2.1.6.2. Servo Amplifier, 100V, 10A (Unit 2 A1 A5 A2)

The Servo Amplifier is a digital servo amplifier providing advanced position control for the Ranger-X5 Antenna System. The servo amplifier works in conjunction with the Aquarian Servo Controller to ensure the pointing accuracy of the pedestal system.

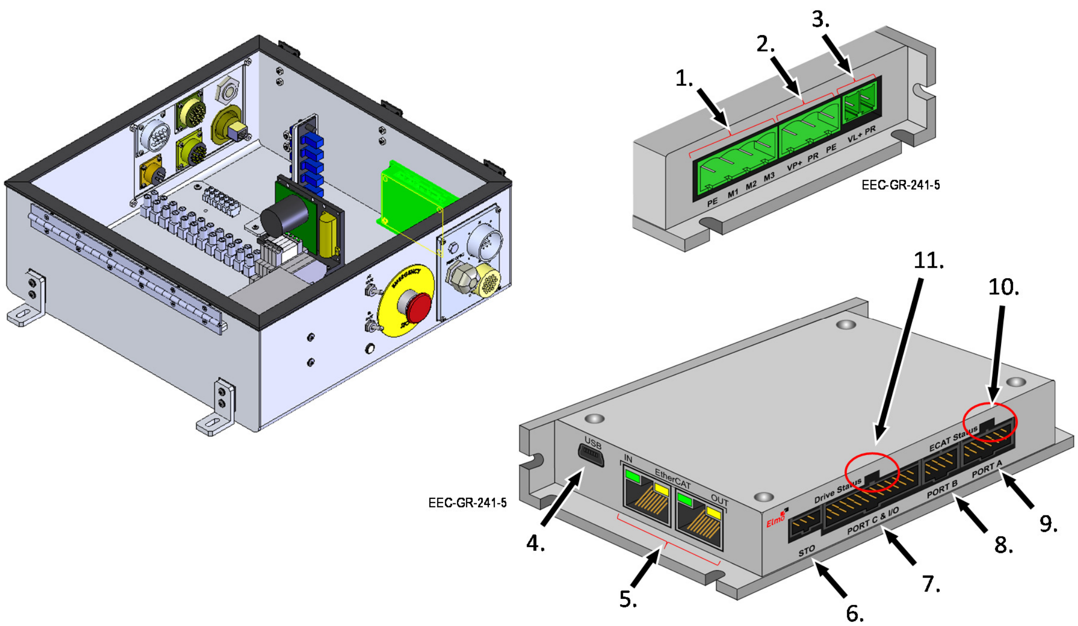

Figure 57. Servo Amplifier (135914-100)

See Paragraph 0 for more details

2.1.6.3. Fiber Optic Coupler (Unit 2 A1 A5 A3)

This unit is functionally identical to the Fiber Optic Coupler in the Control Cabinet. See Paragraph 1.1.7 for details.

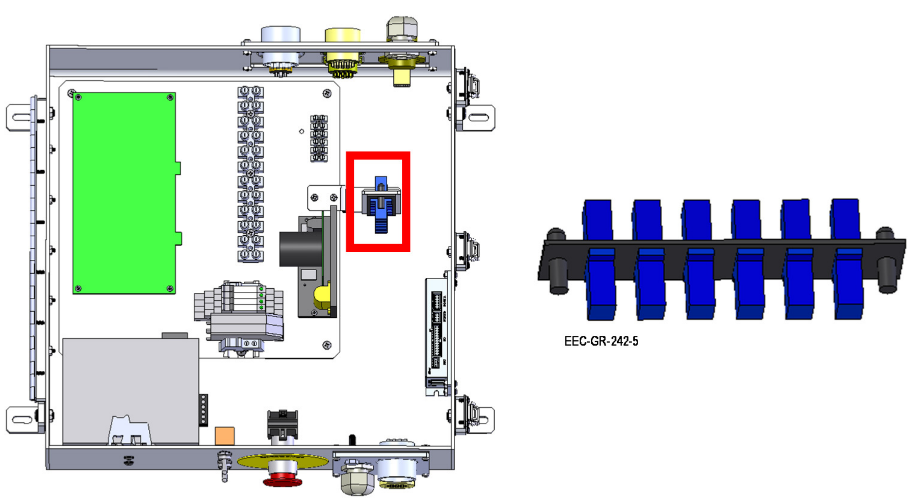

Figure 58. Fiber Optic Coupler (FSP-SC-BR)

2.1.6.4. Aquarian Servo Controller PCA (Unit 2 A1 A5 A4)

This unit is functionally identical to the Elevation Servo Controller. See Paragraph 0 for details.

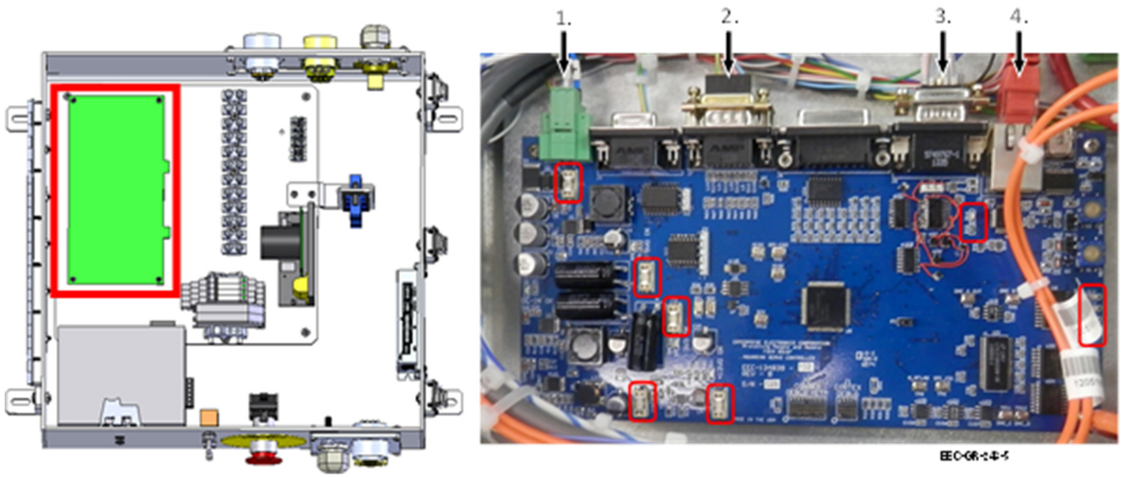

Figure 59. Aquarian Servo Controller (134839-103)

2.1.6.5. Regeneration Clamp (Unit 2 A1 A5 A5)

This unit is functionally identical to the Regeneration Clamp in the Elevation Assembly. See Paragraph 0 for details.

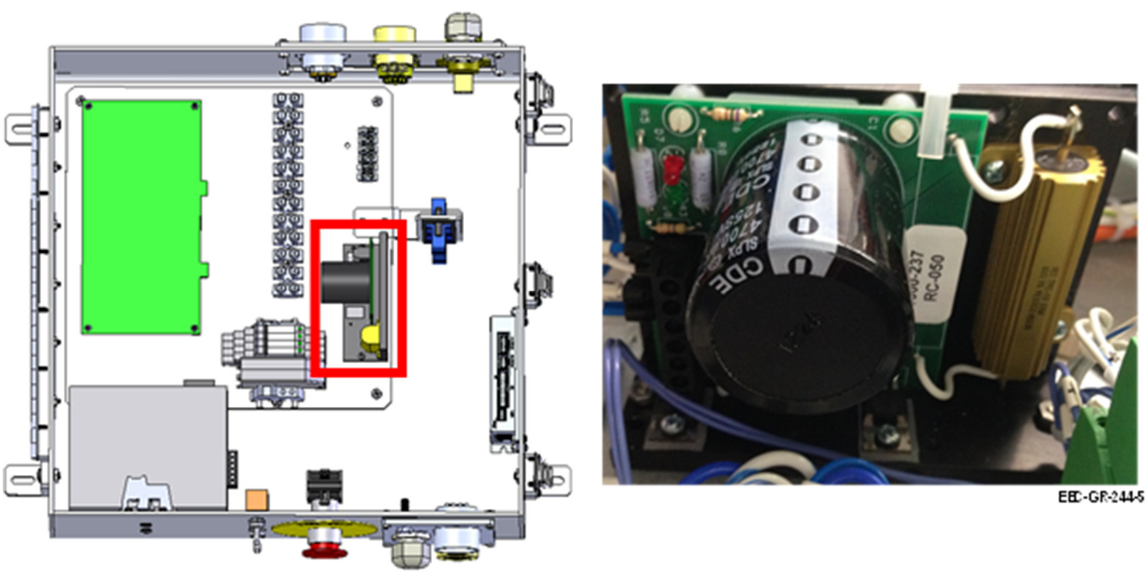

Figure 60. Regeneration Clamp (1000-237)

2.2. Antenna Assembly – 1 Meter Reflector (Unit 2 A2)

The 1.8-Meter Antenna / Feed Horn Assembly is specifically designed and built for the Ranger Series radar system. The unit is a lightweight, composite material. The feed horn is tuned to the reflector and mounted for optimal dual polarization performance.

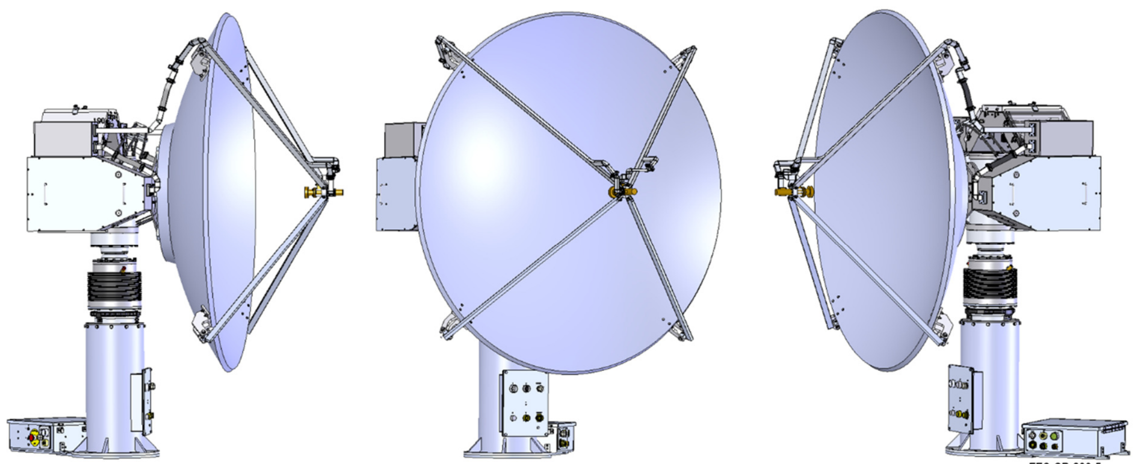

Figure 61. 1.8 Meter Antenna

Antenna Size	Antenna Gain
1 Meter / 3.2 Feet	36.0 ± 0.5 dBi
1.8 Meter / 6 Feet	42.0 ± 0.5 dBi
2.4 Meter / 8 Feet	44.5 ± 0.5 dBi

CHAPTER 3

RADOME

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3. Radome (Unit 3)

A separate (OPTIONAL) Protective Radome technical description is included as an attachment, if provided by EEC.

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CHAPTER 4

SYSTEM THEORY OF OPERATIONS

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4. System Theory of Operations

The following sections describe the system theory of operations. System theory is used to describe software controls, signal flow and the relationships of sub-assemblies. System theory is divided into the following categories:

1. COBRA Software
2. Primary Power Supply and Distribution
3. Interlock Circuitry
4. Transmitter Control and Transmit
5. Transmit Waveguide and Star Waveguide Assembly
6. Receiver Signal Flow
7. Antenna Control and Angle Acquisition
8. Communication Interface

4.1. COBRA Software

The Ranger-X5 local user station operates through the EDGE Software through an interface to the COBRA application software and the Local Control Interface (LCI). COBRA processes all operator commands from either the local or remote operator EDGE workstations and routes them to the appropriate radar control circuits. The I/O modules collect information on radar performance and status, and provide basic, bit level control to specific subsystems. The COBRA program also correlates and processes information and procedures from the BITE sub-system, controls the Antenna/Pedestal operational parameters, and performs basic radar control functions. The Aquarian Servo Controller, the UDC / Transmit Control Unit, and the COBRA software seamlessly integrate with the IQ2-IFD and IQ2-DSP, communicating by standard Ethernet protocol.

The EDGE workstation(s) input the commands and pass system status signals to and from the system units such as the transmitter/receiver system and the Antenna system. In LOCAL mode, manual inputs for Antenna drive commands come from the EDGE operator control. The EDGE Software and the COBRA software can display all radar BITE data on the KVM screen. The COBRA software also sends the BITE data to the EDGE remote host processor.

The interface, internally and to external workstations and processors, is a 10/100/1000 Ethernet data communications circuit. See **Figure 62** for a graphical depiction of the COBRA software Architecture and communications protocols with other radar units.

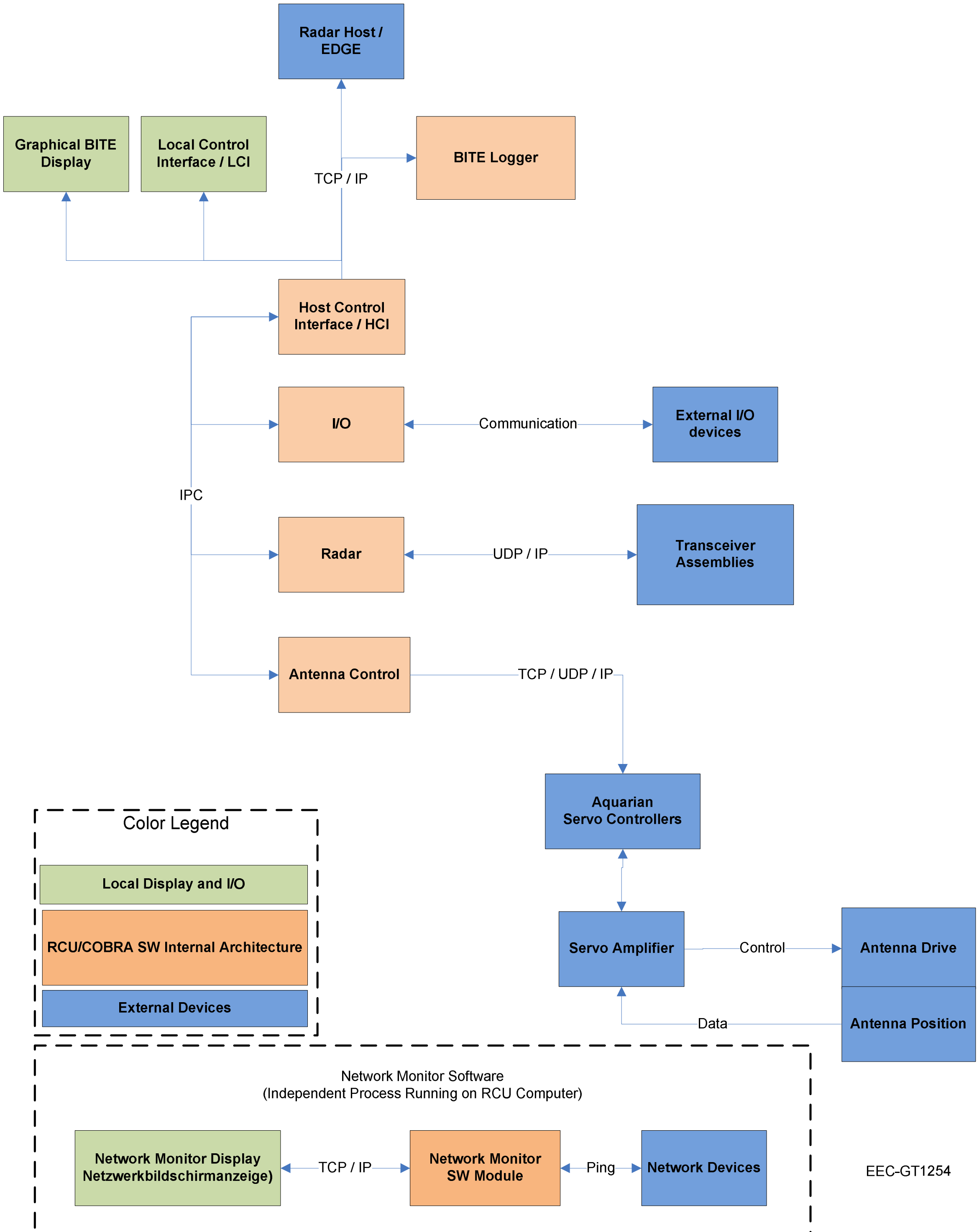


Figure 62.Ranger-X5 COBRA Software Architecture

4.1.1. BITE Page

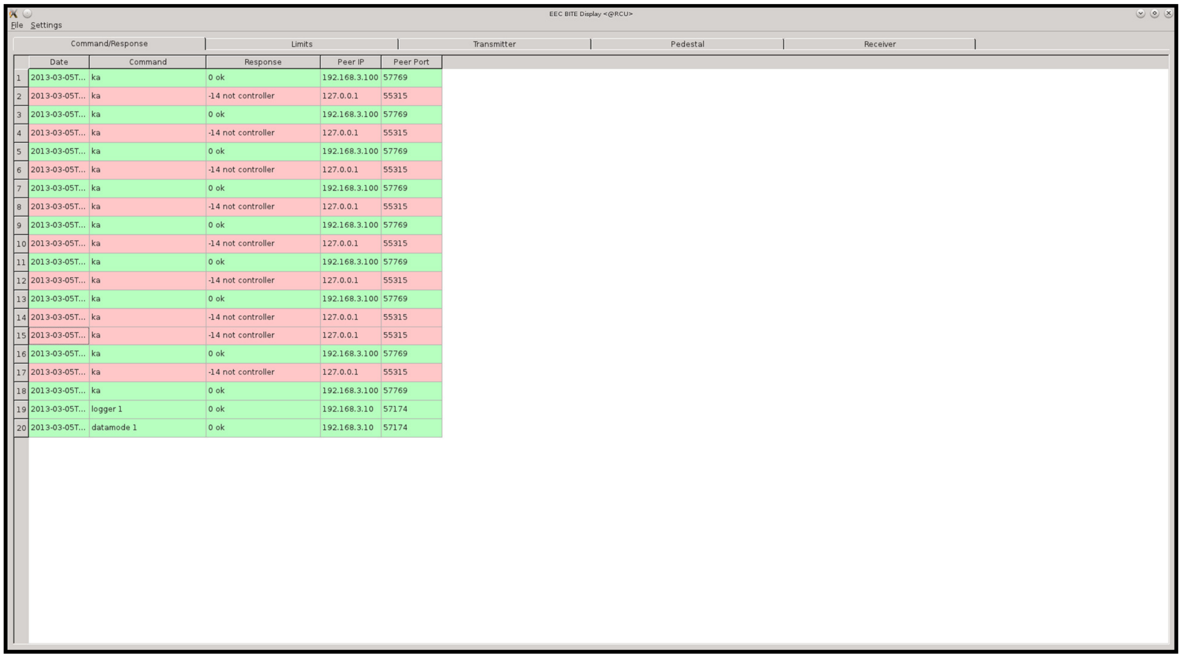
The BITE information from within the RANGER-X5 is processed and routed to the EDGE software. The BITE information can also display on the COBRA LCI software through the KVM display. The COBRA LCI BITE Display has tabs to display the log file of command and responses; to set the limits for the statuses of the various components; and to configure the layout of the Transmitter, Pedestal, Signal Processor, and Receiver BITE screens.

The Naming Conventions and Source are as follows:

Abbreviation	Naming Convention and Source
mrp	IQ2
ped	Pedestal
rcu	Radar Control Unit
rx	Receiver
tx	Transmitter
5v	Direct Current Voltage
12v	Direct Current Voltage
24v	Direct Current Voltage
48v	Direct Current Voltage
az	Azimuth
blanking	Blanking
burst	Burst
cab	Cabinet
clock	Clock
coax	Coaxcable
contactor	Contactor
cpu	Central Processing Unit
current	Current
detected	Detected
dma	Direct Memory Access
downlink	Downlink
dsp	Digital Signal Processor
el	Elevation
enabled	Enabled
error	Error
ext	External
fault	Fault
fifo	First In First Out
filament	Filament
fo	Fiber Optic
forward	Forward
fpga	Field Programmable Gate-Array
free space	Free Space
freq	Frequency
hd	Hard Disk
hh	Horizontal High
hl	Horizontal Low
hold	Hold
home	Home
hotbox	Description of the Klystron Enclosure
humidity	Humidity
hw	Hardware
i	Current
ifd	Intermediate Frequency Digitizer
igbt	Insulated Gate Bipolar Transistor
initialized	Initialized
int	Internal
interlock	Interlock
lock	Lock
lube	Lube
SSPA	Solid State Power Amplifier
main	Main

Abbreviation	Naming Convention and Source
mb	Motherboard
mfc	Manuel Frequency Control
mode	Mode
neg	Negative
normal	Normal
ntp	Network Time Protocol
offset	Offset
online	Online
over	Over
pci	Process Capability Index
performance	Performance
pos	Positive
present	Present
press	Press
proc	Processing
protocol	Protocol
ps	Power Supply
psa12	Power Supply 12V
psa15	Power Supply 15V
psa48	Power Supply 48V
psa5	Power Supply 5V
pump	Pump
purge	Purge
pwr	Power
radiate	Radiate
ray	Ray
relay	Relay
reverse	Reverse
safe	Safe
safety	Safety
sample	Sample
servo	Servo
speed	Speed
Stalo	Stalo
standby	Standby
start	Start
step	Step
switch	Switch
sys	System
sw	Switch
temp	Temperature
timeout	Timeout
tp	Throughput
trigger	Trigger
uplink	Uplink
v	Velocity
velocity	Velocity
vh	Vertical High
vl	Vertical Low
vswr	Voltage Standing Wave Ratio

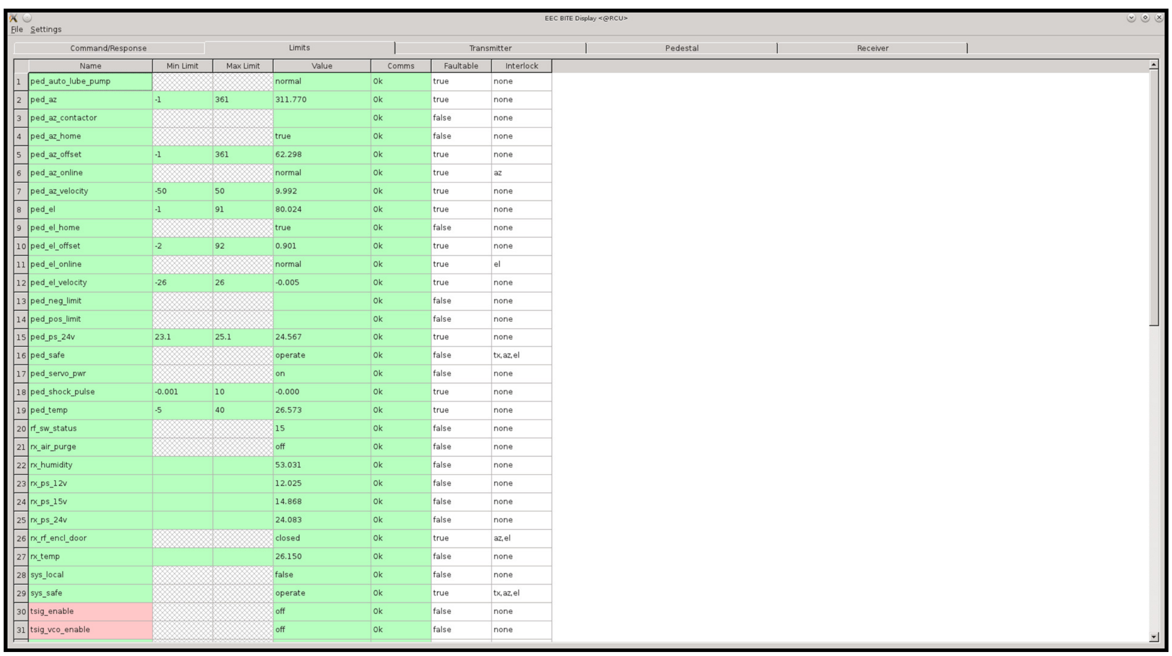
Table 2. BITE Display Naming Convention



	Date	Command	Response	Peer IP	Peer Port
1	2013-03-05T...	ka	0 ok	192.168.3.100	57769
2	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
3	2013-03-05T...	ka	0 ok	192.168.3.100	57769
4	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
5	2013-03-05T...	ka	0 ok	192.168.3.100	57769
6	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
7	2013-03-05T...	ka	0 ok	192.168.3.100	57769
8	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
9	2013-03-05T...	ka	0 ok	192.168.3.100	57769
10	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
11	2013-03-05T...	ka	0 ok	192.168.3.100	57769
12	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
13	2013-03-05T...	ka	0 ok	192.168.3.100	57769
14	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
15	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
16	2013-03-05T...	ka	0 ok	192.168.3.100	57769
17	2013-03-05T...	ka	-14 not controller	127.0.0.1	55315
18	2013-03-05T...	ka	0 ok	192.168.3.100	57769
19	2013-03-05T...	logger 1	0 ok	192.168.3.10	57174
20	2013-03-05T...	datamode 1	0 ok	192.168.3.10	57174

Figure 63. BITE Command / Response Display

Figure 63 contains the command/response display. There is a display of command sent to the COBRA in sequential order along with the response from COBRA and information about where the command came from. Commands with a successful response have a green background; commands resulting in an error have a red background. The most recent 1000 command/response pairs are available in this screen.



	Name	Min Limit	Max Limit	Value	Comms	Faultable	Interlock
1	ped_auto_lube_pump			normal	Ok	true	none
2	ped_az	-1	361	311.770	Ok	true	none
3	ped_az_contactor				Ok	false	none
4	ped_az_home			true	Ok	false	none
5	ped_az_offset	-1	361	62.298	Ok	true	none
6	ped_az_online			normal	Ok	true	az
7	ped_az_velocity	-50	50	9.992	Ok	true	none
8	ped_el	-1	91	80.024	Ok	true	none
9	ped_el_home			true	Ok	false	none
10	ped_el_offset	-2	92	0.901	Ok	true	none
11	ped_el_online			normal	Ok	true	el
12	ped_el_velocity	-26	26	-0.005	Ok	true	none
13	ped_neg_limit				Ok	false	none
14	ped_pos_limit				Ok	false	none
15	ped_ps_24v	23.1	25.1	24.567	Ok	true	none
16	ped_safe			operate	Ok	false	tx,az,el
17	ped_servo_pwr			on	Ok	false	none
18	ped_shock_pulse	-0.001	10	-0.000	Ok	true	none
19	ped_temp	-5	40	26.573	Ok	true	none
20	rf_sw_status			15	Ok	false	none
21	rx_air_purge			off	Ok	false	none
22	rx_humidity			53.031	Ok	false	none
23	rx_ps_12v			12.025	Ok	false	none
24	rx_ps_15v			14.868	Ok	false	none
25	rx_ps_24v			24.083	Ok	false	none
26	rx_rf_encl_door			closed	Ok	true	az,el
27	rx_temp			26.150	Ok	false	none
28	sys_local			false	Ok	false	none
29	sys_safe			operate	Ok	true	tx,az,el
30	tsig_enable			off	Ok	false	none
31	tsig_vco_enable			off	Ok	false	none

Figure 64. BITE Commands and Function with Associated Limits

The BITE Command Functions and Limits screen (see **Figure 64**) displays the BITE limits and allows the user to modify the limits. For example, if the BITE is monitoring a 15 V power supply, the limits may be set to 14.5 and 15.5 volts, meaning anything out of this range will be indicated as an error. If no upper limit is supplied, then anything above the lower limit is considered good. Conversely, if no lower limit is provided, then anything below the upper limit is considered good. If there are no limits, the item is for informational purposes only.

The Network Monitor displays the interaction between the communication devices.

Figure 65. Network Monitor Screen

4.2. Primary Power Supply and Distribution

Primary power for the Ranger-X5 is a single-phase 120/208 VAC input from the sites Main input. The end user is required to provide an external UPS and a service disconnect with an Emergency Stop button to remove all power from the radar system and provide a Lock-out/Tag-out point for maintenance.

See **Figure 66** for a block diagram showing the Primary Power Distribution through the Radar System. For a more detailed drawing of the Power Control & Distribution Assembly, see the Schematics and Circuit Diagrams.

Site power wires directly into the Power Control & Distribution Assembly into the Control Cabinet. Power and ground cables connect to Field Terminals. Input power routes to the **MAINS** Circuit Breaker on the E-Stop Panel Assembly (see **Figure 16**). DC Power controls through the Pedestal Power circuit breaker (CB2) on the E-Stop Panel Assembly.

> AC power is removed from the Ranger-X5 by use of any of the Emergency Stop switches (TX Indicator Control Panel or Pedestal Enclosure). AC power is reset through the E-Stop Reset button located on the E-Stop Panel Assembly.

A 2kVA UPS is an integral part of the system. The UPS power divides into two segments – 1 and 2. Segment 1 feeds the “A-Input” on the Power Distribution Unit. Segment 2 feeds the “B-Input” on the PDU. The 16-Port Ethernet Switch and the KVM Switch are not controlled by the PDU.

The Power Distribution Unit (PDU) provides the operator with remote command and control of the power within the Ranger-X5. The PDU controls all of the operational aspects of the machinery within Ranger-X5 – transmit, receive, antenna motion.

The Ranger-X5 is a DC powered radar system. The DC Power Plate feeds power to the Servo System (AZ and EL), the Transceiver Units, the IQ2 Receiver system, and the cooling systems. The DC Power Plate is controlled by a Circuit Breaker (CB2) on the output of the AC power of port B2 on the Power Distribution Unit. CB2 can be interrupted by activating either of the two E-Stop buttons.

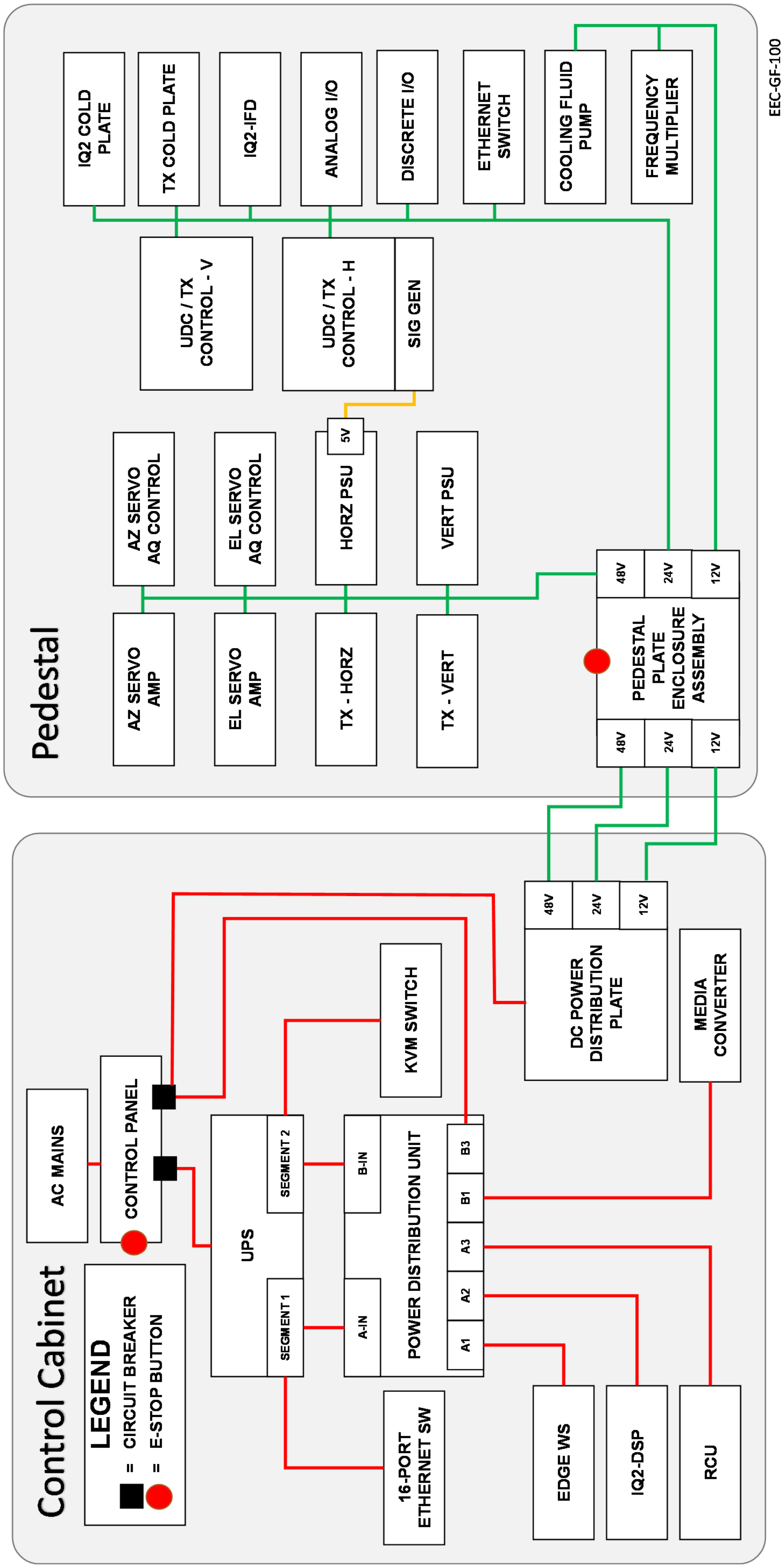


Figure 66. Radar System Power Distribution

4.3. Interlock Circuitry

Use of Interlocks in the Ranger-X5 ensure safe operation of the radar. Should conditions threatening the safety of personnel or equipment exist, they will inhibit some or all radar operations. These interlocks are implemented using mechanical and electrical devices. The interlocks fall into the following categories:

- Emergency Stop Circuitry - removes primary power from the system at the Power Control & Distribution Assembly.
- Transmitter/Radiate inhibit - disables the ability of the Solid-State Power Amplifiers to transmit by removing the radiate command line to the Transceiver Assembly.
- Antenna movement inhibit - disables movement of the Antenna in either or both axes by removing power to the servo amplifiers and holding the controller in a reset condition.
- Antenna Power off - RCU commanded interlock to remove primary power to the Pedestal using PED POWER RESET command.

4.3.1. Hardware Interlocks

Use of hardware interlocks in the Ranger-X5 electromechanically interrupt equipment operation to protect personnel from exposed operating equipment, remove unsafe conditions, ensure safe operations, or protect equipment from damage. These critical hardware interlocks place the radar in a SAFE mode that could include disabling RF transmission, Antenna movement, or both RF transmission and Antenna movement.

Any time the radar is put into operate mode when any axis was previously disabled and servo power is commanded on, the Antenna homing sequence will be initiated.

The hardware interlocks that place the radar in SAFE mode include:

- Main Circuit Breaker (MAINS) - located on the TX Control and Indicator Panel - disables the entire system by removing power.
- AZ Safe Switch - located on the Pedestal Enclosure Plate Assembly - disables azimuth axis Antenna movement
- EL Safe Switch - located on the Pedestal Enclosure Plate Assembly - disables elevation axis Antenna movement

4.3.2. Software Interlocks

Software interlocks are used to interrupt radar operations if certain conditions are present. Configuration of the software interlocks is through the extensible markup language (XML) for the I/O devices used by the BITE system. If a condition exists that is set to disable system operation, the RCU will shut down the associated function and produce a BITE error message indicating the fault that caused the error to occur.

All hardware interlocks are also software interlocked and produces a corresponding BITE message. Software interlocks that disable the transmitter produce a **tx_interlock** fault BITE message and the RCU will issue a "RADIATE OFF" command. Software interlocks that disable both Azimuth and Elevation axes will generate a "SERVO OFF" indication from the RCU.

The following Software Interlocks are generated by the RCU:

- TX Interlock - opens the Radiate Command disabling the Transceivers.
- EL Interlock - disables elevation axis Antenna movement.
- AZ Interlock – disables azimuth axis Antenna movement.
- Mod Power Interlock – turns off the Transceivers.
- Antenna Power Interlock – removes primary power to the Pedestal using PED POWER RESET command.

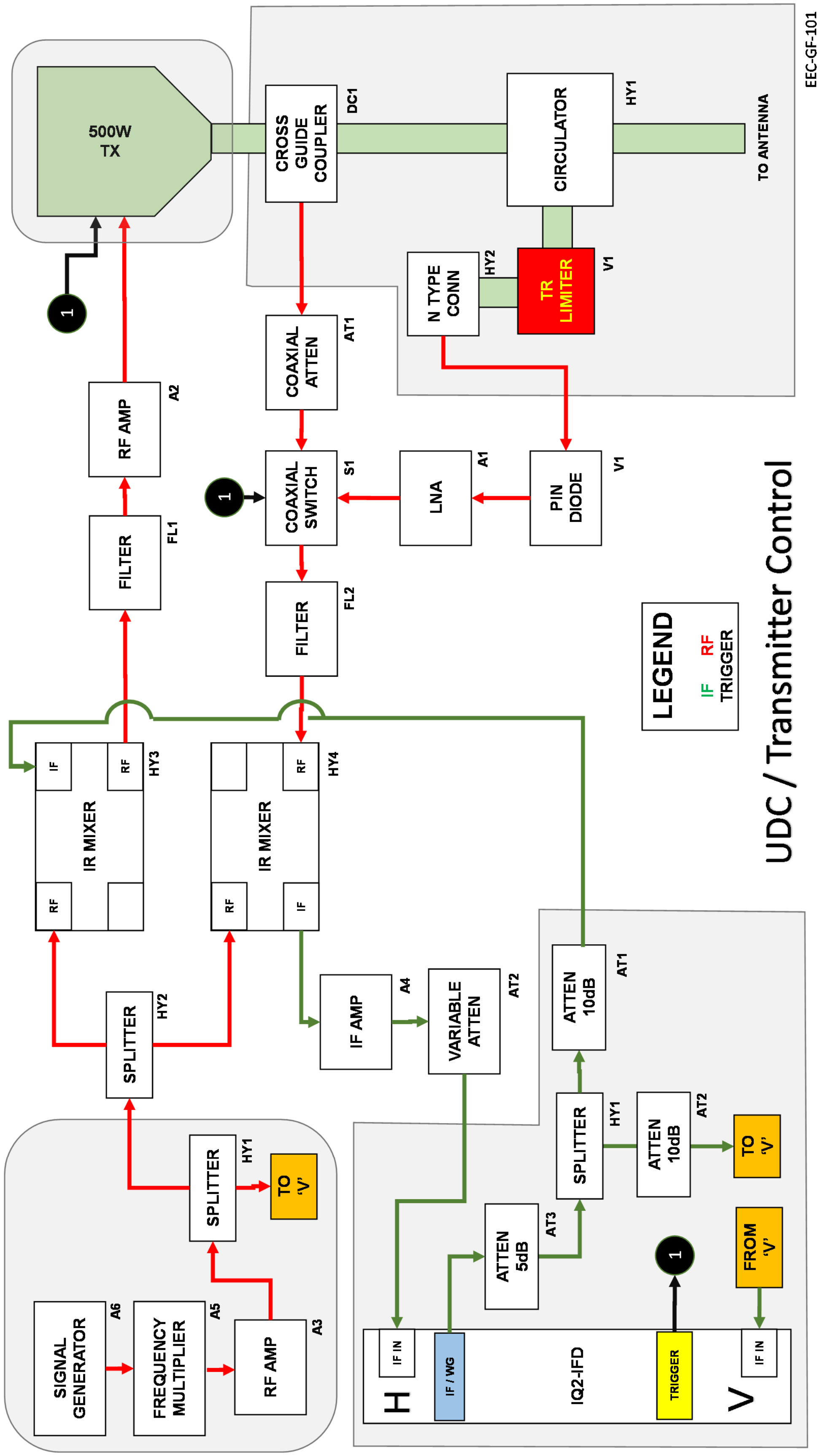


Figure 67.UDC / Transmitter Control

4.3.3. Radiate Command

Radiate is turned on automatically when EDGE is in the scheduler mode or by command from the Surveillance screen "Radiate." Radiate is also available in the LOCAL mode through the LCI screen at the Control Cabinet console. Before the RCU will initiate a "radiate on" command, the system must meet all software **tx_interlock** conditions, and the radar must be in a STANDBY status. The RCU will initiate a "radiate on" command when commanded to radiate by the EDGE Software.

4.3.4. IF to RF Signal Up and Down Conversion

The Up-down converter (UDC) / Transmiter Control for the Ranger-X5 radar translates information between the intermediate frequency (IF) and X-band operating frequencies. It is a high performance unit which greatly reduces the size, weight and complexity of a microwave transceiver subsystem in weather radar, while maintaining excellent performance characteristics. The UDC / Transmit Control system provides the local oscillator signals to both the up-converter and down-converter and utilizes other components, such as filters, low-noise amplifiers (LNA), and RF Amplifier all integrated in the same RF assembly.

A pulsed waveform produced by the IQ2 at the IF frequency of 60MHz drives the up converter, which translates the signal to the desired X-band frequency. A range of RF values are available to select as the up converter output, ranging from 9.2 to 9.7GHz with 20MHz resolution and controlled through a serial interface. An on-board PLL and frequency synthesizer utilizes the 100MHz reference oscillator signal and provides the LO to the single stage mixing network. Similarly, the down conversion block mixes the RF signal with the LO to produce the 60MHz IF signal, then **is** passed to the IQ2 for base band digitization. Prior to the RF input on the down conversion stage, a pre-amplifier network ensures that the dynamic range of the transmitter assembly block is matched to the input of the digital receiver, maximizing the capabilities of the system.

The UDC is a breakthrough in achieving excellent performance of image rejection (without narrow band filters in the module or multiple conversion states), TR isolation, and phase noise in an integrated module. This UDC design combines a very simple single-stage conversion structure and image-rejection mixer technology, which achieves strong image rejection performance without onboard filters or multiple stages of conversion. This technology also helps reduce complexity and minimize space requirements. The shielded RF enclosure helps to achieve the required level of TR isolation. The PLL circuitry gives the phase noise performance and frequency agility, which are normally available only in much more complex microwave signal sources. This also enhances the radar system performance such as clutter visibility and Doppler accuracy.

4.3.5. Fiber-Optic Rotary Joint

The Fiber-Optic Rotary Joint provides the transition Fiber Optic cable transmission through the azimuth axis.

4.4. Receiver Signal Flow

The Ranger-X5 receiver (see **Figure 67**) is fully contained within the Payload Support Assembly on the Pedestal. It is an integral part of the UDC and includes the UDC and IQ2-IFD.

4.4.1. IQ2-IFD

The IQ2-IFD receives the horizontal and vertical receive IF from the two UDCs. The IQ2-IFD digitizes the received IF and outputs I and Q serial data through fiber-optic cable to the Fiber-Optic Rotary Joint. The data is coupled through the Fiber-Optic Rotary Joint and sent to the IQ2-DSP in the Control Cabinet.

4.4.2. IQ2-DSP

The IQ2-DSP digitally processes the “I and Q” data stream from the IQ2-IFD, already broken into range-gate intervals, with floating-point algorithms to provide all required moments.

4.5. Antenna Control

The user utilized the EDGE software or the LCI software on the RCU to send commands or EDGE Software to provide Antenna control. The positioning commands are provided through an Ethernet connection to each axis Aquarian Servo Controller Module, which develops the drive signal for the Servo Amplifier and drive motors to move the Antenna.

The RCU breaks the high level command down into intermediate motion type, some are simple (Point, PPI) some are more complex and require the RCU to execute a state machine to control the desired motion (Sector, RHI). Once the RCU converts the high level command into a intermediate level it is sent to the servo control for further processing.

The Aquarian takes an intermediate level command from the RCU to generate a motion profile in real time. This process is known as trajectory generation. For the desired motions to be successful, the trajectory generator outputs a command for each sample period telling the servo system the position of the motor. The Aquarian samples the encoder for each position axis. The actual position combined with the trajectory information creates a closed loop drive signal known as “error.” The servo amplifier uses the “error” signal to actual the DC brushless motor.

The moving mass of the antenna system can be a hazard to personnel when performing maintenance on the radar system. The Aquarian controller has a “safe input” that requires a ground signal to be applied in order for the antenna to operate in a normal fashion.

4.5.1. Angle Acquisition

The Aquarian samples the incremental encoder via a dedicated high-speed quadrature Integrated Circuit decoder. The sampled encoder positions are converted to angular data in degrees. This resolved position uses a feedback in the closed loop control and is sent to the RCU. The RCU receives angle data via Ethernet from the Aquarian. This data is corrected for true north by an offset stored in the RCU. The data is transferred to the signal processor via high-speed RS422 serial link.

4.5.2. Homing Sequence

A homing sequence is required for each axis in order to resolve the incremental units of the axis encoders and convert them to an absolute angle. The Aquarian performs this when a restart of the controller causes the loss of the zero set point on an axis and there is a request for servo power. In azimuth, the motor is driven clockwise until the homing sensor is detected and the quadrature decoder hardware is reset to zero. In elevation, the motor is driven until it reaches the lower electrical limit. Once the lower electrical limit is detected, the motor will drive in the opposite direction until it detects the homing sensor. At that point, the quadrature encoder hardware is reset to zero.

4.6. Communication Interface

The radar uses an Ethernet network (see **Figure 68**) to provide command and control of the radar set and to receive status flags and BITE information. Three Ethernet switches provide connection points for all the I/O and controlled devices in the Control Cabinet, the Pedestal Enclosure, and RF Enclosure.

Ethernet communications between the Pedestal and the Control Cabinet are provided over a fiber-optic connection by the use of Ethernet Switches with Fiber-Optic Media Converters in the Control Cabinet and Pedestal Enclosure. Communications within the Pedestal is possible by the use of the Ethernet connection through the Slip-ring Module. Communications between the Radar and the local host computer are provided through the rear panel of the Control Cabinet. Additional ports on the front and rear of the Control Cabinet provide access to the radar network for expandability and testing.

Received data from the IQ2-IFD, on the Pedestal, is transmitted via a fiber-optic cable through the Fiber-Optic Rotary Joint to the downlink input and the IQ2-DSP. Uplink information is transmitted from the IQ2-DSP over the Ethernet network to the IQ2-IFD.

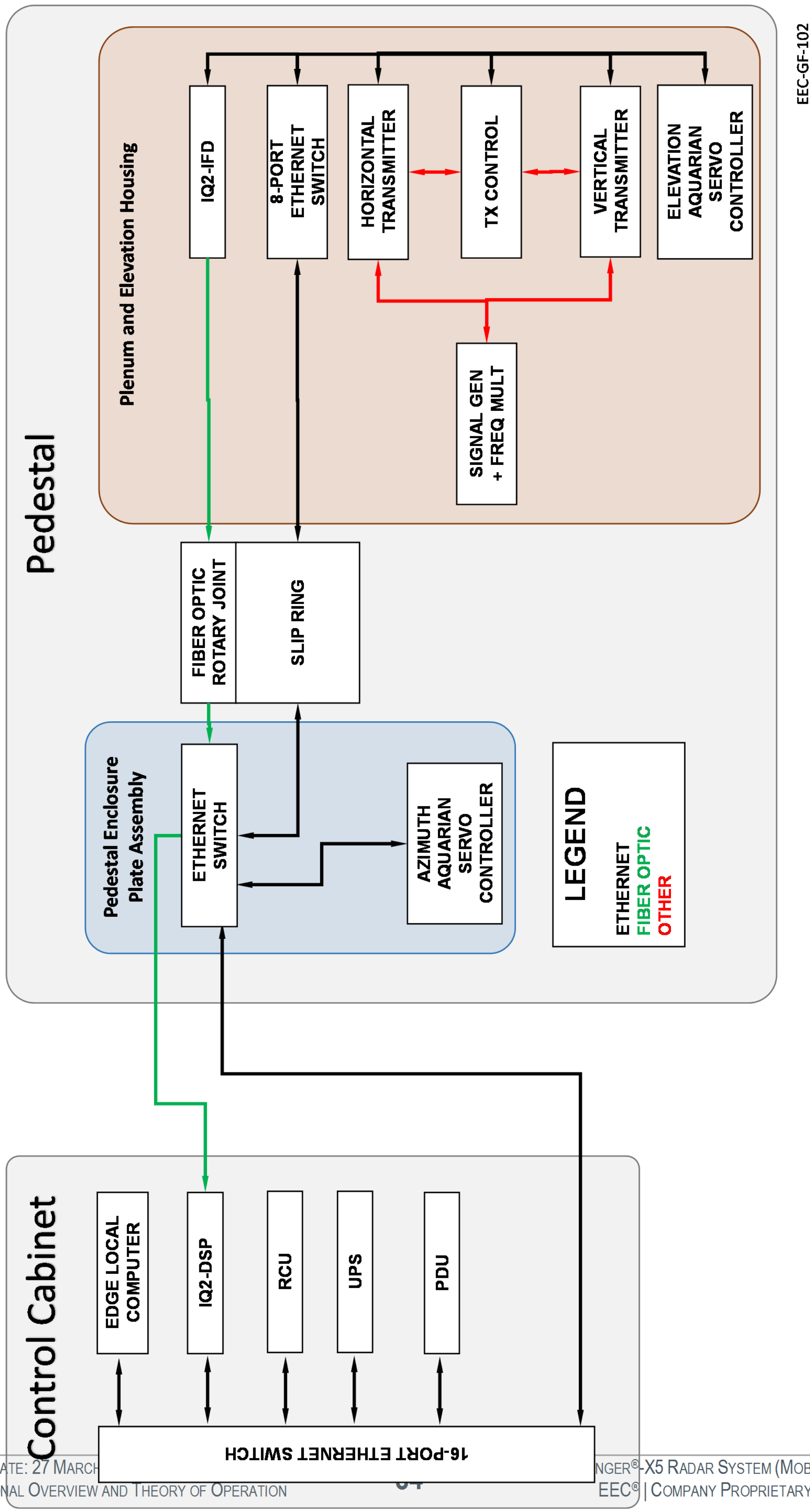

Pedestal
Plenum and Elevation Housing
IQ2-IFD
8-PORT ETHERNET SWITCH
HORIZONTAL TRANSMITTER
TX CONTROL
VERTICAL TRANSMITTER
ELEVATION AQUARIAN SERVO CONTROLLER
SIGNAL GEN + FREQ MULT
FIBER OPTIC ROTARY JOINT
SLIP RING
Pedestal Enclosure Plate Assembly
ETHERNET SWITCH
AZIMUTH AQUARIAN SERVO CONTROLLER
LEGEND
ETHERNET
FIBER OPTIC
OTHER
EEC-GF-102
Control Cabinet
EDGE LOCAL COMPUTER
IQ2-DSP
RCU
UPS
PDU
16-PORT ETHERNET SWITCH

Figure 68.Ranger-X5 Communication

4.6.1. Radiation Safety

RF Hazard regulations are in place to protect personnel from harmful RF exposure. The primary effect of RF exposure is thermal. Exposure to RF energy will cause an increase in the thermal energy of the body's molecules. The heating effect is very similar to how our microwave ovens cook our food. Because of this, Enterprise Electronics Corporation (EEC) weather radar systems are designed with safety at the top of the list.

The Ranger-X5 is a low powered radar system with only 500 watts of power per channel (horizontal and vertical). Even with the longer pulse widths (100 microseconds) the power density is relatively small.

The United States Federal Communications Commission (FCC) and International Commission on Non-Ionizing Radiation Protection (ICNIRP) have established the same MPE limits based on person's awareness of the RF hazard. Two exposure limits exist, Occupational/Controlled and General Population/Uncontrolled. Below is an excerpt from FCC OET 65 explaining the differences1.

"Occupational/Controlled exposure limits apply to situations in which persons are exposed as a consequence of their employment and in which those persons who are exposed have been made fully aware of the potential for exposure and can exercise control over their exposure."

"General Population/Uncontrolled exposure limits apply to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Therefore, members of the general public would always be considered under this category when exposure is not employment-related."

In order to protect personnel, the minimum safety distances for the General Population has been computed and is diagrammed in **Figure 69**.

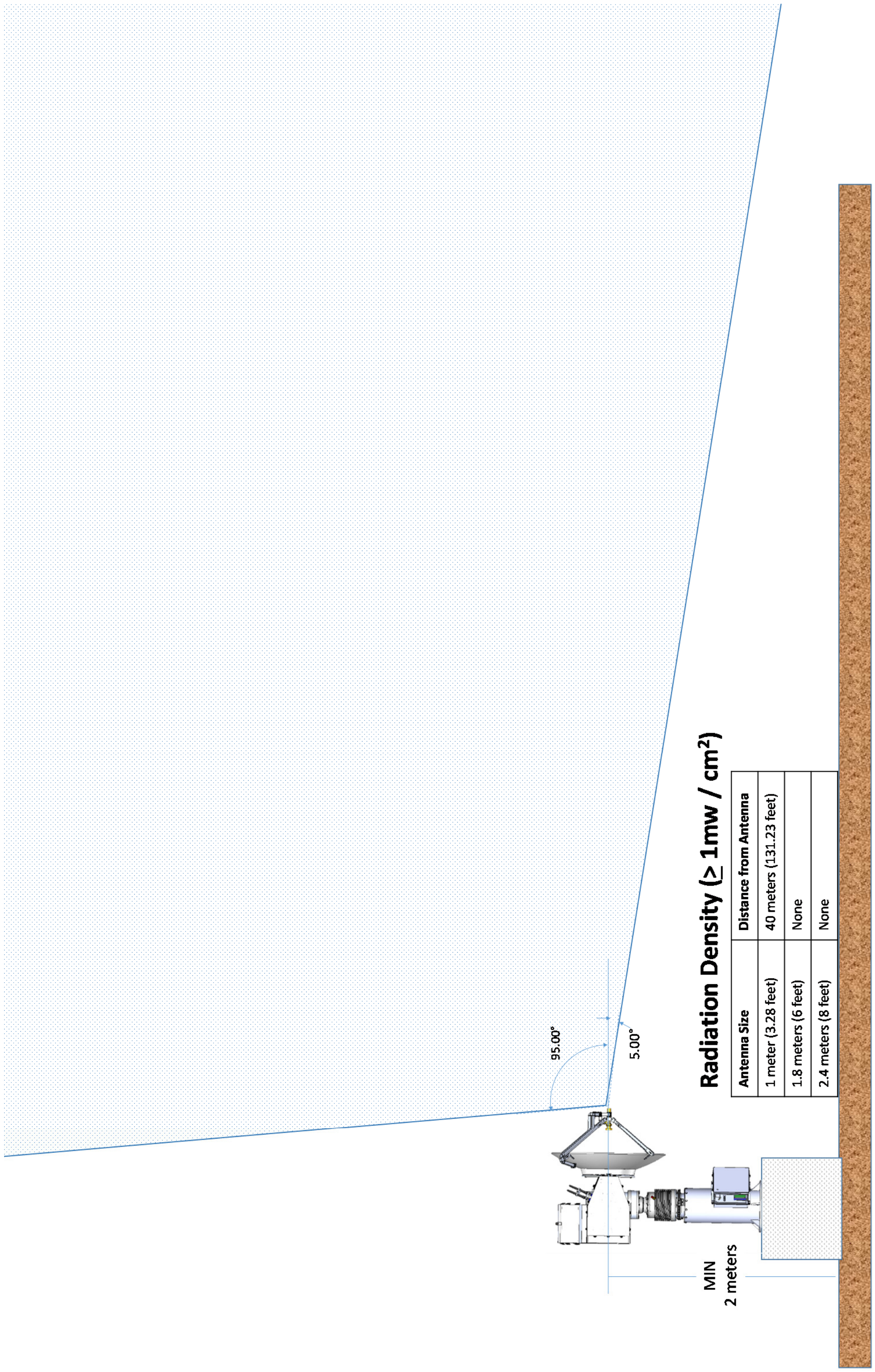


Figure 69. Radiation Hazard Zone – General Population

CHAPTER 5

SYSTEM STARTUP / SHUTDOWN

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5. System Startup / Shutdown

The Startup and Shutdown Procedures include:

- OPTION: Powering on the Generator, UPS, and other components (see **Appropriate Vendor Instructions**)
- OPTION: Connecting the Communication System (See **Appropriate Vendor Instructions**)
- Starting the Radar System (see **Paragraph 5.1**)

5.1. Ranger-X5 Power Procedures

5.1.1. Radar Power-On Procedure

For the safety of the maintenance personnel, DO NOT power-on the Ranger-X5 Radar System until a safety inspection of the equipment is complete to ensure personnel are clear from high-voltage components and the moving parts of the antenna/pedestal.

The complexities and design of the Ranger-X5 radar system requires training for personnel that will operate and maintain the radar system.

The various components in the radar system will require the power switches and circuit breakers to be in the [ON] position before starting the radar system with the reset button.

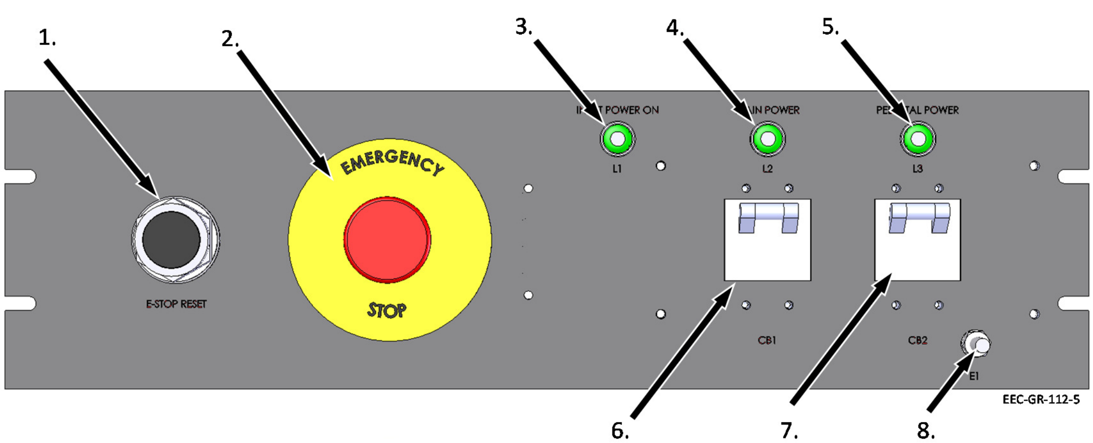

Figure 70. Emergency Stop Panel

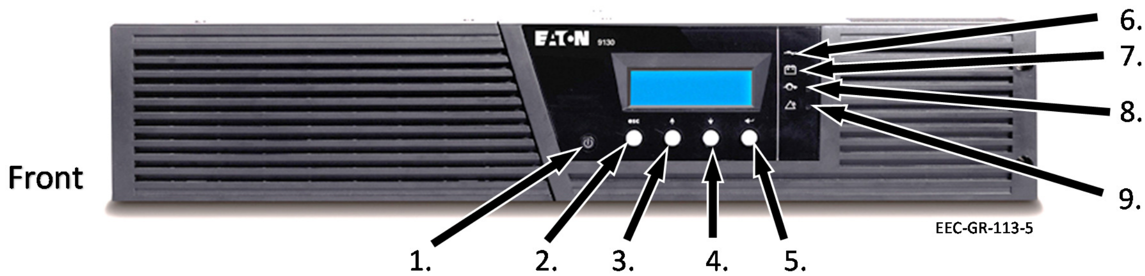

Figure 71. UPS

Power On Sequence:

1. On the Emergency Stop Panel (see **Figure 70**, **Point 6**), ensure the Main Breaker (CB1) is in the [**ON**] position.
2. On the Emergency Stop Panel (see **Figure 70**, **Point 7**), ensure the Pedestal Breaker (CB2) is in the [**ON**] position.
3. On the Radar System UPS (see **Figure 71**, **Point 1**), press and hold the power button until the UPS power on.
4. Wait for the Power Distribution and Control Unit (see **paragraph 1.1.6**) to power on (approximately 2 minutes).
5. Press and hold the E-Stop Reset Button (see **Figure 70**, **Point 1**) for 2-3 seconds, then release.

When the pedestal is initially powered on it will begin a warm-up and alignment process. The pedestal will rotate in azimuth as well as move up and down in elevation following a pre-programmed homing sequence. At the end of the homing process, the pedestal will rotate in azimuth until it reaches its home position, which is a variable position. The pedestal may pause at this position for a brief moment.

6. Ensure the power to the system is active by checking the various components in the Control Cabinet and verifying the lights (see **Figure 70, Point 3, 4, and 5**) are illuminated.

   a. Ensure the KVM monitor displays the blue and magenta login screen (see **Figure 72**, below.)

Figure 72. KVM Login Screen

b. Press “enter” twice to skip past the login prompt in **Figure 72**. You will reach a blue and yellow Selection screen (see **Figure 73.**)

Figure 73. KVM Selection Screen

c. Use the down arrow to highlight the option (01) and then press the “enter” key to selection option (01). This will open the EDGE (OpenSuSE) login screen (green background), as shown in **Figure 74**.

Figure 74. OpenSuSE (EDGE) Login Screen

d. Login to the EDGE computer using the credentials supplied with the radar system.

Normally, it is:

i. User ID: root

ii. Password: eecj#### (where #### us the job number for the production unit – ex. e**ecj9818** or **eecj9821**

e. After completing the EDGE login, the OpenSuSE desktop will display. From the selection of desktop icons, run the "c2inter.sh" icon as shown in **Figure 75.**

Figure 75. EDGE A to EDGE B Script ICON

This icon runs a script that establishes communication between the radar's EDGE "A" computer and an online VPS server used to communicate with the EDGE "B" remote computer located at the TV studio. After selecting the icon the script will begin to run and appear similar to **Figure 76**.

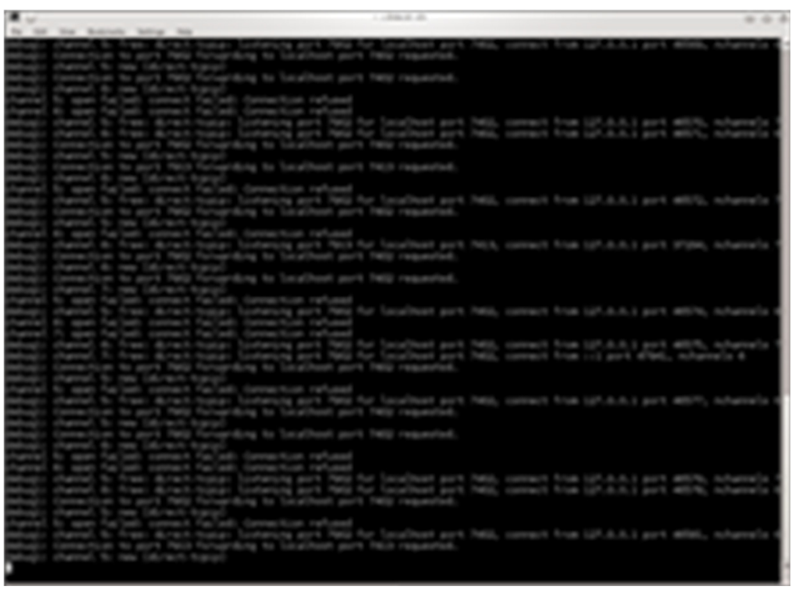

Figure 76. EDGE Communications Window

The EDGE Communications Window may be minimized but it MUST remain running in the background to maintain communication between the Local Radar System workstation and the REMOTE EDGE workstation (normally studio or weather station). Use the down arrow at the upper right-hand corner of the display to minimize, but not close this window.

f. After minimizing the window in Step e., select the EDGE icon located on the

OpenSuSE desktop (see **Figure 77**). Click the icon to open the EDGE program.

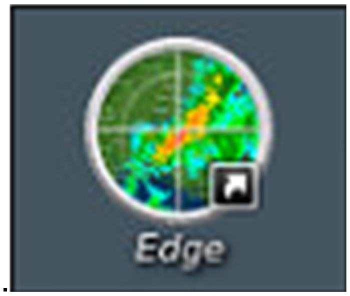

Figure 77. EDGE Application Icon

g. The EDGE "Control Menu" will display once the program starts.

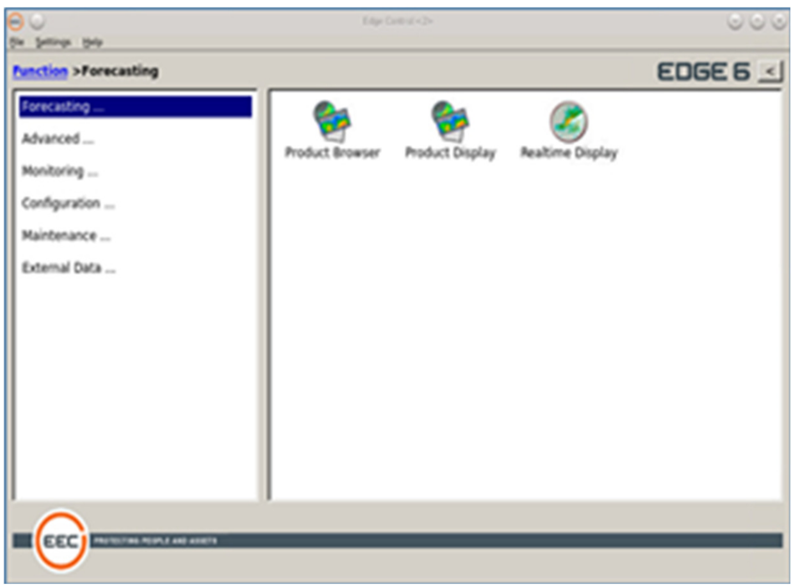

Figure 78. EDGE Control Menu

Refer to the EDGE Operations Manual for Operational Instructions using the EDGE software.

5.1.1.1. Verification of Alignment to True North

1. After all components are powered "ON," the pedestal should have successfully "homed" and "aligned" facing the forward position (based on **Paragraph 5.1.1, Step 5.**) It will continue, automatically, to adjust itself to "True North" as described in this Verification.
2. After aligning with the front of the unit, the antenna will remain in that position until the EDGE software receives the GPS / Compass information from the GPS / Compass

system. EDGE will update the latitude and longitude of the radar system based on input from the GPS / Compass unit. Please allow five to ten minutes for this process to complete.

3. After the latitude and longitude are updated and when the EDGE system has received enough information to determine "True North," the antenna will automatically realign itself to "True North" and it will be ready for operational use.

Please note, the radar can be operated after initial HOMING of the antenna is complete. However, the EDGE display for weather and other data will not be aligned with "True North" and therefore, their positions on the map will not be in the proper location relative to North.

5.1.2. Power-Off Procedure / System Shutdown

For the safety of the maintenance personnel, they MUST complete the following system power off sequence before attempting any maintenance procedures.

The complexities and design of the Ranger-X5 radar system requires training for personnel that will operate and maintain the radar system.

The various components in the radar system will require the power switches and circuit breakers to be in the [OFF] position before performing maintenance.

5.1.2.1. Normal Power-Off Procedure

1. Power Down (in sequence) the following items.
    a. EDGE Local Host Computer (see **Figure 8, Point 5** for switch location)
    b. IQ2-Digital Signal Processor (see **Figure 6, Point 1** for switch location)
    c. RCU Computer (see **Figure 5, Point 1** for switch location)
    d. UPS System (**Figure 71**, **Point 1**), press and hold the power button until the UPS powers off.
2. On the Emergency Stop Panel (see **Figure 70, Point 7**), switch the Pedestal Breaker (CB2) to the [**OFF**] position.
3. On the Emergency Stop Panel (see **Figure 70, Point 6**), switch the Main Breaker (CB1) to the [**OFF**] position.
4. Refer to **Appropriate Vendor Documentation** for shutdown and tear down procedures

for all other equipment (i.e. **UPS, Generator, Scissor Lift, Outriggers, Communications Systems, GPS, etc**).

5.1.2.2. Emergency Power-Off Procedure

The E-STOP Button removes power from the pedestal. It DOES NOT remove power from the Control Cabinet.

1. Press the Pedestal Emergency Stop Button (see **Figure 56, Point 2**) or the Main System Emergency Stop Button (see **Figure 70, Point 2).**
2. On the Emergency Stop Panel (see **Figure 70, Point 6**), switch the Main Breaker (CB1) to the OFF Position.

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