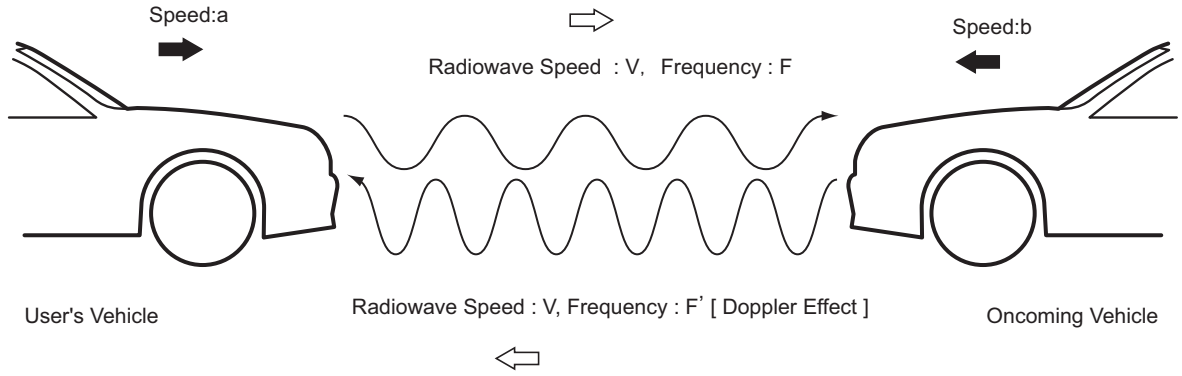
Detection Method for Relative Distance and Relative Speed

- If an object is present within range of the millimeter wave radar sensor, the radar detects the distance to the object, the relative speed, and the direction based on the reflected waves. Based on these pieces of data, the Pre-Crash ECU determines whether a collision is unavoidable.
- The radar uses the angle of the reflected waves to detect the direction to the object, the length of time that elapses after the radiowaves are emitted and the reflected waves return to detect the distance, and the changes in the frequency (the Doppler effect) of the reflected waves to detect the speed of the object.
- Along a curve, the system estimates the radius of the curve based on data provided by the yaw rate sensor and the steering angle sensor, and makes appropriate corrections to the course of travel.



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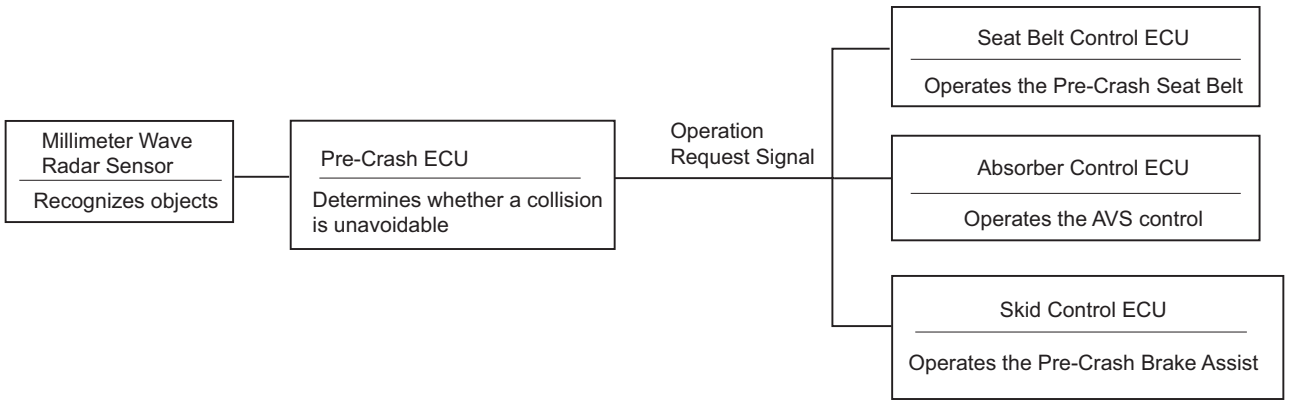
Pre-Crash ECU

● This ECU recognizes an obstacle through the millimeter wave radar sensor, determines whether a collision is unavoidable, and sends an action request signal to the ECUs.



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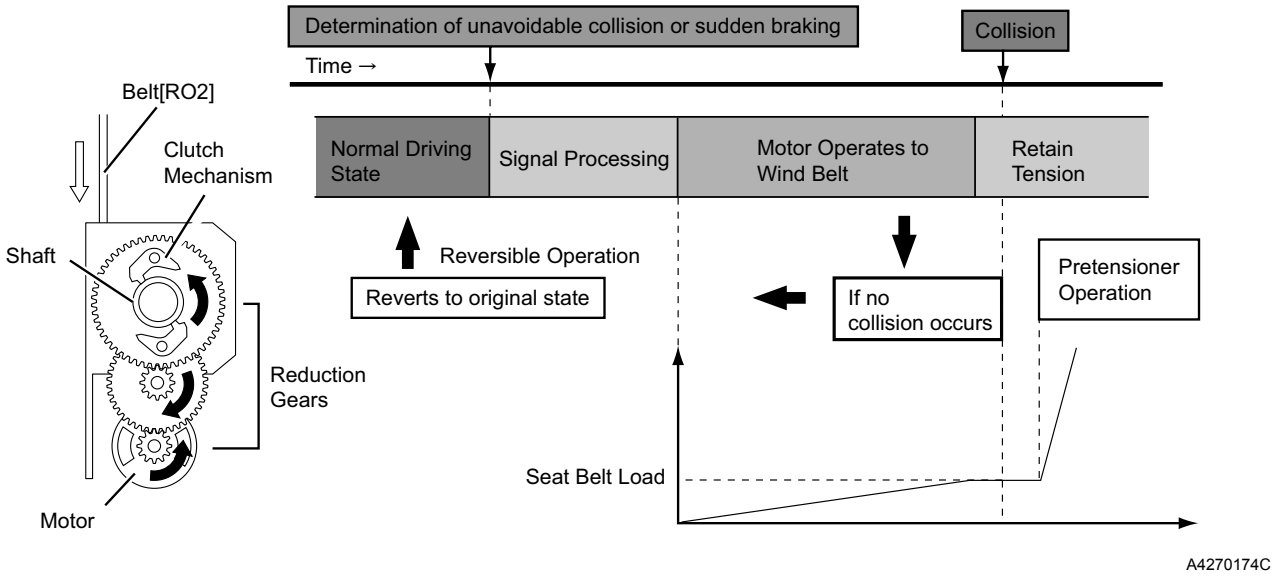
Pre-Crash Seat Belt Operation

- The Pre-Crash ECU determines that a collision is unavoidable.
- The driver suddenly presses on the brake pedal (linked to sudden braking).
- Normally, the clutch mechanism keeps the shaft free.
- Upon receiving a current, the motor transmits a rotational movement to the clutch via the reduction gears. The clutch becomes engaged and winds the belt[RO1].
- To release the winding of the belt after the operation, the motor performs a winding movement again.



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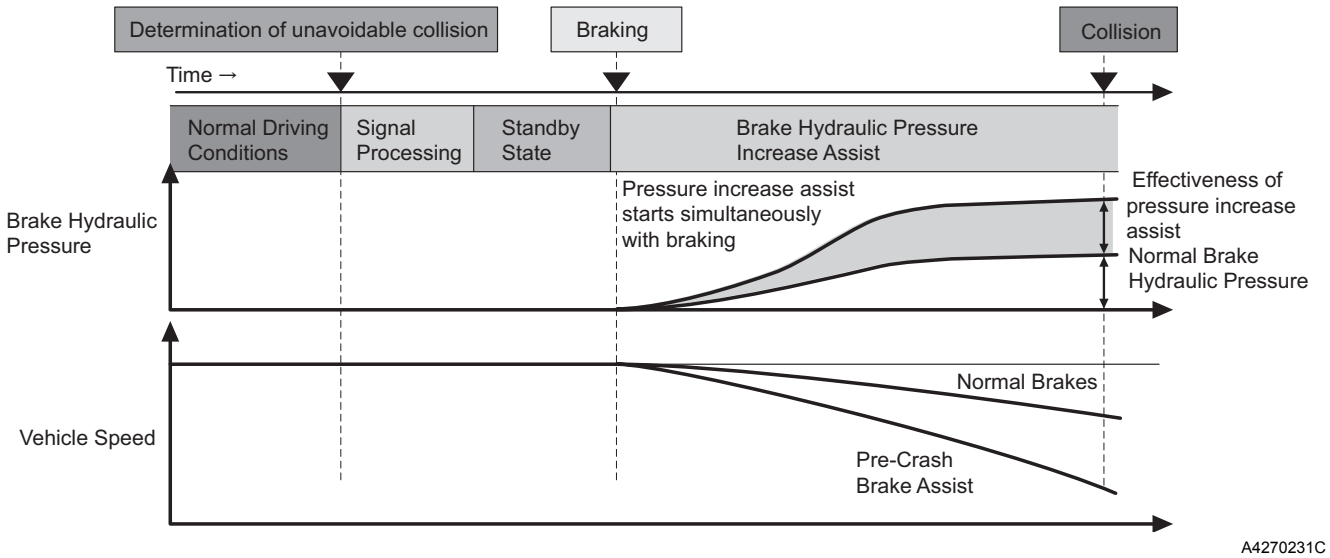
Pre-Crash Brake Assist Control

- When the Pre-Crash ECU determines that a collision is unavoidable and the driver presses on the brake pedal, this control provides an assist to increase the pressure.



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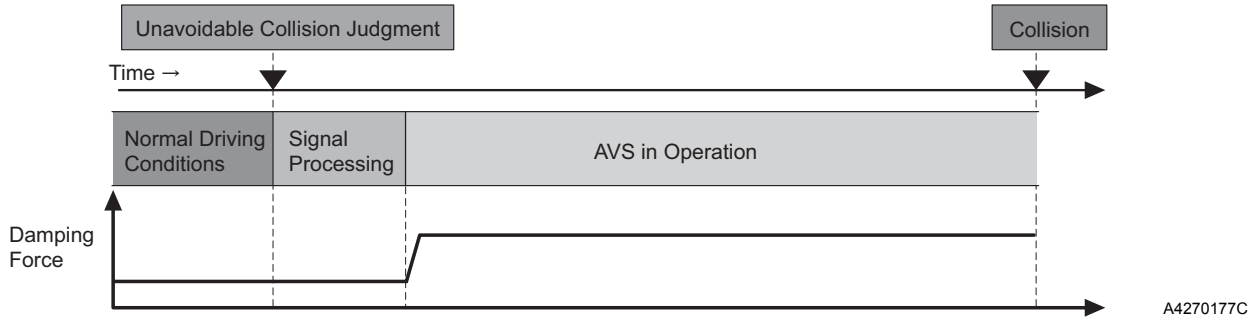
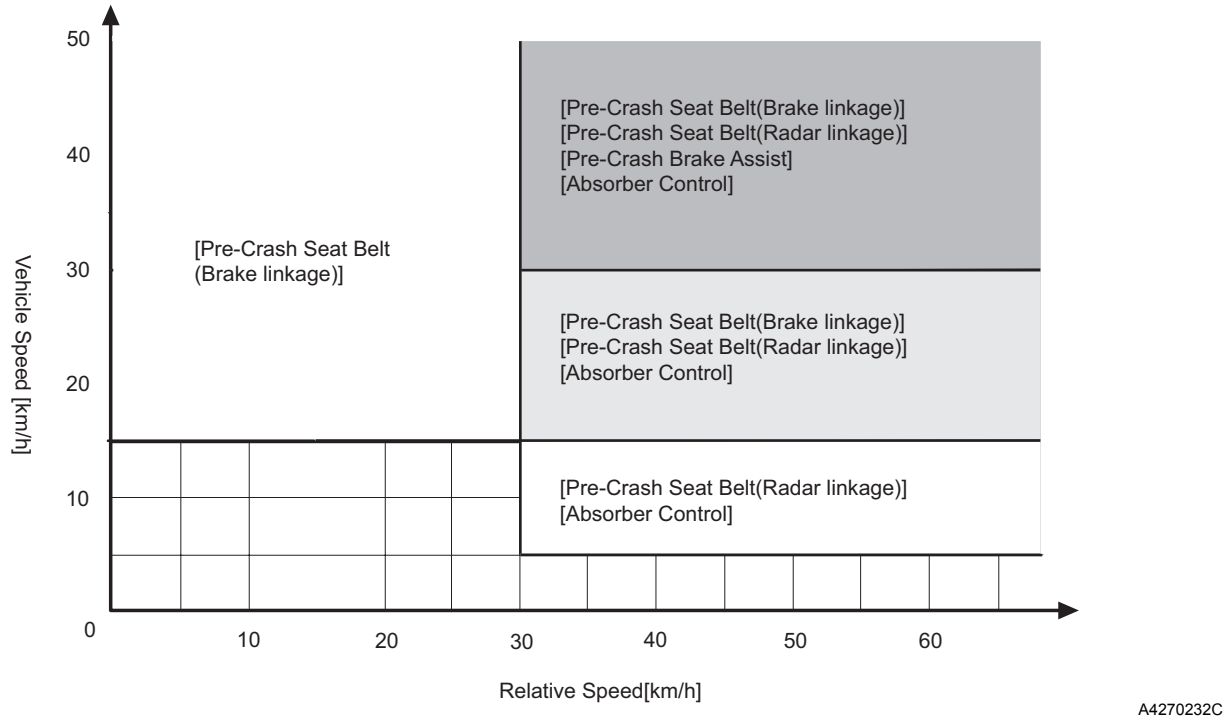
AVS Control

- This control operates if the millimeter wave radar sensor detects an object of collision, and determines that a collision is unavoidable.
- It reverts to the original state if no collision occurs.



The Control Area of Each Control

- The operation domain of each control of Pre-Crash Safety System is as follows.



Non-Operating Conditions

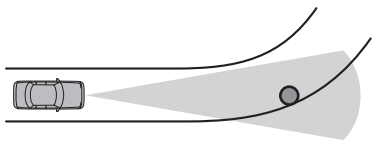
• The conditions of not operating are as follows.

The conditions of not operating

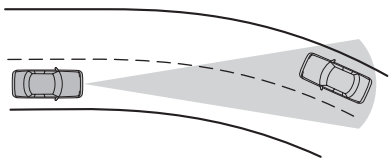
(1)Pre-Crash	The relative speed is below approximately 30 km/h (or pre-crash brake below 15 km/h)
	The driven vehicle's speed is below 15 km/h
	IG is at OFF and IG is at ACC
	The multi-information display indicates "CHECK PCS" or "PCS DISABLED NOW"
	The vehicle collides with an object outside of the detection area of the millimeter wave radar sensor (side collision or rear-end collision)
	The millimeter wave radar sensor is unable to detect an item as an object of collision
	(items that cannot be detected: plastic items such as pylons)
	(items that cannot be detected in a stable manner: people, motorcycles, trees, animals, snow walls)
(2)Pre-Crash Seat Belt	When the foregoing (1) applies
	The seat belt is unbuckled
(3)Pre-Crash Brake Assist	When the foregoing (1) applies
	The driven vehicle's speed is below 30 km/h
	The driver did not step on the brake pedal

Other Operation Cases

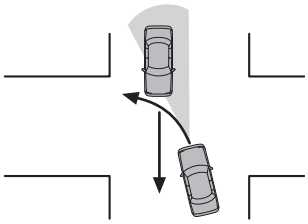
• In the situations described below, the millimeter wave radar sensor a detection object, causing the Pre-Crash Safety System to operate, even if there is no possibility of a collision. This is not a malfunction.



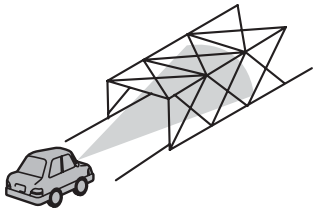
Roadside object at the beginning of a turn (guard rail, street light, signboard, etc.)



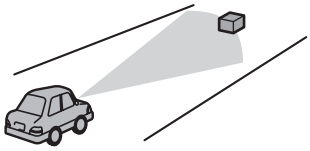
Passing an oncoming vehicle around a turn



Oncoming vehicle during a left turn



Narrow iron bridge



Metal object on the road surface (iron plate used for covering road construction, mesh for covering gutter, manhole, etc.)

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