

iBA OPERATING & MAINTENANCE MANUAL

Passive IM Analyser System



This document contains information which is confidential and the property of Kaelus, and which is not to be communicated to any person or company, or used in any way without the previous authorization of Kaelus.

Document Issue	IR	Description of Document Change	Date	Edited By	Authorization
Rev A		Creation of document by Eng	09/09/2016	LW	OP
Rev B		IR11184 Remove spec content 200Khz Steps sizes IR11200 - Remove Warranty section Update to s/ware release 12.22	22/06/2017	LW	TL
Rev C		IR11525 Add iBA-600C and iBA-600D	31/07/2018	JM	TL
Rev D		IR11588 Add new iBA models	16/01/2019	JM	TL
Rev E		Removal of Infinite Branding	02/12/2020	RA	
Rev F	SUSTM-566	Add iBA 3501 Content and door interlock option	1/09/2021	LW	JN

Precautions



WARNING: INTERFERENCE

This instrument has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in an industrial installation. The instrument generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this instrument does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the instrument and receiver
- Connect the instrument into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help



WARNING: RF HAZARD

This series of instrument is capable of producing up to 80 Watts of radio frequency (RF) power in the 600 MHz to 4000 MHz frequency band. Users are reminded that proper precautions must be taken to minimize exposure to these RF fields to the recommended limits. Please pay particular care to the following areas:

- Switch off the RF power from the test equipment before removing or connecting the cables to the test port. Burns to fingers and permanent damage to eyes can result from exposure to connectors carrying high levels of RF power. Ensure that any antennas being tested are placed so that no personnel are exposed to RF field levels in excess of the maximum exposure limits [Ref ARPANSA RPS No. 3 for Australia] or ICNIRP based standard applicable for your country.

Also, the unit should be operated by a suitably qualified operator in order to ensure interference is not caused to other spectrum users. Radiation through an antenna requires authorization by the frequency license holder to do so.



WARNING: HEAVY INSTRUMENT

The packed weight of the instrument exceeds the 18kg (40lb) guideline for manual handling by a single person (An iBA will weigh as much as 30Kg/66lbs) In addition the weight of the controlling PC should be allowed for. To avoid risk of injury, an assessment should be carried out prior to handling to check individual capability, the equipment weight and the required workplace conditions, accordance with the European Directive 90/269 or equivalent National Regulations for manual handling.

DISCLAIMER: INTERFERENCE

The instrument uses similar frequencies and power levels to several cellular telephone systems. Kaelus and its agents or distributors accept no responsibility for interference to existing communications services as a result of improper operation or misuse. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.



WARNING: ELECTRICAL HAZARD

HAZARDOUS VOLTAGES: The product has potentially hazardous voltages. These voltages can cause serious injury or death upon contact with personnel. There are no user serviceable parts inside. Covers should remain closed.

GENERAL CONDITIONS OF USE

This equipment should be protected from the ingress of liquids and precipitation and is intended for indoor use. The equipment must be operated within the environmental conditions specified on the Kaelus website. This equipment is not approved for use in hazardous atmospheres or medical applications.

UNPACKING

Ensure that the total number of boxes of equipment is checked off against the delivery documentation. At the same time inspect for any obvious transit damage. Should any damage be noted, notify the carrier immediately to file a transit damage claim. Do not discard any packing material until notified by the carrier or Kaelus. Carefully unpack all containers and check that all items listed on the delivery documentation. Please notify Kaelus of any damaged or missing items from the shipment.

Using this manual.

Open the bookmarks tab on your Adobe reader to easily navigate between sections, Items and figures in the text can be clicked on to the referring item for easier navigation through the document. The lists of Figures and Tables also have page links that can be clicked on for easier navigation.

Table of Contents

1.	Conformity Statements	11
1.1	CE Statement	11
1.2	FCC Statement	11
1.3	RCM Statement	11
1.4	CCC/CQC Statement	11
1.5	ISI/BIS Statement	12
2.	Operating Instructions	13
2.1	General Information	13
2.2	Before Applying Power	13
2.3	Grounding	13
2.5	RF Power Precautions	14
2.4	Fuse Replacement/Voltage Setting	14
2.6	Equipment Ratings	15
3.	Product Overview	15
3.1	Front Panel Items	17
3.1.1	Item Details	17
3.1.1.1	Port 1	17
3.1.1.2	Port 2	17
3.1.1.3	RF Power Indicator	17
3.1.1.4	RF Monitor Port	17
3.1.1.5	Slide Lug	17
3.1.1.6	USB Type A Port	17
3.1.1.7	On/Off Switch	17
3.1.1.8	Rack Handles	17
3.2	Identifying Your Equipment Type	17
3.3	System Description	18
3.3.1	System Controller	18
3.3.2	Considerations for large system design	18
3.3.3	iBA PIM Analyser	18
3.3.4	System Control Software	19
3.3.5	Settings	19

3.4	For Additional Technical Assistance	22
4.	Installation	23
4.1	Unpacking and Initial Inspection	23
4.2	Preparation for Installation	23
4.3	Installation	23
4.4	Turning On the Analyser	26
4.5	Shutting Down the Analyser	27
4.6	Connecting a Device for Testing	27
5.1	Add Instrument	28
5.1.1	Create Instrument Menu	28
5.	Home Screen	28
5.2	Instrument Selection	29
5.2.1	REMOVE/VFP/PIM Menu	29
6.	Operation in Engineering Mode	30
6.1	Using the Virtual Front Panel Controls	30
6.1.1	Display Zoom Control	36
6.1.2	Hover over results	37
6.1.3	Advanced Control Panel	38
7.	Operation in Engineering Mode - Tutorial	43
7.1	Overview	43
7.1.1	Time Mode	43
7.1.2	Swept Frequency Mode	44
7.1.3	Spectrum Mode	45
7.1.4	RTF (Range to Fault) Mode	46
7.2	Measurement Detail	47
7.2.1	Confirming Measurement Capability (Residual IM)	47
7.2.2	IM Measurement Time Mode	49
7.2.3	IM Measurement-Swept Frequency	50
7.2.4	Spectrum Mode	52
7.2.4.1	Advanced menu selections in Spectrum mode	52
7.2.5	RTF (Range to Fault) Measurement Mode (Optional)	53
8.	Operation in Production Mode	55

8.1	Entering Production Mode.	55
8.1.1	Overview	55
8.2	Edit Test Steps Menu	57
8.2.1	Edit Steps Time Mode	57
8.2.2	Edit Steps PIM Mode	59
8.3.1	Entering the report settings	60
8.3.2	Saving test reports as PDF	60
8.3	Reports Settings Menu	60
8.3.3	Include failures.	61
8.3.4	Timestamp filename	61
8.3.5	Beep on Limit Failure	61
9.	Applications Information	61
9.1	Introduction	61
9.2	Noise Floor vs. Residual IM Floor	61
9.3	Measuring Residual IM	62
9.4	IM Troubleshooting	63
9.5	Unique Considerations for Antenna IM Testing	63
9.6	Interpreting IM Test Results	63
9.6.1	Time Mode	63
9.6.2	Swept-Frequency Mode	63
9.6.3	Spectrum Mode	64
9.6.4	RTF Mode	64
9.7	IM Measurement Examples	64
9.7.1	Cable Assemblies	64
9.7.2	Duplexers	65
9.7.3	Antennas	65
9.7.4	Measuring High IM Level Devices (e.g. Ferrites)	66
9.7.5	Forward and Reverse PIM	68
10.	Maintenance	68
10.1	Operating Environment	68
10.2	Transporting	68
10.3	Cleaning	68

10.4	Protection	69
10.5	Routine Verification of Performance and Maintenance	69
10.5.1	Verifying Residual IM Performance and Operation of the Analyzer	69
10.5.2	Front Panel Connections and Connector Savers	70
10.5.3	Use and Care of Front Panel Connector Savers	70
10.6	Care and Maintenance of the PIL-0006A Low IM Terminations	71
10.6.1	PIL-0006A Connector Maintenance	71
10.7	Advanced Verification and Troubleshooting Techniques	71
10.7.1	Power Output	71
10.7.2	Frequency Output	72
11.	Service	72
11.1	System Controller	72
11.2	Installing PIM Server Software	73
11.2.1	PIM Analyzer Software	73
11.3	Calibration Files	73
11.4	PIM Server	73
11.5	Trouble Shooting USB Connection Issues.	74
11.6	PIM Server not Starting.	74
12.	Options and Accessories	74
12.1	RTF Module	74
12.2	Test Chamber Door Interlock	75
13.	Index	80

List of Figures

Figure 1	Fuse Housing	14
Figure 2	iBA-A	15
Figure 3	iBA-B	15
Figure 4	iBA-C	16
Figure 5	iBA-D	16
Figure 6	Typical System Label (Sample Only)	18
Figure 7	PIM Server	19
Figure 8	PIM Server Settings Menu	21
Figure 9	System Assembly	24
Figure 10	Block Diagram A Series Passive IM Analyser (4RU)	24
Figure 11	Block Diagram B Series Passive IM Analyser (6RU)	24
Figure 12	Block Diagram C Series Passive IM Analyser (6RU) 40W	25
Figure 13	Block Diagram D Series Passive IM Analyser (8RU) 40W	25
Figure 14	Rear View	26
Figure 15	Home Screen	28
Figure 16	Virtual Front Panel (Time Mode)	30
Figure 17	Trace pull down menu	31
Figure 18	Out of Band Indicator	31
Figure 19	Control Indicator	31
Figure 20	Settings Menu	32
Figure 21	Bargraph Display	32
Figure 22	Zoom Swipe View	36
Figure 23	Zoom Expanded View	37
Figure 24	Mouse hover over result display	37
Figure 25	Advanced Control Panel (Top Part)	38
Figure 26	Advanced Control Panel (Middle Part)	40
Figure 27	Advanced Control Panel (Lower Part)	41
Figure 28	Time Mode	43
Figure 29	Frequency Swept Mode	44
Figure 30	Spectrum Mode	45

Figure 31	RTF (Range to Fault) Mode	46
Figure 32	Browser Print	49
Figure 33	Rx Sweep settings, advance menu spectrum mode	52
Figure 34	RTF fault measurement mode	53
Figure 35	RTF Advanced Configuration Menu	54
Figure 36	Production Mode	55
Figure 37	Edit Steps Menu (Time Mode)	57
Figure 38	Edit Steps Menu (PIM Mode)	59
Figure 39	Report Settings Menu	60
Figure 40	Standard Voltage Error Curve	62
Figure 41	Typical Test Connections for MEasuring Cable Passive IM.	64
Figure 42	Typical Diagram for Evaluating Duplexer Passive IM	65
Figure 43	Typical Connection Diagram for Evaluating Antenna Passive IM.	66
Figure 44	Measuring High Forward IM Levels with the PIM Analyzer	66
Figure 45	Measuring the IM of a Power Combiner Using Individual CW Tones.	67
Figure 46	Reverse PIM	68
Figure 47	Forward PIM	68
Figure 48	Turning on only one carrier	72
Figure 49	RTF Module Option	74
Figure 50	Door Interlock Wiring Diagram	75
Figure 52	Fitting the DIM-0001A Door Interlock module	76
Figure 51	Interlock door open	76
Figure 53	Tx Disabled from interlock warning	77

List of Tables

Table 1	Stimulus Response Indicators	34
Table 2	Default Frequency, Power and Mode.	47
Table 3	Key Measurement Uncertainty Values for 10,20, and 30 dB-Down Error Sources.	61
Table 4	IBA A Series Models	77
Table 5	IBA B Series Models	78
Table 6	IBA C Series Models	79
Table 7	IBA D Series Models	79

1. Conformity Statements

1.1 CE Statement

This product is identified as Professional equipment which is not intended for use in a domestic environment. This unit is verified to meet to the EMC limits set by EN61326 to class A, and may cause interference in a residential or non-commercial environment.

The IBA manual includes warning for RF ports warning of the hazardous RF power at each applicable port in accordance with UL/EN 61010-1.

The IBA manual excludes use of product in explosive or hazardous environments.

This unit meets all relevant requirements of EN61010 / UL61010

1.2 FCC Statement

The IBA family of Test equipment is exempt from the technical requirements of CFR47 part 15 (FCC part 15) as stated in Section §15.103 Exempted devices” for Test equipment per sub part §15.103(c).

§15.5 “(a) Persons operating intentional or unintentional radiators shall not be deemed to have any vested or recognizable right to continued use of any given frequency by virtue of prior registration or certification of equipment, or, for power line carrier systems, on the basis of prior notification of use pursuant to §90.35(g) of this chapter.

§15.5 “(b) Operation of an intentional, unintentional, or incidental radiator is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM) equipment, or by an incidental radiator.”

§15.5 “(c) The operator of a radio frequency device shall be required to cease operating the device upon notification by a Commission representative that the device is causing harmful interference. Operation shall not resume until the condition causing the harmful interference has been corrected.”

The IBA product is not rated for use in hazardous locations or atmospheres.

The IBA manual includes warning for RF ports warning of the hazardous RF power at each applicable port in accordance with UL/EN 61010-1.

The IBA manual excludes use of product in explosive or hazardous environments.

1.3 RCM Statement

This unit is sold in Australia, as commercial test equipment only and is not for domestic consumption. It is outside the scope of ERAC (AS/NZ4417).

An electronic copy of the RCM DoC is available from Kaelus on request.

This product is identified as Professional equipment which is not intended for use in a domestic environment. This unit is verified to meet to the EMC limits set by EN61326 to class A, and may cause interference in a residential or non-commercial environment.

The IBA manual includes warning for RF ports warning of the hazardous RF power at each applicable port in accordance with UL/EN 61010-1.

The IBA manual excludes use of product in explosive or hazardous environments.

This unit meets all relevant requirements of EN61010 / UL61010

1.4 CCC/CQC Statement

This unit is sold in China, as commercial test equipment only and is not for domestic consumption. It is outside the scope of CCC.

Because this equipment is “Electrical equipment for measurement, control and laboratory use” it is in scope for CQC. CQC compliance is voluntary.

The CQC voluntary EMC requirement for this product is specified in GB/T18268. Harmonized European standard

EN61326 contains all relevant requirements specified in GB/T18268.

The CQC voluntary LVD (Electrical safety) requirement for this product is specified in GB 4793.1-2007. Harmonized European standard EN61010 contains all relevant requirements specified in GB 4793.1-2007.

This unit is verified to meet all relevant requirements of both EN61326 and EN61010.

The IBA manual includes warning for RF ports warning of the hazardous RF power at each applicable port in accordance with UL/EN 61010-1.

The IBA manual excludes use of product in explosive or hazardous environments.

This unit is verified to meet to the EMC limits set by EN61326 to class A.

Class A equipment may cause interference in a residential or non-commercial environment.

1.5 ISI/BIS Statement

This unit is sold in India, as commercial test equipment only and is not for domestic consumption. It is outside the scope of Mandatory Certification.

Because this equipment is “Electrical equipment for measurement, control and laboratory use” it is in scope for the ISI harmonised version of EN61326 and EN61010.

Products in this category product may be self-certified.

This unit is verified to meet all relevant requirements of both EN61326 and EN61010.

This unit is verified to meet to the EMC limits set by EN61326 to class A.

Class A equipment may cause interference in a residential or non-commercial environment.

The IBA manual includes warning for RF ports warning of the hazardous RF power at each applicable port in accordance with UL/EN 61010-1.






The IBA manual excludes use of product in explosive or hazardous environments.

2. Operating Instructions

2.1 General Information

Before connecting or using this product, the following safety information must be read and understood to prevent harm to personnel and/or damage to the equipment.

The following symbols are used throughout this manual to call attention specifically to safety-related information:

	PROTECTIVE CONDUCTOR TERMINAL: The product is marked with this symbol to indicate a connection to Earth ground potential.
	NON IONISING RADIATION : The product is marked with this symbol to indicate a connection that carries non ionizing radiation. Ensure RF energy is turned off before disconnecting. Ensure RF any shielding and connectors have been securely fitted before switching on RF. Ensure radiation levels are kept within radiation standards and exposure levels for your facility.
	CAUTION: SEE SYSTEM DOCUMENTATION: This symbol is placed next to ports on the instrument which may be damaged if the information provided in the system documentation is not carefully considered and understood.
 WARNING	WARNING: This symbol indicates information, which, if not carefully considered, could result in personal injury. Carefully read and fully understand information denoted with this symbol before proceeding with the use of this product.
CAUTION	CAUTION: This symbol indicates information that, if not carefully considered, could result in damage or destruction to all or part of the product. Carefully read and understand information denoted with this symbol before proceeding with the use of this product.
	IMPORTANT NOTE: This symbol indicates information that may be helpful in properly using or understanding the operation of the instrument.
F1	Means Frequency One, the frequency derived from the first frequency synthesizer, Carrier 1.
F2	Means Frequency Two, the frequency derived from the second frequency synthesizer, Carrier 2.

2.2 Before Applying Power

CAUTION

This instrument is capable of operating with the following AC line voltages: 115-230 VAC, 50 or 60 Hertz line frequency. However, the AC power receptacle must be correctly configured for the available line voltage. Before connecting AC power to the unit, ensure the proper fuse is installed in the fuse-holder.

See Section 2.4 for additional information on installing fuses and configuring the iBA

2.3 Grounding

The iBA A and B Series Power Supplies must be connected to a grounded (earth ground) outlet.

WARNING

Do not operate this equipment without the power connected to an earth-grounded outlet. Disconnecting or bypassing the earth ground could result in potential personal injury from electrical shock.

In order to comply with EMI/EMC requirements, it is recommended that all equipment be grounded to a common frame ground point. Provision for this grounding is made on the rear panel of each major 19" rack chassis in the form of a M6 stud. See 4.3 item 3

2.4 Fuse Replacement/Voltage Setting

The IBA is equipped with fuse protection on the AC main connector. This fuse is accessible from the rear panel AC receptacle.

WARNING

For continued protection against both fire and injury, replace the iBA fuse according to the following table:

Fuse Type for 110-120 VAC Operation	Fuse Type for 220-240 VAC Operation
125 Voltage, 10A	250 VAC, 5A
Speed: Time Delay	Speed: Time Delay
Size: 5x20 mm	Size: 5x20 mm
No. Required: 1	No. Required: 1

To replace the fuse on the iBA , follow the following procedure:

1. Remove the AC power cord from the receptacle at the rear of the module.
2. Remove the fuse housing by clamping the release clips with your fingers and pulling the fuse housing from the module.
3. Install the appropriate time-delay fuse in the fuse socket.
4. Insert the fuse housing back into the module.



Figure 1 Fuse Housing

2.5 RF Power Precautions

This test equipment is capable of delivering RF powers well in excess of 80 Watts to the front panel. The red flashing LED indicates when RF is present on either Port 1 OR Port 2.

WARNING

To avoid the potential for RF burns or shock, do not touch an exposed RF port when it is active (red LED is flashing). As a further safety precaution against personal injury, do not energize an RF port unless a device is connected to that port.

If a device that radiates RF energy (such as an antenna) is connected to an active RF port, adhere to the appropriate Non-ionizing RF Radiation Safety Standards for your facility.

2.6 Equipment Ratings

Complete technical specifications and equipment ratings may be found in the “Technical Specifications” In the Kaelus Website <https://www.kaelus.com/en/test-and-measurement-solutions/bench-pim>

CAUTION

If this instrument is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

3. Product Overview



Figure 2 iBA-A



Figure 3 iBA-B



Figure 4 iBA-C



Figure 5 iBA-D

3.1 Front Panel Items

3.1.1 Item Details

3.1.1.1 Port 1

Used for Reverse PIM measurements (A/B Series), can also be used for Forward PIM (B Series).

3.1.1.2 Port 2

Used for Both Forward and Reverse PIM (B, D Series).

3.1.1.3 RF Power Indicator

Indicates when RF Power is active. Note : RF output ports should be correctly terminated prior to activating Tx Power. Unused Tx Ports should be left terminated in low radiation loads.

3.1.1.4 RF Monitor Port

Used to connect the RTF Module option when fitted. An N Type Male-Male cable is supplied with the RTF module to connect from the RTF Module to the monitor port.

3.1.1.5 Slide Lug

If the iBA is fitted in a rack with rack slides. The Slide lugs can be used to help slide the unit forward. The Slide lugs are not intended to lift the entire weight of the iBA. The iBA B,C and D series is considered a multi-person lift. Use safe lifting practices at all times.

3.1.1.6 USB Type A Port

When the RTF Module is fitted a short USB A to USB mini B cable is supplied that needs to be connected from the RTF to the iBA USB receptacle.

3.1.1.7 On/Off Switch

Switches the main supply to standby. Note: Power supply cooling fans will still operate.

3.1.1.8 Rack Handles

The C and D Series iBA is fitted with rack handles. These units can be considered a multi-person lift. Use safe lifting practices at all times. Ensure the rear of unit is supported safely while fitting or removing.

3.2 Identifying Your Equipment Type

There are a number of variants of the iBA test system. The unit this manual applies to is the iBA A,B,C and D series Systems, See Figure 2 , Figure 3, Figure 4 and Figure 5. Comprising a PC running Version 12.35.1 of the PIM Server or later which should run at start up, connected to the iBA identified by serial number on the rear of the unit. Controlled by the Chrome web browser also installed on the PC and set as default browser.

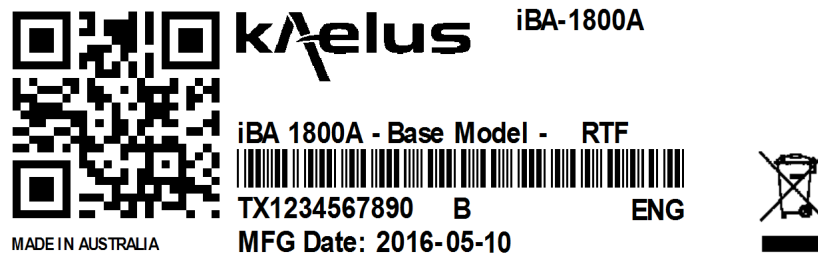


Figure 6 Typical System Label (Sample Only)

Your unique QR code will link you to the product datasheet, test result data and calibration certificate for your product.

3.3 System Description

The Kaelus line of Passive IM (PIM) Analyzers measure the distortion from passive RF components such as cables, filters, antennas, etc. The analyzer consists of two main units:

1. System Controller (Computer, PIM Server and Chrome browser connecting to the Virtual Front Panel)
2. iBA PIM Analyser

The basic configuration is illustrated in Figure 9 . The System Controller is common to all configurations of the PIM Analyzer. The iBA Modules vary according to the specific model number and configuration options. Please refer to the Table 4, Table 5, Table 6 and Table 7 for available models

Common to all standard configurations of the PIM Analyzer are the following characteristics:

- **Dual-Frequency Synthesizers:** The iBA PIM Analyzer provides the ability to independently synthesize two carrier tones at any frequency within the transmit band of the unit.
- **Internal High Power Amplifiers (one for each carrier).**
- **Low-Noise Amplification:** The received signal is low-noise amplified with a high gain amplifier prior to conversion to the IF frequency.
- **High Speed Digital Receiver:** Each iBA converts the received signal to an IF frequency which is directly digitized. Processing of this digitized IF signal is performed to achieve very low random noise floors.

Each of the major components that make up the PIM Analyzer is described in the following paragraphs.

3.3.1 System Controller

The System Controller for the Kaelus PIM Analyzer is a standard PC-style computer. Minimum PC specification as follows. Core i5 CPU, 4GB RAM, Windows 7, Chrome Browser and USB 2.0 support.

The System Controller is connected to the iBA via a USB2.0 port, using a USB A to USB B cable.

3.3.2 Considerations for large system design

The minimum System controller requirements should be considered a minimum for a single iBA. With larger multi instrument systems the PC's capacity to service it's own USB ports may need to be considered, in most cases the number of USB's available directly on a PC can be serviced, likewise if connecting additional iQA's via ethernet, local network performance needs to be adequate. Where more than 3 iBA's are to be used, additional PC's and PIM server instances can be installed to support additional devices to assist scaling larger systems. If you are planning to add additional instruments with external USB Hubs it is recommended to do some system load testing to ensure the PC and USB hardware performance is sufficient. Where a single control point is required browser tabs can be arranged to point to other PIM server IP addresses on your network.

3.3.3 iBA PIM Analyser

The iBA PIM Analyser includes a Diplexer and a transceiver that performs Receiver and Tx Power operations. The iBA also includes a USB Hub to connect the PIM server, internal USB Flash drive, front panel USB socket and the iBA interface.

Please refer to the [Kaelus Website](#) for the specific RF performance.

3.3.4 System Control Software

The system controller will have to have the Kaelus PIM Server and the USB driver installed. When the IBA is connected to the controlling PC via USB it will appear as a USB drive, the Kaelus Web server software R950306-Rev12.*-SWARE-PIM_SERVER will appear on that external drive. Running this software will install both the server and the USB driver software. The USB drive will appear with a label the same as the serial number of the product. Please make a copy of the files on this drive as a backup for future reference. This application communicates with the hardware and provides a control interface via a Webpage that is browsed locally from a Web Browser typically Chrome web browser.

3.3.5 Settings

Enables the settings pop-up menu below.

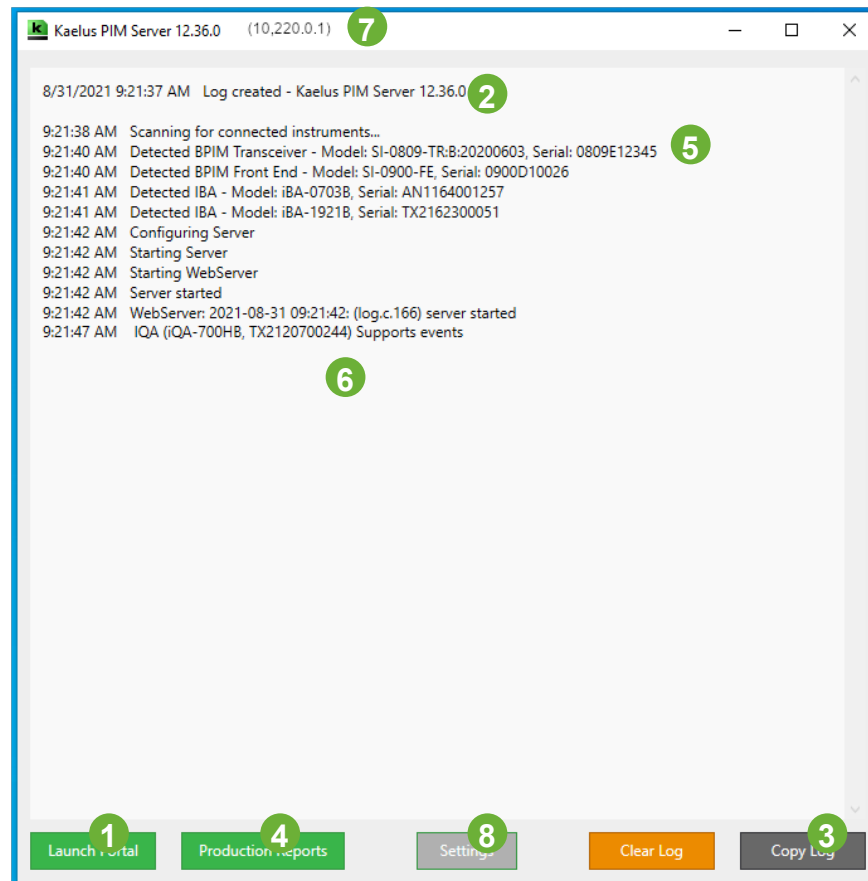


Figure 7 PIM Server

1 Launch Portal

Used to launch the Web Browser and connection to the Virtual Front Panel.

2 Server Started

indicates the PIM Server is available to connect to with your browser.

3 Copy Log

Used to copy the text in the PIM Server, including any errors reported, to the clipboard

- Passive IM Virtual Front Panel: The Instrument is controlled via a web interface. The browser can be launched by clicking on the Launch Portal Button. Alternatively typing <http://127.0.0.1/vfp.HTML> into your local browser will also connect to the local server page.
- The software is installed via the R950306 –Rev12* SWARE-PIM_SERVER.msi software installer under Windows 10 .to the c:\Program Files (x86)\Kaelus\ folder on the System Controller. Complete procedures for re-installing the software are contained in the Service section 11 of this manual.

4 Production reports

Takes you to the directory where product reports generated in Production mode are stored. **Note:** Save test report to file needs to checked. see section 8.3

5 Instruments

Instruments as they are connected appear in the derver screen log.

6 Connected Clients

Each connected client appears in the log with a new token id .

7 Server IP address

Other clients on the same network can connect to this address to control or monitor test progress.

8 Settings

Enables the settings pop-up menu below.

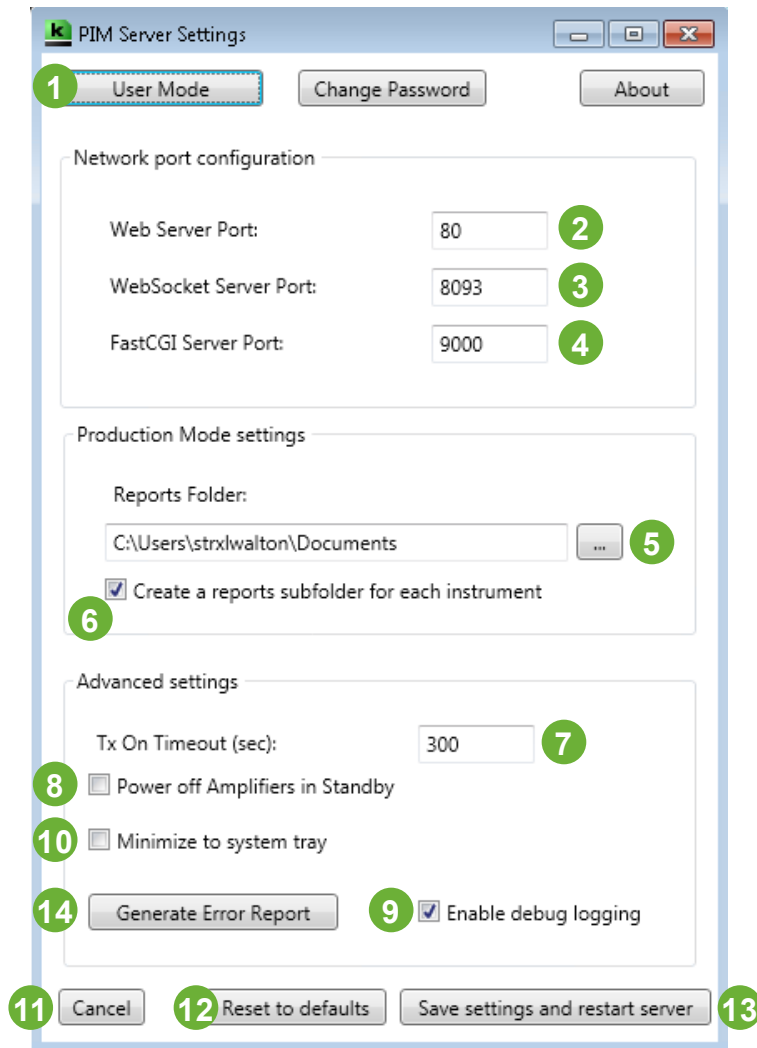


Figure 8 PIM Server Settings Menu

1 Supervisor/ User Mode selection

In Supervisor mode you are prompted for a password, In Supervisor mode it is possible to edit production test steps and the other server configurations listed below. The button icon indicates what state you will switch to when the icon is clicked. Password setting is also available in Supervisor mode.

2 Web Server Port

This sets the port that web stack serve operates on. Default's port 80 this should not need to be changed unless there is a conflict on the network or the port is blocked due to firewall settings. If the Web server port is changed the browser will need to be directed to the new port the application will resolve changes to the web socket server port and fast CGI server ports.

3 Web Socket Server Port

This port is used in conjunction with the web stack server and the API (application program interface) in the Web server. This should only be changed if there is a conflict on the network with this port being used by other services.

4 Fast CGI Server Port

This port is used primarily with the API (application program interface) and with the web stack server. This port should only be changed where there is a conflict on the network with a port being used by other services

5 Reports Folder

This establishes what folder test reports are stored in this defaults to C:\Users\username\Documents\number-Instrument\

6 Create Sub-Folder For Each Instrument

When checked each instrument connected will store it's results, in it's own subdirectory as shown in the green section above. If unchecked all report files go into the same directory.

7 Tx on Timeout

This parameter determines the maximum transmit time that the IBA transmitters are left on for. This is a failsafe to ensure the transmitters are not left on by accident for prolonged periods of time risking overheating and damage to the transmitters.

8 Power Off Amplifiers in Standby

This is a power saving function to turn off the amplifier bias while testing is in standby. There is a testing time trade-off in that you will have to wait for the amplifiers to bias on when tests are commenced. If this is checked, when at the Home screen, or when an API disconnect or timeout has occurred Power amps will be turned off.

9 Enable Debug Logging

This function is to enable debug logging to isolate any problems. Normally left unchecked enable if requested by service support personnel.

10 Minimise In-System Tray

Causes the server panel to run minimised in the system tray.

11 Cancel

Cancel and exit the menu.

12 Reset to Defaults

Reset the Port settings to defaults

13 Save Settings and Restart Server

Save the current settings and restart server to enable the settings.

14 Generate Error Report

This will generate a zip file that can be sent when requesting service support. Your Kaelus support center can use this file to assist with your service query.

3.4 For Additional Technical Assistance

For additional information or technical assistance, please contact:

Kaelus

info@Kaelus.com

<https://www.kaelus.com/en/contact-us>

4. Installation

4.1 Unpacking and Initial Inspection

Inspect each shipping container for unreasonable damage. If the equipment has been damaged in transit, the original packing materials will be required to submit a claim against the carrier.

Notify both the carrier and Kaelus upon the following conditions:

1. The packaging material shows signs of water damage.
2. The protective plastic bag surrounding the equipment is torn.
3. The internal cushioning material shows signs of excessive damage or stress.

The contents of each container should be checked against the packing slip attached to the outside of the container. Please notify Kaelus of any discrepancies.



WARNING

To avoid personal injury, do not connect the equipment to an AC power source if there are obvious signs of damage to the equipment.



IMPORTANT NOTE: RETAIN ALL PACKING MATERIALS FOR USE IN THE EVENT THE EQUIPMENT MUST BE SHIPPED AGAIN. IF UNITS ARE NOT RETURNED IN PROPER PACKAGING, A CHARGE OF USD \$50.00 PER BOX WILL BE CHARGED FOR THE RETURN SHIPMENT.

4.2 Preparation for Installation

Complete the following checklist prior to continuing with the installation:

- Check the AC input fuse on the RF Module to make sure they are of the correct type and rating for the available AC line voltage. The standard fuse should be a 250V, 5A, Slo-Blo fuse. See Section 2.4 for instructions on installing the proper fuse and configuring the AC receptacle for the local supply voltage.
- Ensure the AC power cables supplied with each powered module are compatible with the available AC wall receptacle. These cables must supply an earth ground to the equipment to ensure personnel safety.
- Ensure the circuit to which the four system AC power cords are connected is capable of supplying 1800 VA.

4.3 Installation

Select a hard surface capable of supporting a minimum of 67lb. (30 kg) for the IBA Module and the weight of the selected controller PC. This surface must have a solid surface so as not to impede the airflow from beneath the component modules. All other surfaces must be at least 15 cm (6 inches) from the analyzer module enclosure.

CAUTION

To avoid damaging the equipment, ensure the power switches are turned off on the monitor, the System Controller, and each of the PIM modules before connecting the equipment together.

CAUTION

To avoid damaging the equipment, do not mate or de-mate the Power Supply cables when the power is turned on. Connect the equipment as shown in Figure 9. The System Controller may be separated from the analyzer modules by up to 6 feet (1.8 m).



IMPORTANT NOTE: EARTH STRAPS ARE TO BE CONNECTED BETWEEN THE IBA MODULE AND THE MOUNTING RACK (IF USED). THIS WILL ENSURE CORRECT GROUNDING OF THE UNITS FOR EMC/EMI PERFORMANCE.

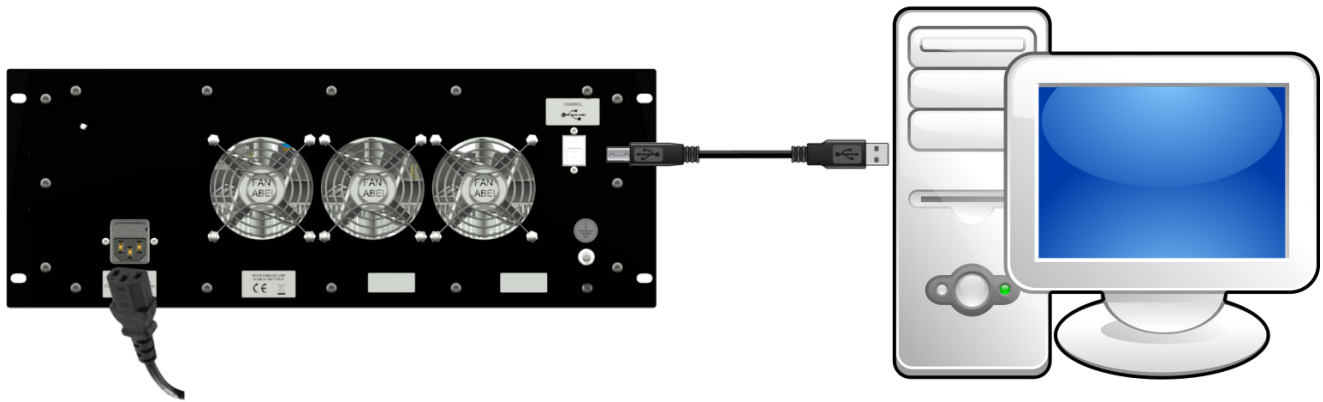


Figure 9 System Assembly

Refer to Section 2.4 to ensure the correct Fuse is fitted. Refer to Figure 14 for Ground strap connection point.

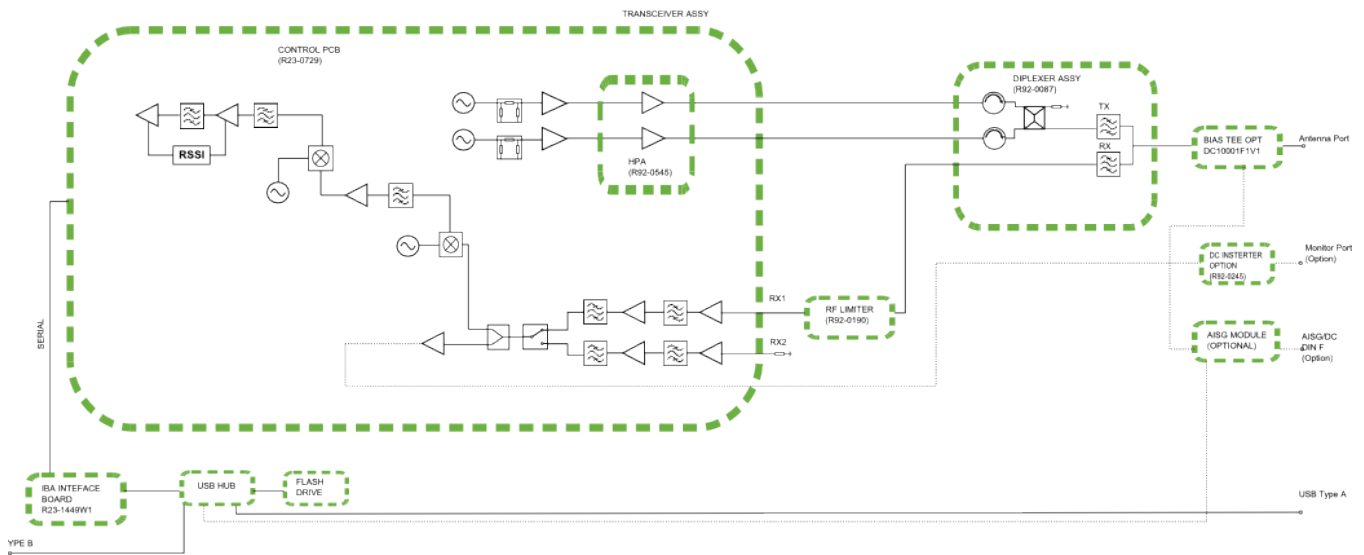


Figure 10 Block Diagram A Series Passive IM Analyser (4RU)

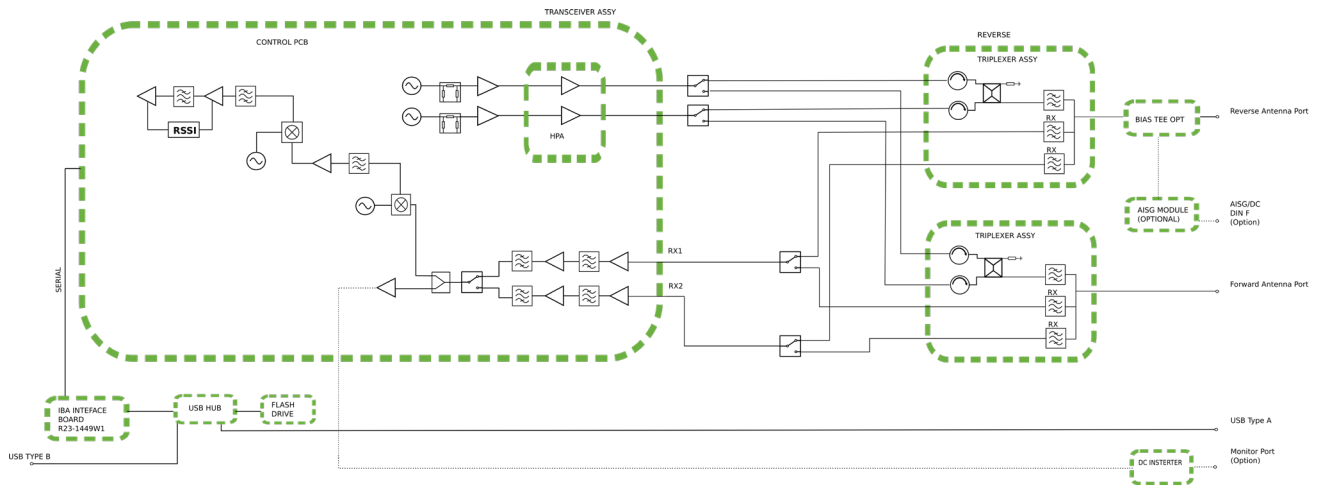


Figure 11 Block Diagram B Series Passive IM Analyser (6RU)

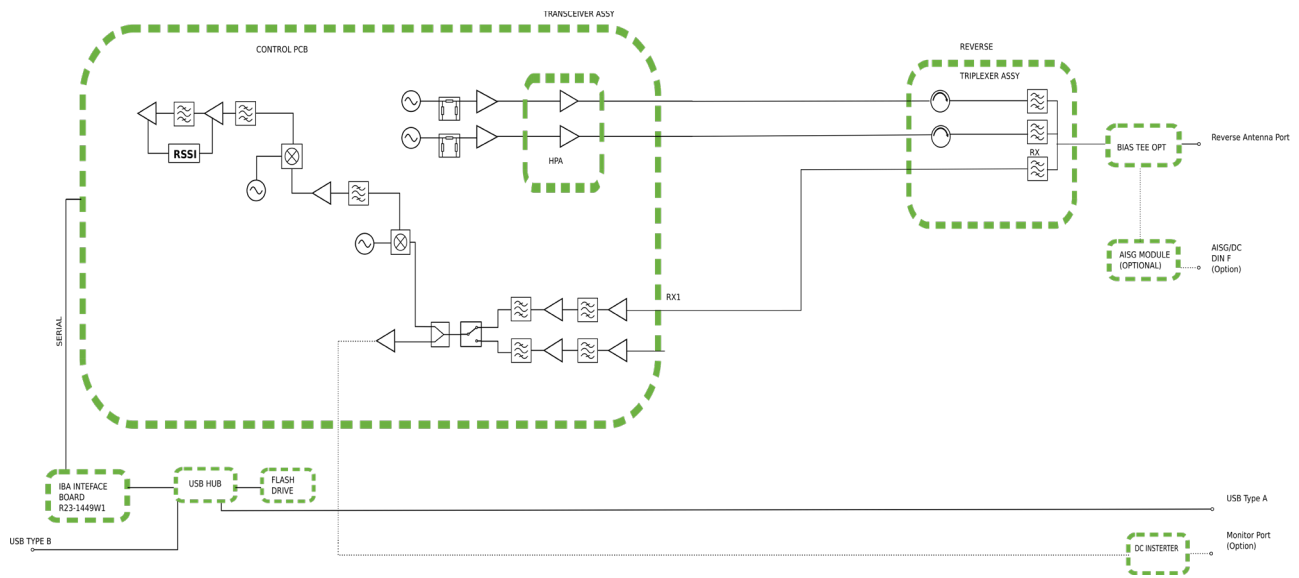


Figure 12 Block Diagram C Series Passive IM Analyser (6RU) 40W

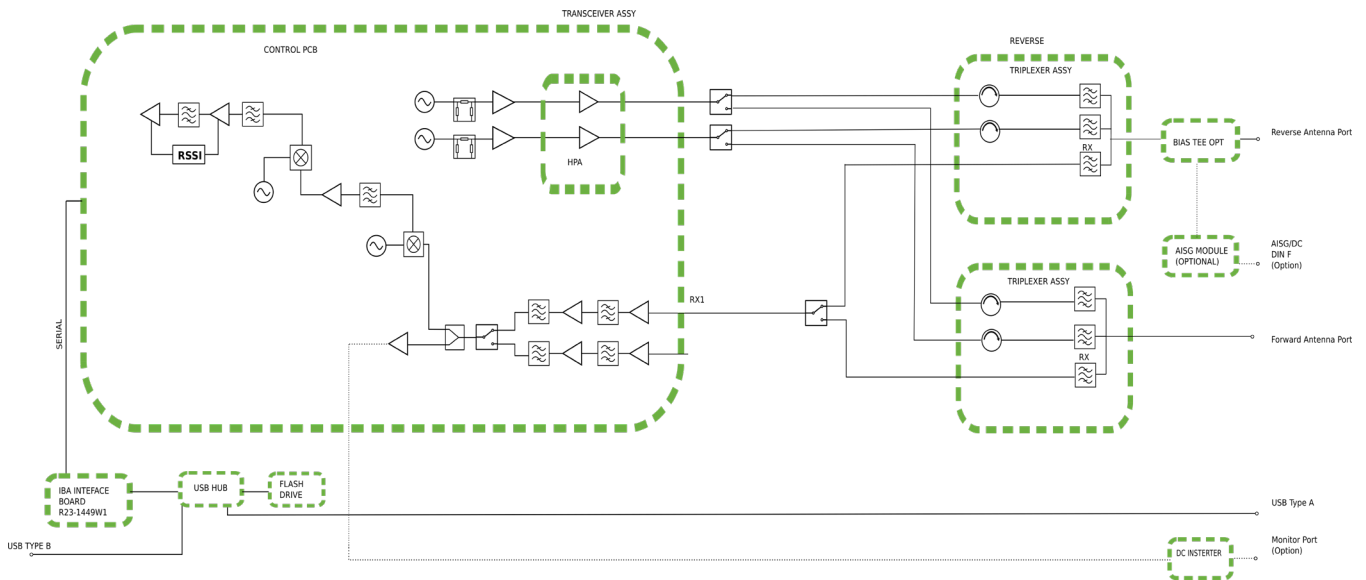


Figure 13 Block Diagram D Series Passive IM Analyser (8RU) 40W

To avoid the possibility of ground loops, ensure the iBA PIM Analyser and the Controller PC are plugged into the same AC power circuit (i.e., they share a common circuit breaker).

Once the connections shown in Figure 3-1 have been verified, the PIM Analyzer may be turned on to confirm the unit will pass initial self-tests and diagnostics. This procedure is described in Section 4.4.

For information on connecting a device under test (DUT) to the PIM Analyzer, please refer to the Applications Information contained in Section 7.

CAUTION

The iBA Module is supplied with connector savers (male-female adapters) for each external carrier port. These adapters are provided to protect the analyzer's port connectors from wear. To help ensure the maximum possible connector life, do not remove these connector savers until they are worn, which is indicated by high and/or intermittent residual IM. Please refer to Section 10.5.3

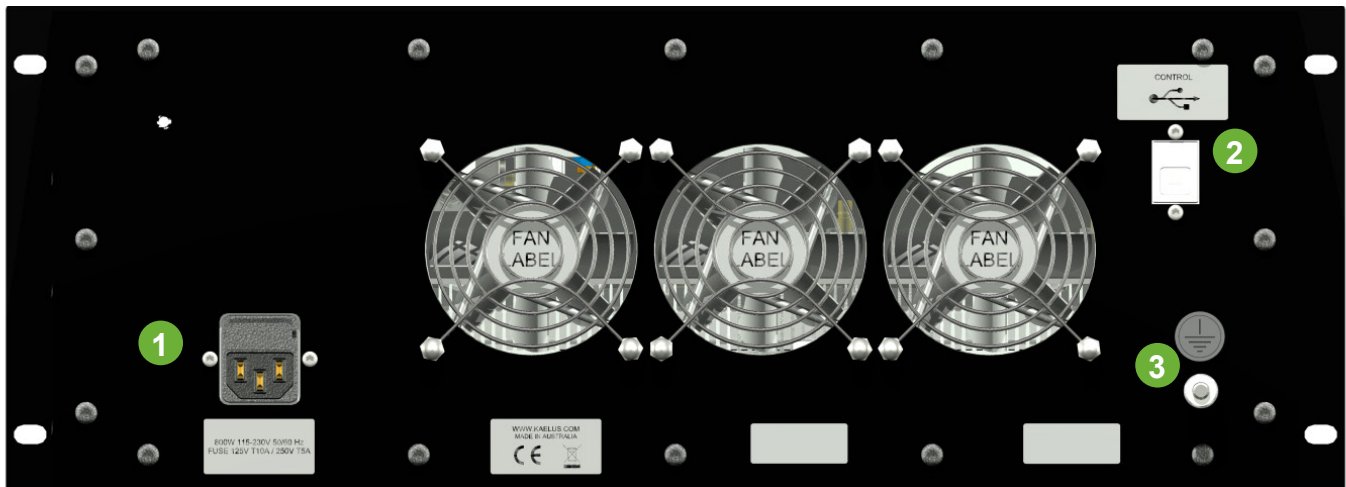


Figure 14 Rear View

1 Mains Power IEC connector with fuse compartment See Figure 1

2 USB Type B connector.

3 Chassis Grounding Stud. Refer Section 4.3

4.4 Turning On the Analyser

The following sequence should be followed in turning on the PIM Analyzer. Although performing these steps out of sequence will not harm the equipment, it is a good practice to follow the same procedure each time.

- Turn on the System Controller's monitor.
- Turn on the power to the iBA.
- Power up the computer by firmly pushing and releasing the On/Off button on the front panel of the System Controller. The power indicator on the System Controller should illuminate, the hard disk and fan should begin to run.

During system boot up, the PC will start the "Kaelus PIM Server" Application. Once it indicates the modules have been found and the server is running, the Launch Portal icon can be pressed. This will launch the default web browser "usually the chrome web browser". This provides the user interface to control the instrument.



WARNING

The PIM Analyzer starts up with the high power RF turned off.

Although the high power output port (Port 1) is internally protected from operating into an open or short circuit at full power, this is not a recommended operating condition. For maximum RF Module reliability, ensure the high power RF port is properly terminated before turning on the RF power.

NOTE: If the iBA is turned off, and PC controller left running, the Kaelus PIM Server application will need to be closed and started again after the modules are turned on, so the hardware is correctly recognized.

4.5 Shutting Down the Analyser

To shut down the PIM Analyzer, the following procedure may be used:

Turn off the power to iBA Module.

Exit the VFP web browser application by clicking on the  in the upper right corner of the window.

Reveal the Kaelus PIM Server by clicking the icon , then exit by pressing the window close button.

Exit the Windows Operating System by using the Start Menu on the Task Bar.

Turn off the power to the monitor.

NOTE: The VFP software will automatically restore the last front panel configuration file on its next startup.

4.6 Connecting a Device for Testing

Please refer to the Applications Information section (Section 9) for details on how to connect typical devices to the analyzer for IM testing.

CAUTION

The iBA Module is supplied with connector savers (male-female adapters) for each carrier port. These adapters are provided to protect the analyzer's port connectors from wear. To help ensure the maximum possible connector life, do not remove these connector savers until they are worn.



WARNING

For operator safety the carrier power on both channels must be turned off prior to the connection or disconnection of a DUT to the iBA.

5. Home Screen

When the PIM Server is started for the first time it detects and displays the first instruments it sees. If additional instruments have been detected, their serial numbers will appear in the PIM server screen. The add instrument function needs to be used for additional instruments so they can be given a meaningful label.

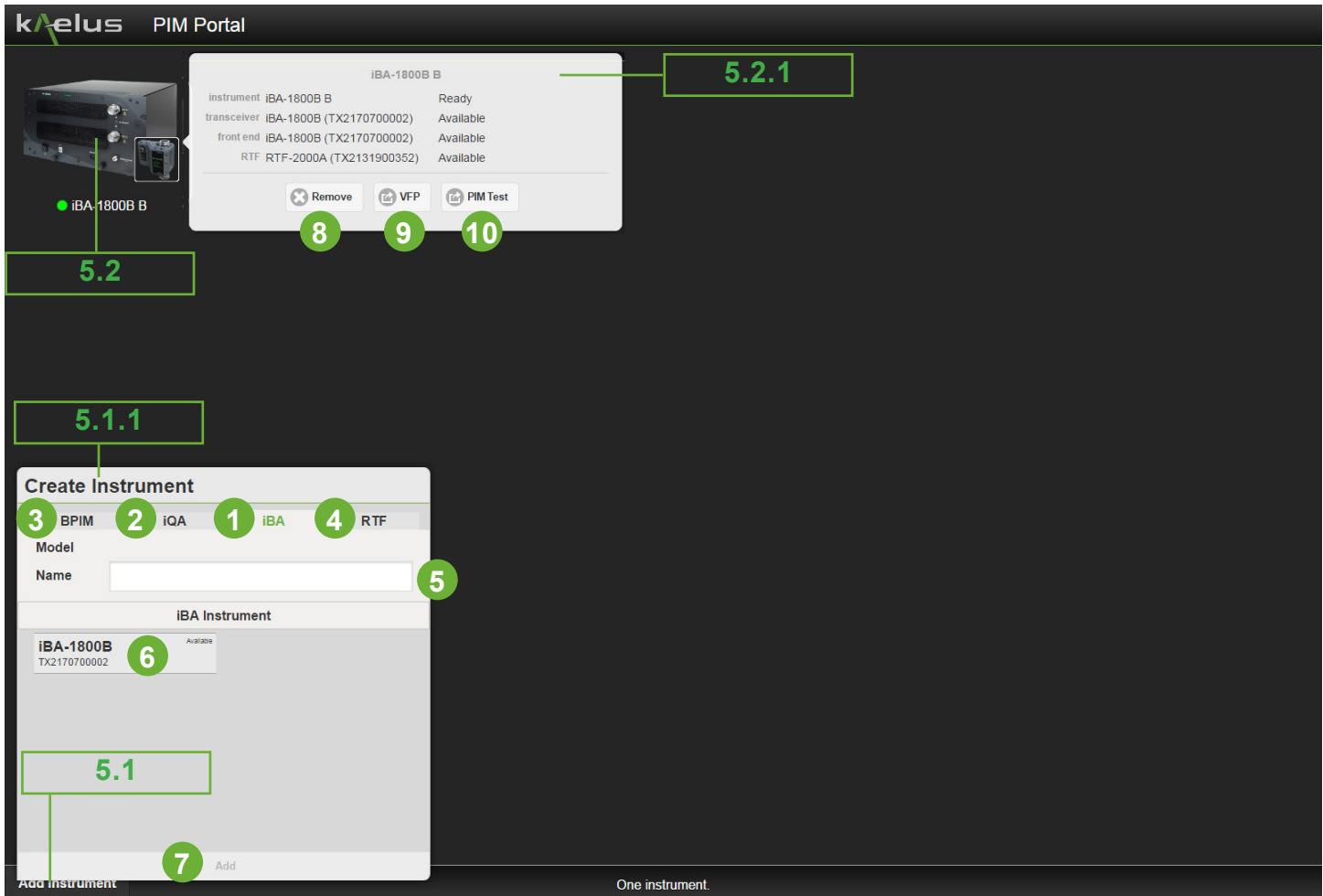


Figure 15 Home Screen

5.1 Add Instrument

The create instrument menu appears when the Add instrument icon is pressed. If only one instrument is connected it will be added as default automatically then add instrument would not be necessary.

5.1.1 Create Instrument Menu

The create instrument menu has several different Tabs for different instrument types that the PIM server is able to control. Select the iBA tab to see the iBA instruments that can be added.

1 iBA instrument tab

Click on this tab to see a list of the connected iBA instruments.

2 iQA Instrument tab

iQA instruments can also be controlled from the PIM Server. Select this tab for a list of connected iQA instruments. See the [R99-0067 iQA Operating Manual C Series](#) for details of this product.

3 BPIM instrument tab

BPIM series instruments can be controlled by the PIM server. Select this tab to list those instruments. See the [Kaelus Website](#) for more details on this product.

4 RTF Instrument tab

When the RTF Option is fitted, the RTF module needs to be associated to the instrument it is connected to. Where multiple iBA's and RTF's are connected to the same PIM Portal you can click on the device image to check what devices are associated with each instrument. This can be confirmed by checking the device serial numbers shown.

5 Instrument name entry

Enter the label you want to use for the new instrument to be added here. When the instrument is selected, the instrument name is chosen by default and can be edited in this field.

6 Available instruments

The available iBA instruments to add is shown here. Other instrument types if available will be displayed in the other tabs. When selected the instrument to be added will highlight green.

7 Add

This will add the selected instrument to the home screen. Once on the Home screen it can be selected to open the REMOVE/VFP/PIM screen.

5.2 Instrument Selection

Click on the desired instrument and a REMOVE/VFP/PIM menu will appear.

5.2.1 REMOVE/VFP/PIM Menu

This menu allows you to either remove the selected device from the home page, launch the Engineering mode front panel or the Production mode front panel. If you want to control multiple instruments at once a new browser tab can be opened by right clicking on either VFP or PIM Test, depending on the mode desired. Select open link in new tab.

8 Remove

Remove will delete the selected instrument from the home page.

9 VFP

Open the Virtual Front Panel in Engineering mode. See Section 6.

10 PIM

Opens the Virtual Front Panel in Production Mode. See Section 8.

2 IM Product pull down menu.

There are 4 product pull down menus, each with a different color that corresponds to the color of the trace line to be used

Off = Trace not Measured
 $IM2H = F1 + F2$
 $IM3L = (2 \times F1 \text{ (Lower Side Frequency)}) - (F2)$
 $IM3H = (2 \times F2 \text{ (Higher Side Frequency)}) - (F1)$
 $IM5L = (3 \times F1 \text{ (Lower Side Frequency)}) - (2 \times F2)$
 $IM5H = (3 \times F2 \text{ (High Side Frequency)}) - (2 \times F1)$
 $IM7L = (4 \times F1 \text{ (Low Side Frequency)}) - (3 \times F2)$
 $IM7H = (4 \times F2 \text{ (High Side Frequency)}) - (3 \times F1)$
 $IM9L = (5 \times F1 \text{ (Low Side Frequency)}) - (4 \times F2)$
 $IM9H = (5 \times F2 \text{ (High Side Frequency)}) - (4 \times F1)$
 $IM11L = (6 \times F1 \text{ (Low Side Frequency)}) - (5 \times F2)$
 $IM11H = (6 \times F2 \text{ (High Side Frequency)}) - (5 \times F1)$
 $F1H2 = (2 \times F1)$
 $F2H2 = (2 \times F2)$

Figure 17 Trace pull down menu

Should the expected product fall out the fitted Rx band/s then a warning symbol will be shown and the trace will not be measured,

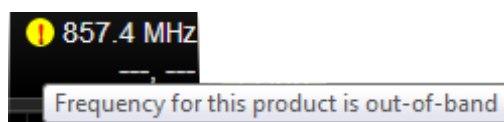


Figure 18 Out of Band Indicator

3 Individual trace pass/fail Indicators

There are individual Pass/Fail indicators for each trace. There is also an overall pass fail indicator. See Item 13.

4 Trace numeric display

Shows the calculated trace frequency for the mode selected, the peak value for the measurement period and the seconds mark at which the peak occurred.

5 Virtual Front Panel (VFP) Browsing address

The standard configuration is to have the PIM Server installed on a local PC. When the (Launch Portal) button on the PIM Server is pressed, the local default web browser will be launched, pointing to <http://127.0.0.1/VFP.html>, this address "echo's" the browser back to the locally installed PIM Server.





	You have control of the iBA and can permit another user to take control
	You have control of the iBA and you are preventing another user taking control
	You are browsing the iBA and could take control.
	You are browsing the iBA and are prevented from taking control.

Figure 19 Control Indicator

6 Lock local control indicator

It is possible to remotely control your test equipment or to browse the test equipment being operated or to take control remotely.

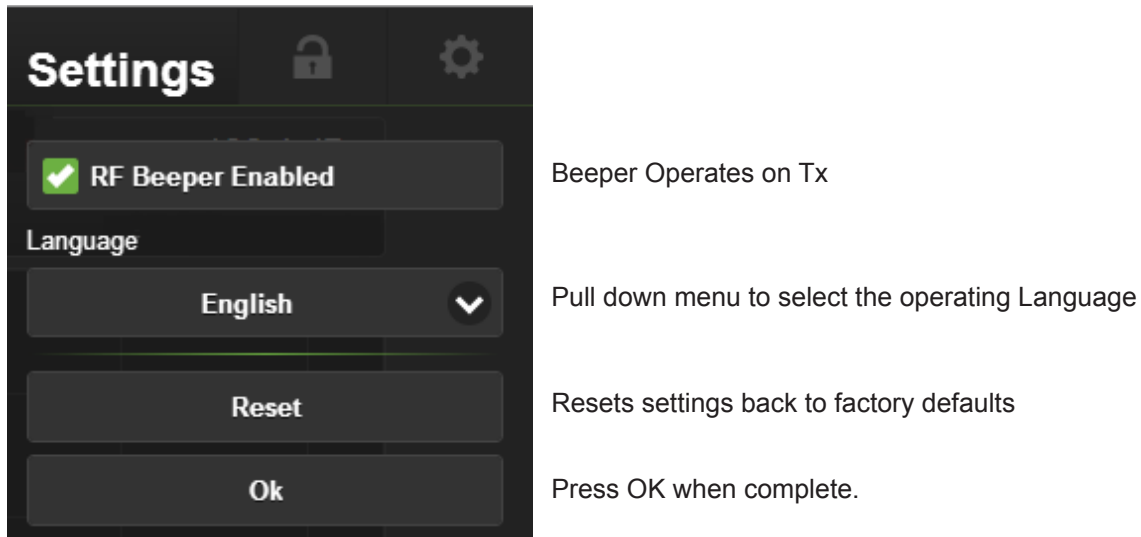


Figure 20 Settings Menu

7 Settings Menu

Click to bring up the settings menu. The settings menu is used to set the RF Beeper Enable/Disable change languages or reset the settings back to factory defaults.



Figure 21 Bar graph Display

8 Bar graph pin icon

By hovering your mouse pointer above the pin icon you can temporarily enable the bargraph display, or by clicking on the icon pin, fix the bargraph on, the bargraph indicator not only gives a bar graph of the current value but also gives a peak indication for all displayed traces.

9 Pass/Fail limit line

Traces need to be below this line in order to indicate a pass, See item 10 for how to set the Pass/Fail limit line.

10 Pass/Fail limit control and numeric display

By clicking on this icon the spec limit line can be slide up and down the display, setting a new spec limit in 1 dB steps, once highlighted by the mouse, up/down arrow keys on the keypad or Page up/down keys on the keyboard can also be used to change the line in larger increments.





11 Time trace

There are 4 possible time trace colors that can be selected, as the DUT is given dynamic testing, the trace can be checked for peaks.

12 Trace peak indicator


Indicates the highest point measured of each trace, the peak indicator will sit on the peak point on the line if in the currently displayed window or above the line if the peak occurred prior to the displayed region.

13 Overall Pass/Fail indicator

If all of the displayed traces fall below the spec limit line set, then the overall pass fail indicator will indicate a pass  or  fail if any of the traces are above the line. A short press will enable the Pass Fail text on the indicator.  


14 Time mode switch

The icon when green indicates that time test mode has been selected.

The  One Key can be used as a hot key to switch to time mode.


15 Frequency swept mode switch.

This icon when green indicates swept PIM mode. Each of the 2 carriers F1 and F2 is swept in turn from start to stop frequency measuring PIM products.

The  Two Key can be used as a hot key to switch to frequency swept mode.


16 Spectrum mode switch

The icon when green indicates spectrum mode is enabled. The received spectrum on the chosen receive port is displayed. This spectrum display is limited to the receive passband of the filter.

The  Three Key can be used as a hot key to switch to spectrum mode.

17 RTF mode switch

The icon when green indicates that RTF (range to fault) mode has been selected. This mode will measure range to fault of return loss or PIM products.

The  Four Key can be used as a hot key to switch to spectrum mode.

18 Measurement units change

The icon indicates the mode that will be set to if pressed, displaying dBc indicates the units will change to dBc if pressed. Changes between dBm / dBc.

19 Erase current display

The current trace, history and peak markers will be cleared, the trace will begin at 0 secs and start again. 

20 Trace time scale

The trace time scale is in seconds since the last Erase current display command. See Item 19 above.

21 Time trace elapsed time

The green bar indicates the amount of history memory used, the time on the left gives start time of available memory and right of the display shows the end time, typically 15mins of history is created. The yellow bar indicates the section of the memory being used and displayed.

22 Advanced control panel select

Click this arrow on the dashboard to pull up the advanced control panel See Section 6.1.3 for more detailed information on the advanced control panel.

23 Scales reset

Click this function to reset the graph axis to full size. This would need to be done after using the display zoom feature. Refer Section 6.1.1

24 Source, Port, Receive indicators.(Dualband future option)

On either side of the RF On/Off control there are sets of indicators for, RF stimulus (Tx), and Receiver(Rx), depending on



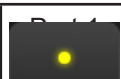
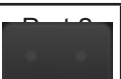
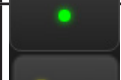







	Description	
	Transmitter and receiver on a common Port 1.	
	Transmitters output on Port 1, Low Band receiver on Port 1 and High Band receiver on Port 1, Port 2 while greyed out, is Terminated.	
	Transmitters output on Port 1, Low Band receiver on Port 1 and High Band receiver on Port 2.	
	Transmitter and receiver on a common Port 2.	
	Transmitter on Port 2 and receiver on Port 1.	

Table 1 Stimulus Response Indicators

the options in your configuration, there may be one or two ports and one or two receive bands.see Table 1 the first line. Yellow indicates this port has active Tx out connected, the two green indicators indicates that two receivers are connected to this port (Port 1) Table 1 line 2. Changing the Port, stimulus and high band receiver port can be changed via the Advanced control panel see section 6.1.3, and Figure 26.

NOTE: Available path and switching options will depend on the iBA model purchased. Refer Figure 10 and Figure 11, not all models have dual receive bands.

25 RF On/Off

Turns the transmitter RF On or Off. Clicking the center of the grey panel or pressing the F4 key on the keyboard will turn both transmitters On or Off. Indicators on this panel turn red when the transmitters are on. Individual transmitters can be turned on and off by clicking on their individual indicator spot. An accompanying beeper on the control PC can also indicate RF on, see Figure 20.



26 Transmitter Frequency and Power indicators.

There are two transmitter power and frequency indicators on the right corner as shown here and the opposite left corner. The frequency and power levels are indicated there.

27 Amplitude Scale

This scale can be in either dBm or dBc by clicking on item 18, the same units as set for transmit power will be used. See the Advanced control panel section for instruction on how to change this Section 6.1.3.

28 Trace Run/Pause

Switches between run  Click on this icon to make the trace run when paused. Click on  when running to pause the display.

29 Autoscale

Rescale/Zoom in, the trace to fit in the screen..

30 CSV

Export the trace data to a CSV (Comma Separated Values) file. This can be used to import the trace data to a spreadsheet or database program.

6.1.1 Display Zoom Control

It is possible to Zoom in on the amplitude of a displayed trace. Click either above or below the section of the trace you want to expand, while holding down the mouse button wipe across the section of display to be expanded, see Figure 22 and Figure 23.



Figure 22 Zoom Swipe View



Figure 23 Zoom Expanded View

1 Resetting Zoom

Click on the icon to return Zoom to full scale

6.1.2 Hover over results

Individual trace results can be shown on the trace lines by hovering the mouse pointer over a measurement point on the trace, this will show it's X,Y result on the Plot, see Figure 24.



Figure 24 Mouse hover over result display

A small colored halo will appear around the measurement point and the X,Y result will appear.

6.1.3 Advanced Control Panel


Many Instrument settings can be accessed via the advance control panel, a scroll bar appears on the right hand side, use it to scroll to other items in this panel. Click on  to dock the advanced control panel.



Figure 25 Advanced Control Panel (Top Part)

1 Power level adjust down F1 Signal

Click on this icon to reduce the power set point for frequency 1, note that if the power setting is linked (See item 5) this will reduce both F1 and F2 power set points, Settings are in 0.1dB steps. When power setting is linked the F2 power display will be a darker grey color, (See item 7).

2 Power level numeric entry and display F1 Signal

This area will display the current power set point level for F1. If you click on this area you can also enter the desired power via the PC keyboard. As with item 1 if the powers adjust is linked then this will set both F1 and F2 power levels.

3 Power level adjust up F1 Signal

Click on this icon to increase the power set point for frequency 1, note that if the power setting is linked (See item 5) this will increase both F1 and F2 power set points. Settings are in 0.1dB steps. When power setting is linked the F2 power display will be a darker grey color, (See item 7).

4 TX Power Units

Changes power units from dB to Watts; this will change the measurement units on the set points.

5 Link Power

Click on this icon to select if the F1 and F2 Power controls are linked together (The same Power level) or able to be adjusted separately.

6 Power level adjust down F2 Signal

Click on this icon to reduce the power set point for frequency 2, note that if the power setting is linked (See item 5) this control will be disabled and be a darker grey color.

7 Power level numeric entry and display F2 Signal

This area will display the current power set point level for F2. If you click on this area you can also enter the desired power via the PC keyboard. If the power adjust is linked then this will disabled and a darker grey color.

8 Power level adjust up F2 Signal

Click on this icon to increase the power set point for frequency 2, note that if the power setting is linked (See item 5) this control will be disabled and be a darker grey color.

9 Advanced control panel slide control

This allows you slide up and down to view the various controls under the advanced control panel.

10 Adjust frequency down F1

This control when clicked adjusts frequency down in -100 KHz steps.

11 Frequency numeric entry and display F1 Signal

This area will display the current frequency for F1. If you click on this area you can also enter the desired frequency via the PC keyboard.

12 Adjust frequency up F1

This control when clicked adjusts frequency up in 100 KHz steps.

13 Frequency Units

Click on this to switch between the available Frequency units, GHz, MHz, KHz, and Hz.

14 Band Edges

Adjusts both F1 and F2 Frequency set points to the edges of the band, likewise the swept frequency ranges (See Figure 27 items 24,28,27 and 31,34,35) are set to the edge of the band.

15 Adjust frequency up F2

This control when clicked adjusts frequency up in 100 KHz steps.

16 Frequency numeric entry and display F2 Signal

This area will display the current frequency for F2. If you click on this area you can also enter the desired frequency via the PC keyboard.

17 Adjust frequency down F2

This control when clicked adjusts frequency down in 100 KHz steps.

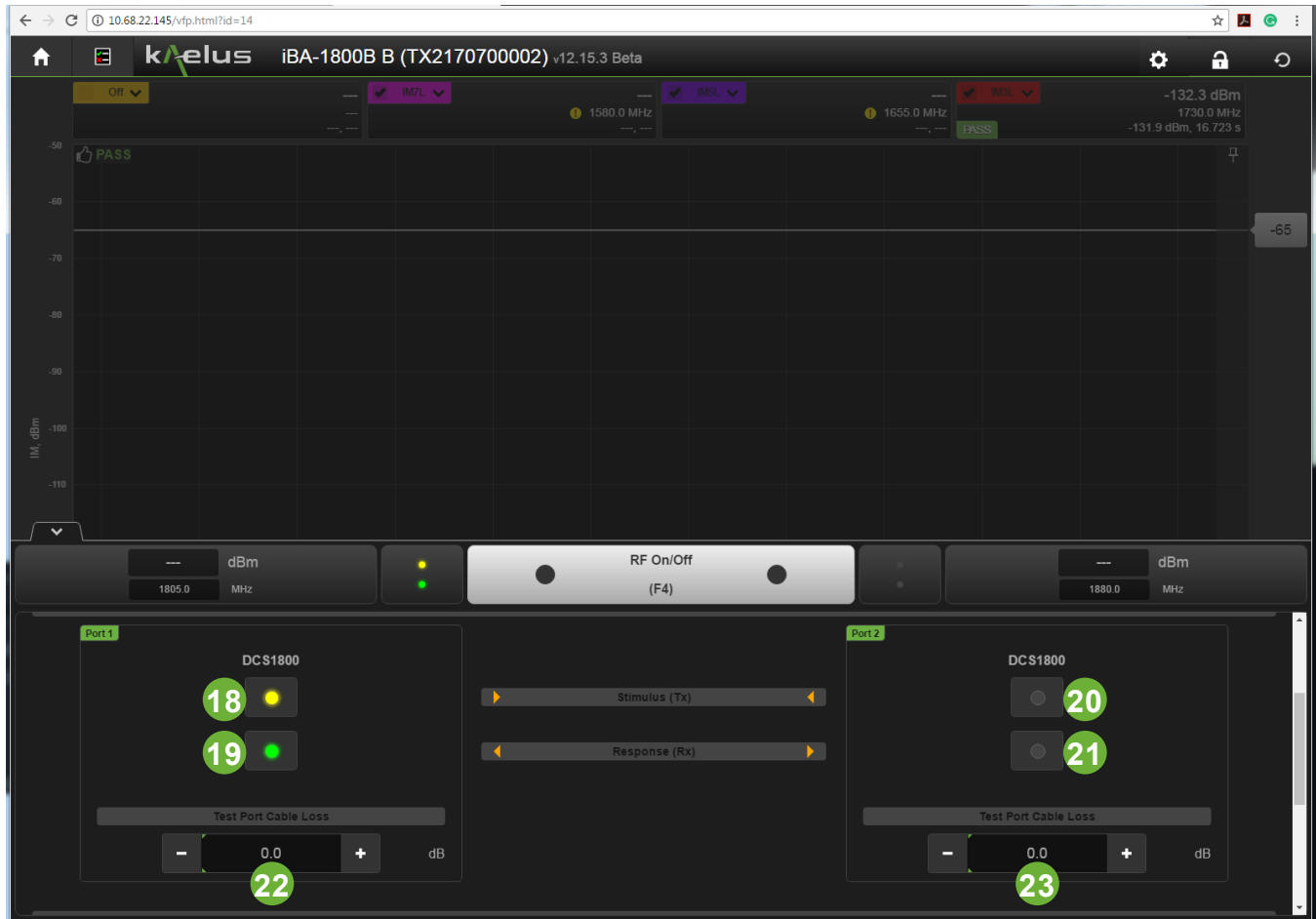


Figure 26 Advanced Control Panel (Middle Part)

18 Stimulus (TX) port 1 indication 1800MHz

Yellow indicator shows the 1800 MHz Transmitter is connected to Port 1.

The ☐ T key can be used as a hotkey to toggle the Transmit port between Port 1 and Port 2.

19 Response (Rx) port 1 indication 1800MHz

Green indicator shows the 1800MHz response receiver is connected to Port 1.

The ☐ R key can be used as a hotkey to toggle the receive port between Port 1 and Port 2.

20 Stimulus (Tx) port 2 indication 1800MHz

A Yellow indicator here would show whether the 1800MHz Transmitter is connected to Port 2. When grey as shown here, means that the 1800MHz transmitter is not connected to port 2.

The ☐ T key can be used as a hotkey to toggle the Transmit port between Port 2 and Port 1.

21 Response (Rx) port 2 indication 1800MHz

A Green indicator here would show if the 1800MHz response receiver is connected to port 2. When grey as shown here, means that the 1800MHz receiver is not connected to port 2.

The ☐ R key can be used as a hotkey to toggle the receive port between Port 2 and Port 1.

22 Test Port cable loss Port 1

Test Port cable loss can be set between 0 and 3 dB. Test equipment output power is adjusted up to compensate for the cable loss entered. Likewise the receive signal level indicated is also compensated up by the selected test cable loss.

23 Test Port cable loss Port 2

As per above for Port 2.

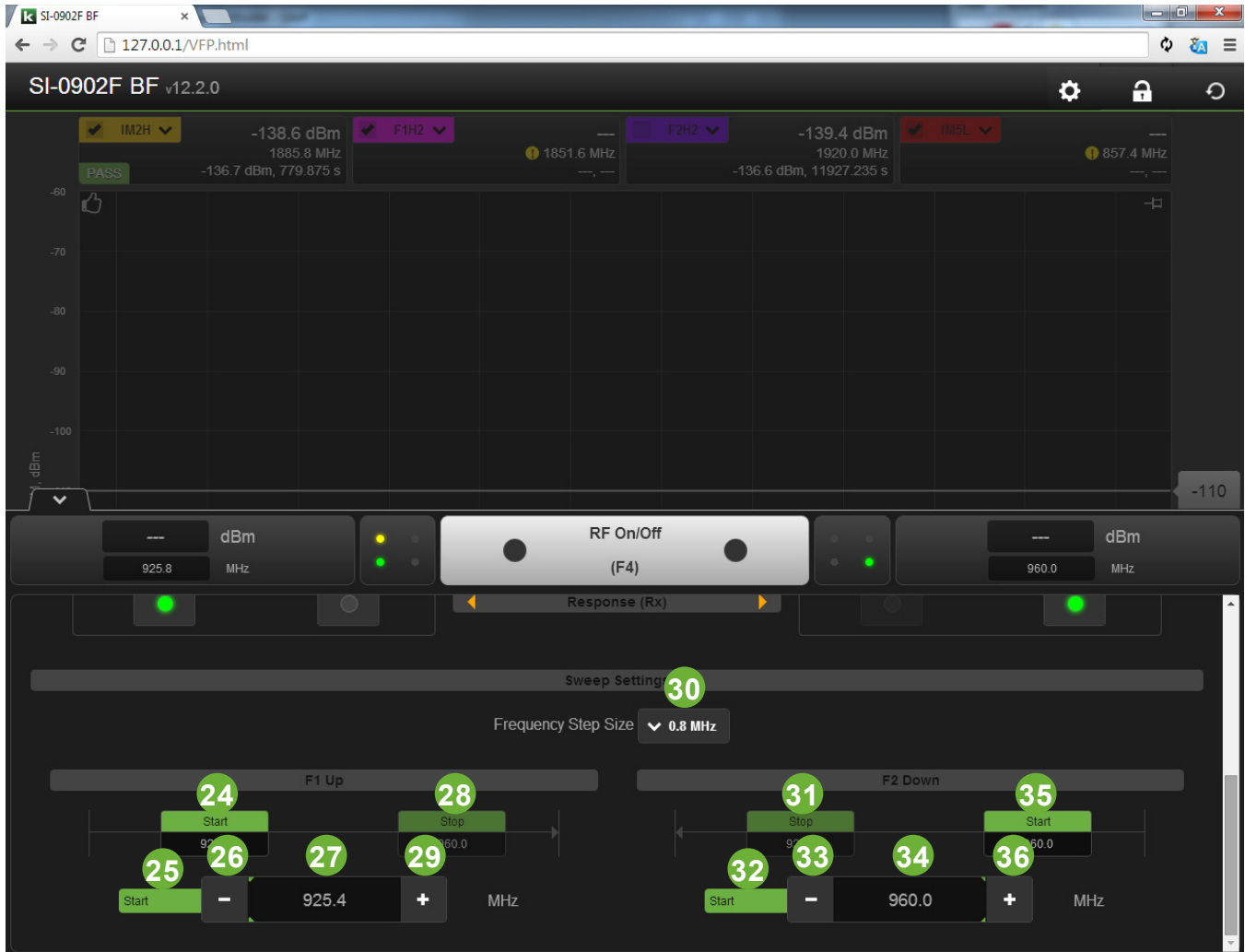


Figure 27 Advanced Control Panel (Lower Part)

Note : The lower part of the Advanced control panel is for the swept frequency mode, refer to Figure 29. Swept mode, sweeps each of the transmitter tones in turn providing a product trace for each. F1 sweeps from a low to a high frequency, then F2 Sweeps from a high to a low frequency.

24 F1 Start frequency indicator

Indicates the lower frequency for the start of the sweep of F1, when highlighted, the controls (Items 26, 27, 29) can be used to adjust the F1 Start frequency.

25 F1 Start/Stop Adjustment indicator

Indicates whether you are adjusting the F1 Start or Stop frequency, clicking on item 24 changes it to start and clicking on item 28 changes it to stop.

26 F1 sweep frequency adjust down

Adjusts indicated sweep frequency limit down in frequency, each click is 100 KHz.

27 Frequency numeric entry and display F1 Swept Signal

This area will display the current frequency sweep limit set point for F1. If you click on this area you can also enter the desired frequency via the PC keyboard.

28 F1 Stop frequency indicator

Indicates the upper frequency for the end of the sweep for F1, when highlighted, the controls (Items 26, 27, 29) can be used to adjust the F1 Stop frequency.

29 F1 sweep frequency adjust up

Adjusts indicated sweep frequency limit up in frequency, each click is 100 KHz.

30 Frequency step size

This adjusts the frequency step size between measurement points. Smaller steps sizes increase test time but adds more detail to the trace. Larger step sizes reduce test time and decreases the number of points measured. Step size can be set to 0.1, 0.2, 0.5, 1.0, or 2.0 MHz.

31 F2 Stop frequency indicator

Indicates the lower frequency for the end of the sweep for F2, when highlighted, the controls (Items 33, 34, 36) can be used to adjust the F2 Stop frequency.

32 F2 Start/Stop Adjustment indicator

Indicates whether you are adjusting the F2 Start or Stop frequency, clicking on item 35 changes it to start and clicking on item 31 changes it to stop.

33 F2 sweep frequency adjust down

Adjusts indicated sweep frequency limit down in frequency, each click is 100 KHz.

34 Frequency numeric entry and display F2 Swept Signal

This area will display the current frequency sweep limit set point for F2. If you click on this area you can also enter the desired frequency via the PC keyboard.

35 F2 Start frequency indicator

Indicates the upper frequency for the start of the sweep of F2, when highlighted, the controls (Items 33, 34, 36) can be used to adjust the F2 Start frequency.

36 F2 sweep frequency adjust up

Adjusts indicated sweep frequency limit up in frequency, each click is 100 KHz.



IMPORTANT NOTE: To optimize measurement speed, the analyzer actually measures only those IM responses which fall within the receive band of the RF unit. Those responses falling outside the receive band are not measured or displayed

7. Operation in Engineering Mode - Tutorial

7.1 Overview

Engineering Mode is used, primarily, during design and development and for diagnosing the source of passive IM. There are four different presentation methods in Engineering Mode. These are the time mode, swept frequency mode, spectrum mode and RTF mode. These display modes are selectable by pressing the icon in the lower left corner of the display area.

7.1.1 Time Mode

Measures and displays the IM response as a function of time. It displays the IM response for all IM products that land within the pass band for the analyzer. This mode is particularly useful for observing how the IM changes with time due to environmental and/or mechanical stress.



Figure 28 Time Mode

7.1.2 Swept Frequency Mode

Swept frequency mode is used to determine how the IM response changes with different pairs of frequencies. The analyzer actually performs two frequency “sweeps”. In the first sweep, it sets F1, Carrier 1 to the lowest frequency in the transmit band and sets Carrier 2 to the highest frequency in the transmit band. It then steps F2, Carrier 2 down in frequency covering all frequency pairs that generate an IM product that lands in band. In the second “sweep”, F2, Carrier 2 is kept constant and Carrier 1 is stepped up in frequency. Swept frequency is a valuable test mode in that it exposes problems that may go unfound if only two fixed frequency carriers are used. This is particularly true on band-limited devices.



Figure 29 Frequency Swept Mode

7.1.3 Spectrum Mode

Spectrum mode give results of the receiver swept across the entered band, this can be done with transmitters on or in LN (low noise) mode (Standby mode). LN mode is useful when you want to reduce any emissions from the iBA to a minimum. Transmitting is not possible in LN Mode. So the internal transmitters cannot be used to generate PIM. In LN mode it is expected that transmit sources to generate PIM are external to the iBA. In LN mode, the iBA is being used as a receiver only. External transmit sources might include other band iBA's or base stations. LN mode can help reduce the number of signals to be examined.

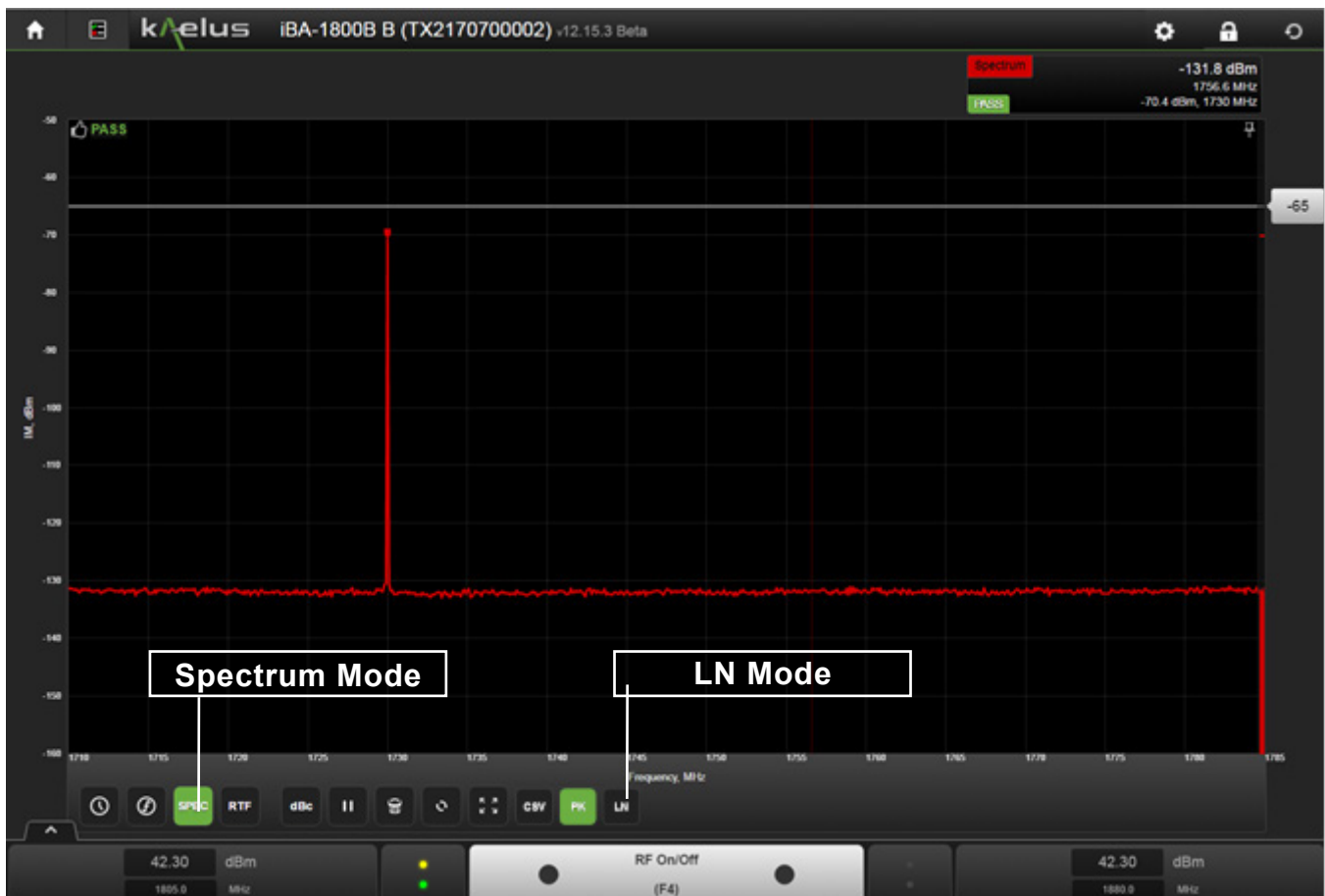


Figure 30 Spectrum Mode

7.1.4 RTF (Range to Fault) Mode

The IBA IM analyser is fitted factory ready for the RTF option module to be fitted. There are 3 different band variants of the RTF module, check Table 4, Table 5, Table 6 and Table 7 for the correct RTF module to use with your IBA IM analyser. A [CIS-0001A](#) PIM Source will also be required for RTF calibration. When attached to an iBA, the external RTF module enables the iBA to determine the location and magnitude of individual PIM faults in the device under test. In addition to this, the RTF module enables the iBA to pinpoint the location and magnitude of individual Return Loss faults in the device under test, refer the RTF operating manual for more details.

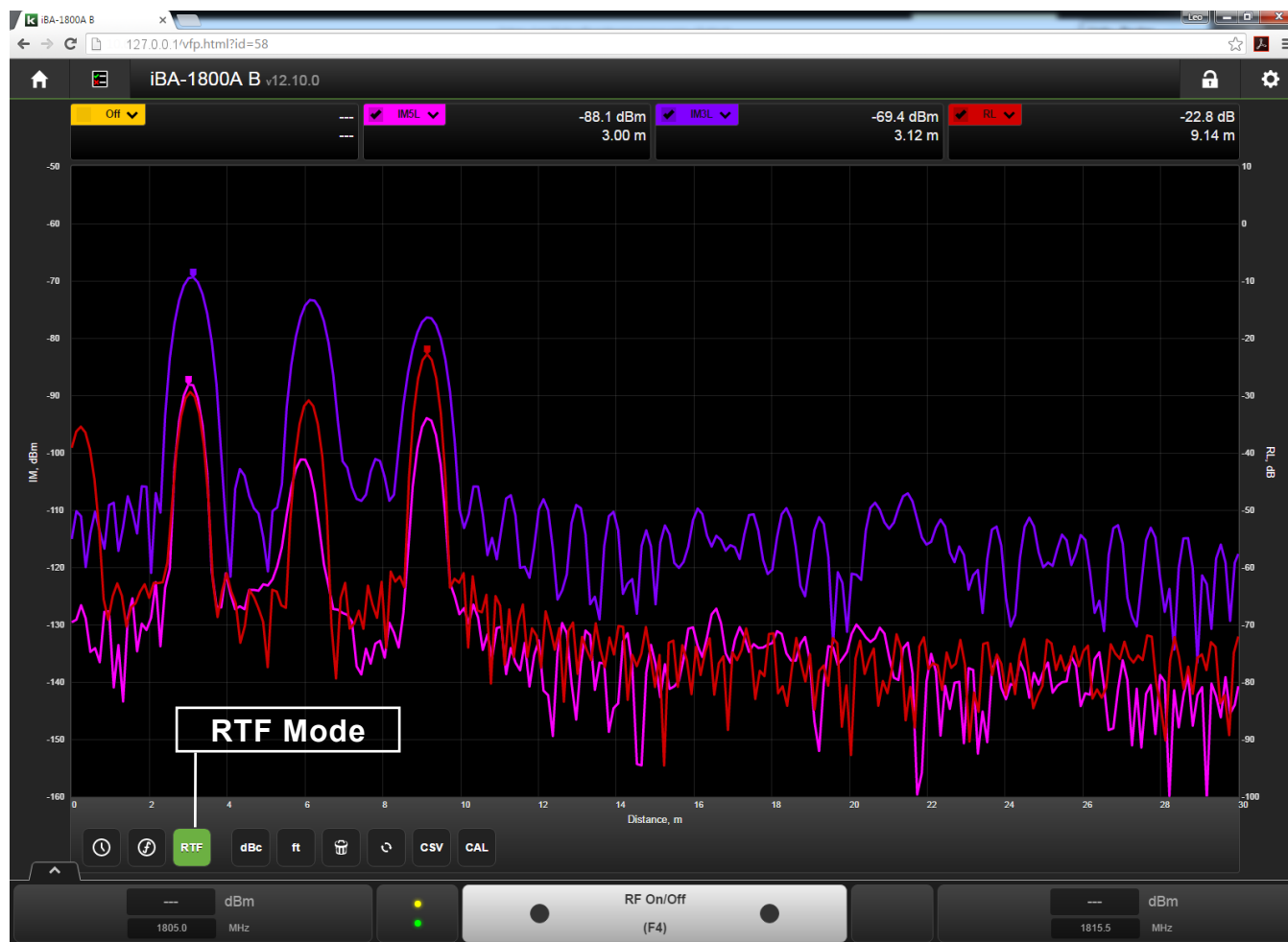


Figure 31 RTF (Range to Fault) Mode

7.2 Measurement Detail

7.2.1 Confirming Measurement Capability (Residual IM)

This example assumes that the test object is a low IM termination (PIL-0006A equivalent) connected directly to Port 1 of the PIM Analyzer. The result of this test is a measurement of the “Residual IM” of the test setup. The Residual IM is a critical performance parameter, because it establishes the minimum level of PIM that can be measured by the test setup. If the PIM of the device under test (DUT) is lower than the Residual IM, the measurement will display the Residual IM level and not the PIM of the DUT. Note that even when the Residual PIM is lower than the PIM of the DUT, this ratio impacts the measurement uncertainty (please refer to Section 9.3 for more information). It is always desired that the Residual PIM be at least 10 dB below the PIM specification for the device being measured. Note that the measurement is not simply a measurement of the PIM of the test instrument, but the combination of the test instrument, any interconnecting cables and/or adapters, and the termination.

Test Set	Freq. (MHz) Start/Stop	Power (dBm)	Power Linked	Measurement Mode
iBA-0600	617/652	43	On	Time
iBA-0700L	728/746	43	On	Time
iBA-0700H	728/757	43	On	Time
iBA-0703	758/803	43	On	Time
iBA-0707C/D	728/757	43	On	Time
iBA-0790	791/821	43	On	Time
iBA-0850	869/894	43	On	Time
iBA-0901	925/960	43	On	Time
iBA-1800	1805/1880	43	On	Time
iBA-1921	1930/1990 2110/2155	43	On	Time
iBA-2101	2110/2170	43	On	Time
iBA-2600	2620/2690	43	On	Time
iBA-3501	3660/3800	43	On	Time

Table 2 Default Frequency, Power and Mode.

NOTE:

- Link Power indicates that Carrier 1 and Carrier 2 are at the same power level of 43 dBm each. See Figure 25 Item 5
 - Frequency values can be set to the band edges. See Figure 25 Item 14.
1. Allow the iBA instrument to warm by turning on the power 20min before starting the test.
 2. If you are not already in Time Mode, switch to time mode see Figure 16 Item 14.
 3. In the advanced control panel , the following default values are given in the table above.
 4. To switch the power selection to Watts, press the dBm/W switch (See Figure 25 Item 4). Press the dBm/W switch to return to dBm for the rest of this tutorial.
 5. The iBA PIM Analyzers have a residual IM specification of –125 dBm with 2 carriers at +43 dBm (20 watts) when terminated with a high performance, low IM termination (SI-30 or equal). To assist in viewing the measured performance relative to the specification limit, set the Reference Value to –125 dBm. Spec Limit Line can be set according to Figure 16 Item 10
 6. Using the pass fail limit line see Figure 16 Item 10. Enter a spec limit of -125dBm.
 7. Upon start-up, the RF power is off and the measured IM value is the system noise floor.

8. Switch on the RF power using F4 or RF on see Figure 16 Item 25. The carrier status indicator lights change to red indicating the RF is on.
 9. The actual, measured power being transmitted from the Port 1 output connector is displayed on the “Virtual Front panel” panel, see Figure 16 Item 27.
 10. With Carrier 1 and Carrier 2 frequencies set at the maximum and minimum frequency for the analyzer (“band edges”), (To set F1 and F2 frequencies to band edges, see Figure 25 Item 14). If we set one Trace to IM3L and another Trace to IM3H, see Figure 16 Item 2 and Figure 17. You will see that IM3H falls outside the Rx band edges giving an indication similar to Figure 18 and IM3L falls inside the Rx passband so the remaining numeric values appear as shown in Figure 16 Item 4.
 11. Note on the “Virtual Front Panel ” (Time Mode) Display the following settings:
 - Pass Fail Limit = -125 dBm.
 - Trace order selected. Order = IM3L
 12. Click on the dBm/dBc Refer Figure 16 Item 18, switch and note that all dBm readings revert to dBc values. These values are all relative to the strongest carrier signal; i.e. 30 dBm in our case.
 13. Note the power levels of the IM products. Increase the carrier power from the present 30 dBm to 43 dBm on the Carrier Control Panel using any of the following techniques.
 - a. Refer to Figure 25 Item 3 and Item 1, adjust power using the - + controls.
 - b. Highlight as outlined in Figure 25 Item 2 and type in the required Power value on the keyboard.
- The new requested power is now displayed. The actual carrier power present at the Port 1 output is displayed in the Figure 16 Item 25 Area.
14. Note that the power levels of both Carriers 1 and 2 have risen to 43 dBm, since they are locked. The IM power levels have also increased due to the increase of power in the transmit carrier signals.
 15. Press the LOCK button (Refer Figure 25 Item 5). This will unlock the carriers and the LOCK indicator will now be unlinked. Decrease the power level of Carrier 2 to 40 dBm, refer to Figure 25, Items 6, 7, 8.
 16. Note that the “Virtual Front Panel” shows the power of Carrier 2 to be lower than Carrier 1.
 17. Press the LOCK button to relock the carrier powers. Note that Carrier 2 increases to the same 43 dBm selected for Carrier 1. (Refer Figure 25 Item 5).
 18. Printing Data. Screen Printing functions are available through the web browser.



Figure 32 Browser Print

In production mode results are available in the reports directory, See Section 3.3.5 item 4, plots are included if the include plots checkbox is ticked, see Figure 37 Item 11.

Plot results can also be stored as Comma Separated Values files in the production reports directory on the computer running the Kaelus PIM server. Usually c:\Users\username\My Documents\Kaelus\PIM Server\Reports\Unit-iBAmode. Note username will be the currently logged on user running the Kaelus PIM server. Unit-iBAmode will depend on the model type being used.


7.2.2 IM Measurement Time Mode

Time Mode measures and displays the IM performance of the device under test (DUT) as a function of time. This creates a history of the IM performance, which can be used to determine how the device performs under mechanical stress (tapping, flexing, etc.) and/or environmental stress (temperature, moisture, etc). For this example, the DUT is assumed to be a low IM termination (Kaelus SI-20, SI-30 or equal) that is attached directly to Port 1 of the PIM Analyzer or attached by a high quality, low IM cable assembly.

1. Reset back to Defaults. See Figure 20 , the Settings Menu
2. To switch to Time Mode, point and click on the Time Mode icon and a display similar to Figure 16 should appear. The analyzer will begin plotting the measured IM level as a function of time.
3. Every IM product (up to four) that lands within the pass band of the analyzer will be measured and displayed. If a product does not fall within the receive passband an exclamation mark will be visible by the product. See Figure 18.
4. Note that until the RF Power is turned on, the indicated measurement value is the system noise floor.
5. By pressing erase the previous trace and reset the peak markers. See Figure 16, Item 19.
6. With Port 1 connected to the DUT, turn the RF Power on.
7. If you want to pause the trace at any given time press the pause button , see Figure 16 item 28 . To start the button again. When the display is paused the run Icon will be displayed signifying that the trace will run if it is pressed.
8. Continue to record data until the trace reaches the right side of the display area. Note that the display continues to update with the current measurement and the prior measurements move off of the display to the left.
9. The Time Mode data can be printed copying to the system clipboard.
10. Press the “Clear” button and we note that the display clears and commences to record afresh.
11. This completes the tutorial on the Time Mode.




7.2.3 IM Measurement-Swept Frequency

The Swept Frequency Mode of the PIM Analyzer allows the characterization of the DUT across the full bandwidth of the communications band. While one carrier remains parked at the band edge, the other carrier sweeps across the full range of frequencies producing an IM response within the receive band of the analyzer. Both carriers are swept using this technique thus producing a two-trace plot on the screen. For this example, the DUT is assumed to be a low IM termination (Kaelus SI-20, SI-30 or equal) that is attached directly to Port 1 of the PIM Analyzer or attached by a high quality, low IM cable assembly.

1. Reset back to defaults. See Figure 20, the Settings Menu.
2. To switch to Swept Frequency Mode, point and click on the Swept Mode icon  and a display similar to Figure 29 should appear. The analyzer will begin plotting the measured IM level. With the advanced control panel (see Figure 27) you can set the frequencies that will be swept between for both F1 and F2 synthesizers and the step size between measurement points, see item 30, default is 0.2 MHz (100 KHz).
3. There are a number of trace pull down menus of different colors, each with a check box to indicate if they will be displayed. If the expected sweep products don't fall inside the receiver passband then a yellow exclamation mark will appear by that trace. See Figure 18. If that is displayed then the trace will not appear, likewise if the trace check box is not checked then that can also cause the trace to not appear. The trace selection and check box functions are the same for both Time and swept frequency modes. See Figure 16 Items 1 and Item 2. See Table 4 and Table 5, Table 6 , Table 7 for IM receive frequencies for each model.
4. With the link power control set to on, see Figure 25 5 indicates that Carrier 1 and 2 are at the same power level of 36 dBm each.

Frequency values in the Carrier Control portion of the VFP are dimmed as these are defined in the Sweep Settings portion of the VFP, which is below the Carrier Control section of the display.

5. On start-up, the RF power is off and the analyzer will begin sweeping frequencies. The displayed IM power level is the system noise floor as has been discussed in the previous sections
6. There are two frequency sweeps performed of each color trace
 - a. Carrier 1 (F1) Up. This sweep is first part of the trace performed. In this measurement, at the beginning of the sweep, Carrier 1 is set to the lowest transmit frequency defined using the advanced control panel, see Figure 27 Items 24, 25, 26, 27, 28, 29. Carrier 2 is set to the highest transmit frequency defined using the advanced control panel, see Figure 27 Items 32, 33, 34, 35, 36. Carrier 1 is then stepped up in frequency in the increment specified with the Frequency step size control, Item 30. Carrier 2 is kept constant at the high frequency specified. Every pair of frequencies that results in an IM frequency that falls within the passband of the analyzer is measured.
 - b. Carrier 2 (F2) Down. This sweep is second part of the trace performed. In this measurement, at the beginning of the sweep, Carrier 1 is set to the lowest transmit frequency defined using the advanced control panel, see Figure 27 . Carrier 2 is set to the highest transmit frequency defined using the Edit control. Carrier 2 is then stepped down in frequency in the increment specified with the Frequency Step control. Carrier 1 is kept constant at the low frequency specified. Every pair of frequencies that results in an IM frequency that falls within the pass band of the analyzer is measured.
7. Use the trace pull down menu to select an IM3 trace and check the check box beside it to ensure it will be displayed. See Figure 16 Item 1 and 2 . Note that the analyzer does not sweep all the way up to the highest frequency on the Carrier 1 Up sweep; nor does it sweep all the way down to Carrier 1 on a Carrier 2 Down sweep. This is because the analyzer only measures those combinations of frequencies that result in an IM frequency that falls within the receive band.

8. The mouse pointer can be hovered over any measurement point on the display and show the X,Y result for that point.
 - Trace Markers will automatically go to the trace peak and the numeric display next to the trace pulldown menu will display the peak value and frequency, see Figure 16 Item 4.
9. The swept frequency measurement will be repeated continuously unless one of the following actions is taken.
 - a. Press the  Button, see Figure 16 Item 19. This will interrupt the current sweep, clear the screen, and start a new sweep.
 - b. Press Trace Run/Pause, refer Figure 16 Item 28. This can hold the display still for further examination. The sweep will still continue in the background and can be viewed again once pause has been released.
10. The Swept Frequency plots can be printed via the browser, or individual results viewed by hovering the cursor over the graph measurement points, results can also be exported as CSV (Comma Separated Values) files on the server.
11. In some cases, it may be desired to test over a narrower bandwidth than the full transmit band capability of the analyzer. For example, a duplexer designed for just a segment of the full band. In these cases, where a reduced bandwidth swept frequency test is preferred, the sweep limits can be changed using the advanced control panel it can be lifted into view by pressing  using the scroll bar on the side of the menu and scroll to the lower part of the menu, refer to Figure 27.
 - a. There is a control on the left to adjust either F1 Start or stop Frequency and a corresponding control for F2. To adjust F1 Sweep Start frequency highlight Start first, see Figure 27 Item 24 . Your choice will be confirmed by both Item 24 “ Sweep Start “, becoming a lighter color , but also start will appear beside the adjustment panel, see item 25, now the F1 start frequency can be adjusted with either +- controls or highlighting the entry display (Item 27) and the desired frequency entered via the keyboard or numeric keypad. To change over to adjusting F1 Stop frequency, highlight the F1 Stop Panel (Item 28). This choice will be confirmed by the icon becoming a lighter color, you may also note that the start label now becomes a dull color and “stop” will now be visible to the left of the F1 adjustment display (Item 27). Now the stop frequency of F1 can be similarly adjusted. Note that the F1 Start frequency will be lower than F1 stop frequency as F1 sweeps low to high.
 - b. There is a control on the right to adjust either F2 Start or stop Frequency. To adjust F2 Sweep Start frequency highlight Start first, see Figure 27 Item 35 . Your choice will be confirmed by both Item 32 “ Sweep Start “, becoming a lighter color , but also start will appear beside the adjustment panel (see item 34), now the F2 start frequency can be adjusted with either +- controls or highlighting the entry display (Item 34) and the desired frequency entered via the keyboard or numeric keypad. To change over to adjusting F2 Stop frequency, highlight the F2 Stop Panel (Item 31). This choice will be confirmed by the icon becoming a lighter color, you may also note that the start label now becomes a dull color and “stop” will now be visible to the left of the F2 adjustment display (Item 34). Now the stop frequency of F2 can be adjusted. In contrast to F1, F2 Start frequency is higher than F2 Stop Frequency as F2 Sweeps from High to Low, so F2 Start frequency needs to be higher than the stop Frequency.
 - c. The power level setting for the swept test is the same as used for the time trace and can be adjusted at the top of the advanced control panel, see Figure 25 Items 1, 2, 3, 4, 5, 6, 7, 8. Whether the power adjustment is linked or independently set, it can be adjusted there. When your adjustments are complete, the advanced control panel can be lowered by pressing .
 - d. The out of band warning icon/s, see Figure 18, can be very useful when adjusting your sweep frequency limits to confirm your sweep selection will give products inside the receive passband for the items you have selected.
 - e. If your DUT is connected safely and ready to test. The Transmitters can be turned on using the Keyboard F4 button or using the mouse to click on the center of the (F4) RF On/Off panel. This will commence each of the checked traces in turn. Each trace is plotted in 2 parts, F1 low to high sweep followed by F2 high to low sweep, this is why you will see 2 lines of the same color for each trace.

7.2.4 Spectrum Mode

Spectrum Mode measures and displays the Spectrum received at the selected test port within constraints of the receive filter.

7.2.4.1 Advanced menu selections in Spectrum mode

Advanced menu settings are similar to those described in other modes. Rx Sweep range is added in the advanced menu for Spectrum mode to set the Rx Sweep Range start and stop frequencies. The ability to set Frequency step size is also included



Figure 33 Rx Sweep settings, advance menu spectrum mode

1 Receive sweep Start Frequency Selection

Press to highlight Rx Sweep Range Start frequency. The control below will then be enabled to adjust the Spectrum mode receive sweep start frequency, this can be adjusted by -+ controls or highlighting the number and entering the value numerically.

2 Receive sweep Stop Frequency Selection

Press to highlight Rx Sweep Range Stop frequency. The control below will then be enabled to adjust the Spectrum mode receive sweep start frequency, this can be adjusted by -+ controls or highlighting the number and entering the value numerically.

3 Frequency Adjust control Spectrum mode

Adjusts the frequency of the by highlighted stop/start Rx Sweep Range. -+ controls or highlighting the number and entering the value numerically.

4 Frequency Step size.

Adjusts the step size between measurement points, 100KHz to 2 MHz.

7.2.5 RTF (Range to Fault) Measurement Mode (Optional)

If you have purchased the optional Range to Fault module. This can be used to establish the distance from the test instrument of a PIM or Return loss source in your device under test.



Figure 34 RTF fault measurement mode

1 Entering RTF mode

First you will need to be in engineering mode and select the RTF icon. The icon will appear green when selected if the RTF module is fitted. You will be unable to enter RTF mode if the module is not fitted in that case the RTF icon will be grey in color.

2 Selecting Trace type

This pulldown menu allows you to select which trace type be displayed Return Loss, IM3 or IM5 products. As with other trace menus the checkbox indicates whether the trace will be shown or not.

3 Advanced RTF menu selection.

This will raise the RTF Advanced configuration menu refer to Figure 35

4 RTF Power Setting

This sets the RF Power level that RTF PIM tests are conducted at. If the Link Power control is set, this will control the output power setting of both transmitters.



Figure 35 RTF Advanced Configuration Menu

5 RTF F1 frequency setting

During RTF tests F1 frequency is set, to the frequency set with this control. The F2 frequency is swept according to the start and stop limits set. F1 must be set at the edge of or outside the F2 sweep range.

6 VF Cable Velocity factor

The cable Velocity Factor can be entered here. This can be obtained from the cable manufacturer's datasheet. Velocity factor is used to help establish the correct distance to the fault. Damaged cables (for example, poor handling or water ingress) or manufacturing tolerances may have a true velocity factor other than that indicated by the manufacturer. Mixing cable types and connectors can also impact on the true velocity factor. The distance to faults is likely to be incorrect if an incorrect velocity factor is applied.

7 Maximum measurement range

This is set to the maximum measurement distance required. The ability of the iBA to measure larger distances can be restricted by high cable insertion losses causing the reflected signal to be too small to be detected. Faults closer to the instrument causing insertion loss many need to be repaired before more distant measurements can be detected.

8 RTF F2 start frequency setting

When the start frequency icon is highlighted the adjustment control can be used to enter the swept start frequency used for RTF measurements.

9 RTF F2 stop frequency setting

When the stop frequency icon is highlighted the adjustment control can be used to enter the swept stop frequency used for RTF measurements.

8. Operation in Production Mode

8.1 Entering Production Mode

Production Mode can be entered directly from the home menu after your device has been selected or via the Engineering/ Production Mode icon.

8.1.1 Overview

Production mode allows for tests to be pre-configured with pass criteria added. Production mode provides for model and serial number information to be added by the test operator. Test reports can be configured to be saved automatically in PDF format. More suited to Go/No Go testing environments. The Swept PIM trace or Timed PIM trace will appear according to the current test step being executed.



Figure 36 Production Mode

1 Model Number entry

The Model number of the unit under test can be entered here for inclusion in the test report.

2 Serial Number entry and increment / decrement

The serial number of the unit under test can be entered here. The Up and Down arrows can increment or decrement numeric serial number if preferred.

3 Operator Entry

Enter the name of the operator conducting the test here.

4 Timestamp Display

The PC's System date and time is displayed here and is included on the report.

5 Comment entry

Any additional comments you want to make for inclusion on the report can be included here.

6 Test Selection and entry

▼ Will activate a pulldown menu of the programmed test sequences. + Will allow you to add another test sequence label. ✕ Will delete the currently displayed test sequence.

7 Test Start/Abort

Used to start or abort the currently selected test as Per item 6.

8 Edit test steps menu

This menu button will open or retract the edit steps menu, see Figure 37. Test steps can be added, deleted or edited via this menu including test times and limits. Access to the edit steps menu is available in Supervisor mode only.

9 Next Step Control

Next step control is used to progress to the next test step, when a test step is set to manual, next step is pressed to progress to the next test step

10 Bar Graph Display

The bar graph indicator gives the current result in bargraph form. This is particularly useful with dynamic testing and you need to be some distance from the test screen while vibrating a cable or connection.

11 Test Display

Shows the current Pass/Fail result of the current test step, a top panel shows Red Fail/Green pass status. The Current PIM Level and Peak result with the test limit that has been set.

12 Transmitter indicators

These show the current Power levels of Transmitter 1 and Transmitter 2 and their current frequencies

13 Step and test Progress indicators

The Step Progress indicator indicates the progress of each test step in turn. The Test Progress indicator indicates the progress of the entire test sequence.

14 Report Settings Menu

See Section 8.3.

15 Test Steps

Test steps are executed in the order indicated. Double click on the desired bar to edit an individual step. See Figure 37 and Figure 38 for step settings.

16 Hover over results

Holding the cursor over a point in the display will show the co-ordinate result for that point.
See also Figure 24 and Section 6.1.2.

8.2 Edit Test Steps Menu

8.2.1 Edit Steps Time Mode



Figure 37 Edit Steps Menu (Time Mode)

1 Up/Down through test steps

Move the currently selected test step Up/Down through the test order.

2 Mode Switch

Switches between [Fixed Frequency over time mode] and [Swept PIM], which will sweep each transmitter frequency in turn over the specified band.

3 Description

This is where you enter the description of the currently selected test step. This will also display in the area indicated by Item 10.

4 Product Selection Menu

This selects the intermodulation product you are looking for, IM3L as example is the 3rd order product Low side.

5 Threshold

Threshold sets the pass fail level in dBc (decibels below the carrier level), where power set levels are unlinked, the average power of the 2 carriers is used as the reference. PIM levels above the threshold cause a fail indication.

6 Message to Display

A pop-up display can be used to prompt the user for a particular action or reminder at the start of a test .

7 Power and Frequency Settings Panel

The operation of the frequency and power settings option in this panel are the same as the advanced menu, see Section 6.1.3.

8 Add/Remove step controls

The + control will add a new test step after the currently highlighted test step, see item 10. The – control will remove the currently highlighted test step.

9 Measurement type

This changes the measurement type between Automatic and Manual for the currently highlighted test step. Automatic will execute the current test step then automatically move on to the next test step. In Manual mode the test will not continue until the next step control is pressed, see Figure 36 Item 9.

10 Duration

This sets the time in seconds the test will run for before moving to the next step in the sequence. Minimum time 5 Secs.

11 Step Selection

Select the current test step to display or edit.

12 Test Port Cable Loss (Port 1)

Set the test cable loss from the instrument to the Device Under Test. Output Power is increased to compensate for this loss and the returned IM signal is also compensated for this loss on Port 1. Keep cable losses to a minimum, particularly if testing at higher power levels. Compensating for higher cable losses causes the Transmitter to run at higher power and temperature.

13 Test Port Cable Loss (Port 2)

As Per 8.2.1 item 12 except compensated for the Port 2 cable.

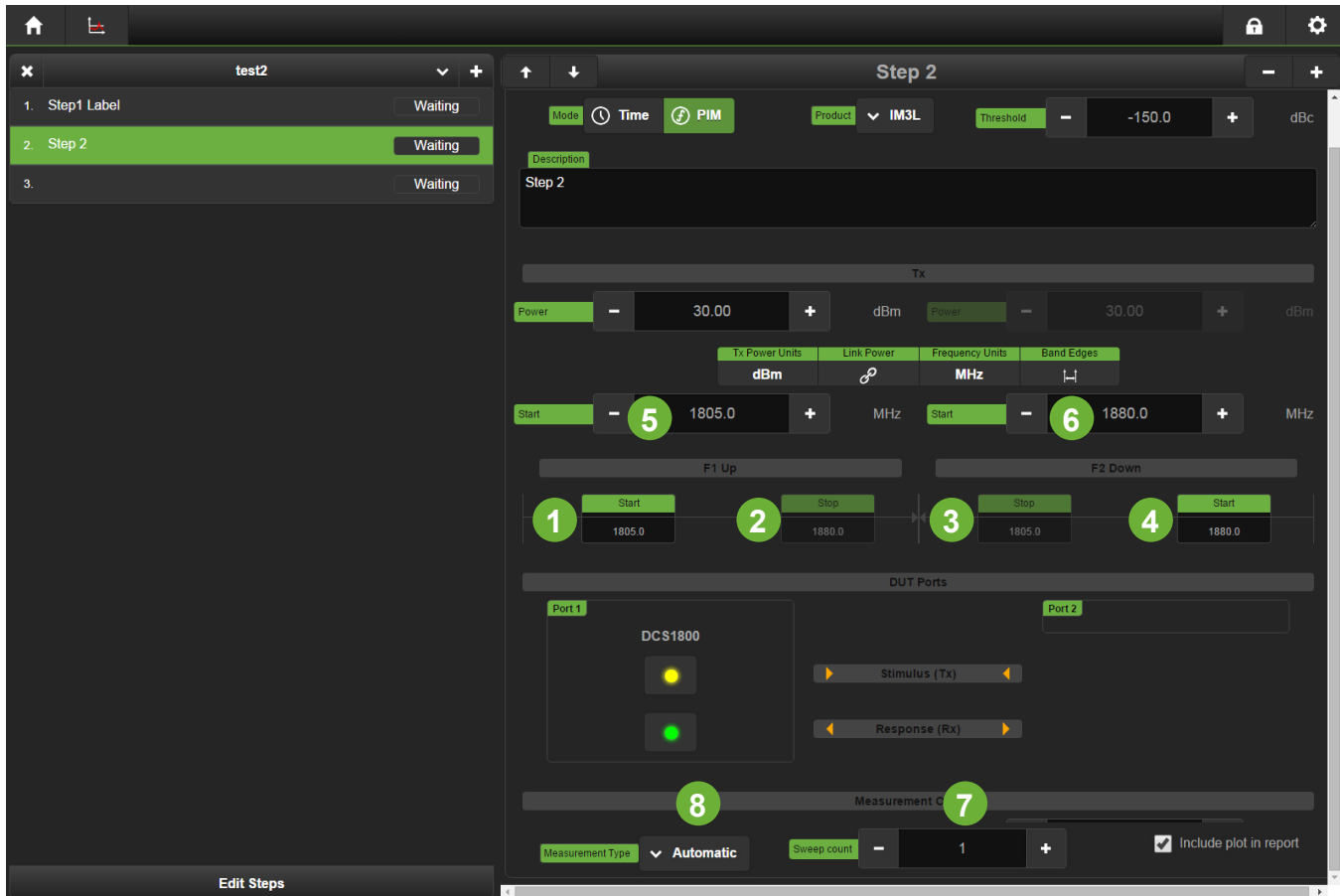


Figure 38 Edit Steps Menu (PIM Mode)

8.2.2 Edit Steps PIM Mode

The controls for PIM mode are very similar to those above for Time mode, menu items to permit frequency sweeping of each tone have been added. Depending on whether Start or Stop is highlighted each of the Transmitter frequency controls are used to set Transmitters Start or Stop Frequency. One transmitter is swept bottom to top frequency, followed by the other transmitter sweeping top to bottom in turn.

1 F1 Start Frequency

Click on the Start Icon, when selected will display a lighter green color Item 15 Control can now be used to adjust the F1 Start Frequency.

2 F1 Stop Frequency

Click on the Stop Icon, when selected will display a lighter green color Item 15 Control can now be used to adjust the F1 Stop Frequency.

3 F2 Stop Frequency

Click on the Stop Icon, when selected will display a lighter green color Item 15 Control can now be used to adjust the F2 Stop Frequency.

4 F2 Start Frequency

Click on the Start Icon, when selected will display a lighter green color Item 15 Control can now be used to adjust the F2 Start Frequency.

5 F1 Frequency Adjust Control

Plus or minus controls can be used to set F1 Frequency or the number can be highlighted and direct keyboard entry can be used.

6 F2 Frequency Adjust Control

Plus or minus controls can be used to set F2 Frequency or the number can be highlighted and direct keyboard entry can be used.

7 Sweep Count Control

Use the Plus or minus controls or direct keyboard entry to adjust the number of sweeps conducted for this step. Note: One sweep consists of both an F1 Start to Stop Sweep and an F2 Start to Stop Sweep. Time taken for each sweep will depend on the start stop frequencies selected and the frequency step size selected, see Figure 27 item 28.

8 Measurement Type

Measurement type can be automatic or manual. Manual mode requires Next Step to be pressed before the next step in the test sequence is executed. Automatic caused the current step to be completed automatically

8.3 Reports Settings Menu

The Report Settings menu is available when in Production Mode

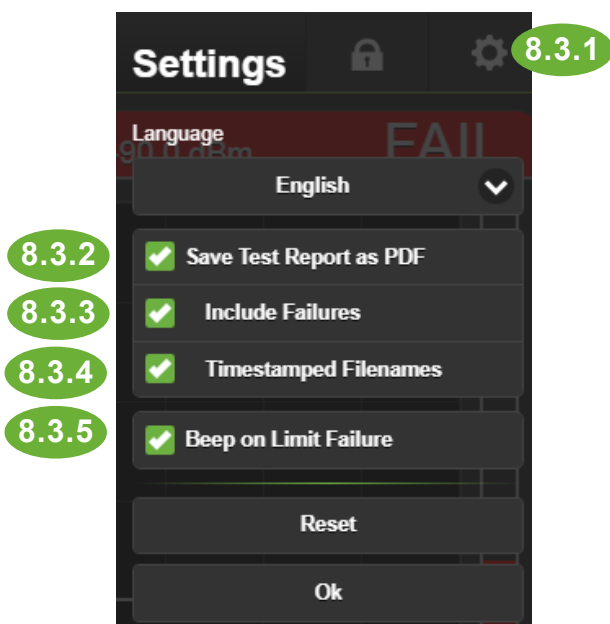


Figure 39 Report Settings Menu

8.3.1 Entering the report settings

Press the gear symbol while in Production mode to enter the report settings menu.

8.3.2 Saving test reports as PDF

When checked test reports are Automatically saved. The directory used is specified reports folder field on the PIM server refer Figure 8, if you have more than one iBA connected the Unit number will increment. The model will be included in the directory name \1-iBA-1800A B\ for example is the first iBA model iBA-1800A B and so on if the (Create a reports subfolder for each instrument) is checked.

8.3.3 Include failures

If checked failed tests will be included in test reports. If unchecked a failed test will not generate a report.

8.3.4 Timestamp filename

The filename used to store the report is derived from a date and time stamp followed by the DUT model and serial number. If unchecked the filename created is derived from the serial number only.

8.3.5 Beep on Limit Failure

If checked the browser session will beep should the product fail the test spec set.

9. Applications Information

9.1 Introduction

For first-time users who require additional information on how to effectively utilize the Passive IM Analyzer, this section presents typical measurement scenarios and applications information. **Important note: let the iBA warm-up for 20min before performing the measurement.**

9.2 Noise Floor vs. Residual IM Floor

Understanding how the random noise floor of the analyzer and the residual IM floor of the analyzer are related is essential.

The noise floor of the analyzer is defined as the mean value of the measured signal when Port 1 and Port 2 (see Note 1) of the analyzer are terminated into 50 Ohms and the RF is turned off. This noise is random and is typically due to a combination of phase noise in the local oscillator and kTBF noise from the receiver's pre-amplifiers. You cannot make a meaningful IM measurement at a level below the noise floor of the receiver.

The residual IM level of the analyzer is caused by internally generated IM within the analyzer's cabling, internal connectors, filters, and duplexers. This level is typically larger than the noise floor of the receiver for the third-order IM product. When an IM measurement is performed on a DUT whose true IM level is near that of the analyzer, measurement errors can occur. This is because the residual IM of the analyzer vectorially combines with the true IM of the DUT producing a measurement with a potentially high uncertainty level.

Figure 40 shows the classical measurement uncertainty curve. The x-axis shows the magnitude of the error source relative to the true magnitude of the response being measured. The y-axis shows the maximum measurement uncertainty in the measurement due to this single error source assuming worst-case coherent addition and subtraction between the error source and the true response.

Some useful data points from this curve are presented in Table 3

NOTE 1: Port 2 only available in the IBA B and D Series

Error Relative to True Value, dB	(+) Uncertainty, dB	(-) Uncertainty, dB
-10.0	2.39	-3.30
-20.0	0.83	-0.92
-30.0	0.27	-0.28

Table 3 Key Measurement Uncertainty Values for 10,20, and 30 dB-Down Error Sources.

In practical terms, what this means is that if the residual IM is 10 dB below the actual IM of the DUT, the Measurement Uncertainty due to the residual IM is +2.39dB and -3.30dB.

(Showing the Maximum Measurement Uncertainty Due to a Single Error Source)

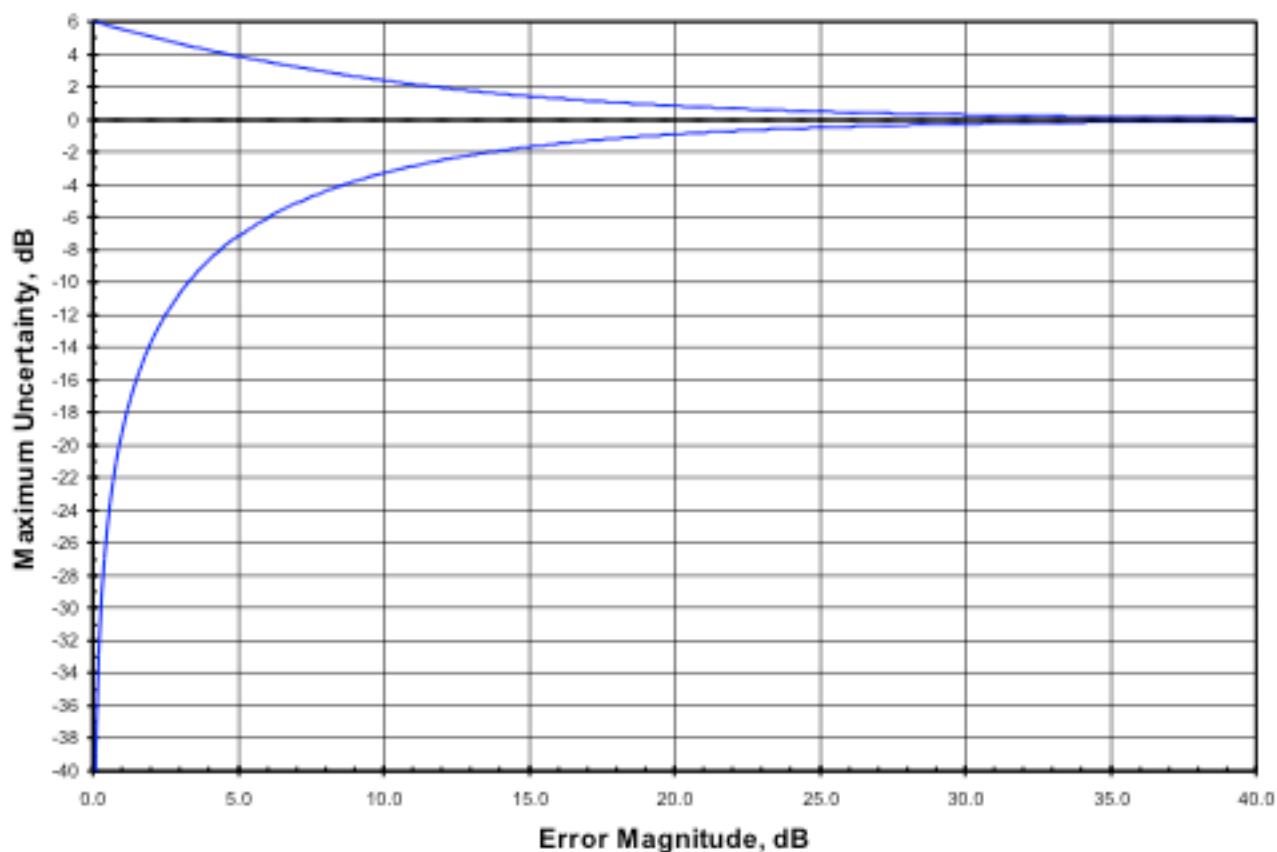


Figure 40 Standard Voltage Error Curve



NOTE: When using the Passive IM Analyzer, the fluctuations in the measured value due to the receiver noise floor are not as great as the values in Figure 40 indicate. This is because the internal receiver in the analyzer utilizes significant amounts of video filtering to effectively reduce the magnitude of random noise errors to their mean value.

9.3 Measuring Residual IM

Warming up the equipment for 20min and measuring the residual IM of the test setup prior to testing the DUT is highly recommended. This measurement establishes the lower limit below which the DUT's IM characteristics cannot be accurately measured. For the typical passive IM measurement, it is desired that the residual IM level be at least 5 to 10 dB below the IM level of the DUT. From

Table 3, a residual IM level 10 dB below the DUT IM level allows the measurement of the DUT's IM with an approximate +2.4 and -3.3 dB uncertainty. To measure the residual IM of the test setup, the high power transmitter must be terminated into a load. This load must not generate significant levels of IM. For example, the PIL-0006A Low-IM Termination produces an IM level not exceeding -120 dBm with 2 x 20W carriers. Placing this load at the end of a cable (which would normally connect to the DUT) allows the user to certify the residual IM of the test setup does not exceed -120 dBm.

When using a connecting device (such as a cable or adapter) between the analyzer and the DUT, it is good practice to ensure that the residual level is stable under all conditions that might be encountered during the DUT measurement. For example, if stress will be placed on the cable or adapter during the test, place a similar stress on the cable or adapter when terminated into the load to ensure the residual level remains at or below the desired limit under all test conditions.

9.4 IM Troubleshooting

When measuring a device, it is sometimes necessary to determine the source of an unacceptably high IM level within the device. There are several techniques that have been found to be useful:

- **Tap Testing:** By lightly tapping on individual locations around the DUT, the IM level will sometimes jump dramatically. Use the lightest possible tapping pressure to induce the jump in IM so the location of the IM problem can be localized. This technique works well on tuning screws, connector joints, and antenna feed networks.
- **Cold Spray:** By spraying a suspect location with a cold spray (such as a Freon-equivalent), the mechanical properties of a junction can be changed slightly. This can result in a dramatic change in IM level thus indicating a possibly poor mechanical joint.

If the IM level remains constant and at an unacceptably high value during the above two tests, the high IM level may be intrinsic to the design, or may be caused by a materials problem somewhere in the high-power RF path.

9.5 Unique Considerations for Antenna IM Testing

When measuring the IM of antennas, it is important to eliminate the following common sources of error:

- **Residual IM Stability:** Ensure the residual IM of the cable connecting to the antenna remains below the desired DUT IM level. This can be tested by placing a low-IM termination at the end of the cable and then moving the cable through the entire range of motion required for antenna IM testing.
- **Ambient IM:** Ensure the environment into which the antenna is radiating is not generating a significant IM level. This is readily demonstrated by physically moving the antenna while monitoring the reverse (reflected) IM level. If the IM level changes with antenna movement, it is possible IM is being generated beyond the antenna itself.
- **Tx Power Loss:** When using a cable with losses in excess of 1 dB, the passive IM measurement error can become significant. For example, if the analyzer indicates a +43 dBm carrier power level, but the cable connecting to the antenna has 1 dB of loss at the carrier frequencies, only +42 dBm is reaching the antenna. This can result in an IM3 measurement error of up to 3 dB compared to a true 2 x +43 dBm carrier measurement.

To reduce the errors associated with cable losses, use the Carrier Power Offset feature of the analyzer. First, measure the insertion loss of the cable assembly using a network analyzer or equivalent instrument. This should be done at the middle of the transmit band of the analyzer. After determining the insertion loss, use the Carrier Power Offset and enter the measured insertion loss as a negative number. The result is that the power reference point is moved to the end of the cable. Therefore, all power indications displayed and printed are accurate for the power present at the end of the cable.

9.6 Interpreting IM Test Results

The Kaelus PIM Analyzer provides four unique displays for evaluating the IM performance of a device-under-test. These are:

Time Mode: Displays up to four IM products simultaneously as a function of time in seconds.

Swept-Frequency Mode: Displays one IM product at a time as the transmit carriers are swept in frequency.

Spectrum Mode: Displays a Spectrum Display at the input Port this can be done with transmitters on, off or Low Noise.

RTF Mode: Establishes the range to fault of either a return loss fault or a passive intermodulation fault.

Each of these modes provides a unique insight into the behavior of a device.

9.6.1 Time Mode

Strip-Chart Mode allows the measurement and recording of IM versus time. When performing some tests on the DUT, it is not always possible for the operator to monitor the measured results while inducing changes on the DUT. Time Mode records data that can be reviewed after the DUT has been disturbed.

9.6.2 Swept-Frequency Mode

By varying the IM frequency, the frequency-domain behavior of the IM response can be analyzed. This can be quite helpful in identifying the source of an IM problem. For example, if the measured forward (through) IM level from a filter closely follows the known S21 curve, it is likely the IM is either being generated prior to the filter, or is being generated at the stimulus (input) side of the filter. If the IM response is virtually flat with frequency, it is likely the IM is originating at the side of the filter from which the IM response is measured (e.g. the output port of a transmit filter).

For a cable assembly, a reverse (reflected) IM measurement that is frequency-dependent typically indicates the presence of more than two IM sources. A frequency-independent reverse (reflected) cable IM response typically indicates only one end of the cable is generating IM

9.6.3 Spectrum Mode

Spectrum mode allows you to monitor Spectrum products in the filter pass band. This can be done in transmitters on mode where different order intermodulation products or other signal sources can be monitored while being excited with RF power. In transmitter off mode where transmitters are powered down. Or low noise mode where both transmitters' output power and exciters are turned off, this can be particularly useful when multiple instruments are being used on a common test setup.

9.6.4 RTF Mode

Devices with variable group delay performance such as filters can cause time changes in the reflected RTF signals. Adjusting test frequencies to be in the area where group delay performance is consistent can assist in locating the correct distance to fault. Setting the test range to less than the actual assembly length can cause additional peaks to be displayed. Setting the range to something slightly larger than the known assembly length is advisable.

9.7 IM Measurement Examples

9.7.1 Cable Assemblies

There are two approaches to measuring the passive IM response from a cable assembly. Figure 41 illustrates the connection diagrams associated with each method.

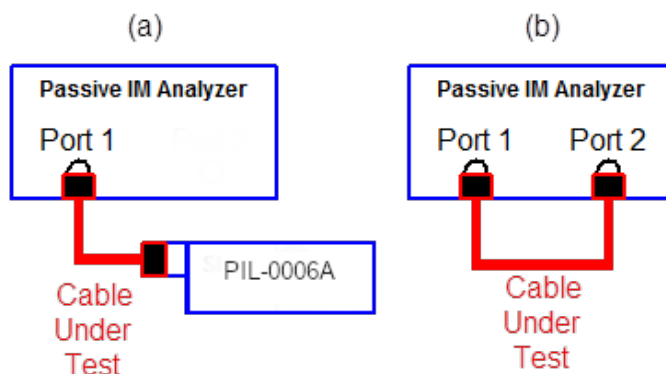


Figure 41 Typical Test Connections for MEasuring Cable Passive IM.

The most accurate measurements are made using the connection shown in Figure 41(a). With this method, the cable is terminated into a low-IM termination. This termination should be capable of handling the combined carrier power used for the test while generating a minimum level of IM. The termination should present a good return loss to the cable not only at the carrier and IM frequencies of interest, but also at the low-order harmonics of the carrier frequencies. Because IM is the result of a combination of harmonics (such as $2 \times F_1$ and F_2 for IM3), maintaining a near-unity VSWR for each of the relevant harmonics enhances measurement accuracy.

The disadvantage to using the termination technique shown in Figure 41 (a) is the possibility of a frequency-dependent IM response. As the IM sources contained within the cable assembly may combine both in and out of phase (depending upon the electrical length of the cable at the IM frequency), a single-frequency test is insufficient to characterize the cable's worst-case performance across an entire communications band. This requires the use of the Swept Frequency Mode to identify the IM peaks and nulls that might occur in a reverse (reflected) IM measurement.

Figure 41(b) illustrates how the analyzer itself may be used to terminate the cable assembly. Port 2 of the analyzer presents a low-IM termination to the cable. However, because this port is actually a filter input, the impedance match at frequencies other than the transmit band or receive band is not typically well behaved. This can result in a high VSWR value within the cable assembly at frequencies that are harmonically related to the carrier frequencies. This can increase the measurement uncertainty of the cable IM measurement.

The one-port method (shown in Figure 41(a)) provides optimal measurement accuracy, but requires an external termination and the use of swept-frequency mode. The two-port technique (shown in Figure 41(b)) provides measurement flexibility at the expense of increased measurement uncertainty.

9.7.2 Duplexers

Figure 42 illustrates a typical connection diagrams for evaluating the IM of a three-port duplexer. The transmit port of the analyzer (Port 1) is connected to the duplexer. The residual IM from Port 1 of the analyzer and the interconnecting cable to the port of the duplexer should be no greater than the expected IM level of the duplexer plus the Rx isolation of the duplexer. For example, if the duplexer has 40 dB Rx-band isolation between the Tx. port and the Antenna port, and the IM specification for the duplexer is -120 dBm, a maximum of -80 dBm of IM is allowable at the input port of the duplexer. The antenna port of the duplexer is terminated in a low-IM termination that has a residual IM below the expected IM measurement level.

Finally, the Rx port of the duplexer is connected to Port 2 of the analyzer. A “Forward” (or through) IM measurement mode is selected on the analyzer. By monitoring the reverse (reflected) IM power, the integrity of the Tx-port connection can be monitored to ensure a high IM level is not being injected into the duplexer.

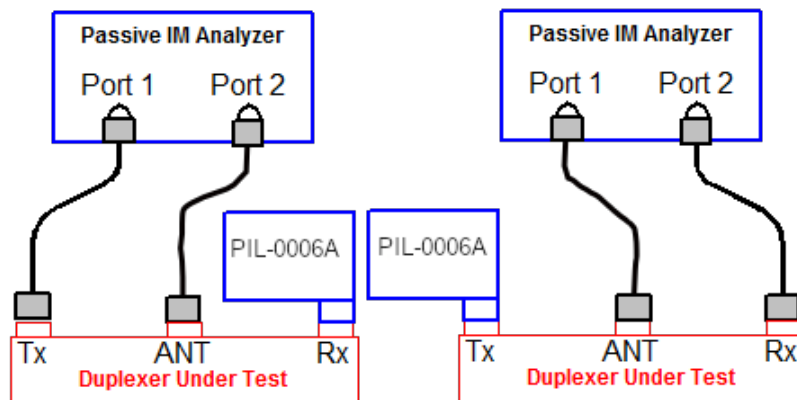


Figure 42 Typical Diagram for Evaluating Duplexer Passive IM

When evaluating the measured IM of a duplexer connected as shown in Figure 42, key information is available for analysis by comparing the results from each configuration. If a high IM level is present on both the antenna to transmit-ports and rx ports of duplexer, a failure is likely within the duplexer near the antenna port connection. If a frequency-dependent IM level is measured with a low IM level present from the other port, the failure is likely located near the port being measured. Note: For single port iBA's the second Duplexer port would be terminated with an additional low IM load and reverse only measurements conducted.

9.7.3 Antennas

Measuring the IM generated by an antenna requires careful attention to the instrumentation, cabling, and surrounding environment. Figure 43 illustrates a typical connection diagram used to measure a dual-polarized (2-port) antenna. Port 1 of the analyzer is connected to one of the two antenna ports. The second port of the antenna can be terminated with a low-IM termination, or can be terminated into the Port 2 of the analyzer. This second approach has the added advantage of being able to measure the IM present on the orthogonal antenna port while the other port is driven with two high power carriers.

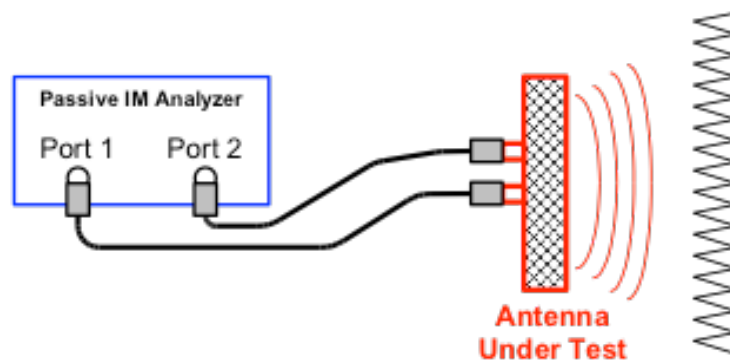


Figure 43 Typical Connection Diagram for Evaluating Antenna Passive IM.

The main beam of the antenna must be allowed to radiate freely. That is, absorbing structures should not be placed in the reactive near field of the antenna. This can adversely impact measurement accuracy. If absorber is used to contain the radiated field, ensure that the conductive backing to the absorber is not generating IM. Also ensure that RF is not leaking around the absorber in co-polarized gaps between the absorber pieces.

9.7.4 Measuring High IM Level Devices (e.g. Ferrites)

The PIM Analyzers provided by Kaelus are optimized for receiving IM signals between approximately -50 and -140 dBm. IM signals above -48 dBm are digitally limited. IM Signals above 20 dBm may damage the receiver protection circuits.

Configure the Test Setup. Figure 44 illustrates the connection used to measure the forward IM of a device that is expected to produce IM levels in excess of -50 dBm. Such a device might be a ferrite isolator. In this configuration, the two carrier tones are injected directly into the DUT. IM generated within the DUT propagates back towards Port 1 of the test set and also into the directional coupler (connected to the DUT output port).

The directional coupler is oriented so that a sample of both the carrier tones and the IM signal are routed to the coupled port. The through arm of the coupler is terminated into a low IM termination such as the Kaelus Model PIL-0006A.

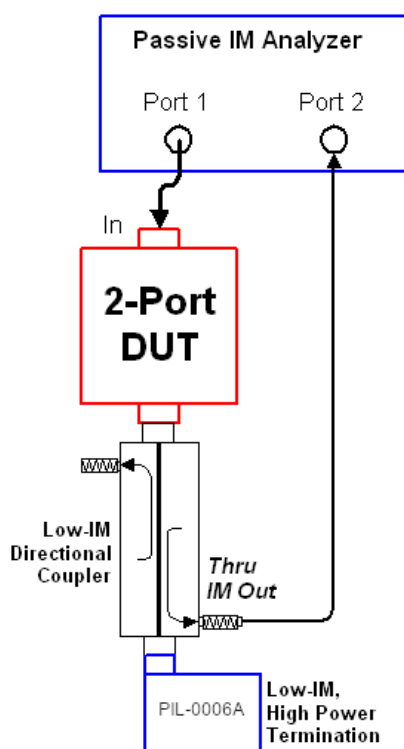


Figure 44 Measuring High Forward IM Levels with the PIM Analyzer

Figure 45 shows how the same approach may be used to measure the reverse IM from a DUT. Notice the coupler direction is reversed in this application compared to Figure 44. This allows the IM signal traveling towards Port 1 of the analyzer to be sampled and eventually measured at Port 2.

In both figures, a fixed attenuator is attached to the coupled arm of the directional coupler. The value of this attenuator is determined by the expected IM level. If unsure, start with two 30 dB attenuators placed back-to-back. The purpose of the attenuators is to further reduce the IM power below the level achieved with the directional coupler alone.

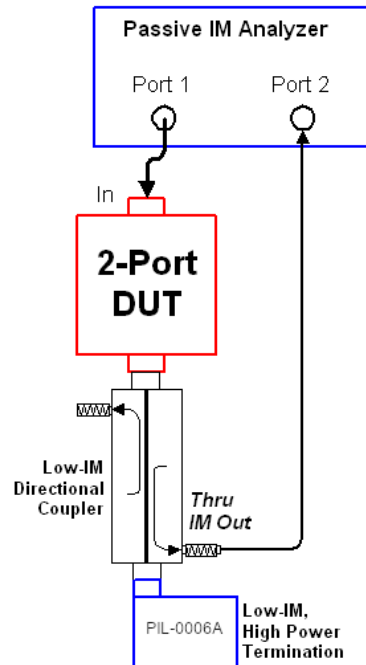


Figure 45 Measuring the IM of a Power Combiner Using Individual CW Tones.

The output of the fixed attenuator is then connected to Port 2 of the analyzer. The green indicator above Port 2 on the web interface should be illuminated for this test. This means that the IM power incident on Port 2 of the analyzer will be displayed on the screen.

In both forward and reverse test setups, ensure the IM generated by the test setup does not generate significant IM levels (relative to the DUT) for the power levels used in the testing. This may be done by simply removing the DUT and checking the residual IM prior to making the measurements.

Making the Measurement. Turn on the carrier power and begin with the carriers set to a very low level.). Increase the power in small increments (3 dB per step) until an IM signal is detected. If an IM signal is not detected at the maximum desired carrier power, remove some attenuation from the coupled port of the directional coupler and repeat this test. It is desirable to find a combination of coupling coefficients and attenuator values that will result in an IM signal that ranges between -130 and -55 dBm over the range of carrier powers of interest. For example, if the indicated IM level on the analyzer's display is -55 dBm for the lowest carrier power level of interest, increase the value of the attenuator by at least 40 dB and insure the IM signal is below the digital saturation level.

Once the IM power level has been placed within the dynamic range of the analyzer, you must manually add back the combined loss inserted by the directional coupler and the attenuator(s). For example, if the display indicates a forward IM level of -90 dBm, and you are using a 30 dB directional coupler and 40 dB of attenuation, the true IM level is -20 dBm (-90 dBm + 70 dB).

Helpful Hints. These quick tips can help reduce measurement uncertainty:

Choose the IM Units to be displayed in "dBm" for the best measurement accuracy. This removes the uncertainty associated with the carrier power level measurement from the receive IM power level results.

Minimize the length of cable between Port 1 of the analyzer and the DUT.

Make sure the IM signal decreases when the carrier power decreases. If not, the receiver may be in hard compression.

9.7.5 Forward and Reverse PIM

PIM can be measured in the forward and reverse direction. Reverse being the most common, where multiple sources of PIM may exist, it is advisable to sweep the test signal frequencies to detect signal nodes cause by returns from multiple PIM sources. Forward PIM can be less effected by multiple PIM sources, where cable losses are greater; in the order of 7dB or more, distributed PIM in the cable may make PIM more difficult to detect. In these instances swapping the end the signal source is applied to and checking reverse PIM on each end can assist.

Reverse PIM

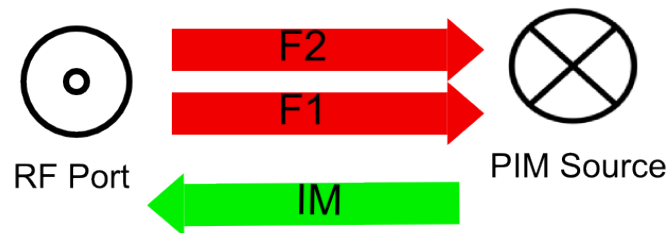


Figure 46 Reverse PIM

Forward PIM

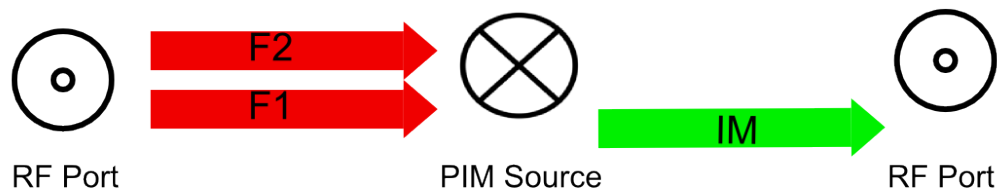


Figure 47 Forward PIM

10. Maintenance

10.1 Operating Environment

For maximum life, operate the equipment within the following environmental limits:

Relative Humidity: 10% to 90%, non-condensing

Ambient Temperature: 60 Degrees to 80 Degrees Fahrenheit (16 to 26.6 Degrees Celsius)

Away from Direct Sunlight

Away from High Levels of Dust or Dirt

10.2 Transporting

It is recommended to retain the original packing materials shipped with the unit for use in the event the equipment must be shipped again. There is a packaging fee of USD \$50.00 per box for return shipments to the customer if the units are returned in inadequate packing.

10.3 Cleaning

If the exterior of the instrument modules become dirty, use only a damp, dust-free cloth to clean. **Do not use abrasive cleansers or excessive moisture to clean the units.**

When cleaning, do not spray the equipment directly. Spray the cloth first, and then wipe the equipment. If the analyzer is operated in an environment heavy with dust or smoke, you should occasionally clean the equipment vents. This is best performed using a special vacuum cleaner and nozzle specifically designed for cleaning computer equipment. Over time it is possible that dust may collect on internal fans and heatsink components. As part of regular maintenance and calibration, qualified service centers will clean the internal cooling galleries and fans, failure to service the cooling system can cause overheating and damage the instrument.

If liquid is spilled into any part of the analyzer, immediately disconnect the AC power at the wall. Disconnect all equipment from the AC power source, not just the unit soaked by the spill. Orient the soaked units for maximum drainage and allow them to dry completely. Once dry, the system can be evaluated for proper performance to see if permanent damage



WARNING

Mains power is connected inside the equipment, do not remove the covers, refer servicing to qualified service personnel. Isolate and disconnect suspect equipment from mains power.

10.4 Protection

It is highly recommended that the PIM Server computer be connected to an uninterruptible power source (UPS) or commercial-grade surge protection device. This will reduce the chance of computer damage in the event of a lightning strike nearby or areas of poor power regulation.

If a lightning storm enters your area, disconnect the computer, monitor, and disconnect PIM Module devices from the wall and wait until the storm passes.

During normal operations, it is recommended not to repeatedly turn the AC power to the computer and power supply on and off with very short intervals of on-time. The life span of the equipment will be increased if the equipment is left on for more than 30 minutes at a time.

The computer and powered PIM modules must be connected into the same AC power circuit (i.e., they share a common circuit breaker) for proper operation.

10.5 Routine Verification of Performance and Maintenance

On a daily basis, it is a good practice to ensure the proper operation of the PIM Analyzer. The verification process determines the baseline performance of the test equipment as well as the accuracy of the measurements being made.

10.5.1 Verifying Residual IM Performance and Operation of the Analyzer

Verifying the residual IM performance of the analyzer ensures proper operation of the analyzer as well as providing a performance baseline for future testing.

To verify proper IM performance of the analyzer, several items are required: 1) A known low IM termination and 2) A test item that will generate IM. For example: a nickel-plated device, a high power attenuator, a PIM reference standard such as Kaelus PIS-0002A, or a failed device.

1. Start the Virtual Front Panel and enter "Engineering Mode".
2. Select and enter desired operating frequencies for Carriers 1 and 2 as described in Section 6.1.3.
3. Select and enter desired testing power levels for Carriers 1 and 2 as described in Section 6.1.3. Typically, set to 43.0 dBm or 20 Watts. If the Power Lock Control is "ON" only Carrier 1 will need to be set.
4. Select which IM order is to be tested as described in Section 6.1.3
5. Attach a low IM termination such as a PIL-0006A to Port 1 of the analyzer. If a PIL-0006A or similar is used, make the attachment with a 7/16 DIN (male to male) adapter. If a SI-30A or similar termination is used, a short cable with known low IM performance may be used to make the connection.
6. Turn the Carrier powers "ON" by either pressing the "F4" key.
7. Read the displayed IM response for the IM order being measured on the Engineering Mode display.
8. At this point, if the interconnections are properly attached the IM level should be below the specification limit.



IMPORTANT NOTE: The interconnecting adapters, terminations, and cables used in this application should have known good IM performance. Typically, the performance of the adapters, terminations, and cables should be nominally, -120 dBm or better than the specification value of the required test.

9. Turn the Carriers “OFF” by either pressing the “F4” key .

If large fluctuations in the IM level are noticed, ensure that the interconnections are clean, properly attached, and that they do not show signs of excessive wear.

The resulting IM value being displayed can be considered the Residual IM Performance of the system. This measurement



IMPORTANT NOTE: At these low signal levels, variations of ± 3 dB are not uncommon. However, there should not be intermittent spikes of high IM.

is the total IM being produced by the internal components of the analyzer, the corresponding adapters and/or cables, and the termination. This measurement can be considered a “Baseline” measurement for future testing reference or analyzer performance.

Once the Residual IM performance of the analyzer has been measured, it is a good practice to determine if the analyzer’s receiver is operating properly. One of the best ways to determine accuracy of measurements is to place an IM reference such as a Kaelus PIS-0002A into the test setup mentioned in steps 1-8. This will allow the user to measure the IM generated by a known IM source and compare the source’s expected IM performance to that of the analyzer. Use of a known PIM source allows the operator to verify and have confidence in the test setup.

Full technical specifications of the Kaelus PIS-0002A PIM Source, shown below, can be found at www.Kaelus.com.

Expected PIM levels from PIS-0002A:

20W: -80dBm (-123dBc) ± 3 dB

4W: -101dBm (-137dBc) ± 4 dB



Note: Nominal values shown. PIM sources can vary between -74 dBm to -86 dBm from the factory, dependent on frequency. During equipment verification, ensure that the performance is within ± 3 dB of nominal for that particular PIM source.

10.5.2 Front Panel Connections and Connector Savers

As with any sensitive measurement equipment, great care must be taken when making connections to either Port 1 or Port 2 on the analyzer. At this point please refer to Kaelus’ Application Note #1900-4, “Proper Mate/De-Mate Procedure for DIN 7/16 Connectors”, available in Section 11 or at: www.Kaelus.com.

10.5.3 Use and Care of Front Panel Connector Savers

Kaelus ships connector saver/s with every unit. The use of the connector saver/s is highly recommended and will contribute to the overall preservation of the residual performance of the analyzer. The connector savers are attached to Port/s on the front panel of the IBA PIM Analyser to protect the analyzer’s 7/16 connectors from excessive wear and damage. Kaelus recommends the use of the connector savers as they are easier and less expensive to replace than the front panel connectors.

The use of proper mating/de-mating procedures is highly recommended. This will ensure optimum mechanical endurance and residual performance. When applying or replacing the connector savers, it is recommended that a torque wrench be used, with a 25 – 30 Nm (Newton meter) setting.

When connector savers are worn, the residual IM performance becomes high. High usage analyzers, such as in a production environment, should have connector savers regularly replaced to ensure measurement accuracy.

Daily maintenance may be performed by using a soft, cotton-like probe such as a Q-tip soaked with Ethyl alcohol. Using



IMPORTANT NOTE: Care should be taken when applying torque to the front panel connectors. Exceeding the torque specifications may cause permanent damage.

Ethyl alcohol and cotton tipped swab, clean out the connector and before the connector dries, use compressed air to blow out the remaining particulates and alcohol. This cleaning will remove tiny particles, such as silver plating, which may lead to high residual IM levels.

10.6 Care and Maintenance of the PIL-0006A Low IM Terminations

The PIL-0006A Low IM load provide a convenient way of terminating devices and test ports without generating significant levels of IM products. To ensure reliable operation of either termination, the following procedures have been included to maintain and verify proper operation. For detailed specifications, please refer to the Operating and Maintenance Manual for the specified termination.

10.6.1 PIL-0006A Connector Maintenance

The PIL-0006A were designed to provide a minimum 16 dB return loss from 600 MHz to 4 GHz. The level of any single IM response generated in the reverse direction from the termination is less than -120 dBm for the PIL-0006A two, +46 dBm carriers are incident upon the termination.

As with any sensitive measurement equipment, great care must be taken when making connections to either Port 1 or Port 2 on the analyzer or when attaching Terminations. At this point please refer to Kaelus' Application Note #1900-4, "Proper Mate/De-Mate Procedure for DIN 7/16 Connectors", available in Section 10 or at: www.kaelus.com.

Occasionally, the measured IM level from the termination may appear to exceed the specification limits. This can occur due to one or more of the following causes:

1. The connector or device mating to the termination also has an approximate -120 dBm IM level. This results in the IM from the termination and the connector adding in-phase to produce a resultant IM level as much as 6 dB higher than any one device's individual IM level.
2. The connector is not torqued properly. This results in partially mated electrical contacts within the connector. The termination's connector is designed for a coupling torque of 30 Newton-meters (approx. 22 foot-pounds). If "O"-rings are installed in the mating connector, or if the mating connector is designed for a higher coupling torque, up to 50 Newton-meters (approx. 36 foot-pounds) may be used. Do not exceed this maximum torque as the termination's connector may be damaged.
3. The connector is contaminated. Ensure both the termination and the mating connector are clean and free of contaminants. Use a lint-free swab and alcohol to clean the interfaces, followed by a blast of clean air. For more detailed connector/connector saver care information, please refer to Section 10.3
4. The connector is excessively worn. After many mate and de-mate cycles, the connector on the termination may become worn. When the silver plating thins, this exposes metals, which can produce an IM response. Please refer to the appropriate termination's manual for more information on replacing the connector on termination or contact Kaelus directly.

10.7 Advanced Verification and Troubleshooting Techniques

The following section has been provided to allow the user to make some simple measurements to verify proper operation of the analyzer.

10.7.1 Power Output

To verify the proper carrier power output of the analyzer, a power meter can be used to measure the output power of each carrier.

With the analyzer turned on.

1. Start the Virtual Front Panel and enter Engineering Mode.
2. With the RF power turned off, connect a power meter to the front panel connector labeled "Port 1".
3. In the Engineering Mode display, disable the "Lock Carrier Power Control" as described in Section 6.1.3, Item 5.
4. Set Carrier 1 Power Control to 40.0 dBm, as described in Section 6.1.3 Items 1,2,3.
5. Turn Carrier 1 power on. Note : To turn on only one carrier press only the red indicator rather than F4, see Figure 48.



IMPORTANT NOTE: Be sure to attach the necessary attenuation or the properly rated power sensors to prevent damage to the power meter and or sensor.



Figure 48 Turning on only one carrier

6. The power meter should read within ± 1.0 dBm of the requested power value (accounting for any attenuation placed “in-line”).
7. Increase the Power for Carrier 1 to 43.0 dBm and verify.



IMPORTANT NOTE: Care should be taken when interpreting displayed power measurements. Cabling loss, calibration inaccuracy in the power sensor, and calibration inaccuracy in the attenuator all need to be considered in determining if there is a discrepancy in measurements. Typically, for this measurement, a calibrated attenuator should be used and allowances must be made for changing attenuation values with the heating of the attenuator.

8. Turn Carrier 1 “OFF” and repeat steps 4 - 9 for Carrier 2.

10.7.2 Frequency Output

To verify the proper frequency output of the analyzer, a frequency counter can be used to measure the frequency of each carrier.

With the analyzer turned on:

1. Start the Virtual Front Panel and enter Time Mode.
2. With the RF power turned off, connect a frequency counter to the front panel connector labeled “Port 1”. Set Carrier 1 Frequency Control to a valid frequency within the analyzers’ transmit band, as described in Section 6.1.3.Items 10,11,12.
3. Turn Carrier 1 power on.



IMPORTANT NOTE: Be sure to attach the necessary attenuation to prevent damage to the frequency counter.

4. The frequency counter should read within a few hundred Hertz of the requested frequency.
5. Vary the Transmit Frequency for Carrier 1 and verify proper operation.
6. Turn Carrier 1 “OFF” and repeat steps 2 - 7 for Carrier 2.

11. Service

If the analyzer appears to require service, please contact your local Technical Support at Kaelus. See www.kaelus.com. If, following your initial contact it appears the unit is malfunctioning; an RMA number will be issued to allow the return of the suspect unit to the factory for repair. **Do not return equipment without first obtaining an RMA number from Kaelus.**

11.1 System Controller

The System Controller is a standard, PC-compatible computer. Please refer to the System Controller’s literature for information regarding servicing this unit. Minimum PC Spec Windows 10 \geq 2Gb Ram, 4Gb recommended, Core i5 Processor, 1GByte of spare disk space typical or additional space for production reports as required.

The system is intended for use with a standalone System Controller for the PIM Analyzer. Installing additional peripheral hardware and/or associated software in the controller is NOT recommended.

11.2 Installing PIM Server Software

This section of the manual refers to the installation of the PIM Analyzer software and instrument drivers under Windows 10. A unique *Calibration File* is required to maintain the calibration coefficients of a particular RF Module. The calibration file is stored on an internal USB Drive and shipped with the Operating and Maintenance Manual and installation software. The calibration files on the USB drive must be transferred to the System Controller connected to the particular RF Module for which the USB Drive has been created. The PIM Server will transfer the required files when a new, or re-calibrated instrument is detected.

Using the USB B to USB A cable. The iBA will appear as an external drive when connected to the control computer. It is recommended you make a backup of the internal USB files and keep them in a safe place. R950306-Rev*.**.-SWARE-PIM_SERVER.msi. Can be copied to the control computer and installed, it is also recommended that the Chrome web browser is installed from the web and set as the default browser for the system. Calibration files will be restored in the C:\ProgramData\Kaelus\PIM Server\Calibration\ directory. After the PIM Server software is installed. The PIM Server software will be included in the computers startup directory, to start as the computer boots. With the iBA connected and switched on at startup. The PIM server will detect the iBA and add it to the Portal Screen that is viewed with the web browser.

11.2.1 PIM Analyzer Software

The PIM Analyzer Internal USB Drive contains all necessary Low-Level instrument drivers. Additionally, the USB Drive also contains the manual.

11.3 Calibration Files

The calibration coefficients for each PIM Analyzer must be placed in the calibration files directory. This is found in the C:\ProgramData\Kaelus\PIM Server\Calibration\Transceiver\ . These calibration coefficients are located on the internal USB Drive. Normally the PIM Server software will copy these files from the iBA to the local directory automatically.

11.4 PIM Server

The PIM Server will run automatically at startup and if the iBA is switched on detect the hardware.

The PIM Server icon should be visible in the task bar panel.



If not visible the PIM Server program will need to be re-started.



IMPORTANT NOTE: The Calibration Files used to store the calibration coefficients for a particular RF Module are unique and must be maintained with the System Controller connected to a particular RF Module. The serial numbers on the RF Module and on the Calibration USB Drive must match in order to maintain accurate measurements.

11.5 Trouble Shooting USB Connection Issues.

When iBA instruments are first installed/Plugged in to the USB, device drivers will be installed by windows. If your PIM server fails to identify your iBA, this can be because the driver installation was delayed. Stop the PIM Server and Plug in each iBA and wait until windows indicates the driver install is complete for each iBA. Restart the PIM Server the instruments can then be added.

11.6 PIM Server not Starting.

The Kaelus PIM server requires Microsoft .NET Framework , the installer will attempt to retrieve this from the web if it is not already installed. Local admin access Privileges will be required to install .NET. Re-installing the software with the appropriate access Privileges while connected to the internet often can resolve the problem. If .NET Framework has been installed a system restart is required.

12. Options and Accessories

12.1 RTF Module



RTF unit is sold separately with various accessory kits and has specific details for its use in user manual. RTF-1000, RTF-2000 and RTF-2600. Modules available. See www.kaelus.com for more details.

Figure 49 RTF Module Option

12.2 Test Chamber Door Interlock

The Chamber Door Interlock option is used when it's required that the transmitters be powered down when a door switch or interlock e-stop switch is open. If the iBA is equipped with this option, Door Open will appear on the production mode start button, see Figure 51. The Door interlock module is affixed to the rear of the iBA using the 4 screws supplied, the rear socket plugging into the iBA back panel, see Figure 52. When the door interlock module is detected, it is then required that the interlock switches be wired in, in order for the TX to operate. Should the Interlock be triggered during a test an interlock warning will appear, see Figure 53. If the Interlock function is not used, add a link to P1 connector to create a closed connection, or remove the interlock module, otherwise the iBA transmitter will not operate.

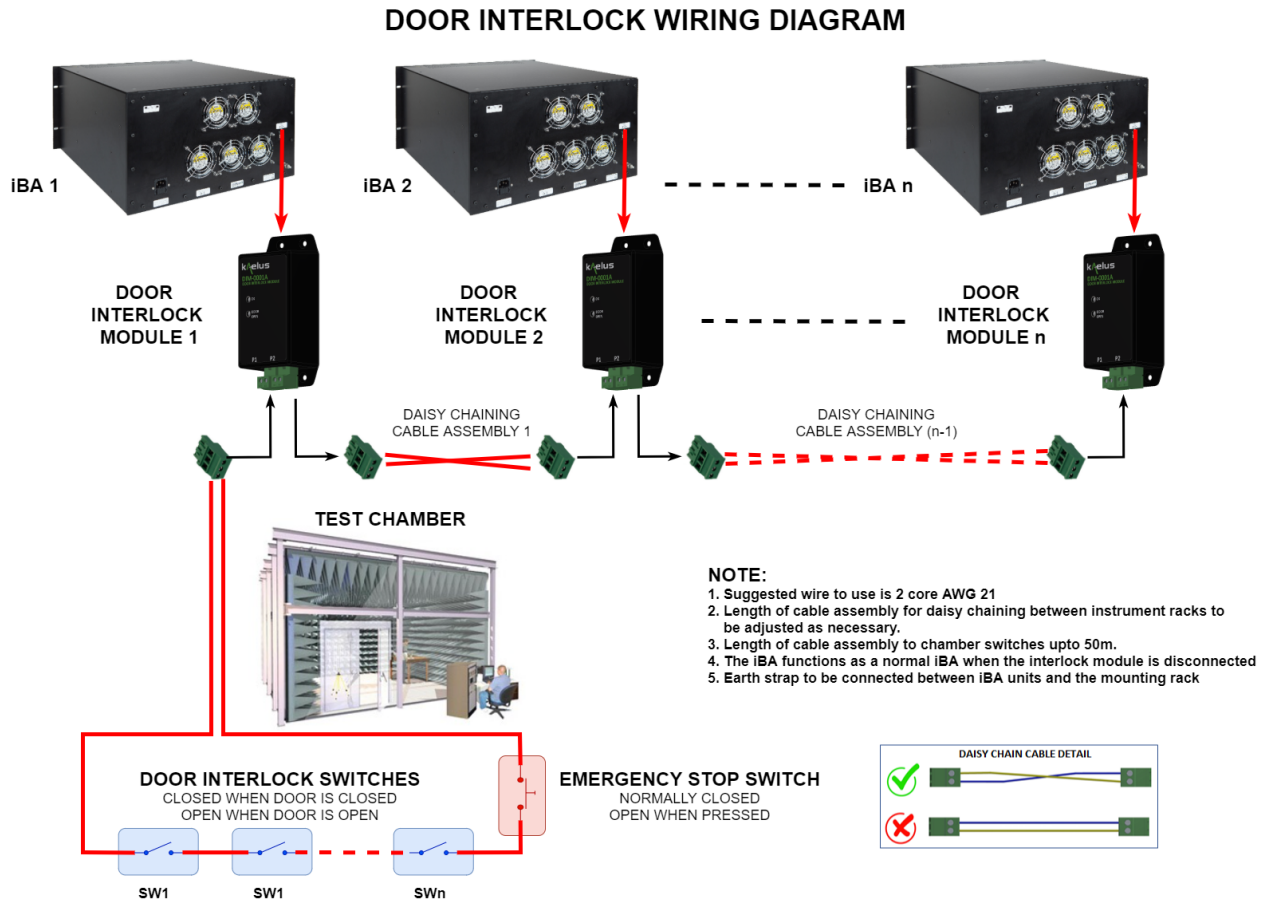


Figure 50 Door Interlock Wiring Diagram

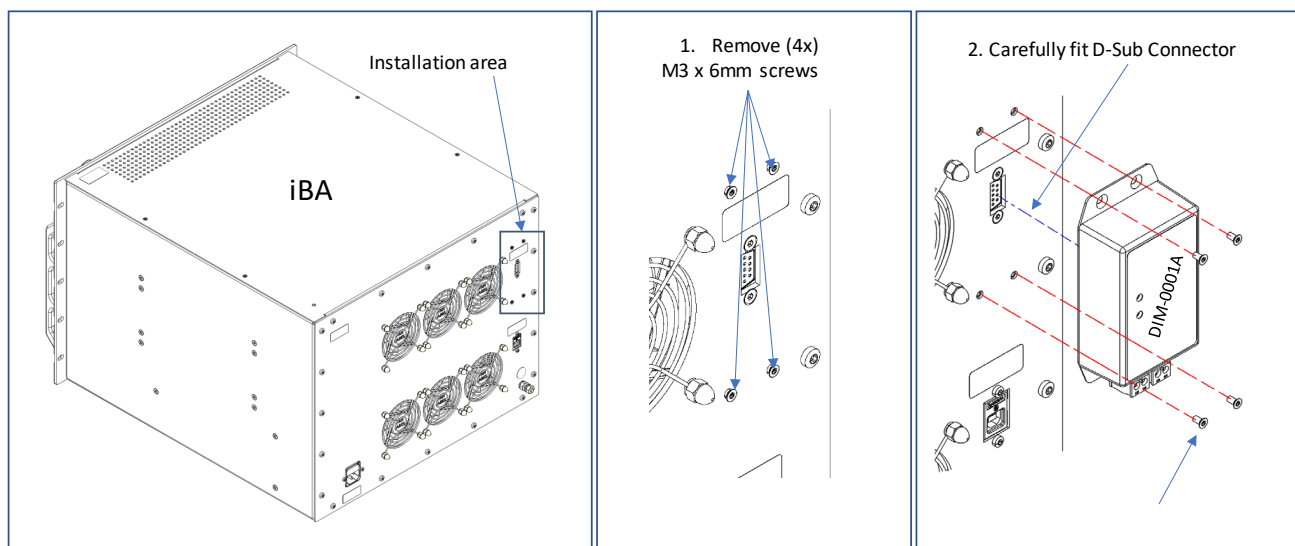


Figure 52 Fitting the DIM-0001A Door Interlock module

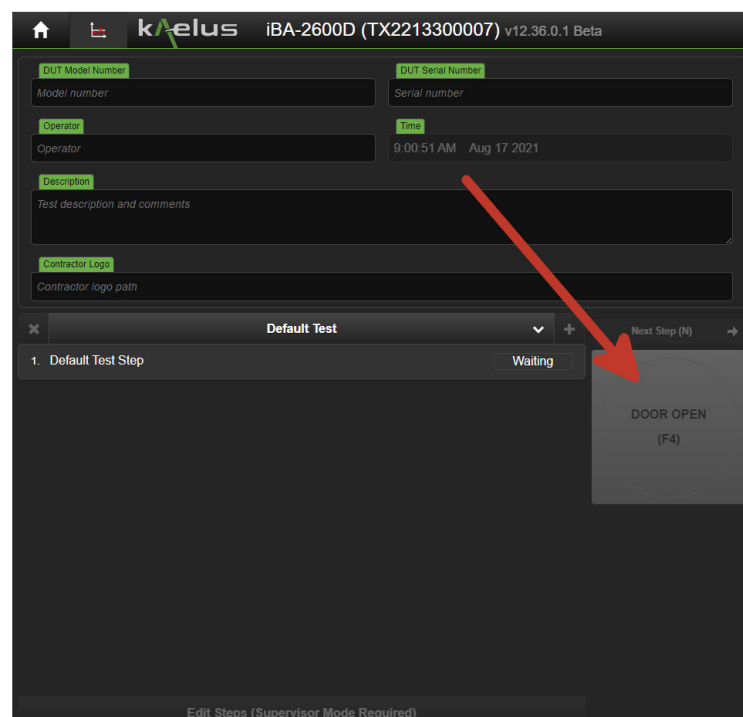


Figure 51 Interlock door open

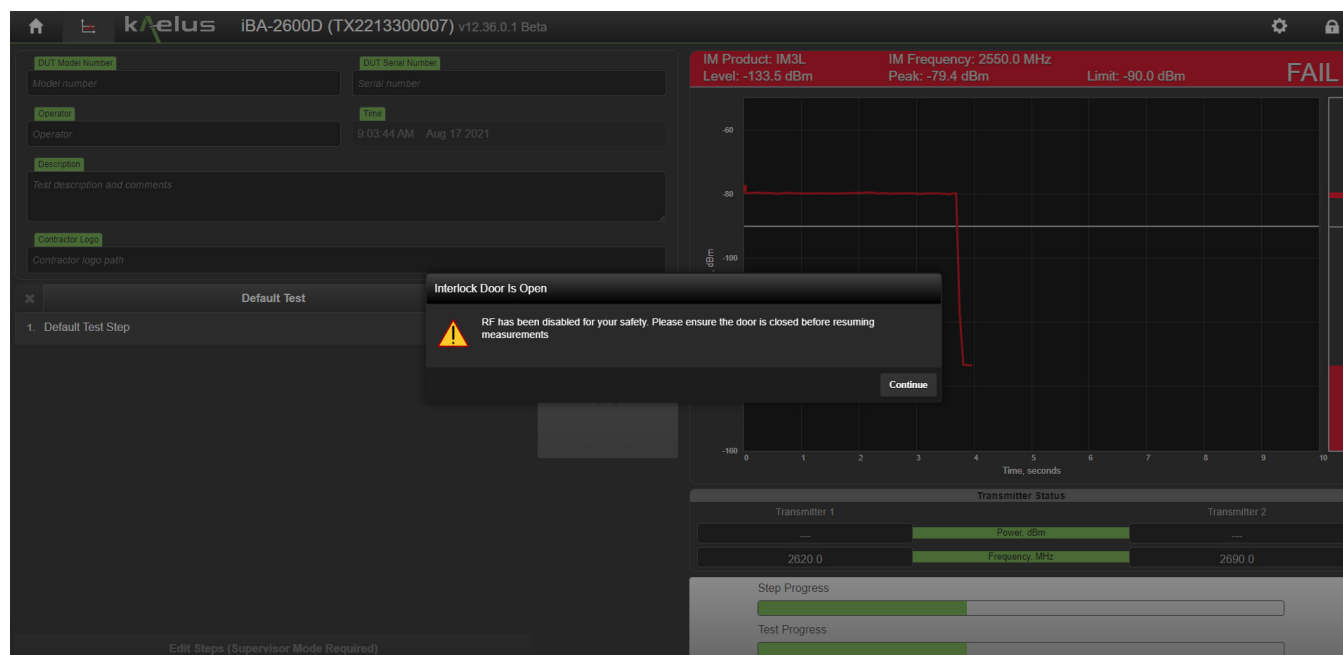


Figure 53 Tx Disabled from interlock warning

IBA A-Series Models					
(Reverse IM Only)					
Model	Model + AISG	Tx Range	RX Range (PIM)	IM Order	RTF Module
iBA-0700LA	iBA-0700LA-1	728-746 MHz	698-716 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0700HA	iBA-0700HA-1	728-757 MHz	776-787 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0703A	iBA-0703A-1	758-803 MHz	703-748 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0790A	iBA-0790A-1	791-821 MHz	832-862 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0850A	iBA-0850A-1	869-894 MHz	824-849 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0901A	iBA-0901A-1	925-960 MHz	880-915 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-1800A	iBA-1800A-1	1805-1880 MHz	1710-1785 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2000
iBA-1921A	iBA-1921A-1	1930-1990 MHz / 2110-2155 MHz	1710-1755 MHz / 1850-1910 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2000
iBA-2101A	iBA-2101A-1	1920-2080 MHz	1920-2080 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2000
iBA-2600A	iBA-2600A-1	2500-2570 MHz	2500-2570 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2600

Table 4 IBA A Series Models

IBA B-Series Models					
(Reverse IM on Port 1 and Port 2, Forward IM on Port 1 to Port 2)					
Model	Model + AISG	Tx Range	RX Range (PIM)	IM Order	RTF Module
iBA-0700LB	iBA-0700LB-1	728-746 MHz	698-716 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0700HB	iBA-0700HB-1	728-757 MHz	776-787 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0703B	iBA-0703B-1	758-803 MHz	703-748 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0790B	iBA-0790B-1	791-821 MHz	832-862 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0850B	iBA-0850B-1	869-894 MHz	824-849 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-0901B	iBA-0901B-1	925-960 MHz	880-915 MHz	3rd, 5th, 7th, 9th, 11th	RTF-1000
iBA-1800B	iBA-1800B-1	1805-1880 MHz	1710-1785 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2000
iBA-1921B	iBA-1921B-1	1930-1990 MHz / 2110-2155 MHz	1710-1755 MHz / 1850-1910 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2000
iBA-2101B	iBA-2101B-1	2110-2170 MHz	1920-2080 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2000
iBA-2600B	iBA-2600B-1	2620-2690 MHz	2500-2570 MHz	3rd, 5th, 7th, 9th, 11th	RTF-2600

Table 5 IBA B Series Models

IBA C-Series Models					
(Reverse IM Only)					
Model	Tx1 Range	Tx2 Range	RX Range (PIM)	IM Order	RTF Module
iBA-0600C	617-630 MHz	640-652 MHz	663-698 MHz	3rd, 5th, 7th	RTF-1000
iBA-0700LC	728-731.5 MHz	741-757 MHz	698-716 MHz	3rd, 5th, 7th	RTF-1000
iBA-0703C	758-768 MHz	778-803 MHz	703-748 MHz	3rd, 5th, 7th	RTF-1000
iBA-0707C	728-731.5MHz	741-764MHz	Rx Low 698-716MHz Rx High 776-802MHz	3rd, 5th, 7th	RTF-1000
iBA-0850C	869 MHz	879-894 MHz	824-849 MHz	3rd, 5th, 7th	RTF-1000
iBA-0901C	925-935 MHz	945-960 MHz	880-915 MHz	3rd, 5th, 7th	RTF-1000
iBA-1800C	1805-1812 MHz	1825-1880 MHz	1710-1785 MHz	3rd, 5th, 7th	RTF-2000
iBA-1921C	PCS 1930-1950 MHz AWS 1930-1950	PCS 1970-1990 MHz AWS 2110-2155	PCS 1850-1910 MHz AWS 1710-1755	3rd, 5th, 7th	RTF-2000

IBA C-Series Models					
(Reverse IM Only)					
Model	Tx1 Range	Tx2 Range	RX Range (PIM)	IM Order	RTF Module
iBA-2101C	2110-2130 MHz	2150-2170 MHz	1920-2080 MHz	3rd, 5th, 7th	RTF-2000
iBA-2600C	2620-2630 MHz	2650-2690 MHz	2500-2570 MHz	3rd, 5th, 7th	RTF-2600
iBA-3501C	3660 - 3700MHz	3730 - 3800MHz	3500-3600 MHz 3850-3980MHz	3rd, 5th, 7th and 9th	N/A

Table 6 IBA C Series Models

IBA D-Series Models					
(Reverse IM on Port 1 and Port 2, Forward IM on Port 1 to Port 2)					
Model	Tx1 Range	Tx2 Range	RX Range (PIM)	IM Order	RTF Module
iBA-0600D	617-630 MHz	640-652 MHz	663-698 MHz	3rd, 5th, 7th	RTF-1000
iBA-0700LD	728-731.5 MHz	741-757 MHz	698-716 MHz	3rd, 5th, 7th	RTF-1000
iBA-0703D	758-768 MHz	778-803 MHz	703-748	3rd, 5th, 7th	RTF-1000
iBA-0707D	728-731.5MHz	741-764MHz	Rx Low 698-716MHz Rx High 776-802MHz	3rd, 5th, 7th	RTF-1000
iBA-0850D	869 MHz	879-894 MHz	824-849 MHz	3rd, 5th, 7th	RTF-1000
iBA-0901D	925-935 MHz	945-960 MHz	880-915 MHz	3rd, 5th, 7th	RTF-1000
iBA-1800D	1805-1812 MHz	1825-1880 MHz	1710-1785 MHz	3rd, 5th, 7th	RTF-2000
iBA-1921D	PCS 1930-1950 MHz AWS 1930-1950 MHz	PCS 1850-1910 MHz AWS 1710-1755	1850-1910 MHz	3rd, 5th, 7th	RTF-2000
iBA-2101D	2110-2130 MHz	1920-2080 MHz	1920-2080 MHz	3rd, 5th, 7th	RTF-2000
iBA-2600D	2620-2630 MHz	2500-2570 MHz	2500-2570 MHz	3rd, 5th, 7th	RTF-2600
iBA-3501D	3660 - 3700MHz	3730 - 3800MHz	3500-3600 MHz 3850 - 3980MHz	3rd, 5th, 7th and 9th	N/A

Table 7 IBA D Series Models

13. Index

A

absorber 67
AC line voltages 14
Amplifiers
 high power 19, 23
 low noise 19, 23
Antenna Passive IM 67

B

Block Diagram
 System 25, 26

C

Cable Assemblies 65
Calibration Files 74
Carrier Power 64, 72
Chamber Door Interlock 76
Chassis Grounding Stud 27
Cleaning 69
Configuration 55
Connector Maintenance 72
Controller
 type 19, 21, 24, 27, 73, 74

D

Door Interlock 76
Door Interlock module 77
Duplexers 66

E

Engineering Mode
 Overview 31, 44, 70, 72

F

Front panel
 exiting 48
Fuse
 rating 15, 25
 replacement 15, 25

G

Grounding 27

H

Humidity 69

I

Installation 24
 checklist 24
 inspection 24

location 24
unpacking 24

Interlock 76

L

lightning 70

N

Noise Floor
 Definition 62

O

Overview
 system 16, 44

P

PIM Server 18, 19, 20, 21, 27, 28, 29, 32, 50, 70, 74, 75
Port 1 15, 28, 35, 41, 48, 49, 50, 51, 59, 62, 66, 67, 68, 70,
 71, 72, 73, 80
Power
 AC 14, 15, 18, 19, 23, 24, 27, 36, 39, 40, 48, 49, 50,
 52, 54, 55, 57, 59, 64, 68, 70, 72, 73

R

Receiver 19
Residual IM
 measuring 48, 62, 63, 64, 70, 71
RF Radiation 15
RMA number 73
RTF Module 18, 75, 79, 80, 81

S

Safety 11, 15
 non-ionizing radiation 11, 15
 RF Power 11, 15
 symbols 11, 15

Service 21
short circuit 28
Software
 re-installing 20, 74

Speed
 measurement 15, 19

Synthesizers 19
System Controller
 overview 19, 21, 24, 27, 73, 74

T

Technical Assistance
 address & phone nos. 23
Technical Specifications 16

Temperature 69
Test Chamber Door Interlock 76
Tx on Timeout 23

U

Uncertainty 62, 63
uninterruptible power source 70

W

Windows 10 74