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**BS EN 50270 TESTS  
 ON THE CATALYTIC BEAD  
 COMBUSTIBLE GAS  
 DETECTOR  
 SENSOR MODULE**

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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 Catalytic Bead Combustible Gas Detector Sensor Module manufactured by Sierra Monitor Corporation, serial number: 1123853, model number: 5100-02-IT, henceforth referred to as Equipment Under Test (**EUT**), was tested for compliance between 18/10/2012 and 06/11/2012 at the premises of ITC Services (Pty) Ltd to the following specifications:

- BS EN 50270: (2006) *Electromagnetic compatibility. Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen*
- SANS 222 (2009) / CISPR 22 (2008): *'Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement'*
  - 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 61000-4-8 (2009) / IEC 61000-4-8 (2009): *Testing and measurement techniques- Power Frequency Electric Field Immunity Test*

## 2. TEST RESULT SUMMARY

CISPR 22 Radiated Emissions: 30-1000MHz	Pass Class A
CISPR 22 Radiated Emissions: 1000-2500MHz	Pass Class B
IEC 61000-4-2 Electrostatic discharge immunity test	Pass Criterion A
IEC 61000-4-3: Radiated, radio-frequency, electromagnetic field immunity test	Pass Criterion A
IEC 61000-4-4: Electrical Fast Transient / Burst	Pass Criterion A
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 61000-4-8: Power Frequency Magnetic Field Immunity Test	Pass Criterion A

## 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:

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

**Criteria 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;

**Criteria 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: 21 - 23 °C
- Relative Humidity: 41 - 58 %

## 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 unit was fully operational.
- The EUT was connected to a laptop computer on the outside of the test chamber
- The EUT was supplied with 24VDC batteries.
- Deviations from the above set-up will be noted in each specific case.

### 6.1 MODIFICATION A

- 2 x LairdTech ferrites with part number: 28A0593-0AZ was added to the RS485 and 4-20mA looms.

### 6.2 MODIFICATION B

- The isolation was stripped off the RS485 and 4-20mA looms and brass wool was added to ensure proper contact to the chassis of the device. See below



**Catalytic Bead Sensor:** Brass wool inserted

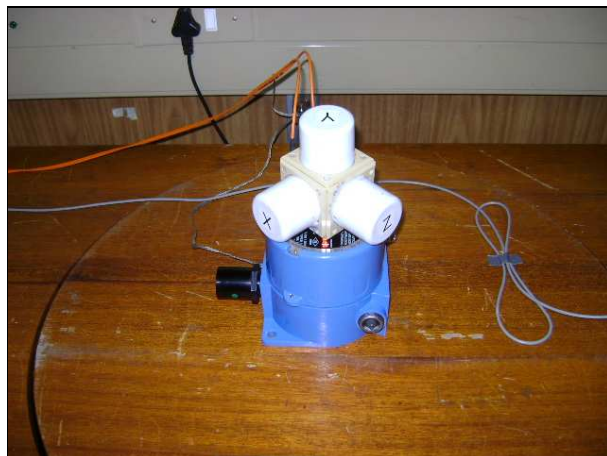
## 7. IMAGES



Catalytic Bead Sensor: Top view



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



SANS / IEC 61000-4-3: Radiated immunity test set-up

## 8. EMISSIONS

### 8.1 SET-UP

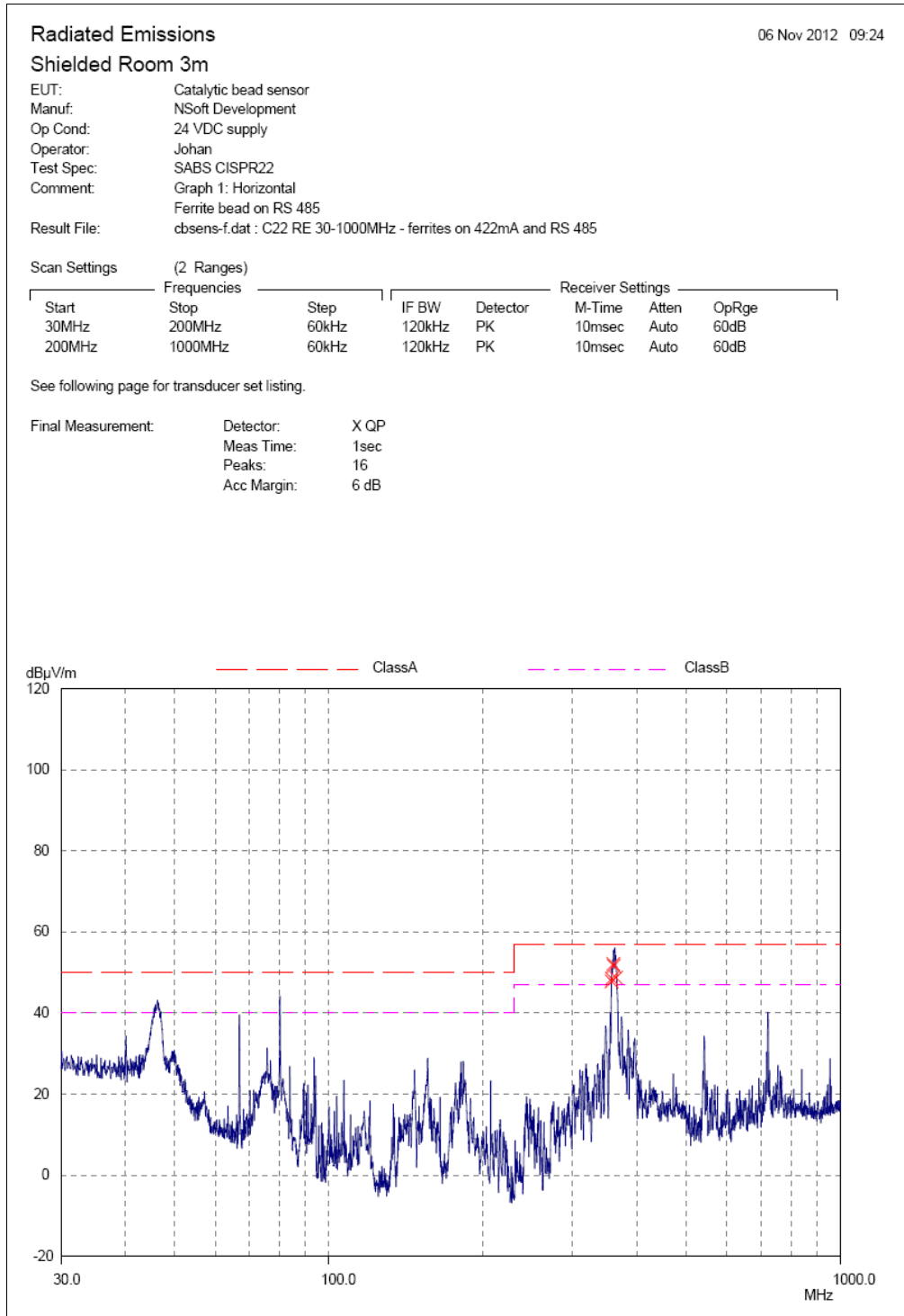
- The EUT was switched on and operated in accordance with the manufacturer instructions.
- Automated scans in the frequency band 30MHz to 2500MHz (radiated emissions) were done in order to determine compliance emission results for the EUT.

**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
EM 6961 Ridge horn antenna	Ser No: 6248

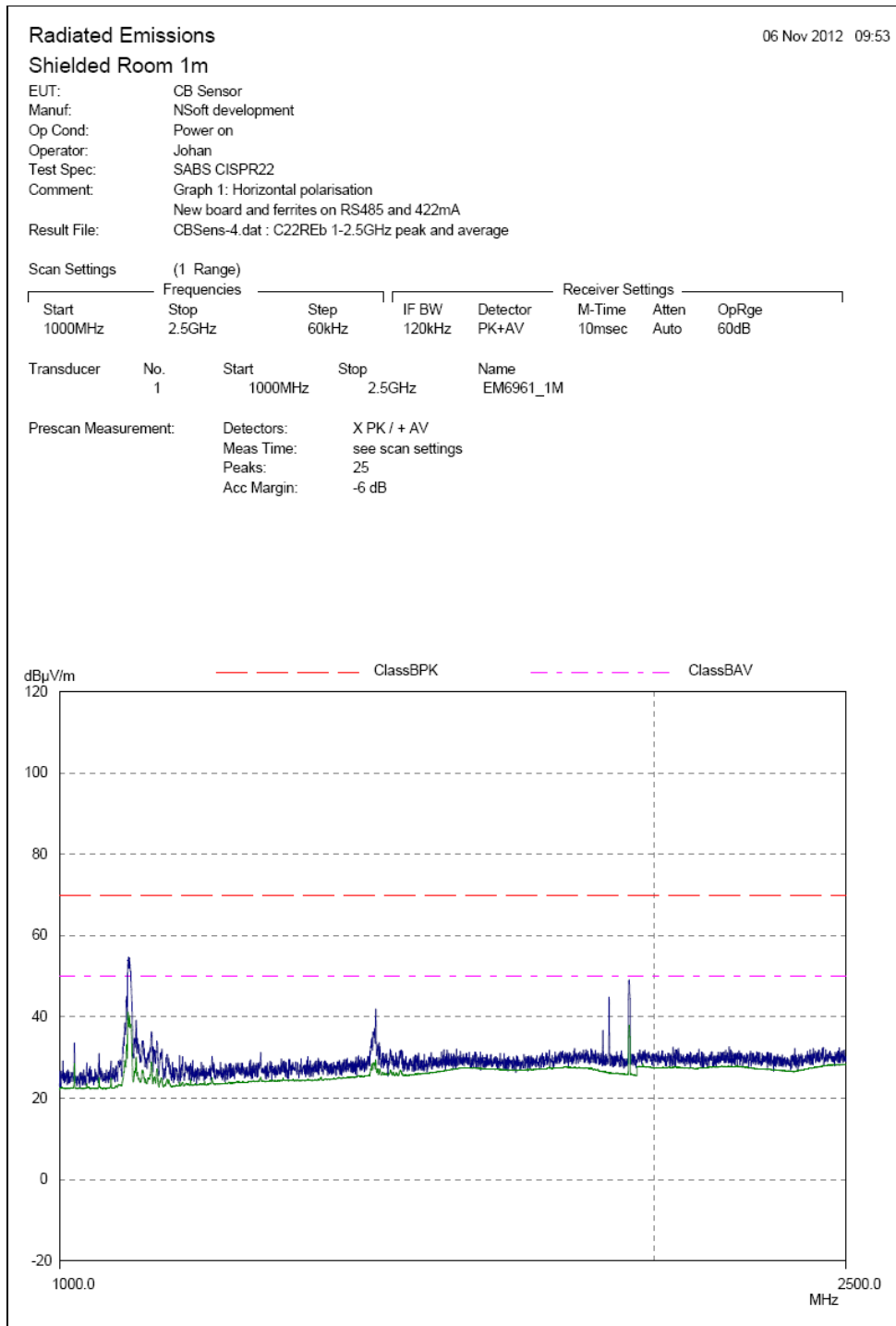
**8.1.1 Radiated Emission Results: 30 – 1000MHz (modification A)**

Graph 1: Represents quasi peak radiated emissions (represented by the red crosses) measured from the EUT. Emission levels were below the Class A limit with the modifications of 6.1 A. 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 Radiated Emission Results: 1000 – 2500MHz (modification A)**

Graph 2: Quasi peak radiated and average emissions measured from the EUT were below the Class B quasi peak and average limits. Note that the test distance was 1m. The test was performed with the antennas in the Horizontal polarization.

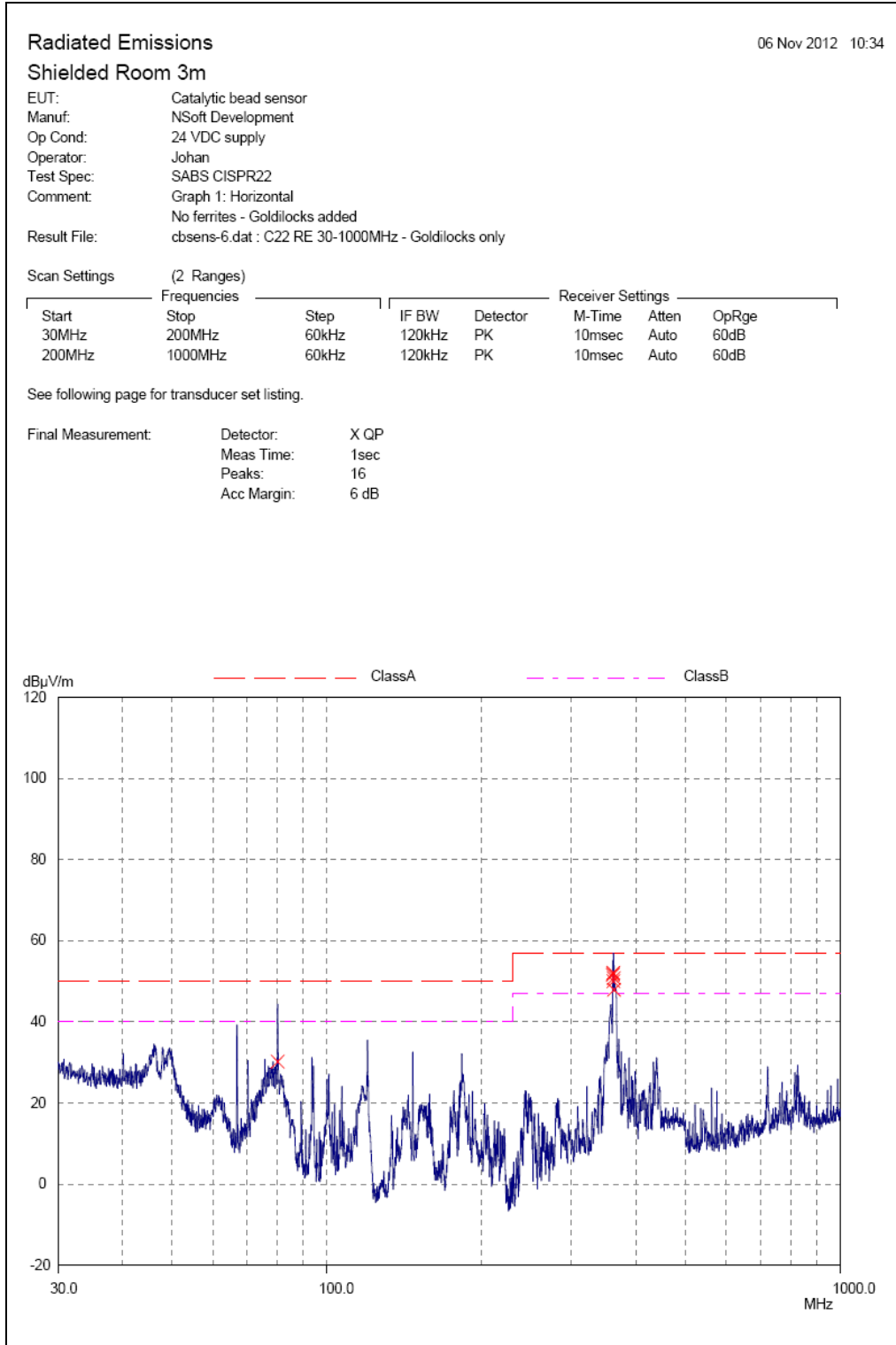


**8.1.3 Conclusion**

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

**8.1.4 Radiated Emission Results: 30 – 1000MHz (modification B)**

Graph 3: Represents quasi peak radiated emissions (represented by the red crosses) measured from the EUT. Emission levels were below the Class A limit with the modifications of 6.1 B. Note that the test distance was 3m. The limit line was adjusted accordingly. The test was performed with the antennas in the Horizontal polarization.



**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. Positive to Negative: Tests were executed with +1kV and -1kV interference signal amplitudes for a 60 second period for each polarity.
  - b. Positive to Negative to Ground Reference: 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 RS 485 loom.
  - b) Capacitive coupled + 0.5 kV and - 0.5 kV interference signal applied to the 4-20mA 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 resilient to the interference signal.
- The EUT functioned normally during and after the test.

I/O ports:

- The EUT was resilient to the capacitive coupled + 0.5 kV and -0.5 kV interference signal applied to the RS-485 and 4-20mA looms individually.
- The EUT functioned normally during and after the test.

**9.1.2 Conclusion**

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

## 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 discharge attempts were made to the enclosure of the device.

**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)

**Table 9.2-3 Results of ESD (Air discharge)**

POSITION ON EUT	VOLTAGE	NUMBER OF DISCHARGES	RESULT	VERDICT
Enclosure	± 8kV	10	Not susceptible	Comply (A)

- The EUT was resilient to the applied ESD pulses and functioned normally during and after application thereof.

### 9.2.2 Conclusion

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



### 9.3 SURGES

#### 9.3.1 Set-up

- The EUT was supplied with the required voltage.
  - Five positive and five negative 1.2/50 $\mu$ s pulses were directly injected into the supply at 60 second intervals. The pulses were applied in the following sequence:
- **AC Power Port**
    - a. Positive to Negative  $\pm 0.5$ kV.
    - b. Positive to GND reference  $\pm 0.5$ kV.
    - c. Negative to GND reference  $\pm 0.5$ kV.
  - **I/O Ports**
    - c)  $\pm 1$  kV surge applied between the RS 485 loom and GND reference.
    - d)  $\pm 1$  kV surge applied between the 4-20mA loom and GND reference.

**Table 9.3-1 Test equipment used for Surges**

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

#### 9.3.2 Results

AC power port:

- The EUT was resilient to the surges applied.

I/O ports:

- The EUT functioned normally during and after application of the surges between signal and GND reference.

#### 9.3.3 Conclusion

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

## 9.4 RADIATED SUSCEPTIBILITY

### 9.4.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The test was performed in a RF shielded chamber 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).

**Table 9.4-1 Test equipment used for Radiated Susceptibility.**

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 1kHz 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.

**(Criteria 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, 4-20mA and RS-485 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 1kHz signal applied at a level of 10V on the power leads.
- The EUT was resilient to the 80% AM 1kHz signal applied at a level of 3V on the 4-20mA loom.
- The EUT was resilient to the 80% AM 1kHz signal applied at a level of 3V on the RS-485 (field port) loom.

### 9.5.3 Conclusion

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

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

## 9.6 POWER FREQUENCY MAGNETIC FIELD IMMUNITY TEST

### 9.6.1 Set-up

- The EUT was switched on and operated in accordance with the manufacturer instructions.
- The test was performed with a single Helmholtz Coil, at a level of 30 A/m according to SANS / IEC 61000-4-8.

**Table 9.6-1 Test equipment used for Power Frequency Magnetic Field Immunity.**

EQUIPMENT	SERIAL NO/ REFERENCE NUMBER
Variac Yokoyama Electric Works	Ser No: 3772
Magnetic Shield Division AC Magnetic Field Evaluator	None
Fluke 77 III Multimeter	72081177
Toptronic T60757 AC/DC Clamp Meter	None
AC Helmholtz Coil	ITC001

### 9.6.2 Results

The EUT was resilient to the 50 Hz signal applied at a level of 30 A/m.

### 9.6.3 Conclusion

The EUT complies with criterion A of the relevant section of SANS / IEC 61000-4-8.

## 10. COMPLIANCE STATEMENT

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

## 11. CONCLUSION

The Sierra Monitor Corporation Catalytic Bead Combustible Gas Detector Sensor Module (In the configuration tested with the modifications of 6.1) meets the requirements of the following specifications called for in BS EN 50270:2006

- BS EN 50270: (2006) *Electromagnetic compatibility. Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen*
- SANS 222 (2009) / CISPR 22 (2008): *'Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement'*
  - 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 61000-4-8 (2009) / IEC 61000-4-8 (2009): *Testing and measurement techniques- Power Frequency Electric Field Immunity Test*