50 YEARS OF BUILDING AUTOMOTIVE EXCELLENCE 1966 - 2016

TEST REPORT

Report No: ARAI/AED/CT/OC-1617-5466/750 **CONFIDENTIAL**
Dated: 21-Nov-2016

Certificate No.:T-1537

1.0	**Name and address of the customer**	POINTER TELOCATION INDIA PVT. LTD. Office No. 102, Pentagon P1, Magarpatta City, Pune 411028, Maharashtra	
2.0	**Customer letter reference**	E-mail Dated: 21-Mar-2016	
3.0	**Description of the Device Under Test (DUT)**	**DUT Name**	VEHICLE TRACKING DEVICE
		Manufacture Name	Pointer Telocation India Pvt. Ltd.
		Model Name	CR 300
		Model No.	CR300 B 2G
		Part No.	CT7801201-000
		Software Version	43
		Hardware Version	B
4.0	**Test objective**	To carry out EMI/EMC tests as per details given in table 8.0	
5.0	**Condition of the test component**	The test component was received in good condition.	

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A C GAMI	A A PAPADE	A A DESHPANDE
ENGINEER	**MANAGER**	**Dy. DIRECTOR & HOD**

ISO 9001, ISO 14001, OHSAS 18001 Certified ISO/IEC17025 Accredited Organization

6.0 FUNCTIONALITY VERIFICATION

DUT was a GSM & GPS based Vehicle tracker unit powered with 27 V_{DC} power supply. DUT has a 3.7 V, 1000 mAh internal battery. GPS receives the latitude and longitude and other GPS related information and it is stored in flash memory and then transferred to server through GPRS then it is stored and plotted on the map. DUT has 2 programmable IOs, and 3 inputs (1 dedicated to ignition or 2 programmable inputs).

For functionality verification data log on the server was checked before, during and after test.

7.0 FUNCTIONAL STATUS CLASSIFICATION
7.1 Class A
All functions of a device/system perform as designed during and after exposure to disturbance.
7.2 Class B
All functions of a device/system perform as designed during exposure: however, one or more of them can go beyond specified tolerance. All functions return automatically to within normal limits after exposure is removed. Memory functions remain Class A.
7.3 Class C
One or more functions of a device/system does not perform as designed during exposure but returns automatically to normal operation after exposure is removed.
7.4 Class D
One or more functions of a device/system does not perform as designed during exposure and does not return to normal operation until exposure is removed and the device/system is reset by simple "operator/use" action.
7.5 Class E
One or more functions of a device/system does not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

A C GAMI ENGINEER	A A PAPADE MANAGER	A A DESHPANDE Dy. DIRECTOR & HOD

8.0 TEST DETAILS						
Sr. no.	**Test title**	**Annexure no.**	**Number of pages**	**Reference standard**	**Acceptance criteria as per standard**	**Functional status classification**
8.1	**Conducted transient immunity on supply line**					
8.1.1	Pulse 1	01	06	AIS004 (Part 3) :2009	**Class C**	**Class B**
8.1.2	Pulse 2a				**Class B**	**Class A**
8.1.3	Pulse 2b				**Class C**	**Class B**
8.1.4	Pulse 3a				**Class A**	**Class A**
8.1.5	Pulse 3b				**Class A**	**Class A**
8.1.6	Pulse 4				**Class B/C**	**Class A**
8.2	**Radiated immunity test**					
8.2.1	Bulk Current Injection (BCI Method)	02	04	AIS004 (Part 3) :2009	-	**Pass**
8.2.2	Radiated Immunity (ALSE Method)	03	06		-	**Pass**
8.3	**Radiated emission test**					
8.3.1	Radiated Emission Test	04	07	AIS004 (Part 3) :2009	-	**Pass**
8.4	**Conducted transient emission test**					
8.4.1	Positive Transient Emission	05	04	AIS004 (Part 3) :2009	**+150V**	**Pass**
8.4.2	Negative Transient Emission				**-450V**	**Pass**

9.0 CONCLUSION
DUT complies with the requirements as per AIS004 (Part3): 2009.

A C GAMI **ENGINEER**	**A A PAPADE** **MANAGER**	**A A DESHPANDE** **Dy. DIRECTOR & HOD**

10.0 LIST OF TEST EQUIPMENTS			
Radiated immunity equipment list			
Description	**ARAI ID**	**Status**	**Cal due date**
Signal generators			
Rhode & Schwarz SML 02 Signal Generator	AED/GEN/02	■	19/11/2017
Rhode & Schwarz SMB 100A Signal Generator	AED/GEN/03	□	09/11/2017
Antennas			
Frankonia Gmbh BTA-M Broad Band Antenna (1MHz-3000MHz)	AED/ANT/09	□	N/A
Schwarzbeck Mess Elektronik BBHA 9120 F 022 Broad Band Horn Antenna (200MHz-2000MHz)	AED/ANT/10	■	N/A
ETS-Lindgren 3109PX Biconical Antenna (Type 2) (20MHz-300MHz)	AED/ANT/11	□	N/A
Schwarzbeck Mess Elektronik UHA 9105 & UHA 9125 D Handy Transmitter Antenna Set (26 MHz-2590MHz)	AED/ANT/12	□	N/A
Schwarzbeck Mess Elektronik BBHA 9120 D Double Ridge Horn Antenna (1GHz-18GHz)	AED/ANT/14	□	N/A
Amplifiers			
AR 250A250AM3 250W RF Power Amplifier	AED/RFAMP/01	□	N/A
AR 250W1000AM3 250W RF Power Amplifier	AED/RFAMP/02	■	N/A
AR 250T1G3M1 250W RF Power Amplifier	AED/RFAMP/03	■	N/A
AR 500W1000AM1 500W RF Power Amplifier	AED/RFAMP/04	□	N/A
AR BLMA 0820-200 200W RF Power Amplifier	AED/RFAMP/05	□	N/A
AR 1000A225 RF Power Amplifier	AED/RFAMP/06	□	N/A
AR 175S1G4 RF Power Amplifier	AED/RFAMP/07	□	N/A
Power sensors			
Agilent Technologies E9304A E-Series Power Sensor	AED/Power Sensor/01	■	N/A
Agilent Technologies E9304A E-Series Power Sensor	AED/Power Sensor/02	□	N/A
Agilent Technologies E9304A E-Series Power Sensor	AED/Power Sensor/03	■	N/A
Rhode & Schwarz NRP-Z91Power Sensor	AED/Power Sensor/04	□	N/A
Rhode & Schwarz NRP-Z91Power Sensor	AED/Power Sensor/05	□	N/A
Power meters			
Agilent Technologies E4419B Dual Power Meter	AED/RFPM/01	□	N/A
Agilent Technologies E4419B Dual Power Meter	AED/RFPM/02	■	N/A
Rhode & Schwarz NRP2 Power Meter	AED/RFPM/03	□	N/A
LISN			
Rhode & Schwarz ESH3-Z6 (5цH/50Ω) LISN	AED/AN/01	■	09/02/2017
Rhode & Schwarz ESH3-Z6 (5цH/50Ω) LISN	AED/AN/03	□	09/02/2017
Rhode & Schwarz ESH3-Z6 (5цH/50Ω) LISN	AED/AN/04	■	09/02/2017

■- Option considered for the test
□- Option not considered for the test

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Description	ARAI ID	Status	Cal due date
EM Test AN200N100 (5µH/50Ω) LISN	AED/AN/07	☐	02/02/2017
Laser powered field probe			
RF FL 7006 Star Probe 2 Laser Powered Field Probe	AED/Field Probe/07	■	18/04/2018
Oscilloscopes			
Tektronics DPO 7104 Digital Phosphor Oscilloscope	AED/OSC/05	☐	25/02/2017
Tektronics DPO 3052 Digital Phosphor Oscilloscope	AED/OSC/07	☐	30/08/2017
Rhode & Schwarz RTM 2052 Digital Oscilloscope	AED/OSC/09	☐	30/08/2017
Test facility			
Frankonia Gmbh Semi-Anachoic ALSE Chamber, ARAI Pune.	AED/ALSE/01	■	13/06/2017
Frankonia Gmbh Semi-Anachoic ALSE Chamber, ARAI Pune.	AED/ALSE/02	☐	28/09/2017
Test software			
Rhode & Schwarz EMC32 Measurement Software Ver. 9.21.00	N/A	■	N/A
Miscellaneous			
Freemans Measuring Tape	AED/TAPE/01	☐	23/12/2016
Aplab L3260 Regulated DC Power Supply	AED/RPS/32	■	N/A
Automotive Battery 12V	N/A	■	N/A
Bulk current injection equipment list			
Signal generators/amplifiers			
EM Test CWS 500D Continuous Wave Simulator	AED/CWS/01	■	09/06/2017
Bulk current injection probes			
FCC F-130A-1 Bulk Current Injection Probe	AED/INJ CLAMP/01	■	N/A
FCC F-120-6A Bulk Current Injection Probe	AED/INJ CLAMP/02	☐	N/A
Current monitor probes			
FCC F-55 Current Monitor Probe	AED/CURRENT PROBE/01	■	22/03/2017
LISN			
Rhode & Schwarz ESH3-Z6 (5µH/50Ω) LISN	AED/AN/01	☐	09/02/2017
Rhode & Schwarz ESH3-Z6 (5µH/50Ω) LISN	AED/AN/03	■	09/02/2017
Rhode & Schwarz ESH3-Z6 (5µH/50Ω) LISN	AED/AN/04	☐	09/02/2017
EM Test AN200N100 (5µH/50Ω) LISN	AED/AN/07	■	02/02/2017
Oscilloscope			
Tektronics DPO 7104 Digital Phosphor Oscilloscope	AED/OSC/05	☐	25/02/2017
Tektronics DPO 3052 Digital Phosphor Oscilloscope	AED/OSC/07	☐	30/08/2017
Rhode & Schwarz RTM 2052 Digital Oscilloscope	AED/OSC/09	☐	30/08/2017
Test facility			
ETS-Lindgren Copper Shielded Room, ARAI Pune.	AED/CSR/01	■	N/A

Description	ARAI ID	Status	Cal due date
Test software			
EM Test ICD Software Ver. 3.31.00	N/A	■	N/A
Miscellaneous			
FCC-BCICF-1 Bulk Current Injection Clamp/Jig	N/A	□	N/A
FCC ATT3/100 Attenuator 3dB	N/A	□	N/A
FCC Attenuator 20dB	N/A	□	N/A
FCC Terminating resistor 50 Ohm	N/A	□	N/A
Spectron PLC 3250 MP DC Regulated Power Supply	AED/RPS/19	■	N/A
Automotive Battery 12V	N/A	■	N/A
Radiated emission equipment list			
Receivers			
Rhode & Schwarz ESU 8 EMI Test Receiver 8GHz	AED/EMIR/04	■	20/11/2016
Rhode & Schwarz ESR 3 EMI Test Receiver 3.6 GHz	AED/EMIR/06	□	18/05/2018
Antennas			
Schwarzbeck Mess Elektronik VAMP 9243 Vertical Active Monopole Antenna	AED/ANT/06	□	11/05/2017
Schwarzbeck Mess Elektronik VHBB 9124 Bi-Conical Antenna	AED/ANT/07	■	11/03/2017
Schwarzbeck Mess Elektronik VUSLP 9111B Log-Periodic Antenna	AED/ANT/08	■	11/03/2017
Schwarzbeck Mess Elektronik VHBB 9124 Bi-Conical Antenna	AED/ANT/15	□	18/07/2017
Schwarzbeck Mess Elektronik VUSLP 9111B Log-Periodic Antenna	AED/ANT/16	□	18/07/2017
LISN			
Rhode & Schwarz ESH3-Z6 (5µH/50Ω) LISN	AED/AN/01	■	09/02/2017
Rhode & Schwarz ESH3-Z6 (5µH/50Ω) LISN	AED/AN/03	□	09/02/2017
Rhode & Schwarz ESH3-Z6 (5µH/50Ω) LISN	AED/AN/04	■	09/02/2017
EM Test AN200N100 (5µH/50Ω) LISN	AED/AN/07	□	02/02/2017
Preamplifiers			
Schwarzbeck Mess Elektronik BBV 9745 Preamplifier (9kHz-2GHz)	AED/PREAMP/03	□	07/01/2017
Schwarzbeck Mess Elektronik BBV 9743 Preamplifier (10MHz-6GHz)	AED/PREAMP/04	□	07/01/2017
Test facility			
Frankonia Gmbh Semi-Anachoic ALSE Chamber, ARAI Pune.	AED/ALSE/01	■	13/06/2017
Frankonia Gmbh Semi-Anachoic ALSE Chamber, ARAI Pune.	AED/ALSE/02	□	28/09/2017
Test software			
Rhode & Schwarz EMC32 Measurement Software Ver. 9.21.00	N/A	■	N/A
Miscellaneous			
Aplab L3260 Regulated DC Power Supply	AED/RPS/32	■	N/A
Automotive Battery 12V	N/A	■	N/A

Description	ARAI ID	Status	Cal due date
Conducted immunity on supply line equipment list			
60A EM TEST conducted immunity test system for 12V/24V DC			
EM Test Auto wave Arbitrary Generator	AED/EM/04	☐	N/A
EM Test LD 200B Load Dump Generator	AED/EM/02	☐	31/08/2017
EM Test MPG 200B Micro Pulse Generator	AED/EM/02	■	31/08/2017
EM Test EFT 200B EFT/Burst Generator	AED/EM/02	■	31/08/2017
EM Test VDS 200B Voltage Drop Simulator	AED/EM/02	■	31/08/2017
60A TESEQ conducted immunity test system for 12V/24V DC			
TESEQ MT5511 Micro Transients	AED/CISYSTEM/02	☐	22/01/2017
TESEQ FT5531 Fast Transients	AED/CISYSTEM/02	☐	22/01/2017
TESEQ LD5550 Load Dump Generator	AED/CISYSTEM/02	☐	22/01/2017
TESEQ PA5840-150/400 Power Supply	AED/CISYSTEM/02	☐	22/01/2017
Oscilloscope			
Tektronics DPO 7104 Digital Phosphor Oscilloscope	AED/OSC/05	☐	25/02/2017
Tektronics DPO 3052 Digital Phosphor Oscilloscope	AED/OSC/07	☐	30/08/2017
Rhode & Schwarz RTM 2052 Digital Oscilloscope	AED/OSC/09	☐	30/08/2017
Test facility			
Conducted Immunity Testing Lab, ARAI Pune.	N/A	■	N/A
Test software			
EM Test ISMISO Transient Software (Ver 3.91)	N/A	■	N/A
Miscellaneous			
EM Test CNA 200B Coupling Network	AED/EM/02	■	N/A
Aplab L3260 Regulated DC Power Supply	AED/RPS/34	☐	N/A
Automotive Battery 12V	N/A	☐	N/A
Conducted transient emission equipment list			
Switch			
EM TEST BSM200N40 CTE SYSTEM	AED/CTESYSTEM/01	■	02/03/2017
EM TEST BS200N100 CTE SYSTEM	AED/CTESYSTEM/01	☐	02/03/2017
Resistive load box			
EM TEST RS-BOX CTE SYSTEM	AED/CTESYSTEM/01	■	02/03/2017
LISN			
EM TEST AN 200N100 Line Impedance Stabilization Network (LISN)	AED/AN/07	■	02/02/2017
EM TEST AN 200N100 Line Impedance Stabilization Network (LISN)	AED/AN/08	■	08/02/2017
Oscilloscope			
Tektronics DPO 7104 Digital Phosphor Oscilloscope	AED/OSC/05	☐	25/02/2017
Tektronics DPO 3052 Digital Phosphor Oscilloscope	AED/OSC/07	☐	30/08/2017
Rhode & Schwarz RTM 2052 Digital Oscilloscope	AED/OSC/09	☐	30/08/2017

Description	ARAI ID	Status	Cal due date
Miscellaneous			
Spectron PLC 3250 MP DC Regulated Power Supply	AED/RPS/19	■	N/A
Automotive Battery 12V	N/A	■	N/A

This test report pertains only to the components / parts / assemblies / vehicles etc., actually tested at ARAI in the presented condition based on the documents / information produced / submitted by the customer. The issuance of this test report alone does not indicate any measure of approval, certification, supervision, control of quality surveillance by ARAI of the product. No extract, abridgement or abstraction from this test report shall be published or used to advertise the product without the written consent of the Director, ARAI, who reserves the absolute right to agree or reject all or any of the details of any items of publicity for which consent may be sought. ARAI is in no way responsible for any misuse of copying of any design / type / system in connection with entire vehicle/components/parts and assemblies. Breach of any statutory provision of Indian laws or laws of other countries, will be the sole responsibility of the customer and ARAI shall not be liable for any claims or damages, made by the party, whatsoever. The customer shall alone be liable for the same and undertakes to indemnify ARAI in this regard. Further, the ARAI has the right to initiate cancellation / withdrawal of the certificate / report issued, in case of any fraud, misrepresentation, when it surfaces and comes in the knowledge of ARAI. The appropriate local courts at Pune shall have the jurisdiction in respect of any dispute, claim or liability arising out of this report.

Place of Issue: ARAI,Pune.

A C GAMI **ENGINEER**	**A A PAPADE** **MANAGER**	**A A DESHPANDE** **Dy. DIRECTOR & HOD**

ANNEXURE 01

1.1 TEST SPECIFICATIONS

TEST DETAILS	CONDUCTED TRANSIENT IMMUNITY ON SUPPLY LINE TEST AS PER AIS004 (PART3):2009 STANDARD.
TEST DATE	25-Oct-2016

1.2 DUT OPERATING CONDITIONS

DUT MODE OF OPERATION	FULL OPERATING ■	PARTIAL OPERATING ☐	POWER ON STATE ☐
DIAGNOSTIC TOOLS CONNECTED	CAN BUS CONV. ☐	USB BUS CONV. ☐	RS232 BUS CONV. ☐
REMARKS			

1.3 MONITORING OF DUT

PASS/FAIL criteria automatically controlled by EMC software. ☐	PASS/FAIL criteria manually controlled by operator. ■
PASS/FAIL criteria not verified. ☐	PASS/FAIL criteria controlled and evaluated by the customer. ☐

1.4 LABORATORY ENVIRONMENT TEST CONDITIONS

Ambient temperature	+ 23.5°C.	Required (23±5)°C.	Relative humidity	45.5%RH.	----

1.5 TEST SETUP DETAILS

DUT Setup Details	Status	Remarks
A) Test setup was done according to	ISO 7637-2: 2004 (E)	Refer Std. ISO 7637-2: 2004 (E) Clause No. 4.4
B) Test table surface	Wooden ☐ Metallic ■	Test table height from ground floor (1000, ±100)mm.
C) Whether the DUT and all test harness of the DUT was placed (50, ±5) mm, above the ground plane?	Yes ■ No ☐	Placed on non-conductive, low relative permittivity material.
D) Length of test harness of the DUT (200, ±50) mm.	Yes ■ No ☐	----
E) Whether DUT was directly grounded (GND) or isolated (ISO) from the ground plane?	GND ☐ ISO ■	----
F) Whether the load box was placed on the ground plane?	Yes ☐ No ■	----

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■- Option considered for the test

☐- Option not considered for the test

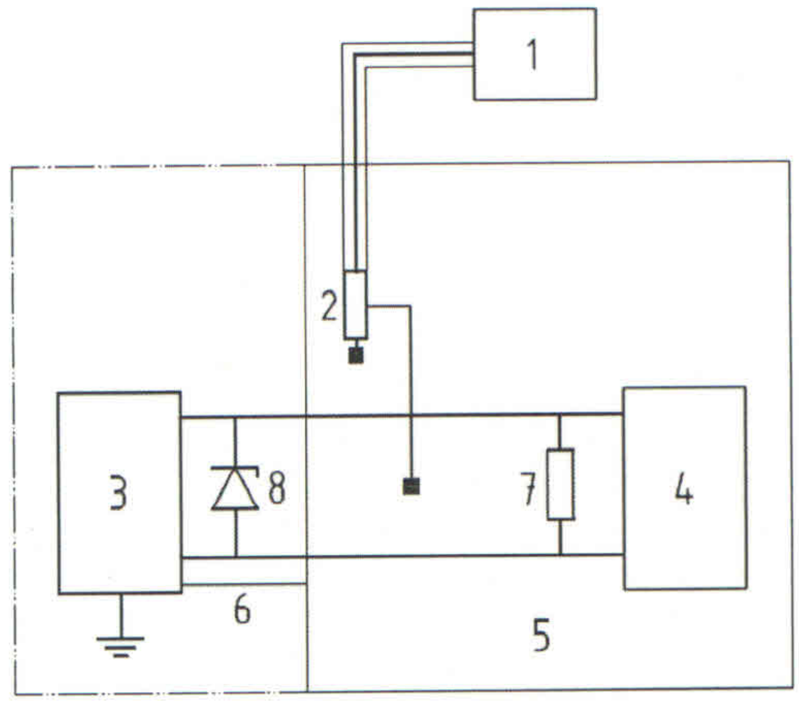
1.6 DUT SUPPLY VOLTAGE DETAILS				
Test voltage	**24V System**		**Current consumption**	
U_A	(27, ±1) V	■	< 1 Amp.	
U_B	(24, ±0.4) V	□		
Power sources	**Status**		**Voltage**	
Battery supply (U_B)	Yes	□	12V	□
	No	■	24V	□
DC power supply (U_A) (External DC power supply connected)	Yes	■	13.5V	□
	No	□	27V	■

1.7 TEST PROCEDURE

- Test pulses, the leads between the terminals of the test pulse generator and the DUT shall be laid out in a straight parallel line at a height of (50 0/+10) mm above the ground plane and shall have a length of (0.5 ± 0.1) m.
- The test pulse generator is set up to provide the specific pulse polarity, amplitude, duration and resistance with the DUT and optional resistance *R*v disconnected. The appropriate values are selected.
- DUT is connected to the generator, while the oscilloscopes disconnected.

1.8 TRANSIENT IMMUNITY TEST SET UP DETAILS

1.8.1 Transient immunity test set up



1.8.2 Transient immunity test set key words

Key

1 oscilloscope or equivalent
2 voltage probe
3 test pulse generator with internal power supply resistance R_i
4 DUT
5 ground plane
6 Ground connection (maximum length for test pulse 3: 100 mm)
7 optional resistor (R_v) [a]
8 optional diode bridge [b]

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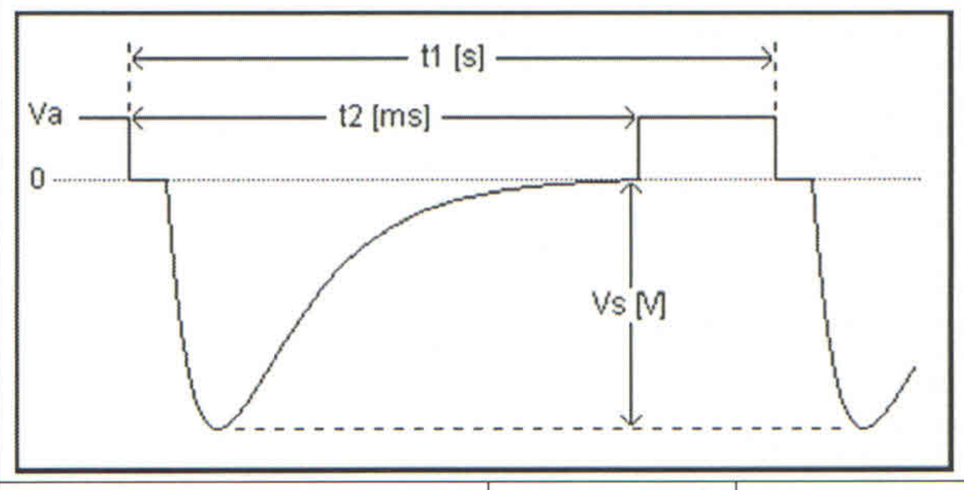
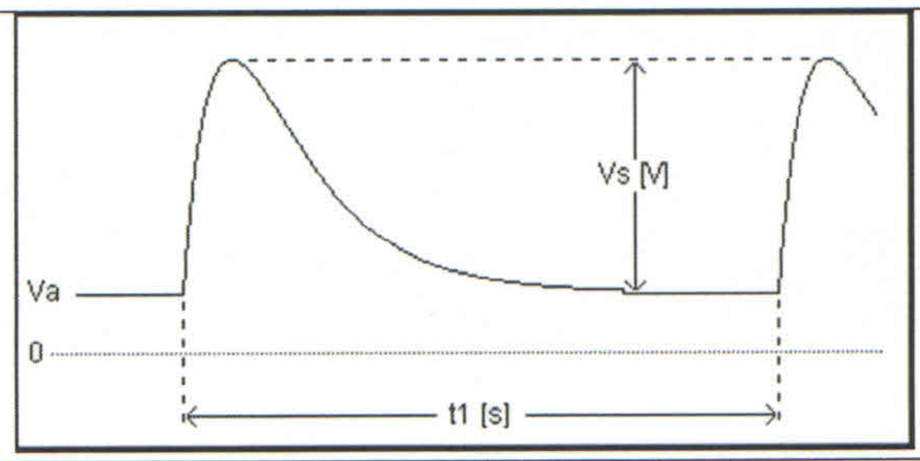
1.9 TEST PARAMETERS: Conducted immunity pulses		
Pulse 1 ■	Pulse 2a ■	Pulse 2b ■
Pulse 3a ■	Pulse 3b ■	Pulse 4 ■

1.9.1 Pulse 1

Test Procedure			ISO 7637 : Pulse 1		
Test generator:	MPG200B		Software No.:	000318	
			Serial No.:	1101-19	
Coupling network:	CNA200		Serial No.:	0103-06	
Va (Alternator):	27.0	V	Current limit:	5	A
Test setup:					
					
Vs:	-450	V			
t1:	1	s			
t2:	200	ms			
Impedance:	50	Ohm	Connection:	+/-	
Events:	5000				
Test duration:		01:23:20			

1.9.2 Pulse 2

Test Procedure			ISO 7637 : Pulse 2a		
Test generator:	MPG200B		Software No.:	000318	
			Serial No.:	1101-19	
Coupling network:	CNA200		Serial No.:	0103-06	
Va (Alternator):	27.0	V	Current limit:	5	A
Test setup:					
					
Vs:	+37	V			
t1:	0.5	s			
Impedance:	2	Ohm	Connection:	+/-	
Events:	5000				
Test duration:		00:41:40			

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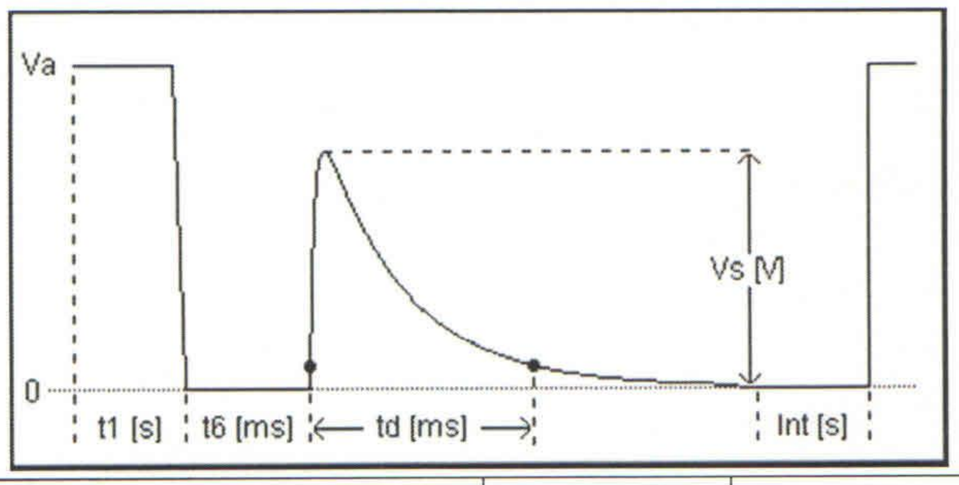
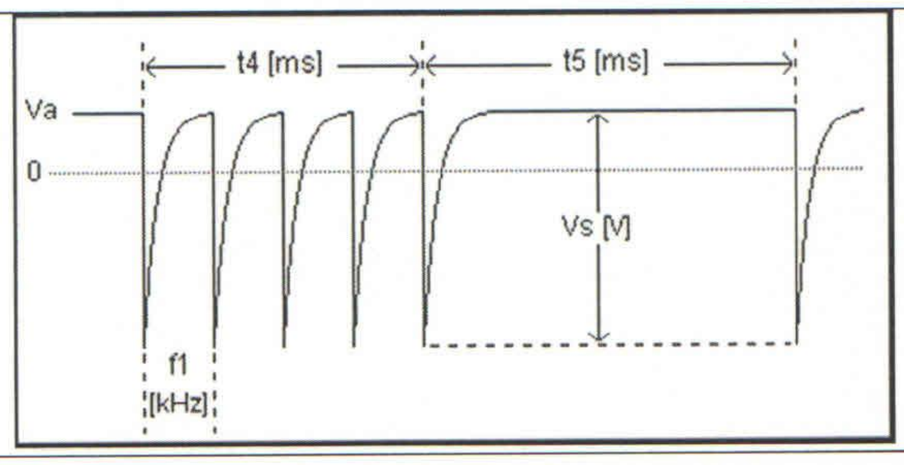
■- Option considered for the test

□- Option not considered for the test

1.9.3 Pulse 2b

Test Procedure			ISO 7637 : Pulse 2b		
Test generator:	VDS200B		Software No.:	000285	
			Serial No.:	0303-02	
Coupling network:	CNA200		Serial No.:	0103-06	
Va (Alternator):	27.0	V	Current limit:	5	A
Test setup:					
Vs:	20.0	V			
t1:	1.0	s			
t6:	1	ms			
td:	200	ms			
Int:	1.0	s			
Ri:	0.02	Ohm			
Events:	10				
Test duration:		00:00:28			

1.9.4 Pulse 3a

Test Procedure			ISO 7637 : Pulse 3a		
Test generator:	EFT200B		Software No.:	000282	
			Serial No.:	1101-08	
Coupling network:	CNA200		Serial No.:	0103-06	
Va (Alternator):	27.0	V	Current limit:	5	A
Test setup:					
Vs:	-150	V			
f1:	10	kHz			
t4:	10	ms			
t5:	90	ms			
Coupling:		+			
Test duration:	1	h			

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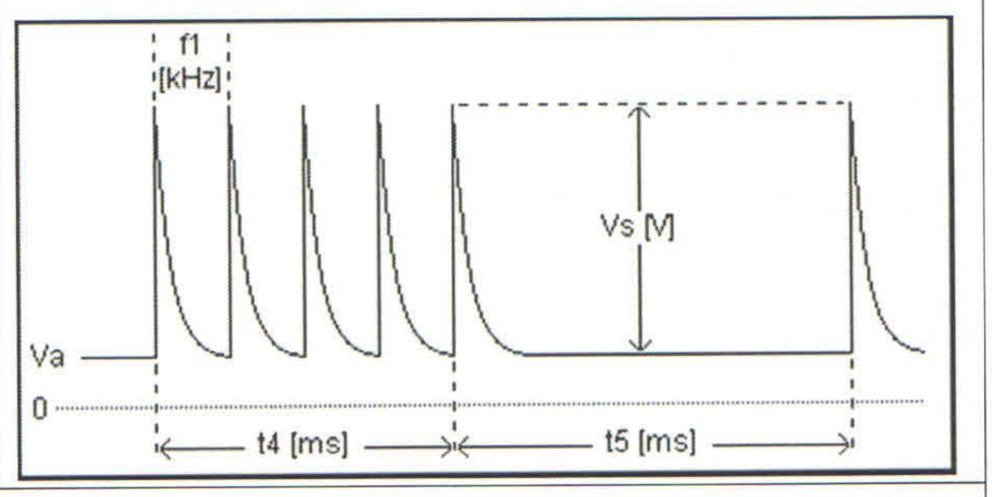
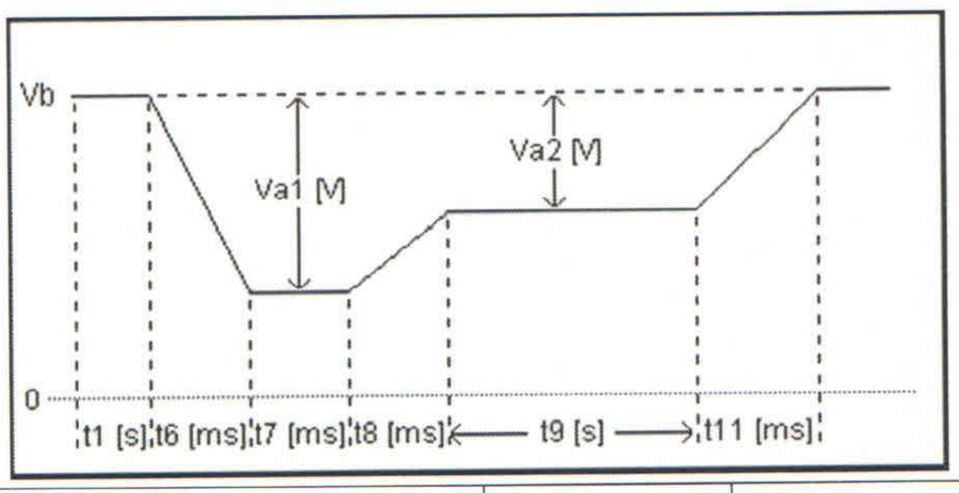
1.9.5 Pulse 3b

Test Procedure			ISO 7637 : Pulse 3b		
Test generator:	EFT200B		Software No.:	000282	
			Serial No.:	1101-08	
Coupling network:	CNA200		Serial No.:	0103-06	
Va (Alternator):	27.0	V	Current limit:	5	A
Test setup:					
					
Vs:	+150	V			
f1:	10	kHz			
t4:	10	ms			
t5:	90	ms			
Coupling:		+			
Test duration:	1	h			

1.9.6 Pulse 4

Test Procedure			ISO 7637 : Pulse 4		
Test generator:	VDS200B		Software No.:	000285	
			Serial No.:	0303-02	
Coupling network:	CNA200		Serial No.:	0103-06	
Vb (Battery):	24.0	V	Current limit:	5	A
Test setup:					
					
Va1:	-12.0	V			
Va2:	-5.0	V			
t1:	1.0	s			
t6:	10	ms			
t7:	50	ms			
t8:	50	ms			
t9:	0.5	s			
t11:	10	ms			
Events:	10				
Test duration:		00:00:19			

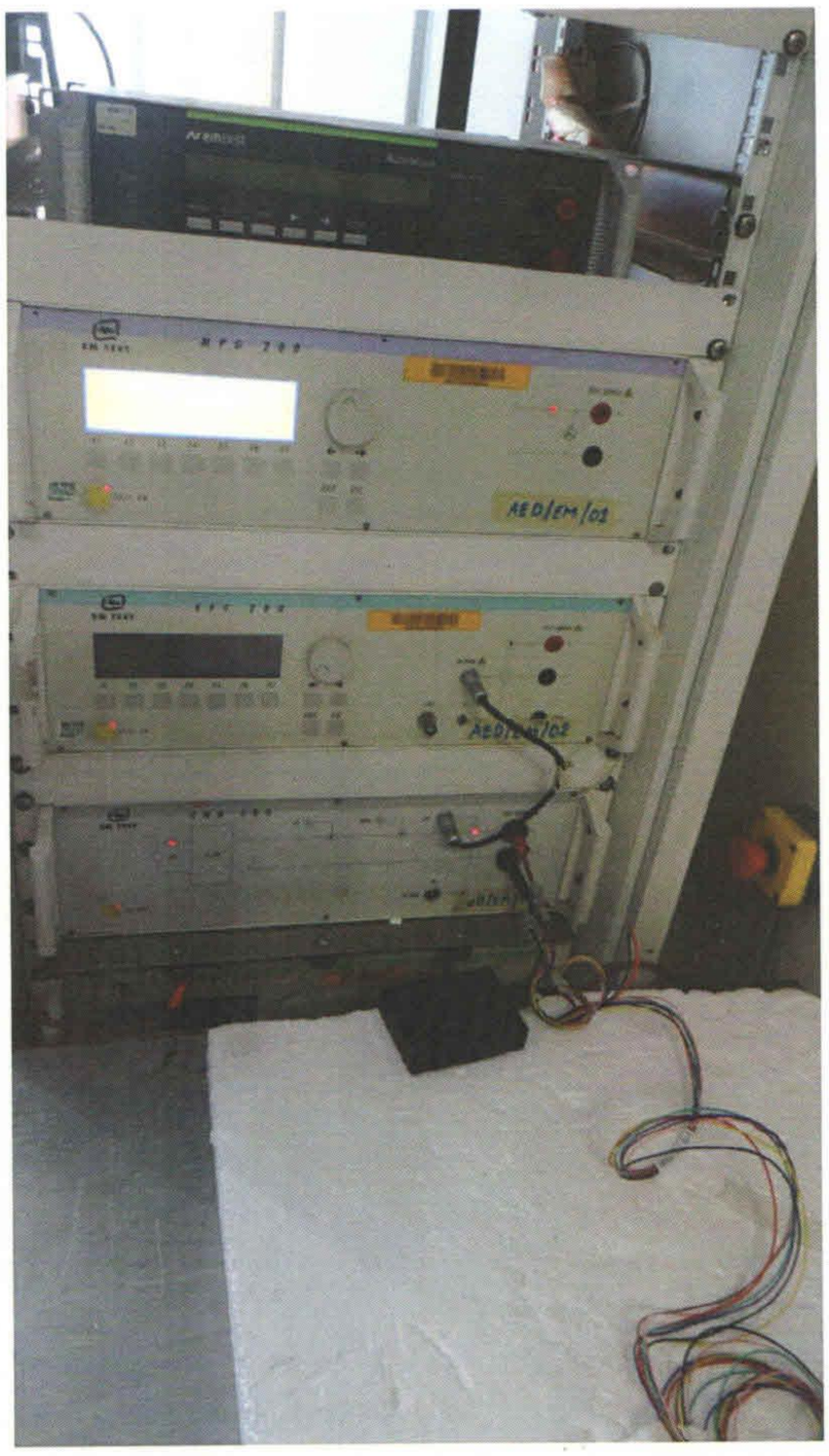
K K PINGLIKAR
TEST ENGINEER SIGN

1.10 TEST OBSERVATION

Sr. No.	Pulse details	Observation
1.1	Pulse 1	DUT switch to internal battery and auto recovered after the test. Functionality Class B.
1.2	Pulse 2a	No deviation was observed in DUT functionality. Functionality Class A.
1.3	Pulse 2b	DUT switch to internal battery and auto recovered after the test. Functionality Class B.
1.4	Pulse 3a	No deviation was observed. Functionality Class A.
1.5	Pulse 3b	
1.6	Pulse 4	No deviation was observed. Functionality Class A.

1.11 TEST SETUP PHOTO

1.11.1 Transient immunity, General set-up



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End of Annexure 01

ANNEXURE 02

2.1 TEST SPECIFICATIONS

TEST DETAILS	RADIATED IMMUNITY TEST: BULK CURRENT INJECTION (BCI METHOD) AS PER AIS004 (PART3): 2009 STANDARD.
TEST DATE	24-Oct-2016

2.2 DUT OPERATING CONDITIONS

DUT MODE OF OPERATION	FULL OPERATING ■	PARTIAL OPERATING ☐	POWER ON STATE ☐
DIAGNOSTIC TOOLS CONNECTED	CAN BUS CONV. ☐	USB BUS CONV. ☐	RS232 BUS CONV. ☐

2.3 MONITORING OF DUT

PASS/FAIL criteria automatically controlled by EMC software. ☐	PASS/FAIL criteria manually controlled by operator. ■
PASS/FAIL criteria not verified. ☐	PASS/FAIL criteria controlled and evaluated by the customer. ☐

2.4 LABORATORY ENVIRONMENT TEST CONDITIONS

Ambient temperature	+ 23.5°C.	Required (23±5)°C.	Relative humidity	45.5% RH.	----

2.5 TEST SETUP DETAILS

DUT Setup Details	Status	Remarks
A) Test setup was done according to	ISO 11452-4: 2005	Refer Std. ISO 11452-4: 2005 Clause No.7
B) Test table surface	Wooden ☐ Metallic ■	Test table height from ground floor (900, ±100)mm.
C) Ground plane	Copper ☐ Galvanized Steel ■	0.5mm thick (min.)
D) Test method used	Substitution ■ Closed Loop ☐	Closed loop method with power limitation
E) Whether the DUT and all test harness of the DUT was placed (50, ±5) mm, above the ground plane?	Yes ■ No ☐	Placed on non-conductive, low relative permittivity material.
F) Total length of test harness between DUT & the load simulator (or the RF boundary) (1000, ±100) mm.	Yes ■ No ☐	----
G) Whether DUT was directly grounded (GND) or isolated (ISO) from the ground plane?	GND ☐ ISO ■	----

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■- Option considered for the test

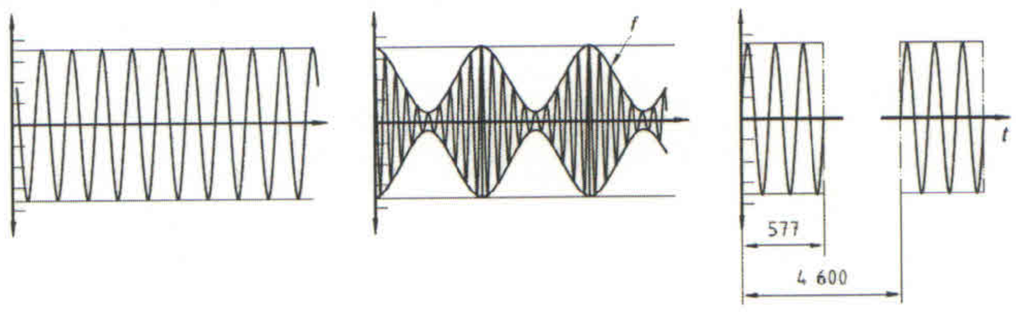
☐- Option not considered for the test

DUT Setup Details	Status	Remarks
H) Whether the load box/simulator was placed directly on the ground plane?	Yes ☐ No ■	----
I) Distance of placing injection probe from the connector of the DUT	(150 ±10)mm ■ (450 ±10)mm ☐ (750 ±10)mm ☐	----
J) Distance of placing current measurement probe from the connector of the DUT	(50 ±10)mm ■ Not Applied ☐	----
K) No. of artificial network (AN) used (5uH/50Ω)	02	For positive supply line. & power return line

2.6 DUT SUPPLY VOLTAGE DETAILS		
Test voltage	**24V System**	**Current consumption**
U_A	(27, ±1) V ■	< 1 Amp.
U_B	(24, ±0.4) V ■	
Power sources	**Status**	**Voltage**
Battery supply (U_B)	Yes ■ No ☐	12V ☐ 24V ■
DC power supply (U_A) (External DC power supply connected)	Yes ■ No ☐	13.5V ☐ 27V ■

2.7 TEST PARAMETERS		
Frequency range	20 MHz to 200 MHz	
Dwell time	3 Sec.	
Frequency step size	2% log.	
Test severity level	60 mA	
Test signal quality	Amplifier output harmonics content limited to -12dB.	
Test method	Substitution method ■	Closed loop method ☐
Frequency modulation	Amplitude modulation (AM) (1 kHz sine wave at 80% (modulation index m=0.8) ■	AM(Peak)=CW(Peak) ■
		AM(Peak)>CW(Peak) ☐
		AM(RMS)=CW(RMS) ☐
	Pulse modulation (PM) (Sine wave) ☐	t_{on} = 577 µs, Period= 4600 µs ☐
	Continuous wave (CW) ☐	Unmodulated sine wave ☐

2.8 FREQUENCY MODULATION DETAILS



a) CW signal b) AM signal c) PM signal

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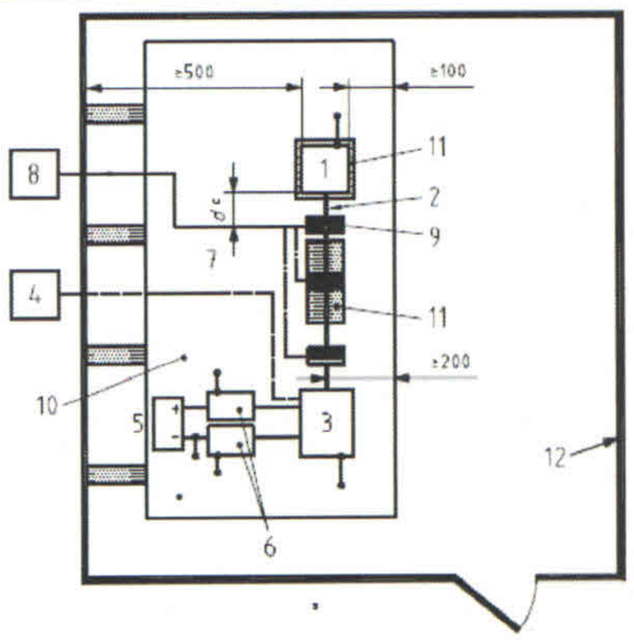
2.9 TEST PROCEDURE

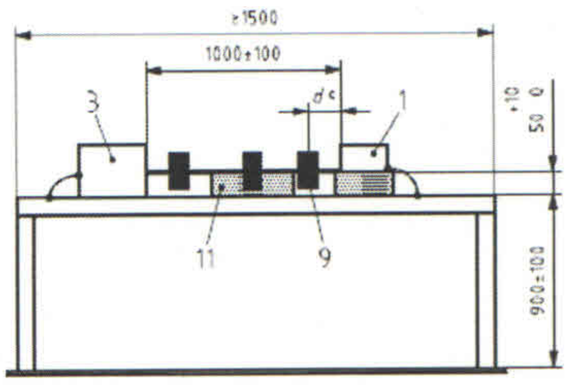
The bulk current injection tests were done inside the copper shielded enclosure chamber.

2.9.1 Substitution method

Install the DUT, harness and associated equipment on the test bench. Subject the DUT to the test signal based on the calibrated value as predetermined in the test plan. A current measurement probe may be mounted between the current injection probe and the DUT. The use of a current measurement probe is optional; it can provide extra, useful information during investigative work on the cause of events and the variances in test conditions after system modifications.

2.9.2 BCI test set up - substitution method





2.9.3 BCI test set up - substitution method key words

Key

1 DUT (grounded if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 stimulation and monitoring system
5 power supply
6 artificial network (AN)
7 optical fibres
8 high-frequency equipment
9 injection probe
10 ground plane (bonded to shielded enclosure)
11 low relative permittivity support ($\varepsilon_r \leq 1{,}4$)
12 Shielded enclosure

2.10 TEST OBSERVATION

Sr. no.	Frequency range	Frequency modulation	Observation
1.0	20 MHz to 200 MHz	Amplitude Modulation (AM) 1 kHz sine wave at 80% (modulation index *m*=0.8)	No deviation was observed in DUT functionality during the test. **Pass.**

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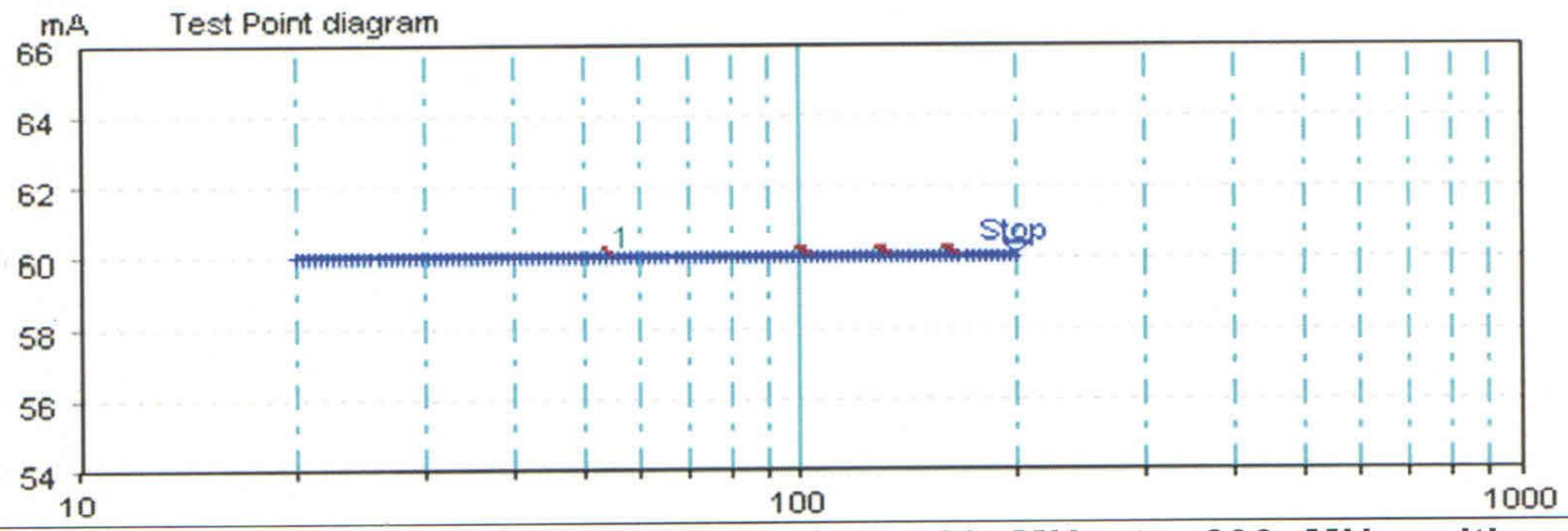
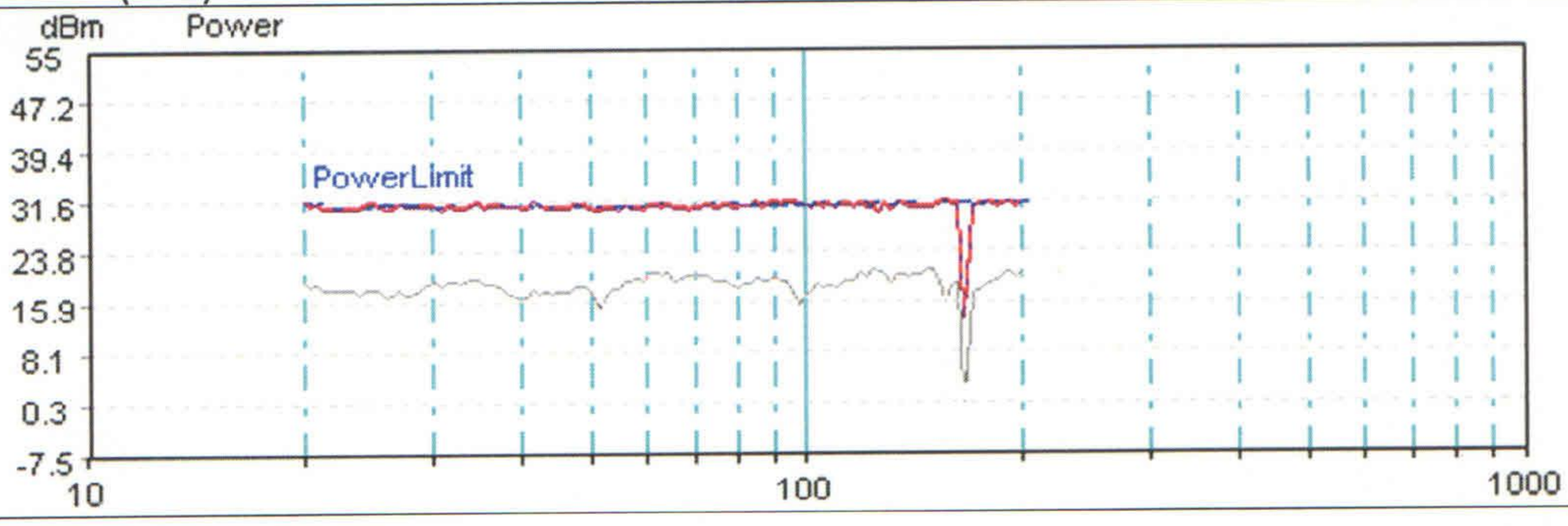
2.11 MEASUREMENT GRAPH

2.11.1 Test graph of RF current for frequency range from 20 MHz to 200 MHz with amplitude modulation (AM)



2.11.2 Power graph for frequency range from 20 MHz to 200 MHz with amplitude modulation (AM)



2.11 TEST SETUP PHOTO

2.11.1 Bulk current injection (BCI method), general set-up

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End of Annexure 02

ANNEXURE 03

3.1 TEST SPECIFICATIONS	
TEST DETAILS	RADIATED IMMUNITY TEST: ABSORBED LINED SHIELDED ENCLOSURE (ALSE) METHOD AS PER AIS004 (PART3): 2009 STANDARD.
TEST DATE	24-Oct-2016

3.2 DUT OPERATING CONDITIONS			
DUT MODE OF OPERATION	FULL OPERATING ■	PARTIAL OPERATING ☐	POWER ON STATE ☐
DIAGNOSTIC TOOLS CONNECTED	CAN BUS CONV. ☐	USB BUS CONV. ☐	RS232 BUS CONV. ☐
REMARKS			

3.3 MONITORING OF DUT			
PASS/FAIL criteria automatically controlled by EMC software.	☐	PASS/FAIL criteria manually controlled by operator.	■
PASS/FAIL criteria not verified.	☐	PASS/FAIL criteria controlled and evaluated by the customer.	☐

3.4 LABORATORY ENVIRONMENT TEST CONDITIONS					
Ambient temperature	+ 24.0 °C.	Required (23±5)°C.	Relative humidity	45.0 %RH.	----

3.5 TEST SETUP DETAILS			
DUT Setup Details	**Status**		**Remarks**
A) Test setup was done according to	ISO 11452-2: 2004		Refer Std. ISO 11452-2: 2004 Clause No. 7
B) Test table surface	Wooden Metallic	☐ ■	Test table height from ground floor (900, ±100)mm.
C) Ground plane	Copper Galvanized Steel	☐ ■	0.5mm thick (min.)
D) Whether the DUT and all test harness of the DUT was placed (50, ±5) mm, above the ground plane?	Yes No	■ ☐	Placed on non-conductive, low relative permittivity material.
E) Total length of test harness between DUT & the load simulator (1500, ±100) mm.	Yes No	■ ☐	----
F) Whether DUT was directly grounded (GND) or isolated (ISO) from the ground plane?	GND ISO	☐ ■	----

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■- Option considered for the test

☐- Option not considered for the test

DUT Setup Details	Status	Remarks
G) Location of load simulator	Inside test chamber ☐ Outside of test chamber ☐	----
H) Antenna distance from the wiring harness of the DUT	(1000 ± 10)mm	----
I) Phase centre of the antenna above the ground plane of test table.	(100 ±10)mm	----
J) Antenna phase centre focused to in line with the centre of wiring harness of DUT	Yes ■ No ☐	For frequency up to 1 GHz.
K) Antenna phase centre focused to in line with the DUT	Yes ■ No ☐	For frequency above 1 GHz.
L) No. of orientation of DUT	1	----
M) No. of LISNs used (5uH/50Ω)	2	----

3.6 DUT SUPPLY VOLTAGE DETAILS		
Test voltage	**24V System**	**Current consumption**
U_A	(27, ±1) V ■	< 1 Amp.
U_B	(24, ±0.4) V ■	
Power sources	**Status**	**Voltage**
Battery supply (U_B)	Yes ■ No ☐	12V ☐ 24V ■
DC power supply (U_A) (External power supply connected)	Yes ■ No ☐	13.5V ☐ 27V ■

3.7 TEST PARAMETERS		
Frequency range	200 MHz to 2000 MHz	
Dwell time	3 s	
Frequency step size	2% log	
Test severity level	30 V/m	
Test signal quality	Amplifier output harmonics content limited to -6dB.	
Test method	Substitution Method ■	Closed Loop Method ☐
Frequency modulation	Amplitude Modulation (AM) (1 kHz sine wave at 80% (modulation index m=0.8) ■	AM(Peak)=CW(Peak) ■ AM(Peak)>CW(Peak) ☐ AM(RMS)=CW(RMS) ☐
	Pulse Modulation (PM) (Sine wave) ■	t_{on} = 577 µs, Period= 4600 µs ■
	Continuous wave (CW) ☐	Unmodulated sine wave ☐

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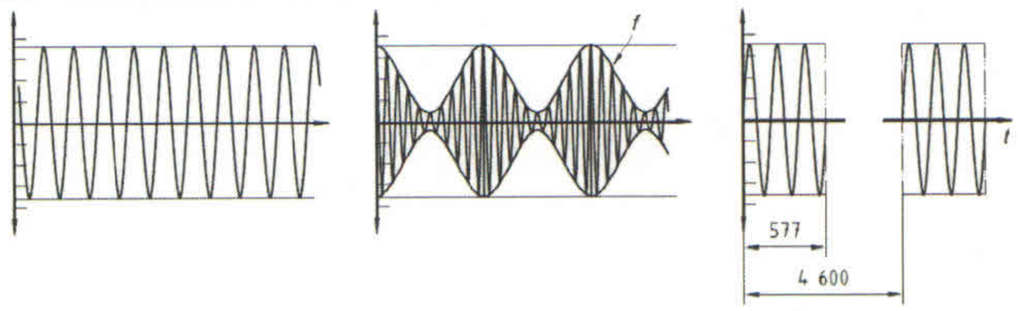
■- Option considered for the test

☐- Option not considered for the test

3.8 FREQUENCY MODULATION DETAILS



a) CW signal b) AM signal c) PM signal

3.9 TEST PROCEDURE

The radiated immunity tests were done inside the anechoic chamber.

3.9.1 Calibration

The calibration was done with a closed loop system where the field strength levels were measured using a field probe that was placed in close proximity to the DUT. The calibration file contains the signal generator levels and power levels required to generate a specific field strength level over the test frequency range.

3.9.2 Verification

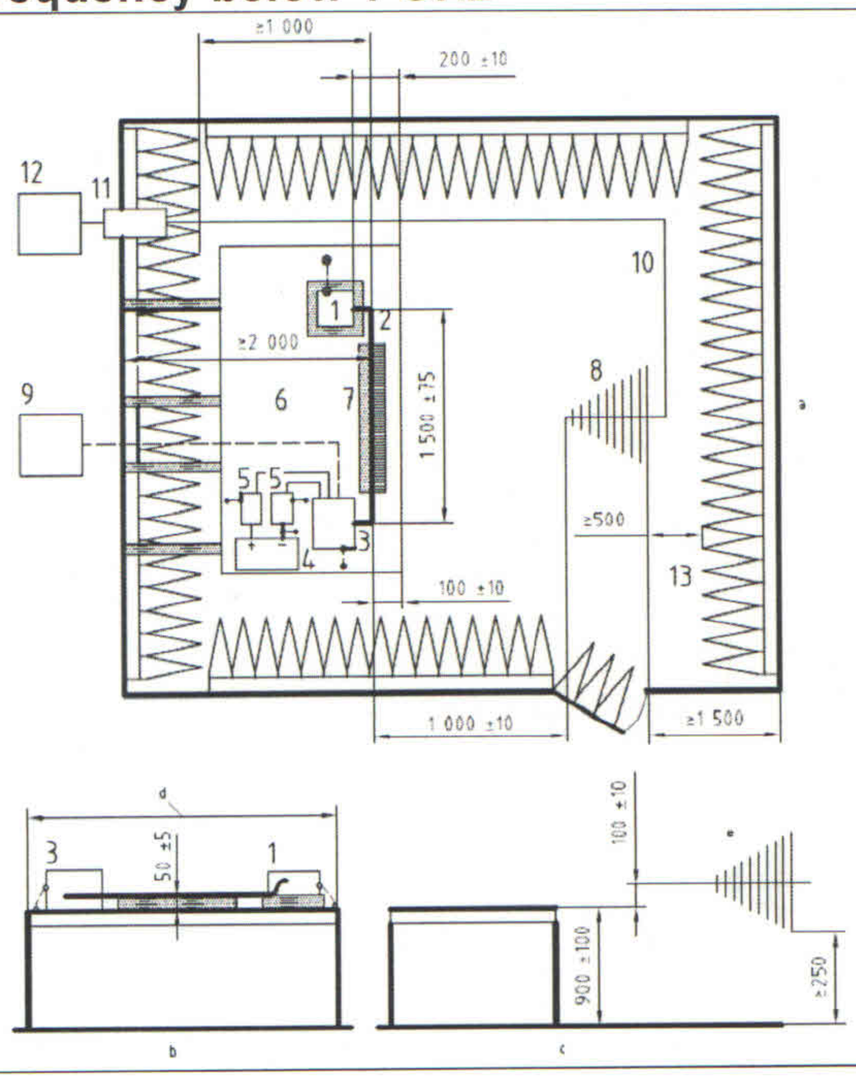
The calibrated settings were verified by emitting a field and monitoring field strength.

3.9.3 DUT RF immunity testing

The DUT was tested by replaying the calibrated test levels (the signal generated levels) from the calibration file. The DUT was tested for immunity over a fixed time called "dwell period" at a particular frequency with the desired field strength.

3.10 RI TEST SET UP

3.10.1 RI test set up for frequency below 1 GHz



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This is ANNEXURE 03 of Report No. ARAI/AED/CT/OC-1617-5466/750, Dated 21-Nov-2016

■ - Option considered for the test

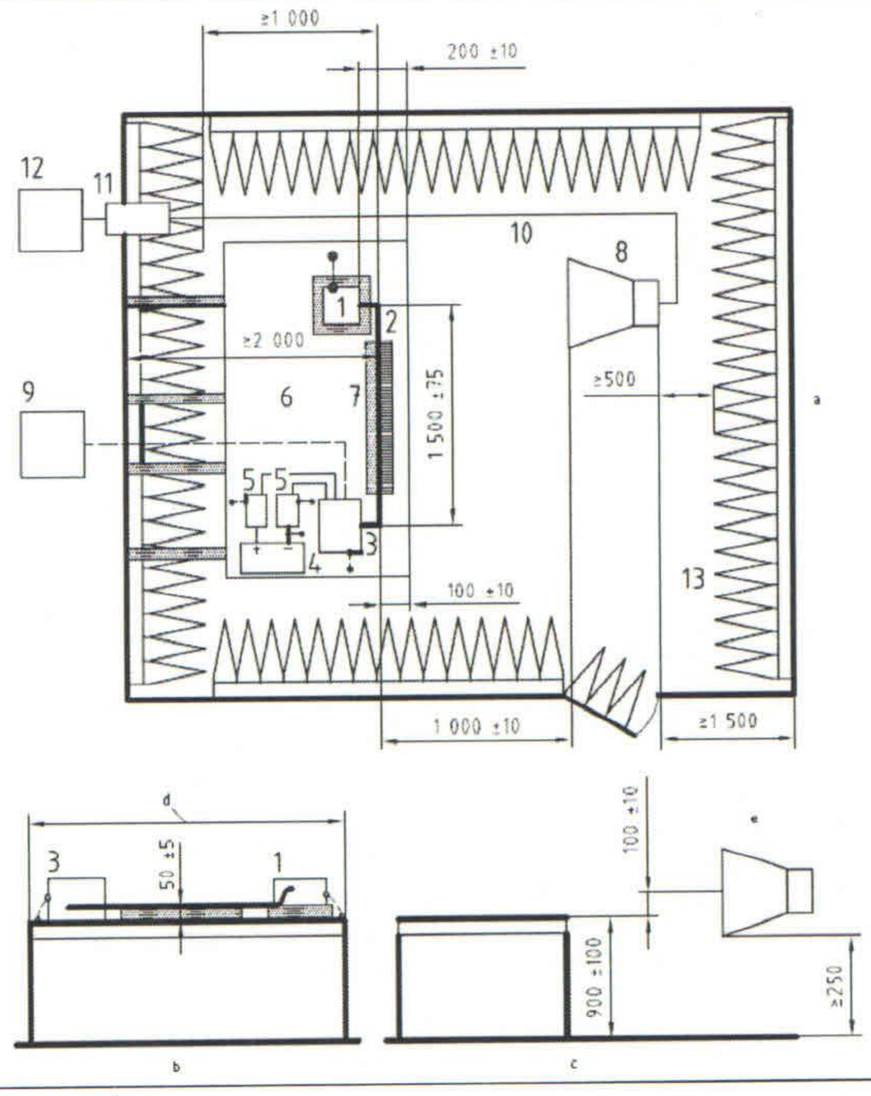
☐ - Option not considered for the test

3.10.2 RI test set up - key words

1 DUT (grounded locally if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 power supply (location optional)
5 artificial network (AN)
6 ground plane (bonded to shielded enclosure)
7 low relative permittivity support ($\varepsilon_r \leqslant 1{,}4$)
8 log-periodic antenna
9 stimulation and monitoring system
10 high quality double-shielded coaxial cable (50 Ω)
11 bulkhead connector
12 RF signal generator and amplifier
13 RF absorber material

a Upper view (horizontal polarisation).
b Front view.
c Side view.
d See 7.1.
e Vertical polarization.

3.10.3 RI test set up for frequency above 1 GHz



3.10.4 RI test set up - key words

1 DUT (grounded locally if required in test plan)
2 test harness
3 load simulator (placement and ground: connection according to 7.5)
4 power supply (location optional)
5 artificial network (AN)
6 ground plane (bonded to shielded enclosure)
7 low relative permittivity support ($\varepsilon_r \leqslant 1{,}4$)
8 horn antenna
9 stimulation and monitoring system
10 high quality double-shielded coaxial cable (50 Ω)
11 bulkhead connector
12 RF signal generator and amplifier
13 RF absorber material

a Upper view (horizontal polarisation).
b Front view.
c Side view.
d See 7.1.
e Vertical polarization.

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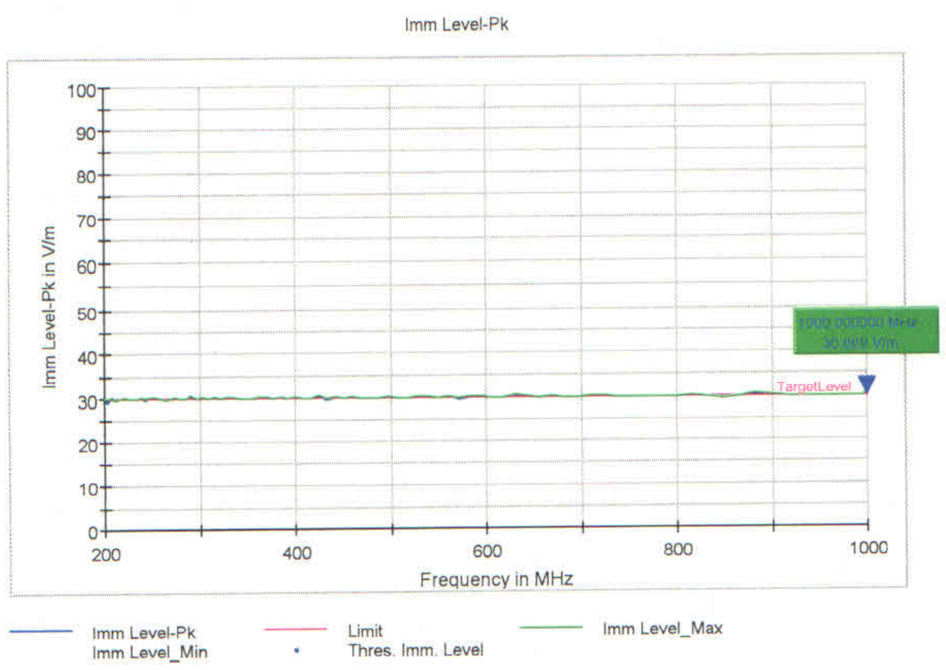
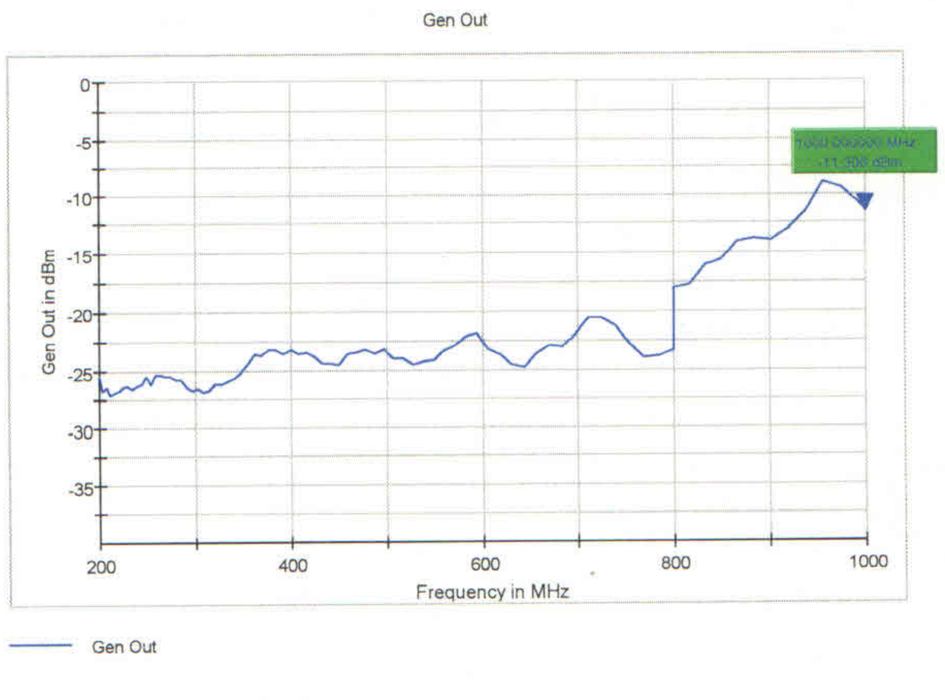
3.11 TEST OBSERVATION			
Sr. no.	**Frequency range**	**Frequency modulation**	**Observation**
1.0	200 MHz-800 MHz	Amplitude Modulation (AM) 1 kHz sine wave at 80% (modulation index *m*=0.8)	No deviation was observed in DUT functionality during the test. **Pass.**
2.0	800 MHz- 2000 MHz	Pulse Modulation (PM) (t_{on} = 577 µs and Period= 4600 µs)	No deviation was observed in DUT functionality during the test. **Pass.**

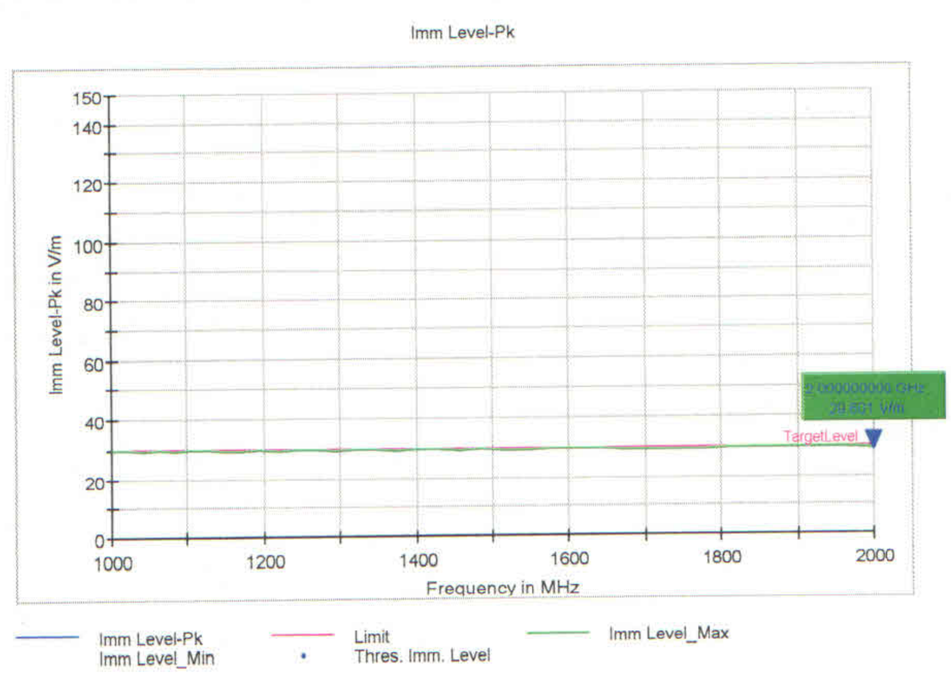
3.12 MEASUREMENT GRAPH

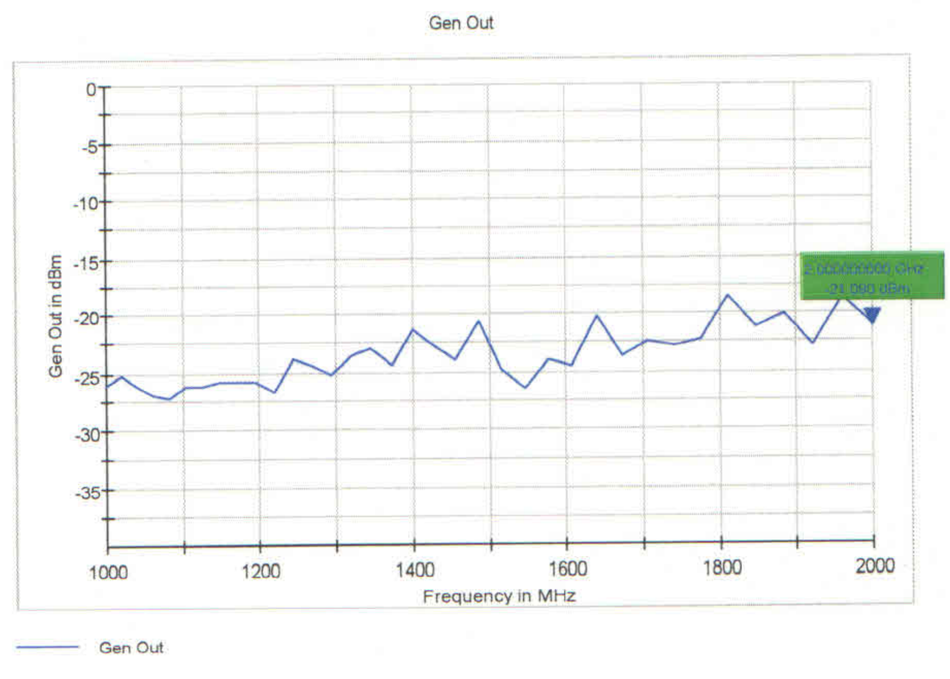
3.12.1 Frequency range from 200 MHz to 800 MHz with amplitude modulation (AM) and 800 MHz to 1000 MHz pulse modulation (PM) with vertical polarization.





3.13.2 Frequency range from 1000 MHz to 2000 MHz with pulse modulation (PM) with vertical polarization.





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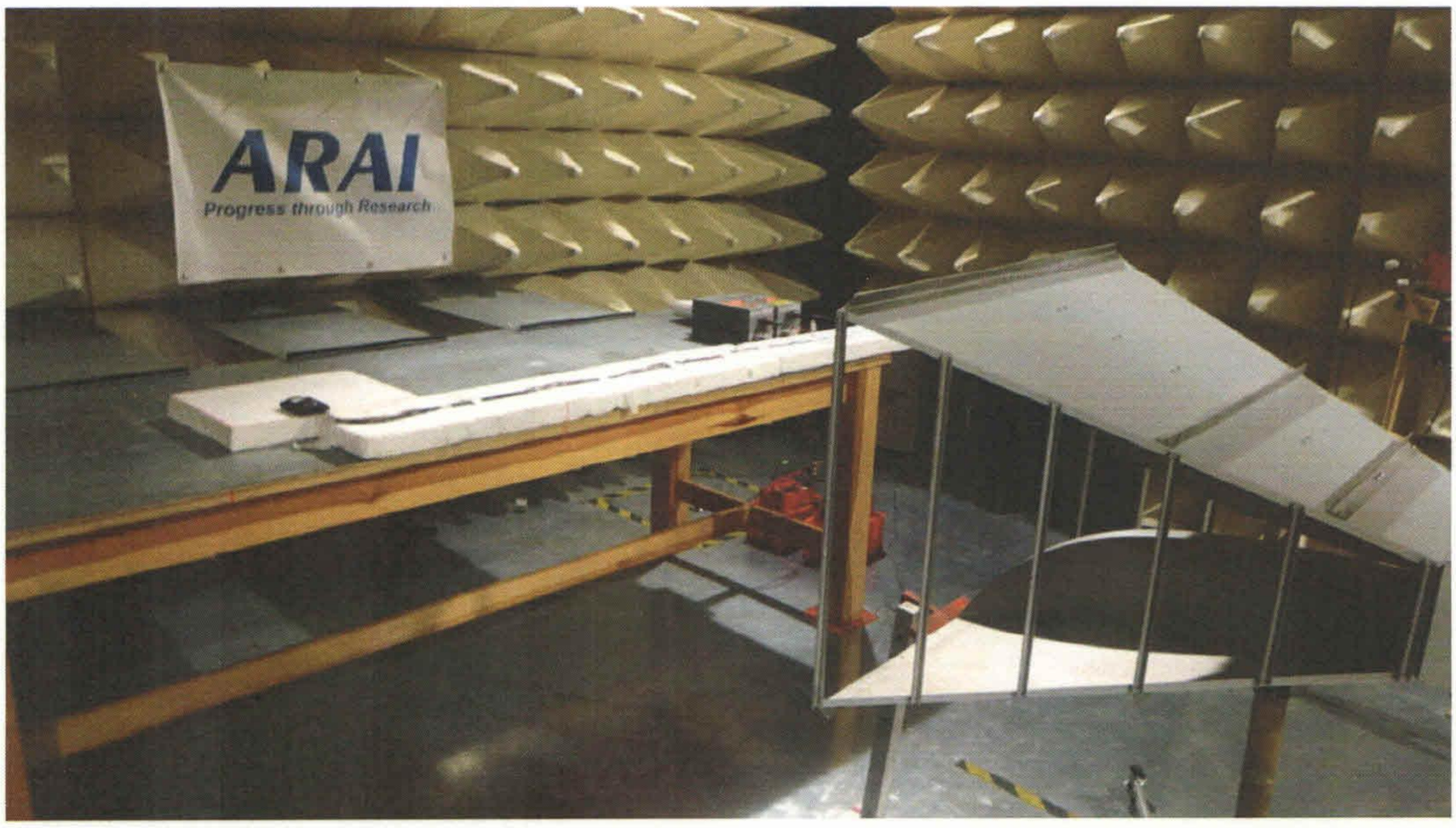
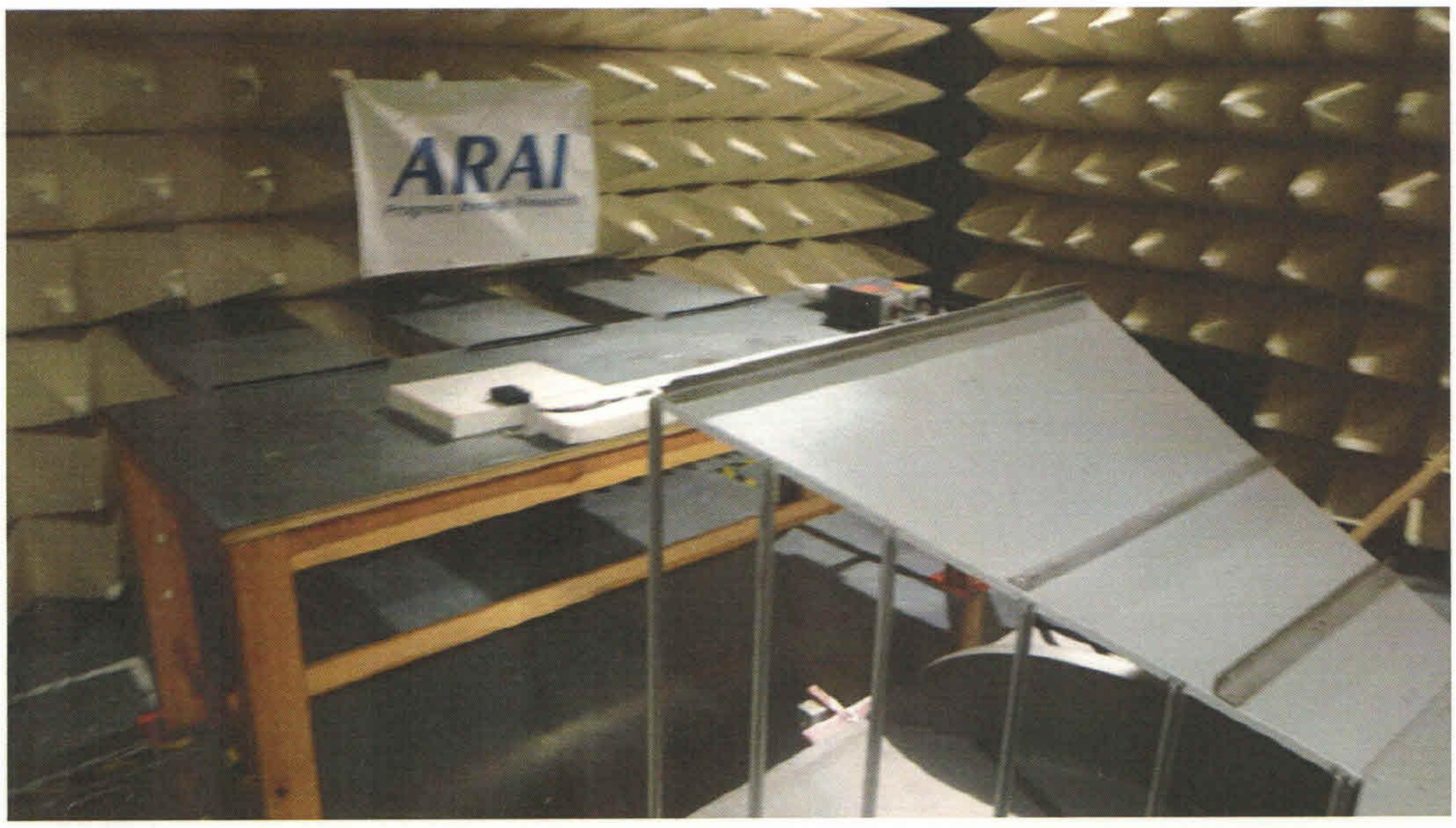
3.13 TEST SETUP PHOTO

3.13.1 Antenna phase centre focused to in line with the centre of wiring harness of DUT



3.12.2 Antenna phase centre focused to in line with the DUT.



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End of Annexure 03

ANNEXURE 04

4.1 TEST SPECIFICATIONS

TEST DETAILS	RADIATED EMISSION TEST AS PER AIS004 (PART3): 2009 STANDARD.
TEST DATE	24-Oct-2016

4.2 DUT OPERATING CONDITIONS

DUT MODE OF OPERATION	FULL OPERATING ■	PARTIAL OPERATING ☐	POWER ON STATE ☐
DIAGNOSTIC TOOLS CONNECTED	CAN BUS CONV. ☐	USB BUS CONV. ☐	RS232 BUS CONV. ☐
REMARKS			

4.3 MONITORING OF DUT

PASS/FAIL criteria automatically controlled by EMC software.	■		PASS/FAIL criteria manually controlled by operator. ☐
PASS/FAIL criteria not verified.	☐		PASS/FAIL criteria controlled and evaluated by the customer. ☐

4.4 LABORATORY ENVIRONMENT TEST CONDITIONS

Ambient temperature	+ 23.5°C.	Required (23±5)°C.	Relative humidity	45.5%RH.	----

4.5 TEST SETUP DETAILS

DUT Setup Details	Status	Remarks
A) Test setup was done according to	CISPR 25: Ed 03-2008-03	Refer Std. CISPR 25: Ed 03-2008-03 Clause No. 6.4.2
B) Test table surface	Wooden ☐ Metallic ■	Test table height from ground floor (900, ±100)mm.
C) Ground plane	Copper ☐ Galvanized Steel ■	0.5mm thick (min.)
D) Whether the DUT and all test harness of the DUT was placed (50, ±5) mm, above the ground plane?	Yes ■ No ☐	Placed on non-conductive, low relative permittivity material.
E) Total length of test harness between DUT & the load simulator (1500, ±100) mm.	Yes ■ No ☐	----
F) DUT position on the table (75 cm from table centre and 20 cm behind table front side)	Yes ■ No ☐	----

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■ - Option considered for the test

☐ - Option not considered for the test

DUT Setup Details	Status	Remarks
G) Whether DUT was directly grounded (GND) or isolated (ISO) from the ground plane?	GND ☐ ISO ■	----
H) Antenna distance from the wiring harness of the DUT	(1000 ± 10)mm	----
I) Phase centre of the antenna above the ground plane of test table. .	(100 ±10)mm	----
J) Antenna phase centre focused to in line with the centre of wiring harness of DUT	Yes ■ No ☐	For frequency up to 1 GHz.
K) No. of orientation of DUT	1	----
L) No. of LISNs used (5uH/50Ω)	2	----

4.6 DUT SUPPLY VOLTAGE DETAILS		
Test voltage	**24V System**	**Current consumption**
U_A	(27, ±1) V ■	< 1 Amp.
U_B	(24, ±0.4) V ■	
Power sources	**Status**	**Voltage**
Battery supply (U_B)	Yes ■ No ☐	12V ☐ 24V ■
DC power supply (U_A) (External DC power supply connected)	Yes ■ No ☐	13.5V ☐ 27V ■

4.7 TEST PROCEDURE
4.7.1 Measurement of radiated field strength was carried out in an ALSE to eliminate the high level of disturbance from other/external electrical equipment and broadcasting stations.
4.7.2 For radiated emission measurement, the arrangement of the DUT, test harness, load simulator and measuring equipment was as per CISPR25.
4.7.3 The measurement was carried out using linearly polarized electric field antenna that has nominal 50Ω output impedance. a) 30 MHz to 200 MHz (Bi-Conical Antenna) b) 200 MHz to 1000 MHz (Log-Periodic Antenna)
4.7.4 The DUT was placed over a non-conductive low relative permittivity material at 50± 5 mm above the ground plane and connected with ground plane through copper strip. The total length of the test harness between the DUT and load simulator was 2000 mm.
4.7.5 The phase centre of the measuring antenna was 100 mm above the table ground plane for bi-conical and log periodic antennae.
4.7.6. From 30 MHz to 1000 MHz, measurement was performed in horizontal and vertical polarizations.

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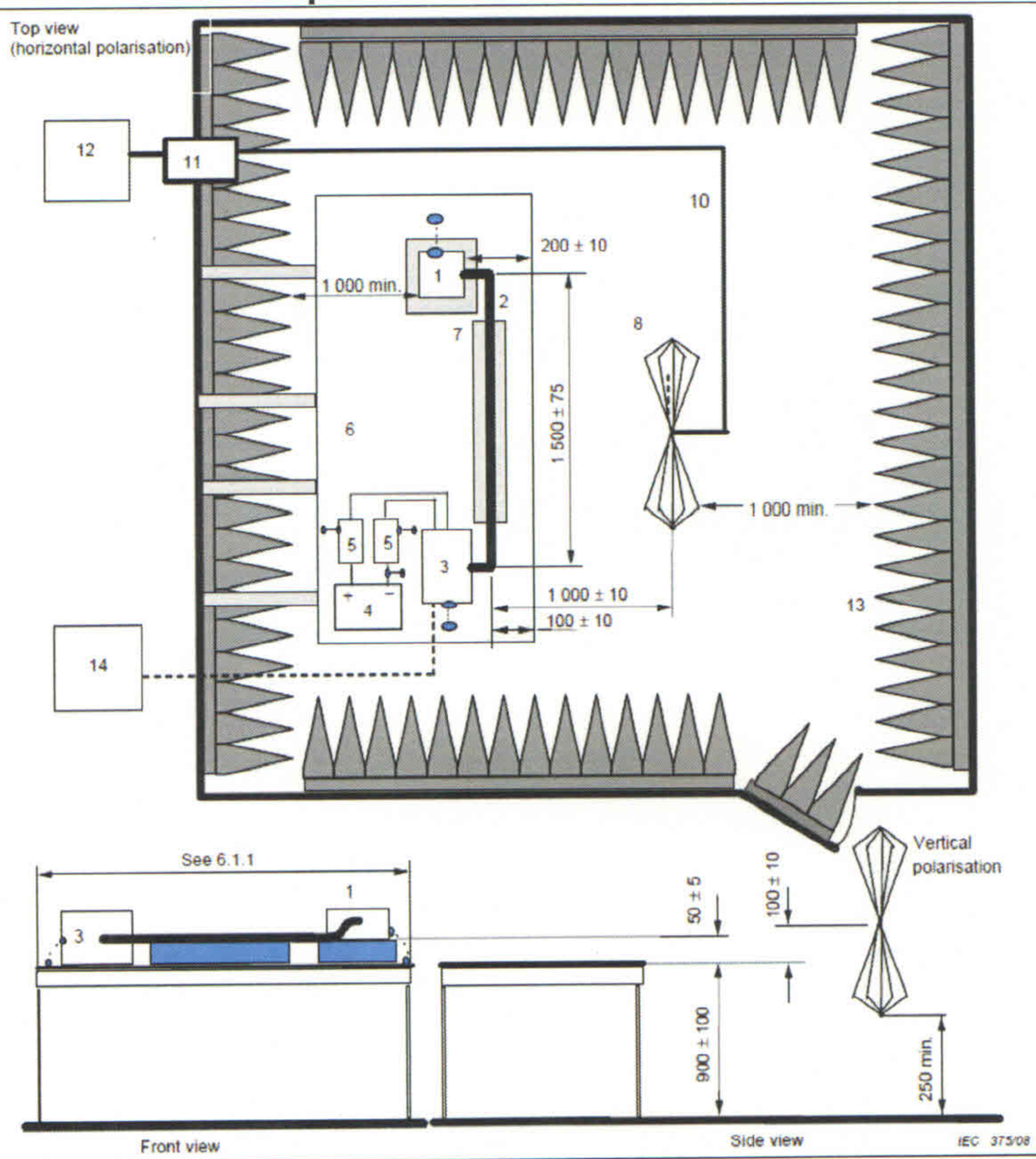
4.8 TEST PARAMETERS				
Frequency range	30 MHz to 1000 MHz			■
Scanning receiver parameters	**Peak detection**			■
	Frequency range	Bandwidth at -6dB	Step Size	Dwell time
	30 MHz-1000 MHz	120 kHz	50 kHz	5 ms
	Average detection			■
	Frequency range	Bandwidth at -6dB	Step Size	Dwell time
	30 MHz-1000 MHz	120 kHz	50 kHz	5 ms
	Quasi-peak detection			□
	Frequency range	Bandwidth at -6dB	Step Size	Dwell time
	30 MHz-1000 MHz	120 kHz	50 kHz	5 ms
Antenna Systems	**Frequency Range**	**Antenna Used**	**Polarization**	
	30 MHz- 200 MHz	Biconical antenna	Horizontal Vertical	■ ■
	200 MHz-1000 MHz	Log-periodic antenna	Horizontal Vertical	■ ■

4.9 RADIATED EMISSION TEST SET UP

4.9.1 Radiated emission test set up- Bi-conical antenna



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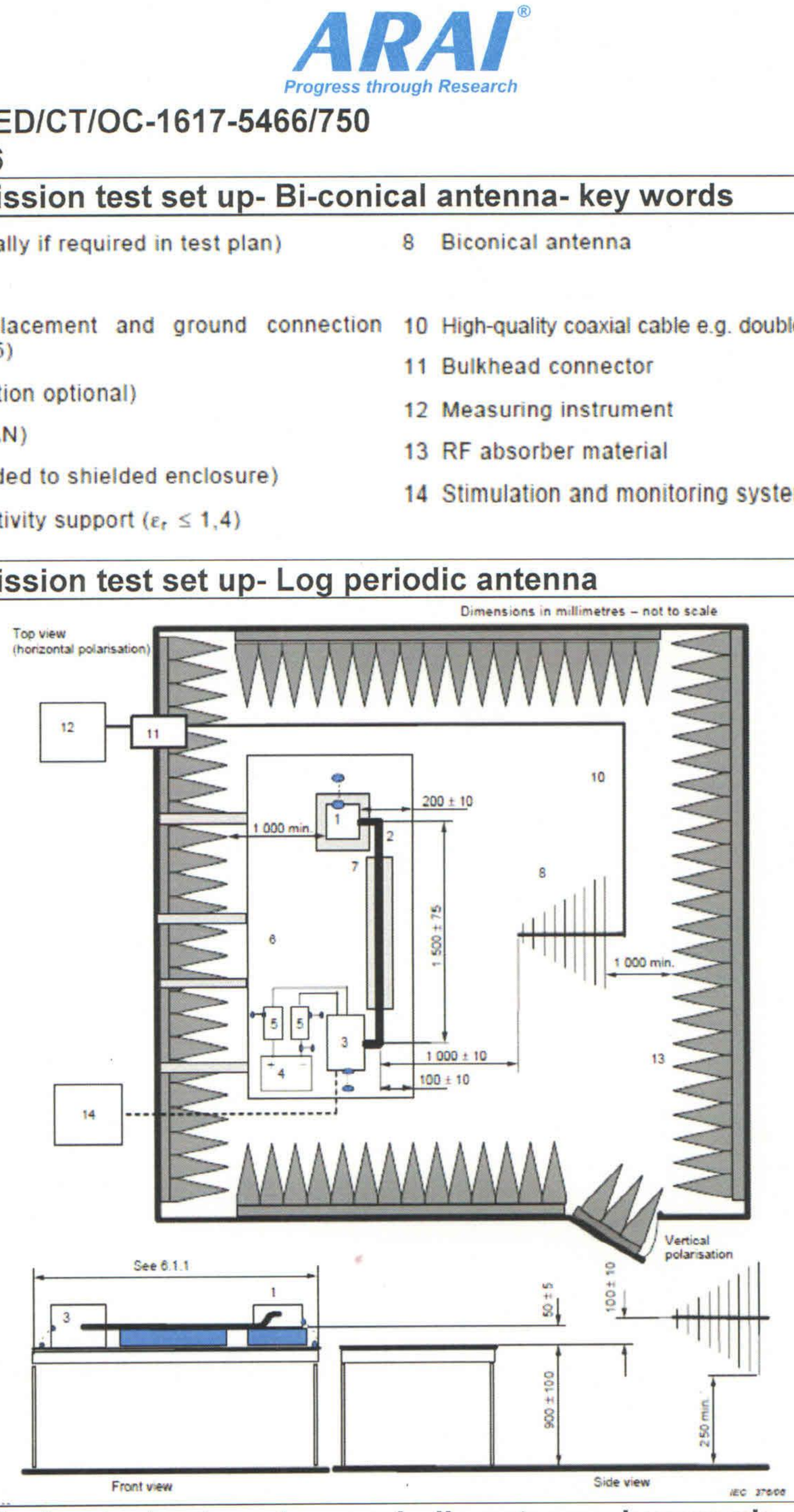
4.9.2 Radiated emission test set up- Bi-conical antenna- key words

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.4.2.5)
4 Power supply (location optional)
5 Artificial network (AN)
6 Ground plane (bonded to shielded enclosure)
7 Low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 Biconical 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

4.9.3 Radiated emission test set up- Log periodic antenna



4.9.4 Radiated emission test set up- Log periodic antenna- key words

1 EUT (grounded locally if required in test plan)
2 Test harness
3 Load simulator (placement and ground connection according to 6.4.2.5)
4 Power supply (location optional)
5 Artificial network (AN)
6 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

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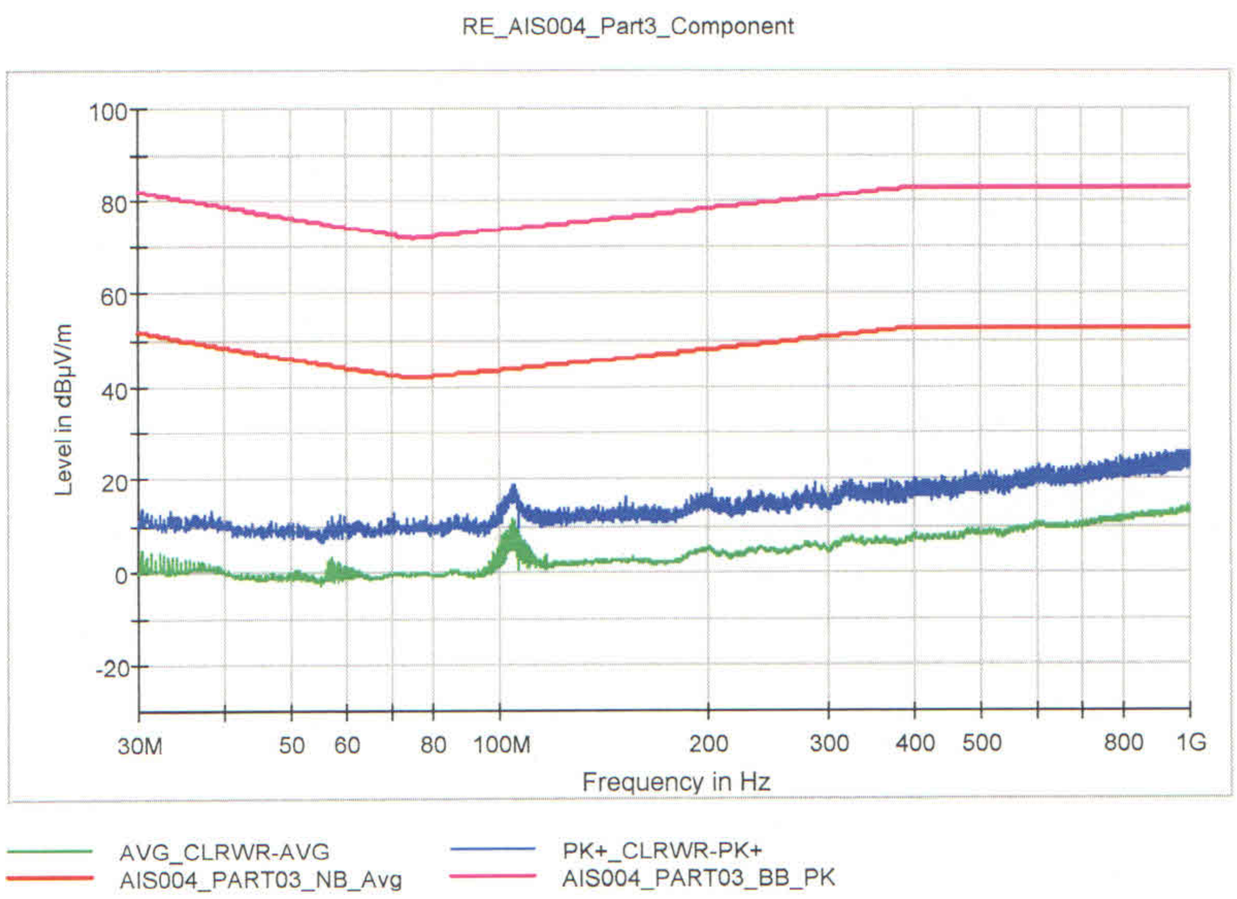
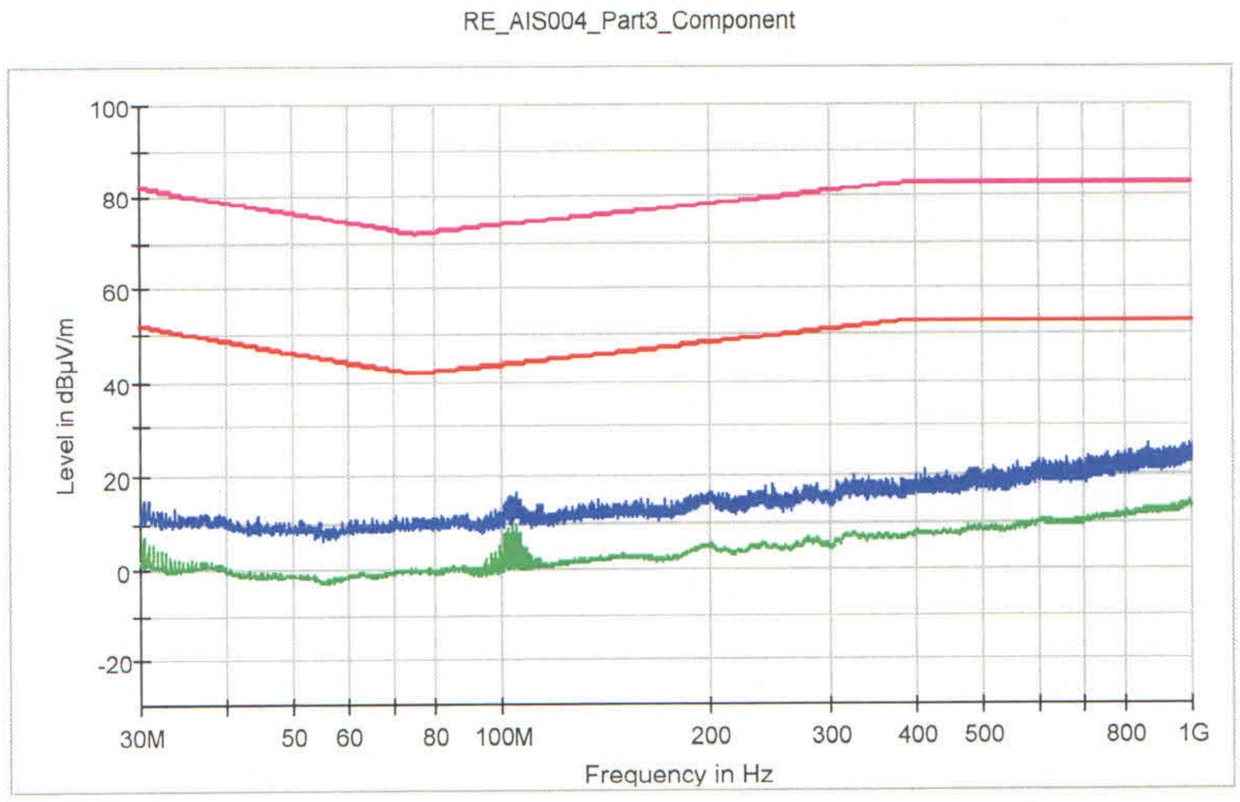
4.10 TEST OBSERVATION			
Sr. No.	**Frequency range**	**Antenna polarization**	**Observation**
1.	30 MHz-1000 MHz	Horizontal	**Pass**
2.	30 MHz-1000 MHz	Vertical	**Pass**

4.11 MEASUREMENT GRAPH

4.11.1 Radiated emission graph for frequency range 30 MHz-1000 MHz with antenna in horizontal polarization



4.11.2 Radiated emission graph for frequency range 30 MHz-1000 MHz with antenna in vertical polarization



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4.12 TEST RESULT ANALYSIS

4.12.1 Analysis of radiated emission test for frequency range 30MHz-1000MHz with antenna in horizontal polarization.

Freq. Band (MHz)	Freq. of Maxima by Peak Detector (MHz)	Maximum Measurement by Peak detector (dBµV/m)	Peak Limit in (dBµV/m)	Result for Peak	Freq. of Maxima by Average Detector (MHz)	Maximum Measurement by Average detector (dBµV/m)	Average limit (dBµV/m)	Result for Average
30 - 50	30.35	13.8	81.87	Pass	30.35	4.6	51.87	Pass
50 - 75	70.5	13.1	72.68	Pass	57.3	3.2	44.94	Pass
75 - 100	99.7	14.6	73.87	Pass	99.2	5.3	43.84	Pass
100 - 130	105.4	18.5	74.24	Pass	104.5	11.8	44.18	Pass
130 - 165	152.25	16.4	76.65	Pass	149.2	3.1	46.52	Pass
165 - 200	197	17	78.35	Pass	197.5	5.2	48.36	Pass
200 - 250	202.95	17.5	78.54	Pass	240	5.8	49.64	Pass
250 - 320	315.45	19.2	81.44	Pass	315.85	7.4	51.45	Pass
320 - 400	370.25	19.5	82.49	Pass	399.7	8.5	52.99	Pass
400 - 520	474.05	21.4	83	Pass	484.25	9.2	53	Pass
520 - 660	629.3	22.8	83	Pass	606.7	10.7	53	Pass
660 - 820	793.55	24.4	83	Pass	814.05	12.2	53	Pass
820 - 1000	927.45	25.6	83	Pass	993.3	14.2	53	Pass

4.12.2 Analysis of radiated emission test for frequency range 30 MHz-1000 MHz with antenna in vertical polarization

Freq. Band (MHz)	Freq. of Maxima by Peak Detector (MHz)	Maximum Measurement by Peak detector (dBµV/m)	Peak Limit in (dBµV/m)	Result for Peak	Freq. of Maxima by Average Detector (MHz)	Maximum Measurement by Average detector (dBµV/m)	Average limit (dBµV/m)	Result for Average
30 - 50	30.35	15	81.87	Pass	30.35	6.8	51.87	Pass
50 - 75	70.65	11.4	72.65	Pass	74.15	0.3	42.12	Pass
75 - 100	97.75	13	73.74	Pass	99.7	5.2	43.87	Pass
100 - 130	105.45	16.9	74.24	Pass	103.55	10.5	44.12	Pass
130 - 165	162.7	14.9	77.09	Pass	149.45	3.2	46.53	Pass
165 - 200	198.7	16.3	78.4	Pass	198.25	5.3	48.39	Pass
200 - 250	247.1	17.9	79.83	Pass	201.7	5.8	48.5	Pass
250 - 320	314.15	19.1	81.41	Pass	316.65	7.5	51.46	Pass
320 - 400	324.85	19.8	81.63	Pass	399.4	8.2	52.99	Pass
400 - 520	518.7	21.3	83	Pass	483.5	9.2	53	Pass
520 - 660	659.05	23	83	Pass	615.85	10.7	53	Pass
660 - 820	819.75	24.5	83	Pass	804.1	12.4	53	Pass
820 - 1000	869.05	25.8	83	Pass	994.8	14.2	53	Pass

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■- Option considered for the test

☐- Option not considered for the test

4.13 TEST SETUP PHOTO

4.13.1 Test setup photo with Bi-conical antenna position in front of centre of wiring harness.

4.13.2 Test setup photo with Log-periodic antenna position in front of centre of wiring harness.

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End of Annexure 04

ANNEXURE 05

5.1 TEST SPECIFICATIONS

TEST DETAILS	CONDUCTED TRANSIENT EMISSION TEST AS PER AIS004 (PART3) 2009 STANDARD.
TEST DATE	24-Oct-2016

5.2 DUT OPERATING CONDITIONS

DUT MODE OF OPERATION	FULL OPERATING ■	PARTIAL OPERATING ☐	POWER ON STATE ☐
DIAGNOSTIC TOOLS CONNECTED	CAN BUS CONV. ☐	USB BUS CONV. ☐	RS232 BUS CONV. ☐

5.3 MONITORING OF DUT

PASS/FAIL criteria automatically controlled by EMC software.	☐	PASS/FAIL criteria manually controlled by operator	■
PASS/FAIL criteria not verified.	☐	PASS/FAIL criteria controlled and evaluated by the customer.	☐

5.4 LABORATORY ENVIRONMENT TEST CONDITIONS

Ambient temperature	+ 24.0 °C.	Required (23±5)°C.	Relative humidity	45.0 %RH.	----

5.5 TEST SETUP DETAILS

DUT Setup Details	DUT Setup Details	DUT Setup Details
A) Test setup was done according to	ISO 7637-2: 2004	Refer Std. ISO 7637-2: 2004 Clause No.4.3
B) Test table surface	Wooden ☐ Metallic ■	Test table height from ground floor (900, ±100)mm.
C) Ground plane	Copper ☐ Galvanized Steel ■	0.5mm thick (min.)
D) Whether the DUT and all test harness of the DUT was placed (50, ±5) mm, above the ground plane?	Yes ■ No ☐	Placed on non-conductive, low relative permittivity material.
E) Total length of test harness between DUT & artificial network (200, ±50) mm.	Yes ■ No ☐	----
F) Whether DUT was directly grounded (GND) or isolated (ISO) from the ground plane?	GND ☐ ISO ■	----
G) No. of LISNs used (5uH/50Ω)	1	----
H) Shunt resistor (R_s) connected in parallel to the DUT & Ignition switch.	40 Ω	----
I) Transient emission measurement according to	Fast pulses ■ Slow pulses ☐	----

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■- Option considered for the test

☐- Option not considered for the test

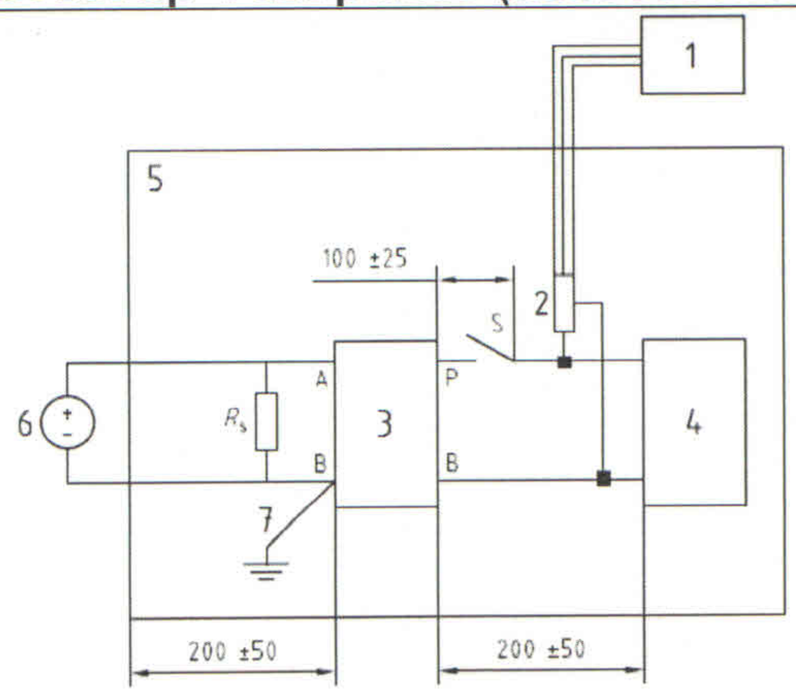
5.6 DUT SUPPLY VOLTAGE DETAILS				
Test voltage	**24V System**		**Current cons.**	
U_A	(27, ±1) V	■	< 1 Amp.	
U_B	(24, ±0.4) V	■		
Power sources	**Status**		**Voltage**	
Battery supply (U_B)	Yes	■	12V	□
	No	□	24V	■
DC power supply (U_A) (External DC power supply connected)	Yes	■	13.5V	□
	No	□	27V	■

5.7 TEST PROCEDURE

The interference voltages emitted from electronic systems and electrical components were measured. The DUT was connected with the Switch S and the power supply-backed starter battery via the AN. The interference voltage was measured between the terminals P and B of the AN using a probe of an oscilloscope. Continuous interference sources are measured when the Switch S was closed. The particular event was repeated for minimum 10 times, in order to capture maximum transient amplitude.

5.8 TRANSIENT EMISSION TEST SET UP

5.8.1 Transient emission test set up- Fast pulses (nanosecond-to-microsecond range)



b) Fast pulses (nanosecond-to-microsecond range)

5.9 TEST OBSERVATION

Sr. No.	Voltage transient measured on supply line	Maximum allowed transient as per AIS 004 Part 3 for 24V System	Observed voltage transient emission
1.	Positive	+150V	No positive transient was observed.
2.	Negative	-450V	No negative transient was observed.

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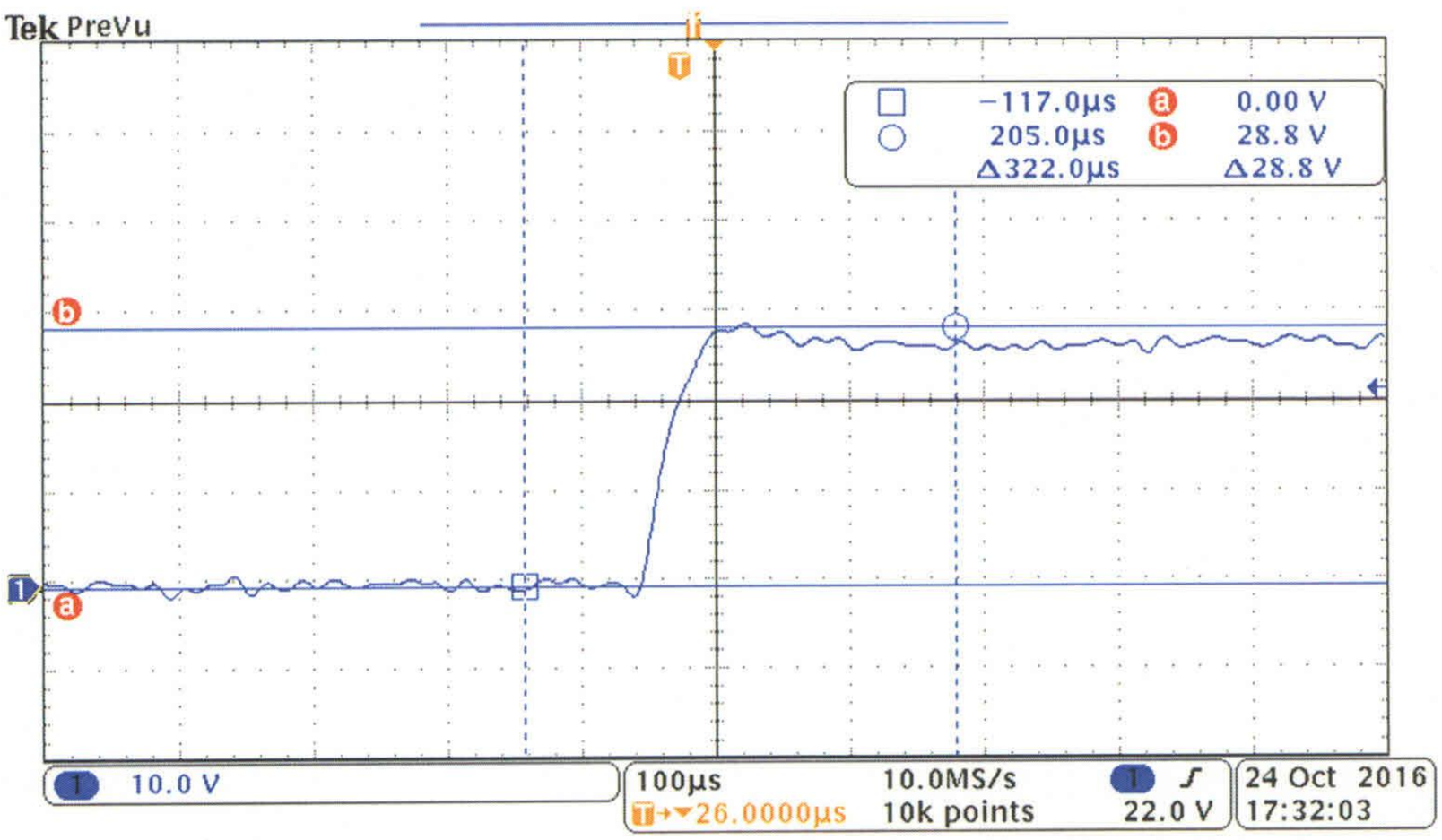
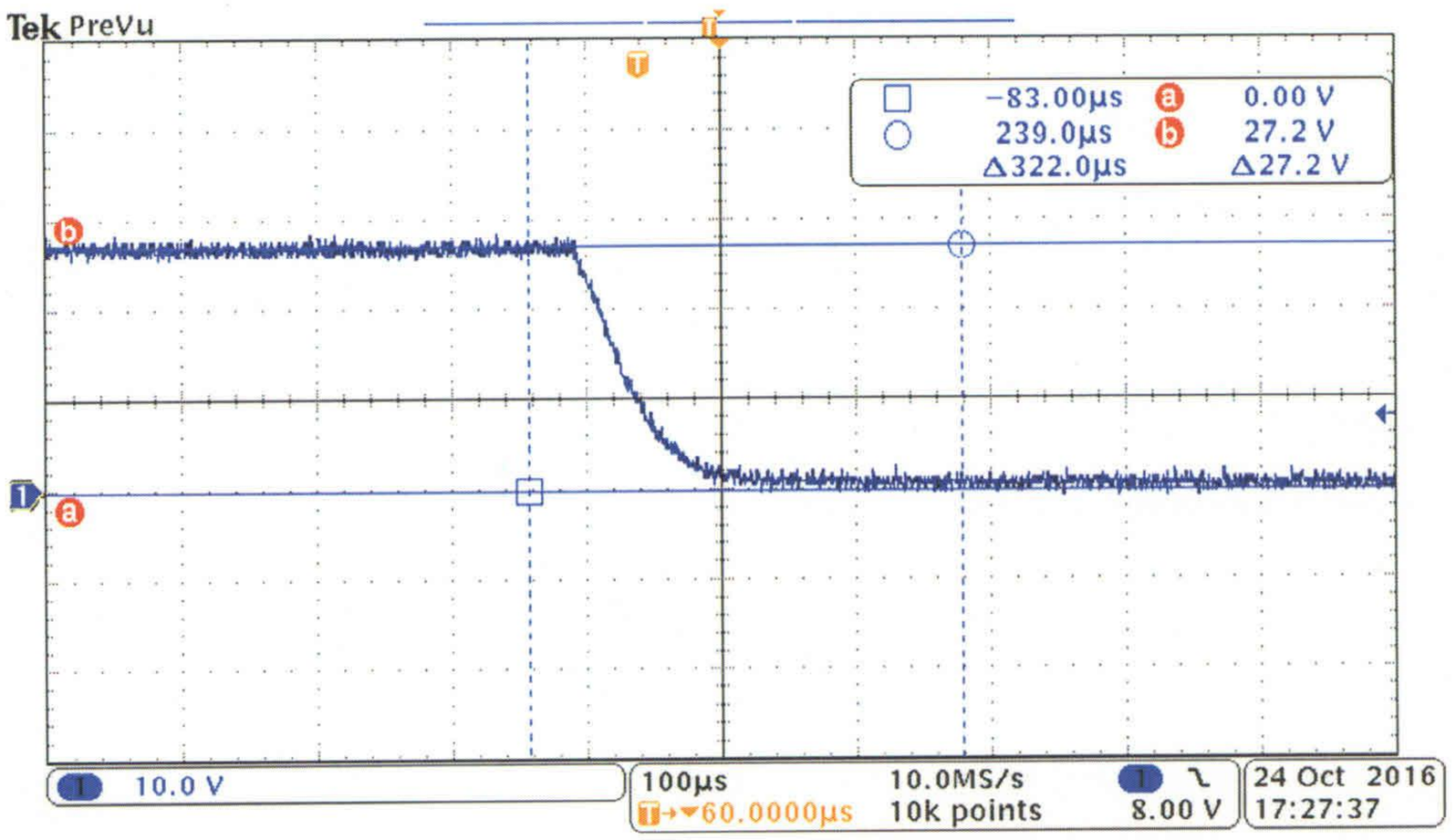
5.10 MEASUREMENT OF VOLTAGE TRANSIENT WAVEFORMS

5.10.1 Positive voltage transient waveform



5.10.2 Negative voltage transient waveform



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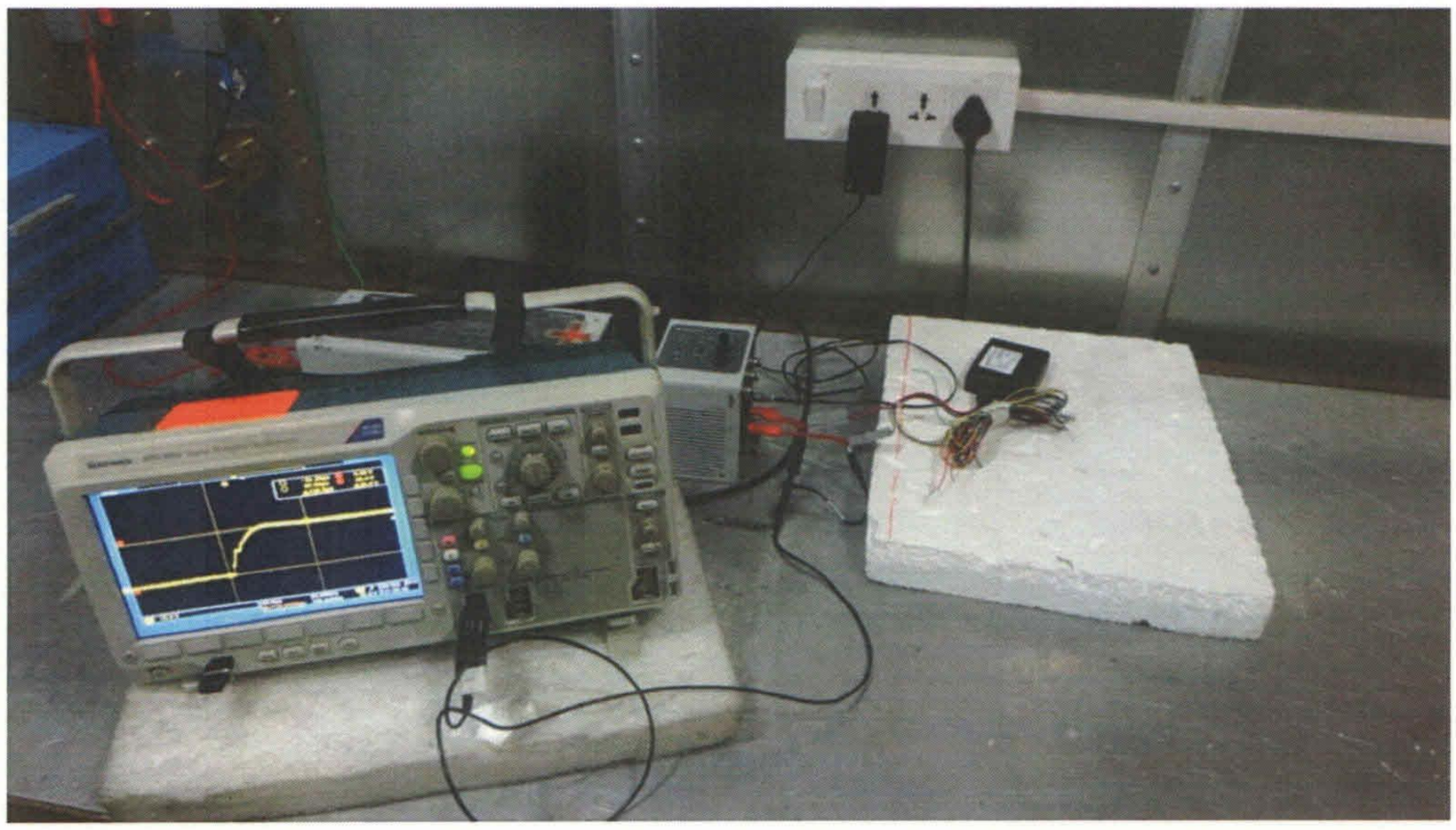
■- Option considered for the test

☐- Option not considered for the test

5.11 TEST SETUP PHOTO

5.11.1 Transient emission, general set-up (Switch on DUT side)



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