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# Acura's SH-AWD System: AWD Performance Leader



by Pete Huscher  
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Acura RL SH-AWD

In previous issues of *Keep Those Trannies Rolling*, we introduced you to some of the all wheel drive systems offered by Ford, General Motors and Chrysler. In this issue we're looking across the Pacific to introduce Acura's SH-AWD system.

The Acura SH-AWD system, short for "Super Handling-All Wheel Drive," is a fulltime, fully automatic, all-wheel drive, traction and handling control system.

This system was designed and engineered by Honda Motor Company and was first introduced in North America in the second generation 2005 Acura RL. The SH-AWD system has since been added to other Acura models such as the RDX, the MDX, the TL, and for 2010, Acura's new ZDX.

Honda describes the SH-AWD as a system that "provides cornering performance that responds to the driver's needs and at the same time provides outstanding vehicle stability." To the regular guy on the street, this means power and performance in an all-wheel drive vehicle, which is something that had been sadly lacking.

## What Makes Acura's SH-AWD Different?

What makes Acura's SH-AWD system so different from the rest of the pack? Acura's SH-AWD, unlike any other AWD system in the world today, has the ability to control front-to-rear torque distribution and independently control torque distribution to each individual rear wheel as needed, depending on driving conditions. This ability to control the torque to each individual rear wheel is what makes the SH-AWD



Acura MDX SH-AWD

system different from all the rest.

## Components of the SH-AWD System

The SH-AWD system consists of a front wheel drive engine and transmission assembly with a torque transfer unit attached to the side of the transmission, a driveshaft, an electronically controlled differential, an acceleration device (on RL models only) and a SH-AWD control module. Let's take a brief look at each of these components.

- **Torque Transfer Unit:** The torque transfer unit or transfer case is mounted to the side of the transmission. The transfer unit is purely mechanical; not computer controlled. The purpose of the torque transfer unit is to transfer

torque from the transmission through the driveshaft to the rear differential.

- **Electronically Controlled Differential:** The electronically controlled rear differential (figure 1) consists of a conventional hypoid ring and gearset, an acceleration device (on RL models only), and a direct, electromagnetically controlled clutch system. This clutch system consists of a set of coils, planetary gearsets, and electromagnetically controlled multiplate clutches. The electronically controlled differential is controlled by the SH-AWD control module, and, unlike any car today, is capable of diverting anywhere from 0%–100% of the driving torque to either rear wheel.

- **Acceleration Device:** The



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acceleration device (on RL models only) is bolted to the front of the electronically controlled differential. It consists of a control solenoid, a high clutch, a one-way clutch, a planetary gearset, and an oil pump. The acceleration device allows the rear wheels to be variably overdriven by as much as 5.7% faster than the front wheels, depending on driving conditions.

• **SH-AWD Control Module:** The SH-AWD control module controls the AWD system. It uses information from several different systems to control AWD operation.

## How the SH-AWD System Operates

The SH-AWD system is controlled by the SH-AWD control module. The SH-AWD control module receives information through the CAN system from these sources (figure 2):

- Powertrain Control Module (PCM)
- Antilock Brake System (ABS)
- Vehicle Stability Assist System (VSA)
- Electronic Brake Force Distribution Module (EBFD)
- Throttle Control System
- Yaw Angle Sensor

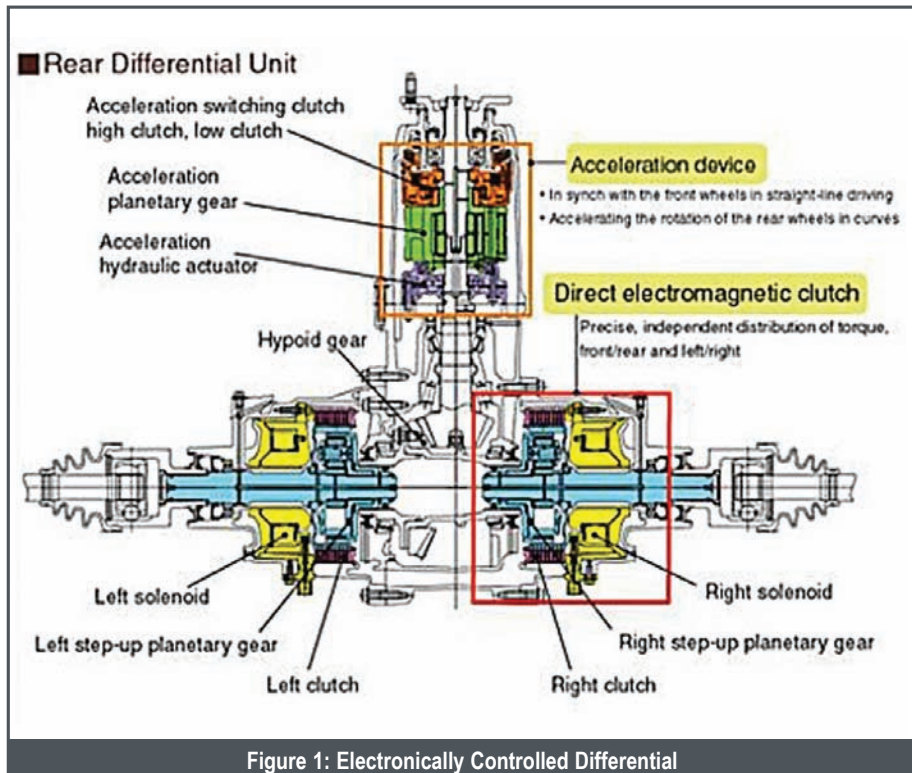


Figure 1: Electronically Controlled Differential

- Speed Sensors
- Steering Angle Sensor
- Lateral G-Force Sensor

The SH-AWD control module uses this information to control the operation of the AWD system. If the SH-AWD

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## ■ System Overview

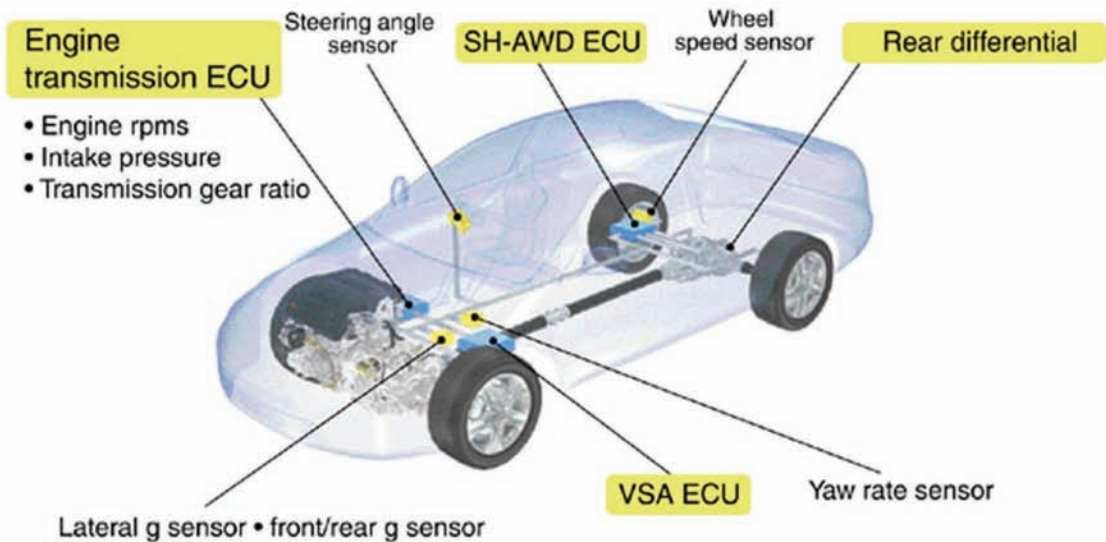


Figure 2: SH-AWD System Overview

control module detects a problem in the system, it turns the SH-AWD indicator lamp on and disables the SH-AWD differential. The vehicle defaults to front wheel drive only and the PCM reduces available engine torque until

the SH-AWD fault has been corrected.

The SH-AWD control module uses two types of programs to control the AWD system:

1. **Driving Force Control:** The driving force control program allows

the SH-AWD control module to distribute torque to each wheel based on the driver's inputs. It distributes torque to the front and rear wheels based on the throttle opening and the available engine torque. When turning, torque is

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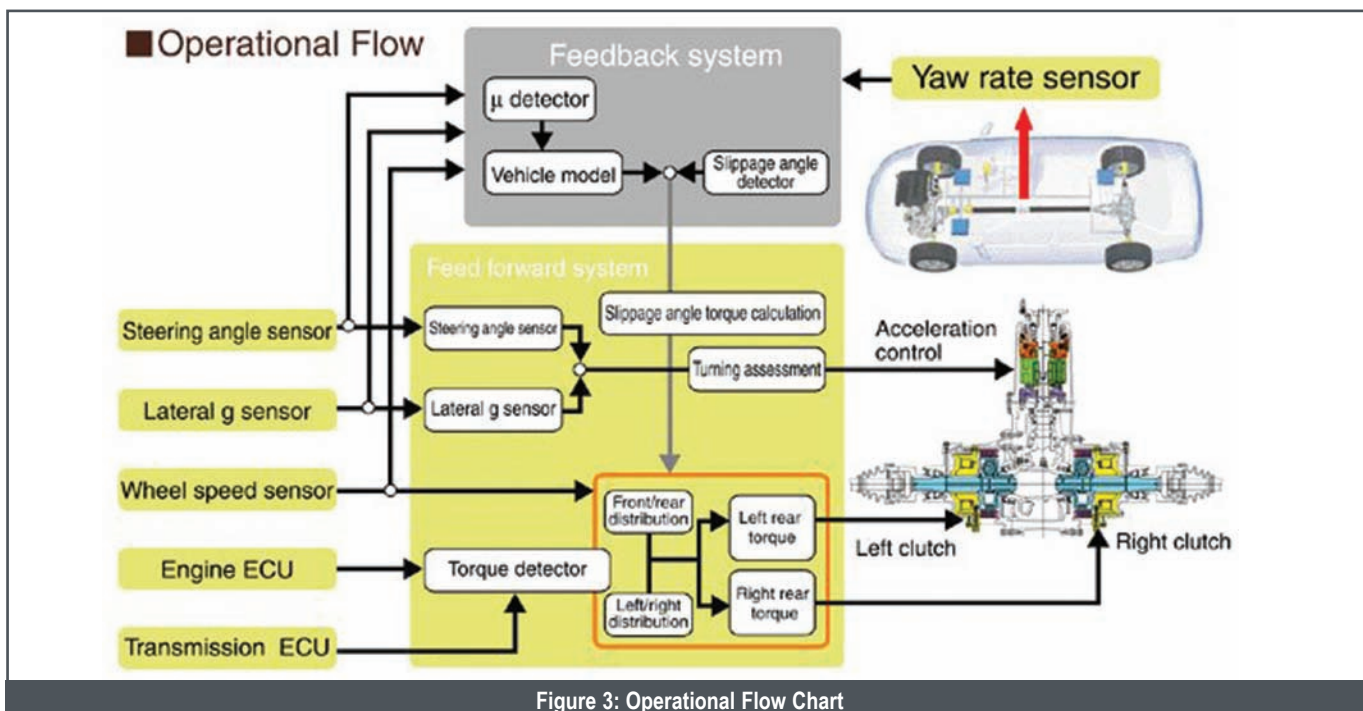


Figure 3: Operational Flow Chart

applied to the rear wheels independently, based on the lateral G-force input and the direction of the turn. This helps steer the vehicle through the turn.

2. Feedback Control: The feedback control program uses inputs to identify low traction conditions. In low

traction conditions, the SH-AWD control module distributes torque to the rear wheels as needed to provide optimum traction.

The SH-AWD control module controls the AWD system by adjusting the amount of torque distributed to

the rear wheels. The SH-AWD control module sends a constantly varying signal to the electronically controlled differential main coils, which engage the electromagnetic clutches in the rear differential. By constantly varying the signal to the electromagnetic clutches, the SH-AWD module is capable of controlling the amount of torque being delivered to each rear wheel (figure 3).



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## Diagnosing Acura's SH-AWD System

Diagnosing Acura's SH-AWD system is pretty straightforward. When the SH-AWD control module detects a problem, it lights the SH-AWD indicator light, sets a DTC, commands the AWD system to front wheel drive operation only, and informs the PCM to reduce engine torque until the fault in the SH-AWD system has been corrected.

The SH-AWD control module may also light the SH-AWD indicator light for non-AWD related issues, including:

- Using high-powered wireless devices in the vehicle (such as CB or Ham radio).
- Slipping or spinning the rear wheels while the vehicle is stuck in sand, mud or snow.
- System voltage drops below 8 volts or rises above 16 volts.

During these situations, the SH-AWD indicator light will stay on

## Diagnostic Trouble Code Chart

DTC	SH-AWD Indicator Light	Code Description	DTC	SH-AWD Indicator Light	Code Description (continued)
12-1	ON	Lateral/Longitudinal Acceleration Sensor Malfunction	44-50	ON	SH-AWD Control Unit Power Supply Voltage Low
12-2	ON	Lateral/Longitudinal Acceleration Sensor Malfunction	46-1	ON	SH-AWD Control Unit Internal Power Supply (open/short)
12-3	ON	Lateral/Longitudinal Acceleration Sensor Malfunction	52-3	ON	Left Clutch Electromagnetic Coil Current Malfunction
14-1	ON	Lateral/Longitudinal Acceleration Sensor Neutral Position	53-1	ON	Left Clutch Electromagnetic Coil (open)
14-2	ON	Lateral/Longitudinal Acceleration Sensor Neutral Position	53-2	ON	Left Clutch Electromagnetic Coil (short)
16-1	ON	Steering Angle Sensor Signal	53-3	ON	Left Clutch Electromagnetic Coil (open)
19-1	ON	Steering Angle Sensor Circuit (open)	53-4	ON	Left Clutch Electromagnetic Coil (short)
19-2	ON	Steering Angle Sensor Circuit (short)	56-3	ON	Right Clutch Electromagnetic Coil Current Malfunction
19-3	ON	Steering Angle sensor Malfunction	57-1	ON	Right Clutch Electromagnetic Coil (open)
19-4	ON	Steering Angle Sensor Circuit	57-2	ON	Right Clutch Electromagnetic Coil (short)
27-1	ON	Hypoid Gear Speed Sensor (open or short)	57-3	ON	Right Clutch Electromagnetic Coil (open)
27-2	ON	Hypoid Gear Speed Sensor Malfunction	57-4	ON	Right Clutch Electromagnetic Coil (short)
33-1	ON	YAW Rate Sensor Malfunction	59-1	ON	SH-AWD Control Unit Power Supply Monitor Circuit
33-2	ON	YAW Rate Sensor Malfunction	61-1	ON	Shift solenoid Valve (open)
33-3	ON	YAW Rate Sensor Malfunction	61-2	ON	Shift Solenoid valve (short)
35-4	ON	YAW Rate Sensor Neutral Position	74-1	ON	One Way Clutch Malfunction
35-2	ON	YAW Rate Sensor Neutral Position	75-1	ON	Acceleration Device Malfunction (stuck off)
41-1	ON	Loss of Communication with PCM	75-2	ON	Acceleration Device Malfunction (stuck on)
41-2	ON	Loss of Communication with VSA Control Unit	76-1	ON	Rear Differential Fluid Overheats
41-3	ON	Loss of Communication with Gauge Assembly	77-1	ON	Functional Abnormalities in Emission or Auto Trans Sys.
42-1	ON	Differential Oil Temperature Sensor (open)	77-2	ON	Functional Abnormalities in VSA System
42-2	ON	Differential Oil Temperature Sensor (short)	77-3	ON	Functional Abnormalities in Gauge Assembly
43-1	ON	Differential Oil Temperature Sensor Circuit	78-XX	ON	SH-AWD Control Unit Self Diagnostic Malfunction
44-11	ON	SH-AWD Control Unit	81-1	ON	Left Search Coil Sensor Malfunction
44-12	ON	SH-AWD Relay Stuck On	81-2	ON	Left Search Coil Sensor (open or short)
44-21	ON	SH-AWD Control Unit	81-3	ON	Left Search Coil Sensor Magnetic Flux
44-31	ON	SH-AWD Relay Stuck Off	82-1	ON	Right Search Coil Sensor Malfunction
44-32	ON	SH-AWD Control Unit Power Supply Stuck On	82-2	ON	Right Search Coil Sensor (open or short)
44-41	ON	Power Supply Stuck Off	82-3	ON	Right Search Coil Sensor Magnetic Flux

**Figure 4: SH-AWD Module Code List**

until you turn the ignition key off; no DTCs will set for these conditions.

### Checking for Diagnostic Codes

When the SH-AWD Control Module detects a problem, the SH-AWD control module will light the SH-AWD indicator light. The MIL (malfunction indicator lamp), the D5 indicator lamp, and the ABS lamp may also light.

Before accessing the SH-AWD control module to retrieve codes, check

for codes in the PCM, Antilock Brake System and the VSA system. Codes in any of these systems must be repaired before attempting to diagnose the SH-AWD system. Codes set in these systems will interfere with SH-AWD system operation.

To access the SH-AWD control module:

- Connect your HDS (Honda Scan Tool) or compatible scan tool to the DLC behind the driver's lower dash panel.

- Turn the Key on, Engine Off.
- Follow the prompts on the scan tool display to access the SH-AWD Control Module.

Once you've gained access to the SH-AWD control module, record and clear the codes listed, test drive the vehicle several times in AWD mode, and recheck for codes. If an AWD system code resets, diagnose and repair the code or codes as needed.

If no codes return, there may be

an intermittent problem in the AWD circuits. Be sure to check all connections within the SH-AWD system. After making any repairs it's always a good idea to update the SH-AWD control module with the latest programming.

After replacing the differential clutch sets, steering angle sensor, or yaw rate sensor, you'll need to perform a memorization procedure for each of these sensors before the SH-AWD system will function properly.

If you replace the SH-AWD control module, you'll need to initialize the new control module with an HDS or compatible scan tool.

## Types of Codes

SH-AWD Control Module codes are usually three- or four-digit codes. The SH-AWD control module codes are broken up into 19 different categories (Refer to figure 4 for a complete code list).

Codes beginning with:

- 12 or 14 indicate a problem in the lateral/longitudinal acceleration sensor circuit.
- 16 or 19 indicate a problem in the

steering angle sensor circuit.

- 27 indicate a problem in the hypoid gear speed sensor circuit.
- 33 or 35 indicate a problem in the yaw rate sensor circuit.
- 41 indicate a loss of communication with another module.
- 42 or 43 indicate a differential oil temperature sensor circuit problem.
- 44 indicate a problem with a power or ground circuit to the control module.
- 46 indicate an internal power source failure in the control module.
- 52 or 53 indicate a left clutch electromagnetic coil circuit problem.
- 56 or 57 indicate a right clutch electromagnetic coil circuit problem.
- 59 indicate a control unit power supply monitor circuit problem.
- 61 indicate a solenoid valve circuit problem.
- 74 indicate a one-way clutch problem.
- 75 indicate an accelerator device problem.
- 76 indicate the rear differential

fluid is overheating.

- 77 indicate a functional error from the PCM, ABS or VSA systems.
- 78 indicate a control module self-test failure.
- 81 indicate a left search coil circuit problem.
- 82 indicate a right search coil circuit problem.

Diagnosing SH-AWD system codes is usually pretty straightforward: check the wiring, connections, and the specific component for failure. Once you've repaired the problem, you'll have to clear the codes from the SH-AWD system with an HDS or compatible scan tool.

Well, there you have it: an inside look at Acura's Super Handling All-Wheel Drive (SH-AWD) system. With a better understanding of how AWD systems operates, you should have no problem keeping those trannies *and AWD systems* rolling.



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- Delay Reverse
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- Slide 1-2
- 3rd Gear Starts

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