

**DISTURBANCE RECORDER\_110V DC\_DSP\_INPUT A(32)/B(132)\_OUTPUT E(2)/M(8)****A. Mandatory Technical Criteria**

Submit the completed and signed deviation schedule:

- ECOU Deviation Schedule for Informal Tenders\_rev1\_2019, stating if there are any deviations to the specified requirements.

If the product is fully compliant, then state "No Deviations" on the Deviation Schedule.

Evaluation requirement: If this Deviation Schedule document is not submitted, the tenderer will be

disqualified at this stage.

The specific requirements include;

- The recorder must be of a 19" rack mounted modular format, multi-functional.
- It should have a multi-processor system
- 32 analog inputs and 128 binary inputs
- Operating software for Windows 7, Windows 8.1 (32 and 64 bit) / Windows 10 (32 and 64 bit), Windows Server 2012 R2
- Operating voltages : 90...365 V DC and 85...265 V AC; 47...63 Hz; 9...18 V DC; 18...36 V DC; 36...72 V DC
- Completed and submitted A and B Schedule

**B1. Objective Criteria****1. General description**

The recorder must be of a 19" rack mounted modular format, multi-functional measurement and analysis system for comprehensively monitoring and assessing equipment in electricity supply systems. It must combine the monitoring functions of high-resolution digital fault recorders, power quality analysers, phasor measurement units, continuous data recorders and event recorders in one device.

Individual devices can be networked via an Interlink interface to monitor extensive installations.

**1.1 Multi-Processor System**

It should have a multi-processor system. A digital signal processor (DSP) for processing signals and processes in real time and a communication processor for mass data storage, simultaneous data communication using different interfaces and protocols, web server functionality and stand-alone operation.

**1.2 User controls and displays**

- Status LEDs for alarm, trigger and status display
- At least a 3.5" colour graphical display with touch screen and function keys

### **1.3 Number of measurement inputs**

- 32 Analog inputs and 128 binary inputs

### **1.4 Data memory**

- At least 32 GB flash RAM for reliable data storage

### **1.5 Quality system**

- Developed and manufactured to DIN ISO 9001:2015

### **1.6 Calibration**

- Software-controlled calibration
- Calibration data is saved on the individual measurement modules
- No calibration required after module replacement or upgrade (plug & play) with a recommended calibration cycle check every 3 years

### **1.7 Operating software**

- Operating software for Windows 7, Windows 8.1 (32 and 64 bit),
- Windows 10 (32 and 64 bit), Windows Server 2012 R2

## **2. Function overview**

### **2.1 Recording functions**

- Digital fault recorder with 2 sampling rates from 500 Hz...30 kHz for RMS fault recorder and sampling rate from 1 Hz...120 Hz for Continuous data recording
- Event data recording
- Power quality analyser, class A (optional) Phasor measurement unit/PMU (optional)

### **2.2 Standards for measurement and analysis**

- IEC 61000-4-30 class A
- IEC 61000-4-7 harmonics and inter-harmonics IEC 61000-4-15 flicker
- EN 50160, IEEE 519, IEEE 1159
- IEEE C37.118

## **3. Analog inputs**

### **3.1 General information**

- Resolution : 16 Bit, S/R:92 dB typical
- Sampling frequency : 200 kHz per channel
- Accuracy : 0.05% of range
- Protection : Galvanic isolation Channel to channel = 2.5 kV, and channel to device = 2.5 kV

### **3.2 Input module**

#### **3.2.1 Number of measurement inputs**

- 8 inputs with selectable measuring ranges for:
- Voltage measurement

- Current measurement with external sensors (e.g. shunts)
- Measurement of low-level signals

### **3.2.2 Measuring ranges**

- Each measurement input should have multiple selectable measuring ranges:
  - Measuring range 1: 300 V AC /  $\pm 424$  V DC (impedance 6.6 M $\Omega$ )
  - Measuring range 2: 700 mV AC /  $\pm 1000$  mV DC (impedance 14.7 k $\Omega$ )
  - Measuring range 3: 200 mV AC /  $\pm 282$  mV DC (impedance 14.7 k $\Omega$ )
  - Measuring range 4:  $\pm 20$  mA / 4...20 mA (impedance 10  $\Omega$ )

### **3.2.3 Overload**

- 1000 V AC sustained in the 300 V measuring range

### **3.2.4 Frequency range**

- DC...10 kHz

## **3.3 Input module**

### **3.3.1 Number of measurement inputs**

- At least 3 separate high-current inputs for connection to protection or instrument transformers

### **3.3.2 Measuring ranges**

- Each measurement input should have at least 3 selectable measuring ranges:
  - Measuring range 1: 10 A AC (impedance 0.002  $\Omega$ )
  - Measuring range 2: 40 A AC (impedance 0.002  $\Omega$ )
  - Measuring range 3: 200 A AC (impedance 0.002  $\Omega$ )

### **3.3.3 Overload**

- 40 A AC sustained (minimum)
- 200 A AC for 5 seconds (minimum)
- 500 A AC for 1 second (minimum)

### **3.3.4 Frequency range**

- 10 Hz...10 kHz

## **4. Binary inputs**

### **4.1 Input module**

- Max. 8 input modules (128 inputs)
- Number of measurement inputs per module should at least be 16 inputs
- Galvanic isolated in 4 groups of 4 inputs (per module)
- Activation range : 24...300 V DC (wide-range inputs)
- Resolution : 0.1 ms

#### 4.1.1 Protection

- Transient protection
- Polarity protection
- Galvanic isolation up to 2.5 kV

### 5. Binary outputs

#### 5.1 Electronic relays

- At least 2 freely configurable relays for status and alarm signals
- Switching capacity : Max. 60 V AC/DC, 200 mA

#### 5.2 Mechanical relays

- At least 8 freely configurable relays for status and alarm signals
- Contact type : Potential-free relay contact, configurable as NC or NO contact
  - Switching capacity Max. 220 V AC, 8 A AC
  - Max. 60 W
  - Max. 500 ms
  - Max. continuous current 2 A AC

### 6. Time synchronisation

#### 6.1 Standard equipment

- Internal real-time clock : Accuracy 2.5 ppm without external time synchronisation
- NTP/SNTP : Synchronisation over Ethernet network
- Interlink interface : Master-slave time synchronisation between several devices

### 7. Interfaces

#### 7.1 Standard equipment

- The device shall have the following standard interfaces as a minimum:
  - Data communication : 2 x RS232, 1 x RS485  
: 2 x USB-A, 1 x USB-B  
: 1 x 10/100 Mbit Ethernet (RJ 45)
  - Interlink interface : Electric 2-wire interface for networking a number of devices
  - Enables cross-triggering and master-slave time synchronisation over distances of up to 500 m

#### 7.2 Interface module

- Data communication : 1 x 10/100 Mbit optical Ethernet (ST II) 1 x 10/100 Mbit Ethernet (RJ 45)
- Interlink interface : Optical Interlink interface for networking a number of devices

- Enables cross-triggering and master-slave time synchronisation by means of a fibre optic loop
- Maximum distance between 2 devices is 2 km

### 7.3 Protocols

Standard : TCP/IP, Modbus TCP, IEC 60870-5-103, GSM, GPRS  
 Standard : IEC 61850, IEEE C37.118 (PMU)

### 8. Power supply

- The device power supply shall comply with the following specifications:
- Operating voltages : 90...365 V DC and 85...265 V AC; 47...63 Hz; 9...18 V DC; 18...36 V DC; 36...72 V DC
- Working range : +6% / -10% of the nominal range
- Power consumption and : Max. 30 VA with maximum configuration (32 analog 128 binary inputs)
- Redundancy : Power supply unit and power supply redundancy provided by accommodation of up to two independent power supply modules of the same type or of different types

### 9. Complete system

#### 9.1 Mechanical

- The device shall comply with the following mechanical specifications:
  - Weight : <3 kg
  - Housing : 19" housing for rack mounting, 84 HP/3 U
  - Protection class : IP 52 (front panel)
  - Dimensions : 483 mm x 132.5 mm x 263 mm

#### 9.2 Environment

- The device shall comply to the following environmental conditions:
  - Storage temperature : -20...+70 °C
  - Relative humidity : 5...95%, non-condensing

### 10. EMC standards

- The device shall comply with the following EMC standards:
  - IEC 60255-1 Measuring relays and protection equipment - Part 1
  - IEC 60255-5  
IEEE C37.90 Dielectric test, 2.5 kV, 50 Hz  
Insulation test, 500 V, 50 Hz  
Impulse voltage test, 5 kV, 0.5 Joule
  - IEC 61000-4-2  
IEC 60255-22-2 Electro-static discharge test, class 4 8 kV contact, 15 kV air
  - IEC 61000-4-3  
IEC 60255-22-3 Radiated susceptibility  
10 V/m, 80...3000 MHz, AM

10 V/m, 900 MHz, PM

- IEC 61000-4-4  
IEC 60255-22-4  
IEEE C37.90.1      Electrical fast transient burst  
4 kV, 2.5 kHz, 5 kHz, 100 kHz
- IEC 61000-4-5  
IEC 60255-22-5      Surge test, class 4 e  
4 kV common mod  
2 kV differential mode
- IEC 61000-4-6  
IEC 60255-22-6      Conducted susceptibility  
10 V, 150 kHz...80 MHz
- IEC 61000-4-8  
IEC 60255-6          Power frequency magnetic field  
30 A/m, 50 Hz, x, y, z axis
- IEC 61000-4-11  
IEC 60255-11        Supply voltage dips and interruptions, class 3
- IEC 61000-4-18  
IEC 60255-22-1      Damped oscillatory waves  
2.5 kV, 1 MHz common mode  
1.0 kV, 1 MHz differential mode

### 11. Vibration Standards

- The device shall comply to the following Vibration Standards:
  - IEC 60068-2-6  
IEC 60255-21-1      Vibration test  
5.2 g, 5...55 Hz, x, y, z axis
  - IEC 60068-2-27  
IEC 60255-21-2      Vibration test  
5 g / 11 ms, x, y, z axis

### 12. Climatic standards

- The device shall comply to the following Climatic Standards:
  - IEC 60068-2-2      Cyclic temperature test, dry heat  
16 hours, 55 °C, operating condition  
96 hours, 70 °C, power off condition

## B2. Test Results

The tenderer should submit the following test results that are not older 10 years old.

1. Dielectric test results, according to IEEE C37.90
2. Insulation test results, according to IEEE C37.90
3. Impulse voltage test results, according to C37.90
4. Electrostatic discharge test results, according to IEC 60255-22-2
5. Radiated susceptibility test results, according to IEC 60255-22-3
6. Electrical fast transient burst test results, according to IEC 60255-22-4
7. Surge test results, according to IEC 60255-22-5
8. Conducted susceptibility test results, according to IEC 60255-22-6
9. Power frequency magnetic field test results, according to IEC 60255-6
10. Supply voltage dips and interruptions test results, according to IEC 60255-11
11. Damped oscillatory waves test results, according to IEC 60255-22-1
12. Vibration test results, according to IEC 60255-21-1/2
13. Cyclic temperature test results, according to IEC 60068-2-2

<b>A and B Schedule for the Disturbance Recorder</b>
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**Note:**

**Section A of the Schedule to be completed by ESKOM**  
**Section B of the Schedule to be completed by THE TENDERER**

**A.**

**1. General description**

The recorder must be of a 19" rack mounted modular format, multi-functional measurement and analysis system for comprehensively monitoring and assessing equipment in electricity supply systems. It must combine the monitoring functions of high-resolution digital fault recorders, power quality analysers, phasor measurement units, continuous data recorders and event recorders in one device.

Individual devices can be networked via an Interlink interface to monitor extensive installations.

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**B.**

**1. General description**

**A.**

**1.1 Multi-Processor System**

It should have a multi-processor system. A digital signal processor (DSP) for processing signals and processes in real time and a communication processor for mass data storage, simultaneous data communication using different interfaces and protocols, web server functionality and stand-alone operation.

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**B.**

**1.1 Multi-Processor System**

**A.**

**1.2 User controls and displays**



- 1.2.1 Status LEDs for alarm, trigger and status display
  - 1.2.2 At least a 3.5" colour graphical display with touch screen and function keys
- 

**B.**

**1.2 User controls and displays**

- 1.2.1
- 1.2.2

**A.**

**1.3 Number of measurement inputs**

- 1.3.1 32 Analog inputs and 128 binary inputs
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**B.**

**1.3 Number of measurement inputs**

- 1.3.1

**A.**

**1.4 Data memory**

- 1.4.1 At least 32 GB flash RAM for reliable data storage
- 

**B.**

**1.4 Data memory**

- 1.4.1

**A.**

**1.5 Quality system**

- 1.5.1 Developed and manufactured to DIN ISO 9001:2015
- 

**B.**

**1.5 Quality system**

- 1.5.1

**A.**

**1.6 Calibration**

- 1.6.1 Software-controlled calibration

1.6.2 Calibration data is saved on the individual measurement modules  
1.6.3 No calibration required after module replacement or upgrade (plug & play) with a recommended calibration cycle check every 3 years

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**B.**

### **1.6 Calibration**

1.6.1  
1.6.2  
1.6.3

**A.**

### **1.7 Operating software**

1.7.1 Operating software for Windows 7, Windows 8.1 (32 and 64 bit),  
1.7.2 Windows 10 (32 and 64 bit), Windows Server 2012 R2

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**B.**

### **1.7 Operating software**

1.7.1  
1.7.2

## **2. Function overview**

**A.**

### **2.1 Recording functions**

2.1.1 Digital fault recorder with 2 sampling rates from 500 Hz...30 kHz for RMS fault recorder and sampling rate from 1 Hz...120 Hz for Continuous data recording  
2.1.2 Event data recording  
2.1.3 Power quality analyser, class A (optional) Phasor measurement unit/PMU (optional)

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**B.**

### **2.1 Recording functions**

2.1.1  
2.1.2  
2.1.3

**A.**

### **2.2 Standards for measurement and analysis complied with**

2.2.1 IEC 61000-4-30 class A  
IEC 61000-4-7 harmonics and inter-harmonics IEC 61000-4-15 flicker  
IEEE 519, IEEE 1159  
IEEE C37.118

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**B.**

## **2.2 Standards for measurement and analysis complied with**

2.2.1

## **3. Analog inputs**

**A.**

### **3.1 General information**

3.1.1 Resolution	: 16 Bit, S/R: 92 dB typical
3.1.2 Sampling frequency	: 200 kHz per channel
3.1.3 Accuracy	: 0.05% of range
3.1.4 Protection	: Galvanic isolation Channel to channel = 2.5 kV, and channel to device = 2.5 kV

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**B.**

### **3.1 General information**

3.1.1  
3.1.2  
3.1.3  
3.1.4

## **3.2 Input module**

**A.**

### **3.2.1 Number of measurement inputs**

3.2.1.1 8 inputs with selectable measuring ranges for:  
Voltage measurement  
Current measurement with external sensors (e.g. shunts)  
Measurement of low-level signals

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**B.**

### **3.2.1 Number of measurement inputs**

3.2.1.1

**A.**

### **3.2.2 Measuring ranges**

3.2.2.1 Each measurement input should have multiple selectable measuring ranges:  
Measuring range 1: 300 V AC /  $\pm 424$  V DC (impedance 6.6 M $\Omega$ )  
Measuring range 2: 700 mV AC /  $\pm 1000$  mV DC (impedance 14.7 k $\Omega$ )  
Measuring range 3: 200 mV AC /  $\pm 282$  mV DC (impedance 14.7 k $\Omega$ )  
Measuring range 4:  $\pm 20$  mA / 4...20 mA (impedance 10  $\Omega$ )

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**B.**

### **3.2.2 Measuring ranges**

3.2.2.1

**A.**

### **3.2.3 Overload**

3.2.3.1 1000 V AC sustained in the 300 V measuring range

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**B.**

### **3.2.3 Overload**

3.2.3.1

**A.**

### **3.2.4 Frequency range**

3.2.4.1 DC...10 kHz

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**B.**

**3.2.4 Frequency range**

3.2.4.1

**3.3 Input module**

**A.**

**3.3.1 Number of measurement inputs**

3.3.1.1 At least 3 separate high-current inputs for connection to protection or instrument transformers

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**B.**

**3.3.1 Number of measurement inputs**

3.3.1.1

**A.**

**3.3.2 Measuring ranges**

3.3.2.1 Each measurement input should have at least 3 selectable measuring ranges:

Measuring range 1: 10 A AC (impedance 0.002  $\Omega$ )

Measuring range 2: 40 A AC (impedance 0.002  $\Omega$ )

Measuring range 3: 200 A AC (impedance 0.002  $\Omega$ )

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**B.**

**3.3.2 Measuring ranges**

3.3.2.1

**A.**

**3.3.3 Overload**

- 3.3.3.1 40 A AC sustained (minimum)
  - 3.3.3.2 200 A AC for 5 seconds (minimum)
  - 3.3.3.3 500 A AC for 1 second (minimum)
- 

**B.**

### **3.3.3 Overload**

- 3.3.3.1
- 3.3.3.2
- 3.3.3.3

**A.**

### **3.3.4 Frequency range**

- 3.3.4.1 10 Hz...10 kHz
- 

**B.**

### **3.3.4 Frequency range**

- 3.3.4.1

## **4. Binary inputs**

**A.**

### **4.1 Input module**

- 4.1.1 Max. 8 input modules (128 inputs)
  - 4.1.2 Number of measurement inputs per module should at least be 16 inputs
  - 4.1.3 Galvanic isolated in 4 groups of 4 inputs (per module)
  - 4.1.4 Activation range : 24...300 V DC (wide-range inputs)
  - 4.1.5 Resolution : 0.1 ms
- 

**B.**

### **4.1 Input module**

- 4.1.1
- 4.1.2
- 4.1.3
- 4.1.4
- 4.1.5

**A.**

### **4.1.1 Protection**

- 4.1.1.1 Transient protection
  - 4.1.1.2 Polarity protection
  - 4.1.1.3 Galvanic isolation up to 2.5 kV
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**B.**

#### **4.1.1 Protection**

- 4.1.1.1
- 4.1.1.2
- 4.1.1.3

### **5. Binary outputs**

**A.**

#### **5.1 Electronic relays**

- 5.1.1 At least 2 freely configurable relays for status and alarm signals
  - 5.1.2 Switching capacity : Max. 60 V AC/DC, 200 mA
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**B.**

#### **5.1 Electronic relays**

- 5.1.1
- 5.1.2

**A.**

#### **5.2 Mechanical relays**

- 5.2.1 At least 8 freely configurable relays for status and alarm signals
  - 5.2.2 Contact type : Potential-free relay contact, configurable as NC or NO contact
  - : Switching capacity Max. 220 V AC, 8 A AC
  - : Max. 60 W
  - : Max. 500 ms
  - : Max. continuous current 2 A AC
- 

**B.**

#### **5.2 Mechanical relays**

- 5.2.1
- 5.2.2

### **6. Time synchronisation**

**A.**

**6.1 Standard equipment**

- 6.1.1 Internal real-time clock : Accuracy 2.5 ppm without external time synchronisation
  - 6.1.2 NTP/SNTP : Synchronisation over Ethernet network
  - 6.1.3 Interlink interface : Master-slave time synchronisation between several devices
- 

**B.**

**6.1 Standard equipment**

- 6.1.1
- 6.1.2
- 6.1.3

**7. Interfaces**

**A.**

**7.1 Standard equipment**

- 7.1.1 The device shall have the following standard interfaces as a minimum:
- Data communication : 2 x RS232, 1 x RS485  
: 2 x USB-A, 1 x USB-B  
: 1 x 10/100 Mbit Ethernet (RJ 45)
  - Interlink interface : Electric 2-wire interface for networking a number of devices  
Enables cross-triggering and master-slave time synchronisation over distances of up to 500 m
- 

**B.**

**7.1 Standard equipment**

- 7.1.1

**A.**

**7.2 Interface module**



- 7.2.1 Data communication : 1 x 10/100 Mbit optical Ethernet (ST II) 1 x 10/100 Mbit Ethernet (RJ 45)
- 7.2.2 Interlink interface : Optical Interlink interface for networking a number of devices
- 7.2.3 Enables cross-triggering and master-slave time synchronisation by means of a fibre optic loop
- 7.2.4 Maximum distance between 2 devices is 2 km
- 

**B.**

### **7.2 Interface module**

- 7.2.1
- 7.2.2
- 7.2.3
- 7.2.4

**A.**

### **7.3 Protocols**

- 7.3.1 Standard : TCP/IP, Modbus TCP, IEC 60870-5-103, GSM, GPRS
- 7.3.2 Standard : IEC 61850, IEEE C37.118 (PMU)
- 

**B.**

### **7.3 Protocols**

- 7.3.1
- 7.3.2

**A.**

### **8. Power supply**

- 8.1 The device power supply shall comply with the following specifications:
- 8.2 Operating voltages : 90...365 V DC and 85...265 V AC; 47...63 Hz; 9...18 V DC; 18...36 V DC; 36...72 V DC
- 8.3 Working range : +6% / -10% of the nominal range
- 8.4 Power consumption : Max. 30 VA with maximum configuration (32 analog and 128 binary inputs)
- 8.5 Redundancy : Power supply unit and power supply redundancy provided by accommodation of up to two independent power supply modules of the same type or of different types
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**B.**

### **8. Power supply**

- 8.1
- 8.2
- 8.3
- 8.4
- 8.5

## **9. Complete system**

**A.**

### **9.1 Mechanical**

9.1.1 The device shall comply with the following mechanical specifications:

- Weight : <5 kg
- Housing : 19" housing for rack mounting, 84 HP/3 U
- Protection class : IP 52 (front panel)
- Dimensions : 483 mm x 132.5 mm x 263 mm
- 

**B.**

### **9.1 Mechanical**

- 9.1.1

**A.**

### **9.2 Environment**

9.2.1 The device shall comply with the following environmental conditions:

Storage temperature : -20...+70 °C

Relative humidity : 5...95%, non-condensing

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**B.**

## **9.2 Environment**

9.2.1

**A.**

## **10. EMC standards**

10.1 The device shall comply with the following EMC standards:

IEC 60255-1 Measuring relays and protection equipment - Part 1

IEC 60255-5

IEEE C37.90

Dielectric test, 2.5 kV, 50 Hz

Insulation test, 500 V, 50 Hz

Impulse voltage test, 5 kV, 0.5 Joule

IEC 61000-4-2

IEC 60255-22-2

Electro-static discharge test, class 4 8 kV contact, 15 kV air

IEC 61000-4-3

IEC 60255-22-3

Radiated susceptibility

10 V/m, 80...3000 MHz, AM

10 V/m, 900 MHz, PM

IEC 61000-4-4

IEC 60255-22-4

IEEE C37.90.1

Electrical fast transient burst

4 kV, 2.5 kHz, 5 kHz, 100 kHz

IEC 61000-4-5

IEC 60255-22-5

Surge test, class 4 e

4 kV common mod

2 kV differential mode

IEC 61000-4-6

IEC 60255-22-6

Conducted susceptibility

10 V, 150 kHz...80 MHz

IEC 61000-4-8

IEC 60255-6

Power frequency magnetic field

30 A/m, 50 Hz, x, y, z axis

IEC 61000-4-11

IEC 60255-11

Supply voltage dips and interruptions, class 3

IEC 61000-4-18

IEC 60255-22-1

Damped oscillatory waves

2.5 kV, 1 MHz common mode  
1.0 kV, 1 MHz differential mode

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**B.**

**10. EMC standards**

10.1

**A.**

**11 Vibration Standards**

11.1 The device shall comply with the following Vibration Standards:

IEC 60068-2-6

IEC 60255-21-1

Vibration test

5.2 g, 5...55 Hz, x, y, z a

IEC 60068-2-27

IEC 60255-21-2

Vibration test

5 g / 11 ms, x, y, z axis

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**B.**

**11 Vibration Standards**

11.1

**A.**

**12 Climatic standards**

12.1 The device shall comply with the following Climatic Standards:

IEC 60068-2-2

Cyclic temperature test, dry heat

16 hours, 55 °C, operating condition

96 hours, 70 °C , power off condition

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**B.**

**12 Climatic standards**

12.1