2002-07 GENINFO

Body Electronics - Overview - MINI

MINI BODY ELECTRONICS

POWER DISTRIBUTION

Purpose of the System

The purpose of the Power Distribution System is to provide a safe delivery of power (Electricity) within the vehicle. Electrical power as produced by the battery and generator is distributed though Fuse Boxes and the main wiring harness to vehicle systems.

The Power Distribution System consists of:

- The Battery
- The Generator
- Fusebox(s)
- Vehicle Wiring Harness
- Ground System

System Components

The Battery

The Battery location is dependent on model variation.

- MINI COOPER - Battery is located in the engine compartment
- MINI COOPER S - Battery is located in the rear luggage compartment (with BST)

Fig. 1: Mini Cooper - Battery Located In Engine Compartment
Courtesy of BMW OF NORTH AMERICA, INC.

MINI COOPER S Battery Mounting

Fig. 2: Mini Cooper S - Battery Located In Rear Luggage Compartment (With BST)
Courtesy of BMW OF NORTH AMERICA, INC.

All batteries used in the MINI are sealed for life and are maintenance free. A battery condition indicator which shows three battery states is located on top of the battery. The battery condition states are:

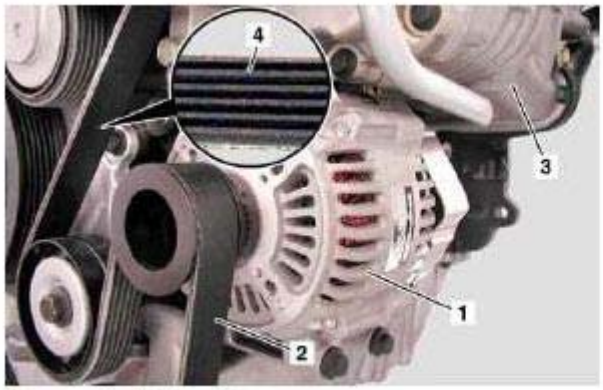
- Green - Battery is in good state of charge
- Dark (Turning to Black) - Battery requires charging
- Clear (Light Yellow) - Battery must be replaced

Battery Specification

MINI COOPER and MINI COOPER S batteries are 12 volt 55 AH Maintenance Free.

Generator

All generators are mounted to the block with 3 fasteners and are located on the right side of the engine (viewed from the front of the engine). The MINI COOPER S generator is situated in a lower position to accommodate the supercharger.



1. Generator
2. Drive Belt
3. Supercharger (COOPER S only)
4. Drive Belt Ribs

Generator Mounting

Fig. 3: Generator Drive Belt
Courtesy of BMW OF NORTH AMERICA, INC.

Generator Specification

All MINI COOPER (COOPER S) Generators are 120 Amp Valeo.

Fuse Boxes

MINI COOPER

There are two Fuse Boxes on the MINI COOPER. One is located in the engine compartment (adjacent to the battery) and the other one is located at the base of the left side A-pillar.

MINI COOPER AND COOPER S

Engine Compartment Fusebox

1. Blade type fuses
2. J-case type fuses

Fig. 4: Fuse Boxes - Blade Type Fuses And J-Case Type Fuses
Courtesy of BMW OF NORTH AMERICA, INC.

MINI COOPER AND COOPER S

A-pillar Fusebox

Fig. 5: A-Pillar Fusebox
Courtesy of BMW OF NORTH AMERICA, INC.

The engine compartment fusebox contains two types of fuses:

- Blade Type Fuse - Conventional pull out male type fuse used to protect circuits between 5 and 30 amps.
- J-case Fuse - A square pull-out fuse used to protect circuits from 30 to 50 amps.

The A-pillar fusebox contains conventional blade type fuses only and three PCB type relays which are integral to the fusebox and cannot be replaced. The PCB relays control the Rear wiper, heated rear window and the cigarette lighter.

MINI COOPER S Only

MINI COOPER S models utilize the two Fuse Boxes as on the MINI COOPER and add a third fusebox. The third fusebox contains a single 250 amp fuse and is located in the rear of the vehicle near the battery compartment.

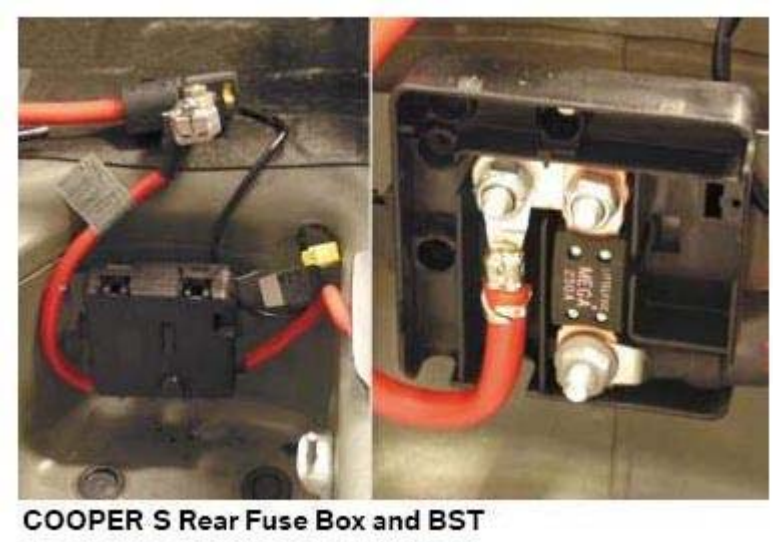


Fig. 6: Cooper S Rear Fuse Box And BST
Courtesy of BMW OF NORTH AMERICA, INC.

MINI COOPER S models are equipped with an additional fusebox that carries a single 250A fusible link. The box is located adjacent to the battery in the luggage compartment.

COOPER S battery is fitted with a BST for the main power cable.

COOPER S Battery Cable

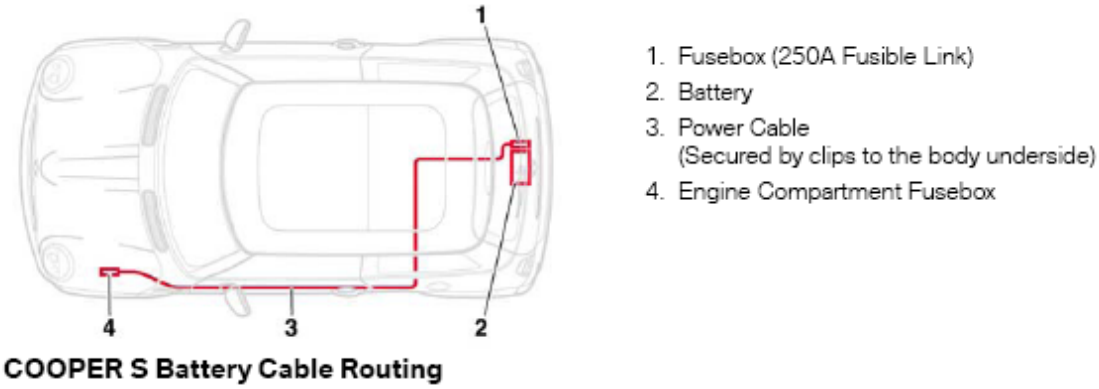


Fig. 7: Cooper S Battery Cable Routing
Courtesy of BMW OF NORTH AMERICA, INC.

Workshop Hint

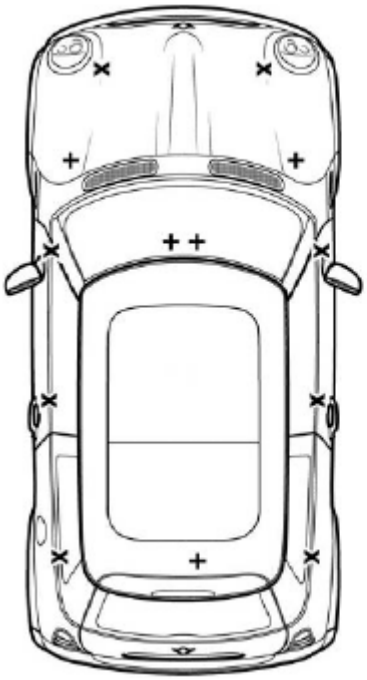
When disconnecting a battery always disarm the alarm and ensure the ignition and all electrical equipment is switched 'off'. Each

Disconnect the negative terminal first, and reconnect the positive terminal first.

Workshop Hint

Each harness, main, door or dashboard is vehicle specific. If replacing a harness, check that the replacement harness has the proper connectors for the equipment installed in the vehicle.

Ground System



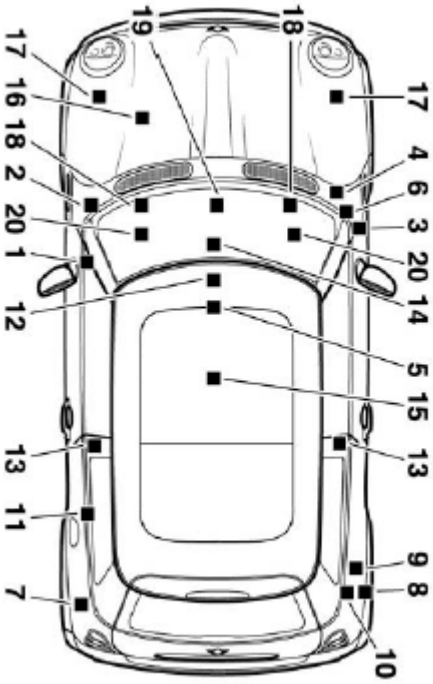
Vehicle Ground Points

X - Ground Header

+ - Single ground screw/stud

Fig. 8: Vehicle Ground Points
Courtesy of BMW OF NORTH AMERICA, INC.

Component Locations



1. Not Used in USA
2. EWS 3
3. BC1
4. DWA Siren
5. MRS 4
6. LWR
7. Tilt Sensor
8. PDC Control Unit
9. PDC Gong
10. RDW
11. Not Used in USA
12. RF Receiver
13. MRS 4 Side Impact Sensor
14. AIC (Rain Sensor)
15. DSC Sensor Cluster
16. EMS 2000
17. Xenon Light Modules
18. GIU (Automatic Transmission Only)
19. IKE
20. Remote Cluster

Fig. 9: Ground System Component Locations

Courtesy of BMW OF NORTH AMERICA, INC.

Vehicle Wiring Harness

The MINI wiring harness is referred to as a single piece harness. The main harness is vehicle specific depending on optional equipment. In addition there are three other modular harnesses which connect to the main body harness:

- Door harness (x2)
- Dashboard harness

Integral to the main body harness are the multiple restraint system (MRS) harness, the CAN-bus twisted wire pairs, the single wire K-bus data link and the single wire diagnostic line. Repairs may be made on most harnesses depending on extent of damage although no part of the MRS harness is repairable.

Principle of Operation

The Power Distribution system reacts to the vehicle demand for electrical power. Current from the battery is routed through the fuses and harnesses to the component demanding power. The battery smooths out voltage fluctuations allowing components to receive a fixed voltage level.

The generator reacts to power demands and battery voltage supplies operating current during times of high demand. The high capacity of the generator ensures that sufficient power is always available.

Circuit protection is afforded by the fuse system. Excess amperage demands either through defective component or wiring harness fault are quickly reduced to protect the vehicle.

The battery location of the MINI COOPER S requires additional protection due to its long B+ battery cable. It is protected by a 250 amp fuse and the BST located in the battery compartment.

Notes:

Review Questions

1. Detail the three states of the indicator on top of the MINI battery.
2. What is the amperage rating of the MINI COOPER S generator?
3. What is the location of the fuses that protect circuits up to 50 amps.

   What types of fuses are they?

4. Why is the COOPER S equipped with a BST and the MINI COOPER is not?

IKE (INSTRUMENT CLUSTER ELECTRONICS)

Purpose of the System

The Instrument Cluster Electronics (IKE) performs a number of different functions within the car. It presents

information visually and acoustically, receives and forwards signals to other controllers and enables diagnosis of the many systems connected to the K-bus.

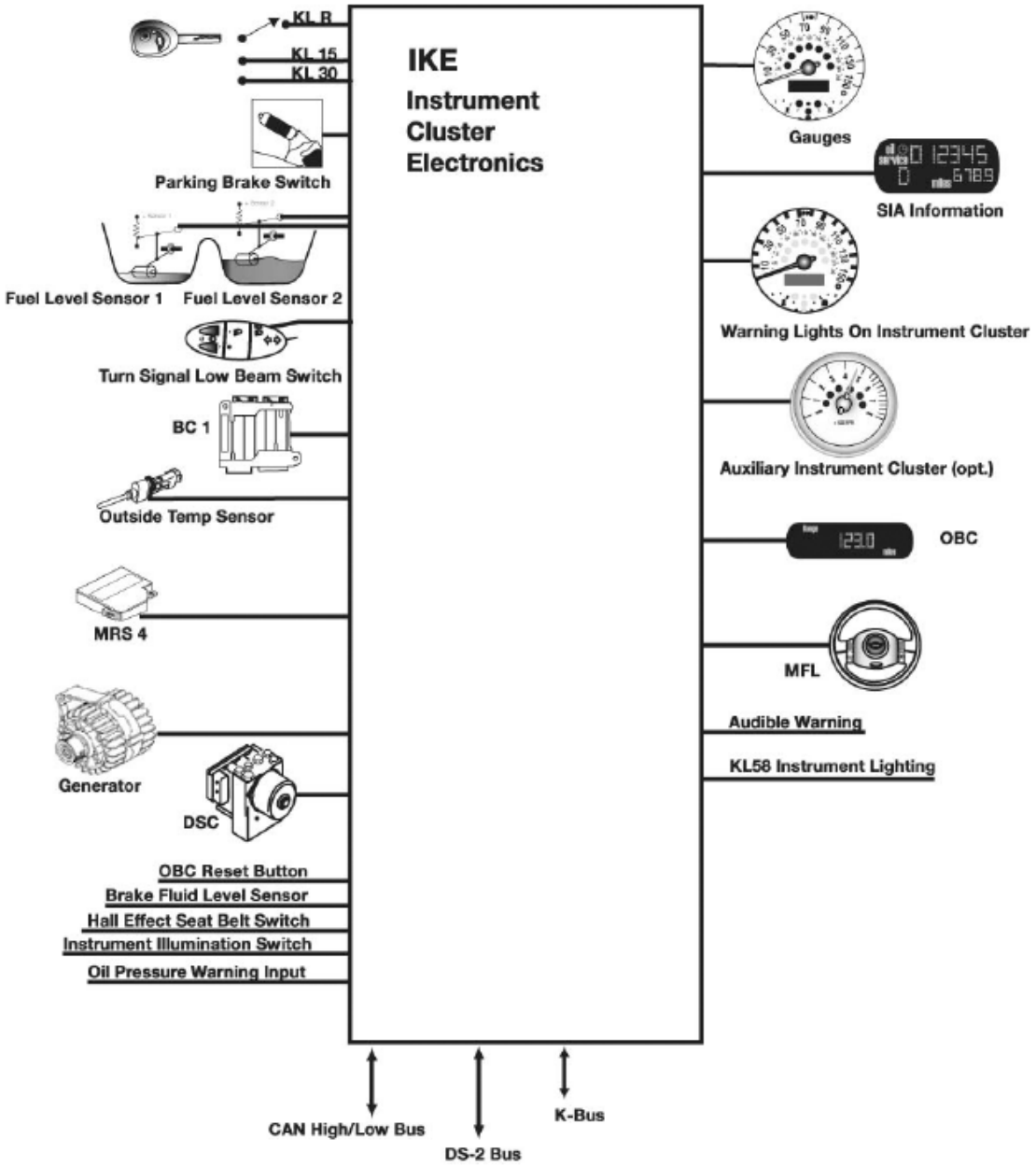


Fig. 10: Instrument Cluster Electronics (IKE)
Courtesy of BMW OF NORTH AMERICA, INC.

For the reception and forwarding of signals to other controllers, the IKE is connected with several interfaces and assumes a gateway function. The interfaces are:

- K-Bus
- CAN-Bus

- DS2-Bus
- D-Bus

The IKE system consists of:

- IKE Electronics
- Center Display
- Remote Display

Speedometer Center Display

Fig. 11: Speedometer Center Display
Courtesy of BMW OF NORTH AMERICA, INC.

IKE Connections

1. 12 pin connector
2. 26 pin connector

Fig. 12: IKE Connections (12 Pin Connector And 26 Pin Connector)
Courtesy of BMW OF NORTH AMERICA, INC.

Navigation Center Display

Fig. 13: Navigation Center Display
Courtesy of BMW OF NORTH AMERICA, INC.

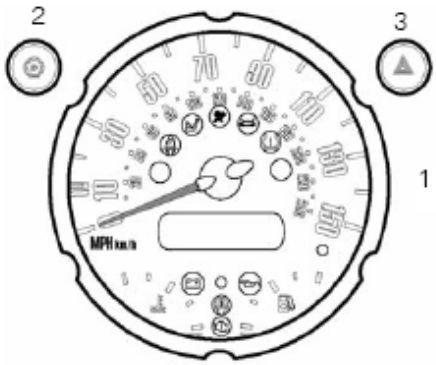
System Components

IKE Electronics

The central display unit, regardless of instrument type (Navigation or Speedometer) acts as the IKE gateway. As a gateway the IKE receives information in different formats from the Bus Network (CAN, K, D, DS2), processes the data and passes it on to the appropriate control module. For instance, the IKE receives a compressor "On" request from the IHKA over the K-Bus, converts this request into a CAN Bus message and sends it to the EMS2000 for compressor activation.

Center Display

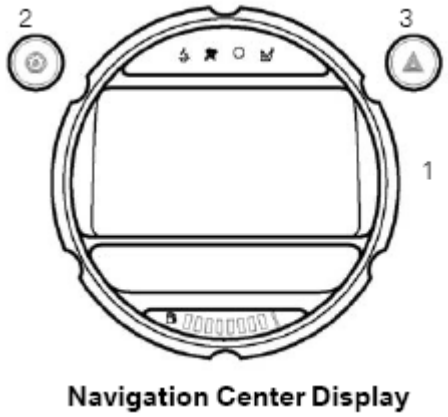
The Center Display is integral with the IKE Electronics assembly. The display will be either the Speedometer and warning lights or the Navigation System.



1. Speedometer with warning indicators, OBC and Analog Fuel Level and Engine Temp Displays
2. Instrument Illumination Switch
3. Hazard Warning Switch

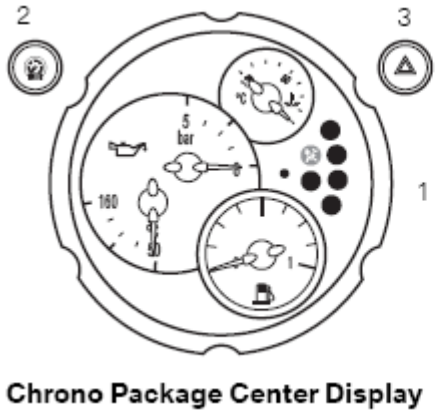
Speedometer Center Display

Fig. 14: Speedometer Center Display
Courtesy of BMW OF NORTH AMERICA, INC.



1. Navigation Display with limited warning indicators and Digital Fuel level Display
2. Instrument Illumination Switch
3. Hazard Warning Switch

Fig. 15: Navigation Center Display
Courtesy of BMW OF NORTH AMERICA, INC.

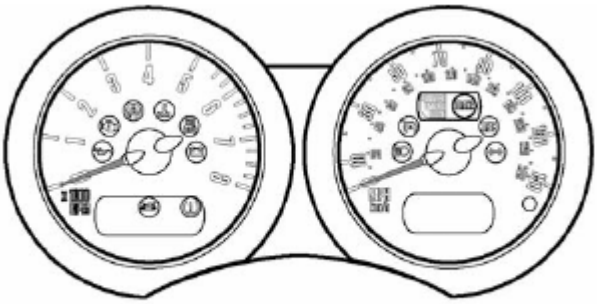


1. Chrono Package Gauge set
2. Instrument Illumination Switch
3. Hazard Warning Switch

Fig. 16: Chrono Package Center Display
Courtesy of BMW OF NORTH AMERICA, INC.

Remote Display

Depending on equipment the Remote Display will contain a single instrument (Tachometer or Speedometer) or dual instruments (Tachometer and Speedometer). Regardless of configuration, the remote display functions only as a display, the IKE Electronic functions being retained in the Center Display.



Remote Tachometer and Speedometer with OBC

Fig. 17: Remote Tachometer And Speedometer With OBC
Courtesy of BMW OF NORTH AMERICA, INC.

Remote Tachometer with OBC

Fig. 18: Remote Tachometer With OBC
Courtesy of BMW OF NORTH AMERICA, INC.

IKE System Functions

System Functions of the IKE include:

- Bus System Gateway
- Vehicle Information Storage
- Function of Pointer Instruments

  Speedometer

  Tachometer

  Engine Coolant Temp

  Fuel Level (Analog or Digital)

- Warning Lamps

  Red - Warning

Yellow - Caution

Green - System Operative

Blue - High Beam on

- OBC functions

Ambient Temperature

Range

Average Fuel Consumption

Average Speed

- Audible warnings

Seat Belt

Lights on

Key in

Hood open

Engine coolant overheated

Turn Signal Indicators

- Instrument Illumination
- Automatic Transmission Display

Bus System Gateway

The IKE provides a gateway for communication between the DS2-bus and K-bus, and between the CAN-bus and K-bus, translating the protocol used between the different systems. The K-bus uses a baud rate of 9600 bits per second and the CAN-bus uses a baud rate of 500 k/bits per second. This speed difference in communication rate makes it impossible for a component on the K-Bus to speak directly to a component on the CAN-Bus. The IKE is the "translator" between the two bus networks.

BUS SYSTEM GATEWAY

Examples of Bus Information Transmitted and Received by IKE			
Information	**Transmitted By**	**Received By**	**Bus System**
Tailgate open	BC1	IKE	K-bus
Gear status	IKE	BC1, PDC	K-bus

Ambient temp	IKE	IHKA	K-bus
Engine Speed	EM2000	IKE	CAN-bus
Fuel usage	EMS2000	IKE	CAN-bus
Gear position	GIU(GIB)	IKE	CAN-bus
Odometer	IKE	BC1	CAN-bus
Vehicle speed	ABS/ASC/DSC	IKE	CAN-bus

NOTE: These are but a few examples of bus information handled by the IKE. Refer to the proper ETM for complete information. Vehicle Information Storage

Vehicle Information Storage

Vehicle information stored in the IKE is sent to the BC1 as a back-up. Information redundantly stored in the BC1 and the IKE is: VIN, Total Miles, Trip Odometer, SIA Information.

Vehicle Identification Number (VIN)

The VIN is stored at the end of production or when the BC1 is replaced. The VIN can only be written to the BC1 if the total mileage is less than 100 km or there is no VIN already stored.

Total Miles

The IKE sends mileage information when it has changed from the previous value. This information will be stored if it is a greater value than the value already stored. During IKE coding the information is stored in two places to prevent corruption.

The updating of the mileage will be as follows:

- If the BC1 has zero km stored in memory (New BC1), it will accept the mileage sent to it by the IKE (irrespective of value up to a limit of 999,900 km).
- Once the BC1 has received a valid mileage (i.e. 5,000 km), it will accept an updated mileage that exceeds the previous mileage by a value no more than 1,000 km. For example, if a new value of 6,500 km was sent and it already had a value in memory of 5,000 km it will ignore the new value.
- The BC1 will update its mileage value every 100 km during a journey. The IKE must therefore send a K-bus telegram message every 100 km so that the BC1 can maintain a running total.
- Once 999,900 miles has been reached there will be no further updates.

During installation of a new IKE the stored reading in the BC1 will be fed back to the IKE.

Odometer

The odometer displays the total distance driven by the vehicle. The odometer and trip counter are also used for displaying the Service Interval Announcement (SIA) information and IKE test functions. The odometer display is capable of displaying the distance travelled as a 6 digit decimal number with a maximum display distance resolution of 1 mile or 1 km depending the unit selected.

The maximum value that can be displayed on the odometer display is 999999 km (or equivalent miles), any distance in excess of this shall cause the odometer display to indicate. ------ The display will not 'roll over' to 000000.

The odometer distance information is calculated based on vehicle speed information received by the IKE from the ASC/DSC control module via the CAN-Bus.

Trip Counter

The trip counter displays the distance driven by the vehicle since the user last reset the trip counter. The trip counter display will be capable of displaying a 3.1 digit decimal number with a maximum display distance resolution of 0.1 miles or 0.1 km, again dependent on the selected display units. The value of the trip counter distance shall be obtained from the vehicle speed signal.

The maximum value that can be displayed on the trip counter display is 999.9. Any display distance in excess of this will cause the trip counter distance to 'roll over' and recommence counting from zero.

This button is also used to access the instrument cluster self test and rest SIA data.

Trip Odometer Reset Button in Speedometer Center Display

Fig. 19: Trip Odometer Reset Button In Speedometer Center Display
Courtesy of BMW OF NORTH AMERICA, INC.

Service Interval Data (SIA)

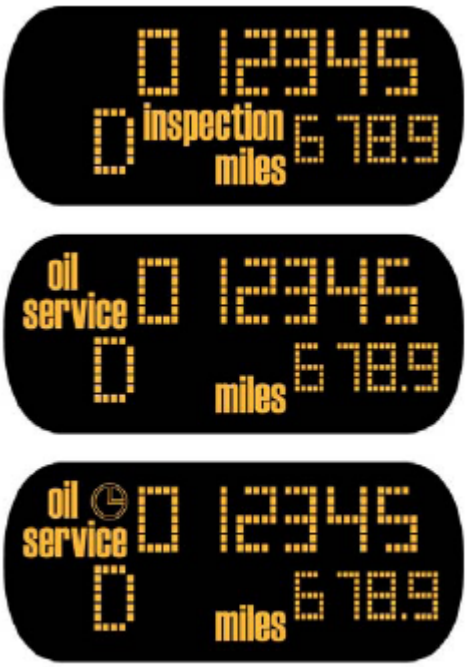
The IKE sends this information when it has changed from the previous stored value. This information will be stored if it is a greater value than the value stored. The IKE sends this information each time the ignition is turned on.

The SIA display is the means by which the vehicle owner is informed of impending or overdue vehicle services. The display must be able to show the following information:

- The remaining distance until the next service
- A minus symbol to go with the remaining distance display
- Km icon for km units
- Miles icon for miles units
- Inspection icon

- Oil Service icon

The SIA information is displayed for a predetermined time after switching the ignition to position 2, replacing the odometer and trip counter information The display will return to displaying odometer and trip counter information when the light check is complete.



SIA Display Information

Fig. 20: Service Interval Data (SIA)
Courtesy of BMW OF NORTH AMERICA, INC.

Remaining Distance

Remaining distance shows the distance remaining until the next service is required. This is displayed in the selected units of the Odometer and Trip counter. If the service is overdue then the display will show how many miles past the service the vehicle is. This is indicated by displaying a '-' (minus symbol) next to the remaining distance. The remaining distance will not show any leading zeros and the minus sign will remain next to the most significant digit, for example:

- -50 km
- -250 km
- -1250 km

The displayed distance will always be quantified to the nearest 50 km or 25 miles depending on the selected display units. The remaining distance is calculated from 3 inputs; fuel used, recommended distance between services and the quantity of fuel to be used between service intervals.

The formula is: Remaining Distance = Recommended distance *(SI fuel quantity - fuel consumed)/SI fuel

quantity

The advantages are that the formula is easily adapted for different engines by supplying different values for the recommended distance and SI fuel quantity, and that the remaining distance will reduce more quickly if the engine is subjected to more arduous usage. Equally the service distance may be extended by moderate usage. The values of recommended distance and SI fuel quantity will be stored in the IKE memory. To prevent the remaining distance counter from being reset in the case of loss of power or software reset, the accumulated fuel used is stored in IKE memory at least once every 2 km synchronized with the Odometer distance storage.

Oil Service and Inspection

The remaining distance shows the distance until the next service, which may be of either an oil service or inspection type. Whenever the SIA information is displayed the type of service next required is also displayed using either the 'oil service' or 'inspection' icons. The type of service next required alternates between oil service and inspection. When either an oil service or inspection is due the remaining distance figure will flash. If either of the oil or inspection services is overdue by a remaining distance greater than the recommended distance then both the 'oil service' and 'inspection' icons are displayed.

SIA Reset

Oil service and inspection reset will be possible only after 20% of the expected fuel usage has been consumed following the previous reset.

The SIA function may be reset through operation of the ignition switch and trip reset button (or via the DISplus).

The following procedure will be used for reset (assuming that resets are due):

- Turn the ignition to position 0.
- Press and hold the trip reset button then turn the ignition switch to position 1. 5 seconds after ignition 1, the display will show the current SIA status (oil or inspection service). The trip reset button can now be released.
- Press and hold the trip reset button for 5 seconds to change to reset mode. The display will flash the reset text 'rst'. If the trip reset button is pressed again within these flashes then the current service requirement is reset and the display will show the new status for 5 seconds.

The oil/inspection data has now been reset.

Speedometer

Speedometer operating range is 0-150 Mph. The vehicle speed information arrives at the IKE via the CAN Bus from the DSC. Other components requiring vehicle speed receive that information from the IKE.

Tachometer

Tachometer

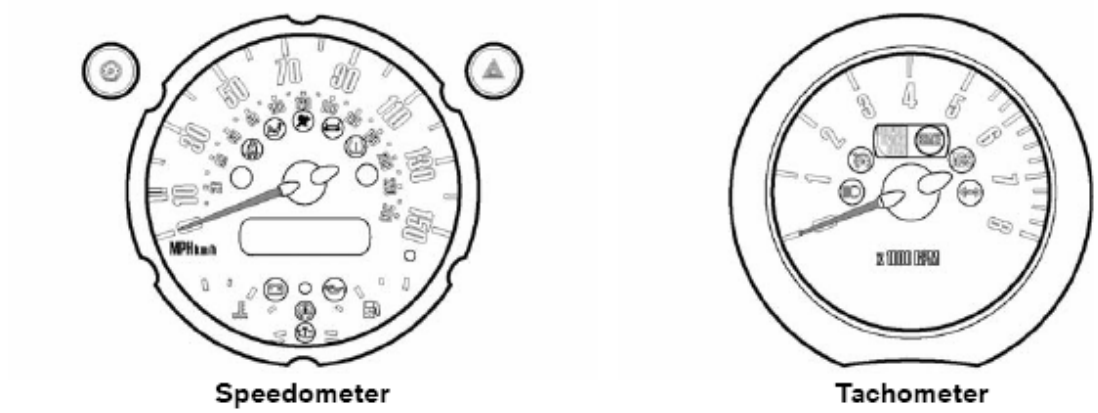


Fig. 21: Tachometer
Courtesy of BMW OF NORTH AMERICA, INC.

Tachometer operating range is 0-8000 RPM.

Engine speed data is received via the CAN Bus from the EMS2000.

From 5500 rpm to 8000 rpm there are a series of LED's, which are lit.

Engine Coolant Temp

Analog Display (Vehicles without Navigation)

A small analogue display incorporating a warning lamp, which illuminates at an engine temperature equal to or greater than 120 degrees Celsius. The warning for high engine temperature is incorporated into the last (highest) marker on the gauge. Engine Temperature data is provided to the IKE by the EMS2000 via the CAN Bus.

Fig. 22: Analog Temperature Display
Courtesy of BMW OF NORTH AMERICA, INC.

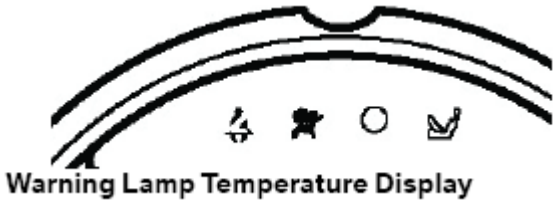


Fig. 23: Warning Lamp Temperature Display
Courtesy of BMW OF NORTH AMERICA, INC.

Warning Lamp (Vehicles with Navigation)

On navigation derivatives, Engine Coolant Temperature is provided via a warning lamp when the engine temperature is high. The engine temp data is still provided by the EMS2000 via the CAN Bus.

Fuel Level

Fuel Level Analog (Vehicles without Navigation)

On non-navigation vehicles fuel level is indicated by an analog display incorporating a warning lamp, which illuminates at low fuel level. When the low fuel level warning lamp illuminates there is approximately 6 liters of (usable) fuel remaining in the fuel tank.

Fig. 24: Analog Fuel Level Display
Courtesy of BMW OF NORTH AMERICA, INC.

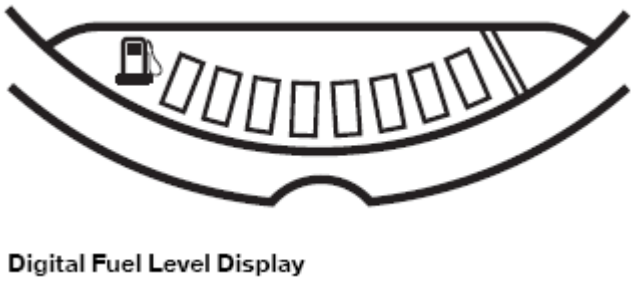


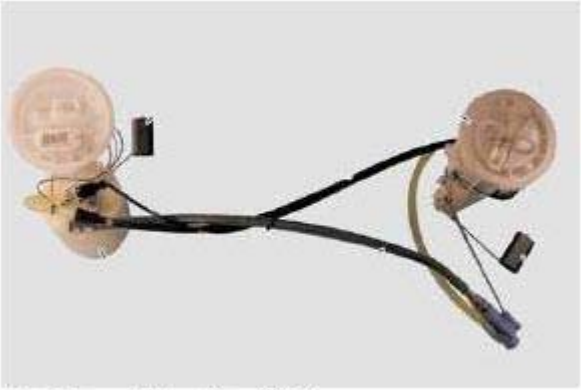
Fig. 25: Digital Fuel Level Display
Courtesy of BMW OF NORTH AMERICA, INC.

Fuel Level Digital (Vehicles with Navigation)

The navigation cluster on MINI features an 8 position LED bar graph display for displaying fuel quantity. This series of LED's when lit indicate to the driver the remaining quantity of fuel in the fuel tank. If all the LED's are lit, this indicates that the fuel tank is FULL. If all the LED's are extinguished the fuel tank is nearly EMPTY. However in the latter event, the first LED (left hand side) in the series will flash 5 times and an audible warning sound will be provided to the driver upon low fuel being detected. At this point there is approximately 6 liters of (usable) fuel in the tank.

Fuel Level Sending Units

Because the MINI utilizes a "saddle" fuel tank, it requires two sending units. The fuel level sending units are connected in parallel and send a varying voltage (analog) signal directly to the IKE. The IKE uses a complex algorithm to accurately measure the fuel quantity in the tank.



Fuel Level Sending Units

Fig. 26: Fuel Level Sending Units
Courtesy of BMW OF NORTH AMERICA, INC.

Audible Warnings

The IKE incorporates an audible warning sounder and is used to provide information to the driver for the following systems.

Seat belt - Warns the driver the Seat Belts are not buckled.

Lights on - Warns the driver that the lights are switched on when the door is opened and the ignition is off. The audible warning will be continual until the door is closed, the ignition is turned ON or the lights are switched OFF.

Key in - Warns the driver that the key is still in the ignition at position 0 and the driver's door is open. The sound will be per-formed indefinitely while the key in warning condition exists. This function is required for the vehicle to satisfy North American legislation.

Hood open - Used when the hood is not correctly closed, with headlight low beam on and at a vehicle speed greater than 5 km/h. Audible warning will continue until either the road speed is reduced below 5 km/h, or the hood is closed.

Engine coolant over-temperature - Used when the engine is overheating. This audible warning is active when the engine coolant temperature warning light becomes illuminated

Park Distance Control (PDC) - Used to assist the driver in judging distances while parking. The closer the vehicle gets to an object, the faster the audible sound. When the vehicle is too close the audible tone will be continuous.

Direction indicator (tick/tock) - Used to indicate to the driver that either the direction indicator or hazard warning lights are operational.

Instrument Illumination

The instrument clusters and all the other additional interior switches are illuminated whenever the exterior lights are switched on. The illumination dimmer switch is located to the left hand side of the central instrument cluster (integral with the IKE).

Fig. 27: Illumination Dimmer Switch
Courtesy of BMW OF NORTH AMERICA, INC.

Continual depressing of the dimmer switch increases the illumination of the instrumentation, and successive presses of the dimmer switch dims the illumination.

The instrument cluster illumination has a feature, whereby when the external lights are switched on, the illumination fades into the current level setting. The illumination fade function also works in the opposite manner, whereby when the lights are switched off the illumination fades off.

On Board Computer (OBC)

The OBC information is displayed in the display field of the remote cluster, regardless of whether it is the Tachometer or speedometer.

The following information is displayed:

- Outside temperature
- Range
- Average fuel consumption
- Average road speed

The values are scrolled through using the OBC switch on the main beam/indicator stalk. Pressing the switch for longer than one second performs a reset of the average consumption or average speed when displayed.

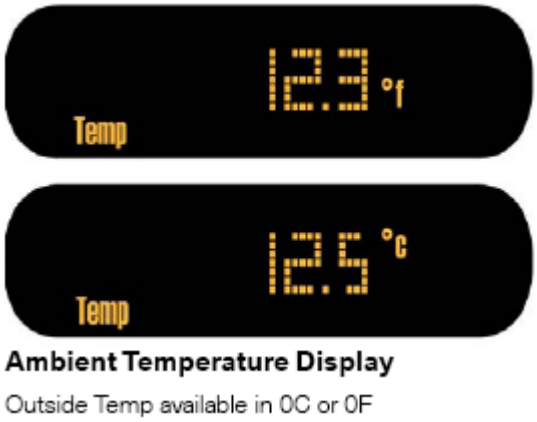


Fig. 28: Ambient Temperature Display
Courtesy of BMW OF NORTH AMERICA, INC.

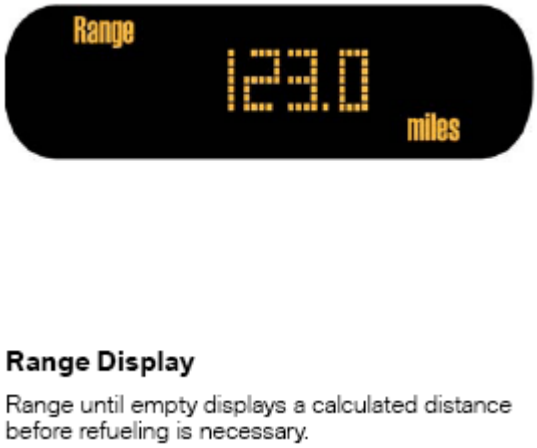


Fig. 29: Range Display
Courtesy of BMW OF NORTH AMERICA, INC.

Average Speed Display

Average Speed since last Reset

Fig. 30: Average Speed Display
Courtesy of BMW OF NORTH AMERICA, INC.

Average Fuel Consumption

Average fuel used since last Reset

Fig. 31: Average Fuel Consumption Display
Courtesy of BMW OF NORTH AMERICA, INC.

Automatic Transmission Display

Cars fitted with automatic transmission have the selector lever position displayed in the center cluster odometer display field. This display is capable of displaying the numeric and alphanumeric characters required to indicate the selector lever position (P/R/N/D) and gearshift mode (S [sport] / M [manual]).

Transmission Range Display

Fig. 32: Transmission Range Display
Courtesy of BMW OF NORTH AMERICA, INC.

Automatic Transmission Range Display

1. Emergency Program
2. Sport Program 4th gear

Fig. 33: Automatic Transmission Range Display
Courtesy of BMW OF NORTH AMERICA, INC.

NOTE: **In the event of a transmission defect the display will show EP to indicate the Emergency Program is active. If the transmission is in the adaptive mode, XP will be displayed in this field.**

Warning Lamp Layout

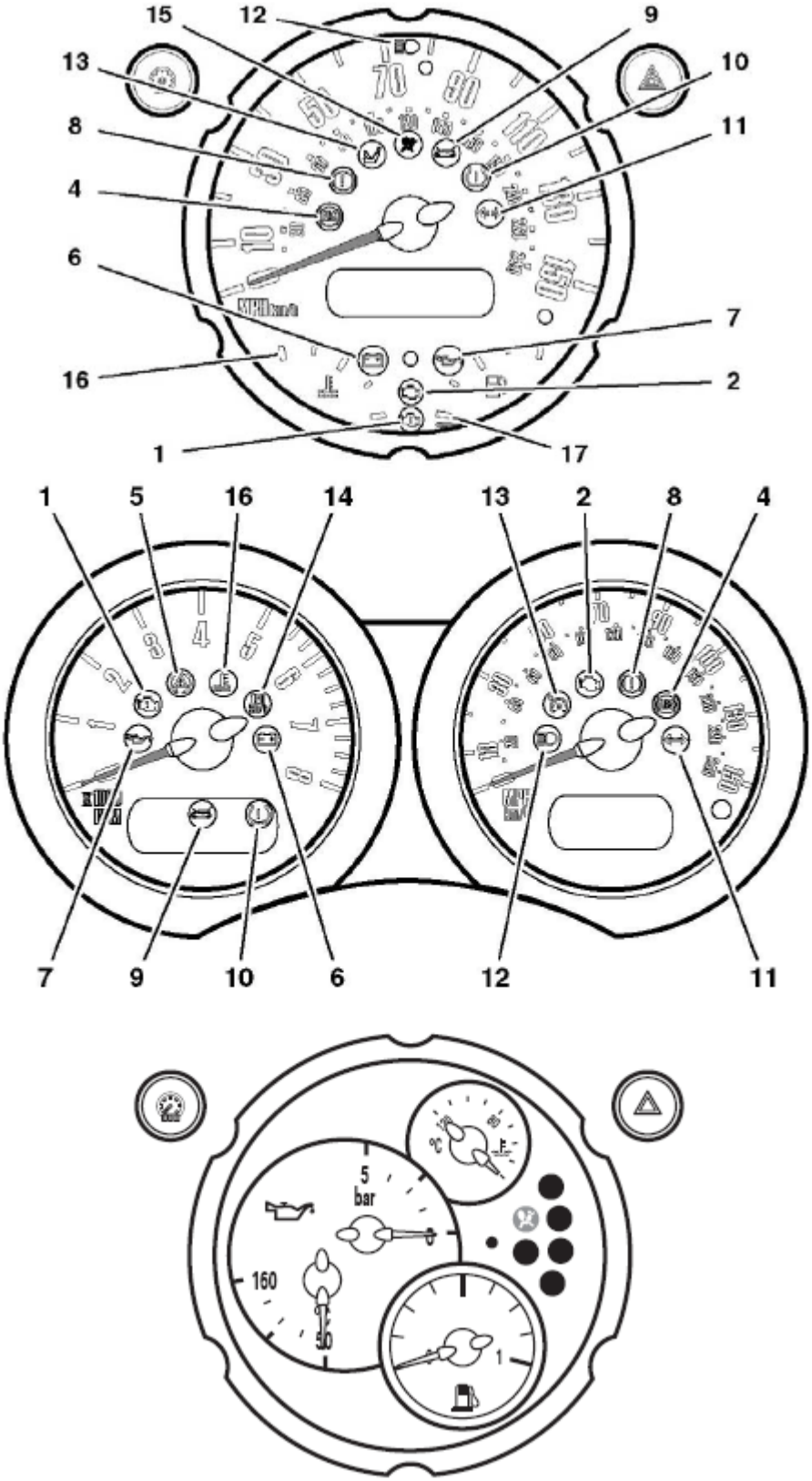


Fig. 34: Warning Lamp Layout

Courtesy of BMW OF NORTH AMERICA, INC.

1. Malfunction Indicator Light (MIL)	Amber		Emission related Fault, Flashing indicates serious fault, driver must stop immediately
2. EML (Drive by Wire)	Amber		Safety related, but not emissions related fault with electronic throttle
3. Cruise Control Active (On MFL)	Green		Signifies Cruise Available
4. ABS	Amber		Fault in ABS system
5. ASC/DSC	Amber		Fault in system or system functioning
6. Generator	Red		Generator not charging
7. Engine Oil Pressure	Red		Oil Pressure too low
8. General Brake Warning	Red		A fault in the brake system, hand brake applied, brake fluid low
9. Hood and/or Tailgate Open	Red		Hood is open, Will flash when road speed exceeds 5km/h
10. RDW	Amber		System Fault, Flashing indicates tire defect
11. Turn Signal Indicator	Green		Flash when turn signal engaged
12. Headlight High Beam Indicator	Blue		High beams on
13. RFIS (Rear Facing Infant Seat)			Infant seat in front passenger seat Not used at this time
14. Not used in this market			
15. MRS	Red		Fault in MRS system
16. Engine Coolant Over Heat	Red		Engine Coolant over 120°C
17. Fuel Level	Red		Low Fuel level
18. Seat Belt Warning	Red		Seat belt not buckled

Fig. 35: Warning Lamp Legends
Courtesy of BMW OF NORTH AMERICA, INC.

Warning Lamps

The warning lamps illuminate in one of four colors. The color indicates the level of importance of the warning as follows:

- Red - Warning
- Amber - Caution
- Green - System operative
- Blue - Headlight main beam on

Certain LED's perform a pre-drive check, while some do not go out until the engine is started or do no illuminate until a system is operational, de-activated or faulty. The LED's do not have dual color capability, but may flash or be accompanied by an acoustic warning.

IKE Test Functions

In addition to the fault memory and diagnostic link, the base instrument cluster contains a series of test functions that can be accessed to check various functions and values. The test functions are displayed in the mileage LCD block. There are a total of 21 test functions. The test functions are similar to those of previous Board computers and contain similar tests.

- Tests 1 & 2 are always unlocked.
- Tests 3 - 21 are only accessible after unlocking the test function. Test 19 is the unlock function for accessing the displays.

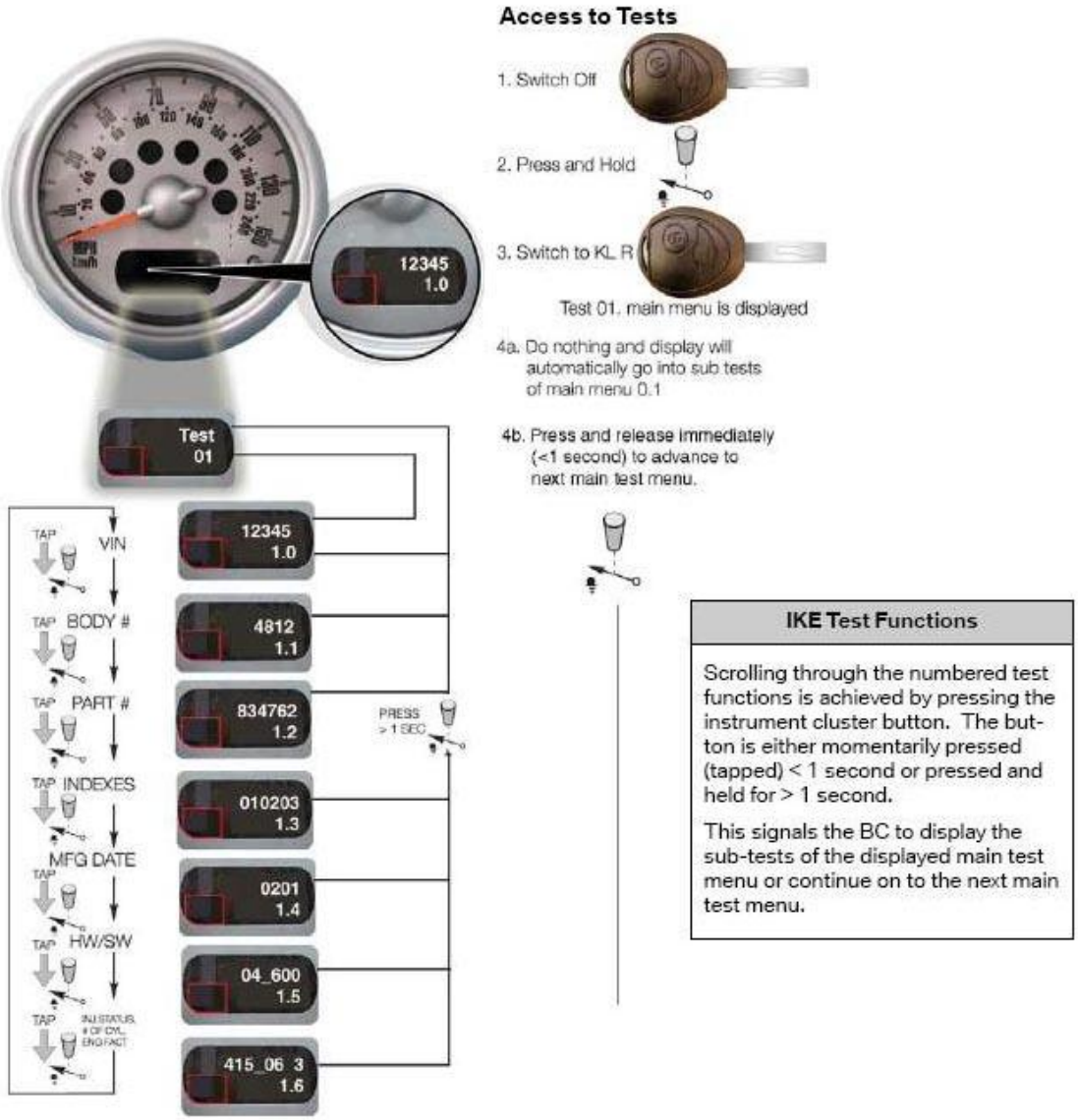


Fig. 36: IKE Test Functions Display (1 Of 6)
Courtesy of BMW OF NORTH AMERICA, INC.

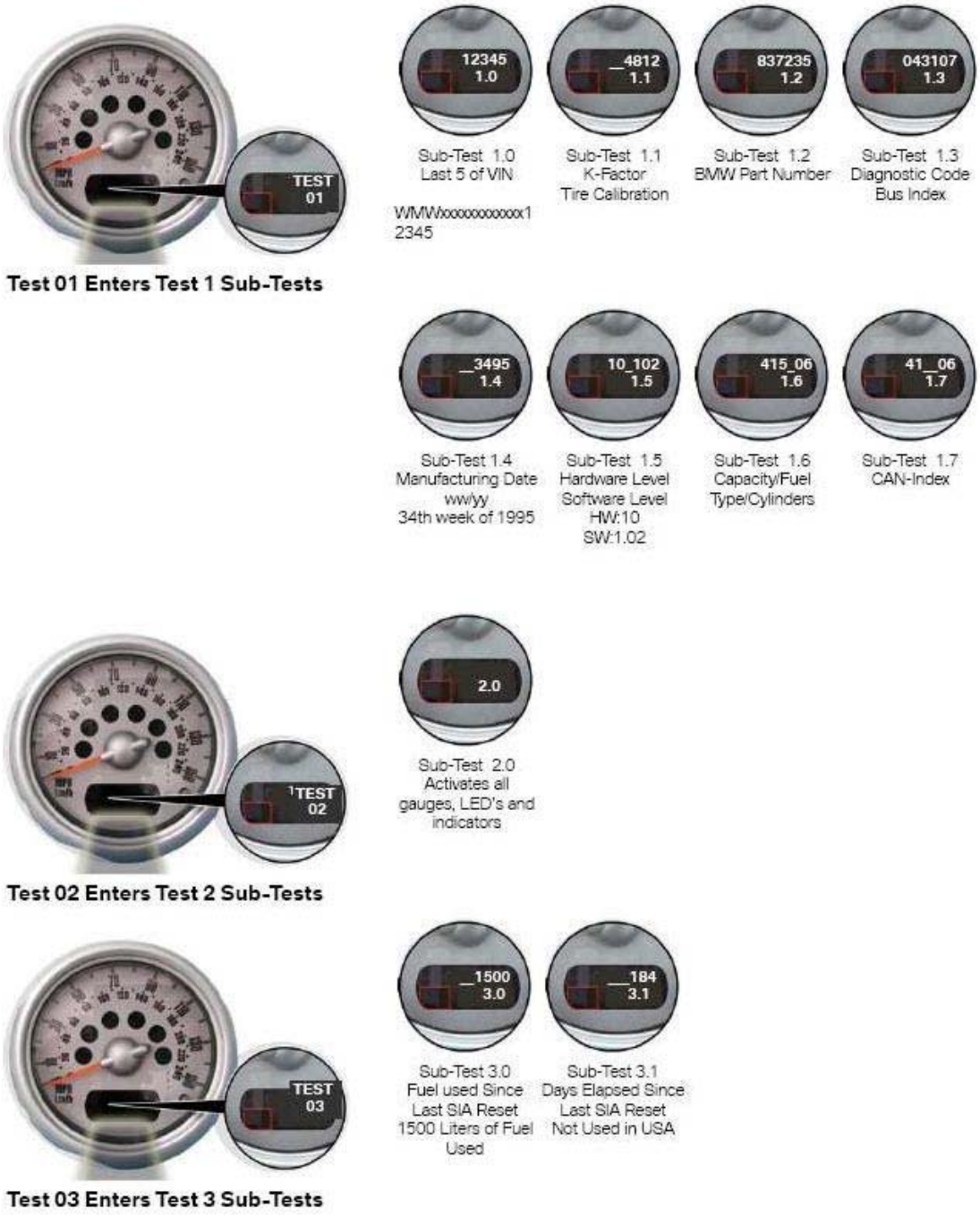


Fig. 37: IKE Test Functions Display (2 Of 6)
Courtesy of BMW OF NORTH AMERICA, INC.

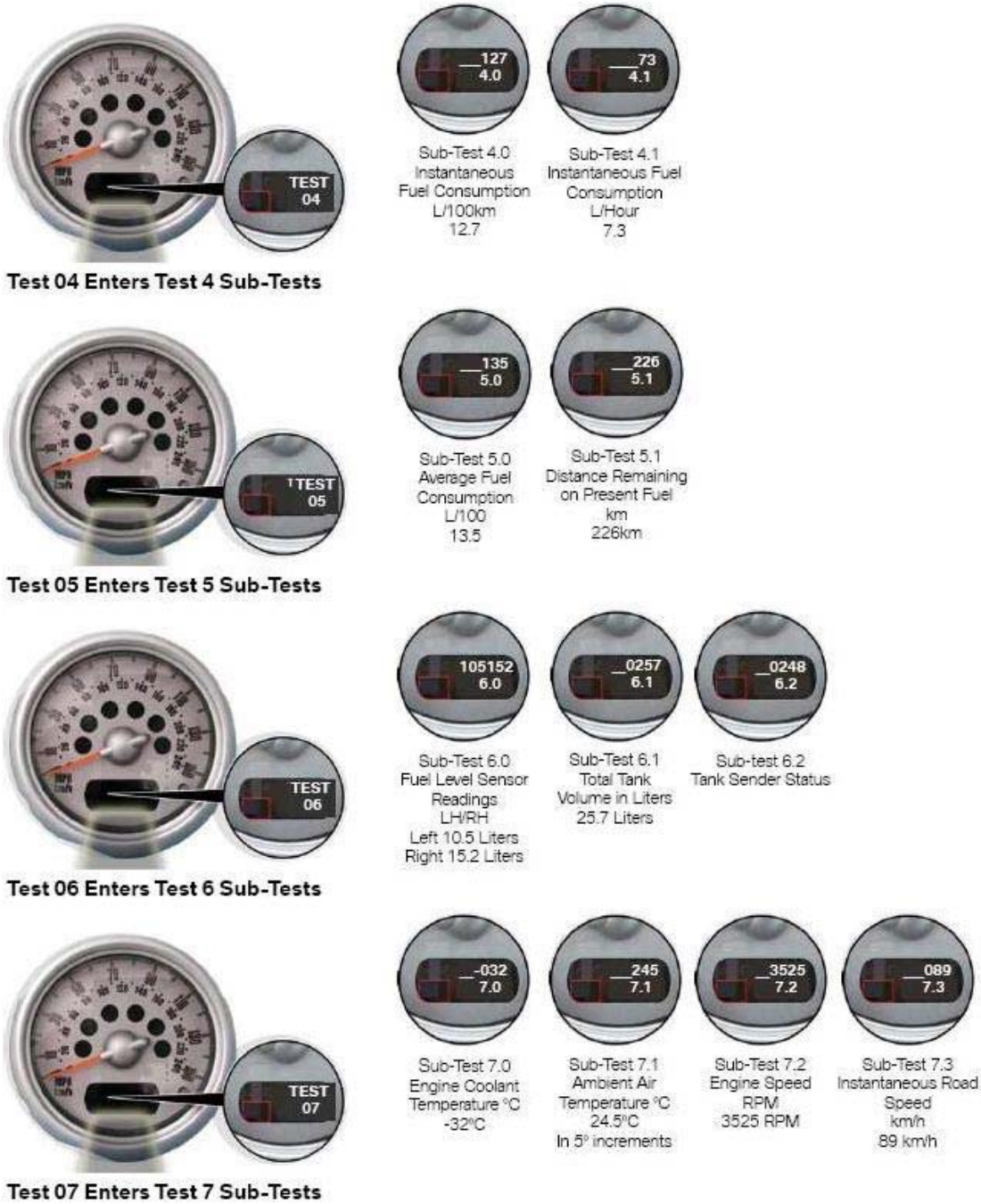


Fig. 38: IKE Test Functions Display (3 Of 6)
Courtesy of BMW OF NORTH AMERICA, INC.

Fig. 39: IKE Test Functions Display (4 Of 6)
Courtesy of BMW OF NORTH AMERICA, INC.

Test 11 Enters Test 11 Sub-Tests

Test 12 Not Used

Test 13 Enters Test 13 Sub-Tests

Test 14 Error Data Not Used for Diagnostics

Fig. 40: IKE Test Functions Display (5 Of 6)
Courtesy of BMW OF NORTH AMERICA, INC.

Tests 15, 16,17,18 Not Used for Diagnostics

Sub-Test 19.0
Lock On
Self Test
Capabilities Not
Available

Sub-Test 19.0
Lock Off
All Available Tests
Accessible

Test 19 Enters Test 19 Sub-Tests

Test 20 Not Used

Sub-Test 21
Software Reset

Test 21 Enters Test 21 Sub-Tests

Fig. 41: IKE Test Functions Display (6 Of 6)
Courtesy of BMW OF NORTH AMERICA, INC.

Review Questions

1. *Why does the IKE perform "Gateway" functions?*
2. *What is the location of the IKE in a MINI equipped with Navigation and Tachometer?*
3. *Is it possible to substitute an IKE from one car to another to check IKE operation with out danger to either IKE unit?*
4. *A (-)Minus Sign in front of the Remaining Distance display indicates?*
5. *Where does the IKE get the vehicle speed information for the speedometer display?*
6. *What is the location of the coolant temp gauge on vehicles equipped with Navigation?*
7. *Are the fuel level sending units connected in series or parallel*
8. *What color is the DSC Warning Lamp?*
9. *Which Warning Lamps on MINI have dual color capability?*
10. *Which IKE Test provides battery voltage?*

EWS (ELECTRONIC DRIVE AWAY PROTECTION)

The MINI is equipped with EWSIII 3.3.

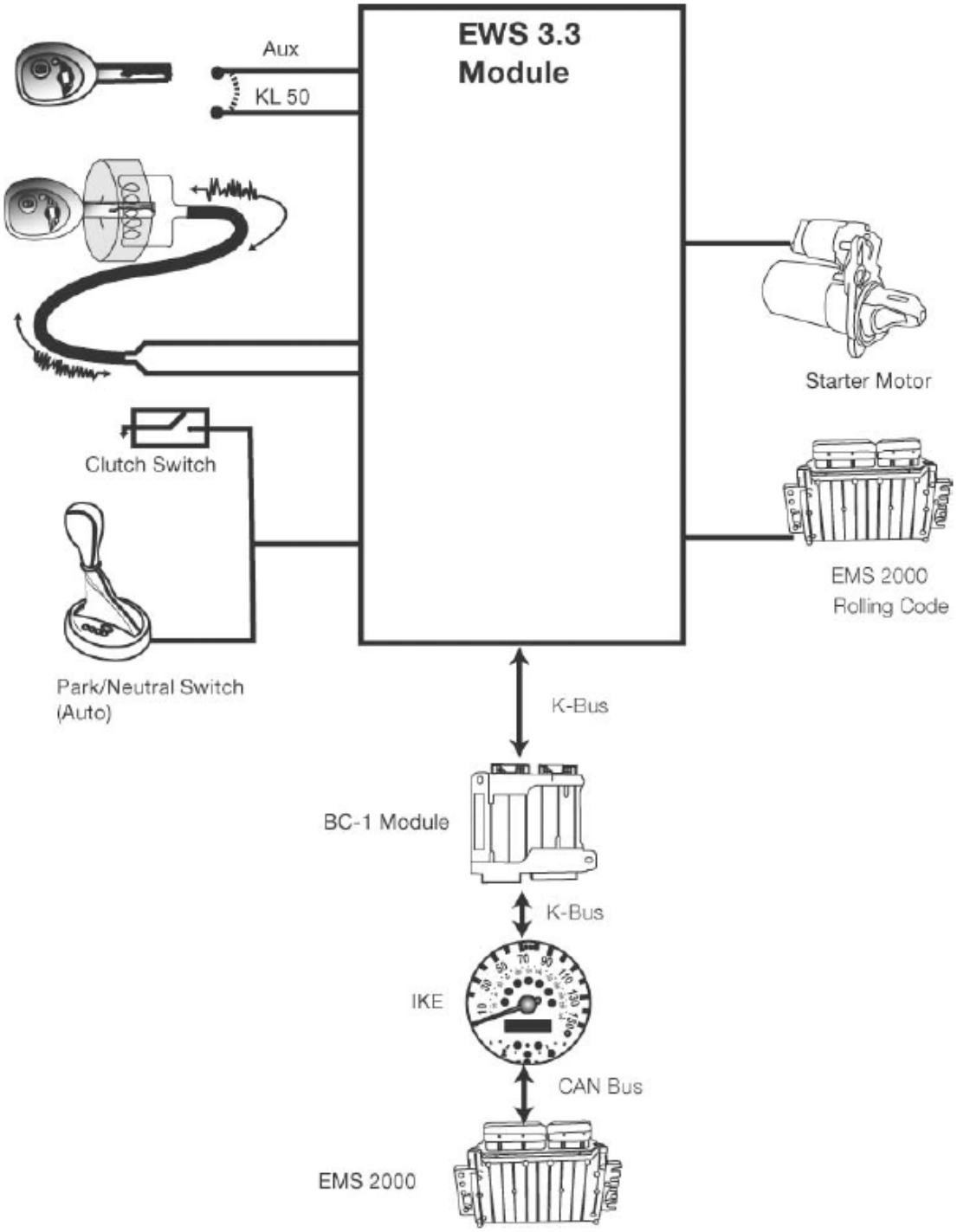


Fig. 42: EWS (Electronic Drive Away Protection)
Courtesy of BMW OF NORTH AMERICA, INC.

Purpose of the System

The purpose of the EWS system is to provide theft protection of the MINI.

The EWSIII 3.3 control module communicates with the EMS2000 and the transponder in the key and activates allows the vehicle to start.

System Components

Primary components of the EWSIII 3.3 system are:

- EWSIII 3.3 Control Module
- EMS2000
- Antenna Ring
- Key with Transponder

Additionally EWSIII 3.3 receives input from the Park/neutral or clutch switch, the BC1, the ignition switch and the EMS 2000.

EWS Control Module

The EWS Control Module is located on the left A-pillar under the dashboard. The EWS Control Module has a "Rolling Code" ISN assigned to it during manufacture. The "Rolling Code" is burned in the permanent memory of the module and can not be overwritten or changed.

The "Rolling Code" is transferred to the EMS2000 on a uni-directional signal line during start-up.

The EWSIII 3.3 module can accept up to 10 keys.

EMS2000

The EMS2000 control module will not activate injection or ignition is a valid rolling code ISN is not received. This allows us to provide an anti-theft system that will disable all major components of the vehicle:

- Ignition
- Injection
- Starter Motor

Antenna Ring

The Antenna Ring is used to power the key for communication with the EWS Control Module. The 125kHZ AM signal sent to the antenna ring, induces a voltage build up in the key coil and powers up the transponder. Data to and from the key is passed through the antenna ring.

Fig. 43: Antenna Ring
Courtesy of BMW OF NORTH AMERICA, INC.

The antenna ring is also used to charge the battery in the remote key.

Key with Transponder

The Key with Transponder contains a single 3 volt battery for remote functions. Battery operation is not required for key recognition. The Key Transponder communicates with the EWS control module, exchanging Password, Key Identification Information, and Changing Codes through the antenna ring.

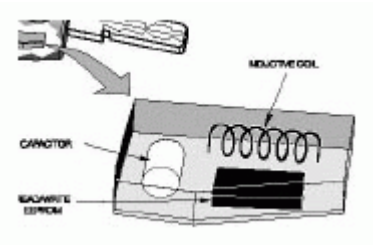


Fig. 44: Key With Transponder
Courtesy of BMW OF NORTH AMERICA, INC.

Principle of Operation

The starting sequence of the EWSIII 3.3 is as follows:

- The key is inserted into the lock cylinder and switched "ON". The EWS III (3.3) control module is powered through KL R and sends a 125kHz AM signal to the ring antenna. The AM signal induces voltage in the key coil and powers up the transponder.
- Powered up, the key transponder sends the key identification code to the EWSIII 3.3 module. The EWSIII 3.3 module verifies the key identification code and checks to see if the key is enabled. If the key is correct and enabled, a password is sent to the transponder over the 125kHz AM signal through the ring antenna.
- When the transponder accepts the password, it releases the changing code which it received from the EWSIII 3.3 module during the last start-up operation to the EWSIII 3.3 module via the ring antenna.
- The EWSIII 3.3 module compares the changing code received from the transponder with the code stored in its memory and if they match the process is allowed to continue. The EWSIII 3.3 module looks at the

other inputs for correct status (e.g. Code function not active, Transmission in P or N or clutch depressed, engine speed below specified RPM) and energizes the internal relay to begin starter operation.

- While energizing the internal starter relay, the EWSIII 3.3 module calculates a stored code from the "Rolling Code Table" and sends the calculated results to the EMS 2000.
- On receipt of the "Rolling Code" from the EWSIII 3.3 the EMS calculates it's own stored code and compares its results with the code it received from the EWSIII 3.3.

  If the "Codes" match the drive away protection is released and injection and ignition are enabled and the engine starts.

  If the "Codes" do NOT match, the EMS "rolls forward" to the next code according to the "Rolling Code Table" and makes the same calculations. The EMS continues this "forward roll" up to a maximum of 200 times or until a match is found. Failure to find a match will result in the engine cranking but not starting.

- When the ignition is switched off and no engine RPM is present in both the EMS and the control module each module will automatically "roll forward" to the next predetermined code based on the "Rolling Code Table". This new code is used for the next starting sequence.

Replacement Procedures

Keys

Up to 6 additional keys may be ordered as replacement keys. The EWS II control module is codeable for only 10 keys (4 delivered with vehicle and 6 replacement).

EWSIII 3.3 Control Module

Replacement EWSIII 3.3 Control Modules are ordered VIN specific. The module is received with the same "Rolling Code Table" as the original module. Once ZCS coded, the DISplus software "resets" the current rolling code in the EMS 2000 back to "Rolling Code" #1, providing synchronization of both modules.

EMS2000 Control Modules

Replacement EMS Control Modules are "off the shelf" and must be programmed for the specific vehicle. After programming the DISplus software informs the EWSIII 3.3 control module that a new EMS has been installed. The next time the ignition is switched on, the EWSIII 3.3 module will send the entire "Rolling Code Table" to the EMS and reset it to "Rolling Code" #1.

The EMS will automatically burn the "Rolling Code Table" into its memory. Once the table has been burned into the EMS memory it can NOT be changed. For this reason once a EMS is "Married" to the vehicle it will not work in any other vehicle.

Under certain conditions "Alignment" of the EMS and EWSIII 3.3 modules may still be necessary. The alignment procedure only resets the code table to code #1 it does not change the "Rolling Code Table".

Key Activation

Keys that are lost or stolen may be deactivated or made to not operate the starter functions. The SERVICE FUNCTIONS of the DISplus for EWSIII 3.3 contains a "bar/release code" function that activates and deactivates keys of the EWSIII 3.3. Any key may be "Barred" except the key in the ignition at the time of deactivation. The lost or stolen key can be identified by the identification of the remaining keys.

There is no limit to the number of times a key can be activated/deactivated.

SHD (SUNROOF)

The sunroof is available as an option and consists of a twin glass front and back panel. The front panel slides over the rear panel and tilts. The rear panel is fixed.

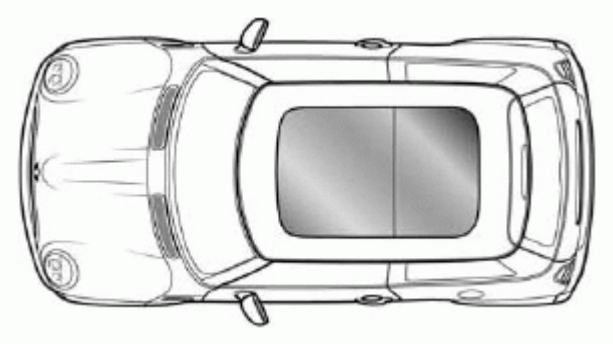


Fig. 45: SHD (Sunroof)
Courtesy of BMW OF NORTH AMERICA, INC.

Purpose of the System

The purpose of the Sunroof system is to provide opening and closing of the sunroof panel.

The Slide/Tilt sunroof system consists of the following components:

- Sunroof Switch
- Sunroof Motor with integrated Control Unit

System Components

Sunroof Switch

The sunroof switch is mounted in the roof headliner at the front of the car. The switch has double contacts: the first contact operates the roof all the time the switch is pressed; the second contact is for the one-touch functions of the roof.

Sunroof Switch

Fig. 46: Sunroof Switch
Courtesy of BMW OF NORTH AMERICA, INC.

Sunroof Switch Positions

- Open tilt - Manual/Automatic
- Open slide - Manual/Automatic
- Close tilt - Manual
- Close slide - Manual/Automatic

Sunroof Motor With Control Unit

The drive for the sunroof is provided by a motor which is controlled by the integrated control unit. This assembly is mounted in front of the roof area between the roof liner and the lower section of the sunroof frame.

The control unit has a 13-pin connector that provides the connection between the wiring harness, the switch and the K-bus.

Two sensors (Hall sensors) are integrated in the motor/control unit for position recognition. When the motor is running, the control unit continuously monitors the sensors.

Sunroof Motor/Control Unit

Fig. 47: Sunroof Motor With Control Unit
Courtesy of BMW OF NORTH AMERICA, INC.

Principle of Operation

Tilt

Pushing in the center of the sunroof switch causes the rear of the sunroof to tilt open. To close the sunroof press the switch in the close direction.

Conventional Operation

Pressing and holding the sunroof switch in the open/close position will cause the sunroof to operate in either direction and operation will continue until the switch is released or the sunroof has reached its travel limit.

One-Touch Operation

Pressing and quickly releasing the switch in the open/close direction will cause the sunroof to either open/close to its travel limit, except in the close direction where the sunroof will stop in the tilt position and manual operation of the switch is required to complete closing.

Convenience Open/Close

Turning the key in the drivers to lock to the lock/unlock position and holding will cause the sunroof to open/close. The operation will continue as long as the key is held in position. Convenience opening is also available through the Interior Central Lock Switch. Pressing and holding the switch in the unlock position will cause the sunroof to open. Opening will occur as long as the switch is pressed.

Sunroof Switch

The switch sends a ground signal to the sunroof control unit. The circuit is closed when the control unit is connected to the ground/earth.

A current of approx. 12 mA then flows to enable the switch to function.

Sunroof Motor With Control Module

The motor with integrated control module has diagnostic capabilities and connects to the K-bus. Two Hall sensors are used to detect the position of the roof and provide the anti-trap function. The protected area is from 200 mm open to 4 mm, if an obstruction is detected within this range the roof will reverse direction for approximately one second.

Initialization

After carrying out any repairs to the sunroof the module must be initialized, this is achieved by pressing and holding the switch in the tilt position for approximately 15 seconds. The roof moving from the raised position to the close position confirms the initialization procedure.

RDW (TIRE PRESSURE WARNING SYSTEM)

RDW is a system which alerts the driver to changes in tire air pressure by monitoring the rotational speed of the tires. RDW interfaces with the ABS/DSC system to receive wheel speed information. Only rotational speed is monitored, not tire pressure.

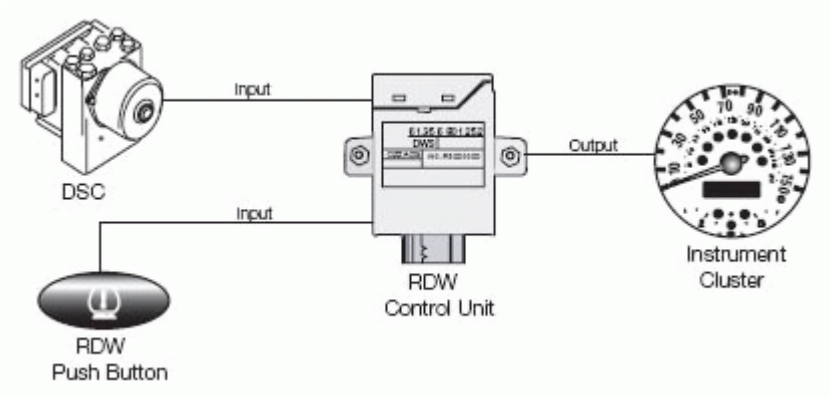


Fig. 48: RDW (Tire Pressure Warning System)
Courtesy of BMW OF NORTH AMERICA, INC.

Purpose of the System

The purpose of the RDW system is to warn drivers of potentially hazardous conditions caused by tire loss of air. Under-inflation is a tire's #1 Enemy. It results in unnecessary tire stress, irregular wear, loss of control and accidents. A tire can lose up to half of its air pressure and not appear to be flat.

Under inflated tires are major causes for blowouts. An under inflated tire runs hot due to the action of the tire as it rolls under the car. The sidewalls become squashed outward, and it is this movement that causes the tire to generate heat and fail.

The RDW system is not a substitute for regular checks of tire air pressure but rather a warning system for loss of air conditions that arise while driving.

The driver is responsible for ensuring that the tire pressure is set correctly. The system cannot perform a plausibility check on whether the tire pressure set is correct. It can only monitor the pressure set at the moment of initialization compared to the warning values stored in the control unit.

The correct cold pressure (= the normal pressure when the tire is cold) must be obtained from the owners handbook.

System Components

The RDW system components are:

- RDW Control Unit (As of 3/2002 the system is integrated in Traction Control Unit)
- RDW Push Button
- Display in IKE
- Wheel Speed Sensors (From ABS/DSC)

RDW Control Unit

The control unit is located in the right hand rear quarter panel.

The control units printed circuit board has an integrated processor. All system functions and interface functions (communication and diagnostics on bus network) are implemented in this processor.

RDW Control Unit

Fig. 49: RDW Control Unit
Courtesy of BMW OF NORTH AMERICA, INC.

RDW Push Button on Console

Fig. 50: RDW Push Button On Console
Courtesy of BMW OF NORTH AMERICA, INC.

RDW Push Button

The switch is installed in the center console. It is marked with its own symbol (a flat tire). The switch is required for the initialization procedure after adjusting the tire pressures. A switched ground signal advises the RDW control unit of a request for initialization.

RDW Display in IKE

On switching the ignition to position 2 the control unit performs a self test and the amber RDW warning LED illuminates. The LED will remain lit unless a 'system OK' message is received via the K-bus from the control unit.

In the event of low tire pressure being detected, the instrument cluster will provide an audible warning to the

driver and the RDW LED will flash.

Fig. 51: RDW Display In Speedometer
Courtesy of BMW OF NORTH AMERICA, INC.

Wheel Speed Sensors

The RDW system makes use of the wheel speed sensors of the ABS/DSC system. Wheel speed information is sent from the wheel speed sensors to the ABS/DSC control module and conditioned. This conditioned signal is sent to the RDW control module. The RDW receives conditioned wheel speed signals for all four wheels.

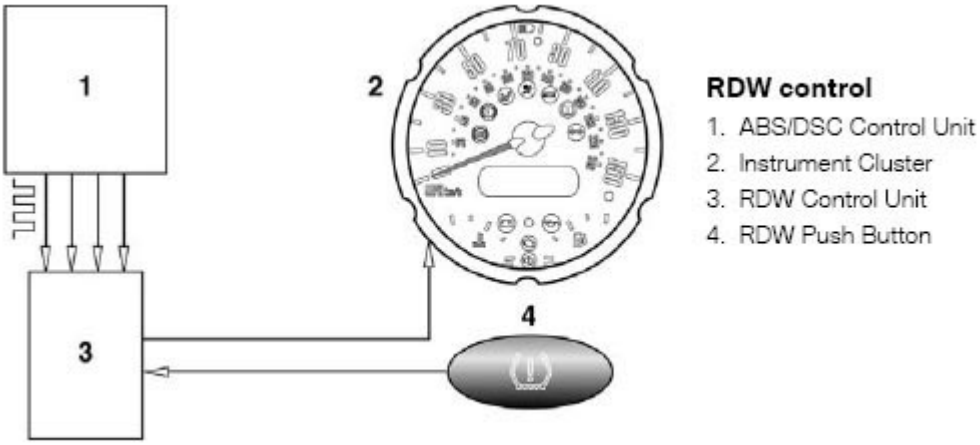


Fig. 52: Wheel Speed Sensors
Courtesy of BMW OF NORTH AMERICA, INC.

Principle of Operation

Primary to the driver receiving accurate tire defect information is the initialization of the system. Without proper and current initialization the system may issue false warnings or may fail to issue a warning when

necessary.

Initialization

The system must be initialized for the particular set of tires used and the cold pressure specified. This process is initiated manually using the RDW button.

Procedure: switch on ignition (engine off) and then press and hold the RDW switch for longer than 4 seconds. The control unit will then go into learn mode (initialization). The system then enters a learning phase. Due to the preset threshold values, this phase can last anywhere from 45 minutes to several hours depending on the driving style and number of data rejections.

The initialization routine can be interrupted as often as desired; interim results are stored in the control unit. The only way to verify if the system is fully initialized is via diagnosis requests using the DISPlus/GT1.

The system must be initialized if:

- The tire pressures are adjusted (must be set cold)
- The tire positions are altered (interchanged on the same axle or between axles)
- Tires are changed (new tires for old tires, summer tires for winter tires etc.)

False warnings may be given if initialization is not performed after pressures have been changed or a wheel/wheel position has been changed. False warnings may also be given if tires with large differences in the degree of ageing/wear are fitted on the same axle. When using a space saver spare tire the RDW cannot compensate for the difference in diameters of the wheels, in this case, initialization cannot be completed.

Detection

RDW compares the wheel speeds of diagonally-opposing wheels to calculate the average speed and thus detect if there has been a loss of pressure. Extreme driving situations such as heavy acceleration or rapid cornering are detected by the software and corrected.

Warnings

The following driving situations can cause a delayed warning of deflation:

- Hard Braking
- Hard Acceleration
- High Lateral Acceleration
- Tight Turning
- Driving Below a Minimum Speed
- High Slip Difference (on the same axle and/or on one side of the car)
- Incomplete Initialization

RDW can only detect differences in pressure between tires. Detection is not possible where two or more tires

lose air at the same rate. Pressure losses resulting from natural diffusion affecting all four tires equally cannot be detected.

Blow-outs cannot be detected.

RDW can detect a pressure loss on an individual wheel of 30% ± 10% of the pressure defined as the set point value at the time of initialization. This is generally the cold pressure recommended in the owners handbook.

Diagnostics

The RDW features full diagnostic capabilities. Diagnosis indicates how often and at what speed a fault has occurred. It also indicates whether initialization has taken place or not.

PDC (PARK DISTANCE CONTROL)

An active PDC system is used in the MINI. It features four sensors in the rear bumper with the control unit and acoustic transmitter located in the right side of the luggage compartment.

Purpose of the System

The PDC system assists the driver during parking maneuvers and helps to avoid damage to the MINI when parking in tight or awkward spaces.

Despite the PDC assessing obstructions it is still the responsibility of the driver to make proper decisions especially when detection of objects approaches the physical limits of the system.

System problems my occur even under optimum preconditions. It is possible that a nonexistent obstruction is signaled or an existing obstruction is not signalled.

System Components

The PDC system consists of:

- PDC Control Unit
- Active Ultrasonic Sensors (4)
- Audio Generator

PDC Sensors Mounted in Rear Bumper

1. PDC Active Ultrasonic Sensors x4.

Fig. 53: PDC Sensors Mounted In Rear Bumper
Courtesy of BMW OF NORTH AMERICA, INC.

PDC Control Unit

The control module is located in the rear right hand quarter panel. The control module is the microprocessor that controls and monitors all of the functions of the system.

The primary tasks of the control unit are:

PDC Control Module

Fig. 54: PDC Control Module
Courtesy of BMW OF NORTH AMERICA, INC.

- Actuation of the ultrasonic sensor and reception of the echo
- Monitoring the sensor for correct function

- Evaluation of the echo pulses received
- Interference suppression
- Actuation of the audio generator
- Monitoring the lead wire of the audio generator
- Evaluation and monitoring of the control inputs
- Monitoring the power supply
- Management of the diagnostics and test function
- Bus communication
- Control of the echo threshold values.

The PDC control module is linked via the K-bus with the other control modules connected to this bus.

Active Ultrasonic Sensors

By means of a digital signal, the ultrasonic converters are set by the control module to either a combined sending and reception operation or to a pure reception operation:

- In the combined operation, the converter first sends out a packet of ultrasonic pulses and then receives the echoes which are reflected by an obstruction within its reception range. These echo signals are amplified and compared with a threshold that is programmed specifically to the vehicle.
- In the area of pure reception, the converter receives the pulses that have been emitted by the adjacent converters of the same system.

By the evaluation of these signals in the control module, the location resolution and the physical shape of the obstruction are better recorded.

Audio Generator

The audio generator acoustically reports the distance to the obstruction to the driver and warns him/her of a potential problem.

Fig. 55: PDC Audio Generator
Courtesy of BMW OF NORTH AMERICA, INC.

Principle of Operation

With the ignition ON the microprocessor of the control module performs a self-test and checks the peripheral components for correct functioning. If the microprocessor does not recognize any faults, the system is operational after approximately one second.

After a successful self-test the PDC control unit is ready to function, and will be switched on when reverse gear is selected for longer than one second. The system is automatically deactivated when the transmission is taken out of reverse gear.

The microprocessor specifies the chronological time frame of the clearance measurements:

- PDC control unit transmits a "send" command via the signal lines to the sensors in accordance with a fixed specification.
- The sensors then send an ultrasonic oscillation packet.
- The echo, which has been reflected from an obstruction, strikes the sensor after a time period that is proportional to the clearance.
- The echo signals are amplified in the sensors and changed into digital signals. These signals are then sent back to the microprocessor in the PDC unit via the signal line.
- The echo transmission times are determined and the clearances of the individual sensors to the obstruction are calculated from this.

The quartz frequency of the microprocessor serves as the time basis for the measurement of the echo transmission time. The clearance between the converter and the obstruction is calculated from the transit time between the beginning of the transmission and the output of a low signal (echo reception). The position of the obstruction and the minimum clearance between the vehicle and the obstruction are derived from the calculated clearances of the individual converters and from the measured clearances by the 2 respective adjacent converters.

An acoustical warning is provided via the acoustical transmitter if the vehicle is in reverse gear and it approaches an obstruction to within 0.6 m for the outer sensors and 1.5 m for the center sensors. The clearance message consists of audio pulses with a duration of 75 ms. The pause between the audio pulses becomes shorter in proportion to the distance as it diminishes. Below the minimum clearance of 0.25 m, the audio sequence converts to a continuous tone. If the clearance to the obstruction remains constant, the center converter maintains the last actuated audio repetition frequency. For the outer converters, the clearance warning is switched off after 3 seconds in this event in order to indicate that the vehicle is moving next to a wall and not approaching an obstruction.

Diagnosis

Faults, which are determined, are filed in the fault memory and may be read out by means of the DISplus. The fault memory is formed by means of the EEPROM of the microprocessor so that the filed data is also maintained when the system is in an inactive status.

UGDO (UNIVERSAL GARAGE DOOR OPENER)

The integrated universal remote control replaces up to three hand held transmitters for various devices, (e.g. garage door/gate openers, alarm systems or house lighting systems). It recognizes and "learns" the signal transmitted by each individual original hand held transmitter.

The signal of an original hand held transmitter can be programmed to one of the three channel buttons. The device is operated with the programmed channel button. The integrated universal remote control uses radio frequencies only (not infrared). Transmission of the signal is indicated by the indicator LED.

Fig. 56: UGDO (Universal Garage Door Opener)
Courtesy of BMW OF NORTH AMERICA, INC.

Original Transmitter

If the symbol depicted to the right is on the packaging or in the instructions of the original hand held transmitter, it may be assumed that this original transmitter is compatible with the integrated universal remote control.

Fig. 57: Transmitter Symbol
Courtesy of BMW OF NORTH AMERICA, INC.

Check for Random Code

The instructions of the original hand held transmitter describe whether or not the original hand transmitter is equipped with a random code system.

Alternatively, a channel button can be programmed to carry out this check. Hold down the programmed channel button on the integrated universal remote control.

If the indicator lamp on the integrated universal remote control flashes quickly for two seconds and then stays on, this means that the original hand transmitter is equipped with a random code system and that the channel

buttons can be programmed accordingly.

NOTE: During the programming procedure and prior to remote activation of a programmed device it is important to ensure that no persons, animals or objects are located within the range of the device in question (e.g. garage door) as a precaution against injury. The safety precautions for the original hand transmitter must also be complied with.

Programming the Integrated Universal Remote Control

To program a channel button with the signal of the original hand transmitter, proceed as follows:

1. Ignition lock position (terminal 15).
2. For initial operation, proceed as follows: press the two outer buttons (1) until the indicator lamp (on the left of the program button) begins to flash, then release the buttons. The three channel buttons are cancelled.
3. Hold the original transmitter max. 5 cm (2in) away from the channel buttons.
4. At the same time, press the transmit button on the original transmitter and the desired channel button on the integrated universal remote control. Release both buttons when the indicator lamp begins to flash quickly.
5. To program additional transmitters, repeat steps 3 and 4.

Fig. 58: Channel And Transmit Buttons
Courtesy of BMW OF NORTH AMERICA, INC.

Programming a Random Code

To use the integrated universal remote control with a random code system, additional programming steps are necessary. A second person simplifies the programming procedure.

1. Program the integrated universal remote control as described previously.
2. Hold down the programming button on the device receiver for approx. two seconds until the programming lamps on the device come on.

3. Press the desired channel button on the integrated universal remote control three times.

Frequency Range

The system operates in the frequency bands 27-40 MHz and 433.2 MHz. Faults and malfunctions may be attributed to radio waves emitted by other transmitters at these frequencies.