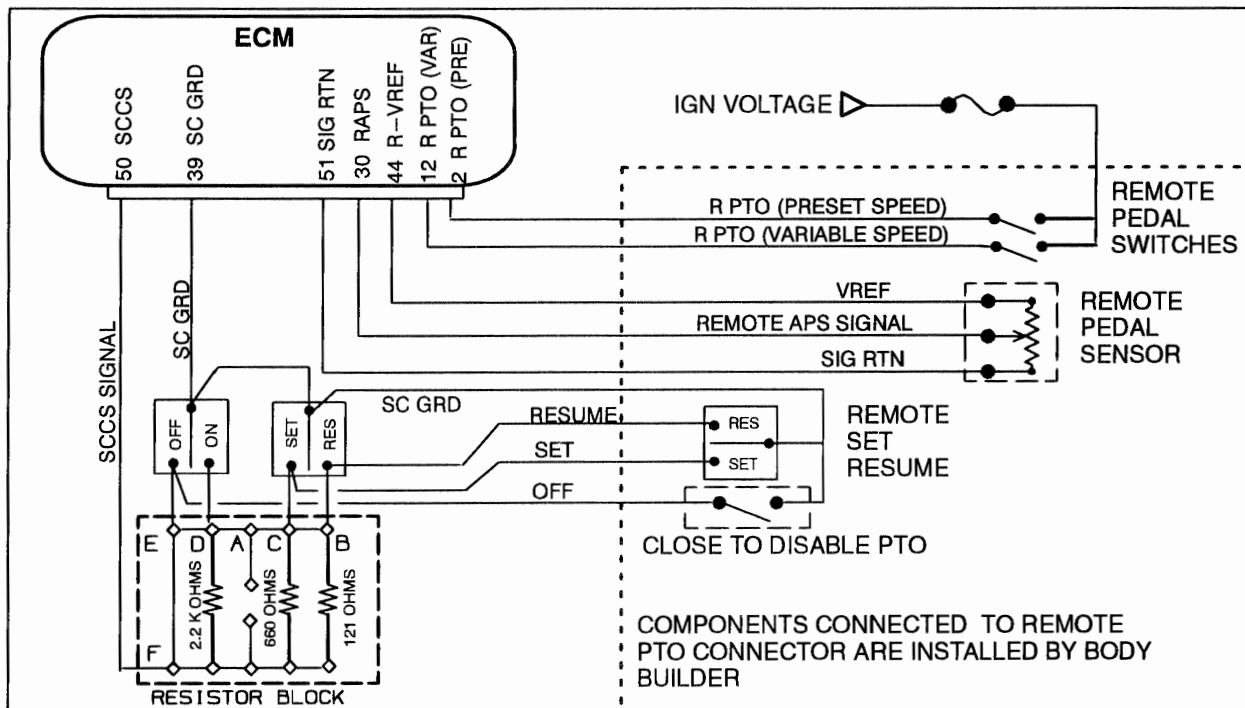


CRUISE CONTROL, PTO, HAND THROTTLE SYSTEM



SIGNAL FUNCTION

CRUISE CONTROL

ECM terminal 50 outputs a 6.58 volt signal to the resistor block. Activating the cruise command switches causes the signal to pass through different resistance levels in the resistor block, altering the signal which is grounded at ECM terminal 39. There are five expected signals to the ECM: OFF, ON, SET, RESUME and open (no switches have been used). Refer to Extended Description on page 188 for additional detail.

REMOTE PTO CONTROLS

To use the remote controls, cruise control must be turned on using the cab cruise ON/OFF switch. The remote Set/Resume switch and disable switch are wired parallel to cab switches and operate in the same manner.

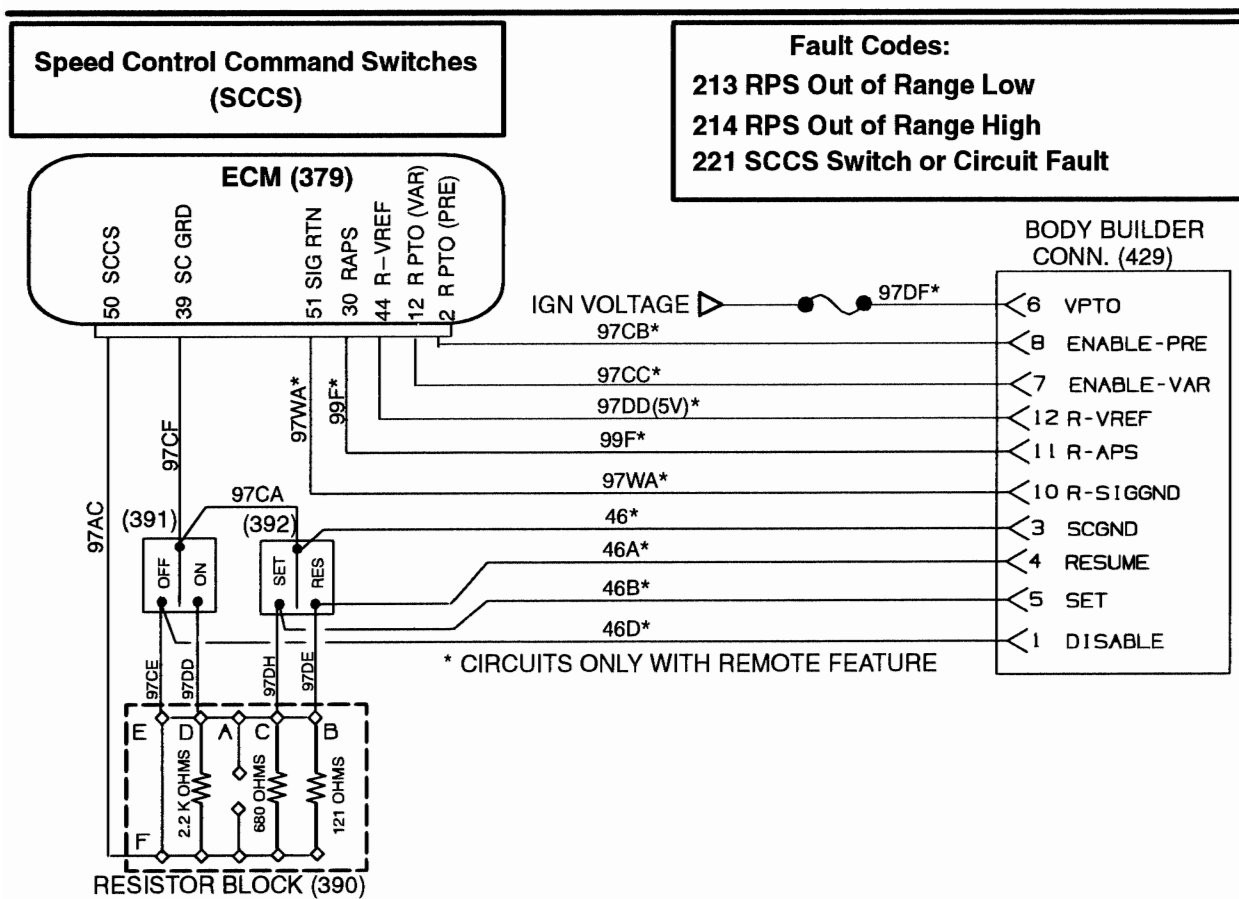
With cruise control ON:

- A. Placing the remote PTO Preset switch in the ON position (closed) causes the PTO to operate at a preset engine speed (customer selected) programmed into the VPM.
- B. Placing the remote PTO Variable switch in the ON position (closed) causes the PTO to operate using remote pedal.

NOTE: IF BOTH OF THE ABOVE SWITCHES ARE ON, THE REMOTE PEDAL IS DEACTIVATED.

FAULT DETECTION MANAGEMENT

The ECM monitors the **SCCS signal** for the five expected signals. If an incorrect signal is detected, Flash Code 221 is logged. The ECM also monitors the **R-APS signal** input at ECM terminal 30 from the remote pedal sensor for out-of-range signals, high or low.

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Operational Voltage Checks

Connector (379) with breakout box installed and key ON

SCCS Sw. Positions	Breakout Test Points	Spec.	Comments
All switches in neutral position	#50 to #39	6.2V–7.1V	< than 6.2V check connections, battery condition. Greater than 7.1V check for short to VBAT
Hold switch in OFF position	#50 to #39	0V–100mV	> than 100mV check connections, switch, resistor block and circuits for correct resistance or short to VBAT or grd
Hold switch in ON position	#50 to #39	4.4V–5.0V	<> than specified voltage drop, check connections, switch, resistor block and related circuits for correct resistance or short to VBAT or grd
Hold Set switch in SET position	#50 to #39	2.2V–3.0V	<> than specified voltage drop, check connections, switch, resistor block and related circuits for correct resistance or short to VBAT or VREF or grd
Hold Res switch in RES position	#50 to #39	700mV–800 mV	<> than specified voltage drop, check connections, switch, resistor block and related circuits for correct resistance or short to VREF or VBAT or grd

Fault Code Descriptions

213 = RPS signal was less than 0.146 volts for more than 0.5 seconds
214 = RPS signal was greater than 4.56 volts for more than 0.5 seconds
221 = SCCS voltage signal does not match expected levels (5 assigned levels for different conditions)

ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

SPEED CONTROL COMMAND SWITCHES (SCCS)

EXTENDED DESCRIPTION

Cruise control and PTO operation (including remote PTO) share many circuits and components, so both systems are included in this section.

The Cruise/PTO system is controlled by the ECM in response to driver input on the Speed Control Command Switches (SCCS), which are the Cruise ON/OFF and SET/RESUME switches. With a remote PTO operation, the body builder installed controls include a remote SET/RESUME switch and a PTO DISABLE switch that are also SCCS switches.

The body builder also installs a Remote pedal sensor and switches to enable the remote PTO at a preset speed or enable in the variable mode, with engine speed controlled by the remote pedal sensor. These circuits will be discussed in Remote Pedal Sensor Circuits later in this section.

The Clutch Pedal Switch supplies the Driveline Disengaged Signal (DDS) to the ECM and the Service Brake Switches supply a Brake Normally Open (BNO) and Brake Normally Closed (BNC) signal to the ECM. These signals indicate pedal positions and are used by the ECM in operating the Cruise/PTO Control System.

The Vehicle Speed Signal (VSS) and CMP signal provide vehicle speed and engine rpm information that the ECM uses in controlling the Cruise/PTO system.

ECM CONTROL

Refer to the circuit diagram on page 191 for the following discussions on circuit operation.

SCCS CIRCUITS

The ECM sends a 6.58 volt signal from ECM terminal 50 to the SCCS system. The signal goes through the SC Resistor Block Assembly to the SCCS switches (see note 1) and returns to the ECM at terminal 39. Depending on SCCS switch position (ON, OFF, SET, RESUME or when no switch is active), one of five different signals is expected when the signal returns to ECM signal ground terminal 39. These five signals are discussed in the following paragraphs.

NOTE 1: The SC Resistor Block is permanently attached to the cab harness and contains a printed circuit board, that includes three resistors. The printed circuit board can be removed by opening the

end of the resistor block assembly and pulling the board out.

NO SCCS SWITCHES ACTIVE

Note in circuit diagram that the ON/OFF, SET/RESUME (including the remote SET/RESUME) and the remote DISABLE PTO switch are normally open, momentary switches. With the key switch ON, voltage is being applied from ECM terminal 50, but the ECM expects to see an open circuit. With no switch depressed, voltage measured between ECM terminals 39 and 50 is expected to be between 6.2 and 7.1 volts. **An OPEN circuit (6.2 to 7.1 volts between terminals 39 and 50) is the signal that the ECM expects to see with no switch depressed.**

CRUISE ON/OFF SWITCH IN ON POSITION

Momentarily placing this switch in the ON position causes the signal from ECM terminal 50 to go through the 2.2K ohm resistor located in the Resistor Block (390) through the ON terminal of the ON/OFF switch and returns to ECM terminal 39. With the ON switch depressed, the voltage drop in this circuit (measured between ECM terminals 39 and 50) is expected to be between 4.4 and 5.0 volts. **A voltage between 4.4 and 5.0 volts is the signal the ECM expects to see with the ON switch depressed.**

CRUISE ON/OFF SWITCH IN OFF POSITION

Momentarily placing this switch in the OFF position causes the signal from ECM terminal 50 to go through the Resistor Block (390), terminals F to E, where there is no resistor, then through the OFF terminal of the ON/OFF switch returning to ECM terminal 39. With the OFF switch depressed, the expected voltage drop in this circuit (measured between ECM terminals 39 and 50) is expected to be between 0 and 100mV. **A voltage between 0 and 100mV is the signal the ECM expects to see with the OFF switch depressed.**

The Remote DISENGAGE PTO Switch is a normally open (NO) momentary switch that is wired parallel to the OFF side of the ON/OFF switch. The PTO can only be turned on from the cab switch, but can be turned OFF from the remote location. When this switch is closed, the ECM expects to see the same signal as when the ON/OFF switch is in the OFF position (0 to 100mV voltage drop).

SPEED CONTROL COMMAND SWITCHES (SCCS)

CRUISE SET/RESUME IN SET POSITION

Momentarily placing this switch in the SET position causes the signal from ECM terminal 50 to go through the 680 ohm resistor located in the Resistor Block (390) through the SET terminal of the SET/RESUME switch returning to ECM terminal 39. With the SET switch depressed, the voltage drop in this circuit (measured between ECM terminals 39 and 50) is expected to be between 2.2 and 3.0 volts. **A voltage between 2.2 and 3.0 volts is the signal the ECM expects to see with the SET switch depressed.**

The Remote PTO SET/RESUME Switch is a normally open (NO) momentary switch that is wired parallel to the cab SET/RESUME switch. When the remote SET switch is in the SET position, the ECM expects to see the same signal as when the cab SET switch is in the SET position (2.2 to 3.0 volts).

CRUISE SET/RESUME IN RESUME POSITION

Momentarily placing this switch in the RESUME position causes the signal from ECM terminal 50 to go through the 121 ohm resistor located in the Resistor Block (390) through the RESUME terminal of the SET/RESUME switch returning to ECM terminal 39. With the RESUME switch depressed, the voltage drop in this circuit (measured between ECM terminals 39 and 50) is expected to be between 700 mV and 810 mV. **A voltage between 700mV and 810mV is the signal the ECM expects to see with the RESUME switch depressed.**

The Remote PTO SET/RESUME Switch is a normally open (NO) momentary switch that is wired parallel to the cab SET/RESUME switch. When the remote SET/RESUME switch is in the RESUME position, the ECM expects to see the same signal as when the cab SET/RESUME switch is in the RESUME position (700mV to 810mV).

REMOTE PEDAL SENSOR (RPS) SWITCHES

To enable the remote PTO, first the cab ON/OFF switch must be set to the ON position. With PTO enabled, the Enable PRESET switch or Enable VARIABLE switch must be turned ON. These are toggle switches, not momentary on switches.

REMOTE PRESET SWITCH

The remote Preset Switch receives ignition voltage from 5A fuse, F6 through the body builder connector 429, terminal 8. Closing this switch applies ignition voltage to ECM terminal 2. When ECM terminal 2 sees 12 volts, it turns on the PTO to the preset speed. Opening the switch turns off the remote PTO. If both the PRESET switch and the VARIABLE

switch are on, the ECM interprets this as an off signal.

REMOTE VARIABLE SWITCH

The remote Variable Switch receives ignition voltage from 5A fuse, F6 through the body builder connector 429, terminal 7. Closing this switch applies ignition voltage to ECM terminal 12. When ECM terminal 12 sees 12 volts, it turns on the PTO in the variable mode, where engine speed is controlled by the remote pedal. Opening the switch turns off the remote PTO. If both the PRESET switch and the VARIABLE switch are on, the ECM interprets this as an off signal.

REMOTE PEDAL SENSOR (RPS)

The RPS receives R-VREF (5V) from ECM terminal 44, through body builder connector (429), terminal 12. As the pedal position is changed, the wiper sends the variable RPS signal through body builder connector (429), terminal 11 to ECM terminal 30. The ECM expects to see a signal between 152 mV and 4.55 volts. This signal is interpreted by the ECM as percent of throttle, from 0 to 100 percent. The RPS sensor is grounded through body builder connector (429), terminal 10 to ECM terminal 51 (SIG RTN).

ECM DIAGNOSTICS**SCCS DIAGNOSTICS**

The ECM monitors the signal on SCCS circuit 97AC for the expected five signals discussed earlier. If a signal is detected by the ECM that does not match any one of the five expected signals, then Flash Code 221 is set and the PTO or Cruise is disabled.

FLASH CODE 221**ATA CODE SID 244 FMI 2****ECM: SCCS SWITCH OR CIRCUIT FAULT**

CAUSES: Open, short (HIGH or LOW), or bias high or low in SCCS circuits or components.

The ECM monitors the R-APS signal input at ECM terminal 30 from the remote pedal sensor for out-of-range signals, high or low.

- Biased High Or Low - A wiring or component defect that changes the circuit resistance (corroded switch contacts, poor connections, dirty or corroded terminals etc.) will alter the signal, causing the code to be set.
- A short to a 12V or 5V circuit will change the expected signal.

ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

SPEED CONTROL COMMAND SWITCHES (SCCS)

SCCS DIAGNOSTICS (Continued)

- A short to ground changes the expected signal.

CORRECTIVE ACTION: Perform Testing SCCS Circuits on page 193.

RPS DIAGNOSTICS

The ECM monitors the R-APS signal input at ECM terminal 30 from the remote pedal sensor for out-of-range signals, high or low.

FLASH CODE 213

ATA CODE SID 29 FMI 4

ECM: RPS ORL

If the ECM detects a RPS signal lower than 152 mV, this code is set and the remote pedal is disabled.

CORRECTIVE ACTION: Perform Testing RPS Circuits on page 200.

FLASH CODE 214

ATA CODE SID 29 FMI 3

ECM: RPS ORH

If the ECM detects a RPS signal greater than 4.55 volts, this code is set and the remote pedal is disabled.

CORRECTIVE ACTION: Perform Testing RPS Circuits on page 200.

TROUBLESHOOTING

Before troubleshooting the Cruise/PTO control system, use the Prolink EST to:

1. Review any logged Flash Codes.
 - A. Code 221 relates directly to Cruise or Remote SCCS switches circuits. Codes 213 and 214 relate to operation of the remote PTO pedal. **First resolve any other codes that may be present, because they may cause the ECM to disable the cruise control.** Flash code 622 indicates the ECM is using Field Defaults that disable cruise and PTO operation. The cause for code 622 must be corrected.
2. Use the Prolink EST to monitor clutch switch operation. There is no diagnostic code for the DDS, Drive Line Disengagement Switch (clutch switch) operation.

If the clutch switch circuit is open, indicating that the switch is depressed, then cruise and PTO controls won't operate. If the clutch switch circuit is defective (shorted high), depressing the clutch pedal may not disengage the cruise or PTO, causing the engine to go to rated rpm when the clutch pedal is depressed.

3. Flash code 222 is a Brake Switch fault which will disable cruise and PTO operation. Use Prolink to check brake switch operation. The BNO and BNC switches must be working properly for cruise control to operate.
4. Flash codes 141 and 142 are Vehicle Speed Sensor faults which will disable the cruise and PTO controls. A speed sensor that is not properly adjusted will affect speedometer and cruise control operation, and no codes will set. Correct any speedometer problems before troubleshooting the PTO system.
5. A severe INTERMITTENT connection or NOISE in the CMP SIGNAL can cause the engine to surge and the cruise control cannot properly maintain vehicle speed or PTO engine rpm will fluctuate.

CRUISE/PTO CONTROLS DO NOT OPERATE PROPERLY

BEFORE TROUBLESHOOTING

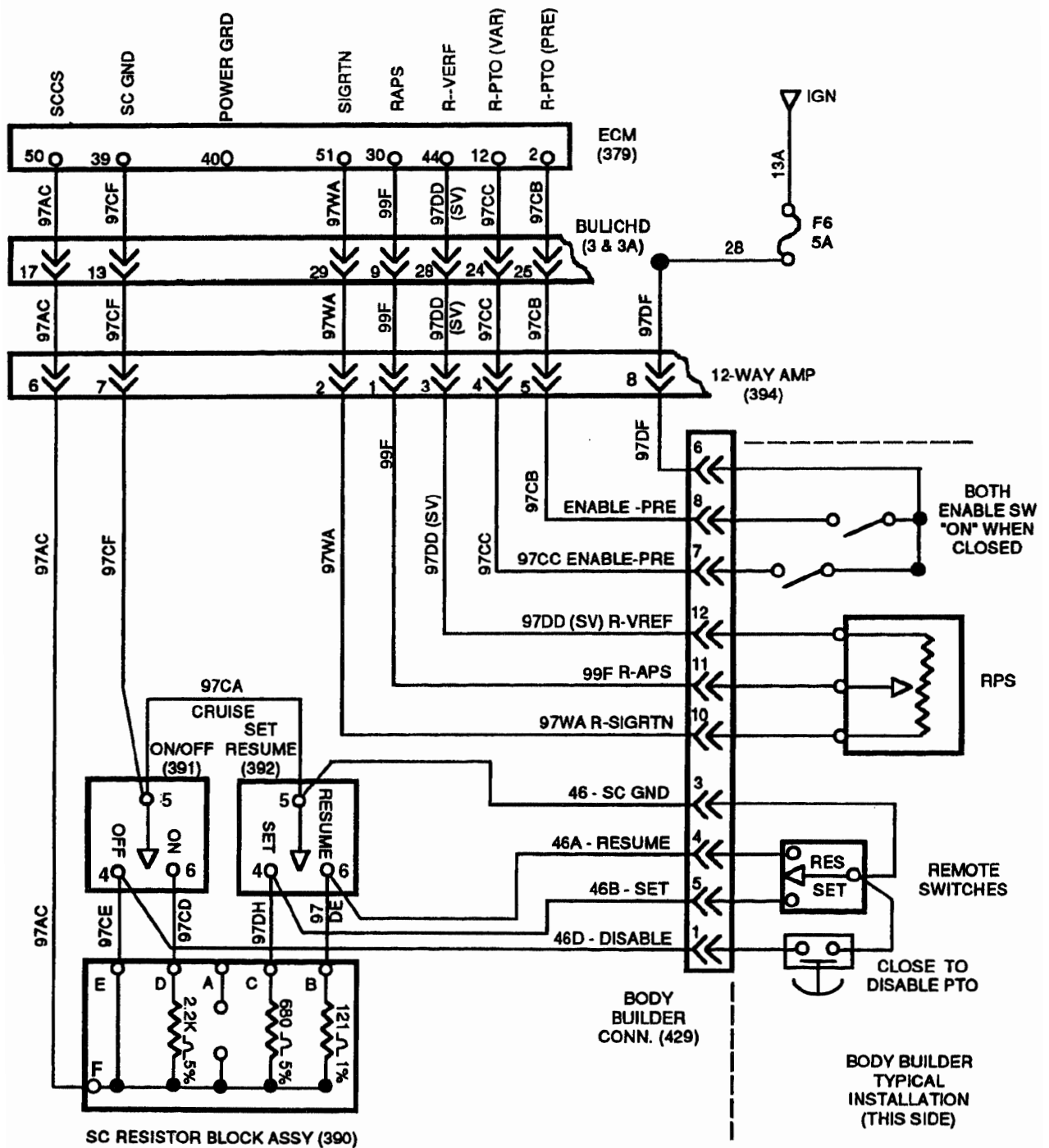
- A. Before troubleshooting, make sure that the batteries are fully charged! Check battery connections and grounds for clean, tight connections free of damage. Voltage tests will give misleading results if the batteries are not fully charged.
- B. Before troubleshooting, inspect circuit connectors for pushed back, loose, or damaged (spread or bent) terminals, or wires with cut strands, etc. Wires and connections must be free of damage or corrosion. When some connectors corrode, a light white residue will be present that must be removed.
- C. Before troubleshooting, inspect suspect circuit grounds for clean, tight connections free of damage.

The Prolink EST can be used to monitor cruise switches, but if code 221 is active, the switches do not operate.

If Flash code 221 is active or if no flash code is present, perform Testing SCCS Circuits on page 193.

SPEED CONTROL COMMAND SWITCHES (SCCS)

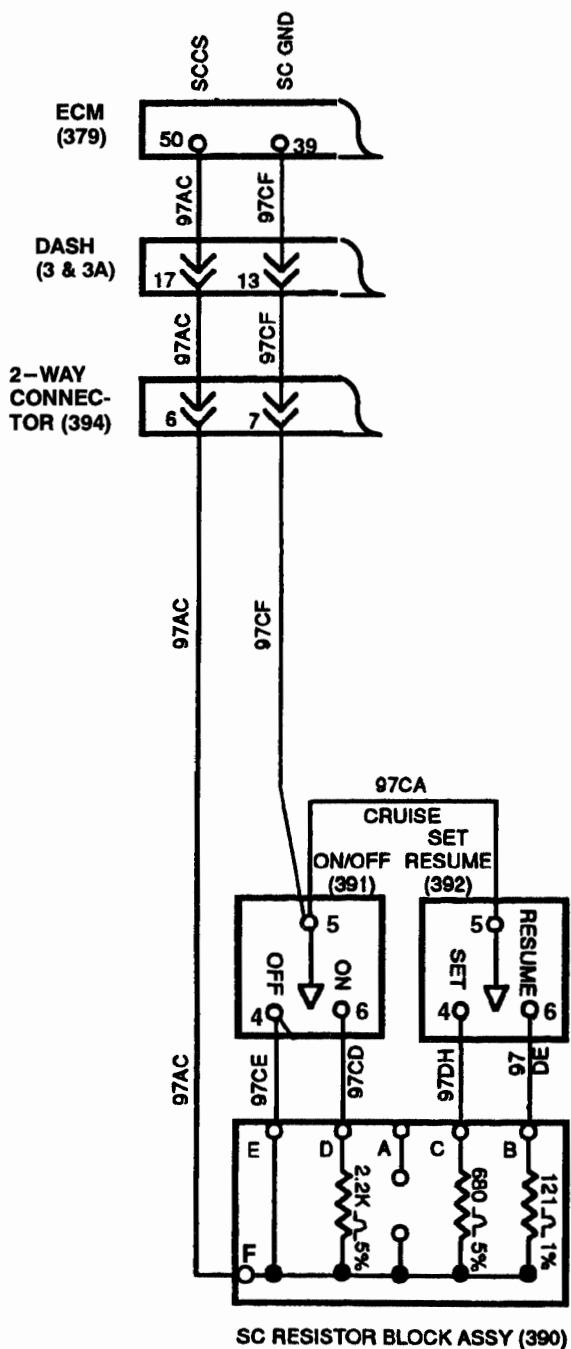
CIRCUIT DIAGRAM



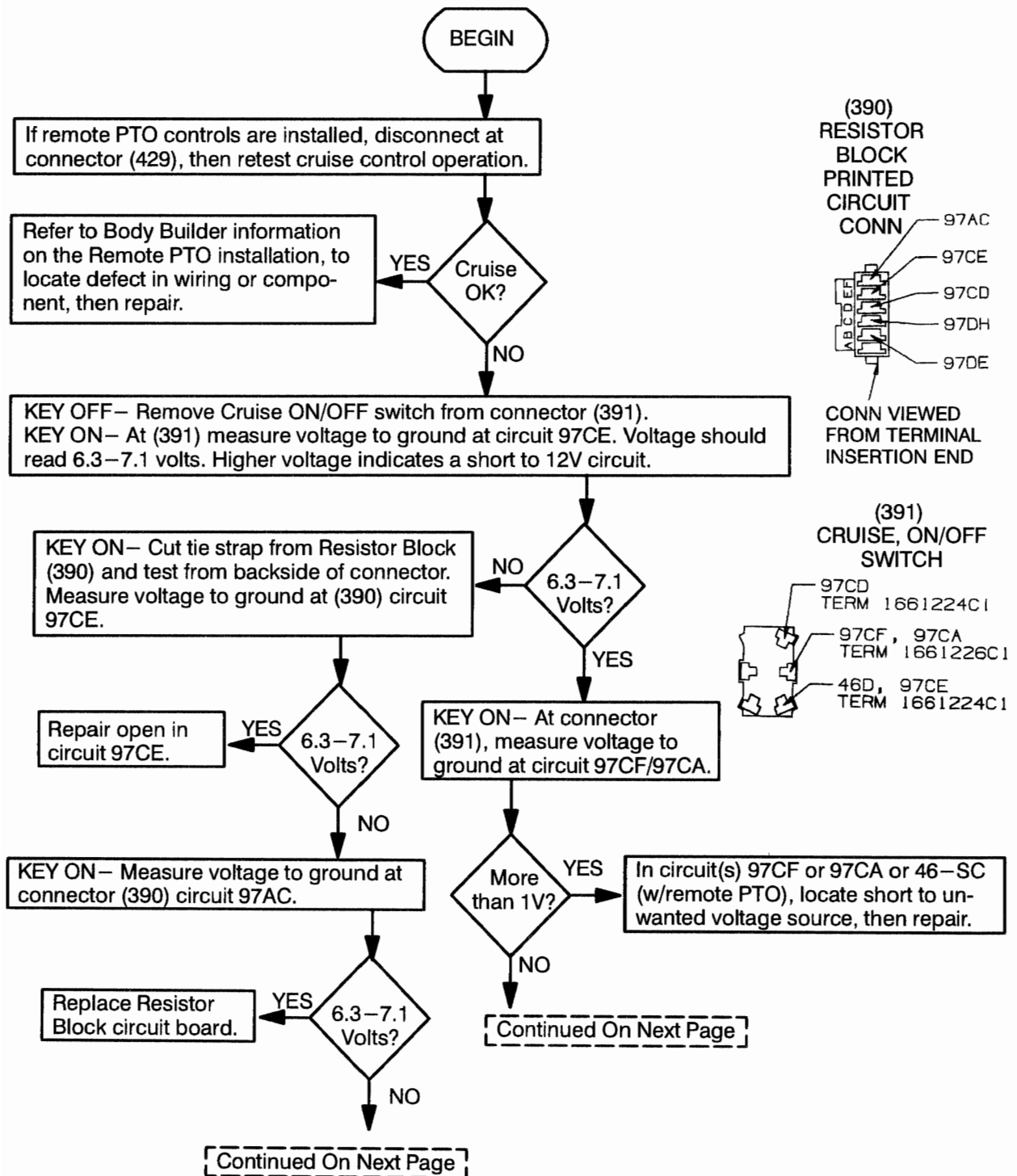
ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

SPEED CONTROL COMMAND SWITCHES (SCCS)

CIRCUIT DIAGRAM (WITHOUT REMOTE CONTROLS)



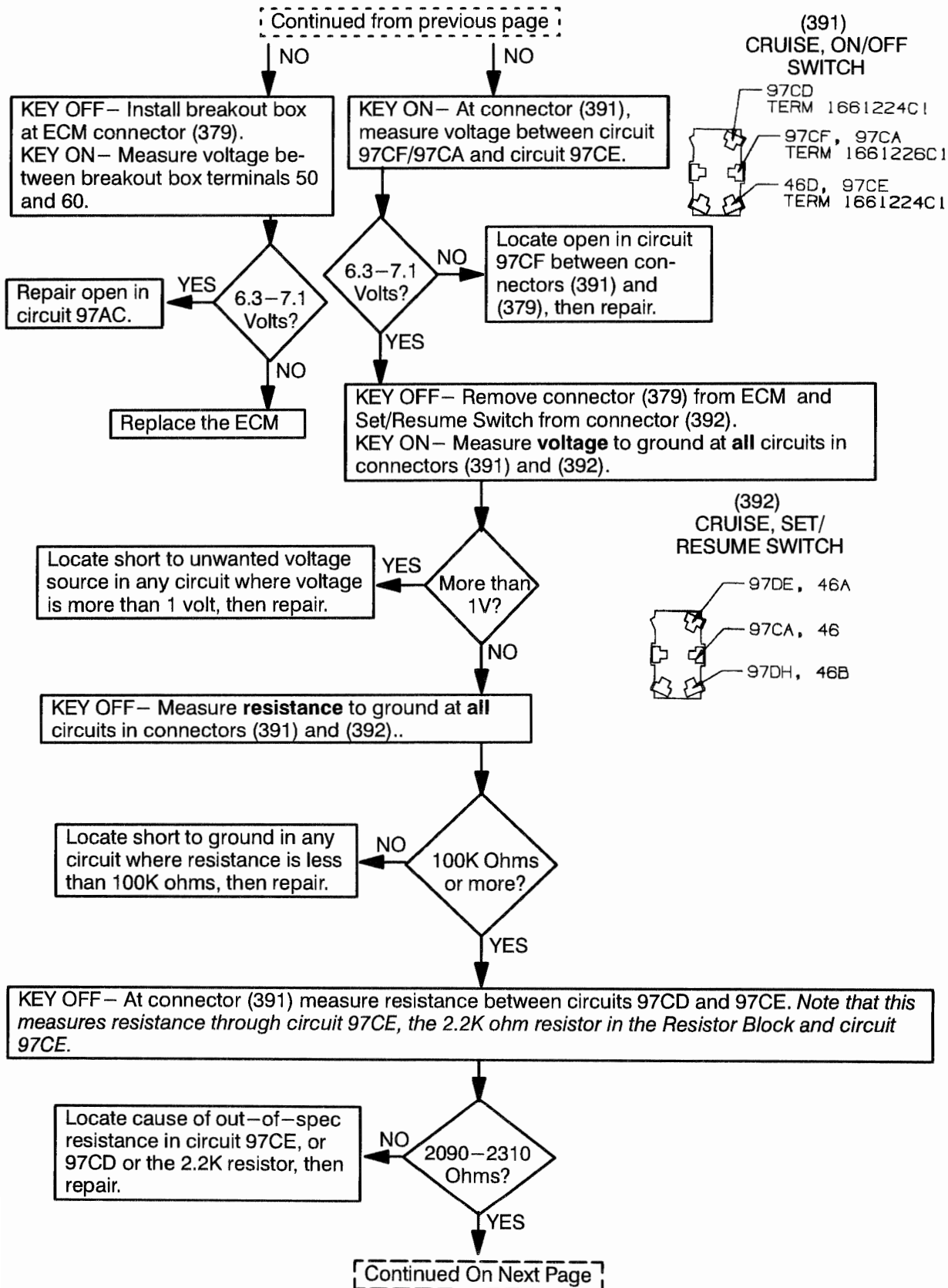
TESTING SPEED CONTROL COMMAND SWITCH (SCCS) CIRCUITS



ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

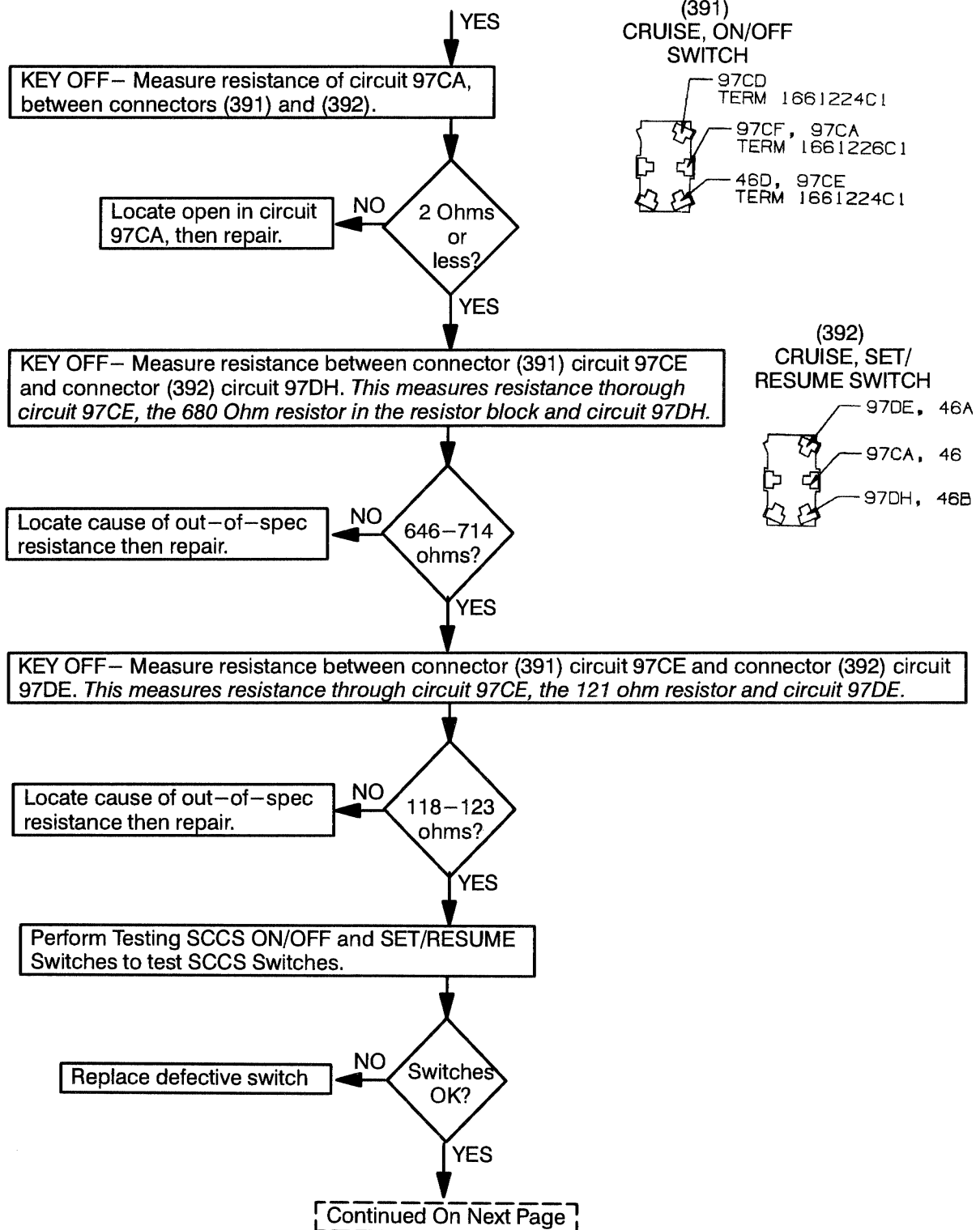
SPEED CONTROL COMMAND SWITCHES (SCCS)

TESTING SPEED CONTROL COMMAND SWITCH (SCCS) CIRCUITS (Continued)



SPEED CONTROL COMMAND SWITCHES (SCCS)

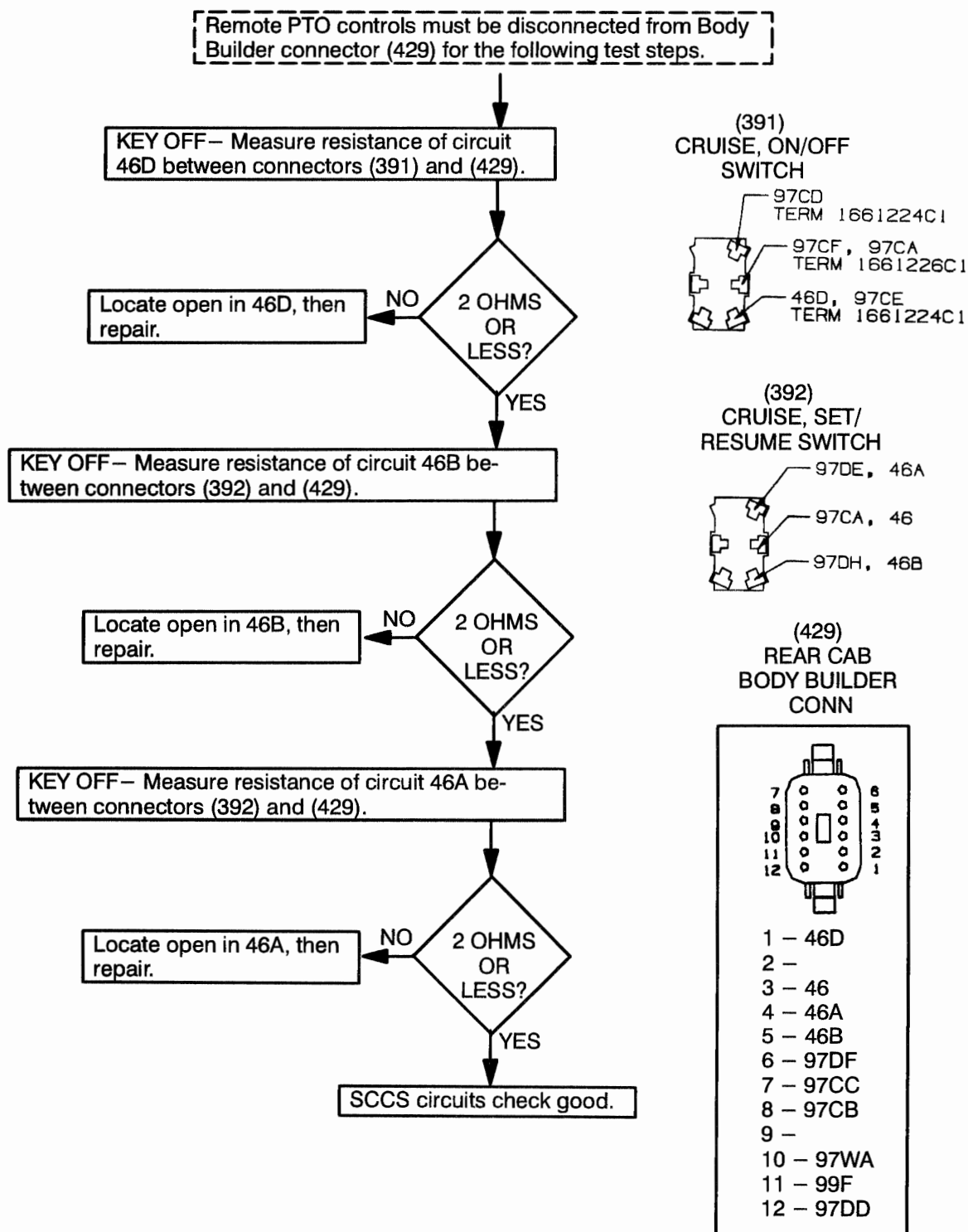
TESTING (SCCS) CIRCUITS (Continued)



ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

SPEED CONTROL COMMAND SWITCHES (SCCS)

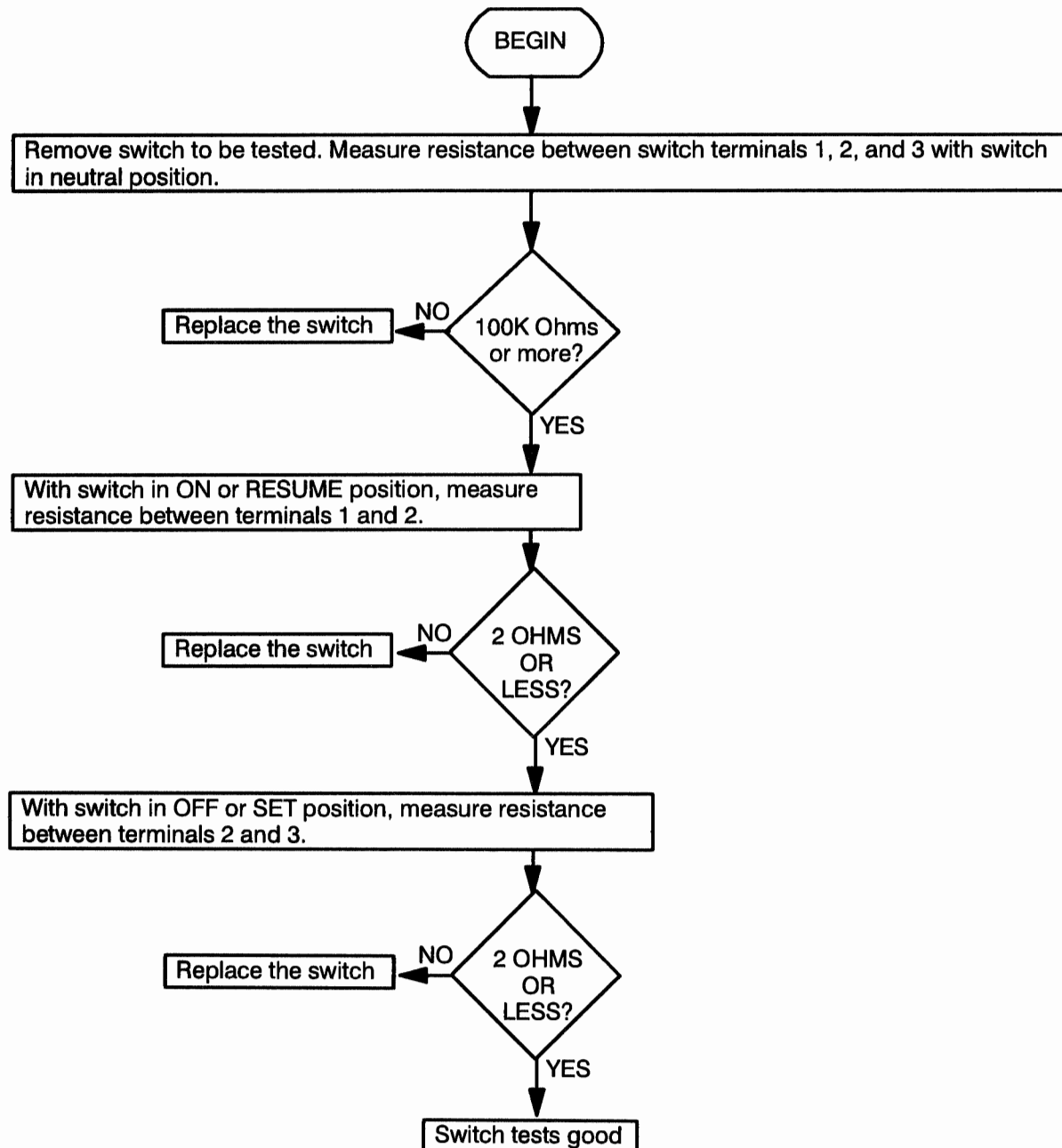
TESTING (SCCS) CIRCUITS (Continued)



SPEED CONTROL COMMAND SWITCHES (SCCS)

TESTING SCCS ON/OFF AND SET/RESUME SWITCHES

This test can be used for either the ON/OFF or SET/RESUME switches. The switch terminal numbers are printed on the side of the switch.



ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

SPEED CONTROL COMMAND SWITCHES (SCCS)

REMOTE PTO ONLY DOES NOT OPERATE (OR OPERATES INCORRECTLY)

NOTE: BEFORE DIAGNOSING ANY PROBLEM WITH THE REMOTE PTO, BE SURE THAT THE VEHICLE CRUISE CONTROL SYSTEM OPERATES CORRECTLY.

Remote Preset PTO Mode Does Not Operate Properly

Turning the cruise control on using the cab Cruise ON/OFF switch, then turning the remote Enable Preset switch ON will cause the PTO to operate at the customer selected preset rpm. The ECM does not diagnose the Enable Preset switch circuit, therefore there are no fault codes to indicate the circuit is defective.

If the vehicle cruise control works properly, but the remote Enable Preset switch does not work, perform Testing Remote PTO Preset And Variable Enable Circuits.

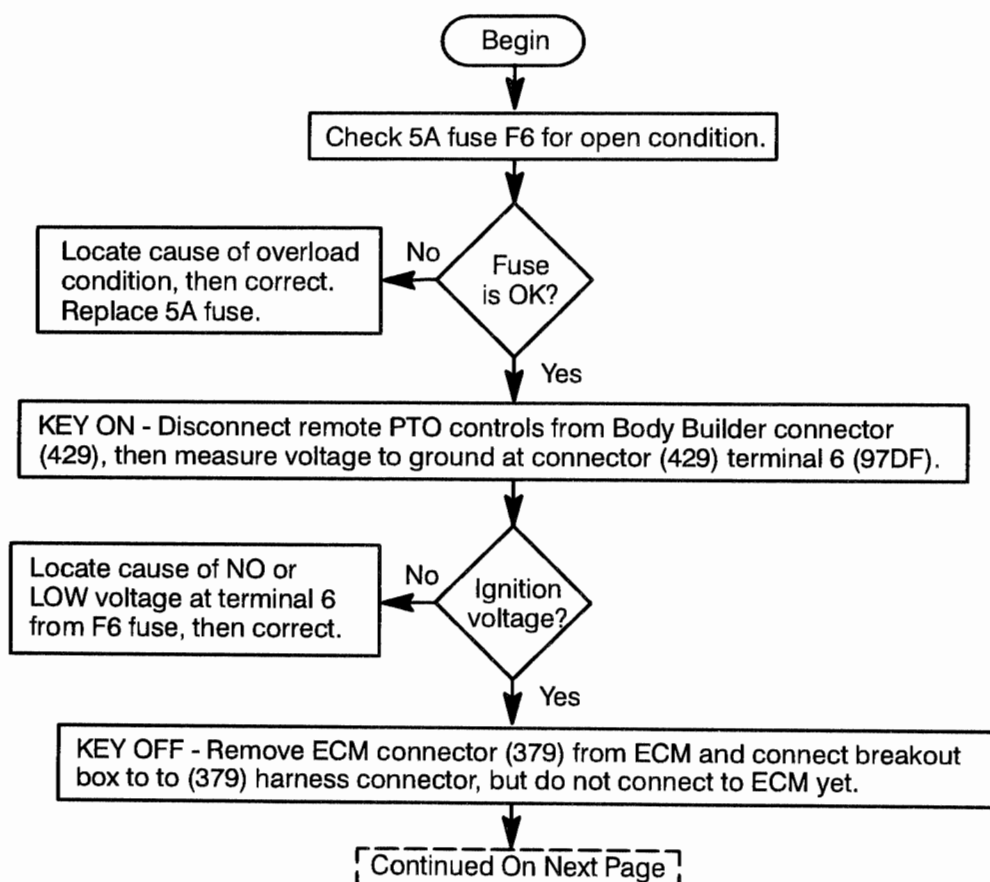
Remote Variable PTO Mode Does Not Operate Properly

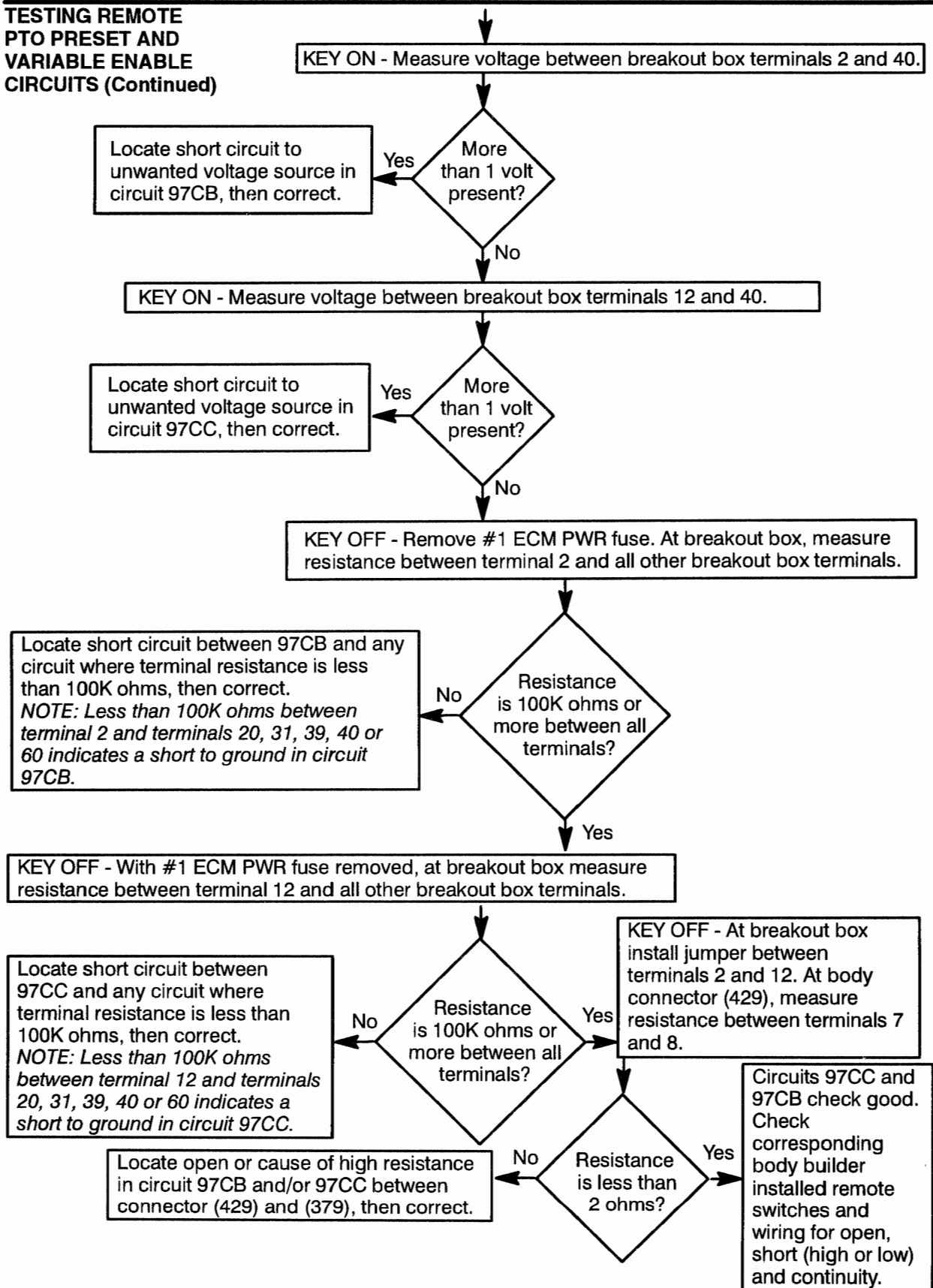
Flash codes 213 and 214 indicate the ECM detected an out-of-range signal (high or low) from the remote pedal sensor (RPS). Note that the ECM **does not** diagnose the Enable Variable switch circuit, therefore there are no fault codes to indicate a defect in that circuit.

If the vehicle cruise control works properly, but the remote PTO does not work in the variable mode, check for flash codes. If Flash Code 213 or 214 is present **or** if no Flash Codes are present, perform Testing Remote PTO Preset And Variable Enable Circuits (below) and Testing Remote Pedal Sensor (RPS) Circuits on page 200.

Testing Remote PTO Preset And Variable Enable Circuits

This test checks the Navistar installed circuits, but not the body builder switches and circuits. The circuit diagram in this section shows a typical installation of the body builder switches.



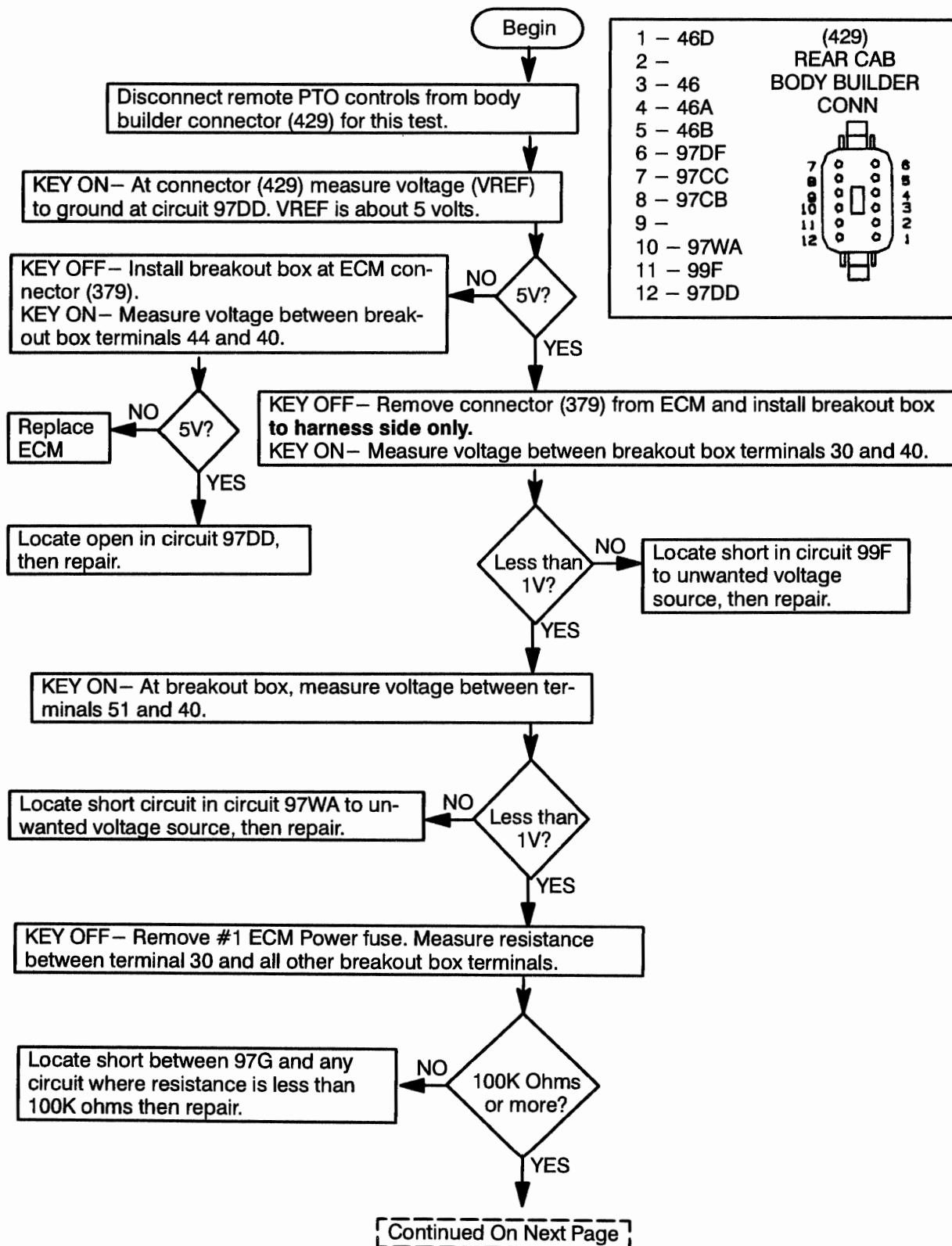
TESTING REMOTE
PTO PRESET AND
VARIABLE ENABLE
CIRCUITS (Continued)

ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

SPEED CONTROL COMMAND SWITCHES (SCCS)

TESTING REMOTE PEDAL SENSOR (RPS) CIRCUITS

This test checks the Navistar installed circuits, but not the body builder installed remote pedal sensor (RPS) or connecting circuits. The circuit diagram shows a typical installation of the body builder installed RPS.



SPEED CONTROL COMMAND SWITCHES (SCCS)

TESTING REMOTE PEDAL SENSOR (RPS) CIRCUITS (Continued)

