STAR-4
Radar Operator Course

DAS.PTP.0031 Version 1.4

Approved by: T. Miller (signed copy on file)

Date: March 24, 2006

INTERMAP

Training Objective

At the end of this training, you will have covered the following topics:

- Radar Operator - Position Overview and Process
- **STAR-4** Radar Basics
- Duties of a Radar Operator, including a typical mission
- The training is in two parts:
  1. Classroom Phase
  2. Aircraft Instruction & Check-Ride Phase

INTERMAP

Introduction

Course Agenda

- RO Position Overview
- Aircraft Safety & Standard Practices
- Vocabulary & Jargon
- **STAR-4** Aircraft & Radar Basics
- Mission Definitions
- Pre-Flight/System Start-up Procedures
- MCC Data Acquisition Operations
- Post Acquisition
- Post Flight
- Summary

INTERMAP

Position Overview

- The position of RO is far more than just flying, it consists of the following key elements:
  - First Line of System Performance & Trend Monitoring
  - Efficient and timely communication
  - Acquisition of Consistent Good Quality Data, by complying with and using, tried and trusted procedures
  - Accurate & detailed Flight Log notes, which aids processing
  - Assisting the Field Manager as req'd, e.g. Logistics Support
  - Reporting system faults / anomalies using Problem Service Reports
  - Verification of Mission Files
  - System Maintenance & Troubleshooting, when required

Aircraft Safety

The Radar Operator is considered a member of the Flight Crew, and is responsible for his own aspects of Ground and In-flight safety:

- Radar Operators must take a Crew Safety Course (Courtesy of Aries).
- Proper Aircraft Practices and Procedures are to be used at all times.
  - Safety & Legal Ramifications
  - Hardware types and size, torque limits
  - Wiring practices, fuse / breaker sizes
  - Reference FAA Document AC43-13
- Aircraft / Radar System Security
- Airport Security Procedures
  - Local Variations , e.g. ‘Guys with Guns’.

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Vocabulary 1

Acronyms, Radar & Flight Jargon

- ACM: Antenna Control Module
- MCC: Master Control Computer
- RCAS: Radar Control & Acquisition System
- MDR Mass Data Recorder
- RCVEX Receiver Exciter
- JBOD: Just a Bunch Of Disks
- STALO: Stable Local Oscillator
- TWTA: Travelling Wave Tube Amplifier
- SAU: Servo Amp Unit
- SNAP Small Network Application
- IMU: Inertial Measurement Unit
- CRAB: Clock Receiver & Buffer
- RIB: Radar Interface Board

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Vocabulary 2

Acronyms, Radar & Flight Jargon

- PPM Pulse Per Meter
- PRF: Pulse Repetition Frequency
- PRI: Pulse Repetition Interval
- SynTar: Synthetic Target
- PSR: Problem Service Report
- CCR: Crew Change Report
- FM: Field Manager
- CSV: Comma Separated Variable
- NCR: Non-Conformance Report
- Drift Angle: Angular Difference Between Aircraft Track and Heading
- KiDAP: Kinematic Data Acquisition and Processing
- SOL/EOL: Start / End Of Line
- STD: Scheduled Departure Time

Vocabulary 3

Acronyms, Radar & Flight Jargon

- Squint: Angular Difference between Zero Doppler and Real Antenna Point
- AGC: Automatic Gain Control
- PDU: Power Distribution Unit
- WMM: Washing Machine Manoeuvre
- Flight Line: The Planned Geographic Mapping Points on the earth
- Flight Pass: An Attempt to Acquire the Flight Line
- AGL: Above Ground Level
- FL: Flight Level
- Data Type: Accuracy Specifications, (50 cm, 1m - Types I, II & III)
- BW: Band Width
- LRU Line Replaceable Unit
- PDOP Position Dilution Of Precision

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STAR-4 Aircraft

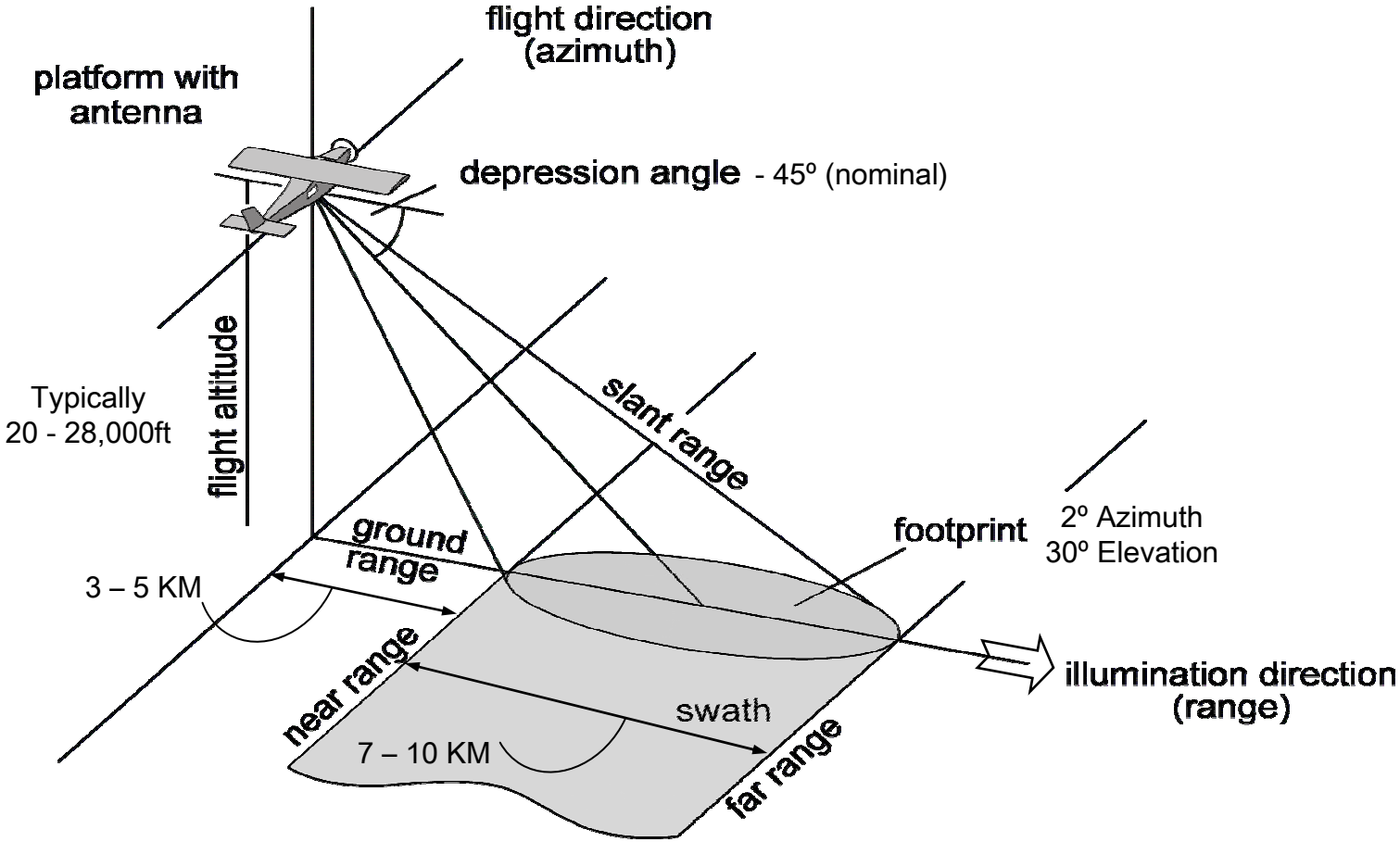
King Air 200T – N857GA

For normal data acquisition:
1 Pilot, 1 Radar Operator, and 1 Security Officer (Project specific)

Radome contains Antenna pedestal with antennas, IMU and electronics.

INTERMAP

STAR-4 System Basics



INTERMAP

STAR-4 System Basics

Parameter	135 MHz Mode	270 MHz Mode
RF Bandwidth	135MHz	270MHz
Chirp Center Frequency	105 MHz	150 MHz
Range Resolution (slant plane)	1.11 m	0.56 m
A/D Rate	300 MHz	600 MHz
Azimuth Resolution	approx. 0.3 meter	approx. 0.3 meter
Transmit PRF (both channels)	Variable 4000 Hz Maximum	
Record Bandwidth	90 MBytes/sec (min)	128 MBytes/sec
Swath Width @ 7,500m (24,600ft)	Approx 11 km	
Swath Width @ 5,000m (16,400ft)	> 6 km	
Transmit Power Peak	8 kW	
Transmitter Maximum Duty Cycle	5 %	
Transmit Pulse Width	22.6 μs	Max 25.0 μs
Transmit Center Frequency	X-Band 9.605 GHz	9.6725 GHz
Azimuth Looks	4	2
Range Looks	1	
Antenna Mode	Ping/Pong	
Antenna Look Angle	Storable / fixed 2.5° increments	
Antenna Look Angle Range	+/- 120°	
Antenna Elevation	30 – 60° depression angle	
Polarization	HH	
Baseline	Min. 0.91 m	

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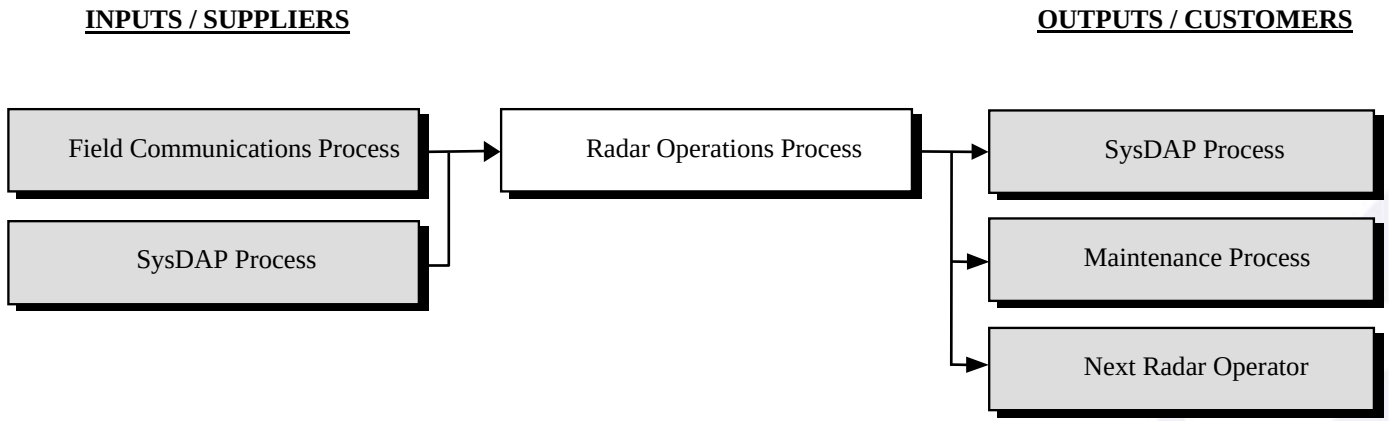
Radar Operations Process

The inputs and outputs are:



Refer To Intermap ISO Document

DAS.QPM.0022 - Radar Operations Process

RO Process ~ Inputs

The inputs (suppliers) of the RO process are as follows:

1. Field Communication Process: *Project Acquisitions Manual, Schedule, Logistics, Maps, Mission files (CSV)*

2. SysDAP Process – *Flight plans, schedules*

RO Process ~ Outputs

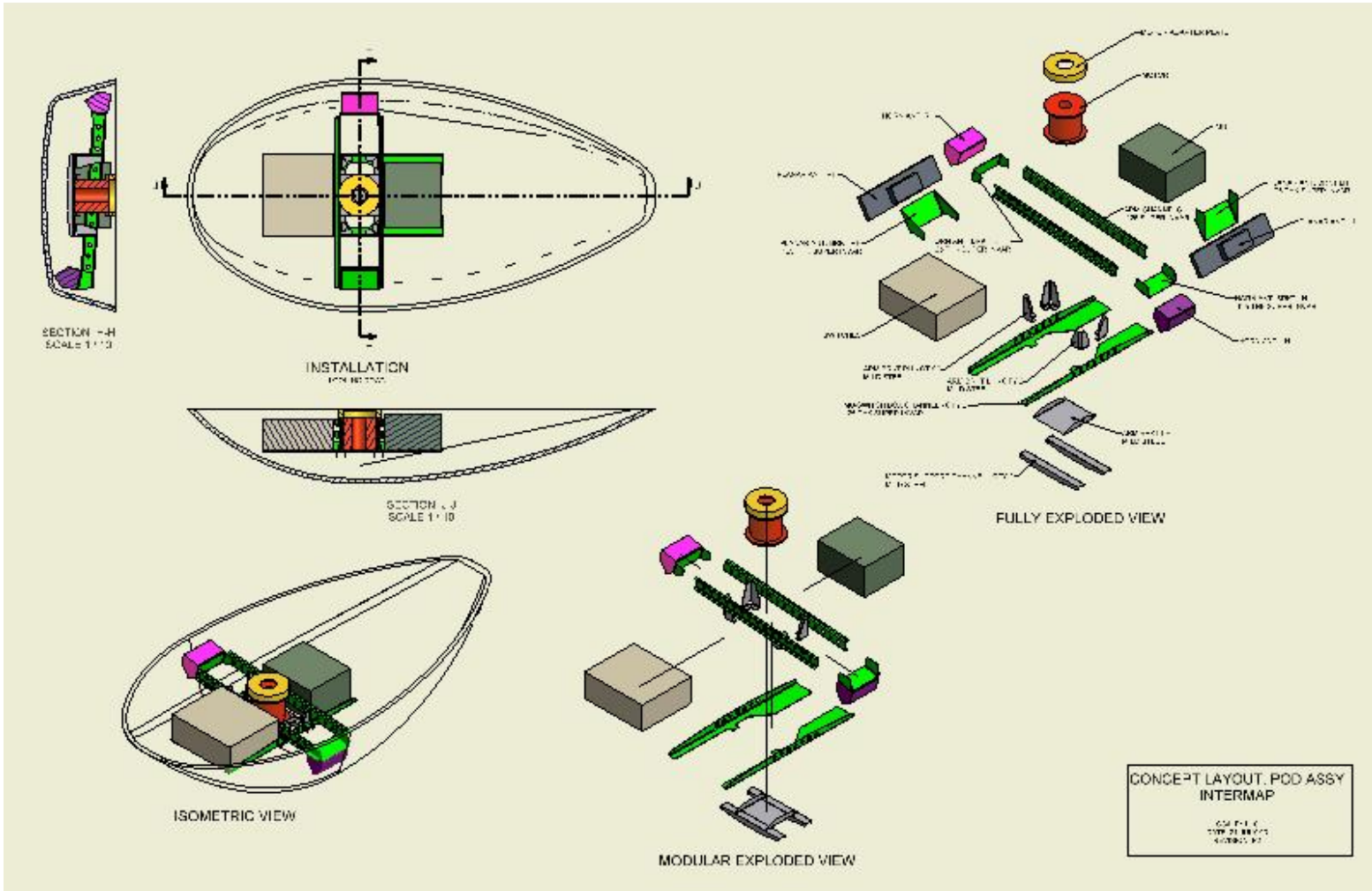
The outputs (customers) of the RO process are as follows:

1. SysDAP Process – *Raw Phase Data, Navigation Data (IMU and GPS), Auxiliary Data.*

2. Maintenance Process – *PSR (Problem Service Reports).*

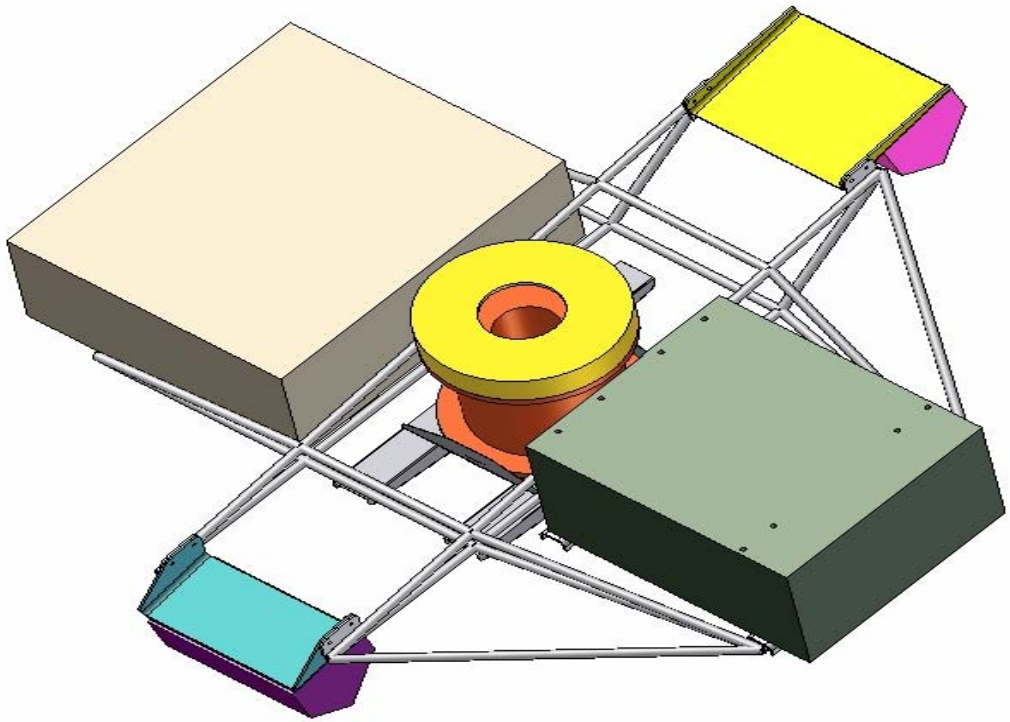
3. Next Radar Operator – *CCR (Crew Change Reports), Flight logs, etc.*

Radome & Pedestal Overview



INTERMAP

Pedestal Assembly



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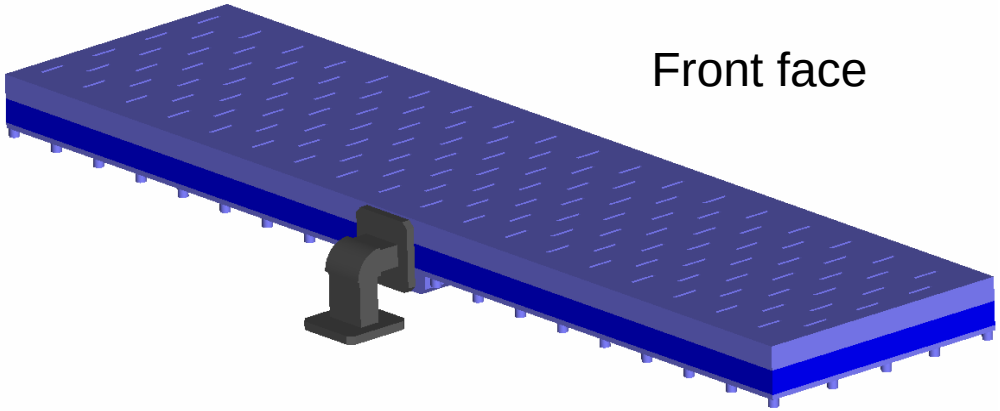
Pedestal & Antennas ~ Existing

INTERMAP

Horn Antenna

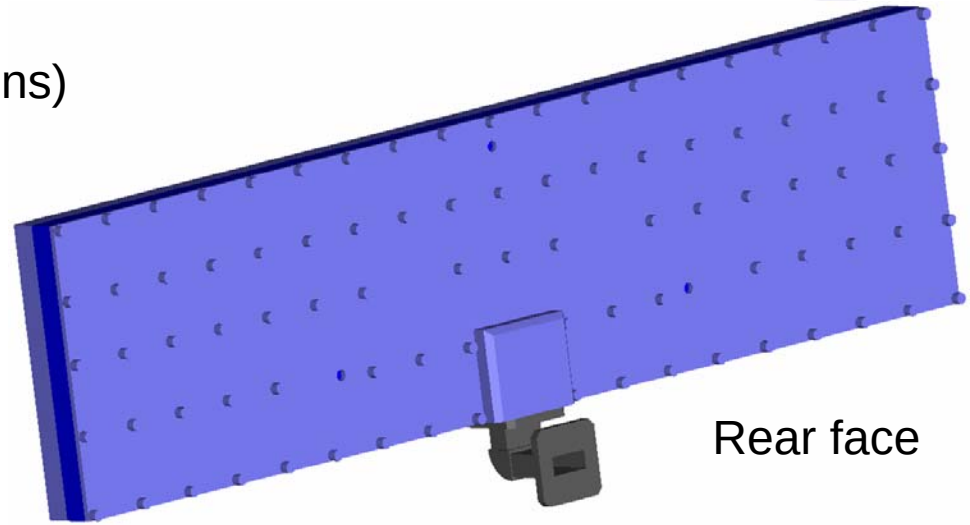
INTERMAP

Antennas (Proposed)



Front face

Slot Antenna 9.4 to 9.8 GHz
Approx 600 x 180 mm (23.6 x 7 ins)



Rear face

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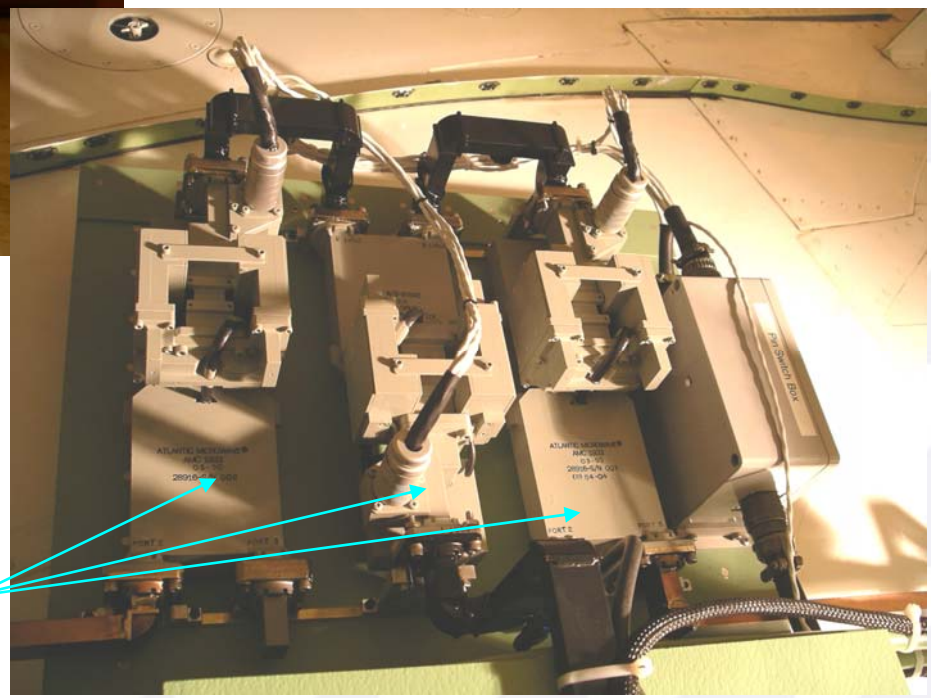
Pedestal ~ IMU & Pin Diode Switches

Inertial Measurement Unit (IMU)

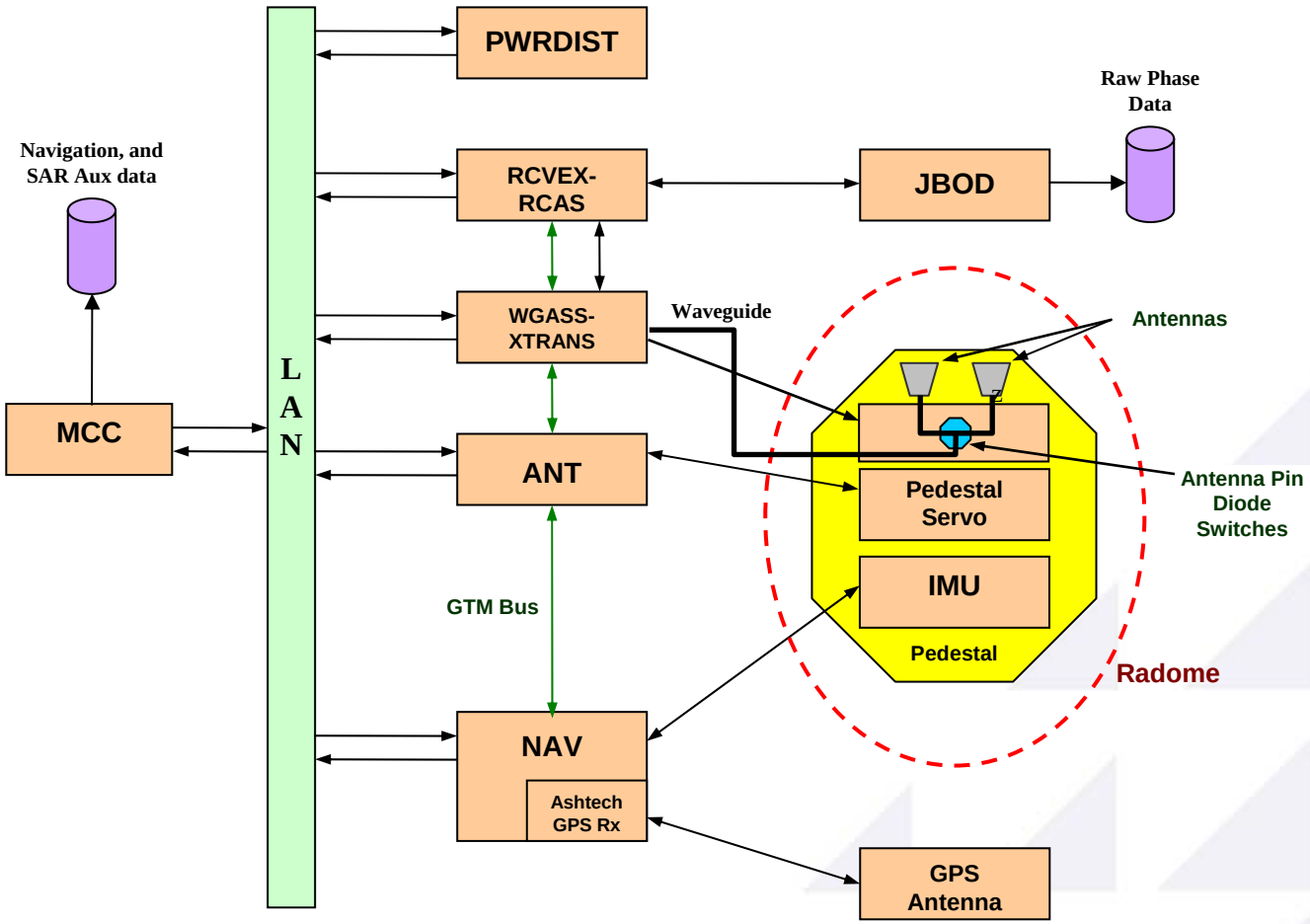
Clock Receiver And Buffer (CRAB)



Pin Diode Switches

INTERMAP

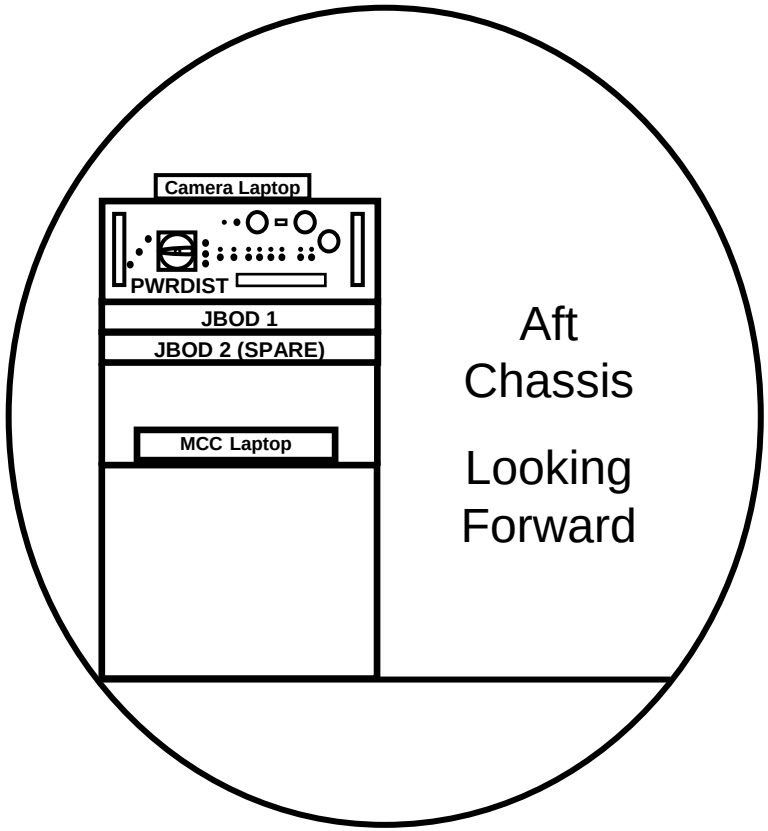
Modular System Design

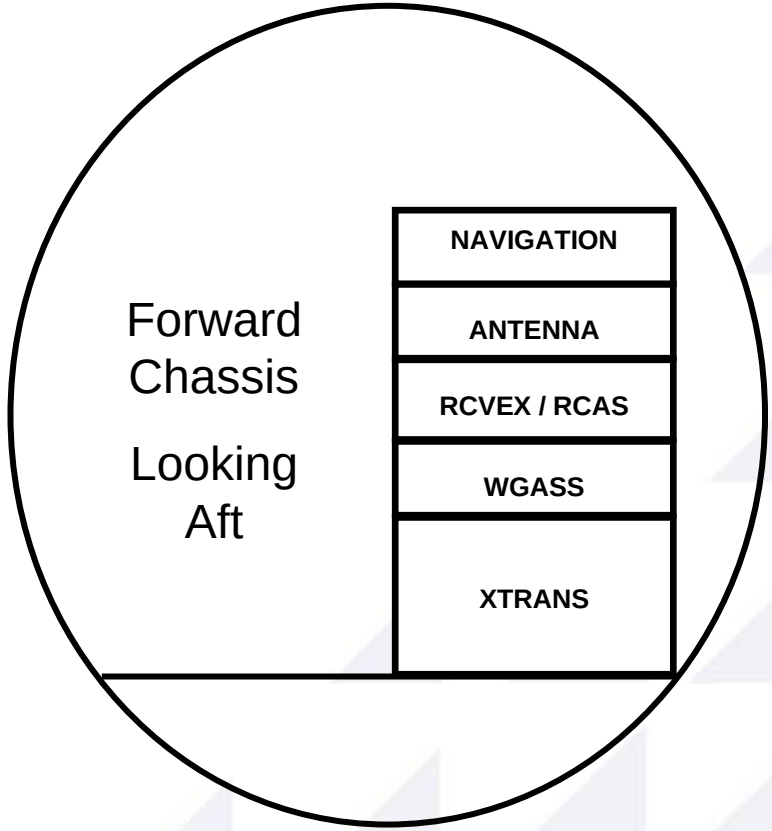


STAR-4 ~ Cabin Configuration

INTERMAP

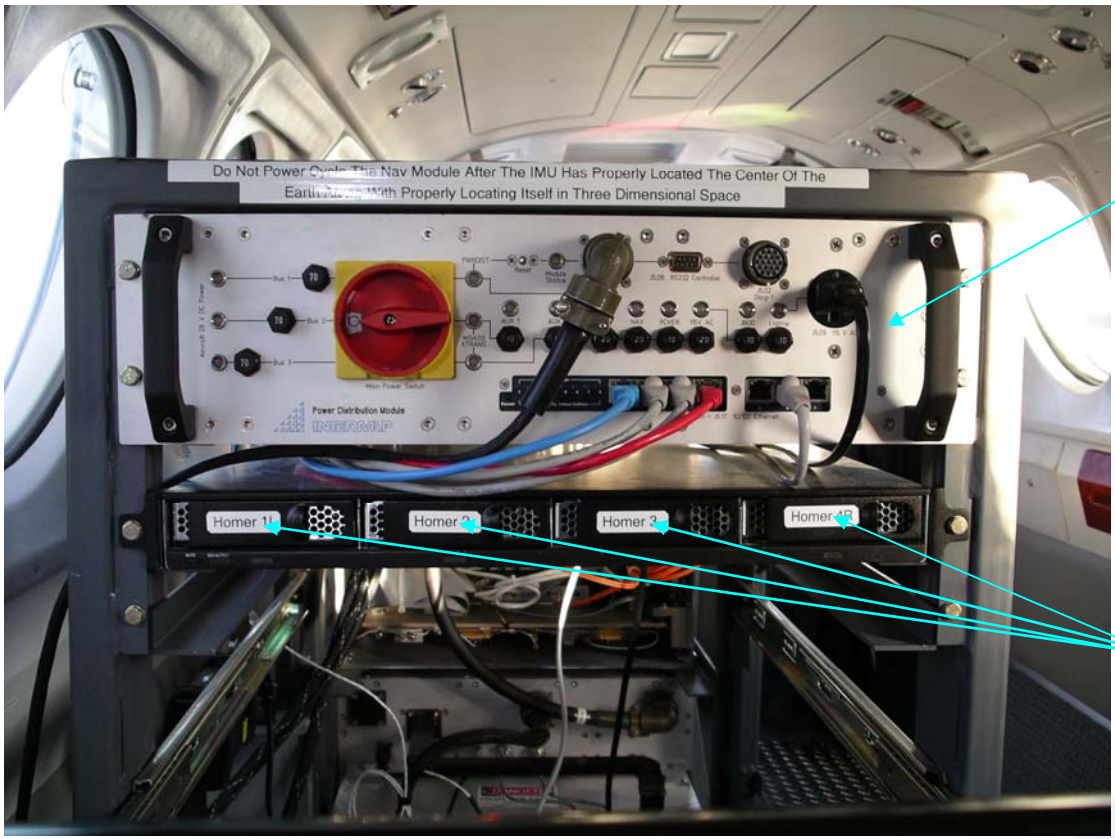
STAR-4 Equipment Rack





INTERMAP

Aft Chassis

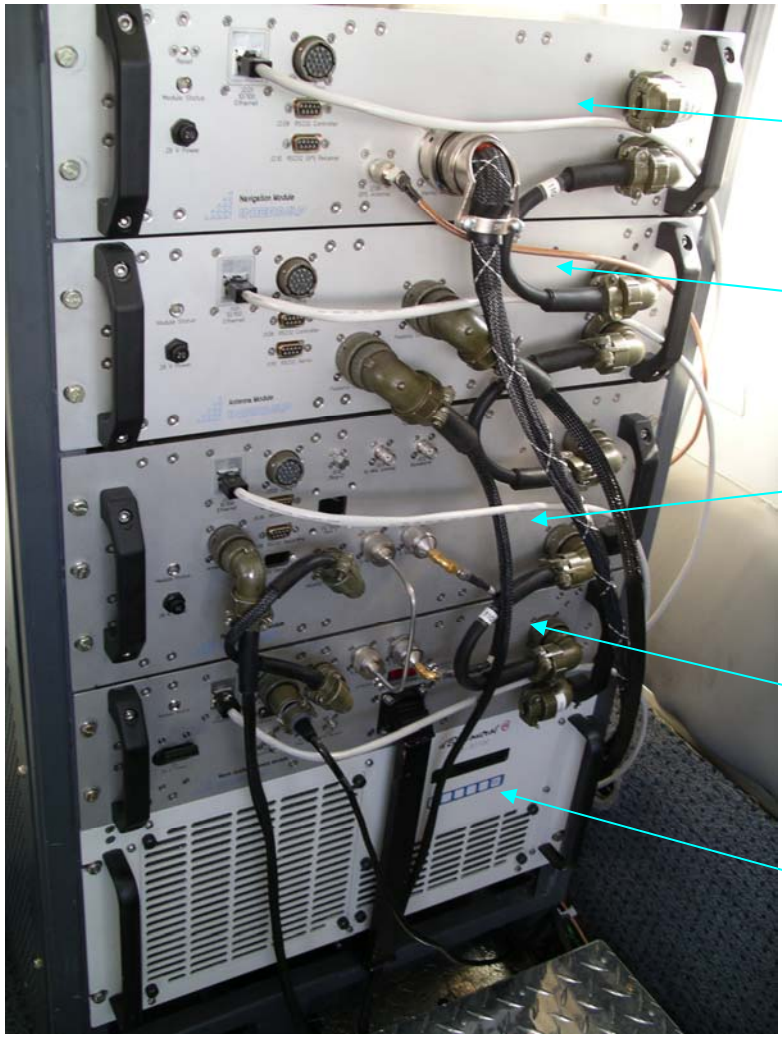


Power Distribution Module (PWRDIST)

JBOD Disks (Qty 4)

INTERMAP

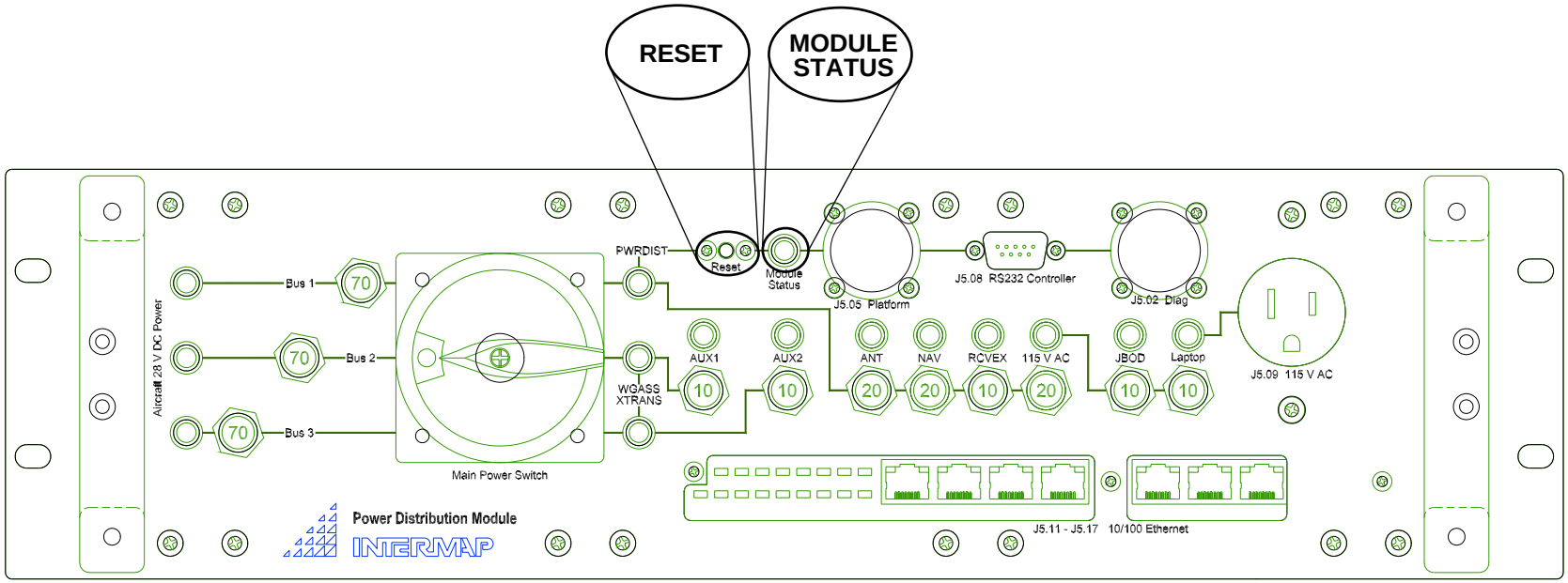
Forward Chassis



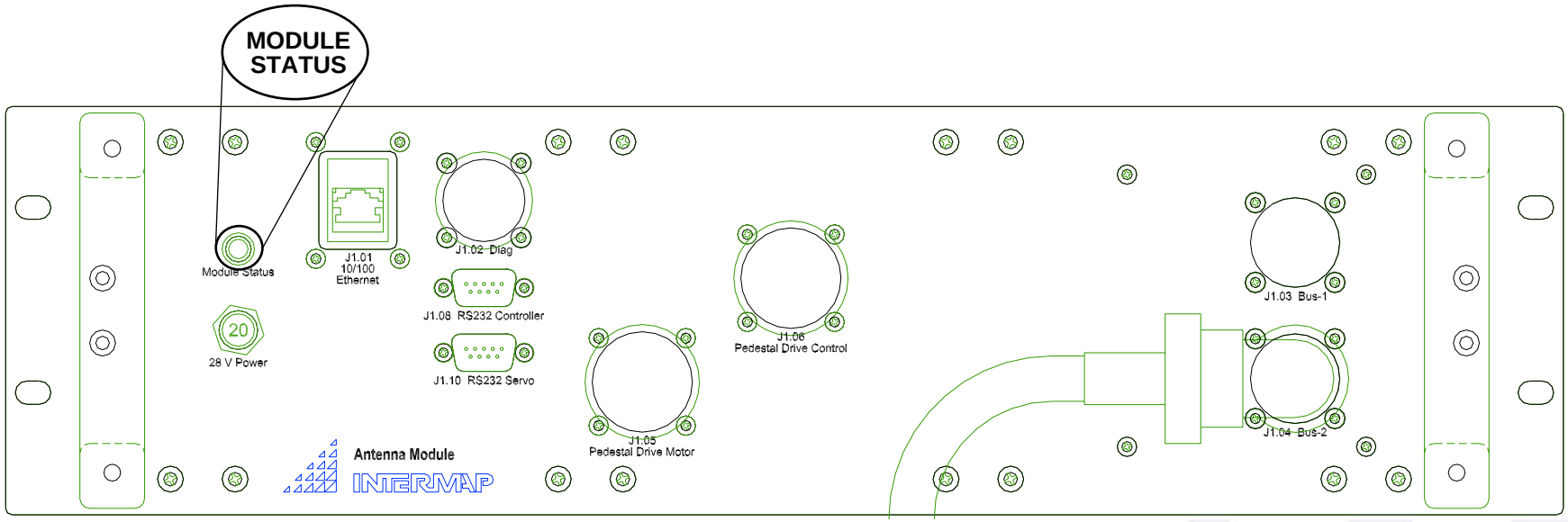
- Navigation Module (NAV)
- Antenna Module (ANT)
- Receiver/Exciter Radar Control Acquisition System Module (RCVEX-RCAS)
- Wave Guide Assembly Module (WGASS)
- X-band Transmitter Module (XTRANS)

INTERMAP

Radar Modules ~ Power Distribution

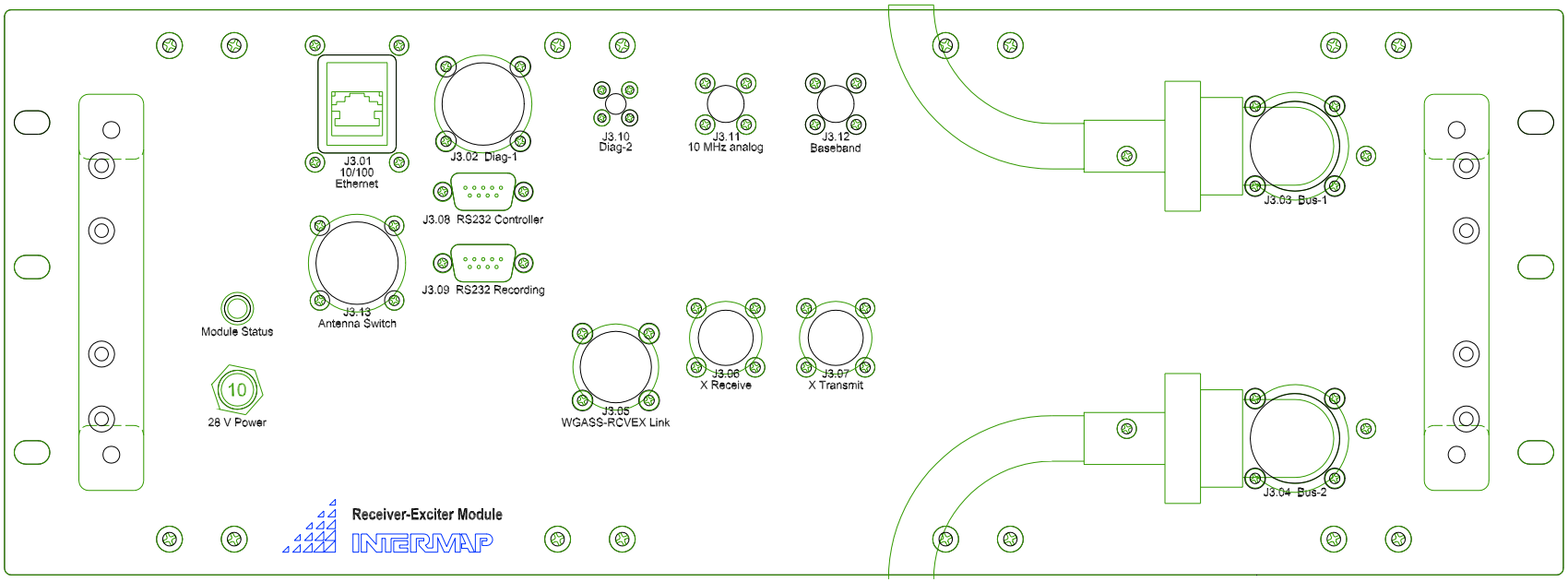


Radar Modules ~ Antenna



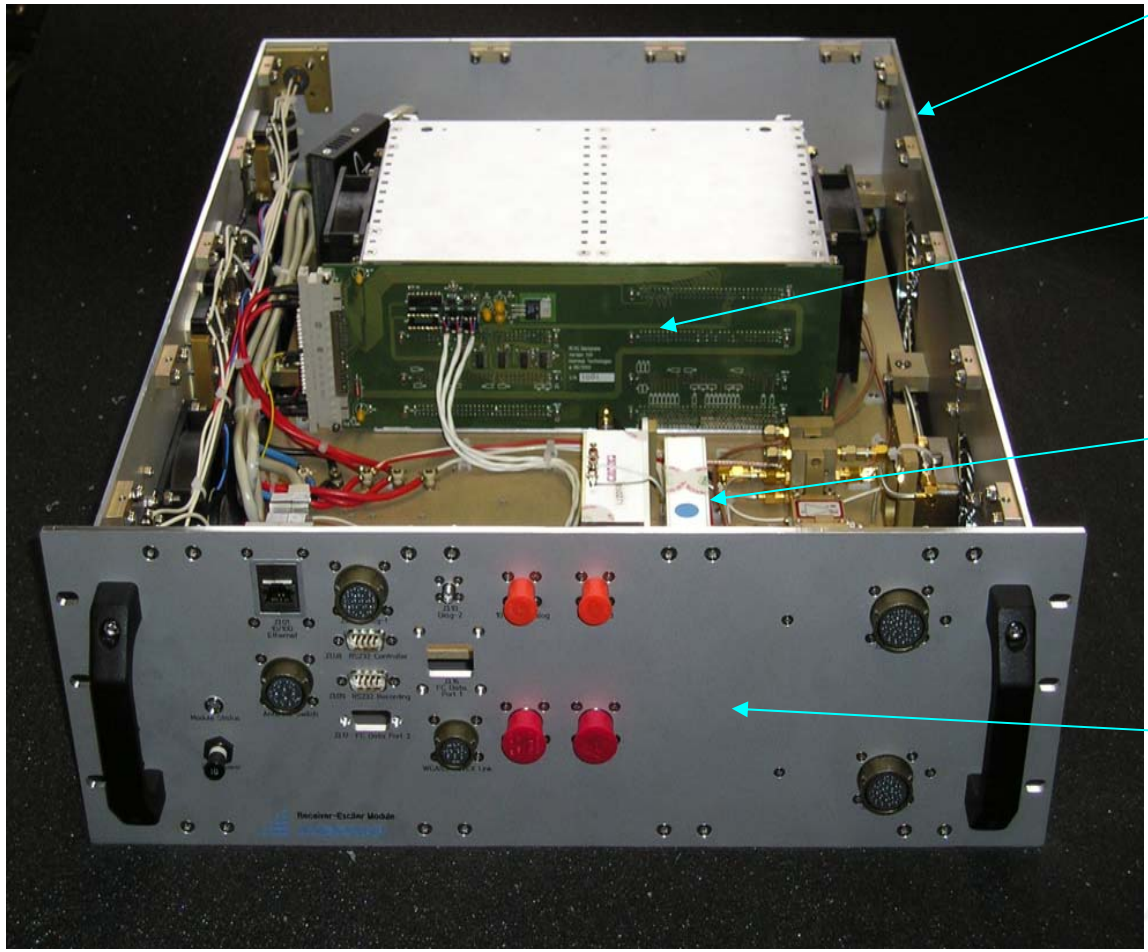
INTERMAP

Radar Modules ~ Receiver-Exciter



INTERMAP

RCVEX / RCAS



Custom VME Chassis

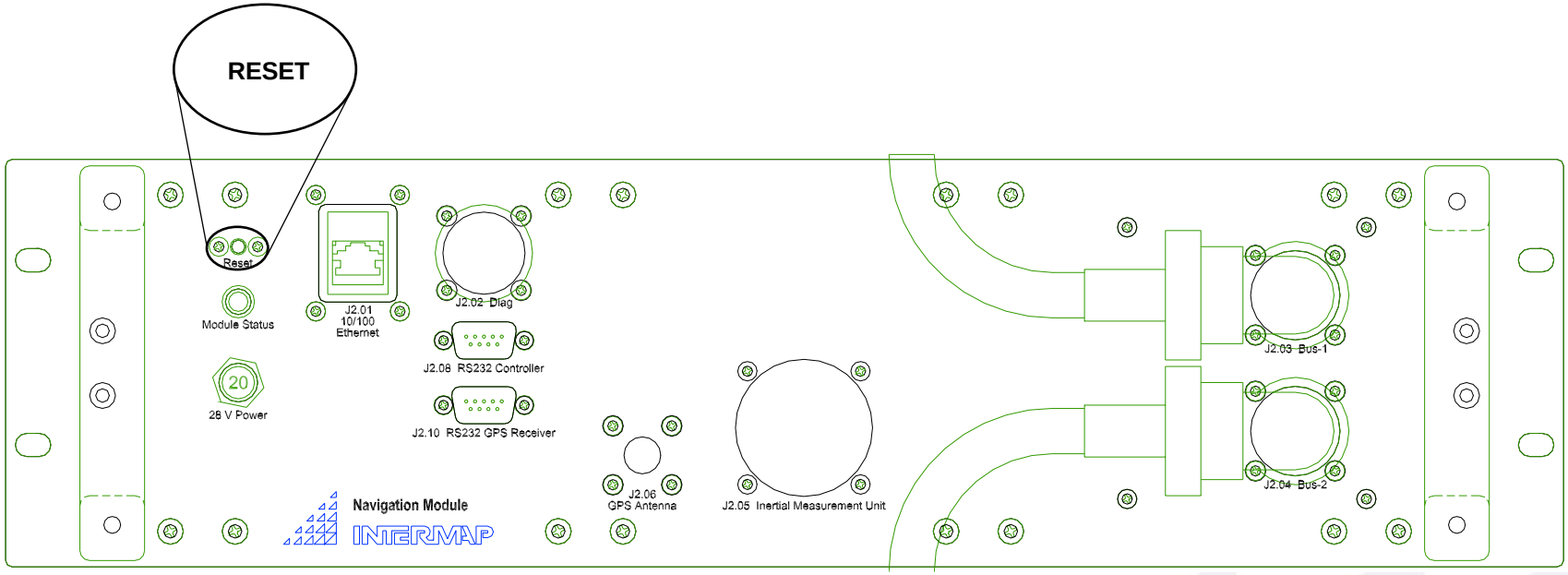
RIB + MDR Recorder

STALO and Osc

RF Chain Under platform

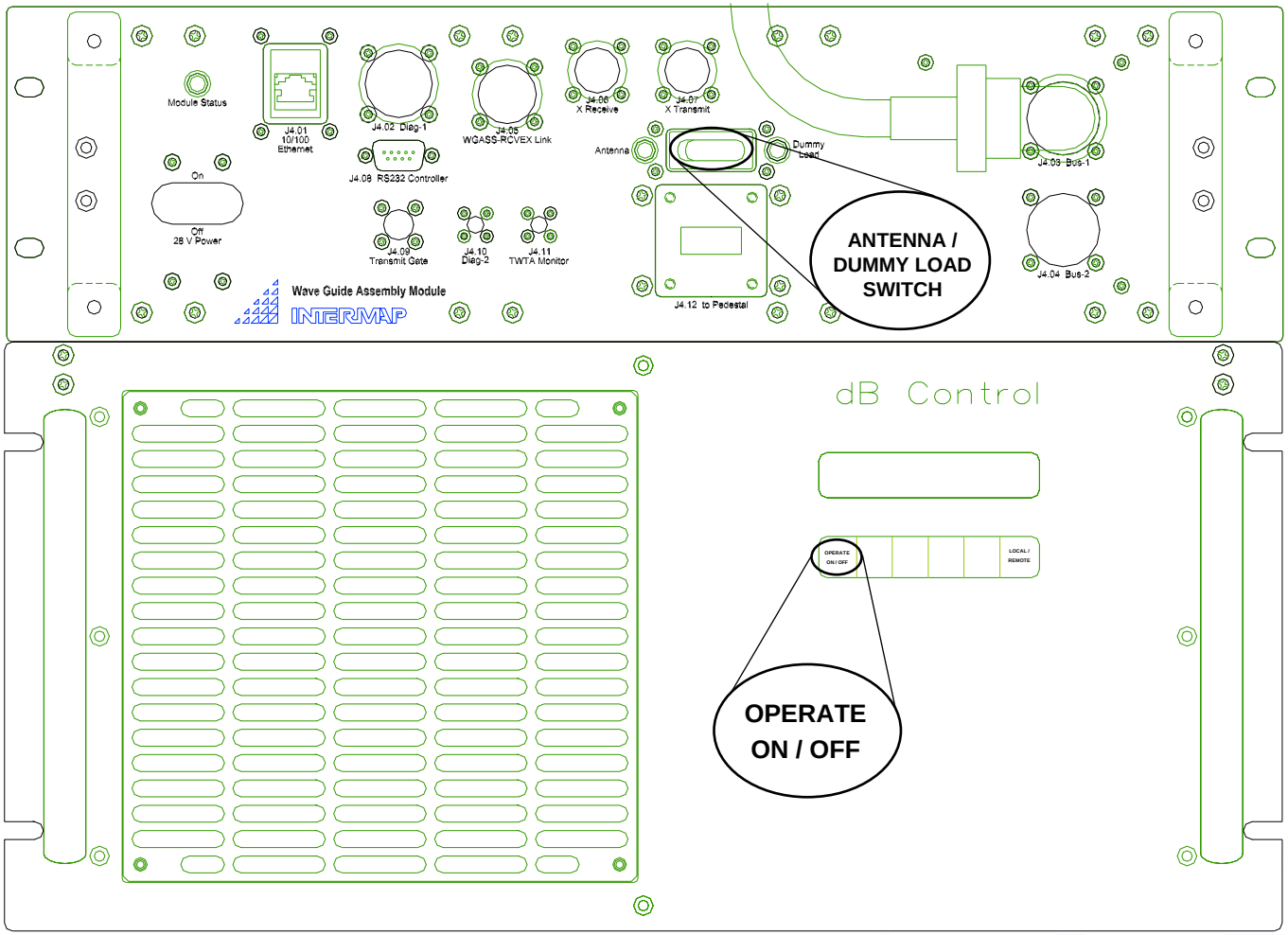
INTERMAP

Radar Modules ~ Navigation



INTERMAP

Radar Modules ~ WGASS/XTRANS



INTERMAP

Configuration Tracking

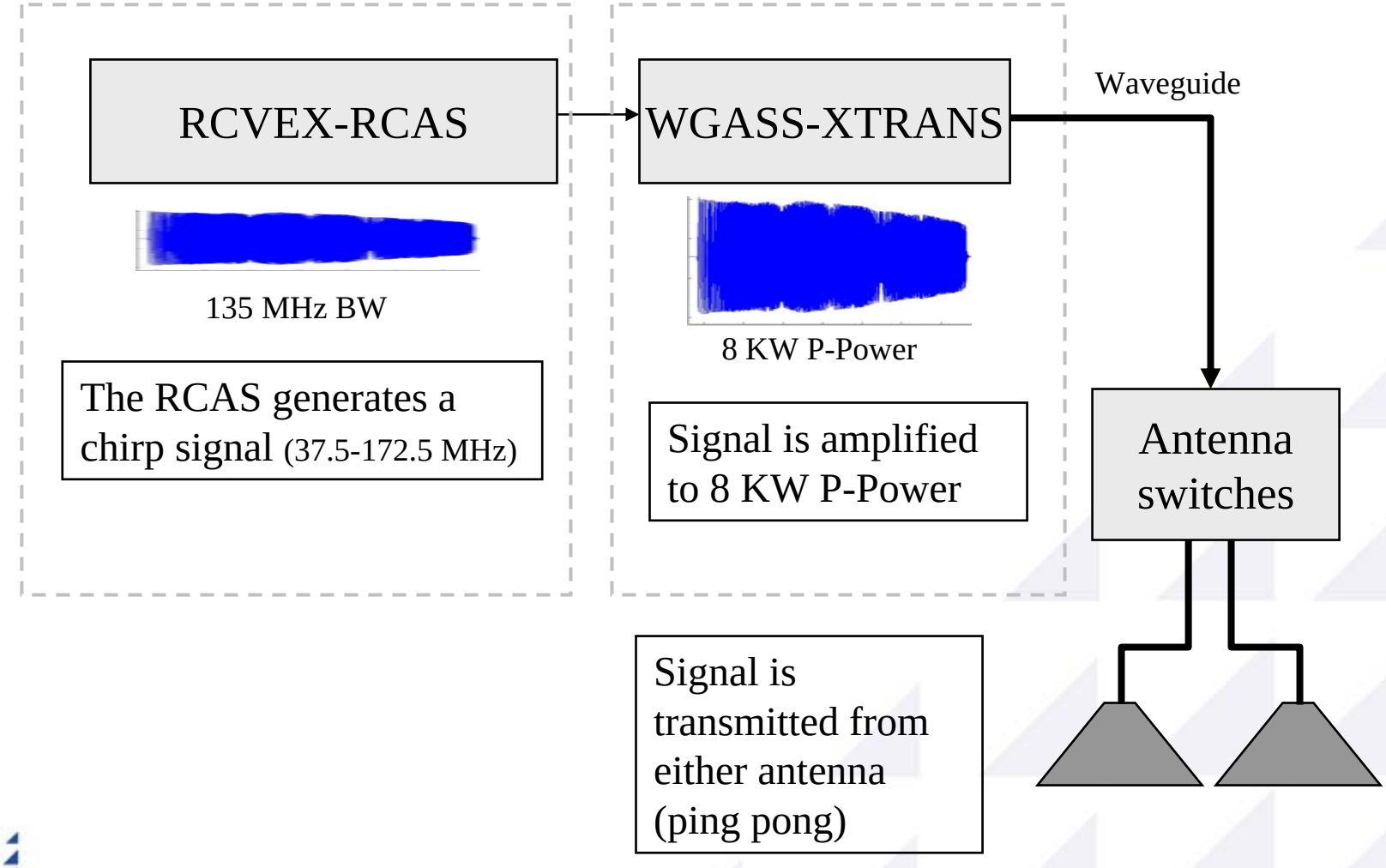
- All data acquired in a flight will contain sufficient information to determine the calibration of the radar. This means that all downstream data processes will be able to determine the calibration parameters for processing, just by inspecting the data.

- Each module will store its own configuration / calibration information on a ROM. The configuration information will include module ID (type, model, serial number), configuration date, calibration date, calibration parameters, and any parameters required during operations.

- Non-LRU components of the radar that do have an impact on the processing of the data, also have a configuration ROM. These are: Pedestal, IMU and Platform.

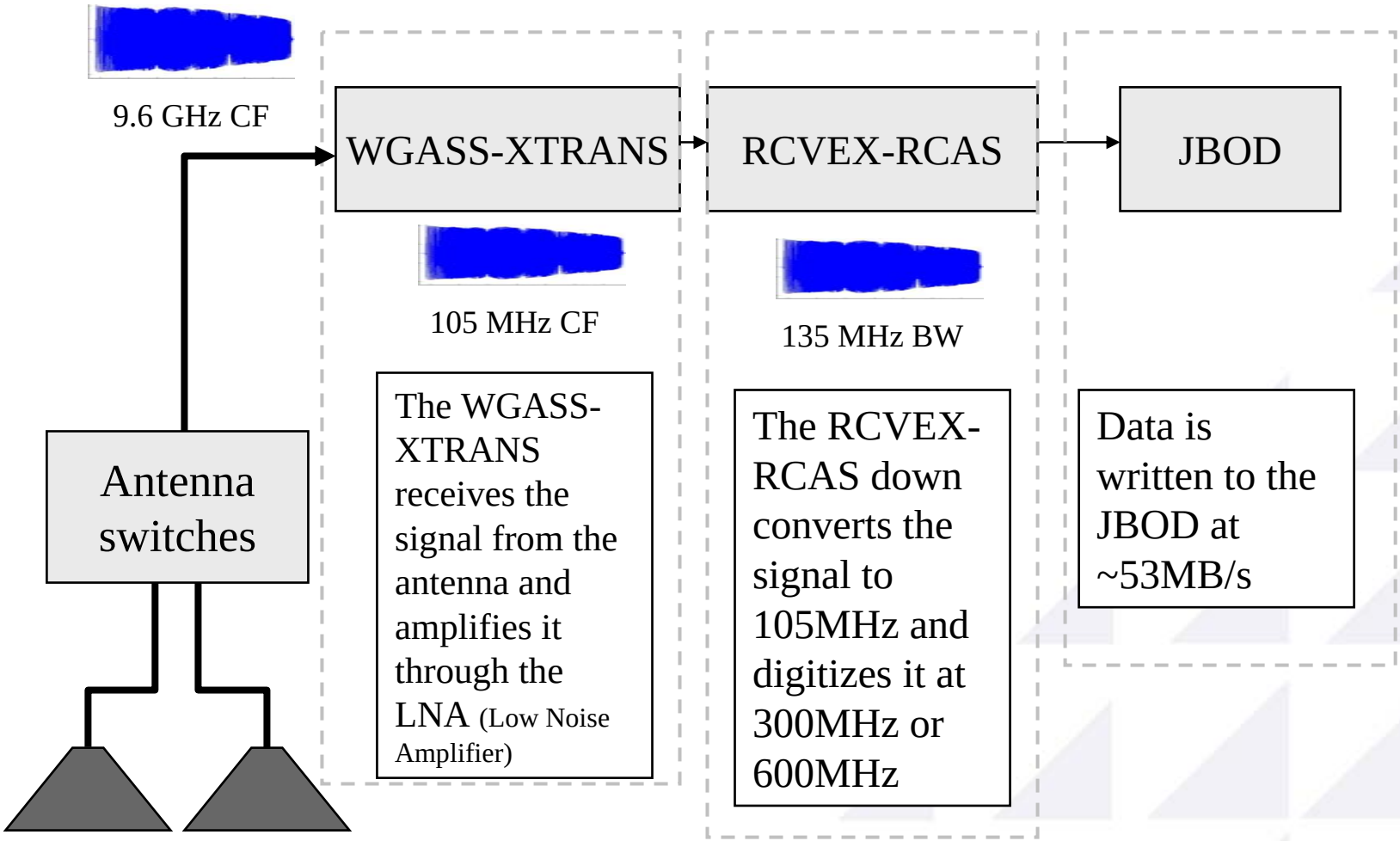
- The MCC collects and records all configuration information from all radar modules and writes them to the session folder(s). These are copied to an appropriate media, which is then transferred to the Field Office as part of the RO deliverable.

Signal Transmit Chain



INTERMAP

Signal Receive Chain



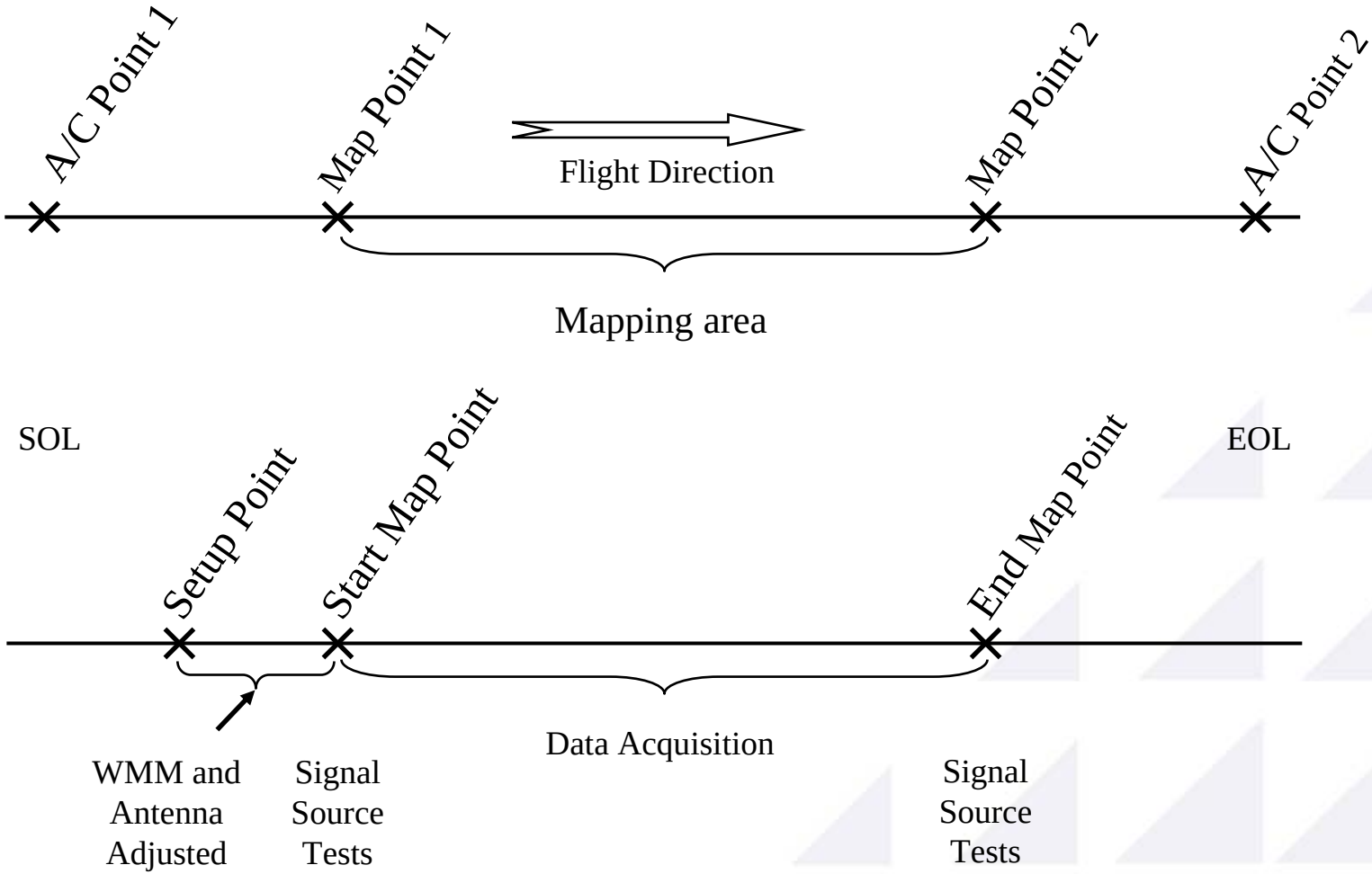
INTERMAP

Projects and Missions

- A Mission is defined by the client's requirements
- Each is assigned a unique four digit Tracking Number (M1234)
- It can be as little as one flight or many months long.
- It can be a contiguous region or a grouping of smaller regions.
- There are Special Missions, for 'Calibration', 'Verification' etc.
- A 'Project' may contain more than one Mission.
- An Acquisition Manual is published for each Project/Mission which defines:
  - detailed requirements such as Area, Accuracy Specifications, Dates, Contacts, etc.
- A minimum of one DGPS base station is required
  - Baseline length vs. navigation accuracy issues
  - Recording data during all flights, Post-Flight processing

INTERMAP

Flight Line

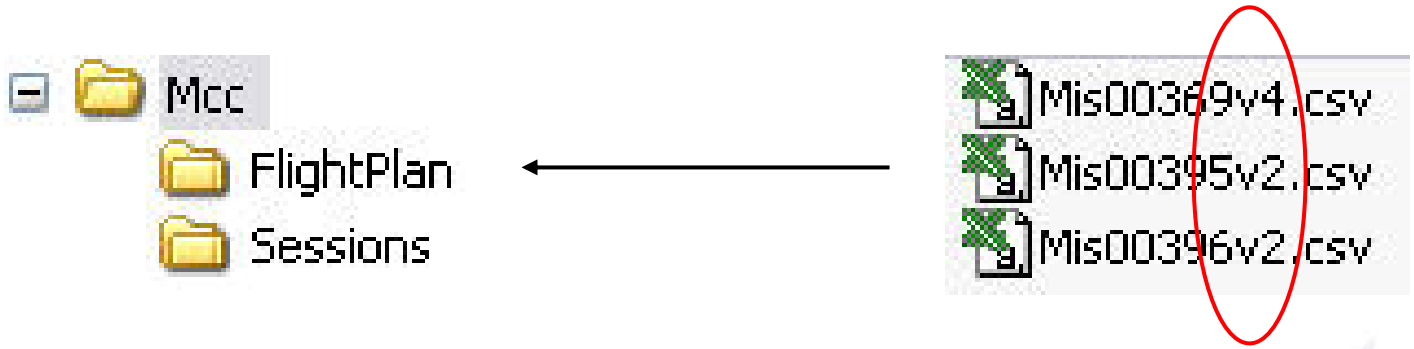

A/C Point 1
Map Point 1
Flight Direction
Map Point 2
A/C Point 2
Mapping area
SOL
Setup Point
Start Map Point
End Map Point
EOL
Data Acquisition
WMM and Antenna Adjusted
Signal Source Tests
Signal Source Tests

Pre-Flight Preparations

- The Radar Operator has a daily meeting with the FM, prior to take-off. This serves as a two-way information exchange:
    - Mission & Flight Briefing / Systems Update
    - Pick up JBOD Disk Set(s) / Blank Flight Logs etc
- At aircraft a minimum of 1 hour in advance of the STD
- Radome External Check - Damage / De-lamination
- Install JBOD Disk Set (Check disk and chassis contacts before insertion & wear anti-static wrist-strap). Secure spare set.
- Aircrew Briefing (Confirm ALL Flight Plan details with pilot, especially Acquisition Altitude)
- Ensure the correct CSV file(s) (mission plans) are loaded on the laptop in the flightplan folder.
- Bio-Break!

CSV File

- The CSV file is loaded on the MCC at the following location:



- It is the Radar Operator's responsibility to the manage the CSV's, and after consultation with the FM, to ensure that he is using the correct version (circled).
- If a "Reflight" CSV file is in use, the RO must ensure that he is using the correct version, as stated in the Flight Briefing documentation.
- The Reflight CSV is provided by the SysDAP program and 'segments' each line, allowing it be flown a line segment at a time. Each *segment* is therefore assigned a unique Line Number, which must not be confused with the Master CSV line numbers.

INTERMAP

CSV File (cont'd)

•Comma Separated Value
•Created in the Mission Planning process
•Contains Mission/Flight-line info and Radar configuration settings, as shown below:

MissDiskVersNo									
3	1								
MissionId	MissionTitl	LineCnt	SiteName	SiteBndPt	SiteBndPt	SiteBndPt	SiteBndPt	SiteBndPt	Si
369	RenoV4- V	32	Reno	39	33	8	N	120	
LineID	ReqmtId	ReqmtDes	RadarMod	RadarMod	UseMode	ACAltMSL	GrndEndP	GrndEndP	Gr
1	1	Reno-01-W	3	FINE	1	8840	39	39	
2	2	Reno-02-W	3	FINE	1	8840	39	39	
3	3	Reno-03-W	3	FINE	1	8840	39	39	
4	4	Reno-04-W	3	FINE	1	8840	39	39	
5	5	Reno-05-W	3	FINE	1	8840	39	39	
6	6	Reno-06-W	3	FINE	1	8840	39	39	
7	7	Reno-07-W	3	FINE	1	8840	39	39	

Note: Data Acquisition (GPS) Altitude

Radar Flight Log - Example

STAR-4 Flight Log

Project # 05001 | Project BAKO-Kalimantan | Pilot JT | Page 1 of 1
Sortie # 4 | Mission # 4017 | RO JM | CSV File Kali V2
T/O Time 2346 | Area Kalimantan | SO WIDODO | Disk Set BENDER
Land Time 0306 | Start Pass 9 | GPS Alt 25768
Date 20050206 | End Pass 11

ALL TIMES GPS

					START			END					JBOD START GB / USED 15 / 3 %		
PASS #	LINE #	LINE DESC	A/C TRK	ANT POS	SQUINT	MAPPING	TX PWR	SQUINT	MAPPING	TX PWR	RMS dB	ATTEN	GB	Used %	COMMENTS
9	28	28P-N	270	90	1.3	0041	-0.5		0054				52	10	ABORTED DUE WX
10	33	33RT-E	180	-85	1.8	0118	-0.5	2.1	0137	-0.5	-14	31	112	21	W:049/9 SQUINT FLOWN N-S
11	34	34RT-W	360	-90	1.3	0152	-0.5	2.3	0213	-0.5	-14	31	173	32	W:081/11 SQUINT FLOWN S-N
															WX ABORT

ADDITIONAL COMMENTS

Could not copy mission files to DVD - wrong format SHOULD BE DVD-R

DAS.QRF.0010 V1.0 July 15, 2004

INTERMAP

MCC Overview

- **Overview**: The MCC is the Master Control Computer used in-flight to control Data Acquisition and Radar Configuration.
- The MCC program is run from a laptop connected via an Ethernet cable.
- The MCC is connected to each of the modules at all times to ensure that all modules are configured to work together to acquire the correct data.
- This Topic deals with all aspects of MCC operation from Startup to Shutdown.