# SKF TraX Technical Specification Connected version

WEM-200/US
WEM-200/32
WEM-200/EU

*WEM-200/US*
*(US version)*

*WEM-200/32*
*(European version)*

*WEM-200/EU*
*(European version)*

Non-contractual images

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# 1 Document identification

Table 1

**Revision**

| Version | Date | Author | Comment |
|---|---|---|---|
| 1 | October 2019 | CV | Initial creation |
| 2 | January 2021 | CV | Update specification for Pilot 2 parts |
| 3 | July 2021 | CV | Update specification for start of production |
| 4 | April 2023 | BT | Addition of other baseplate references and clarifications |
| 5 | September 2023 | BT | Update specification for BSS10 release |

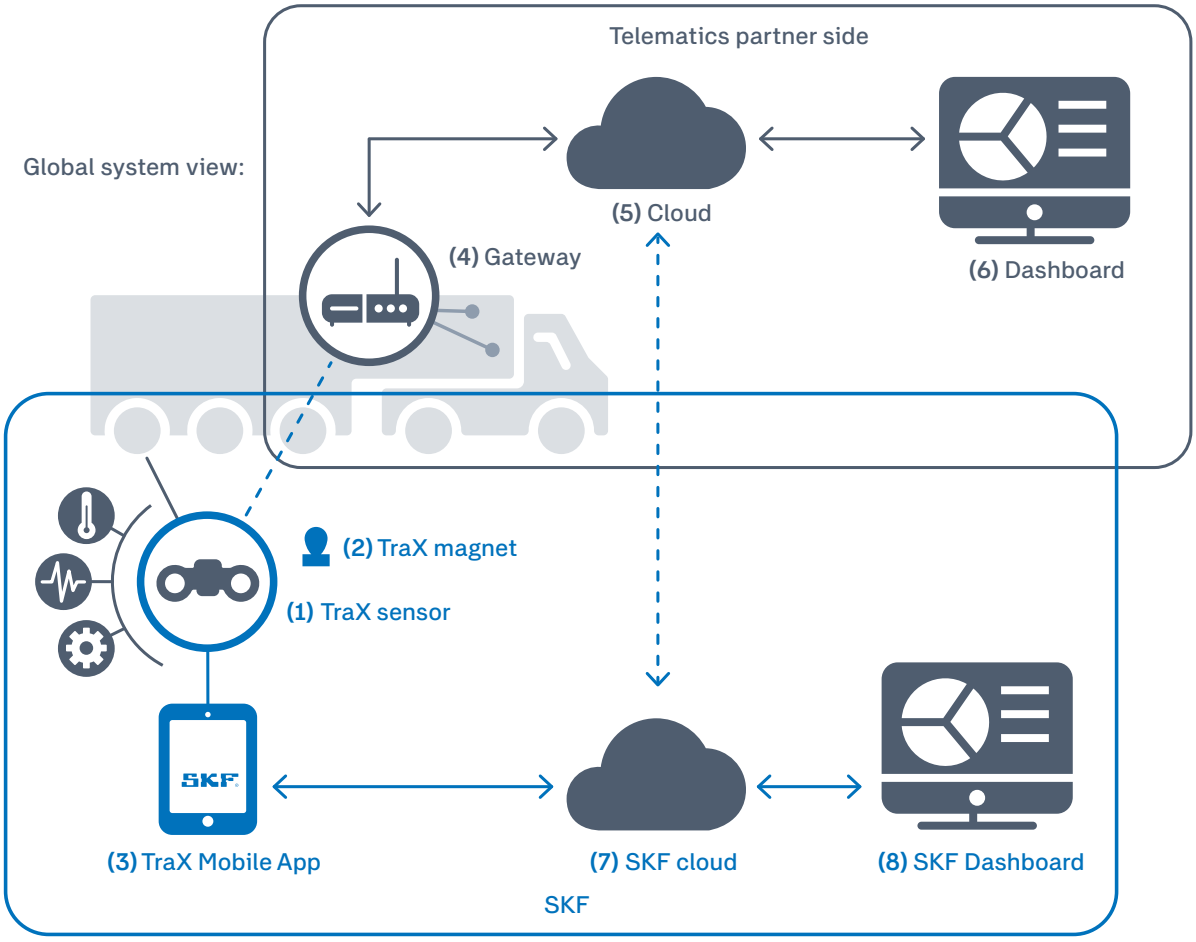
# 2 Document references

Table 2

**References**

| Document title | Document reference | Document revision |
|---|---|---|
| Sensor drawing dwp | WEM-200/US | Ed. 5) 23 09 |
| | WEM-200/32 | Ed. 5) 23 09 |
| | WEM-200/EU | Ed. 6) 23 09 |

# 3 Introduction




The SKF TraX system monitors the condition of wheel end bearings by measuring and analyzing wheel end vibration, usually on trucks, trailers and buses. It provides warnings when bearing failures are detected and facilitates checks on the condition of wheel end bearings.

SKF TraX system is composed of five elements:

**(1)** The TraX WEM-200 sensor, is a battery-powered, wireless sensor that can be mounted on the wheel. It monitors the condition of the bearing and measures its temperature. It is available with three different baseplate dimensions depending on the pitch circle diameter of the wheel. The data it collects is sent by BLE (Bluetooth Low Energy) and collected by the gateway **(4)**, which displays relevant information on the dashboard **(6)**.

**(2)** A standard magnet is used to wake up the TraX sensor with a minimum field strength of 60 Gauss @ 10 mm from the magnet surface. This magnet is not in the scope of SKF's products. For example, a push pin magnet with neodymium material can be used.

**(3)** The TraX Mobile App is an i-OS or Android application that can be installed on a smart device and used to configure the TraX sensor.

**(7)** SKF cloud is used for data storage and exchange

**(8)** SKF dashboard is used for data visualization

**(2)**, **(4)**, **(5)**, **(6)** are not in the scope of SKF's products.
The current technical specification only relates to the TraX sensor **(1)**.

# 4 Specification

## 4.1 Mechanical specification

Table 3

| Parameter | US baseplate | 32 baseplate | EU baseplate | Unit | Comment |
|---|---|---|---|---|---|
| Pitch circle diameter | 285 | 335 | 335 | mm | |
| Holes diameter | 25 | 32 | 25 | mm | |
| Part weight | 225 | 215 | 237 | g | |
| Holes center-to-center distance | 88.302 | 103.52 | 103.52 | mm | |
| | 36 | 36 | 36 | ° | |
| Maximum fixing torque | 725 | 725 | 725 | Nm | |
| Part thickness | 26.86 ± 1.14 | 26.86 ± 1.14 | 26.86 ± 1.14 | mm | |
| Baseplate thickness | 4 ± 0.1 | 4 ± 0.1 | 4 ± 0.1 | mm | |

## 4.2 Operating temperature

Table 4

| Parameter | Value | Unit | Comment |
|---|---|---|---|
| Operating temperature | –10 to 85<br>*14 to 185* | °C<br>*°F* | All functions available |
| Operating temperature for magnet use | –20 to 85<br>*–4 to 185* | °C<br>*°F* | Possibility to pair with the Mobile App |
| Operating temperature for vibration analysis | –10 to 105<br>*14 to 221* | °C<br>*°F* | Bearing damage detection possible |
| Operating temperature for BLE communication | –20 to 105<br>*–4 to 221* | °C<br>*°F* | Receiving data by gateway possible |
| Operating temperature for temperature measurement | –40 to 105<br>*–40 to 221* | <br>*°F* | Temperature alarm enabled |

Above 105 °C (*221 °F*), the sensor will continue to measure and transmit information, although its accuracy cannot be guaranteed.[1] –40 °C is the minimum acceptable limit to use the product.

## 4.3 Application

Table 5

| Parameter | Value | Unit | Comment |
|---|---|---|---|
| Minimum speed for vibration analysis | 60<br>40 | km/h<br>mph | |

[1] A sensor replacement is recommended if the temperature has exceeded 105 °C (*221 °F*)

## 4.4 Temperature measurement

Table 6

| Parameter | Value | Unit | Comment |
|---|---|---|---|
| Temperature measurement frequency | 5<br>10<br>5 | Min<br>Sec<br>Sec | If T < 70 °C (*150 °F)*<br>If 70 °C (*150 °F)* < T < 100 °C (*212 °F)*<br>If T > 100 °C (*212 °F)* |
| Temperature measurement accuracy | ±3 | °C | |

High temperature in wheel ends could be caused by many things: bearing damages, brake problems, braking for long periods, tire problems and ambient conditions.

SKF shall not be liable if a temperature alarm is triggered but no damage is observed on the wheel end, nor if no or late temperature alarm is triggered even where damage has been encountered.

## 4.5 Bearing damage detection

The product has been validated[2)] to detect large spalling bearing damages.

Table 7

| Sensor Ref | Axle type | Bearing Type | Bearing Reference | | SKF Set reference | |
|---|---|---|---|---|---|---|
| | | | Inner | Outer | Inner | Outer |
| WEM-200/32 | Non driven | THU2 | BTF-0110B | BTF-0110B | VKBA5377 | VKBA5377 |
| WEM-200/32 | Drive | sTRB standard hub | 542-100 | 542-100 | VKBA5423 | VKBA5423 |
| WEM-200/US | FF Steer non driven | PreSet | HM212011<br>HM212049 | 3720<br>3782 | Set427 | Set428 |
| WEM-200/US | FF Steer non driven | sTRB standard hub | HM212011<br>HM212049 | 3720<br>3782 | Set413 | Set406 |
| WEM-200/US | TN-TQ Tapered trailer non driven | sTRB standard hub | HM218210<br>HM218248 | HM212011<br>HM212049 | Set414 | Set413 |
| WEM-200/US | TP Parallel trailer non driven | sTRB standard hub | HM518410<br>HM518445 | HM518410<br>HM518445 | Set415 | Set415 |

High vibration in wheel ends could be caused by many things: bearing damages, brake problems, tire problems and ambient conditions. SKF shall not be liable where a vibration alarm is triggered but no damage is observed on the wheel end, nor for cases where no vibration alarm is triggered or it is triggered late, even if damage has been encountered.

The product can be used to detect other types of defects on the wheel end and on other types of axles.

2) Validation has been performed on a reduced number of tests. TraX sensors should only be mounted with agreed data sharing between Telematics and SKF and with a specific customer agreement.

## 4.6 Pilot test session

The product has been tested during specific pilot test sessions on the following bearing designations.

Table 8

| Sensor Ref | Axle type | Bearing Type | Bearing Reference | | SKF Set reference | |
|---|---|---|---|---|---|---|
| | | | Inner | Outer | Inner | Outer |
| WEM-200/USPP | Trailer non driven | THU1 | BTH-0500 | BTH-0500 | VKBA5460 | VKBA5460 |
| WEM-200/USPP | TN Tapered trailer non-driven (Hendrickson) | PreSet | | | Set431 | Set427 |
| WEM-200/USPP | FL Steer (Meritor) | PreSet | | | Set440 | Set495 |
| WEM-200/USPP | BPW | sTRB - Metric | 33118 | 33213 | 33118 | 33213 |
| WEM-200/USPP | Meritor Twin FF Steer | sTRB standard hub | HM212011<br>HM212049 | 3720<br>3782 | Set413 | Set406 |

## 4.7 Temperature alarm

From BSS10 firmware release, the temperature measurement is checked against a predefined temperature threshold. If this temperature is above the threshold for the defined period, an alarm is triggered.

Table 9

| Parameter | Value | Unit | Comment |
|---|---|---|---|
| Temperature threshold | 95<br>203 | °C<br>°F | |
| Time period above the threshold | 30 | min | |

During temperature alarm mode, the product is still in normal operation mode and continues to detect wheel end damage.

High temperature in wheel ends could be caused by many things: bearing damages, brake problems, braking for long periods, tire problems and ambient conditions.
SKF shall not be liable if a temperature alarm is triggered but no damage is observed on the wheel end, nor if no or late temperature alarm is triggered even where damage has been encountered.

# 4.7 Mode description

The product has five modes of operation. The transport mode is used for part transportation only. The standstill and operating modes are used when the product is mounted on a vehicle. The configuration mode is used after wake up to commission the product. The reset/remove mode is used to enable a connection with the Mobile App for product reset and/or decommissioning.

Table 10

| | Transport mode | Configuration mode | Standstill mode | Driving mode | Reset/Remove mode |
|---|---|---|---|---|---|
| BLE emission if T < 70 °C (*150 °F*) | No | Every 1 s | No | Every 30 min | Every 1 s |
| BLE emission if 70 °C (*150 °F*) < T < 100 °C (*212 °F*) | No | Every 1 s | Every 1 min | Every 1 min | Every 1 s |
| BLE emission if T > 100 °C (*212 °F*) | No | Every 1 s | Every 10 s | Every 10 s | Every 1 s |
| Vibration analysis | No | No | No | Yes | No |
| Temperature measurement | No | No | Yes | Yes | No |

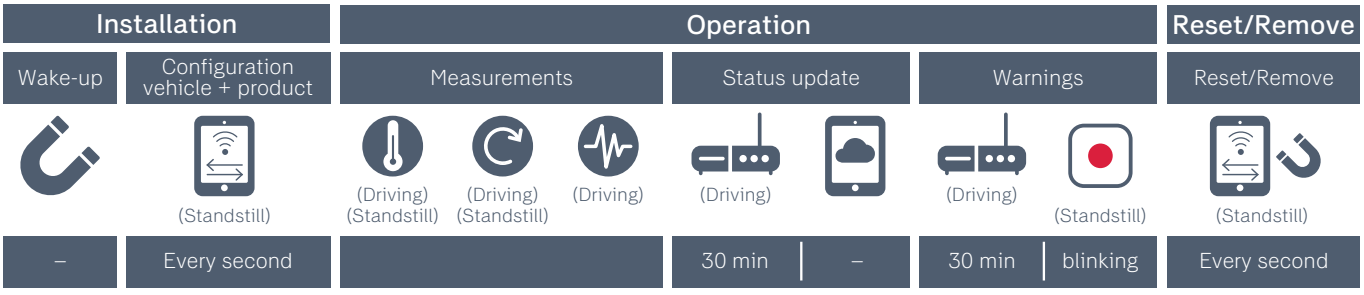



*Figure 1. Modes of operation*

# 4.8 Changing mode description

The product is delivered in transport mode. The product should be put into configuration mode using the magnet. The product is configured with the mobile application in configuration mode. Switching between modes is indicated by an LED light.

When configured, the product automatically goes to standstill mode. The product automatically switches from standstill to operating mode according to vehicle movement[3].

Table 11

| Sensor state | Action[4] | Result |
|---|---|---|
| Transport mode | Put the magnet on the plastic housing until the LED lights | LED lights green<br>The part goes to Configuration mode |
| Wait for Configuration mode | Configure the product with the Mobile App | LED switches off<br>The part goes to Standstill mode |
| Wait for Configuration mode | No action for 30 seconds | LED switches off<br>The part returns to Transport mode |
| Analysis mode (or Operating mode) | Put the magnet on the plastic housing until the LED lights | LED lights green<br>The part goes to Reset/Remove mode |
| Temperature alarm* | Put the magnet on the plastic housing and wait more than 31 sec until LED switches off to reset the Temperature failure alarm | LED lights green during 30 sec<br>LED lights red during 1 sec<br>Temperature alarm cleared.<br>LED switches off |
| Wheel end failure alarm* | Put the magnet on the plastic housing and wait more than 31 sec until LED switches off to reset the Wheel end failure alarm | LED lights green during 30 sec<br>LED lights red during 1 sec<br>Wheel end damage cleared.<br>LED switches off |
| Wheel end failure alarm | Reset the product with the Mobile App | LED switches off<br>Wheel end damage cleared<br>Temperatures cleared<br>The part returns to Standstill mode |
| Reset/Remove mode | Remove configuration of the product with the Mobile App | LED switches off<br>The part returns to Transport mode |
| Reset/Remove mode | Take no further action for 30 seconds | LED switches off<br>The part returns to Standstill mode |

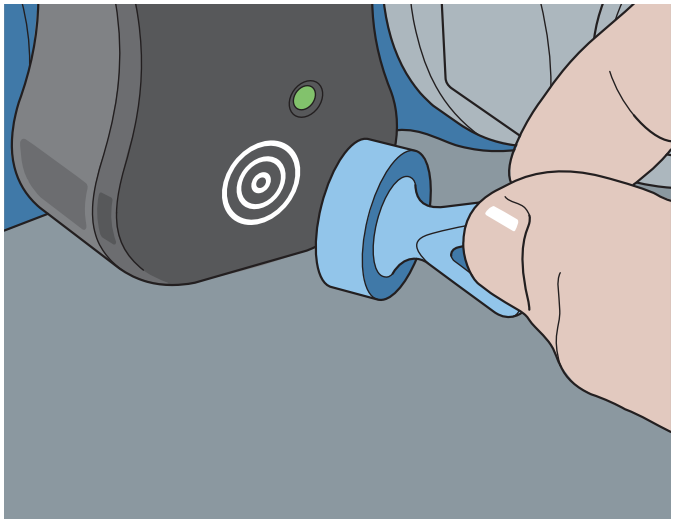


*Figure 2. Magnet activation*

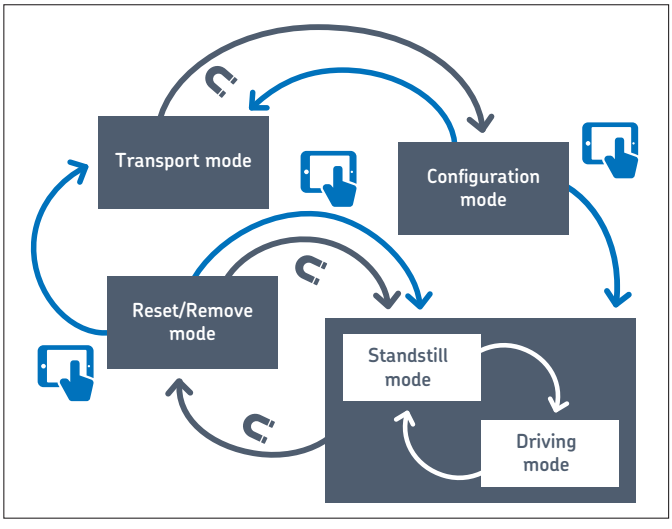



*Figure 3. Changing modes*

[3] The vehicle must be travelling over 30 mph.
[4] Actions identified by a * are not available on firmware prior to BSS10.

# 4.9 Configuration

Configuration is required before using the product.

Use the Mobile App to configure the product following the procedure described in the SKF TraX system User Manual – Quick Start.

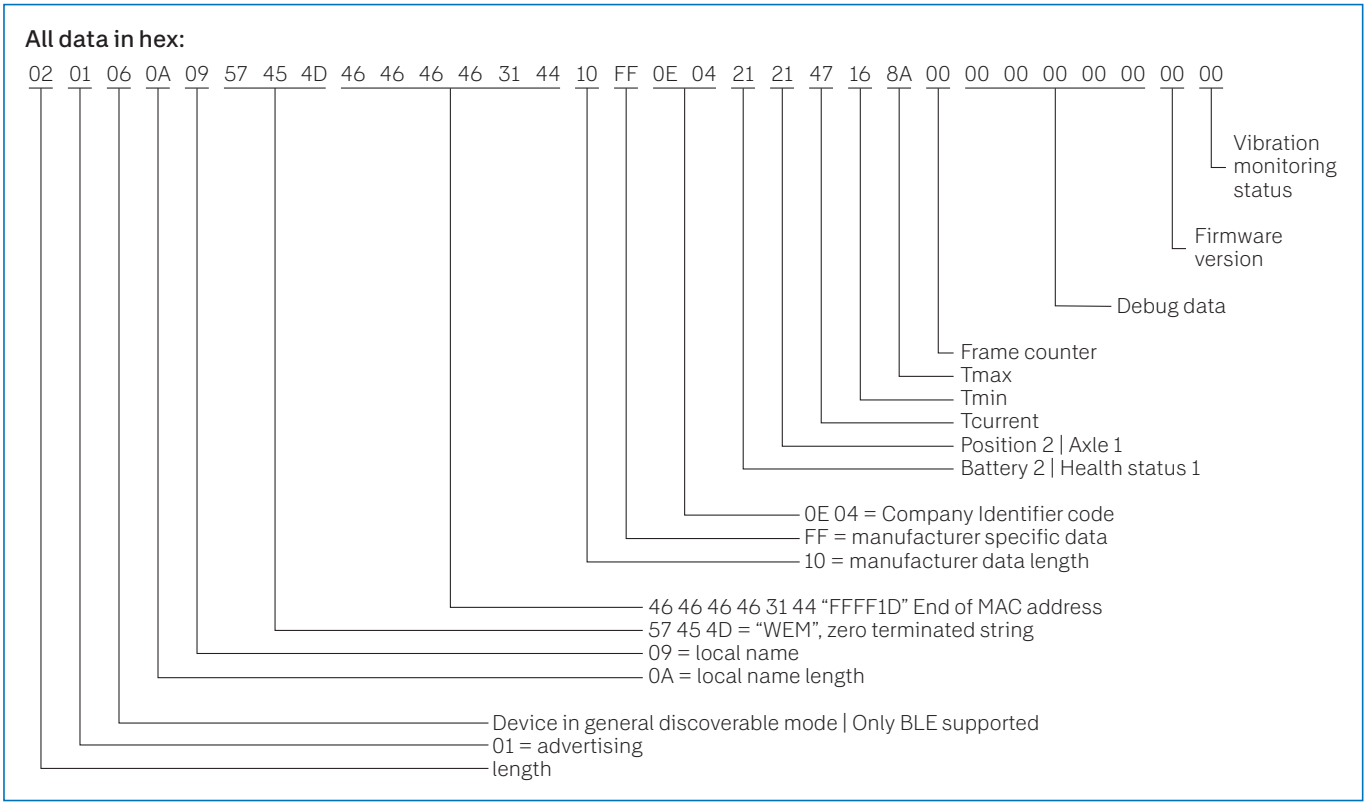
# 4.10 Communication

## 4.10.1 Protocol

Table 12

| Protocol | Version |
|---|---|
| Bluetooth Low Energy Standard (2.4 GHz) | ≥ 4.2 |

## 4.10.2 Advertising frame description



### 4.10.3 Byte Position/Axle

Table 13

| Mask | Description | Comment |
|---|---|---|
| 0x30 | 0: Not positioned<br>1: Left<br>2: Right<br>3: Not Available | Sensor Position |
| 0x0F | 0: Not positioned<br>1: Axle 1<br>2: Axle2<br>3: Axle3<br>4: Axle4<br>5: Axle5<br>6: Axle 6<br>7: Axle 7<br>8: Axle 8<br>9: Axle 9<br>A: Axle 10 | Sensor axle number |

### 4.10.4 Byte Failure status (battery and health status)

Table 14

| Mask | Description | Comment |
|---|---|---|
| 0x30 | 0: Extreme low battery warning<br>1: Low battery warning<br>2: Battery OK<br>3: No data | Battery level |
| 0x03 | 0: No Data<br>1: No failure<br>2: Failure | Wheel End failure |
| 0xC0 | 0: No failure<br>1: Piezo Failure<br>2: WEM Failure<br>3: Reversed position | Vibration sensor failure and other internal failure warnings + incorrect mounting |
| 0x04 | 0: No failure<br>1: Failure | Temperature sensor failure |
| 0x08 | 0: No failure<br>1: Failure | Temperature warning active<br>Available from BSS10 firmware |

### 4.10.5 Temperature

Table 15

| Byte | Description | Comment |
|---|---|---|
| Tmax | Hex value to convert in Dec value<br>Dec value – 50 = temperature value in degrees Celsius<br>8A = 138 – 50 = 88 °C | Maximum recorded temperature from the last product reset |
| Tmin | Hex value to convert in Dec value<br>Dec value – 50 = temperature value in degrees Celsius<br>16 = 22 – 50 = –28 °C | Minimum recorded temperature from the last product reset |
| Tcurrent | Hex value to convert in Dec value<br>Dec value – 50 = temperature value in degrees Celsius<br>47 = 71 – 50 = 21 °C | Last recorded temperature (a measurement is taken every five minutes) |

### 4.10.6 Firmware version

Table 16

| Byte | Description | Comment |
|---|---|---|
| Firmware version | Hex value to convert in Dec value.<br>The first digit is the main BSS version.<br>The second digit is the corrective version (1=a, 2=b,3=c ...9=i).<br>0x54 = 84 = 8d | |

### 4.10.7 Byte Vibration monitoring status

Table 17

| Mask | Description | Comment |
|---|---|---|
| 0xC0 | 0: Vibration monitoring active<br>1: Learning phase complete<br>2: Learning phase on going<br>3: Inconsistent data | Current state of the algorithm. Available from BSS10 firmware. A new TraX starts with the learning phase. After 39 measurements, the algorithm model is calculated, and the vibration monitoring is active. |

### 4.10.8 Advertising timing

1 frame is sent 3 successive times on 3 different channels.

Table 18

| Number of frames | Number of channels | Duration | Frequency |
|---|---|---|---|
| 9 | 3 | 180 ms | Each 30 min in Operating mode and if T < 70 °C (*150 °F)*<br>Every 1 min if 70 °C (*150 °F)* < T < 100 °C (*212 °F)*<br>Every 10 sec if T > 100 °C (*212 °)F* |

## 4.11 Reset

After replacing a damaged wheel end component, it is necessary to reset the device by using the Mobile App or the magnet (functionality available from BSS10 firmware).
The resetting procedure with the Mobile App is described on the SKF TraX User Manual. The resetting procedure with the magnet is described in table 11 and figure 3.

**⚠ WARNING**

From BSS10 firmware, it is important to reset and reconfigure the sensor in case of any change on the wheel end (sensor location change, vehicle function change, bearing replacement, ...) to ensure proper vibration analysis.

## 4.12 LED blinking

Table 19

| Blinking | Frq On time | Off time | Meaning | Duration |
|---|---|---|---|---|
| 🔴 🔴 🔴 | 1s | 5s | Wheel End failure detected | 14 days (only at standstill) |
| 🔴🔴🔴🔴 | 0.5s | 2s | Product internal failure detected | 14 days (all the time) |
| 🔴🟢 🔴🟢 🔴🟢 | 0.25s/0.25s | 4.5s | Temperature alarm | 14 days (only at standstill) |

The temperature alarm is available from BSS10 firmware. It is in lowest priority on alarm modes and will be disabled in case of wheel end or product internal failures.

## 4.13 Product lifespan

The estimated lifespan of the product is five years.
The lifespan of the product is dependent on driving cycles and weather conditions.

# 5 Certifications

## 5.1 FCC

This product is FCC approved.
FCC Identifier: 2AJ99-WEM-200
Certificate n°: 192180930/AA/00

## 5.2 Bluetooth SIG

This product is Bluetooth SIG approved.
Declaration ID: D050056

## 5.3 RCM

The product is RCM compliant.

# 6 Precautions and maintenance

The TraX sensor is maintenance free and non-repairable. Users should not attempt to open the device. Firmware updates will be available OTA (Over The Air).

The TraX sensor may need to be replaced if an internal sensor failure occurs or the battery reaches the end of its life.

**⚠ CAUTION**

When sensors are no longer working, they should be returned to SKF. If this is not possible, they should be disposed of in accordance with applicable local laws and regulations.

No significant performance degradation is expected before the internal battery reaches the end of its life. It is advisable to monitor the estimated remaining battery life, investigate any possible anomalous readings or status errors and, when necessary, replace the sensor.

# 7 General information

## Warranty

This product has a one year warranty against manufacturing defects.

Warranty after the initial one year period must be part of a service agreement.

## FCC Compliance Statement

**(§15.19 Labelling requirements)**

This device complies with part 15 of the FCC Rules.

Operation is subject to the following conditions:

1 This device must not cause harmful interference.
2 This device may receive radio interference that affects its ability to function properly.

**(§15.21 Information to the User)**

« Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment ».

**(§15.105 statement)**

«This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide a reasonable protection against harmful interference in an industrial installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and uses in accordance with the instructions, may cause harmful interference to radio communications ».

**RoHS compliant**

# 8 Technical specification

## 8.1 US baseplate

Figure 4

Drawing for US baseplate

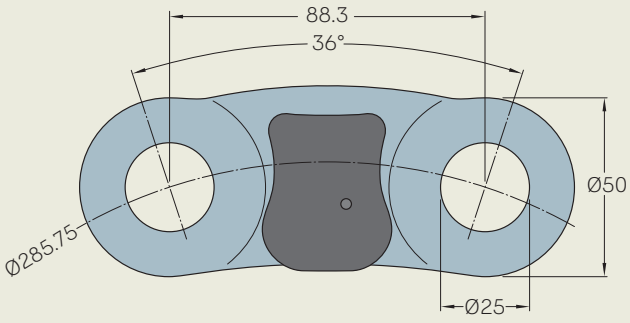
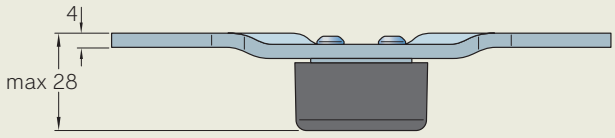



Figure 5

Drawing for US baseplate




## 8.2 32 baseplate

Figure 6

Drawing for 32 baseplate

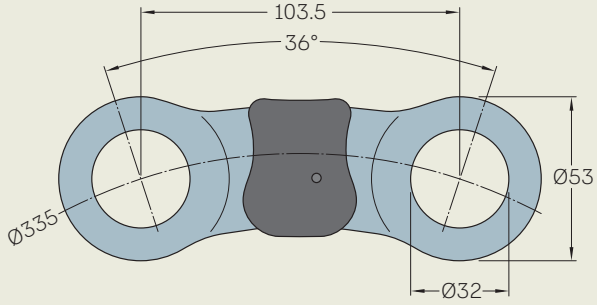
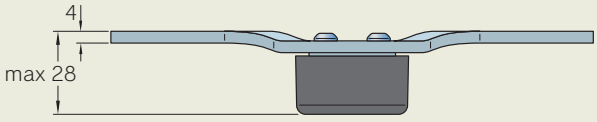



Figure 7

Drawing for 32 baseplate




## 8.3 EU baseplate

Figure 8

Drawing for EU baseplate

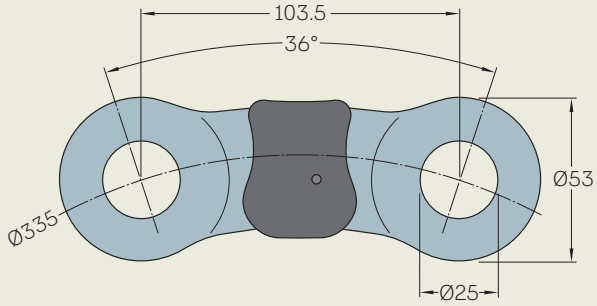
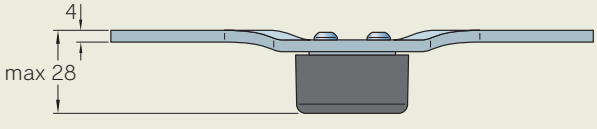



Figure 9

Drawing for EU baseplate




Unless stated otherwise, all dimensions are given in millimeters.

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