WIPER AND WASHER SYSTEM

7810-00

GENERAL INFORMATION

1. WIPER SYSTEM SPECIFICATIONS

Category	Item			Specifications	
Windshield wiper motor	Rated voltage			12 V	
	Operation voltage range			10 to 15 V	
	Lowest operating voltage			Min. 8 V	
Rear wiper motor	Rated voltage			12 V	
	Operation voltage range			10 to 15 V	
	Lowest operating voltage			Min. 8 V	
Wiper arm and blade	Wiper blade length	Front	Driver's seat	600 mm	
			Passenger's seat	400 mm	
		Rear		TIVOLI	275mm
				XLV	250mm
	Wiper blade change interval			Change every 3 months or every 5,000 km of driving. Service more frequently when the wiper blades are used on a contaminated (oil, wax, dust, etc.) or dry windshield, or in rainy season.	
Washer fluid reservoir tank	Capacity			4.3 L	

2. RAIN SENSOR SPECIFICATIONS

Category	Item	Specifications
Rain sensor	Operating voltage	9 to 16 V
	Rated load	Max. 200 mA (relay load)
	Operating temperature	−30°C to +85°C
	Mounting location	Top center of inner side of windshield glass

3. PRECAUTIONS

- During winter time, check if wiper blades are frozen to the windshield.
- Wiper operation with the blades frozen can damage the wiper blade and motor.
- The wiper operation on the dry windshield can scratch the glass and wear the blade prematurely. Do not operate the wiper when the windshield is dry.
- When it does not rain, turn the wiper switch into the "OFF" position.
- Turn the wiper switch to the "OFF" position before any car wash to avoid unwanted operation of the wipers.
- Check if the rain sensor is in position securely when removing, fitting and checking it.
- Be sure to use the wiper blade with specified size.
- Be careful so a maldetection does not occur due to the sticker and foreign materials in the rain sensor sensing part at the windshield glass.

CAUTION

When cleaning the windshield over the sensor with damp clothes, the wiper may operate suddenly. It could cause serious injury. Make sure to place the wiper switch to the OFF position and ignition switch OFF when not in use.

▶ **Irregular operation (abrupt operation)**

- Check if the sensor is not displaced.
- Check if the rain sensor cover is securely installed.
- Check if the customer is familiar with how to control the wiper sensitivity.
  Check if the wiper sensitivity control is set to the FAST side (step 5).
- Check the wiper blades for wear.
- If the wiper blade cannot wipe the glass uniformly and clearly, it may cause the rain sensor to work irregularly. Therefore, in this case, replace the wiper blade with a new one.

Modification basis	
Application basis	
Affected VIN	

4. MAJOR CHANGES

Rear washer nozzle(with spoiler)	
TIVOLI 	XLV 
Integrated with high-mounted stop lamp	Fitted on high-mounted stop lamp cover

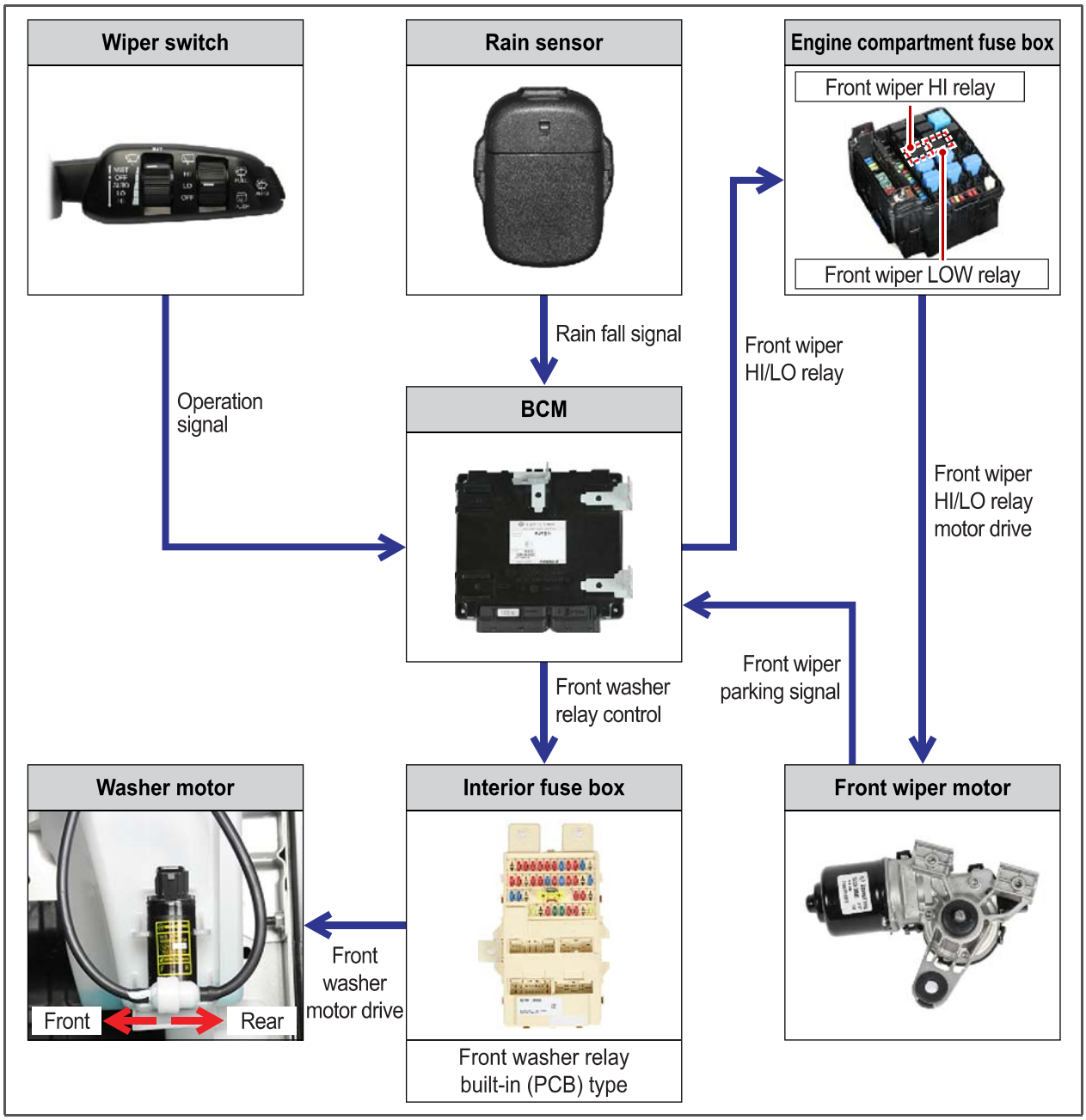
Rear wiper blade	
TIVOLI 	XLV 
Blade length: 11” (275 mm)	Blade length: 10” (250 mm)

OVERVIEW AND OPERATING PROCESS

1. OVERVIEW

1) Windshield Wiper System

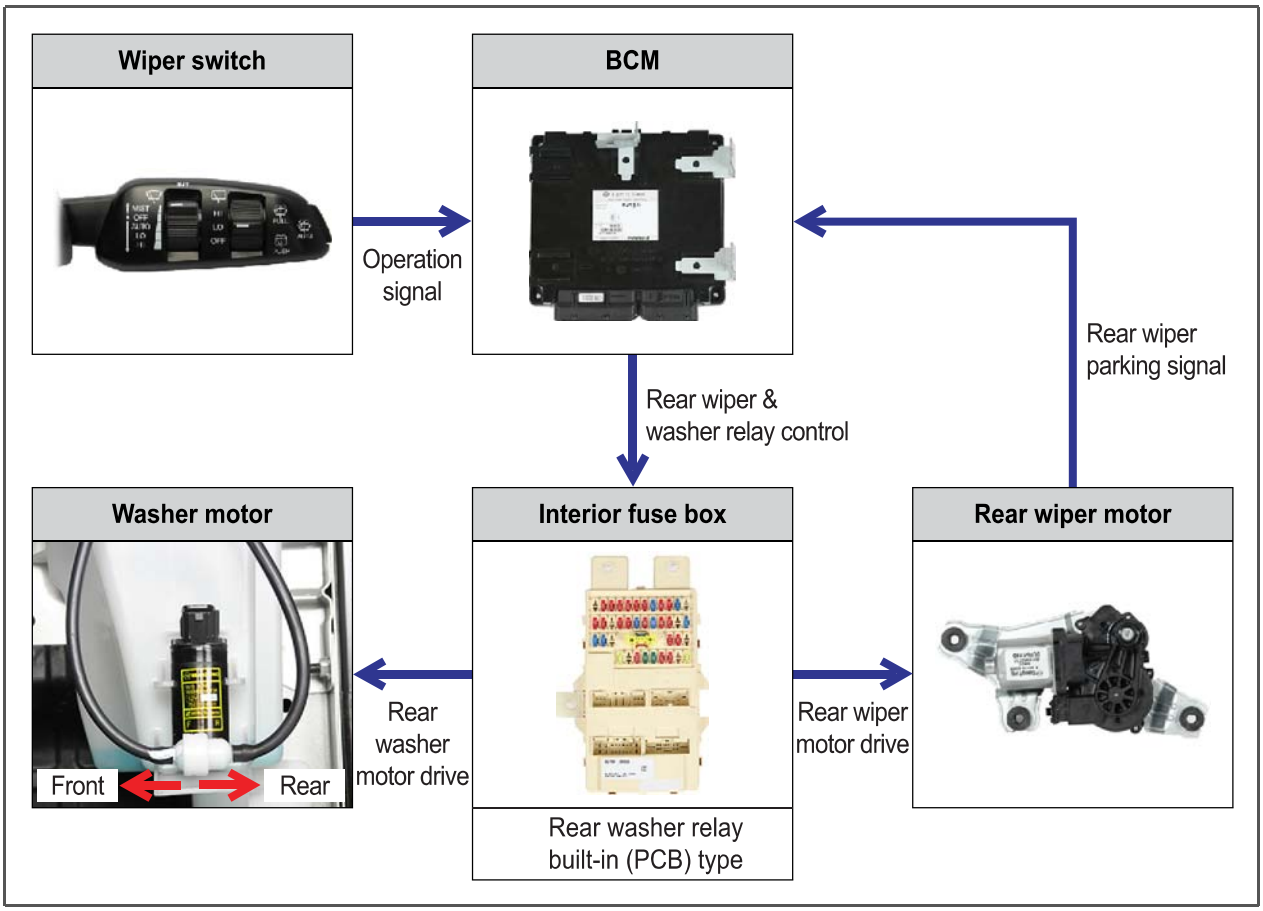
The wiper and rain sensor system consists of the wiper switch, windshield wiper motor and linkage, wiper arm and blade, rain sensor, wiper relay (LO/HI) and washer tank. The rain sensor does not directly operate the rain sensing wiper and it sends only the data of the rainfall to the BCM. The basic operation of the wiper and washer is controlled by the BCM according to the signals from the multifunction switch operation (MIST, AUTO, LO/HI, washer, sensitivity adjustment).



Modification basis	
Application basis	
Affected VIN	

2) Rear Wiper System

The rear wiper system consists of the wiper switch, rear wiper motor, wiper arm and blade, rear wiper relay. The basic operation of the wiper and washer is controlled by the BCM according to the signals from the multifunction switch operation (LO/HI, washer).



3) Rain Sensor System

In the rain sensing wiper operation system, the rain sensing unit only sends the information about the amount of rain drops to the BCM, and it does not operate the wiper directly. The wiper and washer are controlled by the BCM according to the driver's choice.

AUTO light and rain sensor module	AUTO operation and sensitivity control
	
This sensor emits infrared rays through LED and then detects the amount of rain drops by receiving the rays reflected off the sensing section (rain sensor mounting section on the windshield) with photodiode.	**AUTO:** Wiper operates automatically by rain sensor **FAST <-------> SLOW:** Auto delay/auto speed control. timberlake96: A position that can control the sensitivity for the amount of rains on the windshield and transmit the wiping request signal accordingly.

▶ BCM

The rain sensor detects the amount of rain drops and sends the operating request signal to the BCM, which drives the wiper directly. At this moment, the BCM also sends the information on whether the wiper is in operation mode or whether the multifunction wiper switch is in AUTO position to the rain sensor.

BCM	Rain sensor unit
	

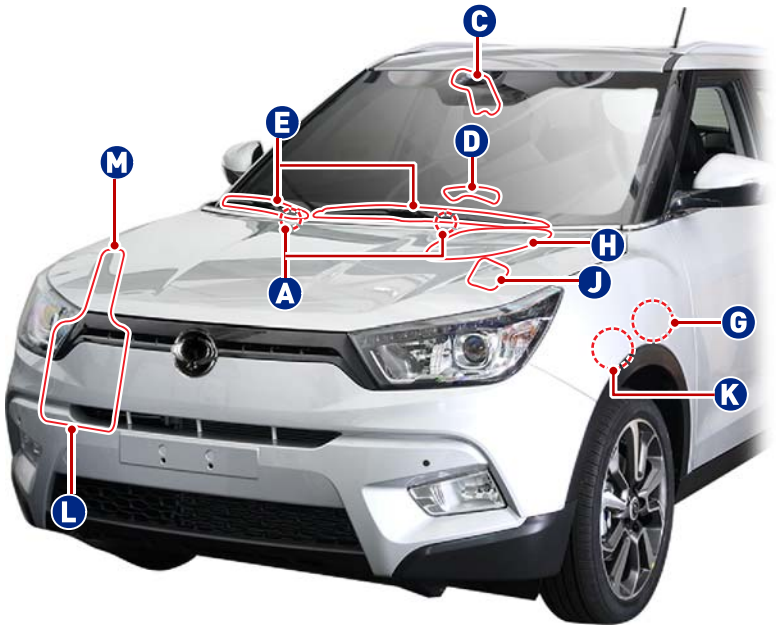
Modification basis	
Application basis	
Affected VIN	

Memo

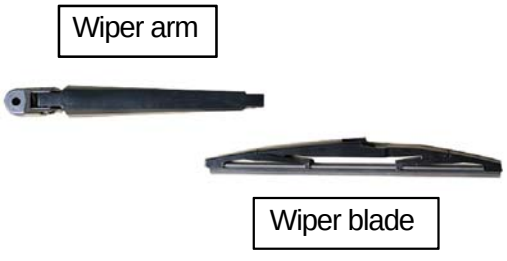
2. COMPONENTS

Washer nozzle			
A Front	B Rear (without spoiler)	B Rear(with spoiler)	
		TIVOLI	XLV
			

C Rain sensor unit



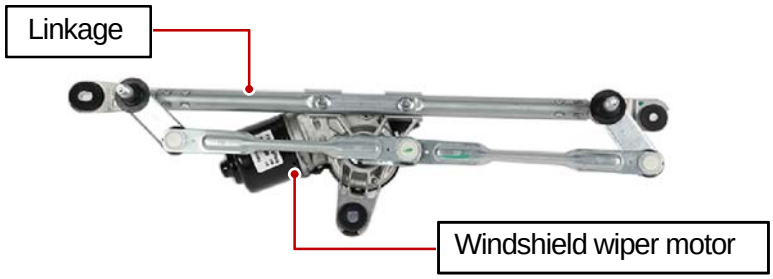
D Wiper switch

Wiper arm and blade	
E Front	F Rear
	

Modification basis	
Application basis	
Affected VIN	

G Interior fuse box

H Windshield wiper motor and linkage assembly



I Rear wiper motor

J Wiper (HI, LO) relay

M Washer fluid reservoir tank

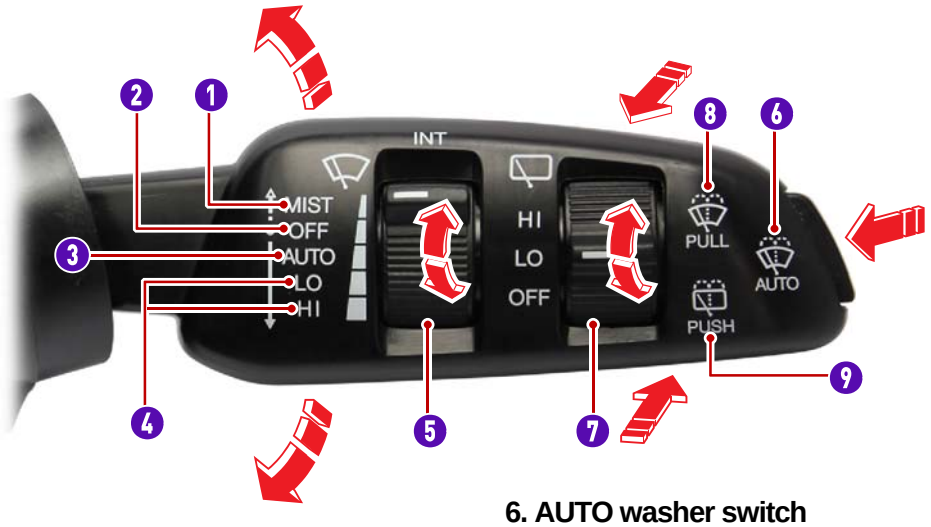
L Windshield/rear washer motor

K BCM

Modification basis	
Application basis	
Affected VIN	

3. OPERATING PROCESS

1) Multifunction Wiper Switch Operation Mode



1. MIST

- When the wiper switch is pushed up to the mist position, the windshield wipers cycle once and then stop in the parking position.

2. OFF

- Stops the windshield wiper operation.

3. AUTO

- When the wiper switch is set to the AUTO position, the wiper speed is adjusted automatically according to the amount of rain detected by the rain sensor mounted on the windshield.

4. LO/HI

- When the wiper switch is set to the LO position, the wiper speed is decreased. When the switch is set to the HI position, the wiper speed is increased.

5. Front wiper volume sensitivity switch

- When the wiper switch is in AUTO position, the wiper speed can be adjusted as follows:
  * FAST: increases wiper speed
  * SLOW: decreases wiper speed

6. AUTO washer switch

- When the AUTO washer switch is pressed, the washer fluid is sprayed once and the wiper cycles 4 times. Then, the fluid is sprayed once again with 3 cycles of the wiper.

7. Rear wiper switch

- Operates the rear wiper.

8. Pull

- The windshield washer fluid is sprayed out and front wiper operates only when the switch is being pulled.

9. Push

- The rear washer fluid is sprayed out and rear wiper operates only when the switch is being pressed down.

Modification basis	
Application basis	
Affected VIN	

2) BCM Operation Mode

(1) Windshield washer switch coupled windshield wiper operation

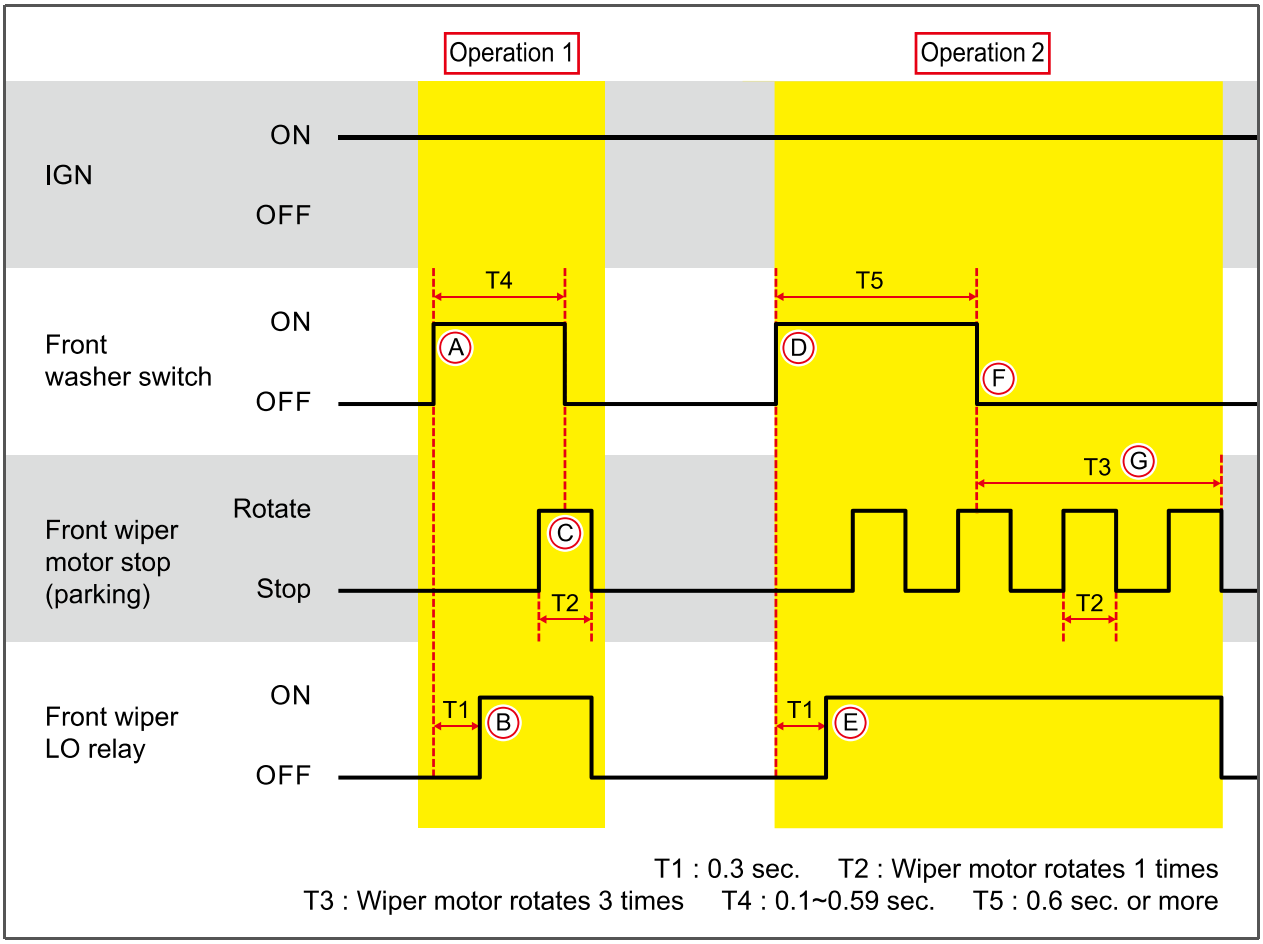
Basic condition	IGN ON

Operation 1. (windshield washer switch pulled for 0.1 to 0.59 sec.)

A. Windshield washer switch ON for 0.1 to 0.59 sec. (T4)
B. After 0.3 sec. (T1), windshield wiper LO relay is activated.
C. Windshield wiper LO relay is deactivated after windshield wiper motor rotates 1 turn (T2).

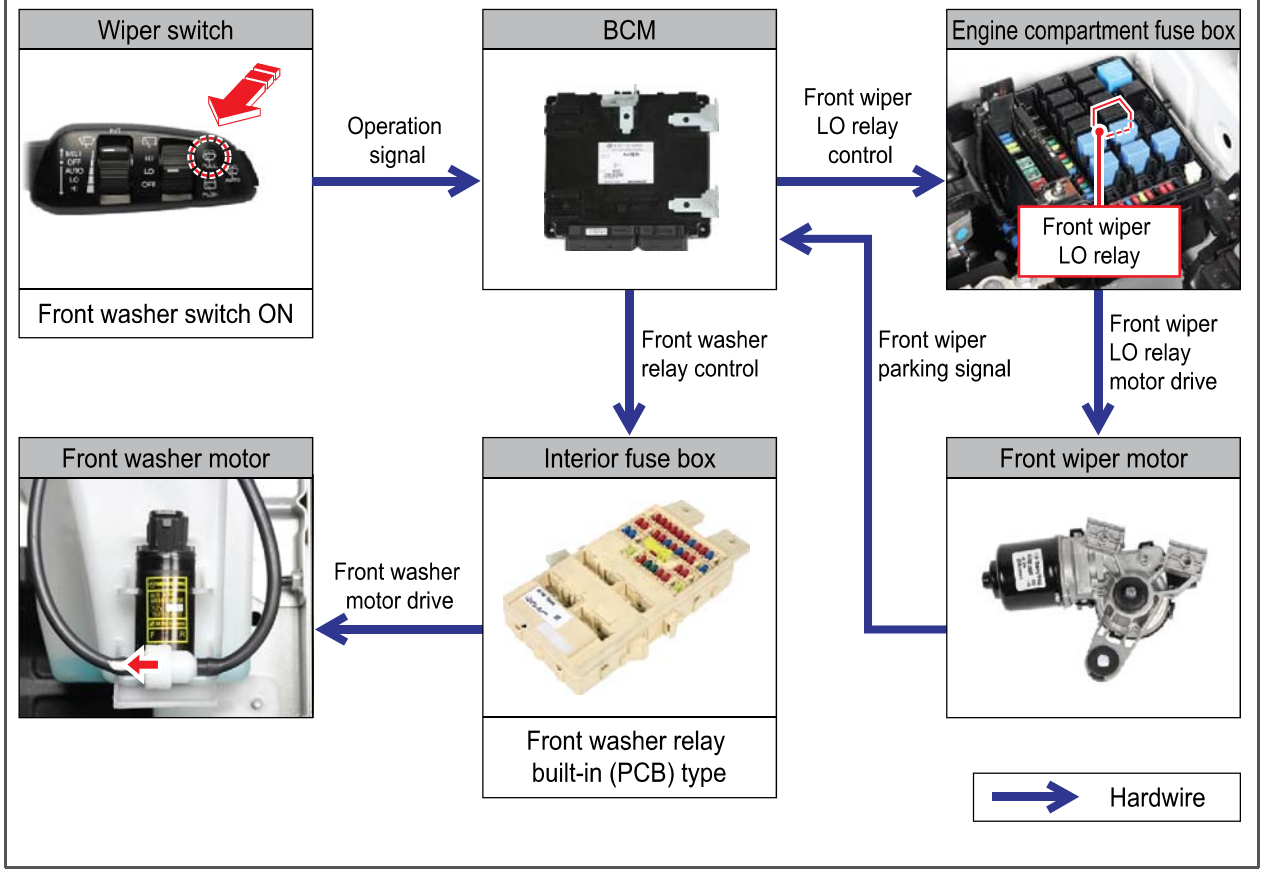
Operation 2. (windshield washer switch pulled for 0.6 seconds or more)

D. Windshield washer switch is ON for more than 0.6 sec. (T5)
E. After 0.3 sec. (T1), windshield wiper LO relay is activated.
F. Windshield washer switch is OFF.
G. Windshield wiper LO relay is deactivated after windshield wiper motor rotates 3 turns (T3).



System flowchart

- With IGN ON



Modification basis	
Application basis	
Affected VIN	

(2) Windshield washer switch coupled wiper operation during intermittent wiper operation

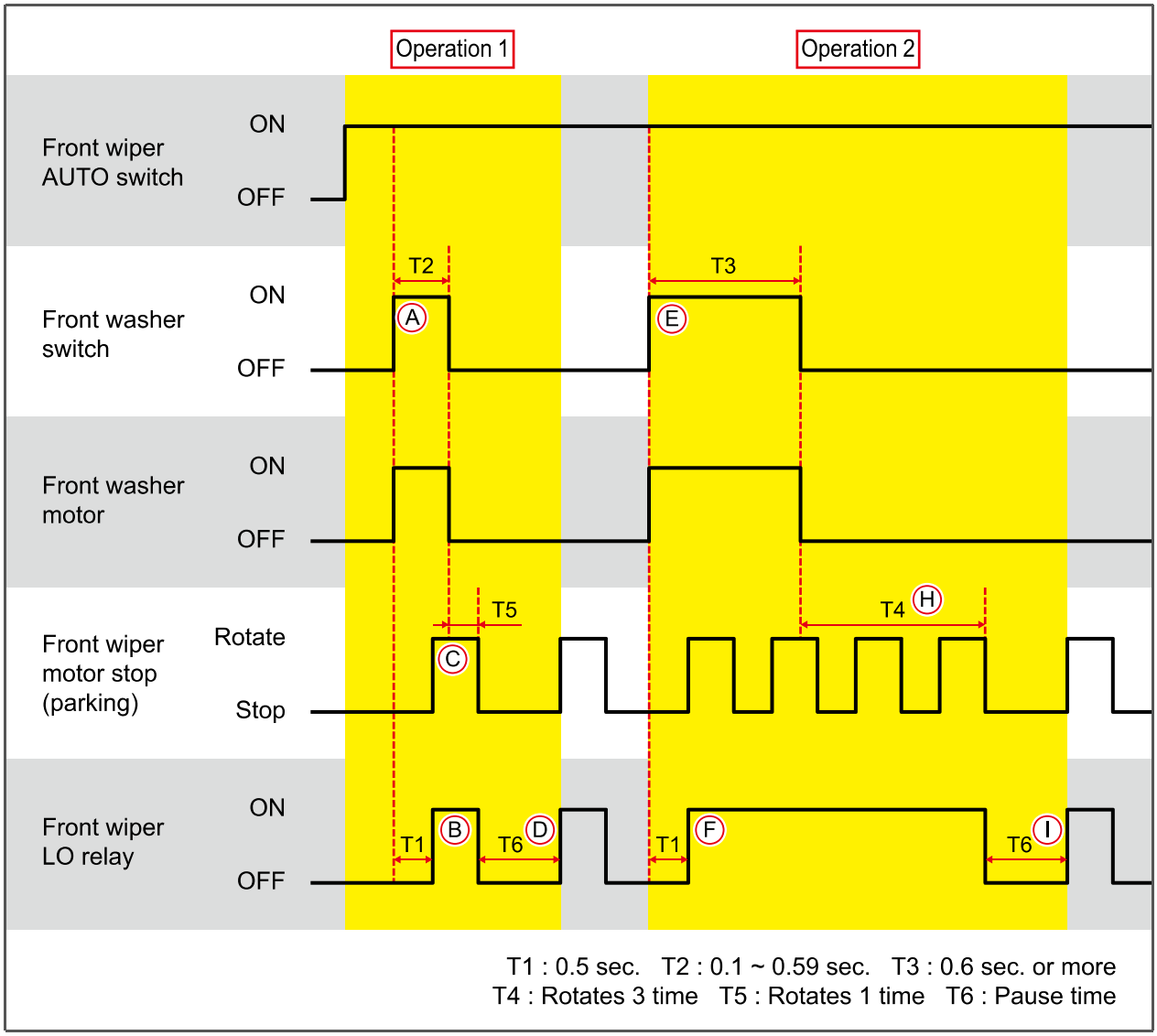
Basic condition	- Windshield intermittent wiper operates with IGN ON and wiper AUTO switch in ON position.

Operation 1. (windshield washer switch pulled for 0.1 to 0.59 sec.)

A. Windshield washer switch is ON for 0.1 to 0.59 sec. (T2)
B. After 0.5 sec. (T1), windshield wiper LO relay is activated.
C. Windshield wiper LO relay is deactivated after windshield wiper motor rotates 1 turn (T5).
D. Intermittent wiper operation is started by windshield wiper LO relay after rest time (T6).

Operation 2. (windshield washer switch pulled for 0.6 seconds or more)

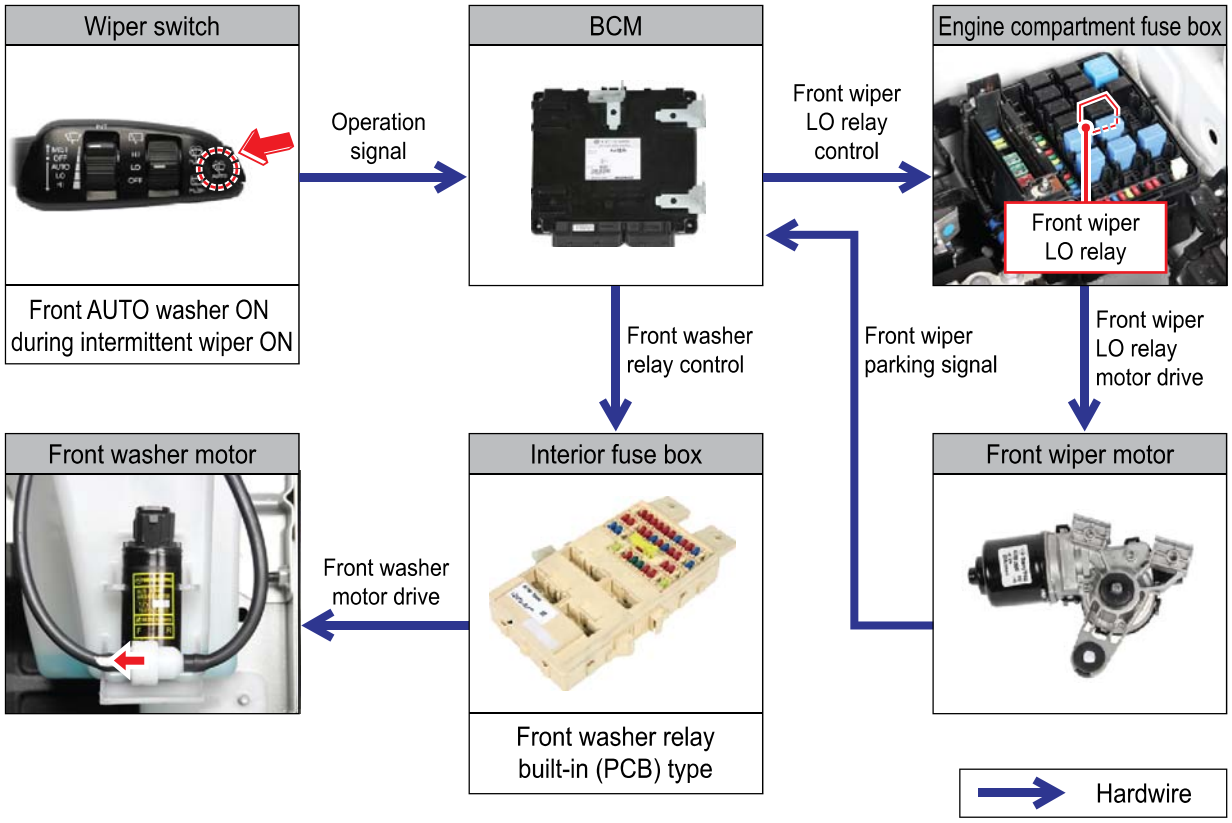
E. Windshield washer switch is ON for 0.6 (T3) seconds or more.
F. After 0.5 sec. (T1), windshield wiper LO relay is activated.
G. Windshield washer switch is OFF.
H. Windshield wiper LO relay is deactivated after windshield wiper motor rotates 3 turns (T4).
I. Intermittent wiper operation is started by windshield wiper LO relay after rest time (T6).



Modification basis	
Application basis	
Affected VIN	

System flowchart

- With IGN ON and Wiper auto switch ON



(3) Windshield auto washer switch coupled windshield wiper operation

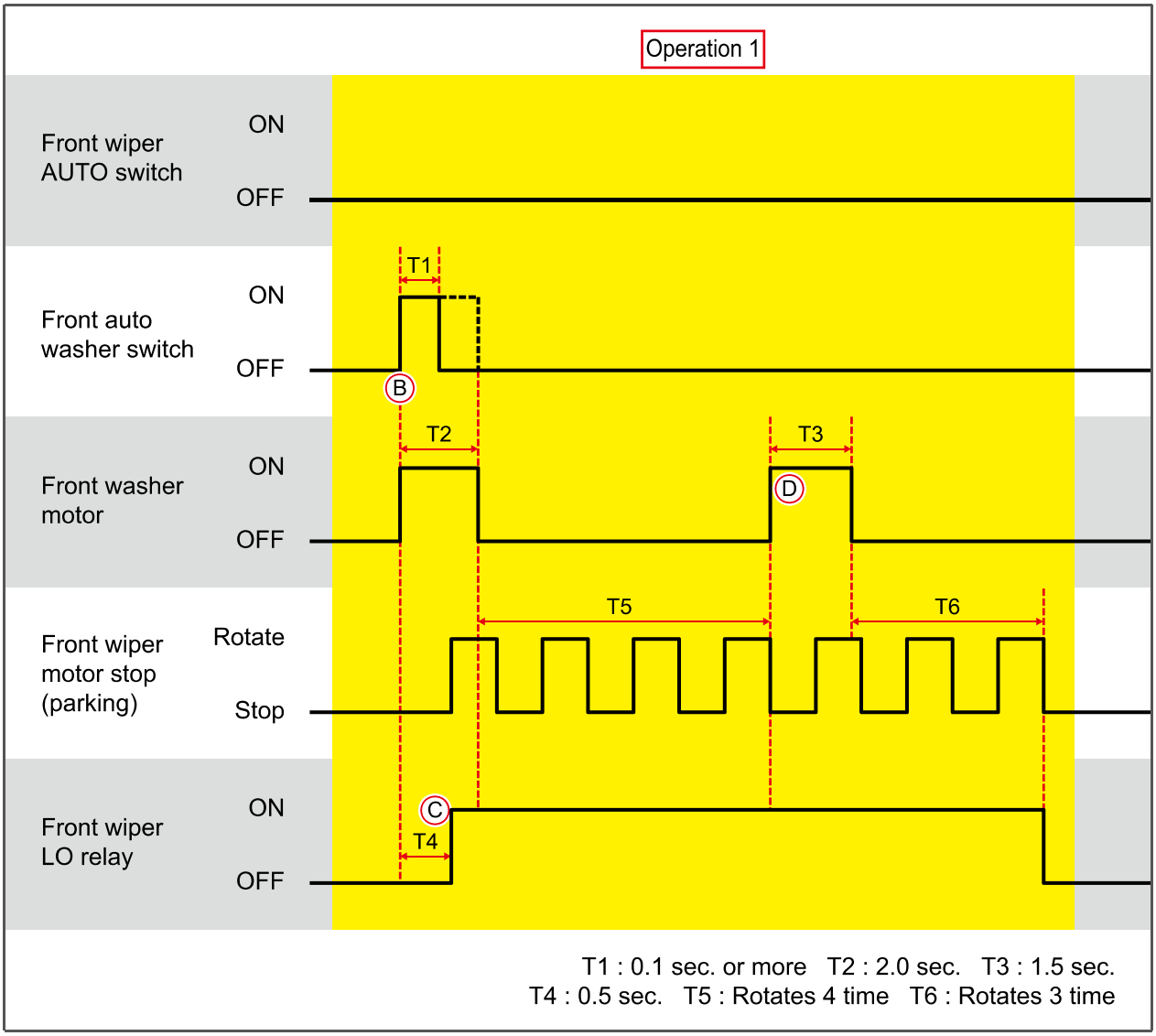
Operation 1.

A. With IGN ON and windshield wiper auto switch is OFF.
B. Windshield auto washer switch is ON for 0.1 seconds or more (T1) and windshield washer motor is ON for 2.0 seconds (T2).
C. The windshield wiper LO relay is operated 4 times (T5) 0.5 seconds (T4) after the windshield washer motor has been activated.
D. Windshield washer motor is activated for 1.5 seconds (T3) and the windshield wiper LO relay is deactivated after 3 times (T6) of operation.

NOTE

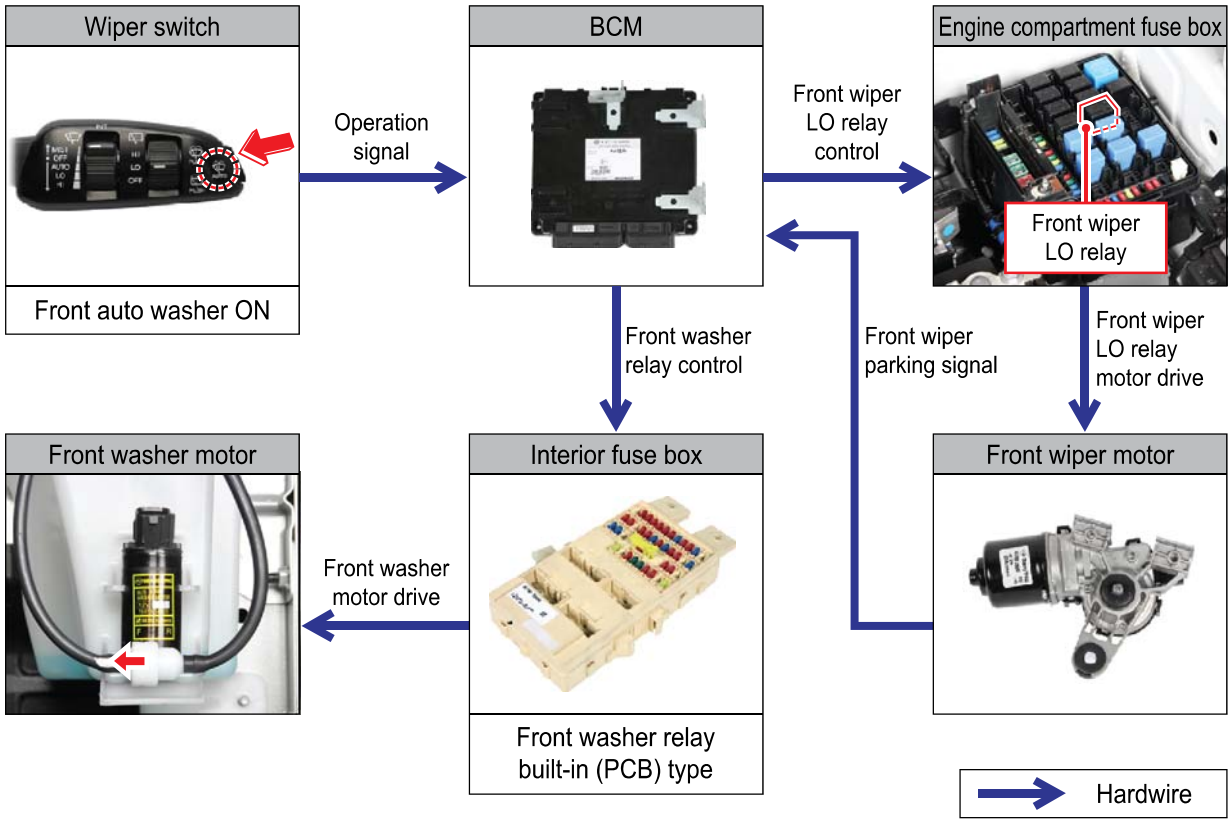
- Input from windshield auto washer is overridden during windshield washer motor operation.
- The second input from windshield auto washer is overridden during windshield auto washer linked windshield wiper operation.
- Input from windshield auto washer is overridden during speed sensitive intermittent wiper operation.
- When ON signal of windshield intermittent wiper switch is received during windshield auto washer operation, windshield auto washer stops operation and windshield intermittent wiper operation starts.
- Input from windshield washer switch is overridden during windshield auto washer operation.

Modification basis	
Application basis	
Affected VIN	


Operation 1
Front wiper AUTO switch
ON
OFF
Front auto washer switch
ON
OFF
T1
B
Front washer motor
ON
OFF
T2
T3
D
Front wiper motor stop (parking)
Rotate
Stop
T5
T6
Front wiper LO relay
ON
OFF
C
T4
T1 : 0.1 sec. or more T2 : 2.0 sec. T3 : 1.5 sec.
T4 : 0.5 sec. T5 : Rotates 4 time T6 : Rotates 3 time

System flowchart

- With IGN ON and Wiper auto switch OFF



NOTE

Priority of operation:

Windshield washer switch → Wiper auto switch

Modification basis	
Application basis	
Affected VIN	

(4) Rear wiper operation

Basic condition	IGN ON

Operation 1. (Rear wiper switch)

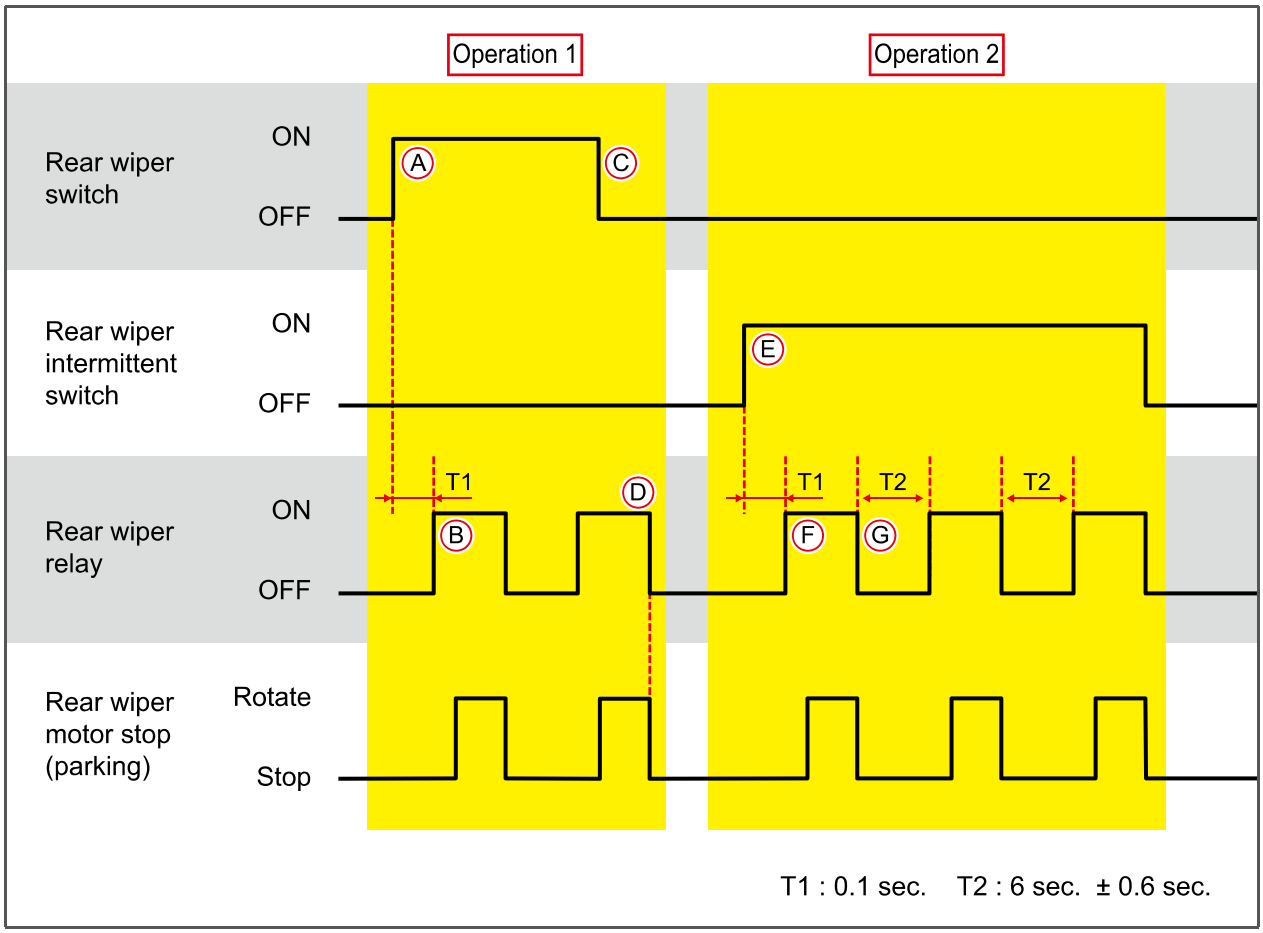
A. Rear wiper switch is ON.
B. After 0.1 sec. (T1), rear wiper relay is activated.
C. Rear wiper switch is OFF.
D. Rear wiper relay is deactivated upon receiving rear wiper motor parking signal.

Operation 2. (Rear wiper intermittent switch)

E. Rear wiper intermittent switch is ON.
F. After 0.1 sec. (T1), rear wiper relay is activated once.
G. After 6 sec. (T2) of deactivation, rear wiper relay is activated once again.

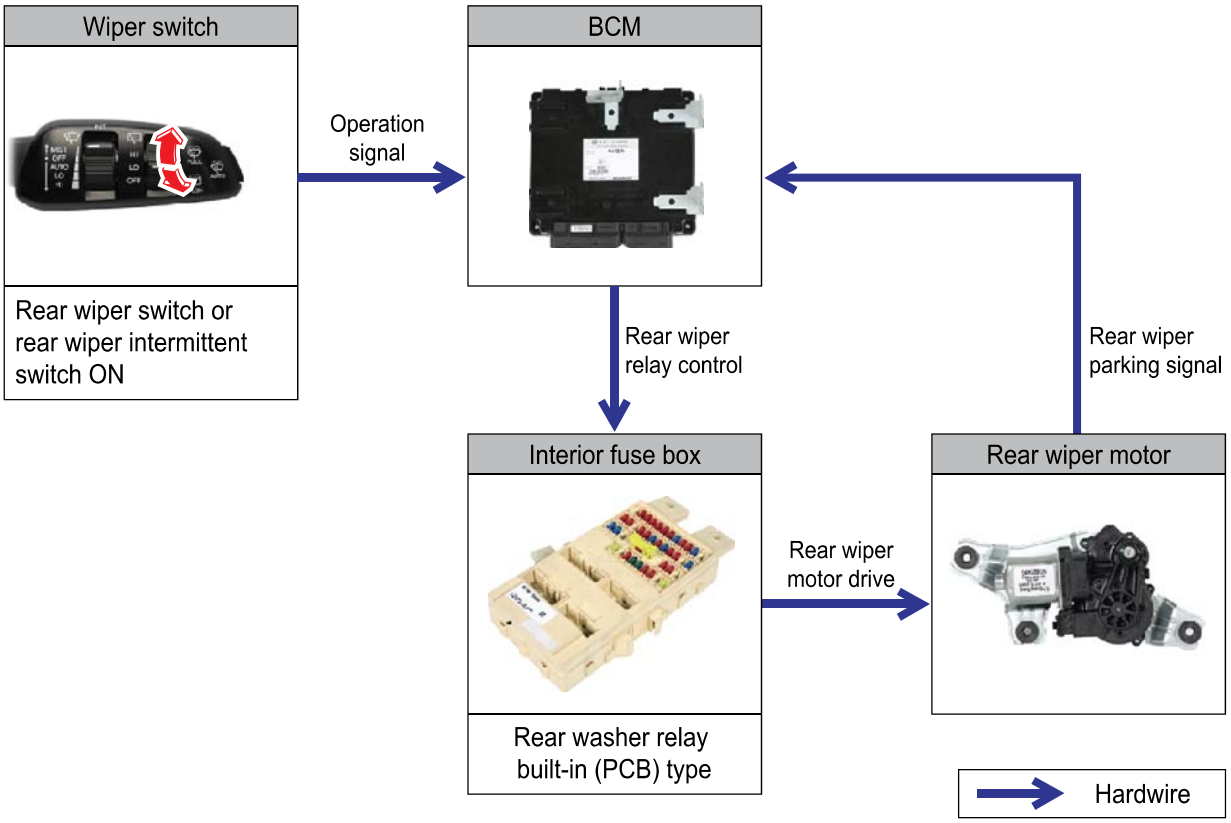
NOTE

When turning ignition off during the rear wiper operation, the rear wiper operates until the rear wiper motor parking signal is received.



System flowchart

- With IGN ON



Modification basis	
Application basis	
Affected VIN	

(5) Rear washer coupled rear wiper operation

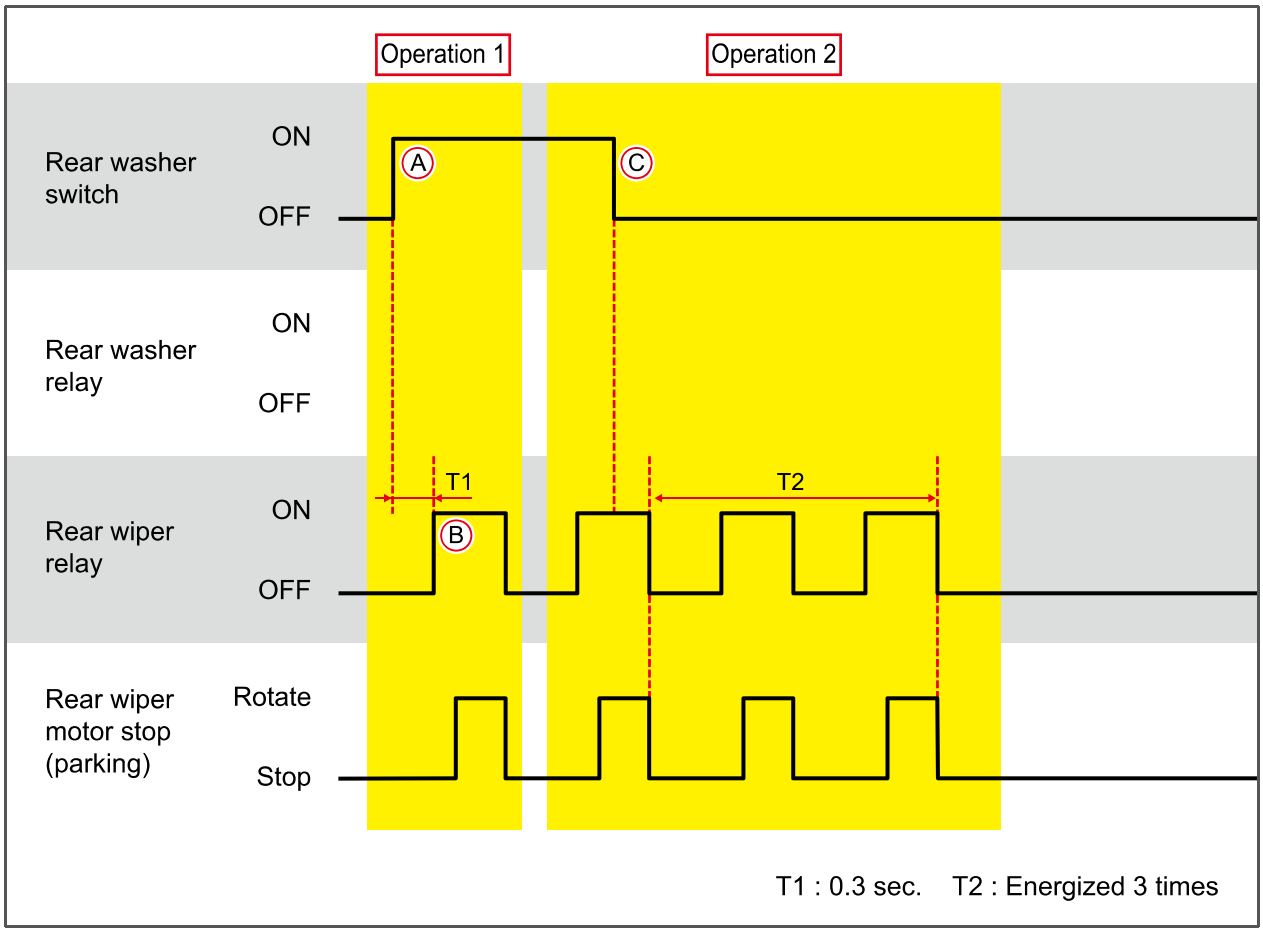
Basic condition	IGN ON

Operation 1.

A. Rear washer relay is ON when rear washer switch is ON.
B. After 0.3 sec. (T1), rear wiper relay is ON.

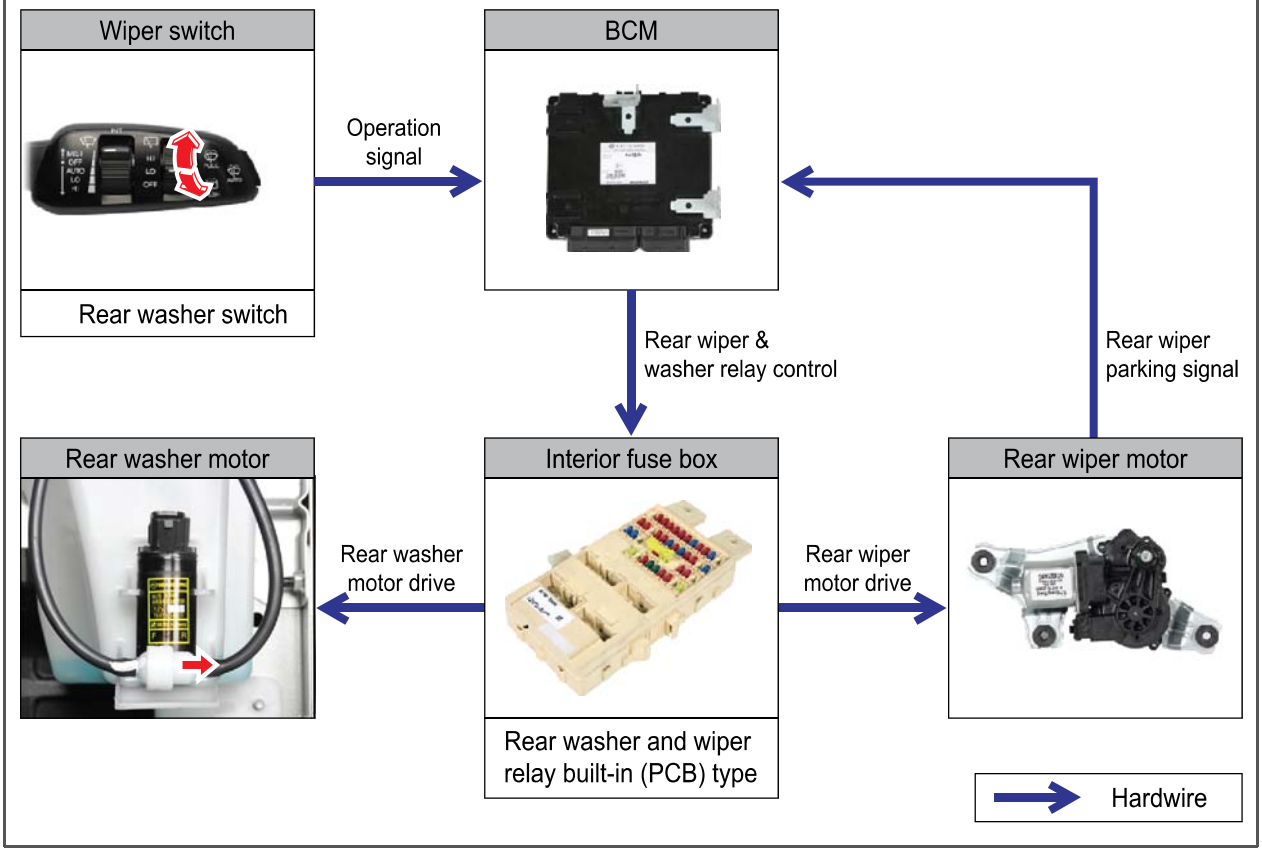
Operation 2.

C. Rear washer motor is turned OFF when rear washer switch is OFF.
D. Rear wiper relay cycles 3 times (T2) and stops after rear washer switch is turned off.



System flowchart

- With IGN ON



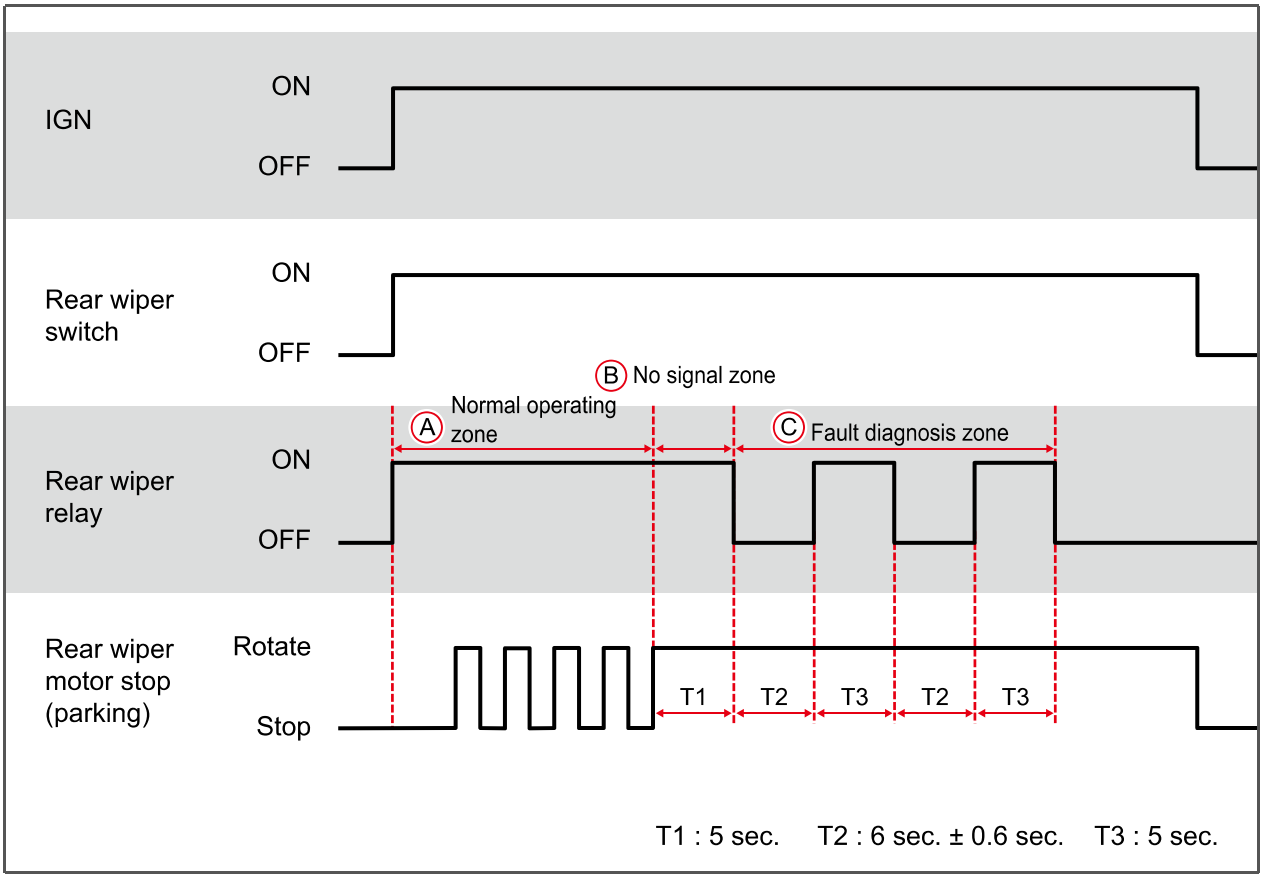
Modification basis	
Application basis	
Affected VIN	

(6) Rear wiper malfunction indicator

Basic condition	IGN ON, rear wiper switch and rear wiper intermittent switch are ON.

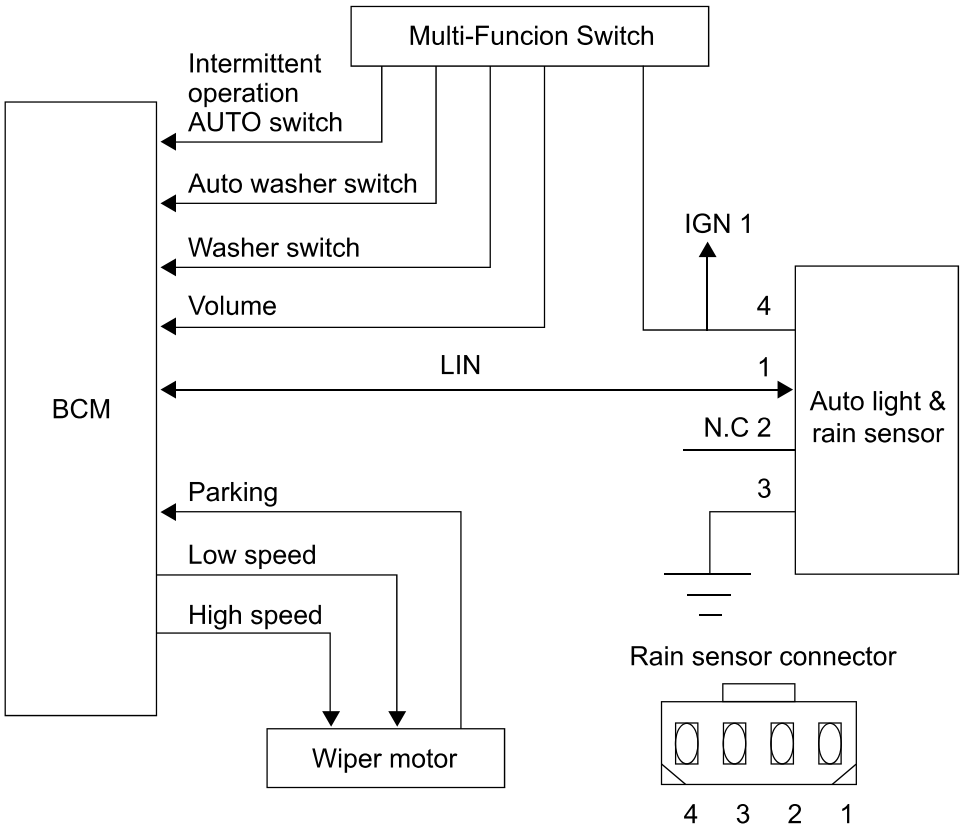
Operation 1. (DTC set)

A. Rear wiper is operating normally.
B. No change in rear wiper motor parking signal for 5 sec. (T3) or longer.
C. Rear wiper stops after 2 cycles of rear wiper parking for 6 sec. (T2) and rear wiper operating for 5 sec. (T1).



(7) Rain sensor operation

System flowchart



Data recognition time

The LIN communication is established when the ignition is turned ON, regardless of the wiper and light switch operation. Then the function for the LIN data is carried out with the wiper AUTO switch or AUTO light switch in the AUTO position.
The data from the rain sensor is recognized as 2 consecutive data.

Operation when data is recognized

Data OFF: Lo/HI relay output OFF.
Low speed signal: LO relay output ON (ON for at least 1 revolution), HI relay output OFF.
High speed signal: HI relay output ON (ON for at least 1 revolution), LO relay output ON.
The washer input is overridden during continuous operation of wiper (washer coupled wiper operation during intermittent operation).

Modification basis	
Application basis	
Affected VIN	

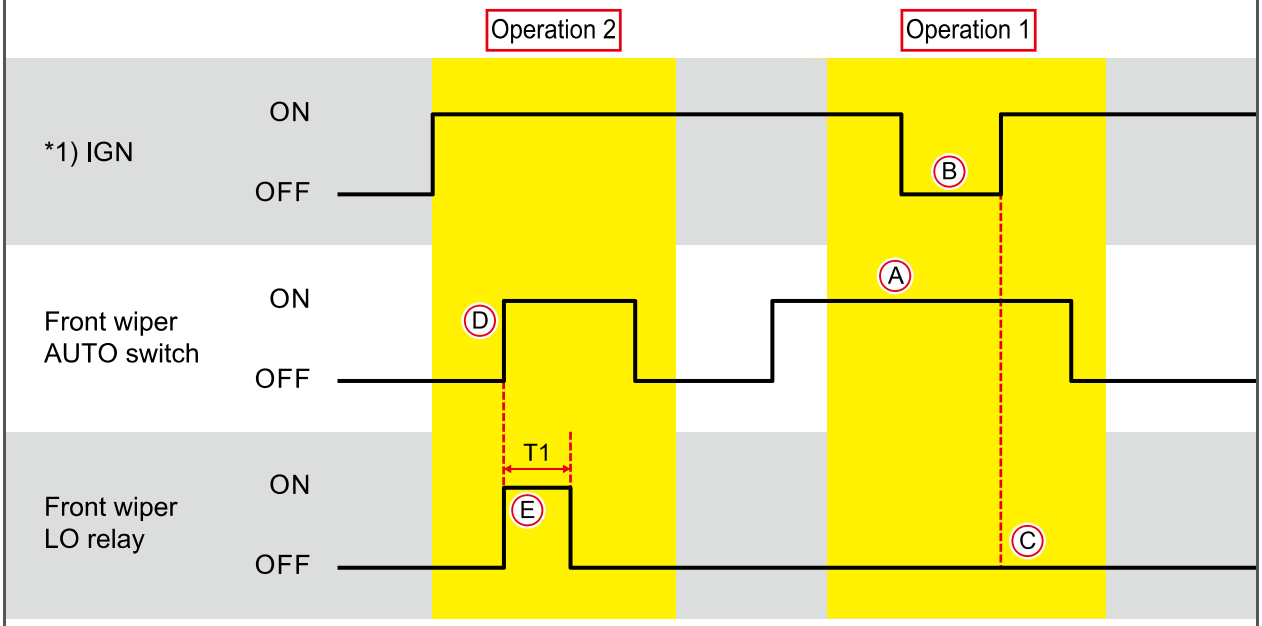
(8) Power-up reminder wiper

Operation 1.

A. Windshield wiper auto switch is ON.
B. Ignition key is cycled (ON → OFF → ON).
C. Windshield wiper LO relay is not operated.

Operation 2.

D. With IGN ON, windshield wiper auto switch is turned from OFF to ON.
E. Windshield wiper LO relay is activated, and windshield wiper motor rotates once (T1) and then stops.



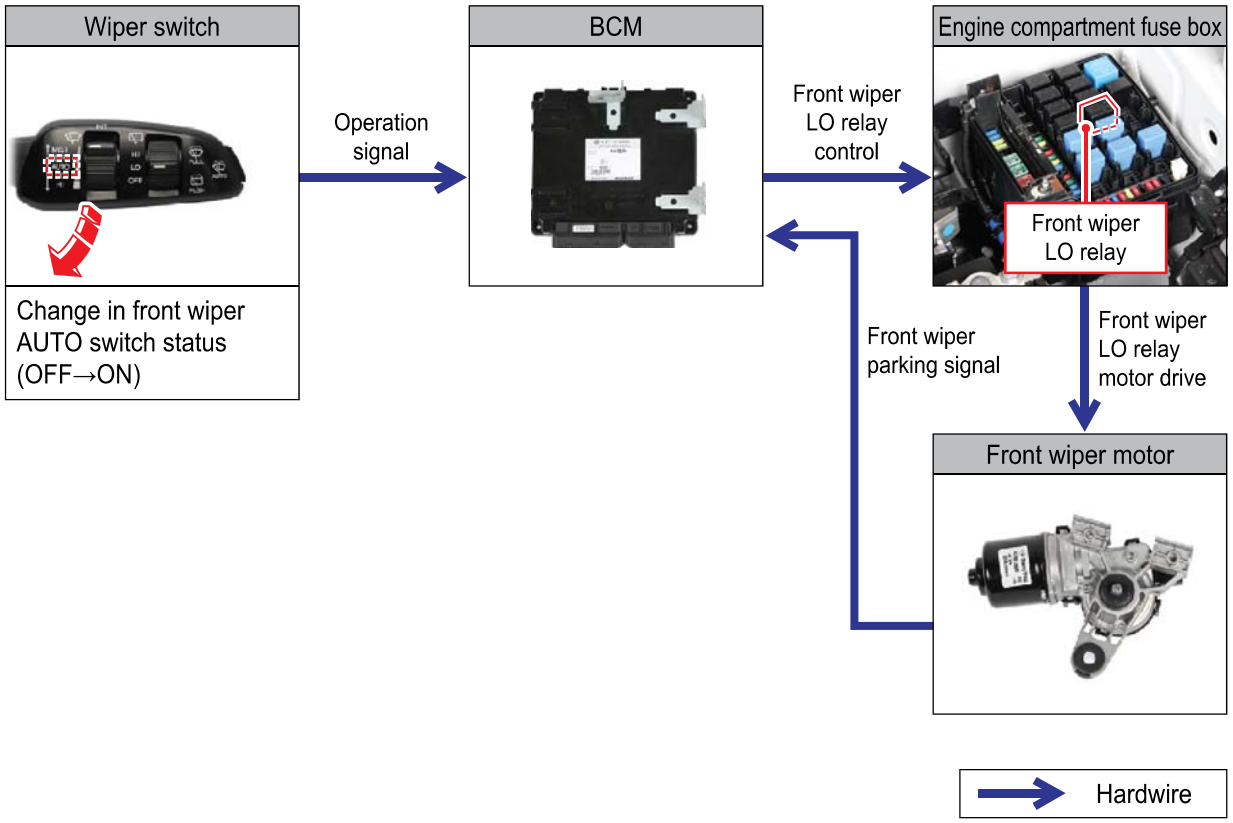
T1 : Rotates 1 time

Operating conditions based on *1)

Condition	Without SKM	With SKM
IGN ON	Ignition key inserted (IGN ON)	IGN ON
IGN OFF	Ignition key removed	IGN OFF

System flowchart

- With IGN ON



Modification basis	
Application basis	
Affected VIN	

(9) Washer switch operation during rain sensor coupled operation

Basic conditions	Intermittent operation with IGN ON and wiper AUTO switch ON

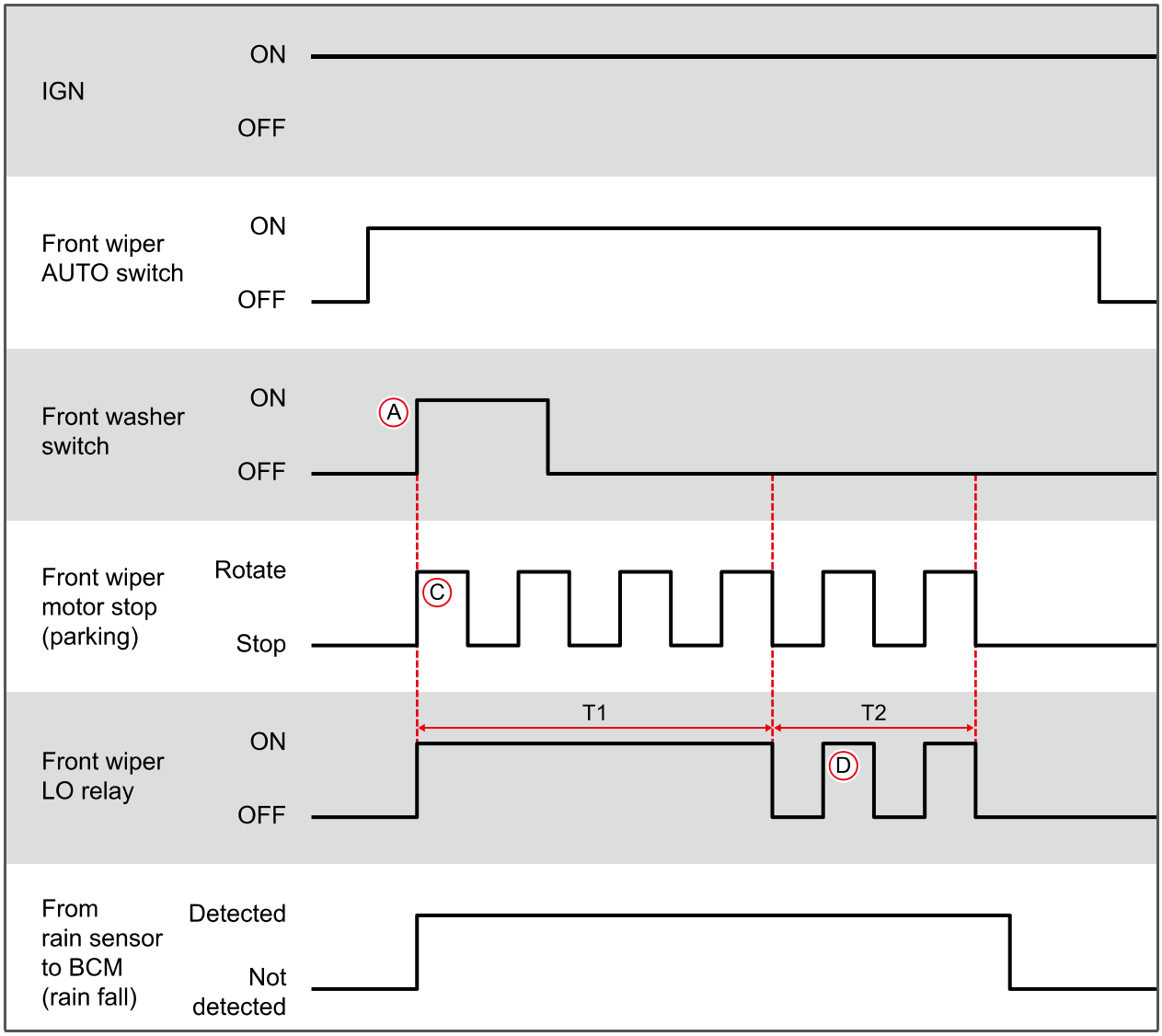
Operation 1.

- If rain sensor linked data does not indicate continuous wiper operation

A. Windshield washer switch is ON.
B. Communication with rain sensor is ignored. (can misread washer fluid as rain drops)
C. Windshield washer linked wiper operation (T1)
D. Rain sensor linked wiper operation (T2) starts after windshield washer linked wiper operation. However, if rain sensor linked wiper operation indicates washer linked wiper operation, only the windshield washer relay is activated while the windshield wiper keeps cycling.

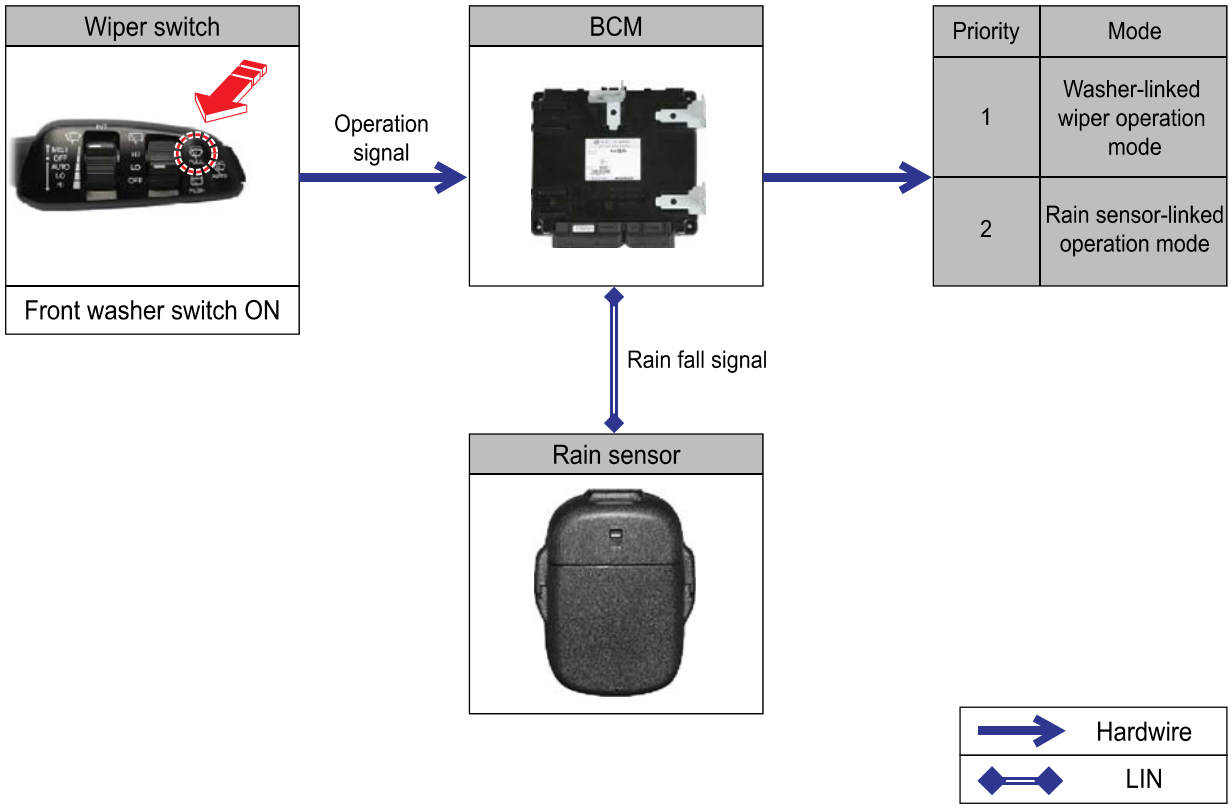
NOTE

Even when the washer linked wiper operation is activated, the BCM sends the operation data to rain sensor.



System flowchart

- During intermittent operation with IGN ON and windshield wiper auto switch ON



Modification basis	
Application basis	
Affected VIN	

(10) Wiper sensitivity control

Basic conditions	IGN ON/Wiper AUTO switch ON/Wiper motor in parking position

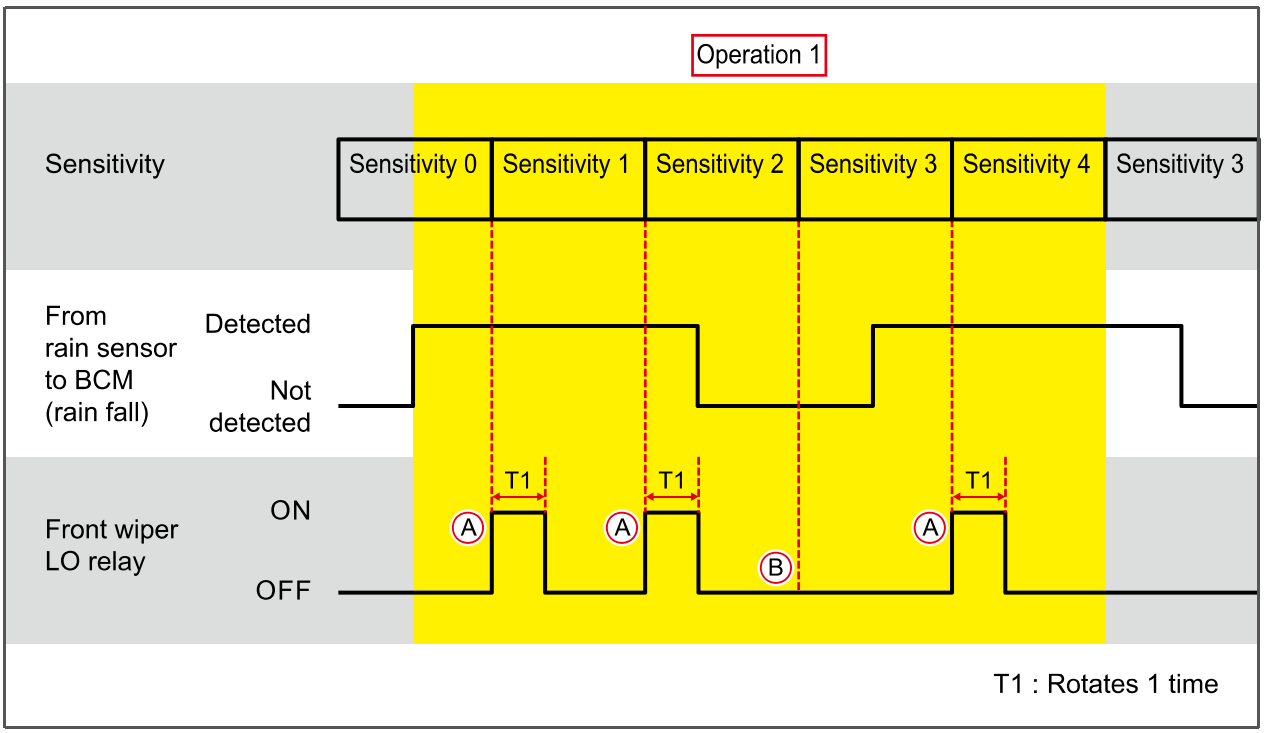
Operation 1.

- Increasing the sensitivity (ex: sensitivity level 0 → sensitivity level 1)

A. The amount of rain is detected by the rain sensor.
The windshield wiper LO relay is operated once (T1).
B. The amount of rain is not detected by the rain sensor.
The windshield wiper LO relay is not operated.

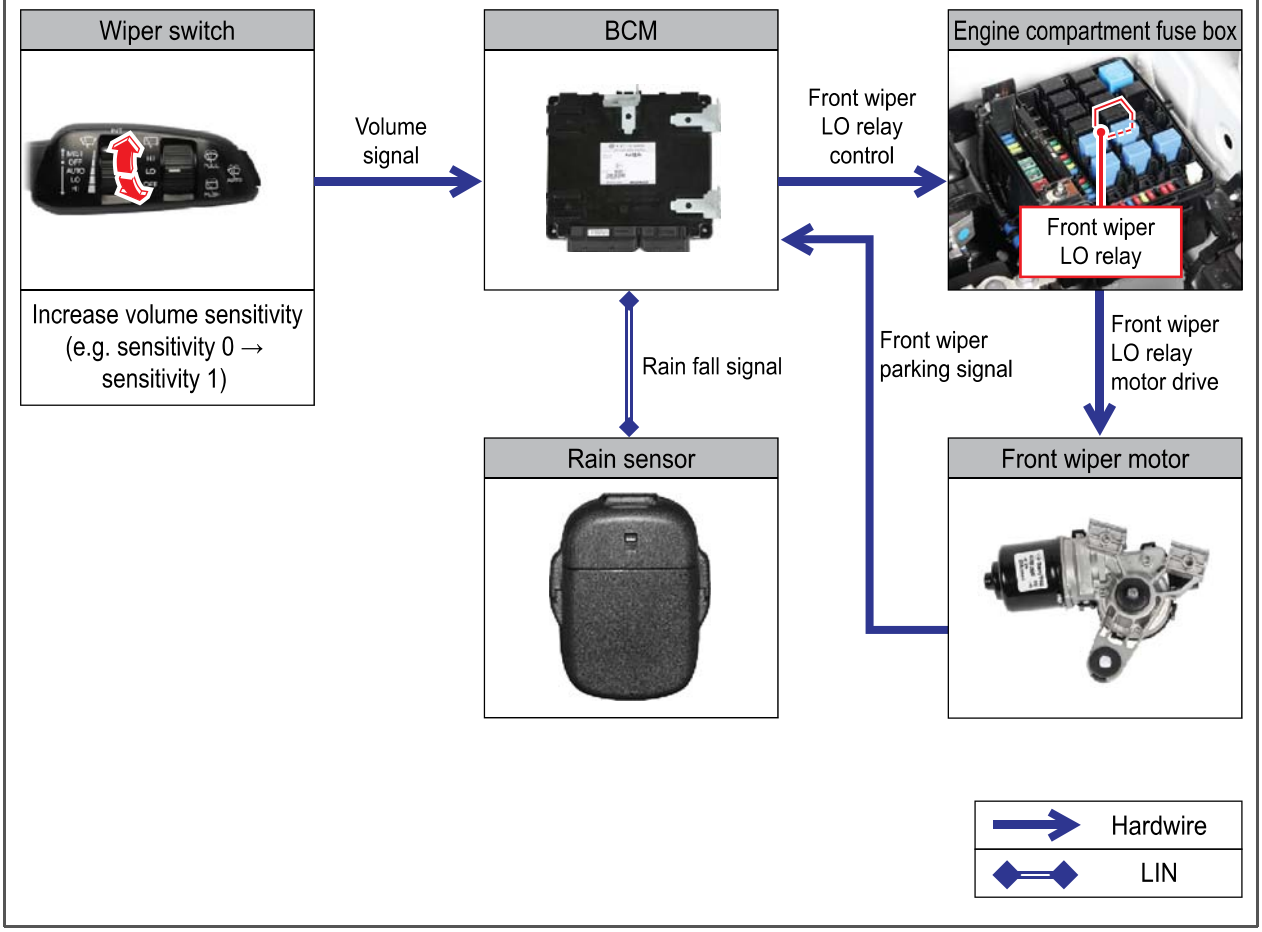
NOTE

Even if the sensitivity level is changed more than 1 stage within 2 seconds, the windshield wiper motor runs only one cycle.



System flowchart

- With IGN ON/Wiper AUTO switch ON/Wiper motor in parking position

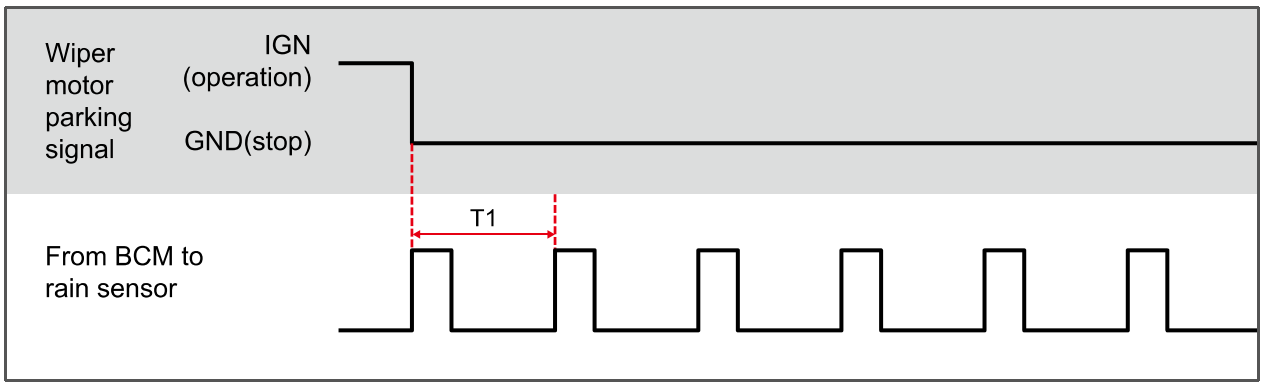


Modification basis	
Application basis	
Affected VIN	

(11) Abnormal wiper parking signal stop (GND)

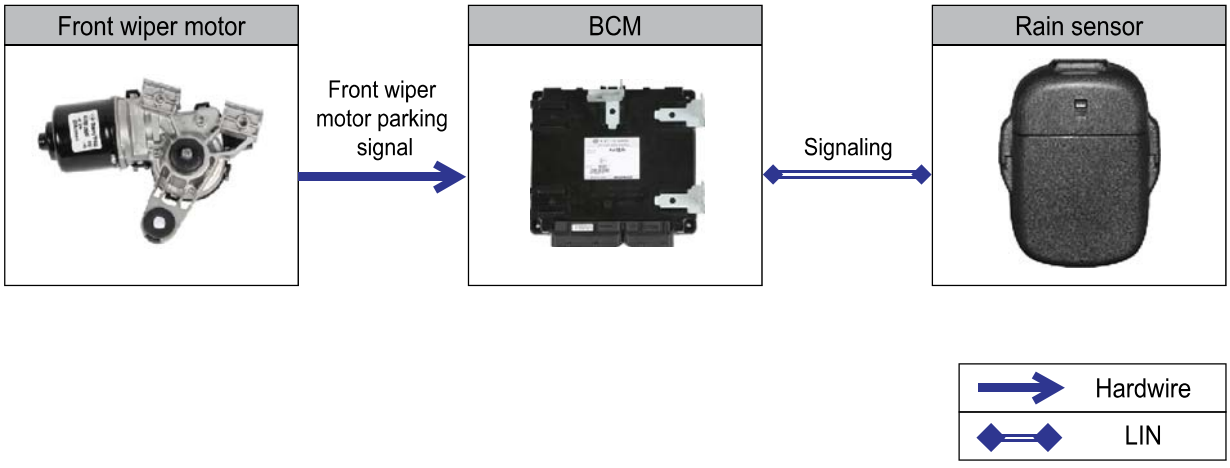
Operation 1. (When the wiper motor parking signal stuck at GND)

A. The wiper system sends the corresponding signal of current status with IGN ON and wiper AUTO switch ON. (The wiper motor is operated only when the request signal from the rain sensor is received.)



System flowchart

- With IGN ON/Windshield wiper auto switch ON/Wiper motor in parking position

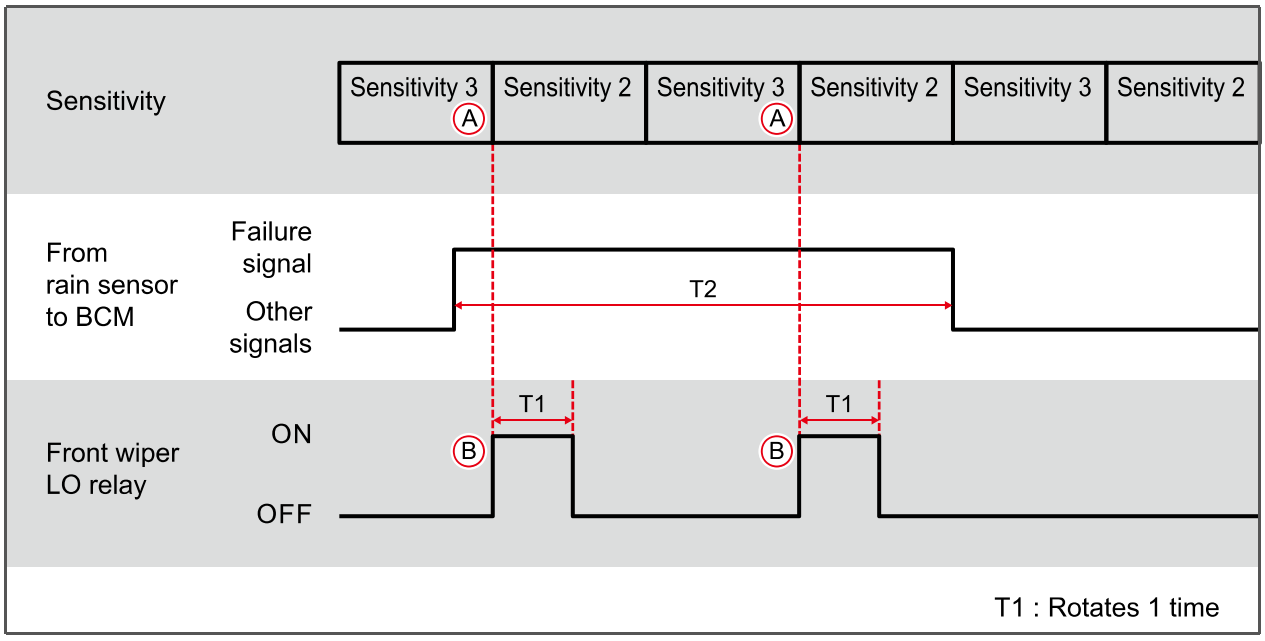


(12) Rain sensor malfunction (rain sensor external malfunction)

Basic conditions	IGN ON and wiper AUTO switch ON

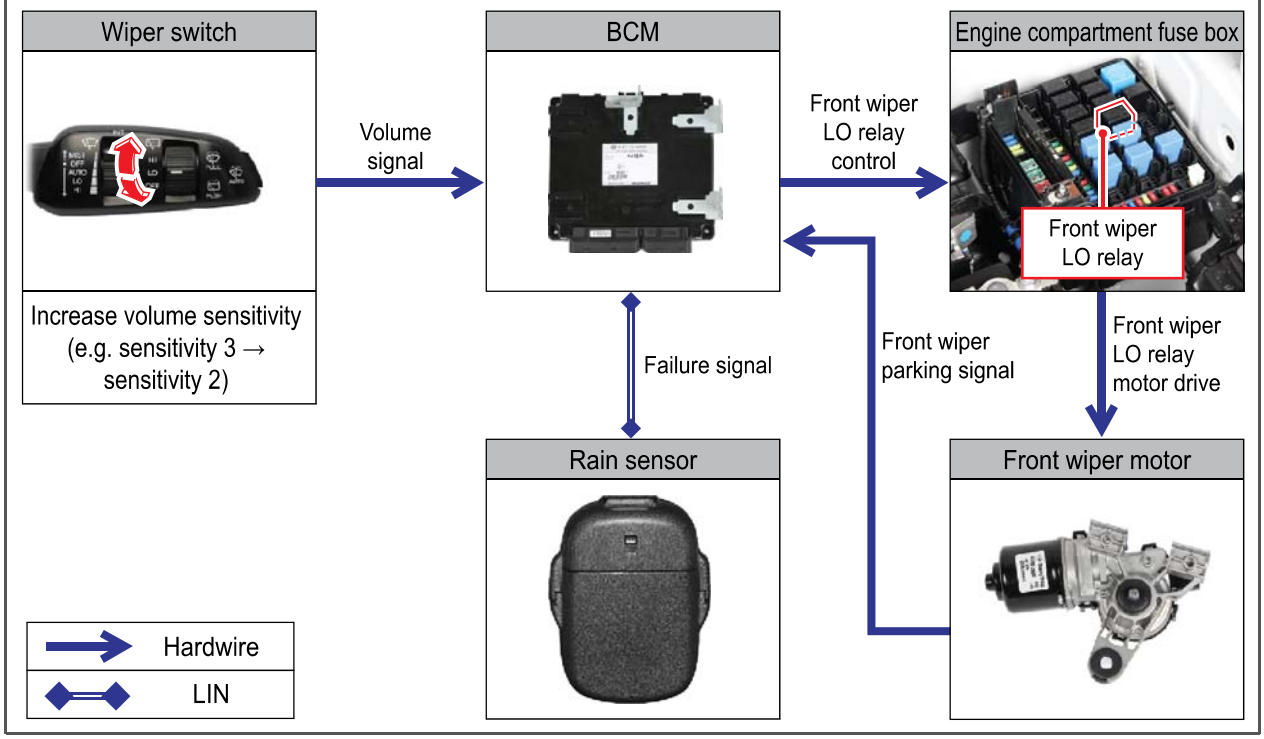
Operation 1. ("rain sensor installed improperly" signal received from the rain sensor)

A. The wiper AUTO switch sensitivity level is adjusted (sensitivity level 3 → sensitivity level 2).
B. The wiper LO relay is operated for one cycle (T1).



System flowchart

- With IGN ON / Windshield wiper AUTO switch ON



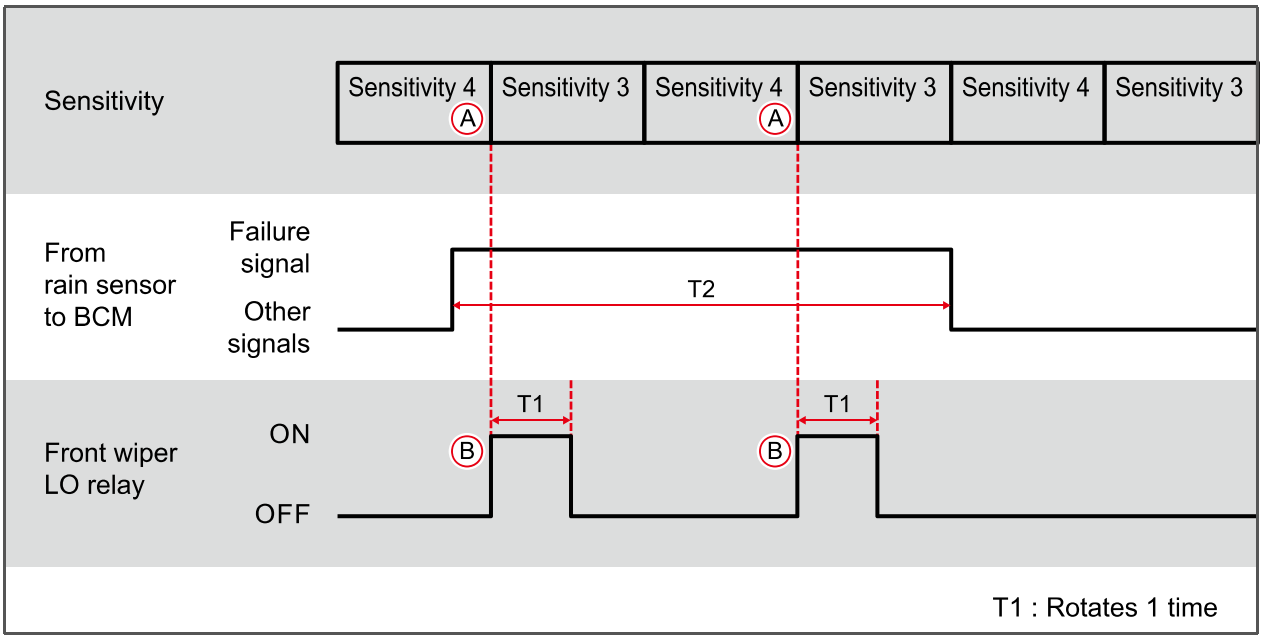
Modification basis	
Application basis	
Affected VIN	

(13) Rain sensor malfunction (no rain sensor signal)

Basic conditions	IGN ON and AUTO switch ON

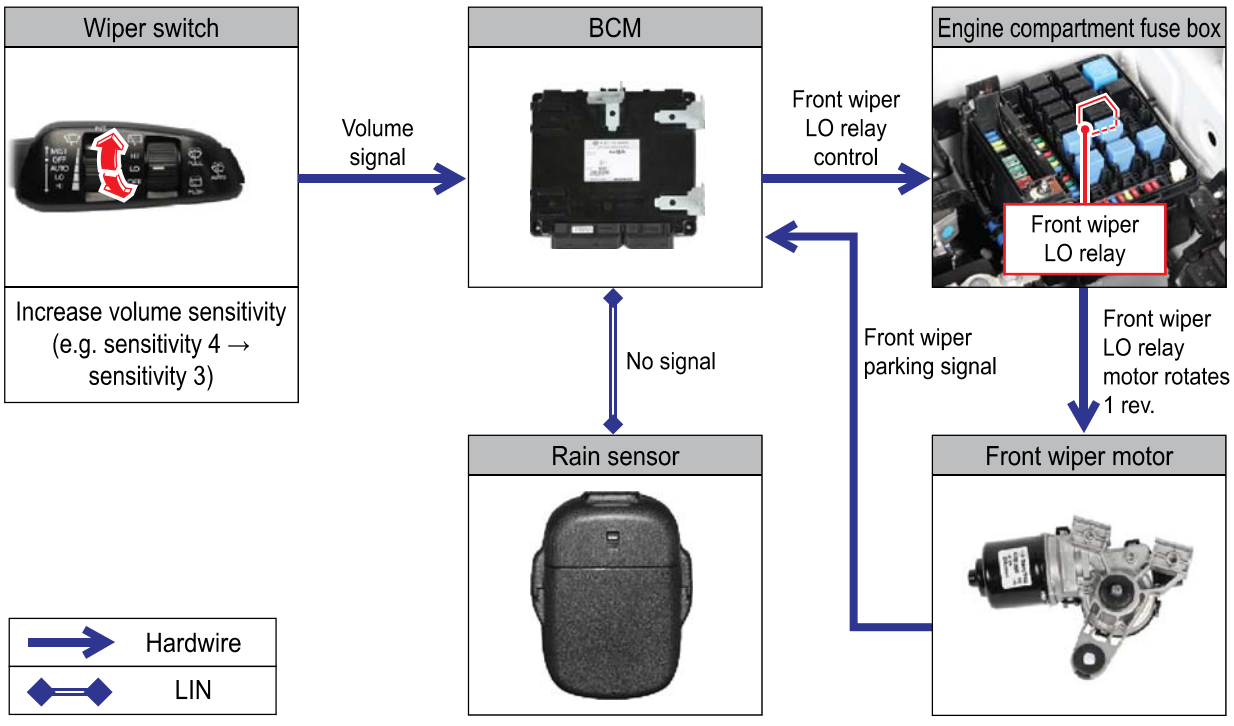
Operation 1. ("no signal detected" signal received from the rain sensor)

A. The AUTO switch sensitivity level is adjusted (ex: sensitivity level 4 → sensitivity level 3).
B. The wiper LO relay is operated for one cycle (T1).



System flowchart

- With IGN ON / Windshield wiper AUTO switch ON



(14) Speed sensitive AUTO wiper

Operation 1. (At vehicle speed of 0 km/h)

A. Windshield wiper auto switch is ON with IGN ON
(or IGN ON with windshield wiper auto switch ON).
B. Wiper LO relay is operated within 0.3 sec. (T1)

Operation 2.

C. The windshield wiper LO relay operation time changes depending on the windshield wiper intermittent switch volume settings and vehicle speed.

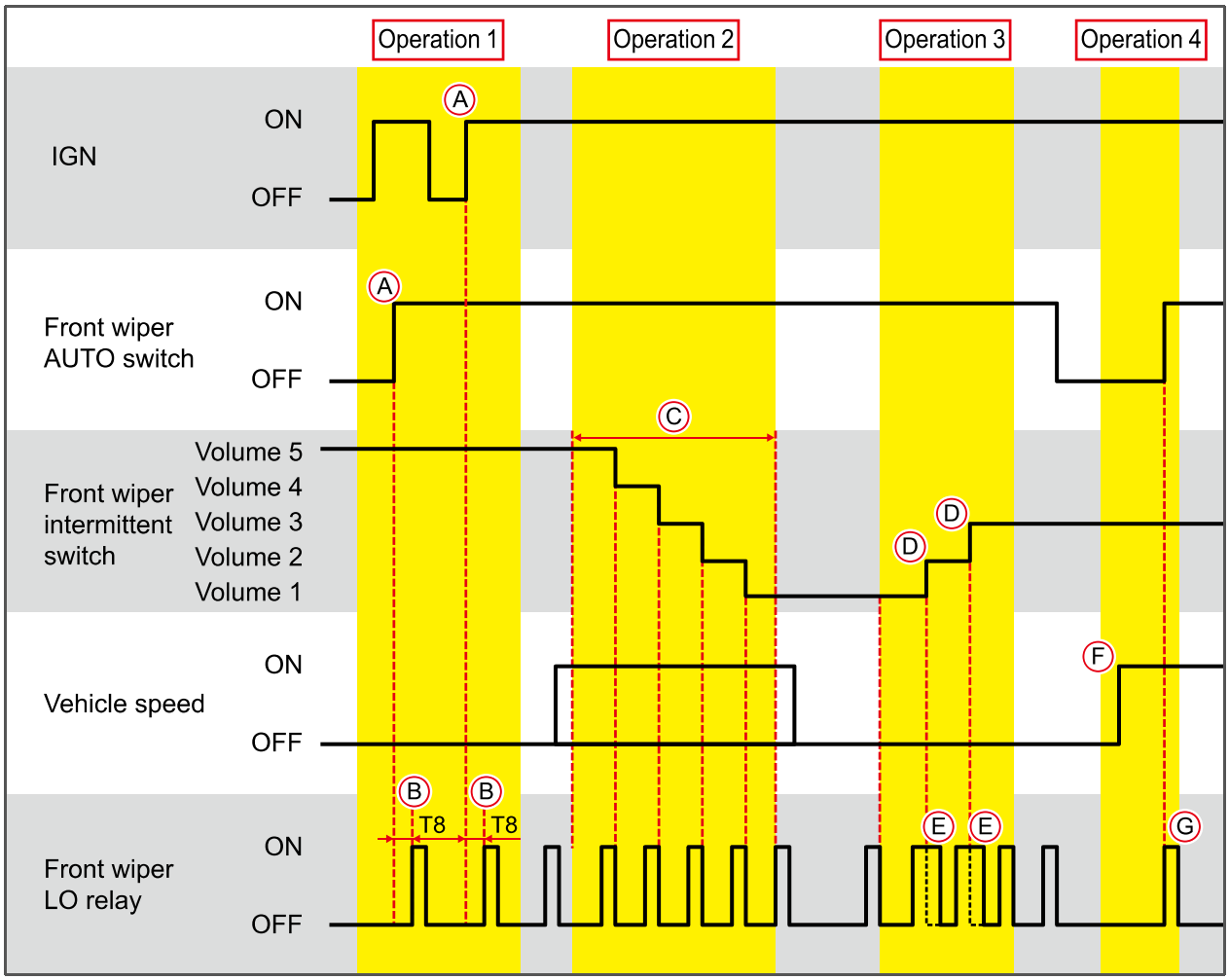
reference See the graph for correlation between windshield wiper auto switch rest time and vehicle speed.

Operation 3.

D. Increase windshield intermittent wiper interval (volume 1 → volume 2)
E. The windshield wiper LO relay operates once.

Operation 4.

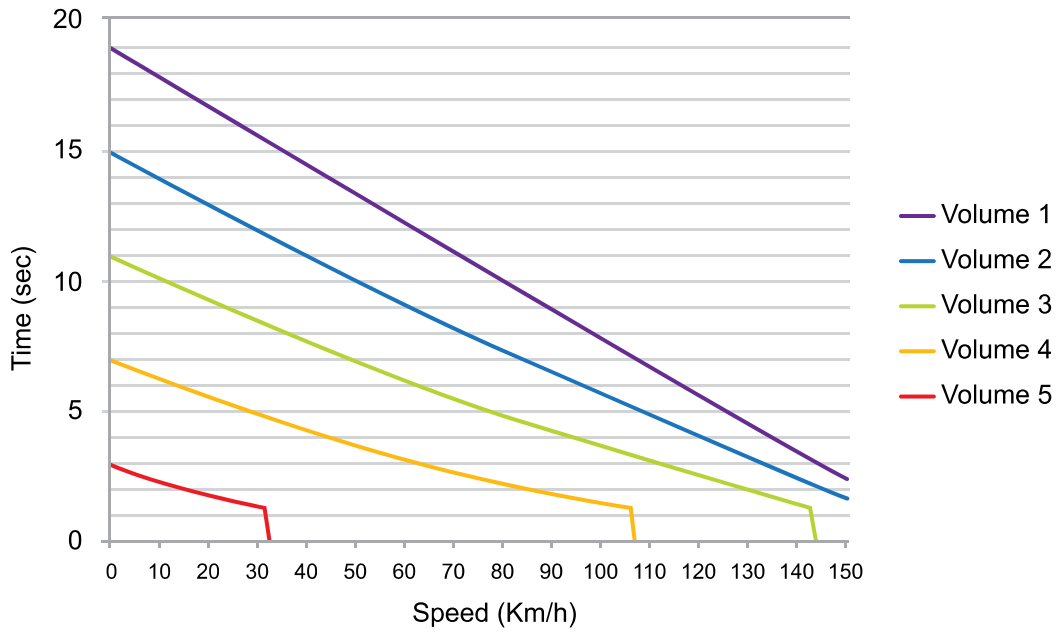
F. When windshield wiper auto switch is ON position at vehicle speed of above 0 km/h.
G. Windshield wiper LO relay is activated immediately.



Modification basis	
Application basis	
Affected VIN	

NOTE

Graph for correlation between windshield wiper auto switch rest time and vehicle speed

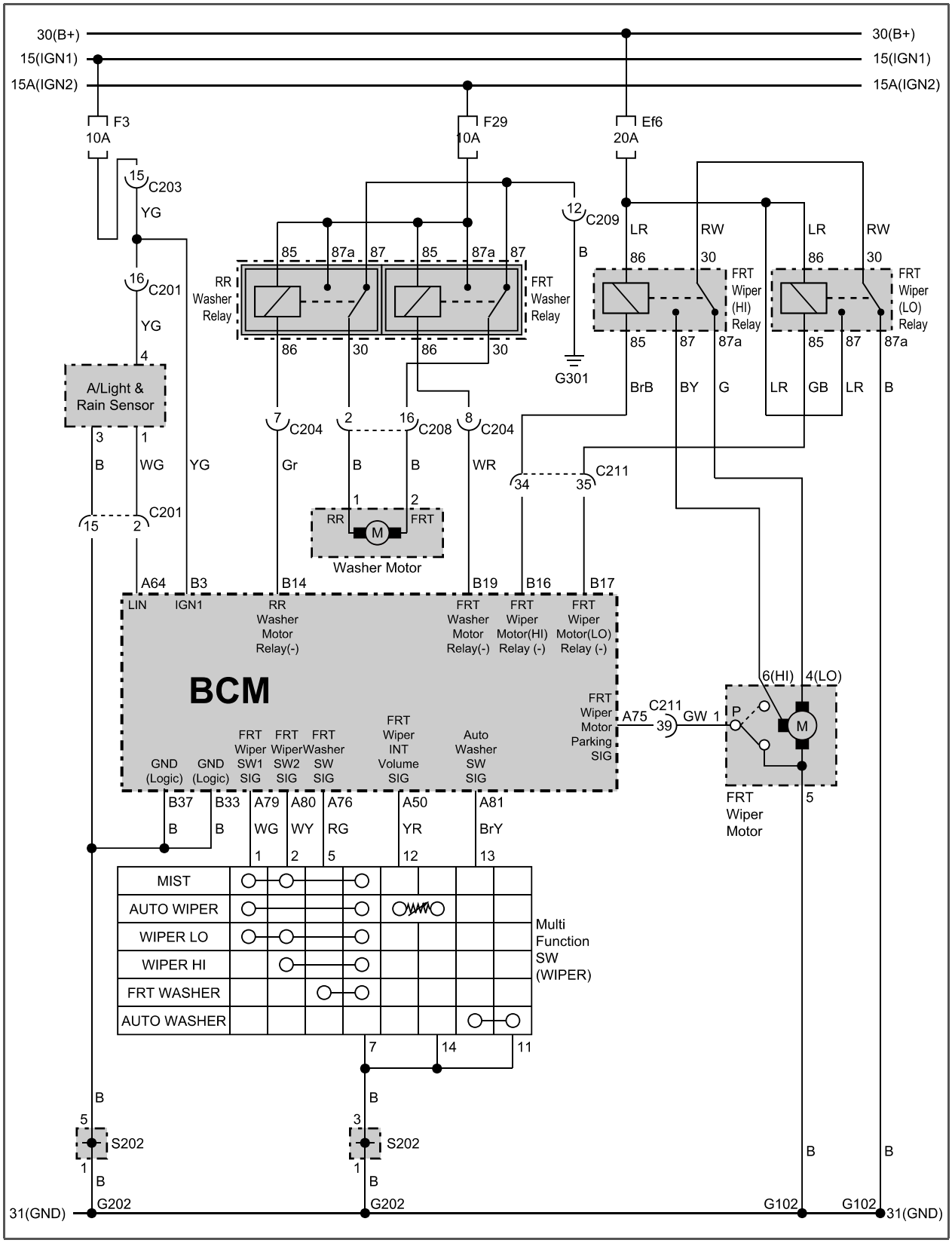


Wiper rest time depending on vehicle speed and volume settings

Vehicle speed	Volume 5	Volume 4	Volume 3	Volume 2	Volume 1
0 km/h	Approx. 3 sec.	Approx. 7 sec.	Approx. 11 sec.	Approx. 15 sec.	Approx. 19 sec.
70 km/h	Approx. 0 sec.	Approx. 3 sec.	Approx. 6 sec.	Approx. 8 sec.	Approx. 11 sec.

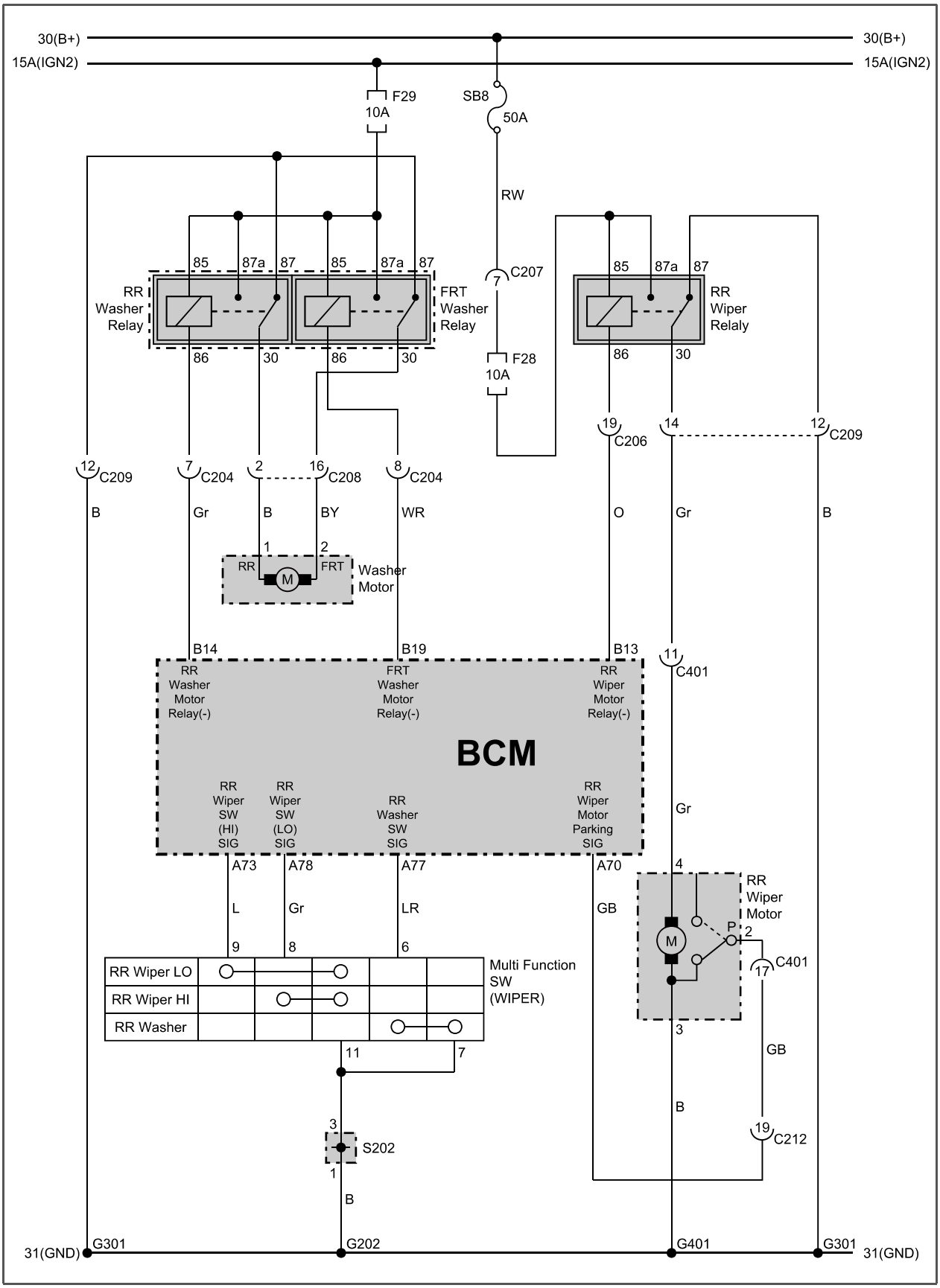
4. CIRCUIT DIAGRAM

▶ Windshield wiper, washer



Modification basis	
Application basis	
Affected VIN	

▶ Rear wiper, washer



Modification basis	
Application basis	
Affected VIN	