■SYSTEM CONTROL

1. General

The electronic control of the multi-mode manual transmission system on the new models has following controls.

Control	Outline	New	Previous
Engine Starting Control (See Page CH-29)	The M-MT ECU permits the operation of the starter to start the engine only when the brake pedal is depressed and the shift lever is in the N position.	○	○
Vehicle Starting Off Control (See Page CH-30)	When the vehicle starts off in the 1st or 2nd position or reverse, the M-MT ECU partially engages the clutch. Thus, it enables the vehicle to start off slowly without requiring the operation of the accelerator pedal.	—	○
	When the vehicle starts off in the 1st or 2nd position or reverse, the M-MT ECU partially engages the clutch. Thus, it enables the vehicle to start off slowly without requiring the operation of the accelerator pedal. However, while the parking brake is applied, the vehicle starting off control is released	○	—
Shifting Control (See Page CH-31)	● The M-MT ECU effects gear shift control in accordance with the shift lever position and driving conditions by way of the actuators and engine output control of the engine ECU. ● When the shift lever is in the M position, the M-MT ECU shifts the gear to the position selected by the driver. In the M-mode, in order to achieve an excellent driving usability and prevent engine stalls, the shifting control shifts the gear down in accordance with the vehicle speed. ● When the shift lever is in the E position, the M-MT ECU selects an optimal gear position that suits the driving conditions.	○	○
Shift Pattern Control	In the E-mode, the driver can select two shift patterns: the normal [E] pattern (which is fuel economy-oriented and achieves fuel economy that surpasses that of general manual transmission models) and the sporty [Es] pattern (which is drivability-oriented and enables sporty driving).	○	—
Shifting Control in Uphill/Downhill Traveling (See Page CH-33)	While the vehicle is being driven in the E-mode, this control restricts the 4th or 5th upshift or provides appropriate engine braking in order to enable the M-MT ECU to determine whether the vehicle is traveling uphill or downhill.	—	○
	While the vehicle is being driven in the E-mode, this control restricts the 3rd, 4th or 5th upshift or provides appropriate engine braking in order to enable the M-MT ECU to determine whether the vehicle is traveling uphill or downhill.	○	—
ΔTA (Delta Throttle Accelerate) Control (See Page CH-34)	The M-MT ECU determines a sudden ON or OFF operation of the accelerator pedal as request by the driver to accelerate or decelerate, and controls the transmission to downshift or upshift.	○	—
Vehicle Stopping Control (See Page CH-34)	● When the input shaft speed decreases to a predetermined level while the vehicle is in motion, the M-MT ECU disengages the clutch to prevent engine stalls. ● When the vehicle is stopped and the shift lever is in the E or M position, this control automatically shifts the gear to the 1st, thus making it unnecessary for the driver to shift when the vehicle is started off again.	○	○

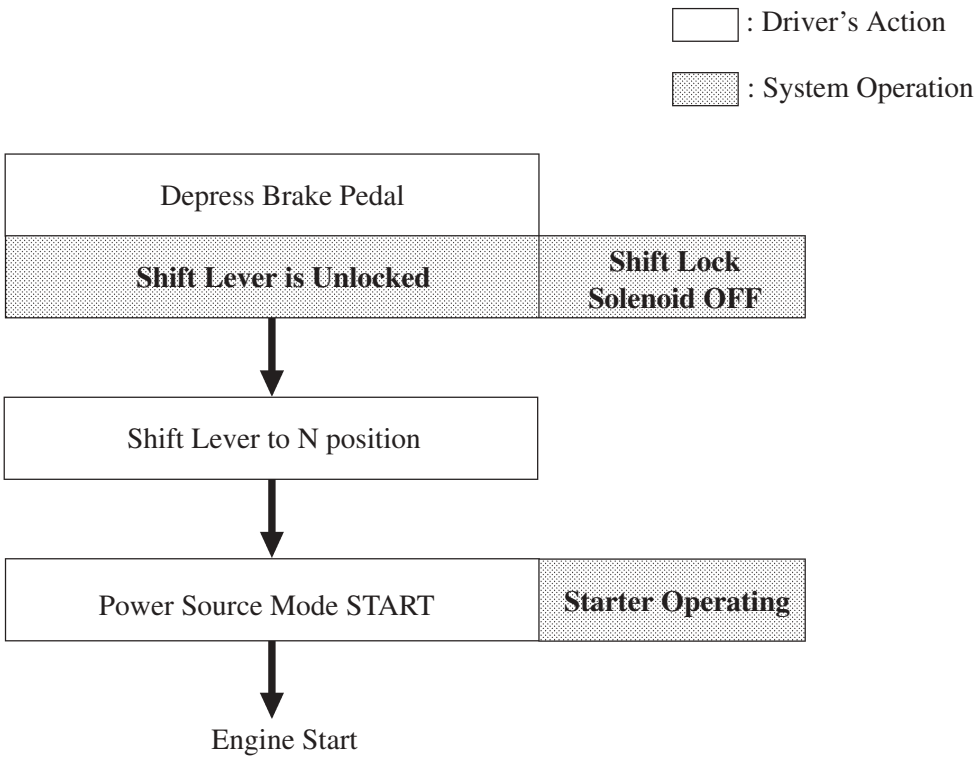
(Continued)

Control	Outline	New	Previous
Parking Control (See Page CH-35)	● When the power source mode is selected to OFF and the shift lever is in the R, E, or M position, the M-MT ECU engages the clutch in order to set the transaxle in the gear parking mode. ● When the power source mode is selected to OFF, the M-MT ECU operates the shift lock solenoid to lock the shift lever position. This prevents the shift lever position and the gear position from becoming mismatched.	○	○
Retry Control (See Page CH-36)	When shifting to the target gear is not succeeded, the M-MT ECU retries gear shifting.	○	○
Shift Protection Control (See Page CH-37)	To protect the transaxle gears, clutch, and engine, the M-MT ECU restricts shifting control when any of the conditions indicated below occur: ● A shift request that could cause the engine to over-rev or under-rev is made. ● A shift request is made to the R position at a vehicle speed that is higher than a predetermined speed. ● A shift request is made to the 1st gear during a low outside air temperature.	○	○
Diagnosis (See Page CH-38)	When the M-MT ECU detects a malfunction, the M-MT ECU makes a diagnosis and memorizes the failed section.	○	○
Fail-safe (See Page CH-38)	Even if a malfunction is detected in the sensors or actuators, the M-MT ECU effects fail-safe control to prevent the vehicle's drivability from being affected significantly.	○	○

CH

2. Engine Starting Control

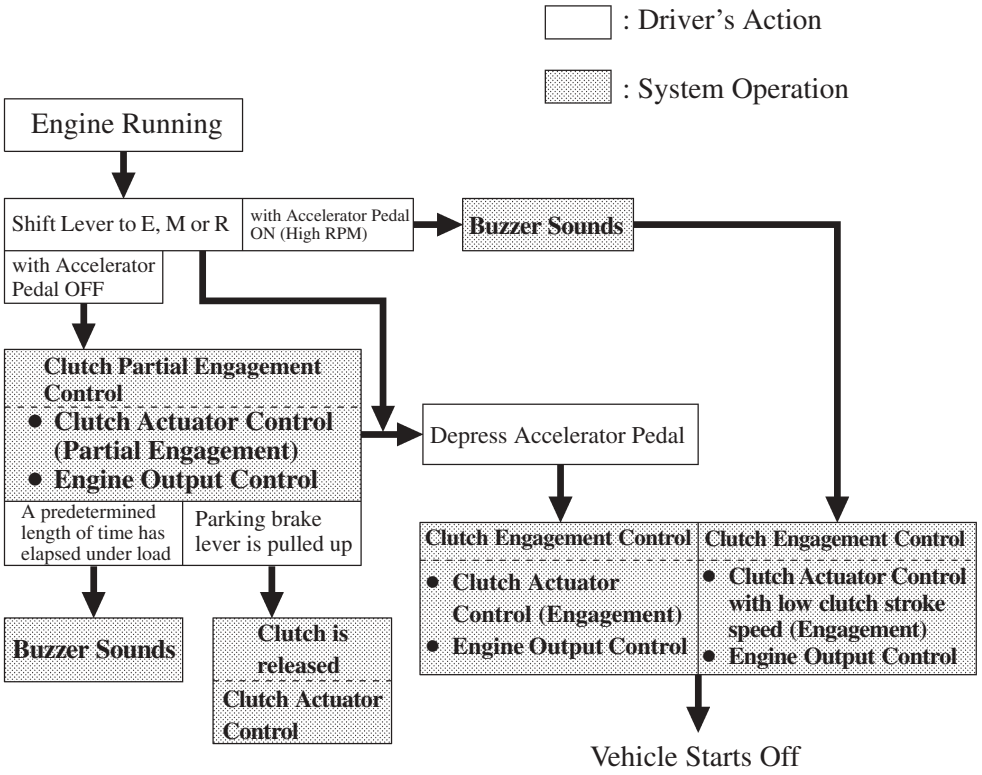
The M-MT ECU permits the operation of the starter to start the engine only when the brake pedal is depressed and the shift lever is in the N position.



3. Vehicle Starting Off Control

- When the gear is in the 1st or 2nd position (shift lever in the E or M position) or reverse (shift lever in the R position), and the brake pedal is released, the M-MT ECU partially engages the clutch via the clutch actuator. To prevent engine stalls, the M-MT ECU requests the engine ECU to effect engine output control. As a result, the vehicle can be driven slowly forward without requiring the driver to depress the accelerator pedal. When the driver depresses the accelerator pedal in this condition, the M-MT ECU engages the clutch.
- When the parking brake lever is pulled up, the M-MT ECU releases the clutch with the clutch actuator, and releases the vehicle starting off control.
- If the partial engagement condition is prolonged, such as when driving on a hill, the M-MT ECU sounds the built-in buzzer to alert the driver to avoid clutch damage.
- If the shift lever is moved from the N to the E, M, or R position while the engine speed is high*, the M-MT ECU sounds the built-in buzzer to alert the driver. At the same time, the M-MT ECU decreases the clutch stroke speed (the speed of the engagement of the clutch) in order to prevent the vehicle from moving suddenly.

*: The M-MT ECU determines this condition based on the transmission revolution sensor signal, crankshaft position sensor signal, and accelerator pedal position sensor signal.



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4. Shifting Control

General

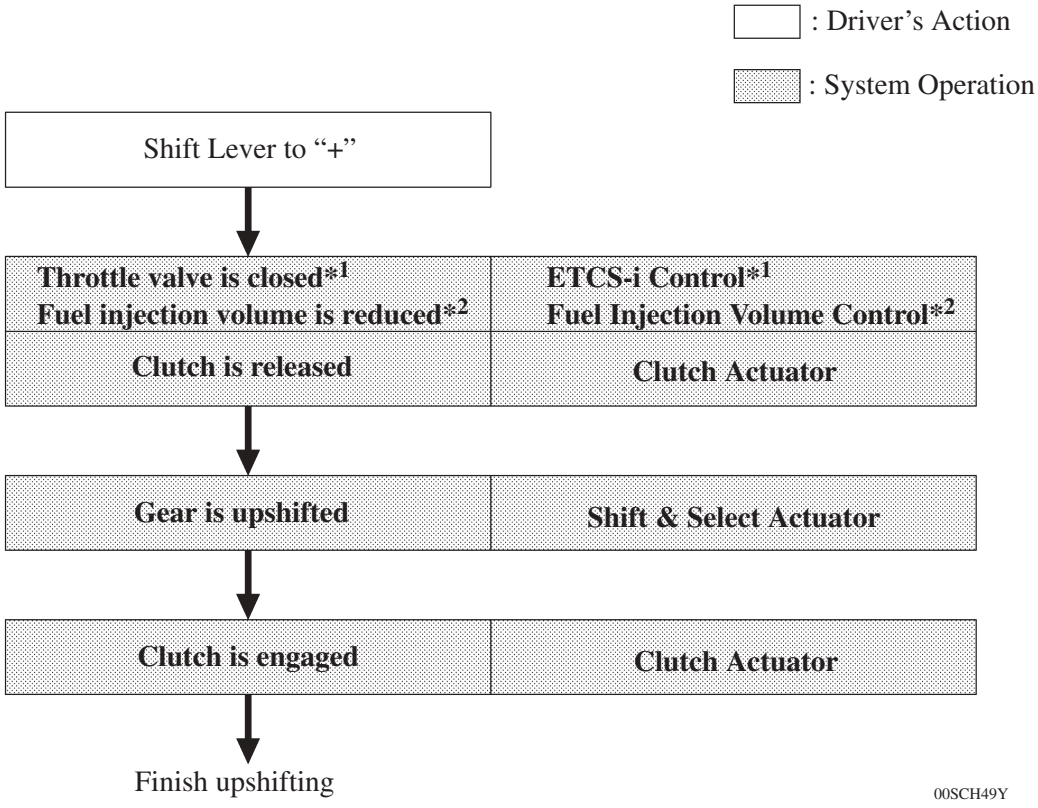
The multi-mode manual transmission system consists of two types of shift modes: the E-mode that shifts automatically to suit the driving conditions; and M-mode that allows the driver to manually operate the shift lever to shift gears without applying the clutch. In the E-mode, the driver can select two shift patterns: the normal [E] pattern (which is fuel economy-oriented and achieves fuel economy that surpasses that of general manual transmission models) and the sporty [Es] pattern (which is drivability-oriented and enables sporty driving).

The M-MT ECU shifts gears by operating the clutch actuator and the shift & select actuator in accordance with the shift lever position and the driving conditions. At the same time, it requests the engine ECU to effect engine output control. As a result, smooth shifting control is realized.

- When the shift lever is in the M position, the driver can operate the shift lever in the "+" or "–" direction to enable the M-MT ECU to effect the gear shift control.
- When the shift lever is in the E position, the M-MT ECU automatically selects an optimal gear position that suits the driving conditions.

Upshifting (M-mode)

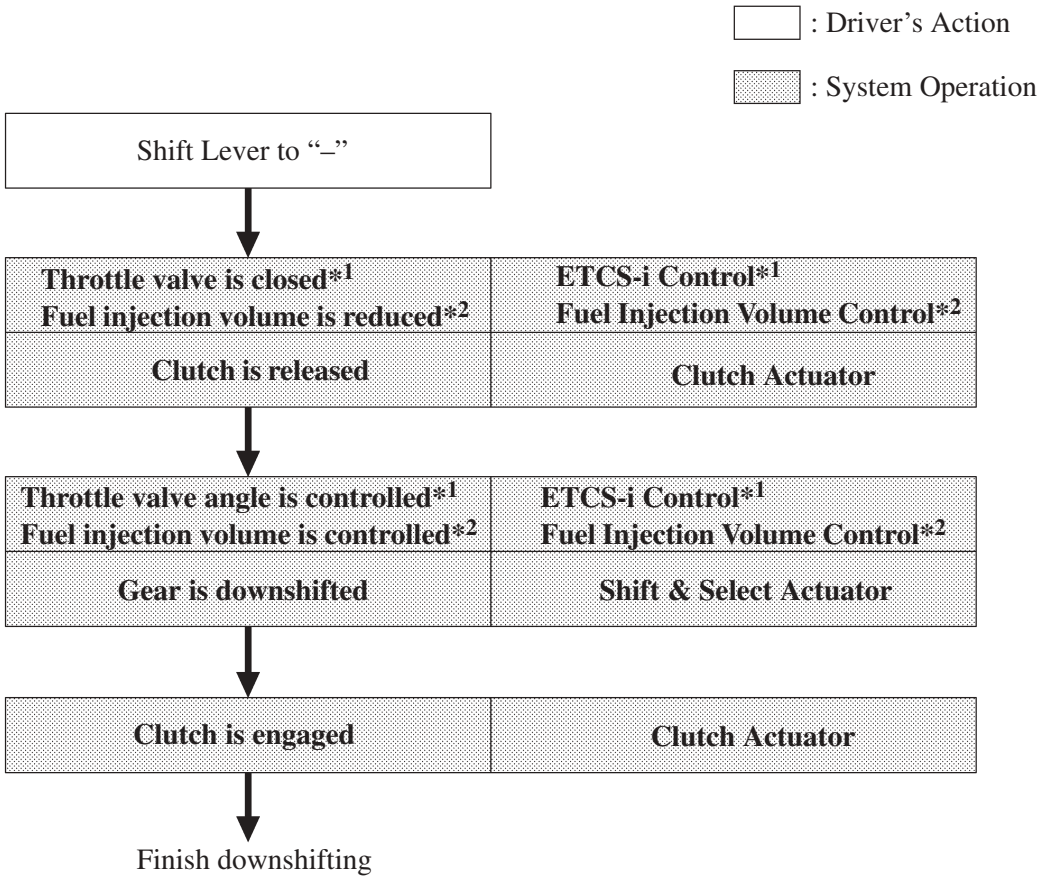
- When the driver moves the shift lever from the M position to the "+" direction, the M-MT ECU releases the clutch by operating the clutch actuator. If the driver is depressing the accelerator pedal at this time, the M-MT ECU prevents the engine from being over-revved by requesting the engine ECU to effect the engine output control.
- After the clutch release movement has been completed, the M-MT ECU operates the shift & select actuator to shift gears.
- After the gear shifting has been completed, the M-MT ECU engages the clutch.



*1: Only for the C551A Multi-mode Manual Transmission
*2: Only for the C53A Multi-mode Manual Transmission

Downshifting (M-mode)

- When the driver moves the shift lever from the M position to the "–" direction, the M-MT ECU operates the clutch actuator to release the clutch.
- In the M-mode, in order to achieve an excellent the driving usability and prevent engine stalls, the shifting control shifts the gear down in accordance with the vehicle speed.
- After the clutch release movement has been completed, the M-MT ECU operates the shift &select actuator to shift gears. At this time, the M-MT ECU requests the engine ECU to effect engine output control.
- After the gear shifting has been completed, the M-MT ECU engages the clutch.



*1: Only for the C551A Multi-mode Manual Transmission
*2: Only for the C53A Multi-mode Manual Transmission

Automatic Up/Downshifting (E-mode)

- When the driver moves the shift lever to the E position, the M-MT ECU calculates an optimal gear position to suit the driving conditions (accelerator pedal position, vehicle speed, etc.), and operates the clutch actuator, shift & select actuator, and ETCS-i control or fuel injection volume control to shift the gears (1st ↔ 5th). The control of the actuators, ETCS-i, fuel injection volume during upshifting and downshifting is the same as for the M-mode.
- The M-MT ECU determines the driver's vehicle acceleration request from the accelerator pedal position sensor value, and downshifts to a gear position that suits the vehicle speed if necessary. Thus, the vehicle can be accelerated as requested by the driver even in the E-mode. In addition, the LHD models have the kick-down function. This function enables the M-MT ECU to perform downshifting when the driver fully depresses the accelerator pedal while driving, in accordance with the actual vehicle speed.

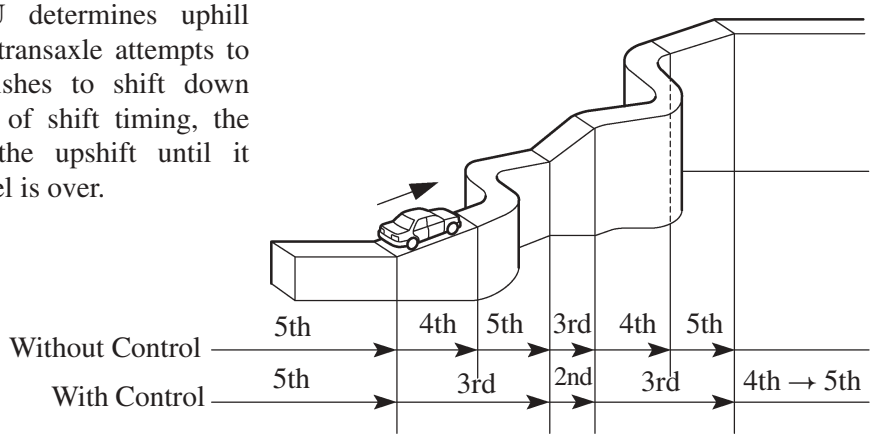
5. Shifting Control in Uphill / Downhill Traveling (E-mode)

General

This control minimizes the gear shifting when the driver operates the accelerator pedal while driving on a winding uphill or downhill road in order to ensure a comfortable drivability.

Shift Control in Uphill Traveling

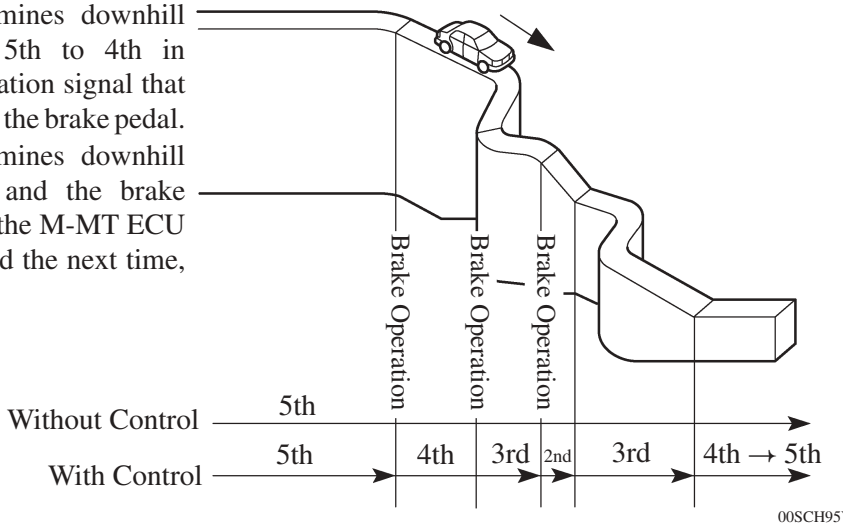
When the M-MT ECU determines uphill traveling and before the transaxle attempts to shift up or after it finishes to shift down according to the control of shift timing, the M-MT ECU prohibits the upshift until it determines the uphill travel is over.



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Shift Control in Downhill Traveling

When the M-MT ECU determines downhill travel, it shifts down from 5th to 4th in accordance with the brake operation signal that is input when the driver operates the brake pedal. When the M-MT ECU determines downhill travel with a steeper grade, and the brake operation signal is input again, the M-MT ECU shifts down from 4th to 3rd, and the next time, 3rd to 2nd.



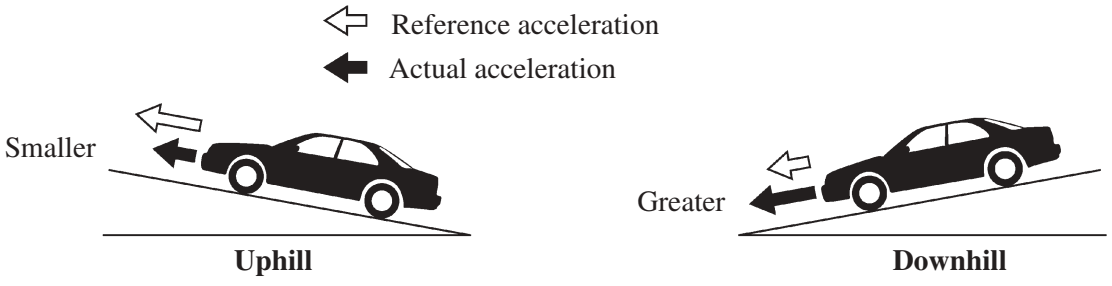
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Uphill / Downhill Judgment

The actual acceleration calculated from the speed sensor signal is compared with the reference acceleration stored in the M-MT ECU to judge uphill or downhill travel.

Actual Acceleration < Reference Acceleration

Actual Acceleration > Reference Acceleration



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6. △TA (Delta Throttle Accelerate) Control

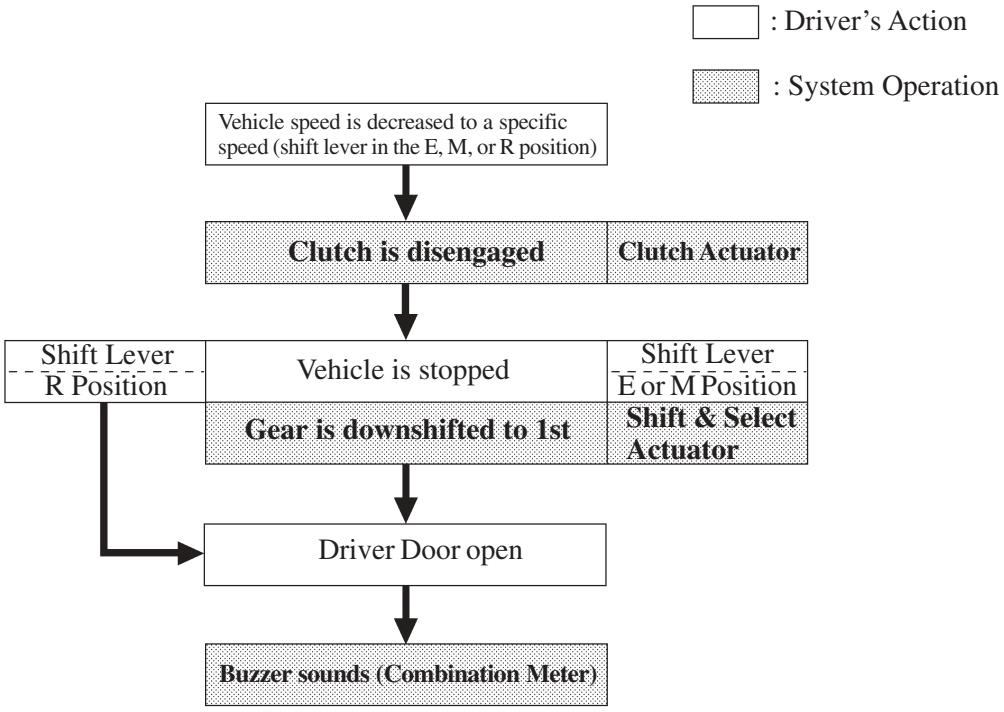
The ΔTA control, which operates in the automatic or manual shift mode (E-mode or M-mode), has the following two control functions:

- At sudden acceleration: The M-MT ECU determines, via the accelerator pedal position sensor, a sudden acceleration ON operation as the driver's request to accelerate, and thus quickens the timing of downshifting.
- At sudden deceleration: The M-MT ECU determines, via the accelerator pedal position sensor, a sudden acceleration OFF operation as the driver's request to decelerate. Thus, instead of upshifting, it ensures engine braking and also the driving force of the subsequent accelerator ON operation.

7. Vehicle Stopping Control

- When the shift lever is in the E, M, or R position and the vehicle speed is decreased to a specific speed*, the M-MT ECU releases the clutch to prevent engine stalls at low speeds.
- In addition, when the vehicle is operating in the E or M position and comes to a stop, the gear is automatically shifted to the 1st to achieve an excellent drivability for starting off again. When the shift lever is in the R position, the gear is not shifted automatically when the vehicle is stopped.
- When the vehicle is stopped with its engine running and the driver door is opened with the shift lever in the E, M, or R position, the M-MT ECU sounds the buzzer in the combination meter to alert the driver.

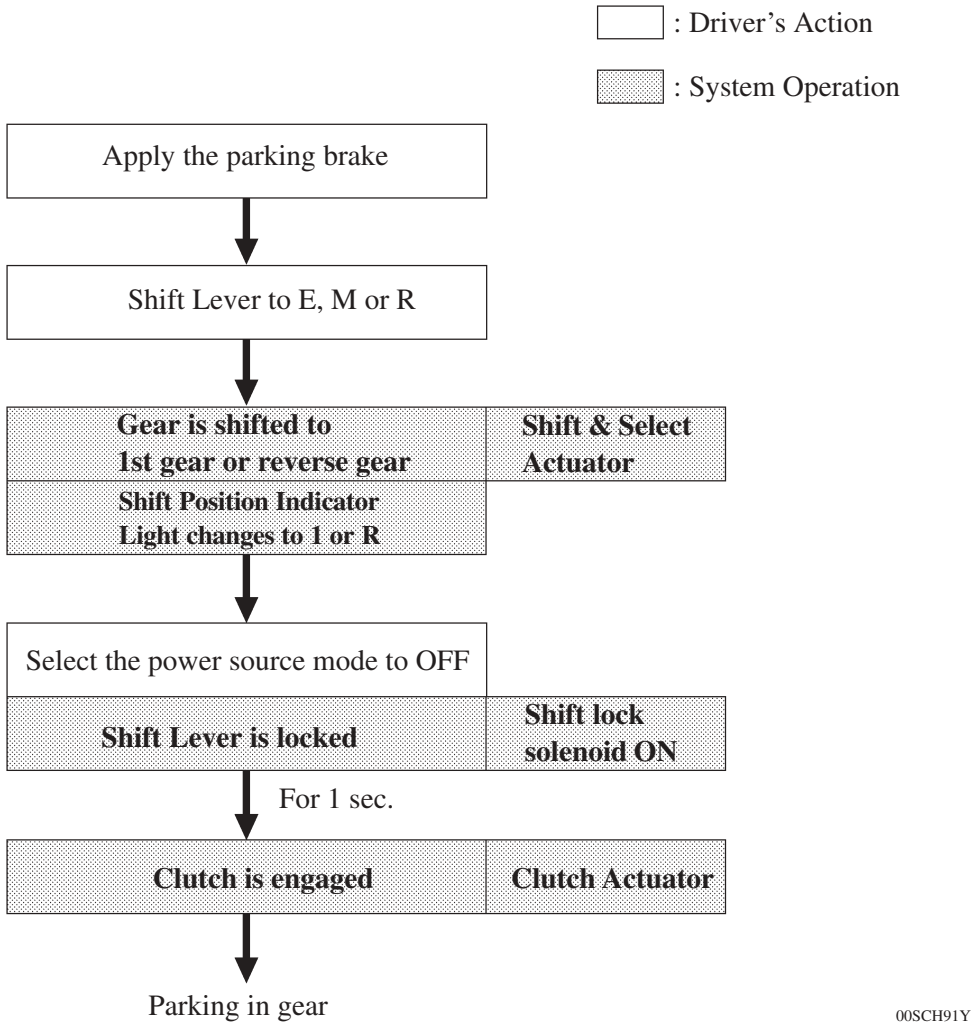
*: Because the M-MT ECU effects this control in accordance with the transmission revolution sensor signal, this value changes with the gear position.



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8. Parking Control

- To park the vehicle, the driver applies the parking brake, moves the shift lever to the E, M or R position, verifies on the shift position indicator light that the shifting has been properly executed, and selects the power source mode to OFF. When the power source mode is selected to OFF, the shift lock mechanism causes the shift lever to lock. Approximately 1 second later, the M-MT ECU engages the clutch. As a result, the transaxle assumes the gear parking mode with its gears meshed.
- The vehicle can be parked whether the shift lever is in any position, E, M, R, or N. However, when the shift lever is in the N position, the gear parking mode described above cannot be effected because the gears are not meshed. Also, when parking the vehicle using the gear parking mode, the driver must select the power source mode to OFF after the shift position indicator light is indicated “1” or “R”.
- For approximately 5 seconds after the power source mode has been selected to OFF, the driver can verify the gear position on the indicator due to the function of the meter ECU.



9. Retry Control

- When shifting to the target gear is not succeeded, M-MT ECU retries gear shifting.

Vehicle Condition	Driver's Action	Retry Operation	Warning
Stopped with Engine OFF	Shift Lever N → E, M or R	If the gear does not shift from the neutral to the 1st or R position, the M-MT ECU effects the following movements: ● Return to the neutral position ● Shift to the other gear ● Shift to the 1st or R gear ● If the gear does not shift to the 1st or R position after the above movements have been repeated a few times, the M-MT ECU stops gear shifting and stands by in the neutral position.	N range indicator light blinks*
Stopped with Engine Running	Shift Lever N → E, M or R	If the gear does not shift from the neutral to the 1st or R position, the M-MT ECU effects the following movements: ● Return to the neutral position ● Clutch is engaged and disengaged once ● Shift to the 1st or R gear ● If the gear does not shift to 1st or R after the above movements have been repeated a few times, the M-MT ECU stops gear shifting and stands by in the neutral position.	N range indicator light blinks* Buzzer in M-MT ECU sounds*
Driving	Upshifting Downshifting	If the gear does not shift to the target gear position, the M-MT effects the following movements: ● Return to the neutral position ● Shift again to the target gear ● If the gear does not shift to the target gear position after the above movements have been repeated a few times, the M-MT ECU stops gear shifting and stands by in the neutral position.	N range indicator light blinks*
	Unintended mechanical popping out of the gears	If the gear pops out unintendedly, the M-MT ECU effects the following movements: ● Return to the neutral position ● Shift to the target gear	N range indicator light blinks*

*: During retry operation

- In case of the stand-by condition in the neutral position as above, the driver should release the condition as follows.

Vehicle Condition	Driver's Action
Stopped with Engine OFF	● Select the power source mode to IG-ON. ● Depress the brake pedal. ● Return the shift lever to the neutral position. ● Move the shift lever to the target position again. ● Select the power source mode to OFF.
Stopped with Engine Running	● Return the shift lever to the neutral position. ● Move the shift lever to the target position again.
Driving (Upshifting or Downshifting)	

10. Shift Protection Control

To protect the transaxle gears, clutch, and engine, the M-MT ECU restricts shifting control when any of the condition indicated in the table below occur:

Driver's Action	System Operation	Warning
Upshifting that causes the engine to under-rev. (Approximately 1,200 rpm or less)	Shifting is rejected	—
Downshifting that causes the engine to over-rev. (Approximately 5,000 rpm or more)*1 (Approximately 6,200 rpm or more)*2	Shifting is rejected	Buzzer in M-MT ECU sounds once
Moves the shift lever to the R position at a vehicle speed of 6 km/h (4 mph) or more. (E → R, M → R or N → R)	Shifting is rejected	N range indicator light blinks
Downshifts to the 1st gear at a low outside air temperature (Estimated transaxle oil temperature: 0°C or below when driving at speeds over 15 km/h and –25°C or below when driving at speeds over 7 km/h). ● Manually downshifts the shift lever in the M-mode. ● Automatically downshifts in the E-mode.	Shifting is rejected (2nd gear is selected)	—

*1: C53A M–MT
*2: C551A M–MT

11. Diagnosis

- When the M-MT ECU detects a malfunction, the M-MT ECU makes a diagnosis and memorizes the failed section. Furthermore, the M-MT warning light and check engine warning light* illuminates or blinks to inform the driver.
- The M-MT ECU will also store the DTCs (Diagnostic Trouble Codes). The DTCs can be accessed by connecting an intelligent tester II. They can also be accessed by connecting the SST (09843-18040) to the DLC3 terminals TC and CG, and reading the blinking of the M-MT warning light.
- The DTCs cannot be deleted by merely disconnecting the battery terminals. To delete the DTCs, an intelligent tester II must be connected to the DLC3 terminal or the SST (09843-18040) must be used to initialize the M-MT ECU. For details on how to initialize the M-MT ECU, see page CH-40

For details, refer to the Yaris Repair Manual (Pub. No. RM00S1E).

*: Depending on the malfunctions, the check engine warning light illuminates.

12. Fail-safe

Even if a malfunction is detected in the sensors or actuators, the M-MT ECU effects fail-safe control to prevent the vehicle's drivability from being affected significantly.

▶ Fail-safe Chart ◀

Malfunction Area		Fail-safe Operation
● Clutch Actuator ● Clutch Stroke Sensor*1		● Impossible to shift ● Impossible to start ● Vehicle cannot start moving or the engine stops after the vehicle stops
● Shift & Select Actuator ● Shift Stroke Sensor*1 ● Select Stroke Sensor*1		● Impossible to shift ● Vehicle cannot start moving
Stroke Sensor*2		Limit to the 3rd or lower gear, or reverse gear
● ETCS-i ● Throttle Control Motor ● Throttle Position Sensor		Throttle opening angle limitation (fixed angle of 10.5°)
Engine Speed Signal Circuit		Converts the engine revolution signal into the CAN communication signal (No affects)
● Transmission Speed Sensor ● Vehicle Speed Sensor		● Impossible to shift down while driving ● Possible to drive only in the 1st or reverse gear after the vehicle stops
● EEPROM ● Motor Relay		● Impossible to shift ● Impossible to start ● Engine stops when vehicle stops
Shift Lever	Shift Lever Position Sensor	● Impossible to use M-mode ● When 1 contact point is malfunctioning: possible to drive normally and shift ● When more than 2 contact points are malfunctioning: impossible to drive or shift
	Transmission Shift Main Switch	Impossible to use M-mode
Crankshaft Position Sensor		Engine stops when vehicle stops
CAN Communication		● Impossible to shift down and up while driving ● Possible to drive only in the 1st or reverse gear after the vehicle stops
Open in Power Source Circuit of M-MT ECU		Beeping buzzer (in the combination meter) when the power source mode is selected to OFF
System Voltage		Impossible to run

*1: Both the main and sub circuits are malfunctioning, or the sensor output is out of the standard operating range.

*2: One of the internal circuits (main and sub) of each sensor is malfunctioning.