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| **Laboratory** | **EMC Division, SAMEER – Centre for Microwave Research, Sector – 7, Rain Tree Marg, CBD – Belapur, Navi Mumbai, Maharashtra** | | | |
| **Accreditation Standard** | **ISO/IEC 17025: 2005** | | | |
| **Certificate Number** | **CC-2273** | | **Page** | **1 of 10** |
| **Validity** | **18.05.2018 to 17.05.2020** | | **Last Amended on** | **11.01.2019** |

| Sl. | Quantity Measured / Instrument | Range/Frequency | *Calibration Measurement Capability (±) | Remarks |
|---|---|---|---|---|
| | **ELECTRO-TECHNICAL CALIBRATION** | | | |
| **I.** | **SOURCE** | | | |
| **1.** | Insertion Loss/RF Attenuation [$]<br>• Transient Limiter<br>• Line Impedance Stabilization Network<br>• Bulk Current Injection Probe<br>• Directional Coupler<br>• Attenuator<br>• Cable or similar equipment<br>• 50 Ω conical adapter line | **9 kHz to 7 GHz**<br>0.005 dB to 40 dB | 0.6 dB to 0.7 dB | Using Vector Network Analyser by Direct method |
| **2.** | Return Loss[$] (VSWR)<br>• Attenuator<br>• Antenna<br>• Amplifier<br>• Termination/RF Load<br>• Directional Coupler or Similar Equipment<br>• 50 Ω conical adapter line | 9 kHz to 7 GHz<br>1 to 46 dB | 0.7 dB to 3.3 dB | Using Vector Network Analyser by Direct method |

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|---|---|---|---|---|
| **3.** | Voltage Division Factor[$]<br>• Coupling & Decoupling Network (CDN)<br>• Impedance Stabilization Network (ISN) | 0.15 MHz to 230 MHz<br>(0 dB to 70 dB) | 0.7 dB | Using Vector Network Analyser by Direct method as per IEC 610004-6: 2013-10 Ed.4.0, CISPR22: 2008-09 Ed.6.0, CISPR32: 2015-03 Ed.2.0 |
| **4.** | Impedance[$]<br>• Line Impedance Stabilization Network<br>• Coupling & Decoupling Network, Impedance Stabilization Network | **(1 to 210 Ω)**<br><br>**9 kHz to 30 MHz**<br>**30 MHz to 230 MHz** | <br><br>11.44% to 10.8%<br>10.8 % to 9 % | Using Vector Network Analyser by Direct method as per CISPR 16-1-2:2014-03 Ed.2.0, CISPR22: 2008-09 Ed.6.0 |
| **5.** | Phase Angle[$]<br>• Line Impedance Stabilization Network | **9 kHz to 30 MHz**<br>**(-)90° to +90°** | 11.44 % to 11.58 % | Using Vector Network Analyser Direct method as per CISPR 16-1-2:2014-03 Ed.2.0 |
| **6.** | Coupling Factor/Coupling Loss[$]<br>• Directional Coupler<br>• EM Clamp | **9 kHz to 1 GHz**<br>1 to 70 dB | 0.5 dB | Using Vector Network Analyser by Direct method |

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|---|---|---|---|---|
| **7.** | Decoupling of Common Mode Disturbance [$]<br>• Coupling & Decoupling Network<br>• Impedance Stabilization Network | 0.15 MHz to 230 MHz<br>(1 dB to 70 dB) | 0.5 dB | Using Vector Network Analyser by Direct method |
| **8.** | Isolation[$]<br>• Line Impedance Stabilization Network<br>• Dual Directional Coupler | 9 kHz to 1000 MHz<br>(10 dB to 90 dB) | 0.5 dB | Using Vector Network Analyser CISPR by Direct method 16-1-2:2014-03 Ed.2.0 |
| **9.** | Combination Wave Surge Test Systems[$] | | | |
| | Voltage Amplitude | ±0.5 kV to ±4.0 kV | 5.57 % | Using Digital Storage Oscilloscope HV differential probe & Current Transformer by Direct method as per IEC 61000-4-5 Ed.3.0 2017-08 |
| | Voltage Front Time | 1.2µs ± 30 % | 8.53 % | |
| | Voltage Pulse Width | 50 µs ± 20 % | 4.0 % | |
| | Current Amplitude | ±0.25 kA to ±3.0 kA | 5.52 % | |
| | Current Front Time | 8 µs ± 20 % | 4.22 % | |
| | Current Pulse Width | 20µs± 20 % | 4.1 % | |

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|---|---|---|---|---|
| **10.** | Electrical Fast Transient Test Systems [$] | | | |
| | Pulse Amplitude | ±125 V to ±4.0 kV | 6.38 % | Using Digital Storage Oscilloscope by Direct method as per IEC 61000-4-4 Ed.2012-04 Ed.3.0 |
| | Pulse Rise Time | 5 ± 1.5 ns | 4.17 % | |
| | Pulse Width | 50 ± 15 ns | 4.1 % | |
| | Repetition Frequency | 5 kHz ± 20 % | 4.00 % | |
| | | 100 kHz ± 20 % | 4.00 % | |
| | Burst Duration | 15 ± 3 ms (5 kHz) | 4.00 % | |
| | Burst Period | 300 ± 60 ms | 4.00 % | |
| **11.** | Electrostatic Discharge Generator Contact Discharge[$] | | | |
| | First Peak Current | 7.5- 56.25 A (±15 %) (±2kV to ±15 kV) | 4.6 % | Using Digital Storage Oscilloscope (DSO) along with current target attenuator cable chain by Direct method as per IEC61000-4-2: 2008-12, Ed.2.0 |
| | Rise Time | 0.8 ns ± 15 % | 7.7 % | |
| | Current at 30 ns | 4.0 -30 A (± 30 %) (±2 kV to ±15 kV) | 4.8 % | |
| | Current at 60 ns | 2.0 -15 A (± 30 %) (±2 kV to ± 15 kV) | 5.7 % | |
| | Air discharge (DC voltage) | | | |
| | Voltage level | ± 2 kV (± 5 %) | 1.7 % | Using Brandeburg make HV volt meter by Direct method |
| | | ± 4 kV (± 5 %) | | |
| | | ± 8 kV (± 5 %) | | |
| | | ± 15 kV (± 5 %) | | |
| | | ± 30 kV (± 5 %) | | |

| Sl. | Quantity Measured / Instrument | Range/Frequency | *Calibration Measurement Capability (±) | Remarks |
|---|---|---|---|---|
| 12. | • Electrostatic Discharge Generator$ (as per automotive standard ISO 10605:2008 E) | | | |
| | Contact Discharge (RC Module: 150pF/330Ω) | | | |
| | First Peak Current | 7.5- 75 A (±15 %) (±2kV to ± 20 kV) | 9.0 % | Using Digital Storage Oscilloscope (DSO) along with current target attenuator cable chain Direct method as per ISO 10605 Second Edition 2014-04-15 |
| | Rise Time | 0.8 ns ± 15 % | 10.7 % | |
| | Current at 30 ns | 4.0 -40 A (± 30 %) (±2 kV to ± 20 kV) | 9.1 % | |
| | Current at 60 ns | 2.0 -20 A (± 30 %) (±2 kV to ± 20 kV) | 9.4 % | |
| | Contact Discharge (RC Module: 330pF/330Ω) | | | |
| | First Peak Current | 7.5- 75 A (±15 %) (±2kV to ± 20 kV) | 9.0 % | Using Digital Storage Oscilloscope (DSO) along with current target attenuator cable chain by Direct method as per ISO 10605: Second Edition 2014-04-15 |
| | Rise Time | 0.8 ns ± 25 % | 10.6 % | |
| | Current at 65 ns | 4.0 -40 A (± 30 %) (±2 kV to ± 20 kV) | 9.1 % | |
| | Current at 130 ns | 2.0 -20 A (± 30 %) (±2 kV to ± 20 kV) | 9.2 % | |

| Sl. | Quantity Measured / Instrument | Range/Frequency | *Calibration Measurement Capability (±) | Remarks |
|---|---|---|---|---|
| | Contact Discharge (RC Module: 150pF/2000Ω) | | | |
| | First Peak Current | 7.5- 75 A (± 30 %) (±2kV to ± 20 kV) | 9.0 % | Using Digital Storage Oscilloscope (DSO) along with current target attenuator cable chain by Direct method as per ISO 10605: Second Edition 2014-04-15 |
| | Rise Time | 0.8 ns ± 25 % | 10.6 % | |
| | Current at 180 ns | 0.55 -5.55 A (± 30 %) (±2 kV to ± 20 kV) | 9.3 % | |
| | Current at 360 ns | 0.3 – 3.0 A (± 50 %) (±2 kV to ± 20 kV) | 9.2 % | |
| | Contact Discharge (RC Module: 330pF/2000Ω) | | | |
| | First Peak Current | 7.5- 75 A (±30 %) (±2kV to ± 20 kV) | 9.0 % | Using Digital Storage Oscilloscope (DSO) along with current target attenuator cable chain by Direct method as per ISO 10605: Second Edition 2014-04-15 |
| | Rise Time | 0.8 ns ± 25 % | 10.6 % | |
| | Current at 180 ns | 0.55 -5.55 A (± 30 %) (±2 kV to ± 20 kV) | 9.3 % | |
| | Current at 360 ns | 0.3 – 3.0 A (± 50 %) (±2 kV to ± 20 kV) | 9.2 % | |
| | Air discharge (DC voltage) | | | |
| | Voltage Level | ± 2 kV (± 5 %) | 0.6 % | Using Brandeburg make HV volt meter by Direct method |
| | | ± 4 kV (± 5 %) | 0.6 % | |
| | | ± 8 kV (± 5 %) | 0.6 % | |
| | | ± 15 kV (± 5 %) | 0.6 % | |
| | | ± 25 kV (± 5 %) | 0.6 % | |
| | | ± 30 kV (± 5 %) | 0.5 % | |

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|---|---|---|---|---|
| **13.** | Target – attenuator-cable chain[$] | | | |
| | Insertion Loss variation(S21) | ± 0.5 dB up to 1 GHz | 0.7 dB | Using R&S Make VNA, Model No. ZVB 8, Sr. No.16232 and Keithly Make DMM by Direct method as per IEC61000-4-2: 2008-12, Ed.2.0 |
| | | ± 1.2 dB 1 to 4 GHz | 0.7 dB | |
| | Low Frequency Transfer Impedance | 0.603 Ω | 0.24% | |
| | DC Resistance | < 2.1 Ω | 0.6% | |
| **14.** | Ring Wave Generator[$] | | | |
| | Voltage Rise Time (Open circuit) | 0.5 µs ± 30 % | 4.64 % | Using Digital Storage Oscilloscope (DSO), HV differential probe & Current Transformer by Direct method as per IEC 61000-4-12: Ed.3.0 2017-07 |
| | Current Rise Time (Short Circuit) | ≤ 1µs | 4.09 % | |
| | Voltage Oscillation Frequency | 100 kHz ± 10 % | 4.0 % | |
| | Decay in voltage | 0.4 < Ratio of Pk2 to Pk1 < 1.1<br>0.4 < Ratio of Pk3 to Pk2 < 0.8<br>0.4 < Ratio of Pk4 to Pk3 < 0.8 | 6.03 % | |
| | Open Circuit Voltage | 250 V - 4 kV±10% | 5.82 % | |
| | Short Circuit Current | 133 - 333 A±10% | 5.56 % | |

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|---|---|---|---|---|
| **15.** | Damped Oscillatory Wave Generator $ | | | |
| | Voltage Amplitude | ±0.25 to ±4.0 kV | 5.74 % | Using Digital Storage Oscilloscope (DSO), HV differential probe & Current Transformer as per IEC 61000-4-12: 2001-04 Ed. 1.1 & by Direct method as per IEC 61000-4-18: 2011-03 Ed.1.1 |
| | Voltage Rise Time | 75 ns ±20 % | 4.32 % | |
| | Oscillation period | 100 kHz ±10 % | 4.0 % | |
| | Current Amplitude | 1.25-80 A, ± 10 % | 6.1 % | |
| | Voltage Decay | $P_{k5} > 0.5\ P_{k1}$ and $P_{k10} < 0.5\ P_{k1}$ | 5.69 % | |
| **16.** | Voltage Dips & Interruption $ | | | |
| | Output Voltage at no load | Nominal line Voltage (0-100 %) | 7.24 % | Using Digital Storage Oscilloscope (DSO), HV differential probe Direct method as per IEC 61000-4-11 Ed. 2.0 2017-05 IEC 61000-4-29:2000-08 first edition |
| | Dips / Interruption Time | 10 ms to 5 s | 4.0 % | |
| **17.** | RF Signal Generator$ | | | |
| | Frequency Accuracy | 100 kHz to 8 GHz | 0.1 % | Using Spectrum Analyzer (SA), Power Meter, & Frequency Counter by Direct method |
| | Level Accuracy | -30 dBm to +10 dBm (10 MHz to 18 GHz) | 0.4 dB | |
| | Harmonic Level (upto third harmonic) | Upto -90 dBc (10 Hz to 13.6 GHz) | 0.2 dB | |
| | Amplitude Modulation (AM) Depth | 10 % to 90 % (10 Hz to 13.6 GHz) | 3.48% | |

| Sl. | Quantity Measured / Instrument | Range/Frequency | *Calibration Measurement Capability (±) | Remarks |
|---|---|---|---|---|
| **18.** | RF Amplifiers $ (Pre amplifier) | | | |
| | Gain | 50 dB (10 Hz to 6 GHz) | 1.7 dB | Using Vector Network Analyzer (VNA), Signal Generator & Spectrum Analyzer (SA) byDirect method |
| | Harmonics Distortion | Upto (-)90 dBc (10 Hz to 13.6 GHz) | 0.2 dB | |
| | Return Loss of Power Input Port & Output Port | 1 to 45 dB (9kHz to 8.5 GHz) | 0.5 dB | |
| | Power Amplifier $ | | | |
| | Gain | 50 dB (10 Hz to 3.0 GHz, 1000 W) | 1.7 dB | Using Vector Network Analyzer (VNA), Signal Generator & Spectrum Analyzer (SA) byDirect method |
| | Harmonics Distortion | Upto - 90 dBc (10 Hz to 13.6 GHz, upto 1000 W) | 0.2 dB | |
| | Return Loss of Power Input Port & Output Port | 1 - 45 dB (9 kHz to 8.5 GHz) | 0.5 dB | |
| **19.** | EMI Test Receiver $ | | | |
| | Return (VSWR) | 100 kHz to 3 GHz | | Using<br>• R & S make VNA<br>• Schwarzbeck make Calibration Pulse Generator<br>• Agilent make signal generator<br><br>As per CISPR 16-1-1 Ed. 3.2 2014-06 byDirect method |
| | Display error of Quasi Peak Detector | Band A<br>100 kHz<br>100 Hz PRF | <br>0.7 dB<br>0.8 dB | |
| | | Band B<br>100 Hz PRF MG<br>100 Hz PRF AG | <br>0.8 dB<br>0.8 dB | |
| | | Band C/D<br>100 Hz PRF MG<br>100 Hz PRF AG | <br>0.8 dB<br>0.8 dB | |

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|---|---|---|---|---|
| | Display error of detector with sinusoidal signal (Pk, Qp, Av) | QP detector 9KHz to 1 GHz | 0.6 dB | |
| | | Peak Detector 9KHz to 1 GHz | 0.6 dB | |
| | | Average Detector 9KHz to 1 GHz | 0.6 dB | |
| | Amplitude Relationship (Peak/QP & QP/AV) | Peak/QP 9KHz to 1 GHz | 0.8 dB | |
| | | QP/AV 9KHz to 1 GHz | 0.8 dB | |
| **20.** | Conducted RF Test System[$] | | | |
| | Harmonics Level (up to 3rd Harmonics) | Upto -90 dBc (10 Hz to 13.6 GHz) | 0.6 dB | Using Spectrum Analyzer or Equivalent by Direct Method |
| | Gain | 50 dB (10 Hz to 6 GHz) | 1.7 dB | |
| | AM Depth | 10 % to 90 % (10 Hz to 13.6 GHz) | 3.48 % | |
| | Level Accuracy | -30 dBm to +10 dBm (10 MHz to 18 GHz) | 0.3 dB | Using Power Meter or Equivalent by Direct Method |
| | Error of Monitor Input | 9 kHz to 1 GHz (-) 40 dBm to (+) 13 dBm | 0.6 dB | Using Signal Generator & Power Meter or Equivalent by Direct Method |
| | Frequency Accuracy | 100 kHz to 8 GHz | 0.1 % | Using Frequency Counter or Equivalent by Direct Method |

*** Measurement Capability is expressed as an uncertainty (±) at a confidence probability of 95%**
**[$]Only in Permanent Laboratory**
**[*]Only for Site Calibration**