Section C10
A/C Clutch Circuit Diagnosis

Contents

General Description

The air conditioning system uses a compressor with variable displacement. This compressor is referred to as the V-5 type compressor. The V-5 compressor meets A/C requirements without cycling.

The A/C compressor operation is controlled by the Powertrain Control Module (PCM) for the following reasons:

- Improves idle quality during compressor clutch engagement.
- Improves wide open throttle performance (WOT).
- Provides A/C compressor protection from operation with incorrect refrigerant pressures

For a description of the system and an explanation of the components used, refer to *SECTION 1B* of the service manual.

The A/C electrical system consists of the following components:

- A/C control head
- A/C refrigerant pressure switch
- A/C compressor clutch
- A/C compressor clutch relay
- PCM

Operation

When A/C is selected through the A/C control head a 12 volt signal is supplied to the A/C request input of the PCM. The A/C compressor clutch relay is controlled through the PCM. This allows the PCM to increase the engine idle speed just prior to A/C clutch engagement for better idle quality. In addition the PCM will command the cooling fans on during A/C operation. The PCM monitors the A/C refrigerant pressure. If the A/C refrigerant pressure, and engine operating conditions are within a specific calibrated acceptable ranges the PCM will enable the A/C compressor relay. This is accomplished by providing a ground path for the A/C relay coil within the PCM. When the A/C compressor relay is enabled battery voltage is supplied to the compressor clutch coil.

The PCM will enable the A/C compressor clutch whenever the engine is running and the A/C has been requested, unless any of the following conditions are met:

- Throttle greater than 90%.
- A/C head pressure greater than 414 psi or less than 34 psi (as determined by the A/C refrigerant pressure sensor).
- Ignition voltage below 10.5 volts.
- Engine speed greater than 4500 RPM for 5 seconds or 5400 RPM.
- ECT greater than 125°C (257°F).
- IAT less than 5°C (41°F).

Diagnosis

CHART C-10 should be used for diagnosing the electrical portion of the A/C compressor clutch circuit. When diagnosing the refrigerant portion of the HVAC system, refer to *SECTION 1B*.

A scan tool will be used in diagnosing the system. The scan tool has the ability to read the A/C request and refrigerant pressure inputs to the PCM. The scan tool can display when the PCM has commanded the A/C clutch "ON." The scan tool should have the ability to override the A/C request signal and energize the A/C control relay.

On-Vehicle Service

A/C Relay

Remove or Disconnect

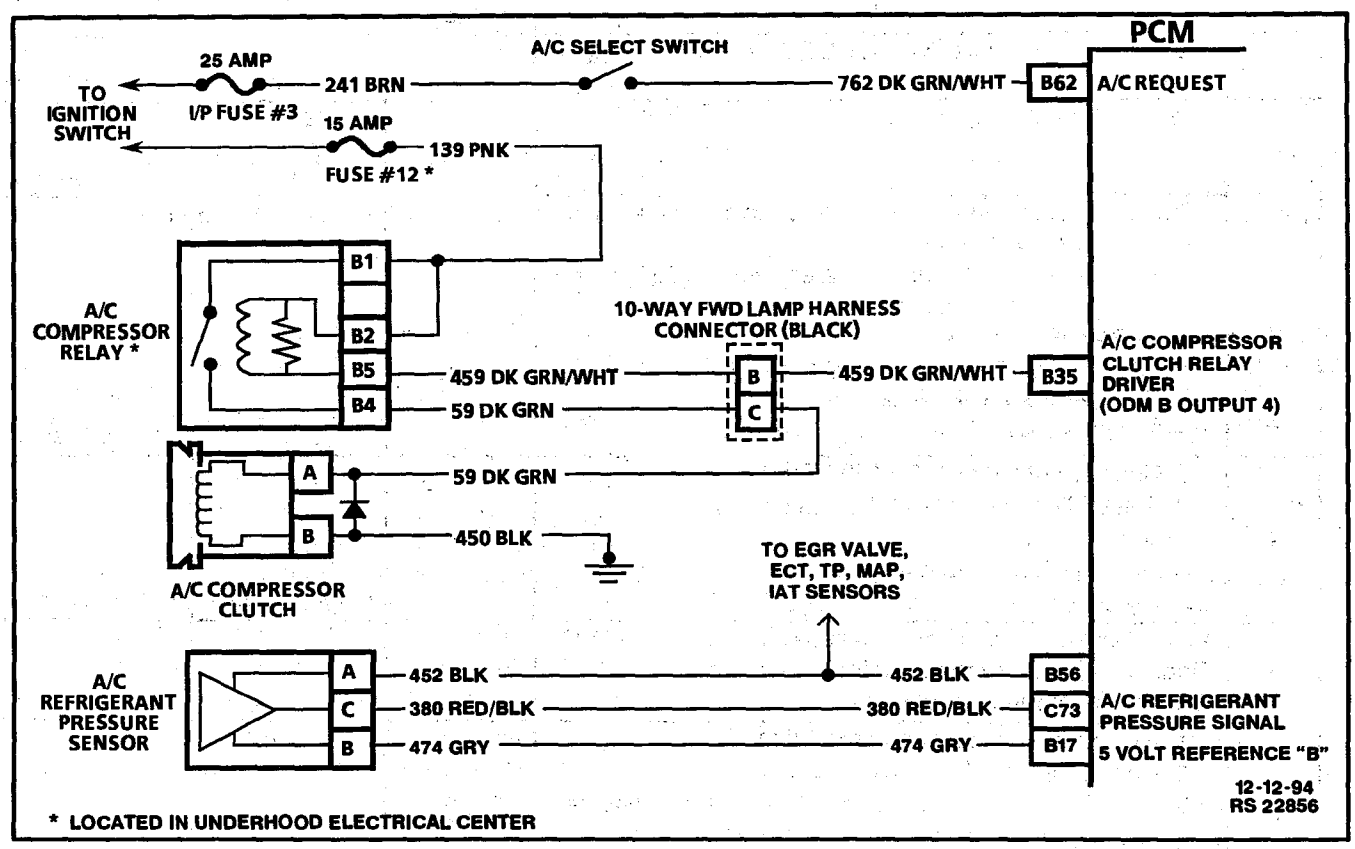
1. Negative battery cable.
2. Cover from underhood electrical center.
3. Relay from underhood electrical center.

Install or Connect

1. Relay in underhood electrical center.
2. Cover to underhood electrical center.
3. Negative battery cable.

For removal and replacement procedures of HVAC components refer to *SECTION 1B*.

CHART C-10 A/C Clutch Circuit Diagnosis



Circuit Description:

When A/C is selected through the A/C control head a 12 volt signal is supplied to the A/C request input of the PCM. The A/C compressor clutch relay is controlled through the PCM. The PCM monitors the A/C refrigerant pressure. If the A/C refrigerant pressure, and engine operating conditions are within a specific calibrated acceptable ranges the PCM will enable the A/C compressor relay. This is accomplished by providing a ground path for the A/C relay coil within the PCM. When the A/C compressor relay is enabled battery voltage is supplied to the compressor clutch coil.

The PCM will enable the A/C compressor clutch whenever the engine is running and the A/C has been requested, unless any of the following conditions are met:

- TP angle greater than 90%.
- A/C head pressure greater than 414 psi or less than 34 psi (as determined by the A/C refrigerant pressure sensor).
- Ignition voltage below 10.5 volts.
- Engine speed greater than 4500 RPM for longer than 5 seconds.
- ECT greater than 125°C (257°F).
- IAT less than 5°C (41°F).

Chart Test Description:

Number(s) below refer to circled number(s) on the diagnostic chart:

The A/C compressor clutch should not be engaged with the engine running if an A/C mode is not selected at the control head.

2. Stored Diagnostic Trouble Codes (That may not illuminate the Malfunction indicator Lamp) may disable the A/C compressor. This Diagnostic Table may lead to improper diagnosis and replacement of good parts if Diagnostic Trouble Codes are present.
3. The A/C compressor clutch should apply if the conditions under the Notice have been met.
6. Checks for an A/C request signal from the control head to the PCM.
12. Checks the ignition feed circuit to the A/C relay.
13. Determines whether the A/C relay or the circuitry is at fault.
21. Determines whether or not the PCM is turning the A/C relay "ON" due to a false A/C request.
22. Isolates problem to the A/C control head or the PCM.
27. Determines whether the A/C relay is faulty or the A/C relay driver circuit is grounded all the time.

Chart C-10 - A/C Clutch Control Circuit Diagnosis

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic" (OBD) system check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any PCM DTC(s) stored?	—	Go to applicable DTC table(s)	Go to Step 3
3	**Notice:** Before continuing with diagnosis, the following conditions must be met: • Intake air temperature greater than 15°C (60°F.) • Engine coolant temperature less than 119°C (246°F.) 1. With A/C "OFF," start and idle the engine. 2. Observe the A/C compressor. Is the A/C compressor clutch engaged?	—	Go to Step 21	Go to Step 4
4	1. Run the engine at 1000-1500 RPM. 2. Select "Defrost" or "MAX" mode on HVAC control head. 3. Observe A/C compressor. Is the A/C compressor clutch engaged?	—	Refer to *Diagnostic Aids*	Go to Step 5
5	With "Defrost" or "Max" mode still selected, observe "A/C Request" display on the scan tool. Does "A/C Request" display "Yes?"	—	Go to Step 9	Go to Step 6
6	1. Ignition "OFF," disconnect the PCM. 2. Ignition "ON." 3. With "Defrost" or "Max" mode still selected, measure voltage on the A/C request circuit at the PCM harness connector. Does the voltage measure near the specified value?	B+	Go to Step 8	Go to Step 7
7	1. Check the A/C request circuit for the following conditions: • Open; • Shorted to ground; • Poor connection at the A/C control head or A/C programmer (as applicable). 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Electrical Diagnosis* Section 8A for A/C Controls diagnostics
8	1. Check the A/C request circuit for a poor connection at the PCM. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 35
9	Observe A/C refrigerant pressure display on the scan tool. Is indicated A/C pressure between the specified values?	0.35 volt - 4.27 volts	Go to Step 12	Go to Step 10

Chart C-10 - A/C Clutch Control Circuit Diagnosis (continued)

Step	Action	Value(s)	Yes	No
10	1. Connect J 39183-C R-134a Manifold gauge set (refer to "*Heater, Ventilation and Air Conditioning*"). 2. Observe high side refrigerant pressure on the gauge. Is high side refrigerant pressure within the specified values?	34 psi - 414 psi	Go To Step 11	Go to *Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures* in *"Heater, Ventilation and Air Conditioning."*
11	1. Ignition "OFF." 2. Disconnect the PCM and the A/C refrigerant pressure sensor. 3. Measure the resistance of the following circuits between the PCM and the A/C Refrigerant Pressure Sensor: • A/C refrigerant pressure sensor signal circuit. • 5 Volt Reference "B" circuit. • Sensor Ground circuit. 4. If any resistance is higher than the specified value, locate and repair cause of high resistance in circuit as necessary. Is any resistance higher than the specified value?	5 ohms	Verify repair	Go to Step 18
12	1. Disconnect the A/C relay electrical connector. 2. Probe the ignition feed circuits at the A/C relay harness connector with a test light to ground. Is the test light "ON?"	—	Go to Step 13	Go To Step 31
13	Connect a fused jumper between the ignition feed circuit and A/C compressor clutch control circuit (CKT 59) at the A/C relay connector. Does the A/C compressor clutch engage?	—	Go to Step 14	Go to Step 15
14	1. Check for poor connections at A/C relay. 2. If a problem is found, replace faulty terminals as necessary. Was a problem found?	—	Verify repair	Go to Step 32
15	1. Disconnect the A/C compressor clutch electrical connector (leave the ignition feed circuit and A/C compressor clutch control circuit (CKT 59) jumpered at the A/C relay connector). 2. Connect a test light between A/C compressor clutch control circuit (CKT 59) and the compressor ground circuit. Is the test light "ON?"	—	Go to Step 16	Go to Step 17
16	1. Check for poor connections at the A/C compressor clutch. 2. If a problem is found, replace faulty terminals as necessary. Was a problem found?	—	Verify repair	Go to Step 33

Chart C-10 - A/C Clutch Control Circuit Diagnosis (continued)

Step	Action	Value(s)	Yes	No
17	Check for an open or short to ground in the A/C compressor clutch control circuit (CKT 59). If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 34
18	1. Leave the PCM and the A/C refrigerant pressure sensor disconnected. 2. Ignition "ON," measure voltage between the A/C refrigerant pressure signal circuit and ground. Does the voltage measure near the specified value?	0 volts	Go to Step 19	Go to Step 20
19	1. Check for the following conditions: • The 5 Volt Reference "B" circuit for poor connections at the PCM or A/C refrigerant pressure sensor. • The A/C Refrigerant Pressure Signal circuit for poor connections at the PCM or A/C refrigerant pressure sensor. • The Sensor Ground circuit for poor connections at the A/C refrigerant pressure sensor. 2. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to Step 36
20	Locate and repair short to voltage in the A/C Refrigerant Pressure Signal circuit. Is action complete?	—	Verify repair	—
21	1. Ignition "ON" 2. A/C "OFF" 3. Observe "A/C Request" display on the scan tool. Does "A/C Request" display "Yes?"	—	Go To Step 22	Go To Step 24
22	1. Ignition "OFF". 2. Disconnect the PCM. 3. Ignition "ON," A/C "OFF". 4. Using a DVM, measure voltage between the A/C request circuit at the PCM harness connector and ground. Does the voltage measure near the specified value?	B+	Go To Step 23	Go to Step 35
23	1. Ignition "OFF," disconnect the A/C control head. 2. Ignition "ON," check the A/C Request circuit for a short to B+. 3. If a problem is found, repair as necessary. Was a problem found?	—	Verify repair	Go to *Electrical Diagnosis* Section 8A for A/C Controls diagnostics
24	1. Disconnect A/C relay. 2. Start vehicle and observe the A/C compressor. Is the A/C compressor clutch engaged?	—	Go to Step 29	Go to Step 25.
25	Probe the A/C compressor clutch control circuit (CKT 59) at the A/C relay harness connector with a test light to ground. Is the test light "ON?"	—	Go to Step 27	Go to Step 26.
26	Replace A/C relay. Is action complete?	—	Verify repair	—

Chart C-10 - A/C Clutch Control Circuit Diagnosis (continued)

Step	Action	Value(s)	Yes	No
27	1. Ignition "OFF". 2. Disconnect the PCM. 3. Probe the A/C relay driver circuit at the PCM connector with a test light connected to B+. Is the test light "ON?"	—	Go to Step 28.	Go to Step 35
28	Repair short to ground in the A/C compressor clutch relay driver circuit. Is action complete?	—	Verify repair	—
29	1. Key "OFF". 2. Disconnect the A/C compressor clutch electrical connector. 3. Start engine and observe A/C compressor. Is the A/C compressor clutch engaged?	—	Go To Step 33	Go to Step 30
30	Locate and repair short to voltage in the A/C compressor clutch control circuit (CKT 59). Is action complete?	—	Verify repair	—
31	Repair open or short to ground in ignition feed circuit to the A/C compressor relay. Is action complete?	—	Verify repair	—
32	Replace A/C compressor relay. Is action complete?	—	Verify repair	—
33	Repair A/C compressor clutch. Refer to *V5 Air Conditioning Compressor Service.* Is action complete?	—	Verify repair	—
34	Locate and repair open in A/C compressor clutch ground circuit (CKT 450). Is action complete?	—	Verify repair	—
35	Replace the PCM. Is action complete?	—	Verify repair	—
36	Replace A/C refrigerant pressure sensor. Is Action complete?	—	Verify repair	—

SECTION C10
A/C COMPRESSOR CLUTCH CONTROL

CONTENTS

GENERAL DESCRIPTION

In order to improve engine operation, and protect the A/C compressor and clutch during Wide Open Throttle (WOT) performance, the A/C compressor operation is controlled by the PCM.

OPERATION

The A/C electrical system consists of an A/C control head, A/C refrigerant low pressure cutoff switch, an A/C refrigerant pressure sensor, an evaporator temperature sensor, a control relay, the compressor clutch, and the PCM.

When A/C is selected "ON" through the A/C control head, a 12 volt signal is supplied to the A/C request input of the PCM. The PCM will poll the A/C refrigerant pressure sensor and A/C evaporator temperature sensor before enabling the compressor clutch control relay. If either switch detects a pressure or temperature variation above or below a calibrated acceptable range, the clutch relay will not be enabled. When the PCM determines that the system temperature and pressure are within acceptable ranges, the A/C compressor clutch relay will be enabled, allowing voltage to be applied to the A/C clutch and A/C status input of the PCM. The A/C status input informs the PCM that the relay has closed and voltage is applied to the clutch, via the A/C compressor low pressure cutoff switch. The A/C compressor low pressure cutoff switch is closed when there is sufficient system pressure (depending on refrigerant charge and ambient temperature). The PCM will also turn the cooling fan "ON" when A/C is requested. Refer to "Cooling Fan Control," Section "6E3-C12" for more information on cooling fan operation. A/C is controlled by the PCM so that the PCM can increase idle speed before turning "ON" the clutch or disable the clutch during WOT or high coolant temperatures.

DIAGNOSIS

The PCM will energize the A/C clutch whenever the engine is running and A/C has been requested, unless any of the following conditions are met:

- Wide Open Throttle (WOT).
- A/C head pressure greater than 492 psi or less than 1 psi (as determined by the A/C refrigerant pressure sensor).
- Evaporator temperature sensor less than 1°C (33°F).
- Low ignition voltage.
- IAT greater than 151°C (304°F).
- Engine speed greater than 5200 RPM.
- ECT greater than 124°C (255°F).

CHART C-10 should be used for diagnosing the electrical portion of the A/C circuit. SECTION 1B of the service manual should be used for diagnosing the refrigerant portion of the system.

The Tech 1 will be used in diagnosing the system, as it has the ability to monitor the A/C request input to the PCM, A/C status, A/C system pressure, as well as displaying when the PCM has commanded the A/C clutch "ON."

ON-VEHICLE SERVICE

A/C RELAY

Remove or Disconnect

1. Negative battery cable.
2. Cover from underhood electrical center.
3. Relay from underhood electrical center.

Install or Connect

1. Relay to underhood electrical center.
2. Cover to underhood electrical center.
3. Negative battery cable.

For removal and replacement procedures of A/C components, refer to SECTION 1B of the service manual.

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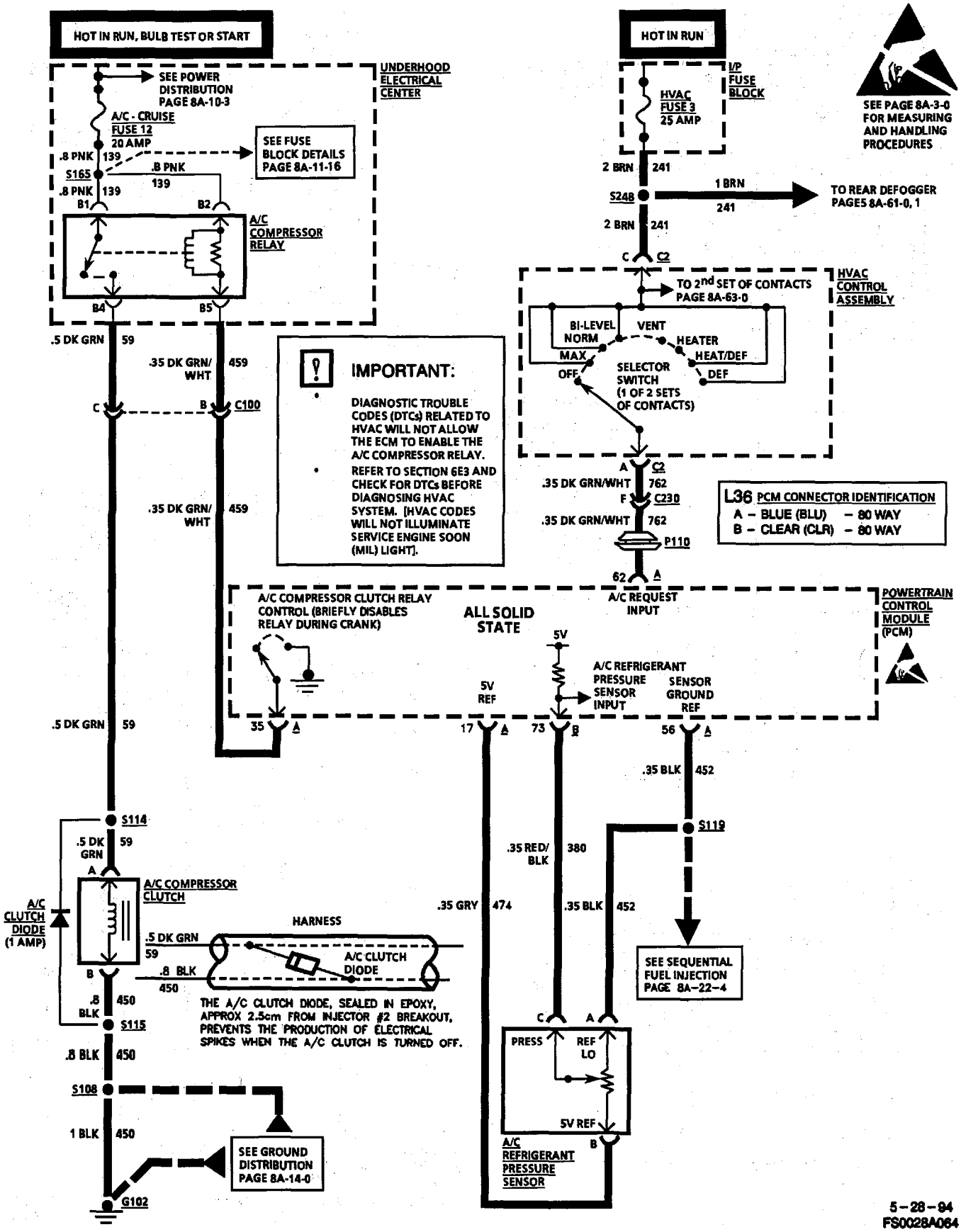

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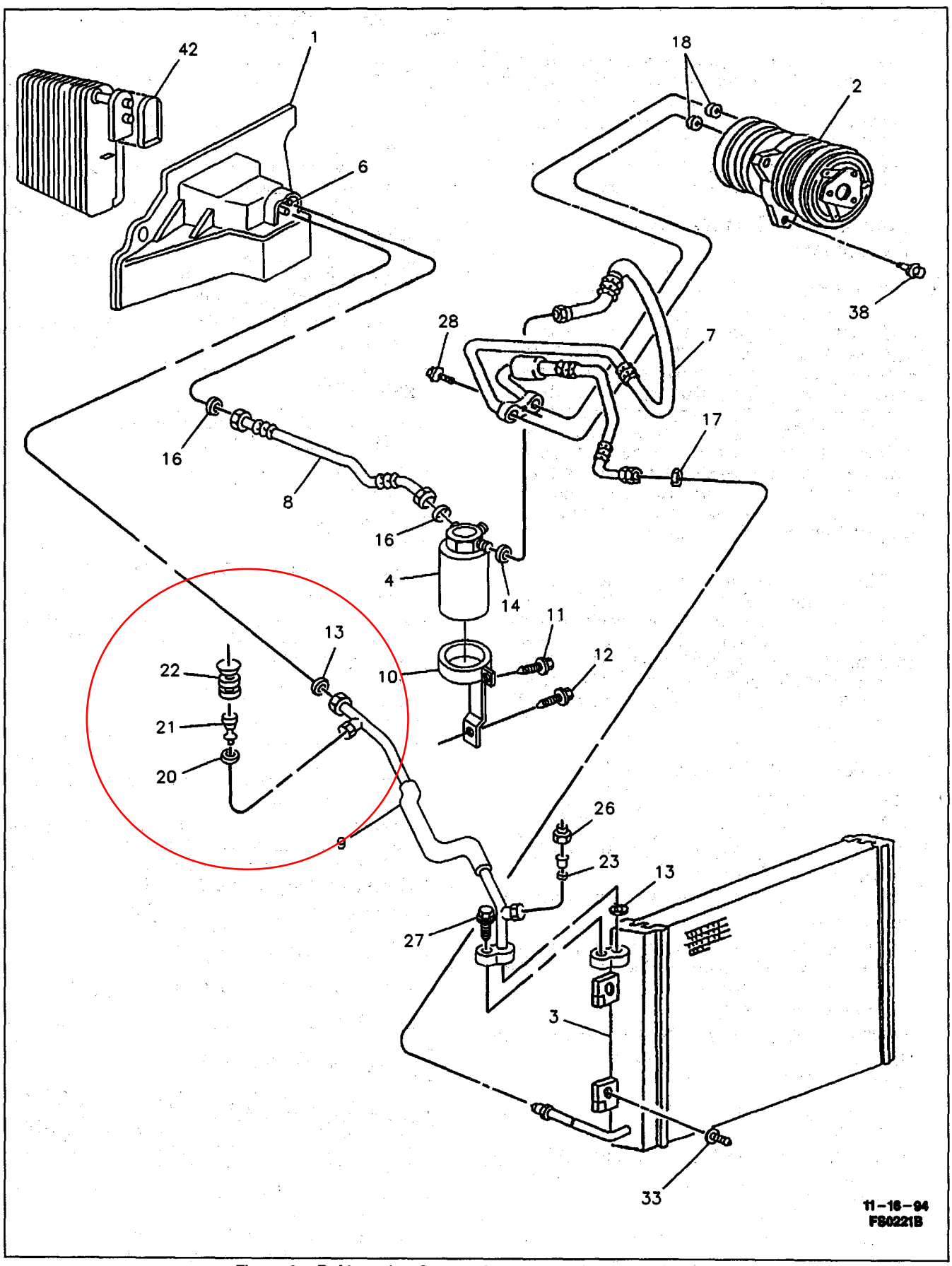

Figure 2 - Refrigeration System Components (3800 L36 Engine)

1 MODULE, HEATER AND AIR CONDITIONING EVAPORATOR
2 COMPRESSOR, AIR CONDITIONING
3 CONDENSER, AIR CONDITIONING
4 ACCUMULATOR, AIR CONDITIONING
6 EVAPORATOR, AIR CONDITIONING
7 HOSE, AIR CONDITIONING COMPRESSOR AND CONDENSER
8 HOSE, ACCUMULATOR
9 TUBE, AIR CONDITIONING EVAPORATOR
10 BRACKET, AIR CONDITIONING ACCUMULATOR
11 BOLT/SCREW, AIR CONDITIONING ACCUMULATOR CLAMP
12 BOLT/SCREW, AIR CONDITIONING ACCUMULATOR BRACKET
13 O-RING, AIR CONDITIONING EVAPORATOR TUBE
14 O-RING, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
16 O-RING, AIR CONDITIONING ACCUMULATOR HOSE
17 O-RING, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
18 SEAL, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
20 O-RING, AIR CONDITIONING REFRIGERANT PRESSURE SENSOR
21 VALVE, AIR CONDITIONING REFRIGERANT PRESSURE SENSOR
22 SENSOR, AIR CONDITIONING REFRIGERANT PRESSURE SENSOR
23 CORE, AIR CONDITIONING REFRIGERANT SERVICE VALVE
26 CAP, AIR CONDITIONING REFRIGERANT CHARGE VALVE
27 BOLT/SCREW, AIR CONDITIONING EVAPORATOR TUBE
28 BOLT/SCREW, AIR CONDITIONING COMPRESSOR AND CONDENSER HOSE
33 RETAINER, RADIATOR AIR UPPER BAFFLE
38 BOLT/SCREW, AIR CONDITIONING COMPRESSOR
39 NUT, AIR CONDITIONING COMPRESSOR

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Figure 3 - Refrigeration Sytem Components -Legend (3800 L36 Engine)

4. Accumulator hose fitting at accumulator (4).
   - Use back-up wrench to hold accumulator fitting while loosening accumulator hose fitting.
   - Discard O-rings (16).
5. Accumulator hose (8).

Install or Connect

NOTICE: See "Notice" on page 1B-1 of this section.

1. Clean fittings with mineral base 525 viscosity refrigerant oil.
2. O-rings (16) to accumulator hose.
   - Lightly coat O-rings (16) with mineral base 525 viscosity refrigerant oil.
3. Accumulator hose (8).
4. Accumulator hose fitting to accumulator (4).

Tighten

- Accumulator hose fitting to 48 N.m (36 lb. ft.).

5. Accumulator hose fitting to evaporator (6).

Tighten

- Accumulator hose fitting to 38 N.m (28 lb. ft.).

6. Nut (58) mounting accumulator hose bracket (59) to shock absorber stud.

Tighten

- Nut (58) to 8 N.m (71 lb. in.).

7. Charge A/C system. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in the 1995 Camaro/Firebird Service Manual.
8. Leak-test fittings. Refer to "Leak-Testing the Refrigeration System" in the 1995 Camaro/Firebird Service Manual.

Air Conditioning Evaporator Tube

Figure 2, 3 and 4

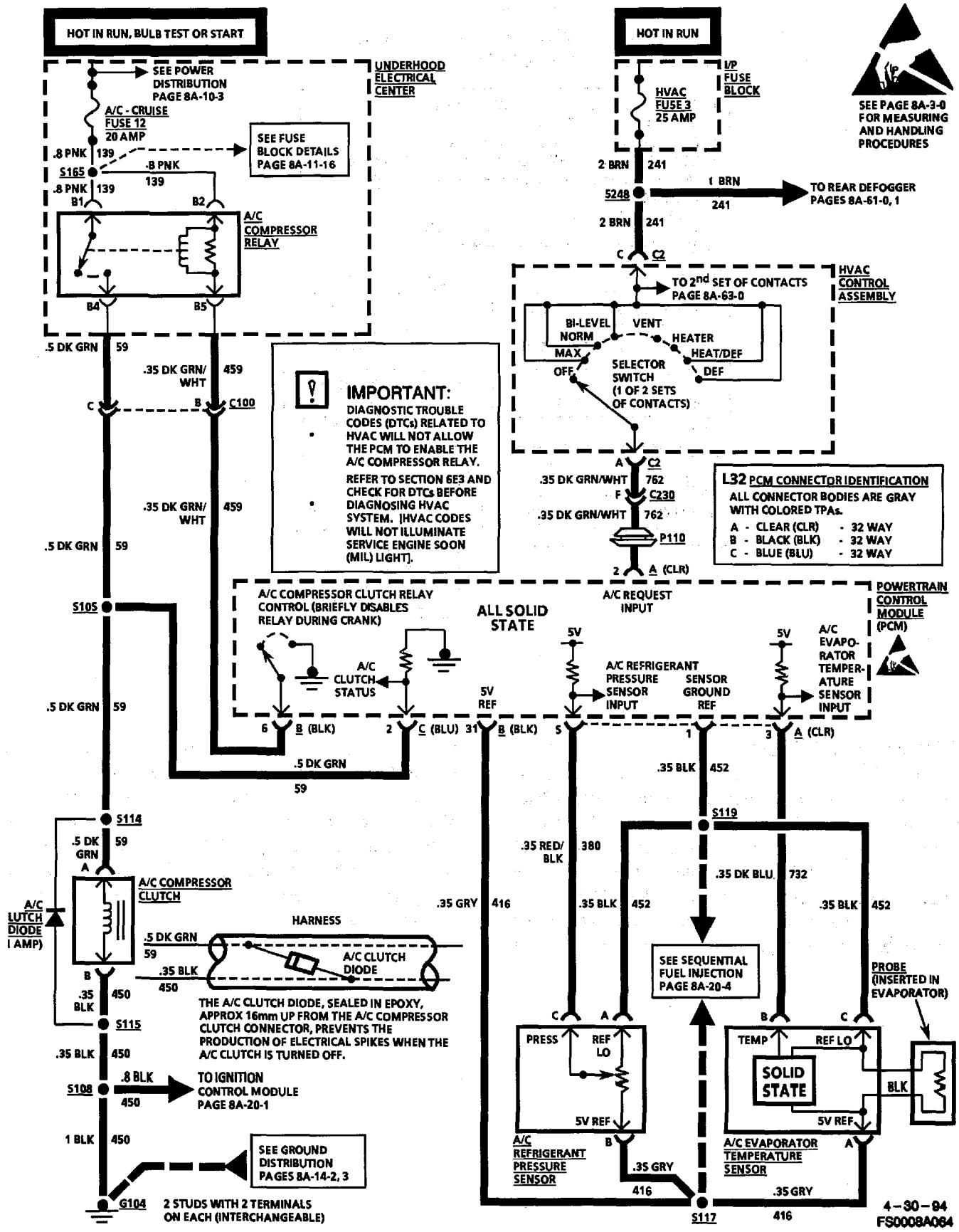
Remove or Disconnect

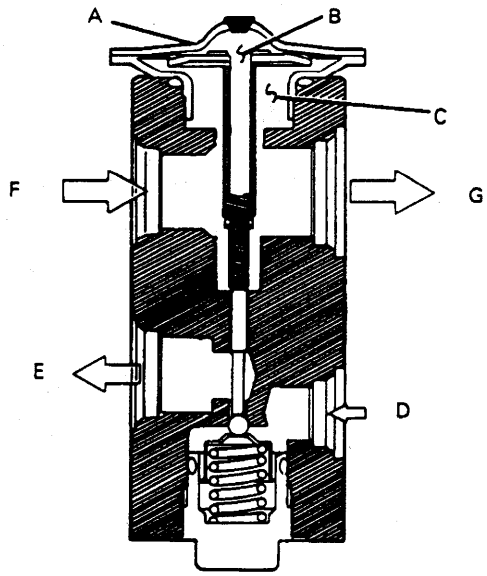
1. Recover refrigerant. Refer to "Refrigerant Recovery and Recycling, Adding Oil, Evacuating and Recharging Procedures" in the 1995 Camaro/Firebird Service Manual.

CAUTION: Refer to "Caution" under "Disconnecting the Negative Cable Assembly" in the 1995 Camaro/Firebird Service Manual.

2. Battery negative cable.
3. Electrical connector at refrigerant pressure sensor (22).
4. Evaporator tube fitting at evaporator (6).
   - Use back-up wrench to hold evaporator fitting while loosening evaporator tube fitting.

HVAC COMPRESSOR CONTROL
V6 VIN S





A POWER DOME
B THERMAL-SIDE PRESSURE
C AIR CONDITIONING SYSTEM LOW-SIDE PRESSURE
D FROM AIR CONDITIONING RECEIVER AND DEHYDRATOR ASSEMBLY (HIGH SIDE)
E TO AIR CONDITIONING EVAPORATOR (LOW SIDE)
F FROM AIR CONDITIONING EVAPORATOR
G TO AIR CONDITIONING COMPRESSOR ASSEMBLY

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Figure 3 – Thermostatic Expansion Valve Assembly

Although the thermostatic expansion valve assembly controls evaporator refrigerant flow, air conditioning capacity control (to prevent ice build-up) is managed by compressor cycling which is controlled by the powertrain control module (PCM).

Air Conditioning Evaporator

The evaporator is a device which cools and dehumidifies the air before it enters the vehicle. High-pressure refrigerant flows through the thermostatic expansion valve assembly and becomes low-pressure refrigerant before entering the evaporator. The heat in the air passing through the evaporator core is lost to the cooler surface of the core, thereby cooling the air. As the process of heat loss from the air to the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside of the evaporator core and is drained off as water.

High Pressure Relief Valve

The compressor assembly is equipped with a pressure relief valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure. To prevent system damage, the valve is designed to open automatically at approximately 3036 kPa (440 psi). Any condition that causes this valve to open should be corrected, and the refrigerant oil should be replaced as necessary. The air conditioning refrigerant pressure sensor should also be checked for proper calibration. Refer to SECTION 6E3 (DTC 61).

RELAYS AND SWITCHES

Blower Motor Assembly Relay

The blower motor assembly relay is used to provide battery voltage to the blower motor assembly only during high blower motor assembly speed. The blower motor resistor assembly is used to provide power to the blower motor assembly in all other speed settings. The blower motor relay is located under the instrument panel. Refer to SECTION 8A-63 for more information.

Air Conditioning Compressor Relay

The air conditioning compressor relay is used to provide battery voltage to the compressor clutch coil. The relay is controlled by the powertrain control module (PCM) only. The relay is located in the underhood electrical center. Refer to SECTION 8A-64 for more information.

Air Conditioning Refrigerant Pressure Sensor Assembly

The A/C refrigerant pressure sensor assembly attached to the air conditioning evaporator liquid line, senses refrigerant pressure on the air conditioning system high-side. The refrigerant pressure status is sent to the PCM. The purpose of this sensor is to inform the PCM of high-side pressure status so the PCM can:

- Control cooling fan assembly operation.
- Prevent compressor assembly operation if ambient temperatures are too cold.
- Disable the compressor assembly before high-side pressure becomes too high.
- Diagnosis of compressor controls.

Refer to SECTION 8A-64 for more information.

Air Conditioning Evaporator Temperature Sensor Assembly

The air conditioning evaporator temperature sensor assembly mounted to the heater and air conditioning evaporator module assembly has a probe inserted into the evaporator which measures evaporator temperature and sends a signal to the PCM. Within the probe is a thermistor which varies output according to temperature. The purpose of this sensor assembly is to inform the PCM of the evaporator temperature so the compressor assembly can be disabled before the evaporator freezes. The evaporator temperature sensor assembly is a solid state device, do not attempt to measure resistance. Measuring resistance across pins can cause sensor damage. Refer to SECTION 8A-64 for more information.

DIAGNOSIS

LEAK-TESTING THE REFRIGERATION SYSTEM

A refrigerant leak test should be performed on the system whenever a leak is suspected due to system indication of low charge or after any service operation which disturbs the components, lines, or connections. Many methods and special tools are available for this purpose; however, no matter which tool is used, care and diligence are the biggest keys to success.