

The serial line protocol is documented in A.1 Serial Data Format on page 149. It supports the following:

- Standard status packets from the RCP8 to the host computer (e.g., antenna angles and angular speed for AZ and EL, Interlock, Local Mode Switch, etc.). Several formats are supported. The antenna utility on the host computer provides the user interface for display and testing.
- Standard control packets from the host to the RCP8 (e.g., position and velocity servo requests, Radiate On, etc.). Several formats are supported. The antenna utility on the host computer provides the user interface for display and testing.
- Arbitrary BITE packets from the RCP8 to the host based on the auxiliary status input bits. The bitex utility on the host computer provides the user interface for display and testing.
- Arbitrary Control Packets from the host to the RCP8 to set the auxiliary control output bits. The bitex utility on the host computer provides the user interface for display and testing.
- Q-BITE packets from the RCP8 to the host computer. The bitex utility on the host computer provides the user interface for display and testing.

3.6 Socket Interface

The RCP8 can be configured to listen on a network port. It does this via a program called **AntExport**. It is also ready to run some commands on the RCP8 itself. The RCP8 comes with some built–in Vaisala supplied utilities such as **setup, antenna** and **bitex**. These utilities are described in the *IRIS Utilities Manual*.

How AntExport Works

AntExport is a daemon program which can be configured to run all the time. When it receives a socket connection request it will establish a bi-direction connection to the RCP8. The remote client is normally another computer running the Vaisala antenna library. This remote library contains internal state storing current information about the antenna. This state will be slaved to the RCP8 state. To see if it is running on your RCP8, try typing

```
$ ps –aef | grep DspExport
```

During development, it can always be started up manually by typing AntExport at a shell prompt. It can be started with the –v option for move detailed logging. It defaults to using port 30745. If you wish to use another port, start it with an option such as –port:12345. The command line option –help lists these options.

Source Examples

The source code for **AntExport** and for the antenna library is supplied on the RCP8 release cdrom. This can be optionally installed as part of the upgrade procedure as discussed in the *Software Installation Manual*. You will find **AntExport** in ${IRIS_ROOT}utils/antenna, and you will find the antenna library in ${IRIS_ROOT}libs/antenna. In the library, you will find example code which talks to **AntExport** in file ant_iosubs.c, ant_rcv.c and iant_pwrp.c. Search for the string SOCKET.

Socket protocol

The socket interface basically transmits to the remote system all commands changing state on the local system. These are all in the form of a sync character, followed by a single byte count, followed by an ASCII command.

CHAPTER 4
TTY MENU CONTROL AND MONITORING

The TTY menus cover two important features of the RCP8:

- **System configuration-** discussed in Chapter 5, TTY Setup Menus, on page 61.
- **Local control and monitoring-** discussed in this section.

The initial test and configuration of the RCP8 is made using the TTY menus on the local keyboard, mouse and monitor. These menus can also be accessed remotely over the network.

In this chapter:

4.1 Starting the TTY Menus

There are different ways to start the TTY menus, depending on your hardware configuration.

```
$ rcp8 –int
```

To start the menus :

```
$ antx
```

This special mode is supported by the Vaisala IRIS software and uses spare bandwidth, on the existing host computer serial or network interface, to allow the user to converse with the RCP8 from an XTERM window. After the initial stabilization and setup, this is the preferred method of using the TTY menus since the "chat" mode can be started up remotely and does not require additional hardware or cabling.

In either case, hitting "Enter" will get you to the RCP8 TTY menu prompt:

RCP>

4.2 The TTY Main Menu

The Main menu represents the top level of communication between the RCP8 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 RCP8, as described in Chapter 5, TTY Setup Menus, on page 61. The remainder of this section describes the control and monitoring features, i.e., the following commands:

- `Help <Support><Listall><View>`
- `Monitor <Ang><INU><SIO><Sta><Con>`

These provide access to the monitoring and local control functions of the RCP8.

4.3 The TTY Help Menu

4.3.1 TTY Help Support Command

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

```
RCP> help support
Vaisala Technical Support Avenues
--------------------------------
  E–Mail: helpdesk@vaisala.com
 US–Mail: 7A Lyberty Way, Westford, MA 01886 USA
Internet: www.vaisala.com
   Phone: (978) 692–9234 (Monday–Friday, 9am–5pm EST)
     FAX: (978) 692–9575 (All hours)
```

4.3.2 TTY Help View Command

This version of "HELP" is used to view internal status and configuration that is not easily visible from other RCP8 commands.

```
RCP> help view
Board Configuration and Status
------------------------------
RCP8 Radar Control Processor V11.6 IRIS–8.11.6P2
  Settings were last saved using V11.6
  RCP8 started at: 11:57:30 13 FEB 2008
  Current time is: 11:57:46 13 FEB 2008

Physical hardware inventory:
  Found PCI Card I/O–62 – Rev.B:1 Serial:2273 Code:30 (/dev/
rda/io62–0)
  \--> IO62CP Backpanel – Rev.B:1 Serial:2019 Code:4
      ( Supply Currents – Panel: 918 mA, Relays: –8 mA )

Parallel execution threads:
  CS–Tick – PID:3830 Priority:12 Policy:RealTimeRR
```

```
    Servos – PID:3830 Priority:12 Policy:RealTimeRR
  Watchdog – PID:3830 Priority:11 Policy:RealTimeRR
  Host–RCV – PID:3830 Priority:11 Policy:RealTimeRR
  Host–XMT – PID:3830 Priority:11 Policy:RealTimeRR
  Host–NET – PID:3830 Priority:11 Policy:RealTimeRR

Shared library build dates:
  RCP8/Core: Tue Feb 12 16:39:52 EST 2008
  RCP8/Open: Tue Feb 12 16:39:55 EST 2008
  RCP8/Site: Sat Feb 9 12:59:15 EST 2008

AZ Axis – Pos: 0.00 Off: –0.00 Vel: 0.0
EL Axis – Pos: 0.00 Off: –0.00 Vel: 0.0
```

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.
- An inventory of all of the PCI cards that are being used.
- A list of all the threads currently running.
- 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.

4.4 The TTY MONITOR Command

The "MONITOR" command provides a live display of changing parameters within the RCP8. 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.

4.4.1 TTY Antenna Monitor and Control

The RCP8 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 RCP8. 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	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 360º range. The Elevation (EL) position is signed and operates from -180 to +180º.

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. If there is no hardware tachometer then the position is differenced to obtain a virtual tachometer. Note that for the virtual tach, the internal dynamic antenna model is used for interpolation.

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.

4.4.1.1 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 RCP8 until a command that moves the antenna is typed on the TTY screen. The RCP8 will remain under the terminal's control until until the local monitor mode has been exited.

NOTE	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.

4.4.1.2 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).

4.4.1.3 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.

4.4.2 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 RCP8. 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.

4.4.2.1 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
```

4.4.2.2 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
```

4.4.3 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.

4.4.3.1 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.

4.4.4 TTY Status Line Monitor

This display provides a concise view of all of the status input lines that are sensed by the RCP8. 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 5.8.2 Logic Equation Control Qualifiers on page 118).

4.4.5 TTY Control Request Monitor

This display provides a concise view of all of the control functions that might be handled by the RCP8. 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 5.8.2 Logic Equation Control Qualifiers on page 118

```
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]

........ ........
```

4.4.6 TTY Internal LOG Monitor

This display allows you to view the RCP8'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:

```
RCP8 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 RCP8 was booted), and the type of entry. One or more additional lines will follow with the specific data for this type of log entry.

4.4.7 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
```

4.5 TTY RESET Command

The RCP8 continually performs antenna consistency checks to guard against faults that might damage the mechanical system. Whenever such conditions are detected, the RCP8 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 (e.g., "reset" in the antenna utility, or
- type the local TTY command "reset."

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

WARNING	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 RCP8 will only shut down when it has control of the antenna. When the external LOCAL status input forces the RCP8 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 RCP8, 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 RCP8 is shutdown at the time the command is received. This allows the command to be used when attempting to exit from stuck conditions; including those times when the RCP8 has not actually shutdown.

NOTE	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 RCP8 continues running smoothly. In some cases, however, the RCP8 may require a more drastic restart in this case, Vaisala recommends that you reboot the system. Alternatively the following commands can be used:

CHAPTER 5
TTY SETUP MENUS

This section describes how to configure the RCP8 software parameters to match the particular specifications of each radar site. These parameters are stored on the hard disk drive in a file called /usr/sigmet/config/rcp8.conf. This ASCII file is convenient for backup and restore. For diagnostic work and trouble shooting, Vaisala may request that a copy of this file be emailed to us.

This section serves as a general reference for the Antenna Stabilization Procedure described in Appendix B, Antenna Stabilization Procedure, on page 175. Note that Vaisala recommends that only trained personnel be permitted to perform antenna stabilization. Training should include basic knowledge of the theory of servo operation (Chapter 6, Theory of Servo Operation, on page 135) as well as the procedures for using the RCP8 TTY menus (this Chapter). Vaisala offers training to those customers who wish to perform antenna stabilization.

WARNING	Disclaimer: In no event shall Vaisala be liable for any damage to the antenna/pedestal system that may occur during stabilization configuration performed by the customer.

In this chapter:

5.1 Using the SETUP Menus

The configuration parameters are setup in an interactive fashion with the use of the TTY. To change a parameter setting, refer to the summary dialogs on the following pages to determine the general category in which the parameter appears. Then, choose that category from the Main Menu. Additional information and prompts will be typed as appropriate. The parameter values will be displayed for each category and the RCP8 will pause for the input.

For each question, the parameter values are displayed then paused to allow the user to respond:

- If the current value is correct, press ENTER.
- If a new value is required, enter the new value. Be careful to enter the numeric values in the proper physical units. For example, do not input the time in seconds if the question is expecting the time in minutes. The RCP8 will then display the expected units with each question.

  Once ENTER is pressed, the RCP8 echoes the new value to verify that it has been correctly entered. If the new value is correct, press ENTER again to proceed to the next parameter.
- Type "up" or "u", and the SETUP menu will return to the previous question.
- Type "quit" or "q" to exit a submenu and return to the top level "RCP>" prompt.

When all of the questions have been answered, or if the "QUIT" command is entered, the RCP8 will run the new values and return to the command prompt. The user may select another SETUP menu command or the user may run the RCP8 with its new settings to verify that the changes are correct. When you are satisfied with the changes, use the "SAVE" command to make the settings permanent.

NOTE	Note: The ESC key retains its general meaning and provides a single keystroke method of exiting the SETUP menus, as well as all other menu levels, within the RCP8.

5.2 Summary of Setup TTY Configuration Parameters

Below is a list of all configuration parameters and their factory default values.

"HELP VIEW" Command Summary Dialogs

```
(Help View) – Board Configuration and Status

--------------------------------------------

RCP8 Radar Control Processor V12.4 IRIS–8.12.4A

Settings were last saved using V12.3

RCP8 started at: 16:56:22 24 JUN 2009

Current time is: 16:56:25 24 JUN 2009

No SIGMET PCI cards are being used

Parallel execution threads:

CSTick  PID:17643 Priority:12 Policy:RealTimeRR

Servos  PID:17643 Priority:12 Policy:RealTimeRR

Watchdog  PID:17643 Priority:11 Policy:RealTimeRR

HostRCV  PID:17643 Priority:11 Policy:RealTimeRR

HostXMT  PID:17643 Priority:11 Policy:RealTimeRR

HostNET  PID:17643 Priority:11 Policy:RealTimeRR

Shared library build dates:

RCP8/Core: Thu Jun 18 17:08:37 EDT 2009

RCP8/Open: Thu Jun 18 17:08:57 EDT 2009

RCP8/Site: Thu Jun 18 17:08:32 EDT 2009
```

```
AZ Axis – Pos: 0.00 Off: -30.00 Vel: 0.0

EL Axis – Pos: 0.00 Off: -0.00 Vel: 0.0
```

"SITE DISPLAY" Command Summary Dialogs

```
(Site Display) – Front Panel Display Setups

--------------------------------------------------

Available Front Panel Display Templates

TB )                --AZ-- --EL--      Title Bar
EP1)                123.45 Earth 23.46 AZ/EL Earth
                                       Positions
EP2)                123.45 Pos 23.46
EP3)                123.45 AZ/EL 23.46
PP )                123.45 Ped 23.46   AZ/EL Pedestal
                                       Positions
PV )                12.00 Ped.V 0.00   AZ/EL Pedestal
                                       Velocities
EV1)                12.00 Geo.V 0.00   AZ/EL Earth
                                       Velocities
EV2)                12.00 Vel 0.00
CMD)                12.00 V Cmd P 10.50AZ/EL Servo
                                       Commands
RTS)                Rad:On T/R:--      Radiate, T/R, and
                    Srv:On             Servo
HRP)                123.4H -12.3R 23.1PHeading, Roll,
                                       Pitch
LL )                148 24.5W 42 35.2N Longitude /
                                       Latitude
TM )                17:22:35 3–Feb–1996Time and Date
SS1)                Status:OK          Status
SS2)                Status:OK –<-->–
VAR)                0000 0000 0000 0000Local Variables
DRCP)               Di/-- Ok/Ok --/On  Dual/Redundant
                    Au                 State
Enc)                Encdr A:Ok E:Ok    Shaft Encoder cal
                                       status
XX )                                   Blank Line


Top display line template: XX

Bottom display line template: XX
```

```
Show hundredths digit in AZ position: NO

Show hundredths digit in EL position: YES

Show hundredths digit in AZ velocity: NO

Show hundredths digit in EL velocity: NO

Front panel display update time: 0.200 sec

User shutdown #1 text: 'User–Shutdown #1 '

User shutdown #2 text: 'User–Shutdown #2 '
```

"SITE HOST" Command Summary Dialogs

```
(Site Host) – Host Computer Setups

-----------------------------------------

Connection type for host computer I/O: Network

Multicast address : 224.0.0.3

Port number: 30785

Network interface : lo

Data format transmitted by host computer: XMT02

Dead–Host–Computer detection time: 5.0 sec

Data format received by host computer: RCV03

RCP8 transmission rate: 30.00 records/sec

Process incoming servo control packets: YES

RCP8 transmits Time–of–Day records: YES

Time between Time–of–Day records : 30 sec

RCP8 transmits internal BITE packets: YES

ID of internal BITE packets: 0x01

RCP8 transmits AUX status BITE packets: YES

Xmt ID of status BITE packets: 0x04

RCP8 receives AUX control BITE packets: YES
```

```
Rcv ID of control BITE packets: 0x03

RCP8 transmits analog voltage Q–BITE packets: YES

ID of analog voltage Q–BITE packets: 0x05

Simulate the incoming channel voltages: YES

Maximum signal generator power level: 0 dBm

Default user interface: Local–TTY
```

"SITE CUSTOM" Command Summary Dialogs

```
(Site Custom) – Customer–specific Setups

-----------------------------------------

Output serial TAG lines: NO

Use WSR–88D DCU Interface (Antenna/Pedestal): NO

Use WSR–88D DAU Interface (BITE/Status): NO

Use Kavouras TCU Interface (Radiate/BITE): NO

Use Andrew–Canada serial pedestal interface: NO

Use Applied Systems TWT Transmitter: NO

Use Orbit serial pedestal controller: NO

Use CAN–Bus serial control/status: NO

Use dehydrator connected in serial port: NO

Use klystron connected in serial port: NO

Use Power MOnitoring: NO

Use ARA ACU–3 Antenna: NO

Use TSC TWT Interface: NO

Use TDRS pedestal angle input: NO

Use TDRS pedestal control output: NO

Use Melco TKY01 Serial Q–Bite: NO

Use Dual/Redundant system configuration: NO
```

```
Generate trigger sector blanking output: NO

Enable Shaft Encoder Simulator: NO

Automatically calibrate Shaft Encoder: NO
```

"SITE MISC" Command Summary Dialogs

```
(Site Misc) – Miscellaneous Setups

-----------------------------------------

External reset 'unsafe' duration: 1.0 sec

Lower EL limit switch causes shutdown: NO

Upper EL limit switch causes shutdown: NO

Primary I/O-62 PCI card (-1:None) : -1

Reset all PCI cards on RCP8 shutdown: YES

Provide IRIS RPC network status server: NO

Pedestal has an auxiliary second antenna: NO

Echo error signals to the chat interface: YES
```

"STATUS" Command Summary Dialog

```
(Status) – Antenna/Transmitter/Receiver Status Input Lines

-----------------------------------------------------------
------

LOCAL input is enabled: NO

STANDBY input is enabled: NO

INTERLOCK input is enabled: NO

MAGNETRON–CURRENT input is enabled: NO

AIRFLOW input is enabled: NO

WAVE–GUIDE–PRESSURE input is enabled: NO

PULSE–WIDTH–0 input is enabled: NO

PULSE–WIDTH–1 input is enabled: NO
```

RADIATE input is enabled: NO

SERVO–POWER input is enabled: NO

LOWER–LIMIT–SWITCH input is enabled: NO

UPPER–LIMIT–SWITCH input is enabled: NO

T/R–POWER input is enabled: NO

T/R–LOCAL input is enabled: NO

IRIS–MODE–0 input is enabled: NO

IRIS–MODE–1 input is enabled: NO

IRIS–MODE–2 input is enabled: NO

SYSTEM–RESET input is enabled: NO

NOISEGEN–ON input is enabled: NO

SIGGEN–ON input is enabled: NO

SIGGEN–CW input is enabled: NO

SIGGEN–FAULT input is enabled: NO

SIGGEN–LEVEL input is enabled: NO

"CONTROL LINES" Command Summary Dialog

(Control Lines) – Antenna/Transmitter/Receiver Control Output Lines

----

RADIATE control protocol: Pulse

RADIATE On/Off pulse duration: 0.75 sec

"CONTROL LOGIC" Command Summary Dialog

(Control Logic) – Boolean Control Equations

Enable logic override of control lines: NO

```
EQ00: # Vert RX to Noise Source one second pulse

\--: t0_single_1 = c32

EQ01: c64 = t0_single_1

EQ02: # Vert RX to Antenna one second pulse

\--: t1_single_1 = !c32

EQ03: c65 = t1_single_1

EQ04: # Horz RX to Noise Source one second pulse

\--: t2_single_1 = c33

EQ05: c66 = t2_single_1

EQ06: # Horz RX to Antenna one second pulse

\--: t3_single_1 = !c33

EQ07: c67 = t3_single_1

EQ08: # Waveguide Switch to H+V one second pulse

\--: t4_single_1 = cPolSimul | cPolVert

EQ09: c68 = t4_single_1

EQ10: # Waveguide Switch to H only one second pulse

\--: t5_single_1 = cPolHoriz

EQ11: c69 = t5_single_1

EQ12: s10 = sTrigBlankSector

EQ13: sPolOkay = true

EQ14:
```

"CONTROL VARMISC" Command Summary Dialog

```
(Control VarMisc) – Miscellaneous Boolean Variables

----------------------------------------------------------

Timer #0          trigger mode:      Single
Timer #0          period/delay:      1.00 sec
```

```
Timer #1          trigger mode:     Single
Timer #1          period/delay:     1.00 sec
Timer #2          trigger mode:     Single
Timer #2          period/delay:     1.00 sec
Timer #3          trigger mode:     Single
Timer #3          period/delay:     1.00 sec
Timer #4          trigger mode:     Single
Timer #4          period/delay:     1.00 sec
Timer #5          trigger mode:     Single
Timer #5          period/delay:     1.00 sec
Timer #6          trigger mode:     Unused
Timer #7          trigger mode:     Unused
Timer #8          trigger mode:     Unused
Timer #9          trigger mode:     Unused
Timer #10         trigger mode:     Unused
Timer #11         trigger mode:     Unused
Timer #12         trigger mode:     Unused
Timer #13         trigger mode:     Unused
Timer #14         trigger mode:     Unused
Timer #15         trigger mode:     Unused

Minimum velocity for 'antstop': 0.50 deg/sec

Minimum time for 'antstop': 2.00 sec
```

"CONTROL VARADC" Command Summary Dialog

```
(Control VarADC) – Analog Input Test Variable Definitions

-----------------------------------------------------------
-----

A/D Logic Variable #0 is defined: NO

A/D Logic Variable #1 is defined: NO

A/D Logic Variable #2 is defined: NO

A/D Logic Variable #3 is defined: NO

A/D Logic Variable #4 is defined: NO

A/D Logic Variable #5 is defined: NO

A/D Logic Variable #6 is defined: NO
```

A/D Logic Variable #7 is defined: NO

A/D Logic Variable #8 is defined: NO

A/D Logic Variable #9 is defined: NO

A/D Logic Variable #10 is defined: NO

A/D Logic Variable #11 is defined: NO

A/D Logic Variable #12 is defined: NO

A/D Logic Variable #13 is defined: NO

A/D Logic Variable #14 is defined: NO

A/D Logic Variable #15 is defined: NO

"CONTROL VARANT" Command Summary Dialog

(Control VarAnt) – Antenna Pos/Vel Test Variable Definitions

Antenna Logic Variable #0 is defined: NO

Antenna Logic Variable #1 is defined: NO

Antenna Logic Variable #2 is defined: NO

Antenna Logic Variable #3 is defined: NO

Antenna Logic Variable #4 is defined: NO

Antenna Logic Variable #5 is defined: NO

Antenna Logic Variable #6 is defined: NO

Antenna Logic Variable #7 is defined: NO

Antenna Logic Variable #8 is defined: NO

Antenna Logic Variable #9 is defined: NO

Antenna Logic Variable #10 is defined: NO

Antenna Logic Variable #11 is defined: NO

Antenna Logic Variable #12 is defined: NO

```
Antenna Logic Variable #13 is defined: NO

Antenna Logic Variable #14 is defined: NO

Antenna Logic Variable #15 is defined: NO
```

"AXIS" Command Summary Dialog

```
(Axis AZ) – AZIMUTH Axis Parameters

------------------------------------------

Use internal antenna simulator: YES

Max simulated acceleration: 18.0 deg/sec/sec

Angle input signal source: Parallel

Angle input format is BCD: NO

Number of bits for angle input: 16

Maximum angle update period: 40.0 ms

Multiplicative angle scale factor: 1.0000

Angle offset from true orientation: 30.00 deg

Use tachometer voltage to estimate velocity: YES

Tachometer calibration -- Level: 50.00 T–Units

Tachometer calibration -- Speed: 20.00 deg/sec

Enforce soft limits of position travel: NO

Enforce shutdown limits of position travel: NO

Force shutdown if tach/pos are inconsistent: NO

Force shutdown for unresponsive antenna: NO

Moment of Inertia: 2.00 (D–Units / T–Units/sec)

Enforce model–based acceleration limits: NO

Use drive compensation for unbalanced antenna: NO

Maximum output drive voltage: +/- 10.00 Volts

Drive voltage is positive for positive motion: YES
```

```
Tach voltage is positive for positive motion: YES

Drive is normal(0), or always Neg(-1)/Pos(1): 0

Drive output offset: 0.00 D–Units

Tachometer input offset: 0.00 T–Units
```

"VSERVO" Command Summary Dialog

```
(Vservo AZ) – AZIMUTH Velocity Servo parameters

-------------------------------------------------------

Motor positive sustaining drive: 5.00 D–Units

Motor negative sustaining drive: -5.00 D–Units

Nominal positive drive slope: 0.800 D/T–Units

Nominal negative drive slope: 0.800 D/T–Units

Velocity feedback slope: 25.000 D/dT–Units

Velocity feedback deadzone: 0.10 T–Units

Apply velocity error integral correction: NO

Generate stepper motor drive control signals: NO

Maximum absolute velocity: 95.00 T–Units

Velocity shutdown safe margin: 4.00 T–Units

Velocity shutdown check time: 1.00 sec

Tach zero–delay–smoother window: 0.150 sec

Model order within the window: 3

Drive slew rate limit for Zero-->Max: 0.10 sec
```

"PSERVO" Command Summary Dialog

```
(Pservo AZ) – AZIMUTH Position Servo parameters

------------------------------------------------------

Hysteresis outer zone: 0.080 deg

Hysteresis inner zone: 0.050 deg
```

```
Servo type: Legacy

First position break point: 1.00 deg

Second position break point: 5.00 deg

First interval slope: 10.00 (T–Units)/deg

Second interval slope: 2.00 (T–Units)/deg

Third interval slope: 1.00 (T–Units)/deg
```

"INU" Command Summary Dialog

```
(INU) – Inertial Navigation Unit (INU) Setups

----------------------------------------------------

Use platform stabilization algorithms: NO

Serial INU Simulation: NO
```

5.3 The SAVE and RESTORE Commands

Use the "SAVE" command to store the current RCP8 parameters in the non-volatile RAM. This will automatically preserve the settings the next time the RCP8 is powered up. The "SAVE" command prints an informational message that counts the actual number of bytes that were changed.

The "RESTORE" command is used to replace the current working parameters with a completely different set. With the "factory" argument, the command restores conservative default values for all parameters. This can be useful to return to a known baseline. With the "saved" argument, the command restores the parameters from the most recent "SAVE" command. The "undo" argument allows you to change your mind if the "factory" or "saved" option has inadvertently overwritten the actual desired settings.

5.4 The SITE Command

The SITE command is used to configure parameters for the local site. The following options represent the possible sub-menus:

- "Display" option — defines how the vacuum-fluorescent, front panel display is configured and represents the default menu if the SITE command is invoked with no argument.

- "Host" option — defines the communication choices and data protocols that are used with the host computer.
- "Custom" option — selects and configures customer specific features.
- "LOG" option — setup internal data and event logger
- "Miscellaneous" option — defines a few other things.

5.4.1 Front Panel Display Setups

These setup questions are accessed by typing "Site Display" at the "RCP>" prompt.

Front panel display update time: 0.200 sec

This shows the time in seconds, between updates, of the front panel display. Set the time to a rate that is comfortable for viewing.

Front panel display brightness (0–7): 4

The brightness of the display is controlled in this setup. For maximum tube life, choose the minimum brightness that still permits easy viewing.

Top display line template: TB

Second display line template: EP2

Third display line template: EV2

Bottom display line template: SS2

The RCP8 permits a flexible reconfiguration of the front panel display, so the parameters, which are most relevant for each site, can always be viewed. For example, if the RCP8 is on a moving ship, the user may wish to display both the pedestal and the Earth angles, as well as the Roll, Pitch, and Heading of the ship. For terrestrial radars, it may be desirable to use the available display lines for angular velocities, status bits, and monitoring of host computer commands.

There are four 20-character lines available on the front panel display. Each line can assigned to carry any of the following templates and may be arranged in any order.

TB)	--AZ-- --EL--	Title Bar
EP1)	123.45 Earth 23.46	AZ/EL Earth Positions
EP2)	123.45 Pos 23.46	
EP3)	123.45 AZ/EL 23.46	

PP)	123.45 Ped 23.46	AZ/EL Pedestal Positions
PV)	12.00 Ped.V 0.00	AZ/EL Pedestal Velocities
EV1)	12.00 Geo.V 0.00	AZ/EL Earth Velocities
EV2)	12.00 Vel 0.00	
CMD)	12.00 V Cmd P 10.50	AZ/EL Servo Commands
RTS)	Rad:On T/R:-- Srv:On	Radiate, T/R, and Servo
HRP)	123.4H -12.3R 23.1P	Heading, Roll, Pitch
LL)	148 24.5W 42 35.2N	Longitude / Latitude
TM)	17:22:35 3–Feb–1996	Time and Date
SS1)	Status:OK	Status
SS2)	Status:OK –<-->–	
VAR)	0000 0000 0000 0000	Local Variables
DRCP)	Di/-- Ok/Ok --/On Au	Dual/Redundant State
XX)		Blank Line

- **TB** — selects a title bar to label the AZ and EL columns.
- **EPn** — selects one of several AZ/EL Earth Position displays. The difference is in the text that appears in the center of the line. Use the "Earth" choice (EP1) to avoid confusion if the pedestal angles are also displayed. Use "Pos" if the Title Bar appears elsewhere on the display or if the user has little trouble remembering which is AZ and EL. Otherwise, use "AZ/EL."
- **PP** and **PV** — select pedestal position and velocity.
- **EVn** — selects one of several AZ/EL Earth velocities that contain different text labels in the center.
- **CMD** — displays the present command from the host computer. The letters "V" and "P" indicate if a position or velocity servo is requested on each axis.
- **RTS** — shows the present state of "Radiate," "T/R Power," and "Servo Power."
- **HRP**, **LL**, and **TM** — these are used only if INU data is available.
- **SSn** — selects one of several status lines. "SS2" includes an entertaining "heartbeat" indicator.

- **VAR —** shows the continuous states of the sixteen local variables V0–V15. This can be handy as a temporary live monitor of states assigned to these variables via logic equations.
- **DRCP —** shows the "Disabled", "Okay", and "Active" summary status of a Dual/Redundant system. The "A" and "B" systems are separated with a slash "/". Lastly, the A/B/Auto mode is shown at the right side.
- **Enc —** shows the shaft encoder calibration status for both Az and El. Possible states are:

  "Indx" – Uncalibrated, waiting for the first index pulse.

  "Prox" – Uncalibrated, index pulse received, waiting for the proximity pulse.

  "Ok"– Calibrated.

  "Fail" – The calibration failed.

Once a status template is assigned to any of the display lines, the RCP8 will use that line to display urgent status, such as a shutdown condition. If a status template has not been assigned, then the bottom display line will be overwritten whenever any urgent messages is displayed.

Show hundredths digit in AZ position: NO

Show hundredths digit in EL position: NO

Show hundredths digit in AZ velocity: NO

Show hundredths digit in EL velocity: NO

You may display either one or two digits to the right of the decimal point in the position and velocity readouts. Since the angle information for most antennas is only accurate to 0.1 degree, the defaults are to not show the hundredths digit.

User shutdown #1 text: 'User–Shutdown #1 '

User shutdown #2 text: 'User–Shutdown #2 '

The text to display for the two user-induced shutdown conditions can be selected here. You may type any 20-character string to pop-up and blink when these shutdowns are triggered.

5.4.2 Host Computer I/O Setups

These setup questions are accessed by typing "Site Host" at the "RCP>" prompt.

Baud rate for host computer I/O: 9600

This sets the baud rate for serial communication with the host computer. Available choices include 1200, 2400, 9600, and 19200.

Data format transmitted by host computer: XMT02

Data format received by host computer: RCV02

The RCP8 can send and receive a variety of serial protocols. Use these questions to match the transmit and receive protocols that coincide with the host computer.

Process incoming servo control packets: YES

Answering "NO" to this questions disables the interpretation of "control" packets that are received by the RCP8, while still allowing BITE interrogation packets and "chat" packets to be treated normally. This makes it easier to setup and analyze the antenna servos via chat mode from the host computer. Previously the servos would resume responding to external control packets whenever the antenna was not explicitly under control of the chat interface, e.g., between monitor and setup command sequences. As a reminder, the RCP8 front panel will display "Lockout" on its status line whenever control packet commands are being ignored.

RCP8 transmission rate: 2.50 records/sec

Antenna data packets are transmitted by the RCP8 at this fixed rate. Choose a rate that makes the best tradeoff between:

1. providing the host computer with up-to-date angles, and
2. relieving the host computer of unnecessary I/O "flooding."

RCP8 transmits Time-of-Day records: YES

Time between Time-of-Day records : 30 sec

The user has the option of transmitting the INU's time-of-day to the host computer if the RCP8 is connected to an INU. Typically, this process is executed every few minutes.

RCP8 transmits internal BITE packets: YES

ID of internal BITE packets: 0(decimal)

The transmission of internal BITE status packets (See Table 18 on page 160) is decided by this question. These should be enabled if the host computer needs to monitor any of the information contained in these packets.

RCP8 transmits AUX status BITE packets: YES

Xmt ID of status BITE packets: 1(decimal)

RCP8 receives AUX control BITE packets: YES

Rcv ID of control BITE packets: 1(decimal)

The transmission and reception of auxiliary status and control BITE packets is selected here. See information at Table 20 on page 162.

These setup questions for the auxiliary control and status bits are organized so that the associated host computer I/O is configured independently of the (optional) assignment of hardware electrical lines to those bits. These questions ask whether the RCP8 will send/receive auxiliary status/command BITE packets to/from the host computer. The C[0:63] and S[0:63] variables have many different uses within the RCP8, so all 64 bits are always included in the 13–byte fixed–format BITE I/O packets. See related questions under "Site Custom" (5.4.3 Customer-Specific Site Setups on page 80).

Dead-Host-Computer detection time: 5.0 sec

This determines the required I/O inactivity time before the RCP8 disables the antenna motion. Once the RCP8 is under the control of the host computer, there is a possibility that the computer may "crash" or that the program, which interacts with the RCP8, may cease to function for other reasons. In such cases, it may be important to not allow the antenna servos to operate in accordance with the last computer command. For example, if the host computer requested a large antenna velocity prior to crashing, it makes little sense to continue honoring that request.

Default user interface: REMOTE-HOST-CHAT

The local TTY I/O can either be with the plug-in TTY or with the host computer via the chat-mode packets during the initial RCP8 power up. This question sets the power-up default.

NOTE	Note: The RCP8 will freely toggle between the TTY and the chat-mode channels. The interface, that most recently received incoming characters, is automatically assigned for the subsequent I/O.

5.4.3 Customer-Specific Site Setups

These setup questions are accessed by typing "Site Custom" at the "RCP>" prompt. They are used to select and configure customized features of the RCP8 that are added as the product evolves.

Output serial TAG lines: YES

Serial port: /dev/ttyS0

Baud rate of the serial TAGs: 9600

Choose: None RCV01 RCV02 RCV03 RCV05

Serial TAG data format: RCV01

Normally the RCP8 outputs azimuth and elevation TAG angles as 16-bit parallel TTL outputs on the back panel. Use these questions to configure an optional serial output stream.

Use WSR–88D DCU Interface (Antenna/Pedestal): YES

Serial port: /dev/ttyS0

Baud rate for DCU: 19200

Choose None Odd Even

DCU data parity: Odd

Bits in position binary angles: 13

ID of DCU BITE status packets: 0x09

ID of DCU Self–Test–1 BITE packets: 0x05

ID of DCU Self–Test–2 BITE packets: 0x06

Spare adjustment for Azimuth : 1.00000

Spare adjustment for Elevation: 1.00000

Additional time lag for Azimuth: 0.000 sec

Additional time lag for Elevation: 0.000 sec

Simulator port:

For NEXRAD systems, use this section to configure the DCU interface. Be sure to set the angle source questions in the axis sections to "Custom" to read these angles.

Use WSR–88D DAU Interface (BITE/Status): YES

Serial port: /dev/ttyS0

Baud rate for DAU: 19200

Choose None Odd Even

DAU data parity: Odd

ID of DAU standard BITE packets: 0x07

ID of Quantitative BITE packets: 0x08

Simulator port:

For NEXRAD systems, use this section to configure the DAU interface.

Use Kavouras TCU Interface (Radiate/BITE): YES

Serial port: /dev/ttyS0

ID of TCU standard BITE packets: 0x09

ID of Quantitative BITE packets: 0x0A

Simulator port: /dev/ttyS1

Simply choose the serial port, and ID for the BITE and Q–BITE packets that will be associated with the TCU. Note that the serial baud rate, parity, and stop bits are fixed at 9600/Odd/2 because they are fixed by the TCU. The built-in simulator can be used for debugging the main code, and you can watch the live I/O from a real TCU using the 'Monitor SIO' command followed by 'Raw rTcu'.

The standard BITE packet for the TCU is 13 bytes long, and maps the 64 TCU status bits into the first 64 packet bits. The timeout bit (no TCU communication) appears in the MSB of Byte #12. These seventy bits of BITE status (10 words of 7 bits apiece) are mapped into status bits S64–S133. If you want to use any of the TCU status bits in a logic equation, those are the variables to grab.

The Q-BITE packet is 27 bytes long and holds 12 14–bit values. The first two are the 'Max strike' and 'Current strike' counts from the TCU status packets, and the next eight are from the temperature report. The last two slots (11 and 12) are unused for now.

The TCU is reset using the standard BITE resetting mechanism. A BITEX reset that is directed at either the BITE or Q–BITE unit will send a reset command to the physical TCU. In addition, a rising edge on Control Variable C63 will also reset the TCU.

The TrPower and Radiate control/status bits are the only ones needed for the TCU, giving you the states OFF, STANDBY, and RADIATE. When you twiddle those two control bits the appropriate commands will be sent to the TCU. Likewise, status from the TCU will set the TrPower and Radiate status bits appropriately.

Use Andrew–Canada serial pedestal interface: YES

Serial port: /dev/ttyS0

ID of Andrew BITE status packets: 11(decimal)

Map Andrew status into S[29:63] variables: NO

Apply boresite offsets to position angles: NO

Simulator port:

When the Andrew interface is enabled you may hookup the serial lines either through a standard Linux TTY port such as "/dev/ttyS0", or through the special "io62-tty0" serializer that is built into the IO62 card firmware . The RCP8 also contains a (minimal) serial simulation of a real Andrew ACU, which you can configure onto a TTY port for loopback testing.

Normally the RCP8 will receive high-speed parallel AZ/EL angles from the Andrew ACU. However, if you set the axis angle source questions to custom, it will then set the RCP8 to use the low-speed (5Hz) serial angle status information from the ACU instead. This option can be handy for testing.

Use Applied Systems TWT Transmitter: YES

Choose: 177 337 377

Model number of the transmitter: 337

Serial port: /dev/ttyS0

Offset of 29 mapped status bits: 64

Offset of 5 mapped control bits: 64

ID of Standard STS BITE packets: 0×0C

ID of Quantitative BITE packets: 0×0D

Simulator port:

When the Applied Systems interface is enabled you may hookup the serial lines either through a standard Linux TTY port such as /dev/ttyS0, or through the special io62-tty0 serializer that is built into the IO62 card firmware. The RCP8 also contains a serial simulation of a real Applied Systems TWT, which you can configure onto a TTY port for loopback testing. A blank device disables the simulation.

The different Applied Systems model vary in the status bytes returned.

Model 177 is: STX Digital Byte 1, Digital Byte 2, Digital Byte 3, Digital Byte 4, Analog 1 (4 characters), Analog 2 (4 characters), Analog 3 (4 characters), EXT Checksum. Total = 19 bytes

Model 377 has a fourth Analog value, for a total of 23 bytes, while model 337 also has a fifth Analog value, for a total of 27 bytes.

The analog fields translate into a Q byte packet, as shown below. Depending on the model, the last values are missing, and the packet will be shorter.

Char	Function
1	SYNC Byte (AF Hex)
2	Identification byte (User Choice)
3–4	Analog 1 (14–bits)
5–6	Analog 2
7–8	Analog 3
9–10	Analog 4 (for Model 377 and 337 only)
11–12	Analog 5 (for Model 337 only)
13	END OF MESSAGE (FF Hex)

Use Orbit serial pedestal controller: YES

Serial port: /dev/ttyS0

Offset of 33 mapped status bits: 64

ID of Standard STS BITE packets: 0×0E

Fixed time lag of Orbit angles: 1.0 ms

Simulator port:

Used for the Orbit pedestal controller. A blank device disables the simulation. Be sure to set the angle source questions in the axis sections to Custom to read these angles.

Use CAN–Bus serial control/status: YES

Use CAN–Bus to radar control: YES

Force shutdown for unresponsive antenna: YES

ID of Standard STS BITE packets: 0×0F

ID of Quantitative BITE packets: 0×10

Used for the CAN-Bus interface to control and monitor the Vaisala pedestal. Be sure to set the angle source questions in the axis sections to Canbus to read these angles.

Use dehydrator connected in serial port: YES

Serial port: /dev/ttyS0

ID of Standard STS BITE packets: 0×11

ID of Quantitative BITE packets: 0×12

Monitor the status of the ADH–2A COM Automatic Air Dehydrator through an RS-422 interface. Dehydrator status includes the waveguide pressure, device temperature, duty cycle and alarms and warnings for fault states.

Use klystron connected in serial port: YES

Serial port: /dev/ttyS0

ID of Standard STS BITE packets: 0×14

ID of Quantitative BITE packets: 0×15

Control bit for fault log print: 30

Monitor the status of the Klystron transmitter in Vaisala WRK100 or WRK200 weather radars. The klystron transmitters voltages, currents and alarms are monitored. The status can be displayed on **bitex**. This software thread retrieved the status and measurement information through a serial interface (RS–422) and creates ITE and QBITE packets from it. Those packet formats are shown below in on page 85 and on page 86.

Klystron BITE Packet (RCP8 to Host)

Char	Function	Status bit	Klystron_status_c field
1	SYNC (C0 Hex)		
2	Identification byte (User choice)		
3	Klystron status and fault conditions (Machine state)		
	D0 = Power On	S134	iMachineState (bit 0)
	D1 = Standby	S135	iMachineState (bit 1)
	D2 = Radiate	S136	iMachineState (bit 2)
	D3 = Fault Sum	S137	iMachineState (bit 3)
	D4 = Fault Latch	S138	iMachineState (bit 4)
	D5 = Reserved	S139	iMachineState (bit 5)
	D6 = Reserved	S140	iMachineState (bit 6)
4	Klystron status and fault conditions (Faults)		
	D0 = HVPS Over Temp	S141	iActiveFaults[0] (bit 0)
	D1 = Oil Level	S142	iActiveFaults[0] (bit 1)
	D2 = Solenoid PS	S143	iActiveFaults[0] (bit 2)
	D3 = HVPS Current	S144	iActiveFaults[0] (bit 3)
	D4 = LVPS	S145	iActiveFaults[0] (bit 4)
	D5 = HVPS (over cur/ und volt)	S146	iActiveFaults[0] (bit 5)
	D6 = Filament PS	S147	iActiveFaults[0] (bit 6)
5	Klystron status and fault conditions (Faults)		
	D0 = Ion Current	S148	iActiveFaults[0] (bit 7)
	D1 = Klystron Current	S149	iActiveFaults[1] (bit 0)
	D2 = Solenoid Current	S150	iActiveFaults[1] (bit 1)
	D3 = Over Duty	S151	iActiveFaults[1] (bit 2)
	D4 = Mod Over Temp	S152	iActiveFaults[1] (bit 3)
	D5 = Spare	S153	spare
	D6 = Spare	S154	spare

Klystron BITE Packet (RCP8 to Host) (Continued)

Char	Function	Status bit	Klystron_status_c field
6	Klystron status and fault conditions (Spare)		
	D0 = Klystron Connected	S155	iConnected
	D1 = Spare	S156	spare
	D2 = Spare	S157	spare
	D3 = Spare	S158	spare
	D4 = Spare	S159	spare
	D5 = Spare	S160	spare
	D6 = Spare	S161	spare
7	End of Message (FF Hex)		

Klystron Q-BITE Packet (RCP8 to Host)

Char	Function	Klystron_status_c field
1	SYNC (AF Hex)	
2	Identification byte (User choice)	
3–4	Solenoid current	fSolenoidCurrent (scale 100)
5–6	Klystron current	fKlystronCurrent (scale 10)
7–8	Ion current	fIonCurrent (scale 100)
9–10	Filament voltage	fFilamentVoltage (scale 100)
11–12	Filament current	fFilamentCurrent (scale 100)
13–14	Modulator current	fModulatorCurrent (scale 100)
15–16	HVPS voltage	iHVPSVoltage (scale 1000)
17–18	Peak cathode voltage	fPeakCathodeVoltage (scale 100)
19–20	Peak cathode current	fPeakCathodeCurrent (scale 1)

Klystron Q-BITE Packet (RCP8 to Host) (Continued)

Char	Function	Klystron_status_c field
21	End of Message (FF Hex)	

Use Power Monitoring: YES

Frequency of the radar (MHz): 5625

Number of sensors: 4

Ser.No of horizontal forward sensor: 0

Ser.No of horizontal reverse sensor: 0

Ser.No of vertical forward sensor: 0

Ser.No of vertical reverse sensor: 0

Offset of 2 mapped status bits: 162

Control bit of rsenssor zeroing: 31

ID of Standard STS BITE packets: 0×16

ID of Quantitative BITE packets: 0×17

The purpose of the Power Monitor thread is to open a connection through USB to the Rohde&Schwarz NRP–Z51 power sensors. The weather radar may have 2 power sensors for each polarizations on the wave guides measuring transmitted and received power level. When measurement is completed, BITE and QBITE packets are created. The format of those packets are shown below in Table 2 on page 87 and Table 3 on page 88.

Table 2 Power Monitor BITE Packet (RCP8 to Host)

Char stPowerResults_c	Function	Status bit
1	SYNC (C0 Hex)	
2	Identification byte (User choice)	

Table 2 Power Monitor BITE Packet (RCP8 to Host)

Char stPowerResults_c	Function	Status bit
3	Power Monitor status/alarm bits	
lAlarmH (bit 0)	D0 = Horizontal Return Loss Alarm	offset+0
lAlarmV (bit 1)	D1 = Vertical Return Loss Alarm	offset+1
lAlarmSum (bit 2)	D2 = Power Monitor Alarm sum	offset+2
lZeroing (bit 3)	D3 = Sensor zeroing in progress	offset+3
	D4 = Reserved	
	D5 = Reserved	
	D6 = Reserved	
4	End of Message (FF Hex)	

Table 3 Power Monitor Q–BITE Packet (RCP8 to Host)

Char	Function	stPoweResults_c field
1	SYNC (AF Hex)	
2	Identification byte (User choice)	
3–4	Power measurement HOR / TX	fTransmittedPowerH (scale 10)
5–6	Power measurement HOR / RX	fReflectedPowerH (scale 10)
7–8	Power measurement VER / TX	fTransmittedPowerV (scale 10)
9–10	Power measurement VER / RX	fReflectedPowerV (scale 10)
11–12	Return Loss HOR	fReturnLossH (scale 10)
13–14	Return Loss VER	fReturnLossV (scale 10)
15–16	TX Peak Power HOR	fPeakPowerH (scale 0.01)
17–18	TX Peak Power VER	fPeakPowerV (scale 0.01)
19	End of Message (FF Hex)	

Use ARA ACU–3 Antenna: YES

Serial port: /usr/sigmet/config/rcp8_ara_acu–y

Baud rate: 19200

Choose: None Odd Even

Data parity: Odd

ID of BITE status packets: 0×08

Fixed time lag of angles: 1.0 ms

Poll for position every 20 ms

Offset of 15 mapped status bits: 40

Control bit for reset: 40

Simulator Serial port: /usr/sigmet/config/rcp8_ara_acu–x

If When the ARA ACU–3 interface is enabled and you supply a serial port, you get the ARA_ACU3 thread visible on the help view screen. If you put a string into the Simulator port, you get the ARA_ACU3–Sim thread. The example above show how to configure the simulator to talk to the main thread using FIFOs. You need to create these 2 files using the **mkfifo** command.

There are 15 TSC TWT status bits output in the BITE packet, as follows. For a detailed description of the bit meanings and the command set see the ICD.

Table 4 ARA ACU–3 BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)
3	Status Bits EL1 AZ6 AZ5 AZ4 AZ3 AZ2 AZ1
4	Status Bits ELF AZF EL6 EL5 EL4 EL3 EL2
5	Status Bits – – – – – – Timeout
6	Spare byte
7	END OF MESSAGE (FF Hex)

These same 15-bits are mapped to the specified status bits. The fundamental period at which the RCP8 polls the ARA for position is set by the Poll for position question. All other activity, like polling for status happens once a second. Command output happens once a second unless there is a change.

Use TSC TWT Interface: YES

T/R Serial port: /usr/sigmet/config/tsc_tr–y

Modulator Serial port: /usr/sigmet/config/tsc_mod–y

ID of BITE status packets: 0×06

ID of QBITE status packets: 0×07

Offset of 23 mapped status bits: 20

Offset of 10 mapped control bits: 20

Simulator T/R Serial port: /usr/sigmet/config/tsc_tr–x

Simulator Mod Serial port: /usr/sigmet/config/tsc_mod–x

This is the TSC TWT transmitter used in the NOAA G4 aircraft. If you answer Yes to the initial question and supply either serial port, you get the TSC–TWT thread visible on the help view screen. If you put a string into either Simulator ports, you get the TSC–TWT–Sim thread. The example above show how to configure the simulator to talk to the main thread using FIFOs. You need to create these 4 files using the **mkfifo** command.

You can monitor the traffic transmitted and received from these two serial lines using the monitor sio command. Once you are in monitor mode, then type something like raw xtsc_tr rtsc_tr. Other available data is xtsc_mod and rtsc_mod.

There are 23 TSC TWT status bits output in the BITE packet, as follows. For a detailed description of the bit meanings contact Vaisala.

Table 5 TSC TWT BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)
3	Status Bits 6 5 4 3 2 1 0
4	Status Bits 13 12 11 10 9 8 7
5	Status Bits 20 19 18 17 16 15 14
6	Status Bits 23 22 21
7	Spare byte
8	END OF MESSAGE (FF Hex)

There are 4 TSC TWT qualitative values output in the QBITE packet, as follows:

Table 6 TSC TWT QBITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (AF Hex)
2	Identification byte (User Choice)
3–4	Frequency code (actually only 6 bits)

Table 6 TSC TWT QBITE Packet (RCP8 to Host) (Continued)

Char	Function
5–6	Receiver protector leakage measurement
7–8	Transmitter power measurement
9–10	Reflected power measurement
11	END OF MESSAGE (FF Hex)

The TSC TWT simulator is fairly simple. For the T/R port, it sends a 9-byte response containing all zeros, except for the first and last byte, and bytes 2 and 3 are copied from bytes 2 and 3 of the command (which have the same meanings). Also the qualitative values are set to: Frequency code=50, Receiver protect leakage=100, Transmitter power=150, and Reflected power=200. If no command, or a bad command arrives, then the whole payload iszero. For the Modulator port, it sends the string <1R0011?0000>\n, where the ? is set to 0 or 1 based on the command supplied. If no command, or a bad command arrives, then the payload is all 0.

For best performance on an ARA controller, get the option for parallel outputs. If not, or if using a simulator, be sure to set the angle source questions in the axis sections to Custom to read these serial angles.

Use TDRS pedestal angle input: YES

Serial port: /dev/ttyS0

The TDRS pedestal has a serial interface used to get angle information.

Use TDRS pedestal control output: YES

IP Address: 191.165.99.99

Port number: 32767

The TDRS pedestal is controlled via a socket interface. You can set the IP and port number here.

Use MELCO TKY01 Serial Q–Bite: YES

Serial port: /dev/ttyS0

Baud rate: 19200

ID of Quantitative BITE packets: 0×13

Simulator port:

We can read serial QBITE packets in MELCO Turkey–01 format. This message includes information from a generator. It produces a QBITE packet, as follows:

Table 7 MELCO TKY01 QBITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (AF Hex)
2	Identification byte (User Choice)
3–4	Generator running hours
7–8	Generator fuel level
9–10	Generator voltage V1
11–12	Generator voltage V2
13–14	Generator voltage V3
11	END OF MESSAGE (FF Hex)

The serial format sends this information in 3 separate packets, each sending 4 bytes of payload, using a similar format. The Identification byte is set to 0, 1, or 2.

Table 8 MELCO Serial Packet (Generator to RCP8)

Char	Function
1	SYNC Byte (AF Hex)
2	Identification byte
3–6	Data
11	END OF MESSAGE (FF Hex)

HPIB/USB interface hardware is installed: YES

HPIB device name: siggen

RF/IF Signal generator is on the bus : YES

Signal generator has pulse modulation : YES

Answer the first question Yes if a USB-to-HPIB interface module is plugged into a USB slot of the RCP8 computer, in which case its Linux device name is supplied on the next line. If a signal generator is attached to the bus, then enter its HPIB address. Also tell whether it supports pulse modulation by answering No if the siggen can only operate in CW mode. Note that IEEE Std 488.2 specifies a command and query protocol that is independent of the hardware manufacturer. For this reason, it it not necessary to specify what brand of signal generator is being used (since the same minimal command set works with all 488.2 devices).

The first class of instruments supported are RF/IF signal generators. The RCP8 can both control and sense the signal generators output power level, output On/Off switch, and pulse modulation selection. These parameters are then directly accessible from the IRIS/Antenna utility.

The RCP8 keeps the signal generator in its normal local mode at all times, and polls its settings every 0.5 seconds. This means that the signal generators front panel is fully functional at all times. However, whenever the RCP8 detects a change in the host computers requested settings, then those changes are sent immediately (but just once) to the signal generator. The correct settings are thus put into place; though the user is still allowed to make further changes using the manual controls. The design philosophy is that the signal generator should simply appear to operate normally, except at those times when changes are requested by the host computer.

When an HPIB signal generator is not installed on the RCP8, the signal generator status sent back to the host computer will be spoofed from whatever siggen settings the host computer is currently requesting. Thus, the RF–Level, On/Off, and Cont/Pulse status are all echoed back, and the Fault status is FALSE (no fault).

For HPIB/GPIB support, you now need to install a new library for the RCP8 to run. If you are installing a new system, this is covered in the sigconfig script, or in the steps described in the *Software Installation Manual*. If you are upgrading, you will need to install a new rpm. This is supplied on our FTP site, and on the CDROM. Here is the command to install:

```
# rpm –Uhv linux–gpib–lib–3.2.09–1.EL.i686.rpm
```

If you are using the GPIB feature, then you will also need to install the kernel module. There is a common kernel module rpm, and a version specific to the installed kernel. We provide driver RPMs for RHEL5:

```
# rpm –Uhv linux–gpib–kmod–common–3.2.09–1.EL.i686.rpm

# rpm –Uhv kmod–linux–gpib–3.2.09–1.EL.2.6.9_5.EL.i686.rpm

# rpm –Uhv linux–gpib–kmod–common–3.2.09–1.EL.i686.rpm

# rpm –Uhv kmod–linux–gpib–smp–3.2.09–
1.EL.2.6.9_5.EL.i686.rpm

# rpm –Uhv linux–gpib–kmod–common–3.2.09–1.el5.i686.rpm
```

```
# rpm –Uhv kmod–linux–gpib–3.2.09–
1.el5.2.6.18_8.el5.i686.rpm
```

Generate trigger sector blanking output: YES

Hardware output line to use: None

Hardware input line to use: None

Include sector #1 in overall test: YES

Sector #1 uses pedestal angles: YES

Sector #1 lower azimuth: 0 deg

Sector #1 upper azimuth: 30 deg

Sector #1 lower elevation: 1 deg

Sector #1 upper elevation: 3 deg

Include sector #2 in overall test: NO

Include sector #3 in overall test: NO

Include sector #4 in overall test: NO

Include sector #5 in overall test: NO

Include sector #6 in overall test: NO

Include sector #7 in overall test: NO

Include sector #8 in overall test: NO

The RCP8 can generate a trigger blanking output whenever the antenna falls within one of eight user-defined solid sectors in azimuth and elevation. Choose the remapped output line that will hold the blanking signal from: TrPwr SvPwr RdOff Reset IRS0 IRS1 IRS2 PW0 PW1 Rly AZ0. Choose an optional remapped input line to OR into the result from: TrPwr MagCr ILock Air WGPrs IRS0 IRS1 IRS2 PW0 PW1. For each sector that is enabled, choose whether Earth or Pedestal angles are to be used in the test, and the AZ and EL lower and upper limits.

The sector blanking latency is 3.5ms. This latency is defined as the maximum time that can elapse between the antenna moving into or out of a blanked sector, and the RCP8s mapped hardware output line actually responding with that indication. The 3.5ms latency will only be realized when the mapped output line is AZ0 (LSB of the parallel azimuth output). All other output lines will run with a 29ms delay; as will any optional remapped input line that is fed into the blanking criteria. As an example, at a 36deg/sec rotation rate, the 29ms delay might have produced a 1.04deg shift in the location of the blanked sector. The 3.5ms delay would position the edge more precisely by introducing only a 0.13deg shift.

Enable Shaft Encoder Simulator: YES

The RCP8 can simulate the shaft encoder signals at 500 Hz. This will only work at relatively slow antenna speeds. It produces outputs using the auxiliary control lines. The configuration is taken from the ax az and ax el setups. Output signals are as follows, including recommended cabling:

Signal	Control	Backpanel J9	Backpanel J3
EL Index	C78	14	1
EL A	C76	15	2
EL B	C77	16	3
EL Prox	C79	17	8
AZ Index	C74	1	4
AZ A	C72	2	5
AZ B	C73	3	6
AZ Prox	C75	4	7
EL Limit Lo	C71	–	–
El Limit Hi	C70	–	–

To get the hardware signals in requires the following lines in the softplane.conf file:

```
splConfig.Io62[0].Opt.Cp.J3_01_14.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_01_14.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_01_14.pinPos =

splConfig.Io62[0].Opt.Cp.J3_01_14.pinNeg = sAux[100]

splConfig.Io62[0].Opt.Cp.J3_02_15.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_02_15.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_02_15.pinPos =

splConfig.Io62[0].Opt.Cp.J3_02_15.pinNeg = sAux[101]

splConfig.Io62[0].Opt.Cp.J3_03_16.lRS422 = 0
```

```
splConfig.Io62[0].Opt.Cp.J3_03_16.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_03_16.pinPos =

splConfig.Io62[0].Opt.Cp.J3_03_16.pinNeg = sAux[102]

splConfig.Io62[0].Opt.Cp.J3_04_17.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_04_17.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_04_17.pinPos =

splConfig.Io62[0].Opt.Cp.J3_04_17.pinNeg = sAux[103]

splConfig.Io62[0].Opt.Cp.J3_05_18.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_05_18.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_05_18.pinPos =

splConfig.Io62[0].Opt.Cp.J3_05_18.pinNeg = sAux[104]

splConfig.Io62[0].Opt.Cp.J3_06_19.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_06_19.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_06_19.pinPos =

splConfig.Io62[0].Opt.Cp.J3_06_19.pinNeg = sAux[105]

splConfig.Io62[0].Opt.Cp.J3_07_20.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_07_20.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_07_20.pinPos = sProxSwAZ

splConfig.Io62[0].Opt.Cp.J3_07_20.pinNeg =

splConfig.Io62[0].Opt.Cp.J3_08_21.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J3_08_21.iTerm = 0

splConfig.Io62[0].Opt.Cp.J3_08_21.pinPos = sProxSwEL

splConfig.Io62[0].Opt.Cp.J3_08_21.pinNeg =
```

To get the hardware signals out requires the following lines in the softplane.conf file:

```
splConfig.Io62[0].Opt.Cp.J9_01_14.lRS422 = 0
```

```
splConfig.Io62[0].Opt.Cp.J9_01_14.iTerm = 0

splConfig.Io62[0].Opt.Cp.J9_01_14.pinPos = cAux[74]

splConfig.Io62[0].Opt.Cp.J9_01_14.pinNeg = cAux[78]

splConfig.Io62[0].Opt.Cp.J9_02_15.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J9_02_15.iTerm = 0

splConfig.Io62[0].Opt.Cp.J9_02_15.pinPos = cAux[72]

splConfig.Io62[0].Opt.Cp.J9_02_15.pinNeg = cAux[76]

splConfig.Io62[0].Opt.Cp.J9_03_16.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J9_03_16.iTerm = 0

splConfig.Io62[0].Opt.Cp.J9_03_16.pinPos = cAux[73]

splConfig.Io62[0].Opt.Cp.J9_03_16.pinNeg = cAux[77]

splConfig.Io62[0].Opt.Cp.J9_04_17.lRS422 = 0

splConfig.Io62[0].Opt.Cp.J9_04_17.iTerm = 0

splConfig.Io62[0].Opt.Cp.J9_04_17.pinPos = cAux[75]

splConfig.Io62[0].Opt.Cp.J9_04_17.pinNeg = cAux[79]
```

To simulate the limit switches, use the following logic equations:

```
EQ00: # Set the lower limit switch

\--: sLowerEL = c71

EQ01: # Set the upper limit switch

\--: sUpperEL = c70
```

Automatically calibrate Shaft Encoder: YES

This causes the RCP8 to initiate an automatic calibration of the shaft encoders each time they newly become uncalibrated. You should only use this on systems which have shaft encoders. If a calibration attempt fails, a failed flag is set and the calibration attempt will not repeat. Resetting from shutdown will clear the last failed state, and setting the *lShaftForceCal* logic control variable will force a new calibration by clearing the calibrate bit and failed bit for each axis. While running, the auto calibration will block normal control of the antenna, similar to the TTY monitor mode. The front panel SS1 and SS2 display will show LockCal in this case.

The algorithm is to scan at 2 rpm in azimuth until calibrated. In elevation, it will scan at 1 deg/second down until the lower limit switch (it should disable shutdown while calibrating), then it goes up at 2 deg/second until it is calibrated. The source code is in /usr/sigmet/rda/rcp8/open/ShaftAutoCal.c. The elevation limit switch shutdown is disabled during auto calibration. The elevation shutdown limits are disabled unties the elevation is calibrated. The calibration will fail if the antenna travels more than 1.5 times the expected distance, or more than 2 minutes elapses before calibration. See 5.4.1 Front Panel Display Setups on page 75 for details on the Enc front panel display option.

5.4.4 Data and Event Logging

An internal logging feature is provided in the RCP8 for recording unusual data and events during normal operation. You may choose the types of events to log, and then view the accumulated entries at any time. For now, the options allow for logging angle glitches and invalid INU parameters; but the RCP8 log is an expandable feature, and we expect to add many new types of entries in the future.

Data and Event Logging Setups

LOG glitches in AZ/EL output angles: YES

Maximum valid AZ/EL change: 1.00 deg / 23.3 ms

LOG invalid/reduced INU data records: YES

The angle glitch logger checks the AZ and EL output angles that are computed every 3.33ms, and makes a log entry if their change over an 8-sample interval is more than the maximum specified value. The log entry records the INU/Earth/Pedestal angle data for all eight samples, and then inhibits additional entries for the next seven samples (so that successive log entries will overlap nicely).

The following sample printout shows the AZ and EL Earth and Pedestal angles, followed by the Roll, Pitch, and Heading INU angles. If moving platform stabilization is not enabled, the printout is much simpler and only lists the AZ and EL pedestal angles.

AZ:	315.13	315.13	EL:	2.07	2.07	RPH:	4.72	-5.20	230.56
AZ:	315.25	315.25	EL:	2.07	2.07	RPH:	0.00	0.00	0.00

AZ:	315.25	315.25	EL:	2.02	2.04	RPH:	0.00	0.00	0.00
AZ:	185.84	315.25	EL:	2.37	2.04	RPH:	4.68	-5.17	230.64
AZ:	185.94	315.36	EL:	2.40	2.04	RPH:	4.68	-5.17	230.64
AZ:	185.94	315.36	EL:	2.37	2.01	RPH:	4.68	-5.17	230.64
AZ:	186.01	315.36	EL:	2.40	2.01	RPH:	4.63	-5.15	230.71
AZ:	186.12	315.48	EL:	2.42	2.01	RPH:	4.63	-5.15	230.71

When setting up the angle glitch logger, you should choose the maximum valid angle change according to the maximum scan speed that is expected; but it should never be less than the quantization of the incoming pedestal angles themselves (lest false alarms be constantly triggered). Because of this interaction, you are asked to express the maximum angle change directly as the angular change over a fixed period of time, rather than as a maximum speed. To compute this, simply multiply the maximum speed in deg/sec by 0.0233 sec, and round this angle up so that it at least exceeds the quantization of the incoming pedestal angles.

The INU data quality logger can be enabled to catch changes in the reported Invalid and Reduced flags for the attitude and motion parameters. Each log entry consists of the flag word, and the current Roll/Pitch/Heading. A new entry is made whenever any bits in the flag word change.

This sample printout shows the Reduced/Invalid flags for Horizontal, Vertical, Heading, and combined Roll and Pitch data. A zero indicates okay. The actual Roll, Pitch, and Heading angles reported from the same INU record are also shown.

```
Hor:0/0 Vrt:0/0 Hed:0/0 Rol:0/0 RPH:-10.42 0.03 249.32
```

5.4.5 Miscellaneous Site Setups

These setup questions are accessed by typing Site Miscellaneous at the RCP> prompt.

Lower EL limit switch causes shutdown: YES

Upper EL limit switch causes shutdown: YES

If an elevation limit-switch closure is detected, the RCP8 drive circuitry will automatically inhibit further motor current in that direction. In this case, the RCP8 can shut down at the users request to prevent further antenna motion until the cause of the switch contact can be ascertained.

Present year: 1996

The INUs time-of-day format does not include the year, hence it must be specified in this area. While the RCP8 is operational this value is automatically incremented if the year changes This will ensure that the correct time packets are sent to the host computer. It is necessary to save the incremented value, using the SAVE command, to establish the permanent change. All non-saved years will flash on the front panels TM display.

5.5 The AXIS Command

This command defines many parameters pertaining to the azimuth or elevation axes. All such definitions, that are not specifically related to the velocity or position servos, are specified here.

Use internal antenna simulator: NO

This variable determines if the internal antenna simulator is normally OFF or normally ON for this axis. The simulator is controlled in this area, rather than from the host computer, to allow identical host computer code to be used regardless if the simulator is operating or not.

NOTE	Note: The simulator may be used independently on each axis. This can be useful when testing only one of the real antenna axes.

Choose: Parallel Synchro A/B/Index Canbus Custom

Angle input signal source: ???

There are several choices for how to read the angles into the RCP8. We discuss each in a separate section below. You must set both axes to the same value.

Angle input signal source: Parallel

Angle input format is BCD: NO

Number of bits for angle input: 16

Maximum angle update period: 0.0 ms

The parallel antenna position inputs are TTL levels. The number of bits used to represent an angle will vary from site to site, depending on the style of encoder and associated circuitry used by the antenna. The RCP8 supports up to 16-bits of binary angle and 4-digit BCD angles. For the binary angles, if all sixteen lines are not used the signals should be applied starting from the most significant line. Unused lines are then masked internally, and external connections are not necessary. For the BCD angles, good to 1/10º, the lowest 14 bits are used.

The maximum period configuration is used to handle cases in which the parallel angles are updated at a slower rate than the 600Hz RCP8 polling rate. If you have a fast source, then type in 0. If the angles actually change slower than this, the RCP8 will think that the antenna has stopped, then suddenly moved. In that case, type in the longest expected period between updates. The RCP8 will only insert angles when they change, or after this period has elapsed.

Angle input signal source: Synchro

Synchro reference frequency: 60 Hz

Shutdown for invalid synchro voltages: YES

Calibration Gain #1: 1.00000

Calibration Gain #2: 1.00000

The RCP8 implements 3-wire synchros as an optional method for measuring both position and velocity. The synchro voltages for both AZ and EL are applied to the 12-pin Molex connector on the IO62/CP backpanel. This connector uses the same wiring that was used for the synchro inputs to the old RCP02; so, for upgrades, you can simply move your existing cable from one to the other.

The Synchro-to-Digital (S/D) conversion is implemented entirely in FPGA code on the I/O-62 card, and in software running in the RCP8. No additional hardware is required to begin using synchro inputs on your system. New setup questions in the Axis command might be set as follows:

The first two questions establish that a 60Hz synchro will be used for angle (position) input on this axis. Moreover, the voltages on the two Ref and three S1/S2/S3 lines will be checked for validity, and the RCP8 will shutdown if these voltages drop below 10% or rise above 95% of full-scale A/D values. Note that the present voltage levels can be checked in the Help View menu. The angle offset from true orientation is set to zero in this case, but you can use it to null out any fixed position error.

When synchros are used for position input you can still use tachometers for velocity input in the usual way. However, if tachometers are not available, an excellent alternative is to use the velocities that are generated by the S/D conversion process itself. The S/D converter is implemented as a Type-II tracking servo that provides zero position error at any velocity whenever the acceleration is zero. The internal velocity that is maintained during this process can be used by the RCP8 in place of a physical tachometer. When doing this, you choose the velocity that will correspond to 100 T-Units of virtual tachometer level. Simply choose an upper bound that is equal to the fastest spin rate you ever intend to use.

The following table lists the maximum RMS voltage that can be applied to the backpanels Molex SYNCHRO connector for each value of plug-in SIP resistor. The AZ channel voltages are set by SIP S1, whereas S2 sets the EL voltage levels. These resistors are socketed, and can be changed by removing the back cover of the IO62–CP panel

S1 or S2	Max Ref(RMS)	Max S–S(RMS)
47K	56V	31V
68K	81V	45V
100K	118V	66V
150K	178V	99V
220K	261V	145V

Note that the Ref inputs have somewhat lower gain than the three S inputs. This is because the precision of the S/D angle conversion is affected primarily by the precision at which the three S voltages can be measured. The backpanel therefore biases the gains so that the S voltages can be made as large as possible, i.e., without the Ref voltages first filling the A/D conversion range.

The appropriate resistor is the smallest value such that the maximum S-to-S voltage of the synchro (which is angle dependent) still fits within the table range. The reference voltage should then fit easily into its corresponding maximum range. Dont worry if it doesnt; the important thing is to match the S line voltages.

For example, a traditional 90Vrms 1:1 synchro would best use the 150K resistor, whereas a 105Vrms unit would require the 220K value. Note that you can check for proper A/D conversion levels of the synchro inputs using the help view menu of the RCP8.

Due to 1% resistors being used in the RCP8 Synchro inputs, it is possible to have small position errors, up to 1% over a 120 degree span. The synchro gain corrections handle this. Because of the redundancy in the 3–wire synchro signals it is possible to examine a collection of (S12,S23,S31) measurements and deduce whether gain errors exist among the three terms. The two setup questions to set calibration gains for synchro inputs on the RCP8. They default to 1.00000 (no correction).

The monitor command contains an ALT display format in which synchro information is shown in detail for each axis that uses those inputs.The fields are:

SyMag?: Magnitude of the synchro input, 0–to–1 range

SyUse?: Fraction of synchro usage history table in use, 0–to–1 range

Gains: The two estimated (suggested) gain terms

```
RCP> mo
AZ–Pos SyMag SyUse Synchro Gains EL–Pos SyMag SyUse Synchro
Gains Time
–––––– ––––– ––––– ––––––––––––––– –––––– ––––– ––––– –––––
–––––––––– ––––
120.90 0.93 0.00 –––––––,––––––– 0.00 0.00 0.00 –––––––,–––
–––– 9.77 res
120.89 0.93 0.00 –––––––,––––––– 0.00 0.00 0.00 –––––––,–––
–––– 1.39
62.38 0.94 0.17 1.00194,1.00111 0.00 0.00 0.00 –––––––,––––
––– 7.00
```

The idea is to estimate the gain terms from synchro information that has been collected over the widest possible span of angles on each axis. In the above example the reset command is first used to clear the history tables, then the antenna was moved slowly over a 60–degree interval. The SyUse? of 17% corresponds to the 60/360 span of collected samples. A pair of gain terms will be suggested whenever SyUse? exceeds 5%. Take these gain numbers and type them into calibration gain setups, and save.

NOTE	Important: The synchro voltage input feature is only available on Rev.B and higher backpanels. If you are running an RCP8 with a Rev.A backpanel and would like to switch to synchro inputs, Vaisala will upgrade your panel at no cost.

Angle input signal source: A/B/Index

Number of A/B ticks per Index pulse: 2048

Number of Index pulses per revolution: 6

Proximity sensor approximate angle: 110.0 deg

Reverse direction of A/B quadrature lines: NO

Sample lines from secondary I/O–62: NO

The RCP8 can accept angle input from A/B/Index (quadrature) shaft encoders using a variety of styles of gearing and indexing. The first two questions choose the number of quadrature transitions (ticks) per index pulse and the number of index pulses per revolution. In this example, the encoder unit produces 2048 ticks between each index pulse, and the gearing is such that the encoder spins around six times for each full revolution of the antenna. The index pulses reset the measured angle to zero, or to the closest multiple according to the gear ratio. If the index pulse(s) correspond to nonzero angle(s), then use the standard *Angle offset from true orientation*question to set the offset of the one closest to zero.

An auxiliary proximity sensor must be used to resolve the ambiguity of the index pulses when the number of index pulses per revolution is greater than one. The sensor can be positioned anywhere along the axis and we only need to know its approximate angle. In the above example with 60-deg sectors per index pulse, contacting the proximity sensor at 110-deg will add some multiple of 60-deg to the present angle such that the result lies between 80-deg and 140-deg. To define your sensors, simply assign *sProxSwAZ* and/or *sProxSwEL* status inputs in *softplane.conf*.

There are fixed I/O-62 pin assignments for the angle encoder inputs:

Signal	**I/O-62 Pin(s)**	**Backpanel J3**
EL Index	5,26	1,14
EL A	6,27	2,15
EL B	7,28	3,16
AZ Index	8,29	4,17
AZ A	9,30	5,18
AZ B	10,31	6,19

You may choose either TTL or RS-422 electrical levels by assigning these pins as status inputs in *softplane.conf*. Simply assign them to some unused *sAux[]* lines, which also has the advantage that the inputs can be monitored in logic equations for debugging.

Note that for test purposes, a simple pair of quadrature signals toggling at 2Hz can be created using the RCP8 itself:

```
EQ00: t1_single_1 = t0_clock_1 & !t2_single_1

EQ01: t2_single_1 = (!t0_clock_1) & t1_single_1
```

Angle input signal source: Canbus

The RCP8 gets angles via the canbus.

Angle input signal source: Custom

The RCP8 gets angles via one of the site custom interfaces. Many of these are serial in nature.

Multiplicative angle scale factor: 1.0000

Input angles are multiplied by this factor before being inserted into the system.

Input offset from true orientation: 0.00 deg

Use this offset value if the pedestal angle positions reported to the RCP8 are biased. You may correct errors as large as ±180º.

NOTE	When synchro inputs are used, you may toggle the input offset and input sense to correct the errors in offset and direction of rotation that result if the synchro lines have accidently been swapped.

Use tachometer voltage to estimate velocity: YES

Tachometer calibration — Level: 50.00 T–Units

Tachometer calibration — Speed: 12.00 deg/sec

Answering Yes to the first question informs the RCP8 that a real tachometer is available on this axis, and that its voltage should be used in all instances where velocity feedback is required.

The RCP8s internal velocity representation is, in many cases, in terms of the A/D converter units from the antenna tachometers (T-units). These units are arbitrary and need not correspond to any particular absolute angular velocity. However, it is often necessary to convert the tachometer units into absolute units to verify that the tach and position information are mutually consistent. This conversion is necessary for moving platform stabilization with an INU and for the benefit of host computer communication.

Absolute velocity calibration is easily performed using the local TTY angle monitor. Use the alt subcommand to choose the alternate display that displays the tachometer calibration values. Start the antenna moving on one axis using a velocity servo or a simple motor drive. For best accuracy, ensure that the tachometer level is at least 50—half of the A/D converter range filled. The displayed calibration ratio-with-saved should remain approximately constant and be very close to 1.000. Enter a new pair of calibration values if the ratio is not close to 1.000.

Use tachometer voltage to estimate velocity: NO

Virtual Tach — Full scale speed: 24.00 deg/sec

Virtual Tach — Differentiation window: 0.50 sec

Virtual Tach — Minimum travel: 0.05 deg/window

Virtual Tach — Use antenna model predictor: YES

Answering No to the first question informs the RCP8 that a real tachometer is not available on this axis, and that a Virtual Tachometer (based on position inputs) should be implemented in its place.

The Virtual Tachometer runs every 10ms and operates in two steps:

- A quadratic fit is computed for the most recent W seconds of position data (time window is adjustable up to 1.2 seconds). The result is a nicely behaved instantaneous velocity estimate that is W/2 seconds old (from the center of the window). The niceness comes from having a large number (100W) of position points to work with, and from the insensitivity to acceleration afforded by the quadratic fit. However, the W/2 second delay makes this estimate not directly usable in feedback loops.
- The delayed tachometer estimate is extrapolated forward using the known history of drive voltages that have been sent to the motor during the past W/2 seconds. The RCP8 uses a first order differential equation model to predict the behavior of each axis. (The same model that is used for background consistency checks). The equation with initial conditions is numerically integrated over the W/2 second interval to produce the tachometer estimate for the present moment.

There are four setup questions that configure the Virtual Tachometer. The first sets the actual velocity in degrees/second that 100 T–Units will represent. This number should be set 20% greater than the fastest anticipated rate of rotation. Do not make it unnecessarily large, as this will introduce quantization errors in the Virtual Tach units.

The second question defines the width of the position history window. The 0.5 second default will be appropriate in almost all cases. Making it larger will produce smoother drive voltages at low scan speeds, but at the expense of greater errors in extrapolating the phase delay. The fourth question permits the extrapolation model to be switched OFF for testing purposes, but it should always remain ON during normal operation.

The third question allows you to minimize the effects of noise in the least significant bits of the antenna positions. It sets a minimum travel that must be observed within the history window in order to produce a nonzero Virtual Tachometer estimate. The minimum travel is similar to a constraint on the standard deviation of the positions within the window. When quantization errors are dominant, the minimum travel should be set to approximately one half the weight of an LSB. The proper setting will ensure that a tachometer value of zero is produced whenever the antenna is genuinely at rest.

Enforce soft limits of position travel: NO

Minimum soft limit of travel: -1.00 deg

Maximum soft limit of travel: 91.00 deg

Most weather radar antennas can operate only over a limited range of elevation angles—typically from slightly below horizon to slightly beyond zenith. Since mechanical stops are encountered, it is important not to run the antenna into its limits at any appreciable speed. To enforce this, the RCP8 can be programmed with two soft angle limits, beyond which the antenna should not travel. These internal bounds will typically be set slightly short of the actual mechanical stops and of any limit switches that might be activated. The stops should never be contacted during normal operation. Enter the two limits (lower/upper) in degrees (º).

NOTE	Note: The angle span defined by these limits may be any clockwise sector as large as 359º.

Enforce shutdown limits of position travel: NO

Minimum shutdown limit of travel: -3.00 deg

Maximum shutdown limit of travel: 93.00 deg

These travel limits represent the hard bounds between where the antenna must lie. If the angle is observed to be outside of these limits, the RCP8 will shutdown immediately. The shutdown limits are intended to catch preposterous angles that might result from broken cables or faulty position encoders. The limits should be set to the furthest downward (lower) and upward (upper) positions that are realizable, preferably just before any limit switches are contacted.

WARNING	Note: The angle span, defined by these limits, may be any clockwise sector as large as 359º.

Force shutdown if tach/pos are inconsistent: YES

Permissible fixed error: 1.50 deg/sec

Permissible relative error: 10.00 %

The RCP8 continually checks to ensure that the velocity measured by the antenna tachometers matches those obtained by differentiating the antenna position. If these quantities are dissimilar, then a failure may have occurred that could lead to the damage of the mechanical system. For example, if a velocity servo is running, and if the tachometer input signal were removed, then the processor would assume that the antenna was not up to speed and would continue to output a large drive. If the antenna were indeed spinning, this large drive could lead to difficulty.

Force shutdown for unresponsive antenna: YES

Permissible tach prediction error: 15.0 T–Units

Maximum duration of such error: 3.0 sec

One of the more damaging types of antenna failures can occur when the motor, the gearbox, or the antenna itself becomes jammed. In such cases, it is important that the servo system remove the motor drive immediately to minimize consequential damages. To accomplish this type of safety action, the RCP8 makes a decision to shutdown based on a comparison of the actual antenna acceleration with the expected acceleration.

Moment of Inertia: 6.00 (D–Units / T–Units/sec)

This parameter defines the moment of inertia in a linear dynamic model of the antenna motion. The moment of inertia can only be measured when the antenna is accelerating. Representative values can be read from the Angle Monitors alt display while applying ad or ed commands. This parameter is used as part of the background calculation that checks for an unresponsive or jammed antenna.

NOTE	Important: The motor sustaining drives and the nominal drive slopes must be properly set, before the moment of inertia, so each axis can be measured.

NOTE	Important: When virtual tachometers are in use, the associated antenna model predictor must be disabled while the moment of inertia is being measured on each axis.

Enforce model–based acceleration limits: YES

Maximum acceleration: 6.0 deg/sec/sec

Extension of bound toward zero drive: 50%

The RCP8 servos can operate under the constraint of bounding the maximum acceleration (on each axis) that the antenna will experience. This acceleration limiter is based on the RCP8s existing first-order linear differential equation antenna model. When the limiter is enabled, output drive levels are clamped within the range of voltages that would keep the antenna acceleration within the configured bounds. This results in much gentler and smoother large-scale motion of the antenna, without compromising small-scale performance in any way.

WARNING	Important: Since the acceleration limiter is based on the RCP8s internal antenna model, all steps up to and including the proper measurement of the moment of inertia must be complete before enabling this feature.

Acceleration limiting works by keeping the motor drive bounded within an interval that is centered on the voltage that would maintain the present velocity. If the simulated model of the antenna is tuned properly, this algorithm limits both the maximum acceleration (increasing drive) and maximum deceleration (decreasing drive) of the antenna.

The third question (Extension of bound...) gives finer control of the extent to which the model-based acceleration limiter is willing to extend the allowable drive interval down to include zero volts. To insure that the antenna could always be stopped, even if the numerical model were badly mistuned, the original implementation of the acceleration limiter always extended the valid drive interval to include zero volts. This meant that zero drive could always be applied to bring the antenna to a stop; but as a result, the maximum deceleration limit would sometimes be exceeded. In some cases this would lead to gear strain as the antenna coasted to a stop from high speed under zero drive.

The third question allows the deceleration region to be controlled. If the antenna can safely coast to a stop from any velocity, then the safest setting is the old default value of 100%, i.e., the allowable drive interval is extended all the way to zero. A value of 0% would enforce the deceleration limit just as strongly as the acceleration limit, but should only be used if the model is properly tuned and if the antenna could be strained by coasting to a stop. The new default value of 50% is usually a reasonable compromise.

Use drive compensation for unbalanced antenna: YES

Neutral droop position of antenna: 35.0 deg

Drive required 90–deg off neutral: 51.4 D–Units

The RCP8 can apply drive compensation to an antenna that is not mechanically balanced. The result is that even a badly unbalanced axis can be properly stabilized without requiring any readjustment of the antenna counterweights. The new setup questions in the axis menu are:

The model being assumed here is that the center of mass of the unbalanced antenna is offset some distance from the axis of rotation. Thus, when no other forces are applied, the antenna will tend to droop to some neutral angle that puts that center of mass directly below that axis. In the above example, the neutral droop angle is 35 degrees, i.e., no motor drive is required to hold the antenna at that position.

Once we know the neutral droop angle *N*, the drive that is required to compensate for the imbalance when positioned at some angle *P* is simply *D sin(P–N)*, where *D* is the drive that would be required to hold the axis 90-degrees away from the neutral point. The second setup question asks for that value *D*.

As an example, suppose we have the unbalanced antenna mentioned above that naturally returns to 35 degrees whenever no drive is applied. We wish to compensate for this, and have manually determined that a drive level of -28 D-Units is required to hold the antenna down when it is positioned at two degrees. The drive that would be required at 90 degrees offset is therefore *-28 / sin(2-35)* = 51.4 D-Units, which we then enter into the second setup question.

Drive voltage is positive for positive motion: YES

Set this Boolean variable to either YES or NO if the numerically positive drive levels result in upward or downward velocities. The correct setting can easily be determined by setting up a small positive drive, using the local TTY angle monitor, and noting whether the positions are increasing or decreasing with time.

Tach voltage is positive for positive motion: YES

Set the Boolean variable to either YES or NO if the positive tachometer A/D values, while the antenna is moving and while using the local TTY angle monitor, correspond to upward (CW) or downward (CCW) velocities. The displayed tachometer values should be positive whenever the position increases with time. If the sign is incorrect, then toggle this variable.

Drive output offset: 0.00 D–Units

Use this offset value if the servo power amplifiers do not produce zero drive when zero voltage is applied. Do not use this value to attempt to compensate for asymmetric motor-drive requirements in the two directions. Instead, use the separate positive and negative sustaining motor drives and the separate nominal drive slopes.

Tachometer input offset: 0.00 T–Units

Use this value if there are DC offsets in the tachometer signals. The RCP8 automatically DC–balances its differential tachometer inputs, so residual offsets may be the result of contact potentials in the wiring of the tachometer. If necessary, adjust this input offset so that a stationary axis produces a tachometer reading of zero.

5.6 The VSERVO Command

Once the velocity servo parameters is set to an initial-guess value, it is important to exercise the servo on each axis to check for proper behavior. When properly setup, the servo should rapidly, and without overshoot, bring the antenna velocity to any requested rate as entered via the local TTY at and et commands. The tachometer readings should be reasonably stable—plus or minus 0.1 T-Units—and the output drive should exhibit minimal oscillation around the mean level necessary to obtain the requested velocity.

The following suggestions will assist to resolve problematic areas in the servo setup.

- If the servo is completely unstable, recheck the tach sign to ensure the positive velocities correspond to the positive position increments.
- If the tach sign is correct, then observe the drive sign. If velocity overshoots are observed, the tachometer and drive filtering time constants may be too long. If the antenna is sluggish and does not quickly reach the desired velocity, then the feedback gain is too low.
- If the antenna chatters, or if the output drive oscillates around its mean value, the feedback gain is probably too high.
- If the equilibrium velocities differ slightly from the requested rates, such as request 50 but get 51, the nominal drive slope and/or sustaining drives are incorrect.

Motor positive sustaining drive: 15.00 D–Units

Motor negative sustaining drive: –15.00 D–Units

These numbers indicate the drives that are required to just overcome the friction of the motor during positive (CW or upward) and negative (CCW or downward) motion. These are given in D-units, ranging from -100 to +100. To determine the proper values, use the local TTY control ad and ed commands. Start from initial rest and gradually increase the drive until the motor suddenly starts to move. Then decrease the drive until the motion stops due to friction. Enter the smallest drive values for which continuous motion could be sustained.

Nominal positive drive slope: 0.800 D/T–Units

Nominal negative drive slope: 0.800 D/T–Units

These parameters are used along with the sustaining drive levels to make an initial guess of the drive required to maintain a given velocity in the steady state.

The following values can be determined by using the local TTY control.

1. Output a drive level that results in a velocity that is approximately 75% of full speed.
2. Record the drive and tach readings from the TTY once a steady tachometer reading has been achieved. The required slope is (Drive - Sustain) / Tach, where Sustain refers to the sustaining drives that was measured in the previous section.

If the motor amplifier has a different gain in each direction, two different slopes are permitted—the first value for positive (CW or upward) motion and the second one for negative (CCW or downward) motion.

NOTE	Note: The slopes are used only as a first-order estimate. Extreme accuracy is not necessary to operate the velocity servos.

Velocity feedback slope: 25.000 D/dT–Units

The tachometer error feedback slope controls the tightness of the velocity servo. The velocity servo is stable for virtually all values of this parameter however, if the value is too small, the motion will be sluggish with relatively large errors in the final achieved velocity. If the value is too large, the currents will thrash wildly as the servo attempts to maintain the exact requested tachometer level. The appropriate value must be determined empirically.

Connect an oscilloscope to the drive and tachometer signals and use the local TTY control to select different servo rates— the at and et commands. Choose the largest value of the parameter that will bring the antenna rapidly to the requested velocities without excessive drive oscillation around its equilibrium value. If a scope is not available, the user can also make a fair judgement by observing the drive values that are displayed on the TTY. The feedback slope has units of Drive/TachError; typical values range from 10 to 200.

Velocity feedback deadzone: 0.10 T–Units

A deadzone is built in to the tachometer feedback path to ensure that the uncertainty of the low bits, of the A/D converters, does not result in motor chatter. Typical values are 0.1 to 0.5 T-units. If values above these limits are necessary to control the chatter, then this is indicative of the excessive noise on the tachometer inputs.

Apply velocity error integral correction: YES New Value:

Characteristic time of the integral: 2.00 sec New Value:

Maximum resulting drive bias: +/-25.00 D–Units New Value:

The RCP8 velocity servos include a velocity error integral feedback term, in addition to the proportional error feedback term and bias terms that have always been available. The error integral effectively removes any remaining steady-state velocity bias from the servo, and guarantees that scans will run at precisely their requested speed. These questions to configure the velocity error integral feedback term. The feature is switched On/Off using the first question.

The second question establishes the characteristic time T_0 of the integral, which is defined as follows. Suppose that a fixed velocity error E was sustained for a period of time. The proportional feedback term would produce a drive $D=SE$, where S is the velocity feedback slope. Then, if that same error E were applied to the integrator for T_0 seconds, the same drive term D would also result.

The gain of the integrator effectively is established by T_0 ; larger times produce smaller gains. One rule of thumb (Ziegler–Nichols) for a first guess of S and T_0 is to disable the integral feedback, and increase S until reaching a value S_u , at which the antenna goes into unstable oscillation with an observed period P_u. Reasonable first settings will then be obtained with $S = S_u / 2.2$, and T0 = $2.2\ P_u$.

The integral can be clamped (the so called anti-windup feature) to prevent it from drifting into large values when the antenna is not in equilibrium. This clamp value is expressed as the maximum drive correction that can be contributed from the integral term alone. If your antenna is well characterized by its sustaining drives and nominal drive slopes, then this clamp value can be reduced (since the nominal guesses do not need to be adjusted very much). This will help reduce brief overshoots that can be caused by the integral feedback.

Maximum absolute velocity: 95.00 T–Units

This value represents the tachometer level which corresponds to the maximum antenna rotation rate that is considered safe. The lower-rate limit will be the negative of the upper-rate limit. If the A/D converter hardware components have been set properly, the maximum value should be at least halfway through the converters full range—at least 50. If the safe value is less than 50, then the A/D range should be altered to make better use of the available 12 bits. The local TTY control, or an external manual control, can be used to cause the antenna to spin at the maximum safe rate while the tach levels are noted from the local TTY angle display.

Velocity shutdown safe margin: 4.00 T–Units

Velocity shutdown check time: 1.00 sec

The RCP8 has provisions to shutdown whenever the observed velocity on either antenna axis exceeds the internal maximum velocity limits that are enforced by the velocity servo. In the event that the velocity overshoots in the vicinity of these limits, the shutdown criterion can sometimes lead to false shutdowns when no actual problem exists. Ideally, the velocity servo will be setup to ensure that overshoots will not occur however, given the influences of motor damping and wind gusts, this strict condition is difficult to enforce.

To minimize false shutdowns due to temporary velocity overshoots, the shutdown criterion is expressed in terms of a velocity tolerance and a time limit. If this condition persist longer than the specified time, shutdown will occur whenever the absolute value of the measured velocity exceeds the sum of the maximum limit and the specified tolerance. As an initial guess, the tolerance should be set slightly higher than the maximum sustained velocity error that is ever observed, under normal operating conditions, while taking into account wind loading and other operational effects. The time should then be set slightly longer than the time by which the longest transient overshoot exceeds the specified tolerance.

Tach filter time constant: 0.025 sec

The tachometer inputs can be filtered with a simple, exponentially-weighted smoothing filter prior to applying to the velocity servo. This filtering is intended to remove spurious components from the digital tachometer samples. The filter time constant is typically set at approximately one–third the reciprocal of the antennas upper-frequency response limit.

The filter time constant is entered directly in seconds but the exact value must be determined by trial and error from an initial approximation. If the time constant is too large, the velocity servo will become unstable and will oscillate around the desired velocities before settling. If the time constant is too small, then no significant smoothing or spurious rejection will be attained. The value should be increased until the velocity overshoots become noticeable on an oscilloscope display of the tachometer signals. The final time-constant value should be slightly less than this level. Velocity overshoots can also be detected by the human eye by requesting zero velocity and observing how the antenna comes to rest.

NOTE	Important: The following drive filter time must be fine-tuned concurrently with the tachometer filtering. Also, both should be tuned whenever the Virtual Tachometer is in use.

Drive filter time constant: 0.025 sec

This drive filter behaves much like the tachometer filter, as described in the previous paragraph, except this is applied to the output drive levels prior to D/A conversion. The purpose of the filter is to smooth the motor drive signal and to remove the high frequency feedback components that can be generated by the velocity servo. Although these components most likely would be filtered by the motor and mechanical system, the users power-drive electronics might be adversely affected by sudden changes in the motor current. The filter time constant should be set as large as possible, consistent with preventing velocity overshoots as described in the previous paragraph. The drive and tachometer filters will have similar time constants however, from this common value, improved performance is usually obtained if the tachometer constant is decreased and the drive constant is increased.

Drive slew rate limit for Zero #rarr#Max: 0.200 sec

A slew rate limit can also be imposed on the output drive signals. The limit is expressed as the number of seconds required for the drive to slew from zero to 100. For example, a value of 0.2 seconds would restrict the rate of change of the output drive to 500 D-Units/second. The slew rate limit is useful in preventing abrupt changes in motor drive since, in some cases, such fluctuations can bring about unwanted oscillations in the antenna/ pedestal mechanical system. The slew rate limiter is applied by the RCP8 software after the output filter.

The Zero-to-Max drive slew rate time can be set as large as 15 seconds. This allows the RCP8 servos to work more gracefully with external motor controllers that incorporate a velocity feedback loop of their own. In such cases, the RCP8 velocity feedback slope should be set to zero, and internal (model based) acceleration limiting should be disabled. Acceleration limiting can be accomplished instead using the RCP8s drive slew rate limiter, which can now work over a longer time span.

Note that the drive filtering and slew rate limiting are both overruled by the detection of shutdown conditions, and the enforcement of soft limits of travel. If the antenna is heading rapidly toward a soft limit, the drive will be immediately adjusted in order to stop before that limit is reached.

5.7 The PSERVO Command

The legacy position servo parameters can be set up using a few iterations of the following procedures:

1. Make sure the velocity servo has been thoroughly checked, in accordance with the previous section, since the position servo cannot work properly with incorrect settings.
2. Set the inner and outer zones of the hysteresis as described below.
3. Set the first position break point to a small value P, such as 1.0º , and attempt several values of first interval slope. Find the largest slope that results in no overshoot when steps of P-degrees or less are performed. Use the ap and ep Angle Monitor commands to test the slope values.
4. Choose a larger second position break point and find the largest second interval slope that accomplishes larger steps without overshoot.
5. Find the largest third interval slope that permits large steps of any size to be travelled without overshoot.

After setting the position servo variables, it is important to exercise the servo on each axis to check for proper behavior. Attempt to move the antenna using the local TTY ap and ep commands. Verify that any position step can be requested without overshooting the final mark. Also, verify that very small steps cause antenna motion to occur. If the position feedback curve is not correct, it is possible for the servo to work properly for some step sizes but not for others. Therefore, a range of steps should be tested.

The procedure, described in the previous paragraph, is an attempt to tune the antenna for maximum performance (i.e., the antenna will arrive at a requested position as rapidly as possible.) On some systems, delays—usually in the response to a drive voltage—can lead to small position overshoots that can usually be eliminated by detuning the antenna performance. Detuning is accomplished by lowering the slopes, for the first and second endpoints, so the approximation to the braking curve lies below the observed curve. This will usually eliminate any position overshoot, with a slight performance penalty.

Hysteresis inner zone: 0.020 deg

Hysteresis outer zone: 0.050 deg

These represent the position errors, in degrees, within which the position servo will not attempt to correct the antennas location. Two values are specified — one for the lower limit and one for the upper limit. Whenever the actual position error is less than the lower limit, the position servo will not drive the antenna (i.e., it will request zero velocity from the velocity servo.) Likewise, whenever the actual position error is greater than the upper limit, the servo will always drive the antenna to correct it. There is hysteresis between these limits which helps to prevent antenna chatter once it has reached the desired position (the servos state between the limits is whatever it was at the time the limits were entered.)

It is important that the inner limit be greater than half the weight of the least significant bit that encodes the antenna position. For example, for 12-bit binary encoding the inner limit must be at least 0.045º. If it were smaller, the position servo might not realize that the final position had been reached and would continually move the antenna around a single LSB interval. As an initial guess, use an inner zone that is 10% larger than half the LSB weight. The outer zone should then be set somewhat larger, perhaps by 50%.

Servo type: Legacy

There are two types of position servo loops, Legacy and Feedfwd. Legacy has a desired speed which ramps to zero at the desired position, using multiple slopes shown here:

First position break point: 1.00 deg

Second position break point: 5.00 deg

These represent the values of the two position-error break points, in a piecewise linear definition, of the desired velocity-versus-position error.

First interval slope: 12.00 (T–units)/deg

Second interval slope: 3.00 (T–units)/deg

Third interval slope: 1.00 (T–units)/deg

These represent the three piecewise linear definition slopes of a desired velocity-versus-position error.

The following three intervals are defined as:

1. Zero to first-break point,
2. first-break point to second-break point, and
3. second-break point to infinity.

Servo type: Feedfwd

The Feedfwd servo uses a feed forward servo to correct for the effects of a stretching rubber belt used on the Vaisala pedestals, for example. Its tuning parameters are:

Period of mechanical resonance: 0.50 sec

This is a mechanical property of the antenna–pedestal combination. Different for azimuth and elevation.

Drive constant: 0.5000 deg/sec/D–Unit

This is a property of the motor driver and gear ratio, defining how many deg/sec drive is produced by a D-unit. This is different for azimuth and elevation in the Vaisala pedestal.

Drive end wait factor (n*T/2+T/4): 1

At the end of the drive, wait for a period of time before reading the current position to check it. T is the period of mechanical resonance, and here you enter the n.

Maximum acceleration: 6.0 deg/sec/sec

This is the maximum acceleration the antenna-pedestal is capable of doing.

5.8 The CONTROL Command

5.8.1 Output Line Configuration

These setup questions are accessed by typing Control Lines at the RCP> prompt. The command prompts the user with a series of similar questions which choose the polarity of the control lines that are driven by the RCP8. Each control line can be either active-high or active-low.

The following two choices are available for the Radiate ON and Radiate OFF control lines:

1. Complementary levels that are either ON or OFF, according to the current radiate request.
2. Pulse levels, in which Radiate ON pulses briefly to enable the radiate and Radiate OFF pulses briefly to disable it. The time duration of the pulses is adjustable.

5.8.2 Logic Equation Control Qualifiers

These setup questions are accessed by typing "Control Logic" at the "RCP>" prompt. The questions are actually a series of up to 32 logic equations that allow the user to qualify the RCP8 control functions in a very general way. Control bits can be modified according to any logical combination of control bits, status bits, and special internal local variables. The result is that the RCP8 can be programmed to perform custom safeguards and implement special feedbacks that are specific to each site.

Each equation consists of a control variable on the left that is assigned to some logical combination of variables on the right. The syntax is that of an ordinary "C" language statement using the operators "&" for AND, "|" for OR, and "!" for NOT. Parentheses may be included anywhere, as needed. New equations and subcommands are typed following the special "-->" prompt that is printed below the current equation. An example of how a few logic equations might appear is shown below.

```
EQ00: v0 = airflow | wavegp | magcur

EQ01: cservo = cservo & !v0

EQ02: relay = relay | c10

EQ03: ctrpower = true

-->
```

In the above example, EQ00 assigns the internal local variable "V0" to the logical OR of the "airflow", "waveguide pressure" and "magnetron current" status bits. V0 will be TRUE whenever any of those status lines are true. The second equation then uses a TRUE sense of V0 to force the "servo power" control line FALSE. Thus, servo power will only be on if it is requested to be on, and if none of the three control lines are asserted. Likewise, EQ02 allows the external local/remote relay to be forced on by the auxiliary control line C10. Finally, EQ03 forces "T/R power" to be on all the time, regardless of any other conditions.

The rules for constructing equations are as follows.

- The right side of the equation must consist of some logical combination of any of the above control variables, plus any of the status variables: spw0, spw1, sradiate, sservo, strpower, sreset, siris0, siris1, siris2, local, standby, ilock, magcur, airflow, wavegp, elimlo, elimhi, ngen_on, sgen_on, sgen_cw, sgen_flt, local_tr, shutdown, s[0:63]. The numbered status variables S[0:63] refer to the optional auxiliary status input lines.
- The left side of the equation must consist of one of the control variables: cpw0, cpw1, cradiate, cservo, ctrpower, creset, ciris0, ciris1, ciris2, ngen_on, sgen_on, sgen_cw, relay, shut1, shut2, v[0:15], c[0:63]. Control variables that have status counterparts are prefixed with the letter "c". Thus, "cradiate" is the request to radiate, whereas "sradiate" is the detected radiate status. The numbered local variables V[0:15] can be used as temporary storage for sub-

expressions, and the numbered control lines C[0:63] refer to the optional auxiliary control outputs.

- It is also possible to write logic equations in which status variables appear on the left–hand side. The meaning given to such assignments is that the working value of the status variable is modified from its default "requested" value, i.e., the value being assigned from whatever hardware line or external condition is normally attached to the status bit. In this sense, the modification of a status variable is identical to the modification of a control variable. In both cases, when the variable appears on the right–hand side, it refers to its default "requested" value.
- The special symbols TRUE and FALSE may be used on the right side of an equation to indicate "always" and "never".
- The maximum number of different variables on the right side of an equation is four. If you need to combine more than four variables into an expression, then make use of multiple equations using local variables to combine all of the bits together. For example, to force servo power off whenever any of the first eight auxiliary status lines is high:

  EQ00 : V0 = S0 | S1 | S2 | S3

  EQ01 : V1 = S4 | S5 | S6 | S7

  EQ02 : Cservo = Cservo & !(V0 | V1)
- Control variables that appear on the right side of an equation refer to the requested control state, whereas those appearing on the left-hand-side reflect the final qualified state. Thus, the equation "cservo = cservo & !v0" causes the requested servo state to be AND'ed with the negation of local variable V0, and the result is the actual servo state. This convention is very handy, and allows you to use control variables on the right without ambiguity. For example, the pair of equations: "EQ00: cpw0 = cpw1" and "EQ01: cpw1 = cpw0", would swap the two pulsewidth control bits.
- Order of evaluation of each equation is from right-to-left. There is no evaluation precedence among the "&", "|", and "!" operators. Thus, "!V0 & V1" means "!(V0 & V1)", rather than "(!V0) & V1". Be sure to use parentheses as needed to express your equations properly.
- Order of evaluation of the set of equations is from EQ00 to EQ31. The order is important only when local variables are assigned in earlier equations so that they can be used in later equations.
- The error message that is printed when an ambiguous variable name is typed into a logic equation includes a list of all of the possible matches. This can help you identify how to type the variable uniquely.
- The logic equation editor prints a warning upon exit if multiple assignments are being made to the same variable. For normal status and control variables this almost certainly indicates an error, since

only the final assignment will have any lasting effect. For local variables, however, multiple sequential assignments are meaningful since an assignment on one line may be referenced on a subsequent line. For now, the warning is printed even for local variables since there is still a chance that that is not what you had intended to do. Spurious local variable warnings can be eliminated by choosing a unique set of numbered variables to use (i.e., by not reusing them within the overall set of equations).

Comments and disabled equations are available:

- It is possible to add a line of comment text to each logic equation. Use the "#" command, followed by the text (which may be up to 74 characters in length). If no non–blank text is found, then the comment is removed. Whenever an equation includes a comment, the comment text will be displayed in the line preceding the equation during the editing process.
- It is possible to enable and disable control logic equations while keeping the content of the equation intact. Use the "/" command within the equation editor to toggle whether the current equation is effectively "commented out". The text for disabled equations will still be shown in the editor, but will be prefixed with the "#" character. This feature is very handy when you want to temporarily disable some trusted and debugged equations without the risk of retyping them incorrectly later.

Some additional notes on the usage of variables should also be kept in mind:

- A side effect of making assignments to local variables is that these bits are also reported to the host computer via the RCP8's Internal BITE packet. This opens many possibilities for designing customized status bits that could be monitored and reported by the IRIS BITEX utility.
- The variables "shut1" and "shut2" cause a user-induced shutdown if they are set to TRUE. Thus, you may now write logic equations that force a shutdown of the RCP8 when certain conditions are present. The two types of shutdowns are provided in case there is a need to distinguish among different causes. Along with this, the status variable "shutdown" is set TRUE whenever the RCP8 is shutdown. For example, adding the equation "CSERVO = CSERVO & !SHUTDOWN" will force the servo power off whenever the RCP8 is shutdown.
- The four status variables "usr0", "usr1", "usr2", and "usr3" correspond to the four input lines at pins 1–4 of header H9 on the RCP8 main board. These are general purpose TTL inputs that you may assign to any purpose you wish. For example, to include an additional status bit in the RCP8's Internal BITE packet, include an equation such as "v13

= usr0". Since the local variables states appear in the BITE packet, the "usr0" line will show up in bit #6 of byte #12 as a result of this assignment.

- The status variable "unsafe" is TRUE if the RCP8 is in the temporary unsafe mode following a "reset" command. The status variables "ovel_az" and "ovel_el" are TRUE whenever the velocity on the corresponding axis exceeds the maximum value setup from the "velocity" command.
- The eight control variables **csgen0** through **csgen7** represent bits zero through seven of the signal generator level that is being requested by the host computer. Having access to these bits makes it possible to remap the level bits in cases where the signal generator is not controlled via the default HPIB interface.
- The two control variables **trig_normal** and **trig_blank** can be used to override the protected sector trigger blanking that is defined in the "Site Custom" menu. These new variables operate as follows (see also 5.8.4 Logic Equation Examples on page 127):

    - When **trig_blank** is FALSE and **trig_normal** is FALSE, the trigger is blanked whenever the antenna is within one of the designated sectors. This is the normal operating mode. You can disable all eight of the sectors if you don't want to use the trigger blanking feature at all.
    - When **trig_blank** is FALSE and **trig_normal** is TRUE, the trigger is always generated, no matter where the antenna is.
    - When **trig_blank** is TRUE, the trigger is always blanked, no matter where the antenna is. The assignment to **trig_normal** is ignored in this case.

When a new equation is entered, the RCP8 immediately parses the input text and converts the right-hand-side into an internal representation that can be evaluated efficiently at run time. The original line of text is discarded. Thus, when the equation is re–displayed, the RCP8 must recreate a printed line of text from this internal compiled representation. As a result, the equation that is echoed back will not always look the same as the equation that was originally typed. It will be logically equivalent, of course, but the exact syntax may be different. Some examples follow:

```
--> v0 = v1 & v2 & !v3

EQ00: v0 = v1 & v2 & !v3
```

Here, the output representation happens to be identical to the original input.

```
--> v0 = v1 & (v2 | v3)
```

```
EQ00: v0 = (v1 & v2) | (v1 & v3)
```

In this case, the equation is printed as an expanded version of the original. Note that the Boolean operators "&" and "|" both distribute symmetrically over each other, so that logical expressions can be factored and expanded over either operator.

```
--> v0 = (v1 & v2) | (v1 & !v2)

EQ00: v0 = v1
```

Here, what appears to be a function of two variables is really only dependent on one.

```
--> v0 = (!v1) & (!v2)

EQ00: v0 = !(v1 | v2)
```

In this case, the DeMorgan equivalent of the "AND of two negations" is printed as the "negation of two OR's". This type of transformation will often be observed, since the RCP8 attempts to minimize the number of "!" operators in its synthesized expressions.

The following list of subcommands is printed at the beginning of the equation list.

```
Subcommands

Del – Delete text of current equation

Ins – Insert free slot before current equation

Pack – Pack equations to consolidate free slots

! – Negate logic sense of equation

?<v> – Additional help
```

The first three subcommands are used to move and edit the list of equations. "Del" deletes the text of the current equation so that the line is blank. "Ins" inserts a blank equation at the current location by shifting the current equation plus all subsequent equations ahead by one. "Pack" removes blank equations and shifts all equations into the lower numbered slots.

The "!" subcommand replaces the current equation with its logical negation. Some examples are:

```
EQ00: v0 = v1 & v2
```

```
--> !

EQ00: v0 = !(v1 & v2)

EQ00: v0 = v1 & !v2

--> !

EQ00: v0 = (!v1) | v2
```

Note that DeMorgan's theorem was used to reprint the second of these two examples, because doing so removes an extra "!" from the equation. Perhaps the simplest equation to negate is:

```
EQ00: cservo = true

--> !

EQ00: cservo = false
```

Here, the output variable is forced TRUE/FALSE each time the "!" subcommand is used. This can be very helpful when testing individual control lines for simple ON/OFF response.

Before the actual equation list appears (in response to the "Control Logic" command), the following initial question is asked:

Enable logic override of control lines: NO New Value:

This first question allows the entire set of equations to easily be switched ON/OFF, without having to change any of the equations themselves. Answering "NO" will leave the control functions unmodified (direct control from the host computer); whereas "YES" will apply all of the logical constraints.

Unlike all other RCP8 setup menus, the logic equation editor is a live menu. This means that each equation becomes active as soon as it is typed in. It then becomes easy to test individual control lines, and to edit the set of equations until the desired effects are obtained. Also, the "!" subcommand becomes a simple shortcut to perform a quick ON/OFF toggle test of any control line.

5.8.3 Logic Equation Timer Variables

A collection of software timer variables are supported for use with logic equations. Eight control variables are available whose names have the generic form "t*n_mode_time*", depending on how each timer has been configured. For example, if timer #3 is configured to be a retriggerable pulse generator with a period of 2.5 seconds, then the variable "t3_retrig_2.5" would appear in the control variable list. You could abbreviate the typed-in name to just "t3", but the full mode and time will be echoed in each equation so that the exact behavior of the timer variables is clear at a glance.

Timer variables can appear on both the left and right sides of logic equations. On the right they act as normal Boolean variables having TRUE/FALSE values that can be used in any logic equation. However, when they appear on the left, the value being assigned from the right-hand side acts as an input trigger to the timer. The timer's response to this input can take several forms, depending on the mode that has been selected. The available modes are:

- **Retriggerable Pulse Generator** ("retrig")

  This timer generates a TRUE pulse whenever a FALSE->TRUE (rising edge) transition is applied to its input. Each rising edge continues to retrigger the output pulse, i.e., a fresh pulse period is begun each time. For example, if a rising edge were presented once per second to the timer "t0_retrig_1.5", then the timer output would be a steady TRUE value. Since the 1.5-second timeout begins anew once per second, the output pulse will never actually end. "Retrig" timers are handy for keeping track of whether any FALSE->TRUE transitions have occurred (perhaps irregularly) over a given period of time.

- **Change-Detecting Pulse Generator** ("change")

  This timer is like the retriggerable timer, except that either input edge will cause the period to reset. Use it whenever you require an output pulse in response to any change in measured conditions, e.g., you could force "radiate" OFF briefly whenever the pulsewidth changed in either direction.

- **Single Pulse Generator** ("single")

  This timer generates a pulse similar to "retrig", except that an active pulse will not be retriggered by additional input transitions. For example, if a rising edge were presented once per second to the timer "t0_single_1.5", then the timer output would be a rectangular wave that is TRUE for 1.5 seconds and FALSE for 0.5 seconds. The 1.5-second TRUE pulse is first triggered by an input edge. One second later the timer is still active, so the next input edge is ignored. The pulse finally ends 1.5-seconds later, remains FALSE for 0.5 second, and then is triggered again by the next rising input edge.

- The active-low application of "single" is also useful, as in the following two equations which prevent "radiate" from being switched back on within 60 seconds of it being switched off. Note that if a "retrig" timer were used here, then repeated attempts at radiating would keep resetting the 60-second interval even though the transmitter had never actually turned back on.

```
EQ00: t0_single_60 = !cradiate
EQ01: cradiate = cradiate & !t0_single_60
```

- **Delay Line Filter/Follower** ("filter")

  This output of this timer attempts to follow its input, but with filtering and delay effects added. Whenever a TRUE input is presented, an internal counter begins counting up until the timer period is reached. At that point the timer's output is set TRUE. Likewise, a FALSE input causes the counter to decrement until reaching zero, at which point the timer's output is set FALSE. The net result is that the output follows the mean value of the input, and thus, a "filter" timer can be used to clean up a noisy logic signal, or combination of logic conditions.

- **Decisive-Grant, Indecisive-Wait** ("fickle")

  The "fickle" timer copies its input immediately to its output, unless the output has just changed recently (within the setup period of the timer), in which case the previous output level is held. Use this timer to cleanup requests for state changes so that "original" and "thoughtful" requests get honored (passed through) right away, but once honored, a given request can not be changed for some minimum amount of time. The "fickle" timer can be used to protect against needless or damaging cycling of equipment that should not be turned On/Off rapidly. Air conditioner thermostats typically have such a timer to prevent the compressor from frequently stopping and restarting if the temperature dial is twirled up and down in an indecisive manner. After remaining in a stable state for a while, new requests will be honored right away (unlike the "filter" timer which always introduces a delay); but once honored, that new setting will once again persist for a little while.

- **Leading Edge Retard** ("retard")

  The output of this timer attempts to follow its input, except that rising input edges are delayed by the timer period, whereas falling input edges are passed through immediately. The result is that the leading edges of the input signal are delayed, but the falling edges are not. A "retard" timer is useful when one wants to delay only the onset portion of a signal, e.g., to holdoff transmitting for a few seconds after a radiate request has been made. It is also useful when filtering signals to remove short spurious TRUE inputs in which, contrasted with the "filter" timer, an instant-off effect is also required.

- **Trailing Edge Extend** ("extend")

  This timer is the counterpart to "retard", in that the falling input edge is extended by the timer period and the rising input edge is passed immediately. An "extend" timer forces a minimum time during which the timer output will be TRUE in response to any (possibly momentary) TRUE input. It is useful for stretching a short input condition out to at least some minimum time, or for adding additional "hold time" to the end of a signal.

Note that the output of an "extend" timer is logically equivalent to the negation of the output of a "retard" timer whose input is also negated. Although these two timer classes are merely inverted-logic duals of each other, it is still conceptually useful to have both the "retard" and "extend" concepts. An analogy is that "AND" and "OR" are both useful logic concepts, even though an OR-gate is merely an AND-gate with inverted inputs and outputs.

- **Periodic Clock Oscillator** ("clock")

  This timer produces a free-running clock having a specified period. The length of the timer's TRUE interval (and hence, the duty cycle) is also adjustable. The "clock" timers usually appear on the right side of equations, where they can supply any periodic input that the logic might require, e.g., to make a light blink, or to perform a periodic reset. But their phase can also be resynchronized to the start of their TRUE output interval by the application of a rising input edge.

5.8.4 Logic Equation Examples

The following examples show how to implement custom logic requirements using the logic equations and timer variables.

Example #1

Suppose that an operational site requires that the radar transmitter be switched off whenever the antenna is not rotating. This is fine for normal operation, but during maintenance periods there must also be a procedure to allow transmitting while stopped. When such an override is requested, an audible warning and flashing light must first occur for 20 seconds; only then does the override actually take effect. At that point the horn becomes silent, but the warning light must continue to flash for the duration of the override.

An RCP8 external status input line "S0" will be used to request the override. Assume that control line "C0" activates the horn, and that "C1" activates the warning light. The necessary equations are:

```
EQ00: v0 = cradiate & antstop & s0

EQ01: t0_retard_20 = v0

EQ02: c0 = v0 & !t0_retard_20

EQ03: c1 = v0 & t1_clock_1.5
```

```
EQ04: cradiate = (cradiate & !antstop) | t0_retard_20
```

EQ00 assigns local variable "V0" as a qualified override request. V0 will be TRUE when there is a request to radiate while stopped, and when the external override request line is also TRUE. EQ03 combines this condition with a 1.5-second periodic clock to produce the flashing light. Meanwhile, EQ01 passes V0 through a 20-second "retard" timer. When the timer output eventually becomes TRUE, EQ04 allows the transmitter to radiate even though the antenna is stopped. Meanwhile, EQ02 sounds the horn only during the timer's initial 20-second delay period.

As soon as the antenna starts moving, V0 and the timer output immediately become FALSE. The horn and light are extinguished right away, and the override input is ignored. The first "&" expression in EQ04 then allows the transmitter to be controlled in the normal On/Off manner.

Example #2

Logic equations can help supply the necessary control signals for backing out of stuck situations. In this example, an antenna servo power unit requires override signals to move away from the low and high elevation physical limit switches. Assume that "C0" and "C1" enable motion in the up and down directions. The following equations will allow the "reset" command to activate these lines briefly:

```
EQ00: c0 = antstop & unsafe & elimlo

EQ01: c1 = antstop & unsafe & elimhi
```

The "unsafe" status variable is TRUE for a short interval of time following an RCP8 reset. Resets from the host computer serial port always give a 1.0-second unsafe interval, whereas those from the RCP8 command line take the number of seconds as an argument, e.g., "reset 2.5". The "antstop" test is added as an additional safeguard to insure that the antenna is motionless when the override is attempted.

Example #3

Logic equations can be used to supply the host computer with BITE information that would not ordinarily be available. The trick is to make an assignment to one of the first fourteen local variables, as those will then be transmitted via the RCP8's Internal BITE Packet. For example, adding the equation:

```
EQ00: v13 = ovel_az | ovel_el
```

will send a "velocity overspeed" bit to the host computer in Bit #6 of Byte #12 (See Table 18 on page 160 for the mapping of the local variable bits).

Example #4

When writing sets of logic equations for the RCP8, keep in mind that assignments to most types of variables can not be referenced as such on subsequent lines. When control and status variables appear on the right side of an equation, they *always* refer to their original requested value. Assignments made on the left will modify the variable's effective working value; but the original requested value still remains unchanged. This is why it is never correct to make more than one assignment to the same control or status variable, and why the pair of equations:

```
EQ00: cpw0 = cpw1

EQ01: cpw1 = cpw0
```

would swap the two pulsewidth control lines without the use of the temporary intermediate variable that would normally be required for sequential assignments. The only variables that can be referenced immediately after being assigned are the local variables V[0:15]. Thus, the pair of equations:

```
EQ00: v0 = v1

EQ01: v1 = v0
```

would *not* swap the two local variables, but instead, would leave both set to the original value of V1 (probably not useful).

Example #5

As an example of how the trigger blanking variables might be used, consider a hypothetical farmhouse that is close enough to the radar that if the antenna is pointing at it, and the antenna is stationary, we would exceed the allowable microwave radiation limit. However, we are also allowed to average the power exposure over longer periods, so that if the antenna is moving we can radiate at the farmhouse as we sweep past it. We don't want to inhibit the trigger whenever the antenna stops; only when it stops within one of the protected sectors.

In summary, we want to stop transmitting while the antenna is stationary and is within one of the designated sectors, but we also want the radar to transmit whenever the antenna is moving. This is accomplished using the single equation:

```
EQ00: TRIG_NORMAL = !ANTSTOP
```

For a related application in which we want to stop transmitting whenever the antenna becomes stationary, simply use:

```
EQ00: TRIG_BLANK = ANTSTOP
```

Note that the built-in timers could also be used to permit brief antenna stoppings without producing the trigger side effects right away.

5.8.5 Logic Equation Configuration of Variables.

These setup questions are accessed by typing "Control Variables" at the "RCP>" prompt. Their purpose is to configure the internal variables that can be used within logic equations.

```
Choose: Retrig Single Filter Retard Extend Clock

Timer #0 trigger mode: Retrig

Timer #0 period/delay: 1.0
```

There are eight questions of this form, one for each of the eight available timers. Choose the mode of each timer (See 5.8.3 Logic Equation Timer Variables on page 124), and its associated period or delay (in seconds).

```
Minimum velocity for 'antstop': 0.50 deg/sec

Minimum time for 'antstop': 2.00 sec
```

The status variable "antstop" is set TRUE whenever the antenna seems to be stopped, i.e., has been moving slower than a prescribed speed for more than a prescribed time. These setup questions configure these speed and time thresholds. Both the AZ and EL axes must appear to be stopped in order for "antstop" to be TRUE. Likewise, "antstop" is set FALSE whenever the antenna seems to be moving, i.e., the speed on either axis has exceeded the threshold speed for more than the specified time.

5.8.6 Analog Voltage Input Control Logic Variables

You may configure Boolean variables whose values are based on comparison tests of the eight analog voltage input lines. In this way, the analog inputs can be thresholded and used as additional inputs to logic equations within the RCP8. Up to sixteen such variables may be defined, i.e., you may have, on the average, two threshold tests for each input line.

To setup the analog input variables, use the "Control ADC" command to define the following information for each voltage comparison test that you need:

```
Analog Input Test Variable Definitions

-------------------------------------

A/D Logic Variable #0 is defined: YES

Description of A00 variable: 'HiTemp '

Input summation term #1: A0

Input summation term #2: –A4

Input summation term #3: Zero

Input summation term #4: Zero

Test for ( A0–A4 > 3.55 Volts )
```

This example defines a new Boolean status variable named "a00_HiTemp". This variable name will appear in the "?v" list of available status variables within the equation editor, and the variable may be used on the right side of any logic equation. The descriptive suffix is intended to make the variable meaningful and readable within the text of the logic equations. You may choose any 8-character name that does not contain spaces or punctuation other than '.', '–', and '–'. The descriptive suffix can be omitted (not recommended) by entering a space at the prompt, but your logic equations will then become less readable.

The comparison test operates by summing the voltages on one or more input channels, and then testing whether that sum is greater than a specified voltage. If the test passes, then the variable is TRUE; otherwise it is FALSE. Moreover, the input channels can be either added or subtracted when computing the sum.

In the above example, "a0_HiTemp" will be TRUE whenever the difference of the voltages on channels 0 and 4 is greater than 3.55 volts. If you wish to create variables with a negated sense, you may reverse the signs of the comparison tests. For example, we could have created "a1_LowTemp" by defining the variable as:

```
A/D Logic Variable #1 is defined: YES

Description of A01 variable: 'LowTemp '

Input summation Term #1: A4
```

```
Input summation Term #2: –A0

Input summation Term #3: Zero

Input summation Term #4: Zero

Test for ( A4–A0 > –2.55 Volts )
```

These could then be combined in a logic equation as follows:

```
EQ00: # V0 will be TRUE when the temperature is normal

\–: v0 = !(a0_HiTemp | a1_LowTemp)

-->
```

5.8.7 The STATUS Command

This command prompts the user with a series of similar questions to choose whether each of the various status input lines are received by the RCP8 and what the polarity of those inputs are.

5.8.8 The INU Command

This command configures the optional Inertial Navigation Unit (INU). The INU provides the RCP8 with navigation and attitude information that is necessary for stabilizing a moving platform.

Use platform stabilization algorithms: YES

A "NO" response will disable all INU features and will inhibit all coordinate transformations between pedestal and Earth frames (the two frames are assumed identical.) None of the questions below will be displayed.

A "YES" response will enable the separate pedestal and Earth coordinate frames and prompt the user with the following additional questions:

Negate sign of Roll angles: NO

Negate sign of Pitch angles: NO

Negate sign of Heading angles: NO

Use these questions if it is necessary to change the sign of the attitude angles.

Roll offset from true orientation: 0.00 deg

Pitch offset from true orientation: 0.00 deg

Heading offset from true orientation: 0.00 deg

Use these questions if there are fixed offsets in the attitude angles. Typically, this will occur if the INU is not bolted directly in line with the ship's principal axes.

Lead time for velocity extrapolation: 0.050 sec

The stability of the Earth-frame velocity servo can sometimes be improved by leading the time derivatives of the attitude angles by a small amount. Typical values are between zero and 80ms.

Dead INU detection time: 5.0 sec

The RCP8 will stop performing coordinate transformations if the INU data stream is absent for more than this length of time. During the dead time, all INU angles and velocities are artificially set to zero.

Built-in INU Simulation: External

The RCP8 contains an internal INU simulator that is very useful during program development as well as for testing simulated moving environments. Typing the response "OFF" will disable the simulator and suppress the remaining questions in this section. Typing the response "EXTERNAL" will result in simulated INU SDLC data signals generated at the INU backpanel connector. This simulated stream can be looped back into the normal INU inputs for testing. Typing the response "INTERNAL" will run the same INU data simulation, but will internally loop it back into the RCP8 and will not generate any SDLC output signals.

The simulated motion is sinuosity on each axis and includes an adjustable amplitude, a center value, and a period. The default values that are displayed are simulating rather rough conditions in presumably bad weather.

Amplitude of motion for Roll axis: 12.00 deg

Amplitude of motion for Pitch axis: 8.00 deg

Amplitude of motion for Heading axis: 80.00 deg

Sets the peak amplitude of simulated motion on each axis.

Center of motion for Roll axis: 0.00 deg

Center of motion for Pitch axis: 0.00 deg

Center of motion for Heading axis: 0.00 deg

Sets the center of simulated motion on each axis.

Period of motion for Roll axis: 15.0 sec

Period of motion for Pitch axis: 13.0 sec

Period of motion for Heading axis: 60.0 sec

Sets the period of simulated motion of each axis.

CHAPTER 6

THEORY OF SERVO OPERATION

6.1 Overview of Servo Concepts

The RCP8 provides two independent, and nearly identical, motion servos for the azimuth and elevation axes of the radar antenna. These servos are implemented digitally within the RCP8 microprocessor. This chapter describes the operational theory of the antenna servos and fail safe algorithms as well as how the theory relates to the various setup parameters, as described in Chapter 5, TTY Setup Menus, on page 61.

In this chapter:

The servo software takes, as input, the digital antenna position and analog tachometer velocity and provides, as output, an analog drive signal for the motor power amplifiers. The interface between the processor and the tachometer and drive signals is made using 12-bit A/D and D/A converters. The servo software is periodically scheduled at 10 millisecond intervals and, in principal, has the capability of controlling antennas that have a significant response—such as 20Hz. In practice, most weather radar antennas are much more sluggish than this. Aside from the presence of limit switches in the elevation axis, the two servos are identical both in the configuration and in the operation.

There are three ways the RCP8 servos can operate:

1. Open loop
2. Velocity servo
3. Position servo

The Open Loop is not really a "servo" at all. This simply applies fixed drive levels to the motor to measure the antenna performance. At installation is the only time when Open loop is run—when the antenna's characteristics are measured to set up the actual control parameters. This is a manual procedure that requires the local TTY and is described in Chapter 4, TTY Menu Control and Monitoring, on page 45.

The velocity and the position servos are interrelated—each mechanism uses parts of the other during normal operation. The velocity servo always runs once either servo is activated. To achieve a particular velocity, the servo is used directly. To achieve a particular position, a non-linear position error is fed into the velocity servo from the position servo.

The position servo is implemented in the following two stages:

1. To convert the position error into a requested velocity, and
2. to convert the requested velocity into a drive signal.

Theoretically, it can be shown that this two-stage position servo can always be made stable—the position will always be reached without overshoot or oscillation. The non-linear feedback function can also be tailored to achieve, not only stability, but a high performance as well. This means that a requested position is reached in the shortest possible time.

6.2 Velocity Servo Theory

The block diagram of the velocity servo is illustrated in the figure below.

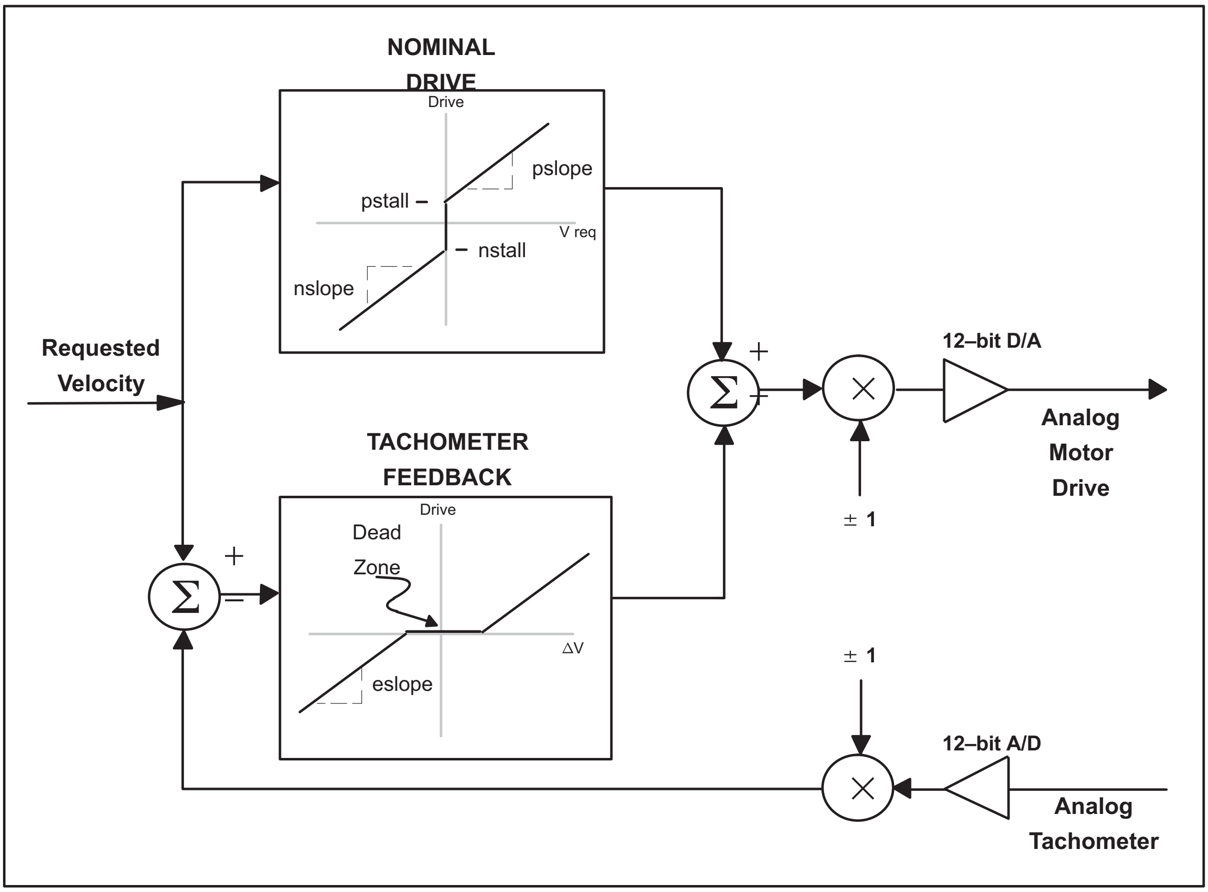


Figure 7 Digital Velocity Servo

6.2.1 Tachometer Input

The tachometer signal, from the motor gear box, is applied to a differential receiver and a 30Hz analog, low-pass filter. The signal is then digitized to 12-bits and added to the processor. The differential receiver ensures that any common-mode signal, on both of the tachometer leads (e.g. power-line noise) will not be falsely interpreted as antenna motion. In the case when there is no analog tachometer, a virtual tachometer based on the differentiated position can be selected as described in 5.5 The AXIS Command on page 100

The drive levels, that are computed by the processor, are applied to a 12-bit D/A converter, scaled by the external analog amplifiers, then applied to the motor power amplifiers.

NOTE	Note: The D/A and A/D convertors are signed. Thus they generate and accept both positive and negative voltage levels.

In Figure 7 on page 137, on the previous page, the drive signal is defined as the sum of two components:

1. A nominal level based solely on the requested velocity, and
2. a feedback term based on the difference between the requested and actual velocities.

The two graphed transfer functions indicate how the drive levels are derived for each of these components.

6.2.2 Nominal Drive Slope

The nominal component is an "initial guess" of the drive level that would sustain a given velocity in the steady state. For a requested velocity of zero, the upper-transfer graph indicates that no drive was applied. Without a drive, the motor will eventually come to rest. For non-zero velocities, most motors exhibit a dead zone in which the armature magnetization is insufficient to overcome the starting friction. Therefore, the nominal drive graph takes a discontinuous jump from zero. Due to the antenna's imbalances, this dead zone can also be asymmetric for both directions of motion.

These positive and negative starting drives are designated as "pstall" and "nstall" on the graph. Once the motor is started, a nominal slope is designated as "pslope" for the positive velocity and "nslope" for the negative velocity. Both are used to predict the required drive for large requested velocities.

6.2.3 Velocity Feedback Slope and Dead Zone

The feedback component of the motor drive is based on the difference between the requested and the actual (tachometer) velocities. The lower transfer graph demonstrates that the output is essentially linear, with a velocity error, except for the possible inclusion of a deadzone around zero. The slope is designated as "eslope" on the diagram. The deadzone, between – V and V , is used to minimize motor "chatter" that can result from uncertainty in the LSB of the tachometer voltage samples. Typically, the "eslope" is fairly large in order to achieve a tight velocity servo however, this large value also magnifies the A/D errors. This small inactive region (dead zone) in the feedback loop, typically two 1 or 2 T-units, will eliminate the problem.

The sum of the nominal and feedback terms is clamped within the - 100 to + 100 drive unit range and is applied to the D/A converter to produce the motor drive voltage. It is important to realize that the nominal term does not need to be calculated with great accuracy. In traditional, hard-wired, analog velocity servos, this term is not even used.

The term is included in the digital servo for the following reasons:

- It provides a simple way to take motor stall currents into account, and,
- it helps reduce the mean error that appears in the feedback term necessary to maintain a given velocity.

Every feedback system requires a non-zero error component to maintain control of a non-equilibrium position. By predicting the equilibrium drive requirements, the nominal term helps to ensure that the mean steady-state value of the velocity error will be zero.

6.2.4 Drive and Tach Sign Correction

There are two optional sign inversions that can be introduced in the velocity servo loop: one for the tachometer input and one for the drive output.

These two inversions must be set in the manner to ensure that :

1. the overall servo is stable, and
2. the positive requested velocities results in the positive tachometer velocities.

If the first condition is not met, then flipping either sign will result in stability. If this leads to a violation of the second condition, then both signs must be reversed together. Therefore, both conditions can be met by a suitable choice of multipliers. The need for the stability condition is obvious but the need for the correct tachometer sign results from the requirements that the position servo imposes when it is running.

6.3 Position Servo Theory

Unlike the velocity servo, the position servo is implemented as a simple extension, as shown in Figure 8 on page 140 on the following page. To reach a given position, the position error is used to calculate the velocity that is necessary to correct it. This velocity is then fed into the velocity servo, which continues to operate as described in the previous sections.

The elevation position servo will work properly over the complete 360-degree interval from -90 to +270 degrees. Servo motion will always be directed "over the top" when the antenna moves from one position to another. For example if the antenna is at +200 degrees, and a request is made to move to -30 degrees, then the antenna will traverse the 230-degree sector passing through 90-degrees. This is different from what would happen on the azimuth axis, where the shorter 130-degree path would be taken.

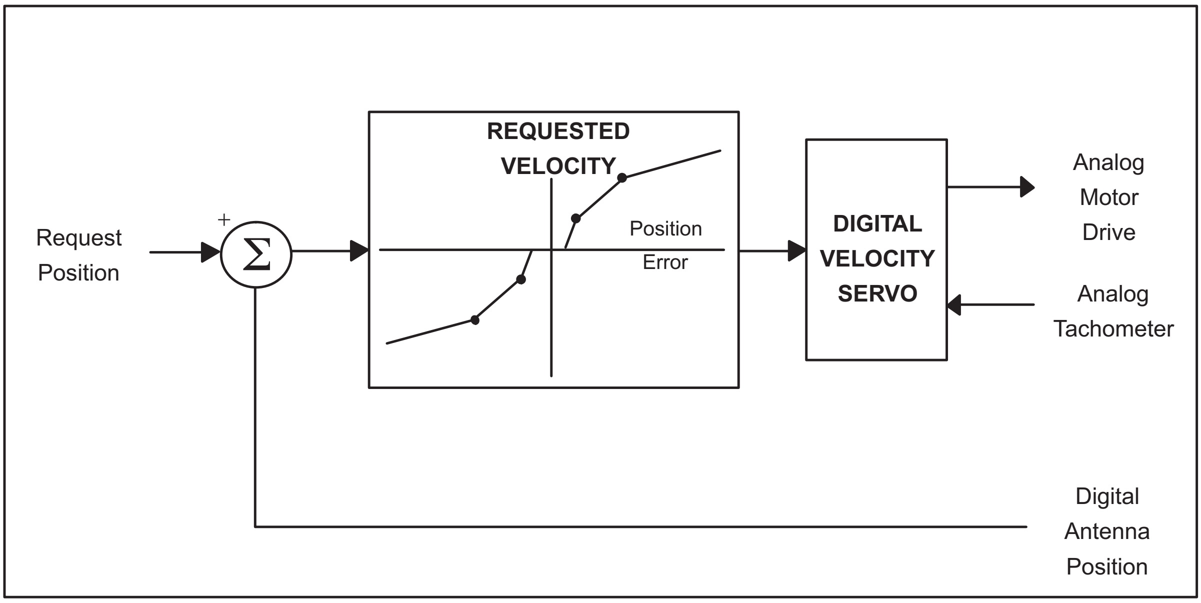


Figure 8 Digital Position Servo

6.3.1 The Position Servo Response Curve

As illustrated in the figure above, the mapping between the position error and the requested velocity, known as the Position Servo Response Curve, is quite non-linear and takes account of:

- Stored kinetic energy in the antenna mass
- Non-ideal, power driver characteristics
- Inductive and regenerative motor effects
- Friction

The details of determining actual values for the curve are discussed in 5.7 The PSERVO Command on page 116, but the overall, concave downward shape can be understood as follows: The angular velocity of the antenna cannot be changed instantaneously, but rather is limited to a rate that may depend on the velocity itself. The time integral, of such velocities, produces roughly "quadratically shaped" positions. When approaching from a far distance at high speed, the distance covered—in the time required to reduce the velocity by half—will be roughly three-quarters of the initial position error.

6.4 Fail-safe Antenna Features

Radar antenna systems consist of the reflector, pedestal, gears, motors and drive amplifiers. These are expensive components that must be protected in the event of failures. The RCP8 has several features that are designed to protect the antenna system from various types of failures.

In the event that a critical failure is detected, the RCP8 diverges into a shutdown state in the following ways:

1. The drive output voltage is zeroed.
2. The drive control relay signal is set to low. If a drive control relay is used, then the RCP8 drive outputs will be physically disconnected from the servo amplifiers. Depending on the installation, this may switch in an alternative drive system such as handwheels.
3. An error message is sent to the front panel display.
4. An error bit is set in the output to the host computer.

WARNING	CAUTION: In the case where the alternative drive system may attempt to move the antenna, it may be undesirable to automatically switch to the alternative drive when a shutdown occurs. In this case, the RCP8 drive relay signal should not be implemented and a manual switching approach should be used instead.

When a shutdown occurs, the operator should investigate the reason for the shutdown, either by viewing the front panel for a detailed message or by viewing the Control/Monitoring menu. After the fault has been corrected, a reset command can be issued, either from the RCP8 menus or over the host computer serial line.

One of the most potentially damaging situations is when the antenna operates out of the specified elevation range. There are several limits that are typically imposed to protect against this. These limits are illustrated in Figure 9 on page 143. The example shows the lower elevation limits for a typical system. Upper elevation limits are analogous.

Elevation Limit Switch Shutdown Algorithm

Elevation limit switches can be set to force an antenna shutdown, as described in5.4.5 Miscellaneous Site Setups on page 99. The algorithm checks 40 times per second for limit-switch contact.

Elevation "Shutdown Limit" Shutdown Algorithm

The Elevation Axis setup, as described in 5.5 The AXIS Command on page 100, allows the user to specify upper and lower elevation limits that, if exceeded, will cause the antenna to shutdown. The limits are checked 100 times per second. There is no tolerance for this test.

Elevation "Soft Limit" Watchdog Algorithm

WARNING	CAUTION: This algorithm should only be activated after the elevation position servo has been configured and tested. Refer to Section 4.5.

In order to enforce the soft position limits on the elevation axis, the velocity servo calls a few of the position servo subroutines on each iteration. This is done in order to determine whether the currently requested velocity, which may not have come from the position servo, is such that the antenna could still be stopped before encountering the limit. If the requested velocity is too great, then it is replaced by the velocity that the position servo would have used in order to just reach the limit. This safeguard ensures that the antenna speed is reduced in plenty of time to to reach a controlled stop before encountering the specified soft limit.

When the soft limit algorithm is activated, it will ensure that the antenna is brought to a safe stop at the soft limits, regardless of the servo mode (i.e., open loop, velocity, or position.)

NOTE	Note: Analogous soft limits can be set for azimuth as well, but these are rarely used since most antennas can rotate freely in azimuth.

Maximum Velocity Watchdog Algorithm

The RCP8 performs the following two types of checks on the velocity to ensure that the antenna is operating within the safe limits:

1. A velocity request limiter that clamps any of the out-of-bounds velocity requests from the host computer or indirectly from the position servo at the maximum value.
2. A continuous check on the antenna velocity to determine that it is operating within safe limits.

The following setup parameters, as described in 5.6 The VSERVO Command on page 111, are defined as:

- Maximum Absolute Velocity — 80 Tach units
- Velocity Shutdown Safe Margin — 5 Tach units
- Velocity Shutdown Time Check — one second

The watchdog will force an antenna shutdown if the velocity exceeds the Maximum Absolute velocity, by more than the Safe margin, during a time period longer than that of the Time check.

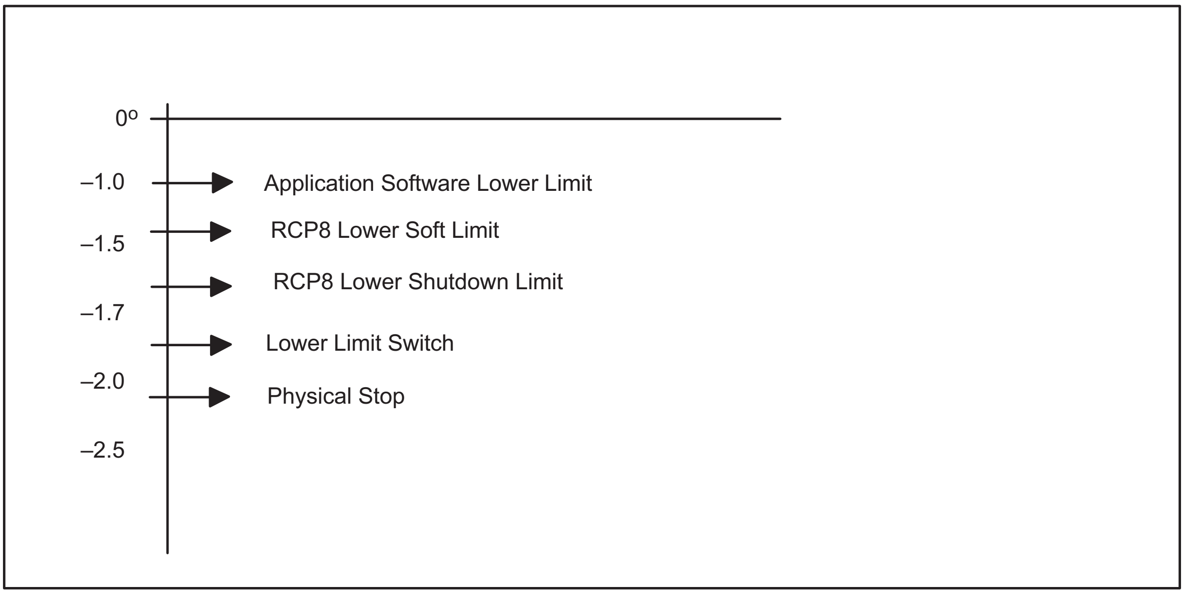


Figure 9 Example of the Lower EL LIMITS.

Tach/Position Consistency Shutdown Algorithm

NOTE	Note: This algorithm requires that the tach be calibrated in degrees per second. If the tach gain potentiometer is adjusted, then the tachometer calibration should be redone.

NOTE	Note: If virtual tach is used rather than an actual tachometer, this algorithm is disabled.

When the Tach is properly calibrated, the observed change in the antenna position should match the integrated velocity. If these are inconsistent, this could indicate failure of either the Tach or the position sensing and continued operation could lead to antenna damage.

The following algorithm parameters, as described in 5.5 The AXIS Command on page 100, are defined as:

- Permissible fixed error — 1.5º
- Permissible relative error — 10.00%

The watchdog algorithm computes the expected difference in position by integrating the velocity and comparing this to the observed position difference over the prior one second. The algorithm will force a shutdown of the antenna if the difference between the observed and the computed antenna displacements exceeds the larger of the fixed and the relative error.

For the antenna displacements greater than 15 degrees—in one second—the relative error of 10%, for an example, would be used as the standard for the test, while for the displacements of less than 15 degrees, the fixed error of 1.5 degrees would be used.

NOTE	Note: The algorithm integrates over the prior one second interval and is updated 16 times per second.

Unresponsive Antenna Watchdog Algorithms

When drive is applied to the antenna, then the antenna will generally accelerate. Failure of the antenna to accelerate could be the result of one, or more, of the following reasons.

- Servo amp. failure or servo amp. turned off.
- RCP8 drive output failure.
- Drive cable failure.
- Catastrophic gear failure of the antenna drive.
- Obstacle impeding the antenna motion, such as a person, a ladder, or a stow pin inadvertently left in the antenna.

With the exception of the servo amplifiers simply being turned off, any of of these events warrants an antenna shutdown. However, if the antenna is scanning at its equilibrium velocity, the output drive will not cause the antenna to accelerate since it is just balancing against frictional losses. This must be taken into account to avoid false alarms.

The unresponsive antenna algorithm is based on a linear model of the antenna velocity, with a constant moment of inertia, and frictional losses that are proportional to velocity. Under this model, the expected change in velocity can be calculated by numerical integration. The expected change is then compared to the actual change in velocity.

The following Axis Setup parameters for this algorithm, as described in 5.5 The AXIS Command on page 100, are defined as:

- Permissible Tach Prediction Error — 15 Tach units
- Maximum duration of such error — two seconds
- Moment of Inertia — 4.00 Drive/Tach units

The moment of inertia is computed whenever the antenna is accelerating and is exhibited in one of the "alt" displays in the Control and Monitoring menu. A representative value is then entered in the setup.

NOTE	Note: This algorithm does not require the tach to be calibrated in degrees per second. However, if the tach or drive potentiometers are adjusted, this algorithm will need to be reconfigured.

The algorithm performs a numerical integration, over the previous 2.5 seconds, to obtain the expected change in velocity (in Tach units.) If the difference between the expected velocity and the current velocity exceeds the "Permissible Tach error" for a period greater than the "Maximum duration," the Watchdog will force an antenna shutdown.

NOTE	Note: The algorithm integrates over the previous 2.5 second interval and is updated 8 times per second.

6.5 Modification of Servos For Use on a Moving Platform

The RCP8 is most commonly used to control land-based weather radar antennas. However, with the addition of base motion inputs, the RCP8 can also carry out electronic stabilization of an antenna that is mounted on a moving platform. The position and velocity servos are modified so the antenna motion is referenced to the inertial (Earth) frame of reference. The positions and the velocities are requested by the user and reported back to the user, relative to the local horizon and local north, just as they would for a stationary pedestal. The RCP8 manages all of the coordinate transformations needed to convert between the Earth system of units and the pedestal system of units.

To stabilize an antenna on a moving pedestal, it is necessary to know the instantaneous roll, pitch, and heading of the pedestal base as well as the time derivatives of those three quantities. Pedestal orientation is necessary to convert between the two systems of coordinates. Less obvious, however, is the need to know the rate of change of pedestal orientation.

The following describe the components that contribute to the net Earth velocity of a scanning antenna:

1. The component results from rotation of the pedestal Azimuth and Elevation axes themselves.

2. The component is the result of projected motion of the entire pedestal assembly.
3. The component is computable from the rate of change in the base orientation angles.

The basic velocity servo, as described in 6.4 Fail-safe Antenna Features on page 141, can be modified to work in Earth coordinates by adding a single coordinate conversion module to the block diagram. The modified servo is illustrated in Figure 10 on page 147. Rather than accepting requests for particular pedestal speeds, the new servo responds to commands to move at real Earth-relative velocities. The conversion module receives pedestal attitude information from an inertial navigation unit mounted on or near the pedestal. Based on these data, and on the current pedestal azimuth and elevation, Earth velocity requests are converted into equivalent pedestal velocity requests. The latter are fed into the two "old-style" velocity servos that use tachometer feedback to compute appropriate motor drives.

The velocity conversion module requires the pedestal azimuth and the elevation angles as input in order to project the Earth velocity into the pedestal frame. As a secondary effect of these calculations, the Earth azimuth and the elevation angles are also computed. When a position servo is running on one or both axes, these computed Earth angles are used by the position servo in the same way that pedestal angles were used in the land-based case. Therefore, the position servo from Figure 8 on page 140 is unchanged with the exception of the Earth angles, which are substituted wherever a pedestal angle previously appeared. Also, the angles can also be wired to a nearby signal processor and simultaneously sampled with the data from the radar.

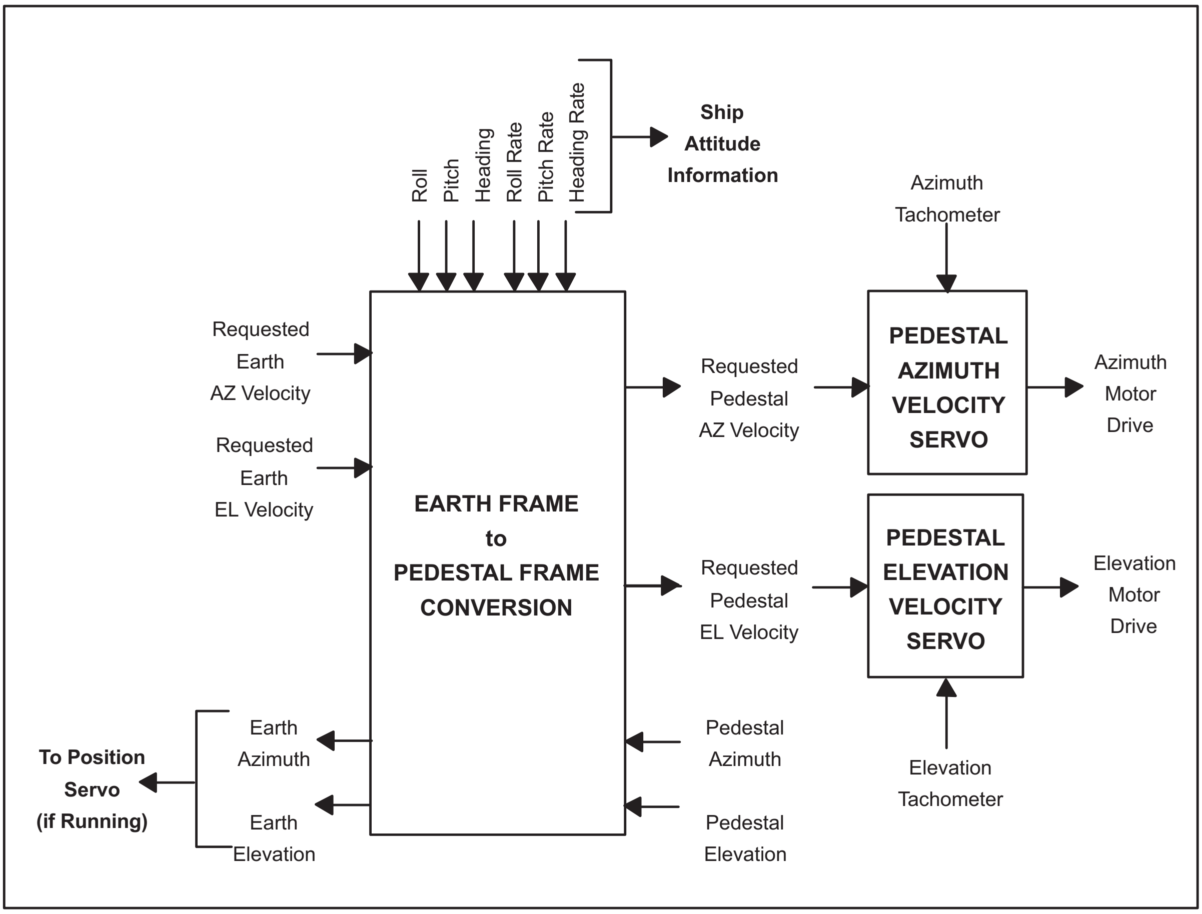


Figure 10 Modification of Velocity Servos

An interesting, complimentary addition to the RCP8 moving platform servos is its ability to scan co-planes. By introducing an artificial bias to the pedestal attitude information, a zero-degree elevation scan can be transformed into a planar scan in any orientation, not simply along the horizontal plane. This technique works equally well on either land or at sea.

The INU data stream may include status bits which convey the validity of the attitude angles. The RCP8 will "coast" for up to one second when it receives an invalid INU Roll/Pitch/Heading bit, or until the invalid bit is cleared, which ever occurs first. The last valid report of INU parameters will be used for stabilization during this time (including computation of the earth-relative output angles). Since it is unlikely that the antenna azimuth and/or the ship attitude will move more than 30 degrees in one second, the IRIS message "DSP AZ angles exceed 30 degrees" will not be triggered by very short bursts of invalid INU data.

Note that the option of continuing to use the new INU parameters for the one second interval (rather than coasting with the last valid ones) was specifically rejected for safety reasons, since there is a possibility that the new angles are truly bad.

APPENDIX A
COMMUNICATION FORMATS

A.1 Serial Data Format

The RCP8 is controlled by a two–way, asynchronous RS–232 data line that is typically run at speed of 19.2K baud. A host computer controls the servo and the antenna while receiving feedback status. The information is then transferred in packets consisting of two or more bytes—each packet begins with a SYNC byte and ends with an END byte of FF(Hex). All SYNC bytes have the MSB set and the value indicates the type of packet to follow. The variety of packets currently available are 80(hex) for antenna, C0(hex) for BITE, and B0(hex) for time. The packet layouts are described in the following paragraph. Each packet–type has a specific direction of travel, such as to or from the RCP8, but packets can arrive in any order within the serial stream.

Several types of antenna communication formats are supported. Older systems use the RCV01 and XMT01 formats but the newer systems can use the RCV02 and the XMT02 formats. The RCV03 format is intended for systems on moving platforms, such as ships or airplanes. One of the challenges of these systems is to correct the radar's measured radial velocity for the motion of the platform. To make this correction, the three–dimensional velocity and orientation of the platform must be recorded. Typically, the information comes from an inertial navigation system. For shipboard system, an update rate of approximately 20 reports per second can satisfy the velocity correction requirements at 19200 baud.

The following angles, with the exception of the latitude and the longitude, are transmitted as 14–bit binary angles. The latitude and longitude are both 21–bit binary angles.

- azimuth and elevation
- train order
- pitch, roll, and heading

In the XMT01 format, the angular speed is a signed number in units of 0.55º/sec. In all other formats, the angular rates are in signed 14–bit binary angles per second. Therefore, the largest possible value is 180º/sec (30 rpm) and the step is 0.022º/sec. All velocities are in signed cm/sec with the altitude in signed meters. If some of the information is not available at the full resolution of the data format, the low bits are filled with zeros.

The azimuth and the elevation angles are corrected angles relative to the north and are the angles that the antenna is pointed relative to the deck of the platform. These calculations are derivable from the other angles but are also reported to assist in the data analysis, especially if one of the sensors or the stabilization fails.

The pitch is the angle between the fore–and–aft axis of the platform and the horizontal is measured in the vertical plane. The pitch is positive when the bow is down and the roll is the rotation angle about the fore–and–aft axis in its pitched position. The pitch is measured in the plane perpendicular to the fore–and–aft axis, which is generally not the vertical plane, and the roll is positive when the deck is down on the port side.

NOTE	Note: The pitch can be directly measured by a level on the fore–and–aft axis but the roll cannot be directly measured by a one–axis tilt meter.

The heading is referred to as the direction the platform is pointed but is not the same as direction of motion. The platform could be pointed one way and drifting backwards.

The time stamp is a 14–bit counter incremented by the RCP8 once per millisecond. The RCP8 should latch all the data for a packet at the same time. This counter allows the host computer to accurately judge the time between samples without the serial line latencies and fluctuations due to the time sharing operating system.

The position of the platform is reported by the latitude, the longitude, and the altitude. Since the altitude may not be implemented for systems on ships, the setting will be zero.

A.2 Socket Data Format

The RCP8 can interface with other machines using a socket interface instead of a serial line. We use the exact same serial data format with an additional 16–byte header added, as shown in Table 9 on page 151. Note that for the ASCII packet types, there are C–style #defines in the antenna_lib.h file with names of the form ANT_PKT_TYPE*.

We use multicast UDP packets for this communication format. Typically the IP address is 224.0.0.3, port 30785 but it can be configured. Note that with socket data, multiple packets can arrive glued together as one, so the packet size is used to separate. Also on a multicast address, the reader will read everything written, so the first letter of the packet type is used to determine direction, and it ignores everything starting with an "R". If you are writing your own code to interface to this, be aware that on a computer with multiple network cards, you must explicitly specify which one to write out on. The destination address is not used at this time, you can fill it with htonl(INADDR_ANY).

Table 9 Socket Header Format

Byte	Function	
1–4	4–char ASCII size of the packet in %04d format.	
5–12	8–char ASCII packet type, 0 padded, choices are:	
	XMT01	Standard antenna XMTnn packets
	XMT02	
	XMT05	
	RCV01	Standard antenna RCVnn packets
	RCV02	
	RCV03	
	RCV05	
	XMTSA	Scientific Atlanta controller
	RCVSA	
	XCHAT	Chat mode packet
	RCHAT	
	RTIME	Time packet
	XBITEC	BITE control/status packet
	RBITES	
	XBINTROG	BITE 'Interrogate' packet
	RBINTROG	
	XBSAMPLE	BITE 'Take Sample' packet
	RBSAMPLE	
	XBSETVAL	BITE 'Take Sample' packet
	RBSETVAL	
	XBRESET	BITE 'Reset' packet
	RBRESET	
12–16	4–byte destination address in network byte order (INADDR_ANY fine)	

A.3 Antenna Status Formats

Table 10 Status Packet RCV01 Format (RCP8 to Host)

Char	Function	
1	SYNC Byte (80 Hex)	
2	Azimuth Low 7 bits	
3	Azimuth High 7 bits	
4	Elevation Low 7 bits	
5	Elevation High 7 bits	
6	Status #1	
		D6 = Low air flow
		D5 = Low Waveguide pressure
		D4 = Servo power
		D3 = Antenna Local mode
		D2 = Interlock
		D1 = Standby
		D0 = Radiate On
7	Status #2	
		D6 = RCP8 is shutdown
		D5 = LSB pulse width
		D4 = T/R power On
		D3 = T/R Local mode
		D2 = Encoders calibrated
		D1 = MSB pulse width
		D0 = Magnetron current normal
8	End Of Message (FF Hex)	

Table 11 Status Packet RCV02 Format (RCP8 to Host)

Char	Function	
1	SYNC Byte (80 Hex)	
2	Azimuth Low 7 bits	
3	Azimuth High 7 bits	
4	Elevation Low 7 bits	
5	Elevation High 7 bits	
6	Azimuth Rate Low 7 bits	
7	Azimuth Rate High 7 bits	
8	Elevation Rate Low 7 bits	
9	Elevation Rate High 7 bits	
10	Status #1	
		D6 = Low air flow
		D5 = Low Waveguide pressure
		D4 = Servo Power
		D3 = Antenna Local mode
		D2 = Interlock Open

Table 11 Status Packet RCV02 Format (RCP8 to Host)

Char	Function	
		D1 = Standby
		D0 = Radiate On
11	Status #2	
		D6 = RCP8 is shutdown
		D5 = LSB pulse width
		D4 = T/R power On
		D3 = T/R Local mode
		D2 = Azimuth encoder calibrated
		D1 = MSB pulse width
		D0 = Mag. current normal
12	Status #3	
		D6 = IRIS Mode 2
		D5 = IRIS Mode 1
		D4 = IRIS Mode 0
		D3 = Elevation encoder calibrated
		D2 = Signal Generator fault
		D1 = Signal Generator On
		D0 = Signal Generator CW
13	Signal generator level (0=max power)	
14	Time Stamp Low 7 bits	
15	Time Stamp High 7 bits	
16	END OF MESSAGE (FF Hex)	

Table 12 Status Packet RCV03 Format (RCP8 to Host)

Char	Function	
1	SYNC Byte (80 Hex)	
2	Identification byte	
3	Azimuth Low 7 bits (Earth relative)	
4	Azimuth High 7 bits	
5	Elevation Low 7 bits (Earth relative)	
6	Elevation High 7 bits	
7	Train Order Low 7 bits (azimuth of pedestal relative to the ship)	
8	Train Order High 7 bits	
9	Elevation Order Low 7 bits (elevation of pedestal relative to the ship)	
10	Elevation Order High 7 bits	
11	Pitch Low 7 bits	

Table 12 Status Packet RCV03 Format (RCP8 to Host)

Char	Function	
12	Pitch High 7 bits	
13	Roll Low 7 bits	
14	Roll High 7 bits	
15	Heading Low 7 bits	
16	Heading High 7 bits	
17	Azimuth Rate Low 7 bits	
18	Azimuth Rate High 7 bits	
19	Elevation Rate Low 7 bits	
20	Elevation Rate High 7 bits	
21	Pitch Rate Low 7 bits (LSB = Zero)	
22	Pitch Rate High 7 bits	
23	Roll Rate Low 7 bits (LSB = Invalid Roll)	
24	Roll Rate High 7 bits	
25	Heading Rate Low 7 bits (LSB = Invalid Heading)	
26	Heading Rate High 7 bits	
27	Status #1	
		D6 = Low air flow
		D5 = Low Waveguide pressure
		D4 = Servo power
		D3 = Antenna Local mode
		D2 = Interlock open
		D1 = Standby
		D0 = Radiate ON
28	Status #2	
		D6 = RCP8 is shutdown
		D5 = LSB pulse width
		D4 = T/R Power on
		D3 = T/R Local mode
		D2 = Azimuth encoder calibrated
		D1 = MSB pulse width
		D0 = Mag. current normal
29	Status #3	
		D6 = Reserved
		D5 = Reserved
		D4 = Reserved
		D3 = Elevation encoder calibrated
		D2 = Signal Generator fault
		D1 = Signal Generator On
		D0 = Signal Generator CW

Table 12 Status Packet RCV03 Format (RCP8 to Host)

Char	Function	
30	Signal generator value (0=full signal)	
31	Time Stamp Low 7 bits	
32	Time Stamp High 7 bits	
33	Latitude Low 7 bits	
34	Latitude Middle 7 bits	
35	Latitude High 7 bits	
36	Longitude Low 7 bits	
37	Longitude Middle 7 bits	
38	Longitude High 7 bits	
39	Altitude Low 7 bits	
40	Altitude High 7 bits	
41	Velocity East Low 7 bits (LSB = Invalid Lat/Lon)	
42	Velocity East High 7 bits	
43	Velocity North Low 7 bits (LSB = Zero)	
44	Velocity North High 7 bits	
45	Velocity Up Low 7 bits (LSB = Invalid Altitude)	
46	Velocity Up High 7 bits	
47	END OF MESSAGE (FF Hex)	

Table 13 Status Packet RCV05 Format (RCP8 to Host)

Char	Function	
1–15	These bytes exactly match the RCV02 / RCV04 format	
1–16	Dual–System Status	
		D6 = RCP8 is configured as a Dual–System
		D5 = Dual–System Mode MSB
		D4 = Dual–System Mode LSB
		D3 = This packet was sent from Unit "A"
		D2 = Information is known about the "Other" unit
		D1 = Unit "A" is the preferred system
		D0 = Unit "B" is disabled
Note: The 2–bit Dual–System Mode codes are: 00 : Unknown 01 : System "A" 10: System "B" 11 : Auto Switch		
17	Dual–System Status	
		D6 = Unit "B" is okay
		D5 = Unit "B" Activity Code MSB

Table 13 Status Packet RCV05 Format (RCP8 to Host)

Char	Function	
		D4 = Unit "B" Activity Code LSB
		D3 = Unit "A" is disabled
		D2 = Unit "A" is okay
		D1 = Unit "A" Activity Code MSB
		D0 = Unit "A" Activity Code LSB
Note: The 2–bit Dual–System Activity codes are:		
00 : Inactive 01 : Warmup 10: Active Now 11 : Reserved		
18	Dual–System Status	
		D6 = RCP8 is configured for voluntary flipping
		D5 = Unit "B" is offering to give up control
		D4 = Unit "A" is offering to give up control
		D3 = Unit "B" would be used if it were available
		D2 = Unit "A" would be used if it were available
19	Polarization Status	
		D2:0 = Current Polarization XMT control
		0=Horizontal; 1=Vertical; 2=Alternating; 3=Simultaneous
		D3 = Polarization switch is OK to XMT
20	Spare	
21	Spare	
22	Spare	
23	Spare	
24	END OF MESSAGE (FF Hex)	

A.4 Antenna Control Formats

Table 14 Control Packet XMT01 Format (Host to RCP8)

Char	Function	
1	SYNC Byte (80 Hex)	
2	Azimuth Low 7 bits	
3	Azimuth High 7 bits	
4	Elevation Low 7 bits	
5	Elevation High 7 bits	
6	Control Word #1	
		D6 = MSB of Pulse Width
		D5 = Leave Pulse Width unchanged
		D4 = Spare
		D3 = Signal Generator On
		D2 = Signal Generator CW
		D1 = EL (1 = Scan, 0 = Position)
		D0 = AZ (1 = Scan, 0 = Position)
7	Control Word #2	
		D6 = Reset RCP8 on edge
		D5 = Noise Source On
		D4 = LSB of Pulse width
		D3 = Radiate On complemented
		D2 = Radiate On
		D1 = Servo Power On
		D0 = T/R Power On
8	Control Word #3 (all spare)	
9	Signal generator level (unsigned 0–127dB attenuation)	
10	AZ/EL Antenna speed (signed 7 bit, 0.55 degree resolution)	
11	END OF MESSAGE (FF Hex)	

Table 15 Control Packet XMT02 Format (Host to RCP8)

Char	Function	
1	SYNC Byte (80 Hex)	
2	Azimuth Low 7 bits	
3	Azimuth High 7 bits	
4	Elevation Low 7 bits	
5	Elevation High 7 bits	
6	Control Word #1	
		D6 = MSB of Pulse Width

Table 15 Control Packet XMT02 Format (Host to RCP8)

Char	Function	
		D5 = Leave Pulse Width unchanged
		D4 = Spare
		D3 = Signal Generator On
		D2 = Signal Generator CW
		D1 = EL (1 = Scan, 0 = Position)
		D0 = AZ (1 = Scan, 0 = Position)
7	Control Word #2	
		D6 = Reset RCP8 on edge
		D5 = Noise Source On
		D4 = LSB of Pulse width
		D3 = Radiate On complemented
		D2 = Radiate On
		D1 = Servo Power On
		D0 = T/R Power On
8	Control Word #3	
		D6 = IRIS Mode 2
		D5 = IRIS Mode 1
		D4 = IRIS Mode 0
		D3 = Radar Workstation A okay
		D2 = Radar Workstation B okay
		D1 = Data Processor A okay
		D0 = Data Processor B okay
9	Signal Generator level (0–127 dB attenuation)	
10	AZ Antenna Speed Low 7 bits	
11	AZ Antenna Speed High 7 bits	
12	EL Antenna Speed Low 7 bits	
13	EL Antenna Speed High 7 bits	
14	END OF MESSAGE (FF Hex)	

Table 16 Control Packet XMT05 Format (Host to RCP8)

Char	Function	
1#endash13	These bytes exactly match the XMT02 / XMT04 format	
14	Control Word #4	
		D6 = Dual–System: Mode MSB
		D5 = Dual–System: Mode LSB

Table 16 Control Packet XMT05 Format (Host to RCP8)

Char	Function	
		D4 = Dual–System: Offer to relinquish control
		D3 = Dual–System: Unit would be used if available
		D2 = Spare
		D1 = Spare
		D0 = Spare
Note: The 2–bit Dual–System Mode codes are:		
	00 : No change	01 : System "A"
	10: System "B"	11 : Auto Switch
15	Control Word #5	
		D2:0 = Requested Polarization XMT control
		0=Horizontal; 1=Vertical; 2=Alternating; 3=Simultaneous
		7=Unchanged
		D6:3 = Spare
16	Spare	
17	Spare	
18	END OF MESSAGE (FF Hex)	

A.5 BITE Formats

The BITE status packet consists of a packet from 3 to 20 bytes in length. The first two bytes, and the last byte, are used for identification purposes. The bytes in the middle must have their MSB zero, but can contain arbitrary status in the lower 7 bits. This is typically used to report test results in the individual bits, such as cabinet interlocks, airflow sensors, and power supply checks.

Table 17 Generic BITE Packet (RCP8 To/From Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (00 Hex)
3	Status byte #1
4	Status byte #2
.	
.	
N–1	Status byte #N–3
N	END OF MESSAGE (FF Hex)

The Q–BITE (Quantitative BITE) status packets consist of from 3 to 128 bytes. The first two and last bytes are used for identification purposes. The middle bytes must have the MSB set to zero and can contain an arbitrary value in the lower 7 bits. Typically this is used to report back voltage/ power levels. This report should not be sent by the BITE every time the status changes. This report is sent in response to the Q–bite interrogate command. IRIS sends the interrogate command every 60 seconds.

The Q–BITE data stream consists of a series of integer values. Each value is packed into a series of 7–bit characters, using between 1 and 5 depending on the desired resolution. The low bits come first, and IRIS supports up to 32 bits per value. IRIS can easily be configured to display any such values with appropriate units and scaling.

Table 18 Q–BITE Status Packet (Both ways)

Char	Function
1	SYNC Byte (AF Hex)
2	BITE Unit ID byte (selectable in the range 00–7F Hex)
3	Status byte #1
4	Status byte #2
.	
.	
N–1	Status byte #N–3
N	END OF MESSAGE (FF Hex)

The RCP8 can optionally generate this "internal" BITE packet. These bits convey additional status information that is not contained in any of the other transmission formats. The shutdown status of the RCP8 (up to 32 different conditions) is contained in the first five bytes. The last five bytes hold other miscellaneous information. The identification byte is selectable, so that conflicts with other BITE packets can be avoided.

Table 19 Internal BITE Packet (RCP8 to Host)

Char	Function	
1	SYNC Byte (C0 Hex)	
2	Identification byte (User Choice)	
3	Shutdown Conditions 0–6	
		D6 = EL Velocity Exceeded
		D5 = AZ Velocity Exceeded
		D4 = EL Axis Unresponsive
		D3 = AZ Axis Unresponsive
		D2 = EL Tach Inconsistent
		D1 = AZ Tach Inconsistent
		D0 = Diagnostics Failed
4	Shutdown Conditions 7–13	

Table 19 Internal BITE Packet (RCP8 to Host) (Continued)

Char	Function	
		D6 = IP–SERIAL Conflicts D5 = EL Upper Lim Switch D4 = EL Lower Lim Switch D3 = EL–UP Shutdown Limit D2 = EL–LO Shutdown Limit D1 = AZ–HI Shutdown Limit D0 = AZ–LO Shutdown Limit
5	Shutdown Conditions 14–20	D6 = Reserved D5 = Reserved D4 = Reserved D3 = Reserved D2 = IP–DIGITAL–48 Conflicts D1 = Output Remap Conflict D0 = Missing IP–SYNCHRO
6	Shutdown Conditions 21–27	D6 = Reserved D5 = Reserved D4 = Reserved D3 = Reserved D2 = Reserved D1 = Reserved D0 = Reserved
7	Shutdown Conditions 28–31	D6 = Spare D5 = Power–up error(s) occured D4 = RCP8 is shutdown (OR of Bits 0–31) D3 = User Shutdown #2 D2 = User Shutdown #1 D1 = Reserved D0 = Reserved
8	INU Status	D6 = Invalid horizontal position/velocity D5 = Reduced vertical position/velocity D4 = Invalid vertical position/ velocity D3 = Reduced roll and pitch D2 = Invalid roll and pitch D1 = Reduced heading D0 = Invalid heading

Table 19 Internal BITE Packet (RCP8 to Host) (Continued)

Char	Function	
9	Antenna/Radar/Servo and INU status	
		D6 = Reduced horizontal position/velocity
		D5 = No INU Data Stream
		D4 = T/R Power On
		D3 = T/R Local mode
		D2 = LSB pulse width
		D1 = MSB pulse width
		D0 = Mag. current normal
10	Antenna/Radar/Servo status	
		D6 = Low air flow
		D5 = Low Waveguide pressure
		D4 = Servo Power
		D3 = Antenna Local mode
		D2 = Interlock Open
		D1 = Standby
		D0 = Radiate On
11	Local Variables V6, V5, V4, V3, V2, V1, V0	
12	Local Variables V13, V12, V11, V10, V9, V8, V7	
13	END OF MESSAGE (FF Hex)	

The RCP8 contains 64 auxiliary status and control variables, labeled S[0:63] and C[0:63]. These bits may be sent to and from the host computer in the form of 13–byte BITE packets holding the full set of 64 bits. The format of these packets is the same in both directions, and the identification byte is selectable so that conflicts with other BITE packets can be avoided. A subset of the auxiliary bits may optionally be assigned to electrical input and output lines on an I/O–62 card using the softplane.conf file. The auxiliary can also be set and accessed via logic equations.

Table 20 Auxiliary Status/Control BITE Packets

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)
3	Control/Status Bits 6 5 4 3 2 1 0
4	Control/Status Bits 13 12 11 10 9 8 7
5	Control/Status Bits 20 19 18 17 16 15 14
6	Control/Status Bits 27 26 25 24 23 22 21
7	Control/Status Bits 34 33 32 31 30 29 28
8	Control/Status Bits 41 40 39 38 37 36 35
9	Control/Status Bits 48 47 46 45 44 43 42

Table 20 Auxiliary Status/Control BITE Packets (Continued)

Char	Function
10	Control/Status Bits 55 54 53 52 51 50 49
11	Control/Status Bits 62 61 60 59 58 57 56
12	Control/Status Bit 63
13	END OF MESSAGE (FF Hex)

The RCP8 will generate this BITE packet whenever the WSR–88D DCU pedestal interface has been enabled. The identification byte is selectable, so that conflicts with other BITE packets can be avoided. The "S" number appearing after each table entry is the numbered status variable that is driven by the respective bit. Most bits in the BITE packet are merely copies of their DCU counterparts (with their original word and bit numbers shown in parenthesis). However, S110 through S119 are supplied by the RCP8 itself.

Table 21 WSR–88D DCU BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)
3	WSR–88D DCU Status and Fault Conditions
	D6 = (1/6) Elev Axis Enc Light Source Monitor (S70)
	D5 = (1/5) Spare (S69)
	D4 = (1/4) Elevation Axis minus Normal Limit (S68)
	D3 = (1/3) Elevation Axis plus Normal Limit (S67)
	D2 = (1/2) Spare (S66)
	D1 = (1/1) Elevation Axis Deal Limit (S65)
	D0 = (1/0) Elevation Axis PCU Data Parity (S64)
4	WSR–88D DCU Status and Fault Conditions
	D6 = (1/14) Elevation Axis Motor Over Temp. (S77)
	D5 = (1/13) +150 V Under Voltage (S76)
	D4 = (1/12) +150 V Over Voltage (S75)
	D3 = (1/11) EL Axis Servo Amp Over Temp (S74)
	D2 = (1/10) EL Axis Servo Amp Short Circuit (S73)
	D1 = (1/9) Elevation Axis Servo Amp Inhibit (S72)
	D0 = (1/7) Elevation Axis Gearbox Oil Level (S71)
5	WSR–88D DCU Status and Fault Conditions
	D6 = (2/5) Elevation Handwheel Engaged (S84)
	D5 = (2/4) Spare (S83)
	D4 = (2/3) Azimuth Axis Bull Gear Oil Level (S82)
	D3 = (2/2) Azimuth Axis Gearbox Oil Level (S81)
	D2 = (2/1) Azith Axis Encoder Light Source Mon (S80)
	D1 = (2/0) Azimuth Axis PCU Data Parity (S79)
	D0 = (1/15) Elevation Axis Stow Pin Engaged (S78)
6	WSR–88D DCU Status and Fault Conditions
	D6 = (2/13) Spare (S91)

Table 21 WSR–88D DCU BITE Packet (RCP8 to Host)

Char	Function
	D5 = (2/12) Spare (S90)
	D4 = (2/11) AZ Axis Servo Amp Over Temp (S89)
	D3 = (2/10) AZ Axis Servo Amp Short Circuit (S88)
	D2 = (2/9) Azimuth Axis Servo Amp Inhibit (S87)
	D1 = (2/7) Spare (S86)
	D0 = (2/6) Azimuth Handwheel Engaged (S85)
7	WSR–88D DCU Status and Fault Conditions
	D6 = (3/4) Spare (S98)
	D5 = (3/3) Spare (S97)
	D4 = (3/2) Spare (S96)
	D3 = (3/1) Spare (S95)
	D2 = (3/0) Spare (S94)
	D1 = (2/15) Azimuth Axis Stow Pin Engaged (S93)
	D0 = (2/14) Azimuth Axis Motor Over Temp (S92)
8	WSR–88D DCU Status and Fault Conditions
	D6 = (3/12) Azimuth Axis Servo Amp PS (S105)
	D5 = (3/11) Spare (S104)
	D4 = (3/10) Spare (S103)
	D3 = (3/9) Spare (S102)
	D2 = (3/7) Spare (S101)
	D1 = (3/6) Spare (S100)
	D0 = (3/5) Spare (S99)
9	WSR–88D DCU Status and Fault Conditions
	D6 = Spare (S112)
	D5 = Spare (S111)
	D4 = Spare (S110)
	D3 = DCU Timeout (From DCU antenna record) (S109)
	D2 = (3/15) Ped Interlock (S108)
	D1 = (3/14) Servo Off (S107)
	D0 = (3/13) Elevation Axis Servo Amp PS (S106)
10	WSR–88D DCU Status and Fault Conditions
	D6 = No ANT record received for 0.5 seconds (S119)
	D5 = No BIT record received for 2.5 seconds (S118)
	D4 = Spare (S117)
	D3 = Spare (S116)
	D2 = Spare (S115)
	D1 = Spare (S114)
	D0 = Spare (S113)
11	END OF MESSAGE (FF Hex)

The RCP8 will generate this BITE packet whenever the WSR–88D DCU pedestal responds to a Self–Test1 command. Most bits in the BITE packet are merely copies of their DCU counterparts (with their original word and bit numbers shown in parenthesis).

Table 22 WSR–88D DCU Self–Test1 BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)
3	D6 = (1/6) Az Command loopback
	D5 = (1/5) Az Command loopback
	D4 = (1/4) Az Command loopback
	D3 = (1/3) Az Command loopback
	D2 = (1/2) Az Command loopback
	D1 = (1/1) Az Command loopback
	D0 = (1/0) Az Command loopback
4	D6 = (1/13) Az Command loopback
	D5 = (1/12) Az Command loopback
	D4 = (1/11) Az Command loopback
	D3 = (1/10) Az Command loopback
	D2 = (1/9) Az Command loopback
	D1 = (1/8) Az Command loopback
	D0 = (1/7) Az Command loopback
5	D6 = (2/4) El Command loopback
	D5 = (2/3) El Command loopback
	D4 = (2/2) El Command loopback
	D3 = (2/1) El Command loopback
	D2 = (2/0) El Command loopback
	D1 = (1/15) Az Command loopback
	D0 = (1/14) Az Command loopback
6	D6 = (2/11) El Command loopback
	D5 = (2/10) El Command loopback
	D4 = (2/9) El Command loopback
	D3 = (2/8) El Command loopback
	D2 = (2/7) El Command loopback
	D1 = (2/6) El Command loopback
	D0 = (2/5) El Command loopback
7	D6 = Spare
	D5 = Spare
	D4 = Spare
	D3 = (2/15) El Command loopback
	D2 = (2/14) El Command loopback
	D1 = (2/13) El Command loopback
	D0 = (2/12) El Command loopback
8	END OF MESSAGE (FF Hex)

The RCP8 will generate this BITE packet whenever the WSR–88D DCU pedestal responds to a Self–Test2 command. Most bits in the BITE packet are merely copies of their DCU counterparts (with their original word and bit numbers shown in parenthesis).

Table 23 WSR–88D DCU Self–Test2 BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)
3	D6 = (1/6) AZ Power Amp
	D5 = (1/5) Spare
	D4 = (1/4) Spare
	D3 = (1/3) Spare
	D2 = (1/2) Spare
	D1 = (1/1) Spare
	D0 = (1/0) Digital PWA
4	D6 = (1/13) Spare
	D5 = (1/12) El Encoder
	D4 = (1/11) AZ Encoder
	D3 = (1/10) El Motor
	D2 = (1/9) AZ Motor
	D1 = (1/8) Analog PWA
	D0 = (1/7) El Power Amp
5	D6 = <unused>
	D5 = <unused>
	D4 = <unused>
	D3 = <unused>
	D2 = <unused>
	D1 = (1/15) Spare
	D0 = (1/14) Spare
6	END OF MESSAGE (FF Hex)

The RCP8 will generate this BITE packet whenever the WSR–88D DAU pedestal interface has been enabled. The identification byte is selectable, so that conflicts with other BITE packets can be avoided. The "S" number appearing after each table entry is the numbered status variable that is driven by the respective bit. Most bits in the BITE packet are merely copies of their DAU counterparts (with their original word and bit numbers shown in parenthesis). However, S232 through S245 are supplied by the RCP8 itself.

Table 24 WSR–88D DAU BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (C0 Hex)
2	Identification byte (User Choice)

Table 24 WSR–88D DAU BITE Packet (RCP8 to Host)

Char	Function
3	WSR–88D DAU Status and Fault Conditions
	D6 = (0/6) Maintenance Work Required (S126)
	D5 = (0/5) Maintenance Model/No Control (S125)
	D4 = (0/4) W/G PFN Transfer Interlock (S124)
	D3 = (0/3) W/G Switch Dummy Load (S123)
	D2 = (0/2) Transmitter Not Available (S122)
	D1 = (0/1) Klystron Preheat (S121)
	D0 = (0/0) Filament PS Off (S120)
4	WSR–88D DAU Status and Fault Conditions
	D6 = (1/5) Filament PS Voltage (S133)
	D5 = (1/4) +45 VDC PS Summary Fault (S132)
	D4 = (1/3) -15 VDC PS Summary Fault (S131)
	D3 = (1/2) +28 VDC PS Summary Fault (S130)
	D2 = (1/1) +15 VDC PS Summary Fault (S129)
	D1 = (1/0) +5 VDC PS Summary Fault (S128)
	D0 = (0/7) PFN Switch Long Pulse (S127)
5	WSR–88D DAU Status and Fault Conditions
	D6 = (2/4) Cabinet Air Temperature (S140)
	D5 = (2/3) Cabinet Interlock (S139)
	D4 = (2/2) W/G Arc/VSWR (summary) (S138)
	D3 = (2/1) Spectrum Filter Low Pressure (S137)
	D2 = (2/0) Circulator Over–Temperature (S136)
	D1 = (1/7) Focus Coil PS Voltage (S135)
	D0 = (1/6) Vacuum Pump PS Voltage (S134)
6	WSR–88D DAU Status and Fault Conditions
	D6 = (3/3) Main Power Overvoltage (S147)
	D5 = (3/2) Modulator Switch Failure (S146)
	D4 = (3/1) Modulator Inverter Current (S145)
	D3 = (3/0) Modulator Overload (S144)
	D2 = (2/7) Transmitter Spare (S143)
	D1 = (2/6) Transmitter Spare (S142)
	D0 = (2/5) Cabinet Airflow (S141)
7	WSR–88D DAU Status and Fault Conditions
	D6 = (4/2) Focus Coil Current (S154)
	D5 = (4/1) Transmitter Overcurrent (S153)
	D4 = (4/0) Transmitter Overvoltage (S152)
	D3 = (3/7) Transmitter Spare (S151)
	D2 = (3/6) Trigger Amplifier Failure (S150)
	D1 = (3/5) Inverse Diode Current/Undervoltage (S149)
	D0 = (3/4) Flyback Charge Failure (S148)
8	WSR–88D DAU Status and Fault Conditions
	D6 = (5/1) Klystron Filament Current (S161)
	D5 = (5/0) Klystron Overcurrent (S160)
	D4 = (4/7) Battery Charging (S159)

Table 24 WSR–88D DAU BITE Packet (RCP8 to Host)

Char	Function
	D3 = (4/6) Oil Level (Transmitter) (S158)
	D2 = (4/5) PRF Limit (Summary) (S157)
	D1 = (4/4) Oil Temperature (Transmitter) (S156)
	D0 = (4/3) Focus Coil Airflow (S155)
9	WSR–88D DAU Status and Fault Conditions
	D6 = (6/0) 'One' Test Bit 0 (S168)
	D5 = (5/7) 'One' Test Bit 7 (S167)
	D4 = (5/6) 'One' Test Bit 6 (S166)
	D3 = (5/5) 'One' Test Bit 5 (S165)
	D2 = (5/4) Klystron Airflow (S164)
	D1 = (5/3) Klystron Air Temperature (S163)
	D0 = (5/2) Klystron Vacion Current (S162)
10	WSR–88D DAU Status and Fault Conditions
	D6 = (6/7) W/G, Pressure/Humidity (S175)
	D5 = (6/6) Post–Charge Regulator Maintenance (S174)
	D4 = (6/5) Modulator Switch Maintenance (S173)
	D3 = (6/4) 'One' Test Bit 4 (S172)
	D2 = (6/3) 'One' Test Bit 3 (S171)
	D1 = (6/2) 'One' Test Bit 2 (S170)
	D0 = (6/1) 'One' Test Bit 1 (S169)
11	WSR–88D DAU Status and Fault Conditions
	D6 = (7/6) 'Zero' Test Bit 6 (S182)
	D5 = (7/5) 'Zero' Test Bit 5 (S181)
	D4 = (7/4) 'Zero' Test Bit 4 (S180)
	D3 = (7/3) 'Zero' Test Bit 3 (S179)
	D2 = (7/2) 'Zero' Test Bit 2 (S178)
	D1 = (7/1) 'Zero' Test Bit 1 (S177)
	D0 = (7/0) 'Zero' Test Bit 0 (S176)
12	WSR–88D DAU Status and Fault Conditions
	D6 = (8/5) Spare (S189)
	D5 = (8/4) UART Error (S188)
	D4 = (8/3) COHO/Clock (S187)
	D3 = (8/2) Transmitter Inoperable (S186)
	D2 = (8/1) Transmitter Recycle (S185)
	D1 = (8/0) HV Off (S184)
	D0 = (7/7) 'Zero' Test Bit 7 (S183)
13	WSR–88D DAU Status and Fault Conditions
	D6 = (9/4) Batter Voltage Low (S196)
	D5 = (9/3) Auto–Transfer SW on Utility Power (S195)
	D4 = (9/2) Generator Maintenance Required (S194)
	D3 = (9/1) AC Unit 2 Compressor Shut Off (S193)
	D2 = (9/0) AC Unit 1 Compressor Shut Off (S192)
	D1 = (8/7) Spare (S191)
	D0 = (8/6) Spare (S190)

Table 24 WSR–88D DAU BITE Packet (RCP8 to Host)

Char	Function
14	WSR–88D DAU Status and Fault Conditions
	D6 = (10/3) Equip Shelter Halon/Detect Sys Troub (S203)
	D5 = (10/2) Aircraft Hazard Light Failure (S202)
	D4 = (10/1) Generator Volt and Freq Available (S201)
	D3 = (10/0) Generator Selector SW Not Auto (S200)
	D2 = (9/7) TPS (Reserved) (S199)
	D1 = (9/6) TPS (S198)
	D0 = (9/5) Generator Engine Malfunction (S197)
15	WSR–88D DAU Status and Fault Conditions
	D6 = (11/2) Utility Voltage and Frequency Avail (S210)
	D5 = (11/1) Gen Shelter Halon/Detect Sys Trbl (S209)
	D4 = (11/0) Fire/Smoke in Generator Shelter (S208)
	D3 = (10/7) -9 V Receiver PS Summary Fault (S207)
	D2 = (10/6) +/- 18 V Receiver PS Summary Fault (S206)
	D1 = (10/5) Fire/Smoke in Equipment Shelter (S205)
	D0 = (10/4) +5 V Receiver PS Summary Fault (S204)
16	WSR–88D DAU Status and Fault Conditions
	D6 = (12/1) Security System Equipment Trouble (S217)
	D5 = (12/0) Security Syst Unauthor Entry Alarm (S216)
	D4 = (11/7) -5.2 V A/D Converter PS Summ Fault (S215)
	D3 = (11/6) Spare (S214)
	D2 = (11/5) +5 V A/D Converter PS Sum. Fault (S213)
	D1 = (11/4) +/- 15 V A/D Convert PS Sum. Fault (S212)
	D0 = (11/3) +9 V Receiver PS Summary Fault (S211)
17	WSR–88D DAU Status and Fault Conditions
	D6 = (13/0) AC Unit 1 Filter Dirty (S224)
	D5 = (12/7) Radome Access Hatch Open (S223)
	D4 = (12/6) Receiver Not Conn. to Antenna (S222)
	D3 = (12/5) Spare (S221)
	D2 = (12/4) Spare (S220)
	D1 = (12/3) +5 V Receivr Protect PS Sum. Fault (S219)
	D0 = (12/2) Security System Disabled (S218)
18	WSR–88D DAU Status and Fault Conditions
	D6 = (13/7) Spare (S231)
	D5 = (13/6) Spare (S230)
	D4 = (13/5) Spare (S229)
	D3 = (13/4) AC Unit 4 Filter Dirty (S228)
	D2 = (13/3) AC Unit 3 Filter Dirty (S227)
	D1 = (13/2) Transmitter Filter Dirty (S226)
	D0 = (13/1) AC Unit 2 Filter Dirty (S225)
19	WSR–88D DAU Status and Fault Conditions
	D6 = Spare (S238)
	D5 = Spare (S237)
	D4 = Spare (S236)

Table 24 WSR–88D DAU BITE Packet (RCP8 to Host)

Char	Function
	D3 = Spare (S235)
	D2 = Spare (S234)
	D1 = Spare (S233)
	D0 = Spare (S232)
20	WSR–88D DAU Status and Fault Conditions
	D6 = No DAU reply to last command (S245)
	D5 = Spare (S244)
	D4 = Spare (S243)
	D3 = Spare (S242)
	D2 = Spare (S241)
	D1 = Spare (S240)
	D0 = Spare (S239)
21	END OF MESSAGE (FF Hex)

Many of the DAU functions can also be controlled from the RCP8 via numbered control variables as follows. When DAU mode is enabled, a new DAU "Data Message" is sent every second, and immediately after a control BITE packet is received.

Audible Alarm Control–1	(C63)
Audible Alarm Control–2	(C62)
High Voltage ON Command	(C61)
Antenna Command	(C60)
Channel 2 Command	(C59)
Pedestal Operate	(C58)
Spare Lamp Driver	(C57)
Switch to Diesel Generator	(C56)
Switch to Utility Power	(C55)
Audible Alarm Enable	(C54)

In addition to the standard BITE packets shown in Table 24 on page 166, the RCP8 will output the following Q–BITE packets which represent the quantitative values that are read from the DAU. The numbers shown in parenthesis are the original DAU status byte numbers that supplied each value. A total of 30 14–bit values are sent.

Table 25 WSR–88D DAU Q–BITE Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (AF Hex)
2	Identification byte (User Choice)
3–4	(14) Outside Ambient Temperature
5–6	(15) Equipment Shelter Temperature
7–8	(16) AC Unit 1 Discharge Air Temperature

Table 25 WSR–88D DAU Q–BITE Packet (RCP8 to Host)

Char	Function
9–10	(17) Transmitter Discharge Air Temperature
11–12	(18) Radome Area Temperature
13–14	(19) Generator Shelter Temperature
15–16	(20) Storage Tank Fuel Level
17–18	(27) AC Unit 3 Discharge Air Temperature
19–20	(28) AC Unit 2 Discharge Air Temperature
21–22	(31) Transmitter RF Power
23–24	(32) Antenna RF Power
25–26	(34) AC Unit 4 Discharge Air Temperature
27–28	(37) Pedestal +28V Power
29–30	(38) Encoder +5V Power
31–32	(39) Pedestal +15V Power
33–34	(41) Pedestal +5V Power
35–36	(44) Signal Processor +5V Power
37–38	(46) Maintenance Console +28V Power
39–40	(47) Maintenance Console +15V Power
41–42	(48) Maintenance Console +5V Power
43–44	(52) Pedestal -15V Power
45–46	(55) Maintenance Console -15V Power
47–48	(57) DAU Test 0
49–50	(58) DAU Test 1
51–52	(59) DAU Test 2
53–54	Spare
55–56	Spare
57–58	Spare
59–60	Spare
61–62	Spare
63	END OF MESSAGE (FF Hex)

The BITE "interrogate" packet is a request to a remote device that it immediately reply with its current BITE packet(s). This is how the local device can insure that it has the most recent valid data.

The RCP8 will send BITE "interrogate" packets to the host computer whenever the RCP8 is expecting to receive BITE packets of any sort. These RCP8 "interrogate" requests are sent every 30 seconds beginning at startup. This insures that all control bits will be valid in the RCP8 immediately upon startup, and will resume their correct states after any serial line interruptions.

The RCP8 responds to incoming BITE "interrogate" packets by sending the current version of all standard BITE status packets that it is configured to output. Q–BITE packets are not sent in response to this command.

Table 26 BITE Interrogate Packet (Host to RCP8)

Char	Function
1	SYNC Byte (C0 Hex)
2	Command (0x4D = Interrogate)
3	END OF MESSAGE (FF Hex)

This packet has the same function as the standard BITE Interrogate packet, except that only the Quantitative BITE units will report back.

Table 27 Q–BITE Interrogate Packet (Host to RCP8)

Char	Function
1	SYNC Byte (90 Hex)
2	Command (0x01 = Interrogate)
3	END OF MESSAGE (FF Hex)

The BITE individual request packet is used to request information about a single BITE unit, separate from all the others.

The RCP8 responds to an interrogate packet by sending the current version of the specified BITE status packet. The RCP8 responds to a sample data packet by sending requests out the the remote device to get information, then responding to the host computer with the new BITE status packet when the information arrives. The RCP8 responds to the reset packet by sending a reset command to the remote device.

Table 28 BITE Individual Request Packet (Host to RCP8)

Char	Function
1	SYNC Byte (C1 Hex)
2	ID of the BITE unit for which the command will be applied
3	Command: 0x4D=Interrogate, 0x44=Sample Data, 0x43=Reset
4	END OF MESSAGE (FF Hex)

A.6 Miscellaneous Formats

Table 29 Time Packet (RCP8 to Host)

Char	Function
1	SYNC Byte (B0 Hex)
2	Year Low 7 bits
3	Year High 7 bits
4	Month
5	Day
6	Hour
7	Minute
8	Second
9	1/100 of second
10	Status (unused, zero)
11	END OF MESSAGE (FF Hex)

These packets are sent in both directions to convey serial TTY communication. Up to six 7–bit characters can be sent in each packet with two characters of overhead for SYNC and END. This allows up to 75% of the available serial bandwidth to be used for chatting. If a "chat–mode" packet contains fewer than six characters, then a NULL (zero byte) is inserted after the last one.

Table 30 Chat–Mode Packet

Char	Function
1	SYNC Byte (F1 Hex)
2...7	7–Bit ASCII characters (possibly NULL terminated)
8	END OF MESSAGE (FF Hex)

APPENDIX B
ANTENNA STABILIZATION PROCEDURE

After the initial power–up and cabling has been completed, configuration of the RCP8 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. Detailed instructions for modifying parameter values are described in Chapter 5, TTY Setup Menus, on page 61 Most of this configuration is made through the RCP8's chat interface. You can always access this by running the rcp8 with the "rcp8 –int" shell command. Once the host computer interface is correctly configured, then you can access this via the **antx** program on the controlling host.

1. Disable host computer control until the positioning is stabilized. Do this by answering "No" in the "site host" section to the "Process incoming servo control packets" question. While you are in there, setup the rest of the host computer interface questions.
2. If this is a shipboard system, disable the platform stabilization until the basic antenna control is tuned up. Do this by answering "No" to the first question in the "INU" section.
3. Use the "site display" command to choose the parameters you would like to show on the front panel display.
4. Define most of the fixed information for each axis, particularly the angle source. This is performed using the "axis" command.
5. Temporarily set the elevation shutdown limits 15 degrees short of mechanical stops, leaving enough distance for the antenna to coast to a stop in case of errors. Disable soft limits. These only work when the position servo is configured. Also, set the limit switch options and polarity.
6. Now using the setup utility in the RCP pop–up, configure the *Interface to RCP* section to match. Once this is done, the **antx** and

antenna utilities should function. Verify that the displayed angles match the RCP8 front panel.

The following steps are performed separately for each axis. Do the azimuth axis first. For most of the elevation axis stabilization, keep the antenna in the middle of the range, away from the stops.

1. Set the "maximum output drive voltage" to +/- 10 Volts to start. Verify that a drive of 0 will not move the antenna. Set the drive sign correctly. If you have a high–gain servo, it may go at full speed at a lower voltage, and it may move with a zero drive (because of a small A/D offset voltage). In this case, you will need to add an external resister divider to lower the drive voltage. If the voltage needs to be lowered a small amount use the drive voltage question. Below about 5 volts, Vaisala recommends the voltage divider.
2. Adjust the tachometer voltage range using the gain potentiometers on the back of the CP. The pot closer to the end of the CP controls elevation. The T units are displayed in the RCP8 in a range of +/-100. The goal is that the maximum velocity that the antenna will ever go should be within the measured limits. Be aware that this speed may exceed the maximum velocity requested by the RCP8. Use the "monitor" command to watch this, then give drive commands like "ad 10" to give small drives. Bring the speed up to 25% of the maximum you expect, then adjust until the T display is below 25.
3. Calibrate the tachometer by getting the sign and offset right, then entering level and speeds in the "axis" command. Set the "Tach zero–delay–smoother window" to a short (0.05 second) value.
4. Determine the motor starting drives, the nominal drive slope, and the maximum angular velocity. Determine the drive sign, then set the drive slew rate fairly short (.10 second). Set the velocity feedback dead zone to 0.3, and the feedback slope to 25. The velocity servo should now be stable.
5. Set up the position servo parameters to achieve a stable motion between two positions that are separated by an angular distance. Make sure that both steps of 1 degrees and of 10 degrees perform quickly with no overshoot.

When both axes are done, perform the following:

1. Now set the final elevation shutdown limits 0.2 degrees or so short of the mechanical stops. Enable the elevation soft limits, and set them short of the shutdown limits by 0.5 degrees or so. In **setup** RCP section set the elevation limits to the same soft limits.
2. If this is a shipboard system, use the "INU" section to enable the data from the INU. See the next section.

B.1 Shipboard INU and Pedestal Alignment

Background of INU Alignment

In the best of worlds the MRU sensor is mounted with an orientation exactly matching the antenna pedestal. To do this while the ship is docked, we use a digital level to match the MRU's tilt to the pedestals tilt in both axis. Then we make the pedestal's azimuth zero when the MRU's heading is zero. The GPS antenna orientation also must match. After such an alignment, we will get the correct roll, pitch, and heading for antenna stabilization. It does not really matter that this match other parts of the ship.

Unfortunately, this is not always possible. The INU data may be shared by many different experiments. To correct for this, we need to add a pitch and roll offset for the INU in the RCP8. There is no need to use a heading offset, because we can still make the zero headings match with a pedestal offset.

INU and Pedestal Alignment Procedure

There are 5 numbers to enter into the RCP8 which need to be determined:

- Parameters set.
- Azimuth Axis Input offset from true orientation.
- Elevation Axis Input offset from true orientation.
- INU Roll offset from true orientation.
- INU Pitch offset from true orientation.
- INU Heading offset from true orientation.

1. Set the INU Heading offset to zero. We will define this to be the pedestal zero azimuth.
2. Get a rough Azimuth Axis offset by manually pushing the antenna to point in the direction of the ships heading. Next adjust the offset until the pedestal azimuth reads zero on the antenna utility.
3. Make sure the INU stabilization is turned on in the RCP02. Set the elevation angle to 0 degrees in the antenna utility, place a digital level on the waveguide feed in front of the dish in a place parallel to the transmitted beam. Sweep the antenna a full 360 degrees slowly recording the tilt every 30 degrees or so. The recorded table should also show the pedestal azimuth. You can see this displayed in **antenna** by selecting Options/ "Stable Platform Params". Also monitor to make sure the RCP02 is really maintaining the earth elevation angle near zero. Plot the resulting data and fit to a sine wave with offset.

4. The fit offset gives you a rough elevation axis offset. It is not the exact offset because the beam pattern may not be exactly aligned with the feed waveguide.
5. The sine wave amplitude at 0 degrees gives you the INU Pitch offset.
6. The sine wave amplitude at 90 degrees gives you the INU Roll offset.
7. After adjusting the offsets, repeat the stabilization measurement scan to check that the corrections are complete. You may need to repeat this many times because of operator mistakes, sign confusions, and cross term contributions.
8. Run a sun calibration. Use the results of the sun calibration to fine tune the pedestal elevation offset, and pedestal azimuth offset. Check to make sure you got the signs correct.

APPENDIX C
RVP8/RCP8 PACKAGING

A standard RVP8/RCP8 processor consists of three separate units:

-	**Main Chassis**	C.1 Main Chassis General Description on page 180	**RVP8 and RCP8**
-	**Connector Panel**	C.2 I/O-62 and Connector Panel on page 192	**RVP8 and RCP8**
-	**IFD (IF Digitizer)**	C.3 IFD Module (RVP8 Only) on page 207	**RVP8 Only**

Because of the similarity of the packaging for the RVP8 and RCP8, both units are described here.

The main chassis and connector panel are located in a rack within 100m of the IFD. Typically the main chassis interfaces to a host computer via 100 BaseT Ethernet. For the RVP8, the IFD receiver module resides in the radar cabinet.

This section describes the general features of the packaging and the electrical specifications and cabling of these units. Please read *CAREFULLY* the following warnings before you apply power to your system.

WARNING	WARNING: The Main Chassis power supply modules are NOT auto ranging. These must be set by a switch on each module for either 115/230 VAC 60/50 Hz. Verify these before applying power to the system. See C.1.3 Main Chassis Back Panel Power Section on page 187.

WARNING	WARNING: Turn off power to the main chassis before installing or removing any PCI boards. For safety, the line cord should be disconnected before opening either the IFD module or main chassis.

NOTE	Important: The circuit boards contain many static sensitive components. Do not handle the boards or open the IFD module unless a properly grounded wrist strap is worn.

C.1 Main Chassis General Description

Vaisala's standard main chassis is a 4U rackmount/table top enclosure (43.2 wide x 43.2 long x 17.8 cm high) or (17 wide x 17 long x 7.00 inch high) which fits a standard 19-inch EIA rack. The system comes standard with hot–swap redundant power supplies. The chassis may be equipped with either a mother board or a single-board computer depending on how the unit was purchased. The chassis is shown in the following figures.

- Front View | on page 182
- Rear View | on page 183
- Side view | on page 184
- Internal Wiring | on page 185

The front of the unit has a plasma matrix display that is used for status information. There is also a CDRW drive (for software installation and backup) and in most cases, a floppy drive as well (for configuration backup).

Two fans are mounted behind the door on the front of the enclosure. These draw ambient air in to the unit. The air flows through the unit and exits the rear. Do not block the slots or the exhaust grills on the fans. Check airflow now and then, and also check the board and fan screen for dust accumulation. If necessary, excessive dust accumulations on the board can be cleaned at a properly equipped static-free workstation with "canned air" or Chemtronics TF-Plus solvent, which can be purchased through electronics distributors.

The boards should be left in the chassis whenever the unit is shipped. This minimizes handling and static risk. Save the original packing provided for shipment.

WARNING	Important: Prior to shipment, contact helpdesk@vaisala.com to obtain a returned materials authorization (RMA) and to coordinate the shipping.

A table top unit can be converted for rack mount by simply installing rack mount ears. The rack ears are installed with #8-32 flat head screws. It is strongly recommended that the rack mount slide brackets supplied with the unit should be installed in the rack for additional structural support.

The internal cabling diagram in on page 185 shows how the various disk drives, power supplies, etc. are connected within the standard Main Chassis. A mother board example is shown. Use this as a guide if you have to replace internal components.

The remainder of this section describes the front and rear panel of the Main Chassis.

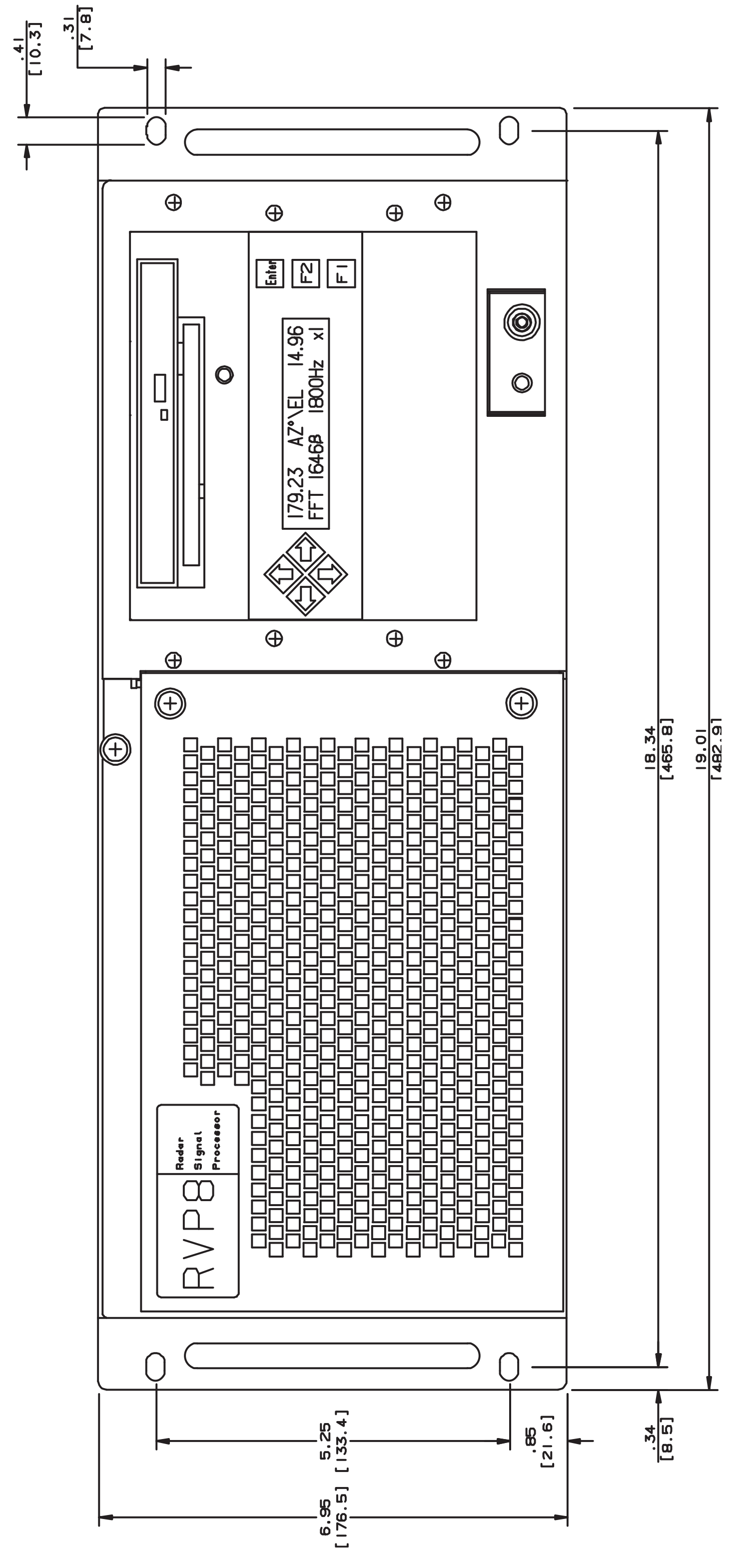


Figure 11 Main Chassis - Front Panel

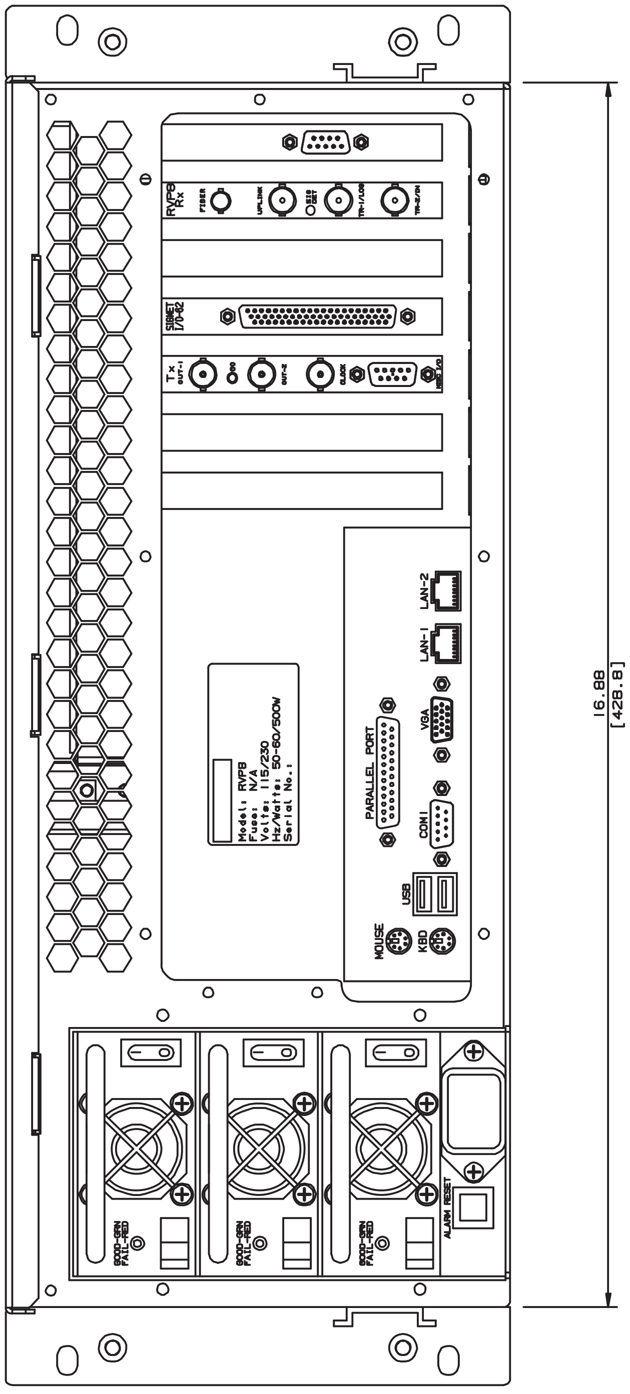


Figure 12 Main Chassis -Back Panel

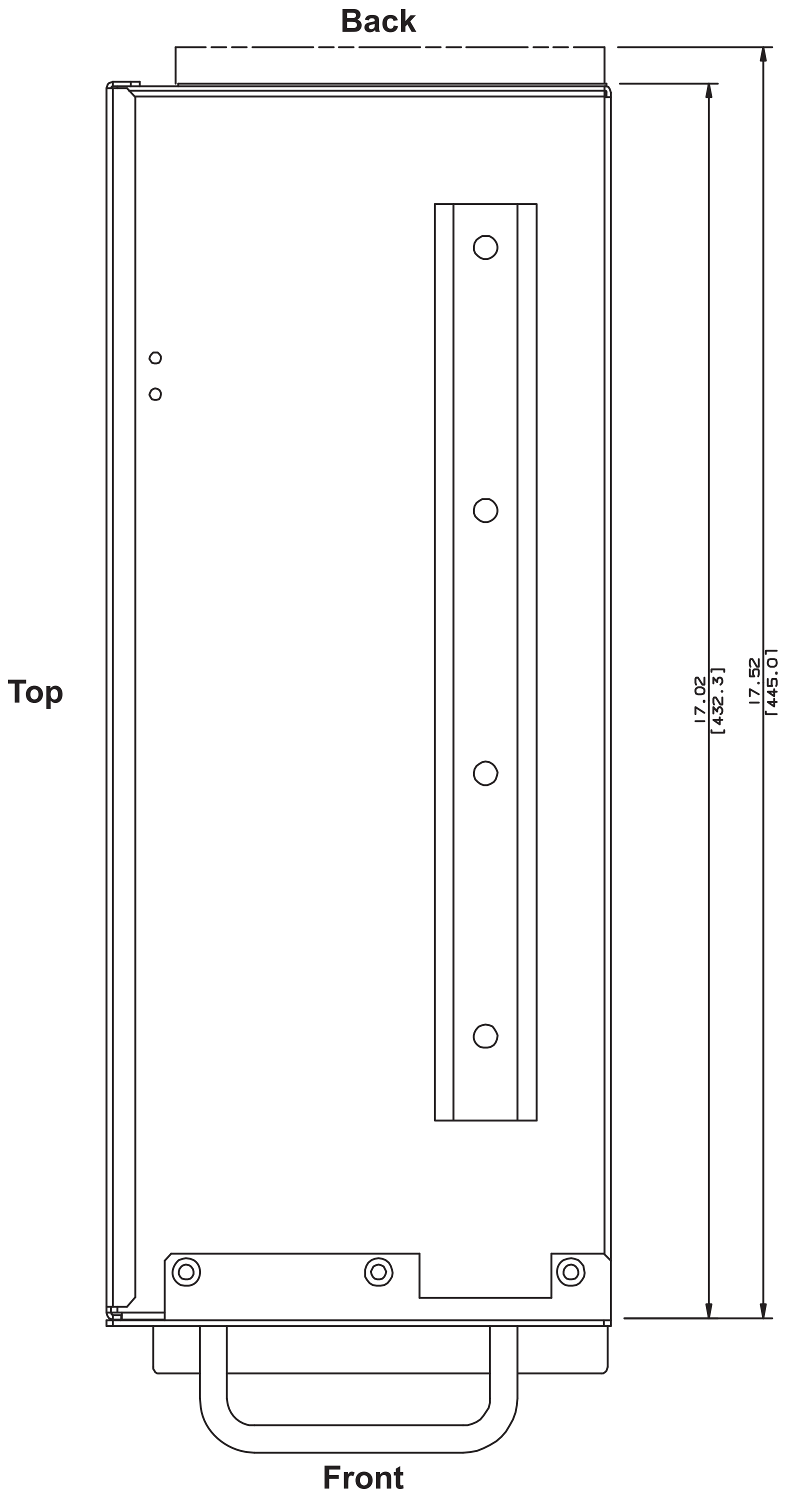


Figure 13 Main Chassis - Right Side View

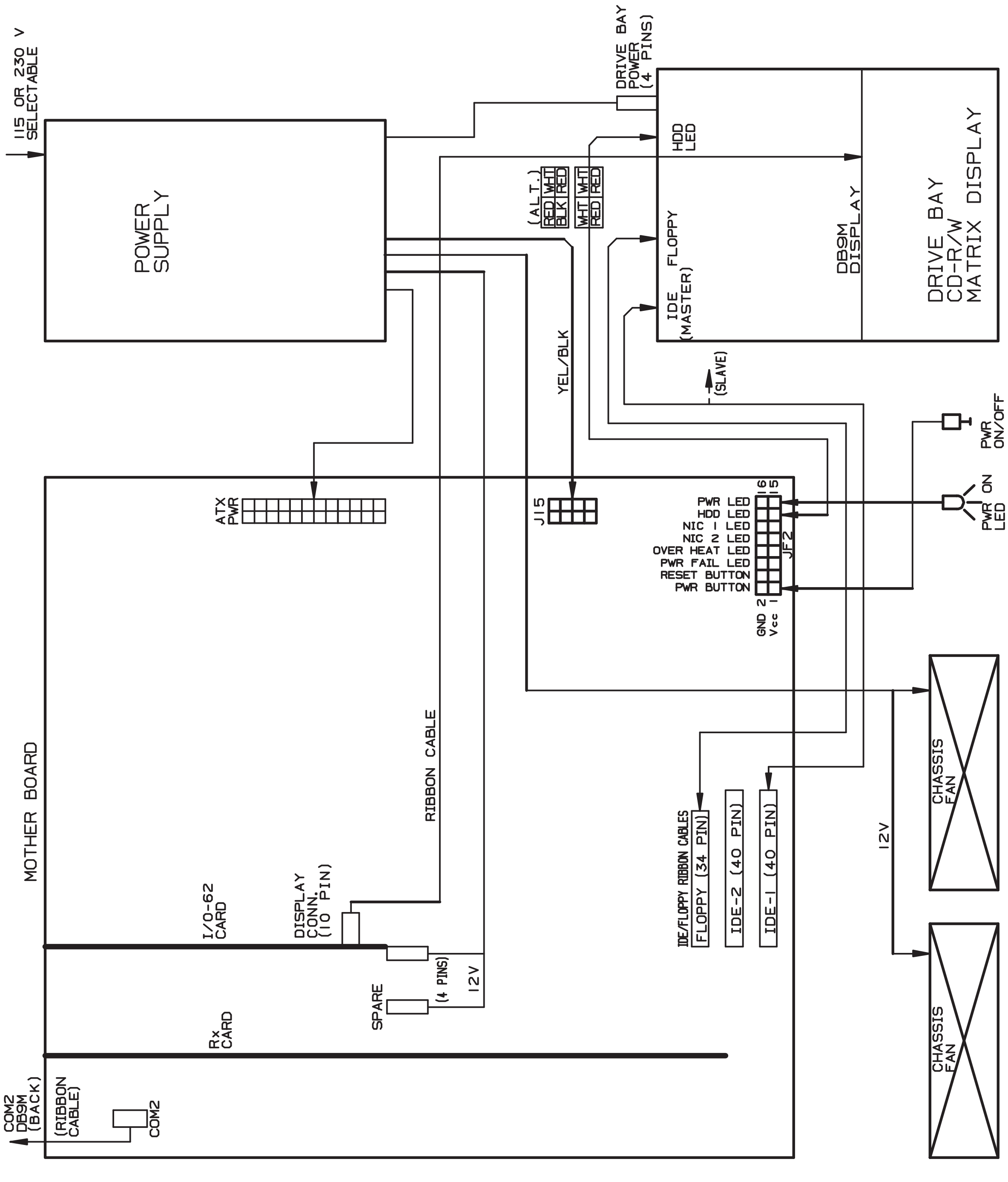


Figure 14 Main Chassis Internal Cabling

C.1.1 Main Chassis Front Panel

The front panel is shown in Figure 11 on page 182. The front panel matrix plasma display is typically connected internally by a ribbon cable to either an I/O-62 card or an RVP8/Rx card. The display is used to show status and power-up test results. The function keys beside the display are not currently used.

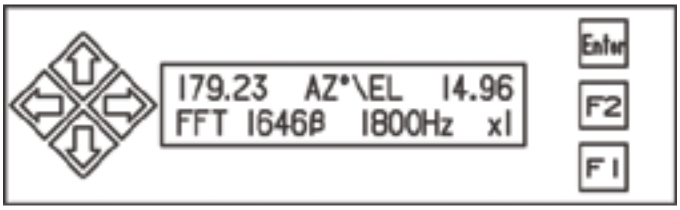


Figure 15 RVP8 Receiver/Signal Processor

Figure 16 RCP8 Radar Control Processor

In addition, the DVD+RW/CDRW are located on the front panel. The various activity lights are for the DVD (yellow), floppy drive (small green) and the hard disk drive (large red). The cabling diagram shows how to connect the activity lights. At the lower right of the unit is a power on/off switch and a green LED to indicate that power is on.

C.1.2 Main Chassis Back Panel

Figure 12 on page 183 shows an example of the main chassis back panel for the case of a motherboard system. There are three main sections to the Main Chassis back panel:

- **Power section**- on the left (looking from the rear) with the power entry module, alarm reset and three redundant hot-swap power supplies.
- **PC I/O section**- in the lower center with connectors for keyboard, mouse, monitor, network, etc. This is for a mother board example.
- **PCI card section**- on the right (looking from the rear) with standard PCI slots for the RVP8/RCP8 circuit cards as well as other standard commercial PCI cards that may be used (e.g., a four port serial card).

Note that depending on whether your system is using a mother board or single-board computer (SBC), the appearance of these sections may be different, but the functions are the same. These sections are described in detail in the sections below.

C.1.3 Main Chassis Back Panel Power Section

WARNING	The Main Chassis power supply modules are NOT auto ranging. These must be set by a switch on each module for either 115/230 VAC 60/50 Hz. Verify these per the procedure below, before applying power to the system.

The Main Chassis back panel is equipped with a modular AC power entry device. There are three hot-swap redundant power supply modules in the system. The procedure for setting/verifying the voltage on each one is as follows:

- The unit should be powered-off. This can be assured by simply not connecting the power input cord.
- Remove the top power supply module by shifting the black release button to the right.
- Use the handle to pull the module out.
- Check the red power selector switch on the right side (rear) of the module and set it as appropriate to your line voltage (115/230).
- Re–insert the module and push the chrome handle down. This switches the module in the on "1" position.
- Repeat this procedure for the middle and lower modules (the order is not critical)).

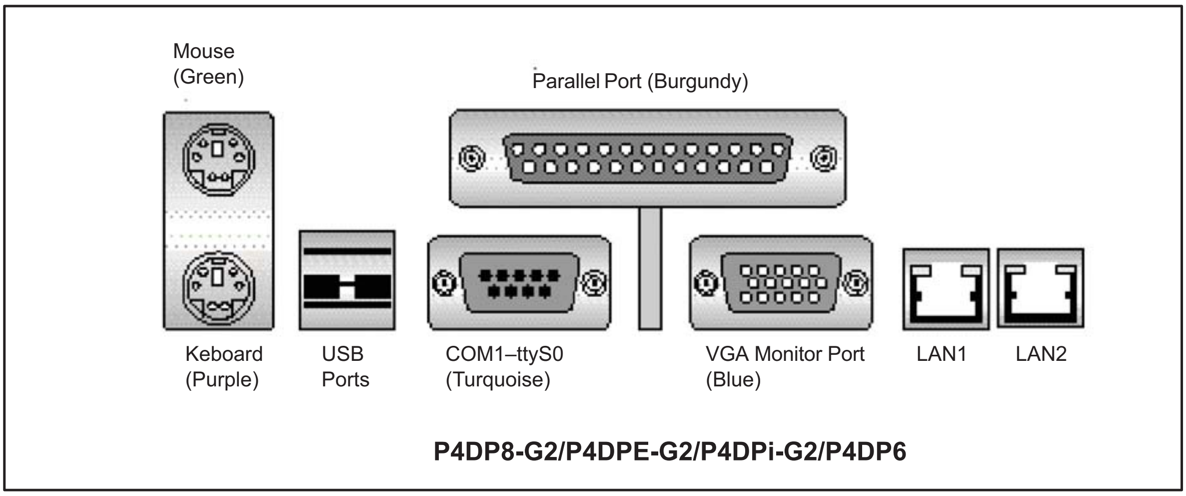
When the system is switched–on, the LED on each module shows green to indicate that it is functioning properly. A red light indicates a failure. There is an audio "buzzer" alarm in the event that a power module is turned-off, removed or fails.

NOTE	The red button next to the power entry module will reset the "buzzer" alarm.

The system will function if there is failure of any one power module, but is not rated to function with only one module, i.e., if two modules fail. Each power module is equipped with internal protection for over-temperature and over-current. In the event that the protection is triggered, the module LED will show red. It can be reset by removing the module for a minute and then inserting the module back into the system. It is best to do this with power–off to the module.

NOTE	If a power module is switched on, but the LED indicator is red, then it is not functioning. The reset procedure is to turn the power off on the failed module, remove it for one minute and then re-insert it and power it back on.

C.1.4 Main Chassis Back Panel PC I/O Section



The PC I/O section shown above is where you make all of your standard PC connections. Note pins (male) are indicated by filled black circles while sockets (female) are indicated by open circles.

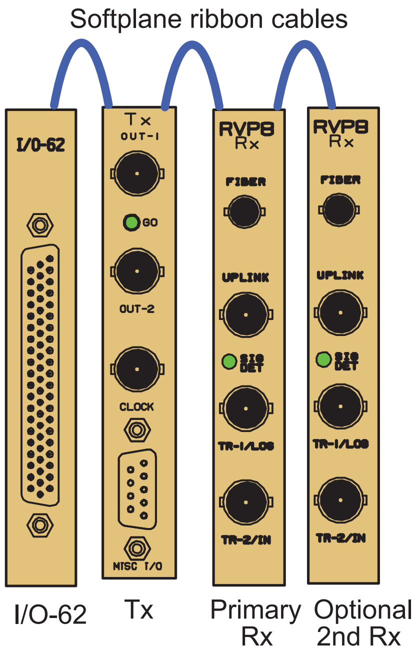
A standard keyboard and mouse are provided with the unit. VGA monitor is supplied by the customer or ordered as an option from Vaisala.

Note that LAN 1 and LAN 2 are standard RJ45 connectors. For the –G2 style mother boards the LAN port speed is 100/1000 BaseT. For the –Q they are 10/100 BaseT.

The keyboard and mouse are standard PS/2. You can use an adapter to plug a USB mouse into the circular mouse connector.

COM1 (/dev/ttyS0) is the DBM9 connector. COM2 (/dev/ttyS1) is typically installed as a separate DBM9 connector in the PCI section.

C.1.5 Main Chassis Back Panel PCI Card Section



The PCI cards are installed vertically on the right of the chassis (looking from the back). Since there are many different RVP8/RCP8 configuration options that can be ordered, there is quite a bit of variability in what PCI cards are installed. The order of the cards in the slots IS important. The table below gives the required card sequence from right to left as viewed from the back of the chassis (like the figure). There can be blank slots in between the cards as long as the order is preserved. Note, all Vaisala cards require a softplane ribbon cable as shown in the figure, except for the case of a minimal system with only a single Rx card. Note that COM2 is typically installed as a DBM9 connector on an otherwise blank panel in the PCI section

Table 31 RVP8 and RCP8 I/O-62 Card Jumper Settings

PCI Card	Card Slot Order	Used on	Vendor	Functions
RVP8/Rx	1st	RVP8 Dual Pol System	Vaisala	Optional Secondary Rx Card. Used for vertical or cross–polarized receiver channel.
RVP8/Rx	2nd	RVP8 Standard	Vaisala	Primary Rx Card. Used for horizontal or co-polarized receiver channel.
RVP8/Rx	3rd	RVP8	Vaisala	Two waveform outputs, clock output/input, 4 RS422 lines

Table 31 RVP8 and RCP8 I/O-62 Card Jumper Settings

PCI Card	Card Slot Order	Used on	Vendor	Functions
I/O –62	4th	RVP8 RCP8	Vaisala	I/O to radar system control and monitoring. Usually connected to an I/O-62 Connector Panel.
COM3–N	5th	RVP8 RCP8	Market	Additional RS232C serial card (typically 4 channels).
HPIB	6th	RVP8 RCP8	Market	HPIB control for signal generator or other test equipment

Card slot order is from right-to-left when viewed from the back.

The I/O-62 is used on both the RVP8 and RCP8. It is described in C.2 I/O-62 and Connector Panel on page 192, along with thestandard connector panels for the RVP8 and RCP8. Please see Chapter 3, Hardware Installation, on page 33 of the *RVP8 User's Manual* for a description of the connectors on the RVP8 PCI cards. The jumper settings for the I/O-62, Rx and Tx Cards are described in the tables below. Note that the high-lighted entries correspond to the default factory jumper settings.

Table 32 RVP8 and RCP8 I/O-62 Card Jumper Settings

Jumper	ID	Description	AB	BC	Not Installed
JP1	BOOT	Controls the card boot–up	**X**	**X**	Normal Boot
JP2	JTAG	Enables on-board "flash" re-programming for code version upgrades. Other settings are reserved for Vaisala maintenance functions.	Enable Flash	Maintenance	Maintenance

Table 32 RVP8 and RCP8 I/O-62 Card Jumper Settings

Jumper	ID	Description	AB	BC	Not Installed
JP3	TTYX0/RSV	These jumpers assign dedicated hardware I/O lines to pins on DBF62 connector on the back of the I/O-62. The selections are made among: 1.) The two RS232 lines noted as TTY0 or 1 with transmit and receive for each). 2.) Four trigger output lines. 3.) The three contact positions of the onboard DIP relays (K1 and K2). Note the specific pins are listed in the AB column.	Pin 47 TTYX0	**X**	**X**
JP4 Pin 49 TRIG0	TRIG0/TTYX0		TTYX0	**X**	
JP5 Pin 53 TRIG2	TRIG2/K1NO		K1 Normally Open Contact	**X**	
JP6 Pin 53 TRIG2	TRIG2/K1NO		K1 Normally Open Contact	**X**	
JP7 Pin 55 TRIG3	TRIG3/K1CT		K1 Center Contact	**X**	
JP8 Pin 57 TTYR0	TTYR0/K2NC		K2 Normally Closed Contact	**X**	
JP9 Pin 59 TTYX1	TTYX1/K2NO		K2 Normally Open Contact	**X**	
JP10 Pin 61 TTYR1	TTYR1/K2CT		K2 Center Contact	**X**	

Table 33 RVP8/Rx Card Jumper Settings

Jumper	ID	Description	AB	BC	Not Installed
JP1	LOG	Select TRIG1 out or LOG out for card BNC labeled "TR-1/ LOG"	LOG Out	TRIG1 Out	**X**
JP2	TGV	TRIG1 output voltage	5 V	12 V	**X**
JP3	TIN	Select TRIG2 out or TRIG-IN for card BNC labeled "TR-2/ IN"	TRIG-IN	TRIG2 Out	**X**
JP4	TGV	TRIG2 output voltage	5 V	12 V	**X**
JP5	BOOT	Controls the card boot–up	**X**	**X**	Normal Boot

Table 33 RVP8/Rx Card Jumper Settings (Continued)

Jumper	ID	Description	AB	BC	Not Installed
JP6	JTAG	Enables on-board "flash" re-programming for code version upgrades. Other settings are reserved for Vaisala maintenance functions.	Enable Flash	Maintenance	Maintenance
JP7	TERM	TRIG-IN Termination	Un-terminated	75 Ohm	**X**

Table 34 RVP8/Tx Card Jumper Settings

Jumper	ID	Description	AB	BC	Not Installed
JP1	BOOT	Controls the card boot–up	**X**	**X**	Normal Boot
JP2	JTAG	Enables on-board "flash" re-programming for code version upgrades. Other settings are reserved for Vaisala maintenance functions.	Enable Flash	Maintenance	Maintenance
JP3A	—	Reserved for future use	Reserved	**X**	**X**
JP3B	—	Reserved for future use	Reserved	**X**	**X**

C.2 I/O-62 and Connector Panel

on page 195 and on page 196 show the I/0-62 Connector Panel for the RVP8 and RCP8. This is typically mounted on the same rack as the Main Chassis. A 1:1 62–position cable (standard 1.8 m/6 foot) connects the connector panel to the I/O-62. As shown in the figures, the cable can be connected to either the front or the back of the panel so that the cable run can be optimized. In most cases, it is recommended to connect the cable to the back of the panel to minimize the risk of physical damage to the cable.

The panel is electrically the same for both the RVP8 and RCP8.Indeed the circuit board is identical. However, the panel labelling and the softplane configurations are different.

The pin assignments to the various connectors are described in Table 35 on page 196 to Table 48 on page 207 located at the end of this section. The tables show the basic electrical properties of each pin and the default signal assignment (if any) that is made in the factory softplane.conf file. The softplane approach provides a great deal of flexibility in assigning the I/O to the panel.

The I/O–62 PCI card provides forty multi–protocol digital interface lines at its 62–pin faceplate connector. These lines are grouped into five independent and identical blocks, each of which contains eight lines. Moreover, each of these blocks of eight lines can be further divided into four line pairs.

Each block of I/O lines can operate in one of the following modes:

- As eight TTL/CMOS single–ended outputs
- As eight TTL/CMOS single–ended inputs
- As N RS–422 differential transmitters or receivers, and (8–2N) TTL/CMOS single–ended inputs.

The assignment of electrical levels and signal directions are all made in the 'oftplane.conf' file. Users do not have to worry about how to configure each block of lines because inconsistent signal assignments will be checked and reported when the file is loaded.

All forty I/O–62 digital lines are individually protected against both overvoltage and electrostatic discharge (ESD). You may safely apply voltages between -27V and +27V to any line regardless of whether it is configured for an input or output. Likewise, external ESD pulses of 15KV (Human body model) will be safely shunted to ground at the 62–pin connector point of entry.

This wide voltage tolerance effectively makes the TTL/CMOS inputs function as wide range comparators with a 2.5V logic threshold. These inputs could be connected directly to a 24V panel bulb, for example, in order to monitor its On/Off status. Note that the line protection circuitry has a side effect of raising the output impedance of the TTL/CMOS drivers to approximately 120–Ohms. This should not cause any trouble unless the signal is heavily terminated at the receiving end. The RS–422 drivers are not affected by the line protection, and have the standard very low output impedance.

The I/O–62 provides a variety of terminations for its digital I/O lines. The TTL/CMOS signals can optionally be pulled either to GND or to +5V through a 2.2K–Ohm resistor. Similarly, the RS–422 linepairs can optionally be terminated with a 100–Ohm resistor across each pair.

There are a few additional constraints that should be kept in mind when assigning electrical signals to a block of eight I/O–62 lines. These are:

- When TTL/CMOS pull-up/pull-down resistors are enabled, they are applied to the entire group of eight lines. This is somewhat inconsistent with using some of those same lines as RS–422.
- Similarly, when RS–422 terminators are enabled, they are applied to all four line pairs. This is completely inconsistent with using some of those same lines as TTL/CMOS.

Thus, if line termination is required, it is usually necessary to split the TTL/CMOS and RS–422 functions so that both do not appear within the same block of eight lines.

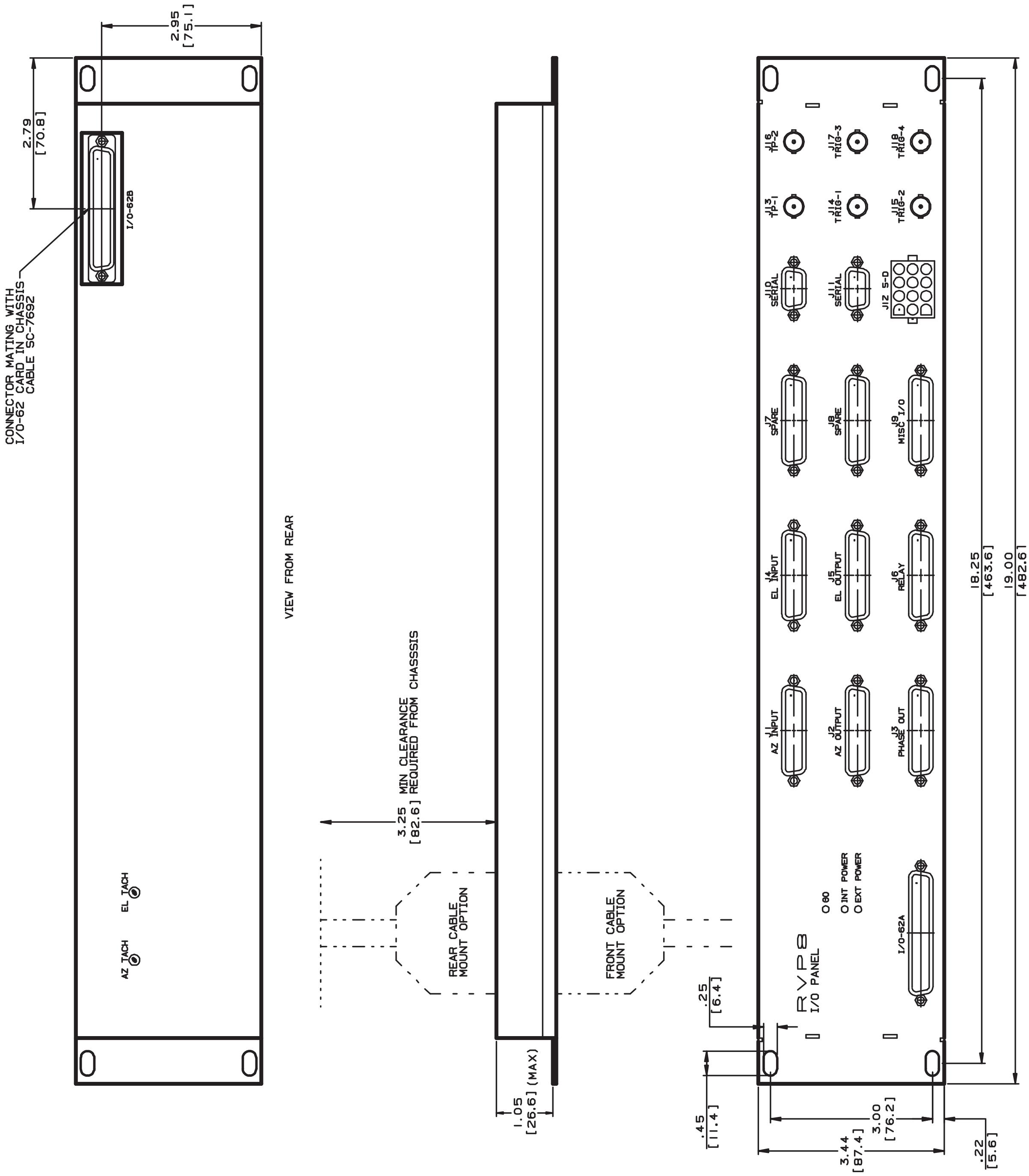


Figure 17 RVP8 I/O-62 Connector Panel

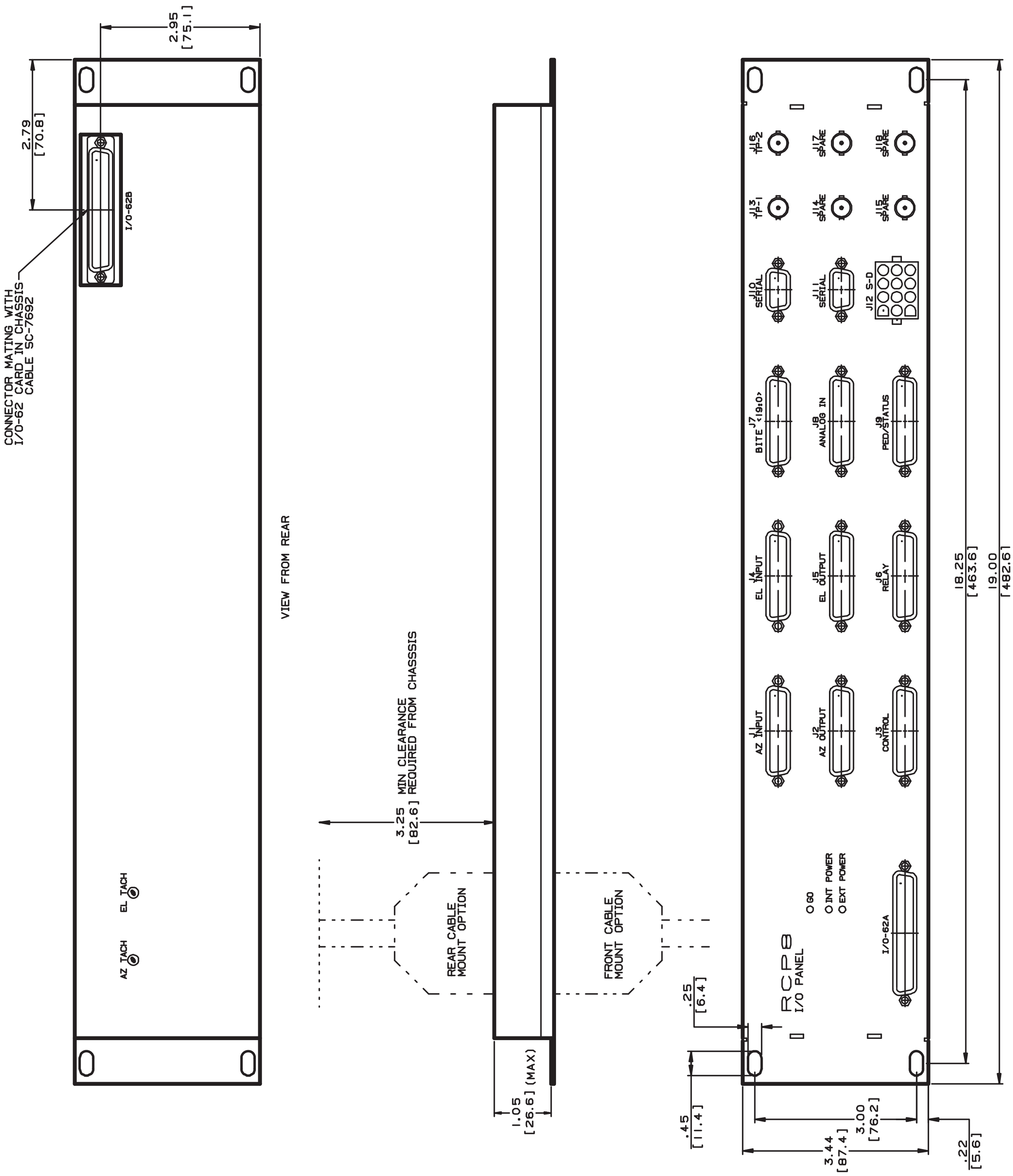


Figure 18 RCP8 I/O-62 Connector Panel

Table 35 J1 AZ INPUT

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	TTL	sPedAZ[0]	sPedAZ[0]
2	TTL	sPedAZ[1]	sPedAZ[1]

Table 35 J1 AZ INPUT (Continued)

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
3	TTL	sPedAZ[2]	sPedAZ[2]
4	TTL	sPedAZ[3]	sPedAZ[3]
5	TTL	sPedAZ[4]	sPedAZ[4]
6	TTL	sPedAZ[5]	sPedAZ[5]
7	TTL	sPedAZ[6]	sPedAZ[6]
8	TTL	sPedAZ[7]	sPedAZ[7]
9	TTL	sPedAZ[8]	sPedAZ[8]
10	TTL	sPedAZ[9]	sPedAZ[9]
11	TTL	sPedAZ[10]	sPedAZ[10]
12	TTL	sPedAZ[11]	sPedAZ[11]
13	TTL	sPedAZ[12]	sPedAZ[12]
14	TTL	sPedAZ[13]	sPedAZ[13]
15	TTL	sPedAZ[14]	sPedAZ[14]
16	TTL	sPedAZ[15]	sPedAZ[15]
17	TTL		
18	TTL		
19	TTL		
20	TTL		
21	GND		
22	GND		
23	GND		
24	GND		
25	GND		

Table 36 J2 AZ OUTPUT

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	TTL	cEarthAZ[0]	cEarthAZ[0]
2	TTL	cEarthAZ[1]	cEarthAZ[1]
3	TTL	cEarthAZ[2]	cEarthAZ[2]
4	TTL	cEarthAZ[3]	cEarthAZ[3]
5	TTL	cEarthAZ[4]	cEarthAZ[4]
6	TTL	cEarthAZ[5]	cEarthAZ[5]
7	TTL	cEarthAZ[6]	cEarthAZ[6]
8	TTL	cEarthAZ[7]	cEarthAZ[7]
9	TTL	cEarthAZ[8]	cEarthAZ[8]
10	TTL	cEarthAZ[9]	cEarthAZ[9]
11	TTL	cEarthAZ[10]	cEarthAZ[10]
12	TTL	cEarthAZ[11]	cEarthAZ[11]
13	TTL	cEarthAZ[12]	cEarthAZ[12]
14	TTL	cEarthAZ[13]	cEarthAZ[13]
15	TTL	cEarthAZ[14]	cEarthAZ[14]
16	TTL	cEarthAZ[15]	cEarthAZ[15]

Table 36 J2 AZ OUTPUT (Continued)

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
17	TTL		
18	TTL		
19	TTL		
20	TTL		
21	GND		
22	GND		
23	GND		
24	GND		
25	GND		

Table 37 J3 RVP8: PHASE OUT; RCP8 CONTROL

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	Configurable I/O–62		cPWidth[0]
2	Digital Lines:	cRadiateOn	
3		cServoPwr	
4		cReset	
5		sPWidth[0]	
6		sRadiate	
7		sServoPwr	
8		sReset	
9	RS422+		
10	RS422+		
11	GND		
12	GND		
13	GND		

Table 37 J3 RVP8: PHASE OUT; RCP8 CONTROL

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
14	Configurable I/O–62 Digital Lines:		cPWidth[1]
15		cRadiateOff	
16		cTransmitPwr	
17			
18		sPWidth[1]	
19			
20		sTransmitPwr	
21			
22	RS422-		
23	RS422-		
24	GND		
25	GND		

Notes:

1.) I/O-62 lines can be configured in **softplane.conf** in groups of 4 for the following options:

RS422 differential vs single–ended

Input or output sense

Input termination for single-ended lines can be pull-up (...Term=1), pull-down (...Term=-1) or un-terminated (...Term=0)

1.) All RCP8 status variables (starting with "s") are terminated with pull–up's in the default **softplane.conf**.

2.) All RCP8 control variables (starting with "c") are un-terminated (...Term=0).

Table 38 J4 EL INPUT

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	TTL	sPedEL[0]	sPedEL[0]
2	TTL	sPedEL[1]	sPedEL[1]
3	TTL	sPedEL[2]	sPedEL[2]
4	TTL	sPedEL[3]	sPedEL[3]

Table 38 J4 EL INPUT (Continued)

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
5	TTL	sPedEL[4]	sPedEL[4]
6	TTL	sPedEL[5]	sPedEL[5]
7	TTL	sPedEL[6]	sPedEL[6]
8	TTL	sPedEL[7]	sPedEL[7]
9	TTL	sPedEL[8]	sPedEL[8]
10	TTL	sPedEL[9]	sPedEL[9]
11	TTL	sPedEL[10]	sPedEL[10]
12	TTL	sPedEL[11]	sPedEL[11]
13	TTL	sPedEL[12]	sPedEL[12]
14	TTL	sPedEL[13]	sPedEL[13]
15	TTL	sPedEL[14]	sPedEL[14]
16	TTL	sPedEL[15]	sPedEL[15]
17	TTL		
18	TTL		
19	TTL		
20	TTL		
21	GND		
22	GND		
23	GND		
24	GND		
25	GND		

Table 39 J5 EL OUTPUT

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	TTL	cEarthEL[0]	cEarthEL[0]
2	TTL	cEarthEL[1]	cEarthEL[1]
3	TTL	cEarthEL[2]	cEarthEL[2]
4	TTL	cEarthEL[3]	cEarthEL[3]
5	TTL	cEarthEL[4]	cEarthEL[4]
6	TTL	cEarthEL[5]	cEarthEL[5]
7	TTL	cEarthEL[6]	cEarthEL[6]
8	TTL	cEarthEL[7]	cEarthEL[7]
9	TTL	cEarthEL[8]	cEarthEL[8]
10	TTL	cEarthEL[9]	cEarthEL[9]
11	TTL	cEarthEL[10]	cEarthEL[10]
12	TTL	cEarthEL[11]	cEarthEL[11]
13	TTL	cEarthEL[12]	cEarthEL[12]
14	TTL	cEarthEL[13]	cEarthEL[13]
15	TTL	cEarthEL[14]	cEarthEL[14]
16	TTL	cEarthEL[15]	cEarthEL[15]
17	TTL		
18	TTL		

Table 39 J5 EL OUTPUT (Continued)

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
19	TTL		
20	TTL		
21	GND		
22	GND		
23	GND		
24	GND		
25	GND		

Table 40 J6 RELAY

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	Relay K1: CT	cPWidth[0]	cPWidth[0]
2	Relay K1: NO		
3	Relay K1: NC		
4	Relay K2: CT	cPWidth[1]	cPWidth[1]
5	Relay K2: NO		
6	Relay K2: NC		
7	Relay K3: CT		
8	Relay K3: NO		
9	Relay K3: NC		
10	—		
11	GND		
12	GND		
13	GND		
14	+12VDC	External	
15	+12VDC	Relay	
16	+12VDC	Control	
17	+12VDC	Power	
18	+12V Unreg		
19	Return14	External	
20	+12V Return15	Relay	
21	+12V Return16	Control	
22	+12V Return17	Returns	
23	—		
24	GND		
25	GND		

WARNING	WARNING: To avoid possible damage to the connector panel, all external relays must be equipped with diode protection against the back EMF generated when the external relay coil is opened. Relays can be purchased with a diode installed or a diode can be added to the relay across the coil supply and return.

Notes: Internal relays K1, K2, K3 on the connector panel are dry contacts:

CT	Center contact
NO	Normally open contact
NC	Normally closed contact

Table 41 J7: RVP8 SPARE; RCP8 BITE 19:0

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	TTL		sAux[0]
2	TTL		sAux[1]
3	TTL		sAux[2]
4	TTL		sAux[3]
5	TTL		sAux[4]
6	TTL		sAux[5]
7	TTL		sAux[6]
8	TTL		sAux[7]
9	TTL		sAux[8]
10	TTL		sAux[9]
11	TTL		sAux[10]
12	TTL		sAux[11]
13	TTL		sAux[12]
14	TTL		sAux[13]
15	TTL		sAux[14]
16	TTL		sAux[15]
17	TTL		sAux[16]
18	TTL		sAux[17]
19	TTL		sAux[18]
20	TTL		sAux[19]
21	GND		
22	GND		
23	GND		
24	GND		
25	GND		

Table 42 J8: RVP8 SPARE; RCP8 ANALOG IN

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1		Amux0+	Amux0+
2	±20VDC	Amux1+	Amux1+
3	Differential	Amux2+	Amux2+
4	Analog	Amux3+	Amux3+
5	Inputs	Amux4+	Amux4+
6		Amux5+	Amux5+
7	Positive	Amux6+	Amux6+
8	Side	Amux7+	Amux7+
9		Amux8+	Amux8+
10		Amux9+	Amux9+
11	GND		
12	GND		
13	GND		
14		Amux0-	Amux0-
15	±20VDC	Amux1-	Amux1-
16	Differential	Amux2-	Amux2-
17	Analog	Amux3-	Amux3-
18	Inputs	Amux4-	Amux4-
19		Amux5-	Amux5-
20	Negative	Amux6-	Amux6-
21	Side	Amux7-	Amux7-
22		Amux8-	Amux8-
23		Amux9-	Amux9-
24	GND		
25	GND		

Table 43 J9 RVP8: MISC I/O ; RCP8: PED/STATUS

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	Configurable I/O–62 Digital Lines:		sWavegpFlt
2		sInterlockFlt	
3		sLocal	
4		sLowerEL	
5			
6			
7			
8	±6 to ±70 VDC Input		AzTach+

Table 43 J9 RVP8: MISC I/O ; RCP8: PED/STATUS

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
9	±6 to ±70 VDC Input		ElTach+
10	±10 VDC Output		AzDrive
11	GND		
12	GND		
13	GND		
14	Configurable I/O–62 Digital Lines:		sAirflowFlt
15		sMagCurrentFlt	
16		sStandby	
17		sUpperEL	
18			
19			
20			
21	±6 to ±70 VDC Input		AzTach-
22	±6 to ±70 VDC Input		ElTach-
23	±10 VDC Output		ElDrive
24	GND		
25	GND		

Notes:

1. I/O-62 lines can be configured in **softplane.conf** in groups of 4 for the following options:

   RS422 differential vs single–ended

   Input or output sense

   Input termination for single–ended lines, pull-up (...Term=1), pull-down (...Term=-1) or un-terminated (...Term=0)

2. All RCP8 status variables (starting with "s") are terminated with pull–up's in the default **softplane.conf**.
3. Antenna pedestal tachometer inputs are adjusted by a pot on back of the Connector Panel. The tach and drive signals are not configured in **softplane.conf**.

Table 44 J10 SERIAL

Pin	Electrical Specification	Comment
1	GND	
2	RS232C Rx	

Table 44 J10 SERIAL (Continued)

Pin	Electrical Specification	Comment
3	RS232C Tx	
4	—	
5	GND	
6	—	
7	—	
8	—	
9	—	

Table 45 J11 SERIAL

Pin	Electrical Specification	Comment
1	GND	
2	RS232C Rx	Channel 0
3	RS232C Tx	Channel 0
4	RS232C Rx	Channel 1
5	GND	
6	RS232C Tx	Channel 1
7	-12VDC @ 50mA max regulated	Regulated power supply
8	+12VDC @ 50mA max	Regulated power supply
9	+5VDC @ 50mA max	Regulated power supply

Table 46 J12 S–D

Pin	Electrical Specification	RVP8 Signal Name	RCP8 Signal Name
1	Nominal 90V 60Hz Synchro Signals	RefEL+	RefEL+
2 RefEL-		RefEL-	
3 SyEL1		SyEL1	
4 SyEL2		SyEL2	
5 SyEL3		SyEL3	
6	GND		
7	Nominal 90V 60Hz Synchro Signals	RefAZ+	RefAZ+
8 RefAZ-		RefAZ-	
9 SyAZ1		SyAZ1	
10 SyAZ2		SyAZ2	
11 SyAZ3		SyAZ3	
12	GND		

The pin numbers are embossed on the J12 plastic connector but can be hard to read by eye. Facing the backpanel connector the pin arrangement is:

1 RefEL+	4 SynEL2	7 RefAZ+	10 SynAZ2
2 RefEL-	5 SynEL3	8 RefAZ-	11 SynAZ3
3 SynEL1	6 Ground	9 SynAZ1	12 Ground

The mating plug is AMP 350735–1 using Amplatch pins 350547–1. The corresponding hood comes in two identical pieces: AMP 640717–1, along with #6 x 1/2" self-tapping screw. You must use two hoods and two screws per plug.

The following table lists the maximum RMS voltage that can be applied to the backpanel's Molex SYNCHRO connector for each value of plug-in SIP resistor. The AZ channel voltages are set by SIP S1, whereas S2 sets the EL voltage levels. These resistors are socketed, and can be changed by removing the back cover of the IO62–CP panel

S1 or S2	Max Ref(RMS)	Max S–S(RMS)
47K	56V	31V
68K	81V	45V
100K	118V	66V
150K	178V	99V
220K	261V	145V

Note that the 'Ref' inputs have somewhat lower gain than the three 'S' inputs. This is because the precision of the S/D angle conversion is affected primarily by the precision at which the three ?S? voltages can be measured. The backpanel therefore biases the gains so that the ?S? voltages can be made as large as possible, i.e., without the ?Ref? voltages first filling the A/D conversion range.

The appropriate resistor is the smallest value such that the maximum S-to-S voltage of the synchro (which is angle dependent) still fits within the table range. The reference voltage should then fit easily into its corresponding maximum range. Don’t worry if it doesn’t; the important thing is to match the 'S' line voltages.

For example, a traditional 90Vrms 1:1 synchro would best use the 150K resistor, whereas a 105Vrms unit would require the 220K value. Note that you can check for proper A/D conversion levels of the synchro inputs using the 'help view' menu of the RCP8.

WARNING	The synchro voltage input feature is only available on Rev.B and higher backpanels. If you are running an RCP8 with a Rev.A backpanel and would like to switch to synchro inputs, Vaisala will be happy to upgrade your panel at no cost.

Table 47 RVP8 BNC Connector Pin Assignments

Ref Designator	Label	Electrical Specification	Signal Name
J13	TP1	5V 75Ohm	
J14	TRIG–1	12V 75Ohm	Trigger[1]
J15	TRIG–2	12V 75Ohm	Trigger[2]
J16	TP2	5V 75Ohm	
J17	TRIG–3	12V 75Ohm	Trigger[3]
J18	TRIG–4	12V 75Ohm	Trigger[4]

Table 48 Table C–17: RCP8 BNC Connector Pin Assignments

Ref Designator	Label	Electrical Specification	Signal Name
J13	TP1	5V 75Ohm	
J14	SPARE		
J15	SPARE		
J16	TP2	5V 75Ohm	
J17	SPARE		
J18	SPARE		

C.3 IFD Module (RVP8 Only)

The IFD module is a small metal box which can be mounted inside the receiver cabinet. The IFD is shown in on page 208. Cooling of the inside components is accomplished bydirect conduction to the case. It is desirable to place the module in an environment that allows external convective cooling.

The IFD is equipped with its own auto ranging power supply (110 to 240 VAC 50/60 Hz) which is mounted on the side of the IFD. On the other side of the IFD are two anti-aliasing filters. These analog filters must be specified for the radar IF frequency. The filters have an 8 MHz bandwidth centered about the IF frequency

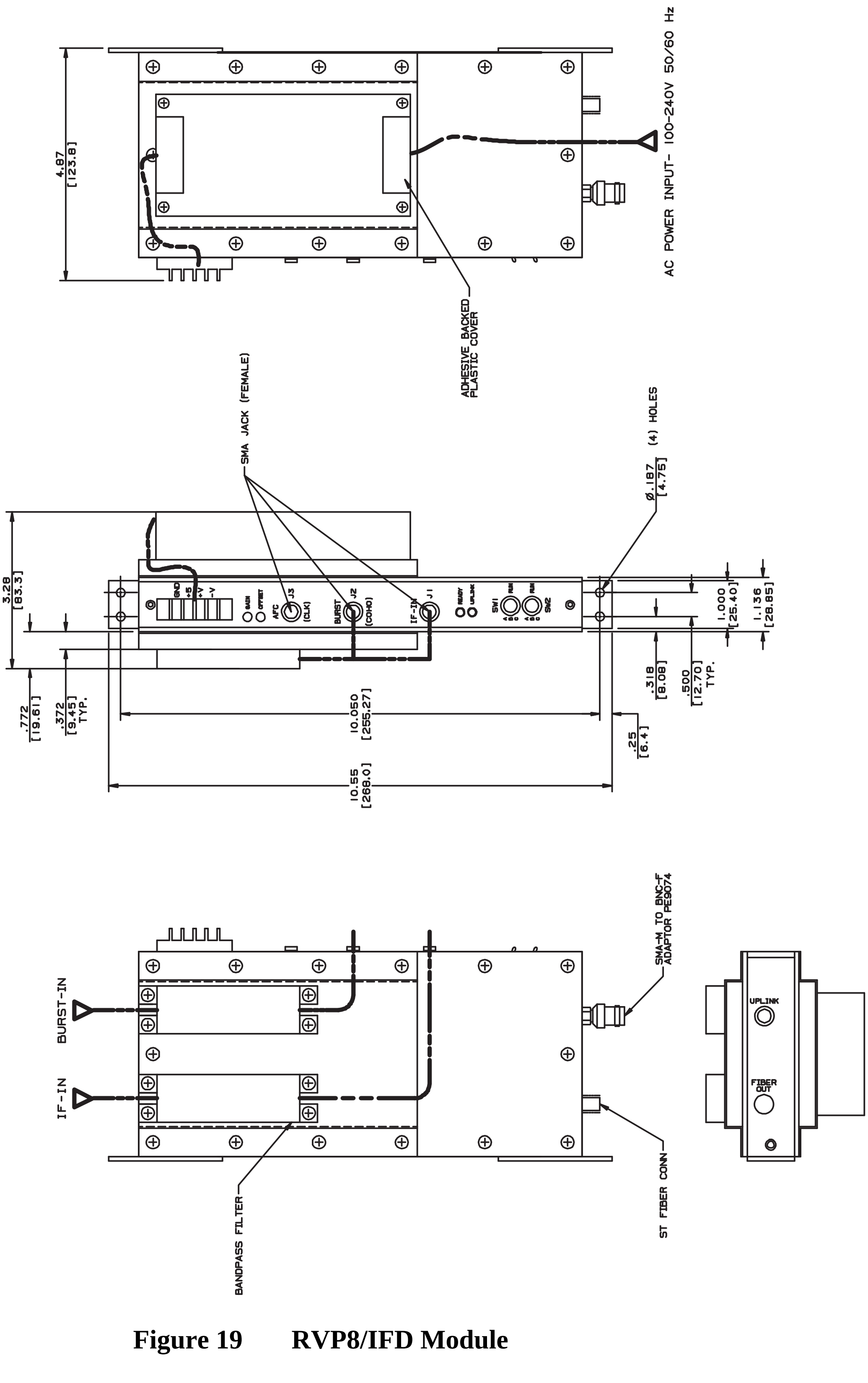


Figure 19 RVP8/IFD Module

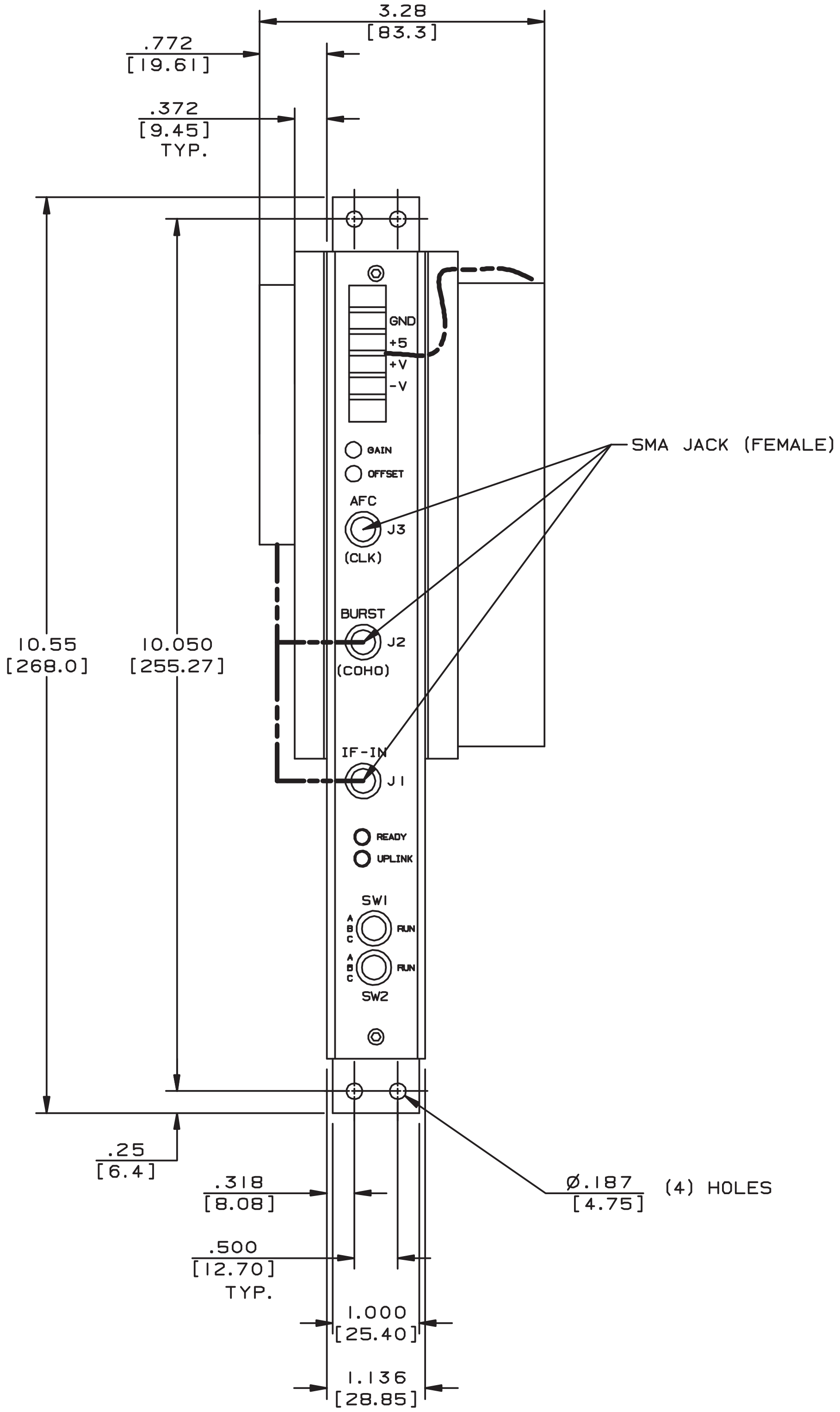


Figure 20 IFD Front Panel

C.4 DAFC Module (RVP8 only)

The Digital AFC (DAFC) module is used on RVP8 for magnetron systems to interface to a digitally controlled STALO. The DAFC "T's" off the coax uplink cable. Power can be provided by running discrete wires from the IFD. Note that +5 VDC is all that is required to run the DAFC. If you want to supply the STALO power over the ribbon cable to the IFD, you can connect the +24 VDC input to an appropriate power supply. Otherwise, you can power the STALO directly.

The DAFC outputs up to 24 TTL lines to the STALO digital control/ interface. Since these are TTL, the DAFC should be mounted within 10 to 30cm of the STALO if possible. For details on the DAFC, including pin assignment examples for some commercial STALO's, please refer to the RVP8's Installation chapter.

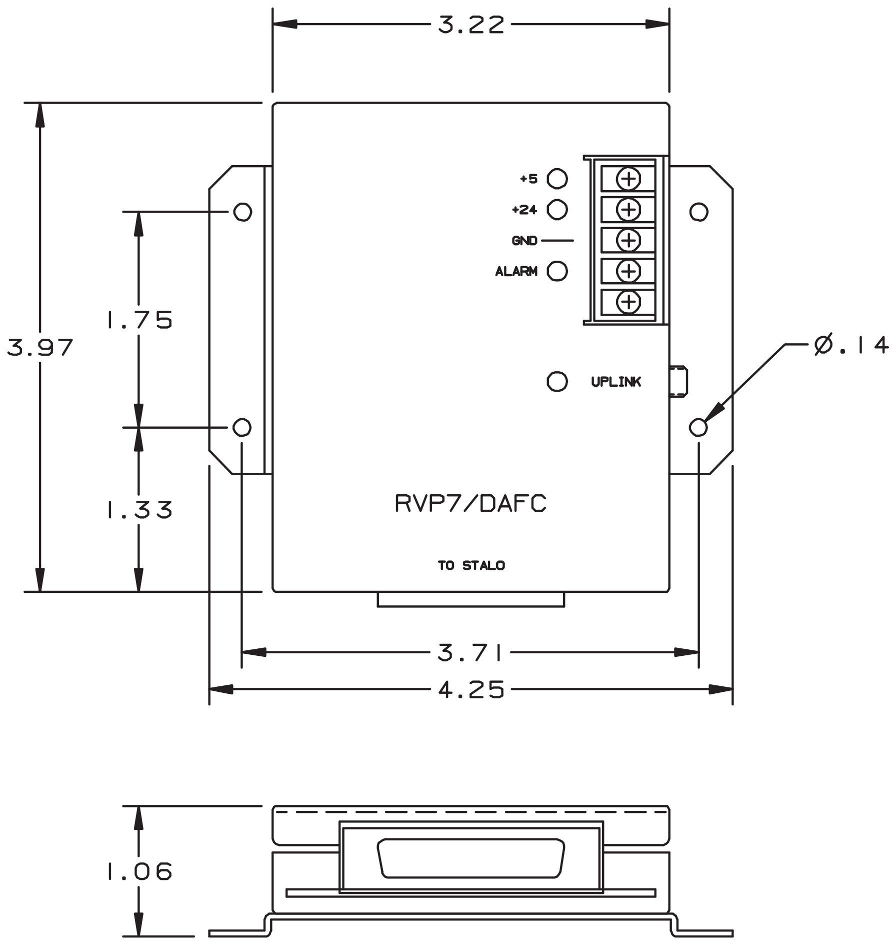


Figure 21 View of DAFC Module

APPENDIX D
DUAL-SYSTEM OPERATION

D.1 Dual-System Applications

A dual-system is the use of two separate transmitters and receivers through a single antenna. There are two primary applications for dual (A/B) systems:

- **Redundant systems** such that if A fails, B provides backup or vice versa. For redundant systems, the two systems function exclusively, that is, they must never be allowed to operate simultaneously. The two systems could be separate radar transmitter/receiver systems sharing the same antenna and/or separate RCP8 systems
- **Dual frequency systems** for which there are two independent transmitters and receivers that share the same antenna. The systems can be operated either exclusively (that is, one-at-a-time), or simultaneously (in parallel) with one system acting as the master and the other acting as the slave (in passive mode).

Both of these applications share common elements with regard to system control, monitoring and data acquisition. In the case of redundant operation, the systems must be capable of switching automatically when a system fails. In the case of dual frequency operation, the systems must be capable of switching sequentially, as in the redundant case, as well as switching between “active” and “passive” state.

It is assumed throughout this discussion that the signal processor is a Vaisala model RVP900 or equivalent and that the host computer is running Vaisala IRIS software. Note however, that it is possible to use dual-RCP8 control with other signal processor and software applications as well.

D.2 Dual-System Architecture

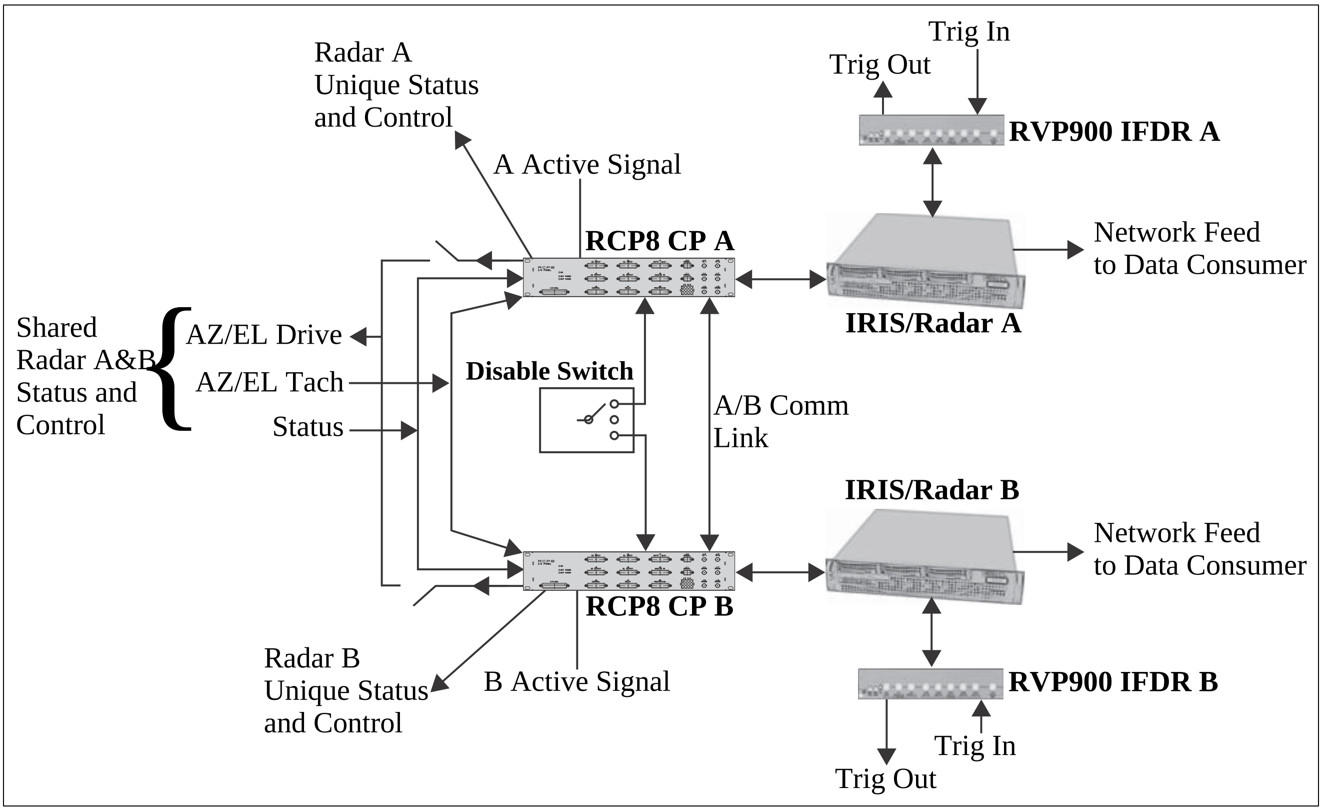


Figure 22 Dual-System Architecture

The dual-system architecture is shown in the figure above. The basic features are:

- **Two RCP8s** that coordinate the system operation via the A/B Comm Link. The RCPs monitor status from the radar, the signal processor, and IRIS, and decide between them who is "active".
- A "**Disable Switch**" that removes either system A or B. The switch (or two separate switches) could also be wired in such a way that it would be possible to disable both A and B simultaneously.
- **Two IRIS/Radar Systems** that are treated as "unreliable" systems. In other words, even in the event of a failure of IRIS, the RCP8s must still make the correct decision about which system is "active".
- **Two RVPs** (radar signal processors) communicating to the IRIS Radar. Note that the 3 functions (RCP, RVP, and IRIS) are normally running on the same computer, but they can be implemented on 2 or 3 computers.

The signals in the figure are summarized below:

Unique Status and Control

These are status and control signals that are unique to each system. Examples are radiate on/off status and control, and transmitter status. The normal status/control and extended BITE inputs/outputs are used for these.

Common Status and Control

These are status and control signals that are common to both system. Examples of common status variables are waveguide pressure, safety interlock on the radome door, antenna servo status, and site/environment status. Common status inputs should be wired in parallel to both RCP8s to the normal status and BITE inputs.

CAUTION	Do not wire common system control outputs in parallel (from both RCP8s). This could result in damage to the RCP8 output drivers.

CAUTION	Do not wire critical common system control outputs to both RCPs without using an external relay to select which is used. A “critical” control output is one that could damage the system in the event that both RCPs commanded the control simultaneously. The A/B Active signal is available for controlling external relays so that only one system can control the output.

Examples of common control outputs are servo power on/off and any environment control such as obstruction light on/off. Common control functions must be handled differently to prevent the possibility of simultaneous, and perhaps conflicting, control by both RCP8.

Critical control functions (that is, those that could potentially damage the radar if both RCPs were to command them), should be routed through an external relay that is controlled by the A/B Active Indicator signal (which can of course be used to control a master relay).

Non-critical control functions (that is, those that would not damage the radar if both RCPs were to command them), can be routed through any of the spare internal relays in the RCP8 (there are 8 total). The approach of using spare internal relays for these common control outputs relies on the RCP8 control logic equations. The internal variable *cDrcpActive* would be equated to one of the extended BITE control output variables. This would be physically wired to a spare TTL relay on the RCP8. The control output would then be wired through the relay (for example, servo power on/off). This approach is not fail-safe, since the user could make an error in the control logics, or simply disable the control logics. Therefore it is not appropriate for critical control functions.

Azimuth and Elevation Drive Output Signals

These are routed through an internal relay in the RCP8 which connects the drive lines when the RCP8 is in the active state. This allows only one RCP to control the antenna. The normal drive output back panel connector assignments are used.

Azimuth and Elevation Tachometer Input Signals

These are wired in parallel to the tachometer inputs on both RCP8s. Tach is sensed by both RCP8s simultaneously, but is not used on the inactive unit. The normal tachometer input back panel connector assignments are used.

Trigger Inhibit

This is an output line from the RCP8 to the signal processor or trigger generator that can be used to inhibit triggers on the inactive system. In the case of an RVP900 the line is the LSB of the normal azimuth output tag line (AZ0). Therefore no special cabling is required.

A/B Active Indicator Output Line

This is an active low TTL signal that is output to indicate that an RCP8 is in active mode. This signal should be used directly to switch (via external relay) critical control functions, that is, those functions that, if operated simultaneously by both RCP8s could cause damage to the system.

The internal logic variable name for this indicator is *cDrcpActive*. This signal can also be configured as a RS422 differential signal.

A/B Disable Switch Input

A switch closure to ground on this input disables a system so that it is not available for automatic switching. This is used, for example, to put a system in “Maintenance Mode”. The input can be implemented as a single, three position selector switch as shown in the figure, or as two separate switches. In the case of a single selector switch, the switch can be labeled as an enable rather than a disable (for example, “A–Auto–B) to indicate the exclusive use of either A or B.

A/B Communications Link

This link is on a special cable between two RCP8s. The link implements a serial protocol that passes status information and requests for control between the two RCP8s. The pin assignments are given in D.3 Dual-System Special Cabling and Modifications on page 215.

D.3 Dual-System Special Cabling and Modifications

Dual-System Connection Cable and Switch

All of the special cabling requirements for the dual-system are handled on connector J3, a 25DBF connector on the back panel of the RCP8 labelled "CONTROL". This connector contains the input for the A/B Disable Switch, the output for the A/B Active Indicator signal and the A/B Communications link. The wiring is shown below. The signals are described in D.2 Dual-System Architecture on page 212.

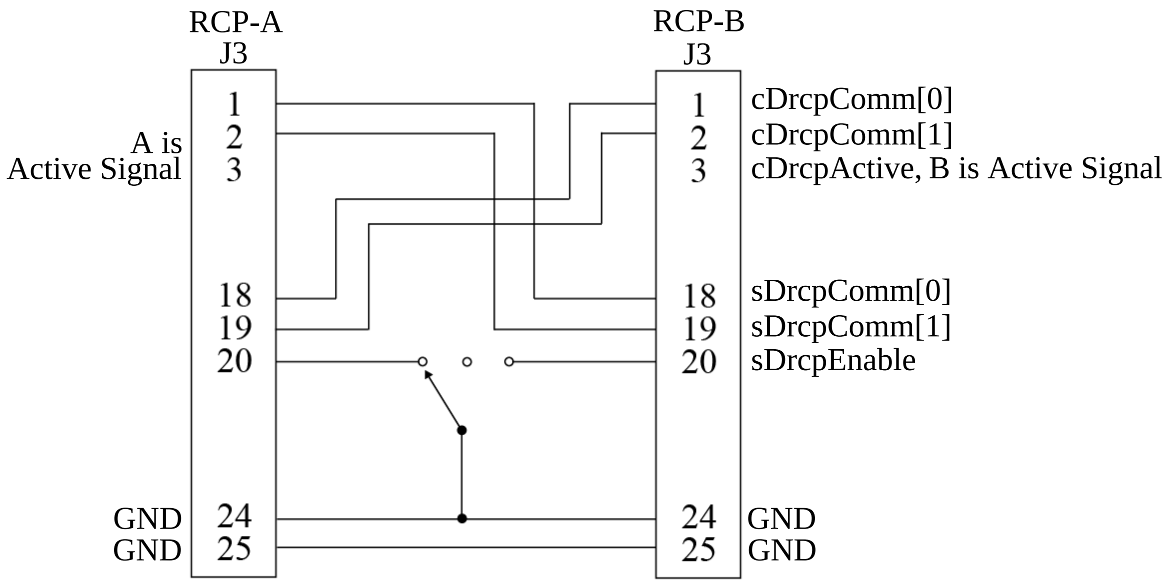


Figure 23 Connector J3 "CONTROL" Dual-System Link Cable

Antenna Drive/Internal Relay Wiring

The cabling to route the output drive signals through the internal relays is shown in Figure 24 on page 216.

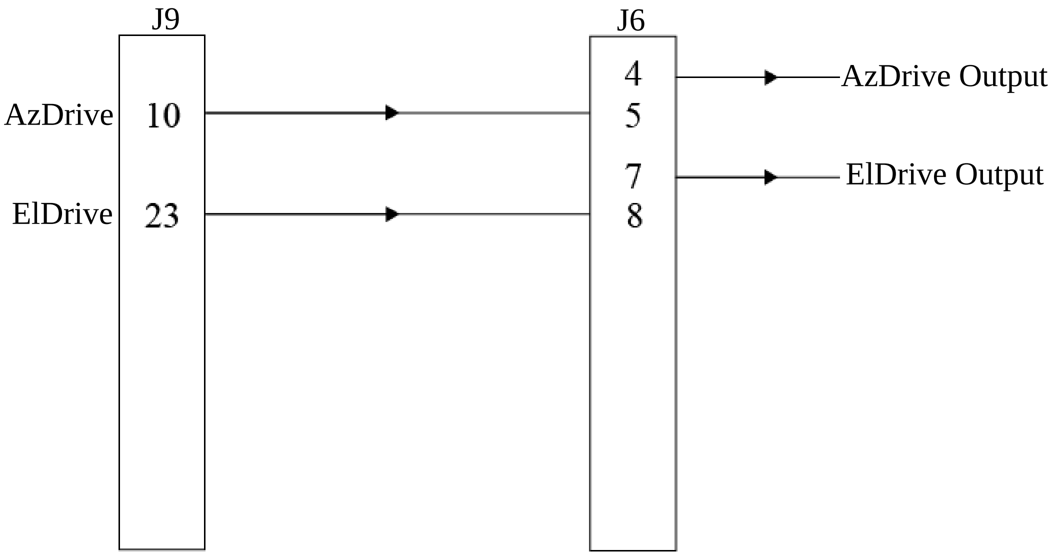


Figure 24 Cabling between Output Drive Signals and Internal Relays

The softplane.conf file needs to be modified to control the internal relays as follows:

- splConfig.Io62[0].Opt.Cp.J6_IntRelay2 = "cDrcpActive"
- splConfig.Io62[0].Opt.Cp.J6_IntRelay3 = "cDrcpActive"

D.4 RCP8 TTY Setups for Dual-System

site custom- Dual-System Setups

The dual-system setups are in the "site custom" section of the RCP8 non-volatile setups. These can be accessed from a setup terminal in the usual way or from IRIS systems through the "awtx" program from an X terminal. The questions are as follows:

```
Use Dual/Redundant system configuration: YES
```

This question is answered YES for dual-system support. Answering NO disables dual-system support.

NOTE	If you answer NO to this question, the safety features that prevent simultaneous usage of the two RCP8s are not in effect. Therefore, Vaisala does not recommend that you answer NO for a dual-system.

```
This RCP8 is the ’A’ unit: NO
Identifying letter for this unit: ’A’
```

The two RCP8s are named the “A” and “B” units. To avoid confusion, Vaisala recommends that you put physical A and B labels on the two units. Respond YES for your A unit and then for the B unit setups respond NO. Note that if you use the “TB” (title bar) option for the first line of the RCP8 front panel display (configured in the site display section), then the characters [A] or [B] appear on the top line of the RCP8 front panel to reflect your choice.

If the “A” and “B” designators really are not what you want, then use the second question to declare the single-letter identifier that appears in the TB title bar for each unit.

```
Default powerup operating mode: Auto
```

You may choose the initial power up mode (that is, None/A/B/Auto) of a dual RCP8 system. On power up, the RCP8 first waits for guidance, either from IRIS or from the other RCP8, about which mode to enter. If the other RCP8 is dead, and if no mode requests have come in from IRIS, then the unit switches to its default powerup mode. Otherwise, the unit acquires the mode of the other RCP8, or follows the direction of IRIS.

Selecting the “AUTO” initial powerup mode handles the case of starting an active scan with no user intervention when just one RCP8 is first switched on. Without this, the user would first have to explicitly choose “AUTO” from an IRIS Dual Switching Menu. But sometimes this is what you want; and by selecting the powerup mode of “None”, the system remains in maintenance mode until the IRIS user makes a specific choice.

```
This RCP8 is the ’Preferred’ unit: NO
```

The concept of a “Preferred” unit is used to resolve negotiation “ties” by the switching algorithm. In other words, when confronted with a choice of using the A or B unit, and all else is equal, the “Preferred” unit is used. Vaisala recommends that you make system A the preferred unit (respond YES) and respond NO for the system B setup.

```
Include Data Processor NST faults: NO
```

This question allows you to include the fault status of the Data Processor reported by IRIS when determining whether a given channel is okay. Answering “YES” means that both the Data Processor and the Radar Workstation must be working in order for the channel to be considered “okay”. Answering “NO” causes only the Radar Workstation to be checked.

```
Cooldown time after becoming inactive:3.0 sec
Additional warmup time when switching:3.0 sec
```

For redundant switching of antenna control, a minimum of 2 seconds is required by the RCP8 itself. The value that is used depends on the specific characteristics of the system and should be measured for each system.

```
Allow voluntary flipping between units: NO
```

The Dual/Redundant system code is capable of switching between systems in response to requests from the host computer. The RCV05 and XMT05 serial formats include two bits to control these transitions. One bit (*WouldUse*) announces that the host computer would like to use the antenna (whether or not it is actually available); and the other bit (*Relinquish*) indicates that control can be voluntarily relinquished to the other system.

When the RCP8 receives a *Relinquish* offer, it checks the other unit to verify that a) it is communicating properly, b) it is not indicating any faults, and c) it has *WouldUse* TRUE and *Relinquish* FALSE. Under these conditions, if control were offered to the other unit, it would actually be in a position to accept it; and so, the switch-over is made at that instant. Since the algorithm only flips to a system that is actually ready to go, it automatically optimizes scheduling of the antenna as each radar is able to use it.

The additional logic variables *cDrcpWouldUse*, *cDrcpRelinquish*, *cDrcpDisabled*, *cDrcpWarmup*, *cDrcpOkay*, *cDrcpMaint*, *sOtherDrcpWouldUse*, *sOtherDrcpRelinquish*, *sOtherDrcpAlive*, *sOtherDrcpDisabled*, *sOtherDrcpWarmup*, *sOtherDrcpActive*, and *sOtherDrcpOkay* appear in the control logic editor whenever voluntary flipping is enabled.

The next group of questions concerns how the IRIS Mode (as defined in the Radar Status Menu) is forced by the RCP8 whenever an RCP8 switches from INACTIVE to ACTIVE state and vice versa.

The first set of questions is for the switch from INACTIVE to ACTIVE. The example responses are for a redundant system with the modes configured as described in D.6 IRIS Configuration for Dual-System Support on page 222:

```
Choose: None Fixed Inherit Resume
Mode switch strategy when ACTIVE: Inherit
    IRIS mode #1 is valid to request: NO
    IRIS mode #2 is valid to request: NO
    IRIS mode #3 is valid to request: YES
    IRIS mode #4 is valid to request: YES
    IRIS mode #5 is valid to request: NO
```

```
    IRIS mode #6 is valid to request: NO
    IRIS mode #7 is valid to request: NO
Default mode to resolve illegal requests:3
```

The two RCP8s negotiate which is the active system such that only one system can be ACTIVE at any given time. (Note that both systems could be INACTIVE). When a system is switched into active mode, it commands its IRIS to change operating modes (that is, the Radar Status Menu mode is loaded per the RCP8 command). This question is used to determine what IRIS mode is commanded when a system is switched to active. The RCP8 simply calls the IRIS modes 1-7. The relation to the IRIS mode names is made in the IRIS Setups (RCP section). See D.6 IRIS Configuration for Dual-System Support on page 222 for a discussion of the IRIS modes. The different strategy choices are:

- **Fixed**—The RCP8 forces IRIS into a particular operating mode.
- **None**—In this case the RCP8 does not request any of the 7 IRIS modes.
- **Inherit**—Here the RCP8 switches IRIS into the operating mode that was being used before the switch. If you respond “Inherit”, you are then prompted to say what modes are valid to inherit.
- **Resume**—In this case the RCP8 switches IRIS into the mode that the RCP8 was last run in. This is useful in the case of dual frequency systems that are sharing an antenna system since it allows a system to resume operation in passive mode even if it is not the active controller. It is not used for redundant systems.

Here the recommended response for a redundant system is “Inherit” so that when a system becomes active, it continues operation in whatever mode the other RCP8 had been using. This assures that if a system is running and faults, it continues in the same mode of operation after an automatic switch.

In the case of “Inherited” or “Resume”, the RCP8 prompts the user to specify which modes of operation are valid to inherit (or resume) when the system becomes active. In this case, based on the example IRIS mode configuration in D.6 IRIS Configuration for Dual-System Support on page 222, the AIRPORT and AERIAL modes would be allowed.

The final question in this sequence above specifies the mode to use when the inherited mode does not match any of the allowed modes. For example, if both systems are in STANDBY when a switch is made, the new ACTIVE system tries to inherit the STANDBY mode (mode 2 in our example). This is not a valid active mode so the ACTIVE system would start mode 3 (AIRPORT) instead.

```
Allow mode changes within IRIS: YES
```

Responding NO prevents both automatic and manual IRIS mode changes (from the IRIS Radar Status Menu). The RCP8 continually forces the IRIS mode.

The second set of questions is for the switch from ACTIVE to INACTIVE.

```
Choose: None Fixed Inherit Resume
Mode switch strategy when INACTIVE: FIXED
Fixed IRIS mode to request: 2
    Allow mode changes within IRIS: NO
```

Fixed is recommended for redundant systems, since it can be used to force IRIS into a STANDBY mode when its RCP8 becomes inactive. In this example, mode Z is used, which corresponds to the mode called STANDBY.

```
Mode to request during Maintenance ACTIVE: 0
Mode to request during Maintenance INACTIVE: 1
    Allow mode changes from within IRIS: YES
```

In the example, the STANDBY mode is forced when the system goes INACTIVE. Note that this makes it impossible to do any modification of the IRIS mode for development or maintenance. In this case, it is recommended that the user temporarily respond YES to this question.

These questions specify what IRIS modes should be set when the RCP8 is intentionally disabled (placed in “Maintenance Mode”) by either the hardware A/B switch or the Select switch in the IRIS Switching menu.

You may choose the IRIS mode to request for Maint Active and for Maint Inactive. If the requested mode is nonzero, then an additional question appears to choose whether auto mode switching is allowed. A recommended strategy is to request a mode of zero in Maint Active, so that a running RCP continues doing whatever it was doing already. Maint Inactive should request the IRIS maintenance RST mode, and allow auto switching.

site display- Front Panel Display Setups

The only other setup questions for dual-system support are to configure the front panel display (the site section of the TTY setups). This is recommended for maintenance personnel since these front panel displays can provide excellent status without the need to look at a workstation.

In “site display” if you select TB for the first line (title bar), the title shows the labels [A] and [B] in the middle to indicate if the RCP8 is the A or B system, for example:

```
–AZ–          [A]          –EL–
```

For the bottom line of the display it is recommended that you select the choice DRCP (dual/redundant state) which shows four fields, for example:

```
En/En        Ok/Ok        On/--        Au
```

The first field shows the status of the hardware A/B disable switch for system A/B. In this case both systems are enabled (En). Other states are “Di” for disabled and “??” for unknown.

The ?? is used for all fields to indicate that the RCP8 does not know a particular state. For example, if the other RCP8 is turned off or the A/B comm link is disconnected, then the RCP8 has no knowledge about whether the other system is disabled by the switch.

The second field shows the overall status (readiness) of both the A/B systems. The possible states are Ok, Er (error) and ??. A system is not available for use if it has state Er. Ok indicates that it is ready for use. These indicators are identical to the “Ready” indicators in the IRIS Dual-System Switching Menu described inD.7 IRIS Dual-System Switching Menu on page 228.

The third field shows whether the A/B system is active (On), inactive (—) or “warming” (Wm). “Warming” is a transition state that occurs just prior to a system becoming active. This corresponds to the “Active” indicators in the IRIS Dual-System Switching Menu described in D.7 IRIS Dual-System Switching Menu on page 228.

The fourth field shows the software control mode, that is, from the IRIS Dual-System Switching Menu described in D.7 IRIS Dual-System Switching Menu on page 228. Only a single status indicator is shown for both systems, since this state is negotiated between the two systems, that is, they both must agree. The state A or B indicates whether system A or B is requested exclusively. The “Au” state indicates that the system switches automatically between A and B in response to failures.

D.5 RVP900 TTY Setups for Dual-System Support

The only setup required by the RVP900 is whether to inhibit the trigger when its associated RCP is inactive. Whether or not this is necessary is determined by the radar manufacturer. The only setup is to respond the following questions in the **mt** (general trigger setup) section:

```
Blank output triggers according to TAG#0: YES
Blank when tag input is high: YES
Blank triggers 1:YES 2:YES 3:YES 4:YES 5:YES 6:YES
```

These questions control trigger blanking based on the TAG0 input line. You first select whether the trigger blanking feature is enabled; and then optionally choose the polarity of TAG0 that results in blanking (consistent with the RCP8 setups), and which subset of the six user definable triggers are to be blanked.

Note that for maintenance, the RVP900 on the inactive system can be made to generate a trigger by any one of the following techniques:

- One of the 6 triggers can be set to "Blank triggers NO". This could be used to provide a permanent maintenance trigger.
- Temporarily respond "Blank output .. TAG#0: NO"
- Install a physical override switch on one of the RCP8 BITE inputs and then, via the control logic, enable the triggers.

D.6 IRIS Configuration for Dual-System Support

The basic concept behind the IRIS configuration is to separately configure systems A and B so they can function independent of one another. After this is done, then the dual-system operation can be tested. The special setups for the dual-system support are described here.

D.6.1 IRIS Radar Status Menu Mode Configuration

The IRIS "Mode" is determined by the Radar Status Menu, that is, the name at the top of the menus. When IRIS is first started, the "DEFAULT" mode is loaded. During operation, the mode can be changed by any of the following three mechanisms:

- Manual mode change by selecting **File**, then **Change RST...** in the Radar Status Menu.
- Automatic mode change forced by a warning product. This is often used for switching between a surveillance mode and perhaps a volume scan or wind shear detection mode.
- External mode switched forced by the RCP8. The RCP8 can be configured to either constantly force a mode (prohibiting manual or automatic mode changes), or trigger a mode change and then allow a manual or automatic mode change from the Radar Status Menu.

The specific modes that are configured for dual-system redundant applications are discussed here. The example used here is for redundant system operation of a wind shear detection system that has two operational modes called AERIAL (for general weather monitoring) and AIRPORT (for optimized for wind shear detection. A summary of the IRIS configuration is provided in the table below:

RCP02 Mode Number	Radar Status Menu (IRIS mode name)	TASK Schedule	Product Schedule	Output Schedule
1	MAINTENANCE	MAINTENANCE	MAINTENANCE	MAINTENANCE
2	STANDBY	STANDBY (inactive)	PRODUCT	OUTPUT
3	AERIAL	AERIAL	PRODUCT	OUTPUT
4	AIRPORT	AIRPORT	PRODUCT	OUTPUT

It is assumed that the same product schedule and output schedules are configured for all modes except the MAINTENANCE mode, that is, these schedules include all of the required products for all of the modes. It is possible to have different product and output schedules, but this increases the configuration maintenance. The modes are summarized below:

- STANDBY—This mode has the TASK scheduler is set to inactive (no TASK scheduled). Also, the servo power and radiate should be set to OFF in the radar status menu for safety.
- AERIAL—This mode would be configured for a long range surveillance scan and a volume scan for routine weather monitoring.
- AIRPORT—This mode would be optimized for wind shear detection.
- MAINTENANCE—This is the mode that is entered when the system is intentionally disabled by either the hardware or software selector switches. It is recommended to blank the TASK Schedule, clear all output assignments and generate no products. For safety, the servo power and radiate can be set to off in the Radar Status Menu.

NOTE For the recommended redundant configuration, you need to have the system disabled by the hardware A/B switch or the A/B select in the Switching menu to configure IRIS modes. For normal redundant configuration of the RCP8, this forces IRIS into MAINTENANCE mode and then release IRIS to allow manual mode changes for configuration of the other IRIS modes.

D.6.2 IRIS Setup Utility Mode Configuration

The various modes of operation should be configured into the IRIS Setup Utility in the RCP section as shown below. Note that the first column in the table above gives the numbers for each mode that are used in the example.

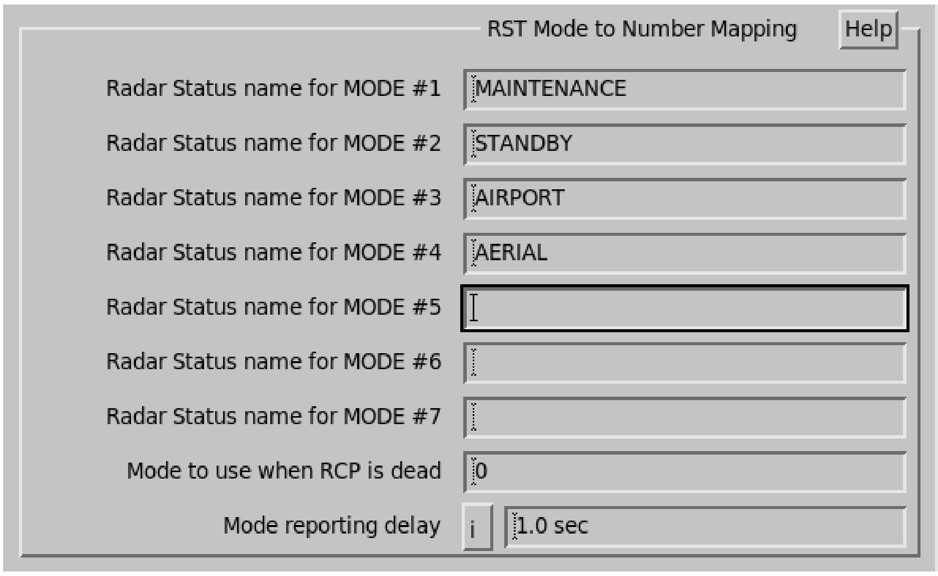


Figure 25 Radar Control Processor Setups - -RST Mode to Number Mapping

The modes are coded 1-7 and must match the mode names configured in the IRIS Radar Status Menu. To force IRIS to switch to the requested mode you must also enable External RCP Mode Change" in the IRIS Setup General question as shown below.

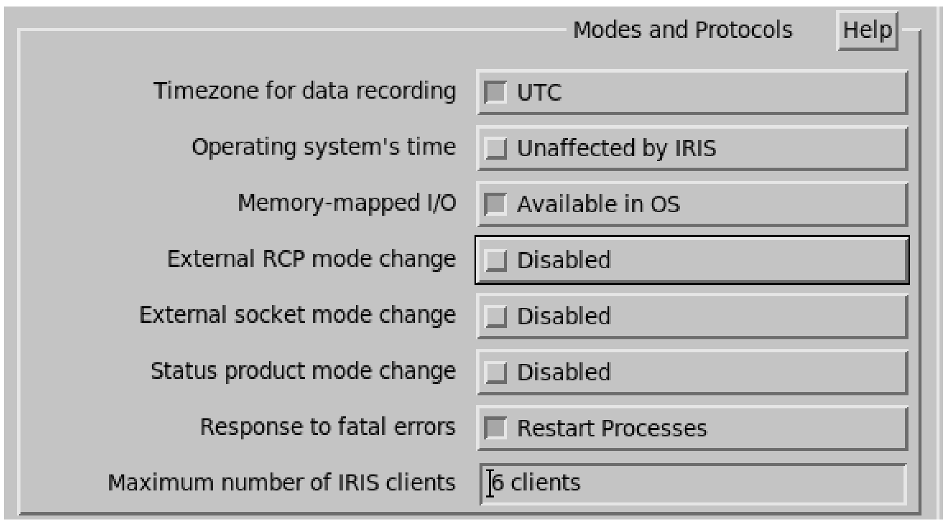


Figure 26 IRIS General Setups - Modes and Protocols

D.6.3 IRIS Status Product Configuration

The Status Product is produced at regular intervals at each of the IRIS radar workstations (A and B). These are used by the RCP8s to assess whether a system is OK or in FAULT, that is, whether a system is available for use. The Status product collects information from various sources and faults if any of the following occurs:

- BITEX critical faults
- RCP8 communication failure (RCP8 “DEAD”)
- RVP900 signal processor error
- IRIS internal critical fault. These are internal errors that are flagged as critical in IRIS.

Thus the Status product provides information on all system components. For a redundant system, IRIS A must be configured to send its Status product results to both RCP A and IRIS B and vice versa.

To configure the status product for dual-system support, first enable status product generation in IRIS setup/product, configure the fields as shown in Figure 27 on page 225.

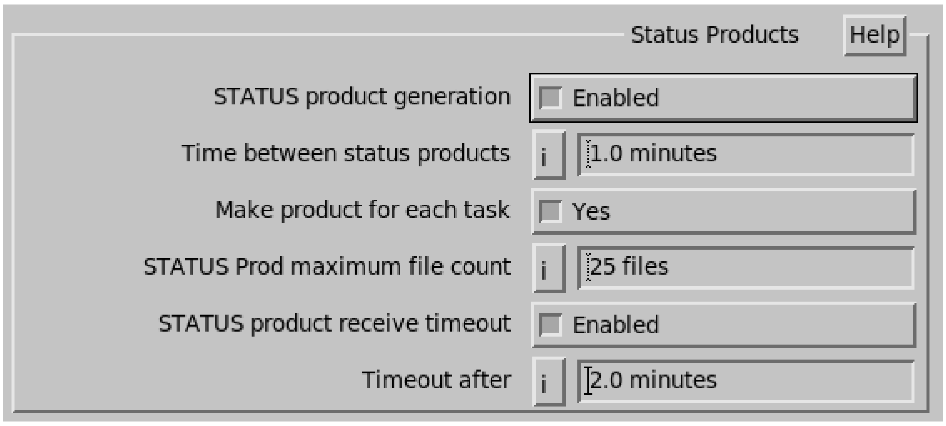


Figure 27 IRIS PRODUCT Setups - Status Products

NOTE In the event of a change in status such as a critical fault, the Status product is generated immediately. The configuration is in setup/product is for the maximum time between status products.

The IRIS Status product result (OK/FAULT) is sent to the RCP8 via the serial line. It is necessary to identify which sites are being reported. Use the IRIS Setup/RCP section as shown in Figure 28 on page 226 for the case of two sites in a redundant system called "RDA" and "RDB".

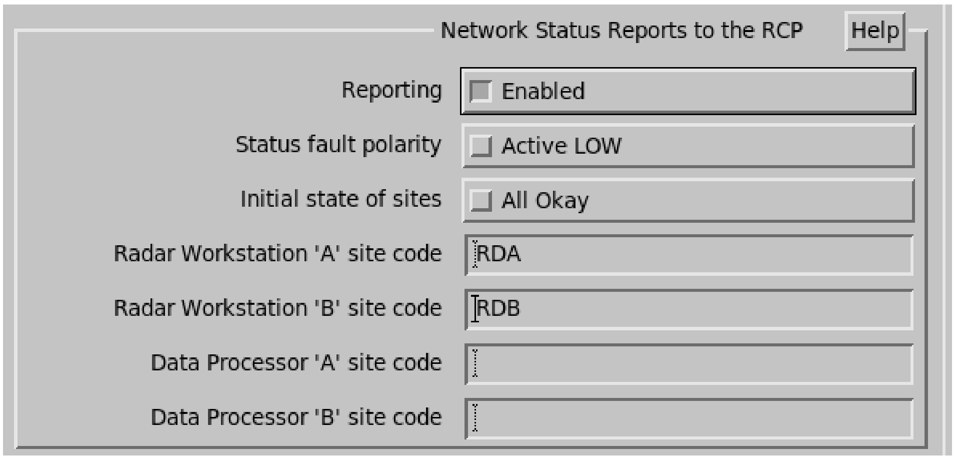


Figure 28 Radar Control Processor Setups - Network Status Reports to the RCP

The three-letter site code is used for this. These are configured in Setup General as for a standard IRIS system.

These configurations should be made identically on both systems. The final step is to use the Product Output Menu to send the Status product from IRIS A to IRIS B and vice versa.

D.6.4 BITEX Setup

BITEX is configured to display all of the available status parameters. The only additional step is to identify those parameters that signal a "Critical Fault". To do this, you must enter as `bitex -setup` with operator privilege. The sub menu for configuring each field has a critical flag (right-click on the field number).

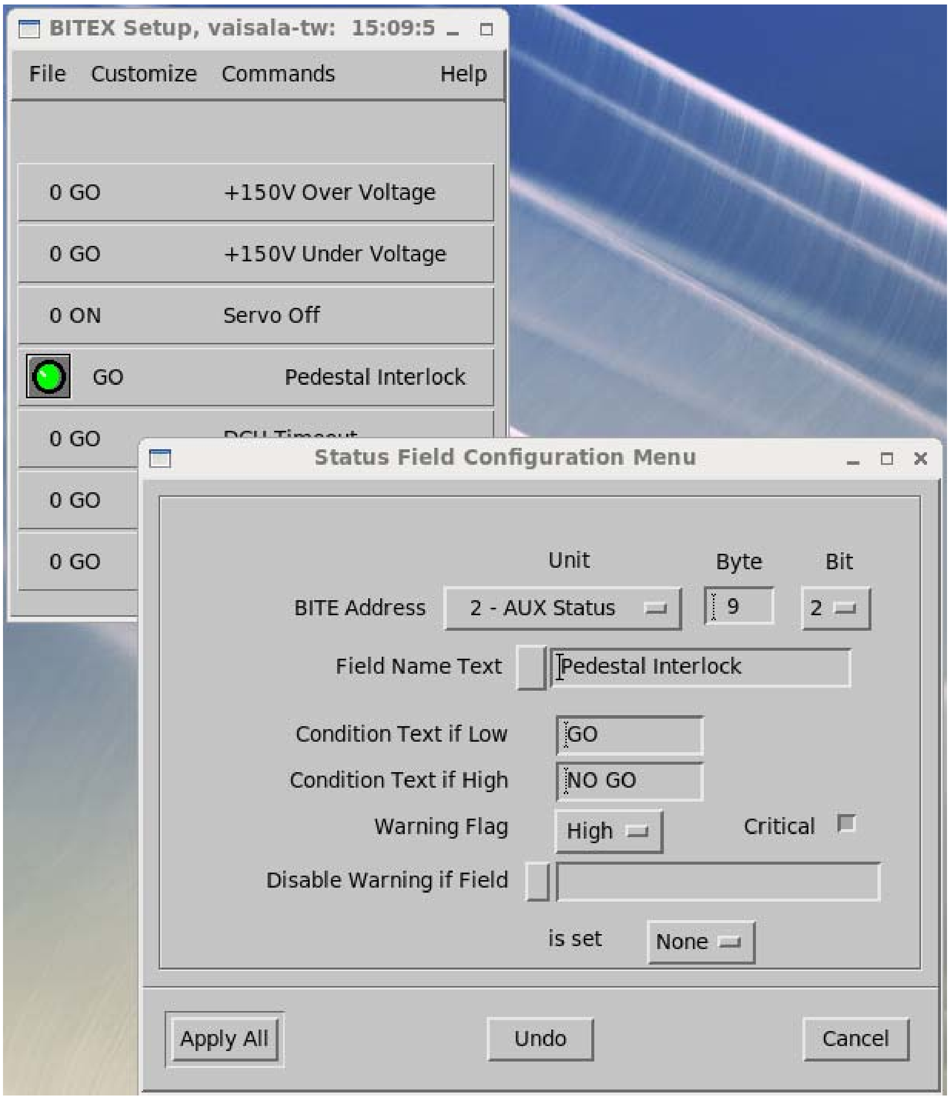


Figure 29 BITEX - Status Field Configuration Menu

In the example in Figure 29 on page 227, the fields for Pedestal Interlock is set as critical fault. When IRIS receives a critical fault message from BITEX, the IRIS site status is set to fault. This message is passed back to the RCP and, by network transfer of the status product, to the other IRIS system.

D.7 IRIS Dual-System Switching Menu

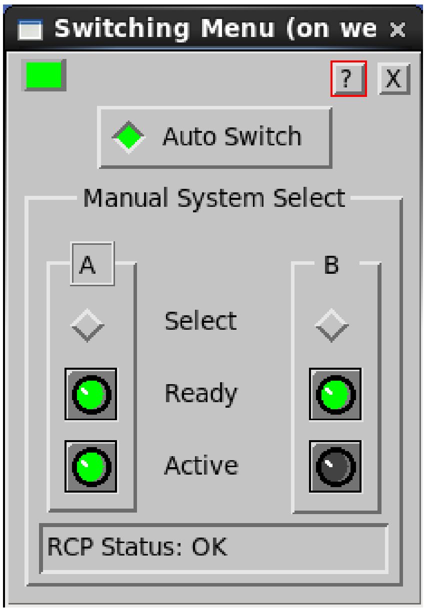


Figure 30 Dual-System Switching Menu

D.7.1 Overview

The Dual-System Switching Menu (Switching menu) provides an easy user interface for controlling and monitoring of the dual-system. The Switching menu allows the operator to see which system (A and/or B) is ready for operation, and which one is currently active (only one is active at any time). The operator can select (request) the exclusive use of either A or B, or enable automatic switching, which occurs in the event of a fault. By default, the menu is set for automatic switching. The menu can run locally at either Radar A or B, or remotely over the network to allow remote controlling and monitoring.

When running the menu on system A, the menu talks directly to RCP8 A through the RCP–to–IRIS serial line. However, the menu also talks indirectly to B through the RCP–to–RCP communications link. Thus, control and status monitoring of both systems A and B are possible through a single menu.

An important concept is that the Switching Menu does not control the RCP8 switching, rather it submits switch requests to the RCP8s, which then negotiate whether the request can be fulfilled. For example, if the operator requests that System A be used, but system A is not available because it is in fault or has been disabled by the hardware A/B switch, then the request is not fulfilled. In this case neither system becomes active. If the operator requests auto switching (the recommended mode of operation), then the RCP8s would negotiate to activate the available system.

D.7.2 Starting the Switching Menu

Operator privilege is required to access this menu. The Switching menu, can be started from either of two places:

- **antenna utility** (Refer to the *IRIS Radar and Utilities Manual*)

  Select **Options** and then select **Dual-System Selection** at the top of the antenna utility.

  This is convenient if IRIS is not running, for example, for configuration and initial testing. You can start antenna by typing "antenna &" in an X terminal or through the Utilities menu which is most easily accessed through IRISnet.

- **IRIS Radar Status Menu** (Refer to the *IRIS Radar User's Manual*)

  Select **Mode** and then select **Dual-System Selection** at the top of the IRIS Radar Status Menu.

  The IRIS Menus must be connected to either Radar Workstation A or B, although the menus themselves can be running on any networked workstation. This method is very convenient for overall control and monitoring since the Radar Status menu provides access to all status monitoring features of IRIS including the **bitex** utility.

As with all IRIS menus, multiple copies of the Switching menu can be run. This is convenient for monitoring status from multiple locations on the network. All menu copies also have control functions and the IRIS server processes every request in the order in which it is received (this is the same for all IRIS menus). The Operator password protection allows the System Manager to limit access so that only authorized personnel can use the menu.

The menu itself can be connected to either system A or B. A small box is drawn around the letter A/B over the status lights to indicate the system to which it is connected. This is a convenient reminder if you are displaying two menus; one connected to A and one connected to B on the same screen.

D.7.3 Menu Features

- **Flashing Light (upper left)**

  The flashing light at the top-left indicates that the menu is alive. A green flashing light indicates that communication with both RCPs is OK. A red flashing light indicates a communication failure of either the IRIS–to–RCP link, or the RCP–to–RCP link. The status field at the bottom also shows red and describe the nature of the failure. In addition, X symbols are drawn over the status indicators for the system for which communication has failed. This is described in more detail in the D.8 Troubleshooting Using the Switching Menu on page 231.

- **Ready Indicator**

  The Ready indicator shows 2-bits of information, that is, whether the system status is OK/Fault, and whether the hardware A/B switch at the radar is set to disable the radar. The light is color-coded as follows:

  - Green — the system status is OK.
  - Red — the system status is in fault, that is, it cannot be used until the fault is cleared.
  - Yellow Bezel— indicates that the hardware A/B select switch at the radar has disabled the system, for example, placed it in a maintenance mode. The system cannot be used operationally until the switch is set to enable the system.
  - X the status is unknown because of a communication problem.

  For a system to be used for operation, the Ready light must be green (status OK) and the Bezel must be gray (not disabled). This makes it easy to see from a single indicator whether the system is ready for operation, and if not, what course of action would make it operational.

  The RCP front panel display also shows the status for both systems (Ok or Er) and the disable switch state (En or Di).

- **Active Indicator**

  - Green—The system is active, that is, it is running or could run an IRIS TASK.
  - Off—The system is inactive. Either the system is in standby (ready to become active) or it has been disabled.
  - Yellow—The system is transitioning from inactive to active, that is, it is going through a warm-up period. See D.4 RCP8 TTY Setups for Dual-System on page 216 for a discussion of the configurable switching time.

  The Active indicator is also displayed on the RCP8 front panel as described in D.4 RCP8 TTY Setups for Dual-System on page 216. This shows either On or —.

- **The Automatic Switching and A/B Select Buttons**

  For normal operation the Automatic Switching button is enabled. This allows the RCP8s to negotiate which system to use. However, operators can request the use of only system A or B. For normal maintenance functions however, the selection of a single system should be done by the hardware A/B selector switch at the radar and the Switching menu left in the Auto position.

  Sometimes it is useful to temporarily force the systems to switch and then immediately reset back into the Auto mode, just to exercise or test the other system.

D.8 Troubleshooting Using the Switching Menu

The Switching Menu is the primary user interface for troubleshooting problems related to switching. This section provides examples of how the Switching menu is used to diagnose different problems on the system.

D.8.1 Notation of Printed Colors

Because of the use of color, is best viewed on-line rather than on the B/W hardcopy reproductions. The colors are indicated for each example as Red, Grn (green), Gry (Gray). Also note that “off” is displayed as gray (the light appears to be off).

The “Ready” light notation shows two colors to indicate the center light color and the bezel color. Recall that the center light color indicates status (OK-green, Fault-red) while the outer bezel color indicates the state of the hardware A/B switch (system enabled is gray, system disabled is yellow). In the example above the Ready light for both systems is Grn/Gry indicating status OK/ Enabled.

D.8.2 Normal Switching Menu

Both systems have OK status. Neither system is disabled by the hardware A/B switch. System A is currently active, but system B is ready to run in the event of a fault.

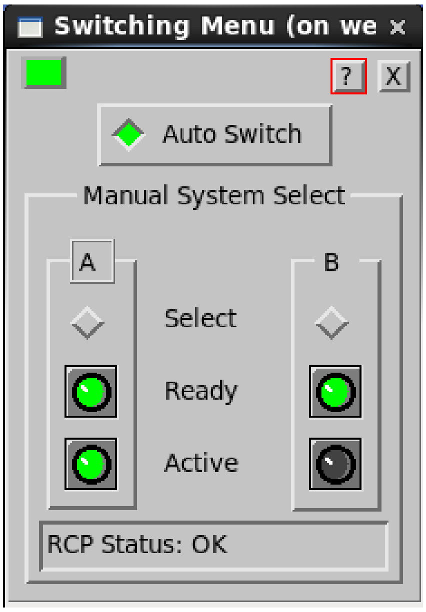


Figure 31 Dual-System Normal Switching Menu

Auto Switch Grn		
A		B
Off	Select	Off
Grn/Gry	Ready	Grn/Gry
Grn	Active	Off

D.8.3 System B Disabled (Maintenance Mode) by Hardware A/B Switch

Here, the yellow bezel of the Ready light indicates that, maintenance personnel have disabled system B.

Action: To make B ready for operation set the hardware switch to enable B (that is, to allow automatic switching).

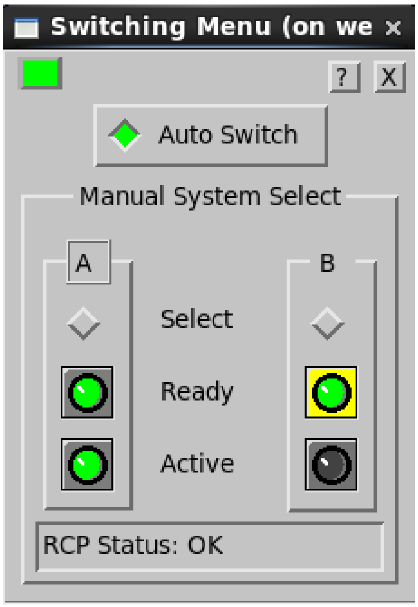


Figure 32 Dual-System B Disabled (Maintenance Mode)

Auto Switch Grn		
A		B
Off	Select	Off
Grn/Gry	Ready	Grn/Yel
Grn	Active	Off

D.8.4 System A in Fault, System B Running

System A has faulted as indicated by the red Ready light. System B is now running.

Action: use the Radar Status Menu for system A to determine the nature of the fault. Check:

- Subsystem Status of RVP and RCP (lower right)
- BITE status (summary display and access lower left)
- Message menu (top middle)

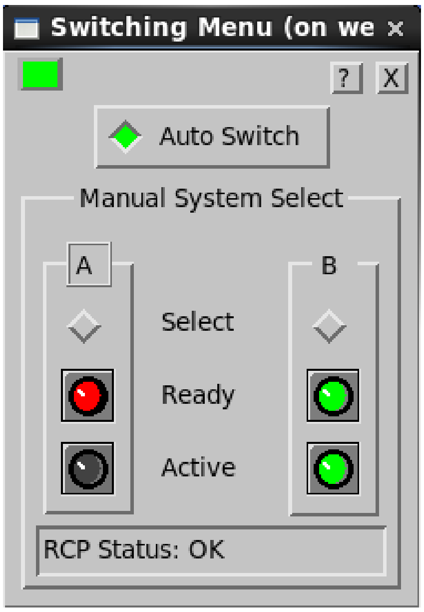


Figure 33 Dual-System A in Fault, B Running

Auto Switch Grn		
A		B
Off	Select	Off
Red/Gry	Ready	Grn/Gry
Off	Active	Grn

D.8.5 System B in Fault and Placed in Maintenance Mode

System B has faulted as indicated by the red Ready light. The yellow bezel on the system B ready light indicates that B has been disabled by the hardware switch. It has probably under repair by maintenance personnel.

Action: Use the Radar Status Menu to identify the fault. When the fault is cleared, put set the switch to enable system B.

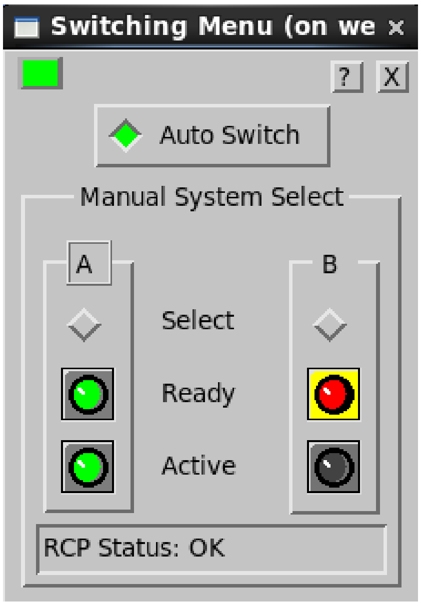


Figure 34 Dual-System B in Fault and Place in Maintenance Mode

Auto Switch Grn		
A		B
Off	Select	Off
Grn/Gry	Ready	Red/Yel
Grn	Active	Off

D.8.6 Both Systems Faulted, No Operation Possible

Both Ready lights are red indicating that neither system can be run. The Active lights are both off indicating that neither system is running To make matters worse, the Ready light bezels are both gray indicating that maintenance personnel may not be working on the problem (the hardware switch has not been set to maintenance mode for either system).

Action: Use the Radar Status Menu to identify the faults. When the fault is cleared the system automatically resumes operation on the good system.

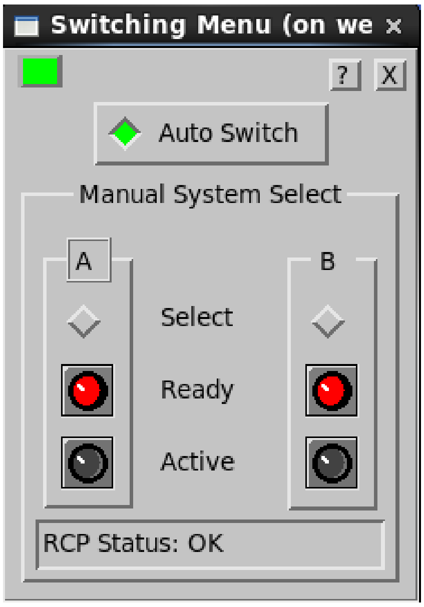


Figure 35 Dual-System Both Systems Faulted (No Operation)

Auto Switch Grn		
A		B
Off	Select	Off
Red/Gry	Ready	Red/Gry
Grn	Active	Off

D.8.7 RCPB is Unreachable (As Viewed from System A)

Here the menu is being viewed from system A as indicated by the small box around the letter “A”. The X’s for the Ready and Active lights on system B indicate that we cannot get the status of these because of a communication failure of the RCP–to–RCP link.

Problem: The RCP–to–RCP link has failed, or RVP02B has been turned off.

Action: Check if RCP8 B has been turned off. Check RCP–to–RCP link cable:

1. Checking the front panel.
2. Checking the Radar Status Menu for system B (”RCP Dead” in Subsystem Status).
3. Starting the Switching menu on system B and observing 4 Xs.

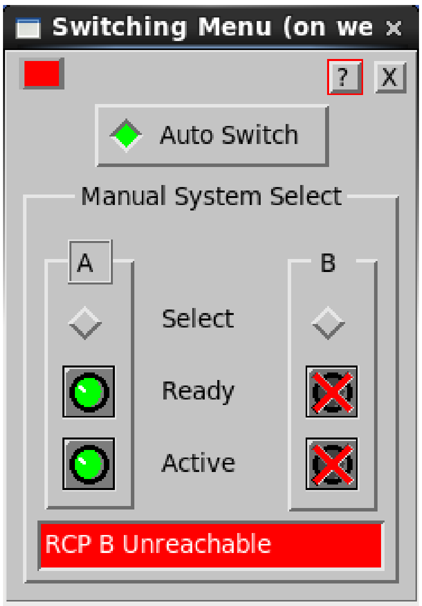


Figure 36 Dual-System RCPB is Unreachable

Auto Switch Grn		
A		B
Off	Select	Off
Grn/Gry	Ready	X
Grn	Active	X

D.8.8 RCP is Dead

The 4 X's indicate that our RCP (in this case for system B as indicated by the [B]) is not communicating to the IRIS workstation.

Problem: The IRIS–to–RCPB link has failed, or RCP8B has been turned off.

Action: Check if RCP8 B has been turned off. Check IRIS–to–RCPB link cable. To see if the RCP has been turned off:

1. Check the front panel.
2. Check the Radar Status Menu for system B ("RCP Dead" in Subsystem Status).

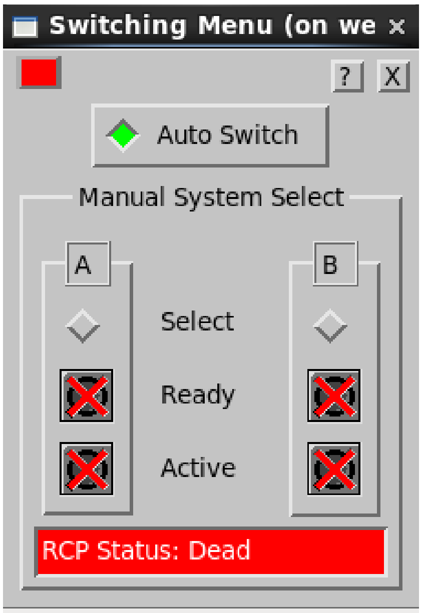


Figure 37 Dual-System RCP Status: Dead

Auto Switch Grn		
A		B
Off	Select	Off
X	Ready	X
X	Active	X

D.8.9 Operation Forced to A—Auto Switching and B Disabled

Here the A Select is green indicating that it has been selected (by pushing the button in this menu) to be the exclusive system. The A Active and Ready lights are both green. B is disable by this action, similar to disabling B via the hardware switch. However, B's Ready light is green so that it could be used.

Action: The system should be restored to Auto Switch mode as soon as possible. If the selection of A was made because of intermittent behavior of B, then isolate the problem. It is recommended to set the hardware A/B switch to disable B during maintenance and then re-enable Auto Switch. This way when maintenance on B is complete, the system is ready to Auto switch without any operator intervention.

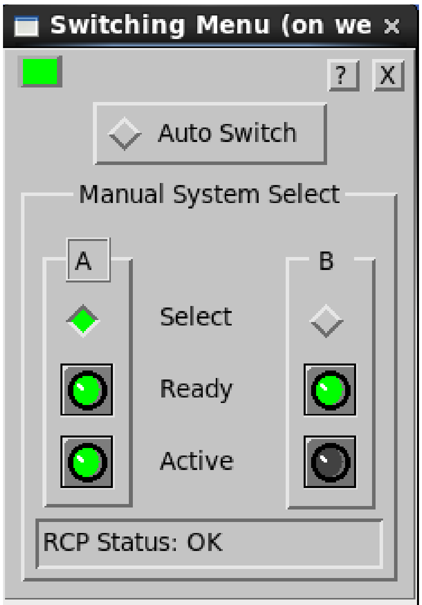


Figure 38 Dual-System Operation Forced to A (Auto Switching and B Disabled)

Auto Switch Off		
A		B
Off	Select	Off
Grn	Ready	Grn
Grn	Active	Off

D.8.10 Non Operational, Both Systems Disabled

Both Active lights are off indicating that no operation is possible. The reason is that the hardware A/B switch has disabled A and the software switch in this menu has disabled B.

Action: Set for Auto Switch. System B automatically switches to active.

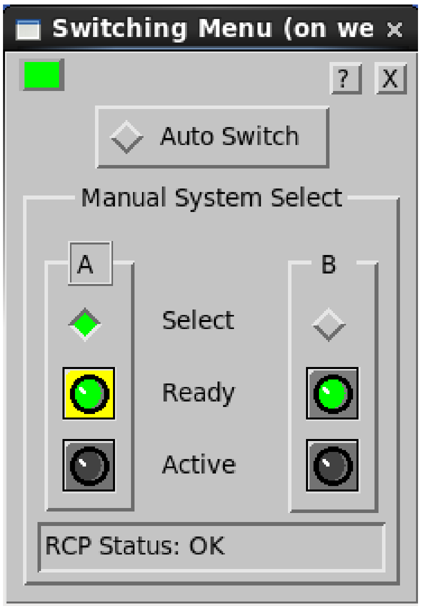


Figure 39 Dual-System Non-Operational, Both Systems Disabled

Auto Switch Off		
A		B
Grn	Select	Off
Grn/Yel	Ready	Grn/Gry
Off	Active	Off

D.8.11 Non-Operational, System A is Menu Selected, but Faulted

Both Active lights are off indicating that no operation is possible. The reason is that system A has faulted and software switch in this menu has disabled B. However, system B is ready to use.

Action: Set Auto Switch on. System B automatically switches to active. Use the Radar Status Menu on system A to determine the fault.

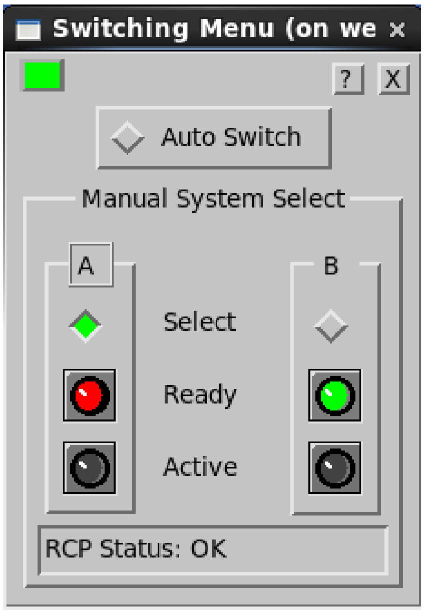


Figure 40 Dual-System Non-Operational, A is Menu Selected, but Faulted

Auto Switch Off		
A		B
Grn	Select	Off
Red/Gry	Ready	Grn/Gry
Off	Active	Off

D.8.12 Avoiding Non-Operational Conditions (Enable Auto Switch)

These last two examples illustrate that it is best to leave this menu with Auto Switch enabled at all times. To place a system in maintenance mode, it is recommended that the hardware switch be used. If absolutely necessary, this menu can be used to disable a system temporarily until someone can go to the radar site and set the hardware A/B switch. The only other reason for selecting A or B is to force the systems to switch to "even-out" or test the usage of each system. After the switch is forced, Auto Switch should be immediately re-enabled.

D.9 Dual-System Parallel Operation

Another application of the dual-system RCP8 is for operation of two separate transmitter/receiver systems through the same antenna pedestal system, that is, a dual-frequency system. In this case, a "radar" can be thought of as the transmitter/receiver of each system and its associated RCP8, RVP900 and IRIS system. These two "radars" must share the same antenna/pedestal. The constraint is that only one RCP8 can control the antenna/pedestal at a time. There are two modes of operation possible in this case:

- **A or B ("Flip") mode: Selectable or Alternating Active Radar:** This case is identical to the operation in the case of a redundant system, that is, either radar A or radar B is used exclusively. The switching menu or the hardware selector switch can be used to force the exclusive use of one "radar" or the other. In addition, the TASK Scheduler menu provides support to "flip" between the two radars so that IRIS can automatically run a TASK from on one radar and then relinquish control so that the other radar can run a TASK.
- **A and B mode: Simultaneous Active/Passive mode:** In this case, one "radar" system is used to actively control the antenna scanning while the other radar system acquires data passively. This allows both radars to operate simultaneously. The RVP900 of the passive system in this case still generates pulse width change output and triggers and the associated passive RCP8 still has control to turn-on the radiate and T/R power. The IRIS Status Product, sent from the active system, is used by the passive system to determine which TASK in the schedule should be run in passive mode.

Note that in principle it is possible to operate in using the "flip" mode (A or B) and the active/passive (A and B) mode simultaneously. In this case the radars would flip between active and passive. However, this is more complex to configure. For active/passive operation, it is simpler to select one radar to always be the active system and never “flip” the active system to the other radar.

A major difference between the dual-redundant case and the dual-system parallel operation is that the RCP8 is typically not setting the mode of operation, that is, not controlling the IRIS mode selection in the Radar Status Menu. In the redundant case, it is important that in the event of a failure, IRIS be told what to do after an automatic switch-over, that is, the RCP8 that is taking control tells IRIS the operating mode. For dual-system parallel operation, IRIS is telling the RCP8s how to operate, that is, which is active and which is passive. This means that the setup of the RCP8 (on the RCP8 and the IRIS end) does not involve defining all the operating modes, mode reporting and mode switching strategies.

The RVP900 setups do not require special consideration for dual-system operation. In most cases, the RCP8 and IRIS setups for dual-system parallel operation are identical to those for the dual redundant system. The differences are described in the following sections.

D.9.1 RCP8 Setups for “Flip” or Simultaneous Operation

- **Site Custom–>Allow voluntary flipping YES**

  This is set to “Yes” if you intend to use the Flip (A or B) feature. This must be done on both RCP8s. This allows the TASK Scheduler of one radar to assume control, and then relinquish control (“flip”) to the other radar. The IRIS TASK Scheduler menu provides support for this in the “Flags” column (that is, the “Flip” flag).

- **Site Custom–>Mode Switch Strategy When ACTIVE (INACTIVE) NONE**

  These questions are described in detail in D.4 RCP8 TTY Setups for Dual-System on page 216. Set the responses to both of these questions to “NONE” on both RCP8s. In this case, the special mode 0 is always requested by the RCP8, which means that the operator controls the IRIS mode, not the RCP8.

- **Site Custom–>Mode to request during Maint ACTIVE (INACTIVE) 0**

  Respond “0” to both of these questions on both RCP8s. “Maintenance Mode” is defined to be when either the hardware switch or the software switch (Switching Menu) is set to disable a radar. Setting the Mode request from the RCP8 to 0 allows the normal IRIS Radar Status Menu mode to be controlled by the operator without interference from the RCP8s, that is, the RCP8s does not force IRIS mode changes. See also D.4 RCP8 TTY Setups for Dual-System on page 216 for more information on these setup questions.

D.9.2 IRIS Setups for "Flip" or Simultaneous Operation

- **setup/ingest/Scanning Options–> Task Scheduling Control Active/Passive**

  To use the simultaneous active/passive feature, set this to "Active/ Passive" on both RCP8s. This is recommended since it allows either radar to assume the active role. However, it is possible to set one radar to "Active Only" and the other to "Passive Only" if you would like to dedicate the systems to these roles. In this case, you would not be able to use the passive system on its own.

- **setup/ingest/Scanning Options–> Passive: use external trigger rate No**

  Responding NO allows the RVP900 of the passive system to generate its own trigger. This is generally recommended so that the two radars can be triggered independently by their own RVP900, for example, to use dual PRF. Set this on both systems.

- **setup/ingest/Scanning Options–> Passive: use status product task Yes**

  Respond YES to slave the passive system TASK to the active one via the Status Product. You should do this on both systems. You also need to make sure that Status Products are enabled (D.6 IRIS Configuration for Dual-System Support on page 222) and set the Product Output Menu to automatically send the Status product to the other system. This should be done for both systems.

  The next question asks for the 3-letter site code of the other system. Do this for both systems, each referring to the other.

- **setup/rcp02/Status Reports to the RCP–>**

```
Reporting                          : Enabled
Status fault polarity              : Active LOW
Initial state of sites             : All Faulted
Radar Workstation 'A' site code    : MPK
Radar Workstation 'B' site code    : MPW
Data Processor 'A' site code       :
Data Processor 'B' site code       :
```

  These settings enable the two RCP8s to know the status of each radar. This is necessary for switching between the two systems in "flip" mode or using one or the other system under manual control. If the status of a system is FAULT, then switching of active control is disabled to that system.

- **setup/rcp02/RST Mode to Number Mapping–>**

```
Radar Status name for MODE #1     : DEFAULT
Radar Status name for MODE #2     : DEFAULT
Radar Status name for MODE #3     : DEFAULT
Radar Status name for MODE #4     : DEFAULT
Radar Status name for MODE #5     : DEFAULT
Radar Status name for MODE #6     : DEFAULT
Radar Status name for MODE #7     : DEFAULT
Mode to use when RCP is dead      : 0
Mode reporting delay              : 1.0 sec
```

The RCP8 can send commands to IRIS to change operating modes. These commands are codes (1–7) that are associated here with different Radar Status Menu names. In general, the RCP is always requesting mode 0 which is a special code that allows the operator to specify the IRIS mode in the Radar Status Menu. As a safety feature, the DEFAULT IRIS mode is set for all of the other numerical codes (1–7) that could be commanded by the RCP. Thus, in the event that the RCP were to request a mode (other than 0), it would be the DEFAULT Radar Status Menu configuration.

- **setup/general/Modes and Protocols–>**

```
External RCP mode change: Disabled
```

Setting this to disabled assures that IRIS modes changes cannot be forced by the RCP8.

D.9.3 IRIS TASK Scheduler: “Flip” Operation

NOTE	To use the “Flip” feature, the Switching Menu must be set to the “Auto” position so that the RCP8s can negotiate which radar to use.

The TSC Editor Menu is where the “Flip” feature is activated. Right-click the mouse in the “Flags” column to toggle the “Flip” flag on/off. Here is how it would work. Suppose that you want a TASK to run on radar A and then another TASK on radar B. You would setup the TASK Schedules with the appropriate TASKS on the two systems and set each to “Flip”. After radar A runs its TASK, it sees that the flip flag is set and then tells the RCP8s that it is willing to relinquish the radar control. If radar B wants to run its TASK (because it is the scheduled time), then it tells the RCP8s that it wants to run. The RCP8s then automatically release control to radar B, etc. For example, if each TASK is set to run continuously, (”Repeat” set to 00:00), then the TASKS on the A and B radars alternate.

Be sure NOT to set the Late Skip flag to “Yes”. This could interfere with the flipping since in general a flip is forced by a TASK that is late, that is, it wants to run but it can’t because the other radar is in control.

Vaisala recommends that you include the word “flip” or other code in the TASK Schedule and perhaps the Radar Status Menu operating mode to indicate that the systems will flip, for example, for the TASK Schedule PPIVOL_FLIP and for the IRIS Radar Status Menu FLIP_MODE.

D.9.4 IRIS TASK Scheduler: Simultaneous Active/Passive Operation

NOTE	To use the simultaneous active/passive feature, the Switching Menu must be set to specify the active system. The active system can be forced by selecting it exclusively. The Switching Menu can also be left in Auto mode after the active system is forced.

At the top of the TSC Editor Menu, is a field labeled “Active” or “Passive”. You can toggle between these two choices if the setup/ingest/scanning is set to active/passive. Otherwise, the text is fixed to either active or passive depending on your selection in setup.

For simultaneous active/passive operation, the TSC Editor Menu of one system should be set to “Active” and the other set to “Passive”. In the active system, configure the TASK as usual. On the passive system, configure a TASK with the same name. All of the TASK parameters can be configured independently except for the antenna scanning parameters (Scan Mode, Azimuth, Elevation, Scan Speed). The scan Resolution does not have to be the same. For example, for a PPI scan mode, the elevation angles in the passive system TASK must match those in the active system TASK. Similarly, if you are doing RHIs, the elevation limits and selected azimuth angles must match on the two TASKS. Other than the scan parameters, you have complete freedom to select PRF, processing mode, range, resolution, etc.

You also need to make sure that the Status Products are enabled on the active system and that the Status Product is output (via the Product Output Menu) to the passive system. This is how the passive system learns which TASK to run.

In operation, when the active system starts a TASK, it sends a Status product to the passive system. The passive system reads the status product and checks to see if there is a passive TASK in the TASK Scheduler with the same name. If there is, it runs the passive TASK.

You should save the TSC Editor menu with a name to indicate active or passive. Likewise, the IRIS mode (Radar Status Menu name) should be saved with a name to reflect active or passive (for example, ACTIV_1 or PASSV_1).

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