A comprehensive ADAS overview.

- You should be able to:
 - Have a good understanding of what ADAS is.
 - And is not.
 - Discuss the differences between an active and a passive calibration.
 - Be aware of the different sensors used in ADAS.
 Their limitations.

Topics

- What is ADAS?
- Why ADAS?
- ADAS Basics
- How to Begin Calibration & Diagnosis
- Case Studies



Driver Assistance Systems are not New!

Provide a visual, audio or tactile warning only.
 Designed to promote safe driving

- Backup Cameras
- Monitoring Systems
 Blind spot, cross traffic, parking

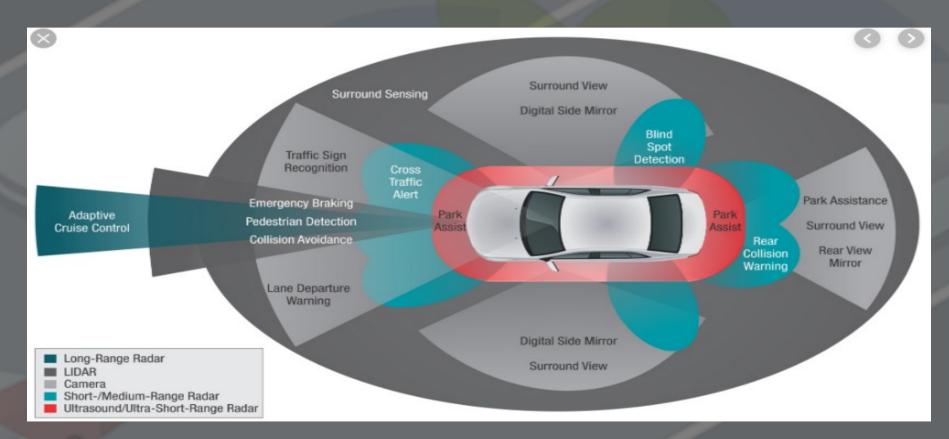
What is ADAS?

- Systems designed to intervene in a limited manner using:
 - Cameras
 - Radar
 - Ultrasonic sensors
 - Lidar
- Examples
 - Lane Keep Assist
 - Automatic Parking
 - Emergency Brake Assist

ADAS is not an autonomous vehicle



Example ADAS Systems





SAE J3016[™] LEVELS OF DRIVING AUTOMATION

	S/E LEVEL 0	S/E LEVEL 1	S/E LEVEL 2	S/E LEVEL 3	SÆ LEVEL 4	S/E LEVEL 5
What does the human in the driver's seat have to do?	You <u>are driving</u> whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You <u>are not</u> driving when these automated driving features are engaged – even if you are seated in "the driver's seat"		
	You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	
	These are driver support features			These are automated driving features		
What do these features do?	These features are limited to providing warnings and momentary assistance	These features provide steering OR brake/ acceleration support to the driver	These features provide steering AND brake/ acceleration support to the driver	These features can drive the vehicle under limited conditions and will not operate unless all required conditions are met		can drive the vehicle under
Example Features	 automatic emergency braking blind spot warning lane departure warning 	 lane centering OR adaptive cruise control 	 lane centering AND adaptive cruise control at the same time 	• traffic jam chauffeur	 local driverless taxi pedals/ steering wheel may or may not be installed 	• same as level 4, but feature can drive everywhere in all conditions

For a more complete description, please download a free copy of SAE J3016: https://www.sae.org/standards/content/J3016 201806/

Why worry about ADAS?

- ADAS systems have an effect on other vehicle systems:
 - Alignment
 - Headlamp, radiator, condenser replacement
 - Windshield etc.
- ADAS is involved with:
 - PCM/TCM
 - EPS (Electronic Power Steering)
 - -ABS



What should you be able to do?

- Read, understand, follow detailed instructions without skipping steps
- Make precision measurements with a metric tape measure
- Utilize a plumb-bob and string
- Create a true 90° triangle
- Draw on the ground with chalk or a marker
- Use a conventional or laser level
- Use most Scan Tool functions



ADAS Basics



- How is the vehicle equipped?
- How is the vehicle supposed to function?
- Read all related procedures to completion before starting any calibration or repair procedures.
- Make sure you have the required tools before beginning.
- Perform vehicle pre and post module scans
- There are many similarities between vehicles from different manufacturers.

Document Everything

- Pre-scan and post-scan report
- Photograph pre-existing damage
- Alignment printout/ screen capture
- Steering angle sensor screen capture
- Odometer/ License plate
- Calibration static/dynamic completion screens

Do you know the secret code?

ADAS Acronym Decoder

ACC ADAS ASDS DOT DSCR	Active Safety Domain Master (Volvo) Department of Transportation	TSA LDW LIDAR LRR MRR
EPS	Electric Power Steering	NULTCA
ESR	Electronically Scanning Radar	NHTSA PCW
FCC	Federal Communications Commission	RACam
HMI	Human Machine Interface	Radar
HMW	Headway Monitoring and Warning	SAE
IEEE	Institute for Electrical and Electronic Engineers	SLI
IFV	Intelligent Forward View	TSR
IIHS	Insurance Institute of Highway Safety	V2I
ISO	International Standards Organization	V2V

	Intelligent Transportation Society of
	America America
	Lane Departure Warning
	Light Imaging Detection and Ranging
	Long Range Radar
	Medium Range Radar
	National Highway Traffic Safety
	Administration
	Pedestrian Collision Warning
	Radar and Camera System (Delphi - 76
1	GHz)
	RAdio Detection And Ranging
	Society of Automotive Engineers
	Speed Limit Indication
	Traffic Sign Recognition
	Vehicle to Infrastructure
	Vehicle to Vehicle

70

The Components

- Radar
 - Short, medium and long range
- Ultrasonic Sensors
- Lidar
- Cameras
- Many Modules
- Network Communication

Radar

Long Range - Detection angle 30° – Distances vary by manufacturer – 100ft to 650ft - Carrier Frequency: 77 GHz "Doppler Principle" Medium/Short Range - Detection angle 90° - Some units have built-in heater element

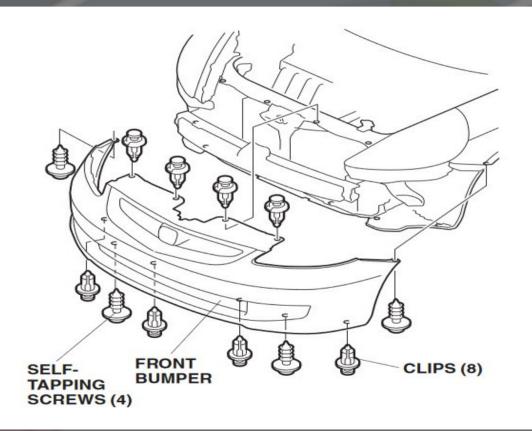
Front Radar



More Front Radar...



Will removing the fascia effect calibration?



Will removing the radiator affect calibration?



Radar Cruise Inoperative



Sensor covered in Ice!



Some Systems are Driver Selectable



Ultrasonic Sensors

- Most commonly used for parking assist
- Operating frequency above human and animal hearing (48 – 58 kHz)
- Close in ranging (1-2 feet)



Rear Sensors



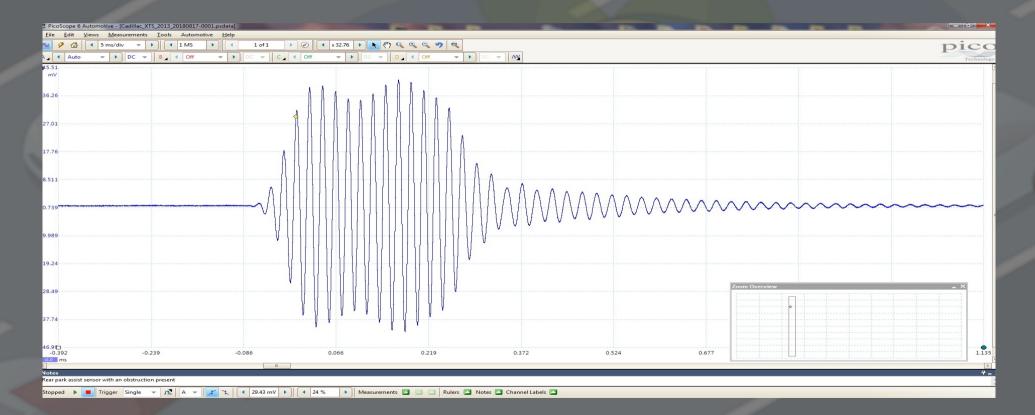
Front Sensors



Pico Ultrasonic Parking Sensor Detector (TA329)



Pico using TA329 detector



Case Study

- 2011 Cadillac Escalade
- Park Assist System Inoperative after collision repair.
- DTC for ultrasonic sensor error
- Issue: Paint thickness on the sensor
 - GM sensors can be repainted once
 - This was a second repair
 - 6 mils too much paint (measured electronically)
 - Sensors were replaced to resolve problem

Cameras



- The use of cameras provides the system the ability to identify objects while extending the distance for the detection of possible hazards.
- The down side of cameras is they do not function as well in poor weather and they may have poor ability to determine distance.

Subaru EyeSight Cameras



Radar & Camera Combination



Camera



Case Study

- 2019 Ram 2500 Collision repair
- Camera would not calibrate after windshield replacement
- OEM windshield resolved issue
- Aftermarket glass quality was concern



Lidar

 A surveying method that measures distance to a target by illuminating the target with laser light and measuring the reflected light with a





Lidar

- Limited use
- Volvo using a radar/LiDAR combination unit
- Unsightly
- Newer solid-state units being developed for future use



LIDAR + RADAR



Modules

- Power
- Ground
- Communication
- Replacement likely
 requires programming

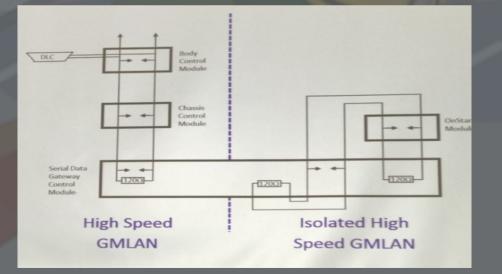


Warm to the Touch



Network Communication

Vehicles have familiar networks for operation
Isolated networks for cyber security



Sensor Fusion

- A sensor may used by multiple systems
- One system will not operate because of a failure in a different system



When is Calibration Needed?

Camera

- Windshield repaired or replaced
- Camera removed or replaced
- DTCs present
- Wheel alignment
- Change in tire size
- Change in ride height

Radar

- Radar removed and replaced
- After a minor collision
- Bumper cover removed and replaced
- Grill removed and replaced
- Wheel Alignment
- DTCs present

Dynamic Calibration

OE Requirements - Good weather conditions – Clear lane markings - Objects on the side of the road - Speed of 32 mph + - Minimal lane changes - Flat road, minimal curves – Minimal traffic



Static Calibration

- OE Requirements

 Controlled environment
 Bright, even lighting
 - No windows
 - No background clutter
 - Flat, level floor
 - Targets, patterns, accessories
 - Calibration procedures and specifications



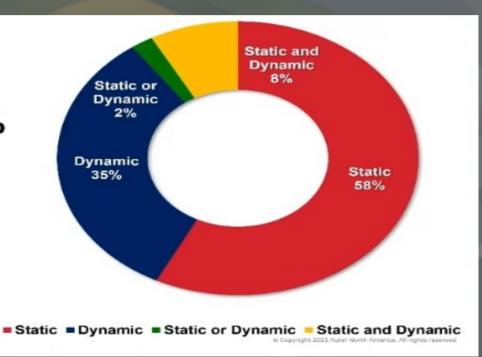
Static & Dynamic Calibration

- Some vehicles require both:
 - Static in a controlled environment
 - Dynamic under specific driving conditions
 - These are two separate calibrations



Calibration Trends

- Static Only 58%
- Dynamic Only 35%
- Static and Dynamic 8%
- Static or Dynamic 2%
- Static 68% 🛧
- Dynamic 45%



AUTEL

OEM and aftermarket Scan Tool are capable of performing ADAS calibrations







Tools: Diagnosis and Service



Tools: Diagnosis and Service



This is a radar reflector

Other Tools You May Need



Vehicle Preconditioning

- All fluids at recommended levels
- Gas tank full
- Tire pressure adjusted to placard levels
- Windshield clean
- Dashboard clean
- No load in vehicle
- All lights off and doors closed
- Connect a battery maintainer
- Front wheels straight ahead
- Rear wheels straight ahead

Sometimes... Calibration is this simple



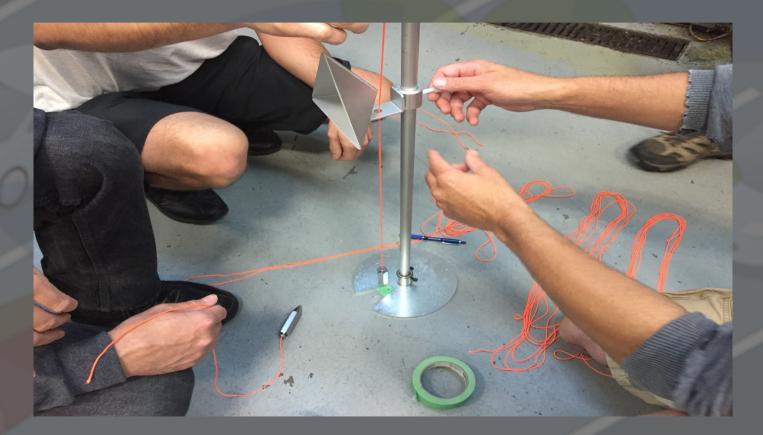
Static Radar Calibration

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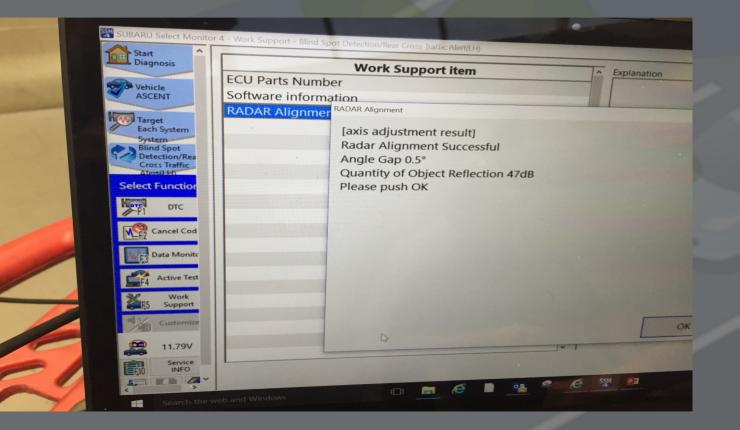
Static Calibration



Static Calibration



Static Calibration Complete



Diagnosis and Service





Begin Diagnosis by Reading DTCs

			6) •		1999	f	energy
							ENERGY STAR
and the second				Create Report		Add Bookmark	k III
Display						DTC Count	DLC Pin
Status	Control Module Nar	ne	Requesting DTCs	Control Module Status			6,14
Control Module	DTC	Symptom Byte	Control Module Communication O	cription bject Detection CAN Bus Off	Symptom Description	Current Current	
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Diagnosis and Service

Module Replacement?
Programming required
Repairs may require static and/or dynamic calibration



2019 Subaru Impreza Alignment

port : 2017-19 🕮

Wheel Alignment Requirements

Vehicles with Front Camera/LDW/LKA (Lane Departure Warning / Lane Keep Assist) require adjustment of the object recognition camera following a wheel alignment. This adjustment requires special tools and procedures.

If using WinAlign software previous to version 7.2.1 (press the ctrl, shift and K1 keys simultaneously to identify the WinAlign version), consult vehicle manufacturer's documentation regarding special tools and procedures prior to performing a wheel alignment.

1

To begin LDW/LKA/Front Camera calibration procedure immediately: Select the Calibrate LDW/LKA icon from the procedure bar.

CAUTION: Do not align vehicles with LDW/LKA without the proper tools and procedures. This could result in an incorrect LDW/LKA alignment.

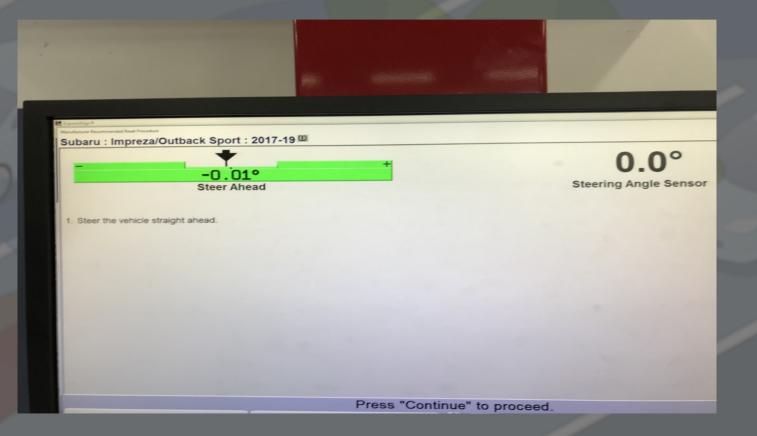
View the illustration,	then press "OK".	
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ustration	Illustration	⊳ OK

Set Rear and Front Toe



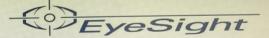


Reset Steering Angle Sensor



EyeSight Specific Screen

LDW Calibration



On models with EyeSight with Lane Keep Assist, perform Lane Keep Assist Learning Value Clear following a wheel alignment adjustment.

Using Subaru Select Monitor:

- 1. On «Start» display, select «Diagnosis».
- 2. On «Vehicle selection» display, input the target vehicle information and select «Confirmed».
- 3. On «Main Menu» display, select «Each System».
- 4. On «Select System» display, select «EyeSight» and select «Enter».
- 5. On «Select Function» display, select «Work Support».
- 6. On «Work Support» display, select «Clear Active Lane Keep System Learning Value».

Subaru Scan Tool

SUBARU Select Monito	or 4 - Vehicle selection		
Start Diagnosis Select Vehicle	Vehicle specifications VIN 4S3GKAD69K3603656	6	
	Vehicle information Vehicle	Vehicle settings IMPREZA / CROSSTREK	
	Model Diagnostic software	19MY SSM4	
A 1218/		4	

Clear Old Data

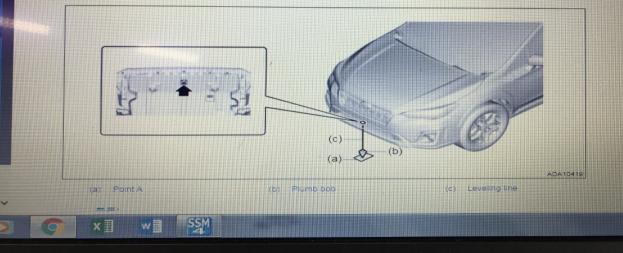
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Service Information

- (3) The inflation pressure of tires is correct.
- (4) The vehicle does not have load.
- (5) The front wheels are directed to the straight ahead position, when the steering wheel is set to the center position. 参考:

When the front wheels are not directed to the straight ahead position, adjust the alignment. (20) FRONT SUSPENSION 参照のこと。

- 2. Prepare the Subaru Select Monitor, measure, plumb bob, leveling line and RANDOM CHART (ST).
 - **Preparation tool:**
 - ST: RANDOM CHART (87599VA000)
- 3. Place the vehicle on a level surface, where approximately 5 m (16.41 ft) space can be secured in front of the vehicle.
- 4. Suspend the plumb bob with leveling line from front center position of vehicle (center clip of under cover), and mark the position where t (Point A)



Locating Vehicle Centerline



Transferring Wheel Centerline Measurements



Place Target



Static Calibration Success

	Work Support item
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lear adjustment valu	Accuracy rate 98% OK!
	Camera inspection has been completed normally.
	To save and apply adjustment, inspection results, turn OFF ignition SW more than 5 seconds.
	more than 5 seconds.
	This screen may not include
	"turn off the ignition",
	but be sure to do it anyway.
	(The vehicle will not save
and the second second second	the new values if you forget.)
	ОК

Dynamic Calibration Test Drive

 Drive the vehicle on street that has lane markings. Make sure the calibration completed with no errors.



Calibration Summary

- Follow instructions!!!
- Take your time.
- Be careful with your measurements

What is likely to occur

Two different ADAS Technicians
 – Diagnostician ("A" Tech)
 – Calibration Specialist (Apprentice)

The End.

There is a home work on Brightspace.
Introduction to ADAS.
Please refer to Brightspace for when due.

