CISPR 25, Class 5 Compliance Report for

UCC12051-Q1 Reference Design, Evaluation Board

PN: PMP22855E1

SN: N/A

Prepared For: Texas Instruments
12500 TI Boulevard
Dallas, TX 75265-5214 US

P.O. Number: 4514252410

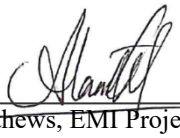
Prepared By: National Technical Systems
1701 E. Plano Pkwy. Ste. 150
Plano, TX 75074
(972) 509- 2566
www.nts.com

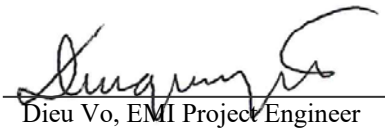
Issued: 4/16/2021

Revision Page

Rev	Date	Description
0	4/16/2021	Original
1	4/22/2021	Re-formatted as per customer request
2	5/21/2021	Schematic diagram changed as per customer request

Signatures

Prepared by 
Alex Mathews, EMI Project Manager

Approved by 
Dieu Vo, EMI Project Engineer

Reviewed by 
Kimberly Zavala, NTS Quality Representative

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

1.0 Purpose

This report presents the test procedures used and the results obtained during the performance of CISPR 25 Class 5 test program. The test program was conducted to assess the ability of the UUT to successfully satisfy the requirements specified in Section 2.0.

2.0 References

- Texas Instrument P.O. Number 4514252410 dated 03/23/2021
- NTS Quotation Number OP0576552 dated 03/08/2021
- CISPR 25: Class 5- Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of on-board receivers
- ISO/IEC 17025:2017(E), *General Requirements for the Competence of Testing and Calibration Laboratories*
- ANSI C63.4-2009, *Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz*
- IEC CISPR 16-1-4: 2020
  Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements

3.0 Test Item Details

3.1 EUT Description

This reference design demonstrates EMI mitigation techniques required for a high-frequency, reinforced 5-kVRMS isolated, 5-V-to-5-V, DC/DC bias, converter module to pass the automotive, CIPSR 25, class 5, EMC test standard. A 12-V-to-5-V, LDO, pre-regulator is used to regulate the required 5-V input to the DC/DC converter module. The design features a 500-mW, high-efficiency, bias supply with integrated transformer, control and power stage in a 2.65 mm height, SOIC 16 package solution. Typical automotive bias examples include: digital isolators, voltage and current sensing, CAN transceivers and signal communication used in the design of traction inverters, onboard chargers, battery management systems, infotainment, charging cables and PTC heaters.

3.2 Hardware Details

Table 1 Hardware Details

Description	P/N	Revision	S/N	Test Location
UCC12051-Q1, Isolated 5-V DC/DC Module, Reference Design EVM Demonstrating Passing CE and RE, Automotive CISPR 25, Class 5 Emissions Standard	PMP22855	E1	N/A	NTS, Plano, TX

3.3 Electrical Requirements

Table 2 Electrical requirements

Parameter	Specification
Input Voltage	12 V<V_{IN}<14 V, (Schematic, J1)
Maximum Input Current	150 mA
Output Voltage	5 V, (Schematic TP4)

Output Current	100 mA (fixed on board resistor)
Converter Switching Frequency (internal fixed)	8 MHz

3.4 Schematic

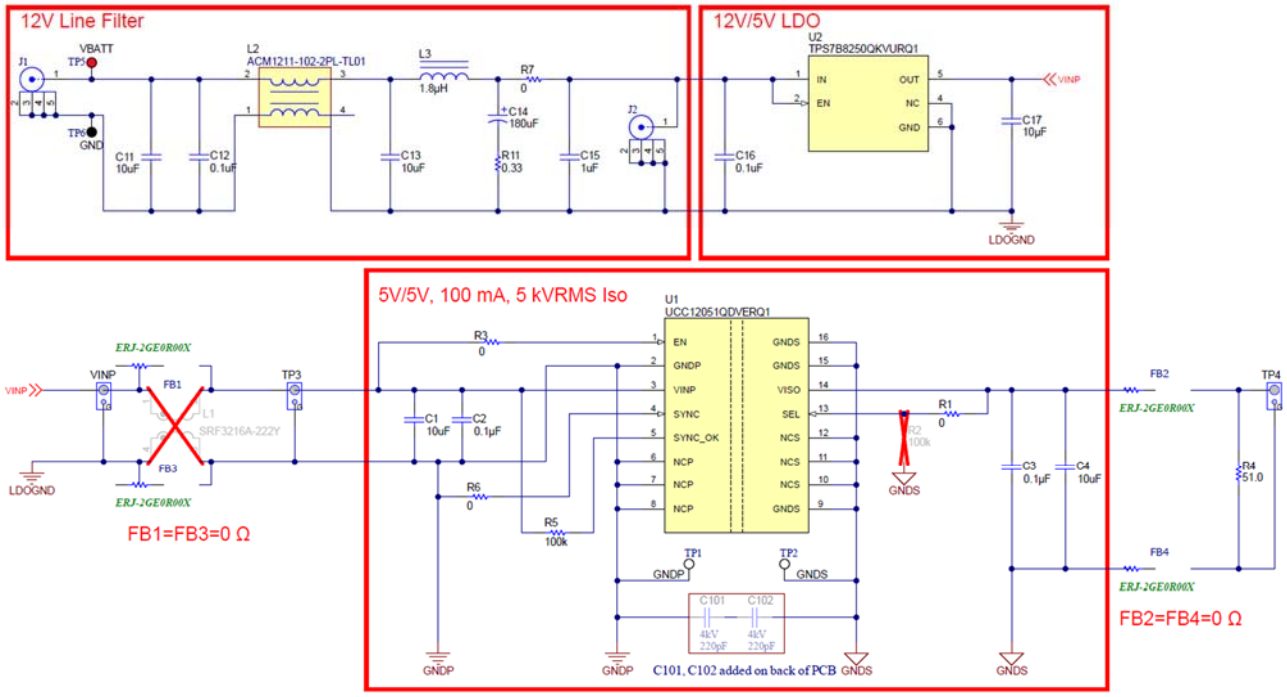


Figure 1 EUT Schematic

3.5 Top and Bottom Assembly (3D view)

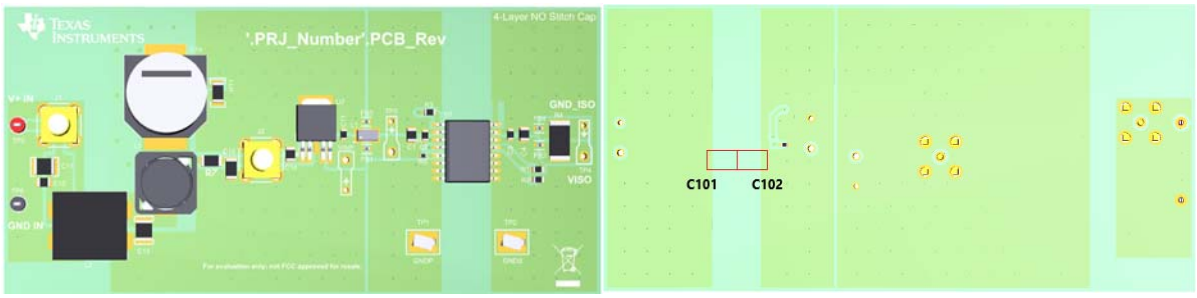


Figure 2 Top and Bottom Assembly (3D view)

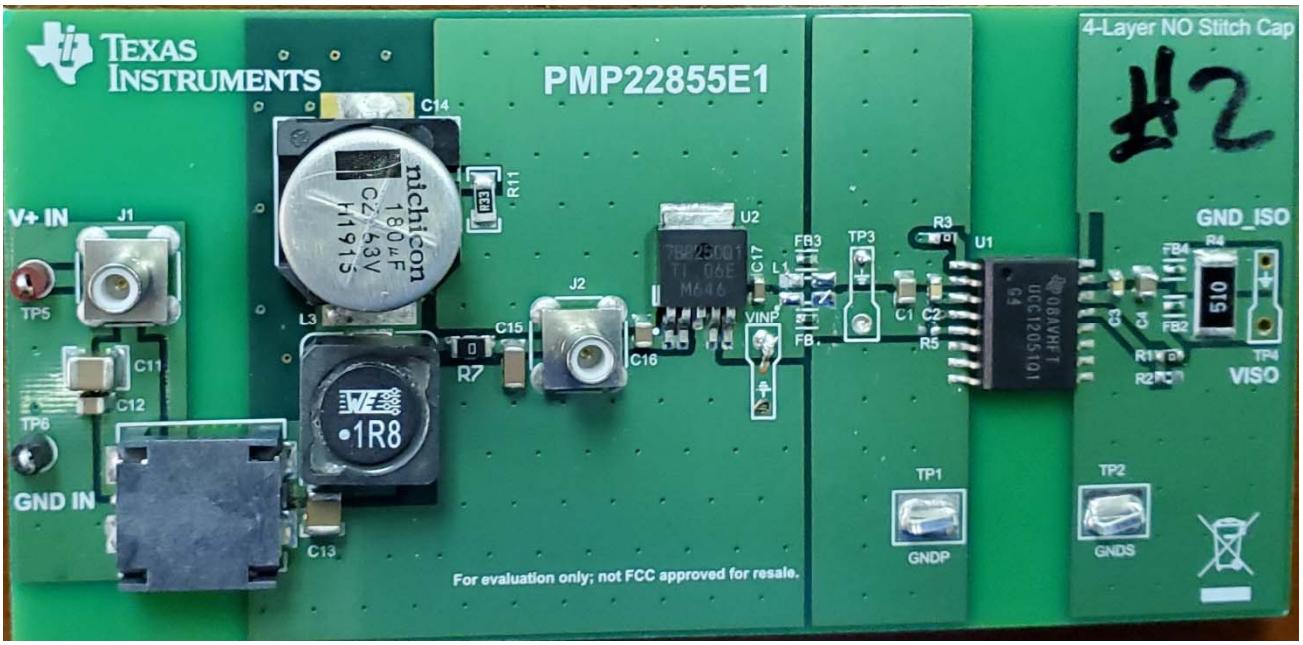


Figure 3 EUT Board Top view

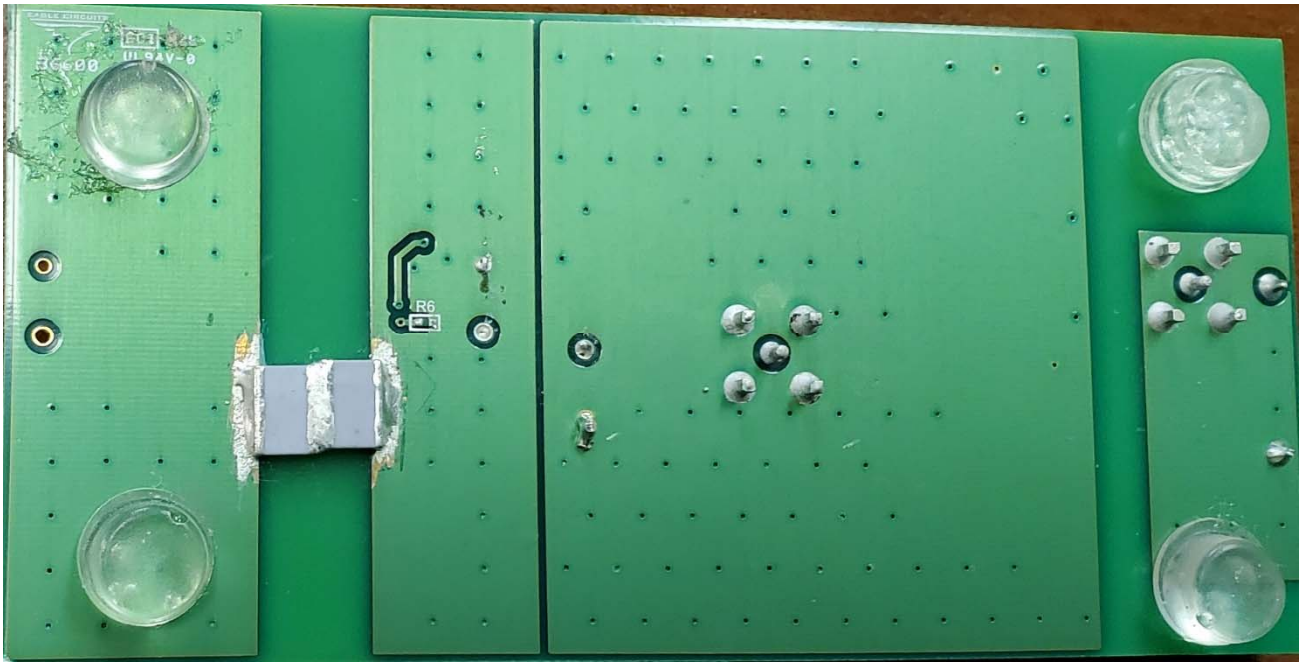


Figure 4 EUT Board Bottom view

4.0 Test Locations, Dates, and Equipment

4.1 Locations and Dates

Table 3 Test Category and Test dates

Test Category	Dates
Radiated Emissions (Electric Field)	3/24/2021
Conducted Emissions (AC Power Leads Voltage)	3/24/2021
Note: All testing was performed at NTS in Plano, TX	

4.2 Calibration Details

Lists of the test equipment used are included at the end of each test section in this report. This equipment is calibrated according to ISO/IEC 17025:2017(E) and calibration is traceable to the National Institute of Standards and Technology (NIST). Calibration records are maintained on file at National Technical Systems.

4.3 Ambient Test Conditions

During testing contained in this test report, average ambient test conditions were as follows: Relative humidity between 30% and 70%, temperature between 20°C and 24°C, and barometric pressure between 93 kPa (27.5 in Hg) and 106 kPa (31.5 in Hg).

4.4 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Table 4 Measurement Uncertianty

Measurement	Frequency	Uncertainty
Conducted Emissions	0.15 MHz-30 MHz	±1.7376
Radiated Emissions	30 MHz-1 GHz (3-Meters)	±6.10
Radiated Emissions	30 MHz-1 GHz (10-Meters)	±5.00
Radiated Emissions	1 GHz – 6 GHz (3-Meters)	±5.00
Radiated Emissions	6 GHz – 18 GHz (3Meters)	±5.30

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Consistent with industry standard (e.g. CISPR 32, clause 11, Measurement Uncertainty determining compliance with the limits shall be based on the results of the compliance measurement. Consequently the measure emissions being less than the maximum allowed emission result in this shall be a compliant test or passing test.

The acceptable Measurement Uncertainty value without requiring revision of the compliance statement is based on conducted and radiated emissions being less than UCISPR which is 3.6dB and 5.2dB respectively. CCS values (called U_{Lab} in CISPR 16-4-2) is less than UCISPR as shown in the table above. Therefore, Measurement Uncertainty need not be considered for compliance.

5.0 Radiated Emission (Electric Field) Test

Radiated measurements are performed in a semi-anechoic chamber which meets the normalized site attenuation of ANSI C63.4 and is listed with the FCC.

Measurements are obtained using an antenna which is positioned 1 m from the test item from 150 KHz -1 GHz. The applicable frequency spectrum is scanned with a calibrated RF measuring system using an antenna and a spectrum analyzer and compared to the appropriate limits. Both the vertical and horizontal polarization are scanned in the frequency range of 30 MHz-1 GHz per ANSI C63.4. Final data is collected in the worst case configurations of the test item with the highest emission levels.

The test item, including all necessary equipment, is set up in the semi-anechoic chamber. The test item is grounded with the grounding point used in the actual installation. The following procedure is used:

1. The UUT is operated in its normal mode of operation. Sufficient time is allowed for stabilization.
2. The antenna is positioned 1 meters from the closest point of any part of the test sample. Testing begins at 150 KHz.
3. Amplitude versus frequency data is recorded using the spectrum analyzer until 1 GHz is reached.
4. Which antennas are used is determined by the frequency ranged tested.
5. Radiated Emissions Field Strength Calculations:

$$FS = RA + AF + CF - AG$$

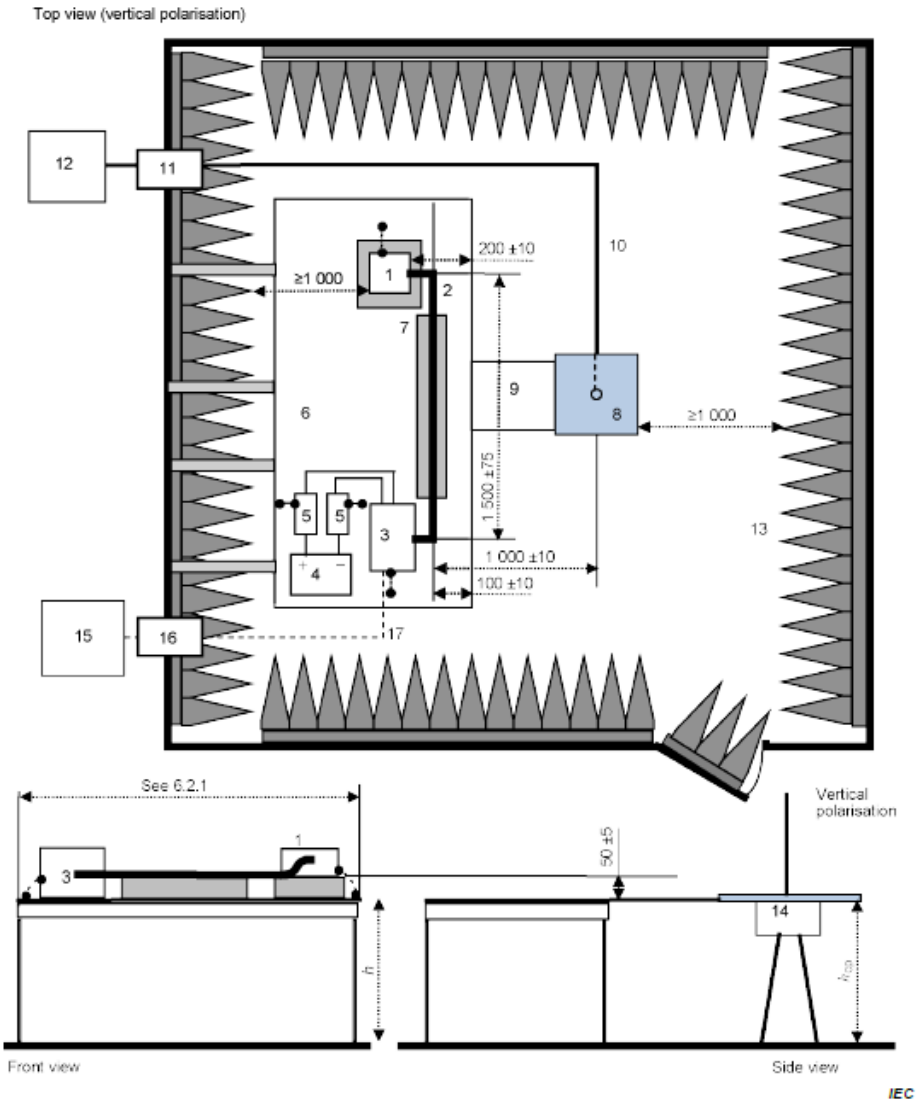
FS: Field Strength, CF: Cable attenuation Factor, RA: Receiver Amplitude , AF: Antenna Factor, AG: Amplifier Gain

The receiver performs the field strength calculations automatically. The program has resident AF and CF figures for individual antennas and cables.

Table 5 EMI Receiver Settings for RE Measurements

Frequency Range	Resolution Bandwidth	Step size	Measurement time
150-kHz – 30-MHz	9-kHz	5-kHz	50-ms/Pts
30-MHz – 200-MHz	120-kHz	50-kHz	5-ms/Pts
200-MHz – 1-GHz	120-kHz	50-kHz	5-ms/Pts

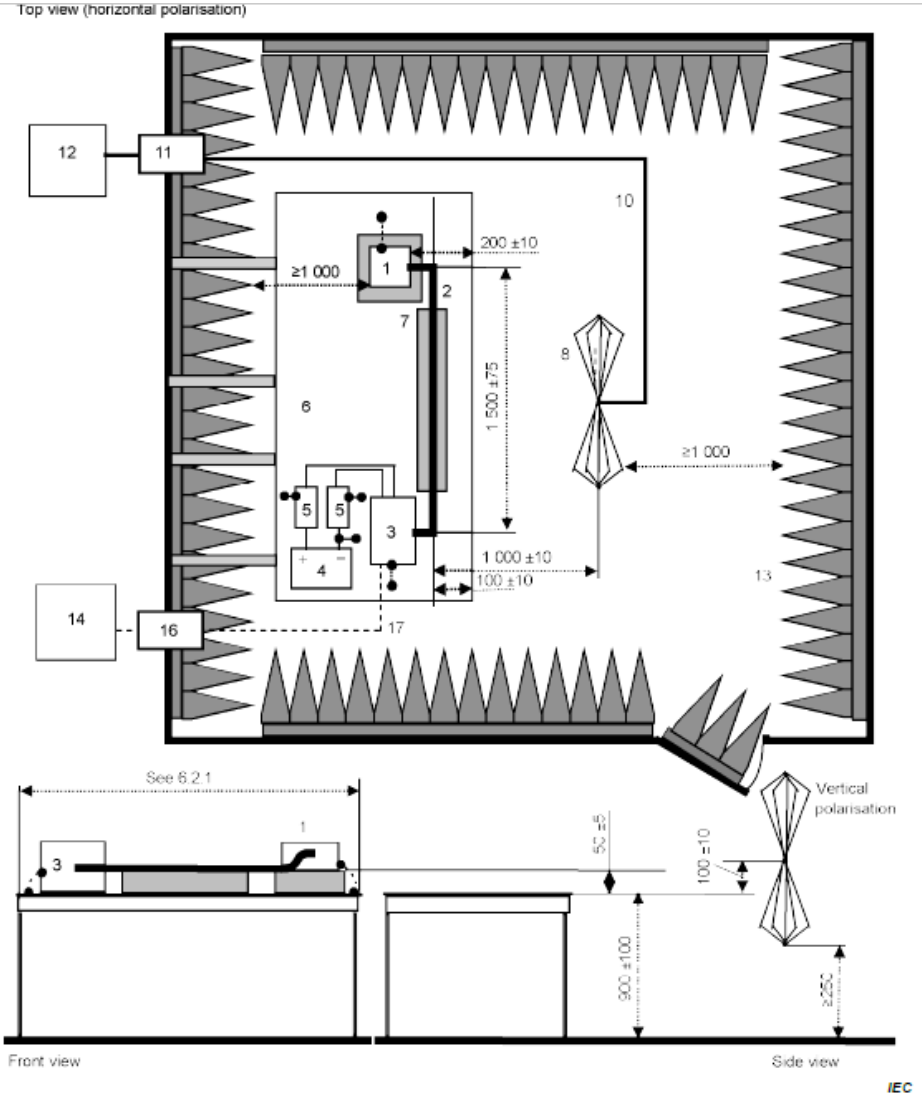
3.6 Test Set up



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.5.2.6)
4 Power supply (location optional)
5 Artificial network (AN)
6 Reference ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
8 Rod antenna with counterpoise
(dimensions: 600 mm by 600 mm typical)
h = (900 ± 100) mm
9 Grounding connection (full width bond between counterpoise and reference ground plane)
10 High-quality coaxial cable e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Antenna matching unit (the preferred location is below the counterpoise; if above the counterpoise then the base of the antenna rod shall be at the height of the reference ground plane)
15 Stimulation and monitoring system
16 Fibre optic feed through
17 Optical fibres

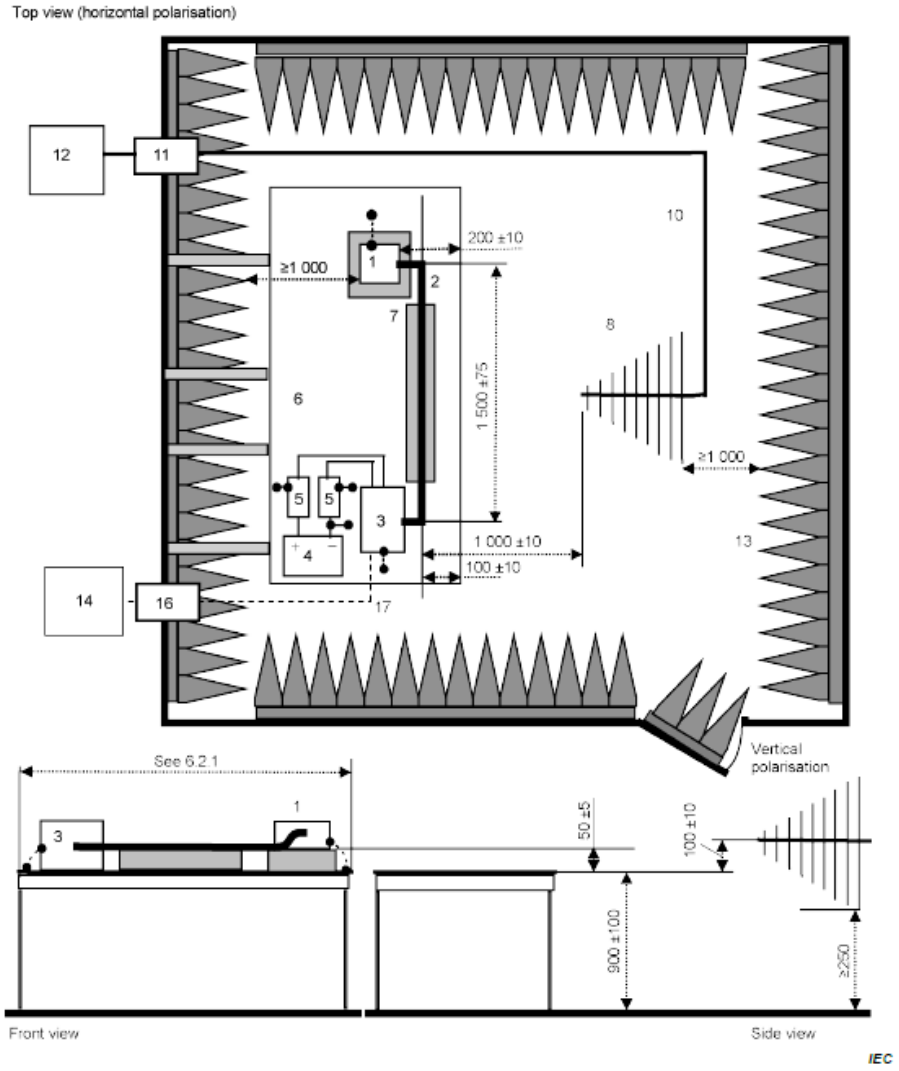
Figure 5 RE Test setup measurement with Rod antenna



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.5.2.6)
4 Power supply (location optional)
5 Artificial network (AN)
6 Reference ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
8 Biconical antenna (no part of the antenna closer than 700 mm to the wiring harness or EUT)
10 High-quality coaxial cable, e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Stimulation and monitoring system
16 Fibre optic feed through
17 Optical fibres

Figure 6 RE Test setup measurement with biconical antenna



Key

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.5.2.6)
4 Power supply (location optional)
5 Artificial network (AN)
6 Reference ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
8 Log-periodic antenna
10 High-quality coaxial cable e.g. double-shielded (50 Ω)
11 Bulkhead connector
12 Measuring instrument
13 RF absorber material
14 Stimulation and monitoring system
16 Fibre optic feed through
17 Optical fibres

Figure 7 RE Test setup measurement with Log-periodic antenna

5.1 Test Results

The UUT **conformed** to the requirements of the Class 5 Radiated Emissions (Electric Field) Test. Emissions were below the limit over the entire frequency range.

5.2 Test Data

Table 6 Radiated Emission test data

Radiated Emissions Test Data					
Frequency (Hz)	Polarity				Comments
	Vertical Results		Horizontal Results		
150kHz-30MHz	☑ Pass	☐ Fail	☐ Pass	☐ Fail	No Horizontal for 150kHz-30MHz
30MHz-200MHz	☑ Pass	☐ Fail	☑ Pass	☐ Fail	
200MHz-1GHz	☑ Pass	☐ Fail	☑ Pass	☐ Fail	

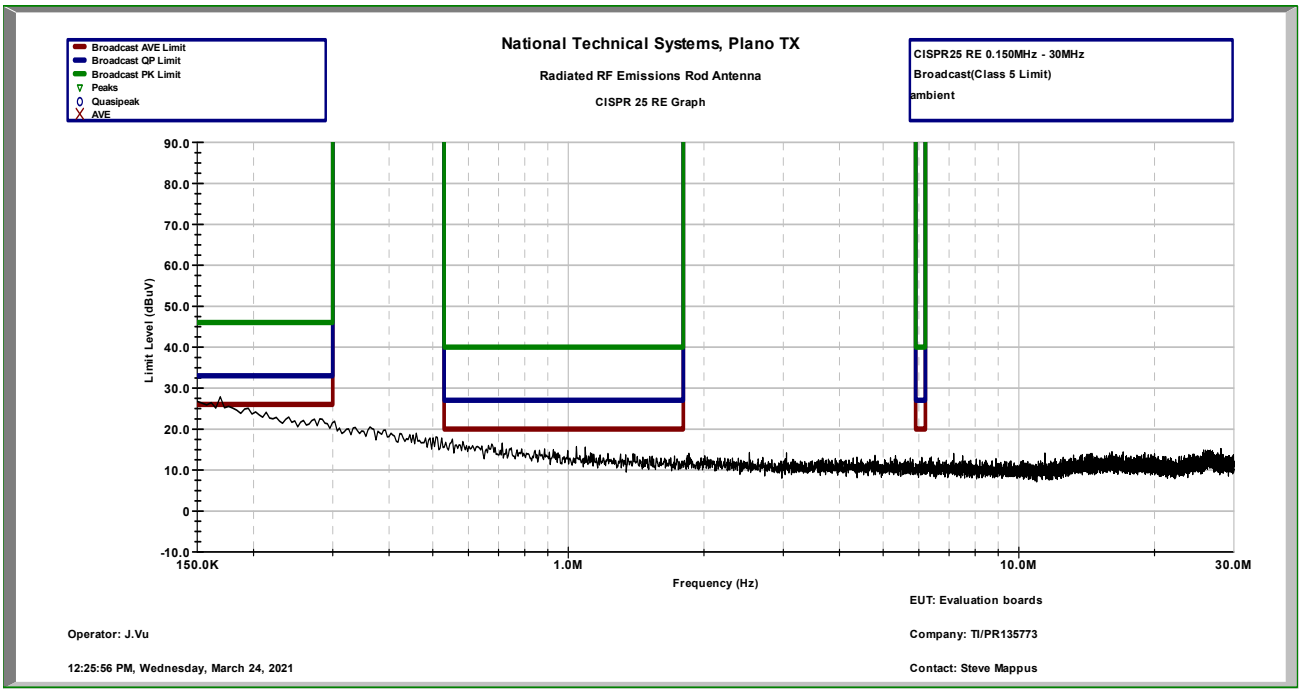


Figure 8 CISPR 25 Radiated Emissions test from 150 kHz - 30MHz, Ambient Graph

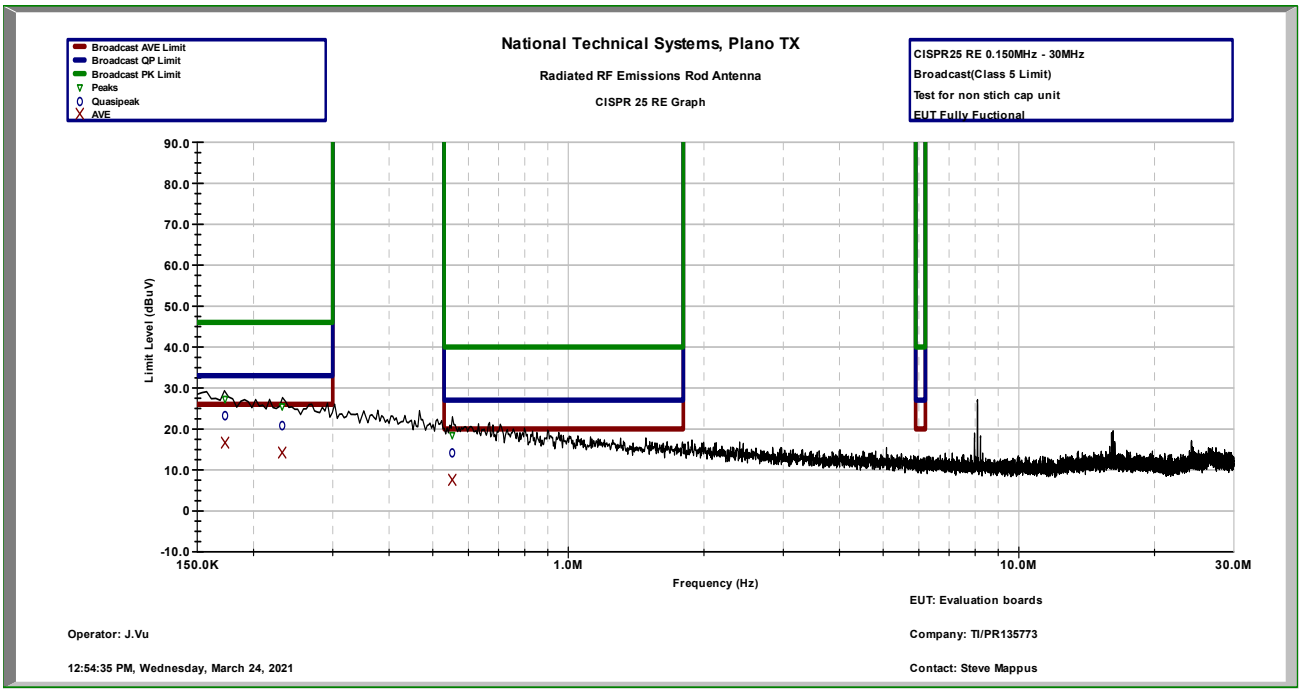


Figure 9 CISPR 25 Radiated Emissions test from 150 kHz - 30MHz, on TI PMP22855E1- Actual Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Current Method
CISPR 25 RE Table

Operator: J.Vu

Company: TI/PR135773

12:54:35 PM, Wednesday, March 24, 2021

Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9	
Frequency MHz	AVE Limit dBuV	AVE Data dBuV	AVE Margin dB	QP Limit dBuV	QP Data dBuV	QP Margin dB	PK Limit dBuV	PK Data dBuV	PK Margin dBuV	
172.39 KHz	26.000	16.653	-9.347	33.000	23.454	-9.546	46.000	27.392	-18.608	
232.09 KHz	26.000	14.176	-11.824	33.000	20.788	-12.212	46.000	25.516	-20.484	
552.98 KHz	20.000	7.514	-12.486	27.000	14.280	-12.720	40.000	18.574	-21.426	
CISPR25 RE 0.150MHz - 30MHz Broadcast(Class 5 Limit) Test for non stich cap unit EUT Fully Fuctional										

Table 7 CISPR 25 Radiated Emissions test from 150 kHz - 30MHz, on TI PMP22855E1- Actual Test Table Final

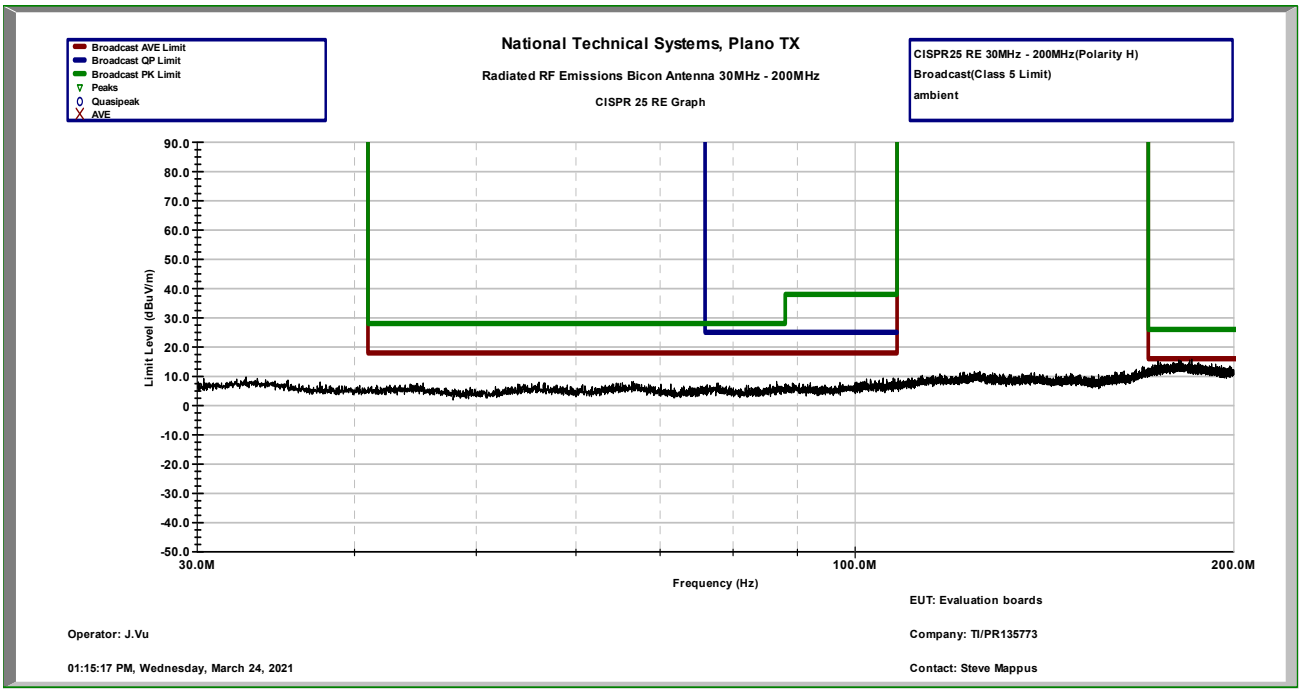


Figure 10 CISPR 25 Radiated Emissions test from 30MHz - 200MHz, Ambient Horizontal Graph

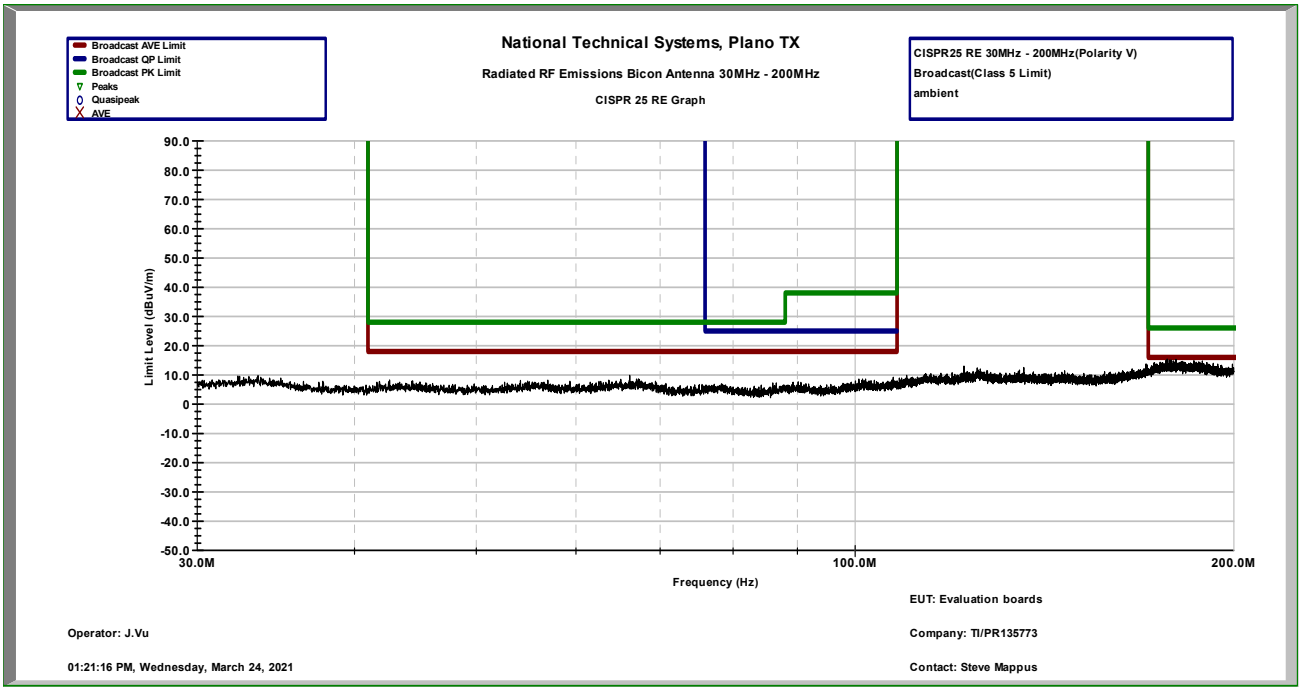


Figure 11 CISPR 25 Radiated Emissions test from 30MHz - 200MHz, Ambient Vertical Graph

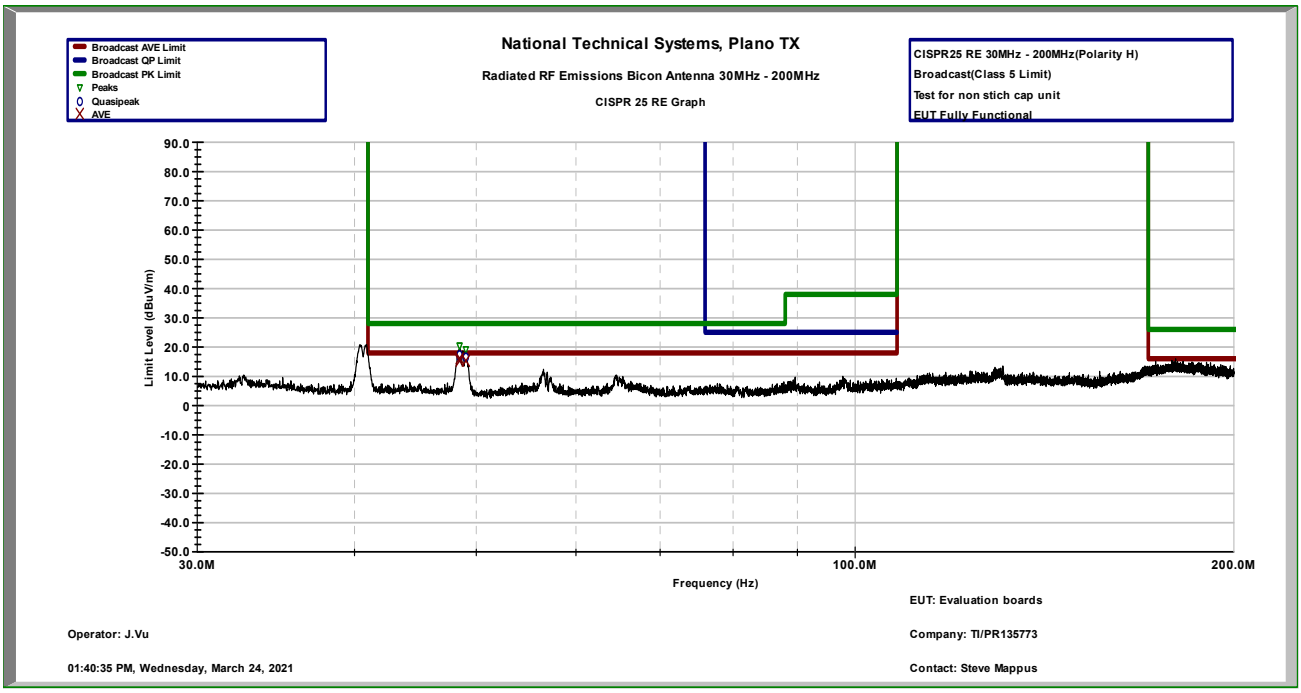


Figure 12 CISPR 25 Radiated Emissions test from 30MHz - 200MHz, on TI PMP22855E1- Actual Test Horizontal Graph

National Technical Systems, Plano TX
Conducted RF Emissions Bicon Antenna
CISPR 25 RE Table

Operator: J.Vu

01:40:35 PM, Wednesday, March 24, 2021

Company: TI/PR135773
Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9	
Frequency MHz	AVE Limit dBuV	AVE Data dBuV	AVE Margin dB	QP Limit dBuV	QP Data dBuV	QP Margin dB	PK Limit dBuV	PK Data dBuV	PK Margin dBuV	
48.45 MHz	18.000	15.115	-2.885	100.000	16.436	-83.564	28.000	20.215	-7.785	
48.51 MHz	18.000	16.158	-1.842	100.000	17.455	-82.545	28.000	20.261	-7.739	
49.02 MHz	18.000	15.148	-2.852	100.000	16.556	-83.444	28.000	19.061	-8.939	

CISPR25 RE 30MHz - 200MHz(Polarity H)
Broadcast(Class 5 Limit)
Test for non stich cap unit
EUT Fully Functional

Table 8 CISPR 25 Radiated Emissions test from 30MHz - 200MHz, on TI PMP22855E1- Actual Test Horizontal Table Final

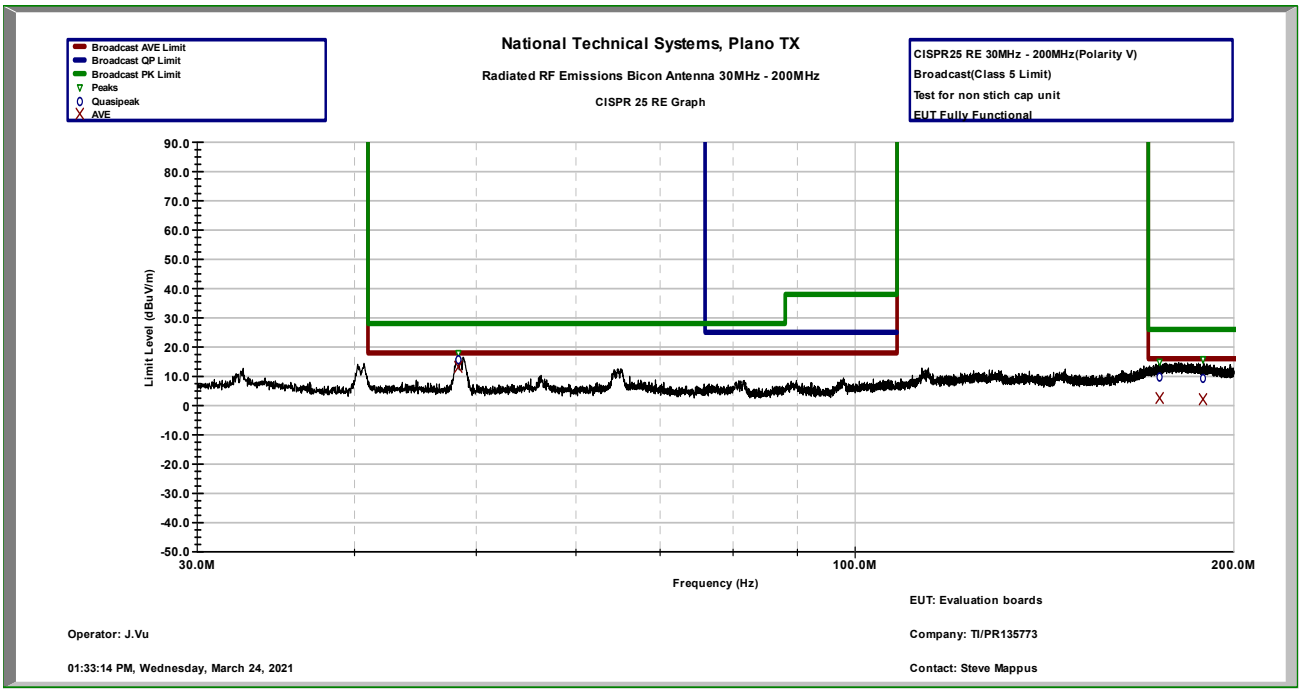


Figure 13 CISPR 25 Radiated Emissions test from 30MHz - 200MHz, on TI PMP22855E1- Actual Test Vertical Graph

National Technical Systems, Plano TX
Conducted RF Emissions Bicon Antenna
CISPR 25 RE Table

Operator: J.Vu

01:33:14 PM, Wednesday, March 24, 2021

Company: TI/PR135773
Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9	
Frequency MHz	AVE Limit dBuV	AVE Data dBuV	AVE Margin dB	QP Limit dBuV	QP Data dBuV	QP Margin dB	PK Limit dBuV	PK Data dBuV	PK Margin dBuV	
48.36 MHz	18.000	13.401	-4.599	100.000	15.707	-84.293	28.000	17.774	-10.226	
174.76 MHz	16.000	2.586	-13.414		9.626		26.000	15.088	-10.912	
189.23 MHz	16.000	2.366	-13.634		9.362		26.000	15.772	-10.228	
CISPR25 RE 30MHz - 200MHz(Polarity V)										
Broadcast(Class 5 Limit)										
Test for non stich cap unit										
EUT Fully Functional										

Table 9 CISPR 25 Radiated Emissions test from 30MHz - 200MHz, on TI PMP22855E1- Actual Test Vertical Table

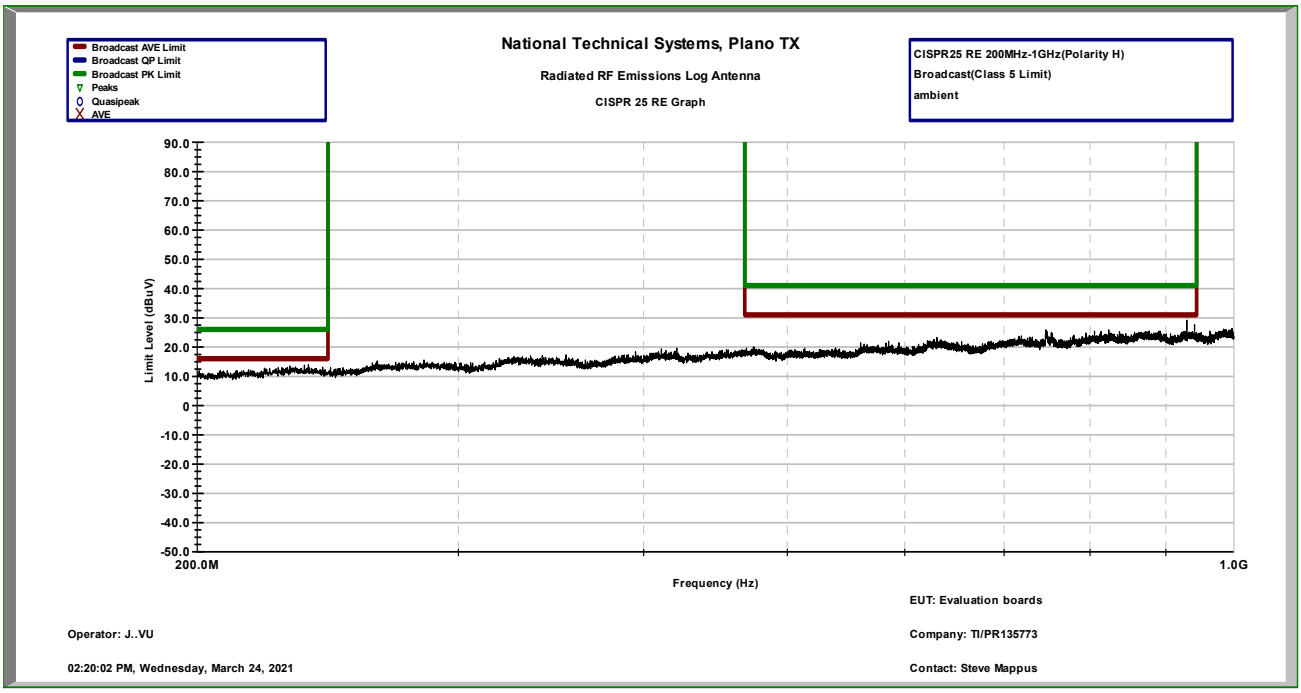


Figure 14 CISPR 25 Radiated Emissions test from 200MHz – 1GHz, Ambient Horizontal Graph

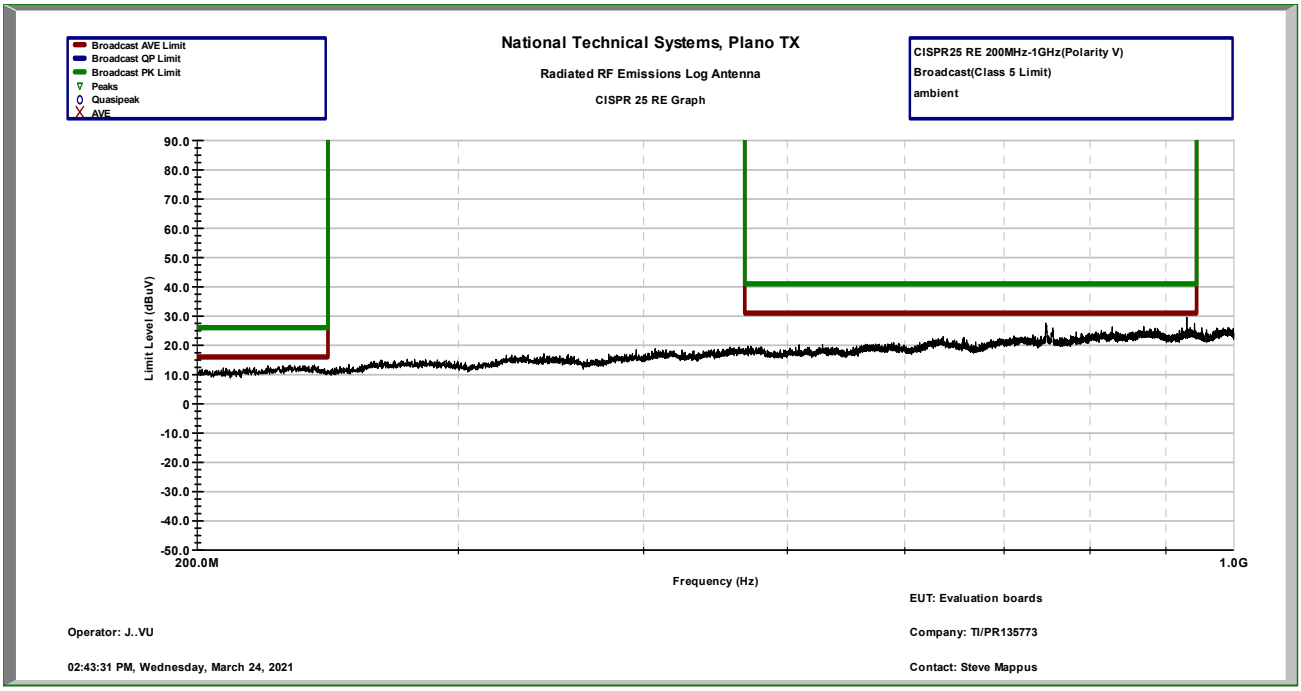


Figure 15 CISPR 25 Radiated Emissions test from 200MHz – 1GHz, Ambient Vertical Graph

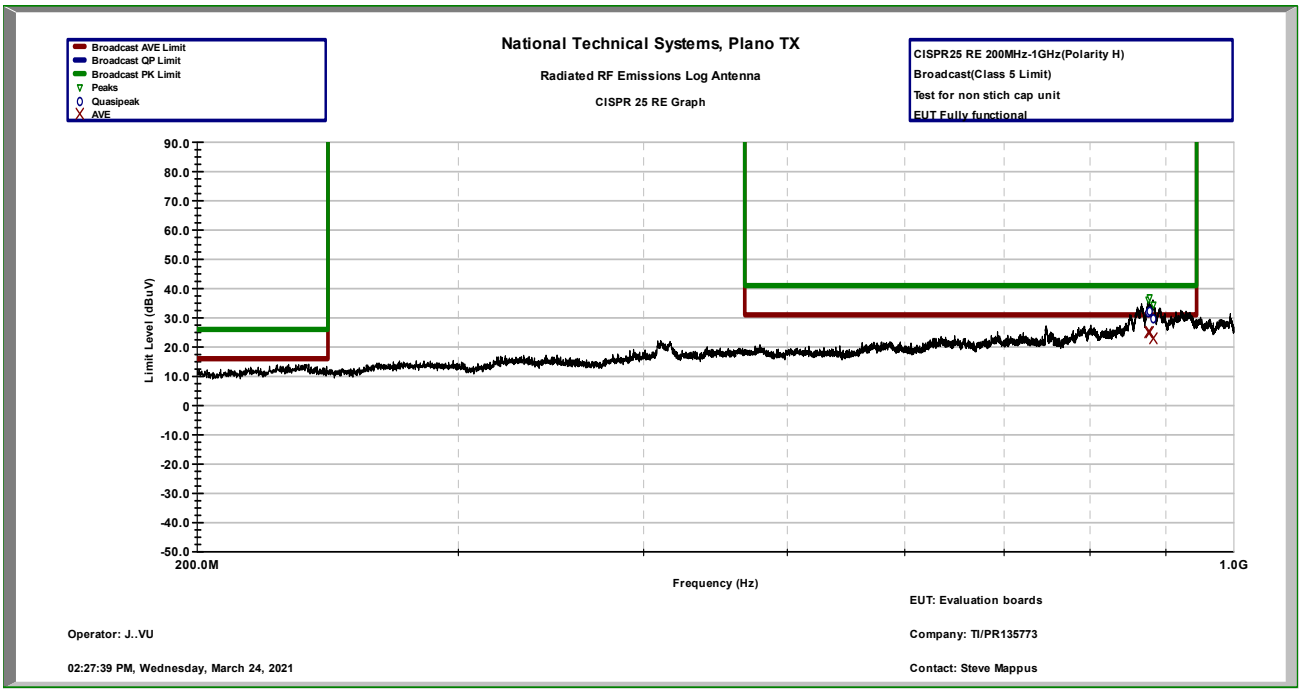


Figure 16 CISPR 25 Radiated Emissions test from 200MHz – 1GHz, on TI PMP22855E1 - Horizontal Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Log Antenna
CISPR 25 RE Table

Operator: J..VU

Company: TI/PR135773

02:27:39 PM, Wednesday, March 24, 2021

Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9	
Frequency	AVE Limit	AVE Data	AVE Margin	QP Limit	QP Data	QP Margin	PK Limit	PK Data	PK Margin	
MHz	dBuV	dBuV	dB	dBuV	dBuV	dB	dBuV	dBuV	dBuV	
875.50 MHz	31.000	25.249	-5.751		31.762		41.000	36.244	-4.756	
877.00 MHz	31.000	25.094	-5.906		32.123		41.000	36.887	-4.113	
882.10 MHz	31.000	23.113	-7.887		29.752		41.000	34.597	-6.403	

CISPR25 RE 200MHz-1GHz(Polarity H)
Broadcast(Class 5 Limit)
Test for non stich cap unit
EUT Fully functional

Table 10 CISPR 25 Radiated Emissions test from 200MHz – 1GHz, on TI PMP22855E1 - Horizontal Test Table Final

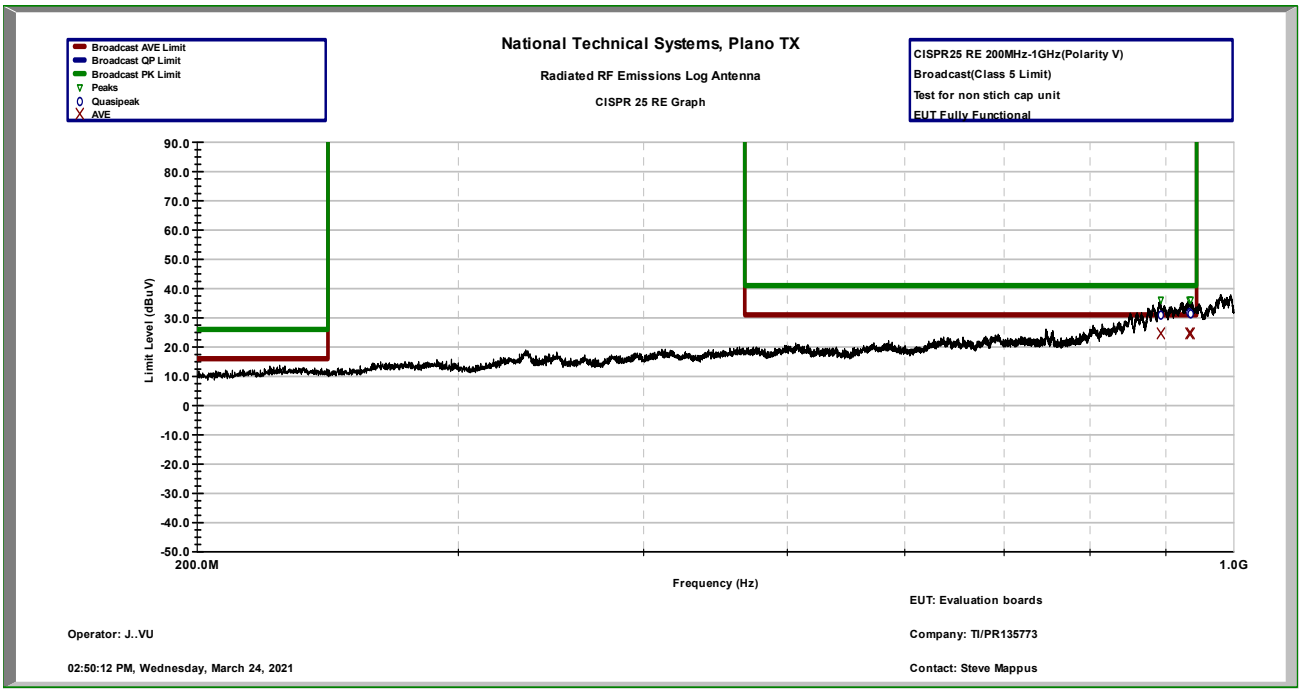


Figure 17 CISPR 25 Radiated Emissions test from 200MHz – 1GHz, on TI PMP22855E1 - Vertical Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Log Antenna
CISPR 25 CE Table

Operator: J..VU

02:50:12 PM, Wednesday, March 24, 2021

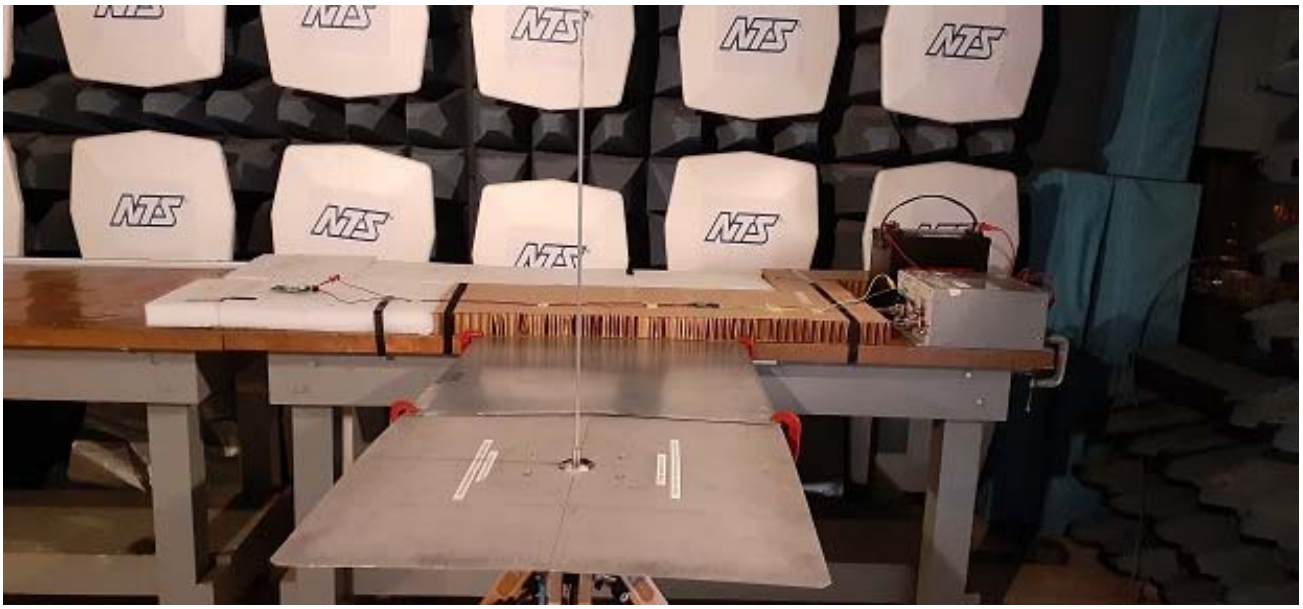
Company: TI/PR135773
Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9	
Frequency MHz	AVE Limit dBuV	AVE Data dBuV	AVE Margin dB	QP Limit dBuV	QP Data dBuV	QP Margin dB	PK Limit dBuV	PK Data dBuV	PK Margin dBuV	
892.40 MHz	31.000	24.579	-6.421		31.132		41.000	35.873	-5.127	
934.20 MHz	31.000	24.683	-6.317		31.753		41.000	36.115	-4.885	
934.50 MHz	31.000	24.662	-6.338		31.506		41.000	35.957	-5.043	

CISPR25 RE 200MHz-1GHz(Polarity V)
Broadcast(Class 5 Limit)
Test for non stich cap unit
EUT Fully Functional

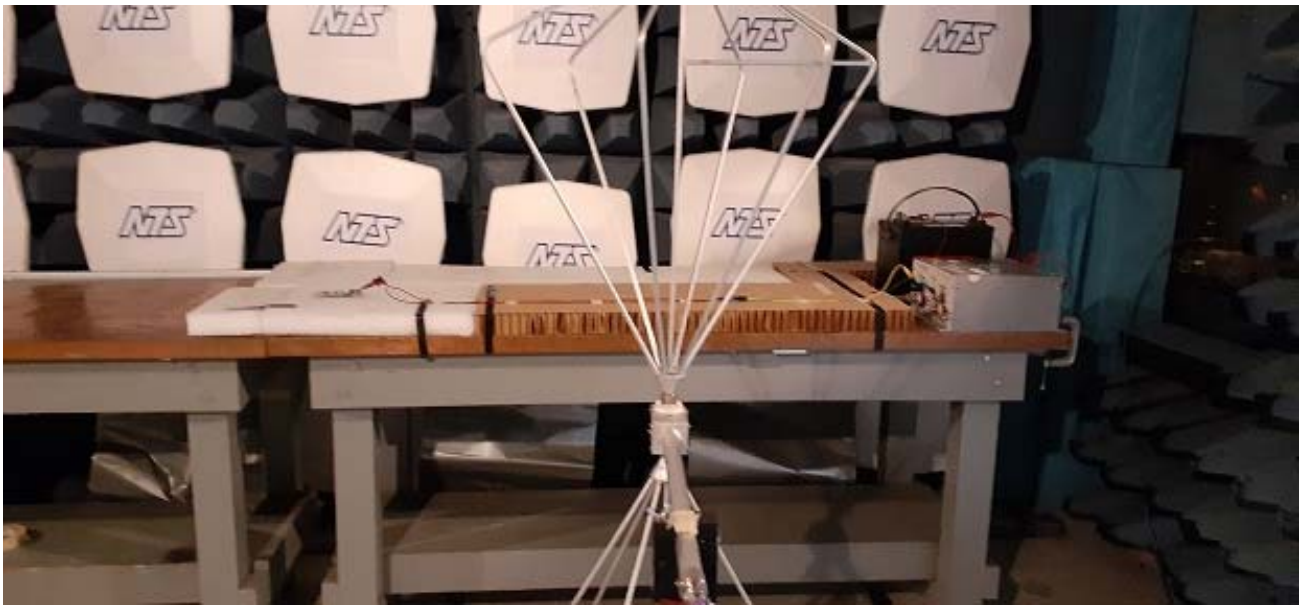
Table 11 CISPR 25 Radiated Emissions test from 200MHz – 1GHz, on TI PMP22855E1 - Vertical Test Table Final

6 Test Photographs



Photograph 1 CISPR 25 RE 150kHz-30Mhz test set up

Photograph 2 CISPR 25 RE 30-200MHz Horizontal test set up



Photograph 3 CISPR 25 RE 30-200MHz Vertical test set up

Photograph 4 CISPR 25 RE 200MHz-1GHz horizontal test set up

Photograph 5 CISPR 25 RE 200MHz-1GHz Vertical test set up

Table 12 Test Equipment Used

Emissions Test Equipment List			
NTS ID#	**Manufacturer/Model**	**Duration**	**Calibration Due**
WC021613	Spectrum Analyzer Agilent E4440A	12 months	4/21/2021
WC021557	EMCO Active Monopole antenna 3301B	12 months	10/22/2021
WC020910	EMCO Bicon Antenna 3110	12 months	4/27/2021
WC021351	EMCO Log periodic Antenna 3147	12 months	10/8/2021
WC021480	Miteq Pre-Amp AM1431-N-1179-WP	12 months	11/30/2021
WC021752	EMI Test Chamber #4	NCR	
WC015560	Model #9123-1N Solar Electronics RF Current Probe	12 months	11/6/2021
WC021317	Solar LISN 9867-5TS-50-N	12 months	4/22/2021
WC021318	Solar LISN 9867-5TS-50-N	12 months	4/22/2021

Calibration Abbreviations
CAL calibrated
NCR no calibration required

7 Conducted Emissions (AC Power Leads Voltage) Test

Conducted measurements were made with power supplied to the UUT through a 5Ω/5 µH Line Impedance Stabilization Network (LISN). Support equipment that is not part of the UUT is powered through a similar, but separate, LISN.

Each of the input power leads are first scanned with a peak detector. The highest peak amplitudes relative to the appropriate limits are identified and measured again using a quasi-peak detector if the peak value approaches the average limit. If the quasi-peak value approaches the average limit, average measurements are performed. At least six peaks closest to the respective limits are recorded.

The Conducted Emissions Test is performed using NTS' automatic EMI test equipment. This equipment utilizes TILE software manufactured by ETS-Lindgren. An electronic copy of the peak, quasi-peak and average measurements is stored in PDF format. The program automatically selects the range of test frequencies or band, and sets the specification line limits to be used during the test. This allows for real-time data reduction and prints tabulated data for peak, quasi-peak, and average value measurements.

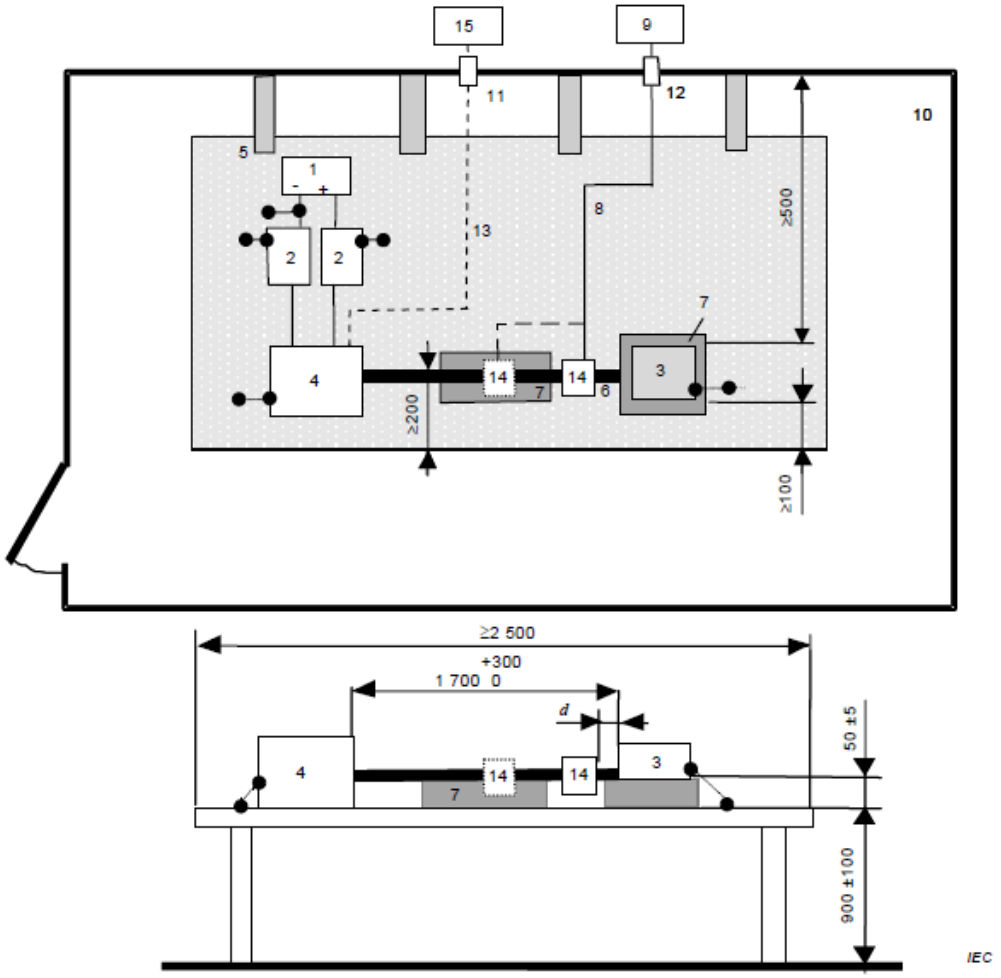
In the performance of this test, the LISNs are placed in series with the DC power lines. The test sample is grounded with the grounding point used in the actual installation. The following procedure is used:

1. The spectrum analyzer is connected to a shielded 50 ohm coaxial cable.
2. The UUT is operated in its normal mode of operation. Sufficient time is allowed for stabilization.
3. The spectrum analyzer cable is connected to the LISN.
4. Frequency scanning is performed from 150 kHz to 30 MHz.
5. Amplitude versus frequency data is recorded using the spectrum analyzer until 30 MHz is reached.

Table 13 EMI Receiver Settings for CE Measurements

Frequency Range	Resolution Bandwidth	Step size	Measurement time
150-kHz – 30-MHz	9-kHz	5-kHz	50-ms/Pts
30-MHz – 108-MHz	120-kHz	50-kHz	5-ms/Pts

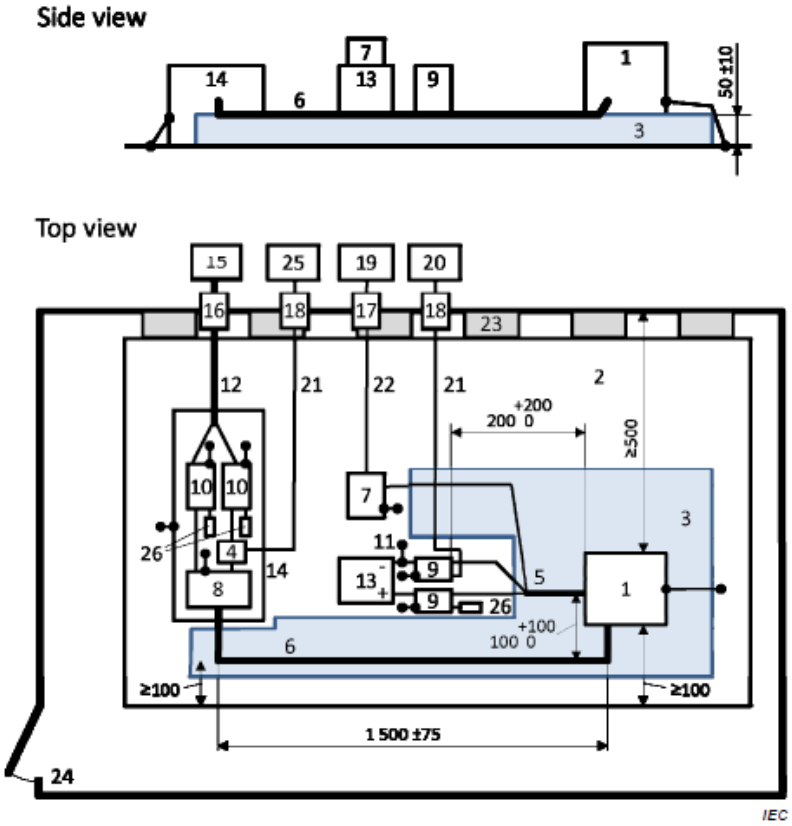
7.1 Test Set up



Key

1 Power supply
2 Artificial network
3 EUT (connected to ground if specified in the test plan)
4 Load simulator (metallic casing grounded if required in test plan)
5 Reference ground plane
6 Wiring harness
7 Low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
8 High-quality coaxial cable e.g. double-shielded (50 Ω)
9 Measuring instrument
10 Shielded enclosure
11 Fibre optic feed through
12 Bulkhead connector
13 Optical fibres
14 Current probe (represented at 2 positions)
15 Stimulation and monitoring system
d The distance from the EUT to the closest probe position

Figure 18 Test setup for conducted emissions – Current method



Key

1	EUT	14	Additional shielded box
2	Reference ground plane	15	HV power supply (should be shielded if placed inside the shielded enclosure)
3	Low relative permittivity support ($\varepsilon_r \leq 1{,}4$) thickness 50 mm	16	Power line filter
4	Test signal coupling element (may be current clamp or capacitor)	17	Fibre optic feed through
5	LV harness	18	Bulk head connector
6	HV lines (HV+, HV−)	19	Stimulating and monitoring system
7	LV load simulator	20	Measuring instrument
8	Impedance matching network (optional)	21	High quality coaxial cable e.g. double shielded (50 Ω)
9	LV AN	22	Optical fibre
10	HV AN	23	Ground straps (see 6.2.1)
11	LV supply lines	24	Shielded enclosure
12	HV supply lines	25	RF generator (may be placed inside the shielded box (14))
13	LV power supply 12 V / 24 V / 48 V (should be placed on the reference ground plane)	26	50 Ω load

Figure 19 Test setup for conducted emissions – Voltage method

7.2 Test Results

The UUT **conformed** to the requirements of the Class 5 Conducted Emission Test. Emissions were below the limit over the entire frequency range.

7.3 Test Data

Table 14 Conducted Emission Test Data

Conducted Emissions Test Data						
Temperature:	63°	Humidity:	40%	Barometric Pressure:		987mbar
Frequency	Test On Cable			Results		Comments
150kHz-108MHz	High site			☑ Pass	☐ Fail	
150kHz-108MHz	Return site			☑ Pass	☐ Fail	
150kHz-245MHz	Both high and return site at 5cm			☑ Pass	☐ Fail	
150kHz-245MHz	Both high and return site at 75cm			☑ Pass	☐ Fail	

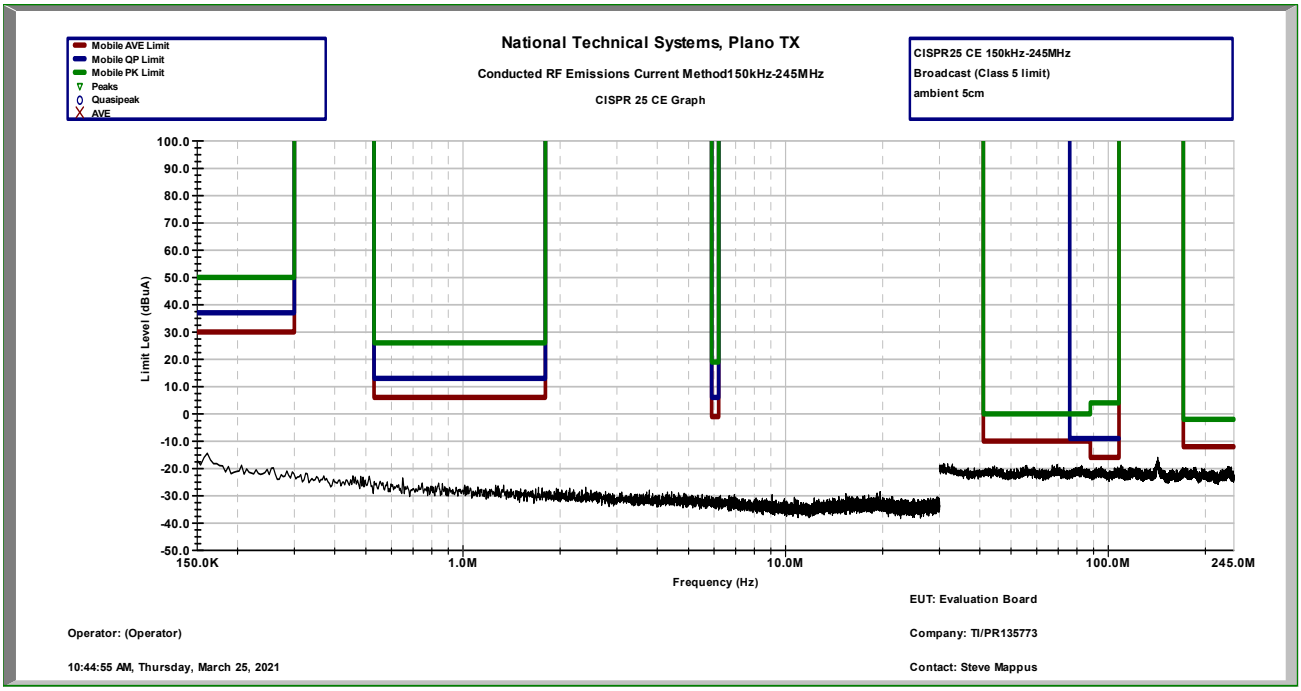


Figure 20 CISPR 25 CE Current at 5cm Ambient Graph

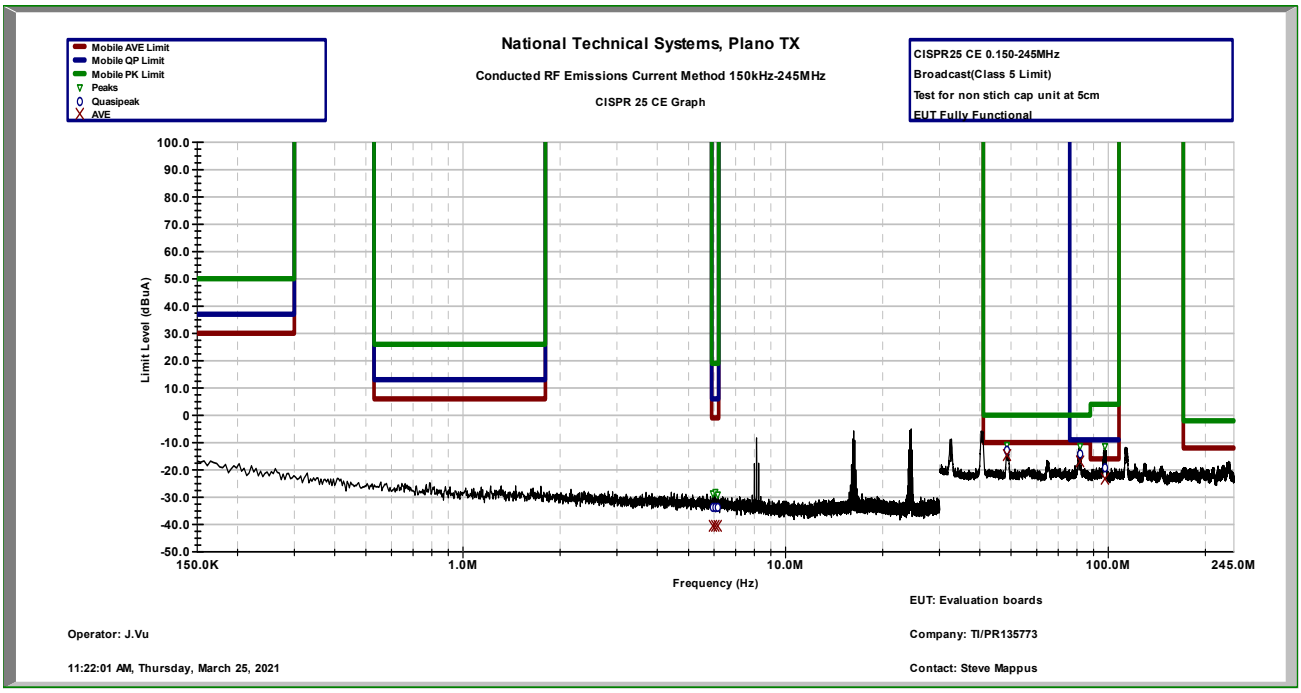


Figure 21 CISPR 25 CE Current at 5cm Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Current Method 150kHz-245MHz
CISPR 25 CE Table

Operator: J.Vu

Company: TI/PR135773
11:22:01 AM, Thursday, March 25, 2021
Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9
Frequency MHz	AVE Limit dBuA	AVE Reading dBuA	AVE Margin dB	QP Limit dBuA	QP Reading dBuA	QP Margin dB	Peak Limit dBuA	PK Reading dBuA	PK Margin dB
5.96 MHz	-1.000	-40.438	-39.438	6.000	-33.621	-39.621	19.000	-28.720	-47.720
6.03 MHz	-1.000	-40.560	-39.560	6.000	-33.714	-39.714	19.000	-28.219	-47.219
6.18 MHz	-1.000	-40.583	-39.583	6.000	-33.693	-39.693	19.000	-28.919	-47.919
48.54 MHz	-10.000	-14.513	-4.513	1000.000	-12.676	-1012.676	0.000	-11.103	-11.103
81.79 MHz	-10.000	-16.928	-6.928	-9.000	-14.277	-5.277	0.000	-11.284	-11.284
97.75 MHz	-16.000	-23.257	-7.257	-9.000	-18.936	-9.936	4.000	-11.600	-15.600

CISPR25 CE 0.150-245MHz
Broadcast(Class 5 Limit)
Test for non stich cap unit at 5cm
EUT Fully Functional

Table 15 CISPR 25 CE Current at 5cm Test Table Final

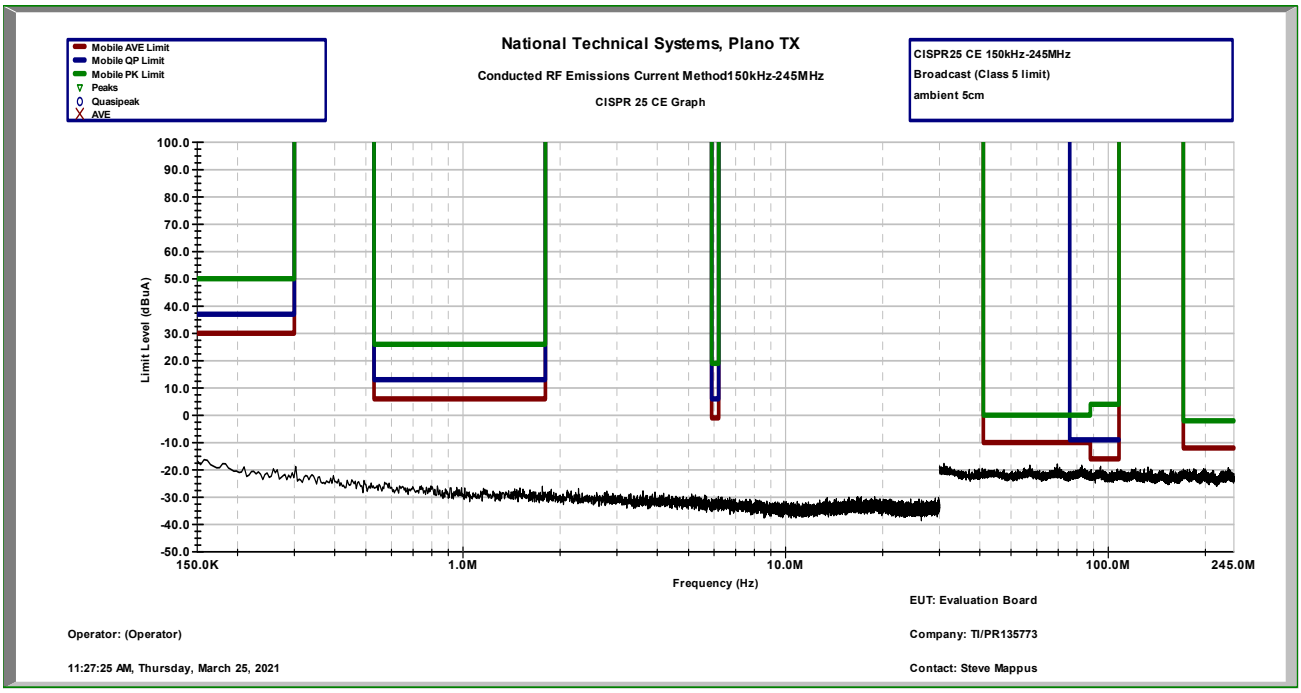


Figure 22 CISPR 25 CE Current at 75cm Ambient Graph

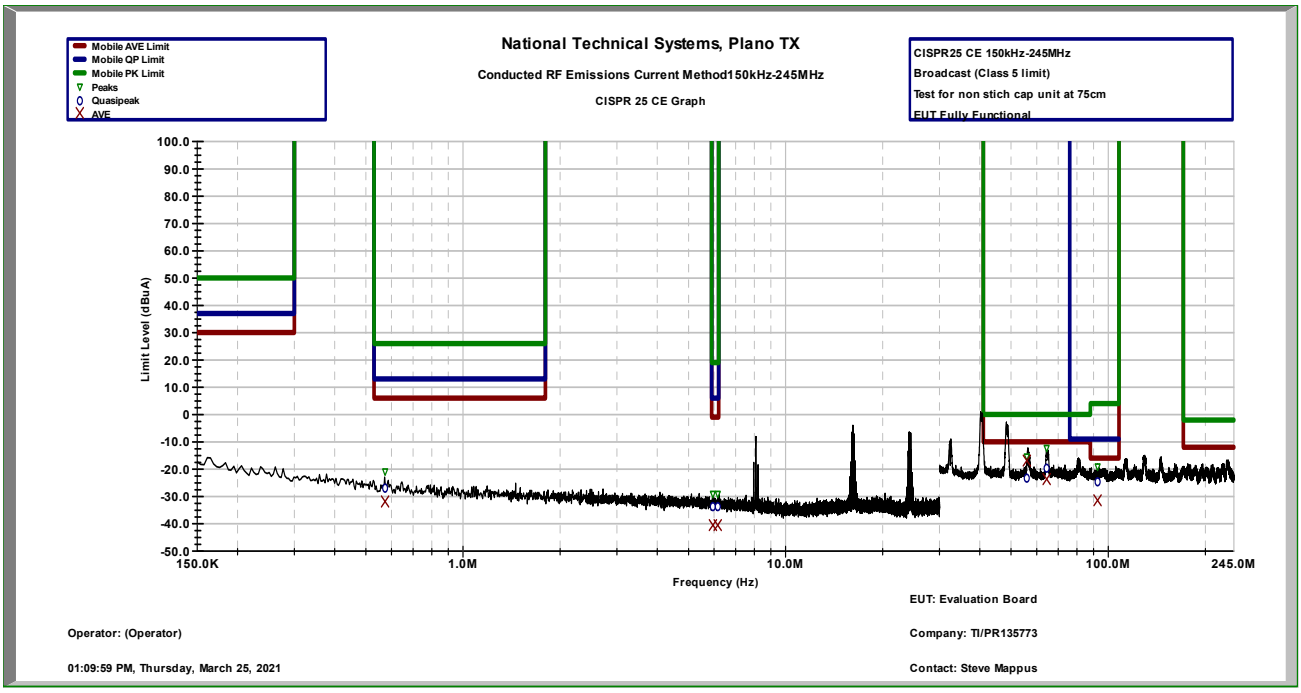


Figure 23 CISPR 25 CE Current at 75cm Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Current Method 150kHz-245MHz
CISPR 25 CE Table

Operator: (Operator)

Company: TI/PR135773
01:09:59 PM, Thursday, March 25, 2021 Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9
Frequency MHz	AVE Limit dBuA	AVE Reading dBuA	AVE Margin dB	QP Limit dBuA	QP Reading dBuA	QP Margin dB	Peak Limit dBuA	PK Reading dBuA	PK Margin dB
571.63 KHz	6.000	-32.002	-38.002	13.000	-26.982	-39.982	26.000	-20.877	-46.877
5.97 MHz	-1.000	-40.501	-39.501	6.000	-33.704	-39.704	19.000	-29.286	-48.286
6.16 MHz	-1.000	-40.556	-39.556	6.000	-33.865	-39.865	19.000	-29.166	-48.166
56.17 MHz	-10.000	-16.844	-6.844	1000.000	-23.083	-1023.083	0.000	-15.503	-15.503
64.40 MHz	-10.000	-23.844	-13.844	1000.000	-19.376	-1019.376	0.000	-12.152	-12.152
92.67 MHz	-16.000	-31.375	-15.375	-9.000	-24.394	-15.394	4.000	-19.172	-23.172

CISPR25 CE 150kHz-245MHz
Broadcast (Class 5 limit)
Test for non stich cap unit at 75cm
EUT Fully Functional

Table 16 CISPR 25 CE Current at 75cm Test Table Final

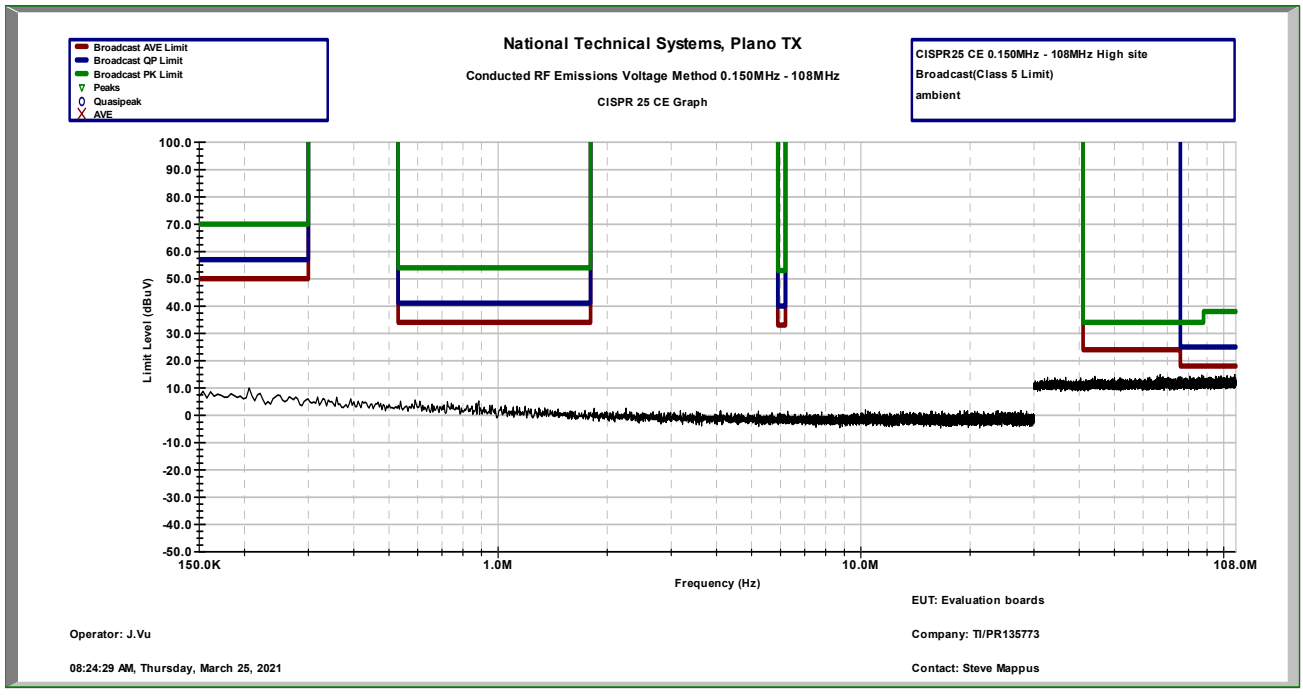


Figure 24 CISPR 25 CE Voltage HS Ambient Graph

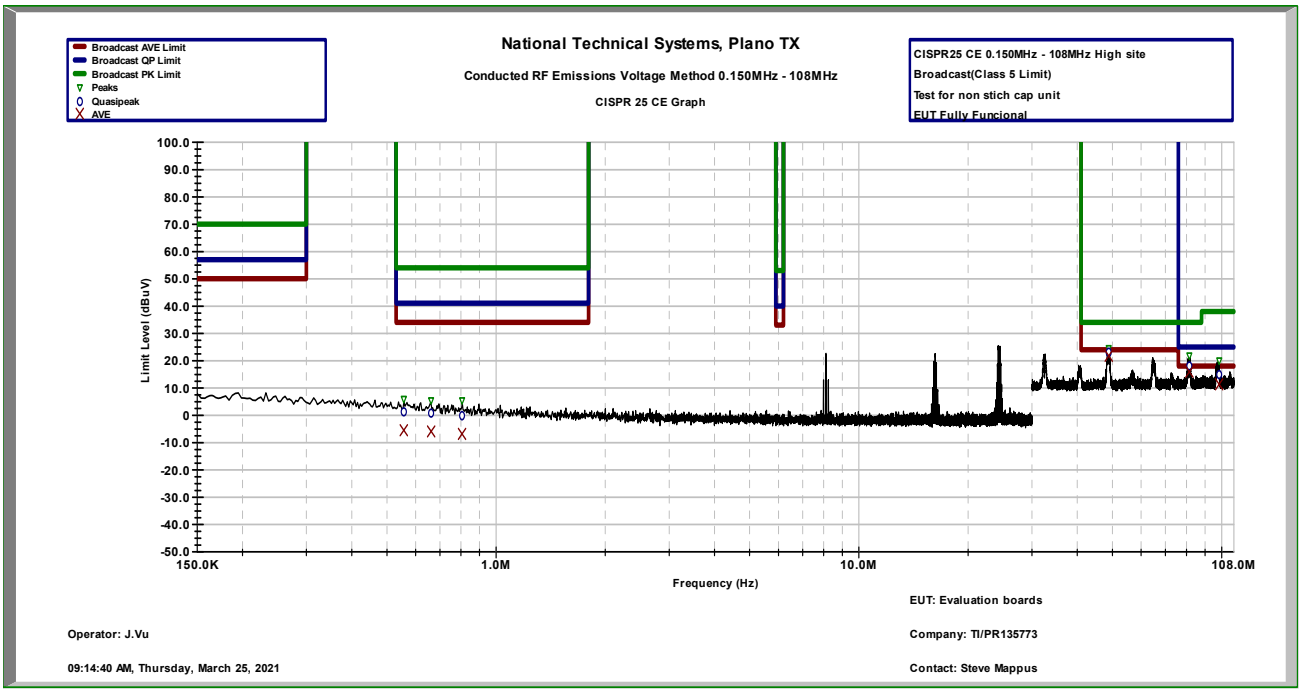


Figure 25 CISPR 25 CE Voltage HS Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Voltage Method 0.150MHz - 108MHz
CISPR 25 CE Table

Operator: J.Vu
09:14:40 AM, Thursday, March 25, 2021
Company: TI/PR135773
Contact: Steve Mappus

1	2	3	4	5	6	7	8	9
Frequency MHz	AVE Limit dBuV	AVE Reading dBuV	AVE Margin dB	QP Limit dBuV	QP Reading dBuV	QP Margin dB	Peak Limit dBuV	PK Reading dBuV	PK Margin dB
556.71 KHz	34.000	-5.515	-39.515	41.000	1.220	-39.780	54.000	5.743	-48.257
661.18 KHz	34.000	-6.076	-40.076	41.000	0.636	-40.364	54.000	5.224	-48.776
806.70 KHz	34.000	-6.742	-40.742	41.000	0.020	-40.980	54.000	5.224	-48.776
48.99 MHz	24.000	21.696	-2.304	1000.000	23.167	-976.833	34.000	24.633	-9.367
81.34 MHz	18.000	15.671	-2.329	25.000	18.201	-6.799	34.000	21.843	-12.157
98.21 MHz	18.000	11.244	-6.756	25.000	15.147	-9.853	38.000	19.991	-18.009

CISPR25 CE 0.150MHz - 108MHz High site
Broadcast(Class 5 Limit)
Test for non stich cap unit
EUT Fully Funcional

Table 17 CISPR 25 CE Voltage HS Test Table Final

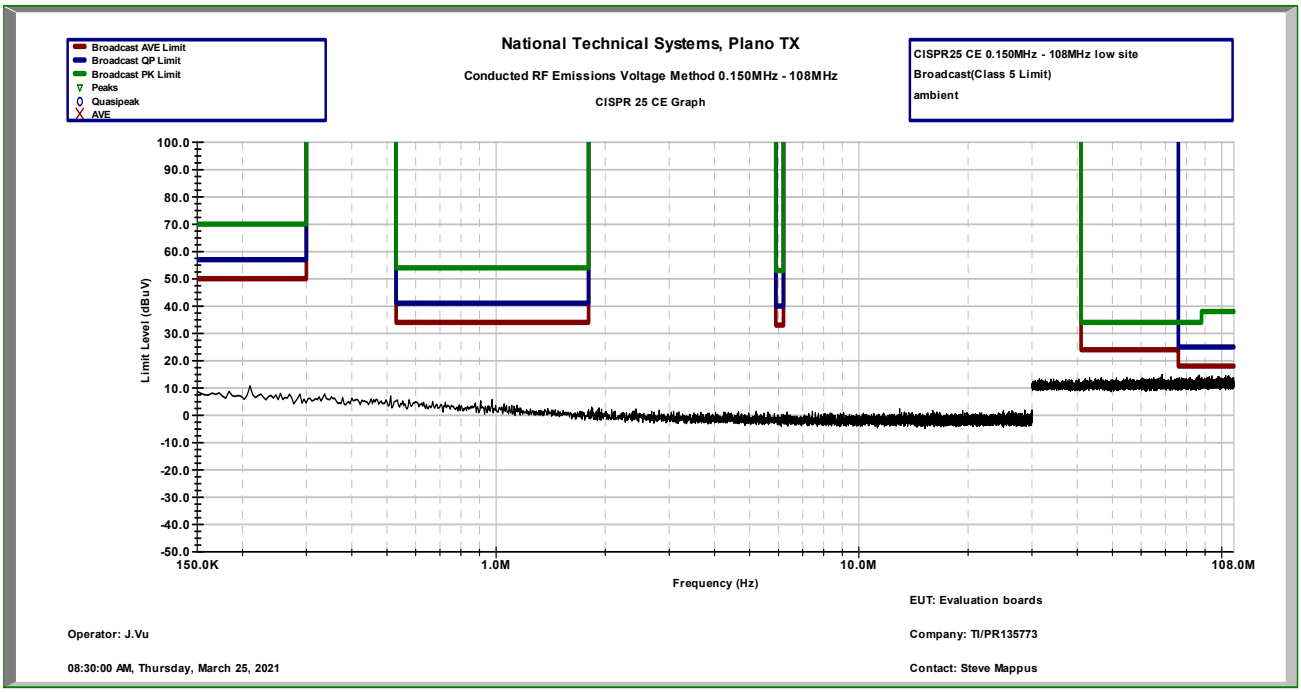


Figure 26 CISPR 25 CE Voltage LS Ambient Graph

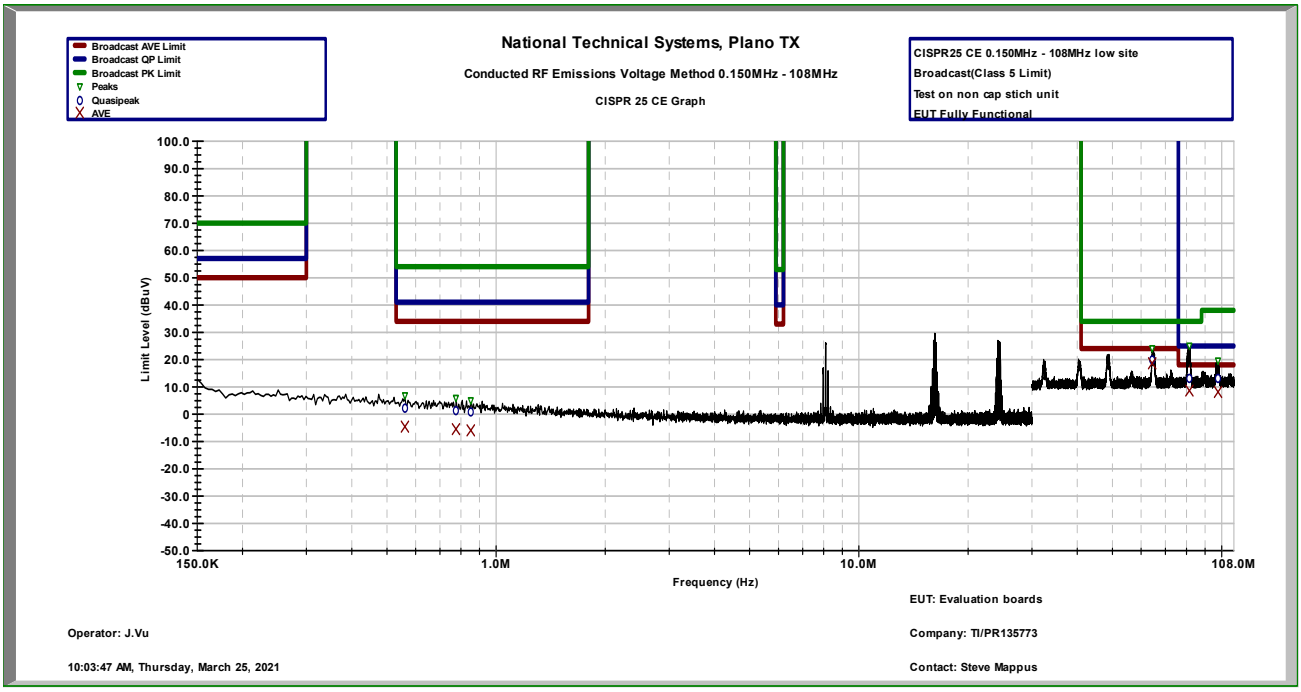


Figure 27 CISPR 25 CE Voltage LS Test Graph

National Technical Systems, Plano TX
Conducted RF Emissions Voltage Method 0.150MHz - 108MHz
CISPR 25 CE Table

Operator: J.Vu

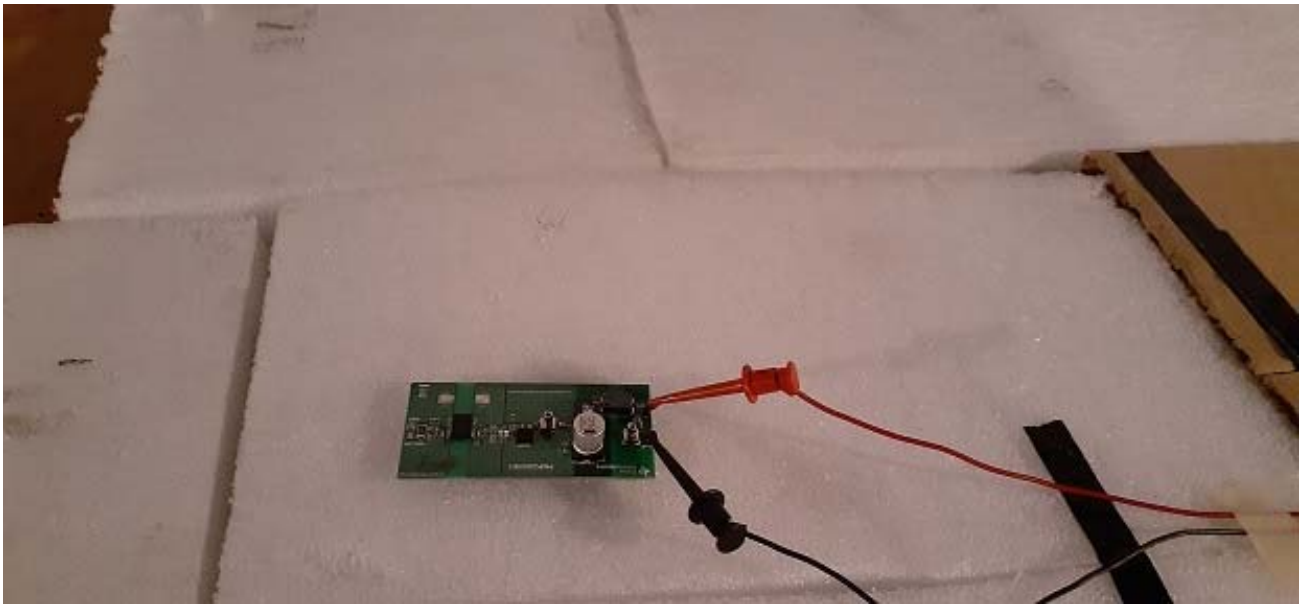
Company: TI/PR135773
10:03:47 AM, Thursday, March 25, 2021 Contact: Steve Mappus

	1	2	3	4	5	6	7	8	9
Frequency	AVE Limit	AVE Reading	AVE Margin	QP Limit	QP Reading	QP Margin	Peak Limit	PK Reading	PK Margin
MHz	dBuV	dBuV	dB	dBuV	dBuV	dB	dBuV	dBuV	dB
560.44 KHz	34.000	-4.543	-38.543	41.000	2.261	-38.739	54.000	6.776	-47.224
776.85 KHz	34.000	-5.635	-39.635	41.000	1.180	-39.820	54.000	5.862	-48.138
851.48 KHz	34.000	-5.949	-39.949	41.000	0.871	-40.129	54.000	5.006	-48.994
64.52 MHz	24.000	18.458	-5.542	1000.000	20.049	-979.951	34.000	23.855	-10.145
81.22 MHz	18.000	8.473	-9.527	25.000	13.392	-11.608	34.000	24.749	-9.251
97.31 MHz	18.000	8.237	-9.763	25.000	13.028	-11.972	38.000	19.531	-18.469

CISPR25 CE 0.150MHz - 108MHz low site
Broadcast(Class 5 Limit)
Test on non cap stich unit
EUT Fully Functional

Table 18 CISPR 25 CE Voltage LS Test Table Final

7.4 Test Photographs

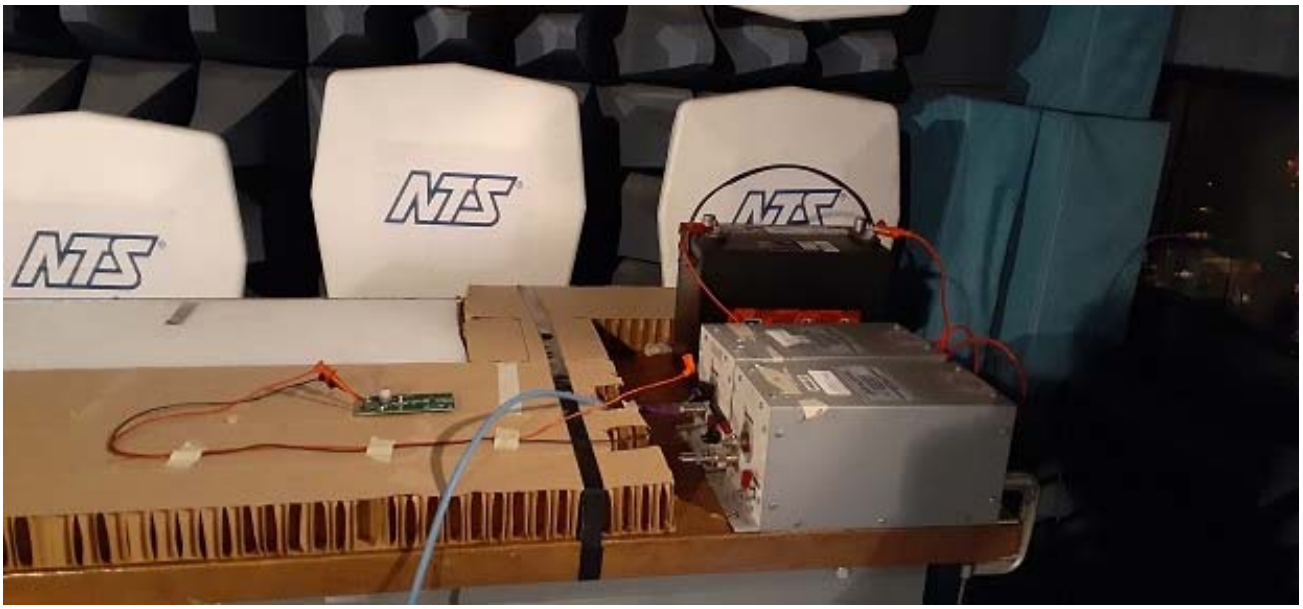


Photograph 6 EUT Close look

Photograph 7 CE 150 Khz-245MHz current@5cm test set up

Photograph 8 CE 150 kHz-245MHz current@75cm test set up

Photograph 9 CE 150Khz-108MHz Voltage HS test set up



Photograph 10 CE 150Khz-108MHz Voltage LS test set up

Table 19 Test Equipment Used

Emissions Test Equipment List			
NTS ID#	**Manufacturer/Model**	**Duration**	**Calibration Due**
WC021613	Spectrum Analyzer Agilent E4440A	12 months	4/21/2021
WC021752	EMI Test Chamber #4	NCR	
WC015560	Model #9123-1N Solar Electronics RF Current Probe	12 months	11/6/2021
WC021317	Solar LISN 9867-5TS-50-N	12 months	4/22/2021
WC021318	Solar LISN 9867-5TS-50-N	12 months	4/22/2021

Calibration Abbreviations
CAL calibrated
NCR no calibration required

End of Report

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (https:www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265