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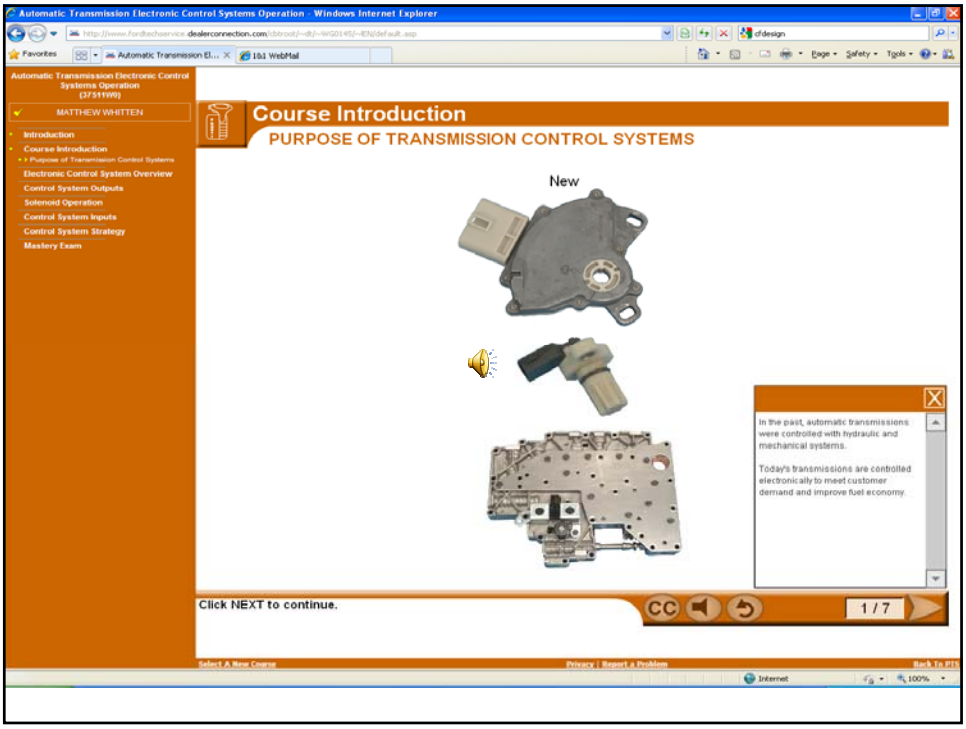

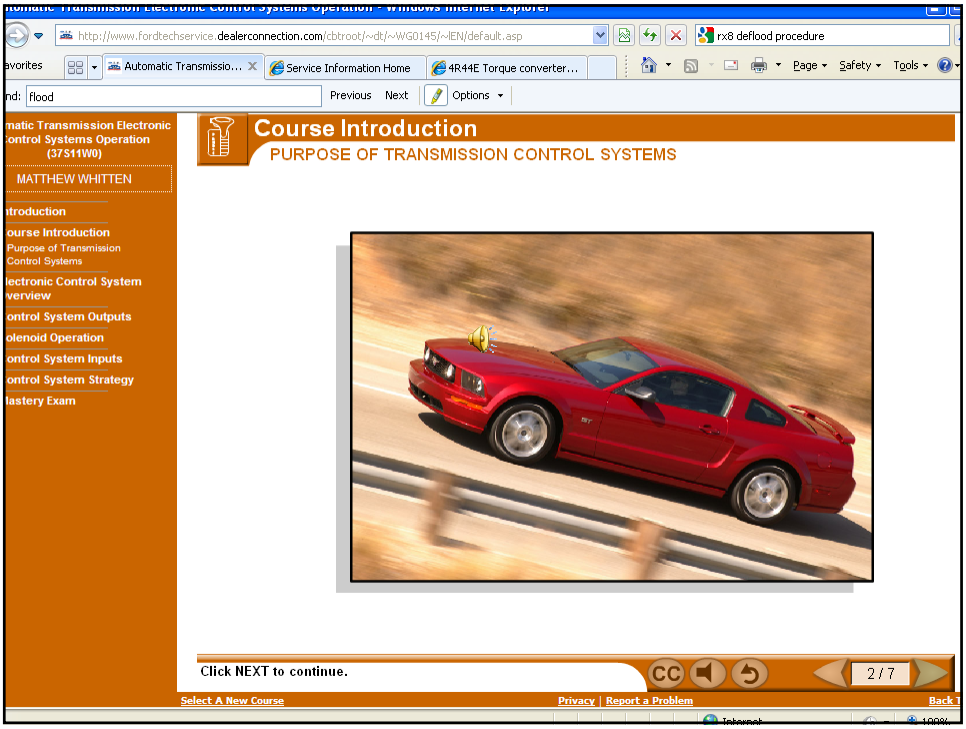
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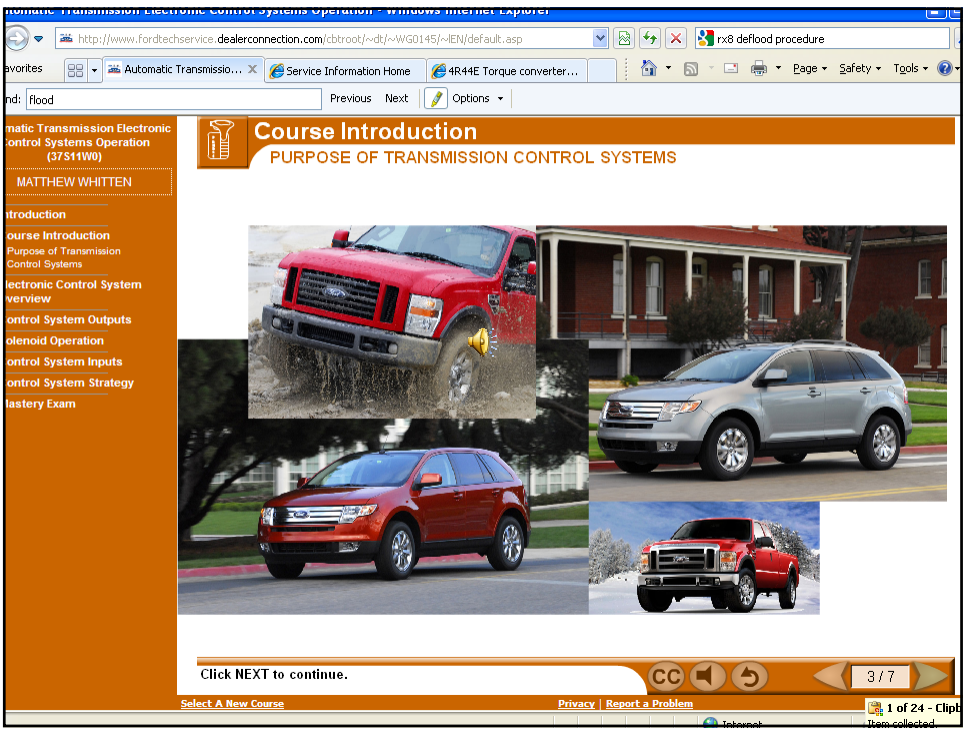
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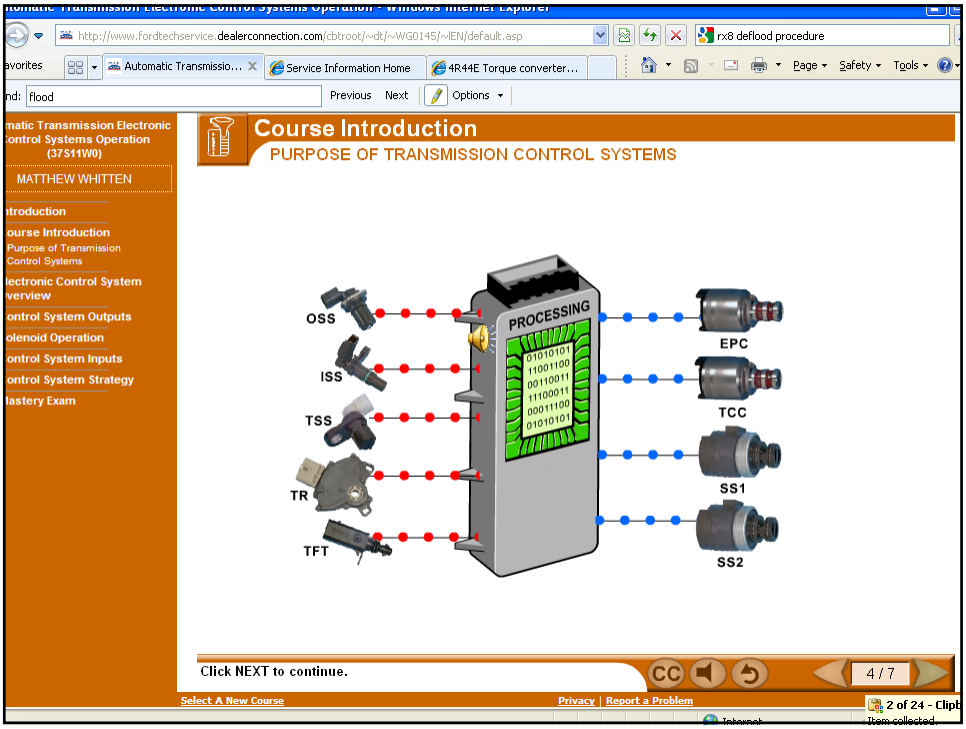
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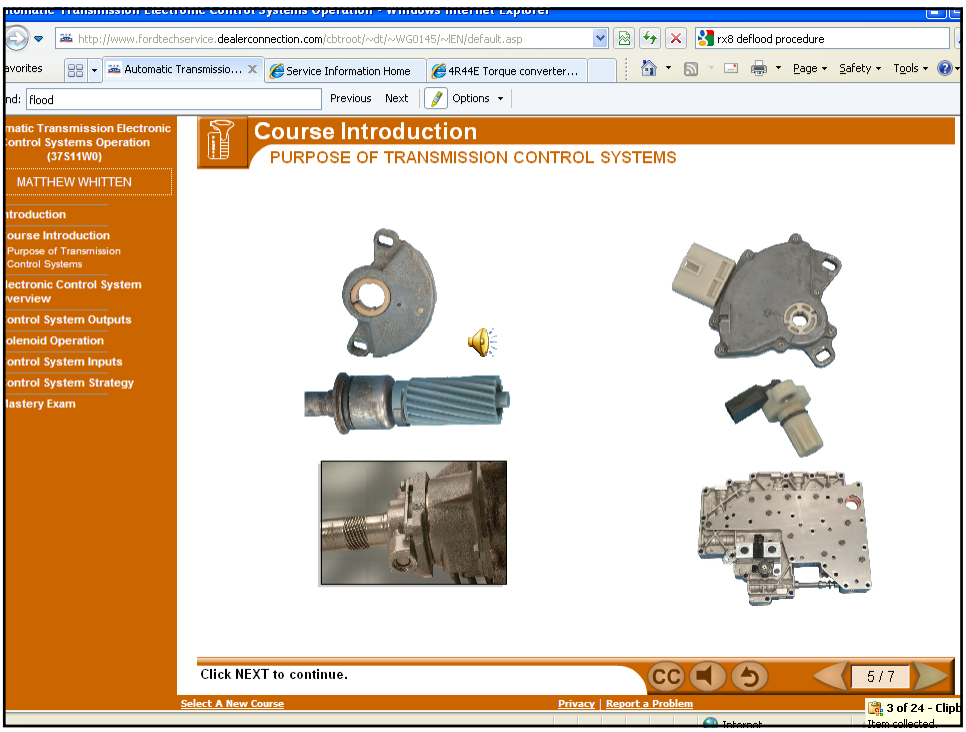
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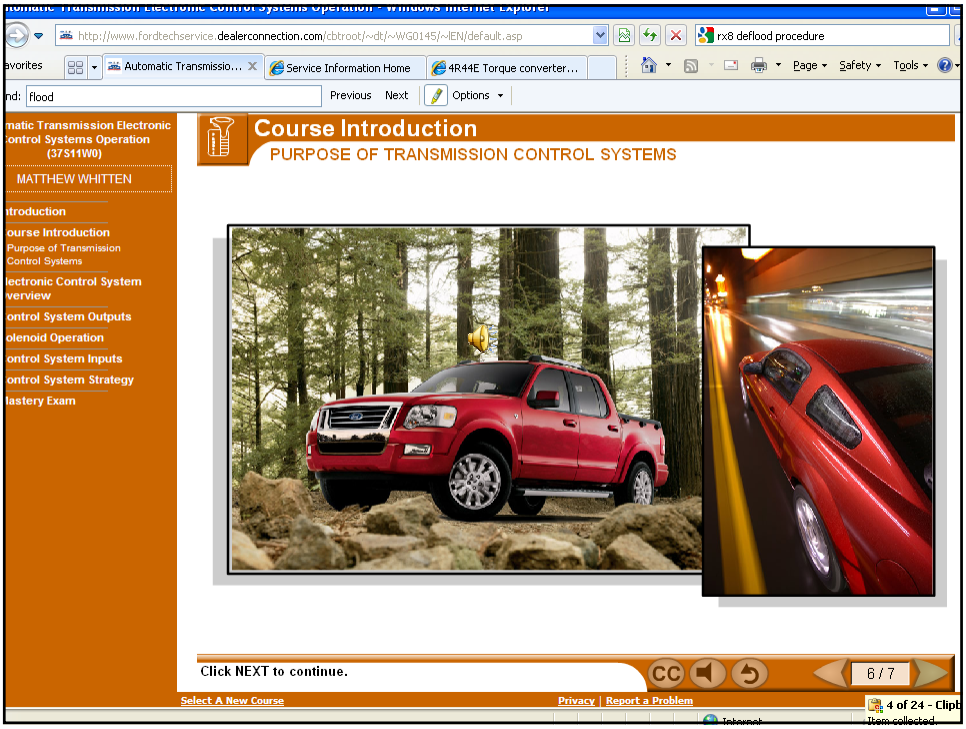
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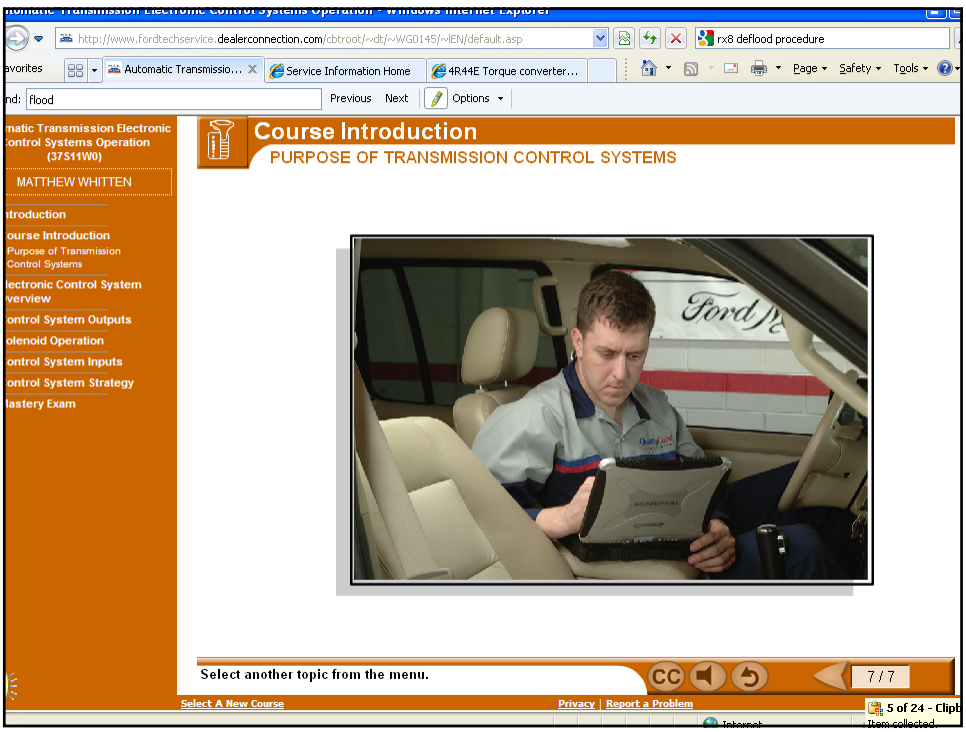
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OBJECTIVES
Upon completion of this lesson you will be able to:
describe the structure of the electronic control system.
identify the location of the transmission control module.
describe the functions of the electronic control system.
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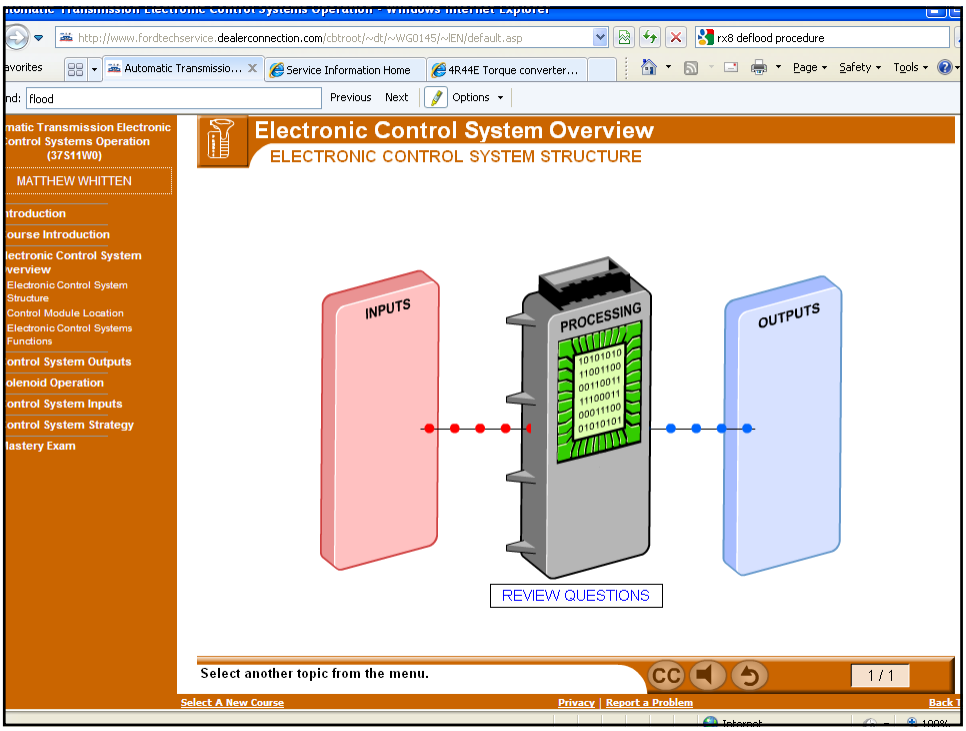
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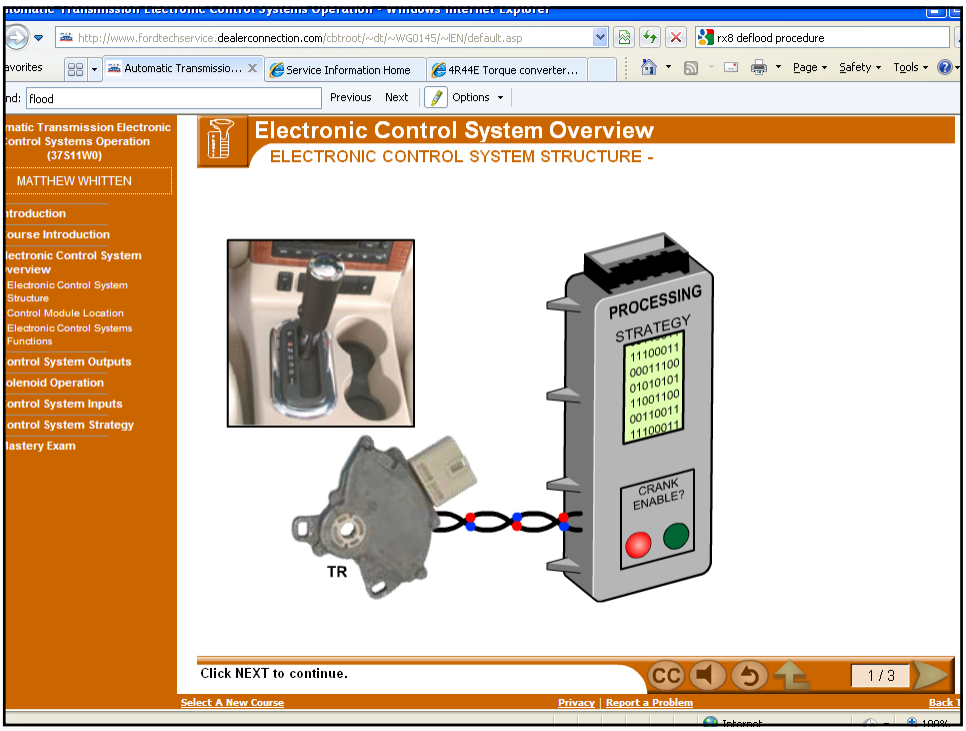
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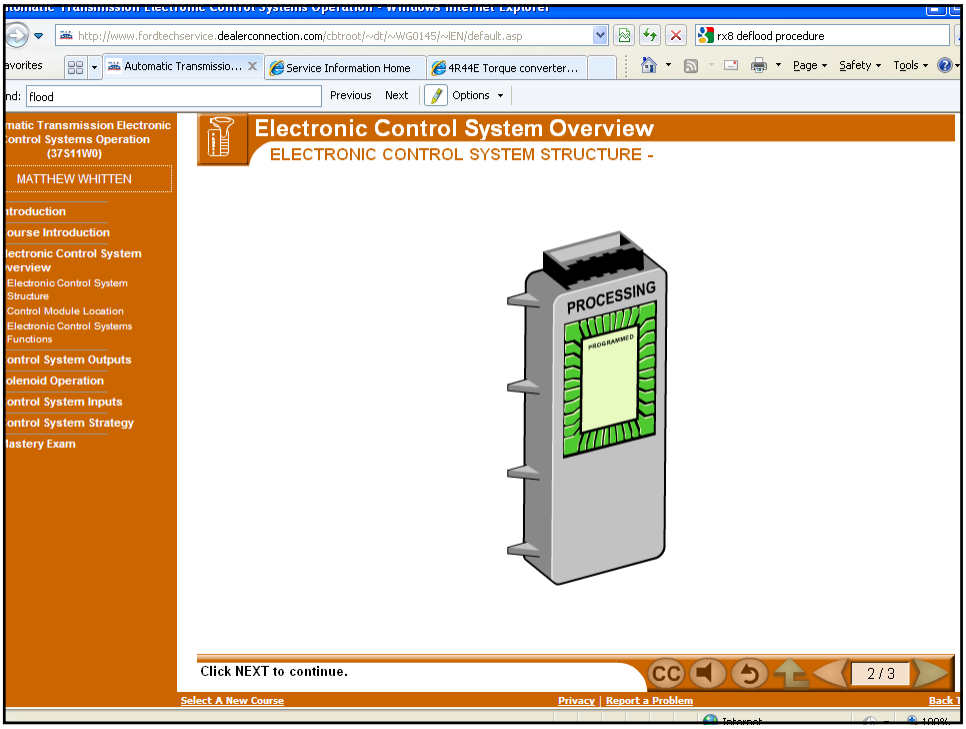
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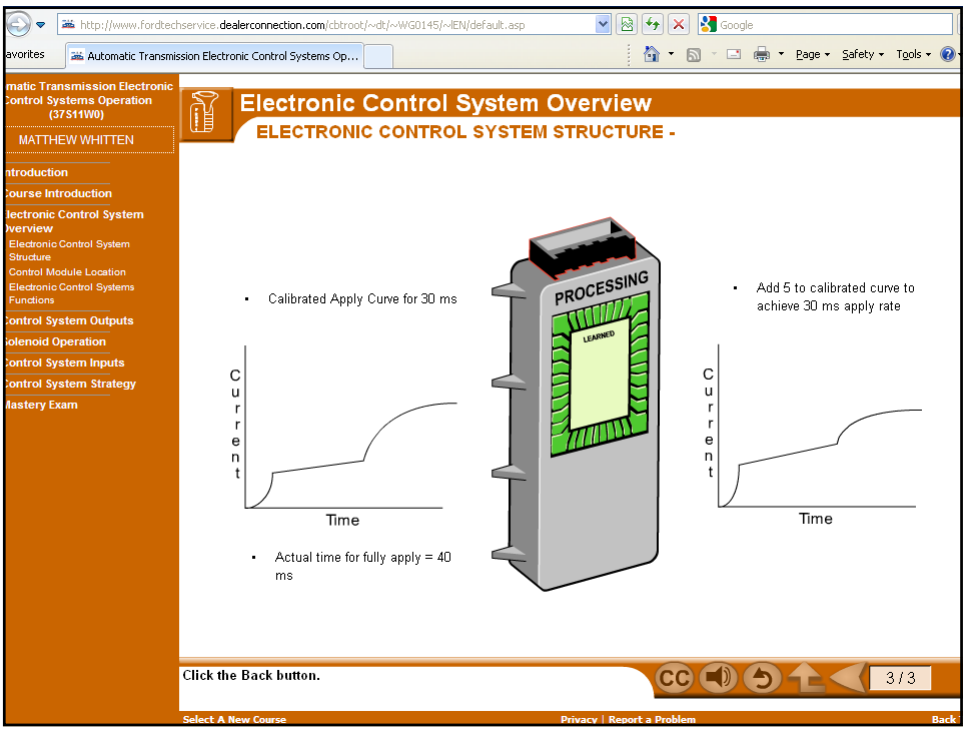
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Calibrated Apply Curve for 30 ms
Current
Time
Actual time for fully apply = 40 ms
PROCESSING
LEARNED
Add 5 to calibrated curve to achieve 30 ms apply rate
Current
Time
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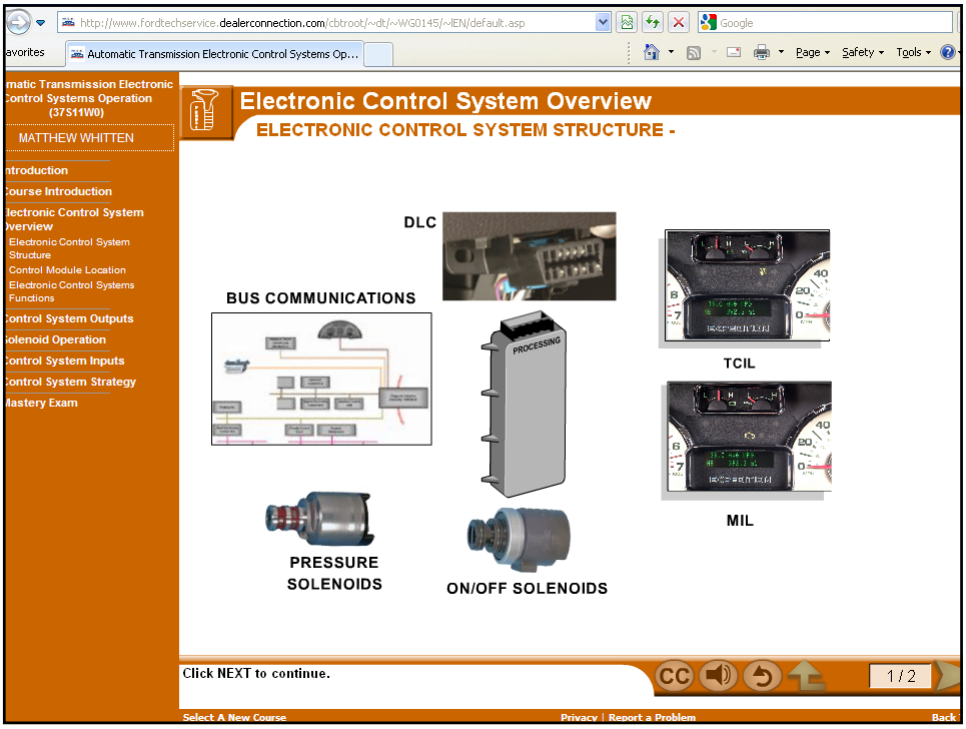
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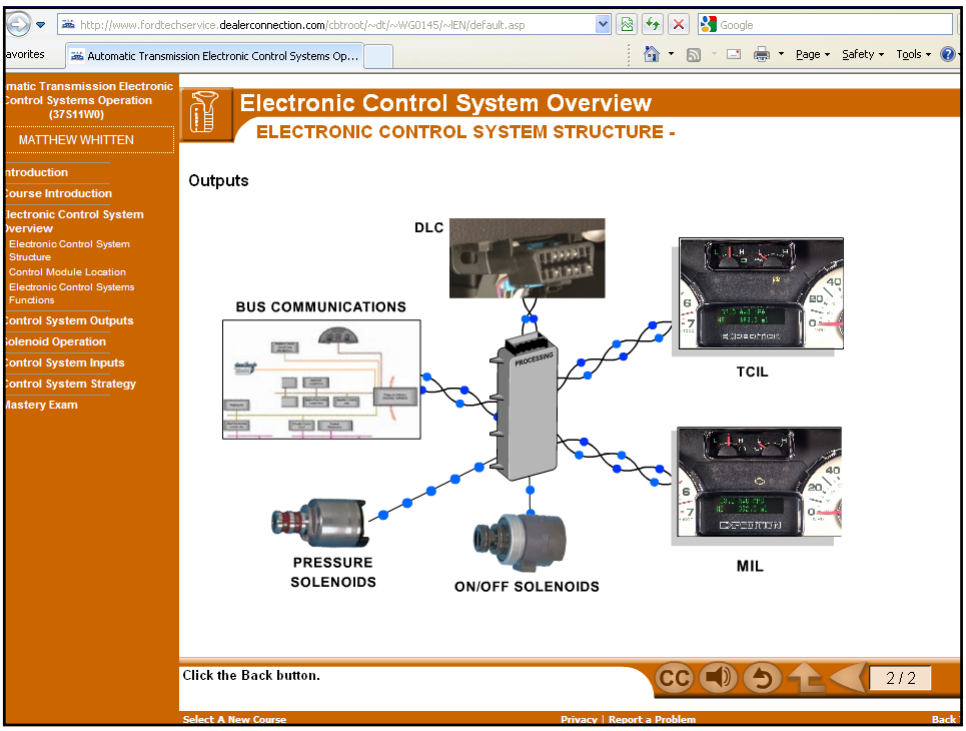
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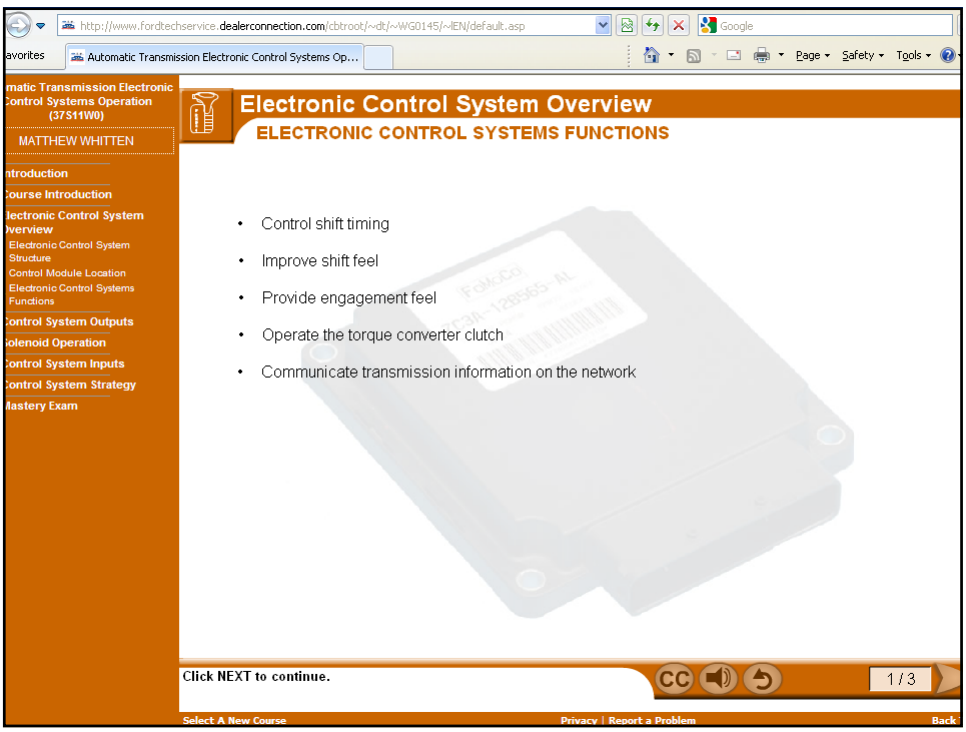
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Control shift timing
Improve shift feel
Provide engagement feel
Operate the torque converter clutch
Communicate transmission information on the network
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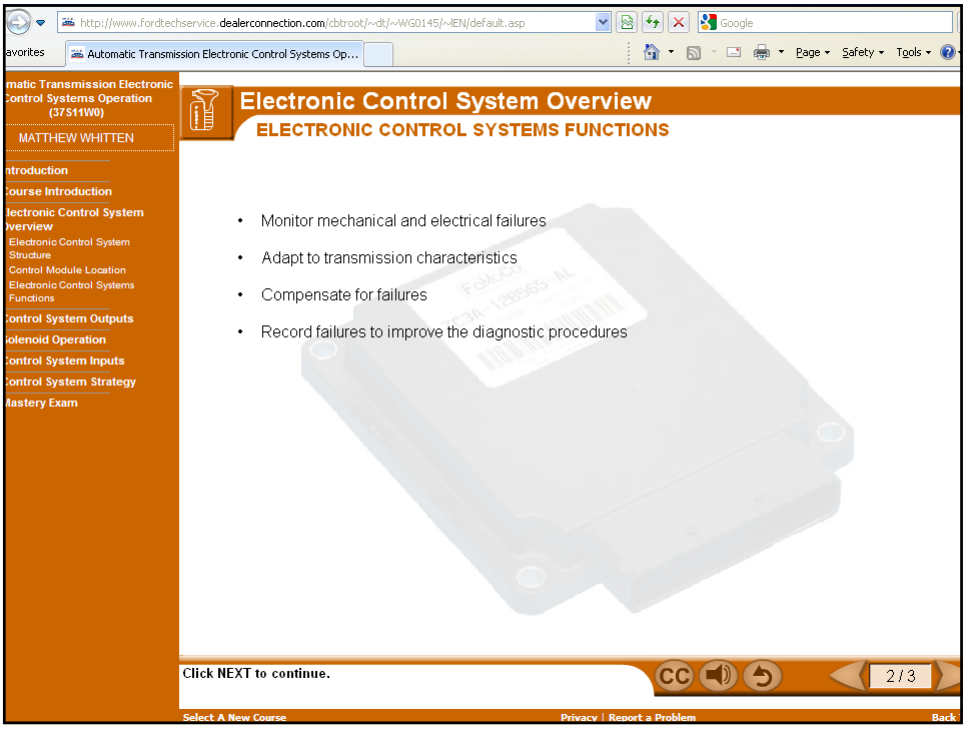
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Monitor mechanical and electrical failures
Adapt to transmission characteristics
Compensate for failures
Record failures to improve the diagnostic procedures
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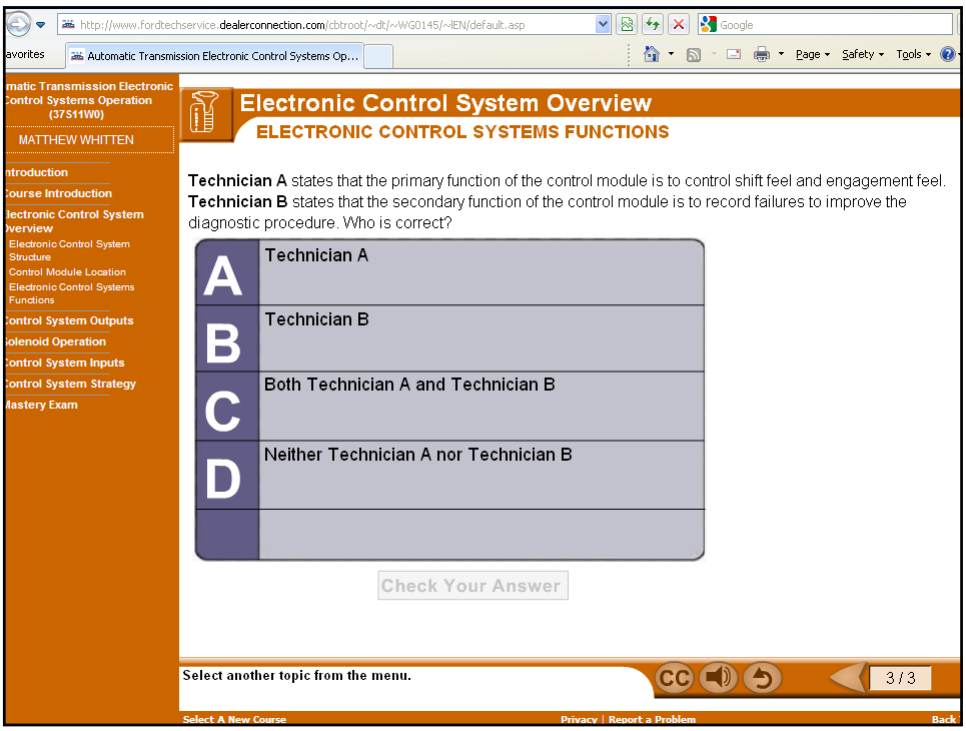
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Technician A states that the primary function of the control module is to control shift feel and engagement feel. Technician B states that the secondary function of the control module is to record failures to improve the diagnostic procedure. Who is correct?
A Technician A
B Technician B
C Both Technician A and Technician B
D Neither Technician A nor Technician B
Check Your Answer
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OBJECTIVES
Upon completion of this lesson you will be able to identify:
typical transmission solenoid locations.
transmission solenoid types.
functions of ON/OFF solenoids.
functions of pressure control shift solenoids.
functions of the Transmission Control Indicator Lamp (TCIL) and Malfunction Indicator Lamp (MIL).
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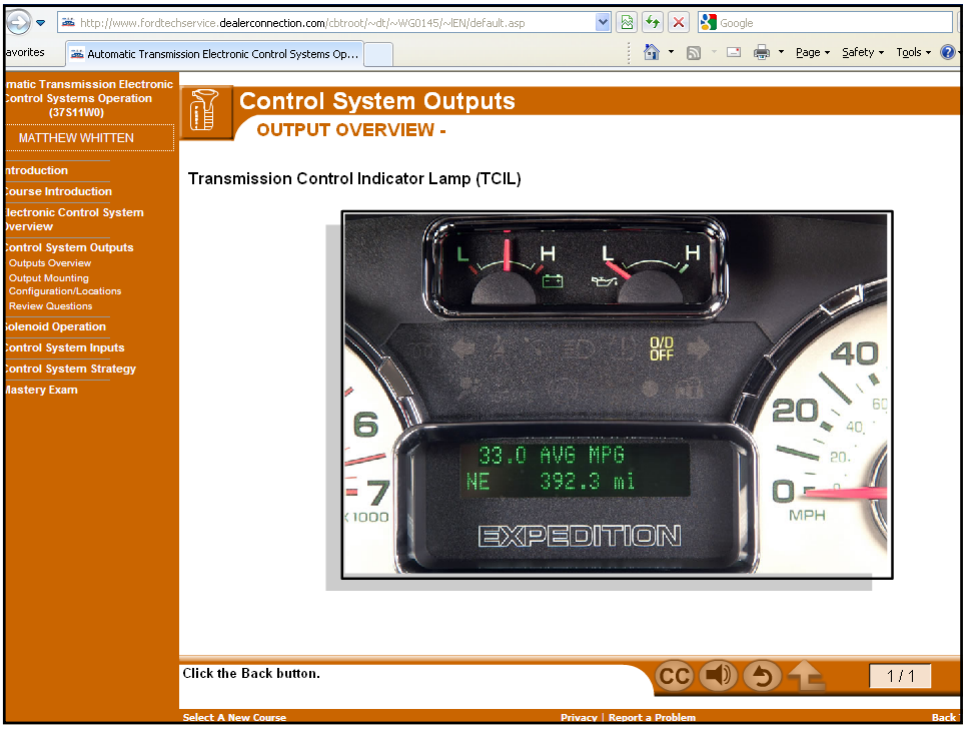
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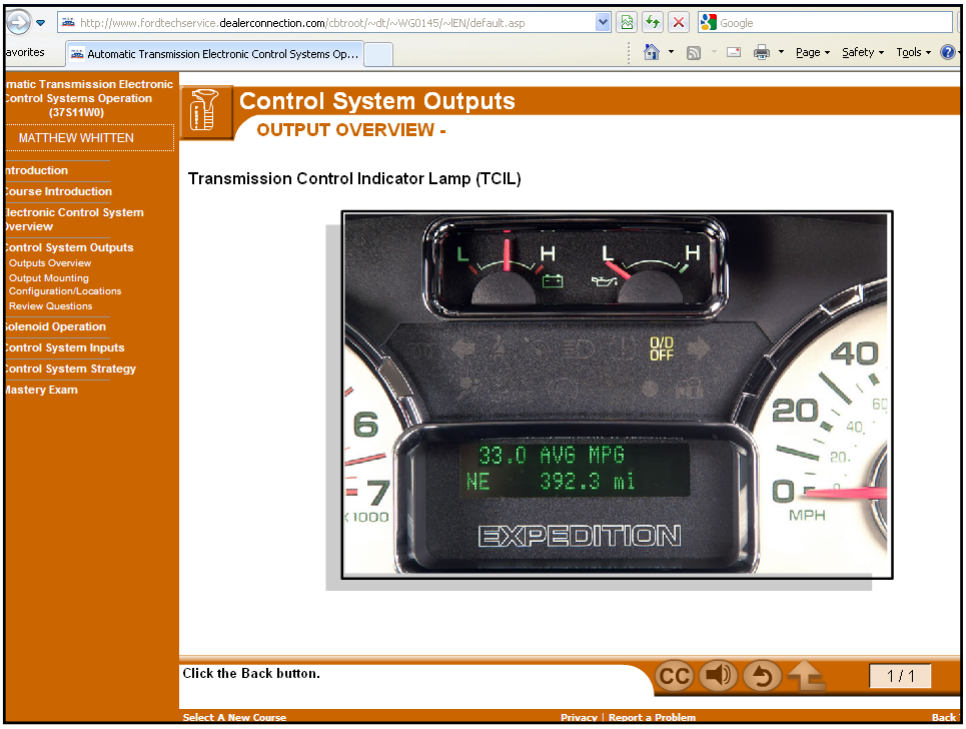
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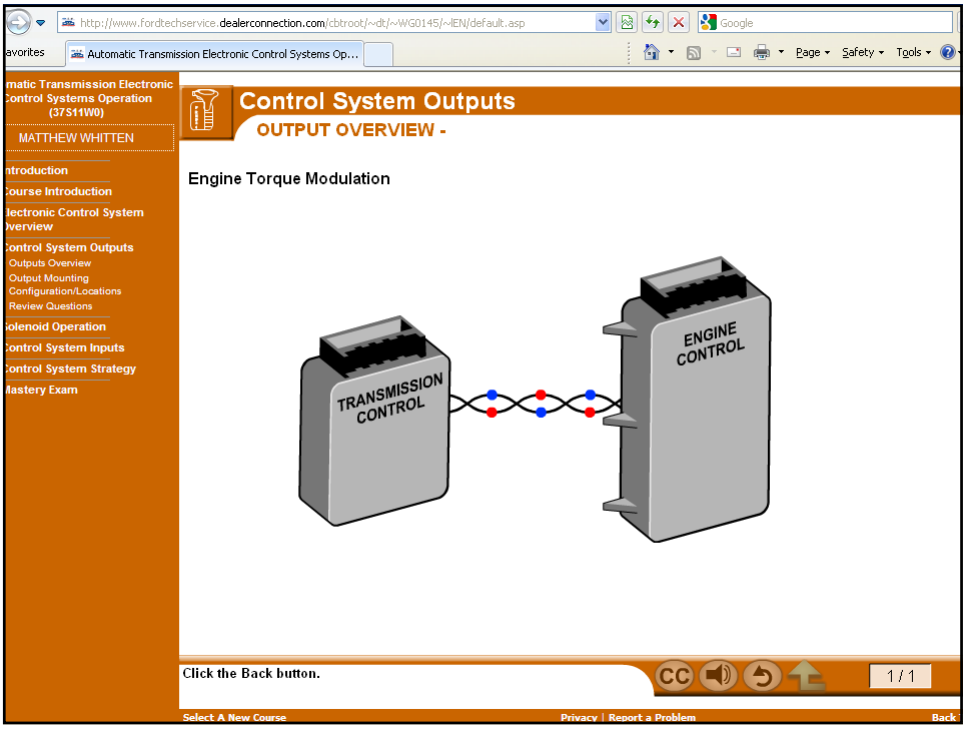
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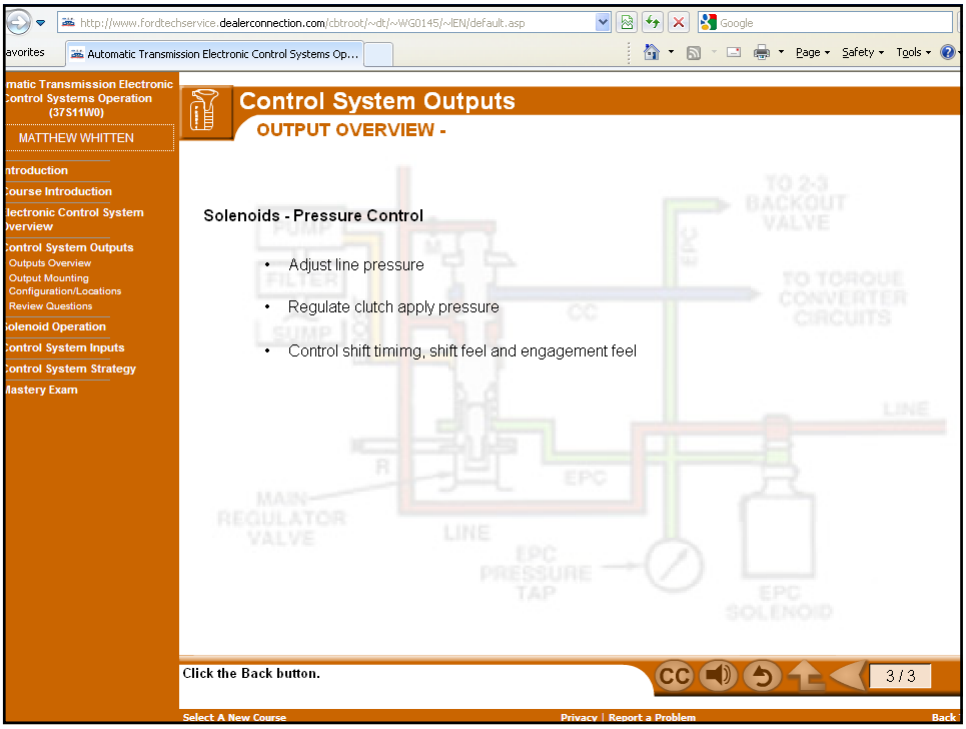
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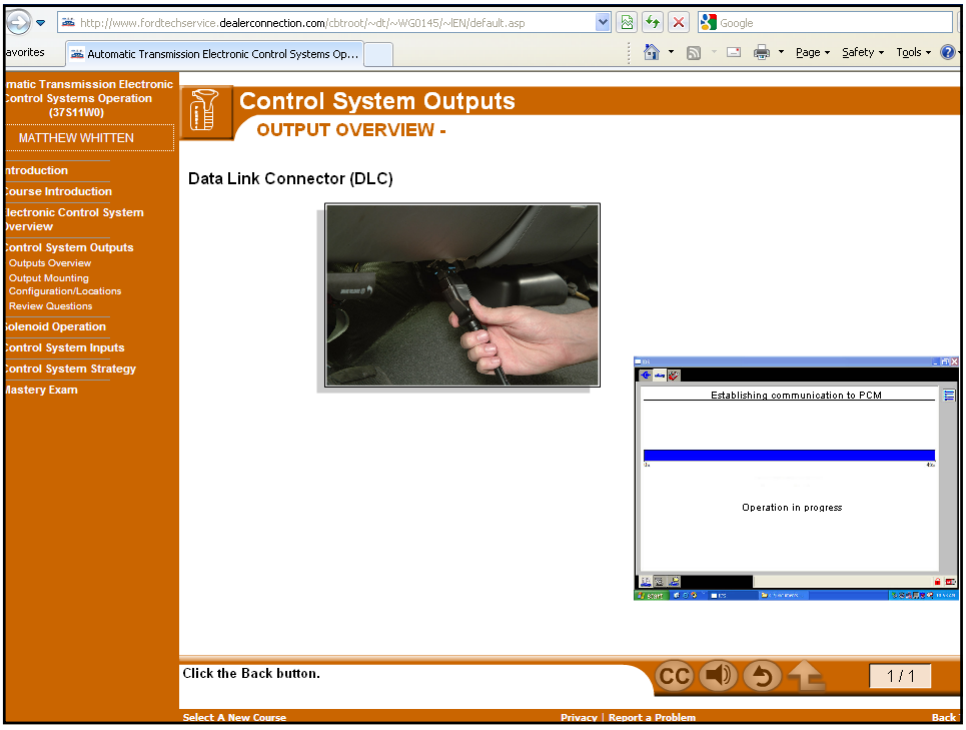
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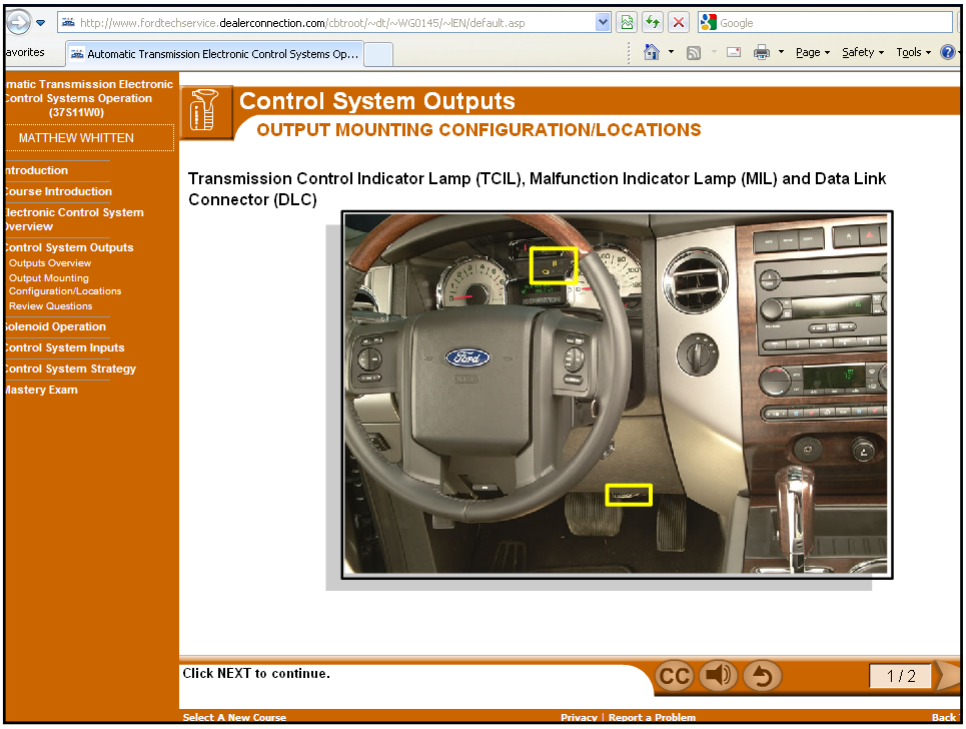
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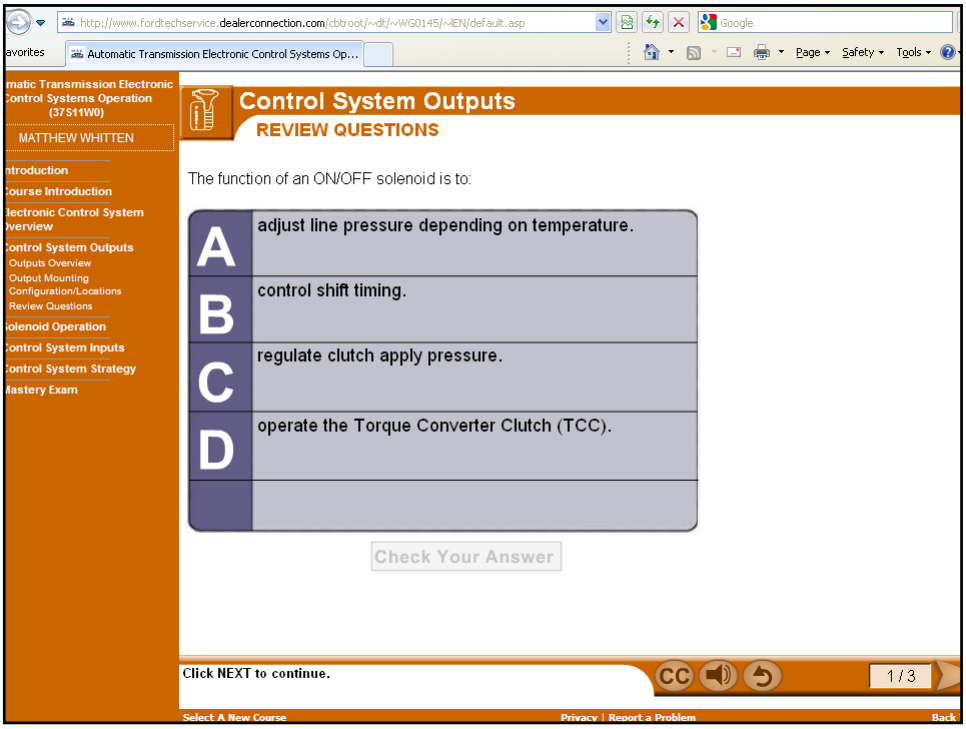
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REVIEW QUESTIONS
The function of an ON/OFF solenoid is to:
A adjust line pressure depending on temperature.
B control shift timing.
C regulate clutch apply pressure.
D operate the Torque Converter Clutch (TCC).
Check Your Answer
Click NEXT to continue.
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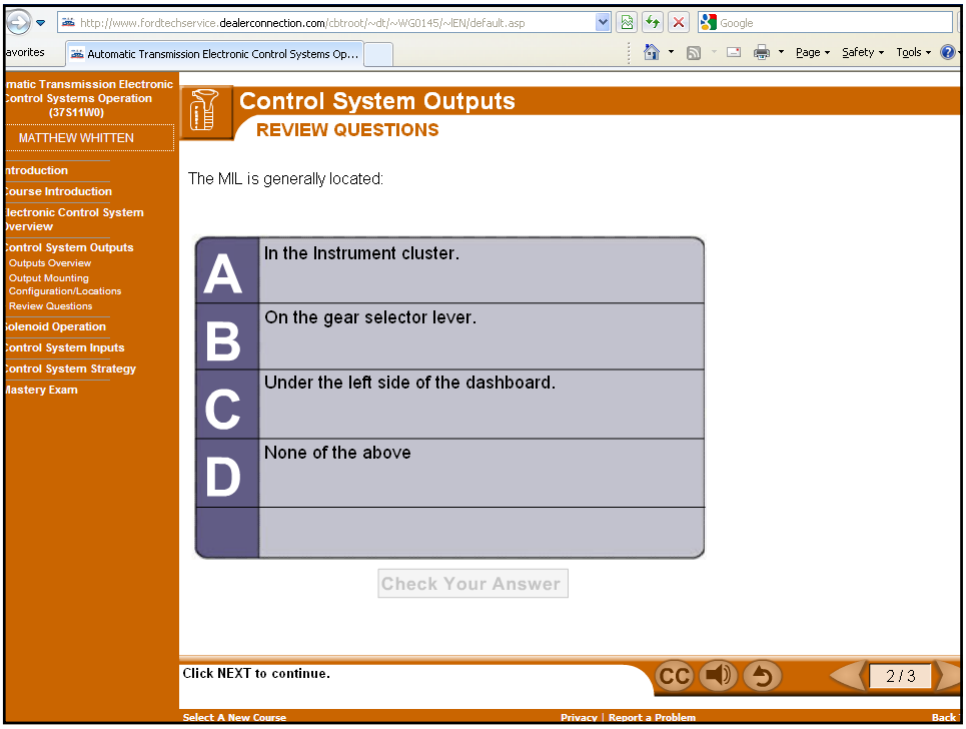
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REVIEW QUESTIONS
The MIL is generally located:
A In the Instrument cluster.
B On the gear selector lever.
C Under the left side of the dashboard.
D None of the above
Check Your Answer
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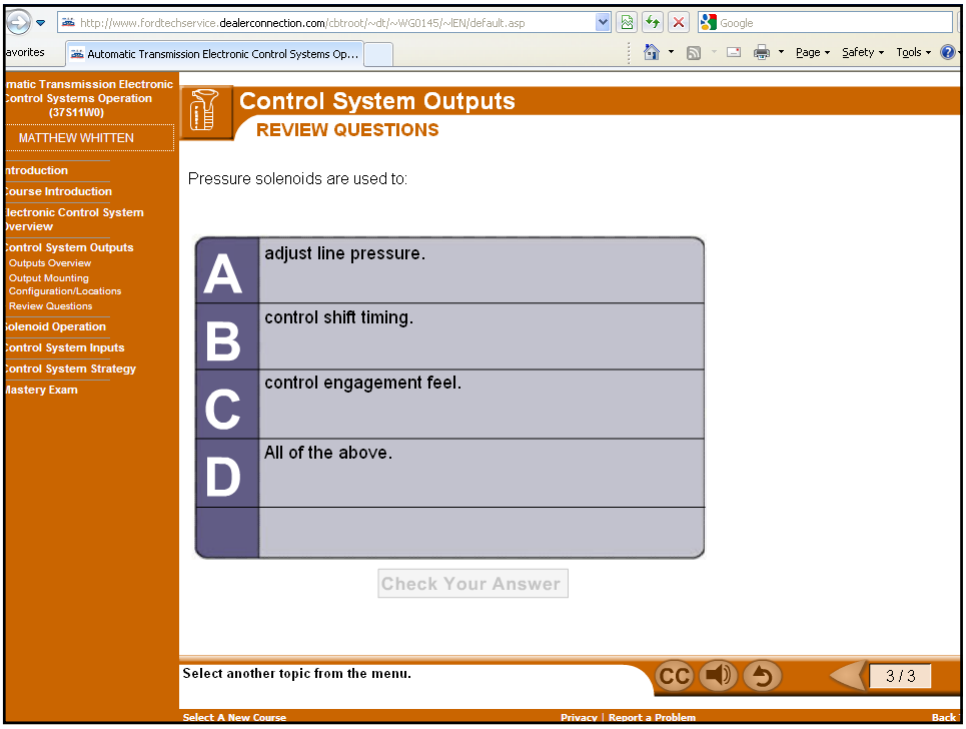
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REVIEW QUESTIONS
Pressure solenoids are used to:
A adjust line pressure.
B control shift timing.
C control engagement feel.
D All of the above.
Check Your Answer
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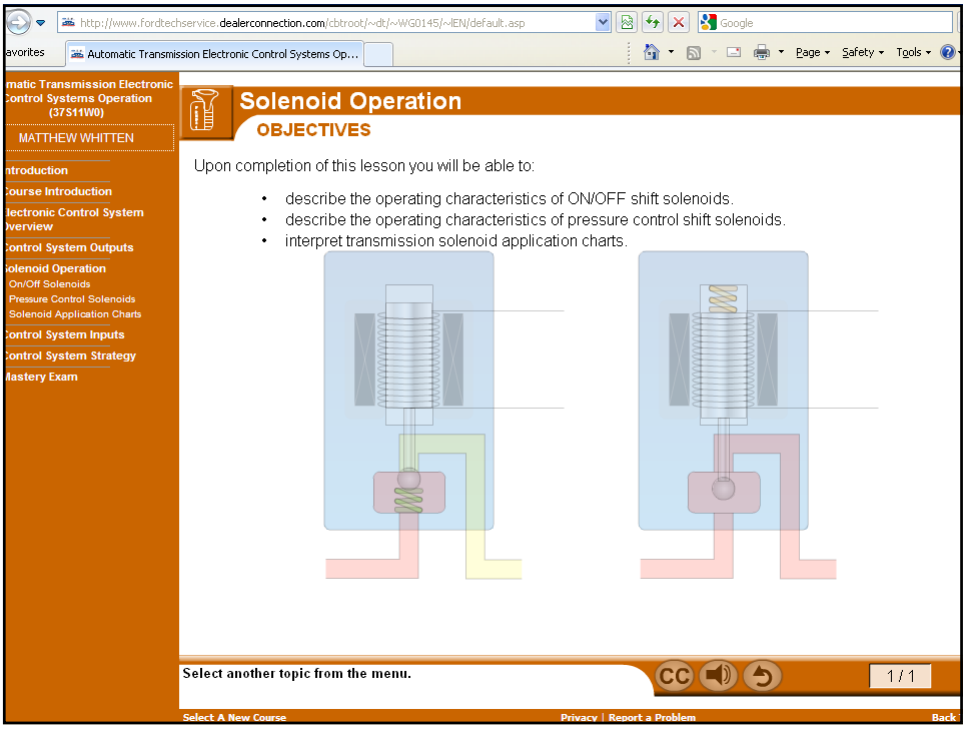
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Solenoid Operation
OBJECTIVES
Upon completion of this lesson you will be able to:
describe the operating characteristics of ON/OFF shift solenoids.
describe the operating characteristics of pressure control shift solenoids.
interpret transmission solenoid application charts.
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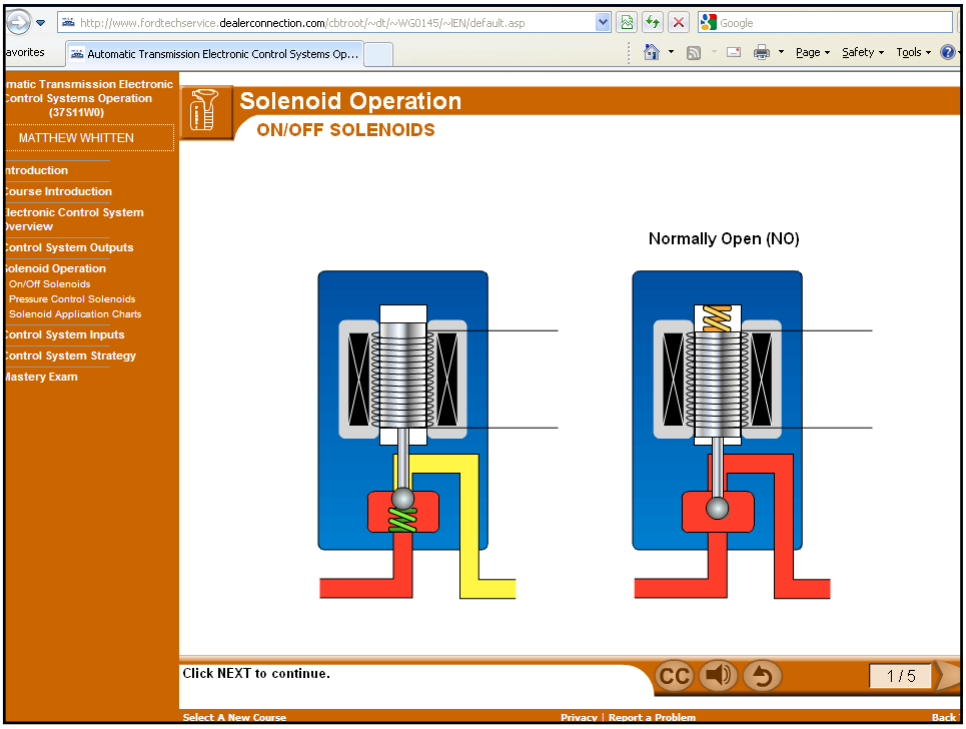
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ON/OFF SOLENOIDS
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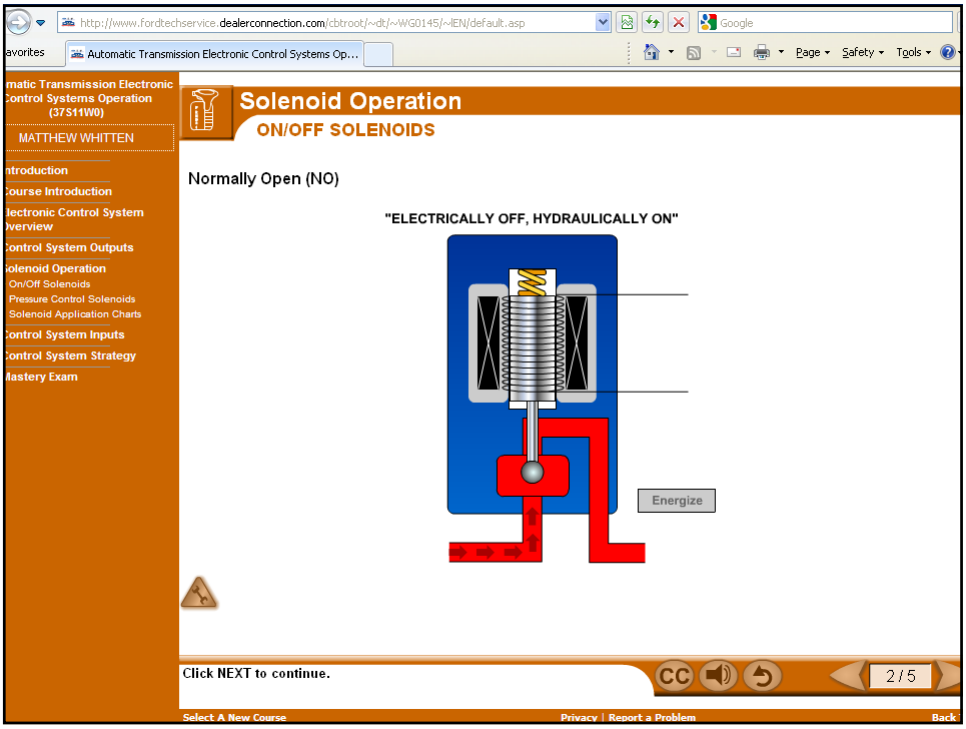
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"ELECTRICALLY OFF, HYDRAULICALLY ON"
Energize
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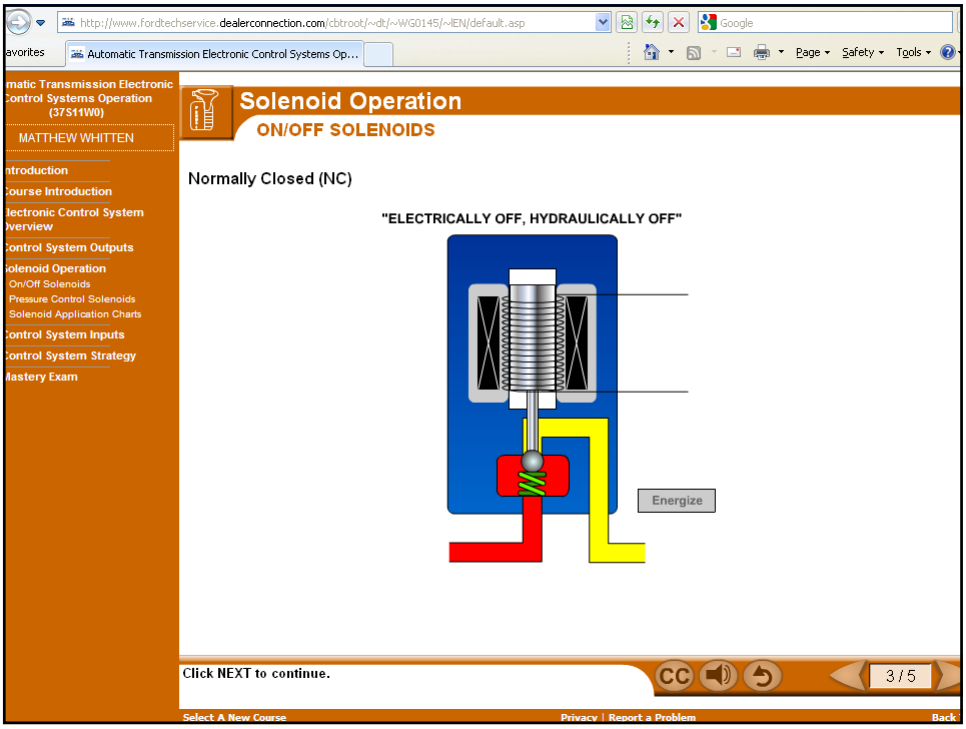
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"ELECTRICALLY OFF, HYDRAULICALLY OFF"
Energize
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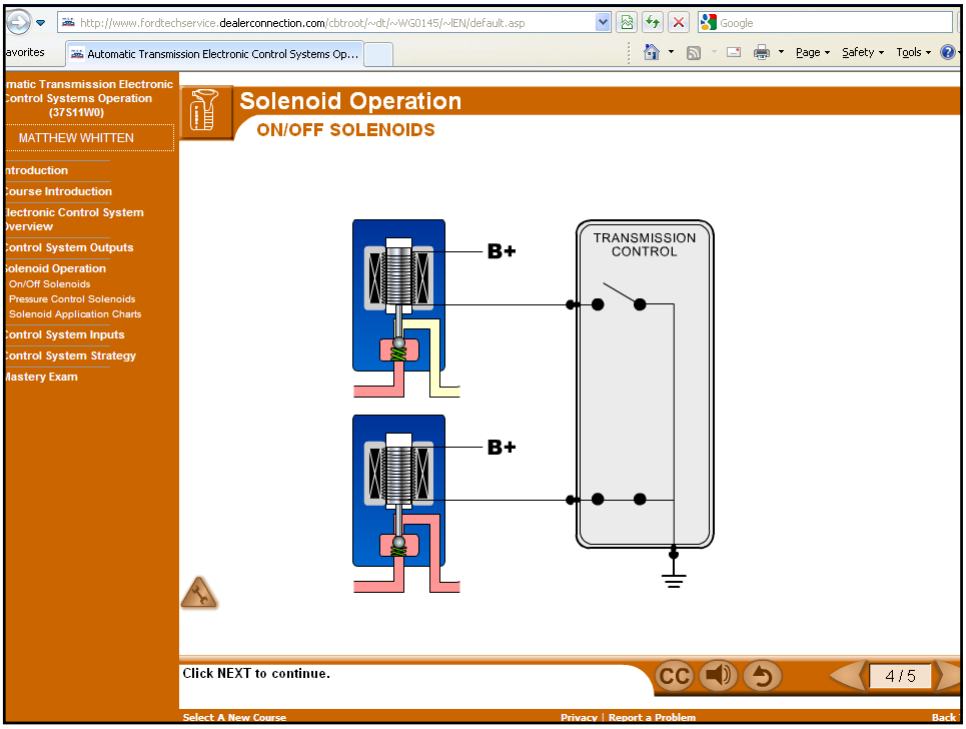
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B+
B+
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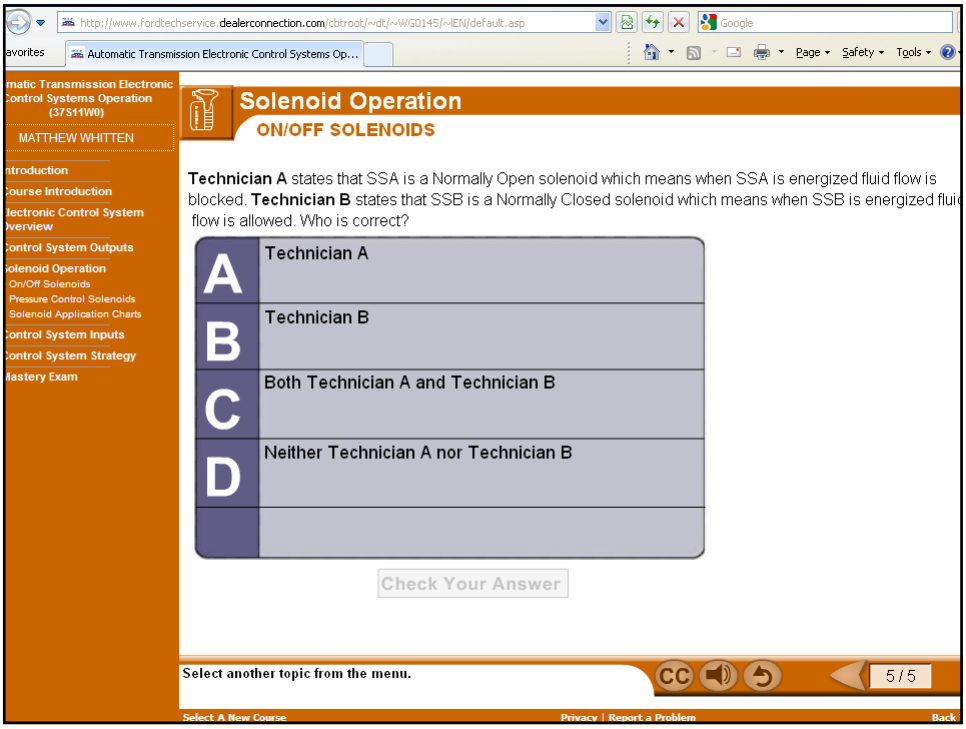
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ON/OFF SOLENOIDS
Technician A states that SSA is a Normally Open solenoid which means when SSA is energized fluid flow is blocked. Technician B states that SSB is a Normally Closed solenoid which means when SSB is energized flui flow is allowed. Who is correct?
A Technician A
B Technician B
C Both Technician A and Technician B
D Neither Technician A nor Technician B
Check Your Answer
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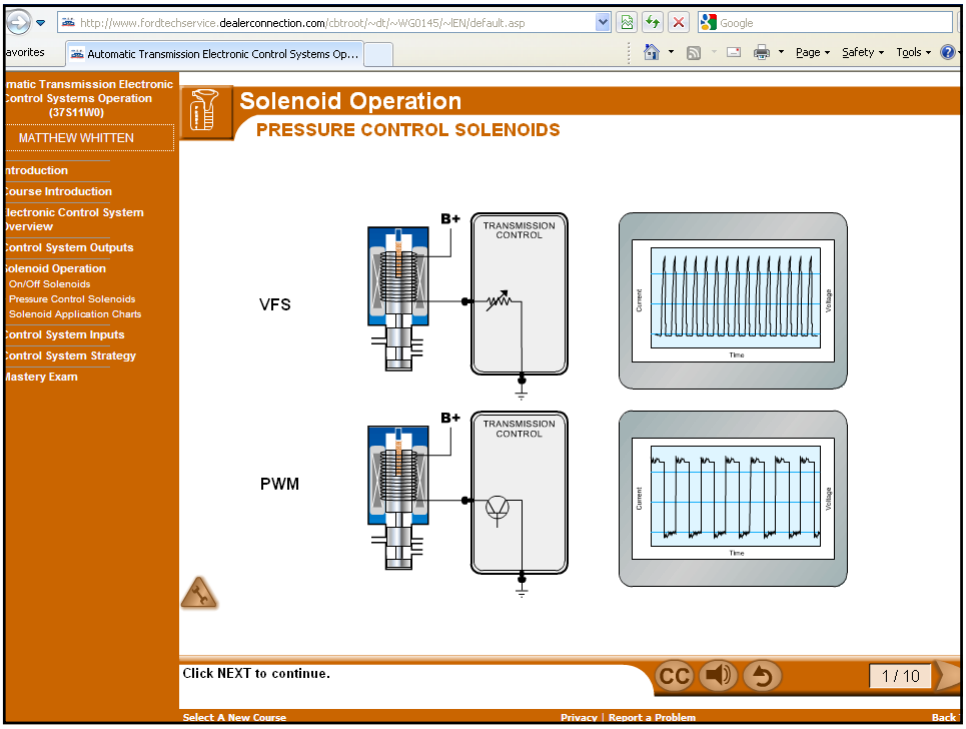
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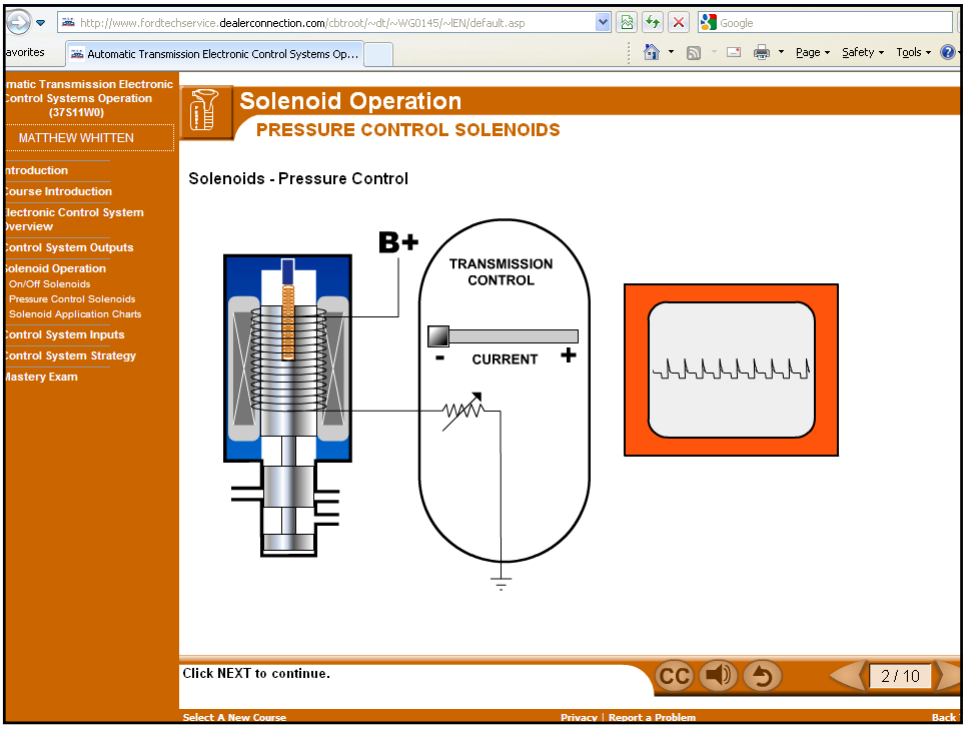
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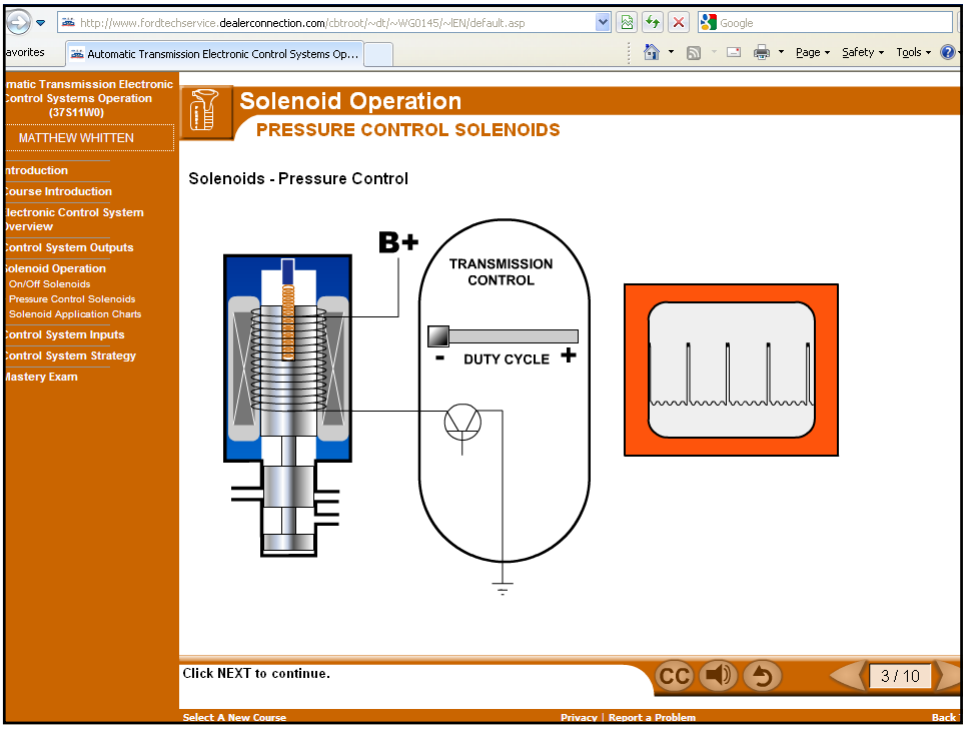
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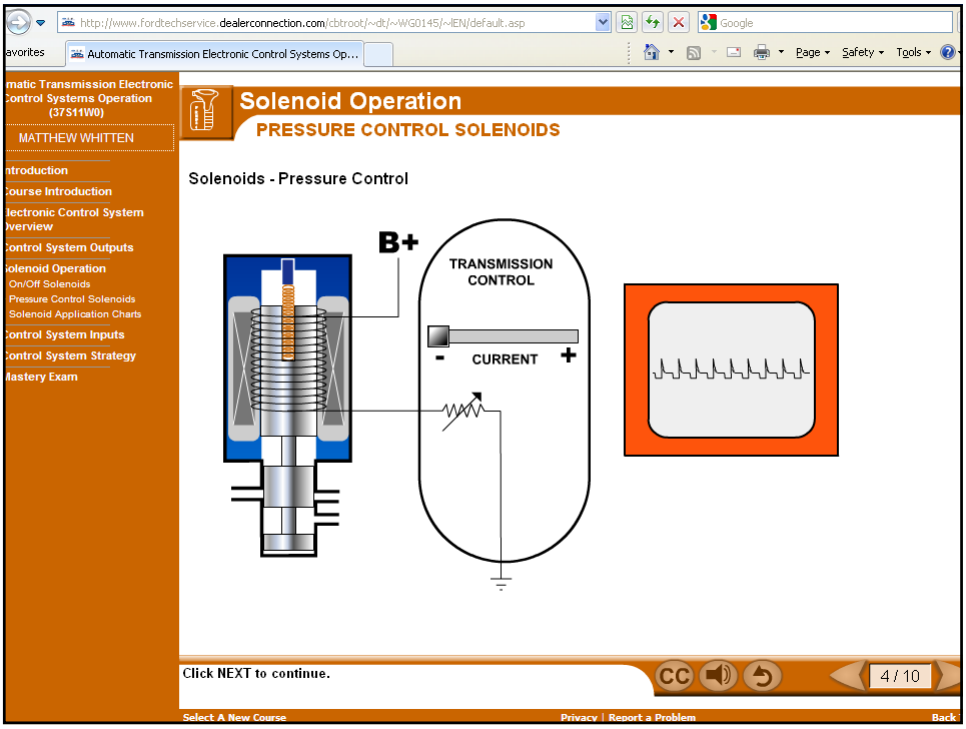
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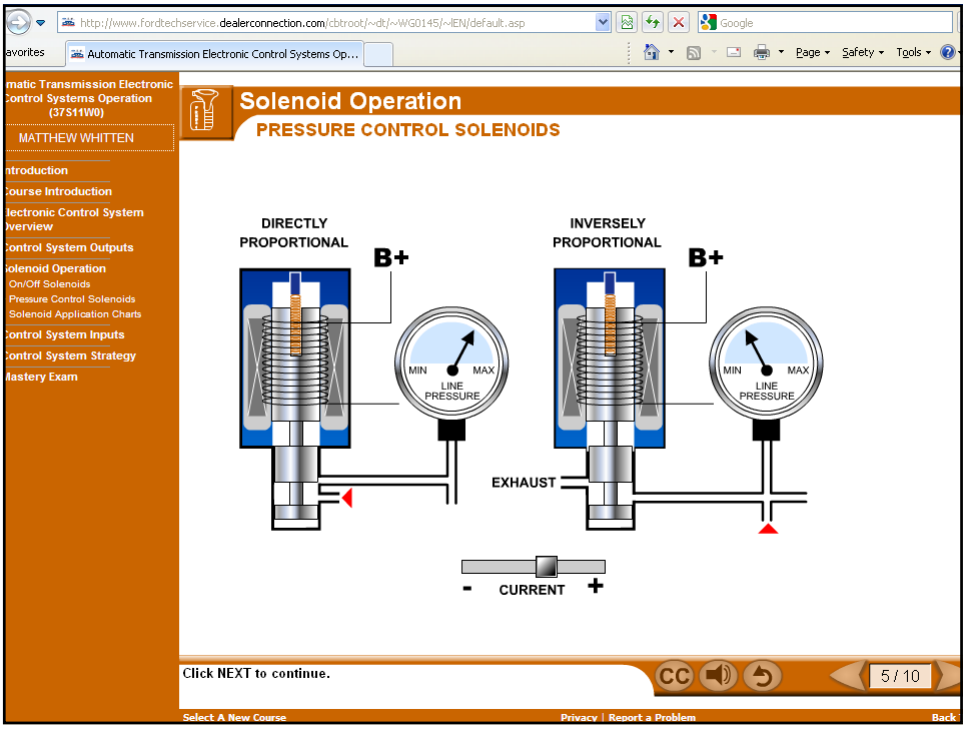
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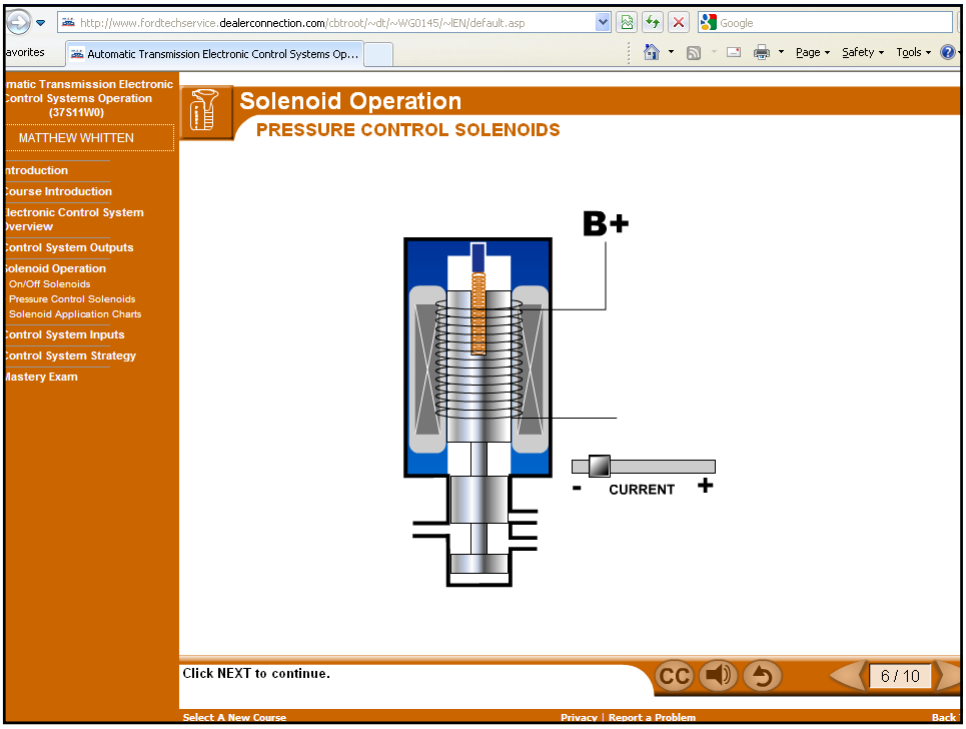
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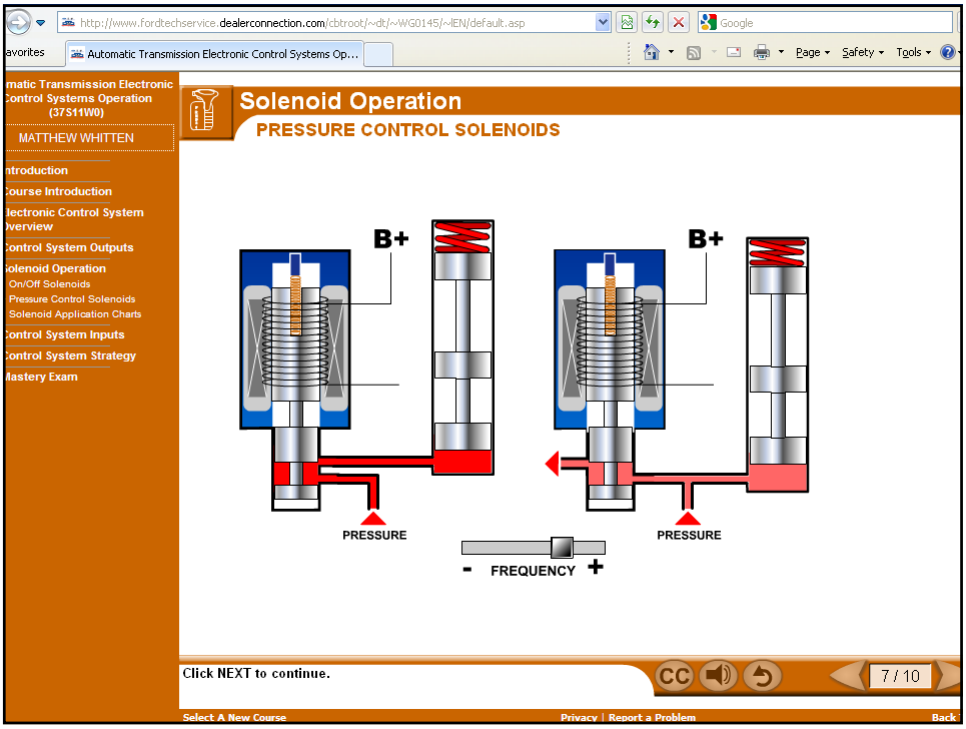
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B+
PRESSURE
PRESSURE
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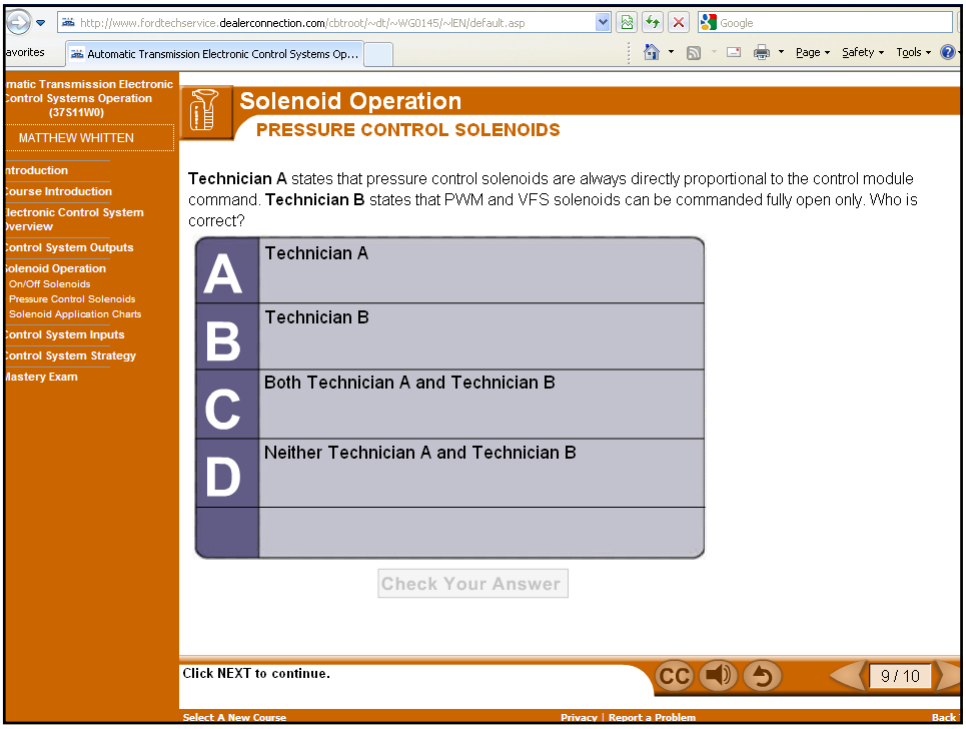
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PRESSURE CONTROL SOLENOIDS
Technician A states that pressure control solenoids are always directly proportional to the control module command. Technician B states that PWM and VFS solenoids can be commanded fully open only. Who is correct?
A Technician A
B Technician B
C Both Technician A and Technician B
D Neither Technician A and Technician B
Check Your Answer
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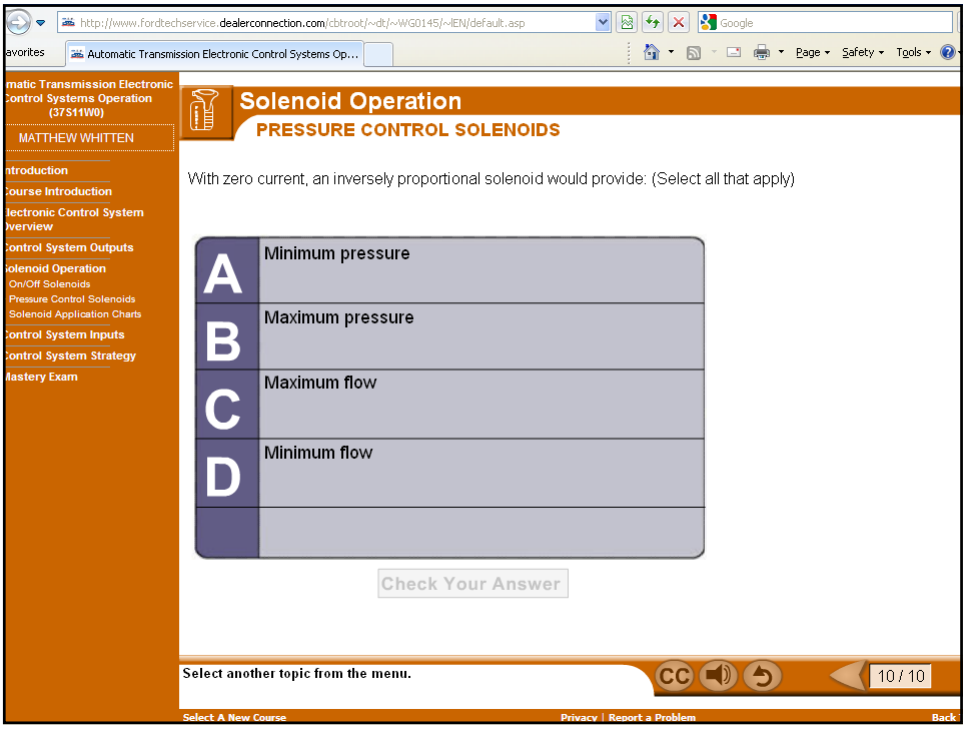
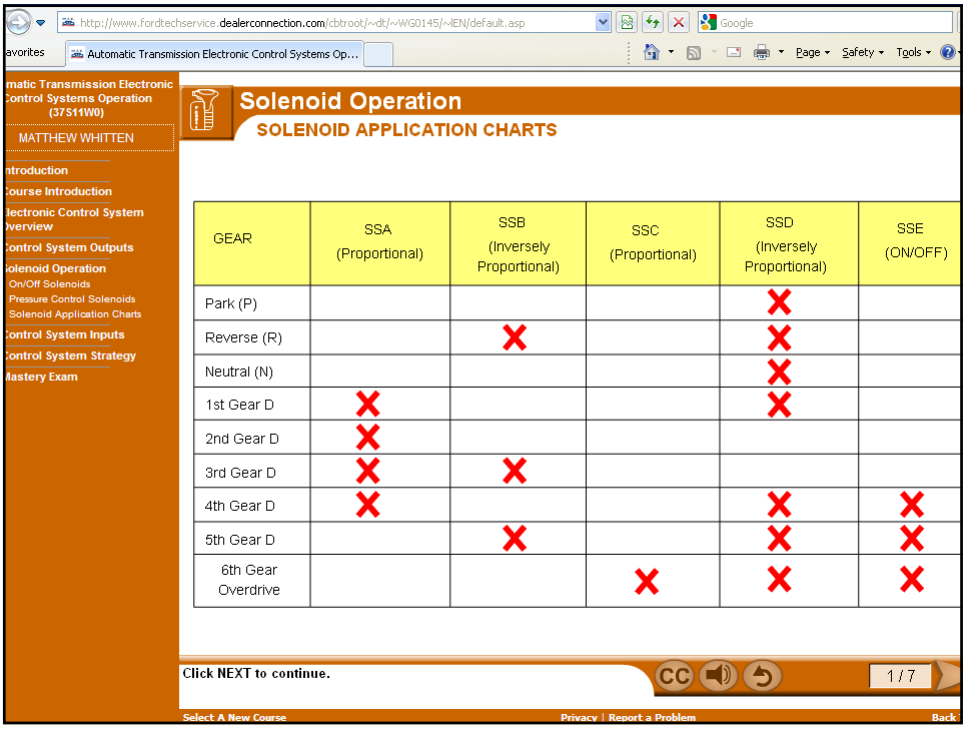
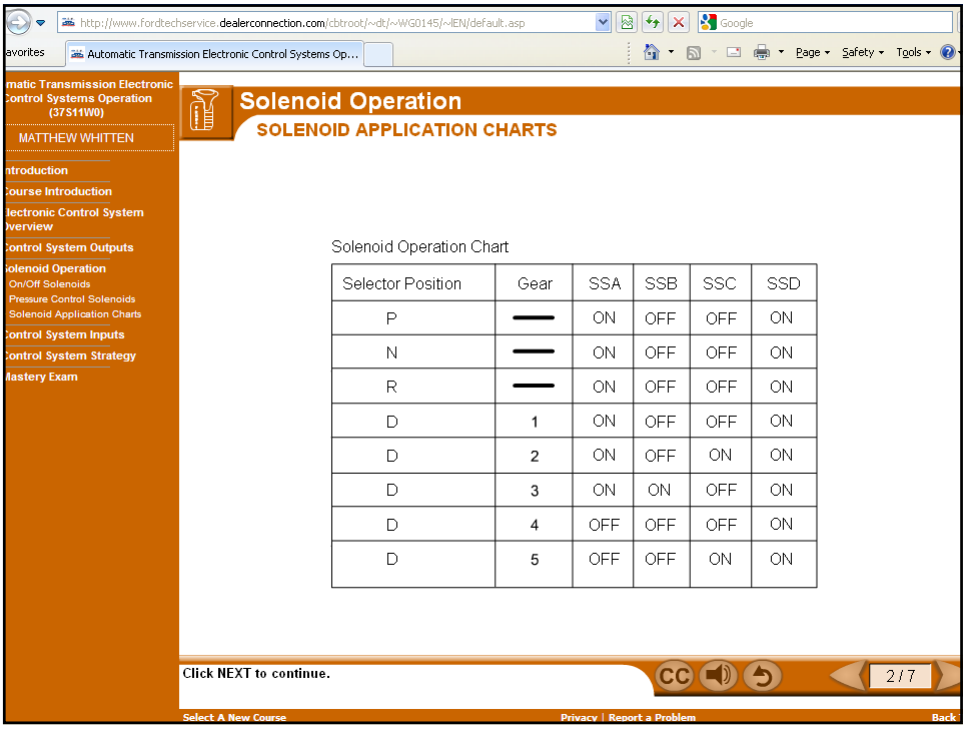




GEAR	SSA (Proportional)	SSB (Inversely Proportional)	SSC (Proportional)	SSD (Inversely Proportional)	SSE (ON/OFF)
Park (P)				X	
Reverse (R)		X		X	
Neutral (N)				X	
1st Gear D	X			X	
2nd Gear D	X				
3rd Gear D	X	X			
4th Gear D	X			X	X
5th Gear D		X		X	X
6th Gear Overdrive			X	X	X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Control System Inputs
Control System Strategy
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Solenoid Operation
SOLENOID APPLICATION CHARTS
Solenoid Operation Chart
Selector Position | Gear | SSA | SSB | SSC | SSD
P | — | ON | OFF | OFF | ON
N | — | ON | OFF | OFF | ON
R | — | ON | OFF | OFF | ON
D | 1 | ON | OFF | OFF | ON
D | 2 | ON | OFF | ON | ON
D | 3 | ON | ON | OFF | ON
D | 4 | OFF | OFF | OFF | ON
D | 5 | OFF | OFF | ON | ON
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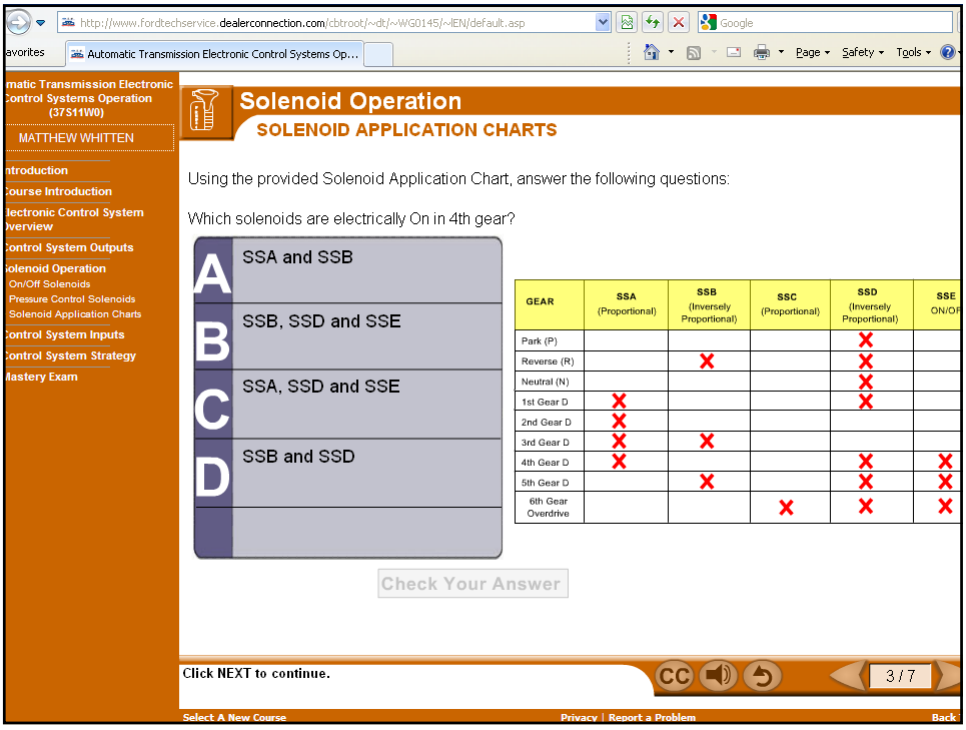
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SOLENOID APPLICATION CHARTS
Using the provided Solenoid Application Chart, answer the following questions:
Which solenoids are electrically On in 4th gear?
A SSA and SSB
B SSB, SSD and SSE
C SSA, SSD and SSE
D SSB and SSD
GEAR | SSA (Proportional) | SSB (Inversely Proportional) | SSC (Proportional) | SSD (Inversely Proportional) | SSE
Park (P) | | | | X |
Reverse (R) | | X | | X |
Neutral (N) | | | | X |
1st Gear D | X | | | X |
2nd Gear D | X | | | |
3rd Gear D | X | X | | |
4th Gear D | X | | | X | X
5th Gear D | | X | | X | X
6th Gear Overdrive | | | X | X | X
Check Your Answer
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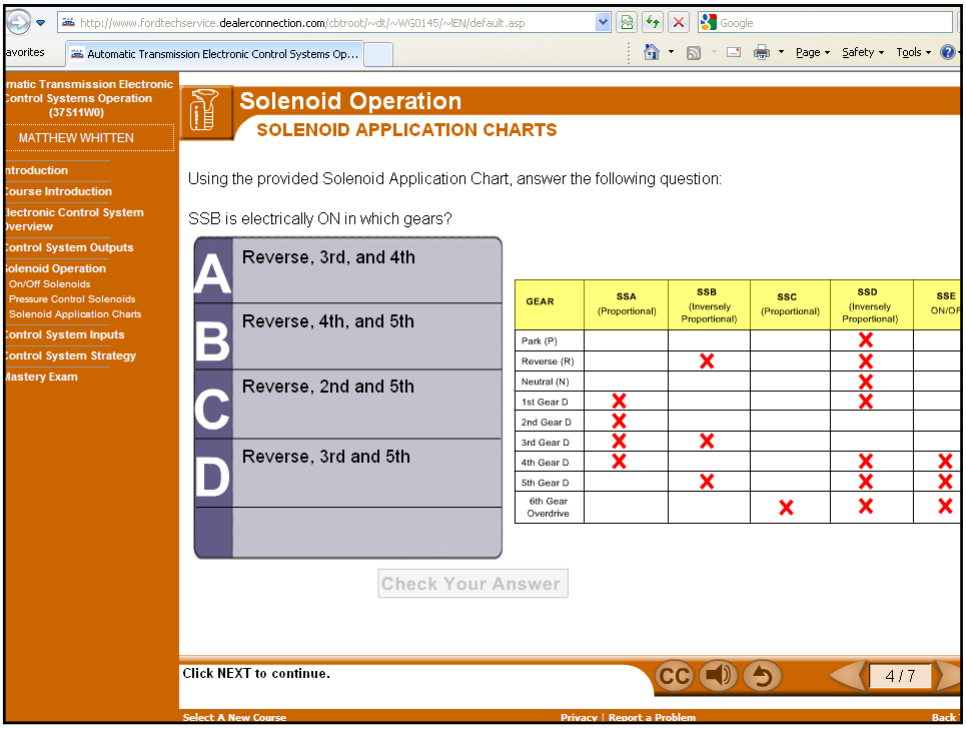
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SOLENOID APPLICATION CHARTS
Using the provided Solenoid Application Chart, answer the following question:
SSB is electrically ON in which gears?
A Reverse, 3rd, and 4th
B Reverse, 4th, and 5th
C Reverse, 2nd and 5th
D Reverse, 3rd and 5th
Check Your Answer
GEAR | SSA (Proportional) | SSB (Inversely Proportional) | SSC (Proportional) | SSD (Inversely Proportional) | SSE ON/OFF
Park (P) | | | | X |
Reverse (R) | | X | | X |
Neutral (N) | | | | X |
1st Gear D | X | | | X |
2nd Gear D | X | | | |
3rd Gear D | X | X | | |
4th Gear D | X | | | X | X
5th Gear D | | X | | X | X
6th Gear Overdrive | | | X | X | X
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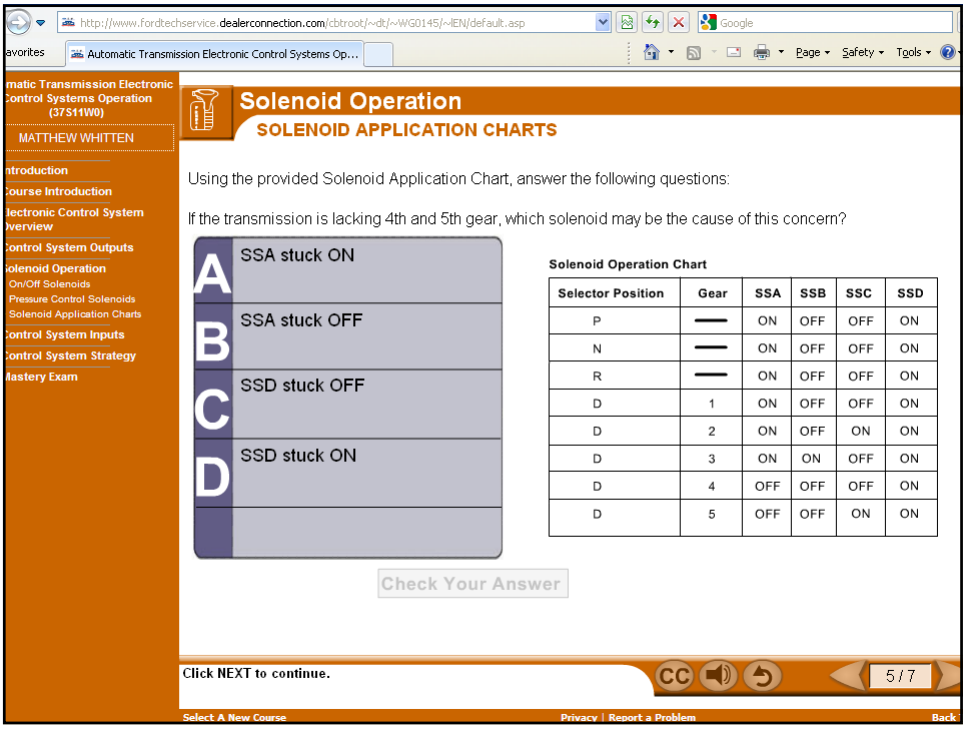
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SOLENOID APPLICATION CHARTS
Using the provided Solenoid Application Chart, answer the following questions:
If the transmission is lacking 4th and 5th gear, which solenoid may be the cause of this concern?
A SSA stuck ON
B SSA stuck OFF
C SSD stuck OFF
D SSD stuck ON
Check Your Answer
Solenoid Operation Chart
Selector Position | Gear | SSA | SSB | SSC | SSD
P | — | ON | OFF | OFF | ON
N | — | ON | OFF | OFF | ON
R | — | ON | OFF | OFF | ON
D | 1 | ON | OFF | OFF | ON
D | 2 | ON | OFF | ON | ON
D | 3 | ON | ON | OFF | ON
D | 4 | OFF | OFF | OFF | ON
D | 5 | OFF | OFF | ON | ON
Click NEXT to continue.
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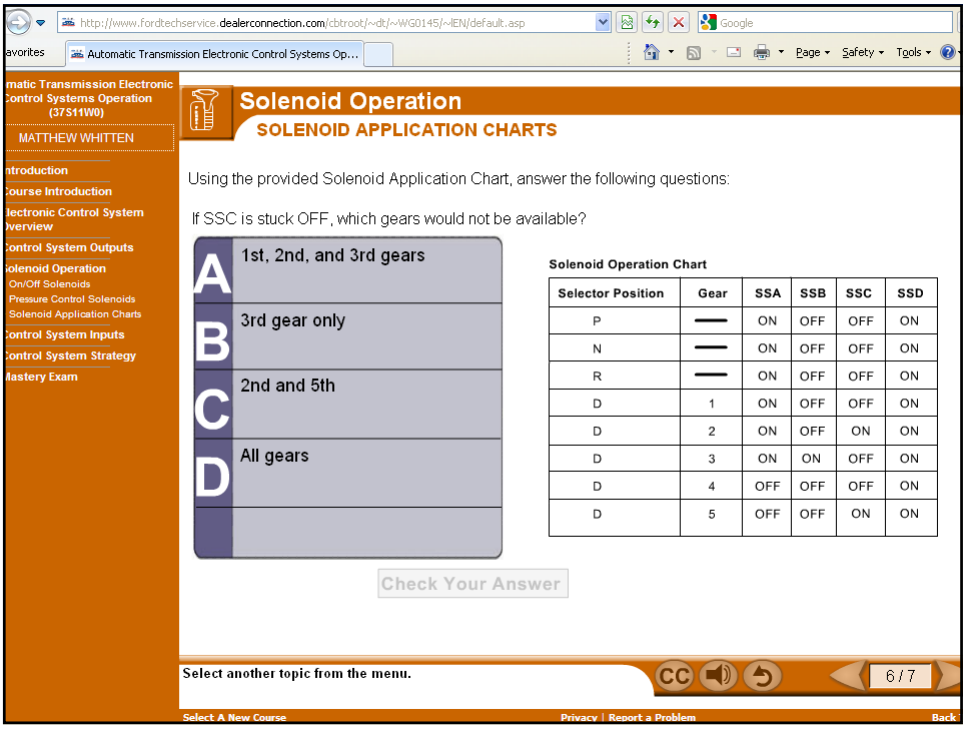
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SOLENOID APPLICATION CHARTS
Using the provided Solenoid Application Chart, answer the following questions:
If SSC is stuck OFF, which gears would not be available?
A 1st, 2nd, and 3rd gears
B 3rd gear only
C 2nd and 5th
D All gears
Check Your Answer
Solenoid Operation Chart
Selector Position | Gear | SSA | SSB | SSC | SSD
P | — | ON | OFF | OFF | ON
N | — | ON | OFF | OFF | ON
R | — | ON | OFF | OFF | ON
D | 1 | ON | OFF | OFF | ON
D | 2 | ON | OFF | ON | ON
D | 3 | ON | ON | OFF | ON
D | 4 | OFF | OFF | OFF | ON
D | 5 | OFF | OFF | ON | ON
Select another topic from the menu.
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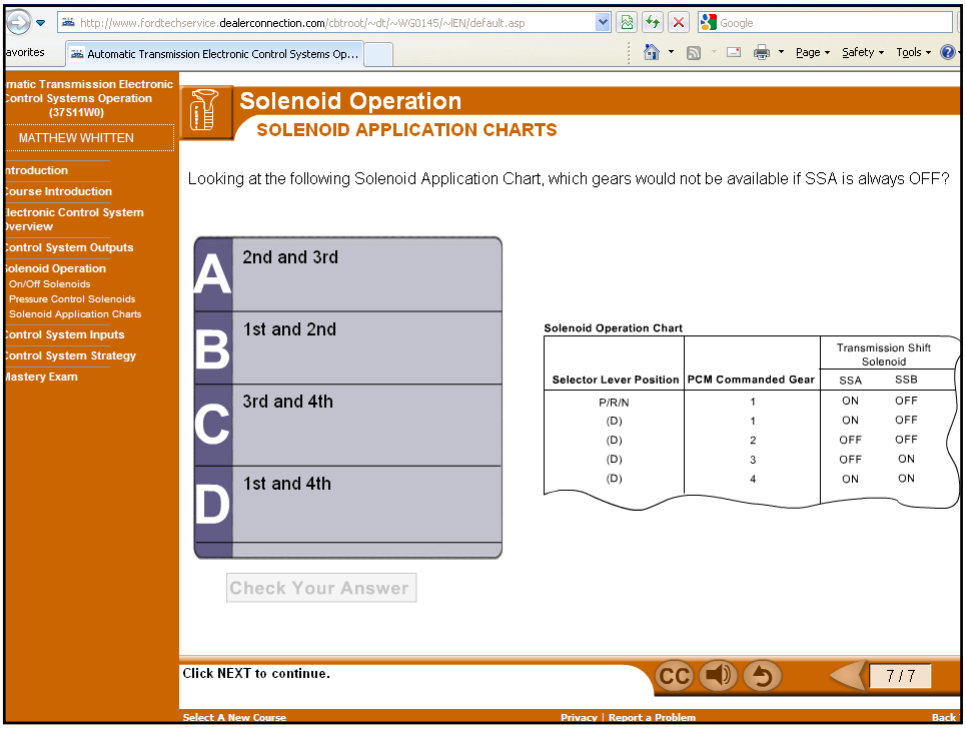
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SOLENOID APPLICATION CHARTS
Looking at the following Solenoid Application Chart, which gears would not be available if SSA is always OFF?
A 2nd and 3rd
B 1st and 2nd
C 3rd and 4th
D 1st and 4th
Check Your Answer
Solenoid Operation Chart
Selector Lever Position | PCM Commanded Gear | Transmission Shift Solenoid SSA | SSB
P/R/N | 1 | ON | OFF
(D) | 1 | ON | OFF
(D) | 2 | OFF | OFF
(D) | 3 | OFF | ON
(D) | 4 | ON | ON
Click NEXT to continue.
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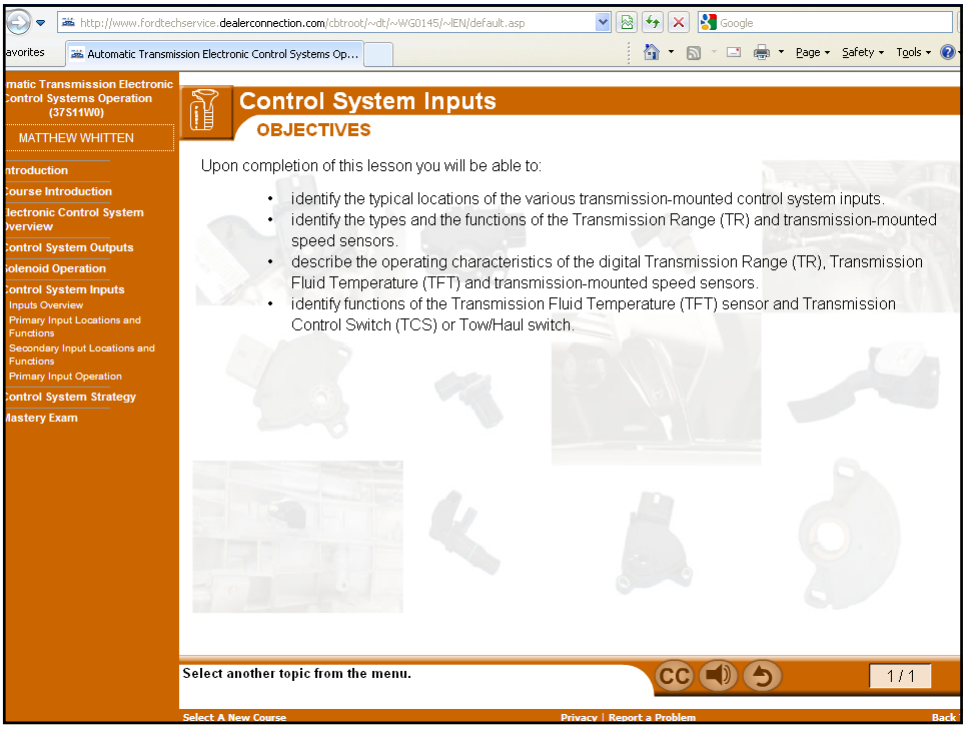
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Control System Inputs
OBJECTIVES
Upon completion of this lesson you will be able to:
identify the typical locations of the various transmission-mounted control system inputs.
identify the types and the functions of the Transmission Range (TR) and transmission-mounted speed sensors.
describe the operating characteristics of the digital Transmission Range (TR), Transmission Fluid Temperature (TFT) and transmission-mounted speed sensors.
identify functions of the Transmission Fluid Temperature (TFT) sensor and Transmission Control Switch (TCS) or Tow/Haul switch.
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TR
TFT
ISS
TSS
ECT/ CHT
BPP
APP
IAT
MAF
CKP
A/C
ENGINE CONTROLLER
ENGINE TORQUE ESTIMATE
TRANSMISSION CONTROLLER
ABS CONTROLLER
OSS
WSS
4X4 CONTROLLER
4WD
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TSS
TRANSMISSION CONTROLLER
OSS
TCS
ENGINE CONTROLLER
ENGINE TORQUE ESTIMATE
BPP
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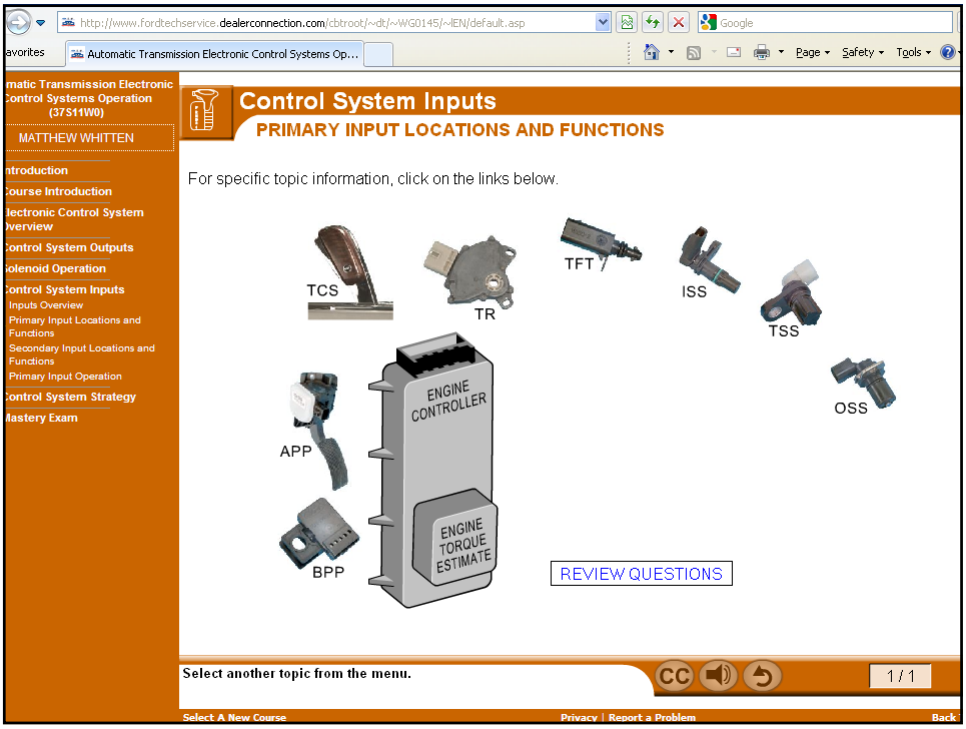
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For specific topic information, click on the links below.
TCS
TR
TFT
ISS
TSS
OSS
APP
BPP
ENGINE CONTROLLER
ENGINE TORQUE ESTIMATE
REVIEW QUESTIONS
Select another topic from the menu.
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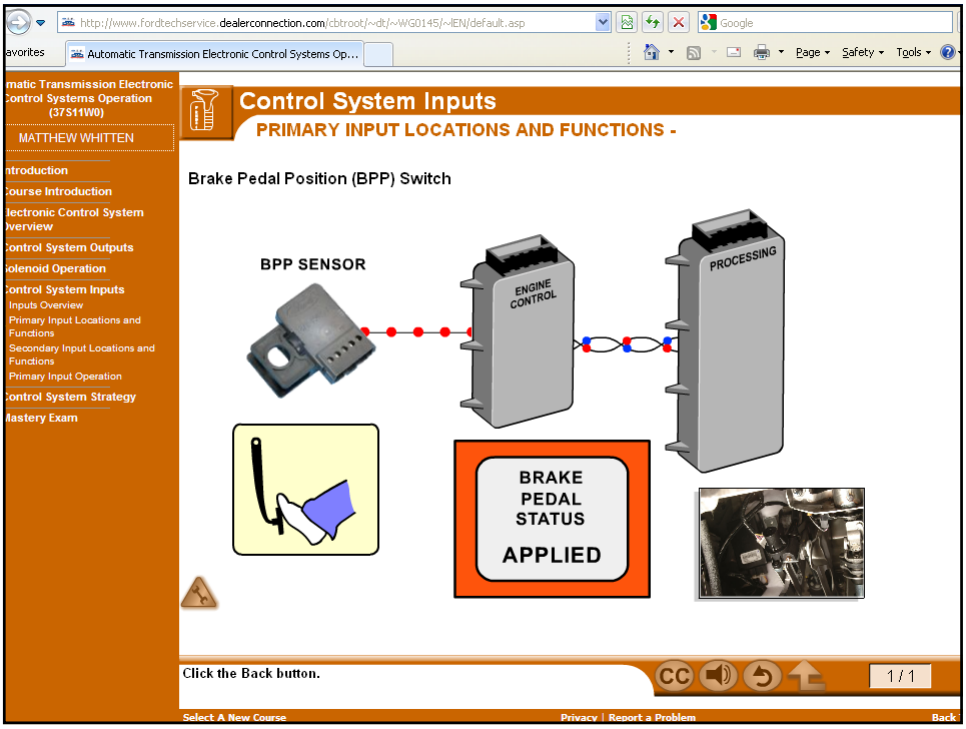
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PRIMARY INPUT LOCATIONS AND FUNCTIONS -
Brake Pedal Position (BPP) Switch
BPP SENSOR
ENGINE CONTROL
PROCESSING
BRAKE PEDAL STATUS
APPLIED
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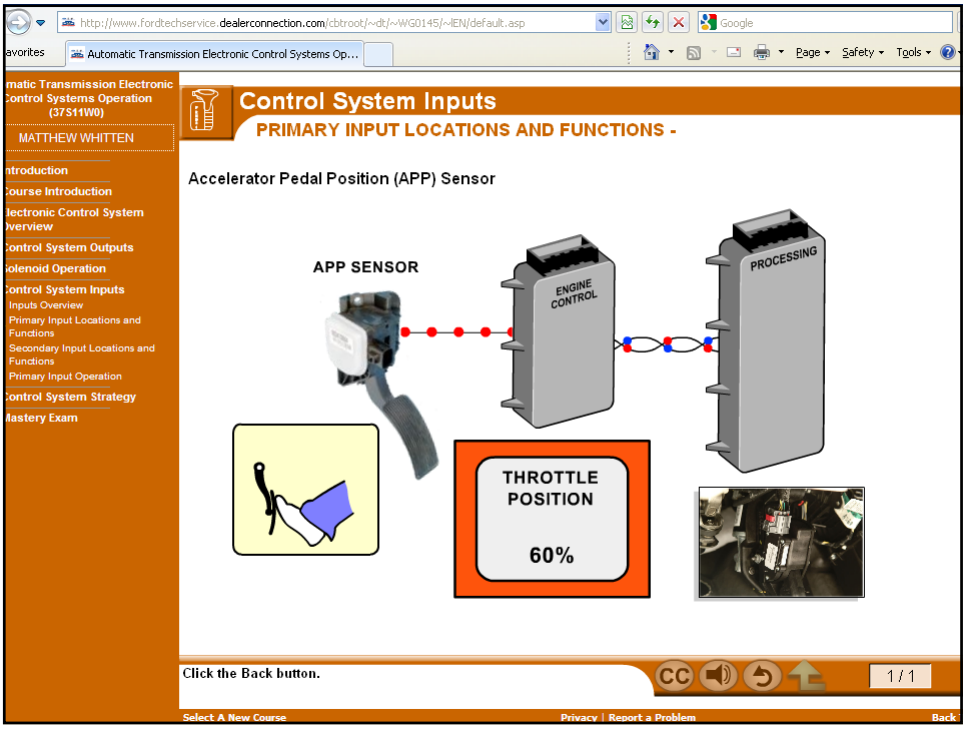
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Accelerator Pedal Position (APP) Sensor
APP SENSOR
ENGINE CONTROL
PROCESSING
THROTTLE POSITION
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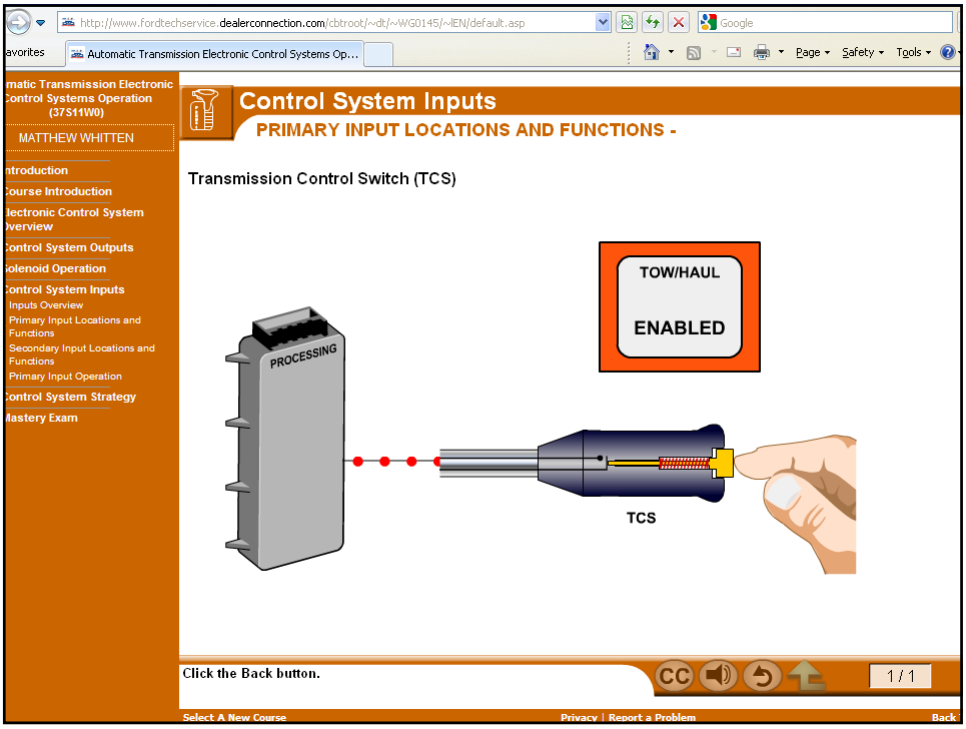
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Transmission Control Switch (TCS)
TOW/HAUL
ENABLED
PROCESSING
TCS
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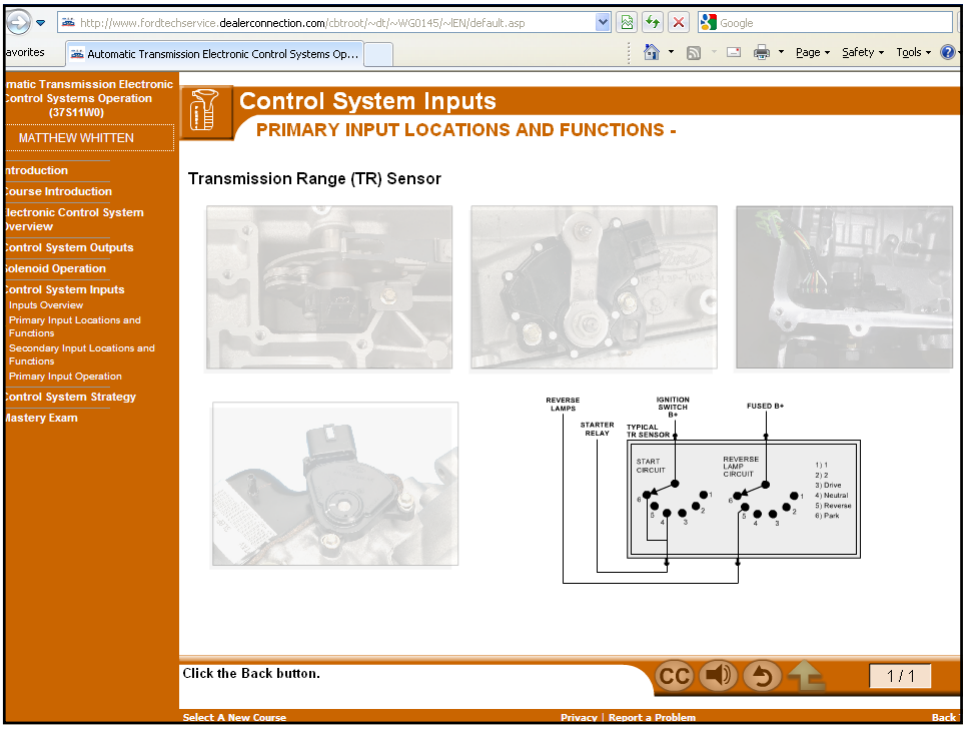
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PRIMARY INPUT LOCATIONS AND FUNCTIONS -
Transmission Range (TR) Sensor
REVERSE LAMPS
IGNITION SWITCH B+
FUSED B+
STARTER RELAY
TYPICAL TR SENSOR
START CIRCUIT
REVERSE LAMP CIRCUIT
1) 1
2) 2
3) Drive
4) Neutral
5) Reverse
6) Park
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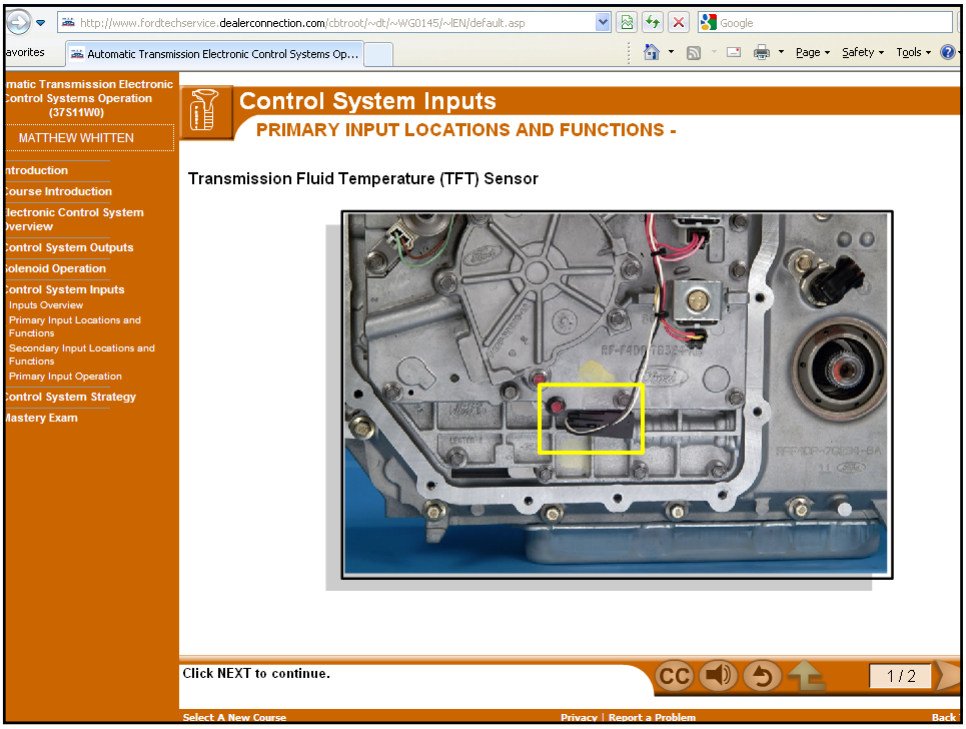
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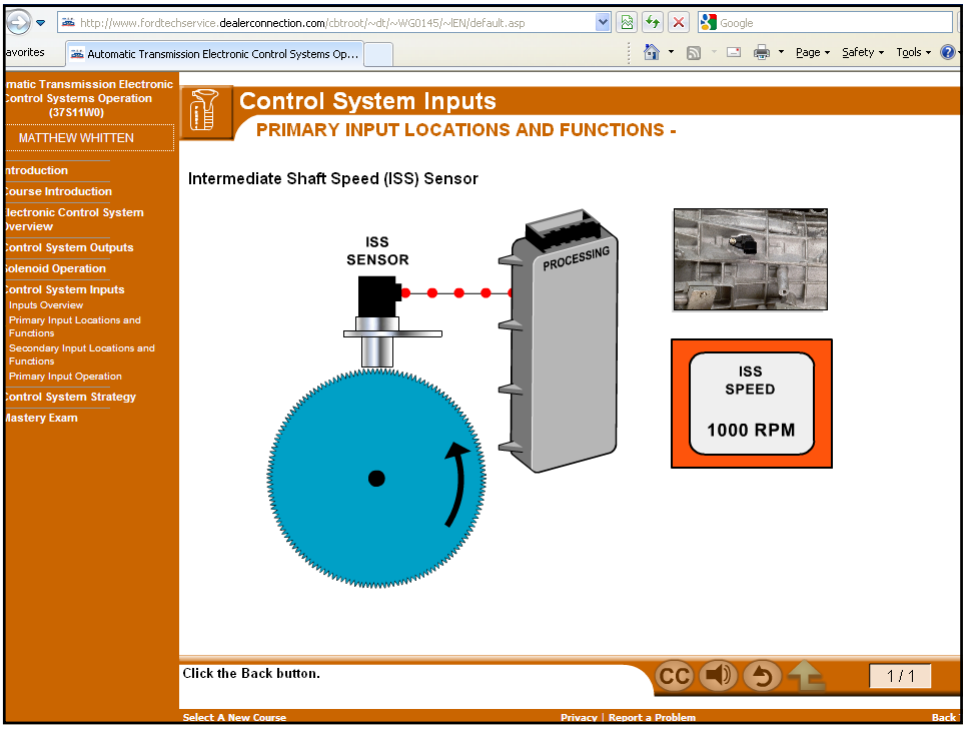
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ISS SENSOR
PROCESSING
ISS SPEED
1000 RPM
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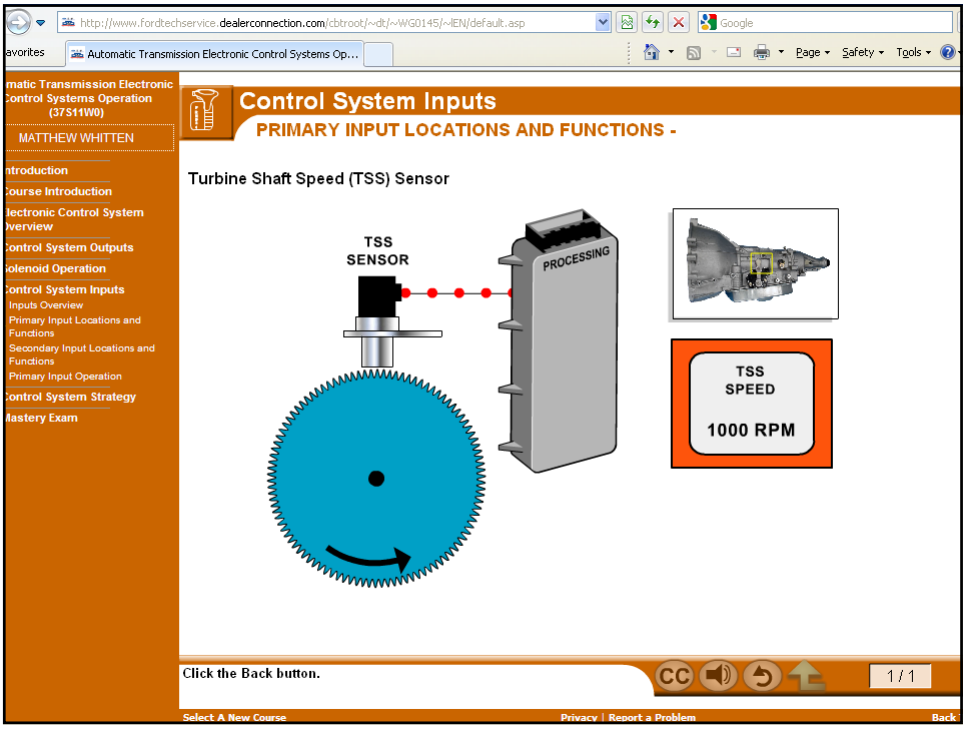
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TSS SENSOR
PROCESSING
TSS SPEED
1000 RPM
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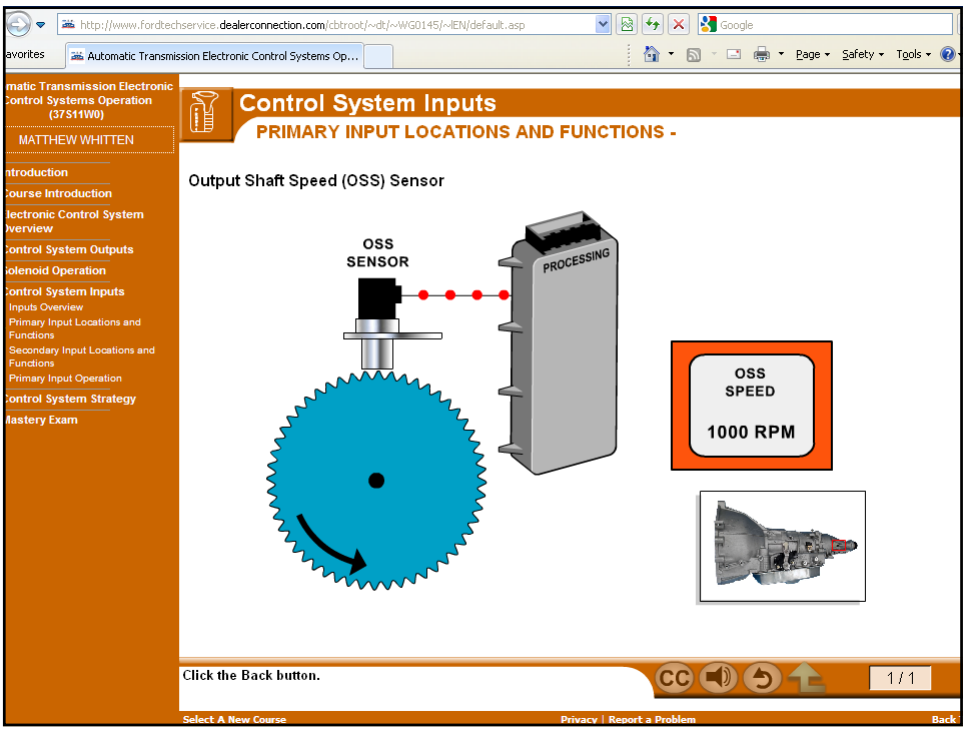
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PRIMARY INPUT LOCATIONS AND FUNCTIONS -
Output Shaft Speed (OSS) Sensor
OSS SENSOR
PROCESSING
OSS SPEED
1000 RPM
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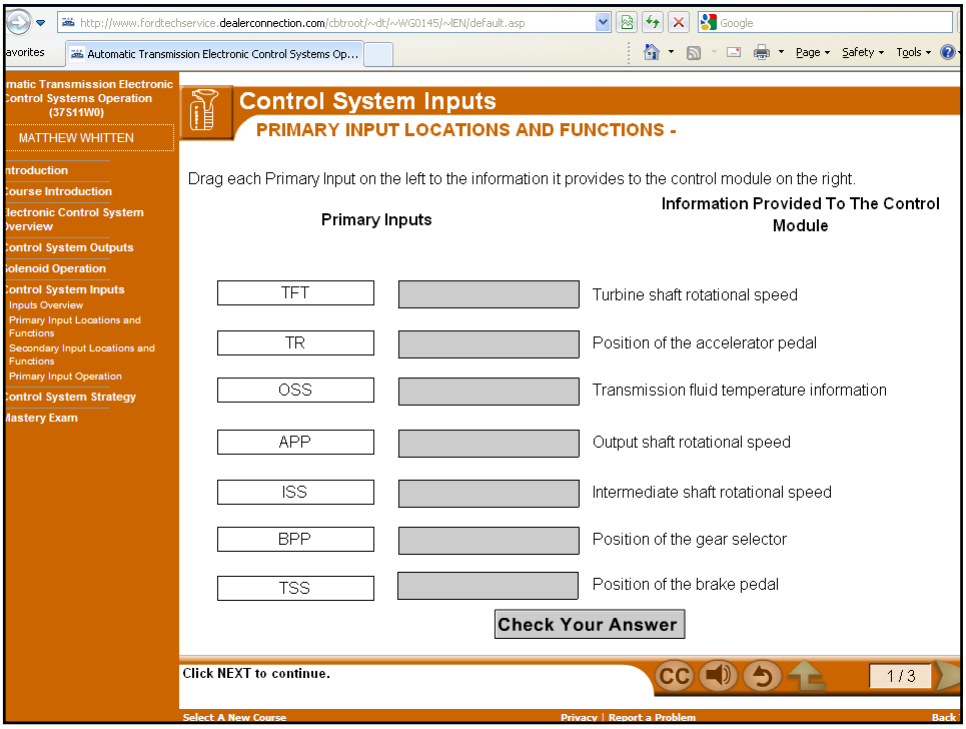
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PRIMARY INPUT LOCATIONS AND FUNCTIONS -
Drag each Primary Input on the left to the information it provides to the control module on the right.
Primary Inputs
Information Provided To The Control Module
TFT
TR
OSS
APP
ISS
BPP
TSS
Turbine shaft rotational speed
Position of the accelerator pedal
Transmission fluid temperature information
Output shaft rotational speed
Intermediate shaft rotational speed
Position of the gear selector
Position of the brake pedal
Check Your Answer
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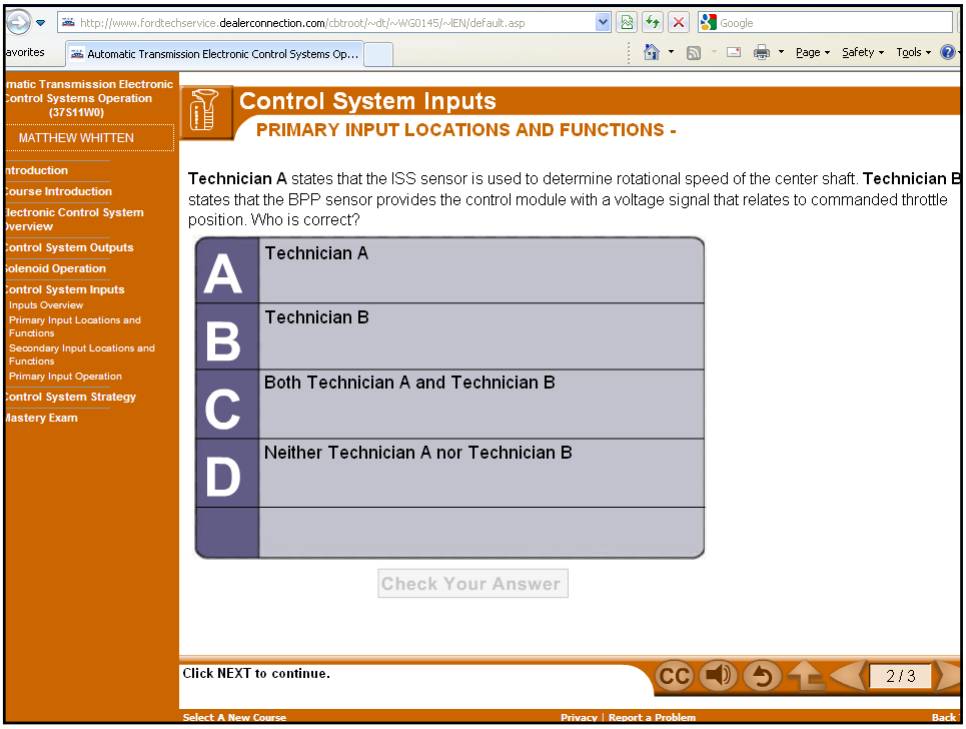
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PRIMARY INPUT LOCATIONS AND FUNCTIONS -
Technician A states that the ISS sensor is used to determine rotational speed of the center shaft. Technician B states that the BPP sensor provides the control module with a voltage signal that relates to commanded throttle position. Who is correct?
A Technician A
B Technician B
C Both Technician A and Technician B
D Neither Technician A nor Technician B
Check Your Answer
Click NEXT to continue.
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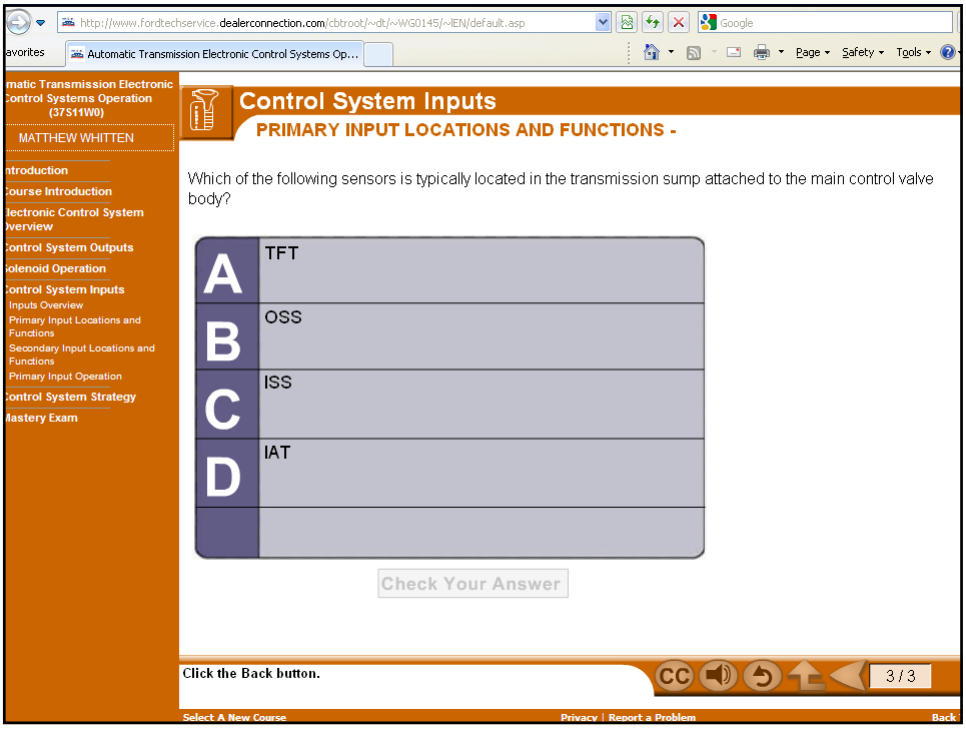
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PRIMARY INPUT LOCATIONS AND FUNCTIONS -
Which of the following sensors is typically located in the transmission sump attached to the main control valve body?
A TFT
B OSS
C ISS
D IAT
Check Your Answer
Click the Back button.
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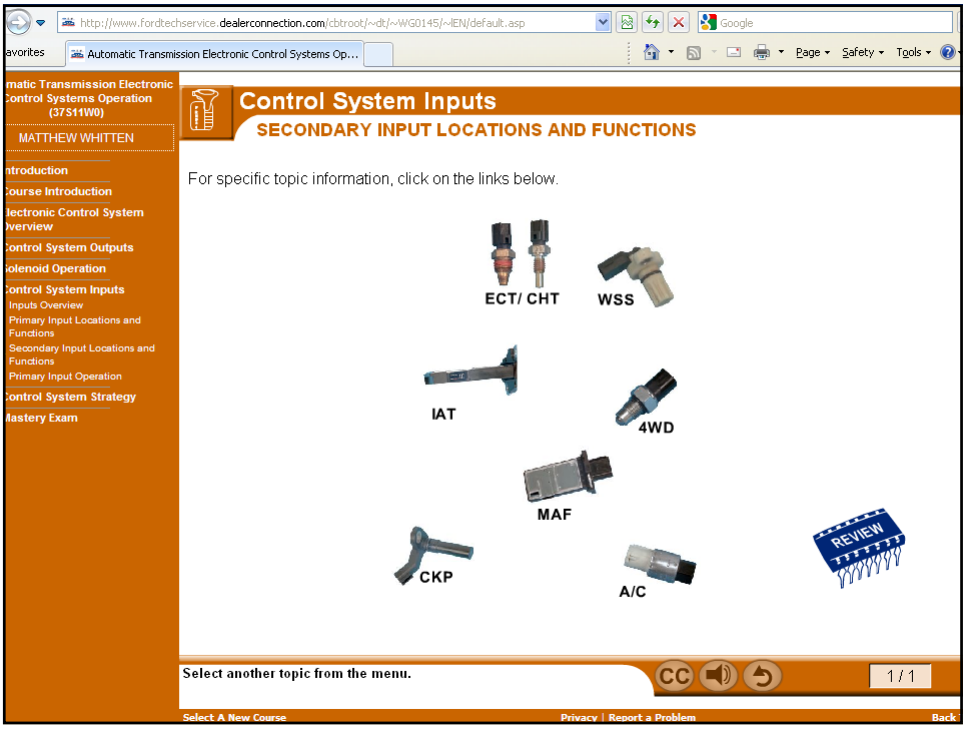
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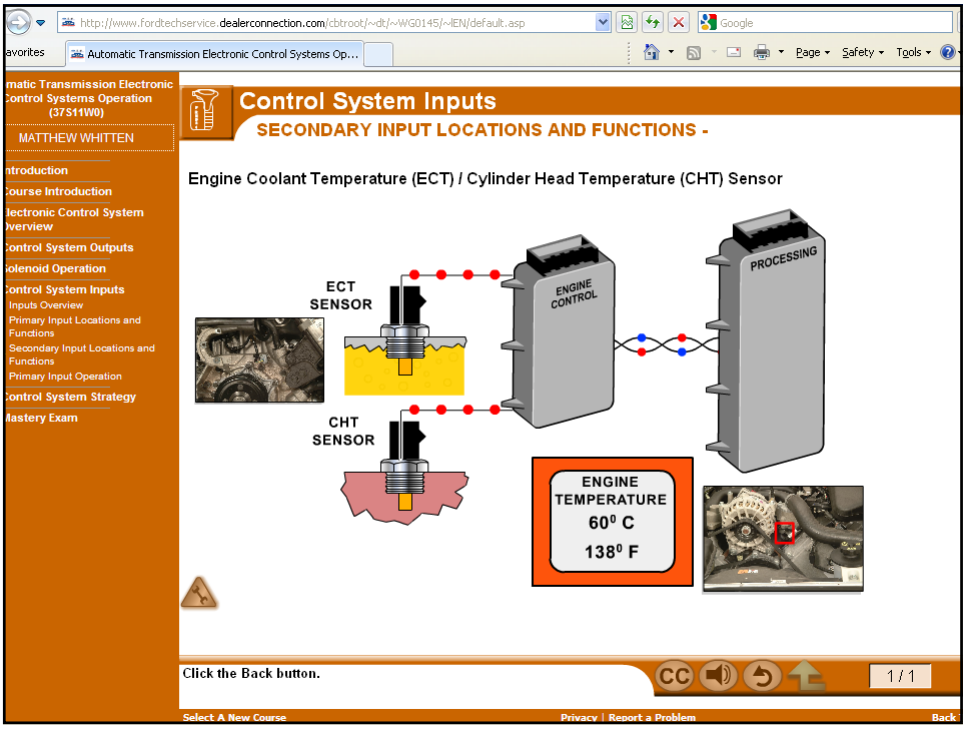
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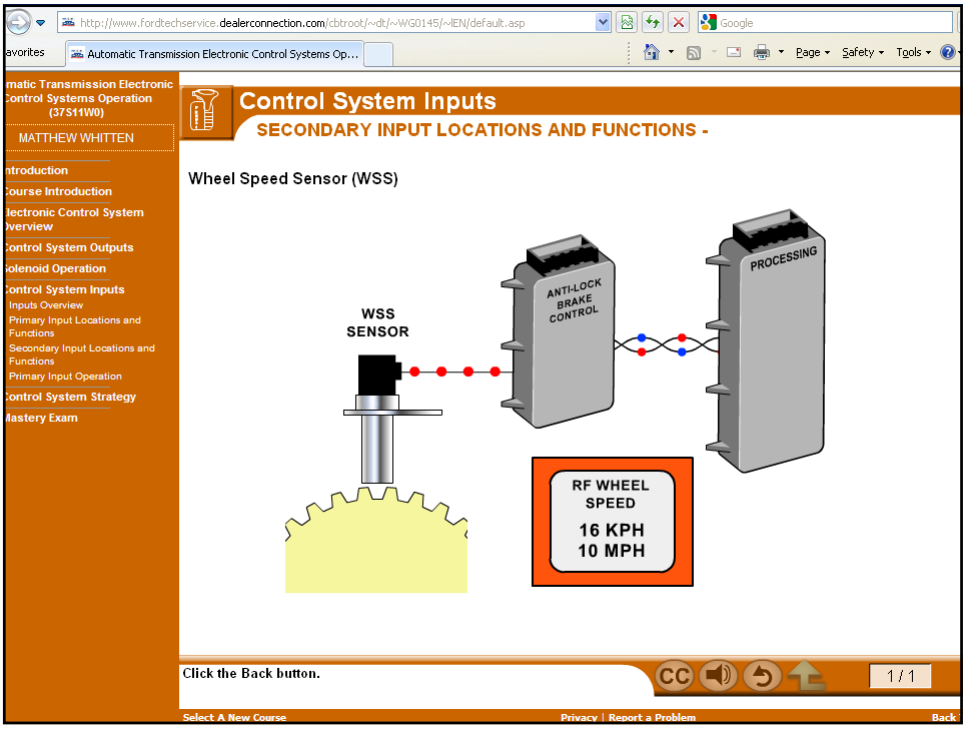
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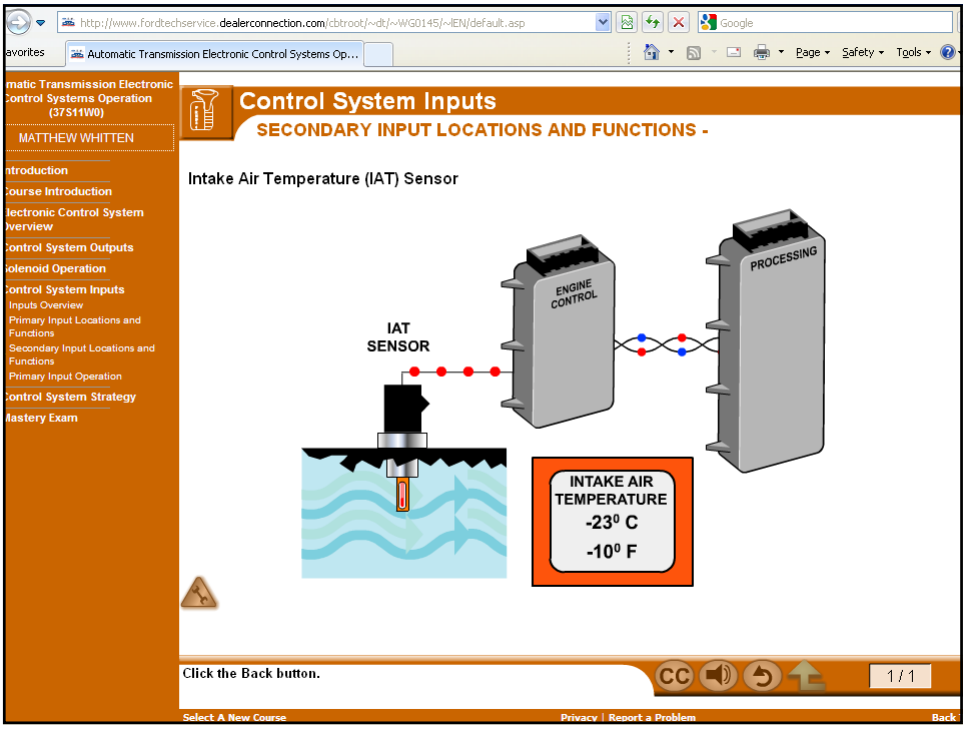
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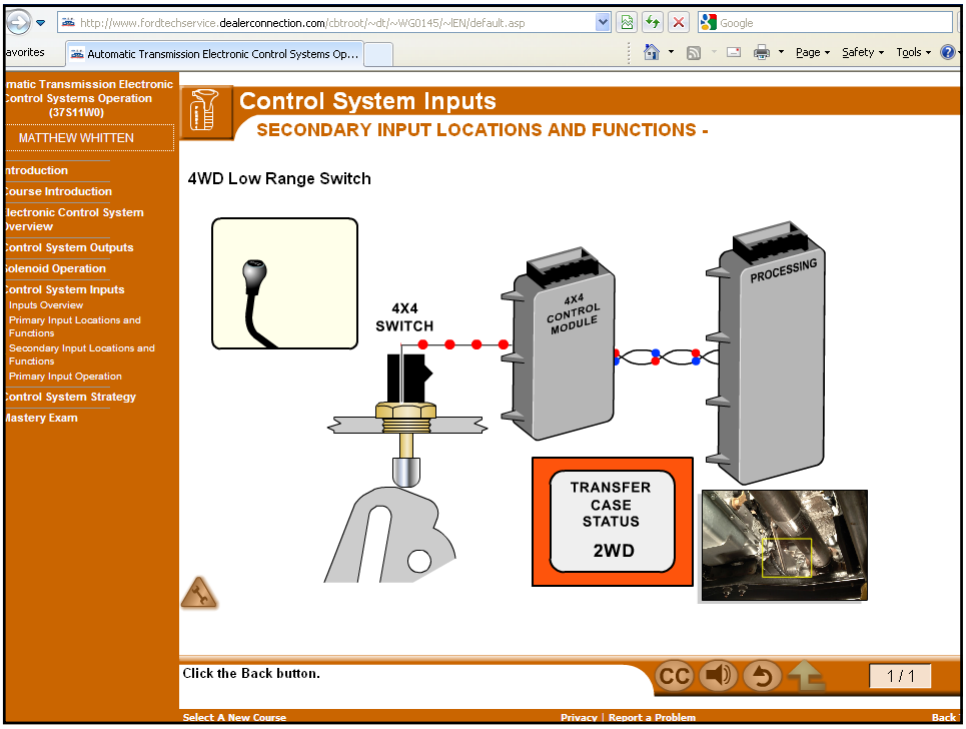
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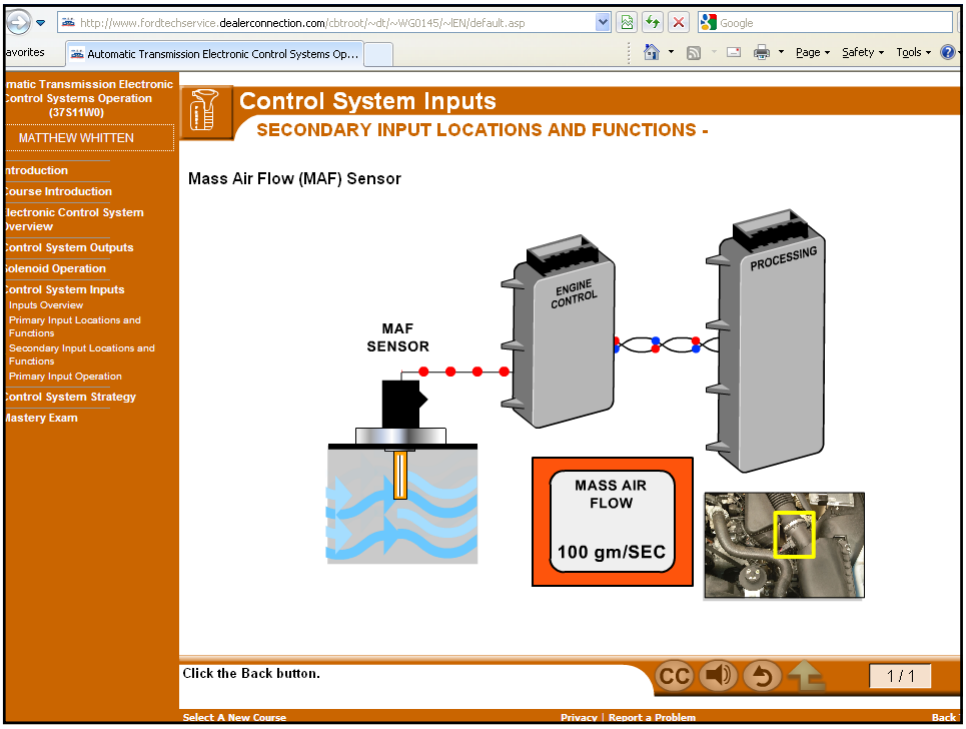
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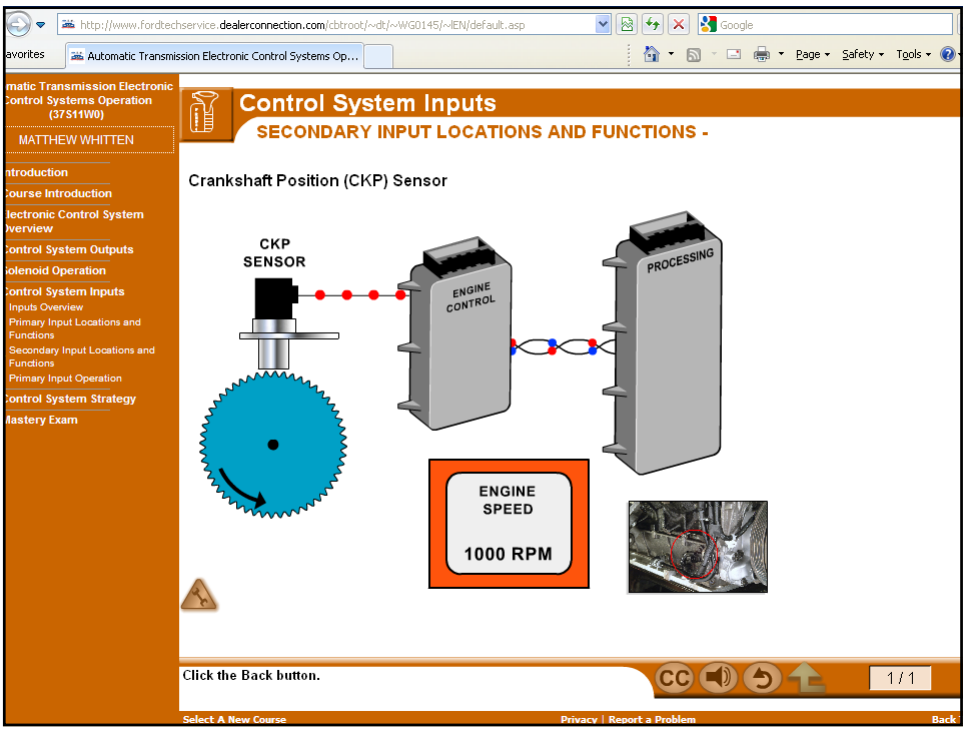
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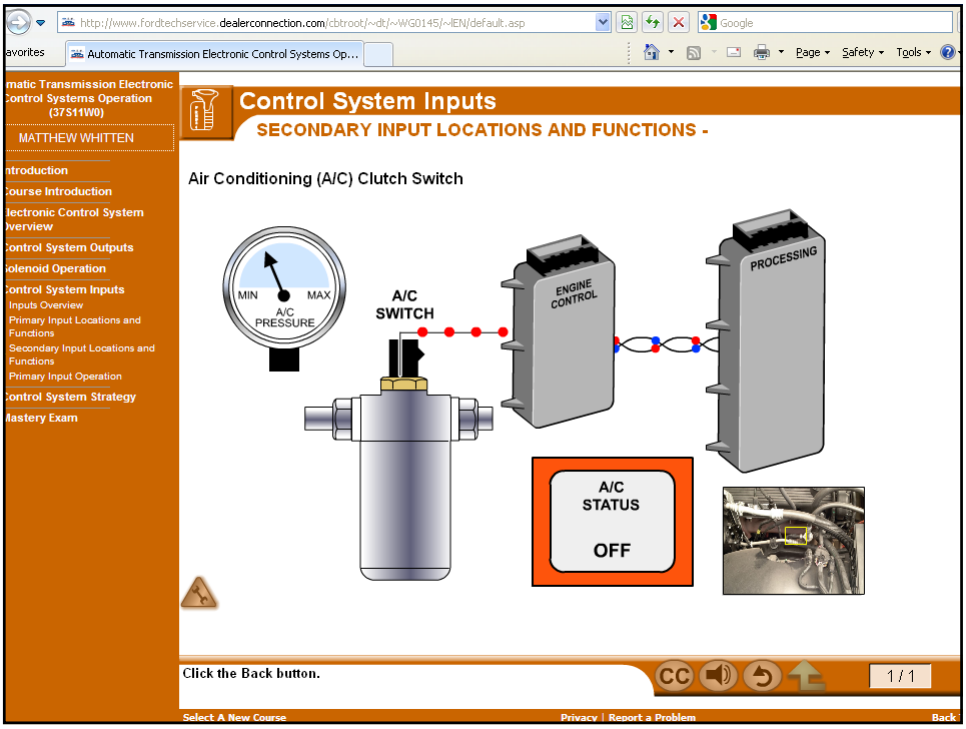
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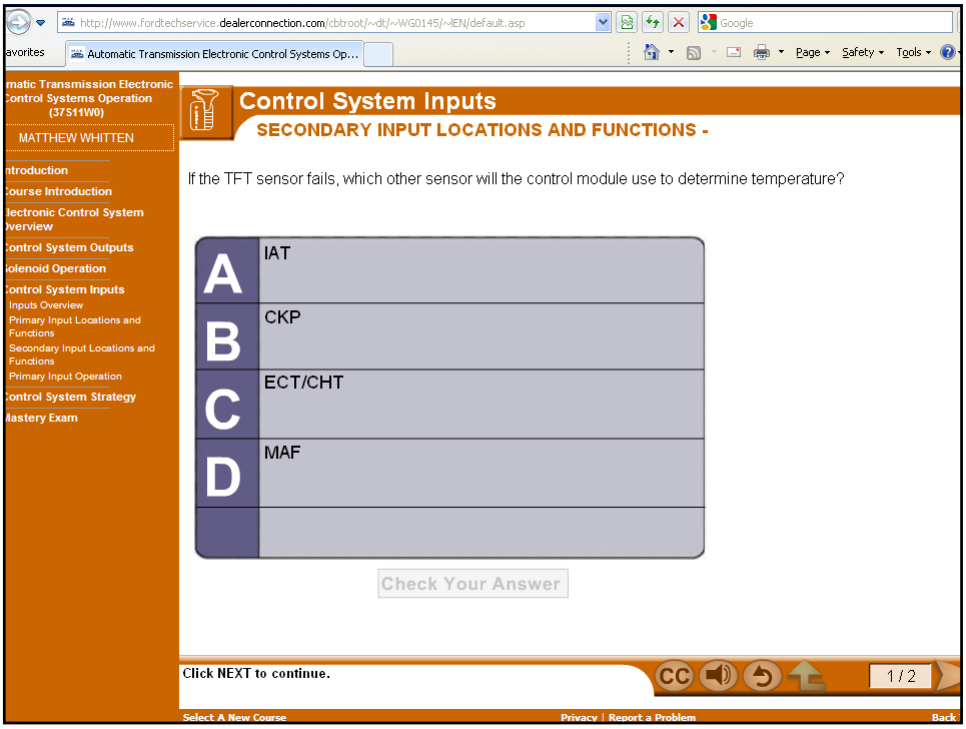
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If the TFT sensor fails, which other sensor will the control module use to determine temperature?
A IAT
B CKP
C ECT/CHT
D MAF
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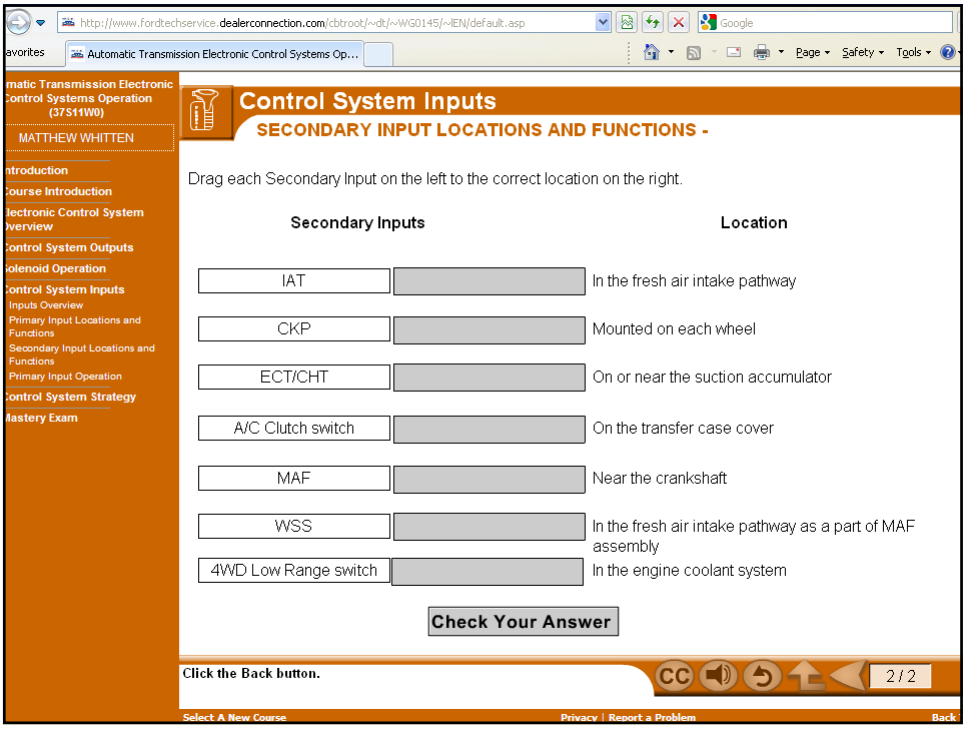
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SECONDARY INPUT LOCATIONS AND FUNCTIONS -
Drag each Secondary Input on the left to the correct location on the right.
Secondary Inputs
Location
IAT
In the fresh air intake pathway
CKP
Mounted on each wheel
ECT/CHT
On or near the suction accumulator
A/C Clutch switch
On the transfer case cover
MAF
Near the crankshaft
WSS
In the fresh air intake pathway as a part of MAF assembly
4WD Low Range switch
In the engine coolant system
Check Your Answer
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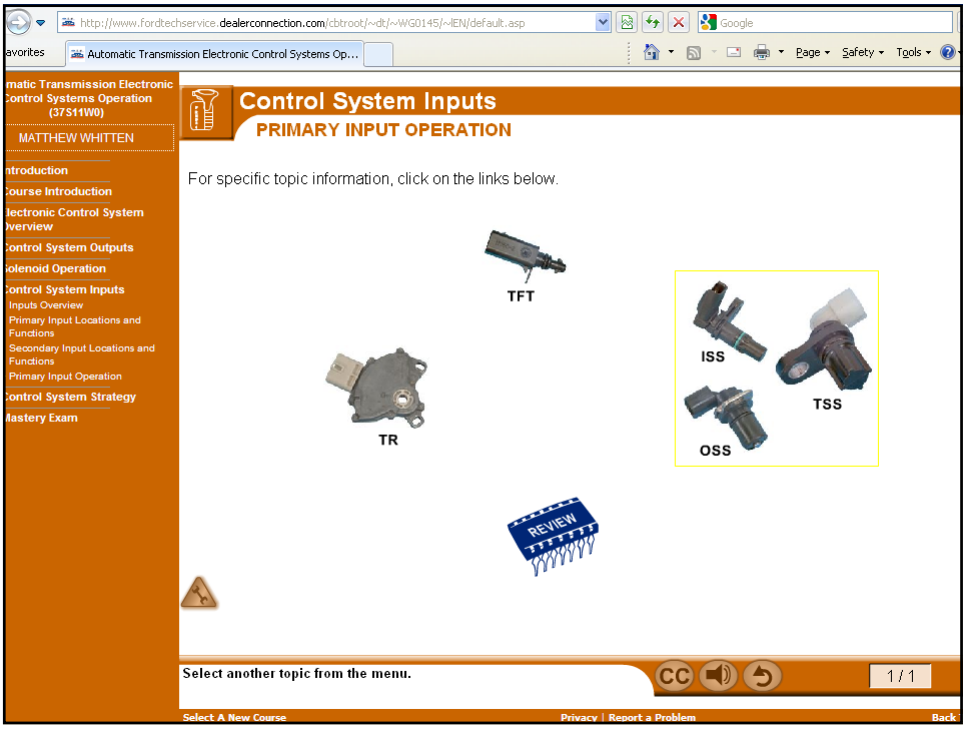
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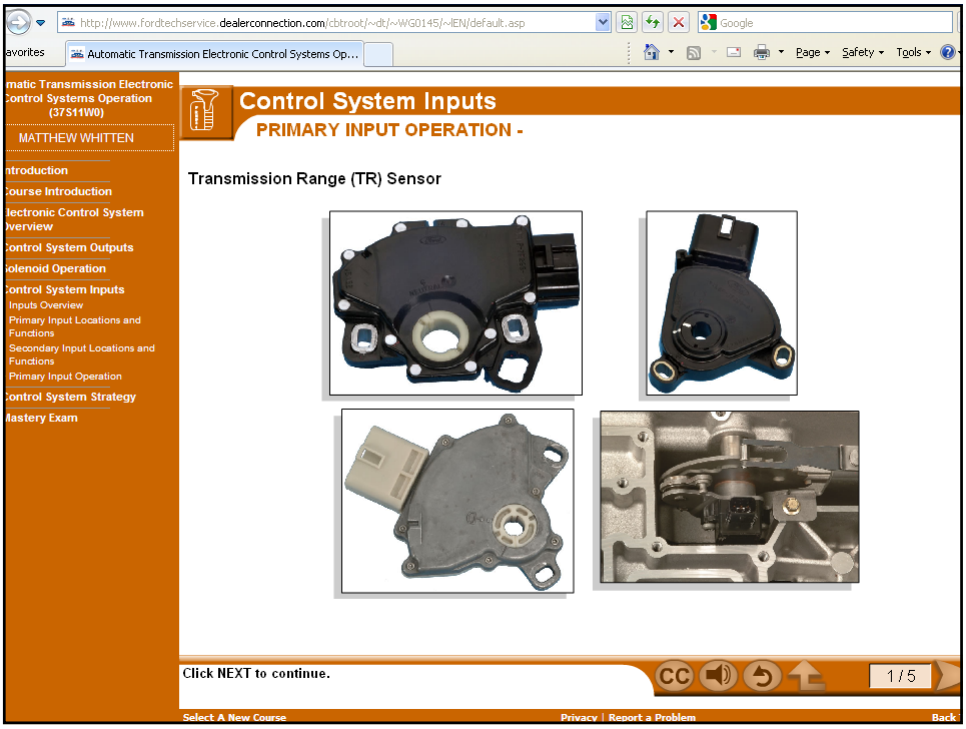
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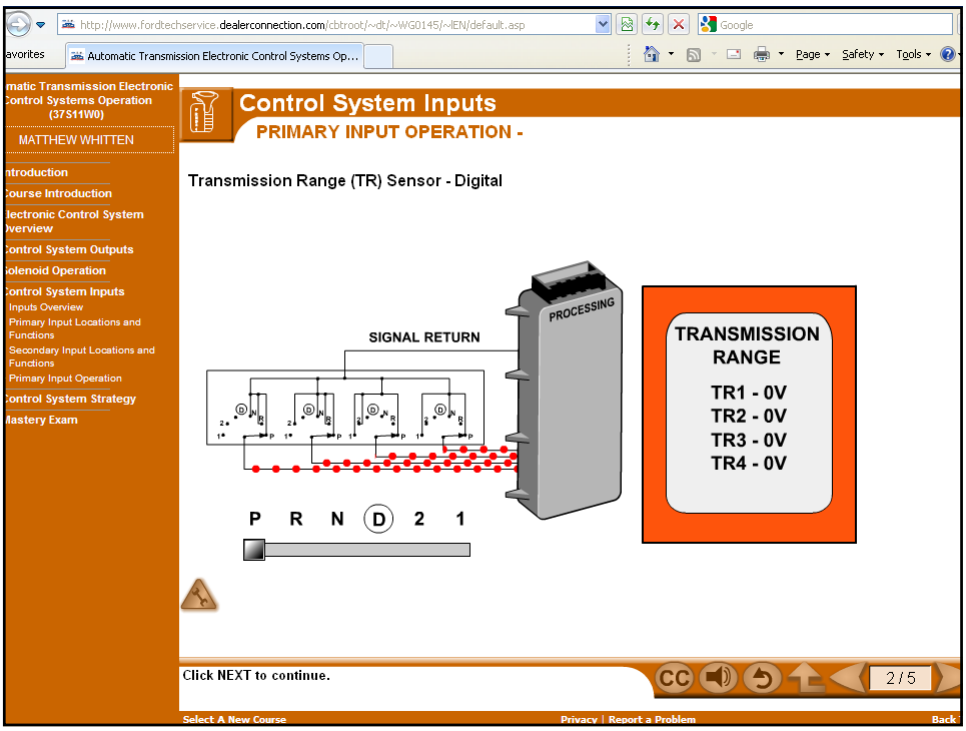
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TRANSMISSION RANGE
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TR2 - 0V
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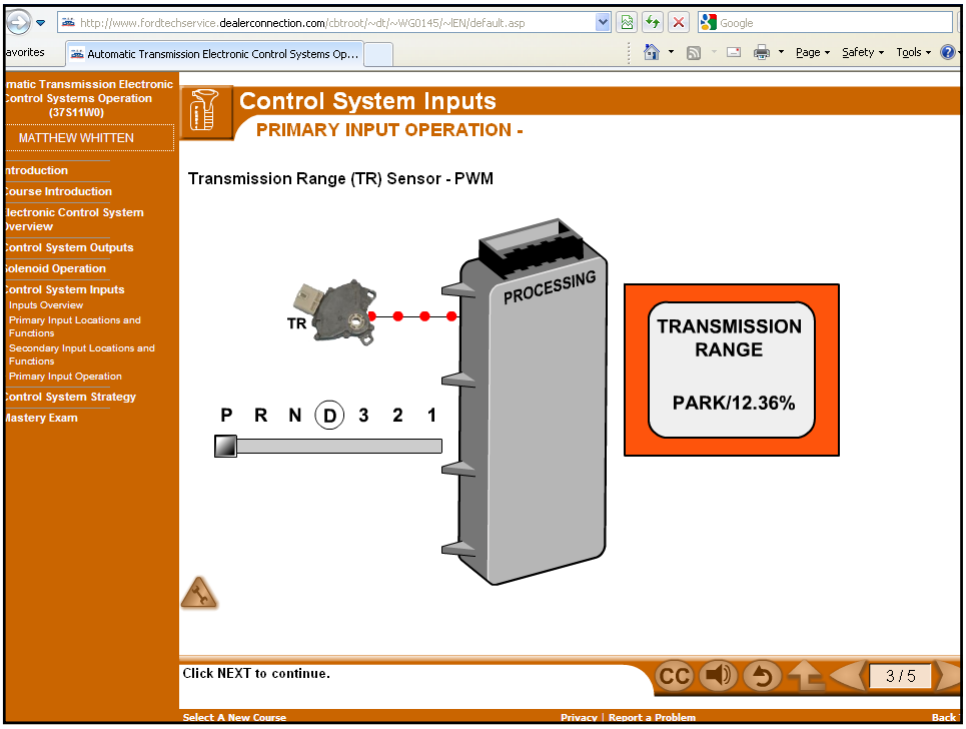
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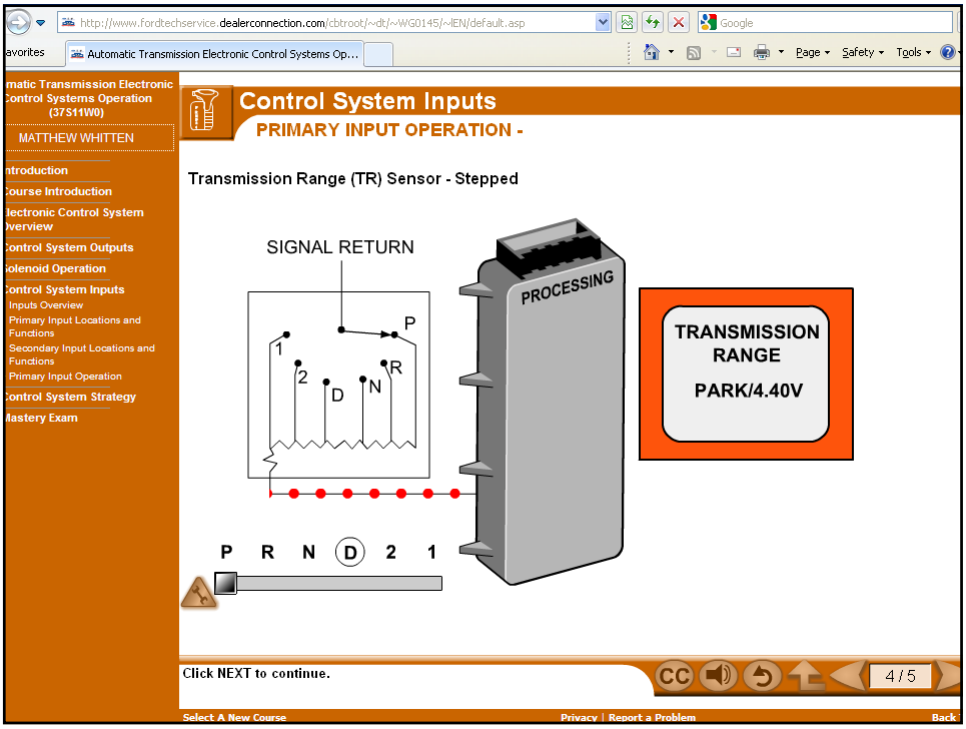
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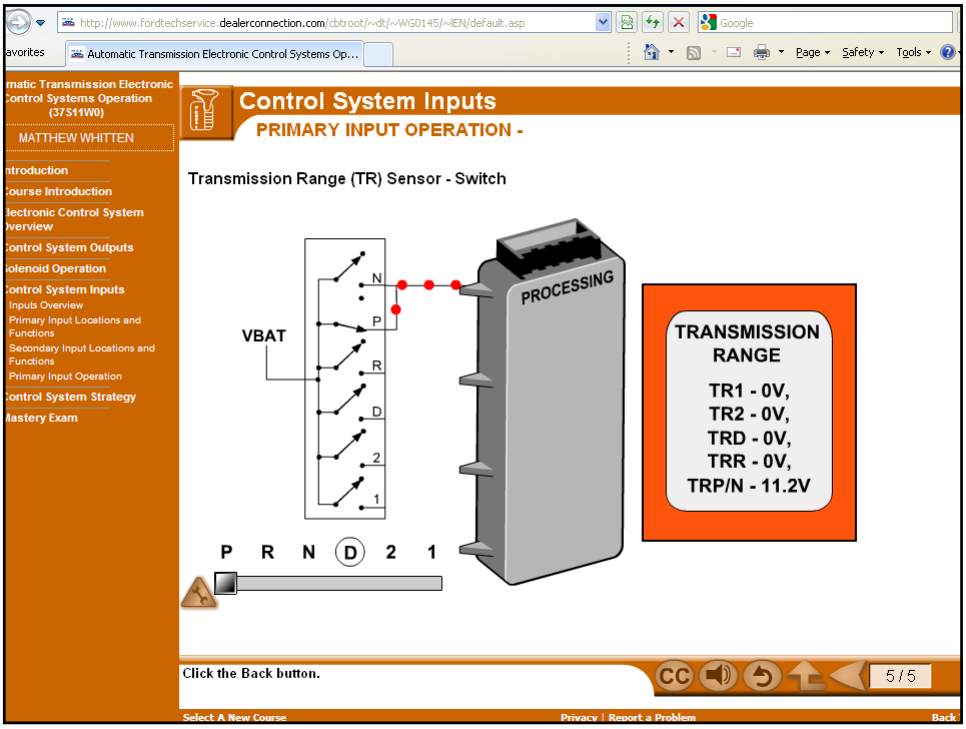
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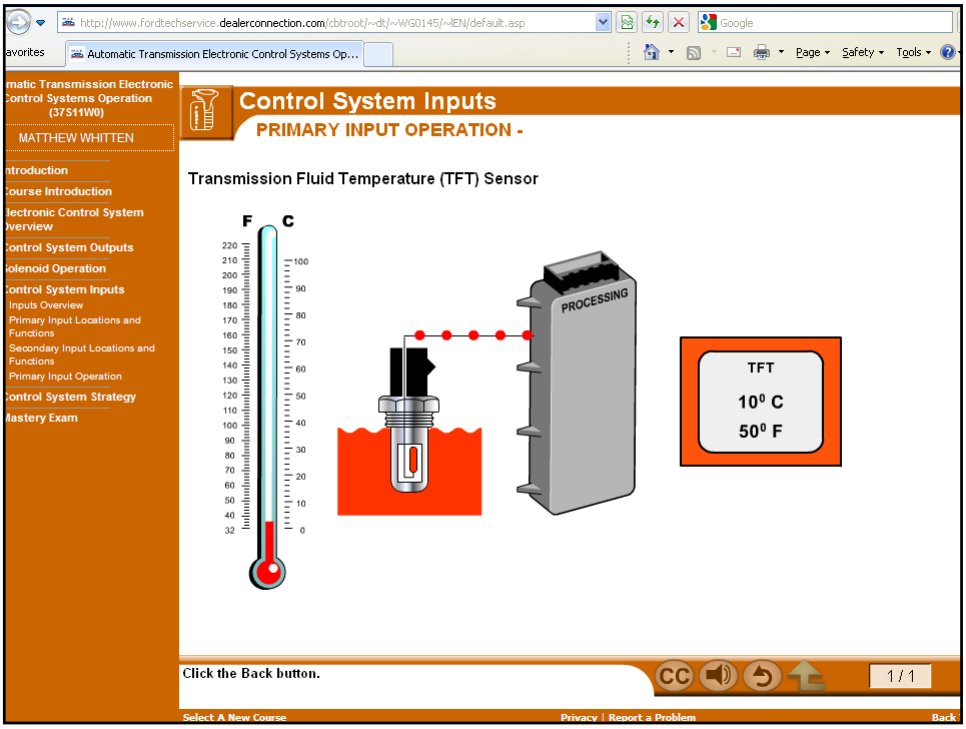
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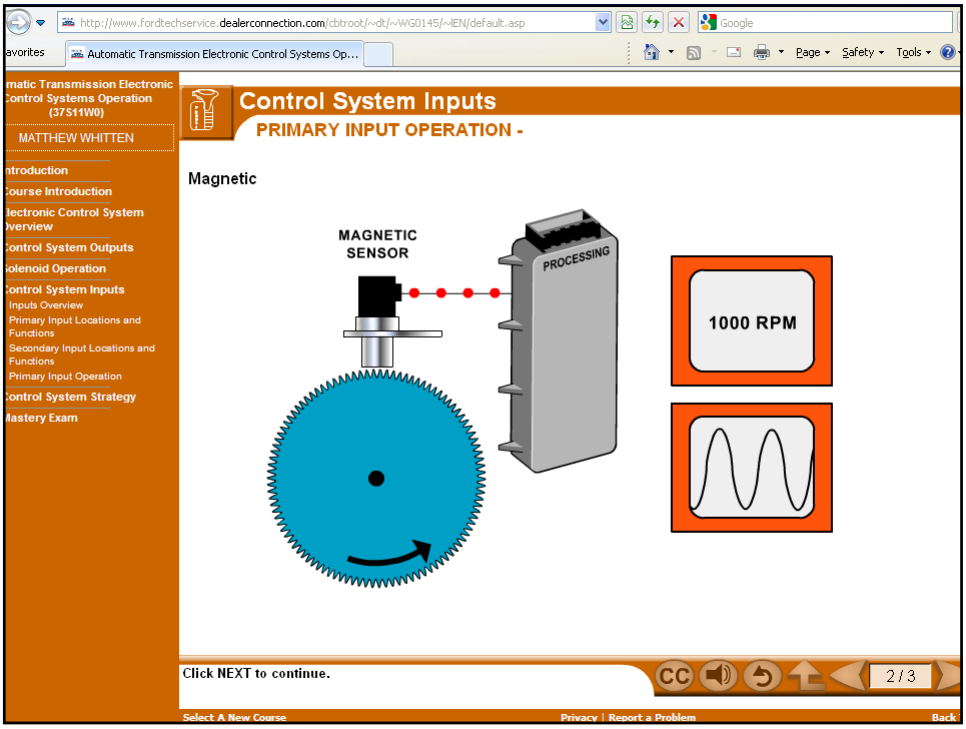
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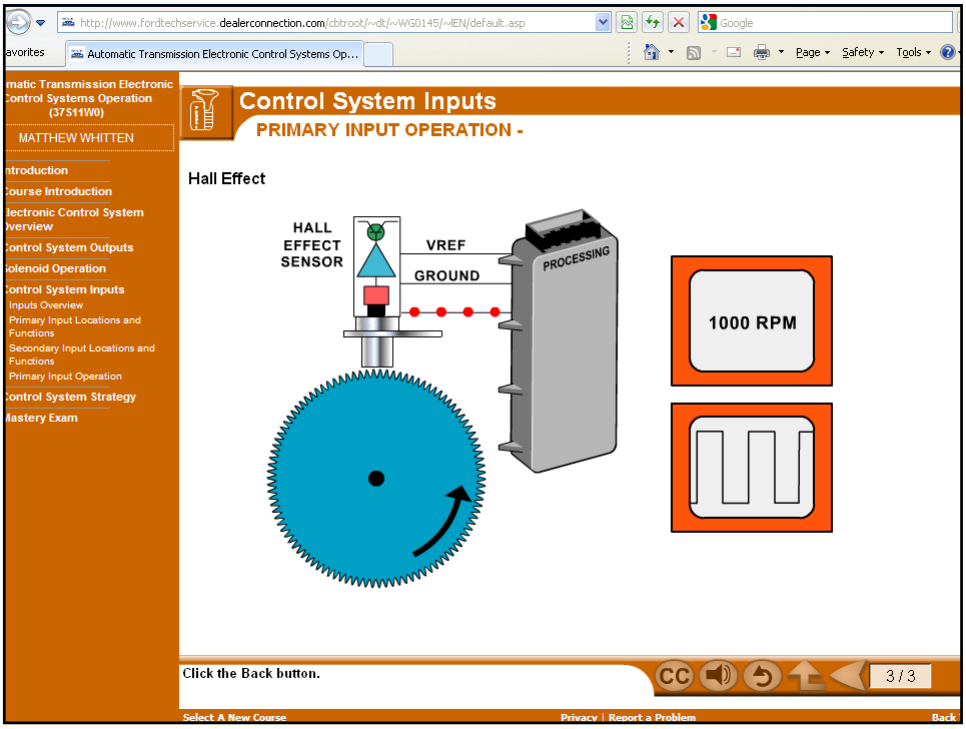
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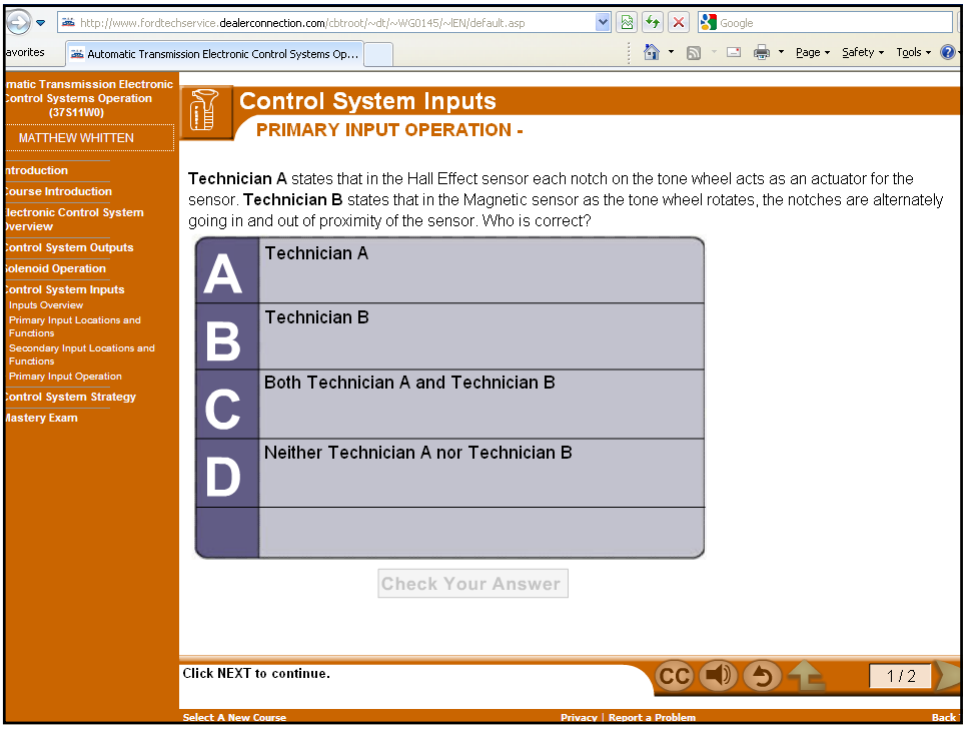
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Technician A states that in the Hall Effect sensor each notch on the tone wheel acts as an actuator for the sensor. Technician B states that in the Magnetic sensor as the tone wheel rotates, the notches are alternately going in and out of proximity of the sensor. Who is correct?
A Technician A
B Technician B
C Both Technician A and Technician B
D Neither Technician A nor Technician B
Check Your Answer
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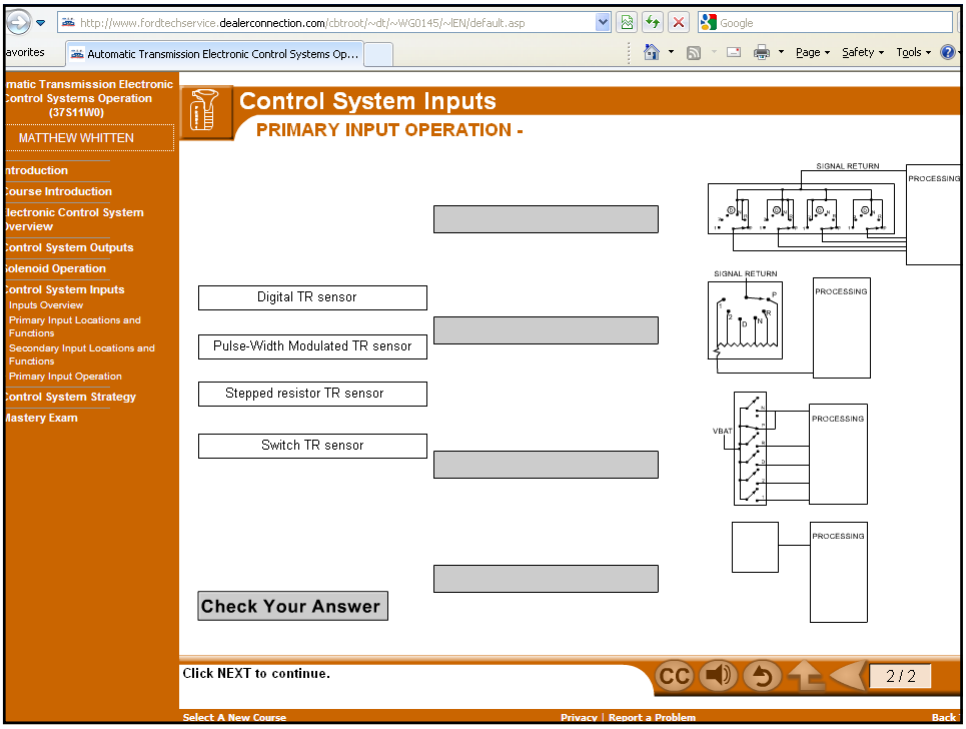
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Digital TR sensor
Pulse-Width Modulated TR sensor
Stepped resistor TR sensor
Switch TR sensor
Check Your Answer
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Normal Operating Strategies
Non-Normal Operating Strategies
Control System Adaptive Strategies
Mastery Exam
Control System Strategy
OBJECTIVES
Upon completion of this lesson you will be able to:
identify control system normal operation strategies.
describe the control system non-normal operation strategies.
describe the control system adaptive strategies.
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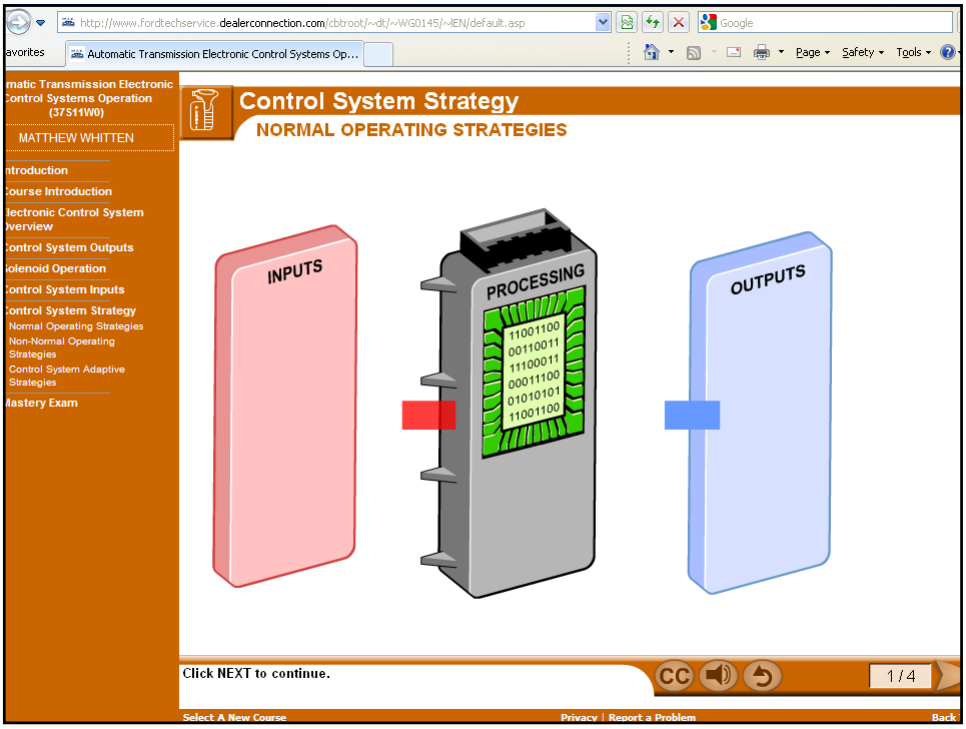
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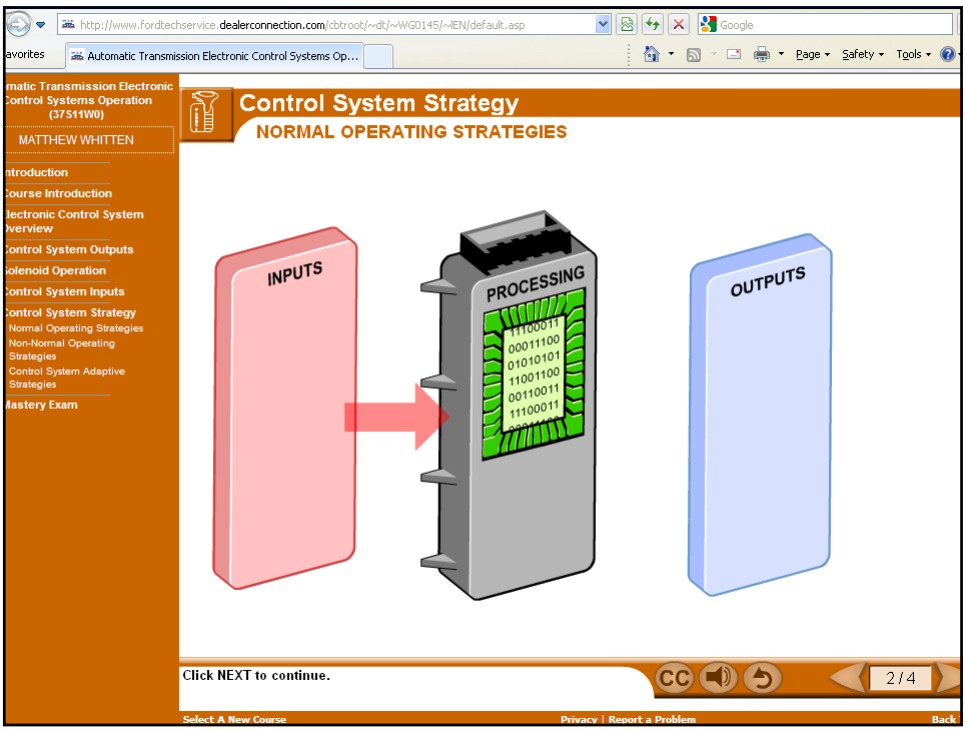
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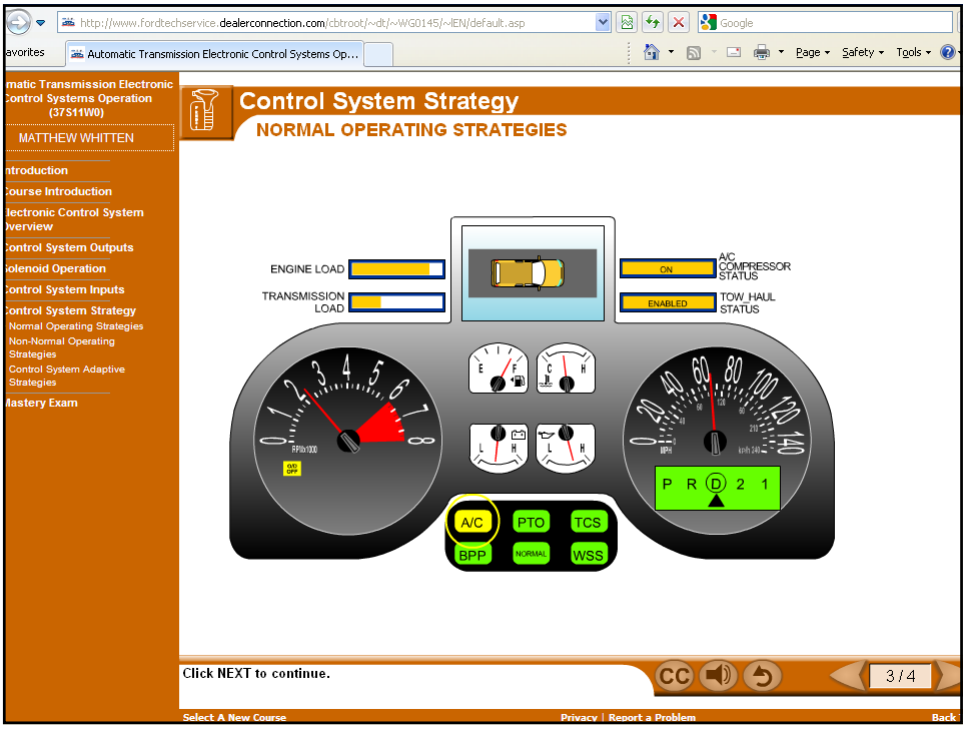
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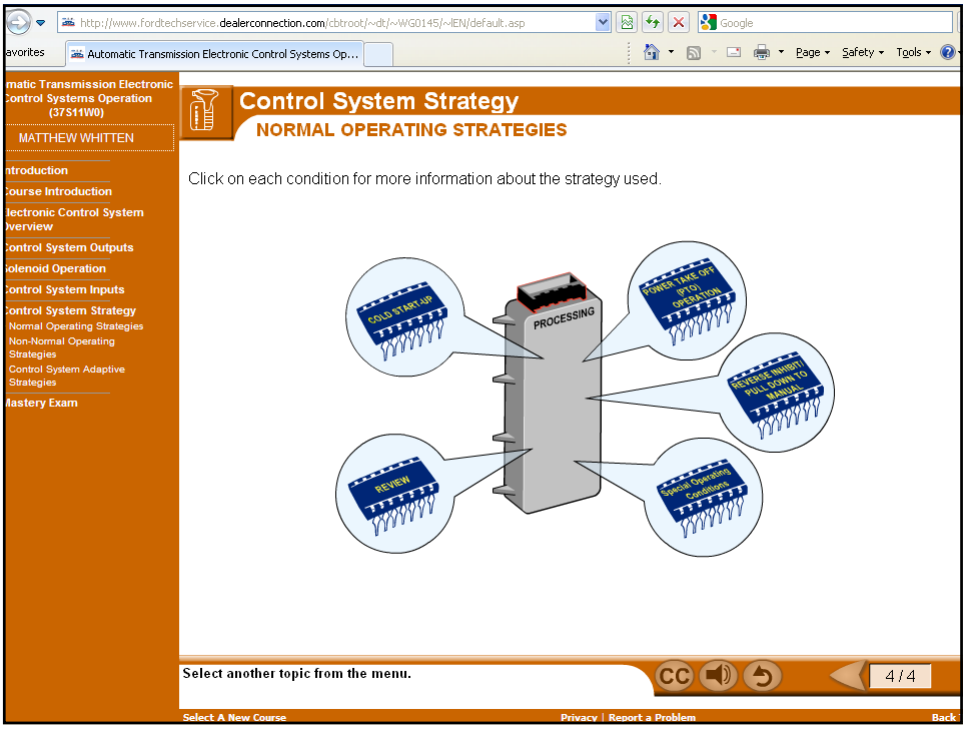
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Click on each condition for more information about the strategy used.
COLD START-UP
PROCESSING
POWER TAKE-OFF (PTO) OPERATION
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Special Operating Conditions
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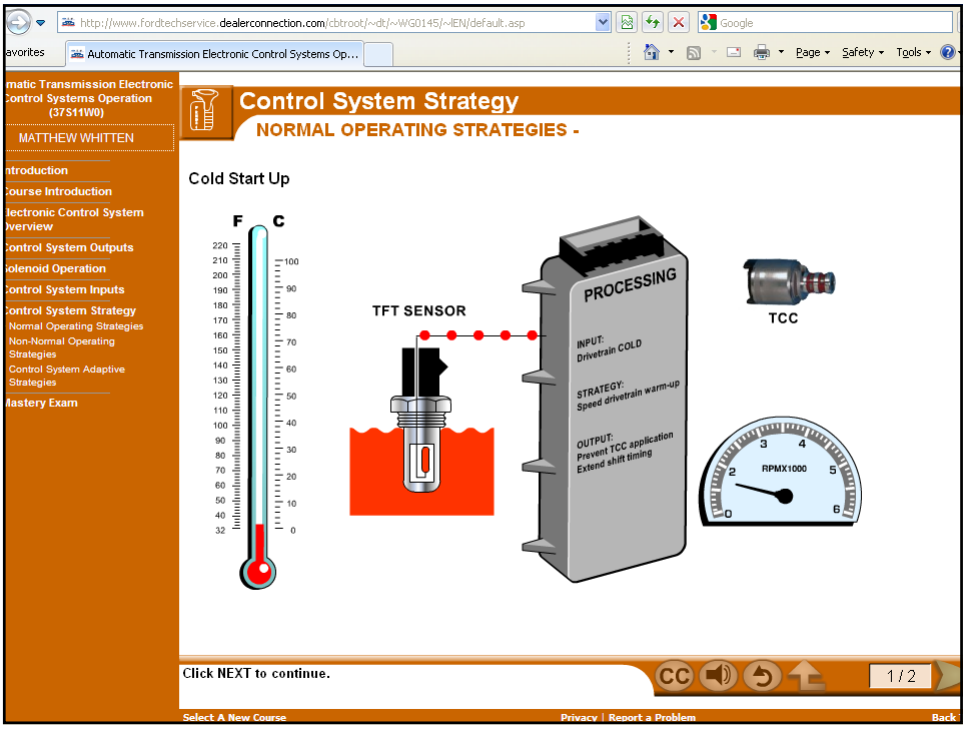
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NORMAL OPERATING STRATEGIES -
Cold Start Up
F
C
TFT SENSOR
PROCESSING
INPUT:
Drivetrain COLD
STRATEGY:
Speed drivetrain warm-up
OUTPUT:
Prevent TCC application
Extend shift timing
TCC
RPMX1000
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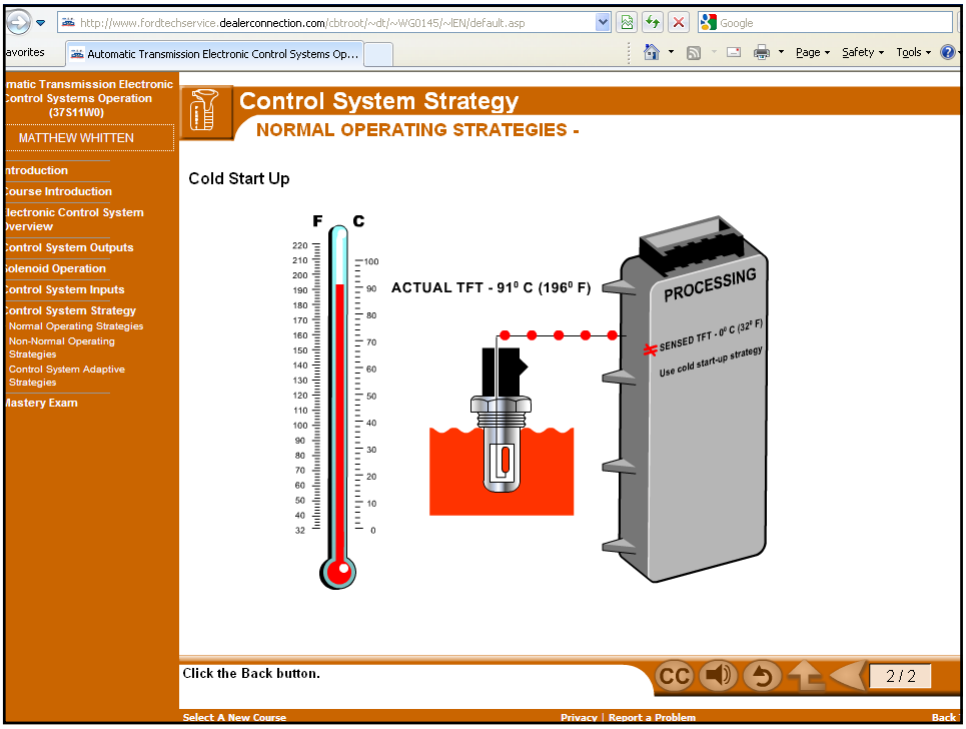
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NORMAL OPERATING STRATEGIES -
Cold Start Up
F
C
ACTUAL TFT - 91° C (196° F)
PROCESSING
SENSED TFT - 0° C (32° F)
Use cold start-up strategy
Click the Back button.
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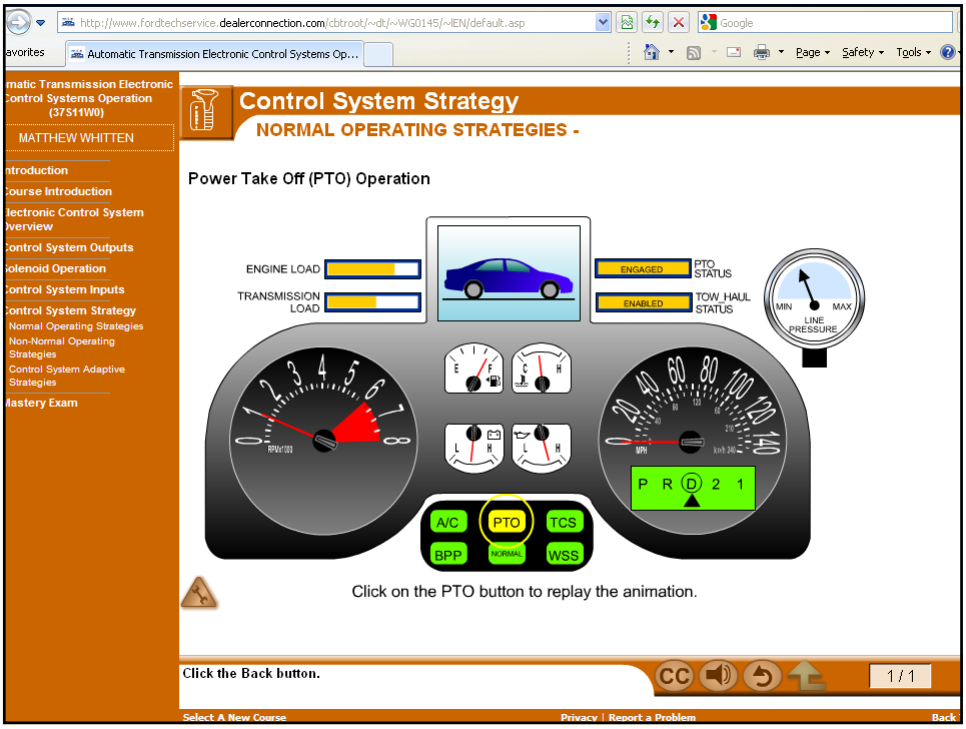
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TRANSMISSION LOAD
ENGAGED
PTO STATUS
ENABLED
TOW_HAUL STATUS
MIN
MAX
LINE PRESSURE
P R D 2 1
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Click on the PTO button to replay the animation.
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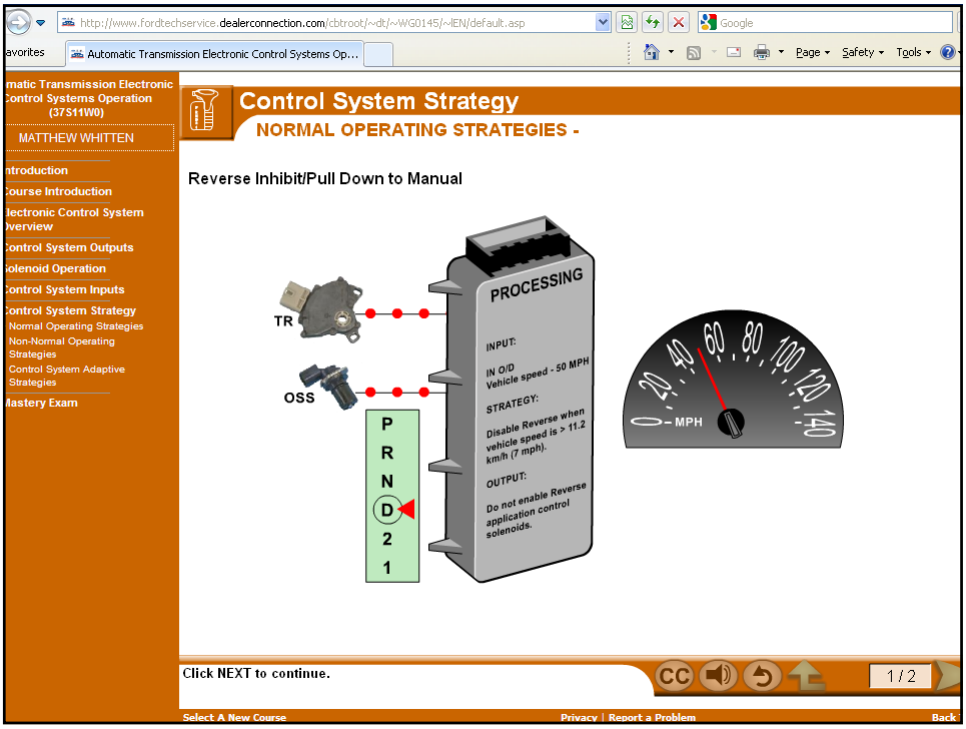
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NORMAL OPERATING STRATEGIES -
Reverse Inhibit/Pull Down to Manual
TR
OSS
P
R
N
D
2
1
PROCESSING
INPUT:
IN O/D
Vehicle speed - 50 MPH
STRATEGY:
Disable Reverse when vehicle speed is > 11.2 km/h (7 mph).
OUTPUT:
Do not enable Reverse application control solenoids.
MPH
Click NEXT to continue.
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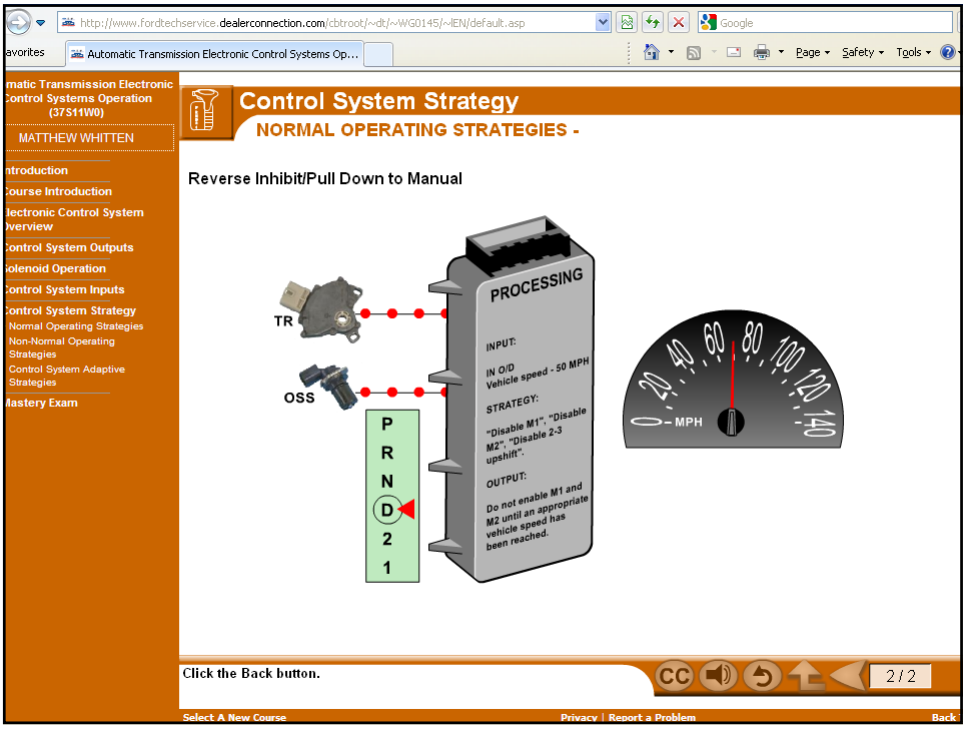
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Reverse Inhibit/Pull Down to Manual
TR
OSS
P R N D 2 1
PROCESSING
INPUT:
IN O/D
Vehicle speed - 50 MPH
STRATEGY:
"Disable M1", "Disable M2", "Disable 2-3 upshift".
OUTPUT:
Do not enable M1 and M2 until an appropriate vehicle speed has been reached.
MPH
Click the Back button.
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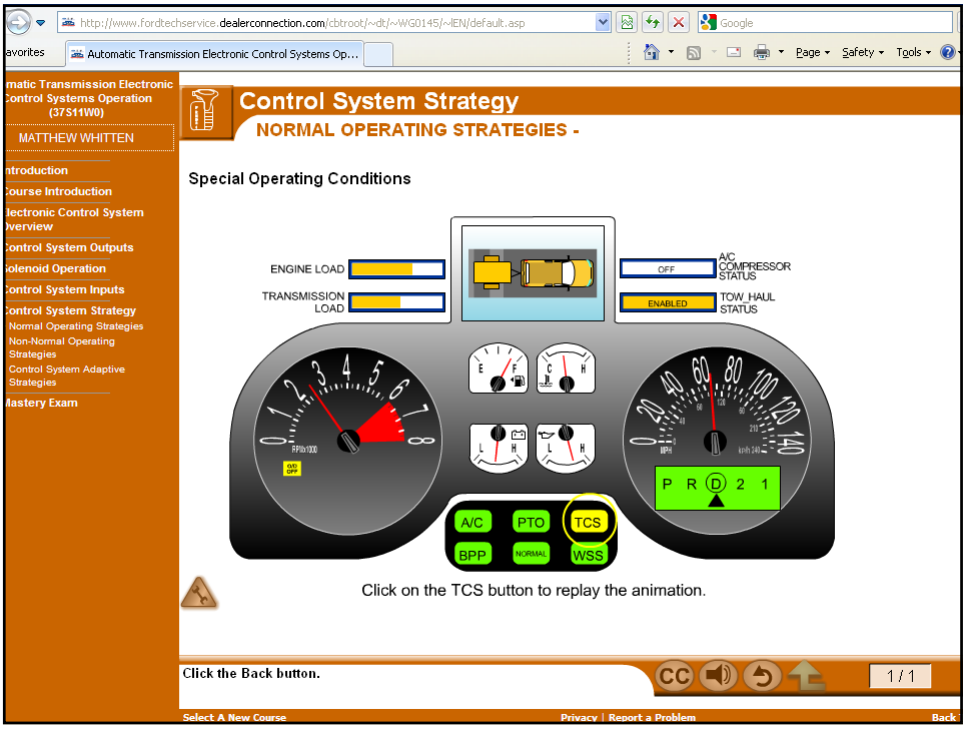
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A/C COMPRESSOR STATUS
ENABLED
TOW_HAUL STATUS
A/C
PTO
TCS
BPP
NORMAL
WSS
P R D 2 1
Click on the TCS button to replay the animation.
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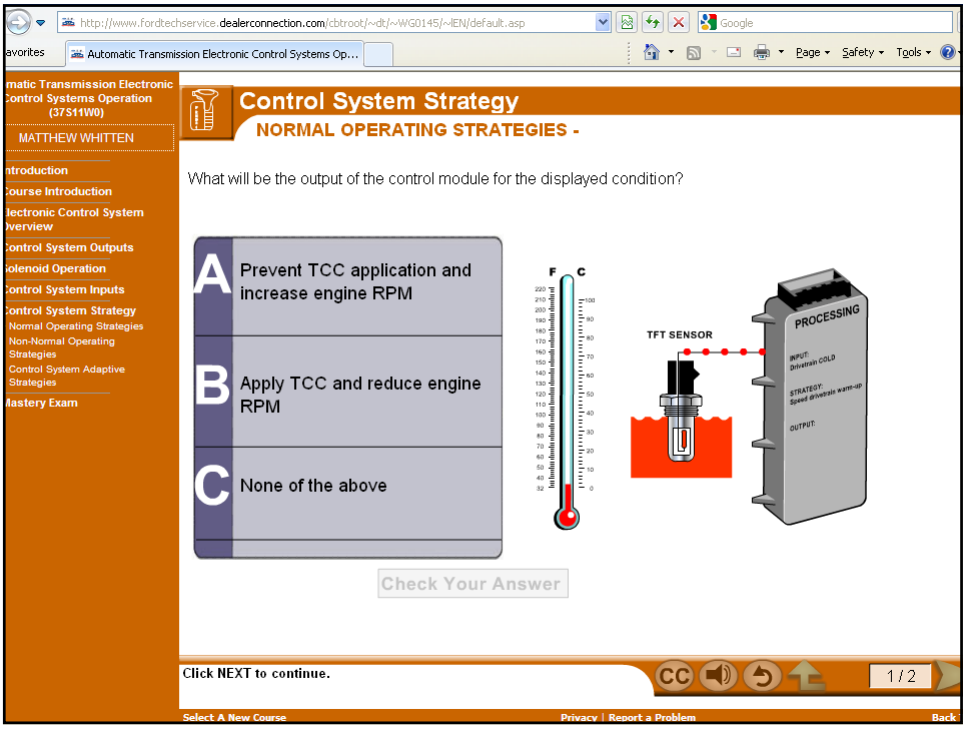
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NORMAL OPERATING STRATEGIES -
What will be the output of the control module for the displayed condition?
A Prevent TCC application and increase engine RPM
B Apply TCC and reduce engine RPM
C None of the above
F C
TFT SENSOR
PROCESSING
Check Your Answer
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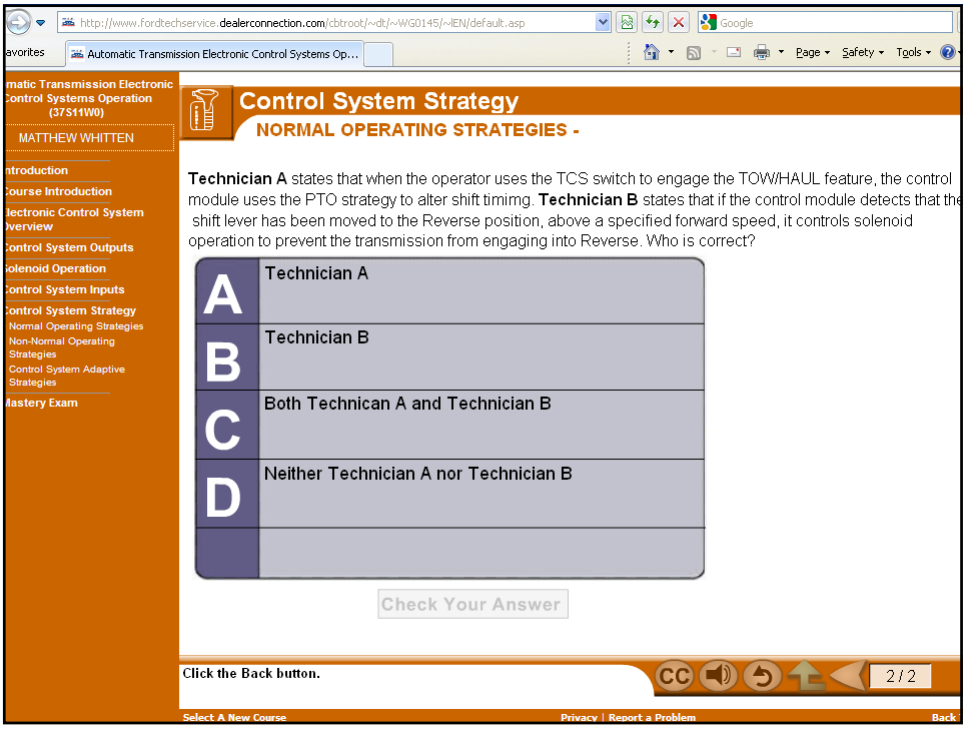
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NORMAL OPERATING STRATEGIES -
Technician A states that when the operator uses the TCS switch to engage the TOW/HAUL feature, the control module uses the PTO strategy to alter shift timimg. Technician B states that if the control module detects that the shift lever has been moved to the Reverse position, above a specified forward speed, it controls solenoid operation to prevent the transmission from engaging into Reverse. Who is correct?
A Technician A
B Technician B
C Both Technican A and Technician B
D Neither Technician A nor Technician B
Check Your Answer
Click the Back button.
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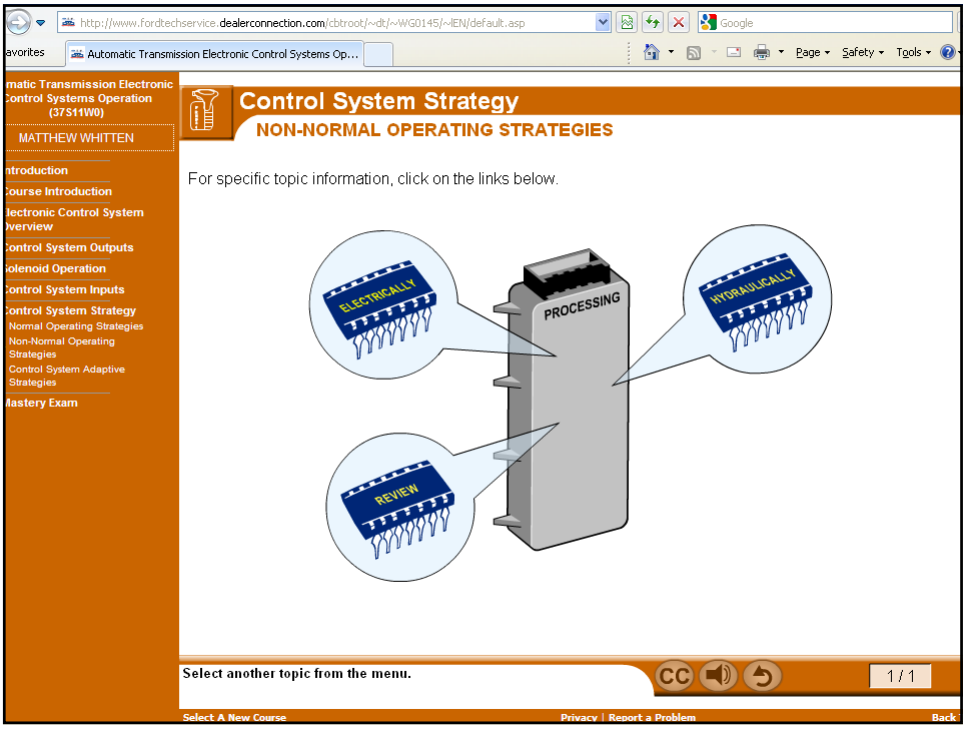
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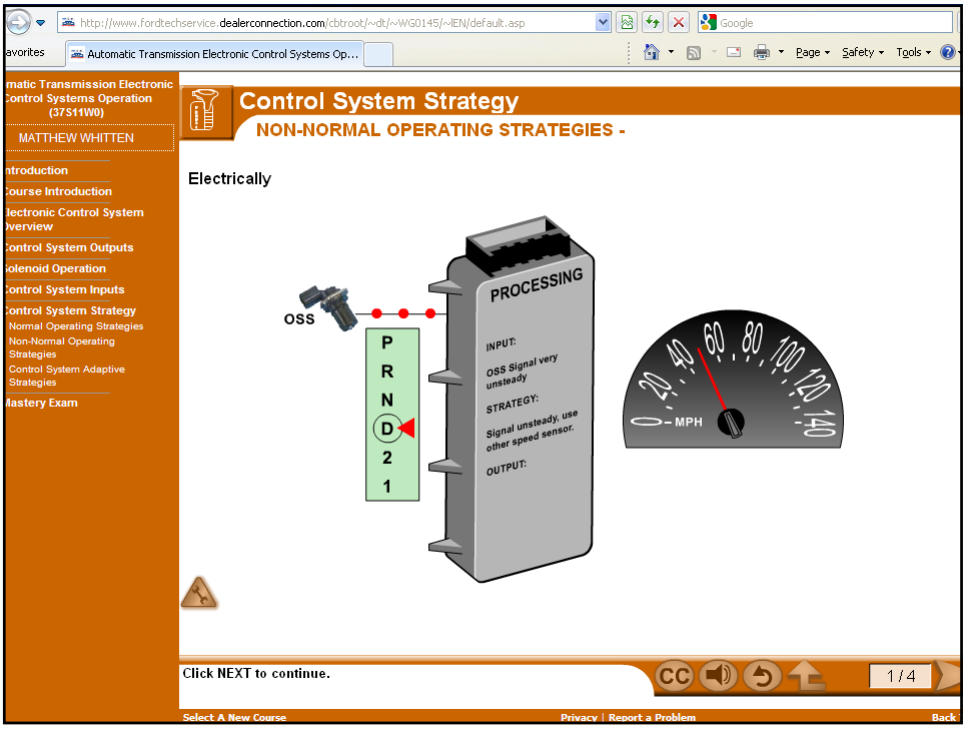
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NON-NORMAL OPERATING STRATEGIES -
Electrically
OSS
P
R
N
D
2
1
PROCESSING
INPUT:
OSS Signal very unsteady
STRATEGY:
Signal unsteady, use other speed sensor.
OUTPUT:
0
20
40
60
80
100
120
140
MPH
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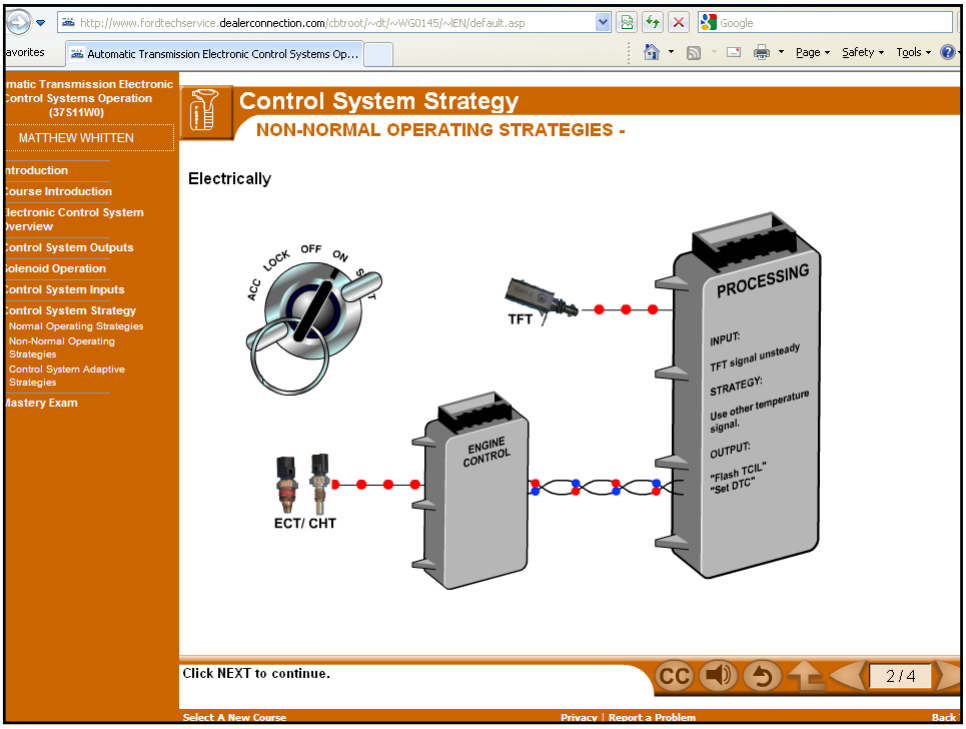
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Electrically
ACC LOCK OFF ON ST
TFT
PROCESSING
INPUT:
TFT signal unsteady
STRATEGY:
Use other temperature signal.
OUTPUT:
"Flash TCIL"
"Set DTC"
ENGINE CONTROL
ECT/ CHT
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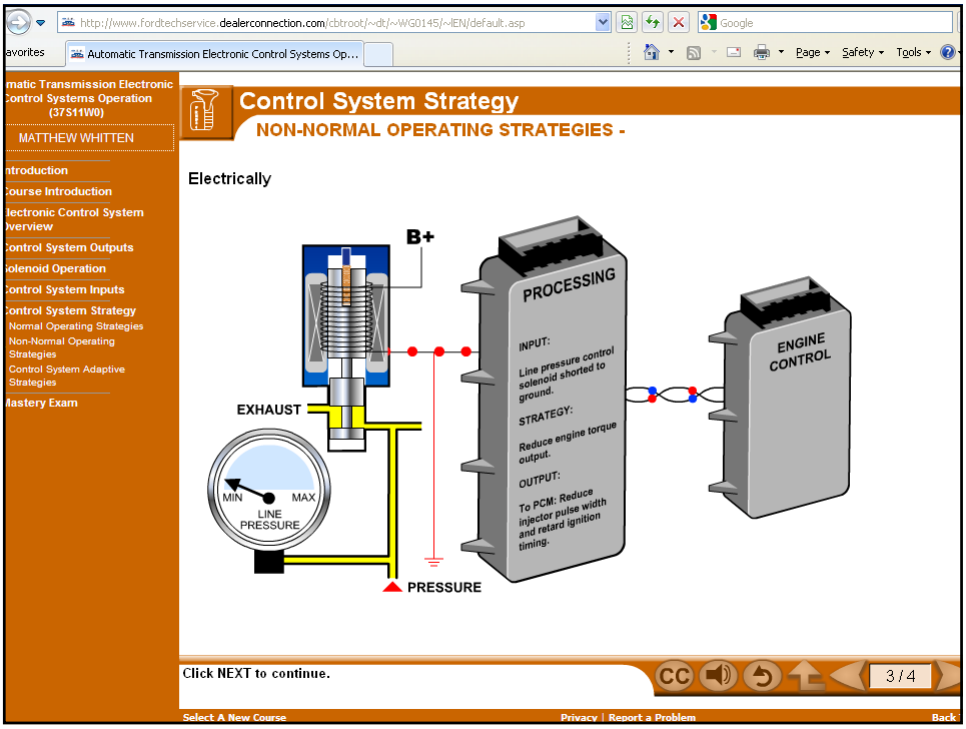
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NON-NORMAL OPERATING STRATEGIES -
Electrically
B+
EXHAUST
MIN
MAX
LINE PRESSURE
PRESSURE
PROCESSING
INPUT:
Line pressure control solenoid shorted to ground.
STRATEGY:
Reduce engine torque output.
OUTPUT:
To PCM: Reduce injector pulse width and retard ignition timing.
ENGINE CONTROL
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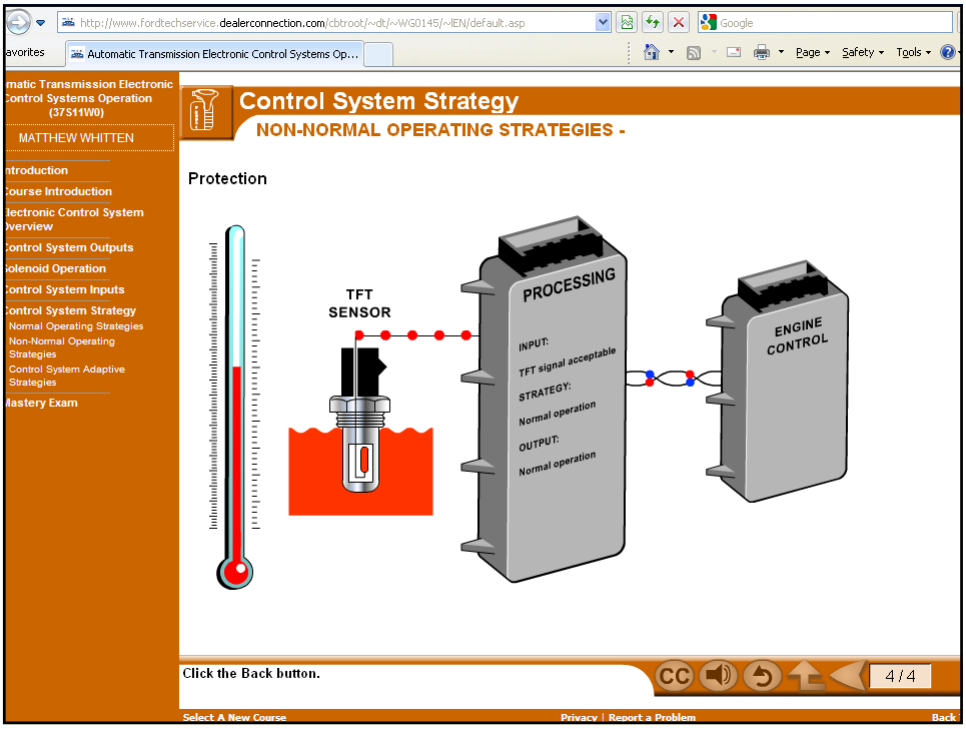
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Protection
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PROCESSING
INPUT:
TFT signal acceptable
STRATEGY:
Normal operation
OUTPUT:
Normal operation
ENGINE CONTROL
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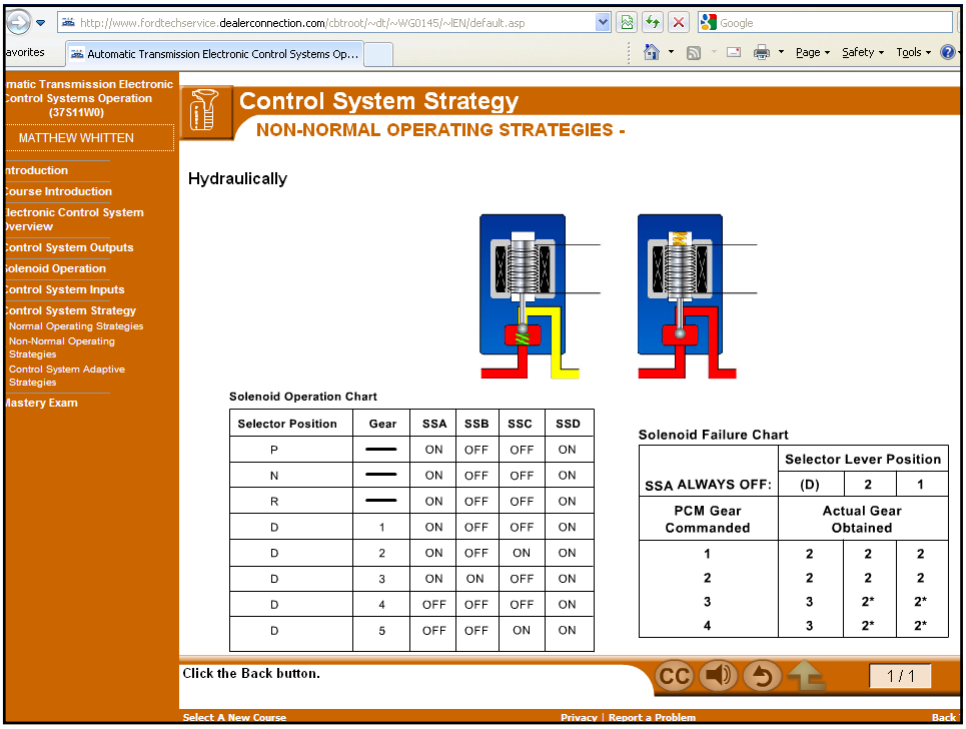
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NON-NORMAL OPERATING STRATEGIES -
Hydraulically
Solenoid Operation Chart
Selector Position | Gear | SSA | SSB | SSC | SSD
P | — | ON | OFF | OFF | ON
N | — | ON | OFF | OFF | ON
R | — | ON | OFF | OFF | ON
D | 1 | ON | OFF | OFF | ON
D | 2 | ON | OFF | ON | ON
D | 3 | ON | ON | OFF | ON
D | 4 | OFF | OFF | OFF | ON
D | 5 | OFF | OFF | ON | ON
Solenoid Failure Chart
SSA ALWAYS OFF: | Selector Lever Position (D) | 2 | 1
PCM Gear Commanded | Actual Gear Obtained
1 | 2 | 2 | 2
2 | 2 | 2 | 2
3 | 3 | 2* | 2*
4 | 3 | 2* | 2*
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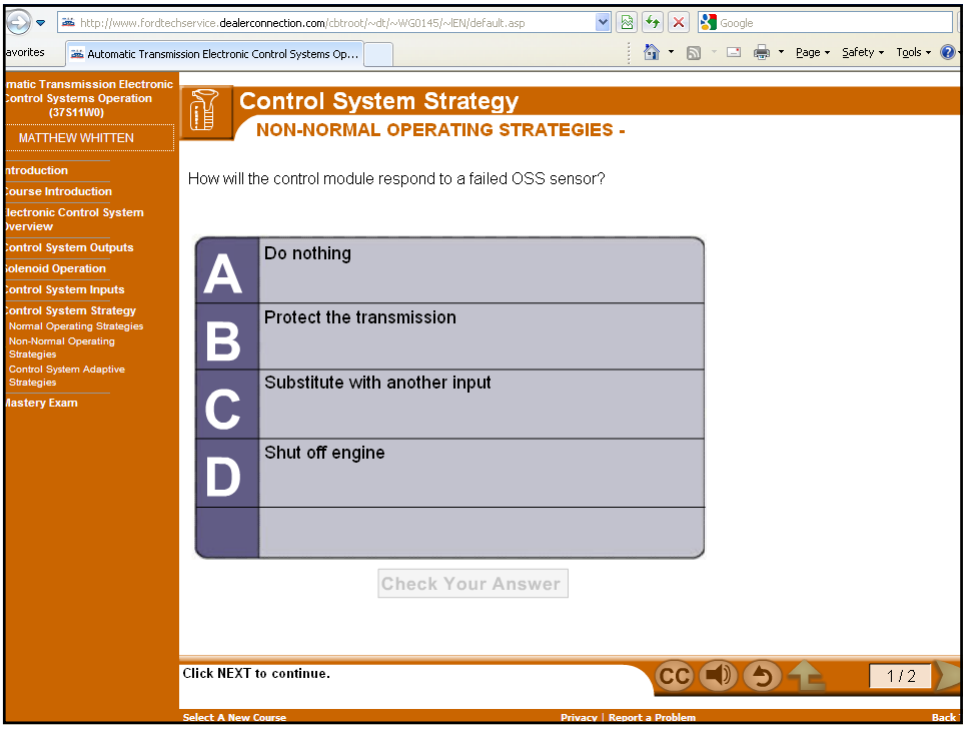
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NON-NORMAL OPERATING STRATEGIES -
How will the control module respond to a failed OSS sensor?
A Do nothing
B Protect the transmission
C Substitute with another input
D Shut off engine
Check Your Answer
Click NEXT to continue.
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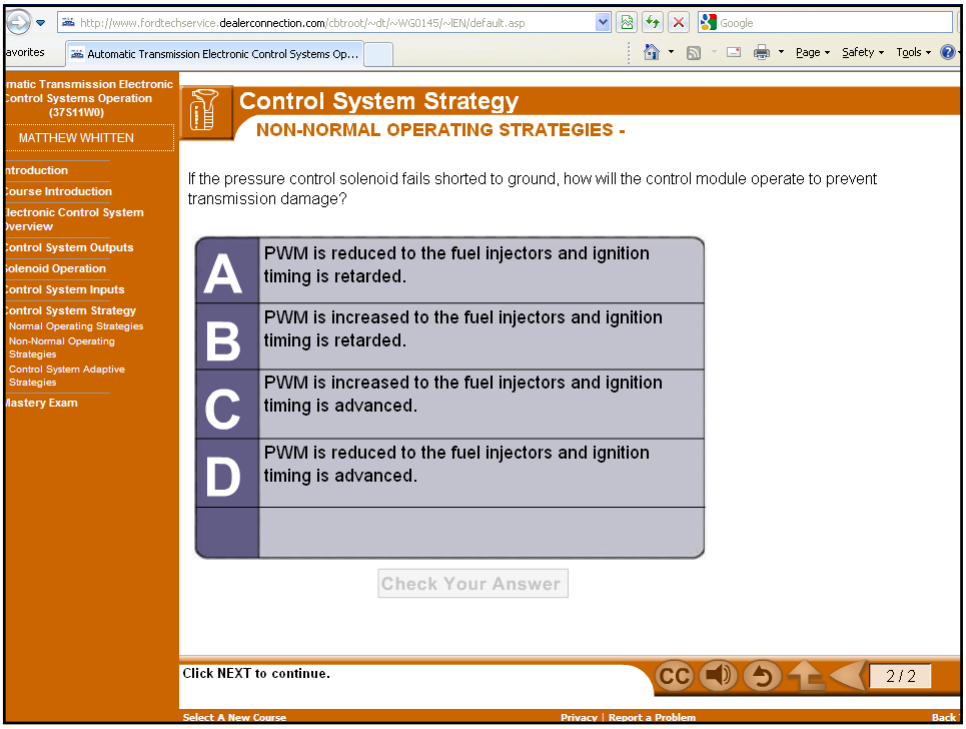
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NON-NORMAL OPERATING STRATEGIES -
If the pressure control solenoid fails shorted to ground, how will the control module operate to prevent transmission damage?
A PWM is reduced to the fuel injectors and ignition timing is retarded.
B PWM is increased to the fuel injectors and ignition timing is retarded.
C PWM is increased to the fuel injectors and ignition timing is advanced.
D PWM is reduced to the fuel injectors and ignition timing is advanced.
Check Your Answer
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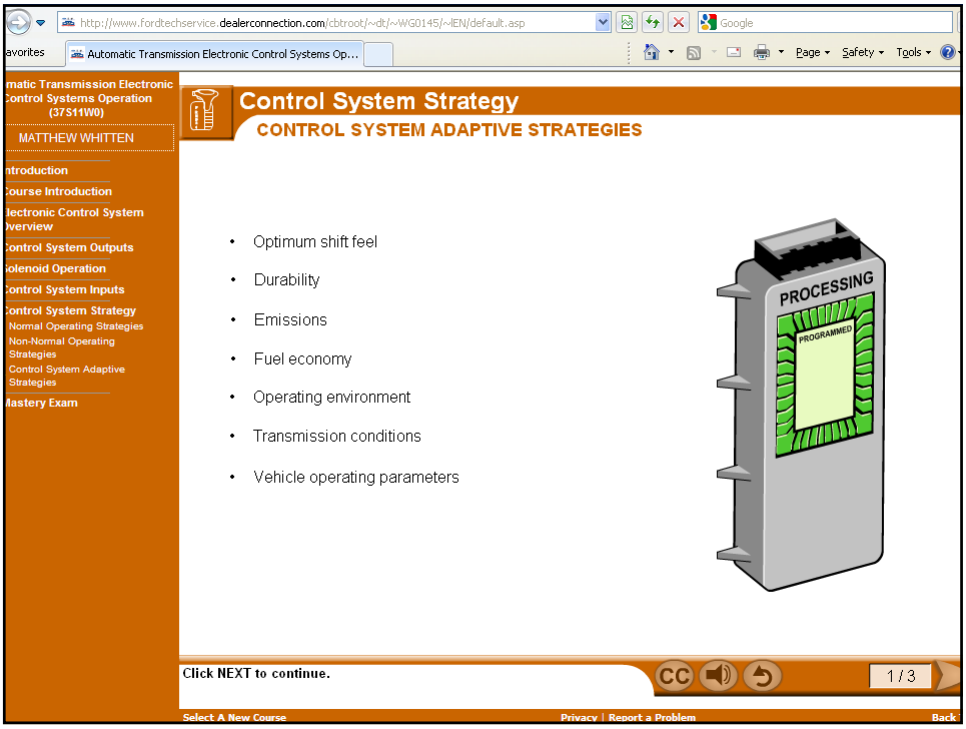
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Optimum shift feel
Durability
Emissions
Fuel economy
Operating environment
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Vehicle operating parameters
PROCESSING
PROGRAMMED
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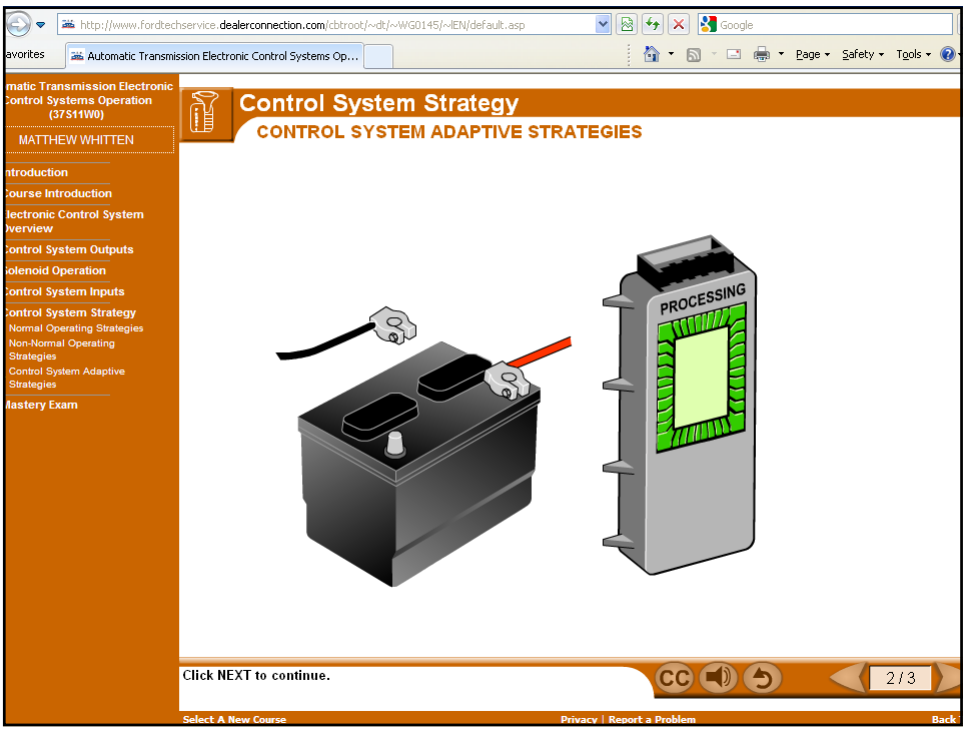
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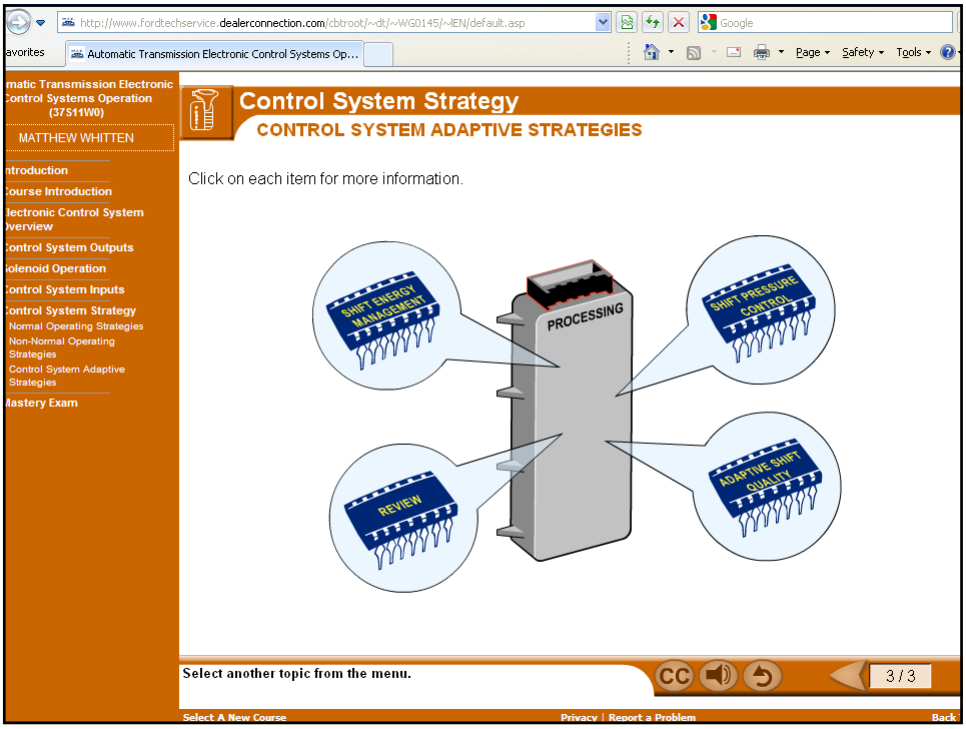
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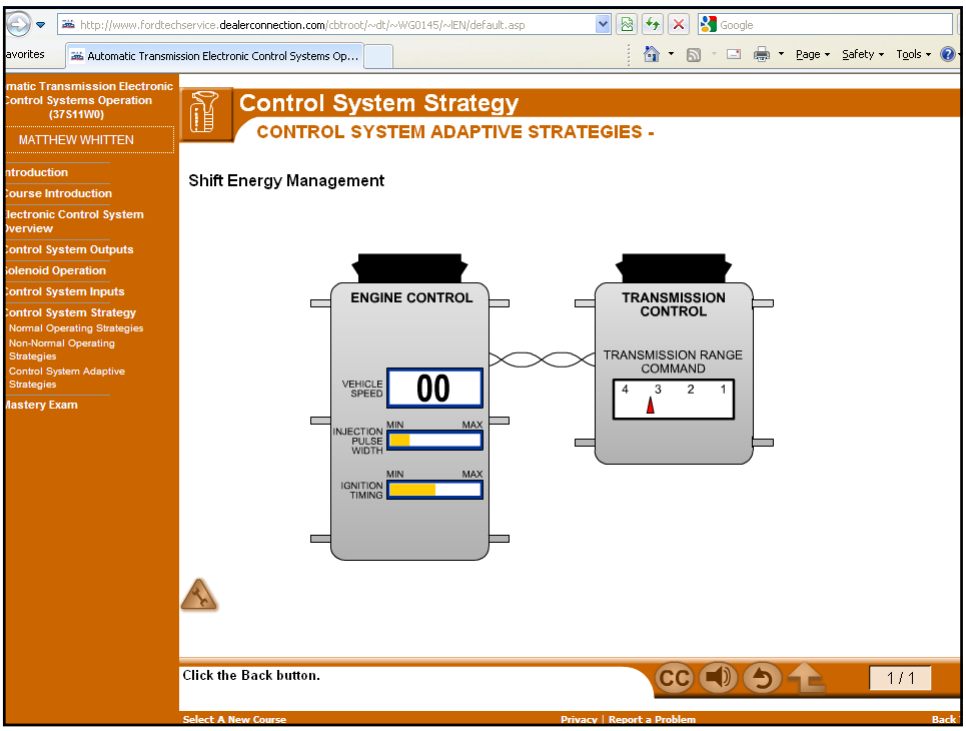
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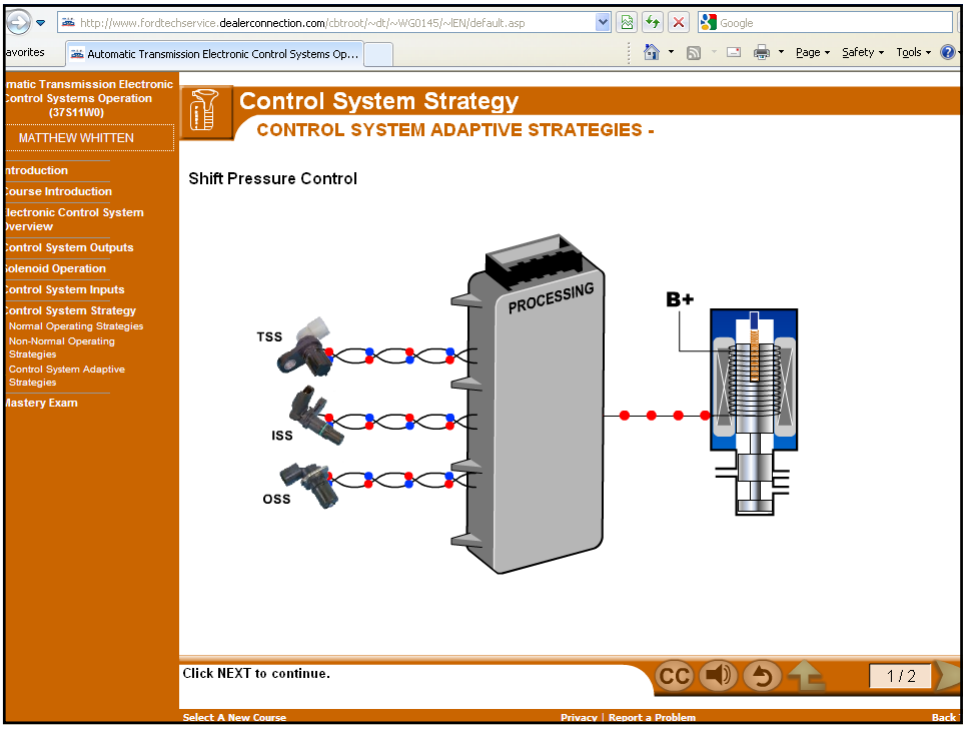
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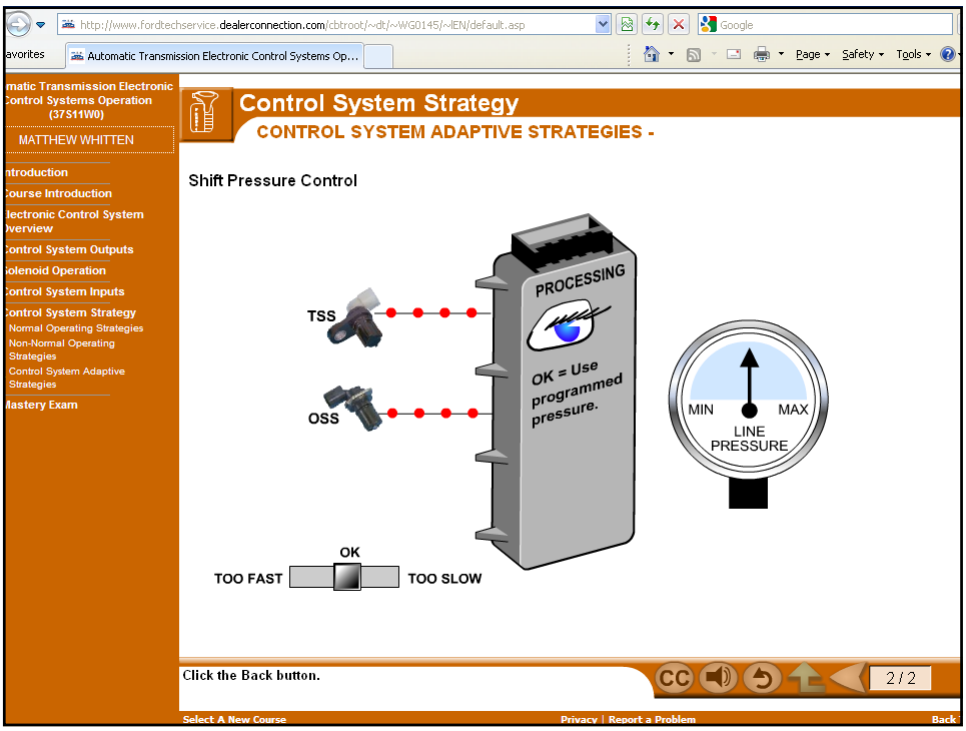
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TSS
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PROCESSING
OK = Use programmed pressure.
MIN
MAX
LINE PRESSURE
OK
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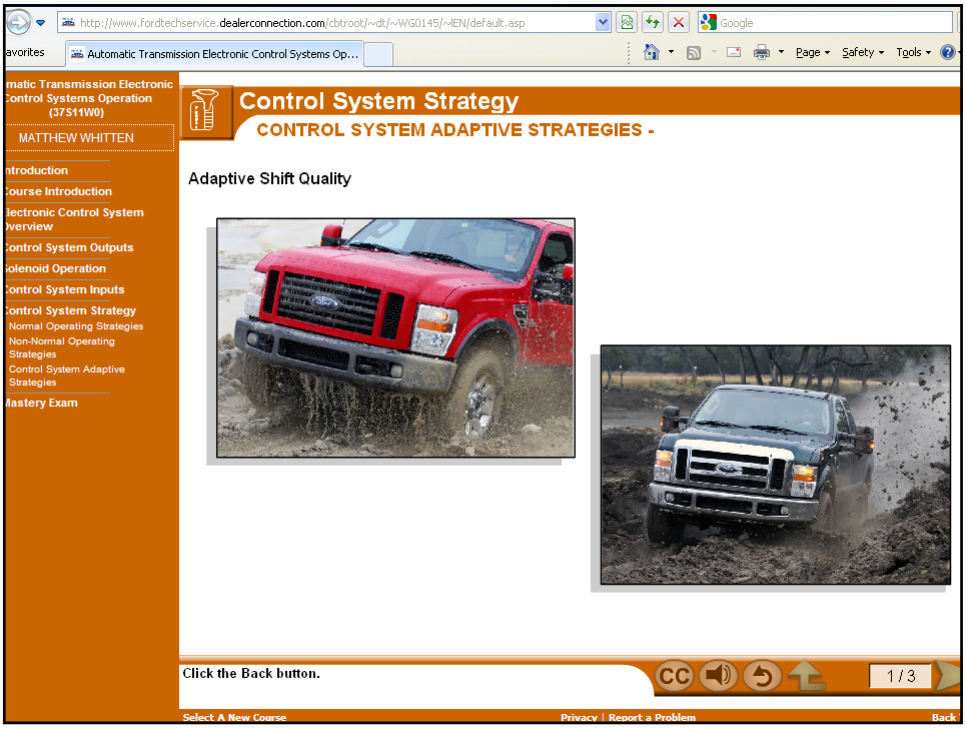
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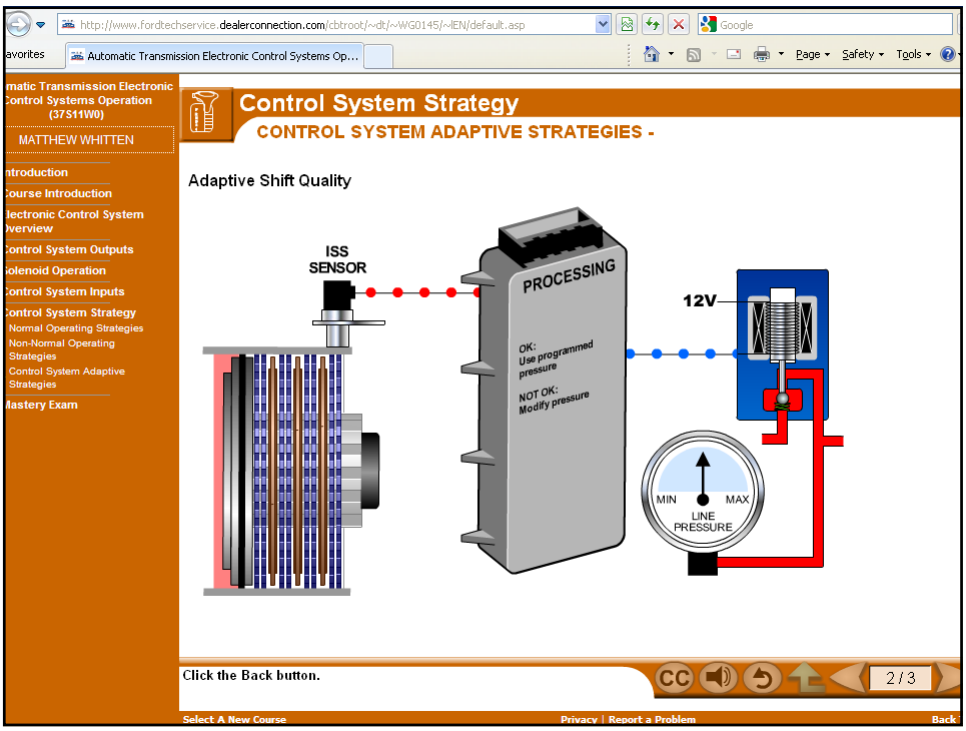
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ISS SENSOR
PROCESSING
OK: Use programmed pressure
NOT OK: Modify pressure
12V
MIN
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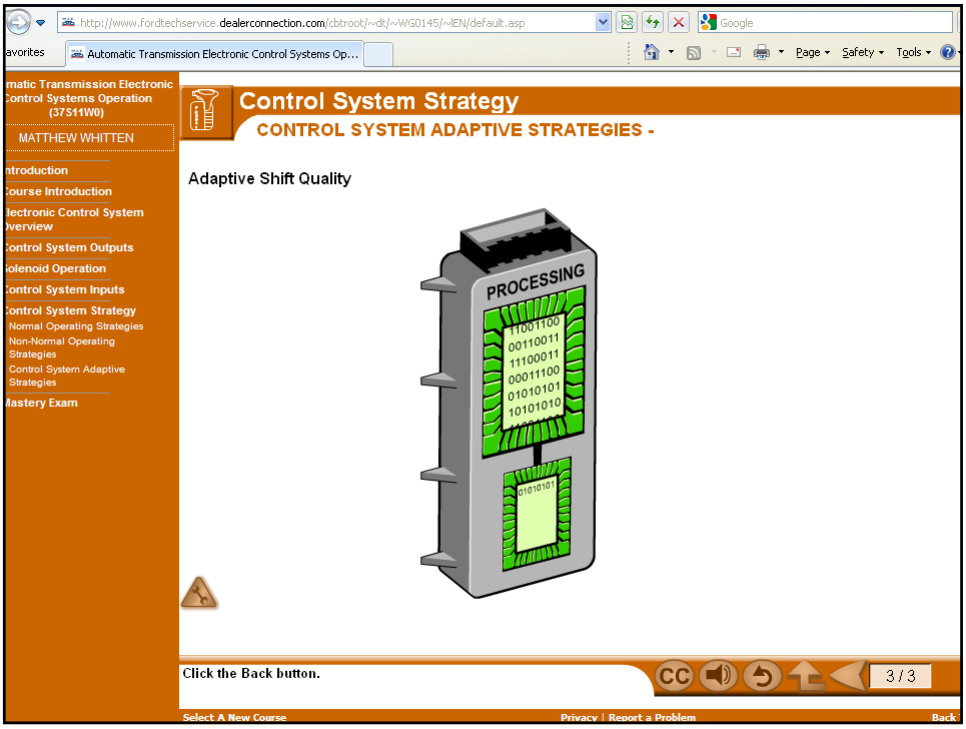
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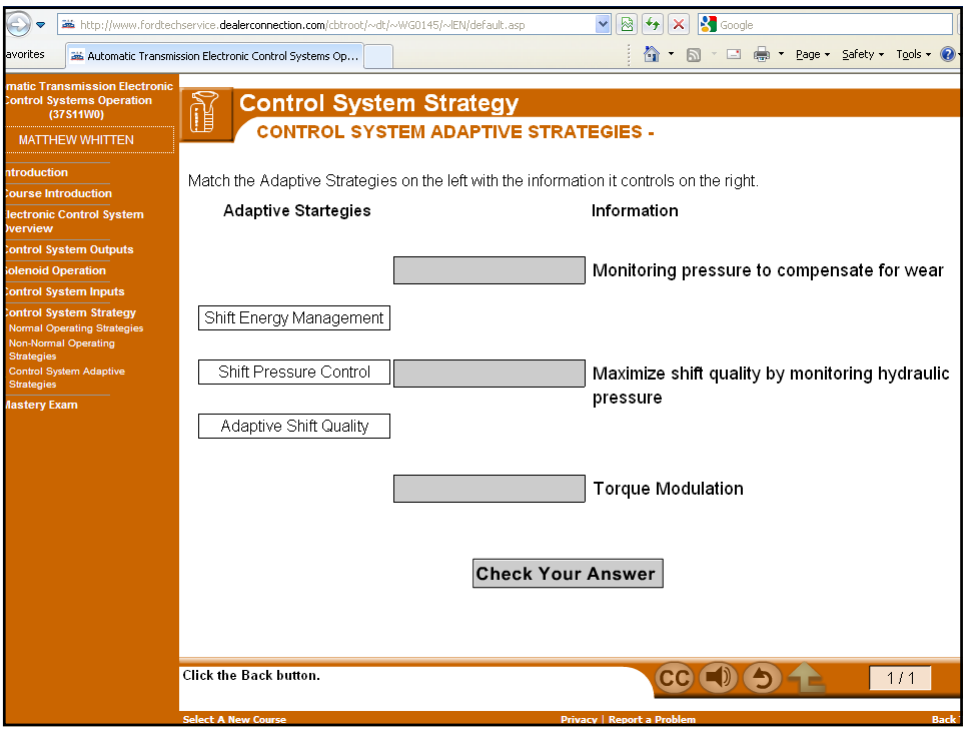
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Match the Adaptive Strategies on the left with the information it controls on the right.
Adaptive Startegies
Information
Monitoring pressure to compensate for wear
Shift Energy Management
Shift Pressure Control
Maximize shift quality by monitoring hydraulic pressure
Adaptive Shift Quality
Torque Modulation
Check Your Answer
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