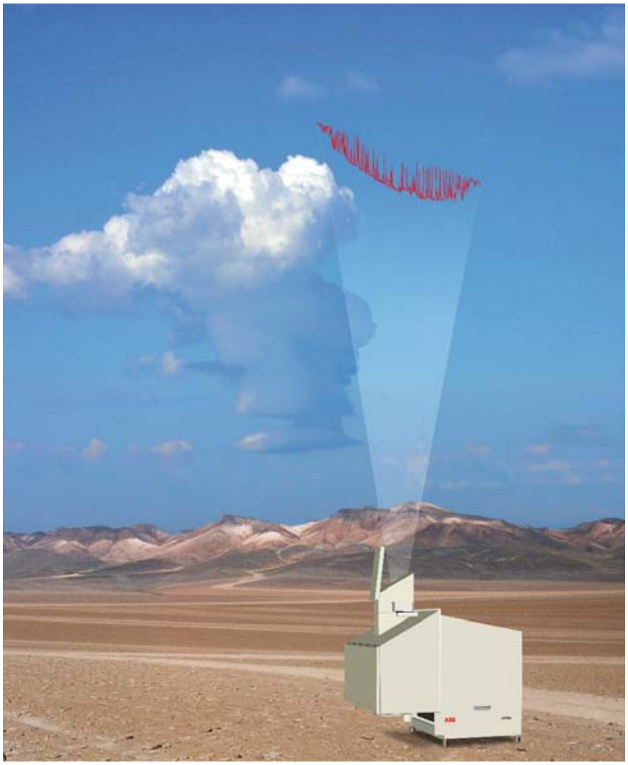
Installation and User Guide AA004389-01 Rev D December 2013

AERI and E-AERI Systems
Installation and User Guide



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Section 1 About this Manual

Purpose of Document

This document is intended for personnel using the AERI and E-AERI spectroradiometers for routine analysis and contains installation, user, maintenance and troubleshooting instructions. This document is intended as an operational guide for the use of personnel in performing the assessment of the AERI system performance and routine maintenance.

All servicing of the equipment is to be performed by Qualified Service Personnel only.

No user/operator adjustments inside the spectrometer are necessary or recommended by the manufacturer.

Definition of Icons

This publication includes Warning, Caution, and Information where appropriate to point out safety related or other important information. It also includes Tip to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

The laser warning icon indicates the presence of a hazard related to the presence of a laser.

The electrical warning icon indicates the presence of a hazard which could result in electrical shock.

The ISO General Warning icon indicates safety information that must be followed by user. The information concerns the presence of a hazard which will, could or may result in personal injury or even death.

The information icon alerts the reader to pertinent facts and conditions in the use of the equipment.

	The tip icon indicates advice on, for example, how to design your project or how to use a certain function.
	The ESD icon indicates the presence of equipment sensitive to electrostatic discharge.
	The hot icon indicates the presence of a hot surface.

Acronyms

ABB	Ambient Blackbody
BFS	Bomem File System
C&DH	Command and Data Handling
GUI	Graphical User Interface
HBB	Hot Blackbody
FTS	Fourier Transform Spectrometer

Section 2 Safety Summary

Warnings, Cautions and Notices

User must comply with all warnings, cautions and notices indicated in this manual. Failing to comply with any of the instructions, precautions or warnings contained in this manual is in direct violation of the standards of design, manufacture, and intended use of the equipment. Failure to comply with any of the warnings, cautions or notices can result in personal injuries and/or equipment damages. If you do not fully understand the information contained in this manual, please contact ABB. Refer to the back cover of this manual. ABB Inc. assumes no liability for the user's failure to comply with any of these safety requirements.

Laser Warnings

Class 3B visible laser radiations (632.8 nm, 1mW output power, Red) are present inside the spectrometer. However, no laser radiation leaks out of the instrument. Use of controls or adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

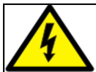
No user/operator shall open the spectrometer.

ESD Warnings

Electrostatic Sensitive Device
Perform maintenance procedures in an ESD protected environment.

Always use an ESD protection to perform maintenance procedures on the AERI or E-AERI spectroradiometer. If you are not familiar with ESD protection, or if ESD protection material is not available, contact ABB customer support. Refer to the back cover of this manual.

Electrical Warnings



High voltages may be present inside the enclosure even when the equipment is not connected to the power source, as some of the capacitors may maintain their load. High voltage is present at both black & white ends connected to the laser tube.

The voltage is approximately 7 kV at startup, and between 1200 V and 1400 V under normal operating conditions.

Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.

Do not open the spectrometer to perform troubleshooting procedures.

Make sure the system is configured to use the available line voltage.

Ensure that the equipment and any devices or power cords connected to it are properly grounded.

The grounding pin of the power connector must be present at all times.If necessary, have a certified electrician install a grounded wall outlet.

Protective earthing connection (grounding) must be active at all times. The absence of grounding can lead to a potential shock hazard that could result in serious personnel injury. If an interruption of the protective earthing connection is suspected, ensure the equipment remains inoperative.

Always replace old fuses with new ones of the same type. If uncertain, contact ABB Inc. Damage may result if wrong fuses are used.

Use the spectrometer ONLY if a power outlet properly grounded is available.

Before using the spectrometer, make sure the appropriate line voltage is available.

Do not use repaired fuses and avoid any situations that could short circuit the fuse.

Use a power extension ONLY if it has proper conductive protection (grounding).

General Warnings

Make sure line voltage configuration plate is set to the correct line voltage and that the correct fuse are installed. Use only the type of fuse specified by the manufacturer as appropriate for this equipment (see Fuse Type).

Do not apply power when connecting or disconnecting components. Connect all components BEFORE powering up the unit. Contact your local ABB support for information.

The system is automatically powered when the AERI or E-AERI system power cable is plugged into a power outlet. There is no power switch to switch the system on and off.

The hatch mechanism is very strong and stiff. Extreme caution must be paid when working around this component.The hatch located on top of the enclosure opens and closes electrically. Avoid putting any objects or body parts as it may damage the hatch and cause serious injuries.

Heater is hot, do not touch.

Always perform troubleshooting procedures on a fully assembled spectrometer (front/rear panels set in place).

Do not attempt any adjustment, maintenance, or repair procedure to the equipment if immediate first aid is not accessible.

Do not, under any circumstances, remove the warning and caution labels. Information must be available at all times for the security of the user.

The fully assembled AERI or E-AERI enclosure weighs 418 kilos (front-end, back-end and dollies). ABB strongly recommends to use a forklift to lift the AERI.

⚠	Do not operate the equipment in the presence of explosive or flammable products, condensing moisture and excessive dust. Do not store the spectrometer in an environment with condensing moisture and excessive dust. Read this manual thoroughly before installing this equipment. If you do not understand the content of this manual, contact ABB service personnel. Allow a minimum of 12 hours for the box and its contents to reach thermal equilibrium with the environment temperature before opening. This will help avoid any moisture condensation on the optics.

General Notices

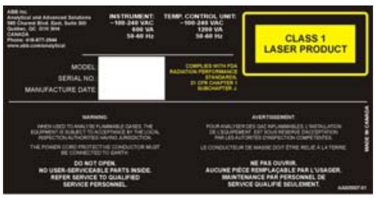
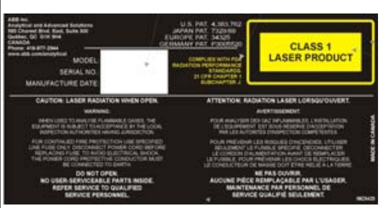
ℹ	Touching the optical parts of the detector (mirror) will damage the spectrometer and it will no longer meet performance specifications. Changing the computer or instrument IP address should be done by qualified personnel only. All components, whether in transportation, operation or storage, must be in a non-corrosive environment. Do not use the equipment if any signs of damages are present. Contact ABB service personnel.

Environmental Information

The EARI system has required the extraction and use of natural resources for its production. Therefore, the E-EARI system may contain hazardous substances that could impact health and environment. In order to avoid dissemination of these hazardous products into the environment and also to reduce the extraction and protect our natural resources, ABB inc. strongly recommends to return old spectroradiometers to your supplier in order to make sure materials used to produce the equipment are reused or recycled in a sound way. Refer to Table 2- 1.

Labels

2- 1. Labels

Label	Description	Location
	This label indicates the following information: - Laser warning - ABB address - Manufacturing date - Model number - Serial number - Use conditions for flammable product samples - Electrical Specs	This label is located on the back cover.
	The hatch mechanism is very strong and stiff. Extreme caution must be paid when working around this component. The hatch located on top of the enclosure opens and closes electrically.	This label is located on the hatch, one on each side and one on the hatch top.
	This label is the spectrometer's name plate	This label is located on the spectrometer.

2- 1. Labels

Label	Description	Location
	He-Ne Laser Class 3B visible laser radiations (632.8 nm, 1mW output power, Red) are present in the enclosure. No user/operator shall open the spectrometer.	This label is located on the spectrometer.
	This label is a warning of hot surface. Do not touch.	This label is located on the heater.
	This label indicates parts under electrical current. Risk of electric shock.	This label is located on the two power supplies.
	This symbol is used to indicate a protective earthing conductor terminal in the equipment.	One label is located on the instrument and one on the temperature control unit.
	Electrostatic Sensitive Device Perform maintenance procedures in an ESD protected environment.	This label is located close to critical electronic components.
	The ISO General Warning icon indicates safety information that must be followed by user. The information concerns the presence of a hazard which will, could or may result in personal injury or even death.	This label is located inside the two fans.

Section 3 About AERI and E-AERI

Overview

AERI stands for Atmospherically Emitted Radiance Interferometer.

E-AERI stands for Extended-range Atmospherically Emitted Radiance Interferometer.

The AERI and E-AERI are systems aimed at the measurement of the atmosphere from the ground to fulfil one of the primary measurements need: the need for accurate measurement of downwelling atmospheric emission over a broad region of the infrared spectrum at high spectral resolution. One of the goals is to reduce the uncertainties in global climate models by improving the accuracy of these models in reproducing measured atmospheric radiation. The AERI measurements are important for validation of models of atmospheric infrared radiation under both “clear” sky and “cloudy” sky conditions. Some of the key scientific questions that AERI measurements address are the relative importance of various greenhouse gases as well as the infrared radiative characteristics of water and ice clouds.

The system measures radiance emitted from the atmosphere by the use of a FTS calibrated with two blackbodies. Temperature, pressure, relative humidity, rain/Sun sensors are also monitored to obtain a complete picture of the measurement conditions.

A temperature control unit maintains the temperature of the thermal enclosure, which contains all electronics and the FTS. This ensures an appropriate life-time for the electrical components as well as an improved radiometric stability for the FTS.

A pointing mirror allows to target the FTS at nadir, zenith, ambient blackbody (ABB) or hot blackbody (HBB) position.

Two IR detecting channels are supported by an extended range MCT detector coupled with an InSb detector mounted in sandwich configuration or as a configuration using a dichroic. The detectors are mounted in a dewar and cooled down to below 70k by a linear cryo-cooler.

A software allows to operate the system unattended. The AERI software system performs all necessary data calibration in real-time and also performs a series of quality control (QC) checks in real-time with problem conditions indicated both on the active system display and on remote monitors. A GUI version is also available to support interactive use of the instrument.

A data processing software extends the system by reading raw spectra and producing fully corrected and calibrated radiance spectra, thereby eliminating the need for post processing. But the AERI data is accessible via digital network upon demand with an on-board storage capacity of several days.

An atmospheric profiler software then reads the radiance spectra to produce temperature, pressure and moisture profiles of the atmosphere.

The instrument is designed to be configured as stand-alone or mounted thru-wall. A protective enclosure protects the instrument against sun, rain, snow, wind, sand, etc. A hatch, actuated by the precipitation or sun sensors can be closed to protect the optical head or opened to look at the atmosphere. Manual opening or closing is also possible by the user with an instrument commanding script.

A mobile base allows to move the instrument and provides a stable mounting for the stand-alone configuration. The instrument is removed from its mobile base for thru-wall installation and needs to be strongly fixed on a facility provided mounting platform.

Weight

Travel box empty	65 kg (143 lb)
Dolly Front-End	68 kg (150 lb)
Dolly Back-End	56 kg (124 lb)
Accessories Box	14 kg (31 lb)
Back-End alone	103 kg (227 lb)
Front-End alone	60 kg (132 lb)
Box complete with Back-End and dolly	224 kg (494 lb)
Box complete with Front-End and dolly	194 kg (428 lb)
Accessories Box complete	26 kg (57 lb)
Temperature Control Unit	28 kg (62 lb)

Definitions

Front-end	The front-end is made of the pointing mirror, the blackbodies and its supporting mechanical structure. This part of the AERI system has been designed to withstand harsh weather and temperature variations.
Back-end	The back-end contains the highly specialized detector that needs to be protected from temperature variations and moisture.
Protective enclosure	The protective enclosure protects the system from rain, snow, wind, sand, etc. It is made of the front-end and back-end protective enclosures.
Temperature control unit	The temperature control unit actively maintains the temperature within the thermal enclosure.
Thermal enclosure	The thermal enclosure contains all the commanding and data handling electronics as well as the FTS. The temperature within the thermal enclosure is maintained by the temperature control unit.
Mobile base	The mobile base allows to move the instrument. It also provides a stable mounting platform when the system is installed as stand-alone, i.e. not thru-wall mounted.

System Overview

System Architecture

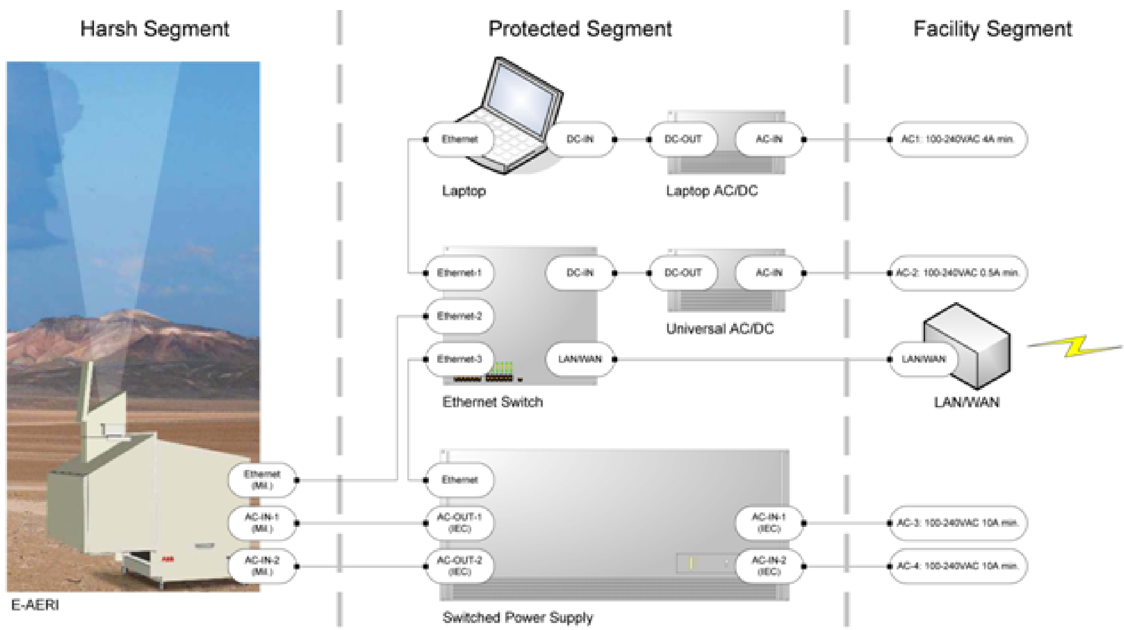


Figure 3- 1. AERI and E-AERI System Architecture

The Front-end of the Interferometer Assembly (consisting of the blackbodies and scene mirror/motor/controller is thermally separated from the rest of the bench so that it can operate at outside ambient temperatures. The harsh segment is composed of the instrument itself and its sealed ethernet and power cables.

Hardware

The AERI (or E-AERI) Hardware is composed of three distinct parts; (1) the Front-End optics, (2) the back-end electronics, and (3) the computer.

Front-End Optics

The Front-end optics consists of the blackbodies and the scene mirror. The calibration blackbodies are of identical construction, consisting of a thermally isolated cavity which is painted with a high emissivity diffuse black paint. Each cavity contains a heater, a feedback thermistor and three sense thermistors. Each blackbody can be controlled to a temperature set at the Blackbody controller with the software. For normal operation, the hot blackbody is controlled to 60°C and the ambient blackbody runs at the outside temperature; there is no heater power applied to the ambient blackbody.

The scene mirror has a gold reflecting surface and is mounted at 45° to the motor rotation axis which is in turn positioned to be coincident with the interferometer input optical axis. This configuration allows different views: nadir, zenith, ambient blackbody (ABB) and hot blackbody (HBB).

Back-end Electronics

The main component of the back-end electronics is the Michelson interferometer with computer interface. Two IR detecting channels are supported by an extended range MCT detector coupled with an InSb detector mounted in sandwich configuration or as a configuration using a dichroic. The detectors are mounted in a dewar and cooled down to below 70k by a linear cryo-cooler. The back-end components are kept at stable temperature with the temperature control unit that is attached at the back of the back-end electronics. Electronic modules are also mounted in the back-end: signal conditioning electronics (SCE), Blackbody Temperature Controller (BTC) and Stirling Cooler support electronics (SCSE).

Computer

The computer is a standard off-the-shelf laptop that comes with the complete software suite installed, refer to Software Components on page 58.

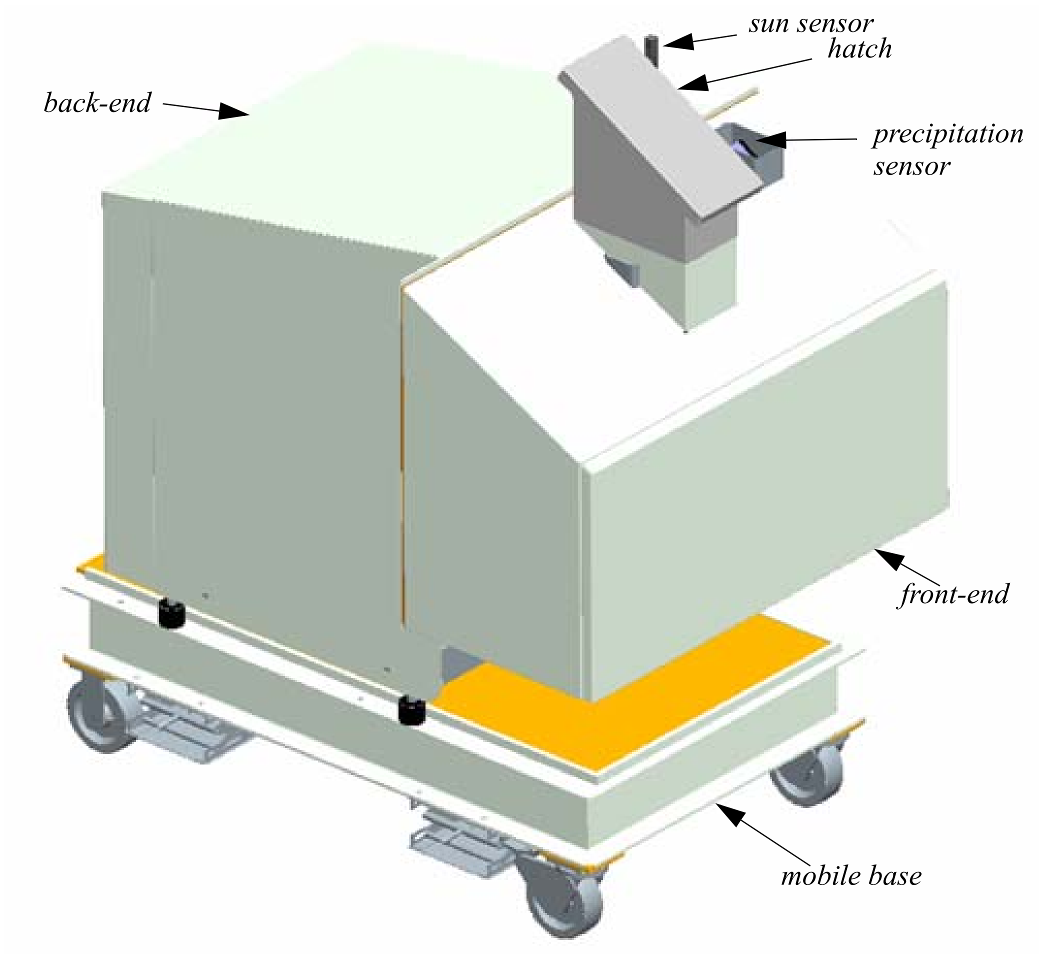


Figure 3- 2. Stand-alone version of the AERI and E-AERI instrument on its mobile base

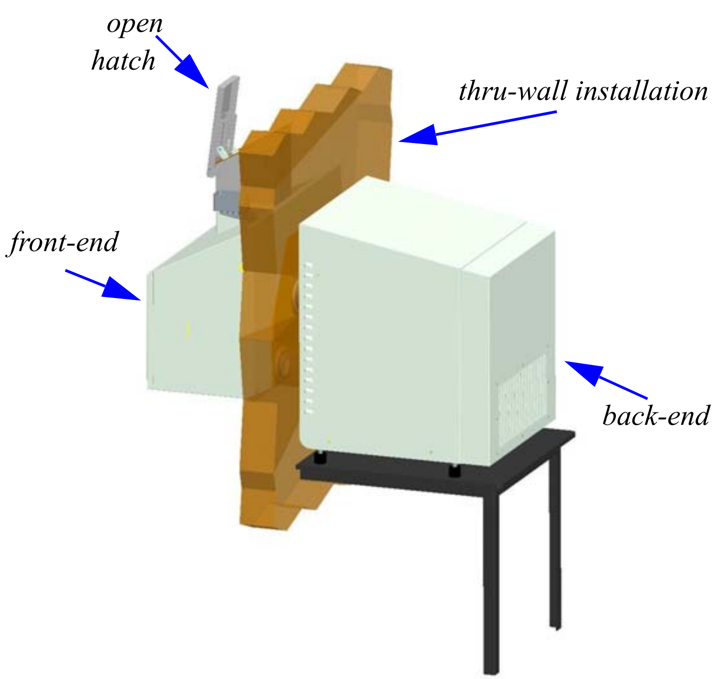


Figure 3- 3. Thru-wall version of the instrument without its mobile base

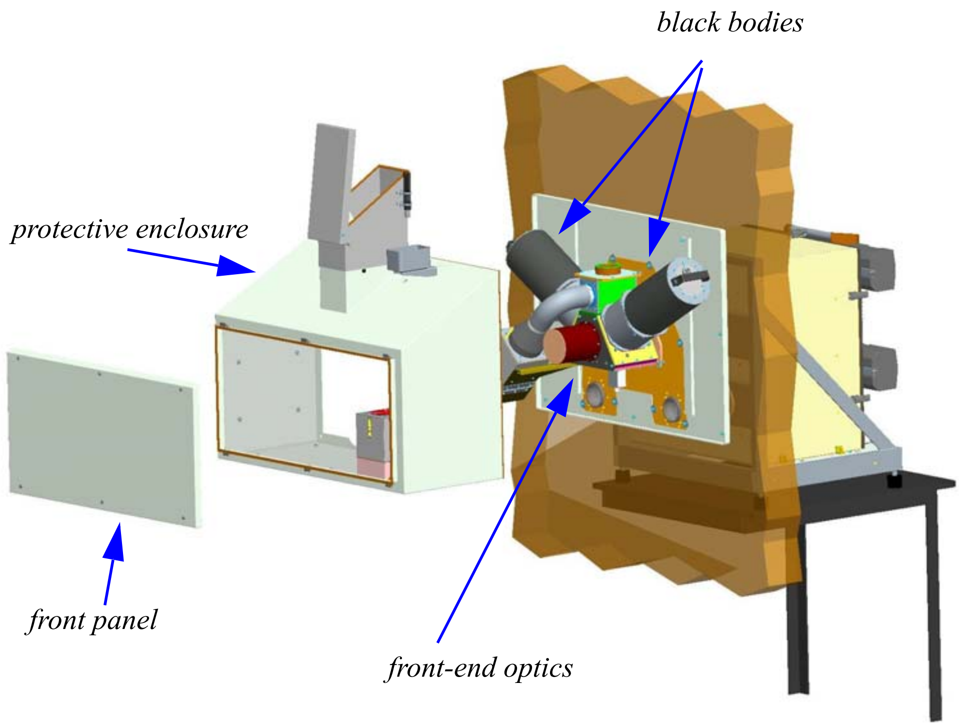


Figure 3- 4. Thru-wall without its front-end and back-end protective enclosures

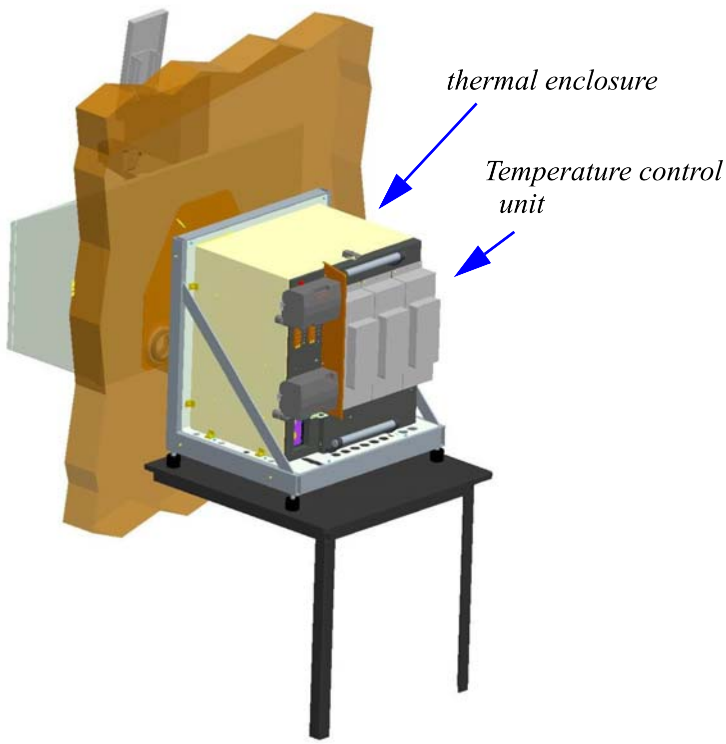


Figure 3- 5. Back-end view without its protective enclosure

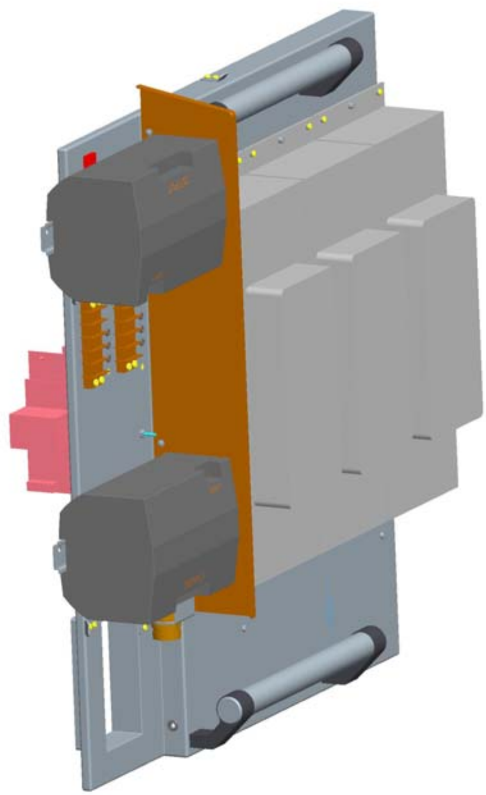


Figure 3- 6. Temperature control unit

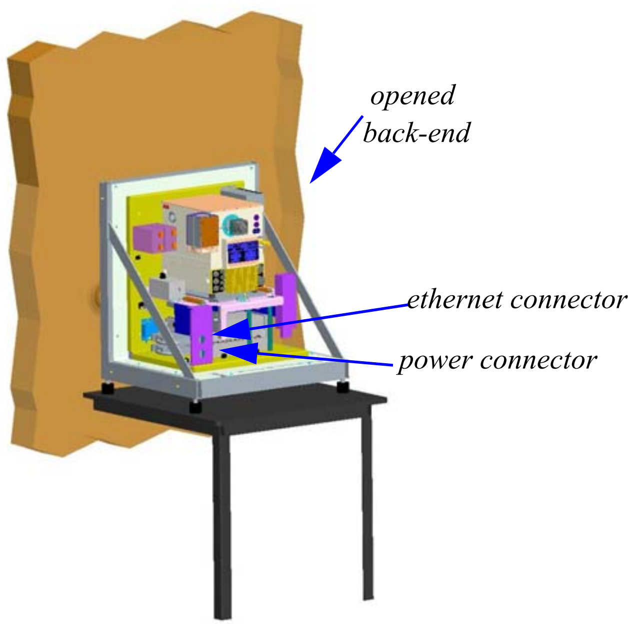


Figure 3- 7. Back-end without its thermal enclosure

Software Architecture

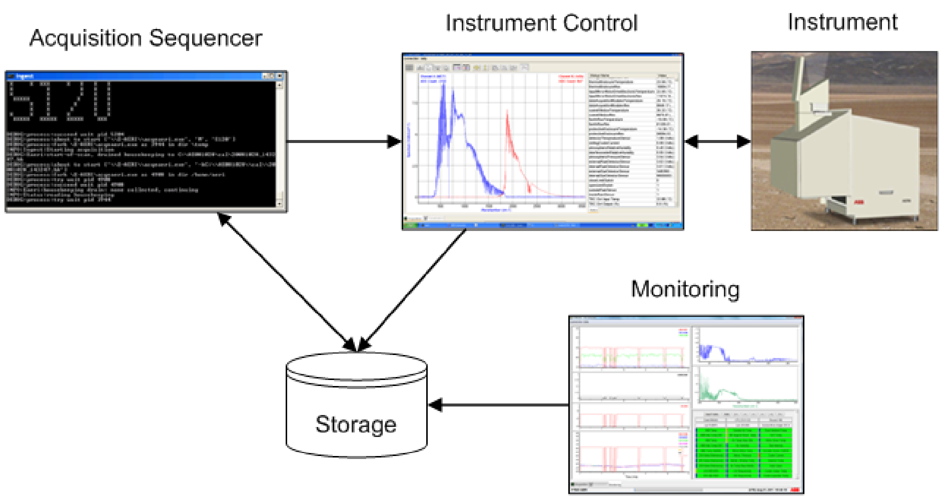


Figure 3- 8. Software architecture

Figure 3- 8 shows the 4 software components below. For a detailed description, refer to Software Components on page 58.

- Instrument Control (FTSW AERI - Acquisition and Monitoring tabs)
- Acquisition Sequencer (Ingest)
- Storage

The AERI (or E-AERI) software system performs all necessary data calibration in real-time thereby eliminating the need for post-processing. The software also performs a series of quality control check in real-time with problem conditions indicated both on the active system display and on remote monitors. The data is accessible via digital network upon demand with an on-board storage capacity of several days.

Key Features

Protective Enclosures

The spectrometer enclosures features heating and cooling power to stabilize the spectrometer surrounding air at 23°C.

The front-end enclosure's purpose is for protection against precipitation (Rain or snow). This enclosure is not stabilized in temperature; it is free running at near ambient temperature and is designed to operate between -30°C and +40°C.

The front-end module enclosure is detachable to allow for the system (spectrometer enclosure) to be installed in a shelter with the front-end section outside through a window opening in the wall.

Precipitation Sensor

Under precipitation, the system will automatically turn itself in a self-protection mode that do not allow sky measurement. After the precipitation, the system will return to normal acquisition mode.

Sun Sensor

The Sun Sensor of the AERI system is used to detect the intensity of light coming from the sun. If sun light enters into the AERI system directly from the zenith position, critical parts in the system could be damaged. The sun sensor is therefore used to detect when the sun approaches the zenith position to ensure that the hatch of the system be closed as long as the sun is located directly over the system. The sun sensor trigger value is set to a standard default value at delivery of the system. It is possible to readjust the trigger value for the sun sensor should the default value be too sensitive and cause the hatch to close too early and for too long. This procedure should be preformed with caution as an adjustment that is not sensitive enough could damage the system.

If the sun sensor glass becomes too dirty, it may not detect the sun according to the settings and the hatch may not close even though it should. At all times make sure the sun sensor glass is clean. Depending on the environment cleaning may be necessary on a very regular basis.

Temperature Regulation System

The AERI and E-AERI systems were designed for measurement in harsh conditions and therefore comes with a complete temperature regulation system. Depending on the measurement location and conditions, the temperature regulation system can heat the instrument in cold conditions or cool it down in a high-temperature environment. Automated Usage.

Interactive Usage

Parameters can be changed and adjusted, acquisitions can be stopped or started on command.

Events Logged with E-mail notification when Critical

E-mail notification for critical cases is possible, refer to Events Logged with E-mail notification when Critical on page 94 on how to configure the settings to enable this feature.

Housekeeping Data

All parameters (like temperature, measurements, resistance) are monitored in real-time and are stored in C:\FTSW_EAERI\data with the raw data in interferogram format (igm). For a complete list of and more details on all parameters, please refer to AERI's Parameters Description on page 147.

Remote access to all Functionalities

Remote access is possible with VNC (Virtual Network Computing).

Preventative Shut-Down

A protective switch is installed inside the thermal enclosure to ensure the instrument is not turned on when its temperature is below 4°C. A special heater is installed inside that will raise the temperature to a point at which it is safe to turn on the instrument.

However, that heater is not as powerful as the regulatory system for the temperature. For very cold temperature, it is possible that this safety heater may not raise the instrument temperature above the safe point. Other means must be used to raise the instrument temperature as using an isolation blanket or a temporary transfer of the instrument to a warm location.

Section 4 Unpacking and Installing

Unpacking

This chapter describes how to unpack and set-up the AERI and E-AERI spectroradiometer either in stand-alone or thru-wall configuration.

Allow a minimum of 12 hours for the box and its contents to reach thermal equilibrium with the environment temperature before opening. This will help prevent any moisture condensati on on the optics.

The standard optical components for the spectrometer are non-hygroscopic in the case of AERI and hygroscopic in the case of E-AERI. For information on the use and handling of hygroscopic materials, refer to the chapter entitled “Handling and Care of Hygroscopic Material” in the FT-Spectroradiometer Reference Manual.

The fully assembled AERI or E-AERI enclosure weighs 418 kilos (front-end, back-end and dollies). Several persons are required to lift the back-end and front-end from the transportation dollies.

The power outlets are controlled through the software. There is no power switch to manually switch the system on and off.

Do not apply power when connecting or disconnecting components. Connect all components BEFORE powering up the unit. Contact your local ABB support for information.

The grounding pin of the power connector must be present at all times.If necessary, have a certified electrician install a grounded wall outlet.

Protective earthing connection (grounding) must be active at all times. The absence of grounding can lead to a potential shock hazard that could result in serious personnel injury. If an interruption of the protective earthing connection is suspected, ensure the equipment remains inoperative.

The AERI and E-AERI systems are delivered in three (3) transportation cases. The back-end and front-end are delivered in two separate transit cases as shown on Figure 4-1. The accessories (laptop, ethernet switch, cables, etc.) are delivered in a smaller case as shown on Figure 4-2.

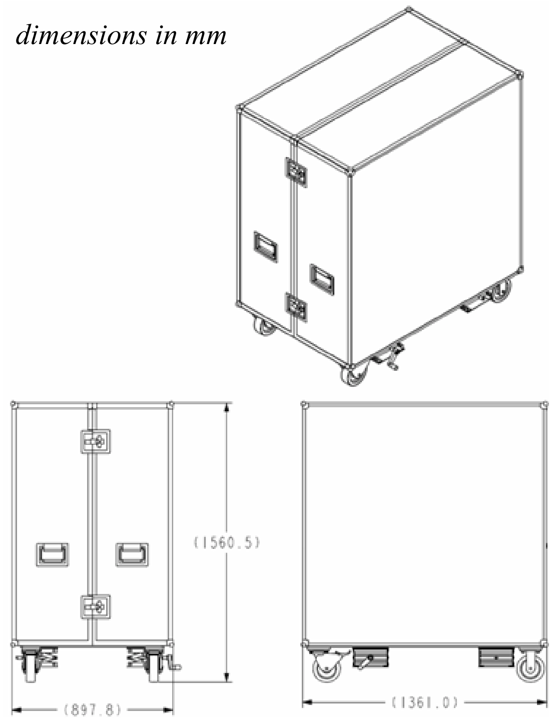


Figure 4-1: Instrument transit case (same design for back-end and front-end cases)

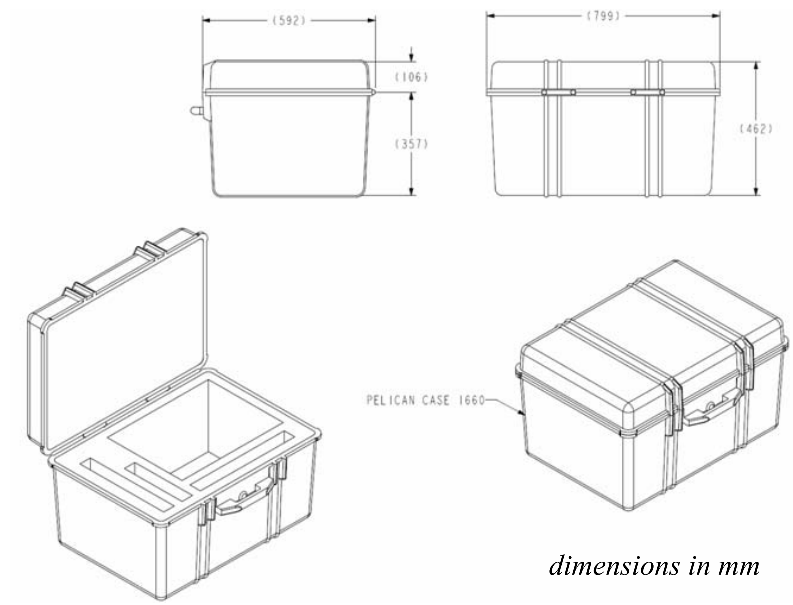


Figure 4-2: Accessories Transit Case

The layout of the shipping case allows for limited placement. It was designed to ensure that components when repacked in the case are firmly held in position. Failing to secure components in the shipping case may result in damage to the enclosed components.

Shipping case contents

Front-end shipping case:

- Front-end assembly

Back-end shipping case:

- Back-end assembly

Accessories shipping case:

- Laptop computer
- Laptop power supply
- Mouse
- USB-Ethernet adapter
- Cisco switch
- iBoot bar

2 power cables with military connector for the instrument

1 Ethernet cable with military connector for the instrument

2 Ethernet cables

Mapping bulb

Mapping jig

MR tools (Allen screw driver)

Stand-Alone Configuration

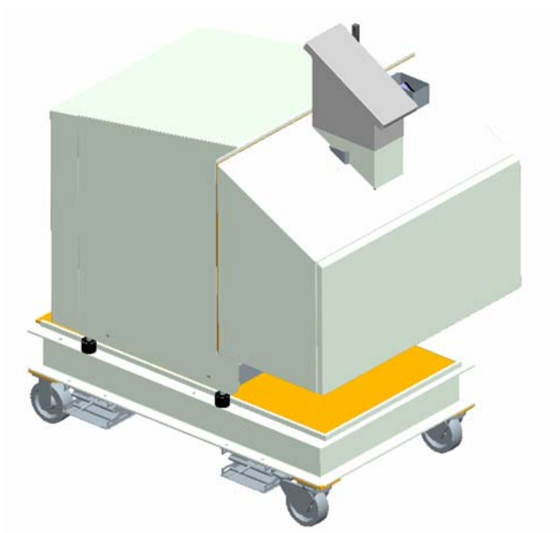


Figure 4-3: System installed stand-alone

Facility Requirements

The ground over which the system is installed shall be stabilized, especially where the levelling pads connect to the ground.

The ground over which the system is installed shall have a flatness better than 2 cm.

The ground over which the system is installed shall be levelled to better than 2 cm.

The system should be secured to the ground by proper use of anchoring (not included).

Outdoor Installation

The AERI and E-AERI systems can be installed outdoors. Before unpacking the system make sure the following requirements are met:

- The base upon which the system will lay must be able to resist temperature variation and be sturdy enough to sustain the weight of the system. The use of a concrete slab is recommended.
- The base must be levelled and properly oriented.
- No objects must interfere with the line of sight of the system (trees, electric or phone wires, other facilities etc.)
- Support for the system must be able to sustain the weight of the AERI or the E-AERI system and must be weather resistant.
- Electric power of 120-220 volts or 50 to 60 hz must be available. We recommend two circuits of 120 V, 15A. One for the instrument and the other one for the temperature control.
- Grounding must be available.

Thru-Wall Configuration

The AERI or E-AERI system can be installed in a shelter, through the wall. Before unpacking the system make sure below requirements are met.

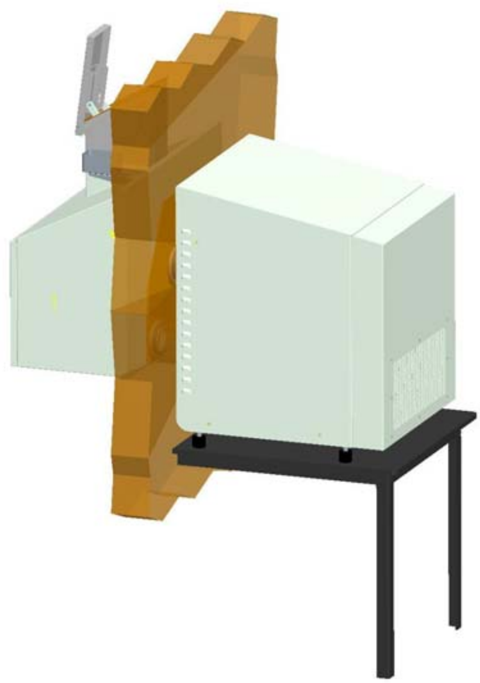


Figure 4-4: Thru-wall installation

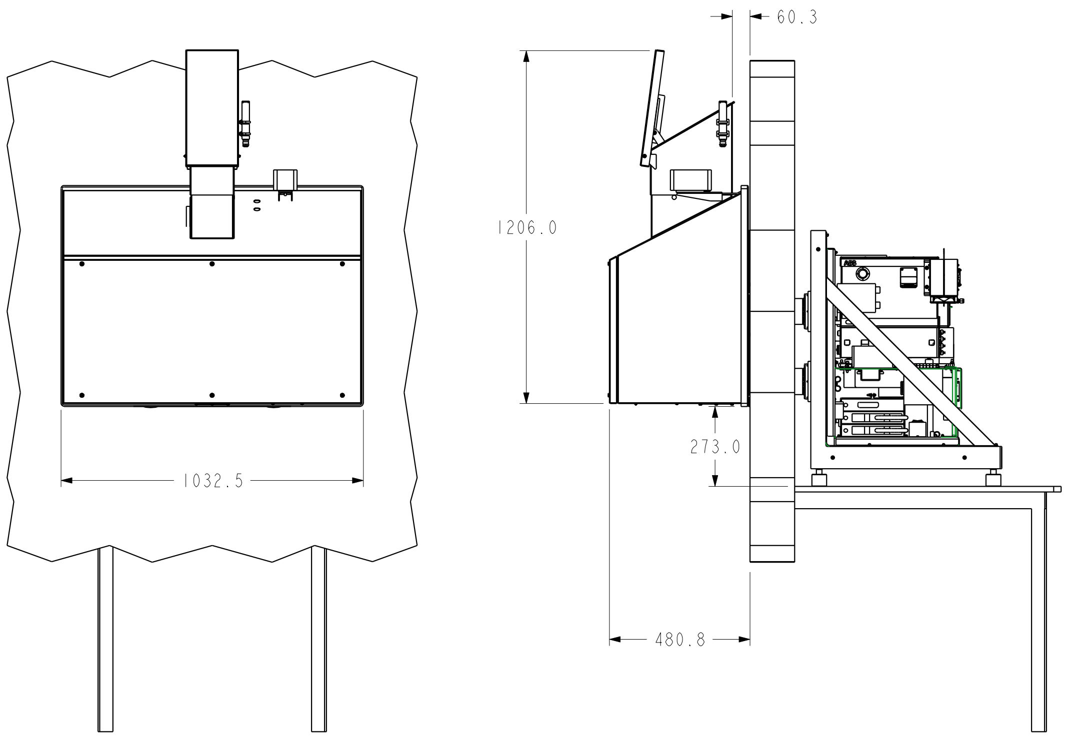


Figure 4-5: Installed thru-wall

Facility Requirements

- The base upon which the system will be installed must be fixed to the ground and must be able to resist temperature variation and sturdy enough to sustain the weight of the system. The use of a concrete slab is recommended.
- The mounting base, on which the back-end is fixed, must be levelled to ensure proper zenith view.
- Shelter must be properly grounded.

- The wall openings (3x) must be 178 mm in diameter as the rings that will be passed through are 138 mm in diameter, refer to Figure 4-7. It is important to note that you must not remove the rings from the tubes. Alignment was validated with the rings and performances are not guaranteed if you remove them.

Figure 4-6: Installation Rings

- The field of view of the system is around 45 milliradians. However, a wider angle needs to be cleared to prevent that scattered photons from any object in this wider cone to reach the detector and contaminate the results. This angle has a value of 14.8 degrees. All angles on the drawings are relative to the vertical.
- No objects must interfere with the line of sight of the system. (trees, electric or phone wires, other facilities etc.)
- Support for the system must be able to sustain the weight of the AERI system. In a through-wall configuration, the tubes support the front-end. But the tubes were not designed to support the weight of the back-end. Their main purpose is to contain the cables that connect from the font-end to the back-end. A proper support needs to be installed capable of supporting the back-end.
- Use insulation around the enclosure protrubing outside the shelter. This will allow maintaining temperature within the shelter.
- The shelter must have electric power of 120-220 volts or 50 to 60 hz.
- The back-end thermal enclosure is not recommended for the sheltered installation

- The mounting base, on which the back-end is fixed, must be prepared as shown for example in Figure 3-7. The mounting base has to be very strong to be able to support the weight of the AERI. The plastic tubes support the front-end in a through-wall configuration but their main purpose is to provide a safe connection for the cables from back-end to front-end. They are not designed to support the weight of the back-end.
- Assuming that the wall is perfectly straight and the AERI is aligned parallel to the wall, the distance from the center of the upper hole up to the top edge of the wall should be 597,8 mm or less. Otherwise the wall will be in the field of view of the AERI system.
- The wall, through which the system is installed, must be prepared as shown in figure below.

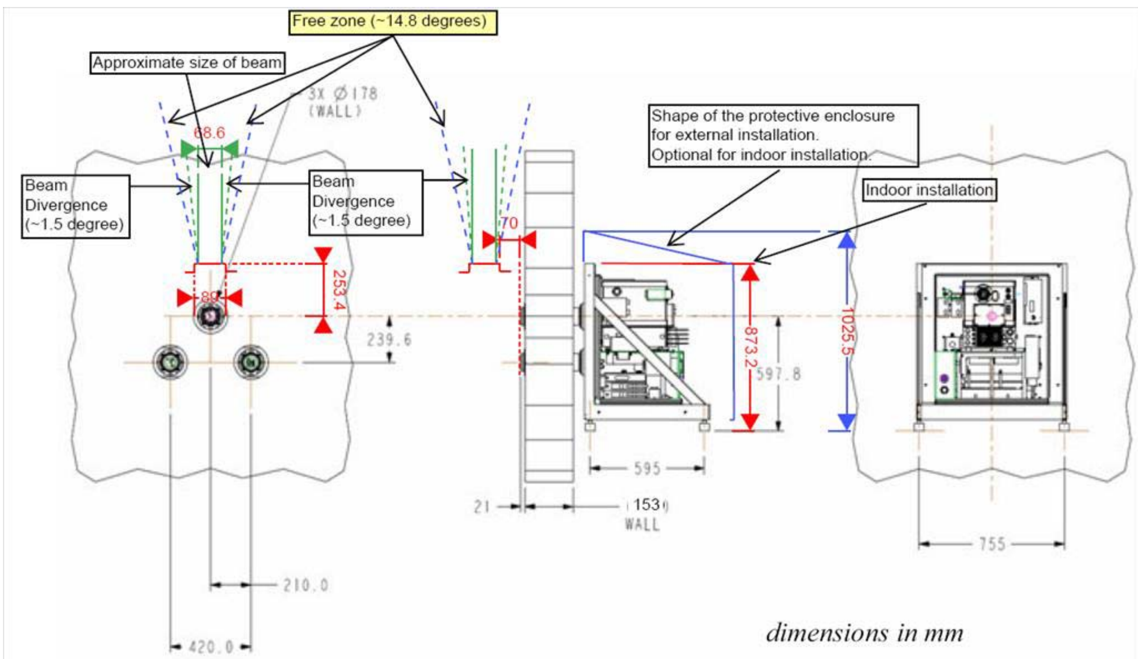


Figure 4-7: Thru-wall mounting base specification

Installation Steps

The system is delivered in three (3) transportation cases. The back-end must first be removed from its mobile base and strongly fixed on its mounting base. To ease handling of the back-end, the temperature control unit, which weighs about 28 kg, should temporarily be removed. When the back-end is strongly fixed on its mounting base, the front-end can be mounted. The final steps are to plug cables and protected segment components. The system is then ready to be started-up.

Back-end Unpacking and Installation

ℹ	The tubes through which the cables from the front-end are linked to the back-end come with an isolation foam filling. Do not remove the isolation.

The detailed steps are as follows:

1. Make sure that the mounting base has been prepared as specified in Facility Requirements on page 28.
2. Open and validate the content of the back-end transportation case. Please refer to Figure 4-8 and delivery checklist.

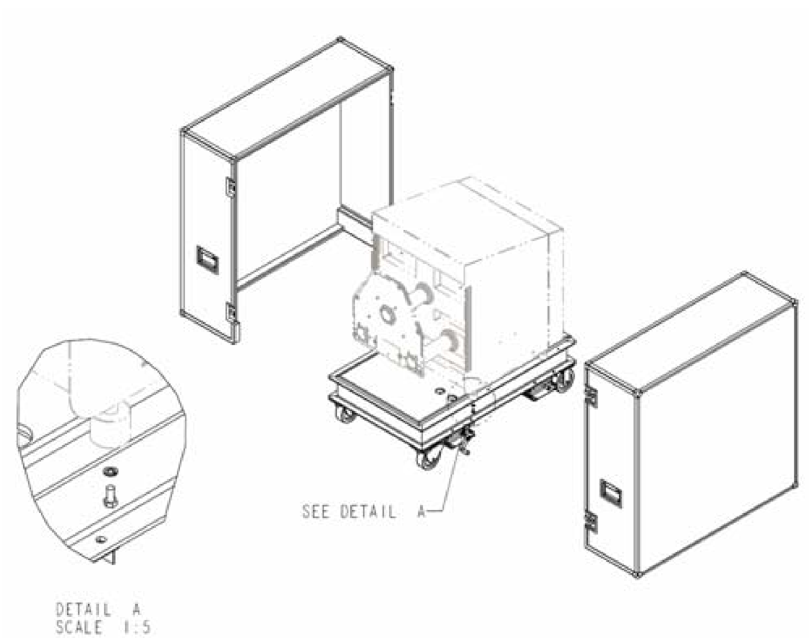


Figure 4-8: Back-end out of its transit case

3. Unscrew the 6 screws holding the protective enclosure in place around the back-end (see Figure 4-10, element (2)) and remove protective enclosure by sliding it towards the back.

> Be careful to disconnect the cable linking the temperature control unit to the back-end as described in the following steps.

4. Remove/unlatch the temperature control unit out of the thermal enclosure. Be careful, when the temperature control unit is unlatched, prior to completely remove it, you need to disconnect the cable that links the back-end to the temperature control unit. To ease handling (Figure 4-10, element (3)), be aware that this unit weighs about 28 kg. Also refer to Figure 4-9
5. Unscrew the 4 damping mounts from the dolly. Please refer to Figure 4-8, elements 1 and 2.
6. For thru-wall configuration, remove the interface plate of the front-end from the back-end and transfer the back-end from the mobile base (see Figure 4-10, element (5)) to its mounting base, as specified in Facility Requirements on page 28. For Stand-alone configuration, lift the back-end, turn 180 degrees and replace it secured with screws on the mobile place. For either of these steps, please make sure that at least 4 persons are available as the back-end is very heavy.
7. IMPORTANT: Adjust the shock mountings of the instrument frame, such that it is leveled, and make sure to strongly fix them to the mounting base, which is itself strongly fixed and secured to the floor.

8. Replace the temperature control unit onto the instrument frame, reconnect the connector (control cable linking the back-end to the temperature control unit) and latch it back onto the thermal enclosure. Refer to Figure 4-9

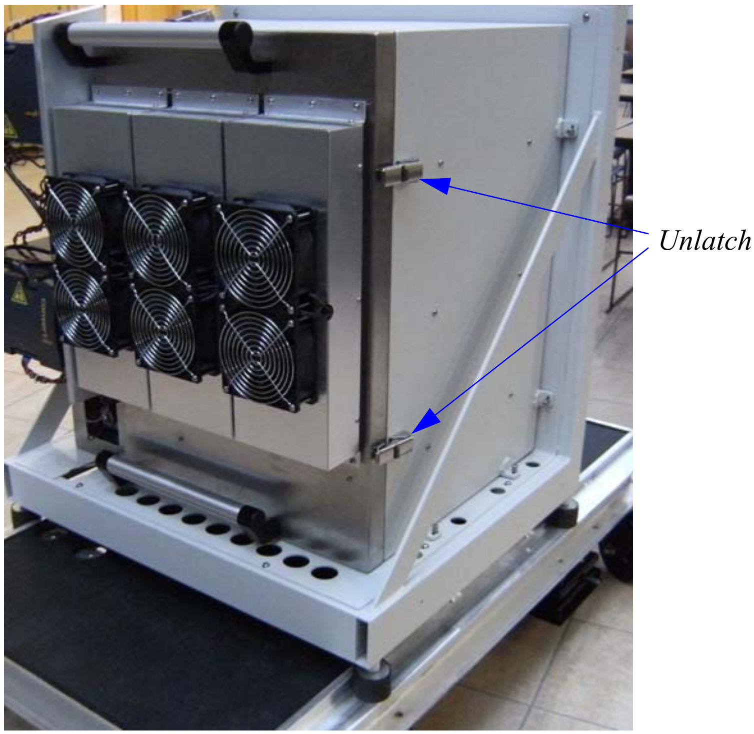


Figure 4-9: Temperature Control Unit

9. Connect the two power connectors and the ethernet connector to the back-end. The cables are in the accessory box. The connectors should be passed through the opening in the frame base in order not to interfere with the protective enclosure.

10. Replace the back-end protective enclosure (optional when the back-end is located inside of a shelter).

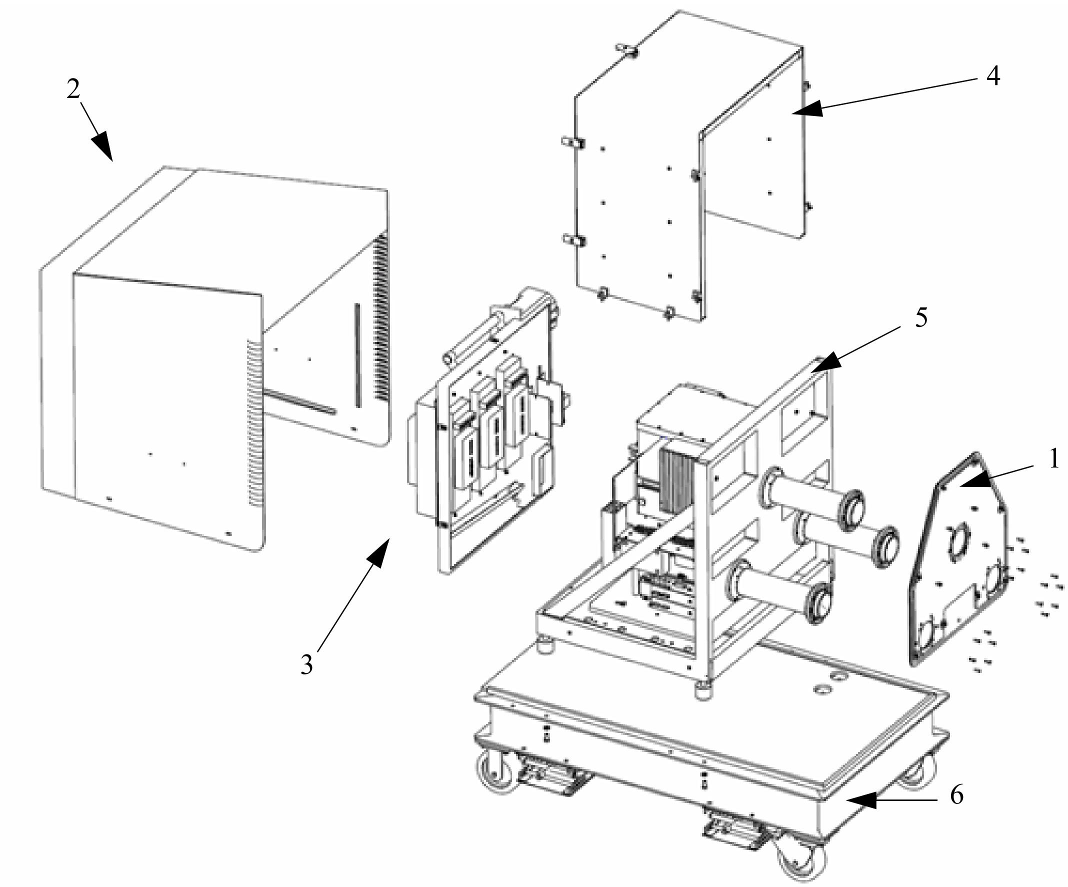


Figure 4-10: Back-end exploded view of interface plate (1), back-end protective enclosure (2), temperature control unit (3), thermal enclosure (4), instrument frame (5) and mobile base (6).

11. Remove all ESD bags, taping from the cables and remove the protection from the optic input port.

Front-end Unpacking and Installation

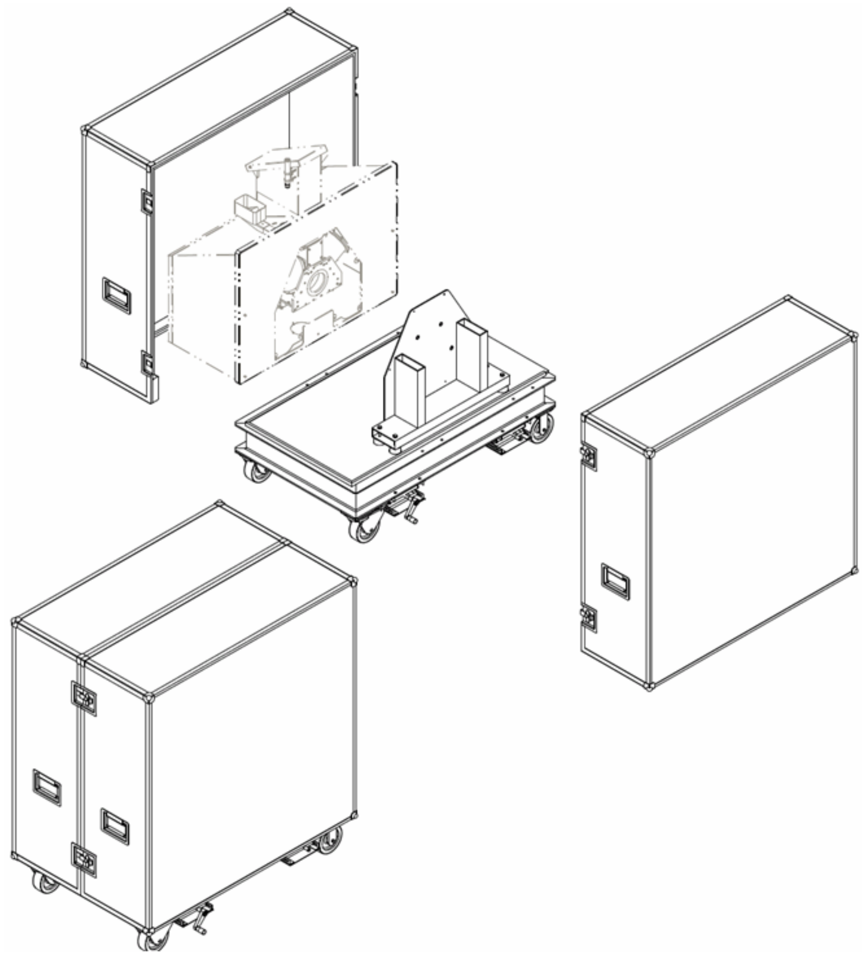


Figure 4-11: EAERI front-end mounted on its dummy interface plate and transit case mobile base

1. Open the front-end transportation case (see Figure 4-11).
2. Remove the front-end protective enclosure front panel.
3. Remove the front-end protective enclosure from its back-plate. To do so, unscrew the 5 screws attaching the protective enclosure to the back plate. Then lift the enclosure to unhook from the back panel bars.

4. Remove the front-end optics from the interface plate dummy of the mobile base. To do so, unscrew first the two bottom nuts. Then remove the two top nuts holding the front-end optics in place. Be careful to push the front-end optics towards the panel and firmly holding the assembly in place while unscrewing to prevent damaging the nuts. After unscrewing the first top screw, you will have to slide the front-end optics sidewards to be able to unscrew the second top nut. Place the front-end optics flat on a cushioned surface.

i	Do not (under any circumstances) unscrew the alignments screws. These are located just underneath the front-end optics assembly, one on the left side and two on the right side. They are easily identified by the black plastic washers around the screws. Refer to Figure 4-12

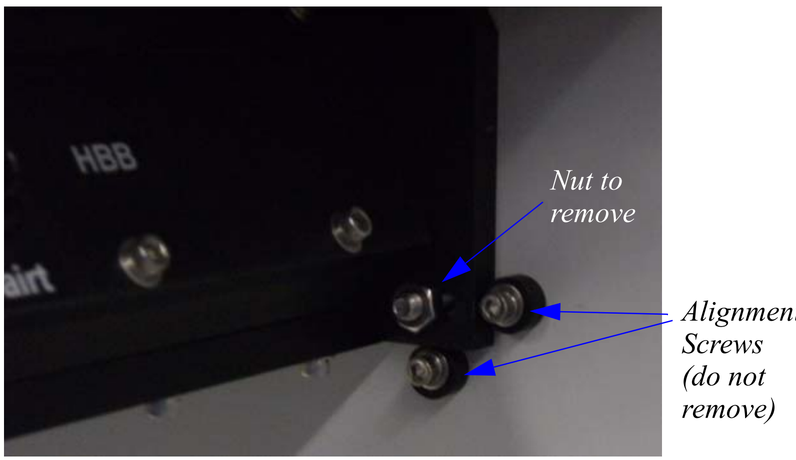


Figure 4-12: Alignments screws

5. Unscrew the front-end interface plate from the dummy front-end plate of the transportation case by means of the 8 screws and washers.

6. Screw the front-end interface plate to the back-end by means of the 8 screws, refer to Figure 4-13 .

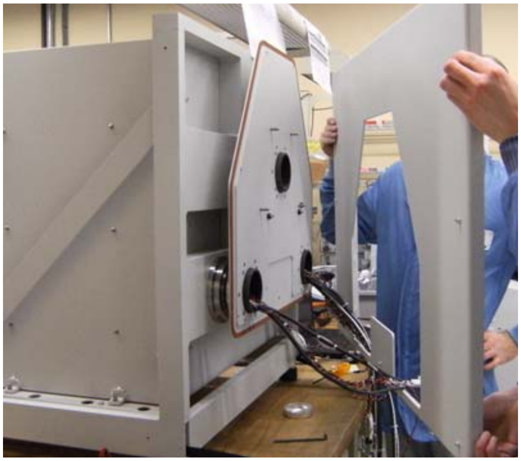


Figure 4-13: Attach front-end interface plate to back-end

7. Install the front-end optic assembly onto the front-end interface plate. Screw first the two top nuts. Access to the screw onto which the nut is to be screwed is limited. Place the hand as flat towards the back panel as possible for this procedure. Refer to Figure 4-14.

Figure 4-14: Attach Front-end Optic assembly to back panel

8. Remove the protection from the optic channel.

9. Tighten the aluminium sleeve around the optics fan. Refer to Figure 4-15

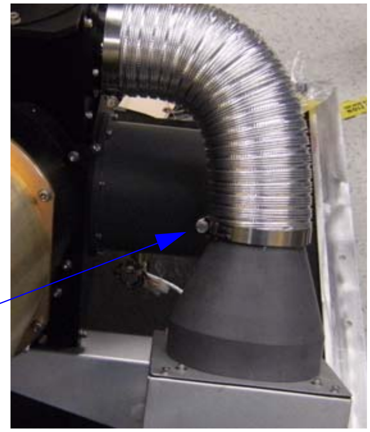


Figure 4-15: Optics Fan Sleeve

10. Connect the cables to the HBB and ABB, then insert the cable into the clamp and screw the clamp to the HBB and on the ABB. Refer to Figure 4-16.

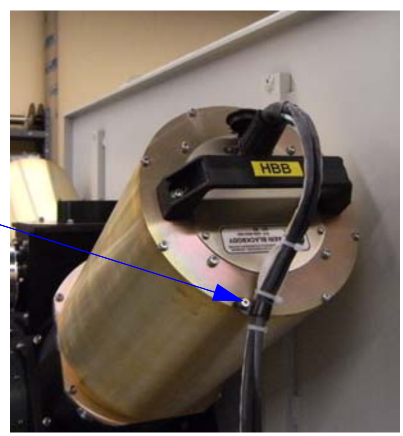


Figure 4-16: Hot Blackbody cable screw

11. Install the front-end protective enclosure. 2 Persons are required to hold the enclosure and insert the hooks of the enclosure and another person to make sure no cables or components inside the enclosure become damaged. Screw the enclosure in place with the 5 screws.

12. Connect cables between front-end and back-end. Table below shows detailed connection schematics for Front-end and Back-end.l

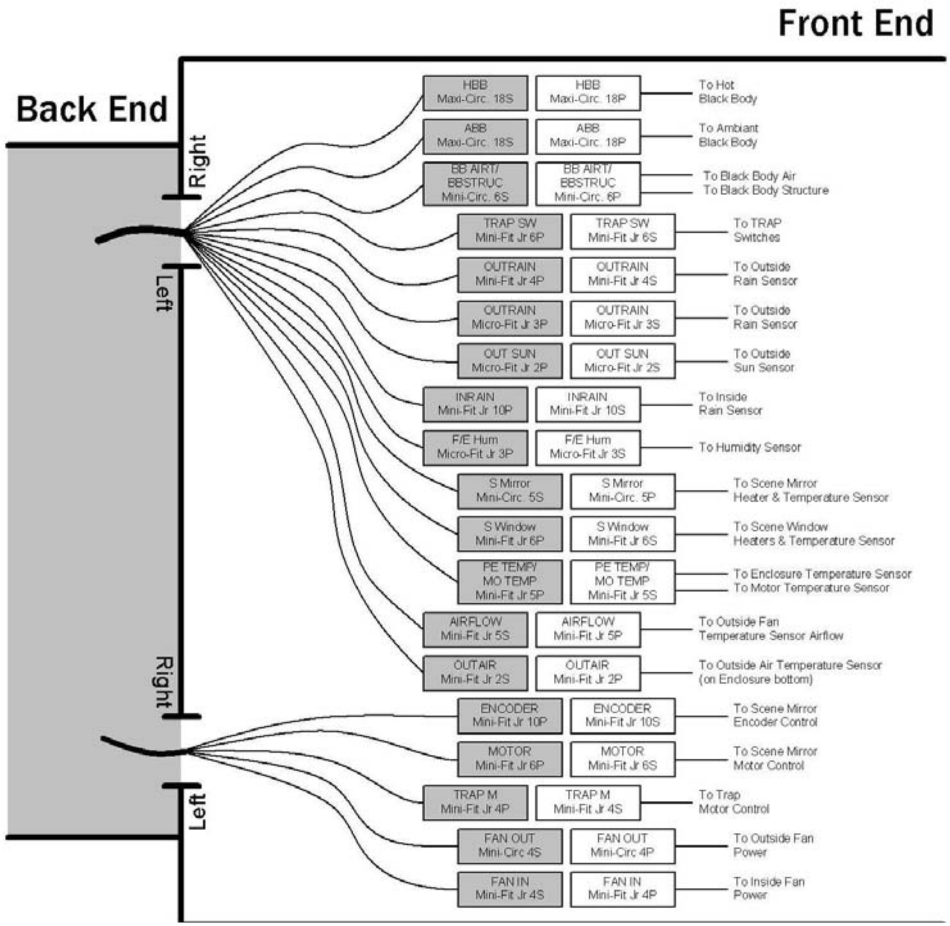


Figure 4-17: Connection between Front-end and Back-end

13. Install the front-end protective enclosure front panel (6 captive screws).

Accessories

1. Open and validate the content of the accessories transportation case with the delivery checklist.

2. Install the switching power supply, the ethernet switch and the laptop on their location, refer to Figure 4-18.

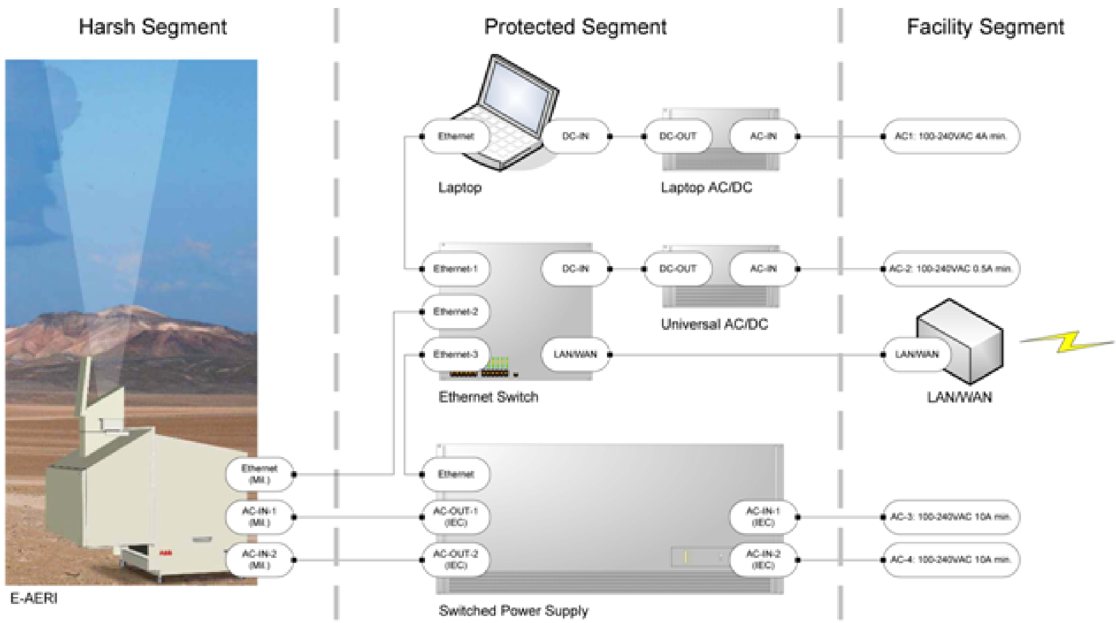


Figure 4-18: System Architecture

3. Plug instrument power cables and into their predefined location of the switchable power supply.
4. Plug the instrument ethernet cable into any location of the ethernet switch.
5. Plug the ethernet cables between the laptop, the switchable power supply and the ethernet switch as shown in Figure 4-18.
6. Plug the laptop, Ethernet switch and switchable power supply power cables into facility power outlet as shown on Figure 4-18.

Section 5 Quick start

AERI and E-AERI system start up procedure

Once the system has been properly installed and connected, refer to Section 4, Unpacking and Installing, refer to the following procedure to start up your system. At this point, system is connected to a power outlet.

⚠	The power outlets are controlled through the software.

The system and all software have been designed to allow auto start mode and all you have to do is to start the computer. The software detects the instrument, turns the power switches on, starts all necessary software. Once all software are properly launched, acquisition will start. If any of the normally automatic steps do not work, below is the manual procedure for the start-up.
The following small sections apply only if for some reason the auto start mode does not work properly or if prefer to start the system manually.

Computer Power-up

STEP 1 Start Computer

STEP 2 Identify yourself as:

User: aeri

Password: go-now

System Power-up

STEP 1 On the laptop, open a web browser.

STEP 2 Enter the IP address as specified in C:\E-AERI\bootbar.add (open this file with Notepad).

STEP 3 Identify yourself as:

User: admin

Password: admin

STEP 4 Select outlets 1 and 5

STEP 5 Click button ON

System Start-up

STEP 1 Open the laptop.

STEP 2 Wait 3 minutes for system initialization.

STEP 3 The Acquisition Sequencer starts.

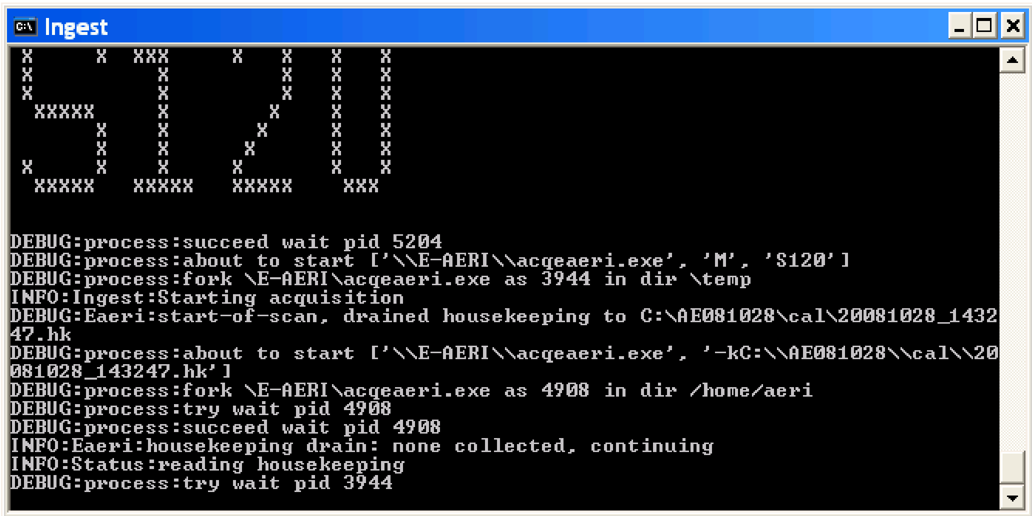


Figure 5- 1. Acquisition Sequencer

STEP 4 The FTSW Software (Instrument Control) starts automatically.

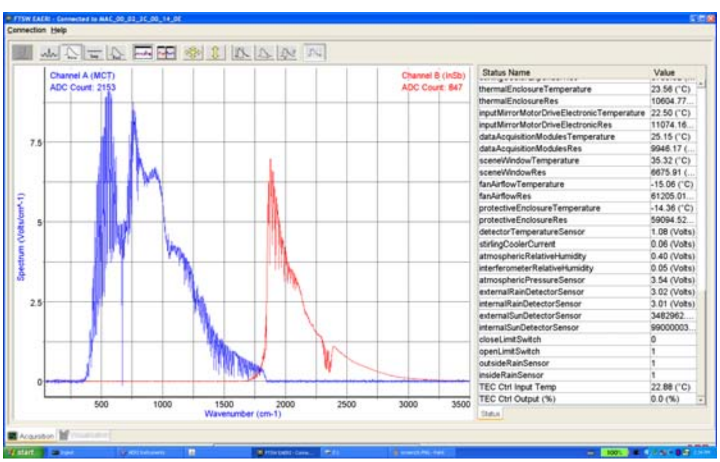


Figure 5- 2. FTSW Software

STEP 5 Connection with the instrument is established.

STEP 6 The AERI Monitoring is accessible through the Monitoring tab.

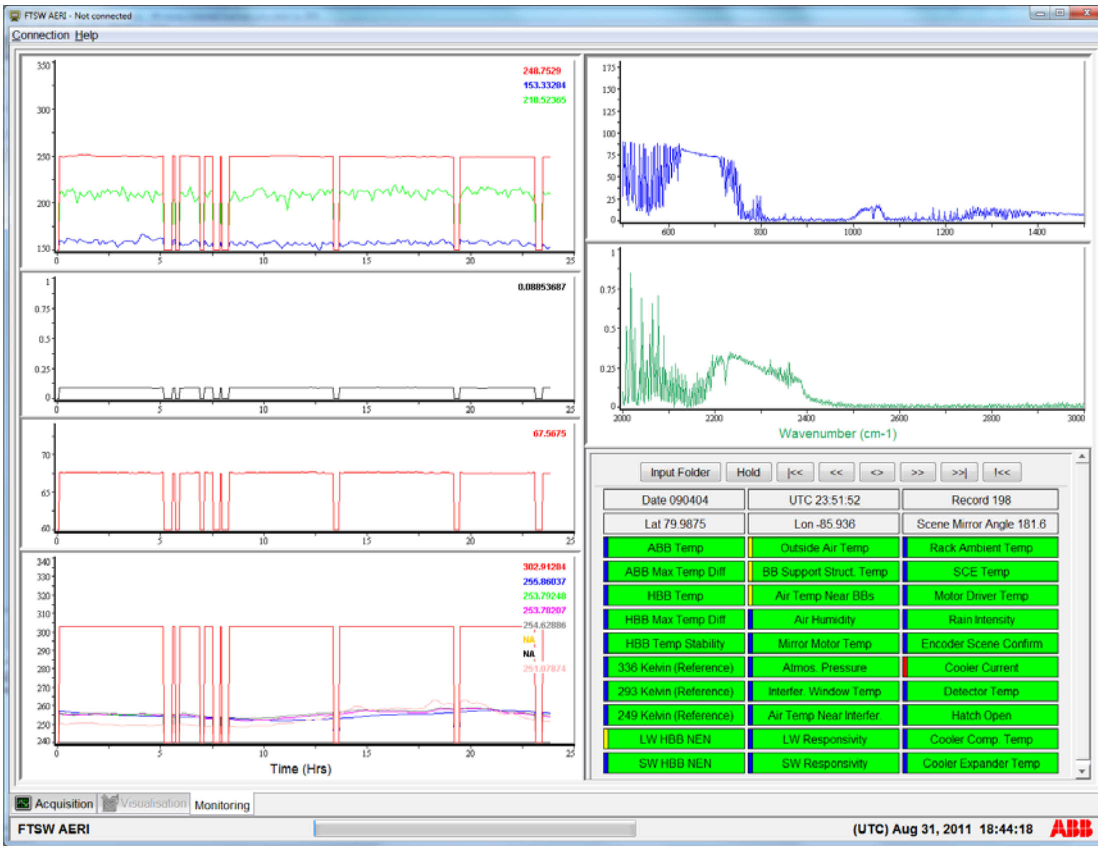


Figure 5- 3. AERI Monitoring

STEP 7 At this point, the AERI system will start acquisition and data is logged.

Close down the system

Stop the acquisition script typing several times CTRL-C in the black window of the Ingest software, until it closes.

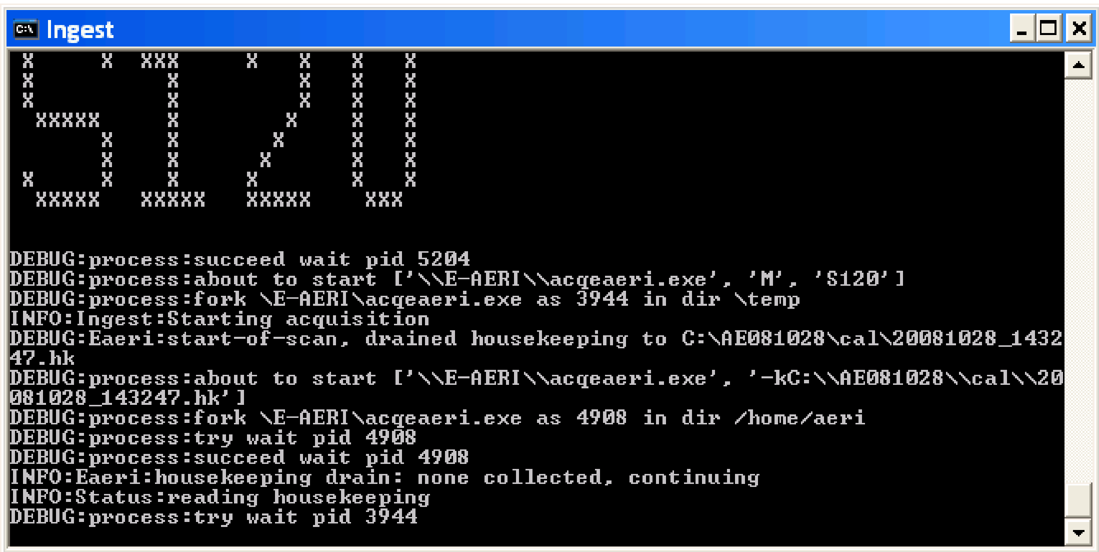


Figure 5- 4. Acquisition Sequencer Window (Ingest)

Close now the FTSW EAERI software.

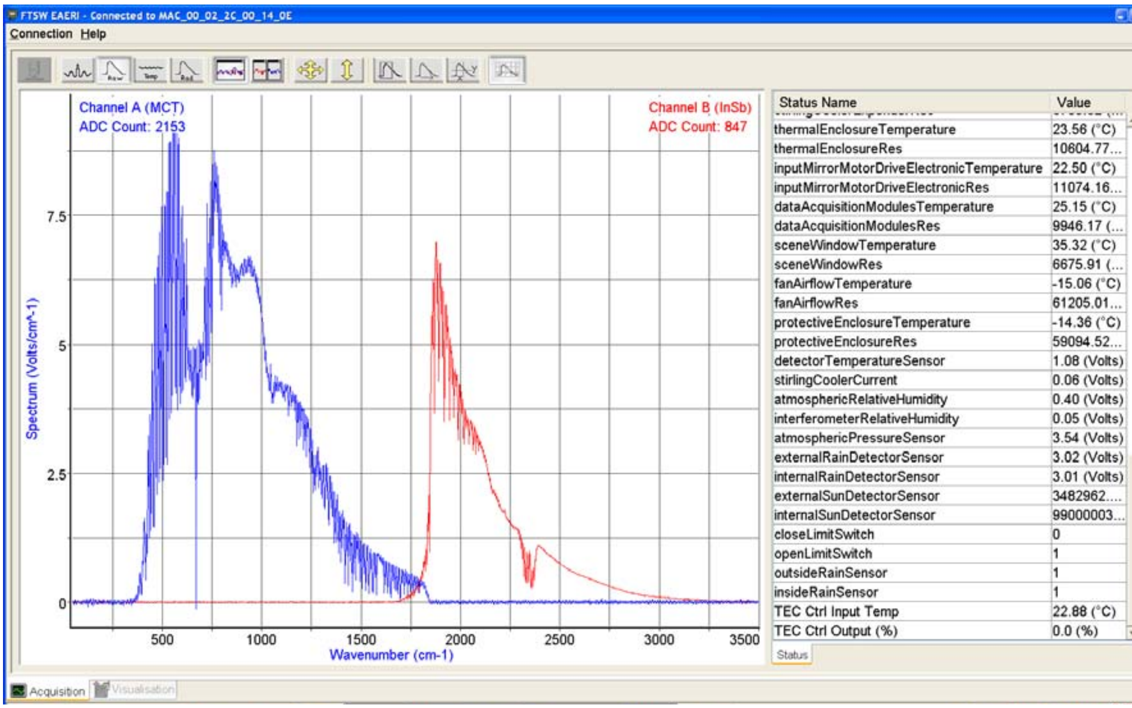


Figure 5- 5. Instrument Control Software Window (FTSW)

Wait 20 seconds, for the software to close properly. The hatch will close automatically even if the system is no longer powered. The hatch closes by means of a spring mechanism. In some cases you may want to close the hatch manually, please refer to How to Manually Open and Close the hatch on page 72.
To turn off the instrument, double click on the "powerOffInst" icon on the desktop.

Figure 5- 6. Power off Instrument Icon

Section 6 Operation

Operation

The system is designed to operate in automatic data acquisition and data storage mode with a minimum of operator interaction. Once the system has been installed by a technical staff it requires only periodic inspection of system components and occasional monitoring of the instrument data stream. This guide is intended to assist personnel in the operation of the instrument including the monitoring of the system system performance.

Routine Operation

The primary routine task is the periodic monitoring of the computer display, known as the Monitoring window that indicates the system status through a panel containing a set of coded lights. When all buttons are GREEN, operation is normal. When the system detects a problem it will cause various Status Indicator Lights (buttons) on the panel to change from green to yellow (warning) and then to red. Yellow or red conditions indicate that the operator should refer to Section 8, Troubleshooting to take appropriate action.
The instrument requires periodic maintenance to help ensure high data quality. Please refer to Section 7, Maintenance for details regarding the schedule and procedure for this maintenance.

Start/Restart

The system is designed to start operation automatically upon power up. All modules should be powered before the system begins data collection. The AERI or E-AERI system also requires that the Front-End and Back-end are each properly connected to a local area network in order to communicate information between them.

Software Architecture

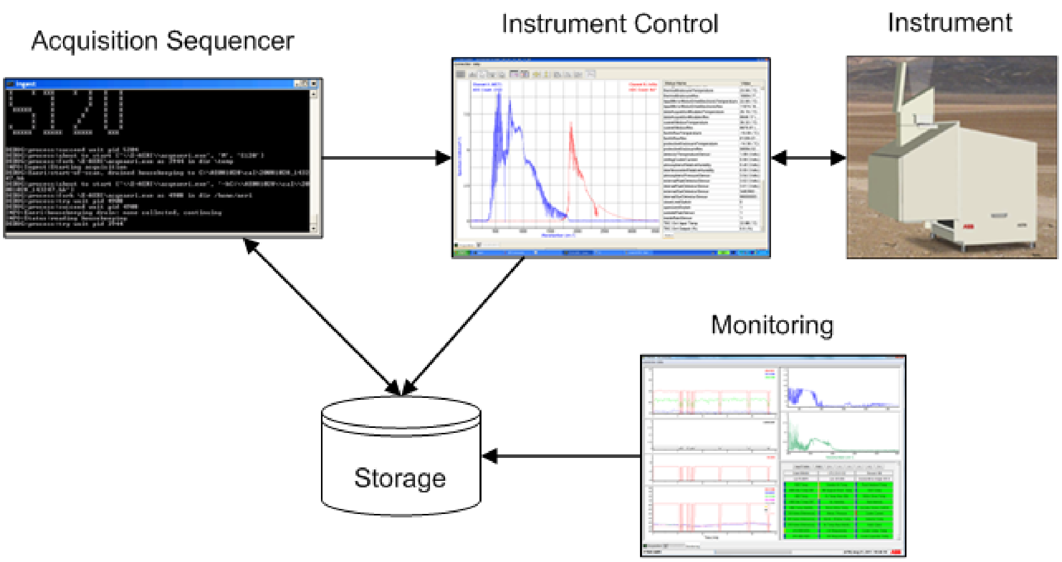


Figure 6- 1. Software Architecture

Figure 6- 1 shows the 4 software components:

- Acquisition Sequencer (Ingest),
- Instrument Control (FTSW AERI, acquisition tab),
- Monitoring (FTSW, monitoring tab),
- Storage.

Data Structure and Data Flow

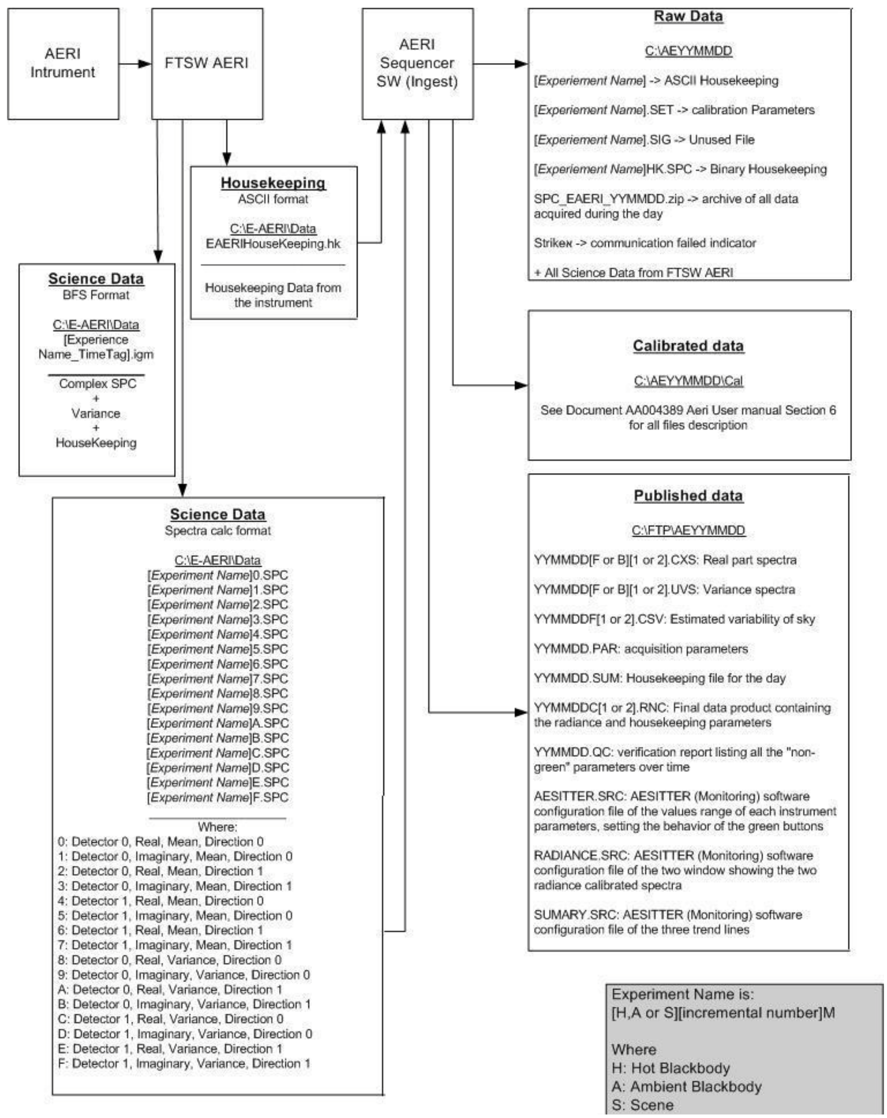


Figure 6- 2. Data Flow of the AERI system

Directory contents are described in the following list:
C:\aeri: Contains tools for the data processing of the Sequencer
C:\aeri_run: Contains the components of the Sequencer
C:\config: Contains configurations files for the Sequencer

In some cases it might be necessary to modify the config file. As a precaution, please copy the default file to be able to overwrite a config file that was modified incorrectly.

C:\E-AERI: Contains the components of the Instrument Control
C:\AEYYMMDD: Directory with name structured like AEYYMMDD, contain data recorded during the day dated year YY, month MM, and day DD.
C:\FTP: Contains directory with name structured like AEYYMMDD, which contain some output data for the corresponding day.

Data Directory Content

C:\AEYYMMDD

This directory contains raw data files and calibrated data files inside a sub-directory. The raw data file name convention begins with one of the three letters A, H, or S, followed by the record number, and something that identifies the file content. The majority of files follow this naming convention. The first letters stand for: “A” for ambient blackbody, “H” for hot blackbody, and “S” for the scene. The record number varies between 1 and 200 approximately.
The files categories are:

A155: Text file used to transmit the housekeeping data between the Instrument Control and the Sequencer.
A155.FIN: Text file containing the path to the *.SIG file.
A155.SET: Text file containing some parameters for the calibration. Some parameters are obsolete.
A155.SIG: Unused file
A155HK.SPC: File containing housekeeping parameters for the record.
A155M0.SPC: File containing the real part of the average spectrum for the long wave detector, forward direction.
A155M1.SPC: File containing the imaginary part of the average spectrum for the long wave detector, forward direction.
A155M2.SPC: File containing the real part of the average spectrum for the long wave detector, reverse direction.
A155M3.SPC: File containing the imaginary part of the average spectrum for the long wave detector, reverse direction.
A155M4.SPC: File containing the real part of the average spectrum for the short wave detector, forward direction.
A155M5.SPC: File containing the imaginary part of the average spectrum for the short wave detector, forward direction.

A155M6.SPC: File containing the real part of the average spectrum for the short wave detector, reverse direction.

A155M7.SPC: File containing the imaginary part of the average spectrum for the short wave detector, reverse direction.

A155M8.SPC: File containing the real part of the variance of spectra for the long wave detector, forward direction.

A155M9.SPC: File containing the imaginary part of the variance of spectra for the long wave detector, forward direction.

A155MA.SPC: File containing the real part of the variance of spectra for the long wave detector, reverse direction.

A155MB.SPC: File containing the real part of the variance of spectra for the long wave detector, reverse direction.

A155MC.SPC: File containing the real part of the variance of spectra for the short wave detector, forward direction.

A155MD.SPC: File containing the imaginary part of the variance of spectra for the short wave detector, forward direction.

A155ME.SPC: File containing the real part of the variance of spectra for the short wave detector, reverse direction.

A155MF.SPC: File containing the imaginary part of the variance of spectra for the short wave detector, reverse direction.

A155M_20081022_195857_Res1__1.Igm: Raw data in interferogram format. This file also contains housekeeping parameters. The file name in this case also contains the date and the recorded time (YYYYMMDD_HHMMSS).

> The Igm files are readable with the FTSW software (Instrument Control).

AERI.CTL: Text file containing description of errors logged.

SPC_EAERI_081022.zip: ZIP file containing the raw data files that have been calibrated during the day.

strike1: File to indicate that one attempt to communicate with the instrument failed. Three attempts are tried (strike1, strike2, strike3).

cal\: Sub-directory containing the calibrated data and log files.

Of the SPC files, only *HK.SPC is not an SPC file from GRAMS, all the other SPC files can be opened with a software compatible with GRAMS.

C:\AEYYMMDD\cal

This directory contains the calibrated data. All the files in that folder are generated by the calibration process. However, only the files with the name composed of the recorded date contains important data. Other files, with none “unique” file name are for debugging purposes; they will be regenerated if the raw data is reprocessed. Renaming those files has no impact on the processing once the data is from a previous day. Below is the file content for the “cal” folder.

C:\AEYYMMDD\cal

CAVEMIS1.MLT:	Blackbody emissivity for the long wave length range
CAVEMIS2.MLT:	Blackbody emissivity for the short wave length range
090404B1.LVF:	Log file identifying the corresponding variance file in FTP\AE090404
090404B2.LVF:	Log file identifying the corresponding variance file in FTP\AE090404
090404F1.LVF:	Log file identifying the corresponding variance file in FTP\AE090404
090404F2.LVF:	Log file identifying the corresponding variance file in FTP\AE090404
ZFLI.LO1:	Log file for the ZFLI process for the long wave length band
ZFLI.LO2:	Log file for the ZFLI process for the short wave length band
090404F1.LNL:	Log file for the NLAPP process
090404B1.LNL:	Log file for the NLAPP process
SCNDIRAV.LC1:	Log file for the SCNDIRAV the long wave length band
SCNDIRAV.LC2:	Log file for the SCNDIRAV the short wave length band
090404F1.IMC:	Diagnostic file for forward scan of the long wave length band
090404F2.IMC:	Diagnostic file for forward scan of the short wave length band
090404B1.IMC:	Diagnostic file for backward scan of the long wave length band
090404B2.IMC:	Diagnostic file for backward scan of the short wave length band
090404F1.CXV:	Real part corrected for non-linearity (if any) for forward scan spectra of the long wave length band
090404B1.CXV:	Real part corrected for non-linearity (if any) for backward scan spectra of the short wave length band No correction needed for the short wave length band.
090404F1.CVS:	Variance file for forward scan of the long wave length band
090404F2.CVS:	Variance file for forward scan of the short wave length band
090404B1.CVS:	Variance file for backward scan of the long wave length band
090404B2.CVS:	Variance file for backward scan of the short wave length band
090404F1.RES:	Responsivity file for forward scan of the long wave length band
090404F2.RES:	Responsivity file for forward scan of the short wave length band
090404B1.RES:	Responsivity file for backward scan of the long wave length band
090404B2.RES:	Responsivity file for backward scan of the short wave length band
090404C1.RFC:	Radiance corrected for field of view effect for the long wave length band
090404C2.RFC:	Radiance corrected for field of view effect for the short wave length band
090404F1.RLC:	Radiance file for forward scan of the long wave length band
090404F2.RLC:	Radiance file for forward scan of the short wave length band
090404B1.RLC:	Radiance file for backward scan of the long wave length band
090404B2.RLC:	Radiance file for backward scan of the short wave length
090404C1.RLC:	Mean forward and backward radiance for the long wave length band
090404C2.RLC:	Mean forward and backward radiance for the short wave length band
RWASPC.STA:	Log file
RWASPC.LOG:	Log file
090404F1.LOG:	Log file
090404F2.LOG:	Log file
090404B1.LOG:	Log file

090404B2.LOG:	Log file
AERISUM.LOG:	Log file
FFOVCMR.LOG:	Log file

C:\FTP\AEYYMMDD

All the files in this folder are produced by the calibration process. Only the files with the name composed of the recorded date contain important data. The three other files were previously used for the monitoring GUI when the data was recorded. Those three files are a copy of what can be found in the C:\config directory when the data was acquired. Renaming those files has no impact on the processing once the data is from a previous day. The new file for the monitoring tab is MonitoringConfig.xml described below.

Below are the file content description for the FTP folder.

090404F1.CXS:	Real part for forward scan spectra for the long wave length band
090404F2.CXS:	Real part for forward scan spectra for the short wave length band
090404B1.CXS:	Real part for backward scan spectra for the long wave length band
090404B2.CXS:	Real part for backward scan spectra for the short wave length band
090404F1.UVS:	Variance for forward scan spectra for the long wave length band
090404F2.UVS:	Variance for forward scan spectra for the short wave length band
090404B1.UVS:	Variance for backward scan spectra for the long wave length band
090404B2.UVS:	Variance for backward scan spectra for the short wave length band
090404F1.CSV:	Estimated variability of sky for the long wave length band
090404F2.CSV:	Estimated variability of sky for the short wave length band
090404.PAR:	File containing parameters used during acquisition
090404.SUM:	Housekeeping file for the day
090404C1.RNC:	Final data product containing the radiance and housekeeping parameters for the long wave length band
090404C2.RNC:	Final data product containing the radiance and housekeeping parameters for the long wave length band
090404.QC:	Quality control file listing each parameter which are not green. The files contains the actual value and the "severity" level used.
AESITTER.SCR:	For AESITTER, contains090404.PAR (no longer used).
RADIANCE.SCR:	Is used to configure the two windows showing the two radiance calibrated spectra in the AESITTER (Monitoring) software (no longer used).
SUMARY.SCR:	File is used to configure the values range of each instrument parameter and determines the behavior of the green buttons, i.e. is used to configure the three trend lines on the left of the AESITTER (Monitoring) software (no longer used).

The last three files, which are contained in the YYMMDD.PAR file, were used to configure the AESITTER (Monitoring) software but are now no longer used.

MonitoringConfig.xml

The monitoring tab (under Instrument Control FTSW) can be edited in the MonitoringConfig.xml file located under E-AERI. Always keep a backup copy of the original MonitoringConfig.xml file.

AERIPROF

The two files needed for AERIPROF are YYMMDDC1.RNC and YYMMDDC2.RNC.

Software Components

Acquisition Sequencer (Ingest)

The Acquisition Sequencer is responsible for the overall acquisition scheme, the calibration, it computes some diagnostics parameters, saves and moves the data to the appropriate location on the hard drive. The Acquisition Sequencer sends the command to the Instrument Control to obtain the raw data coming from the instrument. Debug information is displayed, showing the type of target observed, and the target sequence number.

Instrument Control (Acquisition tab FTSW)

The Instrument Control is responsible for the actual acquisition with the instrument. It receives the commands from the Acquisition Sequencer, and relays them to the instrument. It decodes the data packets coming from the instrument and formats them to be used by the Acquisition Sequencer. In automatic mode, the Instrument

Control is the FTSW AERI software in slave mode. The FTSW AERI software can also be used to manually control the instrument.

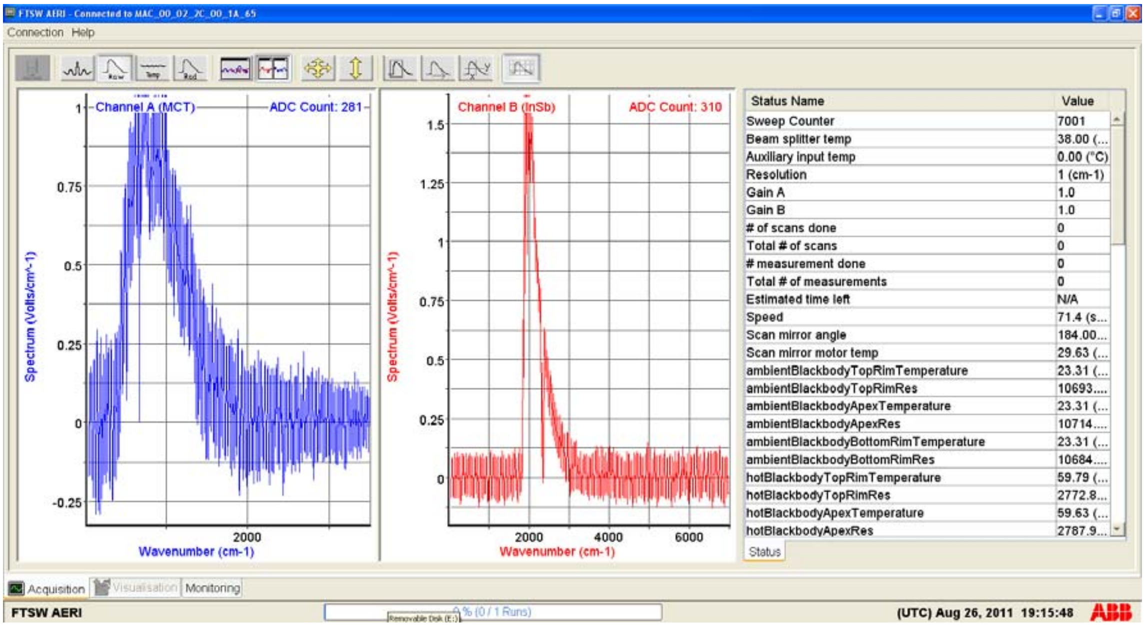


Figure 6- 3. Instrument Control in Slave Mode

Monitoring (Monitoring tab in FTSW)

The Monitoring is responsible to monitor the state of the system. Calibrated spectra and some auxiliary parameters are displayed in semi-real-time. This application is not required for the system to operate. It can be launched multiple times and manually if needed. It is possible to navigate the data recorded previously during the day.

Figure 6- 4 shows an actual display of the Monitoring software of an operating system. The layout is divided in 6 zones.

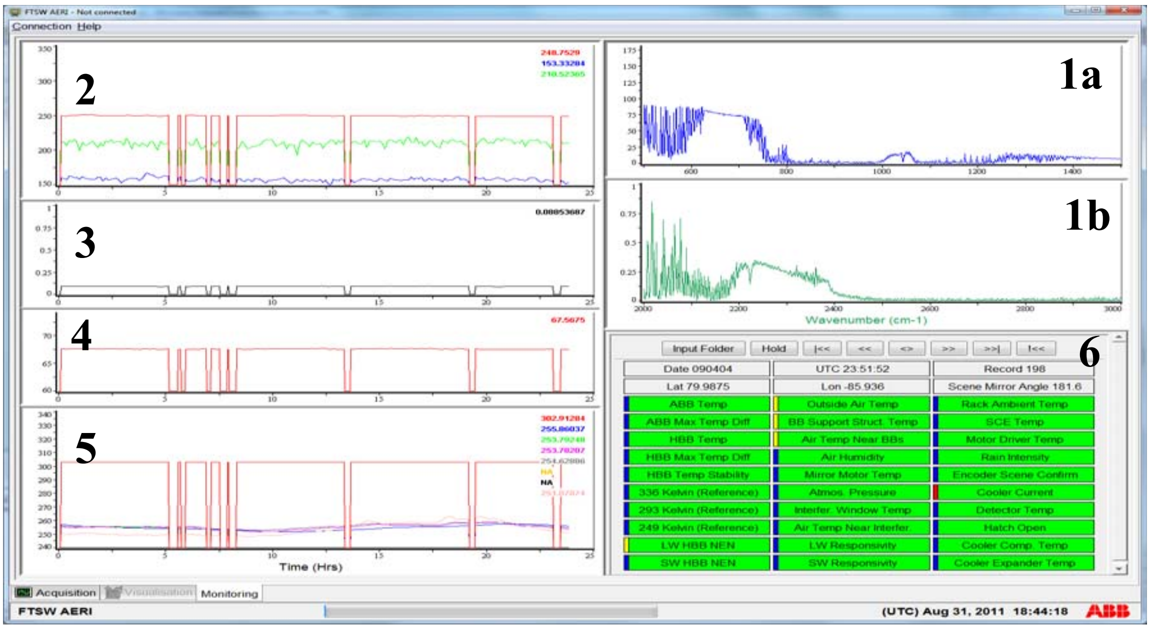


Figure 6- 4. Monitoring Software

Sections identified 1a and 1b in Figure 6- 4 display radiance. Region 1a shows the radiance for the long wave band, and the region 1b shows the radiance for the short wave band. It is possible to zoom a region by left-clicking, and while holding, move diagonally to expand the zoom box.

Zone 2 displays computed air temperature in Kelvin for the three spectral bands:

- Red: Longwave Surface air B. T. (675 to 680 cm^{-1})
- Blue: Longwave Window B. T. (985 to 990 cm^{-1})
- Green: Shortwave Window B. T. (2510 to 2515 cm^{-1})

> When no valid data is available for zones 2-5, the software includes point(s) at the bottom of the graph to emphasize the missing data. For example, when the hatch opens or closes, the temperature readings are not valid and the graphs display drops in otherwise stable curves/lines. These drops can be ignored.

Zone 3 displays the Stirling cooler current (black curve).

Zone 4 displays the detector temperature in Kelvin (red curve).

Zone 5 displays measured temperature in Kelvin at different locations in the system. Refer to

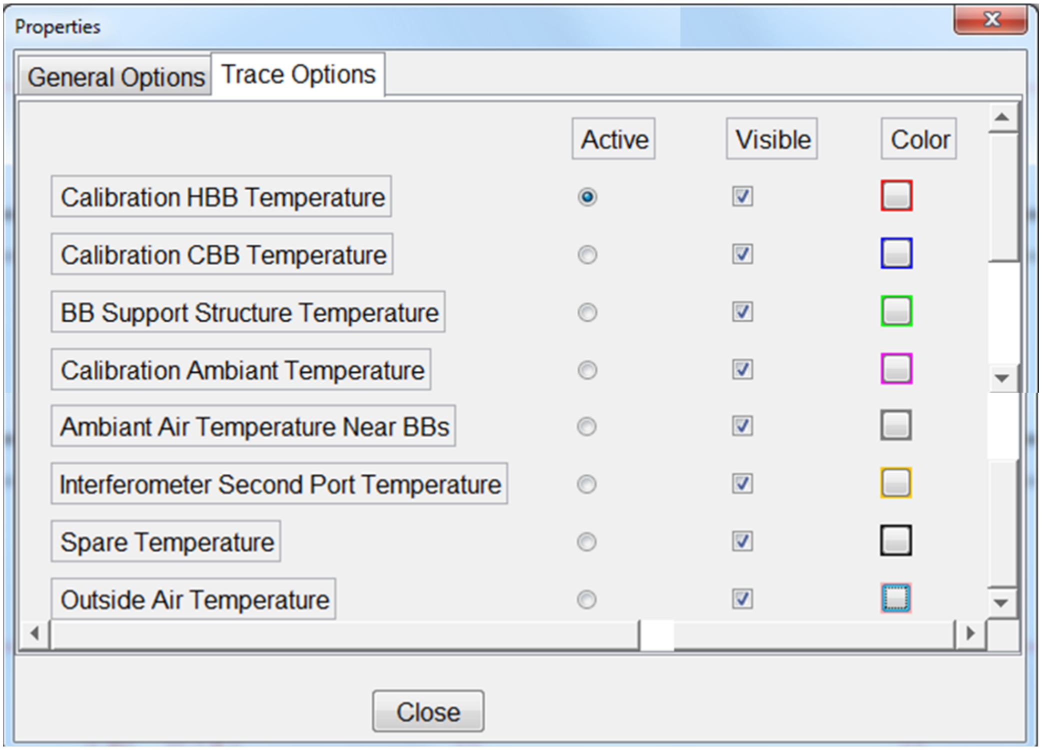


Figure 6- 5. Trace options dialog box

- Red: Hot blackbody
- Blue: Cold blackbody
- Dark green: Blackbody support structure
- Bright Pink: Calibration ambient temperature
- Gray: Air temperature near blackbodies
- Yellow: Outside air temperature
- Black: Spare Temperature
- Soft pink: Outside Air Temperature

Zone 6 contains navigation buttons and scalar validation parameters. This zone is divided in three sections: navigation buttons, localization, and parameters. The navigation buttons functions are:

Figure 6- 6. Navigation buttons

Input Folder	Opens a dialog box to visualize previously saved data sequences.
Hold	The Hold button freezes the graphs (1a, 1b, 2, 3, and 4). The graphs are no longer updated until they are un-frozen by pressing the Hold button one more time.
|<<	This button brings you to the beginning of the data set (data lot). One data set is recorded per day.
<<	This buttons allows to navigate one sequence measurement backwards
Hold	GO TO button. Clicking this button will open a dialog box to chose which recording to go to.
>>	This buttons allows to navigate one sequence measurement forward.
>>|	This button navigates to the end of the data set (data lot). One data set is recorded per day.
|<<	This buttons allows to navigate one sequence measurement backwards but displaying only modifications of the monitoring button statuses.

Also, 6 “buttons” are used to display the date the data was recorded, the UTC time, the record number of the data, the latitude and longitudes of the instrument, and the scene mirror angle in degrees. The scene mirror angle is always around 180 degrees, it is the normal mirror position for scene observation
The thirty color buttons are parameters indicating the state of the instrument. The level of importance of each is not equal, some are more critical than other. The color scheme is composed of 4 colors. The green indicates that everything is nominal. The yellow indicates that the parameter is still within the performances limits, but a watchful eye must be kept. The red indicates that the parameter is out of range and technical support is required. The blue indicates a missing data during the day period of acquisition. On the left of each button, a small vertical bar of the color of the worst state of the day is displayed.
Starting from the left (see Figure 6- 7).

- ABB Temp: Cold blackbody temperature used in calibration.
- ABB Max Temp Diff: Maximum temperature difference between the three temperature sensors inside the ambient blackbody.
- HBB Temp: Hot blackbody temperature used in calibration.
- HBB Max Temp Diff: Maximum temperature difference between the three temperature sensors inside the hot blackbody.
- HBB Temp Stability: The maximum excursion of hot blackbody temperature over 5 consecutive scenes, centered on the sky view.
- 336 Kelvin (Reference): Resistive temperature of 2500 Ohm fixed resistor - banana plug mounted.
- 293 Kelvin (Reference): Resistive temperature of 12 Kohm fixed resistor located in SCE-P3 shell.
- 249 Kelvin (Reference): Resistive temperature of 97 Kohm fixed resistor located in SCE-P4 shell.
- LW HBB NEN: Noise equivalent Radiance in hot blackbody at 1000 cm^{-1}.
- SW HBB NEN: Noise equivalent Radiance in hot blackbody at 2500 cm^{-1}.
- Outside Air Temp: Ambient air temperature at hatch opening.
- BB Support Struct. Temp: Temperature of the AERI blackbody support structure.
- Air Temp Near BBs: Ambient air temperature near blackbodies.
- Air Humidity: Relative humidity measured near Blackbodies. Use with Air Temperature Near BBs only.
- Mirror Motor Temp: Scene mirror motor case temperature.
- Atmos. Pressure: Observation atmospheric pressure in AERI electronics.
- Interfer. Window Temp: Interferometer window temperature measured on the outside of the aluminium window flange.
- Air Temp. Near Interfer.: Ambiant air temperature near the interferometer.
- LW Responsivity: Characteristic value representing overall longwave channel responsivity.
- SW Responsivity: Characteristic value representing overall shortwave channel responsivity.
- Rack Ambient Temp: Temperature of the rack holding the black bodies.

- SCE: Signal Conditioning Electronics inside air temperature.
- Motor Driver Temp: Scene mirror motor driver heat sink temperature.
- Rain Intensity: Rain sensor analog output: the rain sensor is located inside the hatch near the sky aperture and is used to flag critical condition of rain falling on the AERI sky aperture. If rain is detected, the AERI mirror will be safed to the down looking position. The rain sensor is not used to close the AERI viewing hatch; it could be viewed as an independent indicator of a situation where the hatch has not closed to protect the AERI interferometer front end in the presence of rain.
- Encoder Scene Confirm: Difference between the actual and ideal motor encoder values for current view; indicative of quality of the mirror positioning.
- Cooler Current: Stirling cycle cooler current.
- Detector Temp: Detector temperature sensed via diode near detector.
- Hatch Open: Hatch status indicator, boolean with negative error conditions that can be open, closed or indicate an error.
- Cooler Comp. Temp: Stirling cooler compressor temperature measured at compressor heatsink.
- Cooler Expander Temp: Temperature of the hot end of the detector's cooler.

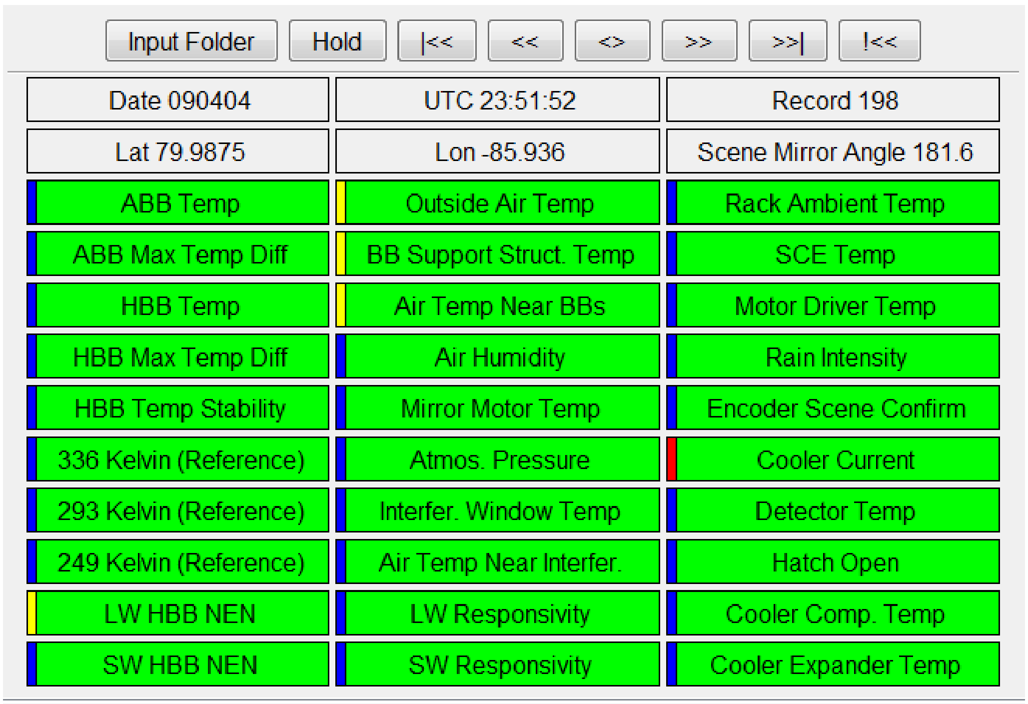


Figure 6- 7. Monitoring Parameters

Left-clicking each button will open a detailed view for the parameter. Figure 6- 8 shows an example for the Cooler compressor's temperature. The name of the parameter is displayed, the record number, actual value, green and yellow range values, and small description of the parameter.

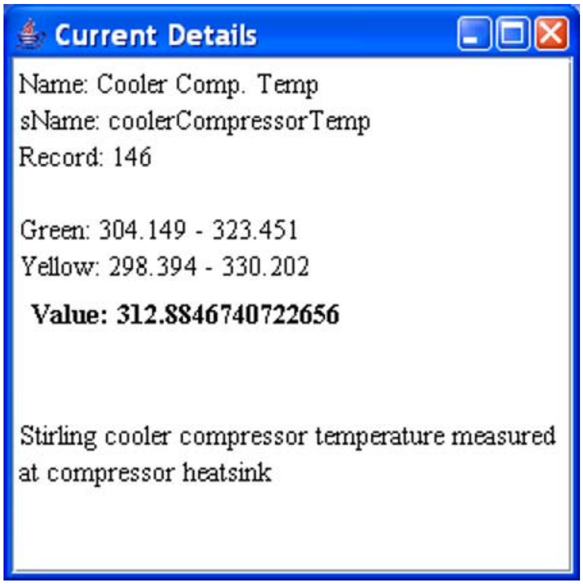


Figure 6- 8. Monitoring parameters lookup window

If the Monitoring buttons are red or yellow but should be green, contact ABB as the configuration file may require adjustment for your application or geographic location.

Storage

Storage is simply the hard drive of the computer on which the AERI software suite is installed. Each acquisition is recorded individually to prevent any data loss if a power failure occurs. Some folders are working folders, some for data transmission, and others for storage. Of course, the user must on regular basis perform some maintenance to prevent excessive disk fragmentation.

Tidy.py Module

The AERI software suite includes also a utility software, called Tidy.py that as a background process cleans up enough space for the full day's data to reside on the disk. This is done by identifying directory purge groups, finding their sizes, and deleting them to free up the necessary space. Purge groups are logically complete days worth of processed data, e.g. both the FTP\AEyymmdd and \AEyymmdd are part of one purge group. The main functions of Tidy are:

- make sure there's enough space to begin taking data,
- clear unused raw data out of workspace directories,
- create new work directories for data ingest and processing,
- clear out data in permitted directories based on age-order to ensure enough data for full-day runs,
- move raw data from the ingest “temporary” directory to the data processing directory when .SIG signal files are created by the data ingest loop,
- delete or ZIP-archive raw data when .FIN signal files are presented by data processing code,
- manage “OUTGOING” directory for systems where site requests all outgoing data be in one place,
- collect startup configuration files, generating a .PAR file which accompanies the science data.

In the event that there's an error that cannot be handled by Tidy, Python exceptions will cascade up to the main Ingest level, errors and a backtrace should get logged, and the ingest system and its child processes should shut down after several restart attempts.

How to Launch the FTSW Software in Interface mode

STEP 1 Open the laptop.

STEP 2 Wait 3 minutes for system initialization.

STEP 3 Launch the FTSW data acquisition software in the Interface mode.

- Launch FTSW EAERI GUI Sim.bat if you are running the software with a simulator.
- Launch FTSW EAERI GUI.bat if you are running the software with the spectroradiometer.

If data is displayed in the graphs, then connection is established. Otherwise refer to Section Troubleshooting.

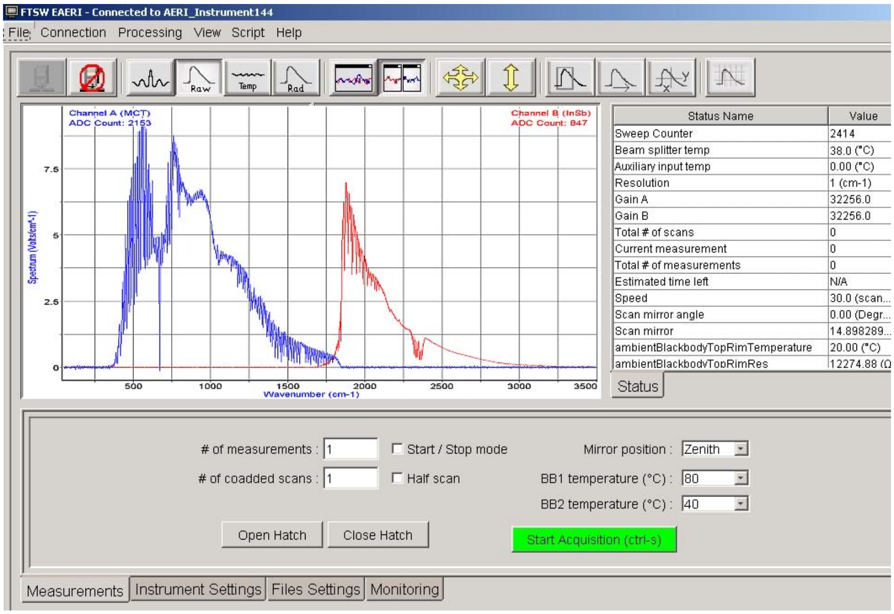


Figure 6- 9. Interface mode

How to Start Acquisition

STEP 1 Launch the FTSW AERI data acquisition software in the Interface mode.

STEP 2 Launch the acquisition by selecting the Start Acquisition button.

How to Launch the Software in Operational mode

STEP 1 Open the laptop.

STEP 2 Wait 3 minutes for system initialization.

STEP 3 Launch the FTSW data acquisition software in the operational mode.

- Launch FTSW EAERI Sim.bat if you are running the software with a simulator.

- Launch FTSW EAERI.bat if you are running the software with the E-AERI spectroradiometer.

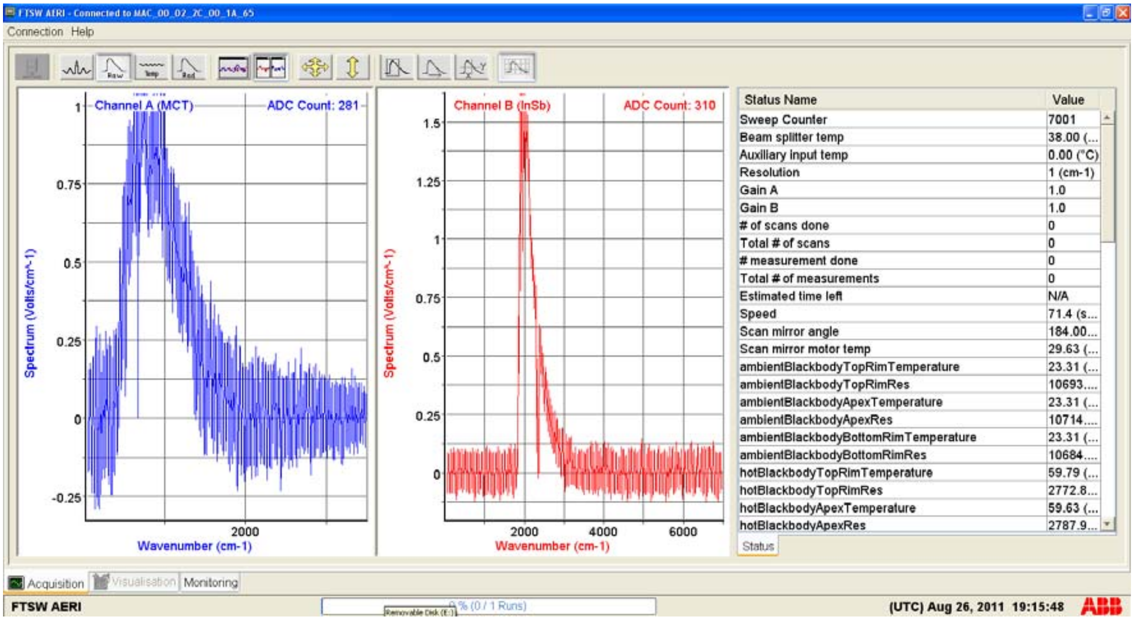


Figure 6- 10. Example of established connection in Operational mode.

SHUTTING DOWN THE SYSTEM

Stop the acquisition script typing several times CTRL-C in the Ingest (Cygwin) black window, until it closes.

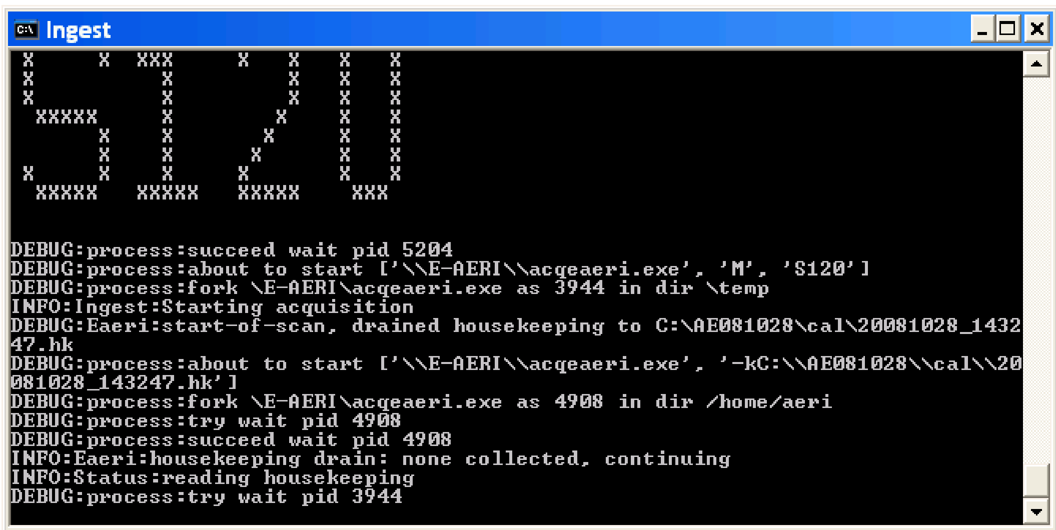


Figure 6- 11. Acquisition Sequencer Window (Ingest)

Close now the FTSW EAERI software.

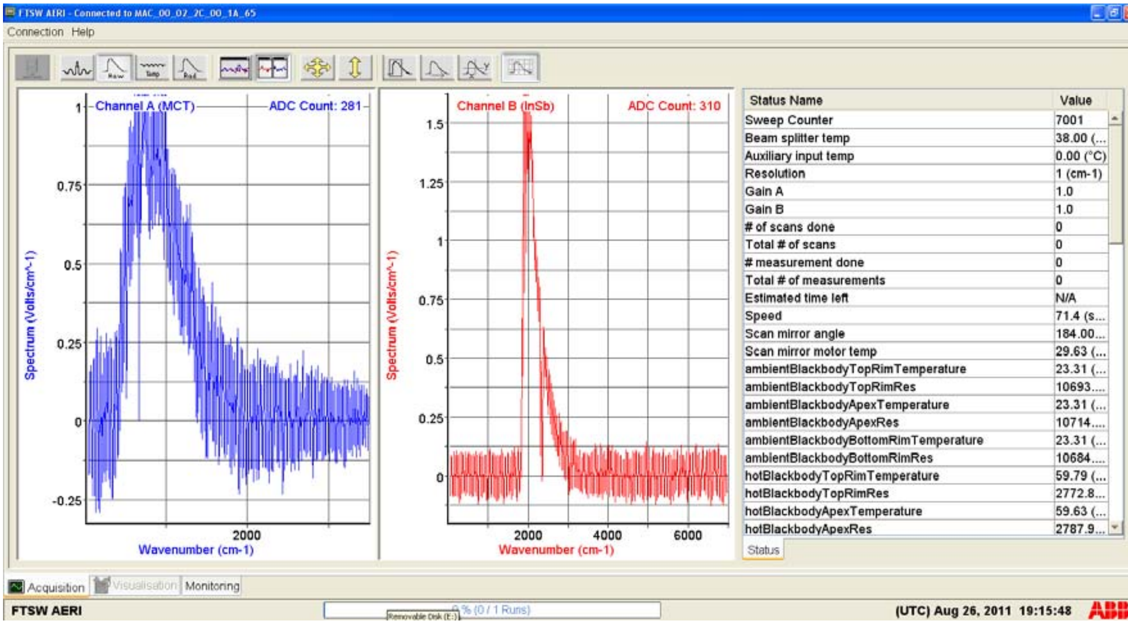


Figure 6- 12. Instrument Control Software Window (FTSW)

Wait 20 seconds, for the software to close properly. The hatch will close automatically even if the system is no longer powered. The hatch closes by means of a spring mechanism. In some cases you may want to close the hatch manually, please refer to How to Manually Open and Close the hatch on page 72.
To turn off the instrument, double click on the “powerOffInst” icon on the desktop.

Figure 6- 13. Power off Instrument Icon

How to Manually Open and Close the hatch

To check the hatch mechanism, follow this procedure:

STEP 1 Open FTSW E-AERI in Interface mode. Refer to Operation on page 51.

STEP 2 In the Acquisition tab of FTSW E-AERI, select Close and Open hatch.
Check if hatch is responding to commands.

CHANGING THE HOT BLACKBODY SET POINT

STEP 1 Close all applications, and wait 20 seconds to give time for the applications to complete their shutdown.

STEP 2 Edit the file C:\E-AERI\FTSW_EAERI.Config

STEP 3 Find the line beginning with "Blackbody.hotVolt =" after the comment "//BlackBodies volt values"

STEP 4 The number at the end of the line is the voltage sent to the blackbody controller

STEP 5 Change the value to the desired one Hot Blackbody Temperature Mapping on page 143

STEP 6 Save the file

STEP 7 Launch all applications, refer to Section 5, Quick start.

STEP 8 Reopen the file C:\E-AERI\FTSW_EAERI.Config, and verify that the voltage is as set. If not, redo the instructions, you may not have waited long enough for the applications to quit.

AERI GUI

Remote access

Remote Access is possible with Microsoft Windows Remote Desktop Application or VNC (Virtual Network Computing).

AERI GUI PARAMETERS FILE

The parameter file for the parameters validation in the AERI GUI is “C:\config\AESITTER.SCR”. To edit this file use the vi editor in a “Cygwin” window by typing: “vi /cygdrive/c/config/AESITTER.SCR”.

HATCH

CLOSING THE HATCH

To close manually the hatch, simply double-click on the icon Close Hatch on the Desktop. The hatch may open when the computer reboot at Zulu 00h.

Figure 6- 14. Close Hatch Icon

OPENING THE HATCH

To open manually the hatch, simply double-click on the icon Open Hatch on the Desktop. The Hatch may not open if the rain sensor detects something.

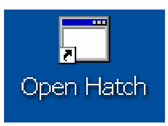


Figure 6- 15. Open Hatch Icon

DAILY CHECKS

AERI GUI

The following figure shows the ideal state, which is all green.

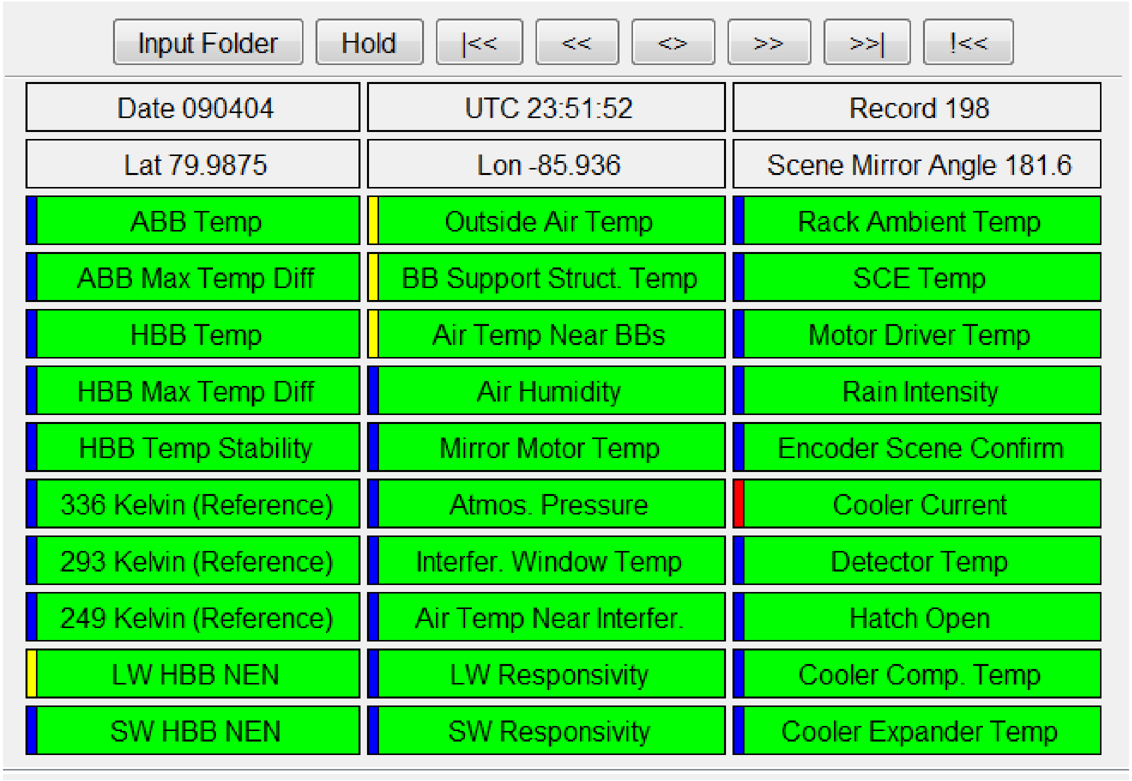


Figure 6- 16. AERI GUI display

Actually, yellow parameters can appear from time to time. If you let the cursor over a rectangle, the value of the parameter will be displayed. Double clicking on the rectangle will open a dialog box providing details.

- Every temperature related to the blackbodies are subject to outside conditions. It may be possible that they may become yellow. The three that must return to green after a while are:
  - ABB Max Temp Diff
  - HBB Max Temp Diff
  - HBB Temp Stability

- The three references temperatures must be green (336, 293, and 249 Kelvin). Those are references resistors, and they should not change.
- The LW HBB NEN and SW HBB NEN should be green. However, the LW HBB NEN may be yellow from time to time.
- The Air Temp Near Interfer. Should be around 33°C, or about 2 to 3 degrees below the beamsplitter temperature.
- The LW and SW Responsivity should be green. However, if the SW becomes RED, it may mean the mirror requires some cleaning. Refer to Scene Mirror Cleaning Procedures on page 99.
- The Cooler current may become yellow, but not RED.
- The Detector Temp must be green.
- The Cooler Comp. Temp and the Cooler Expender Temp should not be RED. There is some margin, but RED means the Stirling cooler is working to hard. It may be caused by a temperature too high inside the thermal enclosure of the instrument.

The AERI Instrument Parameters Details

This section presents the Detailed parameter Description and Action to be taken in the Case of a Red Condition for each of the AERI Instrument Parameters.

- ABB Temp Refer to ABB Temp on page 76
- ABB Max Temp Diff Refer to ABB Max Temp Diff on page 77
- HBB Temp Refer to HBB Temp on page 77
- HBB Max Temp Diff Refer to HBB Max Temp Diff on page 78
- HBB Temp Stability Refer to HBB Temp Stability on page 78
- 336 Kelvin (Reference) Refer to 336 Kelvin (Reference) on page 79
- 293 Kelvin (Reference) Refer to 293 Kelvin (Reference) on page 80
- 249 Kelvin (Reference) Refer to 249 Kelvin (Reference) on page 81
- LW HBB NEN Refer to LW HBB NEN on page 81
- SW HBB NEN Refer to SW HBB NEN on page 82
- Outside Air Temp Refer to Outside Air Temperature on page 82
- BB Support Struct. Temp Refer to BB Support Struct. Temp on page 83
- Air Temp Near BBs Refer to Air Temp Near BBs on page 83
- Air Humidity Refer to Air Humidity on page 84
- Mirror Motor Temp Refer to Mirror Motor Temp on page 84
- Atmos. Pressure: Refer to Atmos. Pressure on page 85

- Interfer. Window Temp Refer to Interfer. Window Temp on page 85
- Air Temp. Near Interfer. Refer to Air Temp Near Interferometer on page 86
- LW Responsivity Refer to LW Responsivity on page 86
- SW Responsivity Refer to SW Responsivity on page 87
- Rack Ambient Temp Refer to Rack Ambient Temp (= Thermal Enclosure Temperature) on page 87
- SCE Refer to SCE Temp on page 88
- Motor Driver Temp Refer to Motor Driver Temp on page 88
- Rain Intensity Refer to Rain Intensity on page 89
- Encoder Scene Confirm Refer to Encoder Scene Confirm on page 89
- Cooler Current Refer to Cooler Current on page 90
- Detector Temp Refer to Detector Temp on page 91
- Hatch Open Refer to Hatch Open on page 91
- Cooler Comp. Temp Refer to Cooler Compressor Temperature on page 92
- Cooler Expander Temp Refer to Cooler Expander Temperature on page 93

Action to be Taken in the Case of a Red Condition

A red condition indicates a failure of an AERI subsystem. The actions to be taken in the case of a red condition are presented. Failures are either Critical or Non-Critical as defined below:
Critical Failure: Indicating that the AERI data may be compromised, or a critical hardware subsystem may have failed.

- take the immediate action outlined, usually powering off the appropriate subsystem or the entire AERI System.
- record the anomaly
- report the problem to ABB Service.

Non-Critical Failure: Indicating that there may be hardware failure, but that the failure is not critical to AERI Operation.

- take the action outlined
- record the anomaly
- report the problem to ABB Service.

ABB Temp

Description
The Ambient BlackBody (ABB) Temperature Indicator Light reports the status of measurements taken from weighted average of three thermistors that are located within the Ambient Blackbody cavity. This temperature is used in the AERI calibration as the radiometric temperature of the Ambient blackbody, thus a Red condition for this sensor may be a Critical Failure. The Red limits for this Instrument parameter are defined to be the

range outside the expected ambient air temperature. The most likely causes of a Red condition for this Instrument Parameter is a faulty sensor.

AERI Software Variable Name for the Instrument Parameter:
[calibrationCBBtemp]

Action to be taken in the case of a Red condition:

1. Determine if the sensor circuit has either an Open or a Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

   Open in Sensor Circuit: <150 Kelvin

   Short in Sensor Circuit: >3,000 Kelvin

   If the value displayed for this Instrument Parameter is consistent with an Open or a Short in the sensor circuit, the failure is a Critical Failure; report the problem immediately to ABB Service and record the anomaly.
2. If the ABB Temp Indicator Light remains Red for longer than 1 hours then there is a Critical Failure: (1) record the anomaly; and (2) contact ABB's support center.

ABB Max Temp Diff

Description

The Ambient BlackBody Maximum Temperature Difference Indicator Light reports the status of the absolute maximum difference between the three thermistors that monitor the temperature of the Ambient BlackBody cavity. This quantity is used to identify an individual sensor failure in the blackbody. Note that the "ABB Temperature" is a weighted average of the three thermistors inside the cavity, and unlike the HBB which controls to a specific temperature, a problem with one of the three ABB thermistors is hard to detect because this blackbody varies with the ambient temperature. Therefore, unlike the case for the Hot BlackBody, a Red condition for the "ABB Max Temp Diff" will not likely mean a Red Condition in the "ABB Temp," especially in the case of a slightly degraded temperature sensor.

AERI Software Variable Name for the Instrument Parameter:
[ABBmaxTempDiff]

Action to be taken in the case of a Red condition:
[1] If the ABB Max Temp Diff Indicator Light remains red for longer than 1 hour then there may be a Critical Failure: (1) record the anomaly; and (2) contact ABB Service.

HBB Temp

Description

The Hot BlackBody (HBB) Temperature Indicator Light reports the status of measurements taken from weighted average of three thermistors that are located within the Hot Blackbody cavity. This temperature is used in the AERI calibration as the radiometric temperature of the Hot Blackbody, thus a Red condition for this sensor may be a Critical Failure. The Red limits for this Instrument parameter are defined to be the range outside the experience base for normal operation of the Hot Blackbody/Blackbody Controller subsystem, when controlling to the fixed HBB temperature. The most likely causes of a Red condition for this Instrument Parameter are a faulty sensor or a malfunctioning Blackbody Controller.

AERI Software Variable Name for the Instrument Parameter:
[calibrationHBBtemp]

Action to be taken in the case of a Red condition:

1. Determine if the sensor circuit has either an Open or a Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

   Open in Sensor Circuit: <150 Kelvin

   Short in Sensor Circuit: >3,000 Kelvin

   If the value displayed for this Instrument Parameter is consistent with an Open or a Short in the sensor circuit, the failure is a Critical Failure; report the problem immediately to ABB Service and record the anomaly.
2. If the ABB Temp Indicator Light remains Red for longer than 1 hours then there is a Critical Failure: (1) record the anomaly; and (2) contact ABB's support center.

HBB Max Temp Diff

Description
The Hot BlackBody Maximum Temperature Difference Indicator Light reports the status of the absolute maximum difference between the three thermistors that monitor the temperature of the Hot BlackBody cavity. This quantity is used to identify an individual sensor failure in the blackbody. Note that the "HBB Temperature" is a weighted average of three thermistors inside the cavity, and thus the "HBB Temperature" Red condition could likely be present when there is a Red condition for the "HBB Max Temperature Diff".

AERI Software Variable Name for the Instrument Parameter:
[HBBmaxTempDiff]

Action to be taken in the case of a Red condition:
[1] Follow the steps listed for the Red condition under "HBB Temperature".

HBB Temp Stability

Description

The Hot BlackBody (HBB) Temperature Stability Indicator Light reports the status of the maximum temperature change of the weighted average of the HBB thermistors over the time span of the current AERI calibration cycle (a period of about 10 minutes). Stability in the Hot Blackbody temperature is required for proper AERI calibration, thus a Red condition for this flag is a Critical Failure. The Red limit for this Instrument Parameter is defined to be any stability worse than can be accepted for proper AERI calibration accuracy. The most likely causes of a Red condition for this Instrument Parameter are a faulty sensor or possibly a malfunctioning Blackbody Controller.

AERI Software Variable Name for the Instrument Parameter:
[HBBtempDrift]

Action to be taken in the case of a Red condition:
[1] If the HBB Temperature Stability Indicator Light remains Red for longer than 1 hour then there may a Critical Failure: (1) record the anomaly; and (2) contact ABB’s support center.

336 Kelvin (Reference)

Description
The 336 Kelvin Equivalent Temperature Indicator Light reports the status of measurements taken from a highly stable fixed resistor that has a resistance close to the resistance of a the AERI thermistors when they are at 336 Kelvin. The resistance measurements is converted into temperature using the same nominal coefficients that are used to convert the measured AERI thermistor resistances into temperatures; thus, an equivalent temperature error of a representative channel of the AERI resistance measurement system can be deduced. The primary reason for this measurement is to indicate any long term drift in the AERI resistance measurement system. Drift in this channel does not necessarily implicate drift in other channels; however, it is a flag to check other appropriate channels for drift. If drift can be found in more than one channel then all the channels may become suspect.

> The limit values for the resistances may vary slightly from one instrument to another, i.e. around 1%.

AERI Software Variable Name for the Instrument Parameter:
[fixed2500ohmResistor]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB’s service Center.

[2] Check to see if the problem is isolated to this Instrument parameter channel by checking the 12K ohm Equiv. Temp Indicator for its status and any similar trends (drifts) over time. Also, check the HBB temperature trend over-time, if no drifts are found in these channels then the failure is most probably a Non-Critical-Failure isolated to the “336 Kelvin Equivalent Temp” channel. Record the anomaly and report the problem to ABB’s Service Center.
[3] If a drift can be found in the 293 Kelvin and/or 249 Kelvin and/or the HBB temperature, then Data Integrity may be an issue, thus, a Critical Failure may exist; record the anomaly and report the problem immediately to ABB’s service center.

293 Kelvin (Reference)

Description
The 293 Kelvin Equivalent Temperature Indicator Light reports the status of measurements taken from a highly stable fixed resistor that has a resistance close to the resistance of a the AERI thermistors when they are at 293 Kelvin. The resistance measurements is converted into temperature using the same nominal coefficients that are used to convert the measured AERI thermistor resistances into temperatures; thus, an equivalent temperature error of a representative channel of the AERI resistance measurement system can be deduced. The primary reason for this measurement is to indicate any long term drift in the AERI resistance measurement system. Drift in this channel does not necessarily implicate drift in other channels; however, it is a flag to check other appropriate channels for drift. If drift can be found in more than one channel then all the channels may become suspect.

i	The limit values for the resistances may vary slightly from one instrument to another, i.e. around 1%.

AERI Software Variable Name for the Instrument Parameter:
[fixed12KohmResistor]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB’s service Center.
[2] Check to see if the problem is isolated to this Instrument parameter channel by checking the 2,5K ohm Equiv. Temp Indicator for its status and any similar trends (drifts) over time. Also, check the HBB temperature trend over-time, if no drifts are found in these channels then the failure is most probably a Non-Critical-Failure isolated to the “293 Kelvin Equivalent Temp” channel. Record the anomaly and report the problem to ABB’s Service Center.

[3] If a drift can be found in the 336 Kelvin and/or in the 249 Kelvin, and/or the HBB temperature, then Data Integrity may be an issue, thus, a Critical Failure may exist; record the anomaly and report the problem immediately to ABB’s service center.

249 Kelvin (Reference)

Description

The 249 Kelvin Equivalent Temperature Indicator Light reports the status of measurements taken from a highly stable fixed resistor that has a resistance close to the resistance of a the AERI thermistors when they are at 249 Kelvin. The resistance measurements is converted into temperature using the same nominal coefficients that are used to convert the measured AERI thermistor resistances into temperatures; thus, an equivalent temperature error of a representative channel of the AERI resistance measurement system can be deduced. The primary reason for this measurement is to indicate any long term drift in the AERI resistance measurement system. Drift in this channel does not necessarily implicate drift in other channels; however, it is a flag to check other appropriate channels for drift. If drift can be found in more than one channel then all the channels may become suspect.

> The limit values for the resistances may vary slightly from one instrument to another, i.e. around 1%.

AERI Software Variable Name for the Instrument Parameter:
[fixed100KohmResistor]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB’s service Center.
[2] Check to see if the problem is isolated to this Instrument parameter channel by checking the 100K ohm Equiv. Temp Indicator for its status and any similar trends (drifts) over time. Also, check the HBB temperature trend over-time, if no drifts are found in these channels then the failure is most probably a Non-Critical-Failure isolated to the “249 Kelvin Equivalent Temp” channel. Record the anomaly and report the problem to ABB’s Service Center.
[3] If a drift can be found in the 336 Kelvin and/or in the 293 Kelvin, and/or the HBB temperature, then Data Integrity may be an issue, thus, a Critical Failure may exist; record the anomaly and report the problem immediately to ABB’s service center.

LW HBB NEN

Description

The Long Wave Noise Equivalent Radiance Indicator Light reports the status of the noise equivalent radiance that is calculated from the current HBB view, in the Long Wave AERI channel (channel-1). This quantity, which is the average over 25 cm^{-1} of the HBB random noise spectrum centered at 1000 cm^{-1}, represents the system level noise performance. Several factors influence this noise level. For example, detector temperature (which is controlled by the Stirling Cooler) fluctuations can lead to variations in this quantity.

AERI Software Variable Name for the Instrument Parameter:
[LW-HBB-NEN]

Action to be taken in the case of a Red condition:
[1] If Red condition persists for longer than 1 hour, then there may be a Critical Failure: (1) record the anomaly; and (2) report the problem to ABB's Service Center.

SW HBB NEN

Description
The Short Wave Noise Equivalent Radiance Indicator Light reports the status of the noise equivalent radiance that is calculated from the current HBB view, in the Short Wave AERI channel (channel-2). This quantity, which is the average over 25 cm^{-1} of the HBB random noise spectrum centered at 2500 cm^{-1}, represents the system level noise performance. Several factors influence this noise level. For example, detector temperature (which is controlled by the Stirling Cooler) fluctuations can lead to variations in this quantity.

AERI Software Variable Name for the Instrument Parameter:
[SW-HBB-NEN]

Action to be taken in the case of a Red condition:
[1] If Red condition persists for longer than 1 hour, then there may be a Critical Failure: (1) record the anomaly; and (2) report the problem to ABB's Service Center.

Outside Air Temperature

Description
The Outside Air Temperature Indicator Light reports the status of measurements taken from a thermistor that is thermally coupled to the outside air near the top of the opening covered by the AERI hatch and just inside of the hatch pane. The red limits for this instrument parameter are defined to be the range outside the expected extremes for ambient temperature. This measurement is not critical to AERI operations; thus, a Red condition is a Non-Critical Failure. The most likely cause of a Red condition for this Instrument Parameter is a faulty sensor.

AERI Software Variable Name for the Instrument Parameter:
[outsideAirTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit: <150 Kelvin

Short in Sensor Circuit: >3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] If the Outside Air Temp Indicator Light remains Red for longer than 8 hours then there is Non-Critical-Failure; record the anomaly and contact ABB's Support Systems Center.

BB Support Struct. Temp

Description
The Black Body Support Structure Temperature Indicator Light reports the status of measurements taken from a thermistor that is thermally coupled to the front structure that supports the blackbodies and the scene mirror; this structure should track, somewhat, the outside ambient temperature. This temperature is used in the AERI calibration as the temperature of the reflected component from the calibration blackbodies, thus, any Red condition (including sensor failure) is a Critical Failure affecting AERi data Integrity. A cause of a Red condition may be extreme high or low outside ambient temperatures.

AERI Software Variable Name for the Instrument Parameter:
[BBSupportStructureTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit: <150 Kelvin

Short in Sensor Circuit: >3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, because AERI data integrity depends on this Instrument Parameter, the failure is a Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] If the BB Support Struct. Temp Indicator Light remains Red for any length of time, then there may be a Critical-Failure. Record the anomaly and report the problem immediately to ABB's Support Systems Center. There is no need to power off any hardware.

Air Temp Near BBs

Description
The Air Temperature Near BlackBodies Indicator Light reports the status of measurements taken from a thermistor that is thermally coupled to the air inside the BlackBody Support Structure, which supports the Hot and Ambient Blackbodies and the Scene Mirror/Motor Assembly. The Red limits for this Instrument Parameter

are defined to be the range outside the acceptable operating limits for the AERI Front End Hardware. The most likely cause of a Red condition for this Instrument Parameter is a faulty sensor.

AERI Software Variable Name for the Instrument Parameter:
[airNearBBsTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] If the Air Temp Near BB's Indicator Light remains Red for longer than 1 hour than there is most likely a Non-Critical-Failure; record the anomaly and contact ABB's Support Systems Center.

Air Humidity

Description
The Relative Humidity (RH) Near BlackBodies (BB's) Indicator Light reports the status of measurements taken from an electronic Humidity gauge that senses the humidity inside the Blackbody Support Structure.This measurement is not critical to AERI operations; thus, a Red condition is a Non-Critical Failure. The Red limits for this Instrument Parameter are defined to be the range of normal atmospheric humidities.

AERI Software Variable Name for the Instrument Parameter:
[atmosphericRelativeHumidity]

Action to be taken in the case of a Red condition:
[1] If the RH Indicator Light remains Red for longer than 8 hours, then there is a Non-Critical Failure; report the problem to ABB's Support Center and then record the anomaly.

Mirror Motor Temp

Description
The Mirror Motor Temperature Indicator Light reports the status of measurements taken from a thermistor that is located on the AERI Scene Mirror Motor housing. The Red limits for this Instrument Parameter are defined to be the range outside the acceptable operating limits of the Rotary Position Encoder. This is coupled to the AERI Scene Mirror Motor, which is located at the front end of the AERI near the Blackbodies. The most likely cause of a Red condition are extremely high or low outside temperature conditions or a problem with the Scene Mirror Motor

AERI Software Variable Name for the Instrument Parameter:
[mirrorMotorTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] If the Mirror Motor Temp is too cold (lower end of Red condition), there is a Critical Failure; (1) leave all power ON, (2) record the anomaly; and (3) report the problem immediately to ABB's Support Center.

Atmos. Pressure

Description
The Atmospheric Pressure Indicator Light reports the status of measurements taken from an electronic barometer which is located inside the AERI Support Electronic Rack. This measurement is not critical to AERI operations; thus, a Red condition is a Non-Critical Failure. The Red limits for this Instrument Parameter are defined to be the range outside normal atmospheric pressure.

AERI Software Variable Name for the Instrument Parameter:
[atmosphericPressure]

Action to be taken in the case of a Red condition:
[1] If the RH Indicator Light remains Red for longer than 8 hours, then there is a Non-Critical Failure; report the problem to ABB's Support Center and then record the anomaly.

Interfer. Window Temp

Description
The Interferometer Temperature Indicator Light reports the status of measurements taken from a thermistor that is located at one end of the central tube that hold the protective enclosure. This measurement is not critical to AERI operations; thus, a Red condition is a Non-Critical Failure.

AERI Software Variable Name for the Instrument Parameter:
[interferometerWindowTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit: <150 Kelvin

Short in Sensor Circuit: >3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] If the Mirror Motor Temp is too cold (lower end of Red condition), there is a Critical Failure; (1) leave all power ON, (2) record the anomaly; and (3) report the problem immediately to ABB's Support Center.

Air Temp Near Interferometer

Description
The Air Temperature Near Interferometer Indicator Light reports the status of measurements taken from a thermistor that is thermally coupled to the air inside the Interferometer Support Structure. The Red limits for this Instrument Parameter are defined to be the range outside the acceptable operating limits for the AERI Front End Hardware. The most likely cause of a Red condition for this Instrument Parameter is a faulty sensor.

AERI Software Variable Name for the Instrument Parameter:
[airNearInterferometerTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit: <150 Kelvin

Short in Sensor Circuit: >3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] If the Air Temp Near Interferometer Indicator Light remains Red for longer than 1 hour then there is most likely a Non-Critical-Failure; record the anomaly and contact ABB's Support Systems Center.

LW Responsivity

Description
The LongWave Responsivity is a measure of the AERI response to incident radiation or system throughput, at 1000 cm^{-1}. The units of LW responsivity are COUNTS per $mW/(m^2\ sr\ cm^{-1})$. This Indicator Light is designed to flag a condition of deteriorated AERI system throughput caused, among other things, by debris in the optical path, a dirty scene mirror, or a dirty interferometer front window.
A Yellow condition indicates a deteriorating condition. A Red condition is a Critical Failure.

AERI Software Variable Name for the Instrument Parameter:
[LWresponsivity]

Action to be taken in the case of a Red condition:
[1] Check optical path for debris; check for dirty scene mirror; check for dirty interferometer front window; cleaning procedures are found in Section 7, Maintenance. After the problem is resolved, record the anomaly and report the problem to ABB's Service Center.

SW Responsivity

Description
The ShortWave Responsivity is a measure of the AERI response, or system throughput, at 2500 cm^{-1}. The units of SW responsivity are COUNTS per mW/(m^2 sr cm^{-1}). This Indicator Light is designed to flag a condition of deteriorated AERI system throughput caused, among other things, by debris in the optical path, a dirty scene mirror, or a dirty interferometer front window.
A Yellow condition indicates a deteriorating condition. A Red condition is a Critical Failure.

AERI Software Variable Name for the Instrument Parameter:
[SWresponsivity]

Action to be taken in the case of a Red condition:
[1] Check optical path for debris; check for dirty scene mirror; check for dirty interferometer front window; cleaning procedures are found in Section 7, Maintenance. After the problem is resolved, record the anomaly and report the problem to ABB's Service Center.

Rack Ambient Temp (= Thermal Enclosure Temperature)

Description
The "Rack Ambient Temperature" Indicator Light reports the status of measurements taken from a thermistor that is located inside the back-end enclosure, coupled to the enclosure air. The most likely cause of a Red condition is room temperature out-of-limit conditions.

AERI Software Variable Name for the Instrument Parameter:
[rackAmbientTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] Check to see if the Room Instrument Parameter is within acceptable limits; if not, record the anomaly, report the problem to ABB's Service Center, and bring the room air temperature into acceptable limits as soon

as possible. If a Red condition persists for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's service Center.

SCE Temp

Description

The Signal Conditioning Electronics (SCE) Temperature Indicator Light reports the status of measurements taken from a thermistor that is thermally coupled to one of the three signal conditioning boards inside the SCE Box, which is located in the AERI Thermal enclosure. The thermistor coupled with the Agilent model does the sampling of all temperatures. The Red limits for this Instrument Parameter are defined to be the range outside the acceptable operating limits set by the manufacturer of the signal conditioning boards. The most likely cause of a Red condition is room temperature out-of-limit conditions.

AERI Software Variable Name for the Instrument Parameter:
[SCETemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] Check to see if the Room Instrument Parameter is within acceptable limits; if not, bring the room air temperature into acceptable limits as soon as possible. If a Red condition persists for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's service Center.
[2] If the SCE Temp Indicator Light remains red for longer than 1 hour, then there is a Critical Failure: (1) turn the SCE power OFF on the front panel of this box; (2) record the anomaly; and (3) report the problem to ABB's service Center.

Motor Driver Temp

Description

The Motor Driver Temperature Indicator Light reports the status of measurements taken from a thermistor located on the scene mirror Motor Driver electronics, located in the back of the AERI Support Electronics Rack. This temperature provides an indication of the overall health of this unit. The Red limits for this Instrument Parameter are defined to be the range outside the acceptable operating limits set by the manufacturer of this subsystem. Causes of out-of-limit temperatures may be room temperatures out-of-limit conditions or Motor Driver electronics problems.

AERI Software Variable Name for the Instrument Parameter:
[motorDriverTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit:	<150 Kelvin
Short in Sensor Circuit:	>3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] Check to see if the Rack Ambient Temperature is within acceptable limits; if not, record the anomaly, report the problem to ABB's Service Center, and bring the room air temperature into acceptable limits as soon as possible. If a Red condition persists for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's service Center.
[3] If the Motor Driver Temp Indicator Light remains red for longer than 1 hour, then there is a Critical Failure: (1) turn the power OFF Power to the Motor Driver Electronics; (2) record the anomaly; and (3) report the problem to ABB's service Center.

Rain Intensity

Description
The Rain Intensity Indicator Light reports the status of measurements taken from the rain sensor in the hatch. This measurement is not critical to AERI operations; thus, a Red condition is a Non-Critical Failure. The Red limits for this Instrument Parameter are defined to be the range of normal atmospheric humidities.

AERI Software Variable Name for the Instrument Parameter:
[rainSensorIntensity]

Action to be taken in the case of a Red condition:
[1] If the Rain Intensity Indicator Light remains Red for longer than 8 hours, then there is a Non-Critical Failure; report the problem to ABB's Support Center and then record the anomaly.

Encoder Scene Confirm

Description
The Encoder Scene Confirm Indicator Light reports the status of the Scene Mirror Rotary Encoder during the last Scene View. The purpose of the rotary encoder is to provide an independent check that the Scene Motor is correctly positioning the Scene Mirror. The Mirror Position Status can be deducted as follows:

Green:	Scene Position Confirmed by Encoder
Yellow:	Scene Position Acceptable, but Shifted from Nominal
Red:	Scene Position not Confirmed by Encoder, or Encoder reporting unfamiliar value

AERI Software Variable Name for the Instrument Parameter:
[sceneMirPosEncoder]

Action to be taken in the case of a Red condition:
[1] If the condition is Red and the AERI Scene Mirror is rotating through a normal sequence, there may be a problem with the encoder, a subtle motor / motor driver problem, or a problem with the coupling between the motor and encoder. If there is a subtle problem in the motor / motor driver it could be a Critical Failure: (1) reboot the AERI by cycling the power OFF then ON at the main power switch; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[2] If the condition is RED and the AERI Scene Mirror is not rotating through a normal sequence, there is Critical Failure: (1) reboot the AERI by cycling the power OFF then ON at the main power switch; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[3] If the condition remains RED after re-booting the AERI (see action [2] above), there is Critical Failure: (1) Turn OFF the power main switch; and (2) report the problem to ABB's Support Center.

Cooler Current

Description
The Cooler Current Indicator Light reports the status of measurements taken from a circuit that monitors the input current to the Stirling Cooler Compressor. The magnitude of this current is monitored to provide a measure of efficiency of the Stirling Cooler. This efficiency will decrease of the one-year time between cooler servicing. During normal operation, the Stirling Cooler Compressor should remain in servo control, drawing currents listed in the Green range. During Stirling Cooler Start-up (the first 10 minutes after power is applied), the Cooler Current will draw the full current of 1.2 amps (Red condition), and this is not a concern. In general, if the full current of 1.2 amps is drawn for extended periods of time (hours), a problem exists in the Stirling cooler. Excessive currents reported from this sensor may be an indication of a cooling fan problem, a problem with the Stirling Cooler, or excessive room temperature.

AERI Software Variable Name for the Instrument Parameter:
[coolerCurrent]

Action to be taken in the case of a Red condition:
[1] Check to see if the Rack Ambient Temperature is within acceptable limits; if not, record the anomaly and report the problem to ABB's Support Center and bring the room air temperature into acceptable limits as soon as possible. If Red conditions persist for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[2] Inspect and verify that the cooling fan that blows air over the Stirling Cooler Compressor Heat Sink is functioning properly. If not, and if the fan cannot be fixed immediately, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[3] Inspect and verify that the cooling fan that blows air over the Stirling Cooler Expander Heat Sink is functioning properly. If not and if the fan cannot be fixed immediately, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.

[4] If the Cooler Current Instrument Parameter has been in the red condition for longer than 8 hours, there is Critical Failure: (1)turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.

Detector Temp

Description

The Detector Temperature Indicator Light reports the status of measurements taken from a temperature sensing diode that is located next to IR detectors inside the dewar assembly on the interferometer. The Detector Temperature is measured to provide stability information and overall health of the Stirling Cooler. A Red condition may be an indication of a cooling fan problem, a problem with the Stirling Cooler, or excessive room temperature.

AERI Software Variable Name for the Instrument Parameter:
[detectorTemp]

Action to be taken in the case of a Red condition:
[1] Check to see if the Rack Ambient Temperature is within acceptable limits; if not, record the anomaly, report the problem to ABB's Service Center, and bring the room air temperature into acceptable limits as soon as possible. If a Red condition persists for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's service Center.
[2] Inspect and verify that the cooling fan that blows air over the Stirling Cooler Compressor Heat Sink is functioning properly. If not, and if the fan cannot be fixed immediately, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[3] Inspect and verify that the cooling fan that blows air over the Stirling Cooler Expander Heat Sink is functioning properly. If not and if the fan cannot be fixed immediately, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[4] If the Cooler Current Instrument Parameter has been in the red condition for longer than 8 hours, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.

Hatch Open

Description

The Hatch Open Indicator Light reports the status of measurements taken form the Hatch Indicator Circuit, which uses the "Hatch Open" and "Hatch Closed" microswitches (note, there is no signal power placed on these lines by the site automated switch (FLAPP) System. The Hatch Status can be deducted as follows:
Green: Hatch Open
Yellow: Hatch Closed
Red: Hatch Not Open and Hatch Not Closed, or Hatch Indicator Circuit Reading an unfamiliar result
NOTE 1:

The Hatch Open Indicator Light does not flag a condition in which the Hatch is erroneously open during precipitation, or when the Hatch is erroneously closed during non-precipitation. The operator must combine current weather conditions with the Hatch Open Indicator Light to deduce: (1) a condition where the Hatch is open during precipitation and thus the AERI may be getting wet, and (2) a condition where the Hatch is closed during non-precipitation and the AERI is not able to take sky data.
NOTE 2:
An occasional “red” indicator comes up if the data is sampled during the hatch switching from open to closed or vice versa, and all is normal on subsequent records.

AERI Software Variable Name for the Instrument Parameter:
[hatchOpen]

Action to be taken in the case of a Red condition:
[1] A Red condition indicates a Critical Failure. If the Hatch is Open or partially Open and cannot be closed during a period of precipitation; turn power to the AERI Off using the switch; then secure a temporary covering over the opening to keep precipitation from encountering the AERI. Then close the Hatch manually, refer to How to Manually Open and Close the hatch on page 72. Dry wet areas (but do not attempt to dry the gold scene mirror at this time). To clean the mirror, follow the procedure in Cleaning Procedures on page 99. Record the anomaly and contact ABB’s Service Center.
[2] When weather permits inspect the Hatch Hardware and repair, record the anomaly, and report the problem resolution to ABB’s Service Center.

Cooler Compressor Temperature

Description
The Cooler Compressor Temperature Indicator Light reports the status of measurements taken from a thermistor on the Stirling Cooler Compressor heat sink. A Red condition may be an indication of a cooling fan problem, a problem with the Stirling cooler, or excessive room temperature.

AERI Software Variable Name for the Instrument Parameter:
[coolerCompressorTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit: <150 Kelvin

Short in Sensor Circuit: >3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB’s service Center.
[2] Check to see if the Rack Ambient Temperature is within acceptable limits; if not, record the anomaly and report the problem to ABB’s Support Center and bring the room air temperature into acceptable limits as soon

as possible. If Red conditions persist for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[3] Inspect and verify that the cooling fan that blows air over the Stirling Cooler Compressor Heat Sink is functioning properly. If not, and if the fan cannot be fixed immediately, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[4] Check to see if the Cooler Current Instrument Parameter has been at 1.2 amps or greater for longer than 8 hours. If this has happened, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.

Cooler Expander Temperature

Description
The Cooler Expander Temperature Indicator Light reports the status of measurements taken from a thermistor located on the Stirling Cooler Expander heat sink. A Red condition may be an indication of a cooling fan problem, a problem with the Stirling cooler, or excessive room temperature.

AERI Software Variable Name for the Instrument Parameter:
[coolerExpanderTemp]

Action to be taken in the case of a Red condition:
[1] Determine if the sensor circuit has either an Open or Short, by comparing the value displayed for this AERI Instrument Parameter with the values below:

Open in Sensor Circuit: <150 Kelvin

Short in Sensor Circuit: >3,000 Kelvin

If the value displayed for this Instrument parameter is consistent with an Open or Short in the sensor circuit, the failure is a Non-Critical-Failure. Record the anomaly and report the problem to ABB's service Center.
[2] Check to see if the Rack Ambient Temperature is within acceptable limits; if not, record the anomaly and report the problem to ABB's Support Center and bring the room air temperature into acceptable limits as soon as possible. If Red conditions persist for longer than 1 hour, then there is a Critical Failure: (1) turn AERI System power OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[3] Inspect and verify that the cooling fan that blows air over the Stirling Cooler Expander Heat Sink is functioning properly. If not, and if the fan cannot be fixed immediately, there is Critical Failure: (1) turn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.
[4] Check to see if the Cooler Current Instrument Parameter has been at 1.2 amps or greater for longer than 8 hours. If this has happened, there is Critical Failure: (1) tturn the instrument OFF; (2) record the anomaly; and (3) report the problem to ABB's Support Center.

INSTRUMENT TEMPERATURE

Operating Temperature

Less important parameters, but useful to watch are:

- Beam Splitter Temp: 33 - 38 °C
- Thermal Enclosure Temperature:20 - 25 °C

Those two temperatures intervals are where the instrument is at its best. Outside this range, performances may be lower.

Cold Temperature

If for some reason the temperature inside the instrument goes below 4 °C, a special safety relay prevents the instrument to operate. The parameter will become red and the AERI (or E-AERI) system will shut down. A special radiator inside will try to raise the temperature. If the temperature outside is higher than 15 °C, it might accelerate the warm up of the instrument to turn the Temperature Control Unit ON.

HARD DISK

Space

Keep at least 5 Gig of free hard disk space, lower than that the system may have performances problem.

Defragmenting the Disk

It is not necessary to defragment the hard drive. But it is recommended to defrag the hard drive from time to time, once every two months. For the defragment procedure, Diskeeper lite is installed, and can be used while the instrument is operation.

Events Logged with E-mail notification when Critical

FTSW-EAERI gives the possibility to notify by e-mail if a critical error occurs during operation.
To configure the AERI e-mail service, you must edit the file c:\E-AERI\mailSrv.Config:

```
// Example configuration file for EAERI mailing Service
// note: this file is parsed line by line, a comment line must begin with // (double slash),
//		a // in middle of a line DO NOT represent a comment.
// The configurable settings are:
// - smtp server address
// - port number
// - username for authentication (left field blank if no authentication)
// - password for authentication (left field blank if no authentication)
// - The recipient list of the notification messages
//smtp server address
smtp = smtp.gmail.com
//port number
port = 25
//username (leave field blank if no authentication)
username =
//password (leave field blank if no authentication)
password =
```

//at the end of the file list all e-mail address where to send the notification mail
email_1@dom.com
email_2@dom.com

The critical error list is as follow:

6- 2. Critical Error List

Module	Error Description
Agilent Error	Agilent configuration file is corrupted
Agilent Error	Error closing L4452A Instrument
Agilent Error	Impossible to connect with Agilent instruments
Agilent Error	Init Connection on L4452A (Digital i/o) Error
Agilent Error	Connection to RMI Server error
Agilent Error	Impossible to find RMI DIO Server
Agilent Error	Error in Agilent configuration file
Agilent Error	Impossible to read Agilent analog input
Agilent Error	Impossible to read Digital Data from L4452A
Agilent Error	Impossible to send configuration to Agilent instruments
Agilent Error	Error closing L4452A Instrument
Agilent Error	Impossible to set an analog input to Agilent instrument
Agilent Error	Impossible to set a digital input to Agilent instrument
Data output	Error exporting data in Spectra Calc format
Instrument monitoring	thermal Enclosure Temperature is too high the instrument will shut down.
Instrument monitoring	Impossible to power off EAERI instrument.
Instrument monitoring	Sterling Cooler Temperature is too high, the instrument will shut down.
Pointing Mirror	Connection with Zeta not established, Pointing Mirror can not be controlled
Pointing Mirror	Error IOException
Pointing Mirror	Error SerialConnectionException
Stub communicator	TCP IOException
TEC Controller	Invalid command length to 5C7-001 controller
TEC Controller	SerialConnectionException

Section 7 Maintenance

Preventive maintenance calendar

To keep the AERI system fully calibrated, operational and minimize the downtime, it is recommended to follow the calibration and maintenance calendar below. Details and instructions are given in the following subsections.

Item	Monthly check	Every year	Every 2 years	Every 3 years	Other
Blackbody calibration				✓	
Agilent multimeter L4411A		✓			
Aiglent multifunction L4452A		✓			
Agilent multiplexer L4421A					Not required
Radiometric verification		✓			Or after laser, blackbody or detector replacement
Resistance measurement verification		✓			
MR laser			✓		
Stirling cooler					After 20 000 hours or operation (27 months @ 24/24)
Scene mirror	✓				Replace as necessary (1)
Mr dessicant	✓				Replace as necessary (1)
Hepa fan filter	✓				Replace as necessary (1)

(1) Directly affected by a dirty environment
(2) Directly affected by air humidity

Always replace old fuses with new ones of the same type. If uncertain, contact ABB Inc. Damage may result if wrong fuses are used.

Spare parts

To minimize downtime, the following spare parts can be purchased.

Part name	Part number
Scene mirror	AA003563-01
Desiccant	SPL6300G
HEPA fan filter	IMZ5655
Stirlling cooler	AA005671-01
TEC ass'y	AA004526-01

Monthly checks

Inspection

Although the AERI and E-EARI systems are designed to withstand harsh environments, ABB recommends performing visual inspections regularly.

- Remove any water or ice accumulation on the AERI and E-EARI system.
- Check if there is any rust or corrosion on the front-end or the back-end protective enclosure. Remove rust and corrosion with care.
- Inspect the pointing mirror. Make sure it is clean and not obstructed.

> If the scene mirror requires to be cleaned, do not wipe, clean or touch the mirror. Refer to Scene Mirror Cleaning Procedures on page 99 for the correct procedure.

- Check the hatch mechanism, it should not be obstructed and should open and close easily. If not refer to The Hatch does not close automatically on page 115.
- Check if power cords and Ethernet cables are in good condition. If necessary replace cables and cords.
- Check if there is ice on the external heat sink. Delicately remove any accumulation of ice.
- Remove the Protective enclosure and check if there is any water infiltration. If there is water inside the enclosure, remove water and call ABB service personnel.
- For a sheltered installation, check if insulation through the thermal barrier is in good condition. Check where cables cross the barrier. Replace insulation if necessary.
- Regularly verify the sun sensor. If the sun sensor glass becomes too dirty, it may not detect the sun according to the settings and the hatch may not close even though it should. At all times make sure the sun sensor glass is clean. Depending on the environment cleaning may be necessary on a very regular basis.

Cleaning Procedures

Scene Mirror Cleaning Procedures

Purpose: To remove accumulated dust and dirt from the scene mirror without actually touching the mirror surface.

1. Interrupt the normal AERI data acquisition and place mirror in the sky view position. Do this by typing Ctrl-C in the black Sequencer window, wait until the computer responds, answer Y to prompt to terminate the batch procedure, type "wdtdis" to disable watchdog timer and type "sky" to move the mirror into the vertical position.
2. Remove the front-end protective enclosure front panel.
3. Inspect the area inside and above the scene mirror and note any possible obstruction (grass, bird droppings, etc.) and the condition of the mirror surface before cleaning.
4. Remove the scene mirror assembly from the front-end optics assembly support structure. First remove the motor cover by unscrewing the 7 screws and lock washers from the mirror motor cover.

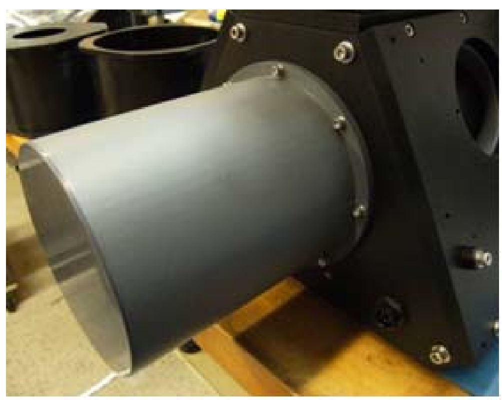


Figure 7-1: Removing the Motor Cover

5. Then remove the 4 screws and washer and remove the mirror assembly from the front end. Note that all operations are performed while fully powered and that electrical cables are still connected to the removed assembly.

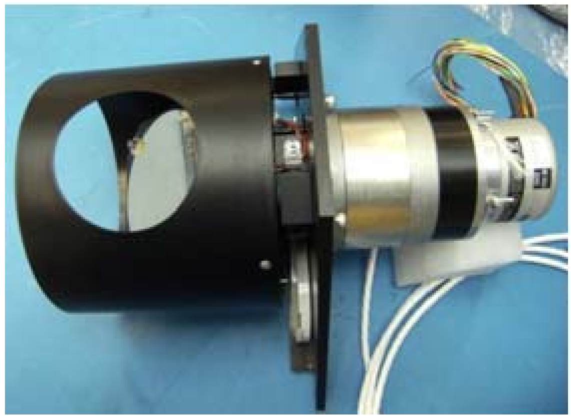


Figure 7-2: Remove mirror assembly

6. Place the scene mirror on a wooden holding block so that the mirror surface is oriented vertically.
7. Place absorbing material below the scene mirror to catch the water and alcohol as it flows off the scene mirror.
8. Using a squeeze bottle, flush the mirror surface with a stream of distilled water followed by a stream of 95% (ethanol) alcohol. (Make sure to flush the water and alcohol only onto the mirror surface; do not spray fluid behind the mirror). The process should be repeated at least three times. The flushing should begin with distilled water and end with alcohol. At no time should the mirror surface be touched in any way except by the stream of fluid.
9. Wick up any fluid that may have seeped into the gap between the mirror and its holder by inserting 2 to 3 inch wide pieces of papers into the gap.
10. Replace the mirror/motor assembly by carefully inserting it straight into the front end, screw the 4 screws and washers in place. Then fix the mirror motor cover back in place with the 7 screws and lock washers.
11. Check that the power cord is in place and all cables are still connected. Replace panels and secure in place.
12. Reboot the AERI computer by pressing Ctrl-Alt-Del. This should restart the normal data collection process. If the system does not restart or red lights come on then contact ABB Service.

Enclosures

We recommend regular vacuuming on or around the instrument to prevent accumulation.

i	Spectrometer is not leakproof. Gaskets can be damaged by solvents, strong acids or strong alkalis.

Maintenance procedures

Blackbody Calibration

The ambient and hot blackbodies must be sent for calibration every 3 years. Contact ABB to schedule when you can send the blackbodies and know when they will be returned to you. The following procedure gives you the instructions to remove the blackbodies from the system and prepare the packing for shipment.

1. On the Front-End enclosure, unscrew the 6 screws on the front panel and remove the front panel.
2. Unscrew the 5 screws of the protective enclosure. It will remain in place as the hooks of the protective enclosure are still inserted in the bars of the back panel.
3. Remove the protective enclosure with much care. 2 Persons are required to remove the enclosure and another person to make sure no cables or components inside the enclosure get damaged.
4. Disconnect the blackbodies connectors. Remove the screw holding the cable clamp on the HBB and on the ABB. Remove the cable from the clamp and put the screw back in place.
5. Remove each blackbody by unscrewing the 4 screws holding it to the front-end input optics assembly.

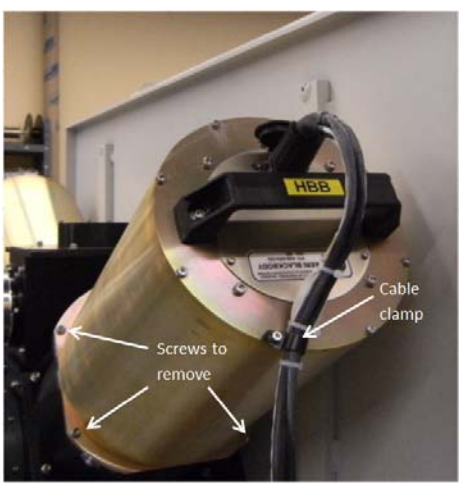


Figure 7-3: Removing the blackbodies

6. Protect the blackbody opening by covering it with a clean plate or tissue. Hold it in place with tape.
7. Carefully pack the blackbodies in bubble wrap to prepare them for shipment.

Agilent modules calibration

The Agilent multimeter L4411A and multifunction L4452A used to measure several sensors and control the AERI must be calibrated yearly. Contact a local calibration supplier to send the modules for calibration or contact Agilent to find a supplier. The modules are located in the back-end thermal enclosure under the MR instrument. Follow these instructions to remove the modules from the instrument to send them for calibration.

1. Remove the back-end precipitation enclosure, the temperature control unit and the thermal enclosure to have access to the Agilent modules.
2. Locate the modules under the MR instrument. The access to them is on the side of the AERI.
3. The two modules that need to be sent for calibration are normally the first two units from the top. On their front panel, remove the cartridge from the L4452A, it does not need to be sent for calibration.
4. Unlatch the retainer clamp to release the modules.

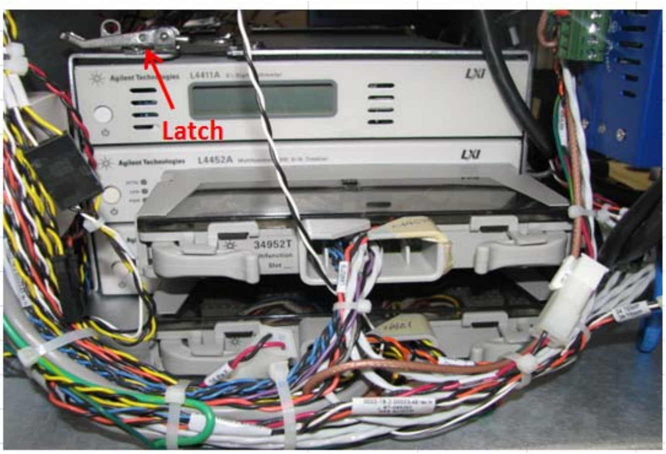


Figure 7-4: Agilent modules front panel

5. On the modules back panel, remove all connectors from the L4411A and L4452A modules. Also remove the temperature sensor in a ring lug and put the screw back in place.

6. Unlatch the retainer clamp to release the modules and take them out.

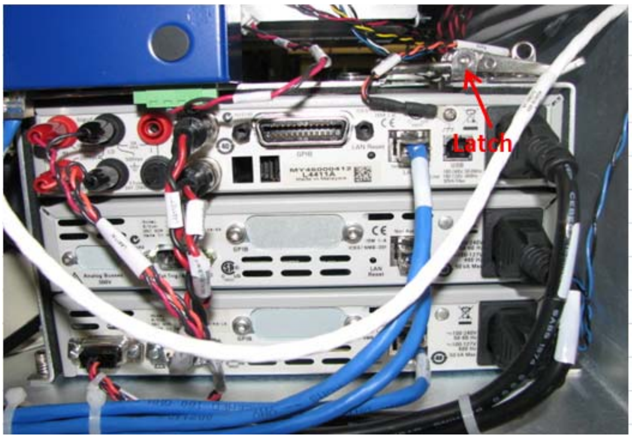


Figure 7-5: Agilent modules back panel

7. Pack the modules to ship them for calibration.

Radiometric verification

This test is done to verify the radiometric accuracy of the AERI system. The test requires a reference blackbody installed on the Zenith position.
The test can be performed by the user but requires purchasing the reference blackbody and cables. Contact ABB for more information.

Resistance measurement verification

This test is doneobjective to verify the accuracy and precision of the blackbody thermistors measurement by the Agilent multimeter. The test requires two calibrated precision resistors boxes, one for the ambient blackbody and the other for the hot blackbody.
The test can be performed by the user but requires purchasing the precision resistors boxes and have them calibrated each year. The boxes come with the instructions to perform the test. Contact ABB for more information.

MR laser replacement

The Helium-Neon laser located in the MR spectroradiometer should be replaced every two years. The replacement should only be done by an ABB field service technician. The end-to-end radiometric verification must also be performed after laser replacement to verify that the AERI acquisitions are within specifications. Contact ABB for more information or to schedule a visit.

Detectors Stirling cooler

The Stirling cooler installed on the MR spectroradiometer is used to cool the detectors to their operating temperature. The mean time to failure (MTTF) of the Stirling cooler is 20 000 hours of operation. The frequency at which the Stirling cooler should be replaced depends on the time the AERI system is powered on. The replacement should only be done by an ABB field service technician. Contact ABB for more information or to schedule a visit.

Hatch mechanism

<table>
<tr>
<td>


</td>
<td>The hatch mechanism is very strong and stiff. Extreme caution must be paid when working around this component.The hatch located on top of the enclosure opens and closes electrically. Avoid putting any objects or body parts as it may damage the hatch and cause serious injuries.</td>
</tr>
</table>

Check the AERI from the outside of the open hatch and check for and make note of any debris found (e.g. bird nesting material, bird droppings, insect homes, etc.). To clean it or if hatch becomes obstructed with ice refer to The Hatch does not close automatically on page 115 for safe procedure on how to manually handle the hatch.

Replacing the desiccant module

The humidity indicator on the dessicant module has a percentage indicator ranging from 20% to 50% RH. The indicator is blue when dry and turns pink with humidity (i.e. 20% pink equals 20% RH). It is recommended to dry or replace the dessicant when 30% RH is reached.

To replace the desiccant module (standard model desiccant assembly SPL6300G), proceed as follows:

Leave the spectrometer on. This will keep the internal optics warm and gives added protection against humidity.

Unscrew the desiccant module (SPL6300G) on the side of the spectrometer (see Figure 7-1).

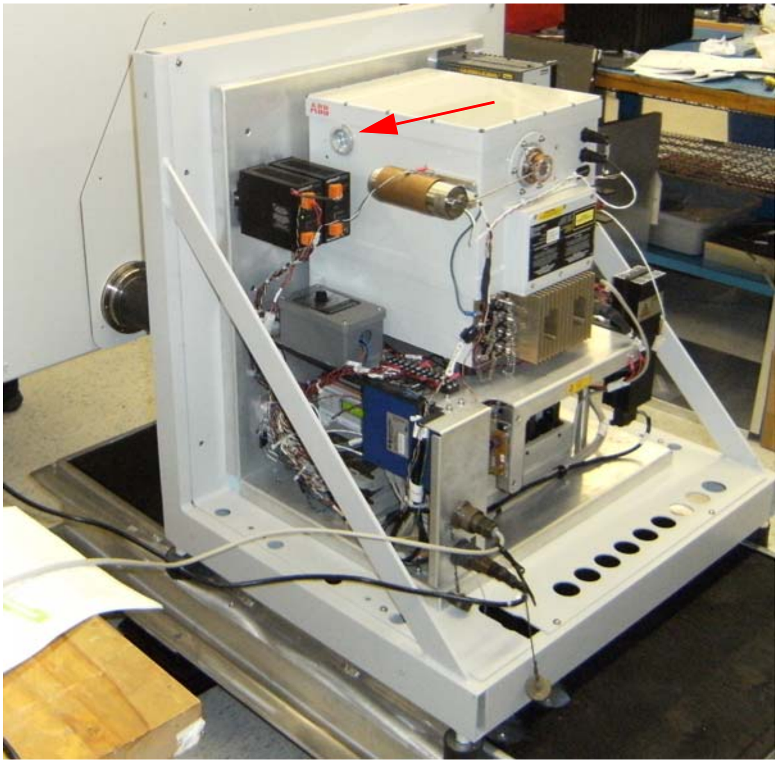


Figure 7-1: Desiccant location

Remove the desiccant module and replace it with a new desiccant module.

Install the new desiccant module.

Figure 7-2: Desiccant replacement

Filter Replacement

Two filters are to be changed on a regular basis and that depending on their use and the environment where the AERI is operated.

Front-end fan filter replacement

They are located inside the Front-end. The procedure is as follows:

1. Unscrew the 6 captive screws of the front-end. Refer to Figure 7-3

Figure 7-3: Remove the 6 captive screws

2. Unlatch the Front-end fan enclosures, remove the old filters (part number IMZ5655) and insert new ones. Refer to Figure 7-4

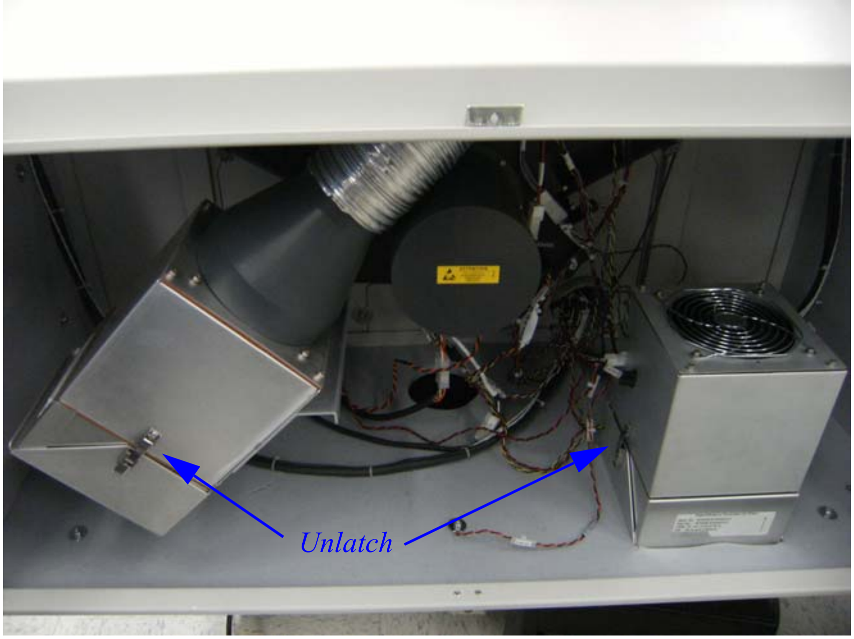


Figure 7-4: Access to Fan Filter

Scene Mirror Replacement

If cleaning the scene mirror was not sufficient to bring the mirror back to a good working condition, use the following instructions to replace the scene mirror with a new one. You will need a new scene mirror (AA003563-01), thermal compound Wakefield engineering type 120, latex or nitrile gloves and a kit of hexagonal screwdrivers.

1. Power off the instrument.
2. Remove the front-end protective enclosure front panel.
3. Disconnect the scene mirror motor and encoder connectors.

4. Remove the scene mirror assembly from the front-end optics assembly support structure. First remove the motor cover by unscrewing the 7 screws and lock washers from the mirror motor cover.

Figure 7-5: Removing the Motor Cover

5. Then remove the 4 screws and washer and remove the mirror assembly from the front end.

Figure 7-6: Remove mirror assembly

6. Place the scene mirror on a table as illustrated in Figure 7-22.

7. Remove all screws retaining the drum wrapped around the scene mirror.

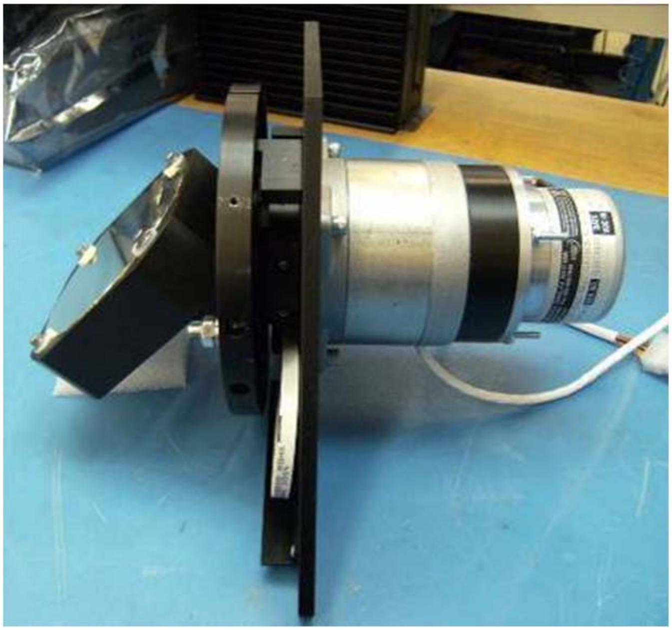


Figure 7-7: Removing the scene mirror drum

8. Remove the 4 screws, metal and nylon washers holding the scene mirror.
9. Remove the scene mirror to be replaced.

10. If necessary, apply additional thermal compound Wakefield engineering type 120 on the mirror heating disk as illustrated below. Keep a 1 cm free of compound all around the disk.

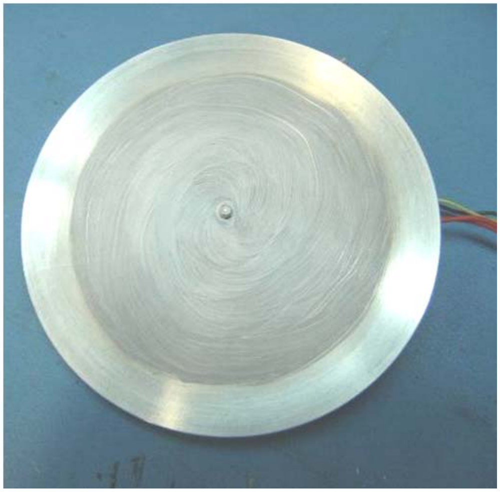


Figure 7-8: Applying thermal compound

11. Use nitrile or latex gloves to manipulate the new scene mirror and make sure to not touch the reflective surface of the mirror. Carefully install the new scene mirror in place on the mirror heating disk.
12. Install the 4 screws, metal and nylon washers in place. Tighten the screws but do not apply to much torque for not damaging the mirror.
13. Install the scene mirror drum back in place.
14. Replace the mirror/motor assembly by carefully inserting it straight into the front end, screw the 4 screws and washers in place. Then fix the mirror motor cover back in place with the 7 screws and lock washers.
15. Reconnect the scene mirror motor and encoder connectors. Replace panels and secure in place.
16. Power on the instrument and return to normal operation.

Section 8 Troubleshooting

This chapter describes the main problems that may be encountered immediately after applying power to the spectroradiometer or during its use.

Class 3B visible laser radiations (632.8 nm, 1mW output power, Red) are present inside the spectrometer. When opening the enclosure, make sure to use appropriate eye protection otherwise injuries will occur.
Use of controls or adjustments, or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Electrostatic Sensitive Device
Perform maintenance procedures in an ESD protected environment.
Always use an ESD protection to perform maintenance procedures on the AERI system. If you are not familiar with ESD protection, or if ESD protection material is not available, contact ABB customer support. Refer to the back cover of this manual.

High voltages may be present inside the enclosure even when the equipment is not connected to the power source, as some of the capacitors may maintain their load.
Disconnect power or take precautions to insure that contact with energized parts is avoided when servicing.
Do not open the spectrometer to perform troubleshooting procedures.
Make sure the system is configured to use the available line voltage.
Ensure that the equipment and any devices or power cords connected to it are properly grounded. The grounding pin of the power connector must be present at all times.If necessary, have a certified electrician install a grounded wall outlet.
Protective earthing connection (grounding) must be active at all times. The absence of grounding can lead to a potential shock hazard that could result in serious personnel injury. If an interruption of the protective earthing connection is suspected, ensure the equipment remains inoperative.
Always make sure the spectrometer is disconnected from a power source and fully assembled (front and back panel installed) BEFORE opening, adjusting or performing any maintenance.
Always replace old fuses with new ones of the same type. If uncertain, contact ABB Inc.   Damage may result if wrong fuses are used.

The Software does not Detect the Instrument

If the software cannot detect the instrument automatically, the script file may be corrupt or may have registered a wrong instrument name by mistake.
To correct the problem, go to C:\E-AERI\FTSW_EAERI.Config or C:\E-AERI\FTSW_AERI.Config, open this file with Notepad. Go to the line: Acquire.instrumentName = and erase everything after the equal sign. At the next start-up, the software will detect the instrument and correct the config file. Please refer to Figure 8- 1.

```
// *** Important **** : for filenames and paths use '/' instead of '\'
FTSW_EAERI.Version = 1.2
Acquire.refreshRate = 2
Acquire.udpPort = 20000
Acquire.instrumentName =
```

Erase everything after the equal sign

Figure 8- 1. Configuration File

⚠	As a precaution, please copy the default file to be able to overwrite a config file that was modified incorrectly.

During use

The following table provides troubleshooting information for problems that may be encountered during use:

Problem	Possible cause	Solution
Undesirable features (such as spikes) appear in the spectra	Sensitivity to strong EMI field from external or internal source.	Verify if there are external source that may impact device. If unable to locate external source, then contact ABB Inc.
Unstable optical head temperature	Operation temperatures are very low or high not allowing adequate control of temperature.	In some cases, a free running system without temperature control may provide more stable results. Care must be taken, however, that the calibration errors due to offset of background or system emission does not affect desired performance.

Checking the Ethernet connection

If the connection cannot be established, the config file may be corrupt and use wrong addresses. Below are the correct addresses for:

iBoot Bar power switch:	169.254.44.254
Instrument:	169.254.44.127
Computer:	169.254.44.1

.

> Changing the computer or spectrometer IP address should be done with caution if one is not knowledgeable of Ethernet settings.

The Hatch does not close automatically

Description

Figure 8- 2 shows the internal mechanism for the hatch. It is responsible for the opening and closing of the hatch. An electric motor, with a gear box, is used to open the hatch, while a spring is used to close it. The sound you hear when the hatch is closing is produced by the gear box.
A socket for a metric Allen key of 3 mm can be used to operate the hatch manually.

Figure 8- 2. Hatch mechanism

MANUAL OPERATION

Turning an Allen key clockwise will slowly open the hatch. However, the spring will close it back if nothing is done. When sufficiently open, the hatch can be locked in place by turning the Allen key counter clockwise (about 90 degrees). When maintenance is completed, slightly turning the Allen clockwise will free the mechanism and the hatch will close itself.
Do not try to open the hatch with bare hands or to hold it open. The mechanism is strong and injuries are possible.

ACCESS PORT

Figure 8- 3 shows where the access port for the locking mechanism is located. A Rubber plug is installed to prevent dust or other contaminant to enter inside the hatch.

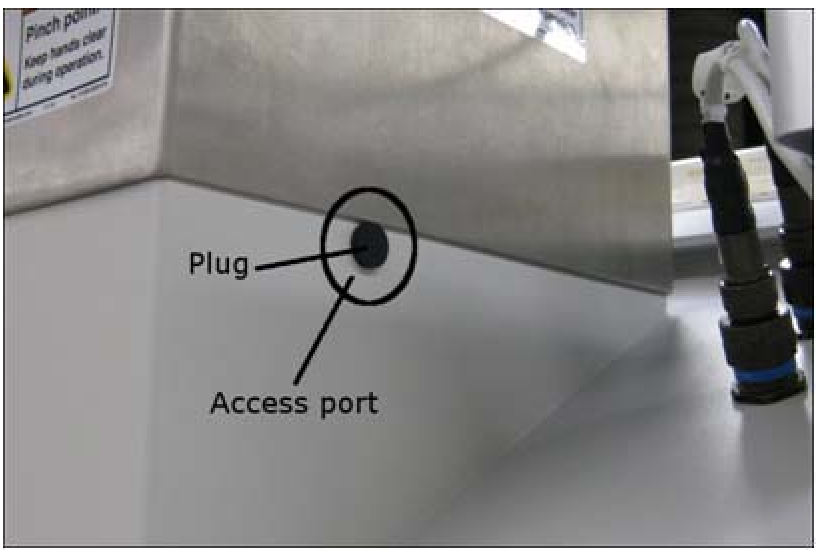


Figure 8- 3. Access Port for the

To access the locking mechanism, remove the rubber plug first, and then insert a 3 mm Allen key, as shows on Figure 8- 4.

Be careful, the socket may not be exactly aligned with the hole in the enclosure, and ice may have formed and blocked the socket.

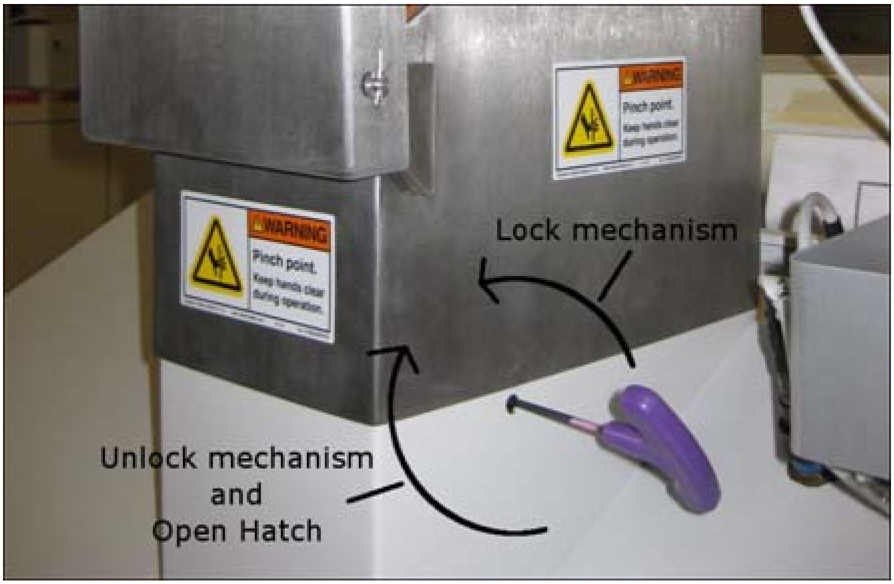


Figure 8- 4. Locking and unlocking of the hatch mechanism

PROCEDURE

To prevent anything from falling inside the aperture, it is necessary to block it before performing maintenance. To be able to protect the aperture, you need access to it. You first remove the front panel on the protective enclosure.

OPENING THE ENCLOSURE

To open the protective enclosure, unscrew the six captive screws as shown in Figure 8- 5.

Figure 8- 5. The 6 screws holding the front panel to the protective enclosure

BLOCKING THE APERTURE

It is possible to pass a hand on either side of the blackbody mount, refer to Figure 8- 6 and Figure 8- 7. Access to the left side is more difficult because of the presence of the fan.

To block the aperture, you can either use a piece of card board with strips of tape in star shape on it, or use an ESD plastic bag. The bag has the advantage to cover more, and probably has more chances to stay in place.

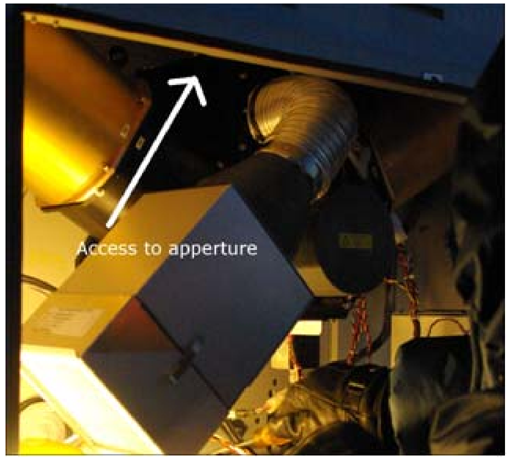


Figure 8- 6. Access to apperture (1)

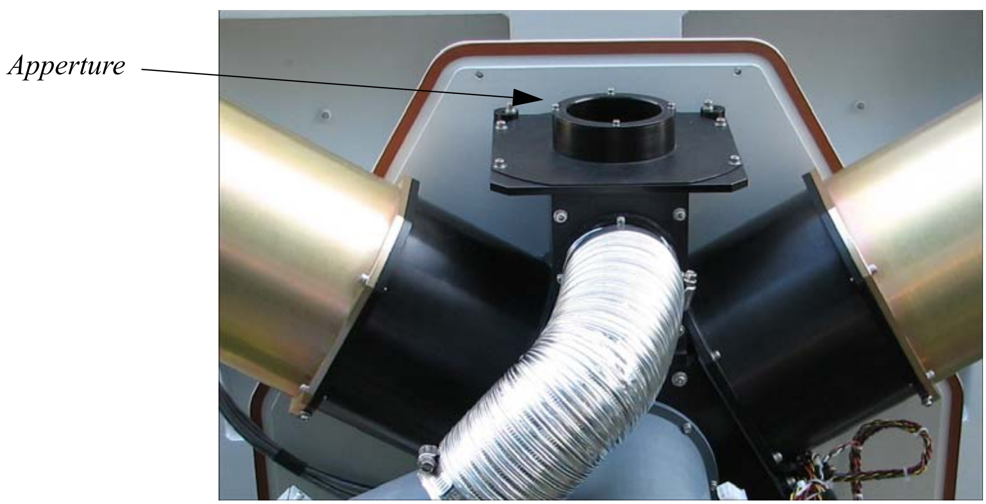


Figure 8- 7. Apperture

MAINTENANCE

Perform maintenance as needed.
Be careful with the cables. They are rated for cold temperature, but it is possible to pull one of them accidentally.

CLOSING THE ENCLOSURE

Closing the enclosure is the reverse procedure as opening it. However, the captive screws don't align them self with their respective socket. To ease the installation of the front panel, install first the middle to screw half way in. after that, align the other screws in their socket, and screw them in. Don't put to much tension on the screw though.

Un-lock the Hatch

Once every steps are completed, un-lock the hatch.

Temperature Control Unit

Turn on the Heaters

The temperature control unit can also be used to heat the instrument in cold conditions. By default the cooling system is working. To turn the heating system on:

STEP 1 Close all applications, and wait 20 seconds to give time for applications to complete their shutdown.

⚠	As a precaution, please copy the default file to be able to overwrite a config file that is modified incorrectly.

STEP 2 Edit the file C:\E-AERI\FTSW_EAERI.Config

STEP 3 Look the line beginning with “TECController.allowHeating =“ after the comment “//TEC Controller configuration”

STEP 4 At the end of the line, change the false to true.

STEP 5 Save the file

STEP 6 Launch the applications

STEP 7 Reopen the file C:\E-AERI\FTSW_EAERI.Config, and verify that the option is at true. If not, redo the instructions, you may not have waited long enough when the application has quit.

Turning off the temperature control unit

The temperature control unit can be controlled separately from the instrument, i.e. can be turned off manually.

⚠	The temperature control unit should never be turned off unless instructed to do so by ABB qualified personnel.

To turn the temperature control unit off:

STEP 1 Double click on the iBoot Bar icon on the Desktop.

Figure 8- 8. iBoot Bar Icon

STEP 2 A login window will appear. Enter the user name and password. They should be admin in both cases.

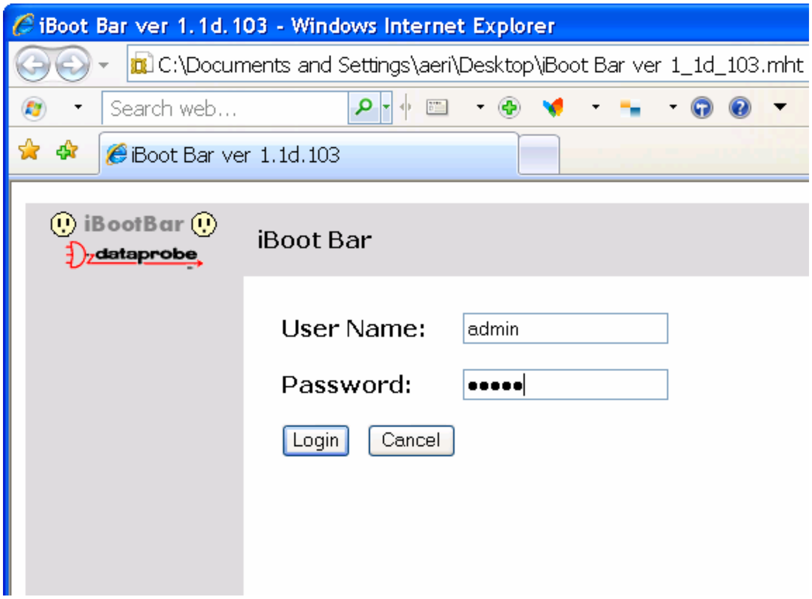


Figure 8- 9. iBoot Bar Window

STEP 3 Select the check box beside the item named enclosure and click on the Off button on the left.

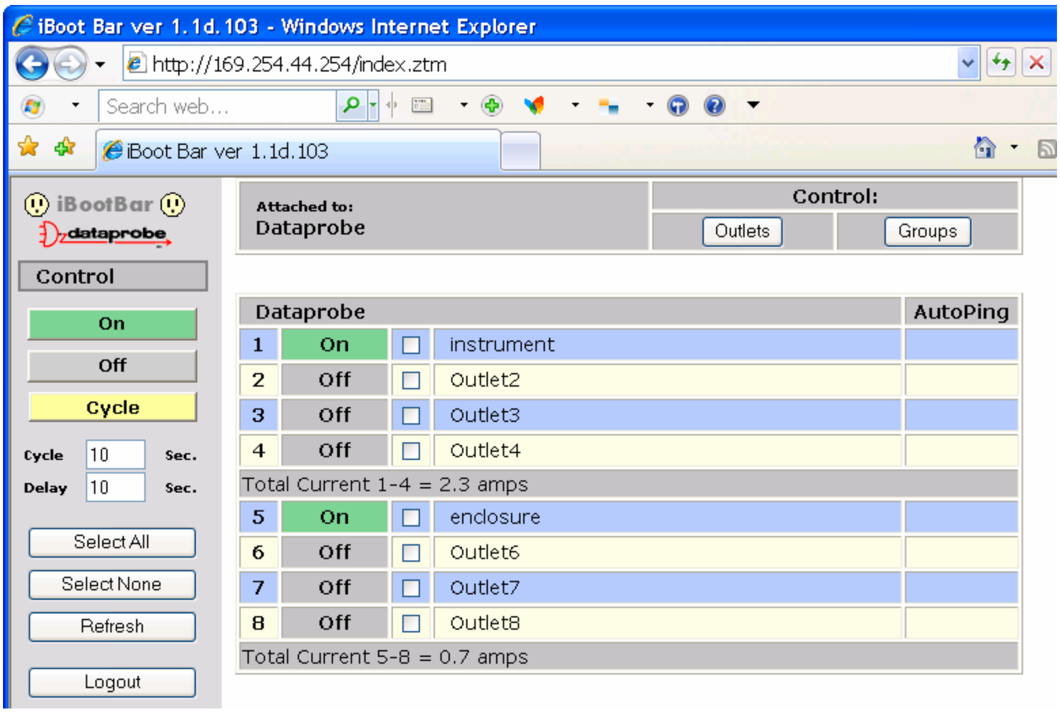


Figure 8- 10. Power and fan control through internet access

At this point, the entire temperature control unit does not function anymore, i.e. the cooling and heating options are not working. The instrument has to remain under surveillance and the temperature control unit has to be turned on again as otherwise the instrument may overheat.

Before Contacting ABB

If you are unable to solve a problem contact ABB. Before contacting ABB, please check the following:

- All cables are properly installed.
- The power switch on the power module is turned ON.
- The STATUS display on the electronic module is ON.
- All pertinent Troubleshooting steps in this manual have been followed.
- The model number of the spectroradiometer.

– The serial number of the spectroradiometer.

Before sending a spectroradiometer to ABB inc.

Before sending a spectrometer to ABB, you must first

- Obtain from ABB's after sales service a Contamination Data Sheet.
- Fill out and sign the Contamination Data Sheet. Do not forget to check the checkboxes of the Non-contaminated Material Declaration section. Then return the fully completed Declaration to ABB.
- Obtain the authorization from ABB personnel.You must receive a Return Merchandise Authorization (RMA) prior to sending the analyzer back to ABB, otherwise reception of analyzer will be refused.

Repacking

To prepare the spectroradiometer for shipment, refer to Appendix A, Transportation/Packing/Unpacking:.

i	ABB recommends to install the case on a shipping pallet to avoid damages during shipment

Appendix A Transportation/Packing/Unpacking

This chapter describes in detail how the AERI or E-AERI system should be disassembled, prepared and packed for shipment.

ESD	Electrostatic Sensitive Device Perform maintenance procedures in an ESD protected environment. Always use an ESD protection to perform maintenance procedures on the AERI system. If you are not familiar with ESD protection, or if ESD protection material is not available, contact ABB customer support. Refer to the back cover of this manual.

For the shipment, the front-end must be disassembled from the back-end and packed in their respective transportation boxes. The necessary tools to assemble or disassemble the system are supplied with the system.

Packing the Front-End

1. Protect the sun sensor (beside the hatch) with a tape or better a latex finger cot.
2. Unscrew the 6 screws on the front panel and remove the front panel.
3. Unscrew the 5 screws of the protective enclosure. It will remain in place as the hooks of the protective enclosure are still inserted in the bars of the back panel.
4. Disconnect all connectors. All connectors are clearly identified for future reconnection. For connections schematics for Front-end and Back-end, please refer to Figure 4-17.
5. Remove the protective enclosure with much care. 2 Persons are required to remove the enclosure and another person to make sure no cables or components inside the enclosure become damaged.

6. Remove the screw holding the cable clamp on the HBB and on the ABB. Remove the cable from the clamp and put the screw back in place. Please refer to Figure A- 1.

Figure A- 1. Hot Blackbody cable screw

7. Do not remove the HBB and the ABB as not necessary.

ℹ	Do not (under any circumstances) unscrew the alignments screws. These are located just underneath the front-end optics assembly, one on the left side and two on the right side. They are easily identified by the black plastic washers around the screws. Please refer to Figure A- 2

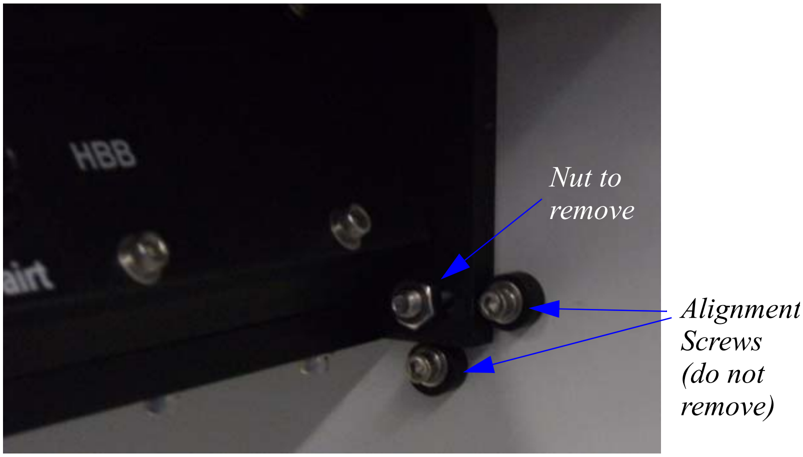


Figure A- 2. Alignments screws

8. Unscrew the two nuts from the bottom holding the front-end optics in place.
9. Unscrew the two top nuts holding the front-end optics in place. Be careful to push the front-end optics towards the panel and firmly holding the assembly in place while unscrewing to prevent damaging the nuts. After unscrewing the first top screw, you will have to slide the front-end optics sidewards to be able to unscrew the second top nut.
10. Remove carefully the front-end optics and lay them down flat on a cushioned surface.
11. Unscrew the 8 screws and washers and remove the front-end interface plate, please refer to Figure A- 3

Figure A- 3. Remove front-end interface plate

12. Screw the front-end interface plate to the dummy front-end plate of the transportation case by means of the 8 screws.
13. Attach the front-end optic assembly to the front-end interface plate by means of the 4 nuts. Screw first the two top nuts. Access to the screw onto which the nut is to be screwed is limited. Place the hand as flat towards the back panel as possible for this procedure. Please refer to Figure A- 4.

Figure A- 4. Attach Front-end Optic assembly to back panel

14. Loosen the aluminium sleeve around the optics fan to allow free movement of the sleeve. Please refer to Figure A- 5

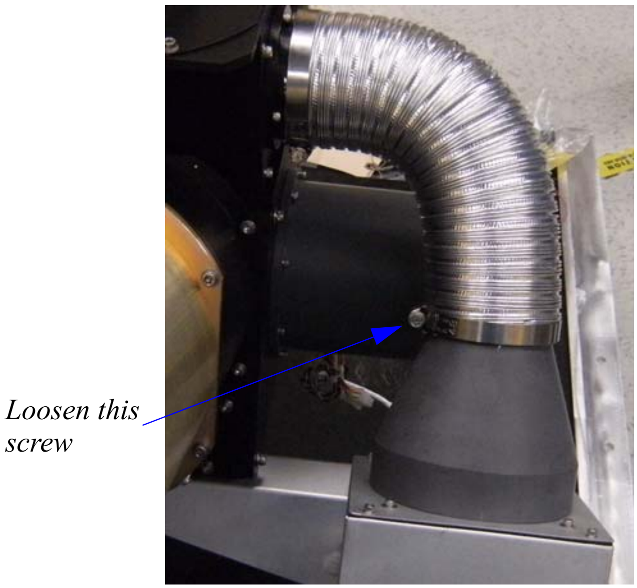


Figure A- 5. Optics Fan Sleeve

15. Protect the optic channel (on top of the front-end) by placing for example an ESD plastic piece that is held in place with masking tape.

16. Attach the protective enclosure to back panel by inserting the two hooks on top of the protective enclosure in the back panel bars as seen below in Figure A- 6.

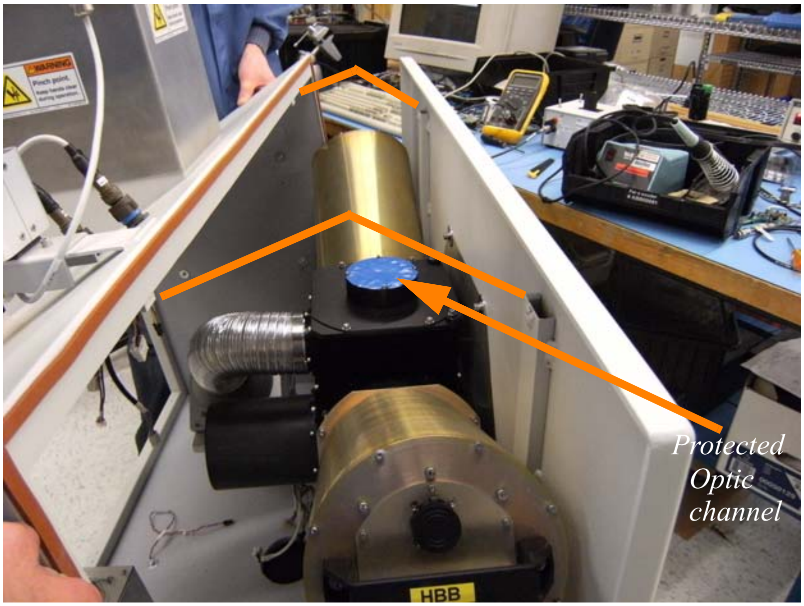


Figure A- 6. Align hooks above the bars for insertion

17. Screw the enclosure to the back panel with the 5 screws removed earlier.
18. Screw the front panel to the enclosure (6 captive screws).

19. Insert a foam between the enclosure and the dolly plywood as in Figure A- 7.

Figure A- 7. Foam protection underneath the front-end

20. The transportation case can now be installed on the dolly.

Packing the Back-End

⚠	The tubes through which the cables from the front-end are linked to the back-end come with an isolation foam filling. Do not remove the isolation.

1. Attach all cables and cover them with ESD bag and protect the optical input port. Please refer to Figure A-8.

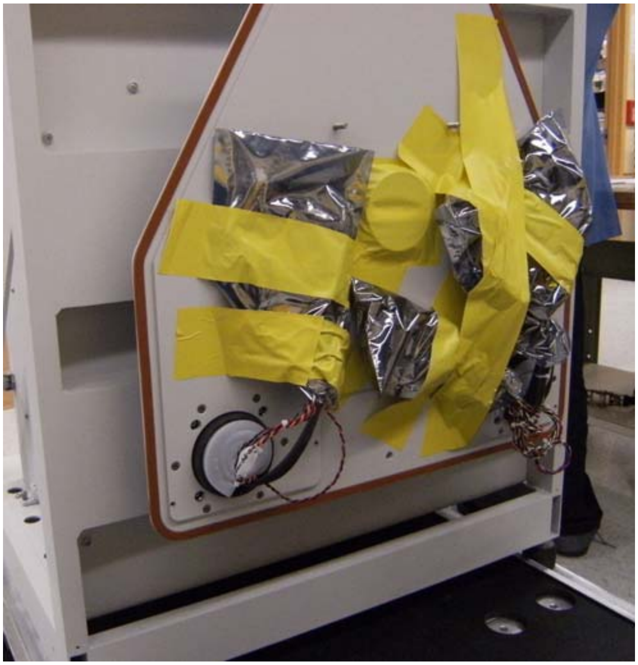


Figure A- 8. Attach cables and protect optical input port

2. Remove the back-end protective enclosure by unscrewing the 3 screws on each side of the enclosure. Slide the enclosure towards the back to remove it.

⚠	Be careful to disconnect the cable linking the temperature control unit to the back-end as described in the following steps.

3. Remove/unlatch the temperature control unit out of the thermal enclosure. Be careful, when the temperature control unit is unlatched, prior to completely remove it, you need to disconnect the cable that

links the back-end to the temperature control unit. To ease handling (Figure A- 9, element (3)), be aware that this unit weighs about 28 kg.

4. Disconnect the two power connectors and the ethernet connector from the back-end.
5. Set the back-end on the travel box dolly. The back-end is very heavy and 4 persons are required to securely install the back-end on the dolly. Please refer to below plan for proper positioning of the back-end on top of the dolly.

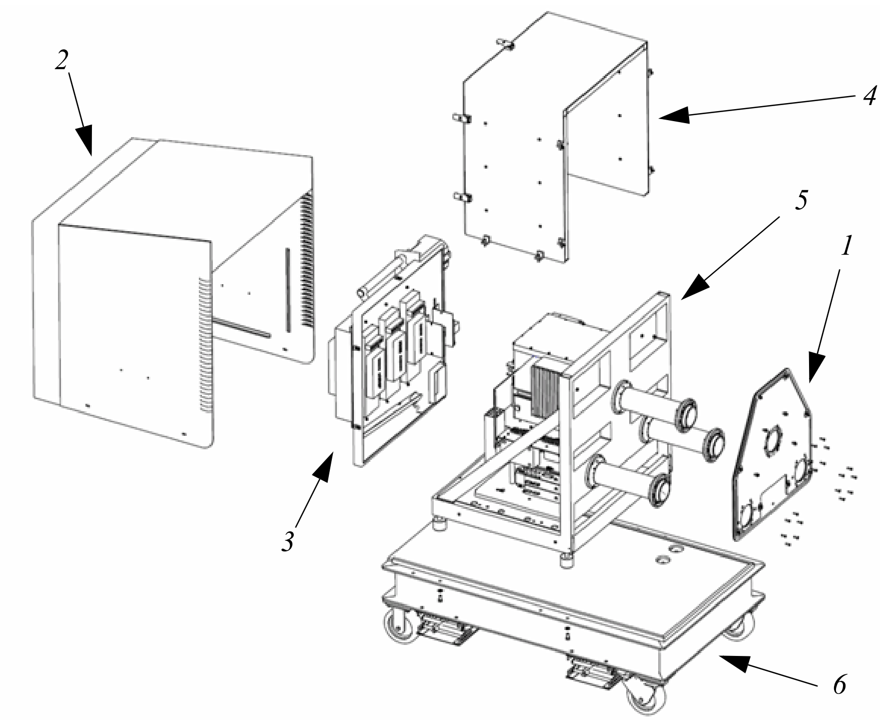


Figure A- 9. Back-end exploded view of interface plate (1), back-end protective enclosure (2), temperature control unit (3), thermal enclosure (4), instrument frame (5) and mobile base (6)

6. Screw the 4 damping mounts to the dolly.
7. Reconnect the cable of the temperature control unit to the back-end then clamp the temperature control unit to the back-end. Be careful as this assembly is quite heavy, i.e. 28 kg.
8. Install the protective enclosure on the back-end and screw with the 6 screws.
9. Install the transportation box (2 parts) on the dolly.

Appendix B System Specifications

System Specifications

Radiometric performance specifications

Spectral coverage and resolution Coverage	E-AERI: 400-3000 cm^{-1} (3.3-25, µm) AERI : 550 -3000 cm^{-1} (3-18, µm)
Resolution	0.8 cm^{-1}, unapodized. [max optical path difference (OPD) of 1 cm]
Spatial FOV Angular FOV	<45 mrad full angle
Radiometric calibration Absolute accuracy	<1% of ambient blackbody radiance
Reproducibility	<0.2% of ambient blackbody radiance

AERI Subsystem Specifications

Blackbody Cavity Characterization	
Temperature Knowledge	± 0.1°C of absolute temperature
Emissivity knowledge	better than ± 0.1%
Temperature knowledge	to within 0.l°C
Temperature stability	better than 0.05°C over viewing period (» 120 s)
Nonlinearity knowledge	better than 0.1%
Polarization	<0.1%

Wavelength calibration	Channel wavenumber knowledge: better than 0.01 cm^{-1}
(RMS for 2-min blackbody view)	E-AERI: <0.4 mW (m2 sr cm^{-1})-1 for 420-1400 cm^{-1} (except 667 cm^{-1}, where CO_2 in the instrument reduces responsivity). <0.015 mW (m2 sr cm^{-1})-1 for 2000-2600 cm^{-1} (except 2300-2400 cm^{-1}, where CO_2 in the instrument reduces responsivity). AERI: <0.2 mW (m2 sr cm^{-1})-1 for 670-1400 cm^{-1} <0.015 mW (m2 sr cm^{-1})-1 for 2000-2600 cm^{-1} (except 2300-2400 cm^{-1}, where CO_2 in the instrument reduces responsivity).
Temporal sampling Repeat cycle	≈10 min

Weight and Dimensions

Dimensions	L = 1.3 Meters W = 0.8 Meter H = 1.0 Meter (1.2 Meters with input port hatch opened)
Weight	200 kg

Electrical requirements

Instrument

Rated line voltage	~100-240 VAC
Rated frequency	50-60 HZ
Rated power consumption	600 VA

Electrical requirements

Temperature control unit

Rated line voltage	~100-240 VAC
Rated frequency	50-60 HZ
Rated power consumption	1200 VA

Operational requirement

The AERI automatic control system hardware contains these features:

- Scheduled sequencing of the following operations:
  - Scene switching between sky and blackbody views.
  - Interferometer and housekeeping data acquisition and transfer.
- Capability of remotely changing the operation listed above.
- 24-h continuous operations with data output at 10-min intervals.
- Real time display with flags for out-of-limit conditions. Examples of quantities to select from include the following:
  - Spectra from sky and blackbody views.
  - Housekeeping data (interferometer temperature, ambient temperature,
  - blackbody temperatures, electronics temperature).
  - Blackbody spectral variance.
  - Scene mirror position
  - Environmental Monitoring System measurement stability (determined from dedicated channels reading fixed precision resistors).

Operating environment

Operating temperature:

- Spectroradiometer enclosure: -30° to +40°C
- Input and calibration enclosure: -70° to +40°C

The Spectroradiometer enclosure features heating and cooling power to stabilize the spectroradiometer surrounding air at 20°C. The Input and calibration enclosure purpose is for protection against precipitation (Rain or Snow). This enclosure is not stabilized in temperature; it is free running at near the ambient temperature.

The Input and calibration module enclosure is detachable to easily seal the enclosure on the external side of a shelter wall. This is very practical when the system is installed in a shelter with the input and calibration section located outside through a window opening on the wall.

Note: Under precipitation the system will automatically turn itself in a self protection mode that do not allow sky measurement, after the precipitation the system will return to normal acquisition mode.

Data products

The AERI data products are divided into primary and secondary products. The primary products required for scientific use include evaluation of the data quality. The secondary products provide important auxiliary information for real-time monitoring of operations as well as historical data for subsequent quality control.

Primary (every viewing cycle; >>10 min.):

- Calibrated spectra.
- Standard deviation for blackbody and sky views.
- Calibration coefficient and blackbody temperature.

Secondary (every cycle):

- Ambient air temperature.
- Ambient pressure.
- Ambient humidity.
- Instrument housekeeping data.

User interface display

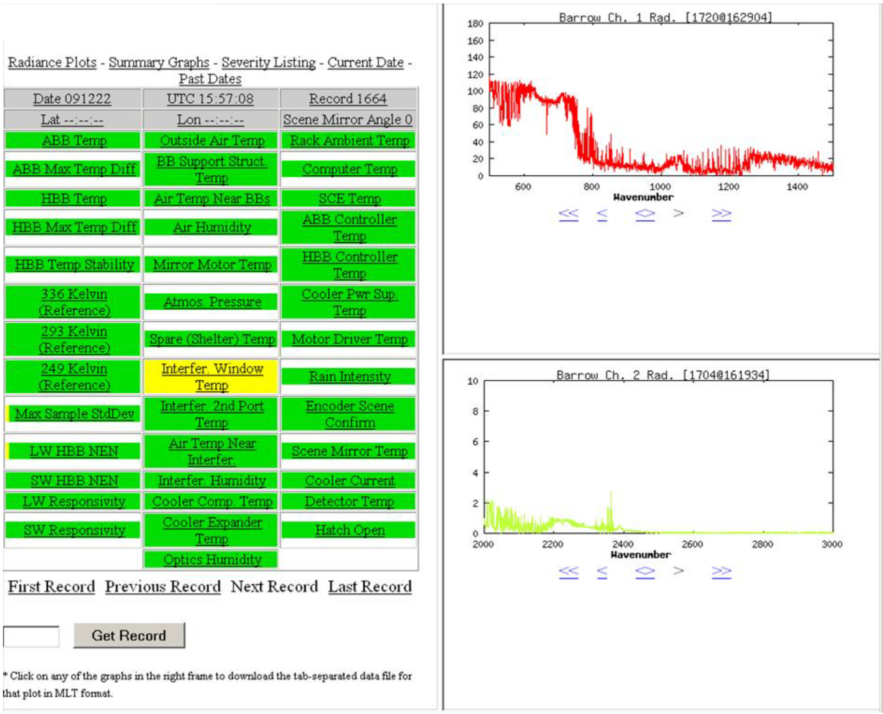


Figure B - 1. User Interface Display

The AERI user interface software can access multiple systems via the Internet, the interface display provide quick access to the health status of the AERI systems.

- The health status of the systems is displayed in color code for easily trace a system or module needing attention.
- Three status color are available:
  - Green = Good
  - Yellow = Warning
  - Red = Fault
- The latest Radiance spectrums acquired are displayed in real time in the right side of the user interface display.

AERI algorithms:

All Radiance spectrums are converted to water vapor concentration profiles and temperature profiles via the supplied algorithms included in the AERI product.

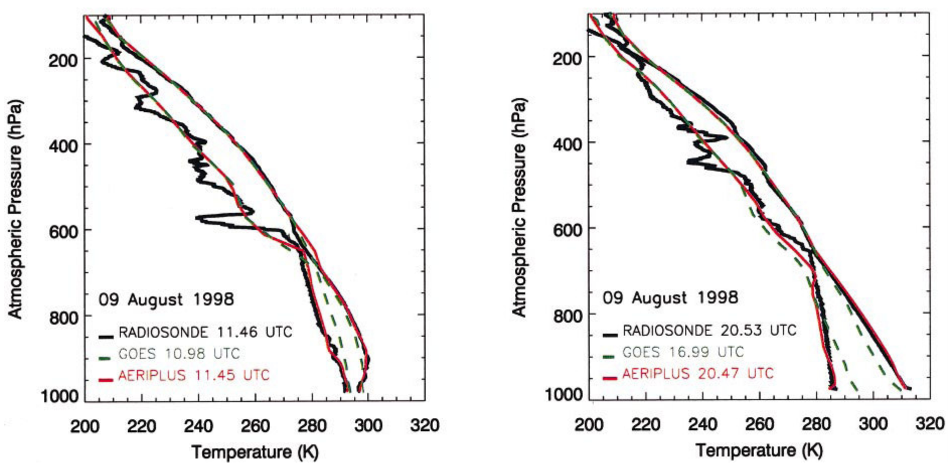


Figure B- 2. A comparison of radiosondes (black lines) with the nearest GOES retrievals (dashed green lines) in time and space and the final AERIplus physical retrievals (red lines0 at (left) 1130 and (right) 2030 UTC on 9 Aug 1998. The right lines for each colored pair are temperature profiles, the left lines are dewpoint temperature (moisture) profiles. Source: "Near-Continuous Profiling of Temperature, Moisture and Atmospheric Stability Using the Atmospheric Emitted Radiance Interferometer (AERI)" published in the Journal of Applied Meteorology in 2002.

ATMOSPHERIC SOUNDING specifications

AERI combined with its atmospheric profiling algorithms, gives an automated atmospheric sounding system capable of continuously generating humidity and temperature profiles every 8 minutes.

No consumables or human interaction are needed; AERI automatically measures the atmosphere radiance and determines the atmospheric humidity and temperature profiles from each radiance measurement.

The sounding performance of AERI was tested in a tempered climate zone; the following specifications are based on the AERI sounding performance test results.

Vertical resolution

100 meters at surface and gradually increase to 250 meters at 3 Km altitude

Limit of monitoring altitude
3 Km or cloud ceiling

Time resolution
Vertical profile every 8 minutes

HumidityAccuracy
5% in absolute water vapor compared to well calibrated radiosondes

TemperatureAccuracy
1 Kelvin

Appendix C Hot Blackbody settings, examples, other

Hot Blackbody Temperature Mapping

Temperature °C	Control Voltage	Temperature °C	Control Voltage	Temperature °C	Control Voltage
-24	4,986	12	3,075	48	1,254
-23	4,950	13	3,013	49	1,219
-22	4,912	14	2,950	50	1,185
-21	4,874	15	2,889	51	1,153
-20	4,834	16	2,828	52	1,121
-19	4,793	17	2,767	53	1,089
-18	4,751	18	2,707	54	1,059
-17	4,708	19	2,648	55	1,030
-16	4,663	20	2,587	56	1,001
-15	4,618	21	2,529	57	0,973
-14	4,571	22	2,471	58	0,946
-13	4,523	23	2,413	59	0,920
-12	4,474	24	2,357	60	0,894
-11	4,424	25	2,301	61	0,869
-10	4,373	26	2,246	62	0,845
-9	4,321	27	2,191	63	0,821
-8	4,268	28	2,137	64	0,798
-7	4,214	29	2,084	65	0,776
-6	4,159	30	2,032	66	0,754
-5	4,103	31	1,981	67	0,733
-4	4,047	32	1,931	68	0,713
-3	3,989	33	1,882	69	0,693
-2	3,931	34	1,833	70	0,674
-1	3,873	35	1,786	71	0,655
0	3,813	36	1,739	72	0,637
1	3,753	37	1,694	73	0,619
2	3,693	38	1,649	74	0,602
3	3,632	39	1,605	75	0,586
4	3,571	40	1,562	76	0,569
5	3,509	41	1,521	77	0,554
6	3,447	42	1,479	78	0,538
7	3,386	43	1,440	79	0,524
8	3,324	44	1,401	80	0,510
9	3,261	45	1,363	81	0,496
10	3,199	46	1,325	82	0,482
11	3,136	47	1,289		

FTSW EAERI Parameters Examples

Status Name	Value
Sweep Counter	202346
Beam splitter temp	35.00 (°C)
Auxiliary input temp	0.00 (°C)
Resolution	1 (cm-1)
Gain A	1.0
Gain B	1.0
# of scans done	21
Total # of scans	127
# measurement done	0
Total # of measurements	1
Estimated time left	N/A
Speed	71.6 (sca...
Scan mirror angle	242.10 (D...
Scan mirror motor temp	-9.47 (°C)
ambientBlackbodyTopRimTemperature	-15.15 (°C)
ambientBlackbodyTopRimRes	61739.46...
ambientBlackbodyApexTemperature	-15.15 (°C)
ambientBlackbodyApexRes	61658.55...
ambientBlackbodyBottomRimTemperature	-15.15 (°C)
ambientBlackbodyBottomRimRes	61588.93...
hotBlackbodyTopRimTemperature	29.87 (°C)
hotBlackbodyTopRimRes	8224.90 (...
hotBlackbodyApexTemperature	29.70 (°C)
hotBlackbodyApexRes	8273.29 (...
hotBlackbodyBottomRimTemperature	30.00 (°C)
hotBlackbodyBottomRimRes	8181.96 (...
refTemp1	63.83 (°C)

Status Name	Value
hotBlackbodyBottomRimRes	8181.90 (...
refTemp1	63.83 (°C)
refRes1	2429.87 (...
refTemp2	23.84 (°C)
refRes2	10486.00...
refTemp3	-24.05 (°C)
refRes3	97714.45...
outsideAirTemperature	-16.29 (°C)
outsideAirRes	65157.62...
interferometerAirTemperature	33.01 (°C)
interferometerAirRes	7294.50 (...
blackbodySupportStructureTemperature	-13.95 (°C)
blackbodySupportStructureRes	57880.31...
blackbodyAirTemperature	-12.80 (°C)
blackbodyAirRes	54653.87...
mirrorMotorTemperature	-9.47 (°C)
mirrorMotorRes	46338.47...
sceneMirrorTemperature	1.61 (°C)
sceneMirrorRes	27395.39...
powerSupplyTemperature24V	26.68 (°C)
powerSupplyRes24V	9354.34 (...
powerSupplyTemperature28V	25.79 (°C)
powerSupplyRes28V	9691.18 (...
stirlingCoolerCompressorTemperature	32.79 (°C)
stirlingCoolerCompressorRes	7356.08 (...
stirlingCoolerExpenderTemperature	35.05 (°C)

Status Name	Value
stirlingCoolerExpenderTemperature	35.08 (°C)
stirlingCoolerExpenderRes	6737.26 (...
thermalEnclosureTemperature	23.57 (°C)
thermalEnclosureRes	10604.54...
inputMirrorMotorDriveElectronicTemperature	22.62 (°C)
inputMirrorMotorDriveElectronicRes	11023.17...
dataAcquisitionModulesTemperature	25.22 (°C)
dataAcquisitionModulesRes	9918.57 (...
sceneWindowTemperature	35.36 (°C)
sceneWindowRes	6665.06 (...
fanAirflowTemperature	-15.01 (°C)
fanAirflowRes	61080.45...
protectiveEnclosureTemperature	-14.39 (°C)
protectiveEnclosureRes	59171.63...
detectorTemperatureSensor	1.08 (Volts)
stirlingCoolerCurrent	0.06 (Volts)
atmosphericRelativeHumidity	0.39 (Volts)
interferometerRelativeHumidity	0.05 (Volts)
atmosphericPressureSensor	3.55 (Volts)
externalRainDetectorSensor	3.02 (Volts)
internalRainDetectorSensor	3.01 (Volts)
externalSunDetectorSensor	3686866....
internalSunDetectorSensor	99000003...
closeLimitSwitch	0
openLimitSwitch	1
outsideRainSensor	1
insideRainSensor	1

outsideRainSensor	1
insideRainSensor	1
TEC Ctrl Input Temp	22.88 (°C)
TEC Ctrl Output (%)	0.0 (%)

AERI's Parameters Description

The following list provides a description of every AERI parameter displayed in the FTSW EAERI software.

Sweep Counter: the number of sweeps the instrument made since it was turned on.

Beam splitter temp: the temperature of the beam splitter in °C. The nominal value should be around 35 °C.

Auxiliary input temp: this parameter is not used.

Resolution: the resolution of the instrument. For AERI and EAERI it should be set to 1 cm^{-1}.

Gain A: the gain for Band A. For AERI and EAERI it should be set to 1.0.

Gain B: the gain for Band B. For AERI and EAERI it should be set to 1.0.

# of scans done: the number of scans done for the current recording.

Total # of scans: the total number of scans to be done for the current recording.

 # measurements done: the number of measurements done.

Total # of measurements: the total number of measurements to be done.

Estimated time left: estimated time to complete the total number of scans.

Speed: the number of scans per minute the instrument is performing in scans/min.

Scan mirror angle: the angle location of the scan mirror. The zenith is approximately at 180 degrees.

Scan mirror motor temp: the temperature of the scan mirror motor in °C.

ambientBlackbodyTopRimTemperature: the temperature in °C of the thermistor located at the Top Rim of the ambient blackbody.

ambientBlackbodyTopRimResistance: the resistance value in Ω of the thermistor located at the Top Rim of the ambient blackbody.

ambientBlackbodyApexTemperature: the temperature in °C of the thermistor located at the Apex of the ambient blackbody.

ambientBlackbodyApexResistance: the resistance value in Ω of the thermistor located at the Apex of the ambient blackbody.

ambientBlackbodyBottomRimTemperature: the temperature in °C of the thermistor located at the Bottom Rim of the ambient blackbody.

ambientBlackbodyBottomRimResistance: the resistance value in Ω of the thermistor located at the Bottom Rim of the ambient blackbody.

hotBlackbodyTopRimTemperature: the temperature in °C of the thermistor located at the Top Rim of the hot blackbody.

hotBlackbodyTopRimResistance: the resistance value in Ω of the thermistor located at the Top Rim of the hot blackbody.

hotBlackbodyApexTemperature: the temperature in °C of the thermistor located at the Apex of the hot blackbody.

hotBlackbodyApexResistance: the resistance value in Ω of the thermistor located at the Apex of the hot blackbody.

hotBlackbodyBottomRimTemperature: the temperature in °C of the thermistor located at the Bottom Rim of the hot blackbody.

hotBlackbodyBottomRimResistance: the resistance value in Ω of the thermistor located at the Bottom Rim of the hot blackbody.

refTemp1: the temperature equivalent in °C of the reference resistor #1. The nominal value should be around 63.83 °C.

refResistance1: the value of the reference resistor #1 in Ω. The nominal value should be around 2430 Ω. This value may vary by 1% from one system to another.

refTemp2: the temperature equivalent in °C of the reference resistor #2. The nominal value should be around 23.84 °C.

refResistance2: the value of the reference resistor #2 in Ω. The nominal value should be around 10 485 Ω.

refTemp3: the temperature equivalent in °C of the reference resistor #3. The nominal value should be around -24.05 °C.

refResistance3: the value of the reference resistor #3 in Ω. The nominal value should be around 97 720 Ω.

outsideAirTemperature: the measured outside temperature in °C.

outsideAirResistance: the measured resistance in Ω of the outsideAirTemperature sensor.

interferometerAirTemperature: the measured air temperature close to the interferometer in °C. This value should be around 33 °C in normal conditions.

interferometerAirResistance: the measured resistance in Ω of the interferometerAirTemperature sensor. This value should be around 7 230 Ω in normal conditions.

blackbodySupportStructureTemperature: the measured temperature in °C of the supporting structure for both blackbodies.

blackbodySupportStructureResistance: the measured resistance in Ω of the blackbodySupportStructureResistance sensor.

blackbodyAirResistance: the measured temperature in °C of the air inside the blackbodies.

blackbodyAirTemperature: the measured resistance in Ω of the blackbodyAirResistance sensor.

mirrorMotorTemperature: the measured temperature in °C of the mirror's motor.

mirrorMotorResistance: the measured resistance in Ω of the mirrorMotorTemperature sensor.

sceneMirrorTemperature: the measured temperature in °C of the mirror.

sceneMirrorResistance: the measured resistance in Ω of the sceneMirrorResistance sensor.

powerSupplyTemperature24V: the measured temperature in °C of the 24 V power supply. This value should be around 27 °C in normal conditions.

powerSupplyResistance24V: the measured resistance in Ω of the powerSupplyResistance24V sensor. This value should be around 9 290 Ω in normal conditions.

powerSupplyTemperature28V: the measured temperature in °C of the 28 V power supply. This value should be around 27 °C in normal conditions.

powerSupplyResistance28V: the measured resistance in Ω of the powerSupplyResistance28V sensor. This value should be around 9 745 Ω in normal conditions.

stirlingCoolerCompressorTemperature: the measured temperature in °C of the Stirling cooler compressor. This value should be below 40 °C in normal conditions.

stirlingCoolerCompressorResistance: the measured resistance in Ω of the stirlingCoolerCompressorResistance sensor. This value should be smaller than 5 700 Ω in normal conditions.

stirlingCoolerExpenderTemperature: the measured temperature in °C of the Stirling cooler Expender. A black heat sink is installed at that location. This value should be below 40 °C in normal conditions.

stirlingCoolerExpenderResistance: the measured resistance in Ω of the stirlingCoolerExpenderResistance sensor. This value should be smaller than 5 700 Ω in normal conditions.

thermalEnclosureTemperature: the measured temperature inside the thermal enclosure. This value should be around 23 °C in normal conditions. If this value is higher, the thermal enclosure is in an environment where the temperature is higher than 35 °C.

thermalEnclosureResistance: the measured resistance in Ω of the thermalEnclosureResistance sensor. This value should be around 10 500 Ω in normal conditions.

inputMirrorMotorDriveElectronicTemperature: the measured temperature of the mirror's motor drive electronic. This value should be around 23 °C in normal conditions.

inputMirrorMotorDriveElectronicResistance: the measured resistance in Ω of the inputMirrorMotorDriveElectronicResistance sensor. This value should be around 10 900 Ω in normal conditions.

dataAcquisitionModulesTemperature: the measured temperature in °C of the data acquisition modules used to sample every sensor. This value should be around 25 °C in normal conditions.

dataAcquisitionModulesResistance: the measured resistance in Ω of the dataAcquisitionModulesResistance sensor. This value should be around 9 920 Ω in normal conditions.

sceneWindowTemperature: is the measured temperature in °C of the window used to isolate the thermally control part of the instrument from the outside. This value should be around 36 °C in normal conditions.

sceneWindowResistance: the measured resistance in Ω of the sceneWindowResistance sensor. This value should be around 6 560 Ω in normal conditions.

fanAirflowTemperature: the measured temperature in °C of the air pushed to increase the pressure inside the protective enclosure.

fanAirflowResistance: the measured resistance in Ω of the fanAirflowResistance sensor.

protectiveEnclosureTemperature: the measured temperature in °C of the protective enclosure.

protectiveEnclosureResistance: the measured resistance in Ω of the protectiveEnclosureResistance sensor.

detectorTemperatureSensor: the measured temperature in Volt of the detector inside the Dewar. This value should be between around 1.077 V in normal conditions (~67K). The transformation in Kelvin is: (1.18968 - Current) / 0.0016853.

stirlingCoolerCurrent: the measured current in Volt that the Stirling cooler is pulling. The value in Amp can be obtained by multiplying by 10.

atmosphericRelativeHumidity: the measured relative humidity in the atmosphere in Volt of the.

interferometerRelativeHumidity: the measured relative humidity of the air close the interferometer in Volt.

atmosphericPressureSensor: the measured atmospheric pressure in Volt.

externalRainDetectorSensor: the measured external rain sensor detector state in Volt. The value goes from 1 to 3 Volts (wet, to dry).

internalRainDetectorSensor: the measured internal rain sensor detector state in Volt. The value goes from 1 to 3 Volts (wet, to dry).

externalSunDetectorSensor: the measured resistance in Ω of the externalSunDetectorSensor sensor.

internalSunDetectorSensor: Not used.

closeLimitSwitch: the status of the limit switch indicating that the hatch is closed.

openLimitSwitch: the status of the limit switch indicating that the hatch is open.

outsideRainSensor: the status of the outside rain sensor indicating that rain was detected. The value of 1 indicates no rain, and the value of 0 indicates that rain was detected.

insideRainSensor: the status of the inside rain sensor indicating that rain was detected.

TECInput1Temperature: This is the measured temperature in °C used to control the cooling system. The **nominal value should be around 23°C**

TECOutput: is the TEC output. A value of -100 means the system is cooling the thermal enclosure, a value of 0 means the system is in standby, and a value of 100 means the system is heating the thermal enclosure. A value of NaN indicates the cooling system is not powered.

> As a precaution, please copy the default file to be able to overwrite a configuration file that was modified incorrectly.

IP Address

Below are the default IP addresses of the iBoot Bar power switch, the instrument and the computer. These default IP addresses should not be modified as the entire programming was built upon these. Changing one of these addresses may make one or several of the software modules unusable.

iBoot Bar power switch:	169.254.44.254
Instrument:	169.254.44.127
Computer:	169.254.44.1

Appendix D Glossary

Glossary

The following terms are defined as they are used in ABB manuals.

absorbance (also called optical density or extinction)

A measure of the amount of light absorbed as it passes through a sample.

The absorbance A is the logarithm of the ratio of the intensity I_0 of the light striking the sample to the intensity I of the light which passes through the sample.

$$A = \log_{10} \frac{I_0}{I} = \log_{10} \frac{1}{T}$$

The absorbance is equal to the logarithm of the reciprocal of the transmittance T.

absorbance spectrum

The absorbance of a sample as a function of the frequency or wavelength over a given spectral range.

The absorbance spectrum is calculated point-by-point from the sample and reference spectra as follows:

$$Absorbance = -\log_{10}\left(\frac{sample}{reference}\right)$$

ADC

Analog-to-digital converter

agreement

The error between the analyzer result and the result obtained with a laboratory primary method. This is often expressed as accuracy.

background spectrum (see reference spectrum)

beamsplitter

A semi-reflecting mirror in the interferometer used to divide the radiation from the infrared source into two beams, and to recombine the two beams into a single beam.

calibration

The process of designing a model that correlates measurements obtained using a primary method to spectral intensities.

channel

An optical channel on the spectrometer. Each channel is usually associated with one = "<*" "sample accessory" "" sampling accessory and one detector.

Many spectrometers have only one channel. This is typical of laboratory instruments. Other spectrometers have multiple channels. This allows one instrument to analyze several streams simultaneously.

If the monitoring (sampling) system is set up for stream switching, one channel can be used to analyze two or more streams.

channel spectrum

A spectral artifact caused by reflections in the gap between two optical surfaces, for example, between parallel window surfaces or at the coupling point between optical fiber ends. Also called Fabry-Perot interference.

To avoid channel spectrum in transmission cells with a small optical pathlength, a wedge in the sample path is used to prevent parallelism of the two windows.

coadded spectrum

The spectrum resulting from averaging, on a point-by-point basis, a number of spectra or interferograms. Coaddition is used to increase the signal-to-noise ratio of a spectrum.

desiccant

A substance used as a drying agent.

detector

A device in a spectrometer that produces an electrical signal that is proportional to the intensity of the light striking it.

detector cut-off

The frequency or wavelength at lower end of the spectral range.

detector saturation

A condition of the detector whereby an increase in the light intensity striking it no longer produces a linearly proportional change in the output signal. This is a nonlinear condition and can cause spectral artifacts.

D-star (D*)

A value used to designate the specific detectivity. This is a performance measure independent of detector size. The higher is the D* value, the better is the detector.

$$D^* = (A \times \Delta f)^{1/2} D$$

where	A	is the sensitive area
	Δf	is the bandwidth frequencies
	D	is the reciprocal of noise equivalent power (NEP)

Fast Fourier transform (FFT)

A mathematical algorithm for efficient calculation of the Fourier transform.

Fourier transform

A mathematical function that transforms the time-dependent information contained in the interferogram into the corresponding optical spectrum.

FT-IR (or FTIR)

Fourier transform infrared.

FT-MIR

Fourier transform mid-infrared.

FT-NIR

Fourier transform near-infrared.

hygroscopic

Able to absorb moisture from the atmosphere.

hygroscopic optical component

An optical component made of hygroscopic material. Such optical components can be damaged if exposed to humidity because they can absorb moisture from the atmosphere.

infrared

A region of the electromagnetic spectrum between visible light and radio waves where the wavelengths are longer than those of red light.

initial reference (or initial zero)

The first reference spectrum collected when the system was commissioned, or after a maintenance intervention (such as replacing the source) is stored for diagnostics purposes. It is used as a base to monitor changes in the analyzer response over time.

The initial reference is used with the current reference to calculate an absorbance or transmittance spectrum that reveals changes in response or the presence of contaminants:

$$Absorbance = -\log_{10}\left(\frac{\text{current reference}}{\text{initial reference}}\right)$$

$$\%Transmittance = \frac{\text{current reference}}{\text{initial reference}} \times 100$$

Installation Qualification (IQ)

A procedure used to ensure that an instrument has been correctly installed.

interferogram

A representation of the electrical signal from the detector of a FT-IR spectrometer. The interferogram is a graph of the voltage at the output of the detector as a function of the position of interferometer scan mechanism. The spectrum is calculated from the interferogram using a Fourier transform.

interferometer

The device in an FT-IR spectrometer that modulates the infrared beam coming from the source.

The interferometer splits the infrared beam into two beams, introduces a continuously varying optical path difference (OPD) between the two beams, and recombines the beams. When the beams are recombined, interference caused by the OPD modulates the beam.

nonlinearity

A deviation from the normally linear relation between the output and the input of a device. Nonlinearity occurs when the output of a device does not vary in direct proportion to the input, for example, when saturation occurs.

open beam

A condition in which there is no sample in the = "<*" "sample accessory" "" sampling accessory.

open-beam spectrum

A spectrum acquired in the open-beam condition.

path length

The distance that light travels through the sample during analysis.

preprocessing

Mathematical treatment applied to a spectrum before the calibration model is applied to it. There are a number of standard preprocessing algorithms commonly used in spectroscopy.

raw spectrum

A spectrum that has not undergone any mathematical alterations.

A single-beam spectrum.

reference spectrum (also called background spectrum or zero spectrum)

A single-beam spectrum that only contains information about the analyzer, including the = "<*" "sample accessory" "" sampling accessory and the air present in any part of the modulated beam optical path. This is required in order to obtain a transmittance or absorbance spectrum of the sample.

A reference spectrum is obtained by removing the sample from the = "<*" "sample accessory" "" sampling accessory or by filling the = "<*" "sample accessory" "" sampling accessory with a blank sample and acquiring a spectrum.

In many systems, a new reference is acquired on a regular basis either automatically or manually. This becomes the current reference until a new reference is acquired.

repeatability

The precision of repeated measurements on the same instrument.

reproducibility

The precision of repeated measurements on different instruments.

resolution

The smallest frequency interval that can be distinguished over a spectral range. The lower the resolution setting on the spectrometer, the more data points there are in the spectrum.

Lowering the resolution setting on the spectrometer yields spectra with a “higher” resolution, since there are more data points covering the same spectral range.

saturation (see detector saturation)

scan

With the ABB FT-IR spectrometers, a forward and a reverse sweep of the interferometer scan mechanism.

A single scan results in two interferograms, one for the forward sweep and one for the reverse sweep (see Coadded spectrum).

single-beam spectrum

The spectrum that results from performing a Fourier transform on the interferogram obtained from a spectrometer.

The single-beam spectrum contains information not only about any sample present in the = "<*" "sample compartment or sample accessory" "" sampling accessory, but also about the instrument (the source, all the optical components, the ambient air, as well as any contamination there may be in the optical path).

spectral range

The range of frequencies (or wavelengths) over which the amplitude of a spectrum is above the acceptable noise level. It is application dependent.

spectrometer

An instrument for producing a spectrum and measuring the wavelengths, energies, etc. involved.

An FT-IR spectrometer has a photoelectric detector and produces a spectrum that shows how the transmittance, absorbance, or reflectance of the sample varies with wavelength. Such instruments are also called spectrophotometers.

spectrum

A range of electromagnetic energies arrayed in order of increasing or decreasing wavelength.

A distribution of transmission or absorbance levels over a range of wavelengths, arrayed in order of increasing or decreasing wavelength.

stray light

Apparent optical energy, caused by nonlinearity, in a spectral region where no energy is expected (Fourier stray light).

Modulated light reaching the detector without having passed through the sample.

transmittance

A measure of the amount of light that passes through the sample, often expressed as a percentage.

The transmittance T is the ratio of the intensity I of the light which passes through the sample to the intensity I_0 of the light striking the sample.

$$T = \frac{I}{I_0} \qquad \%T = 100T$$

transmittance spectrum

The percent transmittance of a sample as a function of the frequency or wavelength over a given spectral range.

The transmittance spectrum is calculated point-by-point from the sample and reference spectra as follows:

$$\%Transmittance = \frac{sample}{reference} \times 100$$

trigger

A trigger represents a signal (usually a digital input) used to activate operations in the software. When a trigger is switched from off (0) to on (1), the associated action is performed.

validation

Tests used to establish that an analyzer is operating correctly (instrument validation) and is providing results within the expected degree of agreement (calibration validation). Analyzer validation can include diagnostics on the reference and sample spectra and predictions with known samples.

Confirmation by examination and provision of objective evidence that computer system specifications conform to user needs and intended uses, and that all requirements can be consistently fulfilled.

validation set

In spectrometer calibration, a set of standard samples similar to a training set but used to validate a calibration model.

wavelength

The distance (λ) between successive points of equal phase in a wave.

In FT-IR spectrometry, wavelength is usually expressed in micrometers (μm) or nanometers (nm).

wavenumber

The number (σ) of cycles of a wave in unit length. The wavenumber is the reciprocal of the wavelength:

$$\sigma = \frac{1}{\lambda}$$

The unit of the wavenumber is $\frac{1}{cm}$ or cm^{-1}.

zero spectrum (see reference spectrum)

ZPD (Zero Path Difference)

The point where the scan mechanism of a Michelson interferometer is positioned so that the two beams from the beamsplitter travel exactly the same distance before being recombined.

Appendix E Data Processing

Compute Spectrum

The Compute Spectrum command is used to transform a single into an apodized self-phase corrected raw spectrum.

Self-phase correction is performed using a scalar product with a low resolution version of the spectrum obtained by zero-filling the corresponding interferogram.

By default, no apodization is applied. Certain special applications may need to use apodization functions.

Compute Calibrated Spectrum

When the radiometer is looking at a source, the measured spectrum will contain contributions that are due not only to the source, but to the surrounding environment, the internal heat sources within the spectroradiometer, and the response curve of the detector.

The goal of radiometric calibration is to obtain the parameters that will allow the contribution of the source alone to be calculated, using the appropriate equation. Since the contributions to these parameters can come from different locations, and may be out of phase, these parameters are complex quantities. There are three types of radiometric calibration:

- spectral radiance calibration

  The spectral radiance is the power radiated from an object per solid angle unit per unit area per wavenumber. Units are expressed in [W/cm2 sr cm^{-1}] $\equiv$ [r.u.].

Calibration equations used by the software are linear. Different equations are used for a filled FOV or an unfilled FOV with or without background correction.

In order to obtain the different parameters of this linear equation, a source with well-defined and predictable characteristics is needed. The calibration source must be a black body source because its spectral emissivity is well known and can be calculated for a given temperature per Planck's radiation law *(see section* Generate BlackBody on page 163*).*

> For more information on radiometric and spectral theory, refer to a FT-Spectroradiometer Reference Manual.

To solve the linear equation, a minimum of two different source temperatures are required. The temperatures that are selected should bracket the expected temperatures of the unknown sources that will be observed and should be as close together as possible to minimize the effects of any nonlinearity that are not modeled. Using more than the minimum required number of temperatures to compute the parameters will improve results by making them less dependent on any given point since all the points will contain some level of uncertainty. The parameters are obtained using a least squares curve fitting algorithm. Once the parameters are known, the calibrated spectrum of any source can be obtained by applying the appropriate equation to the measurement (see Sections Radiance and Apparent Temperature).

The resulting complex calibrated spectrum is furthermore self-phase corrected to produce a real spectrum. The imaginary part can be examined using the *save residual* option. Because of noise the imaginary part will be zero on average and can be used to evaluate the noise associated with the real calibrated spectrum. In some cases the imaginary part will not be close to zero, and will in fact have a significant amplitude when compared with the real part. This is indicative of the fact that the sources used for calibration have a different geometry from the observed source.

For example, if the field of view of the radiometer is completely filled by the calibration source but not by the observed source, or if the field of view covered by the observed source varies, the calibration will exhibit this type of behavior. Whenever possible, use calibration sources that have the same geometry as the observable sources.

Radiance

The software uses one of the following equations to calculate the calibrated radiance spectrum (L), depending on the case.

If the response of the detector to varying intensities is linear there should exist for any given frequency a linear relationship between the source intensity and the intensity measured by the detector. This relationship will have the form:

$M = a_0 + a_1 \times L$	Equation 1

Once the parameters are known, the spectral radiance of any source can be obtained by applying the following equation to the measurement:

$L = \dfrac{M - a_0}{a_1}$	Equation 2

where M is the measured intensity [Volts],

a_0 accounts for any fixed contributions from the surrounding environment or from the instrument [Volts],

a_1 is a scaling factor that serves to calibrate the detector response and takes any losses in the system into account [Volts]/[r.u.],

L the calibrated radiance [r.u.].

Apparent Temperature

The spectral apparent temperature of any source can be obtained by applying the following equation to the calibrated radiance spectrum:

$T = \dfrac{c_2 \sigma}{\ln\left(\dfrac{c_1 \sigma^3}{L} + 1\right)}$	Equation 3

Where $c_1 = 2\,hc^2 = 1.1910428\text{x}10^{-12}$ [W/ (cm2 sr (cm-1)4)] is the first radiation constant,

$c_2 = hc/k = 1.438775$ [K cm] is the second radiation constant,

L is the calibrated spectral radiance [r.u.],

T is the computed spectral apparent temperature in [K].

This computation can be useful for obtaining temperature profiles assuming that the behavior of the observed source is black body like. If the temperature response is not a straight horizontal line the source was not behaving as a black body.

Additional Data Processing

This section describes some additional processing that are available within the AERI software.

Generate BlackBody

The spectral radiance from a scene at a given temperature is given by Planck's black body equation:

$$P_T = \frac{c_1 \sigma^3}{\exp\left(\frac{c_2 \sigma}{T}\right) - 1}$$	Equation 4

Where $c_1 = 2\,hc^2 = 1.1910428\text{x}10^{-12}$ [W/ (cm2 sr (cm-1)4)] is the first radiation constant,

$c_2 = hc/k = 1.438775$ [K cm] is the second radiation constant,

T is the temperature [K],

P_T is the radiated power density or spectral radiance [r.u.]=[W/(cm^2/sr/cm^{-1})].

Apodization

Apodization consist in multiplying an interferogram by a smoothly decreasing symmetric function about the zero path difference (ZPD) point. The different types of apodization functions are listed in Table E- 1.)

E- 1. Apodization functions (D is the optical path difference

Apodization function	**Description**
None	1
Bartlett	(1-D)
Cosine	0.5 + 0.5 cos πD
Hamming	0.53856 + 0.46144 cos πD
Blackman Harris	0.42323 + 0.49755 cos πD + 0.07922 cos 2πD
Gaussian	exp (-3.91202300543D^2)

E- 1. Apodization functions (D is the optical path difference

Norton Beer Weak	$0.548 - 0.0833\ (1-D^2) + 0.07922\ (1-D^2)^2$
Norton Beer Medium	$0.261 - 0.154838\ (1-D^2) + 0.894838\ (1-D^2)^2$
Norton Beer Strong	$0.09 + 0.5875\ (1-D^2)^2 + 0.3225\ (1-D^2)^4$

Appendix F Marine AERI

Introduction

The M-AERI (Marine Atmospheric Emitting Radiance Interferometer) instrument is a version of the standard AERI that has been specifically adapted for marine operation under harsh conditions. It is a self-calibrating, seagoing Fourier-Transform Infrared (FT-IR) spectroradiometer to measure the emission spectra from the sea surface and marine atmosphere.

The M-AERI is designed and built to allow automated operation while mounted externally on a marine vessel, providing protection for exposed components from the corrosive salt air environment. The M-AERI marine-hardened protective enclosure is well suited to protect the instrument against ambient temperature variations from -30°C to +40°C, direct sun exposure, wind, precipitation (rain, sleet, and snow) and water spray or splash.

The M-AERI is an improved ruggedized and reliable instrument for unattended operation under marine conditions. Modifications were made to the front-end protective enclosure, to the scene selection module, as well as to the back-end enclosure. The M-AERI also includes marine-suitable parts to sustain exposition to salt air (ex. connectors, cables, thermoelectric cooler, seals, coatings, etc.).

In summary, the main modifications are:

- A second automated side view-port motorized hatch with precipitation sensor on the front-end enclosure has been added.
- The input scene selection module is adapted for the marine environment with the blackbody source relocated on one side and a hexagonal mechanical structure allowing measurement at zenith, nadir, and slanted angles on one side.
- The front-end enclosure and scene selection module offer reversible installation configuration.
- The back-end precipitation protection enclosure is sealed against the marine corrosive salt air.
- Marine-suitable parts are used to withstand exposition to salt air (ex. connectors, cables, TEC, seals, coatings, etc.)

Key Features

Back-end enclosure

The M-AERI back-end protective enclosure serves to protect and seal the AERI sensor modules (FT-IR, control electronics and signal conditioning modules). This enclosure is temperature controlled by a marine-suitable thermoelectric system (NEMA 4) to prevent heat build-up and maintaining the enclosure's inside temperature at near 20 °C. The external connectors are limited to a power and standard Ethernet connection. The instrument is protected against heat build-up by means of an automated shutdown and restart activation in respect to the internal temperature sensors status being outside or inside the pre-defined temperature threshold values.

Figure F- 1. M-AERI view of the back end TEC coolers

Purge inlet

The M-AERI is equipped with a purge inlet that can be used to purge the back-end enclosure with dry air or nitrogen if the enclosure is exposed to salt air after opening the temperature control unit door or one of its covers. The purge inlet is located on the thermal control door.

Front-end enclosure

The M-AERI front-end enclosure serves to protect the system optics in harsh weather. It protects against direct sun, precipitation (rain, sleet, and snow), wind, and sea spray. It is equipped with two automated view-port motorized hatches, one for atmospheric zenith viewing, and another lateral hatch for side viewing. These motorized hatches automatically close themselves to protect the instrument during precipitation and return to normal operation when the precipitation stops. The M-AERI instrument precipitation and sun sensors manage the opening and closing of the hatches and rotation of the input scene mirror allowing unattended operation 24 h/day, for extended observation periods during marine campaigns. When the hatches are closed, the M-AERI system automatically turns itself into a non-operational safe-mode (rotate mirror to nadir position and remain in stand-by mode).

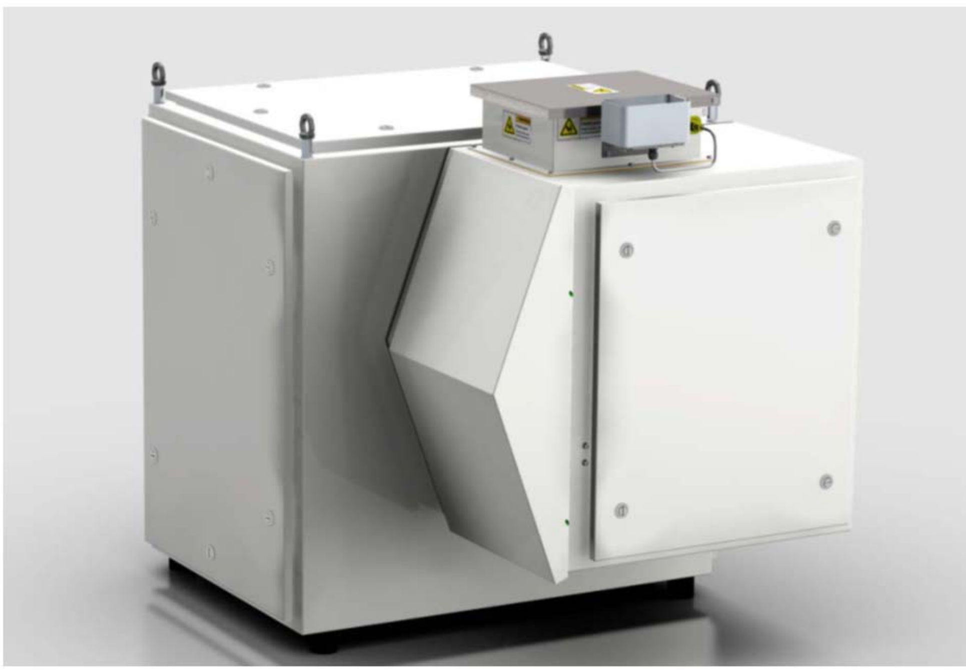


Figure F- 2. Front-end enclosure

FOV Scene Selection Module

The M-AERI system supports typical zenith sky radiance measurements, and, contrary to the standard AERI, also permits slanted views for sea surface measurement. As shown in figure below, the input scene selection module is based on a hexagonal shaped structure with four discrete input ports positions capable of accepting a calibration blackbody at angles of 0, 60, 120, and 180° clock-wise from zenith. These ports present identical input flange aperture compatible to the radiometric calibration sources. In addition to these discrete flanged positions, one side of the hexagonal structure is opened to allow unimpeded view over a continuous scanning FOV from 45° to 135° (or from 225° to 315° counterclockwise from nadir). The calibration sources (HBB and ABB) have been moved to one side of the input scene module in order to clear the FOV on the other side of the input scene module. For the M-AERI, the standard air blowing fan assembly is not used since it would only force salt air into the input scene module.

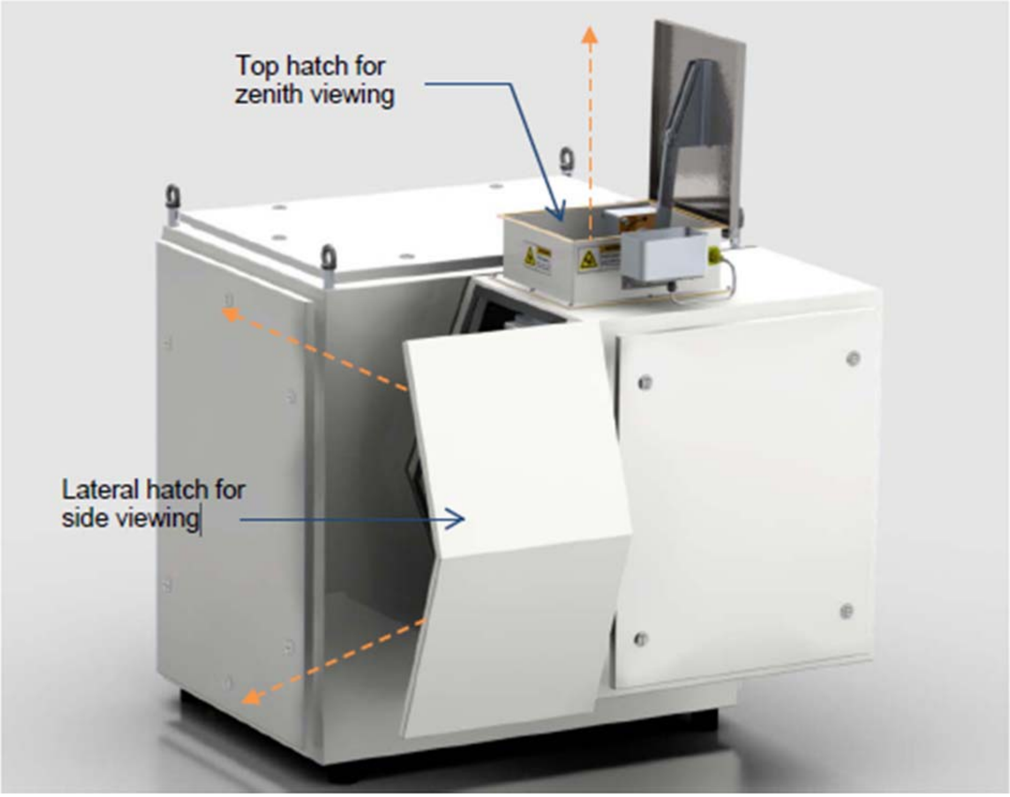


Figure F- 3. Hatches for viewing

The M-AERI is equipped with an internal scene-scan mirror used to direct the instrument field of view to either of the blackbody calibration targets and to the nadir, zenith, and other input positions. The mirror is programmed to step through the various pre-defined input positions accordingly to the sequence defined in a user editable configuration file.

To provide maximum flexibility in terms of sighting and deployment logistics, the M-AERI provides a reversible installation configuration allowing the range of slanted FOV to scan between 45° and 135° or between 225° and 315° (mirror image). The input structure and front-end protective enclosure are designed to be reversible through the mounting points in order to invert the input ports (the attachment points are adapted to allow two mounting configurations with 180° of rotation). This permits installing the input module with reversed input ports viewing the mirror-image of the flanged and unimpeded FOVs. The same mounting principles also apply to the front-end protective enclosure. The open access to the input port is free of obstruction over a 13° FOV from the input scene mirror surface to minimize the possibility of bias measurements.

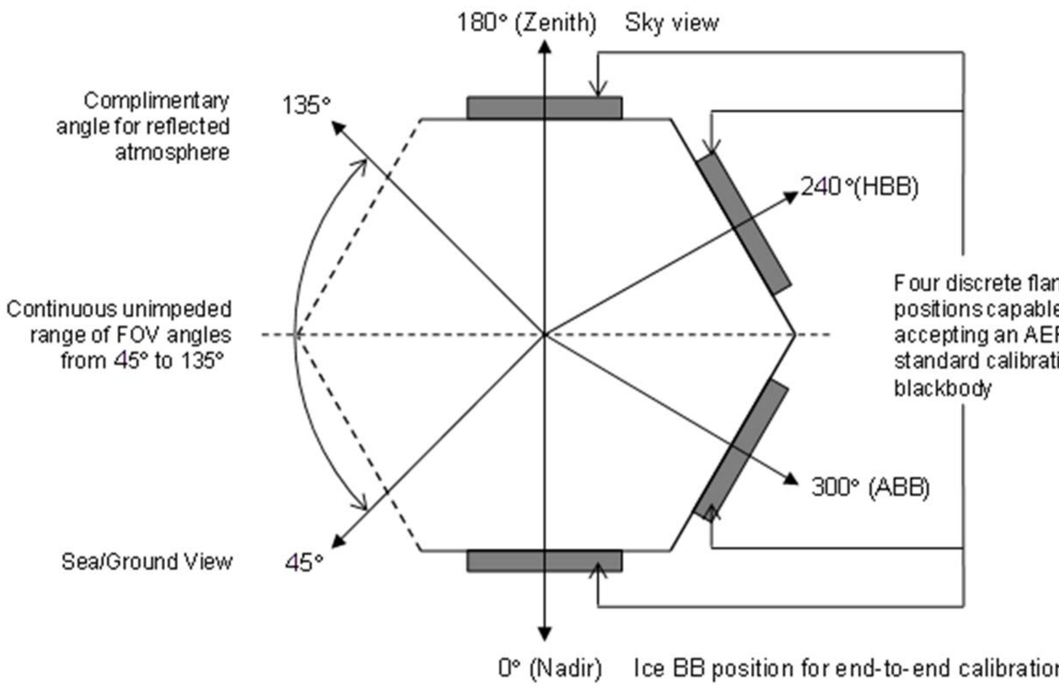


Figure F- 4. FOV Scene Selection Module

Precipitation sensor

The system includes precipitation sensors located on the front-end enclosure and in the side-port opening as shown in figure below. Under precipitation the system will automatically turns itself in a self-protection mode (close input hatch and rotate the scene mirror to the nadir position) that temporarily stops acquisition, returning to normal acquisition mode once the precipitation has stopped.

Figure F- 5. Precipitation sensor location

Sun sensor

The system includes a solar intensity sensor located inside the front-end enclosure as shown in figure below. With the use of a small folding mirror, the sensor always looks in the same direction as the scene mirror. If the solar intensity is too high in the instrument FOV, the system will automatically turns itself in a self-protection mode (close input hatch and rotate the scene mirror to the nadir position) that temporarily stops acquisition, returning to normal acquisition mode once the solar intensity condition changes to favorable conditions.

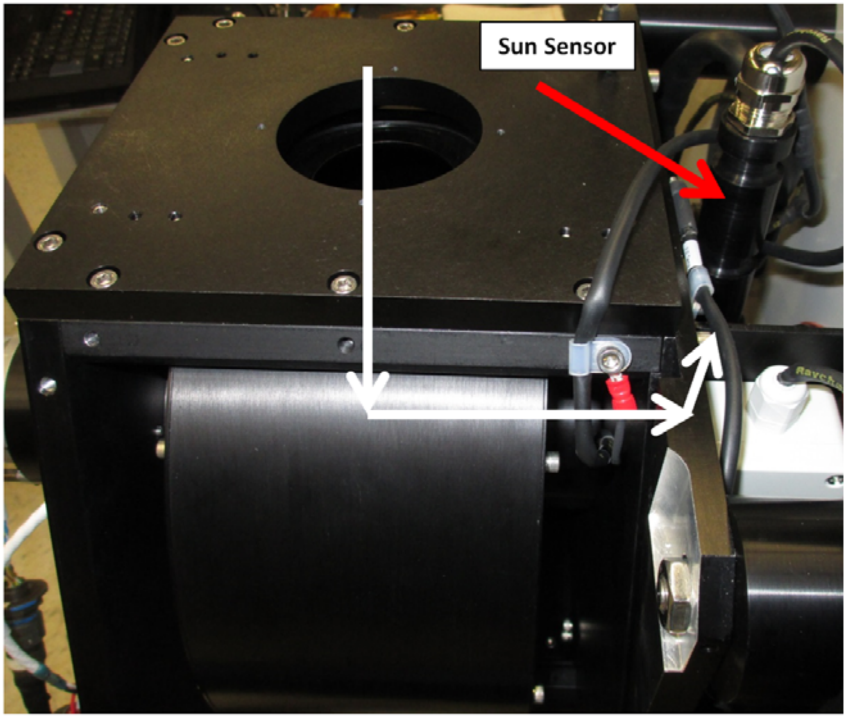


Figure F- 6. Sun sensor

Label

The name plate below is specific to the M-Aeri. This label is located on the inside of the door of the back-end enclosure.

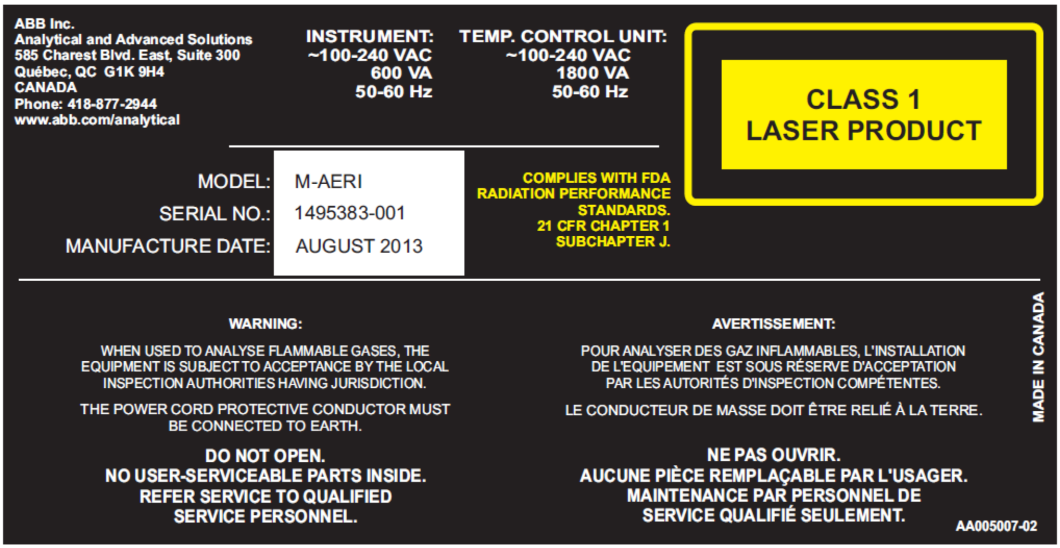


Figure F- 7. Marine-Aeri name plate

Unpacking and installing

Transit case

The Marine AERI is shipped in one travel case which is packed on a pallet and in a wooden box. Make sure to keep the pallet and wooden box for futere shipments (for calibration for example). The dimensions of the travel case are shown on Figure F- 8 below. The accessories (laptop, ethernet switch, cables, etc.) are delivered in a smaller case as shown on Figure F- 9.

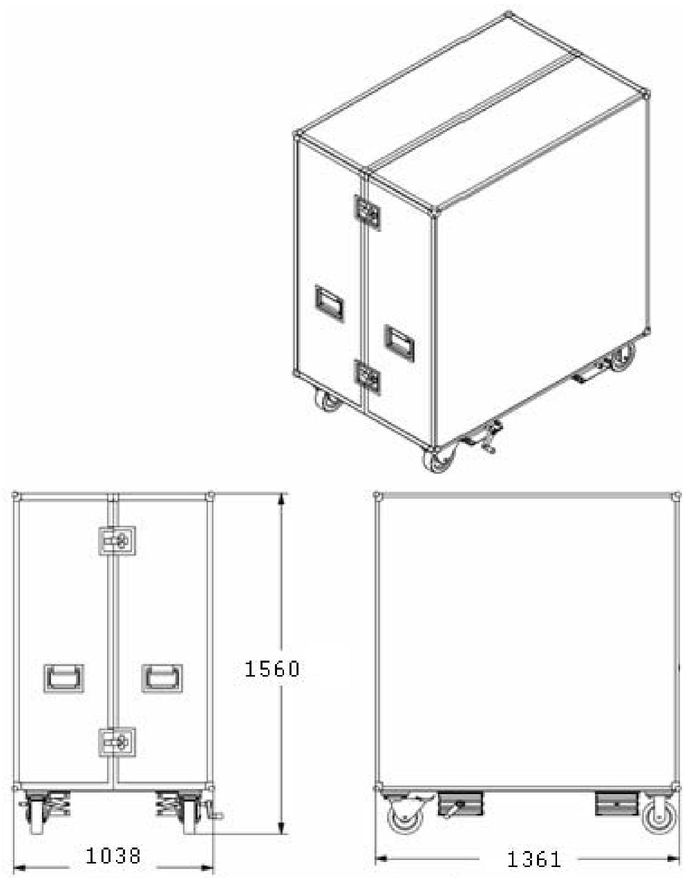


Figure F- 8. Marine AERI Transit Case

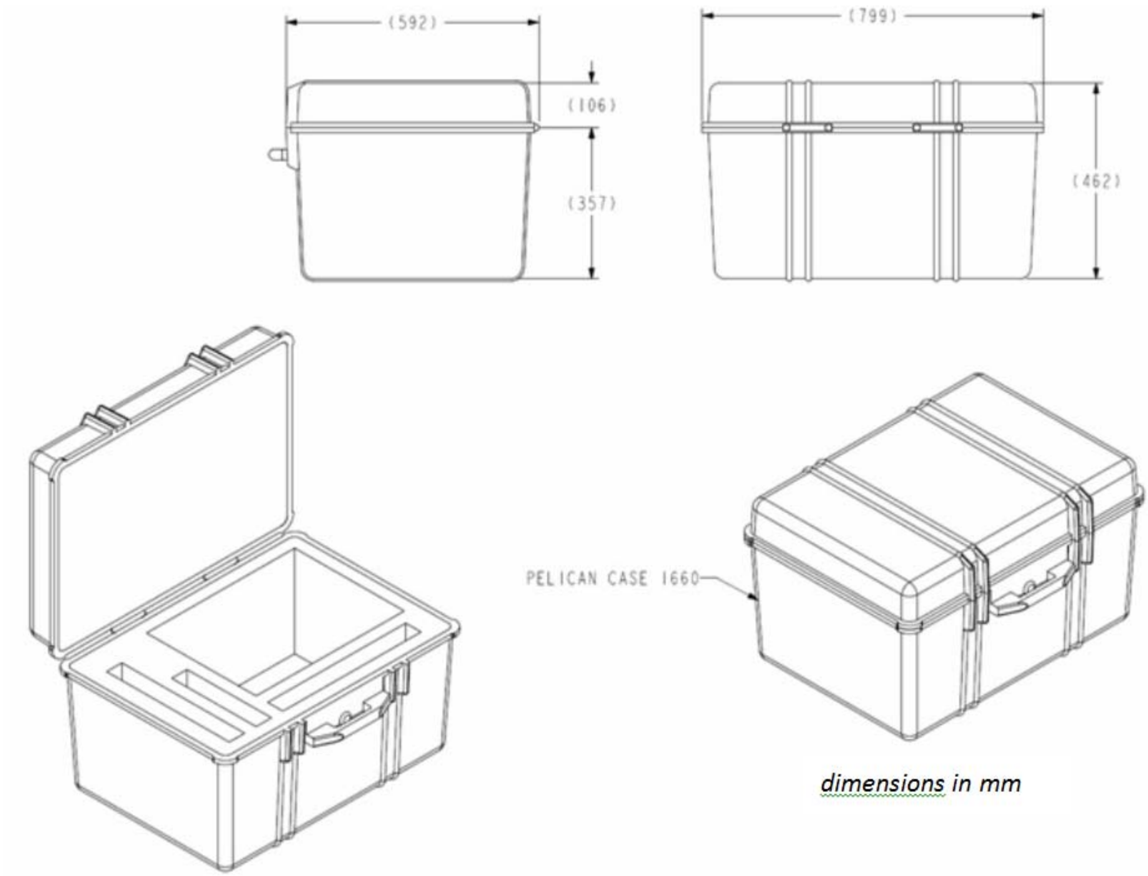


Figure F- 9. Accessories Transit Case

Installation instructions and requirements

The M-AERI weighs 278 kilo (615 lbs). The mounting platform where the instrument is to be installed shall support this weight. The instrument must be lifted using the four lifting bracket on top of the back-end enclosure. These lifting brackets are intended to lift only the instrument. For your safety, do not lift the instrument while it is attached to its dolly.

Electric power of 120-220 volts or 50 to 60 Hz must be available. We recommend two circuits of 120 V, 20A: one for the instrument and the other one for the temperature control. Grounding must be available.

1. Unlatch the transit case and remove both covers by sliding them side way.
2. Attach the lifting hooks to the four lifting bracket to prepare for lifting.
3. Unscrew the screws from the back-end enclosure shockmounts to separate the instrument from its dolly.
4. Lift the instrument and move it to its mounting location. Make sure to secure it by fixing the shockmounts to the mounting platform using screws 3/8"-16 thread. For the shockmount footprint refer to Figure F- 23 and Figure F- 24.
5. Connect the instrument and thermal control unit power cords and the Ethernet cable to the back-end. The cables are in the accessories box.
6. Follow the instructions described in Accessories on page 42 to unpack the accessories box and make the connections between the M-AERI, the laptop, the switched power supply and the Ethernet switch.

Software

Th following temperature readings are not available for the Marine AERI:

- Scene mirror temperature
- Fan airflow temperature
- Protective enclosure temperature

Their status in FTSW AERI will display -265.36 (°C).

M-AERI Instructions

How to reverse the side viewing port

The side viewing port can be reversed to allow an installation where the instrument cannot be installed so the side port is oriented toward the sea. To reverse the side port, the blackbodies and their plate on the input optics hexagonal module need be moved on the opposite side to free the side FOV. The front-end enclosure also needs to be rotated by 180 degrees.

1. Unlatch the front-end panel and remove it.
2. Disconnect the connectors 1J9 (top trap actuator), 1J10 (side trap actuator) and 1J11 (rain sensors) from the interconnect box below the input optics hexagonal module.
3. Disconnect the top trap rain sensor connector from inside the enclosure. From connector 1J11, follow the cable branch going to the top trap rain sensor to find the connector 1J15 to disconnect.

4. Unscrew all 9 x 10-32 and 1 x ¼-20 screws holding the front-end enclosure to the interface plate. The holder plate will help keeping the enclosure in place when all screws are removed. (Some screws are shown in the picture below.)

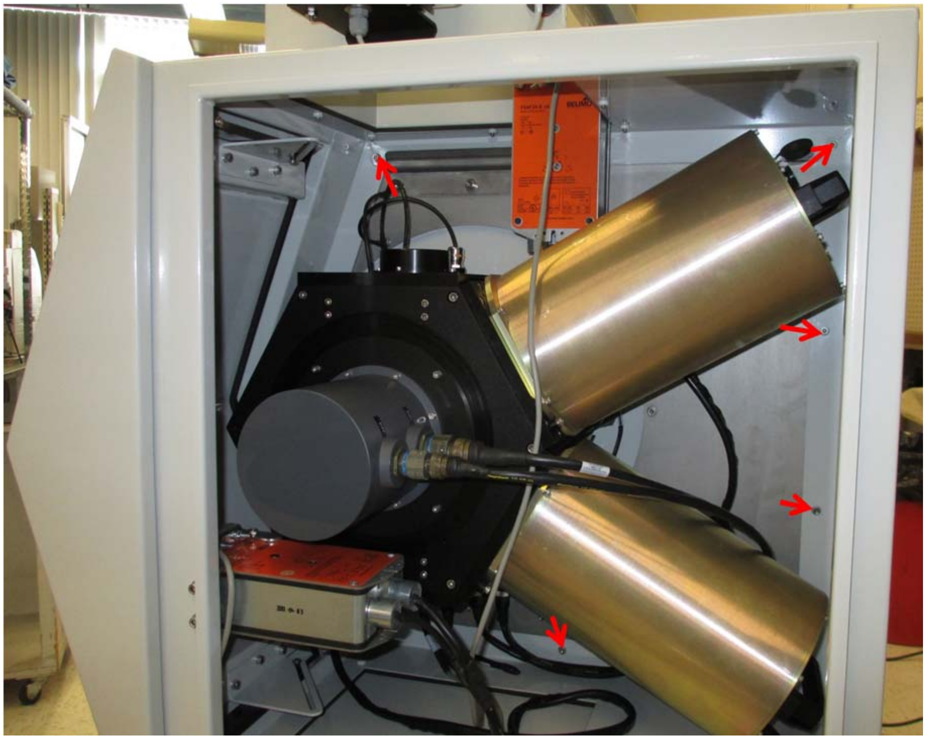


Figure F- 10. Remove front-end enclosure from interface

5. Unscrew the 8 screws holding the top hatch on the front-end enclosure, remove it and put it aside. It will be reinstalled after the front-end enclosure is reversed.
6. Lift the enclosure upward and carefully pull it away from the back panel. Lay the enclosure on a table.
7. Disconnect the connectors on the blackbodies.
8. Remove the blackbodies by unscrewing the 4 screws holding each blackbody to the input optics hexagonal module.
9. Unscrew the 5 screws holding the interface plate to the back-end enclosure.
10. Unscrew the 3 screws holding the holder plate on top of the interface plate and remove it.

11. Carefully rotate the interface plate by 180 degrees going upward with the long part of the plate. Reinstall the 5 screws.

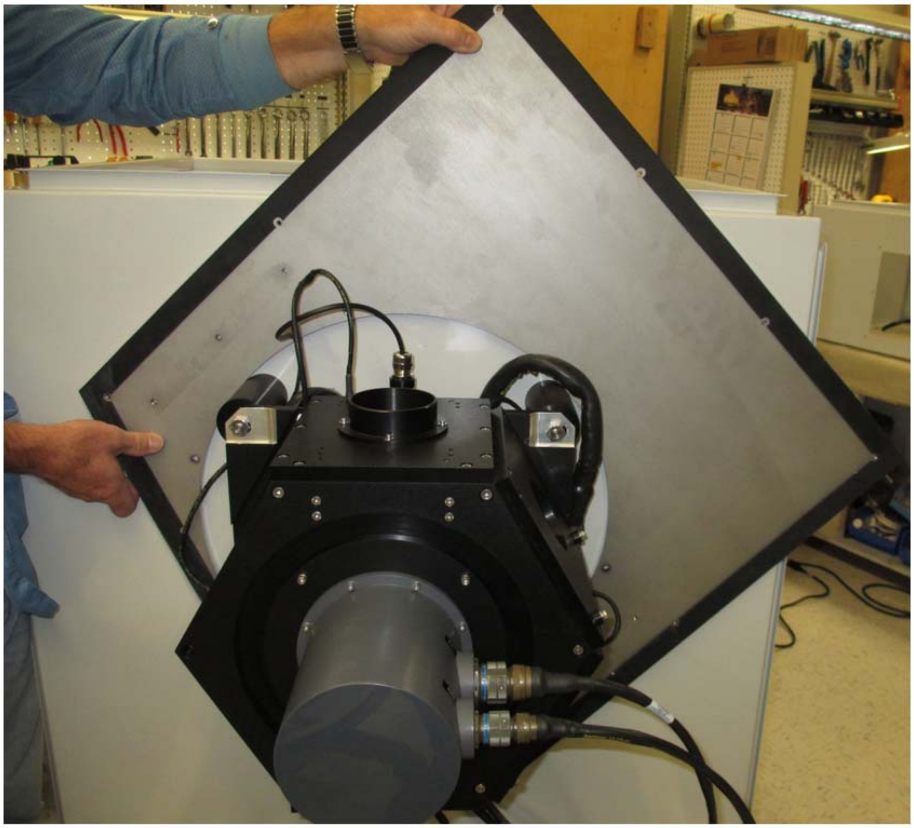


Figure F- 11. Rotate interface plate

12. Do not install a screw where indicated in the picture below, it will be installed with the enclosure in place.

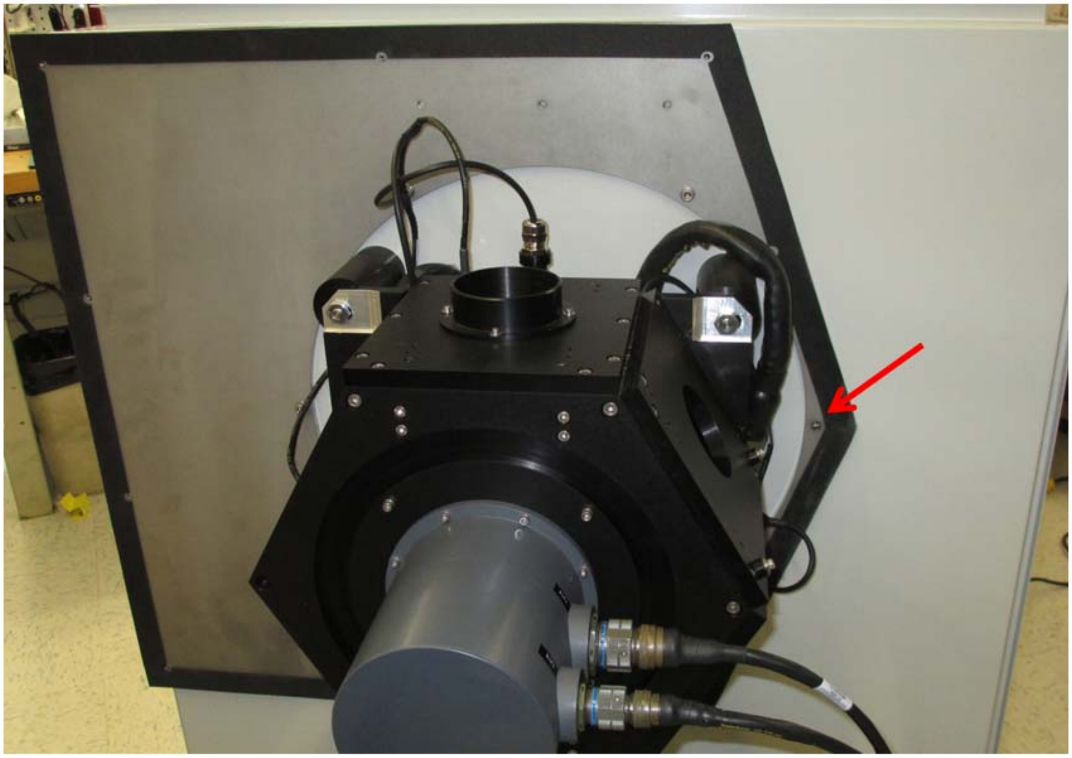


Figure F- 12. Screw not to be installed

13. Install the holder plate on top of the interface plate with its 3 screws.

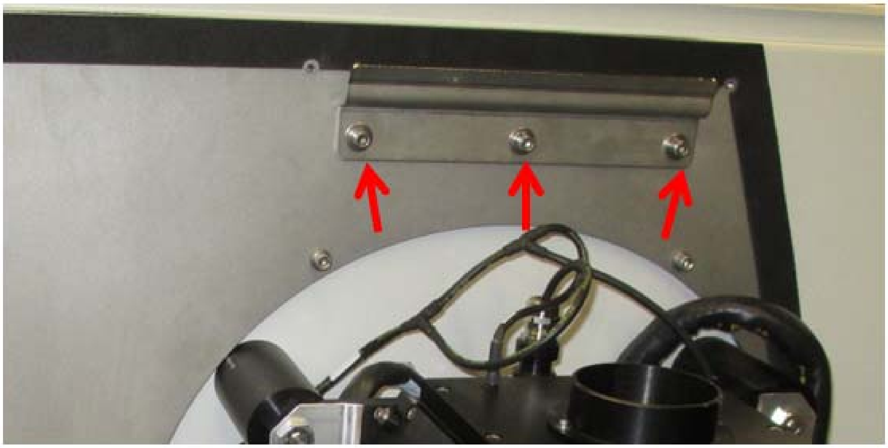


Figure F- 13. Install holder plate

14. Unscrew the 6 screws holding the HBB plate. Remove the plate and put it aside.

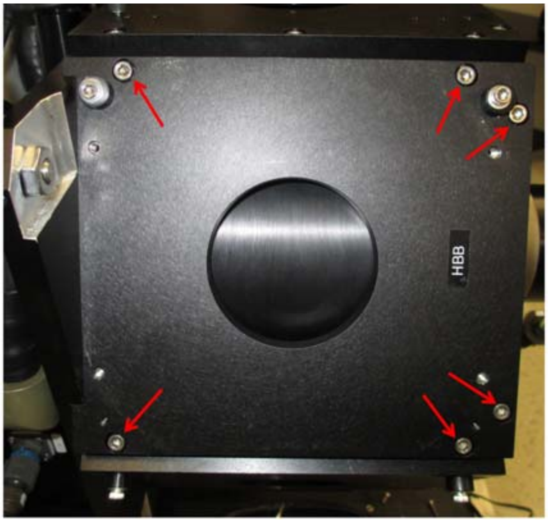


Figure F- 14. Unscrew HBB plate

15. Unscrew the 6 screws holding the ABB plate. Remove the plate and put it aside.
16. Unscrew the screw holding the hexagonal bar between the HBB and ABB plates and reinstall it on the other side but keep the screw loose so it can be rotated to install the blackbodies plate.

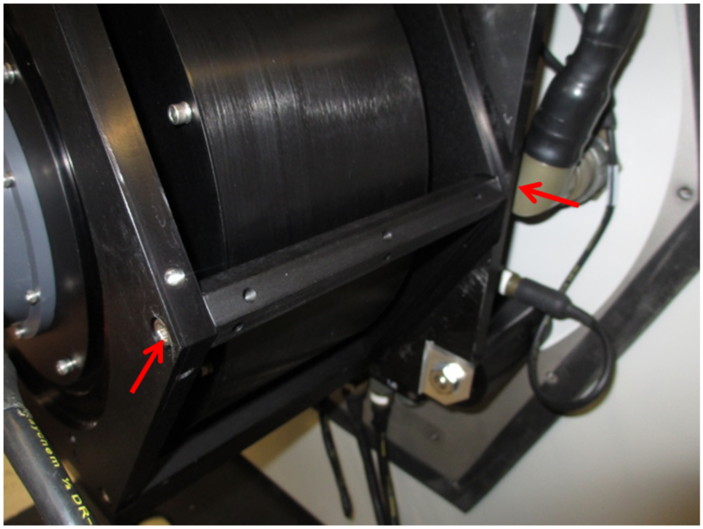


Figure F- 15. Re-install hexagonal bar

17. Unscrew the temperature sensor as shown in the picture below and reinstall it on the opposite side. Flip the cable tie by 180 degree so the cable is away from the scene mirror drum. Make sure that the temperature sensor is floating in the input optic module and does not touch the scene mirror drum.

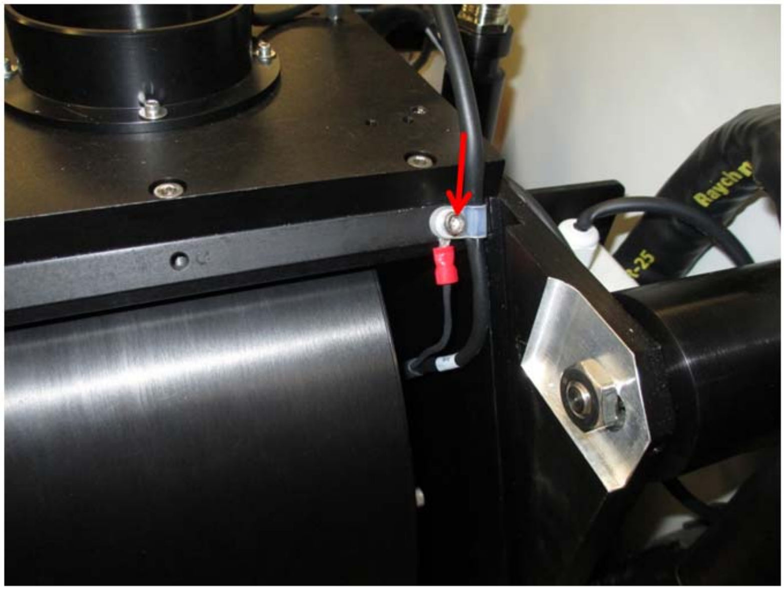


Figure F- 16. Install temperature sensor

18. Install the blackbodies plate on the opposite side, the HBB plate on top and ABB plate below.
19. Tighten the 2 screws of the hexagonal bar between the two plates.
20. Install the HBB on the top side plate with its connector oriented upward.
21. Install the ABB on the bottom side plate with its connector oriented downward.
22. Connect the cables to the blackbodies.
23. On the front-end enclosure put aside previously, remove the enclosure bottom panel by unscrewing the 8 screws and reinstall it on the top opening.
24. Manually open the side viewing port by using an hexagonal key or screwdriver. Refer to section "How to manually open the hatches" for more detailed instructions.

25. Locate the rain sensor as shown in the pictures below.

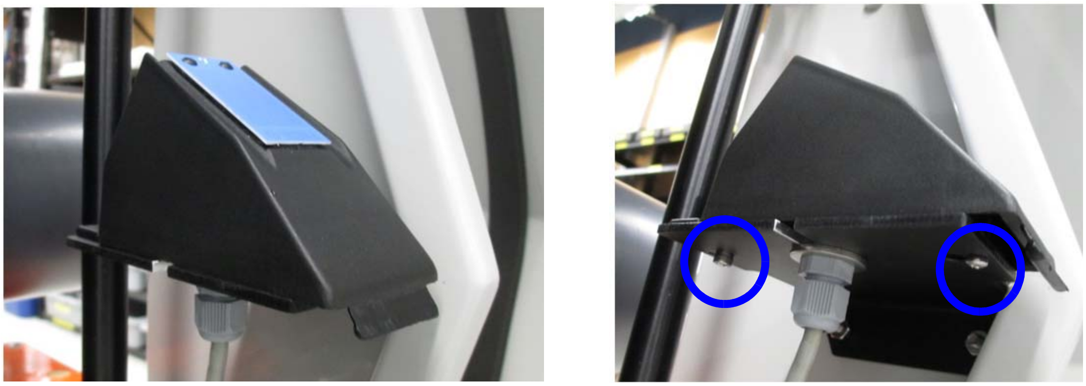


Figure F- 17. Rain sensor

26. Unscrew the philips screw under the bracket holding the sensor.
27. Unscrew the hexagonal screw.
28. Unscrew the cable gland from the sensor cable.
29. Unscrew the cable nut and slide the wires through the slot in the bracket to free the sensor.

30. Turn the sensor upside down and slide the wires through the bracket as shown in the pictures below.

Figure F- 18. Rain sensor re-installed

31. Reinstall the cable nut.
32. Reinstall the cable gland.
33. Reinstall the screws to fix the sensor to its bracket. Do not over tighten the Philips screw.
34. Close the hatch by unlocking the motor, refer to How to manually open the hatches on page 187.
35. Reinstall the front-end enclosure. Put the enclosure so it is held by the holder plate.

36. Install the hatch on top of the front-end enclosure with 8 screws before installing the front-end enclosure screws. The hatch must me oriented so its cover's fixation is on the far side from the side hatch.

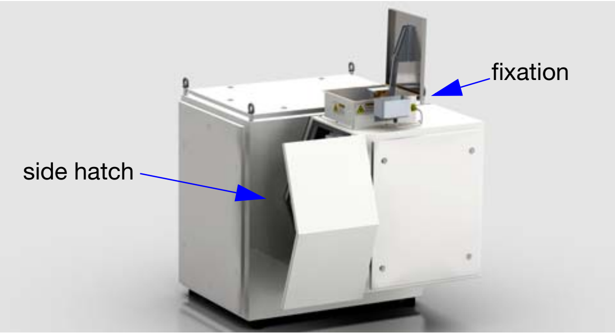


Figure F- 19. Installation of hatch

37. Connect the connectors 1J9 (top trap actuator), 1J10 (side trap actuator) and 1J11 (rain sensors).
38. Fix the front end enclosure with 9 x 10-32 and 1 x ¼-20 screws.
39. Connect the connector 1J15 from the inside of the hatch to the rain sensor.
40. Put the front panel back in place and secure it with the 4 latches.

To finalize the inversion, the FTSW_EAERI configuration file must be changed to tell the software that the blackbodies and side viewing port have changed position.

41. Open C:\E-AERI\FTSW_EAERI.Config and set the flag "Acquire.inputOpticReversed" to "true" or "false" depending on the input optics configuration as described in the comments below.

```
//Flag that determines which mirror angle to use for the ABB & HBB
((mirror.index1Angle & mirror.index2Angle) or
(mirror.reversIndex1Angle & mirror.reversIndex2Angle))
//Set the flag to false when the side viewing port is on the left
when facing the instrument's front-end. Set the flag to true when the
side viewing port is on the right.
Acquire.inputOpticReversed = true
```

Figure F- 20. Config file extract

42. Open C:\config\mirror.beg and replace the angles in the sequence with the new angles for the ABB (mirror.index1Angle or mirror.reversIndex1Angle found in FTSW_EAERI.Config) and HBB (mirror.index2Angle or mirror.reversIndex2Angle found in FTSW_EAERI.Config).

43. In the sequence, replace the side viewing port angles with their equivalent on the other side.

How to manually open the hatches

It is possible to open the hatches manually if the instrument is not powered on.

1. Unlatch the front-end panel and remove it.
2. Insert the provided hexagonal key or an hexagonal screwdriver in the hatch motor you would like to open as shown in the pictures below. An hexagonal hole is available on both sides of the motor

.

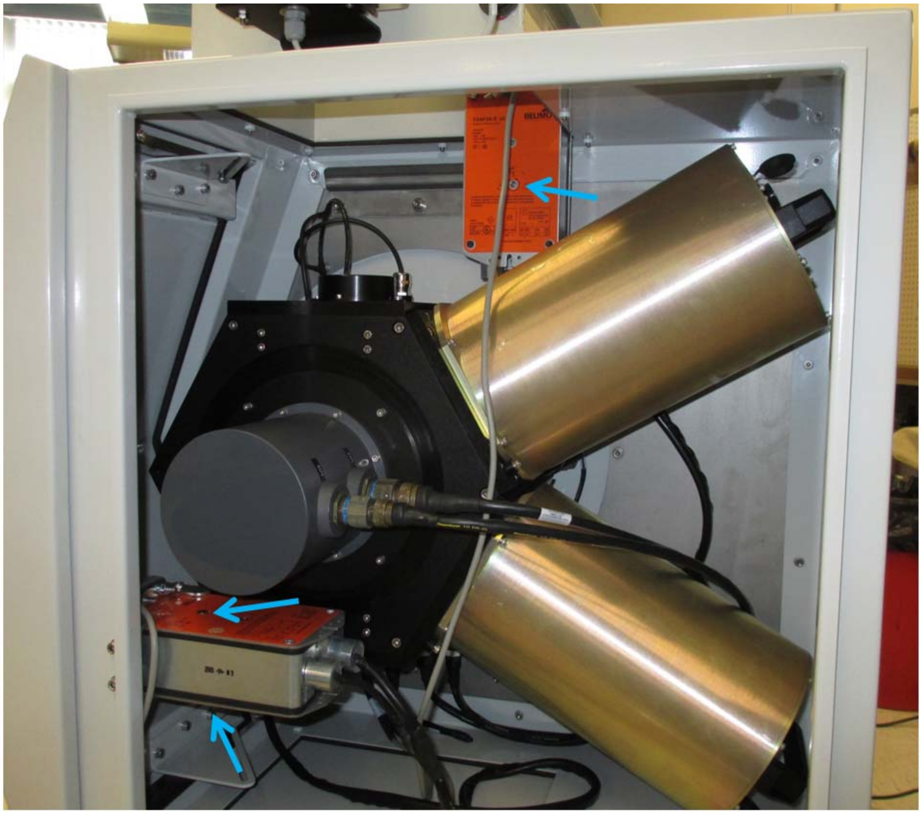


Figure F- 21. Hatch opening mechanisms

Figure F- 22. Close-up of hatch mechanism

3. Turn the hexagonal key counterclockwise to open the hatch. The motor can be locked in OPEN position by turning the hexagonal key clockwise.
4. Unlock the motor close the hatch.

The hatch mechanism is very strong and stiff. Extreme caution must be paid when working around this component.The hatch located on top of the enclosure opens and closes electrically. Avoid putting any objects or body parts as it may damage the hatch and cause serious injuries.

How to access the back-end enclosure

To perform the maintenance procedures in section 7, the user needs to access inside the back-end enclosure.

Temperature Control Unit

The temperature control unit located on the back panel of the back-end enclosure is a door that can be opened by turning the two latches located on the right side of the door. You can pivot the door and even remove it if necessary, the door is fixed with lift-off hinges. Before lifting the door to remove it, make sure to disconnect the power and Ethernet cables connected to an interface plate inside the enclosure. Disconnect also the temperature control communication cable.

Back-End Enclosure

Top and sides covers can be removed to access the back-enclosure. Unlatch the cover, open it and before removing it completely, locate the ground connection and disconnect it to release the cover.

How to make visual inspection of the M-AERI scene mirror

To perform a visual inspection of the scene mirror, proceed as follows:

1. Close ingest software if it is running on the laptop.
2. Open FTSW E-AERI in Interface mode. Refer to Operation on page 53. The software will connect to the AERI system and the hatches will open.
3. On the Measurements tab, select Custom angle in the Mirror position field. Enter an angle between 45 and 135 degrees, the mirror will rotate to a position on the side viewing port if it is located on the left when facing the front-end. Enter an angle between 225 and 315 degrees if the side viewing port is located on the right.
4. Perform the visual inspection of the scene mirror.
5. Close FTSW E-AERI software and return to normal operation.

Packing Instructions

Put the instrument on its dolly, align the shockmounts with the holes on the frame and fix the shockmounts with the screws.

Slide the box covers on the dolly and close the latches. Re-install on the pallet and the wooden box.

System Specifications

Weight

Travel box empty	147 kg (325 lb)
Dolly	77 kg (170 lb)
Accessories Box	14 kg (31 lb)
M-AERI	278 kg (613 lb)
Box complete with M-AERI	355 kg (783 lb)
Accessories Box complete	26 kg (57 lb)
Complete M-AERI system in travel case and inside wooden box (150x117x168 cm / 59"x46"x66")	515 kg (1135 lb)

Dimensions

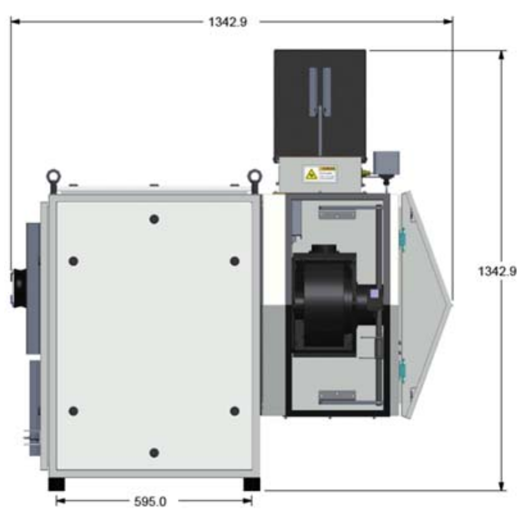


Figure F- 23. Overall dimensions

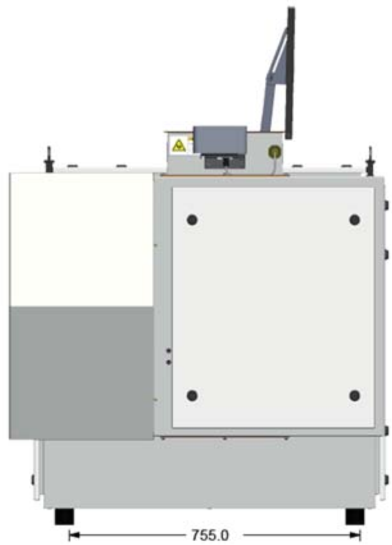


Figure F- 24. Overall dimensions

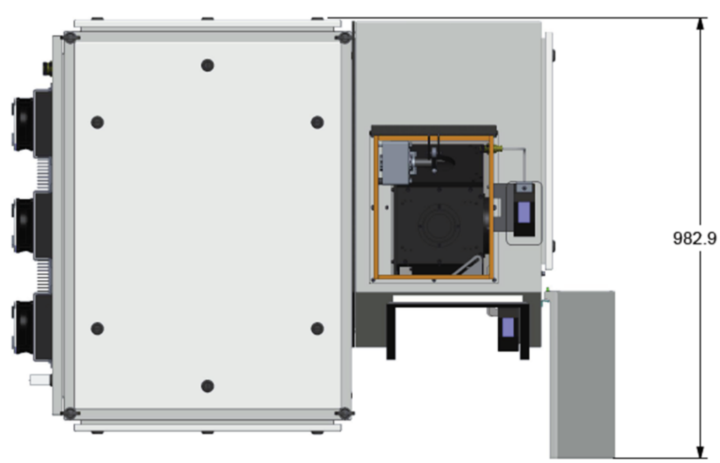


Figure F- 25. Dimensions top view

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