



THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

COMMUNICATION CONCERNING THE APPROVAL GRANTED ⁽¹⁾/ APPROVAL EXTENDED ⁽¹⁾/
APPROVAL REFUSED ⁽⁴⁾/ APPROVAL WITHDRAWN ⁽⁴⁾/ PRODUCTION DEFINITELY
DISCONTINUED ⁽¹⁾ OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY ⁽¹⁾ WITH
REGARD TO REGULATION NO. 10.03




Approval No: 10R-035243

Extension No: 01

1. Make (trade name of manufacturer): LED Technologies Pty Ltd
2. Type and general commercial description(s): Rear, front and side LED lamps for commercial vehicles.
These include Stop, Position (Tail), Indicator, Reverse, Fog, Front and Rear Side Markers, Side Markers etc. Mainly includes LEDs on a circuit board encased in a waterproof resin with a hardened acrylic or polycarbonate cover/lens.
3. Means of identification of type, if marked on the ~~vehicle/component/ separate technical unit~~: ⁽¹⁾
- 3.1. Location of that marking: Laser Engraved or Ink Stamp or Self Adhesive Label
4. Category of vehicle: Front or rear of unit
5. Name and address of manufacturer:
LED Technologies Pty Ltd
12 Brand Drive
Thomastown
Victoria
Australia
3070
6. In the case of components and separate technical units, location and method of affixing of the ECE approval mark: Front or rear of unit Laser Engraved or Ink Stamp or Self Adhesive Label

EAP277521



7. Address(es) of assembly plant(s):
Min Hsiang Corporation
No. 60, Sec. 1, Cheng Kong Road
Kewjjen 711, Tainan Hsien
Taiwan
Republic of China
8. Additional information (where applicable): See Appendix
9. Technical Service responsible for carrying out the tests: MIRA Limited, Nuneaton
10. Date of test report: As before and 03 July 2013
11. No. of test report: As before and 1202591#02
12. Any remarks: See Appendix
13. Place: BRISTOL
14. Date: 09 JULY 2013
15. Signature:  A. W. STENNING
Head of Technical and Quality Support Group
16. The index to the information package lodged with the Approval Authority, which may be obtained on request, is attached.
17. Reasons for extension: To cover:
1) Addition of new models
2) Additional location and method of affixing approval mark

(1) Strike out what does not apply.

APPENDIX

to type-approval communication form No. 10R-035243 Extension 01

concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.03

1. Additional information:
 - 1.1. Electrical system rated voltage: 12 V or 24 V. ~~pos~~/neg ground ⁽¹⁾
 - 1.2. This ESA can be used on any vehicle type with the following restrictions: All voltage specific lamps voltage range between 10-30V. They can be used for 12 V or 24 V vehicles
 - 1.2.1. Installation conditions, if any: Not applicable
 - 1.3. This ESA can be used only on the following vehicle types: Not applicable
 - 1.3.1. Installation conditions, if any: Not applicable
 - 1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (Please specify precise method used from Annex 9): BCI 20 to 400 MHz, Absorber Lined Chamber 400 to 2000 MHz
 - 1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests: MIRA Limited, Nuneaton, United Kingdom
 2. Remarks: None
- (1) Strike out what does not apply.



THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

COMMUNICATION CONCERNING THE EXTENSION OF TYPE-APPROVAL ⁽¹⁾ OF A TYPE OF COMPONENT⁽¹⁾ WITH REGARD TO RADIO INTERFERENCE SUPPRESSION DIRECTIVE 72/245/EEC, AS LAST AMENDED BY DIRECTIVE 2009/19/EC.

Type Approval No: e11*72/245*2009/19*5243*01

Reason for Extension: To cover:

- 1) Addition of new models
- 2) Additional location and method of affixing approval mark

EC type-approval mark to be affixed on ESA: e11 03 5243

SECTION I

- 0.1. Make (trade name of manufacturer): LED Technologies Pty Ltd
- 0.2. Type: Rear, front and side LED lamps for commercial vehicles. These include Stop, Position (Tail), Indicator, Reverse, Fog, Front and Rear Side Markers, Side Markers etc. Mainly includes LEDs on a circuit board encased in a waterproof resin with a hardened acrylic or polycarbonate cover/lens.
- 0.3. Means of identification of type, if marked on the component ⁽¹⁾ ⁽²⁾: Laser Engraved or Ink Stamp or Self Adhesive Label
 - 0.3.1. Location of that marking: Front or rear of unit
- 0.5. Name and address of manufacturer:
LED Technologies Pty Ltd
12 Brand Drive
Thomastown
Victoria
Australia
3070

Name and address of authorised representative, if any;
LED AUTOLAMPS EUROP LIMITED
10a Maybrook Road
Maybrook Business Park
Minworth, West Modlands
B76 1AL
United Kingdom

0.7. In the case of components and separate technical units, location and method of affixing of the EC approval-mark: Front or rear of unit Laser Engraved or Ink Stamp or Self Adhesive Label

0.8. Address(es) of assembly plant(s):
Min Hsiang Corporation
No. 60, Sec. 1, Cheng Kong Road
Kewjjen 711, Tainan Hsien
Taiwan
Republic of China



1. Additional information (where applicable): See Appendix

2. Technical service responsible for carrying out the tests: MIRA Limited, Nuneaton

3. Date of test report: As before and 03 July 2013

4. Number of test report: As before and 1202591#02

5. Remarks (if any): See Appendix

6. Place: BRISTOL

7. Date: 09 JULY 2013

8. Signature: 

A. W. STENNING
Head of Technical and Quality Support Group

9. The type approval file deposited at the Administrative Service having delivered the type approval may be obtained on request

(1) Delete where not applicable.

(2) If the means of identification of type contains characters not relevant to describe the vehicle, component or separate technical unit types covered by this type-approval certificate such characters shall be represented in the documentation by the symbol '?' (e.g. ABC??123??).

(3) As defined in Annex IIA to Directive 70/156/EEC.



APPENDIX

to EC Type Approval Certificate No: e11*72/245*2009/19*5243*01

concerning the type approval of an electric/electronic subassembly with regard to Directive 72/245/EEC
as last amended by Directive 2009/19/EC

1. Additional information:
 - 1.1. Electrical system rated voltage: 12 V or 24 V
 - 1.2. This ESA can be used on any vehicle type with the following restrictions: All voltage specific lamps voltage range between 10-30V. They can be used for 12 V or 24 V vehicles
 - 1.2.1. Installation conditions, if any: Not applicable
 - 1.3. This ESA can only be used on the following vehicle types: Not applicable
 - 1.3.1. Installation conditions, if any: Not applicable
 - 1.4. The specific test method(s) used and the frequency ranges covered to determine immunity were: (please specify precise method used from Annex IX): BCI 20 to 400 MHz, Absorber Lined Chamber 400 to 2000 MHz
 - 1.5. Laboratory accredited to ISO 17025 and recognised by the Approval Authority (for the purpose of this Directive) responsible for carrying out the test: MIRA Limited, Nuneaton, United Kingdom
5. Remarks: None



THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

APPROVAL NUMBER: e11*72/245*2009/19*5243*01

INFORMATION PACKAGE CONTENTS

INDEX REVISION NUMBER: 01 (One)

Total number of sheets: 08 (Eight)

Reasons for Revision: See approval certificate

Revision date
&
Office stamp

EAP277521

An executive agency of the Department for Transport
April 2013 Revision 3



Relating to EEC type-approval of an electric/electronic sub-assembly with respect to electromagnetic compatibility

GENERAL:

Trade name or mark of device: LED AUTOLAMPS

Type and general commercial description: Rear, front and side LED lamps for commercial vehicles. These include Stop, Position (Tail), Indicator, Reverse, Fog, Front & Rear Side Markers, Side Markers etc. Mainly includes LEDs on a circuit board encased in a waterproof resin with a hardened acrylic or polycarbonate cover/lens. These are classified

125 Series
100 Series
80 Series
Generation II Series which includes the 100, 150, 275 & 250 series
200 Series
135 Series
110 Series
130 Series
35 Series
58 Series
235 Series
380 Series
145 Series
MaxiLamp Series
Stalk Lamp Series
101 & 151 Series
102 Series
140 Series
EU195 Series
EU200 Series
EU140 Series
EU390 Series
EU95 Series
EU40 Series
129 series
1490 & 1491 Series
181 Series
37 Series
41 Series
44 Series
81 Series
95 Series
99 Series
LP Series
MB12 Series
J3 Jumbo Series



<i>Location of the marking:</i>	Front of Unit
<i>Name and address of manufacturer:</i>	LED Technologies Pty Ltd 12 Brand Drive Thomastown, Victoria, Australia, 3070 Ph: +61 3 9464 5939 fax: +61 3 9464 5940
<i>Location of EEC approval mark & Method of affixing the EEC approval mark</i>	Front or Rear of unit. Laser engraved or Self Adhesive Label and will also include name, voltage, wattage, materials etc
<i>Name and address of assembly plant: (QA by UKAS and COP by VCA)</i>	Min Hsiang Corporation No. 60, Sec. 1, Cheng Kong Road, Kweijen 711, Tainan Hsien, Taiwan, ROC Ph: +886-6-2398899 fax: +886-6-2398811
<i>The ESA shall be approved as:</i>	A Component
<i>Restrictions of use and conditions for fitting:</i>	No restrictions for EMC purposes. All dual voltage lamps - voltage range between 10-30v. They can be used for 12v or 24v vehicles. Voltage specific lamps are either 12v or 24v and should be used accordingly.
<i>Range of Voltage:</i>	12/24v (Dual voltage lamps range 10-30v); 12v specific; 24v specific; All products are Negative Ground;

APPENDIX 1

1. Description of Items (ESA) chosen to Represent the Type:

- We ~~have~~ **had** initially 54 individually named lamps under this application for approval;
- **We are adding a further 116 lamps as an amendment to the approval;**
- There are 14 of the square lamps which have 3 different sizes;
- The smallest being the 80 series (dimensions 80x80x28mm);
 - 80AME has 36 LEDs;
 - 80RME has 36 LEDs;
 - 80WME has 25 LEDs;
 - 80FME has 20 LEDs; and
 - 80BSTIME has 24 LEDs;
- Medium is the 100 series (dimensions 100x100x31mm);
 - 100AME has 49 LEDs;
 - 100RME has 49 LEDs;
 - 100WME has 25 LEDs;
 - 100FME has 20 LEDs; and
 - 100BSTIME has 28 LEDs;
- The largest is the 125 series (dimensions 125x125x31mm);
 - 125AME has 64 LEDs;



- 125RME has 64 LEDs;
- 125WME has 25 LEDs; and
- 125FME has 20 LEDs;
- Generation II LED lamps (variable dimensions);
 - 150ARME & 150BARE has 14 LEDs (dimensions 158x80x22mm);
 - 100ARME & 100BARE has 14 LEDs (dimensions 100x100x22mm);
 - 275ARME has 24 LEDs (dimensions 175x100x22mm);
 - 250FARM has 37 LEDs (dimensions 250x80x24mm);
 - 250WARM has 37 LEDs (dimensions 250x80x24mm);
 - 250ARWM has 35 LEDs (dimensions 250x80x24mm);
- 9 of the 200 series (dimensions 200x50x28mm);
 - 200AME has 36 LEDs;
 - 200RME has 36 LEDs;
 - 200WME has 25 LEDs;
 - 200BSTIME has 24 LEDs;
 - 200AWE12 has 29 LEDs; and
 - 200AWE24 has 29 LEDs;
 - 200BSTIR48 and 200BSTIRM;
 - 200FME has 22 LEDs;
 - 207BARPE has a total of 14 LEDs, made up of two separate lamps of 7 LEDs each;
- 6 of the 135 series (dimensions 135x38x24mm);
 - 135AME has 8 LEDs;
 - 135RME has 8 LEDs;
 - 135WME has 26 LEDs;
 - 135FME has 18 LEDs;
 - 135ARME has 18 LEDs; and
 - 135CAT1E has 18 LEDs;
- 4 of the round 110 series (dimensions 109mm diameter, and depth 53mm);
 - 100AME has 49 LEDs;
 - 100RME has 49 LEDs;
 - 100WME has 25 LEDs; and
 - 100FME has 20 LEDs;
- 4 of the rectangular 130 series (dimensions 130x86x48mm);
 - 130AME has 64 LEDs;
 - 130RME has 64 LEDs;
 - 130WME has 25 LEDs; and
 - 130FME has 20 LEDs;
- 35 & 58 series small marker lamps (dimensions 35x58x19mm);
 - 35AME has 4 LEDs;
 - 35RME has 4 LEDs;
 - 35WME has 4 LEDs;
 - 35GME has 4 LEDs;
 - 35BME has 4 LEDs;
 - 35BLME has 4 LEDs;
 - 35BLME1 has 4 LEDs;
 - 58AME has 3 LEDs;
 - 58AM-1E has 3 LEDs;
 - 58RME has 2 LEDs;
 - 58WME has 2 LEDs;
 - 58GME has 2 LEDs;
 - 58BME has 2 LEDs;
- Strip 235 & 380 series (dimensions: 235 series – 235x22x16.5mm & 380 series – 380x22x16.5mm);



- 235A12 has 10 LEDs;
- 235A24 has 10 LEDs;
- 235R12 has 10 LEDs;
- 235R24 has 10 LEDs;
- 235RHM12E has 10 LEDs;
- 235RHM24E has 10 LEDs;
- 235W12 has 10 LEDs;
- 235W24 has 10 LEDs;
- 380A12 has 18 LEDs;
- 380A24 has 18 LEDs;
- 380R12 has 18 LEDs;
- 380R24 has 18 LEDs;
- 380W12 has 18 LEDs;
- 380W24 has 18 LEDs;
- The 145 series (dimensions 145mm diameter);
 - 145RM has 11 LEDs;
 - 145AM has 11 LEDs;
 - 145WM has 21 LEDs;
 - 145FM has 20 LEDs;
- Maxilamp Series (dimensions for triple 370x135x40mm, dimensions for single 125mm diameter);
 - Maxilamp1XRE has 30 LEDs;
 - Maxilamp1XFE has 30 LEDs;
 - Maxilamp1XWE has 30 LEDs;
 - Maxilamp1XCE has 30 LEDs;
 - Maxilamp1XCFE has 30 LEDs;
 - Maxilamp1XCWE has 30 LEDs;
 - Maxilamp3XRF has 90 LEDs;
 - Maxilamp3XRW has 90 LEDs;
- Stalk Lamp Marker Series (dimensions for long stalk lamp 193x166x66mm, dimensions for short stalk lamp 82x101x66mm);
 - 1004LE has 6 LEDs;
 - 1004RE has 6 LEDs;
 - 1004RWM has 6 LEDs;
 - 1005LE has 8 LEDs;
 - 1005RE has 8 LEDs;
 - 1005RWM has 8 LEDs
- The 101 & 151 Series (dimensions: 101 series – 100x100x22mm & 151 series – 150x80x22mm);
 - 101BAR has 8 LEDs;
 - 102BAR has 8 LEDs;
 - 103BAR has 8 LEDs;
 - 104BAR has 8 LEDs;
 - 105BAR has 8 LEDs;
 - 151BAR has 8 LEDs;
 - 152BAR has 8 LEDs;
 - 153BAR has 8 LEDs;
 - 154BAR has 8 LEDs;
 - 155BAR has 8 LEDs;
- The 102 series (dimensions 130mm diameter x 42mm depth);
 - 102AM has 21 LEDs;
 - 102RM has 21 LEDs;
 - 102WM has 21 LEDs;
 - 102AC has 21 LEDs;
 - 102RC has 21 LEDs;



- The 140 series (dimensions 140mm diameter x 66mm depth);
 - 140STIM has 28 LEDs;
 - 140STILM has 34 LEDs;
 - 140FM has 24 LEDs;
 - 140WM has 24 LEDs;
- The EU195 series (dimensions 180x195x25mm);
 - EU195L has 46 LEDs;
 - EU195R has 46 LEDs;
- The EU200 series (dimensions 150x200x25mm);
 - EU200L has 46 LEDs;
 - EU200R has 46 LEDs;
- The EU140 series (dimensions 140mm diameter x 20mm depth);
 - EU140STIM has 24 LEDs;
 - EU140TFM has 24 LEDs;
 - EU140TWM has 24 LEDs;
- The EU390 series (dimensions 140x390x20mm);
 - EU390L has 66 LEDs;
 - EU390R has 66 LEDs;
- The EU95 series (dimensions 95 diameter x 20mm depth);
 - EU95STIM;
 - EU95TFM;
 - EU95TWM;
- The EU40 series (dimensions 100x40mm);
 - EU40A has 3 LEDs;
 - EU40R has 3 LEDs;
 - EU40W has 3 LEDs;
- The 129 series (dimensions 130x32x13mm);
 - 129AM has 3 LEDs;
 - 129RM has 3 LEDs;
 - 129WM has 3 LEDs;
- The 1490 & 1491 series (dimensions 40x110x25mm);
 - 1490AM & 1491AM have 4 LEDs;
 - 1490RM & 1491RM have 4 LEDs;
 - 1490WM & 1491WM have 4 LEDs;
- The 181 series (dimensions 28mm diameter);
 - 181AME has 1 LED;
 - 181RME has 1 LED;
 - 181WME has 1 LED;
 - 181GME has 1 LED;
 - 181BME has 1 LED;
- The 37 series (dimensions 70x35x20mm);
 - 37AM has 2 LEDs;
 - 37RM has 2 LEDs;
 - 37WM has 2 LEDs;
- The 41 series (dimensions 70x35x20mm);
 - 41BLM has 4 LEDs;
- The 44 series (dimensions 100x44x12mm);
 - 44AME & 44WAME have 3 LEDs;
 - 44RME & 44WRME have 3 LEDs;
 - 44WME & 44WWME have 3 LEDs;
- The 81 series (dimensions 80x80x24mm);
 - 81A & 81AM have 7 LEDs;
 - 81R & 81RM have 7 LEDs;



- 81F & 81FM have 19 LEDs;
- 81W & 81WM have 15 LEDs;
- 81STI & 81STIM have 12 LEDs;
- The 95 series (dimensions 95mm diameter)
 - 95AM has 10 LEDs;
 - 95RM has 10 LEDs;
 - 95FM has 24 LEDs;
 - 95WM has 24 LEDs;
- The 99 series (dimensions 107x107x23mm);
 - 99AR has 8 LEDs;
 - 99ARL has 8 LEDs;
- The LP100 & LP150 series (dimensions for LP100 80x105x22mm and for LP150 105x150x22mm);
 - LP100, LP101 & LP100M have 3 LEDs;
 - LP150, LP151 & LP150M have 3 LEDs;
- The MB12AME has 12 LEDs (dimensions 96 diameter x 64mm depth);
- The J3 series (dimensions 194x123x30mm);
 - J3RM has 24 LEDs;
 - J3AM has 24 LEDs;
 - J3WM has 24 LEDs;
 - J3FM HAS 24 LEDs;
- The items that we have chosen to best represent the above lamps are as follows:
 - 125AME has 64 LEDs. This is a direction indicator lamp and mandatory on all vehicles;
 - 125RME has 64 LEDs. This is a stop & position lamp and mandatory on all vehicles;
 - 125WME has 25 LEDs. This is a reverse lamp and can be used though not mandatory on all vehicles;
 - 125FME has 20 LEDs. This is a fog lamp and mandatory on approximately 95% of vehicles;
 - 135ARME has 18 LEDs. This can be used as a secondary stop/position/indicator lamp;
 - 35WME has 4 LEDs. This is used as a front position lamp;
 - 35RME has 4 LEDs. This is used as a rear position lamp;
- The products consist of a circuit board with the main components being LEDs and resistors which are benign for EMC purposes;
- Some products have transistors and for this reason they are being tested for EMC;

2. Rated voltage and grounding requirements/polarity:

MULTI/DUAL VOLTAGE PRODUCTS

- 80 Series: 9 – 30v, negative earth;
- 100 Series: 9 – 30v, negative earth;
- 125 Series: 9 – 30v, negative earth;
- Generation II Series: 10 – 30v, negative earth;
- 200 Series: 10 – 30v, negative earth;
- 135 Series: 10 – 30v, negative earth;
- 110 Series: 10 – 30v, negative earth;
- 130 Series: 10 – 30v, negative earth;
- 35 Series: 10 – 30v, negative earth;
- 58 Series: 10 – 30v, negative earth;
- 145 Series: 10 – 30v, negative earth;
- MaxiLamp Series: 10 – 30v, negative earth;
- Stalk Lamp Series: 10 – 30v, negative earth;
- 102 Series: 10 – 30v, negative earth;
- 140 Series: 10 – 30v, negative earth;



- EU195 Series: 10 – 30v, negative earth;
- EU200 Series: 10 – 30v, negative earth;
- EU140 Series: 10 – 30v, negative earth;
- EU390 Series: 10 – 30v, negative earth;
- EU95 Series: 10 – 30v, negative earth;
- EU40 Series: 10 – 30v, negative earth;
- 129 series: 10 – 30v, negative earth;
- 1490 & 1491 Series: 10 – 30v, negative earth;
- 181 Series: 10 – 30v, negative earth;
- 37 Series: 10 – 30v, negative earth;
- 41 Series: 10 – 30v, negative earth;
- 44 Series: 10 – 30v, negative earth;
- 81 Series Multi Volt Range: 10 – 30v, negative earth;
- 95 Series: 10 – 30v, negative earth;
- LP Series Multi Volt Range: 10 – 30v, negative earth;
- MB12 Series: 10 – 110v, negative earth;
- J3 Jumbo Series: 10 – 30v, negative earth;

VOLTAGE SPECIFIC PRODUCTS

- 150BARE: 12v specific;
- 100BARE: 12v specific;
- 235A12, 235R12, 235W12, 235RHM12E: 12v specific;
- 380A12, 380R12, 380W12: 12v specific;
- ~~380A12, 380R12, 380W12~~ 24v specific;
- 235A24, 235R24, 235W24, 235RHM24E: 24v specific;
- 380A24, 380R24, 380W24: 24v specific;
- 101 & 151 Series: 12v specific;
- 81 Series 12 Volt Range: 12v specific;
- 99 Series: 12v specific;
- LP Series 12 Volt Range: 12v specific;

All products are Negative Ground

3. Circuit diagrams, block diagrams and PCB layouts:

- All attached;

4. Casing material and shape:

- ABS hardened acrylic;
- Photographs of lamps to be tested are attached in Appendix 2;

5. Type and length of wiring:

- 40cm hard wire directly from lamp:
 - White wire = negative earth;
 - Yellow wire = direction indicator/left side indicator;
 - Green wire = Right Indicator;
 - Brown wire = position tail lamp/right tail lamp;
 - Black wire = Left tail lamp;
 - Pink wire = Reverse lamp;



- Red wire = stop lamp;
- Red Blue wire marked Fog = fog;

6. *Identification/specification of electrical components:*

- As per attached circuit diagrams;

7. *Details of filters, screening etc. Fitted to improve EMC performance:*

- N/A;

8. *Clock frequencies:*

- N/A

9. *Where changes have been made to an already type approved product, full details of the changes:*

- New lamps to be added to the existing approved lamps, are as follows (shown in the series of the lamp and not each individual lamp under each series. As an example Stalk Lamp Series, includes 6 variants, being 1004LE, 1004RE, 1004RWM, 1005LE, 1005RE, & 1005RWM):
 - Stalk Lamp Series: 10 – 30v, negative earth;
 - 102 Series: 10 – 30v, negative earth;
 - 140 Series: 10 – 30v, negative earth;
 - EU195 Series: 10 – 30v, negative earth;
 - EU200 Series: 10 – 30v, negative earth;
 - EU140 Series: 10 – 30v, negative earth;
 - EU390 Series: 10 – 30v, negative earth;
 - EU95 Series: 10 – 30v, negative earth;
 - EU40 Series: 10 – 30v, negative earth;
 - Eurolamp7F Series: 10 – 30v, negative earth;
 - 129 series: 10 – 30v, negative earth;
 - 1490 & 1491 Series: 10 – 30v, negative earth;
 - 181 Series: 10 – 30v, negative earth;
 - 37 Series: 10 – 30v, negative earth;
 - 41 Series: 10 – 30v, negative earth;
 - 44 Series: 10 – 30v, negative earth;
 - 81 Series Multi Volt Range: 10 – 30v, negative earth;
 - 95 Series: 10 – 30v, negative earth;
 - LP Series Multi Volt Range: 10 – 30v, negative earth;
 - MB12 Series: 10 – 110v, negative earth;
 - J3 Jumbo Series: 10 – 30v, negative earth;

EMC Test Report

This report is the second in a series of three to cover the Development and Type Approval testing of Light Clusters on MIRA Project 1202591

Customer: LED Autolamps Europe Ltd
Unit 10a
Maybrook Business Park
Minworth
B76 1AL

Authority: Order No: Pro-Forma

VCA Job No: EAP 277521


EMC Type Approval of a 250ARWM Light Cluster to 72/245/EEC as amended



Prepared By:

Approved By:


Matt Elwell
EMC Engineering Technician


Carl Wayland
Technical Manager

Date: 3 JULY 2013

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VAT Registration GB 100 1464 84



Summary

Tests have been carried out on a 250ARWM Light Cluster in accordance with Council Directive 72/245/EEC, as last amended by Commission Directive 2009/19/EC of 12 March 2009, titled “amending, for the purposes of their adaptation to technical progress, Council Directive 72/245/EEC of 20 June 1972 relating to the radio interference (electromagnetic compatibility) of vehicles and Council Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers”¹.

In addition, the Technical Service to the VCA reviewed the testing in order to extend the coverage of the 250ARWM Light Cluster against the requirements of ECE Regulation 10 (Revision 3, 14 August 2008).

The 250ARWM Light Cluster met the Type Approval requirements of European Council Directive 72/245/EEC as amended in the following aspects:

- Annex 1, Section 6.5 concerning broadband electromagnetic interference generated by an Electronic Sub Assembly (ESA), when tested using the method described in Annex VII.
- Annex 1, Section 6.6 concerning narrowband electromagnetic interference generated by an ESA, when tested using the method described in Annex VIII.
- Annex 1, Section 6.7 concerning immunity to electromagnetic radiation of an ESA, when tested using the methods described in Annex IX.
- Annex 1, Section 6.8 concerning transient immunity (along supply lines) requirements of an ESA, when tested using the methods as described in Annex X, Paragraphs 1 and 2 respectively.

The 250ARWM Light Cluster submitted for test also met the requirements of ECE Regulation 10 (Revision 3, 14 August 2008) Paragraphs 6.5, 6.6, 6.7 and 6.8 when tested using the methods specified in Annexes VII, VIII, IX and X respectively.

The test results contained within relate only to the samples identified in this report.

¹ Amendments to Council Directive 72/245/EEC include:
Commission Directives 95/54/EC, 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2006/96/EC & 2009/19/EC

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1 Introduction

Tests have been carried out on a 250ARWM Light Cluster in accordance with Council Directive 72/245/EEC, as last amended by Commission Directive 2009/19/EC of 12 March 2009, titled “amending, for the purposes of their adaptation to technical progress, Council Directive 72/245/EEC of 20 June 1972 relating to the radio interference (electromagnetic compatibility) of vehicles and Council Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers”¹.

In addition, the Technical Service to the VCA reviewed the testing in order to extend the coverage of the 250ARWM Light Cluster against the requirements of ECE Regulation 10 (Revision 3, 14 August 2008).

The following MIRA test procedures were used:

EE/2012/T, Issue 2, Radiated Emissions from Components / Modules ref. CISPR 25: 2002.
 EE/2019/T, Issue 7, Radiated Immunity Testing - ALSE ref: ISO 11452-2: 2004.
 EE/2021/T, Issue 7, Radiated Immunity Testing – BCI ref: ISO 11452-4:2005.
 EE/2103/T, Issue 1, Transient Immunity Testing ref. ISO 7637-2 (2004).

The 250ARWM Light Cluster was received at MIRA on 11 June 2013 and tests were performed between 14 and 18 June 2013. At the time of writing this report the 250ARWM Light Cluster had not been returned to the customer.

No customer was present to witness the testing on behalf of LED Autolamps Europe Ltd.

2 Equipment Under Test (EUT) Details

The details of the unit supplied for testing by LED Autolamps Europe Ltd are as follows:

Table 2.1 – EUT Details

Item	Description
Manufacturer:	LED Autolamps Europe Ltd
Model Name:	250ARWM Light Cluster
MIRA Identification Number:	E213-0601
Power Supply:	Dual 12 V / 24 V
Harness Identification:	‘Standard as supplied’

¹ Amendments to Council Directive 72/245/EEC include:
 Commission Directives 95/54/EC, 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2006/96/EC & 2009/19/EC

3 Test Equipment

The Quality Assurance scheme at MIRA has been established to ensure that all equipment has a clearly identified calibration classification, calibration expiry date, and that all calibrations are traceable to national standards. All equipment within the scheme is given a Quality Assurance number of the form Qnnnnnn A DD/MM/YYYY where:

nnnnnn is a unique number assigned to the instrument

A is the calibration category of the instrument e.g. A, A1 etc

DD/MM/YYYY is the date on which the calibration expires

The instruments used to perform the measurements described in this report are listed in Appendix A.



4 Radiated Emissions

The radiated emissions tests were carried out on 14 June 2013 in the Radio Frequency Interference (RFI) Laboratory at MIRA using the off-board (30 – 1000 MHz) measurement method to assess the broadband and narrowband emissions from the EUT.

4.1 Test Method

The tests were performed on the EUT over the frequency range 30 to 1000 MHz. This involved measuring both the broadband and narrowband radiated emissions from the EUT using an antenna and a receiver system. Photographs showing the test configuration for the EUT are shown in Appendix B.

The test arrangement and method were as per Annex VII and VIII of 72/245/EEC as amended, with reference to CISPR 25, 2nd edition, 2002. Tests were conducted using both the vertical and horizontal polarisations of the antenna.

The field strength in dB μ V/m was measured with a receiver using a peak detector for broadband emissions and an average detector for narrowband emissions.

4.2 Test Conditions

The EUT identified as E213-0601 was tested in a mode identified as 'Active' and involved the following connections and test conditions.

Stop Lamp – Powered at 24 V (Red Wire)

Indicator Lamp – Powered at 24 V, with a flash rate of 60 pulses per minute (Yellow Wire)

Tail Lamp (position) – Powered at 24 V (Brown Wire)

Ground Connection (White Wire)

Reverse Lamp – Un-powered, open circuit connection (Pink Wire)

A 24 V supply was fed to the EUT via two DC Line Impedance Stabilisation Network (LISN) units.

4.3 Test Limits

The Type Approval radiated emission limits specified in 72/245/EEC as amended, Annex 1, Sections 6.5.2 and 6.6.2 were applied for the broadband and narrowband emissions respectively.

4.4 Test Results

The results of the broadband (peak) measurements are shown in Appendix C, Figures C1 to C10. Figures C9 to C10 show the ambient emissions, while Figures C1 to C8 show the emissions from the EUT. There were no broadband emissions identified within 6 dB of the Type Approval limit line.

The results of narrowband (average) measurements are shown in Appendix C, Figures C1 to C10. Figures C1 to C4 show the ambient emissions, while Figures C1 to C8 show the emissions from the EUT. There were no narrowband emissions identified within 6 dB of the Type Approval limit line.

The measured emissions from the 250ARWM Light Cluster were shown to be below the broadband and narrowband Type Approval limits specified in Annex 1 Sections 6.5.2 and 6.6.2 respectively.

5 Bulk Current Injection

The testing was carried out on 14 June 2013 in the Radio Frequency Interference (RFI) Laboratory at MIRA using the bulk current injection (20 - 400 MHz) measurement method to assess the immunity to electromagnetic radiation of the EUT.

5.1 Test Method

Tests were carried out over the frequency range 20 to 400 MHz. This is a method of carrying out immunity tests by inducing current directly into a wiring harness using a current injection probe. The injection probe consisted of a coupling clamp through which the cables of the EUT are passed. Immunity tests were carried out by incrementing the frequency of the induced signals at a defined severity level.

The test arrangement and method were as per Annex IX of 72/245/EEC as amended, with reference to ISO 11452-1: 2005 and ISO 11452-4: 2005.

Tests were carried out over the frequency range 20 to 400 MHz at 90 mA, where 60 mA is the minimum required level for Type Approval. The bulk current injection testing was carried out in a fully-anechoic chamber, where all of the surfaces except the floor are lined with RF absorbing material. Photographs showing the test configuration for the EUT are shown in Appendix B

5.2 Test Conditions

The EUT identified as E213-0601 was tested in a mode identified as 'Active' and involved the following connections and test conditions.

Stop Lamp – Powered at 12 V (Red Wire)

Indicator Lamp – Powered at 12 V, with a flash rate of 60 pulses per minute (Yellow Wire)

Tail Lamp (position) – Powered at 12 V (Brown Wire)

Ground Connection (White Wire)

Reverse Lamp – Un-powered, open circuit connection (Pink Wire)

A 12 V supply was fed to the EUT via two DC Line Impedance Stabilisation Network (LISN) units.

5.3 Test Criteria

The criteria applied for recording an operating malfunction of the EUT was to monitor for any deviation from the normal 'Active' mode and the specified flasher rate.

5.4 Test Results

No events were observed over the frequency range 20 to 400 MHz while the EUT was operating in 'Active' mode. The 250ARWM Light Cluster was immune to electromagnetic disturbance of 90 mA over the frequency range 20 to 400 MHz.

The graphical results of the bulk current injection test are presented in Appendix D, Figure D1

6 Radiated Immunity (Free Field)

The testing was carried out on 14 June 2013 in the Radio Frequency Interference (RFI) Laboratory at MIRA using the free field radiated immunity (400 - 2000 MHz) measurement method to assess the immunity to electromagnetic radiation of the EUT.

6.1 Test Method

The EUT was irradiated with electromagnetic fields generated using an antenna and amplifier system. Immunity tests were carried out by incrementing the frequency of the induced signals at a defined severity level.

The test method and test arrangement was as per Annex IX of 72/245/EEC as amended, with reference to ISO 11452-1: 2005 and ISO 11452-2: 2004.

Tests were carried out using a vertically polarized antenna over the frequency range 400 to 2000 MHz at 50 V/m, where 30 V/m is the minimum required level for Type Approval. The radiated immunity testing was carried out in a fully-anechoic chamber, where all of the surfaces except the floor are lined with RF absorbing material. Photographs showing the test configuration for the EUT are shown in Appendix B

6.2 Test Conditions

The EUT identified as E213-0601 was tested in a mode identified as 'Active' and involved the following connections and test conditions.

Stop Lamp – Powered at 12 V (Red Wire)

Indicator Lamp – Powered at 12 V, with a flash rate of 60 pulses per minute (Yellow Wire)

Tail Lamp (position) – Powered at 12 V (Brown Wire)

Ground Connection (White Wire)

Reverse Lamp – Un-powered, open circuit connection (Pink Wire)

A 12 V supply was fed to the EUT via two DC Line Impedance Stabilisation Network (LISN) units.

6.3 Test Criteria

The criteria applied for recording an operating malfunction of the EUT was to monitor for any deviation from the normal 'Active' mode and the specified flasher rate.

6.4 Test Results

There were no events observed over the frequency range 400 to 2000 MHz while the EUT was operating in 'Active' mode. The 250ARWM Light Cluster was immune to electromagnetic disturbance of 50 V/m over the frequency range 400 to 2000 MHz.

The graphical results of the radiated immunity test for the EUT are presented in Appendix D, Figures D2 to D4.

7 Conducted Transient Immunity

The testing was carried out on 17 June 2013 in the Electrical Transient Area (ETA) at MIRA using the conducted transient immunity test method to assess the immunity of the EUT to transients on the power supply.

7.1 Test Method

Transient immunity tests were performed in accordance with Annex X of 72/245/EEC as amended, with reference to ISO 7637-2: 2004. The transient parameters used are summarised in Tables 7.1.1, 7.1.2 and 7.1.3. Photographs showing the test configuration for the EUT are shown in Appendix B.

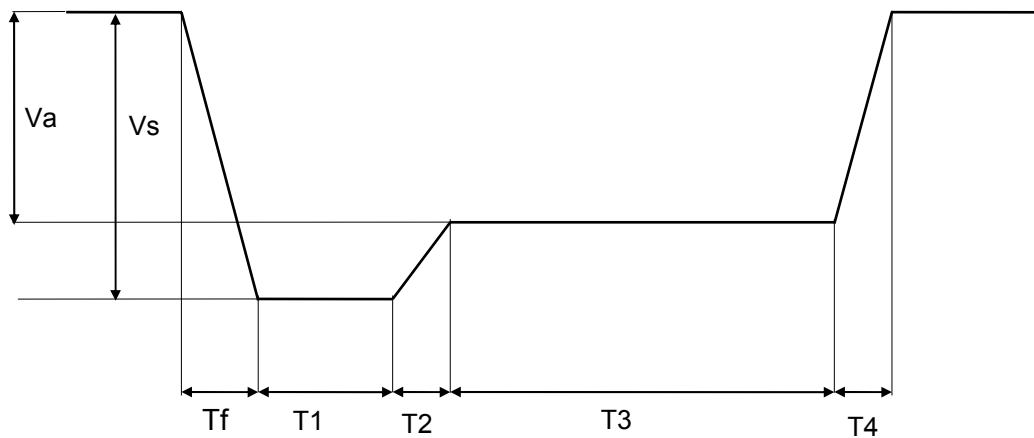
Table 7.1.1 – 12 V Transient Immunity Parameters

System	Pulse	Amplitude (V)	Duration (Td)	Impedance (Ω)	Rise Time (Tr)	Repetition Rate (Seconds)	No. of Pulses/ Test Duration (Pulses)
12 V	1	-75	2 ms	10	1 μ s	2 s	1250
	2a	+37	0.05 ms	2	1 μ s	2 s	1250
	2b	+10	0.2 s	0 to 0.05	1 ms	0.5 s	10
	3a	-112	0.1 μ s	50	5 ns	100 μ s	15 mins, 0.1 s Burst
	3b	+75	0.1 μ s	50	5 ns	100 μ s	
	4	(See Cranking Waveform)		0.01	(See Cranking Waveform)		1

Table 7.1.2 – 24 V Transient Immunity Parameters

System	Pulse	Amplitude (V)	Duration (Td)	Impedance (Ω)	Rise Time (Tr)	Repetition Rate (Seconds)	No. of Pulses/ Test Duration (Pulses)
24 V	1	-450	1 ms	50	3 μ s	2 s	1250
	2a	+37	0.05 ms	2	1 μ s	2 s	1250
	2b	+20	0.2 s	0 to 0.05	1 ms	0.5 s	10
	3a	-150	0.1 μ s	50	5 ns	100 μ s	15 mins, 0.1 s Burst
	3b	+150	0.1 μ s	50	5 ns	100 μ s	
	4	(See Cranking Waveform)		0.01	(See Cranking Waveform)		1

(1) Cranking Waveform – see following diagram for details:



Pulse 4 (Cranking Waveform)

Table 7.1.3 – Pulse 4 Parameters

Pulse	System	Voltage (Vs)	Voltage (Va)	Fall Time (Tf)	T1	T2	T3	T4
4	12 V	-6 V	-2.5 V	5 ms	15 ms	50 ms	10 s	5 ms
4	24 V	-12	-5	10 ms	50ms	50 ms	10s	10 ms

7.2 Test Conditions

The EUT identified as E213-0601 was tested in a mode identified as 'Active' and involved the following connections and test conditions.

Stop Lamp – Powered at 12 V or 24 V (Red Wire)

Indicator Lamp – Powered at 12 V or 24 V, steady state (Yellow Wire)

Tail Lamp (position) – Powered at 12 V or 24 V (Brown Wire)

Ground Connection (White Wire)

Reverse Lamp – Un-powered, open circuit connection (Pink Wire)

The flasher rate operation with a flash rate of 60 pulses per minute was verified before and after each pulse type at each voltage.

7.3 Test Criteria

The criteria applied for recording an operating malfunction of the EUT was to monitor for any deviation from the normal 'Active' mode.

7.4 Test Results

The results for the transient tests are summarised in Table 7.4.1 and 7.4.2.

Table 7.4.1 – 12 V Transient Immunity Test Results

EUT	Line	Mode	Pulse	Results
E213-0601	Stop Lamp, Indicator Lamp and Tail Lamp. Combined.	Active	1	Pass With the application of each pulse all lamps switched off and then self-recovered in between the applied pulses and at the end of the test.
			2a	Pass No deviations were observed during the test.
			2b	Pass With the application of each pulse all lamps switched off and then self-recovered in between the applied pulses and at the end of the test.
			3a	Pass No deviations were observed during the test.
			3b	
			4	Pass When the pulse was applied, the lamps flickered once and then self-recovered.

Table 7.4.2 – 24 V Transient Immunity Test Results

EUT	Line	Mode	Pulse	Results
E213-0601	Stop Lamp, Indicator Lamp and Tail Lamp. Combined	Active	1	Pass With the application of each pulse all lamps switched off and then self-recovered in between the applied pulses and at the end of the test.
			2a	Pass No deviations were observed during the test.
			2b	Pass With the application of each pulse all lamps switched off and then self-recovered in between the applied pulses and at the end of the test.
			3a	Pass No deviations were observed during the test.
			3b	
			4	Pass When the pulse was applied, the intensity of the lamps decreased and then self-recovered.

The 250ARWM Light Cluster submitted for test met the requirements of 72/245/EEC as amended, Annex 1, Section 6.8.1 and Table 1: Immunity of ESA.

8 Measurement Uncertainties

Measurement uncertainties for tests carried out in the MIRA Radio Frequency Interference (RFI) chamber and in the MIRA Electrical Transient Area (ETA) are given in the following MIRA reports:

- 458215/48, Issue 2, 25 August 2005, "Measurement Uncertainty For Component Radiated Immunity Tests in the RFI (ISO 11452-2: 2004)".
- 458215/51, Issue 1, 9 March 2005, "Measurement Uncertainty For Component Bulk Current Injection Tests in the RFI (ISO 11452-4: 2005)".
- 458215/54, Issue 3, 17 November 2005, "Measurement Uncertainty For Component Radiated Emissions Tests in the RFI (CISPR 25: 2002)".
- 458215/64, Issue 1, 1 March 2005, "Measurement Uncertainty For Electrical Transient Conduction Tests in the Transient Facility (ISO 7637-2: 2004)".

The measurement uncertainties for the tests contained in this report are:

- ± 2.5 dB for free-field radiated immunity tests over the frequency range 0.080 to 8.2 GHz.
- ± 2.9 dB for bulk current injection immunity tests over the frequency range 1 to 400 MHz.
- ± 6 dB for free-field radiated emissions tests over the frequency range > 30 to ≤ 70 MHz in the RFI.
- ± 5.5 dB for free-field radiated emissions tests over the frequency range > 70 to ≤ 200 MHz in the RFI.
- ± 4.5 dB for free-field radiated emissions tests over the frequency range > 200 to ≤ 1000 MHz in the RFI.
- It has been demonstrated that the Transient Generators used meet with the specified requirements as detailed in this report and within ISO 7637-2 (second edition: 2004) with at least a 95 % confidence level.

The reported uncertainties contained in this report are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 %.

9 Conclusions

The 250ARWM Light Cluster met the Type Approval requirements of European Council Directive 72/245/EEC as amended¹, in the following aspects:

- Annex 1, Section 6.5 concerning broadband electromagnetic interference generated by an Electronic Sub Assembly (ESA), when tested using the method described in Annex VII.
- Annex 1, Section 6.6 concerning narrowband electromagnetic interference generated by an ESA, when tested using the method described in Annex VIII.
- Annex 1, Section 6.7 concerning immunity to electromagnetic radiation of an ESA, when tested using the free field and bulk current injection methods as described in Annex IX, Paragraphs 4.1 and 4.3 respectively.
- Annex 1, Section 6.8 concerning transient immunity (along supply lines) requirements of an ESA, when tested using the methods as described in Annex X, Paragraphs 1 and 2 respectively.

The 250ARWM Light Cluster submitted for test also met the requirements of ECE Regulation 10 (Revision 3, 14 August 2008) Paragraphs 6.5, 6.6, 6.7 and 6.8 when tested using the methods specified in Annexes VII, VIII, IX and X respectively.

¹ Amendments to Council Directive 72/245/EEC include:
Commission Directives 95/54/EC, 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/E, 2006/96/EC & 2009/19/EC

Appendix A. Test Equipment



RFI Immunity Equipment List

Description	MIRA ID	Status	Cal Due Date
Analyser/Receivers			
Rohde & Schwarz ESU 26 EMI Test Receiver (20Hz-26.5GHz)	Q033326	A	21/09/2013
Signal Generators			
Rohde & Schwarz SML 03 Vector Signal Generator	Q028403	A	19/11/2013
Antennas			
TDK VLA-2001 V-Log Periodic Antenna	Q027355	L	N/A
Schaffner Chase CIP9136 Bulk Current Injection Probe (10kHz-400MHz)	Q032459	A	07/01/2014
AR ATH800M5GA HORN ANTENNA (0.8-5GHz)	Q033577	L	N/A
Couplers			
Amp. Research DC6280 Coupler	Q016358	A	06/06/2014
Amp. Research DC2500 Coupler	Q016359	A	06/06/2014
Amplifier Research DC7140 RF Coupler 1 to 4.2GHz	Q033148	A	16/05/2014
Amplifiers			
AR 2500L Amplifier 2500watt (10kHz-220MHz)	Q016194	L	N/A
AR 1010400-501 2000W Amplifier (A)	Q022211	L	N/A
AR 450S1G3M1 450W Amplifier 800MHz-3.1GHz	Q029470	L	N/A
Signal Paths			
Signal Path (Rack to Amp 1)	Q023201	A	07/06/2014
Signal Path (Rack to Amp 2)	Q023202	A	07/06/2014
Signal path (Rack to Amp 4)	Q030180	A	07/06/2014
Immunity Tx Paths			
Path 1 Coupler Q016359 OP-Relay OP	Q023204	A	06/06/2014
Path 2 Coupler Q016358 OP-Relay OP	Q023205	A	06/06/2014
Measurement Paths			
Pickering 10-780-524 4:1 Measurement relay paths (HF & BCI)	Q030181	A	07/06/2014
Pickering 20-740-511 8:1 Measurement relay paths (LF)	Q030182	A	07/06/2014
RF Cables			
MIRA N/RG239/2/N RF Cable	Q016996	A	26/02/2014
Reynolds SA90-0195-5500 RFI Immunity 5.5m Cable	Q033902	A	26/02/2014
Miscellaneous			
Cuming Microwave RH-5 Test foam spacer	Q026366	A3	06/05/2014
Stanley 33-158 5 m Steel Tape Measure	Q027328	A	29/09/2015
LISN			
Fischer Custom FCC-LISN-5-50-1-01-CISPR25 CISPR 25 50A LISN	Q033077	A	22/05/2014
Fischer Custom FCC-LISN-5-50-1-01-CISPR25 CISPR 25 50A LISN	Q033078	A	22/05/2014
Facility			
MIRA Ltd Radio Frequency Laboratory	Q026890	L	N/A
Software			
RFI EE19 22 Immunity test software ver 6.42	Q001494	L	N/A

RFI Emissions Equipment List

Description	MIRA ID	Status	Cal Due Date
Receivers			
Rohde & Schwarz ESU 26 EMI Test Receiver (20Hz-26.5GHz)	Q033326	A	21/09/2013
Antennas			
Rohde & Schwarz HK116 Biconical Antenna	Q020301	A	03/11/2013
Rohde & Schwarz HL223 Log Periodic Antenna	Q022614	A	23/11/2013
Measurement Paths			
Reynolds RFI Emissions Control Room Path (Q031491 + Q031492)	Q031496	A	26/02/2014
Reynolds RG239-0195-10MO RFI Emissions 10m Cable	Q033451	A	01/03/2014
Pre-amplifier			
Hewlett Packard HP8447F Pre Amp (100kHz-1300 MHz)	Q016376	A	16/08/2013
Miscellaneous			
MOTORISED ANTENNA MAST M100	Q005971	L	N/A
Cuming Microwave RH-5 Test foam spacer	Q026366	A3	06/05/2014
LISN			
Fischer Custom FCC-LISN-5-50-1-01-CISPR25 CISPR 25 50A LISN	Q033077	A	22/05/2014
Fischer Custom FCC-LISN-5-50-1-01-CISPR25 CISPR 25 50A LISN	Q033078	A	22/05/2014
Facility			
MIRA Ltd Radio Frequency Laboratory	Q026890	L	N/A
Software			
EE50 01 Emissions test software ver 1.28	Q001983	L	N/A

Transient Test Facility Equipment List

Description	MIRA ID	Status	Cal Due Date
Amplifiers			
Techron 7792 Power Supply Amplifier	Q029675	L	N/A
100A EMTEST Transient Generator			
EM Test UCS 200M Ultra Compact Simulator	Q027927	A	24/05/2014
Transient/Function Generators			
Tektronix AFG3102 Arbitrary Function Generator	Q032216	L	N/A
Miscellaneous			
Cuming Microwave RH-5 Test foam spacer	Q026366	A3	06/05/2014
RS 212-124 Temp & Humidity Indicator	Q034270	A1	22/05/2014
Oscilloscopes			
Tektronix DP07254C Digitising 2.5GHz 4 ch DSO	Q033701	A	06/02/2014
Facility			
MIRA Ltd Transient Test Facility	Q026888	L	N/A
Test Software			
EM Test ISO.Control Transient Software (version 5.1.7)	Q001996	L	N/A

- Classification A Item conforms to a MIRA QAM Performance Specification, which does not differ from the Manufacturer's Specification.
- Classification A1 Item conforms to a MIRA QAM Performance Specification, which differs from the Manufacturer's Specification.
- Classification A3 Item for which no acceptance criteria is appropriate i.e. where the Calibrating Department is providing a measuring service (e.g. weighing a head form).
- Classification L Item of which the existence should be recorded in order that appropriate records may be kept, but for which a calibration is unnecessary or not required. This may be if the item has no measurement function (amplifiers), the item is used as an indicator only (field monitor systems) or the item is used as part of a system where its output is verified by other, calibrated instruments (antennas).

Appendix B. Photographs

Plate	Description	Image No.
Plate 1	Radiated Emissions and Immunity General Setup	IMG_1399
Plate 2	Annex VII and VIII, Radiated Emissions, Biconic	IMG_1393
Plate 3	Annex VII and VIII, Radiated Emissions, Log Periodic	IMG_1400
Plate 4	Annex IX, Radiated Immunity, V-Log Antenna	IMG_1414
Plate 5	Annex IX, Radiated Immunity, Horn Antenna	IMG_1409
Plate 6	Annex IX, BCI Immunity	IMG_1423
Plate 7	Annex X, Transient Immunity	IMG_8612

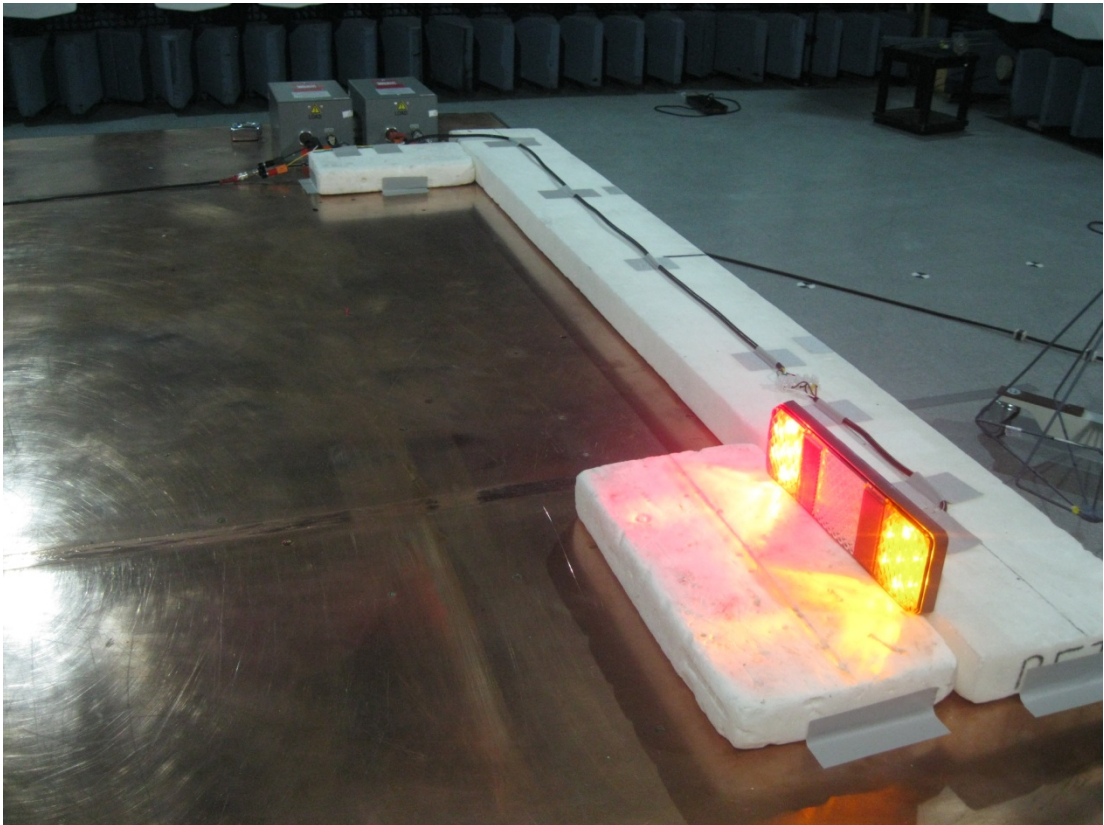


Plate 1 Radiated Emissions and Immunity General Setup

IMG_1399

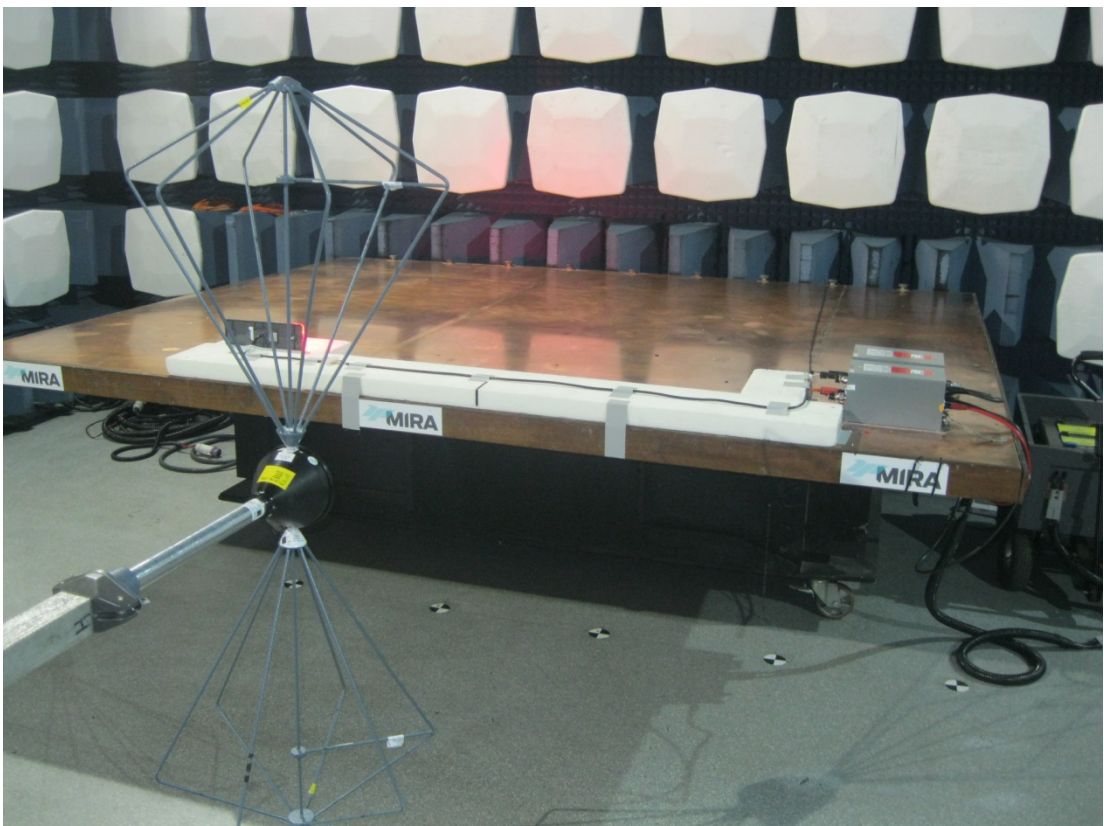


Plate 2 Annex VII and VIII, Radiated Emissions, Biconic

IMG_1393





Plate 3 Annex VII and VIII, Radiated Emissions, Log Periodic IMG_1400

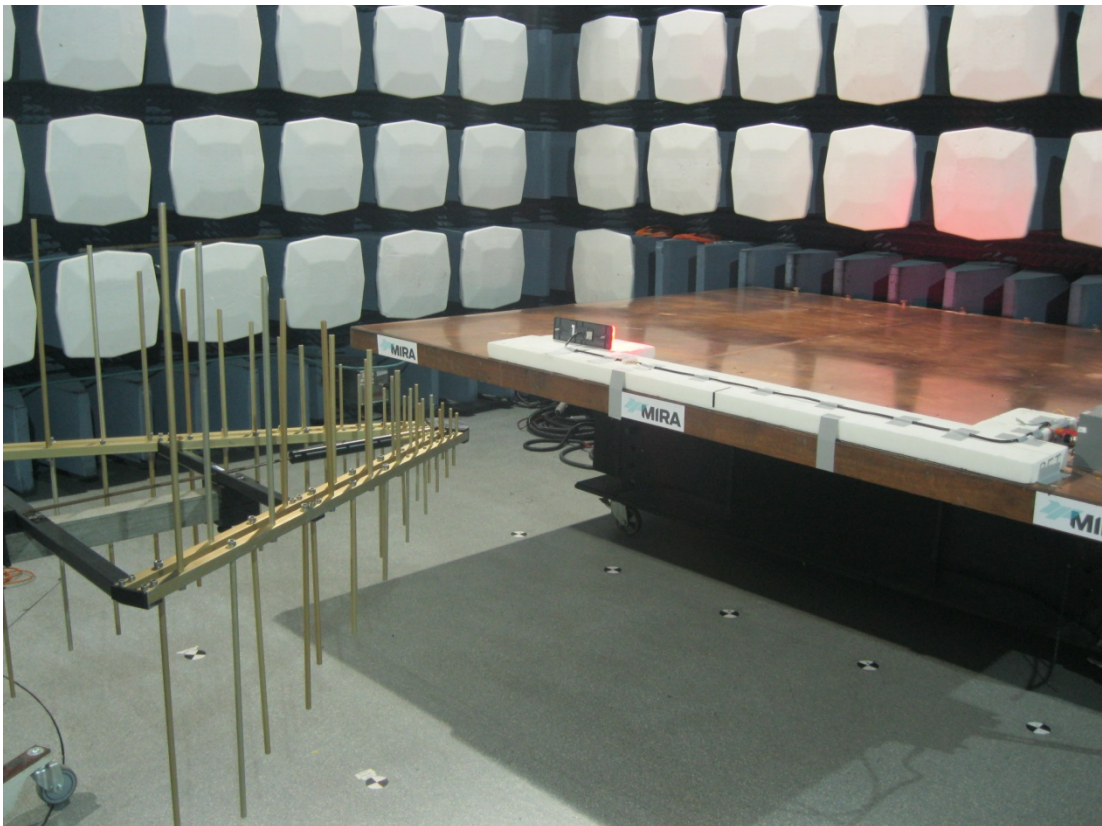


Plate 4 Annex IX, Radiated Immunity, V-Log Antenna IMG_1414





Plate 5 Annex IX, Radiated Immunity, Horn Antenna IMG_1409

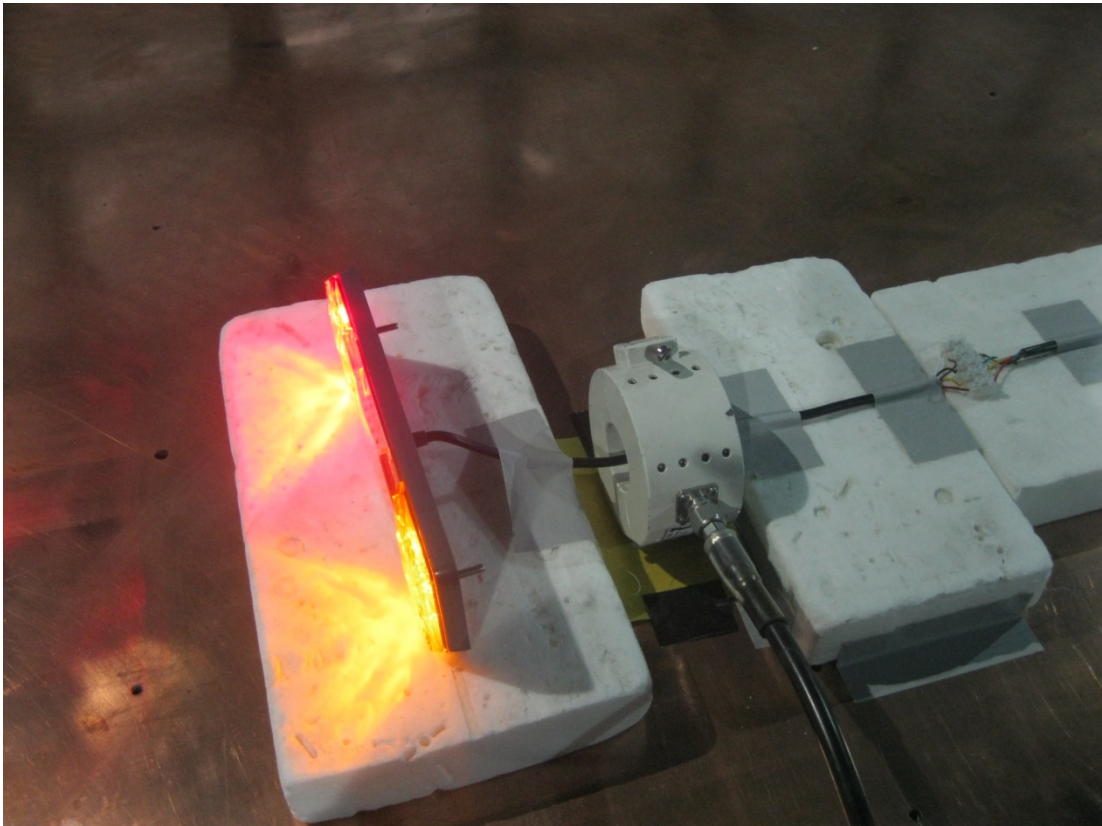


Plate 6 Annex IX, BCI Immunity IMG_1423



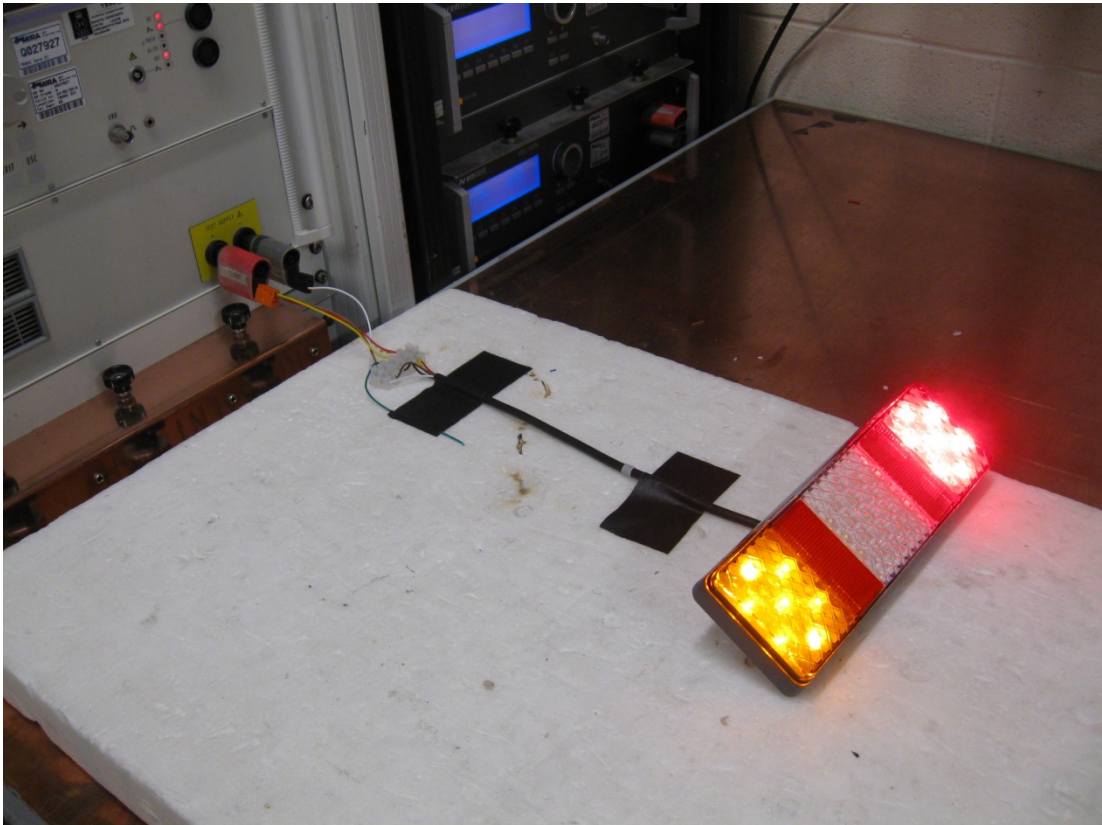


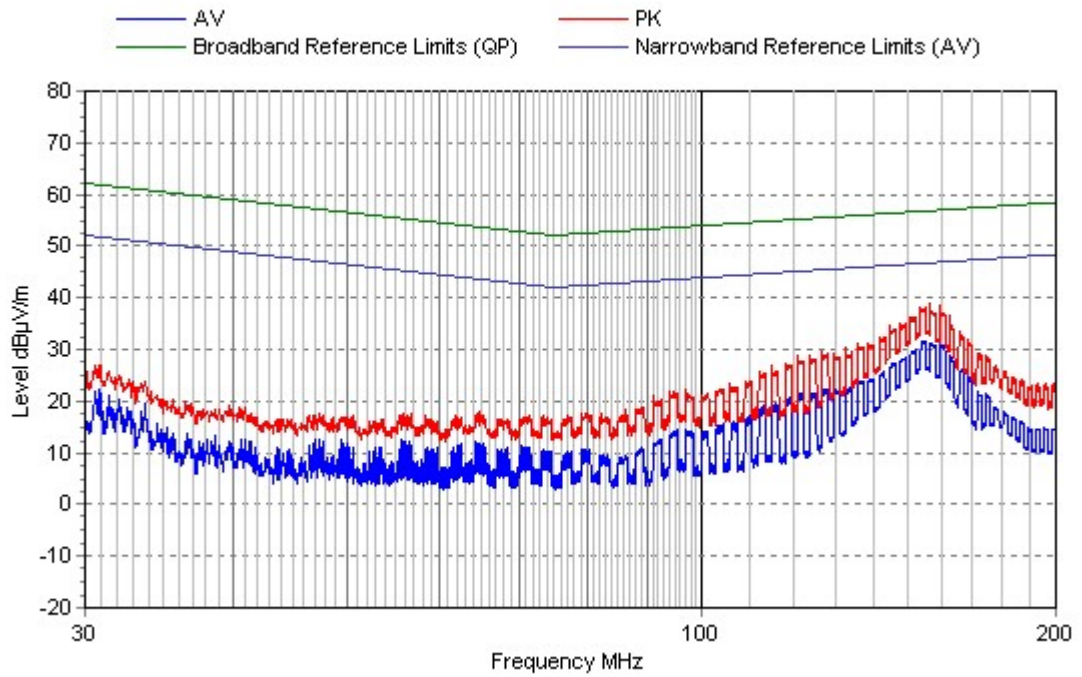
Plate 7 Annex X, Transient Immunity

IMG_8612



Appendix C. Radiated Emissions Results



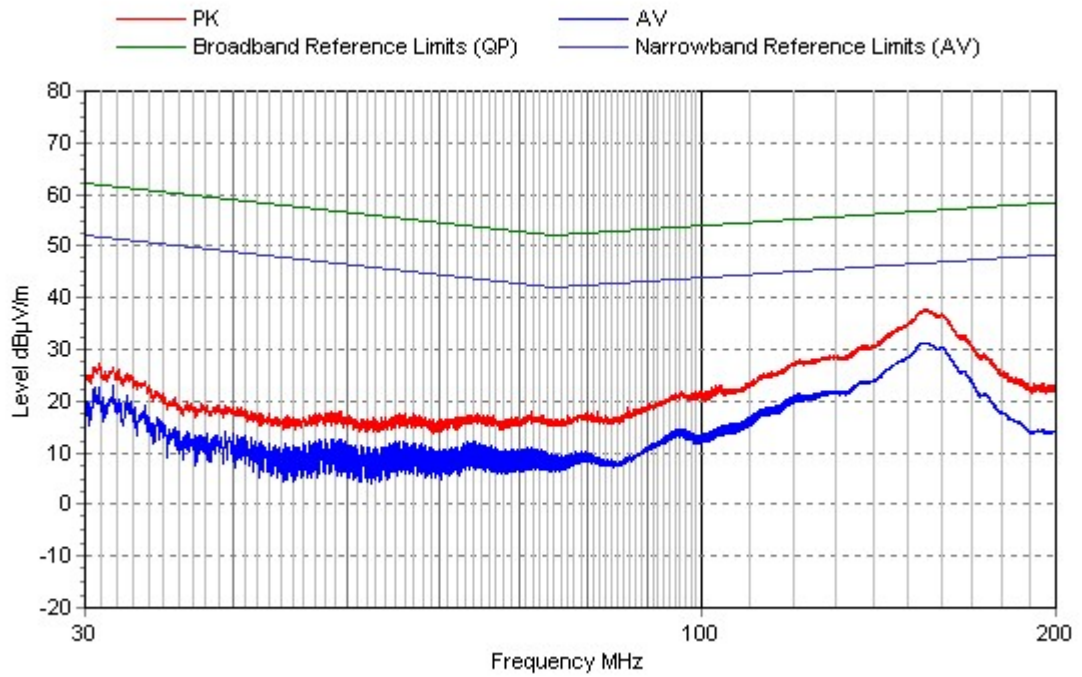


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
1	PK	30.54	27.1	61.8	-34.7	Pass
1	AV	30.84	22.4	51.7	-29.3	Pass
2	AV	154.14	31.4	46.7	-15.3	Pass
2	PK	156.54	38.9	56.8	-17.9	Pass

Figure C1 E213-0601, Biconic, Vertical, Harness, 24 V, IFBW 120 kHz, Step Size 60 kHz, Meas Time 20 ms



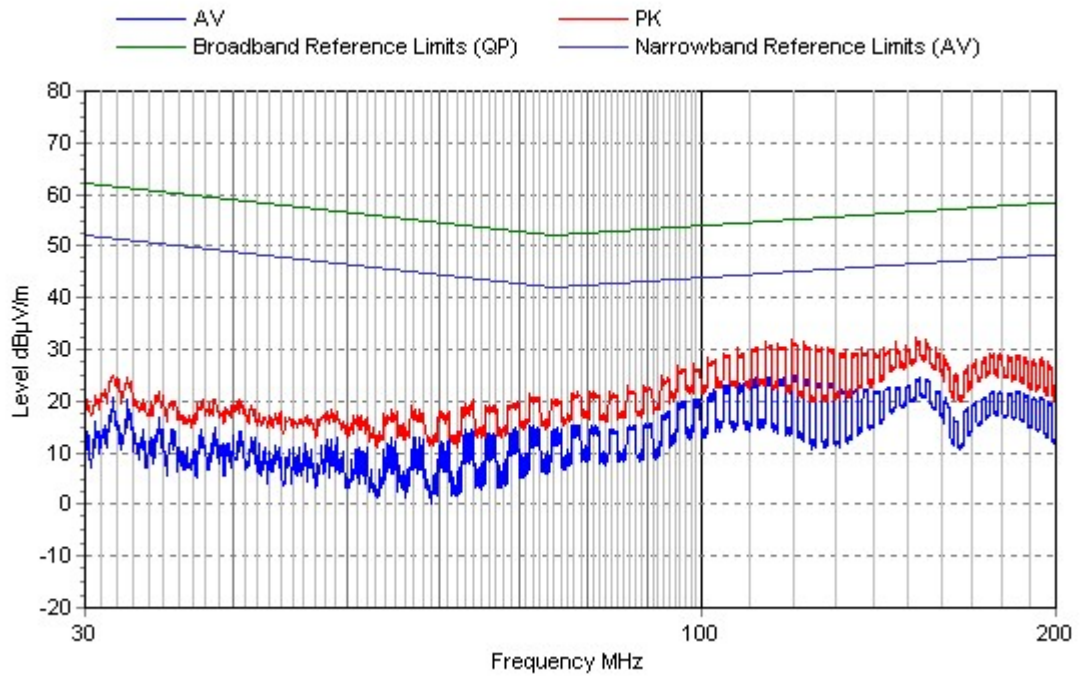


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
1	PK	30.84	27.2	61.7	-34.5	Pass
1	AV	31.71	22.9	51.4	-28.5	Pass
2	AV	154.62	31.3	46.8	-15.4	Pass
2	PK	155.16	37.7	56.8	-19.1	Pass

Figure C2 E213-0601, Biconic, Vertical, Harness, 24 V, FFT Maximisation Scan, IFBW 120 kHz, Step Size 30 kHz, Meas Time 20 ms



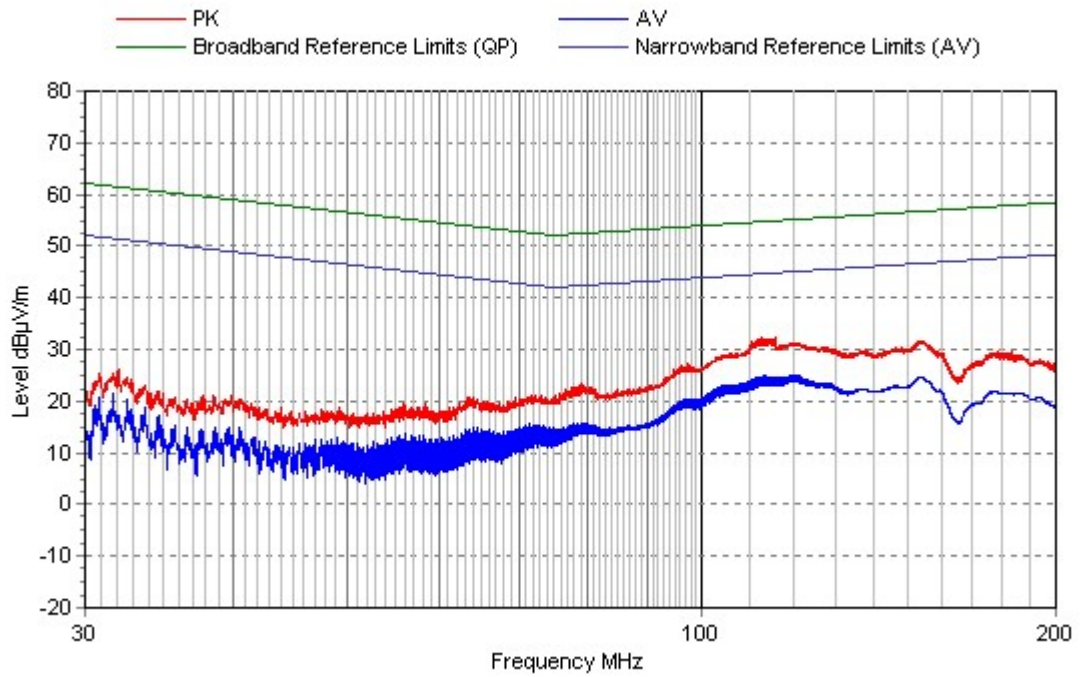


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
1	PK	71.58	21.3	52.5	-31.2	Pass
1	AV	72.18	15.3	42.4	-27.1	Pass
2	PK	113.28	31.6	54.7	-23.1	Pass
2	AV	113.7	24.6	44.7	-20.1	Pass

Figure C3 E213-0601, Biconic, Horizontal, Harness, 24 V, IFBW 120 kHz, Step Size 60 kHz, Meas Time 20 ms



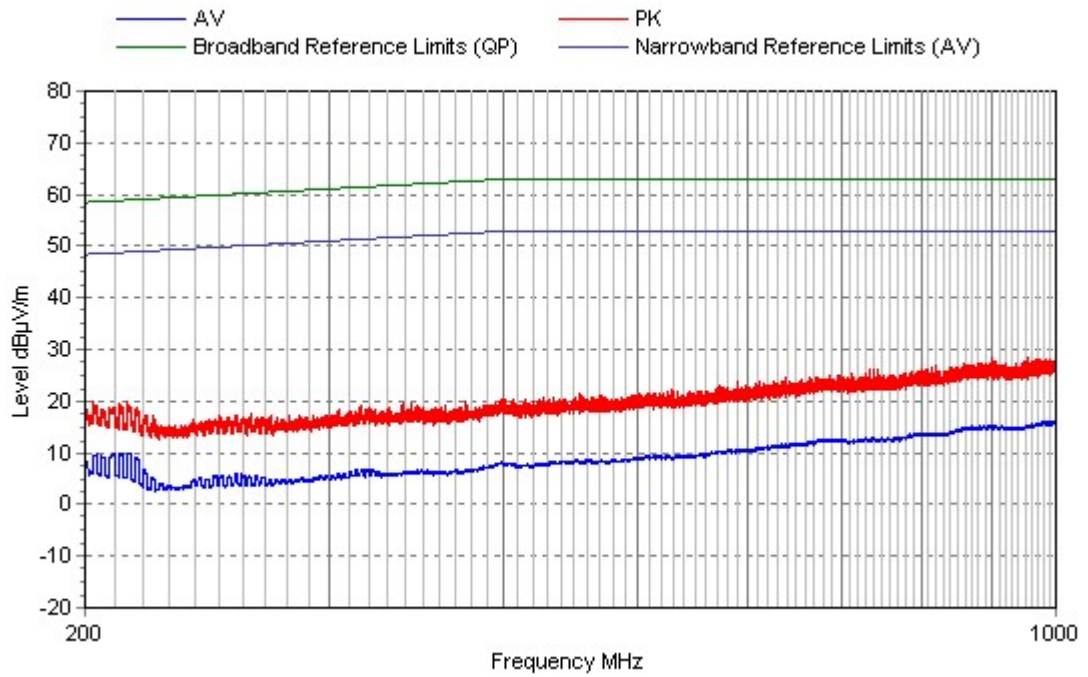


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
1	AV	73.02	15.4	42.3	-26.9	Pass
1	PK	73.05	21.0	52.3	-31.3	Pass
2	PK	112.35	32.3	54.7	-22.4	Pass
2	AV	112.8	24.8	44.7	-19.9	Pass

Figure C4 E213-0601, Biconic, Horizontal, Harness, 24 V, FFT Maximisation Scan, IFBW 120 kHz, Step Size 30 kHz, Meas Time 20 ms



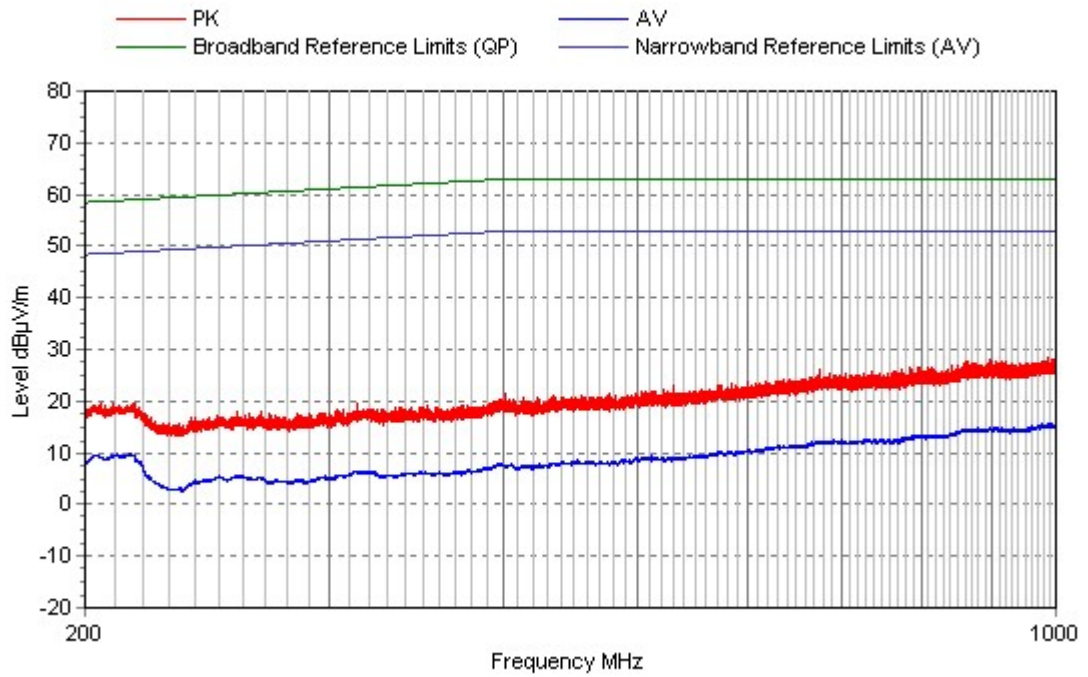


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
2	PK	202.64	19.8	58.5	-38.8	Pass
2	AV	203.84	9.7	48.6	-38.9	Pass
3	PK	898.76	28.5	63.0	-34.5	Pass
3	AV	989.12	16.0	53.0	-37.0	Pass

Figure C5 E213-0601, Log Periodic, Vertical, Harness, 24 V, IFBW 120 kHz, Step Size 60 kHz, Meas Time 20 ms



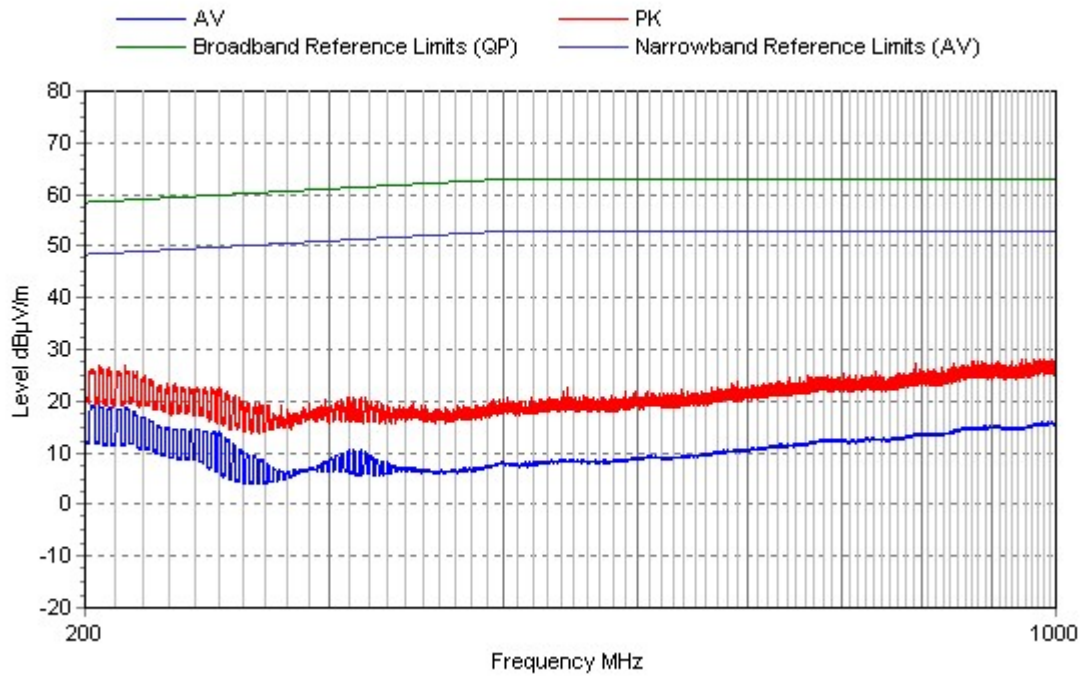


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
2	AV	203.06	9.5	48.5	-39.1	Pass
2	PK	209.21	19.6	58.7	-39.2	Pass
3	PK	986.78	28.6	63.0	-34.4	Pass
3	AV	994.85	15.6	53.0	-37.4	Pass

Figure C6 E213-0601, Log Periodic, Vertical, Harness, 24 V, FFT Maximisation Scan, IFBW 120 kHz, Step Size 30 kHz, Meas Time 20 ms



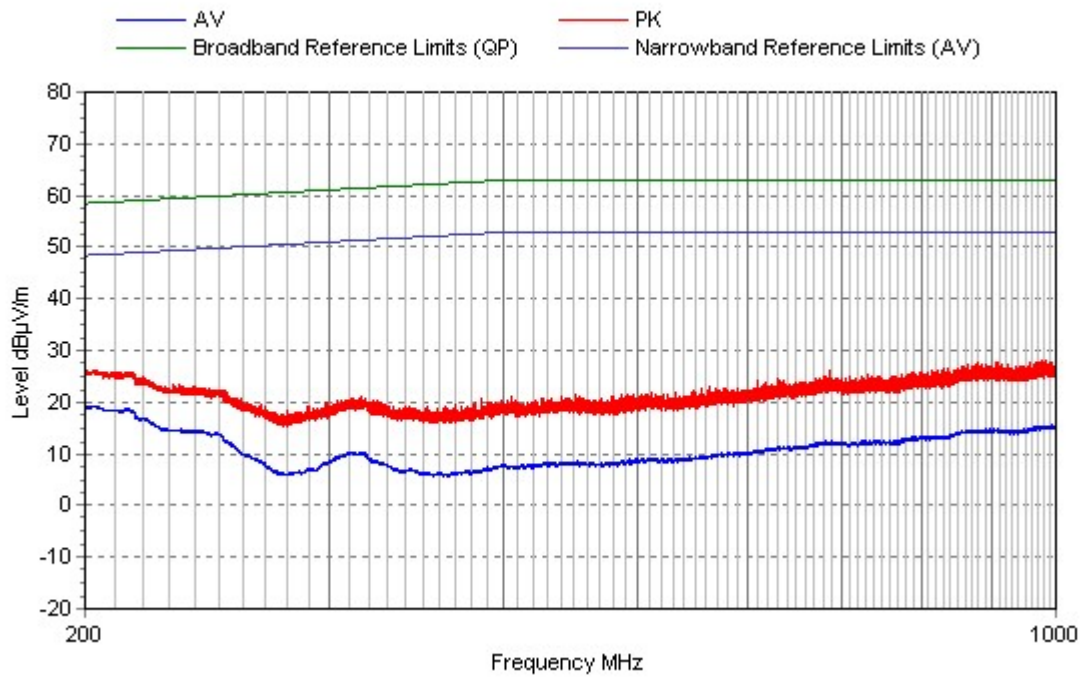


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
2	AV	200.06	19.3	48.4	-29.1	Pass
2	PK	204.62	26.7	58.6	-31.9	Pass
3	PK	979.04	28.2	63.0	-34.8	Pass
3	AV	999.44	15.9	53.0	-37.1	Pass

Figure C7 E213-0601, Log Periodic, Horizontal, Harness, 24 V, IFBW 120 kHz, Step Size 60 kHz, Meas Time 20 ms



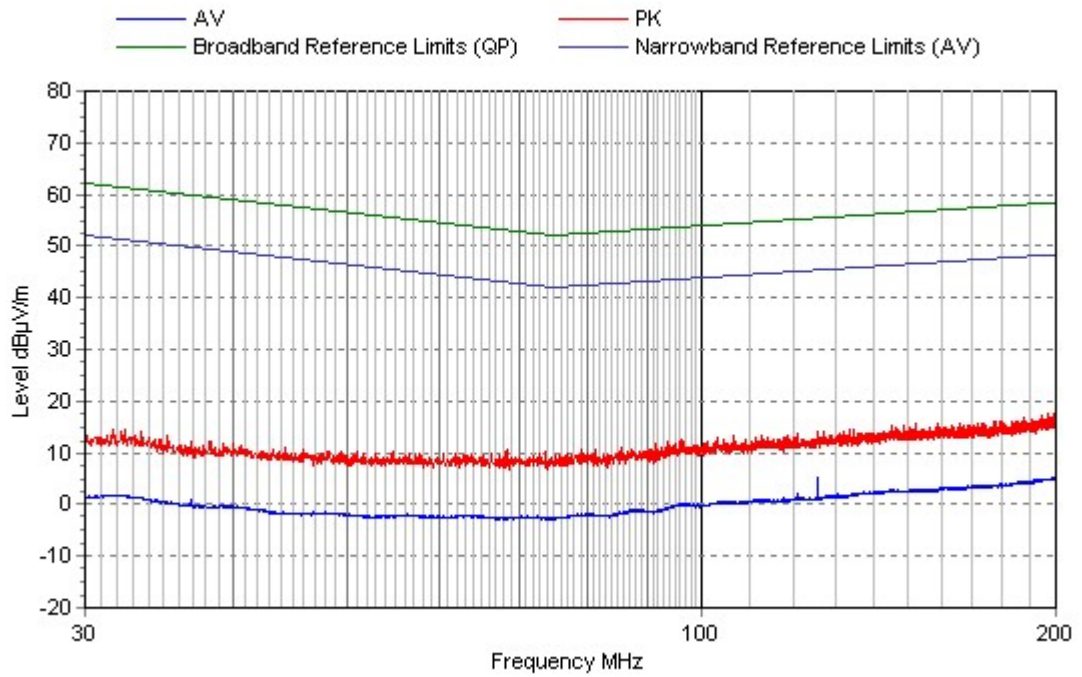


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
2	AV	200.24	19.1	48.5	-29.3	Pass
2	PK	203.3	26.3	58.6	-32.2	Pass
3	PK	976.94	27.9	63.0	-35.1	Pass
3	AV	994.4	15.6	53.0	-37.4	Pass

Figure C8 E213-0601, Log Periodic, Horizontal, Harness, 24 V, FFT Maximisation Scan, IFBW 120 kHz, Step Size 30 kHz, Meas Time 20 ms



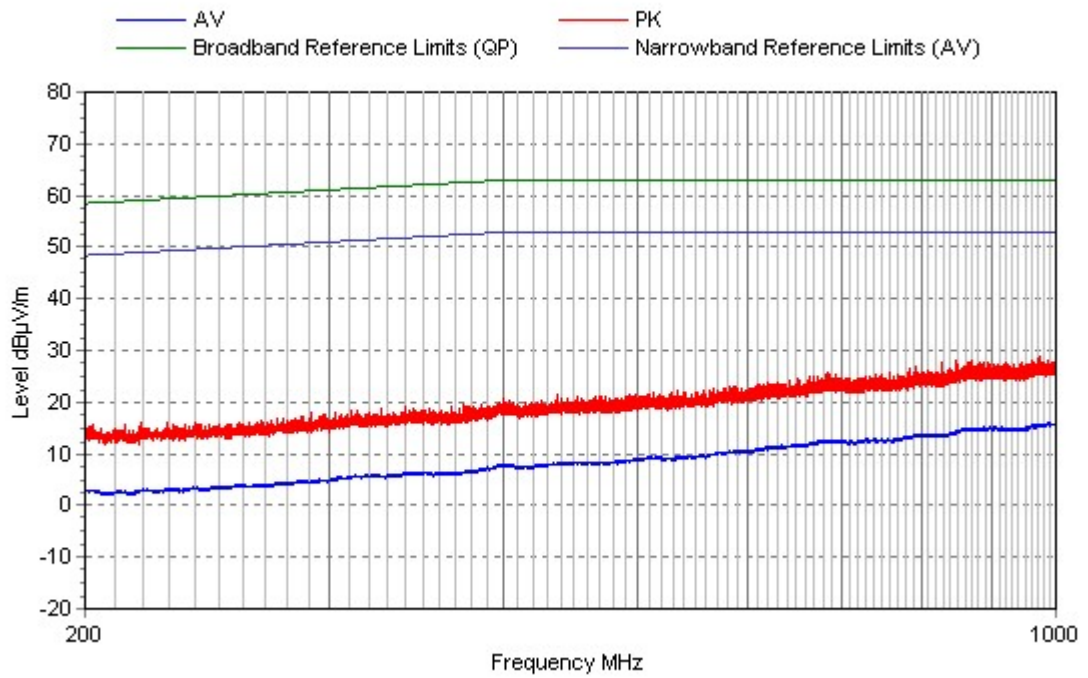


Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
1	AV	72.6	-2.2	42.4	-44.5	Pass
1	PK	73.74	10.2	52.2	-42.0	Pass
2	AV	125.52	5.3	45.4	-40.1	Pass
2	PK	196.56	17.4	58.3	-40.9	Pass

Figure C9 Biconic, Vertical, Harness, Ambient Mode, EUT not powered, 1 Hz signal into chamber, IFBW 120 kHz, Step Size 60 kHz, Meas Time 20 ms





Maximum Level in Band, all points checked

Band	Detector	Freq (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass / Fail
2	PK	339.8	19.2	61.9	-42.8	Pass
2	AV	397.82	8.0	53.0	-45.0	Pass
3	PK	975.38	28.8	63.0	-34.2	Pass
3	AV	989.36	16.0	53.0	-37.0	Pass

Figure C10 Log Periodic, Vertical, Harness, Ambient Mode, EUT not powered, 1 Hz signal into chamber, IFBW 120 kHz, Step Size 60 kHz, Meas Time 20 ms



Appendix D. Radiated Immunity Results



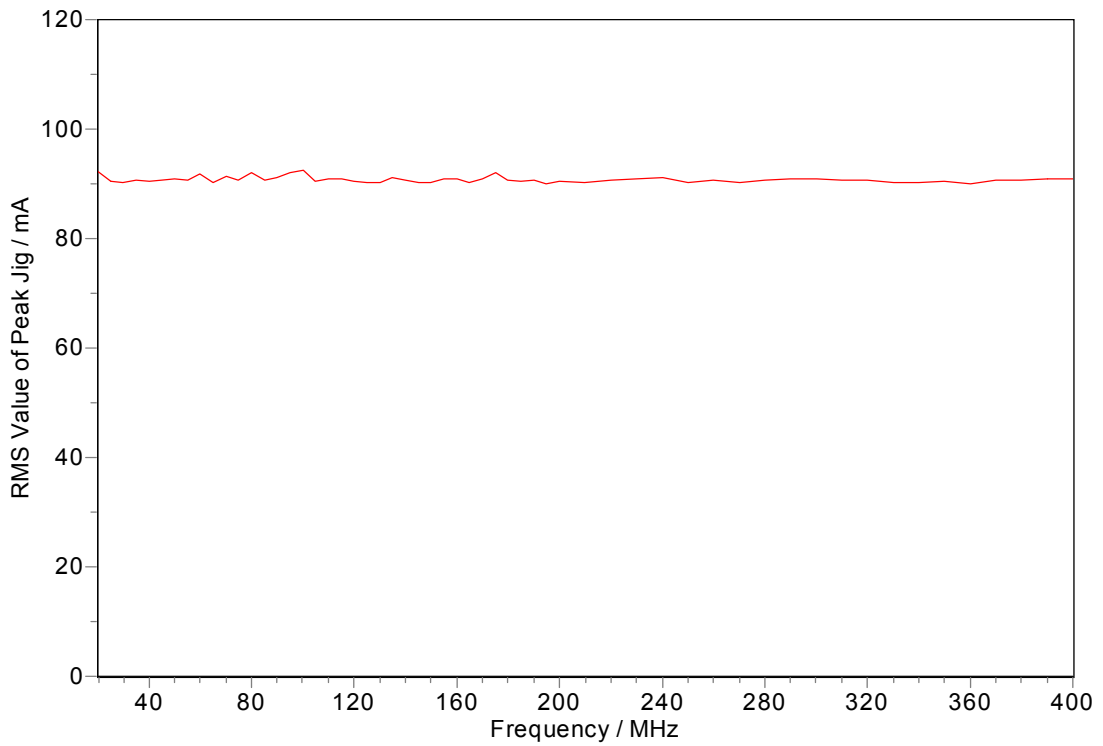


Figure D1 E213-0601, BCI, 150 mm Position, 20 - 400 MHz, 2 s Dwell, AM, 12 V Active Mode (Sweep 3)

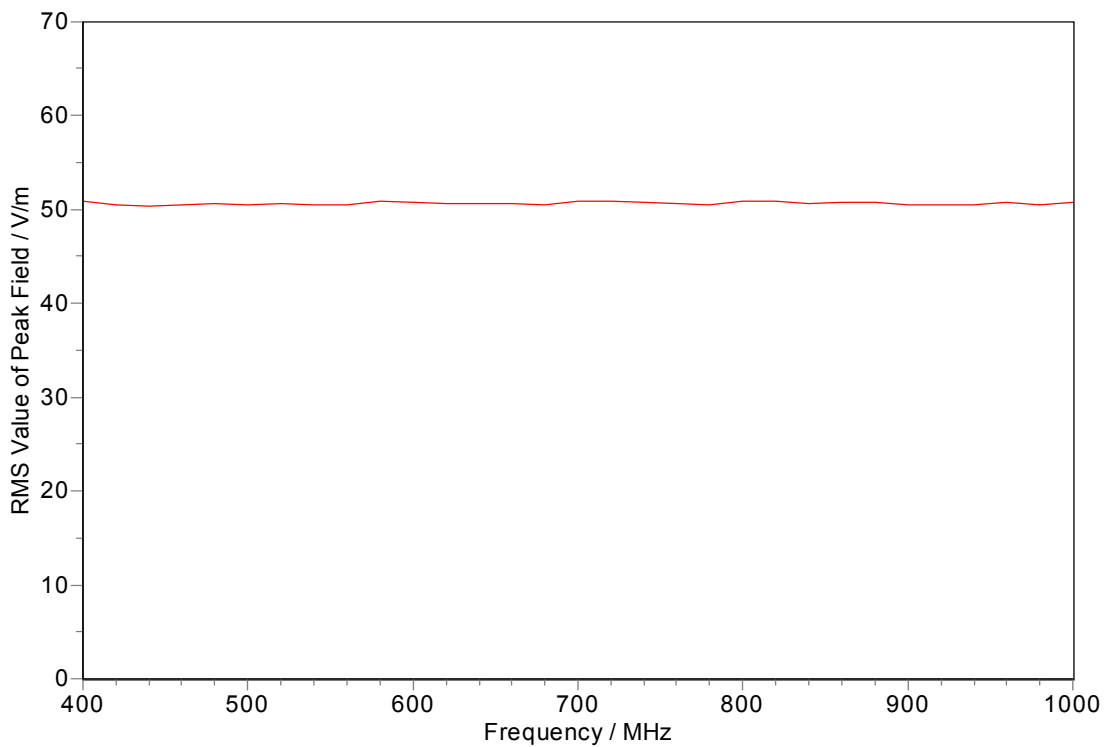


Figure D2 E213-0601, V-log, Vertical, 400 - 1000 MHz, 2 s Dwell, AM, 12 V Active Mode (Sweep 1)



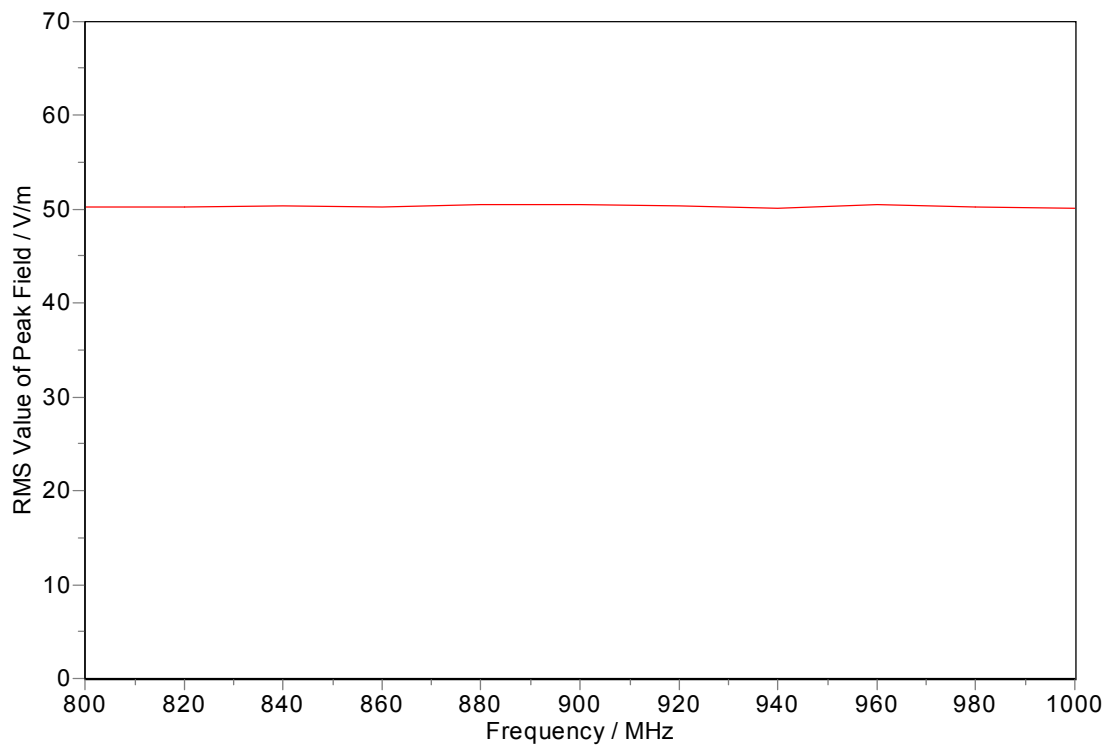


Figure D3 E213-0601, V-log, Vertical, 800 - 1000 MHz, 2 s Dwell, PM, 12V Active Mode (Sweep 2)

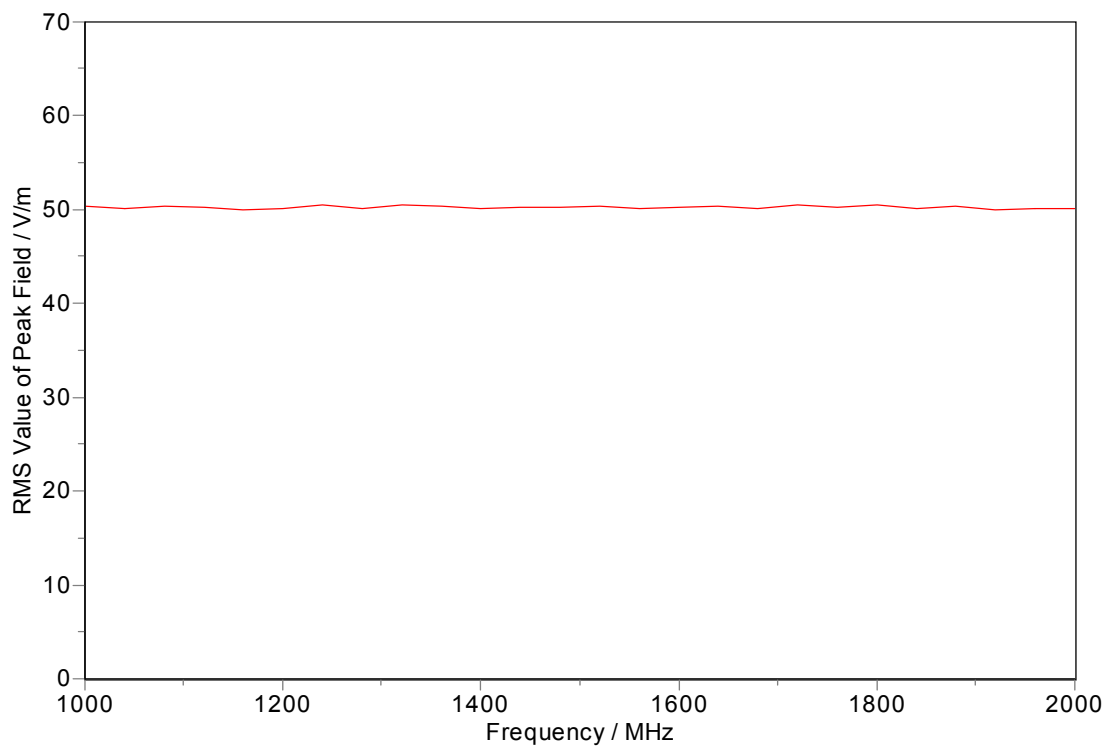
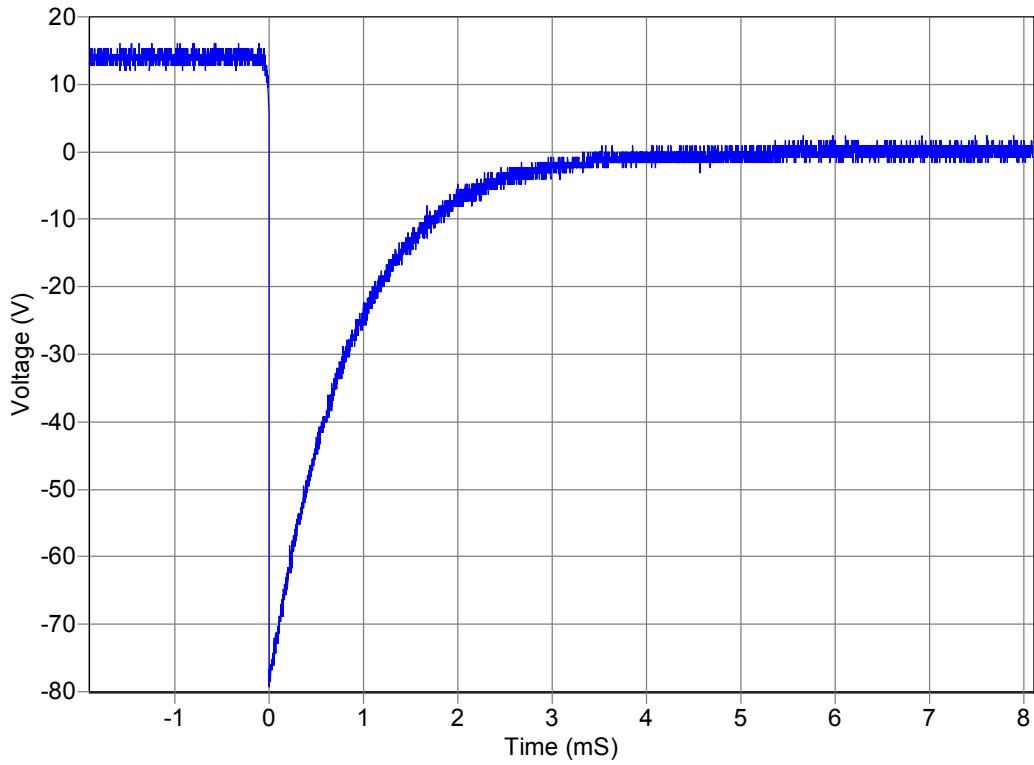


Figure D4 E213-0601, Horn, Vertical, 1000 - 2000 MHz, 2 s Dwell, PM, 12 V Active Mode (Sweep 4)



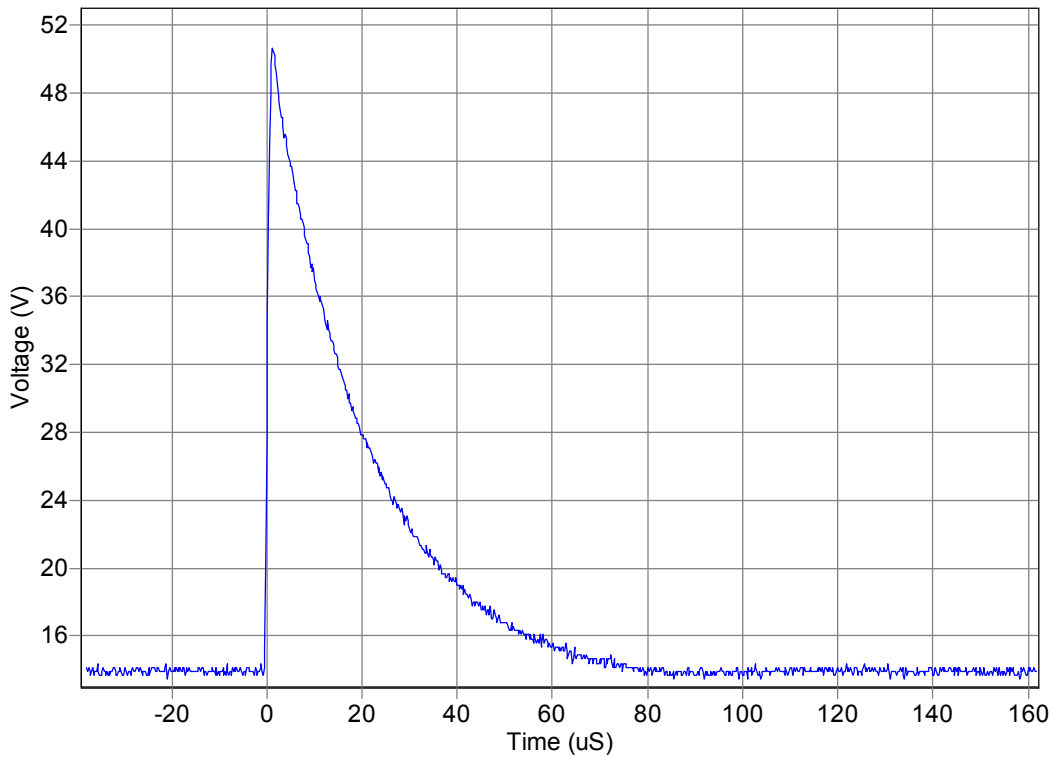
Appendix E. Verified Waveforms





Time=1.000ms/div, Volt=20.000V/div, Trig=-42800000000.000nV(FALL)

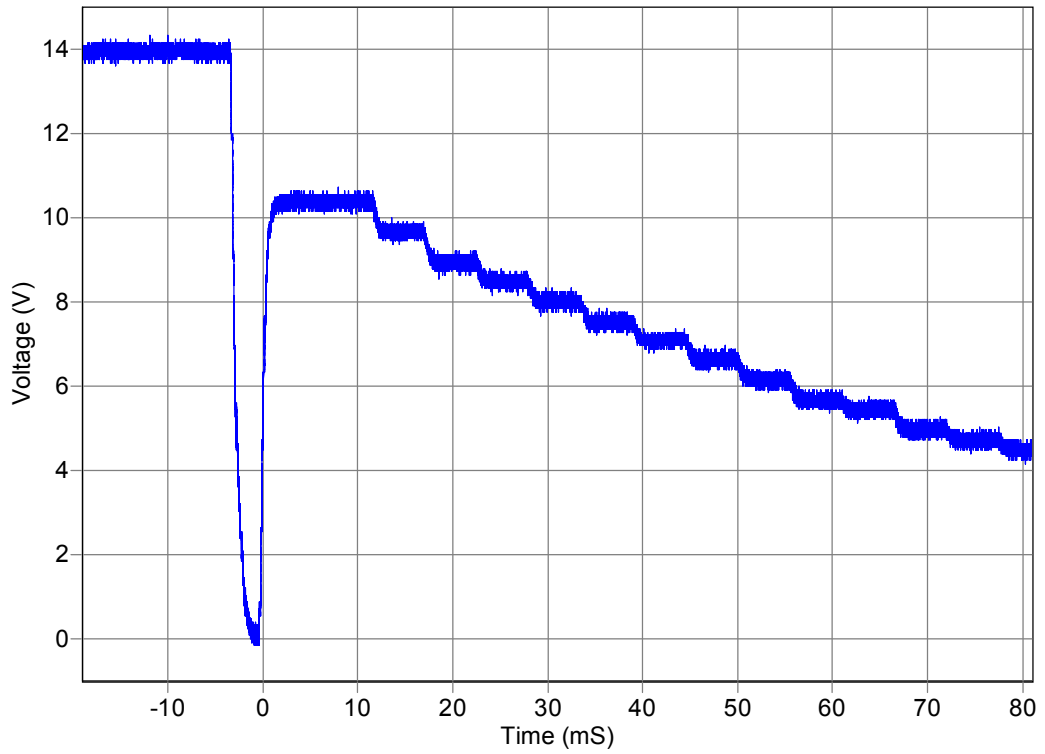
Figure E1 Pulse 1, 12 V



Time=20.000µs/div, Volt=6.000V/div, Trig=24.840V(RISE)

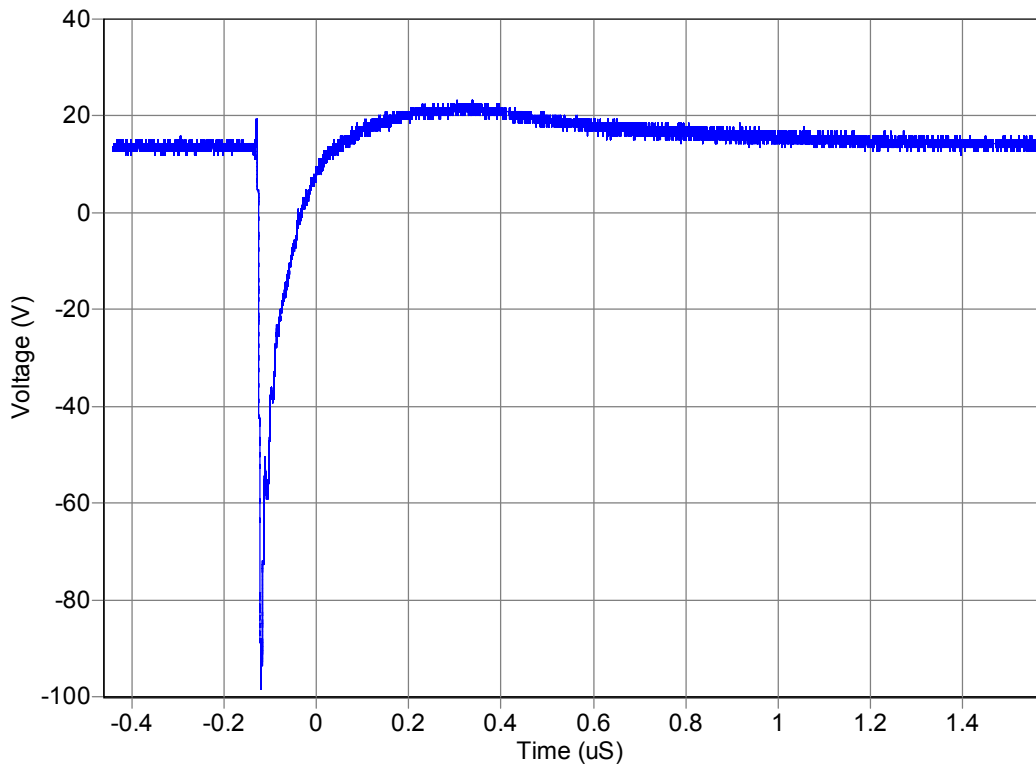
Figure E2 Pulse 2a, 12 V





Time=10.000ms/div, Volt=2.000V/div, Trig=5.120V(RISE)

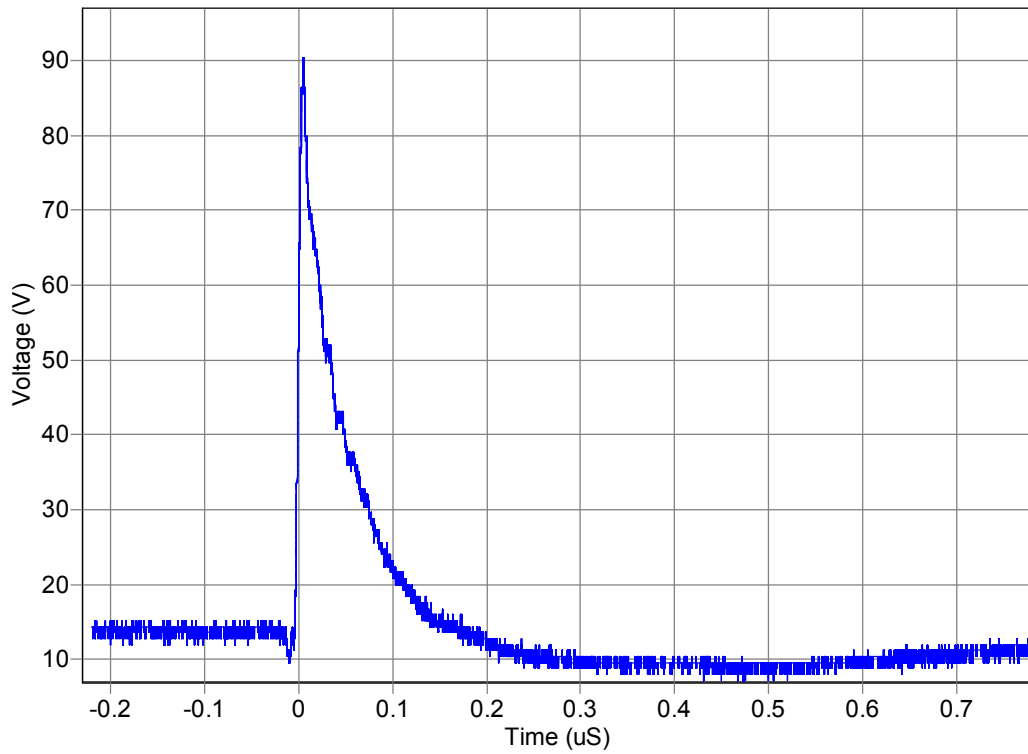
Figure E3 Pulse 2b, 12 V



Time=200.000ns/div, Volt=20.000V/div, Trig=9.200V(RISE)

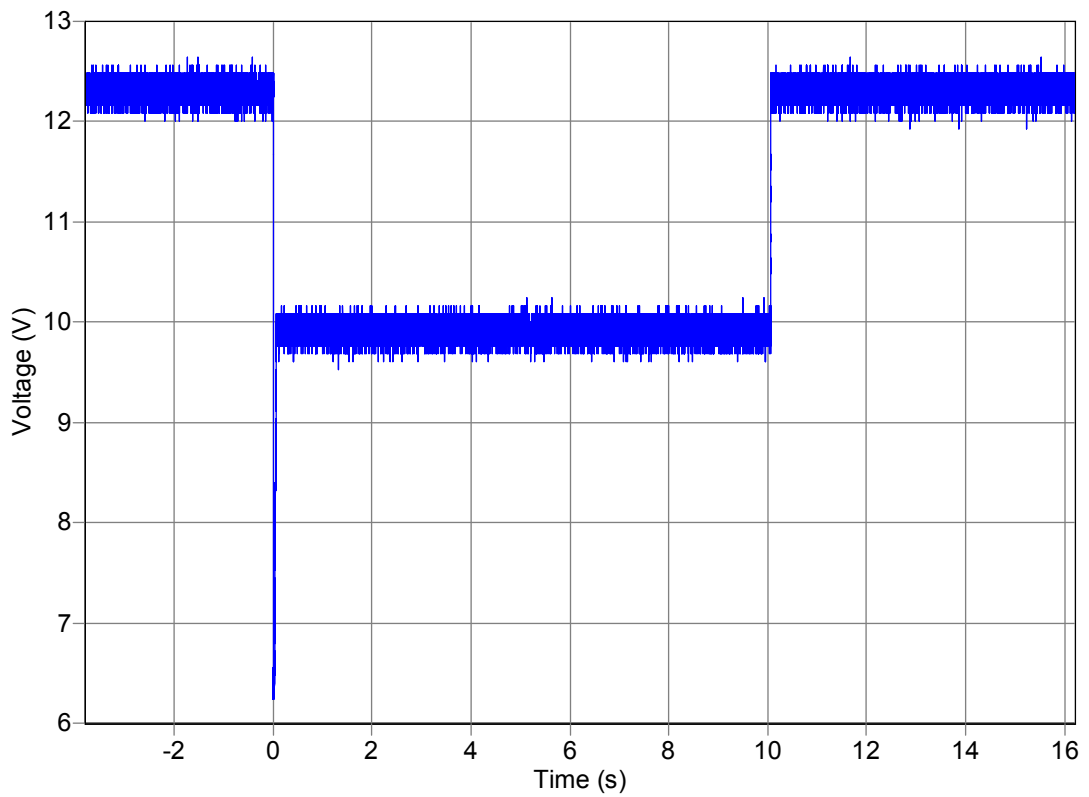
Figure E4 Pulse 3a, 12 V





Time=100.000ns/div, Volt=20.000V/div, Trig=58.000V(RISE)

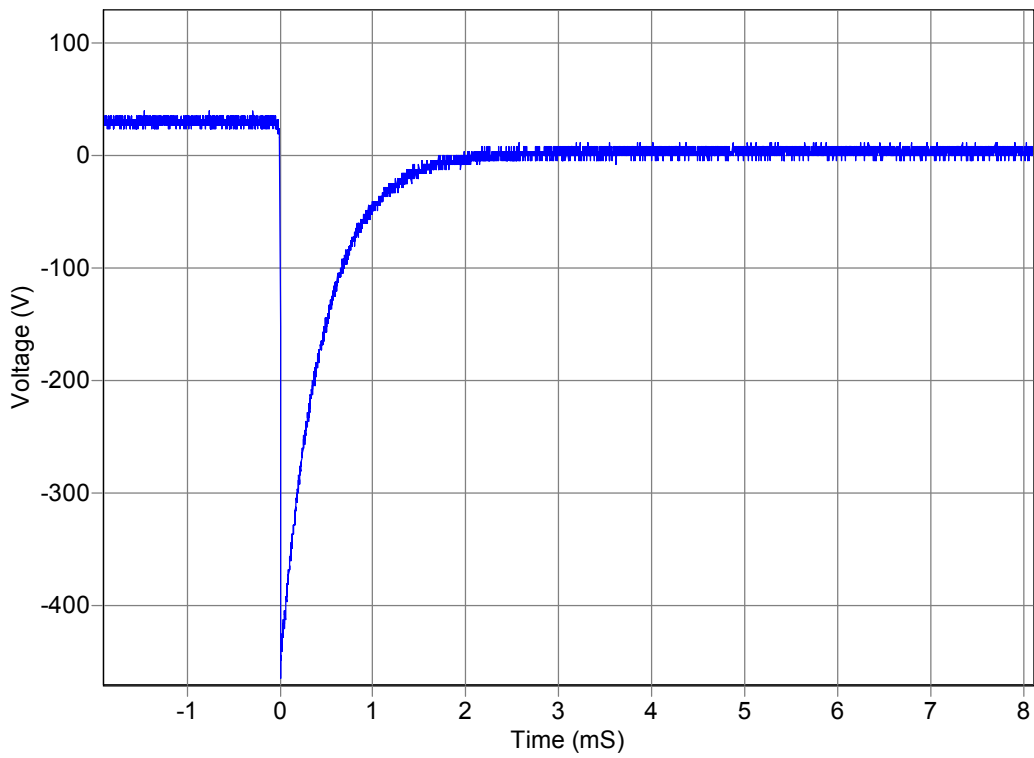
Figure E5 Pulse 3b, 12 V



Time=2.000s/div, Volt=2.000V/div, Trig=9.560V(FALL)

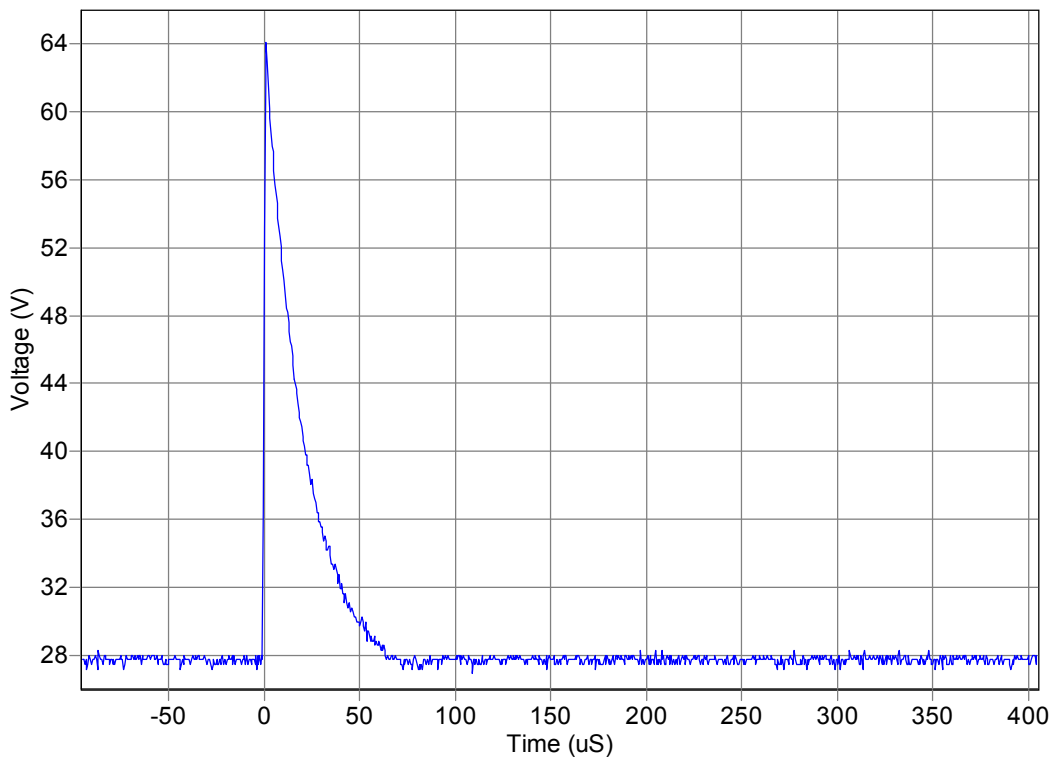
Figure E6 Pulse 4, 12 V





Time=1.000ms/div, Volt=100.000V/div, Trig=-138000000000.000nV(FALL)

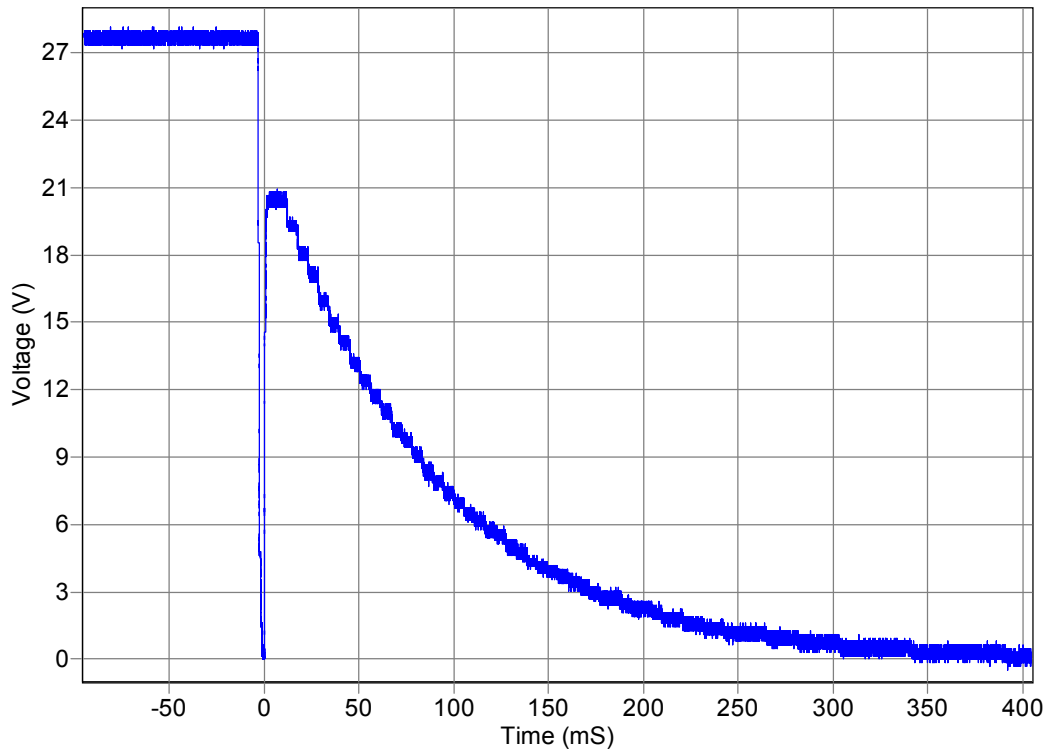
Figure E7 Pulse 1, 24 V



Time=50.000µs/div, Volt=7.000V/div, Trig=43.120V(RISE)

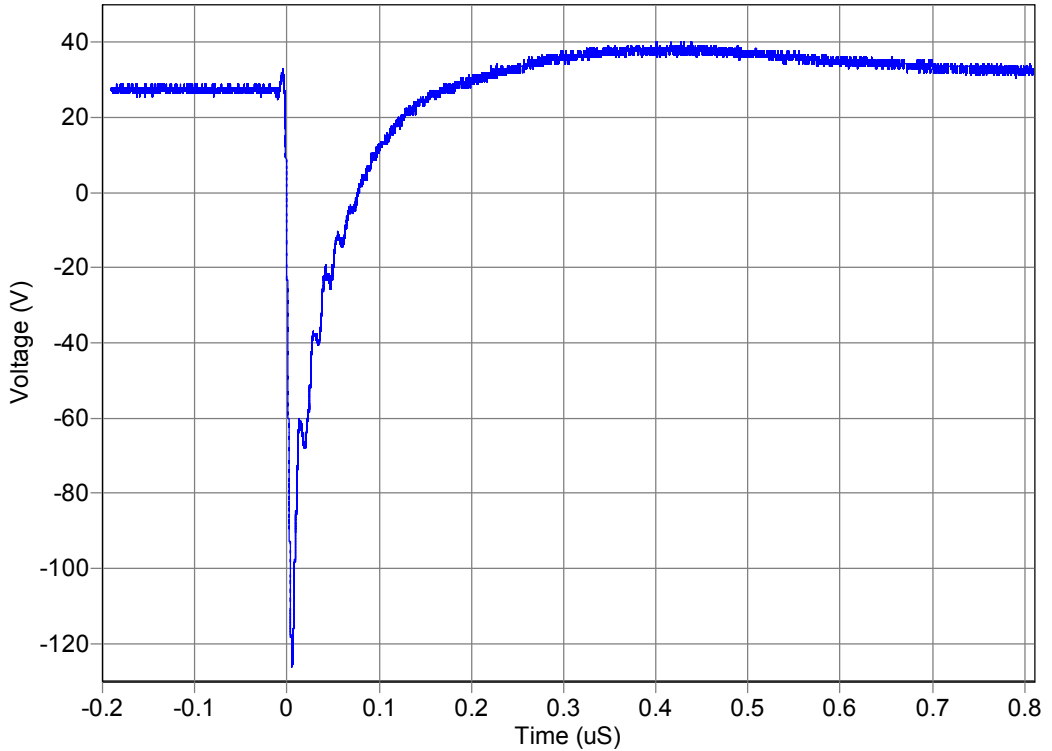
Figure E8 Pulse 2a, 24 V





Time=50.000ms/div, Volt=4.000V/div, Trig=5.120V(RISE)

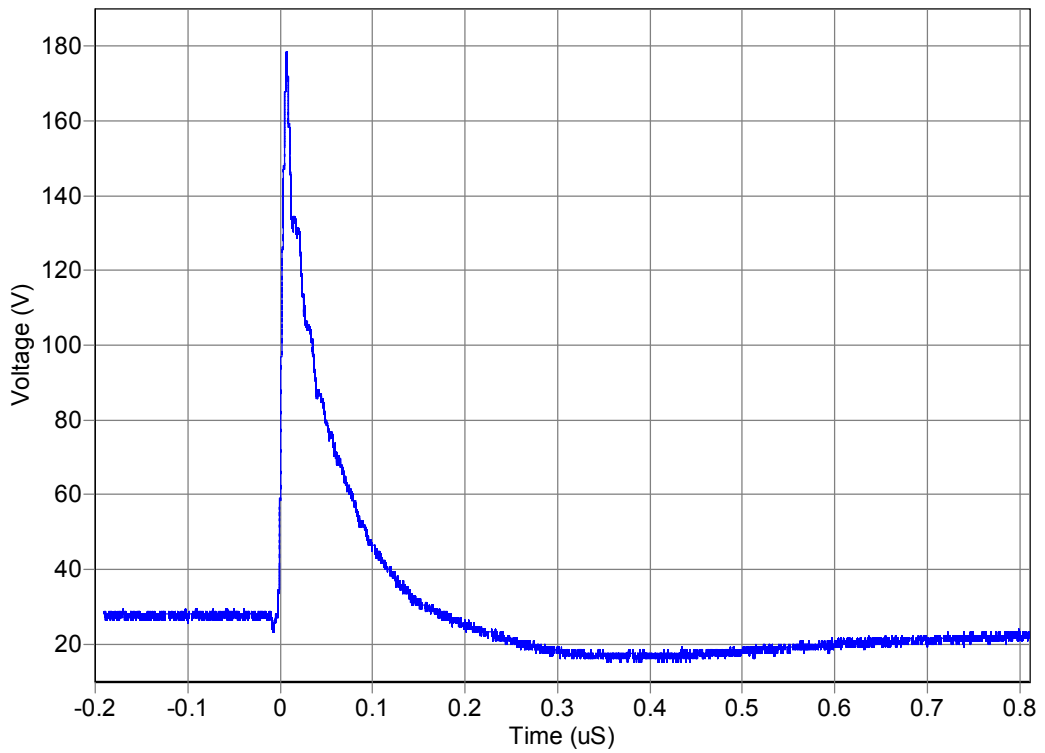
Figure E9 Pulse 2b, 24 V



Time=100.000ns/div, Volt=20.000V/div, Trig=-18000000000.000nV(FALL)

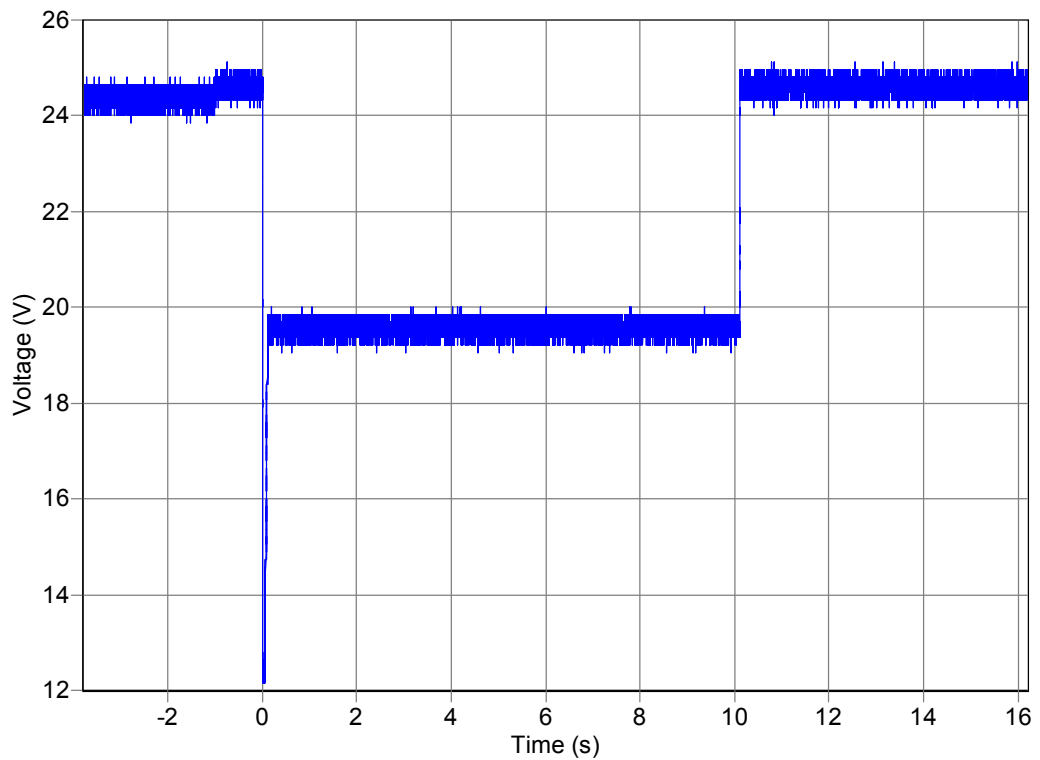
Figure E10 Pulse 3a, 24 V





Time=100.000ns/div, Volt=20.000V/div, Trig=60.400V(RISE)

Figure E11 Pulse 3b, 24 V



Time=2.000s/div, Volt=4.000V/div, Trig=21.840V(FALL)

Figure E12 Pulse 4, 24 V

