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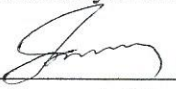
Report No.:  
KES-RE-19T0041  
Page ( 1 ) of ( 25 )

# Test Report

**Test Report No.** : KES-RE-19T0041  
**Date of Issue** : February 13, 2019  
**Description of Product** : NVR  
**Model No.** : TRM-810S  
**Variant Model** : -  
**Applicant** : Hanwha Techwin Co., Ltd.  
**Address** : 13488 6, Pangyo-ro, 319 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, KOREA  
**Manufacturer 1** : D-TECH CO., LTD.  
**Address** : 173-25, Saneop-ro, Gwonseon-gu, suwon-si, Gyeonggi-do, Korea (Suwon Industrial Complex)  
**Manufacturer 2** : HANWHA TECHWIN(TIANJIN) CO., LTD.  
**Address** : No.11 Weiliu Rd, Micro-Electronic Industrial park, TEDA, Tianjin, 300385, People's Republic of China  
**Manufacturer 3** : HANWHA TECHWIN SECURITY VIETNAM CO., LTD.  
**Address** : Lot O-2, Que Vo Industrial Zone extended area, Nam Son commune, Bac Ninh city, Bac Ninh province, Vietnam  
**Applicable Regulation** : EN 50155:2017 Railway applications - Electronic equipment used on rolling stock  
EN 61373:2010 Railway applications - Rolling stock equipment - Shock and vibration tests

**Test Date** : January. 24. 2019 – January. 31. 2019

**Tested by:**

  
Hyunseuk, Oh  
Test Engineer

**Reviewed by:**

  
Kang sun, Lee  
Technical Manager



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## 1. General information

### 1.1 Introduction

<b>Company Name</b>	KES Co., Ltd.
<b>Name of President / CEO</b>	Young, Kim
<b>Address</b>	C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea
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### 1.2 Laboratory

<b>Address</b>	C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do, 14057, Korea  473-21, Gayeo-ro, Yeosu-si, Gyeonggi-do, 12658, Korea
<b>Tel</b>	+82-31-425-6200
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## 2. Information of E.U.T

	<ol style="list-style-type: none"> <li>1) Product : NVR</li> <li>2) Model : TRM-810S</li> <li>3) Ratings : DC 12 V</li> <li>4) Serial No. : ZJD070GKB00006W</li> <li>5) Use of report : For quality management</li> </ol>
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### 3. Shock and vibration tests :

EN 61373:2010 Railway applications – Rolling stock equipment – Shock and vibration tests

#### 1) Scope

This International Standard specifies the requirements for testing items of equipment intended for use on railway vehicles which are subsequently subjected to vibrations and shock owing to the nature of railway operational environment. To gain assurance that the quality of the equipment is acceptable, it has to withstand tests of reasonable duration that simulate the service conditions seen throughout its expected life.

Simulated long-life testing can be achieved in a number of ways each having their associated advantages and disadvantages, the following being the most common:

- a) amplification: where the amplitudes are increased and the time base decreased;
- b) time compression: where the amplitude history is retained and the time base is decreased (increase of the frequency);
- c) decimation: where time slices of the historical data are removed when the amplitudes are below a specified threshold value.

#### 2) Purpose and choice of the tests

Symbol	Test description
Category 1 Body mounted	Class A Cubicles, subassemblies, equipment and components mounted directly on or under the car body.
	Class B Anything mounted inside an equipment case which is in turn mounted directly on or under the car body. NOTE 1 Class B should be used when it is not clear where the equipment is to be located.
Category 2 Bogie mounted	Cubicles, subassemblies, equipment and components which are to be mounted on the bogie of a railway vehicle
Category 3 Axle mounted	Subassemblies, equipment and components or assemblies which are to be mounted on the wheelset assembly of a railway vehicle.

#### 3) General

This standard is intended to highlight any weakness/error which may result in problems as a consequence of operation under environments where vibration and shock are known to occur in service on a railway vehicle. This is not intended to represent a full life test. However, the test conditions are sufficient to provide some reasonable degree of confidence that the equipment will survive the specified life under service conditions.

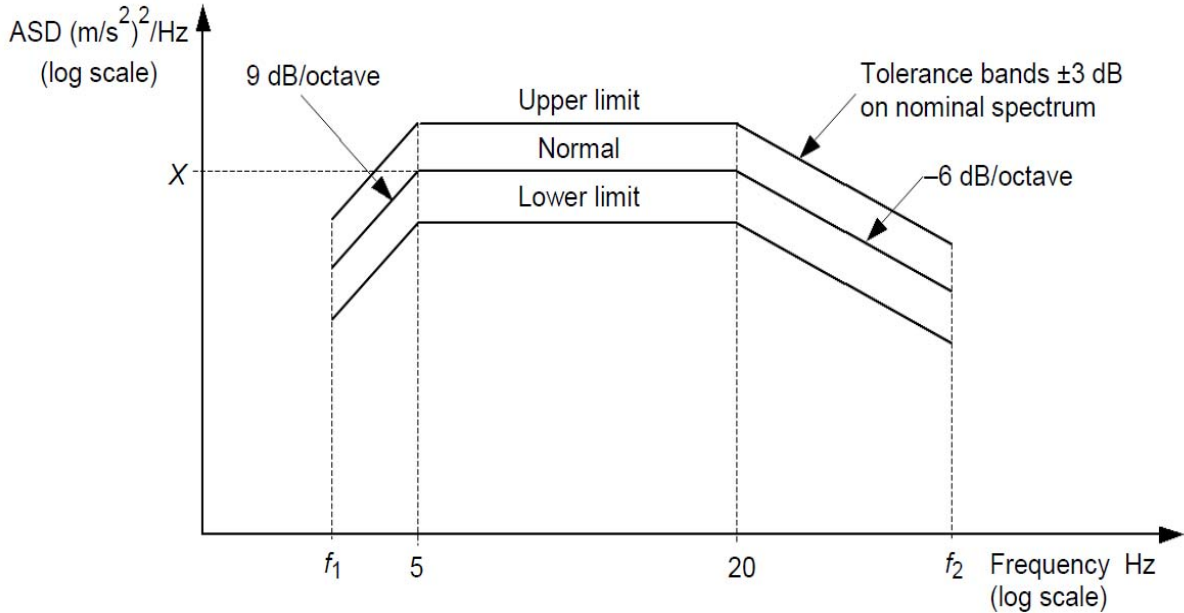


#### 4) Simulated long-life test conditions

Item	Detailed description	Remarks																																				
Test date	January 28, 2019 - January 31, 2019	-																																				
Environmental conditions	Temperature : (25.0 ± 10.0)°C, Humidity : (50 ± 25) % R.H.	-																																				
Power conditions	<input checked="" type="checkbox"/> Store (Power OFF) <input type="checkbox"/> Action (Power ON)	-																																				
Categories	<input checked="" type="checkbox"/> Category 1 ( <input checked="" type="checkbox"/> Class A <input type="checkbox"/> Class B) <input type="checkbox"/> Category 2 <input type="checkbox"/> Category 3	-																																				
Direction time  and  test level	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Vertical (5 h)</th> <th colspan="2">Transverse (5 h)</th> <th colspan="2">Longitudinal (5 h)</th> </tr> <tr> <th>Frequency [ Hz ]</th> <th>ASD Levels [ m/s<sup>2</sup>/Hz ]</th> <th>Frequency [ Hz ]</th> <th>ASD Levels [ m/s<sup>2</sup>/Hz ]</th> <th>Frequency [ Hz ]</th> <th>ASD Levels [ m/s<sup>2</sup>/Hz ]</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5</td> <td style="text-align: center;">0.532</td> <td style="text-align: center;">5</td> <td style="text-align: center;">0.131</td> <td style="text-align: center;">5</td> <td style="text-align: center;">0.234</td> </tr> <tr> <td style="text-align: center;">20</td> <td style="text-align: center;">0.532</td> <td style="text-align: center;">20</td> <td style="text-align: center;">0.131</td> <td style="text-align: center;">20</td> <td style="text-align: center;">0.234</td> </tr> <tr> <td style="text-align: center;">150</td> <td style="text-align: center;">-6 dB/oct</td> <td style="text-align: center;">150</td> <td style="text-align: center;">-6 dB/oct</td> <td style="text-align: center;">150</td> <td style="text-align: center;">-6 dB/oct</td> </tr> <tr> <td colspan="2" style="text-align: center;">4.25 m/s<sup>2</sup> r.m.s</td> <td colspan="2" style="text-align: center;">2.09 m/s<sup>2</sup> r.m.s</td> <td colspan="2" style="text-align: center;">2.83 m/s<sup>2</sup> r.m.s</td> </tr> </tbody> </table>	Vertical (5 h)		Transverse (5 h)		Longitudinal (5 h)		Frequency [ Hz ]	ASD Levels [ m/s <sup>2</sup> /Hz ]	Frequency [ Hz ]	ASD Levels [ m/s <sup>2</sup> /Hz ]	Frequency [ Hz ]	ASD Levels [ m/s <sup>2</sup> /Hz ]	5	0.532	5	0.131	5	0.234	20	0.532	20	0.131	20	0.234	150	-6 dB/oct	150	-6 dB/oct	150	-6 dB/oct	4.25 m/s <sup>2</sup> r.m.s		2.09 m/s <sup>2</sup> r.m.s		2.83 m/s <sup>2</sup> r.m.s		
	Vertical (5 h)		Transverse (5 h)		Longitudinal (5 h)																																	
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ASD spectrum	Category 1 ( <input checked="" type="checkbox"/> Class A <input type="checkbox"/> Class B)	Refer to 3. 5)																																				
Initial measurements	Visual inspection	Mechanical damage, loosening of screw, etc.	-																																			
	Functional test	Normal operation check	-																																			
Intermediate measurements	Visual inspection	Not-Applicable	-																																			
	Functional test	Not-Applicable	-																																			
Final measurements	Visual inspection	Mechanical damage, loosening of screw, etc.	-																																			
	Functional test	Normal operation check	-																																			

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**5) Category 1 – Class A, ASD spectrum**



**6) Simulated long-life test result**

Test Items	Test standard	Test result	Remarks
Simulated long-life test	Simulated long-life test at increased random vibration level according to Category 1, Class A test method. There should be no abnormalities and no mechanical defects when checking the performance test at the initial and final of the test.	No abnormalities and no mechanical defects when the performance test was confirmed at the initial and final of the test	-



<p><b>X</b> axes</p>		<p>January 28, 2019 / 20:43:02</p> <p><b>Test Report</b></p> <p>Remaining: 00:00:00      Total elapsed: 05:00:19      Full level elapsed: 05:00:07 Lines: 400                      DOR: 64                      Frequency range (Hz): Calculated by profile Average: 64                      Run Start Time: Jan-28-2019, 20:43:02</p> <p>• Control Composite •</p>
<p><b>Y</b> axes</p>		<p>January 29, 2019 / 09:47:46</p> <p><b>Test Report</b></p> <p>Remaining: 00:00:00      Total elapsed: 05:01:14      Full level elapsed: 05:00:07 Lines: 400                      DOR: 64                      Frequency range (Hz): Calculated by profile Average: 64                      Run Start Time: Jan-29-2019, 09:47:46</p> <p>• Control Composite •</p>
<p><b>Z</b> axes</p>		<p>January 31, 2019 / 09:45:09</p> <p><b>Test Report</b></p> <p>Remaining: 00:00:00      Total elapsed: 05:01:14      Full level elapsed: 05:00:07 Lines: 400                      DOR: 64                      Frequency range (Hz): Calculated by profile Average: 64                      Run Start Time: Jan-31-2019, 09:45:09</p> <p>• Control Composite •</p>

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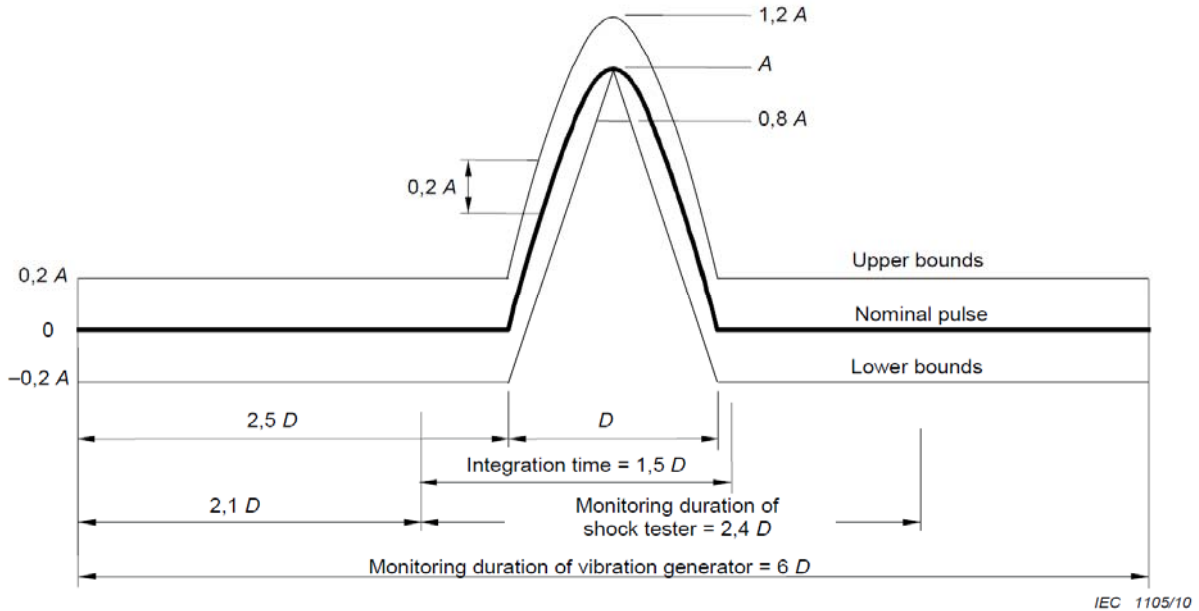
**7) Shock testing conditions**

Item	Detailed description	Remarks		
Test date	January 29, 2019 - January 31, 2019	-		
Environmental conditions	Temperature : (25.0 ± 10.0) °C, Humidity : (50 ± 25) % R.H.	-		
Power conditions	<input checked="" type="checkbox"/> Store (Power OFF) <input type="checkbox"/> Action (Power ON)	-		
Categories	<input checked="" type="checkbox"/> Category 1 ( <input checked="" type="checkbox"/> Class A <input type="checkbox"/> Class B) <input type="checkbox"/> Category 2 <input type="checkbox"/> Category 3	-		
Direction time  and  test level	<b>Vertical</b>	<b>Transverse</b>	<b>Longitudinal</b>	
	<b>Peak acceleration A (m/s<sup>2</sup>)</b>	30	30	50
	<b>Nominal duration D (ms)</b>	30	30	30
	<b>Number of repetitions (+, -)</b>	3 / 3	3 / 3	3 / 3
	<b>Wave form</b>	Half sine wave	Half sine wave	Half sine wave
<b>Allowable width of sine wave type</b>	Category 1 ( <input checked="" type="checkbox"/> Class A <input type="checkbox"/> Class B)	Refer to 3. 8)		
<b>Initial measurements</b>	<b>Visual inspection</b>	Mechanical damage, loosening of screw, etc.	-	
	<b>Functional test</b>	Normal operation check	-	
<b>Intermediate measurements</b>	<b>Visual inspection</b>	Not-Applicable	-	
	<b>Functional test</b>	Not-Applicable	-	
<b>Final measurements</b>	<b>Visual inspection</b>	Mechanical damage, loosening of screw, etc.	-	
	<b>Functional test</b>	Normal operation check	-	

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### 8) Allowable width of sine wave type



### 9) Shock test result

Test Items	Test standard	Test result	Remarks
Shock test	Vertical, transverse, and longitudinal shock tests According to Category 1, Class A test method There should be no abnormalities and no mechanical defects when checking the performance test at the initial and final of the test.	No abnormalities and no mechanical defects when the performance test was confirmed at the initial and final of the test	-

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<b>X axes</b>		<p>January 29, 2019 / 09:13:51</p>	<p>January 29, 2019 / 09:14:03</p>
		<p>January 29, 2019 / 14:52:09</p>	<p>January 29, 2019 / 14:52:24</p>
<b>Y axes</b>		<p>January 31, 2019 / 14:48:53</p>	<p>January 31, 2019 / 14:49:02</p>
		<p>January 31, 2019 / 14:48:53</p>	<p>January 31, 2019 / 14:49:02</p>

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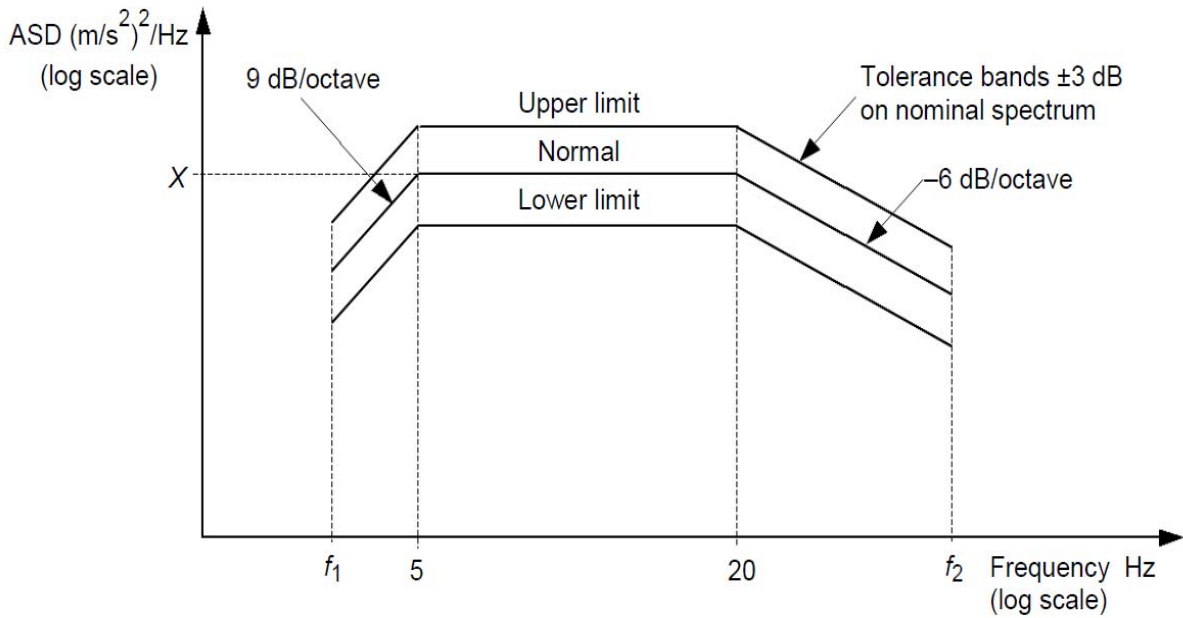


**10) Functional random test conditions**

Item		Detailed description						Remarks
Test date		January 29, 2019 - January 31, 2019						-
Environmental conditions		Temperature : (25.0 ± 10.0) °C, Humidity : (50 ± 25) % R.H.						-
Power conditions		<input type="checkbox"/> Store (Power OFF) <input checked="" type="checkbox"/> Action (Power ON)						-
Categories		<input checked="" type="checkbox"/> Category 1 ( <input checked="" type="checkbox"/> Class A <input type="checkbox"/> Class B) <input type="checkbox"/> Category 2 <input type="checkbox"/> Category 3						-
Direction time  and test level	Vertical (15 min)		Transverse (15 min)		Longitudinal (15 min)			
	Frequency [ Hz ]	ASD Levels [ m/s <sup>2</sup> /Hz ]	Frequency [ Hz ]	ASD Levels [ m/s <sup>2</sup> /Hz ]	Frequency [ Hz ]	ASD Levels [ m/s <sup>2</sup> /Hz ]		
	5	0.016 6	5	0.004 1	5	0.007 3		
	20	0.016 6	20	0.004 1	20	0.007 3		
	150	-6 dB/oct	150	-6 dB/oct	150	-6 dB/oct		
	0.750 m/s <sup>2</sup> r.m.s		0.370 m/s <sup>2</sup> r.m.s		0.500 m/s <sup>2</sup> r.m.s			
ASD spectrum		Category 1 ( <input checked="" type="checkbox"/> Class A <input type="checkbox"/> Class B)						Refer to 3. 11)
Initial measurements	Visual inspection	Mechanical damage, loosening of screw, etc.						-
	Functional test	Normal operation check						-
Intermediate measurements	Visual inspection	Mechanical damage, loosening of screw, etc.						-
	Functional test	Normal operation check						-
Final measurements	Visual inspection	Mechanical damage, loosening of screw, etc.						-
	Functional test	Normal operation check						-

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**11) Category 1 – Class A, ASD spectrum**



**12) Functional random test result**

Test Items	Test standard	Test result	Remarks
Functional random test	Vertical, transverse, and longitudinal functional random test according to Category 1, Class A test method  There should be no abnormalities and no mechanical defects when checking the performance test at the initial and final of the test.	No abnormalities and no mechanical defects when the performance test was confirmed at the initial and final of the test	-



<p><b>X</b> axes</p>		<p>January 29, 2019 / 09:27:05</p> <p><b>Test Report</b></p> <p>Remaining: 00:00:00      Total elapsed: 00:11:19      Full level elapsed: 00:10:07 Lines: 400                      DOF: 64                      Frequency range (Hz): Calculated by profile Average: 64                      Run Start Time: Jan-29-2019, 09:27:05</p> <p>• Control Composite</p>
<p><b>Y</b> axes</p>		<p>January 29, 2019 / 15:05:24</p> <p><b>Test Report</b></p> <p>Remaining: 00:00:00      Total elapsed: 00:11:14      Full level elapsed: 00:10:07 Lines: 400                      DOF: 64                      Frequency range (Hz): Calculated by profile Average: 64                      Run Start Time: Jan-29-2019, 15:05:24</p> <p>• Control Composite</p>
<p><b>Z</b> axes</p>		<p>January 31, 2019 / 15:16:20</p> <p><b>Test Report</b></p> <p>Remaining: 00:00:00      Total elapsed: 00:11:17      Full level elapsed: 00:10:07 Lines: 400                      DOF: 64                      Frequency range (Hz): Calculated by profile Average: 64                      Run Start Time: Jan-31-2019, 15:16:20</p> <p>• Control Composite</p>

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#### 4. Low temperature start-up test : EN 50155:2017 (clause 13.4.4)

##### 1) Test description and symbol

Standard	Symbol	Test description
EN 60068-2-1	Ab	Cold for non heat-dissipating specimens with gradual change of temperature
	Ad	Cold for heat-dissipating specimens with gradual change of temperature that are powered after initial temperature stabilization
	Ae	Cold for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test

##### 2) Table 1 – Operating temperature classes

Class	Equipment operating temperature range	Class	Equipment operating temperature range
OT1	-25 °C ~ 55 °C	OT4	-40 °C ~ 70 °C
OT2	-40 °C ~ 55 °C	OT5	-25 °C ~ 85 °C
OT3	-25 °C ~ 70 °C	OT6	-40 °C ~ 85 °C

##### 3) Test instrument performance

Set point temperature control method	Temperature sensor detection and control
Air flow	High wind speed circulation
Air velocity and direction	7.17 m/s, north wind
Applied temperature change rate (slope)	Max. 1 K/min

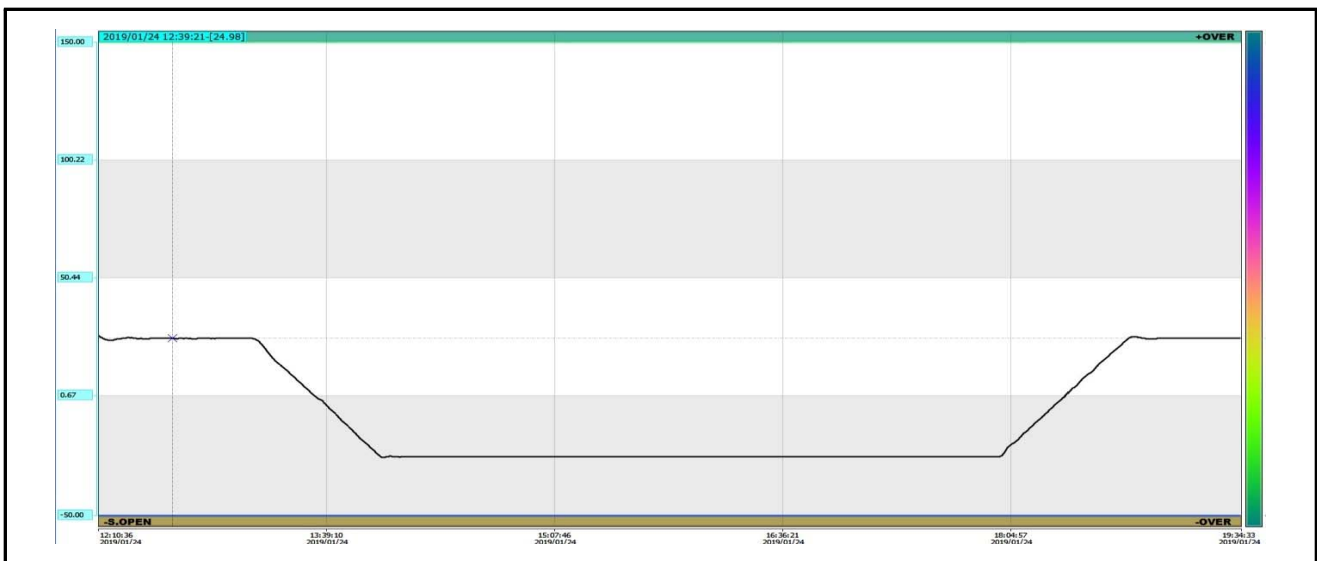
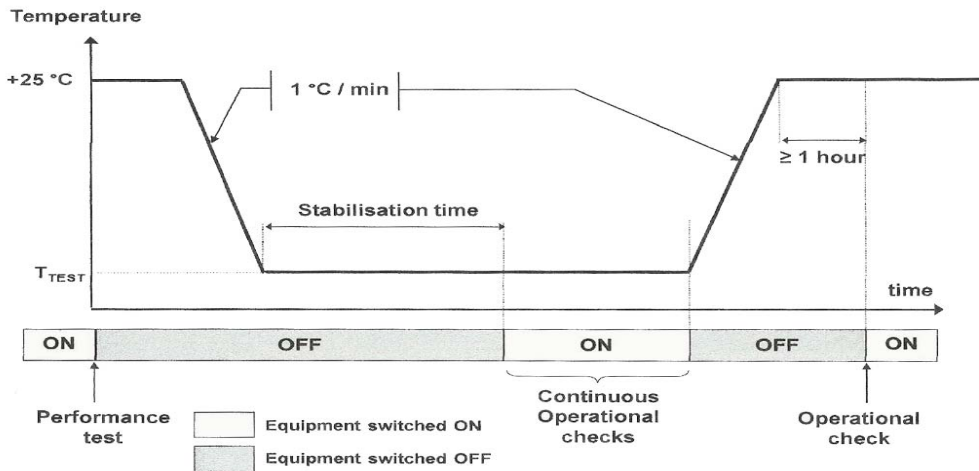


#### 4) Test conditions

Item		Detailed description	Remarks
Test date		January 24, 2019	-
Environmental conditions		Temperature : (25.0 ± 10.0) °C, Humidity : (50 ± 25) % R.H.	-
Power conditions		<input type="checkbox"/> Store (Power OFF) <input checked="" type="checkbox"/> Action (Power ON)	During measurements
Operating temperature classes		OT1	Refer to 4.3.2
Specimen classification		<input type="checkbox"/> Non heat-dissipating specimens <input checked="" type="checkbox"/> heat-dissipating specimens	-
Application testing		<input type="checkbox"/> Test Ab <input checked="" type="checkbox"/> Test Ad <input type="checkbox"/> Test Ae	-
Severity	Temperature	<input type="checkbox"/> -65 °C <input type="checkbox"/> -55 °C <input type="checkbox"/> -50 °C <input type="checkbox"/> -40 °C <input type="checkbox"/> -33 °C <input checked="" type="checkbox"/> -25 °C <input type="checkbox"/> -20 °C <input type="checkbox"/> -10 °C <input type="checkbox"/> -5 °C <input type="checkbox"/> +5 °C	Tolerance ± 2 K
	Duration	<input checked="" type="checkbox"/> 2 h <input type="checkbox"/> 16 h <input type="checkbox"/> 72 h <input type="checkbox"/> 96 h <input type="checkbox"/> Etc	EN 50155
Pre conditioning	Applicability	<input checked="" type="checkbox"/> No Regulations <input type="checkbox"/> Regulations	-
	Contents	-	-
Initial measurements	Visual inspection	Mechanical damage, loosening of screw, etc.	-
	Functional test	Normal operation check	-
Intermediate measurements	Visual inspection	Not-Applicable	-
	Functional test	Normal operation check	-
Recovery	Applicability	<input type="checkbox"/> No Regulations <input checked="" type="checkbox"/> Regulations	-
	Condition	<input checked="" type="checkbox"/> Recovery from standard atmospheric conditions <input type="checkbox"/> Etc :	Minimum 1 hour
Final measurements	Visual inspection	Mechanical damage, loosening of screw, etc.	-
	Functional test	Normal operation check	-

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### 5) Low temperature start-up test graph



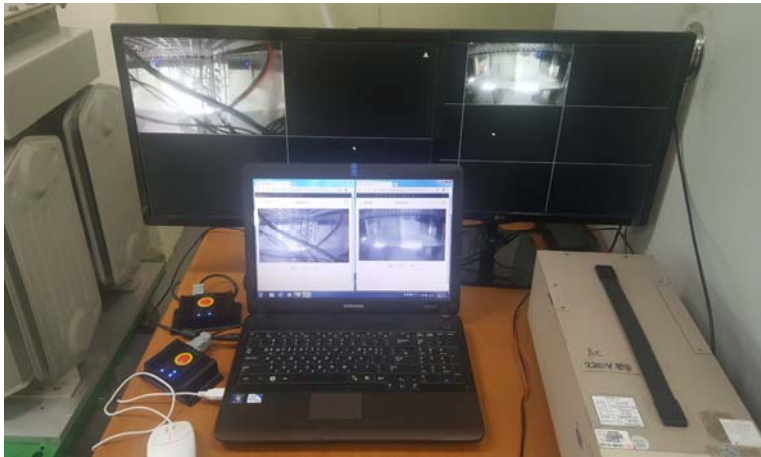


### 6) Test result

Test Items	Test standard	Test result	Remarks
Low temperature start-up test	According to EN 60068-2-1 cold resistance test method, it is allowed to stand at -25 °C, 2 hours, no abnormalities and no mechanical defects when the function test is confirmed at the initial, intermediate and final of the test	When the function test was carried out no abnormality and no mechanical defect	—

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	<p><b>Internal chamber</b></p>	
<p><b>Low temperature start-up test</b></p>	<p><b>During the test</b></p>	
	<p><b>Normal operation check</b></p>	

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## 5. Dry heat test : EN 50155:2017 (clause 13.4.5)

### 1) Test description and symbol

Standard	Symbol	Test description
EN 60068-2-2	Bb	Dry heat for non heat-dissipating specimens with gradual change of temperature
	Bd	Dry heat for heat-dissipating specimens with gradual change of temperature that are not powered during the conditioning period
	Be	Dry heat for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test

### 2) Table 1 – Operating temperature classes

Class	Equipment operating temperature range	Class	Equipment operating temperature range
OT1	-25 °C ~ 55 °C	OT4	-40 °C ~ 70 °C
OT2	-40 °C ~ 55 °C	OT5	-25 °C ~ 85 °C
OT3	-25 °C ~ 70 °C	OT6	-40 °C ~ 85 °C

### 3) Table 2 – Switch-on extended Operating temperature classes

Class	Switch-on extended operating temperature	Thermal test cycle
ST0	No switch-on extended operating temperature	Test cycle A
ST1	OTx + 15 °C	Test cycle B
ST2	OTx + 15 °C	Test cycle C

### 4) Test instrument performance

Set point temperature control method	Temperature sensor detection and control
Air flow	High wind speed circulation
Air velocity and direction	7.38 m/s, north wind
Applied temperature change rate (slope)	Max. 1 K/min

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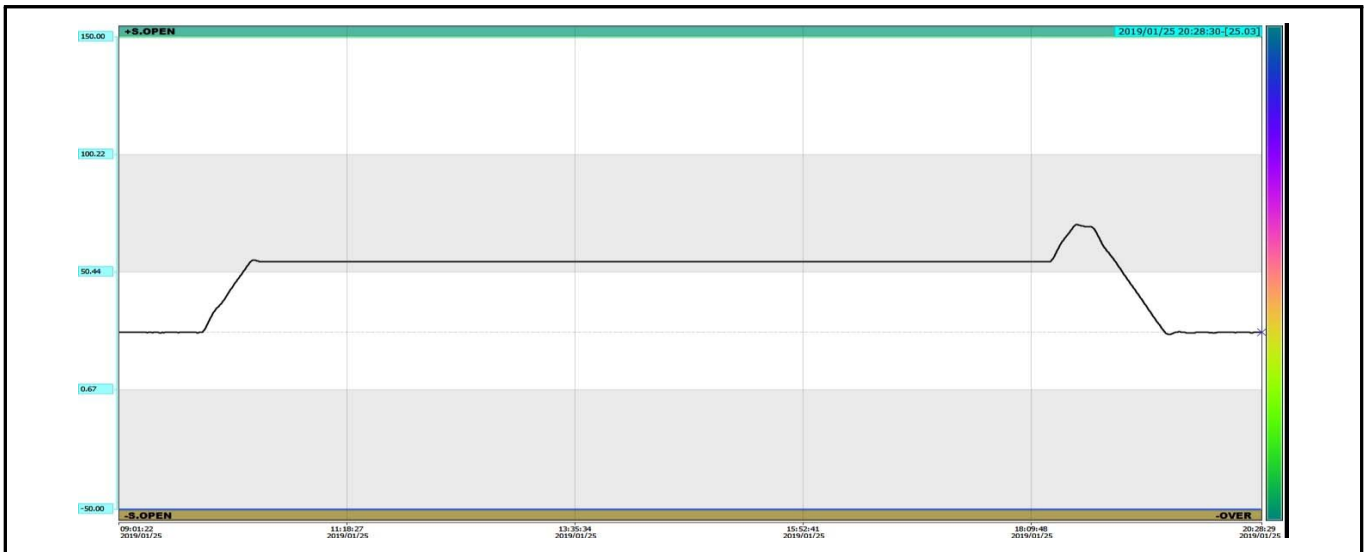
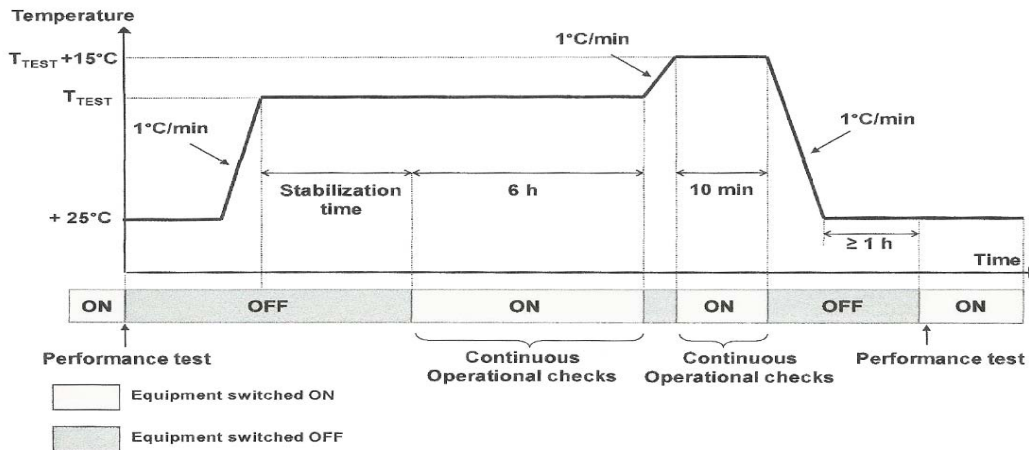


**5) Test conditions**

Item		Detailed description	Remarks
Test date		January 25, 2019	-
Environmental conditions		Temperature : (25.0 ± 10.0) °C, Humidity : (50 ± 25) % R.H.	-
Power conditions		<input type="checkbox"/> Store (Power OFF) <input checked="" type="checkbox"/> Action (Power ON)	During measurements
Operating temperature classes		OT1, ST1 (Test cycle B)	Refer to 4.3.2, 4.3.3
Specimen classification		<input type="checkbox"/> Non heat-dissipating specimens <input checked="" type="checkbox"/> heat-dissipating specimens	-
Application testing		<input type="checkbox"/> Test Bb <input type="checkbox"/> Test Bd <input checked="" type="checkbox"/> Test Be	-
Severity	Temperature	<input type="checkbox"/> 1000 °C <input type="checkbox"/> 800 °C <input type="checkbox"/> 630 °C <input type="checkbox"/> 500 °C <input type="checkbox"/> 400 °C <input type="checkbox"/> 315 °C <input type="checkbox"/> 250 °C <input type="checkbox"/> 175 °C <input type="checkbox"/> 155 °C <input type="checkbox"/> 125 °C <input type="checkbox"/> 100 °C <input type="checkbox"/> 85 °C <input checked="" type="checkbox"/> 70 °C <input type="checkbox"/> 65 °C <input type="checkbox"/> 60 °C <input checked="" type="checkbox"/> 55 °C <input type="checkbox"/> 50 °C <input type="checkbox"/> 45 °C <input type="checkbox"/> 40 °C <input type="checkbox"/> 35 °C <input type="checkbox"/> 30 °C	Tolerance ± 2 K
	Duration	<input type="checkbox"/> 2 h <input type="checkbox"/> 16 h <input type="checkbox"/> 72 h <input type="checkbox"/> 96 h <input type="checkbox"/> 168 h <input type="checkbox"/> 240 h <input type="checkbox"/> 336 h <input type="checkbox"/> 1 000 h <input checked="" type="checkbox"/> Etc : 6 h + 10 min	EN 50155
Initial measurements	Visual inspection	Mechanical damage, loosening of screw, etc.	-
	Functional test	Normal operation check	-
Intermediate measurements	Visual inspection	Not-Applicable	-
	Functional test	Normal operation check	-
An extra performance check	Functional test	70 °C, 10 min, Normal operation check	-
Recovery	Applicability	<input type="checkbox"/> No Regulations <input checked="" type="checkbox"/> Regulations	-
	Condition	<input checked="" type="checkbox"/> Recovery from standard atmospheric conditions <input type="checkbox"/> Etc :	Minimum 1 hour
Final measurements	Visual inspection	Mechanical damage, loosening of screw, etc.	-
	Functional test	Normal operation check	-

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**6) Dry heat test graph (Test cycle B)**



**7) Test result**

Test Items	Test standard	Test result	Remarks
Dry heat test	According to EN 60068-2-2 Dry heat test method, it is allowed to stand at 55 °C, 6 hours, no abnormalities and no mechanical defects when the function test is confirmed at the initial, intermediate and final stages of the test	When the function test was carried out no abnormality and no mechanical defect	-

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	<p><b>Internal chamber</b></p>	
<p><b>Dry heat test</b></p>	<p><b>During the test</b></p>	
	<p><b>Normal operation check</b></p>	

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## 6. Insulation test : EN 50155:2017 (clause 13.4.8)

### 1) General

The aim of this test is to ensure that the mounting of components, their metal connections and casings and the routing of wiring and printed board tracks, are not located too close to surrounding metal parts or fixings.

The test shall be carried out on fully assembled parts of equipment, and/or complete equipment dependent upon the scope of supply.

The test comprises two parts, an insulation measurement test (carried out before and after the voltage withstand test), and the voltage withstand test.

Insulation measurement test shall be carried out at routine and type test at the integration level of the equipment under test (e.g. printed board assemblies, racks)

Insulation measurement test shall be carried out at the integration level of the equipment under test (e.g. printed board assemblies, racks)

Voltage withstand tests should be performed only at routine and type test on concerned electronic equipment and this test is not repeated when this equipment is integrated into other assemblies.

The voltage withstand test procedure shall be arranged such that individual circuits are subjected to the minimum number of applications of the dielectric test voltage.

For subracks and printed board assemblies with exposed metal parts, frames or front panels, or metal fixings, which can either be touched or require galvanic isolation; then, the test shall be carried out between all the connections shorted together and these metal parts.

### 2) Insulation measurement test

The insulation resistance test shall be carried out at 500 V DC and the values shall be recorded for all the equipotential areas defined for the insulation test. During the test, the equipment shall not be powered on.

The insulation of each equipotential area shall be tested and measured against mechanical earth and against all surrounding equipotential areas.

*Test acceptance requirements:*

*The minimum value of the insulation resistance after the withstand test shall be higher than 20 M $\Omega$ .*

*The equipment shall work as intended and within its specified limits after the insulation test.*



### 3) Voltage withstand test

The test shall be performed with AC (50 Hz or 60 Hz) or DC test voltage according to Table 1.

The test voltage shall be applied by gradually increasing the voltage amplitude to the test voltage, and maintained at the specified level for :

- a) Type test : 1 min;
- b) Routine test : 10 s.

Each equipotential area shall be defined and tested against mechanical earth and against all surrounding equipotential areas.

During the test the equipment shall not be powered on. The insulation measurement shall be carried out after the voltage withstand test.

Nominal battery voltage and/or I/O voltage	Test voltage
< 72 V DC or 50 V AC rms	500 V AC or 750 V DC
72 V DC ≤ V DC < 125 V DC or from 50 to 90 V AC rms	1 000 V AC or 1 500 V DC
125 V DC ≤ V DC < 315 V DC or from 90 to 225 V AC rms	1 500 V AC or 2 200 V DC

Table 1 – Test voltages of voltage withstand test

#### *Test acceptance requirements:*

*Neither disruptive discharge nor flashover shall occur. After the withstand test, the equipment shall work as intended and within its specified limits.*



#### 4) Insulation measurement test results

Test Items	Test standard	Test result	Remarks
Insulation measurement test	Carried out at 500 V d.c., There shall be no fundamental deterioration from the initial measurement.	Not applicable	Input : DC 12 V (SELV part)

#### 5) Voltage withstand test results

Test Items	Test standard	Test result	Remarks
Voltage withstand test	AC 500 V, 60 Hz, 1 min, Neither disruptive discharge nor flashover shall occur.	Not applicable	Input : DC 12 V (SELV part)





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**7. Used instrument list**

No	KES Management Number	Instrument Name	Mfr.	Model	Serial #	Date of Calibration	Calibration Valid Until	Calibration Cycle	Remark
1	KES-RE-069	Extended Range DC Power Supply	TAKASAGO	EX-750L2	4053700 30236	2019.01.03	2020.01.03	1 year	-
2	KES-RE-107	Vibration Exciter	JINN Co., Ltd.	S701LS4-450M	20170523	2018.07.11	2019.07.11	1 year	-
3	KES-RE-110	Temp. & Humid. Chamber	SJ SCIENCE CO	SJ-TH-S100	SJ-TH-S100 -171205	2019.01.03	2020.01.03	1 year	-

- The end of test report -

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