Protect Your Investment

A Technical Guide to Selecting the Best Instrument for Your Testing Needs.

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INTRODUCTION

Since 2018, there has been a frenzied deployment of 5G infrastructure across the United States. The deployments have not slowed down even during COVID-19. In addition to 5G deployments, there has been steady growth in in-building and venue deployments of DAS with 4G/5G Infrastructure.

Telecom infrastructure relies heavily on various forms of transmission lines whether it is coaxial or fiber optic cable. This infrastructure requires extensive testing to meet rigorous testing standards required by today's wireless technology. ECSite supports time-saving automation for all transmission line testing today, such as return loss testing, distance to fault (DTF), passive intermodulation testing (PIM), and fiber optic OTDR testing.

There are a total of 382 unique sweep and PIM instruments in the last 18 months that have been used by technicians that used ECSite software. The instruments described in this guide are based on real-world field experiences and data from ECSite users.

These instruments cost anywhere from $5K to $50K per instrument – it is therefore important to make investment decisions on the purchase or rental of these instruments based on various factors such as current market needs, future needs, availability of trained technicians on the instrument, performance and price.

In this guide, we compare various aspects of instruments commonly used in the DAS and oDAS (outdoor small cell) industry. In a future guide we will cover other applications such as macro-sites, public safety, outside plant (OSP), and other RF and fiber instruments.

While there are many instruments in the market that perform similar functions, this guide only includes the instruments that were used by ECSite customers.

We hope that this guide is helpful in making the decision on which testing instruments are the best investment for your company—now and into the future.

If you have any questions, please contact us.

Sincerely,
Subbu Meiyappan - ECSite CEO
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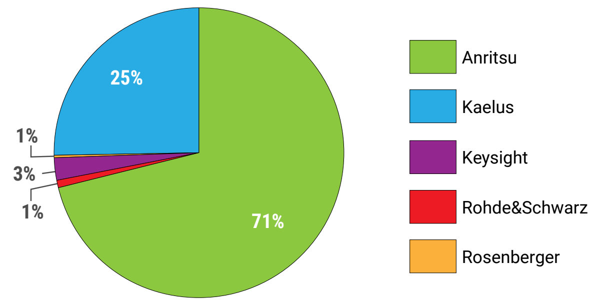
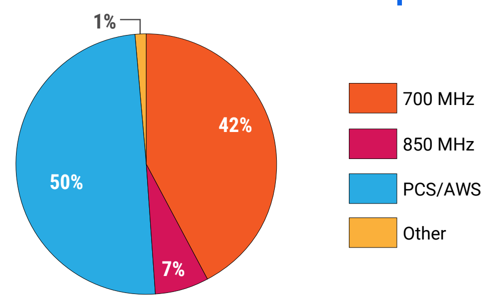
Most-Used Sweep Instrument by Manufacturer

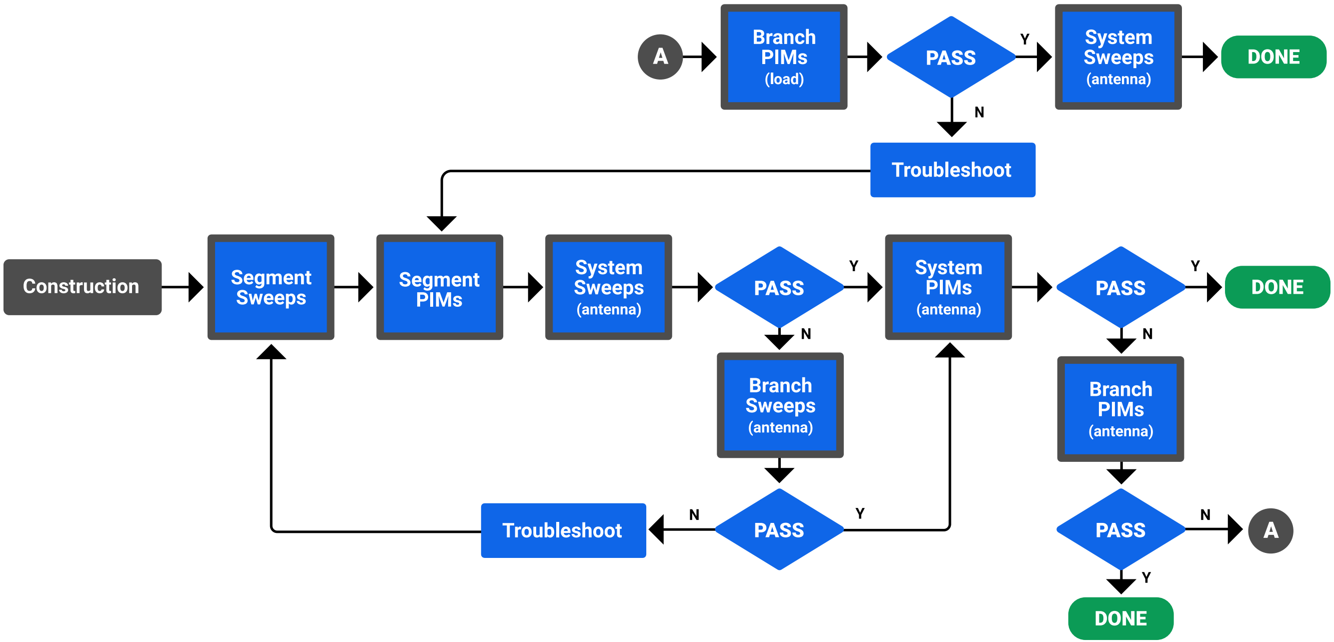


Most-Common PIM Test Frequencies



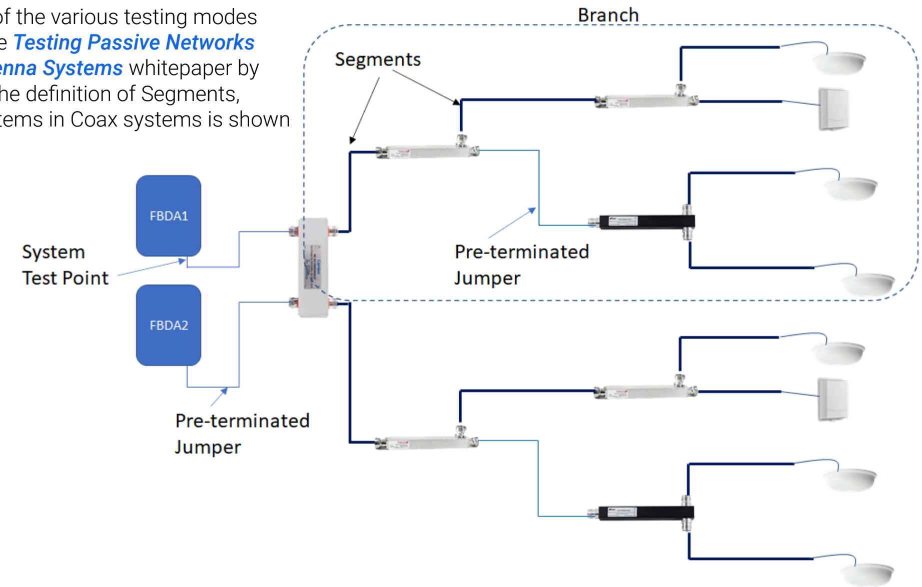
SWEEP TESTING

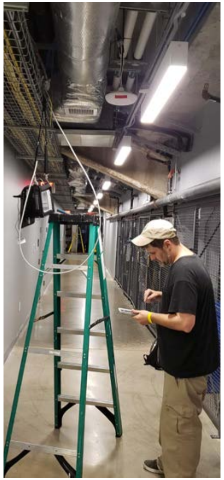
Coaxial cables cut to length and field-terminated with appropriate connectors are used extensively in Distributed Antenna Systems (DAS), small cells, and macros. The cables along with connectors, once in place, will have to be tested for their RF performance; measuring distance, reflection, and non-linear harmonics. To verify their construction and RF performance, various types of testing are performed such as cable sweep (segments), segment PIMs, branch sweeps/PIMs, Systems sweeps/PIMs. The most common sequence of RF test steps in systems involving coax cables are shown in figure below:



SWEEP TESTING

A detailed review of the various testing modes can be found in the ***Testing Passive Networks in Distributed Antenna Systems*** whitepaper by Rohde Schwarz. The definition of Segments, Branches and Systems in Coax systems is shown in this figure:





Coax testing starts with line sweep testing because PIM test results are irrelevant unless accompanied by comprehensive line sweep tests. While PIM performance can be independent of return loss, performing a return loss test prior to PIM testing can eliminate connectorization-related issues. Unfortunately, it has become increasingly common for some to take advantage of poor line sweep performance in order to pass a PIM test.

The RF performance tests include a return loss (RL) measurement and a Distance To Fault (DTF) measurement. While these measurements can be done accurately using a 2-port Vector Network Analyzer (VNA), it is impractical to perform a two-port measurement in the field (the two ends of the cable may be in different floors).

The industry standardized on performing a one-port measurement (S11 or S22 measurement in network-analyzer parlance). The field instruments described in this guide perform one port measurements—i.e. a signal source is used at one end and a measure of the reflected power from the other end determines the performance of the cable and/or antenna system.

A return loss test measures the power transfer efficiency of the component under test. Typical return loss limits of 18dB for segments and 14 dB for systems and branches are used. A table that compares some commonly used return loss limits with the percentage of reflected power and VSWR is shown next.

Return Loss	VSWR	Signal loss in percentage	Power Transferred for a 1W (1000 mw) signal in mW	Power Transferred for a 30dBm (1W) signal in dBm	Comments
18	1.288:1	1.584%	984.16	29.93	Segment RL
17	1.329:1	1.99%	980.1	29.91	Segment RL
14	1.5:1	4%	960	29.82	System/Branch RL
11	1.785:1	8%	920	29.63	System Branch RL limited by Antenna VSWR

The table highlights that between 18dB RL versus 17dB RL, there is only a 0.5% of the signal is lost. As a practical example, a 1W (1000mW) signal output (30dBm) with a 18dB return loss would be transferred at 984mW or 29.94 dBm.

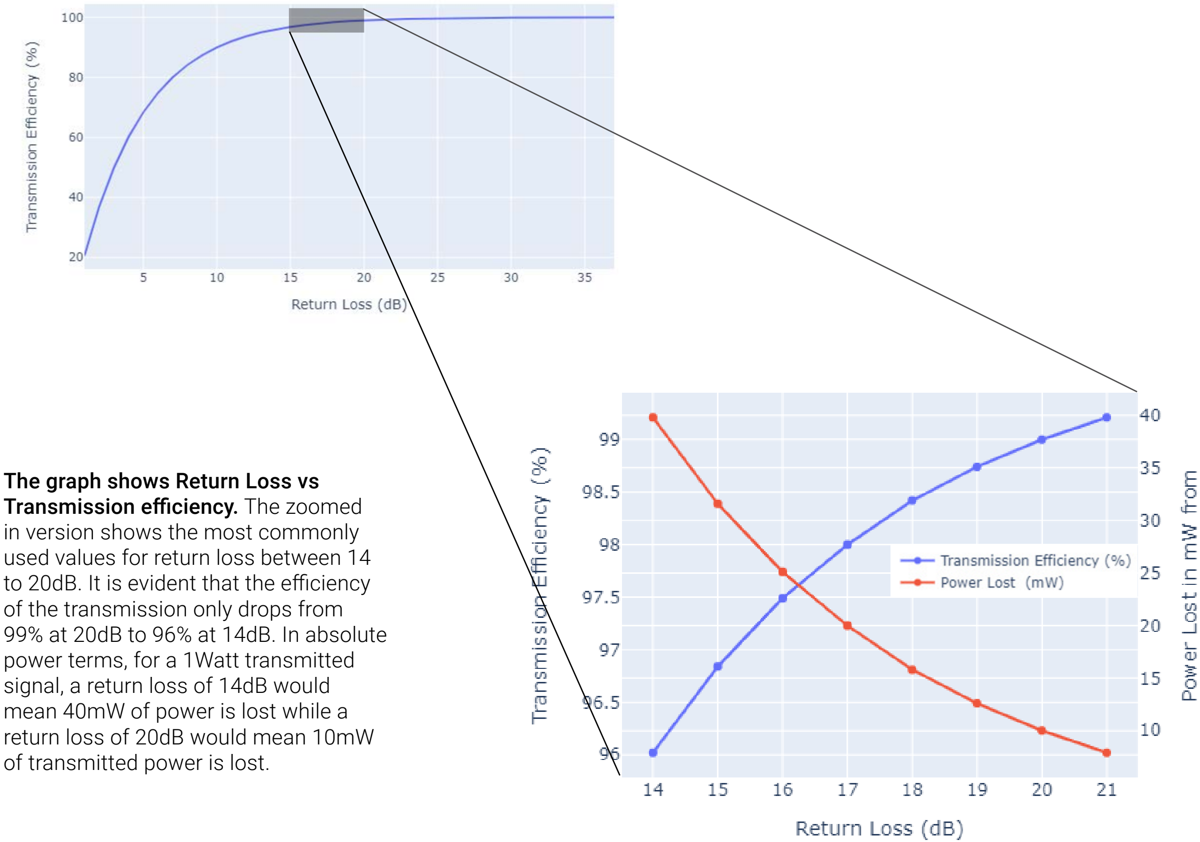
A 17dB return loss means that 29.91 dBm gets transferred. It is beneficial to review the power transfer numbers in context, rather than worrying about a 0.1dB in return loss failures.

For system tests, the return loss is determined and limited by the VSWR of the antennas. Some antennas have a 1.8:1 VSWR and hence the system return loss will be limited to 11dB. For systems with several branches, splitters, and couplers in the path, it may be advisable to perform short branch tests and set the limit lines based on the antenna specs at the end of the branches.

In DAS systems, we often see testing from 600-2700MHz. We are also starting to see some 3500MHz testing (for CBRS deployments) in DAS systems. For small cells, In addition to AWS/PCS bands, we see that CBRS (3500MHz) and LAA bands (~5.8GHz) are tested. Note that all of these tests are done on field terminated coax cables.

Note: *The instruments described in this guide are field-grade and not laboratory grade instruments. If you are looking for a 10th of dB accuracy in the field (or even a 0.25 dB level of consistent accuracy), these instruments may not serve that purpose.*

SWEEP TESTING



The graph shows Return Loss vs Transmission efficiency. The zoomed in version shows the most commonly used values for return loss between 14 to 20dB. It is evident that the efficiency of the transmission only drops from 99% at 20dB to 96% at 14dB. In absolute power terms, for a 1Watt transmitted signal, a return loss of 14dB would mean 40mW of power is lost while a return loss of 20dB would mean 10mW of transmitted power is lost.

Anritsu SiteMaster™ S362E

Analyzer Highlights

- 2-port Transmission Measurement: High/Low Power
- Sweep Speed: 1 msec/data point, typical
- Display : Single or Dual Measurement Touchscreen
- Calibration: OSL, InstaCal, and FlexCal
- Bias Tee: 32 V internal

Due to their early entrance into this market, the Anritsu's SiteMaster™ series are the most commonly used. Several legacy instruments on the market are still being used. The E models have the capability to do 1-port cable/Antenna analysis (essentially, 1-port S-parameter analysis). Optionally, spectrum analysis capability is available through another physical RF port.

The SiteMaster™ series of instruments offer good performance for the price. The SiteMaster™ class of instruments requires periodic calibration in the field (every 5 degree temperature change may require that you re-calibrate the instrument). The calibration, typically done in the field using an Open-Short-Load (OSL) can be done in standard CAL mode (specific to a frequency range) or in flex-cal mode (across a wide frequency range with negligible loss in accuracy). Calibrated settings can be saved so the calibration doesn't have to be redone when changing distance/frequency/cable, etc.

The flex-cal mode is widely used in DAS applications where hundreds of cables need to be tested and the test frequency ranges have to be changed often. In particular cases where there has been 0.1dB of failure, switching to standard CAL for that specific frequency band, has, in some cases, help fix the failures.

The standard instrument does not come with an Ethernet port. It has to be purchased as an additional hardware option. The instrument weighs around 8.2lbs and technicians may find it heavy to carry over extended periods of time. This especially comes into play when performing CW testing, hunting for the max signal power and when hunting for external PIM sources.

While some combined instruments like the BTS Master MT8220T with spectrum analyzer, base station analyzer, and a cable and antenna analyzer are available, the cable analyzer has a limitation of 551 data points which can limit the length of the cable measurement to < 200 feet when performing DTF tests.

Analyzer Highlights

- Directly measure insertion loss and isolation when using multiple iVAs. Measure calculated insertion loss with a single iVA and an RF short
- Accurately measure swept VSWR/return loss and Distance-to-Fault in RF path
- Bluetooth connection to a tablet PC or connect with USB or Bluetooth to a laptop computer
- Connect directly to the device under test; eliminates the need for a phase stable cable in most cases
- Uses the Kaelus iPA reporting workflow & tagging features to facilitate a faster, simpler and more efficient workflow
- Spectrum Monitor mode for interference checking

The Kaelus iVA Cable & Antenna Analyzer allows Sweep testing in RF Infrastructure. The instrument is small, robust, ergonomically designed, and is Bluetooth controlled making the ideal choice for DAS system testing, spectrum analysis, and external PIM finding.

It is well designed to work in challenging DAS jobs where you have a small crawl space to access terminations. Its light weight means that you may not need an additional phase stable cable and can be connected directly to the cable/antenna/device under test. It is remotely controlled through an app running on phone/tablet.

The test times are fast since most of the analysis is done in the mobile app. Having access to the raw data in the app enables several post-processing capabilities. ECSite partnered with Kaelus to integrate their SDK into ECSite software for seamless user experience.

Our users have had the best experience and the most expedient testing when an iVA is used in DAS jobs. Kaelus also requires in-field calibration through OSL and is not very temperature sensitive.

The use of an iVA with ECSite software for DAS jobs, consistently saves over 30% of the time in the field.

An iVA can last for about 8 hours of continuous use in the field on a single charge. The frequency range of an iVA is 560-2750MHz. The capabilities to test CBRS (3.5GHz) and LAA (5.8GHz) is soon to be available in the market.

Use of iVA in a DAS job.

Keysight FieldFox

Analyzer Highlights

- Expand capabilities with optional T/R VNA, spectrum analyzer, built-in power meter, and more
- Save time by measuring RL and DTF simultaneously in the same sweep
- Calibrate simply in the field with QuickCal
- Easily measure average and pulse power with a USB power sensor
- Lightest, all-in-one analyzer at only 6.2 lb. (2.8 kg)

Keysight (formerly Agilent/HP) FieldFox is the best in class instrument due to its performance levels and approaching near lab-grade quality in the field.

A main advantage of the FieldFox is that it comes factory calibrated across the temperature range – in that the user does not need to perform OSL calibration. However, if a user connects a phase-stable cable, that cable can be calibrated out as a one-time user/mechanical cal.

It has built-in Ethernet capabilities for remote control and operation. It was designed from the get-go for a very broad frequency test platform and can easily scale up to 50GHz. Through the Ethernet port, remote users experience fast run and capture times.

Similar to other instruments in its class, the Keysight FieldFox supports spectrum analysis capabilities through an additional RF port. Its lightweight and long battery life are a big plus for use in the field.

In a factory test application where 100s of jumpers were tested, the fieldfox with ECSite software proved to be a handy tool due to its fast sweep and response times.

It is built for 5G mmWave testing in the same instrument as it is for the sub 6GHz testing. It supports up to 10001 data points that allows you to narrow-in on specific failure points. In some very long cable applications (leaky coax in tunnels, for example), FieldFox provides the best performance and detail on the traces.

Fieldfox is the only instrument in this category with CAT and SA capabilities that can be upgraded, through key codes, to enable many hardware and software functions including 5G mmWave OTA demods after the purchase of the base unit, thus protecting your investment.

A subsequent white paper will cover some in-depth features of FieldFox.

R&S Cable Rider ZPH

Analyzer Highlights

- Frequency range up to 3 GHz or 4 GHz, upgrade via keycode
- One-port model features: DTF, return loss, VSWR and cable loss measurements
- Two-port model additionally features S21 measurements, spectrum and interference analysis, AM/FM/ASK/FSK demodulation
- Ideal for field use: up to 9-hour battery life, 2.5 kg (5.5 lb), backlit keypad, fast boot time, non-reflective display, small form factor, ruggedized housing (IP51)

A new entrant in this marketplace – has a good mix of features for the price. Light weight, touchscreen, factory calibrated, long battery life are some of its features that puts it on par with other instruments in the market, but at a reduced price without compromising performance.

While there are other instruments offered by R&S at higher frequencies (like the ZVH), the ZPH is limited to 4GHz at the top end. Having the fastest boot time and fastest sweep time among other instruments, it helps to shorten the measurement time. The very responsive touch screen together with a fast reaction time to inputs, makes it a handy and lightweight solution.

The R&S Cable Rider ZPH has all the essential basic measurement capabilities required for installing and maintaining cable and antenna systems in the field. Its unique features ensure fast and efficient cable and antenna measurements and spectrum analysis.

Two different R&S® ZPH models are available to suit different needs, a pure one-port cable and antenna analyzer and a two-port model with additional spectrum analysis and tracking generator features. The free R&S® MobileView app and R&S®InstrumentView software allows flexible remote controlling the device.

SWEEP INSTRUMENT KEY SPECIFICATIONS COMPARISON

Parameter	Anritsu Site Master S362E	Kaelus iVA-0627A	Keysight FieldFox	Rohde & Schwarz ZPH (.12 model)
Weight	3.7 kg (8.2lbs), fan-cooled	640 g (1.4 lbs)	2.7 (6.2lbs)	5.5lbs, fanless
Display	Touch Screen	External User PC/Laptop/Tablet controlled	LCD with backlit, very bright, viewable in direct sunlight	Touch Screen
Keypad	Yes	No	Yes, backlit keys	Yes, backlit keys
Connectivity	USB, Extra-cost for Ethernet	Bluetooth - With tablet/phone pairing/PC	LAN, USB	LAN, USB
Battery Life	3 hrs	8 Hrs	4 hrs	9 hrs
Calibration	Needs field calibration through OSL	Needs field calibration through OSL	Factory calibration thru temp/ freq range of instrument	Factory calibration thru temp/ freq range of instrument
Frequency (CAT)	2MHz to 6GHz	560 MHz to 2750 MHz	2MHz to 6GHz	2Mhz to 3Ghz or 4Ghz via keycode
RL/DTF Dual Screen plot	Yes	No - Separate Traces/window	Yes	Yes
Speed (CAT)	1ms/point, total 2204 points	4 ms per frequency point	<0.4 ms/point at 1000 points, up to 10001 points	0.3ms/point, 2501 total points
Output Power	0dBm	0 dBm ± 3dBm	+6dBm to -23dBm steps of 1dBm	-3dBm to -30dBm steps of 1dBm (nom)
SA Frequency	100KHz to 6GHz	560MHz to 2750MHz	5kHz to 6 GHz	5khz to 3Ghz or 4Ghz via keycode
Speed (SA)	1.7s	2ms per frequency point	600ms (span: 20MHz, RBW:3kHz, VBW: 3kHz)	–
DANL(SA)	-152 dBm/10 Hz RBW	-120 dBm (Low Power Range selected)	-152 dBm (850MHz, 10 Hz RBW)	<-158dBm, -163 dBm (typical)
Phase Noise (SA)	-100 dBc@10KHz	–	-88dBc@10KHz	<-118 dBc(1Hz), -125dBc (1Hz) typical
Dynamic Range	16dBm , 95dB	90 dB	+18dBm, >96 dB	102 dB
Spur Performance Input related/ SHI	-52dBc to -75dBc	–	-80dBc	–
Operating Range	-10c to +55c	-10c to +55c	-10c to +55c	-20c to +50c
ECSite Use Cases	Sweeps, CW Testing, Grid Testing, PIM Hunting	Sweeps	Sweeps, CW Testing, Grid Testing, PIM Hunting	Sweeps, CW Testing, Grid Testing, PIM Hunting
Price Range	S331E (4GHz model): $7380 S362E (6GHz model with SA): $16,340	$4400	N9912A (4GHz model): $8529, with SA: $12,590	$5380 (4GHz model), with SA $11,335

The nationwide cellular network ecosystem uses a vast array of components, cables, and connectors that generate and route RF signals to antennas. This entire infrastructure is subject to effects due to the environment—think wind, rain, snow, vibration, and aging. Further, there may be effects from less than perfect build quality—poor connectorization, under/over torquing of connectors, excessive cable bend radius, and other construction flaws when the equipment is initially installed and commissioned.

These effects are cumulative and can cause deterioration in the quality of the electrical connections, resulting in nonlinear, diode-like behavior, particularly when dissimilar metals make electrical contact with each other. When multiple closely spaced RF signals pass through these compromised pathways, harmonics may be generated; these harmonics can interfere with the integrity of the network, particularly the receiver's noise threshold. The interference due to such harmonics is known as Passive Intermodulation (PIM). The net result of PIM is loss of capacity and throughput.

The effects of PIM are exacerbated when transmit power is high, since the higher power magnifies the nonlinearity of the diode-like action of the defects in the RF pathway.

It is essential that the presence of PIM in cellular networks is verified and if necessary, corrected. PIM testing requires generating high-power RF tones that mimic the behavior of the network's normal operation, allowing the technician to detect the intermodulation and correct the faulty equipment.

A detailed overview of PIM, its causes and mitigation can be found in ***Understanding PIM article by Anritsu***.

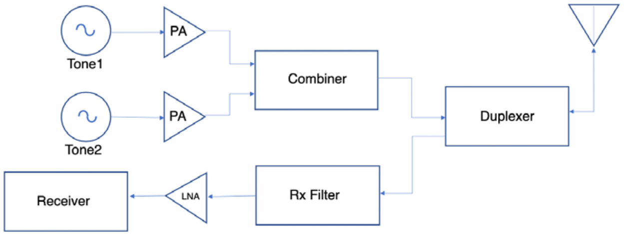
Many technicians wonder why PIM gear cannot be more compact. In order to generate strong intermodulation products that can be measured, the PIM gear is expected to produce two tones at high powers (20W to 40W each). In order to amplify these tones at those power levels, a highly linearized power amplifier—one per tone—is required. The efficiency of these power amplifiers is usually low (between 10-20%).

To produce a tone at 40W, a 10% efficient power amplifier will consume 400W of power with the rest of the power being dissipated as heat. If that heat is not transferred away, the performance of these amplifiers will suffer.

These power amplifiers are typically built with heavy heat-sinks made of metal to conduct the heat away which contribute to the bulkiness of the gear. In addition, it is not possible to build power amplifiers that work across wide frequency ranges between 700-2100MHz, in an efficient manner. Hence we have different devices for different frequencies 700MHz LTE, 850MHz, AWS, PCS etc.

In order to reduce the size of the units and for longer battery life, the industry adopted a *pulsed* mode for the tones. The tones are generated with about 10% duty cycle—most of the time the amplifiers are off so that they don't generate as much heat reducing the size of the heat-sink and the unit. This also helps to significantly extend the time the unit operates on a battery.

A Rohde & Schwarz article ***Comparing CW and Low Duty Cycle PIM Measurements*** further explains this concept.



In DAS systems, we most commonly see 700MHz and AWS/PCS frequencies with the PIM observation on 3rd order intermodulation product (IM3). A typical test procedure would involve segment testing for PIM at 2x43dBm of power for 10-30s, measuring the PIM levels to be better than -110dBm (153dBc) and a system test, for 30-60s, from remote to antennas at the power level of the remote units (2W, 5W, 20W) while measuring the PIM levels to be better than -100dBm.

For lower power systems (2W), -120dBm or better is not an uncommon limit line. In case of PIM failures, a standard debug procedure involves loading off the antennas with a PIM-rated loads and running a test at 2x20W with -110dBm limit lines. In order to isolate the PIM sources, a Distance to PIM measurement (DTP) is also done with and without steel-wool to determine if the PIM source is internal or external to the antenna system.

The DTP measurement is typically done with one fixed tone and the other tone swept across a frequency range. The resolution of the distance is determined by the bandwidth of the spectrum and the propagation velocity of the 'medium'. For example, the minimum resolution of DTP over the air at PCS frequencies is about 4m.

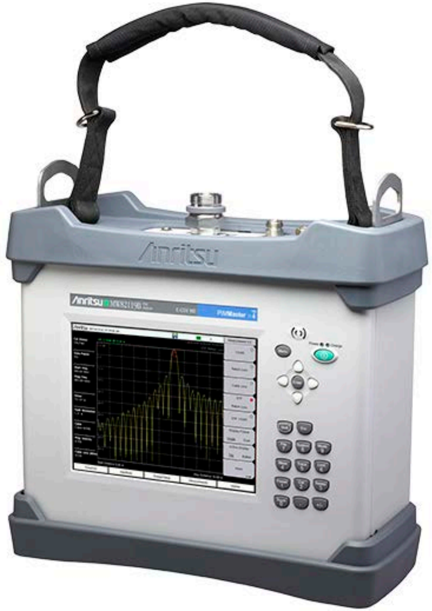
In several in-building installations, system PIM tests through the antennas shows failures in the 700MHz band either due to PIM generating sources in the vicinity or due to interference. It is important to scan the network and perform a noise floor test prior to PIM testing to choose the correct IM3 frequency. For example, we've found in some sites using 703MHz as IM3 works better compared to using 780MHz as IM3. More often than not, this is not a requirement in the MOP, nor even a guideline.

Understanding the RF environment prior to testing will speed up the testing avoiding unnecessary debugging. The users scan and set this IM3 in ECSite prior to testing. In our experience, the RF environment does not seem to change for the duration of the testing (say 2-3 months). In cases where the PIM tests have not been able to pass at acceptable levels, PIM Mitigation techniques such as: i) using absorbent foams behind the antennas; ii) spacing the antenna from the ceiling using an absorbent foam; iii) adding inline attenuators (3dB attenuator, reduces PIM by as much 9dB); iv) removing PIM sources within the near-field of the antenna.

Example setup for DAS jobs:

A typical setup in a DAS job involves both the high band (AWS/PCS) and low band (700MHz) PIM gear with PIM-rated loads. Our recommendation is to limit the PIM loads to 8 per test, beyond which the system needs to be broken up into branches and tested; otherwise, too much time is spent in managing the loads (cleaning, re-terminating etc).

Anritsu PIM Master™ MW82119B



Analyzer Highlights

- RF Component testing
- Antenna testing
- Macro site cable system testing
- Remote Radio Head (RRH) site testing
- Distributed Antenna System (DAS) testing
- 2-port PIM hunting (option 703)

Anritsu PIM gear is the most commonly used PIM gear in the DAS industry – they have different models for different frequency bands.

It has an Ethernet port and a way to control/monitor the instrument through a web interface. It typically operates 2x20W, but a 2x40W option recently became available.

The Anritsu PIM gear also has a hardware option to add a cable and antenna analyzer (S331) that can perform sweep testing up to 3GHz. This is ideal for DAS jobs where sweeps and PIMs have to be performed on several cables and systems.

Another handy feature that Anritsu has is integrated Distance to PIM test capabilities without requiring any external accessories.

Anritsu PIM gear, is in general, sensitive to temperature changes and need recalibration in the field with a PIM source and a PIM load.

ECSite app has seen usage of the Anritsu PIM Master instruments in DAS, small cells and macros.

Kaelus iPA and iTA Series

Analyzer Highlights

- Designed with tower climbers in mind
- Fully configurable frequencies, powers and IM products
- Remote control possible with tablet or cell phone
- Touch screen interface
- Spectrum monitor, frequency sweep and time trace modes
- RTF compatible
- Battery powered
- Two models available A Series 0.1 to 20W, B Series 3mW to 20W

Kaelus was the first to introduce portable PIM testing capabilities to be used in the field.

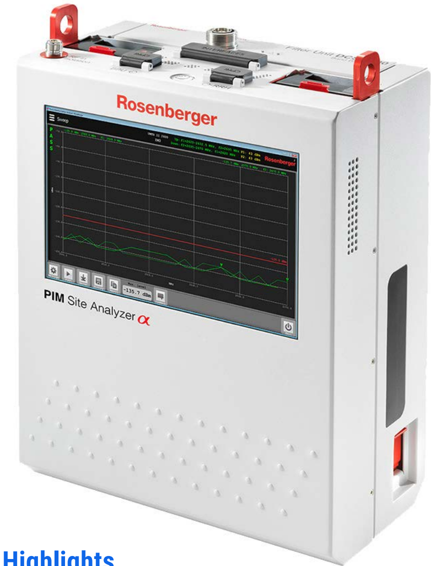
Kaelus offers 40W options for their 600MHz and 700MHz analyzers along with all other bands at the standard 20W Series. The Kaelus PIM analyzers are controlled by an onboard screen and are equipped with built-in Wi-Fi capabilities that allow it to be remote controlled via tablet/smartphone/laptop.

ECSite testing does not report any concern controlling the instrument through a WiFi connection while the testing is conducted. Distance-to-PIM (DTP) measurements are done using the optional external RTF (Range-to-Fault) module. Both the iPA PIM analyzer and the iVA Cable & Antenna analyzer can be controlled simultaneously on one application, using the same tablet/smartphone/laptop.

Kaelus offers the ACE-1000A Calibration Kit for yearly PIM Analyzer Calibrations. Results and yearly calibration certificates for instruments are stored and retrievable from the Kaelus Unify Portal.

ECSite application has seen the use of Kaelus PIM and Sweep analyzers in DAS Systems, Small Cells and Macro Sites.

Rosenberger PIM Site Analyzer



Analyzer Highlights

- Broadband Base Unit 700 - 2700 MHz with field interchangeable, band-specific filter units
- Stressed PIM tests – continuous wave (CW) signal simulates real operating conditions of the base station (in conformity with IEC 62037-1)
- Outstanding PIM performance <-125 dBm (<-130 dBm typ.)
- No on-site calibration
- Accuracy of < 0.3 m for PIM Distance to Fault (DTF) measurement
- Future-proof for upcoming bands
- Hardware ready for later CPRI SW upgrade

Rosenberger's PIM analyzer is commonly used in PIM hunting for Band-14 and Band-17. The unit comes in two pieces – a base "master" unit and a band-specific interchangeable filter unit. The base unit is common for all the frequencies. The interchangeable filter unit future-proofs the investment for any upcoming bands.

Rosenberger units can generate 2x40W tones in both continuous and pulsed modes. The continuous mode comes in very handy for PIM hunting, but power consumption is a consideration and attaching to an AC power source might be necessary for long hours of testing.

The unit does not need in-field calibration and only one of the few models that support both a pulsed mode and a continuous mode.

The unit also has an optional, integrated spectrum analyzer that is useful to hunt PIM sources (with a long cable and a wand tethered to the analyzer) instead of additional field equipment (spectrum analyzer). The 12" touch screen is also very useful in the field. This unit also has built-in WiFi and can be controlled remotely.

The Rosenberger unit supports integrated DTP capabilities without requiring an external accessory. One practical challenge our users have experienced using the the Rosenberger units' remote operation from a tablet is that a user can use only the local screen on the instrument or the remote control.

Work done by a remote user cannot be observed on the local screen. In a use case where there is a technician on a tower and somebody who manages the instrument from the ground, the technician is unable to see anything on the display. ECSite app has seen usage of the Rosenberger for PIM hunting and mitigation for Macros.

PIM INSTRUMENT KEY SPECIFICATIONS COMPARISON

Make & Model	Kaelus iPA Series	Anritsu MW82119B	Rosenberger PIM Analyzer Alpha, IM-B-BU-0727
Measurement Method	Reverse (Reflected)	Reverse (Reflected)	
Risidual PIM	< -117dBm/-160dBc maximum (<-125dBm/-168dBc typical)	<−117 dBm, <−125 dBm typical (2x 43 dBm test tones) <−134 dBm, <−140 dBm typical (2x 20 dBm test tones)	<−125 dBm, <−130 dBm typical (2x 43 dBm test tones)
Interface ports	1x RF output (7-16 DIN female)	7/16 DIN, female, 50 Ω	"7/16 DIN, female, 50 Ω 4.3/10, on Request"
	USB, SD Card, SMB Monitor port, SMA for External WiFi antenna	USB, Flash Drive, SMA for GPS	Keyboard/USB/Flash Drive, LAN, WiFi
User Interface	Local - touch screen display 4.3in (109mm) Remote - tablet computer (included) any Wi-Fi enabled user device with web browser	213 mm (8.4 in) touch screen	12.1" Touchscreen, readable in direct sunlight Remote - tablet computer (included)
Returnloss Alarm	Automatic detection and shutdown when high RL is detected	Not Stated	Not Stated
Transmit Frequencies	700 LTE, 850MHz, DCS, PCS, AWS, E-GSM	700 LTE, 850MHz, DCS, PCS, AWS, E-GSM	698 - 2700, seamless, needs band-specific filters
Frequency increment	100kHz	100kHz	
Frequency accuracy	± 5ppm maximum, aging ± 1ppm maximum after first year	±1.0 ppm at 23 °C	±2.5 ppm
Power per tone (adjustable)	All A series Models 0.1 to 20W (+20 to +43dBm in 1dB increments) All B series Models 0.003 to 20W (+5 to +43dBm in 1dB increments)	Two CW tones 20 dBm to 46 dBm, 0.1 dBm steps	23 to 46 dBm at Test Port
Power accuracy (per tone)	± 0.5dB maximum	±0.5 dB (excluding uncertainty)	

PIM INSTRUMENT KEY SPECIFICATIONS COMPARISON (continued)

	Make & Model	Kaelus iPA Series	Anritsu MW82119B	Rosenberger PIM Analyzer Alpha, IM-B-BU-0727
	Receive band (100kHz steps)	See model table on instrument website	See model table on instrument website	See model table on instrument website
	Measurement noise floor	<-128dBm	-140 dBm	-130dBm
	Measurement range	-50dBm to -128dBm	−70 dBm to −140 dBm (Revision 1 instruments) −50 dBm to −140 dBm (Revision 2 instruments)	–
ELECTRICAL	Battery Power	25.9 VDC, 2600 mAh, 67Wh Lithium Ion battery packs (removable)	Li-Ion	Dual Li-Ion
ELECTRICAL	Battery operating time	Depends on usage, 2 hr minimum per battery pack	3.0 hours, typical	2 hours typical, depends on use
ELECTRICAL	Battery charger	Output: 29.4 VDC, 1.2 Amp	While charging, battery must be 0°C to +45°C, Relative Humidity ≤ 80%	–
MECHANICAL	Dimensions H x D x W	369 x 160 x 240mm 14.5 x 6.3 x 9.4 in	350 mm x 314 mm x 152 mm 13.8 in x 12.4 in x 6.0 in	410 mm x 327 mm x 173
MECHANICAL	Weight	12kg | 26lbs	9.2 kg to 12.4 kg (20 lb to 27 lb), varies by frequency option	13.5Kgs (30lbs) + another 5Kgs for the filter
ENVIRONMENTAL	Temperature range	-10°C to +45°C | +14°F to +113°F	−10 °C to 55 °C	−10 °C to +40 °C (Operating range)
ENVIRONMENTAL	Operational humidity	5% to 95% RH non-condensing	95 %, Non-condensing	5% to 95 %, RH non-condensing
ENVIRONMENTAL	Storage temperature range	-10°C to +60°C | +14°F to +140°F	−51 °C to 71 °C	−20 °C to +80 °C
ENVIRONMENTAL	Mechanical shock	40G shock rating	MIL-PRF-28800F Class 2, (30G half-sine, 6 shocks each axis, while operating)	–
	Price range (depends on features)	$22k-$25k	$22k-$25k	$25k-$40k

About ECSite

ECSite is an End-to-End Software solution for highly technical data collection and reporting during Construction, Installation, Commissioning and Maintenance Operations of Wireless Telecom Infrastructure leading into 5G and beyond.

Launched in 2018, ECSite has built test-automation software consisting of a mobile App and a cloud-based app that helps automate testing in the field with various instruments.

ECSite software has been used in hundreds of in-building venues, stadiums, hospitals, airports, arenas for DAS deployments, thousands of ODAS/CRAN/OSP nodes, Macro PIM Mitigation and Macro sites for various operators, 3POs, Integrators and GCs in the United States.

The types of field tests include Coax related cable testing such as sweep and PIM testing, Fiber testing (OTDR, OLTS, Fiber Inspection), CAT6 cabling, Walk testing, CW Testing with a signal source and a spectrum analyzer.

Through the cloud, users can setup a test plan that is specific to a site where field testing needs to be performed. The test plan then transfers to the mobile device such as a phone or a tablet. A field technician uses the mobile device to perform tests in the field. The mobile app controls the instrument to setup the test parameters and records the test results.

The mobile app checks for the validity of the tests in a context aware manner using proprietary AI/ML algorithms. The results are then pushed to the cloud where further analysis facilitates automatically generating the closeout deliverables.

Through this end to end automation process, ECSite has been able to save its customers significant amount of time and money, avoiding any repeated site visits. The efficiency gains from the use of ECSite has been reported to be greater than 90%.

If you would like to get paid quicker with a much faster closeout and increased accuracy, here's how to get started:

01. Schedule a demo and we will show you how to streamline your closeout.

02. Our team will help you implement ecsite into your testing and close-out procedure.

03. Start reaping the benefits of increased accuracy, project visibility, and faster closeout.

Schedule Your Demo Today

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