STAR
POWER DISTRIBUTION MODULE

DESIGN DOCUMENT

DOC-1014
Version 2.00
March 01, 2006

DOCUMENT HISTORY

Version	Date	Comment / Description of Change	Author(s)
1.00	May 12, 2003	First draft release	TRM, WRT
1.10	July 01, 2003	Block diagrams updated for review	ML
1.20	August 01, 2003	Wiring diagram updated	ML
1.30	Sept 02, 2004	Update to final version	ML, TRM
2.00	June 01, 2006	Updating of design doc with respect to new STAR4 module developments (05535)	PG, ML
2.10	August 02, 2007	Radar power reset section installation of RCCB	EE

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

This document describes the design of the STAR power distribution module as part of the STAR core technology. The STAR core technology provides the basic subsystems required for an interferometric radar system.

1.2 Scope

This document first provides a functional description and the design requirements. It then describes the detailed design in terms of hardware, software, and mechanics. Finally the theory of operation, test procedures, and calibration is included.

The document assumes that the reader has a basic understanding of interferometric radar systems, airborne remote sensing platforms, Intermap products and processes and computer systems technology.

1.3 Definitions, Acronyms, and Abbreviations

LRU.....Line Replaceable Units
TCP/IP.....Network Communication protocol
MCC.....Master Control Computer
ANT .....Antenna Module
RCVEX-RCAS .....Receiver Exciter – Radar Control and Acquisition System Module
PWRDIST .....Power Distribution Module
NAV .....Navigation Module
WGASS-XTRANS .....Wave Guide Assembly – X-Band Transmitter

1.4 References

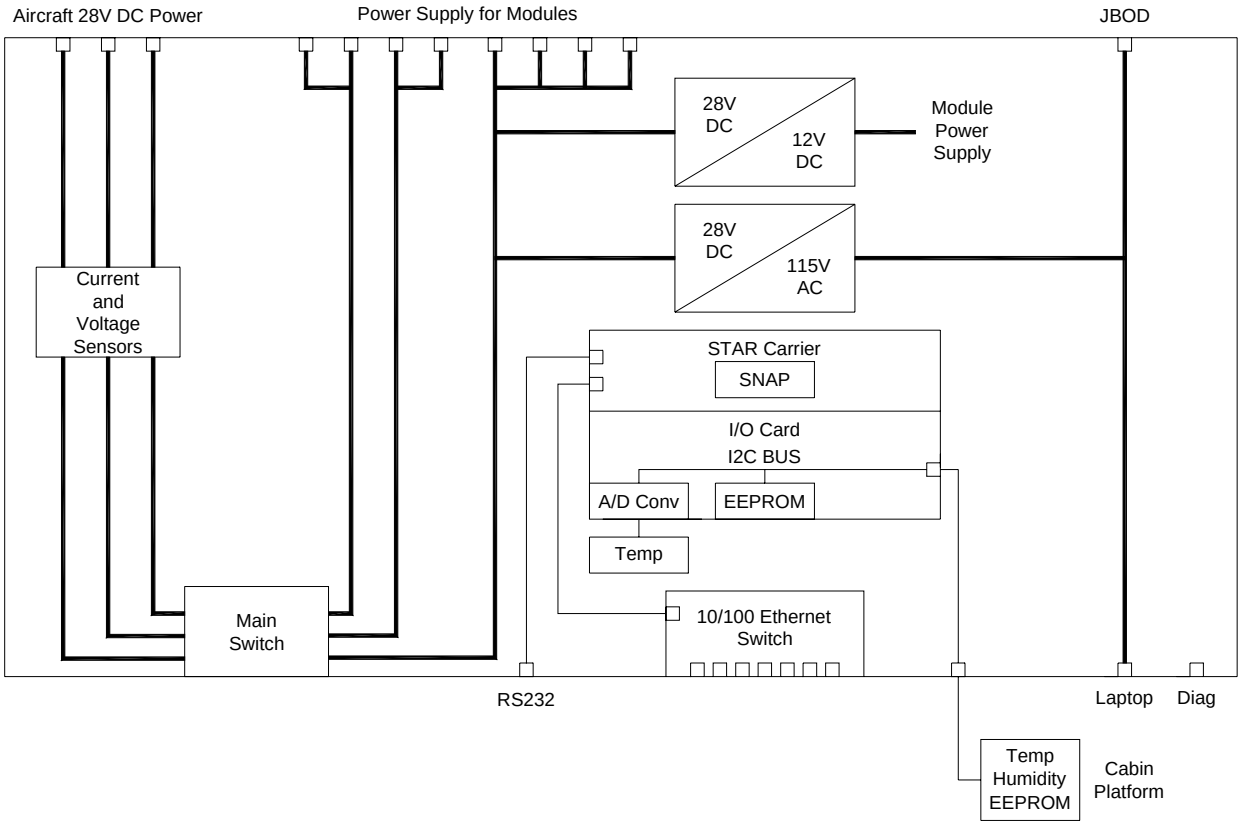
1. DOC1000 – STAR SRS
2. DOC1002 – STAR System ICD
3. DOC1008 – STAR Physical ICD

2 FUNCTIONAL DESCRIPTION

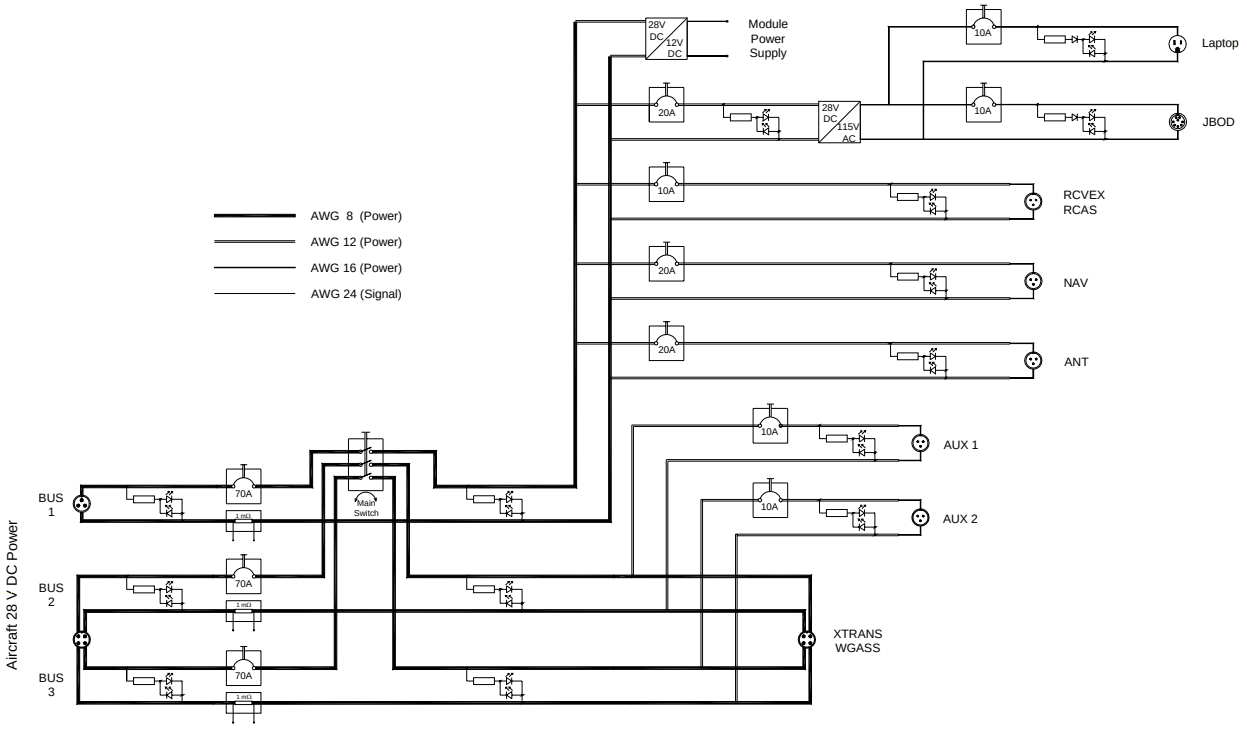
The power distribution module provides:

- distribution of the three 28 V project power lines to the STAR modules
- a main switch for the entire STAR sensor
- individual circuit breaker switches for each module
- signal LEDs for each power connector
- a SNAP module with carrier and daughter card for
  - monitoring the module temperature
  - monitoring the cabin temperature and humidity via an external sensor
  - monitoring voltage and current on the three incoming 28 V busses
  - retrieving information about the aircraft platform via an external EEPROM
  - displaying the PWRDIST status via a red/green status LED
- a 115 V, 60 Hz single phase inverter providing power for a laptop, the JBOD and in case test equipment
- a 8 port 10/100 ethernet switch (from which 7 ports are externally available)
- a diagnostics port for direct analog access to monitoring points

2.1 Functional Blockdiagram



2.2 Power Distribution Wiring Diagram



3 HARDWARE DESIGN

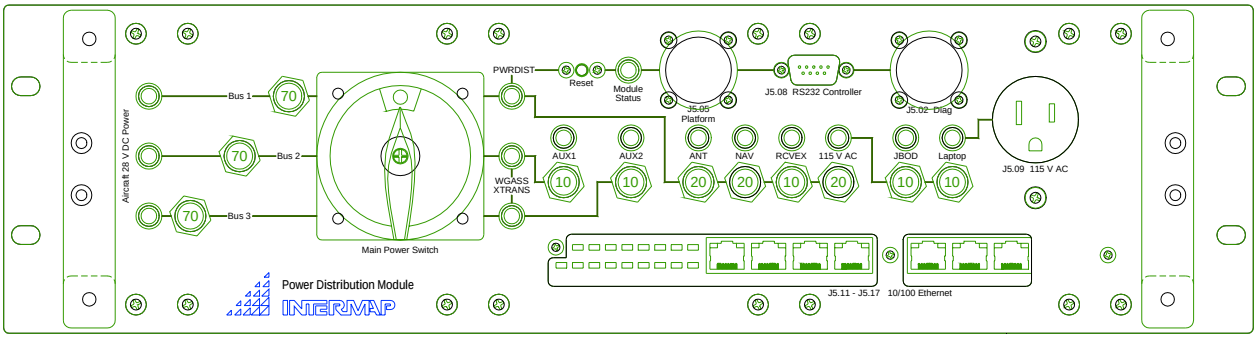
3.1 Dimensions

Height: 118 mm
Depth: 500 mm
Width: 440 mm

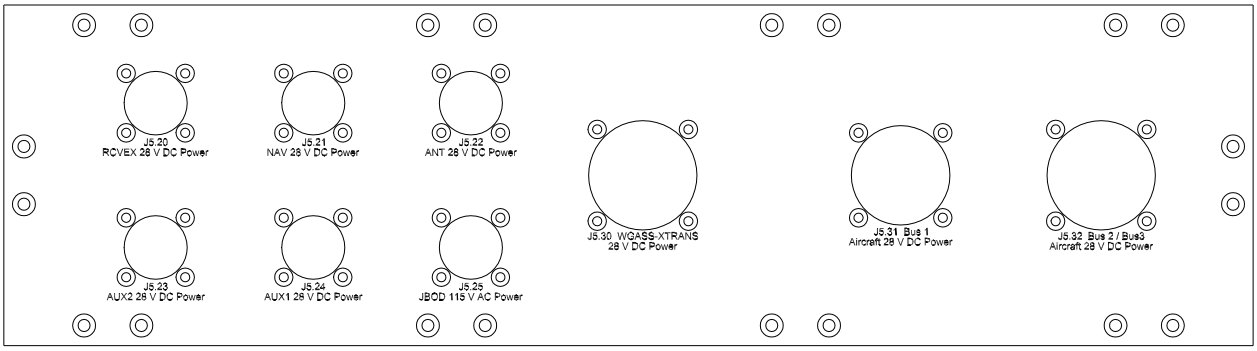
For dimension details see: DOC1008 - STAR System Physical ICD.doc

For weigths see: DOC1008 - STAR System Physical ICD.doc

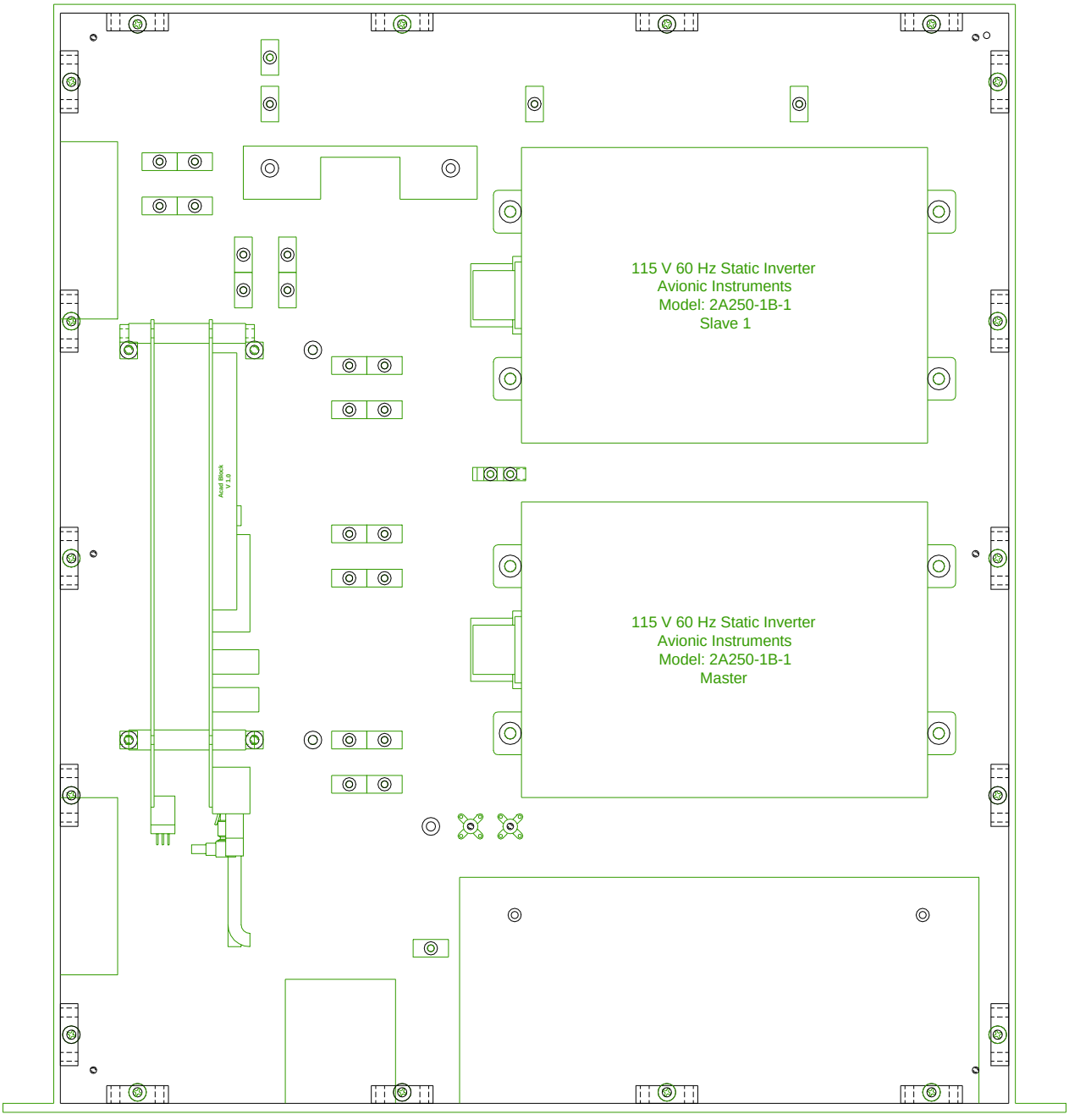
3.2 Front Panel Layout



3.3 Rear Panel Layout

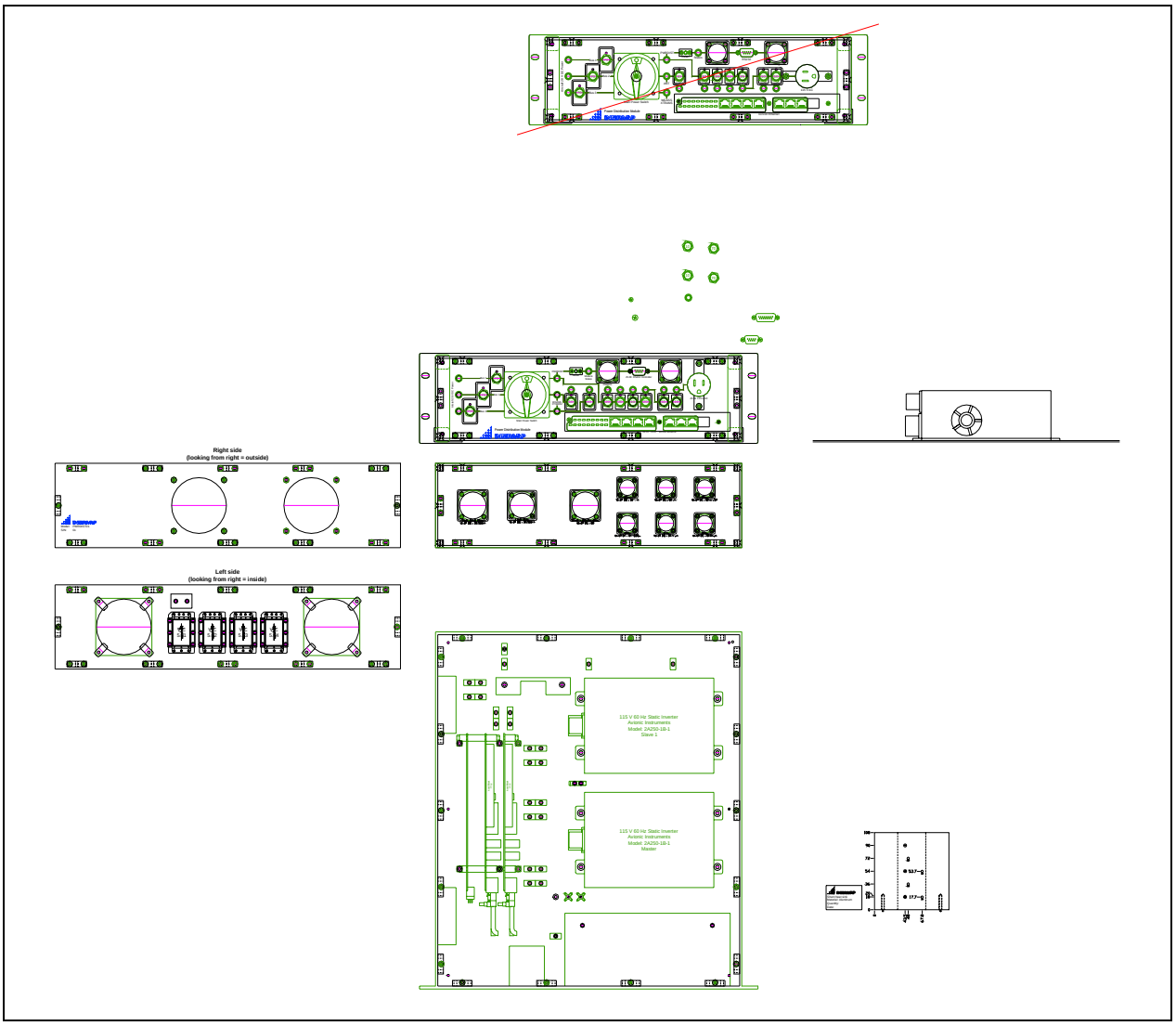


3.4 Chassis Layout

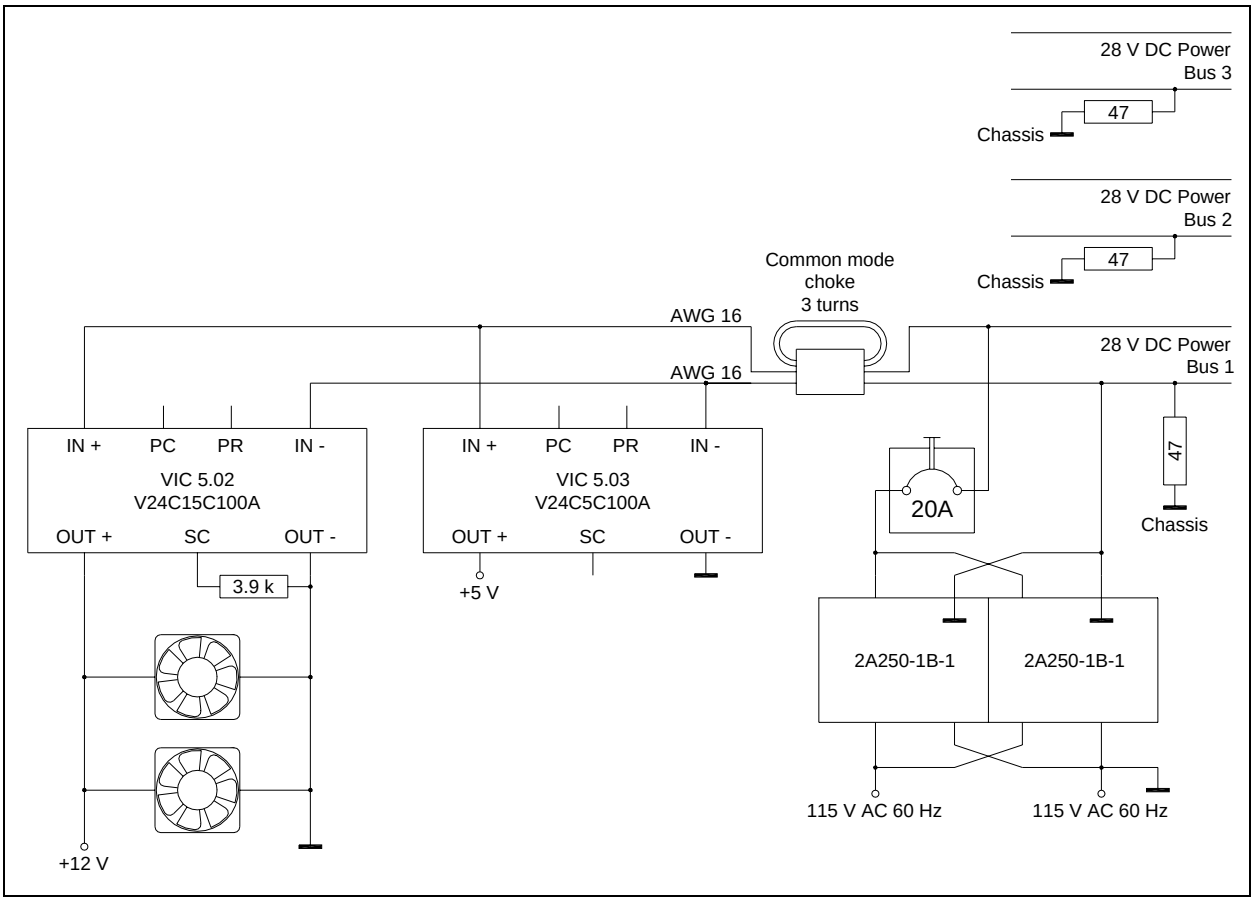


3.5 PWRDIST Reference Drawing

The embedded AutoCad file below (STAR-PWRDIST.DWG) is the primary reference file for the power distribution module.



3.6 Power Supply



3.7 Connectors

All power supply connectors:	DOC1008 - STAR System Physical ICD.doc
RS232 and Ethernet connectors:	DOC1008 - STAR System Physical ICD.doc
All MIL connectors and wiring:	Connectors MIL.XLS
All header connectors and wiring:	Connectors Headers.XLS

3.8 IO-Card

Schematics:	IO-CARD Schematics.pdf
Parts list for assembly:	IO-Card Parts List.xls

3.9 STAR-Carrier

Schematics: STAR-Carrier Schematics.pdf

3.10 Cabin Sensor Box

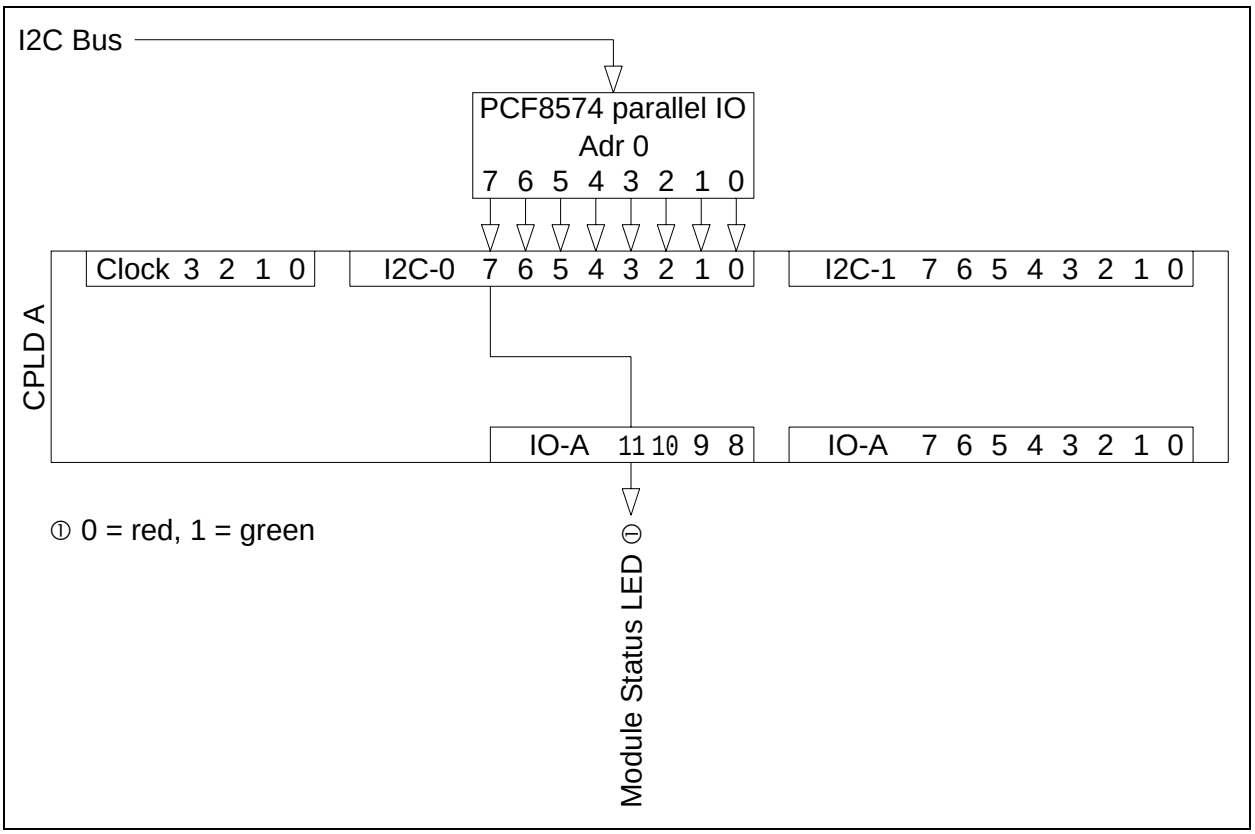
Schematics: Cabin Sensor Schematics .pdf

Parts list: Cabin Sensor Parts List .pdf

Sensor assignment:

temperature sensor 1: cabin (behind rack)
temperature sensor 2: cabin (behind rack)
temperature sensor 3: cabin (behind rack)
temperature sensor 4: cabin (behind rack)
humidity sensor 1: cabin (behind rack)
humidity sensor 2: cabin (behind rack)

3.11 CPLD and I2C Schematic



3.12 RCCB Installation

The installation of RCCB into the initial power leg.

4 SOFTWARE DESIGN

This section outlines some of the design decisions made specifically of the ANT module. For details please refer to the JavaDocs.

4.1 Self Test

1. Start of self test:
2. Test SNAP / FPGA Communication – retrieve version number from FPGA. Verify that 0xff is not read.
3. Switch to internal clock.
4. Test I^2C Parallel I/O
    a. Toggle LED for ¼ second.
5. Test I^2C A/D
    b. read module temperature. Verify within [-30,+100].
    c. Read all 3 voltage levels. Verify that voltage within 18 – 36V
    d. Read all 3 current levels. Verify that current < 70A. On current 1, current > 2A
6. Test I^2C EEPROM – read and write last two bytes in EEPROM.
7. Test IRQ, enable interrupts and wait for 1PPS.
8. Test I^2C Parallel I/O - toggle LED for ¼ second.
9. End of self test

5 DIAGNOSTIC UTILITY

The diagnostic utility allows monitoring and control of all functions of the module.

5.1.1 Interface

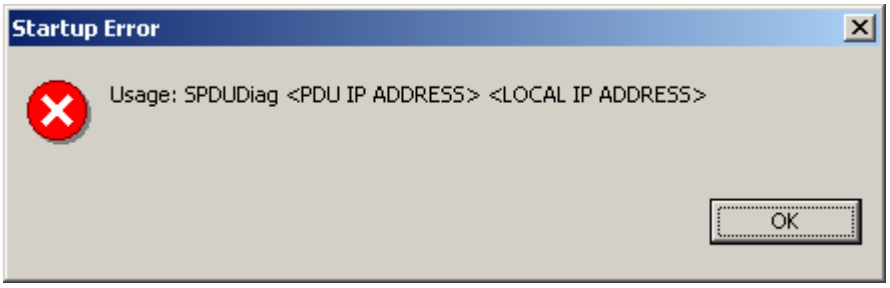
Usage:

```
PDUDiag <PWRDIST IP ADDRESS> <LOCAL IP ADDRESS>
```

Example,

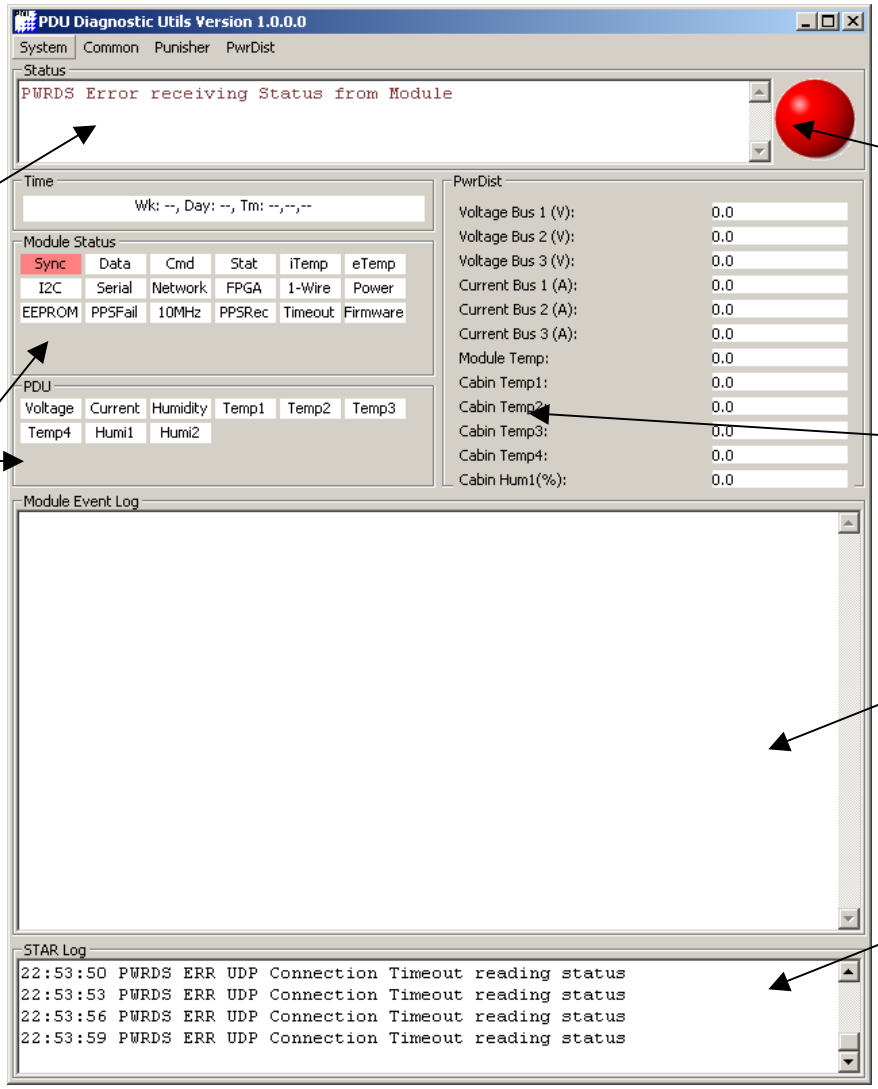
```
PDUDiag 192.168.0.45 192.168.0.3
```

If one or more arguments are missing, the following message is displayed.



Command Menu Bar: Allows you to issue commands to the module

Status Bit indicators: Shows status bits graphically



Fault Indicator: Indicates if there is a module fault, along with description

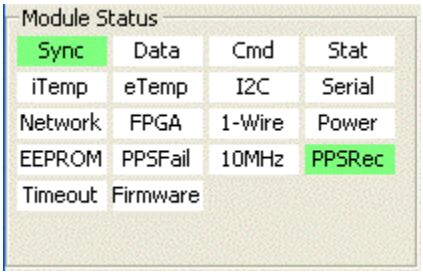
Status Value: Displays all status packet values in a GUI

Module Event Log: Displays log messages from the module

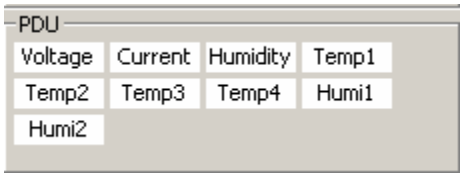
STAR Log: Displays log messages from this Diagnostic application

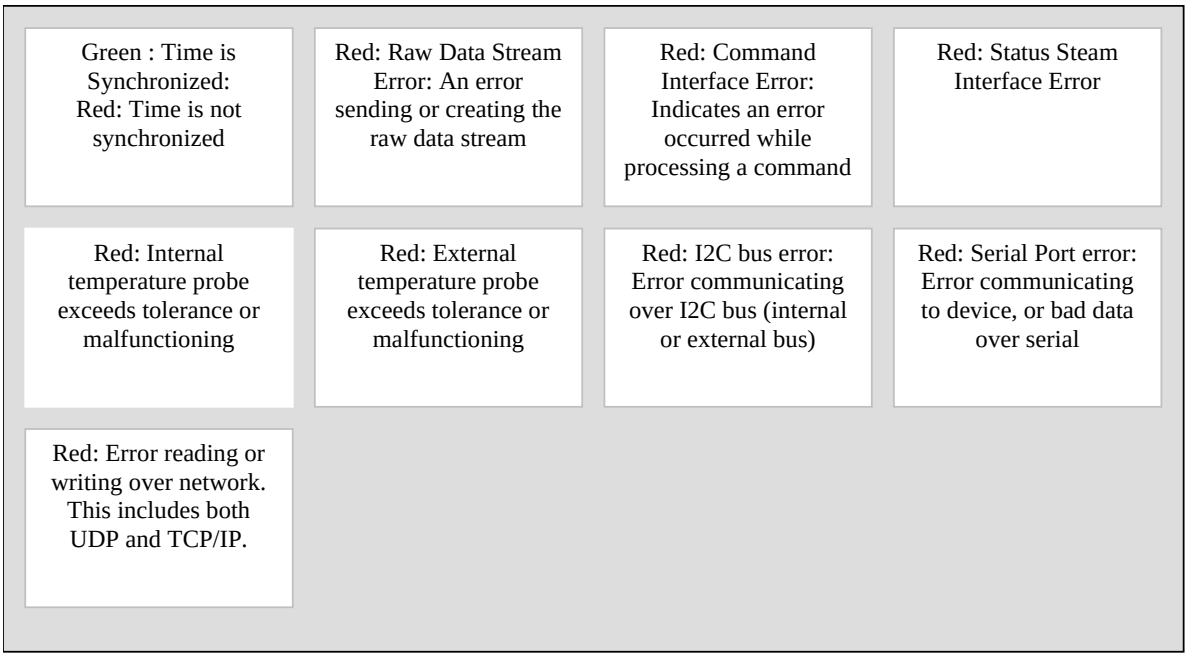
5.1.2 Status Values

The status bits represent all Boolean values, and the common and module status bits as outlined in the software ICD.

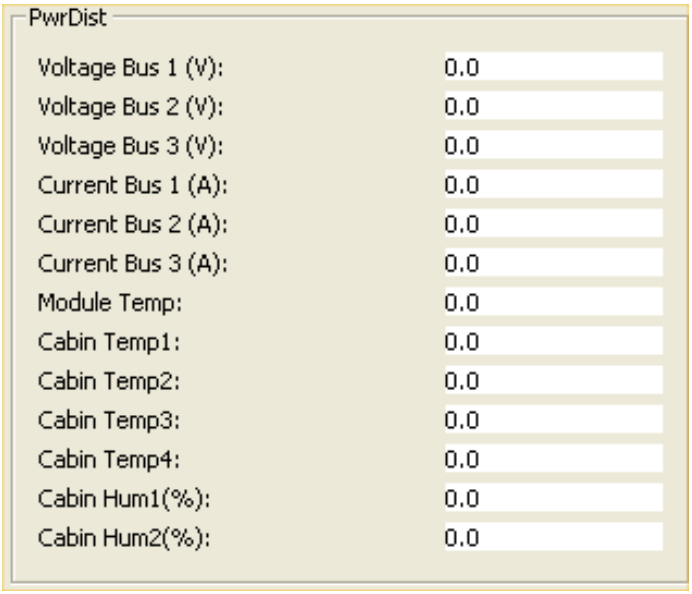


Green : Time is Synchronized: Red: Time is not synchronized	Red: Raw Data Stream Error: An error sending or creating the raw data stream	Red: Command Interface Error: Indicates an error occurred while processing a command	Red: Status Steam Interface Error
Red: Internal temperature probe exceeds tolerance or malfunctioning	Red: External temperature probe exceeds tolerance or malfunctioning	Red: I2C bus error: Error communicating over I2C bus (internal or external bus)	Red: Serial Port error: Error communicating to device, or bad data over serial
Red: Error reading or writing over network. This includes both UDP and TCP/IP.	Red: Error detected on FPGA: No interrupt when expected, 1-wire device detected error, etc.	Red: 1-Wire bus error: Error communicating over 1-Wire bus. Maybe a bad address, bad device, or bad bus.	Red: Power Supply error: A power supply error was detected.
Red: Error reading, or invalid values in 1 or more EEPROM	Red: Error PPS Failure: Due to no PPS, or a bad PPS signal.	Red: 10MHz clock failure: No 10MHz clock source, or a bad 10MHz clock source.	Green: Indicates that this status record is a PPS record (and sent on the PPS)
Red: Timeout Error: Indicates a timeout occurred on a command or other event.	Red: Firmware Error: Generic error used to describe all other error conditions.		





The status values reflect all the non-Boolean values contained in the status packet. For specific details see the Software ICD, otherwise refer to the following summary table.



Name	Description
Voltage Bus 1	Voltage level on power bus 1 (V)
Voltage Bus 2	Voltage level on power bus 2 (V)
Voltage Bus 3	Voltage level on power bus 3 (V)
Current Bus 1	Current draw on bus 1 (A)
Current Bus 2	Current draw on bus 2 (A)
Current Bus 3	Current draw on bus 3 (A)
Module Temp	PWRDIST module temperature (C)
Cabin Temp1	Cabin Temperature 1 (C)
Cabin Temp2	Cabin Temperature 2 (C)
Cabin Temp3	Cabin Temperature 3 (C)
Cabin Temp4	Cabin Temperature 4 (C)
Cabin Hum1(%)	Cabin Humidity (%)

5.2 Operation

5.2.1 Passive Mode

The Diagnostic tool automatically starts in ‘Passive’ mode when executed. This mode passively listens to the UDP status packets and event logs for the particular module. When a log message is received it is appended to the Module Event Log display on the GUI. When a new status packet is received, the values are all updated.

Since the status packets are sent over UDP, multiple diagnostic programs can be executed in passive mode at the same time and will not interfere with each other or the MCC. This has the advantage of allowing external monitoring of the system during normal operation.

5.2.2 Active Mode

Active Mode is when the diagnostic utility has direct control of the module via the command connection. Active mode can be activated / de-activated by the following system functions:

Name	Description
Start Connections	Start active connections (command / raw data) to the module. (Get control of module)
Stop Connections	Stop the active connections (command / raw data) to the module. (Release control of module)

Note: The module only allows 1 connection at any one time. Thus the Diagnostic tool will not be able to connect to the module if another application (like the MCC) already has command control.

5.3 Sending Commands

Once an Active connection is established, you can send commands to the module through the menu, the commands are divided according to their functionality:

5.3.1 Common

Common commands are consist of options and commands that are common to all modules; therefore this menu is present in all module diagnostic tools. The Common Commands are as follows:

Name	Description
Sync Time	Synchronizes the modules time to the local computer system time

Internal ROM	Allows the reading and writing of the internal module configuration EPPROM
Set Status Rate	Sets the status rate of the UDP broadcasts (in Hz)
Self Test	Instructs the module to restart the software. Once restarted, it performs the usual self test.
Init	Instructs the module to restart (re-init). The selftest is not performed. This is typically used after a new configuration ROM is written and to restart.

5.3.2 Punisher

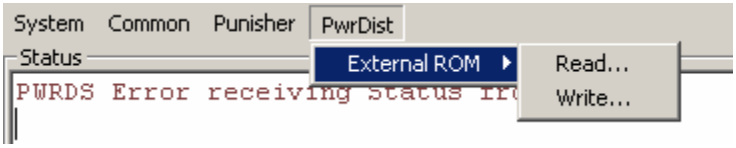
The Punisher section includes commands to 'punish' the NAV hardware / software for stress testing of the system. These operations are normally not used, and only used in development.

Name	Description
Punish…	Initiates a generic punish test

Right click to reset to original zoom.

5.3.3 PWRDIST

The PWRDIST section deals with commands to the PWRDIST module as directly defined in the software ICD.



Name	Description
External ROM - Read	Reads the External EEPROM (platform box)
External ROM - Write	Writes the External EEPROM (platform box)

5.4 Configuration changes

Configuration ROMs can only be loaded using the diagnostic tools in Active Mode (refer to the above). The following procedure is followed:

1) Obtain the new configuration file
2) Load the configuration file.

   The PWRDIST module typically only has two EEPROMs:

   - Module ROM – located in the module (Common->InternalRom->Write..)
   - External ROM – located in the PWRDIST box (PWRDIST->External ROM->Write..)

3) If the configuration file does not have a proper CRC stamp it is immediately rejected by the Diagnostic Utility.
4) Once the config file has been downloaded it is verified by the module. If the config file is for a different module, or has the incorrect section ID, it is rejected and an error message is displayed.
5) If the config is valid, it will be loaded. After a few seconds a 'Configuration ROM Updated' log message will appear.
6) Verify that the config file is loaded:
   a. Issuing an 'init' command (Common->Init).
   b. During the startup, check that the 'Config Date:' is the date of the new configuration file:

      i.e.

      ```
      Reading Configuration ROM from EEPROM
      Validating Configuration ROM
      ConfigRom Valid.   Config Date: 20040716
      ```

   c. Check for any error messages that are the result of bad configuration settings.
      i.e.

      ```
      ConfigRom inValid
      ```

For detailed description of the configuration files and parameters, see the System ICD.

6 INITIAL DESIGN REQUIREMENTS

6.1 Power Distribution

6.1.1 $28V_{DC}$ Module power supply

The power distribution module provides all power to the radar modules from the $28V_{DC}$ aircraft power supply. The master switch provides power to the internal 28V Power bus. The power bus current and voltage level is monitored through the TINI Carrier Board and SNAP module.

6.1.2 $115V_{AC}$ equipment plugs

The power bus also powers a 350 W $115V_{AC}$ @ 60Hz power inverter to supply two North American Style standard wall sockets on the front of the module. These sockets will be available for use by external equipment such as test equipment.

6.1.3 Power Switch

The PWRDIST must have a master power switch that turns on/off power to all modules.

6.2 Ethernet Switch

Integrated in the power distribution module is an 8 port 10/100Mbit Ethernet switch to provide the LAN to the distributed radar modules and the MCC.

6.3 STAR Software Interface

The embedded software will provide an optional raw data stream. The PWRDIST module will also provide a software command interface and a broadcasted PWRDIST status stream. This Status stream will include current module status, GPS Time, Cabin Temperature, PWRDIST configuration, etc..

The PWRDIST Status packet must be broadcast to all radar modules and the MCC at least 1 per second.

6.4 Fault Indicator

The red chassis fault light will illuminate under any of the following circumstances:

- The maximum temperature of the unit is exceeded.
- A fault is detected on the $28V_{DC}$ power bus.
- The embedded software reports an error

6.5 Configuration / Calibration Tracking

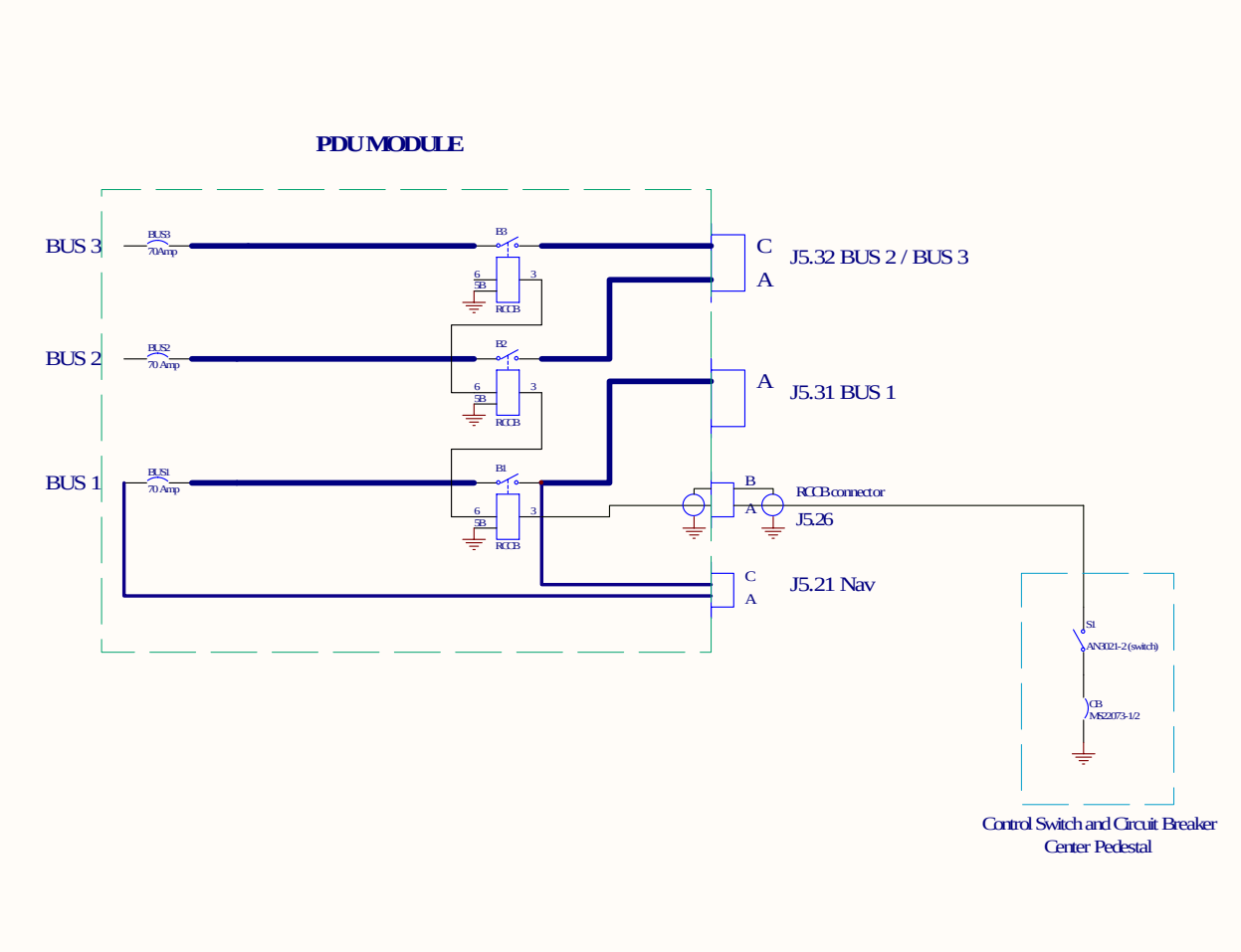
The PWRDIST module will contain the PWRDIST configuration file (EEPROM) via the internal 1-wire data bus.

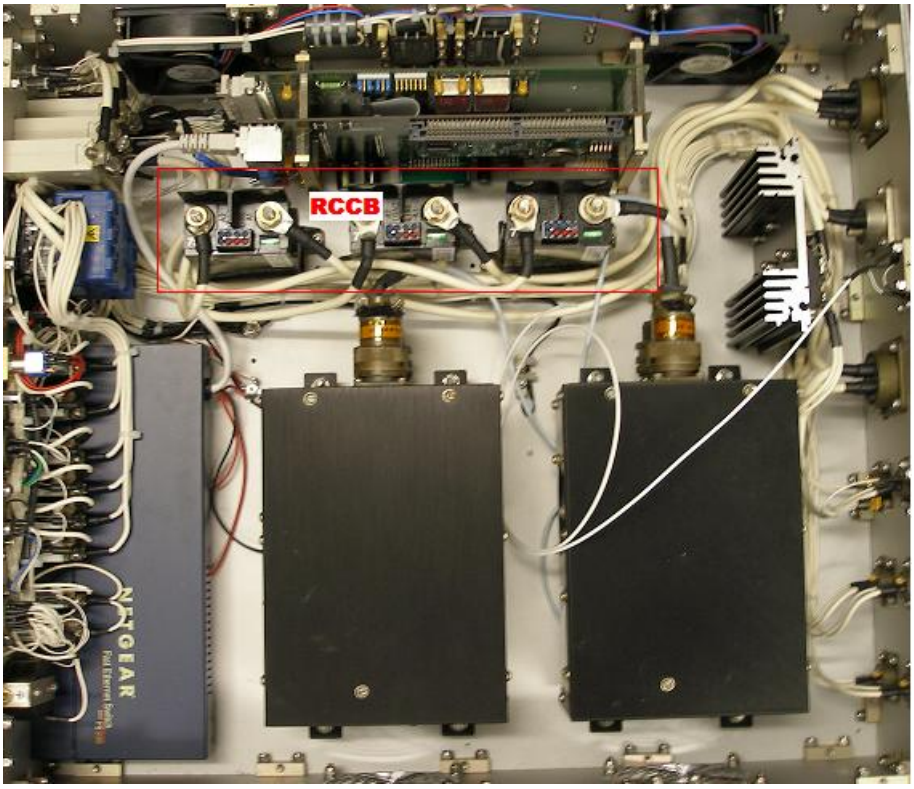
The PWRDIST module will be connected to the Platform configuration file (EEPROM) via an external 1-wire connection. The Platform ID will contain all platform configuration information. Refer to the STAR Core Technology ICD document

7 RADAR POWER RESET

In the case of a critical fault the MCC will prompt the pilot to reset radar power. The radar power reset switch is located on the centre pedestal. The IMU power will be bypassed so that it will remain on during reset.

Three remote control circuit breakers (RCCB) are mounted in the PDU module. There is one RCCB for each BUS which is placed inline at the Aircraft power input. A control line runs from the center pedestal to a connector on the back panel of the PDU. The connector has been designated RCCB (J5.26). The control line consists of a single pole single throw switch and circuit breaker. When the switch is grounded the RCCB contacts are closed. When the switch is open or floating the RCCB contacts are open. When the RCCB is activated the control line will momentarily sink ½ ampere for each RCCB. The control line will activate all three breakers simultaneously.




RCCB
NETGEAR