PIM-P Analyzer

User's Manual

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Advanced Wireless Technology

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1 INTRODUCTION

Thank you for choosing an AWT Analyzer. The PIM-P 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-P Analyzer. This manual contains valuable information on the safe operation of the PIM-P test set and a brief technical background on passive intermodulation.

2 SAFETY SUMMARY

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-P 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 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-P Analyzers transmit two settable CW RF signals, with a power of up to 25W each, to measure passive intermodulation of components and transmitting systems.

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

2.3 POWER REQUIREMENTS

The PIM-P 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-P SERIES PACKING LIST

PIM-P 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-P Transit Case. See chapter Accessories for ordering information.

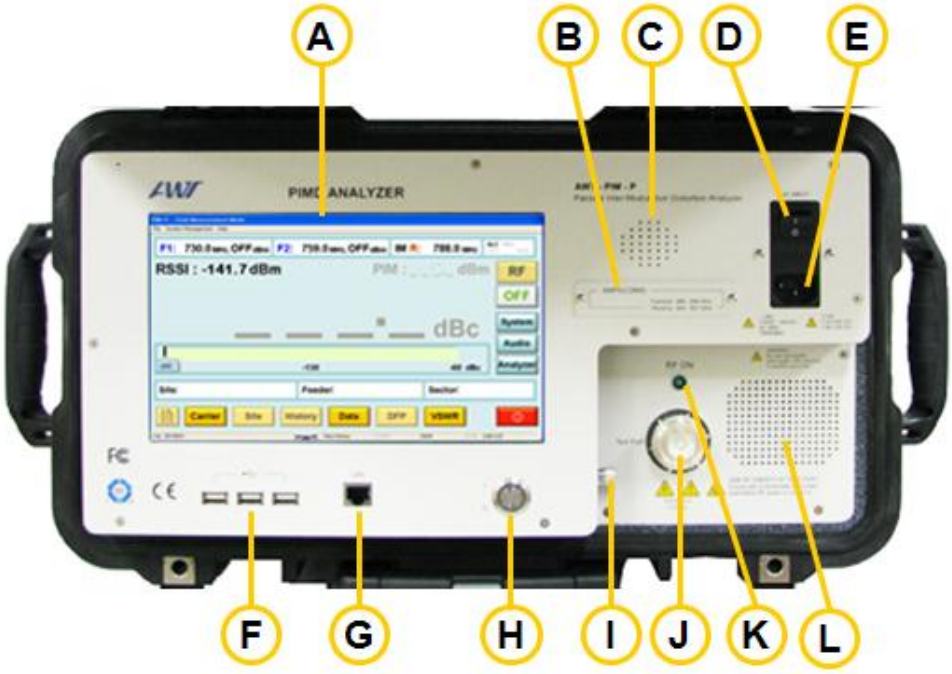
Unless otherwise ordered *, your will receive:

- PIM-P Series Passive Intermodulation Test System
- Line Cord with 90 degree connector
- 1 Connector Saver
- Low PIM Cable 1m (3.3ft)
- Low PIM Load 50W
- Install CD & manual

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

3 PIM-P ELEMENTS

3.1 PIM-P FRONT PANEL



No.	Element	Description
A	Touch Screen Display	Touch screen display 800x600. Never use sharp devices to push buttons on the screen
B	Type Label	Provides information about PIM-P Tx/Rx frequency bands
C	Audio	Loudspeaker for audio signals
D	Main Power Switch	PIM-P contains protection circuitry to control RF Power during operation and during powering on/off cycles. After switching Main Power Switch On wait 2 seconds before pushing Front Power Button. Fans may Briefly run after power off. Note: Do not use Main Power Switch while system is in operation mode, vital files may get corrupted Always use the Front Power Button to power the system down.
E	Main Power supply	AC Supply: 100-240V, 750W /750VA use 90 degree connector only Fuse: 4A /230V or 8A / 110V
F	USB Ports (3)	USB Ports for mouse, keyboard and Memory Stick
G	LAN connector	For factory use only

H	Power Switch	Function similar to a PC: ● one short push – PIM-P powers up, ● Another short push – controlled power down ● Holding it for 3 second – powers unit down immediately See also chapter Powering PIM-P up/down. Note: Main Power Switch on the front must be in ON Position
I	10 MHz Reference out	10 MHz reference output to synchronize external equipment
J	RF Port w	RF Port.
K	RF Power On	RF-Power light indicates when RF Power is present.
L	Front Panel Air Vents	Always allow for proper airflow, prevent alien objects or dust from being sucked in.

4 PRECAUTIONS

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-P
- 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-P in any active systems.

The PIM-P 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-P 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-P.

Always use a cable between PIM-P and DUT. The connector of the PIM-P 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-P 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-P 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-P.

Caution

DO NOT use sharp devices at the touch screen.

Users can operate PIM-P 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

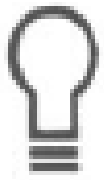
Do NOT touch the cable during the measurement

Should not touch DUT and the cable which is connected to PIM-P 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, DFP, and VSWR values can be incorrect with this incomplete contact.

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-P 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.

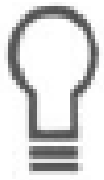
Hint



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.

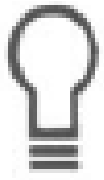
Hint



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.

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-P 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-P 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-P UP/DOWN

5.1 Powering UP

PIM-P 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-P 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.

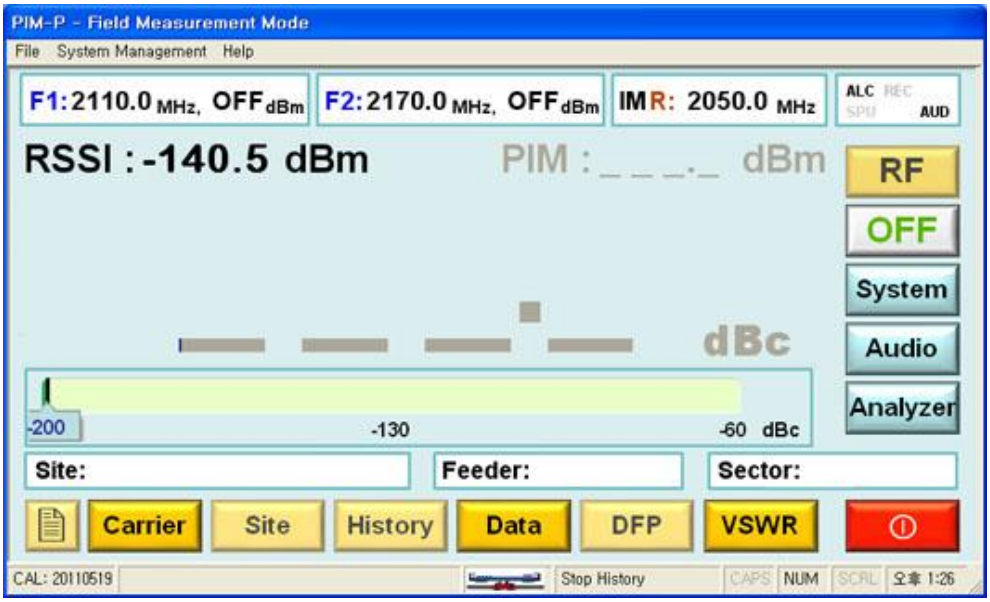
Preparations for powering up:

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-P 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-P 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-P 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

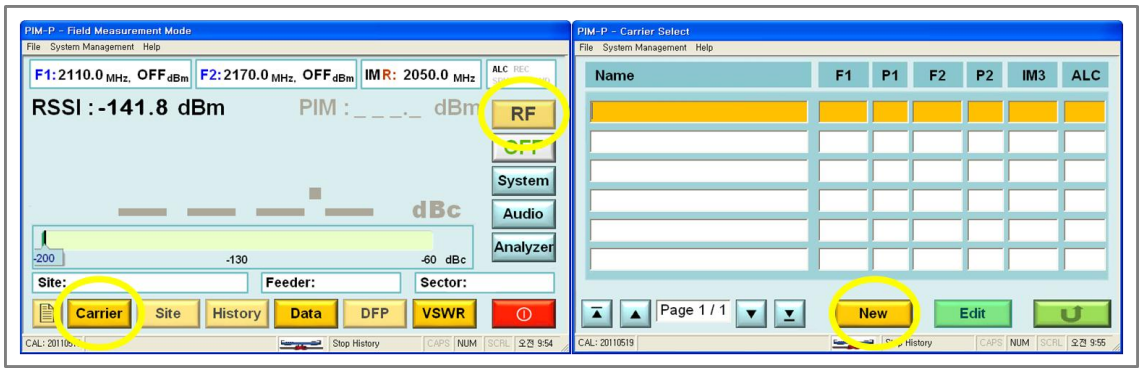
Before starting to measure components with PIM-P systems, users are urged to familiarize themselves with the precautions (Don'ts) in the chapter below. Improper operation and handling can cause bodily harm or damage the instrument.

6.1 THE FIRST MEASUREMENT

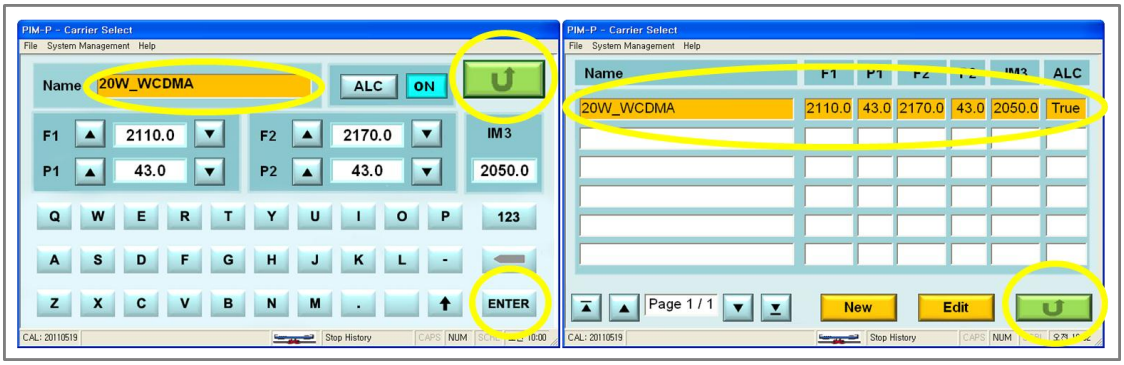
Preparations:

- 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.

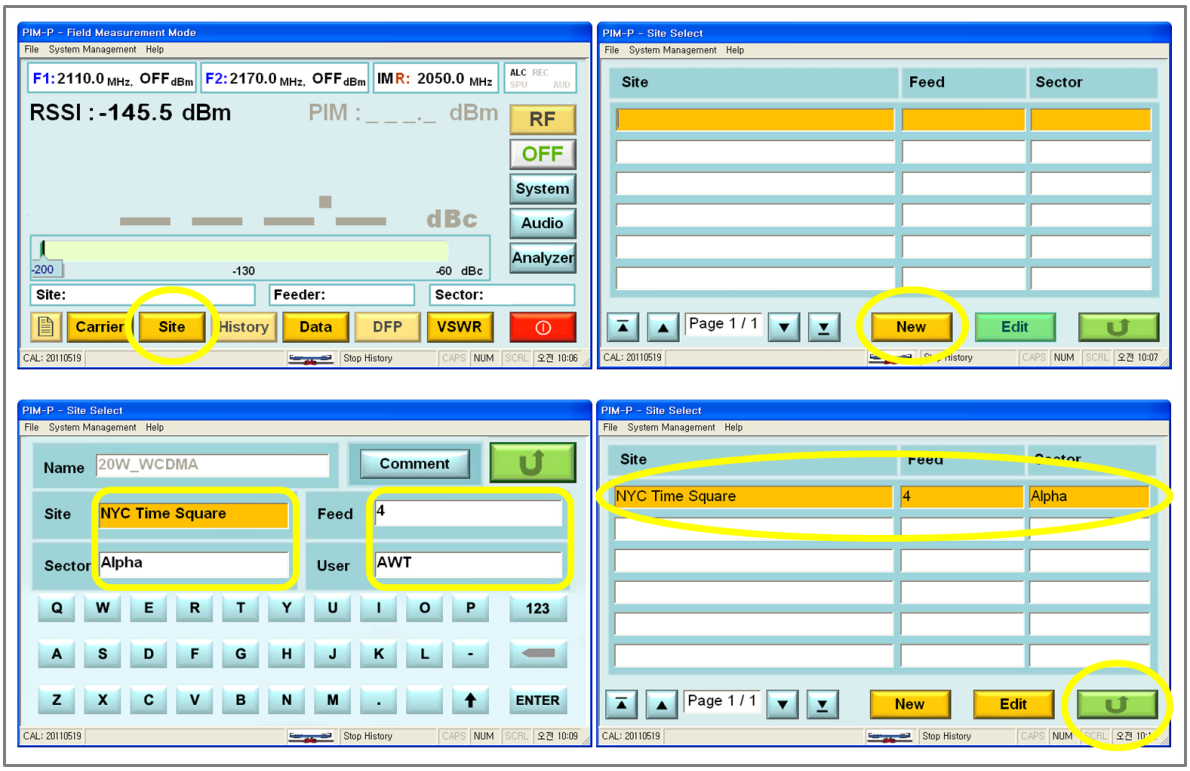
At this point the RF Button is visible but inactive. Power levels and the frequencies of the carrier signals must be set in order to activate the RF button. To do so, pushing the "Carrier" button displays a list of Carrier signal settings.



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

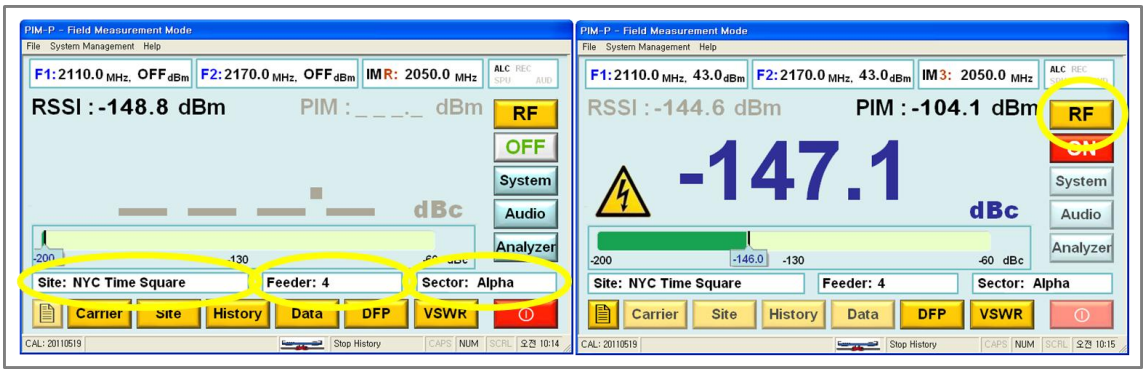


Green return button we come back to the Field Mode screen.

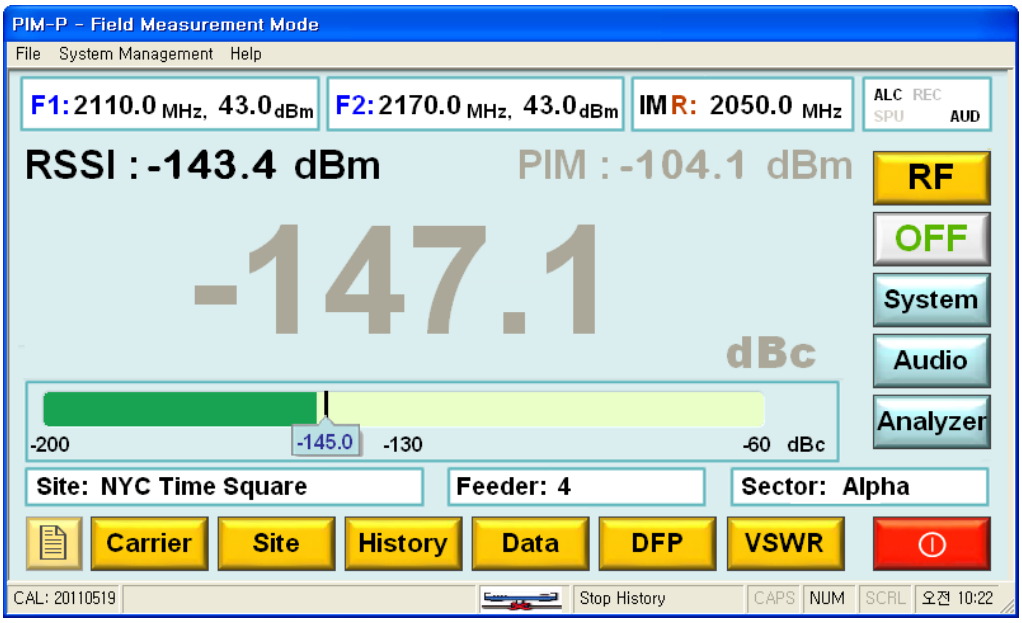
PIM-P Analyzers provide not only accurate PIM analysis, they also allow users to log data that is specific to a particular test setup or particular base station site. At a later point, measurements can be recalled for comparison and to analyze if the performance has changed. This particular information 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.



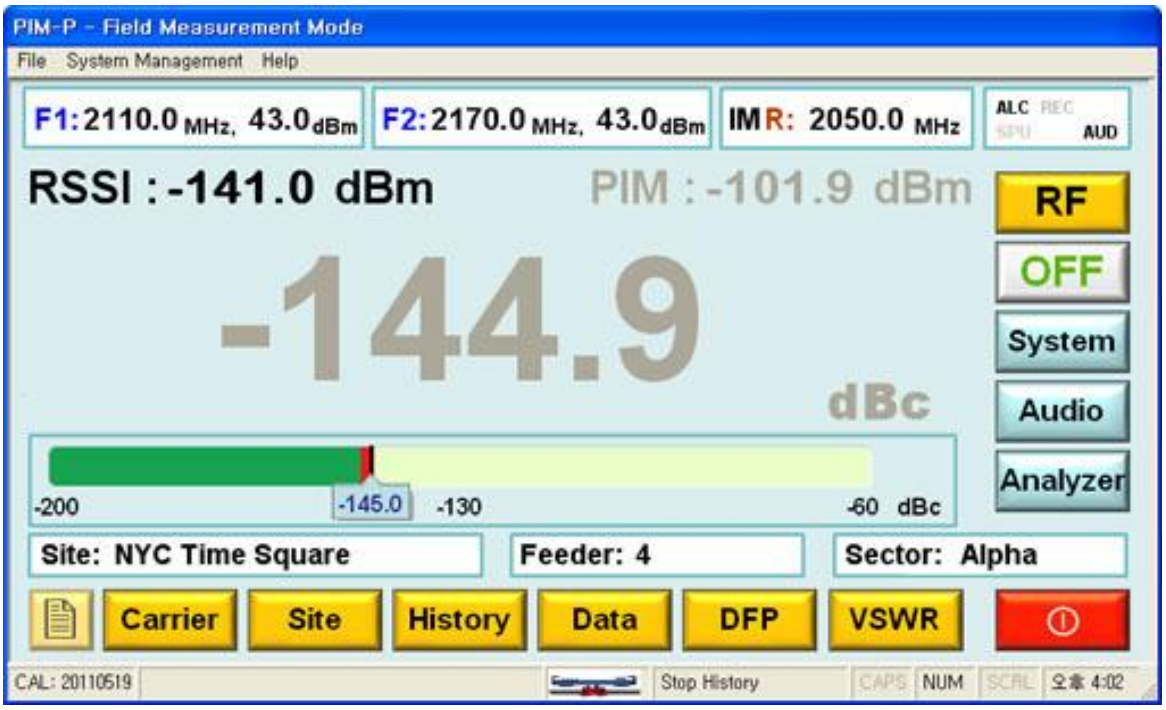
Note: PIM-P Analyzers switch RF Power off after 30mins (default). Other cycles or "Always On" can be selected. For more information refer to chapter System Menu.

7 PIM-P OPERATION

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

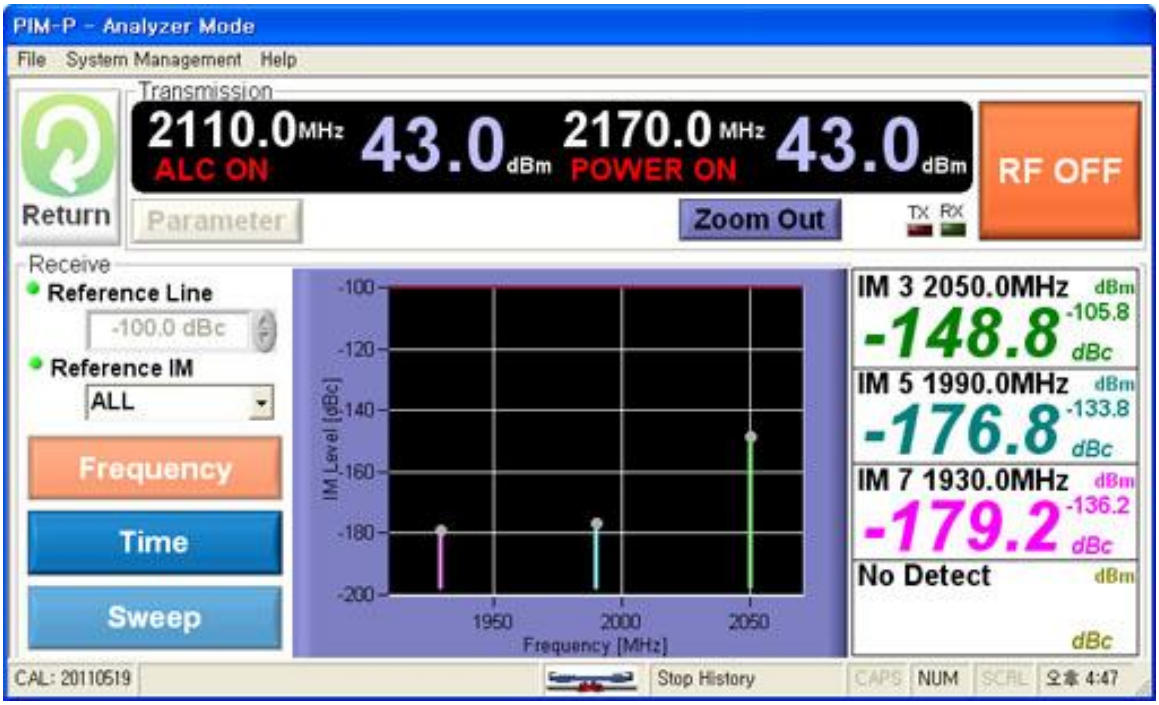
Operation Modes for Different Applications: Field Mode / Analyzer Mode

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-P 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-P Analyzers provide this easy to use functionality in the **Field Mode**. All base station test parameters can be stored in the PIM-P 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-P 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.

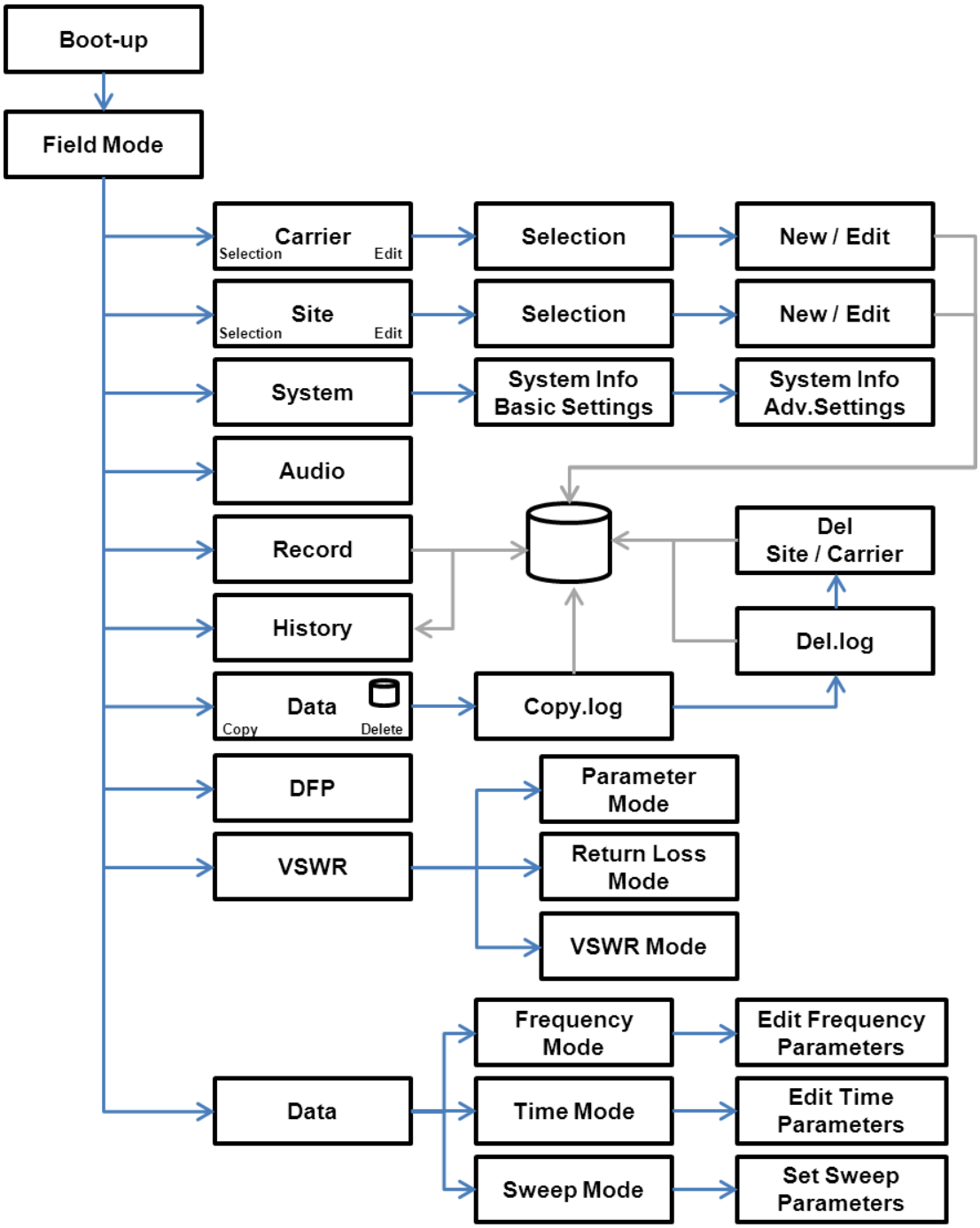


If more detailed information about the DUT is required, it can be accessed by using the **Analyzer Mode** of the PIM-P Analyzer. In this mode the user can analyze multiple intermodulation products at the same time (Frequency Mode), can record graphical traces over a longer time period (Time Mode) and 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

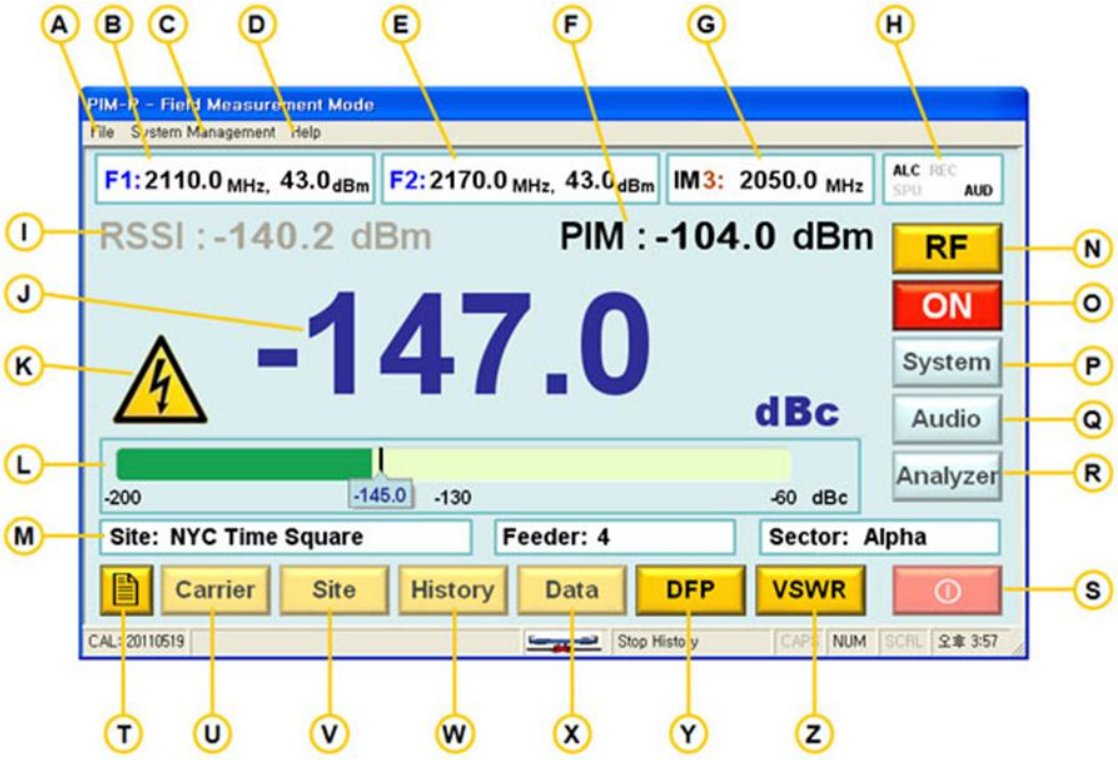
PIM-P Analyzers are designed to provide an efficient workflow. The Menu Tree shows the overall menu structure of the PIM-P.



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-P 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
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	RF Indicator light	Indicates when RF-power is ON
P	System	Opens System menu. See Chapter System Menu for further information
Q	Audio On/Off	Audio Signal when measurement passes green/red threshold of Bar Graph
R	Analyzer	Opens Analyzer Menu For more information see chapter Analyzer Mode.
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 carriers) For more information see chapter Data Active only when RF-Power is OFF
Y	Distance of Faulty PIM	Opens Measure Distance of Faulty PIM screen For more information see chapter DFP
Z	VSWR	Opens VSWR Line Monitor screen For more information see chapter VLM

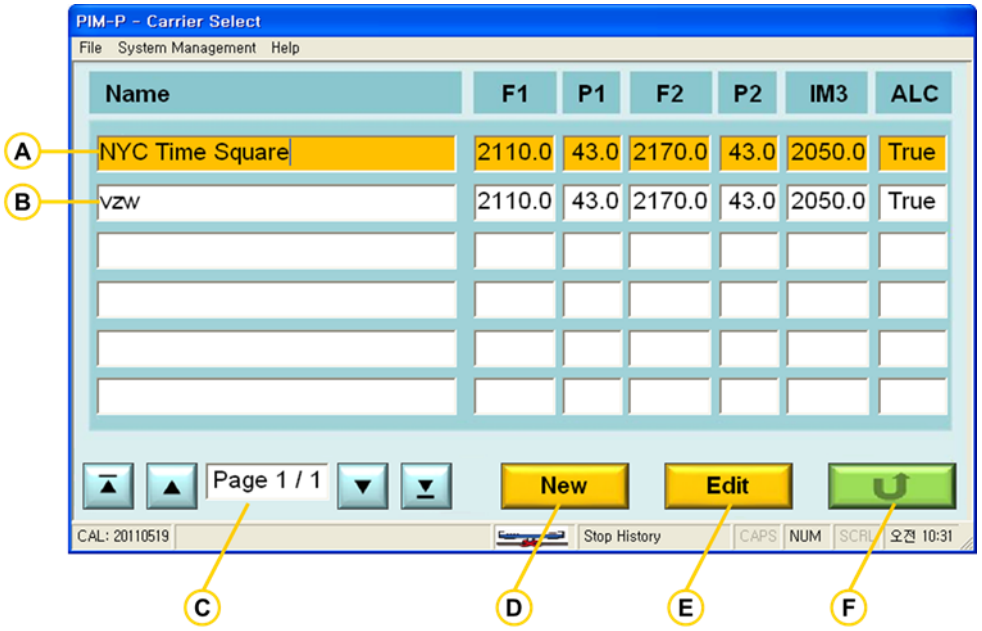
7.2.2 Carrier Entry

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 are 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".

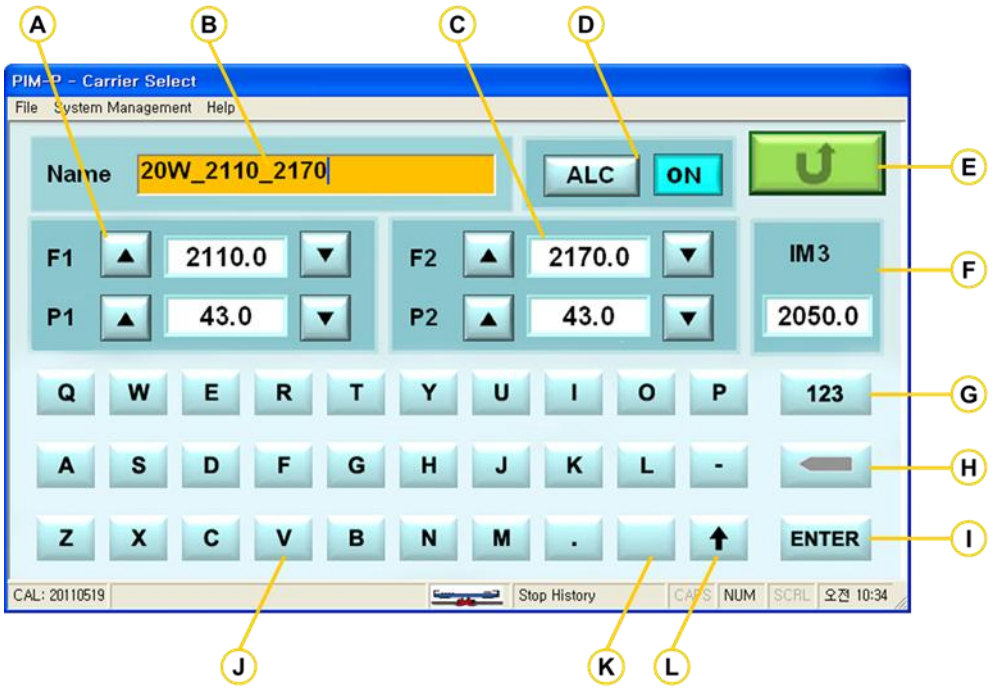
Carrier Select

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-P.
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-P, 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	Return	Returns to previous screen.

PIM-P Carrier Edit



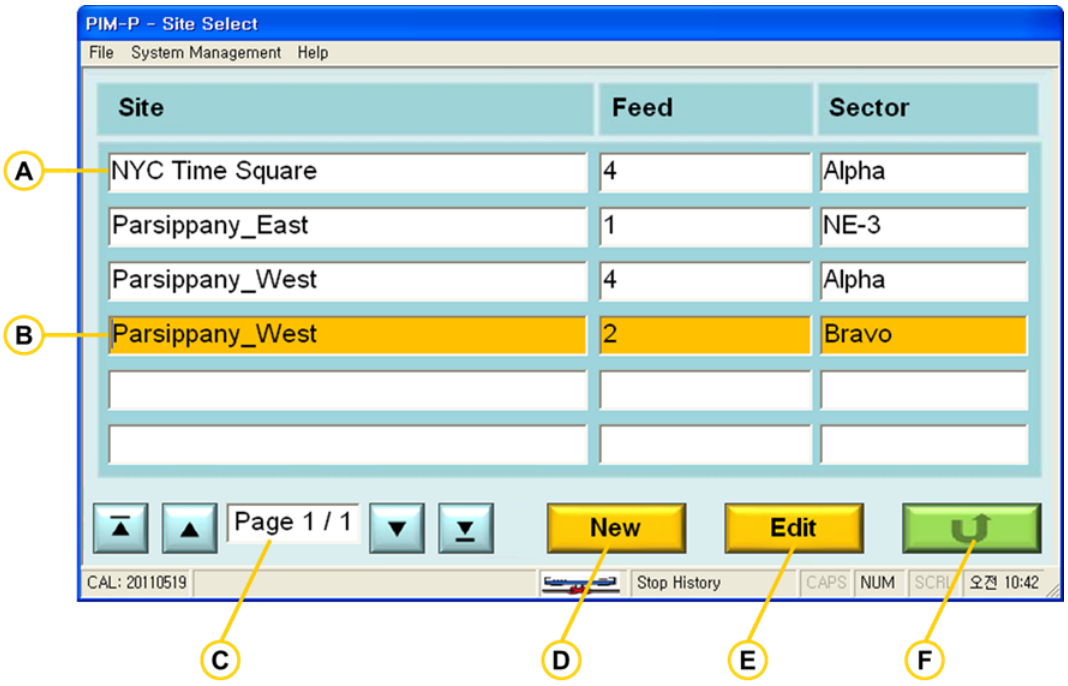
Element	Name	Description / Display
A	Carrier 1 Parameter	Sets power level and frequency of carrier signal 1: Note: when entering this field a numeric keyboard is displayed. A new or changed value is accepted by pushing the Enter button (I)
B	Carrier Name	When entering new carrier information, the cursor 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	Return	Returns to previous site.
F	IM	Automatically calculates and displays the next IM product that lies in the receiving band of the PIM-P
G	123 / ABC	Toggles the touch screen keyboard between characters and numeric.
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.

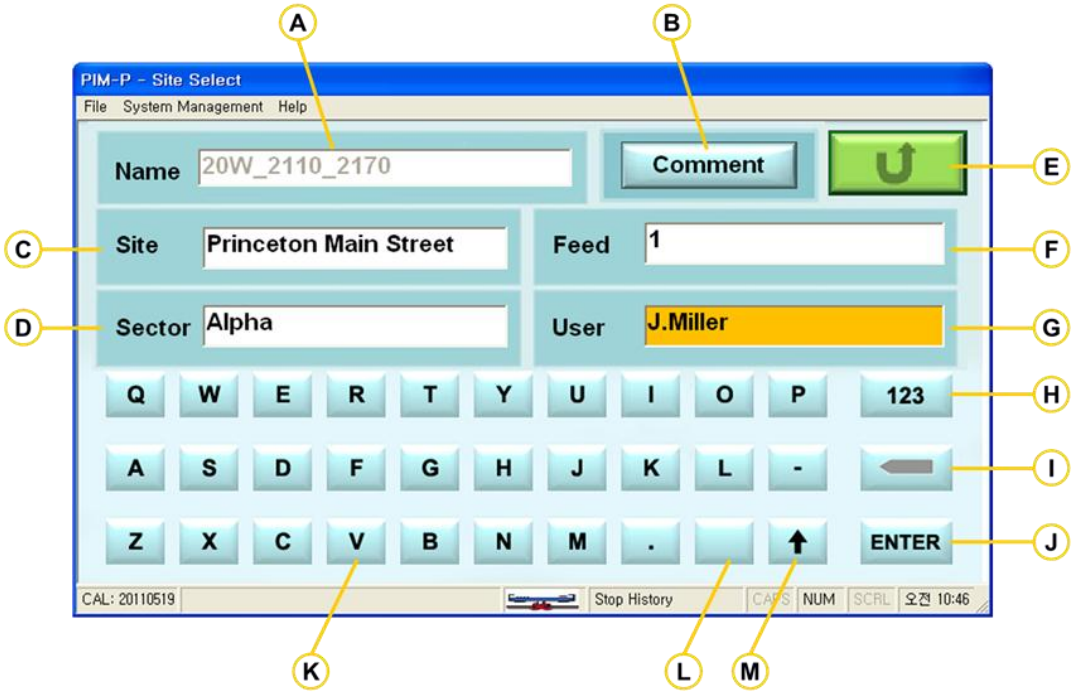
7.2.3 Site Entry

As with Carriers, Sites (or Tests) and linked information can be stored in the memory of the PIM-P. 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-P.
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-P, 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	Return	Returns to previous screen.

PIM-P Site Edit

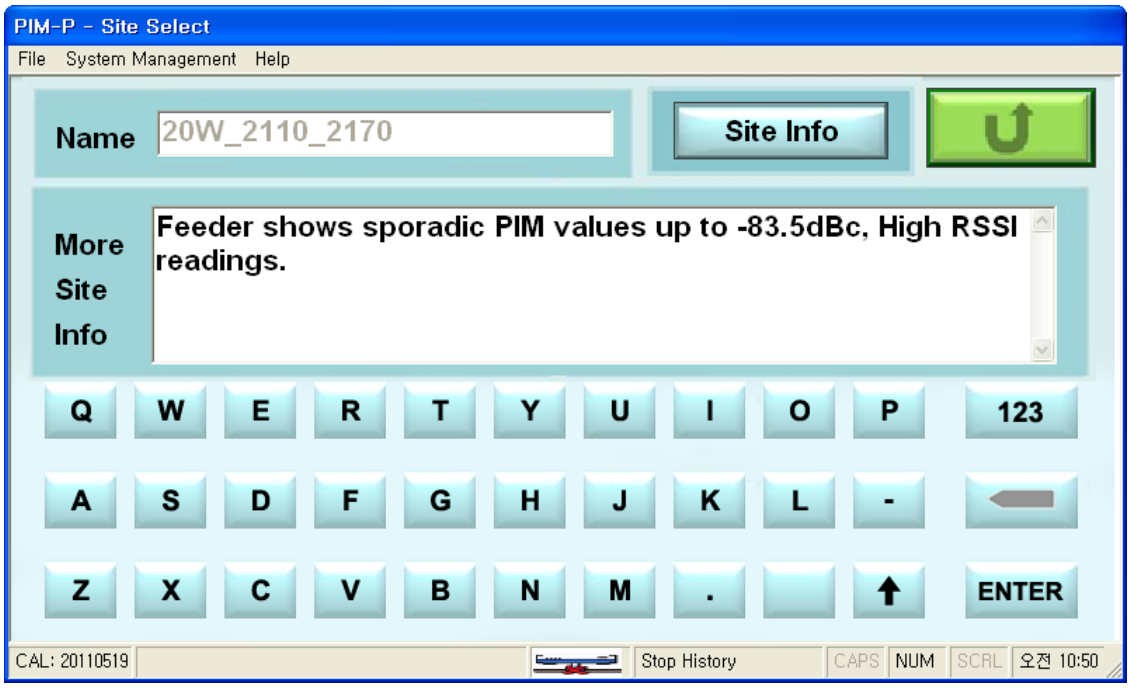


Element	Name	Description / Display
A	Carrier Name	Carrier signal to which site information is related to.
B	Comment	Allows additional entries related to the Site or Test.
C	Site / Test Name	Site / test name New or changed entries are stored by pushing "Enter" (J)
D	Sector	Additional information (Sector) New or changed entries are stored by pushing "Enter" (J)
E	Return	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.

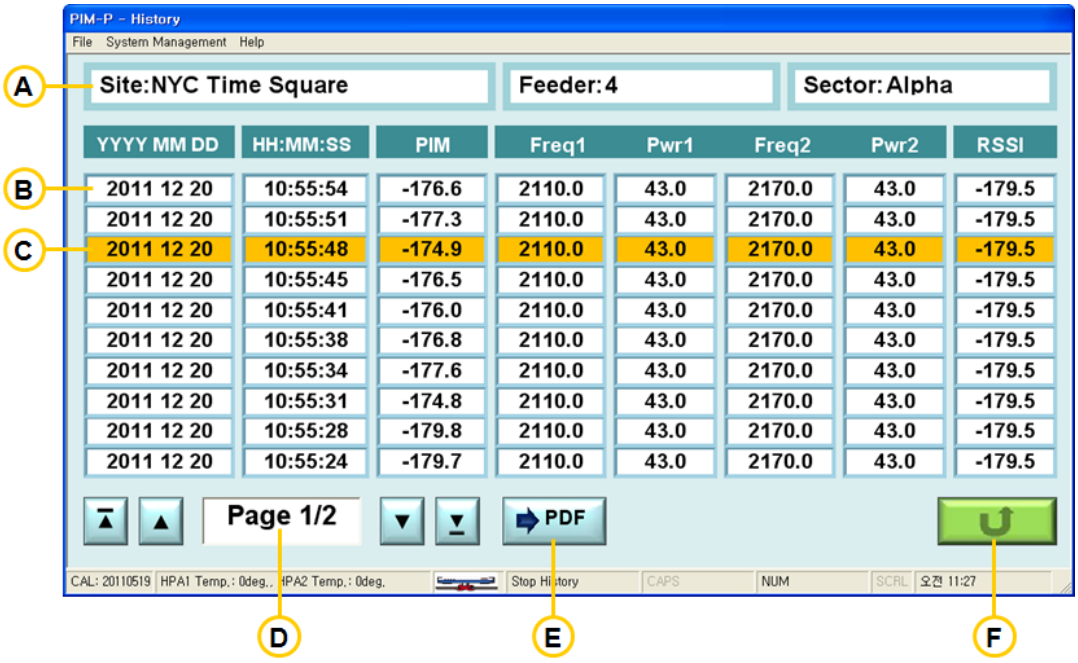
7.2.4 Comments

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.



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-P, 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	Return	Returns to previous site.

7.2.6 Data Management

The following chapter describes the Data Menu and Data structure.

Recording / Record – Button

PIM-P 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-P 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-P\History Users do not need to access this directory directly since the data features of PIM-P 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
IM3 Bandwidth (Hz)	XXXXX	IM 3 Bandwidth in Hz
PIM-P 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
"Acewavetech"	String	For internal use
"PIM-P 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 – 3 Characters max	"ON" or "OFF"

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.

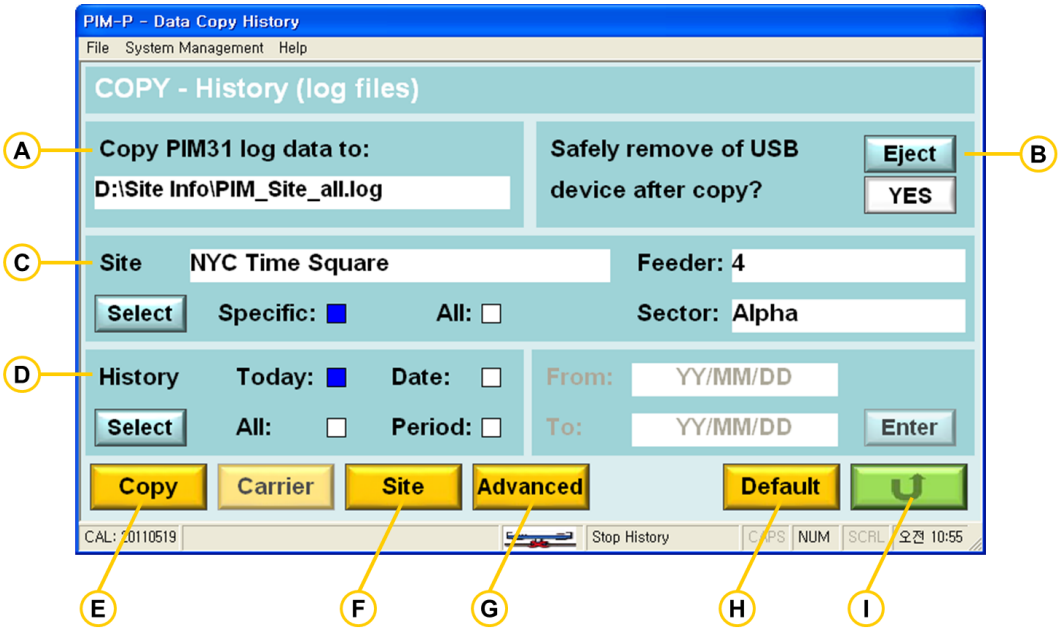
Default drive directory and file name of the merged log data-sets is:

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

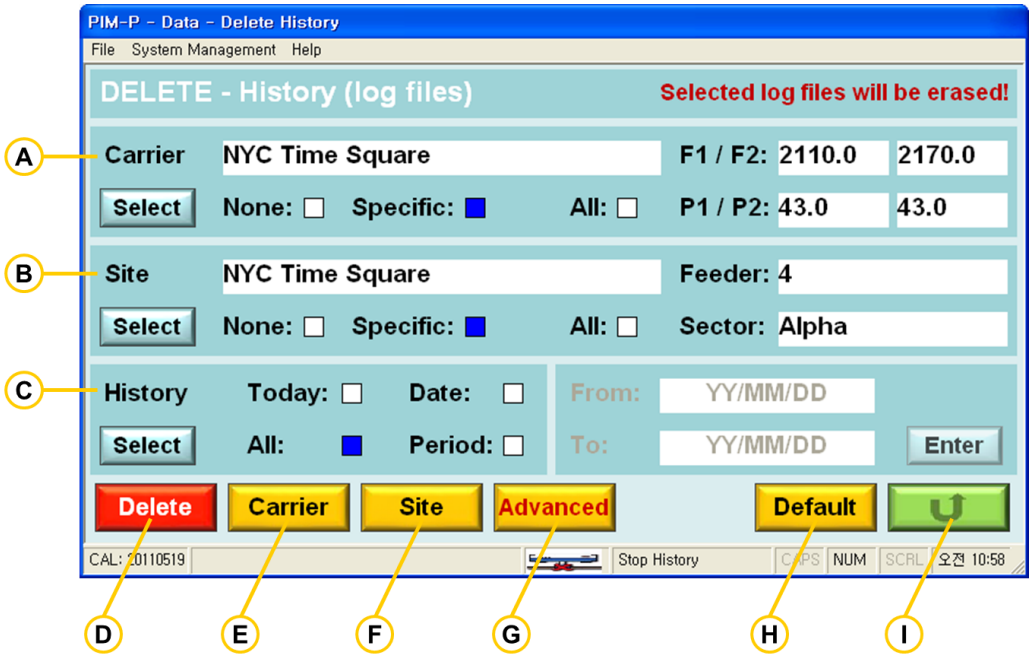
Data copies selected log files to one merged log file at a particular directory.



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: No
C	Site	Allows copying of log data from a specific Site or all Sites the PIM-P 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	Return	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	Return	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.

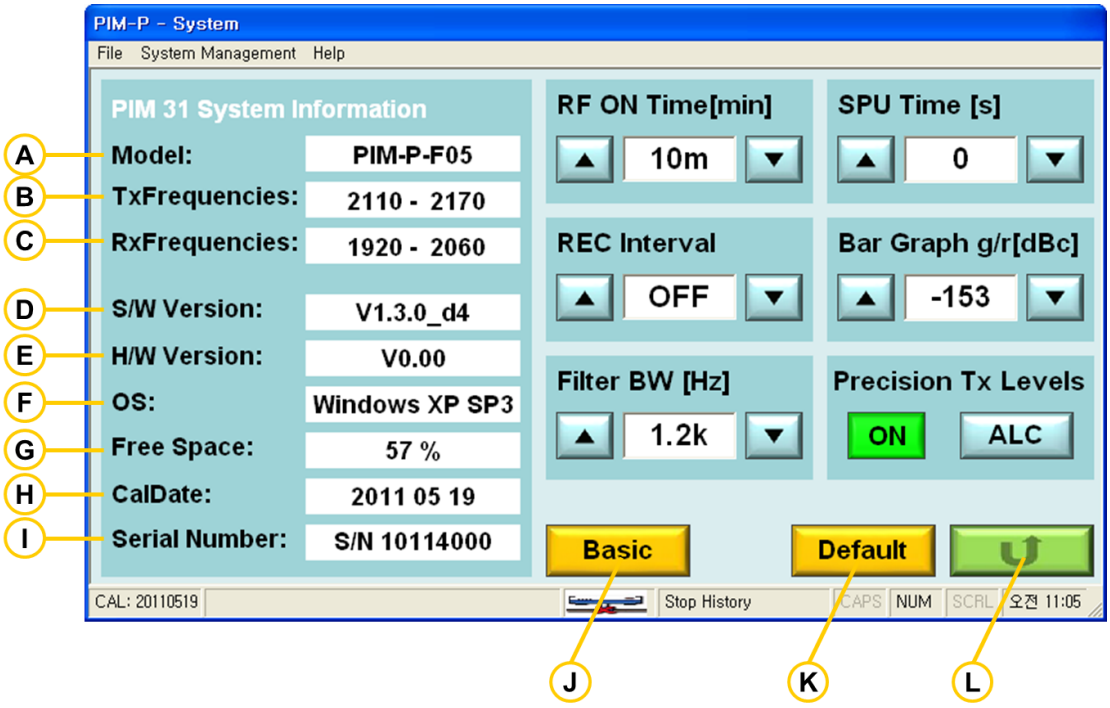
Element	Name	Description / Display
A	Carrier	Selection to erase a specific Carrier, All Carriers or none. Specific Carriers can be selected via the Carrier button Selection: None, Specific, All Default: None
B	Site	Selection to erase a specific Site, all sites or none. Specific Sites can be selected 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	Return	Returns to Data Copy site.

7.3 System Menu

The System Menu provides information about the PIM-P 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-P. 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-P measures PIM.

System Information and Buttons

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



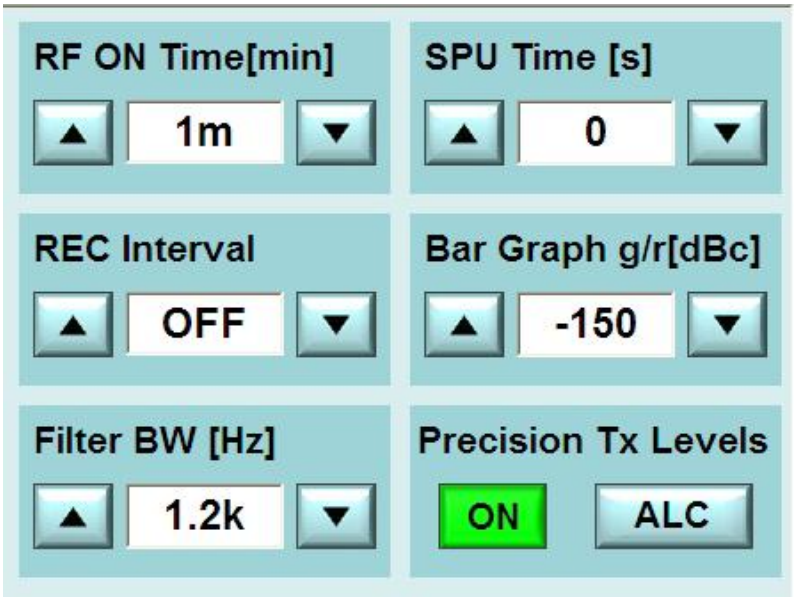
Element	Name	Description / Display
A	Model	Model type of PIMI31. .
B	TX Frequencies	Transmitting frequency range, tester type dependent
C	RX Frequencies	Receiving frequency range, tester type dependent
D	SW Version	Software Version of PIM-P
E	HW Version	Hardware version of PIM-P
F	Operation System	Operation system and service pack used
G	Free Space	Memory space available for data logging.
H	Cal Date	Calibration Date of PIM-P
I	Serial Number	Serial number of PIM-P:

J	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 Function Block for detailed information.
K	Default	Sets default values.
L	Return	Returns to previous site

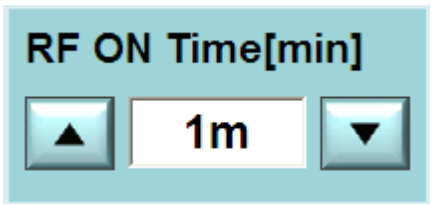
7.3.1 PIM-P Memory Space

PIM-P 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-P Analyzers can store more than 11 Million data sets.

7.3.2 System Menu Functional Block



7.3.2.1 RF ON TIME

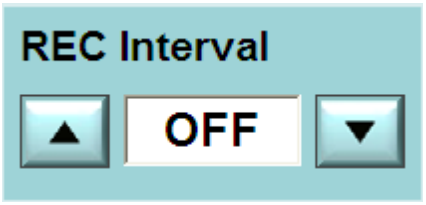


By default, PIM-P Analyzers will switch RF power off after 30mins. This prevents unnecessary transmission of RF power if the system has been left on unintended.

RF-ON periods: 1m, 2m, 5m, 10m, 20m, 60m, 120m, 360m or "Always On".

Default: 10min

7.3.2.2 REC Interval



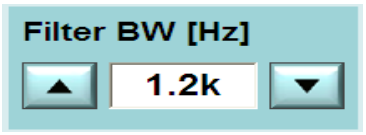
PIM-P Analyzers record measurements whenever the Record button is pushed. Multiple pushes create multiple, corresponding individual log files. If measurements need to be analyzed over a longer of time, PIM-P Analyzers can record log data automatically by setting the REC interval to a value other than "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-P 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-P. 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, 2.4kHz,5kHz,10kHz, 12kHz, 15kHz ,25kHz 50kHz

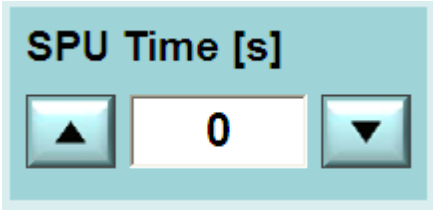
Default:1.2 KHz

Note: Varying filter bandwidth influences the amount of RF energy measured by the PIM-P 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-P 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-P are prone to such reflections. If the returned energy is too high, PIM-P will switch off to protect its hardware. A remedy is to simply increasing RF power gradually.

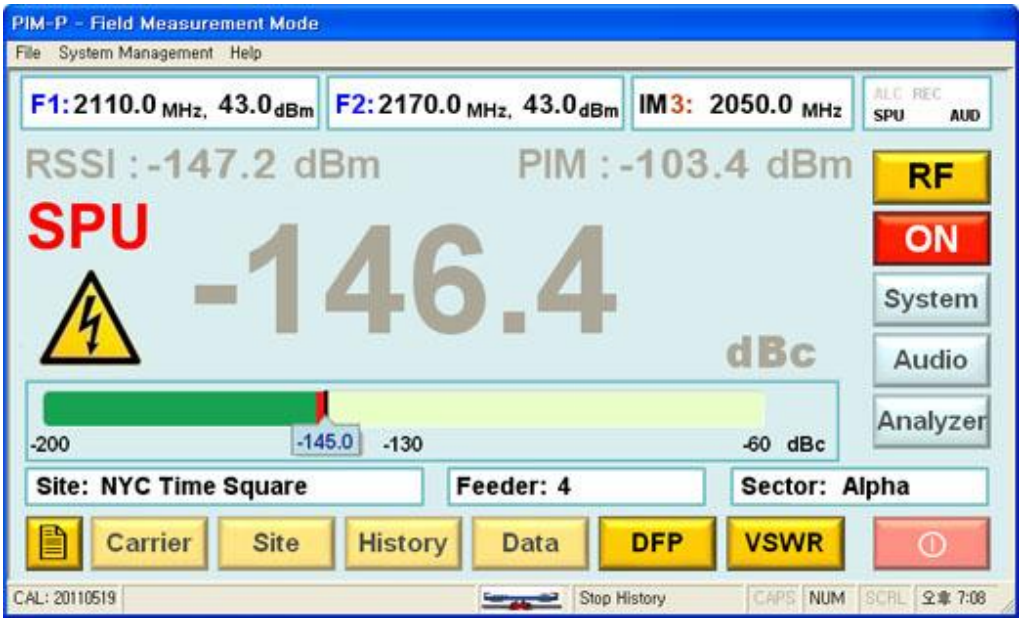
SPU Time: Increments 1s, Settings range 0sec to 60sec

Default: 0s

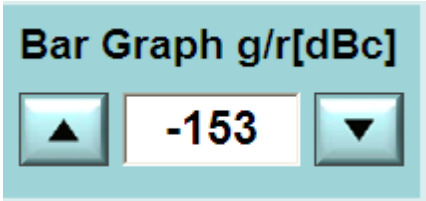
Example: With a power setting for 43dBm and SPU of 10s it takes 10 seconds to ramp RF power up from 20dBm to 43dBm

Note: PIM-P 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.

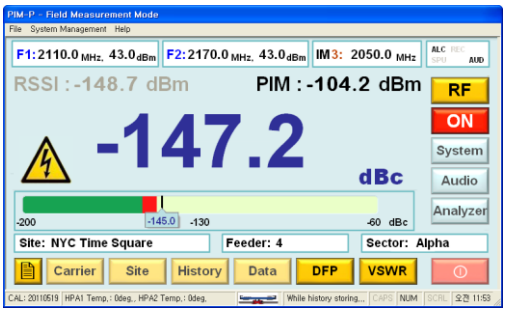


7.3.2.5 BAR Graph G/R



Advanced Mode Only

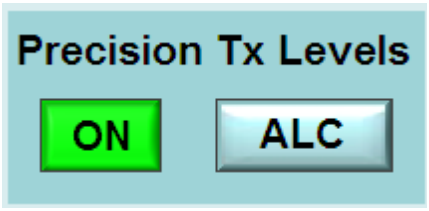
The Bar Graph's green/red threshold is -153dBc by default. The switch from green to red is an optical indicator if a DUT is within limits or if it exceeds them. PIM measurement values higher than the set threshold can provide an audible indicator. Obviously Audio has to be switched on in the Field Mode 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 Precision Tx Levels



Advanced Mode Only

ALC (Auto Level Control) provides an extra boost of Tx Signal accuracy. When measuring PIM, two RF carrier signals are combined and transmitted into a passive RF component (DUT). Depending on its quality, the DUT generates more or less intermodulation energy. For best measurement accuracy the injected signals should closely match their power levels. With ALC: ON, the PIM-P will synchronize these power levels perfectly. Increased accuracy costs a bit more time. Setting Tx power levels with will 0.05 to 0.2 sec longer than with ALC: OFF. With the exception of high volume production, this additional time is not an issue, so it is recommended to always leave ALC ON.

Default: ON

7.4 Analyzer Mode

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

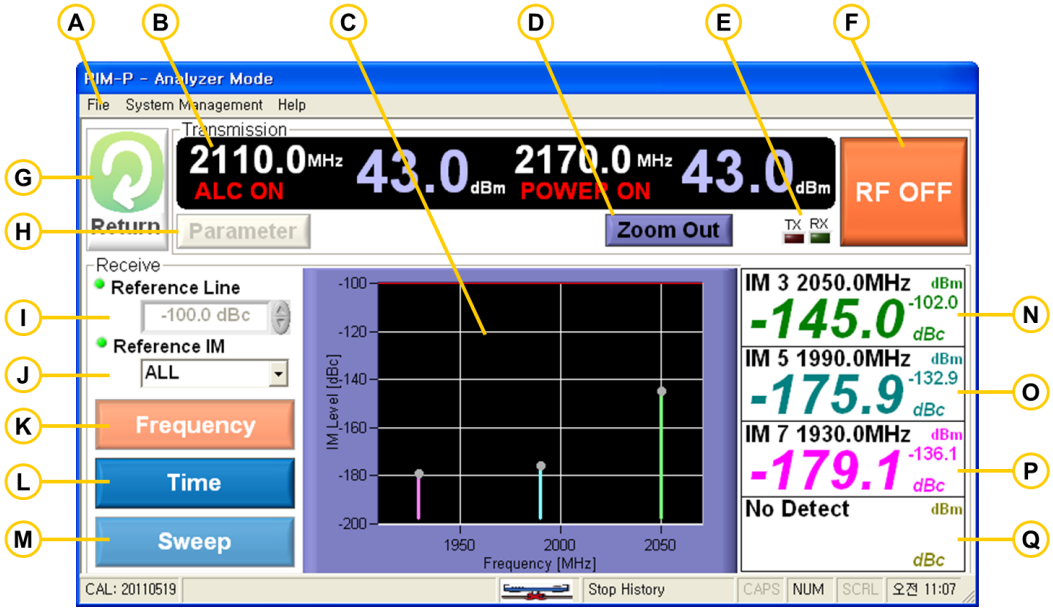
- Frequency
- Time
- Sweep

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

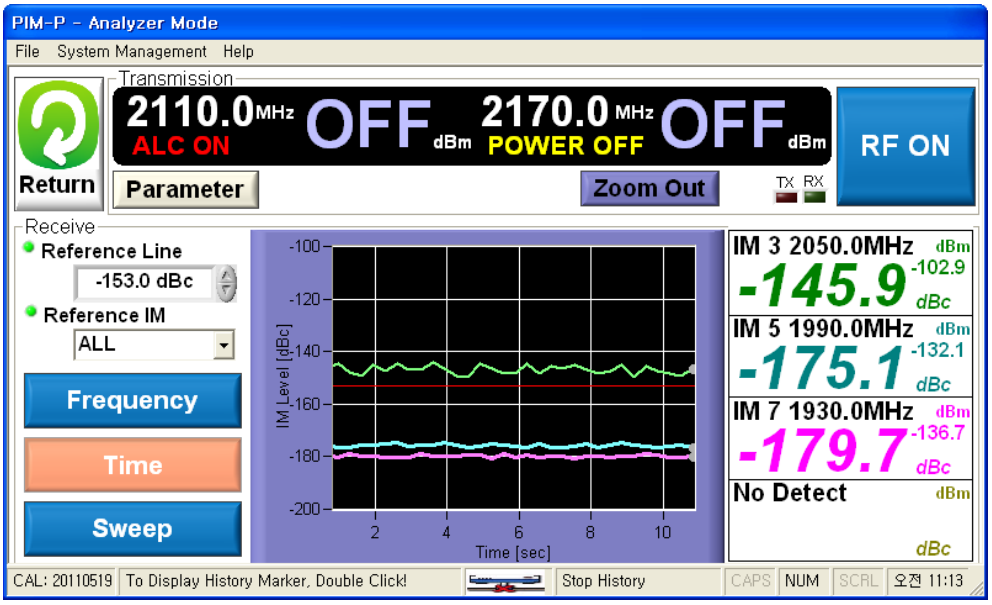
C	Graphical display	Shows up to 4 IM signals as a vertical bar. Position on the x-axis indicates frequency and length indicates power level. Color of the bars refers to the colors of the numeric displays (N-Q). The graphical display is floating, meaning the center area can be moved for better convenience 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	Tx/Rx	Shows internal communication activity to modules.
F	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.
G	Return	Brings PIM-P back to Field Mode. Works only when RF Power is OFF
H	Parameter Setting	Allows modification of frequencies and power levels used in Analyzer Time and Frequency mode. Works only with RF Power OFF
I	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
J	Reference IM	Selects if particular IM products (faster) or All IM products (more comprehensive) that fall into the receiving band of the PIM-P. The test system can show up to 4 IM signals at the same time.
K	Frequency	Graphic Display Frequency mode: IM signals shown as vertical bar, indicating power and frequency. Signal colors relate to numeric display
L	Time	Graphic display – Time Mode: IM signals shown as moving horizontal line, indicating power (changes) over time. Signal color relates to numeric display
M	Sweep	Graphic display Sweep mode. Signals are "swept" over a range to test wide frequency range
N	Numeric field 1	Strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency
O	Numeric field 2	Second strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency
P	Numeric field 3	Third strongest IM Signal in the receiver band Information shown: Power (dBc & dBm) and IM frequency
Q	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

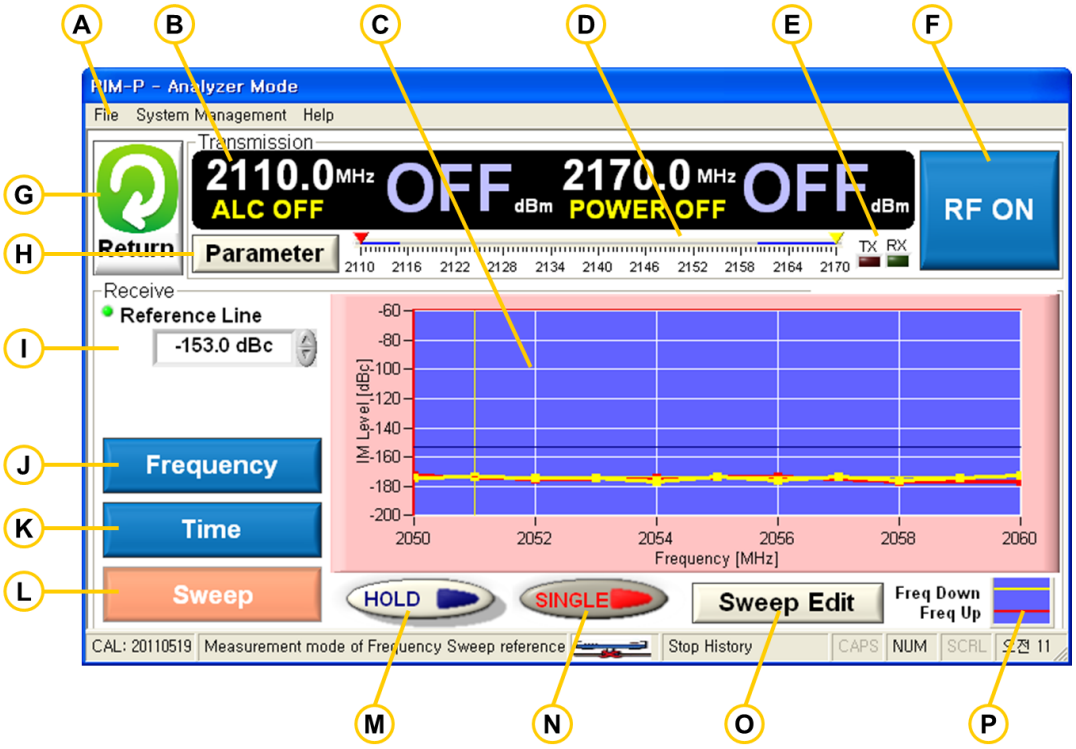
In Time mode IM products are displayed as a horizontally moving line, where the position indicates the power level over the time. This display is very helpful to test immediate PIM variations, like loose connections. Any change is immediately visible. Time mode shows a 10 seconds window, but more information 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 two IM signals IM3 and IM5 With -149.0 dBc IM3 exceeds the reference limit of -153.0 dBc. IM5 measured -176.8 dBc. Frequency information of the IM signals is provided in the numeric displays. In this example (M3 is 846.5 MHz and IM5 824.0 MHz.

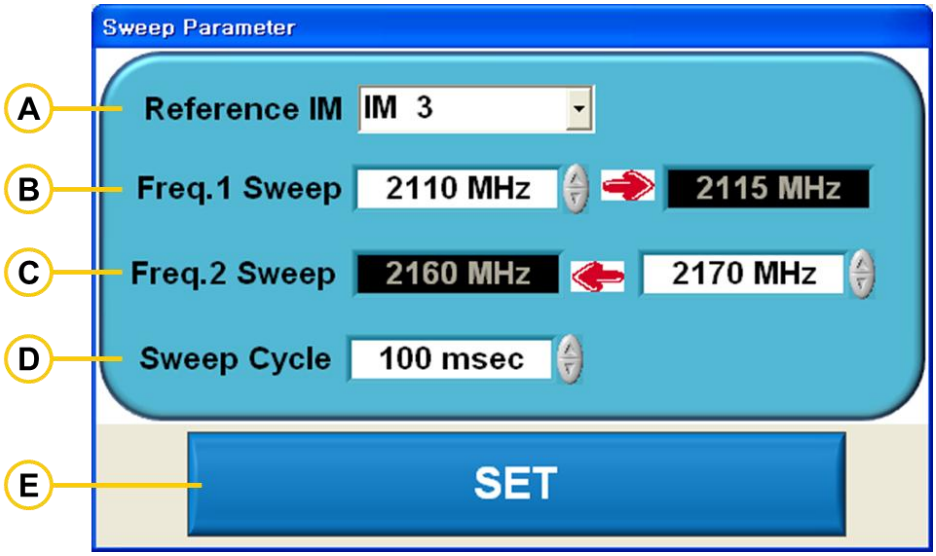
7.4.3 Sweep Mode

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 (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	TX Range	Shows Range of up-sweep and down-sweep.
E	Tx/Rx	Shows internal communication activity to modules.

F	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.
G	Return	Brings PIM-P back to Field Mode. Works only when RF Power is OFF
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	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
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	Hold	Hold Off blue, On red. While sweeping, measurement can be held immediately.
N	Single	Single Off –Blue, On -red. Determines if a single sweep or continuous sweeps are measured.
O	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).
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).

8 DFP (Distance to Faulty PIM) and VLM (VSWR/ Line Monitor)

8.1 Introduction

DFP (Distance to Faulty 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 DFP 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 VLM (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 DFP and VLM 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

- DFP(Distance to Faulty PIM)

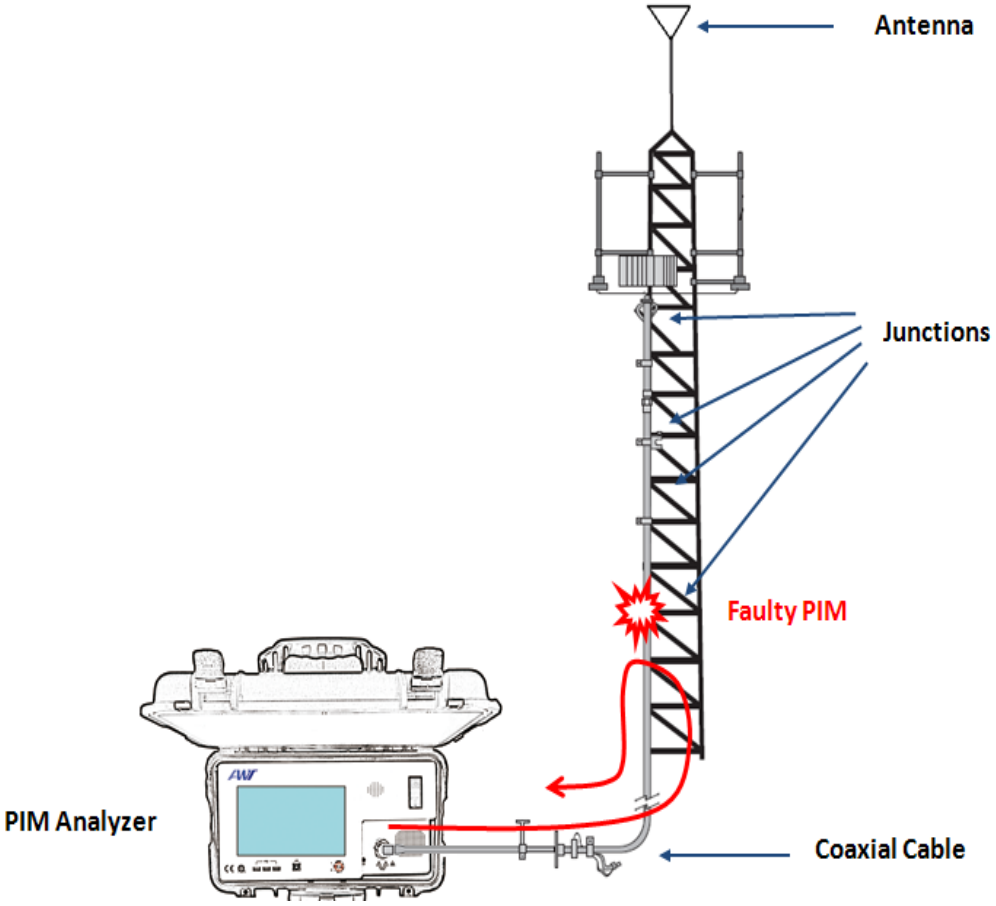
Model(DFP)	Distance to Faulty PIM
Sensitivity	-150dBc, 3rd order, 2X +43dBm
Dynamic Range/ Accuracy	50dB, typical / ±50cm(Typ.), ±1.5m(Max.)

- VLM(VSWR/Line Monitor)

Model(VLM)	Distance to Faulty VSWR
Measurement Range	1 – 20 Watts Average Power
VSWR	1.2:1 (Min), 6:1(Max)
Return Loss	20dB(Max), 3dB(Min)
Resolution (Return Loss)	0.1 dB

8.3 Procedures to measure DFP (Distance to Faulty PIM)

8.3.1 DFP (Distance to Faulty PIM) Setup

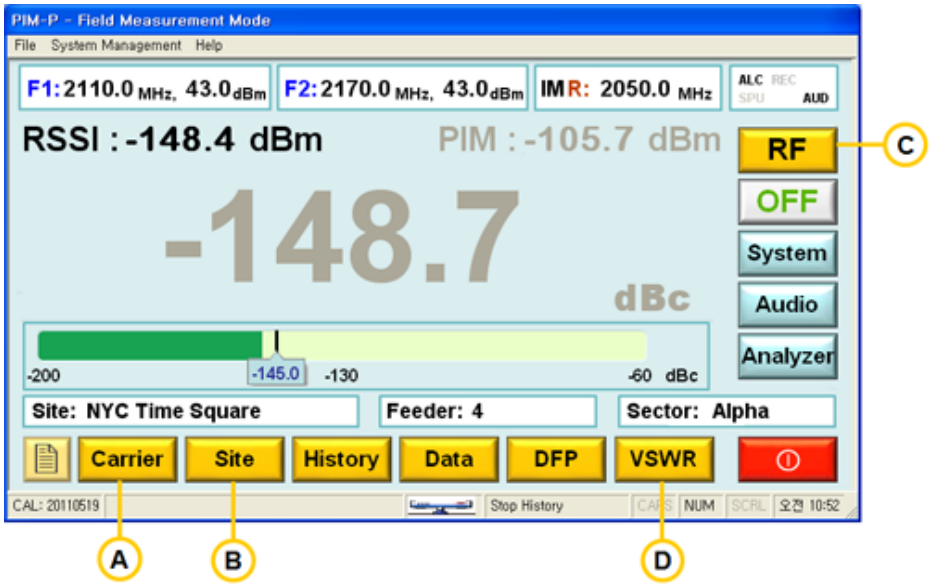


PIMD Analyzer DFP Measurement Setup Diagram

Typical setup in the field is like the figure above.

8.3.2 DFP (Distance to Faulty 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).

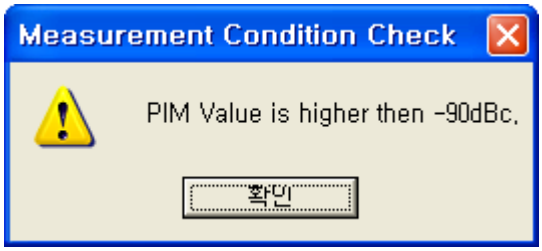


Element	Description / Display
A	Open a window to select, add, and edit a carrier.
B	Open a window to select, add, and edit a site (you have to select a carrier first)
C	Turn the RF of the equipment, then start the actual measurement (Carrier and Site must be selected first)
D	Opens the DFP screen.

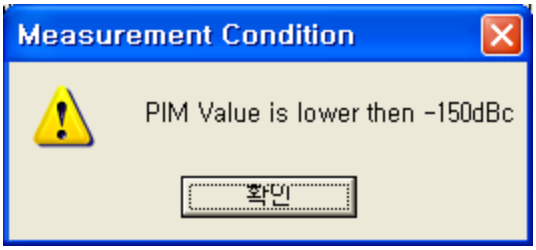
Release RF and judge the fault with measuring PIM of the transmission line connected to PIMD Analyzer. At this time, when you push DFP button without measuring PIM, a message is displayed like Figure 2. If PIM value is above -105 dBc, a message is displayed to protect DFP function. In other side, if the PIM value is under -155 dBc, a message is displayed like Figure 4, indicating the measurement variance increased.

This figure shows when running DFP function without measuring PIM in the Field Measurement Mode.

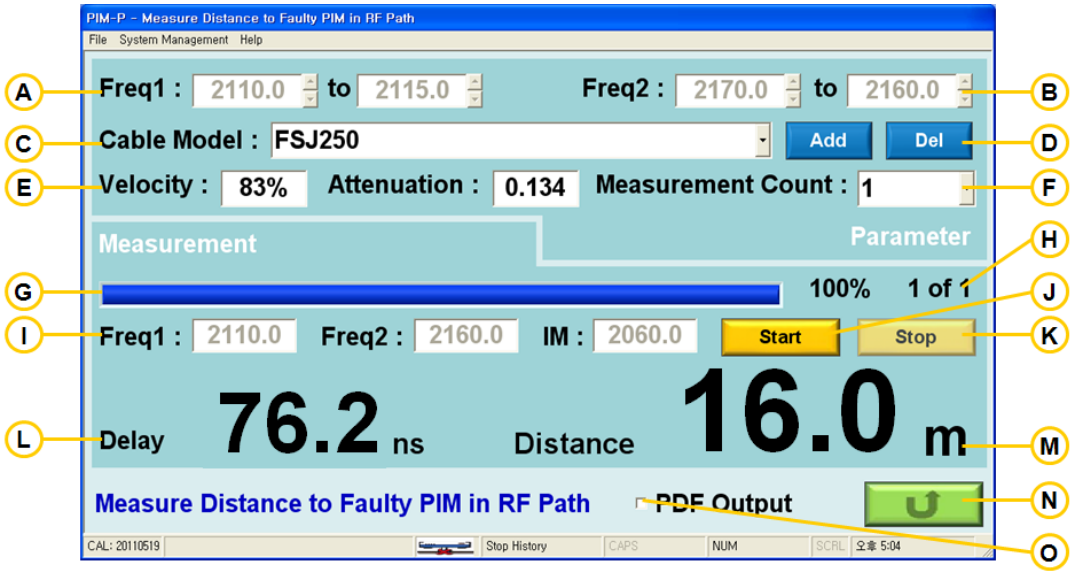
This figure shows when measured PIM is above -90dBc.



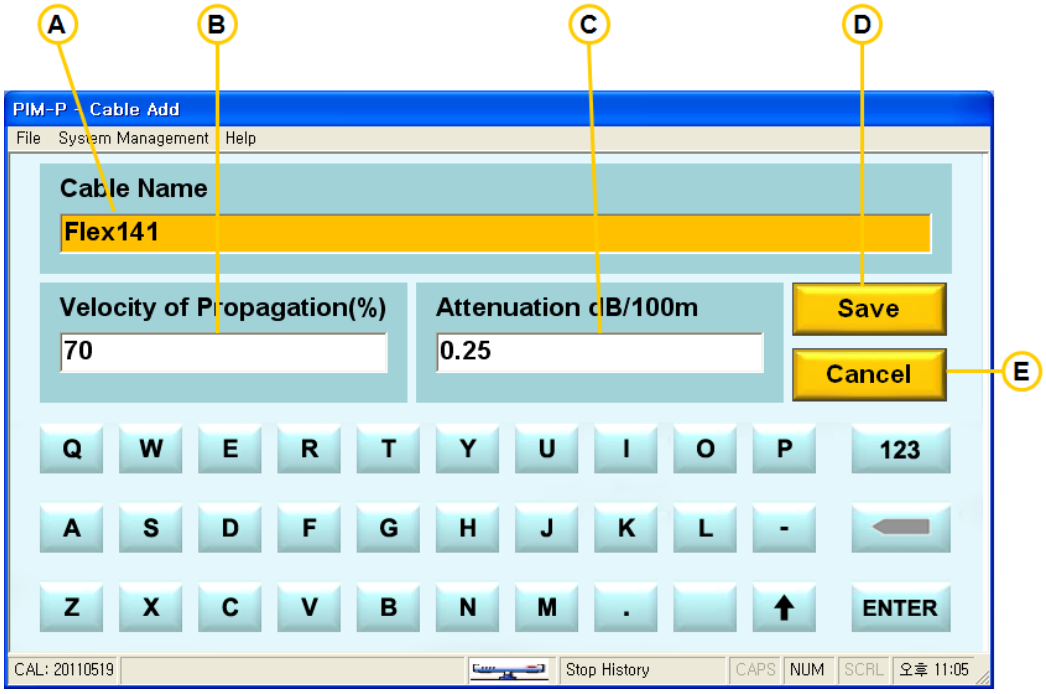
This figure shows when the measured PIM is under -150 dBc.



This is the descriptions for the options and functions.



Element	Description / Display
A	Displays the frequency 1 that is set currently.
B	Displays the frequency 2 that is set currently.
C	Select the cable model to measure
D	Add or Delete Cable model
E	Setting Velocity, Attenuation
F	Select the count to measure (1,3,5,10) .
G	Displays the progress of measurement
H	Displays the measurement count vs. specified count
I	Displays the frequency to be measured
J	Start button to measure.
K	Stop button to measure
L	Displays a delay value for measured cable
M	Displays a distance for measured cable
N	Goes back to the Field Mode screen.
O	Select to Output PDF file after measurement.



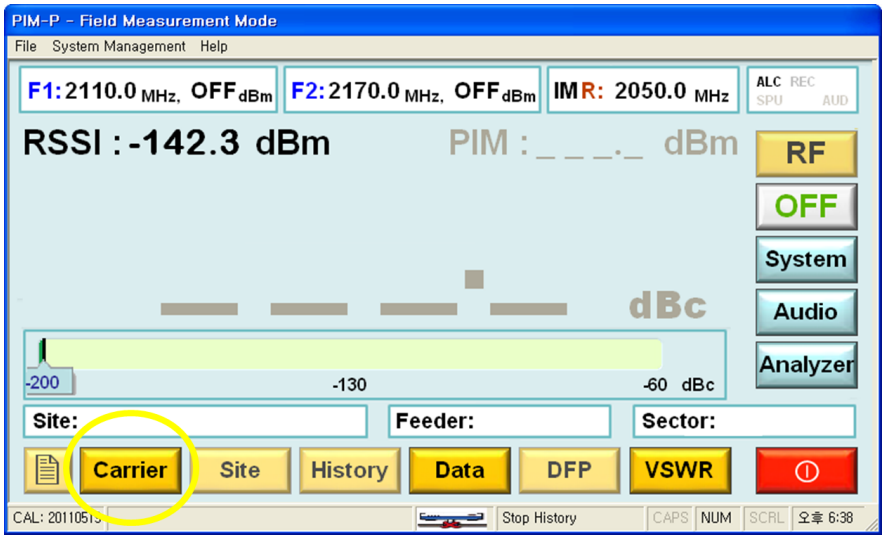
Element	Description / Display
A	Input Cable Name
B	Input Velocity of Propagation
C	Input Attenuation dB/100m
D	Save New Cable Data
E	Cancel

8.3.3 Procedures to measure DFP source

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

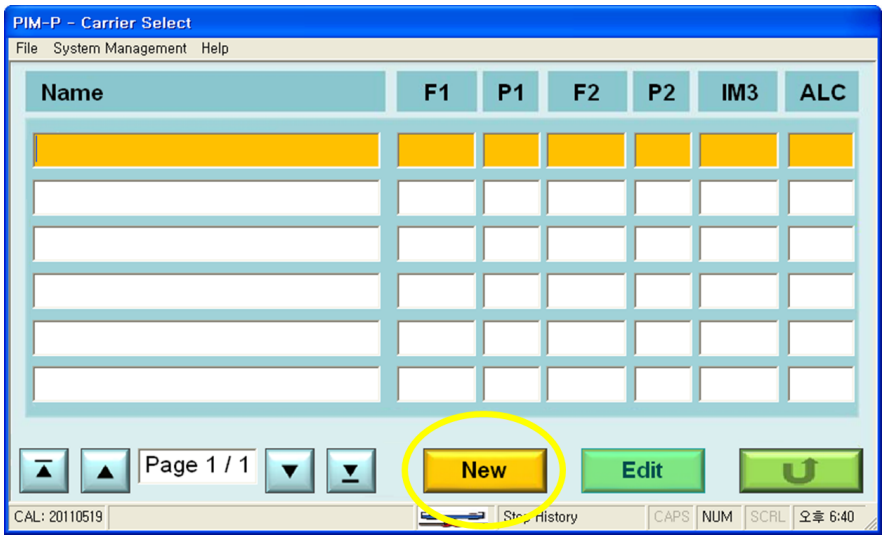
Note: When the PIM value is under -155, the accuracy to identify the distance is reduced. Please pay attention that if the PIM value is above -75 dBc and you try to measure the distance, the module to measure may be damaged and failed.

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



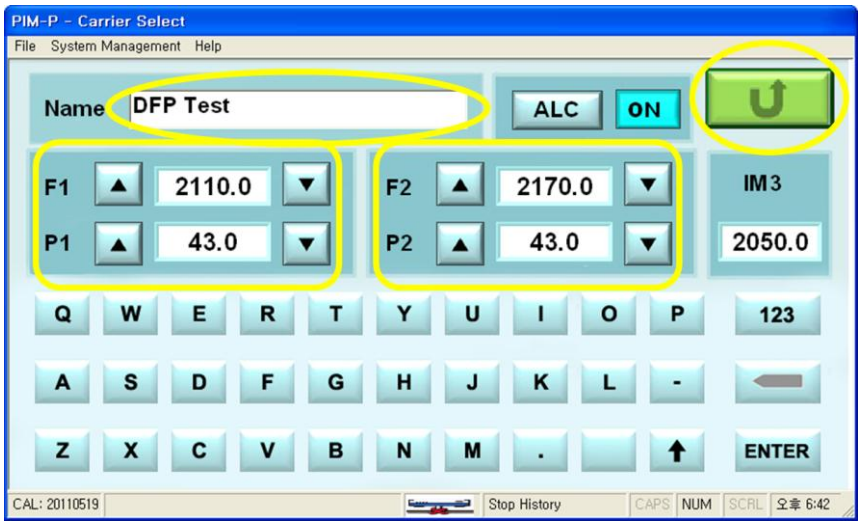
B. In Carrier Select screen, if there is existing data, please select what you want (see the figure in section D).

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).

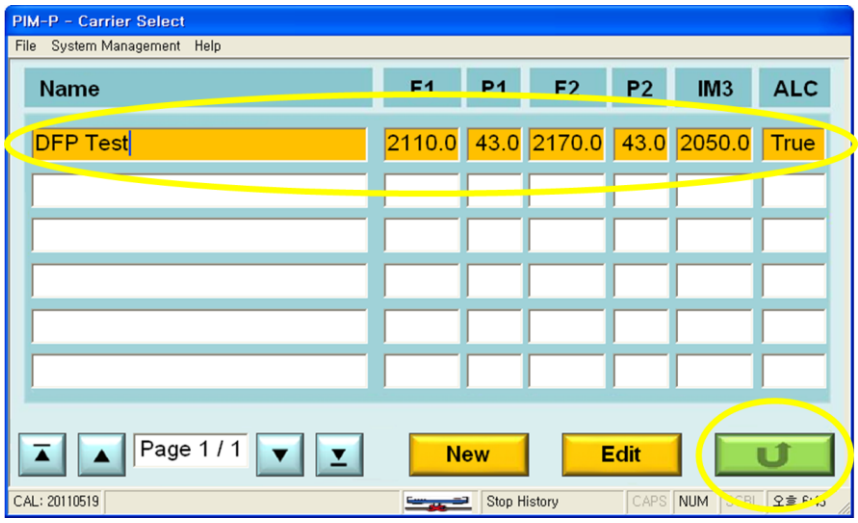
Enter a frequency and output power for Tx1 and Tx2 (respectively F1/P1 and F2/P2). When F1 and F2 is entered, the IM frequency is calculated and displayed internally so you don't need to enter it separately. ACL stands for Auto Level Control and maintain the output power as setting value (Please keep 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.

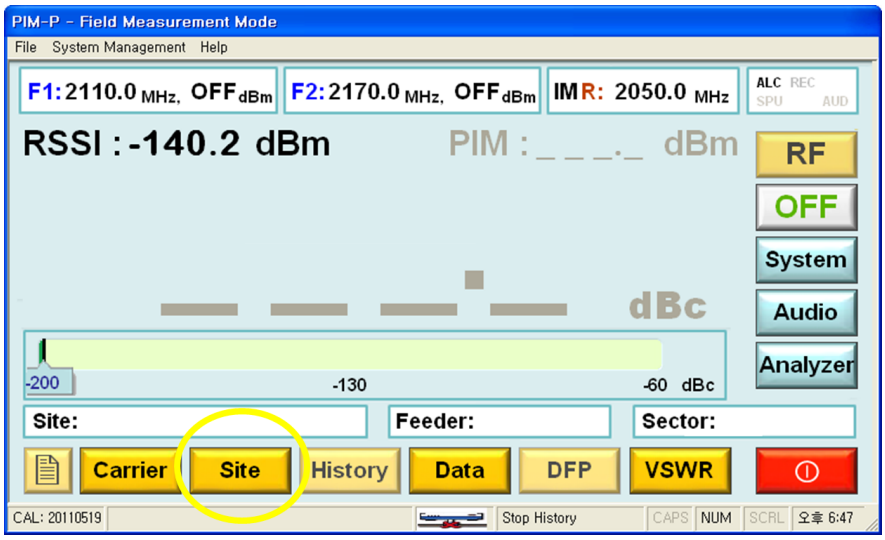
In the list, when you select the Carrier, the background color is changed to yellow and indicates it was selected.

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

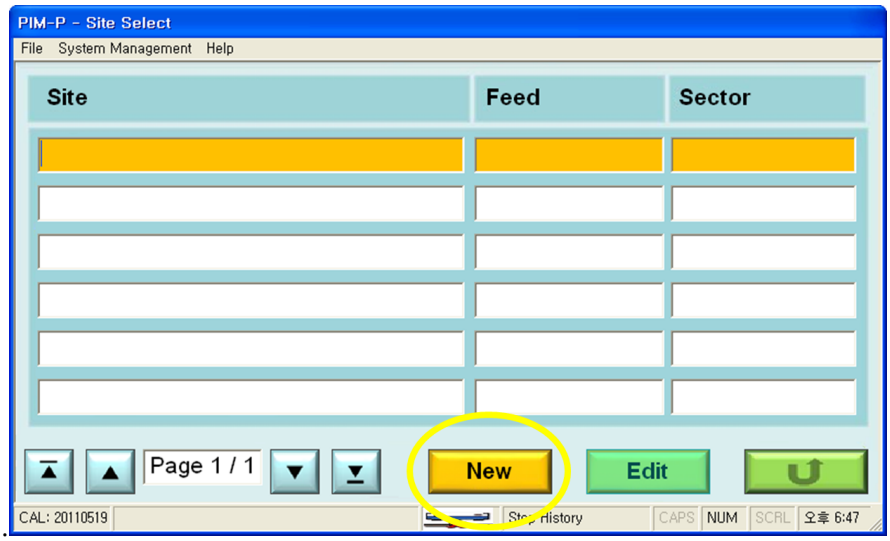


E. You can see the Site button enabled when you select a Carrier.

Push Site button and go to Site Select screen.

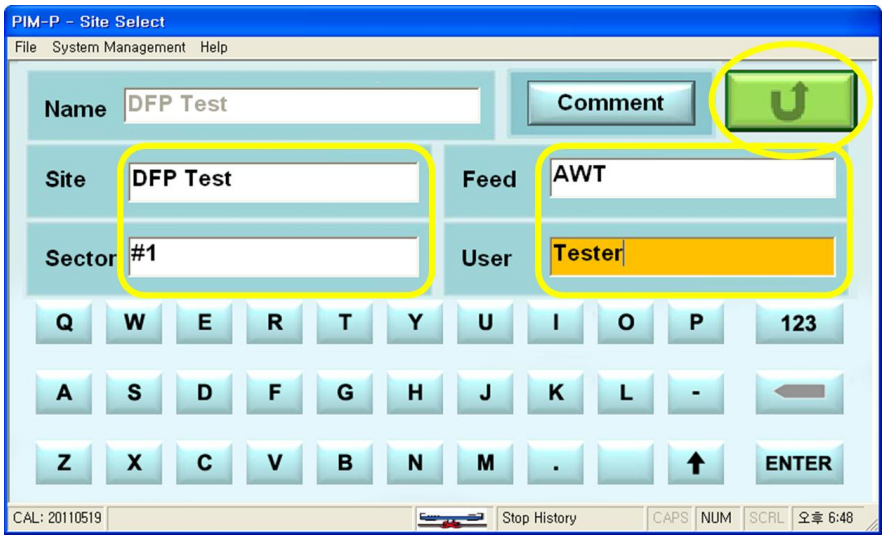


F. In Site Select screen, if there is existing data, please select what you want (see the figure in section H). If there is no data, push New button to create a Site, then an input screen for the site is displayed.



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

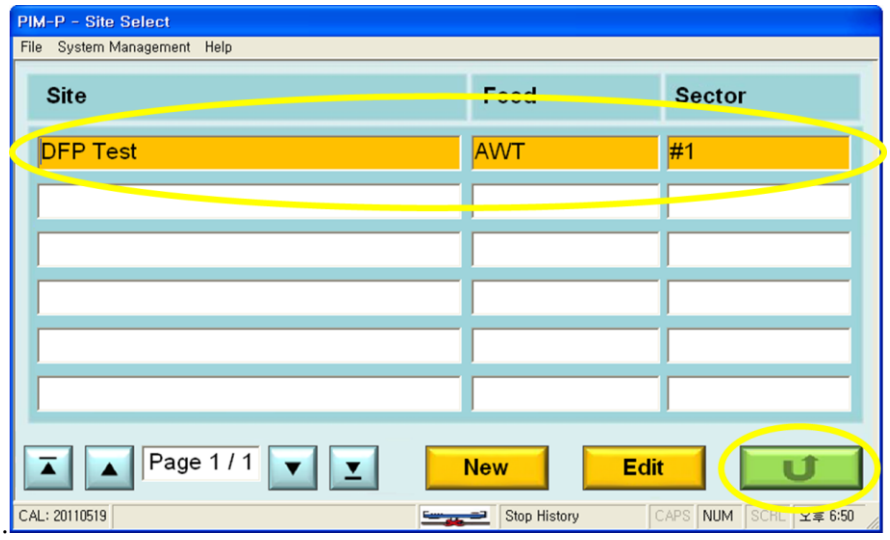
When completed, push Return arrow and return to Site Select screen.



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

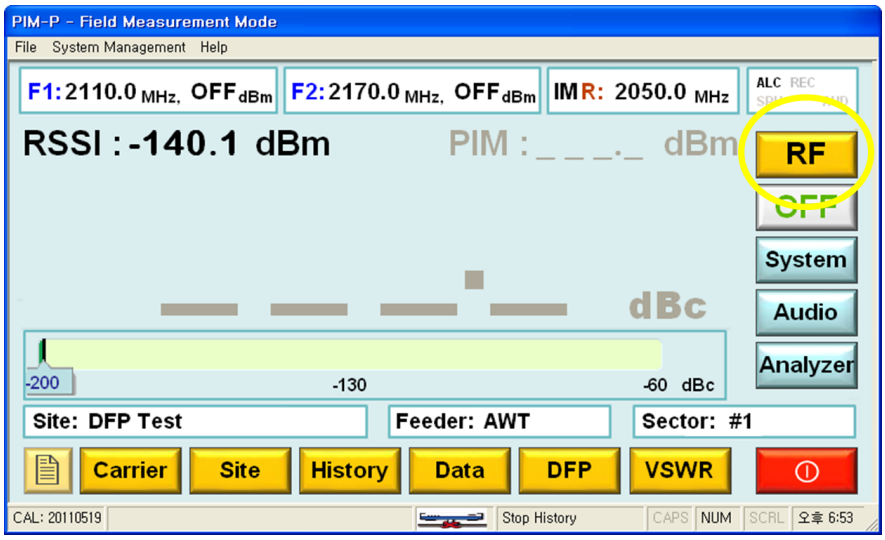
In the list, when you select the Site, the background color is changed to yellow and indicates it was selected.

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

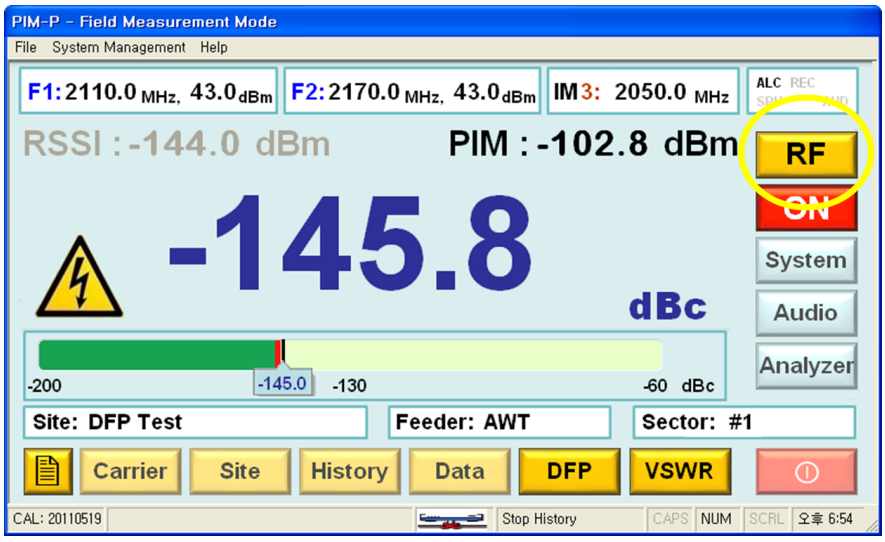


I. You can see Site, Feed, and Sector selected at the bottom in Field Mode screen.

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

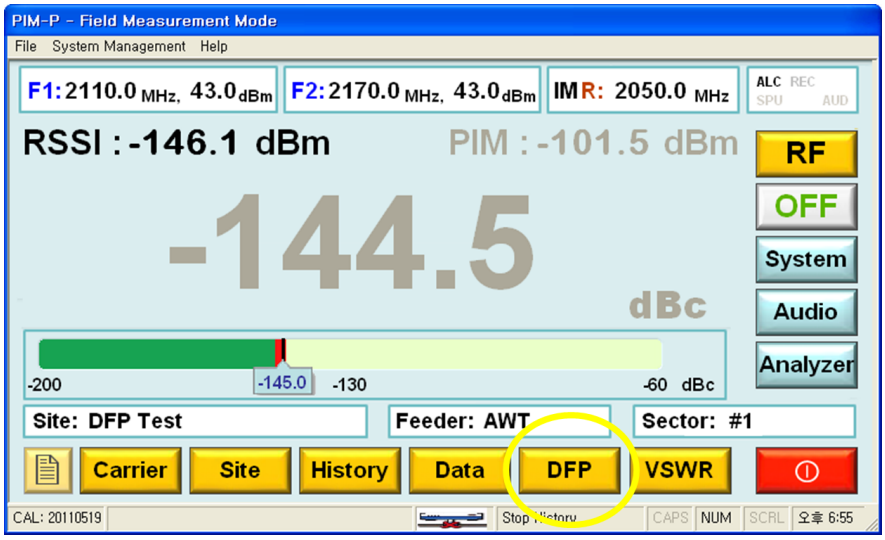


J. IM value is measured and with pushing RF button, please stop the measurement.



2) Measurement of Distance

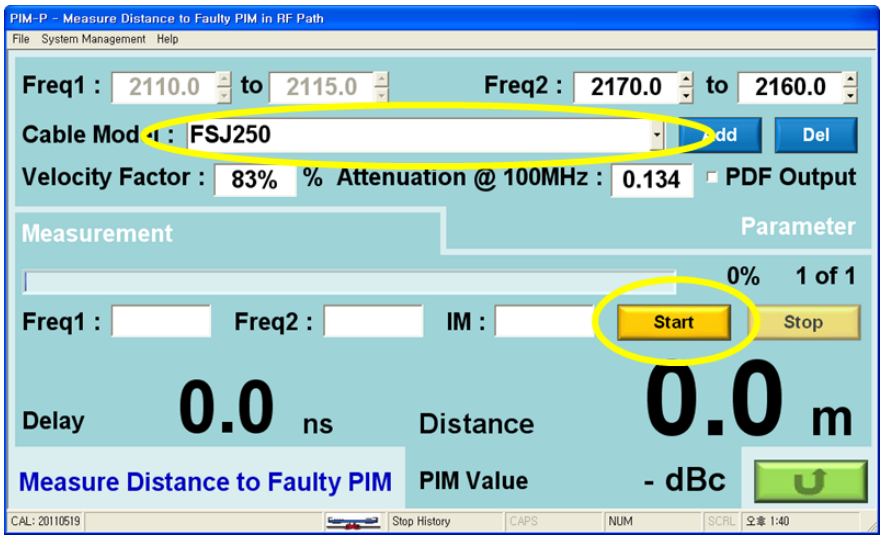
A. Go to a screen called "Measure distance to Faulty PIM in RF path" with pushing DFP button.



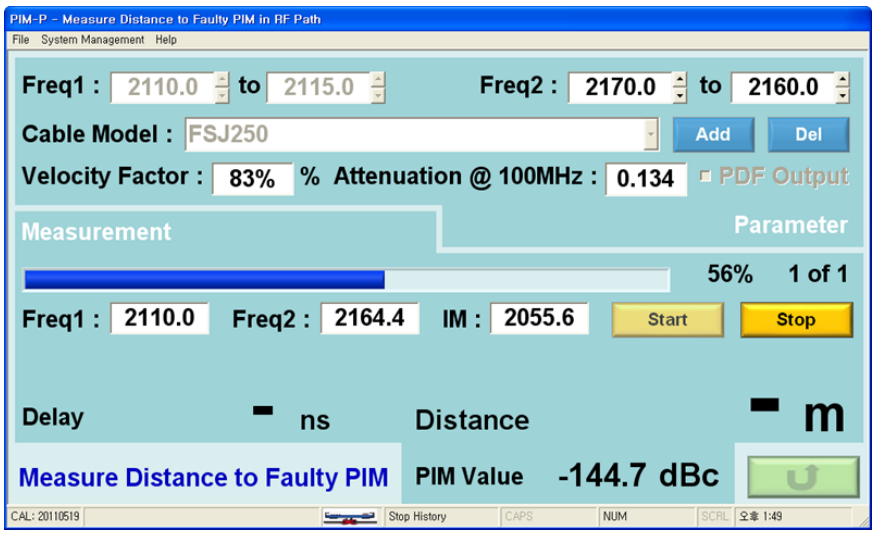
B. Select Measurement Count and Cable Model, push Start button.

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

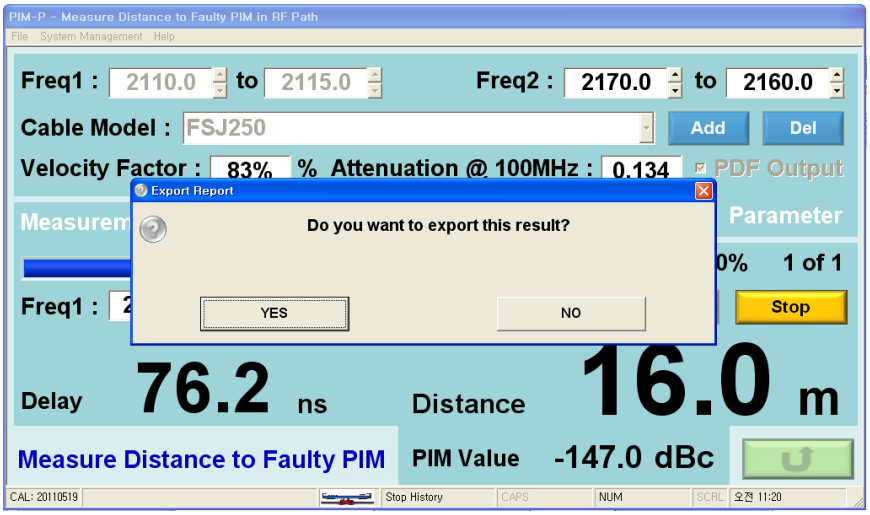
Cable Model is to refer to the Velocity data for the cable to be measured and can impact on the distance data.



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.

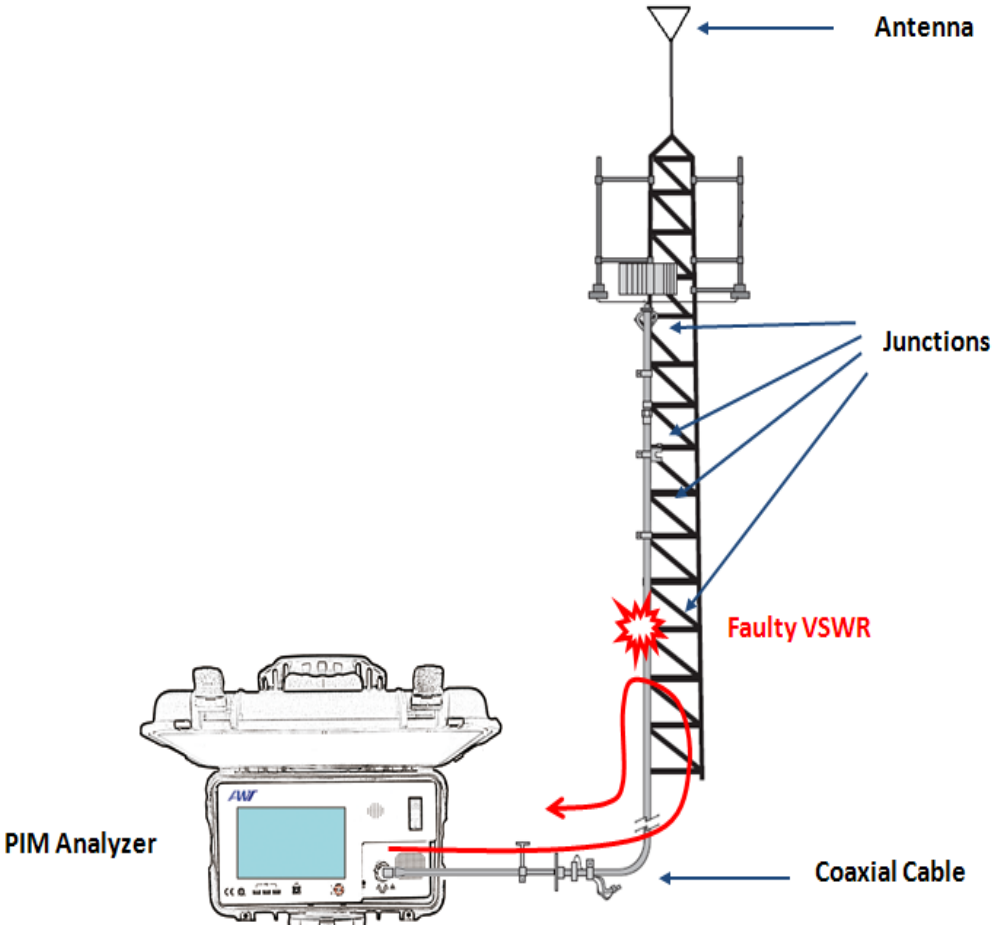


D. When the measurement is completed, the result is displayed on the screen and a prompt appears whether you want to export the result to a PDF file when you checked "PDF output".



8.4 Procedures to measure VLM (VSWR/ Line Monitor)

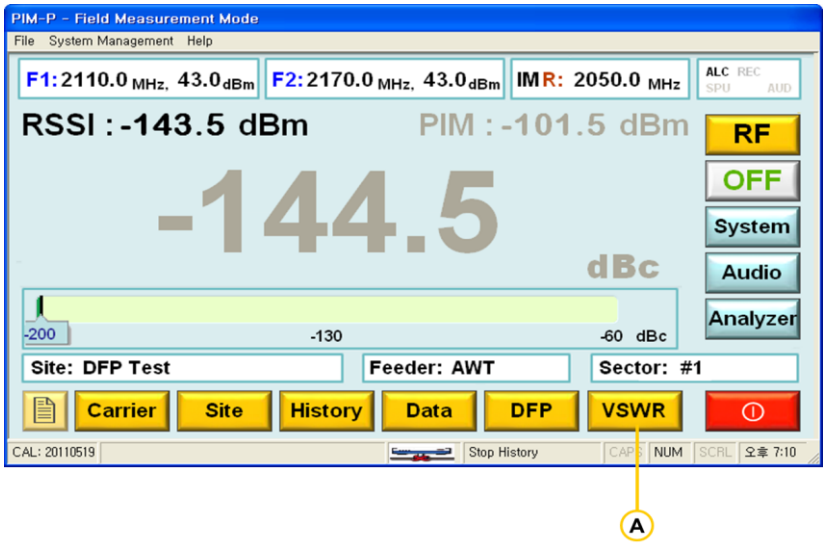
8.4.1 VLM (VSWR/Line Monitor) Setup



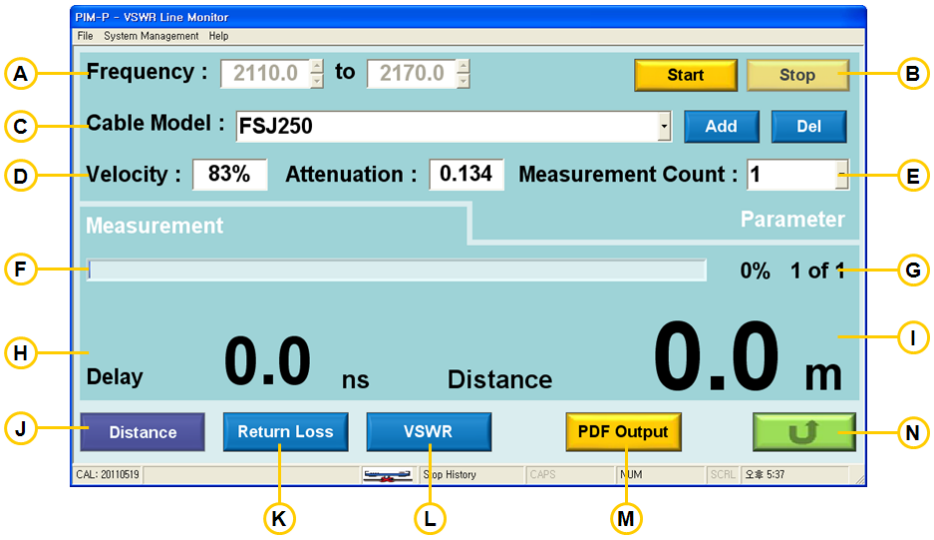
PIMD Analyzer VLM Measurement Setup Diagram

The figure above shows how to setup PIMD Analyzer to measure VLM. At this time, the VLM optional module should be connected at the front side. Each channel of optional module is connected to RF cable from the channel in the front panel.

8.4.2 VLM (VSWR/Line Monitor) Measurement

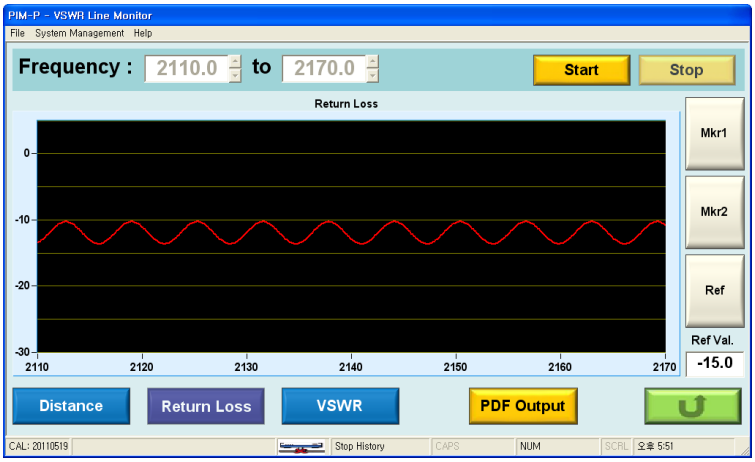


Element	Description / Display
A	Opens the VSWR screen. (It is available only if the equipment is connected)

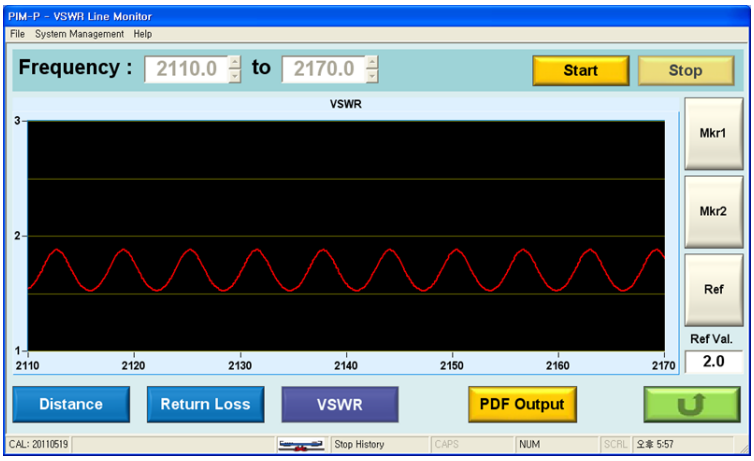


Element	Description / Display
A	Displays a frequency to sweep
B	Start / Stop button to measure
C	Select the cable model to measure
D	Setting Velocity, Attenuation
E	Select a count to measure (1,3,5,10)
F	Displays the progression of measurement
G	Displays the measurement count vs. specified count
H	Displays a delay value for the cable measured
I	Displays the distance for the cable measured

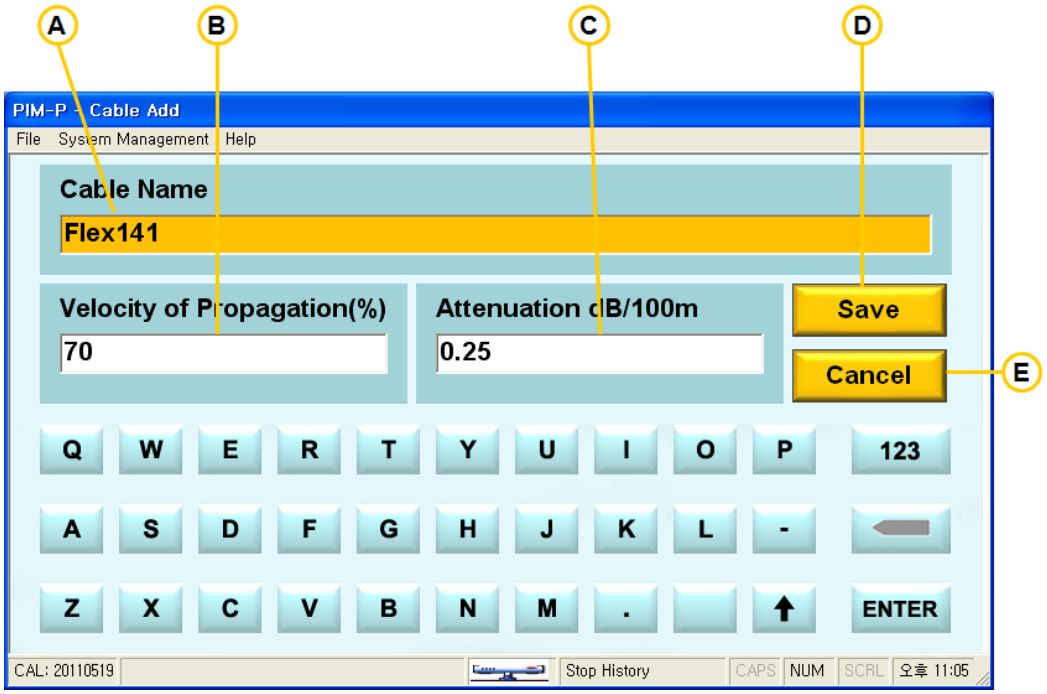
J	Distance for the cable measured.
K	Return loss for the cable measured
L	VSWR for the cable measured
M	Output PDF File
N	Goes back to the Field Mode screen



PIMD Analyzer VLM Return Loss Graph



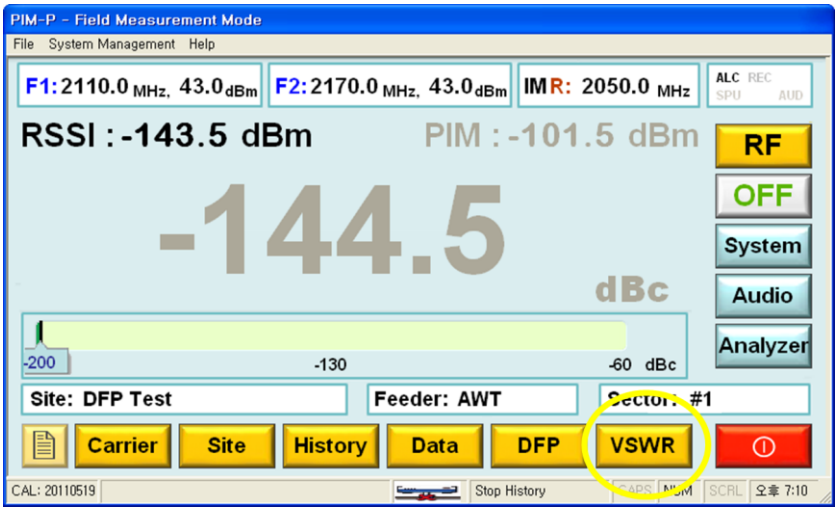
PIMD Analyzer VLM VSWR Graph



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

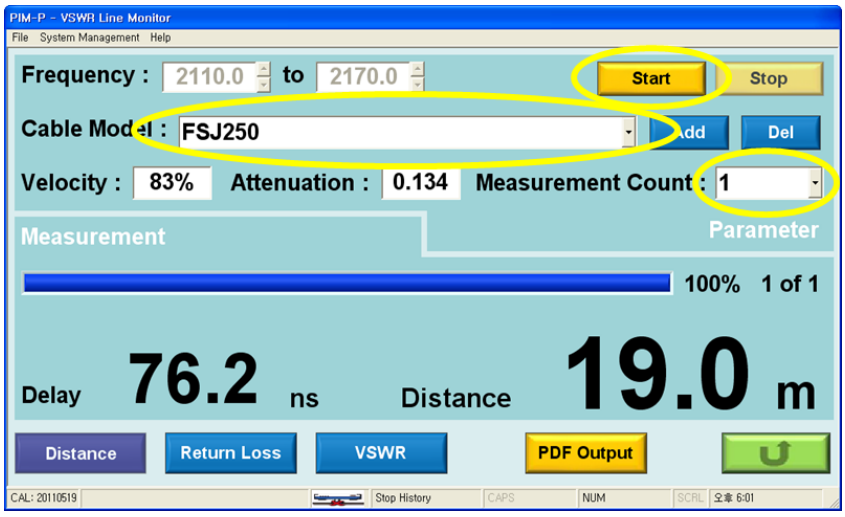
A. Connect a port of VSWR/Line monitor to the output terminal of unit and the cable to measure connection to DUT terminal of VSWR/Line Monitor and then push the VSWR button in Field Measurement Mode.



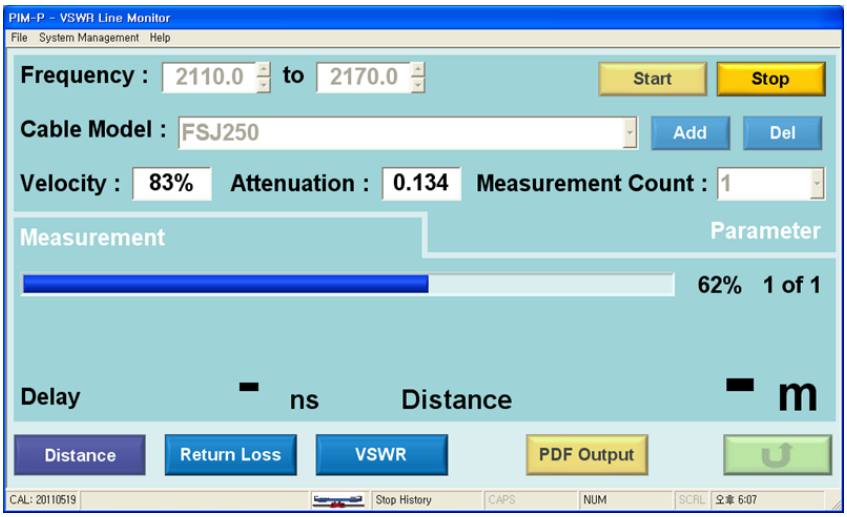
B. Select Measurement Count and Cable Model, push Start button.

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

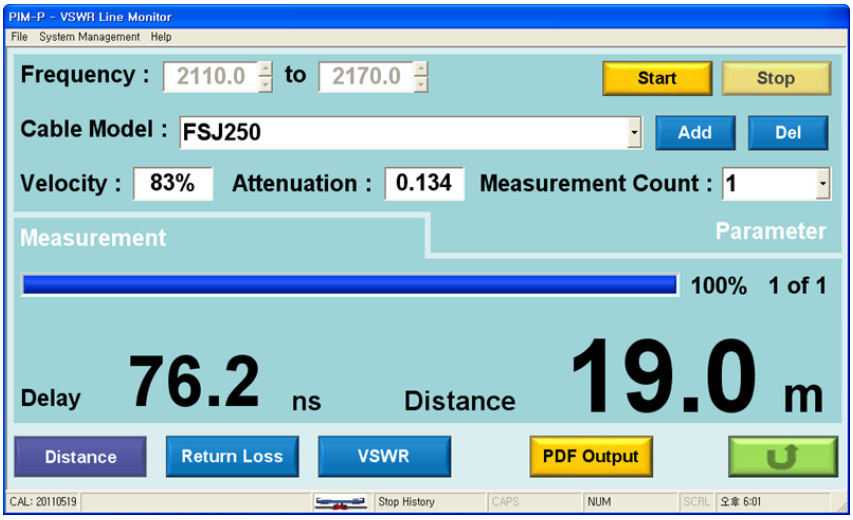
Cable Model is to refer to the Velocity data for the cable to be measured and can impact on the distance data.



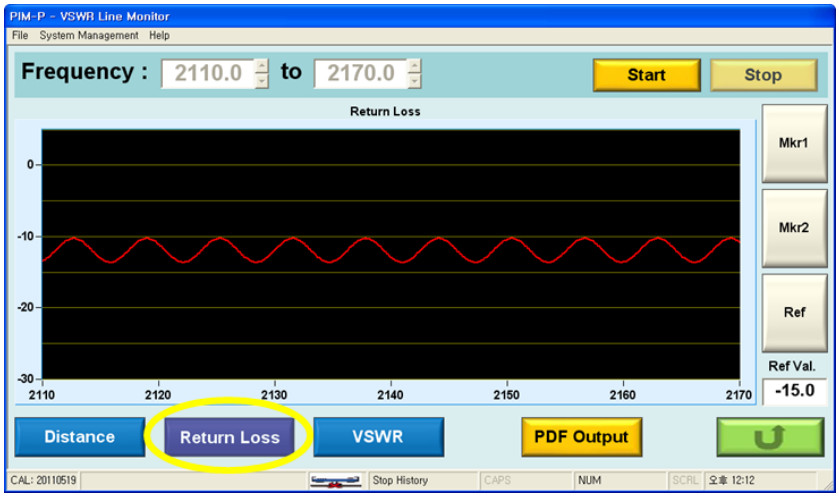
C. During the measurement, the frequency being measured, IM frequency, and the progression status are displayed.
When you push Stop button to stop the measurement, the distance value may not be displayed unless the measurement is more than one.



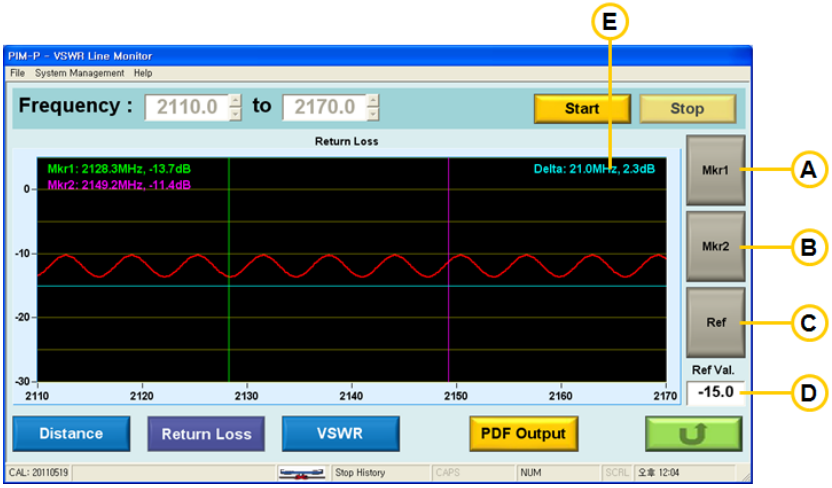
D. When the measurement is completed, the result is displayed on the screen.



E. Push Return Loss button to check Return Loss of frequency measured.

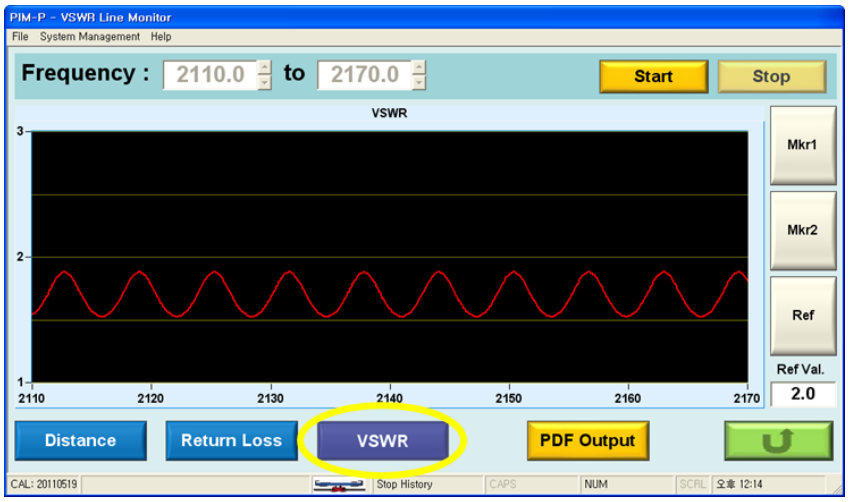


F. Return Loss graph marker function.

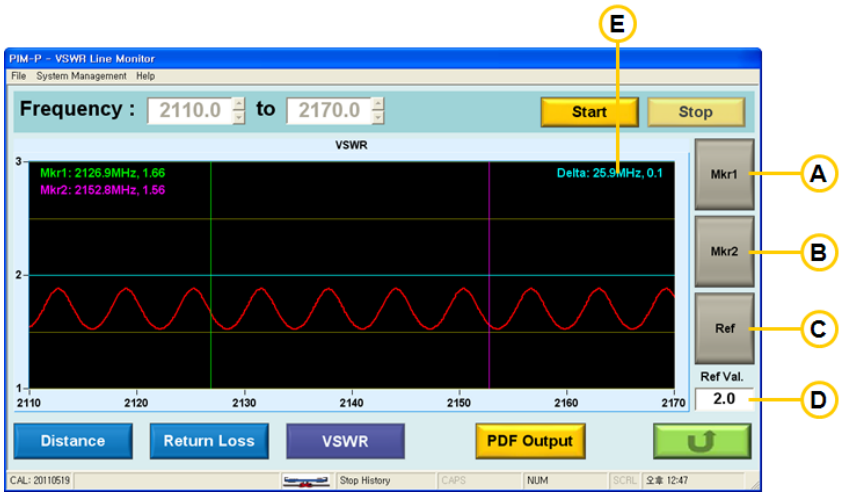


Element	Name	Description / Display
A	Mkr1(Marker 1)	Marker line 1 is vertical green bar. Moves marker line 1 to the worst value and Frequency (or on user's discretion)
B	Mkr2 (Marker 2)	Marker line 2 is vertical pink bar. Moves marker line 2 to the worst value and Frequency (or on user's discretion)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

G. Push VSWR button to check the VSWR of frequency measured.



H. VSWR graph marker function.



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

9 Pull Down Menu

Pull down Menus offer additional features and allow users to set some system parameters. They allow also performing a self-test of the PIM-P 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		O
Stop History Save		O
Screen Capture	O	O
Initialize Program		O
Quit	O	O
System Management		
Self-Test	O	O
PIMD Management		O
Connection Check*		
Help		
Contact Information	O	O

*Connection Check is for factory use only.

9.1 File

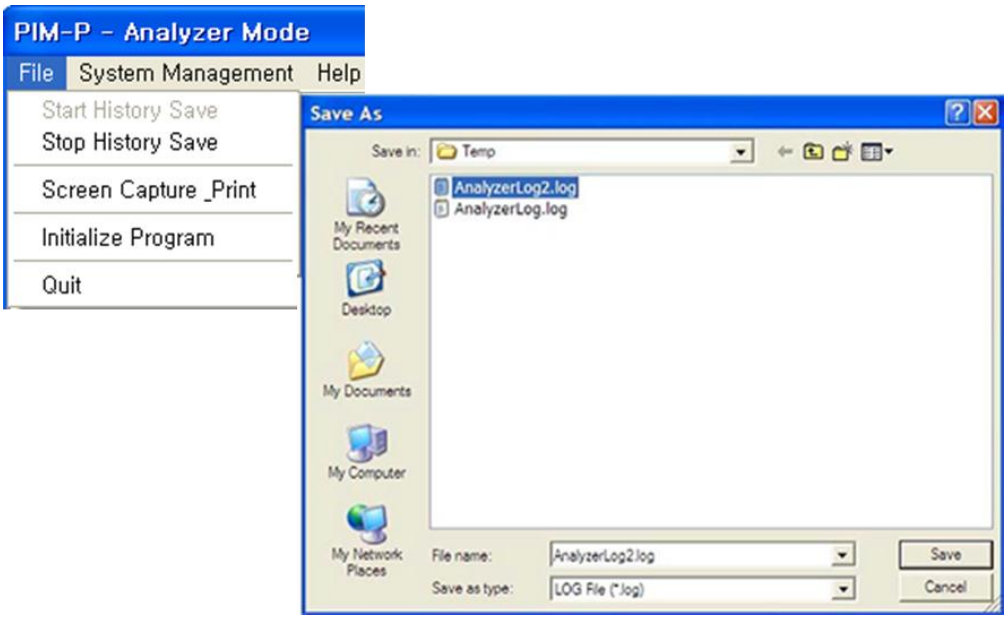
9.1.1 Start / Stop History Save

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.

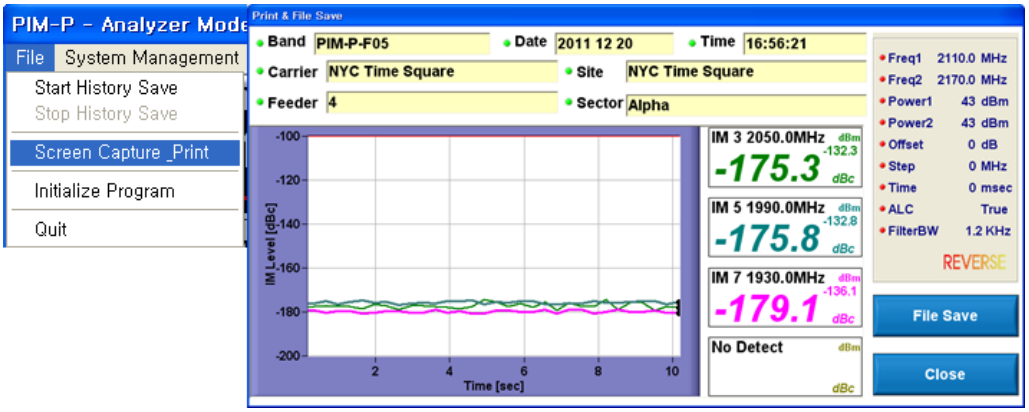
Note: PIM-P does not support Offset, Measure Mode/Pass and IM Level/decision. This are reserved for other test systems. The log data will show a hyphen "-"in these columns. Direction is always reverse for PIM-P Analyzers.

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



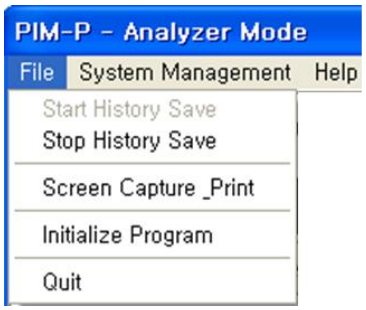
9.1.2 **Screen Capture / Print**

This menu provides capabilities to capture a screen shot from any Graphical Display of the Analyzer 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 pressing the blue save button. The stored file has a size of about 150kB. 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**



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.

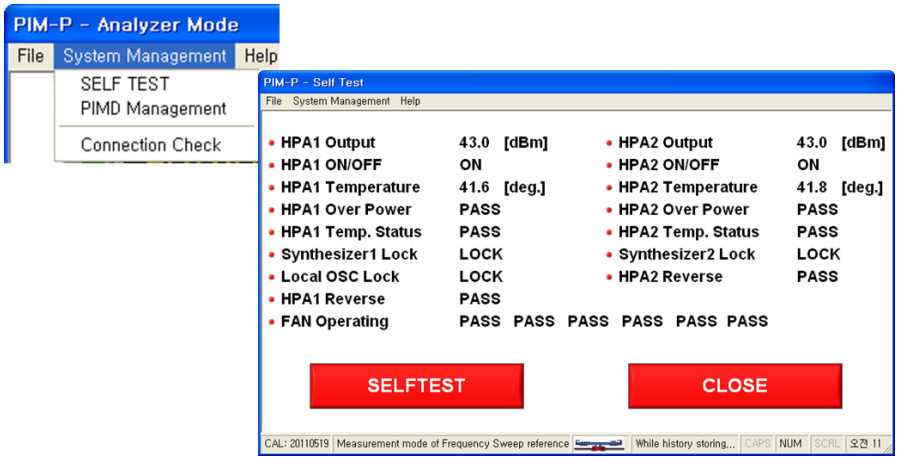
9.1.4 **Quit**

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

9.2 System Management

9.2.1 Self Check

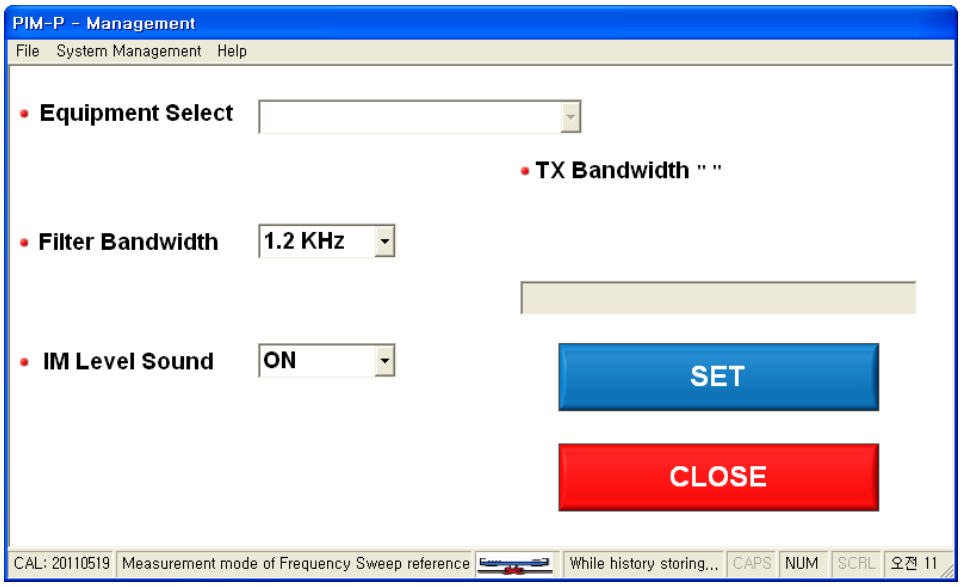
Self check provides information about the PIM-P Analyzer. To allow the self check routine to test all modules, it needs to be performed with **RF Power ON**



Name	Description
HPAx Output	RF Output power level (should be +/- 0.2 dB within the set limits – ALC ON)
HPAx ON/OFF	Status of RF Power (ON/OFF)
HPAx Temperature	Temperature of amplifiers.
HPAx Over Power	Reverse Power
HPAx Temp Status	On Fail (too hot), System will shut down
Synthesizers Lock	Synthesizers of Transmitter and Receiver locked
HPAx Reverse	Reverse PIM measurement blocks status
Local Osc Lock	Local Oscillator functionality
Fan Operating	Operation status of 6 fans

9.2.2 PIMD Management

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



Name	Description
Equipment Selection	Not relevant for PIM-P, since these provide only one frequency band.
Filter Bandwidth	Default 1.2 kHz For further information refer to chapter "System Menu".
IM Level Sound	If ON, sound occurs when PIM level exceeds reference line.
SET	Stores settings
CLOSE	Returns To Analyzer Mode

10 What is PIM?

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.

10.1 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.

10.1.1 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.

10.1.2 Mechanical

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

10.1.3 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.

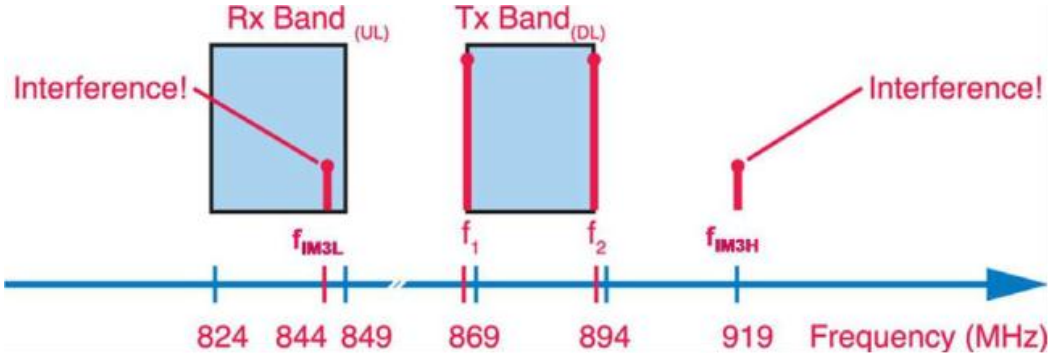
The antenna in the picture shows oxidation within the power divider. Tests with vector analyzer line sweep test would not reveal the problem; however PIM testing detected the issue immediately

10.2 How to test PIM

PIM testing for field applications requires the injection of two CW signals (f1 and f2) 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:

$\mathbf{f_{IM3L} = (2 \times f_1) - f_2}$
$\mathbf{f_{IM3H} = (2 \times f_2) - f_1}$

The picture below shows an example of passive intermodulation. Frequencies f1 (869 MHz) and f2 (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 f1 and f2 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.

11 PIM-P Technical Information

11.1 Tester Types

PIM-P Type	Tx Band	Rx Band	Technology
F01	869-896 MHz	824-851 MHz	CDMA (850)
F02	925-960 MHz	880-915 MHz	E-GSM (900)
F03	1805-1880 MHz	1710-1785 MHz	DCS (1800)
F04	1930-1990 MHz	1850-1910 MHz	PCS (1900)
F05	2110-2170 MHz	1920-2060 MHz	UMTS/WCDMA (2100)
F06	935-960 MHz	890-915 MHz	GSM (900)
F07U	728-759 MHz	776-788 MHz	LTE-US (700-U)
F07L	728-759 MHz	698-716 MHz	LTE-US (700-L)
F07UL	728-759 MHz	776-788 MHz 698-716 MHz	LTE-US (700_UL)
F08	2010-2025 MHz	1900-1920 MHz	TD-SCDMA (2000)
F09	2010-2155 MHz	1710-1755 MHz	AWS
F10	2620-2690 MHz	2500-2570 MHz	IMT-E (2600)
F11	2110-2170 MHz 2300-2390 MHz	1910-1990 MHz	WiBro-KR
F12	390-440 MHz	380-390 MHz	TETRA
F13	420-430 MHz	410-412 MHz	E-TETRA
F14	1488-1520 MHz	1456-1480 MHz	LTE-JP

11.2 Specifications (Data Sheet)

11.2.1 Transmitter Specification

Carrier Power Adjustable Level	+20 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)	1 ppm
Frequency Tuning Lock Time (typical)	1 ms
Reverse Power Protection (Include ON/OFF Function)	43 dBm / 5 sec

11.2.2 Receiver Specifications

Reverse IM	-122 dBm / -165 dBc
Accuracy	±0.35 dB
Average Noise Floor	-140 dBm (300Hz filter)
Dynamic Range (typical) (reference -90 dBm)	96 dB
Measurement Interval	100 to 350 ms
Effective IF Bandwidth (Operator selectable)	300, 600, 1.2k, 2.4k, 5k, 10k, 12k, 15k, 25k, 50kHz
Operational Input Power	- 36 dBm RMS
Input Power without damage	- 15 dBm max
Warm-Up Time for specified accuracy	5 minutes

11.2.3 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

11.2.4 Environmental

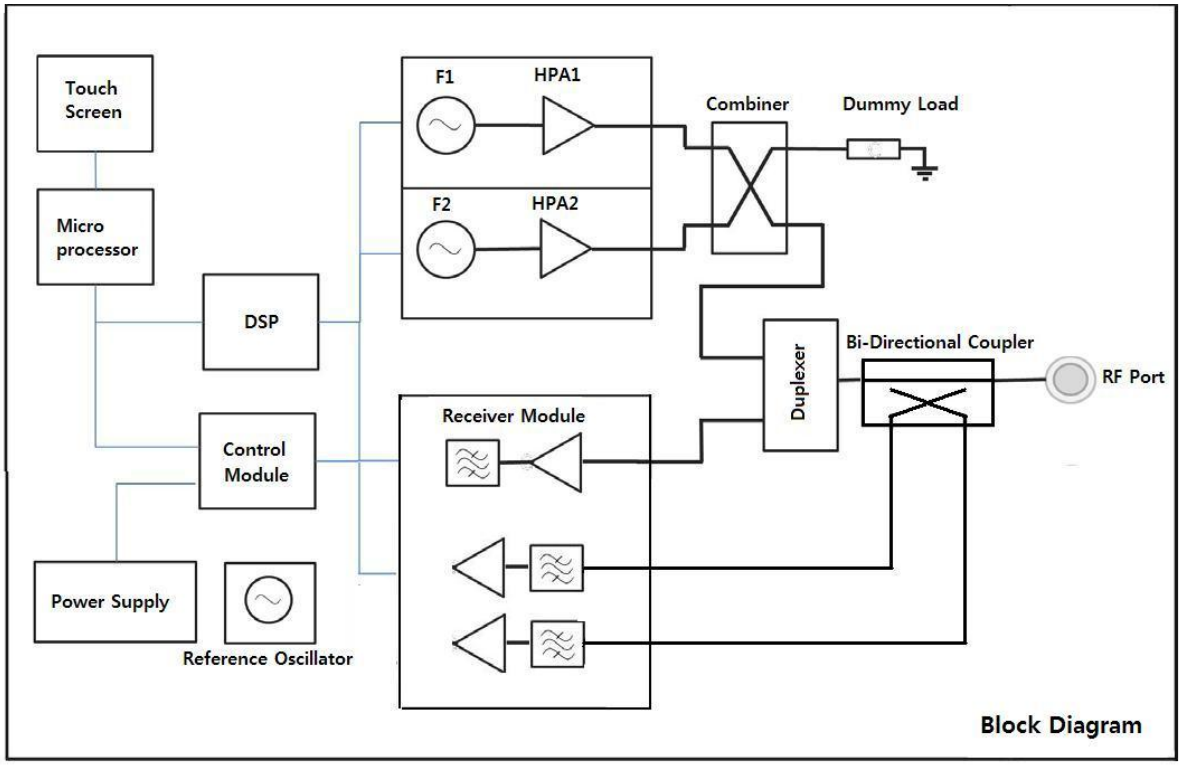
Ingress Protection: IP67 (with Lid closed), IP20 (with Lid open)
Mechanical shock: 40G shock rating
Operating Temperature range: -10° to 40°C (14° to 104°F)
Storage Temperature range: -20° to 60°C (-4° to 140°F)
Humidity (non-condensing): 5% to 95% RH
Max Altitude: 2000 Meters / 6560 ft.

11.2.5 **Dimensions and Weight**

Dimensions (W/D/H)	501.65 x 298.45 x 457.2 (mm) 19.75(L) x 11.75(W) x 18(H) (in)
Weight	27 kg / 59.5 lb 28 kg / 61.7 lb

12 Maintenance

12.1 Block Diagram

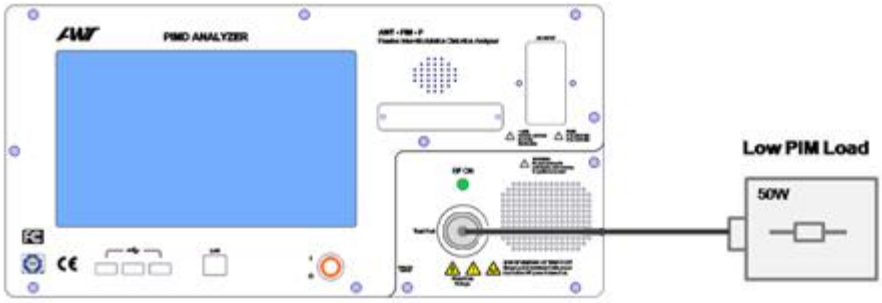


12.2 Performance Check

To maintain maximum performance, it is highly recommended to conduct a basic test of the PIM-P 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:

12.2.1 Testing Analyzer operation status

- Connect the Low PIM Load to a PIM-P Analyzer with torque wrench
- Set PIM-P 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-P to Field Mode
- Since the PIM-P 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

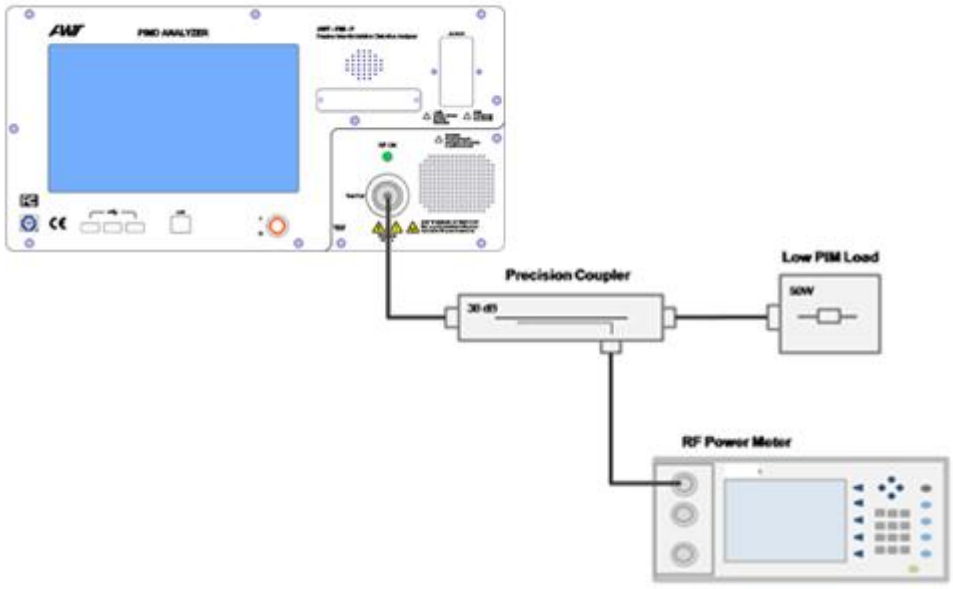
12.3 Performance Verification

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

12.3.1 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-P Analyzer (use torque wrench)
- Set the PIM-P 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-P Analyzer. In this case, contact AWT Service.

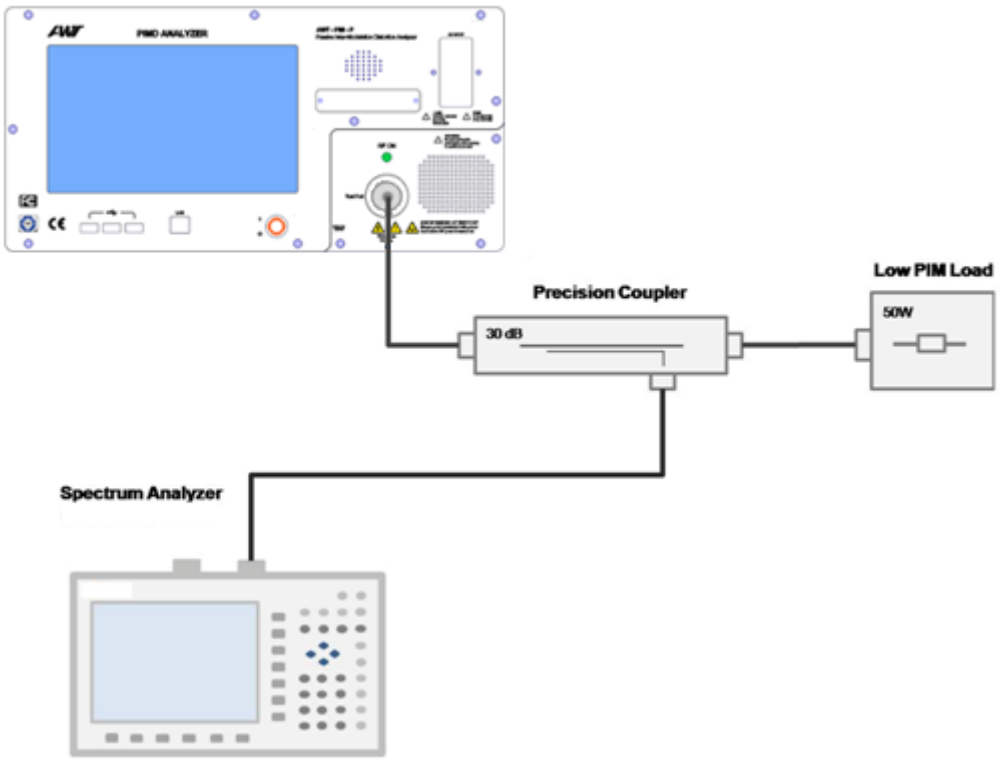
With the reading within limits, continue procedure:

- 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: 46dBm +/- 1.0dB
- **Switch "RF Power OFF**

12.3.2 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-P Analyzer (use torque wrench)
- Set Spectrum Analyzer to proper measurement range
- Set the PIM-P 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-P 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**

12.3.3 Rx Power and Receiving Frequency

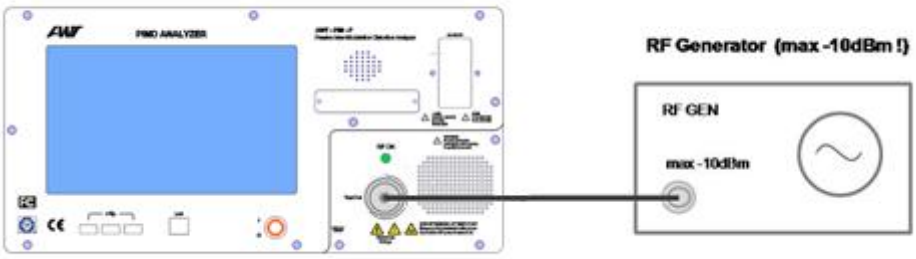
The following measurements have to be executed with utmost care:

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

If the RF output power of the PIM-P 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-P to Field Mode
- Set frequencies of carrier signal 1 and 2 to the start and end frequency of the provided frequency band.
- Set the power level of each signal to 20 dBm (100mW) – with ALC: ON
- Set the Filter bandwidth of the PIM-P to 1.2 kHz (default).
- **To avoid damage, RF Power of the PIM-P must be OFF**
- Set Signal Generator to IM3 frequency.
- Apply signal to PIM-P (-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-P should be lower than -125dBm.

With the reading in limits, continue procedure:

- Increase the PIM-P 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-P; 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-P 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-P; 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-P Signal frequencies F1 and F2 back to Start and End frequencies of PIM-P band.
- Set Signal Generator to Frequency that results for IM3 product of frequencies F1 and F2
- Read the RSSI value on PIM-P; 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-P; 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.

13 Accessories

Test Cable for 20W PIM tester 1m (3.3ft) - Low PIM, DIN7/16(m)-DIN7/16(m)	LIC-3000-160S
Load 50W - Low PIM, DIN7/16 (m) - DIN7/16(f)	LIT-700-2500G
PIM Source for 20W PIM tester - through technology (requires termination load)	PIS-CP35D

Appendix

Appendix A

Warranty Statement

ACEWAVETCH Co., Ltd. (hereafter "AWT") warrants the PIM-P 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.

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 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

TÜV SÜD 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

TÜV SÜD 345930

Date, 2009-10-21

CE 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.

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

NRTL Declaration of Conformity

KAT - CERTIFICADO - CERTIFICAT

TÜV SÜD 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: TÜV PRODUCT SERVICE NRTL C US

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

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William P. Weller

TÜV SÜD 396649

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

Appendix C

Lid Hold

Lid Release

Foot

Contact

Consult the following contact for the technical support as needed.

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2001 Route 46
Waterview Plaza, Suite 310
Parsippany, NJ 07054
Telephone: +1 (973) 321-3423
Fax: +1 (973) 402-8912

info@awt-global.com

www.awt-global.com