05IB5–01

SYSTEM DESCRIPTION

1. SMART ENTRY SYSTEM DESCRIPTION

- In addition to the mechanical key function and the wireless door lock remote control function, this system provides the smart key with a bi–directional communication function. This function enables the smart ECU to recognize the presence of the smart key within several detection areas. The system can lock or unlock the doors, or start the hybrid system without key operation, as long as the smart key is in the user's possession.
- This system consists of a smart key ECU, power source control ECU, transponder key ECU, body ECU, smart key, 5 oscillators, 5 antennas, 2 touch sensors, 3 lock switches, and a wireless door lock receiver. The smart ECU controls the system.
- The smart entry system operates in cooperation with the push button start system, the immobilizer system and the wireless door lock remote control system.

2. FUNCTION OF MAIN COMPONENTS

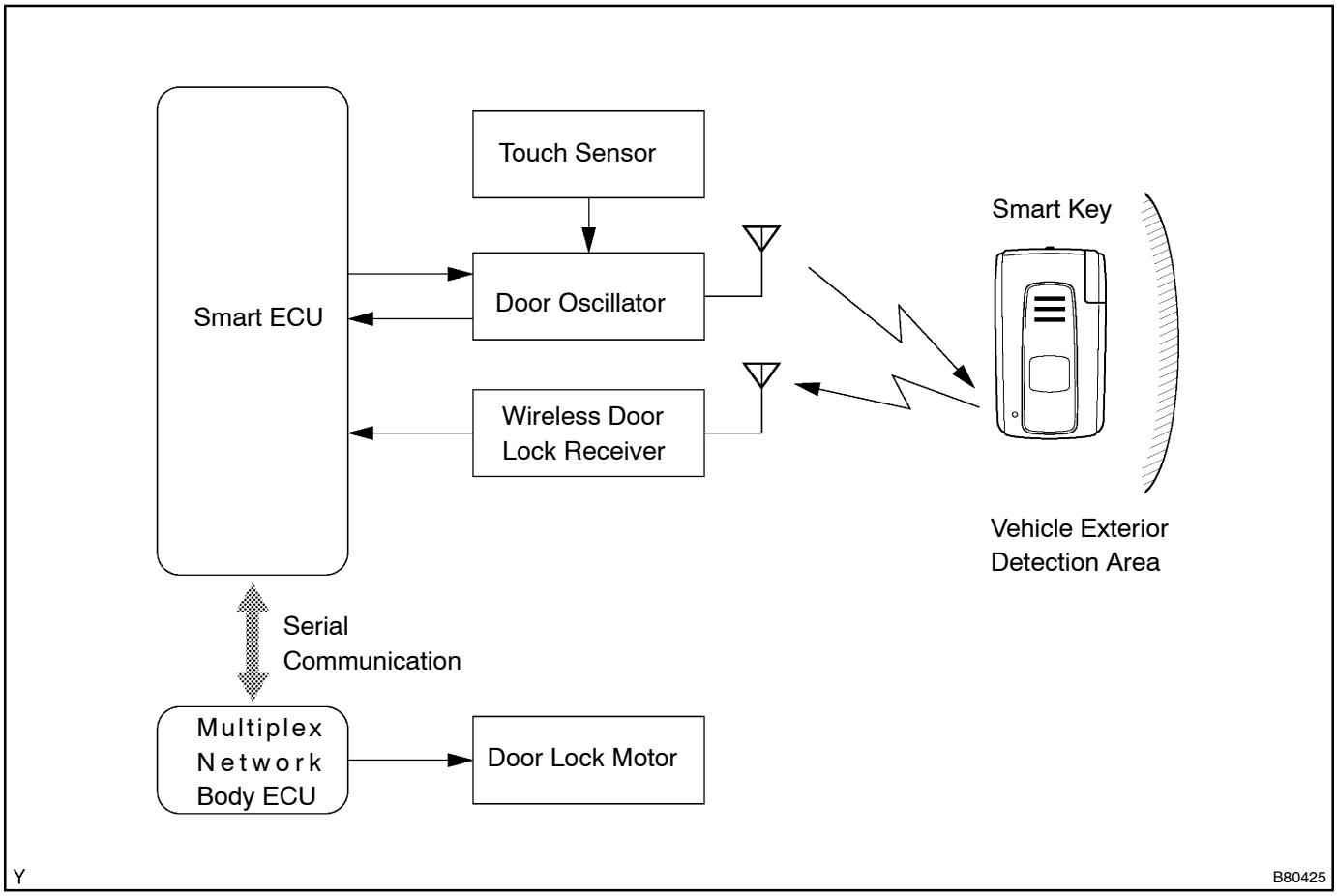
Components	Function
Smart Key	Receives signals from oscillators and returns ID code to wireless door lock receiver.
Door Oscillator (driver and front passenger doors)	Intermittently transmits key detection signals within detection area around each door upon receiving transmission request signal from smart ECU.
Room Oscillator	Transmits key detection signals within detection area in vehicle interior upon receiving transmission request signal from smart ECU.
Back Door Oscillator (inner)	Transmits key detection signals within detection area in luggage room upon receiving transmission request signal from smart ECU.
Back Door Oscillator (outer)	Transmits key detection signals within detection area around back door upon receiving transmission request signal from smart ECU.
Luggage Antenna	Transmits back door oscillator signal.
Door Outside Handle (driver and front passenger) (Touch Sensor)	Transmits door unlock request signal to smart ECU when inside of door outside handle is touched.
Door Outside Handle (driver and front passenger) (Antenna)	Transmits door oscillator signal.
Door Outside Handle (Driver and Front Passenger) (Lock Switch)	Transmits door lock request signal to smart ECU.
Back Door Lock Switch	Transmits door lock request signal to smart ECU.
Back Door Opener Switch	Transmits back door open request signal to smart ECU via body ECU.
Wireless Door Lock Receiver	Receives ID code from smart key and transmits it to smart ECU.
Power Switch	Switches vehicle power modes between four stages (OFF, ON (ACC), ON (IG), and ON (READY) in accordance with shift lever position, state of stoplight switch and check results of smart key.
Smart Key Cancel Switch	Turns smart entry system ON/OFF.
Stop Light Switch	Outputs state of brake pedal to power source control ECU.
Combination Meter (Smart Entry System Warning Light)	Smart ECU illuminates smart entry system warning light to prevent these conditions from occurring: Smart key is moved out of vehicle while hybrid system is in operation, door locks are operated, or smart key is left in vehicle.
Combination Meter (Buzzer)	Smart ECU sounds buzzer to prevent these conditions from occurring: Smart key is moved out of vehicle while hybrid system is in operation, door locks are operated, or smart key is left in vehicle.
Wireless Door Lock Buzzer	Smart ECU sounds wireless door lock buzzer to prevent these conditions from occurring: Smart key is moved out of vehicle while hybrid system is in operation, door locks are operated, or smart key is left in vehicle.
Smart ECU	• Identifies and checks ID codes from wireless door lock receiver, then transmits signals to ECUs if ID codes match. • Upon receiving signals from switches, smart ECU transmits intermittent transmission request signals to door oscillators and transmission request signals to other oscillators in accordance with conditions.
Power Source Control ECU	Main control of push button start system. It receives results of ID code check of smart key provided by smart ECU via transponder key ECU. When check results reveal that ID code is legitimate, power source control ECU authorizes transition of power modes through operation of power switch.
Transponder Key ECU	• Main control of immobilizer system. It transmits results of ID code check of smart key provided by smart ECU to power source control ECU. • Transmits hybrid system start authorization signal to hybrid vehicle control ECU.
Transmission Control ECU	• Actuates parking lock actuator upon receiving power switch OFF signal from power source control ECU. • Transmits state of parking lock operation (whether shift position is in P or some other position) to power source control ECU.

Components	Function
Hybrid Vehicle Control ECU	• Starts hybrid system upon receiving system start signal from power source control ECU (READY ON). • Receives hybrid system start authorization signal from transponder key ECU.
Multiplex Network Body ECU	• Transmits body control system signals (courtesy switch, door key lock/unlock switch, door lock position switch, halfway switch signals, etc.) to smart ECU via BEAN • Receives door lock/unlock request signal from smart ECU via dedicated serial communication line (with local protocol), which is used between body ECU, smart ECU and wireless door lock receiver.

3. SYSTEM FUNCTION

(a) Smart unlock

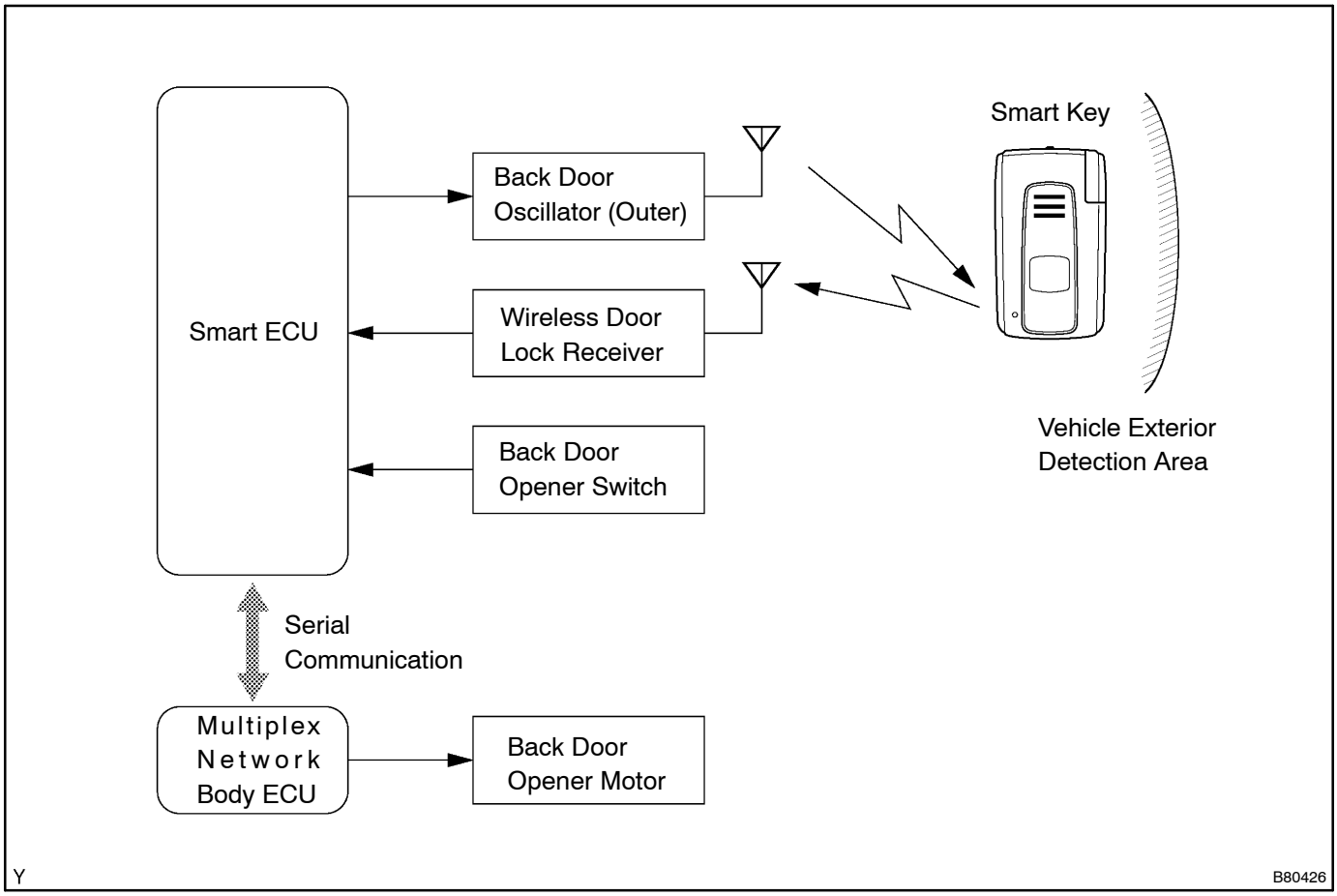
- For the system to be able to detect the location of the smart key, the vehicle doors must be locked. The door oscillators transmit key detection signals at prescribed intervals in order to form vehicle exterior detection areas (approximately 0.7 to 1.0 m (2.3 to 3.3 feet) around each front outside door handle).
- When the smart key is brought into a detection area, the system automatically checks the key's ID code. When this is completed, the door that has detected the smart key assumes the unlock standby condition. In this condition, if a person touches the touch sensor on the outside door handle, all doors becomes unlocked.



(b) Smart back door unlock

- With all doors locked, if the back door opener switch is pressed with the smart key in the user's possession, the back door oscillator (outer) outputs a smart key detection signal and the smart ECU checks the ID code. After the check is completed, the smart ECU unlocks* the back door via the body ECU. At this time, if the user continues to press the back door opener switch, the back door lock latch will be released.

*: If smart unlock is set to individual door unlock mode, only the back door will be unlocked. If set to all door unlock mode, all doors will be unlocked.

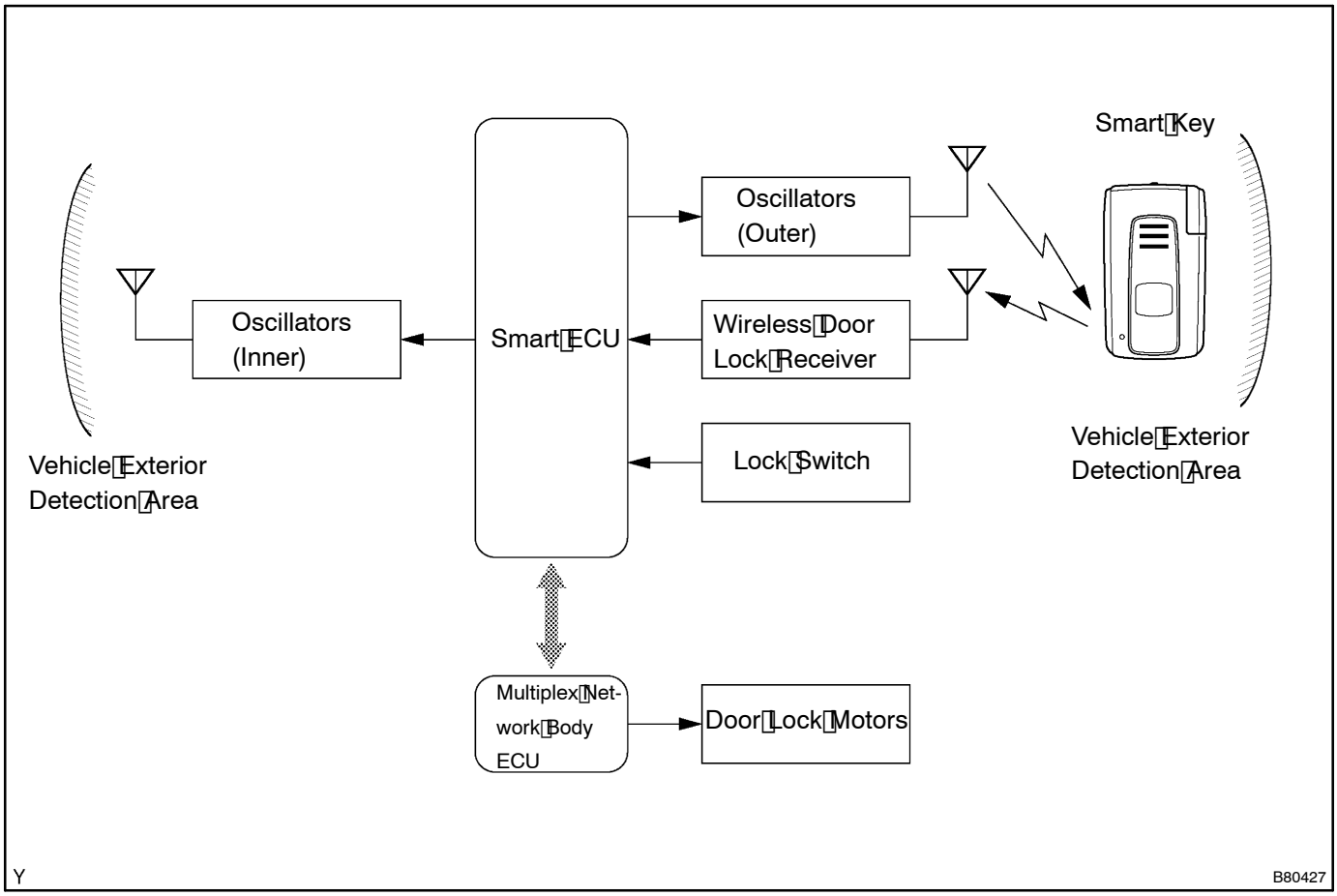


NOTICE: Handling Precaution for Smart Back Door Unlock
Smart back door unlock function may not operate if the smart key is placed near the center of the rear bumper.

(c) Smart lock

- When the smart key is located outside of the vehicle and all the doors are closed, if the user presses the lock switch on the outside door handle or the lock switch on the back door, the smart ECU will actuate all oscillators and start checking for the ID code of a smart key.
- At this time, if an oscillator outside of the vehicle (driver's/front passenger's door oscillator or back door outer oscillator) determines that the ID code of the smart key is legitimate, the smart ECU determines that the smart key has been taken outside the vehicle and locks the doors via the body ECU.
- A smart unlock operation will not be authorized for approximately 3 seconds* after the doors have been locked.

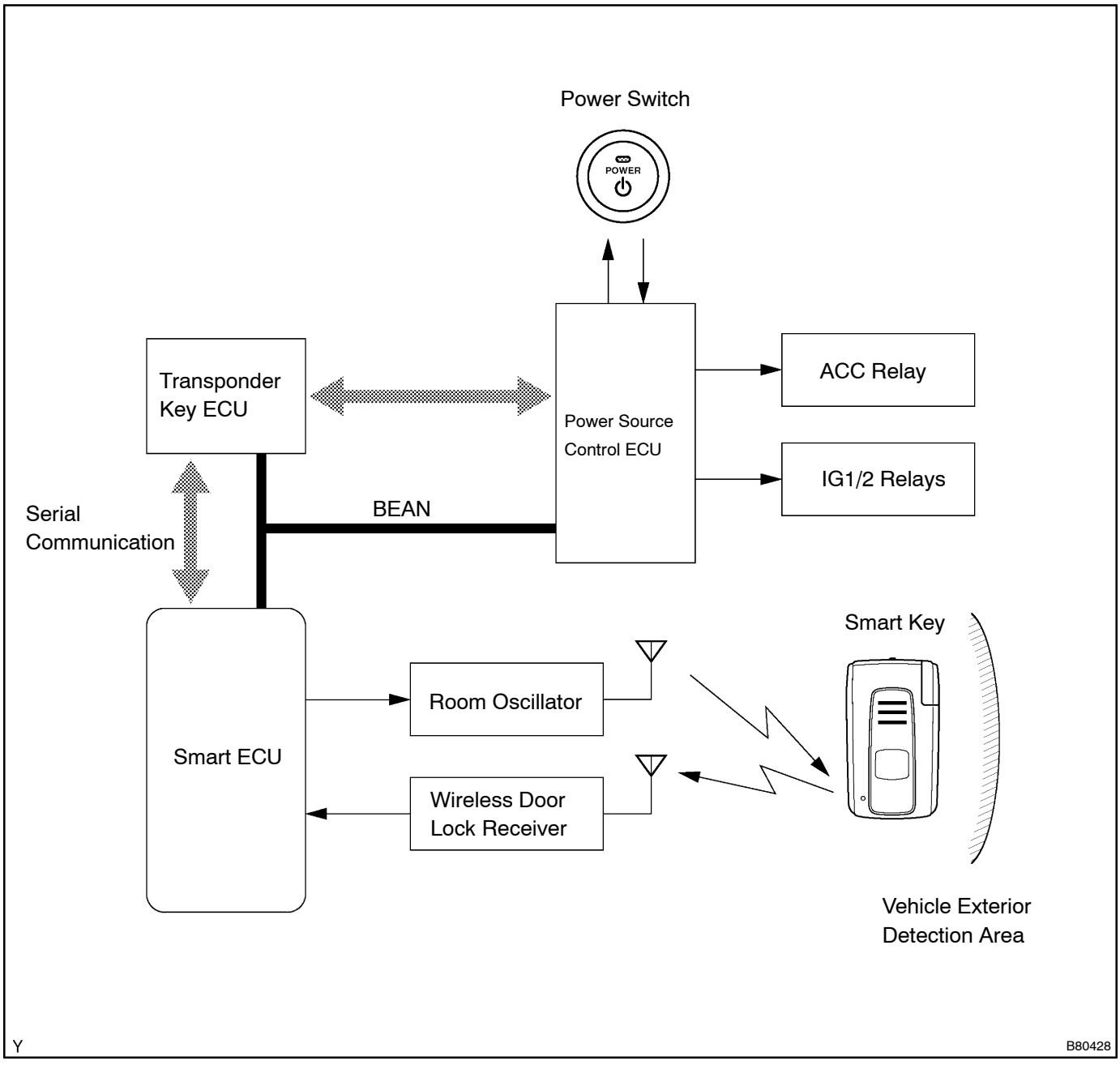
*: The setting of this duration can be changed using the customize function. For details, see page 05–1880.



(d) Smart ignition

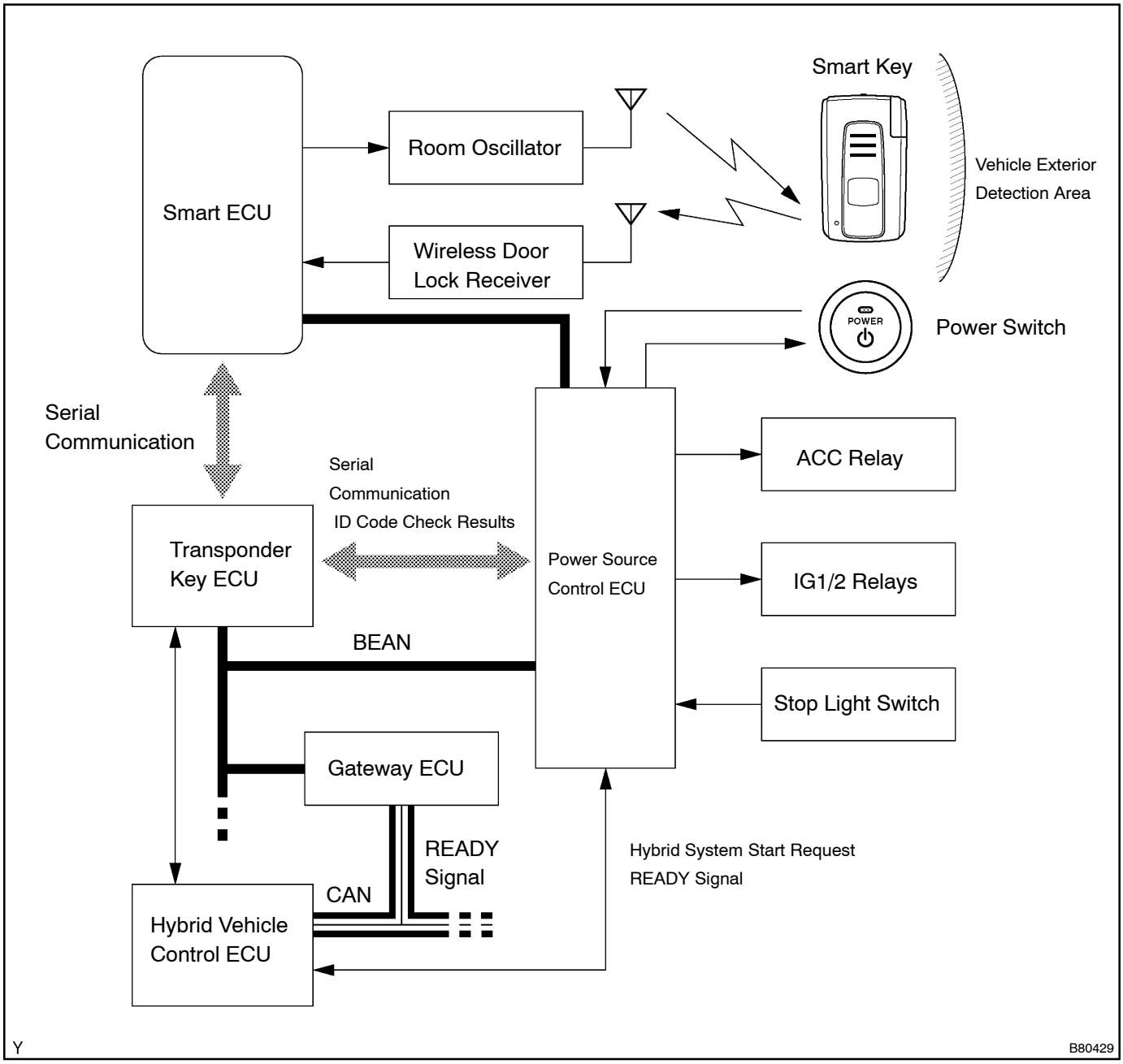
OFF → ON (ACC) → ON (IG)

- If the driver presses the power switch once without depressing the brake pedal, the room oscillator, in accordance with the request signal received from the smart ECU, forms a smart key detection area inside the vehicle by emitting smart key detection signals. Accordingly, the smart key sends an ID code signal to the smart ECU via the wireless door lock receiver. The smart ECU checks the ID code of the smart key and transmits the check results to the transponder key ECU.
- The transponder key ECU transmits the check results to the power source control ECU. If the check results reveal that the ID code is legitimate, the power source control ECU will turn on the ACC relay and start the ACC power supply. At this time, the power source control ECU illuminates a green indicator light on the power switch in order to inform the driver of the ON (ACC) power mode.
- After the transition to the ON (ACC) power mode, if the driver presses the power switch again, the power source control ECU will turn on the IG1 and IG2 relays and start the IG power supply. At this time, the power source control ECU illuminates an amber indicator light on the power switch in order to inform the driver of the ON (IG) power mode.



OFF → ON (READY)

- If the driver presses the power switch once while depressing the brake pedal, the room oscillator, in accordance with the request signal received from the smart ECU, forms a smart key detection area inside the vehicle by emitting smart key detection signals. Accordingly, the smart key sends an ID code signal to the smart ECU via the wireless door lock receiver.
- The smart ECU checks the ID code of the smart key and transmits the check results to the transponder key ECU.
- The transponder key ECU transmits the check results to the power source control ECU. If the check results reveal that the ID code is legitimate, the power source control ECU will turn on the ACC, IG1 and IG2 relays and start the ACC and IG power supply.
- At this time, the power source control ECU illuminates an amber indicator light on the power switch in order to inform the driver of the ON (IG) power mode.
- After the indicator light has illuminated, the power source control ECU transmits a hybrid system start request signal to the hybrid vehicle control ECU.
- Upon receiving this signal, the hybrid vehicle control ECU verifies the check results of the smart key ID code provided by the transponder key ECU.
- If the check results reveal that the ID code is legitimate, the hybrid vehicle control ECU starts the hybrid system.
- At this time, the power source control ECU will turn off the indicator light on the power switch in order to inform the driver of the ON (READY) mode.


Smart Key
Smart ECU
Room Oscillator
Wireless Door Lock Receiver
Vehicle Exterior Detection Area
POWER
Power Switch
Serial Communication
Serial Communication ID Code Check Results
Transponder Key ECU
Power Source Control ECU
ACC Relay
IG1/2 Relays
Stop Light Switch
BEAN
Gateway ECU
READY Signal
CAN
Hybrid Vehicle Control ECU
Hybrid System Start Request
READY Signal
Y
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(e) Warning function

• General

The smart key system is equipped with a warning function to prevent problems resulting from errors in smart key usage. The smart key system works without any requirements from the driver other than having the key in one's possession. The driver, as a result, may become unaware of the presence or location of the key and make errors (listed below) that could lead to serious problems.

Examples:

1. The driver is unaware that the key has been taken out of the vehicle by a passenger.
2. The driver exits the vehicle with the hybrid system running.
3. The driver exits the vehicle with the shift position in a position other than P.

If the above situations occur, the hybrid system may be unable to be started once it has been turned off, the vehicle may be stolen, or other problems may follow. Warning function descriptions for several smart key usage errors are below.

- Warning against the driver taking the smart key outside the vehicle with its shift position in P.
- Warning against the driver taking the smart key outside the vehicle while the shift position is in a position other than P.
- Warning against a passenger taking the smart key outside the vehicle.
- Warning against operating the smart lock while the hybrid system is in operation.
- Warning against operating the door lock while the smart key remains inside the vehicle.
- Warning against low battery of the smart key.
- Warning against operating the smart ignition outside the detection area of the room oscillator.
- Warning against operating the door lock while any of the doors is open.

Warning against the driver taking the smart key outside the vehicle with its shift position in P:

Possible results without warning	Vehicle theft or inability to restart hybrid system
Detection conditions	If all conditions listed below are met and smart key ID code check result by room oscillator fails, warning will be issued: • Shift position is in P position • Power switch is OFF • Driver door is opened and closed
Warning (smart entry system warning light)	Illuminates upon detection and turns OFF if power switch is turned OFF or smart key ID code check result by room oscillator passes
Warning (buzzer (combination meter))	Sounds once upon detection. Sounds a second time if vehicle driven in this state
Warning (wireless door lock buzzer)*	Sounds 3 times upon detection and stops if power switch is turned OFF or smart key ID code check result by room oscillator passes

Warning against the driver taking the smart key outside the vehicle while the shift position is in a position other than P:

Possible results without warning	Vehicle theft or inability to restart hybrid system
Detection conditions	If all conditions listed below are met and smart key ID code check result by room oscillator fails, warning will be issued: • Shift position is in P position • Power switch is in ON (ACC), ON (IG) or ON (READY) position • Driver door is opened and closed
Warning (smart entry system warning light)	• Illuminates upon detection and turns OFF if power switch is turned OFF or smart key ID code check result by room oscillator passes • Warning message is displayed on multi–display
Warning (buzzer (combination meter))	Sounds continuously upon detection and stops if power switch is turned OFF, shift position is changed to P, or smart key ID code check result by room oscillator passes
Warning (wireless door lock buzzer)*	Sounds continuously upon detection and stops if power switch is turned OFF, shift position is changed to P, or smart key ID code check result by room oscillator passes

Warning against a passenger taking the smart key outside the vehicle:

Possible results without warning	Vehicle theft or inability to restart hybrid system
Detection conditions	If all conditions listed below are met and smart key ID code check result by room oscillator fails, warning will be issued: • Power switch is not OFF • Door other than driver door is opened and closed
Warning (smart entry system warning light)	Illuminates upon detection and turns OFF if power switch is turned OFF or smart key ID code check result by room oscillator passes
Warning (buzzer (combination meter))	Sounds once upon detection. Sounds a second time if vehicle is driven in this state
Warning (wireless door lock buzzer)*	Sounds 3 times upon detection and stops if power switch is turned OFF or smart key ID code check result by room oscillator passes

Warning against operating the smart lock while the hybrid system is in operation:

Possible results without warning	Vehicle theft or inability to restart hybrid system
Detection conditions	If all conditions listed below are met, smart key ID code check result by room oscillator fails, and smart key ID code check by door oscillator passes, warning will be issued: • Shift lever is in P position • Power switch is not OFF • All door are closed • Lock switch on outside door handle is ON
Warning (smart entry system warning light)	Illuminates upon detection and turns OFF if power switch is turned OFF or smart key ID code check result by room oscillator passes
Warning (buzzer (combination meter))	–
Warning (wireless door lock buzzer)*	Sounds for 2 seconds

Warning against operating the door lock while the smart key remains in the vehicle:

Possible results without warning	Vehicle theft
Detection conditions	If all conditions listed below are met and smart key ID code check result by room oscillator fails, warning will be issued: • Power switch is in OFF • All door are closed • Lock switch on outside door handle is ON
Warning (smart entry system warning light)	–
Warning (buzzer (combination meter))	–
Warning (wireless door lock buzzer)*	Sounds for 2 seconds

Warning against low battery of the smart key:

Possible results without warning	Smart control is suddenly disabled
Detection conditions	If condition listed below is met, and smart ECU receives code indicating voltage drop of smart key battery while room oscillator checks smart key ID code: • The power switch has been turned OFF after 20 or more minutes have elapsed after hybrid system has been started.
Warning (smart entry system warning light)	–
Warning (buzzer (combination meter))	Sounds once upon detecting
Warning (wireless door lock buzzer)*	–

Warning against operating the smart ignition outside the detection area of the room oscillator:

Possible results without warning	User is confused
Detection conditions	If condition listed below is met and smart key ID code check result by room oscillator fails, warning will be issued: • Power switch is pushed
Warning (smart entry system warning light)	Illuminates for 5 seconds upon detection
Warning (buzzer (combination meter))	Sounds once upon detecting
Warning (wireless door lock buzzer)*	–

Warning against operating the door lock while any of the doors is open:

Possible results without warning	Vehicle theft
Detection conditions	If all conditions listed below are met, warning will be issued: • Power switch is OFF • Any door is open • Lock switch on outside door handle is ON
Warning (smart entry system warning light)	–
Warning (buzzer (combination meter))	–
Warning (wireless door lock buzzer)*	Sounds for 10 seconds and stops when 10 seconds have passed or if any door is closed

*: Australia only.

(f) Power saving function

- When the doors are locked, the door oscillators emit signals to the outside of the vehicle at default intervals of 300 msec. If the vehicle remains parked for a long time or if the smart key remains in the vehicle exterior detection area for a long time, the auxiliary battery could be depleted.
- If the smart key is constantly located within the vehicle exterior detection area, the system saves battery power by deactivating smart entry system. If the vehicle remains parked in the state for a long time, the system first extends door oscillator signal intervals to 600 msec. after 5 days without a response from the smart key. If 14 days elapse since the last smart key response, the system deactivates the smart entry system.

To prevent the smart key's battery and the auxiliary battery from being depleted in the conditions indicated above, the smart entry system performs controls listed in the table below.

Condition	Control	Reinstatement Condition
Vehicle remains parked for a long time. • No response from smart key for more than 5 days	Signal transmission interval is extended from 300 msec. to 600 msec.	• Wireless door lock remote control signal (lock or unlock) is input and ID code matches • Lock switch signal is input • Door is locked or unlocked in unison with movement of mechanical key
Vehicle remains parked for a long time. • No response from smart key for more than 14 days	Automatically deactivates smart entry system	• Wireless door lock remote control signal (lock or unlock) is input and ID code matches • Lock switch signal is input • Door is locked or unlocked in unison with movement of mechanical key
Vehicle remains parked for a long time. • Smart key is located in vehicle exterior detection area for longer than 10 minutes	Automatically deactivates smart entry system	• Wireless door lock remote control signal (lock or unlock) is input and ID code matches • Lock switch signal is input • Door is locked or unlocked in unison with movement of mechanical key

4. SMART ENTRY SYSTEM OPERATION PRECAUTIONS

(a) Smart functions in general

(1) Functions and operating ranges:

The functions will not operate if the smart key is not present within the detection areas described below. Furthermore, the functions may not operate or their operating range may decrease if the battery is depleted or in the presence of strong radiowaves or noise. There are also areas in which the functions may not operate properly due to the shape of the vehicle body.

- Smart lock and smart unlock:
  Applicable within approximately 0.7 to 1.0 m (2.3 to 3.3 feet) radius of each front door handle. However, this function may not operate near the windows or door handles.
- Smart ignition:
  Applicable within vehicle interior. This function may not operate if the smart key is placed on the instrument panel, on the rear tray, in the glove box, or on the floor. If the smart key is placed outside of the vehicle, this function may not operate if the smart key is placed near a window.
- Smart back door unlock:
  Applicable within approximately 0.7 to 1.0 m (2.3 to 3.3 feet) radius of the back door opener switch. However, this function may not operate if the smart key is placed near the center of the rear bumper.

(2) The smart entry system uses very weak radiowaves:

The smart functions and the wireless door lock remote control functions may not operate properly (unable to operate the smart lock, unlock, ignition, and back door unlock functions, or a false alarm is issued) in the situations described below. In this case, use the enclosed mechanical key to lock or unlock the driver's door and insert the smart key to start the hybrid system.

- The presence of a facility that generates strong radiowaves nearby, such as a TV tower, electric power plant, or broadcasting station.
- The user has a wireless communication device such as a wireless transmitter or portable telephone along with the smart key.
- The smart key is covered with a metal object or is placed near a metal object.
- A radiowave type wireless door lock remote control is being used in the vicinity.
- When placing the smart key near electrical appliances.

(b) Smart entry system inoperative conditions:

The smart function will not operate under the conditions listed below.

- The smart cancel switch provided below the driver's side instrument panel is turned on.
- The smart key is inserted into the key slot.
- The smart key has no battery (the indicator light does not flash even if the buttons on the smart key are pressed).