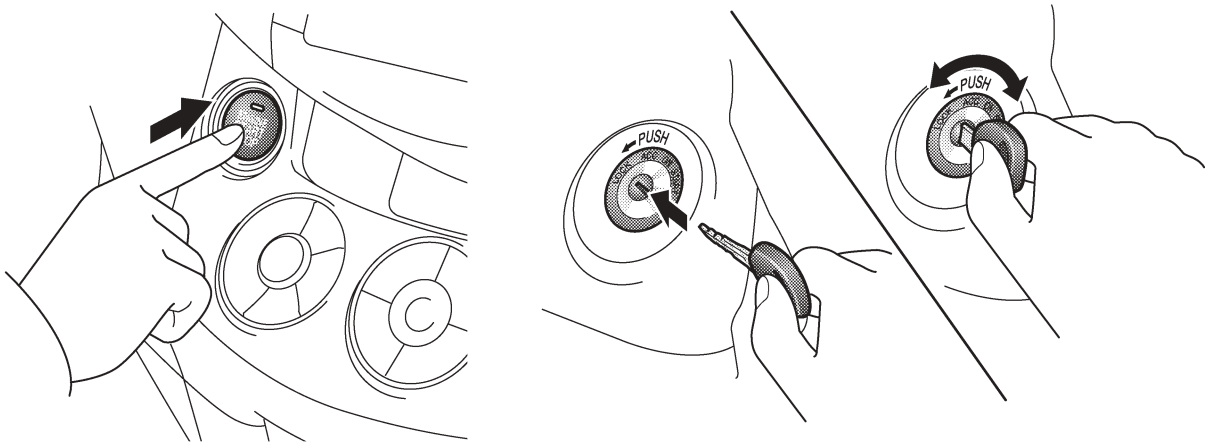
■START FUNCTION

1. General

- On the models without the smart entry & start system, the ignition key is inserted into the key cylinder and turned to switch the ignition switch position from the OFF position to the ACC, IG-ON or START position.
- On the models with the smart entry & start system, it is operated simply by pressing the push-type engine switch while carrying the key. The main body ECU turns OFF and ON the ACC, IG1, IG2 or ST CUT relays to switch the power source mode.
- This function has different power source mode patterns to suit the brake pedal condition and shift lever position, or clutch pedal condition. For details, see page BE-97.
- Along with the adoption of the start function, an engine cranking hold function is used.



With Smart Entry & Start System **Without Smart Entry & Start System**

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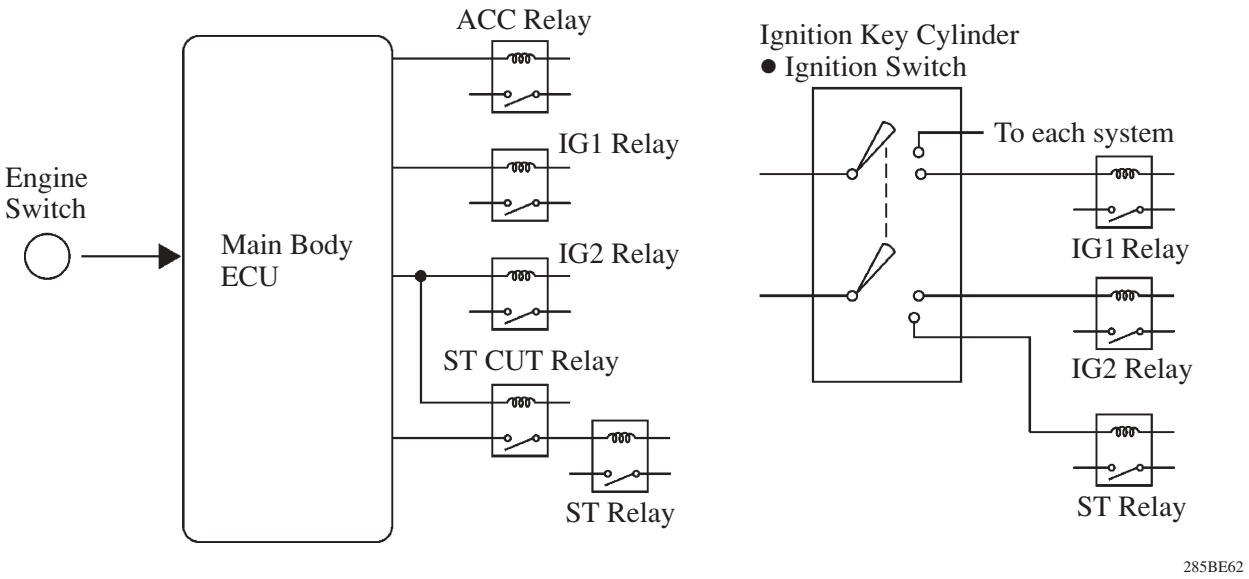
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2. Major Difference

The major differences between the start function and conventional ignition key function are as follows.

Model	New	Previous
Function	Start (Push Button)	Conventional Ignition Key
Switch	Engine Switch	Ignition Switch
Key Cylinder	—	Ignition Key Cylinder
Key	With a built-in transmitter for the smart entry & start system	● With a built-in transponder chip for the engine immobilizer system ● With a built-in transmitter for the wireless door lock remote control system
Relay	Four Relays (ACC, IG1, IG2, and ST CUT Relays)	Three Relays (IG1, IG2, and ST Relays)
Power Relay Control	Main Body ECU	Contact Type Ignition Switch
Security	Restricts the operation of the engine switch unless the certification ECU recognizes the ID code of the key.	Restricts the starting of the engine unless the transponder key ECU recognizes the ID code of the key.
	Restricts the unlocking of the steering lock unless the steering lock ECU receives permissive signals from the certification ECU.	A steering lock mechanism mechanically restricts the movement of the steering in unison with the movement of the key cylinder.

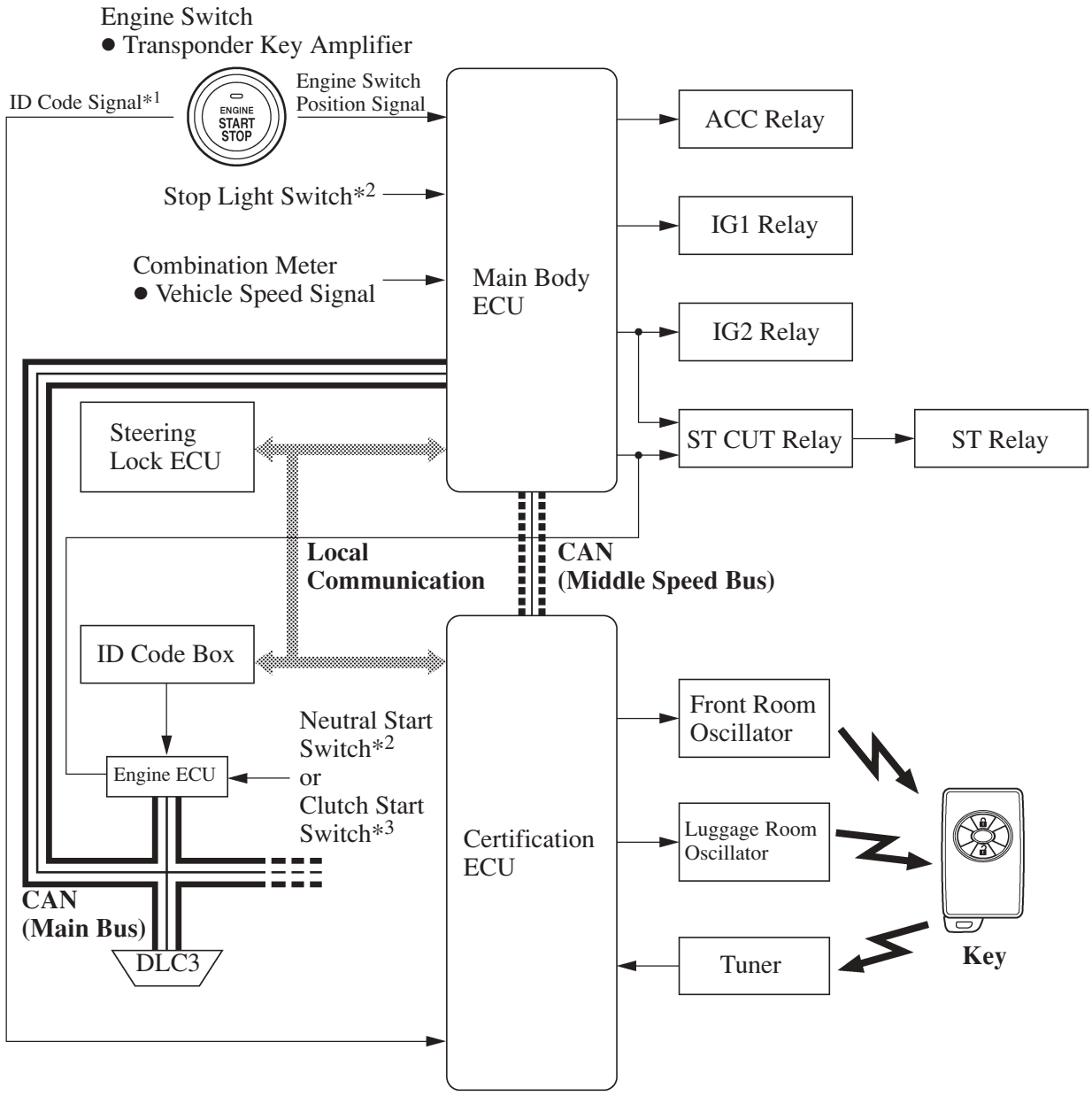
▶ Power Source Circuit ◀



Start System **Conventional Ignition Key System**

3. System Diagram

The main body ECU controls the start function. The system diagram below shows the components of the function.

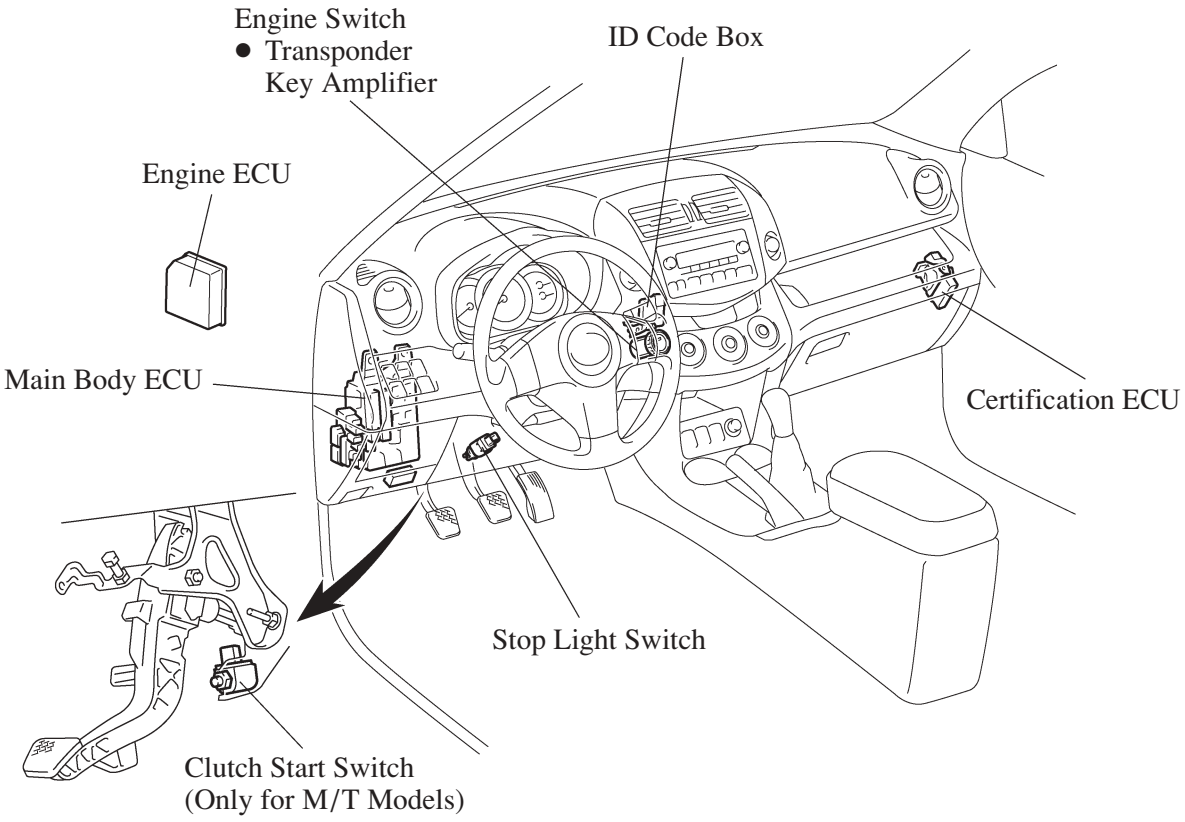


*1: Only when the key battery is low.
*2: Only for A/T Models
*3: Only for M/T Models

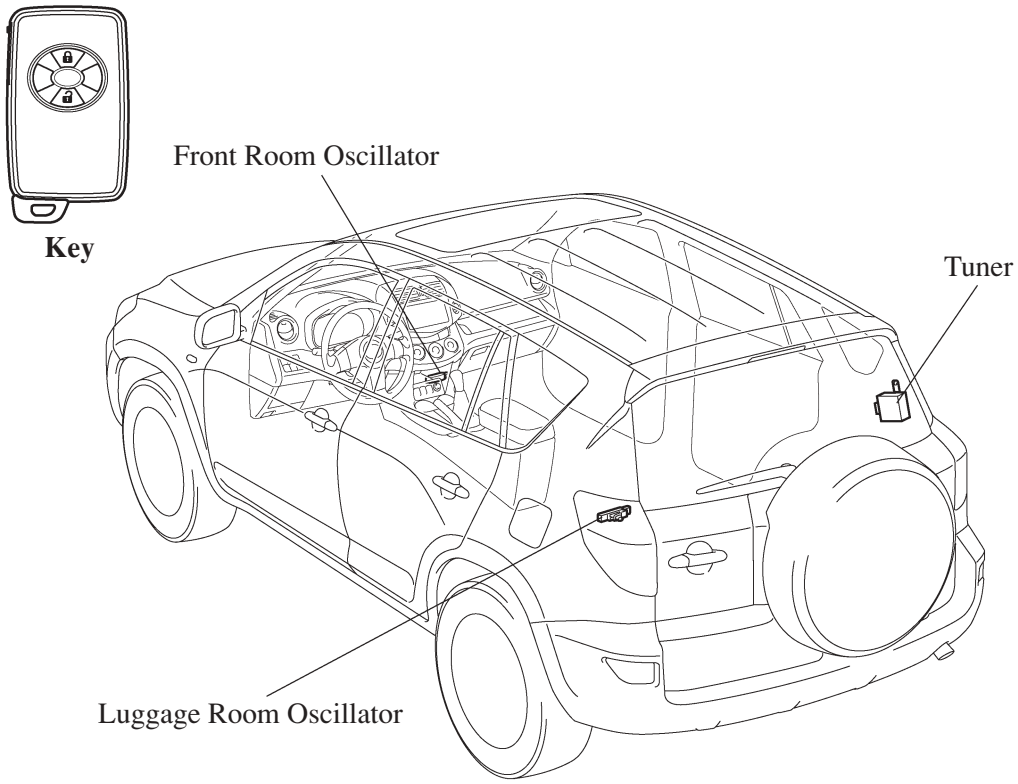
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4. Layout of Main Components



LHD Models 01NBE83Y



LHD Models 01NBE81Y

5. Function of Main Components

Component	Function
Engine Switch ● Transponder Key Amplifier	● Transmits the engine switch signal to the main body ECU. ● Informs the driver of a power source mode or system abnormality with the illumination state of the indicator light. ● Receives the ID code and transmits it to the certification ECU when the key battery is low.
Key	Receives the signals from oscillators and returns the ID code to the tuner.
Room Oscillator ● Front and Luggage	Receives a request signal from the certification ECU and forms the actuation area in the vehicle interior.
Tuner	Receives the ID code from the key and transmits it to the certification ECU.
Main Body ECU	● Switches the power source modes in four modes (OFF, ACC, IG-ON, START) in accordance with the shift position and the state of the stop light switch, or the state of the clutch start switch. ● Controls the start function in accordance with the signals received from the switches and each ECU.
Certification ECU	Certificates the ID code received from the tuner and transmits the certification results to the ID code box and steering lock ECU.
Stop Light Switch*1	Outputs the state of the brake pedal to the main body ECU.
Clutch Start Switch*2	Outputs the state of the clutch pedal to the main body ECU via engine ECU.
ID Code Box	Receives the steering unlock or engine immobilizer unset request signal from the certification ECU, certifies them, and transmits each unset signal to the steering lock ECU or engine ECU.
Engine ECU	● Receives the engine start request signal from the main body ECU, turns ON the ST relay, and starts the engine. ● Receives the signal from the ID code box and performs engine ignition and injection.

*1: Only for A/T Models
*2: Only for M/T Models

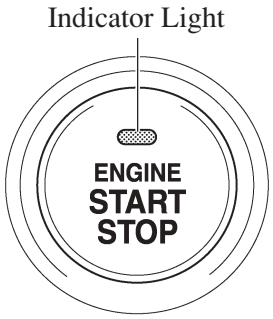
6. Construction and Operation

Engine Switch

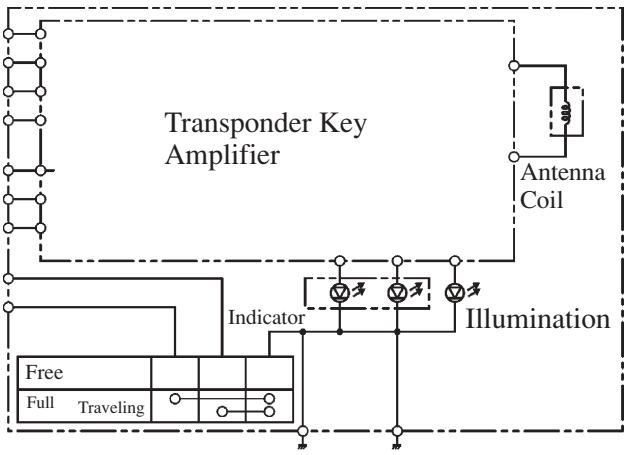
The engine switch consists of the momentary type switch, two color (amber, green) LEDs, and transponder key amplifier.

- The amber and green LEDs are for the indicator light.
- The driver can check the present power source mode and whether the engine can start or not in accordance with the illumination state of the indicator light.
- When the main body ECU detects an abnormality in the start system while the engine is running, it makes the amber indicator light flash. If the engine stopped in this state, it might not be possible to restart it.

▶ Circuit Diagram ◀



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▶ Indicator Light Condition ◀

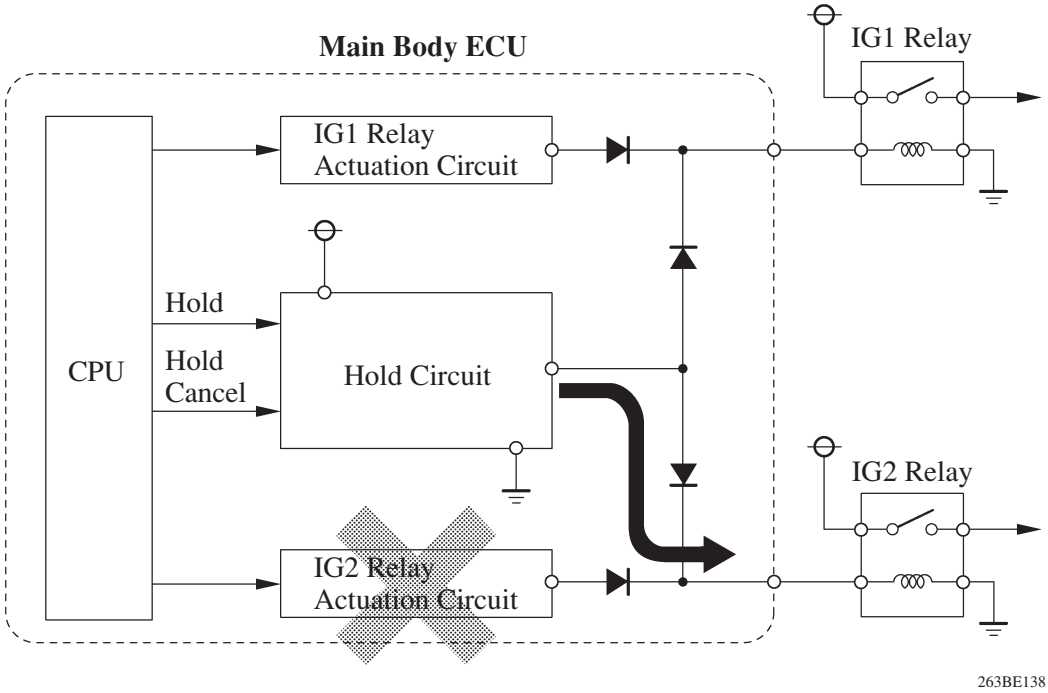
Power Source Mode/ Condition	Indicator Light Condition	
	Brake pedal not depressed*1 or clutch pedal not depressed *2	Brake pedal depressed with shift lever in "P" or "N"*1 or clutch pedal depressed *2
OFF	Turn OFF	Turn ON (Green)
ACC, IG-ON	Turn ON (Amber)	Turn ON (Green)
Engine Running	Turn OFF	Turn OFF
Steering Lock not Unlocked or Clutch Switch Malfunction*2	Flash (Green) for 15 seconds	Flash (Green) for 15 seconds
Start System Malfunction	Flash (Amber) for 15 seconds	Flash (Amber) for 15 seconds

*1: Only for A/T Models
*2: Only for M/T Models

Main Body ECU

The main body ECU consists of the IG1 and IG2 relay actuation circuits, CPU, and hold circuit.

- The hold circuit is installed to prevent the power supply to the relays from being cut off when an abnormality occurs in IG1 and/or IG2 relay actuation circuits during driving.



Service Tip

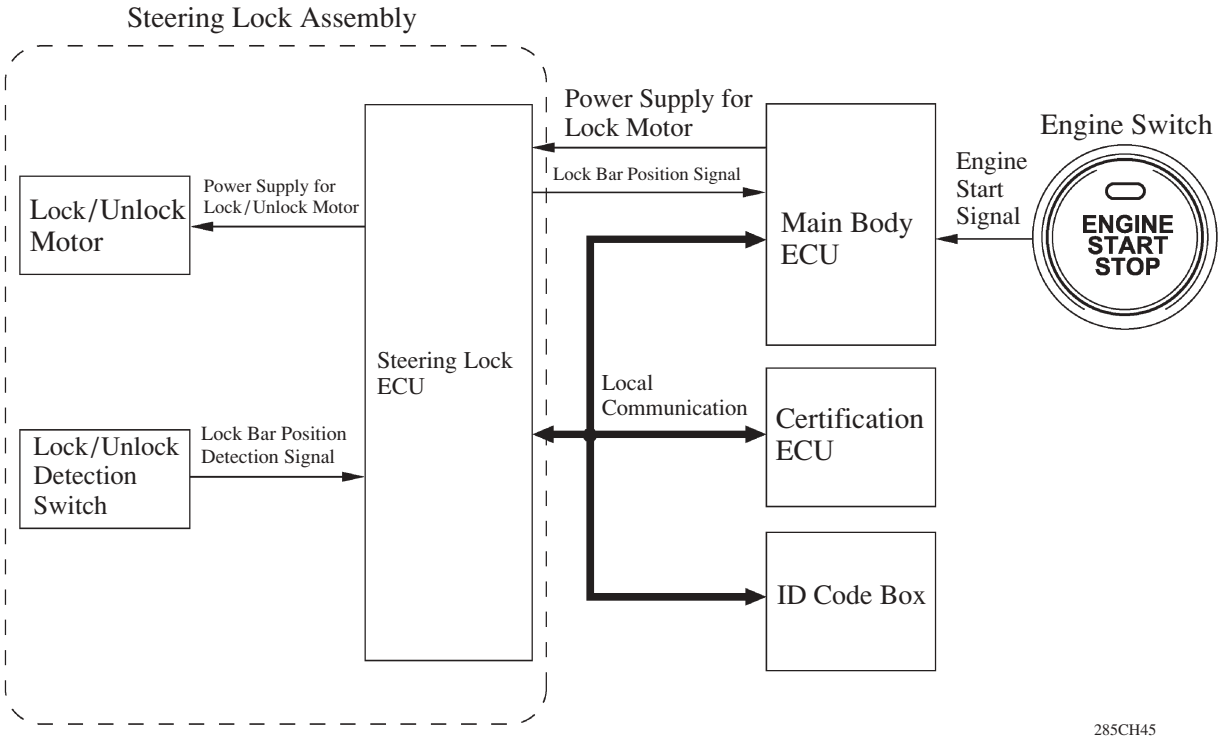
The main body ECU constantly stores the present power source mode in its memory. Therefore, if the power to the main body ECU is interrupted due to the removal of the battery, the main body ECU restores the power source mode after the battery is reconnected.
For this reason, if the battery is removed when the power source mode is in the mode other than OFF, the power source mode will be restored to the vehicle at the same time the power source mode is restored to the main body ECU (by reconnecting the battery).
Therefore, before remove or disconnect the battery, make sure to select the power source mode to OFF.

Steering Lock System

Along with the use of the smart entry & start system, a steering lock system which uses a lock/unlock motor to lock and unlock the steering wheel is used. This system mainly consists of the steering lock assembly, main body ECU, certification ECU and ID code box.

- The steering lock ECU is integrated in the steering lock assembly, and it controls the lock bar operation in the steering lock assembly through the control of the lock/unlock motor.
- The steering lock ECU detects the position (lock/unlock) of the lock bar and transmits this information to the main body ECU and certification ECU.
- In this system, the certification ECU determines whether to lock or unlock the steering wheel based on communication with the main body ECU. Then, the certification ECU sends the lock or unlock request signal to the steering lock ECU through the ID code box. Upon receiving the signal, the steering lock ECU operates the lock/unlock motor to lock or unlock the steering wheel.

▶ System Diagram ◀



Service Tip

It is not possible to replace only the steering lock ECU in the steering lock assembly. Therefore, if a malfunction occurs in the ECU, the entire steering lock assembly must be replaced.

Service Tip

After recharging a depleted battery, the engine may not start the first time (due to the steering lock ECU not correctly detecting the lock bar position).
When this happens, turn off all vehicle power supplies (ACC=OFF, IG=OFF), open and close the doors, and then start the engine again.

7. Start Function Operation

General

- When the driver enters the vehicle with the key carried in the driver's possessions, and the certification ECU recognizes the ID code of the key, the main body ECU authorizes the operation of the engine switch. As a result, the power source mode changes to the mode selected at the engine switch.
- Start function has different power source mode patterns to suit the brake pedal condition and shift lever position, or clutch pedal condition.

Pattern	Brake*1 or Clutch*2 Pedal	Shift Lever*1	Power Source Mode Pattern
A [See page BE-99]	Depressed	P or N Position	When the engine switch is pushed once. ● OFF → IG-ON (After the engine is started)
B [See page BE-102]	Not Depressed	P Position	Each time the engine switch is pushed. ● OFF → ACC → IG-ON → OFF
C*1 [See page BE-104]		Except P Position	Each time the engine switch is pushed. ● OFF → ACC → IG-ON → ACC
D [See page BE-104]	—	P Position	When the engine switch is pushed in the IG-ON mode. ● IG-ON (Engine is started or not started) → OFF
E*1 [See page BE-104]	—	Except P Position	When the engine switch is pushed in the IG-ON mode. ● IG-ON (Engine is started or not started) → ACC

*1: Only for A/T Models
*2: Only for M/T Models

- After approximately 1 hour elapses with the power source mode in ACC, the power source control ECU will automatically turn off the power.
- When the key battery is low, the start function can be made to operate by holding the TOYOTA mark of the key against the engine switch. For details, see page BE-105.
- The tables on the next page show the transition of the power source modes.

▶ Transition of Power Source Mode (A/T Model) ◀

Power Source Mode	P Position			N Position		Except P & N Positions	
	Engine Switch Pushed	Engine Switch Pushed with Brake Pedal Depressed	After 1 hour	Engine Switch Pushed	Engine Switch Pushed with Brake Pedal Depressed	Engine Switch Pushed	Engine Switch Pushed with Brake Pedal Depressed
OFF							
ACC							
IG-ON							
START							

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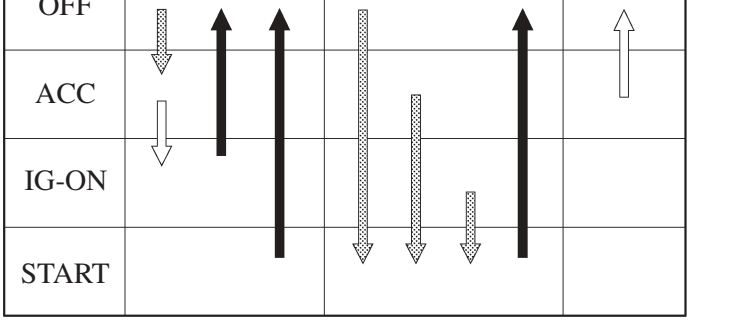
⇨ : Transition

⇨ : Only when the key certification is OK

➡ : Only when the vehicle is stopped

▶ Transition of Power Source Mode (M/T Model) ◀

Power Source Mode	Engine Switch Pushed	Engine Switch Pushed with Clutch Pedal Depressed	After 1 hour
OFF			
ACC			
IG-ON			
START			



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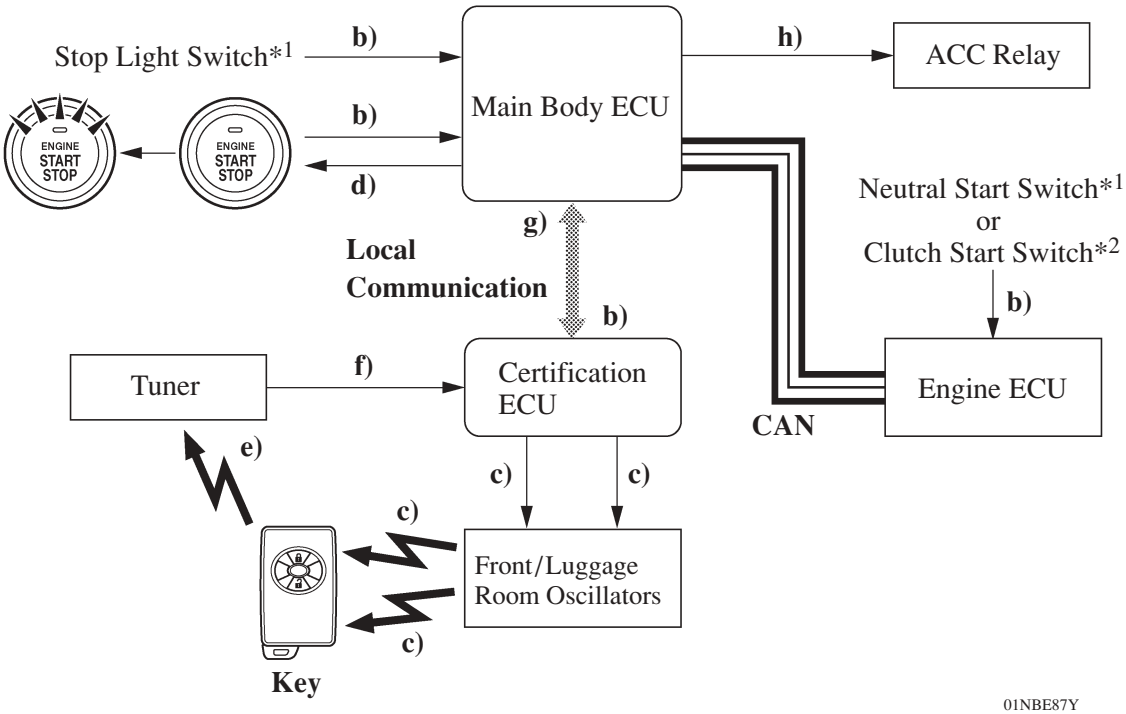
⇨ : Transition

⇨ : Only when the key certification is OK

➡ : Only when the vehicle is stopped

Pattern A: OFF → IG-ON (After the engine is started)

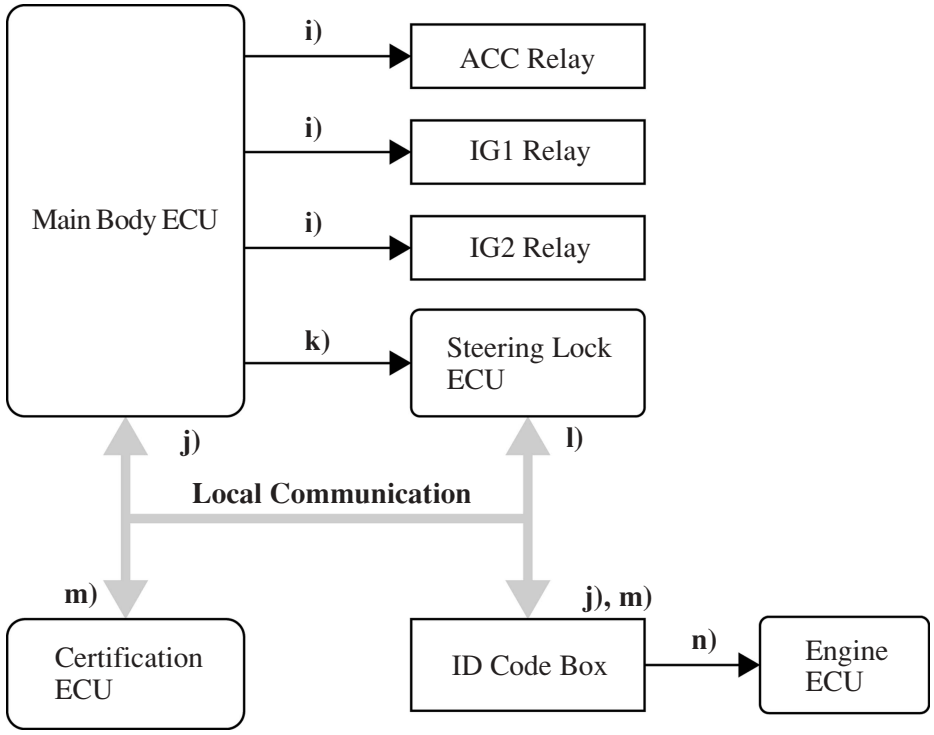
Step	System Operation
a)	The driver enters the vehicle with the key carried in the driver's possessions.
b)	When the driver presses the engine switch once with the following conditions satisfied, the main body ECU recognizes the engine switch signal and transmits the key certification request signal to the certification ECU. ● Shift position is "P"*1. ● Brake pedal depressed*1. ● Clutch pedal depressed*2. ● Power source mode is in "OFF".
c)	The certification ECU receives the key certification request signal and transmits a request signal to the front/luggage room oscillators. These oscillators then transmit the request signal.
d)	The main body ECU turns ON the green indicator light of the engine switch.
e)	At the moment the key receives the request signal, it returns to the tuner an ID code that includes the response code.
f)	The tuner receives this code and transmits it to the certification ECU.
g)	The certification ECU judges and certifies the ID code, and transmits a key certification OK signal to the main body ECU.
h)	After receiving the key certification OK signal, the main body ECU turns ON the ACC relay.



*1: Only for A/T Models
*2: Only for M/T Models

(Continued)

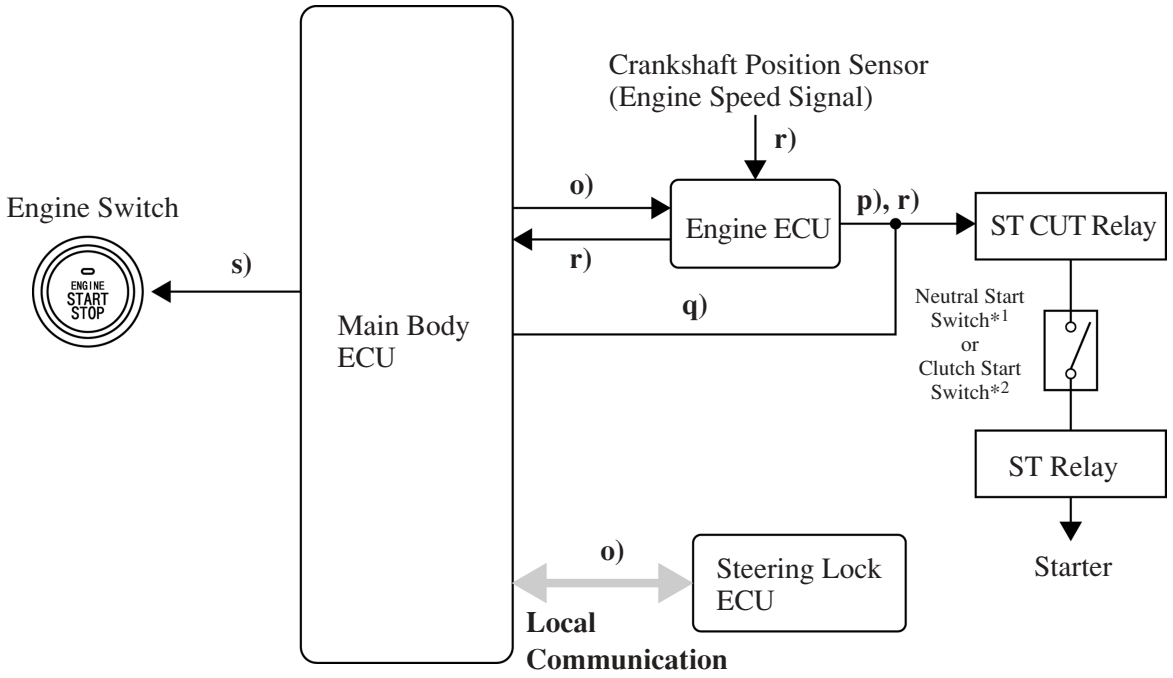
Step	System Operation
i)	The main body ECU turns ON the ACC relay, and then turns ON the IG1 and IG2 relays.
j)	The certification ECU checks that the power source mode has switched from OFF to IG-ON, and transmits a steering unlock request signal to the main body ECU and ID code box.
k)	The main body ECU receives this signal and supplies power to the steering lock ECU.
l)	The steering lock ECU receives the steering unlock request signal via the ID code box, and releases the steering lock.
m)	After checking the steering unlock condition, the certification ECU transmits an engine immobilizer unset request signal to the ID code box.
n)	The ID code box certifies the engine immobilizer unset signal of the certification ECU, transmits the engine immobilizer unset request signal to the engine ECU, and unsets the engine immobilizer.



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(Continued)

Step	System Operation
o)	After checking the steering is in the unlock condition, the main body ECU transmits a starter request (STSW) signal to the engine ECU.
p)	The engine ECU outputs an ST relay (STAR) signal, and actuates the starter.
q)	If the ST relay (STAR) signal cannot be output because the power supplied to the engine ECU is low, the main body ECU outputs the ST relay (STAR) signal instead to help actuate the starter.
r)	When the engine ECU judges from the engine speed signal that engine start is completed, it stops the ST relay (STAR) signal, and stops the starter.
s)	The main body ECU checks that engine start is completed, and turns OFF the indicator light of the engine switch.



*1: Only for A/T Models
*2: Only for M/T Models

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Pattern B: OFF → ACC → IG-ON → OFF

1) OFF → ACC

Step	System Operation
a)	The driver enters the vehicle with the key carried in the driver's possessions.
b)	When the driver presses the engine switch once with the following conditions satisfied, the main body ECU recognizes the engine switch signal and transmits the key certification request signal to the certification ECU. ● Shift position is "P" *1. ● Brake pedal is not depressed*1. ● Clutch pedal is not depressed*2. ● Power source mode is in "OFF".
c)	When the brake pedal*1 or clutch pedal*2 is not depressed, the main body ECU turns ON the amber indicator light of the engine switch.
d)	The subsequent system operation is the same as **d) to h) in pattern "A"**. For details, see page BE-99.

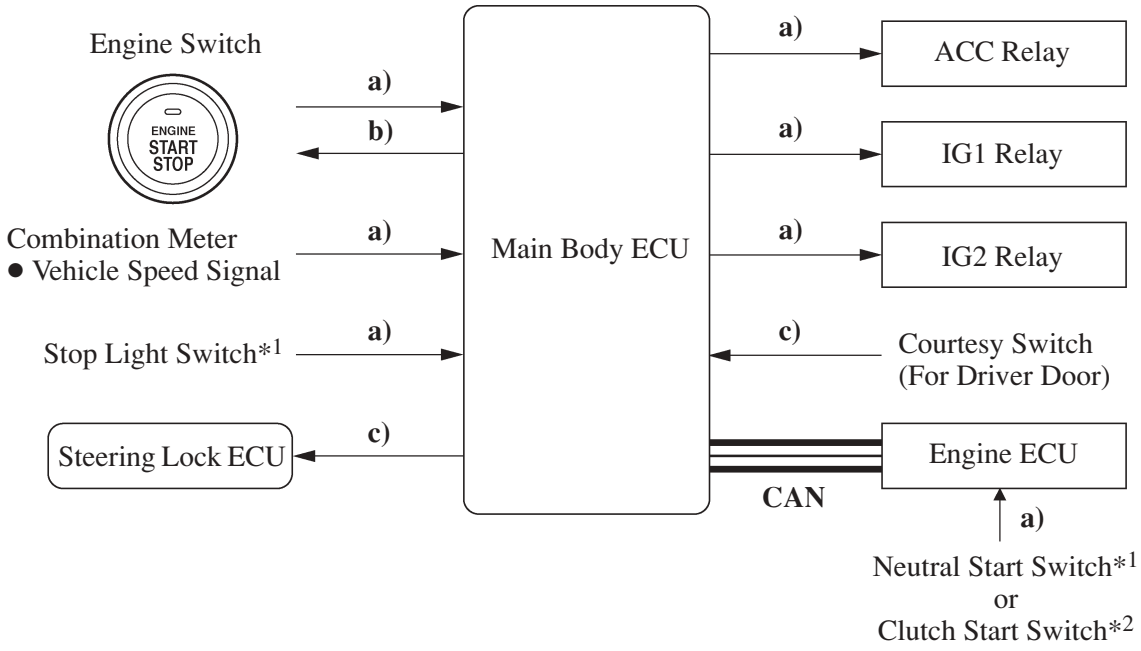
*1: Only for A/T Models
*2: Only for M/T Models

2) ACC → IG-ON

Step	System Operation
a)	When the power source mode is "ACC" and the driver presses the engine switch again, the main body ECU recognizes the engine switch signal and turns ON the IG1 and IG2 relays.
b)	The subsequent system operation is the same as **j) to n) in pattern "A"**. For details, see page BE-100.

3) IG-ON → OFF

Step	System Operation
a)	When the engine switch is pressed once with the following conditions satisfied, the main body ECU recognizes the engine switch signal and turns OFF the ACC, IG1 and IG2 relays. ● Shift position is "P" *1. ● Brake pedal is not depressed*1. ● Clutch pedal is not depressed*2. ● Vehicle speed is 0. ● Power source mode is in "IG-ON".
b)	When the power source mode is switched from IG-ON to OFF, the main body ECU turns OFF the indicator light of the engine switch.
c)	If the driver door is opened, the main body ECU receives a signal from the courtesy switch (for driver door). Then, power supply to the steering lock ECU stops to lock the steering.



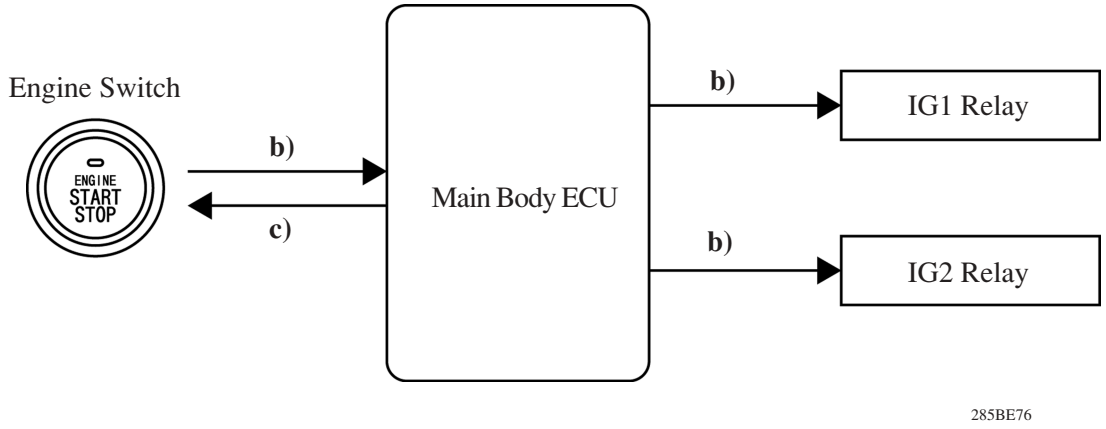
*1: Only for A/T Models
*2: Only for M/T Models

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Pattern C: OFF → ACC → IG-ON → ACC

Step	System Operation
a)	The system operations for the power source mode "OFF → ACC → IG-ON" are the same as those in pattern B. For details, see page BE-102.
b)	When the engine switch is pressed once with the following conditions satisfied, the main body ECU recognizes the engine switch signal and turns off the IG1 and IG2 relays. ● Shift position is except "P". ● Brake pedal is not depressed. ● Vehicle speed is 0. ● Power source mode is in "IG-ON".
c)	Even after the power source mode switches from IG-ON to ACC, the indicator light of the engine switch remains illuminated in amber.



Pattern D: IG-ON → OFF

This system operation is the same as IG-ON → OFF for pattern "B". For details, see page BE-103.

Pattern E: IG-ON → ACC

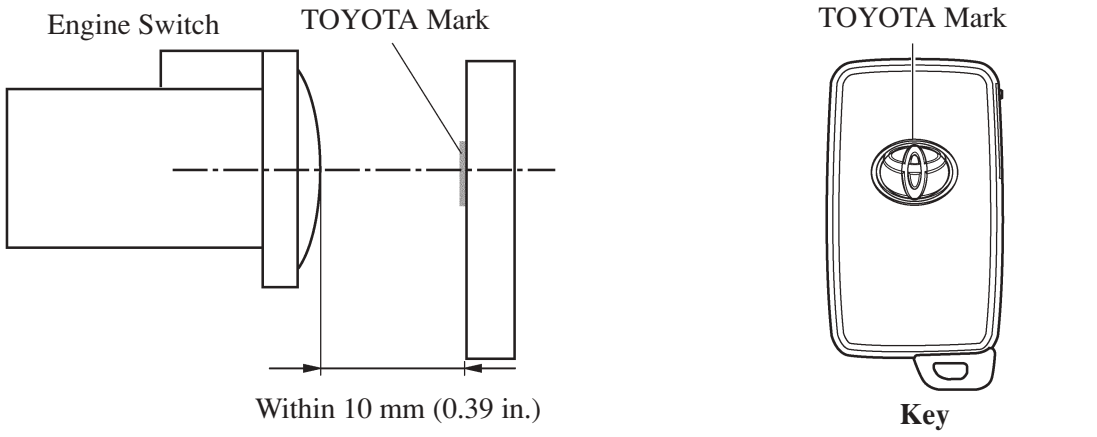
This system operation is the same as pattern "C". For details, see above. However, the indicator light of the engine switch illuminates as follows:

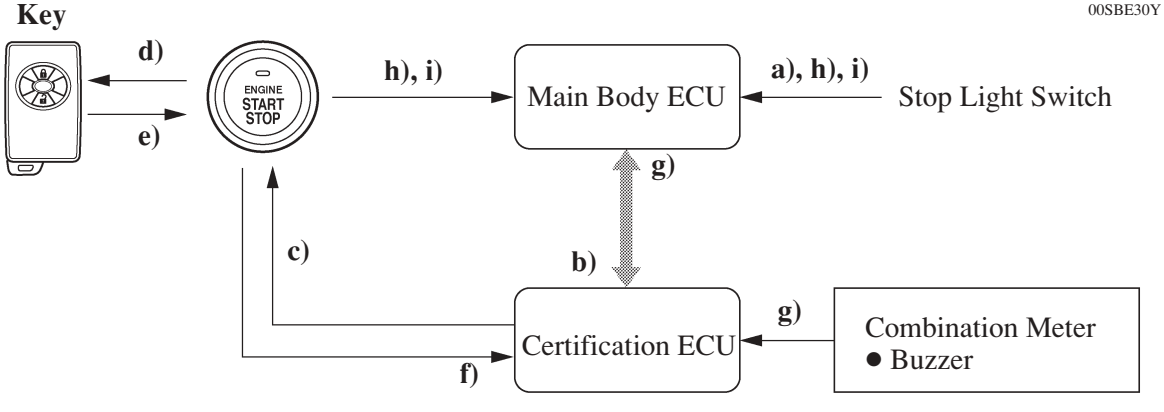
- When the power source mode is switched from IG-ON to ACC, the main body ECU makes the amber indicator light of the engine switch continue to illuminate.
- When the power source mode is switched from engine running to OFF, the main body ECU turns off the indicator light of the engine switch.

When key battery is low

Step	System Operation
a)	To operate the start system when the key battery is low, hold the TOYOTA mark of the key against the engine switch while depressing the brake pedal.
b)	The main body ECU transmits a key certification request signal to the certification ECU.
c)	The certification ECU does not receive an ID code response from the tuner, so it actuates the transponder key amplifier built into the engine switch.
d)	The transponder key amplifier outputs an engine immobilizer radio wave to the key.
e)	The key receives the radio wave, and returns a radio wave response to the transponder key amplifier.
f)	The transponder key amplifier combines the key ID codes with the radio wave response, and transmits it to the certification ECU.
g)	The certification ECU judges and verifies the ID code, and transmits a key certification OK signal to the main body ECU. The buzzer in the combination meter sounds at the same time.
h)	After the buzzer sounds, if the engine switch is pressed within five seconds while the brake pedal*1 or clutch pedal*2 is depressed, the power source mode switches to START as in the normal condition.
i)	After the buzzer sounds, if the engine switch is pressed within five seconds while the brake pedal*1 or clutch pedal*2 is not depressed, the power source mode switches to ACC or IG-ON as in the normal condition.

*1: Only for A/T Models
*2: Only for M/T Models





8. Diagnosis

The main body ECU can detect malfunctions in the start function when the power source mode is IG-ON. When the ECU detects a malfunction, the amber indicator light of the engine switch flashes to warn the driver. At the same time, the ECU stores the 5-digit DTC (Diagnostic Trouble Code) in the memory.

- The indicator light warning continues for 15 seconds even when the power source mode is switched to OFF.
- The DTC can be read by connecting an intelligent tester II to the DLC3.
- The start function cannot be operated again if a malfunction occurs.

For details, see the RAV4 Repair Manual (Pub. No. RM01N0E).