

## ACE™ 400WB MIMO Channel Emulator

### PRODUCT BRIEF

#### Comprehensive Test Platform for Assessing WiMAX Product Performance in Multipath Environments



Multiple-Input Multiple-Output (MIMO) technology is the foundation for the next generation of mobile WiMAX and Wi-Fi products. By leveraging multiple transmit and receive antennas to employ spatial multiplexing, adaptive antenna processing, and space time coding, MIMO products deliver greater wireless throughput and range enabling ubiquitous high-speed voice, video and data services. Channel emulation is required to accurately characterize the effect of RF interactions like a multipath and fading channel on the performance of MIMO systems. The ACE 400WB is an easy to use, full featured channel emulator designed to accurately create complex fading channels for testing the most advanced MIMO technology and devices.

The ACE 400WB is a comprehensive and scalable channel emulation test platform that is used to characterize the performance, interoperability and conformance of Multiple-Input Multiple- Output (MIMO) and Single-Input Single-Output (SISO) broadband wireless devices. The ACE 400WB is purpose-built for MIMO, and designed to emulate real world bi-directional multipath environments to determine the dynamic effect of multi-channel RF interactions on device performance.

The ACE 400WB combines sophisticated real time fading techniques on the highest fidelity RF platform to deliver a full featured set of test capabilities for validating functionality, conformance, performance and interoperability of WiMAX Base Stations and Mobile Stations. The ACE 400WB has an intuitive and easy to use architecture and interface that enables repeatable, efficient and automated testing of WiMAX and Wi-Fi devices.

#### **The ACE 400WB delivers tightly controlled multipath conditions to:**

- Test MIMO algorithms and debug errors
- Evaluate and optimize the performance of wireless devices
- Streamline QA processes for new devices
- Perform competitive performance benchmarks
- Verify that devices meet WiMAX Forum Radio Conformance Test metrics
- Test interoperability of MIMO and SISO WiMAX and Wi-Fi devices
- Test handover and interference between mobile stations and base stations

#### Leverage the Power of the Azimuth Approach

##### **DIRECTOR II™**

Test executive for automation

##### **STUDIO™**

Software for data management

##### **Real2Real™**

Architecture for interoperability

##### **SmartMotion™**

Technology for virtual motion

##### **RadioProof®**

Enclosures for repeatability

## ACE 400WB Fundamental Attributes

### *MIMO and OFDM Optimized*

One of the key benefits of WiMAX delivered through the use of OFDM and MIMO technology is the higher performance of the solution. To achieve this, enhanced RF fidelity is required, which places a burden on test equipment and demands greater scalability and RF fidelity than legacy test tools. The ACE 400WB is designed to exceed the most stringent WiMAX requirements, with the ability to scale up to 4x4 to test different MIMO configurations and provide RF characteristics like EVM and Noise Figure superior to other tools in the industry.

### *Scalable Architecture*

The architecture and control of the ACE 400WB allows the unit to be configured in a variety of flexible topologies, to build a configuration ideally matched to the testing requirements. From SISO or 2x2 through to full 4x4, and uni-directional or bi-directional, the embedded capabilities of the ACE 400WB fulfill all test needs. To address mobility, the ACE can be easily configured for point-to-multipoint topologies, making it the ideal platform to test features such as handoff and collaborative uplink. Additionally, the ACE architecture allows each different device to be assigned a different channel model and velocity for flexible testing.

### *Real Time Channel Fading*

Using state-of-the-art digital signal processing technology, the ACE 400WB recreates up to 4x4, bi-directional channel fading, multipath and MIMO antenna correlation in a real time digital signal processing engine, for dynamic and statistically reliable channel emulation with virtually endless repeat times. The ACE 400WB can run industry standard models, and also offers a model builder capability for the user to program customized models of a complex nature for any type of specialized test case.

### *Ease of Use*

The ACE 400WB is a fully integrated solution that is easy to set up and configure and efficient to run. With simple RF in/RF out connectivity and a system management GUI that is straightforward and intuitive, the ACE 400WB also boasts a set of tools to define custom models, load and run enhanced test scenarios and scripting to automate complete test plans that can be integrated into users' own test suites. The ACE 400WB was designed to meet the needs of a wide range of users, from junior technicians running standard test plans to researchers working on proof of concept applications.

## Features

## Benefits

Dynamic bi-directional channel modeling

Recreates real world conditions emulating dynamic channel conditions in both the downlink and uplink paths simultaneously, enabling applications such as beam forming and full duplex operations.

Azimuth's patented SmartMotion™ mobility

Dynamic fading emulates real world channel conditions and programmable attenuation simplifies the measurement of performance of Subscriber Stations in mobile scenarios without leaving the lab.

MIMO channel emulation up to 4x4

Allows validation of spatial streaming, space time coding, adaptive antenna systems, collaborative uplink and beam forming to be measured with diverse RF conditions between the devices under test.

Custom Channel Builder utility

Gives users the ability to program the ACE 400WB with user defined channel models for increased test flexibility.

GUI-based configuration with advanced user control such as rewind and playback

Fast forward, rewind, play and pause commands allow the user to evaluate specific channel conditions in an instant without waiting for lengthy emulation runs.

Fully contained WiMAX channel emulation

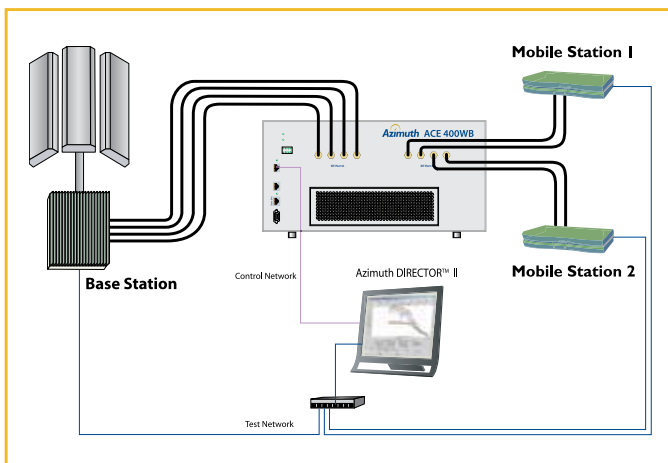
Streamlines testing by providing direct connections to 802.16 devices and eliminates external RF devices.

## Product Description

The ACE 400WB uses advanced signal processing technology to enable real-time lab testing of MIMO, MISO and SISO WiMAX devices in a multipath environment. It provides dynamic, real time channel emulation that scales for testing single channel devices to MIMO 4x4 devices (up to 32 channels) and features dedicated bi-directional channel modeling that accurately emulates wireless over-the-air conditions in both the downlink and uplink paths simultaneously, a capability that can be used to test beamforming applications.

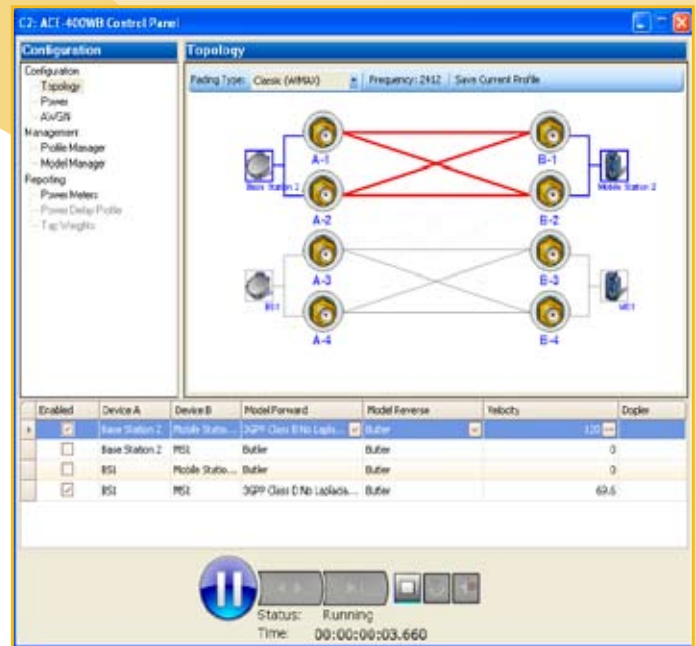
The ACE 400WB is a complete test solution, and all the required RF components are inherent in the design, eliminating the need for external hardware to connect and configure complex test topologies. This simple RF in/RF out design, combined with an easy to use and intuitive graphical user interface makes set up, configuration and initiating testing a quick and easy task.

The Channel Modeling features of the ACE 400WB enable industry accepted channel models or custom models to be run on the real-time dynamic digital signal processing engine. ACE provides sophisticated model operation, including the ability to pause, rewind, step and loop the channel model, and provides for model repeat times that extend to years. The ITU M.1225 A and B model profiles and WiMAX Forum mobile versions for MIMO 802.16e are the base channel models provided on the system, and a library of additional models is available including Wi-Fi and 3GPP models.



## Point-to-Multipoint MIMO Test Configuration

Mobile MIMO WiMAX test configuration shows how two mobile stations are connected to a base station through the channel emulator. Each MS's link can be configured to a unique channel model allowing testing of collaborative uplink under diverse conditions.



## Easy-to-Use Graphical User Interface

The ACE 4x4 MIMO topology can be flexibly configured to any combination of uni-directional or bi-directional topologies with different models and velocities for each individually defined link through point and click selections. Each test configuration can be easily saved to a test profile for later re-use.

The ACE 400WB Custom Model Builder enables users to program their own models or modify existing models. Users can create or import their own environment-specific channel model by introducing power delay profiles and correlation parameters developed in simulations.

The ACE 400WB is designed for automated test, and works in conjunction with Azimuth DIRECTOR II Test Executive. DIRECTOR II provides both GUI access to the ACE 400WB's channel emulator parameters as well as full script control through a TCL API for automated or remote control. DIRECTOR II also allows the ACE 400WB to be integrated into automated test scripts that can use Azimuth's rich array of device and tool control libraries.

## AWGN

Additive White Gaussian Noise (AWGN) introduces spectrally flat Gaussian noise over the faded signal and is used in the analysis, modeling, and performance prediction of communication systems. The ACE 400WB generates AWGN at each RF output to allow the user to accurately set a signal-to-noise ratio of the output signal that will be transmitted from the ACE to the device under test.

## Specifications

Channel Emulation		RF Frequency	
Max Number of Channels	32	RF Input Frequency	2300 - 2700 MHz 3300 - 3800 MHz 4900 - 5900 MHz
Max Number of Taps per Channel (With all Channels in Use)	20	Center Frequency	Tunable in 50KHz steps
Total Max Number of Taps	640	Bandwidth	Up to 40MHz
Pre-configured Models	<ul style="list-style-type: none"> <li>- ITU M.1225 A and B channel models with extensions as defined by the WiMAX Forum for mobile 802.16e</li> <li>- Bypass mode (identity matrix) no correlation, no fading, no multipath</li> <li>- Butler mode (Butler matrix) no correlation, no fading, no multipath</li> <li>- Optional 3GPP-SCM model pack</li> <li>- Optional 802.11 TGn model pack</li> <li>- As an active participant in the WiMAX forum and other groups, Azimuth intends to follow the modeling discussion and make new downloadable model packs available as the need arises</li> </ul>	<b>Signal Levels</b>	
Maximum Doppler Shift	655 Hz, 120km/hr @ 5.9GHz, 308km/hr @ 2.3GHz	Input Signal Level	+20 to -22 dBm
Maximum Delay Spread	40 usec	RF Output Power Peak	-18 dBm
Min Path Insertion Delay	< 1 usec	RF Attenuator Range	65 dB
		- Resolution	1 dB
		- Accuracy	+/- 1 dB
		<b>Dynamic Range</b>	
		Error Vector Magnitude (EVM)	<-41 dB typical (in 40 MHz channel)
		Output Noise Floor	-166 dBm/Hz
		<b>Additive White Gaussian Noise</b>	
		SNR setting	-10 to + 35 dB
		Resolution	0.1 dB
		Crest factor	10 dB

Note: Specifications are subject to change without notice.

## ACE Product Options

Model	Description
ACE-400WB/Wi-Fi	ACE Wi-Fi Channel Emulator for Bi-directional 4x4 MIMO
ACE-400WB/2x2/B	ACE WiMAX Channel Emulator for Bi-directional 2x2 MIMO
ACE-400WB/4x4/U	ACE WiMAX Channel Emulator for Uni-directional 4x4 MIMO
ACE-400WB-2.5/3.5/5	ACE WiMAX Channel Emulator for Bi-directional 4x4 MIMO
ACE-031	Custom Model Builder License
ACE-032	TGn Channel Models A through F Model Pack
ACE-033	ITU M.1225 WiMAX Channel Models Model Pack
ACE-034	3GPP SCM Channel Models Model Pack
ACE-041	AWGN License
RPE-401	RadioProof Isolation Enclosure, MIMO Ready, Single Laptop Size Chamber with Filter
RPE-401/L	RadioProof Isolation Enclosure, MIMO Ready, Single Large Micro BS Size Chamber with Filter
RPE-401L/AC	RadioProof Isolation Enclosure, MIMO Ready, Single Large Micro BS Size Chamber with Filter and 110/220VAC
RPE-402	RadioProof Isolation Enclosure, MIMO Ready, Dual Handset/CPE Size Chamber with Filter
DIR-105	DIRECTOR II Test Executive Application Software
DIR-106	DIRECTOR II Core Applications (Testbed Manager, Test Driver, Test Writer, Test Scheduler)
DIR-107	DIRECTOR II Test Builder Application
DIR-421	MIMO Range Benchmark Suite for ACE-400WB/Wi-Fi

### Corporate Headquarters

Azimuth Systems, Inc.  
31 Nagog Park  
Acton, MA 01720

Phone: 978. 263. 6610  
info@azimuthsystems.com

### West Coast

Azimuth Systems, Inc.  
2890 Zanker Road, Suite 205  
San Jose, CA 95134

Phone: 408. 943. 8300  
www.azimuthsystems.com

