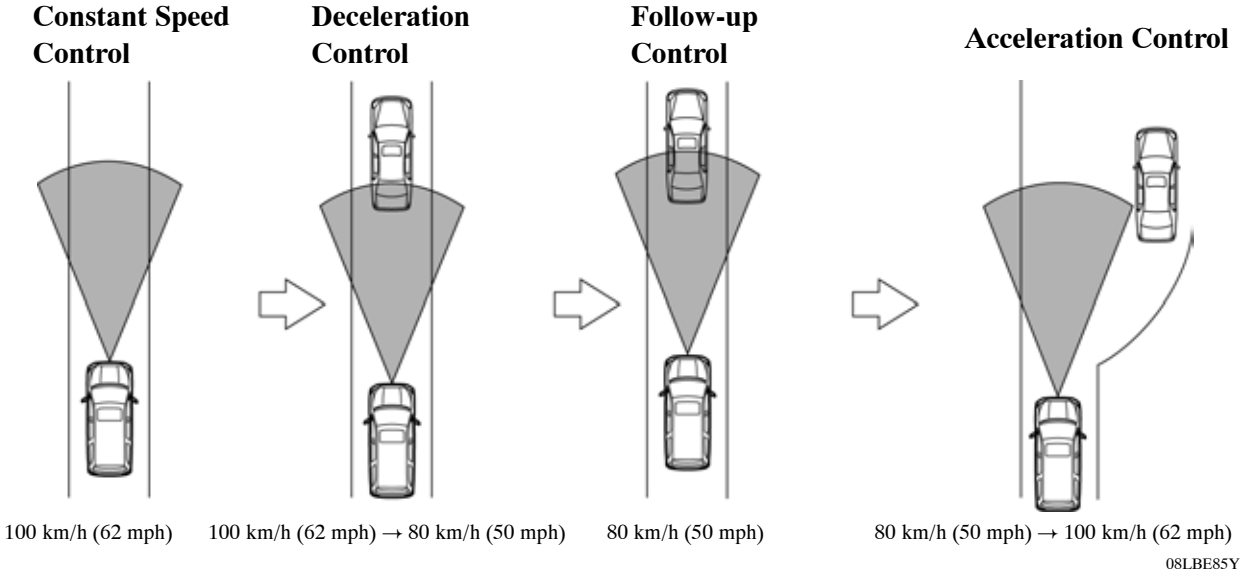
■DYNAMIC LASER CRUISE CONTROL SYSTEM

1. General

The dynamic laser cruise control system has two cruise control modes: Constant speed control mode, and vehicle-to-vehicle distance control mode.

- The cruise control switch is used for switching between the two modes. The mode in which the cruise control system starts is the vehicle-to-vehicle distance control mode.
- The distance control ECU, laser radar sensor and ECM control this system.
- The combination meter informs the driver of the control conditions.

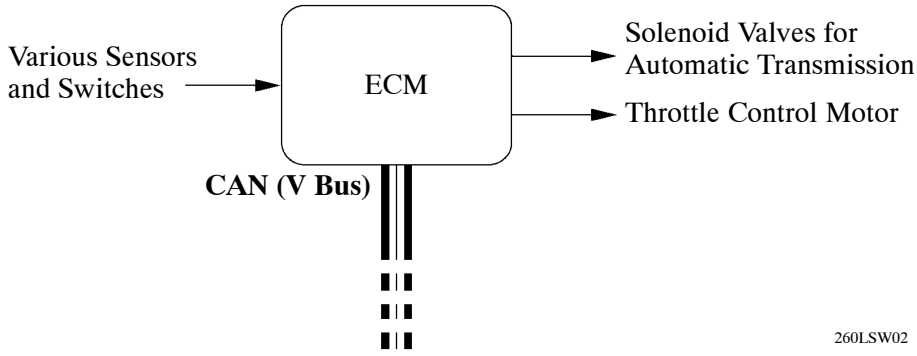
Mode	Outline
Constant Speed Control Mode	The constant speed control mode is the same as in the cruise control system.
Vehicle-to-vehicle Distance Control Mode	In the vehicle-to-vehicle distance control mode, the system recognizes and determines the lane in which the driver's own vehicle and the vehicle ahead are traveling. Thus, the system is able to maintain the proper vehicle-to-vehicle distance in accordance with the vehicle speed, and allows the vehicle to be driven under follow-up control. ● The driver can operate the distance control switch on the steering wheel to select the vehicle-to-vehicle distance in three stages: long, middle, and short. ● This mode consists mainly of four controls: constant speed control, deceleration control, follow-up control, and acceleration control. ● The illustrations below show control examples while the driver's own vehicle is driving at 100 km/h (62 mph), and the vehicle ahead is driving at 80 km/h (50 mph). ● Throttle control and brake control achieve smooth deceleration.



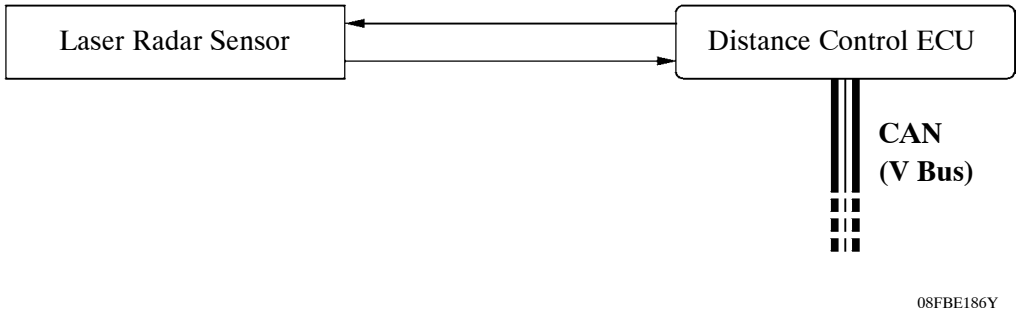
Service Tip

When either the distance control ECU or the ECM is replaced, the laser radar sensor information stored in the replaced ECU must be initialized. For details, see 2008 Sequoia Repair Manual (Pub. No. RM08L0U).

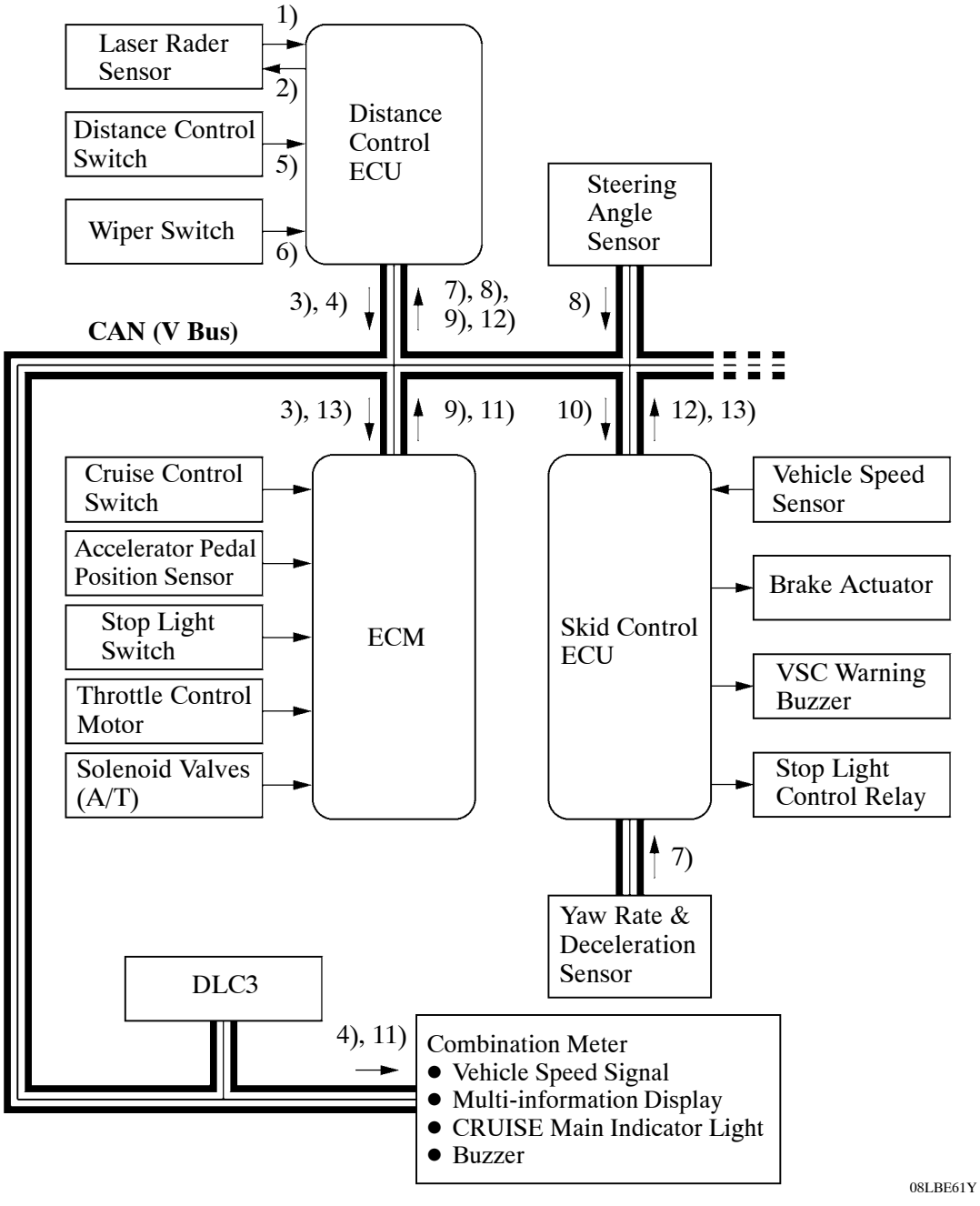
- As in the cruise control system, the constant speed control mode is controlled by the ECM, which outputs signals to the actuators.



- The vehicle-to-vehicle distance control mode is controlled by the laser radar sensor and distance control ECU. Thus, the signals are output to the actuators and the ECU while the data is being exchanged as indicated below.



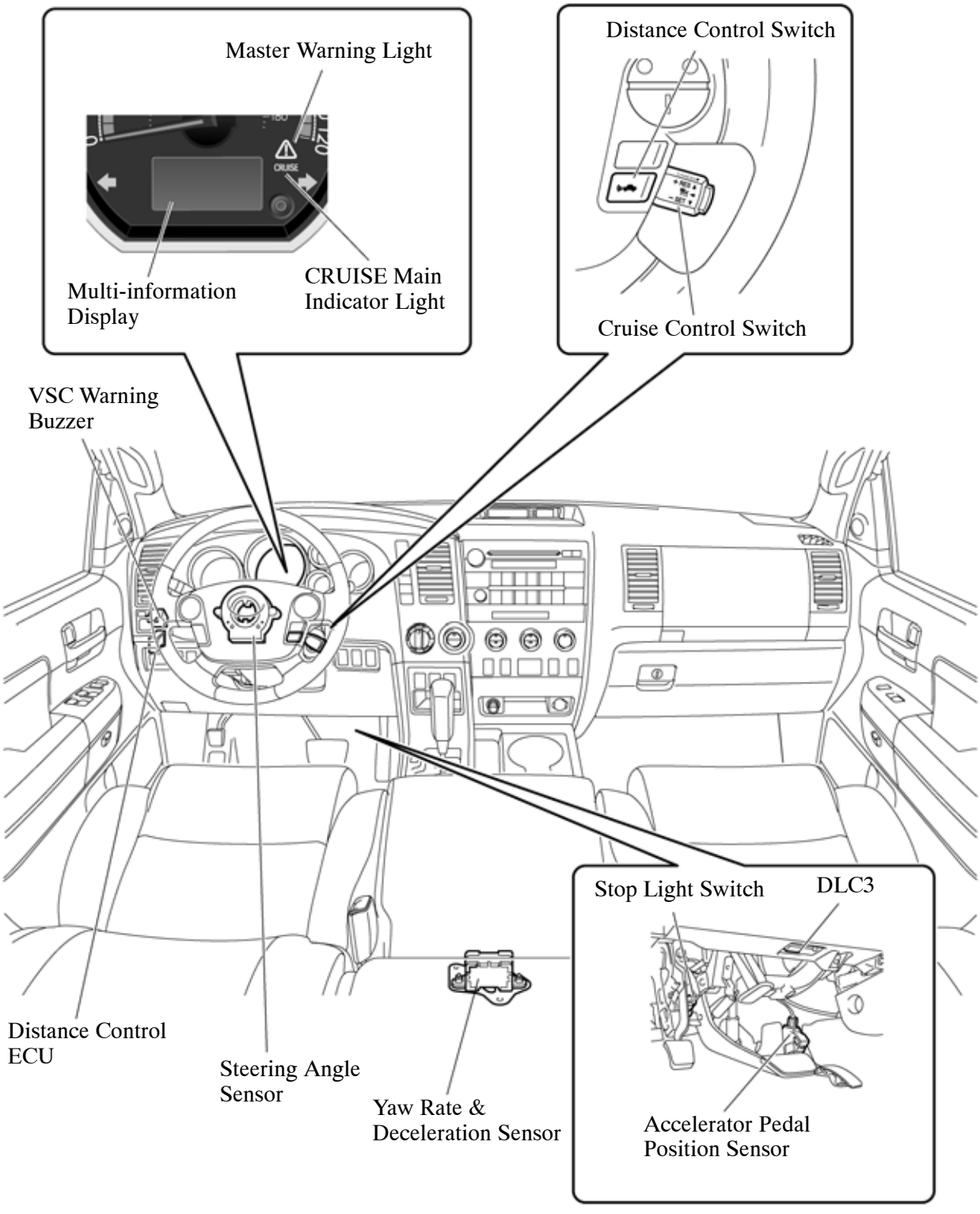
2. System Diagram

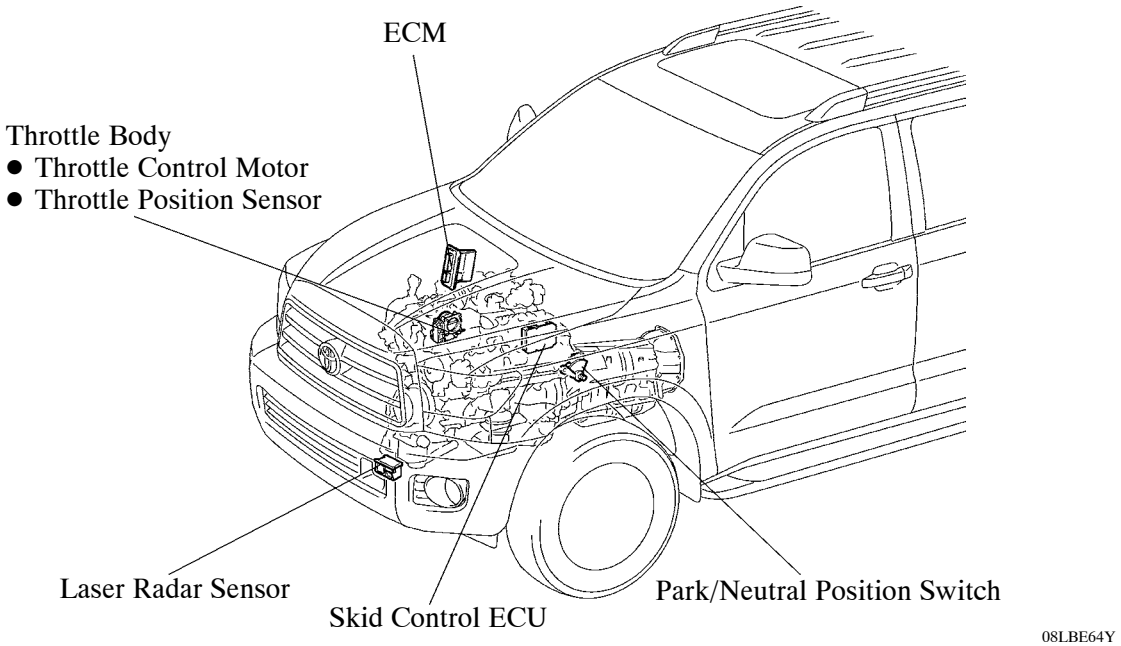


No.	Transmit	Receive	Data List	Communication
1)	Laser Radar Sensor	Distance Control ECU	● Vehicle-to-Vehicle Distance ● Presence of Vehicle Ahead ● Relative Acceleration Rate ● Relative Vehicle Speed ● Width and Position of Object Ahead ● Diagnostic Data	Serial
2)	Distance Control ECU	Laser Radar Sensor	● Actual Vehicle Speed ● Estimated Curve Radius	Serial
3)		ECM	● Target Acceleration Rate ● Target Deceleration Rate ● Vehicle-to-Vehicle Distance ● Presence of Vehicle Ahead ● Brake Request ● Beam Axis Deviation ● Laser Radar Sensor Dirtiness Detection ● Poor Weather Detection ● Proximity Warning ● Gear Request ● Diagnosis Data	CAN
4)		Combination Meter	● Display Data ● Warning	CAN
5)	Distance Control Switch	Distance Control ECU	Change Vehicle-to-vehicle Distance	Wire
6)	Wiper Switch		Wiper ON/OFF	
7)	Yaw Rate & Deceleration Sensor		Yaw Rate	CAN
8)	Steering Angle Sensor		Steering Angle	
9)	ECM		● Set Vehicle Speed ● Actual Vehicle Speed ● Main Switch ON/OFF ● Set Distance ● Brake Request Response ● Accelerator Pedal Idle ● Stop Light Signal ● Transmission Information	
10)		Skid Control ECU	● Target Deceleration Rate ● Target Deceleration Rate Gradient ● Brake Request	
11)		Combination Meter	Cruise Control System ON/OFF	CAN
12)	Skid Control ECU	Distance Control ECU	Zero Point Information of Yaw Rate	CAN
13)		ECM	● Cruise Control Cancel Request ● Brake Request Response ● Brake Control Operation (VSC)	

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3. Layout of Main Components





4. Function of Main Components

Item		Outline
Cruise Control Switch	Main Switch	Turns ON/ OFF the power to the cruise control system.
	MODE Switch	Switches the control mode, between the constant speed control mode and vehicle-to-vehicle distance mode.
	CANCEL Switch	A cancel signal can be output to the ECM through the operation of this switch.
	RES/+ Switch	The acceleration function and resumption of a preset speed can be performed by operating this switch. A signal is output to the ECM when this switch is operated.
	SET/– Switch	The deceleration function and vehicle speed setting resume signals are output to the ECM due to operation of this switch.
Distance Control Switch		While the system is in the vehicle-to-vehicle distance control mode, the driver can operate the distance control switch to select the vehicle-to-vehicle distance in three stages: long, middle, and short.
Stop Light Switch		Detects the pressing of the brake pedal and transmits a signal to the ECM.
Combination Switch	Wiper Switch	Transmits wiper switch information to the distance control ECU.
Laser Radar Sensor		Radiates laser rays forward, uses the reflected rays to detect the presence of a vehicle being driven ahead, the vehicle-to-vehicle distance, and the relative speed, and transmits this information to the distance control ECU.
Distance Control ECU		While the system is in the vehicle-to-vehicle distance control mode, the distance control ECU detects the vehicle being followed based on signals from the laser radar sensor. Then, the distance control ECU calculates the acceleration or deceleration rate required in order to attain the target vehicle-to-vehicle distance, and outputs a request signal to the ECM and or skid control ECU.

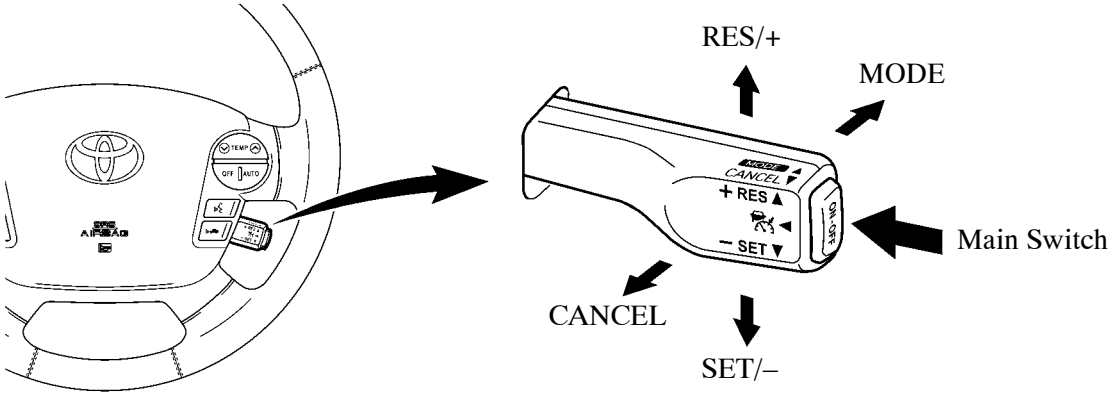
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Item		Outline
Combination Meter		Transmits the vehicle speed signal to the ECM.
	CRUISE Main Indicator Light	● Illuminates when the main switch on the cruise control switch has been pressed to turn the system ON. ● If the distance control ECU detects a malfunction, this light flashes to warn the driver.
	Master Warning Light	Illuminates when there is a malfunction in the system.
	Buzzer	If the ECM or distance control ECU detects automatic cancel or warning signals while the vehicle is operating under cruise control, this buzzer sounds to inform the driver.
	Multi-information Display	During the dynamic laser cruise control, the multi-information display receives signals from distance control ECU, in order to display the system conditions.
Steering Angle Sensor		Detects the angle and direction of steering and transmits signals to the skid control ECU and distance control ECU.
Yaw Rate & Deceleration Sensor		Detects the yaw rate of the vehicle and transmits signals to skid control ECU and distance control ECU.
Skid Control ECU		While the system is operating in vehicle-to-vehicle distance control mode, the skid control ECU actuates the brake actuator in accordance with the brake request signal received from the distance control ECU.
Brake Actuator		Actuates the brakes in accordance with the signals from the skid control ECU.
Stop Light Control Relay		Illuminates the stop light in accordance with the stop light illumination request signal from the skid control ECU.
ECM		● Controls the cruise control system in accordance with signals from the switches, sensors, skid control ECU and distance control ECU. ● If the ECM detects a malfunction in the cruise control system, it will store DTC (Diagnostic Trouble Code).

5. Construction and Operation

Cruise Control Switch

- The cruise control switch consists of the main, RES/+, MODE, SET/– and CANCEL switches. The RES/+, MODE, SET/– and CANCEL switches are a lever that operates in four directions.
- The cruise control switch is an automatic reset (normally open) type that turns ON only when the switch is being operated and turns OFF as soon as the driver releases the switch. Furthermore, the functions of the control switch are active only when the cruise control system has been turned ON using the main switch on the cruise control switch.

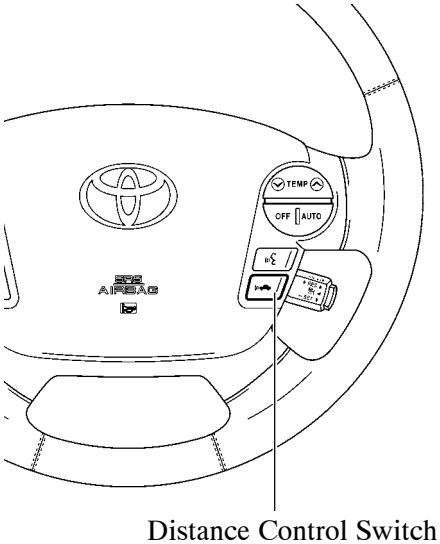


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Distance Control Switch

- While the vehicle is being driven in vehicle-to-vehicle distance control mode, the vehicle-to-vehicle distance setting can be changed each time the distance control switch is pressed, as follows; long → middle → short.
- If the ignition switch is turned OFF and back to ON, the system will default to “long”.
- The vehicle-to-vehicle distance is set as follows:



Distance Control Switch

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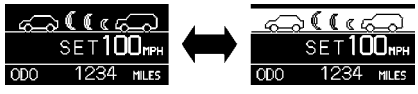
Mode	Vehicle-to-vehicle Distance*
Long	Approx. 75 m (240 ft.)
Middle	Approx. 50 m (160 ft.)
Short	Approx. 30 m (105 ft.)

*: While driving at a vehicle speed of 90 km/h (55mph).

Combination Meter

The combination meter provides a master warning light, CRUISE main indicator light, buzzer, and multi-information display to warn and indicate in the dynamic laser cruise control system.

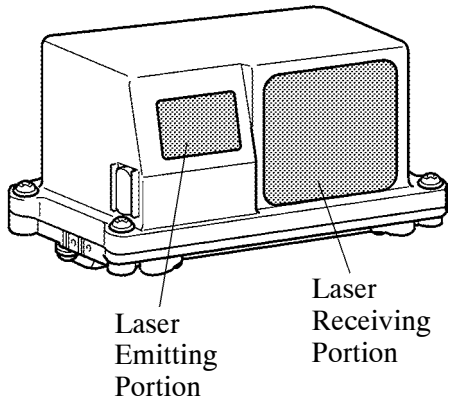
- The multi-information display indicates information such as the set speed, the constant speed control mode, the vehicle-to-vehicle distance, the presence of a vehicle ahead, and the warning message.
- Examples of the illumination or display of the indicator light, warning light or multi-information display are shown below.

Mode	Condition	Multi-information Display	CRUISE 01YBE168P	0150BE35C	Buzzer
Constant Speed Control	Being Controlled	 08LBE67Y	Illuminate	—	—
Vehicle-to-Vehicle Distance Control	Set Standby	 08LBE68Y	Illuminate	—	—
	Under Constant Speed Control (No Vehicle Ahead)	 **Long** **Middle** **Short** 08LBE69Y	Illuminate	—	—
	Under Follow-up Control (Vehicle Ahead)	 **Long** **Middle** **Short** 08LBE70Y	Illuminate	—	—
	Deceleration Control (Vehicle Ahead)	 08LBE71Y Flashes display frame, ahead vehicle and indication between.	Illuminate	—	Sounds Continuously
System Failure	Laser radar sensor is dirty.	 08LBE72Y	Flash	Illuminate	Sounds Once
	Poor Weather Condition	 08LBE73Y	Flash	Illuminate	Sounds Once
	System Check*	 08LBE74Y	Flash	Illuminate	Sounds Once
Beam Axis Adjustment		 08LBE75Y	Flash	—	—

*: When a DTC (Diagnostic Trouble Code) is memorized.

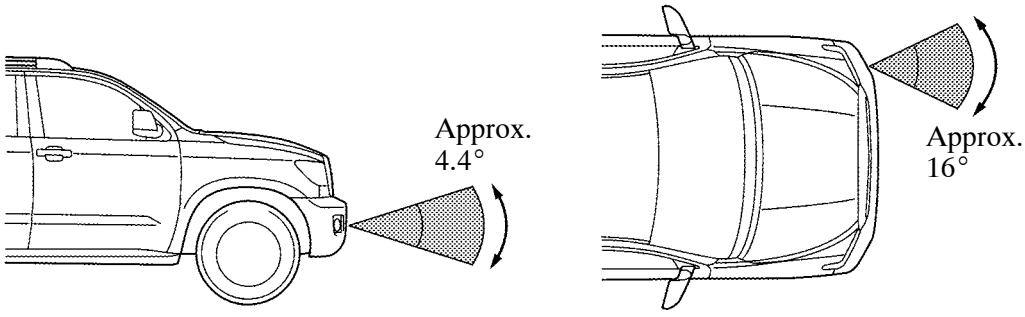
Laser Radar Sensor

The laser radar sensor contains the laser emitting portion, laser receiving portion, and CPU. The laser beams that are output by the laser emitting portion are radiated forward. Then, the laser beams are reflected by the reflectors of the vehicle that is driven ahead. The length of time the reflected beams return to the laser receiving portion is calculated by the CPU. This is to determine the distance to the vehicle ahead and calculate the relative speed. These data are then transmitted to the distance control ECU.
This sensor is designed so that it does not react to non-moving objects.



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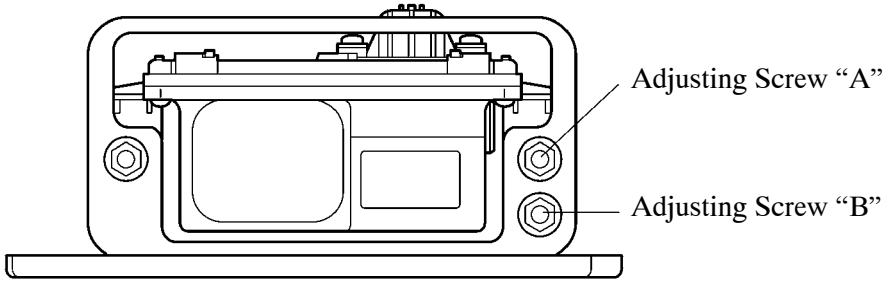
▶ Detection Range ◀



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Service Tip

After a laser radar sensor has been replaced or removed and reinstalled, Techstream must be used to adjust the sensor angle. To ensure the proper precision, the sensor must be adjusted in the horizontal and vertical state. For this reason, the sensor is provided with an area for placing level, as well as the adjusting screws “A” and “B”. For details, see the 2008 Sequoia Repair Manual (Pub. No. RM08L0U).



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6. System Control

General

The control of the dynamic laser cruise control system varies depending on the mode:
A: Constant Speed Control Mode.
B: Vehicle-to-vehicle Distance Control Mode.

Control	Outline	Mode	
		A	B
Constant Speed Control [See page BE-183]	The ECM compares the actual vehicle speed and the set speed and if the vehicle speed is higher than the set speed, it uses the throttle control motor to decrease the throttle opening. If the actual vehicle speed is lower than the set speed, it uses the throttle control motor to increase the throttle opening.	○	○
Deceleration Control [See page BE-184]	Effects throttle control and brake control in order to decelerate the vehicle so that the vehicle-to-vehicle distance between the driver's own vehicle and the vehicle ahead equals the set distance.	—	○
Follow-up Control [See page BE-185]	After effecting deceleration control, the vehicle follows the vehicle ahead in order to maintain the proper vehicle-to-vehicle distance in accordance with the vehicle speed.	—	○
Acceleration Control [See page BE-186]	Accelerates the vehicle in order to attain the set speed if the vehicle ahead or the driver's own vehicle has changed lanes.	—	○
Set Control	While this system fulfils the following conditions, and the cruise control switch is pressed to the SET/– side and released when the main switch on the cruise control switch has been pressed to turn the system ON, the ECM stores the vehicle speed and maintains the vehicle constantly at that speed. ● The shift lever is in D position ● The shift lever is shifted in the S mode, and shift range is 4th, 5th or 6th*.	○	○
	The vehicle is running within the following range: ● U.S.A.: About 27 to 125 mph ● Canada: About 45 to 200 km/h	○	—
	The vehicle is running within the following range: ● U.S.A.: About 27 to 85 mph ● Canada: About 45 to 135 km/h	—	○
Low Speed Limit Control	The low speed limit is the lowest speed that cruise control can be set at and it is designed to be approx. "40 km/h (25 mph)". The cruise control cannot be set below that speed. If the vehicle speed drops below that speed while running in the cruise control, the cruise control will be cancelled automatically. However, the set speed in the memory is kept.	○	○
Coast Control	While the cruise control switch is held to the SET/– side, the vehicle speed and the vehicle setting speed changes as follows, according to the mode:	○	○
	● The vehicle decelerates constantly. ● The set speed changes to the speed at which the switch was turned OFF.	○	—
	● The set speed decreases in increments 5 km/h or 5 mph. [Example: 103 → 100 → 95 km/h, 62 → 60 → 55 mph] ● The vehicle decelerates rapidly due to ETCS-i.	—	○

*: 3UR-FE Engine Model

(Continued)

Control	Outline	Mode	
		A	B
Tap-down Control	When the cruise control switch is pushed momentarily (approx. 0.6 sec) to the SET/– side, the vehicle speed and the set speed change as follows, according to the mode: ● The vehicle will decelerate in increments of approximately 1.6 km/h (1 mph) for each time the switch was pressed. ● However, if the difference between the actual vehicle speed and the set speed is greater than 5 km/h (3 mph), the set speed will change to the speed at which the vehicle was being driven at the time the switch was operated.	○	—
Accelerator Control	When the cruise control switch is pushed to the RES/+ side and held, the vehicle speed and the vehicle setting speed change as follows, according to the mode:	○	○
	● The vehicle will accelerate constantly. ● The set speed changes to the speed at which the switch was turned OFF.	○	—
	● The set speed increases in increments 5 km/h or 5 mph. [Example: 93 → 95 → 100 km/h, 52 → 55 → 60 mph] ● The vehicle will accelerate to the speed that is set at the time the switch is released. However, only the set speed will change during follow-up control.	—	○
Resume Control	When the driver pushes the cruise control switch to the RES/+ side after the vehicle speed has exceeded the low speed limit, the cruise control resumes operation to reach the vehicle speed that was set at the time the driver canceled cruise control.	○	○
	Even if the vehicle speed drops below the low speed limit, resume can be performed when the vehicle speed exceeds the low speed limit.	○	○
	If the vehicle ahead changes driving lanes during follow-up control, the vehicle speed is gradually increased to the set speed. At this time, the vehicle speed can be increased promptly by pushing the cruise control switch to the RES/+ side.	—	○
Tap-up Control	When the cruise control switch is pushed momentarily (approx. 0.6 sec.) to the RES/+ side, the vehicle speed and the set speed change as follows. ● The vehicle will accelerate in increments of approx. 1.6 km/h (1 mph) for each time the switch was pressed. ● However, if the difference between the actual vehicle speed and the set speed is greater than 5 km/h (3 mph), the set speed changes to the speed as which the vehicle was being driven at the time the switch was operated.	○	—
Shift Down Control	When the vehicle is cruising uphill, shift-down control may be performed by the ECT (Electronic Control Transmission). The ECM shifts up the gear when the ECM judges the end of cruising uphill based on the throttle valve angle.	○	○

(Continued)

Control	Outline	Mode	
		A	B
Manual Cancel Control	If any of the following signals is sent to the ECM, the cruise control is cancelled accordingly. ● A stop light switch ON signal (The brake pedal is depressed.) ● A signal to indicate that the shift lever is moved from D to N ● A signal to indicate that the 1st, 2nd or 3rd range is selected in the S mode position ● A CANCEL switch ON signal (The cruise control switch is moved to the CANCEL side.) ● A main switch OFF signal ● A VSC operation signal	○	○
Automatic Cancel Control [See page BE-187]	When an automatic cancel signal is sent to the ECM, the cruise control operation is canceled. At this time, the warning and the control resumption condition vary according to the cancel signal.	○	○
Mode Switching Control	The following operations switch the modes: 1) Main switch on the cruise control switch is ON. (Starts in the vehicle-to-vehicle distance control mode) 2) Cruise control switch is held to the MODE side. (Approx. 1 second or more) If the switch is pushed to any other side before switching modes, switch the cruise control system OFF; then, perform steps 1) and 2) again.	○	○
Diagnosis [See page BE-188]	If a malfunction occurs in the dynamic laser cruise control system during cruise control operation, the ECM cancels cruise control and diagnoses and memorizes the faults related to the malfunction.	○	○

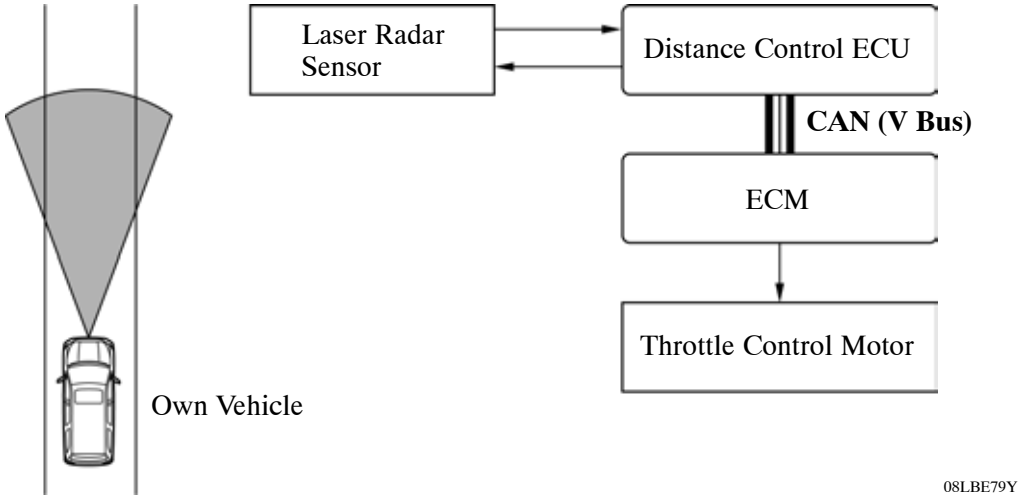
Constant Speed Control

1) General

- In the constant speed control mode, the constant speed control is effected by the ECM.
- In the vehicle-to-vehicle distance control mode, the constant speed control is effected by the laser radar sensor and distance control ECU.

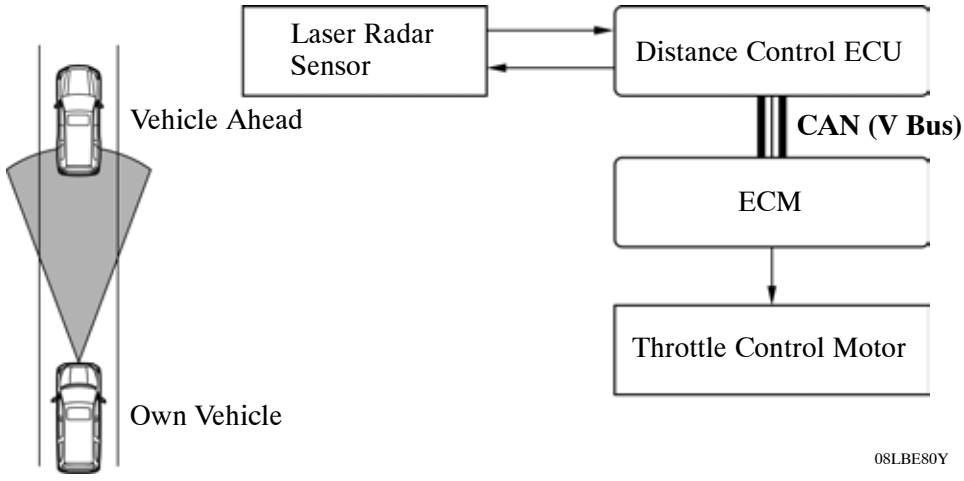
2) Constant Speed Control in Vehicle-to-vehicle Distance Control Mode

The laser radar sensor transmits the information about the vehicle ahead to the distance control ECU. The distance control ECU transmits a laser radar sensor operation signal to the ECM. The ECM compares the set speed and the actual vehicle speed, and effects constant speed control by regulating the throttle control in order to attain the set speed.

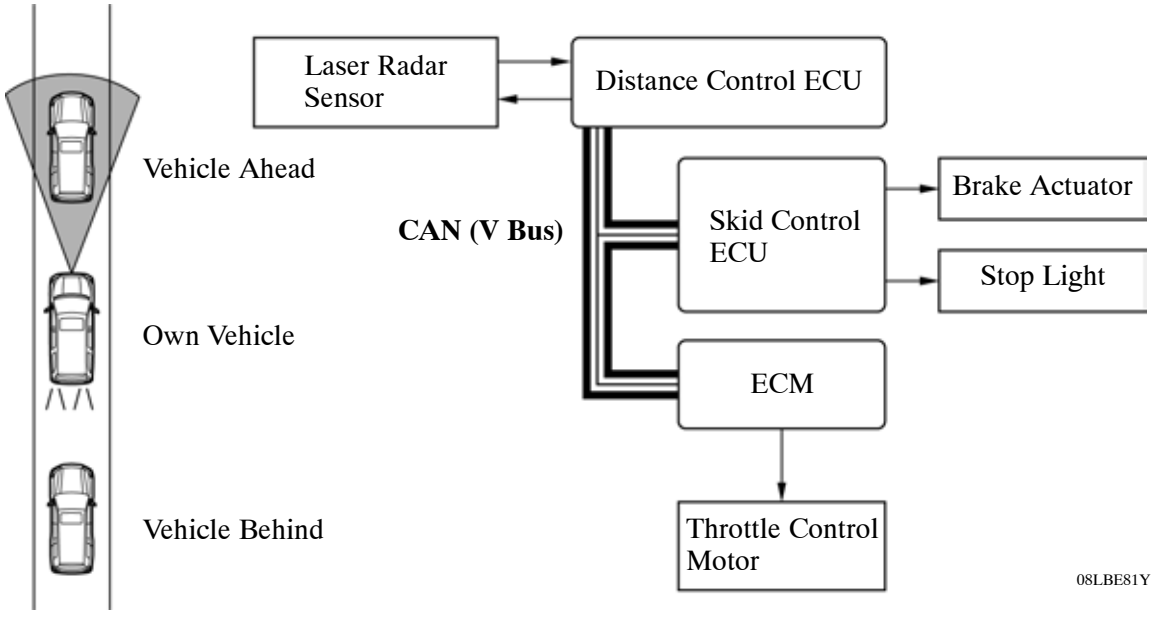


Deceleration Control

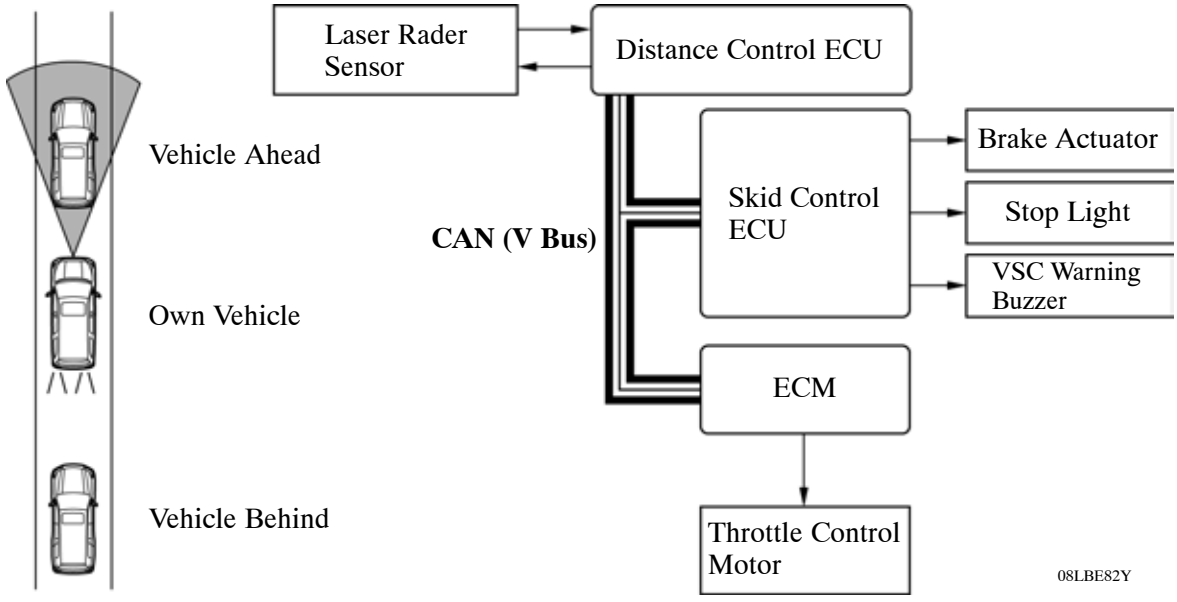
- The distance control ECU calculates the target deceleration rate in accordance with signals from the laser radar sensor, and transmits a deceleration request signal to the ECM. Upon receiving this signal, the ECM closes the throttle valve in order to cause the vehicle to decelerate.
- This control is not effected in the presence of a parked vehicle or object, or below the settable vehicle speed range.



- If distance control ECU determines that further deceleration is necessary, it transmits a brake request signal to the ECM. Upon receiving this signal, the ECM transmits a brake request signal to skid control ECU. The skid control ECU then controls the brake actuator to apply the brakes.
- At this time, if the deceleration rate is higher than a predetermined value, the skid control ECU outputs a stop light illumination request signal to the stop light control relay, in order to inform anyone who might be following the vehicle.



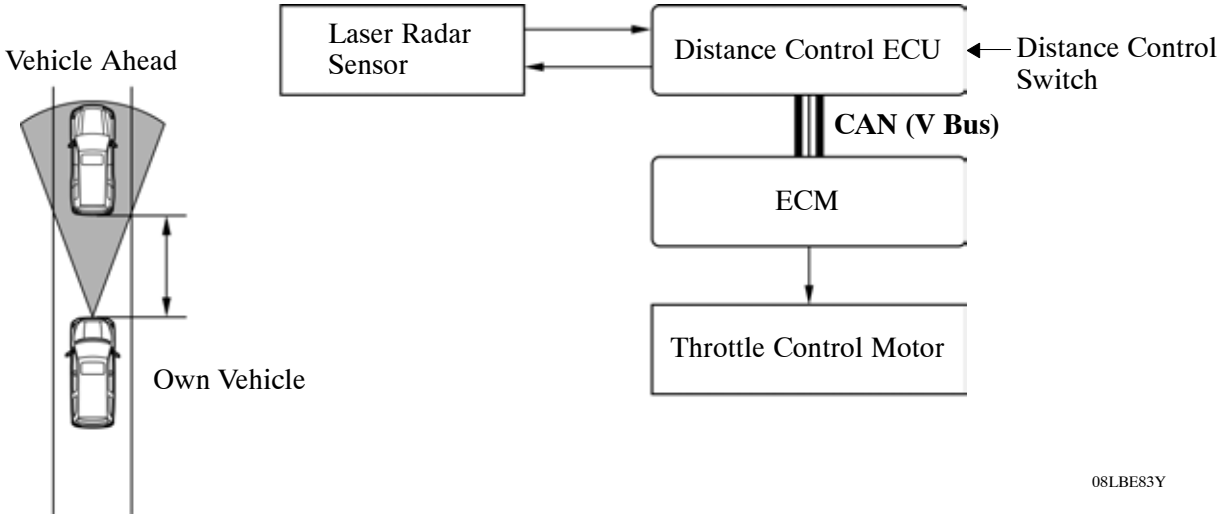
- If further deceleration is necessary after the stop lights are illuminated, the skid control ECU sounds the VSC warning buzzer based on the request signal from the distance control ECU to urge the driver to depress the brake pedal.



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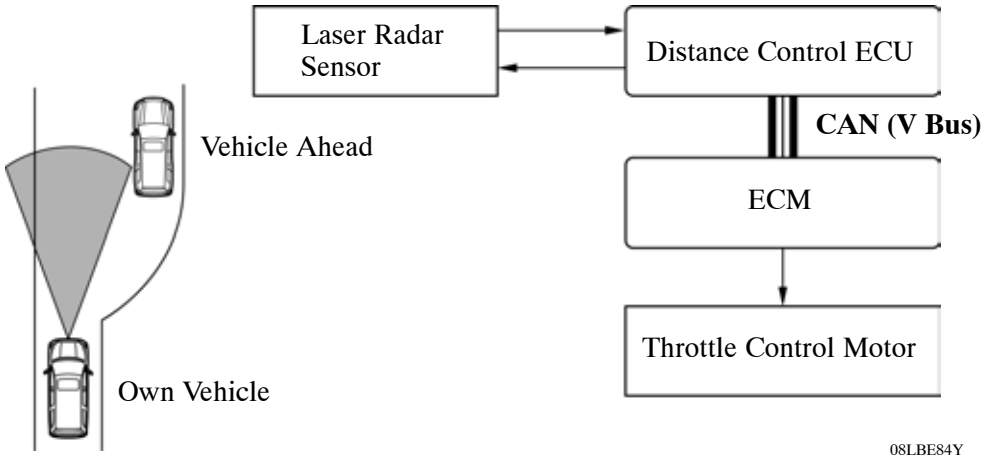
Follow-up Control

- After effecting deceleration control, distance control ECU transmits a request signal to the ECM so that the vehicle can follow the vehicle ahead while maintaining the proper vehicle-to-vehicle distance according to the vehicle speed. Upon receiving this signal, the ECM regulates the throttle in order to effect follow-up control.
- Three stages (long, middle, and short) of vehicle-to-vehicle distance can be selected by operating the distance control switch.



Acceleration Control

If the distance control ECU detects (based on the laser radar sensor) that either the vehicle ahead or own vehicle has changed lanes, an acceleration request signal is transmitted to the ECM in order to attain the set speed. Upon receiving this signal, the ECM regulates the throttle in order to effect acceleration control.



Automatic Cancel Control

If any of the conditions listed below occurs while the vehicle is in cruise control (A: constant speed control mode, B: vehicle-to-vehicle distance control mode), the cruise control will be canceled. Then, the following warning will be issued.

1) Warning message is displayed on the multi-information display.

2) Master warning light illuminates.

3) Buzzer sounds.

4) CRUISE main indicator light flashes.

Mode	Description of Malfunction	Warning
A and B	If any of the conditions listed below occurs, the ECM clears the set speed and cancels the cruise control. ● Malfunction of the vehicle speed signal. ● Malfunction in the ETCS-i. ● An open or short circuit in the stop light switch. The cruise control is prohibited until the conditions are restored or the cruise control system is turned OFF and back ON again using the main switch on the cruise control switch.	1) "CHECK CRUISE SYSTEM" 2) Illuminate 3) Sound Once 4) Flash
	If the condition listed below occurs, the ECM cancels the cruise control while retaining the set speed in its memory. ● The vehicle speed drops below low speed limit [approx. 40 km/h (25 mph)].	1) — 2) — 3) — 4) —
A	If the condition listed below occurs, the ECM cancels the cruise control. ● The vehicle speed drops more than 16 km/h (10 mph) below the set speed.	1) — 2) — 3) — 4) —
B	If any of the conditions listed below occur, the ECM clears the set speed and cancels the cruise control. ● Malfunction of the laser radar sensor. ● Displacement of the axis of the laser radar sensor. ● Malfunction in the dynamic laser cruise control system other than those given above. The cruise control is prohibited until the ignition switch is turned ON again.	1) "CHECK CRUISE SYSTEM" 2) Illuminate 3) Sound Once 4) Flash
	If the condition listed below occurs, the ECM cancels the cruise control while retaining the set speed in its memory. ● The laser radar sensor is dirty. The cruise control is prohibited until the conditions are restored or the main switch on the cruise control switch is turned ON again.	1) "CLEAN RADAR SENSOR" 2) Illuminate 3) Sound Once 4) Flash
	If any of the conditions listed below occur, the ECM cancels the cruise control while retaining the set speed in its memory. ● The wipers operate at HI speed (including AUTO mode). ● The measurement becomes extremely unstable due to poor weather conditions. The cruise control is prohibited until the conditions are remedied or the cruise control system is turned OFF and back ON again using the main switch on the cruise control switch.	1) "CRUISE NOT AVAILABL" 2) Illuminate 3) Sound Once 4) Flash

Diagnosis

If a malfunction occurs in the dynamic laser cruise control system, the ECM actuates the automatic cancel control and blinks the CRUISE main indicator light to inform the driver of a malfunction during cruise control. At this time, the ECM memorizes the malfunction in the form of 5-digit DTCs (Diagnostic Trouble Codes).

- The 5-digit DTCs can be read by connecting a Techstream to the DLC3.

For details, see the 2008 Sequoia Repair Manual (Pub. No. RM08L0U).