MB3000 Series FTIR Spectrometers

Installation and User Guide

May 2008

AA003700-01 rev. G. 2.0

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Section 1 About this Manual

Purpose of Document

This document is intended for personnel using the MB3000 Series FTIR spectrometers for routine analysis and contains installation, user and troubleshooting instructions.

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.

Section 2 Safety Summary

Warnings, Cautions and Notices

User must comply with all warnings, cautions and notices indicated in this manual. 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.

Laser Warnings

Class 3B invisible laser radiations (760 nm, 2mW output power, Near-IR) are present inside the interferometer module. However, no laser radiations leak out of the Interferometer module.

ESD Warnings

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

Always use an ESD protection to perform maintenance procedures on the MB3000 Series FTIR spectrometer. 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

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.

Ensure that the equipment and any devices or power cords connected to MB 3000 FTIR Spectrometer 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 is not used.

Always make sure the spectrometer is disconnected from a power source and fully assembled (front and back panel installed) BEFORE opening or performing any maintenance.

Always use the Lockout/tag out procedure to power OFF the spectrometer. Refer to Lockout/Tag Out Procedure on page 10.

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

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

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

General Warnings

Source Module is Hot! Always manipulate the Source Module with caution: use the non metallic parts to hold the Source Module.

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

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

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 spectrometer weights 24 kilos. ABB strongly recommends to lift the spectrometer with the help of another person. Make sure to use proper body mechanics to lift the spectrometer (bend your knees) otherwise injuries could occur.

Make sure the system is correctly purged for operation in hazardous locations.

Before analyzing flammable products, equipment MUST be approved by local inspection authorities.

Do not operate the equipment in the presence of flammable products, condensing moisture and excessive dust.

Before attempting any maintenance or repair procedure to the equipment make sure immediate first aid is accessible.

Do not store the spectrometer in an environment with condensing moisture and excessive dust.

Read this manual thoroughly before using this equipment. If you do not understand the content of this manual, contact ABB service personnel.

Prior to using the spectrometer, Material Safety Data Sheets (MSDS) of all samples to be analyzed must be available at all times for the security of the user.

General Notices

Touching the optical parts of the detector (mirror) may damage the spectrometer and it may reduce performances.

Changing the computer or instrument IP address should be done by qualified personnel only.

Screws are easily inserted and tighten. If excessive force is required to set the screws in place, remove the screw and retry, the screw is probably not properly aligned.

All components, whether in transportation, operation or storage, must be in a non corrosive environment.

Make sure to maintain a minimum of 6 inches clearance in front of heat sinks.

Always install the spectrometer on a stable, hard, levelled surface.

Do not use the equipment if any signs of damages are present. Contact ABB service personnel.

Conformity Declaration

All ABB MB3000 Series FTIR spectrometers have the following conformity certifications:

- CB
- CE
- WEEE
- TUV
- FCC
- FDA 21 CFR chap 1, sub chapter J.

Refer to Appendix A, Certificates of compliance.

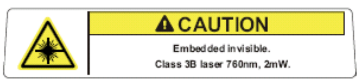
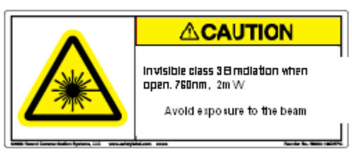
Environmental Information

The MB3000 Series FTIR spectrometers have required the extraction and use of natural resources for its production. Therefore, the MB3000 Series FTIR spectrometers 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 use appropriate recycling systems in order to make sure materials used to produce your equipment are reused or recycled in a sound way. The crossed out wheeled bin reproduced on the Product Label is a clear reminder that the product must not be disposed with household waste. Refer to Table 2- 1 for labels.

For European countries, at the end of life of the analyzer, contact your distributor before disposing of your equipment.

Labels

2- 1. Labels

Label	Description	Location
	This label indicates the presence of laser radiations. Invisible Class 3B laser radiations (760 nm. 2mW output power) are present in the interferometer module.	This label is located on the side of the VCSEL spectrometer.
	Invisible Class 3B laser radiations (760 nm. 2mW output power) are present in the interferometer module.	This label is located inside the enclosure, on the interferometer module.

2- 1. Labels

<table>
<tr><th>Label</th><th>Description</th><th>Location</th></tr>
<tr><td>For all countries except the USA.

</td><td rowspan="2">This label indicates the presence of a hot surface.
Use caution to avoid being burnt. Do not touch surface</td><td>This label is located inside the spectrometer, on the source.</td></tr>
<tr><td>For the US


</td><td>This label is located inside the spectrometer, on the casing near the source.</td></tr>
<tr><td>

</td><td>This label indicates the following information:
- Certifications
- Laser warning
- ABB address
- Analyzer MAC address
- Ports location
- Manufacturing date
- Model number
-Use conditions for flammable product samples
- Purge
-Power inlet</td><td>This label is located outside the spectrometer, on the back cover.

</td></tr>
</table>

Lockout/Tag Out Procedure

To power OFF the spectrometer follow this procedure:

STEP 1 Close the software.

STEP 2 Power OFF the computer holding the software.

STEP 3 Set the ON/OFF power switch of the spectrometer power supply to OFF.

STEP 4 If applicable, set the ON/OFF power switch of the accessory to OFF.

STEP 5 If applicable, disconnect the accessory power connector from the wall outlet.

STEP 6 Disconnect the Ethernet Cable from the spectrometer.

STEP 7 Disconnect the spectrometer power connector from the wall outlet.

Section 3 Unpacking and Installing

Unpacking

Before unpacking, let packaging reach room temperature.

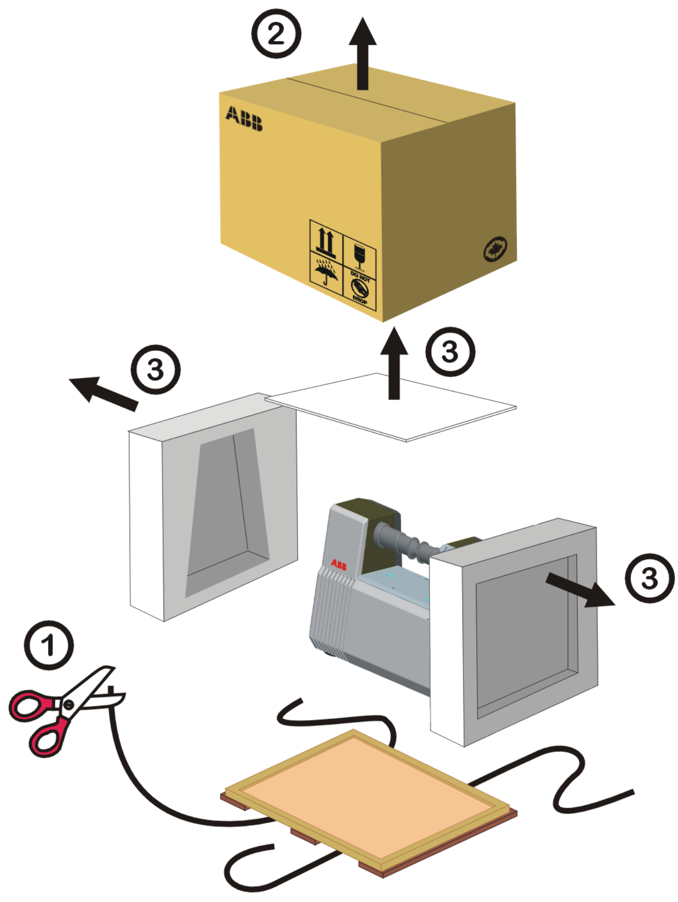


Figure 3- 1. Unpacking the spectrometer

STEP 1 Cut the straps wrapping the box.

STEP 2 Remove the cardboard box from top of wooden crate.

STEP 3 Remove the top and side foam packing.

Make sure to dispose of material according to Federal, State (provincial) and local environmental regulations.

STEP 4 Remove the spectrometer from the wooden crate.

The spectrometer weights 24 kilos. ABB strongly recommends to lift the spectrometer with the help of another person. Make sure to use proper body mechanics to lift the spectrometer (bend your knees) otherwise injuries could occur.

Contents

The shipping box contains the following parts:

Item
One spectrometer
One straight pin Ethernet cable
One crossover Ethernet cable
One power cord for your country
One power supply
One CD or DVD (software and documentation)
One sample holder

Optional software and accessories can also be included.

If any part is missing or presents any sign of damage, please contact ABB before proceeding to the installation. Refer to the back cover of this manual.

Installing the Spectrometer

Make sure there is sufficient free space in front of the heat sinks (15 cm/ 6 inches).

Always use the Lockout/tag out procedure to power OFF the spectrometer. Refer to Lockout/Tag Out Procedure on page 10.

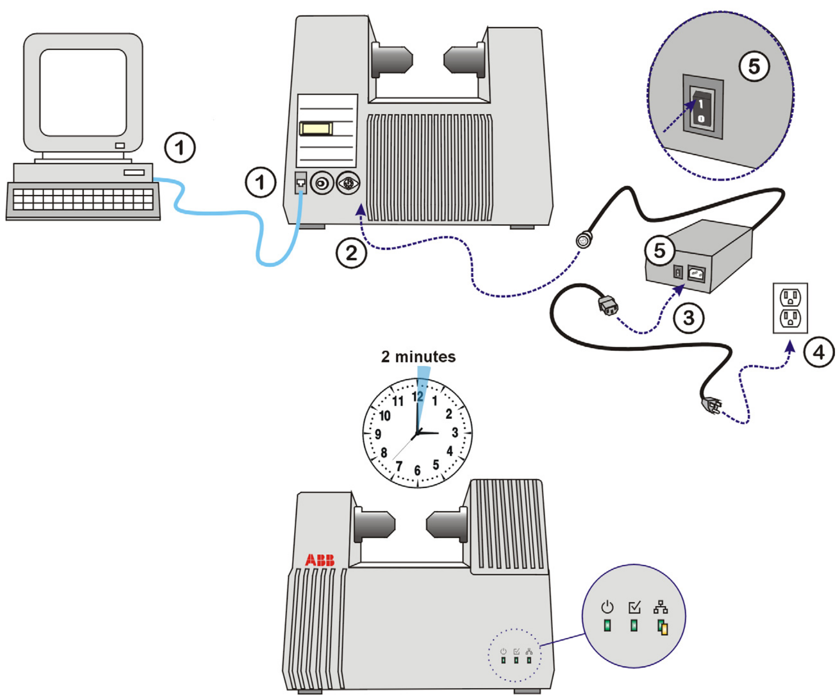


Figure 3- 2. Installation procedure: direct connection

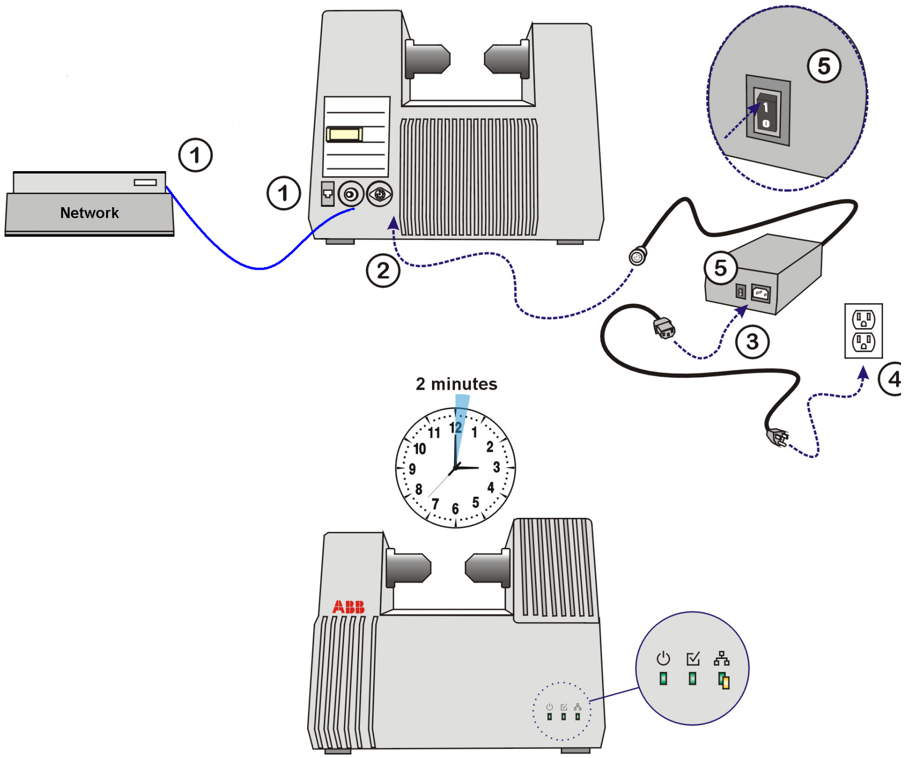


Figure 3- 3. Installation procedure: Network connection

STEP 1 Connect the Ethernet cable to the computer or to the Network port. Use a crossover cable for a private connection (spectrometer to computer), and a straight pin cable for a Network connection (spectrometer to Network).

STEP 2 Connect the Ethernet cable to the spectrometer.

STEP 3 If desired, connect the purge hose to the spectrometer (dry oil-free air or nitrogen only, recommended 7 l/min.).

STEP 4 Make sure the power switch on the power supply is OFF then connect the power supply cable to the spectrometer. Make sure to properly lock the connector to the spectrometer.

STEP 5 Connect the power cable to the power supply and to the wall outlet.

STEP 6 Power up the analyzer. Set the ON/OFF power switch located on the external power supply to ON. When Start-Up LED sequence is completed, the instrument is ready.

STEP 7 Remove desiccant from sample compartment.

STEP 8 Perform the Auto Calibration procedure. Refer to

Table 3- 2. Led Description

Power	Status	Network
Solid Green when power is ON	Blinking green while warming up and spectral calibration	Green on power ON
	Blinking red if no detector detected	Blinking green when activity on network
	Solid red on error	Blinking amber on data activity (Connected to a software)
	Solid green when ready	

ABB recommends to allow a stabilization period of 4 hours prior to using the Spectrometer.

Spectrometer Autocalibration

The MB3000 series spectrometer is designed to automatically perform an autocalibration every 2 weeks. The autocalibration will start between two measurements but never during a measurement. When the autocalibration is started, the MB3000 spectrometer will be inoperative for about 2 minutes. The Status LED will flash. When autocalibration has finished, the spectrometer resumes operation.

Spectrometer is inoperative during autocalibration.

MB3000 Series Spectrometers Calibration

A spectral calibration must be performed in these conditions:

- After installation, once the temperature of the spectrometer has stabilized i.e. when the spectrometer has been under power for four hours.
- Anytime the spectrometer is powered ON after being powered OFF for more than one hour.

To perform spectral calibration, follow this procedure:

Spectrometer must be under power for at least 4 hours before performing spectral calibration.

During calibration, spectrometer does not acquire any data.

STEP 9 Set the ON/OFF power switch of the spectrometer power supply to OFF.

STEP 10 Wait 30 seconds.

STEP 11 Set the ON/OFF power switch of the spectrometer power supply to ON.

After step 3, the spectrometer automatically performs the calibration which lasts approximately three minutes.

When the calibration is completed, the spectrometer resumes operation.

Section 4 Connections

Purpose

Your computer and the spectrometer communicate through an Ethernet interface (cable). You can either use a private connection (i.e. the spectrometer is connected directly to the computer) or communicate through a Network. This section shows how to check if the spectrometer communicates properly to the computer.

The spectrometer comes with two Ethernet cables. One, labeled *Crossover* cable, is intended for a direct connection to the PC. The other Ethernet cable labelled *Straight pin* cable is intended for a connection via a Network.

Computer or Network Connection

If the spectrometer was not connected to the computer or the network (DHCP server), restart the spectrometer to establish proper connection.

When properly connected to the computer or the Network, the spectrometer Network LED will turn Green and the flashing Network LED will indicate activity. Refer to Table 2- 1.

The MAC address (located on the Product Label, refer to Labels on page 8) is used by your computer or the Network to identify the spectrometer. Each spectrometer has a unique MAC address.

Setting up the Ethernet Connection

The computer delivered with your spectrometer has been factory configured for the proper connection.

If you need to configure your computer, there are two possible setups:

- The spectrometer is connected to the Network.
- The spectrometer is directly connected to the computer that requires a Ethernet interface.

To a Network

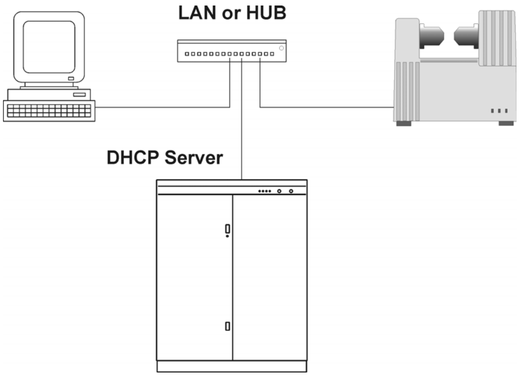


Figure 4- 1. Connection via a Network

In this setup, both the PC and the instrument will obtain their LAN configuration from the control DHCP server.

When first turned **ON**, your spectrometer will attempt to obtain automatically its LAN configuration from the DHCP server.

To ensure the DHCP server is properly detected, perform a power **OFF/ON** cycle after connecting properly the Ethernet cable (i.e. Network LED must be **ON**).

To insure your PC Ethernet interface uses the DHCP server, perform the following procedure:

STEP 1 Open the **Properties** dialog box of the **Local Area Connection**.

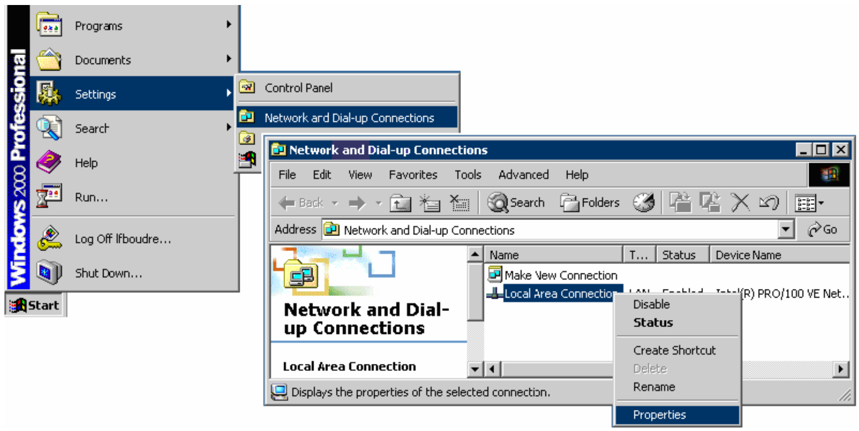


Figure 4- 2. Network and Dial-up Connection window

STEP 2 Select the **Properties** dialog box of the Internet Protocol (TCP/IP) and click **Properties.**

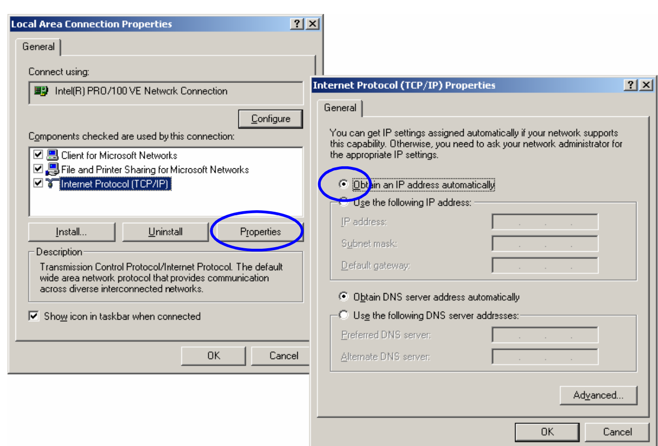


Figure 4- 3. Internet Protocol (TCP/IP) Properties dialog box

STEP 3 Select the radio button **Obtain an IP address automatically** must be selected**.**

STEP 4 Then click **OK.**

Direct Connection

Figure 4- 4. Direct connection

In this case, both the computer and the spectrometer will use a pre-configured LAN configuration parameters.

If, when first turned ON, the spectrometer can not detect a DHCP server, it will automatically use the following IP address:

10.127.127.127

The PC Ethernet interface should be configured to use a compatible set of LAN parameters, for example:

IP address: 10.127.127.1

Subnet Mask: 255.255.255.0

To ensure your PC Ethernet interface is properly set, perform the following procedure:

STEP 1 Open **Start> Settings> Network and Dial-up Connections.**

STEP 2 In the **Network Dial-up connections** window, right click **Local Area Connection** and select **Properties**. Refer to Figure 4- 2.

STEP 3 In the **Properties** dialog box, select **Internet Protocol (TCP/IP)**.

STEP 4 In the **Internet (TCP/IP) Properties** dialog box, select **Use the following IP address** and type the following information.

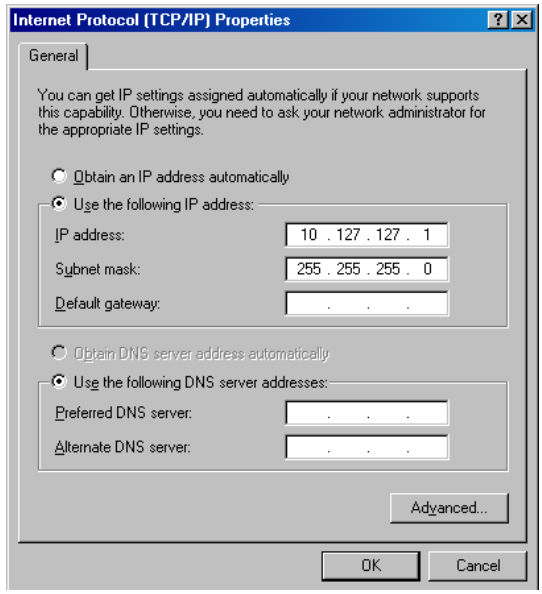


Figure 4- 5. IP address.

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

Checking the Connection

The connection can be checked with the ABB FTIR utility. To run the utility, go to the Windows **Control Panel**.

STEP 1 Click **Start>Settings > Control Panel** and double-click on the **ABB Bomem FTIR utility** icon.

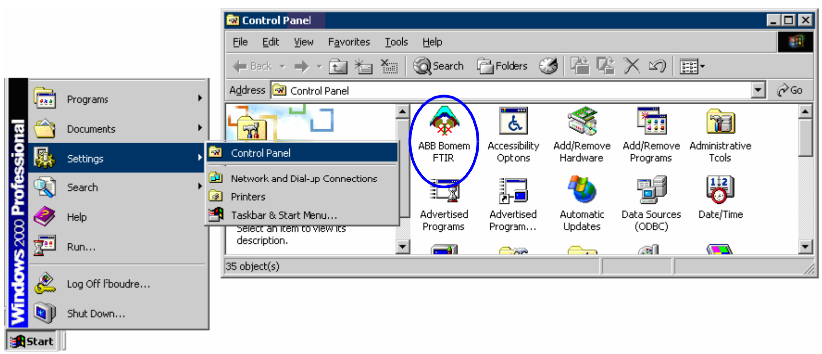


Figure 4- 6. ABB Bomem FTIR utility

STEP 2 The ABB Bomem FTIR Utility will search the Network for the presence of spectrometers. A message indicating that the utility is detecting the presence of spectrometers will appear. Then a list of all the spectrometers present on the Network will appear in the **ABB Bomem FTIR** window..

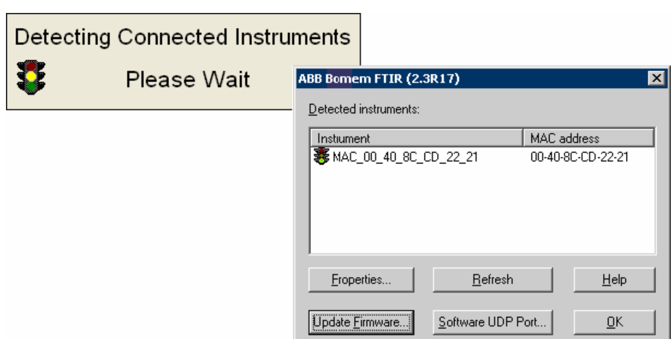


Figure 4- 7. Detecting connected instruments

If your spectrometer is not detected, refer to Section 9, Troubleshooting.

Section 5 Storage, Cleaning and Discarding

Cleaning

Do not perform any cleaning procedures if the Detector Module, the Arid Zone telescopic tube, the front or the rear cover is removed.

Do not wipe, clean or touch the mirrors.

To clean the spectrometer, wipe the outer surface of the spectrometer with lukewarm water and a gentle cloth. You may use a mild household soap (dishwasher soap), but wipe clean surface with clear water before reusing the spectrometer. Always dry wetted surfaces.

Do not use strong household cleaning products. Do not use any cleaning products containing:

- Ammonia
- Bleaching products
- Acetone
- Strong acids
- Strong alkalis

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

Spills

Make sure to wipe clean any spill. Spectrometer is not perfectly leakproof.

Make sure to use appropriate procedure to collect spills. If it is a sample that has been spilled on the spectrometer, refer to the Material Safety Data Sheet (MSDS) of the product for detailed information on collecting spills.

Make sure to dispose of collecting material (cloths, absorbent products, containers etc.) in accordance with Federal, State (provincial) and local regulations.

Storage

ABB recommends to use the shipping box to store the spectrometer.

Do not store the spectrometer in an environment with condensing moisture and excessive dust.

Discarding

The crossed out wheeled bin reproduced on the Product label is a clear reminder that the product must not be disposed with household waste. It is the responsibility of the buyer to discard the spectrometer in accordance with Federal, regional and local environmental regulation.

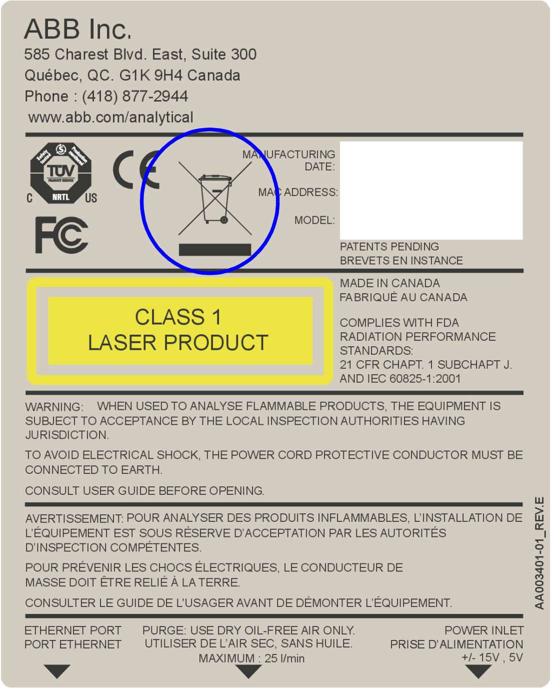


Figure 5- 1. Product label

Section 6 Product Overview

Introduction

The new MB3000 Series FTIR spectrometer is easy to use, reliable and maintenance free. This spectrometer was designed for a large range of analysis for a variety of locations such as factories, educational institutions, quality control laboratories, pharmaceutical plants etc.

LED Identification

	Symbol	LED	State	Description
		Power	Solid Green	Spectrometer is ON
		Status	Flashing Green	Spectrometer is warming up/or calibration
			Solid Green	Spectrometer is ready and running
			Solid Red	Error detected
			Flashing Red	No detector connected
		Network	Solid or Blinking Green	Spectrometer is connected to a Network or computer
			Flashing Amber	Spectrometer is connected to a software.

Table 6- 1. LEDs identification

Connector Location

There are only 3 connectors on the MB3000 Series FTIR spectrometer and 1 power switch on the power supply.

All 3 connectors are located at the rear of the MB3000 Series FTIR spectrometer.

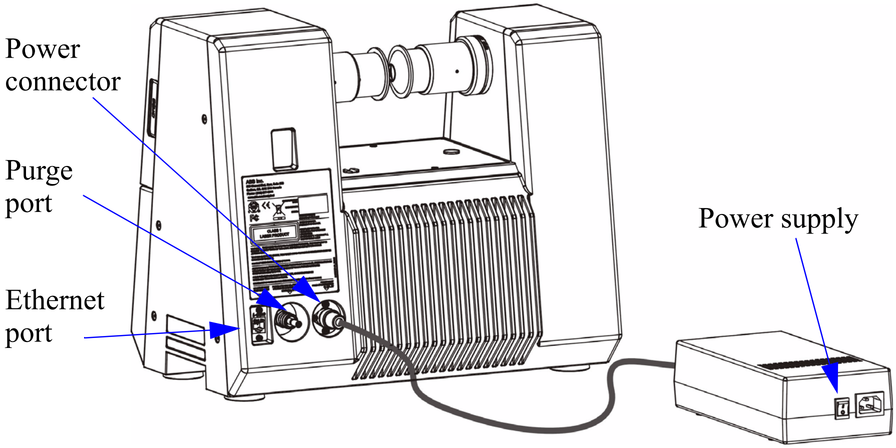


Figure 6- 1 : Connector location

Ethernet Cables

Two Ethernet cables are supplied with the MB3000 Series FTIR spectrometer depending on the type of connection you need. Be sure to use the correct type of cable. Both connectors connect into the Ethernet Port of the spectrometer located at the rear of the spectrometer.

Private connection

A private (direct) connection from the spectrometer to the computer requires a *crossover* cable.

Connection through a Network

A connection from the spectrometer to a local area Network requires a s*traight pin* cable.

Purge

The presence of moisture is no longer an issue with the MB3000 Series FTIR spectrometer since it is designed with non hygroscopic materials. However many compressors tend to let some oil mist enter the air that is being compressed. Oil mist is not removed by moisture-carbon dioxide scrubbing filters. Therefore, use dry oil-free air or nitrogen only to purge the system.

Power Inlet

Power cords are provided in accordance with the destination country.

Attenuator Location

Depending on the type of configuration used, the attenuator may be installed on the MB 3000 series spectrometer at factory before shipment.The attenuator location is on the left side tower .

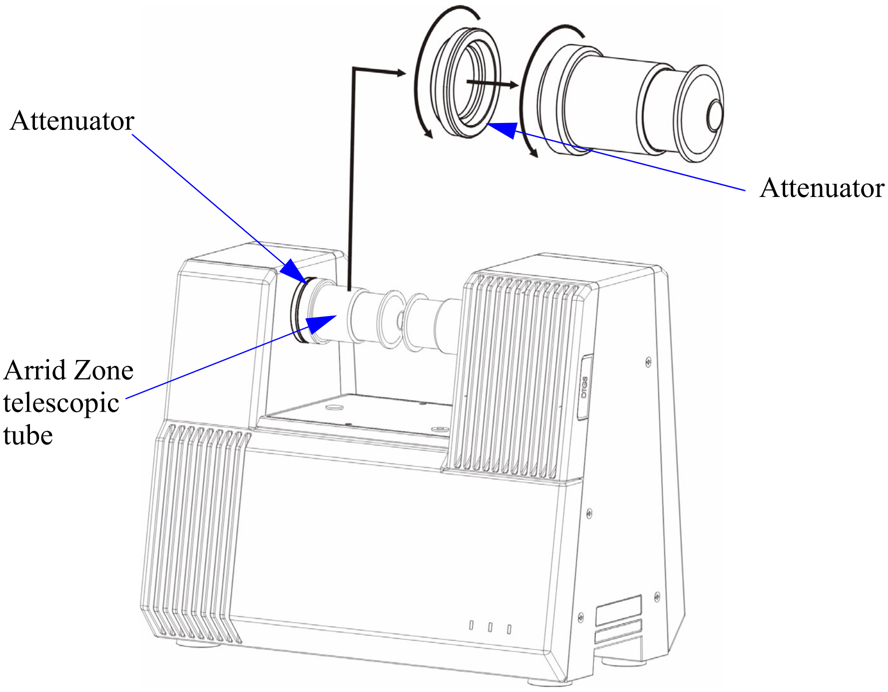


Figure 6- 2. Attenuator location

When using accessories that reduce throughput, for example an ATR, a vial holder, a powder sample, etc., you may remove the attenuator to increase Signal to Noise Ratio (SNR). The Arid Zone telescopic tube and the attenuator are screwed on the tower. Refer to Figure 6- 2.

The value indicated on the attenuator is the throughput value, i.e. the amount of residual energy transmitted.

Section 7 Module Replacement

Detector Module Replacement

Screws are easily inserted and tighten. Do not use excessive force to set the screws in place, otherwise spectrometer could be damaged.

Removing the Detector Module

The type of Detector module being installed into the spectrometer, is automatically detected.

The Detector module can be removed and installed without powering OFF the instrument.

STEP 1 With a 4 mm Hex driver, unscrew the 3 captive screws holding the Detector module into place.

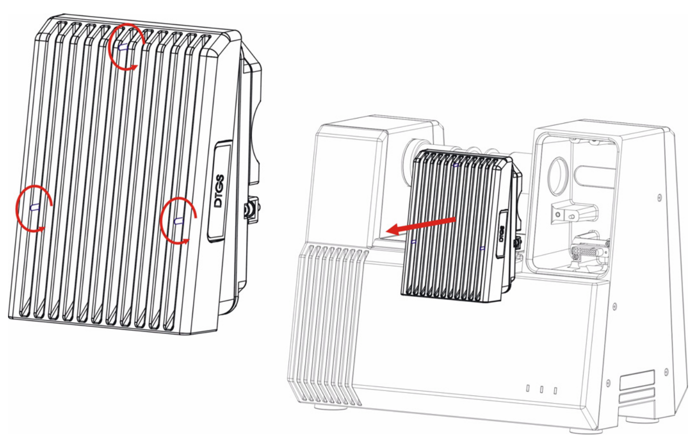


Figure 7- 1. Detector module

STEP 2 Remove the Detector module from the spectrometer: The module is tightly fitted into the housing, gently pull the module to remove it from the spectrometer.

Installing the Detector Module

STEP 1 Select the appropriate detector for your needs. The detector type is clearly indicated on the Detector module.

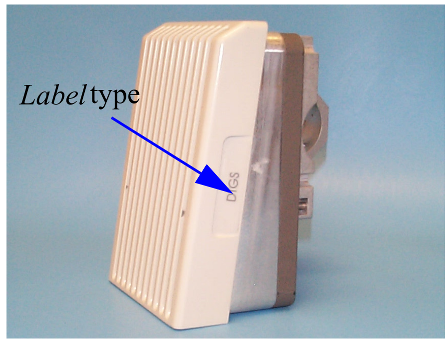


Figure 7- 2. Label location on Detector module

STEP 2 The Detector module fits tightly into the housing of the Detector module, gently push the Detector module into place.

STEP 3 Set all 3 captive screws of the Detector module into place. Do not overthighten.

After installing the Detector module, check the LED statuses to make sure the spectrometer is ready for use. Refer to Table 6- 1. A delay may be required for temperature stabilization if the detector is T.E.cooled (InAS, InGaAs).

Source Module Replacement

Class 3B invisible laser radiations (760 nm, 2mW output power, Near-IR) are present in the interferometer module. However, no laser radiations leak out of the Interferometer module unless the Source module is removed. To remove the Source module refer to Removing the Source Module on page 31 and 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.

Source Module is Hot! Always manipulate the Source module with caution: use the non metallic parts to hold the Source module.

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

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

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

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 use the Lockout/tag out procedure to power OFF the spectrometer. Refer to Lockout/Tag Out Procedure on page 10.

ESD

Perform maintenance procedures in an ESD protected environment. Always use an ESD protection such as wrist strap.

Removing the Source Module

STEP 1 Power OFF the spectrometer. Refer to Lockout/Tag Out Procedure on page 10.

STEP 2 Remove with a 2.5 mm Hex driver the 4 screws holding the front panel in place.

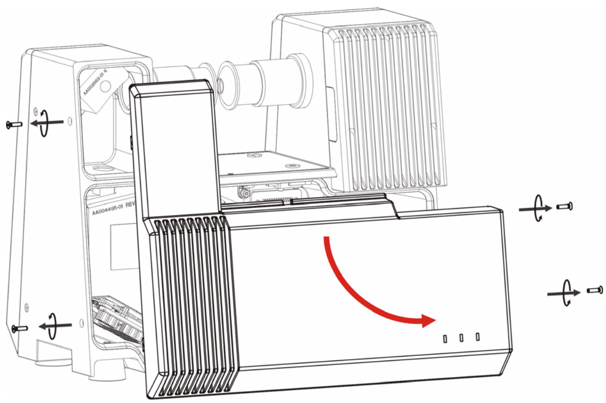


Figure 7- 3. Front panel captive screws

Do not discard the four screws: they will be required to reinstall the front panel.

STEP 3 Slide down and remove the front panel from the spectrometer.

STEP 4 Unscrew with a 2.5 mm Hex driver the bracket holding the Source Electronic Board.

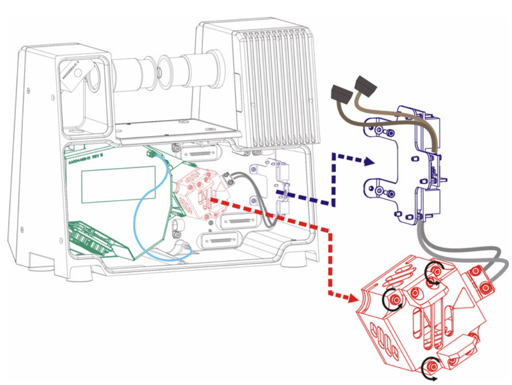


Figure 7- 4. Source module: Source control board and source

You do not need to cut the wires connecting the source control board to the source module. The replacement kit includes the source and the source control board.

STEP 5 Remove the source control board from the spectrometer and gently unplug the two connectors

Connectors are fragile, make sure to manipulate connectors with caution.

STEP 6 Unscrew with a 2.5 mm Hex driver the 3 captive screws of the Source module.

STEP 7 Remove the Source module from the spectrometer.

Installing the Source Module

STEP 1 Power OFF the spectrometer. Refer to Lockout/Tag Out Procedure on page 10.

STEP 2 Set the Source module into place.

STEP 3 Connect all two connectors and tighten the 3 captive screws holding the Source Module into place. Do not overtighten.

STEP 4 Set the source control board (installed on its bracket) into place. Refer to Figure 7- 4.

After installing the Source module, check the LED statuses to make sure spectrometer is ready for use. Refer to Table 6- 1. A delay may be required to allow spectrometer initialization and stabilization.

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Section 8 Technical Information

Specifications

The following tables present the technical data of the MB3000 series FTIR spectrometers. All values are nominal.

Data presented in the following tables are subject to change without prior notice.

Electrical

Rated Line input:	100-240 VAC, 47/63 Hz
Line voltage fluctuation:	Not to exceed 10% of the nominal line voltage
Rated power consumption:	65 W

Mechanical

Enclosure:	Rugged all-metal frame with integrated handles.
Overall dimensions:	435 mm (W) x 280 mm (D) x 372 mm (H)
Footprint:	0.122 m^2; 1.3 $ft.^2$
Weight:	24 kg

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Environmental

In order for the MB3000 series FTIR spectrometer to meet its performance specifications, it must be operated under the following conditions:

Storage temperature range:	0ºC to 30ºC, stable within ±5ºC
Operating temperature range:	10ºC to 35ºC Spectrometer specifications at 25ºC ± 5ºC
Humidity range:	5% to 80%, non-condensing
Pollution degree:	2 *
Altitude:	2000 m maximum

Pollution is any addition of foreign matter, solid, liquid, or gaseous (ionized gases), that may produce a reduction of dielectric strength or surface resistivity. Pollution degree 2 is normally only non-conductive pollution. However, a temporary conductivity caused by condensation must be expected occasionally.

Data Communications

Ethernet 10/100 Mbps
Direct connect or LAN

Optical Bench

Interferometer Mechanism:	High-throughput double pivot Michelson fully jacketed
Laser:	Solid state
Beamsplitter Material:	ZnSe

Lasers

Laser type	Wavelength	Output	Class
VCSEL	760 nm	2 mW	3B invisible

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Section 9 Troubleshooting

Troubleshooting

Do not open the analyzer to perform troubleshooting procedures.

Always use the Lockout/tag out procedure to power OFF the spectrometer. Refer to Lockout/Tag Out Procedure on page 10.

Each time you perform a step of the flow chart (refer to Table 9- 2) to correct a situation, reboot the system by closing and restarting the analyzer.

LED troubleshooting table

Upon powering up the analyzer, all LEDS should light up for a period of 10 seconds.

.

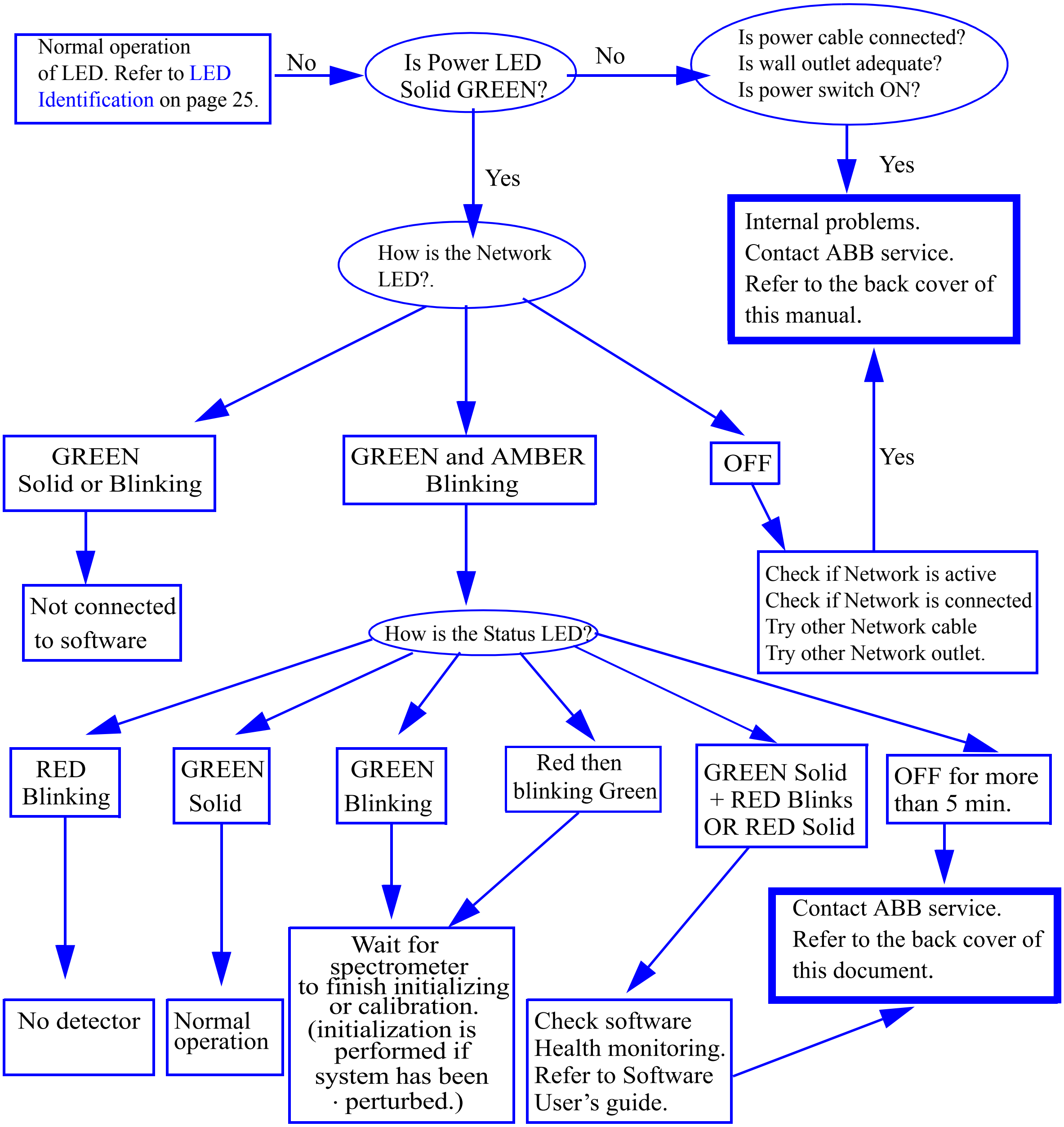
LED	State	Possible cause	Solution
Power	OFF	Power switch not ON	Turn power switch ON. Refer to Connector Location on page 26.
		Power cable not connected	Make sure the power cable is connected in the Spectrometer and in the wall outlet. Refer to Connector Location on page 26
		No current at Power outlet	Test outlet for voltage.
		Internal problems	Contact ABB. Refer to the back cover of this document
	GREEN	Normal operation	
Status	RED blinking	No detector connected	Replace or install detector module. Refer to Detector Module Replacement on page 29.
	GREEN with Red short blinks	Operation Error	Check software health monitoring.
	RED	Internal Error	Check software health monitoring.
	OFF	System is loading	If after 1 min. LED is still OFF, check software health monitoring
	GREEN Blinking	System is initializing or performing calibration. The initialization sequence is performed at startup or after a perturbation.	If this sequence last longer than 5 minutes, it is probably caused by a low laser or white light level Contact ABB. Refer to the back cover of this document.

Table- 9- 1. LED Troubleshooting table

Network	OFF	Network Cable not connected or wrong type of cable	Make sure the proper Network cable is used and connected to the Spectrometer and to a computer or a Network.
	Solid GREEN	Network connected but no communication with the computer or the Network.	Check computer and/or network configurations.

Table- 9- 1. LED Troubleshooting table

9- 2. LED flowchart



Before sending a spectrometer 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.

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Appendix A Certificates of compliance

CE Certificate

For the latest CE declaration of conformity version, contact ABB manufacturer.

ABB

CE DECLARATION OF CONFORMITY

Manufacturer : ABB Bomem Inc
Address : 585 Charest Boulevard East, Suite 300
Québec (Québec), G1K9H4
CANADA

Herewith declares that:

Product : FTIR/NIR Spectrometer **Model** : MB3000, MB3600
Product : FTIR/NIR accessory **Model** : ACC series, ATC series, TFC series, SDG series

- are in conformity with the provisions of the following directives:
  - Electromagnetic Compatibility Directive 2004/108/EC
  - Low Voltage Directive 2006/95/EC
  - CE Marking Directive 93/68/EEC
  - Waste Electrical and Electronic Equipment Directive (WEEE) 2002/95/EC

- and furthermore declares that the following (parts /clauses of) harmonized standards have been applied:
  - EN-61326: 1997 Electrical equipment for measurement, control and laboratory use - EMC requirements
  - EN-61010: 2001 -1 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
  - EN-60825: 1995 -1 Safety of Laser Products - Part 1: Equipment classification, requirements and user guide

TUV SUD certified the MB3000 and MB3600 under the license # U8 08 05 64584 005.

Place: Québec (Québec), CANADA

Josée Labrecque
Product Line Manager

Date : June 2, 2008

Jean-René Roy
General Manager

Date : June 2, 2008

ABB Bomem Inc.

585, boulevard Charest E.
Bureau / suite 300
Québec Qc G1K 9H4
CANADA

Téléphone / Phone
(418) 877-2944
(800) 858-FTIR (3847) Amériques / Americas
0810 620 000 France

Télécopieur / Fax
(418) 877-2834

www.abb.com/analytical

Figure A- 5. CE Certificate

CB Test Certificate

IEC IECEE CB SCHEME

Ref. Certif. No.

DE 3 - 3244M2

IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME

SYSTEME CEI D'ACCEPTATION MUTUELLE DE CERTIFICATS D'ESSAIS DES EQUIPEMENTS ELECTRIQUES (IECEE) METHODE OC

CB TEST CERTIFICATE
CERTIFICAT D'ESSAI OC

Product Produit	Measuring instrument Fourrier Transform Infra Red (FTIR) Spectrometer
Name and address of the applicant Nom et adresse du demandeur	ABB Bomem, Inc. 585 Charest Boulevard East, Suite 300 Quebec QC G1K 9H4, CANADA
Name and address of the manufacturer Nom et adresse du fabricant	ABB Bomem, Inc., 585 Charest Boulevard East, Suite 300, Quebec QC G1K 9H4, CANADA
Name and address of the factory Nom et adresse de l'usine	ABB Bomem, Inc., 585 Charest Boulevard East, Suite 300, Quebec QC G1K 9H4, CANADA
Rating and principal characteristics Valeurs nominales et caractéristiques principales	Rated Input Voltage: +15 V DC/ -15 V DC/ 5 V DC Rated Input Current: 4 A/ 1 A/ 10A Protection Class: I Degree of Protection: IP3X
Trade mark (if any) Marque de fabrique (si elle existe)	ABB
Model/type Ref. Ref. de type	MB 3000 and MB 3600
Additional information (if necessary) Information complémentaire (si nécessaire)	CBTL Procedure
A sample of the product was tested and found to be in conformity with Un échantillon de ce produit a été essayé et a été considéré conforme à la	IEC 61010-1:2001
as shown in the Test Report Ref. No. which form part of this certificate comme indiqué dans le Rapport d'essais numéro de référence qui constitue une partie de ce certificat	TÜV SÜD Product Service 090-704663-200

This CB Test Certificate is issued by the National Certification Body
Ce Certificat d'essai OC est établi par l'Organisme **National de Certification**

Date, 2008-05-19
CB 08 05 64584 006

Joseph Janeliunas

TÜV SÜD Product Service GmbH · Certification Body · Ridlerstrasse 65 · D-80339 München

TÜV SÜD Product Service

CB-1 03.06

Figure A- 6. CB Test Certificate

TUV Certificate

ZERTIFIKAT • CERTIFICATE • 認証証書 • СЕРТИФИКАТ • CERTIFICADO • CERTIFICAT

TÜV SÜD America

CERTIFICATE

No. U8 08 05 64584 005

Holder of Certificate: **ABB Bomem, Inc.**
585 Charest Boulevard East, Suite 300
Quebec QC G1K 9H4
CANADA

Production Facility(ies): 64584

Certification Mark: TÜV PRODUCT SERVICE NRTL C US

Product: **Measuring instrument**
Fourrier Transform Infra Red (FTIR) Spectrometer

Model(s): **MB 3000 and MB 3600**

Parameters:

Rated Input Voltage:	+15 V DC/ -15 V DC/ 5 V DC
Rated Input Current:	4 A/ 1 A/ 10A
Protection Class:	I
Degree of Protection:	IP3X

Tested according to:
CAN/CSA C22.2 No 61010-1:2004
UL 61010-1:2004
EN 61010-1:2001
EN 60825-1:1994/A2:2001

The product was voluntarily tested according to the relevant safety requirements and mentioned properties. It can be marked with the certification mark shown above. The certification mark must not be altered in any way. See also notes overleaf.

Test report no.: 090-704663-200

Date, 2008-05-29

Page 1 of 1

302969

TÜV SÜD AMERICA INC • 10 Centennial Drive • Peabody, MA 01960 USA • www.TUVamerica.com TÜV®

Figure A- 7. TUV compliance certificate

Electromagnetic Compatibility (CE and FCC)

Emissions	**EN 61326, class A, FCC 20780, parts 15, class A**
Radiated Immunity	**EN 61000-4-3, level 2, Perf. criteria A***
	ENV 50204, level 2, Perf. criteria A*
Conducted Immunity	**EN 61000-4-6, level 2, Perf. criteria A***
ESD Immunity	**EN 61000-4-2, level 2, Perf. criteria B**
EFT/Burst	**EN 61000-4-4, level 2, Perf. criteria B**
Surge	**EN 61000-4-5, level 2, Perf. criteria A**
Dips & Interruptions	**CEI 61000-4-11, 100%, 1 period, Perf. criteria A**

* Accepted perturbation level: lower than <0.5%.

Appendix B Firmware Update

Introduction

The instrument's firmware is a computer program stored inside the instrument's electronics and which controls all aspects of the instrument's behavior.

Contact our service department for any questions regarding the availability of firmware updates.

The firmware can be updated with the ABB Bomem FTIR utility.

Firmware Update

The Ethernet connection allows easy update of the instrument's firmware.The update is done via the ABB Bomem FTIR utility.

STEP 1 Click **Start>Settings > Control Panel** and double-click on the **ABB Bomem FTIR** icon.

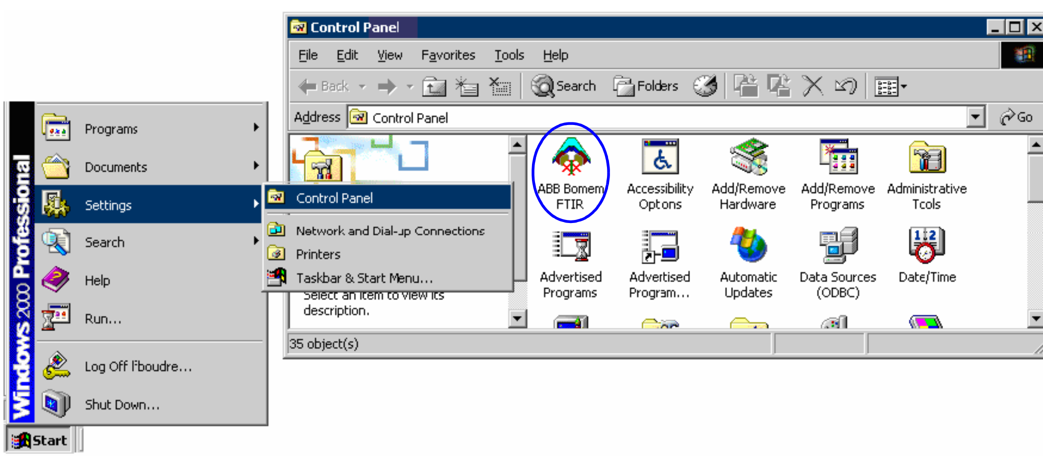

Figure B- 1. ABB Bomem FTIR utility icon

STEP 2 The ABB Bomem FTIR utility will search the Network for the presence of analyzers. A message indicating that the utility is detecting the presence of analyzers will appear. Then a list of all the analyzers present on the Network will appear in the **ABB Bomem FTIR** window.

STEP 3 In the **ABB Bomem FTIR** dialog box, select your instrument and click on **Update Firmware**..

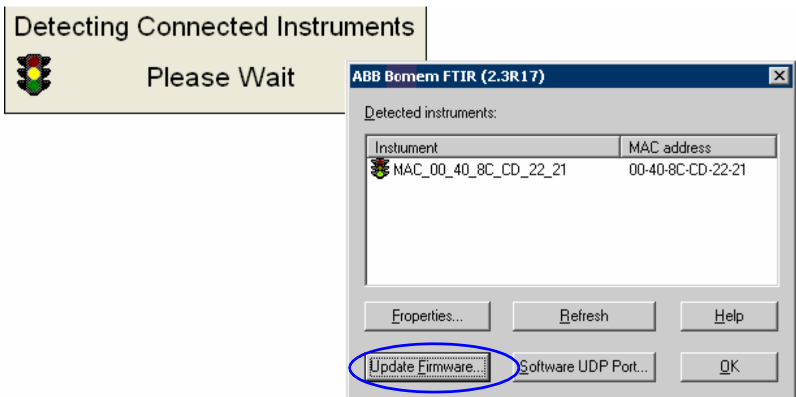

Figure B- 2. ABB Bomem FTIR dialog box

STEP 4 In the **Firmware Upload** dialog box, select **Select File,** browse to locate and to select the updated firmware.

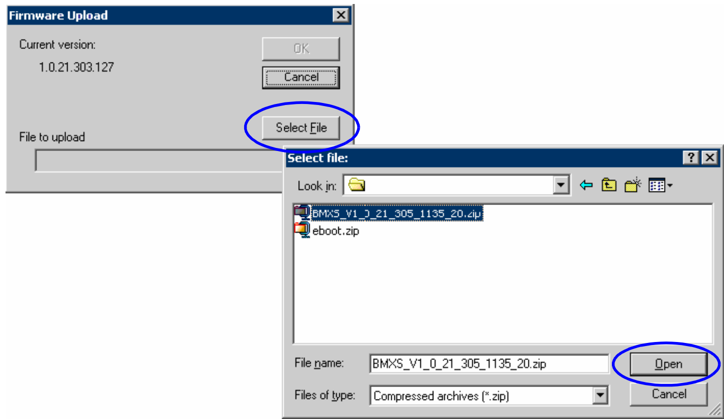

Figure B- 3. Selecting update file

STEP 5 Click **OK** to launch the updating process. This may take up to 5 minutes. At the end you will get a message that the instrument is rebooting.

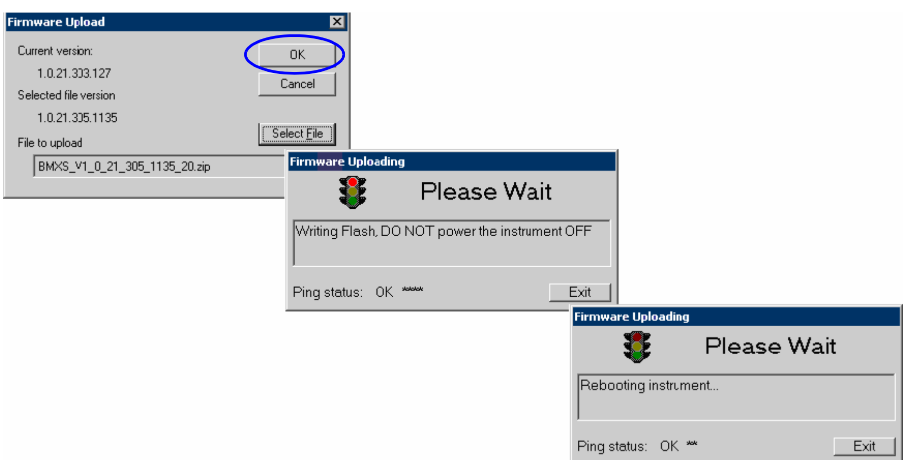

Figure B- 4. Uploading firmware

STEP 6 The update will conclude with the confirmation screen.

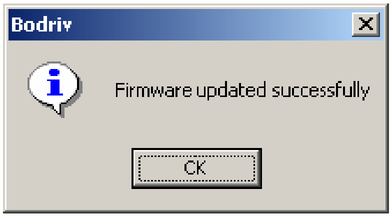

Figure B- 5. Firmware updated confirmation dialog box

Appendix C Spectroscopy Background

Photometric Linearity

Introduction

Beer's law relates the absorbance intensity of spectral bands to the concentration of the analyte and the pathlength of the light beam through the sample. In an FTIR Absorbance is not measured directly, but is derived via the negative logarithm of the ratio of sample spectrum divided by background spectrum. Figure C- 1 shows a series of six absorbance spectra of pure Toluene recorded with a variable path length liquid cell. The pathlength settings are 1000 µm, 750 µm, 500 µm, 250 uµm, 100 µm and 33 µm for highest to lowest absorbance intensity.

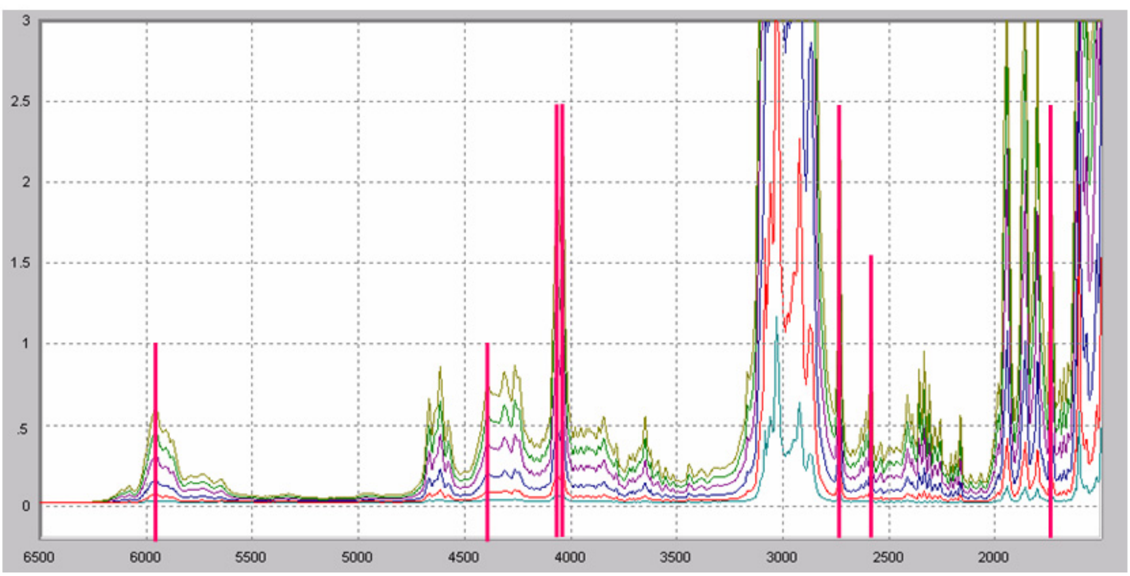

Figure C- 1. Series of toluene spectra

For liquid or solid samples, where the absorption bands are generally broader than the spectral resolution, it is expected that the absorbance will increase linearly with increase in optical path length. Hence a plot of absorbance vs pathlength should be linear. This is called the photometric linearity. As the absorbance increases, the transmittance reduces in a non-linear way. For example at absorbance 1, the transmittance is 10%, at absorbance 2, the transmittance is reduced to 1% and at absorbance 3, the transmittance is further reduced to 0.1%. It is expected that the absorbance vs pathlength will be quite linear for a small absorbance range from example from 0 to 0.3 A. As absorbance range increases, the linearity becomes increasingly challenging.

With an FTIR, spectra are recorded as raw spectra first that are converted to transmittance by dividing by an open beam reference spectrum. In the raw spectra normally the noise level is constant. It becomes weighted according to the spectral response of the reference in transmittance. When converted to absorbance the noise will increase rapidly with level of absorbance because of the non-linear transformation of the logarithm. At high absorbance the fidelity and noise behavior of the spectral response near zero intensity becomes critical. Figure C- 2 shows a plot of absorbance vs normalized pathlength derived from the changes in absorbance at seven frequencies as indicated by red lines in Figure C- 1.

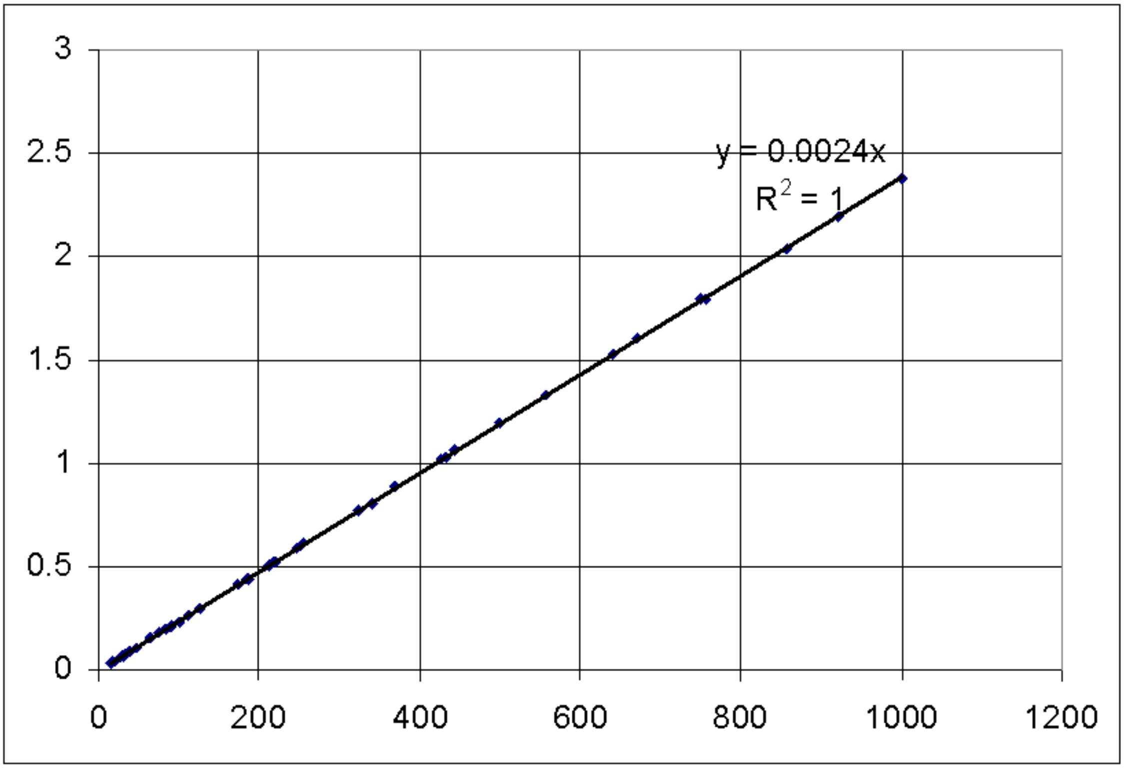

Figure C- 2. Absorbance vs normalized pathlength for 6 absorbance spectra at 7 frequencies

Photometric Linearity Evaluation

Since the spectral fidelity is more critical at high absorbance, the evaluation of photometric linearity is done specifically at the peaks of high absorbance bands where the transmittance is expected to be near zero. Simply attenuating the IR beam over the full spectral range such that transmittance is near zero at all wavelength, the blocked beam case, is a redundant test since an FTIR does not show any stray spectral response when the sample beam is blocked.

A more demanding (and realistic) test is to permit a mixture of high transmittance and near zero transmittance within the same spectrum. This is achieved with a Polystyrene film of at least 75 µm thickness where there are 6 bands that have absorbance greater than 4 (less than 0.01% transmittance) while many parts of the spectrum are quite transparent.

Linearity test performance

When testing an FTIR with a Polystyrene film, the 6 highly absorbing bands should show close to zero transmittance. A satisfactory performance would indicate a residual transmittance of less than 0.1%. It would permit quite linear performance over the absorbance range from 0 to 2 A.

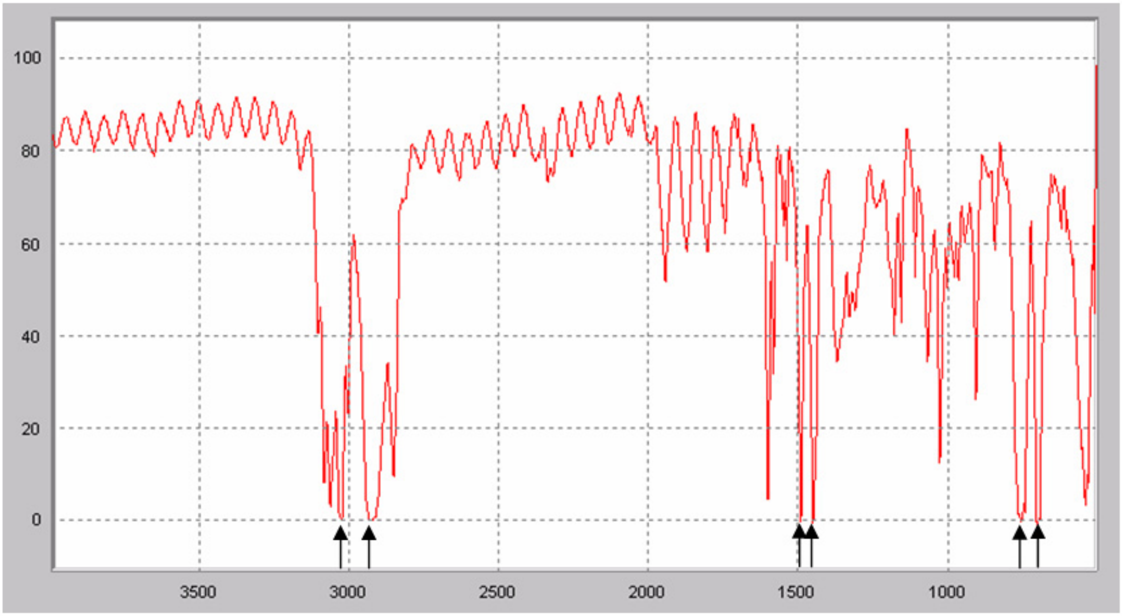

Figure C- 3. Transmittance spectrum of polystyrene film indicating the 6 total absorbing bands

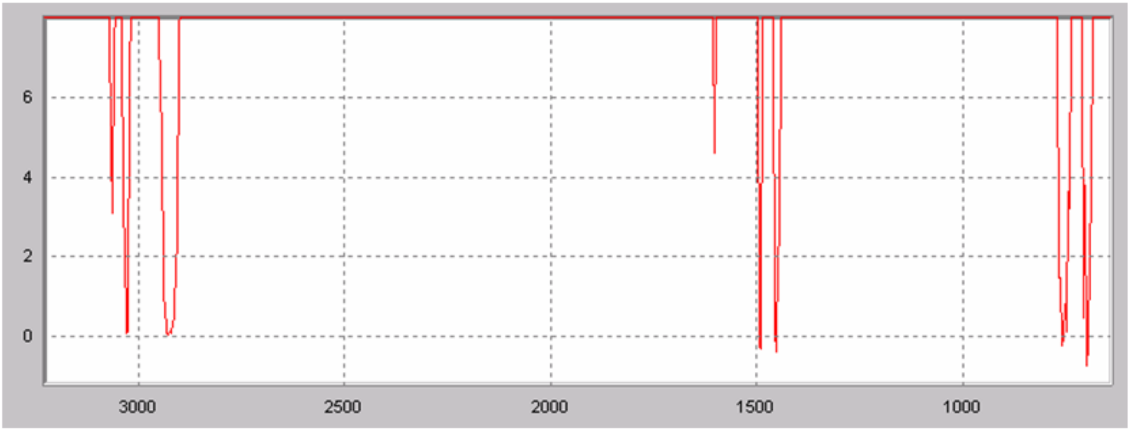

Figure C- 4. Expanded view of figure 3 showing transmittance near zero%. The deviation from zero transmittance for the 6 bands is +/-0.1%T

Reasons for residual transmittance at highly absorbing bands

An FTIR needs a highly linear response detector and high precision electronics to insure low residual transmittance. At the same time the throughput of an FTIR is maximized to insure very high signal to noise ratio even at strongly absorbing bands.

In the ABB MB3000 series FTIRs, the **open beam** flux of radiation on the detector often exceeds the linear flux limit for the detector. In that case Photometric linearity may be unsatisfactory for demanding wide absorbance range measurements. The open beam linearity is quite satisfactory for a limited absorbance range from 0 to 1 A. For a wider range of absorbance measurements, it is recommended to use the supplied attenuator grid.

The attenuator grid is supplied and installed on each new MB3000.

For all general purpose measurements it is best to use the attenuator with the spectrometer. When the spectrometer is used extensively with a sample accessory that already attenuates the open beam intensity by about a factor of 3, the attenuator can be removed thus providing the highest sensitivity for the accessory.

A good example is extensive use of the Miracle accessory. It attenuates the beam by about a factor 3 and thus provides excellent sensitivity with the attenuator removed. Likewise a diffuse reflectance accessory will usually attenuate the beam significantly more than a factor 3 and the attenuator should be removed for best results.

In summary at very high throughput, such as an MB3000 with open beam, there is a slight tendency to non-linear response of the detector causing some reduction in photometric linearity.

Other Causes for Photometric non-linearity

Double modulation

Other than detector/electronics non-linearity, Photometric non-linearity can be caused by “stray light”. In an FTIR there is no stray light when the sample beam is blocked. However, a small amount of light from one wavelength region can be found in another wavelength region. This appears as stray light because when the transmittance at some wavelengths is expected to be zero, there may appear some residual intensity due to this mixing from other wavelengths.

When the light modulated by the interferometer passes through the sample on its way to the detector some of the light may be reflected back to the interferometer where it may be modulated a second time and be reflected back to the sample and the detector. This second pass modulation actually doubles the frequency of the original modulation and makes the radiation spectrum appear to occur at twice the frequency. Thus there is the possibility of some “stray light” due to “double modulation”. Figure C- 5 illustrates (by simulation) the principle of double modulation. The blue trace is the true spectrum. The red trace is a frequency stretched copy of the blue trace. A small fraction of the intensity of the red trace is added to the blue trace when double modulation occurs. A totally absorbing band of the blue trace is prevented from going to zero intensity by the contribution of the red trace.

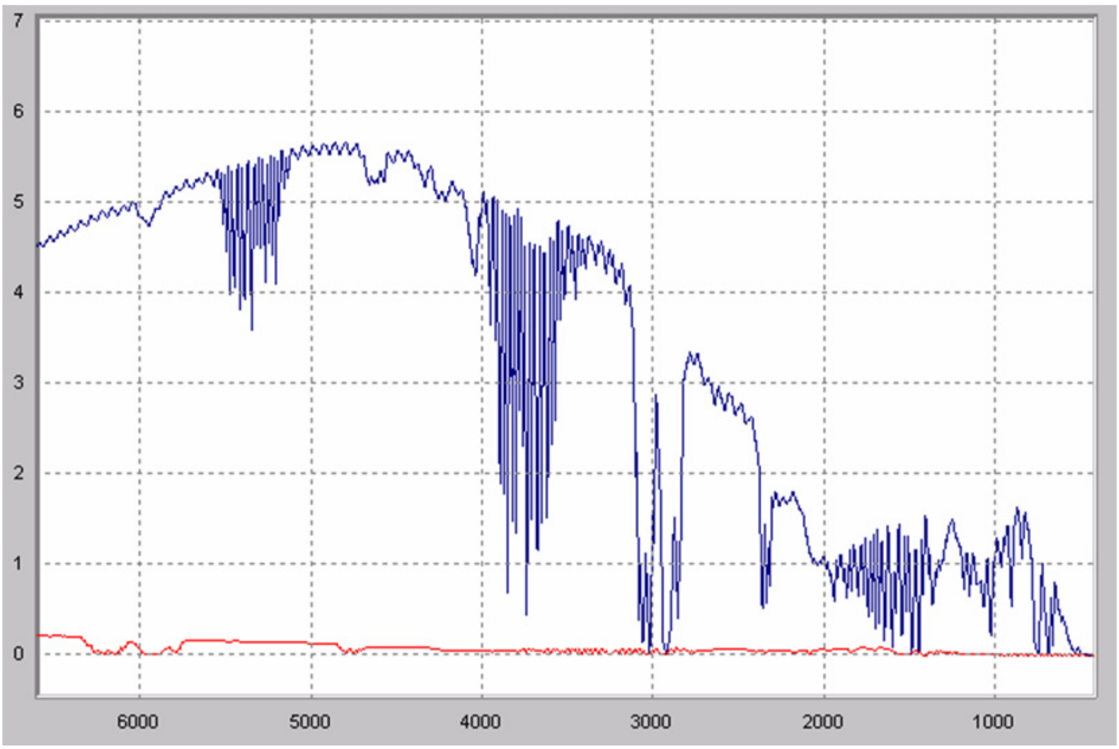

Figure C- 5.

Much effort has been put in the design of the new MB3000 series as well as the original FTLA legacy series of FTIRs to avoid reflecting back radiation once it is modulated. For example the source elements are placed at an angle so that reflection is sent beside the interferometer. The detector optics is also designed to send reflected light beside the interferometer.

When measuring a sample that might have reflective surfaces that are placed perpendicular to the sample beam, there is a chance to reflect modulated light of the sample (such as a liquid cell window) back to the interferometer and have some of it return as double modulated light. This is particularly the case for a liquid cell with high refractive index windows such as ZnSe that is placed at the sample focus. Using lower refractive index windows such as BaF_2, placing the cell away from the sample focus and placing the cell at a slight angle to the beam all are measures that help reduce double modulation stray light.

Here again the supplied grid attenuator, when placed strategically between the sample and the interferometer, will greatly reduce double modulated stray light since the double modulated light has to pass through the attenuator twice.

Suppression of double modulated stray light by spectral band selection

The MB3000 mid IR FTIR has a spectral response starting at about 500 cm^{-1}. The double modulated stray light can start to occur only at 1000 cm^{-1} and higher. By the same principle if highly linear absorbance response over a wide absorbance range is desired say in the 2000 to 2500 cm^{-1} region, then double modulated stray light can be eliminated completely from this region by filtering out the spectral response below 2000 cm^{-1}. By the same token, in the MB3600, the spectral response starts at 3700 cm^{-1} and hence there is no double modulation stray light over the range from 3700 to 7400 cm^{-1}. For higher frequency spectroscopy in the near IR it is recommended to use a shorter wavelength cutoff detector which provides further elimination of double modulation stray light while generally providing higher sensitivity at the same time.

Appendix D Calibration Transfer from FTLA to MB3000

To transfer calibrations from your older FTLA system to the new MB3000 Series, no adjustments are needed. However, the IR optical configuration has slightly changed from the FTLA. The IR source image is a somewhat bigger and better focused. And by using a Jacquinot stop, a more accurate and reproducible line shape function is achieved.

The effect is that the accurate wavelength for narrow lines and for broad bands are the same now while for the FTLA the line asymmetry made the wavelengths for narrow lines a slightly different from those of broad bands. As a result the wavelength calibration, based of the atmospheric water vapor, requires a slightly different value (set at the factory) to insure that spectra of liquids with broad features will be identical to the FTLA Series. For example, the position of the water vapor line near 7300 cm^{-1} is 0.15 cm^{-1} lower for the MB3600 than for the FTLA for identical spectral response of liquid samples.

Technical background:

The MB3000 Series includes a solid state laser in place of the He-Ne laser in order to reduce maintenance and improve the spectrometer life span. ABB already have many years experience of using solid state lasers in his FTIR instruments for satellites. It is with this expertise in hand that ABB has designed the MB3000 Series.

A “single longitudinal mode” solid state laser provides a single monochromatic wavelength suitable for reference fringes of the interferometer, but contrary to a He-Ne laser the wavelength of each solid state laser purchased is likely to be different from the previous one. So there is no fixed wavelength for these lasers. As well the wavelength will shift with temperature and applied current.

In the MB3000 Series, the applied current and temperature are carefully controlled. The temperature is controlled with a small Peltier cooler. So once the MB3000 is up and running the wavelength will remain stable.

At factory, each solid state laser needs to have it wavelength calibrated. Since the laser is used in an FTIR, there is no need to adjust the temperature and/or current to get the same wavelength for all lasers. Instead, the same temperature and current settings are always used and the wavelength is measured: This provides greater reliability since it is not needed to push the temperature or the current to high levels to get the same wavelength.

There are a number of ways to calibrate solid state lasers. The goal is to calibrate the solid state lasers to the same accuracy or better than the He-Ne laser. The best way to do this is to measure a known spectral line and adjust the laser wavelength in software such that the measured line falls on its exact wavelength. For this a built-in cell with a reference vapor and a separate source and detector is used. The wavelength of the laser is stable for an extended period of time. However the firmware in the spectrometer keeps track of the elapsed time and schedules a short calibration procedure automatically every two weeks. The reason for this frequency of calibration is that there is a small frequency shift due to aging of the laser. This aging effect is expected to be quite small and would require recalibration only every few months to stay within specification.

Appendix E FTIR Frequency scale calibration

Differences Between the FTLA and the MB3000 Series

Field of view effects on FTIR Frequency scale calibration

The frequency scale of an FTIR is extremely repeatable, reproducible and linear. The absolute calibration of the frequency scale depends on the frequency assigned to the reference laser and to a smaller extent on the IR beam angular geometry also called “field of view”.

Field of view definition

The field of view is defined by the shape of the IR beam at the focus of the various focusing elements of the FTIR system.

The first focus is the source collimator focus where the source is located.

A first conjugate image of the source collimator focus is produced at the output focusing mirror of the MB3000 interferometer. Its image size is twice the image size at the source focus: Ratio of source collimator focal length to output focusing mirror focal length is 1 to 2.

A second conjugate image of the source focus is produced at the sample compartment IR beam focus. Its image size is 1.4 times the image size at the output focusing mirror and 2.8 times the image size at the source focus.

Finally there is a third conjugate image of the source focus at the IR detector. Its image size is 0.167 times the sample compartment image size and 0.467 times the image size at the source focus. Table 1 summarizes the different field of view defining positions for the MB3600. The source is a quartz halogen lamp with 1 mm diameter filament that is ~2.5 mm long. Table 2 summarizes the different field of view defining positions for the MB3000. The source is a SiC glowbar with a 3 x 3 mm hot emitting area.

Table 10.

Location	**Magnification**	**Size limit**	**FOV limit**
source focal plane	1	1x 2.5 mm	partial limiting
output focal plane	2	3.1 mm	partial limiting
sample beam focal plane	2.8	sample	accessory dependent
detector focal plane	0.467	1 mm	not limiting

Table 11.

location	**magnification**	**size limit**	**FOV limit**
source focal plane	1	3 x 3mm	not limiting
output focal plane	2	4.5 mm	limiting
sample beam focal plane	2.8	sample	accessory dependent
detector focal plane	0.467	1 mm	not limiting

Frequency shift due to Field of View

The frequency scale of an FTIR is highly linear. Hence the frequency scale can be calibrated with one reference frequency realizing that zero frequency is always fixed. A quick verification of the frequency calibration of an FTIR is to measure a raw spectrum of ambient air where fine absorption lines indicate the presence of water vapor. At a resolution of 1 cm^{-1}, two individual water vapor spectral lines have been identified for calibration verification. These are the lines at 1918 cm^{-1} for mid IR and 7300 cm^{-1} for Near IR

Frequency and the optical axis

The optical axis of an interferometer is defined as the direction of light propagation centered on the circular fringe pattern. For a flat mirror type interferometer it corresponds to the perpendicular to the flat mirrors. For a cube corner type interferometer it is the line joining the apex of one cube corner with the apex of the image of the second cube corner as seen reflected by the beamsplitter. The optical path difference is greatest along the optical axis. As light beams are angularly inclined to the optical axis, the optical path difference for the same mirror displacement diminishes as the cosine of the angle.

A pinhole mask placed centered in the sample beam permits selecting an IR beam parallel to the optical axis. For this configuration, the measured frequency of the water vapor lines is highest: The frequencies for the two water vapor lines are 1918.xxx and 7300.10 cm^{-1}. Moving the pinhole away from the center sideways left or right or up or down will cause a decrease in measured frequency. A shift of the pinhole by 2.4 mm from the center corresponds to 1 degree angular shift of the IR beam and hence the frequency reduces to COS (1 degree)= 0.999848 times the nominal frequency; a shift of 1.11 cm^{-1} at 7300 cm^{-1} and 0.29 cm^{-1} at 1918 cm^{-1}.

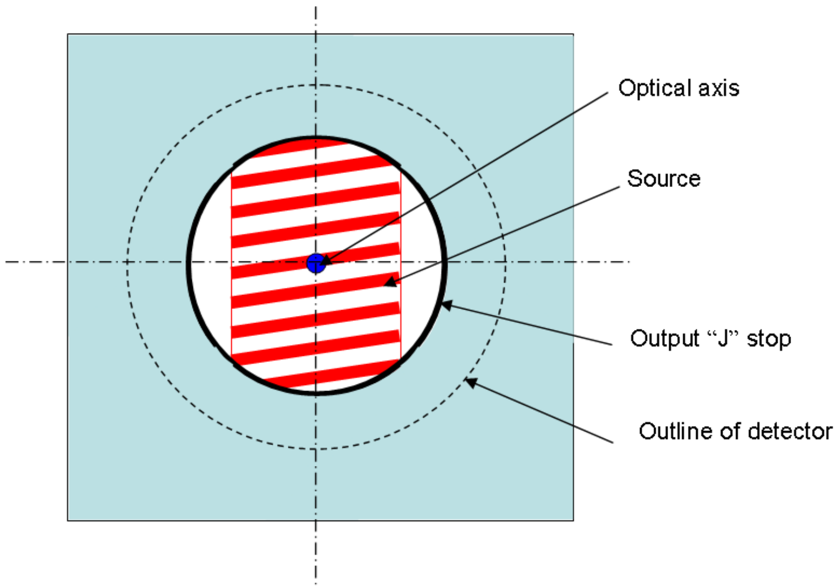

Figure E- 1. different field of view defining elements for the MB3600 with Quartz halogen source

A plot of available light intensity as a function of off-axis angles linearized along the frequency axis shows a rectangle when a circular symmetric illumination distribution occurs. This is the case for the MB3000 where the output J stop limits the illumination to a circle. The quartz halogen lamp of the MB3600 is not quite wide enough to provide circular symmetric illumination through the output J stop and hence the illumination distribution is no longer rectangular. Figure 2 shows the illumination distribution as a function of frequency for figure 1.

The mean frequency for the distribution in figure 2 is shifted to higher frequency as a result of the declining intensity at lower frequency and is 7299.73 cm-1. This is the expected frequency for the NIR water vapor line when measured with an open beam or large throughput sampling accessory.

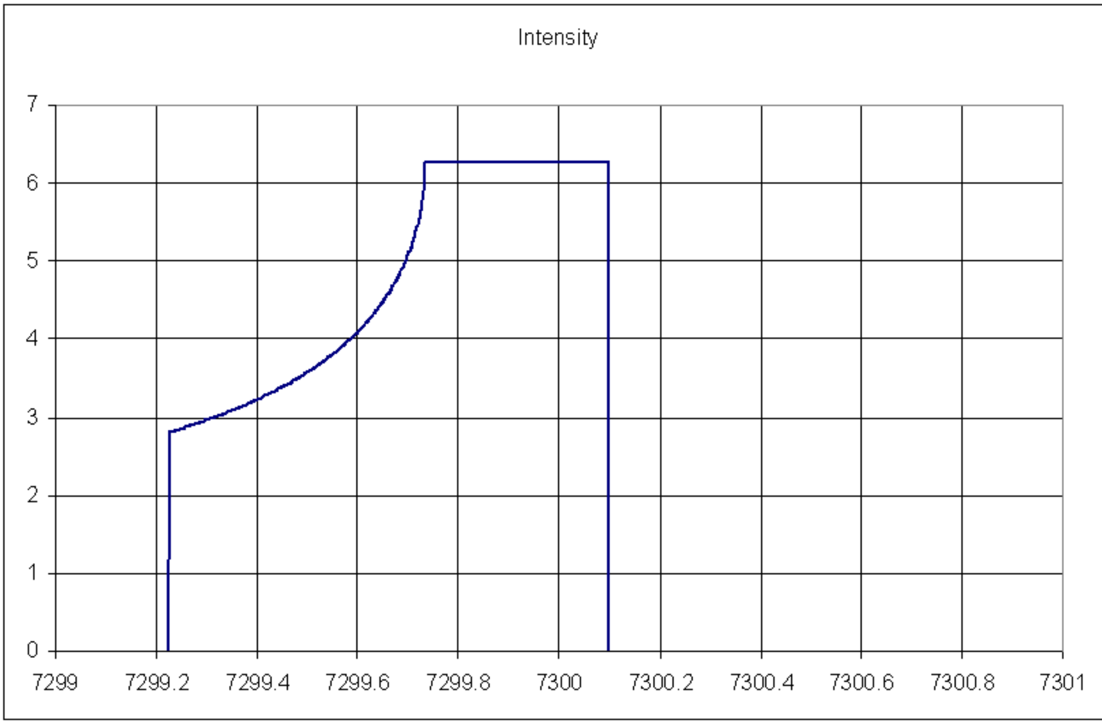

Figure E- 2. Illumination distribution as a function of frequency shift for figure 1 distribution

Effect of IR beam restricting accessories on frequency

A common example of a beam restricting accessory is the vial sampling accessory used with the MB3600. In order to achieve a uniform optical path through the curved walls of small glass vials, the IR beam is restricted by means of a 1mm wide vertical slit in the vial sampling accessory. This changes the illumination distribution and hence the frequency calibration. Figure 3 shows the accessory slit superimposed on the IR beam as restricted by the system (as in Figure 1)

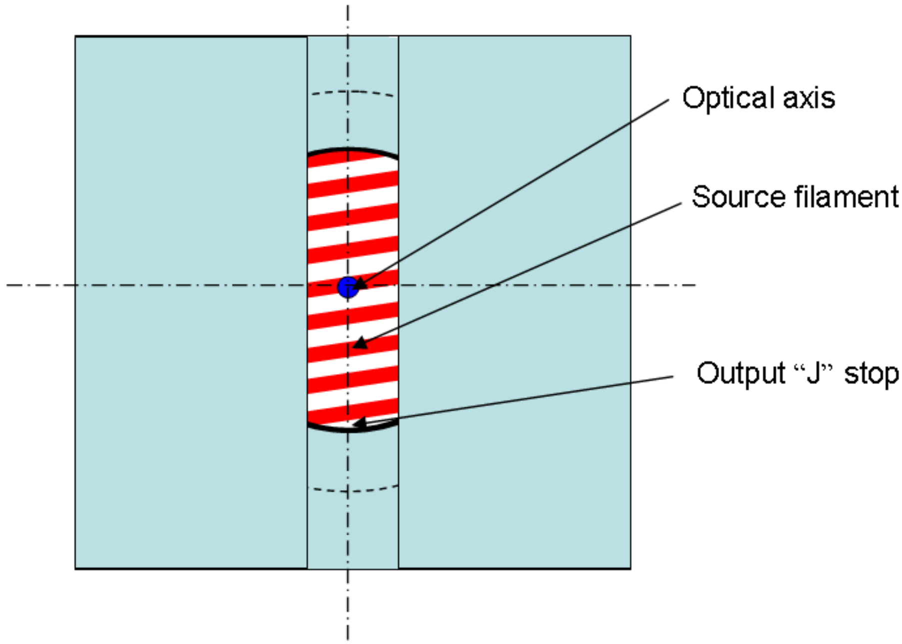

Figure E- 3. Illumination distribution with vial sampling accessory

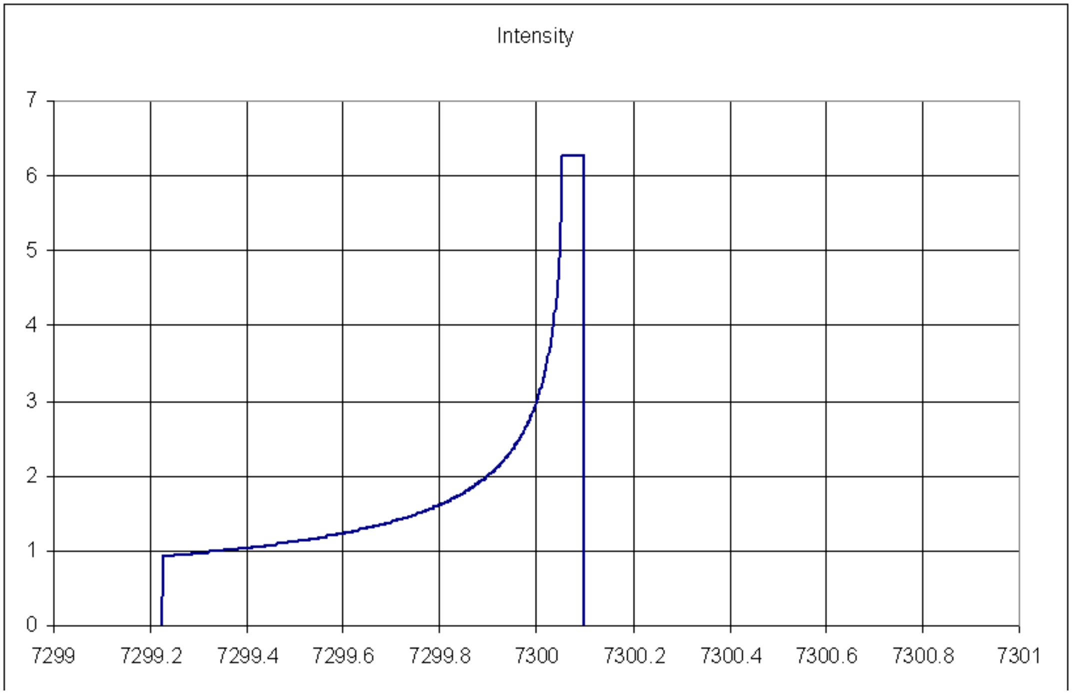

Figure E- 4. Illumination distribution as a function of frequency shift for figure 3

For broad spectral features or low resolution spectroscopy, the mean frequency for figure 4 is 7299.8 cm-1. However, when measuring the frequency of narrow lines such as water vapor at 1 cm-1 resolution, the apparent frequency will be higher than the average frequency because of the strong skew in the curve.

Calibration Transfer between FTLA2000 and MB3000 systems

In the FTLA systems there is no "J" stop in the focal plane of an output focusing mirror. As a result the illumination is further away from circular symmetric and the illumination distribution as a function of frequency is more skew for the open beam case than for the MB3600 when using the same size quartz halogen source

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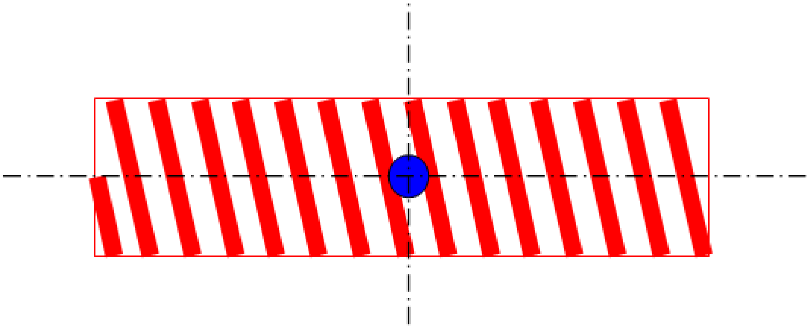

Figure E- 5. Illumination distribution for the FTLA2000-160

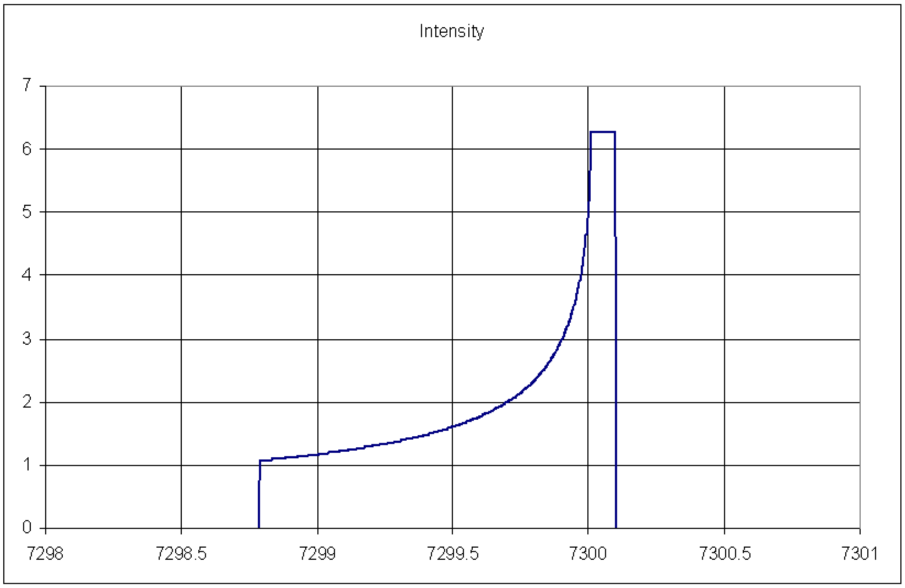

Figure E- 6. illumination distribution as a function of frequency for figure 5.

The mean frequency for broad spectra is 7299.79 cm^{-1} while for narrow spectral features it will appear higher.

When verifying the frequency calibration with the narrow water vapor line at 1 cm-1 resolution, for the same broad spectra average frequency, the water vapor frequency will be at different apparent locations. It means that to transfer calibrations from the FTLA to the MB3600, slightly different values for the water vapor frequency calibration are required. The difference in frequency can be determined by means of the reproducibility test with Toluene which will require different water vapor frequency assignments to provide the best match.

Similarly for the vial sampling accessory, the effective illumination distribution is not the same between the FTLA and the MB3600. For the FTLA, the limiting slit of the vial accessory is perpendicular to the long axis of the source filament and hence the combination forms a small square illumination spot as shown in figure 7

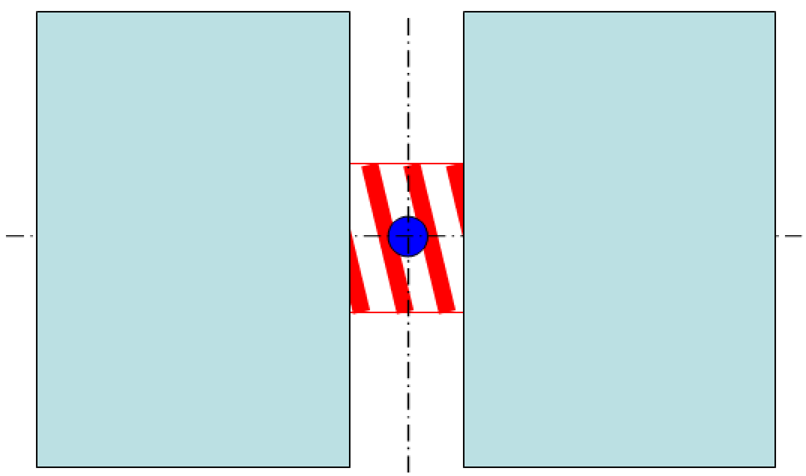

Figure E- 7. Illumination distribution for FTLA with vial sampling accessory

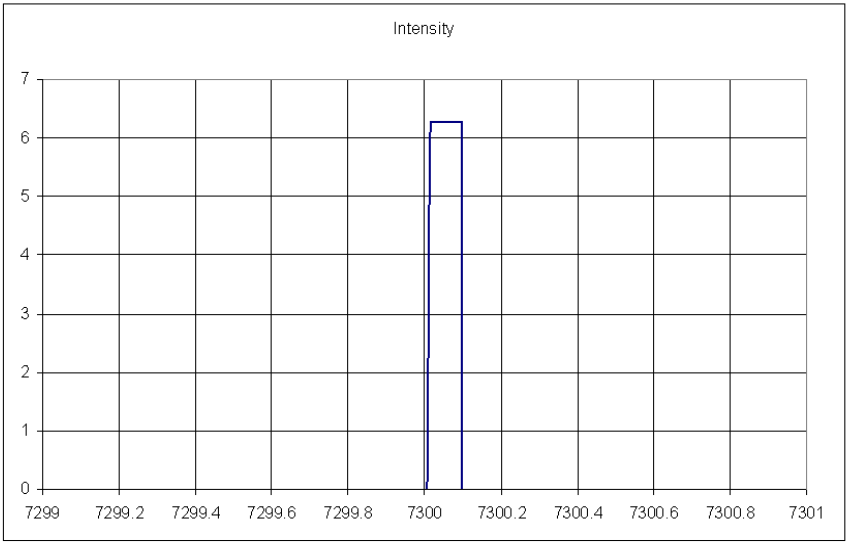

Figure E- 8. Illumination distribution as a function of frequency for figure 7

When using the vial accessory with an FTLA, the mean frequency is significantly shifted compared with open beam. The mean frequency is now 7300.06 cm^{-1}.

In conclusion the MB3600 has better controlled illumination that is closer to circular symmetric than the FTLA. It provides for better control of frequency calibration and a more symmetrically defined line shape. However, when transferring calibrations from an FTLA to an MB3600, there is a need for redefining the measured calibration frequency for the water vapor calibration test. The redefinition of the water vapor frequency requires a change in interpolation as well as a change in frequency assignment to insure that discrete spectral data points align with data points from other spectra. The redefinition of frequency is best determined by the Toluene reproducibility test where spectra are shifted until the Toluene spectrum is reproduced most precisely.

Frequency redefinition requires a specific software module that is available from ABB.

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