4.11 Set-Up State

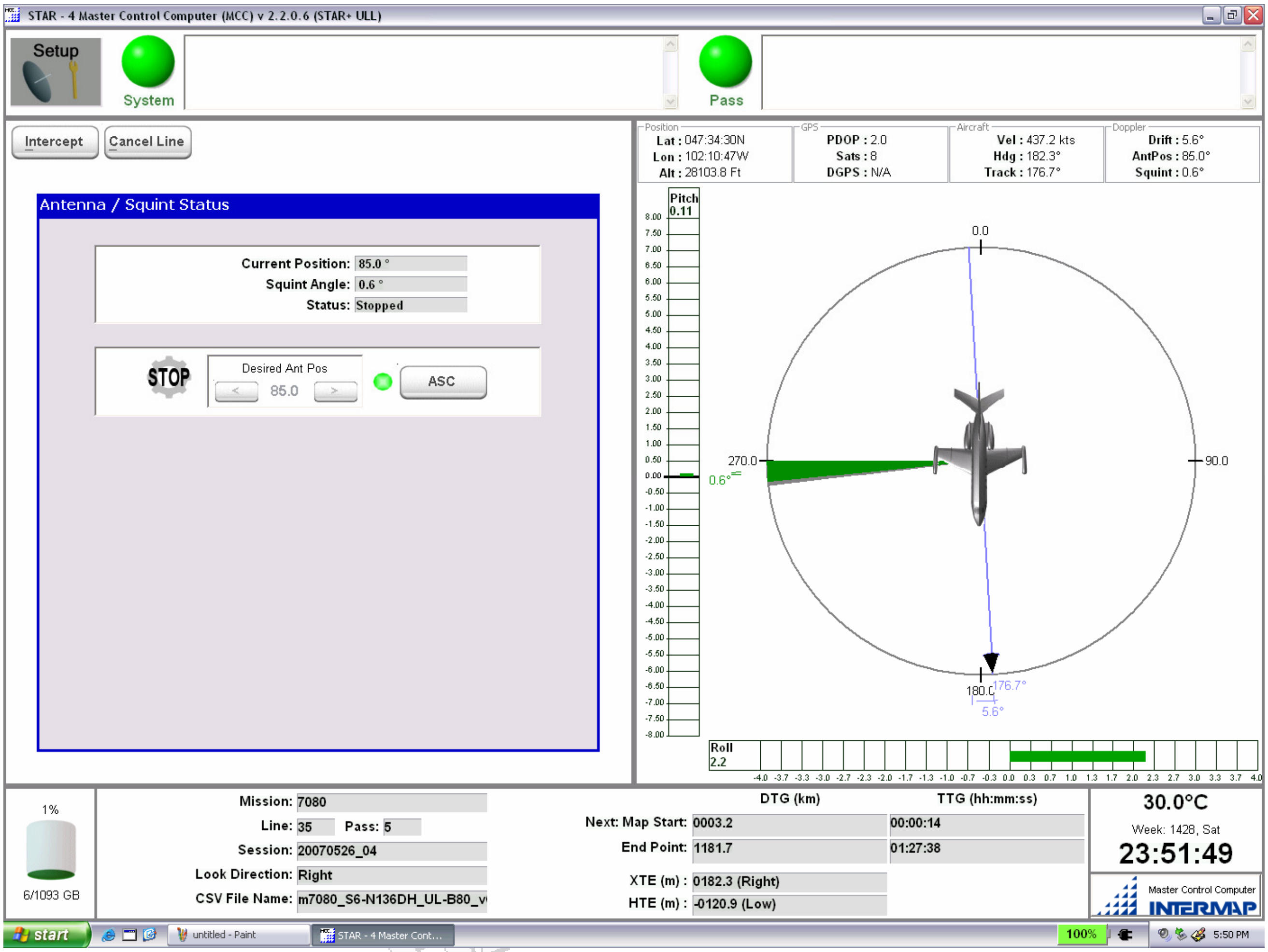

Figure 31: Set Up State: Antenna in position

When the setup point is reached, the following events occur:

1) The Radar timing parameters are configured as per the .csv file.
2) The radar mode is set and chirp file is loaded.
3) The recording is prepared on the MDR / JBOD.
4) The MCC then calculates the optimal antenna position to minimize squint, and moves the antenna incrementally to that position.
5) The operator has the option to move the antenna to a different position so as to minimize squint for the whole line, and compensate for known winds further along the track. The antenna may be moved in 2.5° increments to the limits shown in the NOTE below.

The Automatic Squint Control (ASC) is activated when the green LED is illuminated.

The flashing "move" symbol and the word "slewing" indicate that the pedestal is being rotated.

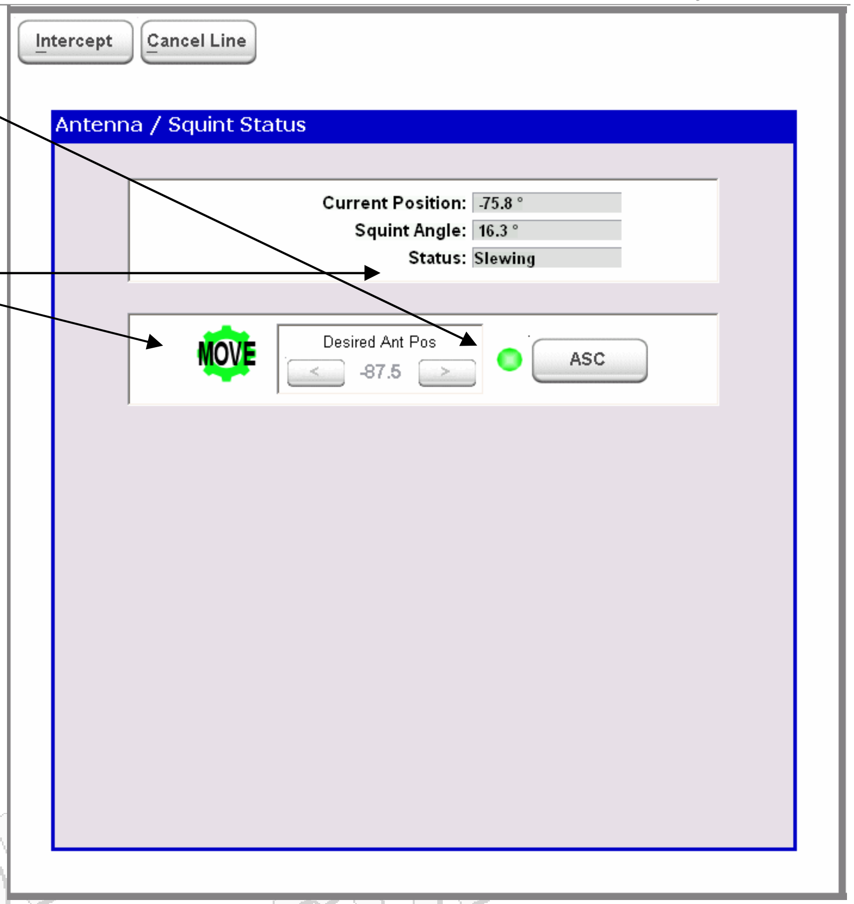

Figure 36: MFD Detail: Antenna Slewing, Automatic Squint Control engaged

6) Once the Start Map point is reached, the antenna may no longer be moved.
7) The TTG and DTG to the Start Map point are displayed.

<u>NOTE</u>: Antenna Azimuth Limits for Type II and Type III data are ± 80° ~ ± 100°

The RO should insure proper antenna placement as soon as he can during the Setup State. He then prepares for the shift to Start Map. He needs to remain vigilant, as the need may arise to "force the intercept" as the Start Map point. He will also need to log the Start Map time, Squint, and Tx. Power levels (although the power levels are not logged until after the Signal Source tests have finished. The Signal Source tests begin as the Start Map point is passed.

4.12 Map State

4.12.1 Signal Source Tests 1

The start of data collection begins with a set of signal source tests, as follows:

Signal Source	Attenuation	RMS Video level (+/- 1dB)
Cal Tone	35	-6
Noise Test	8	-11
Noise Test w/o LNA	8	-11
Syntar	29	-16
Replica	38	-16
Antenna Reflection	24	-40

Table 4: Signal Source Tests

Although the RO does not log Signal Source values, he should watch closely to insure that they progress normally.

After the signal source tests are complete the state will indicate 'Map' and the attenuation and Automatic Gain Controls (AGC) will become unlocked.

Once the AGC becomes active (as indicated by a green LED), the RO can log the Start Map Tx. Power level.

Map State (cont.)

The RO should be attentive to the relationship between the Actual Antenna Position (upper right corner of SAD), and the Desired Antenna position (which is located in the MFD next to the ASC button). The Ant Pos indicates where the antenna is currently positioned, while the Desired Ant Pos indicates where the MCC "thinks" the antenna should be positioned at the next tie line.

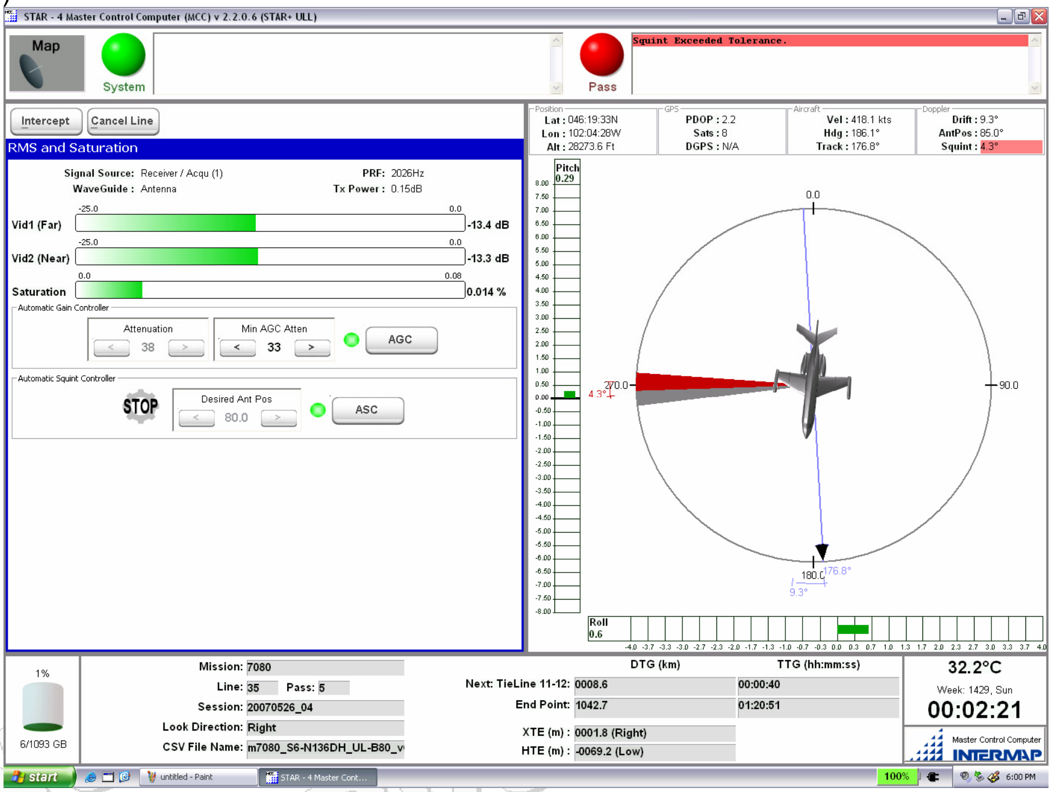

Figure 33: Map State

This is based on an averaging process over the past few seconds. Note that in Figs 24 and 25, there is a difference between the two values, and Squint that is out of spec. Following the next tie line, the antenna has been repositioned using the Automatic Squint Control, and the high squint problem has been resolved.

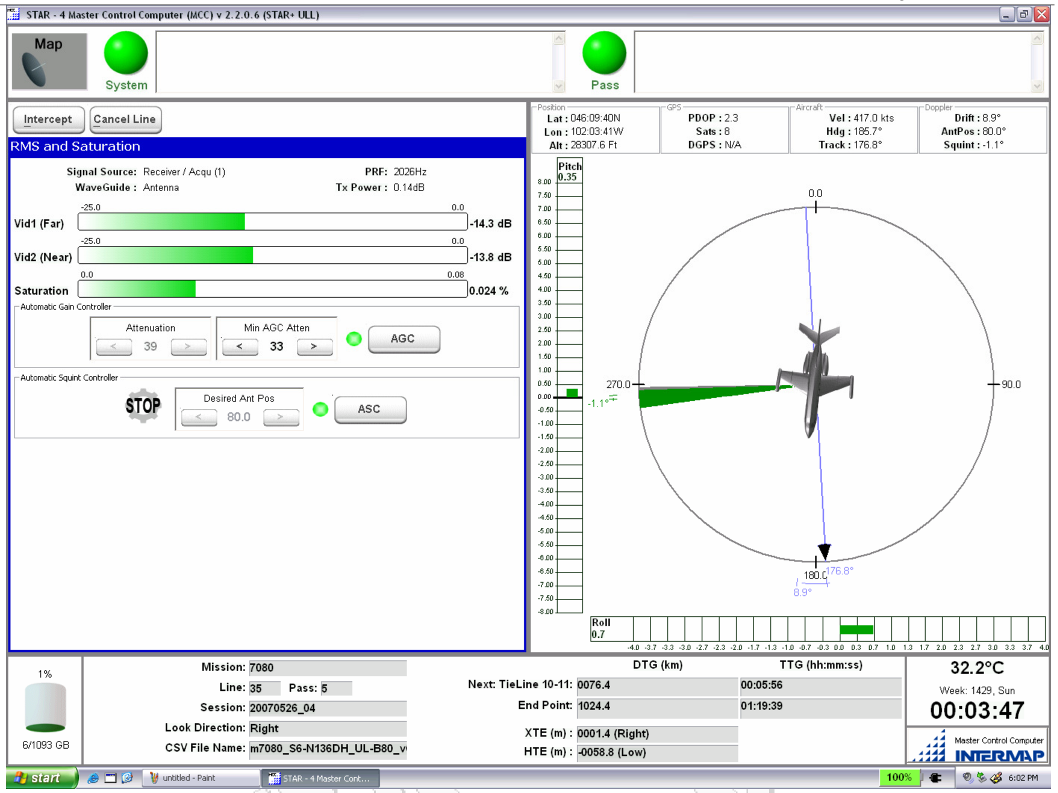

Figure 34: Map State

4.12 **Map State** (Cont'd)

4.12.2 Attenuation / RMS

For normal operating procedures, the AGC should be on. It is, however, very important to monitor the RMS and Saturation. The goal is to maximize signal strength (RMS), without saturating the image. The maximum saturation that is allowed is 0.05%. Under ideal circumstances, the Saturation will be about 0.005% when the RMS is about -15dB (this is not true over water, see section 'Water')

NOTE: Lines should not be rejected by the RO for apparent saturation in-flight. Final rejection, if required, is done during ground QC.

Figure 35: AGC on

Figure 36: AGC off

To increase attenuation (decrease the strength of the return sign) the user must click on the right arrow. To decrease attenuation the left arrow is used. When the AGC is on the user is unable to manually change the attenuation.

AGC OFF

With the AGC off, the operator controls the attenuation directly. The operator must ensure that the saturation does not exceed the maximum. Increase or decrease attenuation level to maintain RMS levels without saturating the system.

AGC ON

The AGC algorithm is a saturation prevention algorithm, and is designed to protect from saturation. As such the AGC makes attenuation adjustments based on saturation only. The AGC is only bound by the 'minimum attenuation' that is controlled by the operator.
In general, the operator should adjust the minimum attenuation in the similar fashion as with AGC off. Under normal (flat terrain) the current attenuation should be stable (not moving) and within the minimum attenuation. When a saturation event occurs, the current

attenuation will increase automatically. When the saturation event is over, the AGC will bring the current attenuation back down. There are only a few basic rules to monitoring AGC:

- **Minimize Toggling:** If the saturation is high enough, the AGC will not be able to bring down the current attenuation to within 1dB of the min attenuation. The current attenuation will then toggle between two values, one value being too high, the other too low. In this situation, increase the minimum attenuation level to match the current level.

- **Maximize RMS:** If the RMS is low (< -16dB), the saturation is very low (~0%) and the current attenuation is within 1dB of the minimum. In this situation, the AGC would like to lower the current attenuation, but it is limited by the minimum. Decrease the minimum value by 1dB, and monitor the results.

Water

The RMS behaves differently over some surfaces. Water is generally a very non-reflective surface and most energy is not returned to the antenna. Thus when mapping areas with lots of water (coast lines, islands, etc) it is important to expect a low RMS signal. In this case, do not maximize RMS, only monitor for high saturation and minimize toggling. If the saturation exceeds the limit, a pass fault is generated.

> NOTE: Use of Topographic maps will greatly improve situational awareness of the project area, and minimize unnecessary re-flights due to possible misinterpretation of data.

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4.12.3 Automatic Squint Control

With the introduction of the Ultra Long Line (ULL) software, the MCC application now includes a feature known as Automatic Squint Control (ASC). ASC functions in such a way that the antenna is repositioned at Tie Lines, when wind changes have resulted in high squint.

NOTE: In the past, the RO has had to concern himself with setting the antenna for the length of the entire line. With Ultra Long Lines, each line is broken into several segments, separated by Tie Lines. While an automated feature, the RO should watch to make sure that the ASC is setting the antenna properly.

Figure 37: ASC ON

Figure 38: ASC OFF

The RO has the option of turning the ASC off, and overriding the MCCs “desired antenna point.” Doing so will be required if the Desired Ant Pos is out of spec (i.e., we are not to allow the MCC to drive the antenna to points beyond the stated limits for any given data type). There may also be situations where the RO has good reason to suspect that the Desired Ant Pos is not “the best” position for a given segment. Such would be the case when the aircraft has had to deviate from the line (due to weather or ATC issues), and the plane is “rejoining” the line.

ASC OFF

With the ASC off, the LED is not illuminated, and the RO can move the antenna by clicking on the Left or Right Arrows. The "Desired Ant Pos" indicates where the antenna **will be changed to** on the next tie line at intersection. The AntPOS in the MDF indicates where the Antenna is **currently** positioned.

ASC ON

With the ASC on, the LED is green and the Left and Right Arrows are "greyed out." The **Desired Ant Pos** indicates where the MCC thinks the antenna *should* be positioned based on an averaging process over the past few seconds. At any point during a flight, the RO may check the actual, current antenna position by reading the **AntPos** value in the upper right portion of the MFD.

In figure 39 at right, we can see that the MCC has determined that, at the next Tie Line, the antenna should be moved to -77.5 degrees. This value is displayed as the **Desired Ant Pos**. This is beyond the antenna position limits, and the RO determined that he wanted the antenna to remain at the current position of -80 degrees (as displayed by the **AntPos** value).

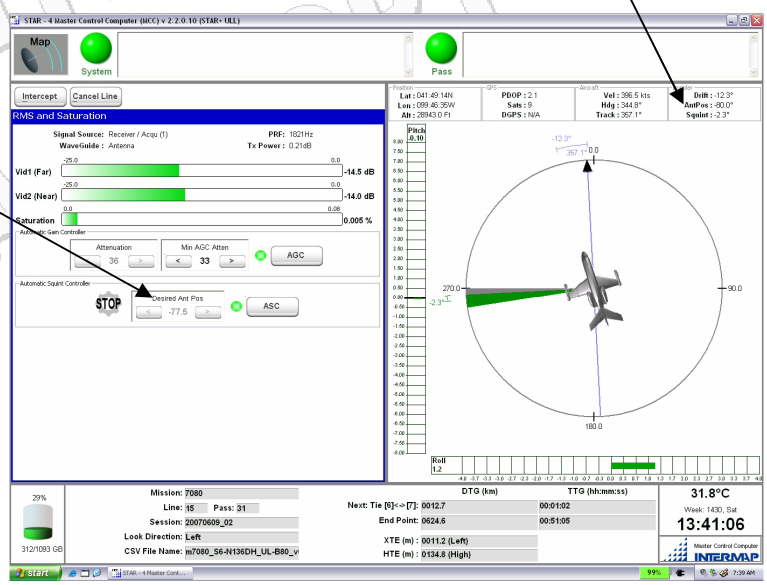

Figure 39: ASC On: Desired Antenna Position Out of limits

In figure 40, we can see that the RO has disengaged the ASC. As such, the **Desired Ant Pos** and the **AntPos** display the same value, and the antenna will not move at the next Tie Lie, even though the squint value is marginal. The RO needs to remain vigilant with respect to the possibility that he may need to override the ASC, and set the antenna manually.

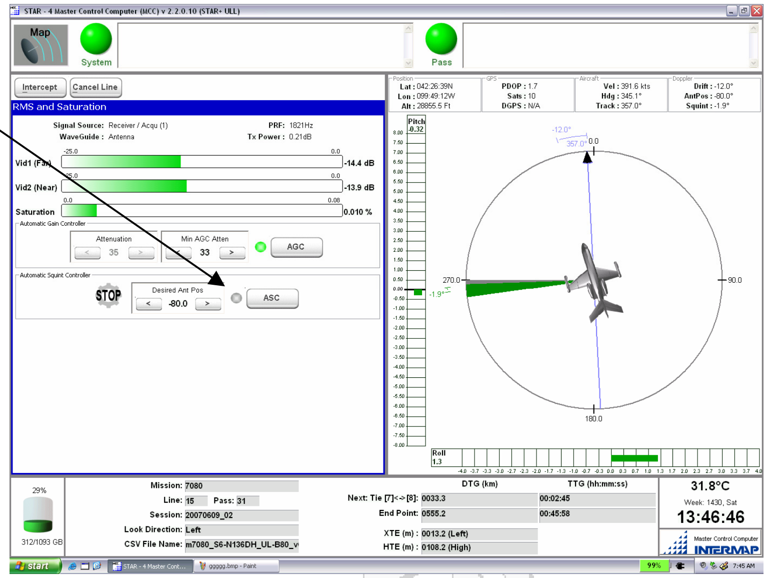

Figure 40: ASC OFF: RO override of improper antenna pos.

4.12.4 Time and Task Management

To aid in ones situational awareness, the RO should monitor the DTG and TTG figures, which are displayed for the Setup Point, the Start Map Point, the "next" Tie line, and the End Map point.

Time To Go and **Distance To Go** indications allow the RO to help manage time, and improve his situational awareness. Remember that these figures are only truly accurate when the aircraft has steadied on line, as they are derived solely from the along track component of the aircraft's velocity vector. Also note that the "Tie Line 11-12" designation should be interpreted as heading toward the Tie Line that separates Segment Number 11 from Segment Number 12. Whether the plane is currently on Segment 11 or Segment 12 is determined by direction of travel, and the RO should refer to the Flight Report for clarification.

	DTG (km)	TTG (hh:mm:ss)
Next: Map Setup:	0021.6	00:02:05
End Point:	1212.6	01:57:46

Figure 41: Intercept State: DTG/TTG to Map Setup Point

	DTG (km)	TTG (hh:mm:ss)
Next: Map Start:	0003.2	00:00:14
End Point:	1181.7	01:27:38

Figure 42: Setup State: DTG/TTG to Map Start Point

	DTG (km)	TTG (hh:mm:ss)
Next: TieLine 11-12:	0031.7	00:02:26
End Point:	1065.6	01:22:06

Figure 43: Map State: DTG/TTG to Next Tie Line

	DTG (km)	TTG (hh:mm:ss)
Next: Map End:	0050.1	00:03:55
End Point:	0050.1	00:03:55

Figure 44: Map State: DTG/TTG to End Point

4.12.5 Forcing the Intercept

With the introduction of the ULL software, the need to "force the intercept" by pushing the **Intercept** button in either Setup or Map State has taken on added complexity. Because each line segment is separated by Tie Lines, each of which constitutes an "event," the RO may encounter situations where he has to force the intercept repeatedly. Two possible situations where such action may be required include deviating from ULL's or turning prior to the end of line, either for weather or ATC requirements.

Figs 45 and 46 display what the RO might expect to see on the SAD when the aircraft is required to divert around weather, or due to ATC demands. The XTE will go very high, as will the Squint. The radar continues to transmit during this entire pass, but the MCC will NOT shift from one segment to the next automatically. As such, the RO must "force the intercept" at each subsequent Tie Line, so long as the XTE remains high. Although the ASC has been turned off in the examples shown, doing so should not normally be required. What is required is that the RO confirm that the antenna position is appropriate upon rejoining the line, as in Fig 46.

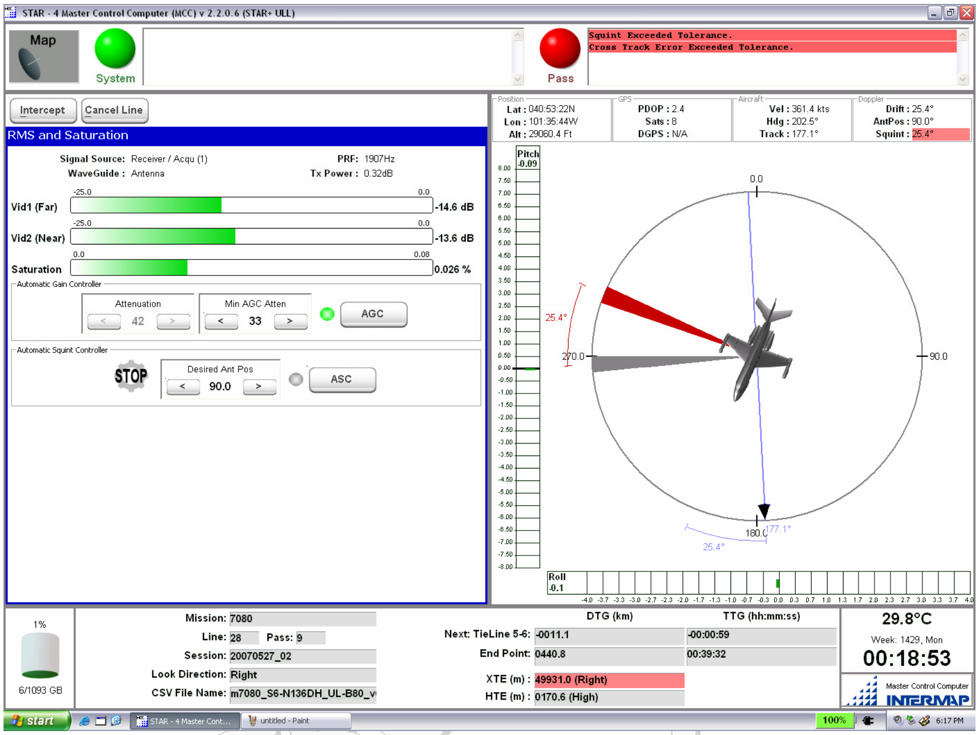

Figure 45: Map State: Diverting around bad weather.

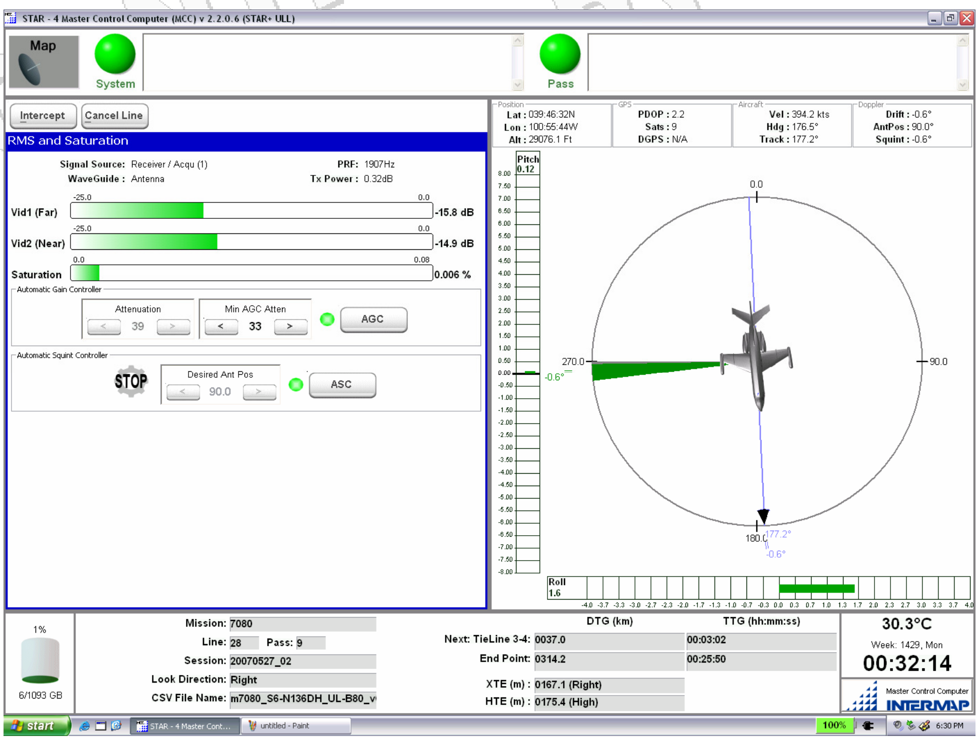

Figure 46: Map State: Having rejoined the line following a deviation.

The figures at right, both taken from Flightaware.com, illustrate two actual ULL flights. Fig 47 displayers a completed, twelve segment (approx 1200 Km) long line. The line extended from near the Canadian border, to northern Oklahoma.

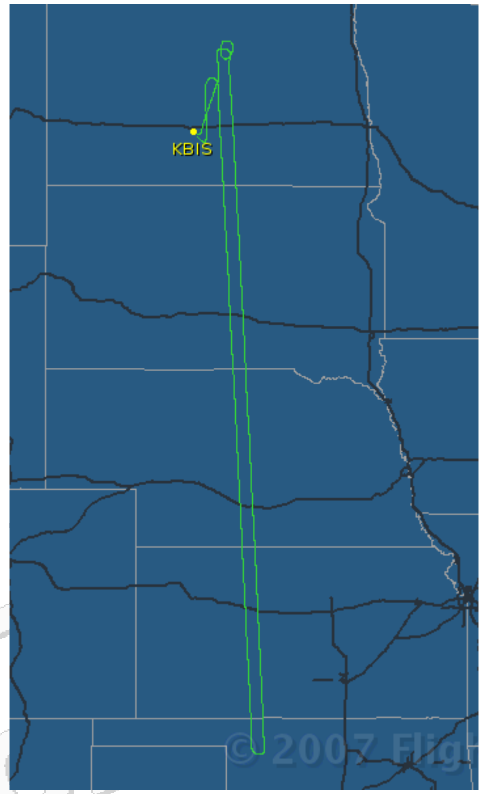

Figure 47: Full length Ultra Long Line

The second flight, part of the same block and flown the same day, illustrates what may happen with bad weather. Due to storms at the southern end of the block, the aircraft had to turn around in northern Kansas. In the process, the three southern most segments were not completed. The RO must be very vigilant in such situations.

Because the ULL primary line (in this case) includes 12 segments, and because the last three segments cannot be flown, the RO will be required to "force the intercept" at the last three Tie Lines as well as the End Map Point.

Having completed the south-bound track, and having "forced the intercept" so as to get back to the Mission State, the RO must now prepare for the north-bound line. After pre-selecting and selecting the correct line, the RO must be ready to join the north-bound track north of the Setup and Start Map points. This will also be north or three or four Tie Lines. As such, the RO must have his head in the game.

Once on line (as indicated by low and steady XTE and drift), the RO must repeatedly (but not too quickly) "force the intercept." He should watch the **TTG** clock closely. When the time value is counting down appropriately, and is not a "negative" value, the RO can assume that he has intercepted as many points as he needs to. Good situational awareness is very important in this situation.

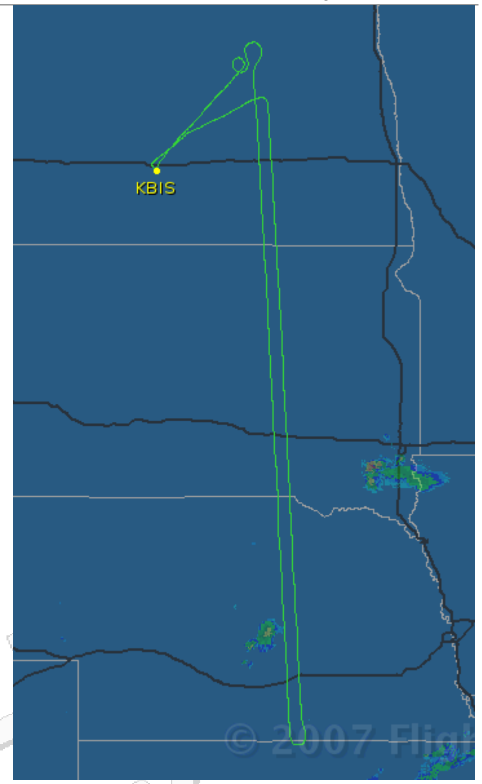

Figure 48: ULL shortened due to weather.

4.12.6 Motion

Monitor the squint angle, pitch, and roll of the aircraft. If the limits are exceeded, the pitch, roll, and squint indicators will turn red and a pass fault will be generated. Annotate the Flight Log accordingly.

4.12.7 Power

The Tx Power will display the nominal power level of the TWTA during mapping. The nominal power is 0 to -1 dB.

4.12.8 Signal Source Tests 2

The end of data collection consists of another set of signal source tests. The same tests as those at start of data are performed, but in the reverse order.

4.13 To Change Mission / Line

After the line is complete the system reverts to the Line select screen (Mission State).

To select a new mission do the following:

1. Select **End Mission** from command bar
2. Select **New Mission** from command bar
3. Proceed as per sub-paragraph "4.7 Ready state, 3. Load a Mission"

4.14 Shutting Down

After the last line has been acquired, the radar system may be shut down. The STAR-4 system does not require a post-alignment, and thus can be shut down in flight once data collection is complete.

! CAUTION: Once the system is shut down in flight, IMU alignment is lost and further data cannot be collected.

1. Select 'End Mission' from command bar
2. Select 'End Session' from command bar
3. Select 'Exit MCC' from command bar
4. **Pull AUX2 CB (STAR-4 only)**
5. **Wait 10 seconds**
6. Turn PWRDIST Master Power Switch to 0 (**OFF**)
7. Copy Session folder(s) to recording media, including pictures, if any
8. Shut down MCC laptop

4.15 Disk Swap

Disks can be swapped during flight, but require the RCAS module to be reset, and thus the start of a new session.

1. Select 'End Mission', 'End Session'
2. Exit the MCC program using the 'Exit MCC' icon.
3. Pull 'JBOD' CB
4. Pull 'RCVEX' CB
5. Change JBOD disks (use strap)
6. Set 'RCVEX' CB
7. Set 'JBOD' CB
8. Launch MCC program using Desktop 'MCC' icon
9. Continue with normal system start up, see sub-paragraph '4.4 Idle'.

NOTE: After a disk swap or any in-flight shut downs (starting of new sessions), a new > 360° orbit must be completed and 10 minutes of NAV data collected before the next pass is started.

4.16 MDR Shell

When the MCC is not able to connect to, or communicate with the MDR, it may be necessary to perform JBOD disk maintenance functions through the MDR Shell program, a text-based utility that enables basic disk operations to be performed on the JBOD.
Control of the MDR/JBOD should be done through the MCC laptop PC. The MDR Shell should only be used as a last resort, and cannot be run simultaneously with the MCC application due to conflicts. MDRShell is normally to be used for trouble shooting and maintenance only.

Proceed as follows:

1. Shut down the MCC application.

NOTE: The Radar does not need to be shut-down.

2. Select MDRshell on desktop
3. Type **192.168.0.3 at prompt**
4. Press Enter to connect to the default disk group.
5. Type **connect YYY** (if no devices are detected)

CAUTION: THERE IS NO 'UNDO' COMMAND

6. Type the appropriate command, e.g. Type **clear** <Enter> if all files are to be deleted. (If unsure of which command to use, type **show)**
7. When asked "Do you really want to continue?" type **y** <Enter>
8. When finished with MDRShell, type **exit** <Enter>
9. When asked "Do you really want to exit?" type **y** <Enter>
10. Restart the MCC application using the 'MCC' icon.
11. Confirm JBOD space is now 1093GB (1.1TB).
12. Continue with the mission

Command	Arguments	Description
Show	N/A	Display a list of all available commands
Clear	N/A	Deletes All Recordings from the disk set. **Use with Caution**
Delete	Recording name or number	Deleted the specified recording from the disk set

Rename	New name	Renames the current recording to the specified name

Table 5: MDRShell Commands

5. RADOME INSPECTION – MOISTURE & DEBRIS

There are no inspection panels on the **STAR-4** or **STAR-5** radomes. The radome must be inspected using the radome camera during each pre-flight to ensure that it is free of moisture, and also for debris such as Radar Absorption Material (RAM) or any other foreign object, which must be removed. Any observable moisture in the radome is also unacceptable, and must be removed prior to data acquisition.

NOTES:

1. The aircraft should be stored in a hangar whenever possible.

2. If any moisture or debris is found/removed, the Flight Log must be annotated accordingly.

Moisture/Debris in Radome:

1. Take pictures with the radome camera, as required. Pictures should be archived on the recording media for later analysis.
2. With help from the AME, remove radome.
3. Remove moisture/debris.
4. Ensure as far as possible that no further debris contamination will occur.
5. Ensure drain holes are clear of debris.
6. Refit radome and have AME reseal with Sealant, P/N DC111 or equivalent.
7. Consider raising a PSR, depending on the circumstances.
8. Proceed with flight, no curing time is required.

6. FAULT RECOVERY

6.1 Start up Problems:

These are common problems that may occur during initialization.

Problem: The modules widgets are all yellow, and do not change to green

Cause: The modules have not been time-synchronized by the NAV module. The NAV module will only synchronize the other modules when it has a valid GPS position / time.

Solution: Make sure that the aircraft has a clear unobstructed view of the sky, or a GPS repeater is installed and working. Check the antenna cable and GPS antenna.

Problem: There is a system fault "XXXX Error receiving status from module", and 1 or more widgets are red.

Cause: The MCC has not received status from 1 or more modules.

Solution: Some modules may require up to 1 minute to fully start up. As such this fault condition may be present until then. If the fault persists confirm that the LED on the front of the module is lit, if it is not check the power connections / breakers. Otherwise check the network connection of the modules.

Problem: 1 or more module is red, while the rest are green, or there is an un-clearable System fault.

Cause: This indicates that one or modules has a fault that needs to be resolved.

Solution: The solution is dependant on the fault condition. Write the error message down for future reference. Depending on the exact message, the problem may easily be solved. Check the list of System Faults at paragraph 6.3. Is the error repeatable? Shut down the module, check all connections and cables, and power the module back up again. Ensure adequate time is allowed for it to start up.

NOTE: In all instances, a full debrief of any fault conditions experienced must be given to the on-site Sensor Support Engineer.

6.2 Pass Faults

NOTE: A pass fault does NOT mean that the data is rejected, but rather provides an indication of possible rejection. Final rejection is done post-flight after detailed analysis.

Pass Fault	Description
PDOP exceeded Tolerance	The GPS Position Dilution Of Precision (PDOP) has exceeded tolerance. This is probably due to poor GPS reception (geometry of satellites). Perhaps blocked by buildings while on the ground or a poor GPS "window".
Pitch Exceeded Tolerance	The Pitch of the aircraft has exceeded tolerance
Roll Exceeded Tolerance	The Roll of the aircraft has exceeded tolerance
Height Error Exceeded Tolerance	The "Height Error" tolerance has been exceeded. This is probably caused by excessive turbulence or by flying at the wrong height.
Cross Track Error Exceeded Tolerance	The Cross Track Error (XTE) has exceeded tolerance. This is most likely due to turbulence, or the selection / navigation of the wrong line.
RMS Video 1 Error Exceeded Tolerance	This is caused when the RMS video level of Antenna 1 is too high for a brief period. The current attenuation setting maybe incorrect.
RMS Video 2 Error Exceeded Tolerance	This is caused when the RMS video level of Antenna 2 is too high for a brief period. The current attenuation setting maybe incorrect.
Squint Exceeded Tolerance	Occurs when the squint angle exceeds the tolerance for an instant. This may be caused by crosswinds (changing of aircraft heading). The problem may be corrected by better positioning of the antenna in the Setup state on subsequent lines.

Table 6: Pass Faults

6.3 System Faults

6.3.1 MDR Data Fault:

Covers the following error messages:

- Anything with MDR!

In event of an MDR Fault, the following steps should be taken to recover.

1. Exit the MCC Application.
2. Pull the **RCVEX** Breaker (turn off RCAS).
3. Pull the **JBOD** breaker (turn off JBOD).
4. Wait 10 seconds.
5. Verify that all disks are inserted correctly (use static strap).
6. Verify the JBOD Fibre Optic cable is connected to the RCAS.
7. Push **JBOD** breaker.
8. Push **RCVEX** breaker.
9. Restart MCC.
10. Wait for RCAS widget to go green, and continue.

<u>NOTES</u>:

1. When the MCC is restarted, it is the start of a new session. A >360 degree orbit and 10 minutes of NAV data is required before starting the next pass.
2. Depending on the error, the JBOD may be full, and require the last pass to be deleted to continue. This will cause the loss of the last pass. If available, the JBOD disk set may be swapped instead, see 4.15.
3. An Error message of 'MDR: No Disks or bad DiskGroup Inserted' indicates that either 1 or more disks are missing, are out of order, or are not configured properly. Check disk connections, and set correct order.

6.3 System Faults (cont'd)

6.3.2 IMU / GPS / NAV Data Errors:

Covers the following error messages:

- GPS/IMU Data Error
- NAV: Timeout reading raw data …
- NAV: unable to connect raw data…

1. Exit the MCC Application.
2. Press the **Reset** button on the front of the NAV module. (Do not pull the circuit breaker!). Be careful when resetting the NAV module. Press the Reset button once only. To ensure that the module has had enough time to reset, wait at least 10 seconds between attempts.
3. Restart MCC.
4. Wait for all modules to synchronize Green again. (They may all flash RED momentarily after the NAV is green)

NOTE: When the MCC is restarted, it is the start of a new session. A >360 degree orbit and 10 minutes of NAV data is required before starting the next pass.

6.3.3 Last Ditch Effort

This is to be done if all else fails, and only as a last ditch effort, as follows:

1. Exit the MCC application.
2. Pull the **JBOD** breaker (turn off JBOD).
3. Pull the **RCVEX** Breaker (turn off RCAS).
4. Pull the **ANT** Breaker (turn off ANT).
5. Switch the WGASS-XTRANS 28V Power switch to Off (switch on front of module).
6. Press the Reset button on the front of the NAV module. (Do not pull the circuit breaker!). Be careful when resetting the NAV module. Press the Reset button once only. To ensure that the module has had enough time to reset, wait at least 10 seconds between attempts.
7. Press the Reset button on the front of the PWRDIST module. (Do not switch off Master Power Switch!). Be careful when resetting the PWRDIST module. Press the Reset button once only. To ensure that the module has had enough time to reset, wait at least 10 seconds between attempts.
8. Wait 10 seconds.
9. Restart MCC application.
10. Push **JBOD** breaker.

11. Push **RCVEX** breaker.

(continued on next page)

6.3.3 Last Ditch Effort (cont'd)

12. Push **ANT** breaker.
13. Turn WGASS-XTRANS switch back On.
14. Wait for RCAS widget to go Green, and continue.

NOTE: When the MCC is restarted, it is the start of a new session. A > 360 degree orbit and 10 minutes of NAV data is required before starting the next pass.

6.4 Miscellaneous Problems

Problem: The MCC did not intercept the start/setup/end point when expected.

Cause: The intercepting point must be within the preset tolerance LIMITS of the MCC.

Solution: Check the aircraft altitude. This problem is often due to the aircraft flying at the wrong Flight Level. Also, check the XTE and confirm that the aircraft was close enough to the line at the time of interception.

The actual intercept range is set to the default values of +/- 800m in altitude, and +/- 500m in XTE.

6.5 Warning Messages

Under normal operating circumstances, the following messages will not be observed:

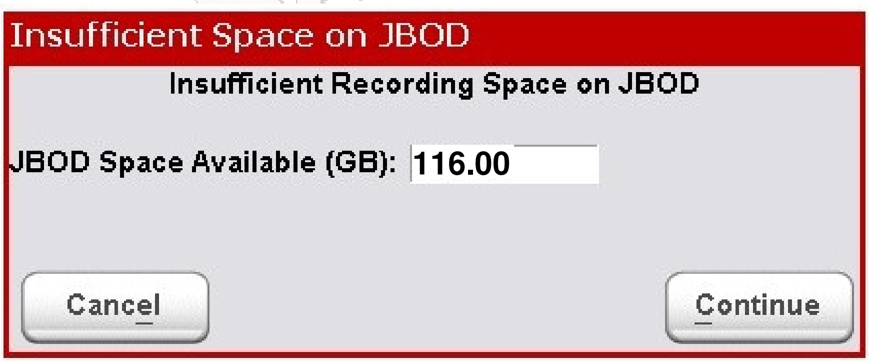

Figure 79: Insufficient Space on JBOD Warning

The JBOD low space warning is triggered at 120GB.

6.5 Warning Messages (cont'd)

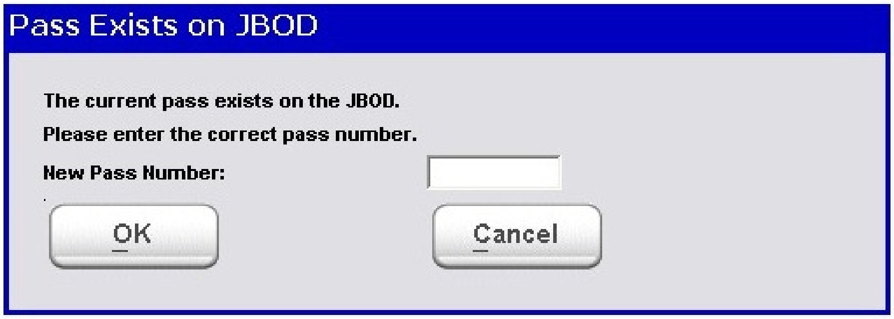

Figure 80: Pass Exists on JBOD Warning

Figure 59: Low Velocity Transmit Warning

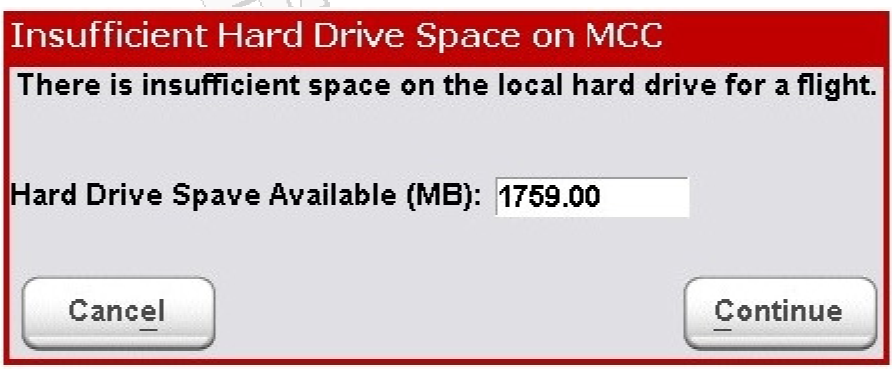

Figure 10: Insufficient Hard Drive Space on MCC Warning

The MCC HD low space warning is triggered at 2GB (2000MB).

7. Appendices

7.1 Appendix A: Diagnostic Tools Overview

The Diagnostic Tools are applications used in troubleshooting and monitoring the radar system from a lower level than the MCC. **Radar Operators must be aware of the basic functionality to assist in-flight problem diagnosis or until an engineer arrives on-site**. These applications can perform all of the functions of the MCC application plus many more that help in diagnosing system issues and aid testing procedures.

7.1.1 Module Diagnostic Tools

The following screen shot is the common layout of all diags:

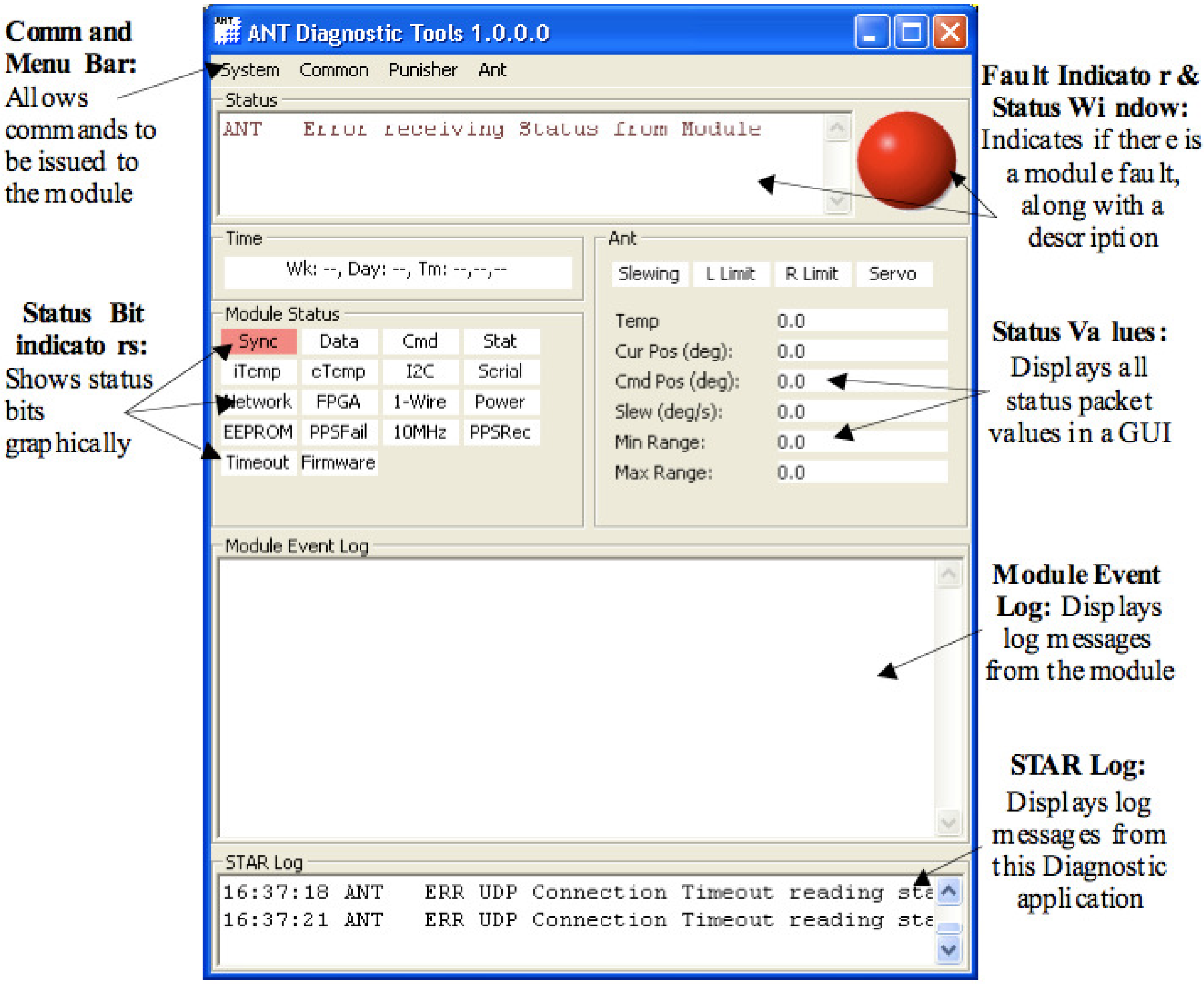

Figure 53: Diag Tool Layout

The Diags are composed of 6 sections that either report system controls or communicate with the modules.

- <u>Command Menu Bar:</u> This is the section that is to be accessed when any communication to the module is required. Pull down menus will display all available commands upon clicking the bar
- <u>Fault indicator & Status window:</u> The red button at the top right of the screen goes red if any fault is detected and reported the fault on the Status window. These errors can be cleared by clicking the button which also clears the error. If the error is only a brief instance the button will go green upon clicking.

- Status Bit indicators: The Bit indicators display simplified status of system parameters. The light on each will be white, green or red.
  - White – The parameter is **not** faulty
  - Green – The parameter is working properly
  - Red – There is a problem of some sort with the parameter
- Status Values: Displays system (module) variables that yield a more complex value than good/bad
- Module Event Log: Reports all execution of the modules from module boot-up sequence to acknowledgement of commands from the diag tools (or MCC). This window is recorded to a "log" file in the working directory of the Diagnostic tool (see 4.2)
- STAR Log: Displays all interaction of the diag tools.

7.1.1.1 Common status bits

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

Figure 11: Common status bits

7.1.1.2 Common commands

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
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)
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.
Punish…	Initiates a generic punish test

Table 2: Common diag commands

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

7.1.2 ANTDiag

The ANT module Diagnostic Tools can be used to monitor and control the pedestal rotation, independent of the MCC application.

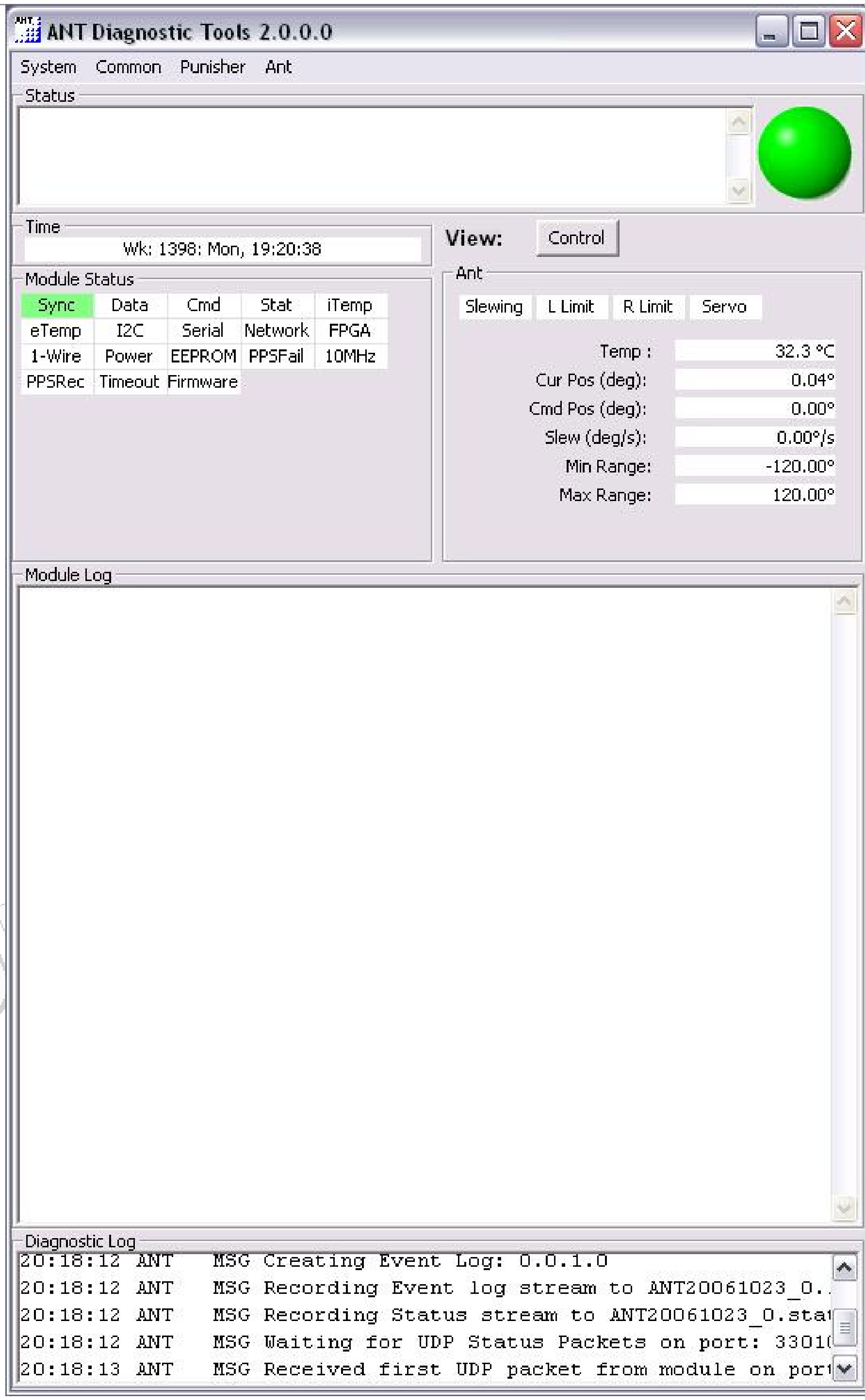

Figure 12: ANTDiag

7.1.2.1 ANTDiag status bits

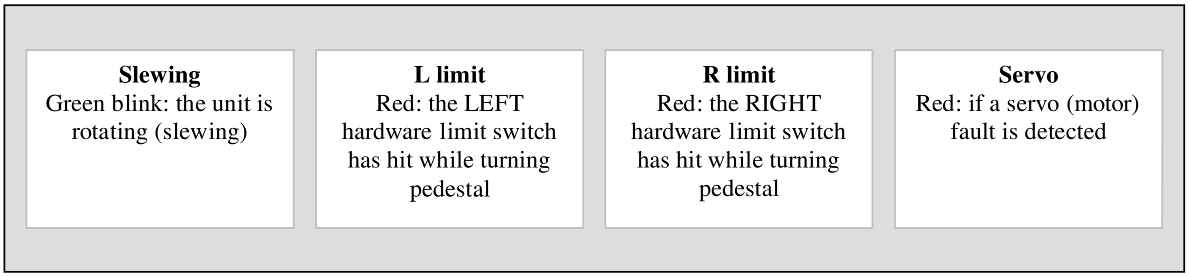

Figure 13: ANT status bits

7.1.2.2 ANTDiag status values

Name	Description
Temp	Current module Temperature
Cur Pos	Current Antenna position (in degrees)
Cmd Pos	Commanded Antenna position (in degrees).
Slew	Current slew rate (angular velocity) (deg / s)
Min Range	Minimum Range of antenna. Commands to move outside this value will result in an error
Max Range	Maximum Range of antenna. Commands to move outside this value will result in an error

Table 3: ANTDiag status values

7.1.2.3 ANTDiag Commands

Name	Description
Ant-> Reset Home	**Resets the pedestal position to the home position (0 degrees)**
Ant-> Move…	**Moves the antenna *to the position entered* when prompted.**
Ant-> Start Reset Home…	Starts the antenna moving towards home without feedback from ANT module
Ant-> Start Move…	Starts the antenna moving towards the position entered at when prompted without feedback from ANT module
Ant->	Sets the (software) limits for the min/max the antennas (pedestal) will be

Set Range…	able to be rotated. NOTE: there is a hard (metal) stop as well outside of the default 120 degrees.

7.1.3 Table 4: ANTDiag commandsNAVDiag

The NAV diagnostic tools are used to provide technical communication to the IMU and GPS receiver the two devices that produce the navigation solution for the radar system.

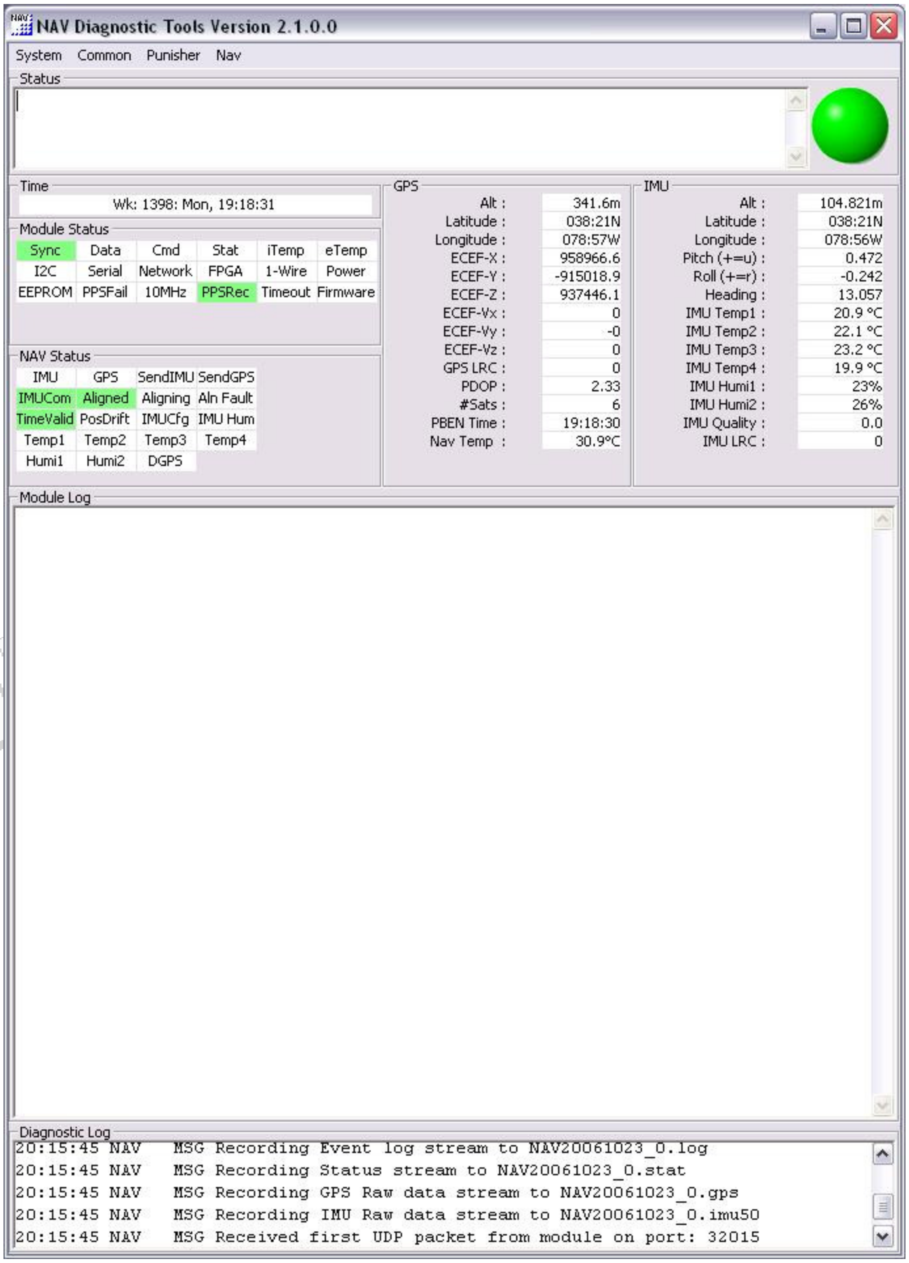

Figure 14: NAVDiag

7.1.3.1 NAVDiag status bits

IMU Red indicates there is an IMU error	**GPS** Red indicates a GPS error	**SendIMU** Green indicates IMU data is being sent	**SendGPS** Green indicates GPS data is being sent
IMUComm Red indicates there is an problem communicating to the IMU	**Aligned** Green indicates the IMU is Aligned	**Aligning** Green indicates IMU is Aligning	**Alignment fault** Red: indicates problem with a previous alignment
TimeValid Green indicates that the GPSTime being broadcast is validated and accurate	**PosDrift** Red indicates that the position difference between IMU and GPS exceeds tolerance	**IMUCfg** Red indicates there is an IMU configuration error	**IMU Hum** Red indicates there is an error reading, or an invalid humidity reading.
Temp1 Red: an invalid IMU temperature probe 1 reading.	**Temp2** Red: an invalid IMU temperature probe 2 reading	**Temp3** Red: an invalid IMU temperature probe 3 reading	**Temp4** Red: an invalid IMU temperature probe 4 reading
Humi1 Red: an invalid IMU Humidity probe 1 reading.	**Humi2** Red: an invalid IMU Humidity probe 2 reading	**DGPS** Red: fault in DGPS	

Figure 15: NAVDiag status bits

7.1.3.2 NAVDiag status values

Name	**Description**
GPS	
Alt	GPS altitude
Latitude	GPS latitude
Longitude	GPS longitude
ECEF-X	GPS Position ECEF-X
ECEF-Y	GPS Position ECEF-Y

ECEF-Z	GPS Position ECEF-Z
ECEF-Vx	GPS Velocity ECEF-X
ECEF-Vy	GPS Velocity ECEF-Y
ECEF-Vz	GPS Velocity ECEF-Z
GPS LRC	GPS Lost Record Count
PDOP	Current PDOP value
# Sats	Number of satellites being tracked
PBEN Time	Last PBEN record time
Nav Temp	Nav module temperature
IMU	
Alt	Current Altitude from IMU
Latitude	Current Latitude from IMU
Longitude	Current Longitude from IMU
Pitch	Current IMU pitch (degrees, positive nose up)
Roll	Current IMU roll (degrees positive right wing up)
Heading	Current IMU heading (degrees, 0 = North)
IMU Temp1	IMU temperature 1
IMU Temp2	IMU temperature 1
IMU Temp3	IMU temperature 1
IMU Temp4	IMU temperature 1
IMU Humi1	IMU humidity 1
IMU Humi2	IMU humidity 2
IMU Quality	IMU Alignment Quality
IMU LRC	IMU Lost Record Count

Table 5: NAVDiag status values

7.1.3.3 NAV Commands

Name	Description
NAV-> IMU ROM-> Read…	Reads the IMU configuration file (from the IMU interface box in the radome) to the destination specified when prompted
NAV-> IMU ROM-> Read…	Writes the IMU configuration file (to the IMU interface box in the radome) from the specified filed

NAV-> Align-> Align IMU	Sends command to start aligning the IMU
NAV-> Align-> Align IMU to…	Sends command to start aligning the IMU to the specified quality when prompted.
NAV-> IMU off	Issues the IMU to stop operation. It is not possible to turn back on without a power reset
NAV-> DGPS on	Turns on DGPS
NAV-> Set time to computer time	**Sets the radar time to the time currently in the MCC laptop. To be used when no GPS signal is available. Once this is done the NAVDiag should be closed.**
NAV-> Reset GPS	Resets the Ashtech GPS receiver to the factory default settings.

Table 6: NAV commands

7.1.4 WGASSDiag (XTRANSDiag)

The WGASS diagnostic tool is the manual interface to the transmitter and waveguide switching.

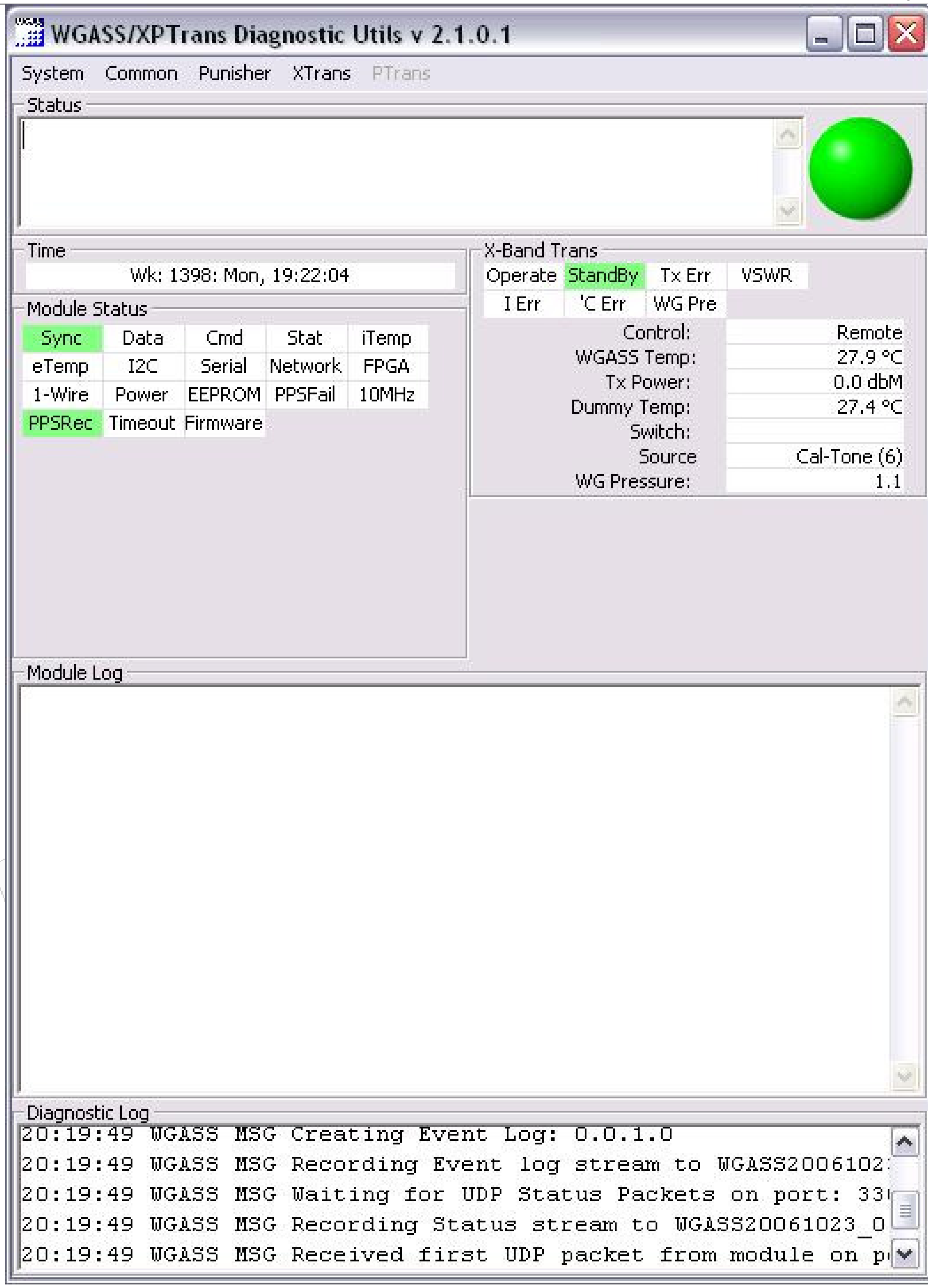

Figure 16: WGASSDiag

7.1.4.1 WGASS status bits

Operate Green: indicates the unit is in operate (on) mode	**Standby** Green: Indicates the unit is in standby (off) mode	**Tx Err** Red: indicates a transmitter fault reported by TWTA	**VSWR** Red: indicates a VSWR (high power RF reflection) fault
I Err Red: I fault	**ŌŒrr** Red: ŌC fault	**WG Pre** Red: waveguide pressure levels is beyond tolerances	

Figure 17: WGASS status bits

7.1.4.2 WGASS status values

Name	Description
Control	Current control of the TWTA. Remote(laptop)/local(front panel)
WGASS Temp	temperature of WGASS module
Tx power	Current Transmitter power
Dummy Temp	temperature of Dummy load in WGASS module
Switch	direction of waveguide RF. Dummy/Antenna
Source	signal feeding the receiver (Cal-tone, Syntar, Replica, Acquisition, Antenna reflection, Noise)
WG Pressure	current pressure of cabin waveguide runs

Table 7: WGASS status values

7.1.4.3 *WGASS commands*

Name	Description
Xtrans-> Operate-> operate (ON)	turns the transmitter to operate (ON)
Xtrans-> Operate-> operate (ON)	turns the transmitter to operate (ON)
Xtrans-> Power-> ON	Not used
Xtrans-> Power-> OFF	Not used
XTrans-> Switch waveguide-> Dummy	Switches the routing of RF waveguide power into the dummy load
XTrans-> Switch waveguide-> Dummy	Switches the routing of RF waveguide power into the antennas NOTE: this can be over-ridden by the manual switch on the front of the WGASS module
XTrans-> Switch waveguide-> Bad value	Tries to switch the waveguide to a value other than dummy or antenna. Should fail and revert to the previous mode
Xtrans-> Signal source-> Signal	Sets the signal feeding the receiver to Syntar (signal half way through transmitter), Cal-tine (simplified symbol for testing), Noise (no signal, just listening through antennas), Replica (sampled signal immediately after transmitter), Receiver (received signal), Antenna reflection (testing antennas), Bad value (software test)

Table 8: WGASS commands

7.1.5 PWRDISTDiag

The PWRDIST Diag is a simple utility for monitoring system power and atmosphere controls. It contains little to no control parameters.

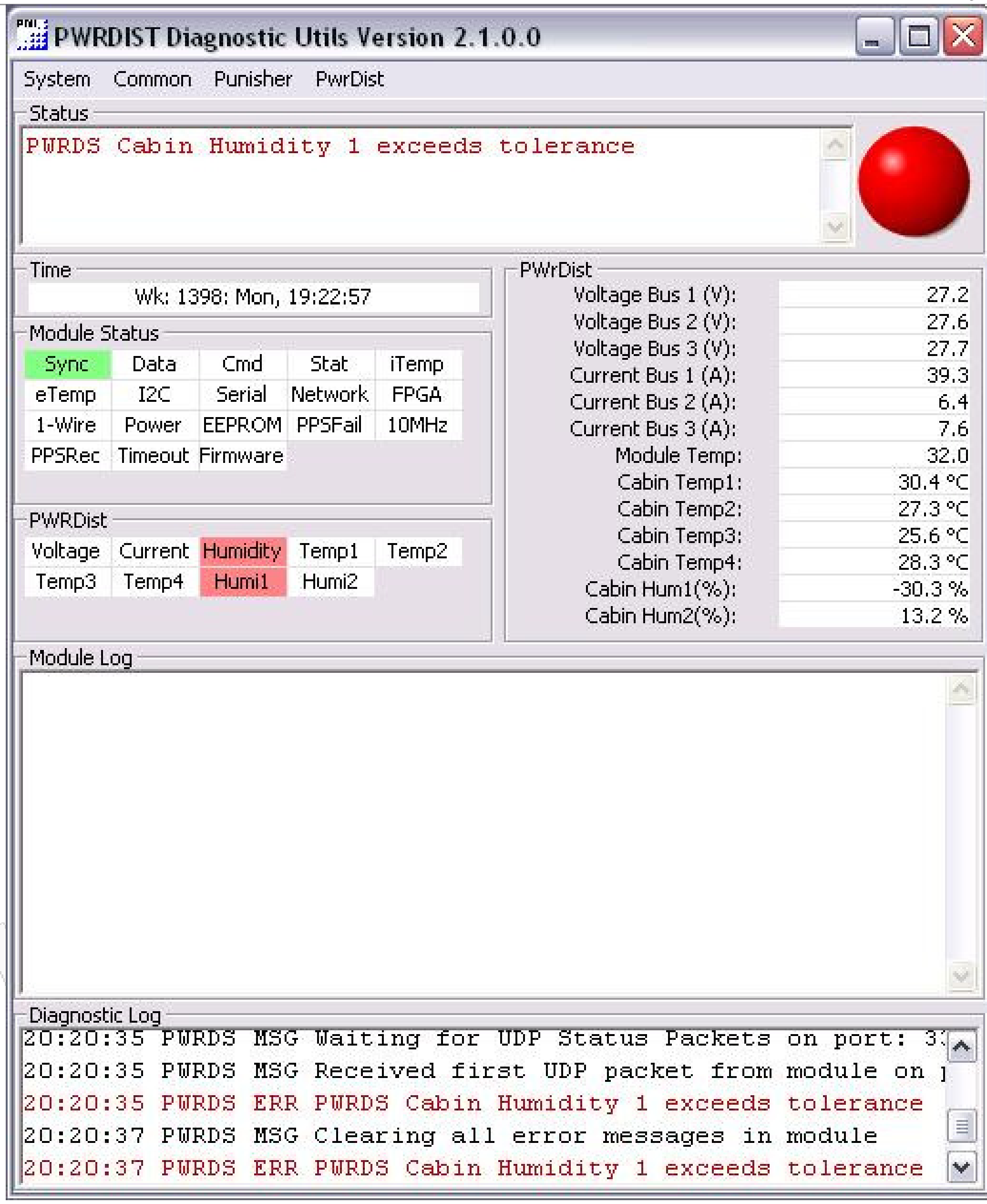

Figure 18: PWRDISTDiag

7.1.5.1 PWRDIST status bits

Voltage Red : Voltage levels of the radar system are beyond tolerances	**Current** Red: Current levels of the radar system are beyond tolerances	**Humidity** Red: Humidity levels of the radar system are beyond tolerances in one of the sensors	**Temp1** Red: temperature level of the sensor area is beyond tolerances
Temp2 Red: temperature level of the sensor area is beyond tolerances	**Temp3** Red: temperature level of the sensor area is beyond tolerances	**Temp4** Red: temperature level of the sensor area is beyond tolerances	**Humi1** Red: humidity level of the sensor area is beyond tolerances
Humi2 Red: humidity level of the sensor area is beyond tolerances			

Figure 19: PWRDIST status bits

7.1.5.2 *PWRDIST status values*

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 (%)
Cabin Hum2(%)	Cabin Humidity (%)

Table 9: PWRDIST status values

7.1.5.3 PWRDIST Commands

Name	Description
PWRDIST-> External ROM -> Read	Reads the External EEPROM (platform/cabin box)
PWRDIST-> External ROM -> Write	Writes the External EEPROM (platform/cabin box)

Table 10: PWRDIST commands

7.1.6 RCVEXDiag (RCASDiag)

The RCVEX Diagnostics control the interaction of the Pin switches, the Radar Interface Board (RIB), and all RF circuitry. Considering the complexity of this application's controls it is not recommended to use without the direct assistace of sensor support.

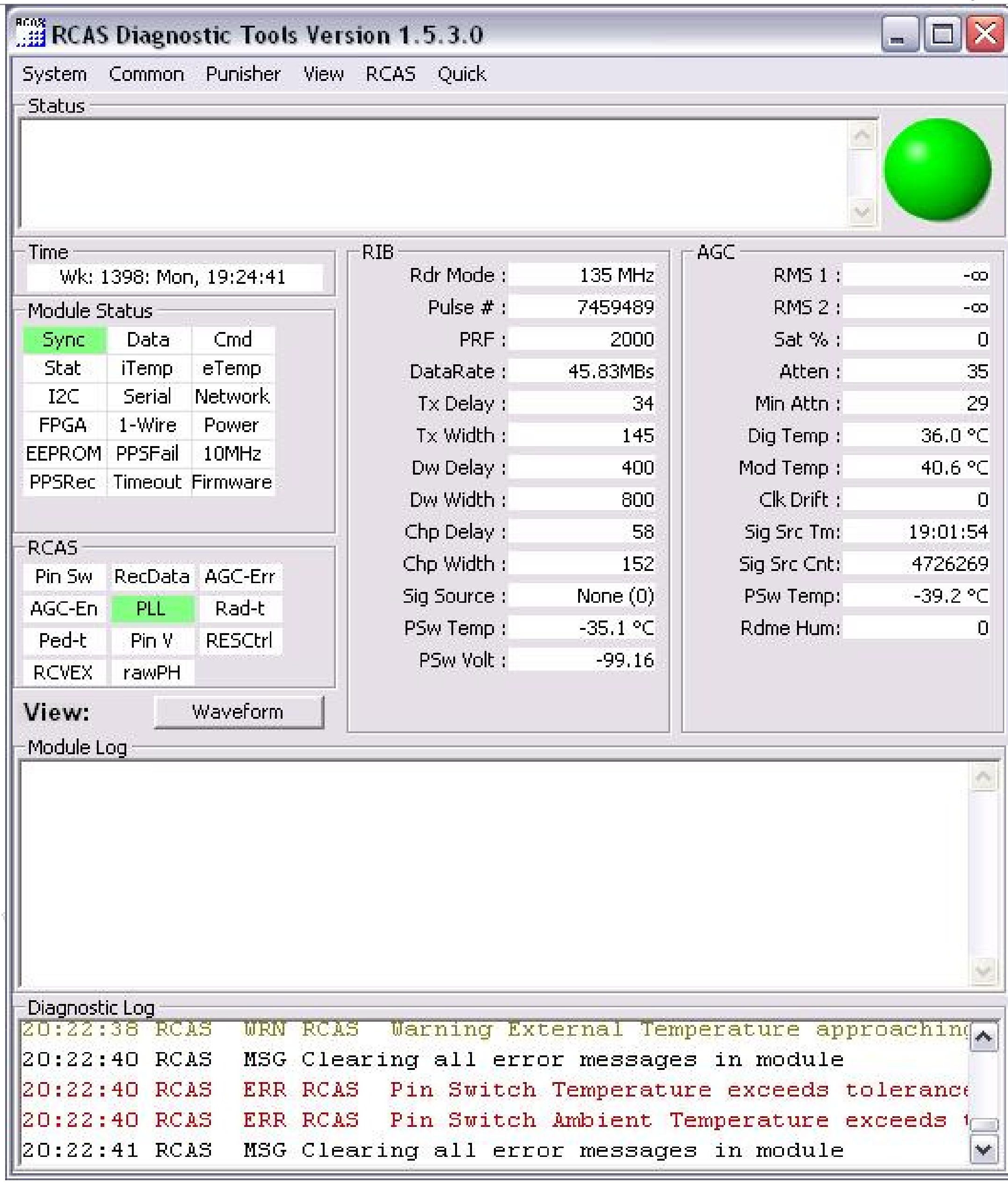

Figure 20: RCVEXDiag

7.1.6.1 <u>RCVEX status bits</u>

Pin Sw Red indicates there is an Pin switch error on any of the three units	**RecData** Red indicates the data recording is faulty	**AGC-Err** Red: indicates the automatic gain control (AGC) has failed	**AGC-En** Red: indicates the automatic gain control encoder has failed
PLL Green indicates the oscillators are phase locked looped. Red: not locked	**Rad-t** Red: the radome temperature is beyond tolerance	**Ped-t** Red: the radome temperature is beyond tolerance	**Pin V** Red: the pin switch voltage bias is beyond tolerance
RESCtrl Red: unknown	**RCVEX** Red: unknown	**rawPH** Red: the stream of raw phase data form the digitizer is faulty	

Figure 21: RCVEX status bits

7.1.6.2 RCVEX status values

Name	Description
RIB	
Rdr Mode	Current mode of radar (135MHz/270MHz)
Pulse #	# of radar pulses since started
PRF	Pulse repitsion frequency (how often radar pulses)
DataRate	Rate of data to JBODs
Tx Delay	# of 10MHz second cycles until Tx gate is set
Tx Width	# of 10MHz second cycles Tx gate is set high
Dw Delay	# of 10MHz second cycles until Data window is set
Dw Width	# of 10MHz second cycles Data window is set high
Chp Delay	# of 10MHz second cycles until Radar chirp (pulse) is sent/transmitted
Chp Width	# of 10MHz second cycles Radar chirp (pulse) is enabled
Sig Source	Indicates the current signal source
PSw Temp	Pin Switch temperature
PSw Volt	Pin Switch Voltage bias
AGC	
RMS 1	RMS video level of Near antenna
RMS 2	RMS video level of Far antenna

Sat %	Saturation percent
Atten	Current attenuation value
Min Attn	Current minimum attenuation
Dig Temp	Temperature of digitizer (A to D)
Mod Temp	Module temperature
Clk Drift	Clock drift
Sig Src Tm	Signal Source Timing
Sig Src Cnt	Signal Source Centre
PSw Temp	Pin Switch temperature
Radome Hum	Not used

Table 11: RCVEX status values

7.1.6.3 Commands

Name	**Description**
View-> Waveform	Views a sample of the RF signal transmitting
RCAS-> PRF-> get...	Reads and displays the current PRF
RCAS-> PRF-> set...	Sets the PRF to the value specified
RCAS-> Signal Source-> signal	Sets the signal feeding the receiver to Syntar (signal half way through transmitter), Cal-tine (simplified symbol for testing), Noise (no signal, just listening through antennas), Replica (sampled signal immediately after transmitter), Receiver (received signal), Antenna reflection (testing antennas), Bad value (software test)
RCAS-> Waveform-> load...	Loads the .wav file (chirp waveform) to the RCVEX from the location specified on the MCC
RCAS-> Waveform-> retrieve...	Retrieves the .wav file (chirp waveform) form the RCVEX to the location specified on the MCC
RCAS-> Radar Timing-> Edit Radar Timing...	Prompts to change values of the radar's timing parameters (Tx Delay, Tx Width, Dw Delay, Dw Width, Chp Delay, Chp Width)

RCAS-> Radar Timing-> 135-> set signal source	Set radar timing to Acquisition, Syntar, Noise, or Replica for 135MHz mode
RCAS-> Radar Timing-> 270-> set signal source	Set radar timing to Acquisition, Syntar, Noise, or Replica for 270MHz mode
RCAS-> Radar Timing-> Get Timing	Displays the current radar timing settings
RCAS-> Record-> Start/stop	Starts and stops the recording of data from the RCVEX to the JBODs
RCAS-> Record-> Tx ON/OFF	Starts and stops the Transmit gate signal that enables the RF signal into the transmitter
RCAS-> Radar mode-> 135MHz	Set radar to transmit/receive 135MHz bandwidth
RCAS-> Radar mode-> 270MHz	Set radar to transmit/receive 270MHz bandwidth
RCAS-> Radar mode-> Bad value	Set a wrong radar mode to test software response
RCAS-> Quick-> signal	Initializes the RCVEX to all setting requirements (waveform, timing, etc.) for the specified signal source.

Table 12: RVCEX commands

ABBREVIATIONS & ACRONYMS

AME	Aircraft Maintenance Engineer	PLL	Phase Locked Loop (oscillator)
ANT	Antenna Module	PWRDIST	Power Distribution Module
DTG	Distance To Go	RCVEX-RCAS	Receiver Exciter – Radar Control & Acquisition System
HTE	Height Error	RO	Radar Operator
IMU	Inertial Measurement Unit	TTG	Time To Go
JBOD	Just a Bunch Of Disks	TWTA	Travelling Wave Tube Amplifier (transmitter)
MCC	Master Control Computer	UDP	User Datagram Protocol
NAV	Navigation Module	WGASS-XTRANS	Wave Guide Assembly and X-band Transmitter
PDOP	Position Dilution Of Precision	XTE	Cross Track Error
LAN	Local area (ethernet) network	CCR	Crew change report
GUI	Graphical user interface	FL	Flight log
CSV	Comma separated variable	SAD	Situational awearness display
ECN	Engineering change notice	MFD	Muti function display

Table 13: Abbreviations and Acronyms