TPMS Mounting Instructions

For products 21851508 / 21780658 / 21780660 / 21780662 / 21923656

Document status: in work ( ) / under review () / released (X) / obsolete ( )

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Abbreviations

Abbreviations	Explanation
DID	Data identifier
ECU	Electronic Control Unit (TPM main control unit)
ECU_P	Primary ECU on truck
ECU_Sx	Secondary ECU on trailer(s)
EWM	External Wheel Module (sensor variant mounted between 2 wheel bolts)
MM	Main module, main part of EWM
P	Tire pressure
RF	Radio Frequency (partly used as synonym for radio[-communication])
TPMS	Tire Pressure Monitoring System
VM	Valve module (part of EWM assembled on tire valve)
WM	Wheel module (sensor on tire)

Naming Conventions

Name	Explanation
Wheel Module Positioning	Procedure to define the position of a wheel module (WM) on a truck or trailer. This defines the tire on which a WM is mounted (belongs to).
Trailer Mating	Procedure to make a trailer part of a convoy
Convoy	A truck with one or more trailers
Vehicle Unit	A single truck or trailer

1 Revision History

Sub-Version Revision: $Rev:: 12424 $

Date	Changes (with reference to change request)	Author
2015-04-17	First version ready to review	Jens Graf / Alan Roue
2015-04-24	Review performed (some findings direct implemented) Review Protocol: Review_Protocol_TPMS_Mounting_Instructions.xls	Jens Graf
2015-04-27	Add remarks of Jens done during the review	Alan Roue
2015-08-24	Add product references in Scope paragraph	Alan Roue
2015-09-15	Add TPMS not safety system §4.4.6	Alan Roue
2017-12-19	Remove P8 and .P08 in front page and scope Add 2 parts statement requested by FCC Part 15.19 (a)(3): could not cause harmfull interference & can accept interferences. §4.4.7	Alan Roue

2 Scope

This Technical Requirements (TR) covers requirements for assembly and calibration process for the Tire Pressure Monitoring System (TPMS) described in table below. For parts specifications, refer to PDM-system (example KOLA), Bill-Of-Material (BOM) or similar.

Customer References	SKF Reference	SKF Designation
21851508	BH-EP-WPM 01	SKF TPMS Electronic Control Unit
21780658	BH-LS-WPM 02E	SKF TPMS External Wheel Module 0°
21780660	BH-LS-WPM 01E	SKF TPMS External Wheel Module 90°
21780662	BH-LS-WPM 03E	SKF TPMS External Wheel Module 135°
21923656	BH-VA-WPM 01E	SKF TPMS Counterweight

Truck rims covered by this this TPMS mounting instructions are:

- Rims of 17.5”
- Rims of 22.5”

3 Preconditions

The TPM system will be active (power supplied) in the following vehicle modes:

- Pre-Running
- Running
- Cranking

4 System description

4.1 System goals

The **T**ire **P**ressure **M**onitoring **S**ystem, **TPMS**, monitors tire air pressure and temperature and displays the information to the driver through the cluster (integrated system) for commercial vehicles.
Overview picture see Figure 1 - TPMS overview.

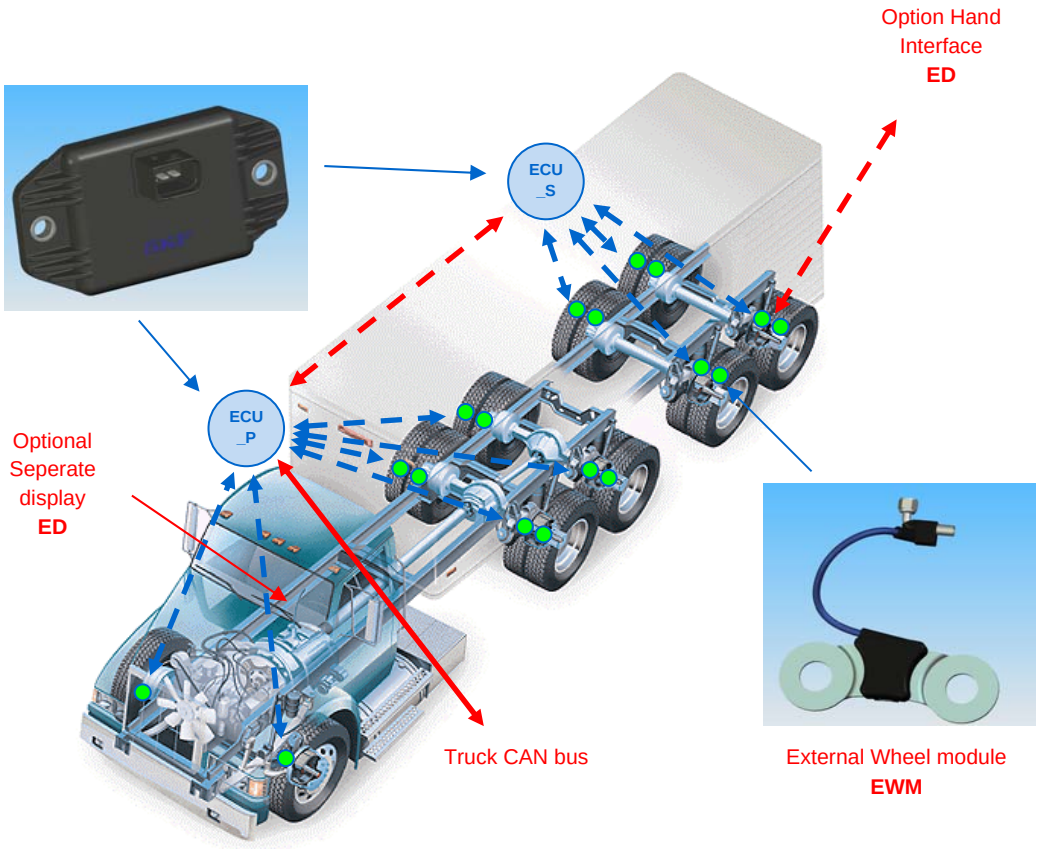

Figure 1 - TPMS overview

4.2 End customer benefits

The customer benefits of the system are:

- Reduced fuel consumption
- Reduced tire wear
- Increased safety (reduce risk of tire explosions)
- Reduced risk of unplanned stops
- Provide a solution for future legislation

4.3 User profiles

The following user profiles are foreseen:

1. Driver:
   The user receives different information from the system: actual tire pressure, under pressure warning, ….
2. Standard service:
   The user can update system configurations, for example:
   - Warning thresholds
   - Vehicle configurations

   The standard service user profile is typically used in the fleet workshop.
3. Extended service:
   - The user can read the diagnostic memory
   - The reset of errors in the diagnostic memory is possible
   - The Software of the ECU can be updated

   This extended service user profile is typically used in the OEM workshop or in the OEM production line.

4.4 System applications

The following applications of the system are foreseen.

4.4.1 Driving situation

During driving the system monitors the pressure and the temperature of the different tires. The tire pressure values are shown on the display. If the tire pressure or wheel temperature is out of normal range, a warning to the driver is initiated.

In these system applications also vehicle stop phases are included. Vehicle stop phases are: short breaks, stops for loading/unloading the truck, breaks over a certain time period (for example weekend).

Also the connection and disconnection of trailers has to be handled by the system. Two modes are possible.

1. **Auto connection**: The system determines automatically the connection or disconnection of a trailer.
2. **Manual connection:** The truck driver supports the system to detect a new connected trailer(s) according to system instructions.

4.4.2 Configuration by the end customer

The configuration by the end customer may be necessary after an error condition, for example a change of a defect system component, after a tire replacement or if a system component has reached its operating lifetime.

If a tire(s) or a tire sensor(s) is/are changed the learning of the relative position of the tire sensors in the vehicle is necessary. Two modes are possible:

1. **Automatic positioning**: The system determines automatically the position of each tire, based on an algorithm which evaluates several sensor data.
2. **Manual positioning:** The end customer manually positions the tire sensors according to system instructions.

If a central receiver on the truck or the optional display is changed or newly installed, the system has also to be learned-in.

This configuration is usually done in a truck workshop.

4.4.3 Configuration during truck production

During the truck production the wheel sensors are assembled to truck wheels. After this assembly, the system has to be learned-in the positions of the tire sensors. This has to be done manually.

If a separate display in the cabin is used, the display must also be paired to the corresponding central receiver on the truck.

4.4.4 Single tire change on road

If during driving a tire is damaged and has to be changed on the road, the system automatically assigns the tire sensor to this new tire.

The change of a tire on the road is usually done by the driver or by a tire service company.

4.4.5 Maintenance, service by the workshop

TPMS EWM is a non reparable module and no software update can be done. Maintenance is also not feasible. Therefore, at module end of life, it shall be recycled by the appropriated means.

4.4.6 Caution

Tyre Pressure Monitoring System is not a safety system. Data provided by TPMS system should be consided as informations. TPMS system does not avoid to have a regular tyre pressure maintenance.

4.4.7 Information to user

TPMS complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Caution: User that changes or modifications not expressly approved by SKF for compliance could void the user's authority to operate the equipment.

5 TPMS mounting instructions

This chapter describes calibration and installation procedures that shall be executed when the TPM system is mounted on the assembly line.

Following steps and actions will be necessary to perform a successful installation and configuration of the TPM system.

Step	Action	Expected behaviour
1	Place the TPM ECU in the programming fixture and download the SW package (see 5.1)	SW download completed without issues
2	Mount the TPM ECU on the gearbox cross member and electrically connect it to the truck (see 5.2)	
3	Mount the appropriate TPM WM variants to the correct wheel and tire air valve (see 5.3)	The WMs gets activated (transmitting RF frames) as soon as a pressure leap is detected and as long as the WMs continue to be pressurized.
4	Scan the barcode of the WMs to create a parameter (see 5.6.1)	A parameter with the WMs ID-number linked with its position is created and uploaded to the assembly server
5	Write the WM ID parameters to the TPM ECU (see 5.6.2).	Parameter programming complete without issues.
7	Check that no DTCs are present at EOL	No DTC related to TPMS shall be raised

5.1 SW download

The TPM ECU is delivered without SW implemented. Use the manufacturing tools to download the SW package (including parameter dataset).

SW download can be performed either by connecting the TPM ECU to interface of the tool used (direct download), or connecting the OBD plug of the truck to the interface of the tool used.

5.2 Mounting the TPM ECU

The TPM ECU is to be positioned on the press screws of the bracket, as shown in Figure 1.

Note: Tighten the self-locking nut to 24±4 Nm.

Note:
Be careful not to touch or damage the ECU connectors during handling.

Figure 1: Example of TPM ECU mounted on

The bracket is to be assembled to the chassis (gear box cross member) in the central part of the vehicle.

Figure 2: Example of the TPM ECU assembled on chassis

5.3 Mounting the WMs

The TPM WM is made up by two modules; the 'main module', with the sheet metal bracket and the 'valve module', containing the pressure sensor. The two modules are connected to each other by an electrical cable.

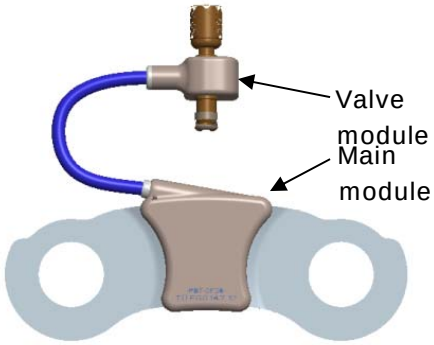

Figure 3: Illustration of the TPM WM (straight connector) and its modules

The 'main module' shall be mounted to the rim and fixated by the standard wheel nuts. Make sure the arrow marking on the WM is pointing away from the center of the rim, as illustrated in figure 4 below.

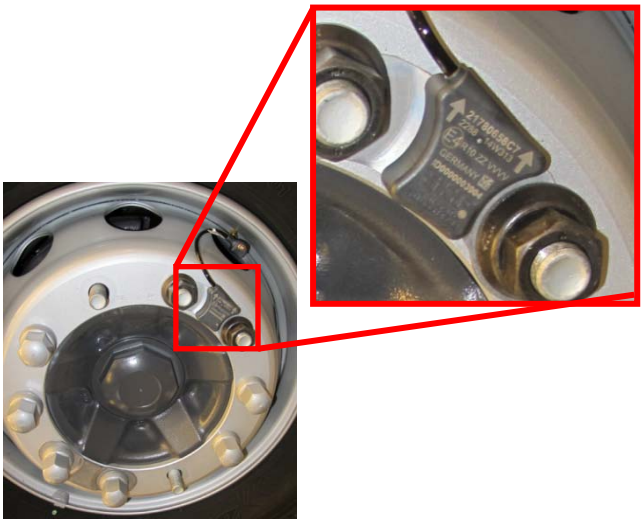

Figure 4: Illustration showing the correct point of direction for the arrow marking

Note: The wheel nuts shall be applied with the tightening torque as specified in TR 1579514 (Volvo standard)

The 'valve module' shall be assembled to the tire air valve by tightening the swirling nut to the tire air valve hand tight. (*Recommended tightening torque approximately 0,3-0,5 Nm)*

Note: There shall not be any air leakage present when correctly assembled. Air leakage will be detected by the system.

Note: Avoid twisting the electrical cable more than 180°.

Note: The electrical cable must not be clamped or damaged during the assembly of the WM.

The WMs will be delivered in "inactive mode" (=no RF transmission active) and will require activation (switching from "inactive mode" to "active mode") to enable RF communication and successful calibration.

The WMs are activated when a pressure leap is detected, e.g. when getting mechanically connected to a pressurized air valve.

As from the point when a WM is initially connected to a pressurized air valve until it gets activated will require 16s. The WMs will stay activated as long as they are pressurized, e.g. connected to an inflated tire. If the pressure is removed, the WMs will switch back to "inactive mode" and that will stop the RF transmission.

5.4 Front and tag/pusher axle installation with single mounted wheel

On single mounted wheels the TPM WM shall be positioned on the two wheel studs closest to the tire air valve, as illustrated in Figure 5 below.

Note: Contact between rim/protection ring and electrical cable is permitted.

5.4.1 Counter weight

The wheel module must not disrupt wheel balance; therefore, the counterweight shall be mounted on the opposite side (180°) of the TPM WM on all front axles.

The curvature of the counter weight shall follow the curve of the rim.

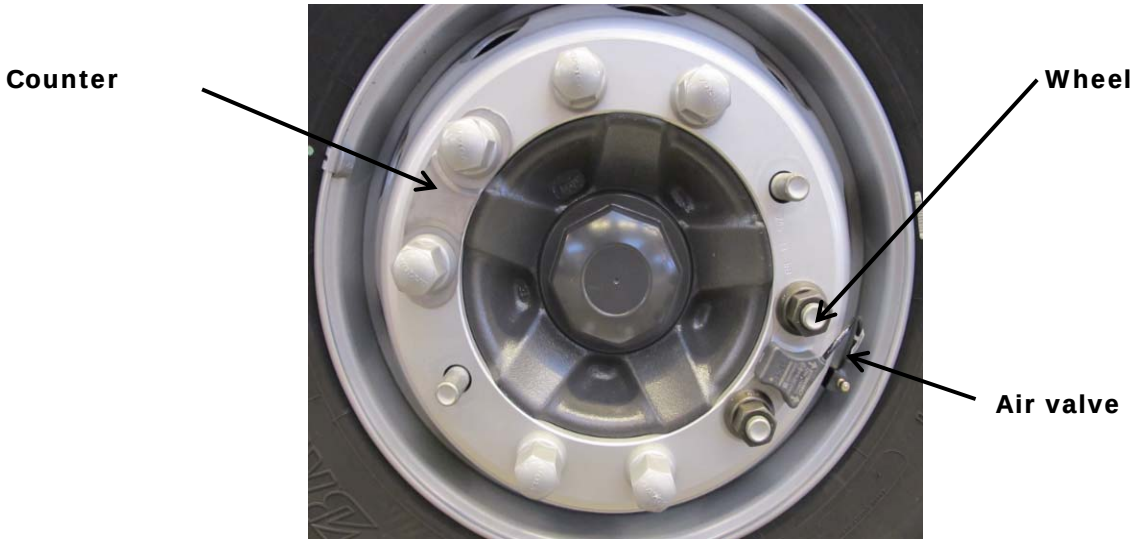

Figure 5: Illustration showing WM and counter weight assembly on single mounted tires

5.4.2 Protecting ring

Make sure that the wheel protecting ring's attachment point is clear from the TPM WM. The protecting ring is not to use the same wheel studs as the TPM WM or counter weight.

Figure 4: Illustration pointing out the protecting ring's

5.4.3 Light weight pusher axle (WTP-D245)

On pusher axles with variant WTP-D245 the TPM WM shall be mounted on the two wheel studs closest to the right next to the tire air valve, as illustrated in Figure 7 below.

Figure 7: Illustration showing WM assembly on light weight pusher axle

5.5 Rear and tag axle double mounted wheel (WTD-DUAL, WTT-DUAL)

On dual mounted wheels the two TPM WMs shall be mounted on the opposite side (180°) of each other. The TPM WMs shall be positioned on the two wheel studs closest to the tire air valves, as illustrated in Figure 8 below.

Figure 8: Illustration showing WM assembly on dual mounted tires

5.6 Calibration of WMs

Each WM will need to get paired to the TPM ECU and the position defined for successful TPM installation. This is to be done by scanning the barcode of each WM, linked with its position, to create a parameter. The parameter is later written to the TPM ECU on the assembly line, which initiates the pairing of the activated WMs to the TPM ECU automatically.

5.6.1 Creating the WM id parameter

Create the parameter by scanning the barcode of each mounted WM and make sure that the WM identification number is linked with correct tire position.

Note: The WM's barcode contains information about WM variant (prefix) and the unique WM identification number, e.g. *S 1234567890*

Prefix definition:

S: Single mounted tire (straight connector)

O: Dual mounted tire/Outer wheel (135° connector)

I: Dual mounted tire/Inner wheel (90° connector)

5.6.2 Writing WM id parameter and WM calibration

Prerequisites to initiate WM calibration:

- *All WMs must be activated and within RF range to the TPM ECU*

Write the WM id parameter to the TPM ECU, by using the manufacturing tools, and perform a reset of the TPM ECU.

Note: The writing of the parameter can be performed either by connecting the TPM ECU to the interface of the tool used (direct download), or connecting the OBD plug of the truck to the interface of the tool used.

Note: Parameter *"P1LWM – TPMS Wheel module identification number"* is to be used for WM identification.

The WM calibration/pairing will automatically start after the TPM ECU reset. Keep the TPM ECU continuously power supplied for minimum of 3 minutes to allow all WMs to get paired with the TPM ECU.

Note: The TPM ECU is power supplied in vehicle modes: Pre-running, cracking and running.

Note: Make sure that the power supply to the TPM ECU is not shut off during required time period for above pairing to not cause damages to the non-volatile memory of the TPM ECU.

Note: DTC *"U300054 – Electronic Control Unit-missing calibration*" will be set to inactive when the calibration is completed (all WMs have been paired to the ECU).

5.7 End of line testing

Read out the chassis number from the TPMS ECU and check that it corresponds to the vehicle chassis number.

Read DTCs from the TPM ECU. Active DTCs shall be remedied and inactive DTCs shall be cleared.

6 TPMS EWM bordeline risks

6.1 Ignition hazard risk analysis

An ignition risk hazard analysis of SKF Tyre Pressure Monitoring System (TPMS) External Wheel Module (EWM) had been performed following EN 1127-1 : 2011 harmonized standards.

Conclusion: All TPMS EWM ATEX risks had been assessed and are limited.

6.2 Borderline risks analysis

Following recommendations of ATEX Directive 94/9/EC Guideline – 4th Edition – September 2012 *(update December 2013)*, a borderline analysis had been performed reviewing potential additional risks compared to Ignition hazard risk analysis.

All listed items had been reviewed and no borderline risk had been identified.

Other potential risks (not listed in ATEX Directive guideline) had been investigated but no other risk had been kept as applicable.

Conclusion: No residual ATEX risks are applicable to TPMS EWM.