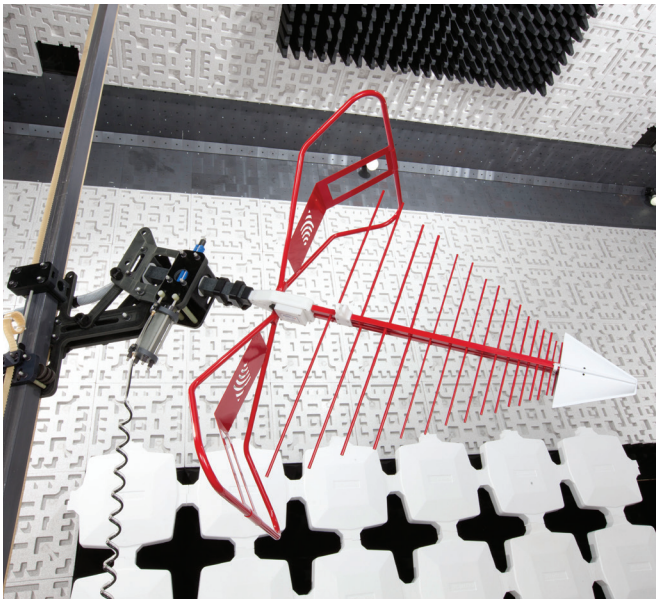
CASE STUDY PCTEST ENGINEERING LABORATORY - COLUMBIA, MD



PCTEST Engineering Laboratory is a world leader in providing EMC/EMI (Electromagnetic Compatibility/ Electromagnetic Interference) and Radio Frequency (RF) testing services to the wireless, electronics and telecommunications industry. Founded by former FCC engineers, PCTEST Engineering Laboratory Inc. was established in 1989 on the principle of providing manufacturers with a much-needed independent facility, fully capable of testing to a comprehensive set of FCC regulatory technical requirements.

Distinctive to its initial pioneering efforts, in 2011 PCTEST became a Verizon Wireless Authorized Test Facility for LTE. This complements their wide array of test services in SAR, HAC, OTA, and testing lithium batteries of wireless devices in accordance with IEEE 1725 and 1625 for CTIA certification.

In December 2016, PCTEST received CTIA authorization to test to the new CTIA Test Plan for 2×2 Downlink MIMO and Transmit Diversity Over-The-Air (OTA) Performance, Version 1.1. Also in December 2016, ETS-Lindgren was included in the CTIA issued MIMO Authorized Equipment List as the first and only supplier that is able to provide a system level solution to conduct MIMO Over-the-Air measurements in accordance with the CTIA Test Plan for 2x2 Downlink MIMO and Transmit Diversity Over-the-Air Performance, Version 1.1. This partnership of pioneering companies has enabled PCTEST to meet their customers' demanding schedules and reduce their time to market effectively.

At PCTEST's Maryland facility, ETS-Lindgren provided a multi-purpose FACT™ 3-2.0 Premium EMC Chamber supporting full certification testing per the ANSI C63.4, ANSI C63.10, ANSI C63.26, CISPR 16-1-4, and IEC 61000-4-3 standards, including Radiated Spurious Emission (RSE) testing.

ETS-Lindgren also upgraded an existing RF shielded enclosure to support EIRP/ ERP measurements, RSE measurements to 18 GHz, PTCRB as well as ETSI applications.

FACT™ 3-2.0 Chamber Overview

The FACT 3 chamber provides a semi-anechoic radiated emissions and fully anechoic radiated immunity compliance test capability for most international EMC compliance regulations. This chamber achieves its performance using an optimized arrangement of hybrid absorber consisting of ferrite based and dielectrically matched high frequency material. The chamber features a 2-meter quiet zone for FCC and CISPR radiated emissions testing of wireless devices. This includes the FCC requirements for ERP and EIRP testing. The shielding attenuation and floor absorber was customized to accommodate RSE testing up to 25 GHz.

Dimensions and Performance

- Main 3 meter chamber is 8.53 m x 6.10 m x 5.49 m (28 ft x 20 ft x 18 ft) interior shield-to-shield dimensions.
- The adjacent RF shielded control room has interior shield dimensions of 4.88 m x 3.05 m x 3.05 m (16 ft x 10 ft x 10 ft).
- An RF shielding effectiveness verification test was performed per MIL-STD-285/IEEE-299.
- The Normalized Site Attenuation (NSA) performance achieved is +/-3 dB per ANSI C63.4 (2009) from 30 MHz to 1 GHz.

- Ongoing Radiated Spurious Emission testing is performed at 20 Hz to 26.5 GHz, -155 dBm to +30 dBm, RBW 1 Hz to 10 MHz, for certification to commercial and military standards.

Chamber and Components

- The FACT Series 81 Shielded Enclosure consists of a shielded modular panel and framing system that are connected to a self-supporting structure.
- The FerroSorb™ Hybrid Absorber material used was created through ETS-Lindgren's unique two-step impregnation process. This uniformly impregnated absorber is truly non-hygroscopic and can effectively operate at 10% to 95% ambient relative humidity levels. ETS-Lindgren provided a hybrid absorber consisting of ferrite tiles (Model FT-1500) and high frequency polyurethane absorber (Model FAA-600H).
- Carts with removable hybrid absorber (Model FS-600H) were provided for RSE testing.
- Removable polyurethane pyramidal floor absorber (Model ERP-12PCL) enables sVSWR testing per CISPR 16-1-4 in front of the quiet zone.
- A EuroPro™ 2188 series medium duty turntable, 2 m (6.5 ft) diameter with a 1000 Kg (2,205 lb) weight capacity, offers a custom variable speed of 5-RPM max.
- ETS-Lindgren's Model 2090 multi-device positioning controller allows simultaneous, yet independent, movement of two primary devices in both manual and remote GPIB modes while controlling the on/off operation. Fiber optic control lines eliminate extraneous RF interference that can normally be conducted through signal cables.
- All chamber components were provided by ETS-Lindgren for a turn-key installation, including RF shielded doors, air vents, penetrations, filters, and antennas, to name a few.

Upgraded Anechoic Chamber Overview

ETS-Lindgren also upgraded an existing 6 m x 3.6 m x 3.6 m (20 ft x 12 ft x 12 ft) RF shielded enclosure to support EIRP/ERP measurements, Radiated Spurious Emissions (RSE) measurements to 18 GHz, and ETSI applications. ETS-Lindgren provided high performance pyramidal RF microwave anechoic absorber material, layout design, and installation including:

- Model EHP-18PCL on sidewalls, ceiling and receive wall
- Model EHP-12PCL on the transmit wall
- Model EHP-18PCL-WW on the floor

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.

Information presented is subject to change as product enhancements are made. Contact ETS-Lindgren Sales Department for current specifications.

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