Advanced Electrical

This publication is intended for instructional purposes only. Always refer to the appropriate Jaguar Service publication for specific details and procedures.

⚠ WARNING: WHILE SERVICING AND TESTING VEHICLES AND VEHICLE SYSTEMS, TAKE ALL NECESSARY SAFETY PRECAUTIONS TO PREVENT THE POSSIBILITY OF BODILY INJURY OR DEATH.

Publication T680/98
Date of Issue: March 1998

Contents

Glossary

A	Ampere (measure of electrical current)
A/C	Air conditioning
ADCM	Adaptive damping control system
Airbag/SRS	Airbag supplementary restraint system
B+	Battery voltage
Baud	Data bit transmission rate
Binary	Numbering system based on the number two
Bit	A single binary code data signal (1 or 0)
BPM	Body processor control module
BPS	Bits per second
Bus	Simple network where modules are connected in series; Also used to refer to a network
Byte	Eight bits (makes up two alphanumeric characters)
CAN	Controller area network
CATS	Computer active technology suspension
CO	Change over
Cyclical	A recurring succession of events
DDCM	Driver door control module
Decimal	Numbering system based on the number 10
DIN	German Institute for Standardization
DLC	Data link connector
DRDCM	Drive rear door control module
DSCM	Driver seat control module
DTC	Diagnostic trouble code
ECM	Engine control module
EGR	Exhaust gas recirculation
Farad	Measure of electrical capacitance
Gateway	A language or protocol translator between two different systems
Hexadecimal	Numbering system based on the number 16
ICE	In -car entertainment
INST	Instrument pack
ISO	International Organization for Standardization
ISO 9141/2	An ISO standard for electronic communications
JDS	Jaguar diagnostic system
Kbps	Kilobauds per second
kg	Kilogram
Kilo	Thousand
km/h	Kilometers per hour
KTM	Key transponder module
LED	Light emitting diode

m	Meter
mA	Mega Amps (million Amps)
mF	Micro Farad
Micro	Millionth
mm	Millimeter
MPA	Multi protocol adapter
mph	Miles per hour
Multiplex	An electrical circuit that carries multiple signals
MY	Model year
NA	Normally aspirated
NAS	North American specification
NC	Normally closed
Network	Connecting modules to share data
NO	Normally open
Node	An individual device in a network
PAS	Power assisted steering
PASCM	Power assisted steering control module
PDCM	Passenger door control module
PDU	Portable diagnostic unit
PRDCM	Passenger rear door control module
Protocol	The “language” used for modules to communicate
PSCM	Passenger seat control module
Quiescent	At rest
ROW	Rest of world
SAE	Society of Automotive Engineers
SAE J 1978	An SAE standard for electronic communications
SC	Supercharged
SCP	Standard Corporate protocol (network)
SLCM	Security and locking control module
Star	Network where modules are connect to a common point or points
TC	Traction control
Token	An identity symbol
V	Volt (measure of electrical potential)
W	Watt (measure of electrical power
ºC	Degrees Celsius
ºF	Degrees Fahrenheit
Ω	Ohm (measure of electrical resistance)
<	Less than
>	Greater than

Electrical Systems Introduction

A new concept in electrical system design was first introduced within Jaguar with the 1997 MY XK8. The new electrical system design concept points the way to future models. Jaguar electrical systems will continue to evolve to support added functionality, but the basic concepts governing the design of the power distribution and electrical protection circuits, harness design and layout, and component control and communications will remain constant. As new vehicles are introduced, the design similarities to existing vehicles will help to make electrical and electronic diagnostics and repair an easier task for the trained technician.

Electrical system benefits

For the customer:

- Increased functionality
- Increased reliability
- Increased on-board diagnostic capabilities with driver fault notification
- Lighter vehicle weight and increased performance

For the technician:

- Increased diagnostic capabilities
- Reduced number of components
- Standardization of components across model lines
- Common diagnostic and repair procedures across model lines

For the manufacturer:

- Increased functionality and reliability
- Reduced amount of wiring, connectors and components
- Increased component compatibility among model lines and variants
- Increased ability to add / delete features without major revision
- Reduced build complexity

What this book contains

This book provides a description of the XK8 and XJ Series Sedan electrical systems and includes a detailed operational analysis of the following XK8 circuits:

- Interior lighting
- Directional indicators and hazard warning lighting
- Headlamps, side markers, tail lamps and front fog lamps
- Stop and reverse lamps
- Rear fog lamps
- Steering column movement
- Door mirrors
- Seats
- Security and locking
- Windshield wipers, washers and headlamp power wash
- Door windows
- Convertible top and quarter windows

Although there are slight differences in some circuits between the XK8 and XJ Series Sedan, the operational logic is the same.

Vehicle Electrical Design

Main Power Distribution

Vehicle electrical power is distributed via two separate heavy duty fused circuits. Each circuit is as short as possible and has a minimum number of connectors.

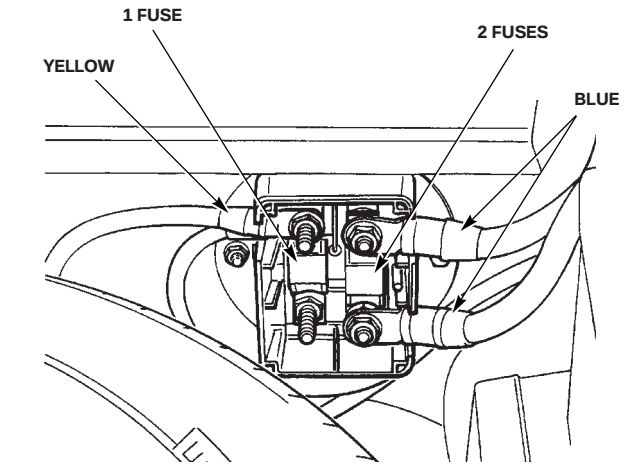
Starting / charging supply circuit

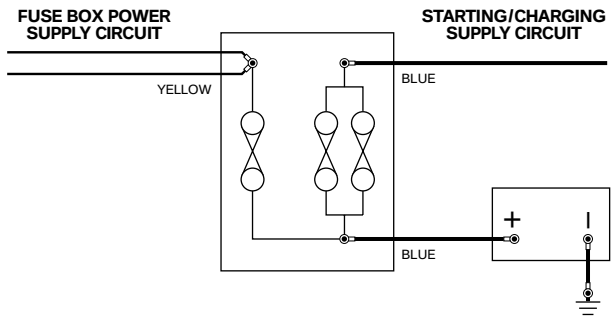
Heavy cabling connects the battery to the starter motor and the generator via the high power protection module. A pair of 250 A fuses in the high power protection module provides 500 A of protection for the starter motor and battery charging circuits.

Fuse box supply circuits

Lighter gauge cabling provides power from the high power protection module to the vehicle fuse boxes. A separate 250 A fuse in the high power protection module protects the fuse box power supply. The fuse boxes are strategically located in the vehicle to provide zoned protection of all electrical components and reduce the length of cables.

HIGH POWER PROTECTION MODULE





T680 / 1.01 A & B

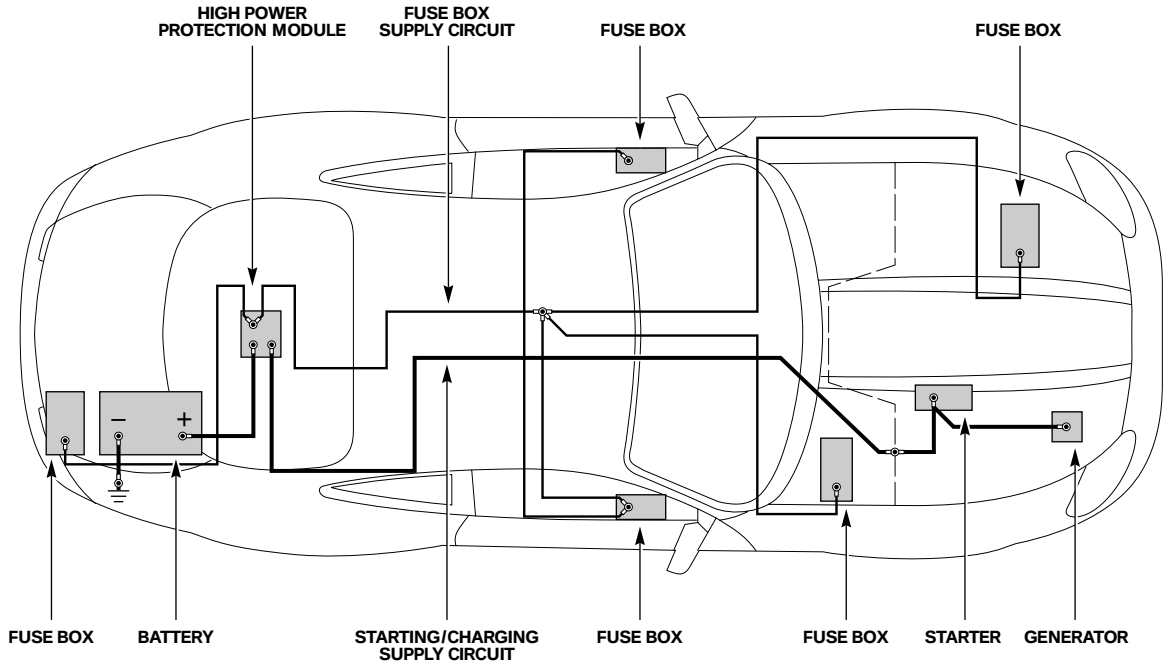
High power protection module

The high power protection module contains three 250 A fuses.

Two 250 A fuses are connected in parallel, providing 500 Amps of protection to the starting and charging system. The third 250 A fuse protects the fuse box power supplies.

NOTES

MAIN POWER DISTRIBUTION: XK8



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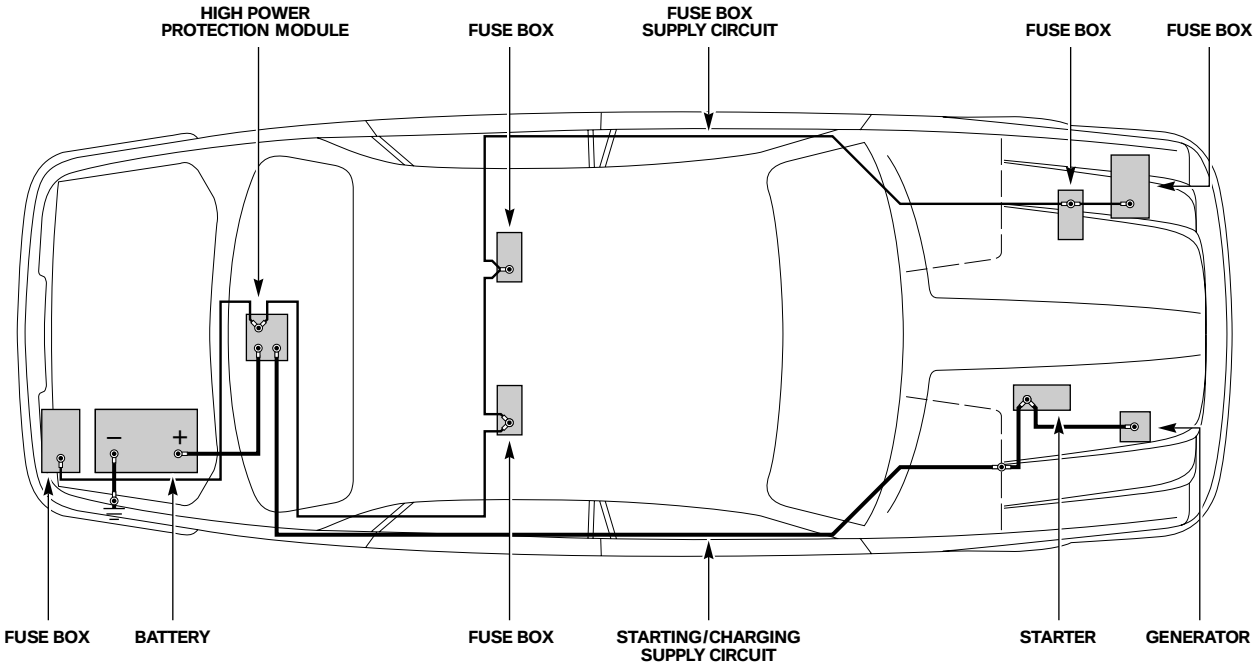
MAIN POWER DISTRIBUTION: XJ SERIES SEDAN



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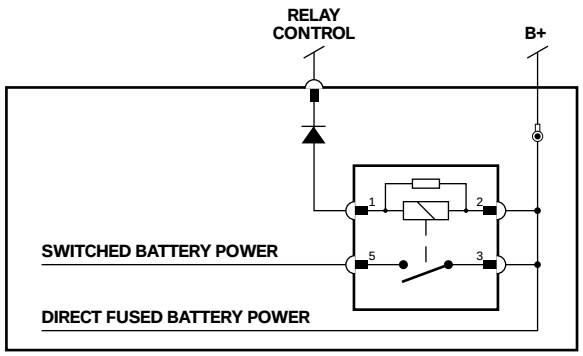
Fuse Boxes and Harnesses

Fuse boxes

Each fuse box incorporates a relay and internal circuitry enabling it to provide direct fused battery power or switched battery power to the components in its zone. The switched battery circuits incorporate a polarity protection diode in each fuse box. Polarity protection for the direct battery supplied components is incorporated within the individual components as required.

TYPICAL FUSE BOX



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Harnesses

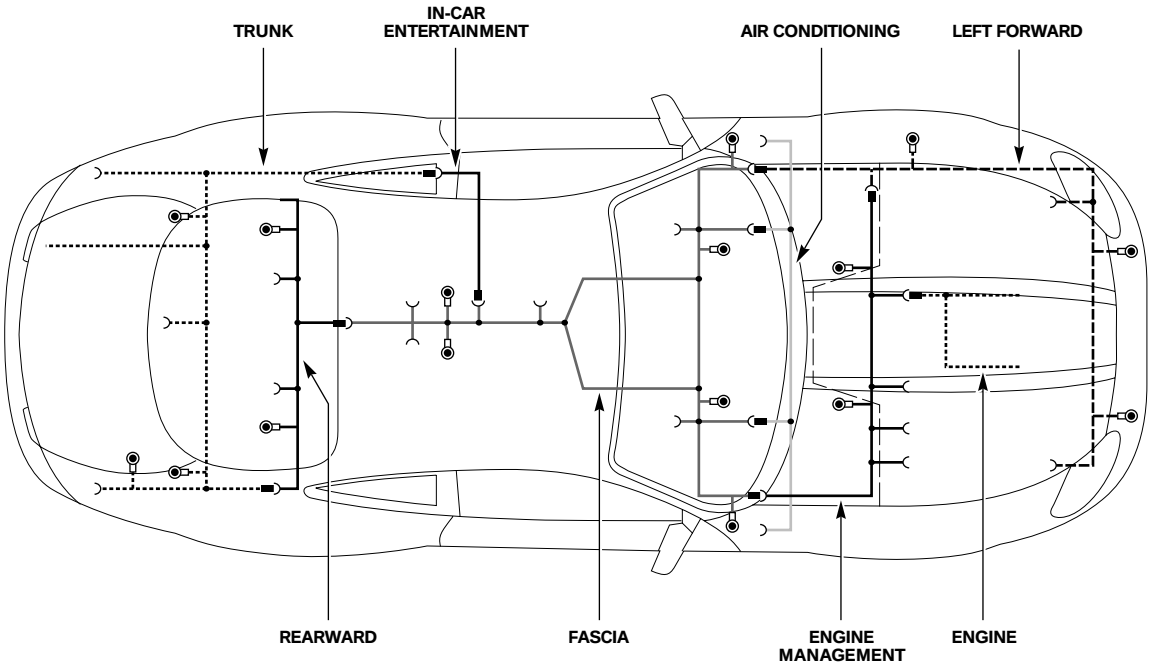
Primary harnesses connect to each fuse box distributing fused power and ground supplies to components and secondary harnesses.

The harness layout reduces the length of cable runs and connections and groups the power and ground connections. In addition, the design allows the standardization of some vehicle subassembly harnesses allowing the subassemblies to be easily electrically connected to the vehicle.

Refer to the Electrical Guide for complete details of power distribution, harness layouts and grounds.

NOTES

PRIMARY HARNESSES: XK8



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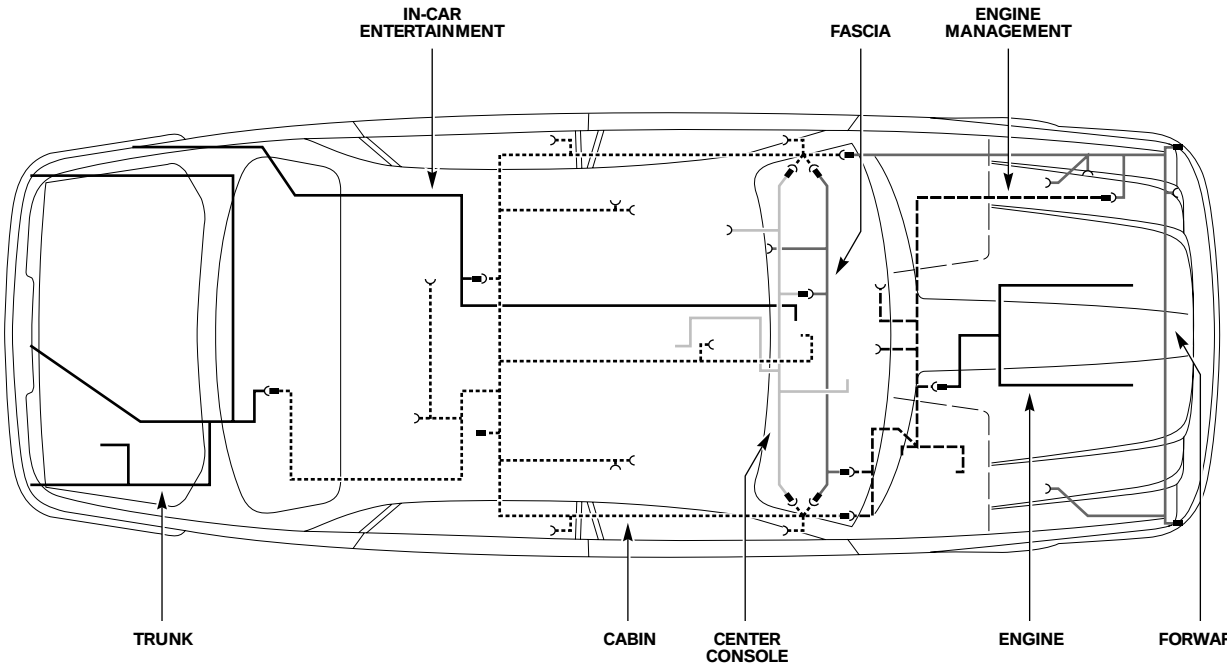
PRIMARY HARNESSES: XJ SERIES SEDAN



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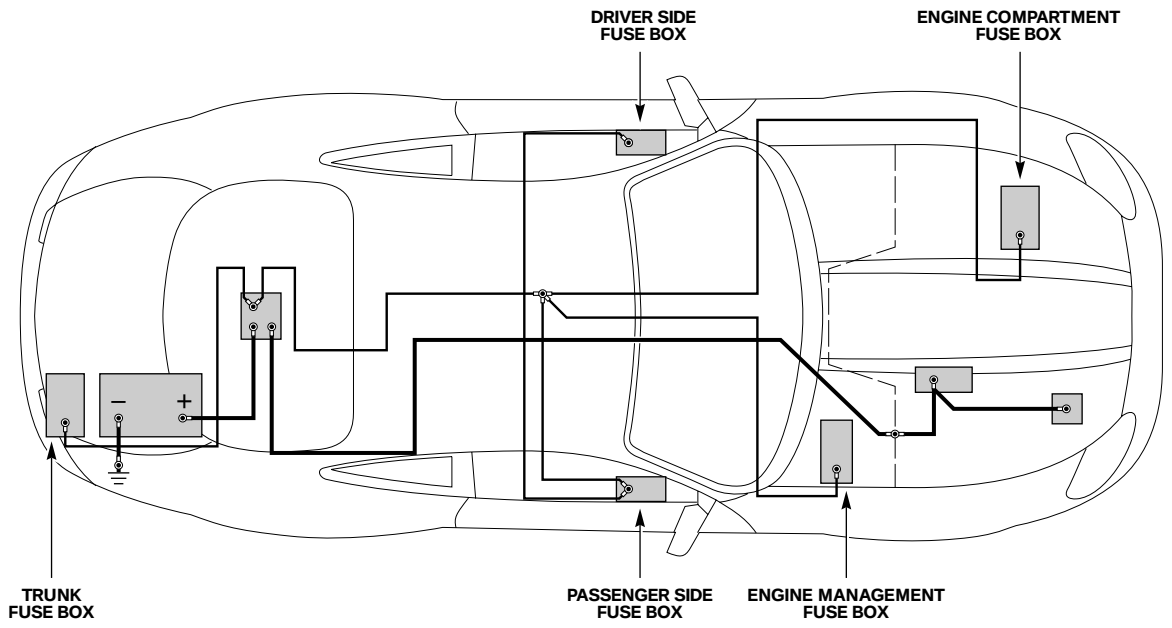
Fuses and Relays

Fuses

The five fuse boxes protect all of the electrical circuits. Refer to the Electrical Guide to verify the location of individual fuses.

CAUTION: When replacing fuses, use only the specified amperage rating for the fuse location.

FUSE BOX LOCATION: XK8



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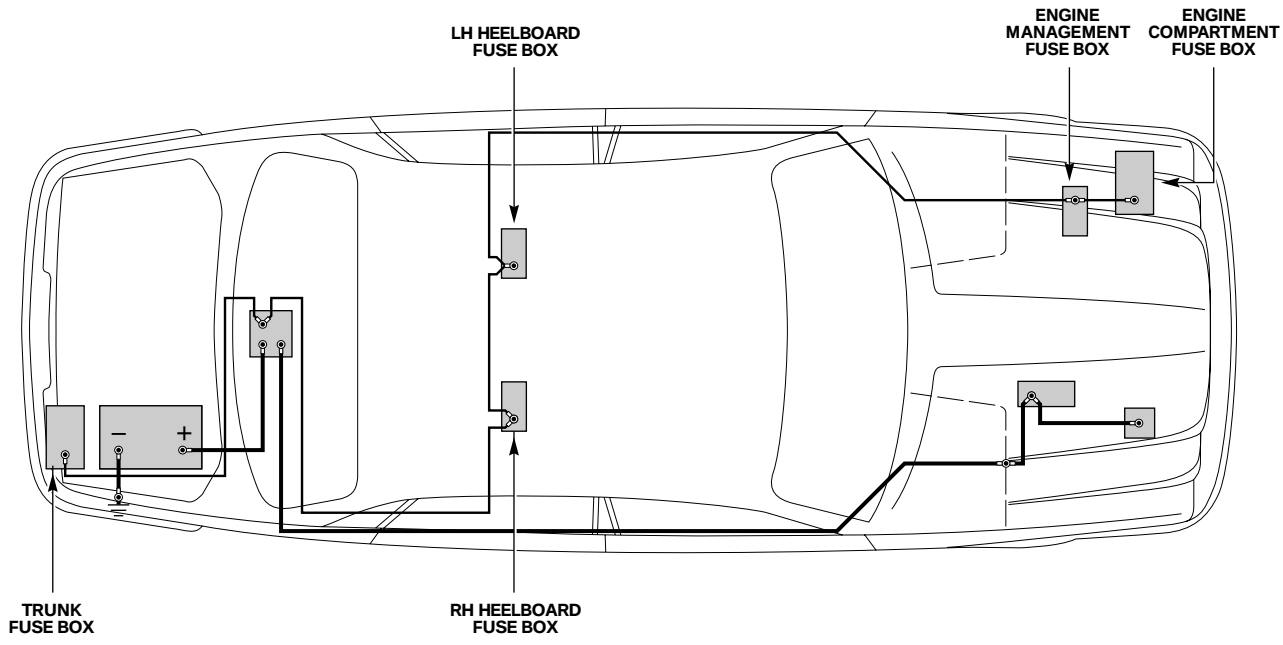
FUSE BOX LOCATION: XJ SERIES SEDAN



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Relays

Relays are color coded for each application. The colors identify differences in relay type and size. All relays use internal resistors to protect the electrical system from high voltage spikes induced into the coil circuit when coil current is switched off and its magnetic field collapses. Refer to the Electrical Guide for correct relay application.

Relay identification

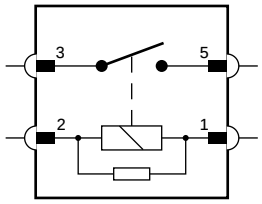
Color	Type
Blue	4 pin micro Normally Open
Brown	4 pin Normally open
Violet	5 pin micro Change-over
Black	5 pin Change-over

All relays connections follow the ISO numbering standard instead of the DIN numbering standard used previously.

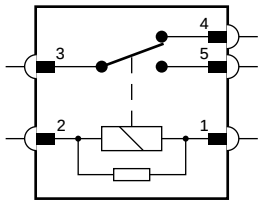
ISO / DIN relay numbering comparison

Single relay		Paired relays	
ISO	DIN	ISO	DIN
1	86	6	86
2	85	7	85
3	30	8	30
4	87A	9	87A
5	87	10	87

TYPICAL RELAYS



NORMALLY OPEN



CHANGE-OVER

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NOTE: Some relays are "clip fitted" to brackets and their positions may vary on the bracket. Do not attempt to identify "clip fit" relays by their position only. Instead, positively identify the relay by verifying the relay connector wire colors in the appropriate Electrical Guide.

Quiescent Current Drain

When the vehicle is first switched off, the control modules "keep alive" in order to perform various tasks. The length of time following vehicle switch-off that each module "keeps alive" depends on the individual module, its state at the time of vehicle switch-off and other activity on the multiplex bus. As a module enters its sleep mode, its quiescent drain is reduced to the value shown below. Total vehicle quiescent drain after all modules have entered sleep mode is between 20 – 30 mA. Any input to a module will wake up that module. Any SCP multiplex message on the network will wake up the modules on the network.

Approximate XK8 time-to-enter sleep mode / quiescent drain in sleep mode

Module	Time to sleep mode	Quiescent drain in sleep mode
ECM	30 seconds	2 mA
Door module (ea.)	2 minutes	0.5 mA
Seat module (ea.)	2 minutes	0.5 mA
BPM	18 minutes	6 mA
A/CCM	50 – 60 minutes	8 mA
SLCM	48 hours	8 mA

NOTE: The SLCM remote transmitter receive function "keeps alive" for 28 days.

Multiplexed Control System Harnesses

The major control modules connect to one of two multiplex electrical circuits. One multiplex circuit (CAN network) provides communication between the power train system modules. The second multiplex circuit (SCP network) provides communication between the body systems control modules. Both networks connect to the major instrument pack (INST), which allows communication of certain data between the CAN and SCP networks.

Power train (CAN) multiplex harness

The control modules for the engine, transmission and braking systems connect to each other with a two wire "twisted pair" multiplex circuit. The multiplex circuit allows the control modules to share data and systems control responsibility via "real time" high speed data communication. Sensors "owned" by each module and components directly controlled by the module connect with conventional "hard wired" circuits. Refer to page 30 for a description of CAN multiplexing.

Body systems (SCP) multiplex harness

The vehicle body systems control modules are similarly connected, utilizing a separate "twisted pair" multiplex circuit allowing the modules to share data and zoned component control responsibilities via multiplex data communication. Refer to page 27 for a description of SCP multiplexing.

CAUTION: Multiplex harnesses require special repair procedures. Refer to the applicable Service Literature for special tools and procedures.

The various control modules for each vehicle range are listed below. The numbers to the right of the control modules correspond to the numbers in the illustrations on the facing page.

Multiplex control modules: XK8

Power train (CAN) modules

ECM (engine control module)	11
TCM (transmission control module)	12
Gear selector illumination module	9
DLC (data link connector)	3
INST (instrument pack)	4
ABS / TCCM (anti-lock brake / traction control control module)	5

Body systems (SCP) modules

BPM (body processor control module)	10
PDCM (passenger door control module)	8
PSCM (passenger seat control module)	7
SLCM (security and locking control module)	6
DSCM (driver seat control module)	1
DDCM (driver door control module)	2
DLC (data link connector)	3
INST (instrument pack)	4

Multiplex control modules: XJ Series Sedan

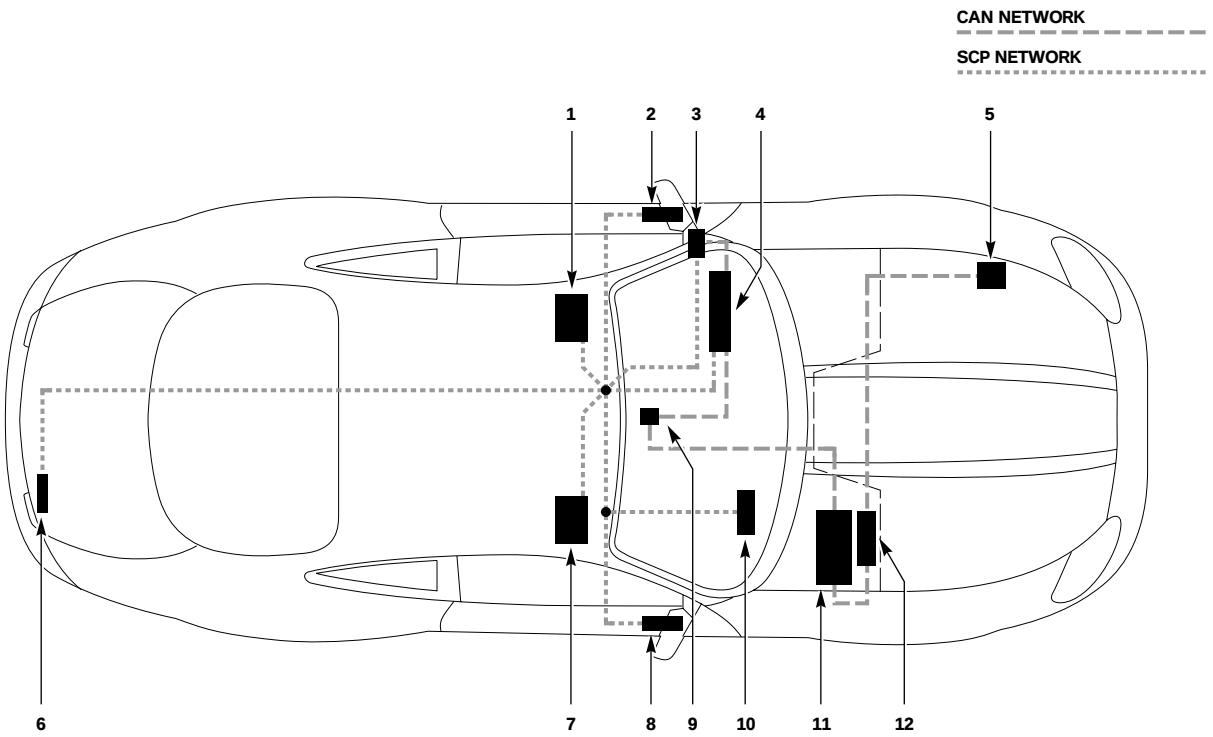
Power train (CAN) modules

ECM (engine control module)	14
TCM (transmission control module)	13
Gear selector illumination module	2
DLC (data link connector)	5
INST (instrument pack)	6
ABS / TCCM (anti-lock brake / traction control control module)	7

Body systems (SCP) modules

BPM (body processor control module)	12
PSCM (passenger seat control module)	11
PDCM (passenger door control module)	10
PRDCM (pass. rear door control module)	9
SLCM (security and locking control module)	8
DSCM (driver seat control module)	4
DDCM (driver door control module)	3
DRDCM (driver rear door control module)	1
DLC (data link connector)	5
INST (instrument pack)	6

MULTIPLEX NETWORKS: XK8



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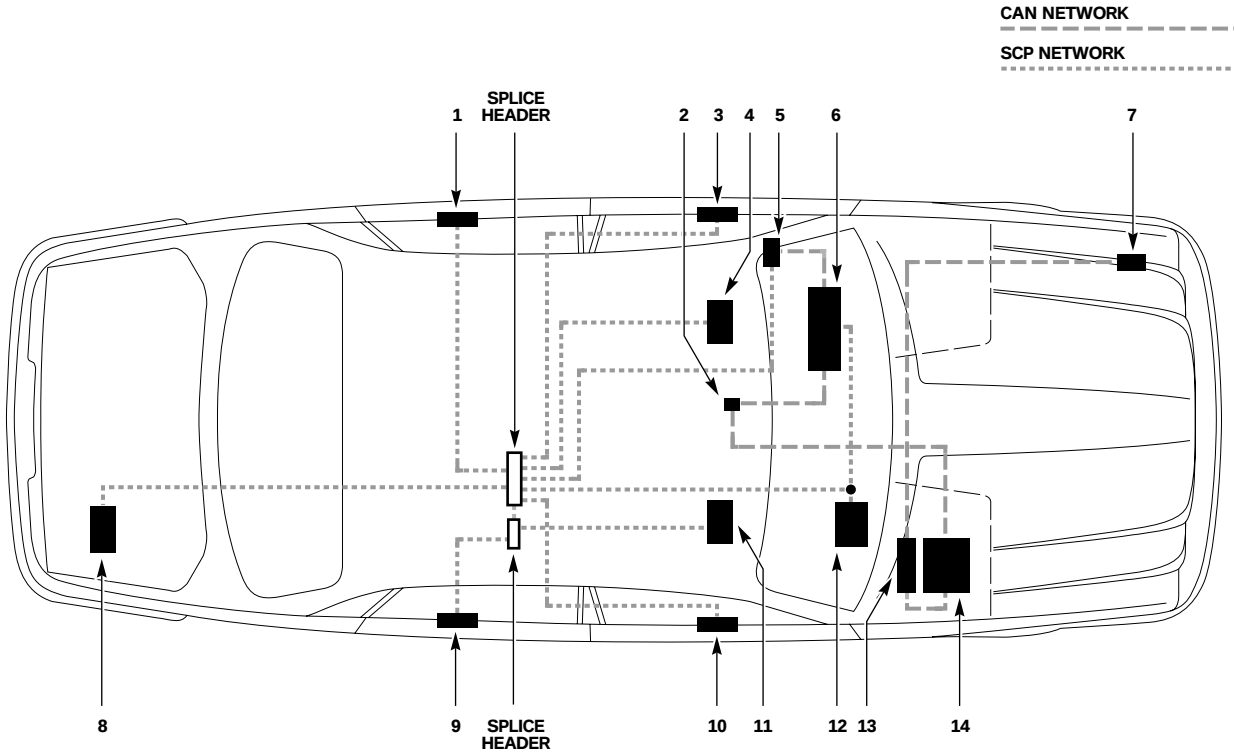
MULTIPLEX NETWORKS: XJ SERIES SEDAN



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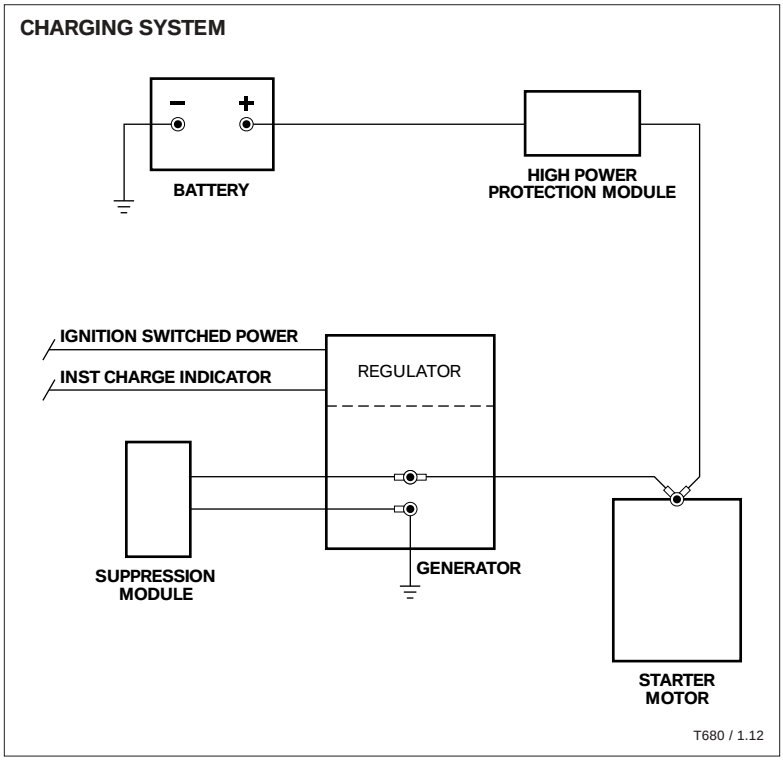
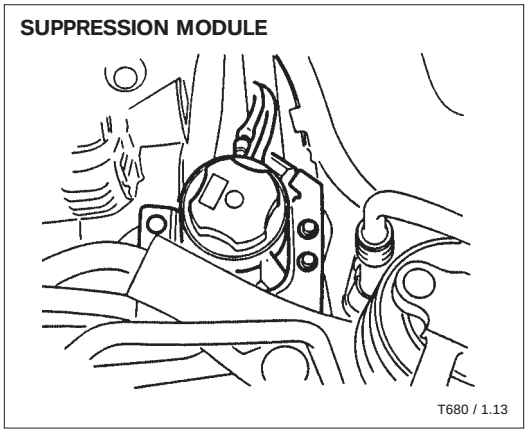




Charging System

Generator

The belt driven generator is rated for 120 A output at 5000 rpm (generator speed) at a temperature of 25 ºC (77 ºF). The internal rectification and voltage regulator provide a low ripple, smooth DC voltage output that is proportional to engine speed. Ignition switched B+ voltage is supplied to the voltage regulator to excite the generator rotor. The generator B+ voltage supply is protected by the same fuse that protects the starter relay coil, the ECM and the fuel injection relay coil.

Refer to the vehicle Diagnostic and Test manual, section 4.14-02, for charging system test procedures.

Suppression module

A suppression module is located on the inner engine compartment panel near the generator. The module dampens any electrical ripple in the generator output to prevent radio frequency interference. A nonserviceable internal fuse in the module protects the generator in case of a short circuit in the module's 22,000 mF capacitor.

Battery

CAUTION: If the battery is disconnected, wait 1 minute before reconnecting to allow the control modules and the clock to reset. When reconnecting the battery, make a positive, "clean" connection to prevent a momentary power ON / OFF, which may disturb the state of the clock and the control modules.

NOTES

Generator drive

The generator is driven by the multi-ribbed serpentine accessories drive belt. The designed service life of the drive belt is 100,000 miles (161,000 km). The belt is tensioned with a spring loaded automatic tensioner that incorporates a belt wear indicator. The belt wear indicator and the contact surfaces of the belt should be inspected at each 10,000 miles (15,000 km) service interval.

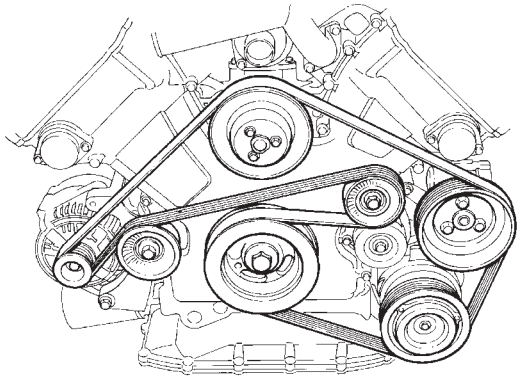
Drive belt replacement

The belt should be replaced if the belt wear indicator shows that the belt is stretched. If an inspection of the belt contact surface shows more than 15 cracks per rib in 100 mm (4 in.) or if rib material has been lost, the belt must also be replaced.

Refer to Repair Manual or Technical Service Bulletins for drive belt replacement procedures.

NOTES

AJV8 NA DRIVE BELT ARRANGEMENT



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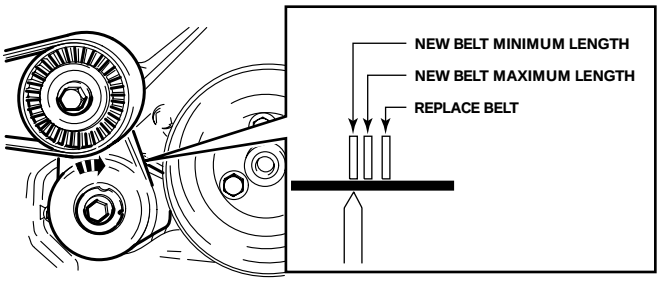
DRIVE BELT WEAR INDICATOR



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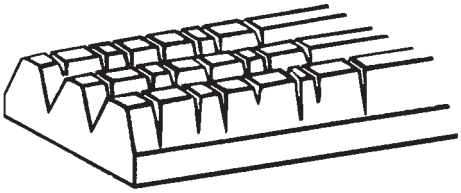
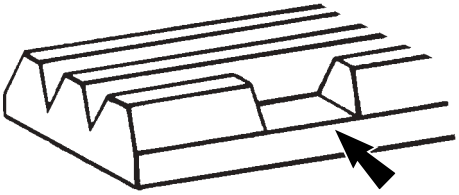
CONDITIONS FOR REPLACEMENT OF DRIVE BELT



> 15 CRACKS/RIB IN 100 mm (4 in.)



RIB MATERIAL LOST

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Multiplexing

A multiplex circuit is an electrical circuit designed to transmit multiple signals between control modules using the same set of conductors. A single circuit (sometimes called a bus) connects the control modules as a communications network. The modules communicate with each other by sending coded serial data messages over the network. The data messages are available to all of the control modules connected to the network. Modules connected to a multiplex circuit are often called nodes.

Why Multiplexing?

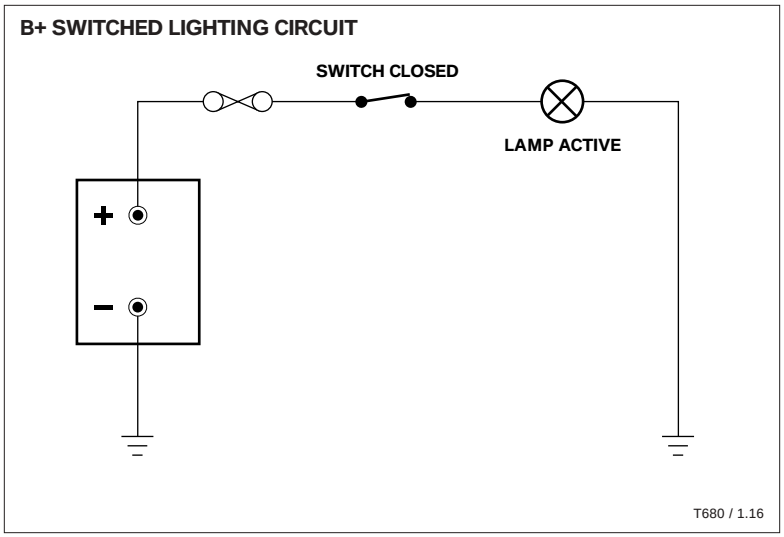
Each module on a multiplex network has access to the data transmitted by other network modules. Modules use this data to control their assigned functions. Multiplexing reduces the amount of wires, connections and components, increases functionality, improves reliability and improves diagnostic access to the vehicle. Function control requirements for different markets can be added or deleted to the vehicle by changing the control module software or the modules connected to the multiplex circuit.

NOTES

Control Circuits

The purpose of a conventional electrical or a multiplex control circuit is to activate or control a function in response to an input. The input can be an operator command such as pressing a switch, an electrical input from a sensor such as wheel speed, or a signal from another control module such as engine speed.

The following circuits are examples of some inputs and outputs that control vehicle systems.

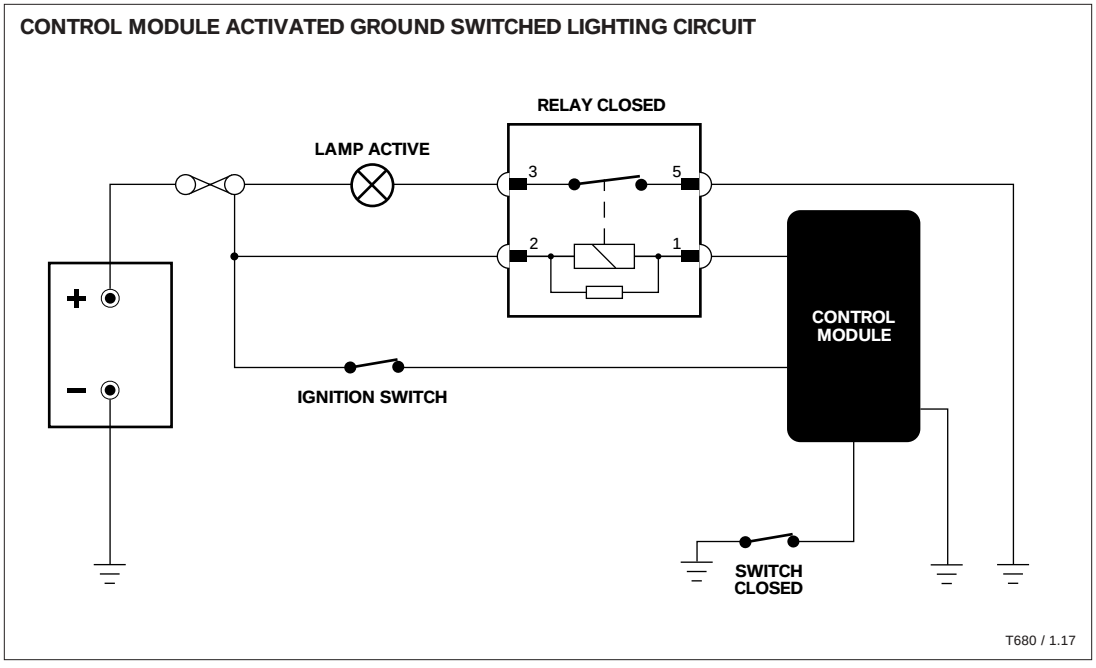


B+ switched lighting circuit

In this circuit, the input is the closing of a switch. The output is a voltage signal that results in activating the lamp.

Control module activated ground switched lighting circuit

In this circuit, more than one input and output can be required to activate the lamp. The first input is closing a switch that inputs a ground signal to the control module. The control module outputs a ground signal to the relay coil causing the relay contacts to close. The relay outputs (provides) the ground to activate the lamp.



NOTES

Multiplex controlled functions

Inputs

Multiplexed control modules use conventional inputs from the sensors or switches that are directly connected to them (hard wired). The control modules also use data message inputs from other control modules connected to the multiplex circuit.

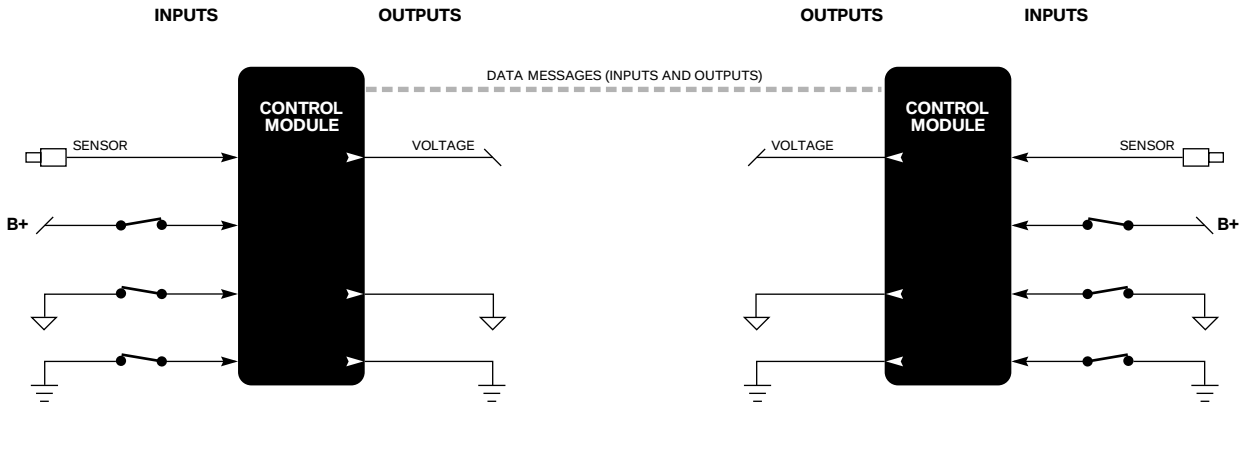
Outputs

The control modules output conventional voltage signals (via individual hard wires) to directly control components. They also output data messages to the network that are used by other control modules.

Shared function control

Because control modules can transmit data messages to each other over the shared network, they can share control functions. One module can activate a function based on inputs received from one or a number of other modules.

EXAMPLES OF MULTIPLEX INPUTS AND OUTPUTS

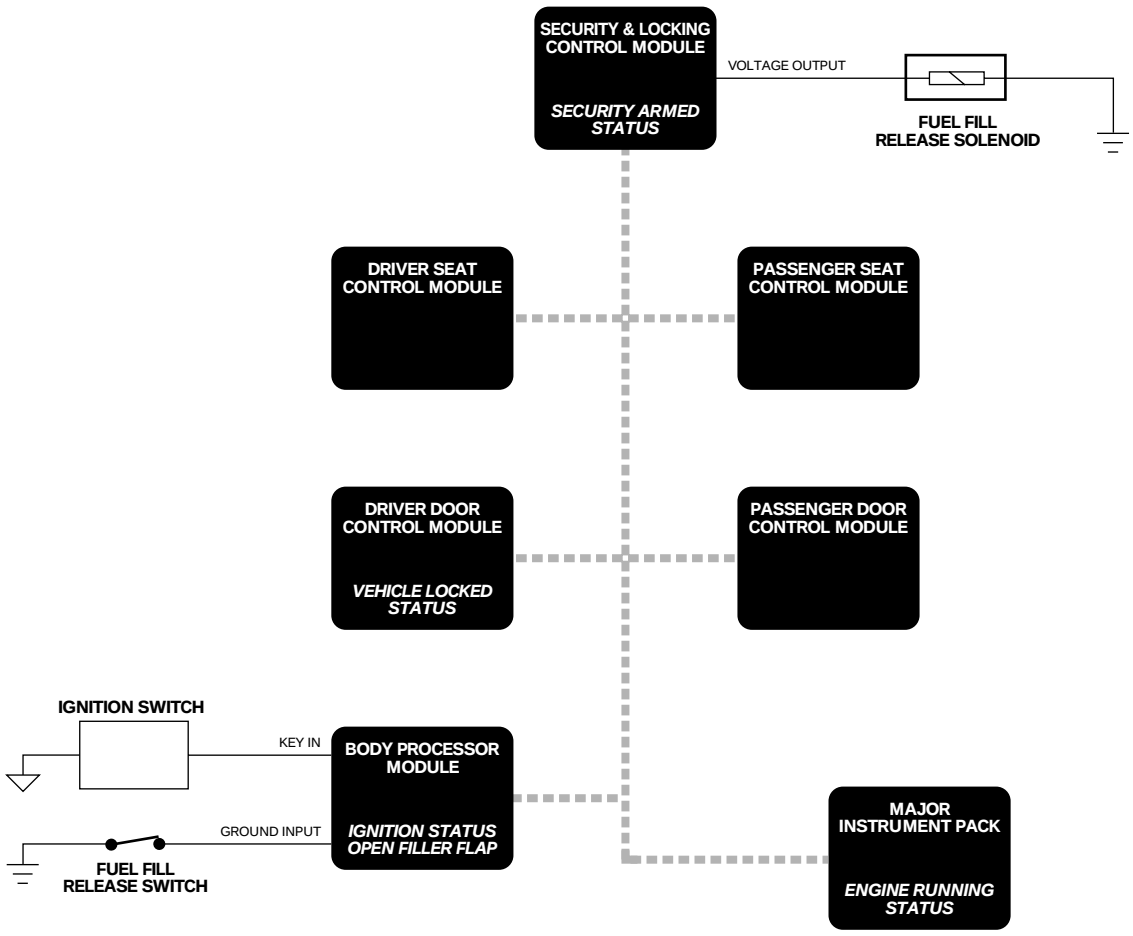


NOTES

Multiplex controlled fuel filler flap circuit

In this circuit, a ground input from the fuel filler flap release switch triggers the body processor module to broadcast an *OPEN FUEL FILLER FLAP* data message on the SCP multiplex network. In response to the data message, the security and locking control module (the closest module to the filler flap) outputs a voltage to activate the filler flap release solenoid. If other data messages on the network indicate that the engine is running, the security system is armed, the vehicle is either locked or the key is not in the ignition, then the open fuel filler flap data message is inhibited.

MULTIPLEX CONTROLLED FUEL FILLER FLAP



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NOTES

Nonmultiplexed signal distribution

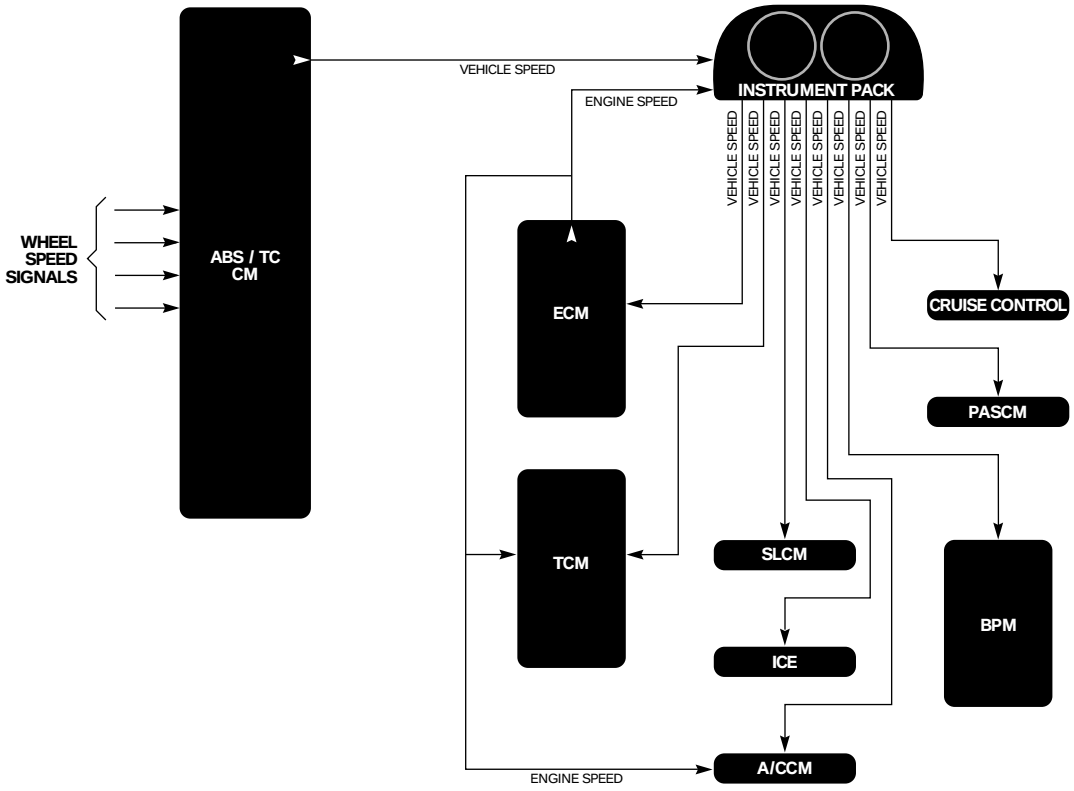
This circuit demonstrates how a vehicle without multiplexing distributes a vehicle speed signal output using the inputs from the four wheel speed sensors. The ABS CM transmits one wheel speed sensor signal to the instrument pack to be used as the vehicle speed signal for the speedometer and for distribution to other vehicle systems.

Control component	Function
INST (instrument pack)	Speedometer
TCM (transmission control module)	Transmission shift control
ICE (radio / cassette head)	ICE volume
A/CCM (air conditioning control module)	Climate control blower speed
ECM (engine control module)	Engine control
PASCM (power assisted steering control module)	Variable assist power steering
SCCM (speed control control module)	Cruise control
BPM (body processor control module)	Wiper speed control
SLCM (security and locking control module)	Locking and security functions

Each of the components receives its vehicle speed input via a separate (hard wired) circuit.

NOTES

NONMULTIPLEXED WHEEL AND VEHICLE SPEED SIGNAL DISTRIBUTION



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Multiplexed signal distribution

This circuit demonstrates how a vehicle speed signal is distributed via multiplex circuits.

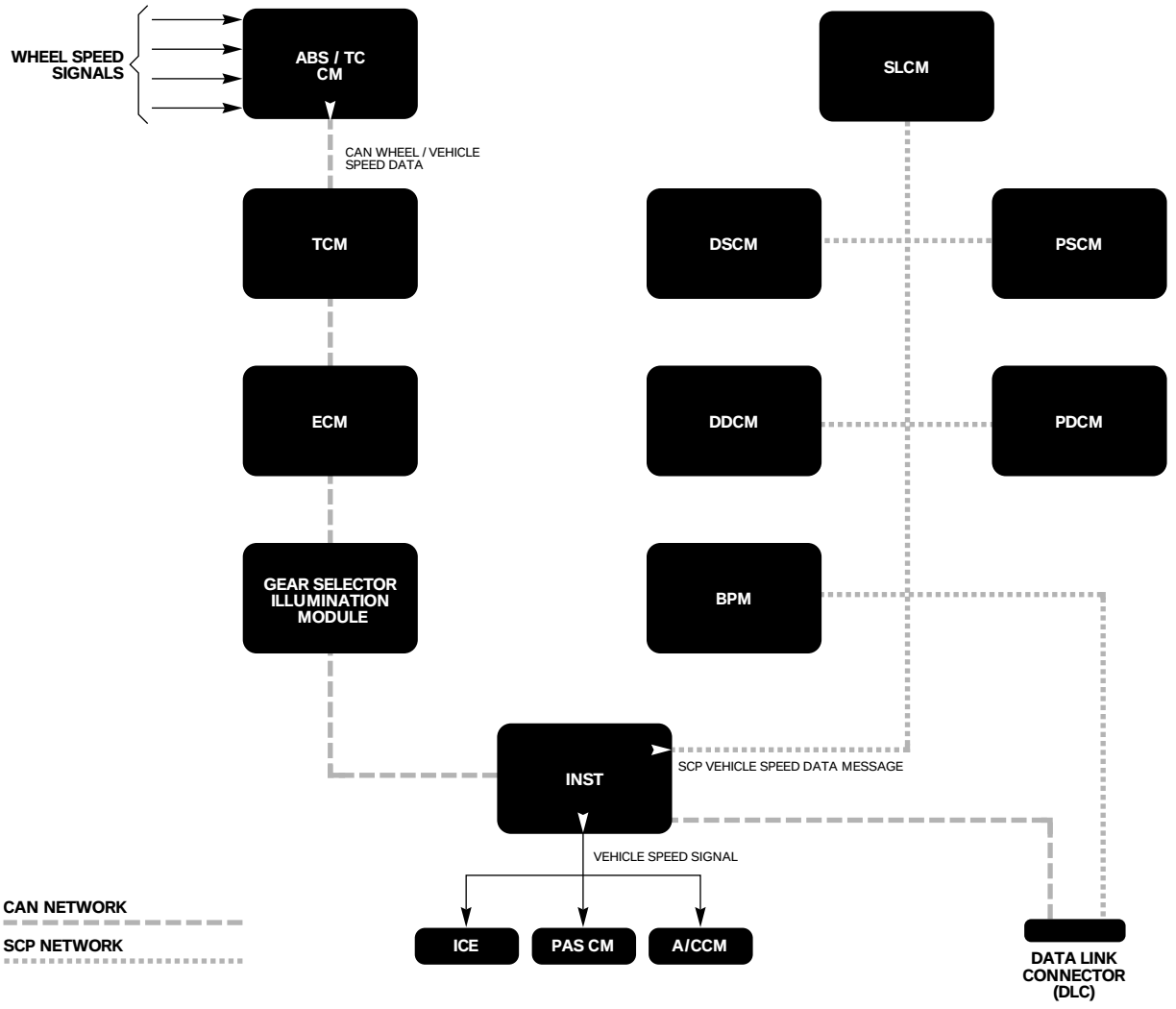
The four wheel speed signals are used by the ABS / TCCM to provide anti-lock braking and traction control. The ABS / TCCM communicates a data messages on the CAN multiplex network. The messages contains data for the four individual wheel speeds plus the vehicle speed. The TCM and ECM are connected to the CAN multiplex circuit and use the wheel and vehicle speed data for control of their functions. The INST (instrument pack) is also connected to the CAN network and converts the vehicle speed data message for use by the speedometer, SCP (body systems) multiplex circuit and nonmultiplexed components.

Control component	Function
TCM (transmission control module)	Transmission shift control
ECM (engine control module)	Engine control, cruise control
INST (instrument pack)	Speedometer
BPM (body processor control module)	Convertible top
SLCM (security and locking control module)	Locking and security functions
ICE (radio / cassette head)	ICE volume
A/CCM (air conditioning control module)	Climate control blower speed
PASCM (power steering control module)	Variable assist power steering

All modules connected to the multiplex circuits share the same message data using only the network wiring and connectors. Modules not connected to the networks (ICE, PASCM and A/CCM) receive the vehicle speed signal via separate hard wires.

NOTES

MULTIPLEXED WHEEL AND VEHICLE SPEED SIGNAL DISTRIBUTION



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Multiplex Networks

Automotive multiplex system classification

Multiplex systems are classed as follows:

- **Class A** transmits up to 10,000 bits of information / second (10 kBaud)
- **Class B** transmits up to 125,000 bits of information / second (10 – 125 kBaud)
- **Class C** transmits over 125,000 bits of information / second (125 kBaud)

Multiplex communication speeds

Jaguar uses two multiplex networks consisting of two separate circuits (busses) that operate at different speeds.

The SCP network (standard corporate protocol [Ford]) is a class B (41.6 kBaud) network connecting the body systems modules: INST, BPM, SLCM, PDCM (passenger door control module), DDCM (driver door control module), PSCM (passenger seat control module) and DSCM (driver seat control module).

The CAN network (controller area network) is a class C (500 kBaud) network connecting the power train modules: ABS / TCCM, TCM, ECM, gear selector illumination module and INST.

CAN and SCP operate at different speeds and use different communications protocols (message structures). They cannot communicate data messages directly with each other. However, both the CAN and SCP networks are connected to the INST, which functions as a "gateway." The "gateway" translates certain data messages so they can be understood and shared between the two networks.

Additional serial communications circuits allow PDU diagnosis of nonmultiplexed control modules via the DLC. The additional serial communication links are class B (10.4 kBaud) networks that perform the same function as in previous vehicles. They are often referred to as ISO (International Organization for Standardization) links because they conform to ISO standard 9141/2 and Society of Automotive Engineers (SAE) standard J 1978.

NOTE: The serial communications data rate of Sedan Range Vehicles through 1994 MY is 4.8 kBaud (4,800 bits of data a second).

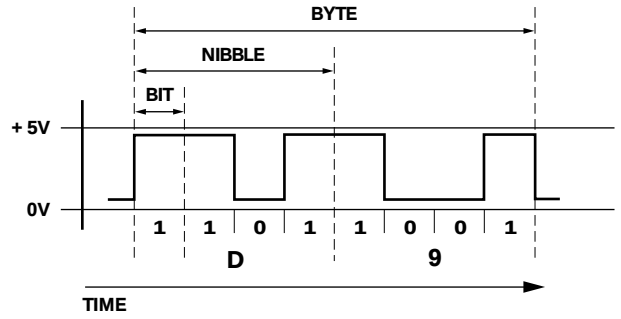
NOTES

Data Messages

Data messages are binary code values transmitted as a series of timed voltage signals on the multiplex bus. A five volt signal is assigned a value of 1 and a zero voltage signal is assigned the value of 0. Each binary code 1 or 0 is called a "bit". A grouping of four binary code data bits (called a "nibble") makes up one character. A grouping of eight data bits (called a "byte") makes up two characters.

Jaguar uses a "time divided" multiplex system that distinguishes the serial "bits" of binary code (1's and 0's) by the amount of time that the signal is high or low.

DATA MESSAGE "BYTE"



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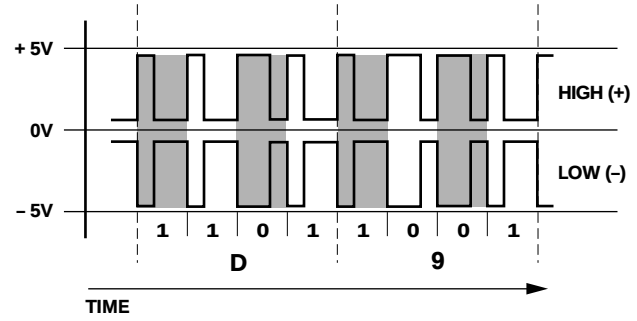
Data message transmission

The multiplex bus consists of two wires that are twisted together – one high (+) and the other low (–). When a module transmits a data bit, it drives the voltage on one wire high and the voltage on the other wire low for a certain period of time. The opposing high and low voltages on the twisted bus wires cancel the possibility of electrical interference being induced into the bus.

Binary code values can be converted by a decimal or hexadecimal decoding system so they can be understood as alphabetic or numeric characters.

DATA MESSAGE VOLTAGES



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Binary	Decimal	Hexadecimal	Binary	Decimal	Hexadecimal
0000	0	0	1000	8	8
0001	1	1	1001	9	9
0010	2	2	1010	10	A
0011	3	3	1011	11	B
0100	4	4	1100	12	C
0101	5	5	1101	13	D
0110	6	6	1110	14	E
0111	7	7	1111	15	F

The binary code "byte" 11011001 translates as D9 when hexadecimal decoded or the number 139 when decimal decoded.

NOTES

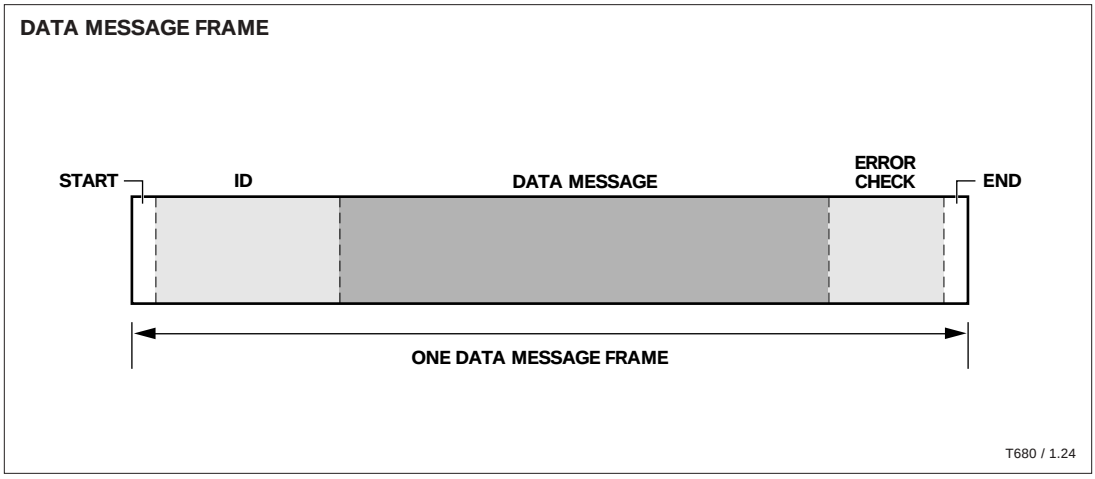
Data Messages (continued)

Data message frame

Data is transmitted on the bus within a data message "frame." A frame contains a number of separate parts or fields that contain the following data:

- The beginning and end of the frame
- The frame identification
- The data message
- Error checking information

A complete data message frame is a serially transmitted stream of binary data 1's and 0's.



Multiplex messages are communicated one at a time over the network bus. A bus can be compared to a single lane road and each data message frame to a vehicle. The capacity of the road is much greater than the maximum traffic at any one time so there is little possibility of one message frame colliding with another. Also, each module constantly watches the network message traffic by monitoring the bus voltages and will not begin a communication until the bus is clear. If two modules attempt communication at the same instant, a method of "arbitration" assures that the message frame with the highest priority will always be communicated. The module with the lower priority message frame will stop transmitting and try again when the bus is clear. Only one message frame will be transmitted on the bus at a time.

NOTES

SCP (Standard Corporate Protocol [Ford version]) Network

The SCP bus is two standard 0.5 mm copper wires twisted as a pair, with 40 twists per meter (39.37 in.). One wire of the pair is designated as SCP high (+) and the other is designated as SCP low (–). The network is wired as a "star" circuit. This method of wiring keeps the network bus as short as possible and allows the rest of the system to continue communication should one module fail. Bus integrity is maintained by using the vehicle speed data message as a "keep alive" signal. If the "keep alive" message is not received by a module, the module assumes that there is a communications fault and takes itself off line. Refer to the Electrical Guide Appendix pages for individual module messages.

The following control modules communicate directly through the SCP network:

- Major instrument pack (INST)
- Body processor control module (BPM)
- Security locking and control module (SLCM)
- Passenger door control module (PDCM)
- Driver door control module (DDCM)
- Passenger seat control module (PSCM)
- Driver seat control module (DSCM)
- Driver rear door control module (DRDCM) (XJ8 Series Sedan only)
- Passenger rear door control module (PRDCM) (XJ8 Series Sedan only)

The SCP network is also connected to the DLC (data link connector) for diagnostics.

NOTE: All modules have fail safe default modes in the event of a network failure.

SCP data message frames

Each SCP data message frame is a complete message unit communicating only the data for one action. Messages on the bus are available to all of the modules connected to the bus but are only "used" by a module if required.

There are 3 general types of SCP data messages:

Cyclical messages are messages that are transmitted on the bus at specified intervals. *VEHICLE SPEED, ENGINE RUNNING* and *CHARGING OK* are examples of three separate cyclical messages that are transmitted by the INST at least every 150 ms.

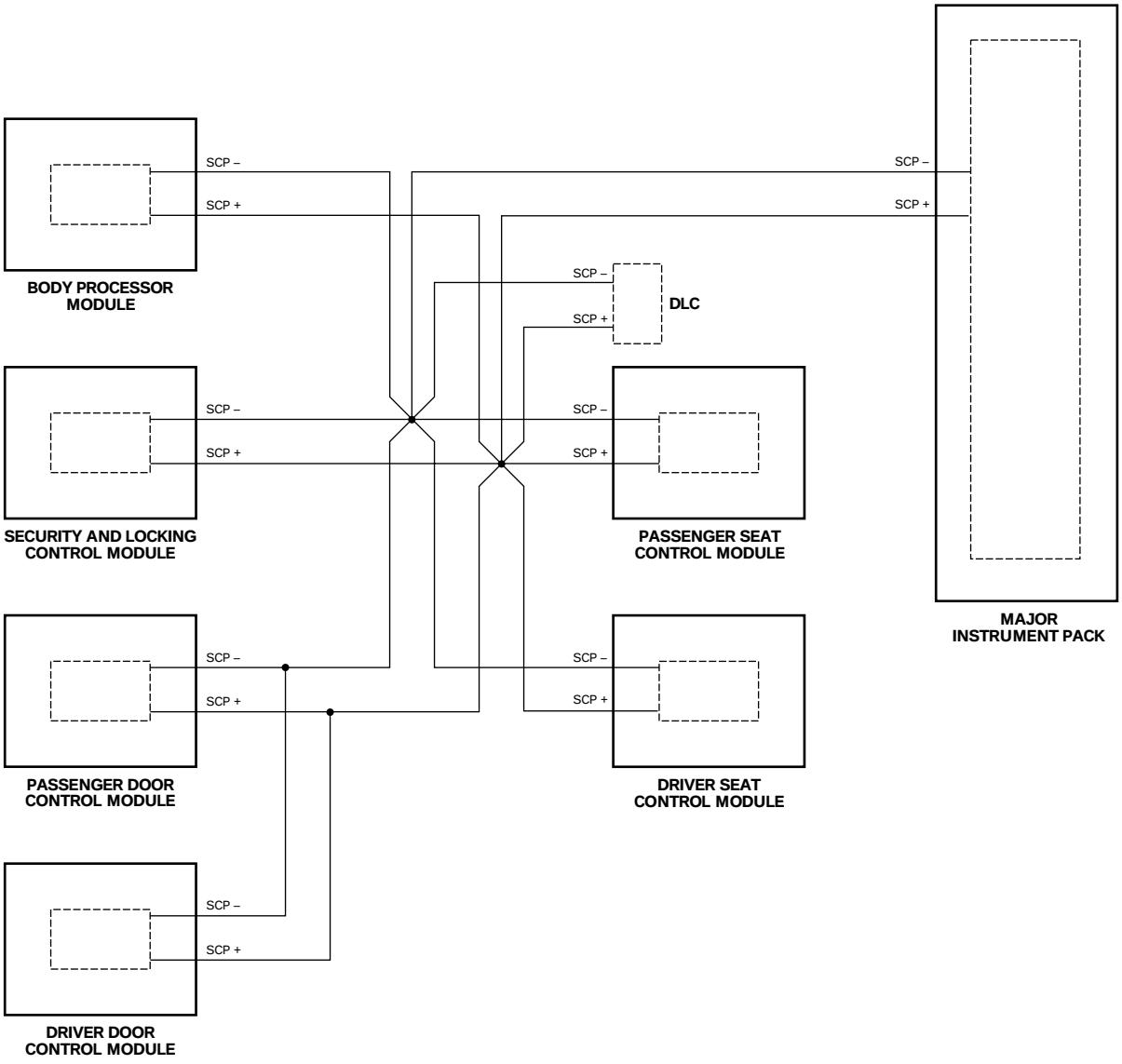
Event messages are messages that are sent once, or for a specific number of times, when something happens. *KEY IN IGNITION* is a message sent by the BPM for use by the SLCM, DDCM and PDCM. The message is transmitted when the key is put into the ignition switch. When the key is withdrawn from the switch, *KEY NOT IN IGNITION* is sent by the BPM to be used by the same modules. Event messages are often used to "toggle" a function ON and OFF through another module.

Request messages ask for specific data. An example of a request message is *REQUEST KEY-IN STATUS* sent by the SLCM, DDCM or PDCM. The BPM then responds with a key status message – either *KEY IN IGNITION* or *KEY NOT IN IGNITION*.

NOTES

SCP (Standard Corporate Protocol [Ford version]) Network (continued)

SCP MULTIPLEX CIRCUIT LAYOUT: XK8



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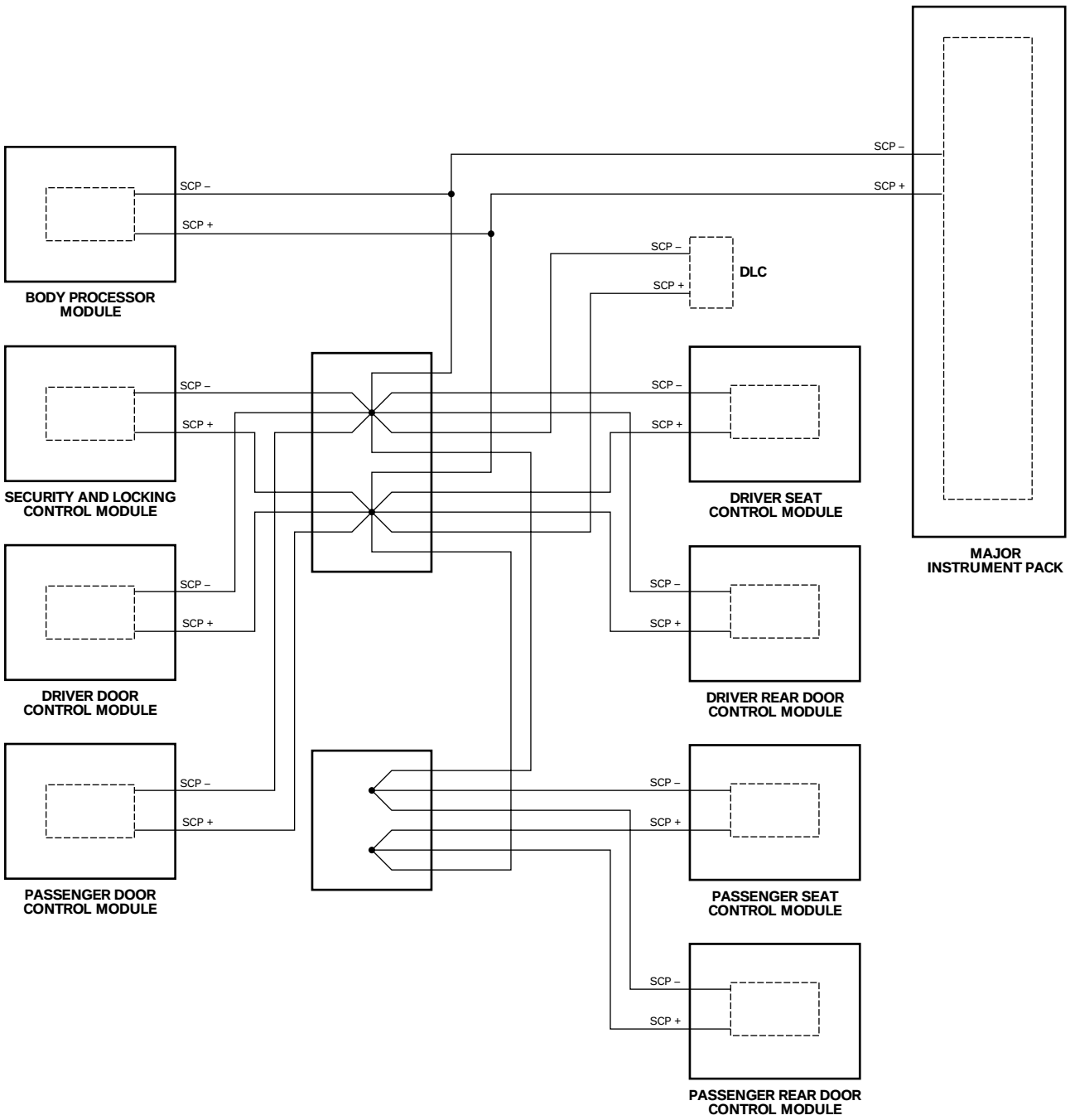
SCP MULTIPLEX CIRCUIT LAYOUT: XJ SERIES SEDAN



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CAN (Controller Area Network)

The CAN bus is two standard 0.5 mm copper wires twisted as a pair, with 40 twists per meter (39.37 in.). One wire of the pair is designated as CAN high (+) and the other is designated as CAN low (–). Although CAN appears wired as a series circuit, it is parallel because of internal module wiring. However, a fault in the internal wiring or connector can stop the network from communicating across the fault. But, each module will still continue to control its own functions by substituting default information for any missing data messages. Refer to the Electrical Guide Appendix pages for individual module messages.

CAN is called “real time” communication because its speed allows extremely fast response time for controlling time critical operations.

The following control modules communicate directly through the CAN network:

- Anti-lock braking / traction control module (ABS / TCCM)
- Engine control module (ECM)
- Transmission control module (TCM)
- Gear selector illumination module – does not transmit, used only for gear selector position illumination
- Major instrument pack (INST)

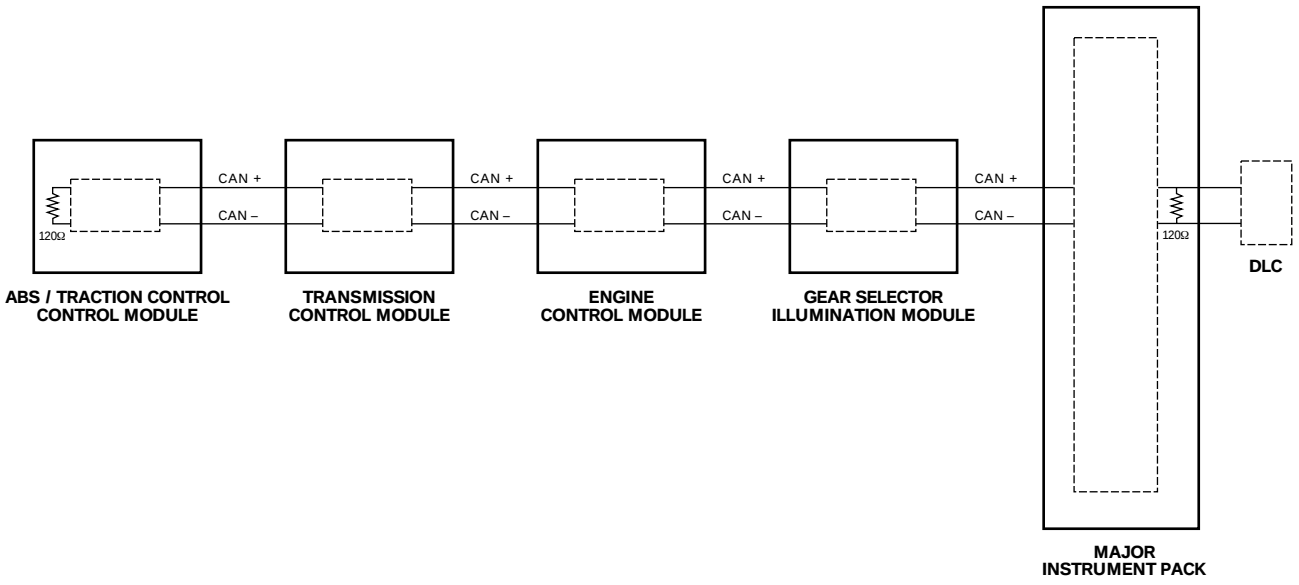
The CAN network is also connected to the DLC (data link connector) for diagnostics.

CAN does not communicate directly with SCP. However, the INST converts specific message data allowing communication between networks.

NOTE: All modules have fail safe default modes in the event of a network failure.

NOTES

CAN MULTIPLEX CIRCUIT LAYOUT: XK8 AND NORMALLY ASPIRATED XJ SERIES SEDAN



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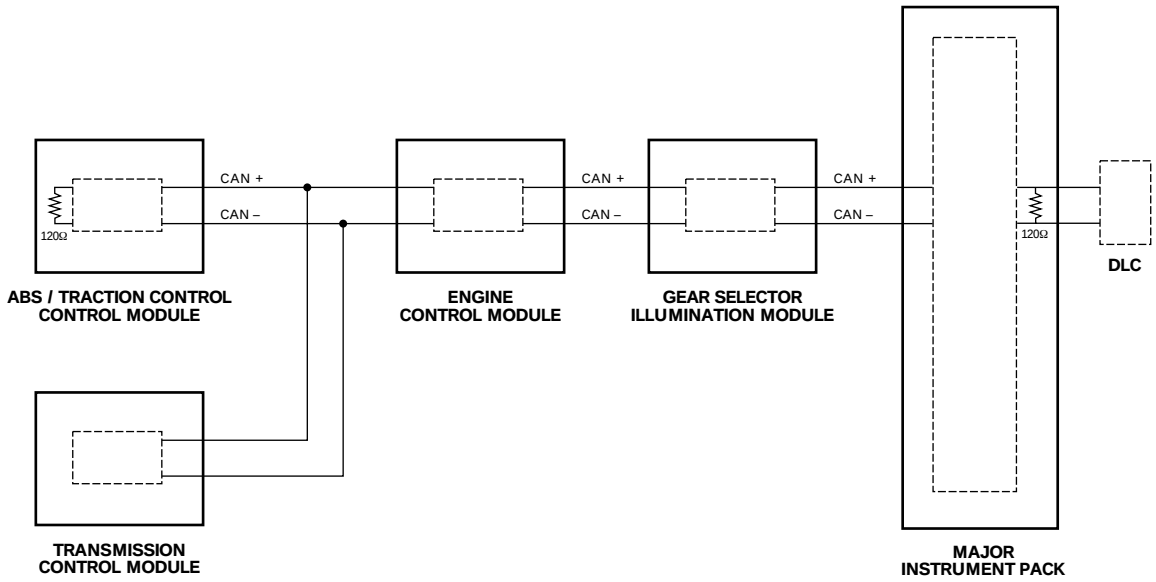
CAN MULTIPLEX CIRCUIT LAYOUT: SUPERCHARGED XJ SERIES SEDAN



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CAN (Controller Area Network) (continued)

CAN data message frames

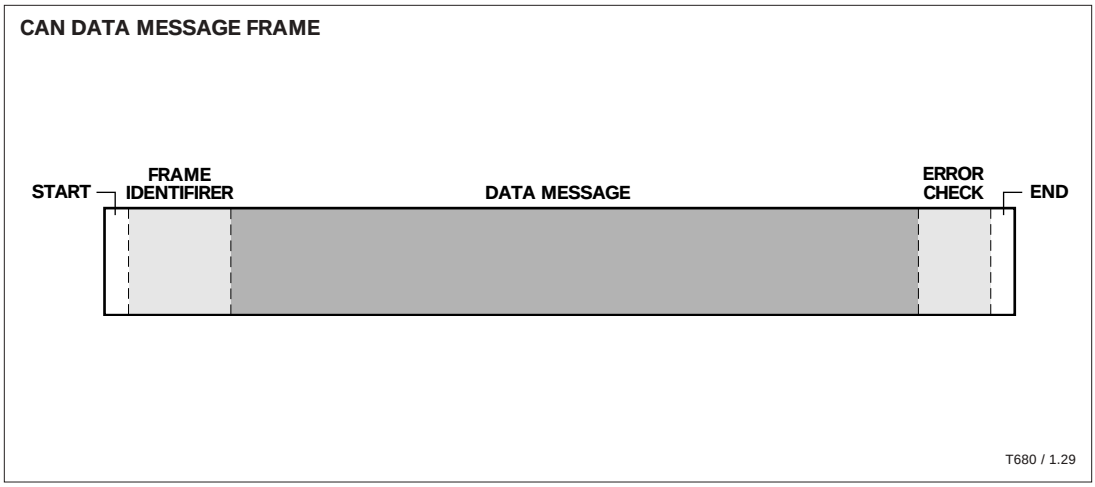
CAN data messages frames contain more data than SCP message frames. Each CAN data message frame contains specific data from the module. The transmitting module and the data contained in a message frame are identified by a frame identifier number. Each bit of data within a CAN data message frame is assigned a fixed position within the data message field.

Each module transmits three types of data messages:

Vehicle operation data messages, which are transmitted cyclically

Module token data messages, which are transmitted cyclically. The token message tells the network that the module is "alive".

Diagnostic data messages, which contain diagnostic data are only transmitted when requested by PDU / MPA



Example of vehicle operation data messages:

The ABS / TCCM transmits three separate vehicle operation data message frames. One message frame contains the torque reduction data required for traction control and automatic stability control functions. A separate message frame contains the traction control and automatic stability control status, and vehicle speed and distance traveled data. The remaining message frame contains the individual wheel speed data. CAN message frames are transmitted at 4 ms to 200 ms intervals depending on the frame. Messages on the CAN bus are available to all CAN modules but are only "used" by a module if required.

The number of separate operational data message frames that a module is designed to transmit depends on the amount of data required by other modules.

XK8 Module	Number of Operational Data Message Frames
ABS / TCCM	3
ECM	3
TCM	2
INST	1

NOTES

Data Link Connector (DLC) Serial Communication Links

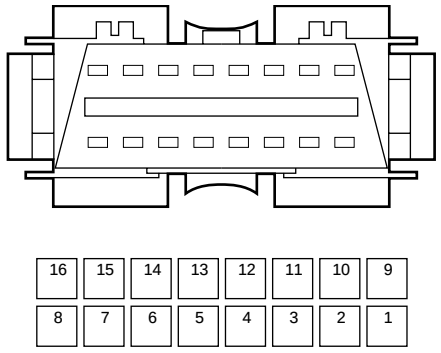
Both the CAN and SCP networks are directly connected to the DLC. PDU / MPA contains hardware and software that allows it to function as a "node," an additional module added to the networks. The software and hardware supports direct communications between PDU / MPA and the CAN or SCP networks for diagnostics. In addition, PDU / MPA software and internal hardware allows direct communication via the DLC with nonmultiplexed modules using ISO 9141/2 standard serial data communications links. ISO 9141/2 serial data communication protocols are different from either the CAN or SCP protocols.

The ISO 9141/2 communications links connect the following components to the DLC:

- ECM — Legislated OBD II DTC and freeze frame generic scan tool diagnostic connection. This link is also used by PDU / MPA for OBD II DTCs and freeze frame data.
- ECM — Module "flash" programming during vehicle manufacturing
- A/CCM — PDU diagnostics
- Airbag / SRS CM — PDU diagnostics

NOTE: Generic scan tools communicate only with the ECM for OBD II DTCs and legislated freeze frame data.

DATA LINK CONNECTOR (DLC)



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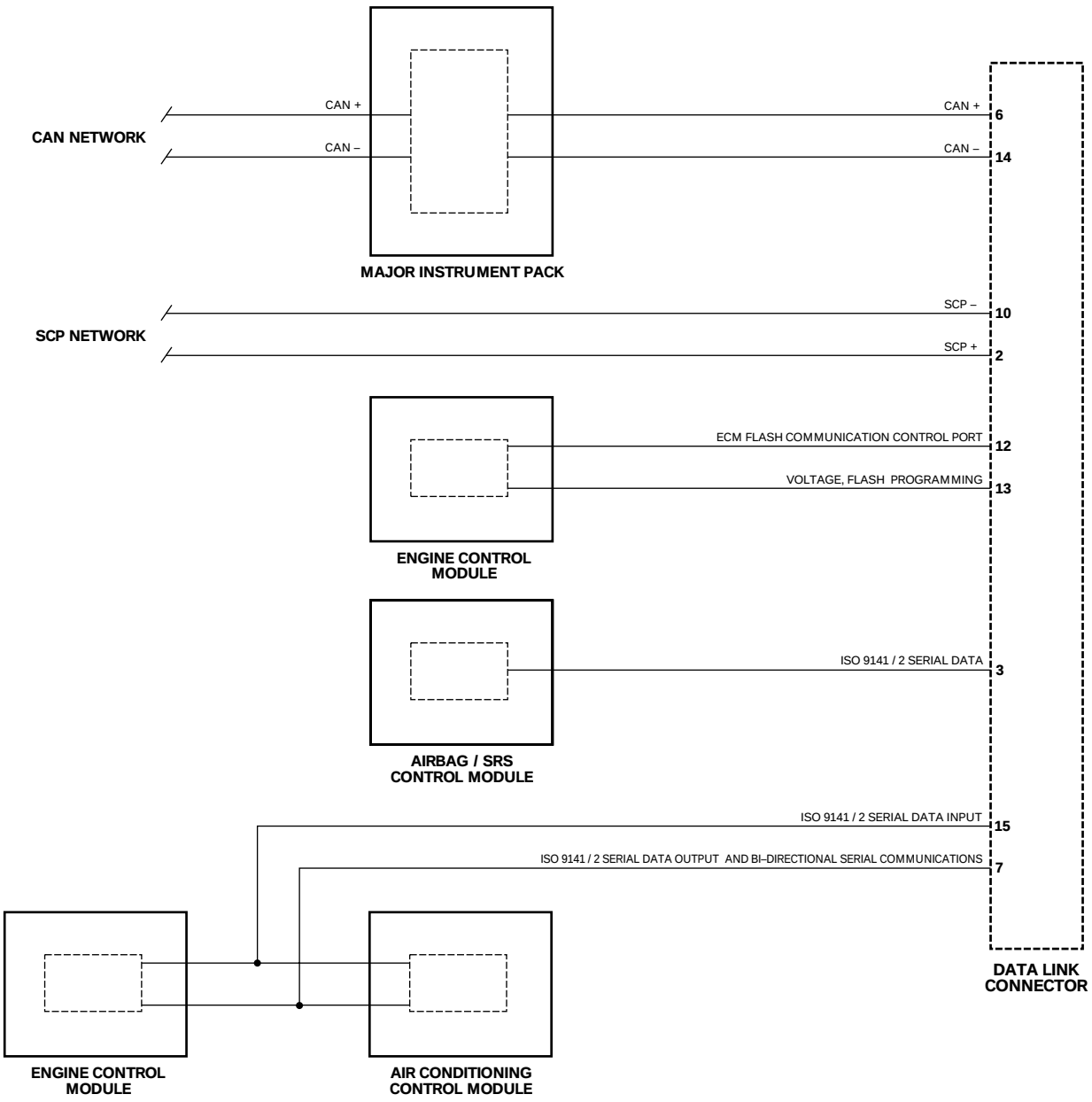
Data Link Connector Pinouts

Pin	Description
1	Ignition position II switched ground
2	SCP high (+)
3	Airbag / SRS CM communications link (XK8 only)
4	Power ground
5	Logic ground
6	CAN high (+)
7	ECM OBD II DTC and non SCP modules
8	Ignition position I switched ground
9	Ignition switched B+
10	SCP low (–)
11	Not used
12	ECM programming (manufacturing use)
13	ECM programming (manufacturing use)
14	CAN low (–)
15	ECM OBD II DTC and non SCP modules
16	B+ supply

NOTES

Data Link Connector (DLC) Serial Communication Links (continued)

DATA LINK CONNECTOR (DLC) SERIAL COMMUNICATION LINKS: 1997 XK8



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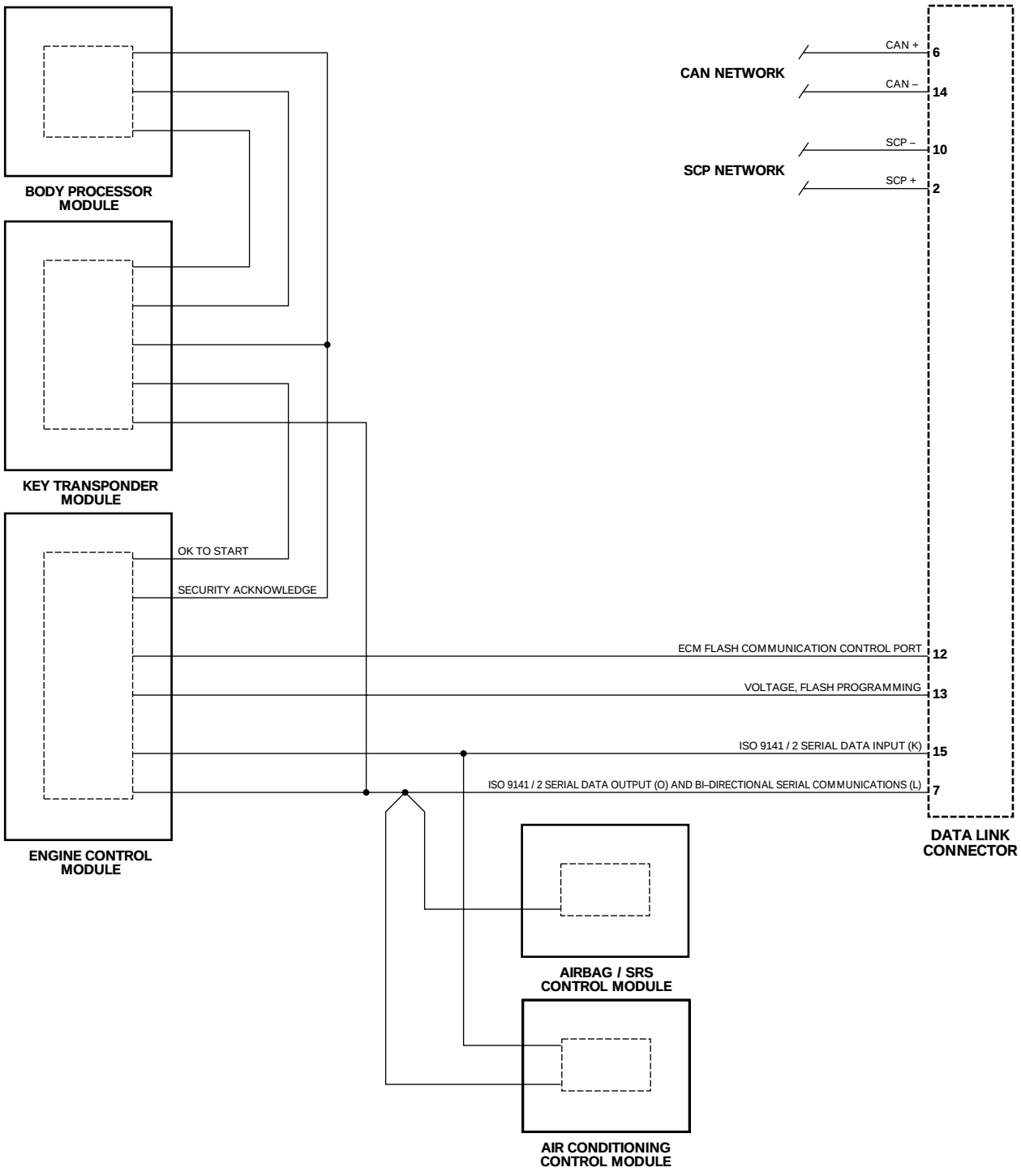
DATA LINK CONNECTOR (DLC) SERIAL COMMUNICATION LINKS: XJ SERIES SEDAN



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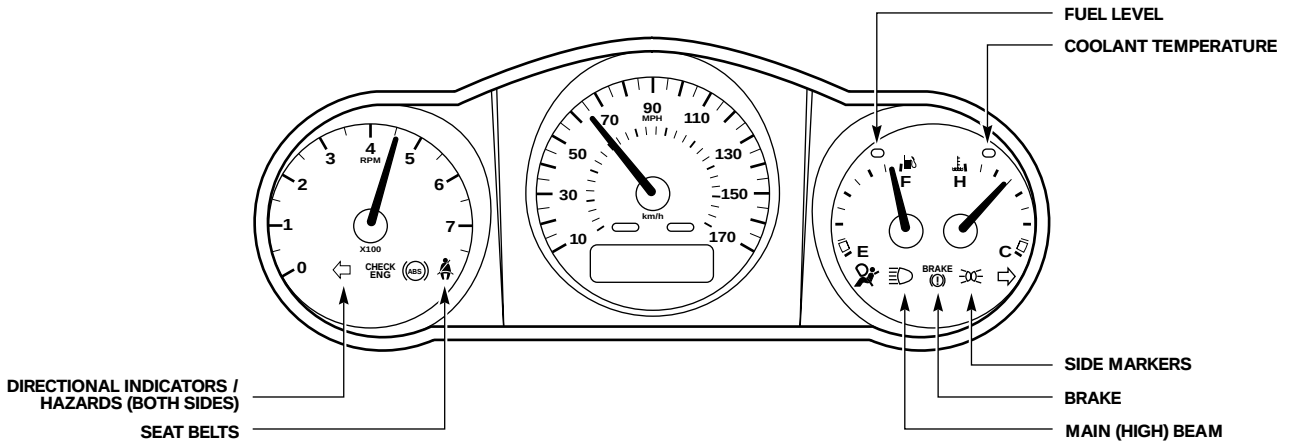
Instrumentation

Vehicle instrumentation is contained in the major instrument pack (INST) and the minor instrument pack. Inputs and outputs to the minor instrument pack are supplied by the INST.

NOTE: Sedan vehicles do not use a minor instrument pack.

INSTRUMENT PACK DISPLAY: XJ SERIES SEDAN



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Instrument pack (INST)

The INST is a microprocessor-controlled module that is connected to both the CAN and SCP networks. The INST performs a number of functions in addition to displaying information for the driver.

Additional INST functions include the following:

Multiplex network “gateway”

The INST translates certain data messages to allow communications between the SCP and CAN networks.

Data message conversion

Nonmultiplexed modules receive required data from the networks via hard wired connection to the INST. The INST converts the required data to a form that can be read by the nonmultiplexed modules.

Driver for the minor instrument pack (XK8 only)

The INST provides power, control and ground signals to the XK8 minor instrument pack. If the minor instrument pack, containing the clock, battery condition gauge and the oil pressure gauge is disconnected from the INST, it should be reconnected before battery power is restored to allow the INST to initialize and calibrate the gauges.

Lamp Replacement

Background illumination, directional indicator and main (high) beam indicator lamps are replaceable. The side lamps / headlamps ON indicator is not replaceable. All other indicator and warning lights are LEDs and are non-replaceable.

NOTES

Warnings

Audible warnings

Audible warnings are driven by BPM control of the audible warning speaker located in the steering column switch gear.

Warning	Condition
Directional and hazard indicators	Directional or hazard indicators active
Side markers ON	Ignition OFF and driver door open
Ignition key in	Ignition in position 0 or I and driver door open
Seat belt	Ignition in position 2 and driver seat belt not buckled
Airbag / SRS fault	Fault in airbag / SRS system
Not-in-park warning	Ignition switched from position II to position I with gear selector not in park
Memory	Memory position set or recalled
Valet mode	Valet switch pressed with trunk closed or trunk release pressed while in valet mode
Convertible top movement	Top switch activated and top ready to open / close
Top movement cycle complete	Top up or down cycle completed

Visual warning lamps

Visual warning lamps are driven by the INST with input from CAN, SCP or hard wires.

Warning	Condition	Source
Engine oil pressure (XK8 only)	Oil pressure below specification	Oil pressure switch
Charge indicator (XK8 only)	Charge rate below specification	Generator
Directional left and right	Ignition in position II and directional indicator active	BPM
Hazard indicator	All ignition positions and hazard indicator active	BPM
Fuel level low	Fuel level below minimum	Fuel level sensor
Coolant temperature high	Coolant temperature above specification	ECM
Seat belt warning	Ignition switched to position II and driver seat belt unbuckled	DSCM
Main beam indicator	All ignition positions and main (high) beam active	BPM
Side marker status	Side markers or low beams active	BPM
Brake	Park brake ON or low brake fluid	ECM ABS / TCCM

Two additional warning lamps above the message center, the AMBER MIL and the RED MIL, activate to call the driver's attention to text in the message center. The RED MIL is used for high priority messages and the AMBER MIL is used for lower priority messages. Refer to the table of messages on page 39.

NOTES

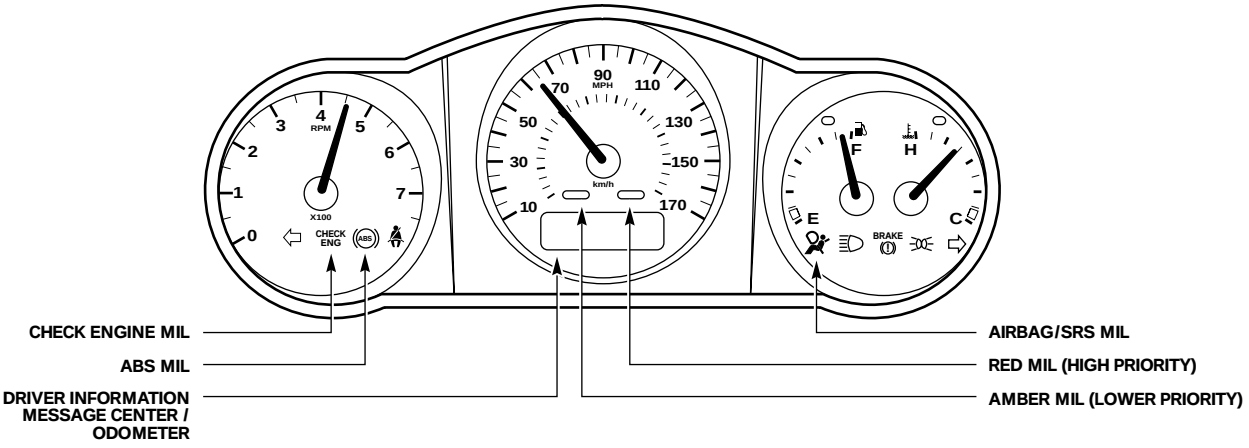
Malfunction Indicator Lamps (MILs)

The following MILs display to alert the driver to vehicle faults. Refer to the literature explaining the individual vehicle systems for descriptions of MIL parameters. An active MIL indicates that a DTC or DTCs are stored in the module memory. Certain DTCs are stored without activating a MIL. The ECM acts as the "host" for all OBD II DTCs and stores OBD II DTC data from the other modules. OBD II DTCs are indicated by the CHECK ENGINE MIL.

MIL	Fault
CHECK ENG MIL	EMS or OBD II fault
ABS MIL	ABS, Traction / ASC fault
Airbag / SRS MIL	Airbag SRS fault

Two additional MILs are located in the speedometer. The RED or AMBER MIL will activate to alert the driver of vehicle faults depending on the type and priority of the fault.

MALFUNCTION INDICATOR LAMPS AND DRIVER INFORMATION MESSAGE CENTER: XJ SERIES SEDAN



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Driver Information Message Center

The driver message center, located in the speedometer, displays the odometer, trip computer data, and driver warning / information messages. The display is a 12 character LCD that is active when the ignition or interior lights are ON. When the interior lights are active the display is bright and when the exterior lights are switched ON the display is dimmed. The interior light dimmer switch will also dim the message center display but has no effect on the other warning lights.

Odometer

The odometer displays in the message center at ignition ON and after the lamp check cycle. It also displays when the ignition is OFF if the side lamps or interior lamps are active.

NOTES

Driver warning / information messages

If a vehicle fault occurs, a driver warning / information text message is immediately displayed on the message center. Either the RED or AMBER MIL activates with most warning / information messages. The RED MIL is active for high priority messages, indicating that the vehicle should be stopped as soon as possible to investigate the cause of the message.

Pressing the trip computer CLEAR button hides one displayed message. The MIL remains active. If more than one message is stored, the CLEAR button must be pressed again to clear each message. Further presses cycle the display through trip information, odometer and back to the warning / information message. Refer to Trip Computer, page 40. If a message is hidden and the fault remains at the next ignition ON cycle, the message will be redisplayed.

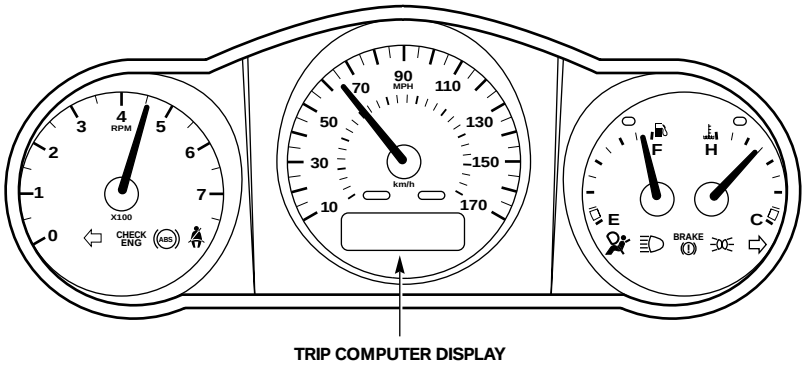
Message	Priority MIL	Description	Source
SYSTEM CHECK	BOTH	Instrument pack, module and lamp check at ignition ON	INST
CONVERTIBLE LATCH FAIL	RED	XK8 convertible only – Top open, unlocked or latch fault	BPM
DRIVER REAR DOOR OPEN	RED	Sedan only – Driver rear door switch active	DRDCM
DRIVER DOOR OPEN	RED	Driver door switch active	DDCM
ENGINE COOLANT LOW	RED	Coolant level below reservoir minimum	INST
ENGINE STALLED	RED	Engine speed below 10 rpm	ECM
HOOD OPEN	RED	Hood switch active	BPM
PARK BRAKE ON	RED	Parking brake applied	ECM
PASSENGER REAR DOOR OPEN	RED	Sedan only – Passenger rear door switch active	PRDCM
PASSENGER DOOR OPEN	RED	Passenger door switch active	PDCM
POOR VEHICLE PERFORMANCE	RED	XK8 only – Loss of power or driveability DO NOT DRIVE VEHICLE	ECM
RESTRICTED PERFORMANCE	RED	Sedan only – Loss of power or driveability DO NOT DRIVE VEHICLE	ECM
TRUNK OPEN	RED	Trunk switch active	SLCM
ASC	AMBER	Traction control or ASC active (may flash)	ABS / TCCM
STOP LAMP FAIL	AMBER	Sedan only – Failed stop lamp	SLCM
TAIL LAMP FAIL	AMBER	Sedan only – Failed tail or number plate lamp	BPM
BULB FAIL REAR	AMBER	XK8 only – Failed tail, number plate or brake lamp	SLCM
CRUISE INHIBITED	AMBER	Cruise control fault	ECM
ELECTRICAL FAULT	AMBER	Charging or electrical communication fault	INST
FAIL SAFE ENGINE MODE	AMBER	Sedan only – Loss of power or driveability	ECM
POOR VEHICLE PERFORMANCE	AMBER	XK8 only – Loss of power or driveability	ECM
STABILITY CONTROL FAIL	AMBER	ASC fault	ABS / TCCM
TRACTION CONTROL FAIL	AMBER	Traction control fault	ABS / TCCM
TRANSMISSION FAULT	AMBER	Transmission in limp home mode	TCM
TRANSMISSION HIGH TEMP	AMBER	Transmission in hot mode	TCM
WASHER FLUID LOW	AMBER	Washer fluid below reservoir minimum	BPM
RECODING KEY RING	None	Remote transmitter may be recoded	SLCM
VALET MODE	None	3 second display when valet mode is active and trunk release is pressed	SLCM

Trip Computer

The trip computer uses two separate memory sites to store data for a trip or a series of trips until it is reset to zero. Trip data is displayed on the driver message center when the ignition is in position II.

The two memory sites (A and B) allow data from trips to be stored separately. The memory sites are useful if the driver wishes to track business usage mileage and personal mileage at the same time. All trip data except for Range and Current Fuel Usage are prefixed by the letter A or B depending on the which trip memory site is selected.

TRIP COMPUTER DISPLAY: XJ SERIES SEDAN



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The following data are available:

Odometer Total vehicle distance traveled.

Trip Distance Distance traveled since the last memory reset (maximum trip distance is 9999.9 miles [16090 kilometers]). The computer resets to zero if the maximum trip distance is exceeded.

Range Distance that the vehicle could travel in miles (kilometers) on the remaining fuel if the average speed and fuel consumption remain constant.

Fuel Used The amount of fuel used in gallons (liters) since the last memory reset.

Average Fuel Average fuel consumption in miles per gallon (liters /100 km) since the last memory reset.

Current Fuel Usage The “at the moment” fuel consumption in miles per gallon (liters /100 km) calculated over a three second period and continuously updated.

Average Speed The average speed in mph (km/h) for the distance traveled since the last memory reset.

NOTES

Trip computer controls

The computer is controlled by the fascia switch pack and the function button on the end of the left steering column stalk.

Function button Pressing the function button cycles the data displayed in the order listed on the facing page.

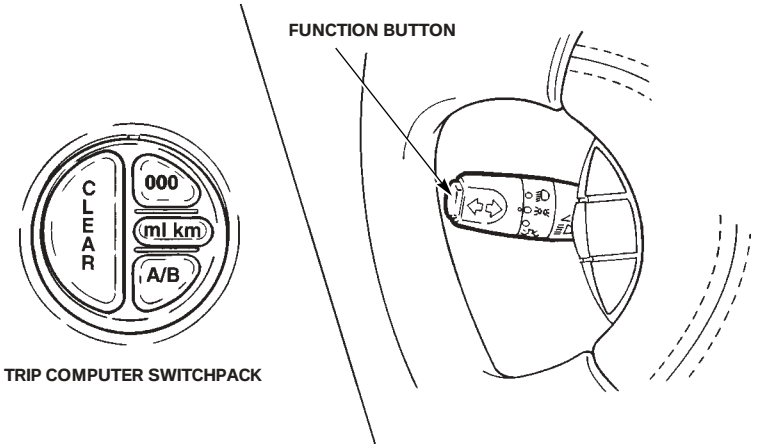
Switch pack 000 Sets the selected trip to zero.

A/B Selects the A or B memory site.

mi km Selects the metric or USA display.s

CLEAR Cycles between the trip computer, odometer and driver message displays.

TRIP COMPUTER CONTROLS



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Setting the trip computer

- Press the function button to select a computer function, the display will show either trip A or trip B information.
- Press the A/B switch to select the desired memory site.
- Press the 000 switch and hold for 3 seconds.

NOTE: Warning and driver information messages have priority over trip data. Any messages will display when the ignition is ON. To hide the messages and display trip data, press CLEAR. More than one message may be active. Pressing CLEAR hides one message at a time. Only the data in the selected memory site will be cleared.

NOTES

Vehicle Systems

Interior Lighting

Interior lighting is controlled by the BPM and the door control modules in response to control signal inputs from various switches. All timing functions are controlled by the BPM.

- The door puddle lamps, trunk, glove box and vanity lamps are driven by the door control modules and enabled by their individual switches.
- The footwell lamps and coupe interior lamp are controlled by the BPM.
- The roof console interior / map lamps and E post reading lamps, individually switched for manual control, are controlled by the BPM.

Interior Lighting Operation

Interior lighting is divided into two functions: illumination enable and fade. The illumination enable circuit provides constant intensity illumination. The fade circuits provide timed fade up, fade off illumination intensity.

Illumination enable circuit

The BPM illumination enable circuit is active with the ignition in position II. When the ignition is switched OFF, the illumination enable circuit will remain active for fifteen minutes after the last input from the door ajar switch, the trunk switch, or ignition switch position I.

The illumination enable circuit powers the following lamps:

Lamp	Control
Trunk lamps	Trunk switch
Glove box lamp	Glove box lamp switch
Vanity lamps	Vanity lamp switches
Map / reading lamps	Map / reading lamp switches

Illumination fade circuits

The BPM fade circuits are activated and timed as described below. The fade circuits power the following lamps:

- Map / reading lamps
- Footwell lamps
- Vanity lamps
- Courtesy lamps

The BPM fade circuits activate in the following manner:

Vehicle unlocked with key or remote transmitter The 2 minute timer is set and the lights fade up to 75% of their power. The lights fade up to full power when a door is opened.

Engine not running and door opened The lights fade up and fade off after 2 minutes. If the lights are on when the last door closes, the 2 minute timer is reset and a 15 second timer is set. The lights will fade off when the first of the timers runs out. If the lights are off when the last door is closed, the lights fade up and only the 15 second timer is set.

Ignition switched to position 3 (crank) All interior lights switch off.

Engine running and door opened The lights fade up and fade down when the last door is closed.

Ignition key removed from ignition The lights fade up and the 15 second timer is set.

Ignition key not in ignition and doors closed and locked The lights fade off.

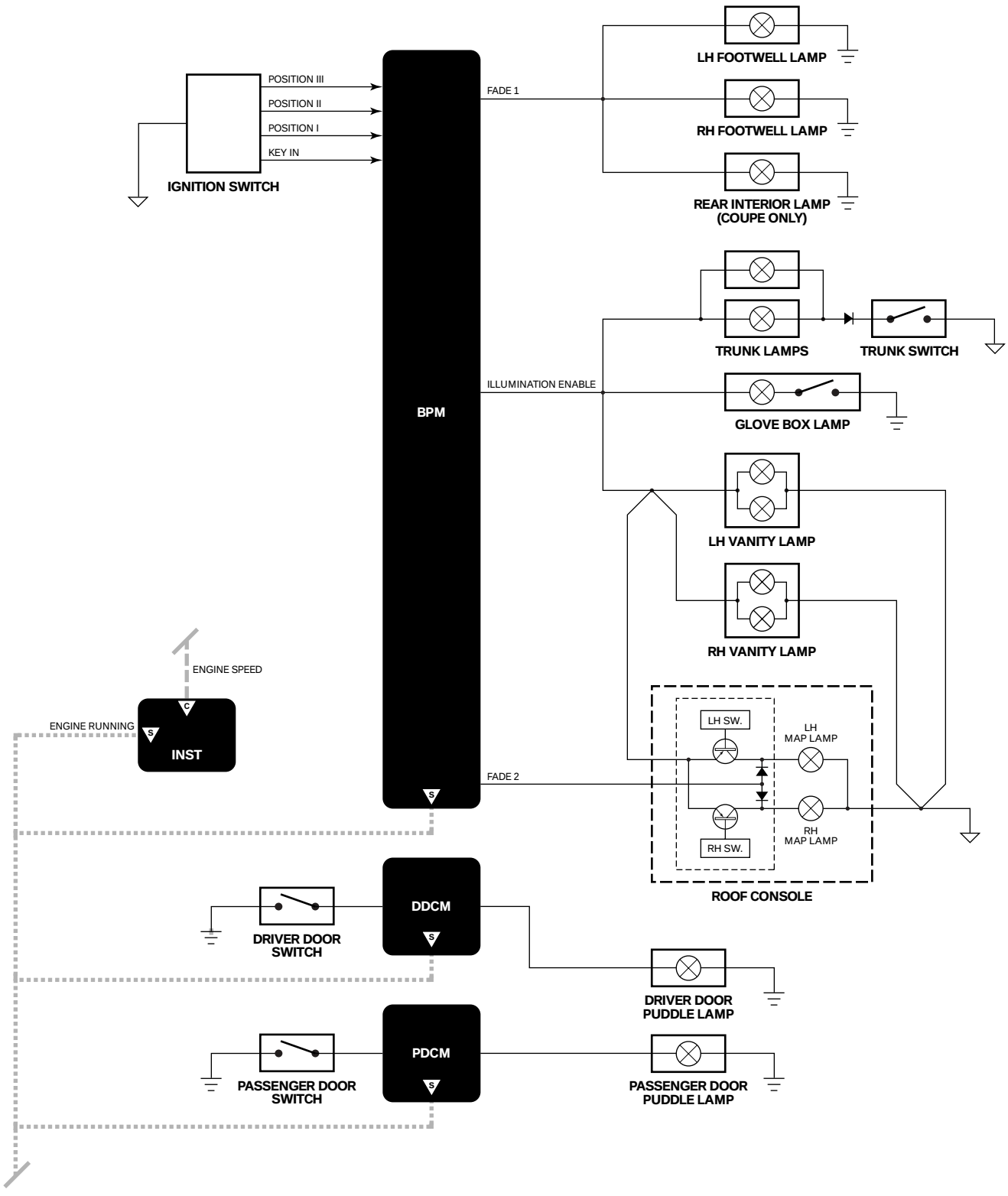
Door puddle lamps

The door puddle lamps are controlled by the door control modules with input from the door switches. When a door is opened, its puddle lamp is activated for 5 minutes or until the door is closed.

Locate Illumination

Locate illumination is conventionally controlled by the dimmer module and the dimmer control switch when the side markers are active.

XK8 INTERIOR LIGHTING CIRCUITS



T680 / 1.37

Exterior Lighting

Headlamps, Side Markers, Tail Lamps and Front Fog Lamps

The BPM controls all front exterior lighting and the rear side markers, tail, and number plate lamps using inputs from the lighting switches. Front fog lamps require the side markers to be active and the front fog lamps selected. The front fog lamps are deactivated when the main (high) beams are active.

Front side marker and head lamps

The front side marker power is supplied directly from the BPM. The headlamp main (high) and dip (low) beam lamps are supplied with power via separate relays that are activated by the BPM. There is no bulb fail monitoring for the front lamps.

Rear side markers, tail and number plate lamps

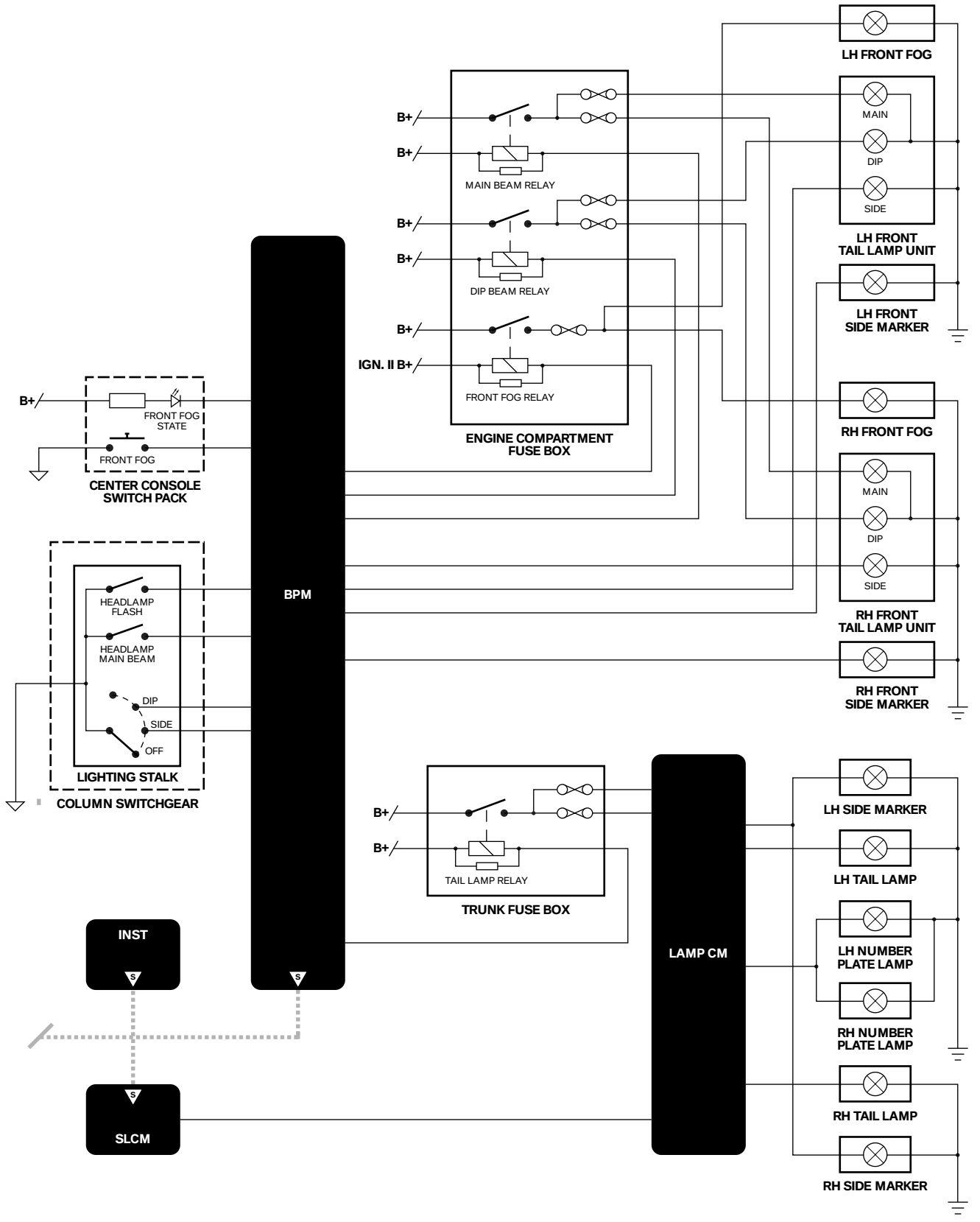
The rear side markers, tail, and number plate lights are supplied with power via the tail lamp relay through the lamp control module. The lamp control module monitors the state of the lamps. If a bulb failure is detected in the tail lamps, the lamp control module outputs a hard wired signal to the SLCM, which transmits the SCP *REAR BULB FAIL* data message on the network. The rear side marker and number plate lamps are not monitored for bulb failure.

Front fog lamps

The front fog lamps are supplied with power from the front fog relay. The BPM activates the relay when the side markers or dip beams are active and a enables the front fog light function. The front fog state LED is driven by the relay coil circuit. Front fog lights are disabled by a second momentary ground signal from the front fog switch.

NOTES

XK8 HEADLAMP, SIDE MARKER, TAIL LAMP AND FRONT FOG LAMP CIRCUITS



Exterior Lighting (continued)

Stop and Reverse Lamps

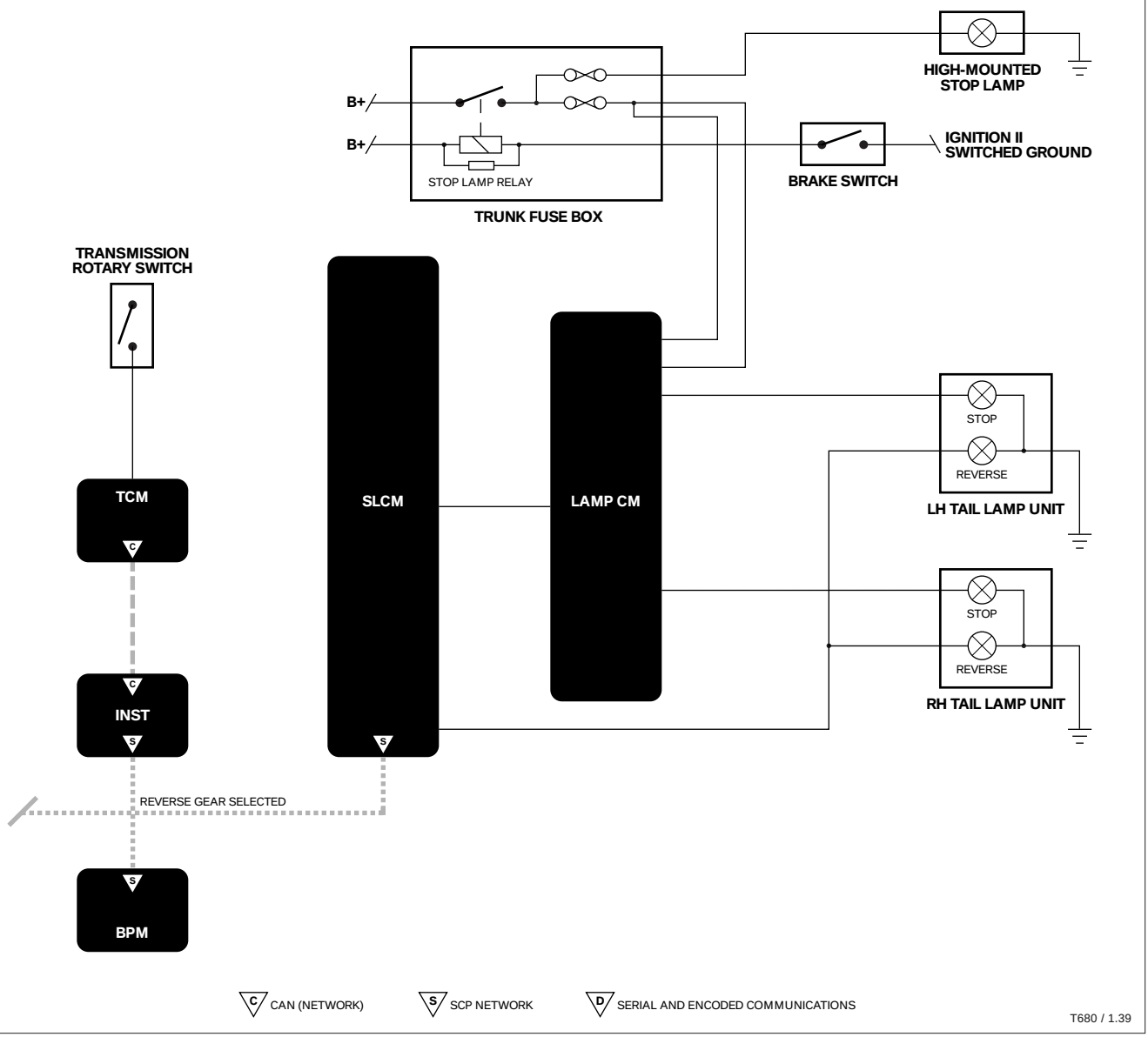
Stop lamps

Stop lamps are controlled by the brake switch ground signal, which activates the stop lamp relay. The relay supplies B+ voltage to the stop lamps via the lamp control module. If the lamp control module detects a stop lamp bulb failure it outputs a hard wired signal to the SLCM, which transmits the SCP *REAR BULB FAIL* data message on the network. The high mount stop lamp is powered directly from the stop lamp relay and is not monitored for bulb failure.

Reverse lamps

Reverse lamp power is supplied directly from the SLCM. The SLCM activates the reverse lamps when the INST *REVERSE GEAR SELECTED* SCP message is on the network. The INST determines reverse gear selection from CAN data provided by the TCM. The transmission rotary switch provides the hard wired gear position signal to the TCM.

XK8 STOP AND REVERSE LAMP CIRCUITS



Rear Lamp Monitoring

XK8 lamp control module

A lamp control module is installed in the trunk electrical carrier along with the SLCM, trunk fuses and relays. The lamp control module monitors the state of the rear side markers, tail lamps, license plate lamps and brake lamps. The high mounted stop lamp is not monitored for bulb failure.

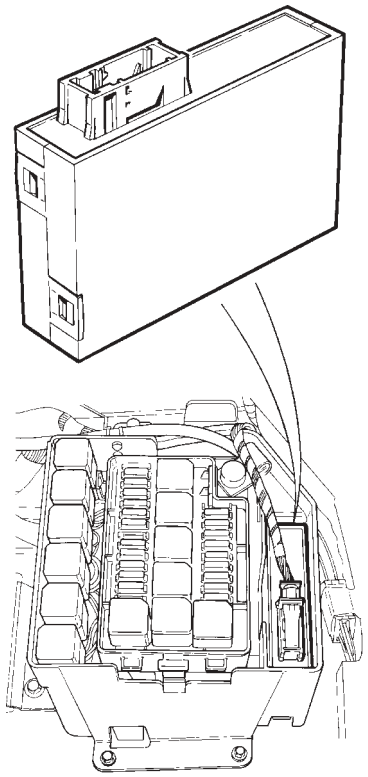
If the lamp control module detects a bulb failure a signal is sent to the SLCM, which transmits a *REAR BULB FAILURE* SCP message to the INST. The INST activates the AMBER MIL and displays the BULB FAIL REAR driver message.

XJ Series Sedan

Sedan Range vehicles do not use a separate bulb failure module to monitor the rear lamps. The brake lamps are monitored by a bulb fail function in the SLCM. A bulb fail function in the BPM monitors the tail lamps. Rear side markers and number plate lights are driven by the BPM and are not monitored for bulb failure

If the SLCM detects a brake lamp failure it transmits a *STOP LAMP FAIL* SCP message to the INST. The INST activates the AMBER MIL and displays the STOP LAMP FAIL driver message.

XK8 LAMP CONTROL MODULE



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If the BPM detects a tail lamp failure it transmits a *TAIL LAMP FAIL* SCP message to the INST. The INST activates the AMBER MIL and displays the TAIL LAMP FAIL driver message.

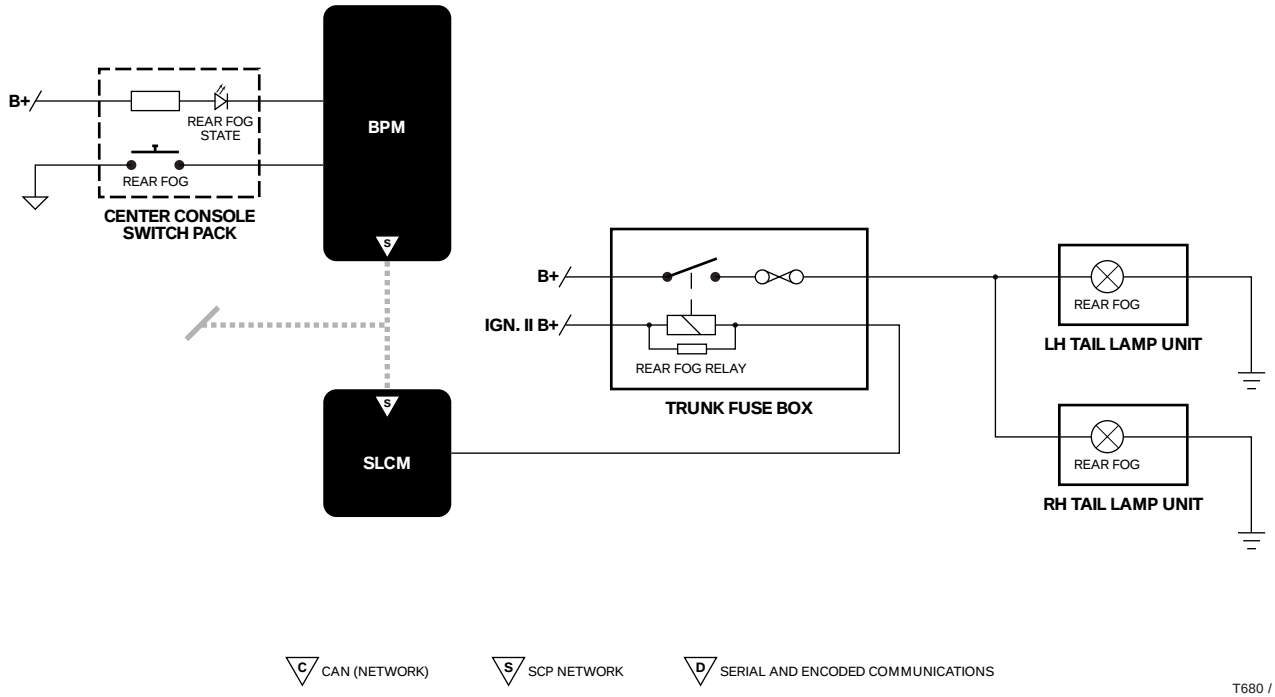
NOTES

Exterior Lighting (continued)

Rear Fog Lamps

Rear fog lamps are activated by the SLCM via the rear fog relay when the BPM transmits the SCP *REAR FOGS ON* message. The lamps are switched off when the BPM transmits the SCP *REAR FOGS OFF* message. The rear fog lamps remain active when the headlamp main beams are activated.

XK8 REAR FOG LAMP CIRCUITS



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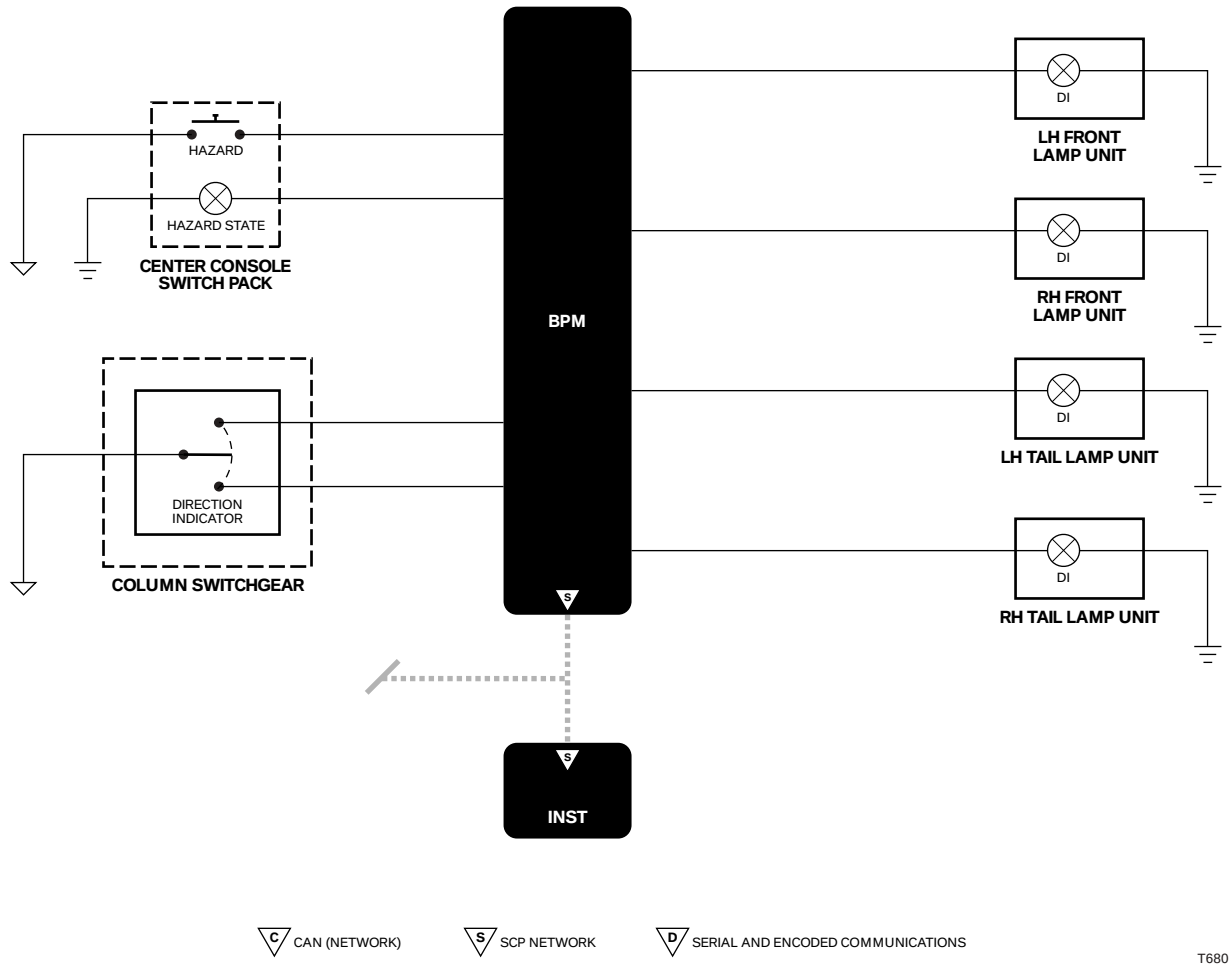
NOTES

Directional Indicators and Hazard Warnings

Directional indicators and hazard warnings are directly controlled by the BPM using inputs from the hazard and directional switches. The BPM operates the directional indicator lamps at 75 cycles per minute via hard wired connections. The INST directional signal indicators are also operated by the BPM via SCP data messages to the INST. If the BPM detects a bulb failure, it operates the INST directional signal indicator at 144 cycles per minute. The exterior indicator lamps continue to operate at 75 cycles per minute. The directional indicator audible warning is a BPM generated audio signal to the column switch gear speaker. The audible warning tone cycles with the INST indicator lights.

The ignition must be in position II for the directional indicators to activate. The hazard warning lamps operate in any ignition position.

XK8 DIRECTIONAL AND HAZARD WARNING CIRCUITS



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NOTES

Steering Column

Steering Column Movement

Steering column movement is accomplished by two motors (tilt and reach) that are driven by the BPM. The driver side fuse box supplies power to the column switch gear joy stick. Four switches route the joy stick control voltage inputs to the BPM through resistors. The BPM interprets the voltage inputs to determine the required column movement direction.

The auto tilt switch enables automatic column movement for entry and exit. When the auto tilt switch is active, a logic ground is provided directly to the BPM.

Steering column adjustment is enabled under the following conditions:

- Ignition in position I or II or
- Within 30 seconds of driver door close or
- Within 30 seconds of ignition key in

Column movement is canceled when the 30 second timer expires.

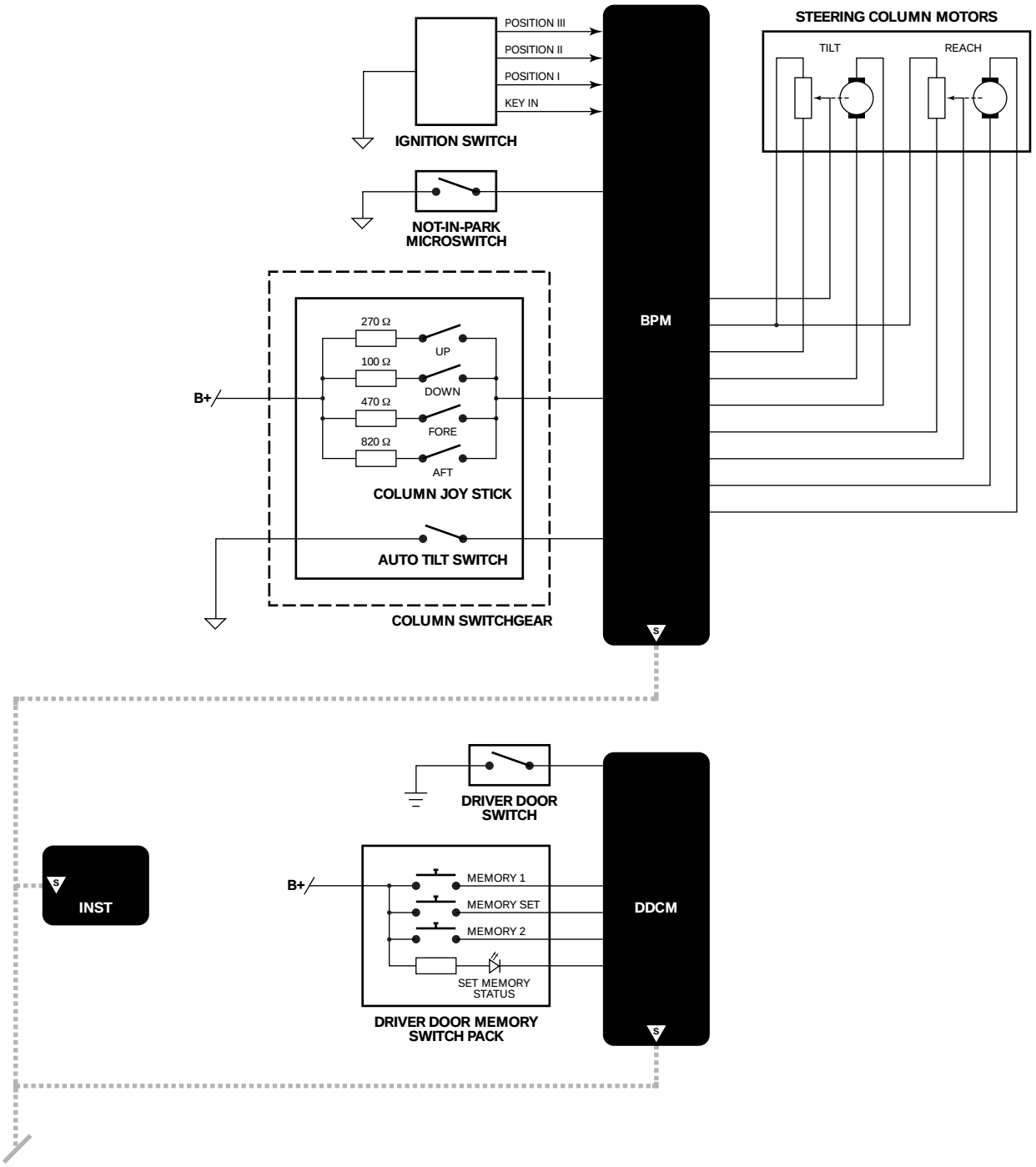
When the ignition is switched to position III (crank) the timer is canceled and movement is canceled.

Tilt away steering

400 milliseconds after the ignition key is removed, with the gear selector in park, the steering column will move up and away from the driver. When the ignition key is inserted, the column will revert to its last memory position. Refer to Seat Memory Control on page 54.

NOTES

XK8 STEERING COLUMN MOVEMENT CIRCUITS



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Door Mirrors

Manual Control

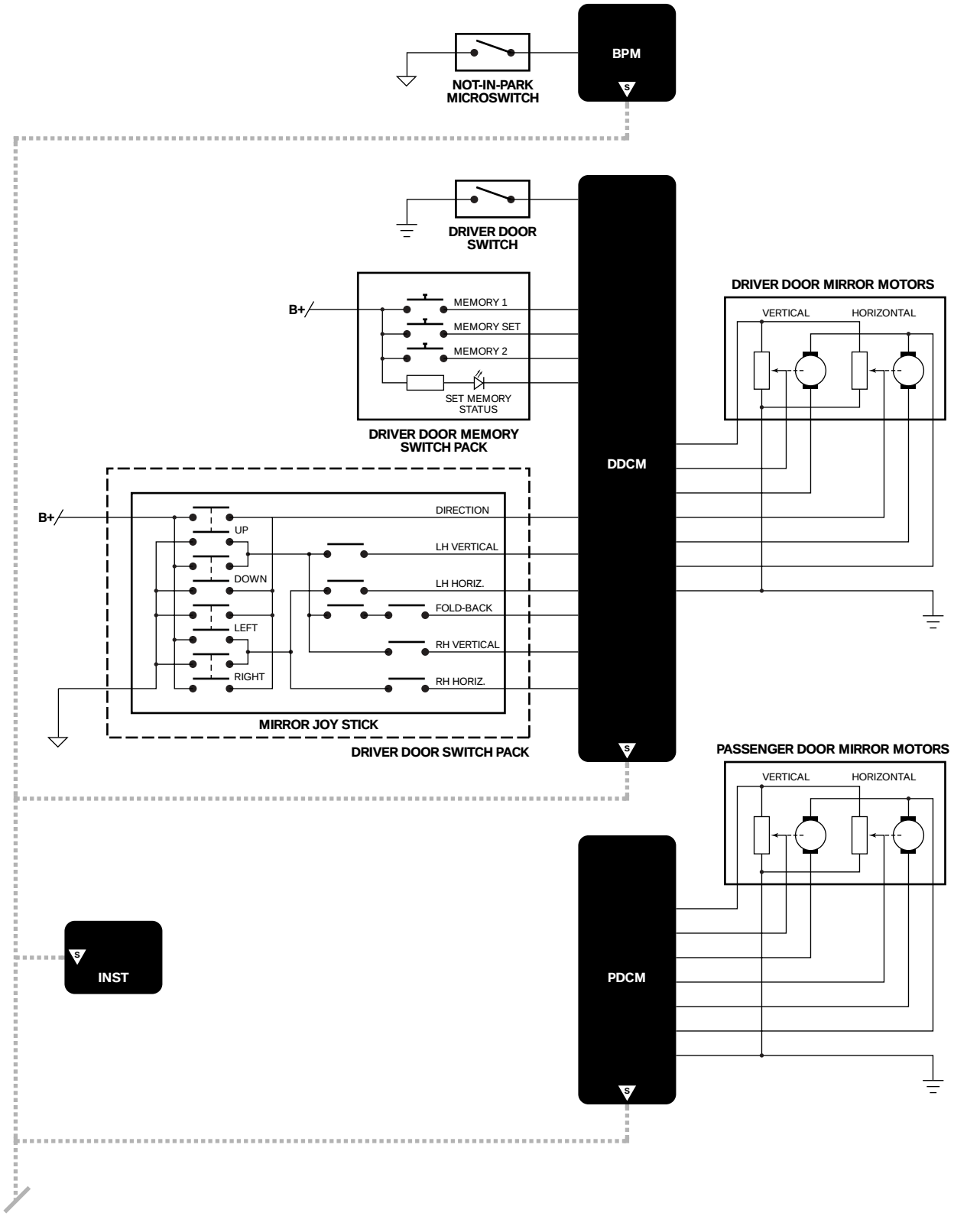
Door mirror position control is enabled by the driver door switch pack via the DDCM and the PDCM. The switch pack provides a logic ground to the DDCM indicating the mirror to be controlled and the movement direction required. If the ignition is in position I or II or the driver door is open, the selected mirror is driven in response to the switch pack inputs. The DDCM drives the driver door mirror motors via hard wires. Commands for the passenger mirror are transmitted as SCP messages to the PDCM, which is hard wired to the passenger door mirror motors.

Mirror tilt

The passenger door mirror can be tilted down 7 degrees from its present position. Mirror tilt is accomplished by activating the mirror down switch with reverse selected and the ignition in position II. The mirror returns to its previous position when reverse gear is deselected, the mirror up switch is activated or the ignition is switched out of position II. Left and right mirror switch commands are ignored while the mirror is tilted down.

NOTES

XK8 DOOR MIRROR MOVEMENT CIRCUITS



C CAN (NETWORK) S SCP NETWORK D SERIAL AND ENCODED COMMUNICATIONS

T680 / 1.44

Seats

The power seats are controlled by their respective seat switches via the seat control module. Power seat adjustment is available during the following conditions:

- Ignition is in position I or II
- Gear selector is in P or N or
- If the associated door is open or has been close within 30 seconds

Only one of the seat motor outputs can be driven at a time.

If the gear selector is not in P or N, seat operation is enabled for 2 seconds only. The seat movement switch must be pressed again to get an additional 2 seconds of movement. This function prevents continuous seat movement while the vehicle is being driven.

Seat heater switch inputs are processed by the BPM and transmitted to the respective seat control module, which controls the heaters via hard wires.

Memory Driver Seat

The lumbar support and all seat movement functions are controlled by the driver seat switch pack switches via the DSCM. The switch pack and seat are both hard wired to the module. In addition, the driver seat belt activates the seat belt switch, the DSCM transmits an SCP seat belt tell tale ON or OFF message to the INST and an SCP seat belt chime ON or OFF to the BPM.

Non-Memory Driver Seat

The non-memory seats function the same as the memory seats with the exception of the memory functions.

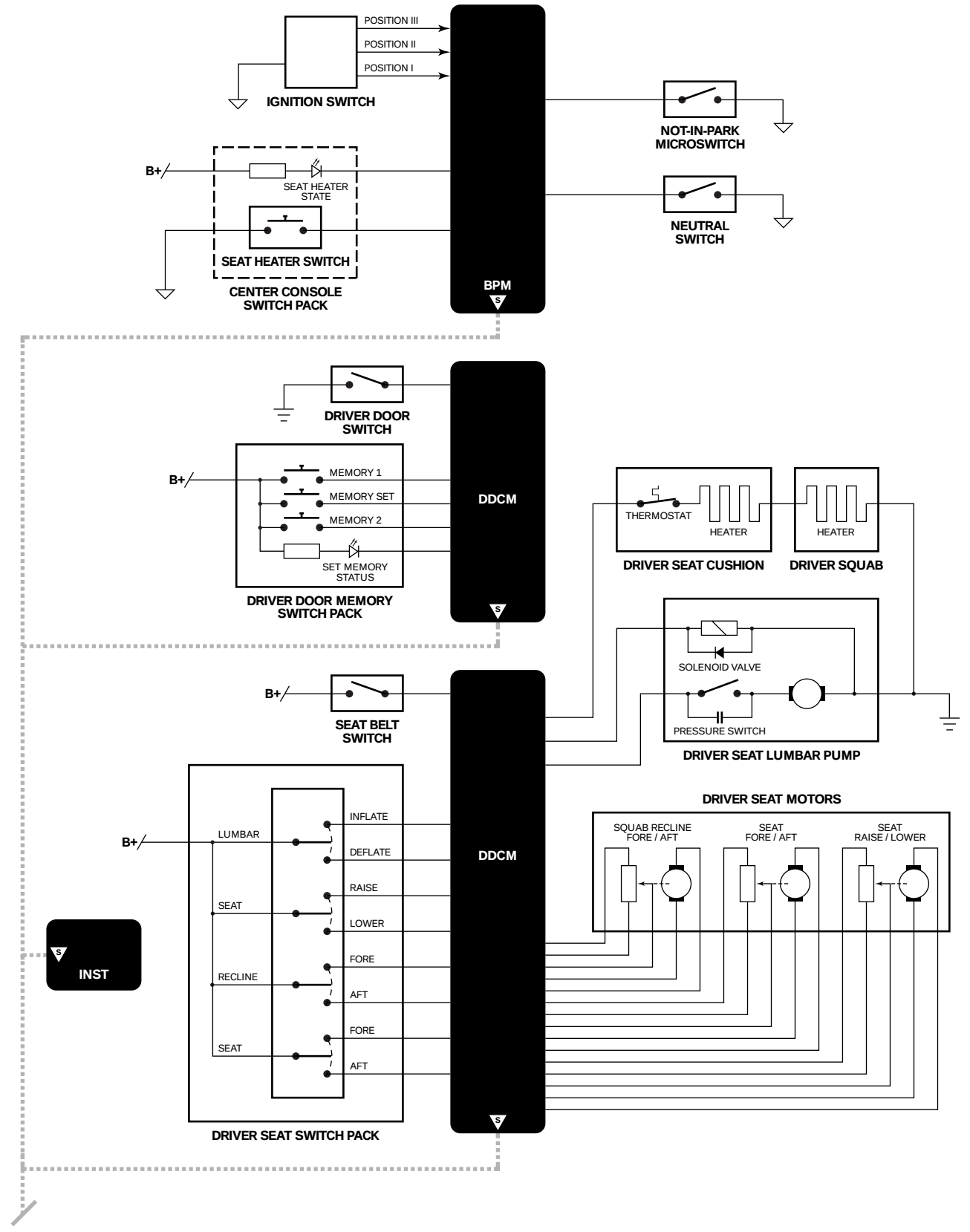
Memory Control

Mirror memory positions are stored in the respective door modules. Driver seat memory positions are stored in the DSCM and steering column memory positions are stored in the BPM.

When memory is recalled, the driver door switch pack memory buttons activate the DDCM to transmit the SCP *RECALL MEMORY 1* or *RECALL MEMORY 2* SCP message. The BPM, PDCM and DSCM respond by recalling the stored position data and driving the steering column, passenger door mirror and driver seat position to their positions. The DDCM drives the driver door mirror to its position. As feedback tells each module that the stored position has been achieved, the module transmits an SCP *MEMORY RECALLED* message, which is received by the BPM.

NOTES

XK8 DRIVER SEAT CONTROL CIRCUITS



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Security and Locking

Security and locking control functions are shared by the following SCP modules: BPM, door control modules and SLCM. The modules communicate and synchronize locking and security activities via SCP data messages.

Central Locking Functions

The vehicle can be locked and unlocked by activating the driver door key barrel switch, the driver or passenger interior door locks, or the remote transmitter. If drive away locking is enabled, the doors lock when the gear selector is moved from park to not-in-park for more than 1 second.

If a door lock actuator is driven more than 10 times within 40 seconds, a 20 second time out is set to allow the actuator to cool off. Other key barrel lock functions continue to operate during the lock actuator cool off period.

If the driver door key barrel lock switch is active for more than 30 seconds, the signal is ignored until the switch becomes inactive. Lock actuator protection does not occur if the unlock signal comes from the inertia switch.

If activated, the inertia switch unlocks the doors while the ignition in position 2. Doors unlocked by inertia switch activation can be relocked by activating central locking.

If one door is locked and the other unlocked, and the inertia switch or key barrel lock / unlock switches are inactive, the locks cycle until both locks are in the same state. Lock cycling is disable after; three cycles, when the inertia switch is active, or when the ignition is switched to position II. When disabled, the locks are left in the last valid locking request position.

Lock / unlock

The vehicle may be centrally locked or unlocked using the driver door key lock or the remote transmitter. A door key lock global lock / unlock function activates the locks, windows and convertible top or sunroof.

Holding the door key lock in the active position for more than 1.5 seconds when the ignition is not in position II or III activates the global lock / unlock function. The global function activates the locks, windows, and convertible top or sunroof. If the key is released, global open / close operation immediately stops.

Trunk release

The trunk is opened using the interior trunk release switch, the trunk key lock or the remote transmitter.

The interior trunk release switch activates the trunk solenoid under the following conditions:

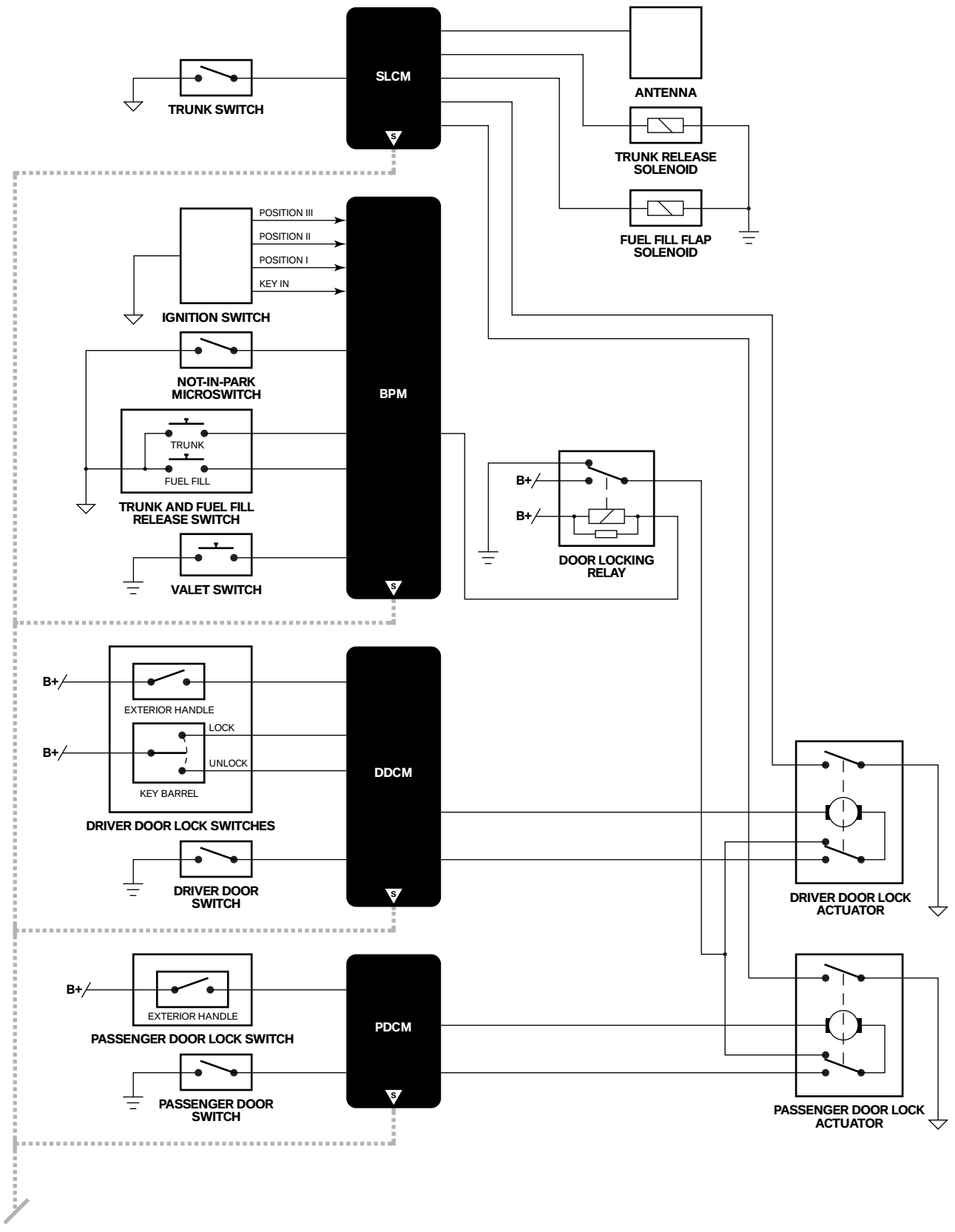
- Valet mode inactive
- Security disarmed
- Vehicle unlocked or key in the ignition

Valet mode (trunk release inhibit)

Valet mode is activated by pressing the valet switch when the trunk is closed. Valet mode is deactivated by disarming the security system or unlocking with the key.

NOTES

XK8 SECURITY AND LOCKING CONTROL CIRCUITS



Security and Locking (continued)

Security Functions

Locking
Locking the vehicle with the ignition key, if the security door locking function is enabled, or with the remote transmitter activates the security system.

Unlocking the vehicle with the ignition key, if the security door locking function is enabled, or with the remote transmitter disarms the security system.

Two stage unlocking If two stage locking is enabled, one press of the remote transmitter unlocks the driver door and fades up the interior lights. A second press unlocks the passenger door.

Remote convenience features
All remote features require that the key not be in the ignition (key not-in-ignition switch inactive).

Remote headlamp If remote headlamps are enabled, one press of the remote transmitter headlamp button activates the headlamps for 25 seconds.

Remote trunk release If remote trunk release is enabled, one press of the trunk release button activates the trunk release solenoid.

Remote panic alarm If remote panic alarm is enabled, three presses of the remote transmitter headlamp button within 3 seconds disarms and unlocks the vehicle, and full alarm is activated for one cycle. The alarm is canceled by turning the ignition switch to position I or II.

Security receiver shutdown
To reduce SLCM quiescent drain, the transmitter receiver portion of the security system will shut down 28 days after the body systems enter the sleep state. Any body systems activity, such as unlocking the vehicle with the key, will repower the receiver.

NOTES

Engine Cranking / Starting

Vehicles without Key Transponder Module (KTM)

Engine cranking and starting are controlled by the ignition switch, ECM, BPM, transmission rotary switch P / N switch and the gear selector not-in-park switch.

Cranking and starting are accomplished in the following manner:

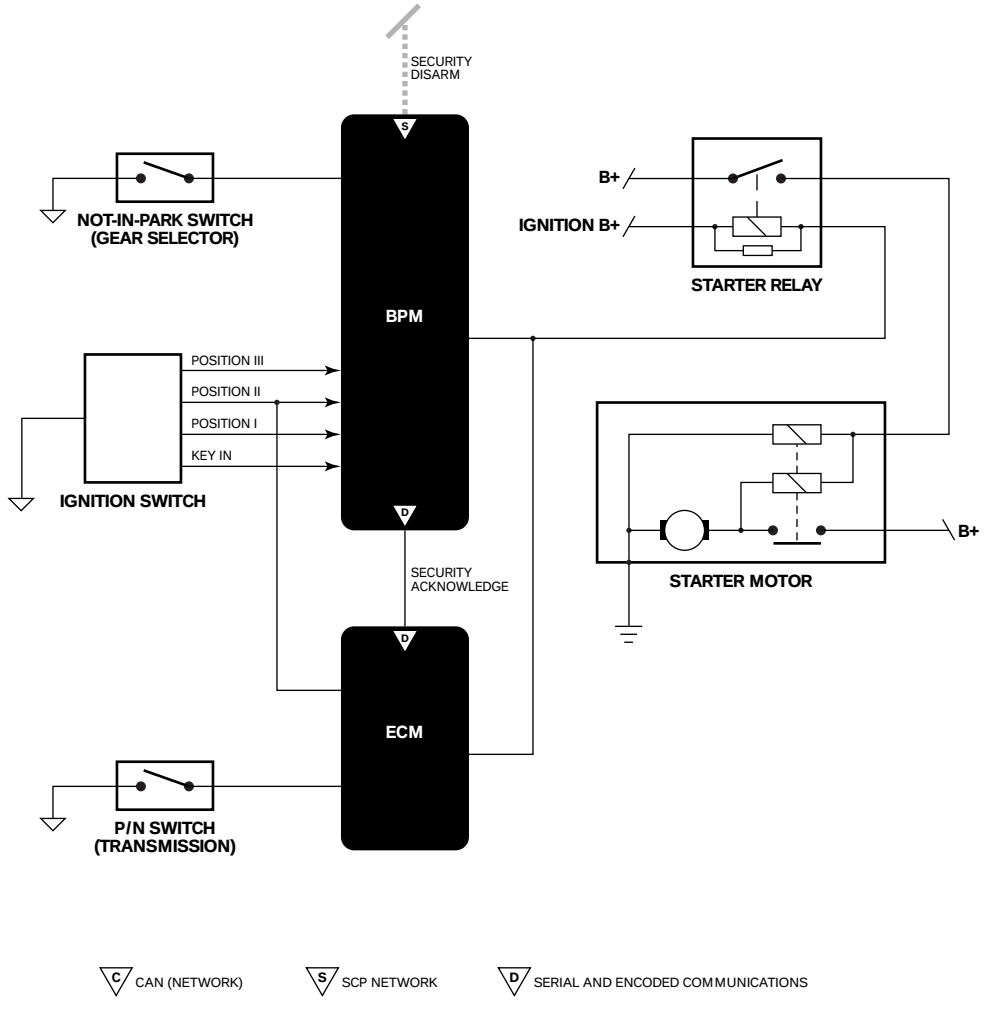
Ignition switch to position II

- Ignition position II and transmission P / N signal (hard wired from rotary switch) are received by the ECM
- ECM enables fueling and ignition and outputs a SECURITY ACKNOWLEDGE signal via a serial data link to the BPM
- BPM receives a park signal from the gear selector not-in-park switch and enables cranking if the security system has been disarmed

Ignition switch to position III (CRANK)

- Ignition position III crank signal received by BPM
- BPM grounds starter relay coil to energized starter motor
- ECM receives starter relay coil signal and sets engine starting values

XK8 STARTING CIRCUITS – WITHOUT KEY TRANSPONDER MODULE



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Engine Cranking / Starting (continued)

Vehicles with Key Transponder Module (KTM)

Engine cranking and starting are controlled by the ignition switch, ECM, BPM, transmission rotary switch P / N switch, key transponder module, ignition key reader exciter in the ignition switch, ignition key transponder and the gear selector not-in-park switch.

Cranking and starting are accomplished in the following manner:

Ignition key switched from the OFF position

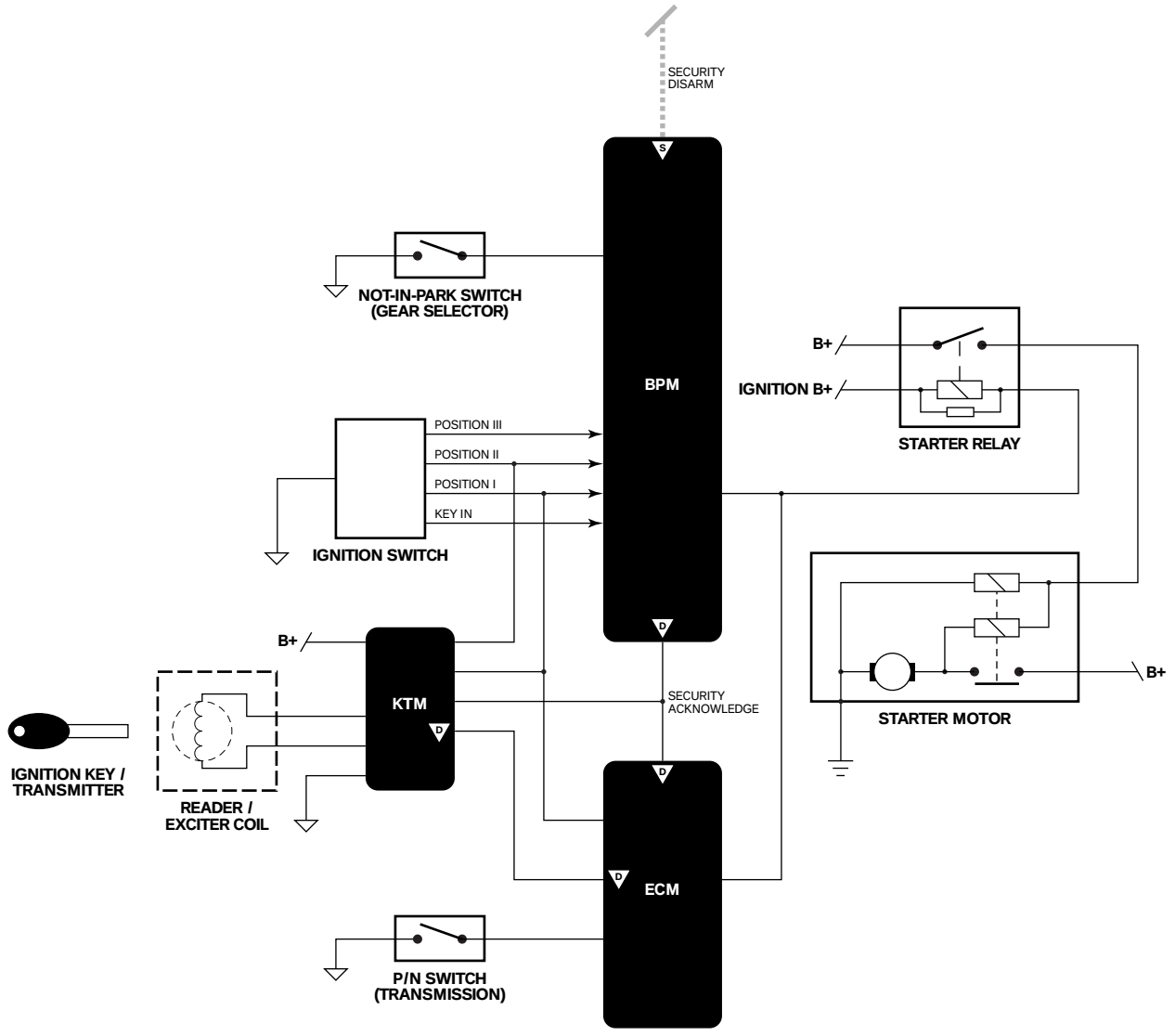
- KTM receives a signal from the ignition switch position I as the key is turned
- KTM energizes the reader / exciter, which causes the key transponder to broadcast its security code
- If the key transponder code matches the programmed KTM code, the KTM outputs an OK TO START signal to the ECM via a serial data link
- ECM receives OK TO START signal and transmission P / N signal (hard wired from transmission), and enables fueling and ignition
- ECM outputs a SECURITY ACKNOWLEDGE signal to the BPM via a serial data link
- BPM receives a park signal from the gear selector not-in-park switch and enables cranking if the security system has been disarmed

Ignition switch to position III (CRANK)

- Ignition position III crank signal is received by the BPM
- BPM grounds starter relay coil to energized starter motor
- ECM receives starter relay coil signal and sets engine starting values

NOTES

XK8 STARTING CIRCUITS – WITH KEY TRANSPONDER MODULE



T680 / 1.48

Windshield Wash / Wipe and Headlamp Power Wash

Wash / wipe functions are controlled by the wash / wipe stalk in the column switch gear with input from the lighting stalk switch for headlamp power wash. Control inputs are hard wired to the BPM, which directly operates the windshield washer pump. The power wash pump and wiper motor are controlled by the BPM via relays.

Two-Speed Wipers

When the slow or fast wipe switch is active, the BPM activates the wiper run / stop relay coil. The stop / run relay supplies B+ voltage to the fast / slow relay. The BPM controls the coil ground of the fast / slow relay depending on the position of the wiper speed switches. The fast / slow relay supplies the B+ voltage to operate the wiper motor. If ignition position II or the wipe switches become inactive, the stop / run circuit remains active until the wiper motor park switch open circuits. If the wipers are operating at fast speed when they are switched off, they default to low speed during the period from switch off to park.

Intermittent wipe

When the intermittent wipe switch is active, the wipers operate once at slow speed, pause in the park position for the selected delay period and operate once again. This cycle continues until the wipers are switched off, switched to another mode or ignition position II becomes inactive.

Wiper delay position	Delay time	Wiper delay position	Delay time
1	2 seconds	4	11 seconds
2	4 seconds	5	15 seconds
3	7 seconds	6	20 seconds

Flick wipe

When flick wipe is activated, the wipers operate once at slow speed and return to the park position. Flick wipe does not cancel intermittent wipe. After the flick wipe cycle is complete, the wiper delay timer is reset and intermittent wipe continues.

Programmed wash / wipe

If the windshield washer fluid level is low, programmed wash wipe is inhibited.

When the wash / wipe switch is held active for less than 1.2 seconds, the windshield wash pump is activated for 1.2 seconds and the wipers operate at slow speed. The wipers continue operation for 3 additional sweeps after the pump becomes inactive. If drip wipe is enabled and fast / slow or intermittent wipe is not selected, the wipers perform 1 additional sweep 4 seconds later.

If the wash / wipe switch is held active for more than 1.2 seconds, the pump operates for 20 seconds or until the switch becomes inactive. The wipers operate at slow speed while the pump is active. When the pump becomes inactive the wipers will continue for three additional sweeps plus the drip wipe cycle as described above. Programmed wash / wipe does not cancel intermittent wipe. After the programmed wash / wipe cycle is complete, the wiper delay timer is reset and intermittent wipe continues.

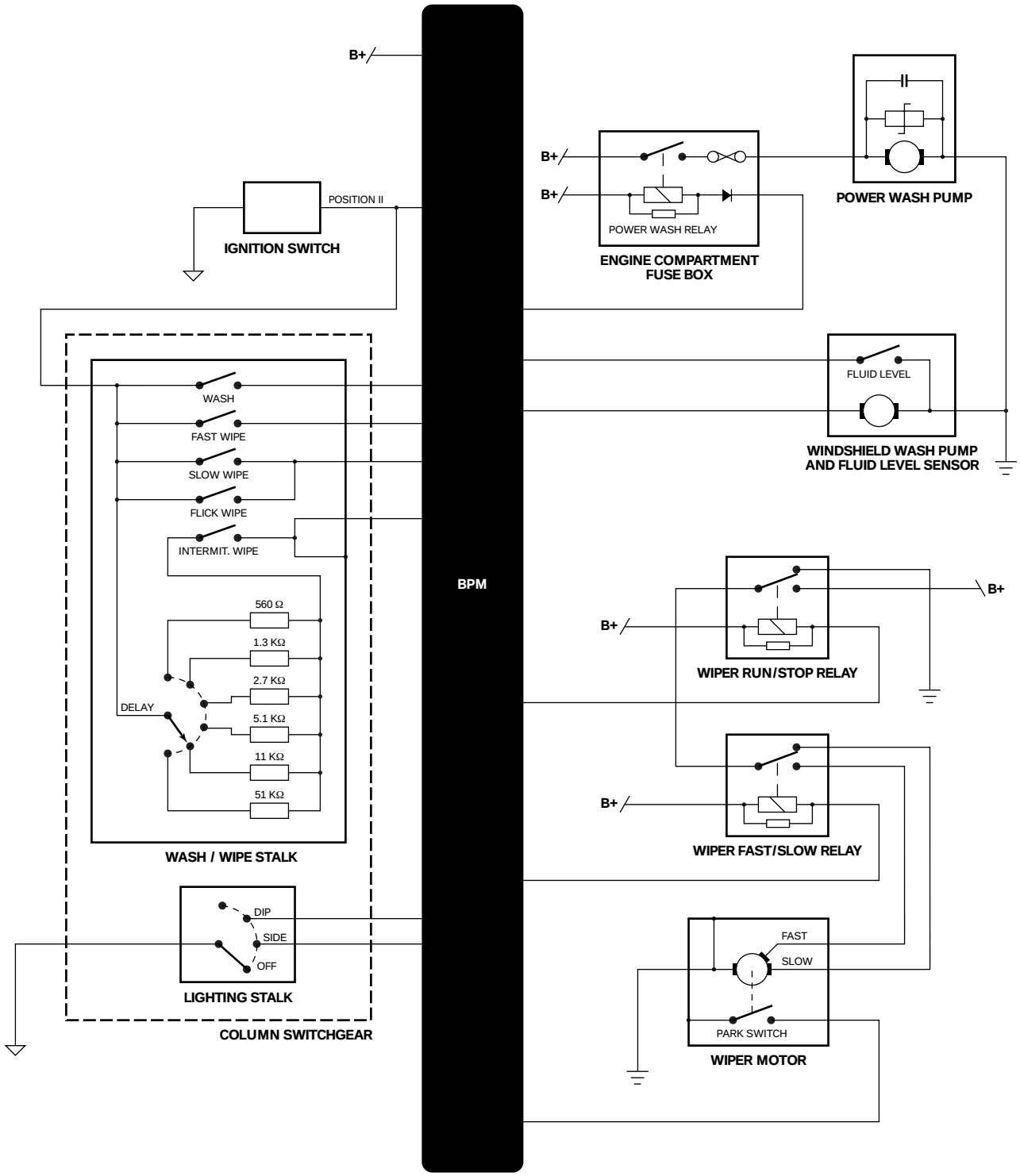
Headlamp power wash

If the windshield washer fluid level is low, headlamp power wash is inhibited. Headlamp power wash is activated by the wash / wipe switch when the headlamps are on dip (low) beam.

When the switch is held active for more than 48 milliseconds, the headlamp power wash pump activates for 800 milliseconds followed by a 6 second pause and another 800 millisecond activation. If the switch is still active after the second pump activation, the cycle will continue for 20 seconds or until the wash / wipe switch is inactive.

Once the wash wipe switch is released, power wash is inhibited for the next 5 wash / wipe operations.

XK8 WINDSHIELD WASH / WIPE AND HEADLAMP POWER WASH CIRCUITS



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Door Windows

Manual Operation

The door windows are controlled by the DDCM with input from the 4 window switches in the driver door switch pack. Manual operation is enabled in ignition position I and II and on switch-off from the time the ignition enters the off position to the time the first door is opened. When a passenger door window is operated by the driver door switch pack, the DDCM transmits an SCP message to the selected door control module, which drives the window. The passenger door switch pack inputs directly to the PDCM for passenger operation of the window. Single switches on the passenger doors control the passenger window only.

If one-touch window operation is enabled, the window fully opens when the switch is active for between 50 and 250 milliseconds. If the switch is active for greater than 250 milliseconds, window operation stops when the switch becomes inactive.

Window drop – XK8 only

The door windows are programmed to drop 12 mm (0.47 in.) before the doors open to prevent seal damage. The door handle switch is mechanically connected to the inner and outer door handle. If a window is closed when the door handle switch becomes active, the window opens 12 mm (0.47 in.). If the window is within 12 mm from the closed position when the door ajar switch becomes inactive, door is closed, the window closes.

If a window is closed with the door ajar switch active, the window stops 12 mm (0.47 in.) from the closed position.

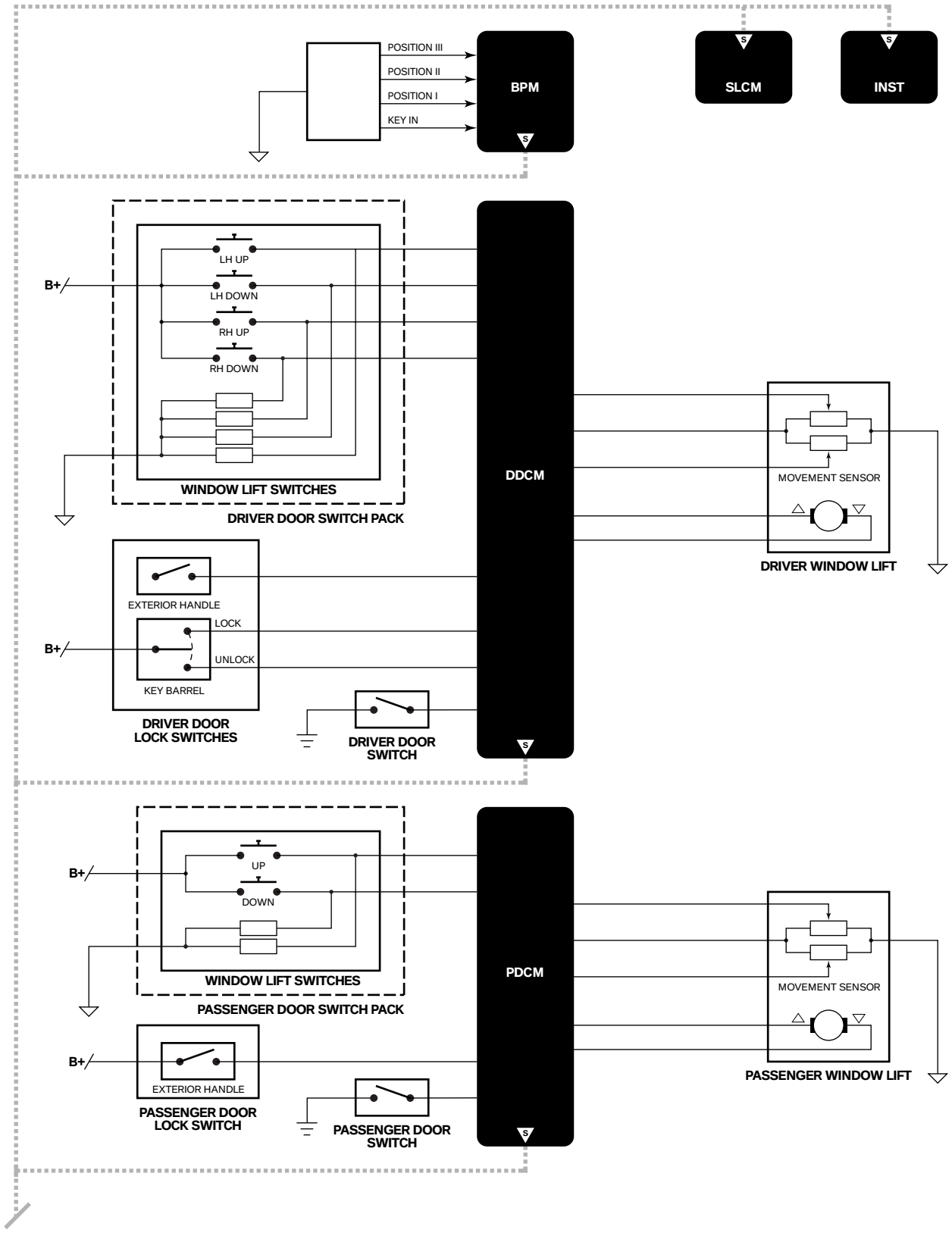
Door window position memory

Door window open and closed positions are retained in door control modules volatile memory. If power is interrupted to a door control module the window positions must be reprogrammed. To reprogram windows after power is restored perform the following procedure:

- Fully open the window and continue to hold the open switch active for 5 seconds
- Fully close the window and continue to hold the close switch active for 5 seconds

NOTES

XK8 DOOR WINDOW CIRCUITS



T680 / 1.50

Convertible Top and Quarter Windows

The convertible top is hydraulically raised and lowered and incorporates a hydraulically operated header latch. An electric motor provides the hydraulic power. The BPM and SLCM control the top's automatic operation using inputs from the convertible top switch, five microswitches and SCP data messages. Three of the microswitches are located in the header rail and two are located on the right side hydraulic cylinder.

Four microswitches connect to the BPM:

Switch	Location	Function
Top raised switch	Top of hydraulic cylinder	signals top is raised over center
Top ready-to-latch switch	Header rail	signals top is in contact with latch
Top latch closed switch	Header rail	signals top is engaged in latch
Top closed switch	Header rail	signals top is closed and fully latched

One microswitch connects to the SLCM:

Switch	Location	Function
Top down switch	Bottom of hydraulic cylinder	signals top is fully down

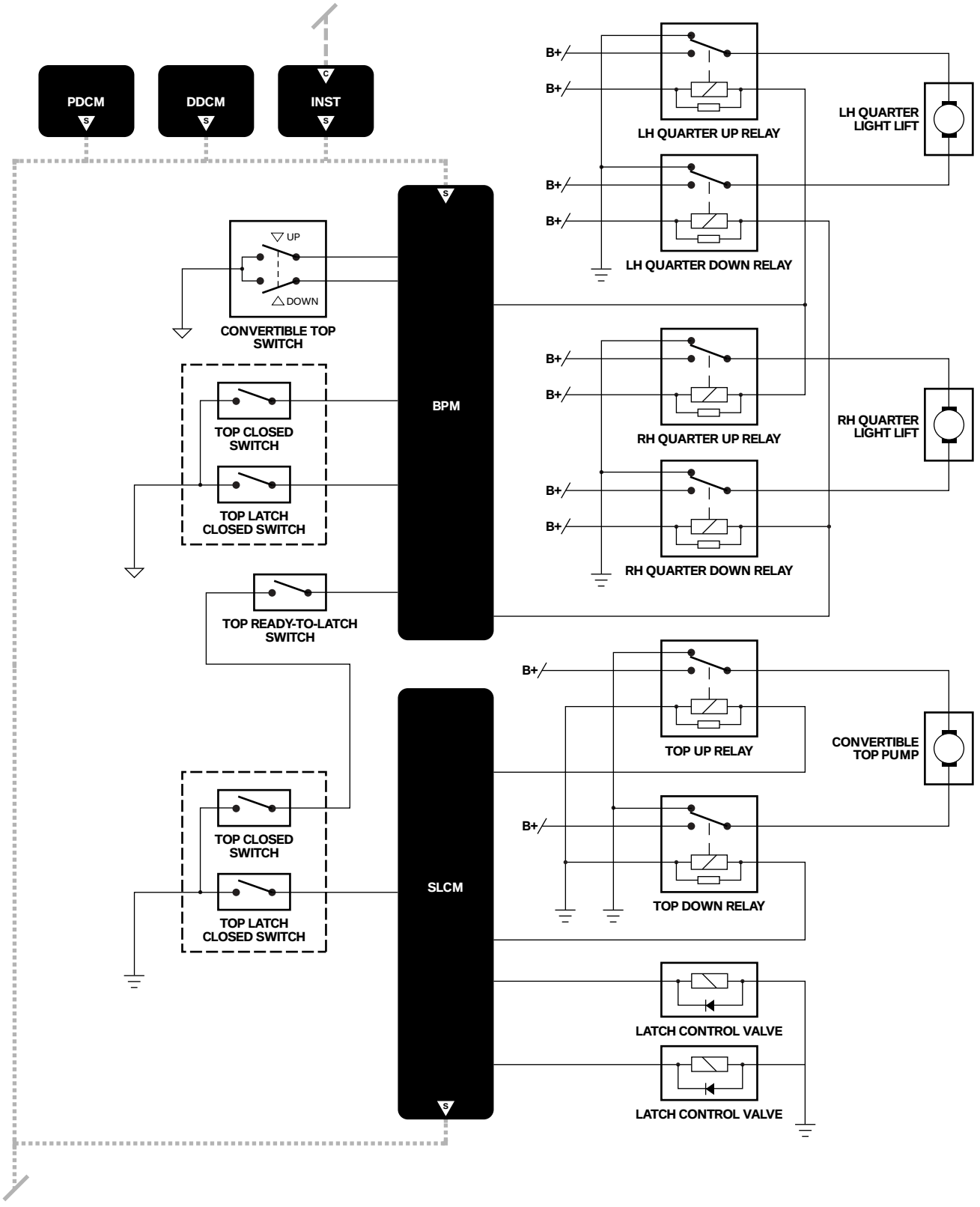
Top Operation

The top is operated by the convertible top switch when the ignition is in position I or II and the vehicle speed is below 10 mph (16 km/h). The convertible top switch must be held active throughout the raise or lower operation.

The top can also be operated using the global open / close functions of the door key lock.

NOTES

XK8 CONVERTIBLE TOP AND QUARTER WINDOW CIRCUITS



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Convertible Top and Quarter Windows (continued)

Top Opening Sequence

When the convertible top switch is held active or global open is activated, the BPM transmits a *HOOD OPEN* (convertible top open) SCP message. The following actions take place in sequence:

- BPM opens the quarter windows
- BPM activates the convertible top audible warning
- If closed, door windows drop 12 mm (0.47 in.)
- SLCM opens the latch control valve and activates the top up relay supplying power to the top hydraulic pump
- Top pump hydraulic pressure opens the header latch
- The top closed microswitch opens followed by the top latch closed microswitch
- SLCM deactivates the top up relay and activates the top down relay reversing top hydraulic pump polarity
- Top pump hydraulic pressure begins to open the top
- The top ready-to-latch and top raised microswitches open
- When the top is fully open, the top down microswitch activates
- BPM activates the convertible top warning
- Door windows return to their previous positions
- SLCM closes the latch control valve and activates the top up relay to supply hydraulic pressure to close the latch
- When the top latch closed microswitch is active, the SLCM deactivates the top down relay

If 10 mph (16 km/h) is exceeded, the top open or close cycle will stop. When the vehicle exceeds 10 mph (16 km/h) and the cycle stops, wind pressure will force the top back to the open position. If the convertible top switch remains active, the open or close cycle continues when the vehicle speed drops to less than 10 mph (16 km/h).

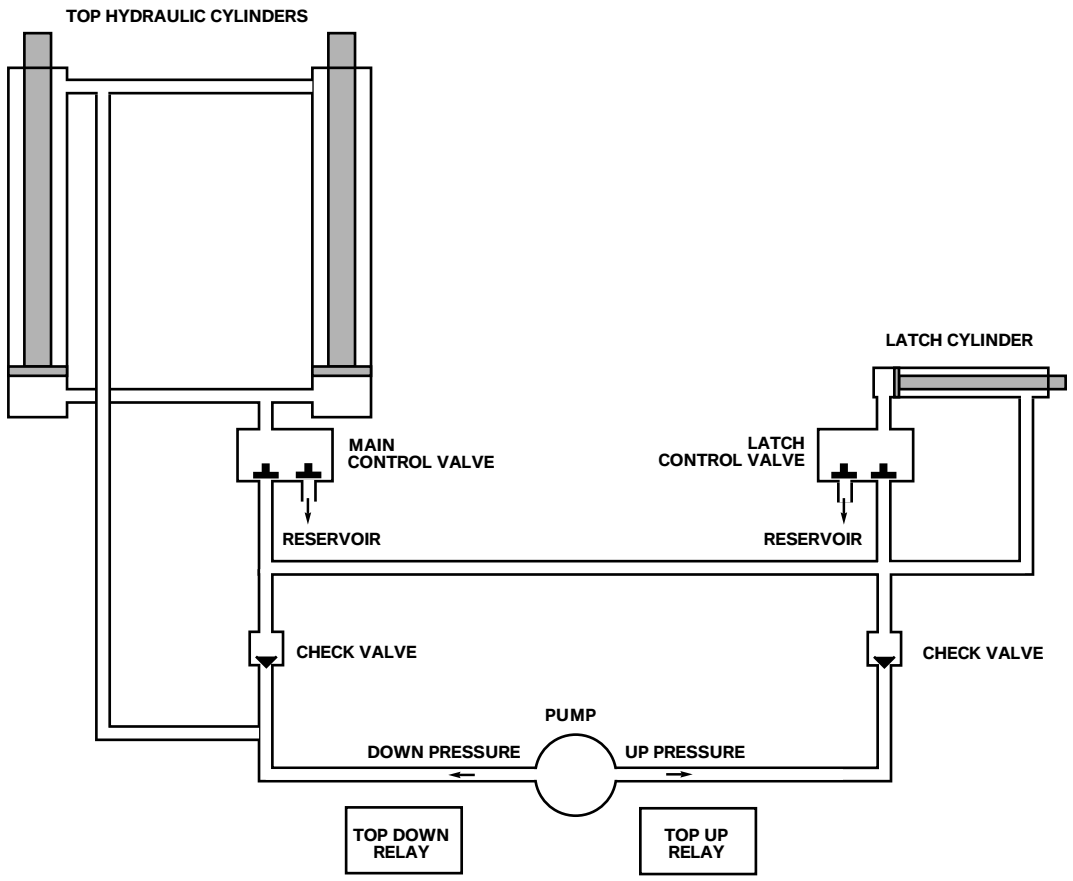
If the convertible top switch becomes inactive or the key switch becomes inactive while operating under global open or close, the top operating cycle immediately stops.

Rear Quarter Window Operation

Rear quarter window position can be set by first fully opening the windows. Then, activate the closing sequence and repress the switch a second time to stop the windows in the desired position.

NOTES

XK8 CONVERTIBLE TOP HYDRAULIC CIRCUITS



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General Notes

Most control functions have time outs associated with their actions. If a function control, such as a door mirror direction switch, has been active for a period of time and no movement is detected, the output drive will be deactivated. In most cases the function control must be reactivated in order to reset the timer. In the case of CM activated functions, the CM may attempt to activate the function periodically or it may time out and not try to activate the function until a new command signal has been received.

Some functions controlled by data messages use one data message to activate the function and another data message to deactivate the function. If a circuit is opened, a power failure occurs or a diagnostic procedure is performed, the state of the modules may become unsynchronized. Further functional testing may give the appearance of system faults. It is important to always disconnect the battery negative cable for 1 minute in order to allow the modules to reset to their default positions.

NOTES