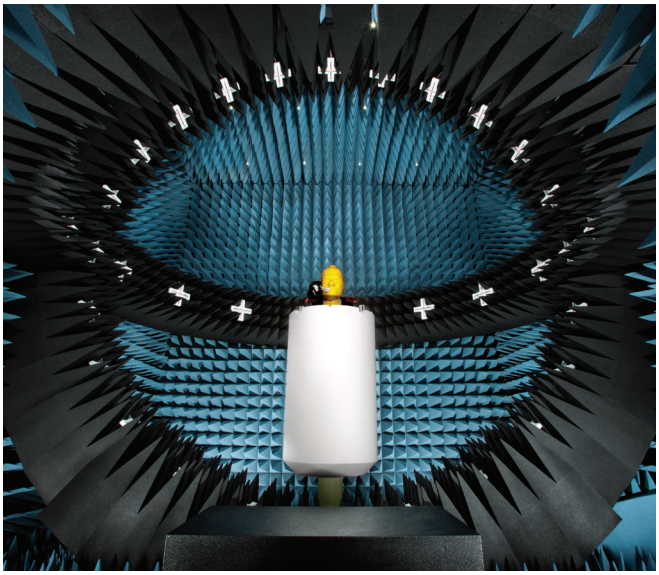
CASE STUDY SGS WIRELESS TEST LAB - SAN DIEGO



SGS, a leading global provider of verification, testing and certification services, has collaborated with ETS-Lindgren, a leader in test and measurement solutions, on dozens of acoustic, EMC and wireless test and measurement chambers at SGS facilities worldwide. When SGS in San Diego was ready to expand their test lab services to include testing of wireless devices, they turned to the experts at ETS-Lindgren. Known for several "industry firsts", including the world's first CTIA Authorized Test Lab (CATL), SGS knew they had a long-time partner they could trust to ensure the new service offering would attract customers. This partnership between SGS San Diego and ETS-Lindgren has continued since that first chamber installation with modifications to add new wireless test capabilities and more!

ETS-Lindgren provided an Antenna Measurement System, Model AMS-8923-195, for radiated wireless antenna measurements with test packages to support Cellular, Wi-Fi, A-GPS, LTE-SISO (FDD/TDD), and MIMO OTA Testing Capabilities. A subsequent addition to this chamber included installation of an LTE-A test system. ETS-Lindgren designed the chamber to easily install additional test protocols as needed in the future. This provides SGS with the flexibility to meet the growing needs of its customers.

Antenna Measurement System Chamber Overview

- The ETS- Lindgren Series 81 shielded enclosure provided consists of shielded modular panel sections assembled with a clamping system into a self-supported enclosure.
- The chamber is lined with ETS-Lindgren polyurethane absorber. A unique two-step impregnation process maximizes carbon distribution uniformity results in higher performance and improved fire resistance. While ammonium based compounds are highly hygroscopic, ETS-Lindgren utilizes a non-hygroscopic, moisture-resistant substrate. FlexSorb™ coating creates durable absorber tips that resist breakage.
- A High-Speed Switch Matrix provides all switching and control necessary for high-speed RF signal routing to the array of dual-polarized antennas. Each antenna polarization is connected to one of two banks of multiple SMA connectors.

Multi Antenna Array and Controller Overview

- Aluminum truss multi-antenna array houses 23 dual-polarized measurement antennas spaced every 15° between black anechoic absorber material.
- Low dielectric materials provide continuous rotation along the phi axis with minimized reflections.
- Each antenna is surrounded by a pyramidal absorber configuration with wedge absorber fillers on either side, providing flexibility to relocate antennas.
- A high-speed switch control box integrated on the array structure provides fast switching between antennas for accelerated testing.

EMQuest™ EMQ-100 Software

ETS-Lindgren's EMQ-100 Antenna Measurement Software offers a wide range of fully parameterized test methods for measuring basic antenna performance metrics as well as testing both radiated and conducted performance of various wireless devices. The baseline test suite includes fully automated 2-D (polar) and 3-D (spherical) pattern measurement capabilities in addition to various frequency response measurements for both passive antennas and active wireless devices for either transmit or receive mode. Vector versions of the tests provide left/right-hand circular polarization, elliptical polarization, and antenna correlation. Scalar and vector response tests perform cable and range loss (path loss) measurements that can correct any subsequent measurement.

MIMO Testing Capability

Theoretical MIMO gain assumes that each individual link between the transmit and the receive antenna is uncorrelated. The MIMO gain can be used for improved performance, either as extended coverage or as higher data throughput. The requirement for excellent RF performance is accompanied by high delay accuracy between both channels and controllable amplitude and phase correlation. ETS-Lindgren provided this capability by supplying a matrix of antennas arrayed around the DUT on a MIMO antenna structure, producing different angles of arrival (AOA). By feeding each antenna with a suitable statistical delay spread, a 2D or 3D spatial channel model can be converted to an over-the-air spatial channel model, with the antennas providing the AOA and angular spread of reflections from the various reflecting clusters in the spatial channel model. Increasing the channel emulator output for OTA testing, an 8-port LNA Power Amplifier (700 MHz to 3 GHz) supports single polarization testing with eight included antennas (or dual polarization testing with four antennas).

Increased Test Capability

As previously mentioned, following the initial chamber installation, SGS upgraded the chamber to support LTE-A testing. LTE-A implements Carrier Aggregation (CA) increasing the bandwidth and therefore increasing the bitrate between the base station and user terminal. The baseline system was designed for radiated wireless antenna measurements over the 700 MHz to 6 GHz frequency range and for supporting MIMO measurements.

About ETS-Lindgren

ETS-Lindgren is an international manufacturer of components and systems that measure, shield, and control electromagnetic and acoustic energy. The company's products are used for electromagnetic compatibility (EMC), microwave and wireless testing, electromagnetic field (EMF) measurement, radio frequency (RF) personal safety monitoring, magnetic resonance imaging (MRI), and control of acoustic environments.

Headquartered in Cedar Park, Texas, ETS-Lindgren has manufacturing facilities in North America, Europe and Asia. The company is a wholly owned subsidiary of ESCO Technologies, a leading supplier of engineered products for growing industrial and commercial markets. ESCO is a New York Stock Exchange listed company (symbol ESE) with headquarters in St. Louis, Missouri. Additional information about ETS-Lindgren is available at www.ets-lindgren.com. Additional information about ESCO and its subsidiaries is available at www.escotechnologies.com.

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