

# **Traco Power**

## **Model: TIB 120-124\***

### **Railway - Test Report**

**EN 50121-4 Railway applications. Electromagnetic compatibility.  
Emission and immunity of the signalling and telecommunications  
apparatus.**

**EN 50121-3-2 Railway applications. Electromagnetic compatibility.  
Emission and immunity. Rolling stock. Apparatus.**

EUT: Traco Power - Model: TIB 120-124

Serial No.: 21711000697/21537100003

Manufacturer No.: 120PSX184

Manufacturer: Traco Power Solutions Ltd.  
Whitemill Industrial Estate  
Wexford  
Republic of Ireland

Tester(s): Kevin Burke, Traco Power Solutions Ltd

Date: 15/03/2019

**\*Also covers models with EX designation**

It should be noted, that combining two or more CE compliant finished appliances does not automatically produce a compliant system. The manufacturer of an apparatus or a fixed installation as defined in the “Guide for the EMC Directive 2004/108EC, 21. May 2007” is responsible for the EMC-compliance of the final apparatus.

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## 1. Conducted Emissions Measurement at Mains Terminals

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21537100003  
**Customer Spec:** XXXPSX184  
**Date:** 15/1/2016  
**Standards:** EN50121-4: 2016 referring to CISPR 16-2-1: 2005

### Notes:

- The unit passes CISPR 16-2-1 Class B limits therefore it also passes the railway requirement CISPR 16-2-1 with higher Class A limits. The results below are extracted from the standard Traco Power EMC test report.
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Emissions measured using Agilent E7402A EMC Analyzer and LISN Schwarzbeck NSLK 8127.
- Tested to IEC 61000-6-3: Ed 2.1 Class B limits.
- Transient limiter is used to protect the Agilent E7402A, with appropriate correction factors applied.
- Tests carried out in a shielded room.

### 1.1. Test Setup

#### Test Equipment Settings:

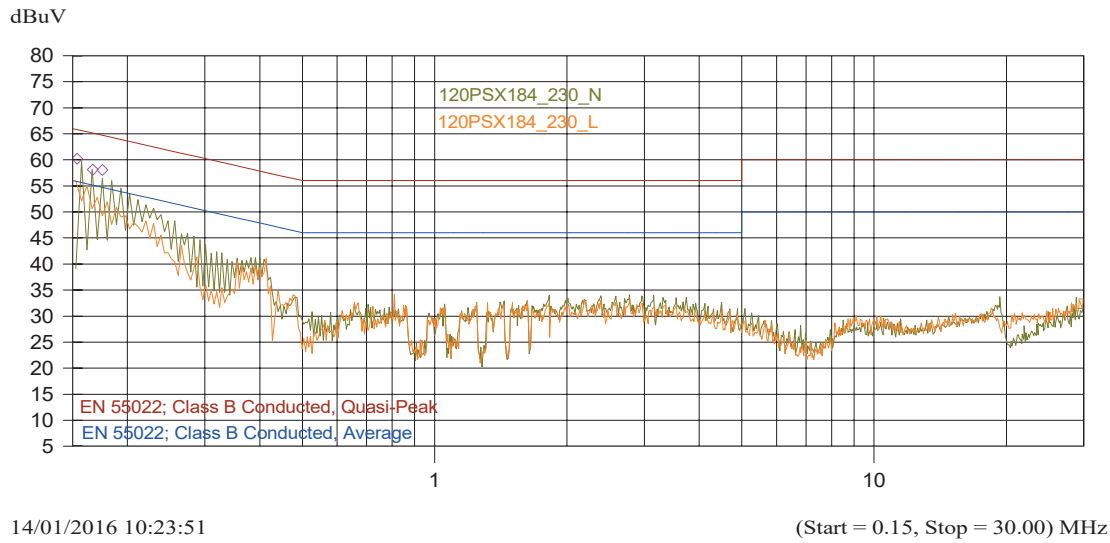
Start Freq.	Stop Freq.	Pk Time	Qpk Time	Avg Time
150kHz	30MHz	200ms	200ms	200ms

#### Test Setup:



## 1.2. Conducted Emissions Test Results (Mains Terminals)

### L and N



### Measurement-List

Frequency	Peak	Avg	QP	Peak-QP	Avg-Avg Limit	QP-QP Limit	Trace Name
MHz	dBuV	dBuV	dBuV	dB	dB		
0.154	60.2	27	53.6	-6	-28.8	-12.2	120PSX184_230_N
0.167	58.1	25.7	51.2	-7.5	-29.4	-13.9	120PSX184_230_N
0.175	58	33.4	50.4	-7.5	-21.3	-14.3	120PSX184_230_N

**Table 1 - Average and Quasi Peak Measurements of the TIB 120-124**

### Remarks:

The orange graph represents peak measurements of Live and the green graph represents peak measurements of Neutral. Quasi peak and average measurements are measured if the peak measurement is above the relevant limit. See Table 1.

**PASS**

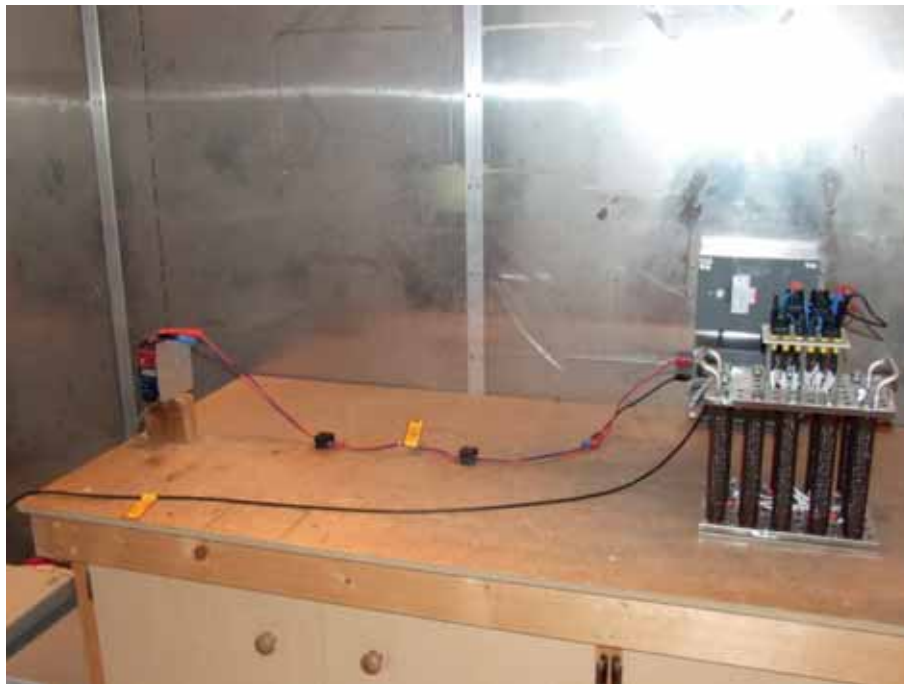
## 2. Conducted Emissions Measurements at DC output Terminals

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21711000697  
**Customer Spec:** XXXPSX184  
**Date:** 24/09/2018  
**Standards:** EN50121-4: 2016 referring to CISPR 16-2-1: 2005

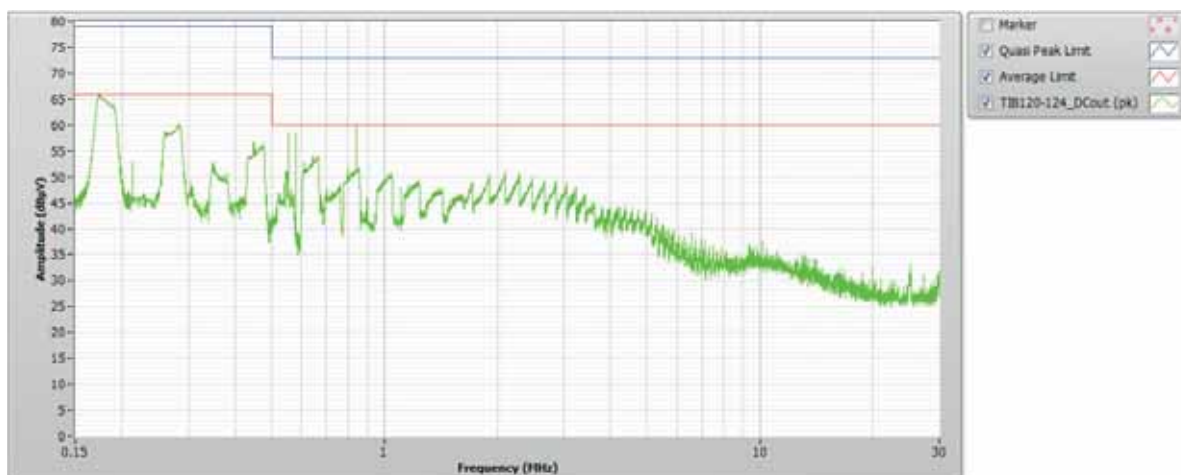
### Notes:

- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Emissions measured using Agilent E7402A and FCC-801-M2-50A Coupling/Decoupling network.
- Tested to EN50121-4 limits.
- Transient limiter used to protect Agilent E7402A, with appropriate correction factors applied.
- Appropriate correction factors also applied for output Coupling/Decoupling network.
- Tests carried out in a shielded room.

### 2.1. Test Setup



## 2.2 Conducted Emissions Test Results (DC output Terminals)



**PASS**



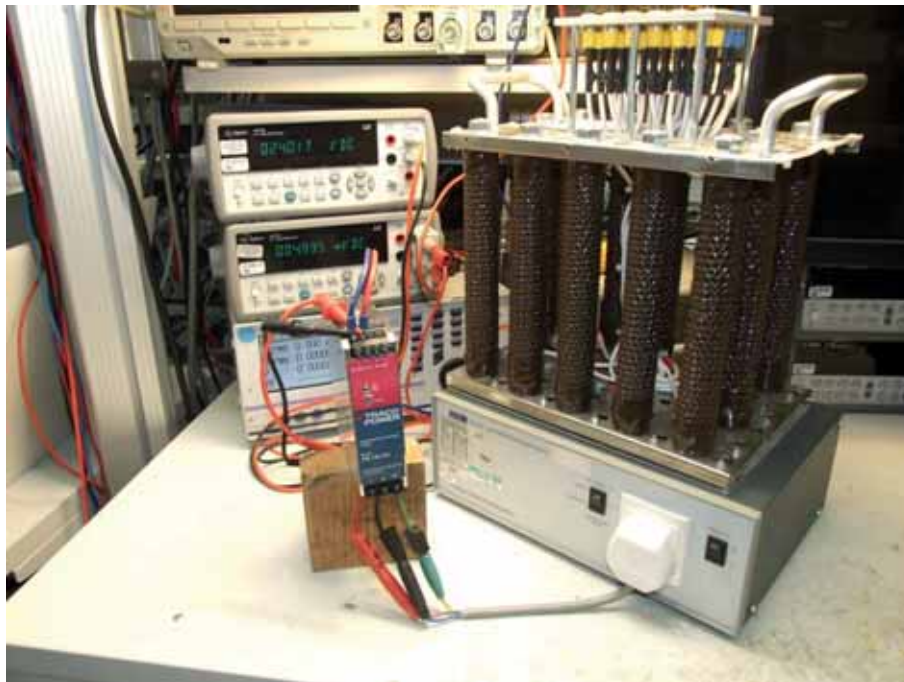
### 3. Harmonic Current Emissions Measurement at Mains Terminal

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21537100003  
**Customer Spec:** XXXPSX184  
**Date:** 15/1/2016  
**Standards:** EN50121-4: 2016 referring to IEC 61000-3-2: 2005

**Notes:**

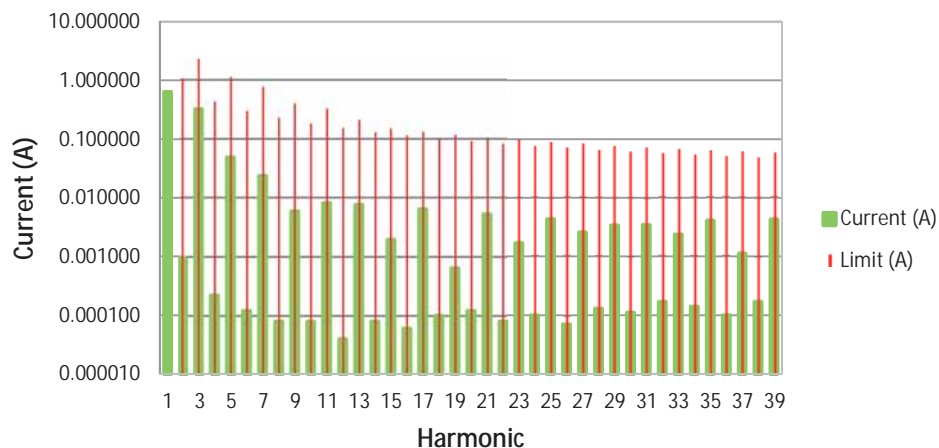
- This railway standard has the same requirements as IEC61000-6-3: 2011. The results below are extracted from the standard Traco Power EMC test report.
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- EUT powered by low-distortion AC Voltage Source, TTI AC-1000.
- Harmonic Limits measured using LMG 95 Power Meter.
- Tested to IEC61000-3-2 Table 1 Class A.

#### 3.1. Test Setup



## 3.2. Harmonic Current Emissions Test Results

Harmonic Measurements



Harmonic	Current (A)	Limit (A)	Harmonic	Current (A)	Limit (A)
0	0.000690		20	0.000120	0.092000
1	0.631630		21	0.005150	0.107143
2	0.000950	1.080000	22	0.000080	0.083636
3	0.315810	2.300000	23	0.001690	0.097826
4	0.000220	0.430000	24	0.000100	0.076667
5	0.047910	1.140000	25	0.004300	0.090000
6	0.000120	0.300000	26	0.000070	0.070769
7	0.023300	0.770000	27	0.002550	0.083333
8	0.000080	0.230000	28	0.000130	0.065714
9	0.005840	0.400000	29	0.003370	0.077586
10	0.000080	0.184000	30	0.000110	0.061333
11	0.007970	0.330000	31	0.003430	0.072581
12	0.000040	0.153333	32	0.000170	0.057500
13	0.007500	0.210000	33	0.002350	0.068182
14	0.000080	0.131429	34	0.000140	0.054118
15	0.001950	0.150000	35	0.003980	0.064286
16	0.000060	0.115000	36	0.000100	0.051111
17	0.006270	0.132353	37	0.001110	0.060811
18	0.000100	0.102222	38	0.000170	0.048421
19	0.000640	0.118421	39	0.004190	0.057692

**PASS**



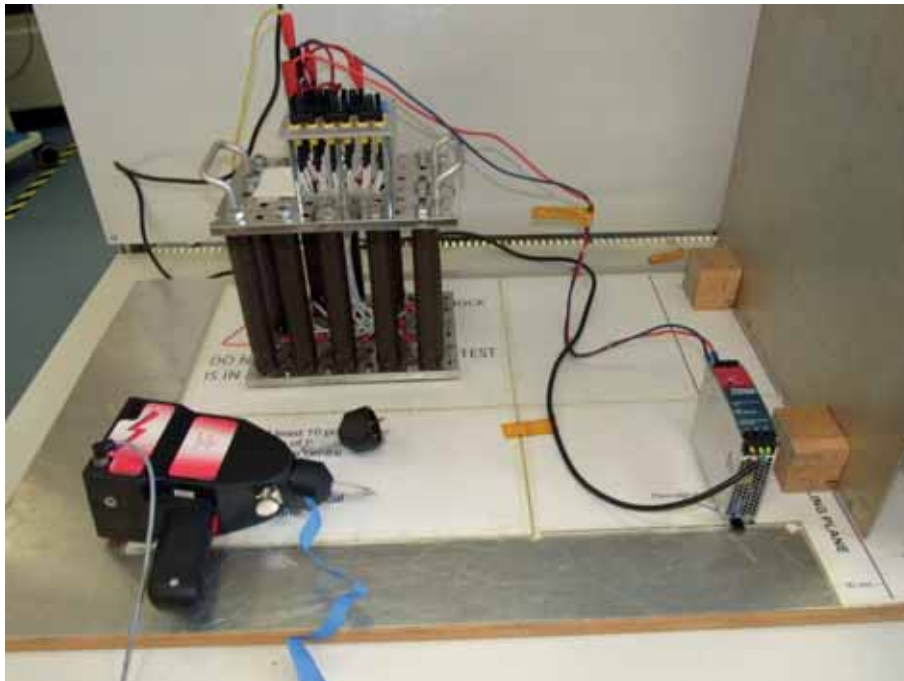
## 4. Electrostatic Discharge Immunity Test

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21711000697  
**Customer Spec:** XXXPSX184  
**Date:** 24/09/2018  
**Standards:** EN50121-4: 2016 referring to IEC 61000-4-2: 2000

### Notes:

- EN50121-4 test values 8kV/6kV (air/contact).
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Since the EUT output is isolated from earth, a 470K HV resistor was placed between output and Earth to provide a discharge path between spikes.
- Contact discharge tests shall be applied to all areas exposed to the end user under final installation using ESD gun SESD 200.
- Test voltage shall be increased from 2kV up to the max 8kV/6kV (air/contact) as required by the standard IEC/EN 61000-4-2.
- At least 10 discharges were applied per test point (in both polarities).
- A time interval between discharges of a least 1s was used.
- The ESD generator was held perpendicular to the test point wherever possible for repeatability of results.
- In the case of air discharges, the trigger is engaged at about 20cm and the tester is moved quickly toward the test point until a spark occurs and trigger is released.

### 4.1. Test Set-Up



## 4.2. Electrostatic Discharge Immunity Test Results

All exposed metal screw heads and ground planes were tested as contact test points and also as air test points. The connector pins and all vents and inlets were also tested as air test points.

	Contact Test points:	Air Test points:
EUT	PASS	PASS

### Conclusion:

The EUT still functions as expected after tests therefore it meets performance criteria B in accordance with EN 50121-1: 2017.

PASS

### Environmental conditions during ESD Test

	Environmental condition required according IEC61000-4-2	Environmental conditions measured
Ambient Temperature in [°C]	15 - 35	24
Air Humidity in [%]	30 - 60	55
Atmospheric Pressure in [kPa]	86.0 - 106.0	101

Environmental conditions during the test:

☒ kept

☐ not kept

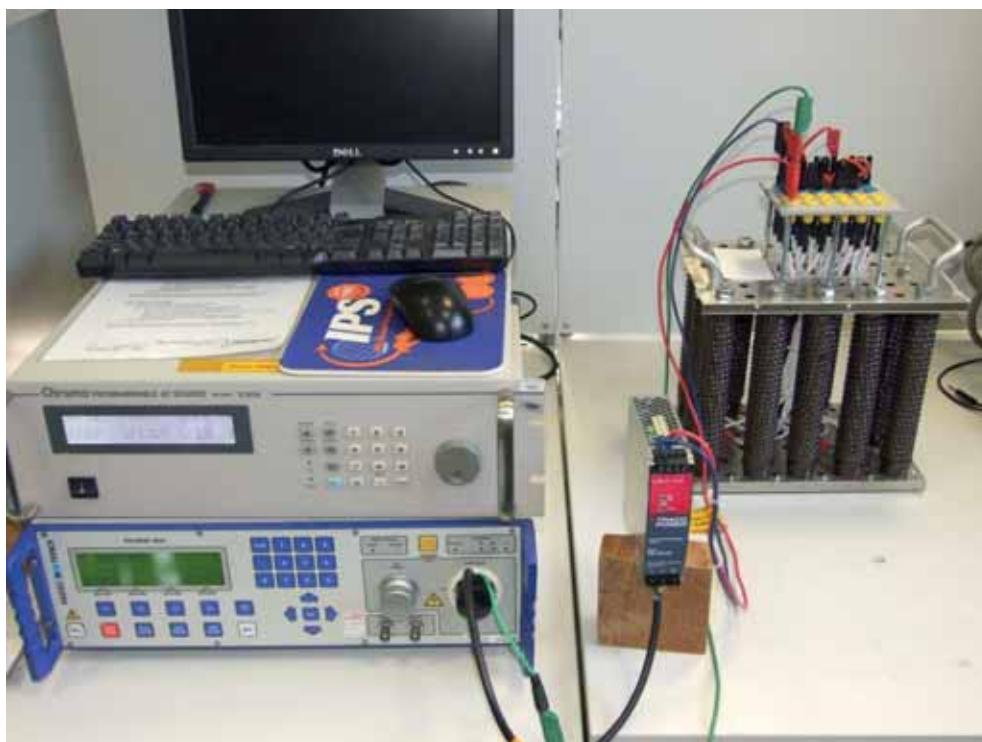
## 5. Surge Voltage Immunity Test

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21537100003  
**Customer Spec:** XXXPSX184  
**Date:** 15/1/2016  
**Standards:** EN50121-4: 2016 referring to IEC 61000-4-5: 2005

### Notes:

- This railway standard requires testing to IEC 61000-4-5 with higher DC port test values than IEC61000-6-2: 2005. The results below are extracted from the standard Traco Power EMC test report for AC port testing only.
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Used Haefely Surge generator PSURGE 4010.
- Voltage test level: AC port Line-Line +/- 1kV, AC port Line-Earth +/- 2kV (installation class 3).
- DC ports Line-Line & DC ports Line-Earth +/- 2kV & Signal Ports Line-Earth +/- 1kV (Not tested due to lack of suitable equipment).
- No. of Surges per set: 5 tests Positive and 5 tests Negative.
- Interval between surges: 10s.

### 5.1. Test Setup



## 5.2. Surge Voltage Immunity Test Results

	AC Line to Line	AC Line to PE	DC Line to Line	DC Line to PE
EUT	PASS	PASS	Not tested	Not tested

**Conclusion:**

The EUT meets performance criteria B as required by EN50121-1: 2017 Section 3.

PASS

## 6. Fast Transient Voltage Immunity Test (Burst)

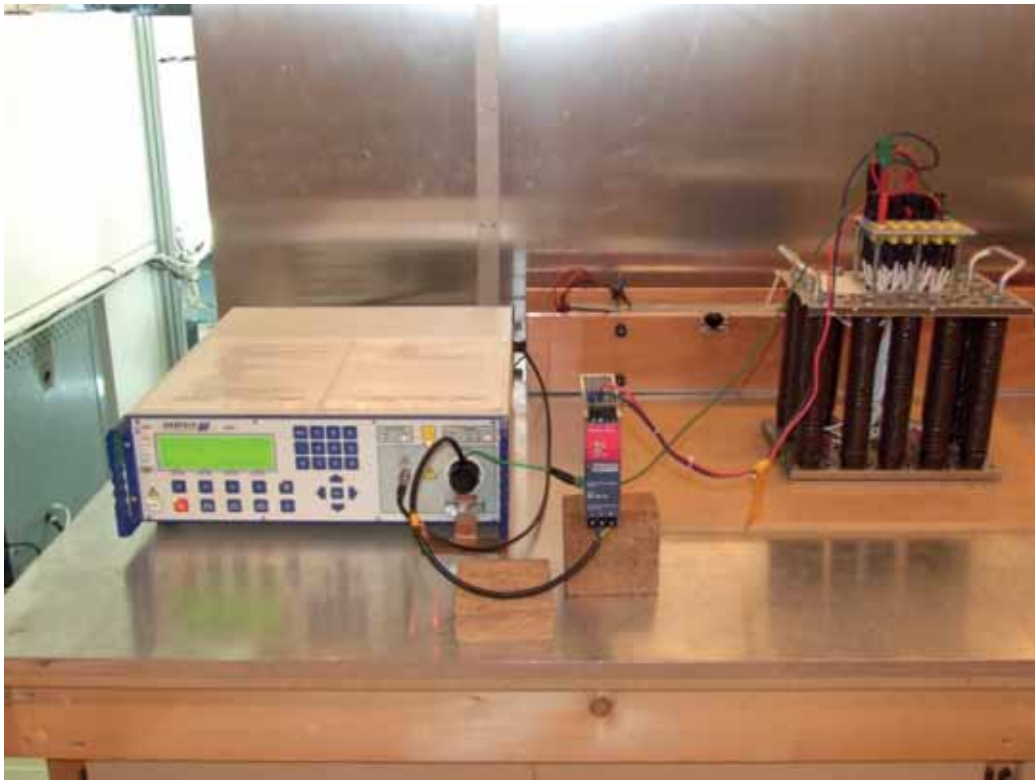
**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21711000697  
**Customer Spec:** XXXPSX184  
**Date:** 24/09/2018  
**Standard:** EN50121-4: 2016 referring to IEC 61000-4-4: 2004

### Notes:

- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Units tested to IEC61000-4-4 test level 3.
- Used Haefely Burst tester PEFT 4010.
- AC & DC Power ports and Signal Ports Voltage test level:  $\pm 2\text{kV}$ .
- Earth Port Voltage test level:  $\pm 1\text{kV}$ .
- Burst Duration: 0.75ms.
- Spike frequency: 5kHz.
- Burst Period: 300ms.
- Individual test time: 1 min.
- Polarity: Positive and Negative.

The Output lines and Signal lines were tested to the above mentioned limits with Haefely coupling capacitor IP4A.

### 6.1. Test Setup



Photograph for illustration only

## 6.2. Fast Transient Voltage (Burst) Test Results.

EUT:	L-G	N-G	PE-G	L, N-G	L,PE-G	N,PE-G	L, N,PE-G	Outputs -G	Signals -G
Positive	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS
Negative	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS	PASS

### Conclusion:

The EUT meets performance criteria A, defined as  $V_{out} > DC\ OK\ Limit$  (see specification) during the test, as required by EN50121-1: 2017 Section 3.

PASS



## 7. Conducted RF Immunity Test at AC Mains Terminals

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21711000697  
**Customer Spec:** XXXPSX184  
**Date:** 24/9/2018  
**Standard:** EN50121-4: 2016 referring to IEC 61000-4-6:2004

### Notes:

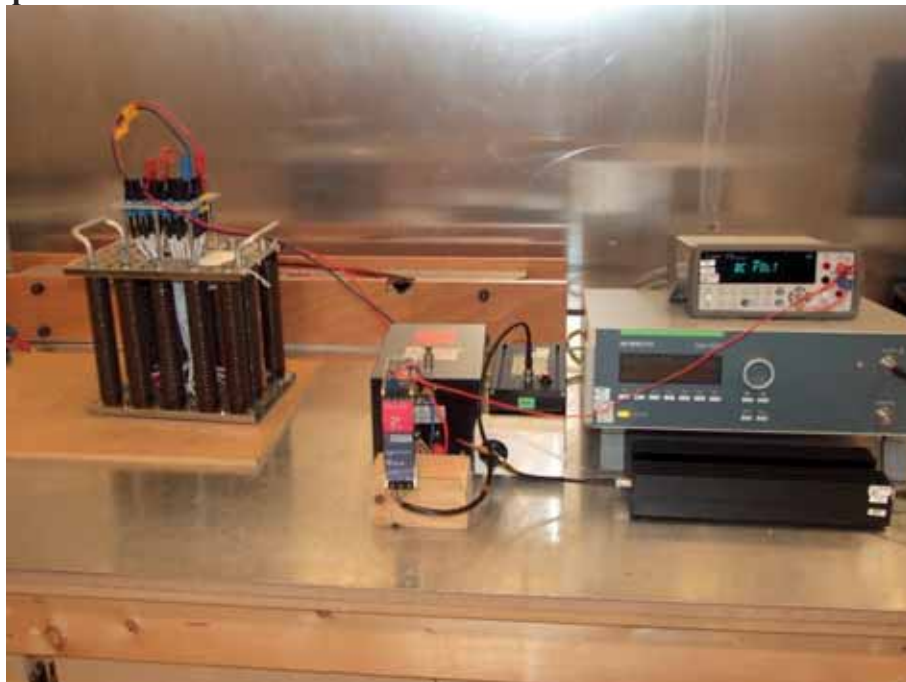
- This railway standard requires testing to IEC61000-4-6: 2004 but with an additional Earth Port measurement not needed for IEC61000-6-2:2005.
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Test carried out using test generator “EM Test CWS 500N”, Coupling/Decoupling network “EM Test CDN M2/M3”, an attenuator “EM Test ATT6/75” and measurement instrument “Agilent 3445A”.
- Unit tested to IEC61000-4-6 test level 3.
- CDN switch set to M2 for L,N testing and M3 for Earth Port (PE) testing.

### 7.1. Test Setup

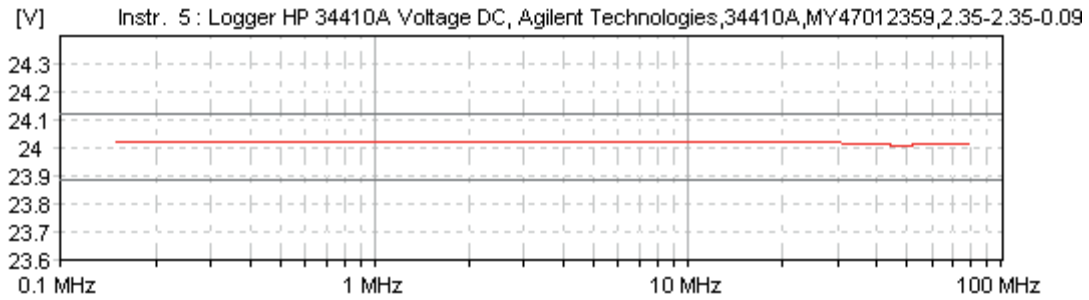
#### Test Equipment Settings:

Frq. start [MHz]	Level start [V]	Frq. stop [MHz]	Level stop [V]	Frq. step	td [s]	tp [s]	Modulation
0.150	10.0	80.000	10.0	1.0 %	0.5	0.0	AM 1kHz 80%

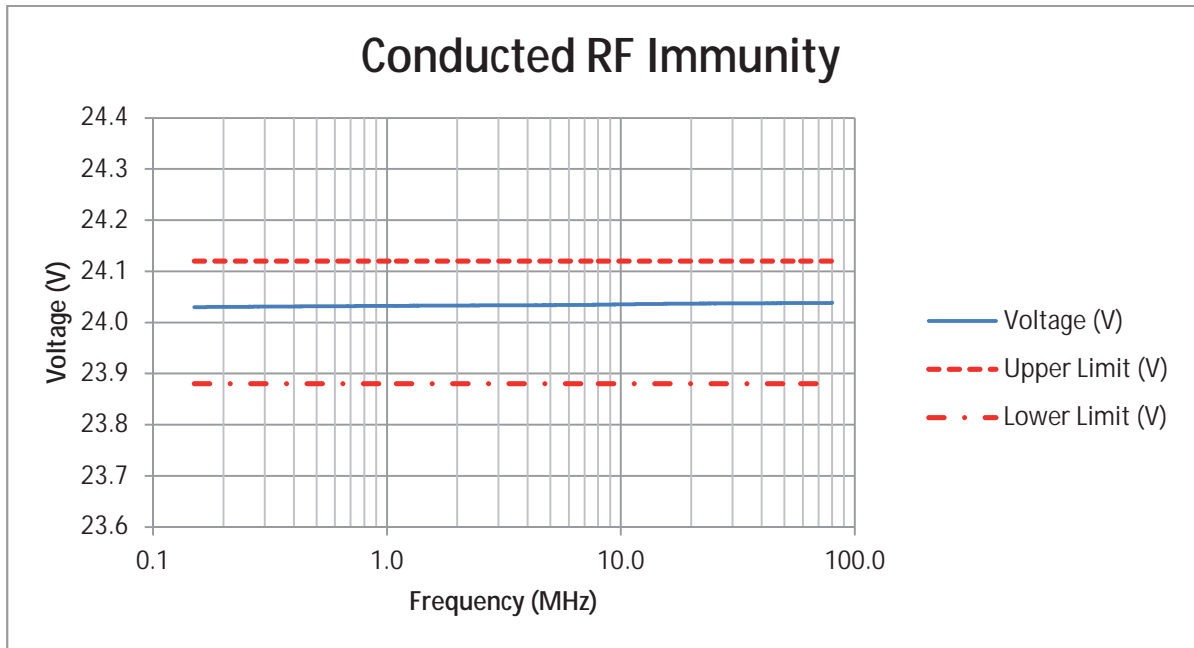
#### Test Setup:



## 7.2. Conducted RF Immunity Test Results



Conducted noise on L and N inputs.



Conducted noise on Earth Port (PE) input.

### Conclusion:

The EUT meets performance criteria A, defined as  $V_{out} > DC\ OK\ Limit$  (see specification) during the test, as required by EN50121-1: 2017 Section 3.

**PASS**

## 8. Conducted RF Immunity Test at DC Output Terminals

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21537100003  
**Customer Spec:** XXXPSX184  
**Date:** 15/1/2016  
**Standard:** EN50121-4: 2016 referring to IEC 61000-4-6:2004

### Notes:

- This railway standard has the same requirements as IEC61000-6-2: 2005. The results below are extracted from the standard Traco Power EMC test report.
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Test carried out using test generator “EM Test CWS 500N”, Coupling/Decoupling network “EM Test CDN M2/M3”, an attenuator “EM Test ATT6/75”, measurement instrument “Agilent 3445A” and FCC-801-M2-50A Coupling/Decoupling network.
- Unit tested to IEC61000-4-6 test level 3.

### 8.1. Test Setup

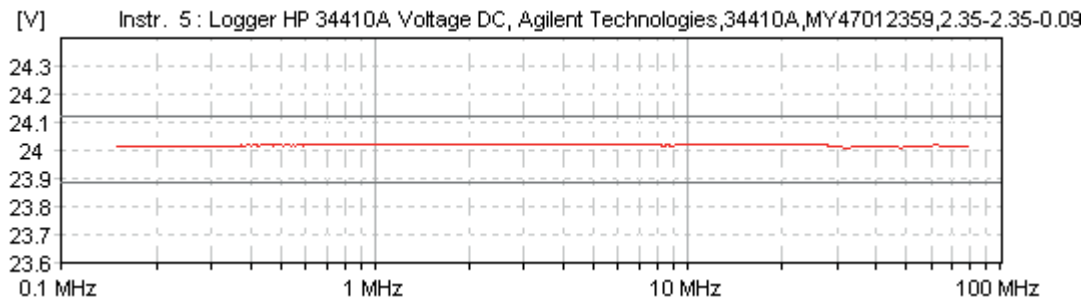
#### Test Equipment Settings:

Frq. start [MHz]	Level start [V]	Frq. stop [MHz]	Level stop [V]	Frq. step	td [s]	tp [s]	Modulation
0.150	10.0	80.000	10.0	1.0 %	0.5	0.0	AM 1kHz 80%

#### Test Setup:



## 8.2. Conducted RF Immunity Test Results



### Conclusion:

The EUT meets performance criteria A, defined as  $V_{out} > DC\ OK\ Limit$  (see specification) during the test, as required by EN50121-1: 2017 Section 3.

**PASS**

## 9. Radiated RF Immunity Test

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21537100003  
**Customer Spec:** XXXPSX184  
**Date:** 15/1/2016  
**Standard:** EN50121-4: 2016 referring to IEC61000-4-3: 2004

### Notes:

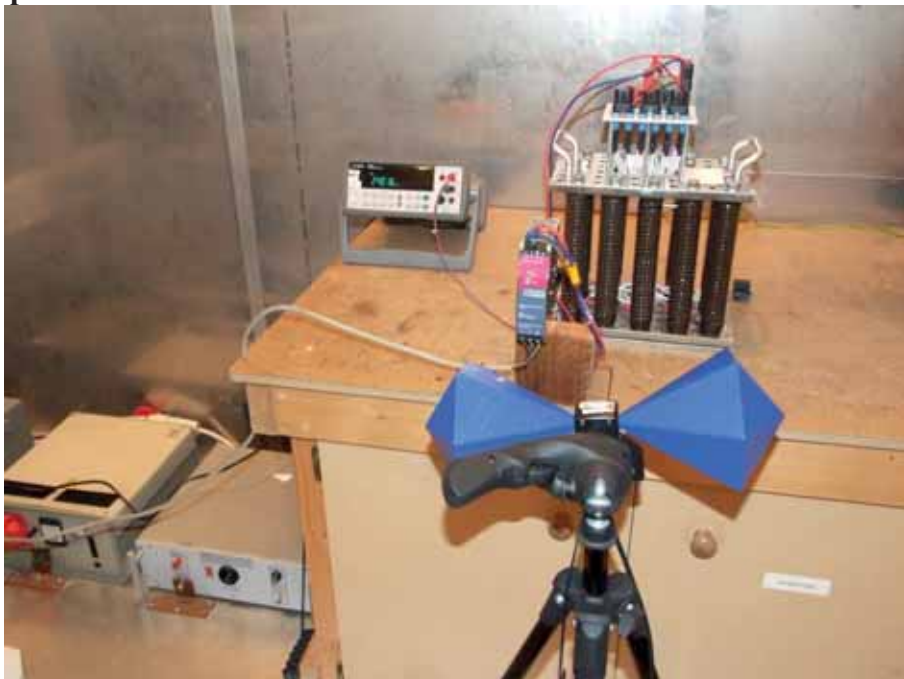
- This railway standard has the same requirements as IEC61000-6-2: 2005 up to 800MHz. The results below are extracted from the standard Traco Power EMC test report up to this frequency.
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Test carried out using test generator “EM Test CWS 500N”, Antenna BicoLOG 30100 X and Digitizing Multi Meter “Agilent 34405A”
- Measurement was carried out in a shielded room
- The input power port of the EUT was connected to mains via a 1.5m 3-core cable
- The output power port of the EUT was connected to the resistor bank via 1.5m long single core wires –wire size 14AWG
- The frequency range 800MHz-6GHz cannot be tested (due to the lack of equipment).

### 9.1. Test Setup

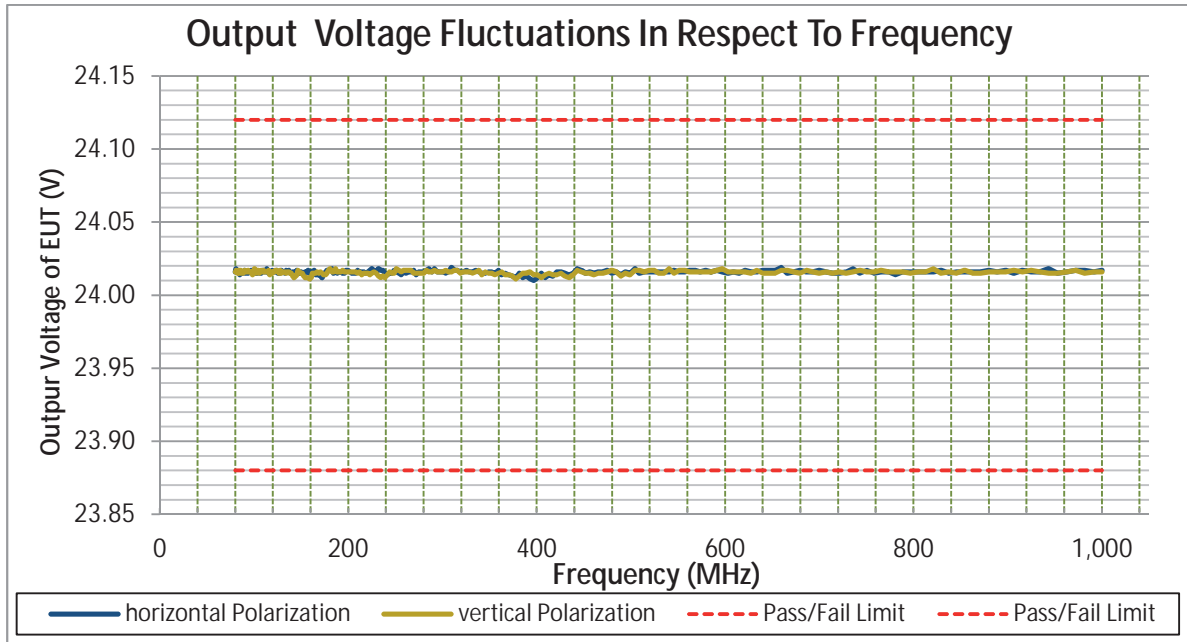
#### Test Equipment Settings:

Frq. start [MHz]	Level start [V]	Frq. stop [MHz]	Level stop [V]	Frq. step	td [s]
80.0	10.0	1000.0	10.0	1.0 %	1

#### Test Setup:



## 9.2. Radiated RF Immunity Test Results



### Conclusion:

The EUT meets performance criteria A, defined as  $V_{out} > DC\ OK\ Limit$  (see specification) during the test, as required by EN50121-1: 2017 Section 3.

**PASS**



## 10. Power Frequency Magnetic Field Immunity Test

**Equipment under Test:** TIB 120-124  
**EUT Serial No.:** 21711000697  
**Customer Spec:** XXXPSX184  
**Date:** 24/09/2018  
**Standard:** EN50121-4:2016 referring to IEC61000-4-8: 2001

### Notes:

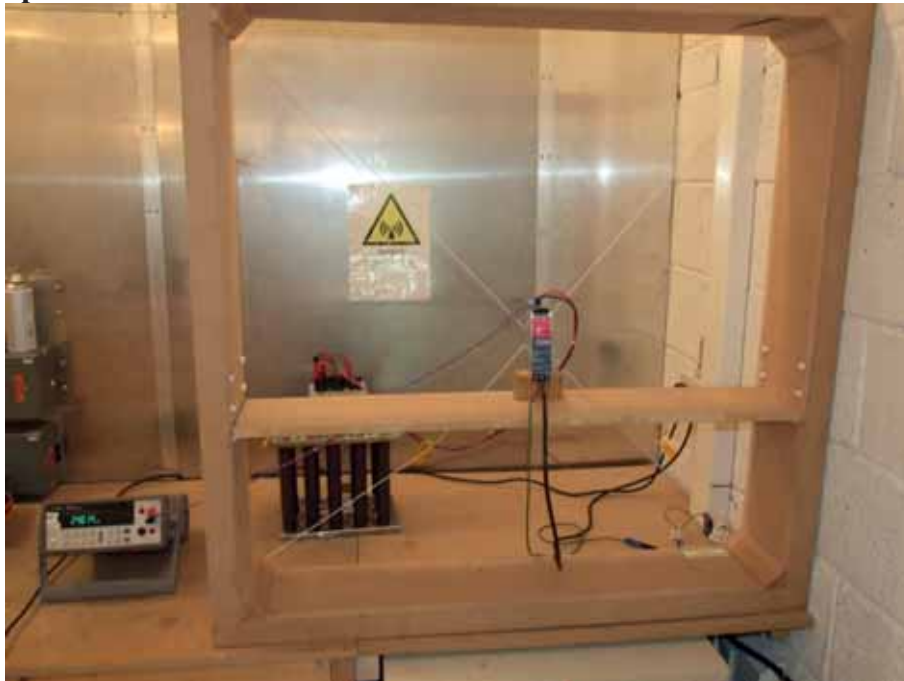
- EUT tested under normal operating conditions of 230V 50Hz input at full nominal load (24V/5A Resistive).
- Test carried out using test generator “Chroma Programmable AC Source”, “1meter x 1meter 100 turn Induction Coil” and measurement instrument “Agilent 34405A”.

### 10.1. Test Setup

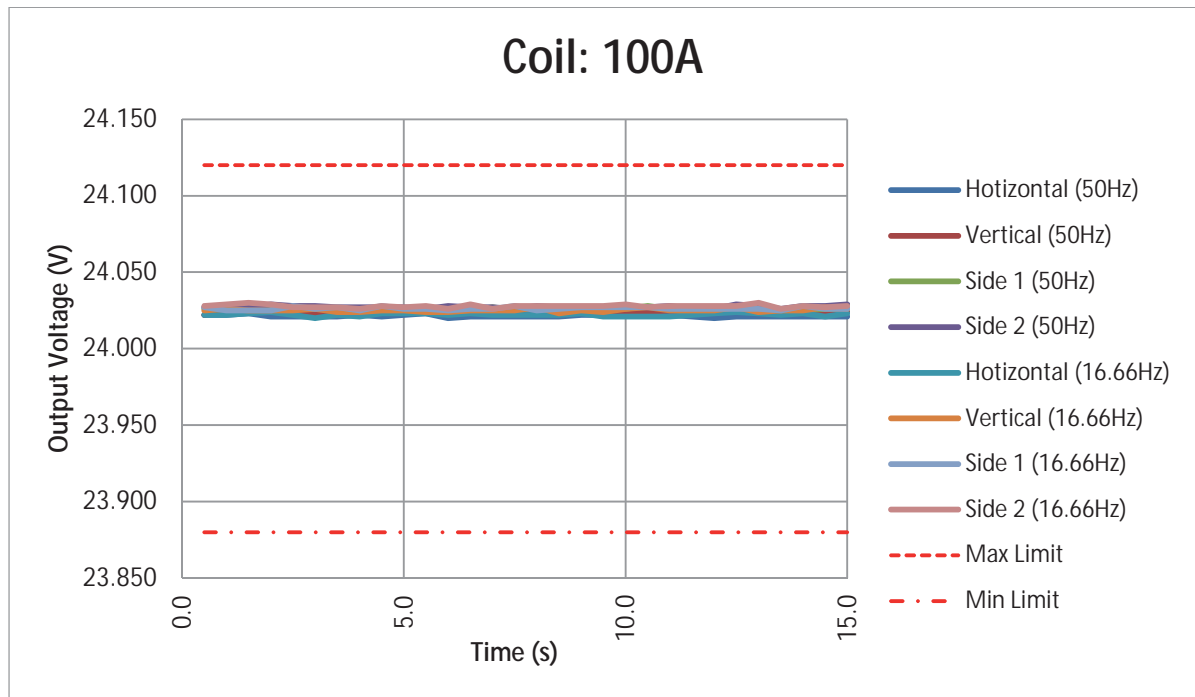
#### Test Equipment Settings:

Test generator settings			
Frequency	AC Current through Induction Coil (Arms)	Magnetic Field Strength (A/m)	Applied Field duration [s]
0Hz	1	100	Continuous (>10s)
16.66Hz	1	100	Continuous (>10s)
50Hz	1	100	Continuous (>10s)

#### Test Setup:



## 10.2. Power Frequency Magnetic Field Immunity Test Results



### Conclusion:

The EUT meets performance criteria A, defined as  $V_{out} > DC\ OK\ Limit$  (see specification) during the test, as required by EN50121-1: 2017 Section 3.

**PASS**

## 11. Summary EN 50121-4

Regulation	Class/Test Level	Result	Comments
<b>EN50121-4:2014 + CISPR 16-1-2: 2003 + CISPR 16-2-3: 2003</b>			
Conducted Input (0.15-30MHz)	Class A	PASS	Passes Class B, automatic Pass Class A
Conducted Output (0.15-30MHz)	Class A with AC input limits	PASS	-
Radiated (30-300MHz)	Class A		See Traco Power EMC - Test Report for Radiated Emission (Passes Class B, automatic Pass Class A)
<b>IEC61000-6-3: 2011 + IEC 61000-3-2: 2005</b>			
Harmonic Current Emissions Measurement at Mains Terminal	Class A	PASS	
<b>EN50121-4:2014 + IEC 61000-4-2:2005</b>			
Electrostatic Discharge			
- Air Discharge	+/- 2/8kV (Class B)	PASS	
- Contact Discharge	+/- 2/4/6kV (Class B)	PASS	
<b>EN50121-4:2014 + IEC 61000-4-5:2005</b>			
Surge			
- AC Power Ports	+/- 1kV (Class B) Line to Line	PASS	
- AC Power Ports	+/- 2kV (Class B) Line to PE	PASS	
- DC Power Ports	+/- 1kV (Class B) Line to Line		Not tested
- DC Power Ports	+/- 2kV (Class B) Line to PE		Not tested
<b>EN50121-4:2014 + IEC 61000-4-4: 2004</b>			
Fast Transient (Burst)			
- AC & DC Power Ports	+/- 2kV (Class A) between all lines and ground plane	PASS	Vout>DC OK Limit (see specification) during test
- Signal Ports	+/- 1kV (Class A) between all lines and ground plane	PASS	Vout>DC OK Limit (see specification) during test
- Earth Ports	+/- 1kV (Class A) between all lines and ground plane	PASS	Vout>DC OK Limit (see specification) during test

<b>EN50121-4:2014 + IEC61000-4-6:2004</b>			
Conducted Input RF Immunity	Level III 10V (Class A)	PASS	
Conducted Output RF Immunity	Level III 10V (Class A)	PASS	
Signal Ports RF Immunity	Level III 10V (Class A)	PASS	
Conducted Earth Port RF Immunity	Level III 10V (Class A)	PASS	
<b>EN50121-4:2014 + IEC61000-4-3:2004</b>			
Radiated RF Immunity		PASS	Limited testing
<b>EN50121-4:2014 + IEC61000-4-8:2001</b>			
Power Frequency Magnetic Field Immunity	Level 4 (Class A)	PASS	

## 12. EN 50121-3-2 Railway applications.

There are very little differences between the requirements of the standard EN 50121-3-2 and the standard EN 50121-4. To avoid repetition the EN 50121-3-2 testing is summarised below.

## 13. Summary EN 50121-3-2

Regulation	Class/Test Level	Result	Comments
<b>EN50121-3-2:2015 + CISPR 16-1-2: 2003 + CISPR 16-2-3: 2003</b>			
Conducted Input (0.15-30MHz)	EN 50121-3-2 Limits = Class A Limits + 20dBuV margin	PASS	Passes Class B, automatic Pass 50121-3-2 with relaxed limits
Conducted Output (0.15-30MHz)	EN 50121-3-2 Limits = EN 50121-4 Limits + 20dBuV margin	PASS	Passes EN 50121-4, automatic Pass 50121-3-2 with relaxed limits
Radiated (30-300MHz)	Class A		See Traco Power EMC - Test Report for Radiated Emission (Passes Class B, automatic Pass Class A)
<b>EN50121-3-2:2015 + IEC 61000-3-2: 2005, EN 61000-4-30</b>			
Harmonic Current Emissions Measurement at Mains Terminal	Class A THD < 8%	PASS FAIL	Meets Class A harmonic limits but THD >8% (51%)
<b>EN50121-3-2:2015 + IEC 61000-4-2:2005</b>			Passes EN 50121-4, also Passes EN 50121-3-2
Electrostatic Discharge			

- Air Discharge	+/- 2/8kV (Class B)	PASS	
- Contact Discharge	+/- 2/4/6kV (Class B)	PASS	
<b>EN50121-3-2:2015 + IEC 61000-4-5:2005</b>			Passes EN 50121-4, also Passes EN 50121-3-2
Surge			
- AC Power Ports	+/- 1kV (Class B) Line to Line	PASS	
- AC Power Ports	+/- 2kV (Class B) Line to PE	PASS	
- DC Power Ports	+/- 1kV (Class B) Line to Line		Not tested
- DC Power Ports	+/- 2kV (Class B) Line to PE		Not tested
<b>EN50121-3-2:2015 + IEC 61000-4-4: 2004</b>			Passes EN 50121-4, also Passes EN 50121-3-2
Fast Transient (Burst)			
- AC & DC Power Ports	+/- 2kV (Class A) between all lines and ground plane	PASS	Vout>DC OK Limit (see specification) during test
- Signal Ports	+/- 1kV (Class A) between all lines and ground plane	PASS	Vout>DC OK Limit (see specification) during test
<b>EN50121-3-2:2015 + IEC61000-4-6:2004</b>			Passes EN 50121-4, also Passes EN 50121-3-2
Conducted Input RF Immunity	Level III 10V (Class A)	PASS	
Conducted Output RF Immunity	Level III 10V (Class A)	PASS	
Signal Ports RF Immunity	Level III 10V (Class A)	PASS	
Conducted Earth Port RF Immunity	Level III 10V (Class A)	PASS	
<b>EN50121-3-2:2015 + IEC61000-4-3:2004</b>			Passes EN 50121-4, also Passes EN 50121-3-2
Radiated RF Immunity		PASS	Limited testing
<b>EN50121-3-2:2015 + IEC61000-4-8: 2001</b>			Passes EN 50121-4, also Passes EN 50121-3-2
Power Frequency Magnetic Field Immunity	Level 4 (Class A)	PASS	

## 14. List of Equipment Used

Description	Model No.	Manufacturer	Serial No.
EMC Analyzer	E7402A	Agilent	MY45119210
LISN 1	PMM L2-16	PMM	1230L00301
LISN 2	FCC-801-M2-50A	FCC	3035
LISN 3	NSLK 8127	Schwarzbeck	8127683
RF Current Probe	F-33-1	FCC	759
Transient Limiter	11947A	Agilent	3107A03645
Precision Power Meter	LMG95	Zimmer	10790709
ESD Gun	SESD 200	Schloder	142261
Surge Generator	PSURGE 4010	Haefely	583 334-63
Burst generator	PEFT 4010	Haefely	080 981-08
Coupling Capacitor	IP4A	Haefely	171241
Electronic Load	ELA 500	Zentro-Elektrik	63145803
High Power Resistors	n/a	n/a	n/a
Multimeter	34405A	Agilent	TW46290007
Multimeter	34405A	Agilent	TW46290015
Multimeter	3445A	Agilent	MY47012359
Multimeter	1906	TTI	n/a
Coupling/Decoupling Network	CDN M2/M3	EM Test	1108-34
Attenuator	ATT6/75	EM Test	1107-53
Oscilloscope	TDS1002	Tektronix	C016388
Oscilloscope	TDS2014C	Tektronix	C010602
Programmable AC Source	61604	Chroma	ABR000000672
DC power supply	SM 7020 - D	Delta elektronika	014604000011
DC power supply	SM 7020 - D	Delta elektronika	014604000024
Pulse Generator	3325A	AGILENT	MY44044002
<b>Cables</b>	<b>Type</b>	<b>Length</b>	<b>Comments</b>
Mains Supply Cable	3-wire	1m	Unshielded
Mains Supply Cable	3-wire	1.5m	Unshielded
DC Lines Cable	2-wire	1m	Unshielded
DC Lines Cable	2-wire	1.5m	Unshielded



Revision History			
Revision	Date	Name	Description
1.0	24/10/2018	Kevin Burke	
1.1	15/03/2019	Sarah Evans	Add reference for EX models and rev. history