



DVTEST

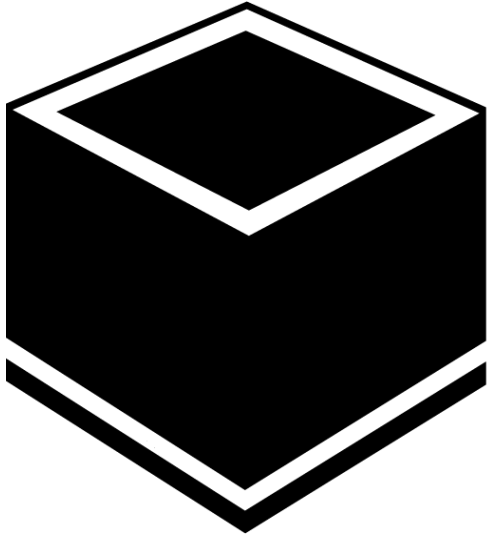
RF Test Enclosure Presentation

Best Isolation

Better Results

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- DVTEST began in 1985 as Multitest and was acquired by Testforce in 1999
- Over 25 employees with engineering backgrounds ranging from Masters, Bachelors and Technology degrees.
- Primarily focused on solutions for the Wireless, Aerospace, Automotive, Power industries.
- Global technical sales network



RF Test Enclosures



RF Test Enclosure Product Family



	dbCHECK	dbGUARD	dbTENT	dbSAFE X	dbSAFE DUO	dbSAFE RME	dbSAFE TSE	dbSAFE MAX	dbSAFE NR6	dbSAFE mm	dbSAFE ARMOR	dbSAFE 5GS
Door Style Opening	Clamshell	Clamshell	Front Load	Top Load	Top Load / Front Load	Front Load	Front Load	Front Load	Front Load	Front Load	Front Load	Front Load
Use Case	Economical RF enclosures suitable for repair environments and compliance testing (In Stock)	Robust RF enclosures recommended for high volume manufacturing and automated testing	Portable RF enclosures suitable for on-site and temporary lab environments	Economical RF enclosures for lab use and compliance testing (In Stock)	Customizable RF enclosures for lab use, compliance testing, and research & development (In Stock)	Rack mount RF enclosures recommended for large UUT testing	Temperature and RF enclosure recommended for lab use, compliance testing, and research & development	Large RF enclosures recommended for lab use, compliance testing, and research & development	RF enclosure designed for high bandwidth, NR6 applications	Dual Cavity RF enclosure designed for mmWave applications	Advanced, modular RF enclosures recommended for multiple frequency ranges and applications	Advanced, modular RF enclosure system recommended for 5G testing
Shielding Effectiveness (Isolation)	> 80 dB	> 80 dB	> 80 dB	> 80 dB	> 100 dB	> 100 dB	> 100 dB	> 100 dB	> 100 dB	> 100 dB	> 100 dB	> 100 dB
Peripheral Test Equipment Rack										Available Internal or External	Available External all models Internal available some models	Available External all models Internal available some models
Frequency Range (GHz)	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 13	0.3 - 40	0.3 - 90	0.3 - 90
Extreme Temperature Testing							Included	✗	✗	✗	✗	✗
Extruded Aluminum Base Available								✗	✗	✗	✗	✗
Waveguide Passive Cooling	Some Models	Some Models	✗		✗	✗	✗	✗	✗	✗	✗	✗
Waveguide Active Cooling	Some Models	Some Models	✗		✗	✗	✗	✗	✗	✗	✗	✗
Custom Sizes Available	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Positioner - Manual Rotation and Translation	✗	✗		✗	✗	✗	✗	✗	✗	✗	✗	✗
Positioner - Full Spherical Pattern											✗	✗
Measurement Software (Optional)								✗	✗	✗	✗	✗
OTA Performance Verification Tools Available	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗
Warranty (Standard / Registered)	1Y / 2Y	1Y / 2Y	1Y	1Y / 2Y	2Y / 3Y	2Y / 3Y	2Y / 3Y	2Y / 3Y	2Y / 3Y	2Y / 3Y	2Y / 3Y	2Y / 3Y
Internal Dimensions (Inches) W x D x H	dbCheck 14 x 11.25 x 8 dbCheck+ 14 x 20 x 8	Small 7 x 14.75 x 7.5 Medium 15.25 x 14.75 x 7.5 Large 18.6 x 16.5 x 9.25	Small 24 x 24 x 24 Medium 36 x 36 x 36 Large 48 x 48 x 48	dbSAFEX 12 x 18 x 8 dbSAFEX+ 18 x 24 x 12	Top Small 8.5 x 11 x 5.5 Medium 11 x 17 x 8 Large 15 x 2 x 13 Front Medium 11 x 17 x 8 Large 15 x 24 x 13	4U 14 x 20 x 4 7U 14 x 20 x 9.25 10U 14 x 20 x 14.5	dbSAFE TSE 10 x 16 x 7	dbSAFE MAX 18 x 24.5 x 30 dbSAFE MAX+ 32 x 32 x 32	dbSAFE NR6 19.5 x 19.5 x 19.5	Upper 24 x 18.5 x 29 Lower 24 x 7.5 x 29	3232 32 x 32 x 32 4242 42 x 42 x 42 2418R Upper: 24 x 27.5 x 24 Lower: 24.5 x 28 x 7 3270 32 x 24 x 70 5242 52 x 42 x 42	5GS - 3270 32 x 24 x 70 5GS - 5242 52 x 42 x 42

dbSAFEx

RF TEST ENCLOSURE



ISOLATION

> 80 dB Isolation



FREQUENCY RANGE

Designed to operate between 300 MHz to 13 GHz



SIZES

Available in 2 sizes :

dbSAFE | W X D X H : 12" X 18" X 8"

dbSAFE + | W X D X H: 18" X 24" X 12"

dbCHECK

RF TEST ENCLOSURE



ISOLATION

> 80 dB Isolation



FREQUENCY RANGE

Designed to operate between 700 MHz – 6000 MHz



SIZES

Available in 2 sizes :

dbCHECK | W X D X H : 11.9" X 14.68" X 8.68"

dbCHECK + | W X D X H: 11.25" X 14" X 8"

RF testing has never been so easy. The TSE utilizes proven double wall dbSafe architecture to provide one of the best RF environments on the market. Incorporating the thermal isolation characteristics of the DVTEST Fixtreme series of moisture free thermal test environments, when paired with a temperature forcing unit, the system is capable of RF shielded testing at extremes of - 80 to +180°C*.



dbSAFE TSE

RADIO FREQUENCY AND THERMAL TESTING COLLIDE



BEST IN CLASS RF ISOLATION

80 dB RF Isolation* enclosure up to 6 GHz



THERMAL CAPACITY

Paired with temperature forcing unit enables RF shielded testing at extremes of - 80 to +180°C*.



WAVEGUIDE TECHNOLOGY

Fan Vents and air inlets are fabricated using our waveguide technology, ensuring no isolation loss due to apertures.



FROST FREE EXHAUST

A frost free adapter on the exhaust port ensures zero moisture build up and dual offset IO panels maintain isolation between the inner and outer RF shields



ANY SIZE

Enclosure sizes can be adjusted based on the exact requirement and workspace available



CUSTOMIZATION

Custom sizes, air distribution and internal fixtures available.

**Extended Temperature and Isolation ranges available*



SMALL



MEDIUM



LARGE

(WITH SAMPLE INTEGRATED FIXTURE)



AUTOMATION



TEST INTEGRATION



ISOLATION

Shields upto 100dB isolation from DC to 18GHz



SIZES

Small: 14.75" X 7.5" X 7"

Medium: 15.25" X 15.25" X 7.5"

Large: 16.5" X 18.6" X 9.25"



ANTENNA COUPLER INTEGRATION

Recessed pocket allows flush mount installation of dbCOUPLER



INTERCHANGEABLE TEST CARTRIDGE

Modular test cartridges allow a variety of DUTs to be tested

The dbTent is an easy to assembly, store and transport high performance RF test enclosure.

Whether you need to make measurements in the field or in the lab, the dbTent provides superior 90db of isolation over a wide frequency range thanks to its patented double layer conductive fabric design.

Featuring interchangeable customizable IO panels the dbTent will meet all of your need for non-permanent isolated testing.

With a setup time in the matter of minutes, the dbTent will get you testing quickly in any environment.



Available in three standard sizes:

Small (24" x 24" x 24")

Medium (36" x 36" x 36")

Large (48" x 48" x 48")

Application:

Remote monitoring and site deployment

Temporary testing in location where conventional enclosure are not feasible

Facilities requiring periodic testing with space constraints.

dbSAFE (DUO, RME & RME+)

RF TEST ENCLOSURE



BEST IN CLASS ISOLATION

Offers up to 100 dB Isolation between 300 MHz to 13 GHz.



SIZES

Front load : Small | Medium | Large

Top load: Medium | Large

Rackmount: RME 4U,7U,10U (19") RME+ 13U,15U (24")

Custom sizes are also available

dbSAFE MAX



RF TEST ENCLOSURE



UUT TESTING

Blends the superior isolation characteristics of dbSAFE into a larger volume for better results for unit under test (**UUT**)



SIZES

W X D X H : 18" X 23" X 30"

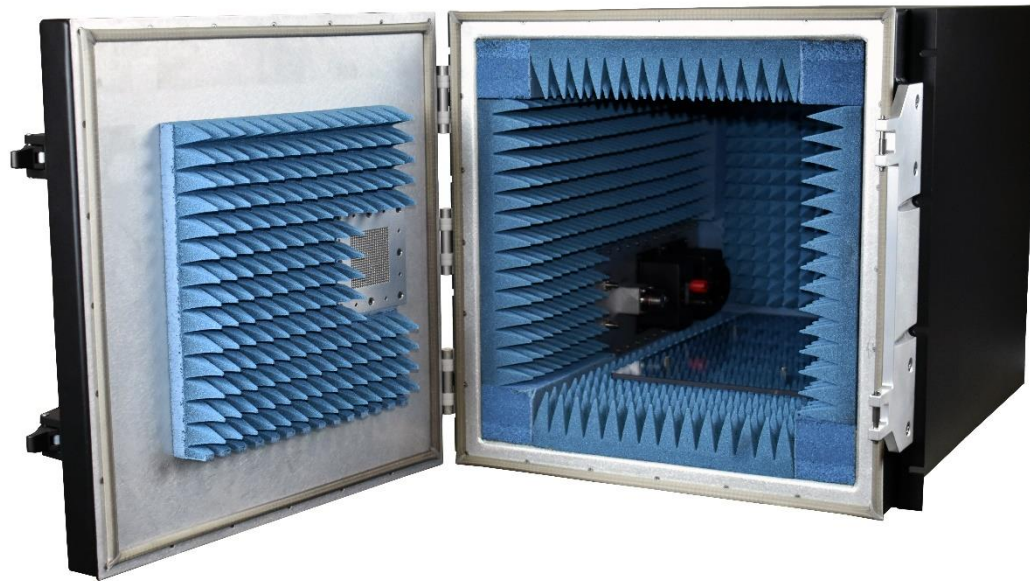
W X D X H : 32" X 32" X 32"

dbSAFE mmWave Frequency Extension

AVAILABLE ON SELECT DUO, RME & RME+ MODELS



10U Rackmount Enclosure



Extends usable frequency from 13GHz to 40 or 60 GHz

dbSafe ARMOR

DVTEST presents the dbSAFE ARMOR series of RF enclosures.

The dbSAFE ARMOR is a cost effective , configurable, modular solution for OTA testing in the millimeter wave spectrum.

The ARMOR series can be used to create portable self contained test systems – freeing up valuable space in test labs and production floors.

The fully anechoic enclosure provides a shielded environment over a very wide frequency range (from 300 MHz to 90 GHz) and ensures stable repeatable measurement.

This wide frequency coverage and high isolation level enables testing of various 5G applications such as low frequency devices (below 1 GHz), LTE-AP, 5G-NR, and mmWave.



dbSafe ARMOR



dbSAFE ARMOR



Advanced mmWave OTA RF Test Enclosure

The dbSAFE ARMOR 3232 / 4242 utilizes DVTEST's advanced double-wall design providing superior isolation without adding bulk. The cube shape maximizes working volume and its symmetrical aspect ratio provides consistent results independent of UE placement. This is the most compact RF test enclosure and is perfectly suited for all wireless frequencies to 90 GHz. The unit is available in two sizes: 32 inches and 42 inches.



Specifications for 3232 / 4242

Isolation	
Shielding Effectiveness (dB)	300 MHz - 40 GHz > 100 dB (Isolation measurements taken adjacent to each seam)
40 GHz - 90 GHz > 90 dB	
Construction	
Wall Type	Double Wall
Door Style	Front Opening Dual Point Latch
RF Gasket	Triple Layer Braid Over Foam
Absorber	High Performance, High Density 2.25" Pyramidal Absorber (Other absorber styles available, consult factory)
Base Type	Extruded Aluminum Trolley
Enclosure Options	
Test Equipment Rack	19" Rack Frame Tray Attaches (Left or Right)
Cooling	Passive Waveguide Vent Active Waveguide Ventilation Module
Waveguide Optical Data Feedthrough	1 or 10 Position Modules Available
USB To Fiber Interface	USB 2.0 / 3.0 / 3.1
Ethernet to Fiber Interface	Up To 10 Gbps
Thermal	Extreme Temperature Testing Rated for -40°C to +50°C
Measurement Software (Optional)	
(System Controller Not Included)	Antenna Under Test OTA DUT Near-Field to Far-Field Spherical Measurement 3D Antenna Patterns Near-Field to Far-Field and Direct Far-Field
Accessories	
OTA Performance Verification	Noise Source and Power Sensor
Test Probe Antenna	dbDIRECT Coax Polarized VNA/S
Calibration Antenna	dbDIRECT Series Standard Gain Horn



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DVTEST • dbSAFE ARMOR • Datasheet

Isolation

Shielding Effectiveness (dB)	300 MHz - 40 GHz > 100 dB
(Isolation measurements taken adjacent to each seam)	40 GHz - 90 GHz > 90 dB

Construction

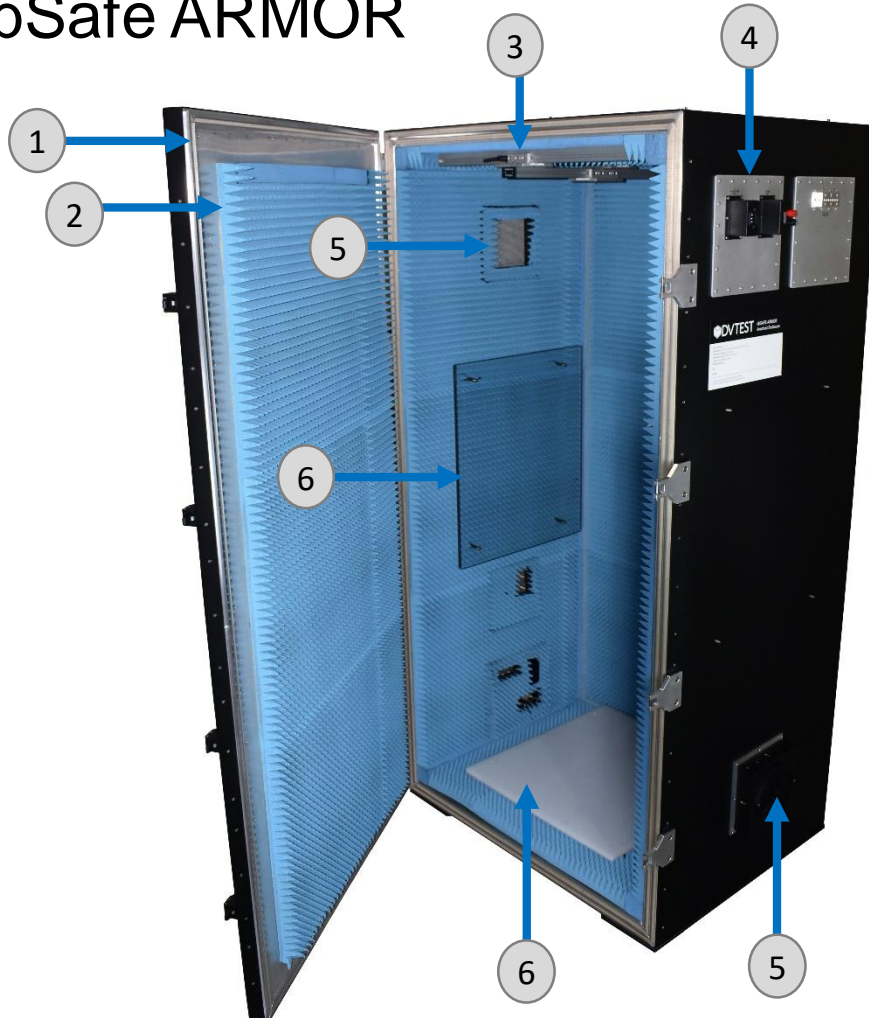
Wall Type	Double Wall
Door Style	Front Opening Dual Point Latch
RF Gasket	Triple Layer Braid Over Foam
Absorber	High Performance, High Density 2.25" Pyramidal Absorber (Other absorber styles available, consult factory)
Base Type	Extruded Aluminum Trolley

Positioning System

(Optional)	Manually Adjusted Rotational and Translational Probe and DUT Mounts
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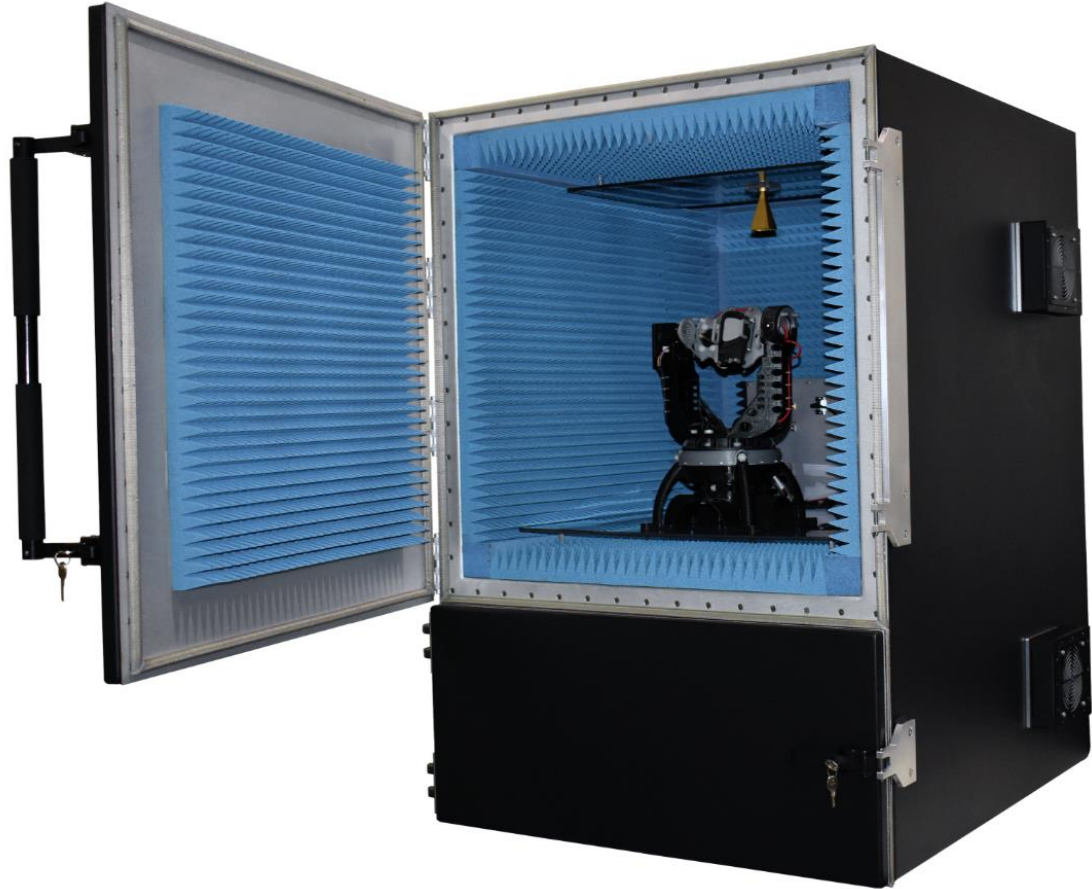
dbSafe ARMOR

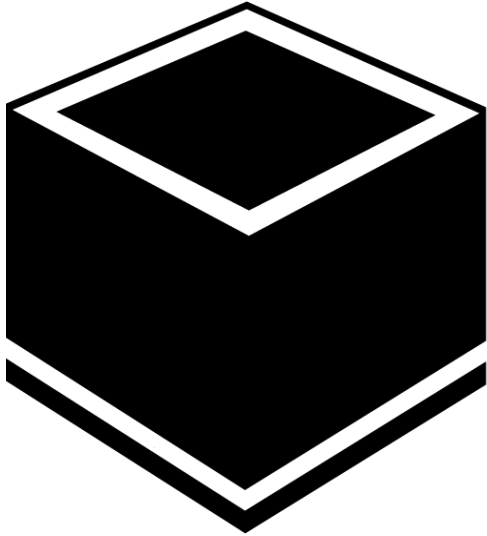


1. Triple shielded machined door geometry
2. High performance pyramidal absorber
3. Manual probe positioner (Automated available)
4. Dedicated power/comms and RF IO panels
5. High volume fan modules
6. Customizable removable base and side plates

dbSafe ARMOR

The ARMOR series can be paired with a variety of DVTEST positioning solutions (Planer, Cylindrical or other) to create turnkey test systems.

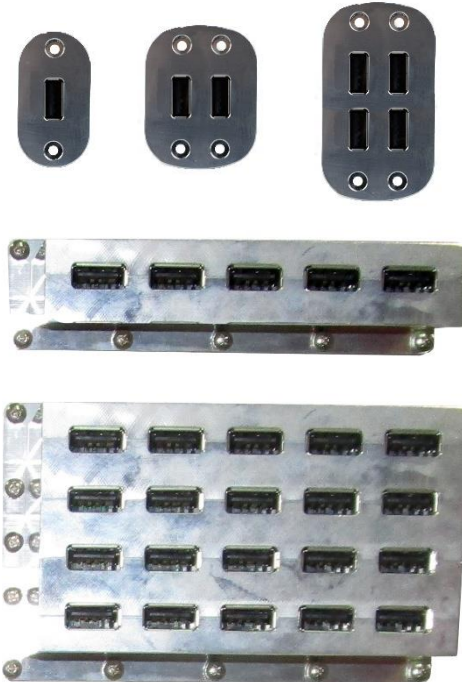




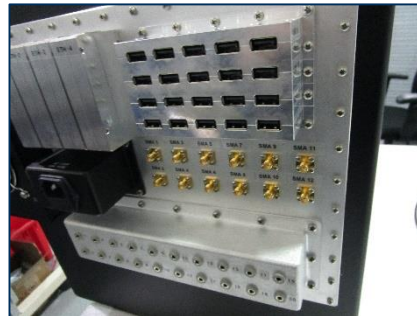
I/O Modules

USB I/O Modules

USB 2.0 & 3.0 A-Type



USB 3.0 B-Type



DVTEST Filtered Shielded USB 2.0 EMI and noise filtering module

Routing high speed data to the RF enclosure requires a solution that will preserve the shielding effectiveness of enclosure. Any aperture on the body of the enclosure reduces shielding effectiveness of the enclosure. High speed data transmission is done using differential pairs. The main challenges are how to avoid Electromagnetic Interference (EMI) from entering into the enclosure and how to minimize the common mode noise generated in data lines.



The speed of the data lines in USB 2.0 is up to 480Mbps, therefore data line filter must be capable of routing that speed while filtering the unwanted noise. Therefore USB 2.0 module consists of a high speed filter that allows differential data signals to pass through it with less than a dB loss, while the filter rejects the unwanted common mode noise. The power line is also filtered to avoid differential noise to pass through the module. The filter is enclosed with shielded housing to avoid EMI affecting the data transmission from two ends of this module.

The RF isolation difference between the inside and the outside of the RF enclosure is shown in the graph on the right (500MHz to 8GHz). The isolation between two ports of USB 2.0 module is provided through machined aluminum housing that can be mounted on DVTest standard IO panel for any sizes RF enclosure.



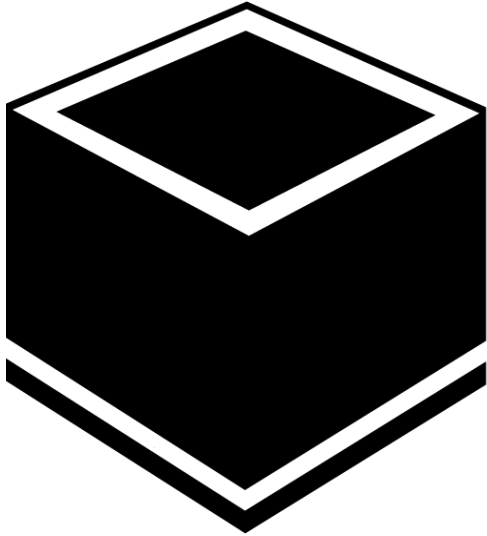
Features and benefits:

- Eliminates other signals (WiFi, LTE, Cellular, etc) and EMI from entering RF enclosure and your DUT (Device Under Test).
- Machined aluminum housing ensures rigidity and durability.
- Precision design in filtering for maximum common mode rejection.



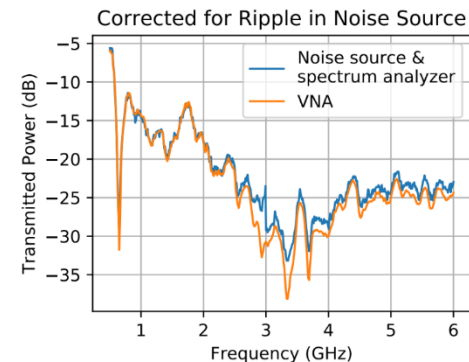
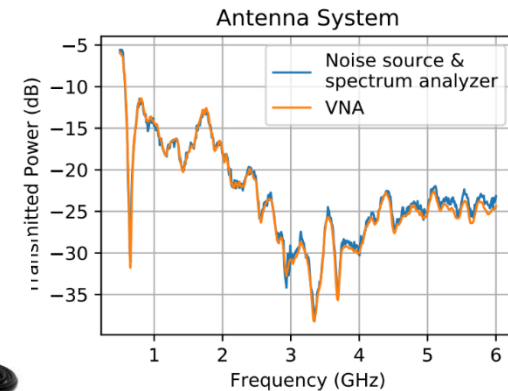
- Routing USB 2.0 signal inside and outside of RF enclosure while eliminating noise and EMI.
- RF Isolation over 80dB from 500MHz to 8GHz.

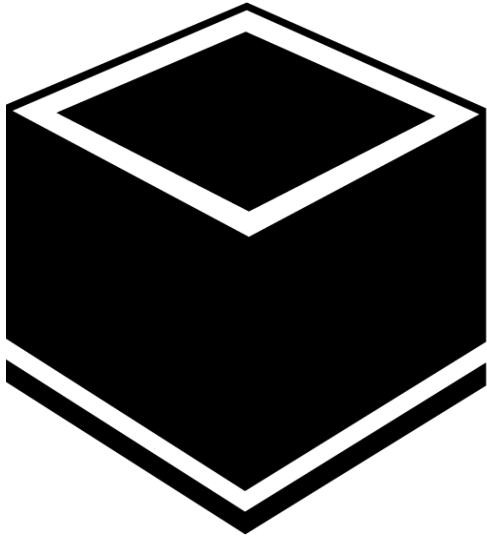
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OTA Performance Verification

5G OTA Performance Verification

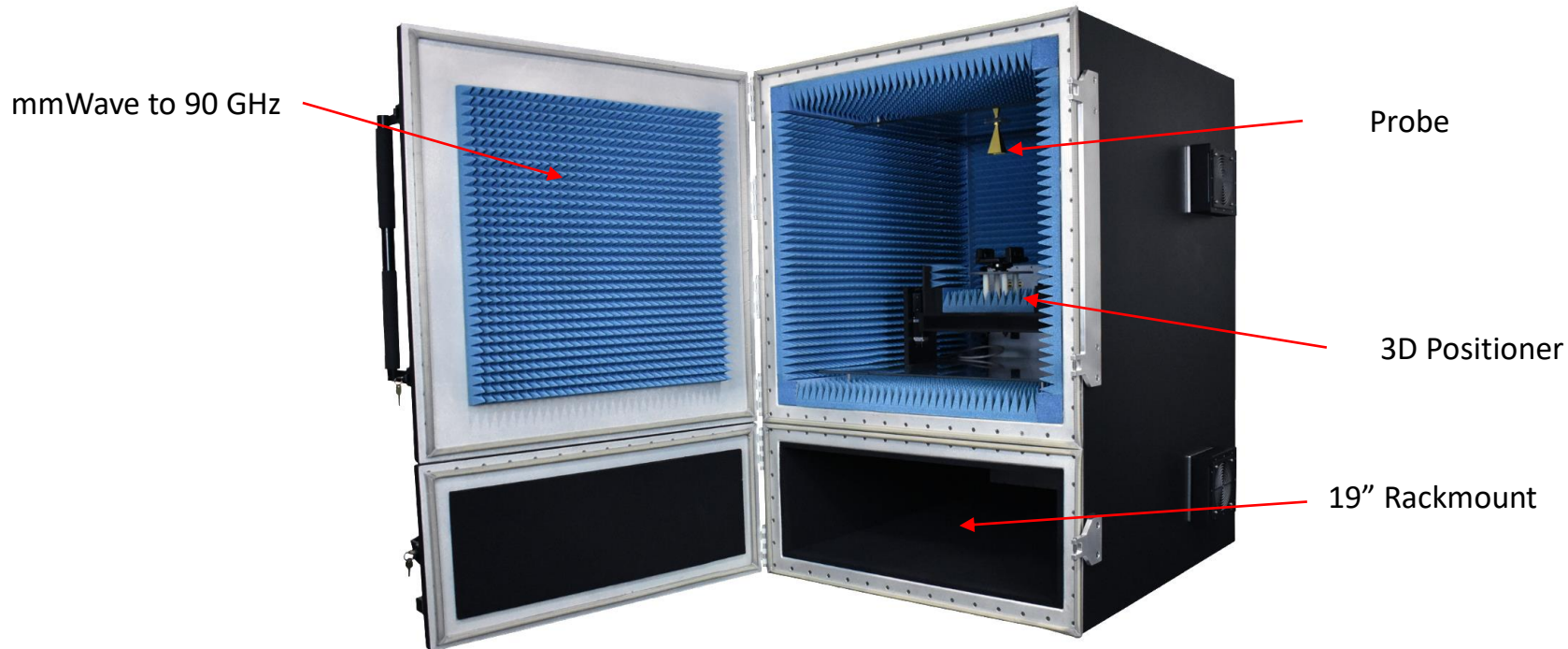


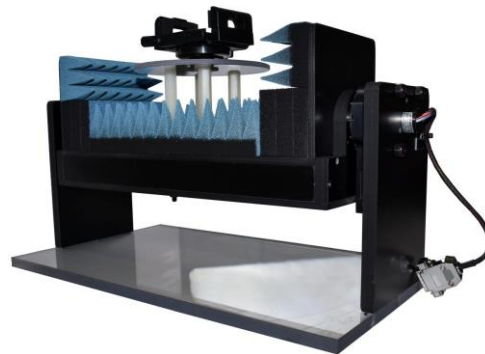
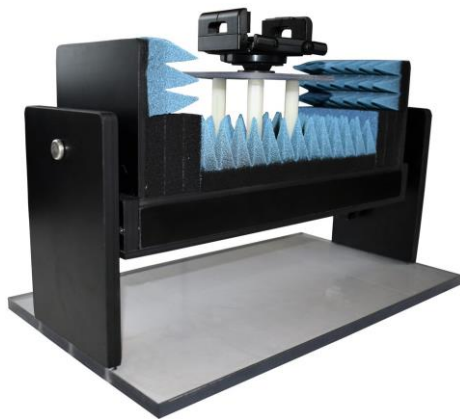


OTA Direct Near-Field Testing

dbSafe ARMOR 2418

Example of Direct Near Field Setup





- Range of rotation – Full 360 degree continuous rotation
- DUT size – 6"x6"x3"
- Accuracy – 0.08°
- Maximum speed – 115 °/s
- DUT weight – 11lbs
- USB controller included

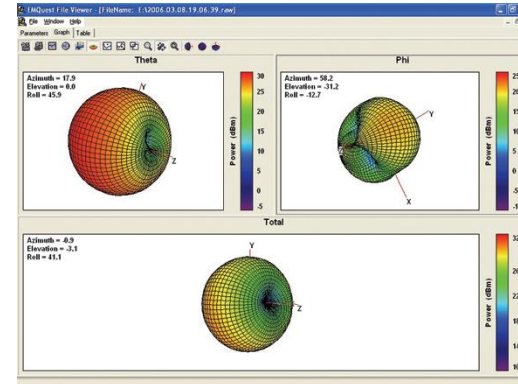
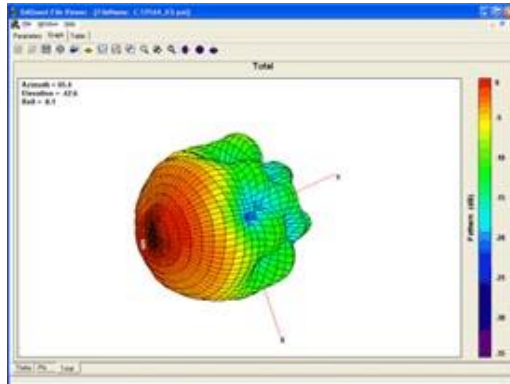
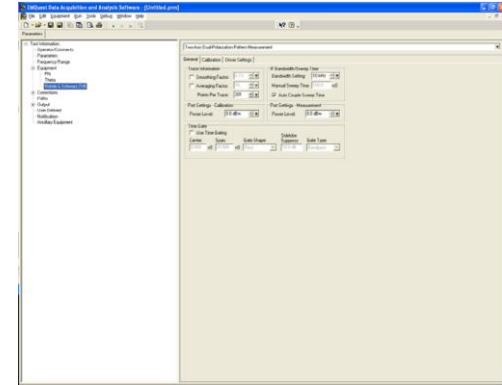
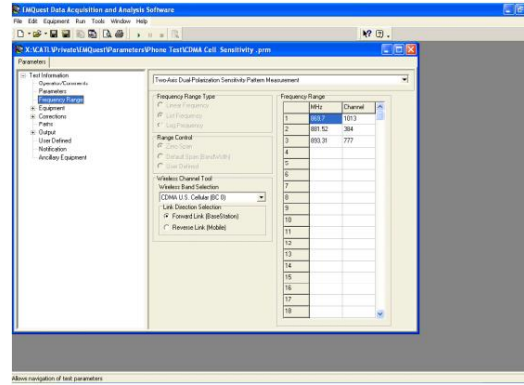
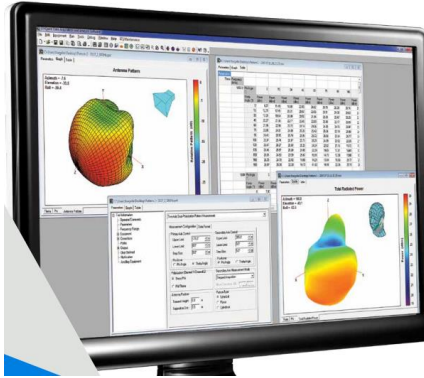


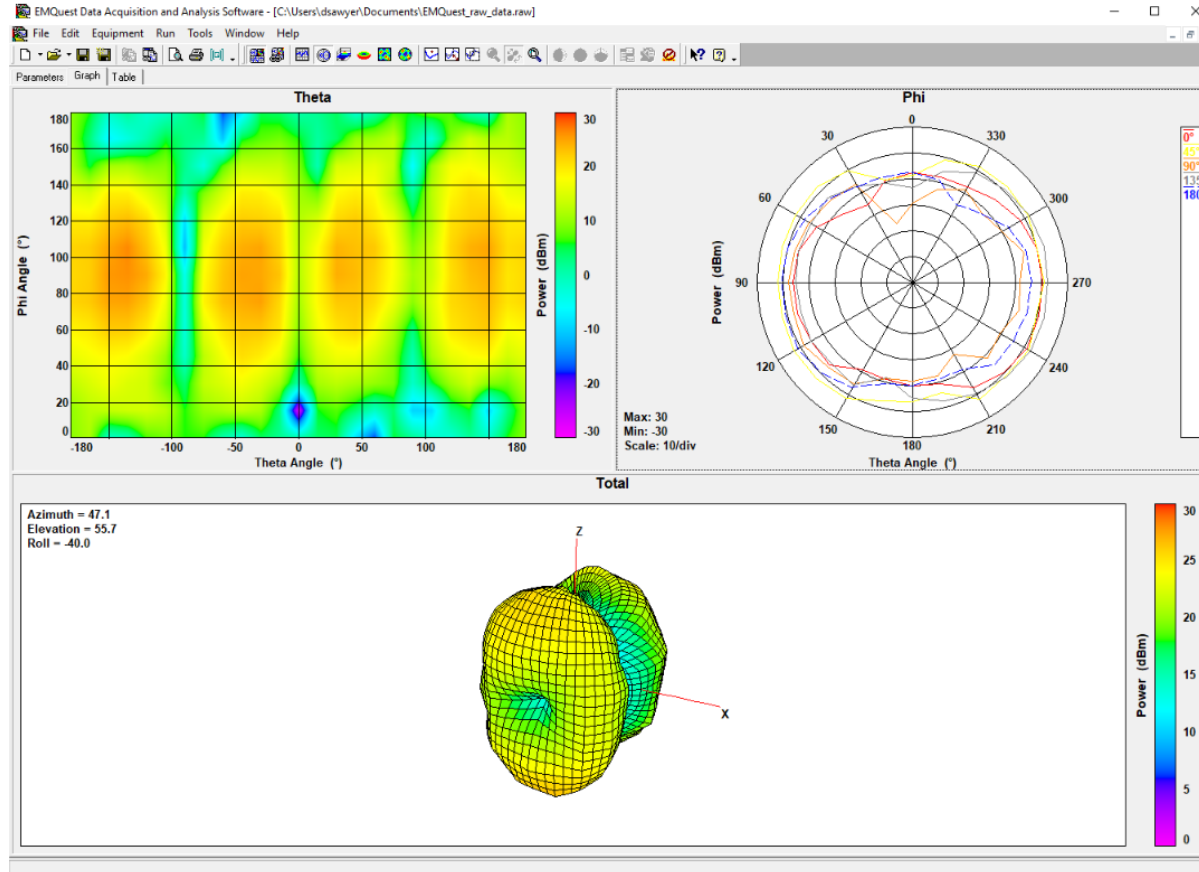
- Range of rotation – ± 180 deg horiz, ± 180 deg vert
- DUT size – 4.3"x4.3"x3"
- Accuracy – Better than 1°
- Maximum speed – 75 °/s
- DUT weight – 11lbs
- USB controller included

- ETS Lindgren EMQuest™
 - Antenna Measurement Software offers a wide range of fully parameterized test methods
 - Expandable Test Package
 - Testing Capabilities
 - Wireless Performance Testing
 - OTA Evaluation
 - TRP/TIS Testing
 - Site Validation and Calibration
 - Parameter Entry and Data Acquisition
 - Allows integration of external NF-FF module



ETS Lindgren EMQuest™





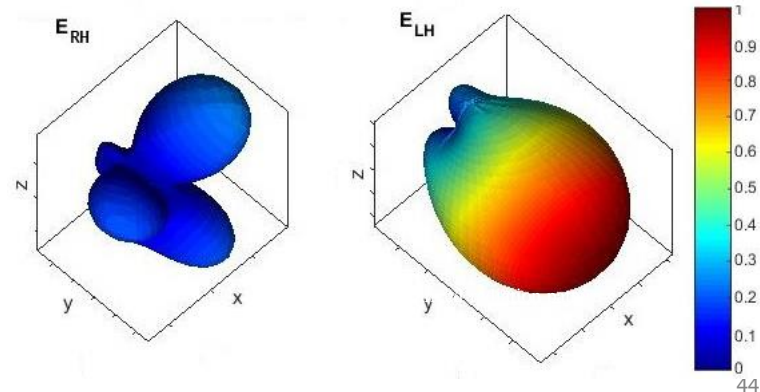
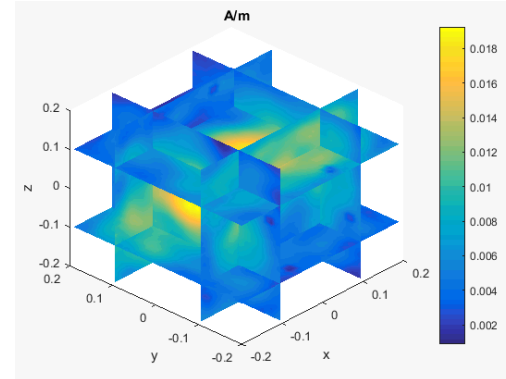
3D Pattern Generation Using 6 Planar Measurements

The Antenna under test (AUT) is placed in front of the scanner.

AUT is rotated and its 6 faces are measured one face at a time.

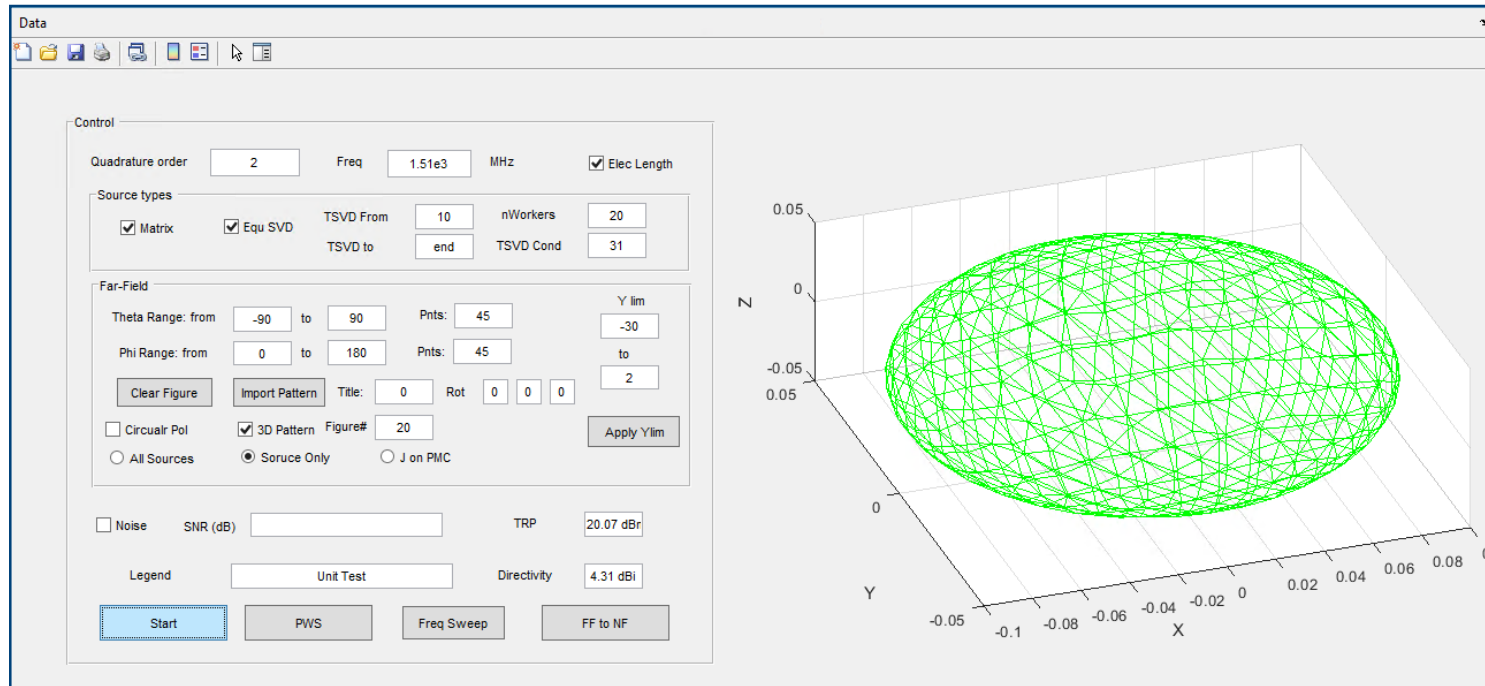
It assumed the measurements are phase coherent.

Measurement at each face might be off by a consistent linear factor.

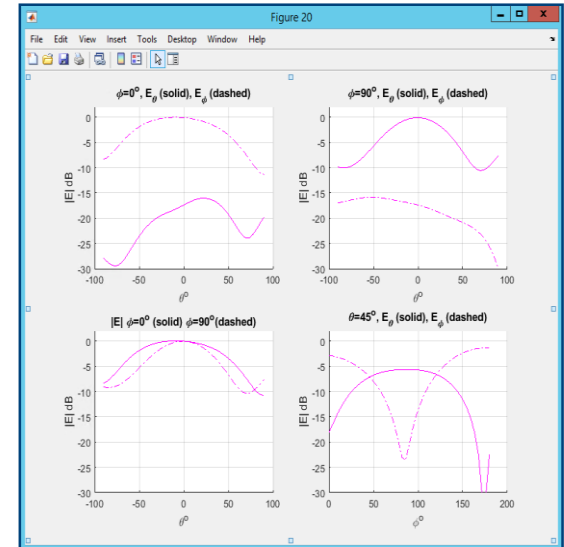
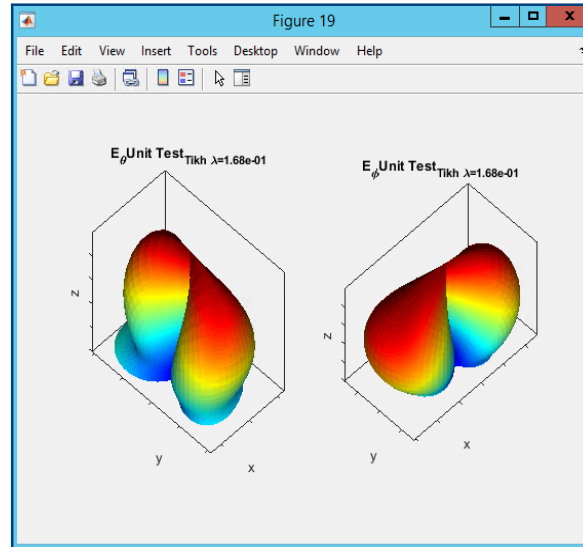
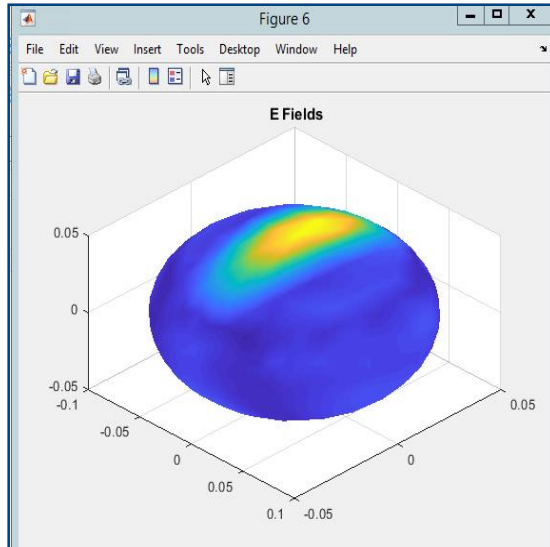


Sample User Interface

(the user can interact with the application using GUI)



User Interface (Examples of Results)





5G TECHNOLOGY PROPELS mmWAVE FREQUENCIES

DVTEST Portable RF
Anechoic Test Enclosures
DC-90 GHz

WHITE PAPER

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www.dvtest.com



RF ENCLOSURE Double-wall and Single-wall Comparison

White Paper

Radio frequency shielding is an approach to avoid undesired energy being coupled into equipment under test. The ability of an enclosure to avoid undesired RF fields to couple to the device under test is known as its Shielding Effectiveness (SE). This term represents the ratio of field strength with and without the enclosure. SE for RF enclosures is always compromised by apertures, slots, cable penetration, etc.

In order to predict the SE of enclosures, various methods have been introduced. Analytical methods can be used to determine SE for enclosures with apertures.

Emerging sensitive wireless devices operate with minimum power levels and require a shielding level of more than 100dB for wireless testing. In this study a new approach to increase the SE of enclosures to more than 100dB is demonstrated.

The enclosure can be considered as a waveguide with only single mode of propagation (TE_{10}). In this paper, the effect and advantages of double-wall on Shielding Effectiveness of RF enclosures are proposed. The effect of considering a gap "G" between walls of enclosure and an offset on apertures are investigated. An enclosure with aluminum walls is modeled and simulated using finite element method in High Frequency Structural Simulator (HFSS, Ansoft).

In Figure 1, horn antennas are used to simulate the SE of the enclosure, aluminum walls are considered 0.125" thick. In Figure 2, E-field is modeled on a single-wall without any aperture on it.

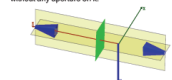


Figure 1: Horn antennas for shielding measurement, single-wall is shown in between two horns.
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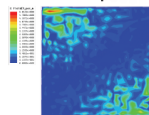


Figure 2: E-field distributed on a wall with no apertures. As it can be seen, field is higher in the wedges where the electric currents flow. The magnitude of E-field is 50 mV/m in the corners.

The effect of single aperture on E-field distribution is simulated in Figure 3. It is shown that field intensity is doubled around the edges of the aperture.

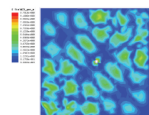


Figure 3: E-field is shown in the case with one single aperture. As it can be seen, E-field is concentrated around the edges of the aperture and the field intensity is almost doubled.

The SE is maximum when there is no aperture, but it is not possible for an enclosure to have no aperture, cable, etc. The aim of this study is to model a structure to increase the SE of an enclosure with apertures. We consider two parallel walls with equal thickness and gap "G" as shown in Figure 4. In Figure 5, SE of structure is shown when the gap is varied.



RF ENCLOSURE High Speed Data Routing

White Paper

Differential transmission lines play an important role in high speed digital circuits due to their immunity to noise and Electromagnetic Interference (EMI). Differential pairs are composed of symmetrical signal traces where signals propagate. The traces are aimed to be designed with minimum fabrication discontinuity ensuring a balanced propagation. Any imbalance will generate noise, which is an unwanted common-mode signal that couples to the shield, ground or I/O cables and causes EMI problems. In recent years, the number of differential pairs for high speed data communication has increased to accommodate higher quality and data rate. As in USB 3.0, PCI Express is the increasing number of differential pairs become a challenge in routing the signal traces symmetrically, and that can cause common-mode noise issue. Also, crosstalk between differential pairs can reduce signal quality.

I. State of Problem

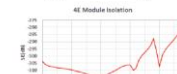
RF enclosures have been used for device testing for decu they provide an environment free of noise and interfere higher magnitude of isolation ensuring lower noise interference within RF enclosures. EMI related issues connections such as USB 3.0, Express II, and Ethernet can degrade the isolation of the enclosure. Common-chokes are used to filter noise for data I/O connections where transmission of the differential-mode signals. In common-mode signals, in most cases, their performance limited to small effective bandwidths, and only up to 1 common-mode noise is rejected. The shortcoming of common-chokes render another mitigation scenario such as high speed data communication.

In recent design approaches, RF enclosure manufacturer bring high speed data lines using data and converters. However, this method compromises the isolation of the enclosure because of using filter components on it of enclosures that result in 20-30dB of isolation loss. The a superior mitigation technique must be adopted.

II. Solution: 4E Module

A high speed module has been designed to account multiple I/O connections for RF enclosures. The 4E MA offers USB 3.0, Ethernet 1000, HDMI 2.0, and PCI Express connections to RF enclosure without compromising the

Interface	Data Rate (Mbps)
USB 3.0	5
Ethernet (10/100/1000)	12.5
HDMI	18.2



RF ENCLOSURE Ventilation Mechanism for Shielded Enclosures

White Paper

I. State of Problem

RF enclosures require ventilation when large amounts of heat are generated in testing. Forced cooling is also required for Device Under Test (DUT) in some applications. As the frequency increases, wavelength becomes smaller. In high frequencies, electromagnetic waves can pass through apertures designed for ventilation and can cause interference to the DUT. Therefore, special design for ventilation is mandatory to filter such waves.

II. Ventilation for RF Enclosures

The configuration of apertures and geometry of ventilation units play an important role in isolation of RF enclosures. The design of ventilation units provide more than 150dB of isolation for a frequency range of DC-90GHz as shown in Figure 3.

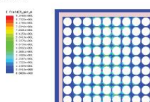


Figure 2: E-field intensity 3D plot on the surface of vent.

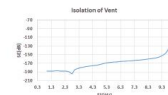


Figure 3: Isolation of ventilation units for RF enclosure.

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III. dbSAFE

RF enclosure options maximize airflow while maintaining shielding integrity. Geometry of the vents form a multi-layer RF filter capable of offering 150dB from DC-90GHz. Surfaces can be coated or screened to prevent dust infiltration and corrosion.

Ventilation is available in several form factors and can be configured to provide uniform air flow across the enclosure.



Figure 2: Top view of dbSAFE configured with uniform ventilation apertures.



Figure 3: RF enclosure with basic ventilation option.

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