International Flight Inspection Symposium
Oklahoma City, OK USA June 2008

Routine ILS Flight Inspections Conducted From a Remote Location

Mr Leslie E Atkinson
Air Force Materiel Command (AFMC)

History

- Centralized Navigational Aids (NAVAIDS) maintenance began as a standard ILS equipment modernization in 2002
- AFMC leadership decided to exploit the remote maintenance capability of the new system in early 2003
- AFMC established the Customer Support Team (CST) as a centralized maintenance facility

History

- The CST maintains the following NAVAIDS at 7 airfields:
  - 11 Category I Instrument Landing Systems and 2 localizer-only systems
  - 5 Tactical Air Navigation (TACAN) systems
  - 1 Very High Frequency Omnirange (VOR)
  - 1 Distance Measuring Equipment (DME)
- Current CST manning is 4 technicians, 1 supervisor, and 1 work group manager

History

- All NAVAIDS systems are under a 15-year parts warranty
- Maintenance and certification activities conducted within a $90K annual budget
- Availability rates exceed 99.6% across the fleet (All single transmitter systems)
- Mean time to repair statistics
  - 15 minutes when no part is required
  - 26 hours when part is required

History

- Centralized ILS Maintenance must address Periodic-with-Monitors flight inspections
- Traveling to perform routine flight inspections defeats the concept
- Procedures, hardware, and software developed to conduct periodic-with-monitors checks currently required in the US Standard Flight Inspection Manual

Software Controls

- All Localizer and Null Reference Glideslope (NRGS) checks/adjustments completed with software controls only
- Some checks and adjustments on Capture Effect (CEGS) and Sideband Reference Glideslopes (SBRGS) are also completed via software controls
- Process begins when the CST initiates a remote maintenance session

Remote Maintenance Session

- Technician contacts Remote Control and Status Unit (RCSU) utilizing the Portable Maintenance Data Terminal (PMDT) program
- RCSU provides:
  - Status to the Remote Status Display Unit (RSDU) in the ATC Operations area
  - Access to the Navigation Aids Remote Maintenance System (RMS) via status lines

Security

- Protocols and Levels:
  - USAF Telephone system that blocks unauthorized modem access
  - Positive control of site dial-in modem numbers
  - RCSU/RMS will only communicate with current PMDT version
    - Software positively controlled

Security

- Protocols and Levels Continued:
  - User Names and Passwords assigned to technicians
    - Highest level required to affect signal-in-space
    - Follow USAF rules for complexity
    - Changed periodically, when employees depart, and when compromises are suspected
  - Passwords and User Names encrypted with a special, proprietary protocol when transmitted

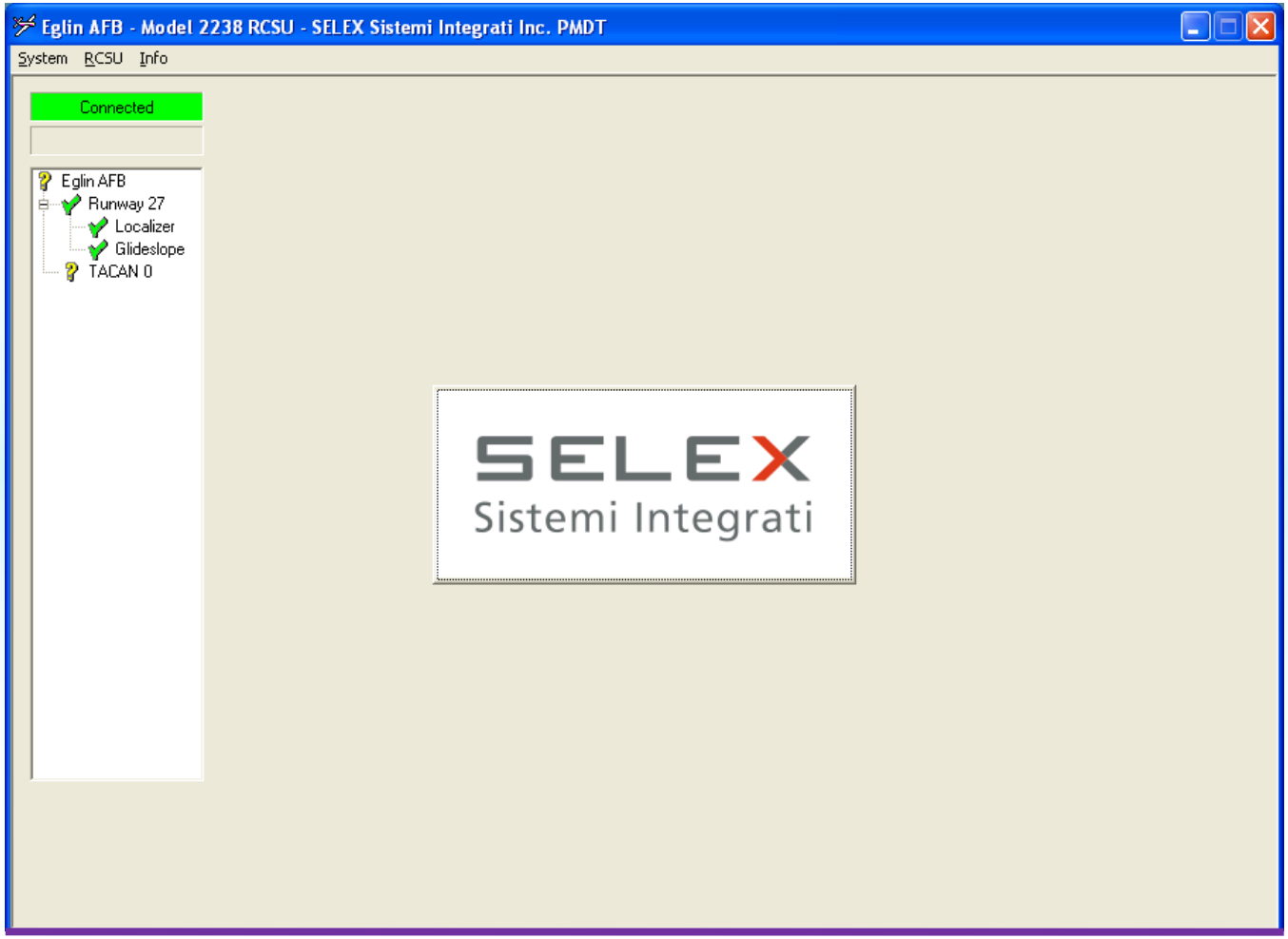
Security

- To affect signal-in-space, the technician must take control of the system
  - Immediate off-air status provided to ATC Operations
  - System removed from service
  - CST notified to begin investigation
- Connection logs are periodically screened to detect unauthorized incursions, none have been detected to date

Remote Maintenance Session

- Upon completion of secure login procedure:
  - Technician right-clicks on desired site
  - PMDT connects to site RMS
  - Pre-flight inspection checks are completed
- Technician can also connect to site directly if there is a line or RCSU failure
  - RCSU connection preferred due to greater transition speed

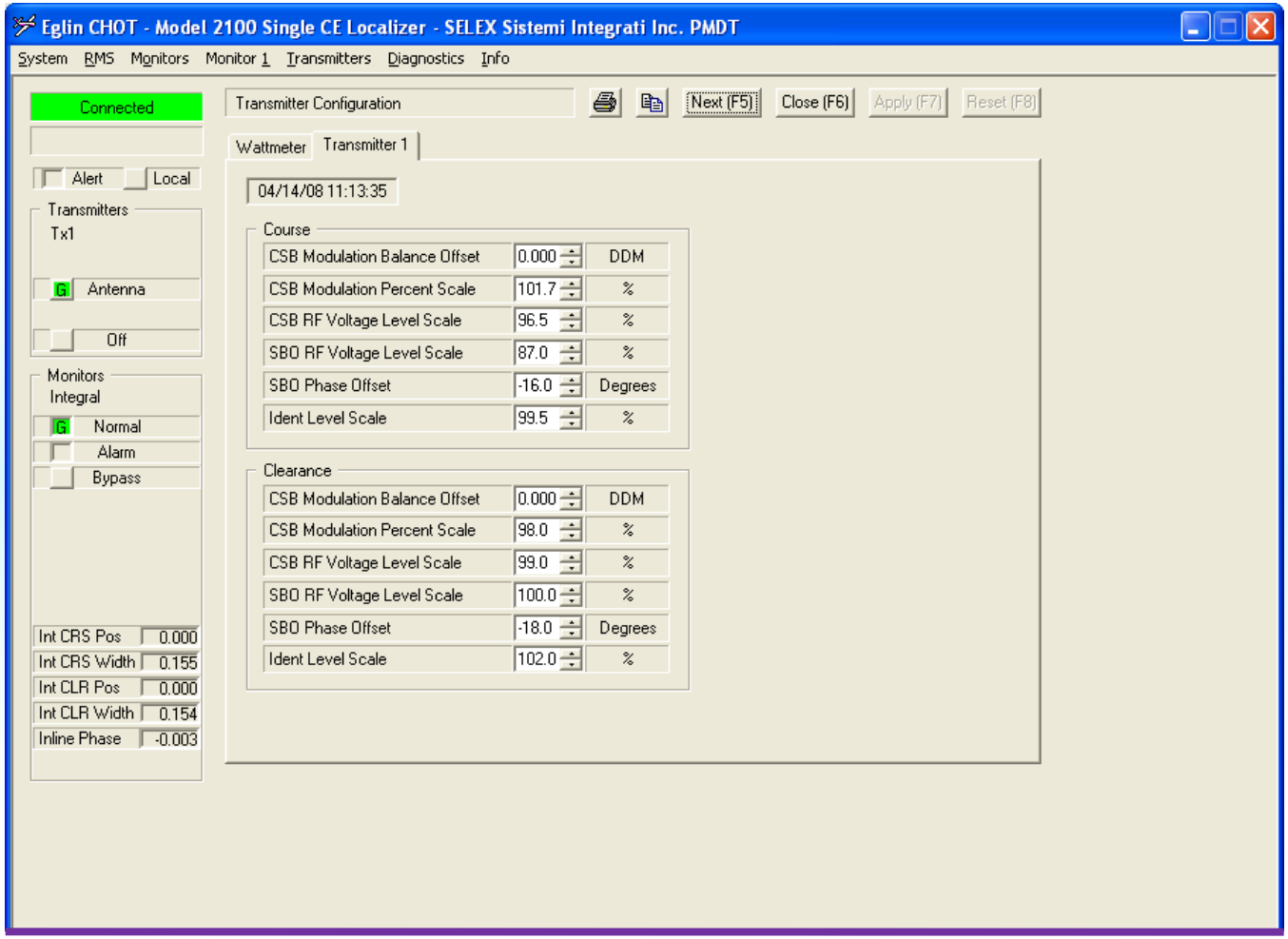
RCSU System Display



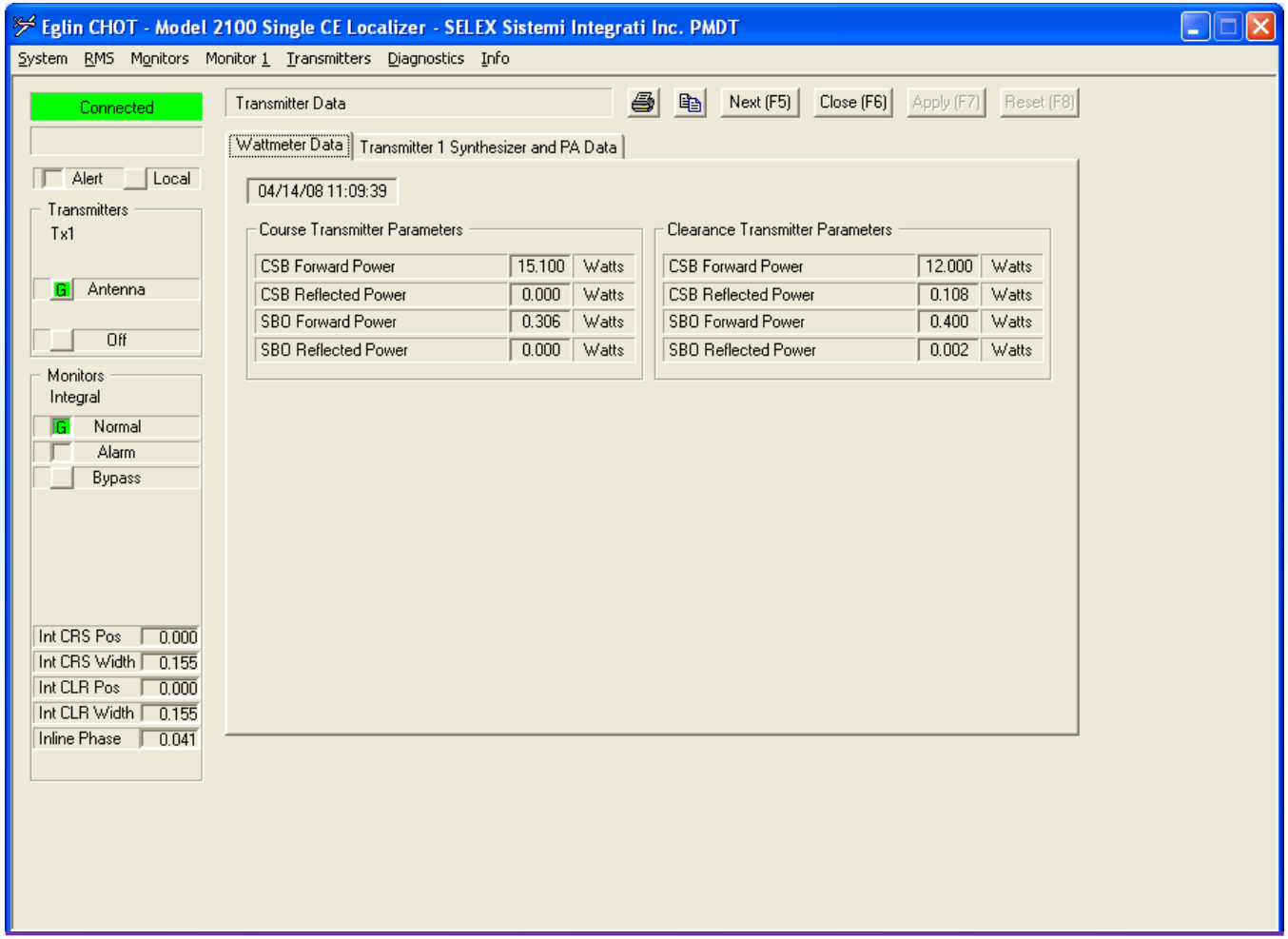
Localizer Flight Inspection

- Normal Alignment , Modulation, and Identity Modulation are adjusted using the PMDT Transmitter Configuration screen
- Normal Width is adjusted using the Transmitter Configuration screen in conjunction with the Wattmeter Data screen

Transmitter Configuration



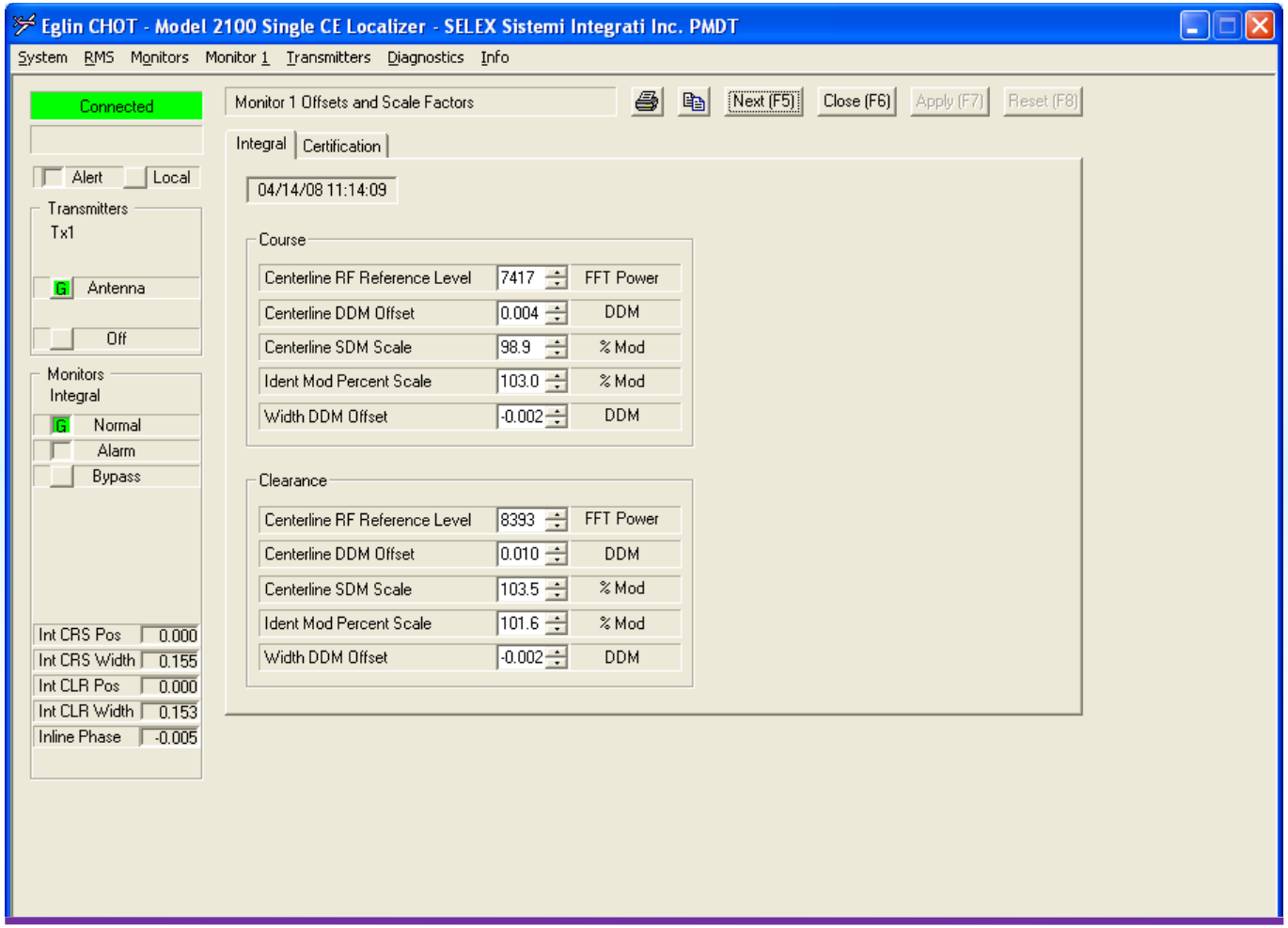
Wattmeter Data



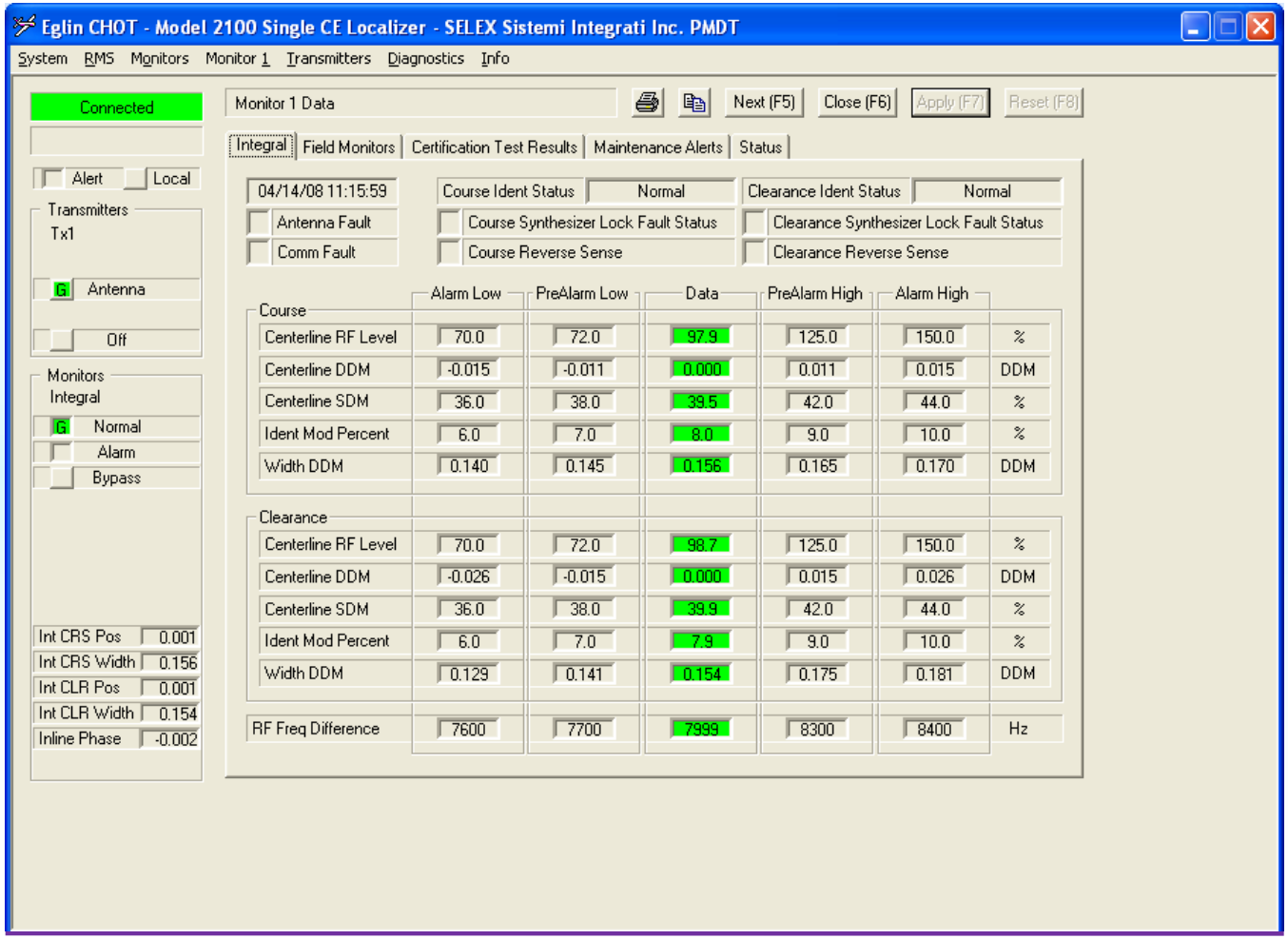
Localizer Flight Inspection

- If normal width, alignment, modulation, or identity modulation adjustments were required, it may be necessary to offset the monitors prior to starting the alarm checks
- This task is accomplished using the Monitor Offsets and Scale Factors screen in conjunction with the Monitor Integral Data screen

Monitor Offsets & Scale Factors



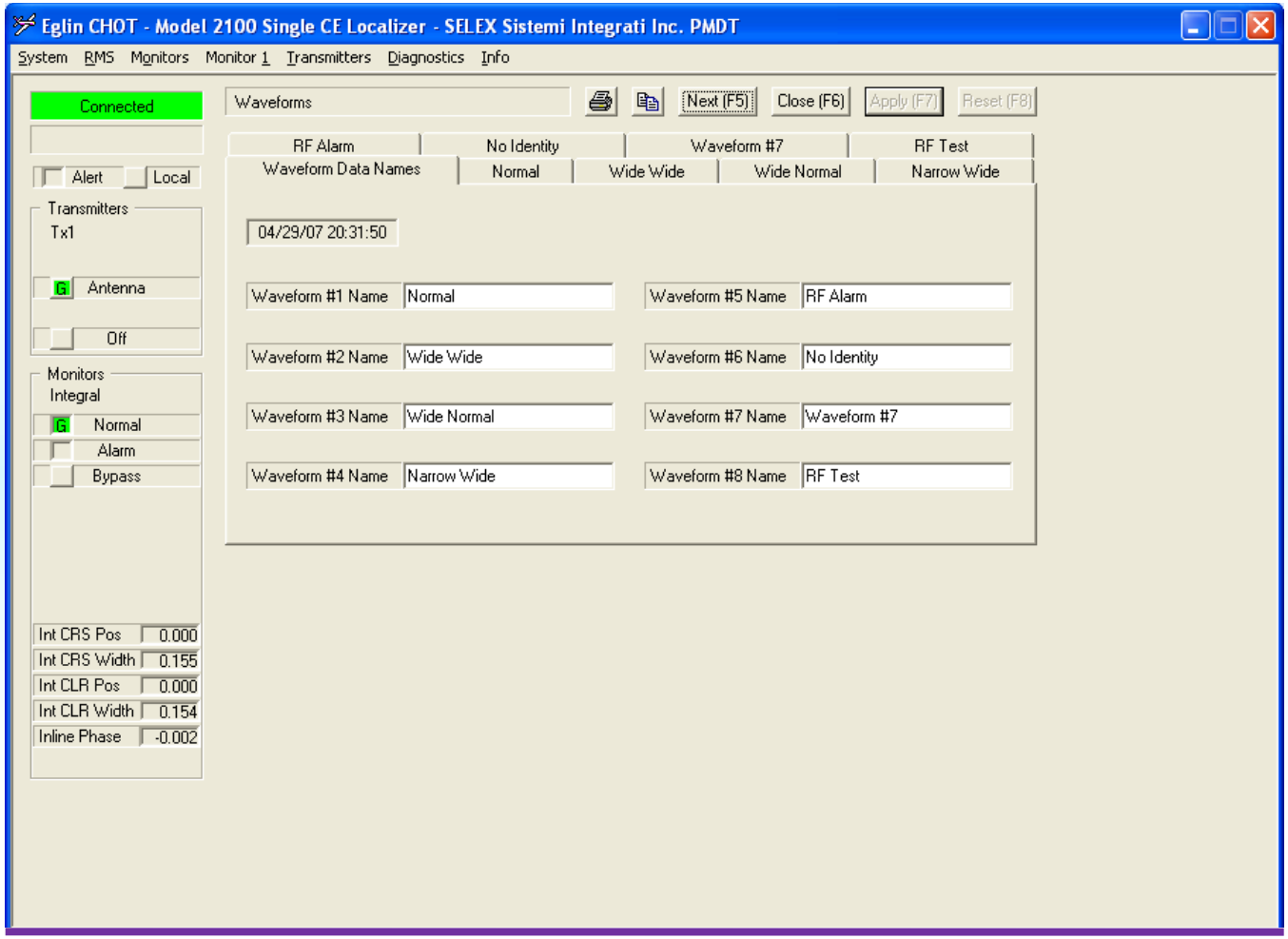
Monitor Integral Data



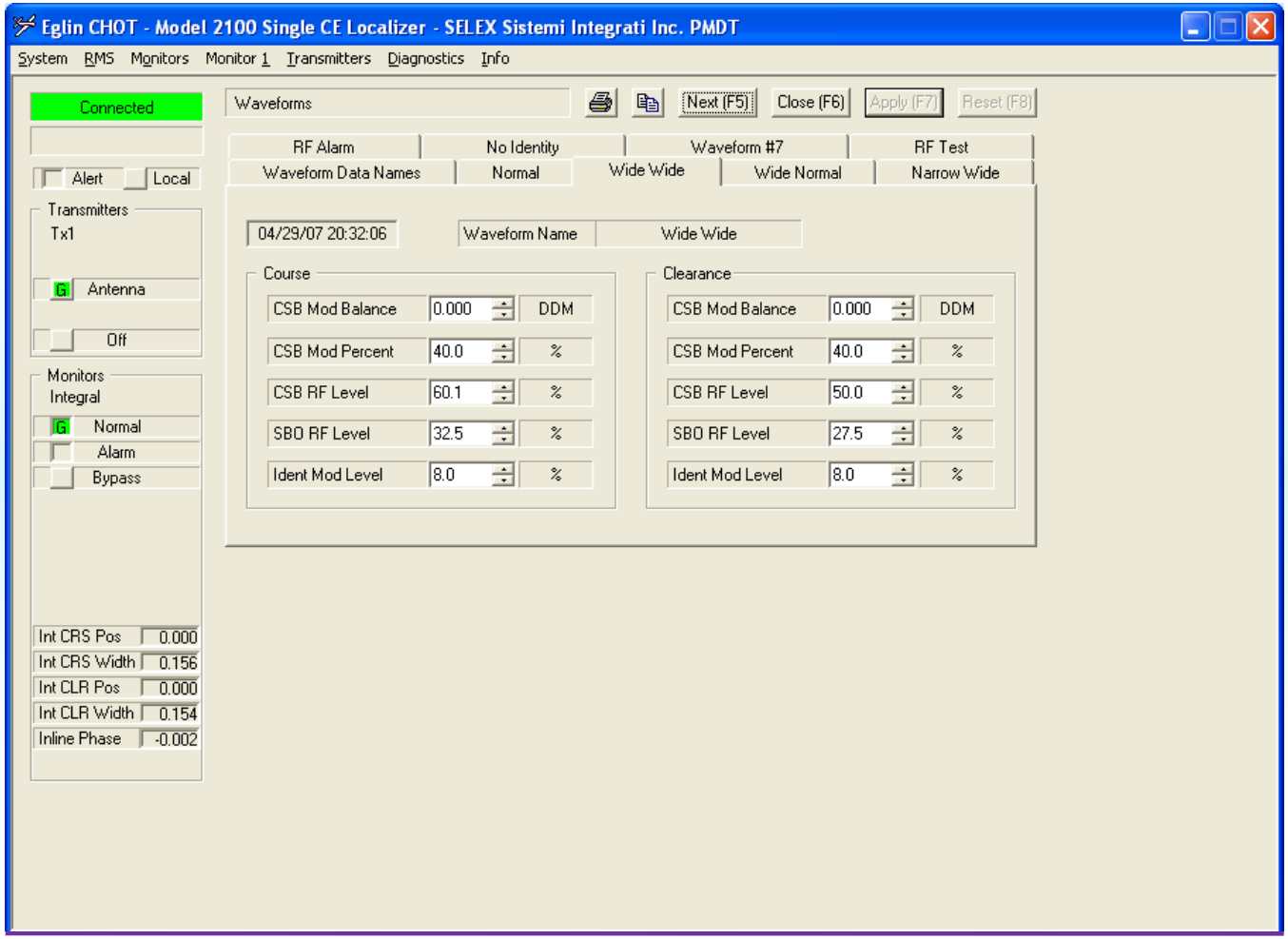
Localizer Flight Inspection

- Alarm conditions are set up prior to flight inspection using the Waveform screens
  - Waveform Data tab
  - Various conditions tab
- Waveform files are named according to function
  - Example “Wide Wide”
- The Waveform screens are individually adjusted to duplicate alarm conditions

Waveform Data Names



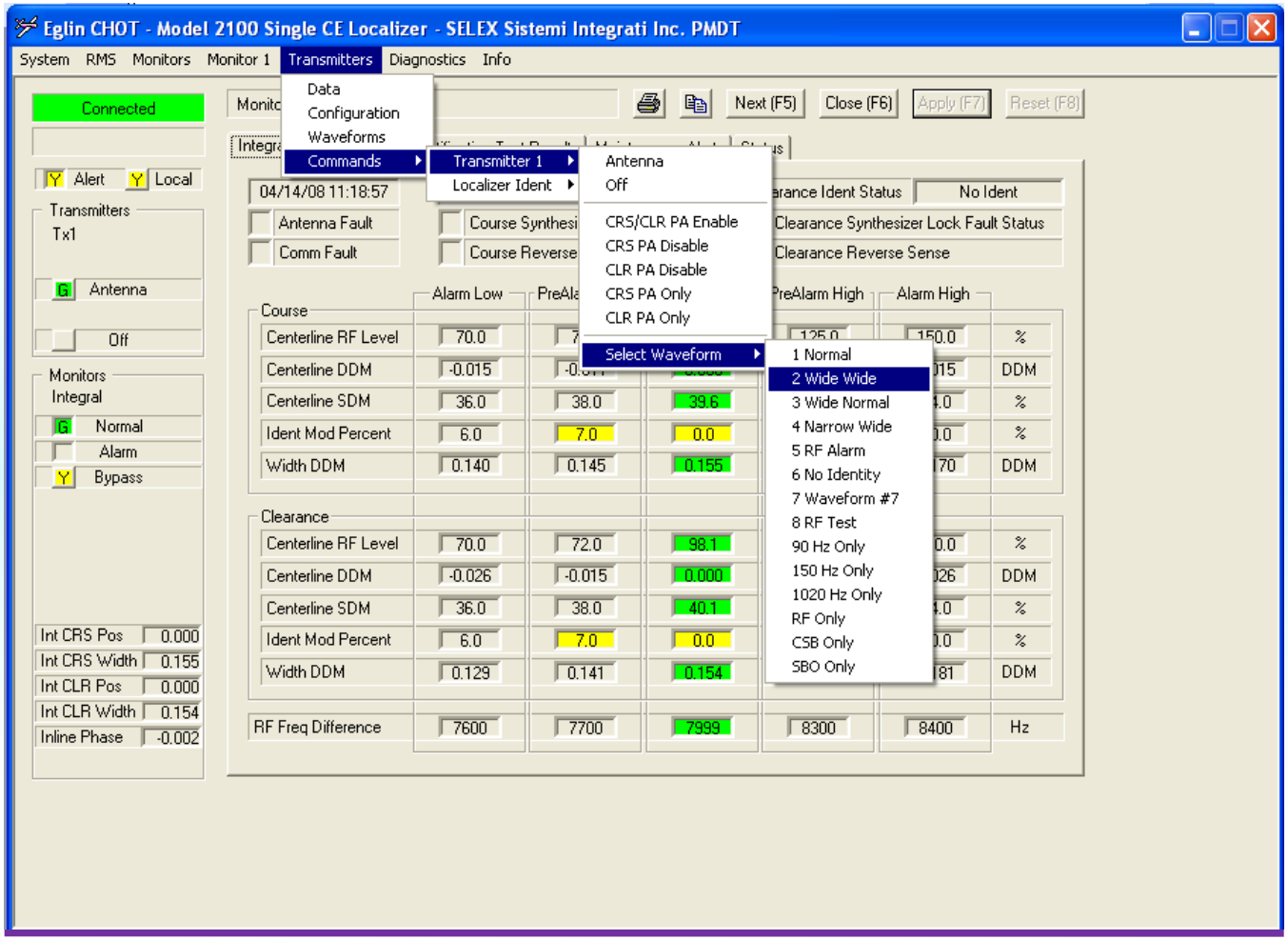
Waveform Wide Wide Setup



Localizer Alarm Checks

- Wide Alarm (for Single Frequency) and Course Wide, Clearance Wide (for Dual Frequency is selected with the appropriate Transmitter Waveform command
- After command is selected, monitor alarm is verified and reported to the panel technician
- At completion of check, the Normal Waveform is selected

Transmitter Commands



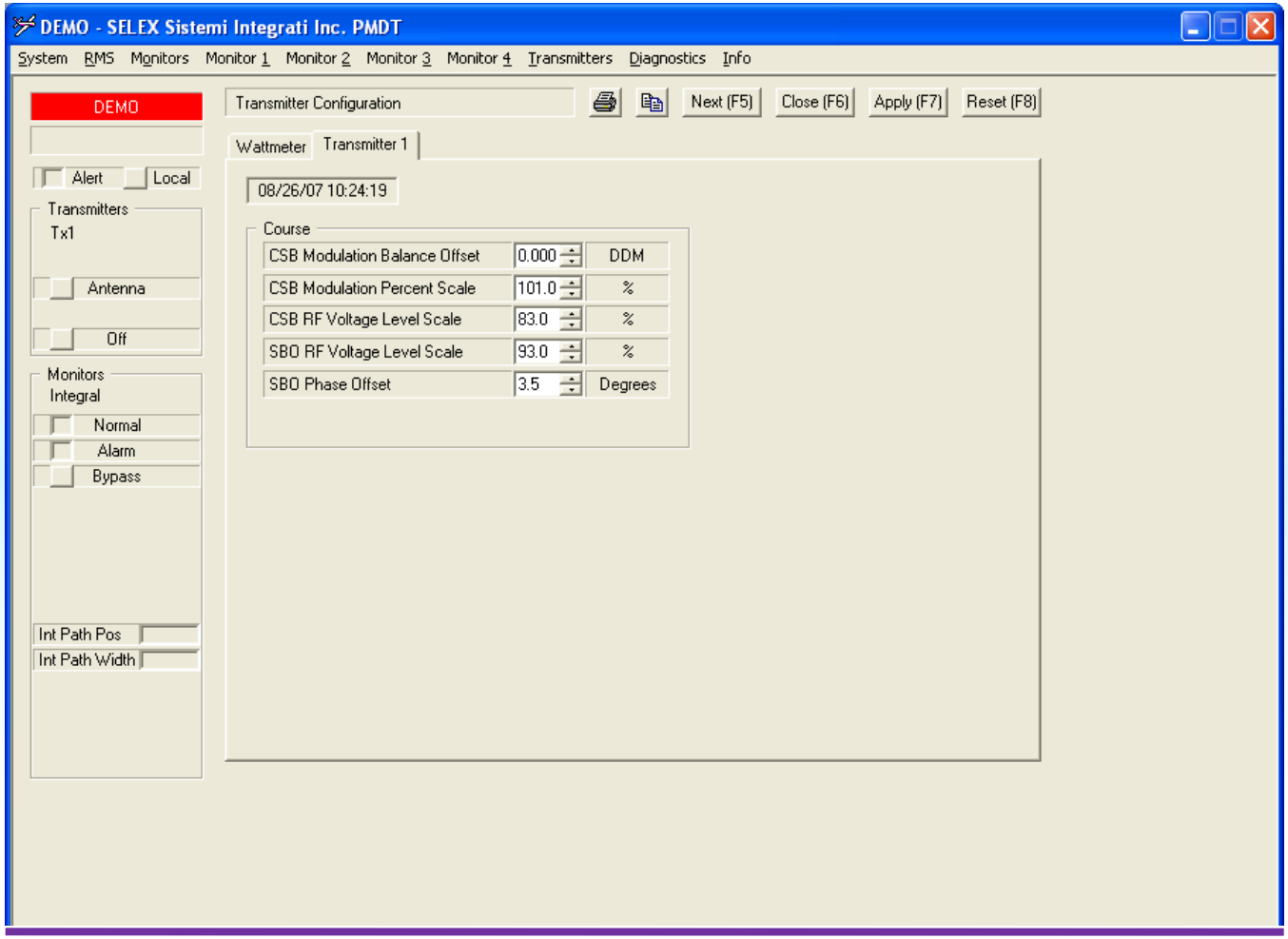
NRGS Flight Inspection

- Most checks/adjustments are the same as the localizer and will not be readdressed
- The exception is advance and delay phase to alarm checks
- This check is accomplished using the Transmitter Configuration screen
- The SBO Phase Offset is recorded, and then the Offset is adjusted in the positive direction until a width alarm occurs

NRGS Flight Inspection

- The technician reports advance to alarm to the panel technician, and how far the Offset was adjusted
- Process is repeated for delay to alarm
- SBO Offset is returned to original value
- Caveat: The initial SBO Offset value must be within ± 5° of zero in order to have sufficient range to adjust the system to alarm

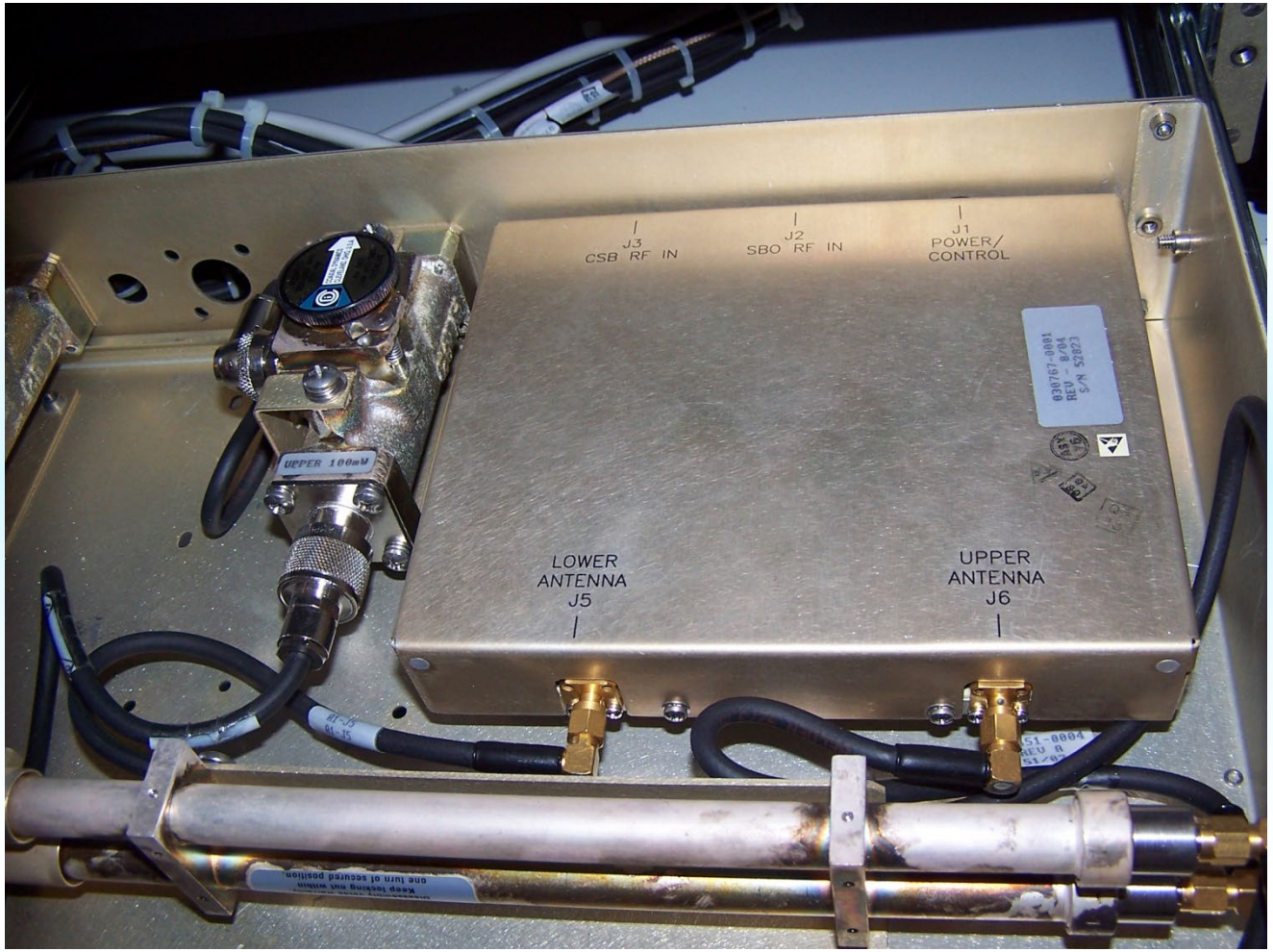
Transmitter Configuration



SBRGS Flight Inspection

- The following checks required an additional hardware solution:
  - Low Angle Alarm
  - Advance Upper Antenna to Alarm
  - Delay Upper Antenna to Alarm
- The solution is the SBRGS Remote Test Unit (RTU)
- The unit is a special version of the SBRGS Amplitude Phase Control Unit (APCU)

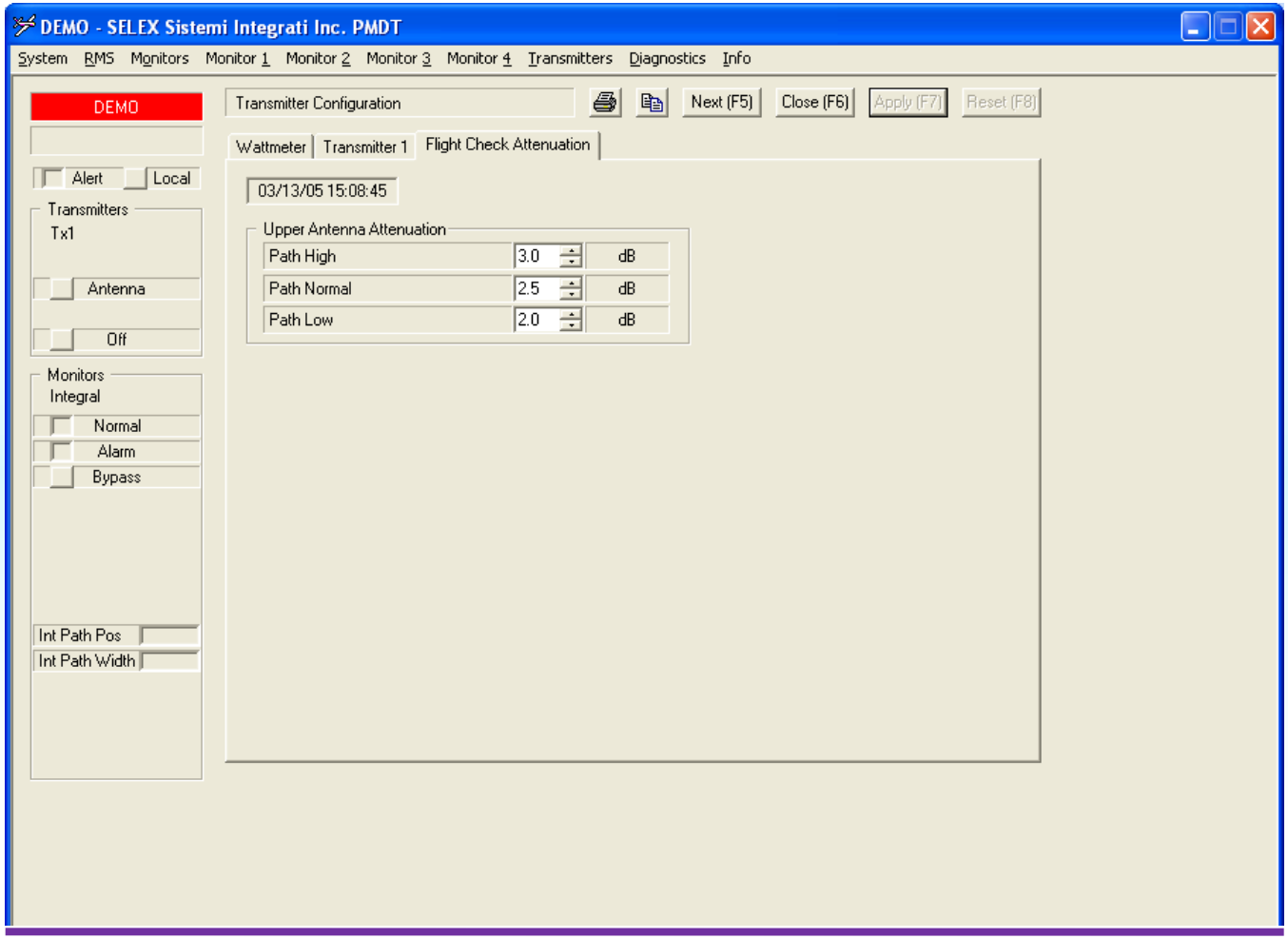
The SBRGS ATU/RTU



SBRGS Flight Inspection

- Low Angle Alarm is set up prior to flight inspection using the Flight Check Attenuation screen in the same manner as the Waveform screens
- The dB difference between Path Normal and Path Low is the value reported to the panel technician
- The Path High option is available for commissioning/special flight inspections

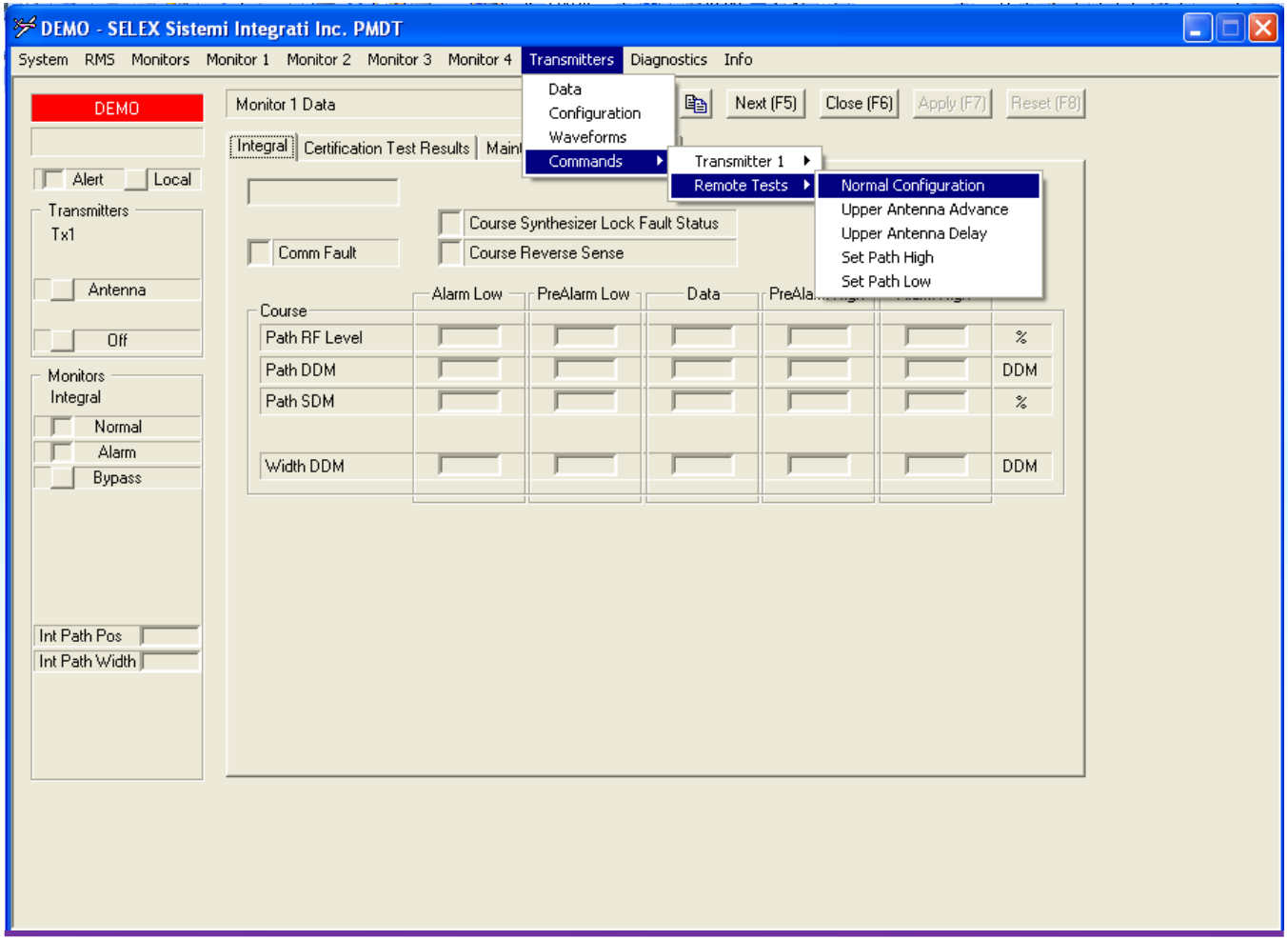
Upper Antenna Attenuation



SBRGS Flight Inspection

- Advance and delay Upper Antenna to alarm switches in a fixed 19 degree phase shift in response to a command from the Remote Test dropdown menu
- That amount of dephase is reported to the panel technician
- The Normal Configuration command is selected at the conclusion of the checks

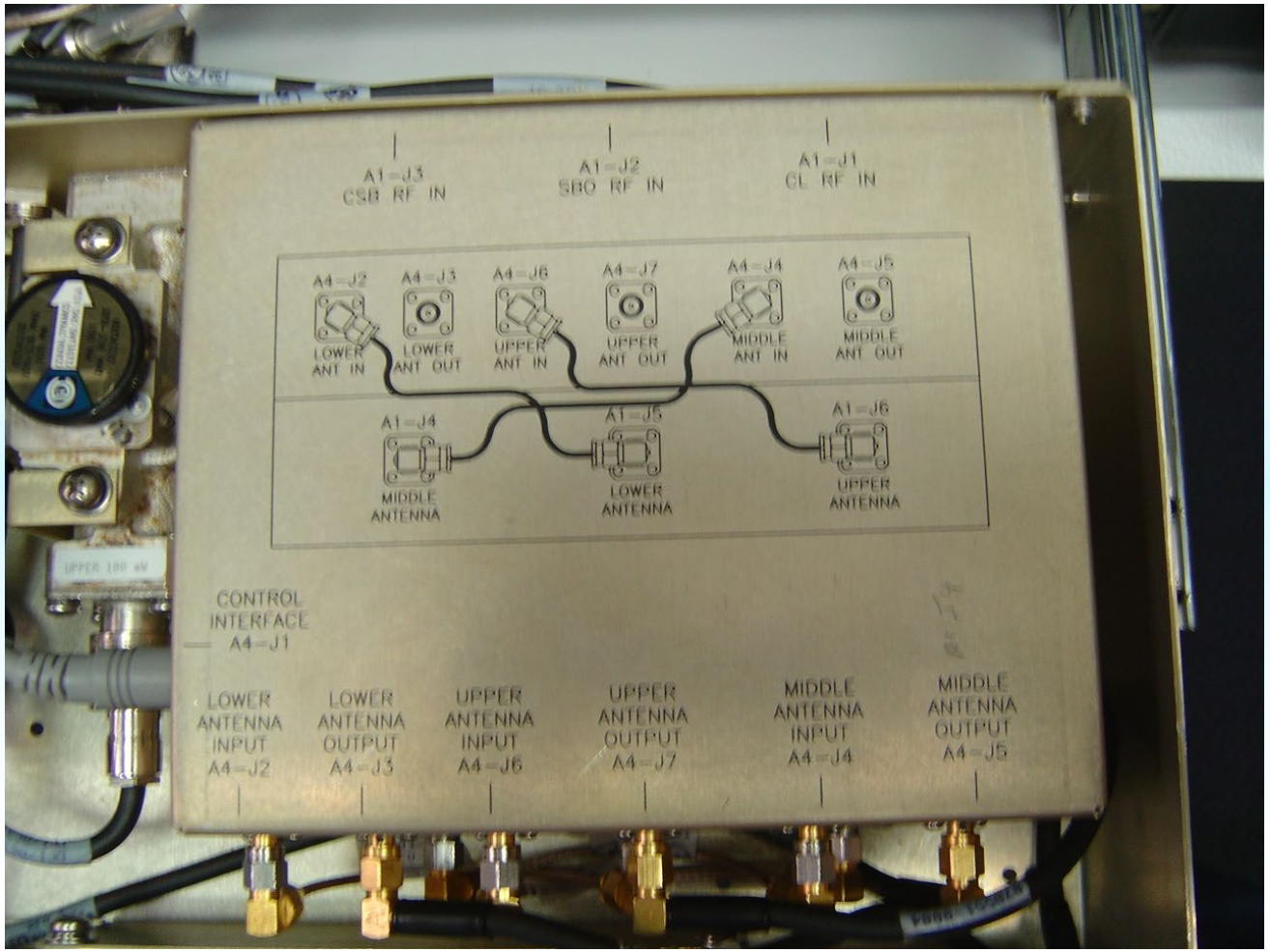
SBRGS Remote Test Dropdown



CEGS Flight Inspection

- The following checks required an additional hardware solution:
  - Attenuate Upper Antenna to Alarm
  - Advance Middle Antenna to Alarm
  - Delay Middle Antenna to Alarm
- The CEGS RTU provides this function
- The unit is mounted atop the CEGS APCU

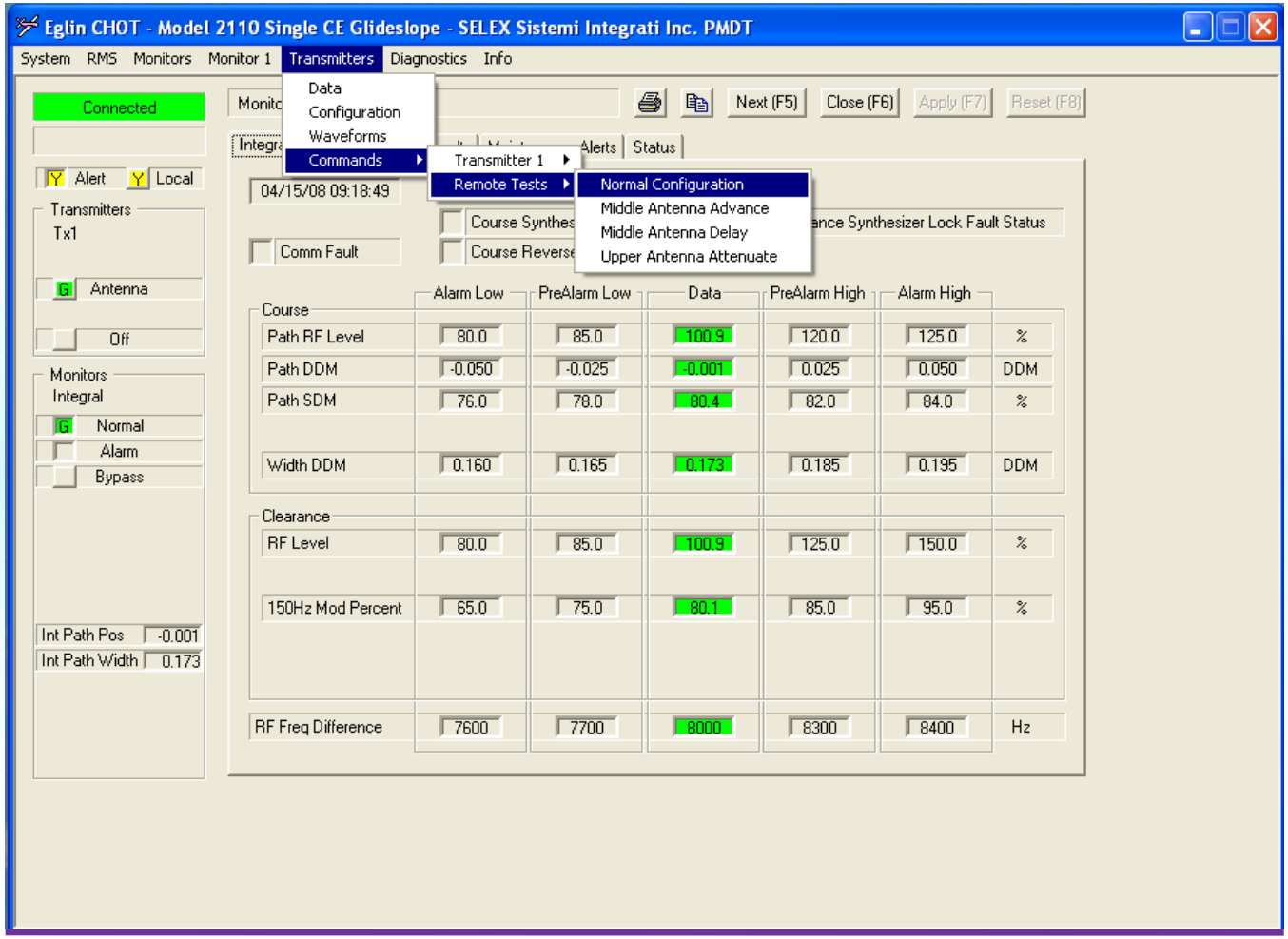
The CEGS ATU


A1-J3
CSB RF IN
A1-J2
SBO RF IN
A1-J1
CL RF IN
A4-J2
LOWER ANT IN
A4-J3
LOWER ANT OUT
A4-J6
UPPER ANT IN
A4-J7
UPPER ANT OUT
A4-J4
MIDDLE ANT IN
A4-J5
MIDDLE ANT OUT
A1-J4
MIDDLE ANTENNA
A1-J5
LOWER ANTENNA
A1-J6
UPPER ANTENNA
CONTROL INTERFACE
A4-J1
LOWER ANTENNA INPUT A4-J2
LOWER ANTENNA OUTPUT A4-J3
UPPER ANTENNA INPUT A4-J6
UPPER ANTENNA OUTPUT A4-J7
MIDDLE ANTENNA INPUT A4-J4
MIDDLE ANTENNA OUTPUT A4-J5

CEGS Flight Inspection

- The Advance and Delay Middle Antenna commands switches in a fixed 15 degree phase shift in response to a command from the Remote Test dropdown menu
- The Attenuate Upper Antenna command switches in a fixed 1.4 dB of attenuation
- Those amounts of dephase and attenuation are reported to the panel technician

CEGS Remote Test Dropdown



Flight Check Communications

- The CST utilizes a dial-up radio system at each airfield, located at one of the glideslopes
- The radio's are pre-programmed with the four flight check frequencies
- An adapter in the CST facility allows the remote radios to act in the same manner as a push-to-talk radio
- A */# keying method is used as a backup

Dial-up Radio

Dial-up Radio Antenna

Remote Control Adapter

Local Augmentation Personnel

- They are Airfield Systems technicians who maintain the Radar, ATC Radio, and Meteorological systems
- NAVAIDS involvement normally limited to:
  - Remove and replace actions
  - Shelter maintenance
  - Interaction with base agencies for phone, power, and temperature control issues
  - Field readings from the portable ILS receiver

Local Augmentation Personnel

- Have not and will not receive formal Navigational Aids system training; the fully trained personnel are assigned to the CST
- These personnel are not normally required to participate in flight inspections except:
  - A communications line or remote radio failure
  - Collecting new field references if changes were mandated during flight inspection

Benefits Realized

- Time Saved
  - Technicians do not have to travel from localizer-to-glideslope to complete inspections
  - Point and click inspections adjustments decrease the time needed to configure systems for alarm and back to normal checks
- Errors Decreased
  - Advance set-up of alarm conditions decreases errors made in the heat of battle

Benefits Realized

- Flexibility
  - The CST is able to handle last minute schedule changes and unannounced arrivals with ease; since we don't have to pack up and drive to the sites, we can be flight checking within 5 minutes of notification
  - If a flight inspection aircraft is delayed, other work can be performed rather than sitting at a site waiting

Benefits Realized

- Proficiency Maintained
  - Due to the long interval between periodic-with-monitors flight inspections, it is difficult to maintain practical proficiency
  - Small cadre of personnel performing all of the inspections at 7 airfields; we get plenty of practice
  - Added benefit, the flight crew knows they are working with very experienced ground technicians at all of our airfields

Benefits Realized

- Potential Manpower and Monetary Savings
  - Flight inspections can be centralized using remote capability – need for less on-site manning
  - The 5 technicians in the CST can conduct 5 flight inspections simultaneously

Drawbacks and Solutions

- Relatively few problems have occurred implementing remote flight inspection
- Initially, the CST needed local assistance to communicate with flight check
  - Remote radios solved this problem
- Also, the CST could not perform CEGS and SBRGS flight inspections remotely at the outset
  - Adding the remote test units solved this issue

Future Work

- Currently working the process to place the RCSU computers on the base networks with the most current security protocols
- While meant to enhance our remote maintenance and monitoring posture, flight inspection program fallout will be:
  - Quicker response times
  - Less reliance on aging copper in the ground communications infrastructure

Summary

- The CST has successfully performed remote flight inspection since Feb 2003
  - This equates to approximately 40 inspections that did not require on-airfield personnel
  - Saved $100k in travel costs alone
- Many hours saved utilizing point and click adjustments and not moving site-to-site
- Flexibility and training opportunities contribute to an already stellar program

Questions?

- (Especially the “what if” variety)