BRM Backreflection Meter

User Manual
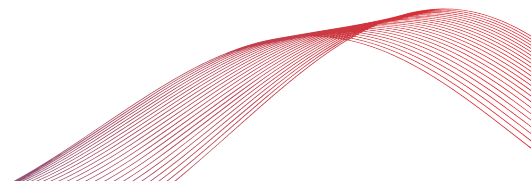
santec

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COMPLIANCE

FDA-CDRH Compliance

Under the US Food and Drug Administration (FDA) Center for Devices and Radiological Health (CDRH), the unit complies with the Code of Federal Regulations (CFR), Title 21, Subchapter J, which pertains to laser safety and labeling. See following link for more information:

- http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/CFRSearch.cfm?CFRPartFrom=1000&CFRPartTo=1050

CSA / IEC Compliance

The unit complies with certain standards of the Canadian Standards Association (CSA) and the International Electrotechnical Commission (IEC).

The unit falls in the Installation Category (Overvoltage Category) II under IEC 664. IEC 664 relates to impulse voltage levels and insulation coordination. The category is defined as: local level, appliances, portable equipment, etc., with smaller transient overvoltages than Installation Category (Overvoltage Category) III.

The unit falls in the Pollution Degree 2 category under IEC 1010-1 and CAN/CSA-C22.2 No. 1010.1. The IEC standard on Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use relates to insulation coordination. The CSA standard is on Safety Requirements for Electrical Equipment for Measurement Control, and Laboratory Use, Part I: General Requirements. The Pollution Degree 2 category is defined as follows: "Normally only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation must be expected."

CE Compliance

Electronic test equipment is subject to the EMC Directive in the European Union. The EN61326 standard prescribes both emission and immunity requirements for laboratory, measurement, and control equipment. This unit has undergone extensive testing according to the European Union Directive and Standards.

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GENERAL INFORMATION

BRM Backreflection Meter Overview

The BRM Backreflection Meter is a user-friendly instrument developed with extremely stable optics for precise measurement of backreflection, insertion loss and power.

Figure 1: BRM Backreflection Meter

Applications

- Component testing
- Connector and patch cord testing
- Incoming inspection
- QA and R&D

Key Features

- Stable BR measurements at low values
- BR range to -85 dB
- Up to 4 internal lasers
- Custom wavelengths and core sizes possible

Test & Measurement Standards

- IL conforms to IEC 61300-3-4 and IEC 61280-4-1
- Multimode IL launch conditions meet the IEC 61280-4-1 Encircled Flux standard

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- BR conforms to IEC 61300-3-6

Included Accessories

- USB A to USB B cable (1.8m)
- Ethernet cable (1.8m)
- AC power cord (2m)
- SD00 slide detector cap
- SD01 slide FC detector adapter
- FC/APC – FC/UPC jumper (1m) calibrated jumper
- ISO 17025 NIST-traceable calibration report

Optional Accessories

- Remote-head detector
- Slide detector adapters
- Barcode scanner
- Rackmount kit

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SAFETY INFORMATION

To avoid situations that could result in serious injuries or death, always observe the following precautions.

The safety instructions must be observed whenever the unit is operated, serviced, or repaired. Failure to comply with any of these instructions or with any precaution or warning contained in the user manual is in direct violation of the standards of design, manufacturing, and intended use of the unit. Santec Inc. assumes no liability for the customer's failure to comply with any of these safety requirements.

Safety Markings on the Unit

See Table 1 for symbols and messages that can be marked on the unit. Observe all safety instructions that are associated with a symbol.

Table 1: Safety symbols

⚠ (laser symbol)	Laser radiation may be present. Refer to the user manual for instructions on handling and operating the unit safely. Avoid looking into any ports near which this symbol appears.
(ground symbol)	Frame or chassis terminal for electrical grounding within the unit.
(earth ground symbol)	Protective conductor terminal for electrical grounding to the earth.
WARNING	Procedure can result in serious injury or loss of life if not carried out in proper compliance with all safety instructions. Ensure that all conditions necessary for safe handling and operation are met before proceeding.
CAUTION	Procedure can result in serious damage to or destruction of the unit if not carried out in compliance with all instructions for proper use. Ensure that all conditions necessary for safe handling and operation are met before proceeding.

Classification

The BRM consists of an exposed metal chassis that is connected directly to earth via a power cord and is therefore classified as a Class 1 instrument.

The laser (or lasers) contained in the BRM is (are) Class 1M laser(s) as specified under the international standard IEC 60825-1 Ed. 3.0 b:2014 and ANSI Z136.1-2014.

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Laser radiation
CLASS 1M
laser product

Important Safety Information

Laser Hazards

Warning

- Never look directly into the end of an optical cable connected to an optical output device that is operating. Laser radiation is invisible and direct exposure can severely injure the human eye.

Electrical Hazards

Warning

- Some of the circuits are powered whenever the unit is connected to the AC power source (line power). To ensure that all circuits are powered off, disconnect the power cord from either the power inlet on the unit's rear panel or from the AC line-power source (receptacle). The power cord must always be accessible from one of these points. If the unit is installed in a cabinet, the operator must be able to disconnect the unit from the line power by the system's line-power switch.

- Use only the type of power cord supplied with the unit. If you need to replace a lost or damaged cord, make sure to replace with a power cord of the same type.

- Connect the power cord only to a power outlet equipped with a protective earth contact. Never connect to an extension cord or any receptacle that is not equipped with this feature.

- If using a voltage-reducing autotransformer to power the unit, ensure that the common terminal connects to the earthed pole of the power source.

- Do not interrupt the protective earth grounding. Such action can lead to a potential shock hazard that can result in serious personal injury. Do not operate the unit if an interruption to the protective grounding is suspected.

- Do not operate the unit when its cover or panels have been removed.

- To prevent potential fire or shock hazard, do not expose the unit to any source of excessive moisture.

- Do not use the unit outdoor.

- Operating the unit in the presence of flammable gases or fumes is extremely hazardous.

- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. Only technicians authorized by Santec Inc. should carry out repairs. In addition to voiding the warranty, opening the unit (even when unplugged) can expose you to potential shock hazards.

- Some of the unit's capacitors can be charged even when the unit is not connected to the power source.

- Do not perform any operating or maintenance procedure that is not described in the user manual.

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GETTING STARTED

Caution

- To avoid injury or death, always observe the precautions listed in SAFETY INFORMATION on page 4.

This manual contains complete operating instructions for safe and effective operation of the BRM Backreflection Meter. It is recommended that users of the BRM familiarize themselves with contents of this manual before using the instrument.

The inspection report and a description of any customer-requested information may be found in the calibration document envelope included with the instrument.

Initial Inspection

Warning

- To avoid electrical shock, do not initialize or operate the unit if it bears any sign of damage. Ensure that the unit and any devices or cords connected to it are properly grounded.

✓ Inspect the package and contents for signs of damage.

✓ Ensure all contents are included.

✓ Read the user manual thoroughly and become familiar with all safety symbols and instructions to ensure that the unit is operated and maintained safely.

✓ If the initial inspection reveals any damage or missing components, immediately notify Santec Inc. and if necessary, the carrier.

Operational Requirements

For the unit to meet the warranted specifications, the operating environment must meet the conditions outlined in Table 2.

Table 2: Environmental requirements

Parameter	Specification
Altitude	Up to 2000m
Temperature	0 to 40°C
Humidity	Up to 95% RH (0 to 40°C)
Voltage	Main supply voltage fluctuations must not exceed ± 10% of the nominal voltage

Product Overview

BRM Front Panel

A front view of the BRM meter is shown in Figure 2. It features a touchscreen which displays information such as references, measurements and setup.

The FC/APC output panel is located on the front of the unit.

Figure 2: Front view of a BRM

BRM Rear Panel

A rear view of the BRM meter is shown in Figure 3. See Table 3 for a detailed description.

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Figure 3: Rear view of a BRM

Table 3: Detailed description of the BRM rear panel components (see Figure 3)

Item #	Description
1	LAN/Reset • Press once: reset network settings • Press and hold for > 5 seconds: restore previous version firmware version ○ **WARNING:** doing this may corrupt the unit and it may have to be sent back to Santec for repair – *contact Santec before proceeding*
2	Ethernet port • Connection to LAN
3	USB B port • Connection to PC
4	USB A ports • Connections to peripherals such as a barcode scanner, etc.
5	Power input • Contains user-replaceable fuse
6	IO switch • On/off toggle

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OPERATION

Before the BRM meter can be used to make a measurement, the user must setup the meter and connect and reference a "test jumper" to the front panel.

Powering Up the Meter

To power up the meter:

1. Verify that the power switch is set to the "off" position (O). Connect the meter to an AC power supply using the power cord provided.
2. Toggle the power switch to the "on" position (I). The Santec logo will flash on the screen during the unit's initialization.
3. Allow for a warm-up period of up to 30 minutes to obtain an accurate reading.

Device Information and Settings

Swipe left to access the *Setup* page (Figure 4). This page will display information about the unit, its connectivity status and test settings. See Table 4 for a detailed description.
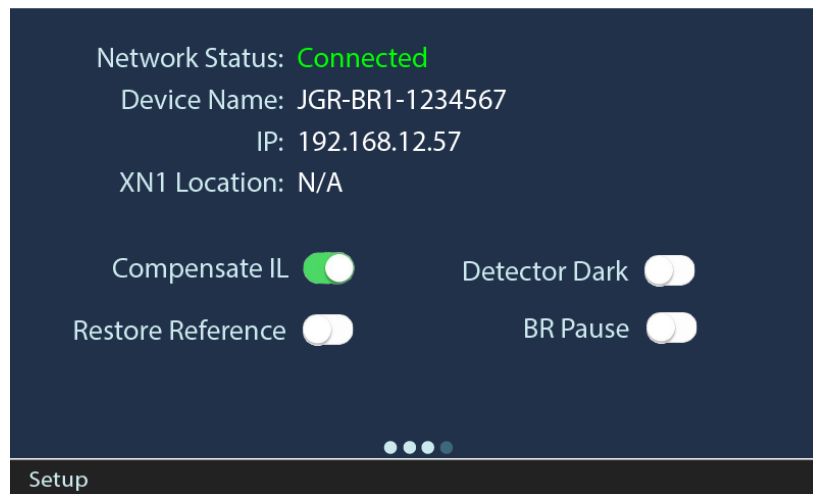
Figure 4: BRM *Setup* page

Table 4: Detailed description of the BRM *Setup* page (Figure 4)

Parameter	Description
Network Status:	• If connected to a network via Ethernet, it will show as *Connected.* • If not connected to a network, it will show as *Disconnected.*
Device Name:	• Product line ("*Santec-BRM*") and unit serial number ("*1234567*") as stored on the unit.
IP:	• If connected to a network via Ethernet, it will show the IP address of the unit. Use this IP address to access the RL1 webpage or connect to it via software. • If not connected to a network, it will show as *N/A*.
XN1 Location:	• Shows the IP address and port of the last connected XN1 server. • If it has not been connected, it will show as *N/A*.
Compensate IL	• When enabled, the internal power monitoring PD will take a reading every 2 min to compensate the stored IL reference. • It is recommended to have this setting enabled however a 1x2 switch must engage so in cases where constant output power without interruption is desired, this setting should be disabled.
Restore Reference	• If enabled, when the unit powers up, the last stored reference will be restored. • If disabled, a new reference will be required after every power cycle.
Detector Dark	• Cap all outputs and detectors then enable to measure the dark current. This will allow measurements for the entire power range of the unit (configuration dependent). • Disable to remove the stored dark current value.
BR Pause	• If enabled, the unit will pause before BR measurements to allow for termination such as a mandrel wrap or index matching gel/block. • In cases where no physical termination is performed (such as APC-to-air termination), this setting can be disabled to speed up testing.

Performing a Reference

Swipe right twice to access the *Reference* page. In Figure 5:

1. tap a row header to reference that parameter (all wavelengths)
2. tap a column header to reference that wavelength (all parameters)
3. tap in the center to reference all wavelengths and parameters

Det.1 designates the IL reference as measured by detector 1.
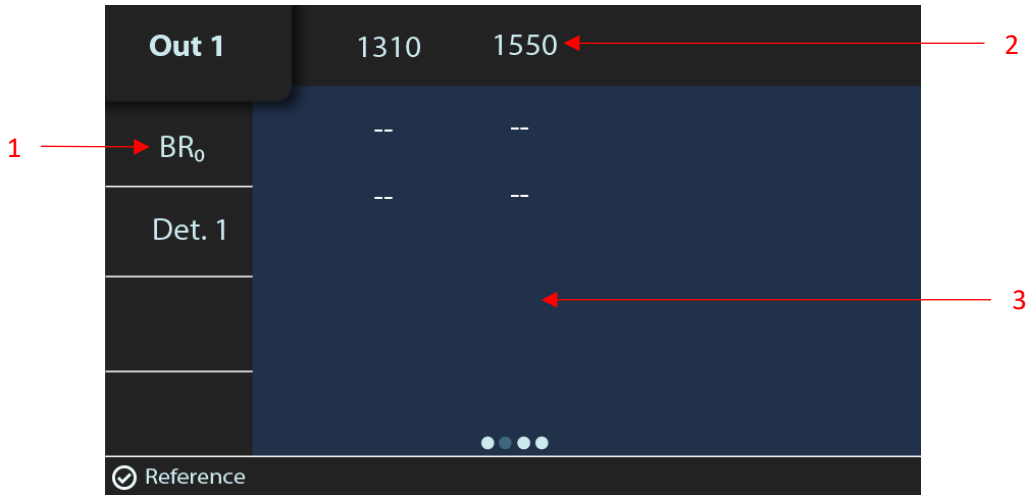
Figure 5: BRM *Reference* page – no stored references

A pause window will appear for a BR_0 reference with a live reading (Figure 6). The BR measurement range is limited to within 15 dB of the BR_0 reference. The display will be red for a BR_0 > -60 dB (SM) or -40 (MM).
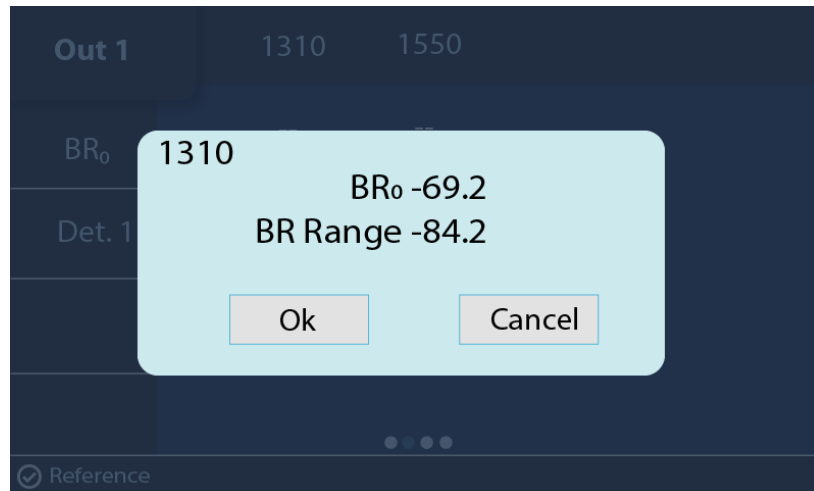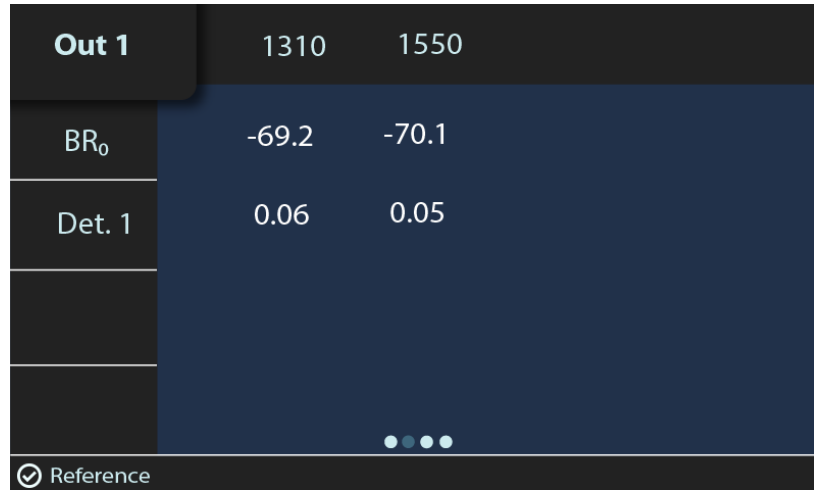
Figure 6: BRM Reference page – BR_0 pause message

The reference page (Figure 7) will display the stored values.
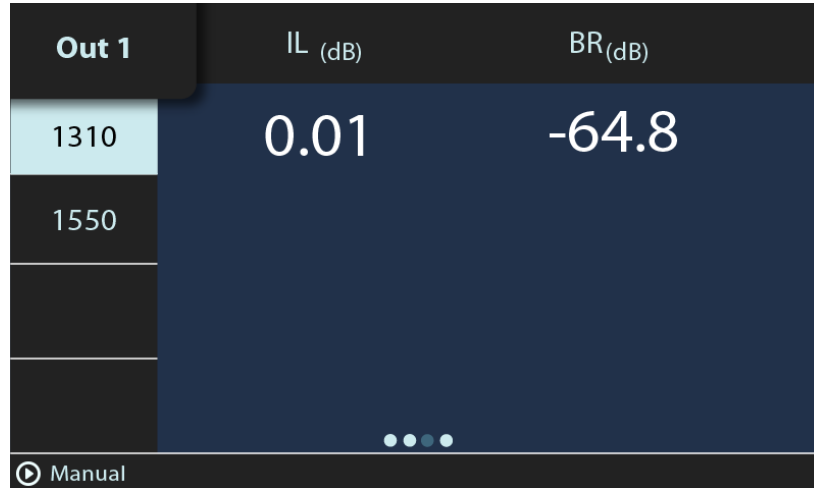
Out 1	1310	1550
BR_0	-69.2	-70.1
Det. 1	0.06	0.05

⊘ Reference

Figure 7: BRM *Reference* page – stored values

Performing an IL and BR Measurement

Swipe left to access the *Measure* page. Tap on a wavelength to display a live reading at that wavelength (Figure 8).

Out 1	IL (dB)	BR(dB)
1310	0.01	-64.8
1550		

▶ Manual

Figure 8: BRM *Measure* page – live reading

Tapping on the $BR_{(dB)}$ header will disable it and only show IL.

Tap in the center to perform a full measurement on all wavelengths and parameters (Figure 9).

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Figure 9: BRM *Measure* page – measurement complete

Performing an Absolute Power Measurement

Swipe right twice to access the *Absolute Power* page (Figure 10). Tap on a wavelength to display a live reading.

Figure 10: BRM *Absolute Power* page – live reading

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Tap in the center to perform a full measurement on all wavelengths (Figure 11).
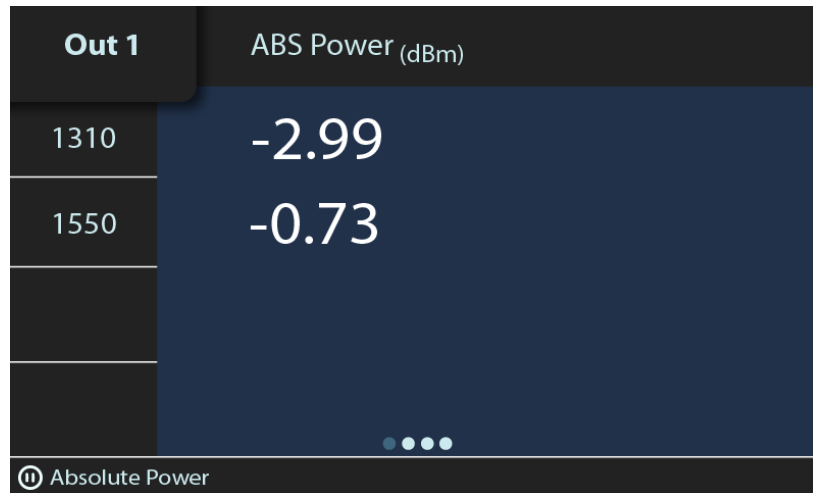
Figure 11: BRM *Absolute Power* page – measurement complete

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BRM WEBPAGE

To access the BRM webpage, connect the meter to a network and on any computer or tablet on the same network, open a web browser (recommended: *Google Chrome* or *Firefox*) and enter the BRM's IP address (see Device Information and Settings on page 10) in the URL bar.

Dashboard

The *Dashboard* tab shows the last calibration date of the meter (Figure 12).
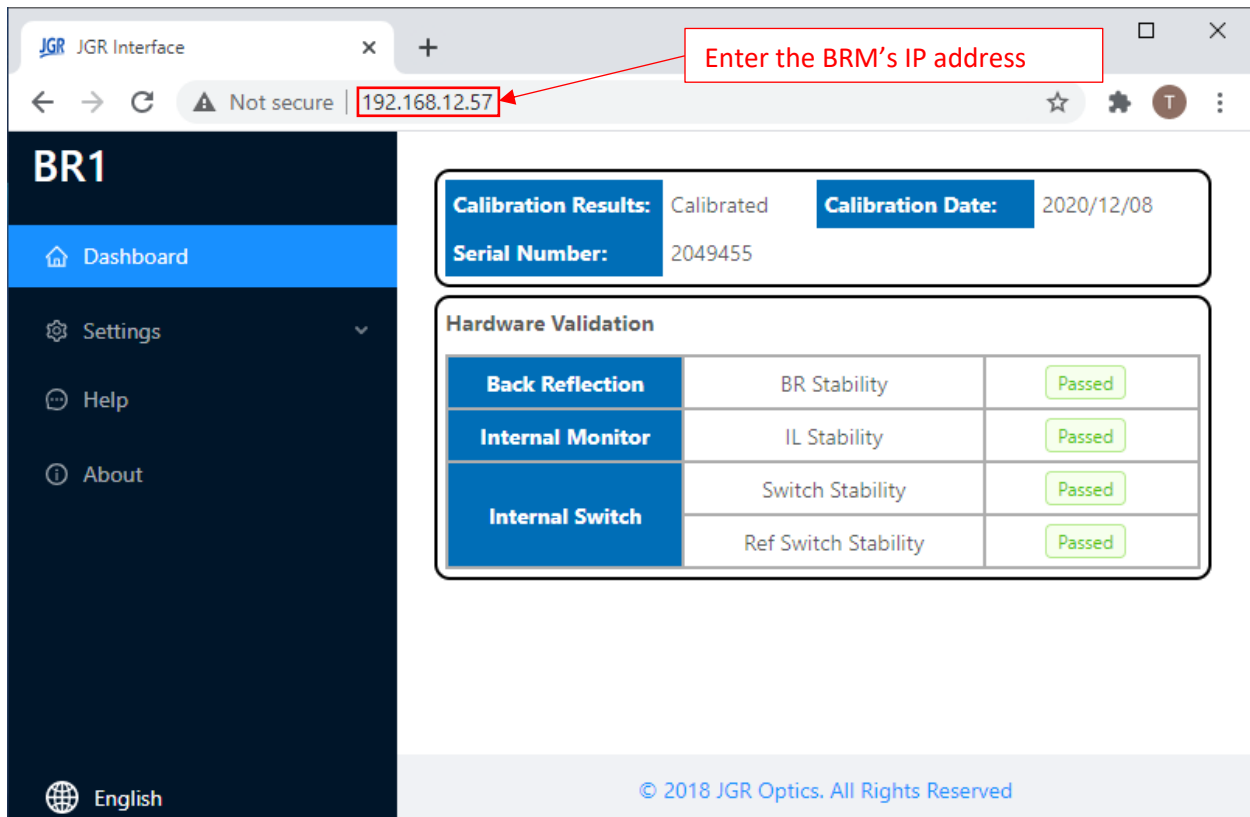
Figure 12: BRM webpage – *Dashboard* tab

Settings

Click on the *Settings* tab to expand.

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Network Settings

You can view, edit or reset the network settings of the BRM from the *Settings > Network Settings* tab (Figure 13).
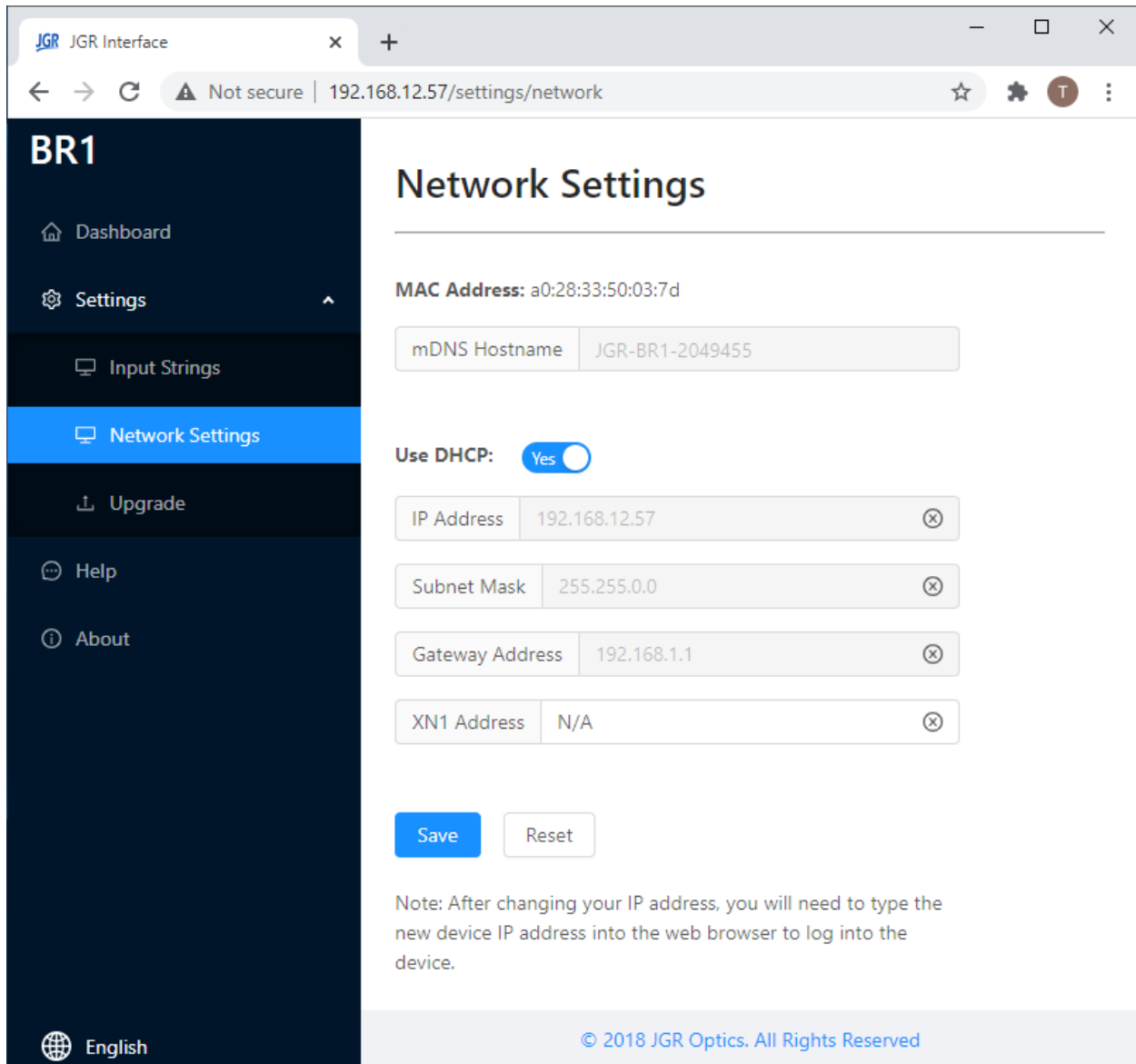
Figure 13: BRM webpage – *Network Settings* tab

Upgrade

Go to *Settings > Upgrade* to view the version of, upgrade or re-install the firmware of the BRM (Figure 14). Please contact support@jgroptics.com before performing a firmware upgrade for additional instructions.

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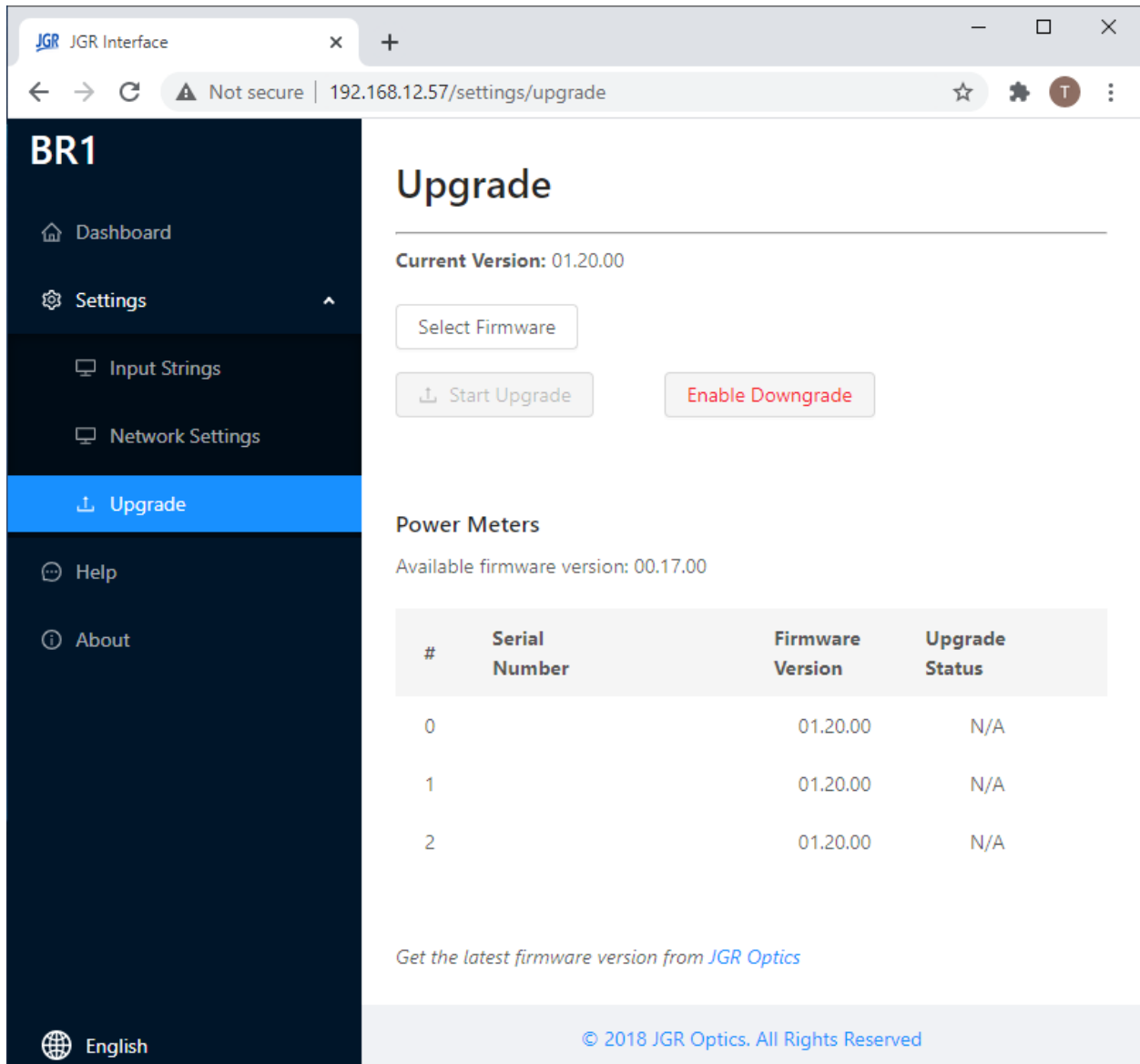
Figure 14: BRM webpage – *Upgrade* tab

Help

Click on the *Help* tab (Figure 15) for the website technical support and sales contact forms. Alternatively, email support@jgroptics.com for technical support or info@jgroptics.com for sales and other inquiries.

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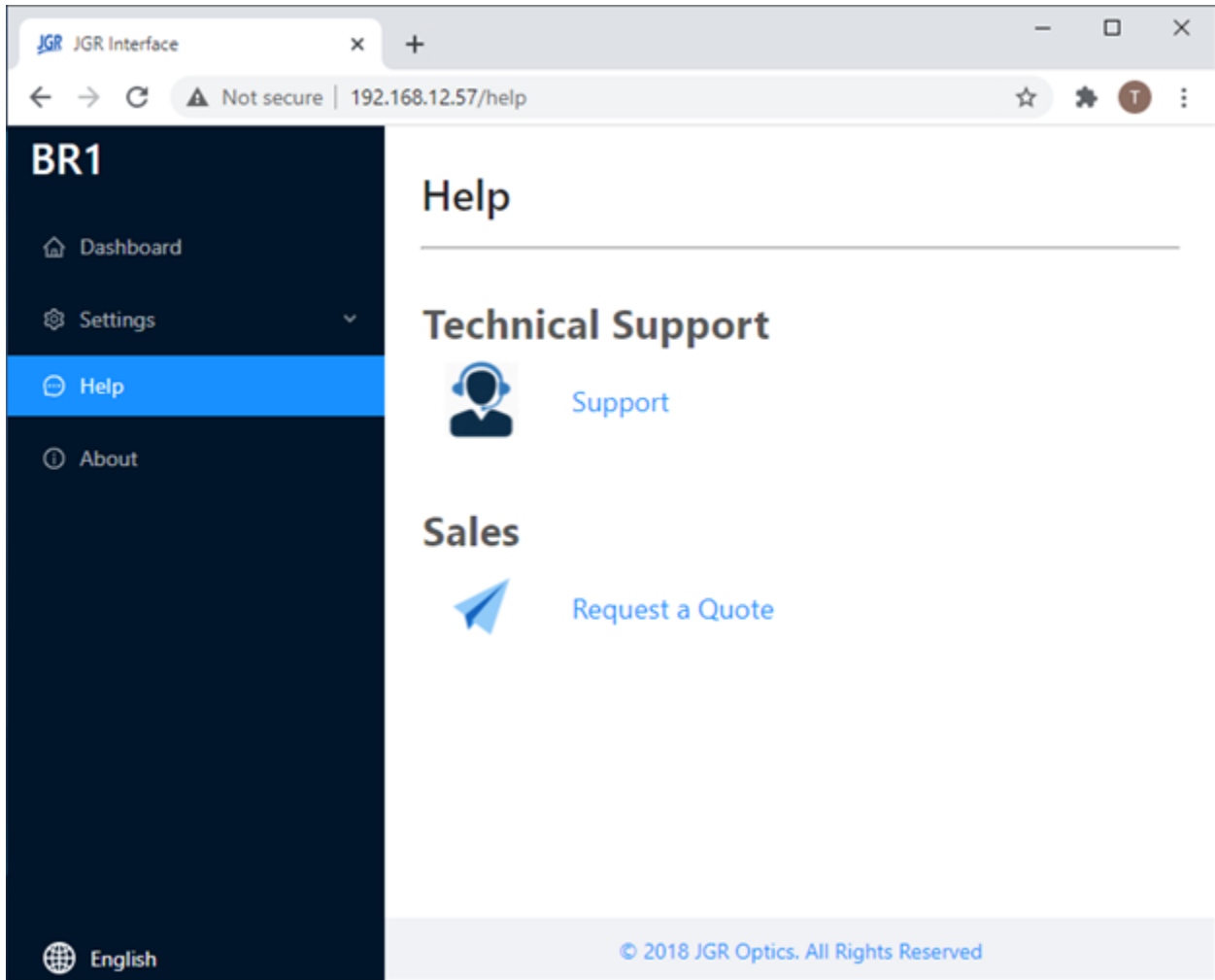
Figure 15: BRM webpage – *Help* tab

About

The *About* tab (Figure 16) displays the unit's firmware version, model and serial number. *Advanced* mode is reserved for Santec technicians and Santec-approved service centers.
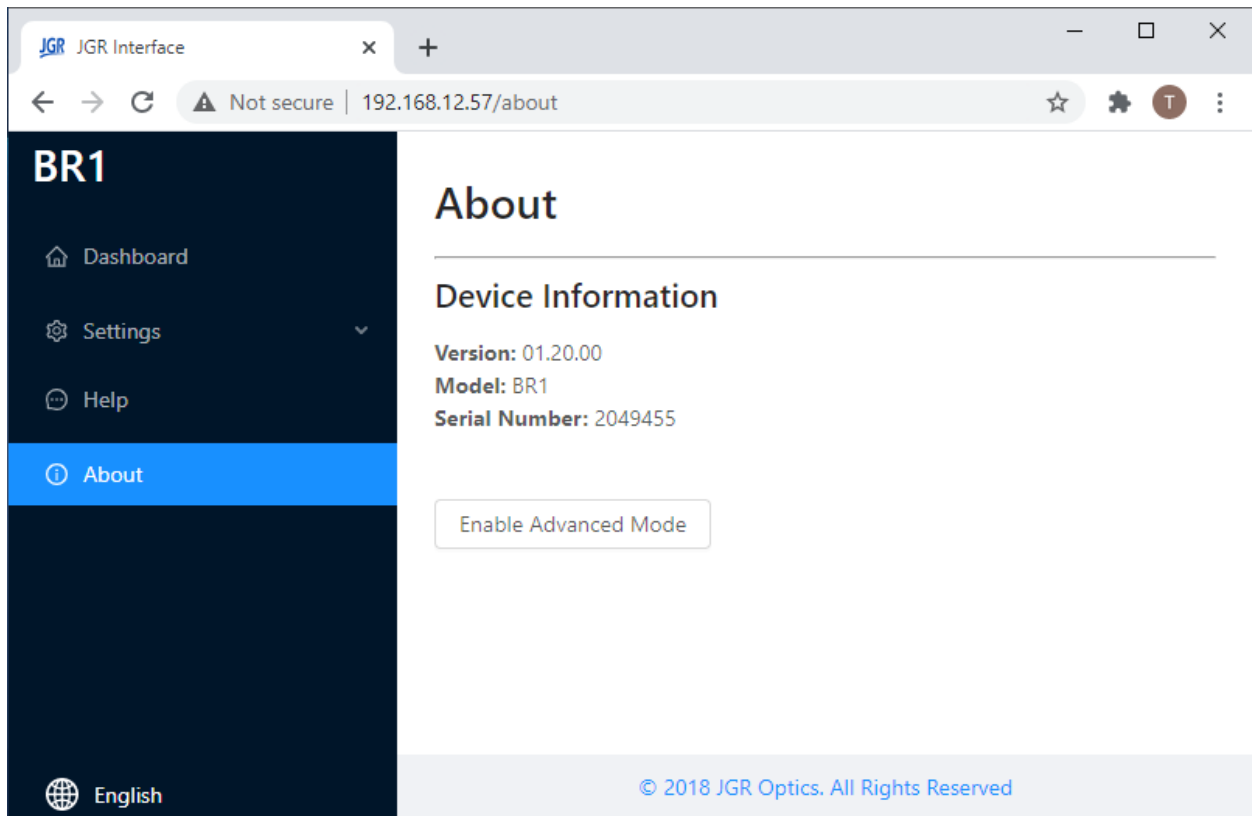
Figure 16: BRM webpage – *About* tab

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PROGRAMMING GUIDE

Establishing Communication

The BRM follows the *SCPI* (Standard Commands for Programmable Instruments) message-based programming standard. It conforms to the *USBTMC* (USB Test and Measurement) standard.

USB

VISA drivers are required for USB communication.

- Recommended: *Rohde and Schwarz*
  - https://www.rohde-schwarz.com/gr/applications/r-s-visa-application-note_56280-148812.html
- Alternatives: *National Instruments*, *Keysight*, etc.

Ethernet

Each BRM is factory pre-set to use DHCP. To connect the BRM:

- Connect the BRM to the network via an Ethernet cable
- Swipe on the front panel touchscreen to the *Setup* page to view the BRM's IP address

The TCP/IP libraries provided by most operating systems are sufficient.

Note: any *VISA* implementation can control the BRM via TCP/IP on port 5025.

Step-by-step Guide

This section will provide a step-by-step programming guide in a *.NET* programming environment such as *C#* or *VB.NET*.

1. Install *VISA* drivers on the development system
2. Connect the BRM via its USB B port to the development system
3. Add a reference to *Ivi.Visa.dll* in your project:

C:\Program Files (x86)\IVI Foundation\VISA\Microsoft.NET\Framework32\v2.0.50727\VISA.NET Shared Components 5.11.0\Ivi.Visa.dll

4. Use the *IVI.Visa.GlobalResourceManager* to find all USB instruments on your system:

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```
Public Overrides Function GetAllAddresses() As String()
    Try
        Dim nameList As New List(Of String)
        nameList = GlobalResourceManager.Find("USB?*INSTR")
        Return nameList.ToArray()
    Catch ex As Exception
        Return Nothing
    End Try
End Function
```

5. Open an *IMessageBasedSession* to the desired device using an address from the *nameList* in the previous step:

```
Private visa As IMessageBasedSession

visa = GlobalResourceManager.Open(addr)
```

6. Use the *Write* method to send SCPI commands and the *Read* method to retrieve results:

```
Public Overrides Function Read(ByVal readableOnly As Boolean) As String
    Dim response As String = String.Empty
    response = visa.RawIO.ReadString()
    If response = String.Empty Then
        Throw New Exception("Read from device failed")
    End If
    Return response
End Function

Public Overrides Sub Write(ByVal strCommand As String)
    visa.RawIO.Write(strCommand)
End Sub
```

Write commands require termination with the linefeed character *\n*.

Notes

1. Some commands can take several seconds to return. The *Read* timeout should be increased to at least 5000ms using *visa.TimeoutMilliseconds*
2. The BRM runs SCPI commands synchronously. An **OPC?* command can be sent and a *1* will be returned when all operations have been completed:

```
Query("LAS:ENAB " + iWavelength.ToString() + ";OPC?" + vbLf)
```

Commands Lists

See Table 5 and Table 6 for SCPI required commands and BRM commands respectively.

Table 5: SCPI required commands list

Command	Description
*CLS	Clears the status byte.
*ESE #	Sets the *<value>* of the Standard Event Status Enable Register.
*ESE?	Returns the value of the Standard Event Status Enable Register.
*ESR?	Returns the value of the Standard Event Status Register.
*IDN?	Returns the instrument's identification (model, serial number, firmware version).
*OPC	Sets bit 0 in the Standard Event Status Register when all pending operations have finished.
*OPC?	Returns the ASCII character 1 when all operations have finished.
*OPT?	Returns a comma-separated list of all of the instrument options.
*RCL "filename"	Recalls a configuration from *<filename>*.
*RST	Resets most functions to factory-defined conditions.
*SAV "filename"	Saves configuration to *<filename>*.
*SRE #	Sets the *<value>* of the Service Request Enable Register.
*SRE?	Returns the value of the Service Request Enable Register.
*STB?	Returns the value of the status byte including the MSS.
*TST?	Initiates the internal self-test and returns the results: 0 if all tests passed and 1 if at least one failed.
*WAI	Causes instrument to wait until all commands are completed.

Table 6: BRM commands list

Command	Description
LASer:DISABle	Disables all lasers.
LASer:ENABle #	Turn on laser with nominal wavelength <#> in IL mode.
LASer:ENABle?	Returns nominal wavelength of enabled laser.
LASer:INFO?	Returns list of supported nominal laser wavelengths.
FIBer:INFO?	Returns the type of fiber (SM or MM).
READ:BR? #	Returns BR of nominal wavelength <#>.
REF:BR $\#_1$[,$\#_2$]	Set BR_0 for nominal wavelength <$\#_1$> (optional: assign value <$\#_2$>).
REF:BR? #	Return BR_0 value for nominal wavelength <#>.
POW[:DET#]:INFO?	Returns serial number, calibration date, FW version, battery level, and connection type of detector <#>.
POW:NUM?	Returns total number of connected power meters.
READ:POW[:DET$\#_1$]? $\#_2$	Returns power read.ing of nominal wavelength <$\#_2$> (optional: specify detector <$\#_1$>)

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READ:POW:MON? #	Returns internal reference power meter reading of nominal wavelength <#>.
READ:IL[:DET#$_1$]? #$_2$	Returns IL reading of nominal wavelength <#$_2$> (optional: specify detector <#$_1$>).
REF:IL[:DET#$_1$] #$_2$[,#$_3$]	Sets IL reference on detector <#$_1$> for nominal wavelength <#$_2$> to <#$_3$> or by measuring if <#$_3$> is left blank.
REF:IL[:DET#$_1$]? #$_2$	Returns IL reference for given detector <#$_1$> and nominal wavelength <#$_2$>.
READ:FACTory:POWer? #	Returns factory stored absolute power values at nominal wavelength <#>.
LCL #	Sets interaction mode <#> (1 = local, 0 = remote).
LCL?	Returns interaction mode.
DIAGnostic:STATus?	Returns self diagnostic status.
LASer:COMPensate #	Sets internal IL compensation (1 = enabled, 0 = disabled).
LASer:COMPensate?	Return IL compensation setting.
READ:BARCode?	Returns a string with the contents of the last barcode scanned.
TEST:NOTIFY# "string"	Push a *<notification>* to the BRM touchscreen display. <#> indicates the icon to be displayed: • 0 = • 1 = • 2 = • 3 =

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MAINTENANCE

Warning

- Devices with malfunctioning lasers must be returned to the manufacturer for repair.

Cleaning the Unit

1. Unplug the unit from the line power.
2. Clean the enclosure with a damp cloth.
3. Do not plug the unit back in until it is completely dry.

Cleaning the Output

Warning

- Connecting contaminated or damaged connectors to the BRM can damage the unit and affect its performance.

- Damaging the output fiber during maintenance can affect the performance of the unit.

1. Inspect all connectors before each mating and if needed, clean with a lint-free wipe and/or IPA. Figure 17 shows a dirty connector requiring cleaning. Figure 18 shows a clean connector ready to be mated.
2. Loosen the front panel thumbscrews.
3. Gently remove the output panel. Ensure a clear line of sight to the fiber to prevent any stress on the output fiber.
4. Remove the connectors from the mating sleeves. For multiple output BRM's, a marking is visible on the fiber to distinguish which fiber is used for which output.
5. Clean the connectors and mating sleeves in accordance with the section Cleaning Jumper Connectors on page 27.
6. Reinstall the connectors into the mating sleeves.
7. Reinstall the output panel with the thumbscrews. To avoid damaging the fibers, keep a clear line of sight to the fiber as it spools back inside the unit. It should lay flat and spool back in without resistance or twisting. Figure 19 shows an exposed view of good output fiber management. Figure 20 shows poor fiber management.

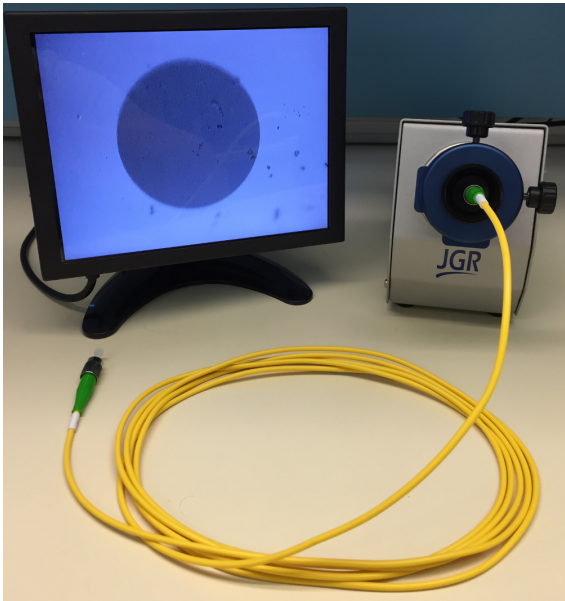**Figure 17: Dirty connector end-face inspection using Santec's EFI-100**
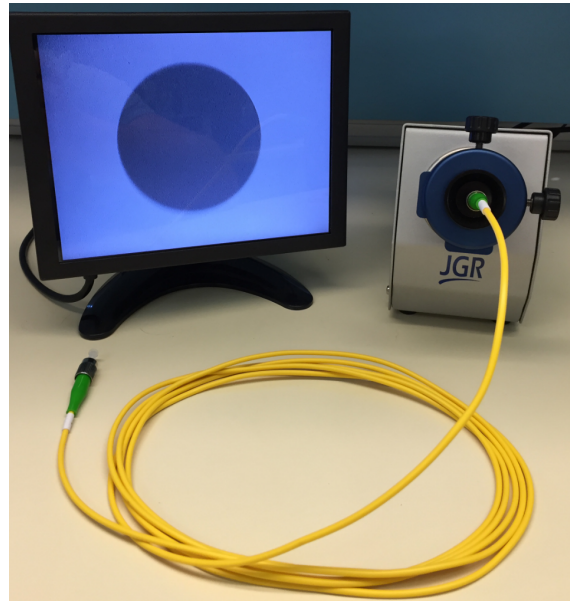

Figure 18: Clean connector end-face inspection using Santec's EFI-100
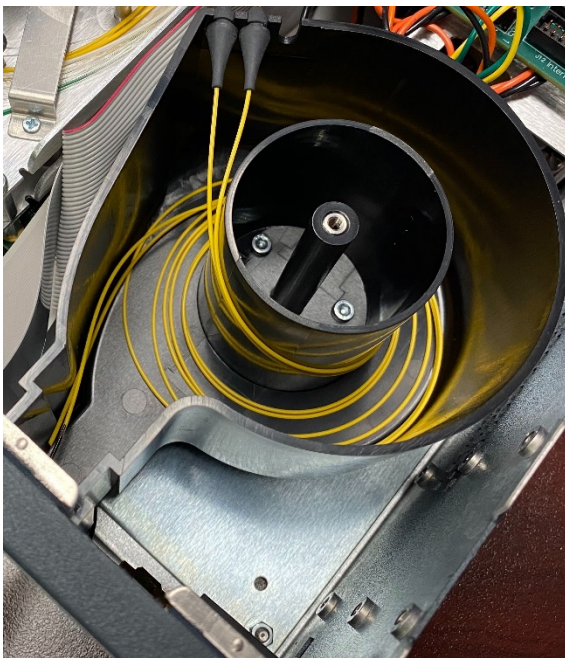

Figure 19: Exposed view of good output fiber management
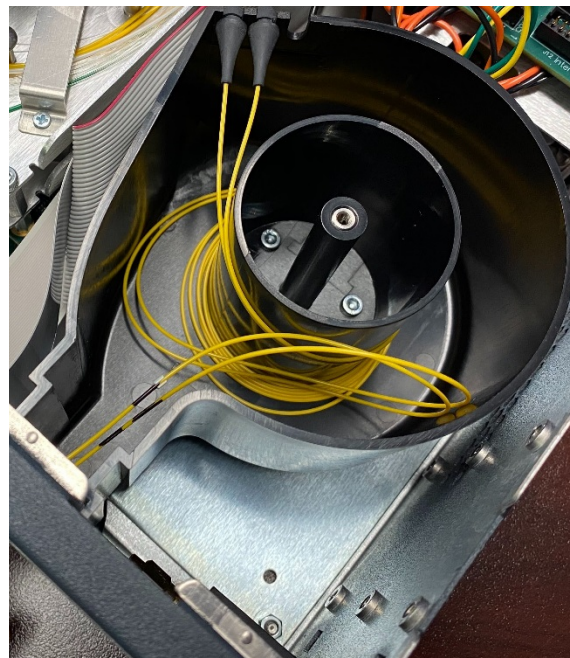

Figure 20: Exposed view of poor output fiber management

Note: the exposed views are only for instructional purposes. **The BRM chassis should not be opened during normal maintenance.**

Cleaning Jumper Connectors

Warning

- Using contaminated or damaged jumpers can affect the performance of the unit.

- Never force an optical connector mating. Some connectors have a ceramic ferrule that can be easily broken.

Optical cable ends need to be inspected before each mating to ensure they are free of contamination or damage. An inspection scope such as Santec's EFI-100 is required.

If they are contaminated, they must be cleaned. The following items are required.

- Filtered compressed air or dusting gas
- Lint-free swabs and lint-free wipes
- Optical grade isopropyl alcohol (IPA) or optical grade 200° ethanol (**do not use rubbing alcohol** which can contain up to 30% water)

To clean the connectors:

1. Blow the sleeve with compressed air.
2. Apply the alcohol to a small area of the lint-free wipe and rub the end of the ferrule over the wet area.
3. Wipe the ferrule on a dry area of the lint-free wipe.
4. Blow the end of the ferrule with compressed air.
5. Apply the alcohol to a lint-free swab to clean the remaining parts of the connector.
6. With the other end of the swab, dry the areas cleaned.
7. Blow the areas cleaned with compressed air.

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STORAGE AND SHIPPING

Damage can occur from improper handling. Make sure to maintain the unit within the specified temperature range during storage or shipping. Please follow the recommendations below to minimize the possibility of damage:

- If possible, pack the unit in its original packing material when shipping.
- Avoid high humidity or large temperature fluctuations that could generate condensation within the unit.
- Avoid unnecessary shocks and vibrations.

Returning Instruments to Santec

As indicated above, please ship the returned material in the original shipping box and packing material. If these are not available, follow the guidelines below:

1. Contact Santec to obtain an RMA number.
2. Cover the front panel with foam to prevent damage.
3. Wrap the unit in anti-static packaging. Use anti-static connector covers.
4. Pack the unit in a strong enough shipping box considering the unit's weight.
5. Use enough shock-absorbing material (10 to 15 cm) to cushion the unit and prevent it from moving inside the box. Pink poly anti-static foam is recommended.
6. Seal the shipping box securely.
7. Clearly mark FRAGILE on at least 3 of the 4 sides of the box.
8. Always provide the model and serial number of the unit and, if applicable, the RMA number on any accompanying documentation. If possible, indicate the RMA number on the box itself to facilitate identification.

Contact Information

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SPECIFICATIONS

Table 7: BRM optical and electrical specifications sheet

Parameter	Specification	
	Single-mode	Multimode
Fiber Type (µm)	9/125	50/125 or 62.5/125
Encircled Flux Standard	N/A	IEC 61280-4-1
Operating Wavelengths (nm)	1310 / 1490 / 1550 / 1625 / 1650	850 / 1300
Backreflection Range (dB)	0 to -85	0 to -60
Return Loss Accuracy (dB)[1,2]	± 0.4	
Detector Type	2mm InGaAs / 5mm Ge / Integrating Sphere	
Powe Range (dBm)	0 to -80 / 0 to -60 / o to -40	
Insertion Loss Accuracy (dB)	± 0.03 (< 5 dB loss) ±0.15 (> 5 dB loss)	
Absolute Power Accuracy (dB)[3]	± 0.25	
Remote Interface	USB/Ethernet	
Display	5" touchscreen	
Input Voltage	100 to 240 V AC, 50 to 60 Hz	
Power Consumption (VA)	60 maximum	

Notes:
[1] add ± 0.1 dB for every 1 dB below -60 dB (single-mode)
[2] add ± 0.1 dB for every 1 dB below -45 dB (multimode)
[3] Measured at -10 dBm

Table 8: BRM mechanical and environmental specifications sheet

Parameter	Specification
Unit Dimensions W x H x D (cm)	23.5 x 12 x 32.5
Shipping Box Dimensions W x H x D (cm)	36.5 x 39 x 53
Unit Weight (kg)	8
Total Shipment Weight (kg)	9
Operating Temperature (°C)	0 to 55
Storage Temperature (°C)	-40 to 70
Humidity (Non-condensing)	Max 95% RH from 0 to 40°C

 WARNING!

In the event of any trouble with this product, turn the unit off in accordance with the procedures to shut off the power described in this operation manual, disconnect the power source cord, make sure the product name and serial number described on the name plate of the product, and then contact our dealer at your place or directly contact us at Santec Photonics Laboratories. Our telephone number and facsimile number are shown below. However, we are not responsible for any trouble arising from your own repair or modification on this product.

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