THE UNITED KINGDOM VEHICLE APPROVAL AUTHORITY

COMMUNICATION CONCERNING THE APPROVAL GRANTED (1)/ ~~APPROVAL EXTENDED (1)~~/ ~~APPROVAL REFUSED (1)~~/ ~~APPROVAL WITHDRAWN (1)~~/ ~~PRODUCTION DEFINITELY DISCONTINUED (1)~~ OF A TYPE OF ELECTRICAL/ ELECTRONIC SUB-ASSEMBLY (1) WITH REGARD TO REGULATION NO. 10.04

E11 Approval No: 10R-047915

Extension No: Not applicable

1. Make (trade name of manufacturer): DEL Equipment (UK) Ltd.

2. Type and general commercial description(s): Midi/Micro Lift Power Pack and Control Assembly, DEL Lift models: see manufacturer's documentation.

3. Means of identification of type, if marked on the ~~vehicle/~~component~~/separate technical unit~~: (1) Aluminium name plate

3.1. Location of that marking: The type is identified in the model box, on the manufacturer's plate.

4. Category of vehicle: Not applicable

5. Name and address of manufacturer:
DEL Equipment (UK) Ltd.
Building 1, Windrush Park Road
Windrush Industrial Park
Witney
Oxfordshire
OX29 7HA
United Kingdom

6. In the case of components and separate technical units, location and method of affixing of the ECE approval mark: See items 3 and 3.1

28-Feb-13
UK Approval Authority

EAN255912

7. Address(es) of assembly plant(s):
DEL Equipment (UK) Ltd.
Building 1, Windrush Park Road
Windrush Industrial Park
Witney
Oxfordshire
OX29 7HA
United Kingdom

8. Additional information (where applicable): See Appendix

9. Technical Service responsible for carrying out the tests: TRaC Global Limited

10. Date of test report: 22 January 2013

11. No. of test report: TRA-012736-38-00A

12. Any remarks: See Appendix

13. Place: BRISTOL

14. Date: 28 FEBRUARY 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: Not applicable

(1) Strike out what does not apply.

28-Feb-13
UK Approval Authority

Appendix

to type-approval communication form No. E11 10R-047915

concerning the type-approval of an electrical/electronic sub-assembly under Regulation No. 10.04

1. Additional information:.

1.1. Electrical system rated voltage: 12 or 24V. ~~pos/~~neg ground (1)

1.2. This ESA can be used on any vehicle type with the following restrictions: Not applicable

1.2.1. Installation conditions, if any: See manufacturer's installation instructions

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 IX): ISO11452-2 over 20MHz to 2GHz

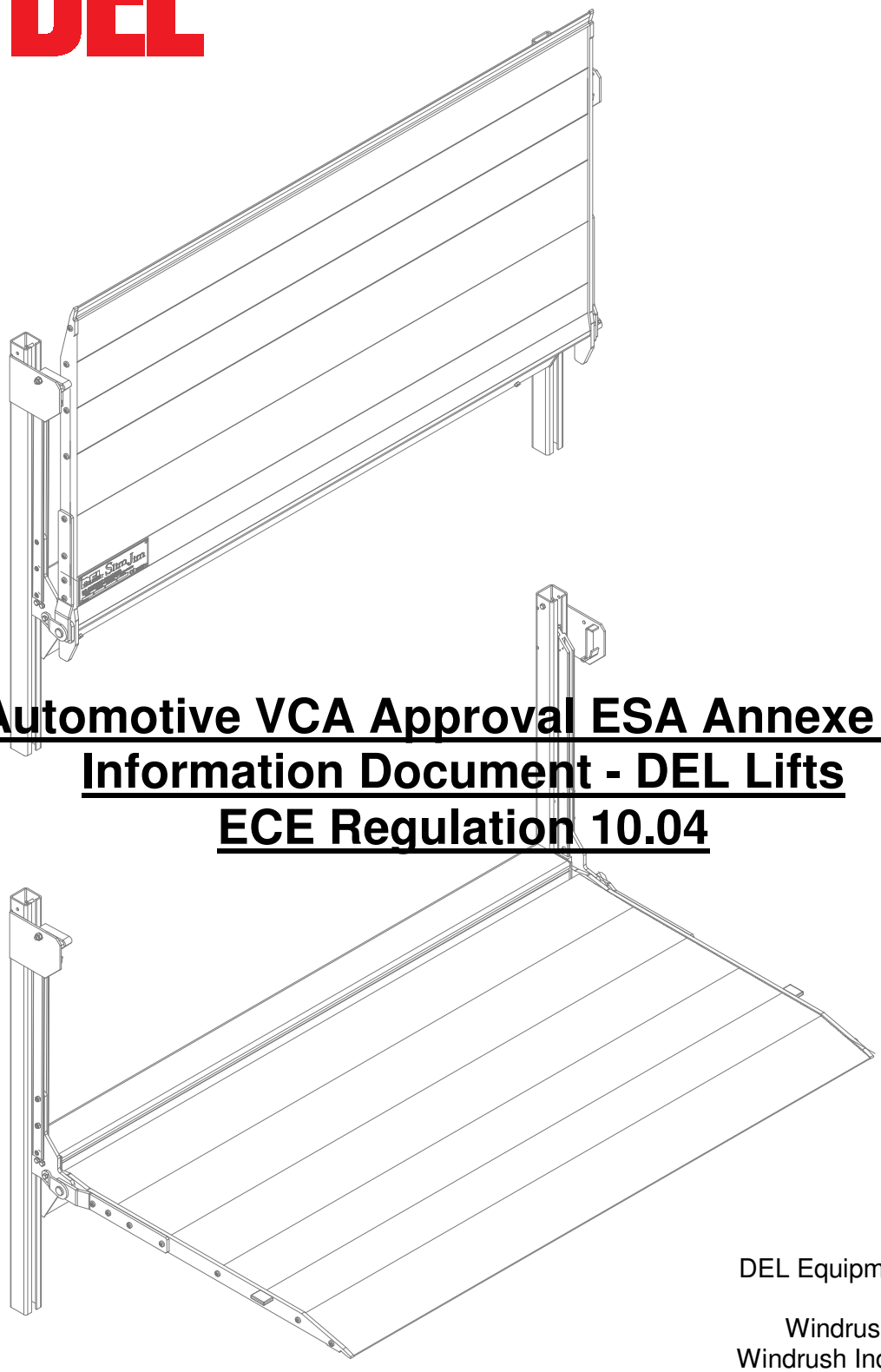
1.5. Laboratory accredited to ISO 17025 and recognized by the Approval Authority responsible for carrying out the tests: TRaC Global Limited, Wimborne, Dorset, United Kingdom.

2. Remarks: None

(1) Strike out what does not apply.

DEL

DEL IS A CARGOTEC BRAND



Automotive VCA Approval ESA Annexe 2B
Information Document - DEL Lifts
ECE Regulation 10.04

DEL Equipment (UK) Ltd
Building 1
Windrush Park Road
Windrush Industrial Park
Witney
Oxon,OX29 7HA
TEL: 01993 708811
FAX: 01993 708787
EMAIL: sales@del-uk.com
WEBSITE: www.del-uk.com

P/No. 60676 – Issue A

CONTENTS

1. Make (trade name of manufacturer).

DEL Equipment (UK) Ltd.

2. Type and general commercial description(s).

DEL Lift Models:

DA - Tuckunder Lift: Tailift that stows below vehicle floor.
DD - Double Decker Lift: Twin column tailift that serves two or more floors.
DL - Column Lift: Twin column tailift.
DO - Dump-over Lift: Twin column Dump-over tailift for Tippers.
DT - Dump-through Lift: Twin column Dump-through tailift for Tippers.
GB - Gas Bottle Lift: Twin column tailift for Gas Bottle vehicle.
LM - Load Mate Lift: Light tailift that stows below vehicle bed, where the platform forms the vehicle rave (*originally model SL).
NL - Narrow Column Lift: Twin column narrow tailift.
PC - Polecat Lift: Single pillar tailift.
S - Superloader Column Lift: Twin column heavy duty tailift.
TL - Trimloader Column Lift: Twin column slim tailift.
WB - Wheelie Bin lift: Single Bin lift.

3. Means of identification of Type.

The identification of type mark, is located on the DEL Name plate;

This is an aluminium plate that is riveted either;
to the underside of the lift platform, for lift type DL????, DO????, DT????, GB????, LM???, NL????, PC???, S???? & TL???? or:
to the powerpack box for lift type DA???? or;
to the carriage for lift type WB???

3.1. Location of that marking.

The type appears stamped in the 'MODEL' box.

4. Name and address of manufacturer.

DEL Equipment (UK) Ltd

Building 1,
Windrush Park Road,
Windrush Industrial Park,
Witney,
Oxon, OX29 7HA.

5. Location and methods of affixing the approval mark.

The approval mark will appear on the DEL Name plate (see 3).

6. Address of assembly plants.

Building 1,
Windrush Park Road,
Windrush Industrial Park,
Witney,
Oxon, OX29 7HA.

7. This ESA shall be approved as a component/STU.

This ESA shall be approved as a component.

8. Any restrictions of use and conditions for fitting.

This product must be installed by a competent person who has fully read, understands and follows the relevant installation manual.

9. Electrical system voltage.

The rated voltage is 12 / 24Vdc.

Appendix 1

The DEL lift is used for loading or unloading goods on a vehicle or raising, tipping and lowering a waste container on a recycling vehicle.

The lift is powered from a vehicle battery. A wire is taken from the battery positive to the powerpack starter switch and the hand control. These circuits are protected by in-line fuses. When the isolation switch is deactivated, the up button on the hand control provides power to the starter switch, which operates the powerpack motor. This pumps high-pressure hydraulic fluid to extend the ram. On release of the up button, the fluid is held in the ram due to a non return valve which locks the ram in position, therefore holding the platform / carriage assy stationary. Pushing the down button powers the lowering solenoid and allows the hydraulic fluid back from the ram to the power pack reservoir, lowering the platform / carriage assy under gravity.

Model Photos:

DA - Tuckunder Lift

DL - Column Lift

DD - Double Decker Lift

DO - Dump-over Lift

DT - Dump-through Lift

GB - Gas Bottle Lift

LM – Load Mate Lift

NL - Narrow Column Lift

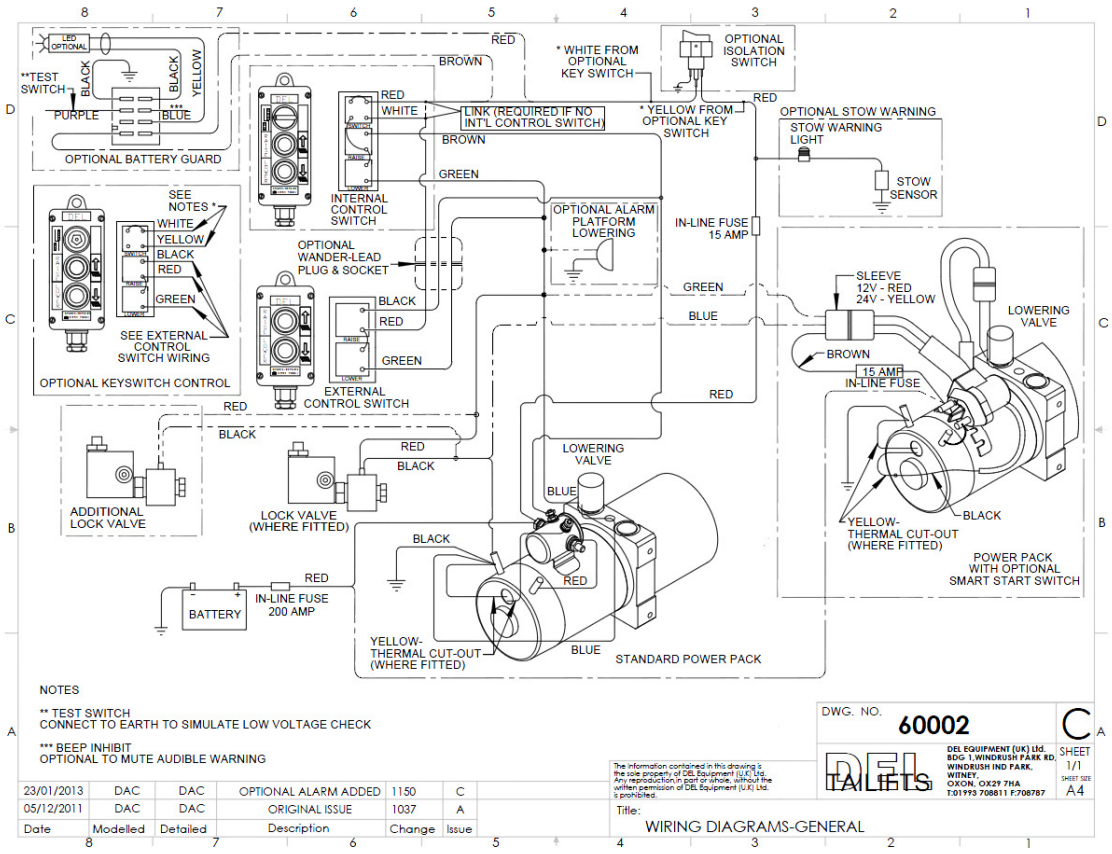
PC - Polecat Lift

S - Superloader Column Lift

TL - Trimloader Column Lift

WB - Wheelie Bin lift

Wiring Diagram: DEL Lifts general



Power Pack (WC Test) – used on models (x):

REVISED TEST No.	MANUFACTURER	VOLTAGE	PACK TYPE	DA	DL	DO	DT	GB	LM	NL	PC	S	TL	WB
1	HYDAC	24	MIDI	X	X	X	X	X		X		X	X	
2	RFP	24	MIDI	X	X	X	X	X		X		X	X	
3	SPX	24	MIDI	X	X	X	X	X		X		X	X	
4	SPX	12	MIDI	X	X	X	X	X		X		X	X	
5	HYDAC	12	MICRO		X	X	X	X	X	X	X			X
6	RFP	12	MICRO		X	X	X	X	X	X	X			X
7	RFP	24	MICRO		X	X	X	X	X	X	X			X

Power Pack WC (Test result) =

Pack 7 (RFP 24V Micro-pack) Pt. no. 60246.

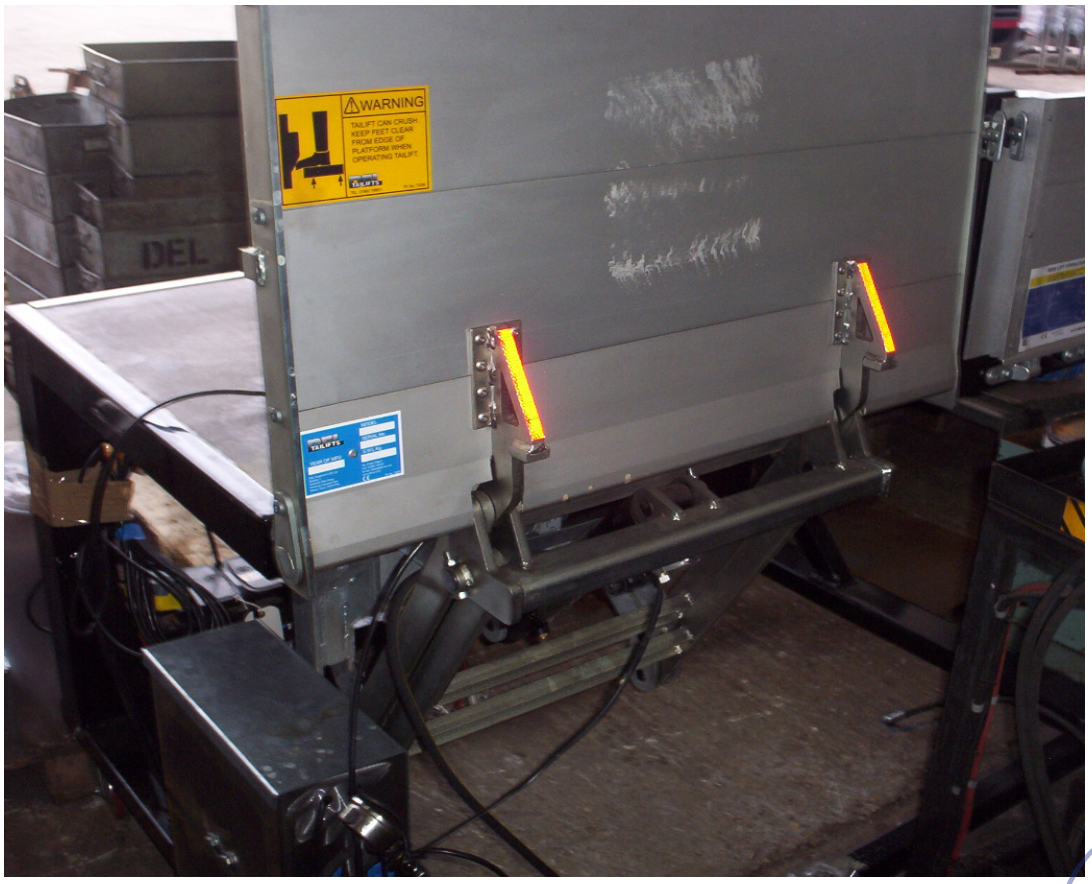
Used on: DEL Lift model type: LM.

DEL Lift Electrical Component List:

ITEM No.	PART No.	DESCRIPTION
1	78750-01	POWER PACK,24V,2.5cc,2.5L WEDGE,175BAR,C/W STARTER,HYDAC
1	78287-01	POWER PACK,24V,2.5cc,2.5L WEDGE,200BAR,C/W STARTER,HYDAC
1	60020	POWER PACK,24V,2.1cc,2.2L WEDGE,175BAR,C/W STARTER,RFP
1	60053	POWER PACK,24V,2.1cc,2.2L WEDGE,200BAR,C/W STARTER,RFP
1	77781	POWER PACK,24V,2.5cc,2.1L SQ,175BAR,C/W 7.5L FLOW CONTROL & STARTER,SPX
1	72692	POWER PACK,24V,2.5cc,1.5L SQ,175BAR,NO FLOW CONTROL,SPX
1	103096	POWER PACK,12V,2.5CC PUMP,2.1L,SPX
1	59889	POWER PACK,12V,0.75cc,0.86L,165BAR,C/W STARTER,FUSE & WIRING,HYDAC
1	57378	POWER PACK,12V,0.8CC,1.0L USABLE,C/W STARTER,FUSE AND WIRING,RFP
1	60245	POWER PACK,12V,1.0CC,1.1L USABLE,C/W STARTER,FUSE AND WIRING,RFP
1	60246	POWER PACK,24V,1.0CC,1.1L USABLE,C/W STARTER,FUSE AND WIRING,RFP
2	103103	HAND CONTROL,3 BUTTON-C/W
2	103195	HAND CONTROL-RED KEY ISO SWITC
2	103425	HAND CONTROL,2 BUTTON-C/W
2	50041	HAND CONTROL,2 BUTTON,C/W EMERGENCY STOP-WB150,SIDEWINDER
2	50507	HAND CONTROL,2 PUSH BUTTON,FENNER C/W LED
2	52319	HAND CONTROL,EXTERNAL-"WARBURTONS"
2	52404	HAND CONTROL,1 ROTARY SWTICH
2	72380	HAND CONTROL,1 ROTARY&3 PUSH BUTTON
2	72537	HAND CONTROL,2 PUSH BUTTON
2	72538	HAND CONTROL,1 ROTARY&2 PUSH BUTTON
2	72605	HAND CONTROL,2 PUSH BUTTON,C/W LINK
2	72606	HAND CONTROL,1 ROTARY&2 PUSH BUTTON,C/W LINK
2	72657	HAND CONTROL,2 PUSH BUTTON,FENNER
2	72672	HAND CONTROL,2 PUSH BUTTON,C/W COIL
2	73782	HAND CONTROL,2 PUSH BUTTON,TELEMECHANIQUE
2	74104	HAND CONTROL,3 PUSH BUTTON WITH LOCKABLE CHANGEOVER
2	75723	HAND CONTROL,3 PUSH BUTTON,FENNER
2	76442	HAND CONTROL,2 PUSH BUTTON-JEWSON
2	76909	HAND CONTROL,2 PUSH BUTTON WITH PLASTIC LOCKABLE CHANGEOVER
2	77163	HAND CONTROL,1 METAL KEY&2 PUSH BUTTON
2	77198	HAND CONTROL,1 EMERGENCY STOP&2 PUSH BUTTON
3	103126	LOCK VALVE ASSY,12V,8L/MIN,WITH FLYING LEAD
3	103131	LOCK VALVE ASSY,24V,8L/MIN,WITH FLYING LEAD
3	103229	LOCK VALVE ASSY,24V,8L/MIN
3	103230	LOCK VALVE ASSY,24V, 5L/MIN,WITH KOSTAL TERM. (DA1500 MK4)
3	52820	LOCK VALVE ASSY,12V,5L/MIN
3	52821	LOCK VALVE ASSY,24V,6.4L/MIN
3	52822	LOCK VALVE ASSY,12V,6.4L/MIN
3	57690	LOCK VALVE ASSY,24V,7.5L/MIN,KOSTAL CONNECTOR
3	57765	LOCK VALVE ASSY,24V,5L/MIN,KOSTAL CONNECTOR
3	59216	LOCK VALVE ASSY,24V,6.4L/MIN (OPPOSITE HAND)
3	59449	LOCK VALVE ASSY,24V,10L/MIN,KOSTAL CONNECTOR
3	60116	LOCK VALVE ASSY,24V,7.5L/MIN,LH
3	60117	LOCK VALVE ASSY,12V,5L/MIN,LH

3	60349	LOCK VALVE ASSY,24V,4L/MIN,WITH FLYING LEAD
3	60350	LOCK VALVE ASSY,24V,4L/MIN,WITH FLYING LEAD,LH
3	74217	LOCK VALVE ASSY,24V,6.4L/MIN
3	74239	LOCK VALVE ASSY-DL1500
3	76014	LOCK VALVE ASSY,24V-DANONE
3	78819	LOCK VALVE ASSY,24V-DL1000,CARTWRIGHTS
3	79764	LOCK VALVE ASSY,24V,7.5L/MIN
4	103085	FUSE,BLADE,1A
4	59484	FUSE,BLADE,15A
4	72517	FUSE,BLADE,30A
5	73168	FUSE,THERMAL,100A
5	73169	FUSE,THERMAL,200A
5	75425	FUSE,THERMAL,250A
6	103287	SWITCH,STOW LOCK & HOUSING ASSY-TL1000
6	51570	SWITCH,MINATURE METAL HOUSED,LEVER
6	52986	SWITCH,MINATURE METAL HOUSED,LEVER ROLLER
6	53907	SWITCH,ROCKER,ON/OFF,OVAL,RED LED,12V
6	54218	SWITCH,ROCKER,ON/OFF,OVAL,RED LED,24V
6	54304	SWITCH,INTERLOCK,24V
6	72534	SWITCH,SOLENOID,12V,SPNO,3TERMINAL,FLAT BRACKET
6	72565	SWITCH,3 POSITION,20A,12V,BIASED OFF
6	72649	SWITCH,PUSH PULL,ILLUMINATED,12V,AMBER
6	72650	SWITCH,PUSH PULL,ILLUMINATED,24V,AMBER
6	72931	SWITCH,SOLENOID,24V,SPNO,4 TERMINAL,FLAT BRACKET
6	72995	SWITCH,ROTARY,15A,3 POSITION,WATERPROOF
6	73031	SWITCH,PROXIMITY,HEAVY DUTY,C/W 3.7M CABLE
6	75415	SWITCH,MICROSWITCH,4BR
6	75544	SWITCH,PROXIMITY,5MM,NC,PNP,C/W CABLE,2M
6	75652	SWITCH,MICROSWITCH,4CRQR
6	77250	SWITCH,SEALED ROLLER,IP65
6	79017	SWITCH,FOOT CONTROL,BLACK
7	52911	BATTERY GUARD ASSY,12V-AIR TRUCKS
7	50498	BATTERY GUARD ASSY,12V-RYDER
7	50499	BATTERY GUARD ASSY,24V-RYDER
7	79326	BATTERY GUARD MODULE,12V
7	77782	BATTERY GUARD MODULE,24V
8	72669	BUZZER,12V
8	72670	BUZZER,24V
8	60435	BUZZER,ALARM,REVERSING,97DB,12-80VDC,WIRE LEAD TYPE
9	73258	LED, C/W PLUG ASSY,12V,YELLOW
9	103327	LED, RED FLASHING 14MM-12VDC,SHORT LED,
9	103328	LED, RED FLASHING 14MM-24VDC,SHORT LED,
9	103467	LED, YELLOW, 14MM, 24VDC
10	60667	VARISTOR,5MM,31V

ESA Test Lift Photos: LM250



Electrical BOM: LM250

ITEM No.	PART No.	DESCRIPTION
1	60246	POWER PACK,24V,1.0CC,1.1L USABLE,C/W STARTER,FUSE AND WIRING,RFP
2	72537	HAND CONTROL,2 PUSH BUTTON
3	60349	LOCK VALVE ASSY,24V,4L/MIN,WITH FLYING LEAD
4	59484	FUSE,BLADE,15A
5	73169	FUSE,THERMAL,200A
6	54218	SWITCH,ROCKER,ON/OFF,OVAL,RED LED,24V
10	60667	VARISTOR,5MM,31V (fit to all power packs across the input power cables)

REPORT ON THE EMC TESTING

FOR

DEL EQUIPMENT LTD.

ON A

24VDC POWERED MICRO TAIL LIFT POWER PACK

DOCUMENT NO. TRA-012736-38-00A

SOUTH
74-78 Condor Close, Woolsbridge Industrial Park, Three Legged Cross, Wimborne, Dorset BH21 6SU, UK.
T +44 (0)1202 811700 **F** +44 (0)1202 811701 **E** test@tracglobal.com
www.tracglobal.com

Report Number: TRA-012736-38-00A
Issue: 1
Copy Number: 1

**REPORT ON THE AUTOMOTIVE EMC TESTING OF A
DEL EQUIPMENT LTD.
24VDC POWERED MICRO TAIL LIFT POWER PACK
WITH RESPECT TO COMMISSION DIRECTIVE'S
2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2009/19/EC and REGULATION 10.04**

TEST DATES: TEST DATE: 9th January to 22nd January 2013

Report By: J. Parker

EMC Engineer

Approved By: S. Youngman

General Manager – TRaC Global Ltd.

Date: 22nd January 2013

Distribution:

Copy 1: TRaC Global Ltd.
Copy 2: Del Equipment Ltd.

SUMMARY

TEST REPORT NO:	TRA-012736-38-00A
PROJECT ID:	TRA-012736-01
PURPOSE OF TEST:	Electromagnetic ESA Emissions and Immunity
TEST SPECIFICATION:	Commission Directive's 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2009/19/EC and Regulation 10.04
ESA MODEL TYPE:	24Vdc powered MICRO Tail Lift Power Pack
ESA MODEL SERIAL NO:	Not supplied
MANUFACTURER:/AGENT	DEL Equipment Ltd
ADDRESS:	Building 1 Windrush Industrial park Witney Oxon OX29 7HA UK
REPRESENTATIVE: TEL ☎: EMAIL ✉:	Mr Steve Carew-Gibson +44 (0)1993 708811 Steve.carew-gibson@cargotec.com
PURCHASE ORDER No:	217953
CONCLUSION:	The above mentioned ESA was tested in accordance with Directive 72/245/EEC as amended by Commission Directive's 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2009/19/EC, Regulation 10.04 and was found to comply in all respects.
TESTED BY:	J. Parker
DATE OF TEST:	9th to 22nd January 2013

The results contained herein relate only to the items tested.

CONTENTS

1 INTRODUCTION

This report presents the results of Automotive Electromagnetic Compatibility (EMC) testing to Commission Directive's 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2009/19/EC and Regulation 10.04 carried out on the 24Vdc powered MICRO Tail Lift Power Pack.

The testing was carried out for DEL Equipment Ltd. by TRaC Global Ltd., an independent test house, at their EMC test facility located at Three Legged Cross, Dorset, England.

The test facilities meet the requirements laid down in specifications CISPR 16-1, CISPR 12, CISPR 25 and Commission Directive's 2004/104/EC and amendment 2009/19/EC, and are calibrated as recommended in the afore mentioned specification(s) / Directive(s).

This report also details the configuration of the equipment under test, the test methods used and any relevant modifications where appropriate.

Throughout this report EUT denotes Equipment Under Test; and ESA denotes Electronic/Electrical Sub-Assembly.

The results of this report also cover the requirements of EN50498:2010.

2 NORMATIVE REFERENCES

- Commission Directive 2004/104/EC 'Relating to the radio interference (electromagnetic compatibility) of vehicles, and type approval of motor vehicles and their trailers', 14th October 2004

- Commission Directive *2005/49/EC 'Relating to the radio interference (electromagnetic compatibility) of vehicles, and type approval of motor vehicles and their trailers', 25th July 2005*

- Commission Directive 2005/83/EC 'Relating to the radio interference (electromagnetic compatibility) of vehicles, and type approval of motor vehicles and their trailers', 23rd November 2005

- Commission Directive *2006/28/EC 'Relating to the radio interference (electromagnetic compatibility) of vehicles, and type approval of motor vehicles and their trailers', 6th March 2006*

- Commission Directive *2009/19/EC 'Relating to the radio interference (electromagnetic compatibility) of vehicles, and type approval of motor vehicles and their trailers', 12th March 2009*

- CISPR 12 'Vehicles', motorboats' and spark-ignited engine-driven devices' radio disturbance characteristics — Limits and methods of measurement', 6th edition 2007*

- *CISPR 16-1 'Specifications for radio disturbance and immunity measuring apparatus and methods — Part 1: Radio disturbance and immunity measuring apparatus', 2nd edition 1999*

- CISPR 25 'Limits and methods of measurement of radio disturbance characteristics for the protection of receivers used on board vehicles', 2nd edition 2002

- *IEC 60050-161 'International Electrotechnical Vocabulary (IEV) — Chapter 161: Electromagnetic compatibility', 1990*

- ISO 7637-1 'Road vehicles — Electrical disturbance from conduction and coupling — Part 1: Definitions and general considerations', 2nd edition 2002*

- ISO 7637-2 'Road vehicles — Electrical disturbance from conduction and coupling — Part 2: Electrical transient conduction along supply lines only on vehicles with nominal 12 V or 24 V supply voltage', 2nd edition 2004

- *ISO-EN 17025 'General requirements for the competence of testing and calibration laboratories', 1st edition 1999*

- ISO 11451 'Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Vehicle test methods'

Part 1: General and definitions (ISO 11451-1: 3rd edition 2005*)
Part 2: Off-vehicle radiation source (ISO 11451-2: 3rd edition 2005)
Part 4: Bulk current injection (BCI) (*ISO 11451-4: 1st edition 1995*)

- ISO 11452 'Road vehicles — Electrical disturbances by narrowband radiated electromagnetic energy — Component test methods'

Part 1: General and definitions (ISO 11452-1: 3rd edition 2005)
Part 2: Absorber-lined chamber (ISO 11452-2: 2nd edition 2004)
Part 3: Transverse electromagnetic mode (TEM) cell (*ISO 11452-3: 2nd edition 2001*)
Part 4: Bulk current injection (BCI) (ISO 11452-4: 3rd edition 2005)
Part 5: Strip line (*ISO 11452-5: 2nd edition 2002*)

- ITU Radio Regulations, Edition 2001

- EN50498:2010 Electromagnetic compatibility (EMC) – Product family standard for aftermarket electronic equipment in vehicles

*indicates a specification or standard or specific amendment that is not listed on TRaC Global's UKAS scope of accreditation.

3 Equipment Under Test

3.1 EUT Identification

- Name: 24Vdc MICRO Tail Lift Power Pack
- Serial Number: N/A
- Model Number: SL250
- Software Revision: N/A
- Build Level / Revision Number: Production

3.2 Support Equipment

Equipment listed below forms part of the overall test setup and is required for equipment functionality and/or monitoring during testing.

- None

3.3 EUT Description

DEL Equipment Lift - Power Pack Assembly and Controls.

The Lift is powered from the vehicle battery. A wire is taken from the battery positive to the Midi / Micro Power Pack starter switch and the hand control. These circuits are protected by in-line fuses. Pushing the 'raise' button on the hand control, provides power to the starter switch, which operates the Power Pack motor. This then pumps high-pressure hydraulic fluid to extend the ram. On release of the 'raise' button, the fluid is held in the ram due to a non-return valve which locks the ram in position, therefore holding the Lift stationary. Pushing the 'lower' button, powers the lowering solenoid, releasing the valve, which then allows the hydraulic fluid back from the ram to the power pack reservoir, which lowers the Lift.

3.4 EUT Mode of Operation

Emissions

- Tail Lift Raising and Lowering

Immunity

- Tail Lift Stationary

3.5 EUT Monitoring

- Visual monitoring using CCTV camera and monitor during radiated emissions and radiated susceptibility
- Visual monitoring in close proximity to EUT during remaining tests

3.6 Pass / Fail Criteria

3.6.1 Immunity – Classification of functional status

The specification allows different levels of immunity depending on the functional status of the equipment. When assessing the pass fail criteria it is important that that the following information, taken from paragraph 2.1.12 of the directive is considered.

Immunity – related functions are:
Functions related to the direct control of the vehicle:

- By degradation or change in engine, gear, brake, suspension, active steering, speed limitation devices.

Functions related to driver, passenger and other road-user protection:

- e.g. Airbag and safety restraint systems;

Functions which, when disturbed, cause confusion to the driver or other road users

- by blocking data transmission on the vehicle data bus-systems, which are used to transmit data, required to ensure the correct functioning of other immunity-related functions;

Functions which when disturbed, affect vehicle statutory data: e.g. tachograph odometer. All classifications are for the total device/system functional status

Class A

All functions of a device/system perform as designed during and after exposure to disturbance

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 shall remain class A.

Class C

One or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.

Class D

One or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple “operator” action

Class E

One or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

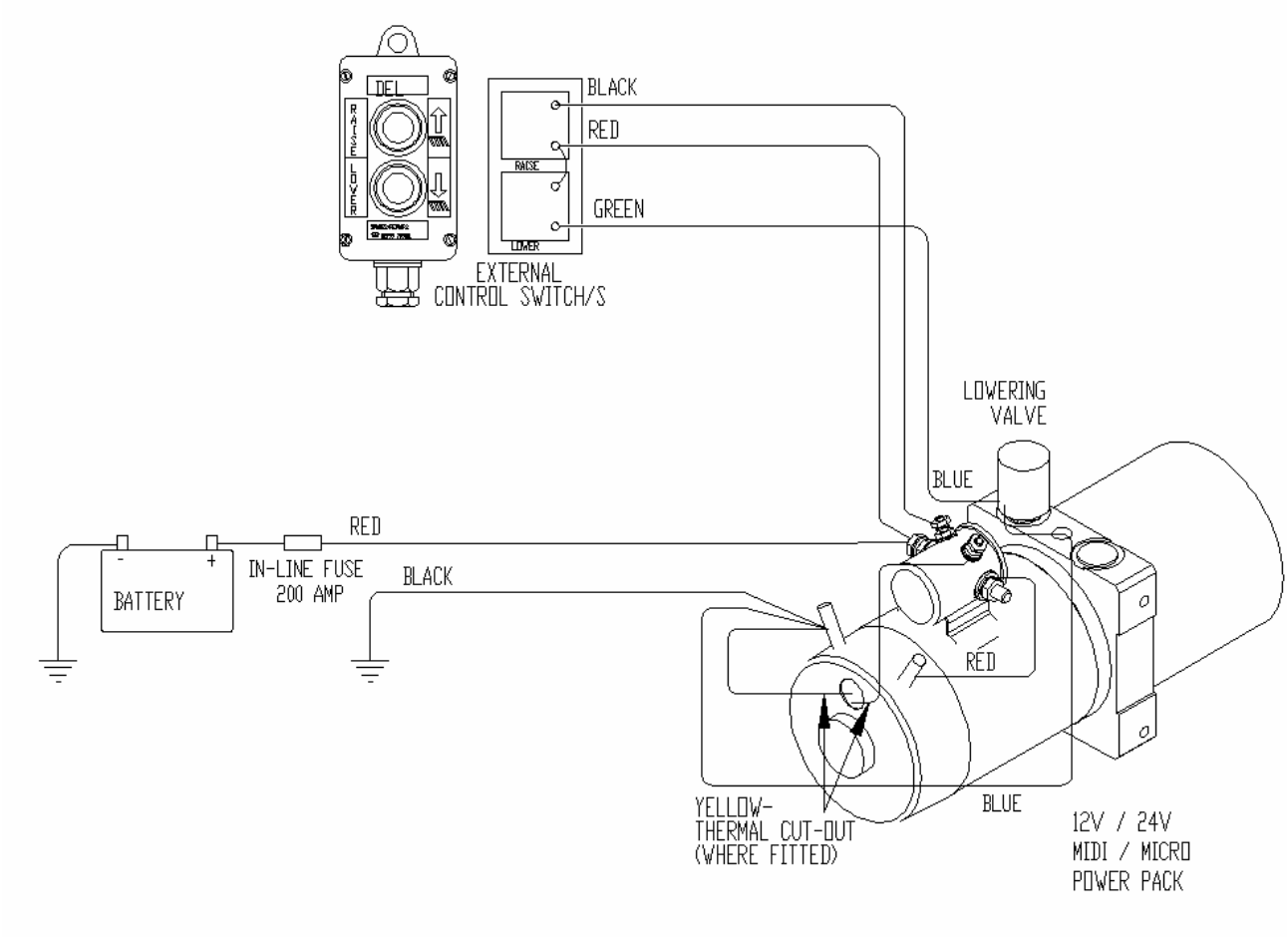
3.6.2 Manufacturers Pass Fail Criteria

The manufacturer set the following failure criteria:

- No movement of tail lift during immunity tests

3.7 Block Diagram of ESA Configuration

The following diagram shows basic EUT interconnections with cable type and cable lengths identified.



All Cables unscreened

4 TEST METHODS

4.1 Electromagnetic Interference Generated By ESA

4.1.1

Test Location

	Observed
Ambient electromagnetic noise at least 6dB below reference limit	✓

4.1.2

Measurement Antenna

	Observed
The height of the antenna reference point was 100 ±10mm above the ground plane	✓
The distance between the wiring harness and the reference point of the antenna was 1000 ± 10mm, and was in line with the phase centre of the longitudinal part of the wiring harness	✓

4.1.3

Test Arrangements

	Observed
The ground plane was located on a non-conductive support at a height of 900 ±50mm above the test facility floor, was parallel to it, and the bonding DC resistance did not exceed 2.5mΩ, with the bond straps placed no greater than 300mm apart.	✓
The ESA and its harness was located on a non-conductive support 50 ±5mm above the ground plane.	✓
The long segment of the test harness was located parallel to the edge of the ground plane facing the antenna at a distance of 100 ±10mm from the edge.	✓
The length of the test harness parallel to the front of the ground plane was 1500 ±75mm, and the overall length between the EUT and the AN(s) / load simulator (or RF boundary) did not exceed 2000mm.	✓
The face of the EUT was located at a distance of 200mm ±10mm from the edge of the ground plane.	✓
The ESA was connected to the grounding system according to the manufacturer's installation instructions.	✓
The ESA was powered via 5μH / 50Ω artificial networks that were electrically bonded to the ground plane.	✓
The supply voltage U_s was maintained to 13.5 ±0.5Vdc and 27 ±1Vdc of the nominal operating voltage for 12Vdc and 24Vdc systems respectively. The PSU superimposed ripple voltage U_r did not exceed 0.2V Pk-Pk >400Hz.	✓
All cable looms were terminated as realistically as possible with real loads and actuators.	✓

4.1.4 Radiated Emissions Broadband Measurements

Measurement Freq. Range	30MHz - 1GHz
Measurement Distance	1m
Antenna Height	100 ±10mm above ground plane
Antenna Polarisation	Vertical and Horizontal
Antenna Type	Biconical antenna (30 – 200MHz) Log-periodic antenna (200MHz – 1GHz)
Receiver	
Bandwidth	120kHz
Detectors	Quasi-Peak (CISPR Time Constants)
LISN	5µH/50Ω
Ambient Conditions	TEMP 21°C, 32% and 1011mb Final measurements were made in an indoor semi-anechoic EMC chamber & therefore were not influenced by external atmospheric and climatic conditions, such as rainfall.
Remarks	Test method as per TRAC RTP1008 (internal company procedure) and CISPR 25.
Measurement Uncertainty	See Appendix B

Test equipment used for this measurement was:

Equipment	*Maker/Supplier*	*Model Number*	*Serial Number*	*Plant Number*	*Calibration Due Date*
Antenna	Schwarzbeck	VHA9103	1FV/305/39	BIC7	19-08-13
Antenna	Schwarzbeck	9111	9111-197	LP7	01-09-13
Receiver	Rohde & Schwarz	ESIB26	100242	RX21	11-02-13
LISN	Rohde & Schwarz	5µH / 50Ω	827730/008	L25-1	14-11-13
LISN	Rohde & Schwarz	5µH / 50Ω	828620/005	L25-2	14-11-13
Hygrometer	RS Components	212-124	None	BAR43	21-02-13

4.1.5 Radiated Emissions Narrowband Measurements

Measurement Freq. Range	30MHz - 1GHz
Measurement Distance	1m
Antenna Height	100 ± 10mm above ground plane
Antenna Polarisation	Vertical and Horizontal
Antenna Type	Biconical antenna (30MHz – 200MHz) Log-periodic antenna (200MHz-1GHz)
Receiver	
Bandwidth	120kHz
Detectors	Average
LISN	5µH / 50Ω
Ambient Conditions	TEMP 20°C, 30% and 1009mb Final measurements were made in an indoor semi-anechoic EMC chamber & therefore were not influenced by external atmospheric and climatic conditions, such as rainfall.
Remarks	Test method as per TRaC RTP1008 (internal company procedure) and CISPR 25.
Measurement Uncertainty	See Appendix B

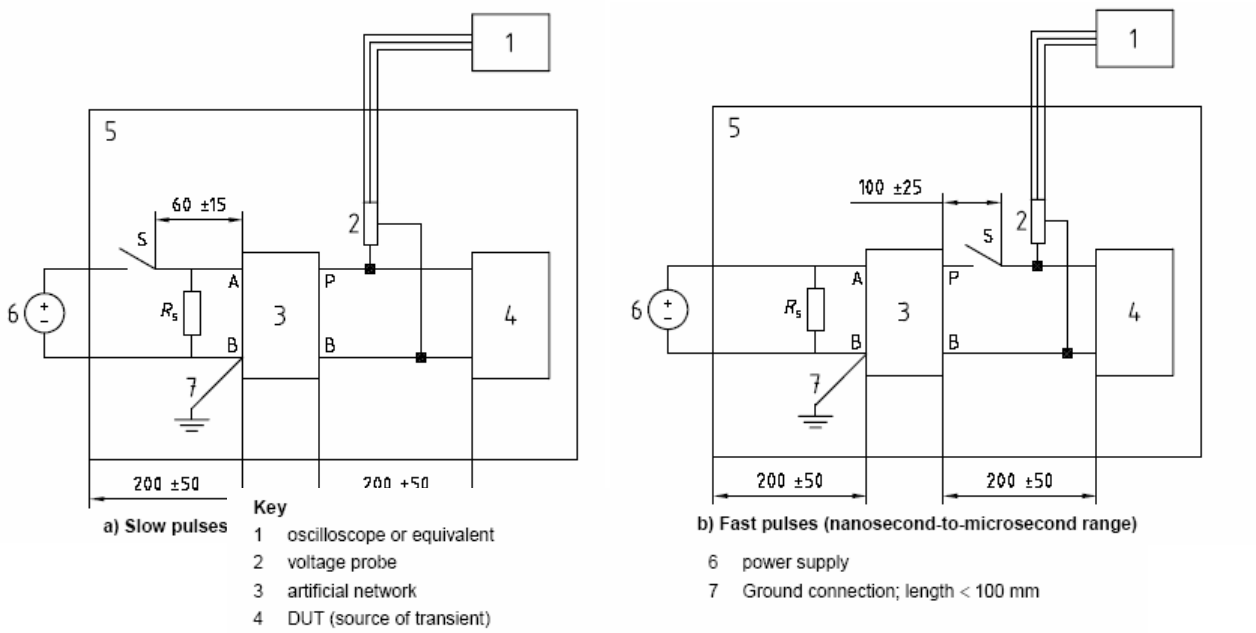
Test equipment used for this measurement was:

Equipment	*Maker/Supplier*	*Model Number*	*Serial Number*	*Plant Number*	*Calibration Due Date*
Antenna	Schwarzbeck	VHA9103	1FV/305/39	BIC7	19-08-13
Antenna	Schwarzbeck	9111	9111-197	LP7	01-09-13
Receiver	Rohde & Schwarz	ESIB26	100242	RX21	11-02-13
LISN	Rohde & Schwarz	5µH / 50Ω	827730/008	L25-1	14-11-13
LISN	Rohde & Schwarz	5µH / 50Ω	828620/005	L25-2	14-11-13
Hygrometer	RS Components	212-124	None	BAR43	21-02-13

4.2 Voltage Transient Emissions

LISN	5µH / 50Ω
Ambient Conditions	TEMP 22°C, HUM 32% and 1010mb
Remarks	Test method as per TRaC RTP1027 (internal company procedure) and ISO 7637-2.
Measurement Uncertainty	See Appendix B
Switching Operations Measured	Power On & Off
Switch Type Used For Power Supply	Automotive Relay

4.2.1 Test Setup



a) Slow pulses

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

Key
1 oscilloscope or equivalent
2 voltage probe
3 artificial network
4 DUT (source of transient)
6 power supply
7 Ground connection; length < 100 mm

4.2.2 Test Method

The purpose of this test is to measure the amplitude and duration of the transients appearing on power lines caused by the normal operation of the EUT (function switching) and also as a result of switching on and off the power supply to the EUT (contactor switching).

An automotive relay was placed in the power supply lines at the locations signified by 'S' in the diagram above, and contactor switching tests were then carried out on the power lines by switching the relay on and off. Functional tests were performed by operating the EUT on/off switch and mode buttons (where applicable).

Measurements were made using an oscilloscope and x100 oscilloscope probe connected to the lines under test. The oscilloscope was set to capture the event.

The test equipment used for this measurement is shown overleaf.

Test equipment used for this measurement was:

Equipment	*Maker/Supplier*	*Model Number*	*Serial Number*	*Plant Number*	*Calibration Due Date*
Oscilloscope	Rohde & Schwarz	RTM1054	101720	OSC8	03-10-13
Oscilloscope Probe	PMK	PHV1000-RO	None	LE34	03-10-13
LISN	Teseq	AN5501	1009	L806b	19-09-13
Switch Relay	Teseq	MS5501	1009	L806d	19-09-13
Switch Control	Teseq	SC5501	1009	L806a	19-09-13
Hygrometer	RS Components	212-124	None	BAR43	21-02-13

4.3 Vehicle Transients and Surge Immunity

Pulses Tested	Pulse 1 Pulse 2a Pulse 2b Pulse 3a Pulse 3b Pulse 4
Pulse severity Level	Level 3
Remarks	Test method as per TRAC RTP1026 (internal company procedure) and ISO 7637-2.
Acceptable Performance Criterion	see section 3.6
Ambient Conditions	TEMP 21°C, HUM 28% and 1010mb
EUT Power Supply Voltage	24Vdc
Cables under Test	DC Power Input

4.3.1 Test Method

The EUT was supplied with DC power via the pulse simulator, which introduced a pulse to the specified level on to the DC lines.

Test equipment used for this test was:

Equipment	*Maker/Supplier*	*Model Number*	*Serial Number*	*Plant Number*	*Calibration Due Date*
System Mainframe	Schaffner	NSG5000	199805A001E	ATS1	27-11-13
Battery Simulator	Schaffner	NSG5004	IN0995-021	ATS5	27-11-13
Burst Generator	Schaffner	NSG5003	23	ATS3	27-11-13
Transient Generator	Schaffner	NSG5001	22AR	ATS2	27-11-13
High Energy Generator	Schaffner	NSG5005A	5	ATS4	27-11-13
Oscilloscope	Rohde & Schwarz	RTM1054	101720	OSC8	03-10-13
Oscilloscope Probe	PMK	PHV1000-RO	None	LE34	03-10-13
Hygrometer	RS Components	212-124	None	BAR43	21-02-13

4.4 RF Immunity

Frequency Range(s)	20 – 2000 MHz (RFS, ISO 11452-2)
Test Level(s)	30V/m (modulated level)
Modulation 20 – 800MHz 800 – 2000MHz	 AM , 80% depth with 1 kHz sinewave PM, t on 577µs, period 4600µs
Remarks	Absorber Chamber test method as per TRaC RTP1028 (internal company procedure) and ISO 11452-1, ISO 11452-2.
Antenna to EUT Distance	1m
Antenna Height	100 ± 10mm above ground plane
Antenna Type	Bicon (20MHz – 80MHz) Log-Periodic (80MHz – 800MHz) Horn (800MHz – 2GHz)
Antenna Polarisation	Vertical
Dwell Time	DWELL s 2s
Frequency Step (of momentary frequency)	<5 % (20 – 400 MHz) <2% (400 – 2000 MHz)
Ambient Conditions:	TEMP 21°C, HUM 28% and PRES 1010mb

4.4.1 Test Method

Compliance tests were carried out using a biconnical, log-periodic and horn transmitting antenna. For radiated RFS, the forward power from a calibration file was called up and used in a computer controlled closed loop system to generate the required RF field of 30V/m (modulated level) across the frequency range by setting the output level from the signal generator.

4.4.2 Conditions of Test

The EUT was tested with the antenna vertically polarised with the support equipment outside the Electromagnetic Field.

The test equipment used for this test was:

Equipment	*Maker/Supplier*	*Model Number*	*Serial Number*	*Plant Number*	*Calibration Due Date*
Signal Generator	Anritsu	68347B	972709	RSG34	15-02-14
LISN	Rohde & Schwarz	5µH / 50Ω	827730/008	L25-1	14-11-13
LISN	Rohde & Schwarz	5µH / 50Ω	828620/005	L25-2	14-11-13
Antenna	EMCO	4106	2028	DRG4	20-06-14
Antenna	Schwarzbeck	VHBD 9134	9134-049	BIC8	25-06-13
Directional Coupler	Werlatone	C5925-20	89087	RDIR8	31-01-14
Directional Coupler	Werlatone	C3908-10	81445	RDIR5	31-01-14
Field Probe	Narda	EMR-300	E-0007	REFS27	01-11-13
Hygrometer	RS Components	212-124	None	BAR43	21-02-13

5 RESULTS OF TESTS

5.1 Radiated Emissions

All measurements were taken with the EUT operating in a mode that activates all components of the equipment see Section 2.3. All external interface cables were connected and loaded with the appropriate terminations as detailed in Commission Directive's 2004/104/EC, 2005/49/EC, 2005/83/EC, and 2006/28/EC.

GRAPH A1: 30-200MHz Radiated Emissions Vertical Polarisation
GRAPH A2: 30-200MHz Radiated Emissions Horizontal Polarisation
GRAPH A3: 200MHz-1GHz Radiated Emissions Vertical Polarisation
GRAPH A4: 200MHz-1GHz Radiated Emissions Horizontal Polarisation

5.1.1 Narrowband Measurements

Emissions given in the table below marked with an asterisk (*), represent a measured level within the limits of measurement uncertainty.

Spot frequency emissions measurements

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	BW (kHz)	Pol.	Corr. (dB)	Margin (dB)	Limit (dBµV/m)	Comment
30.900000	56.3	1000.0	120.0	V	11.6	5.4	61.70	*
33.250000	47.6	1000.0	120.0	H	11.9	13.3	60.90	
39.650000	46.4	1000.0	120.0	H	12.9	13.6	59.00	
43.250000	49.5	1000.0	120.0	V	13.0	8.5	58.00	
45.550000	53.1	1000.0	120.0	H	13.0	4.4	57.40	*
53.400000	42.5	1000.0	120.0	V	12.9	13.2	55.70	
56.500000	39.7	1000.0	120.0	H	12.7	15.4	55.10	
64.400000	50.6	1000.0	120.0	V	12.4	3.1	53.70	*
67.750000	51.3	1000.0	120.0	H	12.3	1.8	53.10	*
78.100000	40.2	1000.0	120.0	V	11.7	12.1	52.30	
87.850000	38.7	1000.0	120.0	V	10.9	14.3	53.00	
99.450000	32.4	1000.0	120.0	H	10.8	21.5	53.90	
171.500000	47.2	1000.0	120.0	V	15.9	10.2	57.40	
200.250000	50.9	1000.0	120.0	V	23.7	7.6	58.50	
226.900000	44.6	1000.0	120.0	H	19.3	14.7	59.30	
236.100000	39.2	1000.0	120.0	H	18.3	20.3	59.50	
239.650000	43.5	1000.0	120.0	V	17.9	16.1	59.60	
250.950000	44.2	1000.0	120.0	V	17.6	15.7	59.90	
292.450000	33.7	1000.0	120.0	H	18.3	27.2	60.90	
306.200000	42.0	1000.0	120.0	V	18.6	19.8	61.20	
331.500000	36.5	1000.0	120.0	H	19.9	25.3	61.80	

5.1.2 Broadband Measurements

Emissions given in the table below marked with an asterisk (*), represent a measured level within the limits of measurement uncertainty.

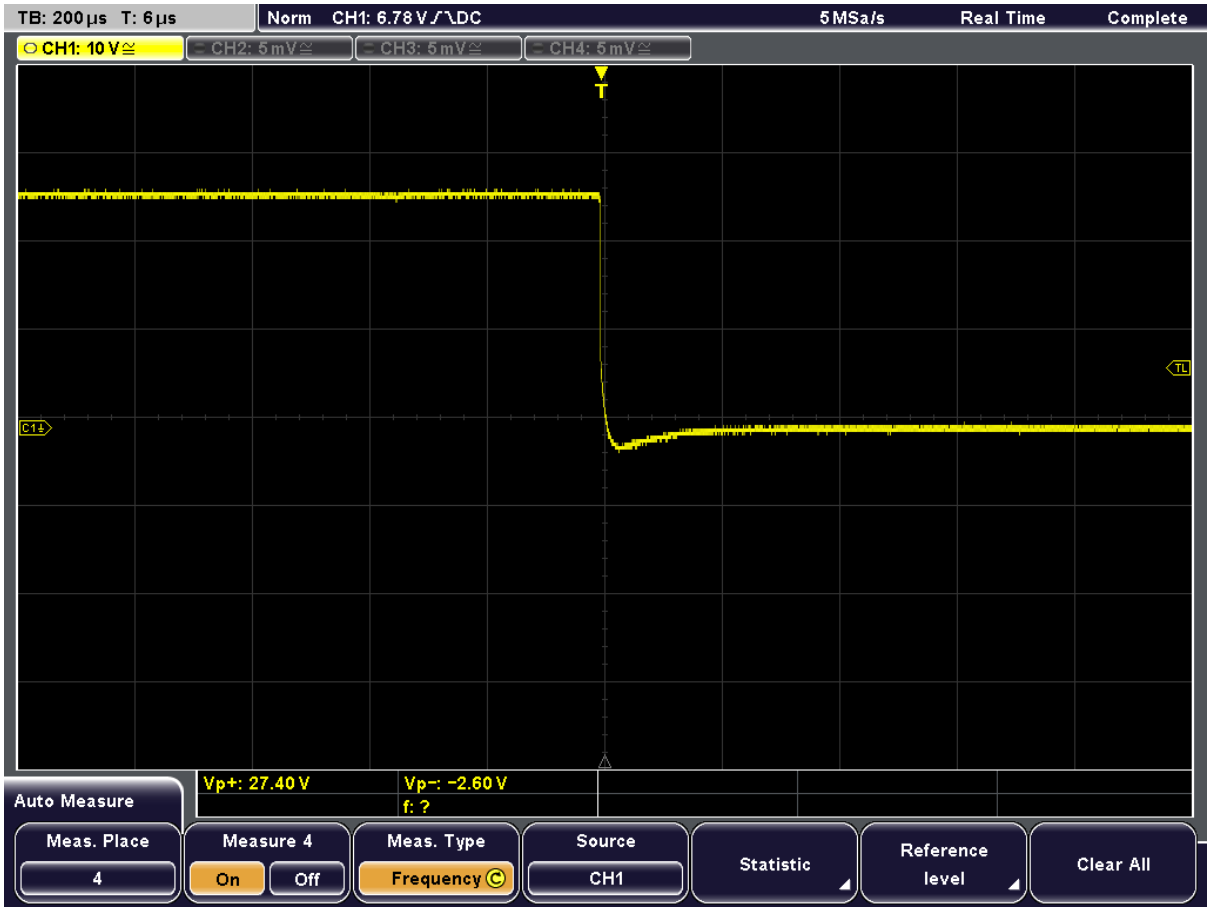
Spot frequency emissions measurements

Frequency (MHz)	Average (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Polarization	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
42.400000	31.1	1000.0	120.000	H	13.0	17.1	48.20
44.150000	30.1	1000.0	120.000	V	13.0	17.7	47.80
44.800000	30.6	1000.0	120.000	H	13.0	17.0	47.60
52.850000	22.6	1000.0	120.000	V	12.9	23.2	45.80
54.700000	21.3	1000.0	120.000	H	12.8	24.1	45.40
64.250000	25.7	1000.0	120.000	V	12.4	18.0	43.70
66.150000	28.4	1000.0	120.000	H	12.3	15.0	43.40
67.900000	30.9	1000.0	120.000	H	12.3	12.2	43.10
75.300000	29.8	1000.0	120.000	V	11.9	12.2	42.00
75.650000	22.5	1000.0	120.000	H	11.8	19.6	42.10
146.350000	24.2	1000.0	120.000	V	15.1	22.2	46.40
200.000000	26.6	1000.0	120.000	V	17.3	21.8	48.40
224.900000	23.1	1000.0	120.000	H	19.5	26.1	49.20
234.550000	23.9	1000.0	120.000	H	18.5	25.6	49.50
238.050000	24.7	1000.0	120.000	V	18.1	24.9	49.60
290.700000	21.2	1000.0	120.000	H	18.3	29.7	50.90
306.900000	22.5	1000.0	120.000	V	18.7	28.8	51.30

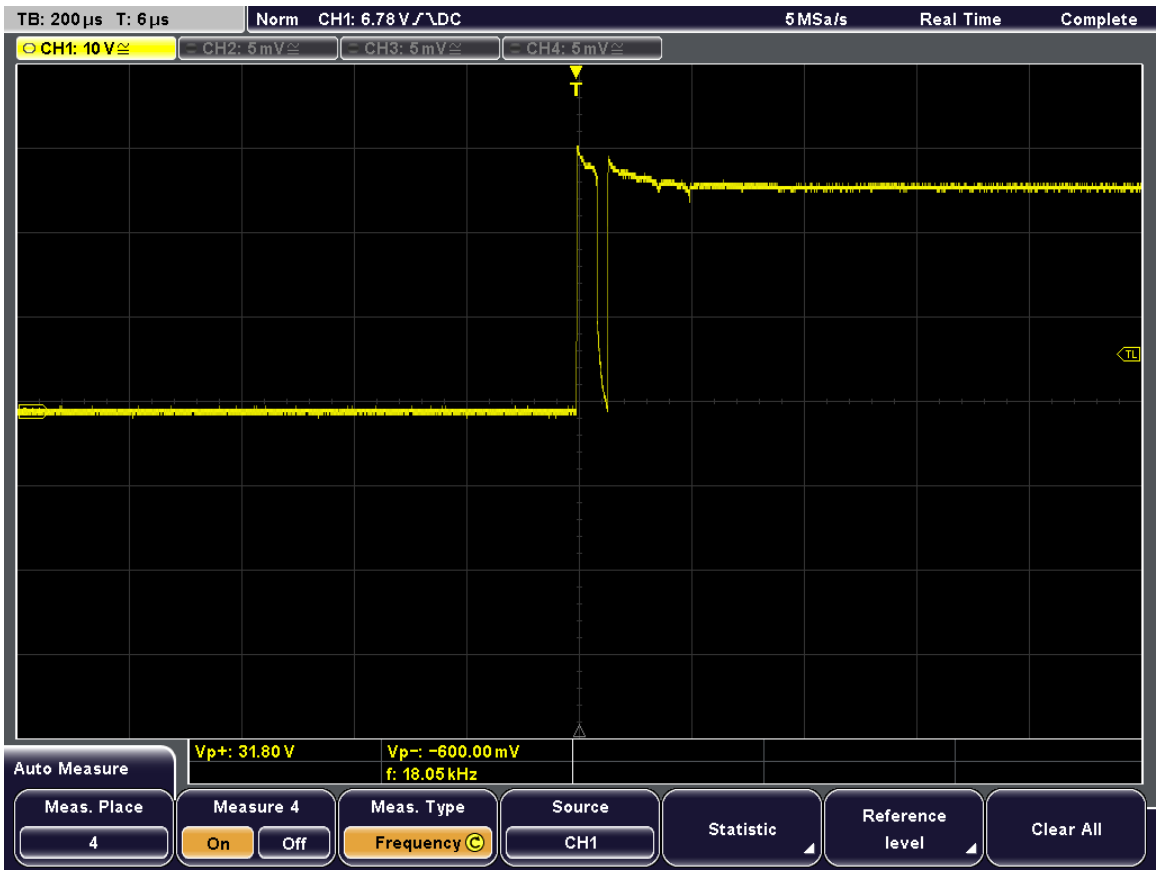
5.2 Voltage Transient Emissions

Pulse	Measurement	Level	Limit
SLOW	Switch Off Transient (relay before LISN)	-2.6V	-450 V to +150 V
SLOW	Switch On Transient (relay before LISN)	31.8V	-450 V to +150 V
FAST	Switch Off Transient (relay after LISN)	-100V	-450 V to +150 V
FAST	Switch On Transient (relay after LISN)	78V	-450 V to +150 V
REPETITIVE	Switch On Transient (relay after LISN)	None seen	-450 V to +150 V

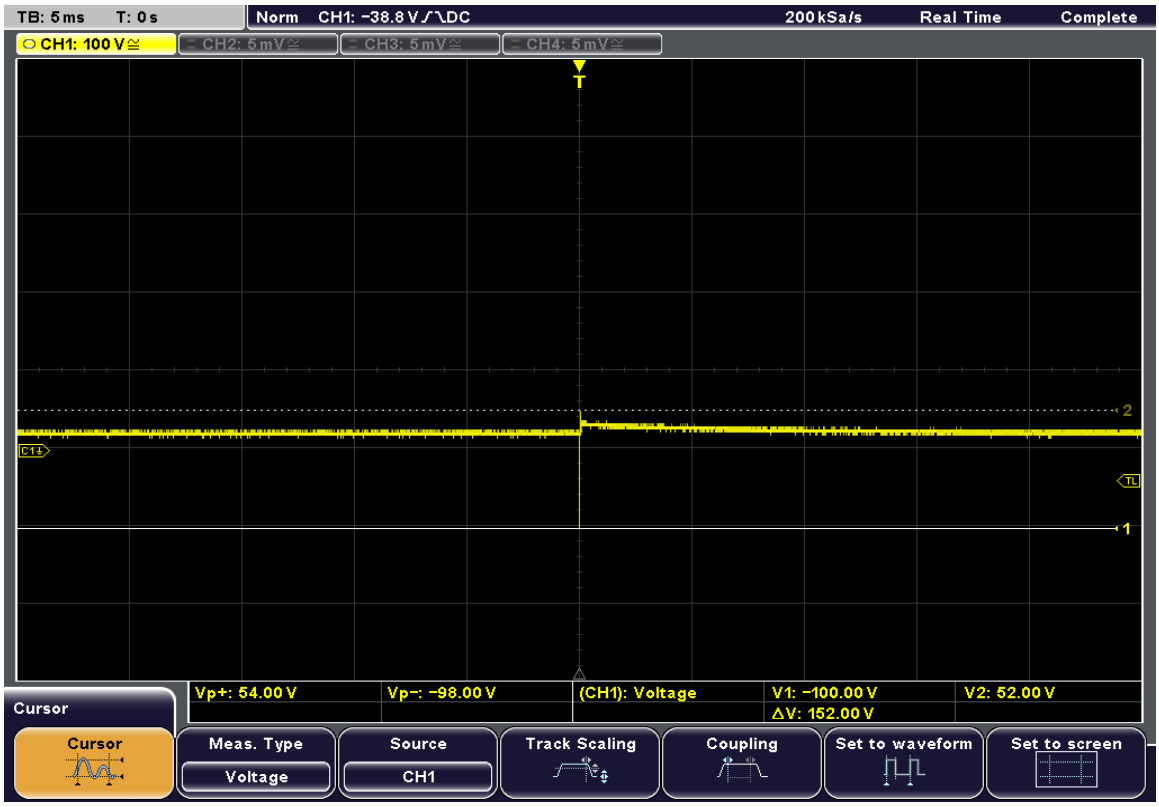
5.2.1 Oscilloscope Trace – Switch Off Transient (relay before LISN)



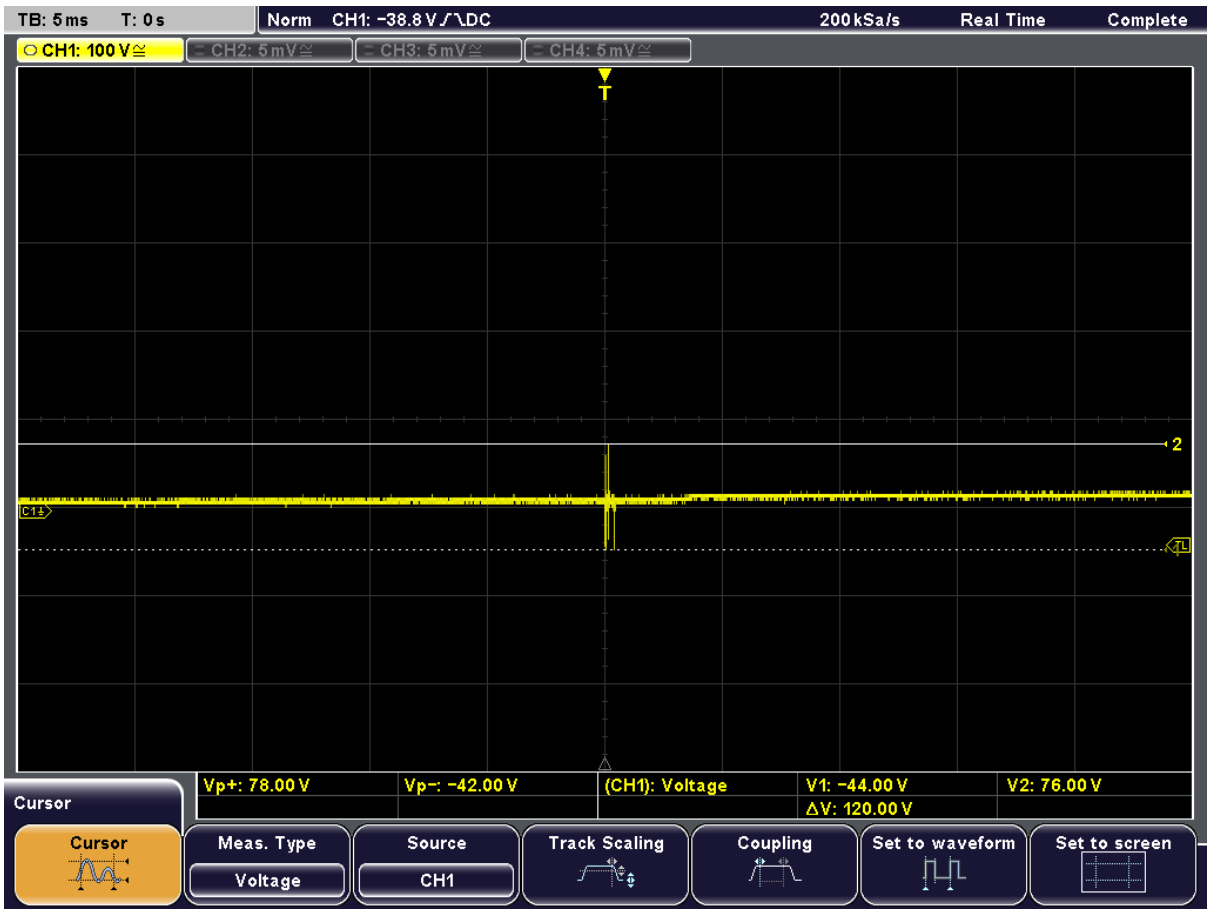
5.2.2 Oscilloscope Trace – Switch On Transient (relay before LISN)



5.2.3 Oscilloscope Trace – Switch Off Transient (relay after LISN)



5.2.4 Oscilloscope Trace – Switch On Transient (relay after LISN)



5.3 Vehicle Transients and Surge Immunity

5.3.1 Classification of Functional Status

Class A: all functions of a device/system perform as designed during and after exposure to disturbance.

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 shall remain class A.

Class C: one or more functions of a device/system do not perform as designed during exposure but return automatically to normal operation after exposure is removed.

Class D: one or more functions of a device/system do not perform as designed during exposure and do not return to normal operation until exposure is removed and the device/system is reset by simple “operator/use” action.

Class E: one or more functions of a device/system do not perform as designed during and after exposure and cannot be returned to proper operation without repairing or replacing the device/system.

Note: The word “function” in this context refers only to the function performed by the electronic system.

Pulse	*2004/104/EC*	*During Test*	*After Test*
Level	III 2004/104/EC		
1	A	No Recorded Effects	No Recorded Effects
2a	A	No Recorded Effects	No Recorded Effects
2b	A	No Recorded Effects	No Recorded Effects
3a	A	No Recorded Effects	No Recorded Effects
3b	A	No Recorded Effects	No Recorded Effects
4	A	No Recorded Effects	No Recorded Effects

5.3.2 Test Pulse 1

Severity Level	*Us (V)*	*Ri (Ω)*	*td (m)s*	*tr (µs)*	*t1 (s)*	*t2 (ms)*	*t3 (µs)*	*Performance Criteria*	
								Actual	*Required*
III (24V System)	-450	50	1	3	2	200	100	A	Note 1 C/D

5.3.3 Test Pulse 2a

Severity Level	*Us (V)*	*Ri (Ω)*	*td (m)s*	*tr (µs)*	*t1 (s)*	*Performance Criteria*	
						Actual	*Required*
III (24V System)	37	2	0.05	1	0.5	A	Note 1 B/D

5.3.4 Test Pulse 2b

Severity Level	*Us (V)*	*Ri (Ω)*	*td (s)*	*T12 (ms)*	*tr (ms)*	*T6 (ms)*	*Performance Criteria*	
							Actual	*Required*
III (24V System)	20	0	0.22	1	1	1	A	Note 1 C/D

5.3.5 Test Pulse 3a

Severity Level	*Us (V)*	*Ri (Ω)*	*td (µs)*	*tr (ns)*	*t1 (µs)*	*t4 (ms)*	*t5 (ms)*	*Performance Criteria*	
								Actual	*Required*
III (24V System)	-150	50	0.1	5	100	10	90	A	Note 1 A/D

5.3.6 Test Pulse 3b

Severity Level	*Us (V)*	*Ri (Ω)*	*td (µs)*	*tr (ns)*	*t1 (µs)*	*t4 (ms)*	*t5 (ms)*	*Performance Criteria*	
								Actual	*Required*
III (24V System)	150	50	0.1	5	100	10	90	A	Note 1 A/D

5.3.7 Test Pulse 4

Severity Level	*Us (V)*	*Ua (V)*	*Ri (Ω)*	*T7 (ms)*	*T8 (ms)*	*T9 (s)*	*T10 (ms)*	*T11 (ms)*	*Performance Criteria*	
									Actual	*Required*
III (24V System)	-12	-5	0.01	100	50	1	10	100	A	Note 1 B/D

Tail Lift exercised on completion of each transient program

5.4 *RF Immunity*

Method	LEVEL (V) Modulated	PERFORMANCE CRITERIA	
		ACTUAL	REQUIRED
ISO 11452-2	30 V/m	No Events	See section 3.6

6 LIST OF EMC MODIFICATIONS

The following EMC modifications were incorporated in the equipment during testing, in the order detailed below giving reference to the associated test.

- Emissions Modification(s)

No.	*Modification*	*Reason for modification*
1	Würth Electronik Disk varistor Pt No. 820 55 250 fitted across motor ± Supply terminals	Failed fast pulse transient emissions when lowering of tail lift ceased

- Immunity Modification(s)

No.	*Modification*	*Reason for modification*
1	None	

Note: Opinions made above, fall outside the TRaC Global UKAS scope of laboratory accreditation, and are based entirely on rationale and assumption obtained from technical information, competence and experience, deemed correct at the time of test.

7 CONCLUSIONS

7.1 Sequence of Test Suite

The applied EMC tests were conducted in the following order of events:

Applied Test	*Order*
Radiated Emissions	1
ISO 7637-2 Pulse 1	4
ISO 7637-2 Pulse 2b	6
ISO 7637-2 Pulse 3b	8
Transient Emission Slow Pulse	2

Applied Test	*Order*
ISO 7637-2 Pulse 2a	5
ISO 7637-2 Pulse 3a	7
ISO 7637-2 Pulse 4	9
Transient Emission Fast Pulse	3
Radiated Susceptibility	10

7.2 Emission Tests

The EUT meets the Broadband and Narrowband ESA emissions requirements and the voltage transient emissions requirements of Commission Directive's 2004/104/EC, 2005/49/EC, 2005/83/EC, 2006/28/EC, 2009/19/EC and Regulation 10.04 in the configuration tested.

7.3 Explanation of the Final Results tables

Emissions in the result tables marked with an asterisk *, represent a level within measurement uncertainty.

Emissions in the result tables marked with a hash #, indicate the limit has been exceeded.

The correction is a value in dB made up from the insertion loss of the RF test cables and the antenna correction factors. These factors are added to the software from the calibration certificates and extrapolated accordingly. The figures are then added to the level read on the receiver at each frequency to give an absolute level in dBµV/m to compare against the published limit.

The margin is the difference between the corrected measured signal and the limit line. Levels with a -(minus) figure are those greater than the specification limit.

7.4 Immunity Tests

Test	*Severity Level*		*Performance Criteria*	
			Actual	*Required*
Vehicle Transients and Surges (as per ISO 7637-2)	Test Pulse 1	Level III	Class A	Note 1 Class C/D
	Test Pulse 2a	Level III	Class A	Note 1 Class B/D
	Test Pulse 2b	Level III	Class A	Note 1 ClassC/D
	Test Pulse 3a	Level III	Class A	Note 1 Class A/D
	Test Pulse 3b	Level III	Class A	Note 1 Class A/D
	Test Pulse 4	Level III	Class A	Note 1 Class B/D

Note should be taken of modifications (if any) as described in section 6 of this report.

Note 1: The higher performance criteria level is for a EUT with an Immunity related function.
Note 2: The lower performance criteria level is required for to a EUT with a Non-Immunity related function.

7.4 Conformity in Production (COP)

TRaC Global Ltd. has based this test report on results from the equipment sample(s) provided.

The manufacturer is advised that they may have an obligation to demonstrate that future production samples are in conformity with the Directive(s) noted.

APPENDIX A

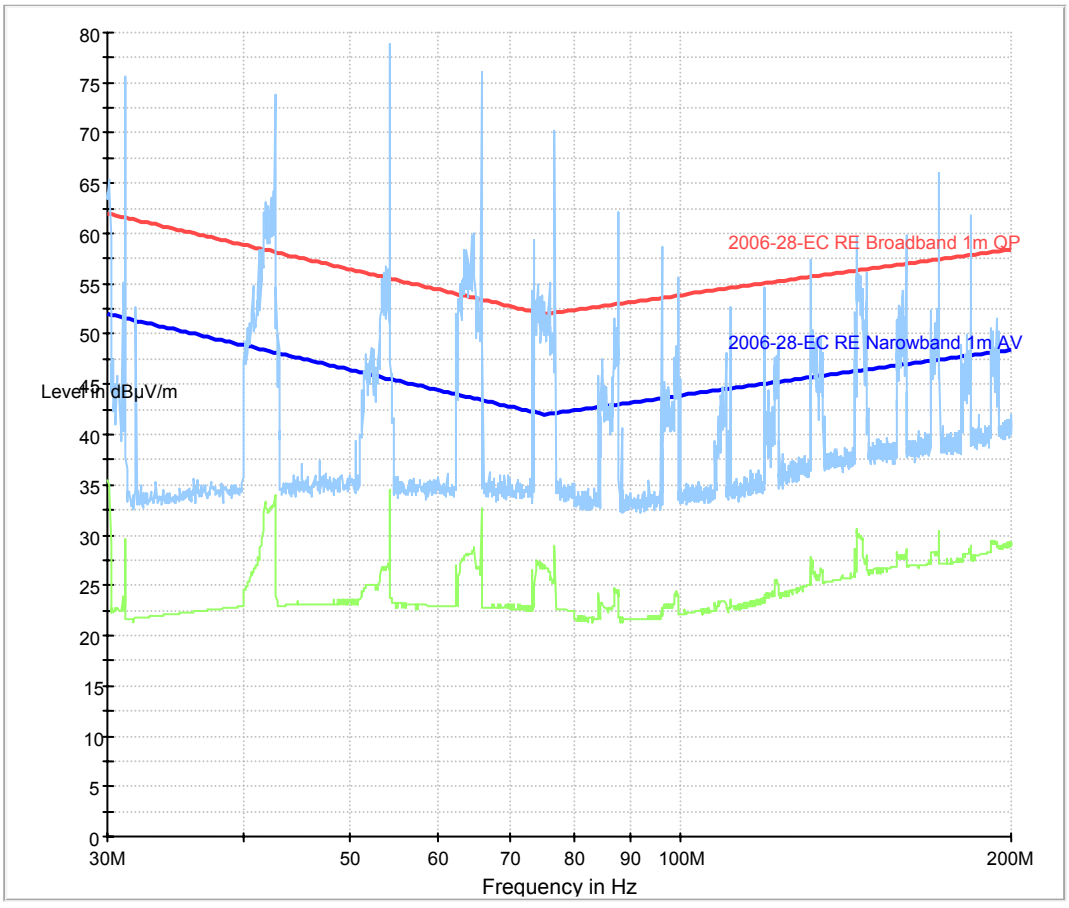
GRAPHS

GRAPH A1: 30-200MHz Emissions - Vertical Polarisation

EUT Information

TRaC Project Number:	TRA-012736-01
Manufacturer:	DEL Equipment Ltd
Model Name:	24VDC MICRO Tail Lift power pack
Model Number:	SL250
Serial Number:	-
Specification:	2004/104/EC
Test Location:	Mil 1
Test Engineer:	JP
Antenna Polarisation:	Vertical
EUT Mode:	Tail lift cycling up and down
Voltage:	27.5Vdc
Modification State:	0
Comment:	

2006-28-EC RE 30-200MHz BB & NB ESI7

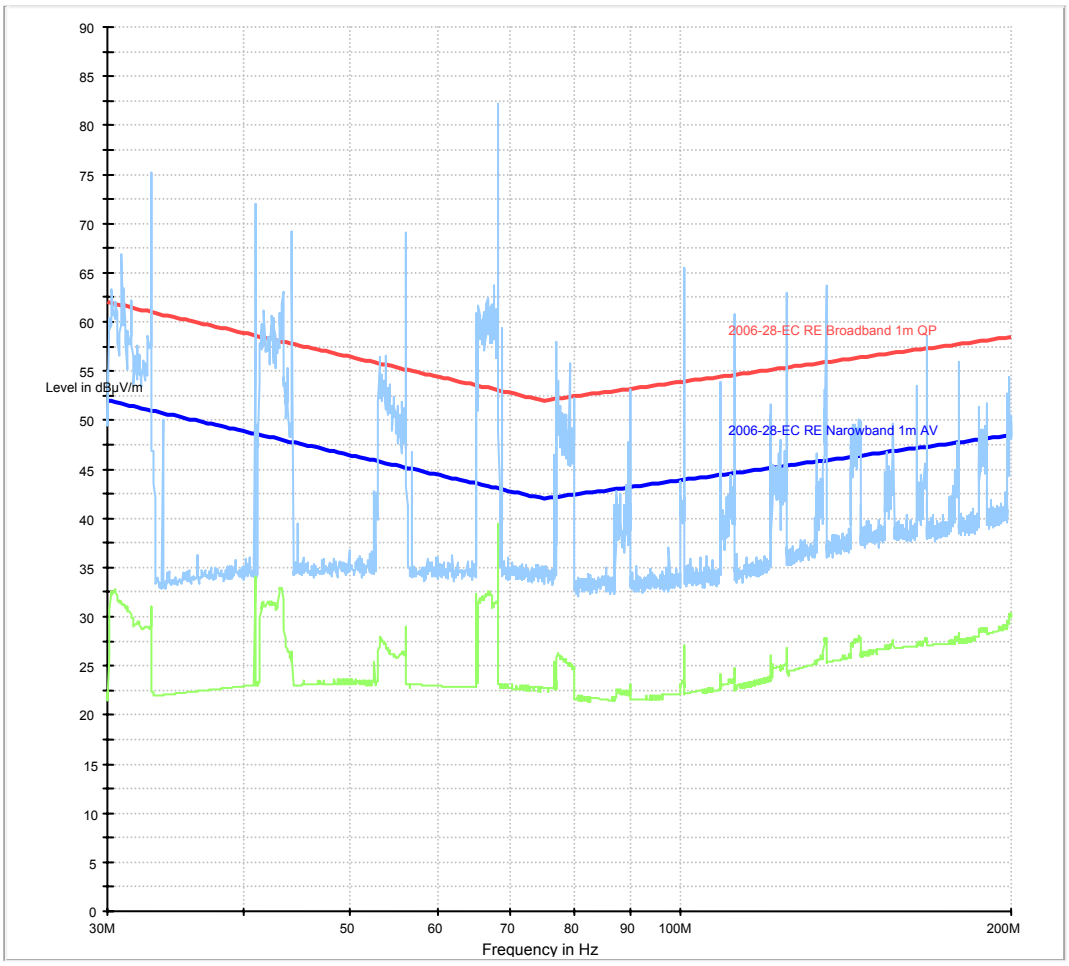


GRAPH A2: 30-200MHz Emissions - Horizontal Polarisation

EUT Information

TRaC Project Number:	TRA-012736-01
Manufacturer:	DEL Equipment Ltd
Model Name:	24VDC MICRO Tail Lift power pack
Model Number:	SL250
Serial Number:	-
Specification:	Directive 2006-28-EC
Test Location:	Mil 1
Test Engineer:	JP
Antenna Polarisation:	Horizontal
EUT Mode:	Tail lift cycling up and down
Voltage:	27.5Vdc
Modification State:	0
Comment:	

2006-28-EC RE 30-200MHz BB & NB ESI7

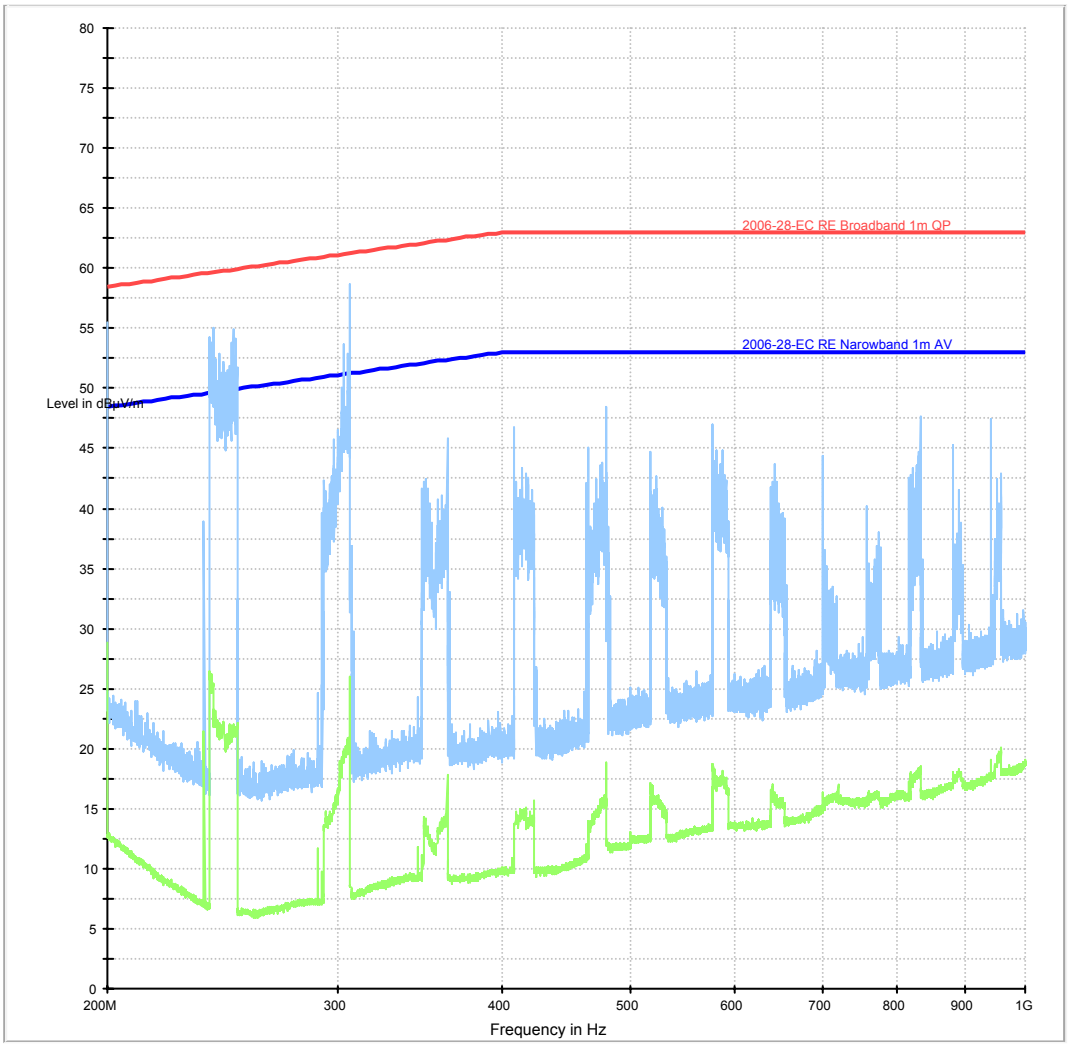


GRAPH A3: 200MHz-1GHz Emissions - Vertical Polarisation

EUT Information

TRaC Project Number:	TRA-012736-01
Manufacturer:	DEL Equipment Ltd
Model Name:	24VDC MIDI/MICRO Tail Lift power pack
Model Number:	SL250
Serial Number:	-
Specification:	Directive 2006-28-EC
Test Location:	Mil 1
Test Engineer:	JP
Antenna Polarisation:	Vertical
EUT Mode:	Tail lift cycling up and down
Voltage:	27.5Vdc
Modification State:	0
Comment:	

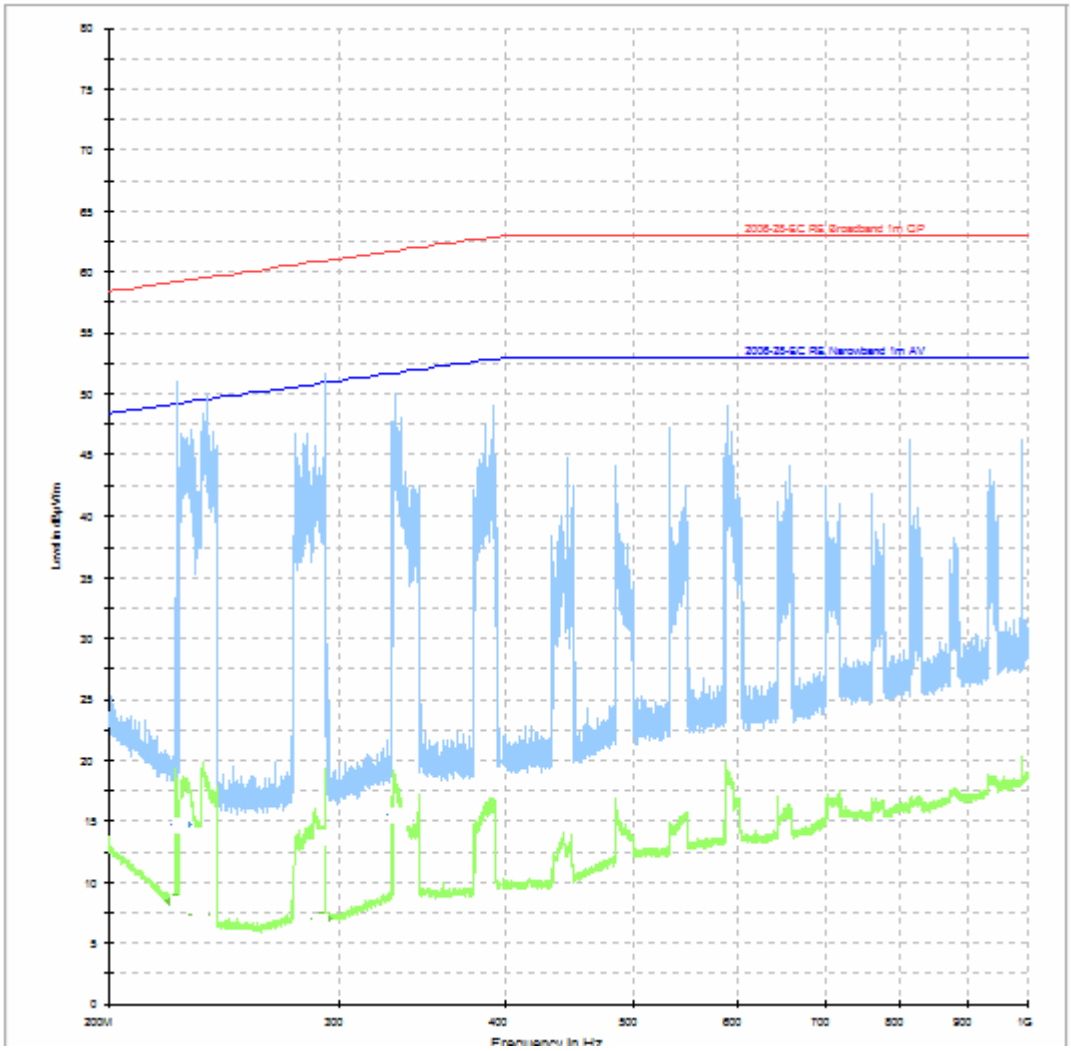
2006-28-EC RE 200MHz-1GHz BB & NB ESI7



GRAPH A4: 200MHz-1GHz Emissions - Horizontal Polarisation

EUT Information

TRaC Project Number:	TRA-012736-01
Manufacturer:	DEL Equipment Ltd
Model Name:	24VDC MIDI/MICRO Tail Lift power pack
Model Number:	SL250
Serial Number:	-
Specification:	Directive 2006-28-EC
Test Location:	Mil 1
Test Engineer:	JP
Antenna Polarisation:	Horizontal
EUT Mode:	Tail lift cycling up and down
Voltage:	27.5Vdc
Modification State:	0
Comment:	



APPENDIX B

EMC TEST MEASUREMENT UNCERTAINTY

2004/104/EC Automotive Measurement Uncertainty

All statements of uncertainty are expanded standard uncertainty using a coverage factor of 2.00 to give a 95% confidence where no required test level exists. Where a test level exists (for example, radiated immunity) the standard uncertainty is expanded by a coverage factor of 1.64 to give a 95% confidence.

[1] Automotive Transients

Waveform Verification Parameters PULSE 1

12V No Load, As per Annex D.3.1 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-105.6	-100	-90	-110	-106.1872	-103.01

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	0.83	1	1	0.5	0.846019	0.81

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	2000	2000	2400	1600	2038.6	1961.40

12V 10Ω Load, As per Annex D.3.1 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-54	-50	-40	-60	-52.542	-55.46

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	1290	1500	1800	1200	1318.896	1261.10

24V No Load, As per Annex D.3.1 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-630	-600	-540	-660	-645.435	-614.57

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	2.6	3	3	1.5	2.65018	2.55

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	1050	1000	1200	800	1070.265	1029.74

24V 50Ω Load, As per Annex D.3.1 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-321	-300	-270	-330	-312.333	-329.67

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	928	1000	1200	800	948.7872	907.21

Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	52	50	55	45	53.274	50.73

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	0.83	1	1	0.5	0.846019	0.81

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	44.6	50	60	40	45.46078	43.74

2Ω Load, As per Annex D.3.2 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	21.2	25	30	20	21.7724	20.63

Parameter	Measured (µs)	Wanted (µs)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	12.72	12	14.4	9.6	13.004928	12.44

Waveform Verification Parameters PULSE 2b

No Load - 12V, As per Annex D.3.2 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	10.72	10	11	9	10.98264	10.46

Parameter	Measured (ms)	Wanted (ms)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	0.8	1	1.5	0.5	0.81544	0.78

Parameter	Measured (s)	Wanted (s)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	2.05	2	2.4	1.6	2.099758	2.02

No Load - 24V, As per Annex D.3.2 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	19.7	20	22	18	20.18265	19.22

Parameter	Measured (ms)	Wanted (ms)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	0.9	1	1.5	0.5	0.91737	0.88

Parameter	Measured (s)	Wanted (s)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	1.99	2	2.4	1.6	2.028407	1.95

0.5Ω Load - 12V, As per Annex D.3.2 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	10.6	10	11	9	10.8862	10.31

Parameter	Measured (ms)	Wanted (ms)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	0.8	1	1.5	0.5	0.81792	0.78

Parameter	Measured (s)	Wanted (s)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	2.06	2	2.4	1.6	2.106144	2.01

0.5Ω Load - 24V, As per Annex D.3.2 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	19.7	20	22	18	20.18265	19.22

Parameter	Measured (ms)	Wanted (ms)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	0.9	1	1.5	0.5	0.91737	0.88

Parameter	Measured (s)	Wanted (s)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	2.06	2	2.4	1.6	2.099758	2.02

Waveform Verification Parameters PULSE 3a

12V No Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-210	-200	-180	-220	-215.145	-204.86

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	4.6	5	6.5	4.5	4.68878	4.51

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	131	150	195	105	133.5283	128.47

24V No Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-210	-200	-180	-220	-215.145	-204.86

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	4.6	5	6.5	4.5	4.68878	4.51

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	131	150	195	105	133.5283	128.47

12V 50Ω Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-112	-100	-80	-120	-115.024	-108.98

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	5	5	6.5	4.5	5.112	4.89

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	107.5	150	195	105	109.908	105.09

24V 50Ω Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	-112	-100	-80	-120	-115.024	-108.98

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	5	5	6.5	4.5	5.112	4.89

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	107.5	150	195	105	109.908	105.09

Waveform Verification Parameters PULSE 3b

12V No Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	209	200	220	180	214.1205	203.88

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	4.52	5	6.5	3.5	4.607236	4.43

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	114	150	195	105	116.2002	111.80

24V No Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.45%
Uncertainty in time measurement 1.93%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	209	200	220	180	214.1205	203.88

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	4.52	5	6.5	3.5	4.607236	4.43

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	114	150	195	105	116.2002	111.80

12V 50Ω Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	114	100	120	80	117.078	110.92

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	4.85	5	6.5	4.5	4.75416	4.55

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	108.2	150	195	105	110.62368	105.78

24V 50Ω Load, As per Annex D.3.3 ISO 7637-2:2004

Uncertainty in amplitude measurement 2.70%
Uncertainty in time measurement 2.24%

Parameter	Measured (V)	Wanted (V)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Us	114	100	120	80	117.078	110.92

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
Tr	4.85	5	6.5	4.5	4.75416	4.55

Parameter	Measured (ns)	Wanted (ns)	Upper Tolerance	Lower Tolerance	Measured+Cal Uncertainty	Measured-Cal Uncertainty
td	108.2	150	195	105	110.62368	105.78

Uncertainty in establishing transient / surge amplitude measurement without load resistor = 2.45%

Uncertainty in establishing transient / surge amplitude measurement with load resistor = 2.70%

Uncertainty in establishing transient / surge time period without load resistor = 1.93%

Uncertainty in establishing transient / surge time period with load resistor = 2.24%

[2] Radiated Emissions

Uncertainty in test result = 5.8dB

[3] Radiated Immunity

Uncertainty in setting test level = 2.74dB

[4] Transient Emissions

Uncertainty in measuring transient amplitude = 2.45%

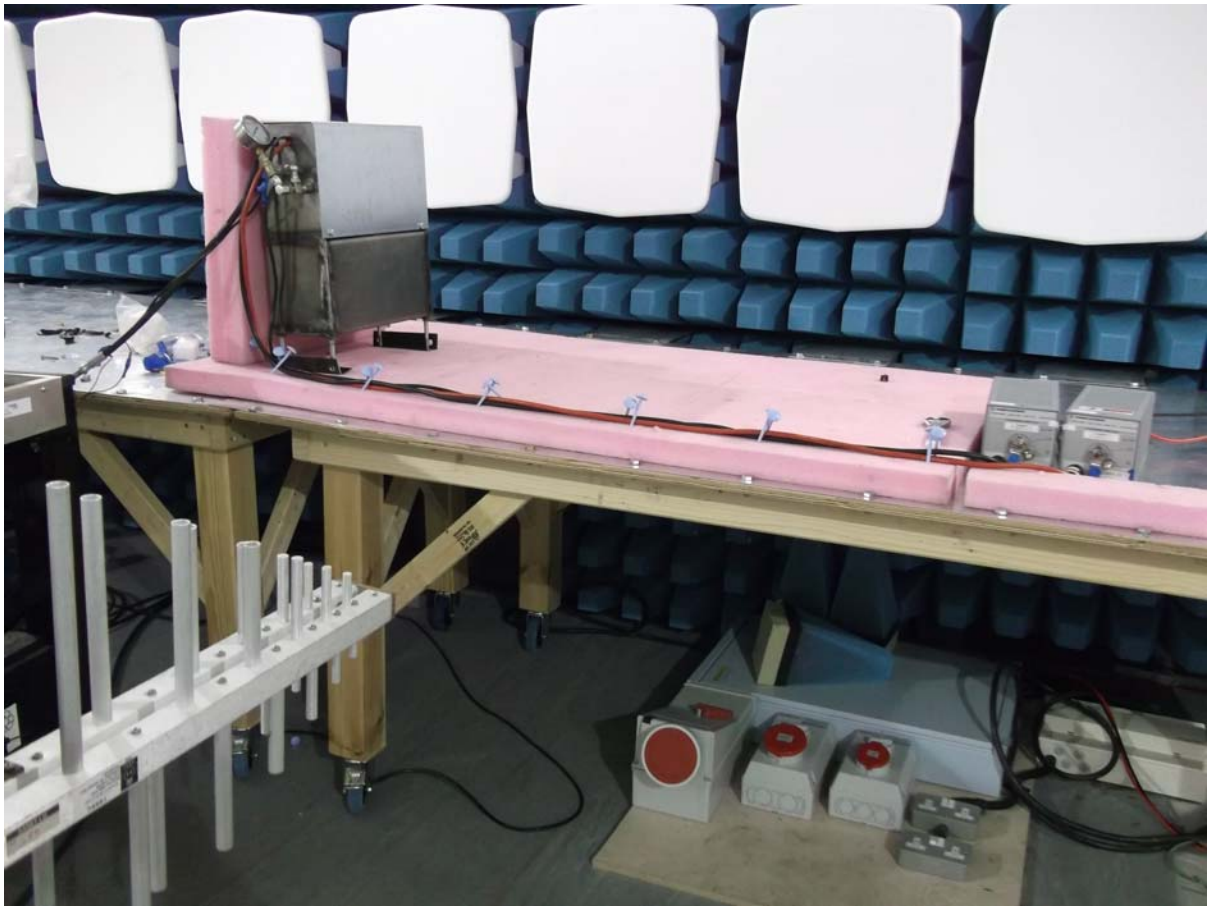
Uncertainty in measuring transient time period = 1.93%

APPENDIX C

PHOTOGRAPHS

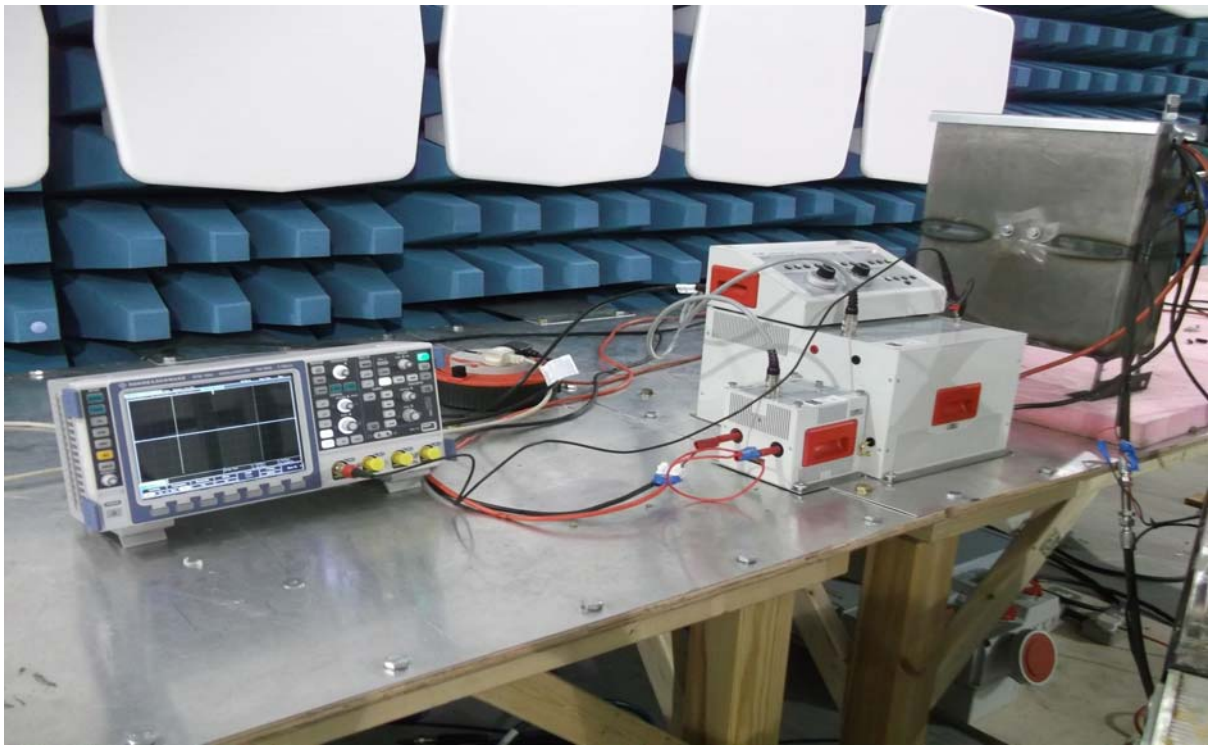
Photograph C1: Broadband and Narrowband Emissions Measurements

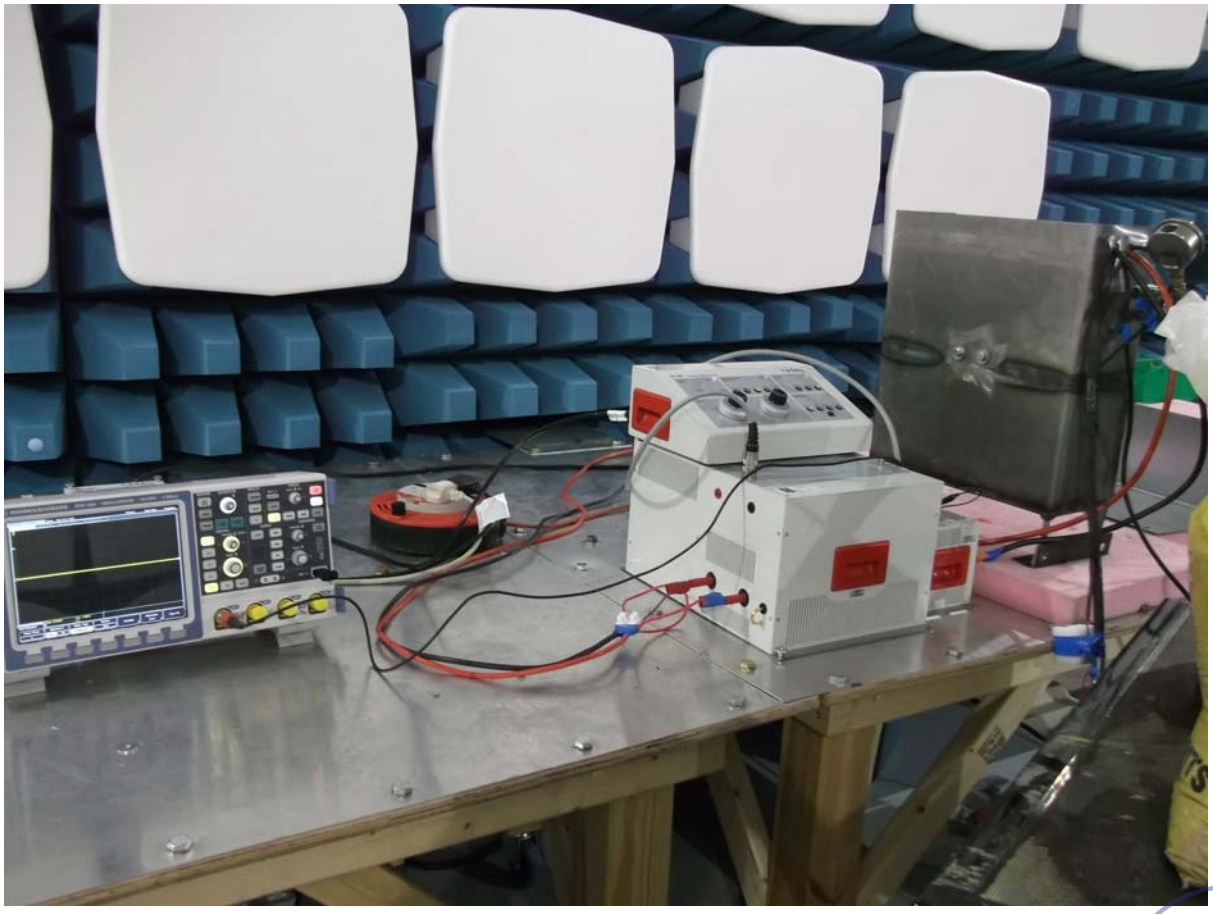
Biconical Antenna 30-200MHz



Log Periodic Antenna 200MHz-1GHz

Photograph C2: **Voltage Transient Emissions Measurements**





Photograph C3: Vehicle Transients and Surge Immunity

Photograph C4: Radiated RF Immunity