THERMOMETRICS
A COMMITMENT TO EXCELLENCE

# Water Detection Sensor BAF147


According to sharp growth of Electrical Vehicles (EV), many OEMs are using cooling systems for their battery pack systems. However, if an instance of water leakage were to occur in Li-ion battery packs, it would create dangerous conditions.

Thermometrics Water Detection Sensor BAF147 detects moisture leakage via a change in resistance value of the sensor and feeds a signal to the Battery Management System (BMS) to warn the driver.

## Applications

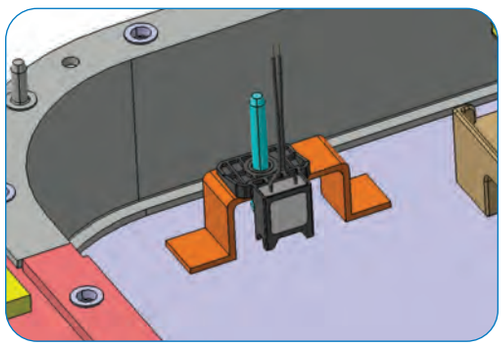
- Battery pack water detection
- Overflow of water/fluid
- Leak detection from a burst pipe
- Level detection on tank fill applications
- Condensate overflow sensor for HVAC applications
- Sump pumps

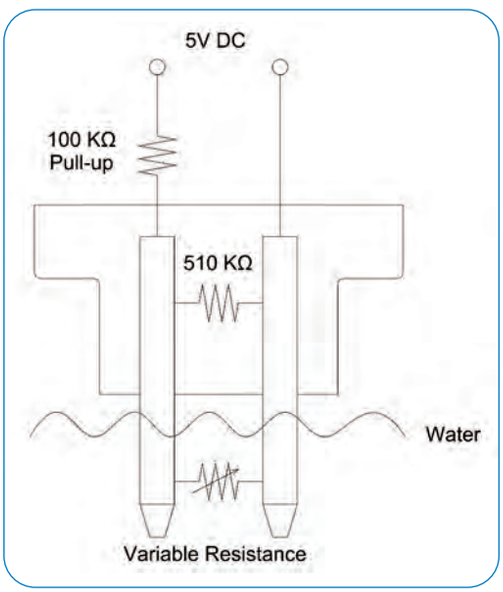
## Features

- 510kΩ ± 3%
- Operating Temperature Range: -40°C to 85°C
- Easy to install
- RoHS Compliance (Directive 2011/65/EU)

## Ordering Part No.

- BAF147B002



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# Water Detection Sensor BAF147 - Specifications

| Parameter | Limits | | | Unit | Condition |
|---|---|---|---|---|---|
| | Min | Typ | Max | | |
| Operating Temperature Range | -40 | | 85 | °C | |
| Resistor in Sensor | 494.7 | 510 | 525.3 | kΩ | 1/4 Watt |
| Rated Power | 5V DC | | | Voltage | Recommended |
| Pull-up Resistor | 100 | | | kΩ | Recommended |
| RoHS | Directive 2011/65/EU | | | | |

## Reliability

| Parameter | Criteria | Condition |
|---|---|---|
| High Temperature<br>Dwell/Operation Test | After test<br>- No deformation<br>- No functional error<br>- To meet requirement | - Temp: 85°C ± 3°C, 1000 hrs<br>- Rated voltage: 5V<br>- Check water immersion at 5V DC |
| Low Temperature<br>Dwell/Operation Test | After test<br>- No deformation<br>- No functional error<br>- To meet requirement | - Temp: -40°C ± 3°C, 1000 hrs<br>- Rated voltage: 5V DC<br>- On: 10 mins, Off: 50 mins<br>- Check water immersion at 5V DC |
| High Temperature/Humidity Test<br>(Voltage rated) | After test<br>- No visual error<br>- Deformation allowed at non-functional area<br>- No functional error<br>- To meet requirement | - Temp: 85°C ± 3°C, 1000 hrs<br>- Humidity: 95 ~ 99 % RH<br>- Rated voltage: 5V DC<br>- On: 10 mins, Off: 50 mins<br>- Check water immersion at 5V DC |
| Temperature/Humidity Cycle Test | After test<br>- No functional error<br>- To meet requirement | See Figure 1 for test condition.<br>- Check water immersion at 5V DC<br>- After the test, dwell specimen at room temperature more than 2 hrs |
| Temperature Cycle Test | During/after test<br>- No functional error<br><br>After test<br>- To meet requirement | See Figure 2 for test condition<br>(On: 10 min, Off: 50 min)<br>- After test, dwell specimens at room temp. (more than 2 hrs)<br>- Check water immersion at 5V DC |
| Impact Test | After test<br>- No visual error<br>- No functional error<br>- To meet requirement | See Figure 3 for test condition.<br>- Impact acceleration: 392±10% m/s$^2$<br>- Impact time: 11 ms<br>- Impact direction: +X, -X, +Y, -Y, +Z, -Z<br>- No. of impact: 3 times (each direction)<br>- Check water immersion at 5V DC |
| Drop Test | After test<br>- No visual error<br>- No functional error (including sealing)<br>- To meet requirement | - Drop height: 1m (concrete or steel floor)<br>- Drop direction: 1st: X, 2nd: -X<br>1. not applicable to connector direction<br>2. switch product to cover before drop<br>- No. of drop: 2 times (per specimen)<br>- Check water immersion at 5V DC |
| Dew Condensation Test | After test<br>- No burning marks<br>- No functional error<br>- To meet requirement | See Figure 4 for test condition.<br>- Total duration: 3 cycles<br>- Check water immersion at 5V DC |

# Water Detection Sensor BAF147 - Specifications

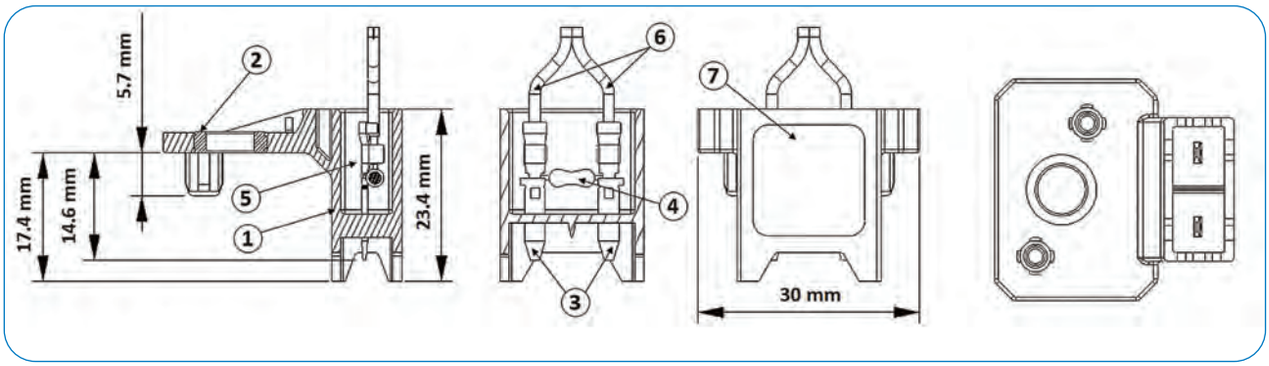
| Parameter | Criteria | Condition |
|---|---|---|
| Dust Dwell Test<br>(Not power rated) | After test<br>(remove dust before inspection)<br>- No functional error<br>- To meet requirement | - Unspecified procedure to follow JIS D 0207<br>- Dust type: JIS Z 8901, 9 types, 3 kg<br>- Air pressure: 294 ~ 490 kPa<br>- Dust spray: 10 sec, every 15 mins (total test duration: 6 hrs)<br>- Check water immersion at 5V DC |
| Temperature Characteristics Test | After test<br>- To meet requirement at each temperature | - Dwell specimens at room temp. for 1 hr (not power rated)<br>- See Figure 5 for test condition<br>- Dwell specimens at each temperature  Test specimens at the same temperature<br>- Rated power: 12.6 V DC<br>(for water leak operation check)<br>- Check water immersion at 5V DC |
| Salt Spray Test | After test<br>- No functional error<br>- No rust allowed<br>(white rust allowed)<br>- To meet requirement | - Salt water density: 5 ± 1 %<br>- Salt water temp.: 35 ± 2°C<br>- Test duration: 24 hrs<br>- Water dispensing: mist type (1~2 ml / hr)<br>- Check water immersion at 5V DC |
| Resonance Durability Test | After test<br>- Bracket breakage<br>* customer approval needed<br>- No visual error<br>- To meet requirement | 1. Resonance frequency search<br>- Frequency: 10 ~ 1000 Hz<br>- Vibration acceleration: 9.8 $m/s^2$<br>- Vibration direction: X, Y, Z<br>2. Resonance durability test<br>- See Table 1 for test condition |
| Vibration Durability Test 1<br>- Accelerated vibration at product (Indoor, trunk, door) | After test<br>- No visual error<br>- No functional error<br>- To meet requirement | - Frequency: 10 ~ 1000 Hz<br>- Acceleration: 20 $m/s^2$<br>- Duration: 8 hrs (each axis)<br>- For vibration frequency, see Figure 6 |
| Vibration Durability Test 2<br>- Accelerated vibration at part (Indoor, trunk, door) | During/after test<br>- No functional error<br><br>After test<br>- No visual error<br>- To meet requirement<br>- Bracket breakage<br>* customer approval needed | - Frequency: 20 ~ 2000 Hz<br>- Acceleration: 60 $m/s^2$<br>- Duration: 5 mins (each axis)<br>- For vibration frequency, see Figure 7 |
| Vibration Durability Test 3<br>- Sweep vibration | During/after test<br>- No functional error<br><br>After test<br>- No visual error<br>- To meet requirement<br>- Bracket breakage<br>* customer approval needed | - Frequency: 10 ~ 200 Hz<br>- Sweep cycle: 15 min (log scale)<br>- No. of sweep cycle: 300 (each axis)<br>- Vibration direction: X, Y, Z<br>- Acceleration for vibration: See Table 2 |
| Vibration Durability Test 4<br>- Mixed condition | During/after test<br>- No functional error<br><br>After test<br>- No visual error<br>- To meet requirement | - Test duration: 20 hrs (each axis)<br>- Test pattern: See Figure 8.<br>- Temp. & operation condition: See Figure 9<br>- Vibration acceleration: 27.8 $m/s^2$ |
| Thermal Shock Test | During/after test<br>- No functional error<br><br>After test<br>- No solder/part error<br>- To meet requirement | - Test 1 duration: 500 cycle (Indoor product)<br>- Test 2 duration: 1000 cycle (engine room, exterior, etc)<br>- Test pattern: See Fig.10 |
| Impact Durability Test | After test<br>- No functional error<br>- To meet requirement | - Impact acceleration: 400 $m/s^2$<br>- Impact time: 11 ms<br>- Number of impacts: See Table 3<br>- Check water immersion at 5V DC |
| High/Low Temperature Test<br>(Product limit lifecycle test) | No criteria<br>(Only functional error above/ below operating temperature is acceptable) | - Place specimens at below temperature for 30 mins and then, operate for 30 mins [°C]<br>(-40, -30, +80, +90, +100, +110, +120, +130)<br>- Check water immersion at 5V DC |

# Water Detection Sensor BAF147 - Specifications

## Materials

| No. | Construction List | Material | Notes |
|---|---|---|---|
| 1 | Case | PBT | Black |
| 2 | Bush | C3604 | |
| 3 | Terminal | C2680-1/2H | Pre-Tin, Cu/Sn |
| 4 | Resistor | 510 kΩ | 1/4 W |
| 5 | Resin | Epoxy | Black |
| 6 | Wire | AVSST, 0.3SQ | Black/Black |
| 7 | Label | 15 X 15 mm | Laminated Coating |

## Dimensions




### Notes:

1. Due to electrolysis of liquid and sensor, it is not suggested to use more than 1 hour in liquid.
2. The sensor must be replaced after warning signal to vehicle.
3. Do not disassemble or change any parts.
4. In use/stock of oil, may cause degradation of the sensor's characteristics.
5. Protect the sensor from flux/fume and high temperature during soldering.
6. Do not immerse sensor in liquid.

# Water Detection Sensor BAF147 - Specifications

Table.1 Resonance Durability Test

| Resonance Frequency | Acceleration (m / s) | Vibration Frequency | Test Time | | |
|---|---|---|---|---|---|
| | | | X-Axis | Y-Axis | Z-Axis |
| 10-50 Hz | 29.4 | Resonance Frequency | 3.00 | 1.50 | 1.50 |
| 50-100 Hz | 9.8 | Resonance Frequency | 0.75 | 0.50 | 0.50 |
| 100-1000 Hz | 4.9 | Resonance Frequency | 0.75 | 0.50 | 0.50 |
| No Resonance Frequency | 29.4 | 33 | 3.00 | 1.50 | 1.50 |

Table.2 Vibration Durability Test 3 – Sweep vibration

| Frequency (Hz) | Direction (Acceleration) | | |
|---|---|---|---|
| | X-Axis | Y-Axis | Z-Axis |
| 10-30 | 34.3 | 36.3 | 22.5 |
| 30-50 | 14.7 | 15.7 | 10.8 |
| 50-80 | 5.88 | 6.86 | 4.31 |
| 80-200 | 2.65 | 2.84 | 1.86 |

Table.3 Impact Durability Test

| Minimum 10-Year Warranty (Number of Impact per Axis) | Minimum 15-Year Warranty (Number of Impact per Axis) | Installation |
|---|---|---|
| 72,000 | 100,000 | Driver Seat Door |
| 36,000 | 50,000 | Passenger/Rear Seat Door |
| 18,000 | 30,000 | Trunk/Liftgate |
| 2,000 | 3,000 | Hood |

# Water Detection Sensor BAF147 - Specifications

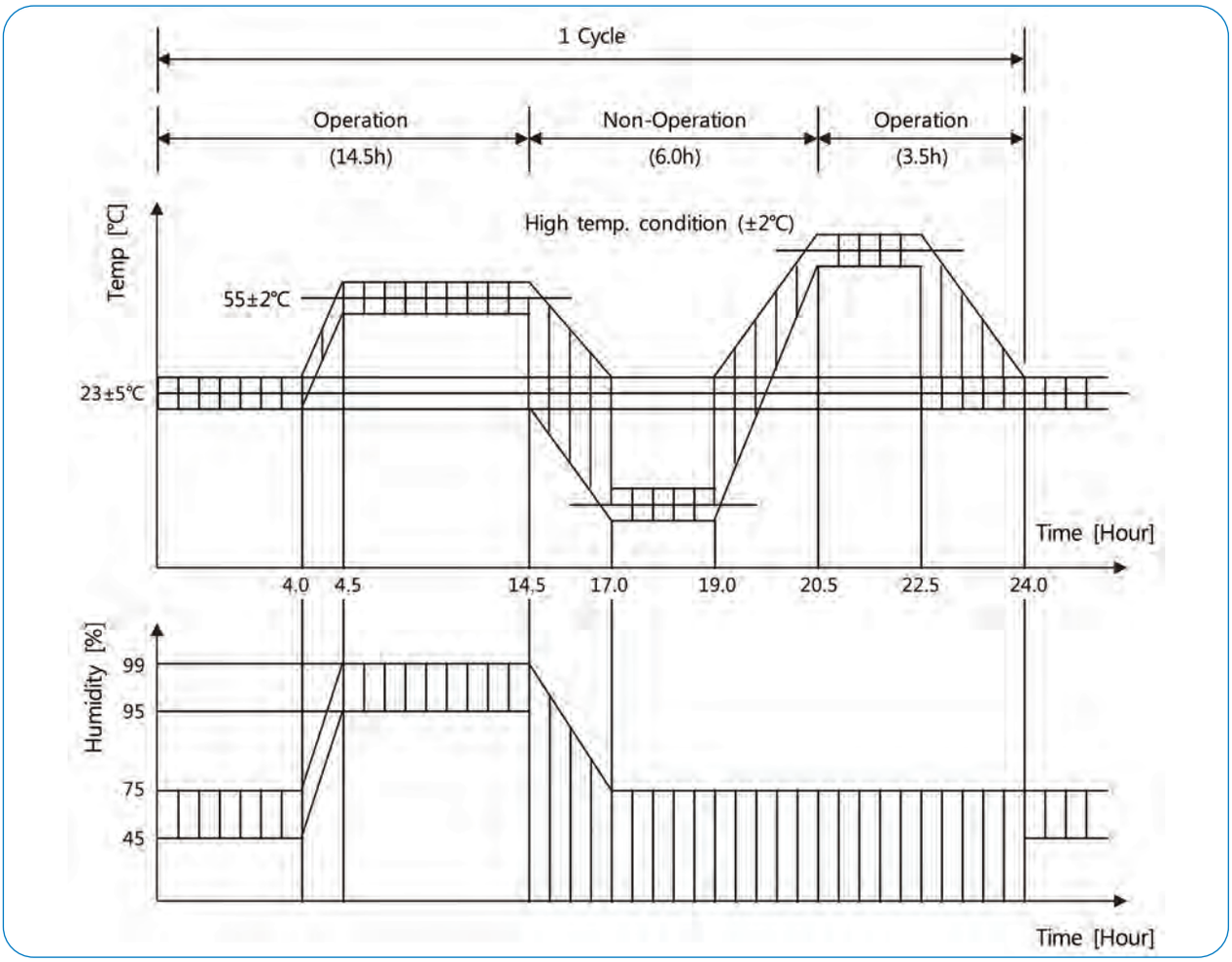



Figure 1: High Temperature/Humidity Cycle Test Graph (Power rated)

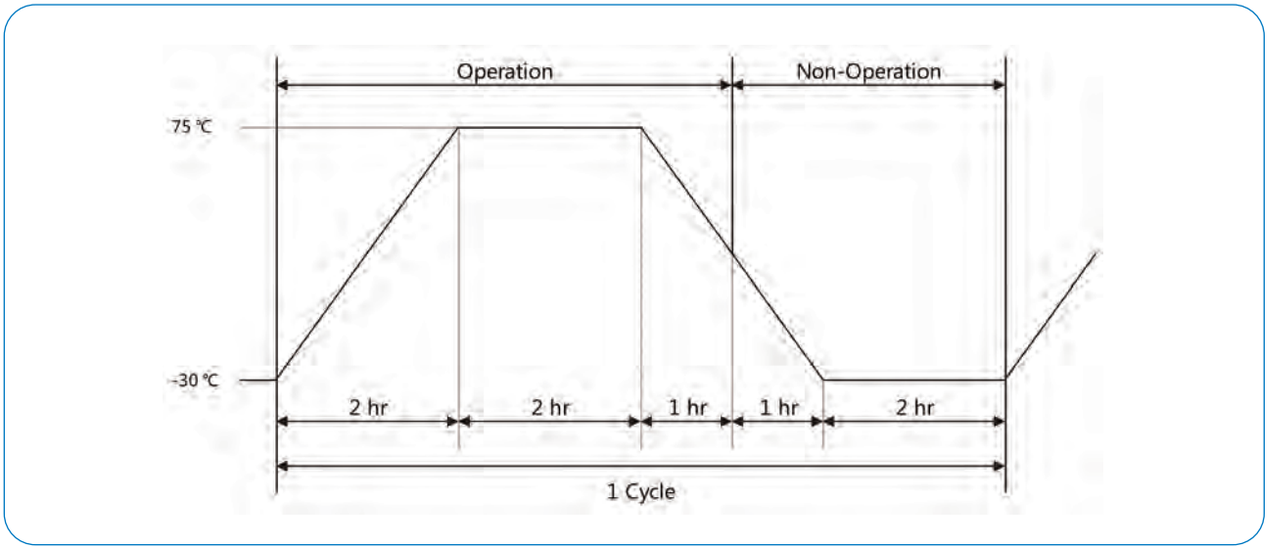



Figure 2: Temperature Cycle Test

# Water Detection Sensor BAF147 - Specifications

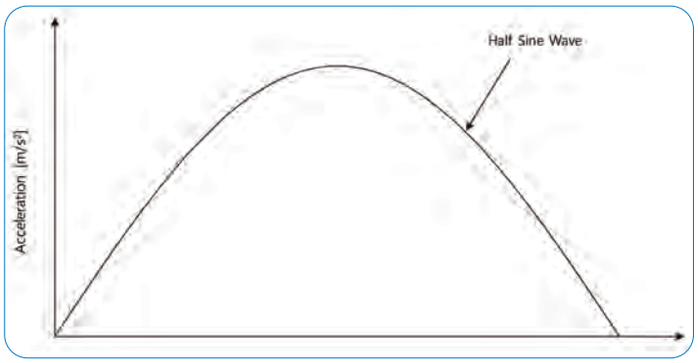



Figure 3: Impact Test

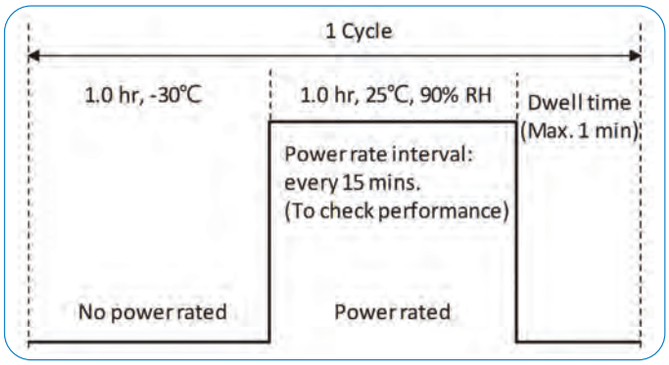



Figure 4: Dew Condensation Test

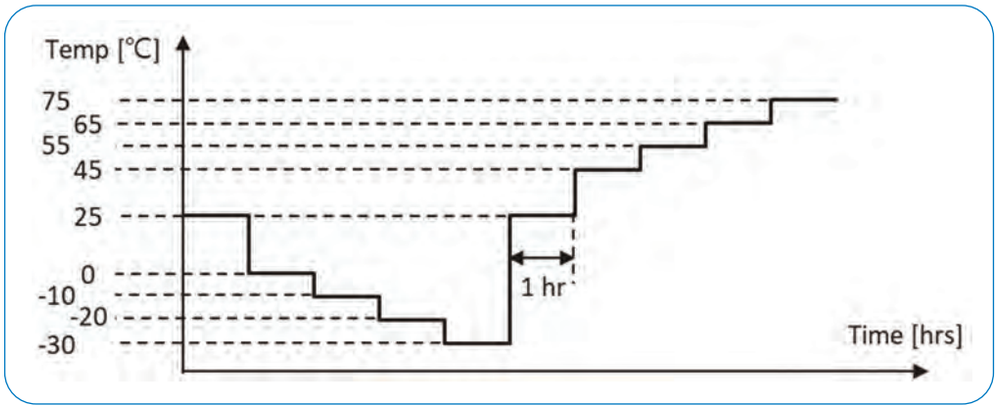



Figure 5: Temperature Characteristics Test

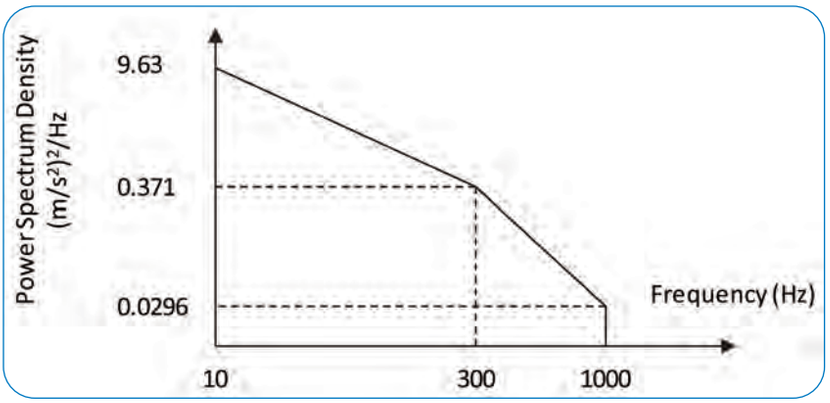



Figure 6: Vibration Durability Test 1 – Accelerated vibration (product)

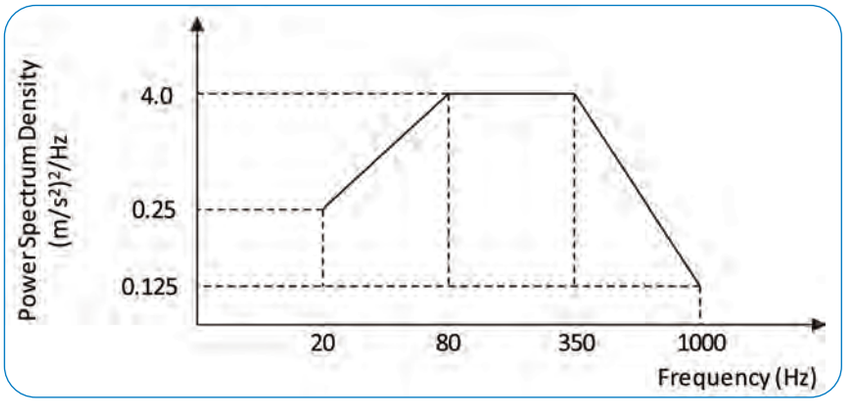



Figure 7: Vibration Durability Test 2 – Accelerated vibration (part)

# Water Detection Sensor BAF147 - Specifications

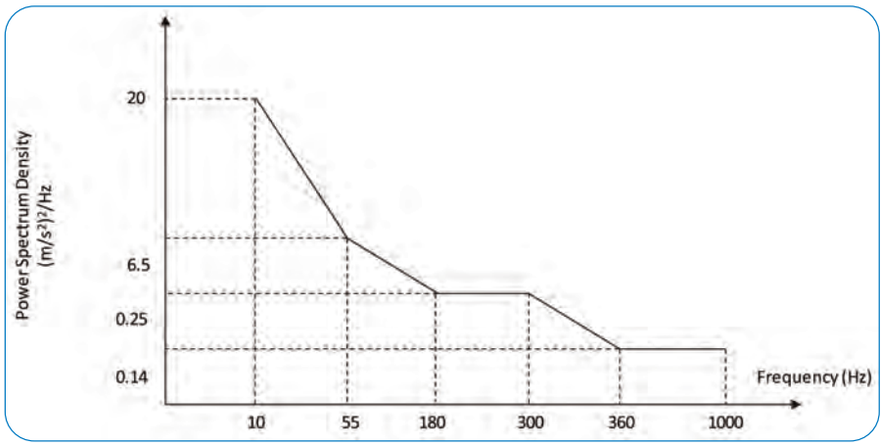



Figure 8: Vibration Durability Test 2 – Accelerated vibration (part)

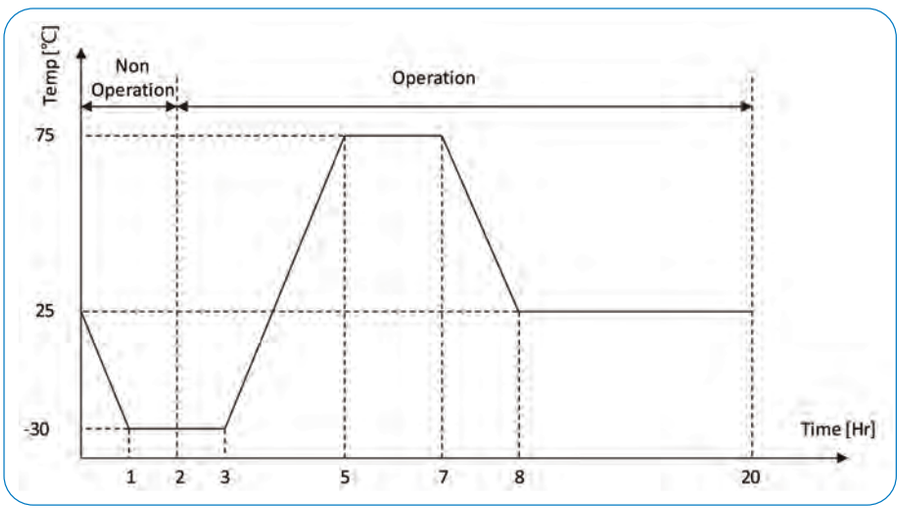



Figure 9: Vibration Durability Test 4 – Mixed condition

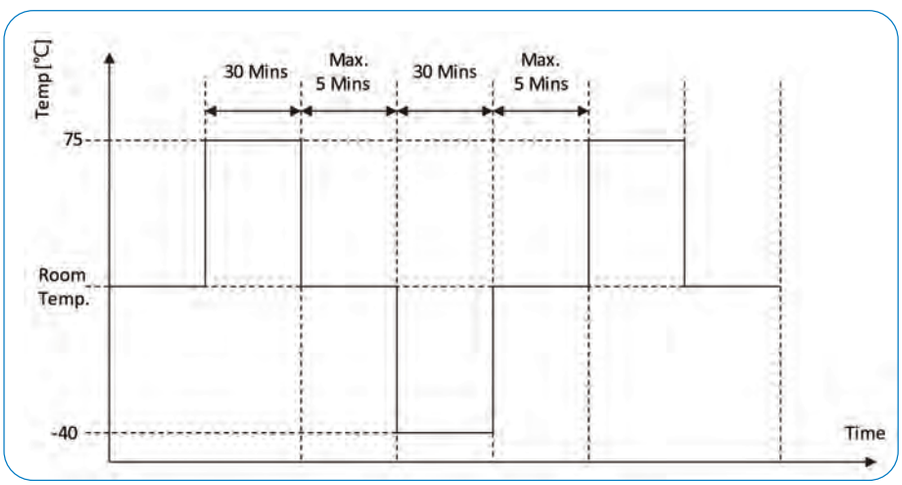



Figure 10: Thermal Shock Test

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