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**BS EN 50293 TESTS ON THE
 JOINT VENTURES ELECTRONIC
 SERVICES DIAMOND PARKING
 GUIDANCE SYSTEM**

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ACRONYMS AND ABBREVIATIONS

AVE	Average
C	Circular
CSIR	Council for Scientific and Industrial Research
E-Fields	Electric Fields
EFT	Electrical Fast Transients
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
EUT	Equipment Under Test
H	Horizontal
HCP	Horizontal Coupling Plane
NIST	National Institute of Science and Technology
OATS	Open Area Test Site
PC	Personal Computer
QP	Quasi-Peak
RF	Radio Frequency
SANAS	South African National Accreditation System
V	Vertical
VCP	Vertical Coupling Plane

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1. INTRODUCTION

The Joint Ventures Electronic Services Diamond Parking Guidance System consisting of:

1. PGS sensors with serial numbers: 1001, 1002, 1003
2. PGS Numeric Display, serial number: 1001
3. PGS Zone Buffer, serial number: 1001
4. PGS Power Supply, serial number: 1001

Henceforth referred to as Equipment Under Test (**EUT**), was tested for compliance on 05/06/2013 and re-tested on 20/06/2013 at the premises of ITC Services (Pty) Ltd to the following specifications:

- BS EN 50293 (2001): *'Electromagnetic compatibility – Road traffic signal systems – Product standard'*
- SANS 222 (2009) / CISPR22 (2008): *'Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement'*
 - SANS 61000-3-2 (2009) / IEC 61000-3-2 (2009): *Limits for Harmonic Current Emissions (Equipment Input Current ≤ 16 A per phase)*
 - SANS 61000-3-3 (2009) / IEC 61000-3-3 (2008) : *Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 16 A per phase*
 - SANS 61000-4-2 (2009) / IEC 61000-4-2 (2008): *Testing and measurement techniques – Electrostatic discharge immunity test*
 - SANS 61000-4-3 (2008) / IEC 61000-4-3 (2010): *Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
 - SANS 61000-4-4 (2011) / IEC 61000-4-4 (2011): *Testing and measurement techniques – Electrical Fast Transient / Burst*
 - SANS 61000-4-5 (2006) / IEC 61000-4-5 (2005): *Testing and measurement techniques – Surge immunity test*
 - SANS 61000-4-6 (2009) / IEC 61000-4-6 (2008): *Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
 - SANS 61000-4-11 (2005) / IEC 61000-4-11(2004): *Testing and measurement techniques – Voltage Dips, Short Interruptions and voltage variations immunity test.*

2. TEST RESULT SUMMARY

CISPR 22 Radiated Emissions	Pass Class B
CISPR 22 Conducted Emissions (Power Leads)	Pass Class B
IEC 61000-4-2 Electrostatic discharge immunity test	Pass Criterion B
IEC 61000-4-3: Radiated, radio-frequency, electromagnetic field immunity test	Pass Criterion A
IEC 61000-4-4: Electrical Fast Transient / Burst	Pass Criterion B
IEC 61000-4-5: Surge immunity test	Pass Criterion A
IEC 61000-4-6: Immunity to conducted disturbances, induced by radio-frequency fields	Pass Criterion A
IEC 61000-4-11: Voltage dips	Pass Criterion B
IEC 61000-4-11: Voltage Interruptions	Pass Criterion B
IEC 61000-3-2: Harmonic emissions	Pass
IEC 61000-3-3: voltage changes, voltage fluctuations and flicker	Pass

2.1 EMISSION CLASSES AND IMMUNITY CRITERIA

2.1.1 Emissions

CISPR 22 Classifies ITE as either Class A or Class B.

Class B ITE is a category of apparatus which satisfies the class B ITE disturbance limits.

Class B ITE is intended primarily for use in the domestic environment and may include:

- Equipment with no fixed place of use; for example, portable equipment powered by built-in batteries;
- Telecommunication terminal equipment powered by a telecommunication network;
- Personal computers and auxiliary connected equipment.

NOTE The domestic environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10 m of the apparatus concerned.

Class A ITE is a category of all other ITE which satisfies the class A ITE limits but not the class B ITE limits. Such equipment should not be restricted in its sale but the following warning shall be included in the instructions for use:

Warning

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

2.1.2 Immunity

The Criteria set-out above are defined as follows:

Criterion A: normal performance within limits specified by the manufacturer, requestor or purchaser;

Criterion B: temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention;

Criterion C: temporary loss of function or degradation of performance, the correction of which requires operator intervention;

3. TEST METHODOLOGY

3.1 ENVIRONMENTAL CONDITIONS DURING TEST:

- Temperature: 19 - 20 °C
- Relative Humidity: 32 -35 %

4. CALIBRATION OF EQUIPMENT

The computer controlled EMI Measuring system is checked for amplitude and frequency accuracy with a signal generator (calibrated by a SANAS accredited laboratory and is traceable to the national standards maintained by the CSIR) on a monthly basis. The calibration of the equipment is performed by Inala Technology. All equipment Calibration Certificates are available on request.

5. MEASUREMENT OF UNCERTAINTY

The uncertainty budget is calculated according to the guidelines of LAB34 and CISPR16-4

5.1 CONDUCTED EMISSIONS

- Compliance is deemed to occur if all measured disturbances are 0.83dB below the CISPR 22 limit.
- Non-compliance is deemed to occur if any measured disturbance is less than 0.83dB below the CISPR 22 limit.

5.2 RADIATED EMISSIONS

- Compliance is deemed to occur if all measured disturbances are below the CISPR 22 limit.
- Non-compliance is deemed to occur if any measured disturbance exceeds the CISPR 22 limit.

6. TEST SAMPLE DESCRIPTION AND TEST SETUP DETAILS

The specific test methodology will be discussed under each relevant test if different to the general set-up guidelines below.

The **EUT** was subjected to all tests in the following way:

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- Tests were performed while the device was fully operational.
- Deviations from the above set-up will be noted in each specific case.

7. IMAGES

7.1 DEVICE IMAGES



PGS Zone Buffer

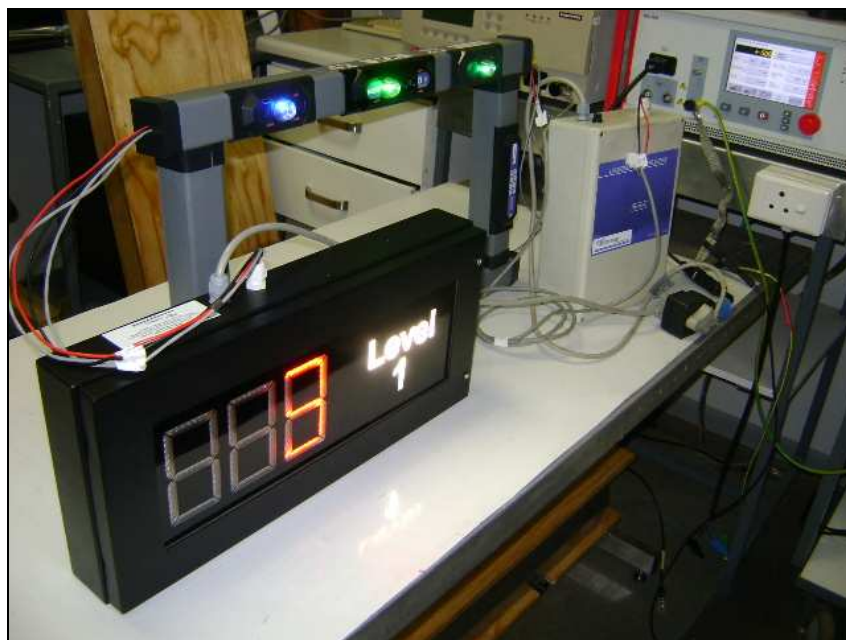


PGS Numeric display

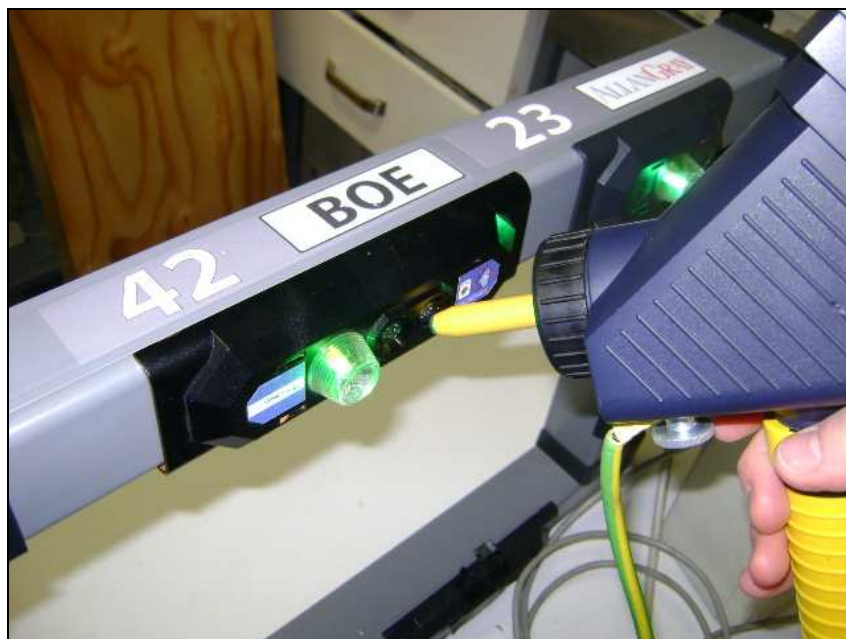


PGS Sensors

7.2 SETUP IMAGES



Diamond Parking Guidance System



SANS / IEC 61000-4-2: Electro Static Discharge test set-up

8. EMISSIONS

8.1 SET-UP

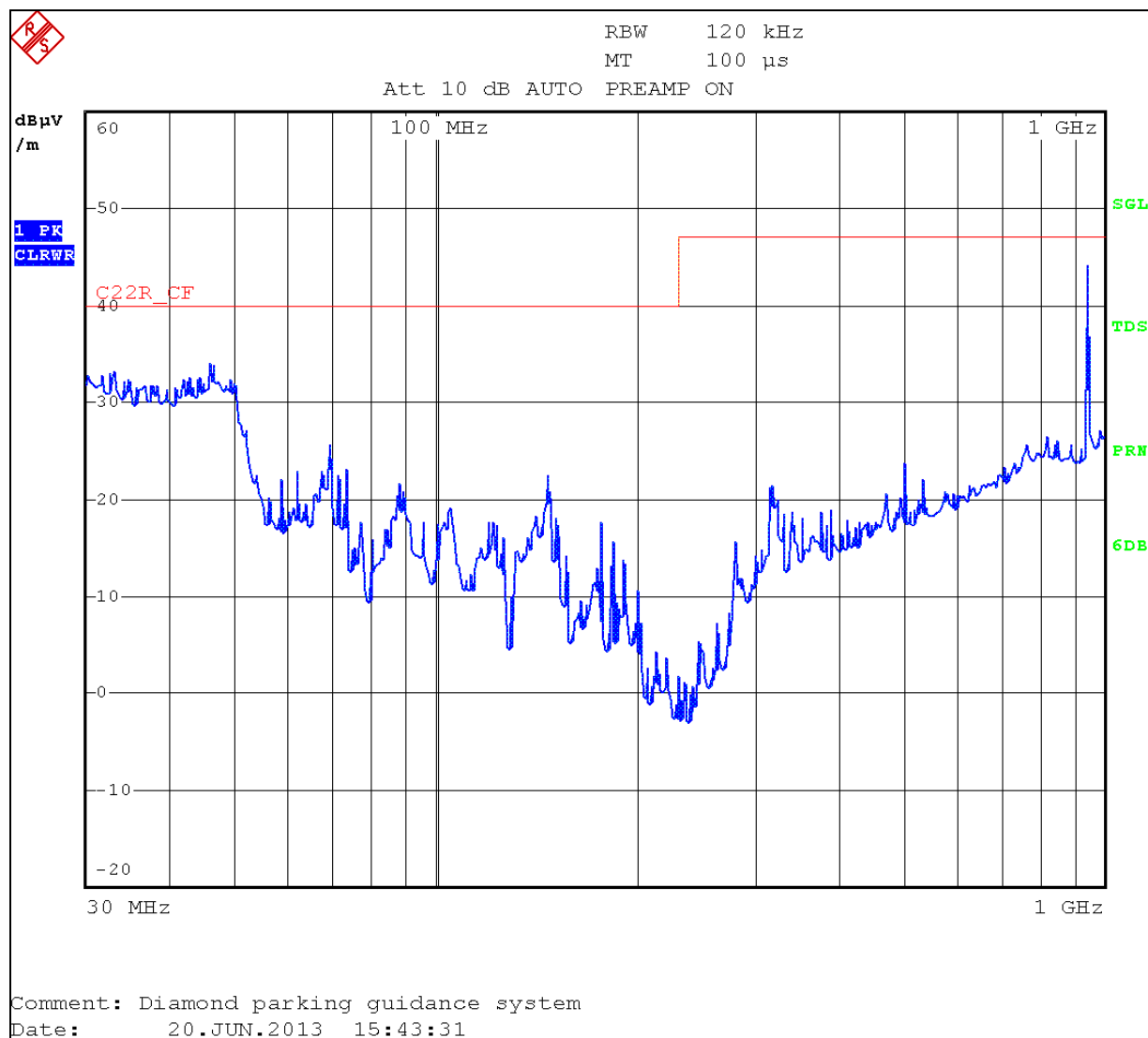
- The EUT was switched on and operated in accordance with the manufacturer instructions.
- Automated scans in the frequency band 30MHz to 1000MHz (radiated emissions) were done in order to determine compliance emission results for the EUT.

Table 8.1-1: Test equipment used for Conducted and Radiated Emission Measurements

EQUIPMENT	SERIAL NO
IBM Compatible PC	Ser No : None
Rohde & Schwarz ESPC	Ser No: 845296/004
BIA 30 Biconical antenna	Ser No : 3568
EM 6950 Log-P Antenna	Ser No: ITC001
AFJ LS-16 LISN	Ser No: 90038

8.1.1 Radiated Emission Results: 30 – 1000MHz

Graph 1: Represents peak radiated emissions measured from the EUT. Emission levels were below the Class B limit. Note that the test distance was 3m. The limit line was adjusted accordingly. The test was performed with the antennas in the Horizontal polarization.

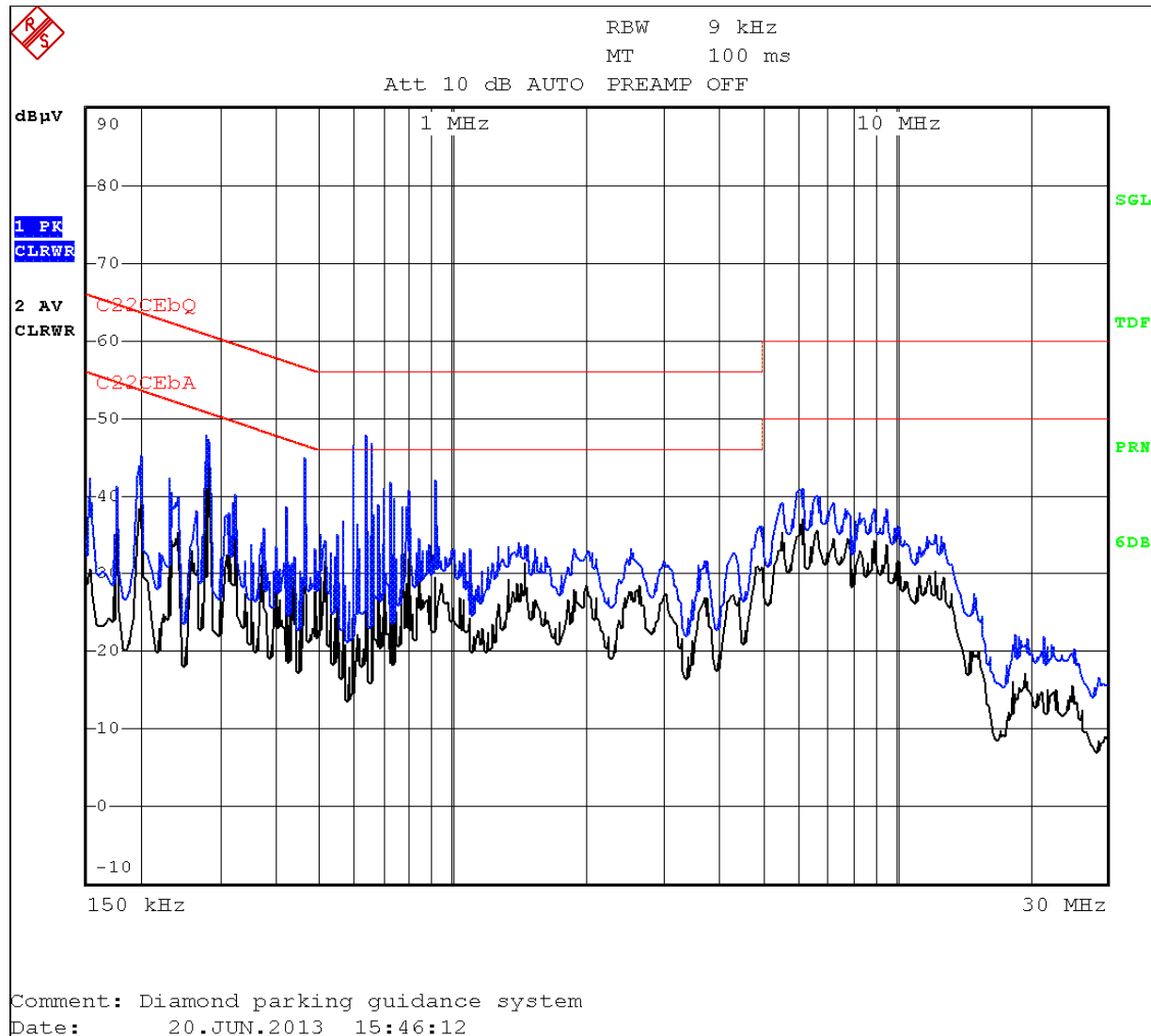


8.1.2 Conclusion

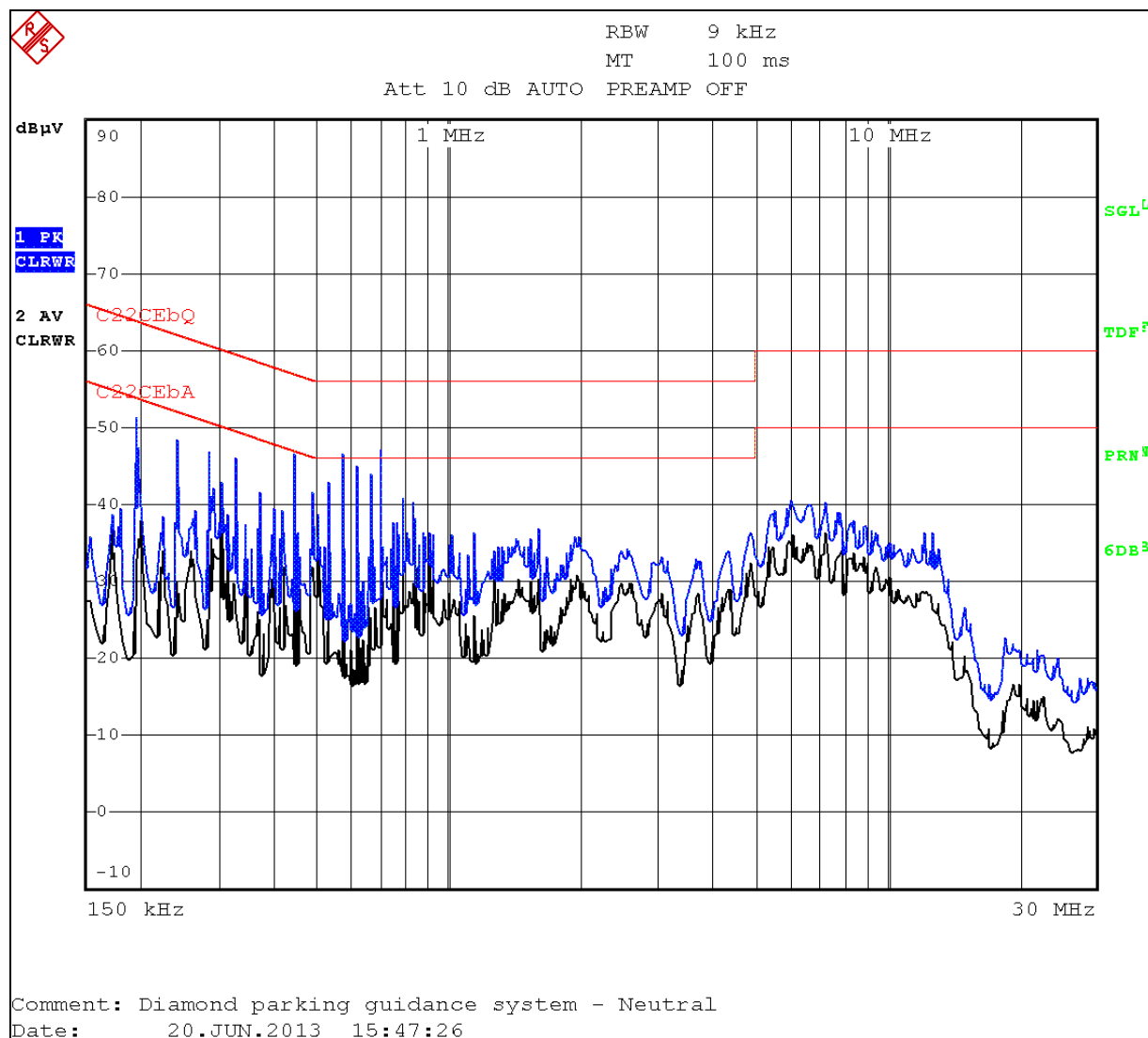
The EUT complies with the radiated emissions requirements of SANS 222 / CISPR 22 Class B.

8.1.3 Conducted Emission Results

Graph CE1: Peak and Average Conducted emissions measured on the live lead of the EUT was below the Class B quasi peak and Average limit.



Graph CE2: Peak and Average Conducted emissions measured on the Neutral lead of the EUT was below the Class B quasi peak and Average limit.



8.1.4 Conclusion

The EUT complies with the conducted emissions requirements of SANS 222 / CISPR 22 Class B.

9. IMMUNITY

9.1 ELECTRICAL FAST TRANSIENTS

- The EUT was supplied with the required voltage and subjected to a direct injected 5kHz repetition rate 5/50nS wave interference signal.
- The EUT was tested as table top equipment.
- The interference signal was applied in the following sequence:
- **AC Power Ports**
 - a. Live to Neutral: Tests were executed with +1kV and -1kV interference signal amplitudes for a 60 second period for each polarity.
 - b. Live and Neutral to Ground Reference: Tests were executed with +1kV and -1kV interference signal amplitudes for a 60 second period for each polarity.
 - c. Live to Earth: Tests were executed with +1kV and -1kV interference signal amplitudes for a 60 second period for each polarity.
 - d. Neutral to Earth: Tests were executed with +1kV and -1kV interference signal amplitudes for a 60 second period for each polarity.
- **I/O Ports**
 - a) Capacitive coupled + 0.5 kV and - 0.5 kV interference signal applied to the Interconnecting (power and communications) loom.
 - b) Capacitive coupled + 0.5 kV and - 0.5 kV interference signal applied to the DC out loom.

Table 9.1-1 Test equipment used for Electrical Fast Transients

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
TESEQ NSG 3040	Ser No: 1856

9.1.1 Results

AC power port:

- The EUT was susceptible to the fast transient bursts applied to the input AC port.
- The device had a false detection but functioned normally after application of the test.

I/O ports:

- The interconnecting lines were susceptible to the fast transient bursts, but functioned normally after application of the test.

9.1.2 Conclusion

The EUT complies with criterion B of SANS / IEC 61000-4-4.

(Criterion B: temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention)

9.2 ELECTROSTATIC DISCHARGE

9.2.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The EUT was tested as tabletop equipment.
- 10 positive and 10 negative contact discharges were applied to the VCP and HCP respectively.
- 10 positive and 10 negative contact discharges were made to the parking system sensors while being un-powered.

Table 9.2-1 Test equipment used for ESD

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
TESEQ NSG 3040	Ser No: 1856
TESEQ NSG 435 ESD gun	Ser No: 6555
Air discharge tip	None
Contact discharge tip	None
Vertical Coupling Plane	None

Table 9.2-2 Results of ESD (Contact discharge)

POSITION ON EUT	VOLTAGE	NUMBER OF DISCHARGES	RESULT	VERDICT
VCP (Vertical)	± 4kV	10	Not susceptible	Comply (A)
HCP (Horizontal)	± 4kV	10	Not susceptible	Comply (A)

- The EUT was susceptible to the ± 4kV contact ESD pulses applied to the HCP and VCP. The Parking sensors experienced false detection but resumed normal operation after application of the Electro Static pulses.

Table 9.2-3 Results of ESD (Air discharge)

POSITION ON EUT	VOLTAGE	NUMBER OF DISCHARGES	RESULT	VERDICT
EUT front panel	± 8kV	10	No discharge path	Comply
Enclosure	± 8kV	10	No discharge path	Comply

- The EUT was resilient to the ± 8kV air discharges applied to the sensors while being unpowered. The EUT functioned normally after they were re-powered.

9.2.2 Conclusion

The EUT complies with criterion B of SANS / IEC 61000-4-2.

(Criterion B: temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention)

9.3 SURGES

9.3.1 Set-up

- The EUT was supplied with the required voltage.
- Five positive and five negative 1.2/50µs pulses were directly injected into the supply at 60 second intervals between surges. The pulses were applied in the following sequence:

- **AC Power Port**

- a. Live to Neutral (and $\pm 1\text{kV}$)
- b. Live to Safety earth (and $\pm 2\text{kV}$)
- c. Neutral to Safety earth (and $\pm 2\text{kV}$)

Table 9.3-1 Test equipment used for Surges

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
TESEQ NSG 3040	Ser No: 1856

9.3.2 Results

The EUT was resilient to the surges applied

9.3.3 Conclusion

The EUT complies with criterion A of the relevant section of SANS / IEC 61000-4-5.

(Criterion A: normal performance within limits specified by the manufacturer, requestor or purchaser)

9.4 RADIATED IMMUNITY

9.4.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The test was performed in a shielded enclosure in the frequency band 80 MHz to 1000 MHz with 80 % AM 1kHz, at a level of 10 V/m according to SANS / IEC 61000-4-3 Clause 8 (Frequency step and dwell method) with the following deviations:

Table 9.4-1 Test equipment used for Radiated Immunity.

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
Olivetti Personal Computer Model PCS 286	Ser No : 00074333
RF Signal Generator HP Model 8657A	Ser No: 2819UO4767
Log Periodic Antenna Model EM6950	Ser No : 1001
RF Amplifier EM Model 4248-1	Ser No : None
Field Strength Meter AR Model FM2000	Ser No: 14021

9.4.2 Results

- The EUT was resilient to the 80% AM 1 kHz signal applied at a level of 10 V/m.

9.4.3 Conclusion

The EUT complies with criterion A of SANS / IEC 61000-4-3.

(Criterion A: normal performance within limits specified by the manufacturer, requestor or purchaser)

9.5 CONDUCTED IMMUNITY

9.5.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The test was performed in a shielded enclosure in the frequency band 150kHz to 80 MHz with 80 % AM 1kHz, at a level of 10 V (unmodulated) on the Power leads, Interconnecting and DC output looms according to SANS / IEC 61000-4-6.

Table 9.5-1 Test equipment used for Conducted Immunity.

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
RF Signal Generator HP Model 8657A	Ser No: 2819UO4767
BCI Probe FCC Model F-120-3	Ser No : 52
RF Amplifier EM Model 4248-1	Ser No : None
Lüthi Coupling decoupling network	Ser No : 2555

9.5.2 Results

- The EUT was resilient to the 80% AM 1 kHz signal applied at a level of 10V on the input Power leads.
- The EUT was resilient to the 80% AM 1 kHz signal applied at a level of 10V on the interconnecting (power and communications) loom.
- The EUT was resilient to the 80% AM 1 kHz signal applied at a level of 10V on the DC output loom.

9.5.3 Conclusion

The EUT complies with criterion A of the relevant section of SANS / IEC 61000-4-6.

(Criterion A: normal performance within limits specified by the manufacturer, requestor or purchaser)

9.6 VOLTAGE DIPS AND INTERRUPTIONS

9.6.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The EUT was subjected to the following voltage dips and interruptions applied to the AC power port of the EUT:
 - - a) 100 % reduction in supply voltage for 0.5 cycle :**Comply criterion B**
 - b) 70 % reduction in supply voltage for 25 cycles :**Comply criterion B**
 - c) 100 % reduction in supply voltage for 250 cycles :**Comply criterion B**

Table 9.6-1 Test equipment used for Voltage Dips and Interruptions

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
Pacific AC Power source Model 140-AMX	0362
TESEQ NSG 3040	Ser No: 1856

9.6.2 Results

- The PL globes of the EUT dipped momentarily during application of the 100% reduction in supply for 0.5 cycles and during application of the 70% reduction for 25 cycles, but resumed normal operation after application of the reduction in supply.
- The EUT switched off during application of the 100% reduction in supply for 250 cycles but resumed normal operation after application of the voltage interruption.

9.6.3 Conclusion

The EUT complies with criterion B of the relevant sections of SANS / IEC 61000-4-11

(Criterion B: temporary loss of function or degradation of performance which ceases after the disturbance ceases, and from which the equipment under test recovers its normal performance, without operator intervention)

9.7 HARMONICS

9.7.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The EUT was tested as Class B equipment.

Table 9.7-1 Test equipment used for Harmonic Current Emissions

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
Pacific AC Power Source Model 140-AMX	0362
Thurlby Thandar Instruments HA1600	227306

9.7.2 Results

- No limits apply below 75 Watt

9.7.3 Conclusion

The EUT complies with the Harmonic Current emission requirements of SANS / IEC 61000-3-2.

9.8 VOLTAGE FLUCTUATIONS & FLICKERS

9.8.1 Setup

- The EUT was switched on and operated in accordance with the manufacturer instructions. The d_{\max} value recorded was 2.31%

9.8.2 Conclusion

The EUT complies with the voltage fluctuations and flicker requirements of SANS / IEC 61000-3-3.

10. COMPLIANCE STATEMENT

The EUT complies with the requirements of the specifications listed in 11 below.

11. CONCLUSION

The Joint Ventures Electronic Services Diamond Parking Guidance System (In the configuration tested) meets the requirements of the following specifications called for in BS EN 50293.

- BS EN 50293 (2001): *'Electromagnetic compatibility – Road traffic signal systems – Product standard'*
- SANS 222 (2009) / CISPR22 (2008): *'Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement'*
- SANS 61000-3-2 (2009) / IEC 61000-3-2 (2009): *Limits for Harmonic Current Emissions (Equipment Input Current ≤ 16 A per phase)*
- SANS 61000-3-3 (2009) / IEC 61000-3-3 (2008) : *Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems – Equipment with rated current ≤ 16 A per phase*
- SANS 61000-4-2 (2009) / IEC 61000-4-2 (2008): *Testing and measurement techniques – Electrostatic discharge immunity test*
- SANS 61000-4-3 (2008) / IEC 61000-4-3 (2010): *Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*
- SANS 61000-4-4 (2011) / IEC 61000-4-4 (2011): *Testing and measurement techniques – Electrical Fast Transient / Burst*
- SANS 61000-4-5 (2006) / IEC 61000-4-5 (2005): *Testing and measurement techniques – Surge immunity test*
- SANS 61000-4-6 (2009) / IEC 61000-4-6 (2008): *Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*
- SANS 61000-4-11 (2005) / IEC 61000-4-11(2004): *Testing and measurement techniques – Voltage Dips, Short Interruptions and voltage variations immunity test.*