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E60 General Vehicle Electrical Systems

Initial Print Date: 08/03 Revision Date: 10/03

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Model: E60

Production: Start of Production MY 2004

General Vehicle Electrical

Objectives:

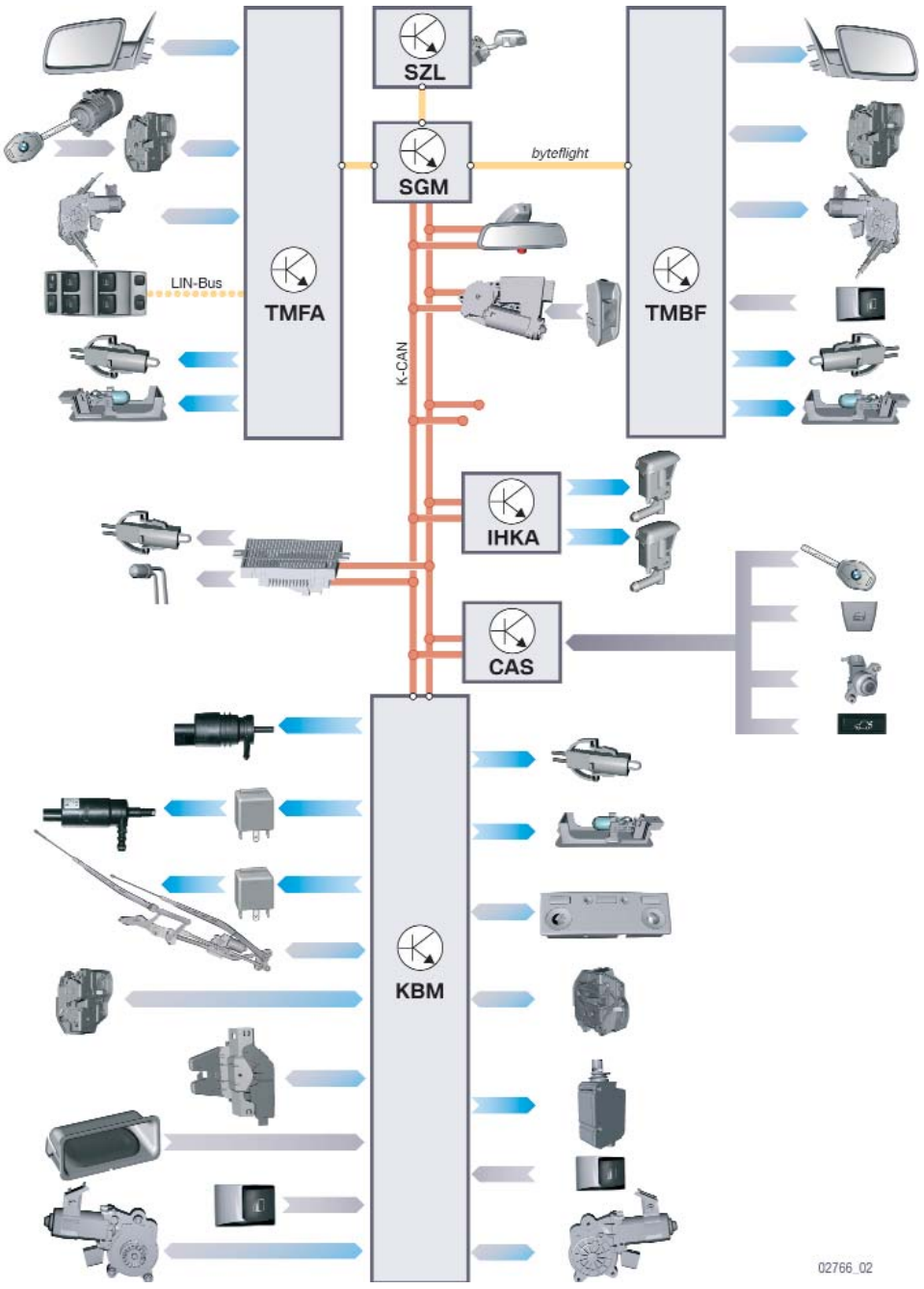
After completion of this module you will be able to:

- Locate electrical control modules in the car.
- Explain the operation of the electrical systems.
- Understand window standardization and initialization.
- Adjust wiper pressure.

General Vehicle Electrical Systems

Components and operation of the following electrical systems will be presented:

- KBM
- Central locking system
- Anti-theft alarm system
- Exterior lighting
- Interior lighting
- Power windows
- Wipe/wash system
- Park distance control
- AHL
- Roller sunblind
- Slide/tilt sunroof
- Car Access System
- Active cruise control



General Electrical New Features

KBM (Body Base Module)

The KBM controls the following functions:
- Rear Power Windows
- Central Locking (Rear Doors, Trunk/Tailgate and Fuel Filler Flap)
- Windshield Wiping/Wash System
- Interior Lighting
- Consumer Shutdown

Door Modules

The Door Module is integrated into the ASE. It communicates with other vehicle systems via the byteflight.
The Door Modules contain the following functions:
- Mirror Adjustment, Heating, Memory, Folding and Lighting
- Central Locking (Front Doors Only)
- Front Power Windows (with indirect anti-trapping)
- Connection to Driver's Door Switch Block
- Connection to Passenger's Door Power Window Switch)
- Door Entry Lights and Switch Illumination
- Recording of Front Door Pressure Sensor Information

CAS System

The Car Access System (CAS2) is based on the CAS of the E65, however in the E60 the ignitions starter switch and the CAS are two separate components. The E60 CAS is connected directly to the K-Bus and does not perform any repeater functions.

PDC

The signal from the PDC button is forwarded to the PDC Control Unit via the K-CAN.

RDW (FTM)

E60 uses RDW (FTM) for low tire warning. Information concerning low tire is based on wheel speed and is received from the DSC.

Roller Sunblind

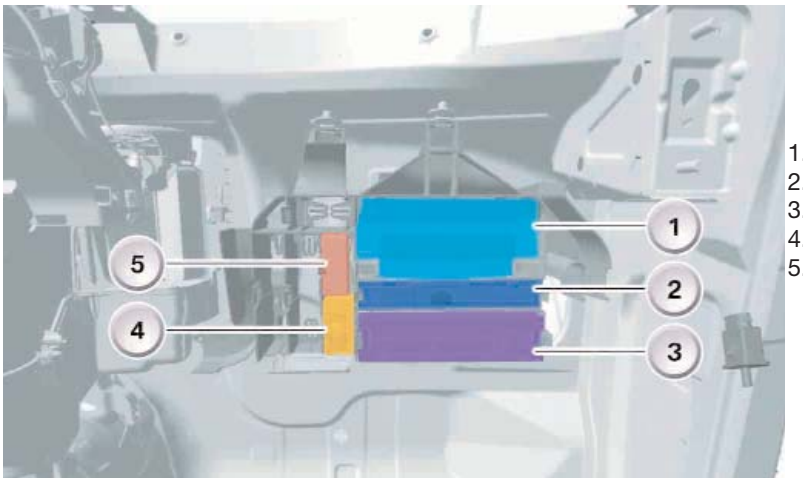
The rear window roller sunblind is controlled from the center console switch panel. The roller sunblinds for the side windows are manually operated.

Multifunction Seat

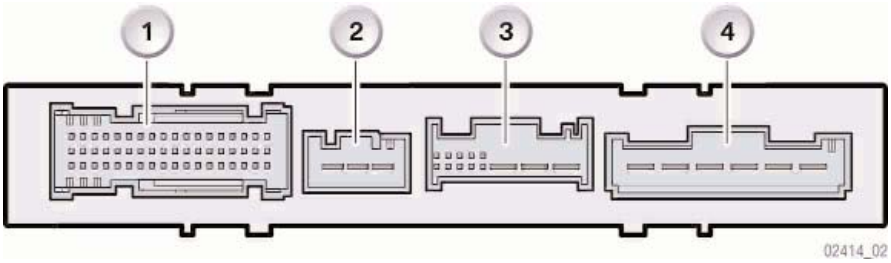
The multifunction seat makes it easier to get in and out of the vehicle. The backrest width and seat cushion depth are retracted for this purpose.

KBM

Located in the equipment frame at the glove box, the KBM has 4 electrical connectors



1. CDC (Compact Disc Changer)
2. KBM (Body Base Module)
3. SGM (Safety and Gateway Module)
4. AHL (Adaptive Headlights)
5. Not for USA.



1. X13252
2. X13254
3. X13253
4. X13255

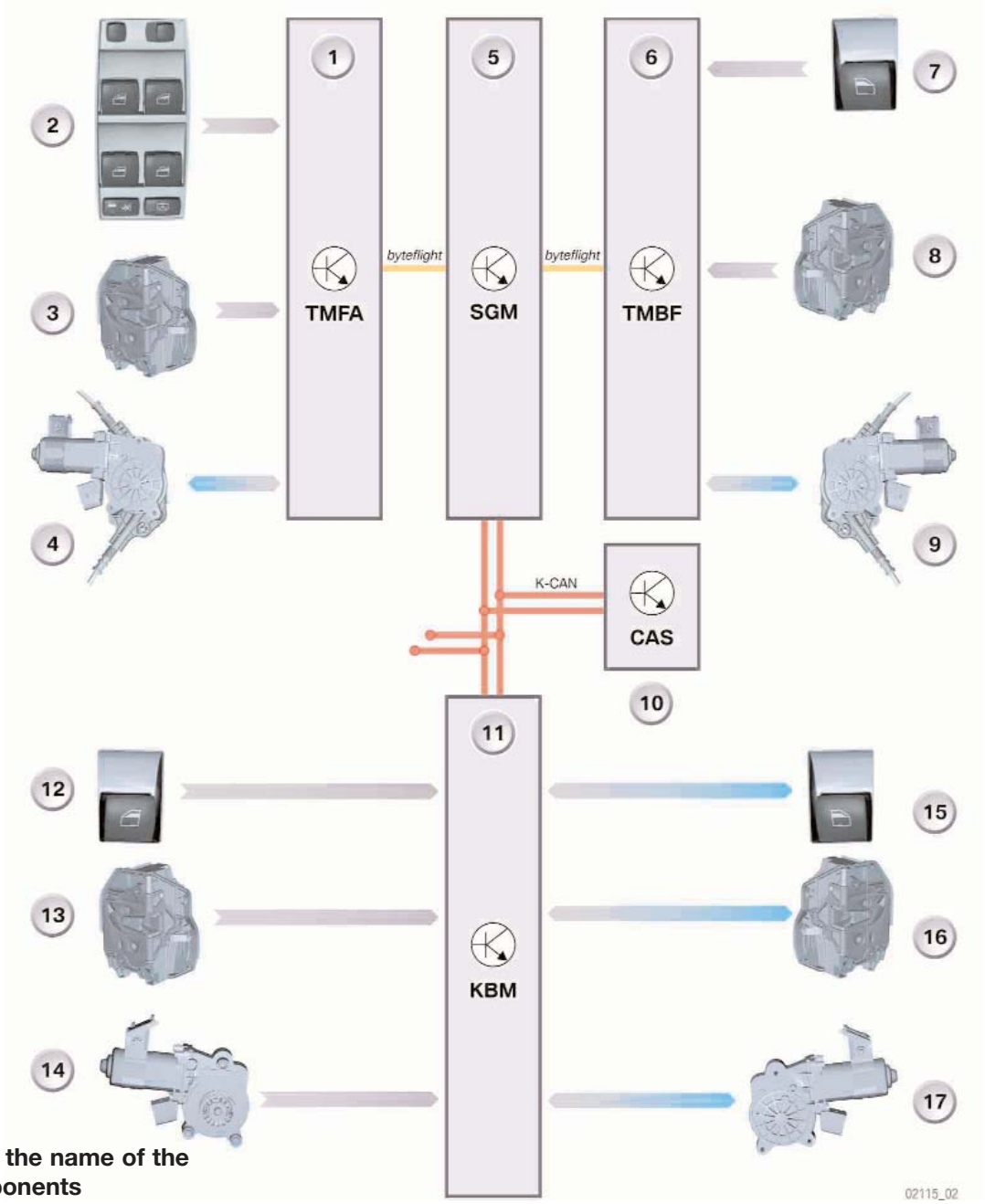
(X13252 54-pin, X13254 3-pin, X13253 13-pin, X13255 6-pin) and an operating voltage range of 9-16 Volts. The KBM is internally protected against shorts to terminal 30 or 31 and equipped with reverse polarity protection.

Power Windows

The front power windows are activated by the door modules of the respective door.

The rear power windows are activated by the basic body module KBM.

The power windows are operated as usual from the switch block in the driver's door (SBFA) and the switches in the other doors. Various safety functions and statutory requirements have been taken into consideration.

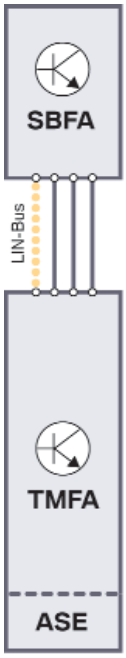


Fill in the name of the components

1.	**10.**
2.	**11.**
3.	**12.**
4.	**13.**
5.	**14.**
6.	**15.**
7.	**16.**
8.	**17.**
9.	

Components

- Switch block, SBFA
- LIN Bus
- Switches, passenger door, front/rear Doors
- Door modules, driver's door (TMFA)/passenger door (TMBF)
- ***byteflight***
- Safety and Gateway Module (SGM)
- Body controller area network (K-CAN)
- Basic body module (KBM)
- Power-window motors with incremental sensor
- Door contacts of all doors
- Car Access System (CAS)



Switch Block SBFA

All the windows may be operated from the SBFA. The Switch Block passes all window requests to the TMFA via the LIN Bus.

LIN Bus

The LIN Bus is a sub bus allowing communication between the TMFA and the SBFA.

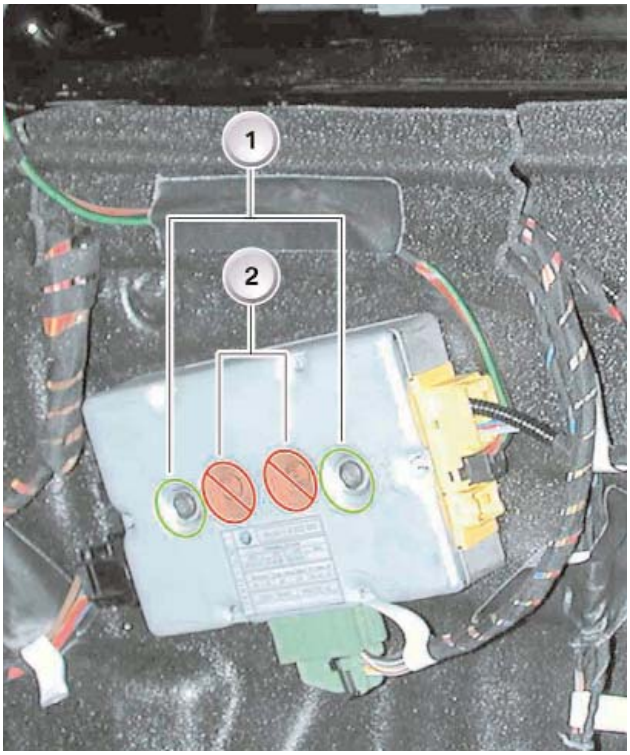
Door Modules

The door module contains separate "modules" for the door module electronics and the Advanced Safety Electronics.

The door module is the interface between:
- Switch block, driver's door
- Switch, passenger side
- Door contact
- Incremental sensor in power-window motor
- ***byteflight***
- Power-window motor

The driver's door switch block is linked to the driver's door module by means of an LIN bus. Control of mirror adjustment, heating and front area light is also integrated in the door modules.

The ASE system is integrated in the Door Modules. The door modules also incorporate the activation system for side air bag deployment.



Door side View of Door Module

1. Mounting Holes
2. Input Channel to pressure sensor
3. Connection for Switch Block
4. Connection for Power Supply
5. Connection for Input Signals
6. Connection for Exterior Mirror
7. Connection for ASE

Note:
When removing the door module, only unscrew the two outer screws(1). The inner screws(2) are exclusively for holding the door module housing together. Loosening the inner screws will cause operation of the door module to fail.

The door module is powered with 10 V from terminal 30. and with 10 V by the SGM. The 10 V supply is buffered for the function of the ASE system. When replacing the door module, bear in mind that the capacitor needs a few minutes to discharge. The airbag might be deployed if you replace the door module with the capacitor still charged.

byteflight

The ***byteflight*** bus system is involved in window operation as a method for door modules to communicate with the SGM.

SGM

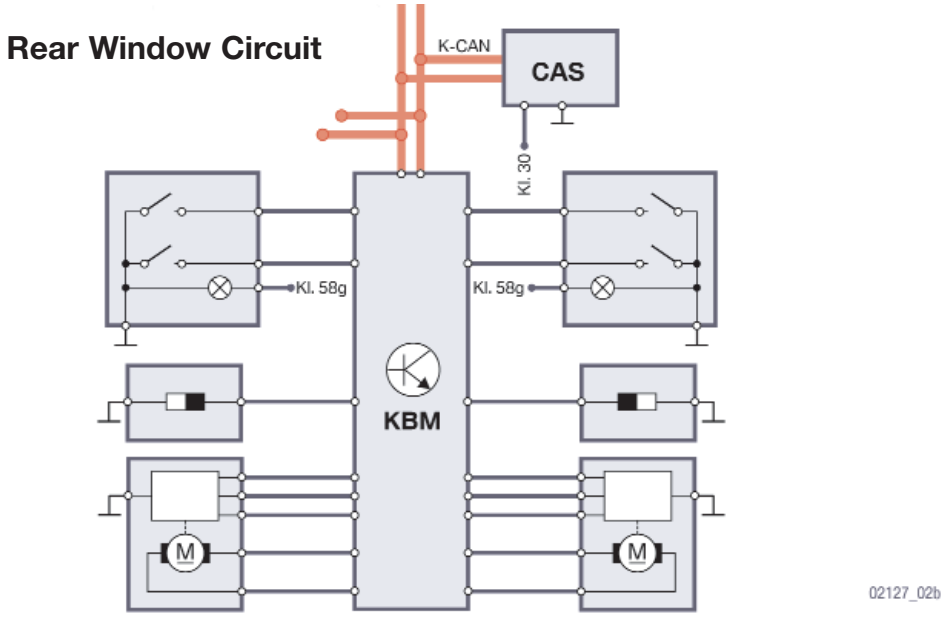
The SGM converts and forwards messages to/from the byteflight and K-Can.

K-CAN

The K-CAN provides a communication path between the SGM, the CAS and the KBM as well as body modules.

KBM

The KBM receives input from the rear door window switches and the rear door contact switches and provides output to the rear window motors. The KBM also monitors the incremental sensor (hall sensors) in the rear window motors for position, speed and rotation.
Additionally the KBM allows also for contact and control of the rear windows through CAN communication with the SGM.
The KBM provides both power and ground to the rear window motors.



Power Window Motors

The drive mechanism of a power window lift is a cable lift mechanism consisting of:

- A DC motor
- A reduction gear with incremental sensor (Hall sensor)
- Evaluation Circuit
- A shrouded connection

1. Power window system, front
2. Power window system, rear

The drive mechanism incorporates two Hall sensors, which are addressed by a magnet wheel mounted on the armature shaft.
The two Hall sensors and the magnet wheel determine with the aid of the door module or the KBM the direction of rotation, the speed and the position of the window.

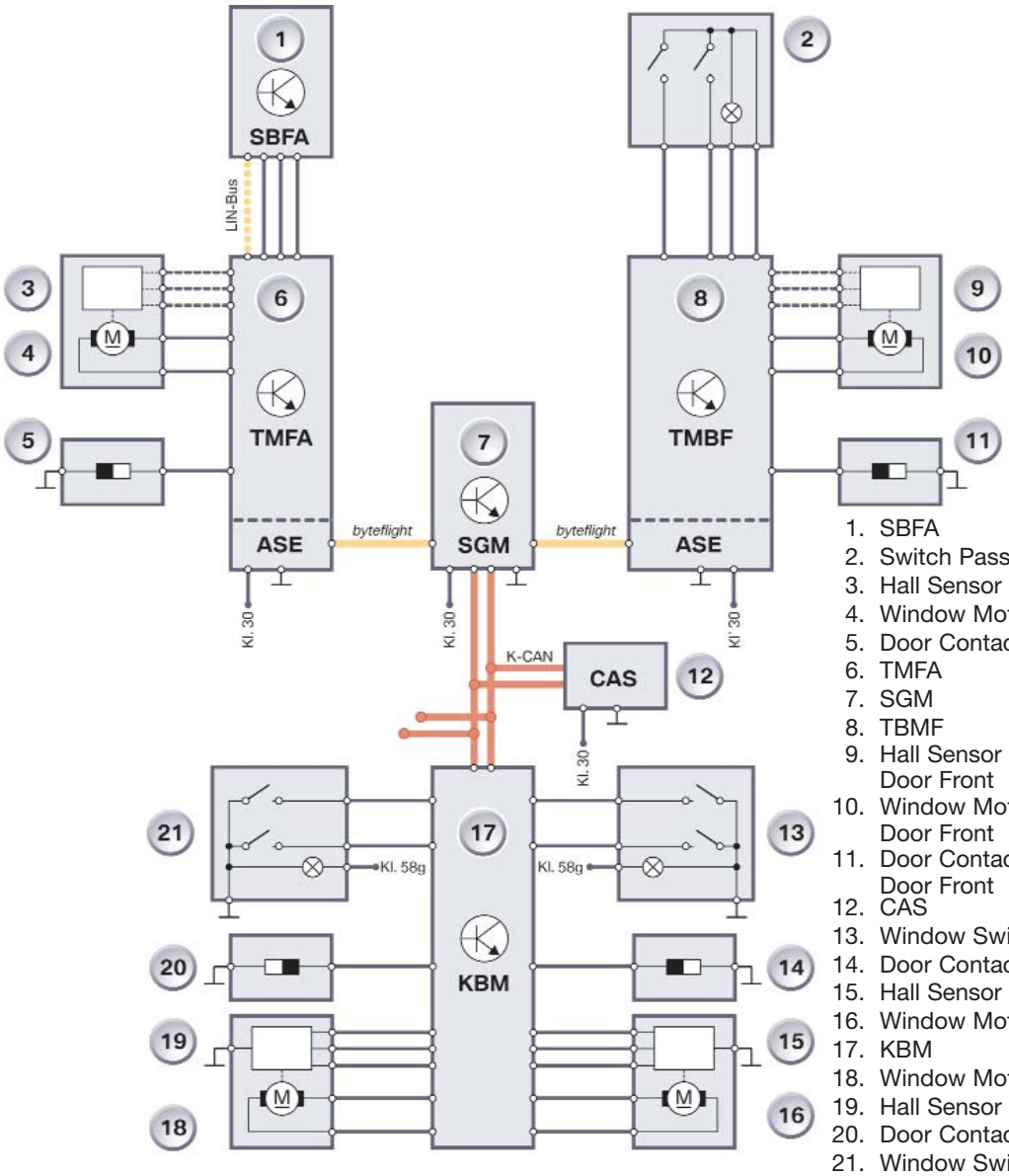
Door Contacts

The door contact switches, incorporated in the door latch mechanisms, provide door open/close data to the Door Modules/KBM.

CAS

The Car Access System control unit functions as the master for power window functions:

- Operation by radio remote control key
- Comfort functions (One-Touch)
- Central-locking interface
- Child lock
- Country-specific programming



1. SBFA
2. Switch Passenger Front
3. Hall Sensor Drivers Door
4. Window Motor Drivers Door
5. Door Contact Drivers Door
6. TMFA
7. SGM
8. TBMF
9. Hall Sensor Passenger Door Front
10. Window Motor Passenger Door Front
11. Door Contact Passenger Door Front
12. CAS
13. Window Switch R/R
14. Door Contact R/R
15. Hall Sensor R/R
16. Window Motor R/R
17. KBM
18. Window Motor L/R
19. Hall Sensor L/R
20. Door Contact L/R
21. Window Switch L/R

Operation

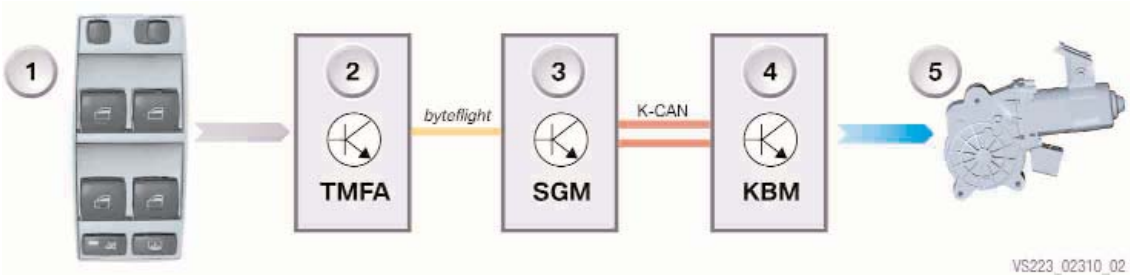
Opening of Passenger Front by Driver

The signal triggered in the SBFA when the button is pressed is sent via a LIN Bus to the TMFA. The TMFA sends the signal via the byteflight to the SGM.

The SGM converts the signal and sends it on the K-CAN to the CAS(the master for the front windows). The CAS evaluates the signal and sends a command to the SGM on the K-CAN. The SGM forward the command via the byteflight to the TMBF.

The TMBF receives the command for window movement, and a check signal from the Hall-sensor in the window motor and if necessary calculates indirect trapping protection. The window is then moved per the request.

Opening of Rear Window by Driver



Indirect Anti-Trapping

Anti-trapping protection is active over the entire window travel in the closing direction.
Indirect anti-trapping protection does not eliminate trapping completely but rather restricts it to a maximum permissible trapping force.

For each subsequent closing operation, the currently required closing force is determined and compared with the stored value. If the difference between the two force values is over the specified trigger threshold, the direction of window movement is reversed immediately. The reversing procedure is country- and function-dependent (emergency mode).

In order to ensure safe closing of the window glass, the drive mechanisms are briefly operated to their full extent when the zero position is reached at the upper stop.

Power-window anti-trapping protection has been developed in accordance with legal requirements in order to reliably prevent injury to vehicle occupants. When an object is detected in the path of the window, window travel is stopped and the window rolled down slightly.
Anti-trapping protection is deactivated by the emergency close function (panic mode). The control sequence is divided into two phases.

Phase 1:
The closing position is overpressed until the emergency close mode is activated after a specific response time. The window is closed at maximum speed and with increased anti-trapping protection force. Anti-trapping protection remains activated even during emergency closing. If trapping is detected, the window is reversed only a short distance.

Phase 2:
The button is released and overpulled again in 4 s. The window is now closed without anti-trapping protection with full force. In the event of blocking, the power-window motor is supplied with power until thermal protection is engaged.
In the event of faulty anti-trapping protection, there is the option of emergency-closing the windows.
If fully operational anti-trapping protection cannot be detected, e.g. faulty sensors, automatic operation is not permitted.

Power Detection

The system adapts itself to changes in the weather and environmental influences. The closing force is recorded by indirect sensors (Hall sensors) and limited accordingly.

Initialization of Power Windows

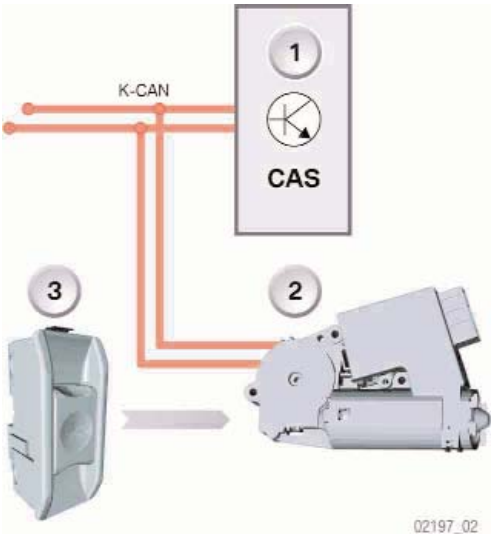
Front Windows	Rear Windows
On Initial start-up, only the upper window stop has to be learned. For this purpose the window must be held for 500ms at the upper stop position. ***Move window to full closed position and hold for at least 500ms.***	The rear windows must be initialized. During the initialization the end positions of the window travel are determined by limit runs into the upper window seal and to the lower window stop. ***Move window to full closed position and hold for at least 500ms.*** ***Move window to lower window stop and hold for 17 seconds.*** ***Move window to full closed and continue to hold the switch in the window closing direction.*** ***The Window will open the close to confirm proper initialization.*** ***Note: This procedure is the same as E65.***
Learns upper limit	**Learns speed, amperage and direction**

Workshop Exercise - Power Windows

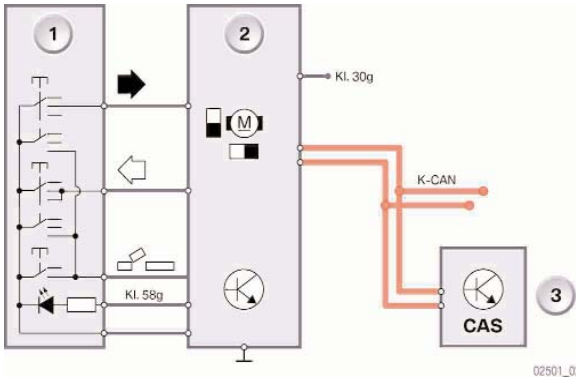
1. *Remove drivers side door panel.*
2. *Scope LIN Bus from switch assembly to door module.*
3. *What is the voltage range of the LIN Bus?* _____
4. *What happens when the LIN Bus is shorted to B+ or B-?* _____
5. *Perform Initialization on front windows.*
6. *Perform Initialization on rear windows.*
7. *Check the anti-trap feature on both the front and rear windows.*
8. *Is the anti-trap closing force approximately the same on both the front and rear?* _____
9. *Is the anti-trap closing force the same for the entire window travel?* _____
10. *Perform the anti-trap test again quickly after performing the test a first time.*
11. *Is the closing force the same as on the first test?* _____

Notes:

Slide/Tilt Sunroof



1. Car Access System (CAS)
2. Slide/tilt sunroof module with integrated electronics
3. Slide/tilt sunroof push-button



1. Slide/Tilt Sunroof Switch
2. Slide/tilt sunroof module with integrated electronics
3. CAS

Slide/Tilt Sunroof Push-Button

The push-button for the slide/tilt sunroof (SHD) switches to ground. The power supply of the push-button features polarity reversal protection and is disconnected from the power supply in the event of overvoltage and in sleep mode.

Slide/Tilt Sunroof Module

The SHD module controls and monitors the electric motor and therefore the movement of the slide/tilt sunroof. The commands the driver selects with the push-button are transferred directly to the slide/tilt sunroof module.
Communication with the vehicle is controlled via the K-CAN. The SHD module receives information relating to terminal 58g via the K-CAN from the light module. The SHD module controls the LEDs of the SHD push-button. Terminal 58g has a clock cycle of 200 Hz for the purpose of dimming the lighting.

Car Access System

The CAS contains the master function for auto-remote opening.

Functions

Panic Mode

Panic Mode is triggered by pressing and holding the SHD button in the 2nd notch position. With this function, the sunroof is closed without anti-trap or closing force limitation protection. Panic close is possible only at speeds under 16 km/h.

Emergency Operation

In Emergency Mode, the sunroof only moves for 750ms at a time. The emergency function is only available when the CAS has signaled the SHD control module, “Emergency Mode Enable”, via the K-CAN.
Emergency operation is active under the following conditions:

- Coding Invalid
- Defective Hall-sensor
- Initialization incomplete

If initialization is incomplete operation is permitted based on scaling or characteristic curves. With no scaling, movement is allowed only in the direction of the scaling position.
With no characteristic curve learned, movement is only is the closing direction.

Initialization

Initialization of the Sunroof is performed as follows:

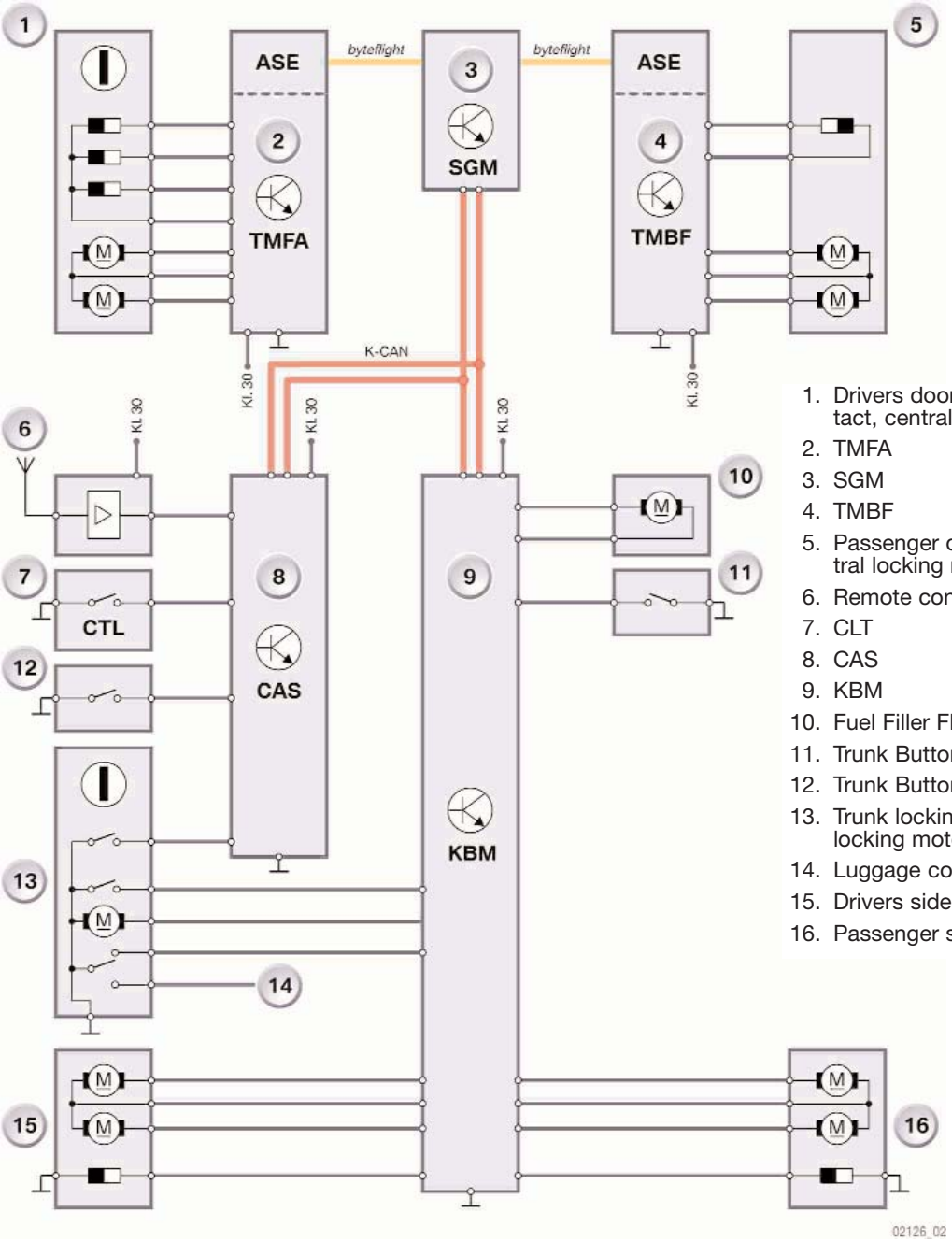
- Press the operating switch to the “Lift” position and hold.
- After 15 seconds, the sunroof will “Lift”. Continue to hold the switch.
- After approximately 5 seconds the sunroof will close. Continue to hold the switch.
- The sunroof will then open completely and close completely.
- If the switch is released at any time during the procedure the operation must be repeated.

Note:

Anti-trapping protection does not function during the initialization process.

Central Locking System

The central locking system ZV involves the actuation/evaluation of the doors, trunk and fuel filler flap. The central locking facilities of the doors are equipped with double lock functions and operate in accordance with the two-motor principle.
The door modules control the central locking facilities of the front doors. The basic body module controls the central locking in the rear area.



1. Drivers door lock cylinder, contact, central locking motors
2. TMFA
3. SGM
4. TMBF
5. Passenger door contact, central locking motors
6. Remote control
7. CLT
8. CAS
9. KBM
10. Fuel Filler Flap
11. Trunk Button, Exterior
12. Trunk Button, Interior
13. Trunk locking cylinder, central locking motor
14. Luggage compartment lighting
15. Drivers side, rear door
16. Passenger side, rear door

The central locking system consists of the following control points:
- Driver's door lock cylinder
- Center-lock button
- Remote control key
- Trunk lock cylinder

The system can be additionally unlocked via the crash sensor and forced release is possible by means of the "key inserted" signal in the CAS. A function is triggered when a status change at the respective input is detected. If several new ZV commands are given while a command is being carried out, only the last command will be subsequently executed.
The CAS is the central locking master and is responsible for enabling all central locking procedures in the vehicle.

The central locking can assume following statuses:

Status	Explanation
Unlocked	All locks are in the unlocked position. Outer and inner door handles are operational.
Selective Unlocked	The driver’s door is unlocked. All other locks are in the lock position.
Locked	All locks are in the lock position. Outer door handle not operational, inner door handle operational.
Secured	All locks are in the lock position. Outer and inner door handles are not operational.
Opened	At least one lock is in the unlocked position.

Secure Lock (Double Lock)

The secure lock function (locking of the vehicle from the outside using either the remote or the drivers door lock cylinder) uses a mechanical coupling to uncouple the locking pin of the door from the lock. The vehicle can then no longer be opened by the following actions:
- Pulling the locking buttons
- Pulling the inner door handle
- Pulling the outer door handle
- Pressing the center-lock button

Secure lock is only possible:
- At terminal R off and key not inserted
- After opening and closing the driver's door or Opening the passenger's door

No action takes place following the secure lock request when the driver's door is open.
A secure locked (secured) vehicle cannot be unlocked via diagnosis functions.
A secure locked (secured) vehicle can be changed to “Lock status” by pressing the center console lock button (CLT).

The vehicle lock status is changed from secure to unlocked when the CAS recognizes a valid transponder key has been inserted.

Automatic Locking

If the system is not yet locked or if a door was opened with the ZV locked, a lock command is executed on exceeding a speed of 16 km/h.

Crash Unlock

In the event of a crash, the safety and gateway module (SGM) releases the central locking system (ZV) via the bus network at terminal R or 15.
The ZV assumes "crash mode" even when the central locking was already unlocked.
Crash unlock is disabled when the vehicle status is secure lock.
Crash mode is released when an unlock/lock request is made. This corresponds to deactivation of crash mode.

Power on Status

The central locking status does not change by disconnecting and reconnecting the supply voltage. There is no reaction if command inputs are active while reconnecting the supply voltage (reset).

DWA - Central Lock Interface

The anti-theft alarm system DWA is not an integral part of the central locking system, however, it requires commands and signals from this system. The central locking system (ZV) monitors the status of the doors, hood,trunk, fuel filler flap and terminals. The DWA monitors the tilt alarm sensor NG as well as the ultrasonic interior protection system USIS.
The DWA is armed by means of any valid ZS command from an authorized control point or via the remote control. An LED provides an optical signal of the DWA status.
The tilt alarm sensor and interior protection are switched off if a ZS command is initiated within 3 s after initially arming the DWA.
The luggage compartment is accessible without triggering alarm even when the DWA is armed via the remote control. An alarm is triggered if the lock cylinder on the trunk is operated mechanically with the DWA armed.

Remote Control FBD

Evaluation of the logic remote control (FBD) signals is integrated in the CAS control unit. In addition to various other functions, the central locking functions that can be coded in the key memory can be selected "personalized" in the CAS control unit.
It is possible to actuate the central locking by means of a second remote control with the key inserted.

Different personalized functions can be selected depending on the type of remote control key used. The functions "selective ZV", "lock as from 16 km/h" as well as "lock after 2 min" can be coded in the CAS.
The remote control number identifies the key on which the "unlock" button was last pressed. Irrespective of this function, the currently used key is always identified as the control point in connection with the "unlock trunk" function.

Trunk Locking

The trunk can be unlocked and opened via:
- Radio remote control FBD
- External trunk button on boot lid handle
- Internal trunk button in driver's footwell
- Lock cylinder on trunk; purely mechanical

Hotel Setting

The hotel setting is initiated via the lock cylinder of the trunk. The following control points are deactivated when the hotel setting is initiated:
- Trunk button via remote control
- Exterior trunk button
- Interior trunk button

The trunk remains locked even when the vehicle is unlocked. The hotel setting is indicated to the customer by means of the switch position.
The push-button on the trunk is therefore only active when the vehicle is unlocked and stationary and not when the hotel setting is initiated.
The interior button is additionally active even when the vehicle is locked but only up to the specified speed threshold.
The system can always be unlocked via the remote control with the ignition key removed without the hotel setting engaged.

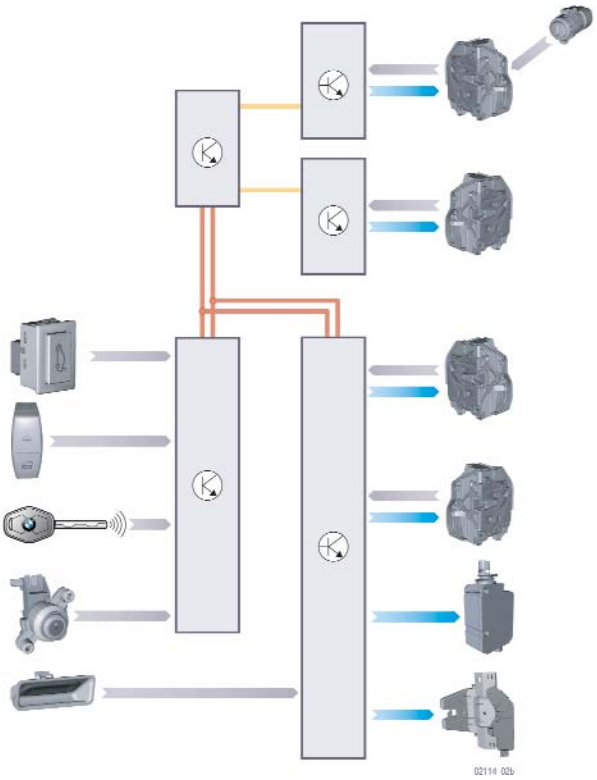
Automatic Relock

The central locking unlocks (selective or global, corresponding to coding) when a release command is triggered inadvertently via the remote control. If no door or hood/trunk is opened within 2 min, the central locking reassumes the locked status in connection with the coding "automatic relock."

Car & Key Memory

The central individualization elements are the coding data of the vehicle. Certain codeable functions are enabled for the car memory as part of the individualization procedure.
In connection with the personalization, individual functions depending on the vehicle key, maximum 4, used to unlock the system, are also controlled for the central locking. Otherwise the central locking operates in accordance with the coded basic setting.

The central locking functions therefore depend on the personalization of the 4 vehicle keys and on the standard coding for the vehicle.



Codeable Key Memory Functions:

Coding	Description
Automatic relock	Relock after 2 min
Speed Lock	Lock from 16 km/h
Selective unlock	Only the drivers door is unlocked

Codeable Car Memory Functions:

Coding	Description
Terminal R prohibits Trunk operation	The trunk is not opened when terminal R is engaged
Unlock on removing Key	The vehicle unlocks after the key is removed IF the system was locked via the speed lock or terminal R Lock.
Cross over operation disabled	A vehicle locked via the remote can not be unlocked with the key.

Wipe/Wash System

The wipe/wash system is a conventional wipe/wash system with reset contact. All wipe/wash functions can be activated with the wiper switch once terminal R is on. The wipe/wash functions are controlled as a function of vehicle speed.

The rain and light sensor is fitted as standard.

To reduce noise and wear, the load circuit of the wiper motor has been designed as an external double relay. A power semiconductor is integrated in the body base module (KBM) for the washer fluid pump.

Headlight Cleaning System (SRA)

The headlight wipe/wash function is controlled by the KBM.

Rain and Light Sensor

If the rain and light sensor should fail or be faulty, the KBM will take control. The KBM will switch to an emergency mode. Emergency mode is a speed-dependent intermittent mode.

Safety and Gateway Module

The SGM switches the wiper switch signal from the byteflight to the K-CAN.

Body Base Module

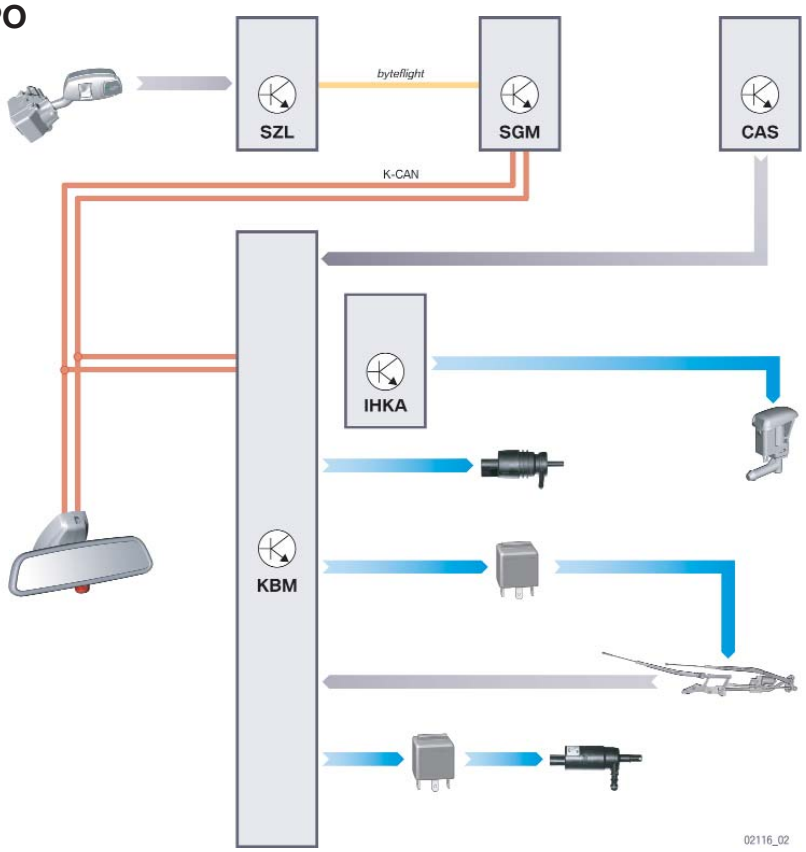
The body base module receives all the information that is required for operation of the wipe/wash system.
The body base module activates the following components:

- Dual relay module for the wiper motor
- Relay for the headlight cleaning system
- Washer fluid pump

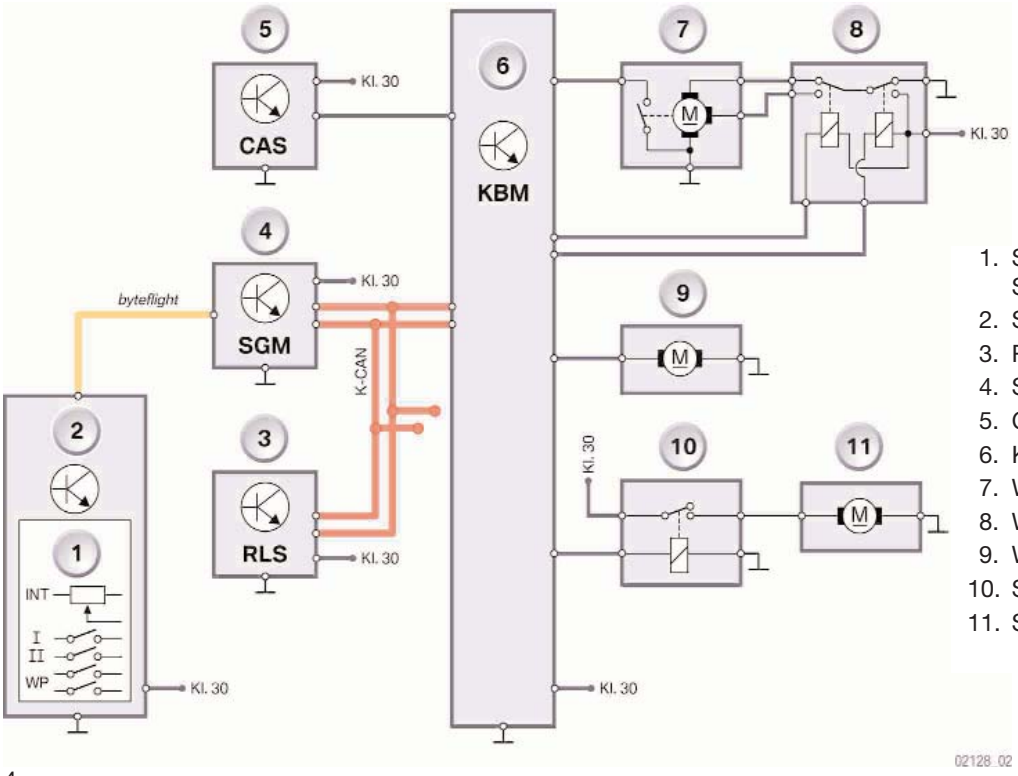
Washer Nozzle Heating

The IHKA activates the heated jets.

Wiper IPO



Wiper Schematic



1. SteeringColumn Switch
2. SZL
3. RLS
4. SGM
5. CAS
6. KBM
7. Wiper Motor
8. Wipe/Wash Relay
9. Washer Fluid Pump
10. SRA Relay
11. SRA Pump

Workshop Exercise - Wipers

1. *Find and print the Repair Instructions for windshield wiper adjustment.*
2. *List the special tools required to perform the adjustment.*

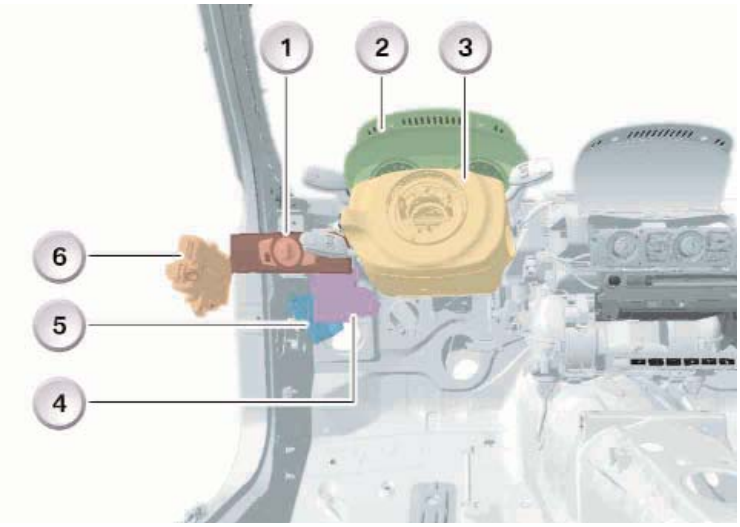
3. *Adjust the wiper arms per the instructions.*
4. *Observe new style wiper blades.*

Notes:

Car Access System

The CAS of the E60 is based on the CAS of the E65. The internal designation is CAS 2. The following changes have been made compared with the CAS of the E65:

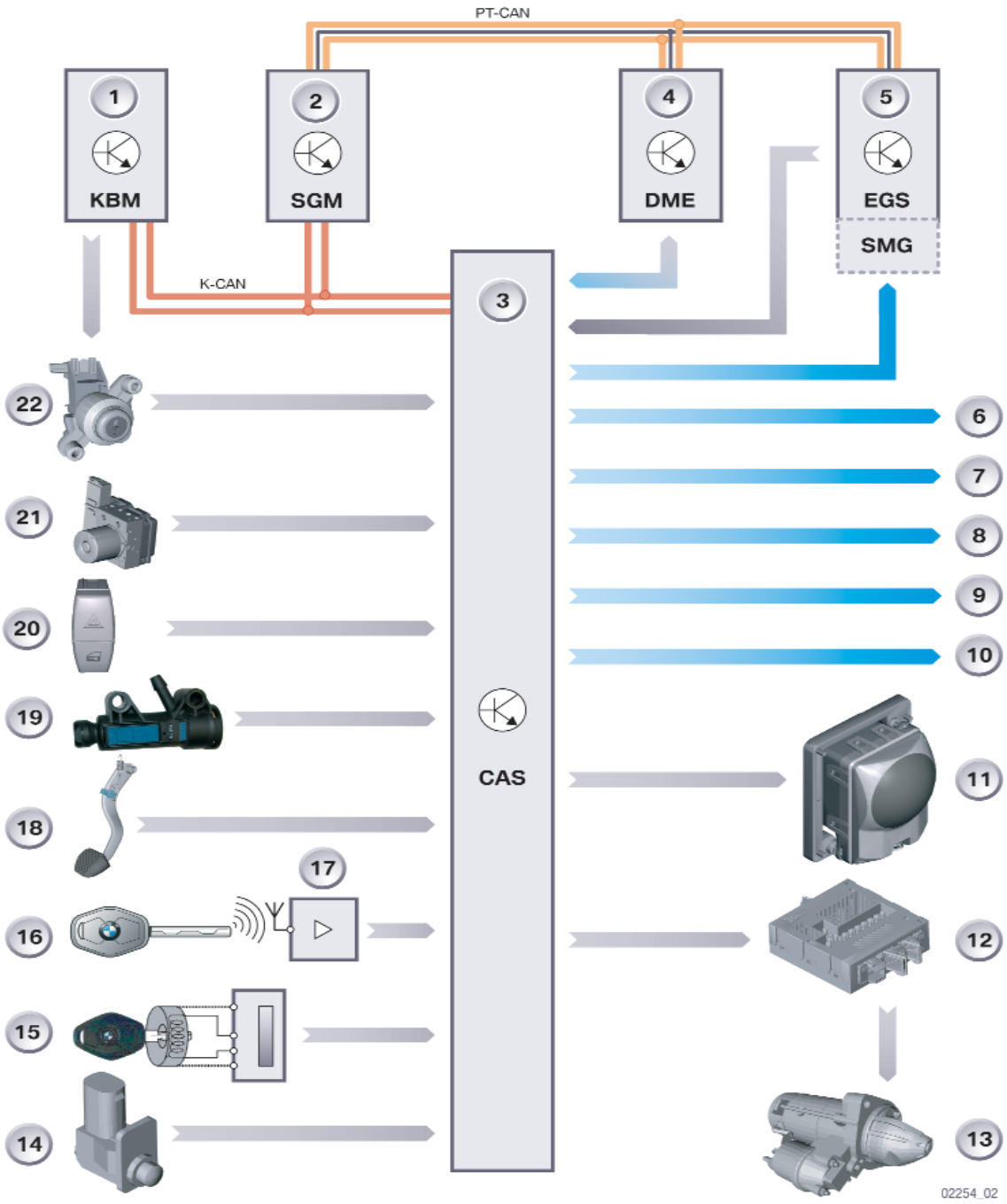
- Direct connection to the K-CAN
- Repeater function has been omitted
- Ignition starter switch and the CAS are 2 separate components
- Data transfer as part of the Condition Based Service



1. Light Switch with Control Panel
2. Instrument Cluster
3. SZL
4. CAS
5. Light Module
6. TMFA

The CAS includes the following functions:

- Reading in ignition starter switch (ZAS)
- Transponder authentication
- Terminal control
- Electronic immobilizer
  enable to injection system
- Master function for central locking system (ZV)
- Master function for power windows (FH) and slide/tilt sunroof (SHD)
- Remote control services (FBD)
- Internal CAS functions
  - Wake-up signals
  - Sleep signals
- Vehicle functions
  - Personalization
  - Auto encoding of vehicle model/transmitter
  - Vehicle order
  - Total distance recorder
  - Condition Based Service CBS
  - Voltage supply, brake-light switch



1. KBM
2. SGM
3. CAS
4. DME
5. EGS/SMG
6. Output EWS
7. Output Terminal R
8. Output Terminal 15 Wake up
9. Output Terminal 15-1 to 15-3
10. Output Terminal 30g Relay
11. ACC Wake up line 15WUP_RS
12. Integrated Power Supply Module
13. Starter
14. Hood Contact
15. Ignition/Starter Switch
16. Remote
17. Radio Receiver
18. Brake Light Switch
19. Clutch Switch Module
20. Centerlock Button
21. DSC
22. Trunk Lock Cylinder

Workshop Exercise - CAS

Vehicle is brought into the shop with a complaint of no start.

1. *Verify the complaint.*

2. *Does the engine crank?* _____

3. *Is the key recognized?* _____
   What is the quickest way to confirm that the key has been recognized? _____
   Where could you find that information in the DISplus or GT1? _____

4. *Are there any relevant fault codes stored?* _____

5. *What pin at the CAS provides the EWS release to the DME?* _____
   Check this signal at the DME.

6. *Continue to Diagnose this problem.*

7. *Repair the fault.*

8. *What pin at the CAS provides the KL50E signal to the DME?* _____

9. *What kind of signal is this? (High/low, PWM, Analog...)* _____

10. *What pin of the CAS controls the 30g Relay?* _____
    Is this B+ or B- control of the relay? _____

11. *What pin of the CAS provides power to the brake light switch?* _____

12. *What pin of the CAS provides power to the OC3 Mat?* _____

Condition Based Service

The data for Condition Based Service (CBS) is updated during each journey. The fault memory data is also updated during each journey. The conditions for this are:

- Activation of terminal 15, speed exceeded 50 km/h and speed dropped below 30km/h
- The data is updated after a distance of 10 km has been covered and after speed has dropped below 30 km/h

Manual Update of CBS Data

The procedure for transferring current data to the key during servicing is as follows:

- Insert key in ignition and turn to position "R"
- Press and hold Centerlock button
- After 15 s the CBS data will have been transferred to the key
- Read out the key

Manual Update of Fault Memory Data

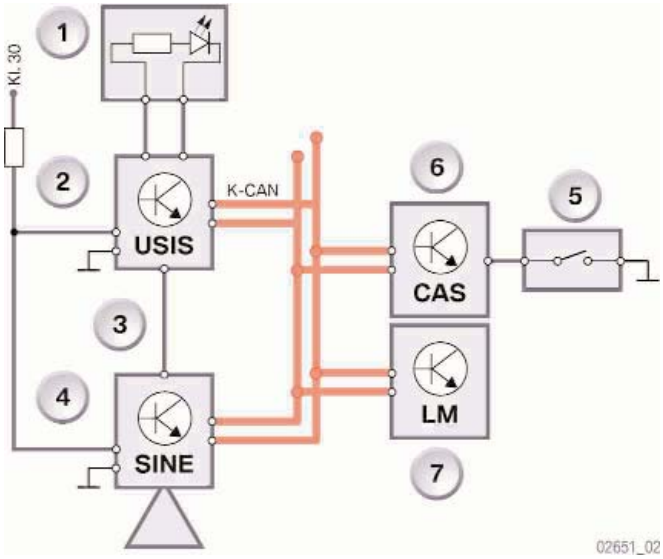
- Press and hold Centerlock button
- Insert key in ignition
- Turn key from position "0" to position "R"
- After 15 s, the fault memory data will have been transferred to the key
- Read out the key

Notes:

Antitheft Alarm System

The alarm system detects and warns of any attempts to break in or tamper with the vehicle.

The DWA comprises the following components:
- Interior sensor with integrated DWA logic
- Emergency siren with integrated tilt sensor
- DWA LED
- Door, Trunk and Hood Switches (fed via K-CAN)
- Car Access System (CAS)
- Light module (LM)
- K-CAN
- Local DWA bus line leading to emergency siren.



1. DWA LED
2. Interior Motion Sensor (USIS)
3. DWA Bus
4. Siren with integrated Tilt Sensor
5. Hood Contact
6. CAS
7. Light Module

System Functions

The following are monitored:
- Doors
- Hood
- Trunk
- Vehicle interior
- Vehicle inclination
- DWA bus line to the emergency siren
- Voltage supply for vehicle electrical system
- Voltage level at the emergency siren

To prevent false alarms, the sensitivity of the DWA can be adapted. For this purpose, the following vehicle conditions are evaluated:
- Status of auxiliary ventilation
- Position of power windows
- Position of slide/tilt sunroof

The alarm system sends the following status messages:
- System status via the DWA LED in the passenger compartment
- Visual arm/disarm via hazard warning lights
- Audible arm/disarm via an acknowledgement signal from the emergency sirenElectrical/

The alarm system outputs the following alarms:
- Audible alarm via emergency siren
- Visual alarm via hazard warning lights, dipped headlights, main beam headlights

Independent Voltage Supply

Thanks to the independent voltage supply, the emergency siren can issue an alarm even when the vehicle voltage supply is disconnected. The independent voltage supply is provided by Li cells. The Li cells are not rechargeable. The status of the batteries can be read out via the diagnostics system.

System Operation

Monitoring of the Vehicle Battery
The emergency siren detects:
- A drop in voltage from the vehicle battery due to a break in the wiring
- A voltage > 17 V
- A voltage drop from a value of 7.5 V to 6.5 V in less than 40 mins

The emergency siren monitors the B+, GND and DWA bus connection leads. If these leads are cut through, the independent alarm will be issued immediately.

In accordance with ECE regulations, the emergency siren will not issue an alarm if, as a result of the vehicle being immobile for a long time, the battery is being continually discharged and the vehicle electrical system voltage drops by 0.5 V/h to 3 V in the process.

System Power-Down for Storage
If the emergency siren is disarmed and without an external power supply, the batteries switch to a low power status. Current consumption is then a maximum of 25 µA.
The electronics return the emergency siren to its normal operating status when the vehicle battery is reconnected.

Reverse Polarity Detection
The reverse polarity detection system detects reverse polarity in the event of the vehicle being jump-started and stores this in its information memory.

Tilt Sensor
The tilt sensor monitors the position of the vehicle. It detects and warns of any attempt to steal the tires and wheels or to tow the vehicle away.
The tilt sensor is integrated in the emergency siren. The tilt sensor is triggered and evaluated by the microprocessor used in the emergency siren. The tilt sensor has diagnostic capability.

DWA LED

As before, the DWA LED is activated directly by the DWA (positive switching).

DWA Bus

The DWA bus is a local sub bus with K bus specification. The DWA communicates with the emergency siren and the tilt sensor via the DWA bus.

DWA Arming Sequence

Immediately after arming the emergency siren is armed and monitors its voltage supply. The DWA commences line monitoring on the local DWA bus.

3 s after arming each of the door and tailgate contacts to be monitored is included in the alarm table. Faulty contacts are evaluated as closed, but are not included in the alarm table. The tyre pressure monitoring system is included in the alarm table.

3 s after centrally locking the vehicle or after locking the last door or tailgate the referencing phase of the tilt sensor commences. During this period, the ultrasonic sensors are verified for signal plausibility. The sensitivity level is set in accordance with the window and slide/tilt sunroof positions.

30 s after locking the last door or tailgate the tilt sensor is included in the alarm table upon expiration of its referencing period.

If no acknowledgement message is received from the tilt sensor within 60 s of arming, this sensor is deleted. If at least one input signal is not in idle state or if a sensor is defective, this is signalled by the flashing LED.
If the emergency siren does not acknowledge the "arm" command, this is also indicated by the LED.

CAS Authentication to Prevent Tampering

To prevent the DWA from being easily disarmed by the central locking and tailgate status message "Central locking control" using a CAN tool, the CAS authenticates itself with the DWA.
Each time an unlocked vehicle is locked for the first time, the CAS sends an authentication to the DWA. Any further "locking" signals are then no longer accepted.
When the system is disarmed, the DWA expects the CAS to again send authentication with the first locking operation.
The system permits two disarming attempts with the wrong authentication, after which an alarm is issued.

Forced Disarming

The DWA is forcibly disarmed if a person located in the vehicle centrally locks the vehicle and then inserts the key into the ignition. The CAS evaluates this action and transmits a "locked" message. The DWA is thus disarmed.

Deletion of Cross-Wise Operation

Where cross-wise operation is deleted, the alarm is triggered if the DWA is armed by the remote control and disarmed by the door lock. This occurs because, even though the CAS recognizes when the lock is unlocked, it does not transfer the signal to the K-CAN. The DWA therefore remains armed and triggers the alarm when the door is opened. This function is encoded in the CAS.

Bus Monitoring

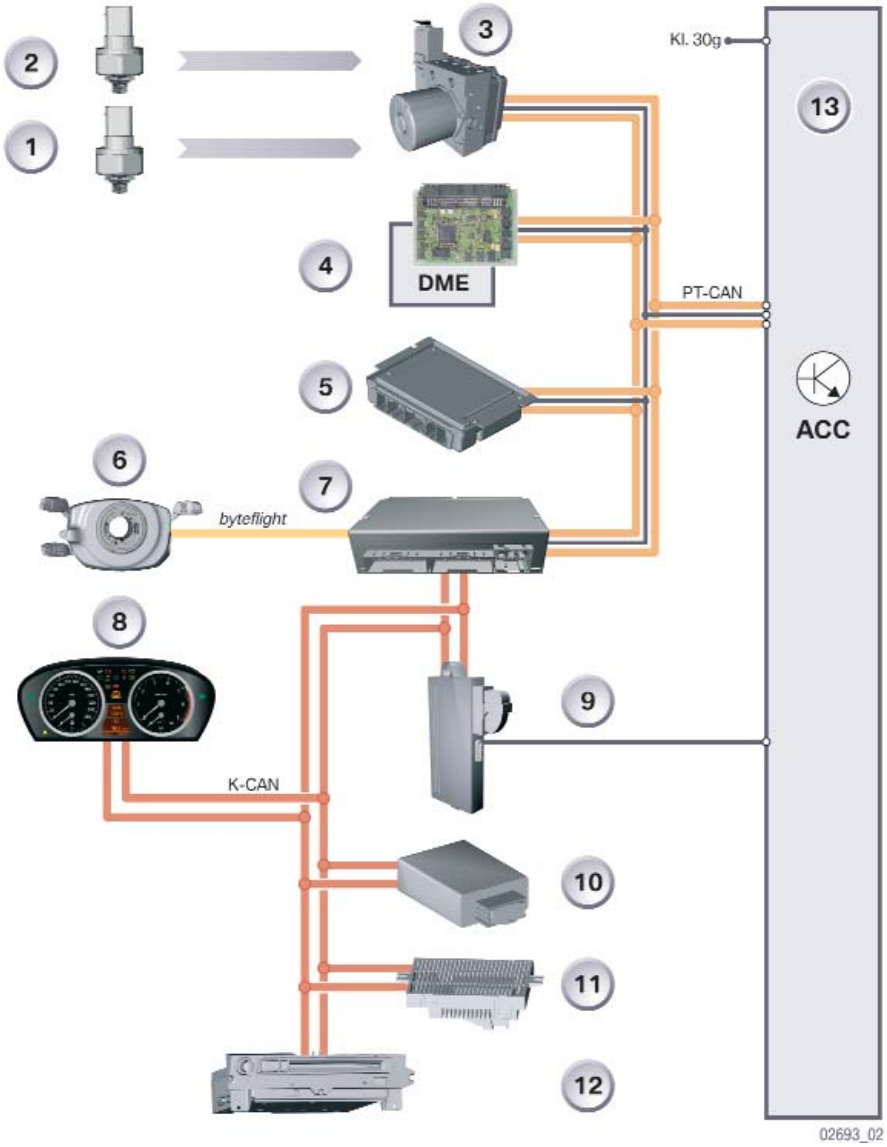
If the DWA detects messages on the local DWA bus that indicate attempts to disarm or tamper with the emergency siren or the tilt sensor, an alarm will be triggered.

Park Distance Control PDC

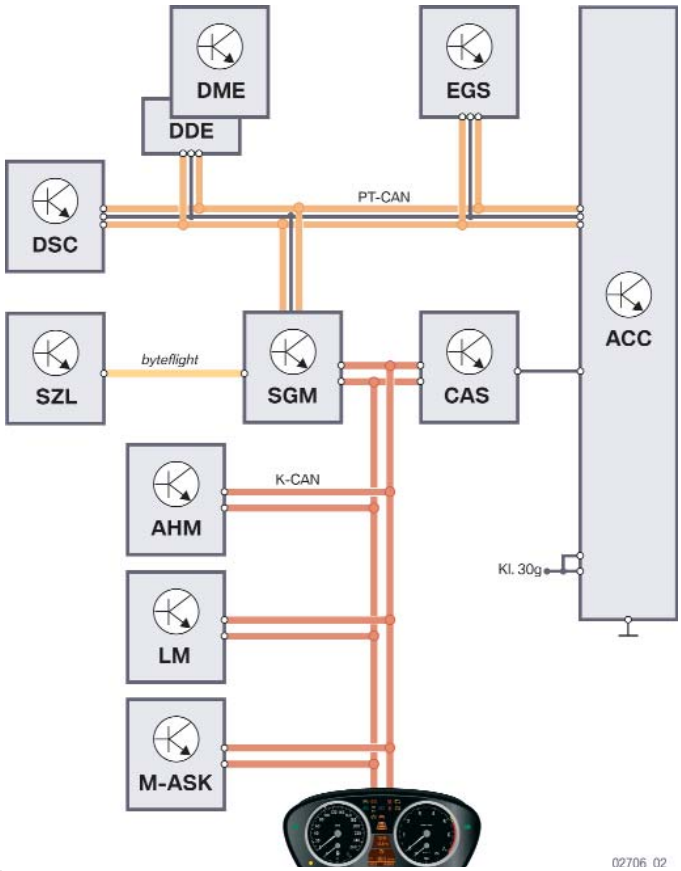
The E60 is equipped with the 8-channel PDC system already known from the E65. The PDC button is integrated in the center console switch center SZM. In the E60 the button signal is forwarded via the K-CAN to the PDC control unit.
The PDC sensors for front and rear introduced in the E65 are used as sensors here.
For a manual gearbox, the signal for reverse gear is made available by the light module by way of a K-CAN message.
For an automatic gearbox, the signal for reverse gear is made available by the transmission control unit by way of a K-CAN message.

Active Cruise Control

The Active Cruise Control system (ACC) is the same as that in the E65.
The ACC has the following defining properties:
- Operated from a steering column stalk
- Statuses are shown in the instrument cluster display
- Four selectable increment stages
- Speed preselection in 1 km/h stages
- Sheet steel bracket in the E60 with plastic intermediate holder for the sensor control unit
- Audible instructions to the driver have been omitted



1. Rear Brake Pressure Sensor
2. Front Brake Pressure Sensor
3. DSC
4. DME
5. EGS
6. SZL
7. SGM
8. Instrument Cluster
9. CAS
10. Trailer Module (Not for U.S.)
11. Light Module
12. M-ASK
13. ACC Control Unit



Exterior Lights

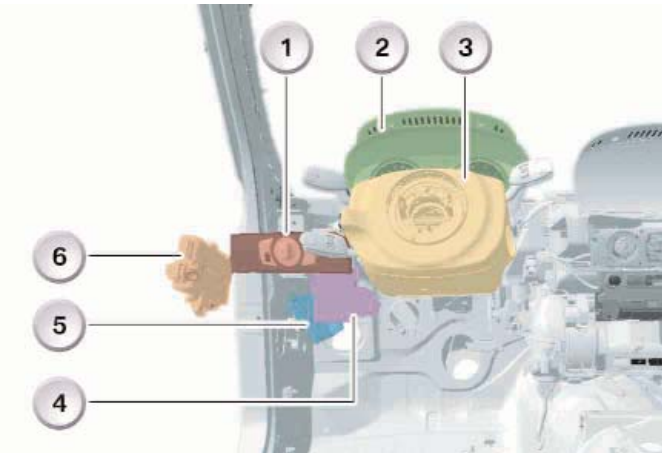
The exterior lighting is based on the exterior lighting of the E65 and available in the following versions:

- Basic version with halogen headlights
- Adaptive cornering light with bi-xenon headlights

Voltage for all the lights is regulated by the light module. This regulation compensates for fluctuations in vehicle voltage.

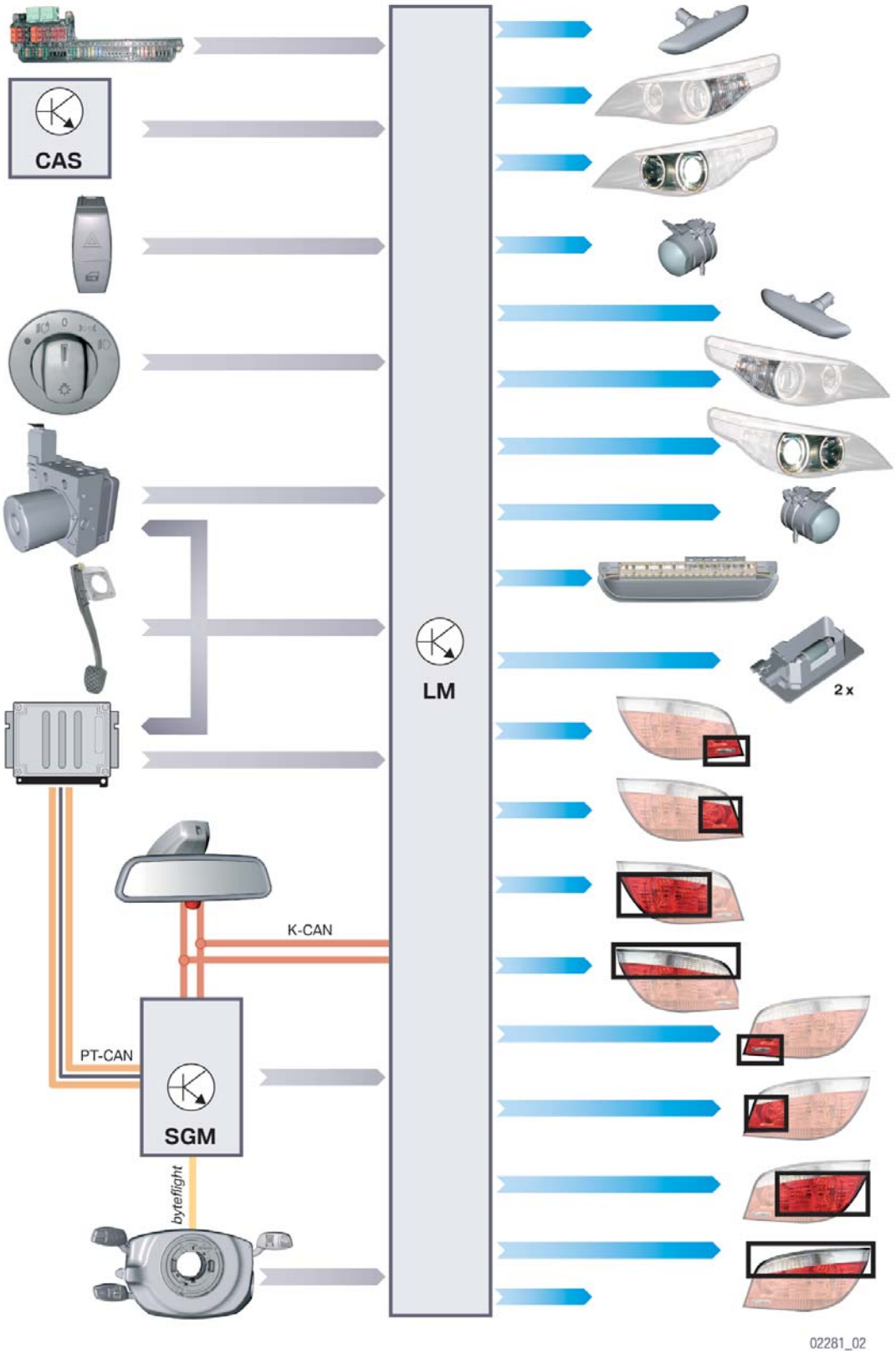
Light Switch with Control Panel Unit

The light switch is remotely mounted from the light module. They are connected by means of a ribbon cable.

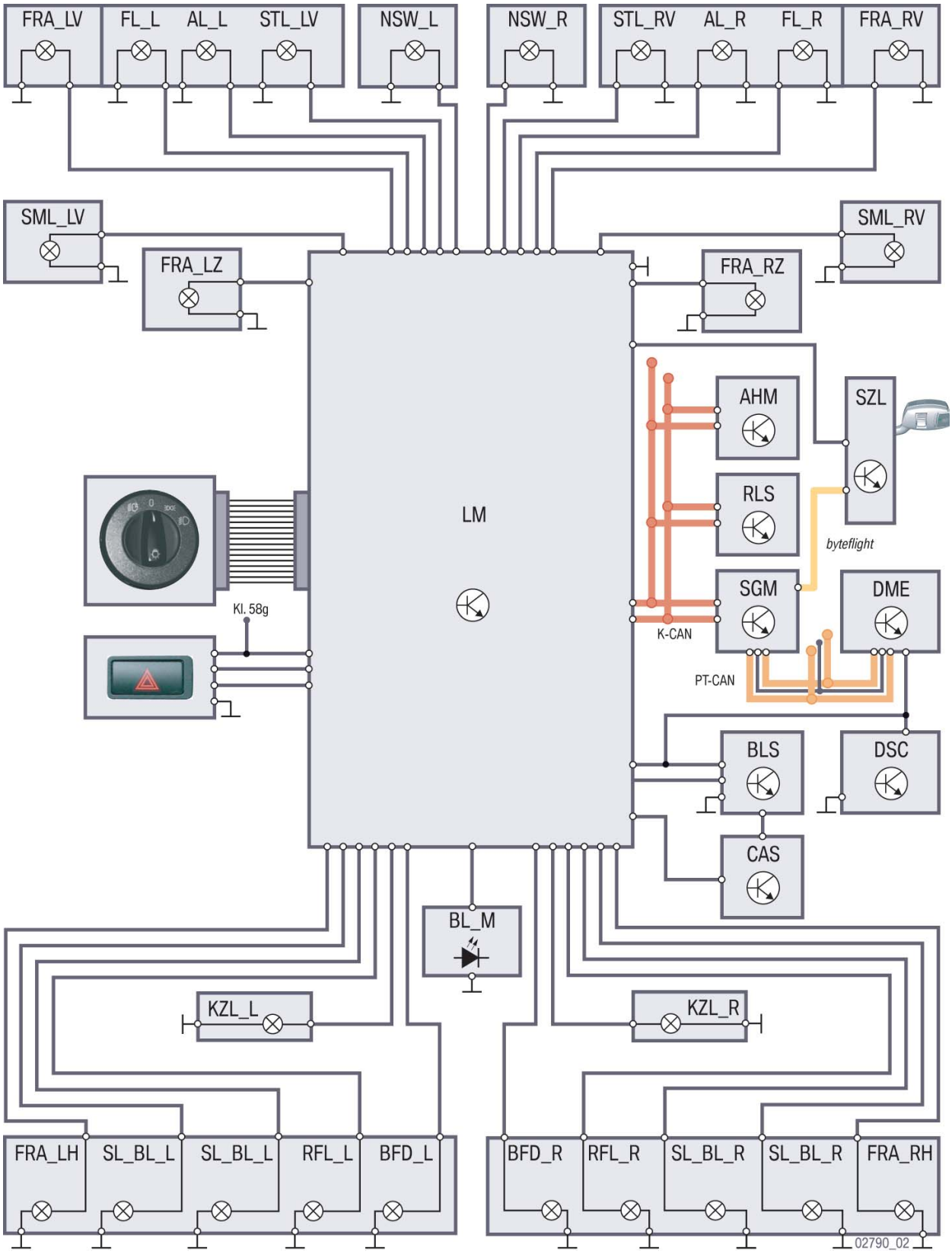


1. Light switch
2. Instrument Cluster
3. SZL
4. CAS
5. Light Module
6. TMFA

Light System IPO



Lighting Schematic

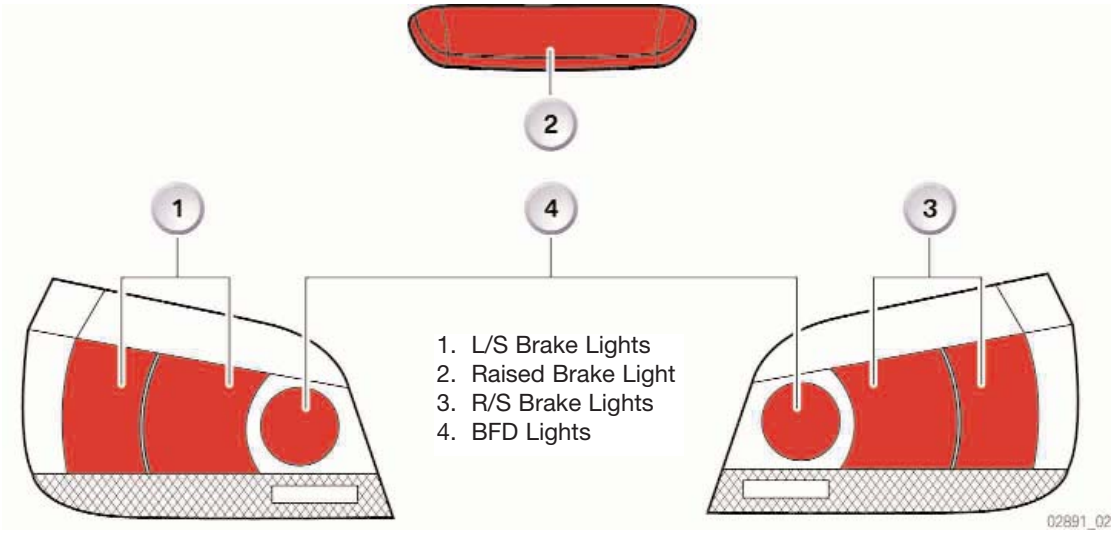


Brake Light Switch

The car access system supplies the brake light switch with voltage. Signals from the brake light switch are used by the Light Module to activate the brake lights.
The Light Module also supplies the brake signal to other systems via the K-CAN.

Reverse Lights

On manual transmission vehicles, the signal is made available via a switch from the gear selector lever. The light module controls the reversing lights accordingly.
On automatic transmission vehicles, the signal is made available by the transmission control unit via the PT-CAN.
The signals for reverse gear and the brake light are made available to other subscribers by the light module via the K-CAN.



Brake Force Display

The segments of the rear fog light are used as the BFD as of a deceleration of 5 m/sec^2

Service Information

In the E60, the light switch contributes to improved protection for the occupants. This increased level of protection is achieved by artificially enlarging the impact surface of the light switch.
In the event of an accident, a person sitting behind the steering wheel could knock against the light switch with his/her knee for instance. While retaining full functionality, the light switch can be shifted towards the rear. This increases the impact surface about the light switch. After being pressed back, the light switch must be pulled out to move it into the forward position again.

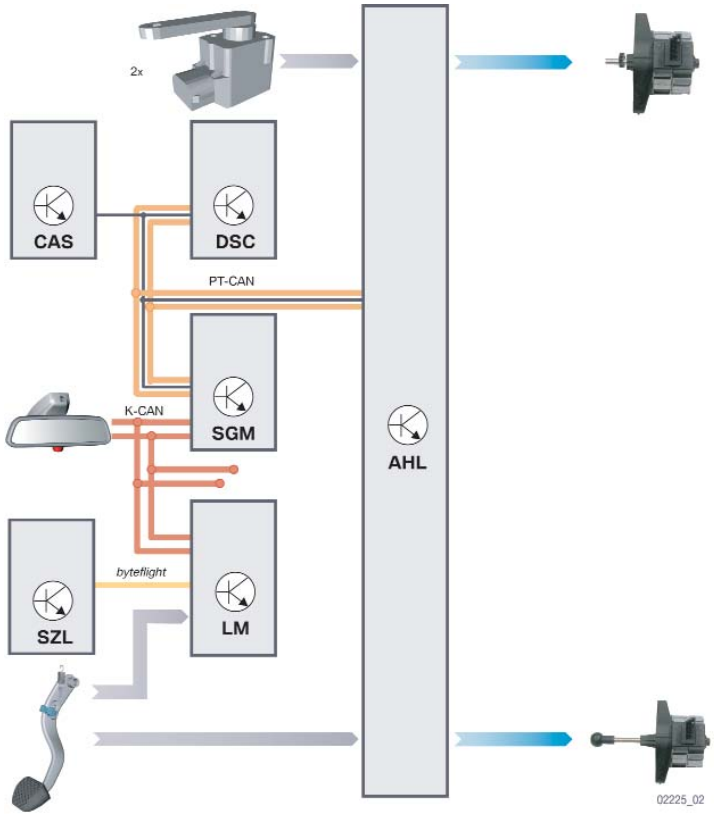
AHL

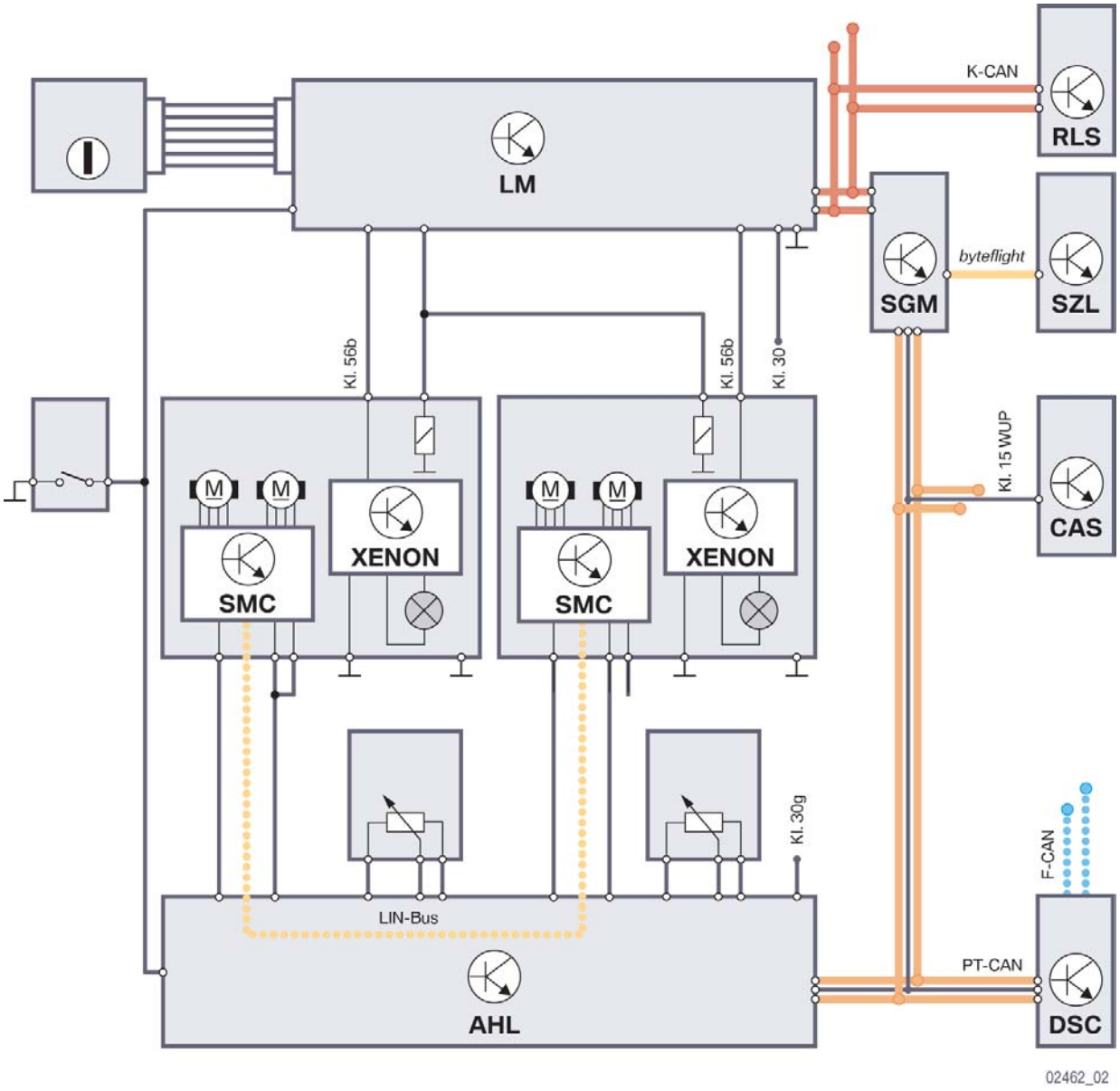
The AHL control unit is linked to the following components:

- Front and rear level sensor
- Brake pedal switch
- Steering angle sensor
- Yaw rate sensor
- DSC control unit, supplies speed signal
- Car Access System
- Safety and gateway module
- Light module
- Steering column switch cluster
- Swivel module for bi-xenon headlights
- Stepper motor controller
- Stepper motors for AHL and steering angle sensor (LWR)
- LIN bus

AHL Control Unit

The AHL control unit is the master control unit for vertical and horizontal adjustment of the bi-xenon headlights. The stepper motor controllers actuate the stepper motors of the bi-xenon headlights. The AHL control unit is installed on the carrier plate behind the glove compartment.





Function Indicator

The function of the AHL is indicated by the FLC LED lighting permanently. A fault in the AHL system is indicated by the FLC LED flashing with the AHL active.
The low beam headlight and the headlight vertical aim control (LWR) remain active in the case of fault. The swivel function of the bi-xenon modules is deactivated.
A reference run is performed during every new start. If a defect is found, the bi-xenon headlights are switched off to ensure oncoming traffic cannot be dazzled. The fog lights are switched on as a substitute
function.

Repairs

Various repairs may be necessary during the course of vehicle's service life. As a consequence of repair work, it may be that the system parts for the AHL are installed with different software and hardware versions. In each case, the replaced components must be adapted to the specific requirements of the vehicle.

AHL Control Unit

After replacing an AHL control unit, it is necessary to enter the vehicle identification number and to encode the control unit depending on specific vehicle data.
The complete AHL function will not be operative if adaptation to the vehicle is not performed.

Replacing SMC

After replacing the SMC, it is necessary to enter the vehicle identification number and headlight-dependent coding in the SMC control unit.
The complete AHL function will remain inoperative if this adaptation is not performed.
Particular care must be taken when replacing the SMC to ensure that the housing seal of the SMC is fitted correctly.

Replace Bi-Xenon Headlights

After replacing the bi-xenon headlights, it is necessary to encode the corresponding SMC depending on the headlights.
If this adaptation is not performed, the function will appear to be operative but not correct.
The swivel range and zero point can vary from vehicle model to vehicle model and the bi-xenon headlight can have a different status!
The headlights must be adjusted and checked.

Diagnosis

The AHL system must be set to diagnosis mode in order to perform the following jobs:

- Read out of relevant bus signals with vehicle stationary
  - -Road speed
  - -Yaw rate
  - -Steering angle
- Checking signal plausibility
- Checking that conditions for activation are fulfilled
  - -Rain and light sensor status
  - -Light switch status

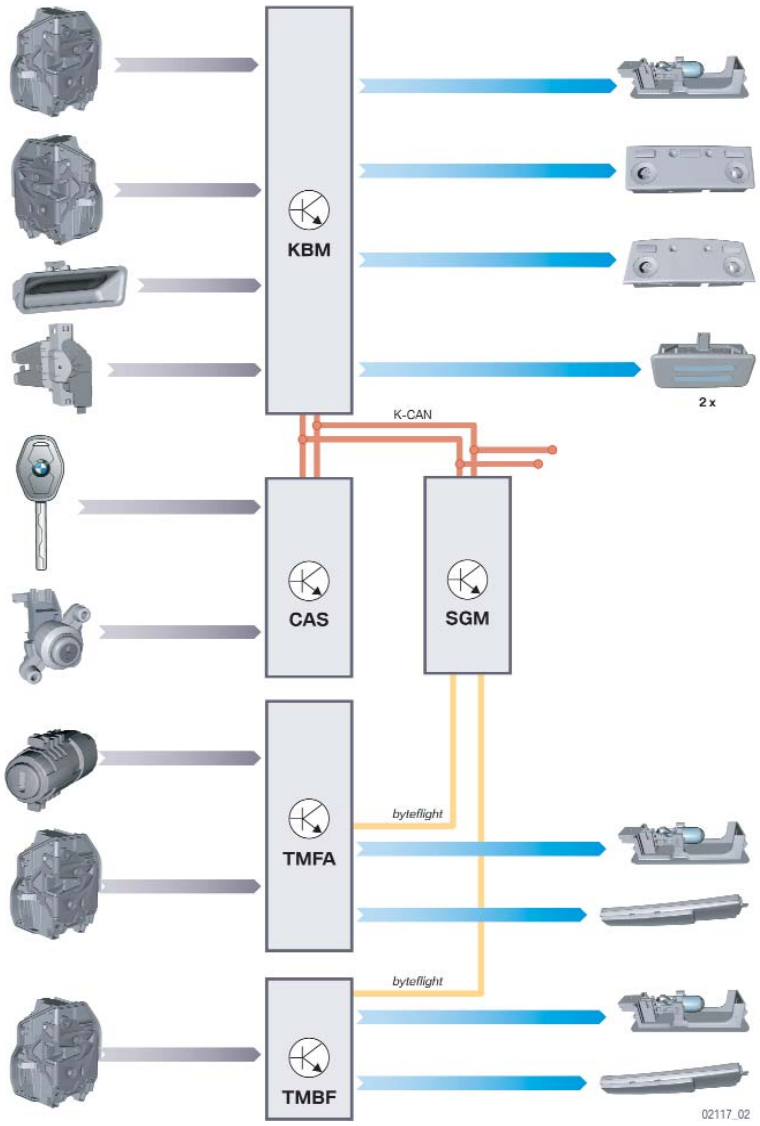
Missing or non-plausible BUS signals are stored in the form of fault codes in the AHL control unit. The types of fault are stored in the SMC. The SMCs are accessed via the AHL control unit.

Interior Lighting

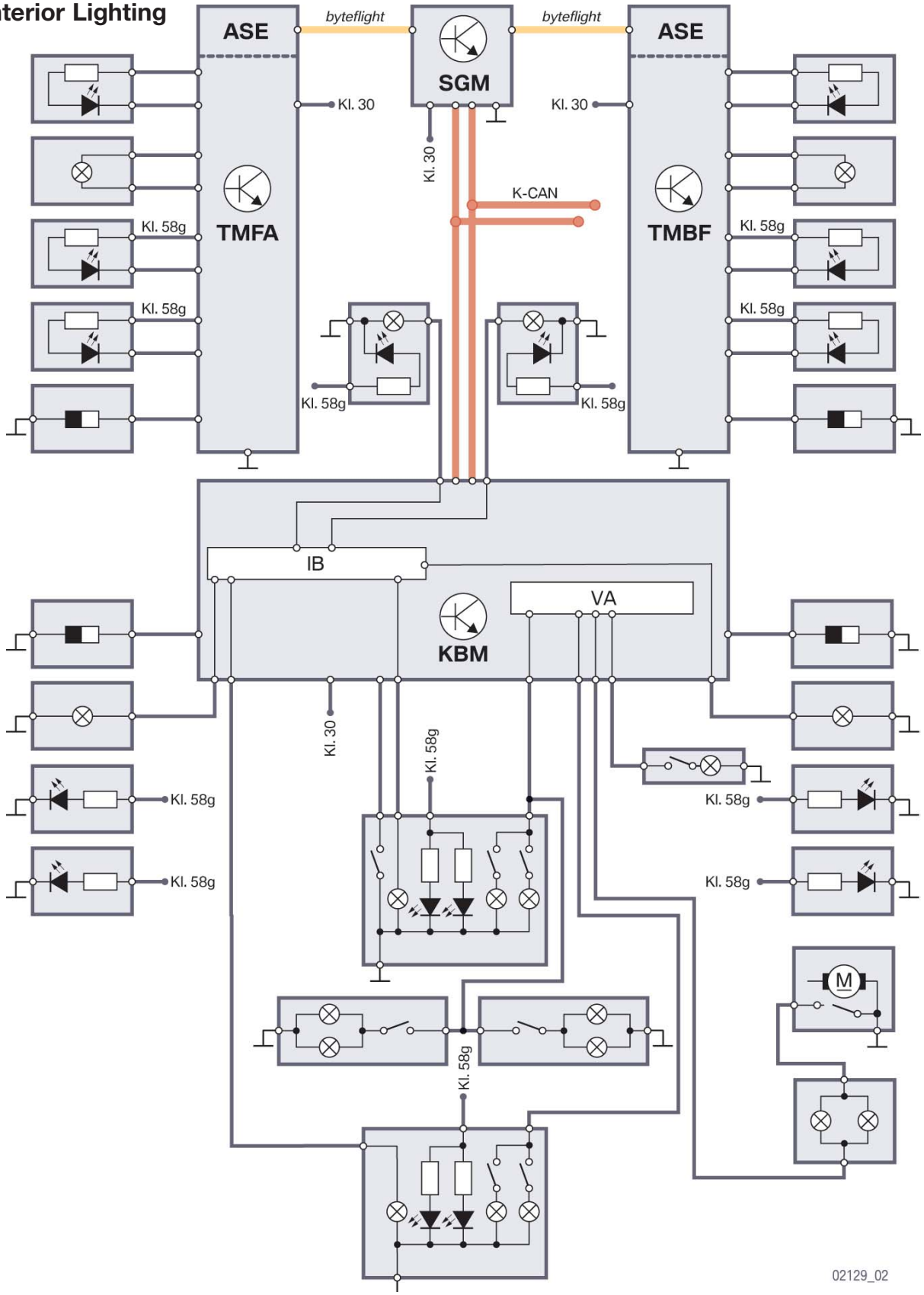
The interior lights of the E60 are pulse width modulated and automatically controlled by various inputs.

PWM Control

The output is active from terminal 15 with a permanent clocking in a frequency of 100 Hz. In this way the power output is controlled. From a voltage of 12.8 V the pulse width modulation is adjusted in such a way as to provide a power output of 100% as for 12.8 V.
In the case of voltage drops in the vehicle electrical system of up to 1 V, the pulse width modulation is corrected and thus a constant brightness of the lamps connected at the consumer shutdown output is ensured.
Below 12.8 V voltage regulation is no longer corrected. The brightness can fluctuate with the battery voltage level.



Interior Lighting



Consumer Shutdown Terminal

Some loads/consumers such as reading, glovebox and luggage compartment lights can remain switched on when the car is stopped. In order to protect the battery, these consumers are shut down after a drop at terminal R with a delay of 16 mins. or immediately with the diagnosis telegram.

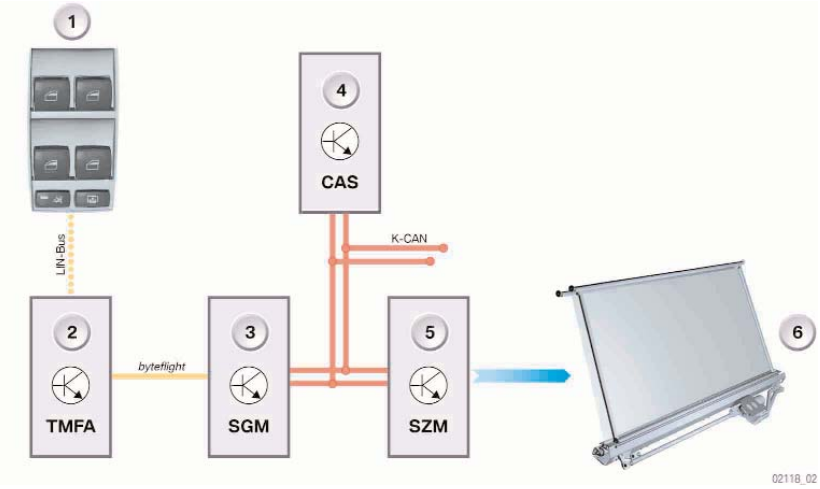
Consumer Shutdown

Power outputs are made available by the KBM 2 for consumer shutdown.

- VA 1:
  - Reading lights
  - Vanity lights
  - Boot
- IB 2:
  - Glovebox light

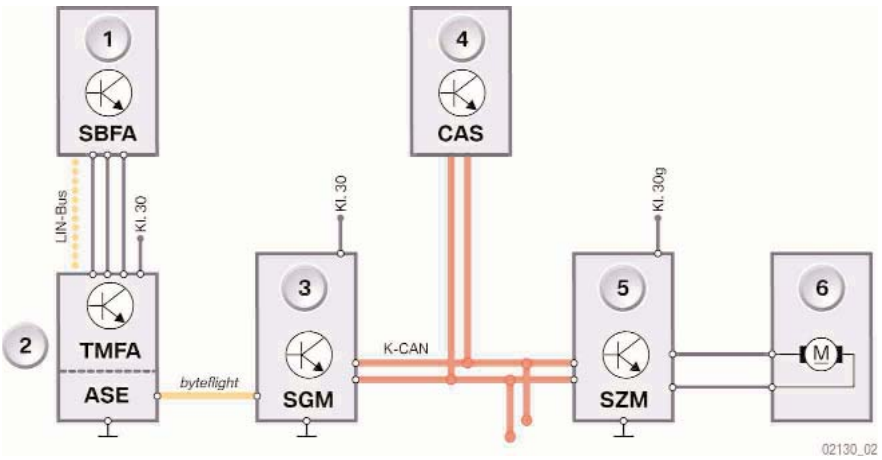
Roller Sunblind

An electric roller sunblind is available for the rear window of the E60. Mechanical roller sunblinds are also available for the side windows of the E60.



System Function

The roller sunblind is operated from the switch in the driver's side switch block.



Seats

Seat Variants

Three different seat versions are available for the E60.
- Electric basic seat with memory
- Electric sports seat with memory
- Multi-function seat with memory

Provision is also made for the installation of various options:
- Electric seat heater
- Seat ventilation system
- Active seat option
- Lumbar support option

Electrical Interfaces

One 8-pin and one 25-pin connector are used to connect the system to the vehicle electrical system. The pin assignment of the 10 compartment plug connections has not changed from those for the seats in the E65. The 6 compartment plug connections for the seat modules have not changed either.

Electric, Sport and Multi-Function Seats

The signals required for seat adjustment are generated with the aid of the adjustment switches. The signals are forwarded to the center console switch centre (SZM) by means of an interface similar to a K bus. The centre console switch centre then forwards the data to the seat modules via the K-CAN.
Signals are processed in the seat modules. With the aid of the output stage in the seat modules, the motors in the seat are activated for seat adjustment.

Seat Heating

The heating circuits vary depending on the equipment fitted. The multifunction seat and the option seat ventilation system have 4 heating circuits. In a 4 heating circuit system, the backrest and seat cushion each have a rapid-heat area and a secondary heat area. Each heat area is fitted with a temperature sensor. Current is applied to a maximum of two heating circuits at any one time.
Seat variants that are not based on the multi-function seat and that are not fitted with the option seat ventilation system have 2 heat circuits. In a 2 heating circuit system, the backrest and seat cushion each have one heat area.

Lumbar Support

The seats are fitted with a pneumatically operated lumbar support adjustment.

Active Seat

The active seat is already described in the training material for the E65. To provide support and relieve the strain on the spinal column and back muscles during long journeys, the active seat can be installed in the vehicle. The up and down movement of the seat surface is initiated at the ischiatic tuberosity.

Entry/Exit Function for the Multi-Function Seat

There is an entry/exit aid for both the driver and passenger. The entry/exit aid is available in conjunction with the multi-function seat. The entry/exit aid system uses the backrest width (LBV) and seat cushion depth (STV) adjustment functions.
The backrest width is retracted to allow entry/exit into the vehicle. This creates more space in the area of the backrest. The seat cushion depth is reduced. This creates more space around the seat area.

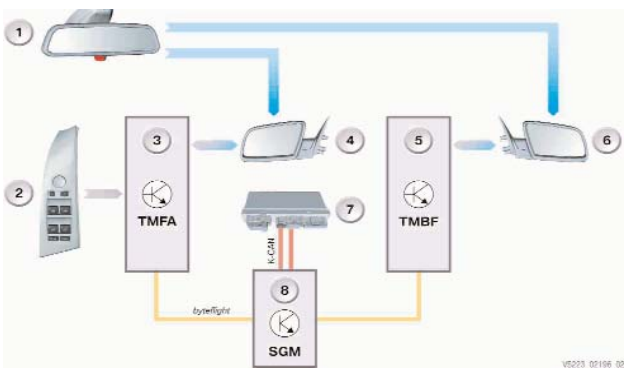
Functional Principle

One example in which the entry/exit aid is activated:
The customer stops the vehicle. The vehicle is not in gear, the engine is either running or switched off. The vehicle door is opened. The door contact indicates this. The exit aid is activated. The LBV and then the STV are retracted. The customer gets out and the door is closed. The exit aid remains in that position and is used to assist entry when the customer gets back in the car.

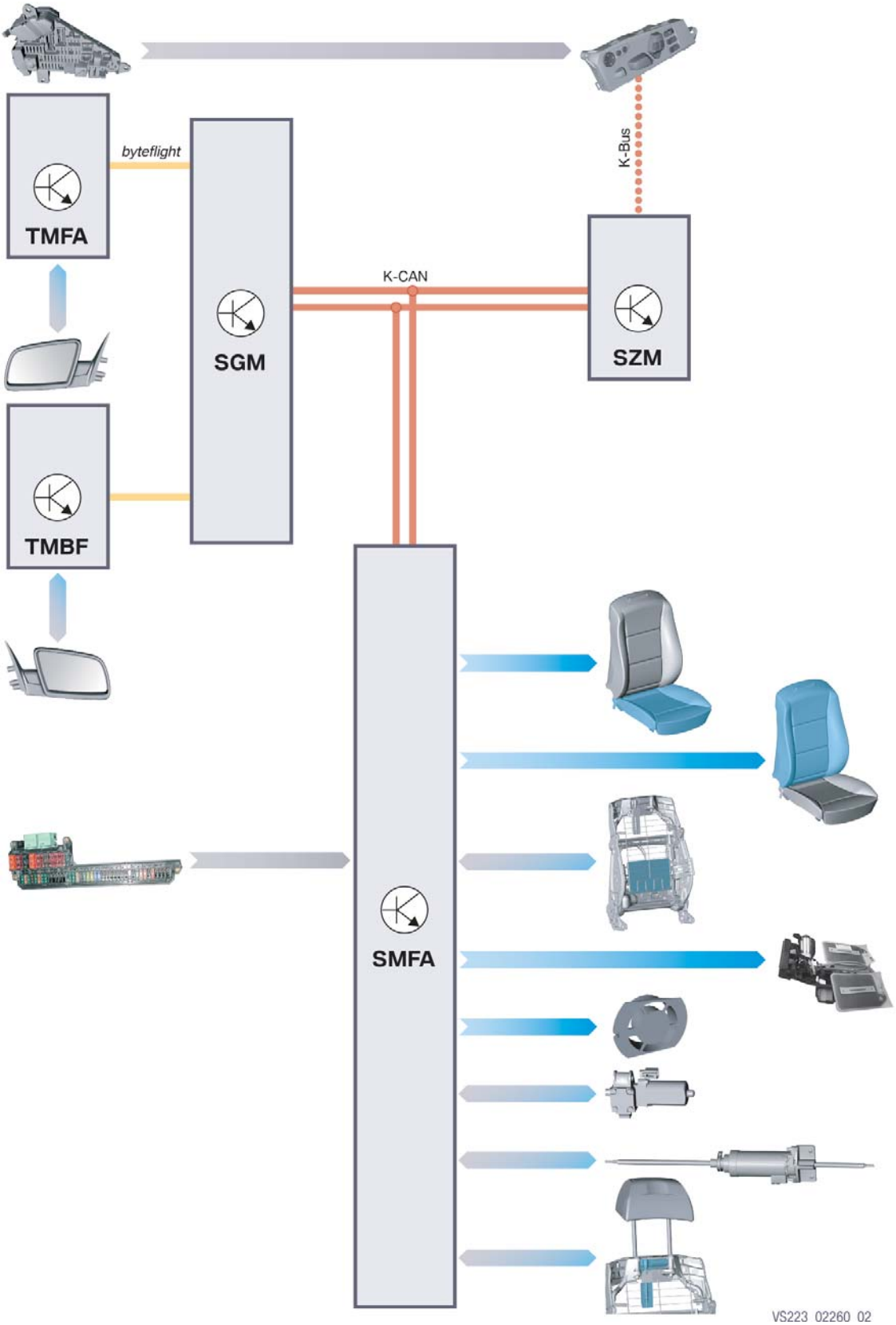
Outside Mirrors

Activation of the wing mirrors is performed by the door modules by means of the local electronics in the front doors. All the mirror functions, except for electrochrome wing mirror and mirror heating, are active with terminal R on through to consumer shutdown.
The mirror functions are controlled exclusively in the door modules, which communicate with each other via the byteflight. All the mirror adjustment functions are served by the adjusting switches in the switch block in the driver's door.
The following options are available:

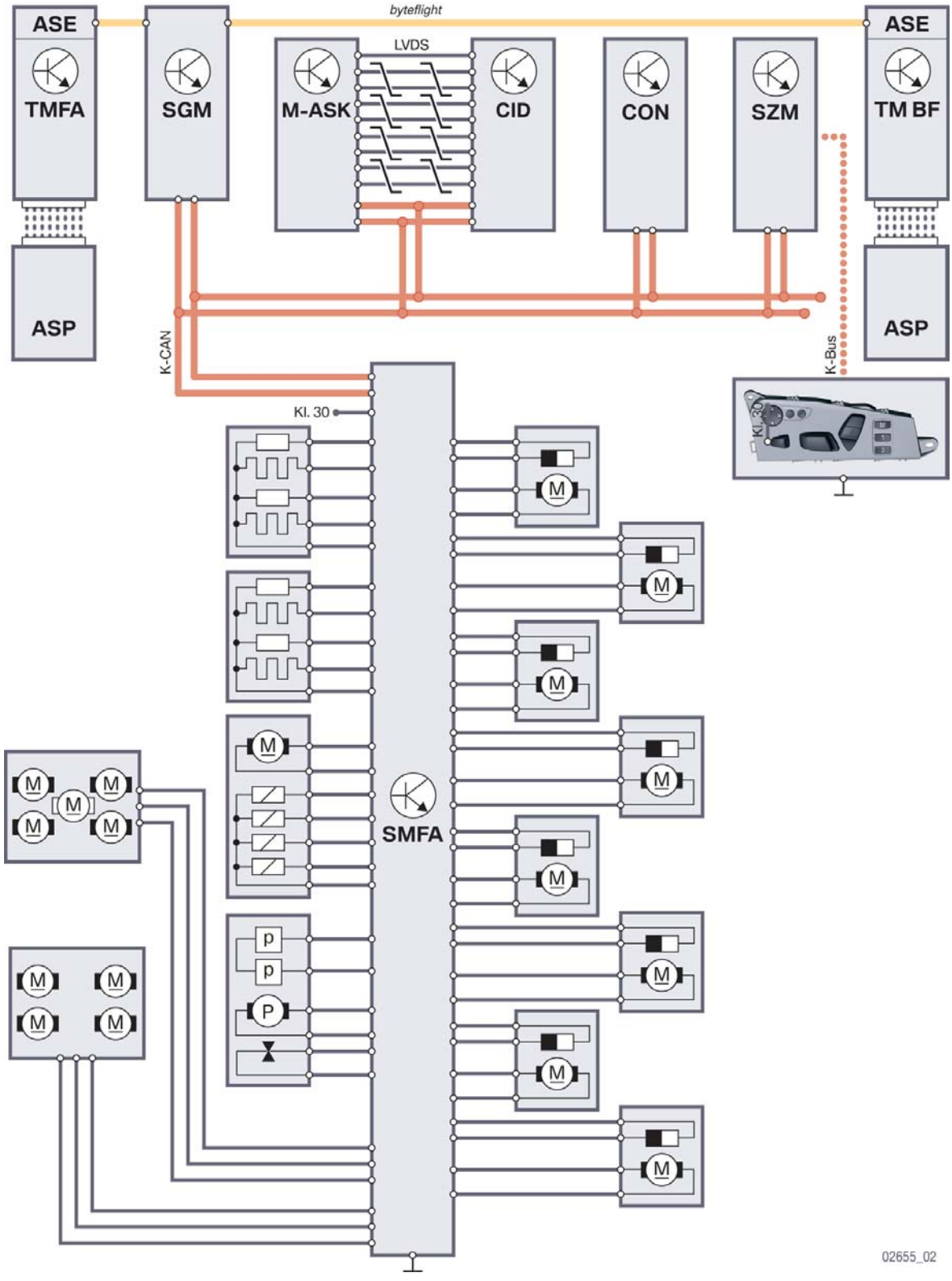
- Electrochrome interior rearview and wing mirrors
- Electrochrome interior rearview mirror
- Light package including front-area lights in wing mirrors
- Wing-mirror memory in conjunction with seat memory

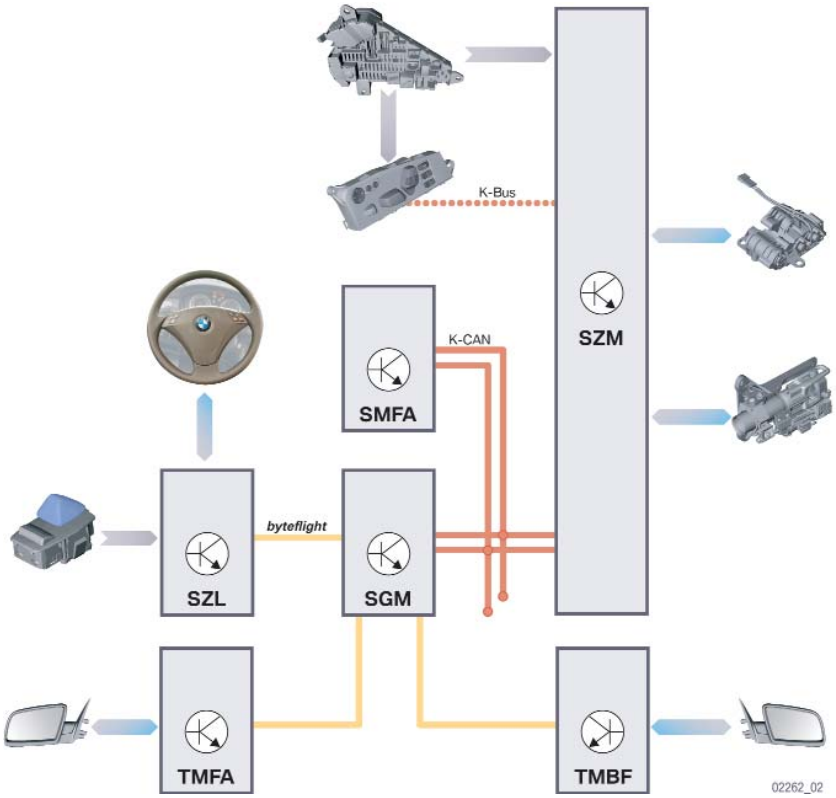


Seat IPO (Typical)



Seat Schematic

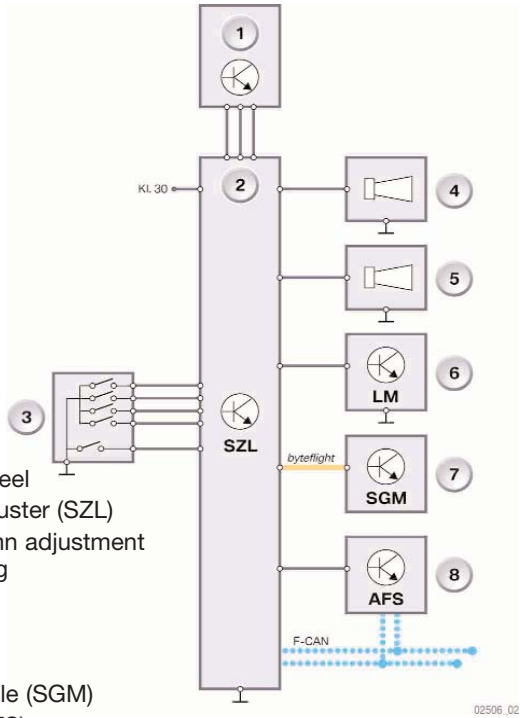




Steering Column

The steering column adjustment function is described in the information for the E65. Possible functions of steering column adjustment are:

- Height adjustment
- Reach adjustment
- Entry/exit aid
- Steering-column memory
- Motor protection



System Circuit Diagram

1. Multi-function steering wheel
2. Steering column switch cluster (SZL)
3. Buttons for steering column adjustment and steering wheel heating
4. Fanfare horn
5. Fanfare horn
6. Light Module (LM)
7. Safety and gateway module (SGM)
8. Active steering system (AFS)

K-CAN - Bodyshell CAN
F-CAN - Chassis CAN

Workshop Exercise - Seats

Vehicle is brought into shop with drivers seat non-operational.

1. *Verify the complaint.*
2. *Does the passenger seat operate?* _____
3. *Perform a short test and note the stored fault codes.*

   _____
4. *Are either of the seats able to be operated through component activation?* _____
5. *What is the path of the signal from the seat switch to the seat modules?*

   _____
6. *What is the best place to check the seat switch operation request signal?* _____
7. *What is the problem with the seat?* _____

   _____

   _____

   _____

   _____