Electronic Throttle Control System-intelligence (ETCS-i)

- Powerpoint presentation of the ETCS-i
- Explains the operation and advantages over mechanical-linked throttle control (e.g. emissions, throttle control)
- Explains the failsafe mechanisms of ETCS-i

Electronic **T**hrottle **C**ontrol
System - **i**ntelligence

ETCS-i

AGENDA

1. **Introduction**
2. **ETCS-i control modes.**
3. **Types of ETCS-I.**
4. **Link type system operation.**
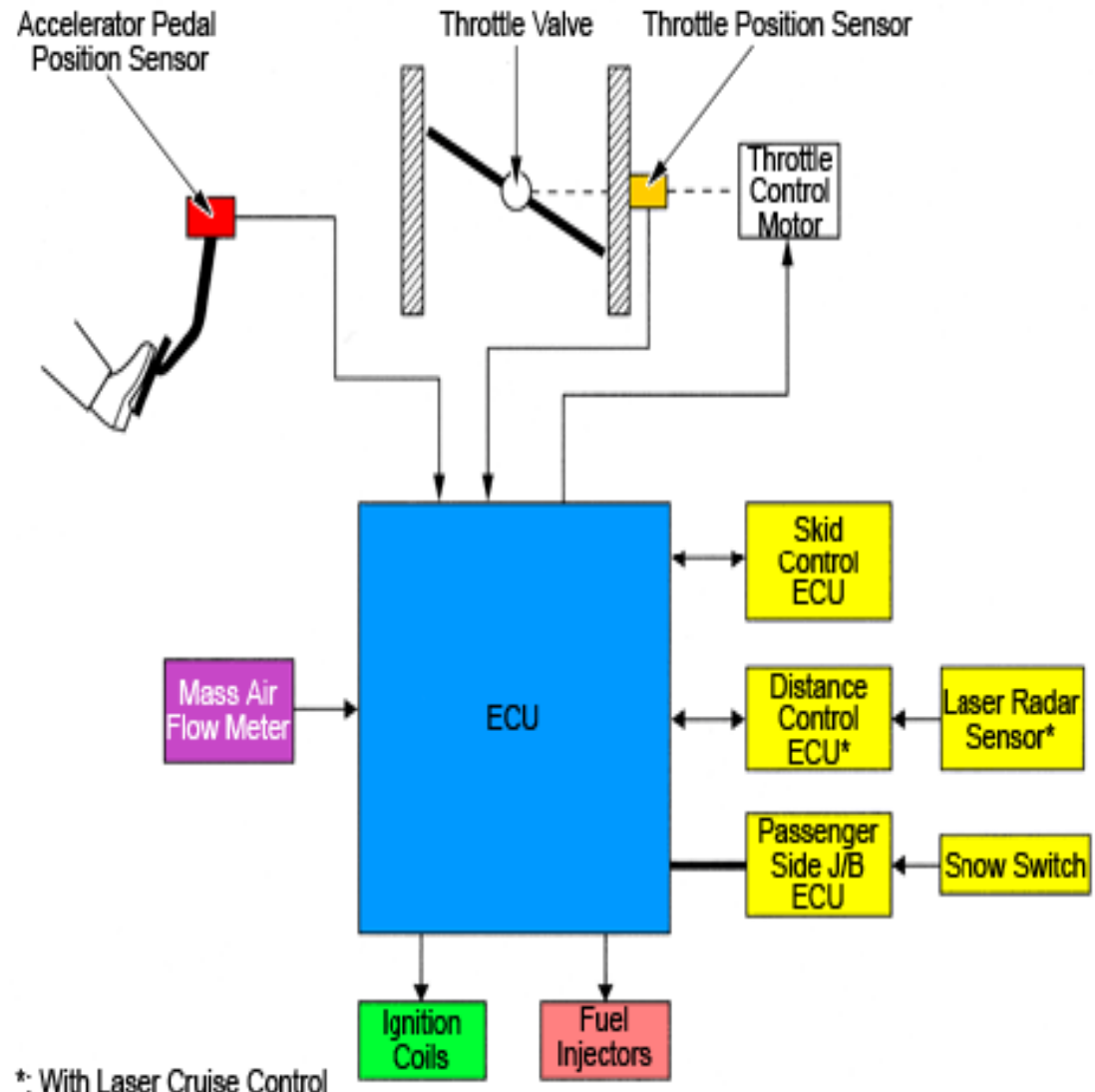5. **Linkless type system operation.**

Introduction

The Accelerator Pedal Position Sensor (APPS) detects the accelerator pedal position (driver input) and sends a signal to the ECM. Based on the input from the APPS and other ECUs (ABS, TRAC and VSC), the engine ECM directs the Throttle Control Motor to change throttle valve position. The Throttle Position Sensor (TPS) detects throttle valve angle and confirms to the ECM that the desired throttle valve position has been achieved. Both the APPS and the TPS have two sensing elements.

- Electronic Throttle Control System-intelligence (ETCS-i) provides several advantages over a mechanical linked throttle valve system as the ECM can position the throttle valve for optimum performance under a variety of conditions.

- The ETCS-i system gives the ECM precise control over the opening and closing of the throttle valve, based upon the driver's input (accelerator pedal).

- And in conjunction with input from chassis control ECUs, such as those for Traction Control and Vehicle Stability Control (Skid Control ECU).

- This system not only enhances drive line control, but also assists in reducing tailpipe emissions and improving fuel economy.

Introduction

The ETCS-i system allows the ECM to precisely control the opening and closing of the throttle valve based on drivers input and is also interrelated with chassis control ECUs such as Traction Control and Vehicle Stability Control (Skid Control ECU).

Accelerator Pedal Position Sensor

Throttle Valve

Throttle Position Sensor

Throttle Control Motor

ECU

Mass Air Flow Meter

Skid Control ECU

Distance Control ECU*

Laser Radar Sensor*

Passenger Side J/B ECU

Snow Switch

Ignition Coils

Fuel Injectors

*: With Laser Cruise Control

ETCS-I Control modes

- The ECM drives the throttle valve to a specified angle as determined by operating conditions.

- Different throttle valve angles in relation to the accelerator pedal position are used to achieve different engine output characteristics.

- The following describes the different modes that affect throttle valve angles.

ETCS-I Control modes

- **Non-linear Control**
- **Power mode control**
- **Snow mode control**
- **Shift shock reduction control**
- **Idle speed control**
- **TRAC throttle control**
- **VSC coordination control**
- **Cruise control**
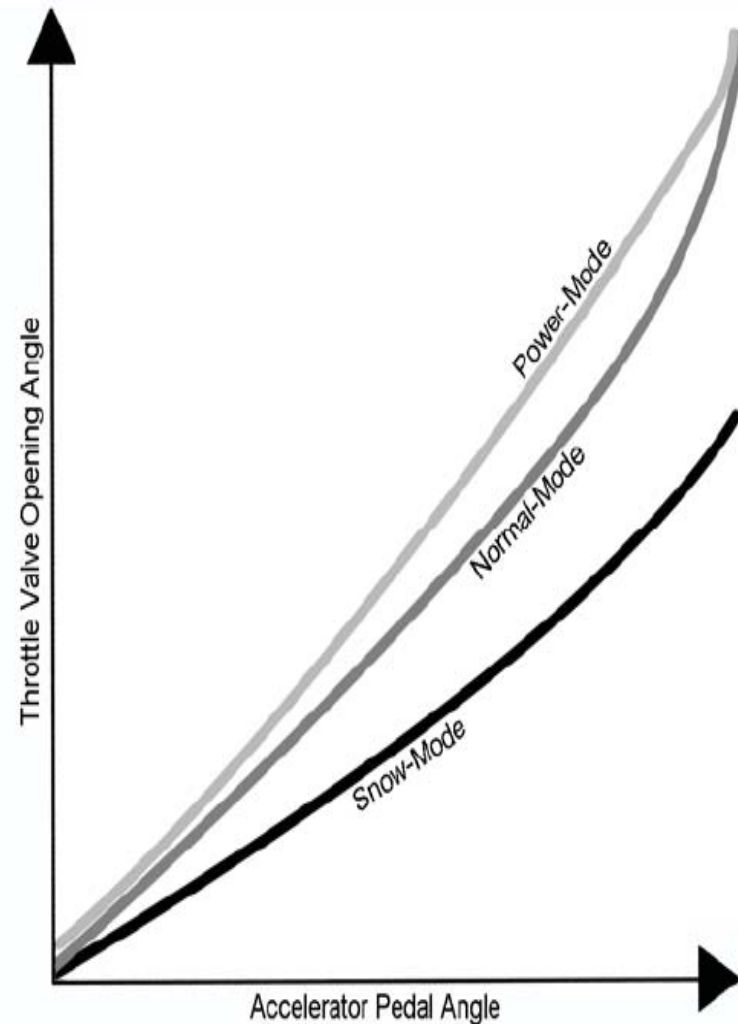
Types of ETCS-i

- Link type system
  (1st Generation)
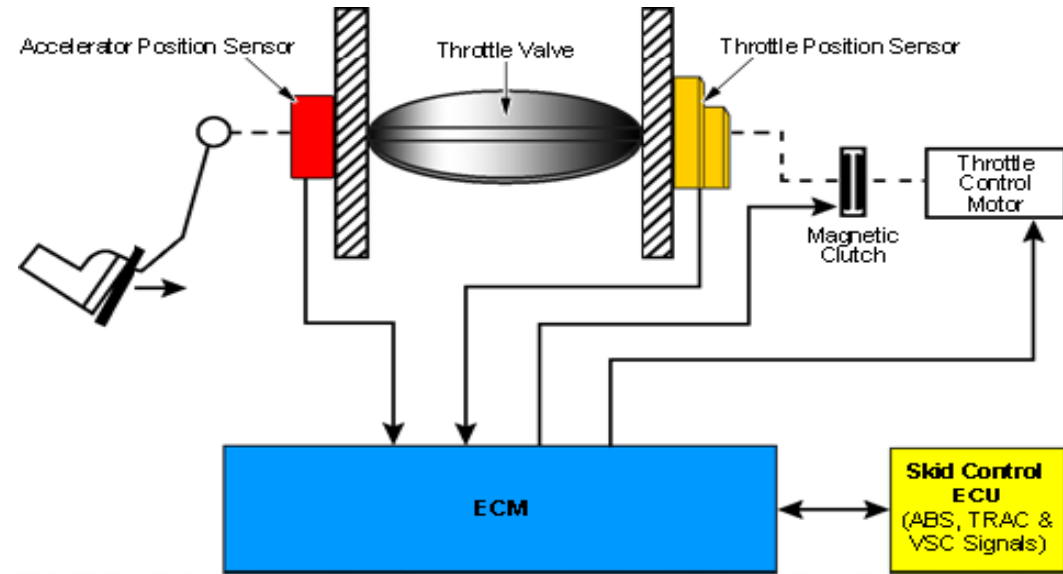
- Linkless type system
  (2nd Generation)

Types of ETCS-i

Electronic
Throttle
Control
System -
intelligent

Reduction Gears

Throttle Motor

Throttle Valve

Throttle Return Spring

Throttle Control Motor

Limp Mode Lever

Throttle Valve

Accelerator Pedal Position Sensor

Throttle Position Sensor

Magnetic Clutch

Throttle Control Motor
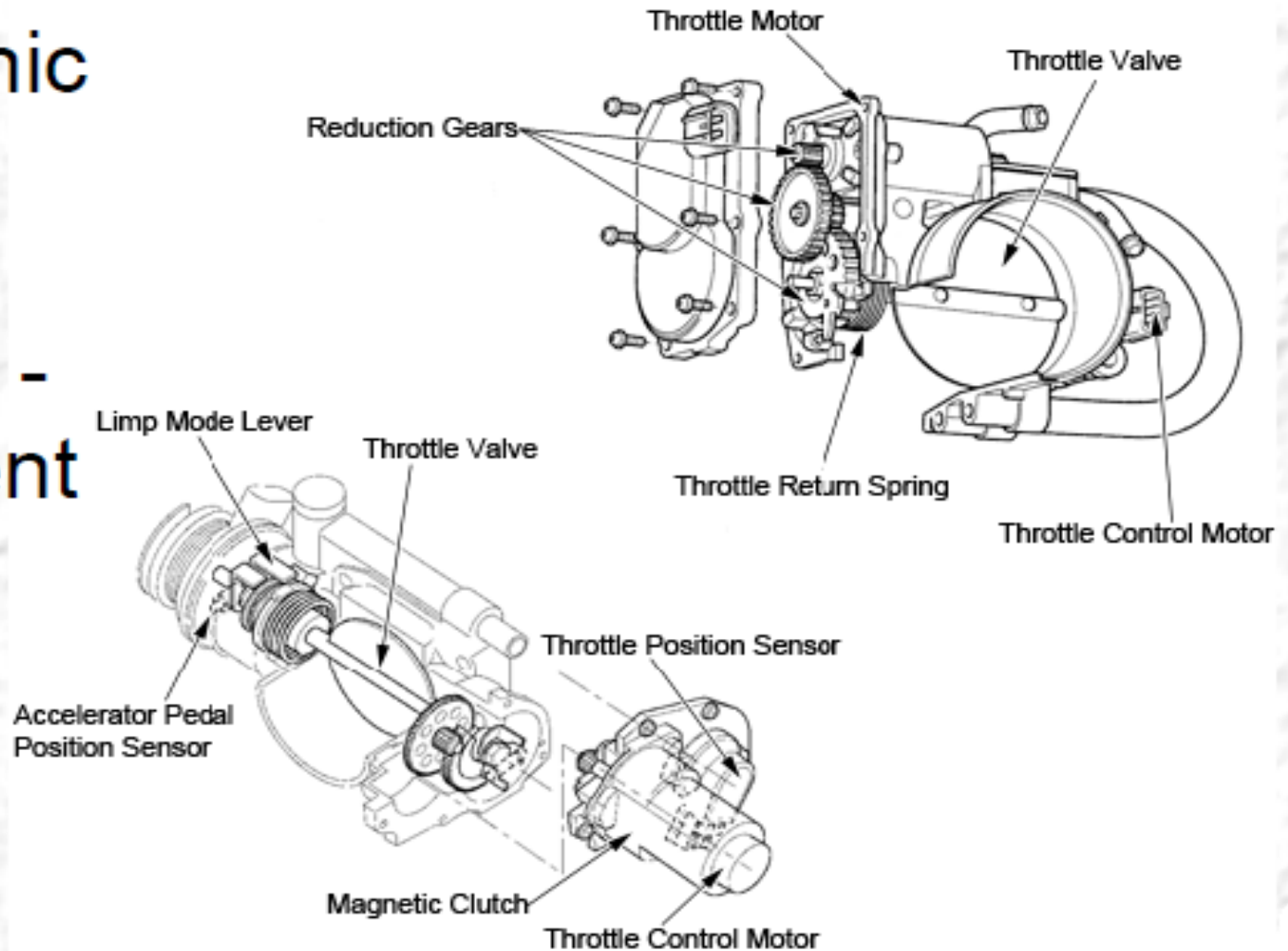
Link type system operation

<u>Operation:</u>

- The throttle motor operates the throttle valve.

- An electromagnetic clutch connects the throttle motor to the throttle valve.

- The throttle position sensor detects throttle valve angle.

- The Accelerator Pedal Position Sensor (APPS) detects accelerator pedal position.

- The throttle lever is connected by cable to the accelerator pedal.

- As the driver moves the accelerator pedal, the APPS signal voltage changes indicating a new pedal position.

- The ECM then adjusts the throttle angle based on the APPS signals, engine conditions and vehicle conditions.

Link type system operation

Fail Safe Mode:

- If an abnormal condition occurs with the ETCS-i, the MIL will illuminate to alert the driver.

- At the same time, current to the throttle control motor and magnetic clutch are cut off.

- With no power to the motor or magnetic clutch, the return spring closes the throttle valve to the default position.

- In this situation, called limp mode, the accelerator pedal operates the limp mode lever.

- When in limp mode, the throttle can only be partially opened reducing engine power.

- The driver will notice the pedal travel is longer in relation to engine response and that the MIL is on.

- Furthermore, ISC and cruise control systems will not operate.

Linkless type system operation

Operation:

- The linkless ETCS-i uses a compact throttle body.
- No mechanical connection between the accelerator pedal and throttle body.
- The Accelerator Pedal Position Sensor is mounted at the accelerator pedal.
- As the driver moves the accelerator pedal, the APPS signal voltage changes indicating a new pedal position.
- The ECM then adjusts the throttle angle based on the APPS signals, engine conditions and vehicle conditions.
- The throttle position sensor detects throttle valve angle.
- This system does not use a magnetic clutch.
- Operation of this system is nearly identical to the link type

Linkless type system operation

Types of Accelerator and Throttle position sensors:

1. Non contact type sensor.

2. Contact type sensor

- **While the sensors generate their output signal in a different process, common similarities included:**

   1- The Sensor operate at 5.0 volts which is supplied by the ECM's VC power source

   2- They utilize the same sensor ground terminals of the ECM, E2.

   3- They both output a linear DC voltage

Linkless type system operation

Fail Safe mode:

1- Accelerator position sensor:

2nd Generation - Fail Safe VPA VPA2

Normal Operation	Single Signal Failure	Double Signal Failure
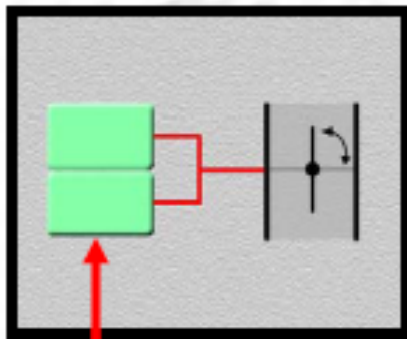
Accelerator Pedal Sensor
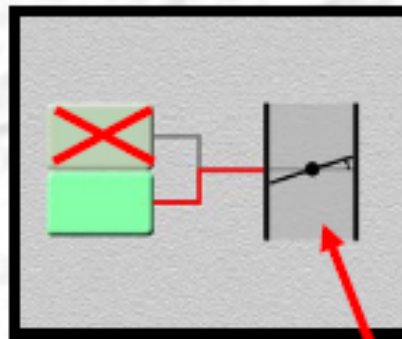
Opens between Idle Position and 25% of max.
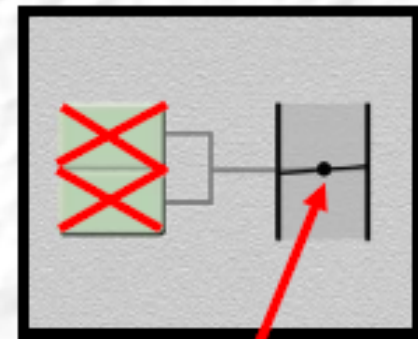
Idle Position Only

Linkless type system operation

Fail Safe mode:
1- Throttle position sensor:

2nd Generation - Fail Safe VTA ,VTA2, or Throttle Motor

Engine ECU (ECM)

Fixed

4 → 2 cylinder
6 → 3 cylinder
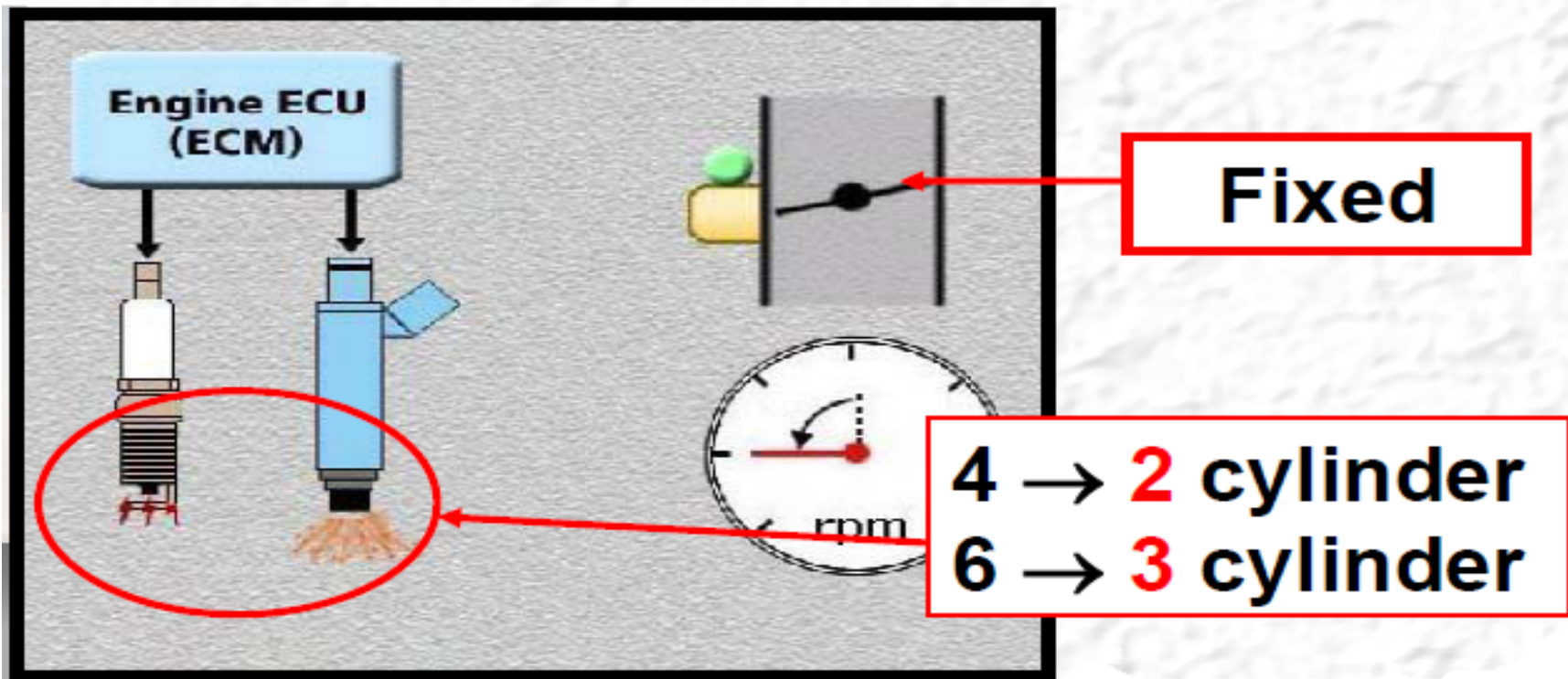
Electronic Throttle Control System

History

Electronic Throttle Control System Toyota Cars

Legend

Color	Description
Dark red	Drive by Cable with contact type throttle position sensor
Orange	ETCS-I contact type accelerator pedal and throttle position sensor
Yellow	ETCS-I & Drive by Cable with contact type accelerator pedal position sensor (mounted on TB) and throttle position sensor
Light blue	ETCS-I contact type accelerator pedal and non contact type throttle position sensor
Green	ETCS-I Non contact type accelerator pedal and throttle position sensor

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Avalon	dark red	dark red	dark red	dark red	dark red	green	green	green	green	green	green
Camry	dark red	dark red	orange	orange	orange	orange	orange	green	green	green	green
Camry HV	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green
Celica GTS	dark red	dark red	dark red	light blue	light blue	light blue	N/A	N/A	N/A	N/A	N/A
Celica GT	dark red	dark red	dark red	dark red	dark red	dark red	N/A	N/A	N/A	N/A	N/A
Corolla	dark red	dark red	dark red	dark red	dark red	light blue	light blue	light blue	green	green	green
Corolla XRS	N/A	N/A	N/A	N/A	N/A	dark red	dark red	N/A	N/A	green	green
Echo	dark red	dark red	dark red	dark red	dark red	dark red	N/A	N/A	N/A	N/A	N/A
Matrix	N/A	N/A	N/A	dark red	dark red	light blue	light blue	N/A	N/A	green	green
Matrix XRS	N/A	N/A	N/A	dark red	dark red	dark red	dark red	N/A	N/A	green	green
Prius	light blue	light blue	light blue	light blue	green	green	green	green	green	green	green
Solara	dark red	dark red	dark red	dark red	light blue	light blue	light blue	light blue	light blue	light blue	N/A
Solara V6	dark red	dark red	dark red	light blue	light blue	light blue	light blue	light blue	light blue	light blue	N/A
Yaris	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green	green

Electronic Throttle Control System Toyota Trucks

Legend

Description	Color
Drive by Cable with contact type throttle position sensor	Dark Red
ETCS-I contact type accelerator pedal and throttle position sensor	Orange
ETCS-I & Drive by Cable with contact type accelerator pedal position sensor (mounted on TB) and throttle position sensor	Yellow
ETCS-I contact type accelerator pedal and non contact type throttle position sensor	Light Blue
ETCS-I Non contact type accelerator pedal and throttle position sensor	Green

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
4Runner	Dark Red	Dark Red	Dark Red	Light Blue	Green	Green	Green	Green	Green	Green	Green
FJ Cruiser	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Green	Green	Green	Green
Highlander	Dark Red	Dark Red	Dark Red	Dark Red	Light Blue	Light Blue	Light Blue	Light Blue	Green	Green	Green
Highlander HV	N/A	N/A	N/A	N/A	N/A	N/A	Green	Green	Green	Green	Green
Rav4 L4	Dark Red	Dark Red	Dark Red	Dark Red	Light Blue	Light Blue	Green	Green	Green	Green	Green
Rav4 V6	N/A	N/A	N/A	N/A	N/A	N/A	Green	Green	Green	Green	Green
Sequoia	N/A	Orange	Orange	Orange	Orange	Orange	Orange	Orange	Green	Green	Green
Sequoia 5.7L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Green	Green	Green
Sienna	Dark Red	Dark Red	Dark Red	Dark Red	Green	Green	Green	Green	Green	Green	Green
Tacoma L4	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Green	Green	Green	Green	Green	Green
Tacoma V6	Dark Red	Dark Red	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green
Tundra 2UZ	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Green	Green	Green	Green
Tundra 5VZ	Dark Red	Dark Red	Dark Red	Dark Red	Green	Green	Green	Green	Green	Green	Green
Tundra 5.7L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Green	Green	Green	Green
Venza	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Green	Green

Electronic Throttle Control System - Lexus

Legend
- **Dark red** — Drive by Cable with contact type throttle position sensor
- **Orange** — ETCS-I contact type accelerator pedal and throttle position sensor
- **Yellow** — ETCS-I & Drive by Cable with contact type accelerator pedal position sensor (mounted on TB) and throttle position sensor
- **Light blue** — ETCS-I contact type accelerator pedal and non contact type throttle position sensor
- **Green** — ETCS-I Non contact type accelerator pedal and throttle position sensor

Model	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ES 300	dark red	dark red	orange	orange	N/A	N/A	N/A	N/A	N/A	N/A	N/A
ES 330	N/A	N/A	N/A	N/A	blue	blue	blue	N/A	N/A	N/A	N/A
ES 350	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green
GS300	yellow	yellow	yellow	yellow	yellow	yellow	green	N/A	N/A	N/A	N/A
GS400	yellow	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
GS430	N/A	orange	orange	orange	orange	orange	green	green	N/A	N/A	N/A
GS450h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green
GS 460	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green
GX 460	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green
GX 470	N/A	N/A	N/A	green	green	green	green	green	green	green	N/A
IS 250/C	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green	green
IS 300	N/A	yellow	yellow	yellow	yellow	yellow	N/A	N/A	N/A	N/A	N/A
IS 350/C	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green	green
LS 400	yellow	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LS 430	N/A	orange	orange	orange	blue	blue	blue	N/A	N/A	N/A	N/A
LS 460	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green
LS 600h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green
LX 470	orange	orange	orange	blue	blue	blue	blue	blue	N/A	N/A	N/A
LX 570	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green
RX 300	dark red	dark red	dark red	dark red	N/A	N/A	N/A	N/A	N/A	N/A	N/A
RX 330	N/A	N/A	N/A	N/A	green	green	green	N/A	N/A	N/A	N/A
RX 350	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green	green
RX 400h	N/A	N/A	N/A	N/A	N/A	N/A	green	green	green	green	N/A
RX 450h	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	green
SC 300/400	yellow	yellow	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SC 430	N/A	N/A	orange	orange	orange	orange	blue	blue	blue	blue	blue