

## 1997 Mazda MX-5 Miata

1997 AUTOMATIC TRANSMISSIONS NC4A-EL Electronic Controls

### 1997 AUTOMATIC TRANSMISSIONS

#### NC4A-EL Electronic Controls

## APPLICATION

### TRANSMISSION APPLICATION

Vehicle	Transmission Model
Miata	NC4A-EL

**CAUTION:** Vehicle is equipped with Supplemental Restraint System (SRS). When servicing vehicle, use care to avoid accidental air bag deployment. SRS-related components are located in steering column, center console and instrument panel. DO NOT use electrical test equipment on these circuits. If necessary, deactivate SRS before servicing components. See AIR BAG DEACTIVATION PROCEDURES article in GENERAL INFORMATION.

**CAUTION:** Disconnecting battery on models equipped with anti-theft radio require canceling of anti-theft operation. See appropriate AUTOMATIC TRANSMISSION SERVICING article in TRANSMISSION SERVICING. Refer to vehicle owner's manual to identify radio type.

## DESCRIPTION

The NC4A-EL series is a 4-speed electronically controlled automatic transmission. Five solenoids attached to valve body control shift changes. Solenoids are controlled by the Transmission Control Module (TCM).

**NOTE:** Torque Converter Clutch (TCC) solenoid is also known as lock-up solenoid, TCC lock-up or 4th gear solenoid.

The TCM receives information from various input devices. The TCM uses this information to control following solenoids:

- Shift solenoids for transmission shifting.
- Torque Converter Clutch (TCC) solenoid for torque converter clutch lock-up.
- 3-2 control solenoid for downshift timing control.

A HOLD switch is mounted on the shift lever. HOLD function may be activated in "D", "S" or "L" gears by pressing HOLD button. In "L" and "S" positions, vehicle is held in selected gear and no upshift or downshift takes place. This function is used for driving up steep inclines or for engine braking assistance when descending steep grades. If activated in "D" position a 1-2 and 2-3 upshift is permitted when starting from a stop, but after the 2-3 upshift the vehicle is locked in "D" until it comes to a complete stop. The 1-2 and 2-3 upshift pattern is changed to a "short shift" specification. This function is used for starting off or driving on slippery surfaces. Pushing HOLD button again deactivates system.

## **OPERATION**

### **TCM**

TCM receives information from various input devices and uses this information to control solenoids on transmission valve body for transmission shifting and torque converter clutch engagement.

TCM automatically switches from NORMAL mode to POWER mode corresponding to driving condition in "D" range. Upshifts and downshifts are performed at a higher speed in POWER mode than in NORMAL mode.

TCM contains a self-diagnostic system, which will store Diagnostic Trouble Codes (DTC) if a failure or problem exists in electronic control system. DTC can be retrieved to determine problem area. See **SELF-DIAGNOSTIC SYSTEM** . TCM is located under left side of instrument panel, above fuse block.

### **TCM INPUT DEVICES & SIGNALS**

#### **4th Gear Inhibit Signal**

Signal is input to TCM when cruise control is on. Signal detects when difference between target speed and actual speed exceeds specification.

#### **HOLD Switch**

HOLD switch delivers input to TCM to indicate gears preferred by operator. Switch is located on shift lever handle. HOLD switch is canceled when ignition switch is turned off.

#### **Input/Turbine Speed Sensor**

Sensor is a magnetic pick-up type pulse generator that monitors input shaft speed. AC waveform is input to TCM by output speed sensor. Sensor is located on front of transmission, back of converter housing.

#### **Throttle Position (TP) Sensor**

TP sensor delivers an input signal to TCM indicating throttle valve position (opening). TP sensor is located on side of throttle body.

#### **Transmission Range Switch**

Transmission range switch delivers an input signal to TCM indicating shift lever position. Switch is located on side of transmission.

#### **Transmission Fluid Temperature (TFT) Sensor**

TFT sensor is threaded into cooler line banjo mounting on side of transmission case. Sensor sends signal to TCM indicating fluid temperature.

#### **Vehicle Speed Sensor**

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Sensor is a cable driven pulse generator that is part of speedometer. Pulse signals are sent to TCM.

## TCM OUTPUT DEVICES

### HOLD Indicator Light

Receives signal from TCM to indicate switch position.

### Inhibitor Signal

When shift selector lever is moved from Park or Neutral to another gear, signal is sent from TCM to ECM to regulate fuel injection volume for shift shock prevention.

### Shift Solenoids & 3-2 Control Solenoid

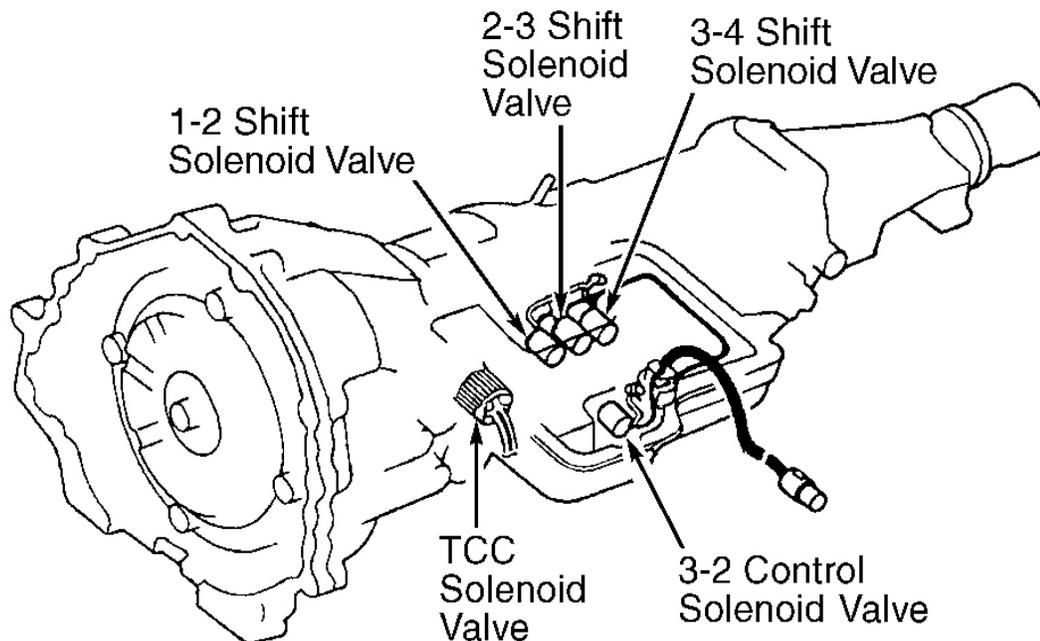
The TCM controls transmission shifting by delivering an output signal to operate proper solenoid. 3-2 control solenoid affects downshift timing. See **SOLENOID OPERATION** table. Hydraulic pressure is retained when solenoid is off and drained when solenoid is on. Solenoids are located on transmission valve body. See **Fig. 1**.

## SOLENOID OPERATION

Shift Lever Position	1-2 Shift Solenoid	2-3 Shift Solenoid	3-4 Shift Solenoid
"D" (Drive)			
1st Gear	On	On	On
2nd Gear	Off	On	On
3rd Gear	Off	Off	On
4th Gear	Off	Off	Off
"2" (Second)			
1st Gear	On	On	On
2nd Gear	Off	On	On
"L" (Low)			
1st Gear	On	On	On
"R" (Reverse)	Off	Off	On
"N" or "P"	On	On	On

### TCC Solenoid Valve

Solenoid valve is ON/OFF type controlled by TCM. Solenoid regulates pilot pressure to applied to lock-up control plug. Hydraulic pressure is retained when solenoid is on and drained when solenoid is off. Solenoid is located on side of case. See **Fig. 1**.



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**Fig. 1: Locating Solenoid Valves**  
 Courtesy of MAZDA MOTORS CORP.

## SELF-DIAGNOSTIC SYSTEM

### SYSTEM DIAGNOSIS

**NOTE:** Before testing transmission, ensure fluid level is correct. Ensure engine starts with shift lever in Park and Neutral to ensure proper adjustment of transmission range switch. Transmission Control Module (TCM) must first be checked for stored codes. See **RETRIEVING TROUBLE CODES** .

TCM monitors transmission operation and contains a self-diagnostic system which stores a Diagnostic Trouble Code (DTC) if an electronic control system failure or component malfunction exists. If a problem exists in any of the solenoids or speed sensors and DTC is set, TCM will deliver a signal to blink the HOLD indicator light on instrument panel to warn the driver. DTC may be set if a failure exists and can be retrieved for transmission diagnosis.

### RETRIEVING TROUBLE CODES

**NOTE:** Before retrieving DTC, ensure proper battery voltage exists for self-diagnostic system operation. If any DTC are present other than those listed below, see

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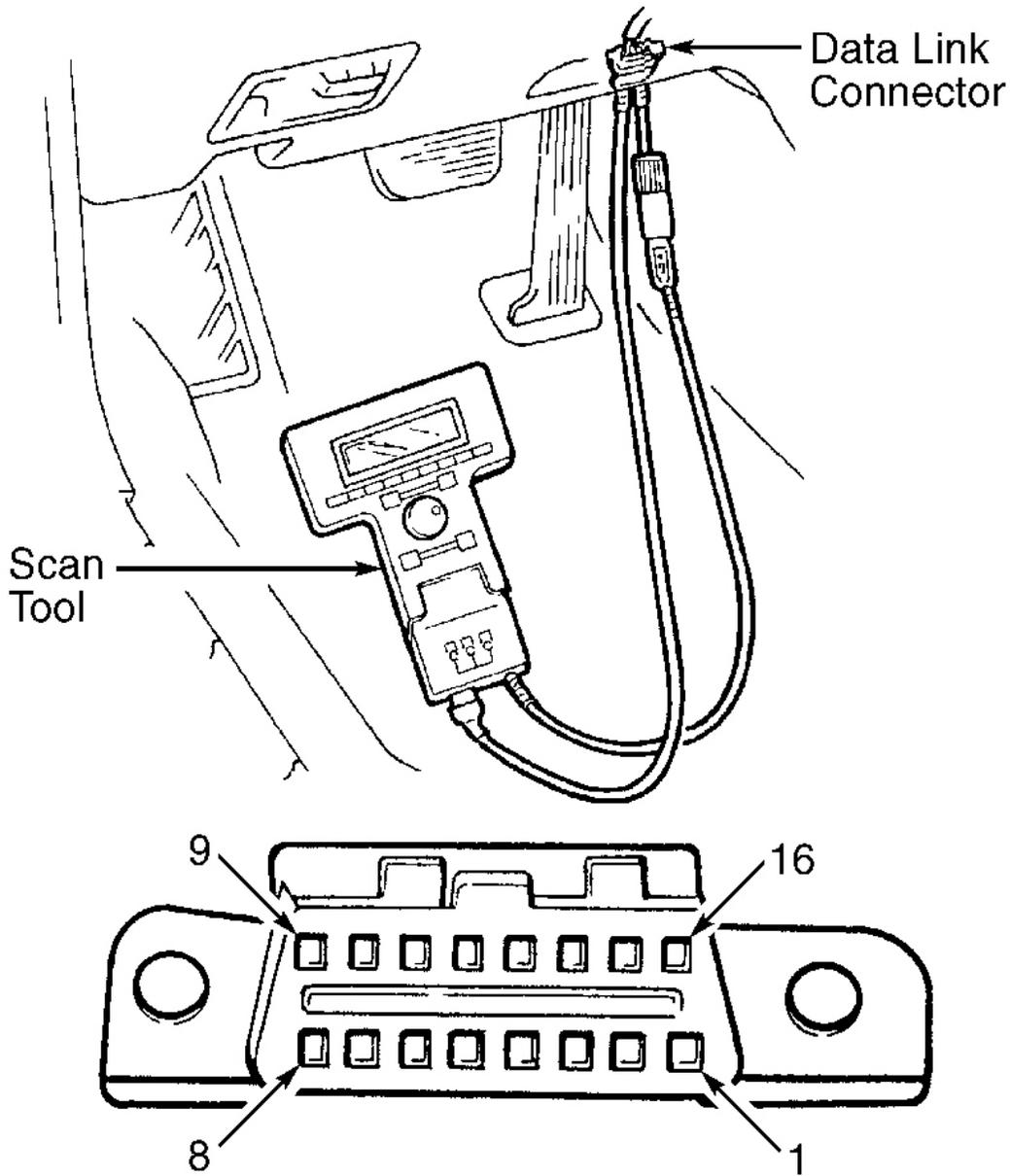
appropriate **SELF-DIAGNOSTIC SYSTEM** article in **ENGINE PERFORMANCE**.

### Using Scan Tool

Ensure ignition is in OFF position. Connect scan tool to Data Link Connector (DLC) located under left side of instrument panel, near center console. Turn ignition switch to ON position. Check for stored DTC. See **DIAGNOSTIC TROUBLE CODE IDENTIFICATION** table. For trouble shooting of codes, see **DIAGNOSTIC TESTS** .

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**Fig. 2: Locating Data Link Connector (DLC) Location**  
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**DIAGNOSTIC TROUBLE CODE IDENTIFICATION**

DTC No.	(1) Probable Cause
<b>P0705</b>	Transmission Range Sensor Malfunction

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<b>P0706</b>	Transmission Range Sensor Range/Performance
<b>P0710</b>	(2) TFT Sensor Malfunction
<b>P0711</b>	(2) TFT Sensor Range/Performance
<b>P0715</b>	Input/Turbine Speed Sensor
<b>P0725</b>	Engine Speed Input Circuit Malfunction
<b>P0731</b>	Incorrect 1st Gear Ratio
<b>P0732</b>	Incorrect 2nd Gear Ratio
<b>P0733</b>	Incorrect 3rd Gear Ratio
<b>P0734</b>	Incorrect 4th Gear Ratio
<b>P0740</b>	TCC System Malfunction
<b>P0750</b>	1-2 Shift Solenoid
<b>P0755</b>	2-3 Shift Solenoid
<b>P0760</b>	3-4 Shift Solenoid
<b>P1720</b>	Vehicle Speed Sensor
<b>P1743</b>	Lock-Up Solenoid Valve
<b>P1765</b>	3-2 Timing Control Solenoid Valve
<b>P1790</b>	Throttle Position Sensor
<b>P1795</b>	Idle Switch

(1) Check listed component for probable cause. Check wiring and connection of specified component.

(2) Transmission Fluid Temperature.

### CLEARING CODES

To clear DTC stored in TCM, use scan tool. See scan tool instruction manual. Road test vehicle.

### COMPONENT LOCATION

#### COMPONENT LOCATION

<b>Description</b>	<b>Location</b>
Engine Control Module	Behind Passenger Seat
Input/Turbine Speed Sensor	Mounted To 4th Gear Case
Shift Solenoids	See <b>Fig. 1</b>
TCC Lock-Up Solenoid	See <b>Fig. 1</b>
Transmission Control Unit	Above Fuse Box
3-2 Control Valve	See <b>Fig. 1</b>
TFT Sensor	Mounted In-Line To Cooler Line
Vehicle Speed Sensor	Mounted In Speedometer

### COMPONENT CONNECTOR IDENTIFICATION

**COMPONENT CONNECTOR IDENTIFICATION <sup>(1)</sup>**

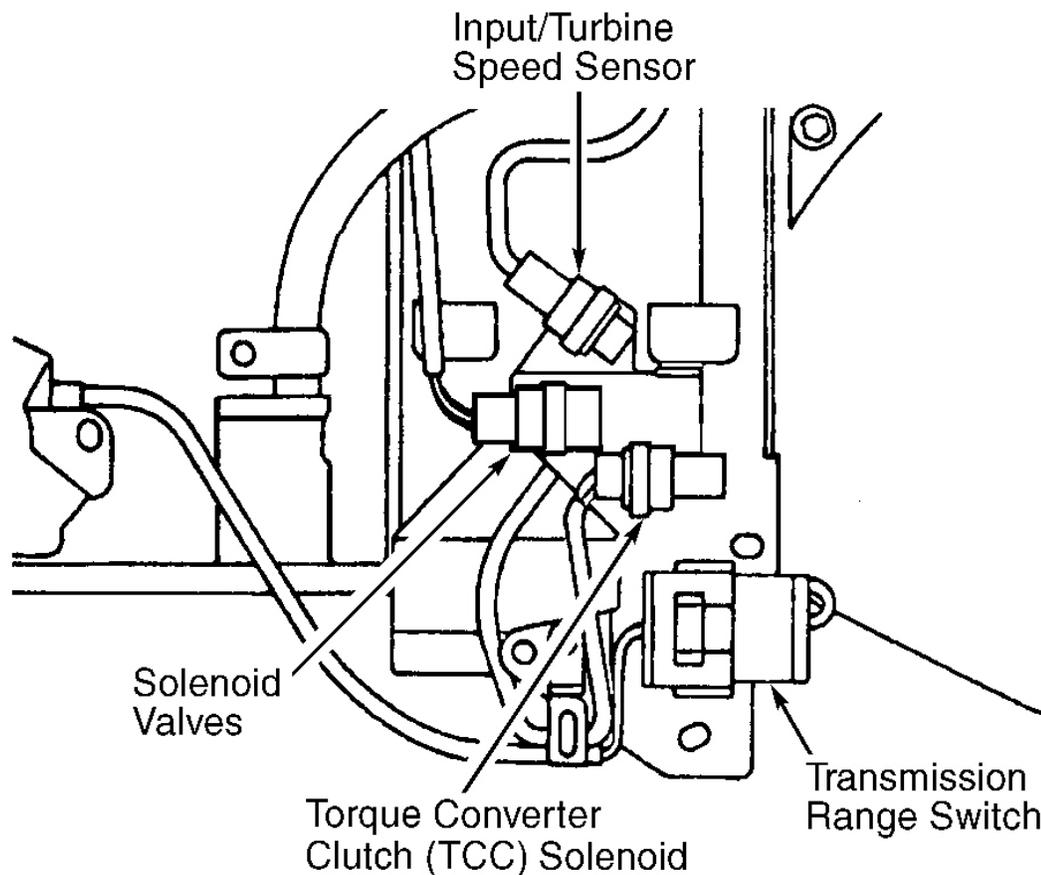
Component	See Fig.
Engine Control Module (ECM)	<b>Fig. 5</b>
Hold Switch	(2)
Instrument Cluster	(3)
Transmission Control Module (TCM)	<b>Fig. 4</b>
Valve Body Solenoids	(4)

(1) For connector location see **Fig. 3** .

(2) See **HOLD SWITCH** under COMPONENT TESTING.

(3) See **VEHICLE SPEED SENSOR (VSS)** under COMPONENT TESTING.

(4) See **SOLENOID VALVES** under COMPONENT TESTING.



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**Fig. 3: Locating Transmission Component Connectors**

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Courtesy of MAZDA MOTORS CORP.

2S	2Q	2O	2M	2K	2I	2G	2E	2C	2A	1O	1M	1K	1I	1G	1E	1C	1A
2T	2R	2P	2N	2L	2J	2H	2F	2D	2B	1P	1N	1L	1J	1H	1F	1D	1B

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**Fig. 4: Identifying TCM Component Connector Terminals**  
Courtesy of MAZDA MOTORS CORP.

4Y	4W	4U	4S	4Q	4O	4M	4K	4I	4G	4E	4C	4A	3O	3M	3K	3I	3G	3E	3C	3A	2K	2I	2G	2E	2C	2A	1U	1S	1Q	1O	1M	1K	1I	1G	1E	1C	1A
4Z	4X	4V	4T	4R	4P	4N	4L	4J	4H	4F	4D	4B	3P	3N	3L	3J	3H	3F	3D	3B	2L	2J	2H	2F	2D	2B	1V	1T	1R	1P	1N	1L	1J	1H	1F	1D	1B

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**Fig. 5: Identifying ECM Component Connector Terminals**  
Courtesy of MAZDA MOTORS CORP.

## DIAGNOSTIC TESTS

**NOTE:** For connector terminal identification, see **COMPONENT CONNECTOR IDENTIFICATION** table under **SELF-DIAGNOSTIC SYSTEM**. For circuit or wire color identification, see appropriate wiring diagram in **WIRING DIAGRAMS**.

### DTC P0705: TRANSMISSION RANGE SWITCH CIRCUIT MALFUNCTION & DTC P0706: TRANSMISSION RANGE SWITCH CIRCUIT RANGE/PERFORMANCE

#### Condition

No signal is received from range switch or more than 2 signals are received at one time. Possible causes for either condition are:

- Transmission range switch malfunction.
- Damaged wiring or connectors between transmission range switch and TCM.
- TCM malfunction.

#### Diagnosis & Repair Procedure

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1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Using voltmeter, backprobe TCM connector (as applicable). Measure voltage between ground and specified terminal. See **DTC P0705 VOLTAGE TEST** table. If all voltages are within specification, go to step 5 . If any voltage is not within specification, go to next step.

#### DTC P0705 VOLTAGE TEST

TCM Terminal No.	Measured Voltage	Range Switch Position
2B	0	"P" Or "N"
2B	10-14	"R", "D", "S" Or "L"
2D	10-14	"D"
2D	0	All Except "D"
2F	10-14	"S"
2F	0	All Except "S"
2H	10-14	"L"
2H	0	All Except "L"

2. Check continuity of circuits between transmission range switch and TCM. See appropriate wiring diagram in **WIRING DIAGRAMS** . Repair as needed. If all circuits are okay, go to next step.
3. Disconnect negative battery cable. Disconnect transmission range switch harness connector. Inspect continuity of transmission range switch internal circuits. See **TRANSMISSION RANGE SWITCH** under COMPONENT TESTING. Replace as needed. If switch is okay, go to next step.
4. Reconnect negative battery cable. Turn ignition on. Measure voltage at terminal "I" (Black/Blue wire) on transmission range switch harness connector. If battery voltage does not exist, repair Black/Blue wire between switch and ignition switch. If battery voltage exists, go to next step.
5. Road test vehicle. Retrieve DTC. If code P0705 is still present, replace TCM. If code is no longer present, system is okay.

#### DTC P0710: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR CIRCUIT MALFUNCTION & DTC P0711: TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR CIRCUIT RANGE/PERFORMANCE

##### Condition

Voltage input to TCM is less than .1 volt or greater than 5.0 volts. Possible causes for condition are:

- Transmission fluid temperature sensor malfunction.
- Damaged wiring or connectors between transmission fluid temperature sensor and TCM.
- TCM malfunction.

##### Diagnosis & Repair Procedure

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.

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2. Measure voltage between terminal No. 1G (Green wire) and No. 2P (Black/Light Blue wire) on TCM connector. Voltage should be about 3.3 volts at 77°F (25°C). If voltage is within specifications, go to step 6 . If voltage is not within specifications, go to next step.
3. Turn ignition off. Disconnect TCM harness connector. Measure resistance between terminals No. 1G and No. 2P. See **TFT SENSOR SPECIFICATIONS** table. If resistance is within specification, go to step 6 . If resistance is not within specification, go to next step.
4. Inspect TFT sensor. Disconnect TFT sensor harness connector. Measure resistance between connector terminals. See **TFT SENSOR SPECIFICATIONS** table. If resistance is within specification, go to step 6 . If resistance is not within specification, replace TFT sensor.
5. Check continuity of circuits between TFT sensor and TCM. See appropriate wiring diagram in **WIRING DIAGRAMS** . Repair as needed. If circuit is okay, go to next step.
6. Reconnect all harness connectors. Road test vehicle. Retrieve DTC. If code P0710 or P0711 is still present, replace TCM. If code is no longer present, system is okay.

#### TFT SENSOR SPECIFICATIONS

Fluid Temperature	k/ohms
68°F (20°C)	2.5
140°F (60°C)	.6
176°F (80°C)	.35

#### DTC P0715: INPUT/TURBINE SPEED SENSOR

##### Condition

Input/Turbine speed sensor signal is not input to TCM when vehicle is moving. Possible causes for condition are:

- Input/Turbine speed sensor malfunction.
- Damaged wiring or connectors between turbine speed sensor and TCM.
- TCM malfunction.

##### Diagnosis & Repair Procedure

1. Turn ignition on. Using voltmeter, backprobe TCM harness connector. DO NOT disconnect connector. Measure AC voltage between terminals No. 2J (positive) and No. 2L (negative). Voltage should be 0-.1 volts when idling and zero with engine stopped. If voltage is within specification, go to step 5 . If voltage is not within specification, go to next step.
2. Turn ignition off. Disconnect TCM harness connector. Check for continuity between terminals No. 2J (Yellow/Green wire) and No. 2L (Yellow/Blue wire). If continuity is present, go to step 5 . If continuity is not present, go to next step.
3. Inspect sensor. See **INPUT/TURBINE SPEED SENSOR** under COMPONENT TESTING. Repair as needed. If sensor is okay, go to next step.
4. Check continuity of circuits between input/turbine speed sensor and TCM. See appropriate wiring diagram in **WIRING DIAGRAMS** . Repair as needed. If circuits are okay, go to next step.

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5. Reconnect all harness connectors. Road test vehicle. Retrieve DTC. If code P0715 is still present, replace PCM. If code is no longer present, system is okay.

### DTC P0725: ENGINE SPEED INPUT CIRCUIT MALFUNCTION

**NOTE:** If DTC P0335 is also present, repair it first and then proceed with this test. Go to appropriate SELF-DIAGNOSTICS article in ENGINE PERFORMANCE and perform test.

#### Condition

Engine speed input signal is not input to TCM. Possible causes are:

- Crankshaft position sensor malfunction.
- Damaged wiring or connectors between ECM and TCM.
- ECM malfunction.
- TCM malfunction.

#### Diagnosis & Repair Procedure

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Using voltmeter, backprobe TCM harness connector. DO NOT disconnect connector.
2. Measure voltage between ground and terminal No. 1N (White wire) on TCM harness connector. Voltage should be zero or 4.5-5.5 volts with engine stopped or 2-3 volts with engine idling. If voltage is within specifications, go to step 7 . If voltage is not within specifications, go to next step.
3. Ignition off. Measure continuity between terminal No. 1N (White wire) on TCM harness connector and terminal No. 4F (White wire) on ECM harness connector. If continuity is not present, repair wiring then go to step 7 .
4. Using voltmeter, backprobe ECM harness connector. Measure voltage between ground and terminal No. 4H (Yellow/White wire). Voltage should be less than one volt with engine stopped or greater than one volt with engine idling. If voltage is within specifications, go to step 7 . If voltage is not within specifications, go to next step.
5. Inspect crankshaft position sensor. See appropriate SYSTEM & COMPONENT TESTS article in ENGINE PERFORMANCE. Replace as needed. If sensor is okay, go to next step.
6. Turn ignition off. Using ohmmeter, backprobe TCM harness connector. DO NOT disconnect connector. Measure resistance between terminals 1N (White wire) and 2P (Black/Light Green wire). If resistance is 7.2-8.0 ohms, go to next step. If resistance is not 7.2-8.0 ohms, replace TCM.
7. Reconnect all harness connectors. Road test vehicle. Retrieve DTC. If code P0725 is still present, replace TCM. If code is no longer present, problem is intermittent.

### DTC P0731: INCORRECT 1ST GEAR RATIO

**NOTE:** If any following DTC is also present, repair it first and then proceed with this test: **DTC P0750 , P0755 , P0760 .**

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#### Condition

TCM outputs solenoid pattern of 1st gear when gear ratio is other than 1st gear. Possible causes are:

- Low ATF level.
- Low line pressure.
- Control valve stuck.
- Solenoid valve malfunction.
- TCM malfunction.

#### Diagnosis & Repair Procedure

1. Ensure ATF level and condition is okay. Check line pressure and stall speed. See **LINE PRESSURE TEST** and **STALL SPEED** under **TESTING** in **MAZDA NC4A-EL OVERHAUL** article. Repair any components as necessary. If malfunction is not present, go to next step.
2. Inspect 1-2, 2-3 and 3-4 shift solenoid valves. See **SOLENOID VALVES** under **COMPONENT TESTING**. Repair as needed. If solenoid valves are okay, go to next step.
3. Inspect valve body. Ensure all valves operate smoothly. Repair as needed. If valve body is okay, go to next step.
4. Clear DTC and retest. See **CLEARING CODES** . If code P0731 is still present, replace TCM. If code is no longer present and symptom still exists, problem may be caused by intermittent clutch slippage. Further investigation may be required. See **MAZDA NC4A-EL OVERHAUL** article.

#### DTC P0732: INCORRECT 2ND GEAR RATIO

**NOTE:** If any following DTC is also present, repair it first and then proceed with this test: **DTC P0750** , **P0755** , **P0760** .

#### Condition

TCM outputs solenoid pattern of 2nd gear when gear ratio is other than 2nd gear. Possible causes are:

- Low ATF level.
- Direct clutch slippage.
- One-way clutch slippage.
- Faulty band servo.
- Low line pressure.
- Control valve stuck.
- Solenoid valve malfunction.
- TCM malfunction.

#### Diagnosis & Repair Procedure

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1. Ensure ATF level and condition is okay. Check line pressure and stall speed. See **LINE PRESSURE TEST** and **STALL SPEED** under **TESTING** in **MAZDA NC4A-EL OVERHAUL** article. Repair any components as necessary. If malfunction is not present, go to next step.
2. Inspect 1-2, 2-3 and 3-4 shift solenoid valves. See **SOLENOID VALVES** under **COMPONENT TESTING**. Repair as needed. If solenoid valves are okay, go to next step.
3. Inspect valve body. Ensure all valves operate smoothly. Repair as needed. If valve body is okay, go to next step.
4. Clear DTC and retest. See **CLEARING CODES** . If code P0732 is still present, replace PCM. If code is no longer present and symptom still exists, problem may be caused by intermittent clutch slippage. Further investigation may be required. See **MAZDA NC4A-EL OVERHAUL** article.

#### **DTC P0733: INCORRECT 3RD GEAR RATIO**

**NOTE:** If any following DTC is also present, repair it first and then proceed with this test: **DTC P0750 , P0755 , P0760 .**

#### **Condition**

TCM outputs solenoid pattern of 3rd gear when gear ratio is other than 3rd gear. Possible causes are:

- Low ATF level.
- Direct clutch slippage.
- One-way clutch slippage.
- Front clutch slippage.
- Low line pressure.
- Control valve stuck.
- Solenoid valve malfunction.
- TCM malfunction.

#### **Diagnosis & Repair Procedure**

1. Ensure ATF level and condition is okay. Check line pressure and stall speed. See **LINE PRESSURE TEST** and **STALL SPEED** under **TESTING** in **MAZDA NC4A-EL OVERHAUL** article. Repair any components as necessary. If malfunction is not present, go to next step.
2. Inspect 1-2, 2-3 and 3-4 shift solenoid valves. See **SOLENOID VALVES** under **COMPONENT TESTING**. Repair as needed. If solenoid valves are okay, go to next step.
3. Inspect valve body. Ensure all valves operate smoothly. Repair as needed. If valve body is okay, go to next step.
4. Clear DTC and retest. See **CLEARING CODES** . If DTC P0733 is still present, replace PCM. If code is no longer present and symptom still exists, problem may be caused by intermittent clutch slippage. Further investigation may be required. See **MAZDA NC4A-EL OVERHAUL** article.

#### **DTC P0734: INCORRECT 4TH GEAR RATIO**

**NOTE:** If any following DTC is also present, repair it first and then proceed with this test: DTC P0750 , P0755 , P0760 .

**Condition**

TCM outputs solenoid pattern of 3rd gear when gear ratio is other than 3rd gear. Possible causes are:

- Low ATF level.
- Band servo slippage.
- Front clutch slippage.
- Low line pressure.
- Control valve stuck.
- Solenoid valve malfunction.
- TCM malfunction.

**Diagnosis & Repair Procedure**

1. Ensure ATF level and condition is okay. Check line pressure and stall speed. See **LINE PRESSURE TEST** and **STALL SPEED** under **TESTING** in **MAZDA NC4A-EL OVERHAUL** article. Repair any components as necessary. If malfunction is not present, go to next step.
2. Inspect 1-2, 2-3 and 3-4 shift solenoid valves. See **SOLENOID VALVES** under **COMPONENT TESTING**. Repair as needed. If solenoid valves are okay, go to next step.
3. Inspect valve body. Ensure all valves operate smoothly. Repair as needed. If valve body is okay, go to next step.
4. Clear DTC and retest. See **CLEARING CODES** . If DTC P0734 is still present, replace PCM. If code is no longer present and symptom still exists, problem may be caused by intermittent clutch slippage. Further investigation may be required. See **MAZDA NC4A-EL OVERHAUL** article.

**DTC P0740: TORQUE CONVERTER CLUTCH MALFUNCTION****Condition**

TCM outputs TCC signal, but TCC does not operate. Possible causes are:

- Low ATF level.
- Low line pressure.
- Torque converter slippage.
- Control valve stuck.
- Lock-up solenoid valve malfunction.
- TCM malfunction.

**Diagnosis & Repair Procedure**

1. Inspect ATF level and condition. Correct as needed. If fluid level and condition is okay, check line pressure. See **LINE PRESSURE TEST** under **TESTING** in **MAZDA NC4A-EL OVERHAUL** article. Follow repair recommendations if line pressure is not within specifications. If line pressure is okay, go to next step.
2. Inspect lock-up solenoid. See **SOLENOID VALVES** under **COMPONENT TESTING**. Repair as needed. If solenoid valve is okay, go to next step.
3. Inspect lock-up control valve in valve body. If valve is okay, go to next step.
4. Using an EC-AT tester connected to TCM, ensure that engine speed and turbine speed during TCC lock-up in 4th gear are the same. If speeds are different, replace torque converter. If speeds are the same, go to next step.
5. Clear DTC. See **CLEARING CODES**. Retrieve DTC. If DTC P0740 is still present, replace TCM. If code is no longer present and symptom still exists, problem may be caused by intermittent TCC slippage. Further investigation may be required. See **MAZDA NC4A-EL OVERHAUL** article.

### **DTC P0750: 1-2 SHIFT SOLENOID MALFUNCTION**

#### **Possible Causes:**

- Short or open circuit between TCM and solenoid.
- TCM malfunction.
- Shift solenoid malfunction.

#### **Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. **DO NOT** disconnect connectors. Go to next step.
2. Measure voltage between ground and terminal No. 2E (Blue/Yellow wire) on TCM connector. During test drive, voltage should be less than one volt when solenoid is off and battery voltage when solenoid is on. See **SOLENOID OPERATION** table under **TCM OUTPUT DEVICES**. If voltage is within specification, go to step 5. If voltage is not within specification, go to next step.
3. Turn ignition off. Disconnect TCM harness connector. Measure resistance between ground and terminal No. 2E. If resistance is 13-27 ohms at 68°F (20°C), go to step 5. If resistance is not 13-27 ohms at 68°F (20°C), go to next step.
4. Inspect 1-2 shift solenoid and related circuits. See **SOLENOID VALVES** under **COMPONENT TESTING**. Repair as needed. If solenoid valve and related circuits are okay, go to next step.
5. Clear DTC and road test vehicle. Retrieve DTC. If DTC P0750 is still present, replace TCM. If code is no longer present, system is okay.

### **DTC P0755: 2-3 SHIFT SOLENOID MALFUNCTION**

#### **Possible Causes:**

- Short or open circuit between TCM and solenoid.
- TCM malfunction.

- Shift solenoid malfunction.

**Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.
2. Measure voltage between ground and terminal No. 2G (Orange wire) on TCM connector. During test drive, voltage should be less than one volt when solenoid is off and battery voltage when solenoid is on. See **SOLENOID OPERATION** table under TCM OUTPUT DEVICES. If voltage is within specification, go to step 5 . If voltage is not within specification, go to next step.
3. Turn ignition off. Disconnect TCM harness connector. Measure resistance between ground and terminal No. 2G. If resistance is 13-27 ohms at 68°F (20°C), go to step 5 . If resistance is not 13-27 ohms at 68°F (20°C), go to next step.
4. Inspect 2-3 shift solenoid and related circuits. See **SOLENOID VALVES** under COMPONENT TESTING. Repair as needed. If solenoid valve and related circuits are okay, go to next step.
5. Clear trouble codes and road test vehicle. Retrieve DTC. If DTC P0755 is still present, replace TCM. If code is no longer present, system is okay.

**DTC P0760: 3-4 SHIFT SOLENOID MALFUNCTION****Possible Causes:**

- Short or open circuit between TCM and solenoid.
- TCM malfunction.
- Shift solenoid malfunction.

**Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.
2. Measure voltage between ground and terminal No. 2I (Blue wire) on TCM connector. During test drive, voltage should be less than one volt when solenoid is off and battery voltage when solenoid is on. See **SOLENOID OPERATION** table under TCM OUTPUT DEVICES. If voltage is within specification, go to step 5 . If voltage is not within specification, go to next step.
3. Turn ignition off. Disconnect TCM harness connector. Measure resistance between ground and terminal No. 2E. If resistance is 13-27 ohms at 68°F (20°C), go to step 5 . If resistance is not 13-27 ohms at 68°F (20°C), go to next step.
4. Inspect 3-4 shift solenoid and related circuits. See **SOLENOID VALVES** under COMPONENT TESTING. Repair as needed. If solenoid valve and related circuits are okay, go to next step.
5. Clear codes and road test vehicle. Retrieve DTC. If DTC P0760 is still present, replace TCM. If code is no longer present, problem is intermittent. Further investigation may be necessary.

**DTC P1720: VEHICLE SPEED SENSOR SIGNAL MISSING**

**Condition**

Vehicle speed sensor signal is not input to TCM. Possible causes are:

- Vehicle speed sensor malfunction.
- Vehicle speedometer sensor malfunction.
- Damaged circuits or connectors between sensors and TCM.

**Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Using voltmeter, backprobe TCM harness connector. DO NOT disconnect connector. Test drive vehicle.
2. Measure voltage between ground and terminal No. 1P (Green/Red wire) on TCM harness connector. During test drive voltage should be about 4 volts. When parked, voltage should be less than 1.5 or 7-9 volts. If voltage is within specifications, go to step 5 . If voltage is not within specifications, go to next step.
3. Turn ignition off. Disconnect negative battery cable. Remove instrument cluster. Disconnect TCM harness connectors. Ensure continuity exists on Green/Red wire between terminal No. 1P on TCM connector and terminal No. 2F on instrument cluster harness left connector. Repair as needed. If continuity exists, go to next step.
4. With combination meter removed, measure voltage between terminals No. 2F and 2D on combination meter connector using analog voltmeter. Raise and support vehicle. Rotate rear wheels. If voltage pulse is present, go to next step. If voltage pulse is not present, inspect speedometer cable. Replace as needed. If cable is okay, replace combination meter or circuit board (as applicable).
5. Clear codes and road test vehicle. Retrieve DTC. If DTC 1720 is still present, replace TCM. If code is no longer present, problem may be caused by poor connection. Repair as needed.

**DTC P1743: TORQUE CONVERTER CLUTCH (TCC) SOLENOID MALFUNCTION****Possible Causes:**

- Short or open circuit between TCM and solenoid.
- TCM malfunction.
- Lock-up solenoid malfunction.

**Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.
2. Measure voltage between ground and terminal No. 2K (Yellow/Black wire). Battery voltage should be present with solenoid on and zero volts with solenoid off. If voltage is within specifications, go to step 5 . If voltage is not within specifications, go to next step.
3. Turn ignition off. Disconnect TCM harness connector. Measure resistance between ground and terminal No. 2K. If resistance is 13-25 ohms at 68°F (20°C), go to step 5 . If resistance is not 13-25 ohms at 68°F (20°C), go to next step.

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4. Inspect lock-up solenoid and related circuits. See **SOLENOID VALVES** under COMPONENT TESTING. Repair as needed. If solenoid valve and related circuits are okay, go to next step.
5. Clear codes and road test vehicle. Retrieve DTC. If DTC P1743 is still present, replace TCM. If code is no longer present, problem may be caused by poor connection. Repair as needed.

#### **DTC P1765: 3-2 CONTROL SOLENOID VALVE MALFUNCTION**

##### **Possible Causes:**

- Short or open circuit between TCM and solenoid.
- TCM malfunction.
- 3-2 control solenoid malfunction.

##### **Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.
2. Drive vehicle and measure voltage between ground and terminal No. 2M (Blue/Orange wire). Battery voltage should be present with solenoid on during 3-2 or 4-3 downshift, and zero volts with solenoid off. If voltage is within specifications, go to step 5 . If voltage is not within specifications, go to next step.
3. Turn ignition off. Disconnect TCM harness connector. Measure resistance between ground and terminal No. 2M. If resistance is 13-27 ohms at 68°F (20°C), go to step 5 . If resistance is not 13-27 ohms at 68°F (20°C), go to next step.
4. Inspect 3-2 control clutch solenoid and related circuits. See **SOLENOID VALVES** under COMPONENT TESTING. Repair as needed. If solenoid valve and related circuits are okay, go to next step.
5. Clear codes and road test vehicle. Retrieve DTC. If DTC P1765 is still present, replace TCM. If code is no longer present, problem may be caused by poor connection. Repair as needed.

#### **DTC P1790: THROTTLE POSITION (TP) SENSOR MALFUNCTION**

**NOTE:** If **DTC P0725** is also present, repair it first and then proceed with this test.

##### **Condition**

TP sensor voltage is less than one volt or more than 4.9 volts. Possible causes are:

- Poor harness connection at TP sensor.
- Circuit fault between TP sensor and ECM or TCM.
- TP sensor malfunction.
- ECM or TCM malfunction.

##### **Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Ensure that TP sensor is adjusted correctly. See appropriate ON-VEHICLE ADJUSTMENTS article in ENGINE PERFORMANCE. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.
2. Measure voltage between ground and terminal No. 2T (Red/Black wire) on TCM harness connector. With throttle closed, voltage should be .1-1.1 volts. With wide open throttle, voltage should be 3.1-4.4 volts. If voltage is within specification, go to step 5 . If voltage is not within specification, go to next step.
3. Measure voltage between ground and terminal No. 2A (Light Green/White wire) on TCM harness connector. With ignition on, voltage should be 4.5-5.5 volts. With ignition off, voltage should be zero volts. If voltage is within specification, go to step 5 . If voltage is not within specification, go to next step.
4. Inspect circuits between TP sensor and TCM. See appropriate wiring diagram under **WIRING DIAGRAMS** . Repair as needed. If circuits are okay between sensor and TCM, go to next step.
5. Clear codes, and road test vehicle. Retrieve DTC. If DTC P1790 is still present, replace TCM. If code is no longer present, system is okay.

## **DTC P1795: IDLE SWITCH OPEN OR SHORT**

### **Condition**

Closed throttle position switch is ON and TP sensor position is closed. Possible causes are:

- Damaged wiring or connectors between closed throttle position switch and TCM.
- Closed throttle position switch malfunction.
- TCM malfunction.

### **Diagnosis & Repair Procedure**

1. Ensure all connections are clean and tight. Repair as needed. Turn ignition on. Access TCM connectors. Using voltmeter, backprobe harness connectors. DO NOT disconnect connectors. Go to next step.
2. Measure voltage between ground and terminal No. 1O (Red wire) on TCM harness connector. With throttle closed, battery voltage should be present. With wide open throttle, voltage should be zero volts. If voltage is within specification, go to step 5 . If voltage is not within specification, go to next step.
3. Inspect circuits between closed throttle position switch and TCM. See appropriate wiring diagram under **WIRING DIAGRAMS** . Repair as needed. If circuits are okay between sensor and TCM, go to next step.
4. Disconnect battery negative cable. Disconnect closed throttle position switch connector. Check for continuity between closed throttle position switch terminals. If continuity exists, go to next step. If continuity does not exist, replace or adjust throttle position sensor.
5. Clear codes, and road test vehicle. Retrieve DTC. If DTC P1795 is still present, replace TCM. If code is no longer present, problem is intermittent. Further investigation is required.

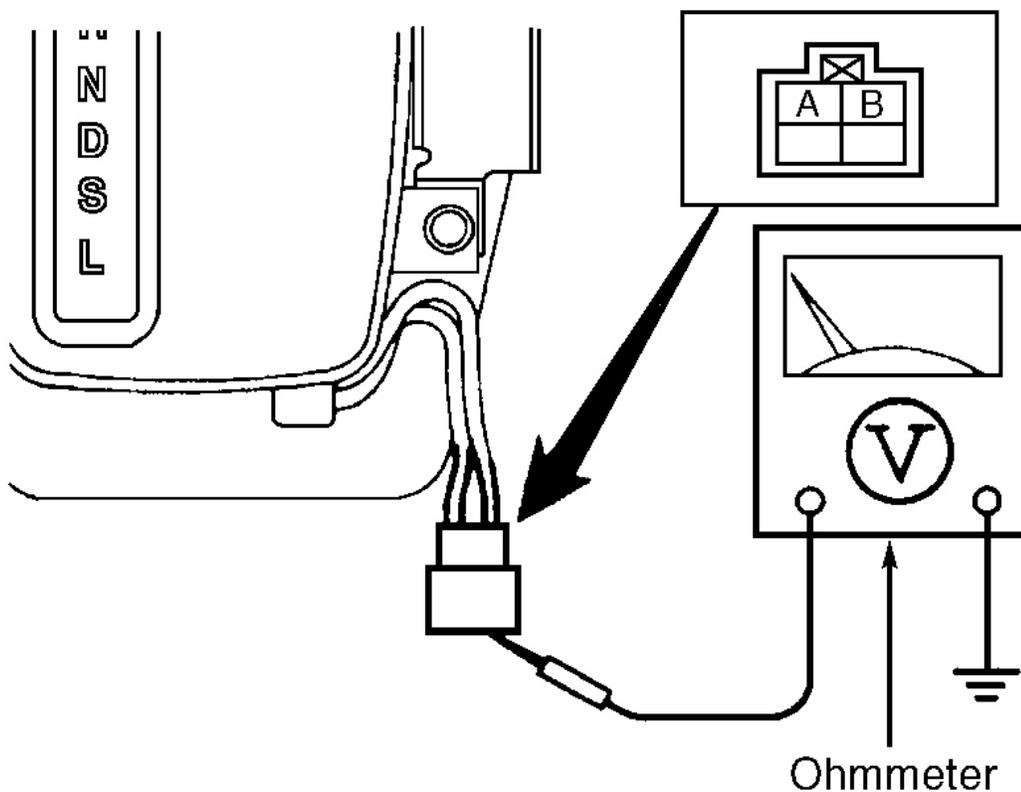
## **COMPONENT TESTING**

**NOTE:** For connector terminal identification, see **COMPONENT CONNECTOR**

**IDENTIFICATION** table under **SELF-DIAGNOSTIC SYSTEM**. For circuit or wire color identification, see appropriate wiring diagram in **WIRING DIAGRAMS** .

## HOLD SWITCH

1. Turn ignition on. Ensure HOLD indicator illuminates with switch depressed. Ensure indicator light is not illuminated when switch is released. If switch is not working as described, go to next step.
2. Access switch connector under center console. Disconnect connector. Check continuity between terminals "A" and "B". See **Fig. 6** . Continuity should exist when switch is depressed. When switch is released, continuity should not exist. Replace as needed. If HOLD switch system does not function correctly, inspect circuits between switch and TCM. See appropriate wiring diagram in **WIRING DIAGRAMS** .



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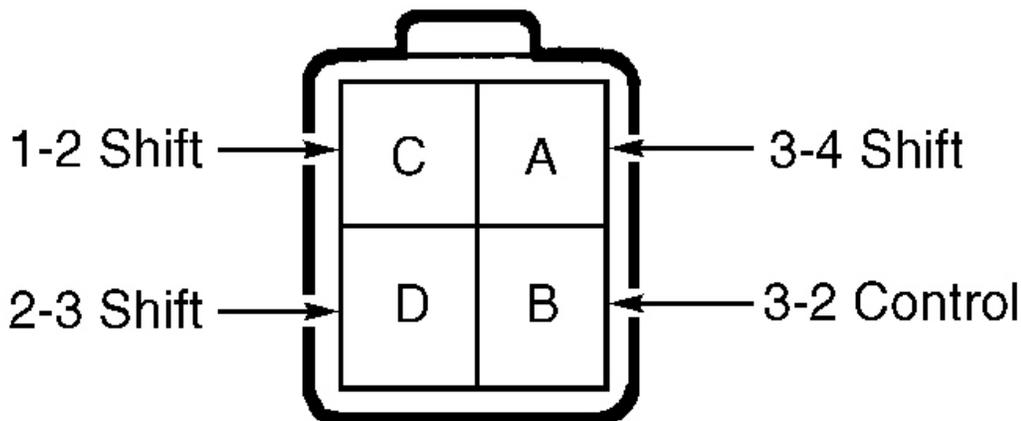
**Fig. 6: Testing HOLD Switch**  
 Courtesy of MAZDA MOTORS CORP.

## INPUT/TURBINE SPEED SENSOR

Disconnect output speed sensor connector. See **Fig. 3** . Measure resistance between terminals. Resistance should be 245 ohms. Replace as needed.

**SOLENOID VALVES (EXCEPT TCC SOLENOID)**

Disconnect negative battery cable. Disconnect transmission solenoid harness connector. See **Fig. 3** . Note that solenoids ground through transmission case. Check resistance between connector terminals and ground. See **Fig. 7** . Resistance should be 13-27 ohms. Replace solenoids as necessary. See **SOLENOID VALVE IDENTIFICATION** table. Ensure transmission case is grounded.



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**Fig. 7: Identifying Solenoid Valve Terminals**  
 Courtesy of MAZDA MOTORS CORP.

**SOLENOID VALVE IDENTIFICATION**

Solenoid Valve	(1) Terminal No.
1-2 Shift Solenoid	C
2-3 Shift Solenoid	D
3-4 Shift Solenoid	A
3-2 Control	B

(1) See **Fig. 7** for terminal identification.

**TCC SOLENOID**

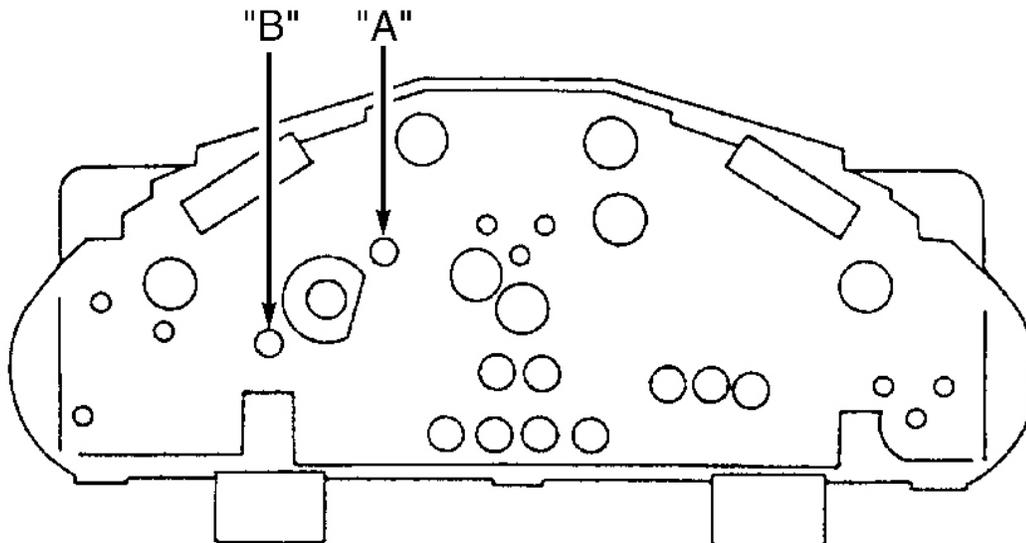
Disconnect negative battery cable. Disconnect TCC solenoid harness connector. See **Fig. 3** . Check resistance

between connector terminals and ground. Resistance should be 13-25 ohms. Replace solenoids as necessary. Ensure transmission case is grounded.

**VEHICLE SPEED SENSOR (VSS)**

**NOTE:** Vehicle speed sensor signal is input to TCM from combination meter driven by speedometer cable.

Disconnect negative battery cable. Remove combination meter. Disconnect harness connectors and speedometer cable. Connect analog voltmeter leads to meter terminals "A" and "B". See **Fig. 8** . Using appropriate screwdriver, rotate speedometer cable shaft. If voltmeter needle does not fluctuate, replace sensor.



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**Fig. 8: Testing Vehicle Speed Sensor**  
 Courtesy of MAZDA MOTORS CORP.

**TRANSMISSION FLUID TEMPERATURE (TFT) SENSOR**

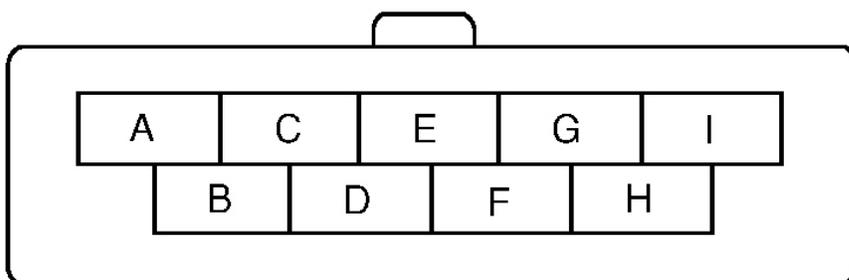
Disconnect TFT sensor harness connector. Sensor is threaded into cooler line banjo mounting on side of transmission case. Measure resistance between connector terminals. See **TFT SENSOR SPECIFICATIONS** table.

**TFT SENSOR SPECIFICATIONS**

Fluid Temperature	k/ohms
68°F (20°C)	2.5
140°F (60°C)	.6

**TRANSMISSION RANGE SWITCH**

1. Check for starter operation with ignition switch in START position and selector lever in "P" and "N" position only. Ensure back-up lights illuminate with ignition in ON position and selector lever in "R" position. If any problems are found, go to next step.
2. Disconnect transmission range switch connector. See **Fig. 3** . Check continuity between specified terminals. See **Fig. 9** . If continuity is not as specified, replace switch.



COMPONENT CONNECTOR

Position/ Range	Connector Terminal								
	A	B	C	D	E	F	G	H	I
P		○			○			○	○
R							○		○
N		○		○				○	○
D			○						○
S						○			○
L	○								○

○—○ : Indicates Continuity

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**Fig. 9: Checking Transmission Range Switch**  
 Courtesy of MAZDA MOTORS CORP.

## **TCM TERMINAL VOLTAGE TESTS**

Turn ignition switch to ON position. Access TCM. TCM is mounted under left corner of dash, above fuse box. DO NOT disconnect harness connector. Using DVOM, measure voltage. See **Fig. 4** for terminal identification. See **Fig. 10** and **Fig. 11** . After verifying that appropriate condition has been met, check voltage. If voltage is not within specification, inspect component or appropriate circuit. If voltage is within specification, replace TCM.

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Terminal	Connected to	Voltmeter		Voltage	Condition	
		+ terminal	- terminal			
1A	—	—	—	—	—	
1B (Output)	HOLD indicator light	1B	Ground	B+	Except HOLD mode	
				Below 1.5 V	HOLD mode	
1C (Output)	FAIL signal	1C		B+	TEST mode	
				Below 1.0 V or repeat B+ and 0 V	Other modes	
1D (Output)	Engine control module (terminal R)	1D		Below 2.5 V	N or P position	
				B+	All ranges, R position	
1E (Input)	TEST signal	1E		B+	Ignition switch ON	
				Below 1.0 V or repeat B+ and 0 V	TEST mode	
1F	—	—		—	—	—
1G	Transmission fluid temperature sensor	1G		Ground	3.3 V	ATF temperature 25 °C { 77 °F }
1H (Input)	HOLD switch	1H	B+		Switch depressed	
			0 V		Switch released	
1I	—	—	—	—	—	
1J	—	—	—	—	—	
1K (Input)	Water temperature switch	1K	Ground	Below 1.5 V	Water temperature below 50 °C { 122 °F }	
				B+	Water temperature above 60 °C { 140 °F }	
1L	—	—	—	—	—	
1M (Input)	Cruise control unit	1M	Ground	B+	Normal conditions	
				Below 1.5 V	Set or Resume switch ON or vehicle speed 8 km/h { 5 MPH } lower than preset speed (Driving vehicle cruise control operation)	
1N (Input)	Engine rpm signal (Ne signal)	1N		0 V or 4.5 V—5.5 V	Engine stopped (ignition switch ON)	
				2.0 V—3.0 V	Engine running at idle	
1O	Closed throttle position switch	1O		0 V	Accelerator pedal depressed	
				B+	Accelerator pedal released	
1P (Input)	Vehicle speed sensor	1P		Approx. 4 V	While driving	
				Approx. 7—9 V or Below 1.5 V	Vehicle stopped	
2A (Input)	Throttle position sensor	2A		Approx. 4.4—5.5 V	Ignition switch ON	
				0 V	Ignition switch OFF	
2B (Input)	Transmission range switch (N and P position)	2B		0 V	N or P position	
				B+	All ranges, R position	
2C	—	—		—	—	—

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**Fig. 10: TCM Pin Voltage Table (1 Of 2)**  
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## 1997 AUTOMATIC TRANSMISSIONS NC4A-EL Electronic Controls

Terminal	Connected to	Voltmeter		Voltage	Condition
		+ terminal	- terminal		
2D (Input)	Transmission range switch (D range)	2D	Ground	B+	D range
				0 V	Other ranges, all positions
2E (Output)	Shift solenoid A	2E		B+	Solenoid ON in following condition: • 1GR position
				0 V	Solenoid OFF in following condition: • 2GR, 3GR, and 4GR positions
2F (Input)	Transmission range switch (S range)	2F		B+	S range
				0 V	Other ranges, all positions
2G (Output)	Shift solenoid B	2G		B+	Solenoid ON in following condition: • 1GR and 2GR positions
				0 V	Solenoid OFF in following condition: • 3GR and 4GR positions
2H (Input)	Transmission range switch (L range)	2F		B+	L range
				0 V	Other ranges, all positions
2I (Output)	Shift solenoid C	2I	B+	Solenoid ON in following condition: • 1GR, 2GR, and 3GR positions	
			0 V	Solenoid OFF in following condition: • 4GR position	
2J (Input)*	Input/turbine speed sensor	2J	Ground	0—0.1 V (AC)	Engine running
				0 V (AC)	Engine stopped
2K (Output)	TCC control solenoid valve	2K		B+	Solenoid ON, TCC operation
				0 V	Solenoid OFF, TCC non-operation
2L (Ground)*	Input/turbine speed sensor	2L		Below 1.5 V	—
				B+	3-2 or 4-3 downshift
2M (Output)	3-2 control solenoid valve	2M		0 V	Other conditions
				—	—
2N	—	—		—	—
2O (Memory power)	Battery	2O		Ground	B+
2P (Ground)	—	2P	0 V		—
2Q (Battery power)	Battery	2Q	B+		Ignition switch ON
			0 V		Ignition switch OFF
2R	—	—	—	—	
2S	—	—	—	—	
2T (Input)	Throttle position sensor	2T	Ground	Approx. 0.4—4.1 V	Closed throttle position to wide open throttle

\* : Checked with AC range

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**Fig. 11: TCM Pin Voltage Table (2 Of 2)**  
Courtesy of MAZDA MOTORS CORP.

## ELECTRICAL SPECIFICATIONS

### SOLENOID RESISTANCE SPECIFICATIONS

Component	Resistance Ohms
<b>Solenoids</b>	
Shift Solenoids	13-27
TCC Solenoid	13-25
<b>Sensor</b>	
TSS	245

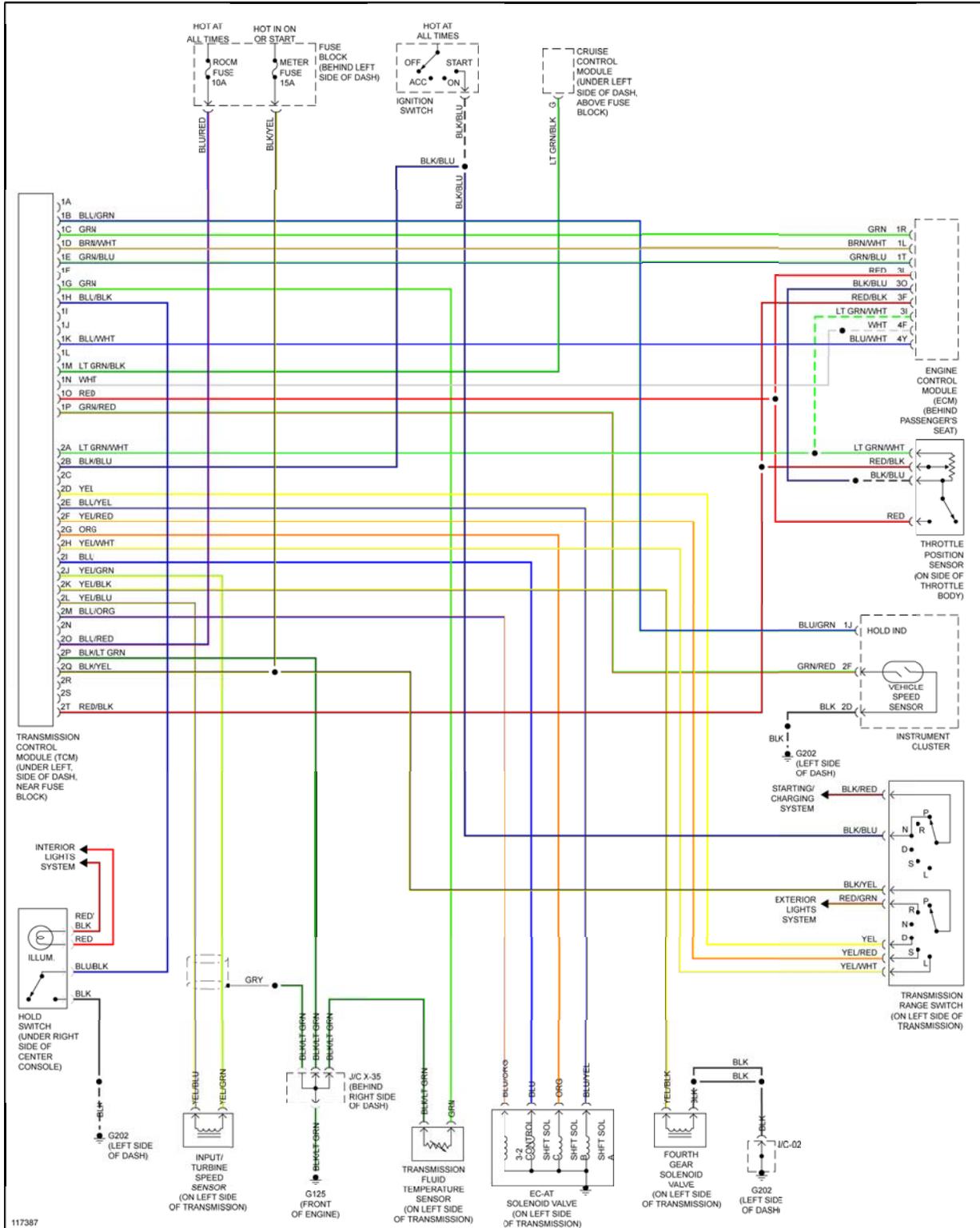
**1997 Mazda MX-5 Miata**

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**WIRING DIAGRAMS**

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## 1997 AUTOMATIC TRANSMISSIONS NC4A-EL Electronic Controls



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**Fig. 12: Transmission Wiring Diagram (1997 Miata)**