K: Engine Coolant Temperature (ECT) Sensor

Note: *Regeneration may occur during normal operation. During regeneration, diagnostic procedures may display biased values. If a regeneration occurs during diagnostic procedures, allow the process to complete before continuing diagnostics.*

This pinpoint test is intended to diagnose the following:

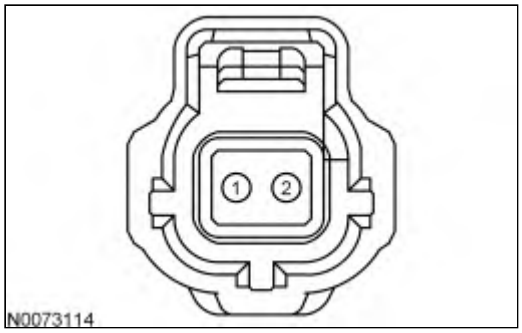
- ECT sensor (12A648)
- secondary cooling system engine coolant temperature 2 (ECT2) sensor (12A648)
- harness circuits: ECT, ECT2 and SIGRTN
- PCM (12A650)

TEMPERATURE VS. RESISTANCE VALUES (APPROXIMATE)

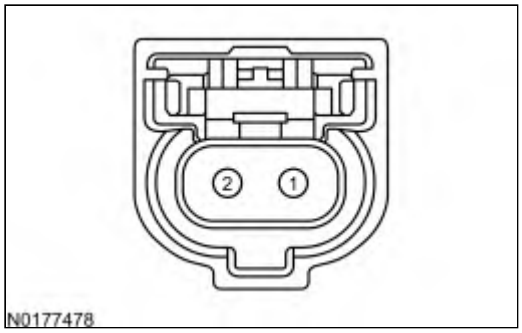
°C	°F	Ohms
100	212	2,080
90	194	2,803
80	176	3,836
70	158	5,337
60	140	7,556
50	122	10,908
45	113	13,216
40	104	16,092
35	95	19,696
30	86	24,329
25	77	30,000
20	68	37,352
15	59	46,797
10	50	59,016
5	41	74,940
0	32	95,851
-5	23	123,485
-10	14	160,313
-15	5	209,816
-20	-4	276,959
-30	-22	496,051
-40	-40	925,021

Engine Coolant Temperature (ECT) Sensor Connector

A



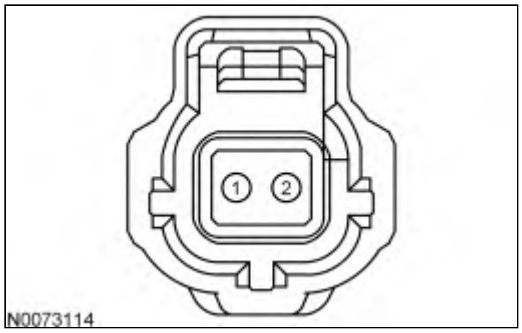
B



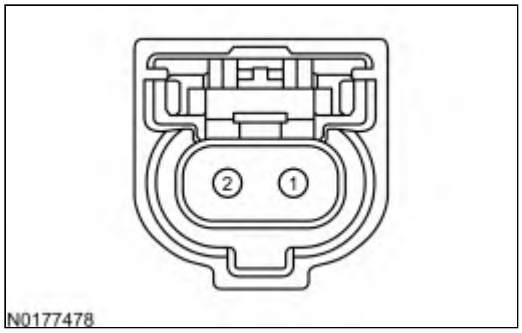
Vehicle	Connector	Pin	Circuit
F-650 / F-750, Transit	A	2 1	SIGRTN ECT
All other vehicles	B	2 1	SIGRTN ECT

Engine Coolant Temperature 2 (ECT2) Sensor Connector

A



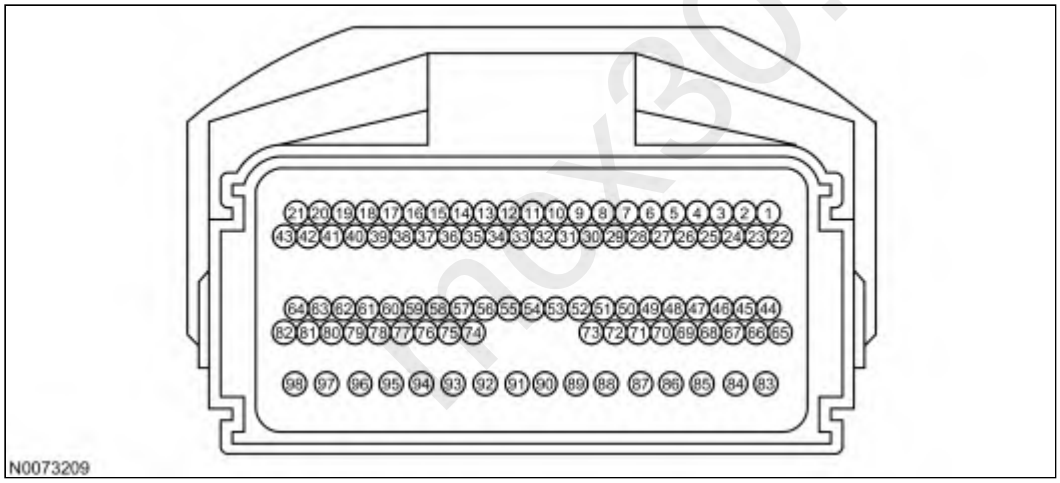
B



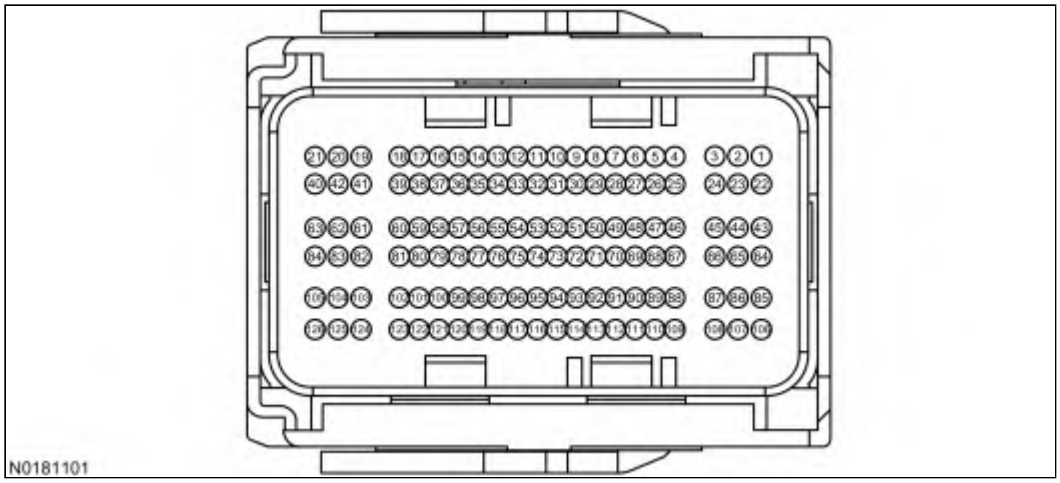
Vehicle	Connector	Pin	Circuit
F-650 / F-750	A	2 1	SIGRTN ECT2
F-Series Super Duty	B	2 1	SIGRTN ECT2

Powertrain Control Module-E (PCM-E) Connector

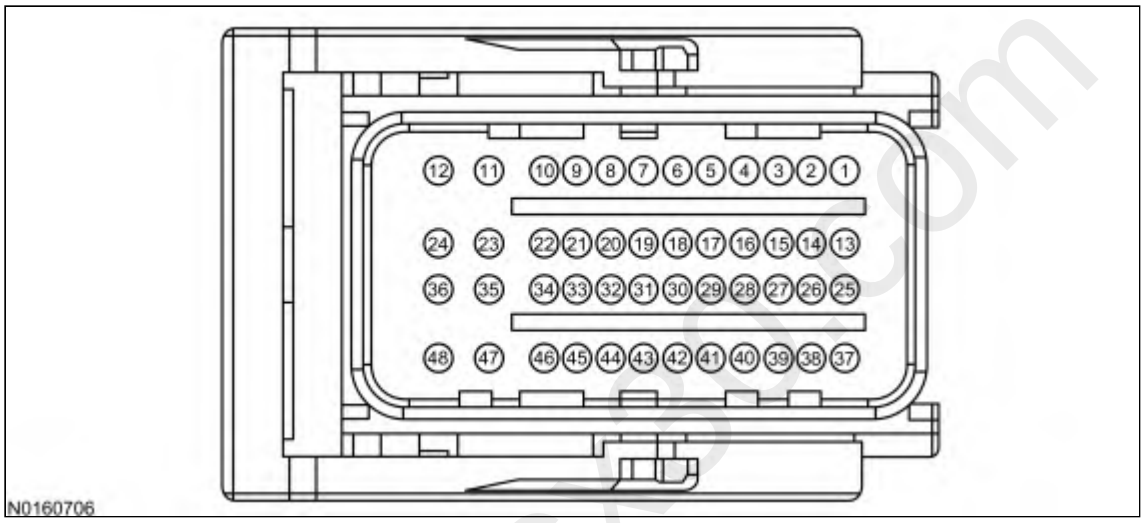
A



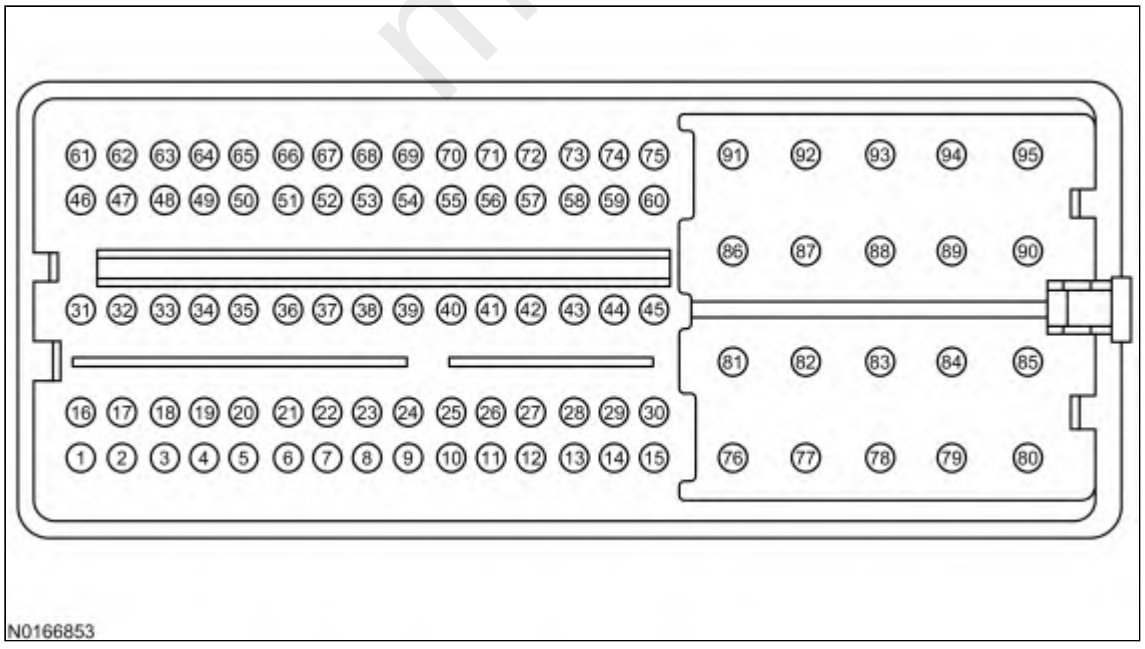
B


N0181101

C


12 11 10 9 8 7 6 5 4 3 2 1
24 23 22 21 20 19 18 17 16 15 14 13
36 35 34 33 32 31 30 29 28 27 26 25
48 47 46 45 44 43 42 41 40 39 38 37
N0160706

D


61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
91 92 93 94 95
86 87 88 89 90
81 82 83 84 85
76 77 78 79 80
N0166853

Vehicle	Connector	Pin	Circuit
F-650 / F-750	A	4 28 4 31	SIGRTN ECT SIGRTN ECT2
F-Series Super Duty	B	36 34 4 35	SIGRTN ECT SIGRTN ECT2
Transit	C	18 22	ECT SIGRTN
Transit Connect	D	57 45	ECT SIGRTN
All other vehicles	A	4 28 4	SIGRTN ECT SIGRTN

K1 CHECK FOR DIAGNOSTIC TROUBLE CODES (DTCS)
Are DTCs P0115, P0116, P0117, P0118, P0128, P1116, P2182, P2183, P2184, or P2185 present?

Yes	GO to K2.
No	RETURN to Section 3, Symptom Charts for further direction.

K2 CHECK THE ENGINE COOLANT LEVEL

WARNING: Always allow the engine to cool before opening the cooling system. Do not unscrew the coolant pressure relief cap when the engine is operating or the cooling system is hot. The cooling system is under pressure; steam and hot liquid can come out forcefully when the cap is loosened slightly. Failure to follow these instructions may result in serious personal injury.

- Check the engine coolant and the secondary cooling system levels.

Is the coolant fill level correct?

Yes	GO to K3.
No	REFER to the Workshop Manual Section 303-03, Engine Cooling, Diagnosis and Testing to continue diagnosis. Clear the PCM DTCs. REPEAT the self-test.

K3 CHECK THE RESISTANCE OF THE ECT OR THE ECT2 SENSORS WITH THE ENGINE OFF

Note: *Verify the engine temperature is at ambient room temperature before continuing with this test. A soak period of 8 hours may be required. Refer to Section 4, Diagnostic Trouble Code (DTC) Charts and Descriptions for information concerning DTC P0115, P0116, P1116 or P2183.*

Note: *Refer to the chart at the beginning of this test for the resistance specifications.*

- Ignition OFF.
- For DTC's P2182, P2183, P2184, or P2185,
- ECT2 Sensor connector disconnected.
- Measure the resistance between:

(+) ECT2 Sensor Connector, Component Side	(-) ECT2 Sensor Connector, Component Side
ECT2	SIGRTN

- For all others,
- ECT Sensor connector disconnected.
- Measure the resistance between:

(+) ECT Sensor Connector, Component Side	(-) ECT Sensor Connector, Component Side
ECT	SIGRTN

Is the resistance within specification?

Yes	GO to K4.
No	INSTALL a new ECT or secondary cooling system ECT2 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.

K4 CHECK FOR AN OPEN

- Ignition OFF.
- PCM-E connector disconnected.
- For DTC's P2182, P2183, P2184, or P2185,
- Measure the resistance between:

(+) PCM-E Connector, Harness Side	(-) ECT2 Sensor Connector, Harness Side
ECT2	ECT2
SIGRTN	SIGRTN

- For all others,
- Measure the resistance between:

(+) PCM-E Connector, Harness Side	(-) ECT Sensor Connector, Harness Side
ECT	ECT
SIGRTN	SIGRTN

Is the resistance less then 5 ohms?

Yes	GO to K5.
No	REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

K5 CHECK FOR A SHORT TO GROUND

- For DTC's P2182, P2183, P2184, or P2185,
- Measure the resistance between:

(+) ECT2 Sensor Connector, Harness Side	(-)
ECT2	Ground

- For all others,
- Measure the resistance between:

(+) ECT Sensor Connector, Harness Side	(-)
ECT	Ground

Is the resistance greater than 10K ohms?

Yes	GO to K6.
No	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.

K6 CHECK THE SIGNAL CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition ON, engine OFF.
- For DTC's P2182, P2183, P2184, or P2185,
- Measure the voltage between:

(+) ECT2 Sensor Connector, Harness Side	(-)
ECT2	Ground

- For all others,
- Measure the voltage between:

(+) ECT Sensor Connector, Harness Side	(-)
ECT	Ground

Is any voltage present?

Yes	REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test.
No	GO to K7.

K7 CHECK THE RESISTANCE OF THE ECT OR SECONDARY COOLING SYSTEM ECT2 SENSORS

Note: *Refer to the chart at the beginning of this test for the resistance specifications.*

Note: *Verify the engine is at operating temperature before taking the ECT or ECT2 reading.*

- For DTC's P2182, P2183, P2184, or P2185,
- ECT2 Sensor connector connected.
- Run the engine until the engine temperature stabilizes.
- Ignition OFF.
- ECT2 Sensor connector disconnected.
- Measure the resistance between:

(+) ECT2 Sensor Connector, Component Side	(-) ECT2 Sensor Connector, Component Side
ECT2	SIGRTN

- For all others,
- ECT Sensor connector connected.
- Run the engine until the engine temperature stabilizes.
- Ignition OFF.
- ECT Sensor connector disconnected.
- Measure the resistance between:

(+) ECT Sensor Connector, Component Side	(-) ECT Sensor Connector, Component Side
ECT	SIGRTN

Is the resistance within specification?

Yes	For DTCs P0116 and P0128, GO to K8. For DTCs P2182 and P2183. GO to K9. For all others, The system is operating correctly at this time. RETURN to Section 3, Symptom Charts for further direction.
No	INSTALL a new ECT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.

K8 CHECK THE SENSOR OPERATION

- Run the engine until the engine temperature stabilizes.
- Verify the radiator hoses are hot and the cooling system is pressurized.
- For F-650 / F-750 and Transit,
- Access the PCM and monitor the ECT (TEMP) PID.
- For all others,
- Access the PCM and monitor the ECT1 (TEMP) PID.

Is the temperature greater than 77°C (170.6°F) ?

Yes	The test is complete. DISREGARD the current diagnostic trouble code (DTC) at this time. DIAGNOSE the next DTC. GO to Section 4, Diagnostic Trouble Code (DTC) Charts and Descriptions.
No	REFER to the Workshop Manual Section 303-03, Engine Cooling to diagnose why the engine does not reach operating temperature. REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.

K9 TEMPERATURE SENSOR CORRELATION

Note: *Verify the engine temperature is at ambient room temperature before continuing with this test. A soak period of 8 hours may be required.*

- Ignition ON, engine OFF.
- Access the PCM and monitor the AAT (TEMP), CAC_T (TEMP), IAT11 (TEMP), EGRTC (TEMP) and ECT2_1 (TEMP) PIDs.
- The secondary cooling system ECT2 temperature must be within the following ranges:
  - Within 20°C (36°F) degrees of the AAT reading

- Within 20°C (36°F) degrees of the CAC_T reading
- Within 20°C (36°F) degrees of the EGRTC reading
- Within 20°C (36°F) degrees of the IAT11 reading

Is the ECT2 PID within specification?

Yes	Unable to duplicate the condition. CHECK for a loose connection, and damaged or corroded terminals. WIGGLE the harness attempting to recreate the concern. REPAIR as necessary.
No	INSTALL a new secondary engine coolant temperature ECT2 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test.