

PIM Analyzer

User's Manual



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Table of Contents

1	INTRODUCTION.....	1-1
2	SAFETY SUMMARY	2-1
	2.1 Symbols	2-2
	2.2 Disclaimer.....	2-3
	2.3 Power Requirements.....	2-4
	2.4 PIM Series Packing list.....	2-4
3	PIM ELEMENTS	3-5
	3.1 PIM Analyzer Front Panel	3-6
4	PRECAUTIONS	4-1
	4.1 USING HIGH PERFORMANCE RF ACCESSORIES	4-5
	4.2 USING HIGH PERFORMANCE RF CABLES	4-7
5	POWERING PIM UP/DOWN	5-1
	5.1 Powering UP.....	5-2
	5.2 POWERING DOWN.....	5-3
6	GETTING STARTED	6-1
	6.1 The First Measurement.....	6-2
7	PIM OPERATION.....	7-1
	7.1 Operations Menu Tree	7-4
	7.2 Field Mode.....	7-5
	7.2.1 Field Mode Elements	7-5
	7.2.2 Carrier Entry.....	7-7
	7.2.3 Site Entry.....	7-10
	7.2.4 Comments	7-13
	7.2.5 History Screen.....	7-14
	7.2.6 Data Management	7-15
	7.2.7 Log Files and Content	7-15
	7.2.8 Log File Management.....	7-16
	7.2.9 Data Copy	7-17
	7.2.10 Data Delete Log Files.....	7-18
	7.2.11 Data Delete Carrier & Site	7-19
	7.3 System Menu	7-20
	7.3.1 PIM Memory Space	7-21
	7.3.2 System Menu Functional Block	7-21
	7.4 Analyzer Mode	7-25
	7.4.1 Frequency Mode.....	7-27
	7.4.2 Time Mode	7-27
	7.4.3 Sweep Mode.....	7-28
8	DTP (Distance to PIM) and VSWR (VSWR/ Line Monitor).....	8-1
	8.1 Introduction	8-2
	8.2 Specification	8-2
	8.3 Procedures to measure DTP (Distance to PIM).....	8-3
	8.3.1 DTP (Distance to PIM) Setup	8-3
	8.3.2 DTP (Distance to PIM)	8-3
	8.3.3 Procedures to measure DTP source.....	8-7
	8.4 Procedures to measure VSWR (VSWR/ Line Monitor).....	8-14
	8.4.1 VSWR (VSWR/Line Monitor) Setup	8-14
	8.4.2 VSWR (VSWR/Line Monitor) Measurement.....	8-15
	8.4.3 Procedures to measure the distance to a faulty VSWR	8-18

9	Pull Down Menu	9-21
9.1	File.....	9-23
9.1.1	Start / Stop History Save	9-23
9.1.2	Screen Capture / Print	9-24
9.1.3	Initialize Program.....	9-25
9.1.4	Quit.....	9-25
9.2	System Management.....	9-26
9.2.1	Self-check.....	9-26
9.2.2	PIMD Management	9-27
10	Change Logo and Address in Report File	10-1
10.1	Change Logo	10-2
10.1.1	Prepare logo image file.	10-2
10.1.2	Replace the logo image file.....	10-2
10.1.3	Check the report file.....	10-2
10.2	Change address	10-2
10.2.1	Open.	10-2
10.2.2	Editing Address.	10-2
10.2.3	Check the report file.....	10-2
10.3	Applicable version.....	10-2
10.3.1	V1.4.3 and later.(S1L)	10-2
10.3.2	All of S1P Unit.....	10-2
11	What is PIM?.....	11-1
11.1	What Causes PIM?	11-2
11.1.1	Manufacturing & Design.....	11-2
11.1.2	Mechanical	11-2
11.1.3	Environment.....	11-2
11.2	How to test PIM.....	11-3
12	PIM Technical Information	12-1
12.1	Tester Types	12-2
12.2	Specifications (Data Sheet)	12-3
12.2.1	Transmitter Specification	12-3
12.2.2	Receiver Specifications	12-3
12.2.3	System Specifications	12-3
12.2.4	Environmental.....	12-3
12.2.5	Dimensions and Weight (Except for TETRA ver.).....	12-3
13	Maintenance	13-4
13.1	Block Diagram.....	13-5
13.2	Performance Check.....	13-6
13.2.1	Testing Analyzer operation status	13-6
13.3	Performance Verification	13-7
13.3.1	Tx Signal Power Level.....	13-7
13.3.2	Tx Signal Frequency	13-8
13.3.3	Rx Power and Receiving Frequency	13-9
14	System Message	14-12
14.1	Communication Error	14-13
14.2	IM Frequency not found.....	14-13
14.3	Tx Carrier Frequency Setting error.....	14-13
14.4	Temperature Warning	14-14
14.5	ALC Fail.....	14-14
14.6	HPA Reverse Alarm.....	14-14
15	Options & Accessories	15-15
16	File & Directory information	15-17

16.1	Windows virtual store.....	15-18
16.2	File name information	15-18
16.3	History directory naming.....	15-18
Appendix		i
Appendix A.....		ii
Appendix B.....		iv



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1 INTRODUCTION

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Thank you for choosing an AWT Analyzer. The PIM is a high performance instrument that allows users to make reliably, highly accurate measurements of passive intermodulation, in systems and/or components. Our test systems are built to the highest quality standards. We strive to provide the most reliable, state of the art test equipment allowing our customers to have the utmost confidence in the results of their testing. To ensure you can utilize all functions and features of this test system, we strongly recommend you familiarize yourself with this manual prior to operating your PIM Analyzer. This manual contains valuable information on the safe operation of the PIM test set and a brief technical background on passive intermodulation.



2 SAFETY SUMMARY

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2.1 Symbols



This safety requirement symbol (located on the rear panel) has been adopted by the International Electro-technical Commission, Document 66 (Central Office) 3, Paragraph 5.3, which directs that an instrument be so labeled if, for the correct use of the instrument, it is necessary to refer to the instruction manual. In this case it is recommended that reference be made to the instruction manual when connecting the instrument to the proper power source. Verify that the correct fuse is installed for the power available.



The CAUTION symbol denotes a hazard. It calls attention to an operational procedure, practice or instruction that, if not followed, could result in damage to or destruction of part or all of the instrument and accessories. Do not proceed beyond a CAUTION symbol until its conditions are fully understood and met.



The NOTE symbol is used to mark information which should be read. This information may be very useful to the operation when with the subject covered in this section.



The HINT symbol is used to identify additional comments which are outside of the normal format of the manual, however can give the user additional information about the subject.

The following general safety precautions must be observed during all phases of operation and maintenance of the AWT PIM Passive Intermodulation Analyzer. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. AWT assumes no liability for the customer's failure to comply with these requirements.



INSTRUMENT MUST BE GROUNDED

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three conductor, three prong AC power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to a two-contact adapter with the (green) grounding wire firmly connected to an electrical ground at the power outlet.



DO NOT OPERATE THE INSTRUMENT IN AN EXPLOSIVE ATMOSPHERE

Do not operate the instrument in the presence of flammable gases or fumes.

**KEEP AWAY FROM LIVE CIRCUITS**

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel only. Never replace components or operate the instrument with the covers removed and the power cable connected. Even with the power cable removed, dangerous voltages may be present. Always remove all jewelry (rings, watches, etc.) and discharge circuits before touching them. Never attempt internal service or adjustment of the test system unless another person, capable of rendering first aid and resuscitation, is present.

**DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT**

Do not substitute parts or perform any unauthorized modification of the instrument. Return the instrument to AWT for repair to insure that the warranty and safety features are maintained.

**NON IONIZING RADIO FREQUENCY RADIATION HAZARD**

This device generates Radio Frequency (RF) energy under normal operation, and should always be operated in accordance with local and national licensing laws. RF energy in the 385 to 480 MHz, 700 to 1,000 MHz and 1,800 to 2,200 MHz with a total power of up to 50W Watts or +47 dBm is present at the test port during testing. The Test Port is to be terminated into a non radiating 50 ohm load to reduce the risk of RF exposure. Do not switch RF Power On if Test Port is open or load is unknown.

**ELECTRIC SHOCK HAZARD**

The device is supplied with 100 to 240 Volt AC. Prior to AC connection always inspect the power cord and instrument case for damage. If damage is observed, do not use this until inspected and repaired by an authorized AWT Service center.

2.2 Disclaimer

PIM Analyzers transmit two settable CW RF signals, with a power of up to 25W (Optional 40W) each, to measure passive intermodulation of components and transmitting systems.

ACEWAVETECH is under no circumstances accountable for use of PIM analyzer not conforming to laws and regulations of national and local authorities. Customer / user bear the full responsibility and legal accountability to use PIM only in a lawful manner.

2.3 Power Requirements

The PIM Series is equipped with a switching power supply that provides automatic operation from a 100 to 240 volt, 47 to 63 Hz, single-phase, AC power source. Maximum power consumption is 750W / 750 VA

Caution



For bench-top use, choose a clear, uncluttered area. For field use, choose a dust free environment. Ensure that there is at least 2" of clearance at the fan air intake on right side vents of front panel, and the exhaust vents on the left side vents of front panel to allow for proper air circulation.

Before powering the unit up make sure the instrument does not show indications of exposure to extensive force like dents, torn off pieces or loose parts in the case.

2.4 PIM Series Packing list

PIM Series Analyzer is shipped complete and is ready to use upon receipt.

Note



Save the original packing material and container to reship the instrument, if necessary. If the original materials (or suitable substitute) are not available, contact AWT Co., Ltd. to purchase replacements. Store the packing materials always in dry environment. If frequent used in the field with we strongly recommend purchasing our PIM Transit Case. See chapter Accessories for ordering information.

Unless otherwise ordered *, your will receive:

- PIM Series Passive Intermodulation Test System
- Line Cord with 90 deg connector
- Recovery Install USB & manual
- Accessory kit(Optional)
 - **Low PIM Cable 3m(10ft) (DM-DM)**
 - **4 Low PIM Adaptors (DM-DF, DF-DF, DF-NM, DF-NF)**
 - **Low PIM Load 50W or 100W**
 - **Torque Wrench DIN 7/16**
 - **Cleaning tabs**
 - **Manual wrench(17", 19", 20", 21" 24")**
 - **Hand Carry Case**

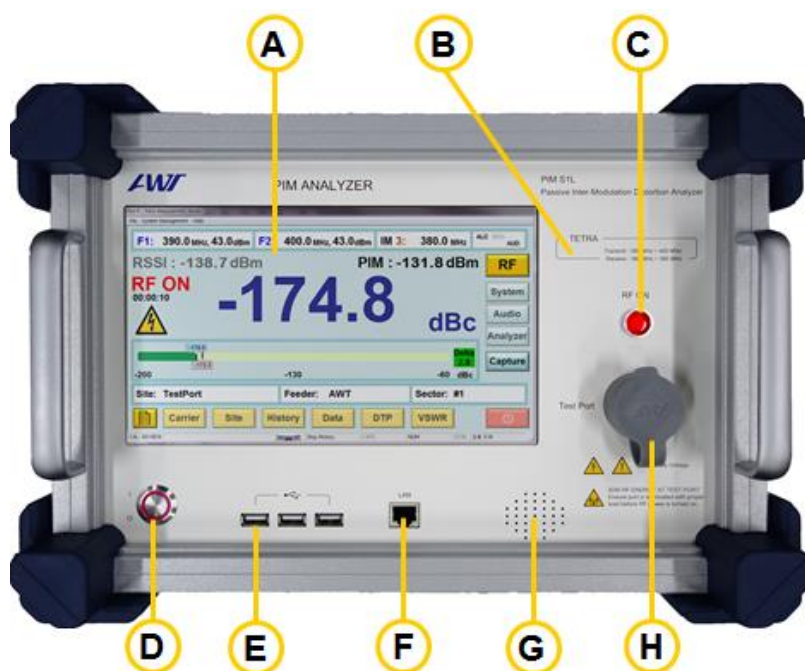
* PIM and accessories are available in customized versions / packages. Please refer to Appendix A for specific package lists.

3 PIM ELEMENTS

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3.1 PIM Analyzer Front Panel



No.	Element	Description
A	Touch Screen Display	Touch screen display 1024x600. Never use sharp devices to push buttons on the screen
B	Type Label	Provides information about PIM Analyzer Tx/Rx frequency bands
C	RF Power On	RF-Power light indicates when RF Power is present.
D	Main Power Switch	<p>PIM Analyzer contains protection circuitry to control RF Power during operation and during powering on/off cycles.</p> <p>After switching Main Power Switch On wait 2 seconds before pushing Front Power Button.</p> <p>Fans may Briefly run after power off.</p> <p>Note: Do not use Main Power Switch while system is in operation mode, vital files may get corrupted</p> <p>Always use the Front Power Button to power the system down.</p>
E	USB Ports (3)	USB Ports for mouse, keyboard and Memory Stick
F	LAN connector	For remote control
G	Audio	Loudspeaker for audio signals
H	RF Port	RF Port.



4 PRECAUTIONS

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Caution

DO NOT touch RF Connecting parts of components with bare fingers.

Even the smallest amount of sweat on the conductors can cause oxidation, which will reduce the performance of the element and can cause PIM.

Elements Included:

- RF Port of PIM
- Low PIM Cables
- Low PIM Load
- Low PIM Adapters
- All components in the transmitting path of the System under Test or DUT.

Caution

DO NOT switch on RF power without load or antenna attached.

Switching RF power on without termination, results in the full transmitted energy of the test system being reflected back into the test system. This can overstress the system cause damage. The load ensures energy flow from the test system to the load, which transforms all RF energy into heat.

Caution

DO NOT operate the PIM in any active systems.

The PIM is a very sensitive Test System that allows testing and analyzing passive RF components. Under no circumstances should the tester be operated when the RF path is active, no outside carrier signals should be present in the RF path under test. This includes all active signals even when they are operating in different frequency bands. Operation with active signals present will cause serious damage to the instrument.

Caution

DO NOT connect or disconnect any accessory or component of the test setup with RF power switched on.

Even at low RF power levels, spark discharge can occur with sudden energy flow or flow disruption. Spark discharge - must be avoided, because it will alter the surface of the pins and connection areas. "Burned" surfaces will not only reduce the performance of the component, but can also cause permanent PIM.

Caution**DO NOT operate test system and load without connector savers.**

All connectors wear out when used frequently. Connector savers on the RF Port and the load port(s) help to prevent costly repairs of the PIM connector savers offer negligible influence on measurements. We suggest to always leaving the connector saver attached to the tester / load to ensure they are always utilized. Replace them when they wear out, and their performance deteriorates. For order information please refer to the chapter accessories.

Caution**DO NOT mount components directly on the PIM.**

Always use a cable between PIM and DUT. The connector of the PIM is a high quality, high precision element. It is designed to withstand tangential forces that occur when connector savers or cables are torqued on with the appropriate force. The RF Port connector is not designed to support the weight of a component.

Caution**DO NOT block air vents.**

Due to its high RF output power, PIM consumes up to 750W. This energy has to be disposed. While these test systems have protection against overheating, it is vital to keep air vents clear of any obstructions that would prevent or limit the air flow.

Air vent locations

- Front Panel
- Both sides of Front Panel

Keep clearance at least 15 cm / 6 inches for Front Panel Vents.

Caution**DO NOT bent cable tighter than 40 cm / 16 inches of diameter.**

Cables that come with the PIM offer a combination of high quality, low PIM, and high reliability. The test cable is a vital piece of the measurement setup, and a damaged or worn cable will influence PIM measurements. The structure of AWT's PIM cable offers customer friendly utilization in the field and in the factory it allows for a bending radius of 40 cm / 16 inches. Tighter bending will permanently alter the cable structure, which will cause performance loss and can cause permanent PIM, rendering the cable unusable. See also chapter: Using the Cable

Caution**DO NOT over-torque the RF Port connector and accessories.**

The best performance of RF connectors is achieved when the connections are made with the correct torque. Too much of a torque can permanently deform PINs and connections areas, too little torque can hinder the electron flow, varying the impedance or in some cases can cause spark discharge. All these effects can damage the components permanently. To ensure proper connections always use the torque-wrench that comes standard with the PIM.

Caution**DO NOT use sharp devices at the touch screen.**

Users can operate PIM Analyzers but utilizing the touch screen or via keyboard/mouse. The user interface is designed specifically for field use; all vital operations can be conveniently accessed via the touch screen interface. Do not use sharp devices; they can damage the touch screen. The touch screen, display and CPU are a single integrated module. In case of service the complete module has to be exchanged. To prevent costly repairs, use only your fingers or very dull devices to interact with the screen.

Caution**Do NOT touch the cable during the measurement**

Should not touch DUT and the cable which is connected to PIM unit after RF Power ON. Touching the cable and DUT makes the contact (the discontinuous contact point) between the unit and them incomplete. The IMD, DTP, and VSWR values can be incorrect with this incomplete contact.

Caution**Do NOT connect the USB device which exceeds 500mA overall**

Should not connect device which exceeds 500mA to USB ports of PIM unit. When the device is connected to more than 500mA it may not work properly. Recommend using USB memory stick, USB mouse or USB keyboard.

4.1 USING HIGH PERFORMANCE RF ACCESSORIES

PIM test sets combine very high output power, with extremely sensitive receivers. Note: The sensitivity of the PIM receiver is many times greater than the sensitivity of a Base Station. Any unwanted influence generated by poor performing accessories will reduce the accuracy of the desired measurement. To ensure quality measurements great care has to be taken; not only for the test system but also for the cables and accessories. Remember you want to measure the PIM of the device under test, not a poor performing or worn accessory.

Hint



Prevent unnecessary force:

Nearly all RF connectors are designed to allow for manual connection. To ensure a proper connection, RF connectors should be manually mated, push in to seat the center pin, then hand tightened until seated. The torque wrench should only be used to tighten the last ½ turn or less. Improper connections will cause performance loss. This includes under torqueing and over torqueing. Both, over and under-torqueing, result in weak connections which contribute to PIM. Over tightening may damage the connector and lead to visible metal fragments in the connector's surface. All damaged connectors and connectors savers should be replace prior to testing.

Hint



Keep Accessories clean:

Dust and dirt may affect test results. Make sure accessories are stored properly and clean. Please use the protective caps - to keep the accessories free from contamination. Never use sharp devices to remove any contamination because scraping can cause metal chips in the contact areas, which will generate PIM. If any dirt, corrosion or any other foreign matter needs to be removed use special RF contact cleaning tabs and / or compressed air.

Hint



Keep Accessories dry:

Even the best plating will wear if accessories are frequently used. Moisture will cause oxidation. Prevent moisture by using supplied protective caps and keeping accessories stored properly. Many connectors are weather sealed to prevent moisture from entering the contact area. If you discover moisture use RF contact cleaning tabs and blow dry with compressed air.

Hint**Check for wear and tear:**

All metal to metal surface subjected to movement will eventually show the effects of wear and tear. In the case of PIM measurements the results appear as an increase in PIM level. Check your accessories frequently to ensure that they are working properly. Once you have determined that an accessory is no longer performing as it should, replace it with a new device. When you received the replacement, dispose of the old one to prevent accidental reuse. Check chapter on Accessories for ordering information of spare and replacement accessories. Accessories are key to accurate PIM measurements. Although properly functioning, they are also wear and tear items and will need to be replaced.



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4.2 USING HIGH PERFORMANCE RF CABLES

Cables are as vital to proper PIM testing as any of the other accessories are. Treat them with the appropriate care. All hints listed above for accessories apply to cables as well. Always use cable caps to protect connectors when the cable is not in use. The bending radius for the PIM cable delivered by AWT is 20cm / 8 inches. To prevent damage, coil cable no tighter than 40 cm / 16 inches in diameter. A transit case for PIM systems is available. This case has dedicated space for test systems, accessories and also the low PIM cable. For more information please refer to the chapter on accessories.

***“Treat accessories and cables for what they are:
High precision measurement devices”***

PIM tests measure the device in the testing path that generates the highest level of PIM. Worn or malfunctioning accessories lead to inaccurate measurements. Remember you want to measure the PIM level for the RF path or device under test, not a worn accessory or test cable. Inspect your accessories and cables prior to each use, and treat them as part of a high precision measurement device.



5 POWERING PIM UP/DOWN

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5.1 Powering UP

PIM Analyzers power up in a similar fashion to a desktop PC. However, there is one exception: significant RF power has to be controlled and managed. For this reason PIM series test systems contain a protection system to protect the hardware, e.g. prevents unusual on/and off cycles (e.g. 3 cycles per second). When used normally, the user will not even recognize that these protective mechanisms are working.

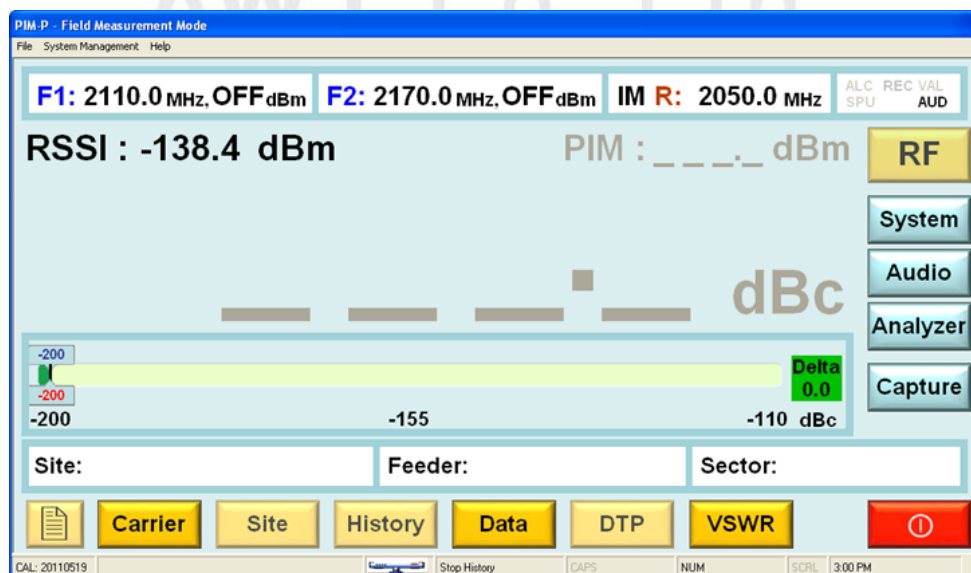
Preparations for powering up:

Ensure that the main outlet has proper grounding. Connect the correct power cable to the tester. Connect the power cable to the main outlet.

- Switch on the PIM main power switch at the backside of the unit. Allow for a short delay before switching on front power button. (This will allow protection circuitry to enable all PIM modules).
- Push Start Button briefly at the front panel.



The system will boot up automatically and show the user interface in the Field Mode.

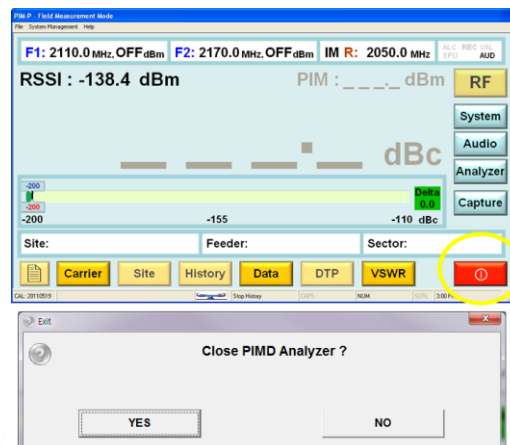


5.2 POWERING DOWN

PIM can be powered down in different ways listed below. It is not recommended to power down simply by “Pulling the plug” or switching off the Main Switch on the front panel.

Exiting

The proper way is to Exit the UI is by pressing the red exit button. This will generate an exit pop up. Respond to the pop-up menu's choice Yes / NO to power the system down or not. This method ensures the RF is switched off properly, all UI and computer processes are terminated in an orderly fashion, and data files are closed.



Caution



Forced Termination

Holding the Start Button on the front panel for 3 seconds generates a soft reset. RF is switched off, and all vital files will be closed and stored. In this mode, the urgency to power off the unit trumps handling and closing all files. Some information, e.g. log data may be lost.

Caution



Main Switch

When not following the proper shutdown sequence and using the Main switch on the front to terminate power it is likely that files get corrupted, and the test system may be harmed.

Note: Cooling fans may become operational after the main switch is placed in the off position until discharge of all internal capacitors is complete; typically within 5 seconds

Caution



“Pulling the Plug”

This “method” should be avoided under all circumstances. It can damage the hardware and corrupt files. This “method” is especially critical if the RF port is still connected to a grounded system under test. Residual discharges may flow via RF Ground / Shield. With the main connector no longer plugged in, ground connection is also disrupted.

6 GETTING STARTED

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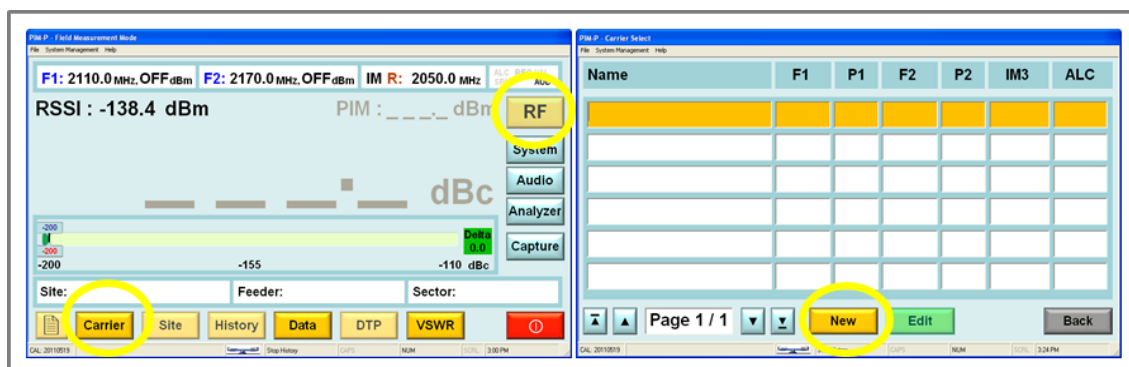
Before starting to measure components with PIM systems, users are urged to familiarize themselves with the precautions (Don'ts) in the chapter below. Improper operation and handling can cause bodily harm or damage the instrument.

6.1 The First Measurement

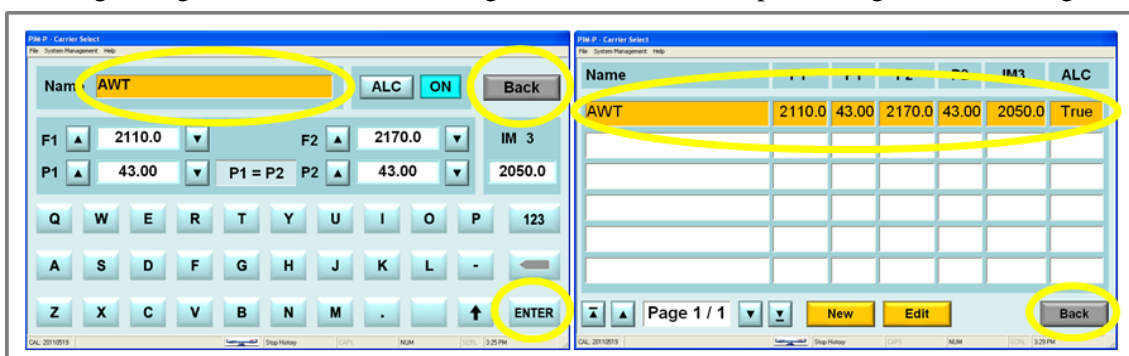
Preparations:

- Mount connector saver to RF Port and Load (if not already mounted)
- Connect Low PIM cable to Test system (Note: always connect the test cable to the instrument prior to connecting to the DUT)
- Connect Load to cable.

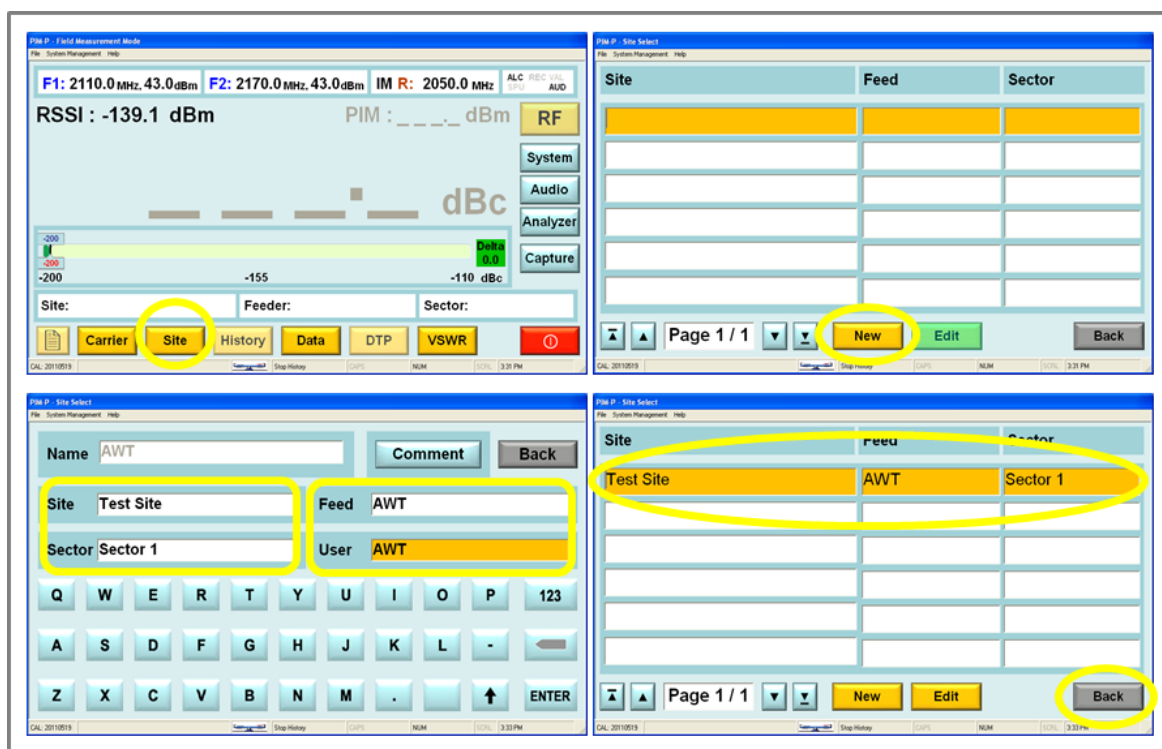
At this point the RF Button is visible but inactive. Power levels and the frequencies of the carrier signals must be set in order to activate the RF button. To do so, pushing the “Carrier” button displays a list of Carrier signal settings.



Since this is the first boot up, the list is empty. To enter carrier parameters, push “New” at the Carrier Select screen. Now we can enter a Carrier name, frequencies and power levels. With growing list of carriers, meaningful carrier names help to recognize the settings:



Example 20W_WCDMA means: power of the signals is 20W, and the frequencies used are 2110 MHz and 2170MHz. Every entry or change needs to be confirmed by pushing the “Enter” button. Once our entries are complete, we return to the previous screen, “Carrier List” by pushing the green Return button. The list shows now a carrier entry. By pushing the



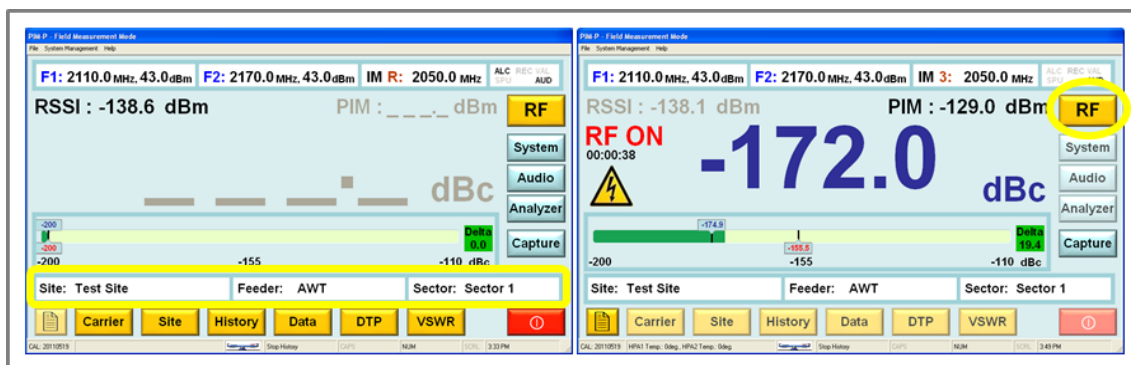
Green return button we come back to the Field Mode screen.

PIM Analyzers provide not only accurate PIM analysis, they also allow users to log data that is specific to a particular test setup or particular base station site. At a later point, measurements can be recalled for comparison and to analyze if the performance has changed. This particular information has to be entered as well. The process is similar to the Carrier entry, except this time we push the “Site” button. As with the carrier, the system lists all available Sites (or Tests). Since we have not entered a Site the list is still empty.

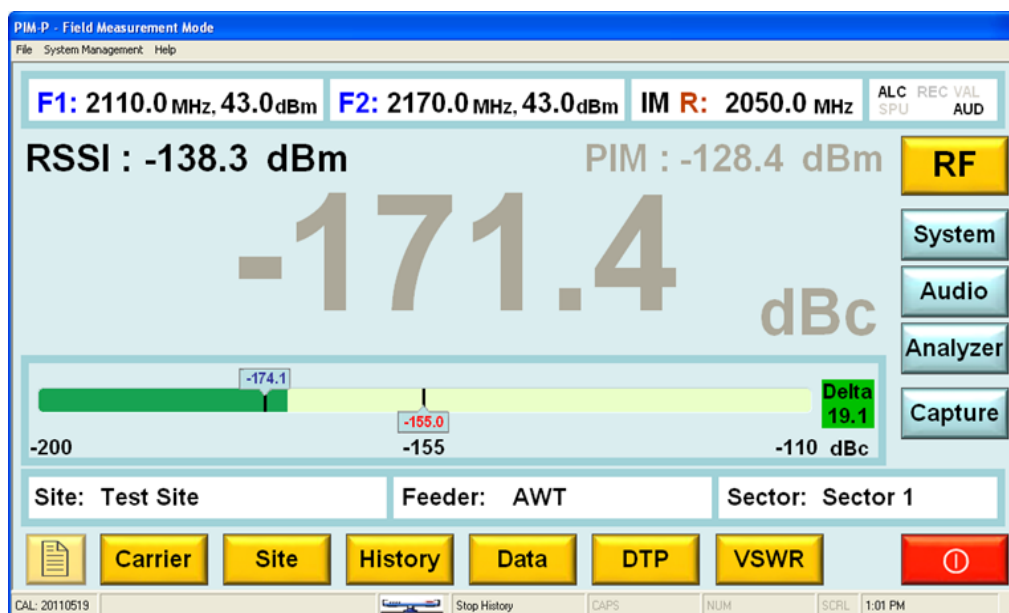


Note: Site information is linked to particular Carriers. If a different Carrier is selected the associated list of Sites (Tests) corresponds to Sites that were entered under this Carrier.

Now we can enter detailed base station or measurement setup information. Once completed, we return to the initial Field Mode Screen. The selected Site (Test) information is now visible in the appropriate fields and the RF Button is now active.



By pressing the RF Button, the system initializes, and starts measuring PIM. A second push of the RF button stops measurements and transmission of RF signal carriers. The last PIM reading is held and shown in grey.



Note: PIM Analyzers switch RF Power off after 10mins (default). Other cycles or “Always On” can be selected. For more information refer to chapter System Menu.

7 PIM OPERATION

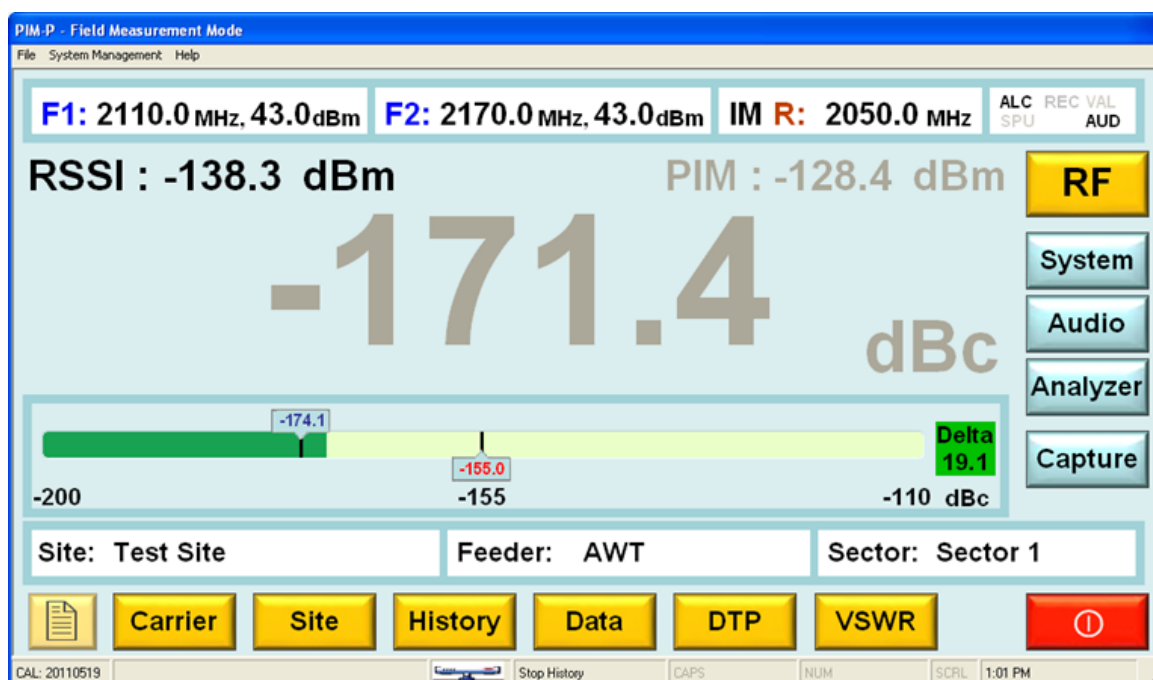
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PIM Analyzers were developed to measure and analyze PIM data of RF-components, cables, or complete RF systems.

Operation Modes for Different Applications: Field Mode / Analyzer Mode

Depending on the application, the users' requirements will be different. The main task at a base station site is to quickly analyze the RF Path, and document the measurements. If unacceptable PIM levels are detected the PIM can be used to identify and pin-point problematic components. When testing base stations,



Typically the frequency and power settings of the test equipment are site specific. Focus lies on quick measurement and documentation of data. PIM Analyzers provide this easy to use functionality in the **Field Mode**. All base station test parameters can be stored in the PIM Analyzer, including feeder and sector information. By selecting the base station, the user is ready to go. For preventive maintenance it can be very helpful to compare actual with historical data, which the PIM offers this as well. Measurements can be stored in the system as .log files. Whenever data are logged, the log field stores measurements, test system settings, and even complete information of the base station. The operator can view the historical data of a base station at any time and analyze if readings have changed compared to historical measurements.

Similar conditions apply when components are tested. The instrument settings do not change, but for quality reasons every measurement has to be documented. For measuring RF Components, the **Field Mode** is a very comfortable and efficient.

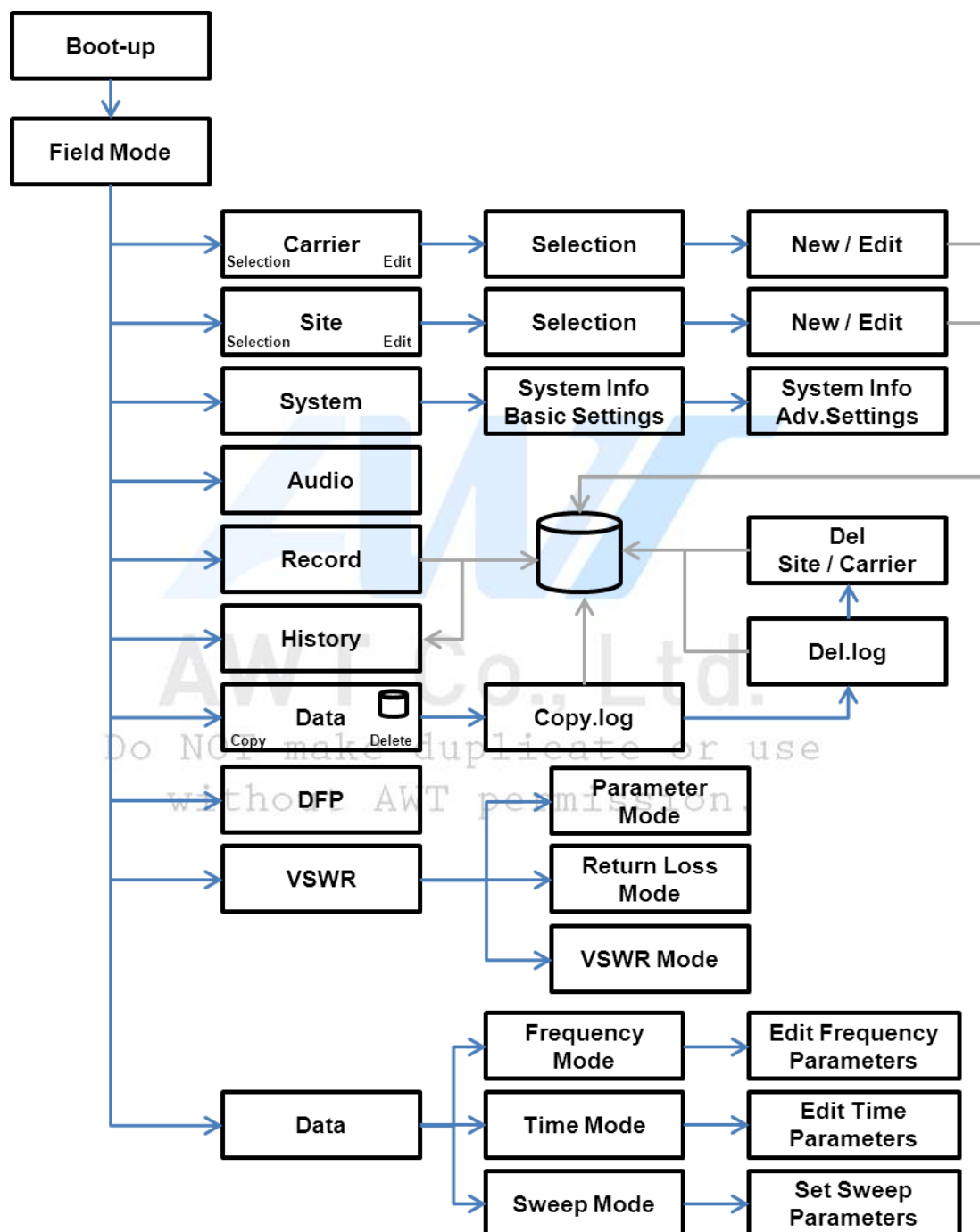


If more detailed information about the DUT is required, it can be accessed by using the **Analyzer Mode** of the PIM Analyzer. In this mode the user can analyze multiple intermodulation products at the same time (Frequency Mode), can record graphical traces over a longer time period (Time Mode) and can frequency sweep DUTs (Sweep Mode) to ensure it performs within the complete frequency band within specification.

The following chapters Field Mode and Analyzer Mode provide more detailed information.

7.1 Operations Menu Tree

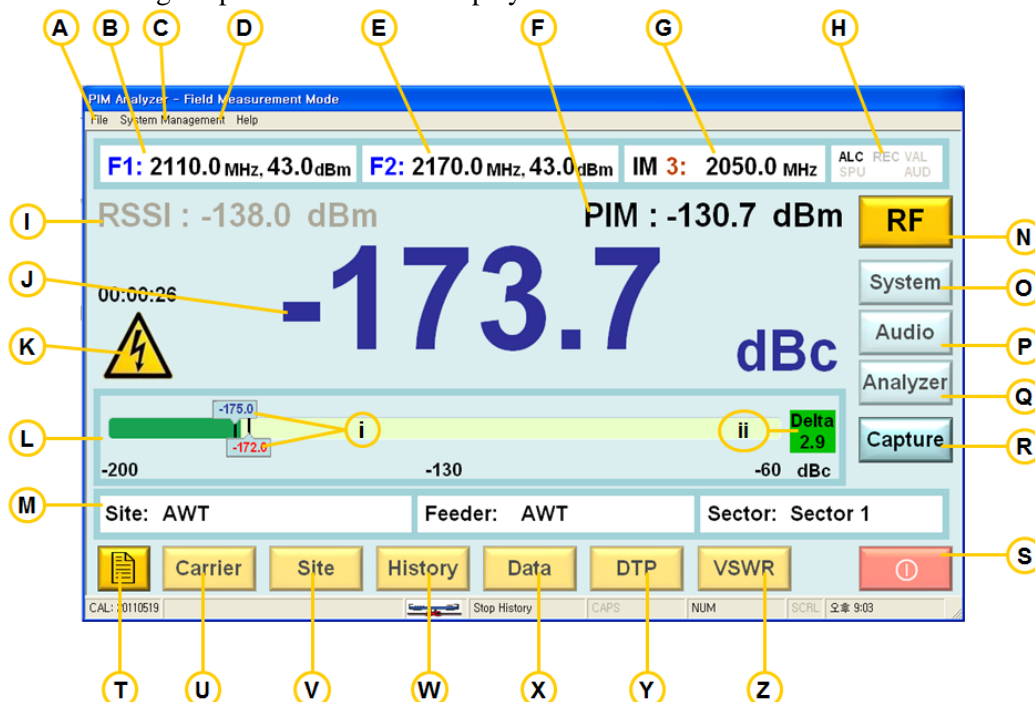
PIM Analyzers are designed to provide an efficient workflow. The Menu Tree shows the overall menu structure of the PIM.



7.2 Field Mode

7.2.1 Field Mode Elements

The following chapter describes the Display elements of the **Field Mode** screen.



Element	Name	Description / Display
A	File Menu	Pull down Menu, choices: “Quit”, same function as Exit Button. See also chapter Pull-down Menus.
B	Carrier Field:F1	Shows Frequency (MHz) and Power level (dBm) of first carrier signal.
C	System management	Pull down Menu, choices: “Self Test”, tests PIM functionality with RF ON and OFF. See also chapter Pull-down Menus.
D	Help	Pull down Menu, choices: “Program Information”, shows version of S/W
E	Carrier Field:F2	Frequency (MHz) and Power level (dBm) of second carrier signal.
F	PIM Value dBm	Measured PIM value numerically in dBm. Displays last value after RF Power is turned off.
G	IM Frequency	Frequency (MHz) if strongest IM signal in the receiving band and indicates which IM it is (3, 5, 7, 9, 11, 13, or 15).
H	Status Indicator Field	Shows status and activities of PIMM31: ALC – Automatic Level Control AUD – Audio On REC –Data Recording SPU – Soft Power

Element	Name	Description / Display
I	RSSI	RSSI (Received Signal Strength Indication) in dBm. External signals at the receiving frequency / frequencies may disturb PIM measurements. For accurate PIM measurements RSSI should always be below -130dBm.
J	PIM Value dBc	Measured PIM value numerically in dBc. The unit dBc describes a measurement relative to the carriers, in this case the carrier signals transmitted by the test system. Displays last value after RF power is turned off
K	Voltage Warning	Warning Sign appears when RF Power is switched on. Voltage at the RF-port can reach up to 50V.
L	Bar Graph PIM indicator	Graphical display of PIM measurement. Range is: -175dBc (start green bar) to -110dBc (end red bar). Default threshold green/red is -153dBc. See System Menu for further information.
M	Display fields (3) Site, Feeder, Sector	Detailed Information of selected Site (e.g. Base Station Location), and Site specific information like Feeder line and antenna sector. Also often used to describe test setup, e.g. "Site: 20W Combiner Test".
N	RF On / Off Switch	One Push switched RF ON, Second push switches RF ON. The button is only active if Carrier parameters have been set and Site information is available. For further information see menus: Carrier Select and Site Select
O	System	Opens System menu. See Chapter System Menu for further information
P	Audio On/Off	Audio Signal when measurement passes green/red threshold of Bar Graph
Q	Analyzer	Opens Analyzer Menu For more information see chapter Analyzer Mode.
R	Capture	Capture the recent field mode screen and save as a file.
S	EXIT	Triggers Power down sequence. Active only when RF-power is OFF.
T	Record	In single mode (default), log measurement and system data of current measurement. In auto mode, start/stop for recording continuous log sequences. For further information on recorded data and auto mode see chapters Data and System Menu.
U	Carrier	Opens Carrier Select screen. For more information see chapter Carrier Select: Active only when RF-Power is OFF.
V	Site	Opens Site Select screen. For more information see chapter Site Carrier: Active only when RF-Power is OFF.
W	History	Opens Site History screen For more information see chapter Site Carrier: Active only when RF-Power is OFF.
X	Data	Opens Data menu (copy log files, delete log files, sites and

Element	Name	Description / Display
		carriers) For more information see chapter Data Active only when RF-Power is OFF
Y	Distance to PIM	Opens Measure Distance of Faulty PIM screen For more information see chapter DTP
Z	VSWR	Opens VSWR Line Monitor screen For more information see chapter VLM
i	Max/Min Hold	Displays Min and Max PIM value. This value is reset when RF-Power is ON.
ii	Delta Value	Displays the difference between max PIM value and min PIM value.

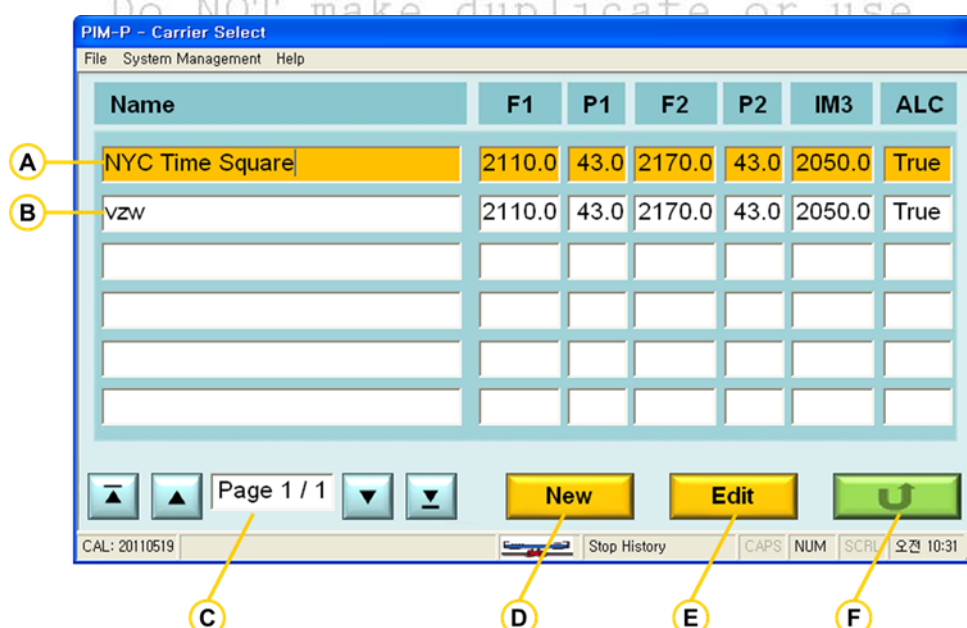
7.2.2 Carrier Entry

Carrier Signal settings specify the frequencies of the transmitting RF signals and their power level. Site information allows to a) specify the tested site in detail or to specify component tests more closely. All settings entered with Carrier signals or Site/Test information is recorded when measurement data is logged, this allows for detailed analysis after a series of tests has been completed.

Furthermore settings and vital measurements are stored in the system so that historical data related to site information can be viewed for comparison, e.g. if systems are deteriorating. For more information on this see chapter "History Screen".

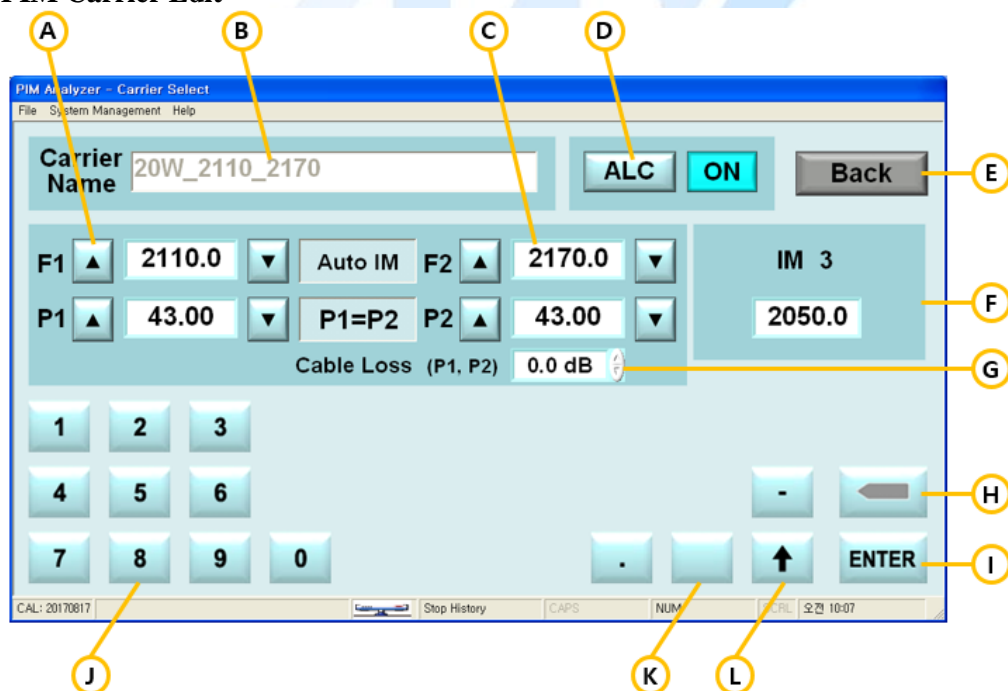
Carrier Select

Once carriers have been stored in the system, they can be easily recalled. The screenshot shows a list of 2 carriers with related information on transmit frequencies and power levels.



Element	Name	Description / Display
A	Carrier	Carrier specific information on frequencies and power levels stored in the PIM.
B	Selected Carrier	The yellow background indicates the carrier that is selected and will be used for test after pressing Return
C	Page Indicator & Jump arrows	If more than 6 different carrier signals are stored in the PIM, the current page and number of pages are shown. Inner arrows: One page jumps in both directions Outer arrows: Jump to Pos1 or End of list Carriers are selected by clicking / tapping them.
D	New	Opens Edit Carrier screen without carrier name. Note: Once the carrier name has been entered, it cannot be changed (only deleted) at a later time.
E	Edit	Opens Carrier Edit screen, allowing the modification of frequencies or power levels.
F	Back	Returns to previous screen.

PIM Carrier Edit



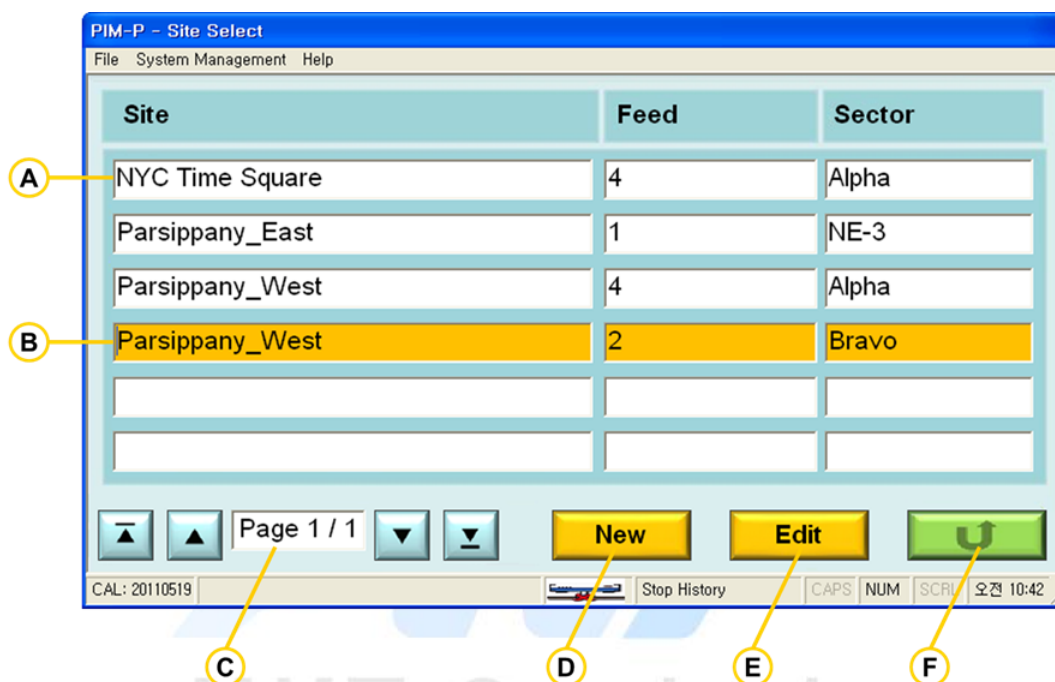
Element	Name	Description / Display
A	Carrier 1 Parameter	Sets power level and frequency of carrier signal 1: Note: when entering this field a numeric keyboard is displayed. A new or changed value is accepted by pushing the Enter button (I)
B	Carrier Name	When entering new carrier information, the cursor is set to this field and marked orange for editing. The name will be stored by pushing "Enter" (I)
C	Carrier 2 Parameter	Sets power level and frequency of Carrier Signal 2: Note: when entering this field a numeric keyboard is displayed. A new or changed value is accepted by pushing "Enter" (I)
D	ALC	Auto Level Control – for utmost accuracy it is recommended to set ALC to ON (default). For more information see chapter "System Menu".
E	Back	Returns to previous site.
F	IM	Automatically calculates and displays the next IM product that lies in the receiving band of the PIM
G	Cable Loss	Enter the total cable loss connected to the DUT. The output of PIM Analyzer increases in addition to Cable Loss, P1 and P2. (increased by 0.1 dB, up to 1 dB)
H	Delete	Deletes last character / character to the left of the cursor
I	Enter	Entries are stored in the system when the "Enter" button is pressed
J	Keyboard	Keyboard, toggles between characters and numeric
K	Space	Space
L	Capitals	Upper case entries



Note: When using an external keyboard do not use commas in names or descriptions. Log Data is stored in a CSV (Comma-separated value) text form. Commas in the description will mix up fields that are assigned for particular values, relevant e.g. when importing data in a spreadsheet or database. The touch screen keyboard does not offer commas for entry.

7.2.3 Site Entry

As with Carriers, Sites (or Tests) and linked information can be stored in the memory of the PIM. Once Sites have been stored in the system, they can be easily recalled. The screenshot shows a list of 4 Sites with related information on feeder and sector.



Element	Name	Description / Display
A	Site	Sites, with information on feeder and sector stored in the PIM.
B	Selected Site	The yellow background indicates that this site is selected and will be used for data logging.
C	Page Indicator & Jump arrows	If more than 6 different sites are stored in the PIM, the current page and number of pages are shown. Inner arrows: One page jumps in both directions Outer arrows: Jump to Pos1 or End of list Sites are selected by clicking / tapping them.
D	New	Opens Edit Site screen without site name. Note: Once the site name has been entered, it cannot be changed (only deleted) at a later time.
E	Edit	Opens Site Edit screen, allowing the modification of site related information.
F	Back	Returns to previous screen.

PIM Site Edit



Element	Name	Description / Display
A	Carrier Name	Carrier signal to which site information is related to.
B	Comment	Allows additional entries related to the Site or Test.
C	Site / Test Name	Site / test name New or changed entries are stored by pushing "Enter" (J)
D	Sector	Additional information (Sector) New or changed entries are stored by pushing "Enter" (J)
E	Back	Returns to previous site.
F	Feed	Additional information (Feeder) New or changed entries are stored by pushing "Enter" (J)
G	User	Additional information (User) New or changed entries are stored by pushing "Enter" (J)
H	123 / ABC	Toggles the touch screen keyboard between characters and numeric.
I	Delete	Deletes last character / character to the left of the cursor
J	Enter	Entries are stored in the system when the Enter button is pressed
K	Keyboard	Keyboard, toggles between characters and numeric
L	Space	Space
M	Capitals	Upper case entries



Note: When using an external keyboard do not use commas in names or descriptions. Log Data is stored in a CSV (Comma-separated value) text form. Commas in the description will mix up fields that are assigned for particular values, relevant e.g. when importing data in a spreadsheet or database. The touch screen keyboard does not offer commas for entry.

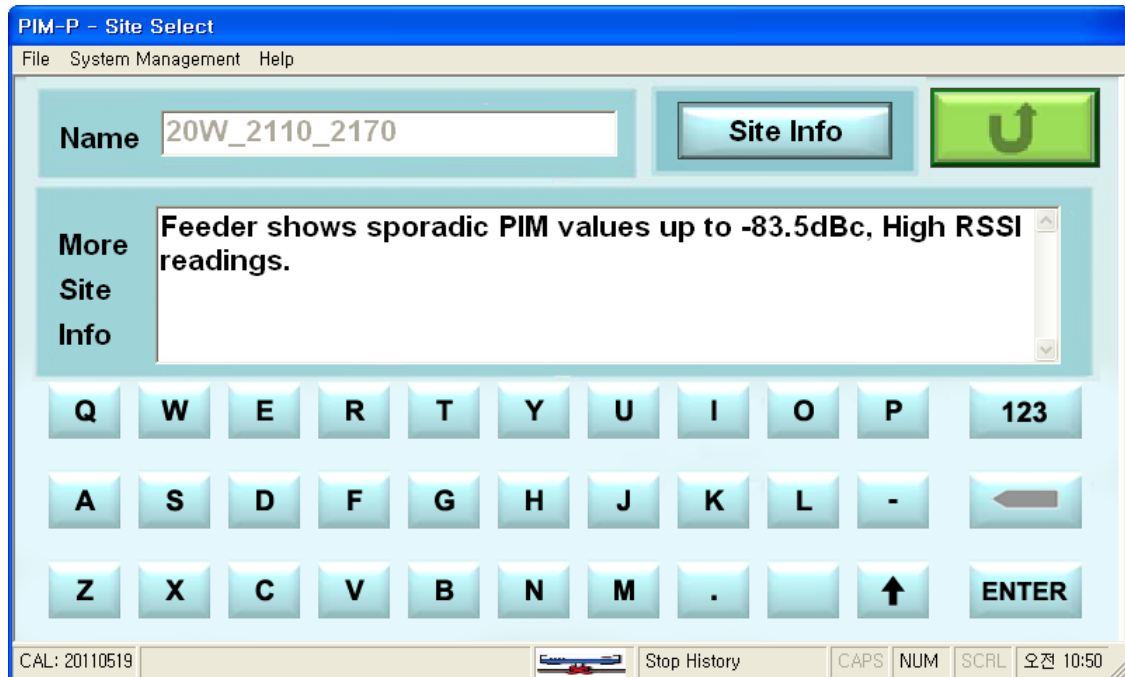


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7.2.4 Comments

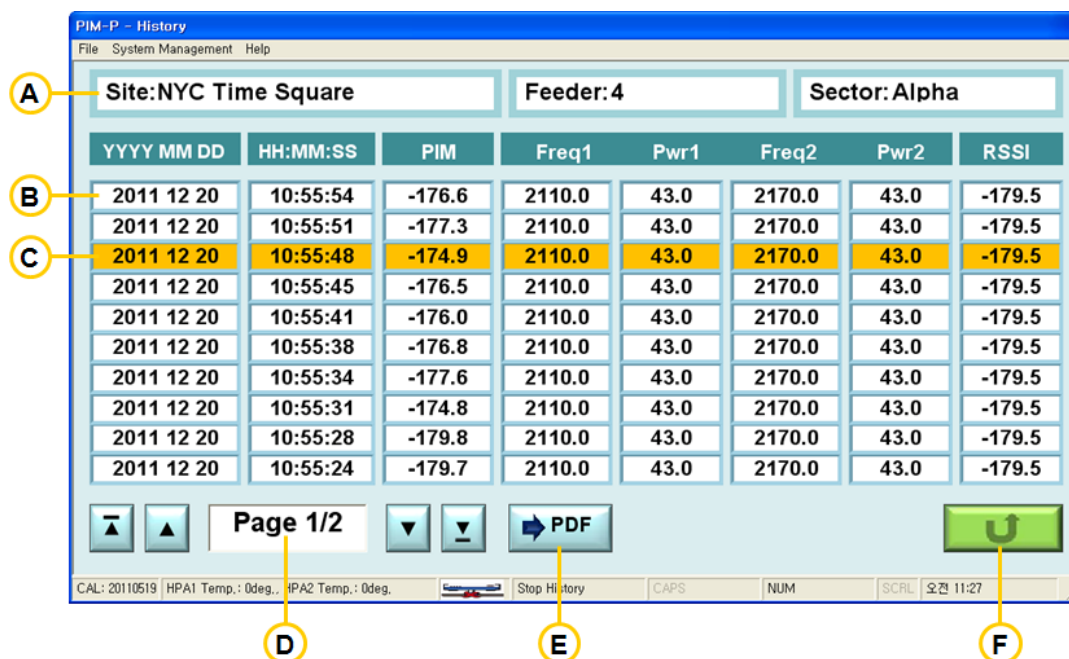
Site information allows users to add comments that provide further information about the Site or the Test. Comments are not stored in the log file.



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7.2.5 History Screen

Log data is stored in the test system memory whenever the REC button is pushed. Log data stores the measurements, tester settings, and site related information. With this capability operators can view historic information of specific sites, allowing them to compare current and former measurements and analyze if their performance has changed over time.



Element	Name	Description / Display
A	Site	Site (test) information including Site name, Feeder, and Sector.
B	Log Data Set	Shows historical information of measurement: Date, Time, PIM reading, Frequencies, Power levels and RSSI.
C	Yellow Cursor	As in A. The cursor is for visually aiding the user and displays selected data for PDF files output.
D	Page Indicator & Jump arrows	If more than 6 different sets of log data are stored in the PIM, the current page and number of pages are shown. Inner arrows: One page jumps in both directions Outer arrows: Jump to Pos1 or End of list.
E	PDF Files Output	Export the selected log data in "C" to a PDF file.
F	Back	Returns to previous site.

7.2.6 Data Management

The following chapter describes the Data Menu and Data structure.

Recording / Record – Button



PIM can store measurement data manually (default) or automatically with predetermined intervals. When the “Record” button in the “Field Mode” screen is pushed, the system stores one data set in a log file. The recorded measurement data is stored in a log file. This file is stored in ASCII text format with CSV structure. (Comma-Separated Values), allowing convenient importing of log data into databases or spreadsheet applications.

For more information about Automatic Mode refer to chapter “System Menu”.



Note: While it is theoretically possible to enter commas in descriptive fields like Carrier Name, Site, Feeder and Sector, it is strongly suggested to refrain from such practice. In a CSV structure, text after the comma will be taken as new value when importing into a database or spreadsheet which will mix up field assignments. Important information will be at an incorrect location.

7.2.7 Log Files and Content

With PIM firmware versions 1.2 and later, log file names are a combination of Carrier, Site, Feeder, Sector, Date and Time. This way every log data file is absolutely unique and allows for easy identification:

SITE_FEEDER_YYYYMMDD_HHMMSS.log

Previous firmware versions used the nomenclature: PIM_YYYYMMDD_HHMMSS.log

Log files are stored in the directory C:\Program Files\PIM\History Users do not need to access this directory directly since the data features of PIM Analyzer offer a convenient way to extract and copy the data.

Information stored in log files is listed in the table below.

Content (comma separated)		
Variable	Format	Description
Date	YYYYMMDD	
Time	HHMMSS	
PIM (dBc)	-XXX.X	Signed Field
PIM (dBm)	-XXX.X	Signed Field
RSSI (dBm)	-XXX.X	Signed Field
F1 (MHz)	XXXX.X	Frequency 1 in MHz
F2 (MHz)	XXXX.X	Frequency 2 in MHz
IM 3 (MHz)	XXXX.X	IM3 Frequency in MHz
F1 (dBm)	XX.X	F1 Power level in dBm
F2 (dBm)	XX.X	F1 Power Level in dBm

Content (comma separated)		
Variable	Format	Description
IM3 Bandwidth (Hz)	XXXXXX	IM 3 Bandwidth in Hz
PIM Type	XXX	Example: "F03"
Model	String - 40 Characters max	
Serial Number	String - 40 Characters max	Serial number of test system
HW Version	String - 40 Characters max	Hardware version
SW Version	String - 40 Characters max	Software version installed
OS Version	String - 40 Characters max	Operating system
Carrier	String - 70 Characters max	Carrier name
Site Name	String - 70 Characters max	Site / Test description
Feeder	String - 40 Characters max	Feeder description
User	String - 70 Characters max	User name / Initials
"Acwavetech"	String	For internal use
"PIM Data Log"	String	For internal use
Cal date	YYYYMMDD	Date of Last Calibration
CHKSUM	XXX	For future use

Added with firmware version 1.2 and later.

Sector	String – 40 Characters max	Sector description.
BarGraph_RG	-XXX	Value of Bar Graph green / red threshold (-dBc).
RFON	String	RF On time in seconds, 1m, 2m, 5m, 10m, 20m, 30m, 60m, 120m, 180m or "Always On".
RECINTRV	String	Lists Recording interval time and units or "OFF".
ALC	String	ON-"True" or OFF-"False"

7.2.8 Log File Management

All measurements are stored in separate log files. When transferring files to an external drive (e.g. memory stick), all log data is merged into one file for ease of importing into databases and spreadsheets.

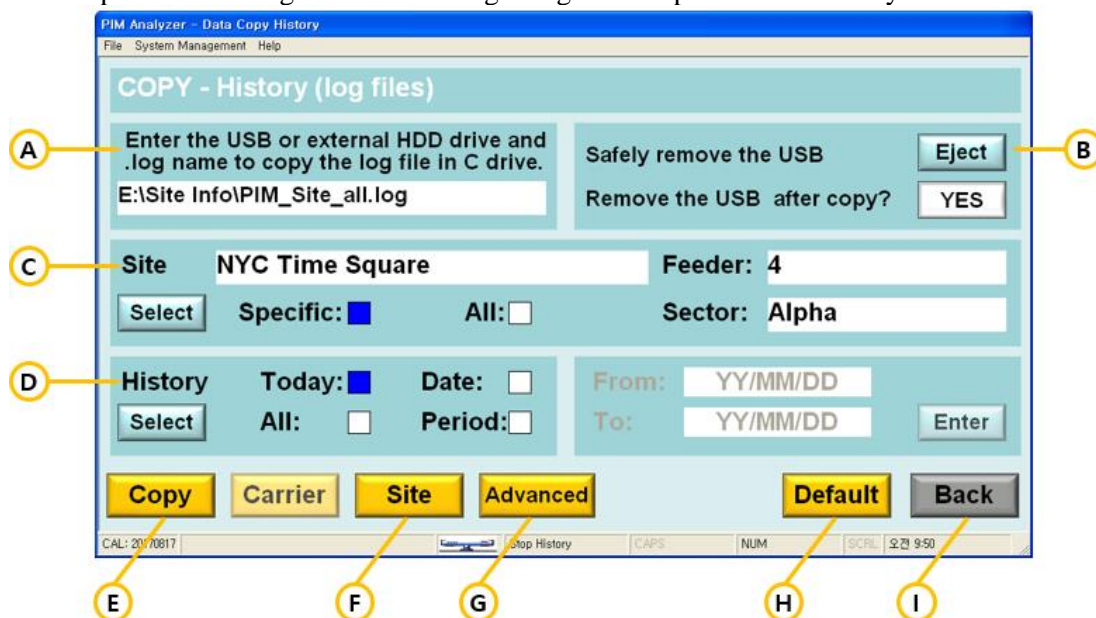
Default drive directory and file name of the merged log data-sets is:

D:\Site Info\PIM_Site_all.log

The default setting can be overwritten when specific locations or filenames are required (requires keyboard).

7.2.9 Data Copy

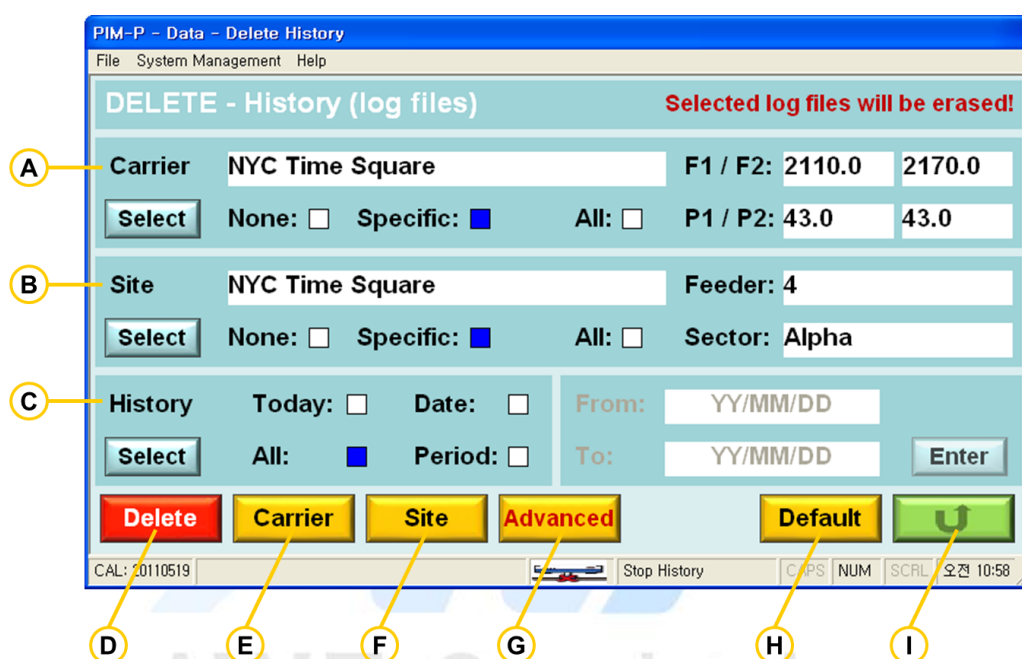
Data copies selected log files to one merged log file at a particular directory.



Element	Name	Description / Display
A	Copy location	Drive, directory and file name of the merged log data file.
B	Erase Yes/No	Selects if log files are to be deleted after files have been copied. Note: Historical site information is no longer available when related log data are erased. Default: Yes
C	Site	Allows copying of log data from a specific Site or all Sites the PIM contains. Specific Sites can be selected via the Site Button Selection: Specific, All Default: Specific
D	History	Allows copying of log data recorded at specific dates Selection: Today, Specific, All, Date, Period Date or Period require entry in YY/MM/DD format. Press enter to store setting Default: Today
E	Copy	Executes copy process
F	Site	Opens Site Selection screen. Marked Site on Site Selection screen will be transferred to Data Menu after Return
G	Advanced	Opens Data Delete menu (allows deletion of log data without copying)
H	Default	Sets default values
I	Back	Returns to previous site

7.2.10 Data Delete Log Files

The Data Delete Menu allows the user to delete specific log files or all log files. In this mode the data is not copied before it is deleted so extreme care need to be taken because with lost log files, historical data of related sites is no longer available.

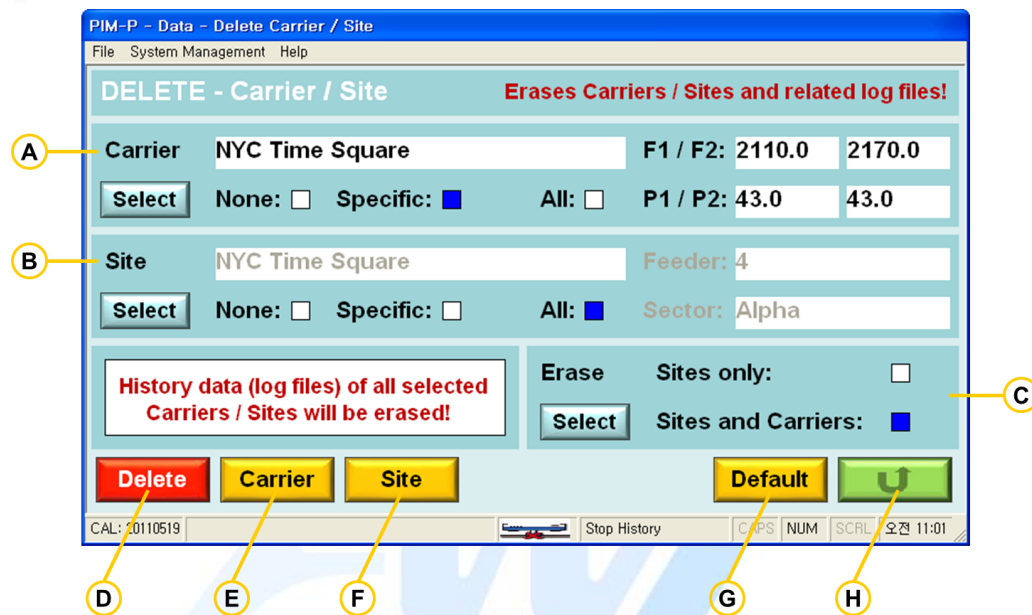


Element	Name	Description / Display
A	Carrier	Selection to erase log data of a specific Carrier, All Carriers or none. Specific Carriers can be selected via the Carrier button Selection: None, Specific, All Default: None
B	Site	Selection to erase log data of a specific Site, all sites or none. Specific Sites can be selected via the Site button Selection: None, Specific, All Default: None
C	History	Allows deletion of log data recorded at specific dates Selection: Today, Specific, All, Date, Period Date or Period require entry in YY/MM/DD format. Press enter to store setting Default: Today
D	Delete	Executes deletion
E	Carrier	Opens Carrier Selection screen. Marked Carrier on Carrier Selection screen will be transferred to Data Delete Menu after Return
F	Site	Opens Site Selection screen. Marked Site on site Selection screen will be transferred to Data Delete Menu after Return
G	Advanced	Opens Data Carrier & Site Delete menu
H	Default	Sets default values
I	Back	Returns to Data Copy site.

7.2.11 Data Delete Carrier & Site



This Menu allows users to delete Sites and/or Carriers. After the deletion process, all Carrier and/or Site related settings and data, including log data, will be erased.



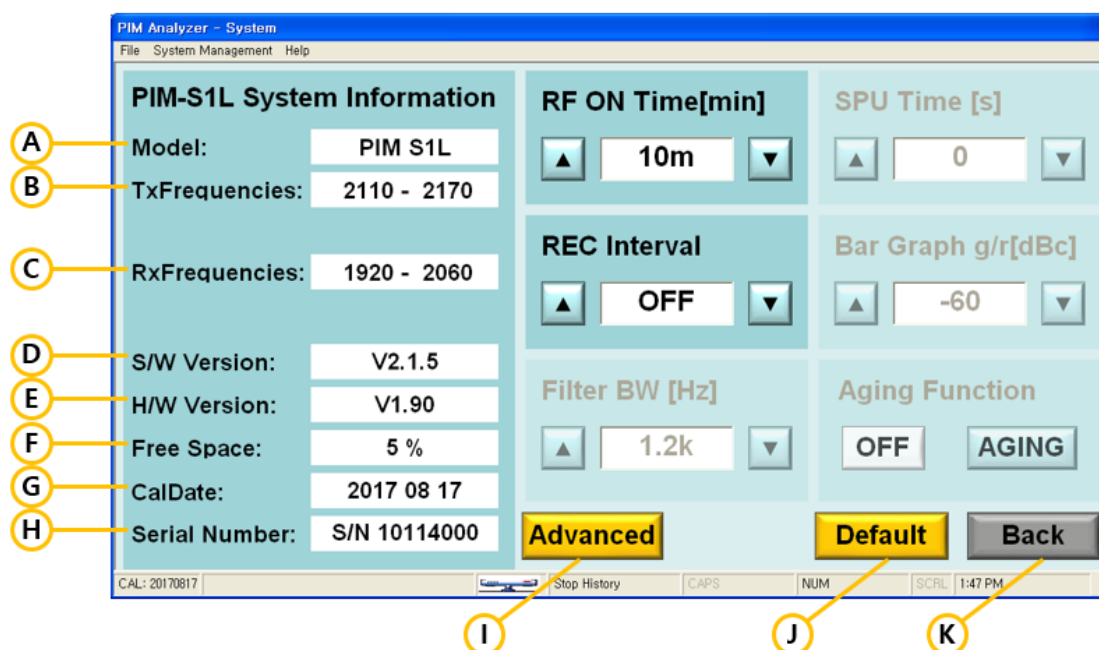
Element	Name	Description / Display
A	Carrier	Selection to erase a specific Carrier, All Carriers or none. Specific Carriers can be selected via the Carrier button Selection: None, Specific, All Default: None
B	Site	Selection to erase a specific Site, all sites or none. Specific Sites can be selected via the Site button Selection: None, Specific, All Default: None
C	Sites Only Sites & Carriers	Selection of only Sites are erased or both Sites and Carriers. Selection: Sites only, Sites & Carriers Default: Sites only
D	Delete	Executes deletion of Sites / Sites & Carriers (all settings and data will be lost)
E	Carrier	Opens Carrier Selection screen. Marked Carrier on Carrier Selection screen will be transferred to Data Site & Carries Delete Menu after Return
F	Site	Opens Site Selection screen. Marked Site on site Selection screen will be transferred to Data Site & Carrier Delete Menu after Return
G	Default	Sets default values
H	Back	Returns to Data Copy site.

7.3 System Menu

The System Menu provides information about the PIM Analyzer. Information shown includes software version, hardware version, and memory space available for log data. This menu allows users to modify the default settings of the PIM. The need to modifying basic settings may be required during regular testing. Advanced settings should only be modified by advanced operators since they influence how the PIM measures PIM.

System Information and Buttons

Note: This screenshot has been taken form a PIM SW Simulator running on a PC, therefore some values are displayed as OS.



Element	Name	Description / Display
A	Model	Model type of PIM S1L
B	TX Frequencies	Transmitting frequency range, tester type dependent
C	RX Frequencies	Receiving frequency range, tester type dependent
D	SW Version	Software Version of PIM
E	HW Version	Hardware version of PIM
F	Free Space	Memory space available for data logging.
G	Cal Date	Calibration Date of PIM
H	Serial Number	Serial number of PIM:
I	Basic / Advanced	Toggles between Basic mode and Advanced mode: Basic mode: RF On Time, REC Interval Advanced mode: Access to all settings See chapter System Menu Functional Block for detailed information.
J	Default	Sets default values.

Element	Name	Description / Display
K	Back	Returns to previous site

7.3.1 PIM Memory Space



PIM Passive intermodulation test systems come with a total of 5.75 GB of user accessible memory. This memory is used to store log data and site setup information. The average size of a Log data set is 250 Bytes. With a drive segmentation of 512 Byte per block, PIM Analyzers can store more than 11 Million data sets.

7.3.2 System Menu Functional Block

RF ON Time[min] <input type="button" value="▲"/> <input type="text" value="10m"/> <input type="button" value="▼"/>	SPU Time [s] <input type="button" value="▲"/> <input type="text" value="0"/> <input type="button" value="▼"/>
REC Interval <input type="button" value="▲"/> <input type="text" value="OFF"/> <input type="button" value="▼"/>	Bar Graph g/r[dBc] <input type="button" value="▲"/> <input type="text" value="-153"/> <input type="button" value="▼"/>
Filter BW [Hz] <input type="button" value="▲"/> <input type="text" value="1.2k"/> <input type="button" value="▼"/>	Aging Function <input type="button" value="OFF"/> <input type="button" value="AGING"/>

7.3.2.1 RF ON TIME

By default, PIM Analyzers will switch RF power off after 10mins. This prevents unnecessary transmission of RF power if the system has been left on unintended.

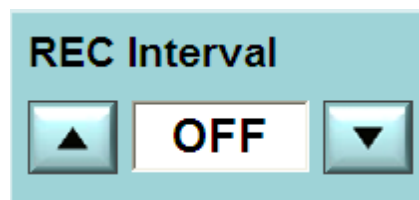
RF ON Time[min] <input type="button" value="▲"/> <input type="text" value="1m"/> <input type="button" value="▼"/>

RF-ON periods: 1m, 2m, 5m, 10m, 20m, 30m, 60m, 120m, 180m, or “Always On”.

Default: 10min

7.3.2.2 REC Interval

PIM Analyzers record measurements whenever the Record button is pushed. Multiple pushes create multiple, corresponding individual log files. If measurements need to be analyzed over a longer of time, PIM Analyzers can record log data automatically by setting the REC interval to a value other than “OFF”, which will record data automatically at the interval entered. When RF power is activated in the Field mode screen pressing the Record once starts recording, the second push stops recording. The Status Indicator field will show the REC symbol lit during recording. If RF power is switched off during recording, data logging stops.



REC Intervals: 1s, 2s, 5s, 10s, 20s, 30s, 1m, 2m, 5m, 10m, 15m, 30m, 1h, 2h, 5h, 12h, 24h and “OFF”,

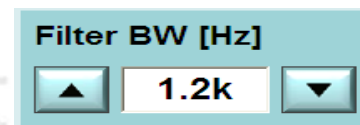


Default: OFF

7.3.2.3 Filter BW

Advanced Mode Only.

Default filter bandwidth of the PIM receiver is 1.2 kHz; which is the optimized setting for best performance. Increasing bandwidth opens the receiver, allowing to “see” if signals are present close to the receiving signal frequencies. If Change of Filter Bandwidth effects all IM frequencies that fall in the receiving range of the PIM. Decreasing the filter bandwidth allows to eliminate unwanted signals very close to the receiving signal frequencies. Possible Filter BW settings are:



Filer BW: 300Hz, 600Hz, 1.2kHz, 2.5kHz, 5kHz, 10kHz, 12kHz, 15kHz, 25kHz 50kHz

Default: 1.2 KHz



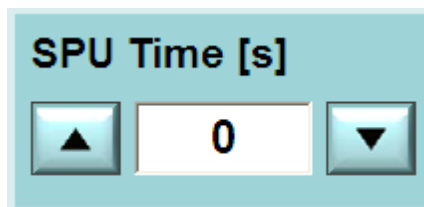
Note: Varying filter bandwidth influences the amount of RF energy measured by the PIM receiver.

Wider Filter BW measurement values increase (lower negative number),
Tighter Filter BW measurement values decrease (higher negative numbers).

7.3.2.4 SPU Time

Advanced Mode Only.

SPU (Soft Power-Up) gradually ramps up the RF output power, starting from 20dBm, to the actual power level. When the PIM amplifiers switch the RF Power on, the full power is practically immediately present at the RF Port. Depending on the DUT, this can sometimes cause strong reflections. Antennas which are directly (only with a short cable) connected to the RF port of the PIM are prone to such reflections. If the returned energy is too high, PIM will switch off to protect its hardware. A remedy is to simply increasing RF power gradually.



SPU Time: Increments 1s, Settings range 0sec to 60sec

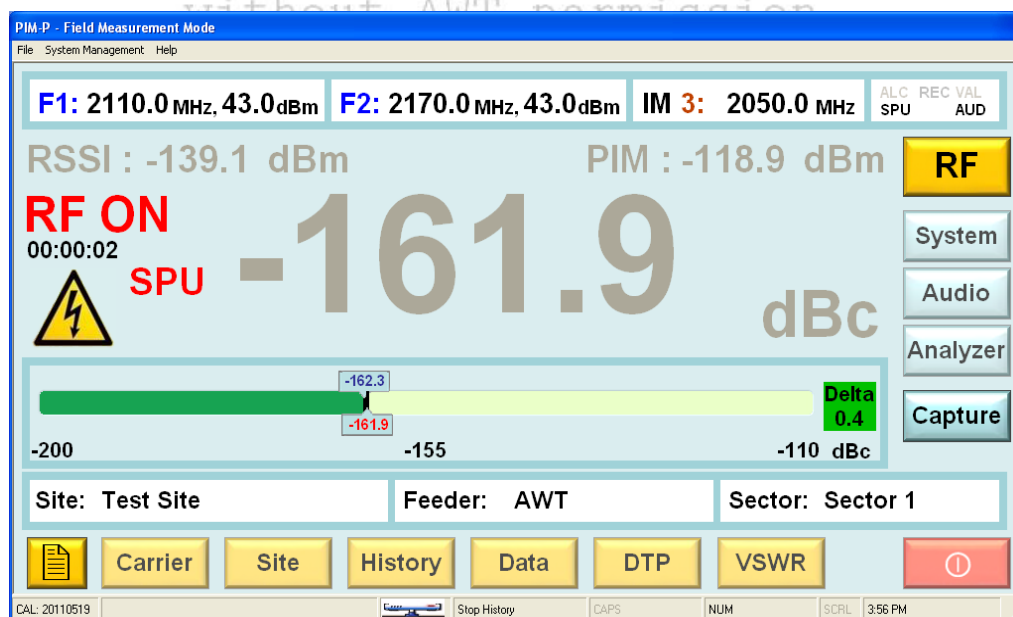
Default: 0s

Example: With a power setting for 43dBm and SPU of 10s it takes 10 seconds to ramp RF power up from 20dBm to 43dBm



Note: PIM starts measuring immediately after RF power is present at the RF Port. During the period power is ramping up, PIM measurements are lower than the ones at the final power level. Remember, PIM is measured in dBc – power relative to the carrier: Lower carrier power equals lower PIM readings.

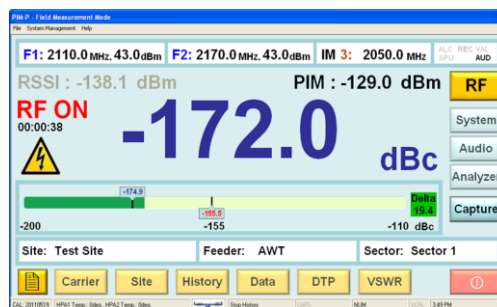
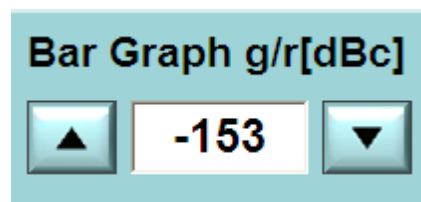
To ensure users do not misinterpret a “good” reading during power ramp-up, a blinking “SPU” marker is shown during the time. Measurements should not be considered valid when the red SPU indicator is flashing. Please wait for this indicator to disappear before considering the measurement valid.



7.3.2.5 BAR Graph G/R

Advanced Mode Only

The Bar Graph's green/red threshold is -153dBc by default. The switch from green to red is an optical indicator if a DUT is within limits or if it exceeds them. PIM measurement values higher than the set threshold can provide an audible indicator. Obviously Audio has to be switched on in the Field Mode screen. Maxhold is an important feature which holds the maximum value during PIM measurements. In this example the maxhold value is -147 dBc.



Bar Graph g/r: -60dBc to -180dBc in 1dB increments

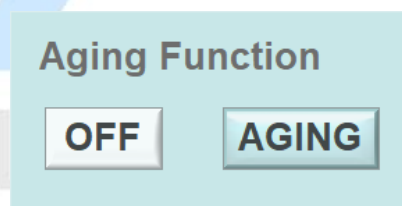
Default: -153 dBc

7.3.2.6 Aging Function

Advanced Mode Only

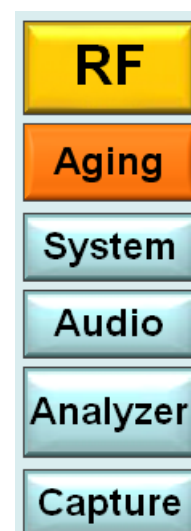
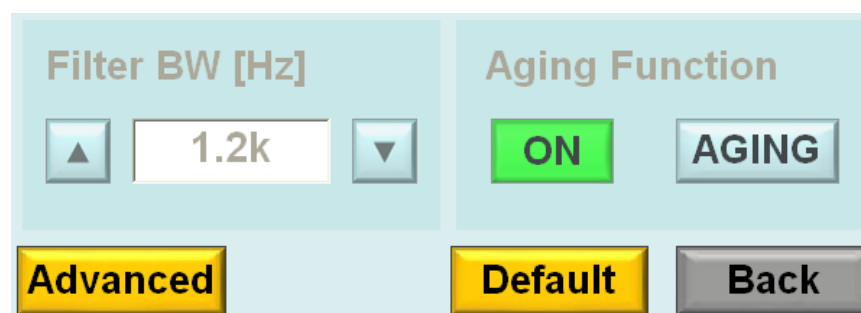
When the PIM is powered on in a cold environment, the PIM sends ALC Alarm when the transmit output power is +/- 1.5 dB compared to the set value, which takes a long time to preheat the equipment. Aging Function solves this problem to allow the PIM to preheat itself. High Power Amplifier is turned on to output +35 dBm of Carrier 1 and Carrier 2, respectively, with Filter BW set to 1.2 KHz default. IM values are not measured in this state.

Note that high frequency +35 dBm is outputted in free space, and therefore a DIN-type 10Watt or higher termination must be connected to the front panel port.



Default: OFF

Once Advanced is selected, Aging function will be activated and appears on the Menu.

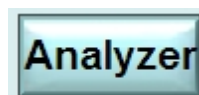


7.4 Analyzer Mode

The Analyzer Mode of the PIM offers more possibilities to analyze PIM measurements. It contains of 3 Sub modes:

- Frequency
- Time
- Sweep

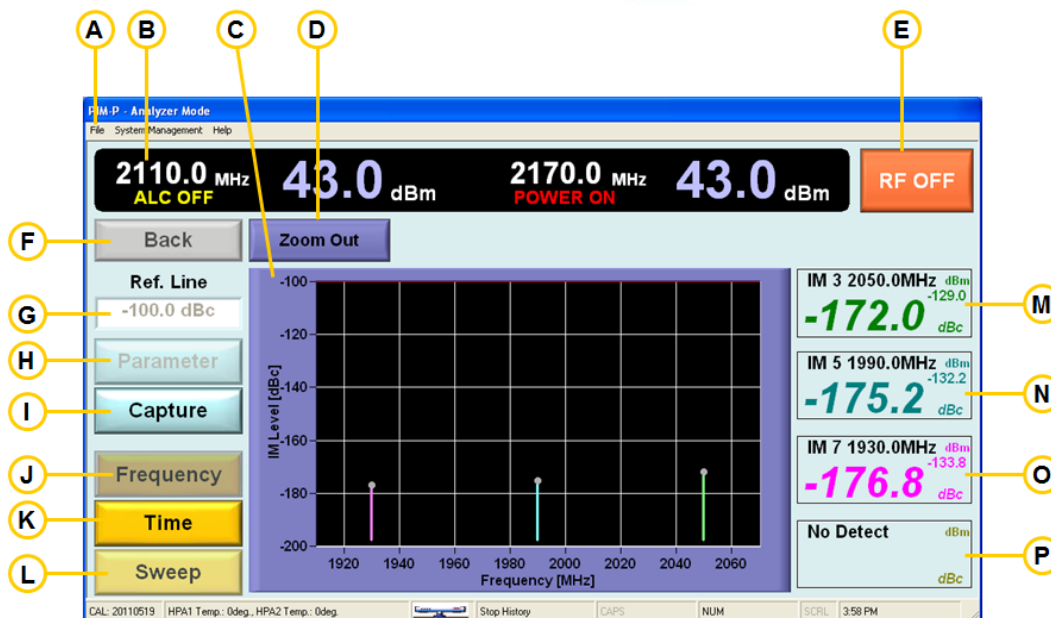
The Analyzer mode is selected by pressing the Analyzer button while in the Field Mode Screen. Returning to field mode is possible by pressing the return button. RF Power needs to be OFF



Frequency and power values can be set directly without utilizing Carrier or Site information. For larger display we recommend to use an external monitor.

As in the Field Mode, the Analyzer Mode allows to log data over a period of time. In this mode only the settings and measurement values are recorded. The analyzer mode allows taking screenshots. This is helpful due to the graphic display and measurement traces. Analyzing an image often reveals more details than analyzing numeric values.

For more information on data logging and screen shots see chapter “Pull-Down menus”.



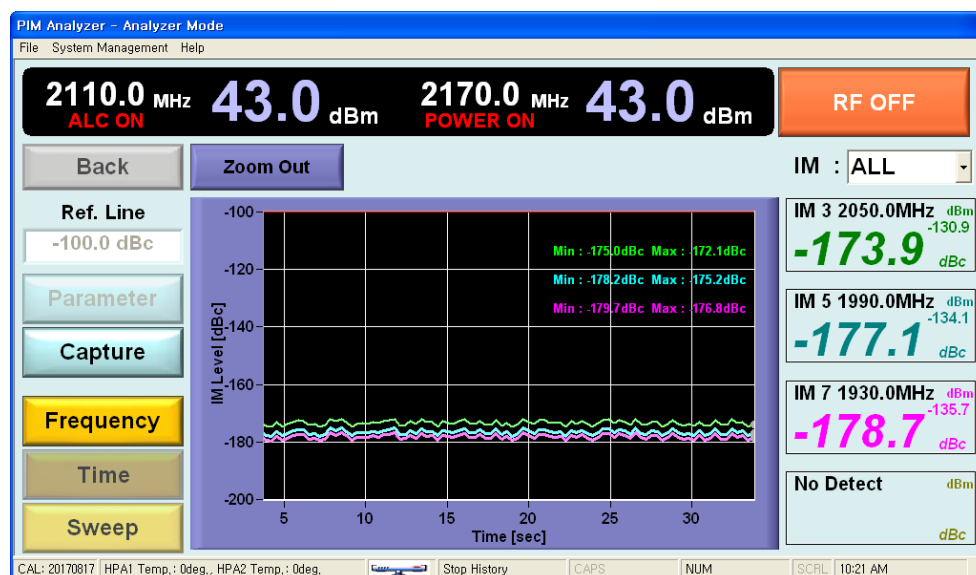
Element	Name	Description / Display
A	Pull-Down menu	Allows Screenshots, data logging, and self test. For more information refer to chapter Pull-Down menus.
B	Carrier display	Carrier signal information: Frequencies, Power levels
C	Graphical display	Shows up to 4 IM signals as a vertical bar. Position on the x-axis indicates frequency and length indicates power level. Color of the bars refers to the colors of the numeric displays (N-Q). The graphical display is floating, meaning the center area can be moved for better convenience and visibility of important display information. Moving by touching grid part of the display and the screen and drawing it to the desired location
D	Zoom Out	Allows modification of the range from -60 to -200 dBc to -100 to 200dBc, which provides a better resolution.
E	RF Power Button	Switches RF Power ON / OFF The Button inscription shows what happens if the button is pushed. In the shown screenshot RF power is ON, the next button push will switch RF power OFF.
F	Back	Brings PIM back to Field Mode. Works only when RF Power is OFF
G	Reference Line	Moves reference line for audible indication of measurements that exceed the limit. Same as Green/Red threshold of Bar graph in field mode. Range -60 to -200 dBc
H	Parameter Setting	Allows modification of frequencies and power levels used in Analyzer Time and Frequency mode. Works only with RF Power OFF
I	Capture	Capture the recent analyzer mode screen and save as a file.
J	Frequency	Graphic Display Frequency mode: IM signals shown as vertical bar, indicating power and frequency. Signal colors relate to numeric display
K	Time	Graphic display – Time Mode: IM signals shown as moving horizontal line, indicating power (changes) over time. Signal color relates to numeric display
L	Sweep	Graphic display Sweep mode. Signals are “swept” over a range to test wide frequency range
M	Numeric field 1	Strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency
N	Numeric field 2	Second strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency
O	Numeric field 3	Third strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency
P	Numeric field 4	Forth strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency

7.4.1 Frequency Mode

In Frequency mode IM products are displayed as vertical bars, where the positions indicate the frequencies and the length the power level. Up to 4 signals can be shown at the same time. Different colors are used when more IM products are shown. PIM products are also shown numerically, where the colors of the bars correlates with the colors of the 4 numeric displays.

7.4.2 Time Mode

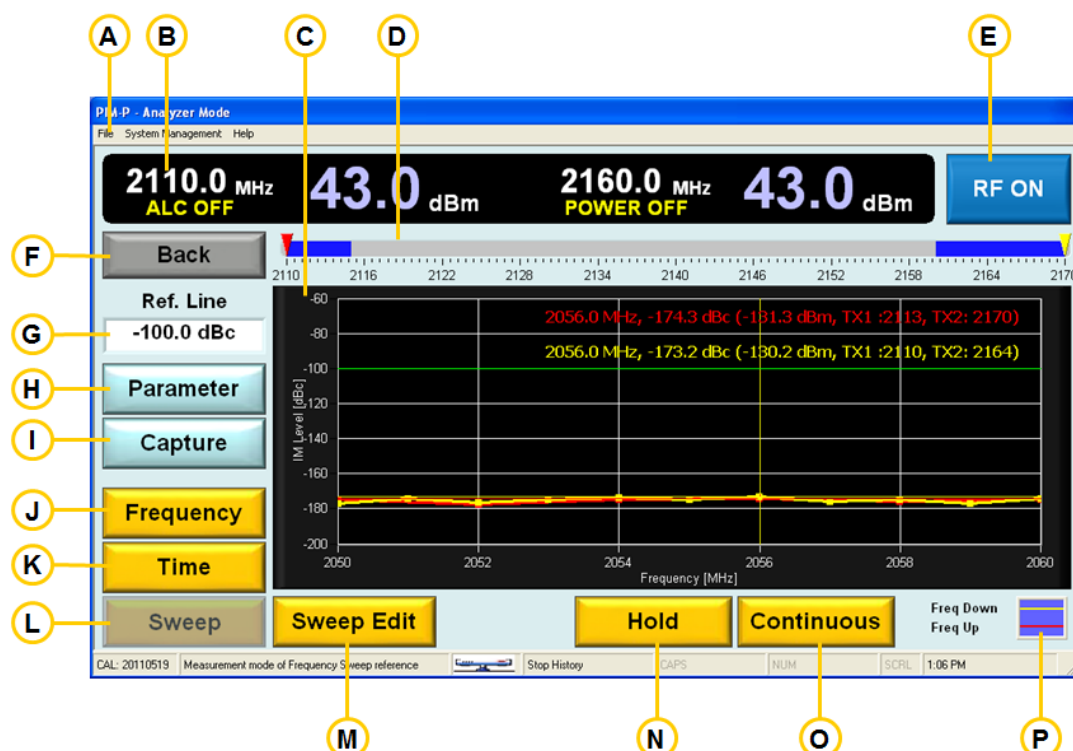
In Time mode IM products are displayed as a horizontally moving line, where the position indicates the power level over the time. This display is very helpful to test immediate PIM variations, like loose connections. Any change is immediately visible. Time mode shows a 10 seconds window, but more information up to 10 minutes may be recorded. Move past traces to the window by touching, holding and drawing it to right until the wanted information is appears.



The screenshot shows three IM signals IM3 and IM5 and IM7 With -172.5 dBc IM3 exceeds the reference limit of -127.0 dBc. IM5 measured -175.7 dBc. Frequency information of the IM signals is provided in the numeric displays. In this example (IM3 is 2050.0 MHz and IM5 1990.0 MHz and IM7 1930.0 MHz).

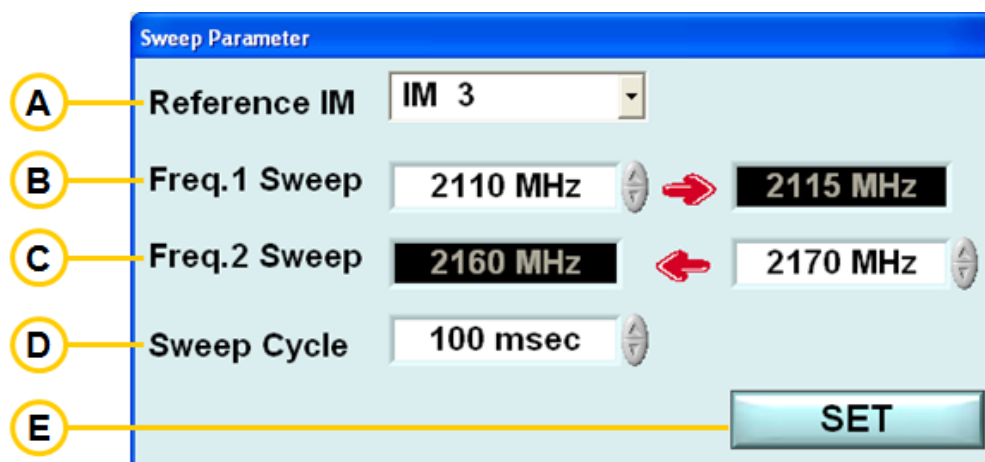
7.4.3 Sweep Mode

IM products in linear environment are frequency independent. Many passive components show a frequency response that is less linear or strongly frequency dependent. The sweep mode increments / decrements carrier signals by 1 MHz, covering a Tx range that results in a sweep of the complete Rx frequency range. Any deviations of PIM measurements that are frequency dependent are immediately visible.



Element	Name	Description / Display
A	Pull-Down menu	Allows Screenshots, data logging, and self test. For more information refer to chapter "Pull-Down menus".
B	Carrier display	Carrier signal information: Frequencies, Power levels
C	Graphical display	Shows two traces (red / yellow) of an IM product that are generated by a) sweeping the lowest frequency upwards – red trace and after that b) sweeping highest frequency carrier signal downwards –yellow trace. Increments are 1 MHz IM signals as a vertical bar. Position on the x-axis indicates frequency and length indicates power level. Color of the bars refers to the colors of the numeric displays (M-P). The graphical display is floating, meaning the center area can be moved for better convenience and visibility of important display information. Moving by touching grid part of the display and the screen and drawing it to the desired location. (Single sweep is completed, the grid is automatically placed

Element	Name	Description / Display
		in the lowest PIM value.)
D	TX Range	Shows Range of up-sweep and down-sweep.
E	RF Power Button	Switches RF Power ON / OFF The Button inscription shows what happens if the button is pushed. In the shown screenshot RF power is OFF, the next button push will switch RF power ON. When RF is ON, ALC is OFF because frequency sweep speed is fast.
F	Back	Brings PIM back to Field Mode. Works only when RF Power is OFF
G	Reference Line	Moves reference line for audible indication of measurements that exceed the limit. Same as Green/Red threshold of Bar graph in field mode. Range -60 to -200 dBc
H	Parameter Setting	To set power levels for the sweep cycles: Menu comes up only with RF Power OFF Note: frequency setting in the parameter menu is not relevant for sweep measurements. Sweep Edit (P) sets frequency ranges.
I	Capture	Capture the recent analyzer mode screen and save as a file.
J	Frequency	Graphic Display Frequency mode: IM signals shown as vertical bar, indicating power and frequency. Signal colors relate to numeric display
K	Time	Graphic display – Time Mode: IM signals shown as moving horizontal line, indicating power (changes) over time. Signal color relates to numeric display
L	Sweep	Graphic display Sweep mode. Signals are “swept” over a range to test wide frequency range
M	Sweep Edit	Opens Sweep Edit menu, allowing to set: End of Lower Tx range, Start of Higher Tx range, Selection of measured IM (in case more than one are in the range), sweep increment time (default 100ms, range 10ms to 2000ms).
N	Hold	Hold Off blue, On red. While sweeping, measurement can be held immediately.
O	Single	Single Off –Blue, On -red. Determines if a single sweep or continuous sweeps are measured.
P	Freq Up/Down	Only for visualization of Tx sweep ranges



Element	Name	Description / Display
A	Reference IM	Allows selection of IM product (in case more than one are in the swept range)
B	Freq 1 Sweep	Start Frequency of up-sweep Default: lowest Tx frequency the tester can generate
C	Freq 2 Sweep	Start frequency of down-sweep Default: lowest Tx frequency the tester can generate
D	Sweep Cycle	Time between setting and measurement of increments
E	Set	Stores settings and returns to Analyzer Sweep Mode



Note: Sweep mode requires setting the power levels (Parameter button) and also to define the sweep frequency range (Sweep Edit Button).

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8 DTP (Distance to PIM) and VSWR (VSWR/ Line Monitor)

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8.1 Introduction

DTP (Distance to PIM) is to identify a faulty position on the RF path in the RF system. In particular, it detects the point where PIM occurs and a distance to the faulty PIM point on RF path for the base station and relay equipment in mobile communication.

In the past, the maintenance persons spend lots of time and cost to maintain the communication tower because they cannot know the point where the faulty PIM occurs on the RF path. However DTP use PIMD Analyzer to identify the Distance to faulty PIM on the RF path on the ground instead of going up to the tower.

The transmission line is the most common error point in the communication system. A discontinuity between cable and module connection can occurs on the line over time because the line is exposed to external environment and on the tower. Because VSWR (VSWR/Line Monitor) measures VSWR on the transmission line and identifies the faulty VSWR point on the line, it can be diagnosed and replaced before the severe damages occur.

These DTP and VSWR features can optimized and improve the communication quality with reducing the maintenance cost of the base station and relay equipment as well as eliminating the compromised factors.

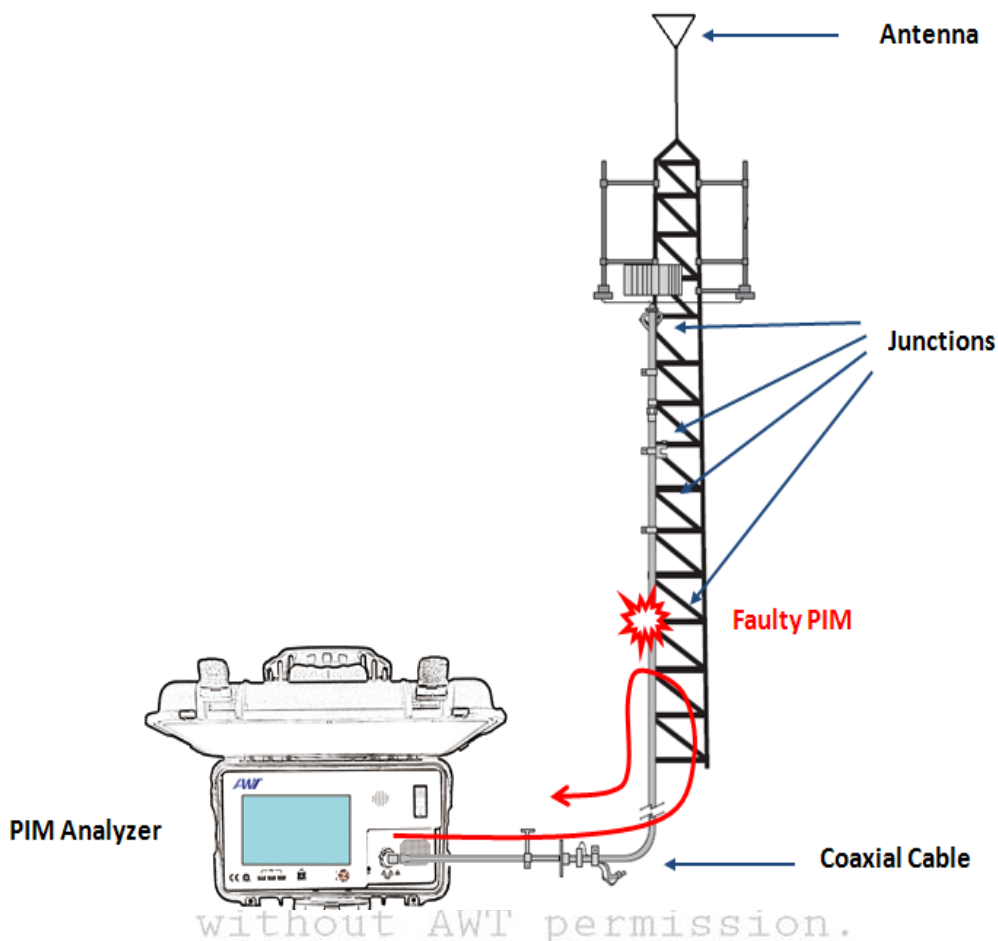
8.2 Specification

- DTP(Distance to PIM) / VSWR

DTP/DTF resolution	0.1m
DTP Accuracy	0.5m(typ.) except TETRA, E-TETRA
DTF Accuracy	0.5m(typ.) except TETRA, E-TETRA
Cable type	Pre stored types and user can add new cable types

8.3 Procedures to measure DTP (Distance to PIM)

8.3.1 DTP (Distance to PIM) Setup

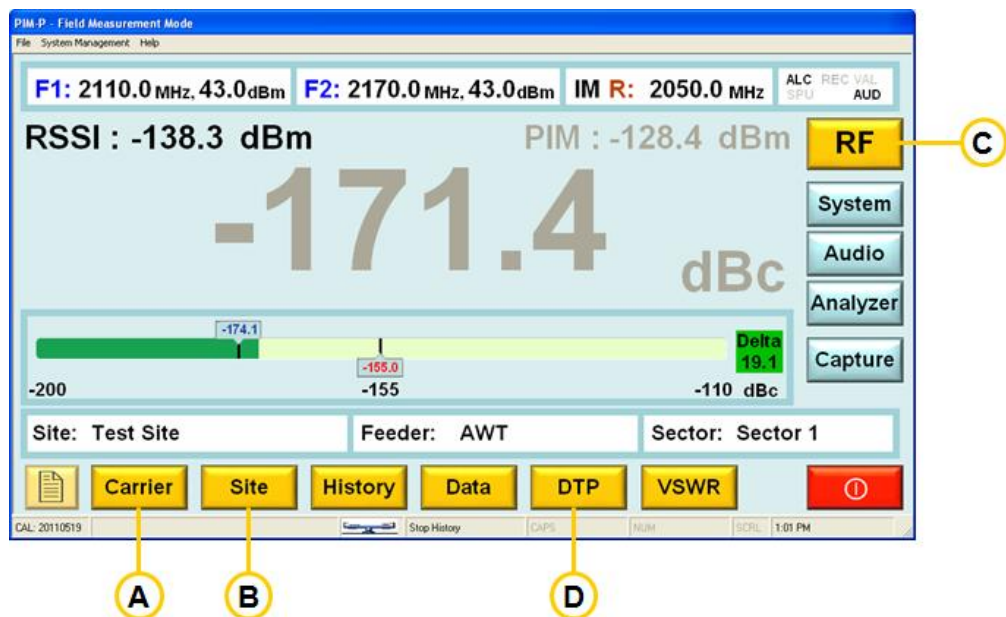


PIM Analyzer DTP Measurement Setup Diagram

Typical setup in the field is like the figure above.

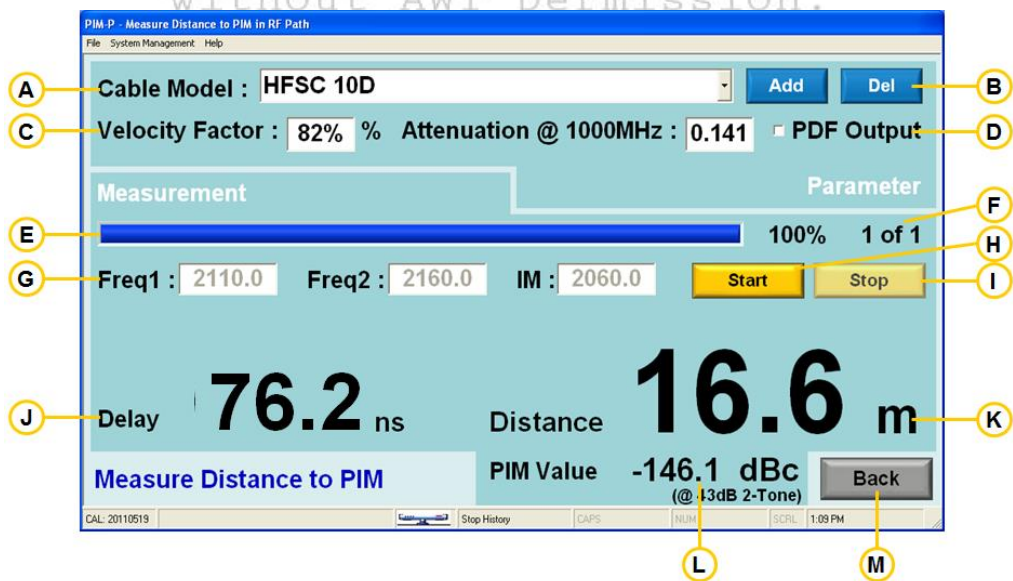
8.3.2 DTP (Distance to PIM)

Turn the unit on and create a carrier and site in the filed measurement mode. Then release RF and measure PIM on the RF path (See chapter 4. Software User Manual for creating a carrier and site).



Element	Description / Display
A	Open a window to select, add, and edit a carrier.
B	Open a window to select, add, and edit a site (you have to select a carrier first)
C	Turn the RF of the equipment, then start the actual measurement (Carrier and Site must be selected first)
D	Opens the DTP screen.

This is the descriptions for the options and functions.



Element	Description / Display
A	Select the cable model to measure
B	Add or Delete Cable model
C	Setting Velocity, Attenuation
D	Select to Output PDF file after measurement.
E	Displays the progress of measurement
F	Displays the measurement count vs. specified count
G	Displays the frequency to be measured
H	Start button to measure.
I	Stop button to measure
J	Displays a delay value for measured cable
K	Displays a distance for measured cable
L	Displays measured PIM value before start DTP.
M	Goes back to the Field Mode screen.


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PIM-P Cable Add

File System Management Help

Cable Name
Flex141

Velocity of Propagation(%)
70

Attenuation dB/100m
0.25

Save

Cancel

Q W E R T Y U I O P 123

A S D F G H J K L -

Z X C V B N M . ↑ ENTER

CAL: 20110519 Stop History CAPS NUM SCRL 11:05

Element	Description / Display
A	Input Cable Name
B	Input Velocity of Propagation
C	Input Attenuation dB/100m
D	Save New Cable Data
E	Cancel

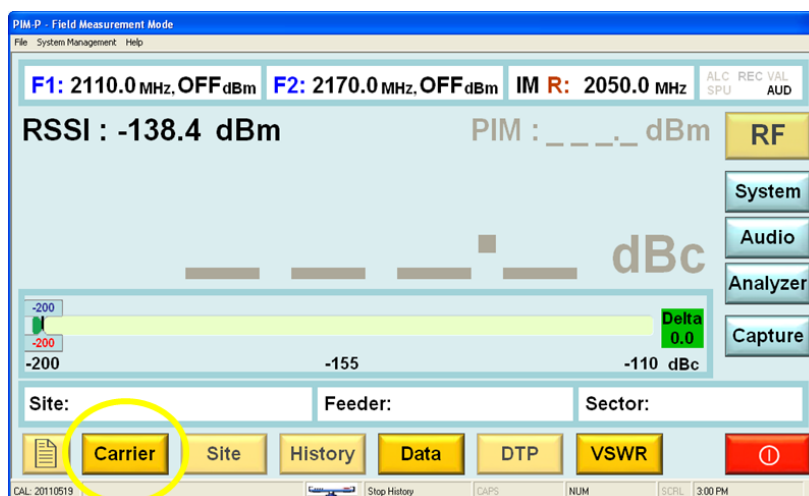
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8.3.3 Procedures to measure DTP source

1) Perform a PIM measurement after selecting a Carrier and Site.

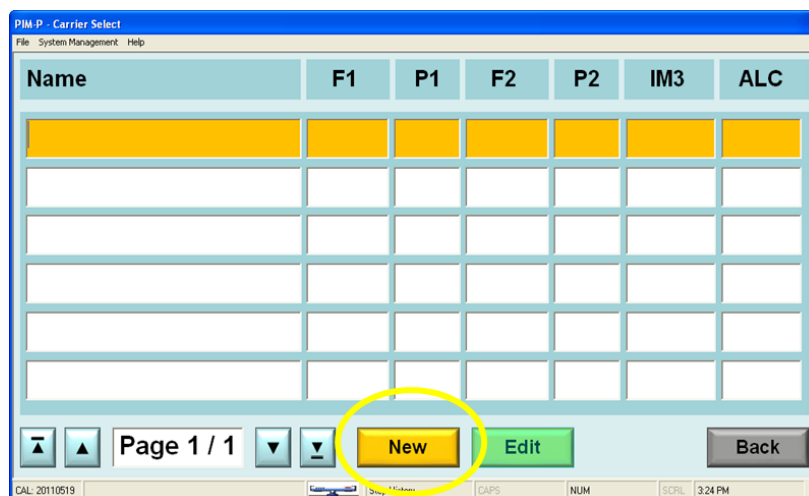
Note: When the PIM value is under -155, the accuracy to identify the distance is reduced. Measures the worst point of PIM between PIM Analyzer and DUT.

- A. Turn the unit on and push Carrier button in the Field mode, which is started automatically.



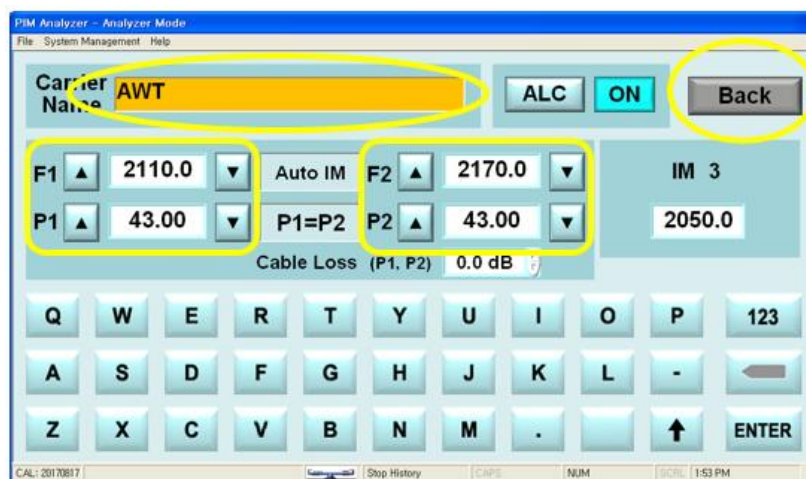
- B. In Carrier Select screen, if there is existing data, please select what you want (see the figure in section D).

If there is no data, push New button to create a Carrier, then an input screen for the carrier is displayed.



- C. In the screen, enter Name field (Carrier Name).

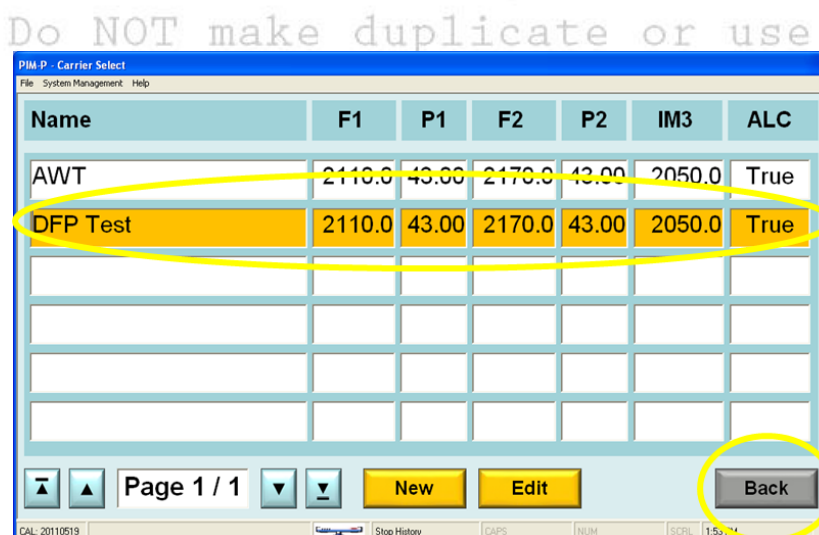
Enter a frequency and output power for Tx1 and Tx2 (respectively F1/P1 and F2/P2). When F1 and F2 are entered, the IM frequency is calculated and displayed internally so you don't need to enter it separately. ACL stands for Auto Level Control and maintain the output power as setting value (Please keep it on at initial setting). When complete, push "3" button (Return arrow) and return to Carrier Select screen.



- D. And you can see the Carrier is added in the list.

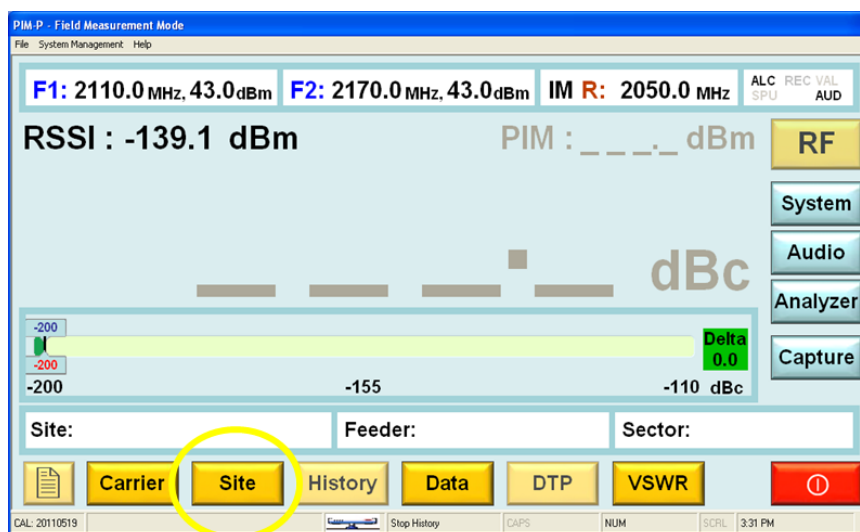
In the list, when you select the Carrier, the background color is changed to yellow and indicates it was selected.

After selecting, push Return arrow and return to Field Mode screen.

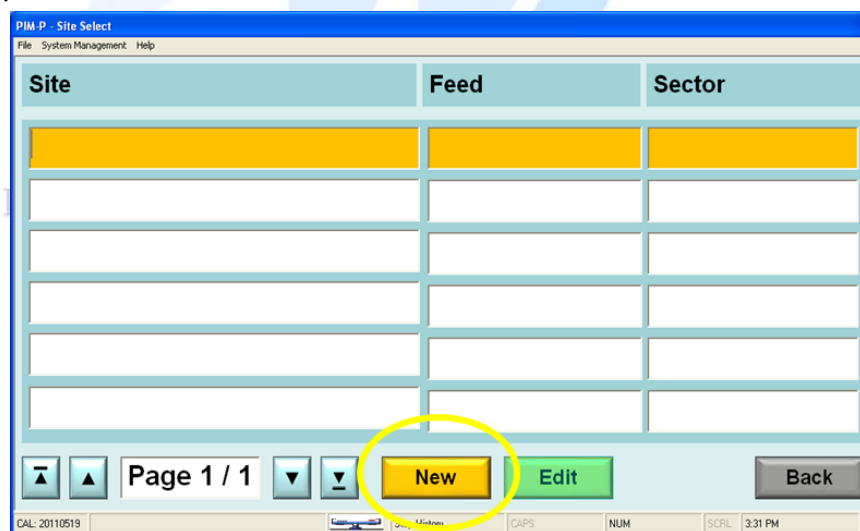


- E. You can see the Site button enabled when you select a Carrier.

Push Site button and go to Site Select screen.



F. In Site Select screen, if there is existing data, please select what you want (see the figure in section H). If there is no data, push [New] button to create a Site, then an input screen for the site is displayed.



G. In the input screen for Site, you have to fill in all 4 fields including Site, Feed, Sector, and User.

When completed, push Return arrow and return to Site Select screen.

PIM-P - Analyzer Mode

File System Management Help

Name

Site Feed

Sector User

Q W E R T Y U I O P 123

A S D F G H J K L - <

Z X C V B N M . < ENTER

CAL: 20110519 Stop History CAPS NUM SCRL 1:52 PM

H. Like Carrier Select screen, you can see the entered site when you are back.

In the list, when you select the Site, the background color is changed to yellow and indicates it was selected.

After selecting, push Return arrow and return to Field Mode screen.

PIM Analyzer - Analyzer Mode

File System Management Help

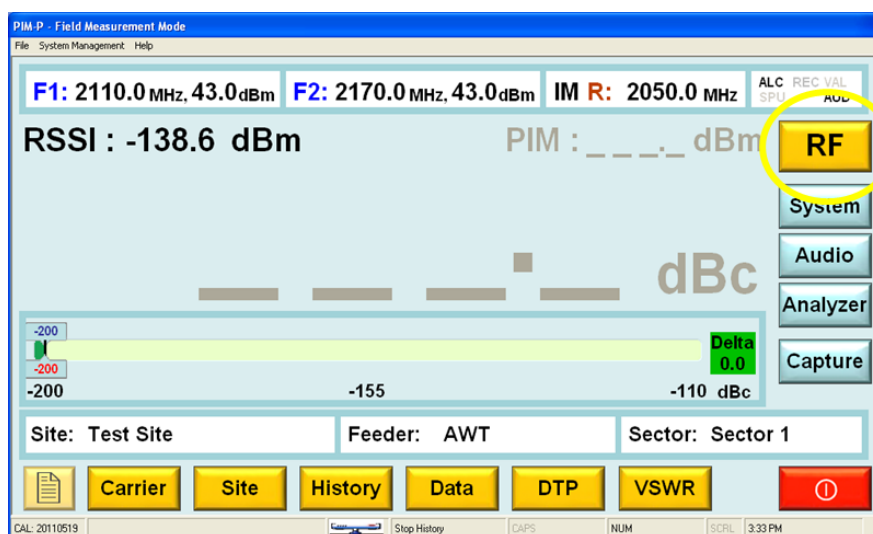
Site	Feed	Sector
DTP TEST	AWT	#1

Page 1 / 1

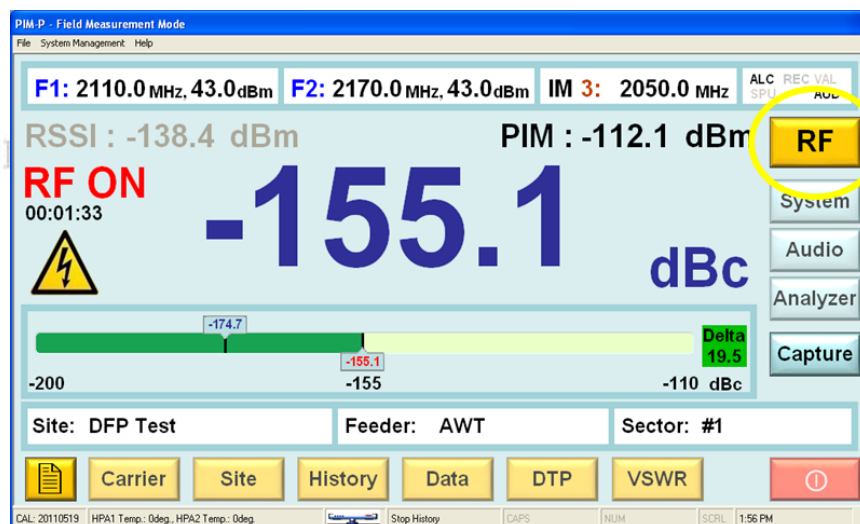
CAL: 20110517 Stop History CAPS NUM SCRL 1:56 PM

I. You can see Site, Feed, and Sector selected at the bottom in Field Mode screen.

Now, connect a DUT to a DUT connecting portion of unit and push RF button.

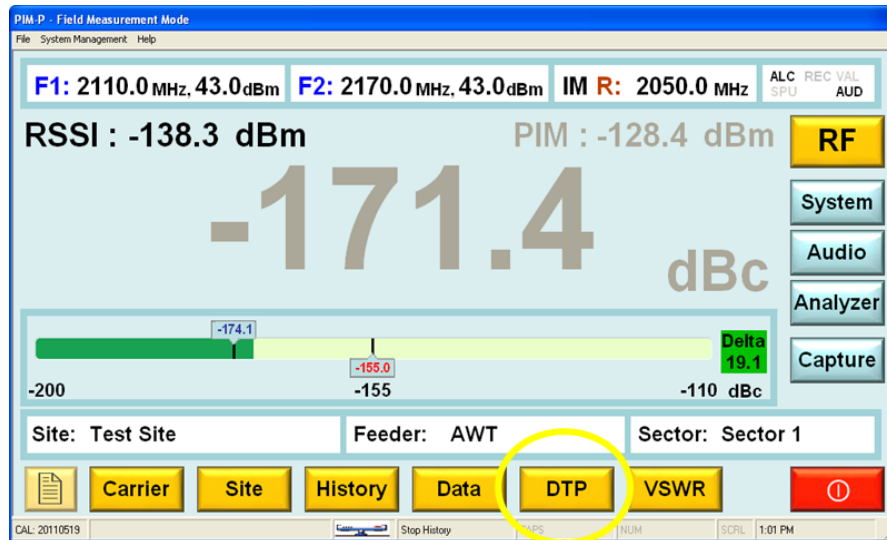


J. IM value is measured and with pushing RF button, please stop the measurement.



2) Measurement of Distance

A. Go to a screen called “Measure distance to Faulty PIM in RF path” with pushing DTP button.

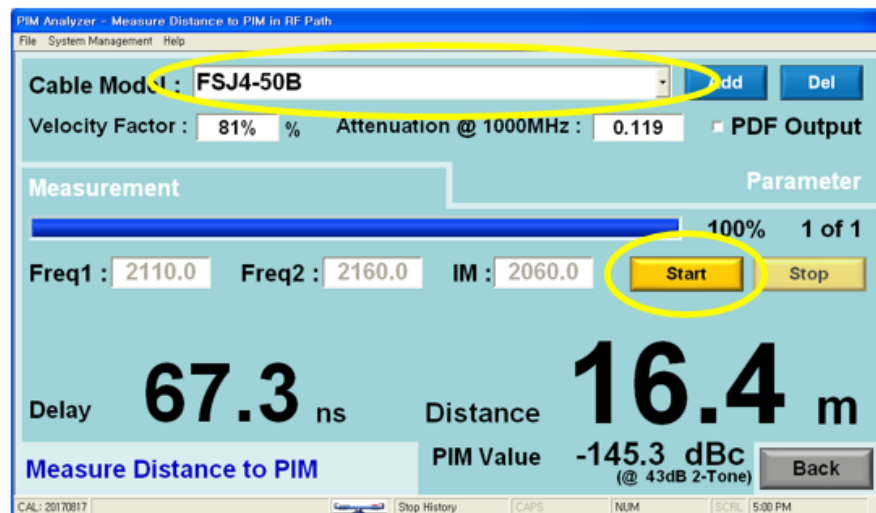


B. Select Measurement Count and Cable Model, push Start button.

Measurement Count is a selected value and can reduce the aberration of measured value acquiring the average of total measured values.

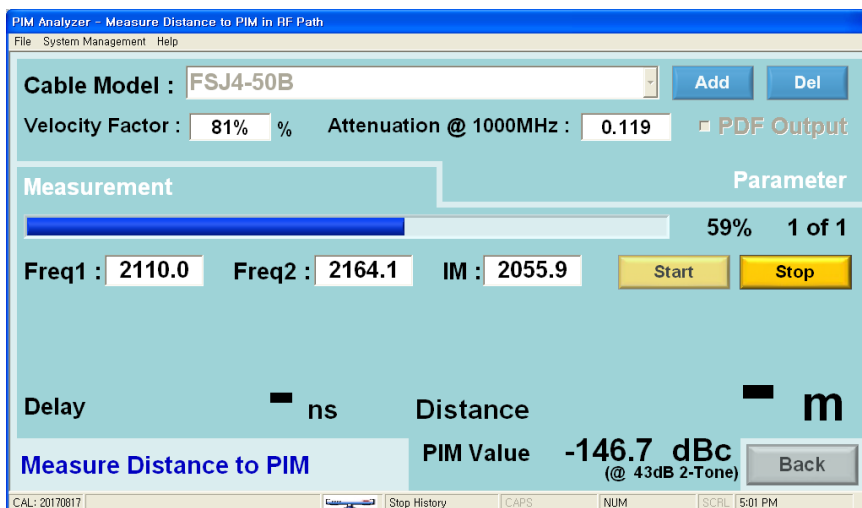
Cable Model is to refer to the Velocity data for the cable to be measured and can impact on the distance data.

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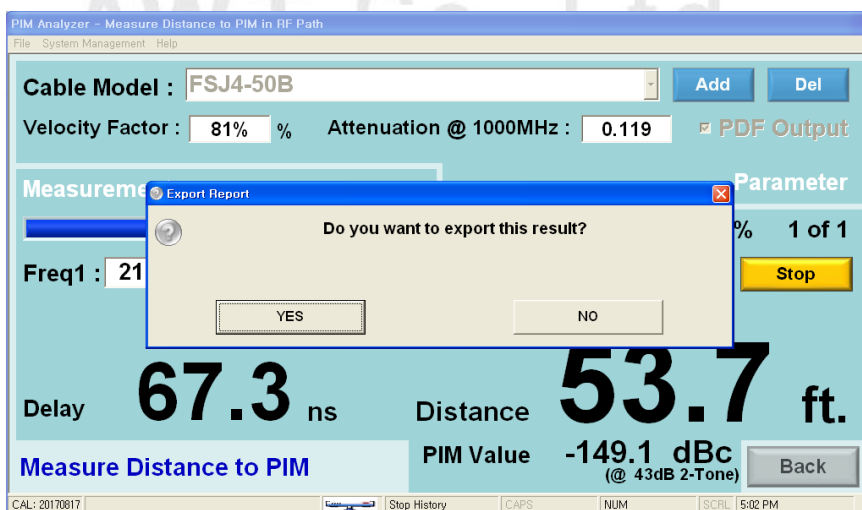


C. During the measurement, the frequency being measured, IM frequency, and the progression status are displayed.

When you push Stop button to stop the measurement, the distance value may not be displayed unless the measurement is more than one.

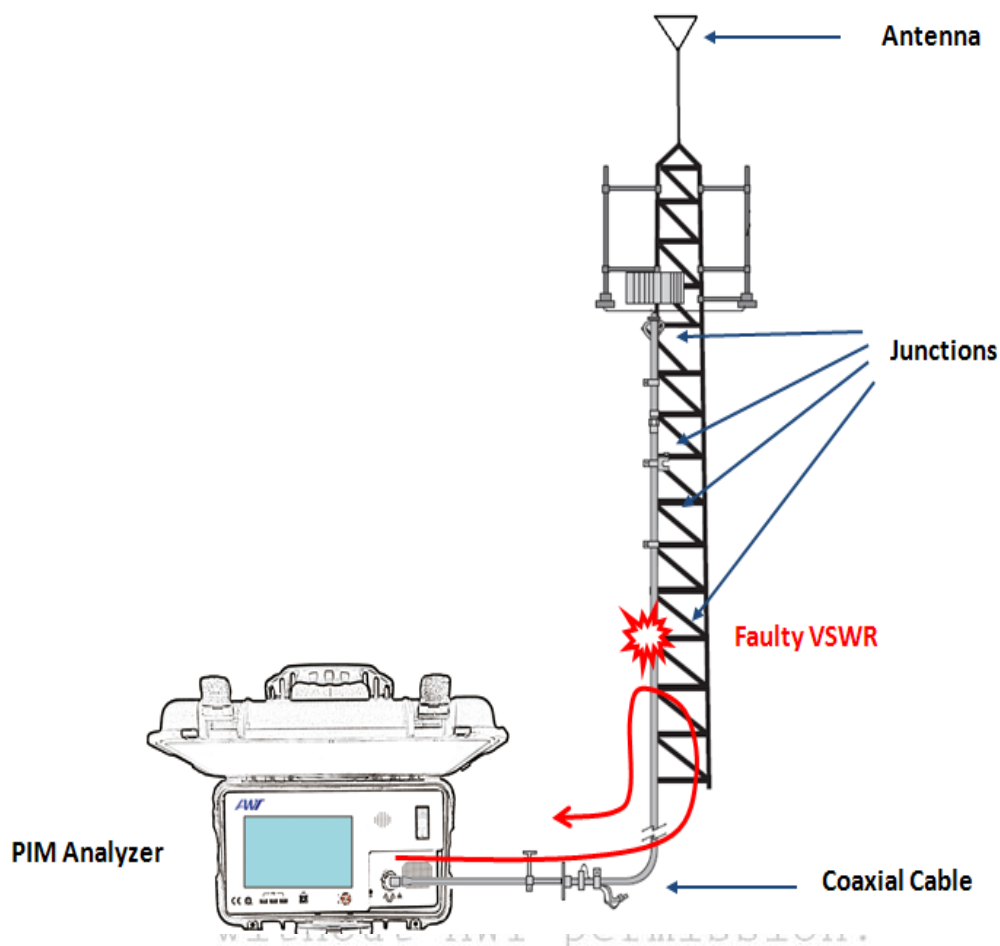


D. When the measurement is completed, the result is displayed on the screen and a prompt appears whether you want to export the result to a PDF file when you checked "PDF output".



8.4 Procedures to measure VSWR (VSWR/ Line Monitor)

8.4.1 VSWR (VSWR/Line Monitor) Setup



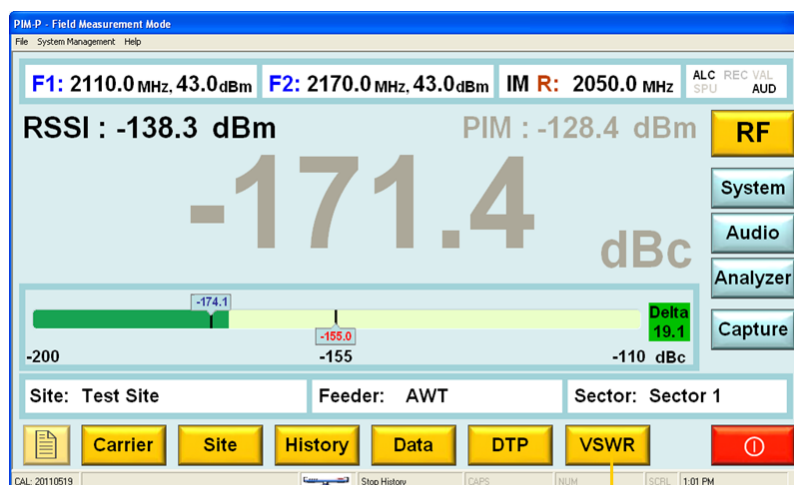
PIM Analyzer VLM Measurement Setup Diagram

The figure above shows how to setup PIM Analyzer to measure VSWR.

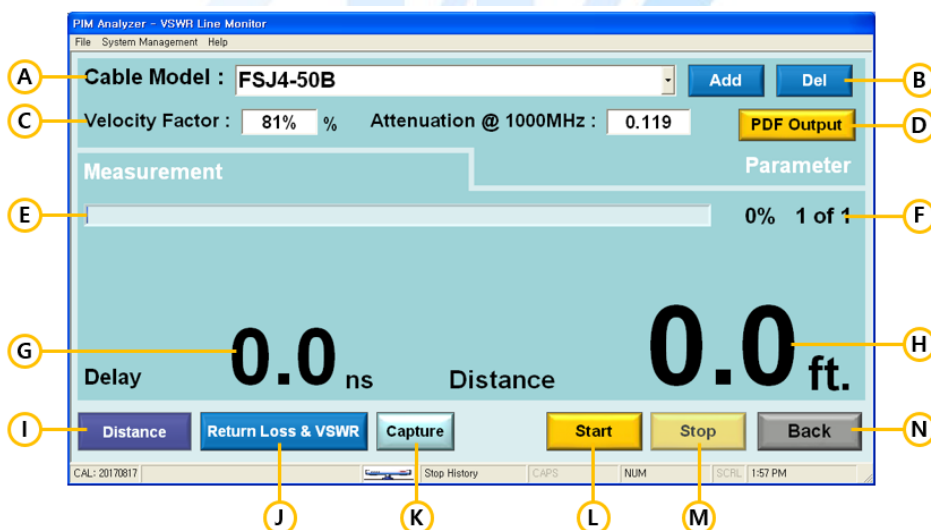


Note. PIM Analyzer measures the worst point of VSWR or Return Loss between PIM Analyzer and DUT.

8.4.2 VSWR (VSWR/Line Monitor) Measurement

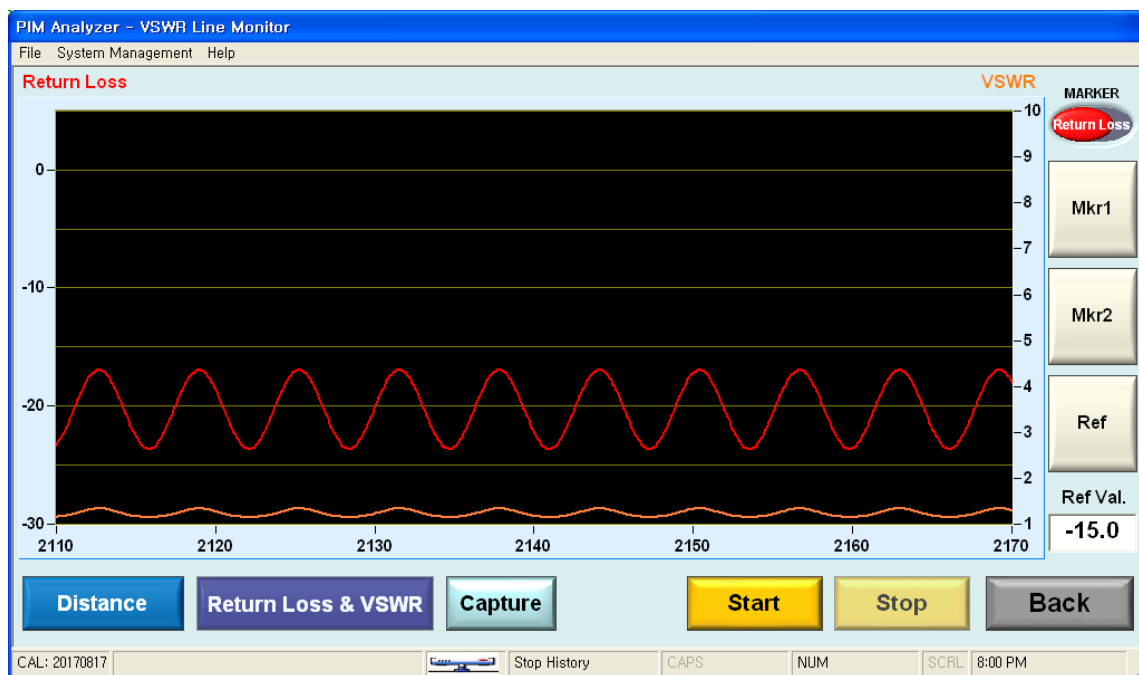


Element	Description / Display
A	Opens the VSWR screen. (It is available only if the equipment is connected)



Element	Description / Display
A	Select the cable model to measure
B	Add or Delete Cable model
C	Selected cable Velocity, Attenuation
D	Output PDF File
E	Displays the progression of measurement
F	Displays the measurement count vs. specified count
G	Displays a delay value for the cable measured
H	Displays the distance for the cable measured
I	Distance for the cable measured.
J	Return loss & VSWR for the cable measured.

Element	Description / Display
K	Capture the screen as a .jpg file.
L	Start Measurement
M	Stop Measurement
N	Goes back to the Field Mode screen



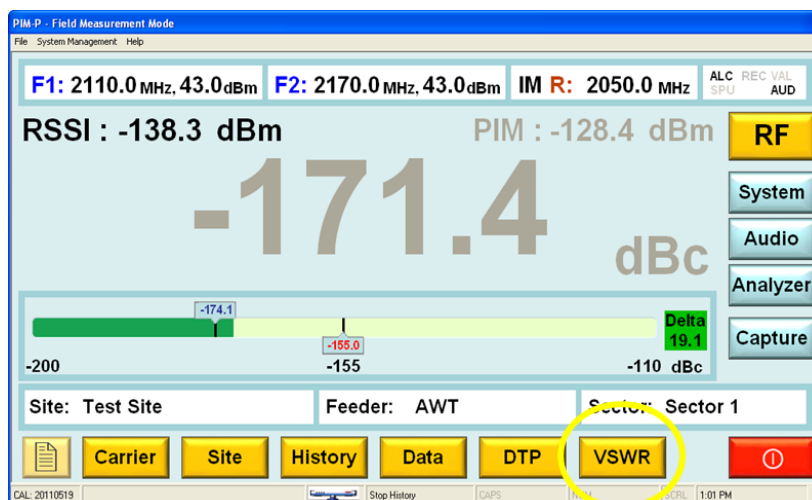
Do NOT PIM Analyzer VLM Return Loss and VSWR Graph
without AWT permission.



Element	Description / Display
A	Input Cable Name
B	Input Velocity of Propagation
C	Input Attenuation dB/100m
D	Save New Cable Data
E	Cancel

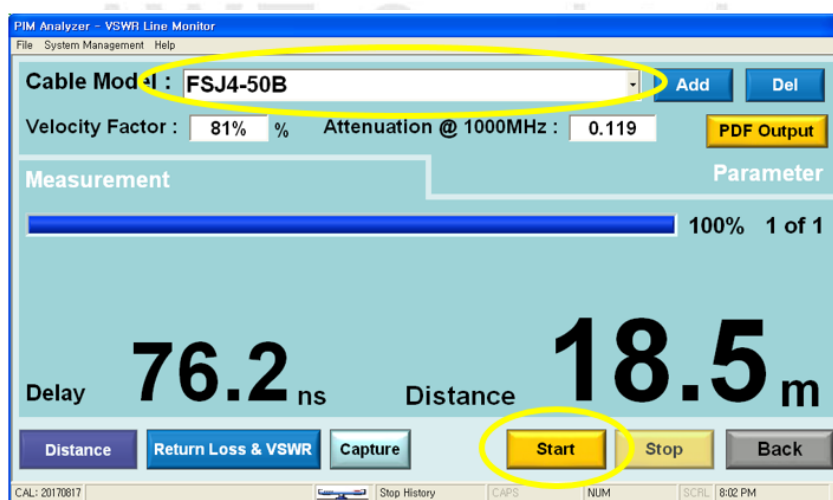
8.4.3 Procedures to measure the distance to a faulty VSWR

- A. Push the VSWR button in Field Measurement Mode.

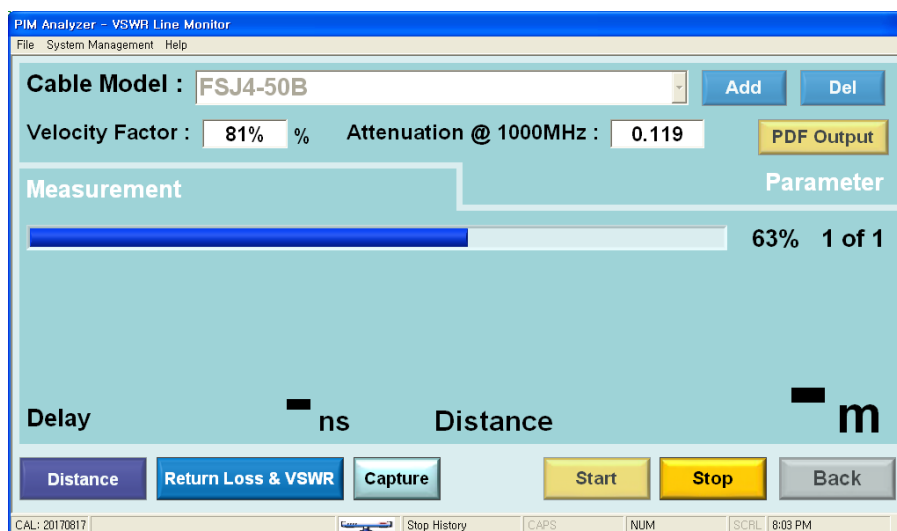


- B. Push Start button.

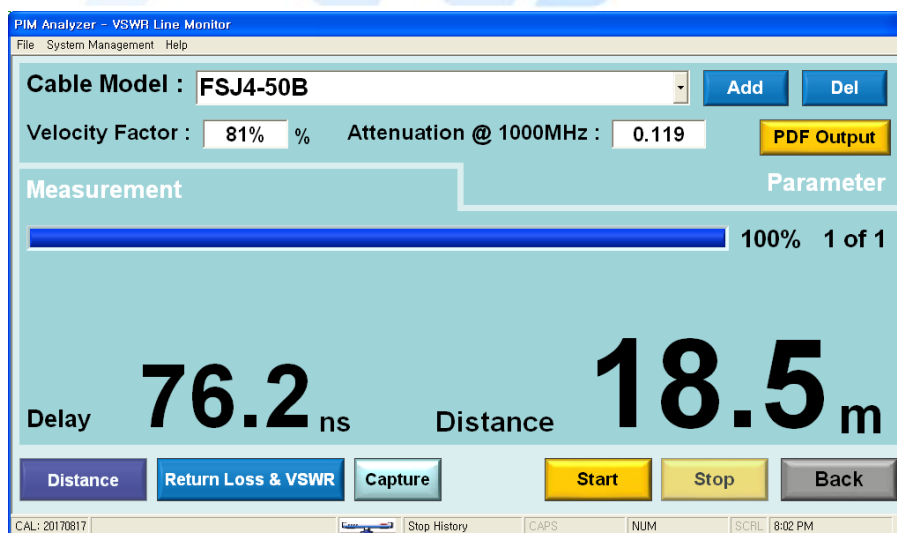
Cable Model is to refer to the Velocity data for the cable to be measured and can impact on the distance data.



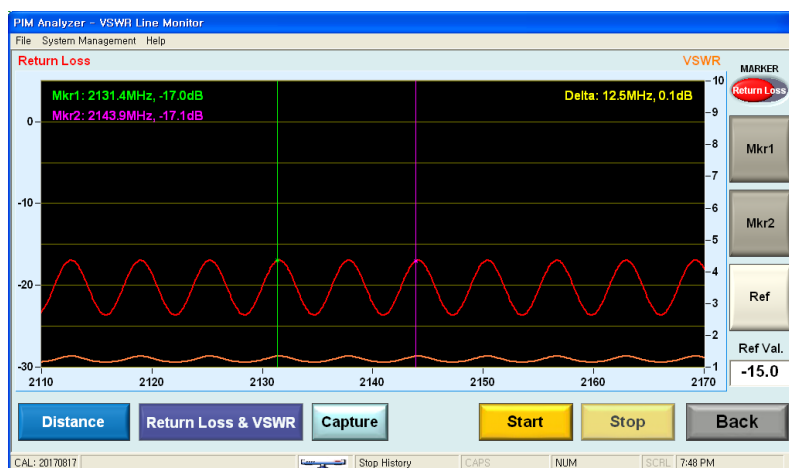
- C. During the measurement, the progression status is displayed.
When you push Stop button to stop the measurement, the distance value may not be displayed unless the measurement is more than one.



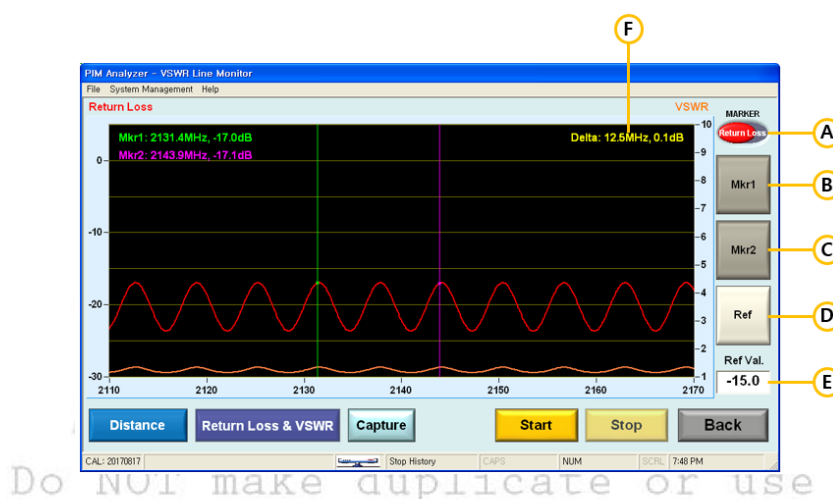
- D. When the measurement is completed, the result is displayed on the screen.



- E. Push Return Loss & VSWR button to check Return Loss & VSWR of frequency measured. When double-clicked on the graph screen, the VSWR graph is enlarged, and when double-clicked again, it is back to its original state.



F. Return Loss & VSWR graph marker function.



Element	Name	Description / Display
A	Marker Select	Select Return Loss or VSWR for maker measurement.
B	Mkr1(Marker 1)	Marker line 1 is vertical green bar and Peak Search. Moves marker line 1 to the worst value and Frequency (or on user's discretion)
C	Mkr2 (Marker 2)	Marker line 2 is vertical pink bar and Next Peak Search. Moves marker line 2 to the worst value and Frequency (or on user's discretion)
D	Ref.(Reference line)	Moves reference line of measurements that exceed the limit. The default value is -15dB.
E	Ref. Val.(Reference Value)	Displays a value that "C (Reference Line)" has.
F	Delta	Is a difference between Return loss or VSWR of marker1 and Return loss or VSWR of marker2

9 Pull Down Menu

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Pull down Menus offer additional features and allow users to set some system parameters. They allow also performing a self-test of the PIM Analyzer.

Three Pull-Down menus are available:

- **File**

- ☐ Start History Save
- ☐ Stop History Save
- ☐ Screen Capture
- ☐ Initialize Program
- ☐ Quit

- **System Management**

- ☐ Self Test
- ☐ PIMD management
- ☐ Connection check *

Field Mode offers a subset of Pull-Down menus, Analyzer mode offers all of them. The features are available in field mode.

	Field Mode	Analyzer Mode
File		
Start History Save		<input type="radio"/>
Stop History Save		<input type="radio"/>
Screen Capture	<input type="radio"/>	<input type="radio"/>
Initialize Program		<input type="radio"/>
Quit	<input type="radio"/>	<input type="radio"/>
System Management		
Self Test	<input type="radio"/>	<input type="radio"/>
PIMD Management		<input type="radio"/>
Connection Check*		
Help		
Contact Information	<input type="radio"/>	<input type="radio"/>

*Connection Check is for factory use only.

9.1 File

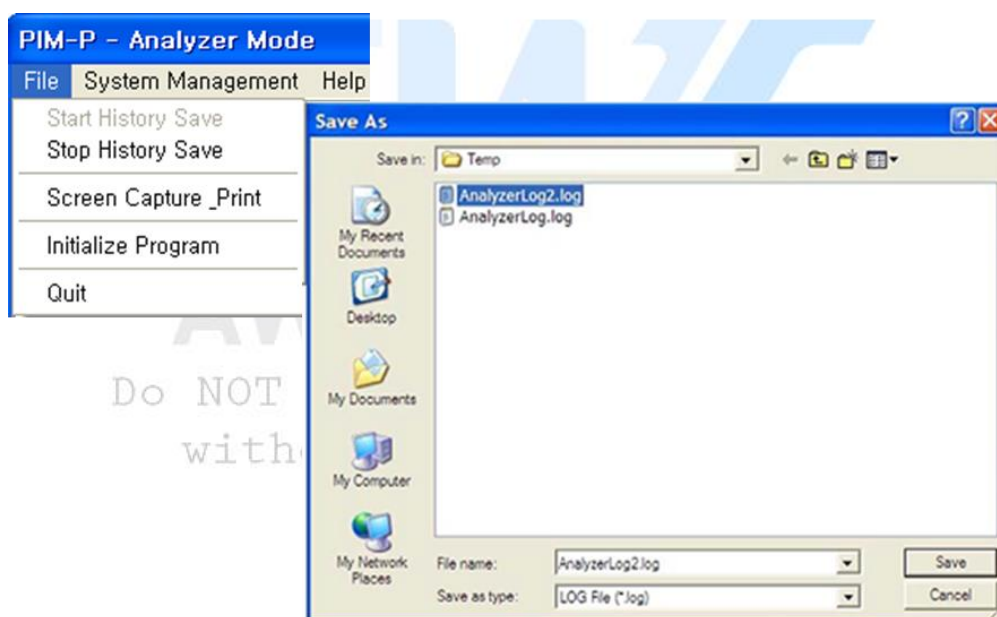
9.1.1 Start / Stop History Save

This feature allows users to log measurements over a period of time in Analyzer mode. The log files are stored in TSV (Tab Separated Value) ASCII text format. Values listed are:

Date, Time, Carrier1 (MHz), Carrier2 (MHz), Output Level1 (dBm), Output Level2 (dBm), Offset (dB), ALC On/Off, Screen Mode, IM Number (Order), IM Frequency (MHz), IM Measure(dBc), Direction, Measure Mode/Pass IM Level/decision.

Note: PIM does not support Offset, Measure Mode/Pass and IM Level/decision. This are reserved for other test systems. The log data will show a hyphen “-“in these columns. Direction is always reverse for PIM Analyzers.

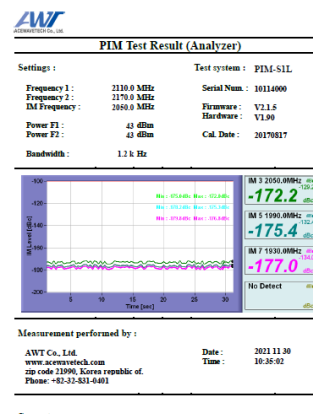
Each log cycle requires manual start, entering a file name, and manual stop. File name directory and drive can be chosen at liberty.



9.1.2 Screen Capture / Print

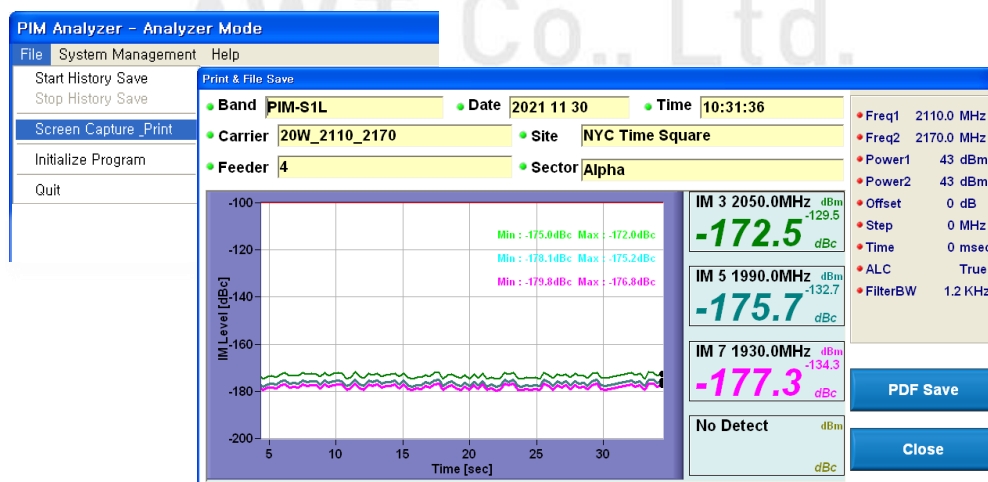
On the Field Measurement Mode screen, data is stored in the jpeg format. On the Analyzer Mode screen, PIM Test Results in the PDF are stored.

This menu provides capabilities to capture a screen shot from any Graphical Display of the Field Measurement Mode. Capturing a screen shot requires manual trigger, entering a file name, drive and directory. By default, the file name consists of date and time, but can be modified by the user. The file is stored in jpeg format by Save As dialog box. The stored file has a size of about 270kB.



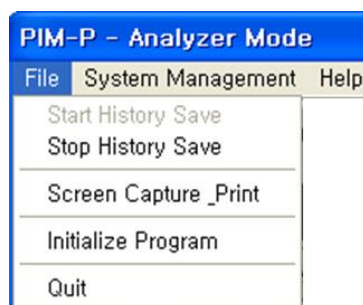
This menu provides capabilities to PIM Test Result with capture a screen shot from any Graphical Display of the Analyzer Mode. PIM Test Result requires manual trigger, entering a file name, drive and directory. By default, the file name consists of site name, date and time, but can be modified by the user. The file is stored in pdf format by pressing the blue PDF Save button. The stored file has a size of about 450kB.

In addition to the graphic display and IM related information the screen capture procedure allows the user to enter equipment information and a serial number for the DUT.



Note: Only the graphic display and relevant information is stored with the screen shot. Active measurements will be stopped during the screen capture process.

9.1.3 Initialize Program



Note: Initialize should only be triggered if the system shows signs of irregular function. It sets system values to default values, manual settings may be lost.

9.1.4 Quit

Quit has the same functionality as Exit in the Field Mode. The user will be asked if he really wants to quit the PIM. If answered YES, the system will power down. Quit works only with RF power OFF

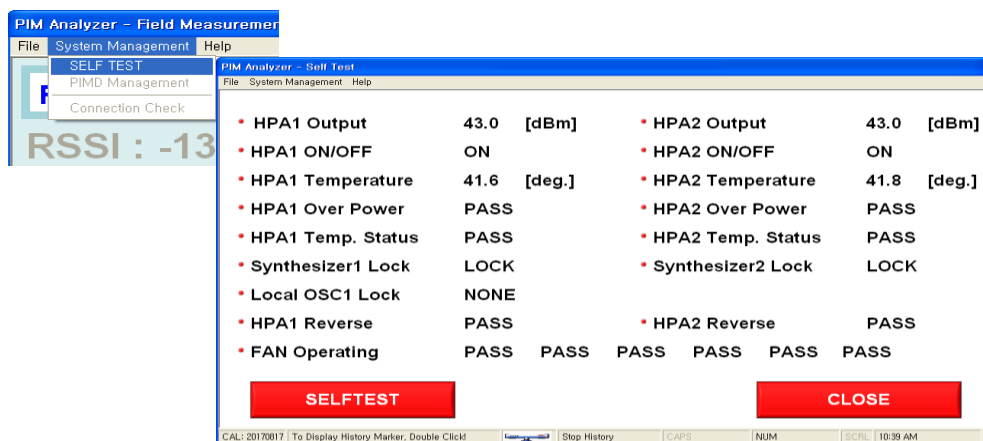
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9.2 System Management

9.2.1 Self-check



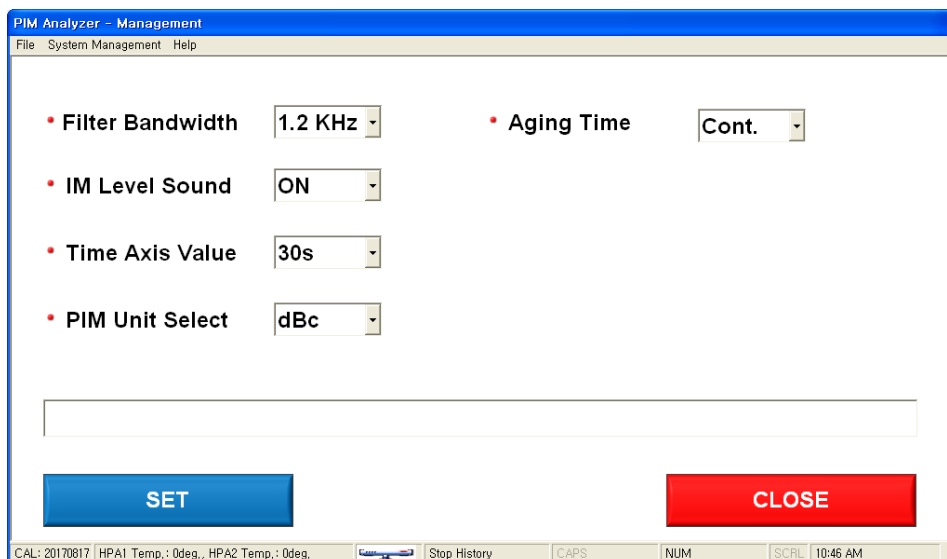
Self-check provides information about the PIM Analyzer. To allow the self-check routine to test all modules, it needs to be performed with **RF Power ON**



Name	Description
HPA x Output	RF Output power level (should be +/- 0.2 dB within the set limits – ALC ON)
HPA x ON/OFF	Status of RF Power (ON/OFF)
HPA x Temperature	Temperature of amplifiers.
HPA x Over Power	Reverse Power
HPA x Temp Status	On Fail (too hot), System will shut down
Synthesizers x Lock	Synthesizers of Transmitter and Receiver locked
HPA x Reverse	Reverse PIM measurement blocks status
Local OSC1 Lock	Local Oscillator functionality
FAN Operating	Check the fan operation status

9.2.2 PIMD Management

PIMD management allows setting some system and measurement parameters on the Analyzer Mode. With the exception of Sound On /Off, it is not required to change these settings.



Name	Description
Equipment Selection	Not relevant for PIM, since these provide only one frequency band.
Filter Bandwidth	Default 1.2 kHz For further information refer to chapter "System Menu".
Aging Time	Operating time when set Aging function button ON on the System information screen in the Field Measurement Mode (1 min, 2 min, 5 min, 10 min, 20 min, 30 min, 1 hour)
IM Level Sound	If ON, sound occurs when PIM level exceeds reference line.
Time Axis Value	Time on the horizontal axis in Time Mode Button
PIM Unit Select	Changed marker display units. (dBm/dBc, Default dBc)
SET	Stores settings
CLOSE	Returns To Analyzer Mode



10 Change Logo and Address in Report File

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10.1 Change Logo

10.1.1 Prepare logo image file.

- A. File type : Jpeg image file (*.jpg).
- B. File name : "logo_eng.jpg".
- C. Aspect ratio : 2:1 (horizontal : vertical).
- D. File size : Less than 500 Kbyte (Recommended).

10.1.2 Replace the logo image file.

- A. The path of the file to be replaced : "C:\Program Files\AWT\PIM\Logo\" (In case of installed in default folder).
- B. Replace the file to the same file name.

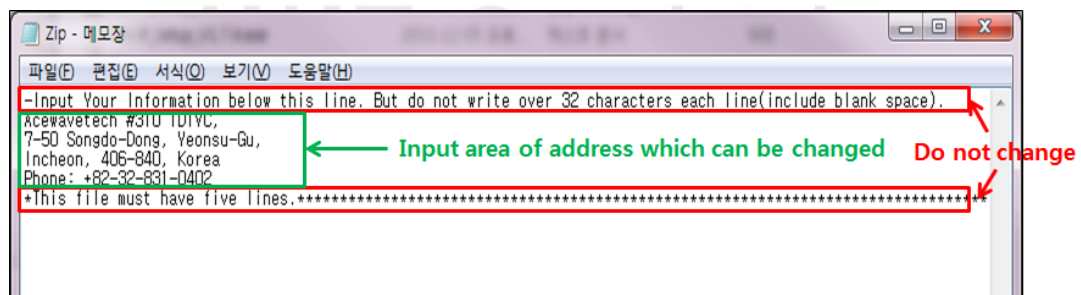
10.1.3 Check the report file.

10.2 Change address

10.2.1 Open.

Open the "zip.ini" file(in the "C:\Program Files\AWT\PIM") with notepad.

10.2.2 Editing Address.



10.2.3 Check the report file.

10.3 Applicable version.

- 10.3.1 V1.4.3 and later.(S1L)
- 10.3.2 All of S1P Unit.

11 What is PIM?



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PIM distortion is caused by non-linear mixing of two or more frequencies in passive devices like cables and connectors. Ideal passive devices are considered linear. In reality any linear component has a non-linear factor that can cause PIM distortion. For optimal operation of RF systems, PIM has to be kept at a very low level that has virtually no influence on the network operation. PIM signals are generally unwanted because they can interfere with signals in a receive path.

11.1 What Causes PIM?

Passive intermodulation can be caused by a variety of factors. PIM distortion is often the result of flaws in component design and manufacturing processes. PIM distortion may also be caused by wear and tear on components due to mechanical constraints or environmental conditions.

11.1.1 Manufacturing & Design

- Use of ferromagnetic materials, such as nickel or steel, within the current path. Especially at higher power levels, PIM can be generated due to hysteresis effect of these materials and the non-linear voltage to current ratio.
- Contaminations, like particles from machining operations or soldering splatters that touch current carrying surfaces.
- Separation of current carrying contact zones through irregular contact surfaces, corrosion and insufficient contact pressure.
- Dissimilar metals at contact areas.
- Insufficient thickness of plated metal causing RF heating through the skin effect of RF.
- Bad solder joints.

11.1.2 Mechanical

- Poor mechanical alignment of components
- Too much or too little torque at connections
- Contaminated connectors

11.1.3 Environment

- Daily temperature variations, thermal loading by the sun and RF heating vary junctions and can cause, often intermittent, PIM distortions.
- Wind-induced vibrations vary junctions, and can weaken or break down joints.
- Airborne dirt and moisture cause oxidation of materials and cause PIM distortion.



The antenna in the picture shows oxidation within the power divider. Tests with vector analyzer line sweep test would not reveal the problem; however PIM testing detected the issue immediately

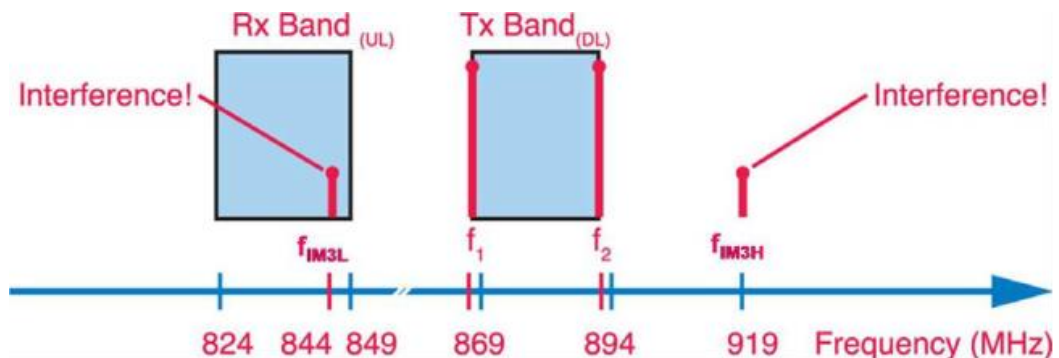
11.2 How to test PIM

PIM testing for field applications requires the injection of two CW signals (f_1 and f_2) into a system under test. Intermodulation products (IM) of the 3rd, 5th, 7th... order, caused by faulty components, appear immediately. The strongest intermodulation product is usually that of the 3rd order (IM3). Frequencies of these intermodulation products can be calculated as follows:

$$f_{IM3L} = (2 \times f_1) - f_2$$

$$f_{IM3H} = (2 \times f_2) - f_1$$

The picture below shows an example of passive intermodulation. Frequencies f_1 (869 MHz) and f_2 (894 MHz) are located in the Tx range, causing intermodulation f_{IM3L} (844 MHz) and f_{IM3H} (919 MHz). Both IM products can cause serious interference.



A visual example of intermodulation is caused by two CW signals. Ideally, test frequencies f_1 and f_2 should be at the edge of the transmit guard bands, so that the IM3 products f_{IM3L} and f_{IM3H} fall at the edge of the receive band(s), usually utilized as guard bands. This minimizes interference within the system under test and also eliminates potential interference in other wireless bands.

IM3 serves as an example. With IM3 as a result of PIM, other IM products (IM5, IM7, IM9, IM11, ...) will be present as well, and can impact base station performance significantly.

12 PIM Technical Information

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12.1 Tester Types

No.	Order No.	Model	Tx(MHz)	Rx(MHz)
1	PS1L400 MK2	TETRA 400	390 ~ 400	380 ~ 385
2	PS1L400E MK2	E-TERA	420 ~ 430	410 ~ 412
3	PS1L385 MK2	TETRA 385	410 ~ 425	385 ~ 400
4	PS1L450 MK2	TETRA 450	460 ~ 470	450 ~ 455
5	PS1L460 MK2	TETRA 460	TX 1 : 463 ~ 468 TX 2 : 473 ~ 478	448 ~ 458
6	PS1L700L	LTE700 (low)	728 ~ 759	698 ~ 716
7	PS1L700U	LTE700 (high)	728 ~ 759	776 ~ 788
8	PS1L700UL	LTE700-UL	728 ~ 759	698 ~ 716 776 ~ 788
9	PS1L700APT	APT700, 3GPP-28	758 ~ 803	703 ~ 748
10	PS1L800	LTE800	791 ~ 821	832 ~ 862
11	PS1L800SMR	SMR800	851 ~ 869	806 ~ 824
12	PS1L850	AMPS/CDMA	869 ~ 896	824 ~ 851
13	PS1L900	GSM900	935 ~ 960	890 ~ 915
14	PS1L900E	E-GSM & GSM900	925 ~ 960	880 ~ 915
15	PS1L1800	DCS 1800/GSM 1800	1805 ~ 1880	1710 ~ 1785
16	PS1L1900	PCS1900/PCS 1900-C	1930 ~ 1995	1850 ~ 1915
17	PS1L2000TD	TD-SCDMA(2000)	2010 ~ 2025	1900 ~ 1920
18	PS1L2100UMTS	TS/W-CDMA	2110 ~ 2170	1920 ~ 1980 2060
19	PS1L2100AWS	AWS	2100 ~ 2155	1710 ~ 1755
20	PS1L1921PA	PSC & AWS	1930 ~ 1990 2110 ~ 2155	1850 ~ 1910 1710 ~ 1755
21	PS1L2160JP	W-CDMA-JP	2150 ~ 2170	2110 ~ 2140
22	PS1LWBKR	WiBro-KR	2110 ~ 2170 2300 ~ 2390	1910 ~ 1990
23	PS1L2600LTE	IMT-E(2600), LTE2600	2620 ~ 2690	2500 ~ 2570
24	PS1L3400	PIM2371	3340 ~ 3450 3460 ~ 3470	3490 ~ 3510
25	PS1L3500	PIM2372	3530 ~ 3540 3550 ~ 3560	3490 ~ 3510
26	PS1L3600	PIM2373	3630 ~ 3640 3650 ~ 3660	3590 ~ 3610

12.2 Specifications (Data Sheet)

12.2.1 Transmitter Specification

Carrier Power Adjustable Level	+15 to + 44 dBm
Carrier Power Resolution / Accuracy	0.25 dB / ± 0.35 dB
Frequency Range	see version table
Frequency Increment	100 kHz
Frequency Accuracy (typical)	2 ppm
Frequency Tuning Lock Time (typical)	1 ms
Reverse Power Protection (Include ON/OFF Function)	43 dBm / 5 sec

12.2.2 Receiver Specifications

Reverse IM	-129 dBm / -172 dBc typ. @ 2 x 43dBm
Reverse IM (TETRA)	-119 dBm / -163 dBc typ. @ 2 x 43dBm
Accuracy	± 1.0 dB
Average Noise Floor (/TETRA)	-140 dBm / -132dBm (300Hz filter)
Dynamic Range (/TETRA) (typical) (reference -90 dBm)	90 dB / 80dB
Measurement Interval	100 to 350 ms
Effective IF Bandwidth (Operator selectable)	300, 600, 1.2k, 2.5k, 5k, 10k, 12k, 15k, 25k, 50kHz
Operational Input Power	- 50 dBm RMS
Input Power without damage	0 dBm max
Warm-Up Time for specified accuracy	5 minutes

12.2.3 System Specifications

RF Connector DIN 7-16	
(3) USB ports	
LAN port	
REF Out 10MHz	
User Interface Display 10.2" (WIDE)	TFT with touch screen display
IM Measurement Alarms Audio / visual	
Operating Voltage 110 to 240 V (50-60 Hz)	
Power requirements 750 VA max	
HDMI output port	

12.2.4 Environmental

Ingress Protection: IP20
Operating Temperature range: -0° to 40°C (32° to 104°F)
Storage Temperature range: -20° to 60°C (-4° to 140°F)
Humidity (non-condensing): 85% RH

12.2.5 Dimensions and Weight (Except for TETRA ver.)

Dimensions (W/D/H)	504 x 398 x 276 (mm) 19.8(L) x 15.7(W) x 10.9(H) (in)
Weight	24~30kg / 53~141lb



13 Maintenance

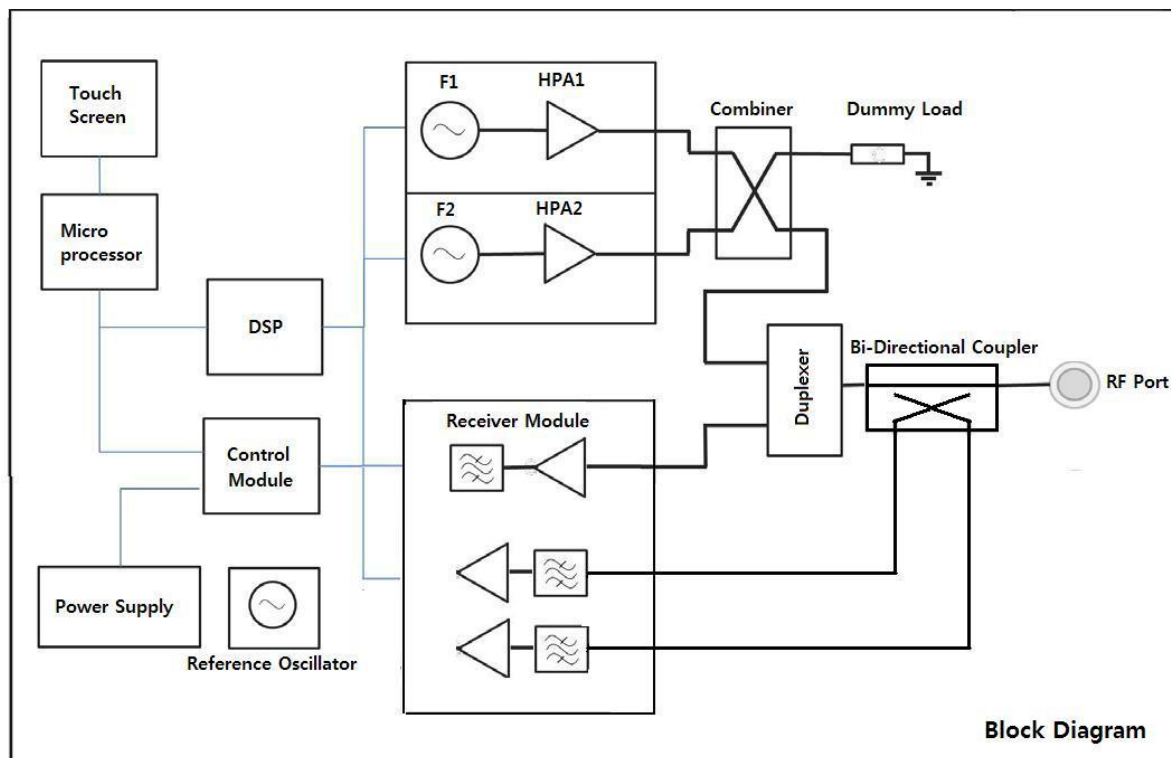


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13.1 Block Diagram



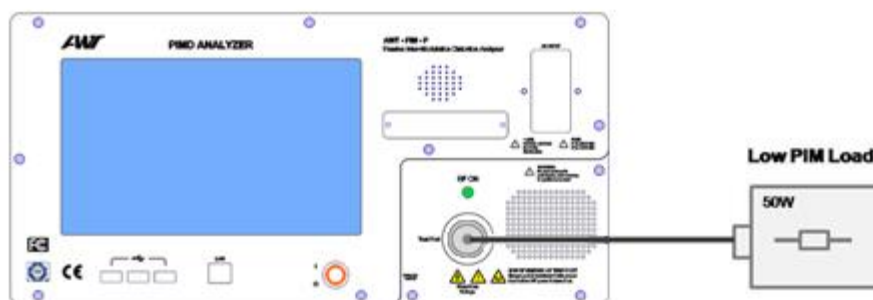
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13.2 Performance Check

To maintain maximum performance, it is highly recommended to conduct a basic test of the PIM on a daily basis.

The following components are required for the performance test:

- Low-IM Termination Load (AWT 50W Low PIM Load)
- Low PIM Cable



Install the test set-up as shown:

13.2.1 Testing Analyzer operation status

- Connect the Low PIM Load to a PIM Analyzer with torque wrench
- Set PIM to Analyzer Mode
- Set the frequencies of carrier signals 1 and 2.
- Set the power levels to 43 dBm (20W) – with ALC: ON
- **Switch RF Power ON**
- The PIM Signal(s) should be at a level below -160 dBc.

If the reading is higher (lower negative value), switch RF OFF, disconnect connections and re-connect them. Repeat test

If the reading is still above -160dBc replace low PIM cable and retest.



Hint: Low PIM cables wear out with use. If a cable does not longer perform in the desired way, dispose of it and replace it with a new cable. Worn out cables can cause unnecessary work and costs. Trying to repair a base station with a worn out cable will lead to no avail.

- **Switch “RF Power OFF**
- Set the PIM to Field Mode
- Since the PIM Analyzer is connected to a low PIM load (not to an active antenna), the RSSI value shows the noise floor of the instrument.
- RSSI should be below -130dBm

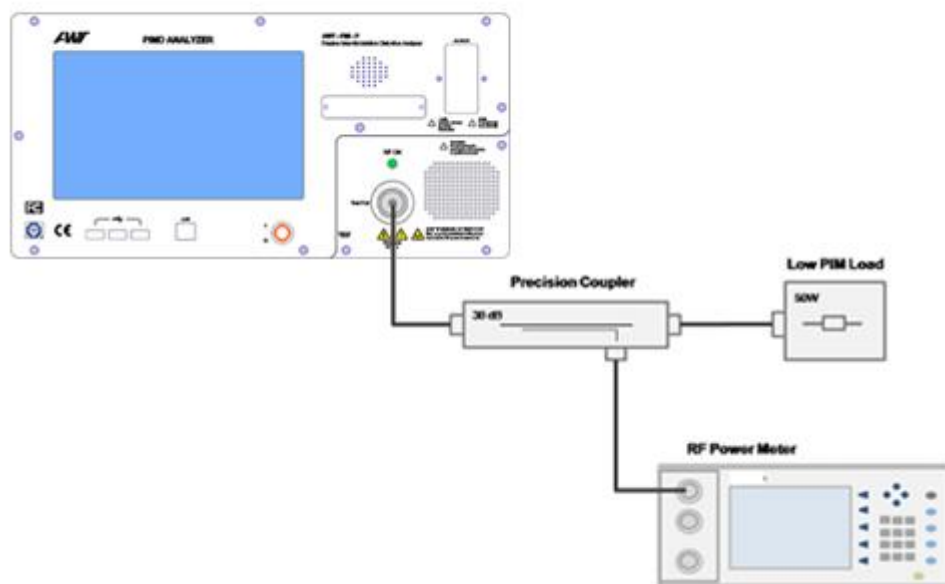
13.3 Performance Verification

Performance Verification measures output signals and frequency accuracy of the PIM.

13.3.1 Tx Signal Power Level

The following components are required for the performance verification.

- 50W Low-PIM Termination Load
- Low PIM Cable
- High Power coupler 30dB coupling (with known coupling factor)
- RF Power Meter



Install the test set-up as shown:

- Connect the Coupler, Low PIM Load and Power Meter to the PIM Analyzer (use torque wrench)
- Set the PIM to Analyzer Mode
- Set frequencies of carrier signals 1 and 2 to the start and end frequency of the provided frequency band.
- Set the power level of each signal to 40 dBm (10W) – with ALC: ON
- **Switch RF Power ON**
- With offset compensation of the coupler (30dB) the power meter should read 43dBm +/- 1.0dB.

If the reading deviates, switch RF power OFF, disconnect connections, reconnect and repeat the test.



If the reading is off by more than 1 dB, the deviation could be caused by a malfunctioning attenuator or amplifier in the PIM Analyzer. In this case, contact AWT Service.

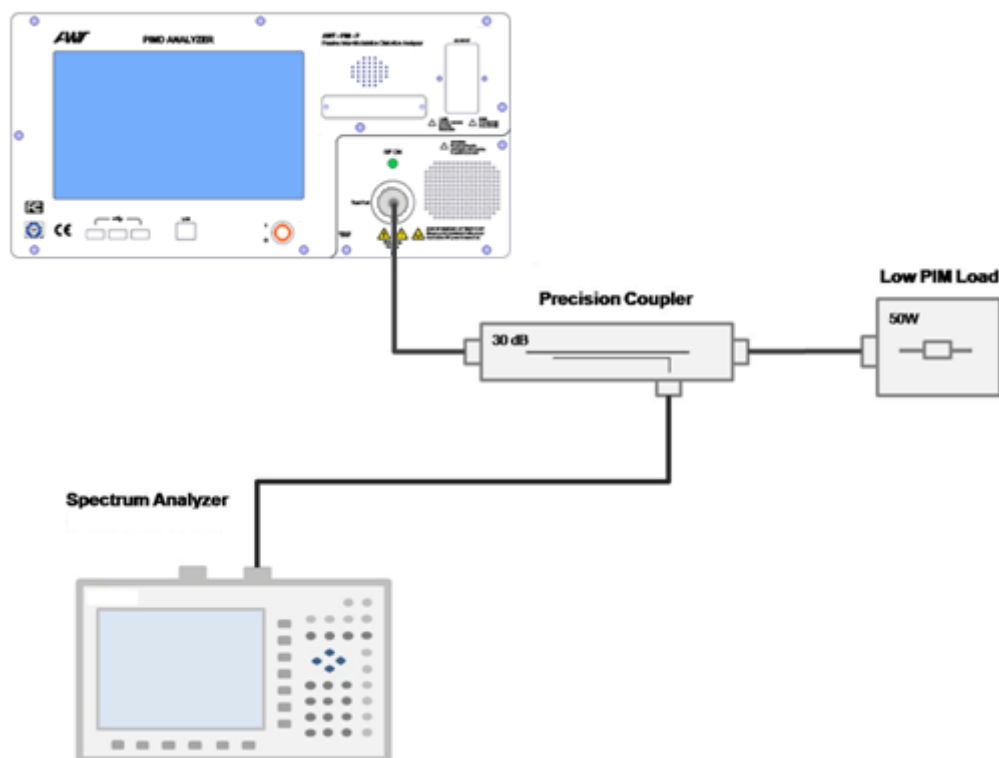
With the reading within limits, continue procedure:

- Increase Signal Levels by 1dB,
- Measure power
- Repeat until Signal Levels are both at 43dBm.
- With offset compensation of the coupler (30dB) the power meter should read now: 43dBm +/- 1.0dB
- Switch "RF Power OFF"

13.3.2 Tx Signal Frequency

In order to measure the accuracy of carrier frequencies, use the following components and equipment.

- Spectrum Analyzer
- High power coupler 30 dB
- 50W Low PIM Load



Install the test set-up as shown:

- Connect the Coupler, Low PIM Load and Spectrum Analyzer to the PIM Analyzer (use torque wrench)
- Set Spectrum Analyzer to proper measurement range
- Set the PIM to Analyzer Mode
- Set the frequencies of carrier signals 1 and 2 to the start and end frequency of the provided frequency band.
- Set the power level of each signal to 40 dBm (10W) – with ALC: ON
- **Switch RF Power ON**
- Spectrum analyzer should show both PIM frequencies with +/-100 kHz accuracy.

If the reading deviates, switch RF power OFF, disconnect connections, reconnect and repeat the test.



If the reading is off by more than 200 kHz, it may be an indication that the synthesizer module is malfunctioning. In this case, contact your nearest AWT Service Center.

With the reading in limits, continue procedure:

- Increase on F1 Signal frequency by 1MHz
- Measure both frequencies
- Repeat the process you are no longer able to increase the signal frequency F1
- If done, set F1 back to start frequency
- Decrease F2 by 1 MHz
- Measure both frequencies
- Repeat the process you are no longer able to decrease the signal frequency F2
- **Switch "RF Power OFF"**

13.3.3 Rx Power and Receiving Frequency

The following measurements have to be executed with utmost care:

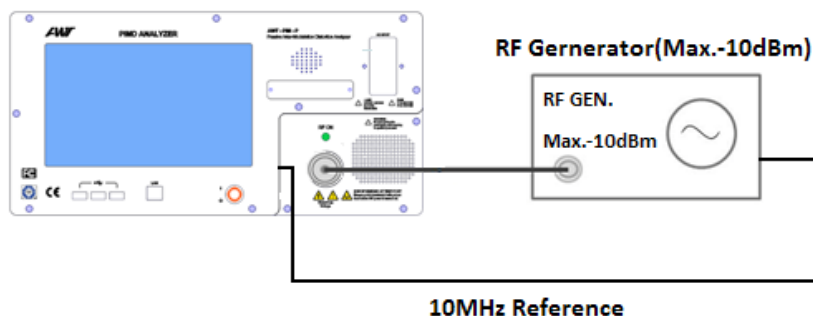


If too much power is applied to the PIM Analyzer, the receiver module will be damaged.

If the RF output power of the PIM is accidentally switched ON, it will damage the Signal Generator.

In order to measure the accuracy and frequency selectivity of the receiver, the following components and

- Signal Generator



Install the test set-up as shown:

- Set the PIM to Field Mode
- Set frequencies of carrier signal 1 and 2 to the start and end frequency of the provided frequency band.
- Set the Filter bandwidth of the PIM to 1.2 kHz (default).
- **To avoid damage, RF Power of the PIM must be OFF**
- Set Signal Generator to IM3 frequency.
- Apply signal to PIM (-60dBm to -120dBm)
- RSSI should measure the applied power
- If the reading is off by more than +/- 0.8 dB but not worse than +/-15 dB, it may be an indication that receiver is out of calibration. If the measurement shows a level lower than -125dBm, the receiver does not detect the frequency at all. It may be asynchronous. In the cases described above, contact your nearest AWT Service Center.



With the reading in limits, continue procedure:

- Change the frequency of the RF Generator by 2.5 kHz.
- The receiver will filter the signal out and the RSSI reading of PIM should be lower than -125dBm.

With the reading in limits, continue procedure:

- Increase the PIM Signal frequency F1 by 1 MHz
- Set Signal Generator to the frequency that correlates to the IM3 product of frequencies F1 and F2
- Read the RSSI on PIM; the value should be equal to +/-1 dB of Signal Generator's Power level.
- Repeat the process you are no longer able to increase the signal frequency F1 due to band restrictions
- If done, set F1 back to start frequency
- Decrease PIM Signal frequency F2 by 1 MHz
- Set Signal Generator to Frequency that results for IM3 product of frequencies F1 and F2
- Read RSSI on PIM; value should be +/-1 dB of to Signal Generator's Power level.

- Repeat the process you are no longer able to decrease the signal frequency F2
- Set PIM Signal frequencies F1 and F2 back to Start and End frequencies of PIM band.
- Set Signal Generator to Frequency that results for IM3 product of frequencies F1 and F2
- Read the RSSI value on PIM; the value should be equal to +/-1 dB of the Signal Generator's Power level.
- Change the power level of the Signal Generator by 5dB. Never exceed -60dBm
- Read RSSI on PIM; value should be equal to +/-1 dB of the Signal Generator's Power level.
- Repeat until power level range of -60dBm to -120dBm has been covered
- Switch RF Signal of Signal Generator OFF

If the readings from the previously listed procedures deviate by more than +/- 1 dB, contact your AWT Service.

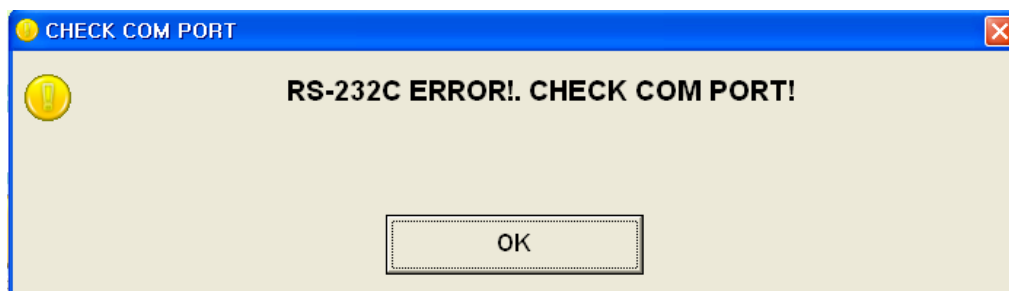




14 System Message

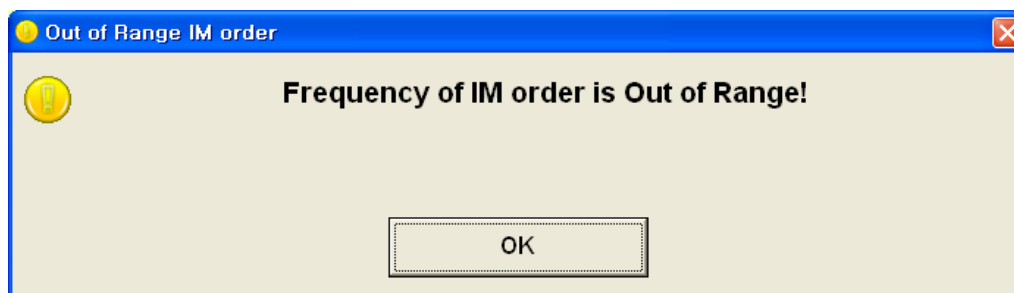
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14.1 Communication Error



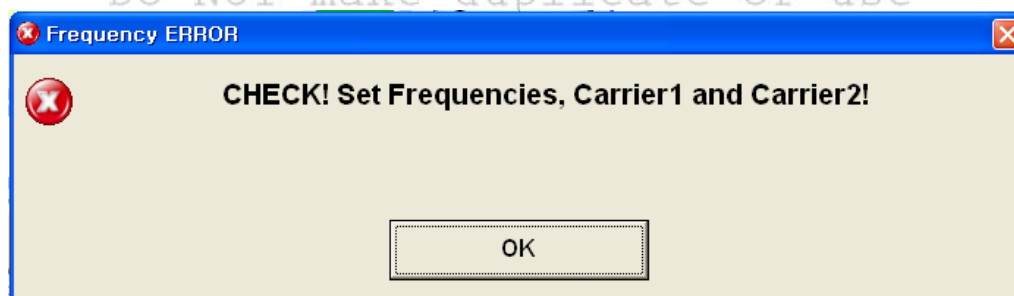
This Message is caused by the problem of internal communication H/W.
Please contact us or service manager.

14.2 IM Frequency not found



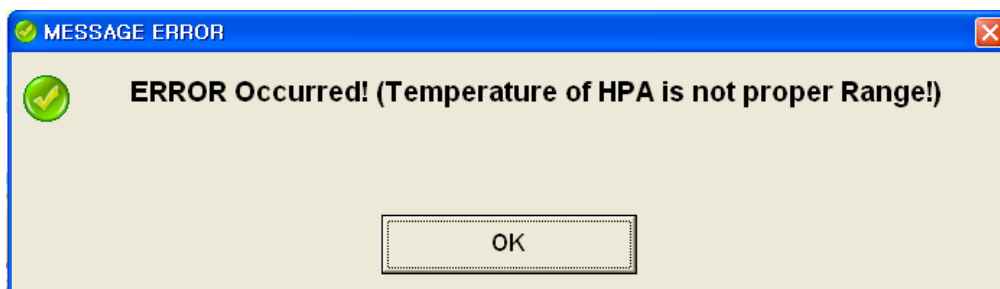
Show this message when frequency of IM order is out of range.
Change the Tx Carriers frequency.

14.3 Tx Carrier Frequency Setting error.



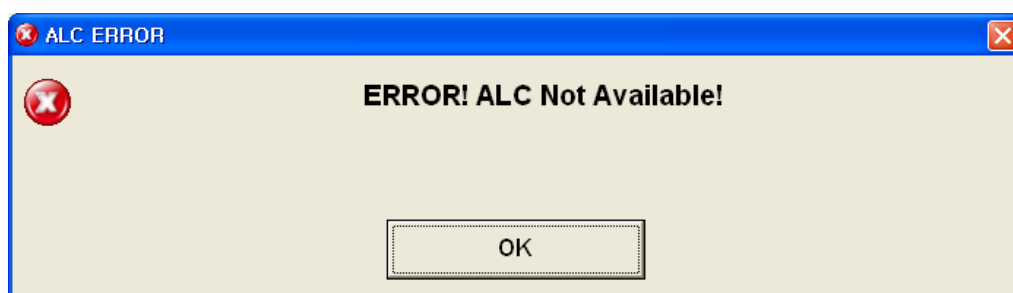
This message displayed when Carrier1 and Carrier2 is set to same value.
Change the Tx Carriers frequency

14.4 Temperature Warning



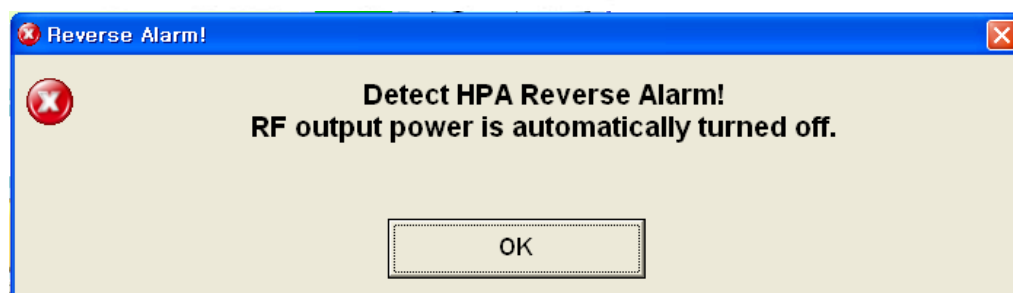
This message displayed when HPA Temperature is out of range.
Turn RF Signal off and wait for the cooling.

14.5 ALC Fail



This message displayed when ALC function is not under control.
Please contact us or service manager.

14.6 HPA Reverse Alarm



This message displayed when the return RF power level is too high.



15 Options & Accessories

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Options		
No.	Order No.	Description
1	POPT1	Embedded option for distance- to-PIM(DTP), Return Loss, VSWR and distance-to-fault

Accessories				
No.	Order No.	Model	Part No.	Description
1	PACC2L	Accessory kit	PIM9100	Low PIM cable 3m/10ft(1), Low PIM load 100W(380-2800MHz)(1), Low PIM adapters(4), Torque wrench(1), Hard carry case
2	PIMGEN	PIM Generator	PIS-CP30D	PIM Value -80dBm(+/-10) for quick system tests
3	PLOAD100	Low PIM Load	LIT028G	100W, <-165 dBc @ 2* 43W, DIN 7/16 (f), 690-2800MHz
4	PLOAD100L	Low PIM Load		100W, <-163 dBc @ 2* 43W, DIN 7/16 (f), 380-2800MHz
5	PLOAD50	Low PIM Load	LIT028D	50W, <-165 dBc @ 2* 43W, DIN 7/16(m)-DIN 7/16 (f), 690-2800MHz
6	PLOAD50 L	Low PIM Load		50W, <-160 dBc @ 2* 43W, DIN 7/16(m)-DIN 7/16 (f), 380-2800MHz
7	LIC308DMDM-1MR	Low PIM Cable	LIC-308DMDM-1MR	< -165dBc@2*43W, DIN 7/16(m)-DIN 7/16(m) Corrugated cable, 1MR,
8	LIC308DMNM-1MR	Low PIM Cable	LIC-308DMNM-1MR	< -165dBc@2*43W, DIN 7/16(m)-N (m) Corrugated cable, 1MR

16 File & Directory information

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16.1 Windows virtual store

When changing, deleting, or backing up files, system automatically applies to the installed directory in Windows XP. However starting from Windows 8 version, files such as C:\Windows, C:\Program Files, C:\Program Data, etc. cannot be arbitrarily modified or deleted due to Microsoft's security issues.

Virtualization files can be found in the C:\Users\App Data\Local\Virtual Store. It only stores the data which PIM Analyzer can read, write, delete, and create.

Follow below instruction to find folder.

- Windows Explorer's Menu View → Select Hidden items
- C:\User\username(ex:PIMD)\App Data\Local\Virtual Store\Program Files (x86)\AWT\PIM

16.2 File name information

Directory Position : PIM\		
1	PIMD.CFG	Program setting data file.
2	CARSEL.INI	Carrier and Site data file.
3	CABLE.DAT	Cable data file.
4	VSWR.DAT	VSWR data file
5	Zip.ini	Company data file from PIM Test Result ("Measurement performed by:")
6	Pwd.ini	Password file which used for deleting Carrier or Site data.
7	Date_time.log	Data (output level, IM frequency, IM Measured time, Carrier1/2, Output Level1/2, IM order, IM frequency, IM Value etc.) when saving history on Analyzer Mode (ex: 20210811_10_13_38.log)



An error may occur if the file name is changed or deleted and damaged.

16.3 History directory naming

Directory Position : PIM\History\ (Carrier directory name example: A4)	
First letter	First letter when registering a new Carrier name. (ex: Acwavetech ► A)
Second letter	Order of registration of new Carrier. (ex: 4 th registration ► 4)

Directory Position : PIM\History\((Carrier directory)\(Site directory name example: A4_N2)	
Two letters before the underbar	Carrier directory name (ex: A4)
Two letters after the underbar	First letter when registering a new Site name (ex: NYC Time Square ► N) Order of registration of Site (ex: 2 nd registration ► 2)



If the directory name or file name is changed or deleted and damaged, an error may occur.



When reinstalling the operation program, backup and paste subdata, including the CARSEL.INI file and history folder. It will allow you to use Carrier and Site information after reinstallation.



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Appendix

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Appendix A

Warranty Statement

ACEWAVETCH Co., Ltd. (hereafter "AWT") warrants the PIM to the original Purchaser to be free from defects in material and workmanship and to operate within applicable specifications for a period of two years from date of shipment. Test cable(s) and connector savers are not covered under warranty. AWT further warrants that its instruments will perform within all current specifications under normal use and service for two years from date of shipment. These warranties do not cover sealed assemblies which have been opened, or any item which has been repaired or altered without AWT's authorization. AWT's warranties are limited to either the repair or replacement, at AWT's option, of any product found to be defective under the terms of these warranties. There will be no charge for parts and labor during the warranty period. The Purchaser shall prepay inbound shipping charges to AWT or its designated service facility and shall return the product in its original or an equivalent shipping container. AWT or its designated service facility shall pay shipping charges to return the product to the Purchaser for domestic shipping addresses. For addresses outside the Republic of KOREA, the Purchaser is responsible for prepaying all shipping charges, duties and taxes (both inbound and outbound).

At AWT's option, an extended Warranty period may be available for an additional charge. Please contact one of our sales offices for further information. If an extended warranty option has been purchased, the extended period is substituted for the 2 year period above. Note that the extended warranty does not extend the instrument's calibration interval past 12 months. The instrument must be maintained in a calibrated (instrument having received calibration or verification at recommended interval) state throughout the warranty period to be eligible for warranty service to remedy "out of spec" operation.



Warranty void if seal is broken sticker

Instrument Verification Definition:

Instrument verification is comprised of the following:

Inspection: Each unit is inspected for damage and wear and tear. Key functions are checked. The inspection is carried out both external and internally. Any damaged or malfunction is noted on the service report, providing the user with an overview of the equipment's status.

Maintenance: Units sent in for verification undergo a standard maintenance procedure. The instrument is cleaned of dust and marks on both the inside and outside. Most AWT testers have EMI protection cover and screen can impair visibility. Fans and filters are cleaned to enhance cooling and the device's lifespan.

Verification: All specified values which can deviate over time are checked. This includes all paths a signal can take for measurement.

Instrument Calibration Definition:

Instrument calibration is comprised of Instrument Verification PLUS the following:

Alignment: If equipment has drifted out of verification limits then the instrument will be aligned. Alignment tunes the unit into the center of these verification limits. This results in maximum measurement precision. Only AWT, as manufacturer has the competence necessary to provide such alignment.

Documentation: Together with the calibrated instrument the user receives documents which certify and describe the status of this instrument. The Calibration Certification declares the conformity of the unit with published specifications. A Calibration Report shows all test points with rated value, verification limit and measurement uncertainty. The service report provides the user with status of his instrument.



Appendix B

EC Declaration of Conformity

ZERTIFIKAT ♦ CERTIFICATE ♦ 認証書 ♦ CERTIFICADO ♦ CERTIFICAT


 Product Service

Attestation of Conformity

No. N8 09 10 70922 001

Holder of Certificate: **AWT Co., Ltd.**
 #313 IDTVC, 7-50 Songdo-Dong, Yeonsu-Gu
 Incheon 406-840
 REPUBLIC OF KOREA

Product: **Electrical equ. for measurement, control
 and laboratory use
 (Portable PIMD Analyzer)**

This Attestation of Conformity is issued on a voluntary basis according to the Low Voltage Directive 2006/95/EC relating to electrical equipment designed for use within certain voltage limits. It confirms that the listed equipment complies with the principal protection requirements of the directive. It refers only to the particular sample submitted for testing and certification. See also notes overleaf.

Test report no.: CPSA0136869

Date, 2009-10-21 



After preparation of the necessary technical documentation as well as the EC conformity declaration the required CE marking can be affixed on the product. Other relevant directives have to be observed.

Page 1 of 2

TÜV SÜD Product Service GmbH · Zertifizierstelle · Ridlerstraße 65 · 80339 München · Germany



A1 / 07.09

NRTL Declaration of Conformity

KAT - CERTIFICADO - CERTIFICAT



Product Service

CERTIFICATE

No. U8 09 10 70922 002

Holder of Certificate: AWT Co., Ltd.
 #313 IDTVC, 7-50 Songdo-Dong, Yeonsu-Gu
 Incheon 406-840
 REPUBLIC OF KOREA

Certification Mark:



Product: Electrical equ. for measurement, control
 and laboratory use
 (Portable PIMD Analyzer)

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

Test report no.: CPSA0738429



Date, 2010-07-02
 Page 1 of 2



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

Contact

Consult the following contact for the technical support as needed.

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Smart valley B-804, 30, Songdomirae-Ro, Yeonsu-Gu, Incheon, Korea, 21990

Tel : 82-32-831-0401

FAX : 82-32-831-3297

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AWT Co., Ltd.

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