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Model:

Production: Start of Production MY

Objectives:

After completion of this module you should be able to:

- Identify Components in Tire Pressure Warning Systems
- Diagnose Tire Pressure Warning Systems
- Initialize Tire Pressure Warning Systems

Tire Pressure Warning Systems

Purpose of the System

The Tire Pressure Warning System (RDW) is being introduced for the US market on the new E39 M5. RDW is the German acronym for "*Reifen Druck Warnen*" and it follows the tire pressure control system (RDC) that has been in use in other markets for several years. The RDW and RDC systems will eventually be linked to the run flat tires as a means of warning the driver of pressure losses in the tires.

Experience has shown that the majority of owners are unaware that the owner's manual recommends that the inflation pressure be checked at 14 day intervals. The RDW system will aid in this by warning the driver of pressure losses in one or more of the tires.

Consequences of incorrect inflation pressures result in:

- Increased tire wear
- Reduced service life of the tires
- Impaired vehicle handling
- Increased risk of punctures due to worn tread

Regardless of the terminology used, the Tire Pressure warning system is designed to warn the driver of pressure losses in one or more of the tires through the "Check Control" display (or Warning Light)

The system measures the wheel speeds of all four tires and compares the speed of the diagonal wheels for the average speed. A rolling circumference value is calculated from the wheel speeds and this value is stored in the control module.

In the event of pressure loss, the rolling circumference of the affected tire is reduced. With this, the wheel speed of the tire increases and the control module will detect the change and post the warning in the Check Control matrix display or will display a warning light in the instrument cluster.

An additional acoustical warning is sounded if the pressure loss is greater than 40%.

The tire pressure warning system is switched "ON" every time the ignition is switched "ON" and it can be switched OFF with the button on the lower dash to the right of the steering column.

NOTE: The system can only react to the pressures in the tires when the system is initialized, it cannot check for the correct inflation pressure.

Tire Pressure Warning Systems have 2 basic configurations:

- Systems which uses wheel speed sensor input to detect rotational irregularities to determine pressure loss. The systems either use a separate RDW module which receives individual wheel speed input from the DSC module or the RDW functions are incorporated directly into the DSC electronics. These systems have numerous acronyms to identify them depending upon model and production date etc.

Some of the acronyms currently in use are:

- RDW - This system is usually associated with the E39 M5 and E46 M3.
 - RPA - This term is currently used on the E85 and E46 (from 2001).
 - DDS - This acronym can sometimes be found when using the diagnosis program with the DISplus or GT-1.
 - DWS - This system was installed on the E52 Z8.
- Systems which use pressure transmitters located inside the tire assembly. These transmitters send signals to external antennae at all 4 wheels. Currently, the only US market vehicle to use this system is the E65/E66. This system will be covered later in this text. These systems are generally referred to as RDC and use Run Flat Tire Technology (RFT).



System Components

The tire pressure warning system consists of the following components:

- RDW Module (On early systems only, deleted as of 2001 MY)
- DSC Module
- Wheel Speed Sensors
- RDW/RPA Button
- Warning Indicator (Cluster Check Control or Warning Indicator lamp)

DSC III Control Module / Wheel Speed Sensor

The four wheel speed sensor inputs are processed by the DSC control module and four dedicated square wave output signals are provided to the RDW control module for its processing functions.

RDW Control Module

The RDW control module was only used on the early production models such as the E39 M5 and the E52 Z8. All RDW modules have been eliminated as of the 2001 model year. The newer systems incorporate the RDW functions into the DSC module, this eliminates the need for a separate RDW module.

The RDW control module is located behind the glove box in the control module carrier. In addition to the four wheel speed signals, the module receives power (KL 15), ground (KL 31) and a ground signal input from the set/push button switch in the console.

The control module is connected to the K-Bus for:

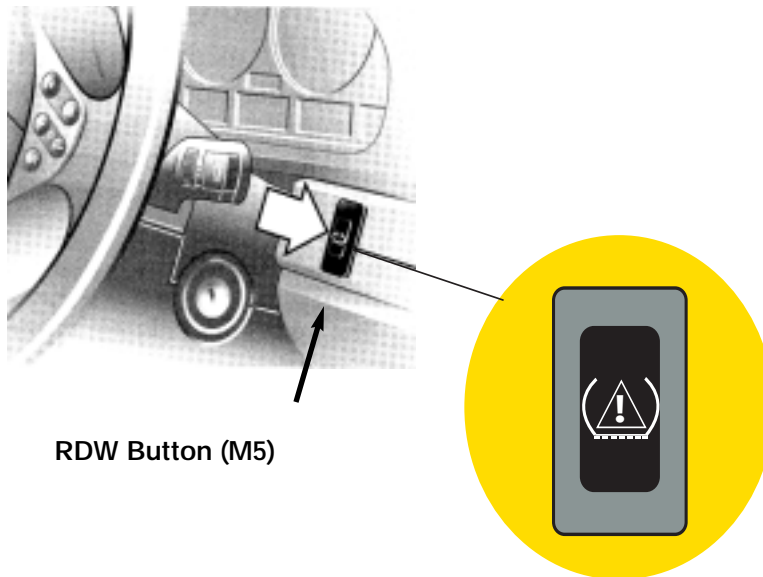
- Output display in the check control matrix or Warning Light
- Diagnostic communication through the instrument cluster with the DISplus tester or GT-1.

The control module processes the wheel speed signals and stores rolling circumference values for determining pressure losses in one or more tires.

Set/Push Button Switch

The push button (with tire failure symbol) is mounted below the instrument cluster to the right of the steering wheel. The push button is used to carry out the following functions:

- Initialization of the system - after changing inflation pressures or tires.
- Switching the RDW system OFF - After switching the ignition switch ON, briefly press the button "TIRE MONITORING INACTIVE" will be displayed in the matrix.
- Self diagnosis of the control module (only for manufacturing purposes) - however if the push button is pressed and held while switching the ignition ON, "TIRE PRESSURE INACTIVE" will be displayed in the matrix.



RDW Button (M5)



RDW/RPA Button (E85)

Check Control Display

The check control display is used to show the operating status of the RDW system. The displays are as follows:

- "TIRE PRESSURE FAILURE" - (with an acoustic warning) this display will remain active until the ignition is switched OFF.
- "TIRE PRESSURE SET" - Will be displayed when the system is put into the initialization mode.
- "TIRE MONITORING INACTIVE" - Will be displayed when the system is manually switched OFF or there is a system fault.



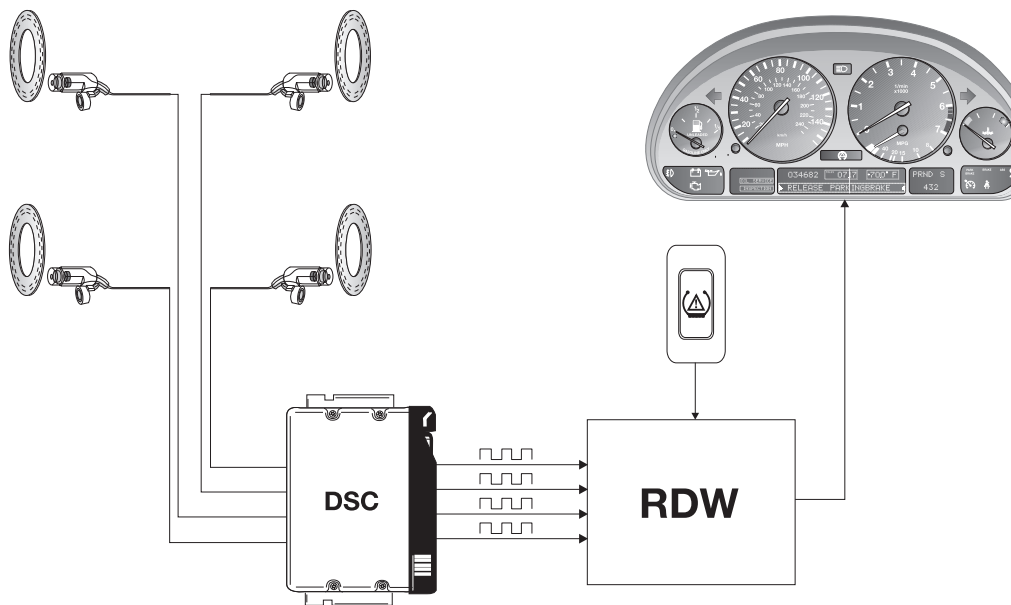
Principle of Operation

The Tire Pressure Warning System is designed to inform the driver of a loss in tire pressure. Rather than monitored actual tire pressure, the rolling circumference is calculated from the wheel speed signals. When a tire loses pressure, circumference decreases which corresponds to an increase in wheel speed. The wheel speeds are compared diagonally and with one another to determine rotational speed irregularities.

If there is a difference, this is recognized as pressure loss. The RPA can inform the driver after a short drive, approx. 1-3 minutes, from a vehicle speed > 10 mph. Depending upon vehicle application, the driver is warned via an indicator light in the cluster or by a check control message.

When a slow inflation pressure loss is present, it is more difficult for the driver to recognize the gradually increasing “spongy” handling of the vehicle (this constitutes approx. 80% of flat tire cases). The condition is more difficult to detect with RFT because of the increased sidewall rigidity. The Tire Deflation Warning (RPA) monitors tire deflation and will alert the driver.

The Tire Deflation Warning (RPA) function is performed by the DSC Control Module or as on early systems by the RDW module. The RDW module has been eliminated as of the 2001 model year, the RDW electronics are now incorporated into the DSC Module.



Initialization

The RDW system must be initialized to allow the control module to adopt the wheel speed signals and set the rolling circumferences in its memory. Initialization must be carried out when:

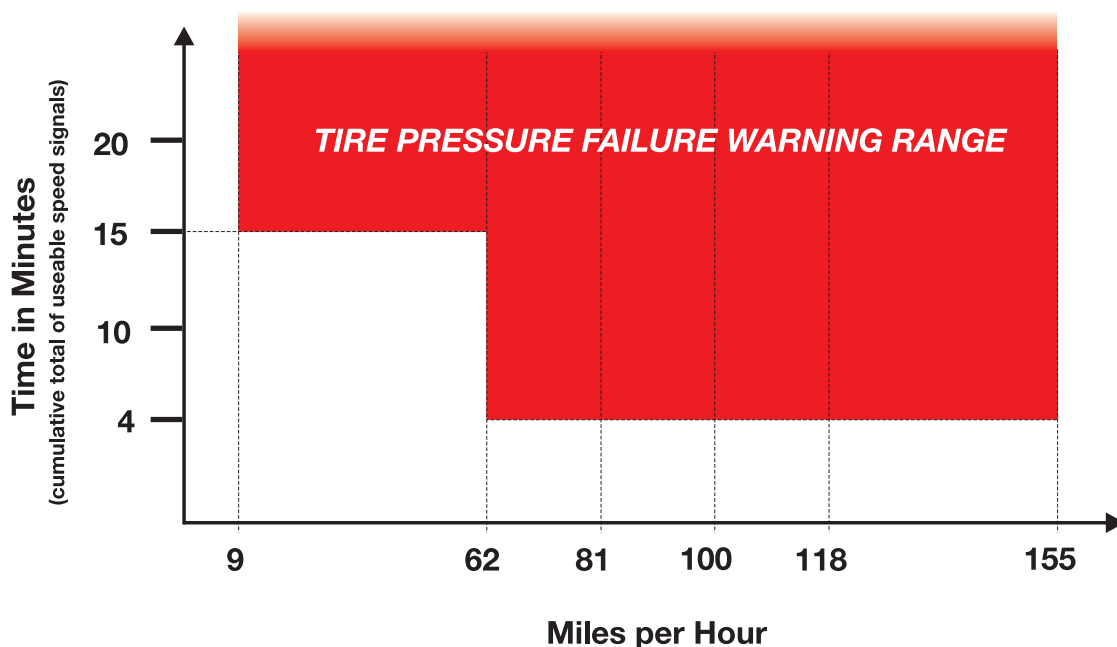
- Tire inflation pressures are changed.
- New tires are installed.
- The control module or wheel speed sensors are changed.

The initialization process is started by pressing the push button >4 seconds (Tire Pressure Set will be displayed in the matrix). The system is now in the learn mode and after driving off, the control module will start to store the values for the rolling circumferences of the tires based on the road speed.

For leakage detection, three different speed ranges are taken into account and must be recognized by the control module to complete a full initialization process. The control module must receive useable speed signals for a cumulative total of 4 to 15 minutes depending on the speed range.

Once a speed range is set, the control module will then monitor that speed range for and pressure losses. The system can only display a pressure loss warning, it can not display the exact tire with the pressure loss. All tires need to be checked when the warning is displayed in the matrix.

NOTE: Not all speed ranges need be set for the system to function properly.



Initialization

Under certain driving conditions the control module will not evaluate the wheel speed sensors as false warnings could be triggered. These conditions include:

- Initialization in a speed range that has not been complete
- During rapid acceleration
- Severe (heavy) braking
- High speed cornering
- Road speeds < 7MPH
- High slip differentials between individual wheels

No Warning Conditions

The system can only detect pressure differences between tires, it can not measure absolute pressure. The system can not detect the following:

- Natural diffusion that occurs on all tires equally
- A tire blow out
- Pressure loss at the rear axle at speeds > 90 MPH

E85 Initialization/Operation

The system must be initialized when the tire inflation pressures are changed or when the wheels/tires are replaced.

The RPA switch (1) in the center console switching center must be pressed to start initialization.

With KL15 "on", press the RPA switch until the RPA indicator light in the Instrument Cluster illuminates in "yellow".



After a short drive (approx. 1-3 minutes), from a vehicle speed > 10 mph, the system learns the new wheel speed sensor reference values and the RPA indicator light (yellow) goes out.

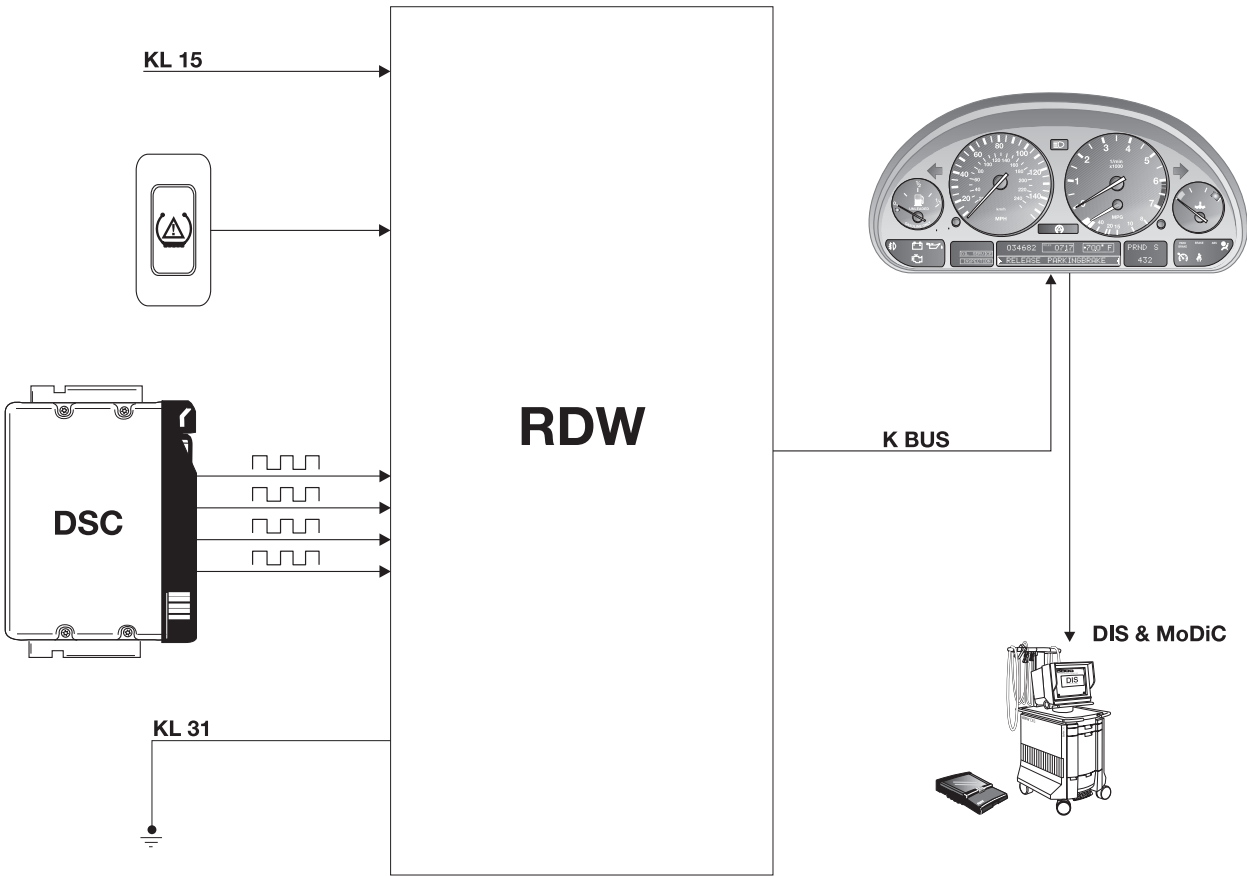
When an inflation pressure loss is determined, the RPA indicator light illuminates in "red". The driver is informed of a RPA system failure by the "yellow" illuminated RPA indicator light.

Diagnosis

The RDW is fully diagnoseable via the K-bus interface using the DISplus tester or GT-1.

Information included in the diagnosis includes:

- How often and at what speed the fault occurred
- If the initialization has been carried out for all speed ranges



Run Flat Tire (RFT) Technology

Purpose of the System

BMW Run Flat Tire (RFT) Technology which was first introduced on the Z8, is standard on the E85 (Z4). RFT technology offers large advantages to the customer in dynamic stability with slow or sudden air pressure loss and Deflation Warning. In addition, the spare wheel and jacking equipment in the trunk is deleted which provides additional storage space.

A tire with back up running ability (RFT) will be differentiated from a non-run flat tire by the encircled letter designation on the sidewall (for example: RSC - Runflat System Component).



Principle of Operation

If slow or sudden inflation pressure loss occurs in a RFT, it is still mobile because of the additional high temperature rubber reinforcements that strengthen the side wall.

These reinforcements prevent side wall damage when the tire is deflated and also provides support during extreme loads (even when negotiating curves). In addition, the special RFT wheel (rim) grips the tire for sufficient steering, braking and accelerating power.

Note:

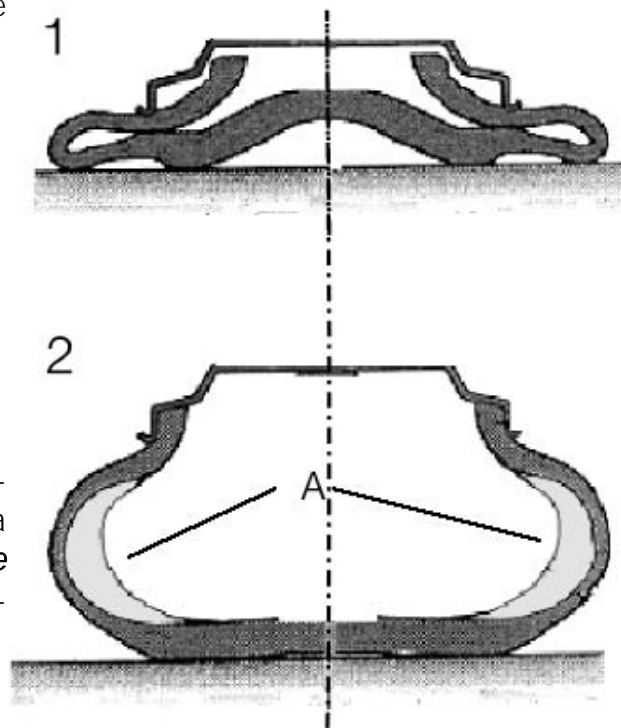
- With a sudden inflation pressure loss the vehicle can be driven with a maximum speed of 50 mph for a maximum distance of approx. 100 miles.
- With a slow inflation pressure loss the vehicle can be driven with a maximum speed of 50 mph for a maximum distance of approx. 1200 miles.
- A winter profile RFT will also be offered.
- In an extreme case, standard tires can be temporarily substituted on the same wheel (rim) if RFT is not available.

System Components

Comparison (cross section) of a standard tire to a self supporting RFT:

1. Standard tire (deflated)
 2. Self supporting RFT (deflated)
- A. High temperature rubber reinforcements

Note: Because of the self supporting characteristics of the RFT, it is difficult to visualize a deflation, therefore; *always verify air pressure with a tire pressure gage* (refer to RPA initialization).



Tire Manufacturer information

All tires, regardless of brand, must be designated with the RSC icon. This indicates that the tire is a Run Flat System Component. The following is a breakdown of the various manufacturers internal designations:

Manufacturer	Acronym	Definition
Bridgestone	RFT	Run Flat Technology
Continental	TBA	Designation To be decided
Dunlop	DSST	Dunlop Self Supporting Technology
Goodyear	EMT	Extended Mobility Technology
Michelin	ZP	Zero Pressure
Pirelli	PTM	Pirelli Total Mobility

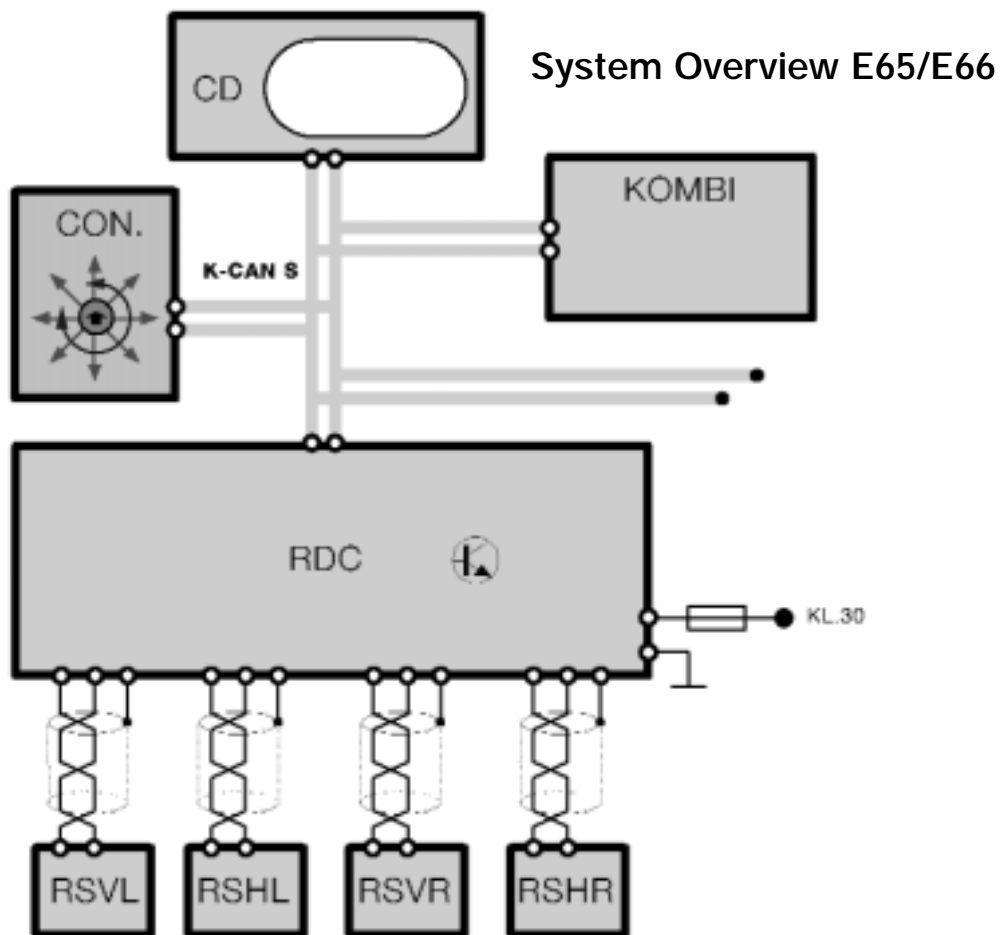
RDC Tire Pressure Control (E65/E66)

Purpose of System

RDC is an available option for the E65. The system monitors the tire inflation pressures, both when the vehicle is being driven and when it is stationary.

An electronic transmitter module mounted inside each tire measures the tire pressure and temperature at regular intervals and transmits the information by radio frequency to the RDC control unit.

The driver is warned with a Check Control message of a tire that needs inflation or a possible flat tire.



Components

RDC Control Unit

The RDC control unit is located behind the glove box on the equipment carrier above the ZGM.

The control unit is connected to the K-CAN System bus.



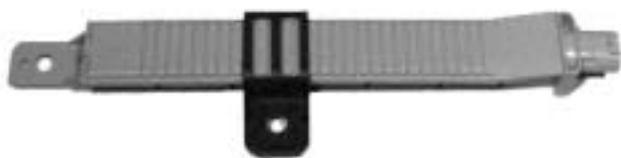
The RDC control unit is responsible for monitoring the individual pressures and temperatures of the tires (including the spare). If one of the tires inflation pressure falls below a specific threshold then the RDC generates a CC warning and telegrams it over the K-CAN-S.

The Instrument Cluster displays the check control warning icon and text message according to the message sent. The Control Display is informed by the Instrument Cluster of the required extended message.

Receiving Antennas

The RDC antennas are located behind the splash shield of each of the four wheel houses.

The antennas receive the radio signals from the RDC transmitters and pass the signals along a shielded cable to the RDC control unit.



Wheel Transmitter Modules

The transmitter modules are located inside the tire attached to the valve stem. The modules contain a pressure and temperature sensor, a long life 3.6V lithium battery and a radio transmitter.

- Operating frequency for the U.S. : 315Mhz
- Battery life: 5 to 7 years



The transmitter modules are active in an energy saving mode even when they are sitting as spare parts on the shelf.

Each transmitter module has its own unique I.D. code. The I.D. code is assigned to a position on the vehicle (Right rear, left front etc.) after a successful initialization has been completed.

The radio signal transmitted by the wheel modules is received when the tire passes close to the antenna. The valve stem of the spare tire should be pointed towards the right rear wheel house because the spare is also included in the monitoring (although it is not displayed on the CD).

The wheel transmitter module measures its ambient air pressure every minute. If the air pressure increases by 0.5 bar between measurements, the transmission rate increases to every 0.8 seconds.

If the increase in air pressure is detected for approximately 216 seconds, the full functionality of the wheel module is activated. If the higher pressure then continues, the module remains permanently active and measures the air pressure and temperature every 0.3 seconds and transmits the information by radio signal every 55 seconds.

At temperatures over 120°C the transmitter modules are switched off. Once the transmitter cools to below 110°C operation resumes.

Principle of Operation

Initialization

After the tires are replaced, rotated or if their inflation pressures are adjusted, then the wheel transmitter modules must be initialized using the RDC function in the "Settings" menu of the Control Display.

During initialization the following processes are performed:


- Individual wheel recognition (Identification of wheel transmitter modules).
- Wheel position assignment.
- Plausibility check (setpoint pressures checked).
- Adoption of setpoint pressures as specified pressures.

The RDC then learns the wheel transmitter module position.

The minimum air pressure accepted by the RDC on initialization is 1.7 bar (24.7psi). If the tire pressures deviate more than 0.4 bar (6psi) per axle the initialization is rejected after a plausibility check.

1.3 bar is the lowest pressure detected by the wheel transmitter module. At that point, a tire failure warning will always be issued.

Complete initialization can take up to 30 minutes. Only the actual driving time over 6 km/h is taken into account. During initialization, the CC message "Initializing RDC!" is displayed on the Instrument Cluster.

Check Control Message displayed in KOMBI	Message displayed in Control Display
Initializing RDC! 	"Initializing RDC!" RDC tire pressure monitor not available for 15 to 30 min. System is temporarily unable to detect flat tires

When the initialization from the Control Display is activated, the wheels appear black and the pressures are not shown.




Once initialization is complete, the tires of the car on the graphic turn green and pressure values are shown for each tire.

Tire Pressure Monitoring

During monitoring, the RDC control unit takes the measured temperature and pressure and determines a target pressure value.

If the tire pressure being monitored falls below the required level by 0.2 bar for more than 8 minutes, a CC message appears on the instrument cluster after the car is started. The driver is prompted to to check the tire pressure.

- "Autumn warning": If the tire temperature is 20°C lower for 14 days than the temperature was when the RDC was last initialized the RDC will also warn the driver to check the tire pressures.


Check Control Message displayed in KOMBI	Message displayed in Control Display
Check tire pressures! 	"Check tire pressures!" Check tire inflation pressures; refer to owners manual or inflation chart.

When the RDC menu on the Control Display is activated, the car is shown with yellow tires.

The tire pressures must be adjusted and an initialization carried out.

Tire Failure Warning

If a tire being monitored falls below the specified level by 0.4 bar after temperature calculation or 16% of the inflated pressure then a CC message appears on the instrument cluster with an audible warning tone. A message also appears on the Control Display.

Check Control Message displayed in KOMBI	Message displayed in Control Display
Flat tire! stop vehicle carefully. 	Left front tire is flat, refer to owners manual or contact BMW Roadside assistance.

When the RDC menu on the Control Display is activated, the car is shown with the defective tire in red. In the case of a spare tire failure, all wheels are shown in red.

Once the tire pressures are restored to the setpoint in the RDS control unit the tires of the car graphic in the Control Display return to green and the Check Control message is withdrawn.

See the chapter "E65 Instrument cluster" for details on additional Check Control messages.

Review Questions

1. Where are the transmitters and antennas located for the RDC system on the E65/E66? What is the operating frequency for the U.S.?

2. What conditions cause the wheel transmitter units to go from energy saving mode to full functionality?

3. When adjusting tire pressures on a vehicle equipped with RDC, what is the maximum difference between tires of the same axle allowed by the system?

4. When is initialization of the RDC system necessary? Explain briefly what the system is doing during the learning process.

5. How does the RDW/RPA system detect pressure loss in the tire?

6. What conditions are NOT detected by the RDW/RPA system?

7. When should initialization be carried out the RDW/RPA system?

8. What designation should be common to ALL run flat tires?
