WaveJudge

5000

The WaveJudge 5000, the

ultimate authority in wireless

testing, is your essential

tool for troubleshooting

wireless development and

deployment issues

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Benefits of the WaveJudge 5000 Modular Architecture

- <u>Flexible:</u> Tailor the system to your specific test requirements.
- <u>Scalable:</u> Start small and add the modules you need when you need them.
- <u>Powerful:</u> 40 MHz channels allow you to test high-port-density solutions such as MIMO, CA, and beamforming.
- <u>Cost-effective:</u> Purpose-built proprietary architecture in a small footprint is more efficient.
- <u>Future-proof:</u> Architecture can adapt to the transformation of the wireless industry, protecting your investment.

Use the WaveJudge 5000 to:

<u>Identify & Analyze</u>
- DL assignment and UL grant analysis
- Scheduling errors
- DL/UL timing offsets
- Resource block assignments
- Subcarrier energy usage
- L1–L3 usage
- MIMO type and rank comparison
- MIMO decodes
- Handover issues
- Synchronization and reference signal errors
- Attach process failures

<u>Solve</u>
- Interference questions
- Attach process failures
- Cell synchronization
- Handover issues
- Optimization and efficiency issues
- Finger pointing /engineering confusion
- Deployment delays

The best wireless troubleshooting solution just got better

The WaveJudge, the first air monitor solution to give you real-time visibility into the interaction between protocol and physical layers in wireless transmissions, is now more scalable, customizable, and cost-effective than ever.

From the beginning, Sanjole has delivered solutions that collapse troubleshooting from days to minutes. Building on the power of the capabilities of the WaveJudge/IntelliJudge product line, the WaveJudge 5000 features a modular chassis that enables you to customize your troubleshooting platform to address specific challenges.

- **Need more ports to test higher-order MIMO?** The WaveJudge 5000 can support up to 16 truly synchronized ports. Test up to 8×8 MIMO configurations and incorporate multiple layers beyond the current two-layer scheme.
- **Need more bandwidth to test Carrier Aggregation?** The WaveJudge 5000 can support up to five Component Carriers of CA with 40 MHz channels.
- **Need more memory for data capture to troubleshoot timing or functionality?** The WaveJudge 5000 memory modules can store hours of IQ data with flexible configuration options.
- **Need to perform a large-scale test with a large number of antennas that must be sample- and phase-locked?** The WaveJudge 5000 ports are truly synchronized, allowing you to avoid time-consuming tangents such as troubleshooting alignment issues between devices.

These capabilities are complemented by advanced features including:

- Programmable frequency (from 380 MHz to 6 GHz) to facilitate systems development for multiple markets.
- The latest in DSP cores, FPGA density, and technology-specific accelerators to enable real-time testing.

As wireless technology marches forward to 5G, technologies such as Carrier Aggregation, higher-order MIMO, coordinated multipoint, and beamforming arise to meet the ever-increasing demand for speed, quality, and reliability in wireless communications. The WaveJudge 5000 keeps your test solution at the front of the technology curve by maximizing bandwidth and spectrum.

How did we make this giant-leap forward? By developing a cost-effective, proprietary, modular platform that maximizes flexibility and scalability. This modularity gives the WaveJudge 5000 the ability to cover the RF profiles of today's LTE networks and the flexibility to adapt to new spectrum as the RF industry continues to evolve.

The WaveJudge 5000, the ultimate authority in wireless testing, is your essential tool for troubleshooting wireless development and deployment issues.
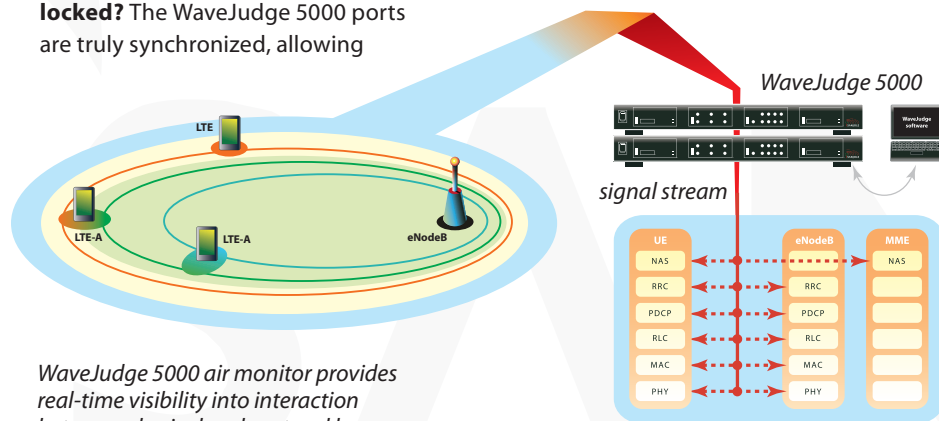
WaveJudge 5000 air monitor provides real-time visibility into interaction between physical and protocol layers in wireless communications, in this case, over an LTE-Advanced Carrier Aggregation network.

WaveJudge 5000 Platform Features

Modular Architecture

By moving from a single-use box to a modular system, the WaveJudge 5000 transfers the components of the system from fixed motherboards and daughterboards to a selection of modules (cards) that can be installed or removed as the application requires.

Up to 256 modules can be employed in a single WaveJudge 5000 test system, enabling massive scalability (including ports and memory) and welcomed flexibility in system configuration to meet specific or demanding test situations.

This flexibility is enhanced by the WaveJudge 5000's system-wide port synchronization, enabling faster and easier module installation.

From a practical point of view, this proprietary, purpose-built, modular architecture is much more targeted and cost-effective than a one-size-fits-all standard platform, and so allows maximized coverage of your testing budget.

Modules

RXJudge (RF Module)

RXJudge modules feature superior sensitivity and dynamic range enabling you to test in the lab and in the field. Each module features four independent, configurable 40 MHz receivers.

All ports in a system are truly synchronized and are sample- and phased-locked (coherent). By providing synchronized, coherent ports right out of the box, the WaveJudge 5000 does not rely on independent synchronization lock per test device that can drift with respect to a common source. This saves you the time required up front to assure all devices are synchronized, or in the case of some multi-box solutions, calibrated. You also save the time lost in troubleshooting synchronization and coherence issues during testing.

IntelliJudge2 (DSP Module)

The latest in DSP cores, FPGA density, dynamic RAM and technology-specific accelerators power the IntelliJudge2 modules and provide real-time testing. Cost-effectively analyze, trigger, filter, log, and chart everything in the wireless channel for any amount of time.

Because the IntelliJudge2 modules are now completely integrated into the WaveJudge 5000 platform, you can configure your system to take advantage of real-time analysis with no time constraints, triggering on lower and upper layer events, errors, messages, and message content. This gives you the powerful ability to isolate problem areas regardless of the layer in which they occur, to detect and eliminate transient errors and bypass the finger pointing between vendors that can delay release dates by weeks or months.

SynthJudge (OCXO Module)

Dual-frequency, from 380 MHz to 6 GHz, is particularly useful when developing systems for multiple markets. Leverage your testing investment to cover multiple spectrum bands.

Some test solutions require multiple boxes, which must synchronize to a common external clock (typically 10 MHz) received via cables for sampling. Sample count alignment is typically handled by either field calibration or GPS timestamp correlation between boxes. In the WaveJudge 5000, there is only one master clock module, which is derived from a selection of internal OCXO, external user clock, or GPS. This sample clock, along with the exact sample count, is distributed to all chassis and modules in a WaveJudge 5000 system. There is never a need to worry about sample count or timestamp misalignment.

StoraJudge (Memory Module)

You can customize your system for analysis/troubleshooting of short captures or for tracking long-term trends or to isolate intermittent anomalies.

In addition, down-converted analog IQ signals are now stored on the memory modules instead of a fixed 4 GB cache, allowing you to extend the capture timeframe for enhanced troubleshooting. Depending on your application, IQ captures can be invaluable in recreating the wireless channel and providing in-depth physical analysis.

The IntelliJudge2 modules share dynamic RAM for short captures of seconds or minutes depending on your module arrangement, while StoraJudge SSD modules store hours of IQ capture. This flexibility addresses your application requirements without breaking your budget.

Management

The WaveJudge 5000 is controlled by a laptop or desktop PC running WaveJudge 5000 software connected to the test network via an Ethernet port. The user-friendly software control package, with its strong visual emphasis, greatly simplifies test set up and provides quick graphic confirmation of the test configuration. This feature is very valuable when dealing with complex scenarios.

Call for a Demonstration

To inquire about a demonstration or for more information about the WaveJudge 5000, please call Sanjole at 1-808-457-1452 or email sales@sanjole.com.

Contact

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Features & Benefits

Features

- Scalable architecture allowing up to 256 modules
- Flexibility of modules include RF, Synth, DSP, and SSD memory
- RF wideband support 380 MHz to 6 GHz up to 40 MHz BW
- Wide dynamic range supports use in the lab and in the field
- Coherent RF ports up to 16 per set
- Support for all transmission modes up to 8 layers
- CA (×5) support with 40 MHz channels
- LTE-specific hardware accelerators
- Real-time streaming analysis of unlimited UEs for any length of time
- IQ storage in expandable SSD for minutes or hours
- Best in class close-in phase noise

Benefits – Executive Level

- Cost effective large scale potential test configurations for complex antenna schemes
- One system covers all RF bands and channels including CA
- Real-time testing at an affordable entry point using less DSPs
- Track intermittent or transient issues in reduced test time
- Accelerate problem solving and time to market
- Dynamic range and sensitivity allows testing in the lab and in the field
- IntelliJudge2 DSP modules provide real-time bidirectional analysis of all interactions at all layers
- Eliminate worries about future technologies obsolescing your test investment
- Decrease test time by quickly locating faulty devices

Benefits – Technical Level

- Close-in phase noise allows 8 layer testing
- Analyze complex antenna schemes including MIMO and beamforming
- Compare expected vs. received frame structure and identify allocation issues
- Visually inspect scheduler performance
- Capture the attach process beginning with UL power
- Understand channel characteristics and their relationship to device behavior
- Test CA (×5) with all DL and UL interactions with latest RF port scalability
- Locate complex issues that span LTE layered technology
- Verify eNodeB channel outputs
- Locate eNodeB UL grants and verify UE correct usage
- Identify channel conditions and compare with modulation scheme chosen by eNodeB
- Locate protocol exchange per UE and identify errors
- Trace the bytes as they move through the MAC, RLC, and PDCP layers

Specifications

WaveJudge 5000 Chassis

- Operating Temperature Range: 0°C to +55°C
- Storage Temperature Range: -40°C to +80°C
- Dimensions: 16.75" width × 1.72" height × 12" depth
- Power, Converter to Chassis: 12 V, 15 A
- Power, AC to Converter: 110 to 240 V, 2.5 A, 50 to 60 Hz

Mobility and MIMO
- No. of Ports per Chassis: 8
- No. of Synthesizers per Chassis: 2

Inputs and Outputs
- 1 Gb Ethernet – 20 Gb SRIO
- GPS, ANT IN, PPS IN, PPS OUT (SMA)
- Power Jack

WaveJudge 5000 Analysis

Modulation Formats
- OFDMA/SC-FDMA with BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, Zadoff-Chu

Traces
- Constellation
- 2D Physical
- Time Domain Power
- EVM vs. Subcarrier
- EVM vs. Symbol Time
- MIMO Rank per Subcarrier
- MIMO Rank per Symbol
- Spectral Flatness (Frequency Domain)
- Amplitude Flatness (Time Domain)
- CCDF, PAPR
- Spectral Power
- Amplitude, Phase, Frequency during synchronization signal
- Impulse Response

Statistics (partial)
- EVM
- EVM Peak
- Reference signal EVM
- Carrier and Sampling Clock Frequency Error
- IQ Offset
- CFI Error Rate
- Payload Bits
- RSSI, RSRP, RSRQ
- MCS
- N Resources
- Modulation type

Protocol Analyzer Decodes
- MAC
- RLC
- PDCP
- RRC
- NAS
- TCP/IP (WireShark supported decodes available)

StoraJudge Memory Module

- SSD-based 1TB per module

RXJudge RF Module (380 MHz to 6 GHz)

General Specifications
- No. of Receiver Modules per chassis: 2
- No. of RX per Module: 2 or 4

Amplitude Specifications
- Variable Attenuator: 0 to 60 dB in 2 dB Steps
- Variable Gain Ex. at 2 GHz: -35 to +25 dB
- Measurement Range: DANL to Maximum Input Level
- Maximum Input Level: +22 dBm
- DANL – 1024 pts, 10 MHz channel BW (~15 kHz RBW) Normalized to 1 Hz, -172 dBm
- Absolute Amplitude Accuracy: ±2.5 dB
- Relative Amplitude Accuracy: (adjacent tones ~11 kHz) ±0.2 dB

Sampling System
- A/D Bits: 16 bits
- A/D Clock (Sampling Frequency) ~90 MHz
- 2nd Harmonic Distortion: -70 dBc
- 3rd Harmonic Distortion: -70 dBc
- Two Tone intermodulation: -80 dBc
- Sample Frequency Set (Fs): 1 to 45 MHz (optimized for channel BW)
- Sample Frequency Set Accuracy: 10 Hz

Inputs
- Receive RX 1: MCX female, 50 Ohm
- Receive RX 2: MCX female, 50 Ohm
- Receive RX 3: MCX female, 50 Ohm
- Receive RX 4: MCX female, 50 Ohm

SynthJudge OCXO Module

Carrier Frequency
- Frequency Range: 380 MHz to 6 GHz
- Center Frequency Set Resolution: 4 Hz
- Frequency Calibration Accuracy: 1 ppm ±4 Hz

Reference Frequency Source
- 100 MHz OCXO
- 10 MHz Ref Input, MCX
- Internal GPS, External 1pps
- Another Sanjole WaveJudge 5000

OCXO
- Aging per year: ±500 ppb
- Aging over 10 years: ±3 ppm
- Temperature stability (0°C to +50°C): ±50 ppb
- Calibration accuracy: ±1 ppm
- Accuracy: ± (time since last adjust × aging rate) + temperature stability + calibration accuracy

Sideband Phase Noise (normalized to 2 GHz)
- 1 kHz offset: -96 dBc/Hz
- 10 kHz offset: -106 dBc/Hz
- 100 kHz offset: -111 dBc/Hz
- 1 MHz offset: -121 dBc/Hz

Inputs and Outputs
- 10 MHz Reference Input: MCX female, 50 Ohm
- Synth 1: 380 MHz TO 6 GHz, female (×4), 50 Ohm
- Synth 2: 380 MHz TO 6 GHz, female (×4), 50 Ohm

IntelliJudge2 Analysis Module

- Dual TMS320C6670 multi-core DSPs
- 4 GB DDR3 SDRAM per Module
- Gen2 SRIO 8 port switch
  - Per DSP SRIO 1 port @ 5 GHz = 16 Gbps
  - Back plane SRIO 3 ports @ 6 GHz = 60 Gbps
  - Front plane SRIO 1 Port @ 6 GHz = 20 Gbps
- Front Panel SFP support for Gigabit Ethernet PHY
- Charts
  - EVM
  - Power
  - CRC
  - Throughput
  - TB Count
  - SINR, RSSI, RSRP, RSRQ
  - 2D Physical
  - RNTI

About Sanjole

Sanjole is a leader in 4G, WIFI and 5G testing with expertise in innovative wireless technology. Sanjole provides problem solving capabilities from inside the wireless network through over-the-air analysis tools that provide visibility into events spanning multiple layers. Sanjole has been involved from the very beginning of LTE as a test vendor in the LTE/SAE Trial Initiative (LSTI) events for both fixed and wireless devices. Our work with the WiMAX Forum and 3GPP, participation in the Small Cell Forum, TETRA, WIFI Alliance and extensive experience in interoperability trials, enable deep insight into the complex technical issues specific to the LTE and 4G community.

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