

Society for Applied Microwave Electronics Engineering and Research
Centre for Electromagnetic Environmental Effects (CE3)
Visakhapatnam



Passion For Performance

One Stop Solution
for all
E3 & EMI/EMC
Needs



National EMC Facility established by
Ministry of Electronics and Information Technology (Meity)
Government of India

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🌐 ce3.sameer.gov.in

One Stop Solution for all E3 & EMI/EMC Needs

**National E3 facility established by
Ministry of Electronics and Information Technology (MeitY), Government of India**

Society for Applied Microwave Electronics Engineering & Research (SAMEER) is an autonomous R & D institute under the Ministry of Electronics and Information Technology (MeitY), Govt. of India since 1984.

SAMEER operates through its headquarters at Powai, Mumbai and the other four Centre's at Chennai – Centre for Electromagnetics, Kolkata - Centre for Millimeter Wave research, Visakhapatnam - Centre for Electromagnetic Environmental Effects (CE3), and Guwahati - Centre for High-power Microwave Tubes.

In order to meet growing demand from manufacturers/industries, Defence services for “EMI/EMC Research & Development, Test, measurement, and consultancy services” SAMEER - Centre for Electromagnetic Environmental Effects (E3) Visakhapatnam, Andhra Pradesh is now established with state-of-the-art unique/specialized High Power Electromagnetics & EMI/EMC test facilities/instrumentation to meet the requirements as per the International EMC standards in the country in the field of E3.



Activities of the centre:

- Electromagnetic Environmental Effects (E3) Research & Development
- EMC Compliance Testing
- Scientific Publication, Evolving standards & test specifications
- E3 Prediction, Analysis, Design consultancy and Hardening services
- Training and Education
- EM Modeling and Analysis

Electromagnetic Pulse (EMP) facility as per MIL STD 461 E/F/G and 464

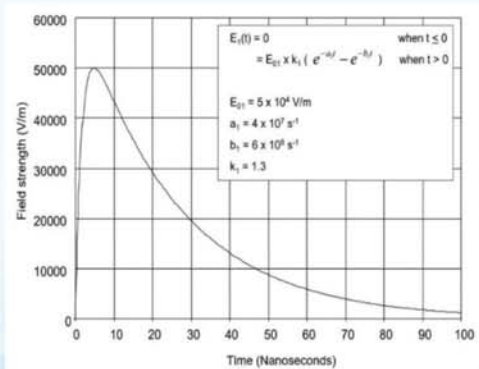
EMP is a high amplitude, short duration, broadband pulse of electromagnetic energy, which can have devastating effects on unprotected electronic equipment and systems.

- Defence Systems requires EMP Compliance for nearly every installation platform, surface ships, submarines, and aircraft, to ground applications as per MIL STD 461 and 464.
- Civilian systems also need to comply EMP due to newly emerging transient antenna technology and increasing use of digital electronics.

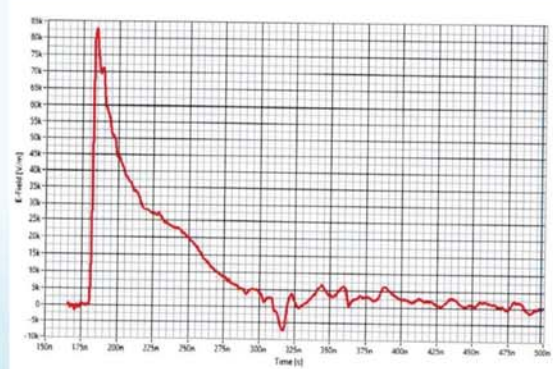
India's Largest Outdoor EMP Research Centre



- **Measured EMP wave from at par with ideal waveform as per MIL STD 461**
 - Capable to generate peak electric field (E) greater than **50 kV/m up to 100 kV/m** with rise time (1.8 ns to 2.8 ns) and FWHM (23 ns +/- 5 ns)



EMP ideal waveform



EMP waveform measured

- **Bounded Wave triangular TEM Transmission Line Structure**

- Provision to **lower down** the complete antenna structure during heavy windstorms/cyclones.
- Capable to test EUT s of Size: **17m (L) x 12m (W) x 3m (H) & Weight up to 40 Ton.**



EMP Bounded Wave Transmission Line Structure



EMP Pulse Generator

First of its kind EMP compliance services for Indian Defence and Industries



EMP Compliance Measurements

EMP technological strengths: SAMEER Expertise in High Altitude Electromagnetic Pulse (HEMP) Compliance requirements in the country for qualification of indigenous Electrical and Electronic Systems to make self-reliant India under **Aathmanirbhar Bharat Abhiyaan**.

Pulsed Current Injection (PCI) facility as per MIL STD 188-125-1&2

PCI is a test method for measuring the performance of a Point-of-Entry (POE) protective device on a penetrating conductor. A HEMP threat-relatable transient is injected on the penetrating conductor at a point outside the electromagnetic barrier, and the residual internal transient stress is measured inside the barrier.

PCI test facility at SAMEER CE3 Visakhapatnam



Short Pulse (E1) measurement



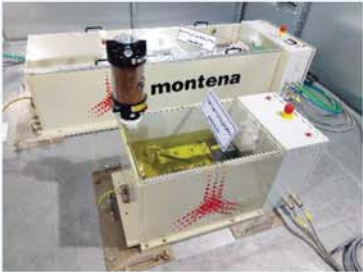
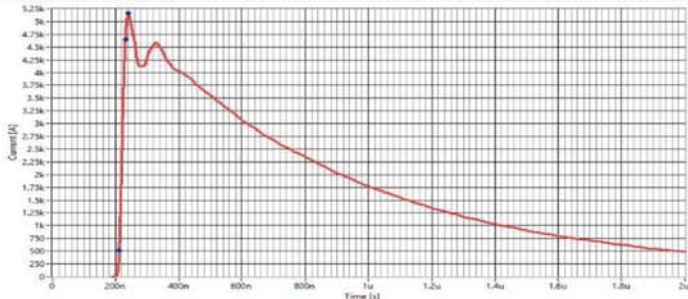

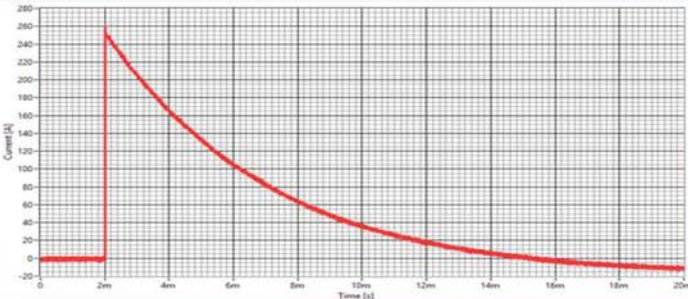
Intermediate Pulse (E2) measurement

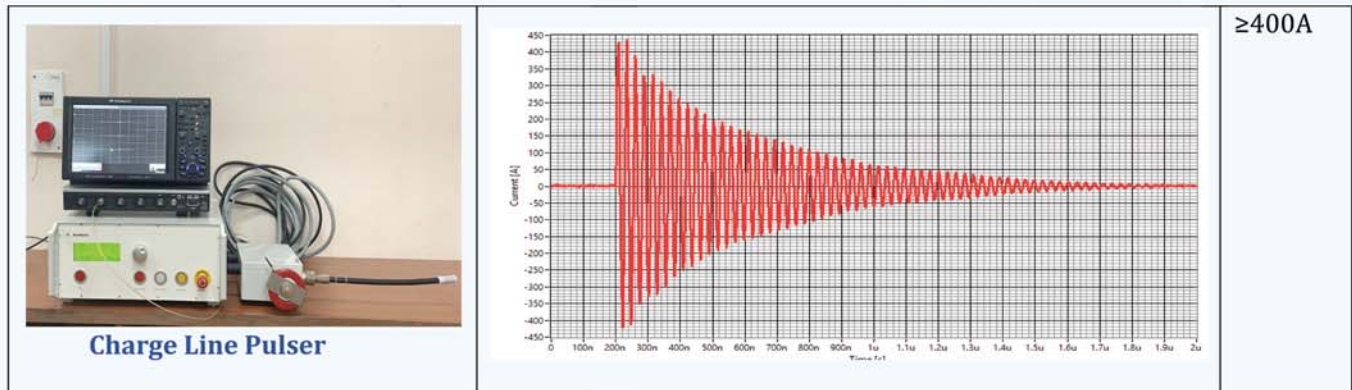


Charge Line Pulse measurement

World class highly specialized test facilities are established, and expertise is built in evaluating the Electrical POE HEMP systems for protecting the C⁴I systems against HEMP. The injected and residual measurements are carried out inside Shielded enclosures which isolates the generator and measuring instruments.

PCI Pulse generators:

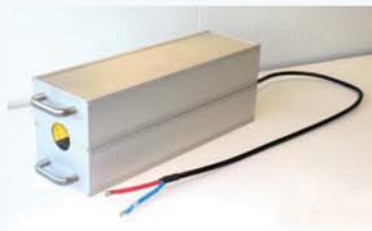
| Test Generator | Generated Waveform | Short-Circuit Current |
|--|--|-----------------------|
|  E1 |  | ≥5000A |
|  E2 |  | ≥250A |



- The facility measures the performance of conductive POE protective devices as installed for acceptance and in operational for verifications tests.
- The optical fibre links used for the measurements in harsh electromagnetic environment at long distances of more than 100 meters.
- The Capacitive & Inductive couplers and Power & Signal line Decouplers are used for verification of HEMP systems for wide varieties of cables.



Capacitive Coupler



Inductive Coupler



Power & Signal line Decoupler

- The facilities available can evaluate wide range of electrical POE filters such as power, control, signal, etc.



DC Power Line POE Filter



RJ45 Ethernet POE Filter



RF Coaxial Filter

Evaluation of Indigenously developed Electrical POE HEMP systems:



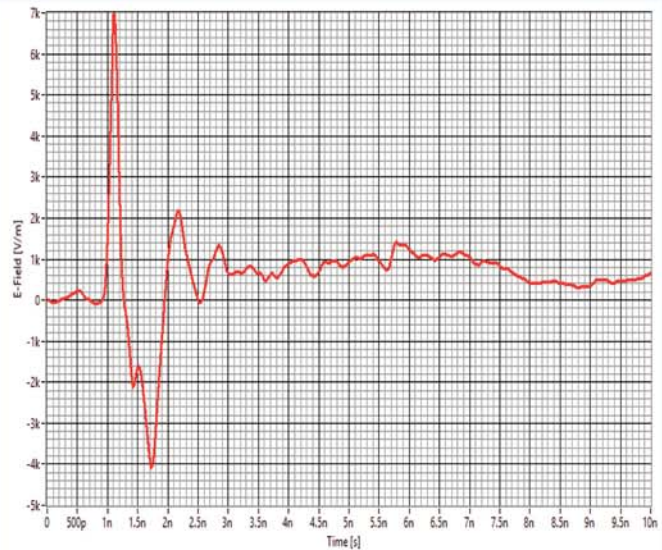
PCI Acceptance Measurement: Injected and Residual

Ultra-Wide Band (UWB) Facility

Ultra-Wideband (UBW) is a short duration, Pulsed RF technology that achieves the highest possible bandwidth at lowest possible center frequency. The Intentional Electromagnetic Interference (IEMI) is of increasing concern as the world is more dependent on electronics. The UWB facility at SAMEER CE3 generates high intensity pulses of the order of kV/m to evaluate the immunity of equipment under study.



HIRA Antenna



Time Domain UWB Pulse

The Half Impulse Radiating Antenna (HIRA) is an ultra-wideband radiating antenna for high intensity pulses, using a ground plane as an electromagnetic mirror. This antenna is particularly suited for hyperband tests according to IEC 61000-4-36. UWB system can be used as mobile EMP facility for assessing EMP/ high intensity pulse effects on fixed and large structures e.g., data centers, ships, etc.

Specifications of the UWB test system:

| | |
|---------------------------|--------------------------------|
| Generator maximum voltage | 20 kV – 30 kV |
| Rise Time | 115 ps |
| FWHM pulse width | 450 ps |
| Field strength | 7 kV/m @20mtr, 13KV @10m |
| Antenna | Half Impulse Radiating Antenna |
| Frequency range | 100 MHz – 6 GHz |
| Pulses per second | 1Hz-100Hz |



Field Measurement Probe & balun

Applications of UWB System other than IEMI:

Other applications of this UWB system include Ground Penetrating Radar (GPR), wideband jammers, Through-the-Wall radar imaging (TWRI) and wideband source for vulnerability studies via transfer function measurements, etc.

Commercial Conducted Measurements Lab



High Energy/Telecom Surge Immunity test
(IEC 61000-4-5)



Voltage dips, short interruptions and variations Immunity test
(IEC 61000-4-11)



Harmonics & Flicker Emission test
(IEC 61000-3-2 & 3)



Power Frequency Magnetic Field Immunity test
(IEC 61000-4-8)



Conducted Radio Frequency Immunity test
(IEC 61000-4-6)



Electrostatic Discharge Immunity test
(IEC 61000-4-2)

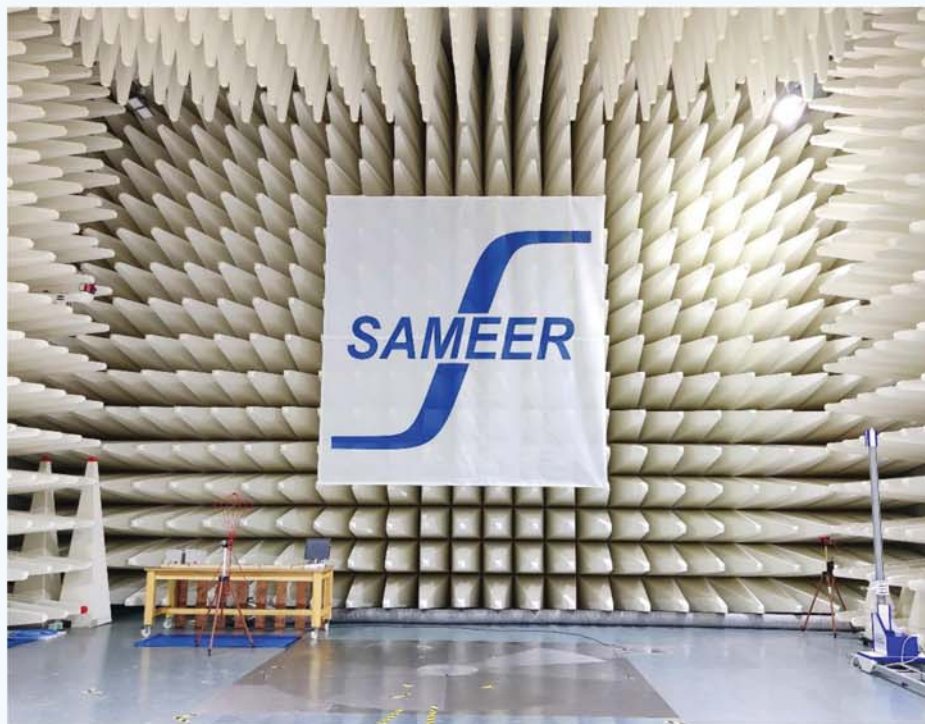
Electromagnetic Interference & Compatibility (EMI/ EMC) facility as per MIL STD 461 E/F/G

EMI/ EMC test facilities up to 40 GHz and radiated immunity test levels of 200 V/m are established as per MIL STD 461 E/F/G standard. The scope of test & measurement activities extends beyond the military standards to commercial, automotive, telecom, medical, etc. covering the requirements of the diverse industries in the country.

RF Shielded Semi-anechoic Chamber:

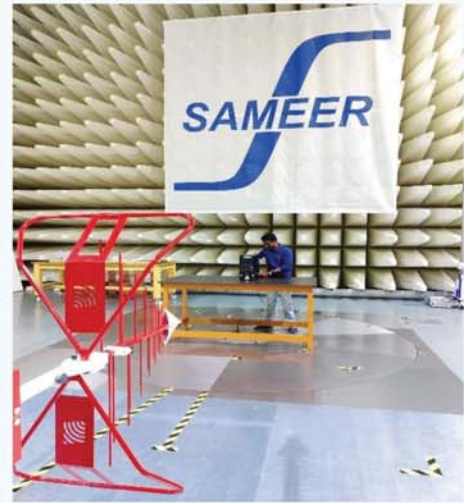
- Size of chamber is 22 m (L) x 16 m (W) x 10 m (H).
- Turn table diameter is **4 meters**.
- Special provision pathway for heavy loads with sizes of **12 m (L) x 3 m (W) for 40 tons**.
- Shielding Effectiveness of chamber is more than 100 dB.
- Chamber is validated for Normalized Site Attenuation (NSA), Field Uniformity (FU), Shielding Effectiveness (SE) and Site VSWR (SVSWR).

Radiated Emission & Susceptibility (RE/RS) Laboratory:



RF Shielded Semi-anechoic chamber at SAMEER CE3 Visakhapatnam

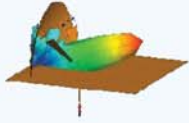
- Measurement Frequency range is **10 Hz to 40 GHz**.
- Immunity Test level is **200 V/m at 1 meter distance**.
- The facility can carry out the commercial RE & RS measurements as per CISPR, FCC at 10m & 3m and IEC standards at 3m & 1m distances.
- Fully equipped with audio & video monitoring systems for monitoring the equipment parameters during Radiated Susceptibility testing.
- Provisions are made for conducting additional tests in parallel at different shielded rooms.
- Provision for vehicle exhaust is made for fume extraction for automotive EMI/EMC tests.
- The facility can carry out specialized RE103 measurement up to 40 GHz using the tunable notch filters.



Conducted Emission & Susceptibility (CE/CS) Laboratory:

- Apart from MIL, commercial CE measurements also carried out up to 100A per phase for 3 phase systems.
- The specialized CE106 measurement can be carried out as per standard.
- The facility is equipped with the new test facilities CS117- Lightning induced transients for all safety-critical equipment's and CS118- Personnel borne Electrostatic Discharge (ESD) for electrical, electronic, and electromechanical subsystems and equipment's as per requirements of MIL STD 461 G.
- The modular based conducted susceptibility test instruments offer flexible and parallel measurements.
- All the EMI/EMC tests are carried out with advanced & validated test automation software for faster and accurate measurements.





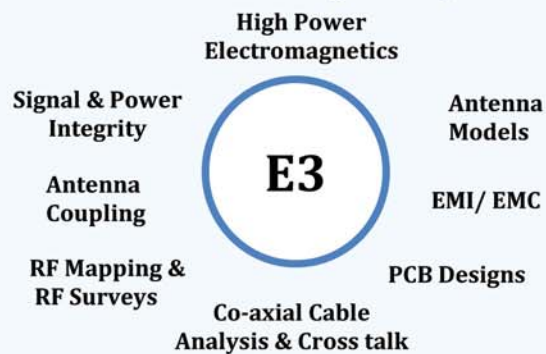
3DElectromagneticModeling andConsultancy Works

SAMEER CE3 atVisakhapatnam establishedthehigh-end computational and simulation software packages and built the expertise in real time Electromagnetic modeling & simulations to serve the Indian industries across wide domains.

Software Packages at SAMEER CE3:



Research areas in EM Modeling & Computational Analysis:

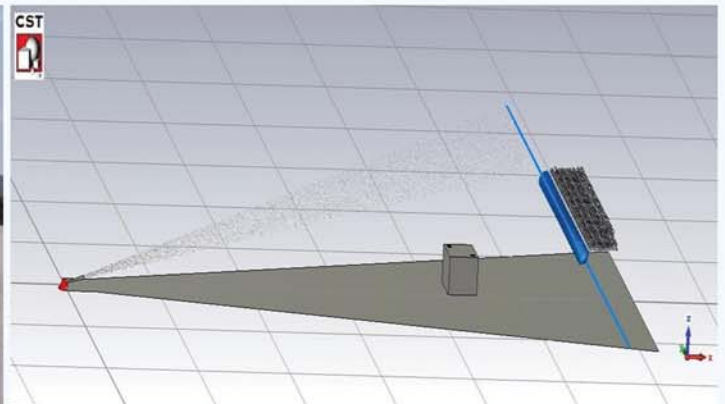


3D EM Activities in HEMP & HPEM Domains:

HEMP and IEMI Hardening computational analysis and validation using advancedElectromagnetic modeling tools.



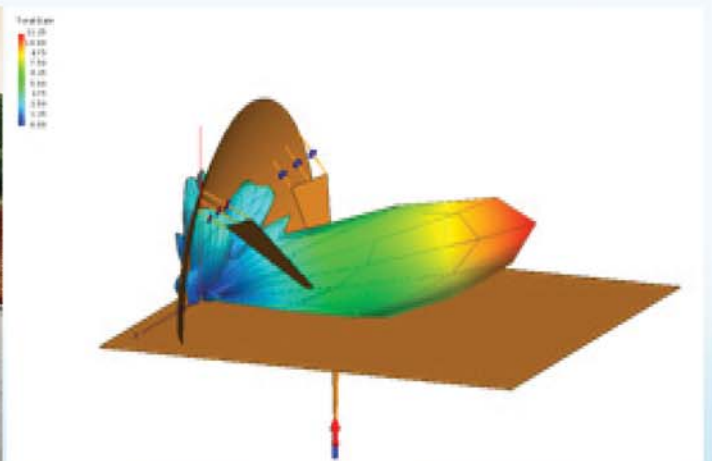
ShieldedEnclosure HEMP Hardening measurements



3D EM Simulation of Shielded Enclosure for HEMP Hardening



Typical HIRA for IEMI Hardening



3D EM Simulation of HIRA for IEMI Hardening

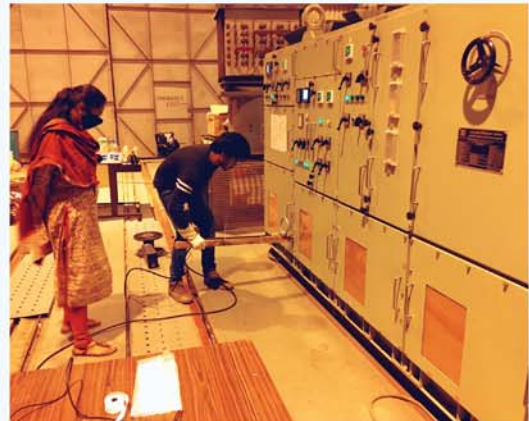
- 3D Electromagnetic computational analysis for EMI/EMC and HPEM areas for Electrical & Electronics systems compliance to E3.
- Best and Robust Solutions to the industries and organizations working in the field of E3.
- First of its kind 3D EM computational electromagnetics modeling and simulations laboratory to serve Indian industries.

EMI/EMC Consultancy Services

Apart from providing comprehensive EMI/EMC testing facilities, SAMEER CE3 also offers expert consultancy services for engineering and design analysis. Major objective of SAMEER CE3 is to provide one stop solution for all EMI/EMC services to customers from concept to production. Our expert engineering and consulting team provide support to design, plan, execute, inspect, and verify EMI compliant systems.

Some of the Major Consultant assignments in the recent past:

- HEMP Expert consultant for Indian Defense sector for their HEMP Strategic facility developments across the country.
- EMC Expert consultant for DRDO in development of Advanced Torpedo's for Air/Surface launch platforms.
- Validation of Indian secure Data centers which housed Critical integrated Data for EMC/EMP requirements.
- Qualification of Indigenous Electrical and Electronic systems developed by Government, PSUs and private sectors for EMP.
- Expertise in Modelling and Simulation Analysis of High-Power Electromagnetics for Critical Infrastructure Protection.



EMI/EMC & HEMP Services

EMI/EMC & HEMP services offered by SAMEER – Centre for Electromagnetic Environmental Effects (CE3) at Visakhapatnam covers wide range of test, measurement, and calibration services across various domains as per different national and international standards. The test facilities established at SAMEER CE3 covers the test & measurement as per MIL STD 461E/F/G, MIL STD 464 and MIL STD-188-125-1&2, CISPR, FCC, ISO & IEC standards.

| S. No. | Test Facility | Description | Specifications |
|--------|--|---|--|
| 1. | EMP Testing - Radiated Susceptibility (RS105) | Radiated Susceptibility, Transient Electromagnetic Field facility for Electromagnetic Pulse (EMP) immunity test for large objects as per MIL STD 461 E/F/G & 464 | E field level-50 kV/m Rise time (t_r) – (1.8-2.8) ns FWHM pulse width (t_d) – (18 – 28) ns For Volume of 17 x 12 x 3 (LWH) (in m) |
| 2. | Pulse Current Injection (PCI) as per MIL STD 188-125-1&2 | PCI acceptance testing is used to demonstrate that electrical POE(Point-of-Entry) protective devices, as-installed, perform in accordance with the transient suppression/attenuation requirements | E1 – 5 kA E2 – 250 A Charge Line – 400 A (Damped Sinusoidal) |
| 3. | Ultra-Wide Band (UWB) Test Facility | Assess the immunity of electronic equipment against high Intensity very fast electromagnetic pulses. | Up to 20 kV/m |
| 4. | CE101 | Conducted Emissions, Power Leads | 30 Hz to 10 kHz DC/1 Φ /3 Φ |
| 5. | CE102 | Conducted Emissions, Power Leads | 10 kHz to 10 MHz DC/1 Φ /3 Φ |
| 6. | CE106 | Conducted Emissions, Antenna Terminal | 10 kHz to 40 GHz |
| 7. | CS101 | Conducted Susceptibility, Power Leads | 30 Hz to 150 kHz DC/1 Φ /3 Φ |
| 8. | CS103 | Conducted Susceptibility, Antenna Port, Intermodulation | 15 kHz to 10 GHz DC/1 Φ /3 Φ |
| 9. | CS104 | Conducted Susceptibility, Antenna Port, Rejection of Undesired Signals | 30 Hz to 20 GHz |
| 10. | CS105 | Conducted Susceptibility, Antenna Port, Cross-Modulation | 30 Hz to 20 GHz |
| 11. | CS106 | Conducted Susceptibility, Transients, Power Leads | $V_{peak}=400V$ peak $t_r=1.5 \mu s$, $t_f=3.5 \mu s$, $t_d=5.0 \mu s$, $V_{sag}\leq 120V$ peak (maximum) $t_{sag}\leq 20 \mu s$ |
| 12. | CS109 | Conducted Susceptibility, Structure Current | 60 Hz to 100 kHz |
| 13. | CS114 | Conducted Susceptibility, Bulk Cable Injection | 4 kHz to 200 MHz |
| 14. | CS115 | Conducted Susceptibility, Bulk Cable Injection | 5A, t_r & $t_f \leq 2ns$, Pulse width 30 ns. (min.) |
| 15. | CS116 | Conducted Susceptibility, Damped Sinusoidal Transients, Cables and Power Leads | 10 kHz to 100 MHz |
| 16. | CS117 | Conducted Susceptibility, lightning induced transients, cables and power leads | Multiple strokes & Multiple burst – Internal Levels |

Society for Applied Microwave Electronics Engineering and Research

Centre for Electromagnetic Environmental Effects (CE3)

Visakhapatnam

| | | | |
|-----|---|--|---|
| 17. | CS 118 | Personnel borne electrostatic discharge as per MIL-STD-461 G (Human Body) | Contact discharge (up to 10 kV), Air discharge (up to 16 kV) |
| 18. | RE101 | Radiated Emissions, Magnetic Field | 30 Hz to 100 kHz |
| 19. | RE102 | Radiated Emissions, Electric Field | 10 kHz - 18 GHz Extendable up to 40 GHz |
| 20. | RE103 | Radiated Emissions, Antenna Spurious and Harmonic Outputs | 10 kHz - 40 GHz |
| 21. | RS101 | Radiated Susceptibility, Magnetic Field | 30 Hz to 100 kHz |
| 22. | RS103 | Radiated Susceptibility, Electric Field | 10 kHz - 40 GHz, for up to 200 V/m |
| 23. | Normalized Site Attenuation (NSA) | NSA as per CISPR 16-1-4 & ANSI C63.4 | 30 MHz - 1 GHz |
| 24. | Site Voltage Standing Wave Ratio (SVSWR) | SVSWR as per CISPR 16-1-4 | 1 GHz - 6 GHz |
| 25. | Shielding Effectiveness (SE) | SE as per IEEE 299/ EN 50147-1 | 9 kHz - 18 GHz |
| 26. | Field Uniformity (FU) | FU as per IEC 61000-4-3 | 80 MHz - 6 GHz |
| 27. | RF Electric Field Probe Calibration | RF Field probe calibration from 10 MHz - 40 GHz. | 10 MHz - 40 GHz |
| 28. | 3D Electromagnetic Modelling & Simulation | Real time Electromagnetic Modelling & simulation assignments using the state-of-the art Software tools. | ANSYS HFSS/ CST/ Altair HyperWorks FEKO |
| 29. | In-situ EMI/ EMC test & measurements | Test as per MIL STD 461 E/F/G, CISPR, EN, IEC, ANSI, IEEE, etc. | 10 Hz to 18 GHz |
| 30. | EMI/EMC consultancy services | Consultancy services to the industry to make their products EMI free during design and development stage itself. | For all EMC needs |
| 31. | Conducted Susceptibility (Commercial) | IEC 61000-4-2 | Contact Discharge - ± 8 kV Air Discharge - ± 15 kV |
| | | IEC 61000-4-4 | DC/1 Φ - ± 4 kV (max.) Signal lines - ± 4 kV (max.) |
| | | IEC 61000-4-5 | DC/1 Φ - ± 6 kV (max.) Signal lines - ± 4 kV (max.) |
| | | IEC 61000-4-6 | DC/1 Φ /3 Φ - 10Vrms |
| | | IEC 61000-4-8 | DC/1 Φ /3 Φ - 0.5m x 0.5m Continuous - 100A Short - 1000A |
| | | IEC 61000-4-11 | DC/1 Φ |
| | | IEC 61000-4-12 | DC/1 Φ - ± 6 kV (max.) Signal lines - ± 4 kV (max.) |
| | | IEC 61000-3-2 | 1 Φ |
| | | IEC 61000-3-3 | 1 Φ |

Society for Applied Microwave Electronics Engineering and Research Centre for Electromagnetic Environmental Effects (CE3) Visakhapatnam

Vice President's visit to SAMEER CE3 Visakhapatnam



Honourable Vice President of India, Shri. M. Venkaiah Naidu visited SAMEER CE3 Visakhapatnam on 29th August 2019.



110 kW of roof-top grid connected Solar Power, Green plantation, and Rainwater harvesting

Clean & Green Campus





**Plot No: 40, APIC Industrial Park,
Gambheeram, Anandapuram,
Visakhapatnam-531163,
Andhra Pradesh, India.**