Cassini
Maintenance Training

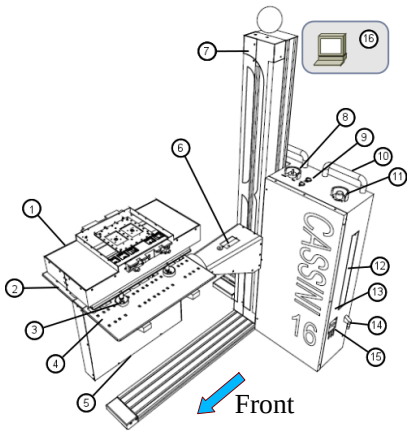
Cassini Maintenance Training

- **System Introduction**
- **Routine Care & Maintenance**
- **Troubleshooting**
- **Wrap-up and Review**

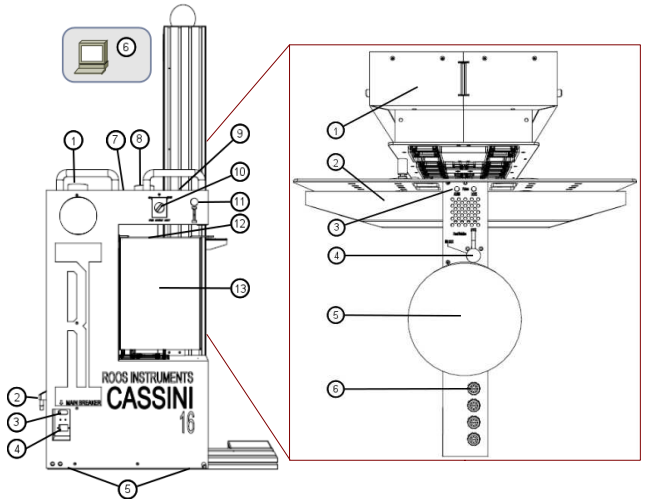
System Introduction

- Identification (Front/Back & Testhead)
- Block Diagrams (40 GHz)
- Power Supply, ON/OFF
- Emergency Off (EMO)
- Aux Rack
- Guru & System Controller Disaster Recovery
- Starting Cassini
- RIFL

Cassini 16 Front

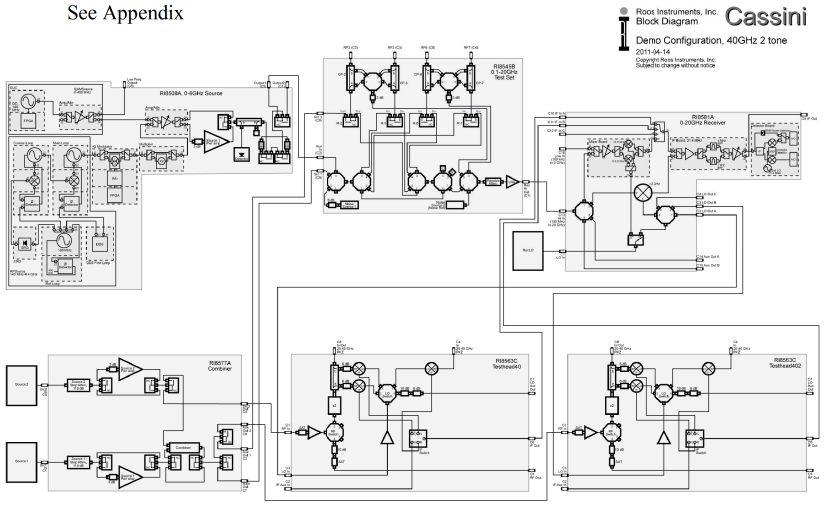


Cassini 16 Back & Testhead



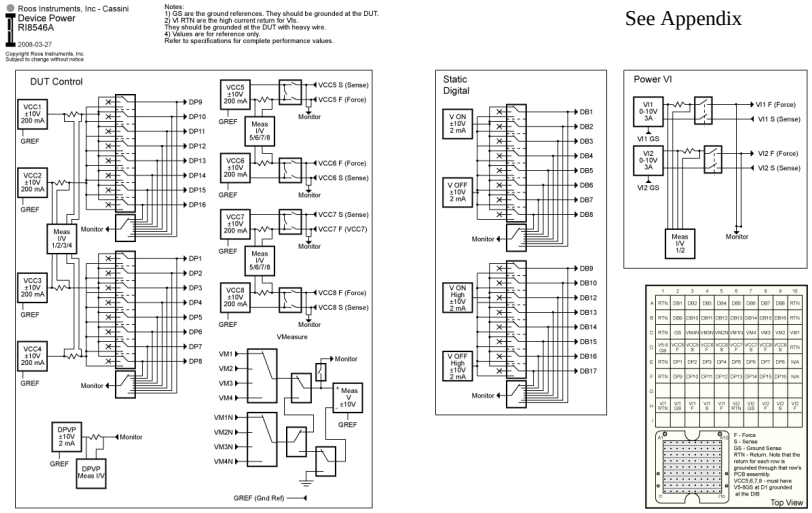
40 GHz Cassini Block Diagram

See Appendix



Cassini Device Power Diagram

See Appendix



Test System Power

- Always power down a module before working on it
  - TIMs are plug&play and can be removed without powering down the rack
  - Aux Rack sources are powered from the AC line
  - System Controller should be “Shut Down” via software prior to removal (watch for “blink animation”)
  - Always switch off Test Head +48V breaker switch on side of rack before opening Testhead (note: also powers down system controller)
- You don’t need to power down the entire test system.
- Remember the RIFL cable has power too (+48VDC)

Note: You do not need to shut down the entire test system for most service.

Internal Breaker

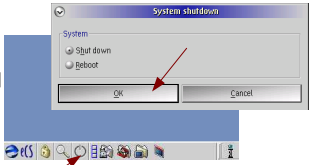
- Test Head
  - Internal Test Head RIFL hubs
  - System Controller
- TIM Front – 8 TIMs farthest from the tower
- TIM Rear – 8 TIMs closest to the tower

System Power

Cassini 16, Front Cover Removed

Side Cover Removed

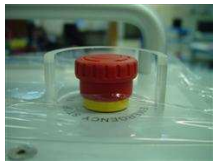
Entire System Shut-down



- Shut-down the System Controller
  - Shut-down the operating system
- System Power
  - Turn the switch to OFF
  - Note that the power supply's startup circuit is still active.
- Main Breaker
  - Shuts off AC at the mains line

Emergency Off (EMO)

- Shuts off the entire tester in an emergency
  - To shut off the tester, press the button.
  - To re-start the tester, twist the button until it pops back out, then turn the System Power switch to 'Start'.

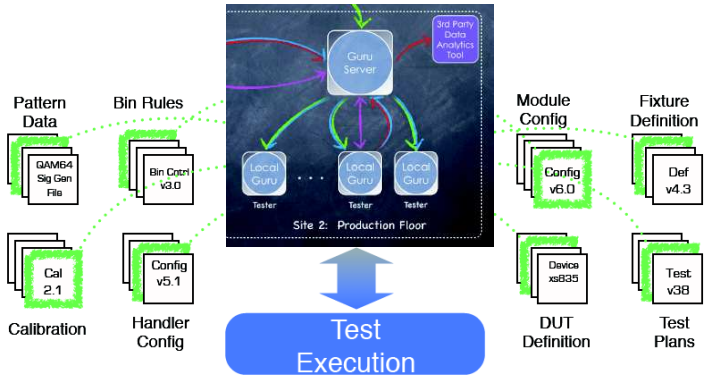


Aux Rack Shut Down/Turn On

- The Aux Rack is powered separately from the main tester
- The circuit breaker is also the EMO

A Note About Guru

- Automatic Backup and Version Control



Guru Reliability

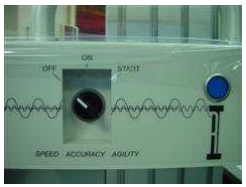
- All guru objects are tamper proof, hash verified and secure (no accidental overwrites)
- Complete validation and backups
- All programs are copied fresh and unzipped prior to execution (fresh)
- Latest version of every object retrieved instantly from Update Guru (no old versions)
- All versions (every save) is stored and backed up to Backup Guru, only removed by expiration policy. (never lose anything)

System Disaster Recovery

- If System Controller Fails, only data currently in RAM is lost, all saved guru objects (including test data) are always copied to the Backup Guru Server
- FAST & EASY – Factory replaced with ID already loaded, setup network and OS settings
- Login with “DefaultUser”, “Roos” and update Guru Address Book to point to Update/Backup Guru, Restart and GO!
  If available, Guru Server auto-discovery and GO!
- Optional, use System | Syncronize used to restore the latest version of all guru objects owned by the GuruID

Entire System Turn On

- Main Breaker is on.
- MO button is deactivated (popped out).
- Breakers on the side of the rack are on.
- FIXTURE SHOULD NOT BE ATTACHED
- Turn the front panel switch to 'On', then momentarily turn it to 'Start'.



Starting the Tester's Image

- The test system software (image) is a Guru object
- After the System Controller has booted, Login and Select 'Shortcuts' & choose the appropriate Shortcut
- The test system will startup
  - First it loads and compiles patches as defined by the Shortcut
  - Then it finds the hardware and identifies instruments
  - Then it assigns symbolic names to the instruments (for example, 'source1') from the tester definition

A Note About RIFL

- Contains:
  - 10 MHz reference to which everything is synchronized
    - System time base is in the RIFL master in the System Controller
  - +48VDC to power some modules
    - If it doesn't have a plug, it's powered from the RIFL
  - Serial data lines

RIFL II looks like a network cable
BUT ITS'NOT!

- If you plug it into a network hub, smoke results.
- RIFL cables must be RF shielded, most network cables are not.

RIFL II (shielded RJ45)

RIFL III (Round)

RIFL:
Roos Instruments
Fast Link

Cassini Maintenance Training

- System Introduction
- **Routine Care & Maintenance**
- Troubleshooting
- Wrap-up and Review

Routine Care & Maintenance

- Daily, Periodic and Annual PMC Procedure
- Basic Care with PKZ, Coax
- Service Plans
- Transient Instruments & Cak Kits
- Calibration Process
- Inspecting & Special Cal Buttons
- Diagnostic Testplan Review

Regular (Daily) Maintenance

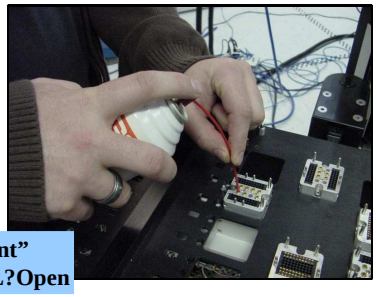
- Inspect Socket and Load Board
- If changing Fixtures, inspect all RF and DC connections between Fixture and TIMs
- Inspect Docking Hardware (wear)
- Check Handler POD RIFL cable (no kinks, damages)
- Clean with 90%+ Isopropyl Alcohol & Dry Compressed Air to remove desbris

Preventive Maintenance Procedure

- Inspect and clean all connectors
- Inspect all cables and connections in the rack
- Clean connectors if required
- Clean air filters if required (always turn off each instrument before servicing an air filter)
- Run diagnostics and verifies

A Note about Cleaning PKZ Connectors

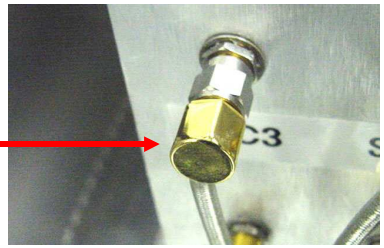
- Spray an appropriate cleaner into the connector
- Dry with clean dry air or CO2



See "Cassini Fixture Care and Maint" http://roos.com/docs/RBES-84B49L?Open

Handling coax cables

- Always turn the coupling nut, do not spin the center conductor
- Do not twist the cable
- On rear panel cables, do not try to put a wrench on the gold trim cap



Access to Service Plans

- Virtually all service activity is performed through the system's 'Configuration' window
  - To open the configuration window, from the Cassini application window, select the 'System' button, then 'Tester'
- If you don't know what it does, DON'T TOUCH IT.

Types of Service Plans

- Calibrate
  - Changes cal factors
  - Don't run if you don't know what you're doing
- Validate
  - Validates that the cal ran properly
  - Only valid immediately after cal
- Verify
  - Verifies that a calibrated system is working
  - Run any time
- Diagnose
  - Verifies that Hardware is working
  - Theoretically does not require calibration

Periodic & Yearly PMC Sched.

- Calibration at 1 year intervals
  - Includes diagnose/verify
- Diagnose/Verify as required
  - Some customers perform at 1 month intervals
  - Some customers perform only if a problem is noted (recommended)

Activating a Cal Fixture

- Cal fixtures should activate automatically when a 'System' 'Check' is performed
- To activate manually, from the system's 'Configuration' window, select 'Instrument' 'Add Fixture Def'
- If another fixture is active, the system cals will be wrong, because of that fixture's cal data.
  - Cals are just test plans with a couple of special buttons for resetting/saving the cal data.
  - A DUT interface can also affect the cal if the DUT interface contains cal data.

Transient Instruments

- Instruments such as Power Meter and Cal Kit are "transient" (meaning they are not always connected to the system)
- Transient instruments are listed in the system's Configuration window
- Always remove a transient instrument before disconnecting
  - To remove any instrument, Right click on the instrument in the system's Configuration, then "Remove"

Activating a Transient Instrument

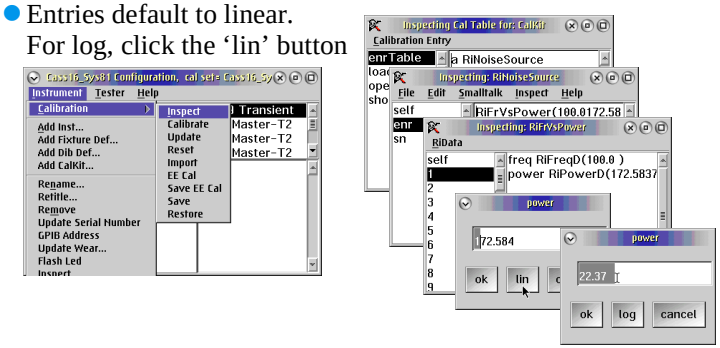
- Activating a Transient Instrument is done in the Configuration Window
- Select "Instrument" "Add Inst"
  - The tester will ask you for a name. Generally, accept the default name.
  - For GPIB instruments, the tester will ask for a GPIB address.
    - Roos always puts power meters at address 5.
- Although the cal kit is considered an instrument, it is activated differently

A Note About Cal Kit Maintenance

- Cal Kit:
  - DMM: Standard for DC (Voltage & Current)
  - Power Meter: Standard for RF Power
  - Open/Short/Load (OSL): Standard for RF impedance
  - Noise Standard: Standard for Noise Figure
  - Cal/Diag/Engineering Fixture
- Cal kit components **must be calibrated**
  - Power meter and DMM: 1 year
  - OSL and Noise standard: 2 years

Updating a Cal Kit Definition

- After calibration, cal kit coefficients may need to be changed
  - Configuration window, ‘Instrument’ ‘Calibration’ ‘Inspect’
  - Double-click the appropriate element.
  - Entries default to linear.
    For log, click the ‘lin’ button



Verify that the System Knows the Cal Kit Definition

- The system must have the proper Cal Kit definition
- Coefficients are stored in the Cal Kit definition
  - OSL coefficients, particularly the open's fringing capacitance
  - Noise standard's ENR table
- Cal kits are activated thru the Configuration window
  - “Instrument...” “Add CalKit”

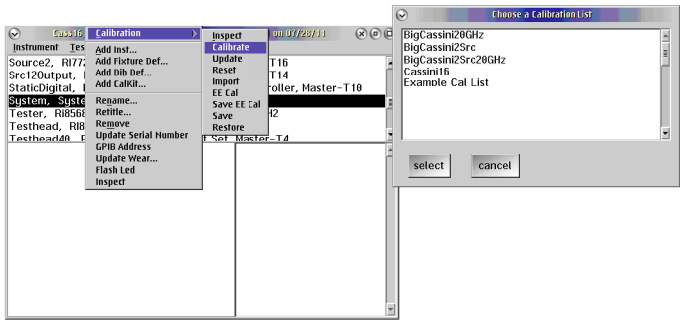
Calibration Process Overview

- Open the appropriate cal list from the configuration window
- Activate the appropriate instruments (cal kit and power meter) and activate a cal fixture definition.
- Perform Diagnostics
- Calibrate the test system
- Perform Diagnostics again

- Notes:
  - Calibration requires User in Maintenance Group
  - Cals should be run a few at a time
  - Remember, you have the power to damage the test system!!

Opening a Calibration Executive

- From the Configuration window
  - ‘System’ Calibration Calibrate
  - Choose the cal list



A Note About RF Cals

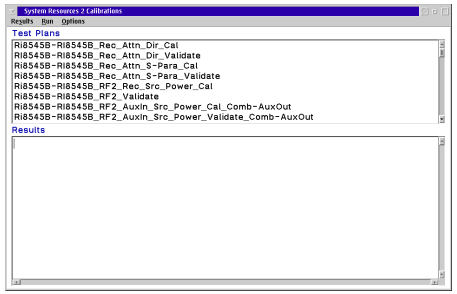
- DC and Analog are 'self contained'. There is no interaction with other TIMs
- RF interacts due to mismatch ripple and cable length
  - Individual TIMs are calibrated one time, at the factory
  - The 'testhead' cals serve as 'RF System' cals
    - Compensate for TIM-TIM interaction
    - Some cals can be affected if a source, combiner, or receiver is changed.

Show All Results

- 'Options' 'Show All Results'
- Always select "show all results" when taking data to send to RI

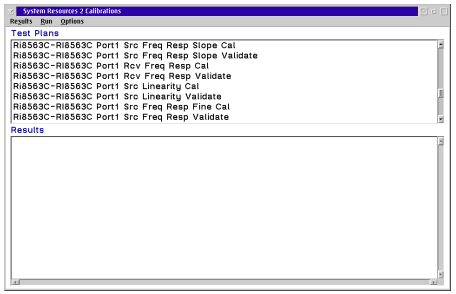
Cal Plan Summary

- DC Cals
  - Vmeasure
  - VCC
  - Parametric Meas/Supply
  - VI
  - Static Digital
- Waveform Cals
  - Digitizer (Oscilloscope)
  - Waveform Generator
  - Sinegen
- RF cals
  - Receive Attenuator
  - RF paths
  - EA (Error Adapter)
  - Direct Receive
  - Noise Cals
    - Receive
    - Source



40 GHz Cal Plan Summary

- Source Slope
  - Gets source close at one power
  - 'Iterative' cal, may need to be repeated
- Port 1 Rec Freq Response
- Source Linearity
- Source Freq Response
- EA Error Adapter)
- Port 2 Rec Freq Response



Inspecting Cal Data

- ‘System’ Button ‘Tester’
  Select desired instrument
  ‘Instrument’ ‘Calibration’ ‘Inspect’
- View data tabular or graph
- Never edit cal data unless specifically Instructed by RI
  - You can get the test system into a state where it won’t even start up

Special Calibration Buttons

- Special buttons
  - Reset cal factors
  - Write to cal factors
  - Perform special calculations for calibration
- Not available through normal editor
- Do not copy or modify special buttons

Diagnostic Plans

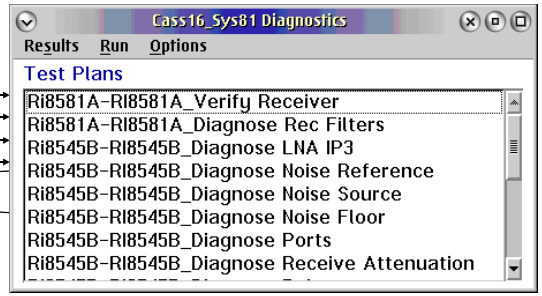
Checks the noise source and the noise receive path. Note that these can fail if receive path has too much loss

Checks the internal noise reference

Measures receive path IP3. Note: Most failures on this test are, in fact, path loss problems, not IP3 problems

Checks the bandwidth and rejection of filters in the receiver

Checks the receiver's detectors and IF gains

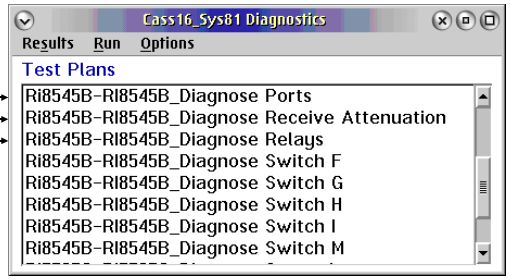


Diagnostic Plans

Checks source/receive RF relays in test head (11, 12, 21, 22)

Checks the receive attenuator’s relative attenuation (receive attenuator is in the test head.)

Checks that signal is getting to the ports and that they are a good match

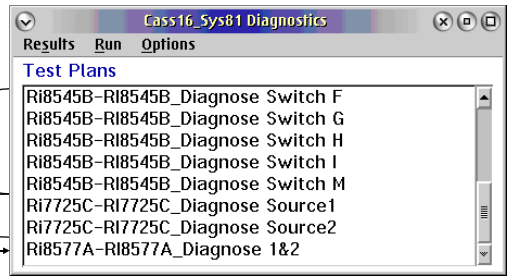


Diagnostic Plans

Checks the source1/2 combiner's switches and attenuators

Checks the sources produce RF properly

Checks the coaxial switches in the test head for through loss and match



Cassini Maintenance Training

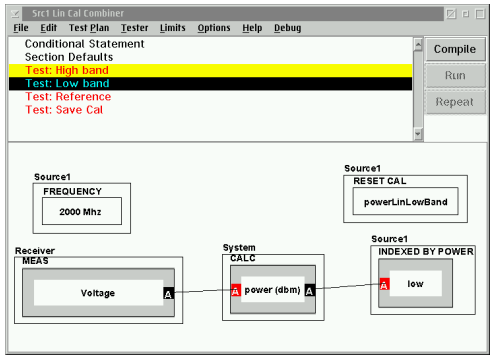
- System Introduction
- Routine Care & Maintenance
- **Troubleshooting**
- Wrap-up and Review

Troubleshooting

- Breakpoints & Control
- Limits, Graphs
- Disabling Tests
- Basic, Normal Troubleshooting Tree
- Common Senario (Example)
- Source Basics, Block Diagram
- Common Source Failures
- Troubleshooting Hints
- Find Phase Lock Errors with Averaging

Test Plans - Setting Break Points

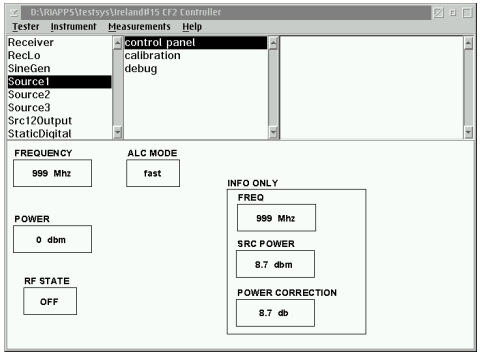
- 'Options'
  'Set Break Point'
  - Changes color at the break point
  - Can only break on a test, not on defaults etc.
  - Test plan will stop after setting up the hardware and taking the measurements
  - Breakpoint stops after the post-measure
  - Only 1 break point per test plan
  - You can continue, single-step, abort, or open the control panel



Note: Do not do a system start-up or check while at a break point

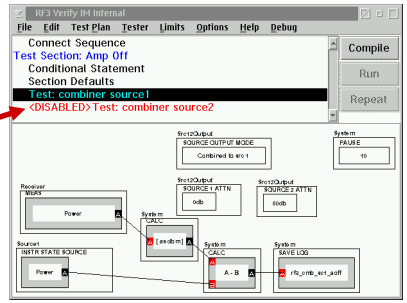
Test Plans - Control Panel

- ‘Options’ ‘Control’
  or
  From Breakpoint
  - If reached from a breakpoint, reflects the settings at the breakpoint. Remember that the testhead is ‘hot’ at this point.
  - Manually control system instruments



Disabling Parts of Tests

- Disable parts of tests to increase speed or decrease confusion
- Programmer message window will always say ‘Fail’ if any test or test section is disabled
- ‘Edit’ ‘Disable/Enable’
  ‘Selected’
  or
  ‘Disable All’
  then re-enable selected



Aborting a Test Plan

- Validate, Verify, Diagnose can be aborted if necessary
  - ‘Ctrl’ ‘Break’
  - System will show a walkback error. Select ‘Abort’
  - From Cassini's ‘System’ menu, select ‘Reset’
    - Always do a system reset after aborting a test plan
  - If a plan is to be re-run, select ‘Debug’ ‘Clear Compile’
- Cals can be aborted, but only if absolutely needed
  - Cal data will be invalid

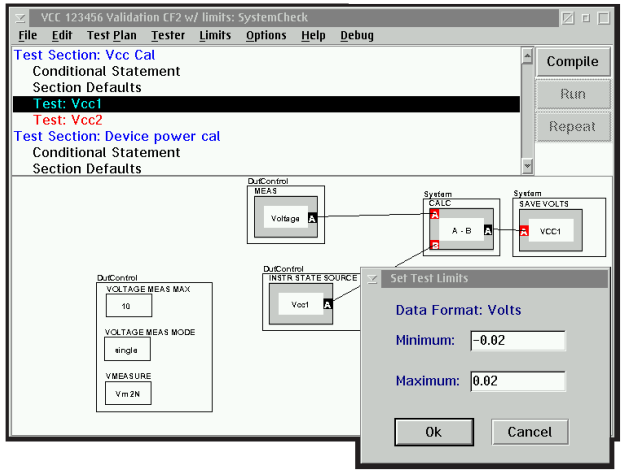
Note: If a validate fails, the cal data is not saved. It can be manually saved by RMBC on the appropriate instrument and selecting ‘Save’.

Test Plans - Finding Limits

- Limits are helpful for seeing how close the instrument is to failing.
- Limits are set on data save buttons
- To check limits:
  - ‘Limits’ ‘Select’ ‘SystemCheck’
    - All limits for cal/service plans are called SystemCheck

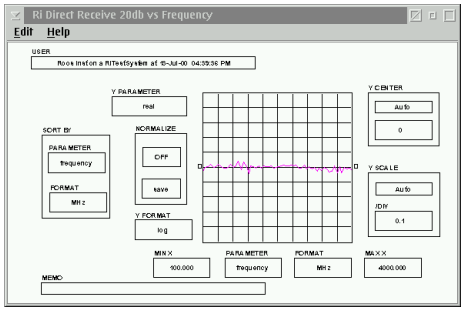
    RMBC on data save button
    ‘Single Value Limit’ (same as customer test plans)
- NEVER CHANGE A SERVICE TEST PLAN!!!

Test Plans - Finding Limits



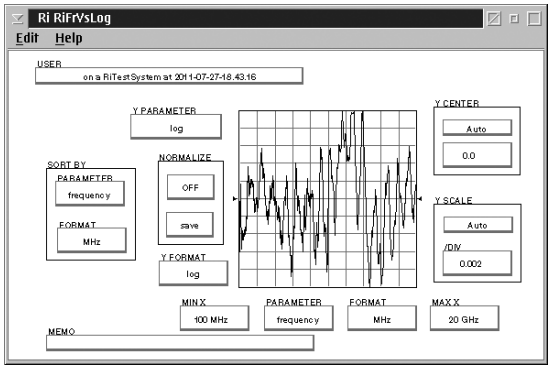
Test Plans - Viewing Data as Graphs

- Left click on Data Save or Local Variable button
- Select graph type
  - Rectangular for arrayed data (freq. Response data, etc.)
    - Moving strip chart for CW data
      - Moving strip chart can handle up to 500 measurements
- If local variable, will need to format graph
  - Sort by 'Index', X value sort by 'Index'



Test Plans - Viewing Data as Graphs

- Does this graph show good data or bad data?



Troubleshooting Basics

1. Is the problem in the source path or receive path?
2. Does the problem
   1. Change with respect to frequency?
   2. Change with respect to power?
3. Murphy's corollary: There is always more than one problem
4. One problem can cause multiple failures
   1. Be sure you're looking for the right problem
   2. Usually run all diagnostics

‘Normal’ Troubleshooting Tree

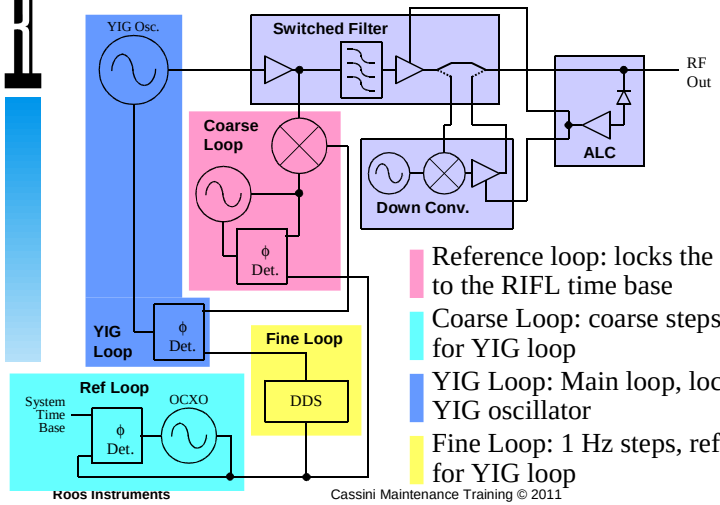
- Run Diagnostics (all of them)
- Review failed data
- Look for patterns (only 1 port, direct receive path, etc.)
- Pull up test plan
- Re-name to ‘Junk’
- Set breakpoint
- Run to breakpoint
- Open Controller
- Manipulate settings through controller
- Begin ‘halving’ signal path
- Isolate bad component

Common Scenario

- During Cal, a validate fails
- You troubleshoot the problem to a bad switch
- You replace the switch
- You run diagnostics, and now diagnostics fail

- What’s wrong?

Source Block Diagram



- Reference loop: locks the source to the RIFL time base
- Coarse Loop: coarse steps, L.O. for YIG loop
- YIG Loop: Main loop, locks YIG oscillator
- Fine Loop: 1 Hz steps, reference for YIG loop

Source Common Failures

1. A3, reference loop
   - Certain vintages
   - Time base ‘shifts’ after 1-3 years
2. Down Converter
   - Dead
   - Phase lock (frequency accuracy) problems
   - ALC (power control) problems

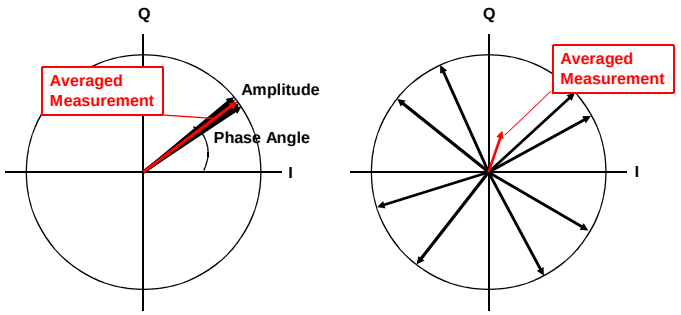
Source Basics

- Startup Source Tests
  - Check all loops
  - Check ALC range
  - Single frequency test
- Self Test (Control Panel)
  - Check all loops
  - Check ALC range
  - Multiple frequency test

Source Troubleshooting Hints

- Problem only below 2 GHz
  - Likely down converter
- Different averages can help diagnose lock problems
- Power meter can eliminate confusion from receiver issues (remember Murphy's corollary)
- Power correct can be turned off (but not all corrections are removed)

Why Averaging can Find Phase Lock Errors



Effect of averaging on a phase locked (synchronous) signal

Effect of averaging on a non-phase locked (asynchronous) signal

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- System Introduction
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- **Wrap-up and Review**

Wrap-up and Review

- Exchanging TIMs
- Sending Data to RI
- Guru Object Class Definitions
- How to Get Information
- How to Get Help from RI

Exchanging TIMs

- TIMs can be hot-swapped (DO NOT power down the system)
- Pull top to prepare, hold tight and pull bottom to release TIM
- Get RMA from support@roos.com
- Ship in double box
  - Inner origional package (carboard & plastic)
  - Outer Package (at least 26" x 20" x 8")
  - At least 3” of packing material on all sides

Sending Data to Roos

- Often we can be of more help if we can see the test data or the calibration data.
- To send the cal data, use Guru Browser to export a “.gzp” (Guru Export) of the instrument's cal data.
- Filter Guru Objects with the following keys:
  - ri.sys.ObjClass = RiInstrumentCal
  - ri.hw.Model = <Instrument Model Number>
  - Right click, select “export” Guru Format
- To send results from Diag testplans, use “Results | Save to Guru” and export “RiEquipDiagLog” object class.
- Or the results can be saved as text (.txt) file.

Important Tester Guru Object Classes

- RiBaseInstDef – Instrument Feature Definitions
- RiCalibrationKit – Calibration Offsets
- RiCalList – Calibration Test Plans
- RiEquipDiagLog – Diagnostic Logs
- RiFixtureDef – Fixture Definitions
- RiFixtureCal – Fixture Calibrations
- RiInstrumentDef – Instrument System Drivers
- RiInstrumentCal – Instrument Calibrations
- RiPatch – Cassini System Software Update
- RiShortcut – Cassini System Software Management
- RiTesterDef – Cassini Instrument Collection Definition
- RiTestplan - Testplan

How to Obtain More Info

- Roos Instruments Web Site
  - Wealth of Support and Applications information
  - www.roos.com
  - 'Customers Only' for the good stuff.
  - Log-in required (register online)

How to Get Help from RI

- Roos Instruments
  - +1 408-748-8589
    Mon-Fri: 8-7pm PST (-8 GMT)
- Service contracts offer phone/email support and fast turn-around for parts
  - Check for the local support phone number
- Email: support@roos.com
  - Routes the email to several support people so it never gets missed.

Cassini Maintenance Training

- **Questions?**
- **Hands On**