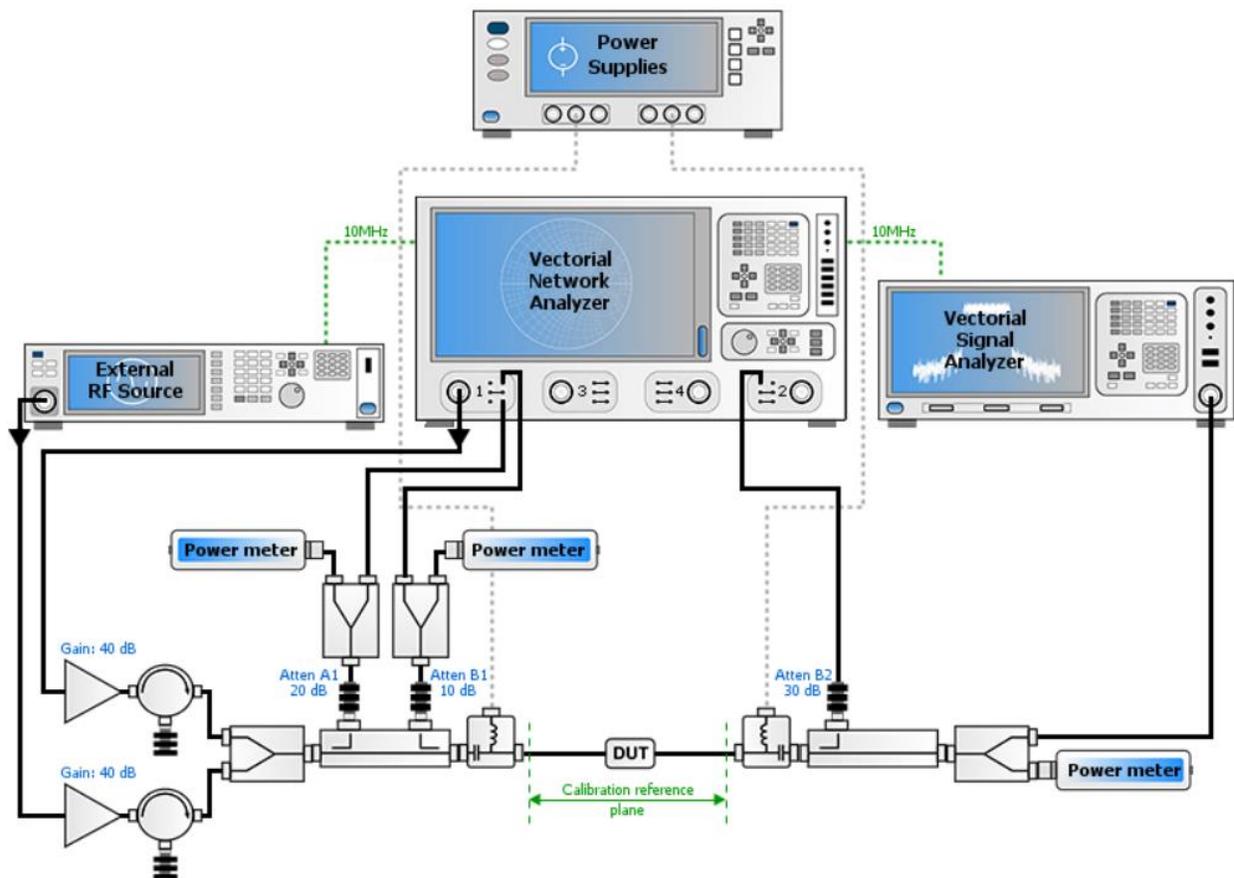


IQSTAR

Turnkey Solution to Accelerate and Automatize Circuit Test Flow

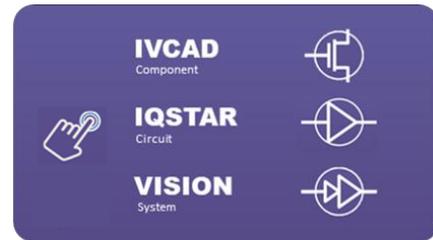


IQSTAR

Multiple measurements with a single test bench

Production testing of RF/microwave components and circuits is becoming a real challenge for many companies. Eager to get their latest developments to market, they must achieve performances that highlight the superiority of their products compared to the competition's.

With its highly flexible and versatile setups, IQSTAR enables multiple measurements configuration with your existing test benches.



IQSTAR Features

- ✓ Turn key software solution for 50Ω circuit characterization
- ✓ Fully customizable with flexible setup schematic
- ✓ Complete characterization flow, including:
 - Instrument control
 - Calibration process
 - Different measurement configurations
 - S-Parameters (Pulsed and CW)
 - 1-Tone (Pulsed and CW)
 - 2-tone signals
 - Modulated signal
 - Flexible DC measurements and control (up to 20 DC stages)
 - Automation and test sequencing
 - Data export to standard formats (MDIF, CSV...)
 - Data analysis
 - Reporting
- ✓ Instrument agnostic solution
 - Large list of instrument drivers available
 - Compatible with most instrument vendors
 - Simple implementation of new drivers using a Driver Wizard.
- ✓ No programming skills required
- ✓ Compatible for coaxial, fixtured, and on-wafer measurements
- ✓ Export data files in CSV or MDIF formats for commercial circuit simulators

Benefits of IQSTAR

- Re-use of existing hardware in the lab
 - o A cost-effective testing solution
 - o Quicker development time and faster time to market
 - o Less downtime and reduced maintenance costs
- Faster test times
 - o Automate your tests
 - o Combine multiple measurements types
 - o Single calibration, multiple measurements
- High Accuracy
 - o Proven calibration process
 - o Vector and scalar calibration available
 - o Embedded validation and verification procedures
- Flexible setups
 - o Great adaptability to future test requirements
 - o Instrument driver wizard for new hardware
 - o Multi-brand instruments based setups supported.



The World most versatile and flexible bench control software

IQSTAR brings speed, accuracy, and ease-of-use to common RF measurements, in coaxial, fixtured and on-wafer environments. Measurements include:

- S-Parameters (CW and Pulsed)
- 1-Tone (CW and Pulsed)
 - o Power & frequency sweeps
 - o Gain Compression
 - o PAE
 - o Harmonics
- 2-Tone
 - o Intermodulation distortion
 - o Video Bandwidth
- Modulated signal
 - o ACPR
 - o EVM
 - o CCDF
 - o Dynamic AM-AM
 - o Dynamic AM-PM
 - o Spectrum



Case Study 1

New Design division of a large component supplier got their test capabilities ready on day one with available test equipments in their lab.

Challenges

This customer offers 27 product lines with over 10,000 active models. Their products are widely used in commercial, industrial and defense applications. This customer opened a new design center for Power Amplifiers. The new lab was equipped with new acquired instruments as well as legacy instruments. The objective was to build few benches with limited CAPEX. In order to test, debug and validate their new designs, the team needed a measurement software to control the benches and speed-up their time to Market. The Key challenges included:

- Instruments from different vendors including new and old ones
- Multiple measurements types needed
- Significant retesting of devices
- Limited programming skills of their design team

Results

IQSTAR's ability to control multiple instruments from different vendors including legacy ones and allowing a single setup, multiple measurements provided:

- A cost effective solution reducing CAPEX and re-using existing hardware
- A turn key bench control software allowing testing, tuning and validation of the design
- Faster measurement with an automation procedure
- The design team was focused on the RF product design rather on the programming of the testing procedures
- Increased operator productivity by monitoring multiple benches simultaneously
- Four benches were operating after an Online training of the test engineers

Case Study 2

A large device manufacturer with labs present on 3 continents had to increase their measurements capabilities by adding new Instruments and new functionalities to their existing in-house bench control software.

Challenges

With more than 40 measurement benches over more than 5 sites, the manufacturer developed over the last 15 years an in-house application to perform the required measurements. The support of the software was done by an RF manager and a software engineer.

With the increase of the number of benches and the number of functionalities, different sites were using different versions leading to:

- Results correlation issues between sites
- Incompatibilities of data formats between teams
- Very long support lead time
- Difficulty to upgrade or change instruments due to lack of drivers.
- Measurement time reduced considerably due to outdated software.

Results

With the purchase of IQSTAR, the customer was able to upgrade his hardware without having to invest in high-end instruments. The user-friendly interface was very easy to learn and very minimum training was necessary to get the teams up and running. Multiple benches were updated and the throughput was increased considerable with minimum down time.

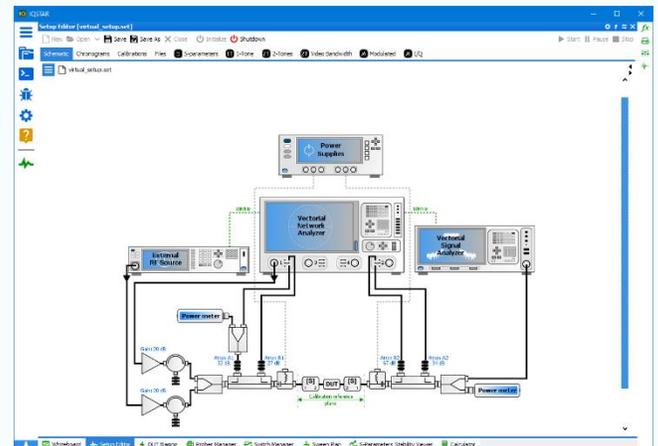
A contract support was signed with AMCAD to insure that all the teams receive the latest version with the enhancements and potential fixes. With application engineers present in North America, Europe and Asia, the customer can receive now an around the clock support.

Capabilities

Schematic Editor

IQSTAR is a turnkey software with a versatile and customizable schematic editor for building a test bench with available laboratory instruments. Depending on the measurements required, multiple test configurations are possible: scalar, vector or a combination of scalar and vector. Devices and circuits can be connectorized or on-wafer.

Each instrument selected in the setup can be controlled using specific drivers allowing full automation of the measurements. With 15 year of device characterization software development, AMCAD masterizes instrument controls and provides drivers that optimize the measurement speed without sacrificing the accuracy. Each instrument can be set with different options and in different modes.

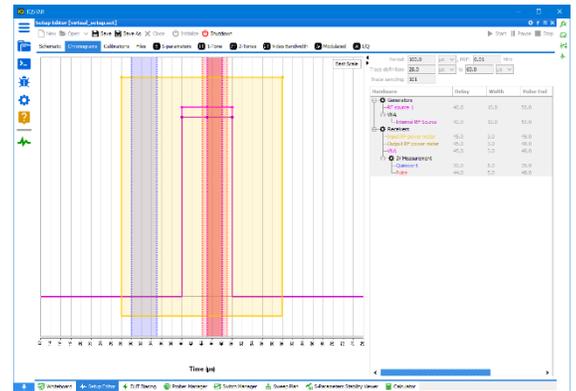


Chronogram

High power devices require measurements in pulsed mode to mitigate thermal effects. Pulsed options often add a complexity to define the settings. Therefore, IQSTAR provides a simple user interface for full control of the pulse generators, the receivers and the trigger signals. Different instruments in the setup can be set with appropriate timings for the pulse setting and pulse measurements.

In order to simplify the task for the end-user, IQSTAR embeds a Chronogram that describes on a time axis the pulse mode settings and where all the timing specifications can be set in one place. All instruments in pulsed mode will automatically show up in the appropriate section of the chronogram: generators (RF signal Generators, DC supplies) or receivers (VNA, Multimeters, Power-Meters)

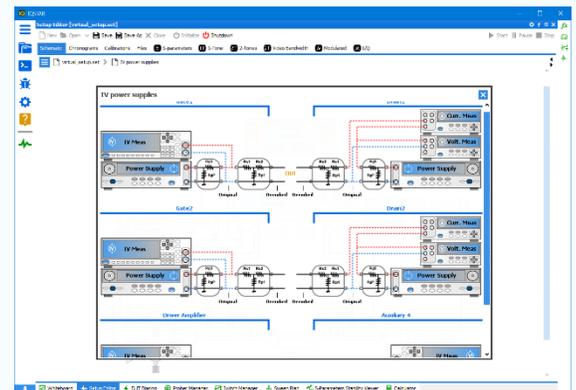
Measurement windows can be configured for each receiver, and once the chronogram is closed, all the settings are configured automatically in the appropriate instruments.



DC supplies

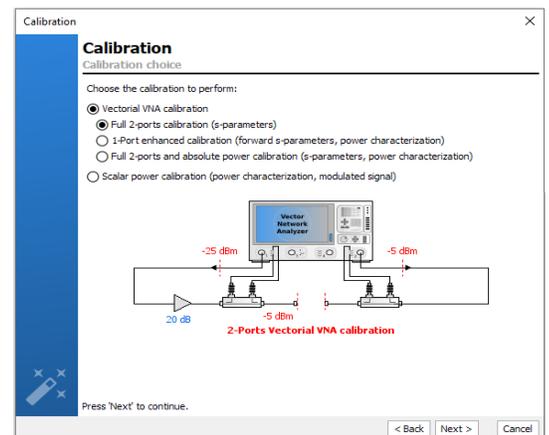
Power amplifier measurements can be very challenging when dealing with multi-stages circuits. IQSTAR allows the control of up to 20 Power supplies with associated IV measurements either from the power supplies or using DC multimeters and oscilloscopes.

The flexibility of the DC power supplies settings allows custom labeling of each instrument and its associated IV parameters to simplify the biasing procedure of multi-stage circuits. A resistive network can also be configured to de-embed the measurements and the voltage settings to the DUT reference plane in case of current or voltage drops through serial or parallel resistances. Customized formulas can be defined to calculate the power consumption.



Calibration

IQSTAR provides corrected data at the DUT reference plane. The correction terms are calculated during the calibration process using a step-by-step wizard. Depending on the setup configuration, different calibrations can be performed. In the case of a scalar setup, the calibration procedure is based on power measurements using power meters and signal generators, while for vector setups, the calibration of the Vector Network Analyzer (VNA) is necessary to extract the error terms. Furthermore, depending if the VNA is configured with three (3) or four (4) receivers, the vector calibration and power calibration can be different. Therefore, and in order to minimize the source of errors, IQSTAR provides a state-of-the-art calibration wizard



that relies on the schematic setup to identify the type calibration that is possible to perform and guides the end-user through all the steps including the validation process to verify and assess the expected accuracy.

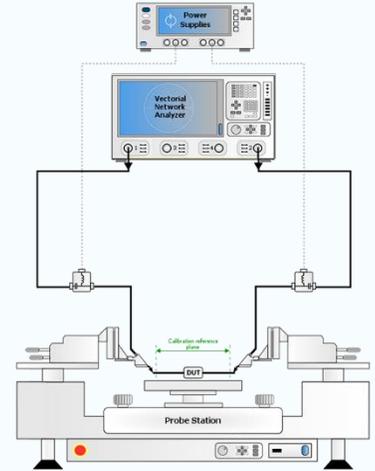
Measurements

Depending on the selected calibration, different measurements can be performed with IQSTAR. :

S-Parameters

Perform a frequency sweep on the VNA and display the corrected S-parameters at the DUT reference plane using the live visualization tool. Device tuning will be easier with trace history as up to fifty (50) iterations and measurements can be displayed on the same graph. Import S2P simulation files and compare it with measurements in different display formats.

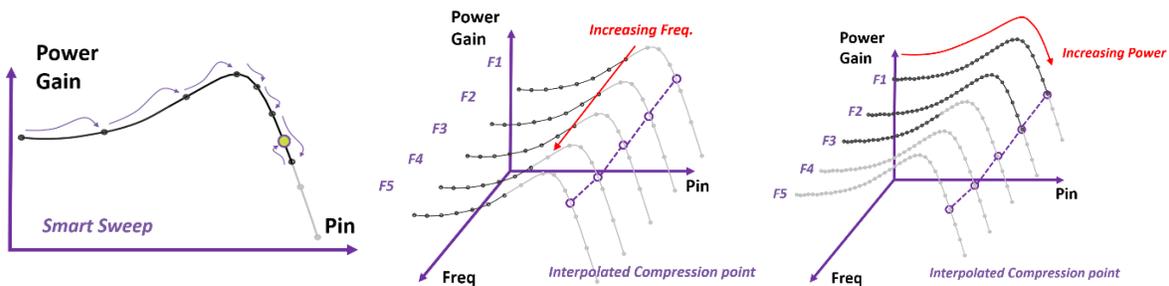
With Probe station control, measure multiple devices with one click. IQSTAR supports major automatic probe station vendors and remotely controls the wafer movement. Adding the bias conditions to the sweep plan, one can generate a big amount of data with minimum interaction with the instruments.



1-Tone measurements

Different sweep settings are available to the end-user allowing appropriate characterization of different power amplifier technologies:

- A two-dimensional (2D) sweeps, with the choice of sweeping power per frequency or frequency per power
- A fast and convenient Smart Sweep incrementing the input power with a coarse step and then with fine steps to prevent overdriving the DUT .



Different operating and transducer gain compression modes are made available to characterize the power amplifier under test including compression from linear and compression from maximum gain.

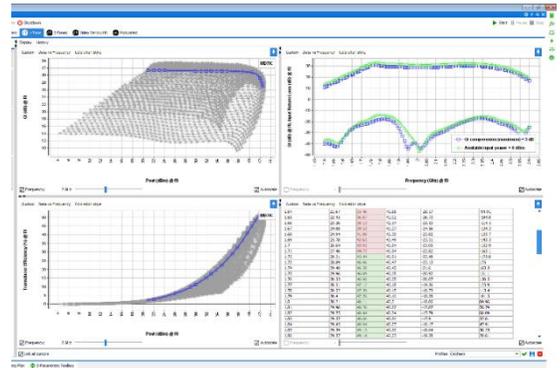
Gan-based Power amplifier need more cautious characterization as the power sweeps need to start always from the same trapping level. So that IQSTAR embeds a quiescent current stabilization option allowing to monitor the current settling in quiescent state over time and assure it reaches the right level before triggering a new power sweep.

The Protection of the test bench and the measured circuits are top priorities when it comes to power characterization. Multiple stop conditions can be set in the software: Gain compression, Maximum output power, Efficiency compression, Input Gamma and more.

IQSTAR embeds a Robust optimization algorithm of the input power level at the DUT reference plane allowing a complete control independently of the RF source or driver amplifier drift or bias voltage drop.

Depending on the setup configuration, an extensive list of predefined parameters are measured and available during the live visualization, including, harmonic power, return loss over frequencies and power and much more. Customized user data can be defined.

During the measurement, the user can consult the results on the live visualization tool. Besides the history measurements available for display, it is also possible to set some specifications limits that the circuit under test needs to reach. A color coded display allows a very fast evaluation of the DUT and indicates if it passes or fails.



Tips from our experts:

When the DUT presents hysteresis due to trapping effect or thermal effects, it is recommended to sweep frequency per power rather than power per frequency, or to use the Quiescent Current stabilization options in order to reduce the effects from previous measurements. Reverse power sweeps, from high power to lower power level, can also be defined.

2-Tone measurements

IQSTAR allows multiple configurations to measure intermodulation distortion (IMD) with a 2-Tone signal.

Either using two combined analog RF sources or a vector signal generators, a spectrum analyzer or a vector network analyzer, IQSTAR will guide you through a simplified calibration procedure and will provide high measurement accuracy.

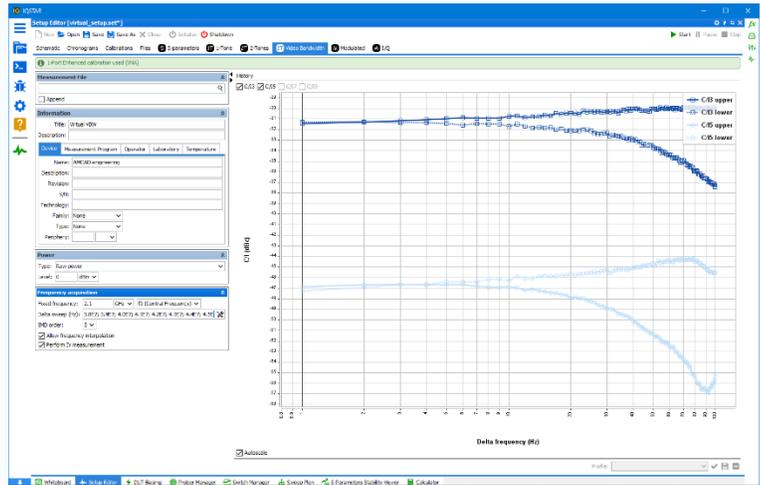
Using the VNA, IQSTAR takes advantages of the dynamic range of the receivers and measures the a- and b-waves in amplitude and phase to extract the intermodulation product signals along with the two carrier tones to calculate the IMD up to the ninth level. The Frequency Offset option is required in the VNA for this measurements.

As for the generators, IQSTAR handles sources from the VNA, independent sources or a combination of both and optimizes the balance of the tones levels for a accurate IMD characterization.

The use of Spectrum analyzers or Signal analyzer are also possible by setting the right instruments in the setup schematic.

A 3D sweep including the carrier frequency, the power, and the tones spacing can be performed to extract a complete IMD characterization of the Power Amplifier in one step.

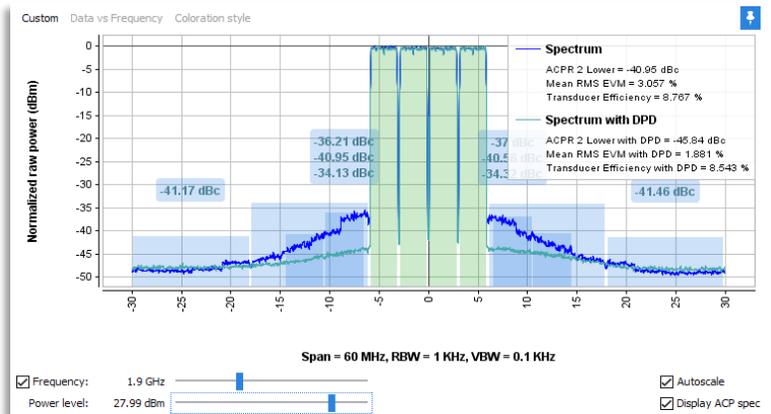
VBW measurements represent a challenging measurement task. IQSTAR handles this measurement efficiently, setting the amplitude of the tones according to the target third-order intermodulation distortion (IMD3) value set by the user. The software sweeps the spacing between the tones and adjusts the balance between them before recording the intermodulation—up to the ninth order. Taking advantage of the speed of VNA sweeps, this measurement takes just a few minutes.



Modulated signal Module

The growing complexity of wireless systems, imposes a through and detailed characterization of RF power amplifiers using wideband signals. IQSTAR enables the measurements of high speed signal quality to evaluate the performances of the DUT in terms of (EVM, ACPR, CCDF, PAPR...)

With a full control of the vector signal generator, it is possible to set manually the modulation scheme with adequate settings and have IQSTAR recall the required state on the instrument. Otherwise, it is possible to generate an IQ waveform using third party software and use it directly in IQSTAR by loading a text file containing the two columns “I” and “Q”. Finally, IQSTAR embeds a waveform generator that can create different PSK and QAM signals and inject them directly in the signal generator.



The Signal analyzer with appropriate options and power meters will be used to measure different parameters like:

- Adjacent Channel Power Ratio (ACPR)
- Error Vector Magnitude (EVM)
- Complementary-Cumulative-Distribution-Function (CCDF)
- Peak-to-Average Power Ratio (PAPR)
- Spectrum
- Dynamic AM/AM and AM/PM (available only with NI PXI VSA for now)
- Digital Pre-Distorsion (available only with NI PXI VSA for now)

IQSTAR Modulation measurements supports multiple combinations of vector signal generators and signal analyzers from different vendors, allowing the test engineer to switch between instruments without having to know how to set the parameters on different interfaces.

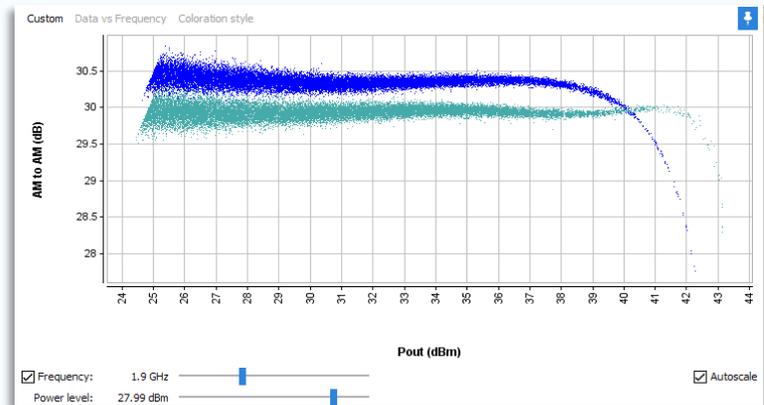
I/Q Module

IQSTAR uses IQ values sent to the Vector signal Generator (VSG) and fetches the IQ values from the Vector Signal Analyzer (VSA). The IQ data is resized, realigned and demodulated in IQSTAR to extract user-selected parameters (ACPR, EVM, CCDF, PAPR, Dynamic AM-AM etc). With this option, the VSA does not need to have any software options.

The Available Measurements are:

- IQ Data
- ACPR
- CCDF with Trace
- Dynamic AM/AM and AM/PM

If the signal is generated by the Waveform Generator (now supports only PSK and QAM) then IQ Option can also extract the EVM Constellation and EVM Data.

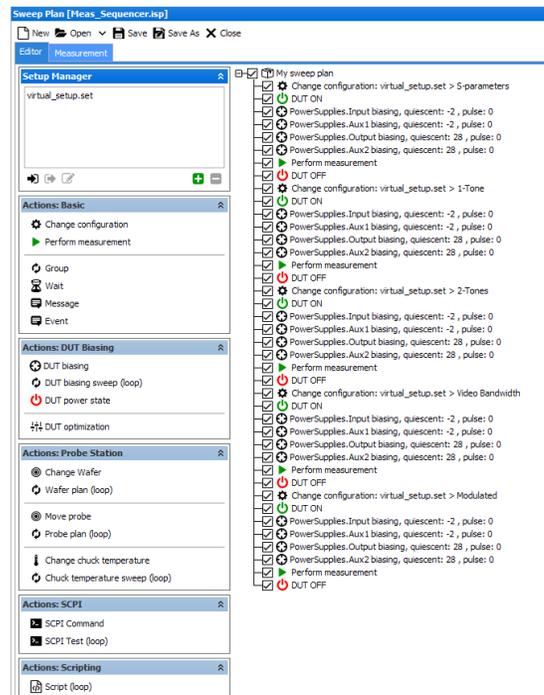


With the IQ Module, no software options are required in the instruments to analyze the signal which makes it a an evolutive solution with minimum hardware updates needed. The setup will be limited only by the instantaneous bandwidth of the signal generator and the signal analyzer. Also, in-house developed DPD algorithm can be used as IQSTAR can generate the IQ data at the output of the circuit under test.

Sweep Plan

Automated measurements is an easy task with IQSTAR. Sequencing measurements with minimum human intervention is a key to an optimal testing efficiency. One person can run multiple benches at the same time to speed up testing capabilities. Through **drag and drop actions**, it is possible to define several tasks to be performed, and run the complete measurement scenario automatically.

The sweep plan will take benefit of all the GUI tools already available in the bench definition interface or from the measurement interface. This way, defining a complete measurement task is possible, **without any programming skill requirements**, and without any loss of flexibility.



IQSTAR automation capabilities using the sweep plan allow:

- Single setup and multi-setup configurations
- Measurement sequencing with loop and stop conditions
- Nested measurements sweeps
- DUT bias control & optimization
- Probe station control
- Chuck temperature control
- SCPI commands for specific instrument control during the automation
- Possibility to save sweep plans with all parameters for future use

Visualization Tool

IQSTAR is provided with a visualization tool for each measurement module. Different displays are made available allowing single or multiple graphs. Depending on the performed measurements, an extensive list of graph types are predefined including:

- XY Graphs
- Smith Charts
- Polar
- Tables
- Spectrum
- CCDF traces
- EVM
- ACPR Mask
- And many others

Different controls allowing the display of different parameters at specific frequency or power level make the evaluation of the performance of the device easier to analyze. User-defined templates can be saved and recalled. Measurement data can be exported to standard formats like CSV and MDIF.

MAINTENANCE

AMCAD Engineering considers the maintenance as a critical asset for its customers, to provide a premium assistance program during one year from the date of delivery. After this initial period, you will be kindly invited to extend this maintenance through a support agreement.

Three different maintenance program are available :

- One-year maintenance and support agreement
- Two-years maintenance and support agreement
- Three-years maintenance and support agreement

In addition with ongoing customer support, this maintenance program keeps your software version up-to-date, so you can take benefit of all the improvements and fixes which are available with the latest release.

IQSTAR Configuration Information

| | IQS100B-10 | IQS100B-11 | IQS100B-20* | IQS100B-30 | IQS100B-40 |
|---------------------------|------------|-------------------|-------------------|-------------------|-------------------|
| Scalar Bench Control | • | • | | | |
| Vector Bench Control | | • | | | |
| Schematic Editor | • | • | | | |
| Calibration | • | • | | | |
| Chronogram | • | • | | | |
| Sweep Plan | • | • | | | |
| S-Parameters Measurements | | • | | | |
| 1-Tone measurements | • | • | | | |
| 2-Tones Measurements | | | • | | |
| Modulated Signal Module | | | | • | |
| IQ Module | | | | | • |
| S-parameter Viewer | | • | | | |
| 1-Tone Viewer | • | • | | | |
| 2-Tone Viewer | | | • | | |
| Modulated Signal Viewer | | | | • | |
| IQ Data Viewer | | | | | • |
| Minimum Required Modules | | IQS100B-10 | IQS100B-10 | IQS100B-10 | IQS100B-10 |

* For 2-Tones measurements using a VNA, IQS100B11 is required.



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