TS2470EN

Troubleshooting Manual

Allison Transmission

MD/HD/B Series Transmissions
WTEC II Controls
(Pre-TransID and TID 1)

MD 3060/MD 3066/MD 3560(P)(R)
MD 3070PT
HD 4060/HD 4560(P)(R)
B 300/B 400/ B 500(P)(R)

May 1998
Revision 1, 199910

Allison Transmission
Division of General Motors Corporation
P.O. Box 894 Indianapolis, Indiana 46206-0894

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FOREWORD — How to Use This Manual

This manual provides troubleshooting information for Allison Transmission Division, MD/HD/B Series Transmissions. Service Manuals SM2148EN and SM2457EN, and Parts Catalogs PC2150EN and PC2456EN may be used in conjunction with this manual.

This manual includes:

- Description of the WTEC II electronic control system.
- Description of the electronic control system components.
- Description of diagnostic codes, system responses to faults, and troubleshooting.
- Wire, terminal, and connector repair information.

Specific instructions for using many of the available or required service tools and equipment are not included in this manual. The service tool manufacturer will furnish instructions for using the tools or equipment.

Additional information may be published from time to time in Service Information Letters (SIL) and will be included in future revisions of this and other manuals. Please use these SILs to obtain up-to-date information concerning Allison Transmission products.

This publication is revised periodically to include improvements, new models, special tools, and procedures. A revision is indicated by a letter suffix added to the publication number. Check with your Allison Transmission service outlet for the currently applicable publication. Additional copies of this publication may be purchased from authorized Allison Transmission service outlets. Look in your telephone directory under the heading of Transmissions — Truck, Tractor, etc.

Take time to review the Table of Contents and the manual. Reviewing the Table of Contents will aid you in quickly locating information.

NOTE: Allison Transmission is providing for service of WTEC II wiring harnesses and wiring harness components as follows: (See Service Information Letter 1-WT-97 for further information.)

- Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission is responsible for warranty on these parts.
- Since January, 1998, all WTEC II external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes ATD, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI has parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:

St. Clair Technologies, Inc.
1050 Old Glass Road
Wallaceburg, Ontario, Canada, N8A 3T2
Phone: (519) 627-1673
Fax: (519) 627-4227

St. Clair Technologies, Inc.
1111 Mikesell Street
Charlotte, Michigan 48813
Phone: (517) 541-8166
Fax: (517) 541-8167

St. Clair Technologies, Inc.
c/o Mequilas Tetakawi
Carr. Internationale KM 1969
Guadalajara – Nogales, KM2
Empalme, Sonora, Mexico
Phone: 011-52-622-34661
Fax: 011-52-622-34662

IMPORTANT SAFETY NOTICE

IT IS YOUR RESPONSIBILITY to be completely familiar with the warnings and cautions used in this manual. These warnings and cautions advise against using specific service procedures that can result in personal injury, equipment damage, or cause the equipment to become unsafe. These warnings and cautions are not exhaustive. Allison Transmission could not possibly know, evaluate, or advise the service trade of all conceivable procedures by which service might be performed or of the possible hazardous consequences of each procedure. Consequently, Allison Transmission has not undertaken any such broad evaluation. Accordingly, ANYONE WHO USES A SERVICE PROCEDURE OR TOOL WHICH IS NOT RECOMMENDED BY ALLISON TRANSMISSION MUST first be thoroughly satisfied that neither personal safety nor equipment safety will be jeopardized by the service procedures used.

Also, be sure to review and observe WARNINGS, CAUTIONS, and NOTES provided by the vehicle manufacturer and/or body builder before servicing the Allison transmission in that vehicle.

Proper service and repair is important to the safe and reliable operation of the equipment. The service procedures recommended by Allison Transmission and described in this manual are effective methods for performing troubleshooting operations. Some procedures require using specially designed tools. Use special tools when and in the manner recommended.

The WARNINGS, CAUTIONS, and NOTES in this manual apply only to the Allison transmission and not to other vehicle systems which may interact with the transmission. Be sure to review and observe any vehicle system information provided by the vehicle manufacturer and/or body builder at all times the Allison transmission is being serviced.

WARNINGS, CAUTIONS, AND NOTES

Three types of headings are used in this manual to attract your attention:

WARNING!	**Is used when an operating procedure, practice, etc., which, if not correctly followed, could result in injury or loss of life.**

CAUTION:	Is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE: Is used when an operating procedure, practice, etc., is essential to highlight.

TRADEMARKS USED IN THIS MANUAL

The following trademarks are the property of the companies indicated:

- LPS® Cleaner is a registered trademark of LPS Laboratories.
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SHIFT SELECTOR TERMS AND DISPLAY INDICATIONS

Shift selector terms and displays are represented in this manual as follows:

- Button Names — ⇑ ⇓, **DISPLAY MODE, MONITOR, SELECT, etc.**
- Transmission Ranges — **D** (Drive), **N** (Neutral), **1** (First), **R** (Reverse), etc.
- Displays — "**OL**", "**OK**", etc.

TABLE OF CONTENTS

SECTION 5. OIL LEVEL SENSOR **Page**

SECTION 6. DIAGNOSTIC CODES

SECTION 7. INPUT AND OUTPUT FUNCTIONS

SECTION 8. GENERAL TROUBLESHOOTING OF PERFORMANCE COMPLAINTS

APPENDICES

SECTION 1 — GENERAL DESCRIPTION

1–1. TRANSMISSION

The World Transmission Electronic Controls WTEC II system features closed-loop clutch control to provide superior shift quality over a wide range of operating conditions. MD 3000 (except 3070), HD 4000, and B Series configurations can be programmed to have up to six forward ranges, neutral, and one reverse range. The MD 3070 has seven forward ranges and one reverse range. Figures 1–1 and 1–2 show electronic control unit components.

WTEC II Electronic Controls consist of the following components:

- Basic or Max Feature Electronic Control Unit (ECU)
- Pushbutton or Lever Shift Selectors (remote or integral to the ECU)
- Optional Secondary Shift Selector
- Engine, Turbine and Output Speed Sensors
- Throttle Position Sensor (TPS) (or electronic engine throttle signal or PWM signal)
- Control Module (Electro-Hydraulic Valve Body)
- Wiring Harnesses
- Vehicle Interface Module (VIM)
- Optional Retarder Controls
- TransID Feature

NOTE: ***Model Year '94 and earlier WT Series Electronic Controls operate on 12VDC. Vehicles with a 24VDC system require a voltage equalizer or converter to supply 12V to the electronic control system. Model Year '95 and later transmissions operating on 24VDC require a 24V VIM and a 24V wiring harness which includes shielding for the turbine and output speed sensors.***

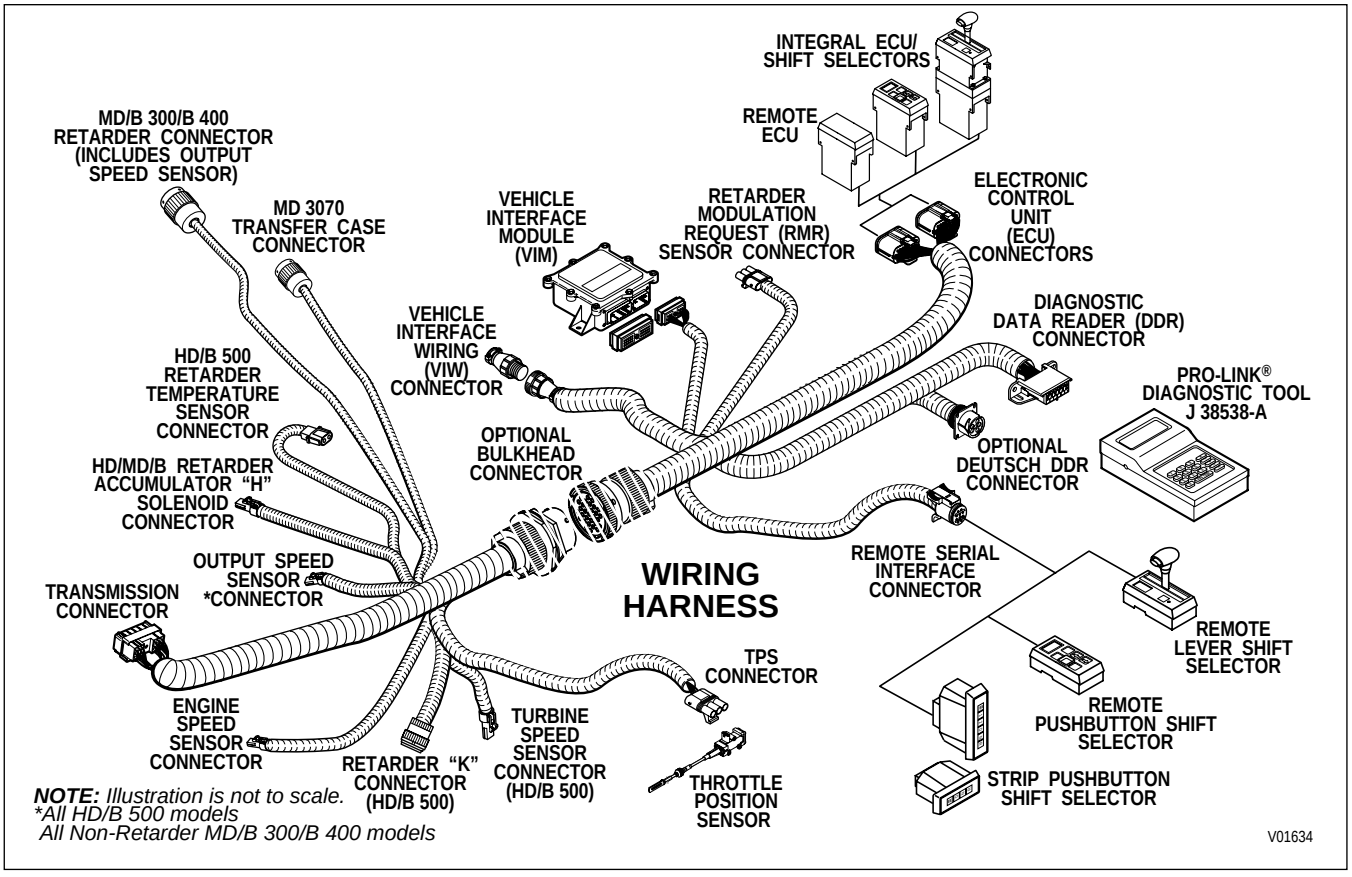

Figure 1–1. WTEC II Electronic Control Components (Units Produced Before 9/94)

GENERAL DESCRIPTION

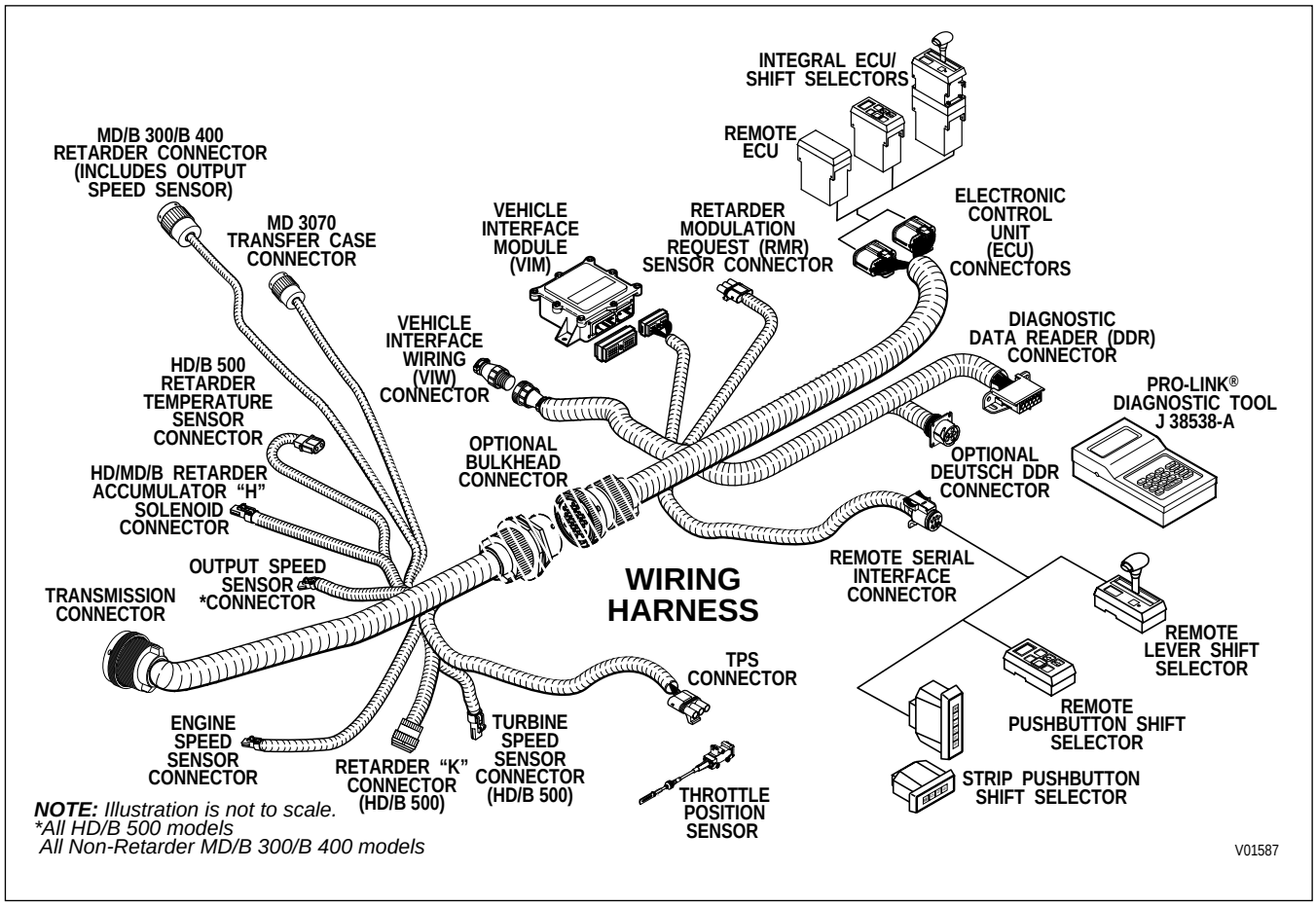

Figure 1–2. WT Electronic Control Unit Components (Units Produced 9/94–12/97)

Figure 1–3 is a block diagram of the basic system's inputs and outputs.

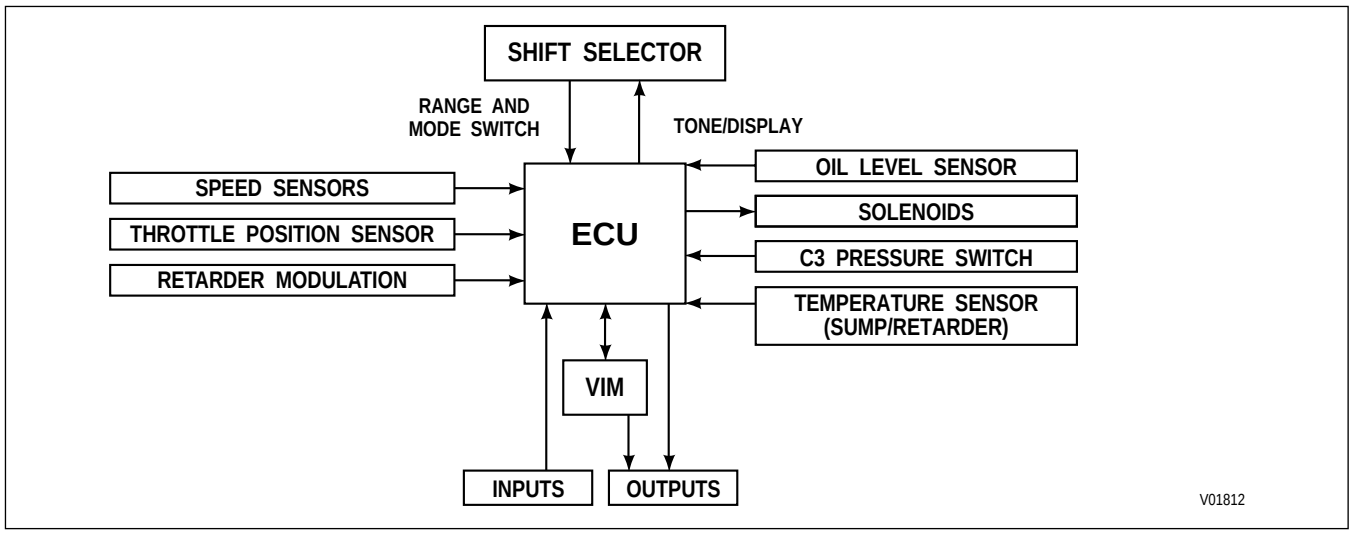

Figure 1–3. Electronic Control Unit Block Diagram

GENERAL DESCRIPTION

1–2. ELECTRONIC CONTROL UNIT (ECU)

The ECU (Figure 1–4) contains the microcomputer which is the brain of the control system. The ECU receives and processes information defining: shift selector position, throttle position, sump/retarder temperature, engine speed, turbine speed, and transmission output speed. The ECU uses the information to control transmission solenoids and valves, supply system status, and provide diagnostic information.

The ECU contains an Electronically Erasable Programmable Read Only Memory (EEPROM) which is programmed with the shift calibration and other data for a specific transmission assembly, engine, and vehicle vocation.

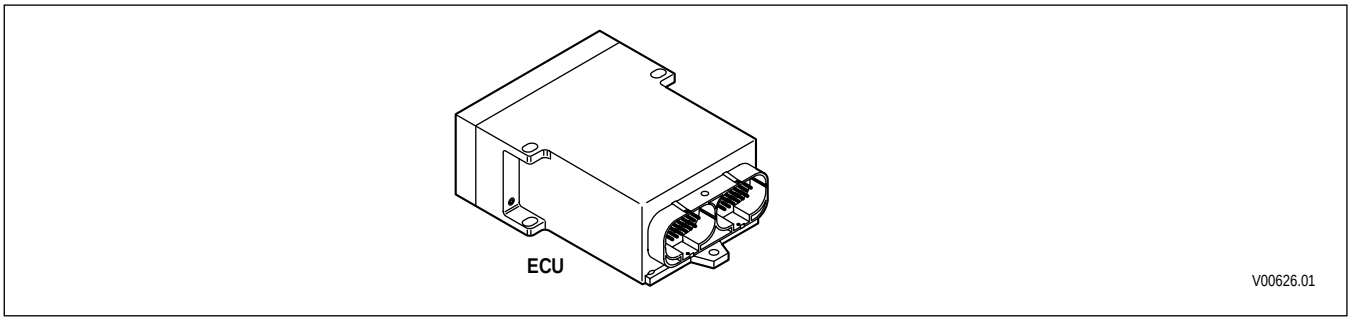

Figure 1–4. Electronic Control Unit (ECU)

1–3. SHIFT SELECTOR

Pushbutton and lever shift selectors are available for the WT Series. Either shift selector may be ordered attached to (integral with), or remote from, the ECU. Both shift selectors are equipped with a digital display. However, the strip pushbutton shift selector does not have a digital display.

On the shift selectors, between the range selected and the range monitored (attained) digits, is a **MODE ON** indicator position. During normal transmission operation **MODE ON** indicates that a secondary or special operating condition has been selected by pressing the **MODE** button. In diagnostic display mode, **MODE ON** indicates the displayed diagnostic code is active. There is a **SERVICE** indicator icon under the **MODE ON** indicator. It is illuminated when codes 21 XX, 63 00, and 66 00 are active (for ECUs programmed after 9/26/94). When a transmission fault occurs that causes the **DO NOT SHIFT** light to turn on, the shift selector sounds a tone to indicate transmission shifting is restricted.

A. Pushbutton Shift Selector *(Figure 1–5)*

The full-function pushbutton shift selector has six (6) buttons and a digital display. The six buttons are: **R** (Reverse), **N** (Neutral), **D** (Drive), ⇑ (Up), ⇓ (Down), and **MODE**. Manual forward range downshifts; upshifts are made by pressing the ⇑ (Up) or ⇓ (Down) arrow buttons after selecting **D** (Drive). The **N** (Neutral) button has a raised lip to aid in finding it by touch. The digital display on the pushbutton selector indicates the range selected on the left side and the range monitored (attained) on the right side. The **MODE** button is pressed to select a secondary or special operating condition, such as ECONOMY shift schedule. The vehicle dimmer-control changes display brightness. Diagnostic information is obtained by pressing the ⇑ (Up) and ⇓ (Down) arrow buttons at the same time.

GENERAL DESCRIPTION

A strip pushbutton shift selector does not have a **MODE** button, **SERVICE** icon, or diagnostic display capability. The Pro-Link® 9000 or a customer-furnished remote display must be used for diagnostic purposes.

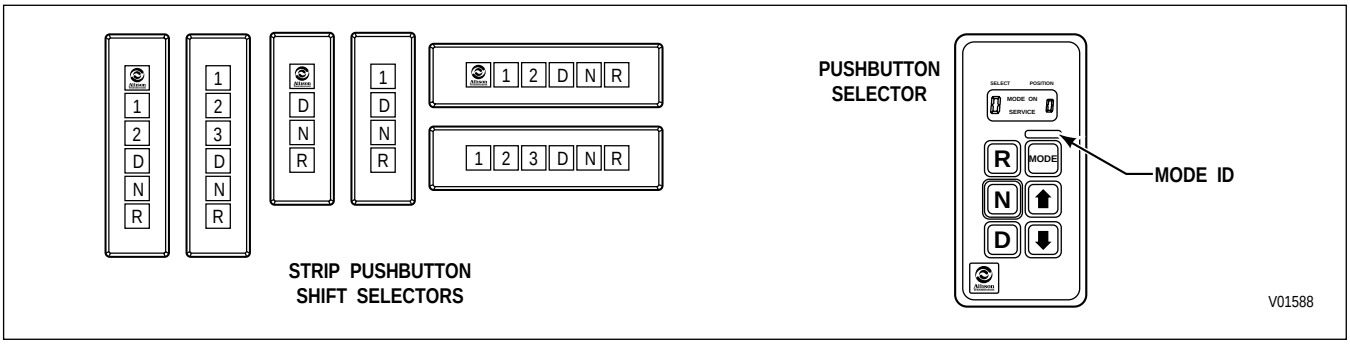

Figure 1–5. Pushbutton Shift Selectors

B. Lever Shift Selector *(Figure 1–6)*

The lever shift selector can only be ordered with as many as six forward range positions (seven for the MD 3070), as well as **R** (Reverse) and **N** (Neutral). The shift hold mechanism is released by pressing a button on the side of the shift handle. The range selector lever can be moved freely between numbered forward ranges. Press and hold the shift hold button to move into or out of the **D** (Drive) position or when moving into or out of **N** (Neutral) or **R** (Reverse).

The digital display on the lever selector indicates the selected range at the top and the range monitored (attained) at the bottom. A **MODE** button and a recessed **DISPLAY MODE** button are also on the face of the lever shift selector. The **MODE** button is pressed to select a secondary or special operating condition, such as ECONOMY shift schedule. Diagnostic information is obtained by pressing the **DISPLAY MODE** button. The vehicle dimmer-control changes display brightness.

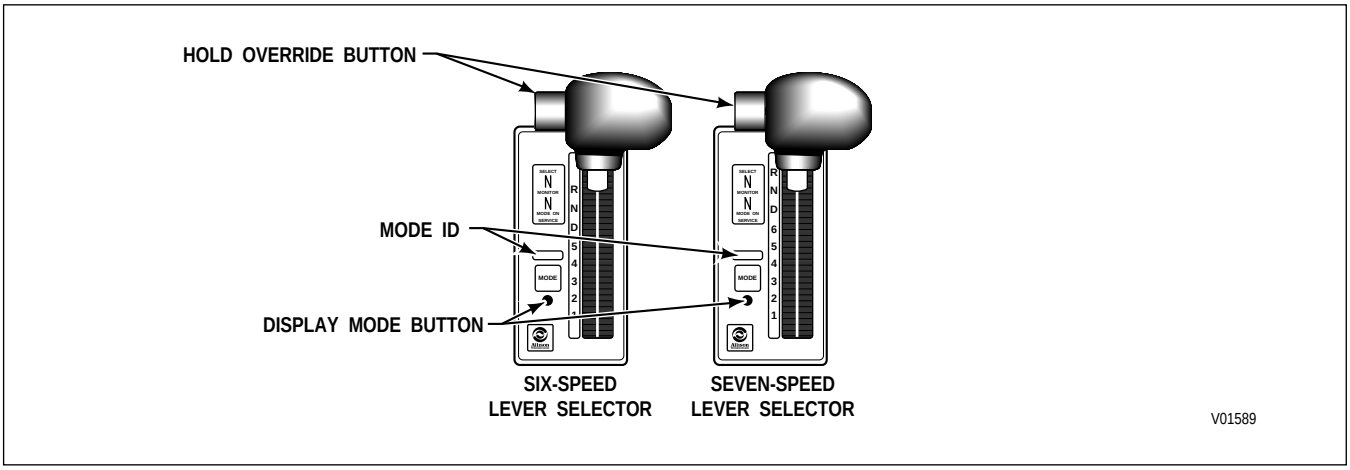

Figure 1–6. Six-Speed And Seven-Speed Lever Shift Selectors

GENERAL DESCRIPTION

1–4. THROTTLE POSITION SENSOR *(Figure 1–7)*

The Throttle Position Sensor (TPS) can be mounted to the engine, chassis, or transmission. The TPS contains a pull actuation cable and a potentiometer. One end of the cable is attached to the engine fuel lever and the other, inside a protective housing, to the TPS potentiometer. Output voltage from the TPS is directed to the ECU through the external harness. The voltage signal indicates the throttle position and, in combination with other input data, determines shift timing.

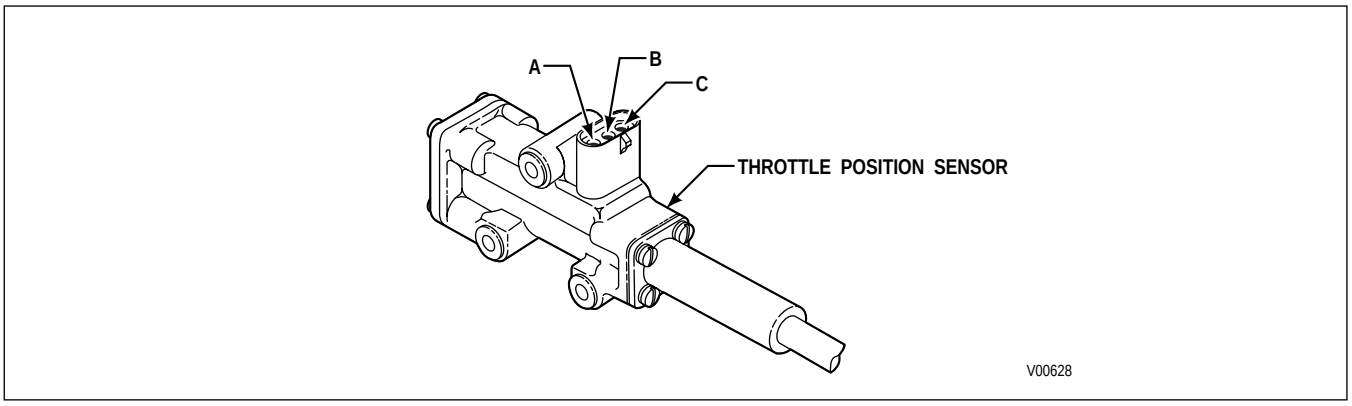

Figure 1–7. Throttle Position Sensor

1–5. SPEED SENSORS *(Figure 1–8)*

Three speed sensors — engine speed, turbine speed, and output speed — provide information to the ECU. The engine speed signal is generated by ribs on the shell of the torque converter pump. The turbine speed signal is generated by the rotating-clutch housing spline contours. The output speed signal is generated by a toothed member attached to the output shaft (except for the MD 3070, where the toothed member is the transfer case idler gear). The speed ratios between the various speed sensors allow the ECU to determine if the transmission is in the selected range. Speed sensor information is also used to control the timing of clutch apply pressures, resulting in the smoothest shifts possible. Hydraulic problems are detected by comparing the speed sensor information for the current range to that range's speed sensor information stored in the ECU memory.

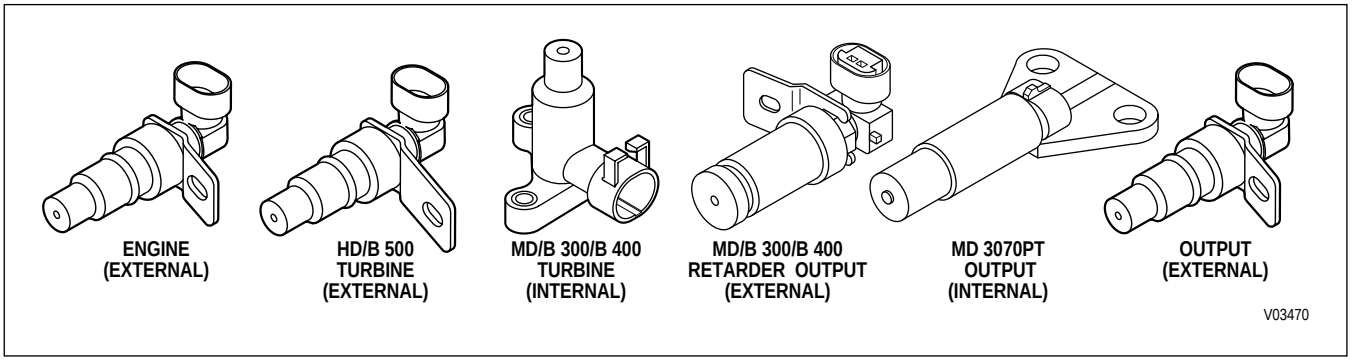

Figure 1–8. Speed Sensors

GENERAL DESCRIPTION

1–6. CONTROL MODULE *(Figure 1–9)*

The WT Series transmission control module contains a channel plate on which is mounted: the main valve body assembly, the stationary-clutch valve body assembly, and the rotating-clutch valve body assembly. For valve locations, refer to SIL 27-WT-93, Rev. A. Pulse width modulated solenoids are used in the valve bodies. The rotating-clutch valve body assembly contains A (C1), B (C2), and F (lockup) solenoids, solenoid regulator valves controlled by the solenoids, and the C3 pressure switch. The stationary-clutch valve body assembly contains C (C3), D (C4), and E (C5) solenoids and solenoid regulator valves controlled by the solenoids and the C3 accumulator relay valve. The main valve body assembly contains G solenoid and the C1 and C2 latch valves controlled by the solenoid, the main and lube regulator valves, the control main and converter regulator valves, and the converter flow valve and exhaust backfill valves.

A temperature sensor (thermistor) is located in the internal wiring harness. Changes in sump fluid temperature are indicated by changes in sensor resistance which changes the signal sent to the ECU (see chart in Section 6, Code 24).

The oil level sensor is required on all models with a shallow sump but is optional on other models. The oil level sensor is a float-type device, mounted on the control module channel plate, which senses transmission fluid level by electronically measuring the buoyancy forces on the float. The sensor operates on 5VDC supplied by the ECU.

The C3 pressure switch is mounted on the rotating-clutch valve body assembly and indicates when pressure exists in the C3 clutch-apply passage. An accumulator/relay valve is in-line ahead of the C3 pressure switch and prevents high frequency hydraulic pulses generated by the C3 solenoid from cycling the C3 pressure switch.

Also mounted in the control module is the turbine speed sensor for the MD/B 300/B 400 models. The turbine speed sensor is directed at the rotating-clutch housing. (The turbine speed sensor on the HD/B 500 models is located on the outside of the main housing.)

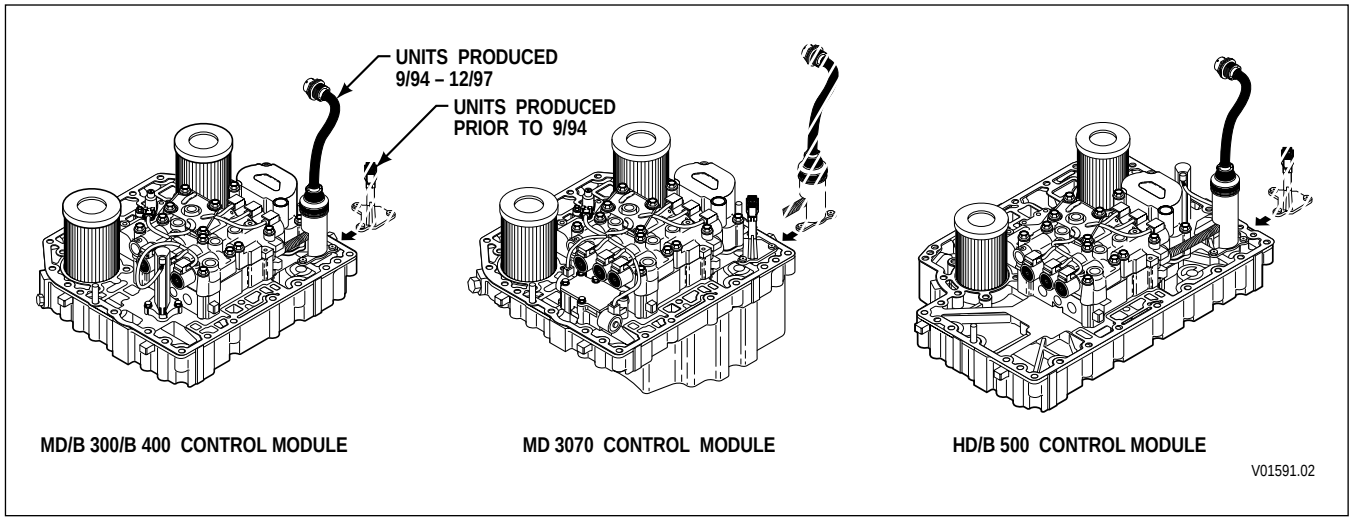

Figure 1–9. Control Module

GENERAL DESCRIPTION

1–7. WIRING HARNESSES

A. External Wiring Harness *(Figures 1–10 and 1–11)*

The external wiring harness provides a connection between the ECU, the transmission (including engine, turbine, and output speed sensors), the throttle position sensor, the vehicle interface module (VIM), retarder control module, shift selectors, diagnostic tool connector, retarder, retarder temperature sensor, accumulator, and vehicle interface. Many harnesses will include a bulkhead to separate cab and chassis components. Also, many different styles and materials for harnesses are likely to be encountered.

NOTE: Allison Transmission is providing for service of WTEC II wiring harnesses and wiring harness components as follows: (See Service Information Letter 1-WT-97 for further information.)

- Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission is responsible for warranty on these parts.
- Since January, 1998, all WTEC II external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes ATD, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI has parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:

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Phone: (519) 627-1673
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St. Clair Technologies, Inc.
1111 Mikesell Street
Charlotte, Michigan 48813
Phone: (517) 541-8166
Fax: (517) 541-8167

St. Clair Technologies, Inc.
c/o Mequilas Tetakawi
Carr. Internationale KM 1969
Guadalajara – Nogales, KM2
Empalme, Sonora, Mexico
Phone: 011-52-622-34661
Fax: 011-52-622-34662

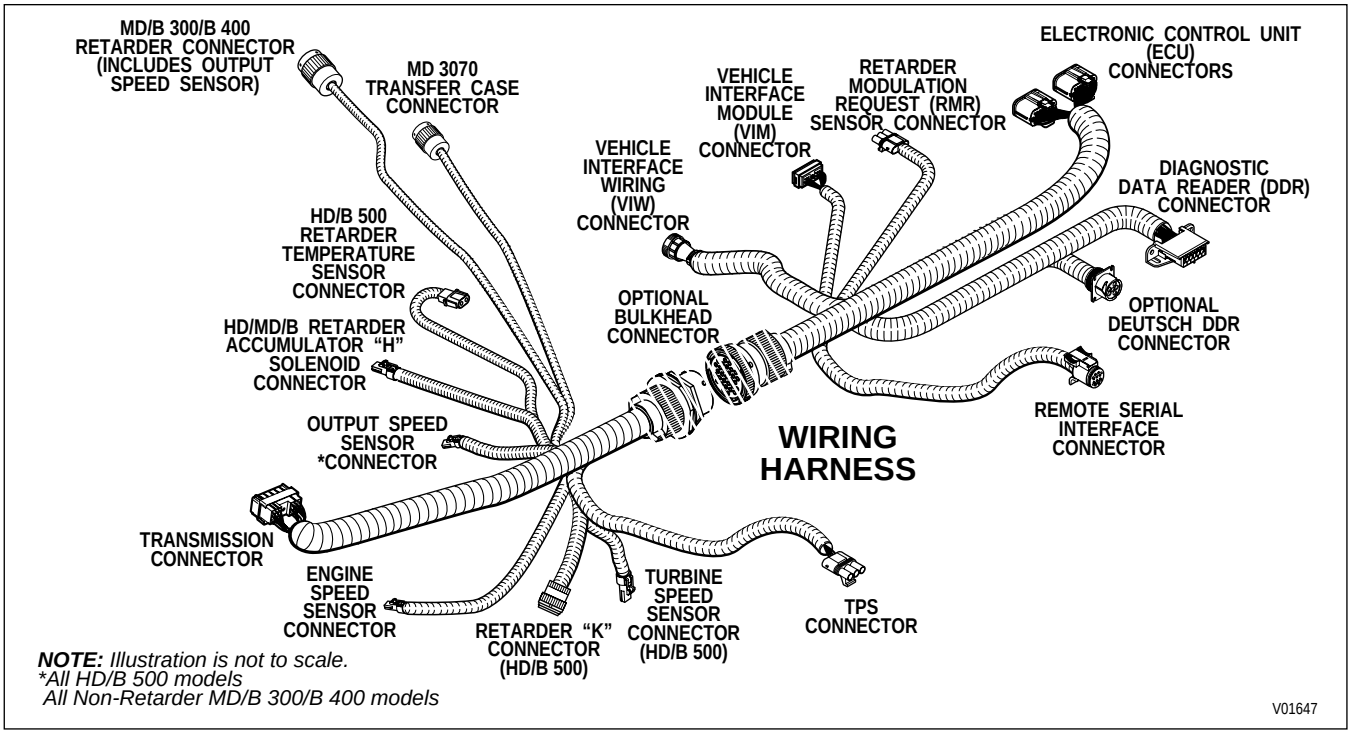


Figure 1–10. WTEC II External Wiring Harness (Units Produced Before 9/94)

GENERAL DESCRIPTION

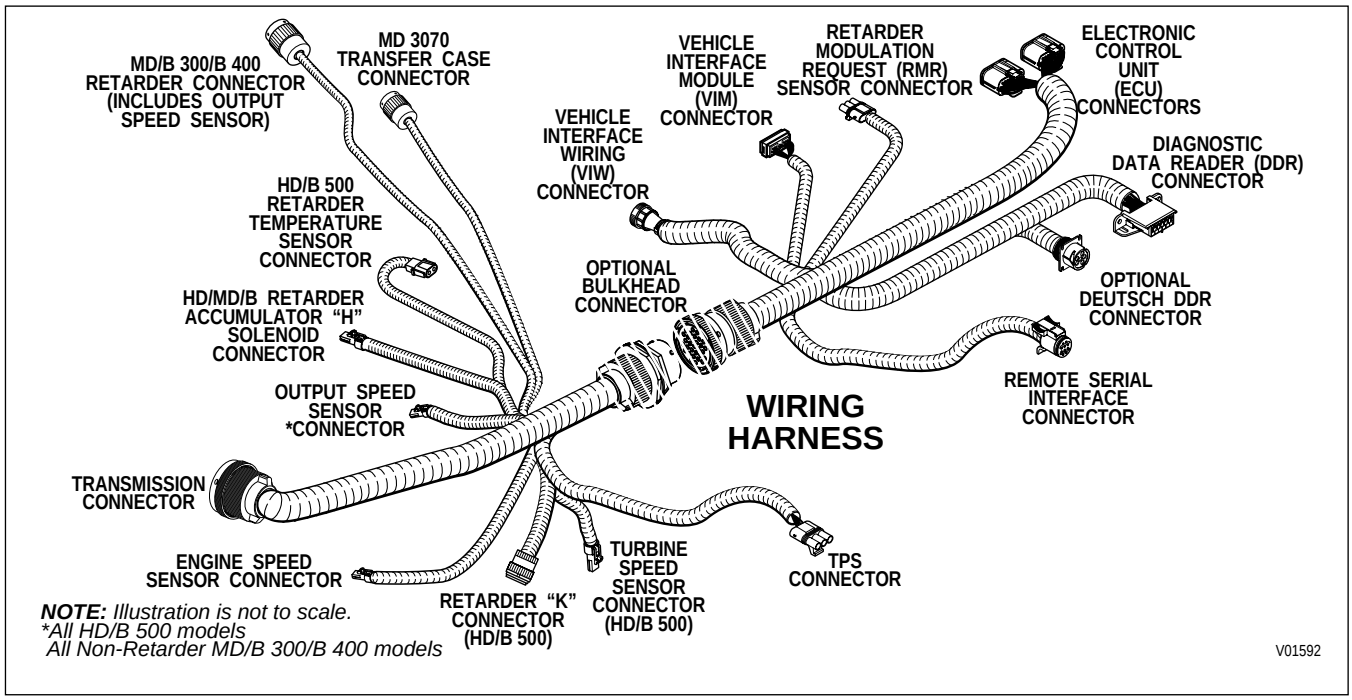


Figure 1–11. WTEC II External Wiring Harness (Units Produced 9/94–12/97)

B. Internal Wiring Harness *(Figures 1–12, 1–13, and 1–14)*

The internal wiring harness provides connection between the external harness, the pulse width modulated solenoids, oil level sensor, C3 pressure switch, and the temperature sensor.

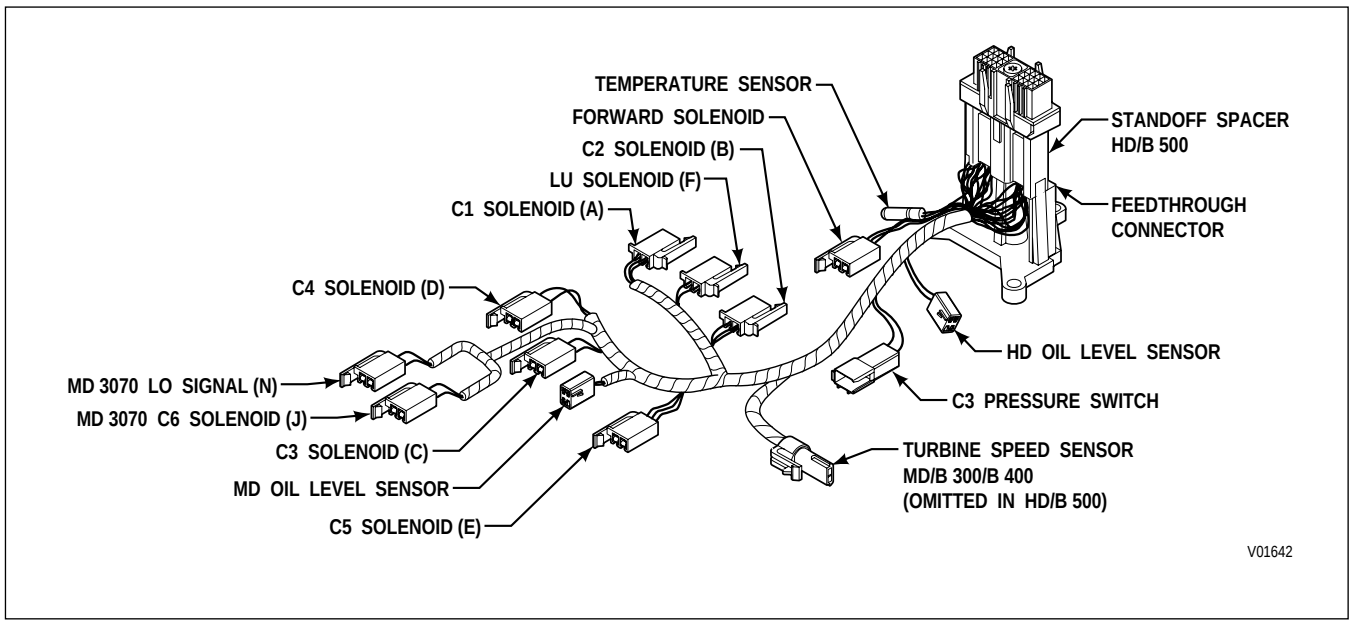


Figure 1–12. WTEC II Internal Wiring Harness (Units Produced Before 9/94)

GENERAL DESCRIPTION

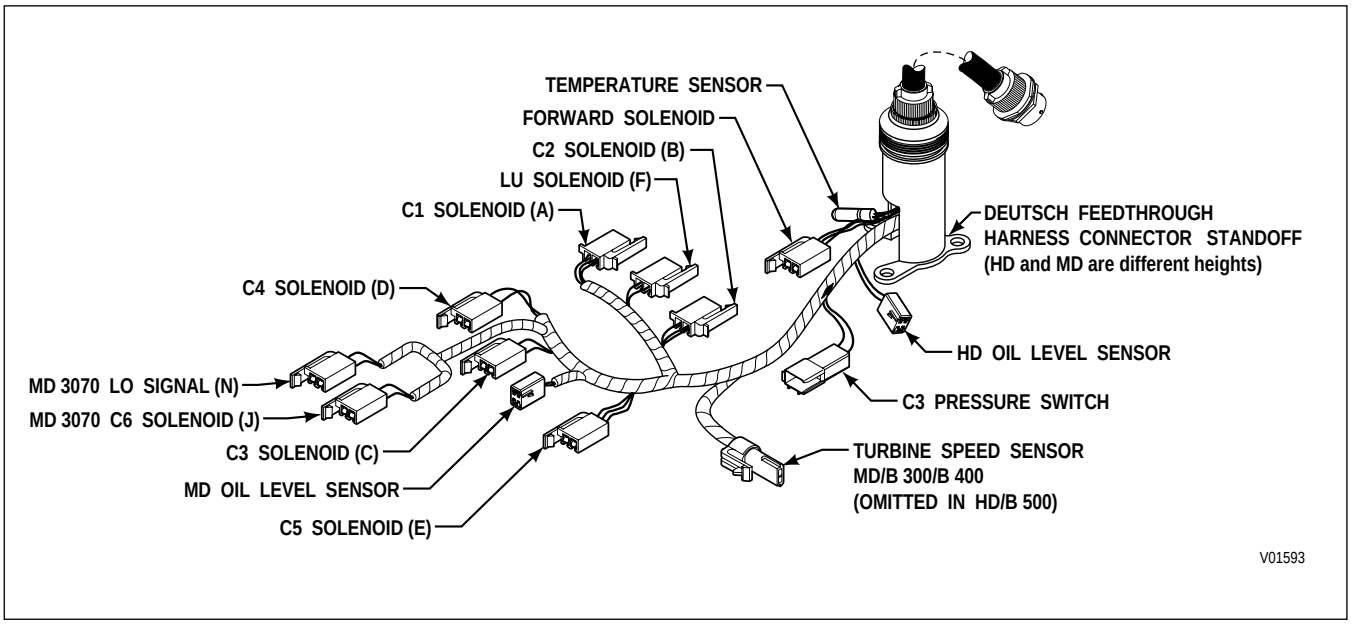


Figure 1–13. WTEC II Internal Wiring Harness (Units Produced 9/94–11/96)

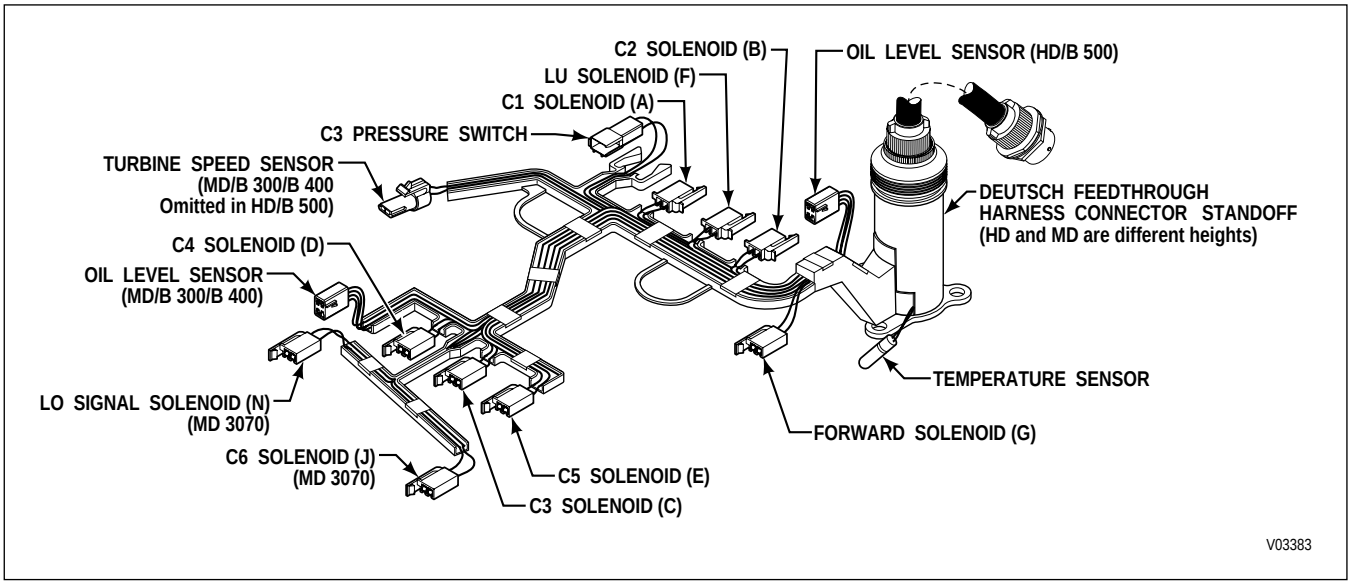


Figure 1–14. WTEC II Internal Wiring Harness (Units Produced 11/96–12/97)

GENERAL DESCRIPTION

1–8. VEHICLE INTERFACE MODULE *(Figure 1–15)*

The vehicle interface module (VIM) provides relays, fuses, and connection points for interface with the output side of the vehicle electrical system. VIMs are available for both 12V and 24V electrical systems. The VIM for 12V systems uses all 12V relays. The VIM for 24V systems had four 24V relays and two 12V relays prior to Model Year 1995 and all 24V relays beginning with Model Year 1995. Refer to the Parts Catalog for the transmission assembly number that you are servicing for detailed parts information. Refer to pages D–25 and D–26 for VIM wire number and terminal information.

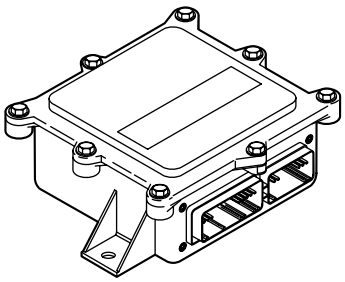


Figure 1–15. Vehicle Interface Module (VIM)

1–9. TRANSID FEATURE

A. General Description

The TransID feature has been provided so that Allison Transmission can make component changes which require calibration changes but still retain both the original transmission A/N and the original calibrated ECU A/N. The purpose of TransID is to reduce the need for OEMs to use cross-reference lists of transmission and calibrated ECU A/Ns when such changes to the transmission are made. TransID allows OEMs to order specific transmission A/Ns and calibrated ECU A/Ns and receive all changes made to the transmission and all of the corresponding calibrations. This will reduce the number of A/N changeovers with which an OEM must contend.

The basis for the TransID system is the creation of a TransID wire in the WTEC II and III system to provide a signal to the ECU of the TransID level of the transmission. This wire for WTEC II and III will be connected directly to the Analog Ground (wire 135) to signal TransID level 1 (TID 1). TransID levels 2 through 8 will only apply to WTEC III and are covered in TS2973EN, WTEC III Troubleshooting. The connection point of the TransID wire will provide the signal to tell the ECU which calibration is required by the transmission.

Whenever a TransID level change is to be made, the new TransID level calibrations will be placed in the PROM Calibration Configurator System (PCCS) ninety days before the change(s) is(are) made in production to the transmissions. All ECUs programmed and sold after that date will then be loaded with the new TransID level calibration. These ECUs will contain calibrations for the new level transmission and all previous TransID levels and will automatically load the correct calibration for the transmission. This eliminates worry on the part of the OEM of coordinating the implementation of the new ECU and the new transmission and allows their focus to be on using the stock of the earlier level ECU.

GENERAL DESCRIPTION

B. Transmission Changes Versus TransID Number

1. TransID 1

The internal wiring harness wiring change to make a TID 1 transmission was put into production before the introduction of the WTEC III system and does pertain to some WTEC II units. The TID 1 internal harness was made by connecting the C3 Pressure Switch ground (digital/signal ground; WTEC II wire 161) to the Sump Temperature Sensor and Oil Level Sensor ground (analog ground; wire 135) in the internal harness. In WTEC II, the signal ground wire (wire 161) is routed through the transmission connector, terminal W, and then to the ECU, terminal B27. In WTEC III, this same wire in the internal harness becomes the TransID wire (wire 195), and it goes to the ECU, terminal T13 (blue connector). The purpose of TransID 1 was to provide a common transmission for use with both WTEC II and WTEC III systems (V7A and V8).

The only difference between a pre-TransID transmission and a TransID 1 transmission is the internal wiring harness which connects the digital and analog grounds on the TID 1 harness. Adapter harness P/N 200100 can be ordered from St. Clair Technologies to provide the same connection outside the transmission and allow a pre-TransID transmission to be “converted” to a TransID 1 transmission.

All models of the World Transmission were built with the TransID 1 internal (feedthrough) harness beginning in September, 1996. Two changes were rolled into this update: the wiring change for TID 1 and a change to use a molded channel rather than the braided covering which was previously used. Both changes were rolled into the same internal harness P/N even though there was a delay in implementing the channel which resulted in the two S/N breaks. Table 1–1 lists the internal harness P/Ns for the different transmission models along with the S/Ns for both changes for each harness.

Table 1–1. TransID 1 S/N Breakpoint

Transmission Model	Pre-TransID Harness P/N	TransID 1 Harness P/N	S/N at Wiring Change	S/N at U-Channel
MD 3000/B 300/B 400 w/OLS	29516322	29529472	6510088864	6510096671
MD 3000/B 300/B 400 w/o OLS	29516323	29529473	6510089316	6510096683
MD 3070PT	29516324	29529474	6510090786	6510096675
HD 4000/B 500 w/OLS	29516325	29529475	6610014067	6610015591
HD 4000/B 500 w/o OLS	29516326	29529476	6610014084	6610015700

2. TransID 2

TransID 2 is only used with WTEC III controls and is covered in TS2973EN Troubleshooting Manual.

GENERAL DESCRIPTION

C. Compatibility Between TransID Level And ECU Calibration Level

Table 1–2 shows the compatibility of the different ECU software levels with the different TransID level transmissions.

Table 1–2. Software Level And TransID Compatibility

	CIN Compatibility Number	Software Level	Compatible with TransID Level	ECU Production Dates
WTEC II	07	V6E	pre-TransID and TID 1	until 9/94
	08	V7 and V7A	pre-TransID and TID 1	9/94 until 12/97
WTEC III	0A	V8	TID 1	2/97 until 9/97
	0B	V8A	TID 1 and TID 2 (and beyond)	beginning 10/97

The manufacture and sale of both WTEC II and WTEC III ECUs during most of 1997 required a means of using a common transmission with either a WTEC II or a WTEC III ECU. A TID 1 transmission is the common transmission configuration for both control systems and production began in September, 1996 (see Table 1–2). A TransID level 1 transmission is compatible with V6E, V7, V7A, V8, and V8A ECUs.

TransID level 2 transmissions were produced beginning in late December, 1997 and all were for WTEC III units. A TransID 2 transmission is compatible with only V8A ECUs.

Pre-TransID transmissions are only compatible with V6E, V7, and V7A ECUs. Pre-TransID transmissions were produced before the first S/N break in Table 1–1.

SECTION 2 — DEFINITIONS AND ABBREVIATIONS

2–1. DO NOT SHIFT LIGHT

If the ECU detects a serious transmission fault, the **DO NOT SHIFT** light (usually located on the vehicle instrument panel) illuminates, the shift selector sounds short beeps for eight seconds, and the SELECT digit on the shift selector display becomes blank. Transmission shifting is restricted while the **DO NOT SHIFT** light is illuminated. The ECU will not respond to shift selector requests including direction changes and shifts to or from Neutral.

If the shift selector lever is moved while **DO NOT SHIFT** is illuminated, a continuous alarm will sound until the lever is moved back to the position where **DO NOT SHIFT** was first indicated. Normal shift selector operation is restored when the conditions causing the **DO NOT SHIFT** alarm are corrected.

The ECU will log a diagnostic code when the **DO NOT SHIFT** light is illuminated. Use the shift selector display or the Pro-Link® 9000 Diagnostic Tool to display the diagnostic code. Codes related to the **DO NOT SHIFT** light are detailed in the code chart (refer to Section 6).

2–2. DIAGNOSTIC DATA READER *(Figure 2–1)*

The current Diagnostic Data Reader (DDR) is the Pro-Link® 9000 (J 38538-D) diagnostic tool which is available through Kent-Moore Heavy-Duty Division. A portable microcomputer-based receiver/transmitter/display unit, the Pro-Link® transmits and receives data to and from the ECU, processes the data, and displays appropriate information. Use the Pro-Link® during installation checkout and troubleshooting. There is a new Pro-Link® cartridge needed for use with WTEC III controls. The new Multi-Protocol Cartridge (MPC) contains a programmed PCMCIA card which allows for reprogramming of GPI/GPO packages. Reprogramming includes selection of a GPI/GPO package, enabling/disabling of wires, and modification of certain data parameters. Operating instructions are supplied with each Pro-Link® and further information is also included in Appendix N of this manual. Connect the Pro-Link® 9000 to the diagnostic connector provided in the selector wiring harness.

NOTE: The new MPC is usable with WTEC II controls but the old WTEC II reprogramming cartridge will not display the WTEC III new information. The new MPC must be used to reprogram WTEC III systems.

Tool part numbers for the Pro-Link® are as follows:

Diagnostic Kit J 38538D + J 38500-313 (PROM Update) = J 38538E
Diagnostic Cartridge J 38500-302 + J 38500-313 = J 38500-303
MPC J 38500-1500C
PCMCIA (Diagnostic And Reprogramming) J 38500-1700B
PCMCIA (Diagnostic Only) J 38500-1800A

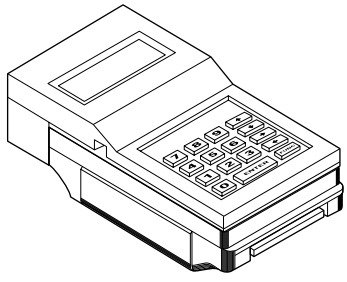


Figure 2–1. Pro-Link® 9000 Diagnostic Tool

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS

A/N	**A**ssembly **N**umber
Amp	Unit of electrical current.
C3PS	**C3 P**ressure **S**witch — Pressure switch to signal the presence or absence of pressure in the C3 clutch-apply circuit.
COP	**C**entral **O**perating **P**rocessor — Hardware protection which causes the ECU to reset if software gets lost.
CT	**C**losed **T**hrottle.
DDR	**D**iagnostic **D**ata **R**eader — Diagnostic tool; most current version is the Pro-Link® 9000 made by MicroProcessor Systems, Inc. Used to interrogate the ECU for diagnostic information and for reprogramming I/O packages in a calibration.
DNA	**D**oes **N**ot **A**dapt — Adaptive shift control is disabled.
DNS	**D**O **N**OT **S**HIFT — Refers to **DO NOT SHIFT** light and **DO NOT SHIFT** diagnostic response during which the transmission will not shift and will not respond to the Shift Selector.
DVOM	**D**igital **V**olt-**O**hm**m**eter.
ECU	**E**lectronic **C**ontrol **U**nit (also commonly referred to as the “computer”).
EEPROM	**E**lectronically **E**rasable **P**rogrammable **R**ead **O**nly **M**emory — This is the microchip that contains the transmission shift calibration information. The EEPROM is soldered into the ECU and is not removable.
IF	**I**nput **F**unction — Input signal to the ECU to request a special operating mode or condition.
LED	**L**ight-**E**mitting **D**iode — Electronic device used for illumination.
MPC	**M**ulti-**P**rotocol **C**artridge — Added to Pro-Link 9000® to do reprogramming.
NNC	**N**eutral **N**o **C**lutches — Neutral commanded with no clutches applied.
NVL	**N**eutral **V**ery **L**ow — The ECU has sensed turbine speed below 350 rpm. This is usually caused by a dragging C1 or C3 clutch or a failed turbine speed sensor. When attained, the C4 and C5 clutches are applied to lock the transmission output.
OEM	**O**riginal **E**quipment **M**anufacturer — Maker of vehicle or equipment.
Ohm	Unit of electrical resistance.
OF	**O**utput **F**unction — Output signal from the ECU to control vehicle components (such as PTOs, backup lights, etc.) or allow a special operating mode or condition.

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS *(cont'd)*

OL	**O**ver **L**imit or **O**il **L**evel — For **O**ver **L**imit see "∞." Indicates **O**il **L**evel is being displayed on a shift selector.
OLS	**O**il **L**evel **S**ensor — Electronic device (optional) on control module for indicating transmission fluid level.
PCCS	**P**ROM **C**alibration **C**onfigurator **S**ystem.
PCMCIA	**P**ersonal **C**omputer **M**emory **C**ard **I**nternational **A**ssociation — Memory device for use with Pro-Link®. Contains Allison Transmission programming and diagnostics.
PROM	**P**rogrammable **R**ead **O**nly **M**emory.
PTO	**P**ower **T**ake**o**ff.
PWM Solenoid	**P**ulse **W**idth **M**odulated **Solenoid** — Solenoids are controlled by pulse width modulation. Solenoid control of clutch pressures is based on the solenoid's duty cycle. Duty cycle is determined by the ratio of solenoid's on-time to off-time.
RMR	**R**etarder **M**odulation **R**equest.
RPR	**R**eturn to **P**revious **R**ange — Diagnostic response in which the transmission is commanded to return to previously commanded range.
RSI	**R**emote **S**erial **I**nterface — Communications lines between remote shift selector and the ECU.
SCI	**S**erial **C**ommunication **I**nterface — Used to transmit data and messages between the diagnostic tool and the ECU and other systems such as electronically-controlled engines.
SOL OFF	All **SOL**enoids **OFF**.
SPI	**S**erial **P**eripheral **I**nterface — Connection between ECU and integral shift selector.
TID	**T**rans**ID** — A feature which allows the ECU to know the transmission configuration and provide the corresponding calibration required.
TPS	**T**hrottle **P**osition **S**ensor — Potentiometer for signaling the position of the engine fuel control lever.
V	**V**ersion — Abbreviation used in describing ECU software level.
VDC	**V**olts **D**irect **C**urrent (DC).
VIM	**V**ehicle **I**nterface **M**odule — A watertight box containing relays and fuses — interfaces the transmission electronic control system with components on the vehicle.
VIW	**V**ehicle **I**nterface **W**iring — Interfaces ECU programmed input and output functions with the vehicle wiring. Also contains the Serial Communications Interface.

DEFINITIONS AND ABBREVIATIONS

2–3. ABBREVIATIONS *(cont'd)*

Volt	Unit of electrical force.
VOM	**V**olt-**O**hm**m**eter.
WOT	**W**ide **O**pen **T**hrottle.
WT	**W**orld **T**ransmission.
∞	Infinity — Condition of a circuit with higher resistance than can be measured, effectively an open circuit.

SECTION 3 — BASIC KNOWLEDGE

3–1. BASIC KNOWLEDGE REQUIRED

To service WT Series Electronic Controls, the technician must understand basic electrical concepts. Technicians need to know how to use a Volt-Ohmmeter to make resistance and continuity checks. Most troubleshooting checks consist of checking resistance, continuity, and checking for shorts between wires and to ground. The technician should be able to use jumper wires and breakout harnesses and connectors. Technicians unsure of making the required checks should ask questions of experienced personnel or find instruction.

The technician should also have the mechanical aptitude required to connect pressure gauges or transducers to identified pressure ports used in the troubleshooting process. Pressure tap locations and pressure values are shown in Appendix B — Checking Clutch Pressures.

Input power, ground, neutral start circuitry, etc., can cause problems with electronic controls or vehicle functioning and may not generate a diagnostic code. A working knowledge of WT Series Electronic Controls vehicle installation is necessary in troubleshooting installation-related problems.

Refer to Section 8 for information concerning performance complaints (non-code) troubleshooting. A complete wiring schematic is shown in Appendix J. Refer to the MD, HD, B 300, and B 500 Series Sales Tech Data Book for information concerning electronic controls installation and the Installation Checklist. Reliable transmission operation and performance depend upon a correctly installed transmission. Review the Installation Checklist to ensure proper installation.

NOTE: Allison Transmission is providing for service of WTEC II wiring harnesses and wiring harness components as follows: (See Service Information Letter 1-WT-97 for further information.)

- Repair parts for the internal wiring harness and for wiring harness components attached to the shift selector will be available through the Allison Transmission Parts Distribution Center (PDC). Use the P/N from your appropriate parts catalog or from Appendix E in this manual. Allison Transmission is responsible for warranty on these parts.
- Since January, 1998, all WTEC II external harnesses and external harness components must be obtained from St. Clair Technologies Inc. (SCTI). SCTI provides parts to any Allison customer or OEM and is responsible for warranty on these parts. SCTI recognizes ATD, manufacturers, and SCTI part numbers. SCTI provides a technical HELPLINE at 519-627-1673 (Wallaceburg). SCTI has parts catalogs available. The SCTI addresses and phone numbers for parts outlets are:

St. Clair Technologies, Inc.
1050 Old Glass Road
Wallaceburg, Ontario, Canada, N8A 3T2
Phone: (519) 627-1673
Fax: (519) 627-4227

St. Clair Technologies, Inc.
1111 Mikesell Street
Charlotte, Michigan 48813
Phone: (517) 541-8166
Fax: (517) 541-8167

St. Clair Technologies, Inc.
c/o Mequilas Tetakawi
Carr. Internationale KM 1969
Guadalajara – Nogales, KM2
Empalme, Sonora, Mexico
Phone: 011-52-622-34661
Fax: 011-52-622-34662

3–2. USING THE TROUBLESHOOTING MANUAL

Use this manual as an aid to troubleshooting the WT Series Electronic Controls. Every possible problem and its solution cannot be encompassed by any manual. However, this manual does provide a starting point from which most problems can be resolved.

Once a solution to a problem is discovered in the manual do not look further for other solutions. It is necessary to determine *why* a problem occurred. For example, taping a wire that has been rubbing on a frame rail will not correct the problem unless the rubbing contact is eliminated.

BASIC KNOWLEDGE

3–3. SYSTEM OVERVIEW

WT Series Electronic Control functions are controlled by the ECU. The ECU reads shift selector range selection, output speed, and throttle position to determine when to command a shift. When a shift occurs, the ECU monitors turbine speed, output speed, and throttle position to control the oncoming and off-going clutches during the shift.

When the ECU detects an electrical fault, it logs a diagnostic code indicating the faulty circuit and alters the operation of the transmission to prevent or reduce damage.

When the ECU detects a non-electrical problem while trying to make a shift, the ECU may try that shift a second or third time before setting a diagnostic code. Once that shift has been retried, and a fault is still detected, the ECU sets a diagnostic code and holds the transmission in a fail-to-range mode of operation.

3–4. IMPORTANT INFORMATION IN THE TROUBLESHOOTING PROCESS

Before beginning the troubleshooting process, read and understand the following:

- Shut off the engine and ignition before any harness connectors are disconnected or connected.
- Remember to do the following when checking for shorts and opens:
  - — Minimize movement of wiring harnesses when looking for shorts. Shorts involve wire-to-wire or wire-to-ground contacts and moving the harnesses may eliminate the problem.
  - — Wiggle connectors, harnesses, and splices when looking for opens. This simulates vehicle movements which occur during actual operation.
- When disconnecting a harness connector, be sure that pulling force is applied to the connector itself and **not the wires** extending from the connector.
- *When conducting circuit checks that include the external harness, add 1 Ohm to the values shown.*
- Inspect all connector terminals for damage. Terminals may have bent or lost the necessary tension to maintain firm contact.
- Clean dirty terminals or connectors with isopropyl alcohol and a cotton swab, or a good quality, non-residue, non-lubricating, cleaning solvent such as LPS Electro Contact Cleaner® or LPS NoFlash Electro Contact Cleaner®.

CAUTION:	The cleaning solvent must not be chlorine based, contain petroleum distillates, or conduct electricity. The cleaning solvent should evaporate quickly to prevent the possibility of condensation within the connectors. Always blow or shake any excess cleaner from the connector before assembling it to its mating connector or hardware. Cleaner trapped in the connector can affect the connector seal. (Refer to SIL 17-TR-94 for detailed information on the recommended cleaners.)

CAUTION:	Care should be taken when welding on a vehicle equipped with electronic controls. Refer to Appendix G, Paragraph 1–1.

- Diagnostic codes displayed after system power is turned on with a harness connector disconnected can be ignored and cleared from memory. Refer to Section 6, Diagnostic Codes, for the code clearing procedure.

BASIC KNOWLEDGE

3–5. BEGINNING THE TROUBLESHOOTING PROCESS

NOTE: Whenever a transmission is overhauled, exchanged, or has undergone internal repairs, the Electronic Control Unit (ECU) must be "RESET TO UNADAPTED SHIFTS." See Service Information Letter 16-WT-96, Revision A for further details.

1. Begin troubleshooting by checking the transmission fluid level and ECU input voltage. Remember that some problems may be temperature related. Do troubleshooting at the temperature level where the problem occurs. Check diagnostic codes by:

   - Using the shift selector display.
   - Using the Pro-Link® 9000 diagnostic tool.

2. When a problem exists but a diagnostic code is not indicated, refer to the Performance Complaint Section for a listing of various electrical and hydraulic problems, their causes, and remedies.

3. If a diagnostic code is found in the ECU memory, record all available code information and clear the active indicator (refer to Section 6).

4. Test drive the vehicle to confirm a diagnostic code or performance complaint.

   - If the code reappears, refer to the Diagnostic Code section (Section 6) and the appropriate code chart. The Diagnostic Code section lists diagnostic codes and their description. Locate the appropriate troubleshooting chart and follow the instructions.
   - If the code does not reappear, it may be an intermittent problem. Use the Pro-Link® and the code display procedure described in Section 6. The code display procedure will indicate the number of times the diagnostic code has occurred. Refer to the troubleshooting chart for possible cause(s) of the problem.
   - Appendix A deals with the identification of potential circuit problems. Refer to Appendix A if a circuit problem is suspected.

NOTE: Information concerning specific items is contained in the appendices located in the back of this manual. The appendices are referred to throughout the manual.

BASIC KNOWLEDGE

NOTES

SECTION 4 — WIRE CHECK PROCEDURES

4–1. CHECKING OPENS, SHORTS BETWEEN WIRES, AND SHORTS-TO-GROUND

(Use Digital Volt-Ohmmeter J 34520-A and Jumper Wire Set J 39197).

NOTE: Please refer to Section 3–5 to begin the troubleshooting process.

1. Make sure all connectors are tightly connected and recheck the circuit.
2. Disconnect and inspect all connectors.
3. Thoroughly clean corroded or dirty terminals. If dirty or corroded terminals are the probable cause of the problems, reconnect the clean connectors and operate the vehicle normally. If the problem recurs, proceed with Step 4.

CAUTION:	The cleaning solvent must not be chlorine based, contain petroleum distillates, or conduct electricity. The cleaning solvent should evaporate quickly to prevent the possibility of condensation within the connectors. Always blow or shake any excess cleaner from the connector before assembling it to its mating connector or hardware. Cleaner trapped in the connector can affect the connector seal. (Refer to SIL 17-TR-94 for detailed information on the recommended cleaners.)

4. If all connectors are clean and connected correctly, determine which wires in the chassis harness are indicated by the diagnostic code. For example, Code 41 12, indicates an open or short-to-ground in the solenoid A circuit — wires 102 and 120.

   a. Check continuity of wires 102 and 120 by performing the following (refer to Figure 4–1):

      (1) Disconnect both connectors at the ECU and disconnect the harness from the transmission main connector. At one end of the harness, using jumper wire kit J 39197, connect wire 102 and 120 to each other, being careful not to distort the terminals. Jumping the wires together creates a circuit between wires 102 and 120.

      (2) On the opposite end of the harness, check the continuity of the jumpered pair. No continuity in a jumpered pair circuit (infinite resistance reading) indicates an open in the wire being tested. Locate and repair the damaged portion of the wire.

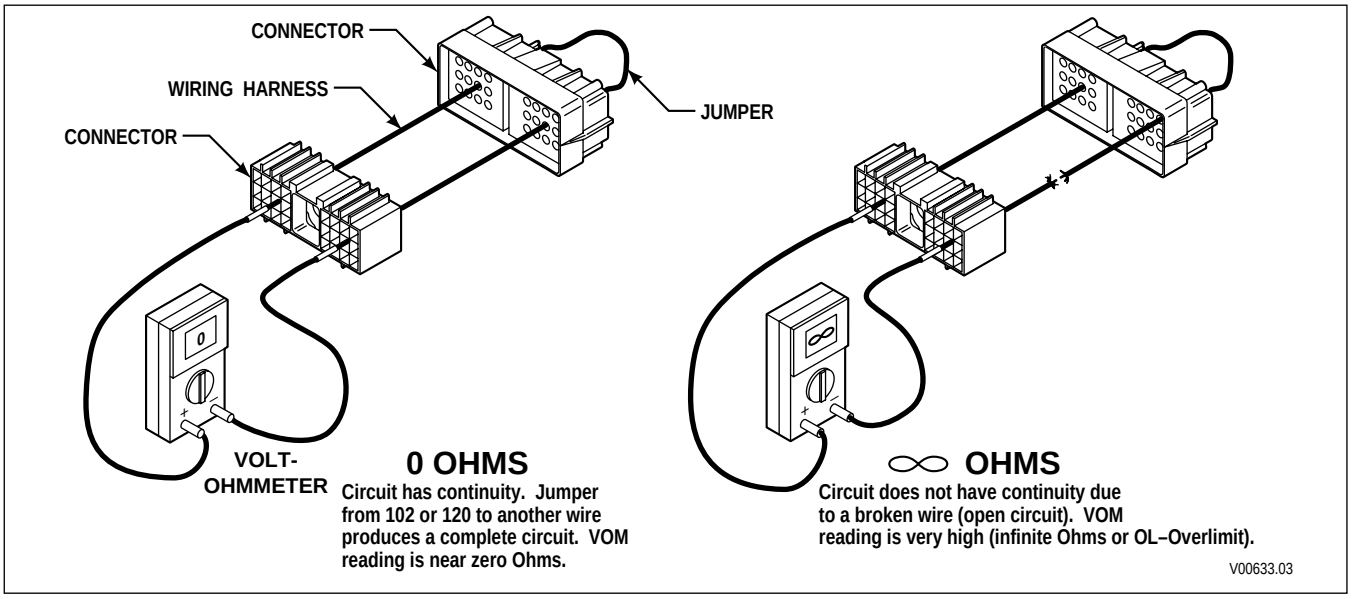


Figure 4–1. Open Circuit

WIRE CHECK PROCEDURES

b. If the continuity check is good (0–2 Ohms resistance), remove the jumpers. Check the harness for shorts between wires and shorts-to-ground by performing the following (refer to Figure 4–2):

(1) At the ECU end of the harness, touch one VOM probe to one wire of the circuit being tested and touch the other probe to each terminal (in both connectors), then touch the probe to chassis ground and to the transmission main housing. Do this for both wires in the circuit being tested.

(2) If at any time the VOM shows zero to low resistance, or the meter's continuity beeper sounds, there is a short between the two points being probed — wire-to-wire or wire-to-ground. Isolate and repair the short.

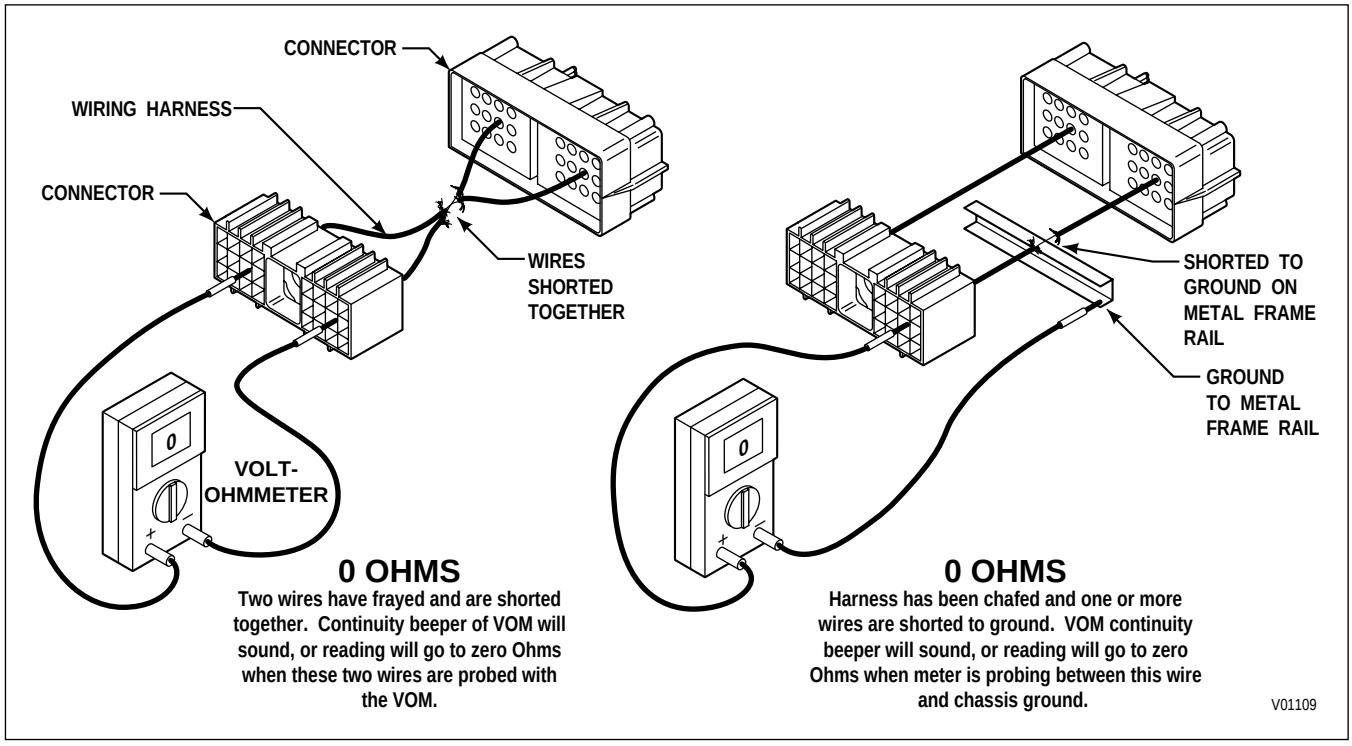


Figure 4–2. Short Between Wires And To Ground

4–2. CHECKING AT TRANSMISSION CONNECTOR AND THE INTERNAL HARNESS FOR OPENS, SHORTS BETWEEN WIRES, AND SHORTS-TO-GROUND

1. Disconnect the external wiring harness from the transmission.

   a. For MD, B 300, and B 400 transmissions prior to S/N 6510015259, refer to SIL 11-WT-94, Rev. A.

   b. Water and white film contamination have been found in the main transmission connector (external) in these transmissions. This condition has usually caused the setting of diagnostic codes 25 11 or 22 16.

   c. If water is found at the main transmission connector, properly torque the retaining bolt to 2.0–2.8 N·m (18–25 lb in.) following the prescribed cleaning of the connector terminals.

2. Inspect the connectors. Any terminals which are corroded or dirty must be thoroughly cleaned.

WIRE CHECK PROCEDURES

3. If all connectors are clean and connected correctly, and the unit being serviced is an MD, B 300, or B 400 transmission prior to S/N 6510015259, refer to SIL 11-WT-94, Rev. A.

CAUTION:	The cleaning solvent must not be chlorine based, contain petroleum distillates, or conduct electricity. The cleaning solvent should evaporate quickly to prevent the possibility of condensation within the connectors. Always blow or shake any excess cleaner from the connector before assembling it to its mating connector or hardware. Cleaner trapped in the connector can affect the connector seal. (Refer to SIL 17-TR-94 for detailed information on the recommended cleaners.)

a. If diagnostic code 25 11 or 22 16 is still being set and no water was found in the main transmission connector (external), the problem may be a white film contamination found inside the transmission.

b. Remove the control module. Inspect for white film contamination. (Refer to appropriate transmission Service Manual for proper procedure.)

c. If white film contamination is present, clean the interior of the transmission using mineral spirits.

d. Replace the feedthrough connector and internal harness with wire seals (Figure 4–3).

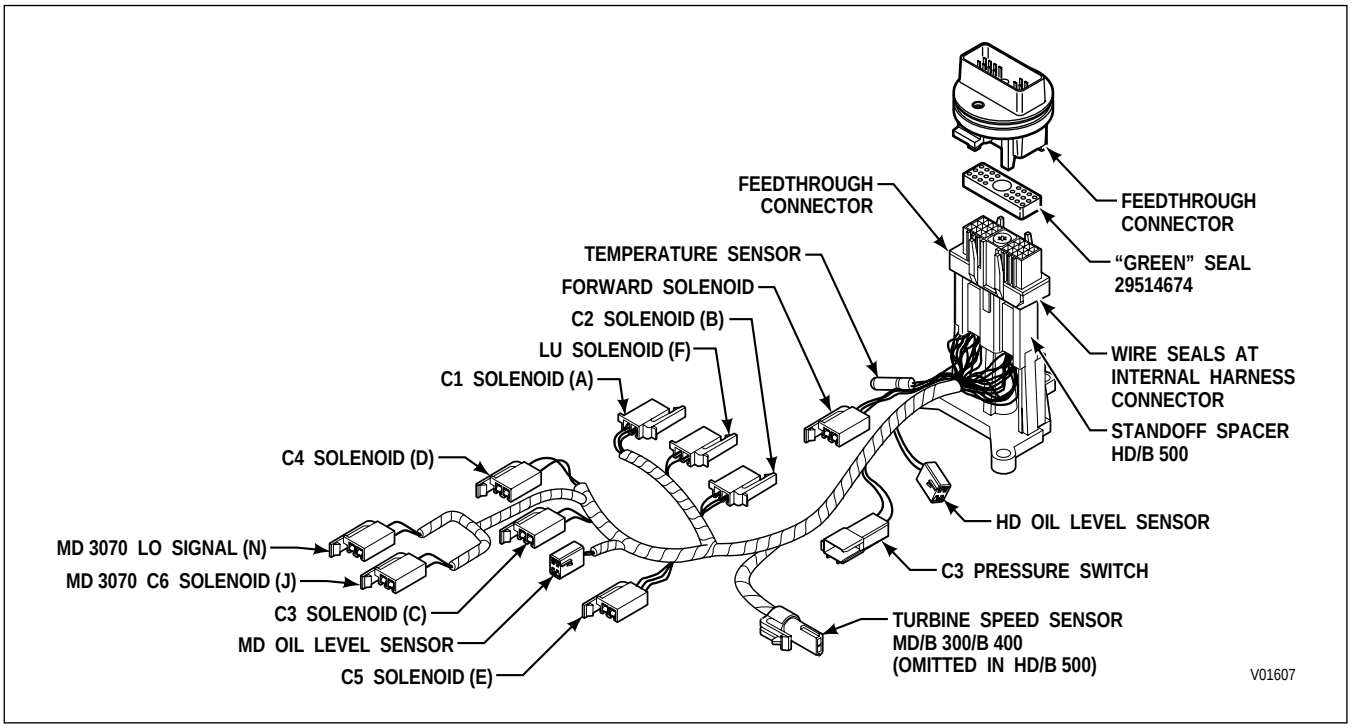


Figure 4–3. Feedthrough Connector, "Green Seal," And Internal Harness

WIRE CHECK PROCEDURES

4. If the transmission being tested is an MD 3000, B 300, or B 400 after S/N 6510015259 or is an HD 4000 or B 500, and if the connectors are clean and connected correctly, determine which wires in the harness to test. Use the diagnostic code system schematic to locate the wire terminals. For this example, Code 41 12, indicates an open or short-to-ground in solenoid "A" circuit — wires 102 and 120 (refer to Figure 4–4).

   a. At the transmission connector, check the resistance of the A solenoid circuit. Resistance of a solenoid circuit should be 2.4–5.0 Ohms — covering a temperature range of –18°C to 149°C (0°F to 300°F). Refer to Solenoid Resistance vs. Temperature chart in Appendix K. No continuity in the circuit (infinite resistance) indicates an open in the internal harness, the feedthrough connector, or the solenoid coil. Locate and repair the open in the internal harness or replace the internal harness, replace the feedthrough connector, or replace the solenoid.

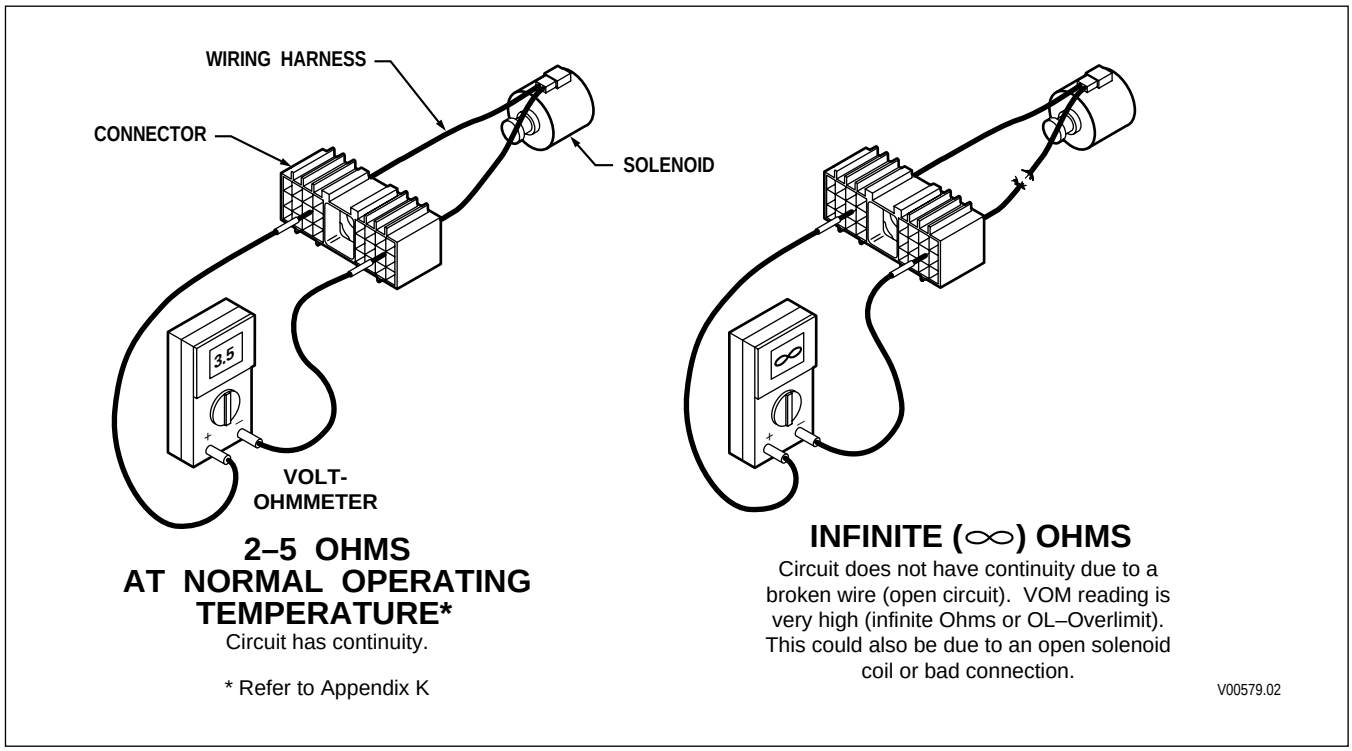


Figure 4–4. Checking Continuity

   b. If the resistance check is good, check the harness for shorts between wires and to ground by performing the following (refer to Figure 4–5):

      (1) At the transmission connector, touch one probe of the VOM to one wire of the circuit being tested and touch the other probe to each terminal in the connector and to chassis ground and to the transmission main housing. Do this for both wires in the circuit being tested.

      (2) If the VOM shows zero to low resistance, or the continuity beeper sounds, there is a short between the two points being probed, wire-to-wire or wire-to-ground. An indication of a short may be caused by a splice to the wire being checked. Check the wiring diagram in Appendix J for splice locations. If the short is not a splice, then isolate and repair the short.

WIRE CHECK PROCEDURES

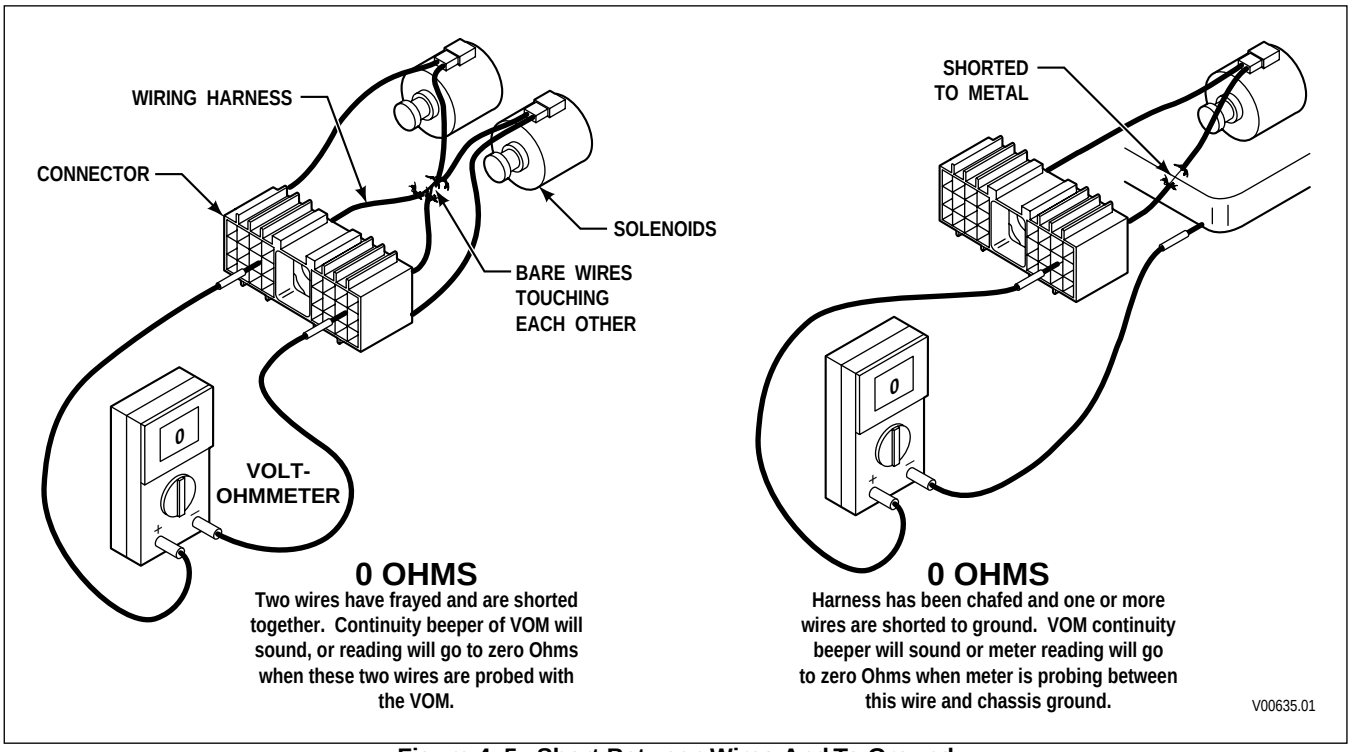


Figure 4–5. Short Between Wires And To Ground

NOTE: ***When conducting circuit checks that include the external harness, add one (1) Ohm to the values shown. Speed sensor resistance is 270–330 Ohms. C3 pressure switch resistance is two (2) Ohms maximum when switch is closed and 20,000 Ohms minimum when switch is open.***

WIRE CHECK PROCEDURES

NOTES

SECTION 5 — OIL LEVEL SENSOR

The Oil Level Sensor (Figure 5–1) provides a means of electronically checking the transmission fluid level from the shift selector display, the Pro-Link® 9000 diagnostic tool, or a custom-furnished remove display.

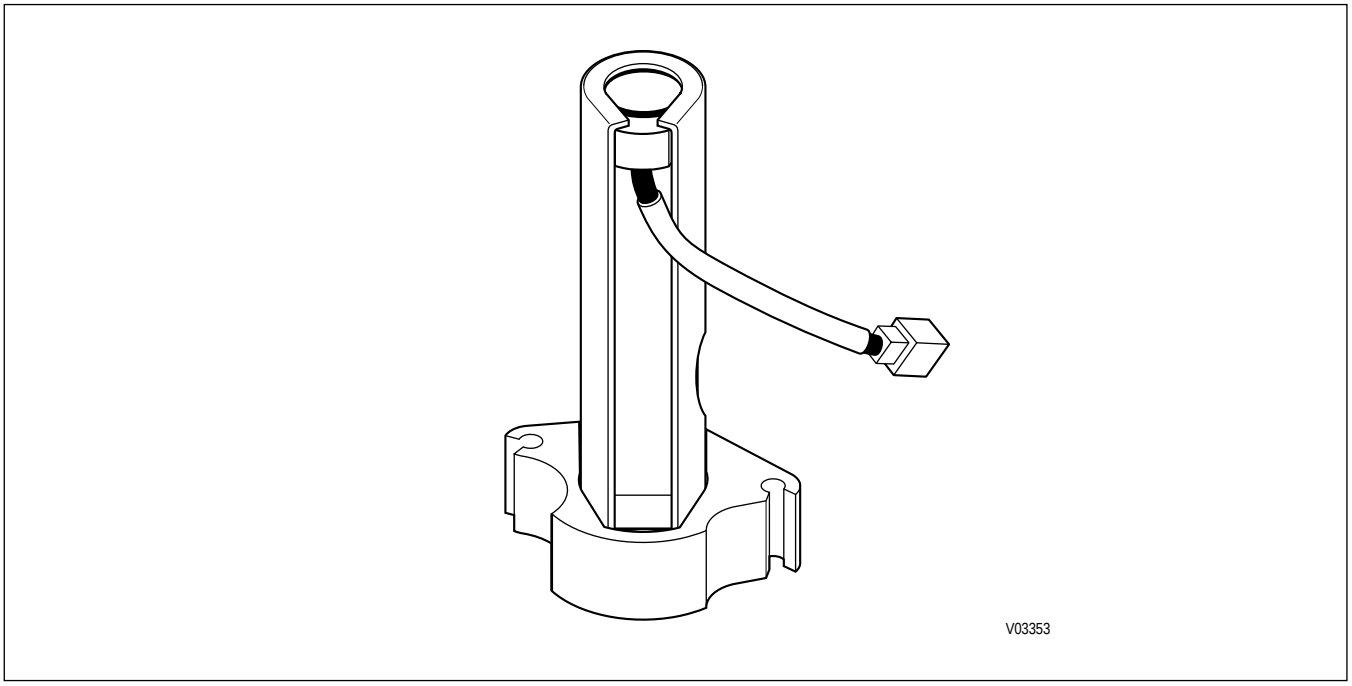


Figure 5–1. Oil Level Sensor

5–1. ELECTRONIC FLUID LEVEL CHECK (SHIFT SELECTOR)

NOTE: ***The Pushbutton and Lever shift selectors can display two characters at one time. One character is displayed under the SELECT label and one under the MONITOR label. The strip pushbutton shift selector uses illuminated pushbuttons and tones to convey fluid level information.***

A. Fluid Level Check Procedure

1. Park the vehicle on a level surface and shift to **N** (Neutral). Apply the parking brake.
2. On the Pushbutton shift selector, simultaneously press the ⇑ (Up) and ⇓ (Down) arrow buttons once.
3. On the Lever shift selector, press the **DISPLAY MODE** button once.
4. For a strip pushbutton shift selector, go directly to Step 11.

NOTE: ***The ECU may delay the fluid level check until the following conditions are met:***

- ***The fluid temperature is above 60°C (140°F) or below 104°C (220°F).***
- ***The transmission is in neutral.***
- ***The vehicle has been stationary for approximately two minutes to allow the fluid to settle.***
- ***The engine is at idle (below 1000 rpm — not "fast" idle).***

A delayed fluid level display is signaled by sequentially illuminated segments of the digital display under the SELECT display and a countdown from 8 to 1 under the MONITOR display.

OIL LEVEL SENSOR

5. Correct fluid level is reported when **O L** is displayed (**O L** indicates the Oil Level Check Mode), followed by **O K**. The **O K** display indicates the fluid level is within the **O K** zone. The sensor display and the transmission dipstick may not agree exactly because the oil level sensor compensates for fluid temperature.

   Example: **O L, O K, O K** — Indicates correct fluid level

6. Low fluid level is reported when **O L** is displayed, followed by **L O** and a number. **L O** indicates a low fluid level and the number is the number of quarts of fluid the transmission requires.

   Example: **O L, L O, 0 2** — Indicates 2 additional quarts of fluid will bring the fluid level within the middle of the **O K** zone.

7. High fluid level is reported when **O L** is displayed, followed by **H I**. **H I** indicates high fluid level and the number of quarts the transmission is overfilled.

   Example: **O L, H I, 0 1** — Indicates 1 quart of fluid past the full level.

CAUTION:	A low or high fluid level causes overheating and irregular shift patterns. An incorrect fluid level can damage the transmission.

8. An Invalid for Display condition is reported when **O L** is displayed, followed by "– –" and a number display. The displayed number is a fault code, and indicates improper conditions or a system malfunction.

   Example: **O L,** – – , **70** — Indicates an Invalid for Display condition and fault code 70.

9. Invalid for Display is activated when conditions do not allow the fluid level to be checked electronically. Review the following codes and conditions, and correct as necessary. If these conditions cannot be corrected, contact the nearest distributor or dealer in your area (check the telephone directory for the Allison Transmission service outlet nearest you).

10. To exit the oil level display mode:

    - Pushbutton shift selector — press the **R** (Reverse), **N** (Neutral), or **D** (Drive) pushbutton.
    - Lever shift selector — press the **DISPLAY MODE** button two times or move the lever.

11. The strip pushbutton selector indicates fluid level as follows:

    a. Initiate display of oil level information using separate switch provided by the vehicle manufacturer.

    b. Correct Fluid Level — Indicated by a flashing red LED on the **N** (Neutral) pushbutton. When this occurs, the fluid is within the "**O K**" zone.

OIL LEVEL SENSOR

c. Low Fluid Level — Indicated by a flashing red LED on the **R** (Reverse) pushbutton and a tone. The number of times the tone sounds indicates the number of quarts of transmission fluid which need to be added to produce an "**O K**" level. The **N** (Neutral) pushbutton red LED will remain on during this display.

d. High Fluid Level — Indicated by a flashing red LED on the **D** (Drive) pushbutton and a tone. The number of times the tone sounds indicates the number of quarts of transmission fluid which need to be drained to produce an "**O K**" level. The **N** (Neutral) pushbutton red LED will remain on during this check.

e. Invalid for Display — Indicated by flashing red LED in a repeated sequence from **R** (Reverse) down through the lowest **D** (Drive) range while the **N** (Neutral) red LED remains constantly illuminated. A constant tone will sound until the fluid level mode is exited. (Reasons for Invalid for Display are the same as those shown in Table 5–1 under Cause of Code.)

f. To exit the fluid level display mode, press any pushbutton or deactivate the separate switch provided by the vehicle manufacturer that was used to enter the fluid level display mode in Step a.

Table 5–1. Invalid for Display Codes

CODE		CAUSE OF CODE
0X*	—	Settling time too short
50	—	Engine speed (rpm) too low
59	—	Engine speed (rpm) too high
65	—	Neutral (N) must be selected
70	—	Sump fluid temperature too low
79	—	Sump fluid temperature too high
89	—	Output shaft rotation
95	—	Sensor failure**

* The zero represents "chasing segments" in the SELECT display and the X is a number between 8 and 1 which appears in the MONITOR display during the countdown period.

** Report sensor failure to a distributor or dealer in your area (check the telephone directory for an Allison Transmission distributor or dealer nearest you).

OIL LEVEL SENSOR

5–2. ELECTRONIC FLUID LEVEL CHECK (PRO-LINK® 9000)

The Pro-Link® 9000 can also be used to electronically check the transmission fluid level. Further detail is also provided in Appendix N of this manual.

CAUTION:	A low or high fluid level causes overheating and irregular shift patterns and, if not corrected, can damage the transmission.

A. Fluid Level Check Procedure

1. Connect the DDR to the DDR connector.
2. Scroll (down) the Diagnostic Data List to “OIL LVL” display.
3. Read the fluid level, repeat the check to confirm the first reading.

NOTE: The ECU may delay the fluid level check until the following conditions are met:

- ***The fluid temperature is above 60°C (140°F) or below 104°C (220°F).***
- ***The transmission is in neutral.***
- ***The vehicle has been stationary for approximately two minutes to allow the fluid to settle.***
- ***The engine is at idle (below 1000 rpm — not “fast” idle).***

The reason for a delayed fluid level check is indicated on the DDR by one of the following diagnostic messages as shown in Table 5–2:

Table 5–2.

DDR MESSAGE		
O L	—	SETTLING TIME (8 down to 1)
O L	—	ENGINE SPEED LO
O L	—	ENGINE SPEED HI
O L	—	SELECT **N** (NEUTRAL)
O L	—	SUMP TEMP LO
O L	—	SUMP TEMP HI
O L	—	OUTPUT SPEED HI
O L	—	CHECK CODES

SECTION 6 — DIAGNOSTIC CODES

6–1. DIAGNOSTIC CODE MEMORY

Diagnostic codes are logged in a list in memory (sometimes referred to as the queue), listing the most recently occurring code first and logging up to five codes. The codes contained in the list have information recorded as shown in the chart below (codes are examples). Access to the code list position, main code, subcode and active indicator is through either the shift selector display or the Pro-Link® 9000 diagnostic tool. Access to ignition cycle counter and event counter information is through the diagnostic tool only. Further detail on the use of Pro-Link® 9000 is presented in Appendix N of this manual.

Table 6–1. Code List

Code List Position	Main Code	Subcode	Active Indicator	Ignition Cycle Counter	Event Counter
d1	21	12	YES	00	10
d2	41	12	YES	00	04
d3	23	12	NO	08	02
d4	34	12	NO	13	01
d5	56	11	NO	22	02
Displayed on shift selector and diagnostic tool d = “diagnostic”			YES = **MODE ON** displayed	Not available on shift selector display	

The following paragraphs define the different parts of the code list.

A. Code List Position. The position which a code occupies in the code list. Positions are displayed as “d1” through “d5” (Code List Position #1 through Code List Position #5).

B. Main Code. The general condition or area of fault detected by the ECU.

C. Subcode. The specific area or condition related to the main code in which a fault is detected.

D. Active Indicator. Indicates when a diagnostic code is active. The shift selector displays **MODE ON**, the diagnostic tool displays **YES**.

E. Ignition Cycle Counter. Determines when inactive diagnostic codes are automatically cleared from the code list. The counter is incremented each time a normal ECU powerdown occurs (ignition turned off). Inactive codes are cleared from the code list after the counter exceeds 25.

F. Event Counter. Counts the number of occurrences of a diagnostic code. If a code is already in the code list and the code is again detected, that code is moved to position d1, the active indicator is turned on, the Ignition Cycle Counter is cleared, and 1 is added to the Event Counter.

6–2. CODE READING AND CODE CLEARING

Diagnostic codes can be read and cleared by two methods: by using the Pro-Link® 9000 diagnostic tool or by using the shift selector display. The use of the Pro-Link® 9000 diagnostic tool is described in the instruction manual furnished with each tool. The method of reading and clearing codes described in this section refers to only entering the Diagnostic Display Mode by the proper button and/or lever movements on the shift selector.

The Diagnostic Display Mode may be entered for viewing of codes at any speed. Codes can only be cleared when the output speed = 0 and no output speed sensor failure is active.

A. Reading Codes. Enter the diagnostic display mode by pressing the ⇑ (Up) and ⇓ (Down) arrow buttons at the same time on a pushbutton selector, or by momentarily pressing the **DISPLAY MODE** button on a lever shift selector.

DIAGNOSTIC CODES

NOTE: ***If a DO NOT SHIFT condition is present at this time, the shift lever should remain in the same position where it was when the DO NOT SHIFT was detected. If the lever is moved, a continuous tone will be heard until the lever is returned to the correct position.***

NOTE: ***If an oil level sensor is present, then fluid level will be displayed first. Diagnostic code display is achieved by depressing the ⇑ (Up) and ⇓ (Down) arrow buttons or the DISPLAY MODE button a second time.***

The code list position is the first item displayed, followed by the main code and the Subcode. Each item is displayed for two seconds. The two second item display cycles continuously until the next code list position is accessed. The following list represents the display cycle using Code 25 11 as an example:

1. Code list position — **d1**
2. Main code — **25**
3. Subcode —**11**
4. Cycle repeats — **d1**

To view the second, third, fourth, and fifth positions (d2, d3, d4, and d5), momentarily press the **MODE** button as explained above.

Momentarily press the **MODE** button after the fifth position is displayed to restart the sequence of code list positions.

An active code is indicated by the **MODE ON** indicator (active indicator) illuminating when a code position is displayed. In the normal operating mode, the **MODE ON** display indicates secondary mode operation.

Any code position which does not have a diagnostic code logged will display "– –" for both the main and Subcodes. No diagnostic codes are logged after an empty code position.

B. Clearing Active Indicators. A diagnostic code's active indicator can be cleared, which allows the code to be removed from the code list.

The active indicator clearing methods are:

1. Power down — All active indicators, except Code 69 34 (refer to the code chart), are cleared at ECU power down.
2. Self-clearing — Some codes will clear their active indicator when the condition causing the code is no longer detected by the ECU.
3. Manual — Some active indicators can be cleared manually, while in the diagnostic display mode, after the condition causing the code is corrected.

CAUTION:	If an active indicator is cleared while the transmission is locked in a forward range or reverse (fail-to-range), the transmission will remain in the forward range or reverse after the clearing procedure is completed. Neutral must be manually selected.

C. Manually Clearing Codes and Active Indicators from the Code List. To clear active indicators or all codes:

1. Enter the Diagnostic Display Mode.
2. Press and hold the **MODE** button, approximately three seconds, until a tone sounds once. All active indicators are cleared. To remove all codes, press and hold the **MODE** button for ten seconds until the shift selector tone sounds twice. All codes will be cleared at ECU power down.

DIAGNOSTIC CODES

D. Exiting the Diagnostic Display Mode. Exit the diagnostic display mode using one of the following procedures:

1. On a pushbutton shift selector, press the ⇑ (Up) and ⇓ (Down) arrow buttons at the same time or press any range button, **D**, **N**, or **R**. The shift (**D**, **N**, or **R**) is commanded if not inhibited by an active code.
2. On a lever shift selector, momentarily press the **DISPLAY MODE** button or move the shift lever to any shift position other than the one it was in when the diagnostic display mode was activated. If the shift is inhibited, the ECU will continue to command the current range and sound the tone continuously until the lever is returned to its original position.
3. Wait until timeout (approximately 10 minutes) and the system will automatically return to the normal operating mode.
4. Turn off power to the ECU (turn off the vehicle engine at the ignition switch).

6–3. DIAGNOSTIC CODE RESPONSE

The following ECU responses to a fault provide for safe transmission operation:

- **D**o **N**ot **S**hift (DNS) Response
  - — Release lockup clutch and inhibit lockup operation.
  - — Inhibit all shifts.
  - — Turn on **Do Not Shift** light.
  - — Pulse the tone generator for 8 seconds when the fault is first detected.
  - — Blank the select digit in the display.
  - — Ignore any range selection inputs and disable the button feedback tone for the pushbutton shift selector. On the lever shift selector sound the tone continuously if the shift lever is moved to a position other than the one selected when the fault was first detected.
- **D**o **N**ot **A**dapt (DNA) Response
  - — The ECU stops adaptive shift control while the code is active. Do not adapt shifts when a code with the DNA response is active.
- **Sol**enoid **Off** (SOL OFF) Response
  - — All solenoids are commanded off (turning solenoids “A” and “B” off electrically causes them to be on hydraulically).
- **R**eturn to **P**revious **R**ange (RPR) Response
  - — When the speed sensor ratio or C3 pressure switch tests associated with a shift are not successful, the ECU commands the same range as commanded before the shift.
- **N**eutral **N**o **C**lutches (NNC) Response
  - — When certain speed sensor ratio or C3 pressure switch tests are not successful, the ECU commands a neutral condition with no clutches applied.

6–4. SHIFT SELECTOR DISPLAYS RELATED TO ACTIVE CODES

- “Cateyes” — The forward slash segments and the middle horizontal segments (-\-; -\-) will be on for each display digit under the following conditions:
  - — RSI link fault is active (Code 23 12 or 23 14)
  - — When two COP timeouts occur within two seconds of each other (reference Code 69 33) for a remote selector display
  - — An SPI communications fault is active (Code 69 32)

DIAGNOSTIC CODES

- All Segments Displayed — All display segments will be illuminated if a severity 1 diagnostic code is present during initialization or if an electrical code for solenoids A, B, C, D, E, or G is logged before initialization completes.
- All Segments Blank — When two COP timeouts occur within two seconds of each other (reference Code 69 33) for an integral selector display.

6–5. DIAGNOSTIC CODE LIST AND DESCRIPTION

Table 6–2. WT Series Diagnostic Codes

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
13	12	ECU input voltage, low	Yes	DNS, SOL OFF (Hydraulic default), DNA
	13	ECU input voltage, medium low	No	None, DNA
	23	ECU input voltage, high	Yes	DNS, SOL OFF (Hydraulic default)
14	12	Oil level sensor, failed low	No	None
	23	Oil level sensor, failed high (not used)	No	None
21	12	Throttle position sensor, failed low	No	Use full throttle default, DNA
	23	Throttle position sensor, failed high	No	Use full throttle default, DNA
22	14	Engine speed sensor reasonableness test	No	Use default engine speed, DNA
	15	Turbine speed sensor reasonableness test	Yes	DNS, Lock in current range, DNA
	16	Output speed sensor reasonableness test	Yes(1)	DNS, Lock in current range, DNA
23	12	Primary Shift Selector or RSI Link Fault	No	Hold in last valid direction. May cause “cateyes” display.
	13	Primary Shift Selector Mode Function Fault	No	Mode change not permitted
	14	Secondary Shift Selector or RSI Link Fault	No	Hold in last valid direction. May cause “cateyes” display.
	15	Secondary Shift Selector Mode Function Fault	No	Mode change not permitted
24	12	Sump fluid temperature, cold	Yes	DNS, Lock-in-neutral
	23	Sump fluid temperature, hot	No	No upshifts above a calibration rang

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
25	00	Output speed sensor detected at 0 output rpm, Low	Yes(1)	DNS, Lock in current range (Low), DNA
	11	Output speed sensor, detected at 0 output rpm, 1st	Yes(1)	DNS, Lock in current range (1st), DNA
	22	Output speed sensor, detected at 0 output rpm, 2nd	Yes(1)	DNS, Lock in current range (2nd), DNA
	33	Output speed sensor, detected at 0 output rpm, 3rd	Yes(1)	DNS, Lock in current range (3rd), DNA
	44	Output speed sensor, detected at 0 output rpm, 4th	Yes(1)	DNS, Lock in current range (4th), DNA
	55	Output speed sensor, detected at 0 output rpm, 5th	Yes(1)	DNS, Lock in current range (5th), DNA
	66	Output speed sensor, detected at 0 output rpm, 6th	Yes(1)	DNS, Lock in current range (6th), DNA
	77	Output speed sensor, detected at 0 output rpm, Reverse range	Yes(1)	DNS, Lock in current range (R), DNA
32	00	C3 pressure switch open	Yes	DNS, Lock in current (Low), DNA
	33	C3 pressure switch open, 3rd range	Yes	DNS, Lock in current range (3rd), DNA
	55	C3 pressure switch open, 5th range	Yes	DNS, Lock in current range (5th), DNA
	77	C3 pressure switch open, Reverse range	Yes	DNS, Lock in current range (R), DNA
33	12	Sump oil temperature sensor, failed low	No	Use default value of 93°C (200°F)
	23	Sump oil temperature sensor, failed high	No	Use default value of 93°C (200°F)
34	12	EEPROM, factory calibration compatibility number wrong	Yes(2)	DNS, SOL OFF (Hydraulic default), DNA
	13	EEPROM, factory calibration block checksum	Yes(2)	DNS, SOL OFF (Hydraulic default), DNA
	14	EEPROM, Power Off Block Checksum	No	Use previous location, or factory calibration and reset adaptive, DNA
	15	EEPROM, Diagnostic Queue Block Checksum	No	Use previous location, or clear diagnostic queue, DNA
	16	EEPROM, Real Time Block Checksum	Yes	DNS, SOL OFF (Hydraulic default), DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
35	00	Power interruption (Code set after power restored)	No	None (Hydraulic default during interruption)
	16	Real Time EEPROM Write Interruption	Yes	DNS, SOL OFF (Hydraulic default), DNA
36	00	Hardware/Software not compatible	Yes(3)	DNS, SOL OFF (Hydraulic default), DNA
41	12	Open or short-to-ground, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	13	Open or short-to-ground, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	14	Open or short-to-ground, C solenoid circuit	Yes	DNS, SOL OFF Hydraulic default), DNA
	15	Open or short-to-ground, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	16	Open or short-to-ground, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	21	Open or short-to-ground, F solenoid circuit	No	Lockup inhibited, DNA
	22	Open or short-to-ground, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	23	Open or short-to-ground, H solenoid circuit	No	Retarder allowed, differential lock inhibited
	24	Open or short-to-ground, J solenoid circuit	No	Low and 1st inhibited
	25	Open or short-to-ground, K solenoid circuit	No	K solenoid operation inhibited
	26	Open or short-to-ground, N solenoid circuit	No	Low and 1st inhibited
42	12	Short-to-battery, A solenoid circuit	Yes	DNS, Lock in a range, DNA
	13	Short-to-battery, B solenoid circuit	Yes	DNS, Lock in a range, DNA
	14	Short-to-battery, C solenoid circuit	Yes	DNS, Lock in a range, DNA
	15	Short-to-battery, D solenoid circuit	Yes	DNS, Lock in a range, DNA
	16	Short-to-battery, E solenoid circuit	Yes	DNS, Lock in a range, DNA
	21	Short-to-battery, F solenoid circuit	No	Lockup inhibited, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
42 *(cont'd)*	22	Short-to-battery, G solenoid circuit	Yes	DNS, Lock in a range, DNA
	23	Short-to-battery, H solenoid circuit	No	Retarder allowed, differential lock inhibited
	24	Short-to-battery, J solenoid circuit	No	Low and 1st inhibited
	25	Short-to-battery, K solenoid circuit	No	Retarder operation inhibited
	26	Short-to-battery, N solenoid circuit	No	Low and 1st inhibited
43	21	Low side driver, F solenoid circuit	No	Lockup inhibited, DNA
	25	Low side driver, K solenoid circuit	No	K solenoid operation inhibited, DNA
	26	Low side driver, N solenoid circuit	No	Low and 1st inhibited, DNA
44	12	Short-to-ground, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	13	Short-to-ground, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	14	Short-to-ground, C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	15	Short-to-ground, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	16	Short-to-ground, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	21	Short-to-ground, F solenoid circuit	No	Lockup inhibited, DNA
	22	Short-to-ground, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	23	Short-to-ground, H solenoid circuit	No	Retarder allowed, differential lock inhibited
	24	Short-to-ground, J solenoid circuit	No	Low and 1st inhibited
	25	Short-to-ground, K solenoid circuit	No	K solenoid operation inhibited
	26	Short-to-ground, N solenoid circuit	No	Low and 1st inhibited
45	12	Open circuit, A solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	13	Open circuit, B solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	14	Open circuit, C solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
45 *(cont'd)*	15	Open circuit, D solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	16	Open circuit, E solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	21	Open circuit, F solenoid circuit	No	Lockup inhibited, DNA
	22	Open circuit, G solenoid circuit	Yes	DNS, SOL OFF (Hydraulic default), DNA
	23	Open circuit, H solenoid circuit	No	Retarder allowed, differential lock inhibited
	24	Open circuit, J solenoid circuit	No	Low and 1st inhibited
	25	Open circuit, K solenoid circuit	No	Retarder operation inhibited
	26	Open circuit, N solenoid circuit	No	Low and 1st inhibited
51	01	Offgoing ratio test (during shift), L to 1	Yes	DNS, RPR, DNA
	10	Offgoing ratio test (during shift), 1 to L	Yes	DNS, RPR, DNA
	12	Offgoing ratio test (during shift), 1 to 2	Yes	DNS, RPR, DNA
	21	Offgoing ratio test (during shift), 2 to 1	Yes	DNS, RPR, DNA
	23	Offgoing ratio test (during shift), 2 to 3	Yes	DNS, RPR, DNA
	24	Offgoing ratio test (during shift), 2 to 4	Yes	DNS, RPR, DNA
	35	Offgoing ratio test (during shift), 3 to 5	Yes	DNS, RPR, DNA
	42	Offgoing ratio test (during shift), 4 to 2	Yes	DNS, RPR, DNA
	43	Offgoing ratio test (during shift), 4 to 3	Yes(1)	DNS, RPR, DNA
	45	Offgoing ratio test (during shift), 4 to 5	Yes(1)	DNS, RPR, DNA
	46	Offgoing ratio test (during shift), 4 to 6	Yes	DNS, RPR, DNA
	53	Offgoing ratio test (during shift), 5 to 3	Yes	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
51 *(cont'd)*	64	Offgoing ratio test (during shift), 6 to 4	Yes	DNS, RPR, DNA
	65	Offgoing ratio test (during shift), 6 to 5	Yes	DNS, RPR, DNA
	XY	Offgoing ratio test, X to Y(4)		
52	01	Offgoing C3PS test (during shift), L to 1	Yes	DNS, RPR, DNA
	08	Offgoing C3PS test (during shift), L to N1	Yes	DNS, NNC, DNA
	32	Offgoing C3PS test (during shift), 3 to 2	Yes	DNS, RPR, DNA
	34	Offgoing C3PS test (during shift), 3 to 4	Yes	DNS, RPR, DNA
	54	Offgoing C3PS test (during shift), 5 to 4	Yes	DNS, RPR, DNA
	56	Offgoing C3PS test (during shift), 5 to 6	Yes	DNS, RPR, DNA
	71	Offgoing C3PS test (during shift), R to 1	Yes	DNS, NNC, DNA
	72	Offgoing C3PS test (during shift), R to 2	Yes	DNS, NNC, DNA
	78	Offgoing C3PS test (during shift), R to N1	Yes	DNS, NNC, DNA
	79	Offgoing C3PS test, R to 2 (R to NNC to 2)	Yes	DNS, NNC, DNA
	99	Offgoing C3PS test (during shift), N3 to N2	Yes	DNS, RPR, DNA
	XY	Offgoing C3PS test, X to Y(4)		
53	08	Offgoing speed test (during shift), L to N1	Yes(1)	DNS, NNC, DNA
	09	Offgoing speed test, Low to NNC	Yes(1)	DNS, NNC, DNA
	18	Offgoing speed test (during shift), 1 to N1	Yes(1)	DNS, NNC, DNA
	28	Offgoing speed test (during shift), 2 to N1	Yes(1)	DNS, NNC, DNA
	29	Offgoing speed test (during shift), 2 to N2	Yes(1)	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
53 *(cont'd)*	38	Offgoing speed test (during shift), 3 to N1	Yes(1)	DNS, NNC, DNA
	39	Offgoing speed test (during shift), 3 to N3	Yes(1)	DNS, RPR, DNA
	48	Offgoing speed test (during shift), 4 to N1	Yes(1)	DNS, NNC, DNA
	49	Offgoing speed test (during shift), 4 to N3	Yes(1)	DNS, RPR, DNA
	58	Offgoing speed test (during shift), 5 to N1	Yes(1)	DNS, NNC, DNA
	59	Offgoing speed test (during shift), 5 to N3	Yes(1)	DNS, RPR, DNA
	68	Offgoing speed test (during shift), 6 to N1	Yes(1)	DNS, NNC, DNA
	69	Offgoing speed test (during shift), 6 to N4	Yes(1)	DNS, RPR, DNA
	78	Offgoing speed test (during shift), R to N1	Yes	DNS, NNC, DNA
	99	Offgoing speed test (during shift), N2 to N3 or N3 to N2	Yes	DNS, RPR, DNA
	XY	Offgoing speed test, X to Y(4)		
54	01	Oncoming ratio test (after shift), L to 1	Yes	DNS, RPR, DNA
	07	Oncoming ratio test (after shift), L to R	Yes	DNS, NNC, DNA
	10	Oncoming ratio test (after shift), 1 to L	Yes	DNS, RPR, DNA
	12	Oncoming ratio test (after shift), 1 to 2	Yes	DNS, RPR, DNA
	17	Oncoming ratio test (after shift), 1 to R	Yes	DNS, NNC, DNA
	21	Oncoming ratio test (after shift), 2 to 1	Yes	DNS, RPR, DNA
	23	Oncoming ratio test (after shift), 2 to 3	Yes	DNS, RPR, DNA
	24	Oncoming ratio test (during shift), 2 to 4	Yes	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
54 *(cont'd)*	27	Oncoming ratio test (after shift), 2 to R	Yes	DNS, NNC, DNA
	32	Oncoming ratio test (after shift), 3 to 2	Yes	DNS, RPR, DNA
	34	Oncoming ratio test (after shift), 3 to 4	Yes	DNS, RPR, DNA
	35	Oncoming ratio test (during shift), 3 to 5	Yes	DNS, RPR, DNA
	42	Oncoming ratio test (during shift), 4 to 2	Yes	DNS, RPR, DNA
	43	Oncoming ratio test (after shift), 4 to 3	Yes	DNS, RPR, DNA
	45	Oncoming ratio test (after shift), 4 to 5	Yes	DNS, RPR or SOL OFF (Hydraulic default), DNA
	46	Oncoming ratio test (during shift), 4 to 6	Yes	DNS, RPR, DNA
	53	Oncoming ratio test (during shift), 5 to 3	Yes	DNS, RPR, DNA
	54	Oncoming ratio test (after shift), 5 to 4	Yes	DNS, RPR, DNA
	56	Oncoming ratio test (after shift), 5 to 6	Yes	DNS, RPR, DNA
	64	Oncoming ratio test (after shift), 6 to 4	Yes	DNS, RPR, DNA
	65	Oncoming ratio test (after shift), 6 to 5	Yes	DNS, RPR, DNA
	70	Oncoming ratio test (after shift), R to L	Yes	DNS, NNC, DNA
	71	Oncoming ratio test (after shift), R to 1	Yes	DNS, NNC, DNA
	72	Oncoming ratio test (after shift), R to 2	Yes	DNS, NNC, DNA
	80	Oncoming ratio test (after shift), N1 to L	Yes	DNS, RPR, DNA
	81	Oncoming ratio test (after shift), N1 to 1	Yes	DNS, RPR, DNA
	82	Oncoming ratio test (after shift), N1 to 2	Yes	DNS, RPR, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
54 *(cont'd)*	83	Oncoming ratio test (after shift), N1 to 3	Yes	DNS, RPR, DNA
	85	Oncoming ratio test (after shift), N1 to 5	Yes	DNS, RPR, DNA
	86	Oncoming ratio test (after shift), N1 to 6	Yes	DNS, RPR, DNA
	92	Oncoming ratio test (after shift), N2 to 2	Yes	DNS, RPR, DNA
	93	Oncoming ratio test (after shift), N3 to 3	Yes	DNS, RPR, DNA
	95	Oncoming ratio test (after shift), N3 to 5	Yes	DNS, RPR, DNA
	96	Oncoming ratio test (after shift), N4 to 6	Yes	DNS, RPR, DNA
	97	Oncoming ratio test (after shift), 2 to R (2 to NNC to R)	Yes	DNS, NNC, DNA
	XY	Oncoming ratio test, X to Y(4)		
55	07	Oncoming C3PS test, L to R	Yes(1)	DNS, NNC, DNA
	17	Oncoming C3PS test (after shift), 1 to R	Yes(1)	DNS, NNC, DNA
	27	Oncoming C3PS test (after shift), 2 to R	Yes(1)	DNS, NNC, DNA
	87	Oncoming C3PS test (after shift), N1 to R	Yes	DNS, RPR, DNA
	97	Oncoming C3PS test (after shift), NVL to Reverse	Yes(1)	DNS, NNC, DNA
	XY	Oncoming C3PS test, X to Y(4)		
56	00	Range verification test, L	Yes(1)	DNS, 1st, Low, or SOL OFF (Low), DNA
	11	Range verification ratio test, 1st	Yes	DNS, 6th, DNA
	22	Range verification ratio test, 2nd	Yes(1)	DNS, 6th or 5th, DNA
	33	Range verification ratio test, 3rd	Yes(1)	DNS, 5th or SOL OFF (4th), DNA
	44	Range verification ratio test, 4th	Yes	DNS, 3rd or 5th, DNA
	55	Range verification ratio test, 5th	Yes(1)	DNS, SOL OFF, 5th or 3rd, DNA
	66	Range verification ratio test, 6th	Yes	DNS, 5th, 3rd, or SOL OFF (3rd), DNA
	77	Range verification ratio test, R	Yes	DNS, N2 or N3, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
57	11	Range verification C3PS test, 1st	Yes	DNS, SOL OFF (3rd), DNA
	22	Range verification C3PS test, 2nd	Yes	DNS, 3rd, DNA
	44	Range verification C3PS test, 4th	Yes	DNS, 5th or SOL OFF (3rd), DNA
	66	Range verification C3PS test, 6th	Yes	DNS, SOL OFF (5th), DNA
	88	Range verification C3PS test, N1	Yes	DNS, N3, DNA
	99	Range verification C3PS test, N2 or N4	Yes	DNS, N3, DNA
61	00	Retarder oil temperature, hot	No	None
62	12	Retarder oil temperature sensor, failed low	No	None
	23	Retarder oil temperature sensor, failed high	No	None
63	00	Input function fault	No	Depends on input function, DNA
	26	Kickdown input failed on	No	Kickdown operation inhibited
	40	Service brake status input failed on	No	No auto neutral to drive shifts for refuse packer. (I/O package #41)
	41	Pump/pack and a neutral general purpose input	No	No auto Neutral to drive shifts for refuse packer. (I/O package #41)
64	12	Retarder modulation request sensor, failed low	No	Retarder operation inhibited
	23	Retarder modulation request sensor, failed high	No	Retarder operation inhibited
65	00	Engine rating too high	Yes	DNS, Lock-in-neutral
66	00	Serial communications interface fault	No	Use default throttle values, DNA
69	12	ECU, A solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default), DNA
	13	ECU, B solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default), DNA
	14	ECU, C solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default), DNA
	15	ECU, D solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default), DNA
	16	ECU, E solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default), DNA
	21	ECU, F solenoid driver open	No	Lockup inhibited, DNA

DIAGNOSTIC CODES

Table 6–2. WT Series Diagnostic Codes *(cont'd)*

Main Code	Subcode	Description	DO NOT SHIFT Light	Inhibited Operation Description
69 *(cont'd)*	22	ECU, G solenoid driver open	Yes	DNS, SOL OFF (Hydraulic default), DNA
	23	ECU, H solenoid driver open	No	Retarder allowed, DNA
	24	ECU, J solenoid driver open	No	Low and 1st inhibited, DNA
	25	ECU, K solenoid driver open	No	Retarder operation inhibited, DNA
	26	ECU, N solenoid driver open	No	Low and 1st inhibited, DNA
	32	ECU, SPI communications link fault	No	Induce COP timeout (reset ECU), DNA
	33	ECU, Computer Operating Properly (COP) timeout	No(5)	Reset ECU, Shutdown ECU on 2nd occurrence. This code may cause "cateyes" or all segments blank, DNA
	34	ECU, EEPROM write timeout	Yes	DNS, SOL OFF (Hydraulic default), DNA
	35	ECU, EEPROM checksum test	No(5)	Induce COP timeout (reset ECU), DNA
	36	ECU, RAM self test	No(5)	Induce COP timeout (reset ECU), DNA
	41	ECU, I/O ASIC addressing test	No(5)	Induce COP timeout (reset ECU), DNA

NOTES

(1) This code is logged to real time to protect the transmission in case a loss of power to the ECU (Power Interruption, Code 35 00) occurs.

(2) The factory calibration must be rewritten to the ECU, or a different factory calibration is required to match the software in the ECU.

(3) The ECU hardware or software must be changed so that they are compatible.

(4) Additional codes could be logged for other shifts where X indicates range shifted from and Y indicates range shifted to.

(5) The COP reset will clear the active inhibit.

TRANSMISSION COMPONENT WIRING DIAGRAMS AND DIAGNOSTICS

DIAGNOSTIC CODES

NOTES

DIAGNOSTIC CODES

6–6. DIAGNOSTIC CODE TROUBLESHOOTING

A. Beginning The Troubleshooting Process

1. Begin troubleshooting by checking the transmission fluid level and ECU input voltage. Check diagnostic codes by:
   - Using the shift selector display.
   - Using the Pro-Link® 9000 diagnostic tool.
2. When a problem exists but a diagnostic code is not indicated, refer to the Performance Complaint Section for a listing of various electrical and hydraulic problems, their causes, and remedies.
3. If a diagnostic code is found in the ECU memory, record all available code information and clear the active indicator (refer to Section 6).
4. Test drive the vehicle to confirm a diagnostic code or performance complaint.
   - If the code reappears, refer to the Diagnostic Code section (Section 6) and the appropriate code chart. The Diagnostic Code section lists diagnostic codes and their description. Locate the appropriate troubleshooting chart and follow the instructions.
   - If the code does not reappear, it may be an intermittent problem. Use the Pro-Link® and the code display procedure described in Section 6. The code display procedure will indicate the number of times the diagnostic code has occurred. Refer to the troubleshooting chart for possible cause(s) of the problem.
   - Appendix A deals with the identification of potential circuit problems. Refer to Appendix A if a circuit problem is suspected.

NOTE: Information concerning specific items is contained in the appendices located in the back of this manual. The appendices are referred to throughout the manual.

B. Solenoid Locations

Solenoid locations in the control module are as illustrated in Figure 6–1. Refer to Figure 6–1 as necessary when using the diagnostic code schematics.

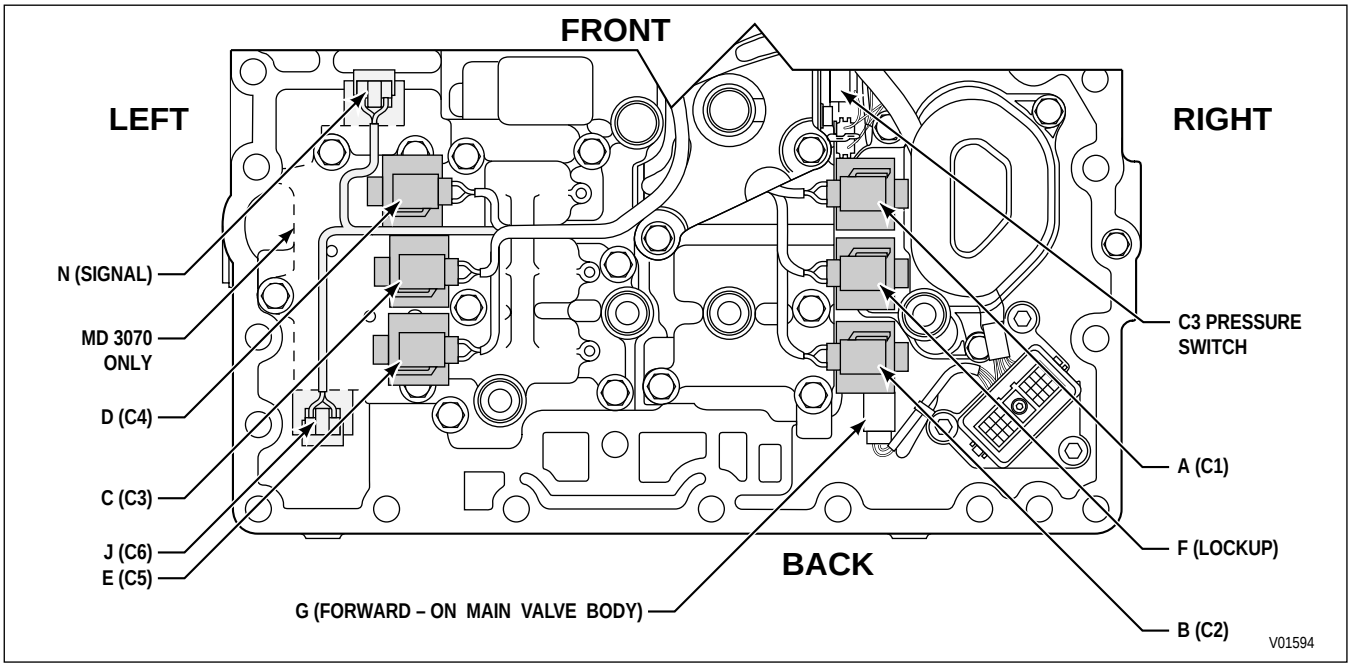


Figure 6–1. Control Module Solenoid Location

DIAGNOSTIC CODES

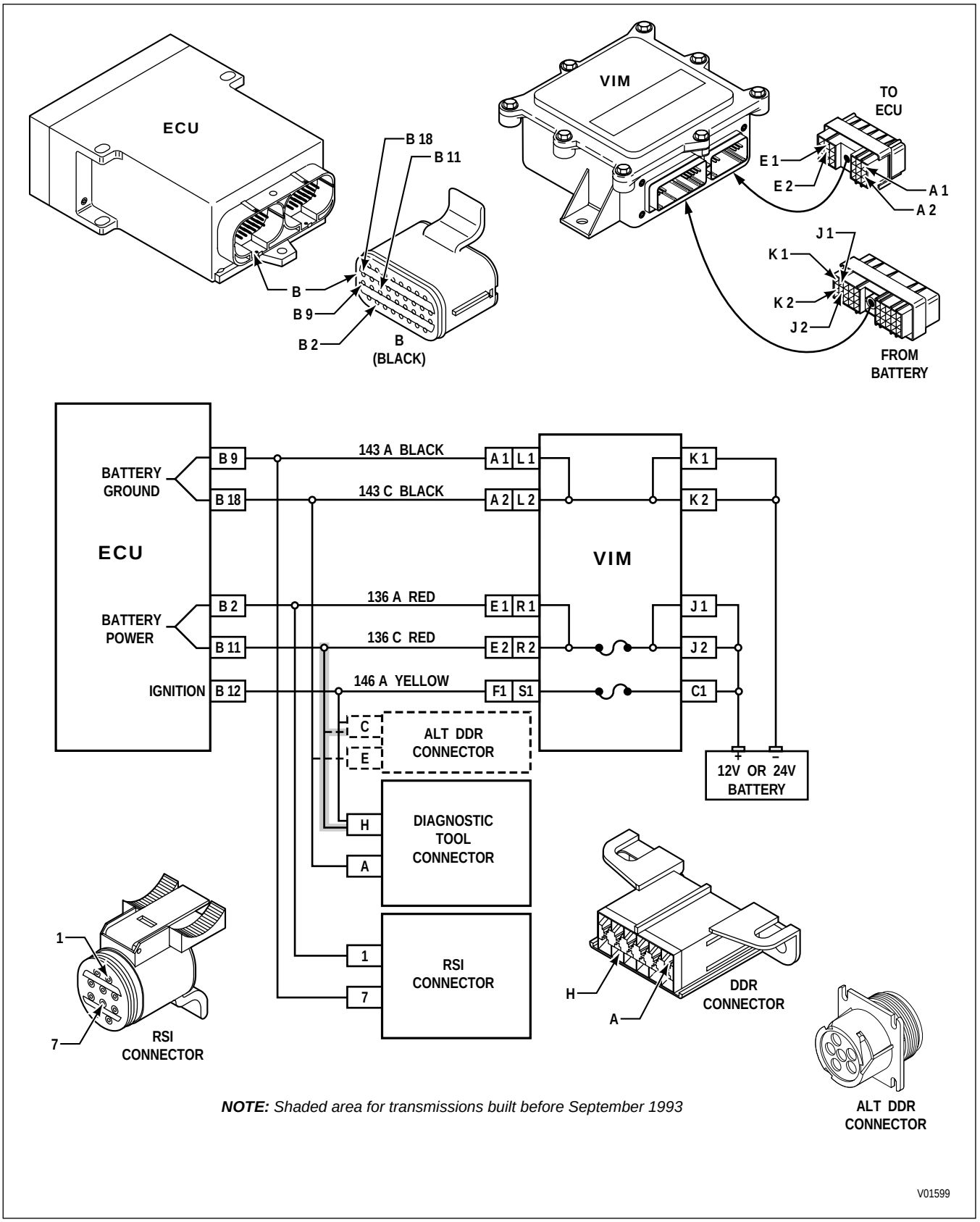
C. Diagnostic Code Schematics

The diagnostic code schematics in this section show wiring for both the optional oil level sensor and retarder, where applicable. If your transmission is not equipped with an oil level sensor or retarder, disregard the portions of the schematic pertaining to those optional pieces of equipment. Refer to the appropriate transmission Service Manual for solenoid replacement procedures.

D. Diagnostic Code 13 and 35 Schematics

The shaded area in Code 13 and 35 schematics indicates a change in the wiring harness incorporated in transmissions manufactured before September 1993.

CODE 13 XX — ECU INPUT VOLTAGE



NOTE: *Shaded area for transmissions built before September 1993*

Figure 6–2. Code 13 Schematic Drawing

CODE 13 XX — ECU INPUT VOLTAGE *(Figure 6–2)*

Main code 13 indicates either a high or low input voltage. Low voltage is less than 8V. High voltage is over 35V.

Common causes for a low voltage code are:

- Bad batteries
- Faulty vehicle charging system
- No battery-direct power and ground

Common causes for the high voltage code are:

- Faulty vehicle alternator
- Faulty vehicle voltage regulator

In the event of a power loss, the transmission fails to the ranges indicated in the following, depending upon which latch valve releases first:

Attained Range	Fail to Range
Reverse and Neutral	Neutral
Low, 1	3C
2, 3, 4	4C usually, 3C sometimes
5	4C usually, 5C sometimes
6	5C

Main Code	Subcode	Meaning
13	12	Battery voltage to the ECU too low
13	13	Battery voltage to the ECU too low (medium)
13	23	Battery voltage to the ECU too high

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

Troubleshooting:

1. Connect the diagnostic tool and turn on vehicle ignition. Select Diagnostic Data to find input voltage. Record reading.
2. Turn off vehicle ignition and remove the connectors from the ECU.
3. Check system voltage at wire 136A and 136C, pin B2 and B11. If power is low or high at this point, and the diagnostic tool reading is also low or high, the vehicle wiring is suspect. Check for fuse problems, lack of battery-direct power and ground, faulty charging system/batteries, and loose or dirty connections (see Appendix A). Power may also be low or high at pins B2 and B11 (system power) if the batteries/charging system is faulty. Bad grounds may also cause incorrect input power readings.

CODE 13 XX — ECU INPUT VOLTAGE *(Figure 6–2)*

4. If power is correct but the diagnostic tool reading indicates incorrect voltage, closely inspect terminals B2 and B11; make sure they are not corroded or deformed. Clean or replace as necessary (see Appendix E, Paragraph 1–1).
5. If the voltage condition is intermittent, closely inspect the vehicle wiring for transmission system power and grounds. Check for loose, dirty, or painted connections. Check the VIM for loose, incorrect, or overheating relays or fuses (refer to Appendix G). Check for wires that are chafed and touching other components.
6. If no other cause is found, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

Table 6–3. Voltage Chart

Voltage	Condition
35.0 (High Set Point)	Maximum Surge For 2 Minutes, High Fail Limit
32.0	Maximum Continuous ECU Voltage
10.0 (Med. Low Set Point)	Cannot Compensate W/Sub-Modulation (Bad Shifts). Adaptive logic stops functioning
8.0	Low Voltage Fail Limit, Set Code, DNS
7.0 (Low Set Point)	Software Off (ECU loses power)
4.5	Neutral Start Off

DIAGNOSTIC CODES

NOTES

CODE 14 XX — OIL LEVEL SENSOR

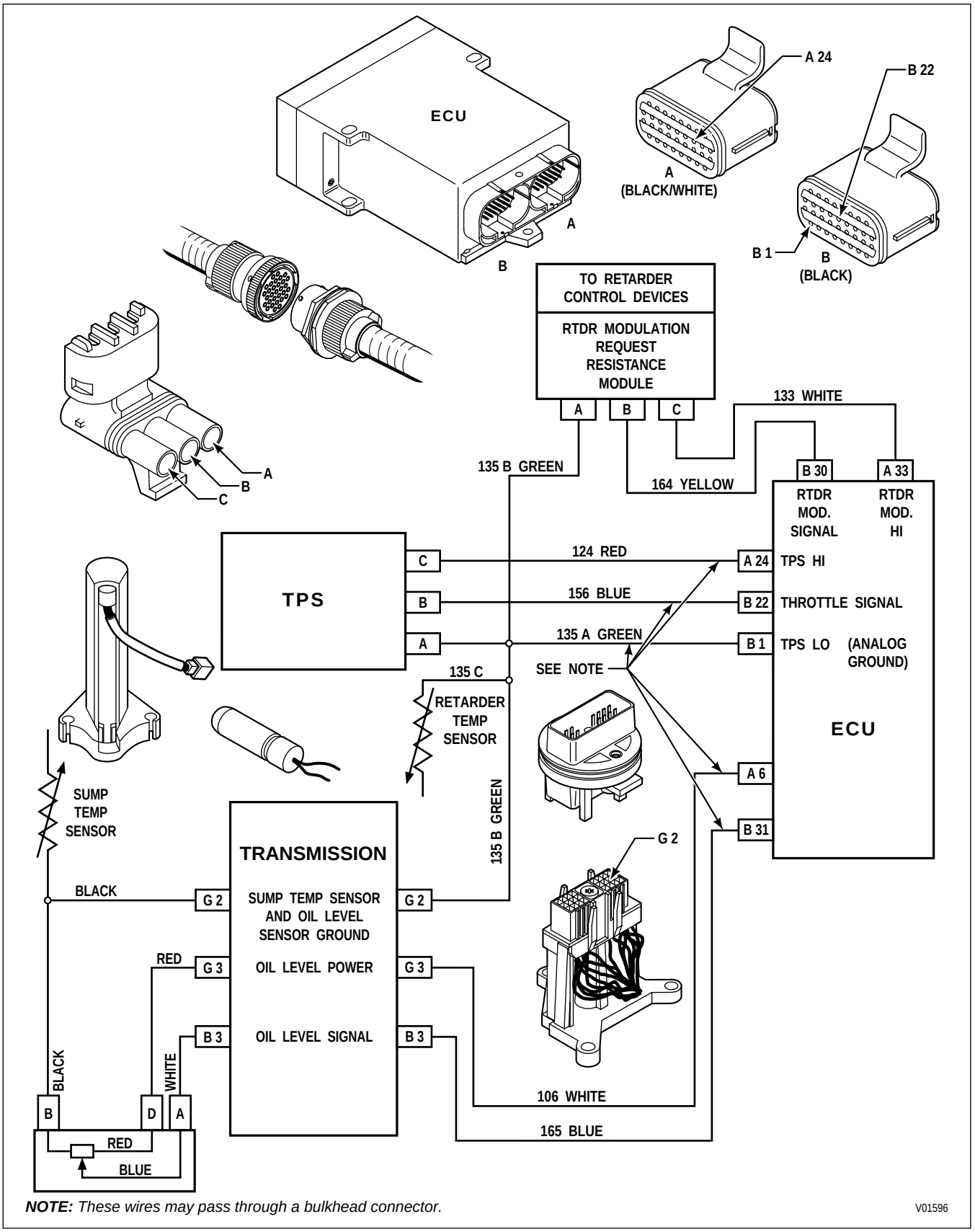
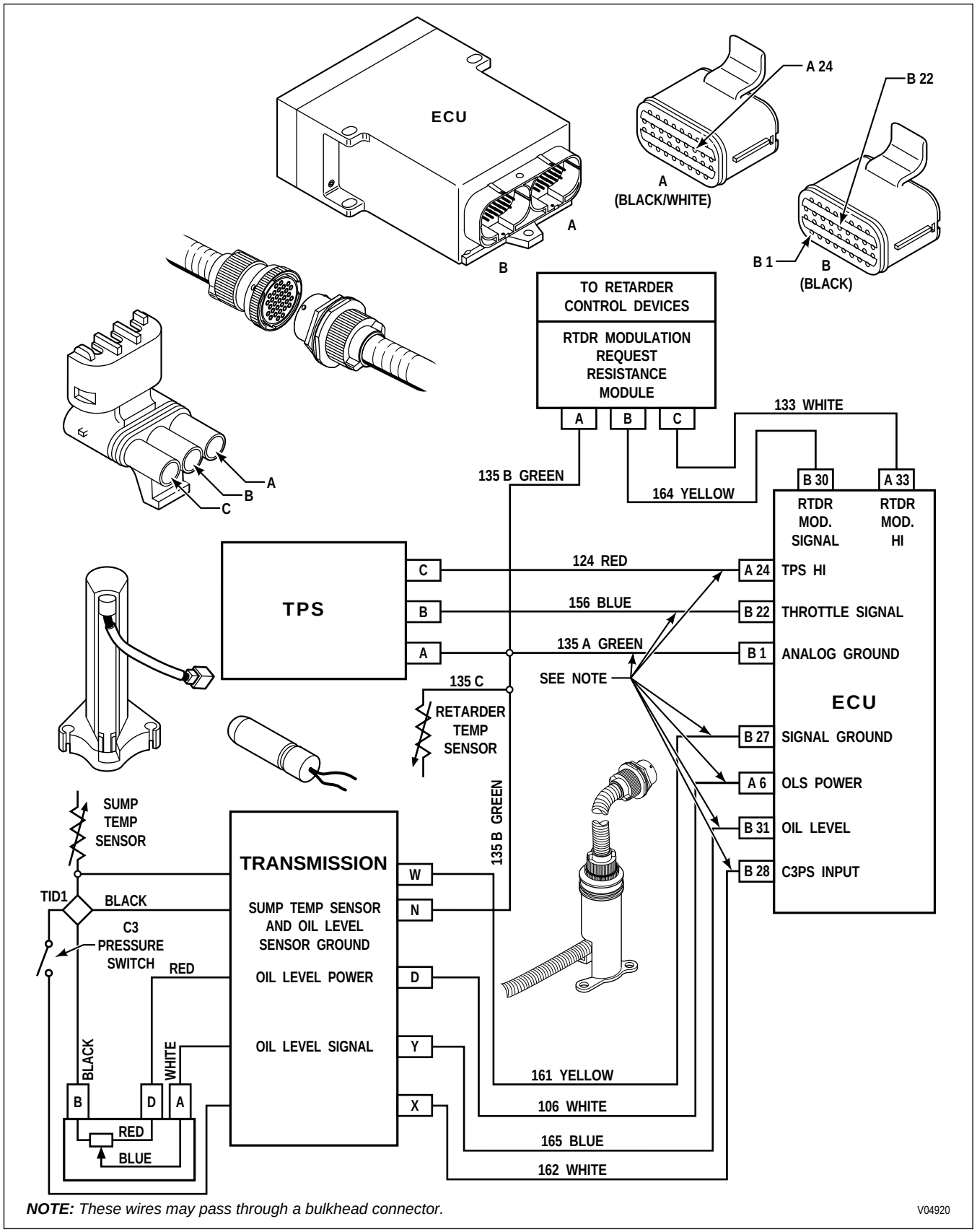


Figure 6–3. Code 14 Schematic Drawing (Units Produced Prior To 9/94)

CODE 14 XX — OIL LEVEL SENSOR



NOTE: *These wires may pass through a bulkhead connector.*

Figure 6–4. Code 14 Schematic Drawing (Units Produced 9/94–12/97)

CODE 14 XX — OIL LEVEL SENSOR (OLS) *(Figures 6–3, 6–4)*

Code 14 12 indicates the ECU has detected a voltage signal in the low error zone.

Code 14 12 can be caused by:

- Faulty wiring to the OLS
- A faulty OLS
- A faulty ECU

CAUTION:	Never use a Volt-Ohmmeter to measure any parameters on the OLS. Damage to the OLS will result.

OLS ground wire 135B is common to the TPS and the RMR devices. A power wire short-to-ground for any of these devices will cause “sensor failed low” codes (21 12 and 64 12). An OLS signal open or short-to-ground results in a Code 14 12 only. Code 14 23 is programmed out of all calibrations.

A permanent maximum voltage signal generates a steady OLS sensor maximum count and a maximum fluid level overfill indication. A maximum overfill indication occurs if signal wire 165 or power wire 106 are shorted to battery or the ground wire (wire 135). An open in the ground circuit wire 135 in the portion common to the OLS, TPS and RMR devices results in Code 14 12, 21 23, and 64 23.

If the ECU software supports it, Oil Level Sensor counts can be read by a DDR with Pro-Link® version 3.0 (or later). For complete description of oil level checking procedures using the oil level sensor, see Section 5. Normal operation of the OLS can be checked as follows: Attach the DDR and display OIL LEVEL COUNTS. Read the number of counts when the engine is not running, but the ignition is ON. The count reading should be near 255. Start the engine and observe the counts. In normal operation, the count should be 100–200 because the oil level drops when the engine starts and oil from the sump is delivered to other parts of the transmission.

NOTE: Intermittent connections or lack of battery-direct power and ground connections can cause this and other electronic control codes.

Main Code	Subcode	Meaning
14	12	Oil level sensor failed low
14	23	Oil level sensor failed high (not used)

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check the following:

- ***Fluid level, using dipstick***
- ***Battery voltage***
- ***ECU input voltage***
- ***Other diagnostic codes***

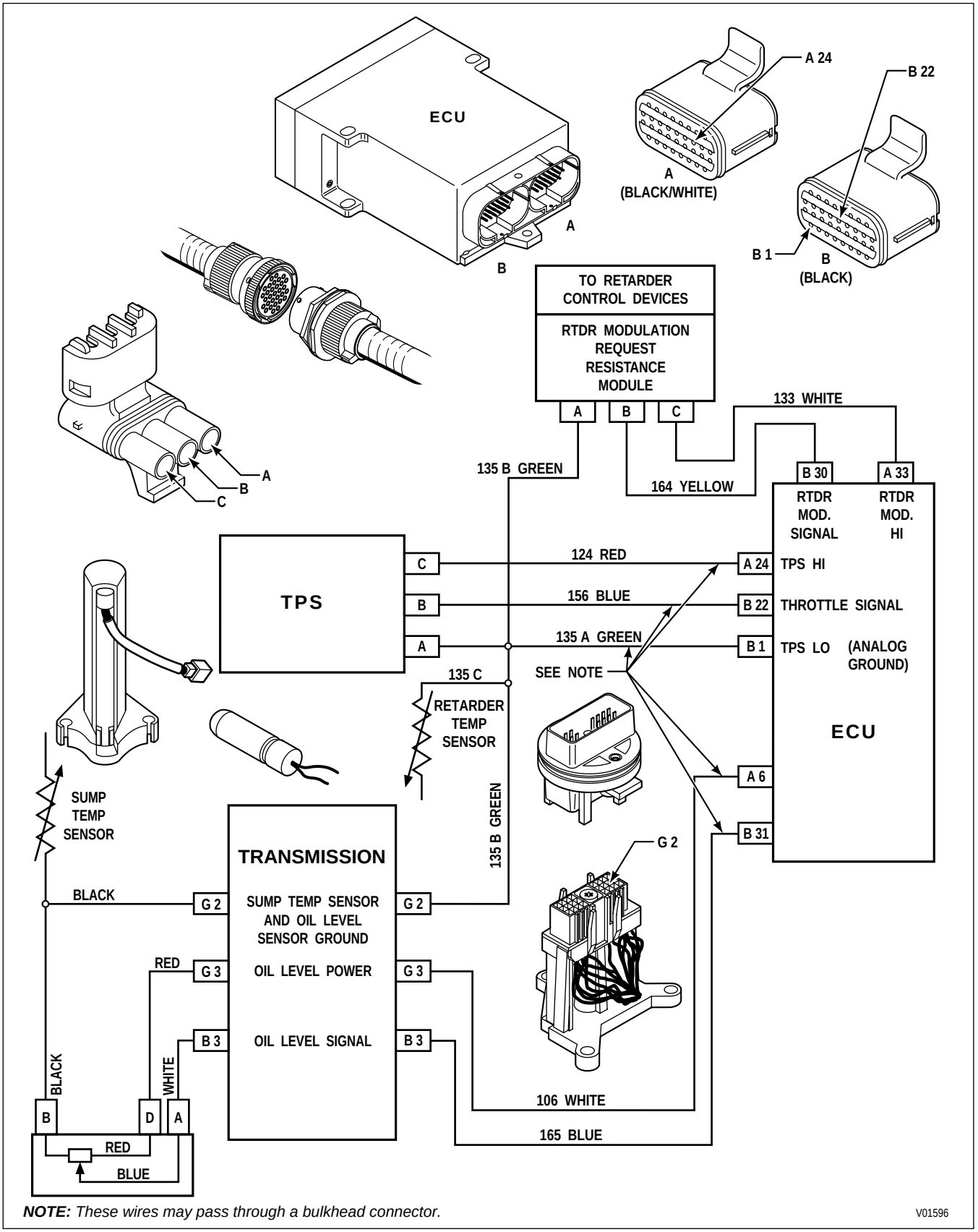
CODE 14 XX — OIL LEVEL SENSOR (OLS) *(Figures 6–3, 6–4)*

Troubleshooting:

The following procedure is to find the cause for an OLS problem. The procedure is sequential. Follow the procedure until the cause for the OLS problem is found and repaired. Once the problem is found and repaired, STOP. For example, if the problem is fixed in Step 3, there is no need to continue to the other steps.

1. Disconnect the external wiring harness at the transmission feedthrough connector. With the ignition ON, verify there is 5.0VDC between the OLS power and ground pins (see Page D–8 or D–9) on the external harness connector. This is to verify that power and ground are getting to the OLS. If 5.0VDC is not present, check the wiring for the OLS power and ground circuits (wires 124 and 135, respectively). If there are no wiring problems (opens, shorts-to-ground, shorts-to-battery), and if 5.0VDC is present, go to Step 2.
2. Observe the OIL LEVEL COUNTS on the DDR while jumpering the OLS power pin to the OLS signal pin. If the count jumps from 0 to 250+, the OLS signal line is good and the ECU function is good. Continue to Step 3. If the count remains at zero, locate and repair problems in the wiring of OLS signal (wire 165). If there are no wiring problems, and the count still remains at zero, the ECU may be bad. Go to Step 5.
3. If all checks prior to this have been normal, the problem is either in the OLS itself, the internal harness wires, or the transmission side of the feedthrough harness connection. Inspect the transmission feedthrough harness connector to be sure that the OLS power, ground, and signal pins are not loose or out of position. Correct any connector problems found. Reconnect the external harness to the transmission feedthrough harness connector. See if Code 14 12 recurs before continuing to Step 4.
4. Consult the appropriate transmission Service Manual for proper procedure and remove the control module from the transmission. Remove the OLS from the channel plate. Reconnect the external harness to the transmission feedthrough connector, if not done in Step 3. With the ignition ON, observe OIL LEVEL COUNTS on the DDR. With the OLS in normal position, the count should be 8–35. Invert the OLS and the count should be 192–255. If the counts are abnormal, replace the sensor. Check the new sensor in both normal and inverted positions. If the counts respond correctly, the problem should be resolved. Attach the new OLS to the channel plate and reinstall the control module using the appropriate transmission Service Manual for proper procedure.
5. Replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 21 XX — THROTTLE POSITION SENSOR FAULT OR ADJUSTMENT



NOTE: *These wires may pass through a bulkhead connector.*

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Figure 6–5. Code 21 Schematic Drawing (Units Produced Prior to 9/94)

CODE 21 XX — THROTTLE POSITION SENSOR FAULT OR ADJUSTMENT

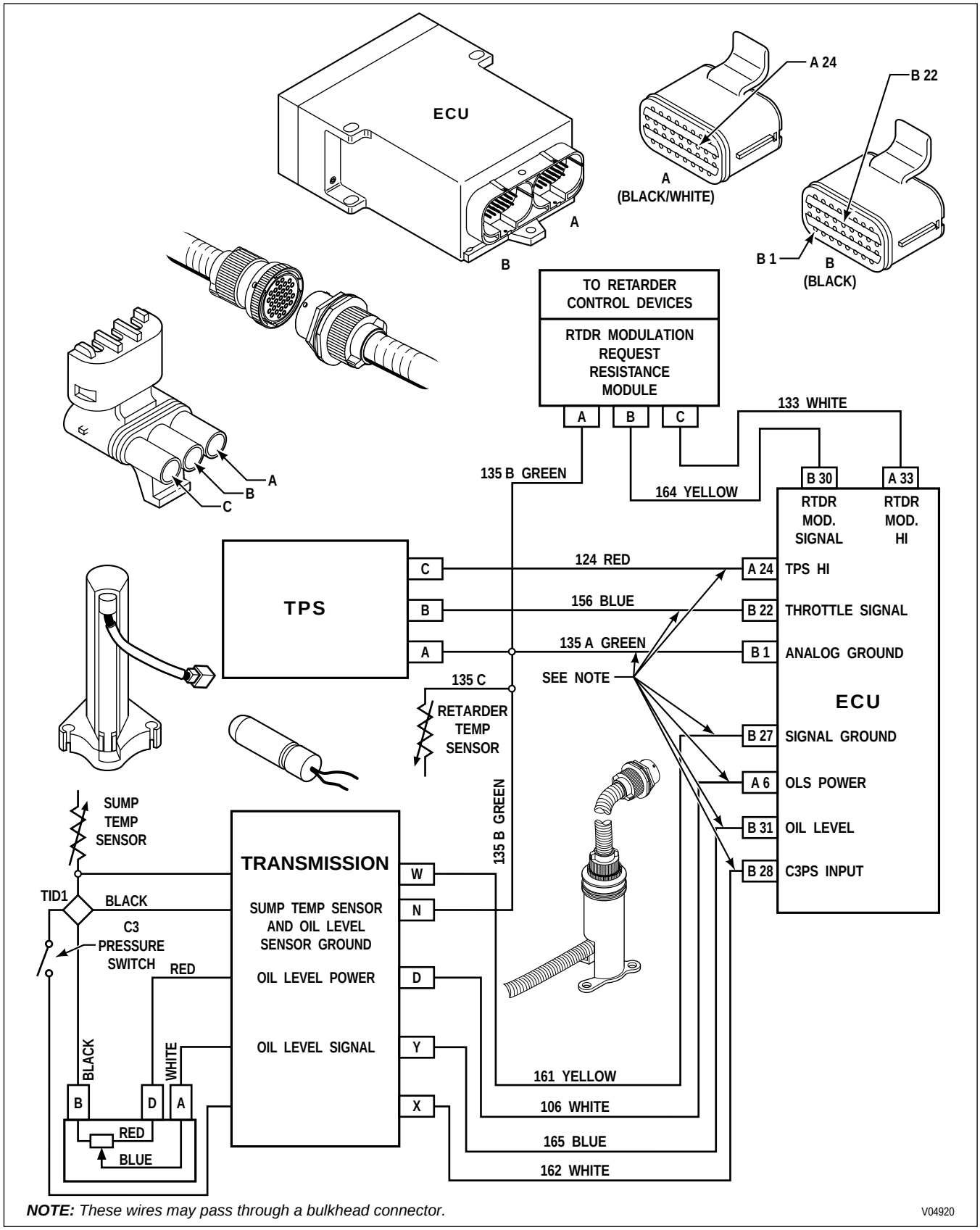


Figure 6–6. Code 21 Schematic Drawing (Units Produced 9/94–12/97)

CODE 21 XX — THROTTLE POSITION SENSOR OR PWM FAULT OR ADJUSTMENT *(Figures 6–5, 6–6)*

Main code 21 indicates the throttle position sensor has been retracted or extended by its linkage into an error zone. This may be due to a fault with the sensor, or a fault in the wiring to the sensor or to the ECU. This code may also indicate a PWM signal problem. Code 21 12 is set when the ECU receives TPS counts of 14 or less. Code 21 23 is set when the ECU senses TPS counts of 233–255. Whenever a Code 21 XX condition is detected, the system defaults to 100 percent throttle and part throttle shifts will be abrupt.

NOTE: Whenever Code 21 12 or 21 23 is set and the ECU was programmed after 9/26/94, the SERVICE icon on the shift selector will be illuminated.

NOTE: Code 21 XX in conjunction with Code 33 XX or Code 14 XX indicates the potential loss of common ground wire 135 between the throttle, temperature sensor, and oil level sensor.

Main Code	Subcode	Meaning
21	12	Throttle position sensor failed low and ECU signals 100 percent throttle
21	23	Throttle position sensor failed high

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check the ECU input voltage.

Troubleshooting:

1. Plug in the DDR, select Diagnostic Data, and read throttle counts and percent. If the TPS failed high (Code 21 23), the problem may be toward the full throttle end of the TPS travel. If the TPS failed low (Code 21 12), the problem may be at the closed throttle end of the TPS travel.
2. If counts are high but the percentage never reaches 100 percent, TPS linkage may have bound up and overstroked the TPS to set a false 100 percent reading. After TPS overstroking ceases, the TPS will not automatically return to 100 percent. After the TPS is correctly installed and adjusted, use the Pro-Link® to reset throttle calibration or cycle the ignition 5 times to reset the 0 percent and 100 percent settings. See TPS section of this book (Appendix F) for installation and adjustment procedures.
3. If the throttle counts do not change or are erratic, check the throttle sensor wiring for opens, shorts between wires, or shorts-to-ground. Also check for correct TPS voltages using test wiring harness J 41339. If wiring problems are found, isolate and repair the fault (refer to Appendix E for repair information).
4. If the wiring is satisfactory, replace the throttle position sensor and adjust its linkage so the counts are not in the error zones (See Appendix F).
5. If the throttle sensor and its linkage adjustment are correct and the wiring to the sensor is satisfactory, the condition is intermittent. Replace the sensor and properly adjust the new sensor.
6. If the condition recurs, use spare harness wires for the throttle sensor circuit. See Appendix D for available spare wires and Appendix E for connector repair information.

CODE 21 XX — THROTTLE POSITION SENSOR OR PWM FAULT OR ADJUSTMENT *(Figures 6–5, 6–6)*

7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem reoccurs, reinstall the replacement ECU.
8. The only troubleshooting necessary for a PWM fault is to check for an open, short-to-ground, or short-to-battery in the signal wire from the PWM source. An open or short-to-ground will set Code 21 12. A short to battery will set Code 21 23.

NOTE: A good throttle position sensor should have resistance of:

1. 9000–15,000 Ohms across terminals A and C.

2. 500 ohms, moving to 9000–15,000 Ohms as TPS is stroked (measured across terminals A and B).

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT

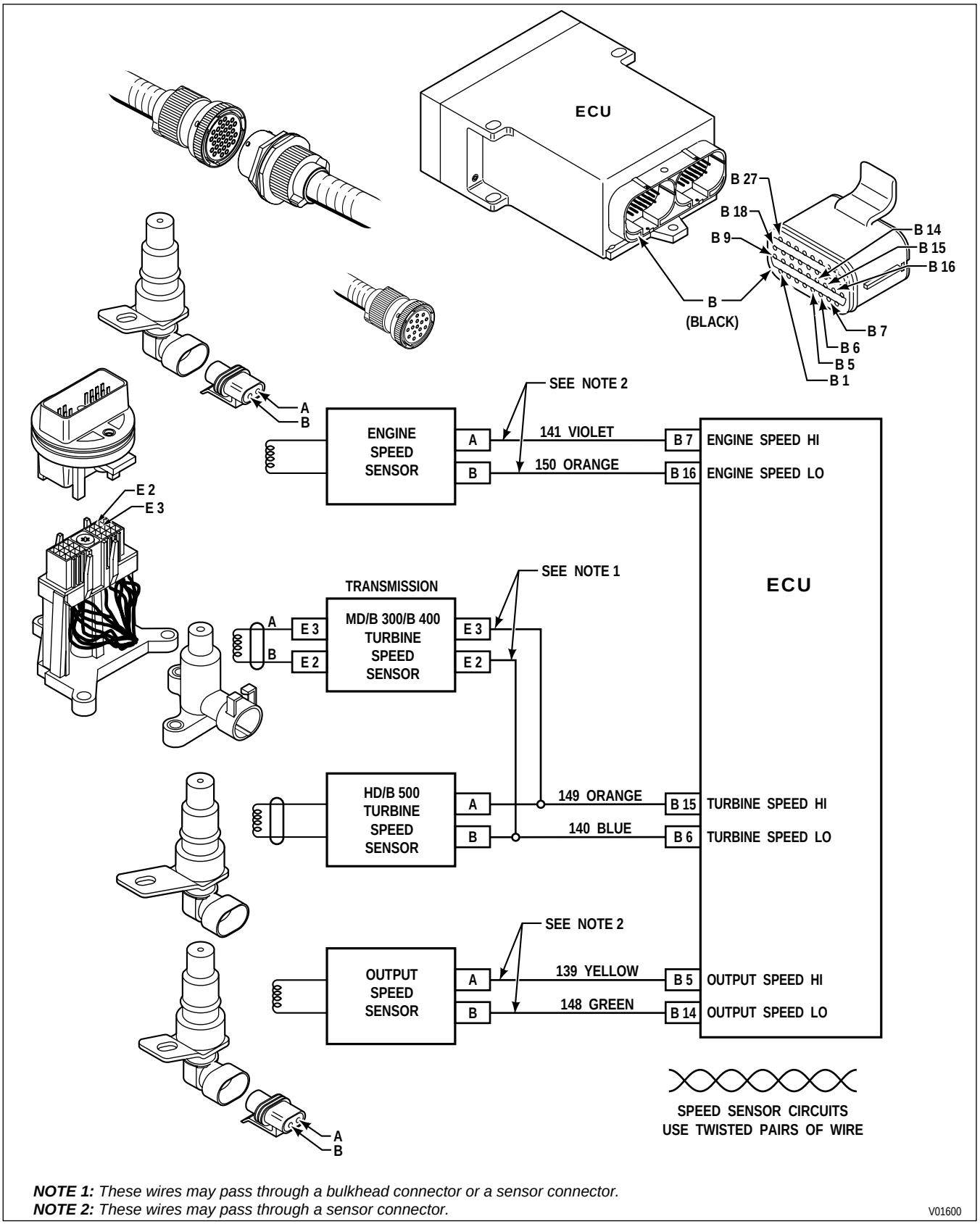
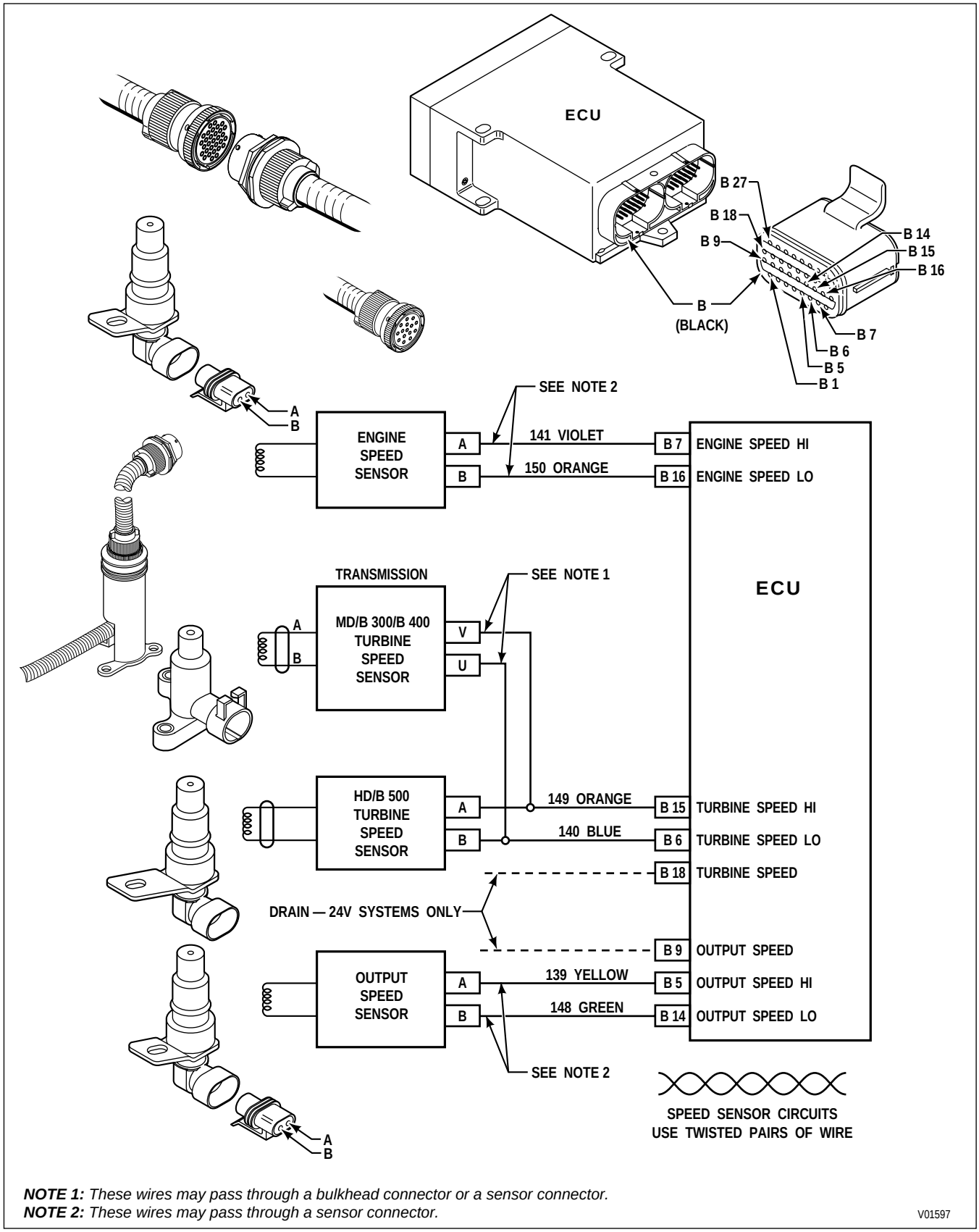


Figure 6–7. Code 22 Schematic Drawing (Units Produced Prior To 9/94)

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT



NOTE 1: *These wires may pass through a bulkhead connector or a sensor connector.*
NOTE 2: *These wires may pass through a sensor connector.*

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Figure 6–8. Code 22 Schematic Drawing (Units Produced 9/94–12/97)

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT *(Figures 6–7, 6–8)*

Main code 22 indicates a fault within a speed sensor, the wiring to a speed sensor, incorrect speed sensor gap, or damaged bumps or teeth which create the speed signal. This fault is determined by the reasonableness of a speed sensor signal when compared with the other two speed sensors and the commanded range. A speed sensor will not pass the reasonableness test if there is no signal at all from that sensor when a signal should be present.

NOTE: If the engine speed sensor code (22 14) is active and a range verification test is failed, the range verification code will not be set but a DO NOT SHIFT response is commanded.

Main Code	Subcode	Failed Sensor
22	14	Engine Speed
22	15	Turbine Speed
22	16	Output Speed

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check the ECU input voltage.

Troubleshooting:

1. Check to see if the sensor is loose, missing, or disconnected. If not, disconnect the wiring harness from the sensor and measure the resistance of the sensor (see chart below). Also check the terminals for dirt, corrosion, or damage. If resistance is not correct, replace the sensor.

Resistance	Temp. °C	Temp. °F
200 Ω	–40	–40
300 Ω	20	68
400 Ω	110	230

2. Remove the connectors from the ECU. Check the sensor circuit (in the external harness) for open wires, shorts between wires, or shorts-to-ground. Isolate and repair any faults (refer to Appendix E for repair information).
3. If no opens or shorts are found, the condition must be intermittent. Replace the sensor indicated by the trouble code. Before replacing a speed sensor, check the sensor for physical damage or contamination. Refer to the appropriate transmission Service Manual for proper replacement procedure.
4. If the condition recurs, install new wiring (twisted-pair) for the sensor circuit between the ECU and the transmission. Use P/N 29522703 Service Harness Twisted Shielded Pair for this purpose.
5. If the condition again recurs, connect the diagnostic tool and select the speed signal indicated by the trouble code. Drive the vehicle and watch the speed reading on the diagnostic tool. If the signal is erratic, sensor gap, vehicle vibration, an external AC signal source, or intermittent connector

CODE 22 XX — SPEED SENSOR/CIRCUITRY FAULT *(Figures 6–7, 6–8)*

contact may be inducing the erratic signal. Inspect the sensor and its surroundings for irregularities that would affect sensor gap. Isolate and correct any abnormal vehicle vibrations (particularly driveline and abnormal engine torsionals, see Sales Tech Data Book (SA2404EN) Part II Section C). Recheck the sensor wiring for intermittent conditions (see Appendix A).

6. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

DIAGNOSTIC CODES

NOTES

CODE 23 XX — SHIFT SELECTOR

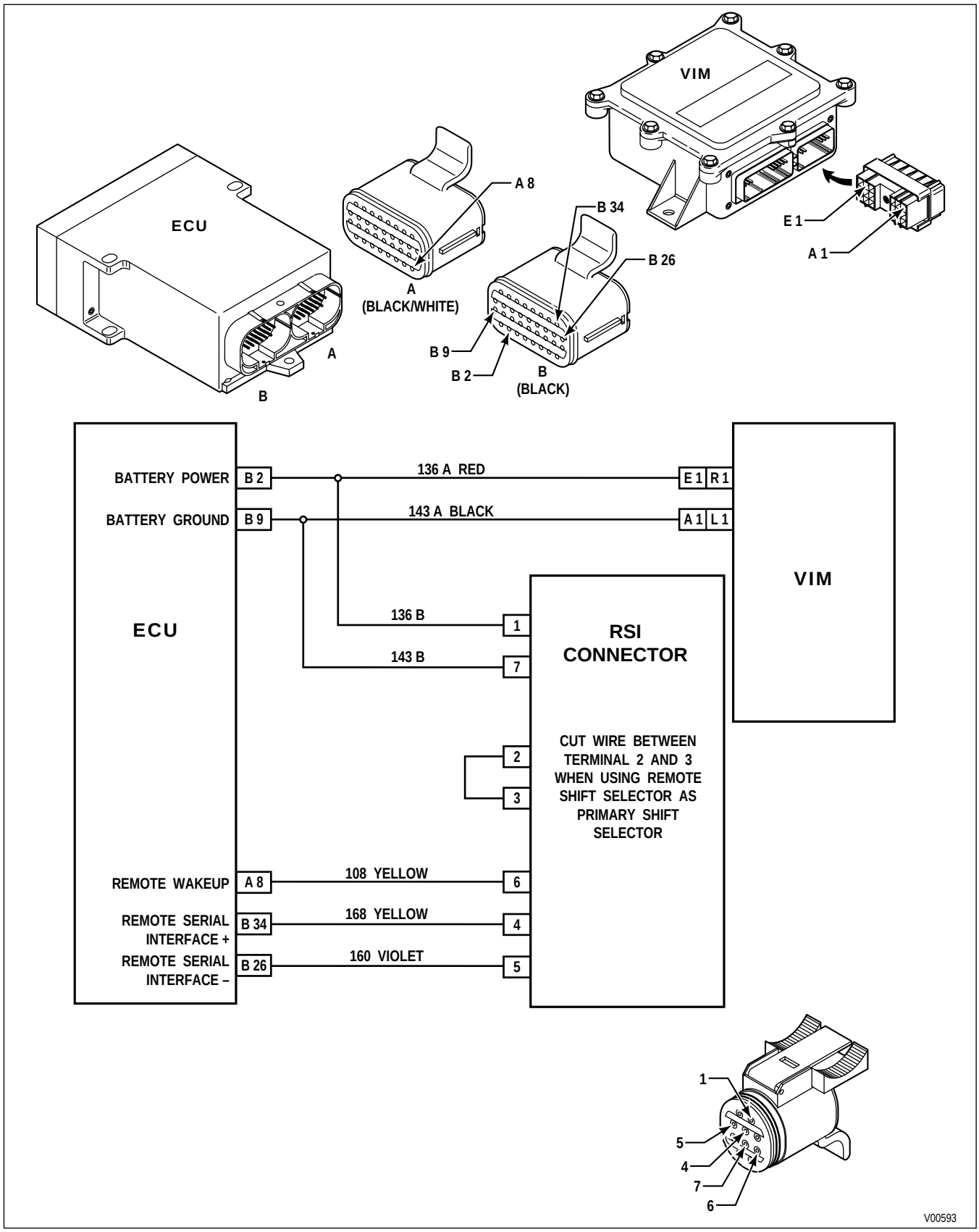


Figure 6–9. Code 23 Schematic Drawing

CODE 23 XX — SHIFT SELECTOR *(Figures 6–9)*

Main code 23 indicates a fault with a shift selector or the wiring between a shift selector and the ECU.

Main Code	Subcode	Meaning
23	12	Primary shift selector or RSI link fault — a “cateyes” type display may occur
23	13	Primary shift selector mode button
23	14	Secondary shift selector or RSI link fault — a “cateyes” type display may occur
23	15	Second shift selector mode button

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5.

Troubleshooting:

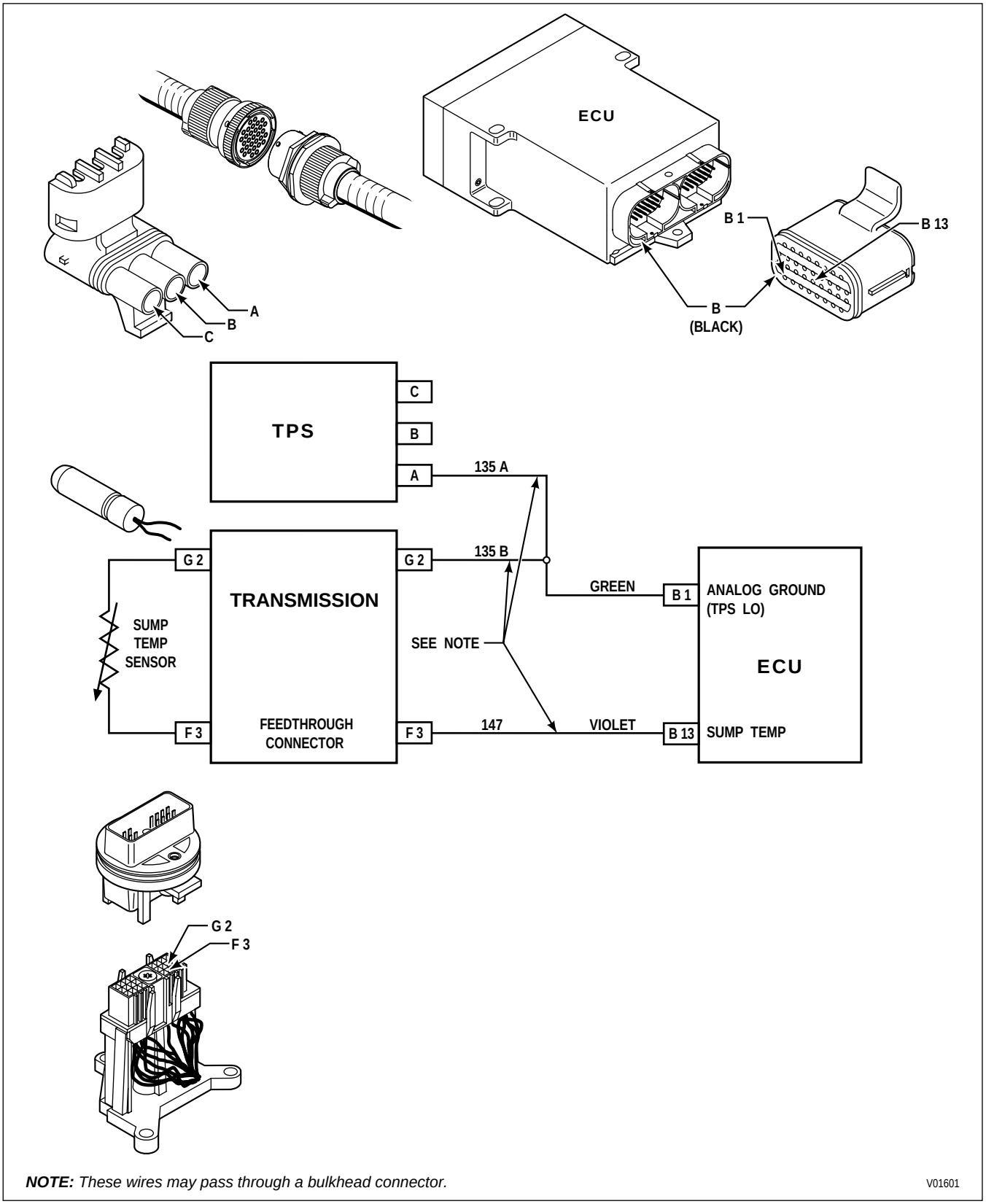
1. Clear the active indicator for Code 23 XX. If code recurs, continue to Step 2.
2. Check for a poor connection at the shift selector.
3. If this is a remote shift selector, disconnect the external harness connectors from the ECU and from the remote shift selector and check for opens, shorts, and shorts-to-ground between the shift selector and ECU (refer to Section 4). Repair as needed (refer to Appendix E).
4. If no problem is found with the shift selector connection or wiring, replace the shift selector.
5. Use care in separating and disconnecting the shift selector head from the ECU. If this is a remote shift selector, replace the shift selector assembly.
6. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CAUTION: Static electricity can destroy the EEPROM. When replacing an integral shift selector, use Anti-Static Wrist Strap BT 8639-B to prevent a static electricity discharge to the EEPROM.

DIAGNOSTIC CODES

NOTES

CODE 24 XX — SUMP FLUID TEMPERATURE



NOTE: *These wires may pass through a bulkhead connector.*

Figure 6–10. Code 24 Schematic Drawing (Units Produced Prior To 9/94)

CODE 24 XX — SUMP FLUID TEMPERATURE

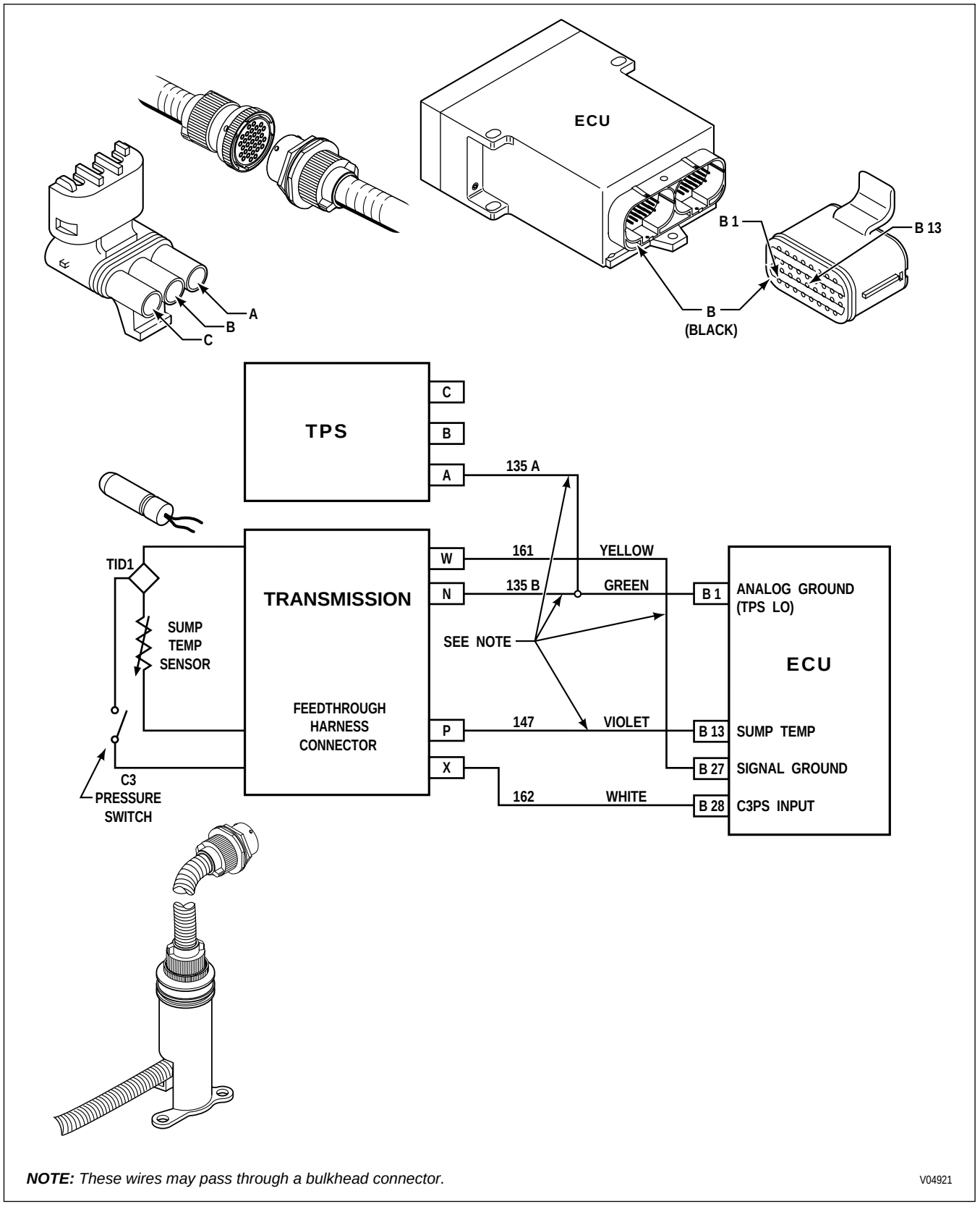


Figure 6–11. Code 24 Schematic Drawing (Units Produced 9/94–12/97)

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figures 6–10, 6–11)*

Main code 24 indicates the ECU has detected either a high or low fluid temperature in the transmission sump (via the sump temperature sensor in the internal harness). All shifts are inhibited when Code 24 12 is set (only Neutral range operation is allowed). No upshifts are allowed above a calibration range when Code 24 23 is set. All inhibits are cleared when the temperature conditions are normal. A related code is 33 12 which indicates a temperature reading outside the usable range of the sensor and indicates a probable sensor failure.

Main Code	Subcode	Meaning
24	12	Oil temperature cold
24	23	Oil temperature hot

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check the ECU input voltage.

Troubleshooting:

A. Code 24 12:

1. If Code 24 12 is set and the outside temperature is low enough to cause this trouble, lower than –32°C (–25°F), the ECU will not allow range operation (See Table 6–4 on next page). The sump must be preheated to an acceptable temperature to avoid logging codes and transmission diagnostic response.

NOTE: Medium cold fluid, –29°C (–20°F) to –7°C (+20°F), will allow reverse, neutral, and second-range-start operation. Only hold override upshifts are allowed.

2. If ambient temperature does not match the sump temperature reading (check using diagnostic tool), compare resistance versus sump fluid temperature (refer to Figure 6–12). Then check the sensor wiring for opens, shorts, or shorts-to-ground.
3. If the sensor wiring is satisfactory, drain the fluid, remove the control module, and replace the temperature sensor (refer to appropriate transmission Service Manual).
4. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage that may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figures 6–10, 6–11)*

Table 6–4. Transmission Operation As A Function Of Temperature

Condition	Version 6 Software*	Version 7 Software*	V7A/V6E/ V7 Recals
	°C (°F)	°C (°F)	°C (°F)
Temperature sensor failed high (Refer to Code 33 23)	177 (351)	177 (351)	
Hot fluid (Code 24 23) adaptive turned off; max range limited	128 (262)	128 (262)	132 (270)
Output function “on” for sump over temp above this temperature	119 (246)	121 (250)	132 (270)
Output function “off” for sump over temp below this temperature	113 (235)	116 (240)	
Cool/cold fluid; adaptive turned off	34 (93)	34 (93)	
Turbine reasonableness and speed tie-up tests turned off	0 (32)	0 (32)	
Medium cold fluid R, N, D allowed, 2nd gear start (hold override upshifts only)	–7 (19)	–7 (19)	
All C3 Pressure Switch tests turned off (Neutral operation only for R03, D4C, and 200 software version. Also, **DO NOT SHIFT** light is illuminated.)	–32 (–25)	–32 (–25)	
Temperature sensor failed low (Refer to Code 33 12)	–45 (–49)	–45 (–49)	

**** NOTE: Use the Pro-Link® diagnostic tool to determine the software version being used. Version 6 software includes R03, D4C, 200, 501, and 502. Version 7 software is D70.***

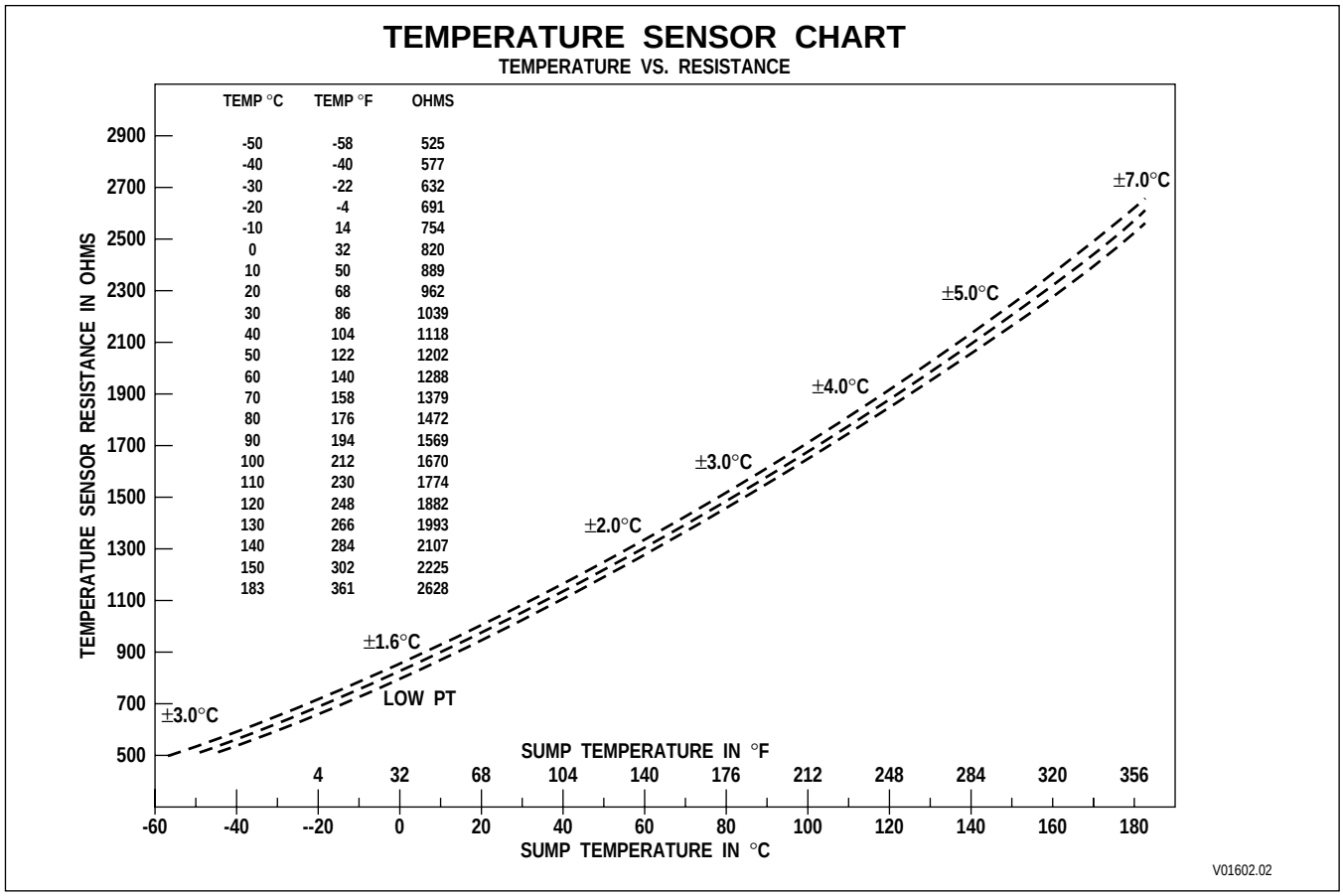


Figure 6–12. TransID 1 Temperature Sensor Chart

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figures 6–10, 6–11)*

B. Code 24 23:

1. Install temperature gauges for transmission temperature and engine water temperature. Drive the vehicle. Verify the code can be reproduced and verify the reading shown on the diagnostic tool. Observe the gauges and check for hot fluid when the code is produced.
2. If the fluid is not hot when the code is produced, remove the connectors at the ECU and the transmission. Check the fluid temperature sensor wiring for opens, shorts, and shorts-to-ground. Compare the resistance readings of the sensor and the actual temperature as shown on the gauge with Figure 6–12 on previous page. If wiring problems or a great difference between temperature and resistance compared with the chart are found, drain the fluid, remove the control module, and replace the temperature sensor (refer to the Service Manual for the transmission being checked). If wiring problems are found, repair or replace as necessary.
3. If the fluid is hot when the code is produced, observe the gauges to see if the engine became hot before the transmission. If the engine cooling system is overheating and heating the transmission, the problem is with the engine or its cooling system.
4. If the transmission became hot before the engine, allow the vehicle to idle for 3–5 minutes and check the transmission fluid level. Correct the fluid level if necessary.
5. Attach pressure gauges to the cooling system (from a “to cooler” connection to a point after the cooling circuit filter) and check for pressure drop problems. If pressure drop is excessive (refer to Table 6–5), check for a plugged cooler filter, collapsed lines, obstructions, etc.
6. If the fluid level is correct and the cooling circuits satisfactory, drain the fluid, remove the control module, and inspect for damaged valve body gaskets. Replace any damaged gaskets (refer to the appropriate transmission Service Manual).
7. If no problems are found in the control module area, remove the transmission and disassemble, inspecting for causes of overheating (stuck stator, plugged orifices, dragging clutches, etc.). (See the Service Manual for the transmission being checked.)

Table 6–5. External Hydraulic Circuit Characteristics
Non-Retarder, PTO, 93°C (200°F) Sump Temperature

HD/B 500

CONVERTER OPERATION
MAXIMUM
COOLER FLOW

Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.22	3.4	0	0
900	0.38	6.1	0	0
1200	0.55	8.7	0	0
1500	0.80	12.7	0	0
1800	1.03	16.4	0	0
2100	1.13	18.0	0	0
2300	1.20	19.0	0	0

CONVERTER OPERATION
MAXIMUM ALLOWABLE
PRESSURE DROP

Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.20	3.2	31	4.5
900	0.37	5.8	63	9.1
1200	0.55	8.7	108	15.7
1500	0.77	12.2	167	24.2
1800	0.92	14.5	213	30.9
2100	0.97	15.3	238	34.5
2300	1.00	15.9	250	36.3

CODE 24 XX — SUMP FLUID TEMPERATURE *(Figures 6–10, 6–11)*

Table 6–6. External Hydraulic Circuit Characteristics
Non-Retarder, PTO, 93°C (200°F) Sump Temperature

MD/B 300/B 400

CONVERTER OPERATION
MAXIMUM COOLER FLOW

Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	0	0
800	0.23	3.7	0	0
1200	0.47	7.4	0	0
1400	0.61	9.7	0	0
1600	0.74	11.7	0	0
2000	0.94	14.9	0	0
2400	1.19	18.9	0	0
3200	1.28	20.3	0	0

LOCKUP OPERATION
MAXIMUM COOLER FLOW

Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	0	0
800	0.23	3.7	0	0
1200	0.50	7.9	0	0
1400	0.63	10.0	0	0
1600	0.77	12.2	0	0
2000	0.95	15.1	0	0
2400	1.12	17.8	0	0
2800	1.22	19.3	0	0
3200	1.28	20.3	0	0

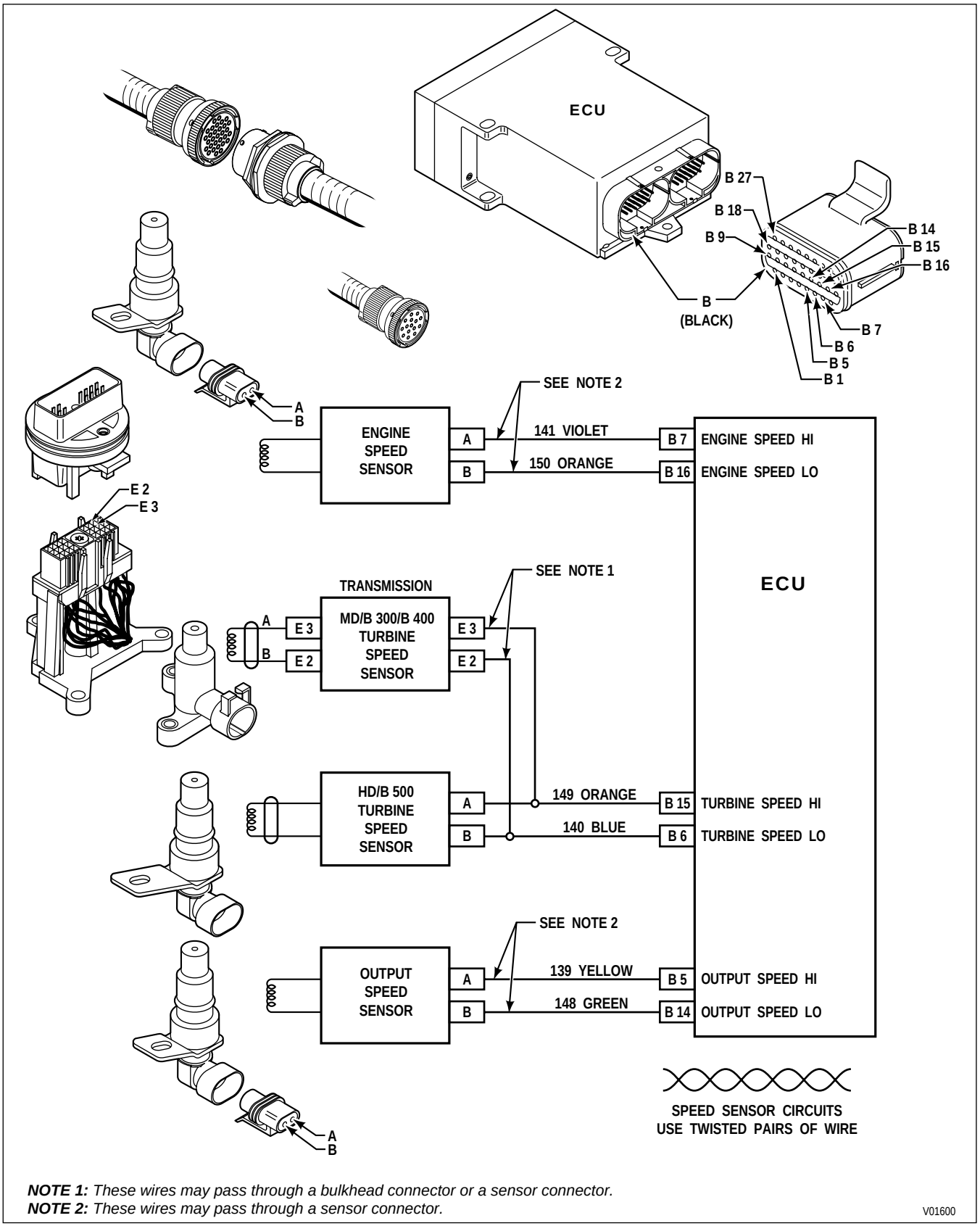
CONVERTER OPERATION
MAXIMUM ALLOWABLE
PRESSURE DROP

Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	10	1.5
800	0.22	3.5	40	5.8
1200	0.45	7.1	159	23.1
1400	0.57	9.0	252	36.6
1600	0.67	10.6	338	49.0
2000	0.80	12.7	481	69.8
2400	0.85	13.5	549	79.6
3200	0.85	13.5	549	79.6

LOCKUP OPERATION
MAXIMUM ALLOWABLE
PRESSURE DROP

Input rpm	Flow		Pressure Drop	
	L/s	gpm	kPa	psi
600	0.10	1.6	5	0.7
800	0.23	3.7	46	6.7
1200	0.48	7.6	148	21.5
1400	0.62	9.8	247	35.8
1600	0.73	11.6	346	50.2
2000	0.90	14.3	561	81.4
2400	1.07	17.0	737	106.9
2800	1.10	17.4	770	111.7
3200	1.10	17.4	791	114.7

CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE

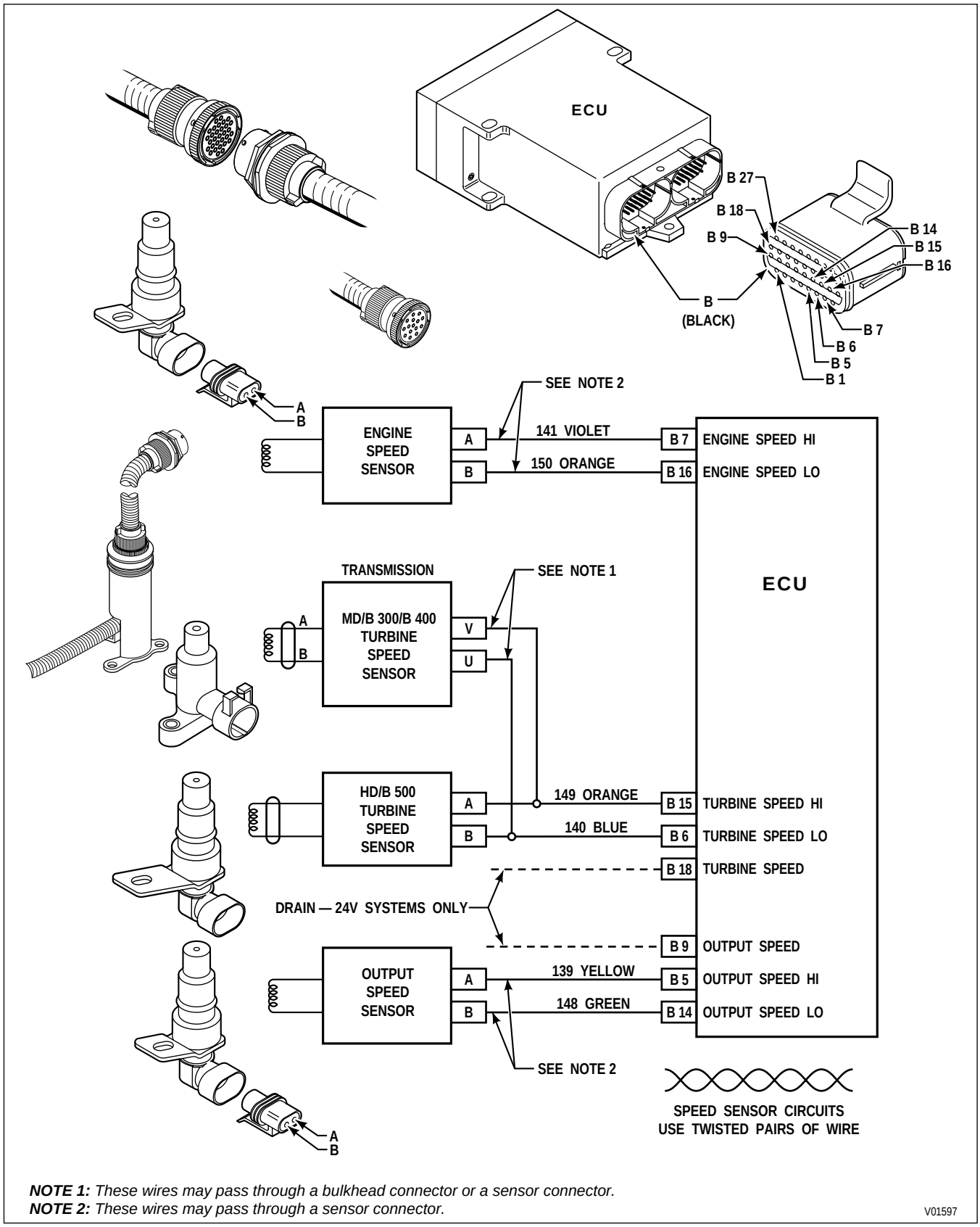


NOTE 1: *These wires may pass through a bulkhead connector or a sensor connector.*
NOTE 2: *These wires may pass through a sensor connector.*

V01600

Figure 6–13. Code 25 Schematic Drawing (Units Produced Prior To 9/94)

CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE



NOTE 1: *These wires may pass through a bulkhead connector or a sensor connector.*
NOTE 2: *These wires may pass through a sensor connector.*

Figure 6–14. Code 25 Schematic Drawing (Units Produced 9/94–12/97)

CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE *(Figures 6–13, 6–14)*

Main code 25 occurs if the output speed sensor reports a zero speed reading while both engine and turbine speeds are approximately equal, turbine speed is above a calibration value, and neutral is not selected or commanded. Main code 25 indicates either the output speed sensor has failed or the required oncoming clutch or clutches did not come on. Code 25 11 can be generated by a false turbine speed reading. This may be due to crosstalk between solenoid and turbine speed sensor circuits caused by direct wire-to-wire short or by water in the electrical connectors. See Section 4 for corrective action.

NOTE: If Code 25 XX is in memory at ECU initialization (ignition on) all display segments are illuminated.

Main Code	Subcode	Meaning	Applied Clutches
25	00	Output speed sensor, detected at zero speed, low range	C3, C6
25	11	Output speed sensor, detected at zero speed, 1st range	C1, C5
25	22	Output speed sensor, detected at zero speed, 2nd range	C1, C4
25	33	Output speed sensor, detected at zero speed, 3rd range	C1, C3
25	44	Output speed sensor, detected at zero speed, 4th range	C1, C2
25	55	Output speed sensor, detected at zero speed, 5th range	C2, C3
25	66	Output speed sensor, detected at zero speed, 6th range	C2, C4
25	77	Output speed sensor, detected at zero speed, reverse	C3, C5

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections can cause this and other codes.

1. Check the transmission fluid level and ensure correct fluid level.
2. Check for the presence of Code 22 16. If Code 22 16 is in the code list, go to Code 22 XX section and follow troubleshooting steps for Code 22 16.
3. Connect the Pro-Link® 9000 with ignition on, engine off; check for indication of turbine speed. If turbine speed is indicated, refer to Section 4–2 for corrective action.
4. If the output speed sensor and wiring are satisfactory, install pressure gauges into the appropriate clutch pressure taps (see appropriate transmission Service Manual or Appendix B in this manual) and make the shift again. See if either of the clutches has low or no pressure. Lack of pressure in first range may be due to a G solenoid stuck closed.
5. If a clutch is leaking pressure, drain the fluid, remove the control module and check for damaged valve body gaskets and stuck or sticky valves. If no problems are found, replace the solenoids for the clutches used in the range indicated by the code (refer to Figure 6–1). Refer to the appropriate transmission Service Manual for replacement procedure.

CODE 25 XX — OUTPUT SPEED SENSOR, DETECTED AT ZERO SPEED, X RANGE *(Figures 6–13, 6–14)*

6. If, after detecting leaking pressure and replacing solenoids, the problem persists, check for worn clutch or piston seals. Remove the transmission and repair or replace as necessary (refer to the proper transmission Service Manual).
7. This code requires accurate output and turbine speed readings. If there were no transmission problems detected, use the diagnostic tool and watch the speed readings for noise (erratic signals) from low speed to high speed in the range indicated by the code.
8. If a noisy sensor is found, check the sensor resistance (refer to the sensor resistance chart below) and check its wiring for opens, shorts, and shorts-to-ground (see Code 22 XX). Also closely check the terminals in the connectors for corrosion, contamination, or damage. Ensure the wiring to the sensors is a properly twisted wire pair. Remove the sensor and check for damage at the tone wheel end. Check for looseness of the tone wheel. Refer to the appropriate Service Manual if repair of a loose tone wheel is necessary. Replace the sensor if it is damaged or if its resistance (refer to Service Manual for proper procedure) is incorrect and isolate and repair any noted wiring problems. (Use twisted-pair if new speed sensor circuit is needed in external harness. Service Harness Twisted Shielded Pair P/N 29522703 is available for this procedure.)

Resistance	Temp. °C	Temp. °F
200 Ω	–40	–40
300 Ω	20	68
400 Ω	110	230

9. If no apparent cause for the code can be located, replace the turbine and output speed sensors. Refer to the appropriate transmission Service Manual for proper procedure.
10. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 32 XX — C3 PRESSURE SWITCH

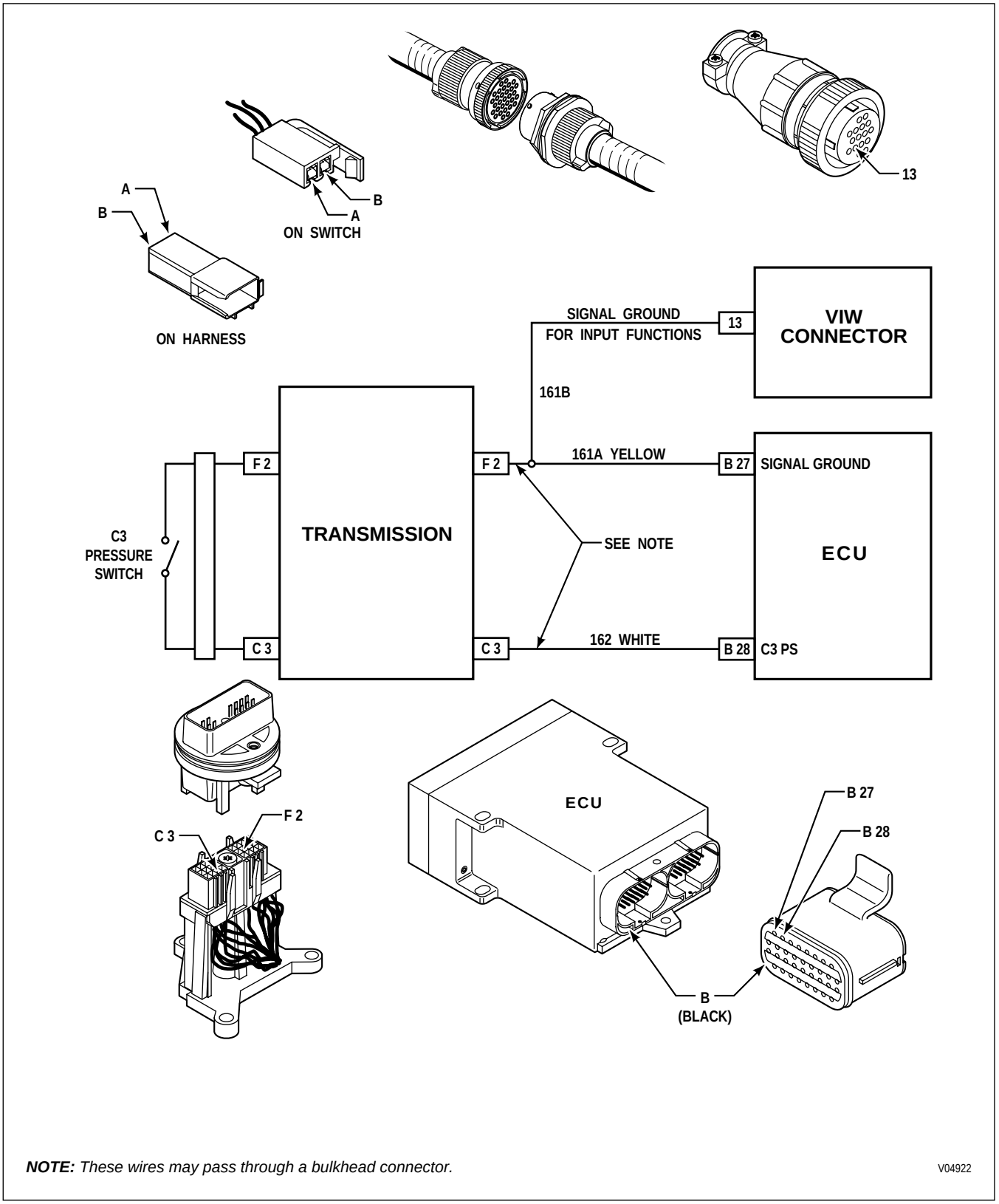
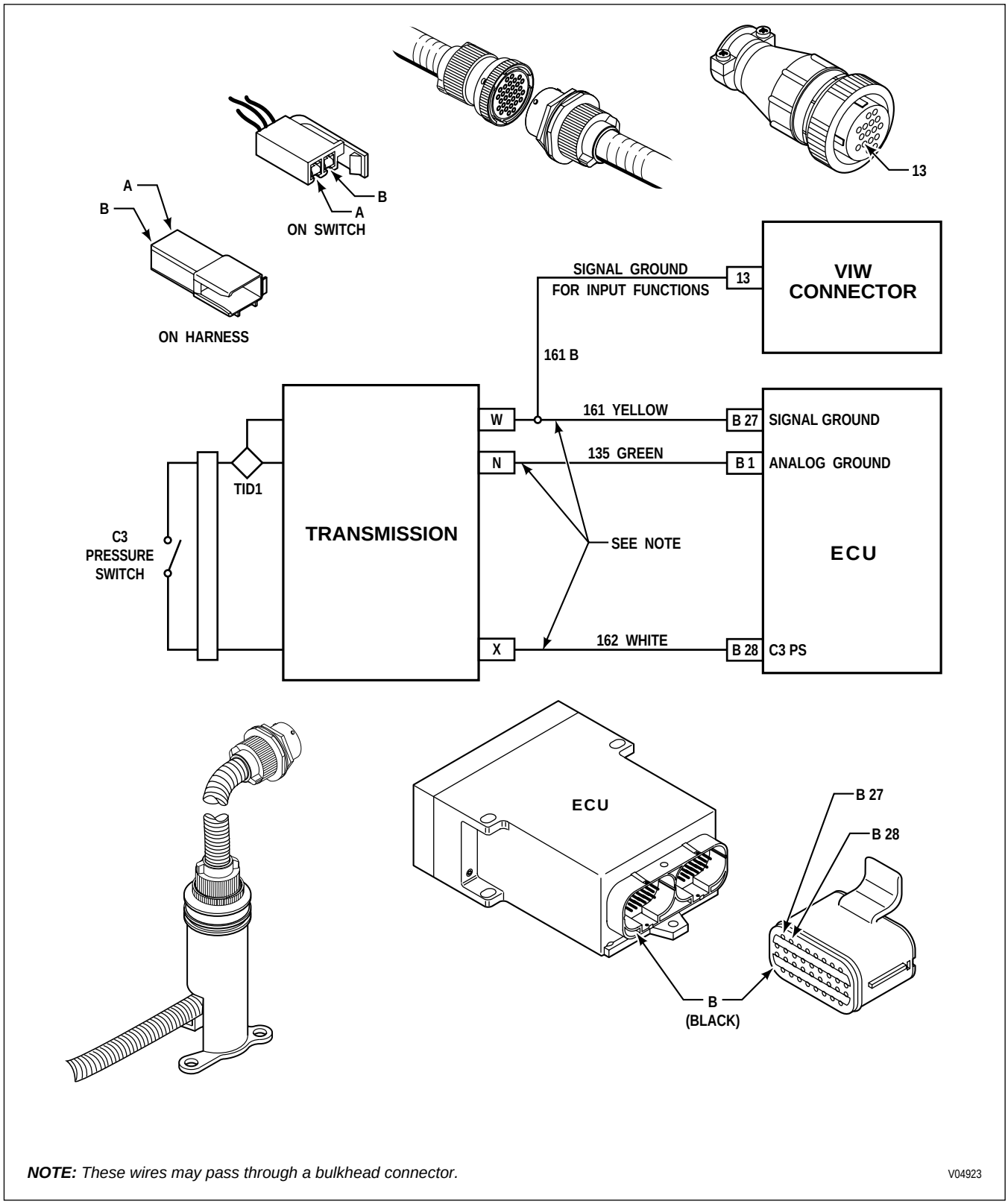


Figure 6–15. Code 32 Schematic Drawing (Units Produced Prior To 9/94)

CODE 32 XX — C3 PRESSURE SWITCH



NOTE: *These wires may pass through a bulkhead connector.*

V04923

Figure 6–16. Code 32 Schematic Drawing (Units Produced 9/94–12/97)

CODE 32 XX — C3 PRESSURE SWITCH *(Figures 6–15, 6–16)*

Main code 32 indicates the transmission gear ratio is correct, but the C3 pressure switch is open when it should be closed.

Main Code	Subcode	Meaning
32	00	C3 switch open in low range
32	33	C3 switch open in third range
32	55	C3 switch open in fifth range
32	77	C3 switch open in reverse range

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

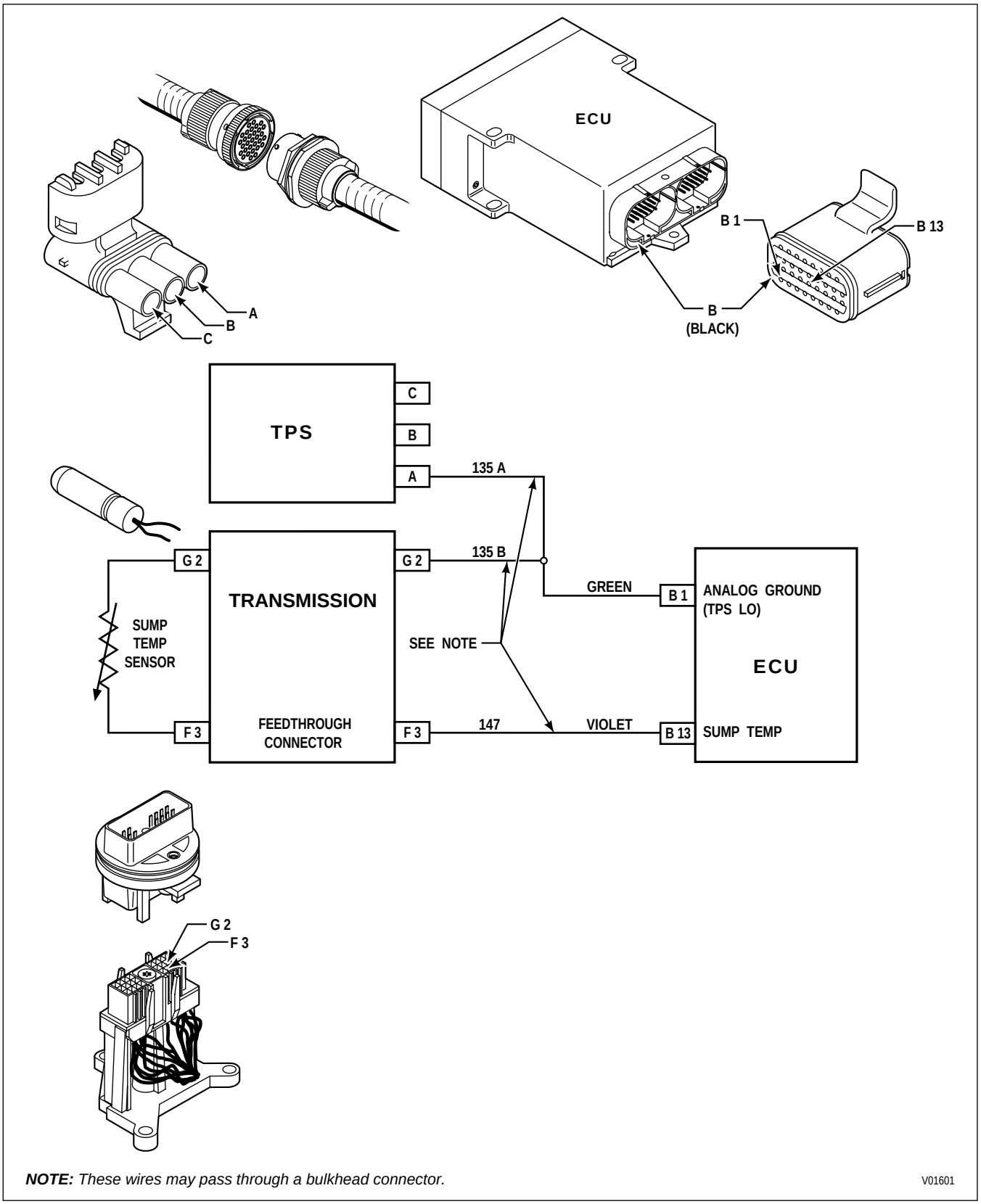
CAUTION: It is very important to correct any short-to-battery condition found. A short-to-battery can damage a circuit in the ECU, requiring the ECU to be replaced. Replacing a failed ECU without correcting the short-to-battery could damage the new ECU.

1. Disconnect the connectors at the ECU and the transmission. Check the C3 switch circuit for opens, shorts to other wires, shorts-to-ground, or shorts-to-battery. If wiring problems are found, isolate and repair. The C3 pressure switch closes at 206.8 ± 48 kPa (30 ± 7 psi). Resistance should be 2 Ohms maximum when the switch is closed and 20,000 – infinity (overlimit) Ohms when the switch is open.
2. If problems are not found in the external harness, drain the fluid, remove the control module, and check the internal harness for opens, shorts between wires, or shorts-to-ground (refer to the proper transmission Service Manual). If wiring problems are found, isolate and repair (see Appendix E, Paragraph 1–9).
3. If no wiring problems are found, replace the C3 pressure switch (refer to transmission Service Manual).
4. If the problem recurs, use spare wires for the C3 pressure switch circuit.
5. If the problem recurs again, replace the internal harness.
6. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

DIAGNOSTIC CODES

NOTES

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR



NOTE: *These wires may pass through a bulkhead connector.*

V01601

Figure 6–17. Code 33 Schematic Drawing (Units Produced Prior To 9/94)

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR

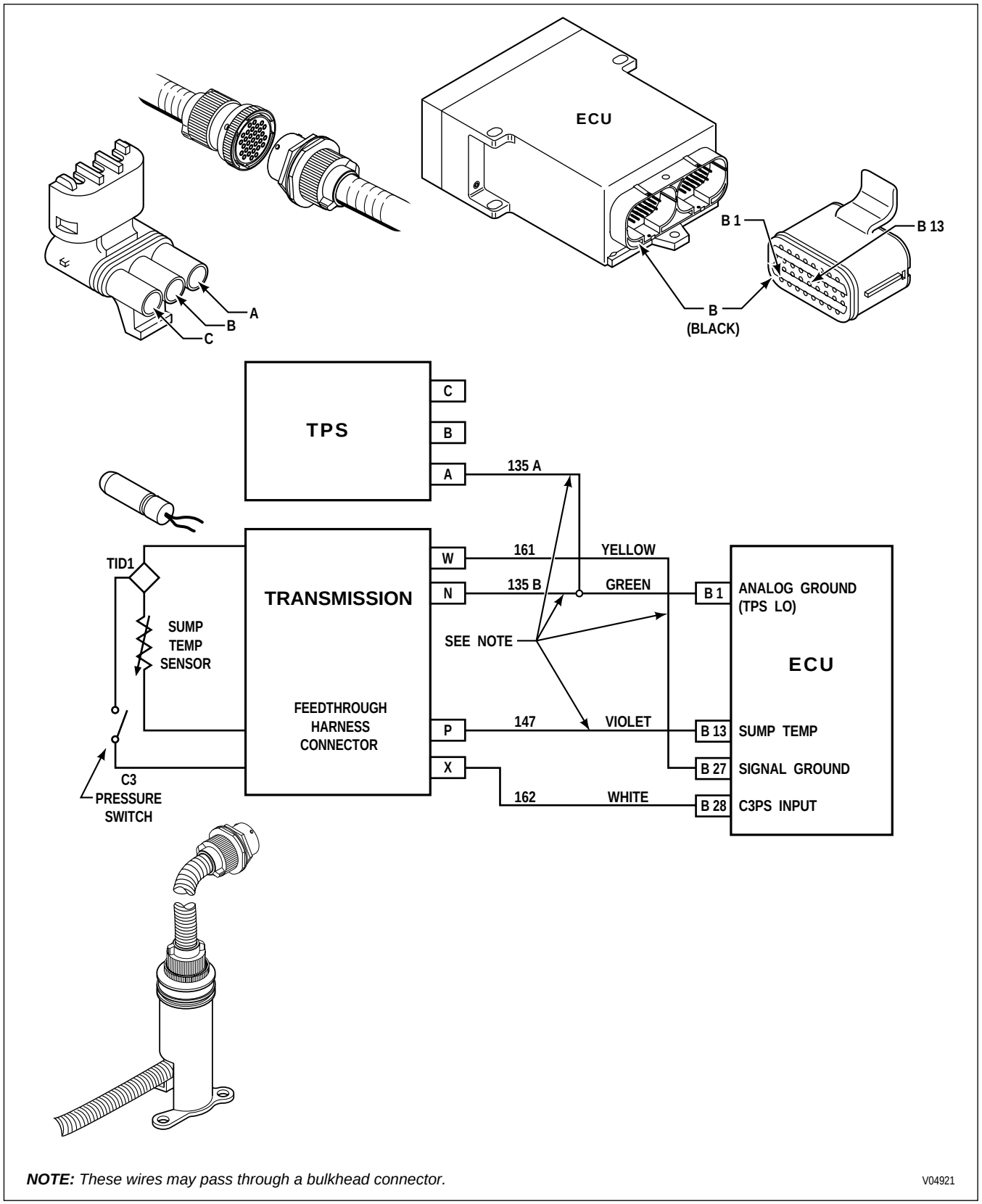


Figure 6–18. Code 33 Schematic Drawing (Units Produced 9/94–12/97)

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR *(Figures 6–17, 6–18)*

Main code 33 indicates the sump temperature sensor is providing a signal outside the usable range of the ECU. This code indicates the sensor failed showing abnormally high or low temperature readings. Main code 33 can be caused by a component or circuit failure or by extremely high or low temperatures. There are no operational inhibits related to main code 33. The ECU assumes a hardware failure and that transmission temperatures are normal (93ºC; 200ºF). Temperatures above or below normal cause poor shift quality.

NOTE: Code 33 23 in conjunction with Code 21 23 indicates the loss of common ground (wire 135) between the throttle and temperature sensors.

Main Code	Subcode	Meaning
33	12	Temperature sensor failed low
33	23	Temperature sensor failed high

Active Indicator Clearing Procedure:

- Power down
- Manual
- Self-clearing

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check the transmission fluid level.

Troubleshooting:

1. If possible, check the sump temperature with a DDR. If a DDR is not available, use the shift selector display to determine if the code is active (refer to Section 6–2). Disconnect harness at ECU and check resistance of the sensor and compare with Figure 6–19.
2. If Step 1 reveals that the extreme temperature indication is no longer present, the temperature limit could have been reached due to operational or ambient temperature extremes. Also, you may be experiencing an intermittent problem and the code will not be active. Proceed cautiously, it is unlikely there is a sensor hardware fault.
3. Disconnect the external harness at the transmission. Check the connectors and terminals for dirt, corrosion, or damage. Clean or replace as necessary.
4. Check the sensor wires in the external harness for opens (Code 33 23), shorts between wires, or shorts-to-ground (code 33 12 — refer to Section 4). If wiring problems are found, isolate and repair as described in Appendix E.
5. If no harness problems are found check the feedthrough connector for damage. If the feedthrough harness connector is satisfactory, drain the fluid and remove the control module. Check for chafing of the sensor wires, especially near the separator plate. Eliminate the chafe point and repair the wire as required. If no chafe point is found, replace the sensor (refer to the Transmission Service Manual and Appendix E, Paragraph 1–14 in this Manual).
6. If the problem recurs, use spare wires in the external harness for the temperature sensor circuit.
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 33 XX — SUMP OIL TEMPERATURE SENSOR *(Figures 6–17, 6–18)*

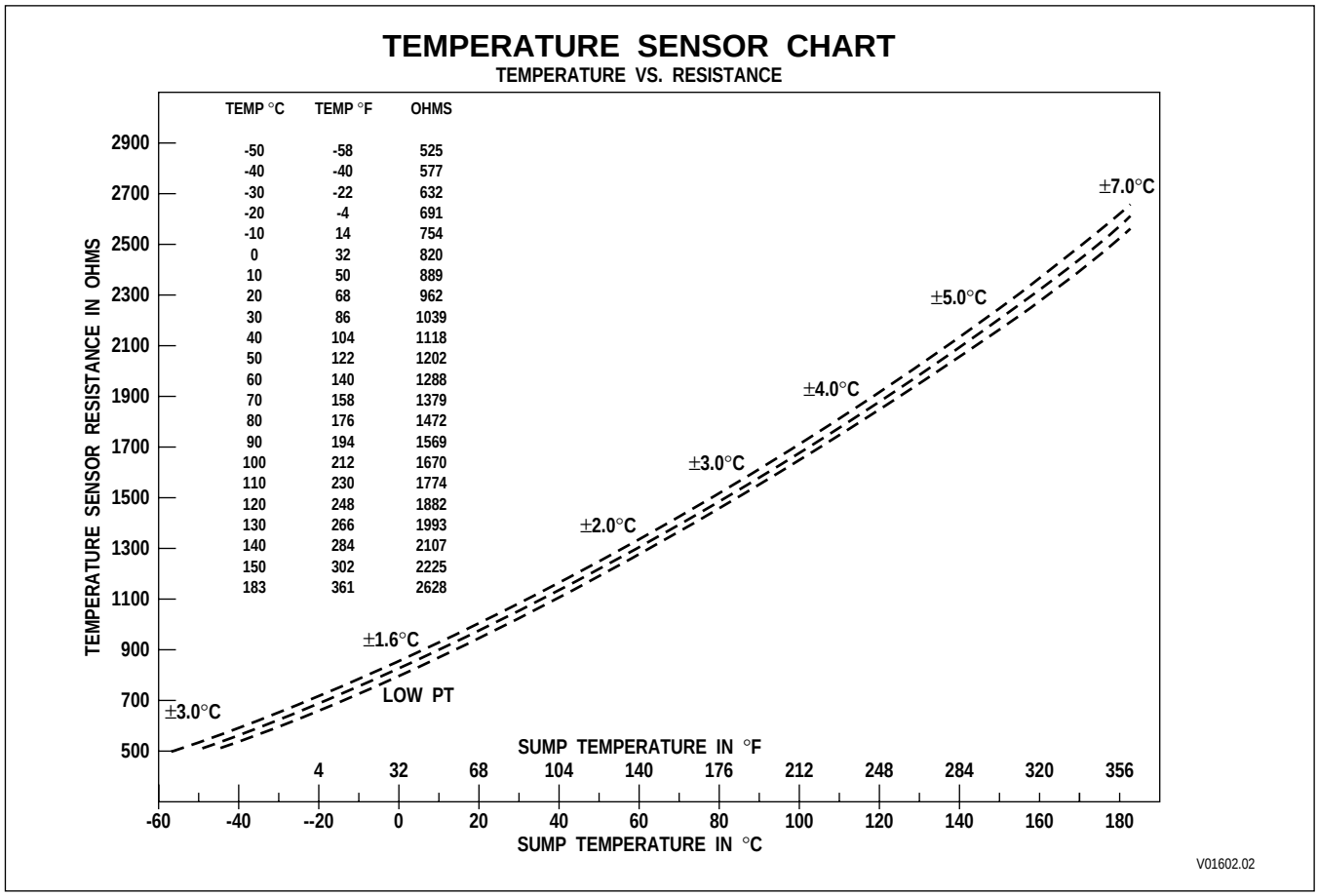


Figure 6–19. Temperature Sensor Chart

CODE 34 XX — EEPROM COMPATIBILITY OR CHECKSUM FAULT

Main code 34 indicates there is a problem with the calibration EEPROM.

Main Code	Subcode	Meaning
34	12	EEPROM, factory calibration compatibility number wrong
34	13	EEPROM, factory calibration checksum
34	14	EEPROM, power off block checksum
34	15	EEPROM, diagnostic queue block checksum
34	16	EEPROM, real-time block checksum

Active Indicator Clearing Procedure:

- Power down

NOTE: Copying and reloading the current calibration into the ECU will not correct the fault.

Troubleshooting:

1. If the code set is 34 14 and it occurs in conjunction with Code 35 00, proceed to find the cause for Code 35 00 and correct it.
2. After the cause for Code 35 00 has been corrected, drive the vehicle to see if Code 34 14 recurs. If Code 34 14 recurs, proceed to Step 3.
3. Reprogram the correct calibration into the EEPROM. Contact your nearest Allison distributor/ dealer for locations qualified to do recalibration. Be certain the calibration and the software level are compatible.
4. If the code recurs after reprogramming the EEPROM calibration, replace the ECU.

CODE 35 XX — POWER INTERRUPTION

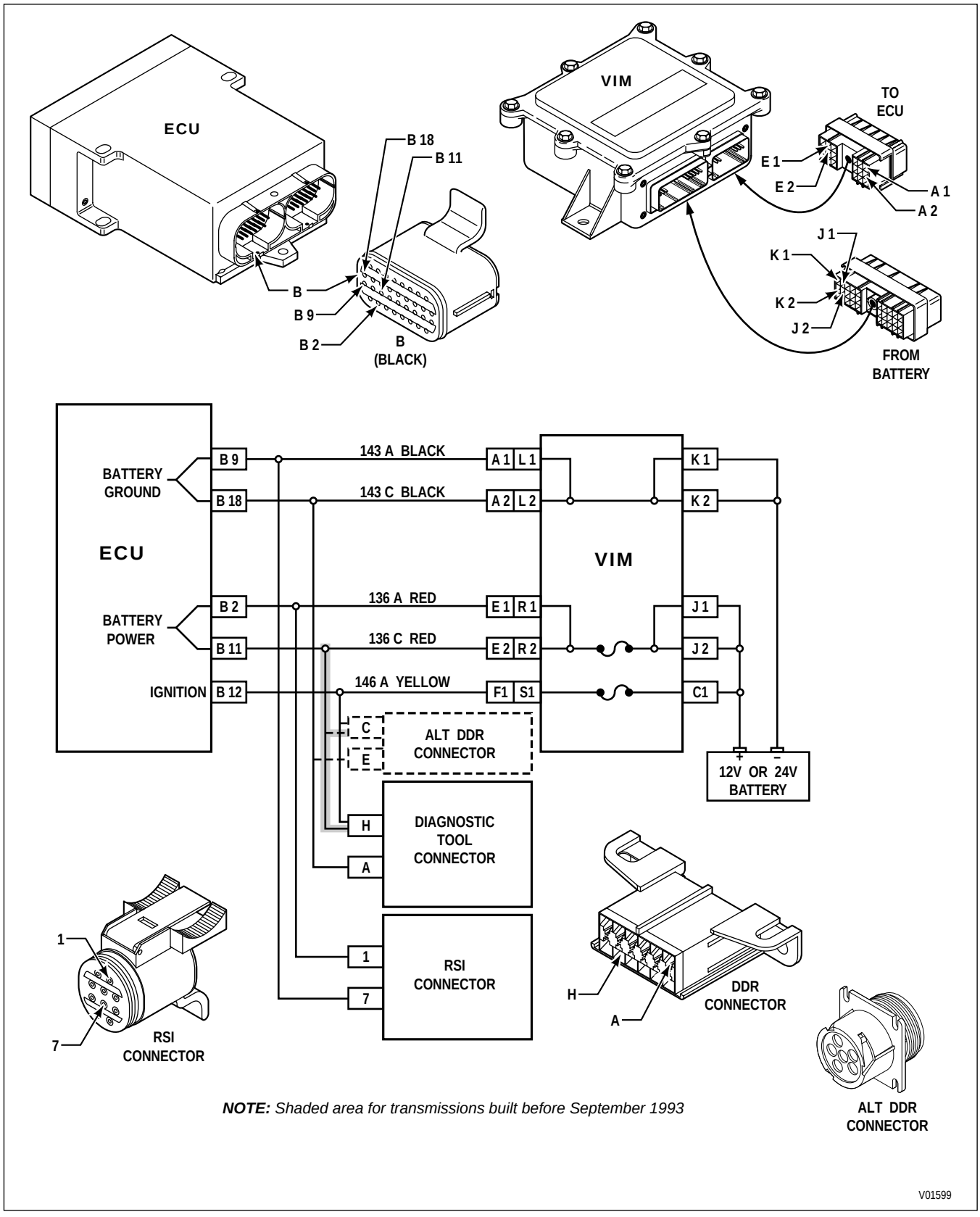


Figure 6–20. Code 35 Schematic Drawing

CODE 35 XX — POWER INTERRUPTION *(Figure 6–20)*

Main code 35 indicates the ECU has detected a complete power loss before the ignition was turned off. When this happens, the ECU is not able to save the current operating parameters in memory before turning itself off.

Main Code	Subcode	Meaning
35	00	Power interruption. (Not an active code; only appears after power is restored.) During power interruption, DNS light is not illuminated and the transmission will not shift.
35	16	Real-time EEPROM write interruption. (Power interruption at the same time the ECU is recording a critical code to the real-time section of the EEPROM.)

Active Indicator Clearing Procedure:

- Power down
- Manual — except Code 35 16

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

Troubleshooting:

1. If the vehicle has a master switch controlling battery power to the ECU and an ignition switch, turning the master switch off before turning the ignition switch off can cause this code. No troubleshooting is necessary.
2. If improper switch sequencing is not the cause, check ECU power and ground for opens, shorts, and shorts-to-ground. Not using battery-direct power and battery ground connections can cause this code. A defective charging system, or open battery fuse or fusible link can also cause this code. The battery fuse or fusible link may be at the battery or in the VIM. Dirty, corroded, or painted power and ground connections can also cause this code.
3. If all system power and ground connections are satisfactory and the problem persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem reoccurs, reinstall the replacement ECU.

CODE 36 XX — HARDWARE AND SOFTWARE NOT COMPATIBLE

Main code 36 indicates the system has detected a mismatch between the ECU hardware and the ECU EPROM software or that there is a TransID (TID) problem.

Main Code	Subcode	Meaning
36	00	Mismatch between ECU hardware and software

Active Indicator Clearing Procedure:

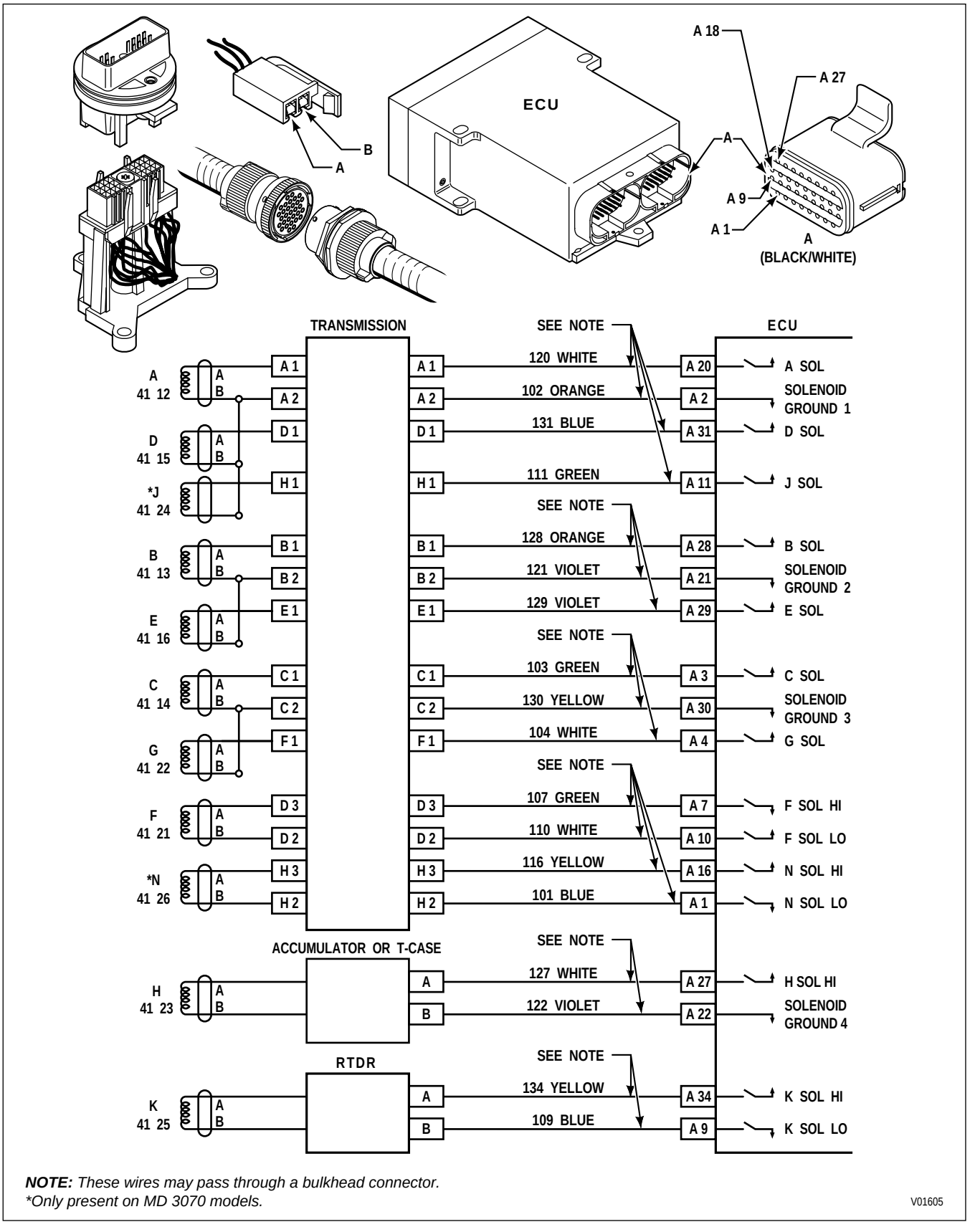
- Power down

CAUTION:	Static electricity can destroy the EEPROM. If the ECU must be opened, use the Anti-Static Wrist Strap BT 8639-B to prevent a static electricity discharge to the EEPROM.

Troubleshooting:

1. Correction for subcode 36 00 requires the installation of EPROM software that is compatible with the ECU hardware involved. (If a different EEPROM calibration is required, update the ECU hardware to be compatible.)

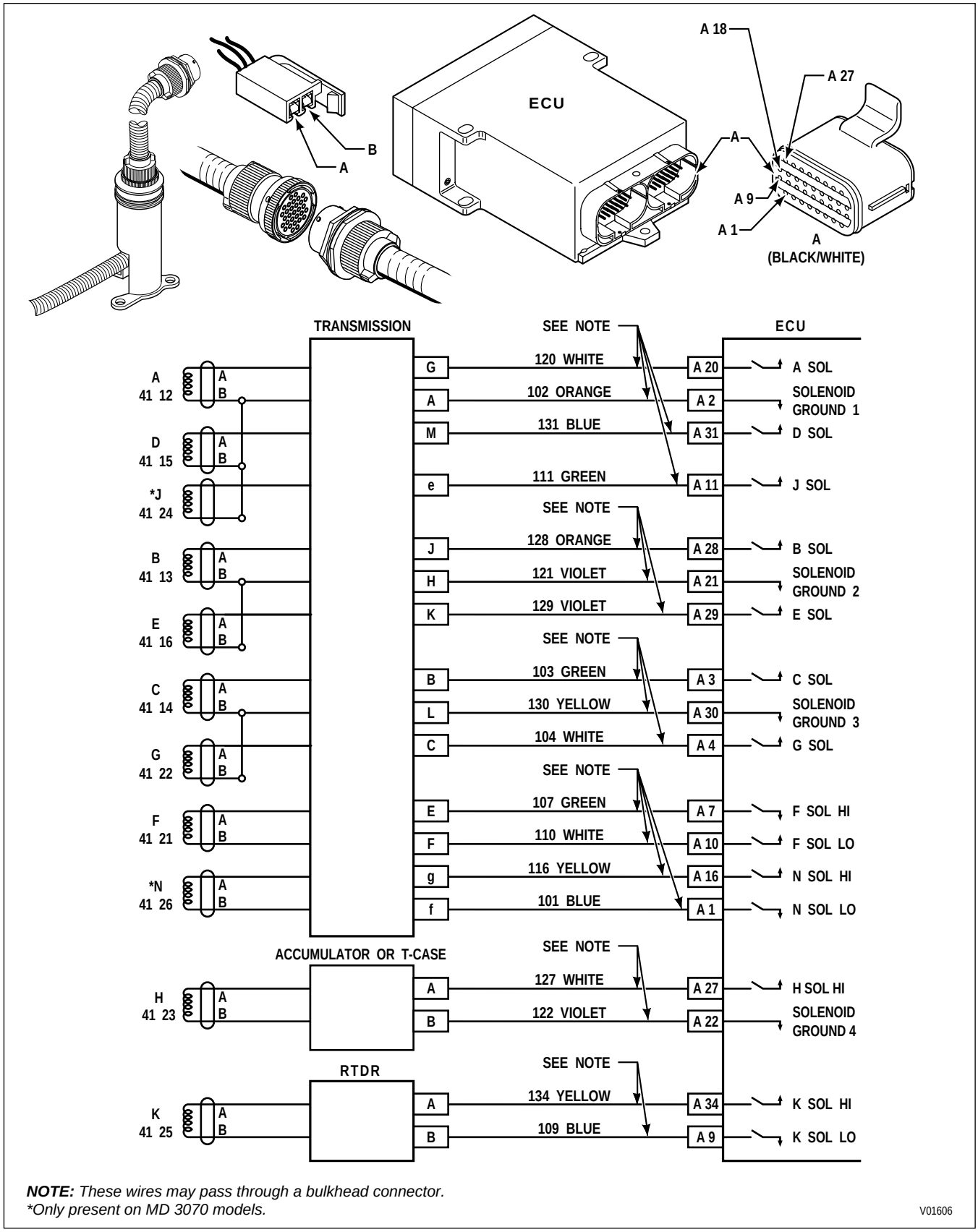
CODE 41 XX — OPEN OR SHORT-TO-GROUND IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

Figure 6–21. Code 41 Schematic Drawing (Units Produced Prior To 9/94)

CODE 41 XX — OPEN OR SHORT-TO-GROUND IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

Figure 6–22. Code 41 Schematic Drawing (Units Produced 9/94–12/97)

CODE 41 XX — OPEN OR SHORT-TO-GROUND IN SOLENOID CIRCUIT

(Figures 6–21, 6–22)

Main code 41 indicates the ECU has detected either an open circuit or a short-to-ground in a solenoid or the solenoid wiring. The **DO NOT SHIFT** response is activated when this code is detected and all solenoids are turned off.

NOTE: ***For subcodes 12, 13, 14, 15, 16, 22 — neutral start is inoperable; all display segments are on if the code is logged during ECU initialization (ignition on). Subcodes 21, 23, 24, 25, and 26 will not trigger the DO NOT SHIFT light.***

NOTE: ***If solenoid resistance is about 1–2 Ohms, a short-to-ground code may not be set but could cause a burned-out solenoid driver in the ECU. Replace the solenoid when this occurs (see appropriate transmission Service Manual for replacement procedure). If the solenoid driver is burned out, 69 XX codes will be set. See the troubleshooting procedure for 69 XX codes.***

Main Code	Subcode	Meaning
41	12	Open or Short-to-Ground A Solenoid Circuit
41	13	Open or Short-to-Ground B Solenoid Circuit
41	14	Open or Short-to-Ground C Solenoid Circuit
41	15	Open or Short-to-Ground D Solenoid Circuit
41	16	Open or Short-to-Ground E Solenoid Circuit
41	21	Open or Short-to-Ground F Solenoid Circuit
41	22	Open or Short-to-Ground G Solenoid Circuit
41	23	Open or Short-to-Ground H Solenoid Circuit
41	24	Open or Short-to-Ground J Solenoid Circuit
41	25	Open or Short-to-Ground K Solenoid Circuit
41	26	Open or Short-to-Ground N Solenoid Circuit

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

CAUTION: All solenoids (except “H”) are pulse width modulated to control current levels. Any DC battery voltage applied directly to the solenoid must be no greater than 5–6V to prevent damage to the solenoid coil.

CODE 41 XX — OPEN OR SHORT-TO-GROUND IN SOLENOID CIRCUIT

(Figures 6–21, 6–22)

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, contact with the following pairs of terminals will result in resistance measurements of two solenoids through a shared ground. The resistance should be twice that of a single solenoid. Refer to Figure 6–23 for solenoid resistance values versus temperature.

Terminals	Solenoids Which Share Ground
A1, D1	A, D
B1, E1	B, E
C1, F1	C, G

NOTE: ***Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.***

NOTE: ***The retarder accumulator solenoid ("H") has a 30 Ohm coil. Since "H" solenoid is not mounted in the sump, no relationship between temperature and resistance is required.***

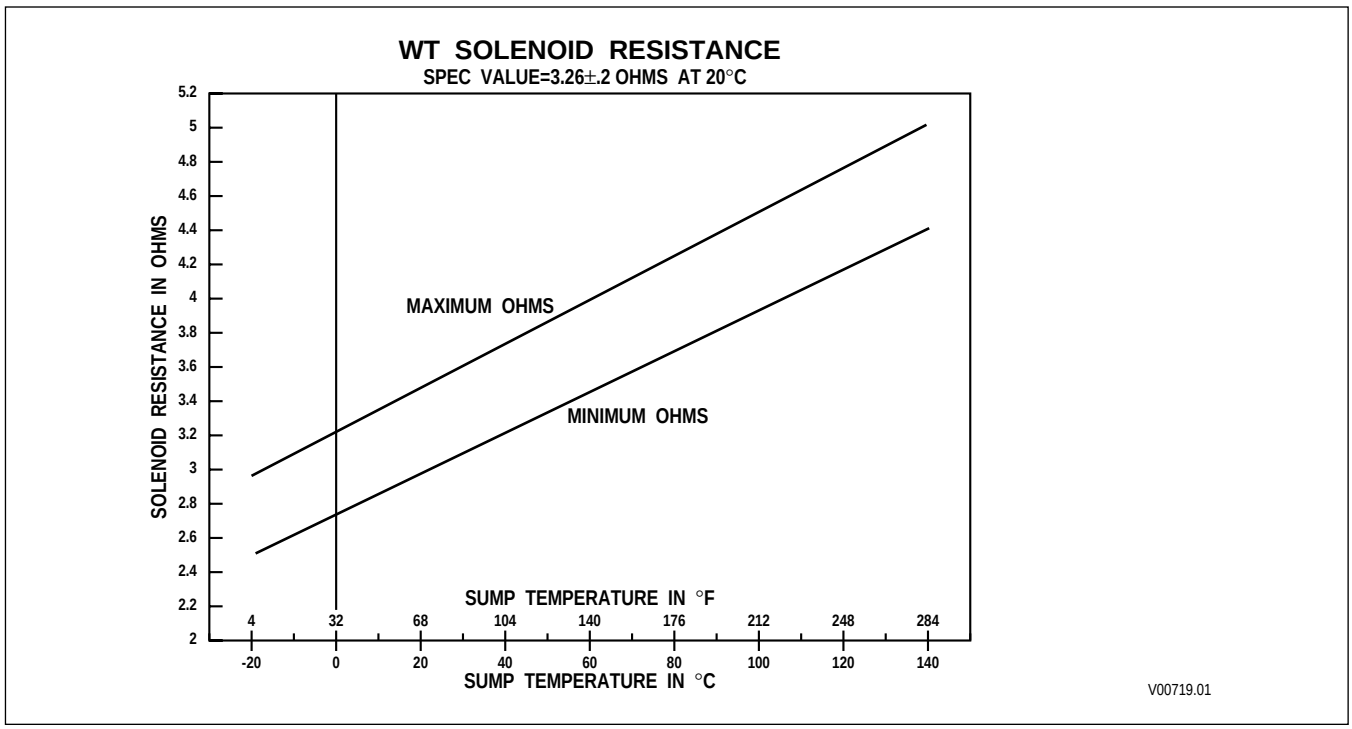


Figure 6–23. Solenoid Resistance vs. Temperature

CODE 41 XX — OPEN OR SHORT-TO-GROUND IN SOLENOID CIRCUIT

(Figures 6–21, 6–22)

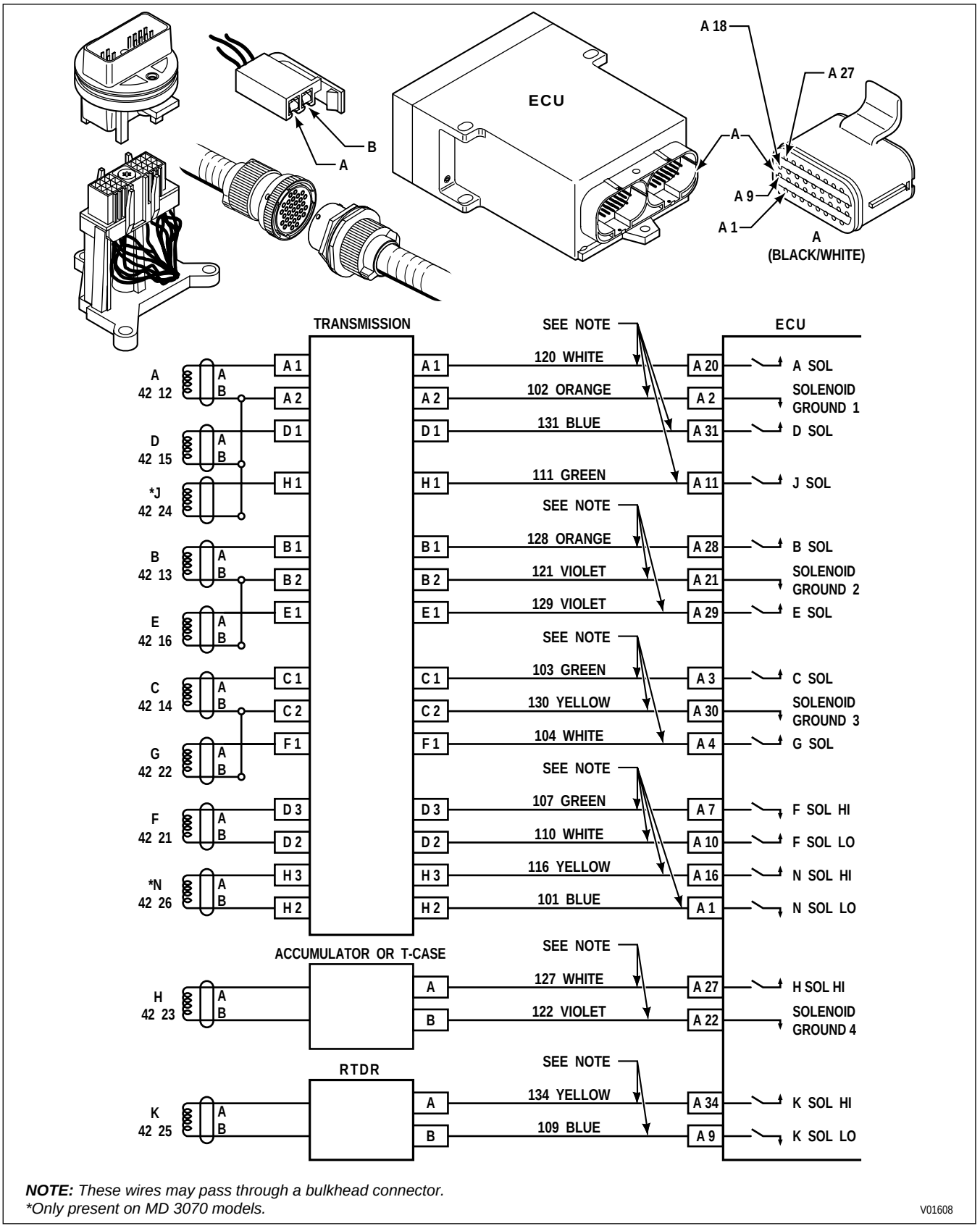
Troubleshooting:

1. Make sure the transmission connector is tightly connected. If the connector is properly connected, disconnect the harness at the transmission and check the terminals in the external harness and feedthrough connectors. Clean or replace as necessary.
2. If the connector is connected, clean, and not damaged, check the solenoid circuit in the transmission for opens or shorts to other wires (refer to the temperature/resistance chart). Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If an open or short circuit is located, drain the fluid, remove the control module (refer to the transmission Service Manual), and isolate the open or short. The fault is probably in the feedthrough connector, the internal harness, or the solenoid itself (refer to Figure 6–1 for solenoid location).
3. If the open or short is not found at the transmission connector, disconnect the connectors at the ECU and inspect the terminals in the connectors and the ECU for damage or contamination. Clean or replace as necessary. If the terminals are satisfactory, check the wires of the solenoid circuit in the external harness for continuity and shorts-to-ground or shorts between wires. If an open or short is found in one of the wires, isolate and repair it or use a spare wire in the external harness.
4. If the open or short is not found in either the transmission or the harness, the condition must be intermittent.
5. Drain the fluid, remove the control module, and replace the solenoid and internal harness (refer to the transmission Service Manual).
6. If the condition recurs, use spare wire(s) for the solenoid circuit indicated by the trouble code. See Appendix D for location of spare wires and Appendix E for connector assembly/disassembly information.
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

DIAGNOSTIC CODES

NOTES

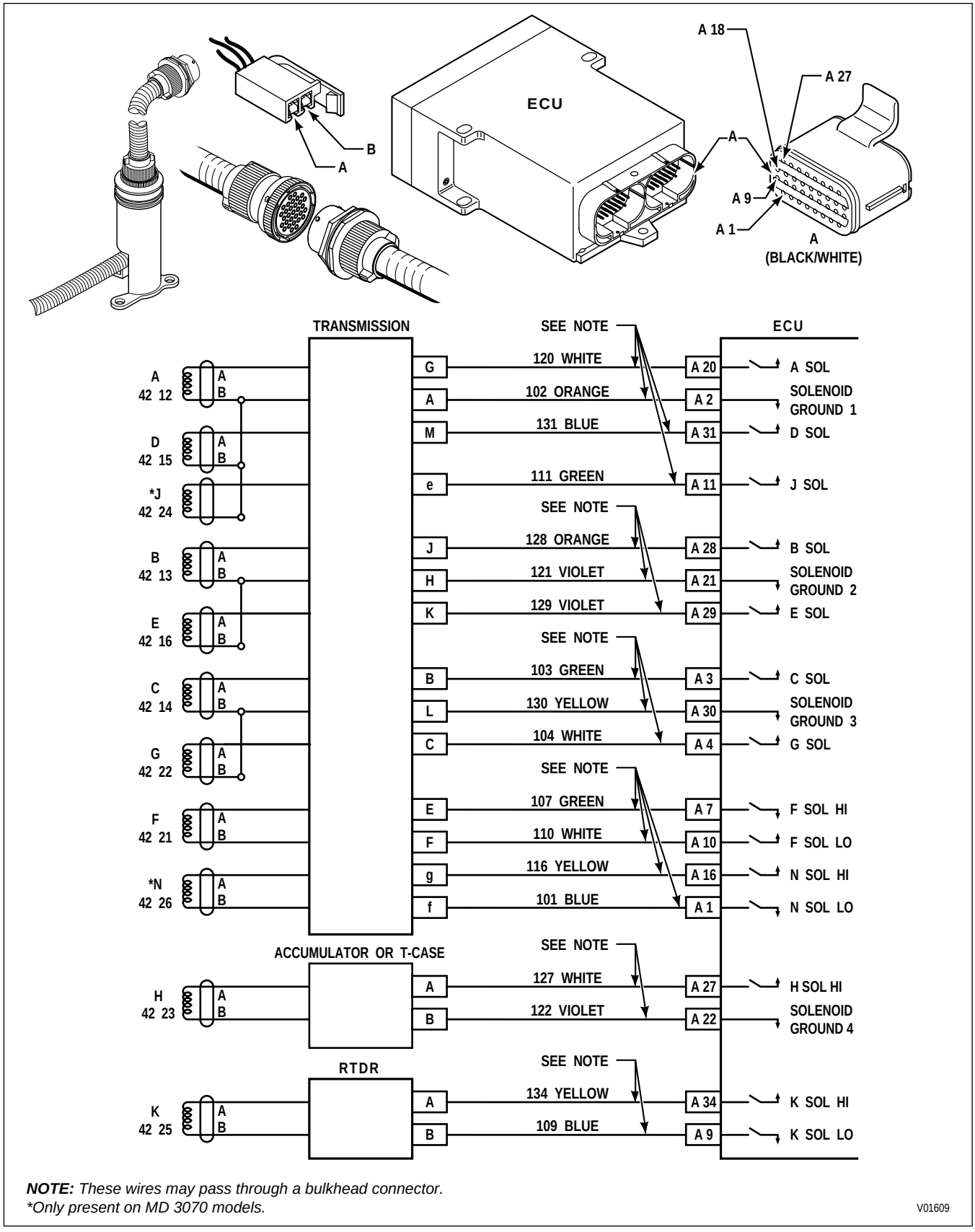
CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

Figure 6–24. Code 42 Schematic Drawing (Units Produced Prior To 9/94)

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

V01609

Figure 6–25. Code 42 Schematic Drawing (Units Produced 9/94–12/97)

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT

(Figures 6–24, 6–25)

Main code 42 indicates the ECU has detected a short-to-battery condition in a solenoid wiring circuit. Solenoids F and K have a second driver on the low (ground) side which can turn off the solenoid. All other solenoids have a driver only on the high (power) side of the solenoid. Even though the driver can be turned off, a stuck solenoid is shorted-to-battery which means it is continuously powered at an unregulated 12V or 24V instead of a regulated (pulse width modulated) voltage. A power-side driven solenoid stuck closed will not allow current regulation and the same code will occur. Eventually, the solenoid coil will burn up and become open. If the vehicle is turned off and restarted, a Code 41 XX occurs in early units and a Code 45 XX in later units.

NOTE: For subcodes 12, 13, 14, 15, 16, 22 — neutral start is inoperable; all display segments are on if the code is logged during ECU initialization (ignition on). Subcodes 21, 23, 24, 25, and 26 will not trigger the DO NOT SHIFT light.

NOTE: If solenoid resistance is about 1–2 Ohms, a short-to-ground code may not be set but could cause a burned-out solenoid driver in the ECU. Replace the solenoid when this occurs (see appropriate transmission Service Manual for replacement procedure). If the solenoid driver is burned out, 69 XX codes will be set. See the troubleshooting procedure for 69 XX codes.

Main Code	Subcode	Meaning
42	12	Short-to-Battery A Solenoid Circuit
42	13	Short-to-Battery B Solenoid Circuit
42	14	Short-to-Battery C Solenoid Circuit
42	15	Short-to-Battery D Solenoid Circuit
42	16	Short-to-Battery E Solenoid Circuit
42	21	Short-to-Battery F Solenoid Circuit
42	22	Short-to-Battery G Solenoid Circuit
42	23	Short-to-Battery H Solenoid Circuit
42	24	Short-to-Battery J Solenoid Circuit
42	25	Short-to-Battery K Solenoid Circuit
42	26	Short-to-Battery N Solenoid Circuit

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

NOTE: The retarder accumulator solenoid (“H”) has a 30 Ohm coil. Since “H” solenoid is not mounted in the sump, no relationship between temperature and resistance is required.

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

NOTE: Energizing the solenoids and listening for ball/plunger movement is sometimes useful in troubleshooting.

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT

(Figures 6–24, 6–25)

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, contact with the following pairs of terminals will result in resistance measurements of two solenoids through a shared ground. The resistance should be twice that of a single solenoid. Refer to Figure 6–26 for solenoid resistance versus temperature.

Terminals	Solenoids Which Share Ground
A1, D1	A, D
B1, E1	B, E
C1, F1	C, G

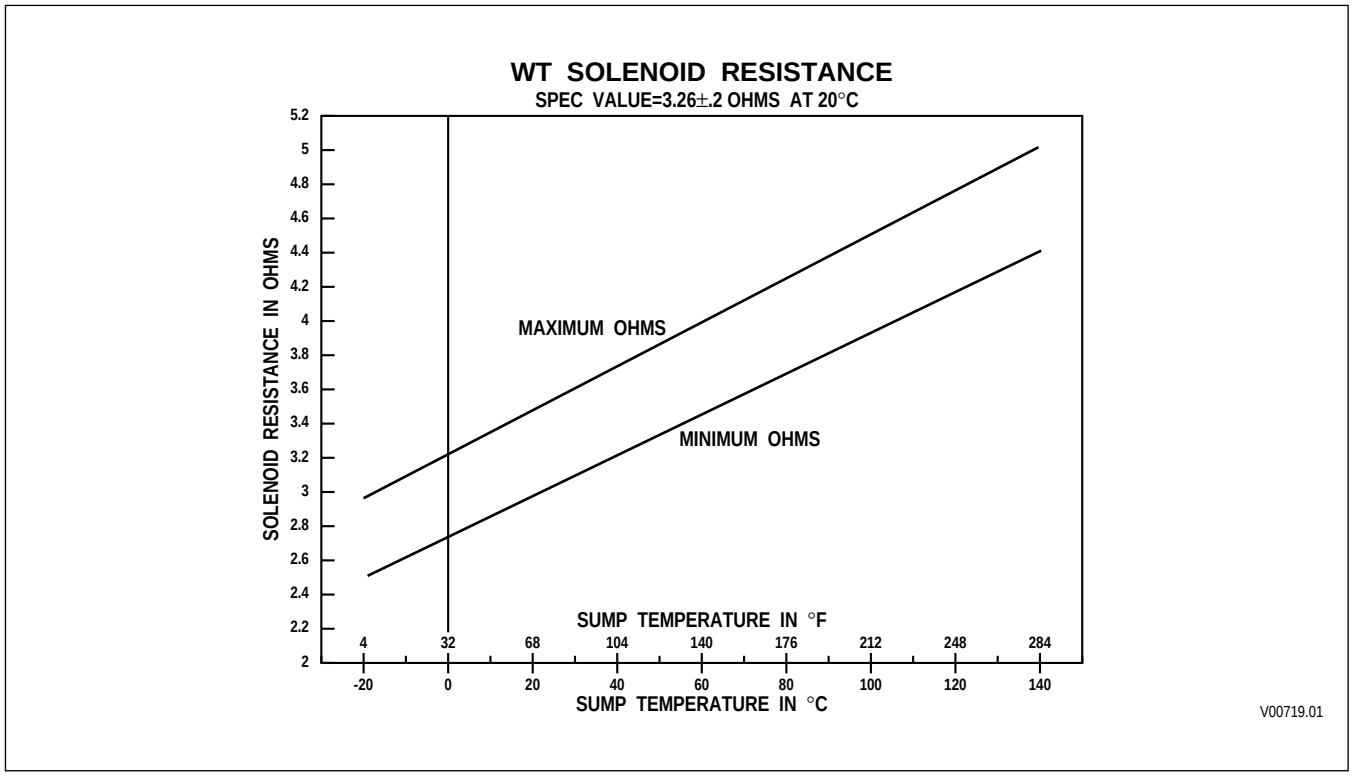


Figure 6–26. Solenoid Resistance vs. Temperature

Troubleshooting:

1. Make sure the transmission connector is tightly connected. If the connector is properly connected, disconnect the wiring harness at the transmission. Check the connector for water contamination and for corroded or damaged terminals. Clean or replace as necessary.
2. Test solenoid circuit at the transmission connector for shorts between the solenoid circuit being diagnosed and all other terminals in the connector. This test may be simplified by using the J 38850 test tool. Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If a short is found, isolate and repair the short. The short will probably be in the internal wiring harness.

CODE 42 XX — SHORT-TO-BATTERY IN SOLENOID CIRCUIT

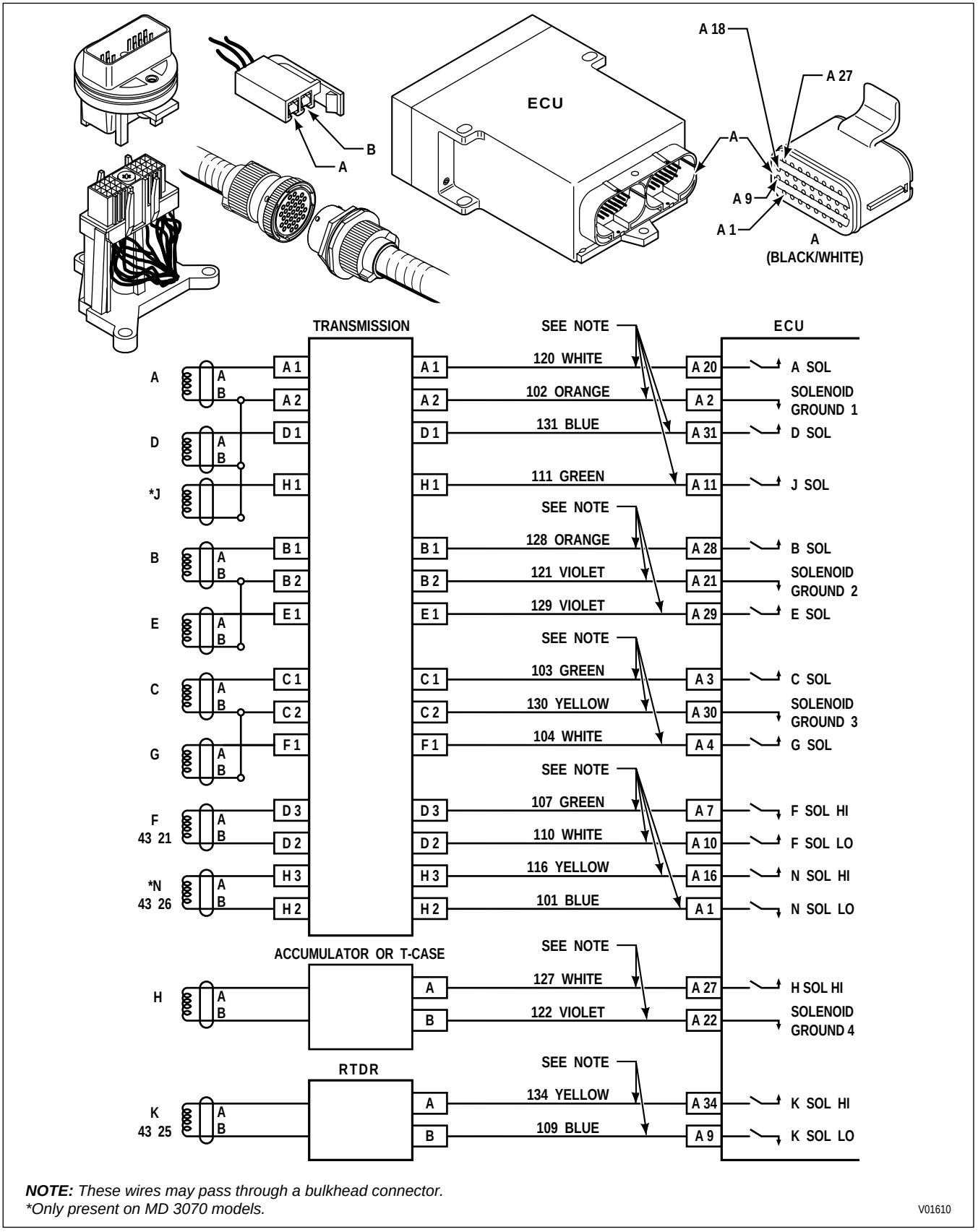
(Figures 6–24, 6–25)

3. If the short is not found at the transmission connector, disconnect the connectors at the ECU and check the wires of the solenoid circuit for shorts between the solenoid wires and all other terminals in both connectors (at the ECU). If the short is found in one of the wires, isolate and repair it or use a spare wire (Appendix E, 1–7).
4. If the short is not found in either the transmission or the harness, the condition must be intermittent.
5. Drain the fluid, remove the control module (see the transmission Service Manual), and replace the internal harness.
6. If the condition recurs, use spare wire(s) in the external harness for the solenoid circuit indicated by the trouble code. (Refer to Appendix D for location of spare wire(s) and Appendix E for connector assembly/disassembly information.)
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

DIAGNOSTIC CODES

NOTES

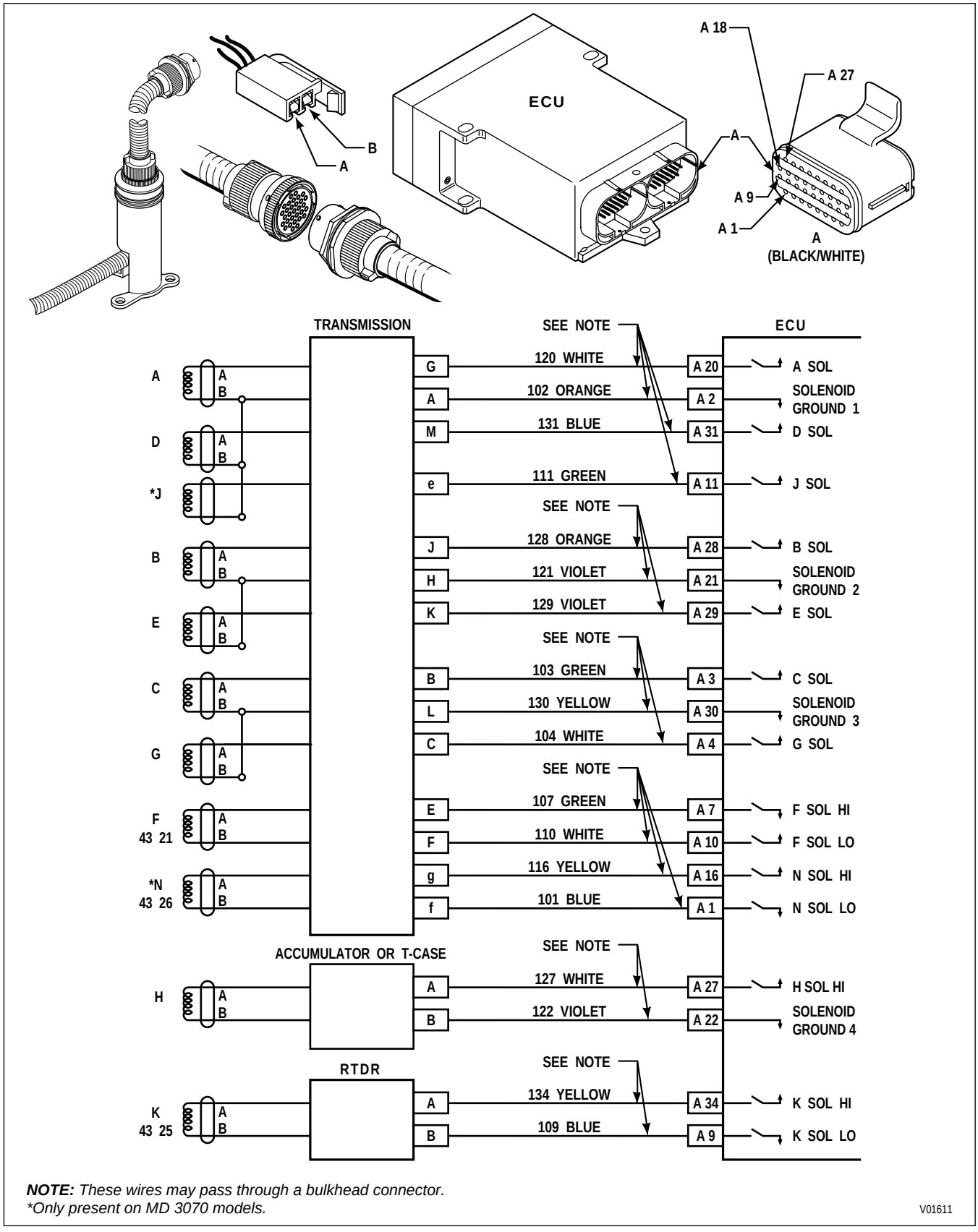
CODE 43 XX — SOLENOID LOW SIDE CIRCUIT, OPEN DRIVER, OR WIRE SHORTED-TO-GROUND



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

Figure 6–27. Code 43 Schematic Drawing (Units Produced Prior To 9/94)

CODE 43 XX — SOLENOID LOW SIDE CIRCUIT, OPEN DRIVER, OR WIRE SHORTED-TO-GROUND



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

V01611

Figure 6–28. Code 43 Schematic Drawing (Units Produced 9/94–12/97)

CODE 43 XX — SOLENOID LOW SIDE CIRCUIT, OPEN DRIVER, OR WIRE SHORTED-TO-GROUND *(Figures 6–27, 6–28)*

Main code 43 indicates the ECU has detected an open solenoid low side driver (switch) or a low side (ground) solenoid wire shorted-to-ground. An open or short prevents the ECU from turning off the F or K solenoid on the high (power) and the low (ground) sides as required (described in Code 42 XX). A Code 43 XX can trigger a Code 45 XX.

NOTE: ***If solenoid resistance is about 1–2 Ohms, a short-to-ground code may not be set but could cause a burned-out solenoid driver in the ECU. Replace the solenoid when this occurs (see appropriate transmission Service Manual for replacement procedure). If the solenoid driver is burned out, 69 XX codes will be set. See the troubleshooting procedure for 69 XX codes.***

Main Code	Subcode	Meaning
43	21	Low Side Driver F Solenoid Circuit open
43	25	Low Side Driver K Solenoid Circuit open
43	26	Low Side Driver N Solenoid Circuit open

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

NOTE: ***Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.***

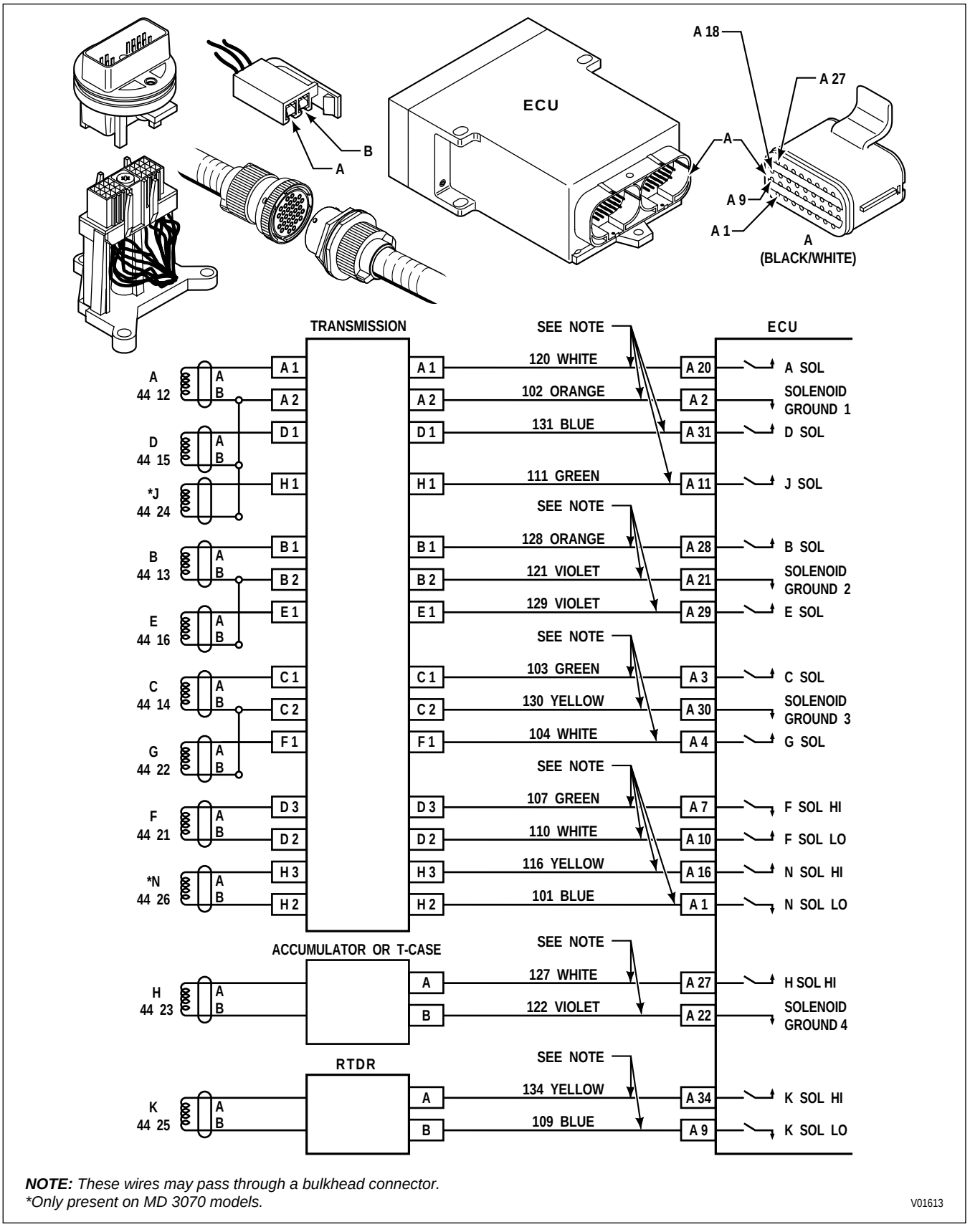
Troubleshooting:

1. Make sure the transmission connector is tightly connected. If the connector is properly connected, disconnect the wiring harness at the transmission. Check the connector for water contamination and check terminals for corrosion or damage. Clean or replace as necessary.
2. If the external harness-to-transmission connection is satisfactory, check the solenoid circuits at the transmission connector for a short-to-chassis ground or a short-to-ground wire. (Tool J 38850 may be useful in making this test.) If a short is found, drain the fluid, remove the control module (refer to the Service Manual), isolate and repair the short. The short will probably be in the internal wiring harness (refer to Figure 6–1 for solenoid location).
3. If the short is not found at the transmission connector, disconnect the connectors at the ECU and check the wires of the solenoid circuit for shorts between the solenoid wires and all other terminals in both connectors (at the ECU). If the short-to-ground is found in any of the wires, isolate and repair the problem.
4. If the condition recurs, use spare wire(s) in the external harness for the solenoid circuit indicated by the trouble code. See Appendix D for location of spare wire(s) and Appendix E for connector assembly/disassembly information.
5. If the condition continues, examine the feedthrough connector. Replace if necessary (refer to transmission Service Manual).
6. If the condition occurs again, replace the internal harness (refer to transmission Service Manual).
7. If the condition again recurs, replace the solenoid (refer to transmission Service Manual).
8. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

DIAGNOSTIC CODES

NOTES

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT

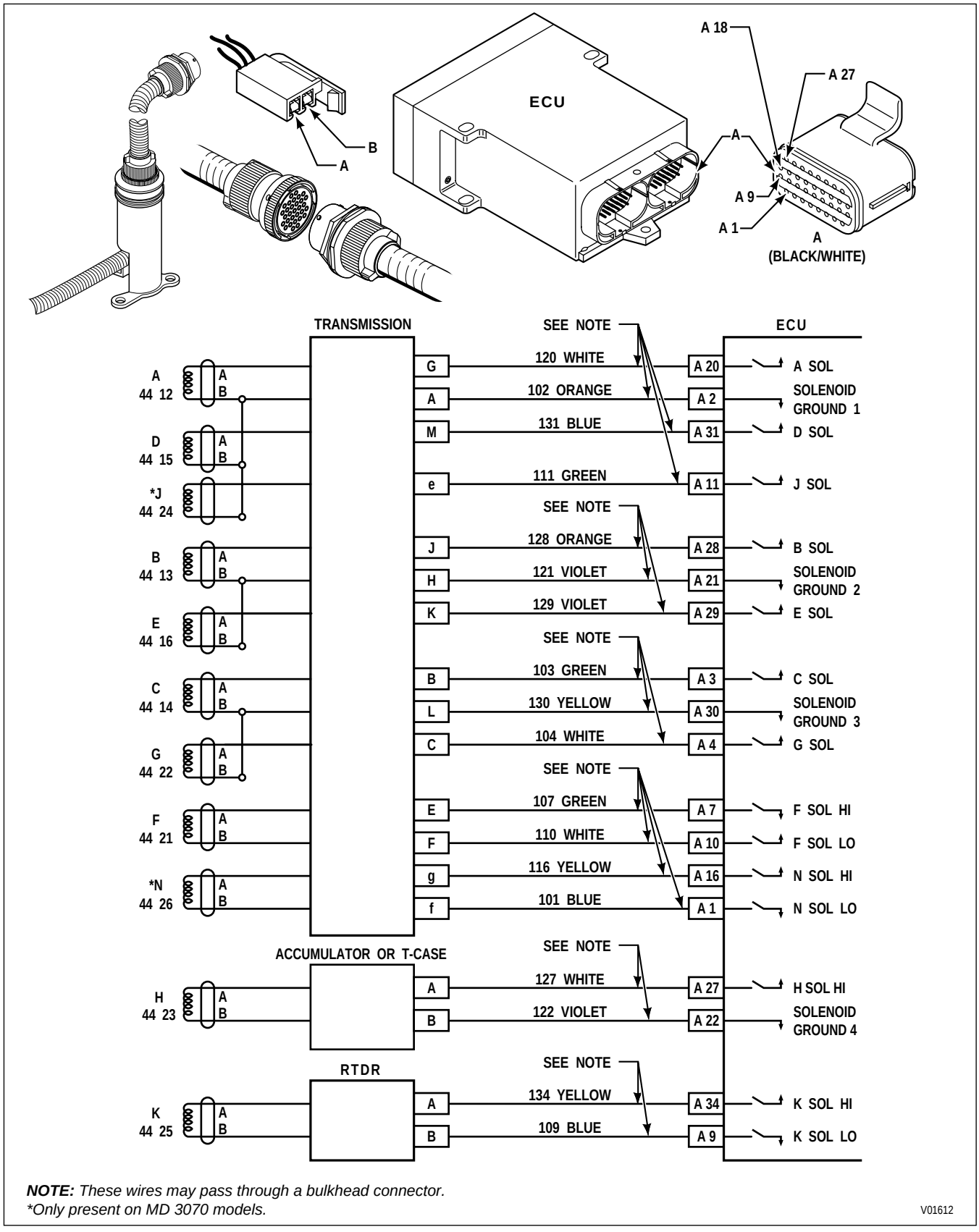


NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

V01613

Figure 6–29. Code 44 Schematic Drawing (Units Produced Prior To 9/94)

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

Figure 6–30. Code 44 Schematic Drawing (Units Produced 9/94–12/97)

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT

(Figures 6–29, 6–30)

Main code 44 indicates the ECU has detected a short-to-ground in a solenoid or its wiring. The **DO NOT SHIFT** response is activated when this code is detected and all solenoids are turned off.

NOTE: For subcodes 12, 13, 14, 15, 16, 22 — neutral start is inoperable. Subcodes 21, 23, 24, 25, and 26 do not trigger the DO NOT SHIFT light.

NOTE: If solenoid resistance is about 1–2 Ohms, a short-to-ground code may not be set but could cause a burned-out solenoid driver in the ECU. Replace the solenoid when this occurs (see appropriate transmission Service Manual for replacement procedure). If the solenoid driver is burned out, 69 XX codes will be set. See the troubleshooting procedure for 69 XX codes.

Main Code	Subcode	Meaning
44	12	Short-to-Ground A Solenoid Circuit
44	13	Short-to-Ground B Solenoid Circuit
44	14	Short-to-Ground C Solenoid Circuit
44	15	Short-to-Ground D Solenoid Circuit
44	16	Short-to-Ground E Solenoid Circuit
44	21	Short-to-Ground F Solenoid Circuit
44	22	Short-to-Ground G Solenoid Circuit
44	23	Short-to-Ground H Solenoid Circuit
44	24	Short-to-Ground J Solenoid Circuit
44	25	Short-to-Ground K Solenoid Circuit
44	26	Short-to-Ground N Solenoid Circuit

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

NOTE: The retarder accumulator solenoid (“H”) has a 30 Ohm coil. Since “H” solenoid is not mounted in the sump, no relationship between temperature and resistance is required.

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT

(Figures 6–29, 6–30)

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, contact with the following pairs of terminals will result in resistance measurements of two solenoids through a shared ground. The resistance should be twice that of a single solenoid. Refer to Figure 6–31 for resistance values versus temperature.

Terminals	Solenoids Which Share Ground
A1, D1	A, D
B1, E1	B, E
C1, F1	C, G

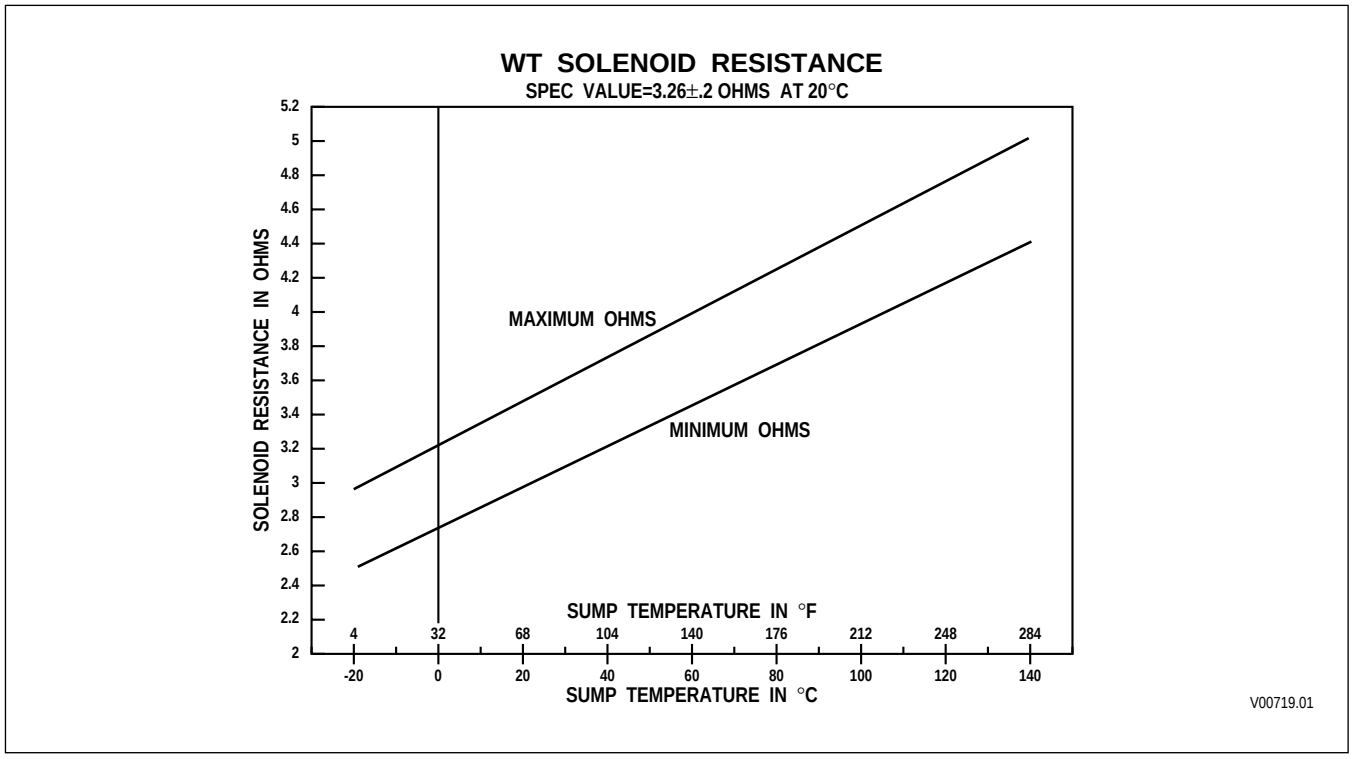


Figure 6–31. Solenoid Resistance vs. Temperature

CODE 44 XX — SHORT-TO-GROUND IN SOLENOID CIRCUIT

(Figures 6–29, 6–30)

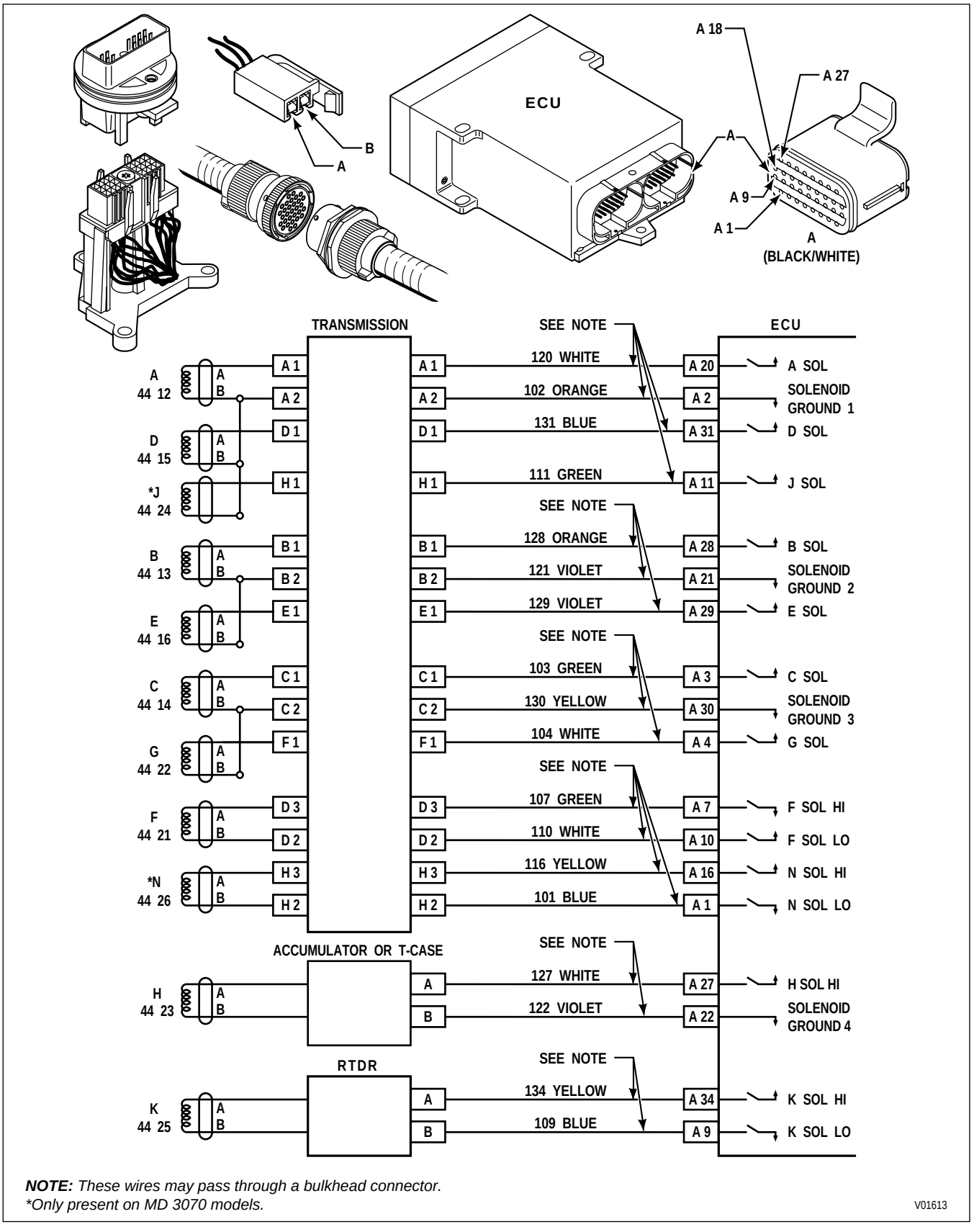
Troubleshooting:

1. Check the transmission connector and make sure it is tightly connected. If the connector is properly connected, disconnect the harness at the transmission and check for water contamination and inspect the terminals in the external harness and feedthrough connectors. Clean or replace as necessary (Appendix D).
2. If the connector is connected, clean, and not damaged, check the solenoid circuit in the transmission for shorts to other wires. (Tool J 38850 may be useful in making this test.) Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If the short circuit is found, drain the fluid, remove the control module (refer to the transmission Service Manual), and isolate the short. The short is probably in the feedthrough connector, internal harness, or the solenoid itself (refer to Figure 6–1 for solenoid locations).
3. If the short is not found at the transmission connector, disconnect the connectors at the ECU and inspect their terminals for damage or contamination. Clean or replace as necessary. If the terminals are satisfactory, check the wires of the solenoid circuit in the external harness for shorts-to-ground or shorts between wires. If a short is found in one of the wires, isolate and repair it or use a spare wire in the external harness. Refer to Appendix E for connector/terminal repair information.
4. If the short is not found in either the transmission or the harness, the condition must be intermittent.
5. Drain the fluid, remove the control module, and replace the solenoid and internal harness (refer to the transmission Service Manual).
6. If the condition recurs, use spare wire(s) for the solenoid circuit indicated by the diagnostic code. See Appendix D for location of spare wires and Appendix E for connector assembly/disassembly information.
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

DIAGNOSTIC CODES

NOTES

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT



NOTE: *These wires may pass through a bulkhead connector.*
**Only present on MD 3070 models.*

Figure 6–32. Code 45 Schematic Drawing (Units Produced Prior To 9/94)

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT

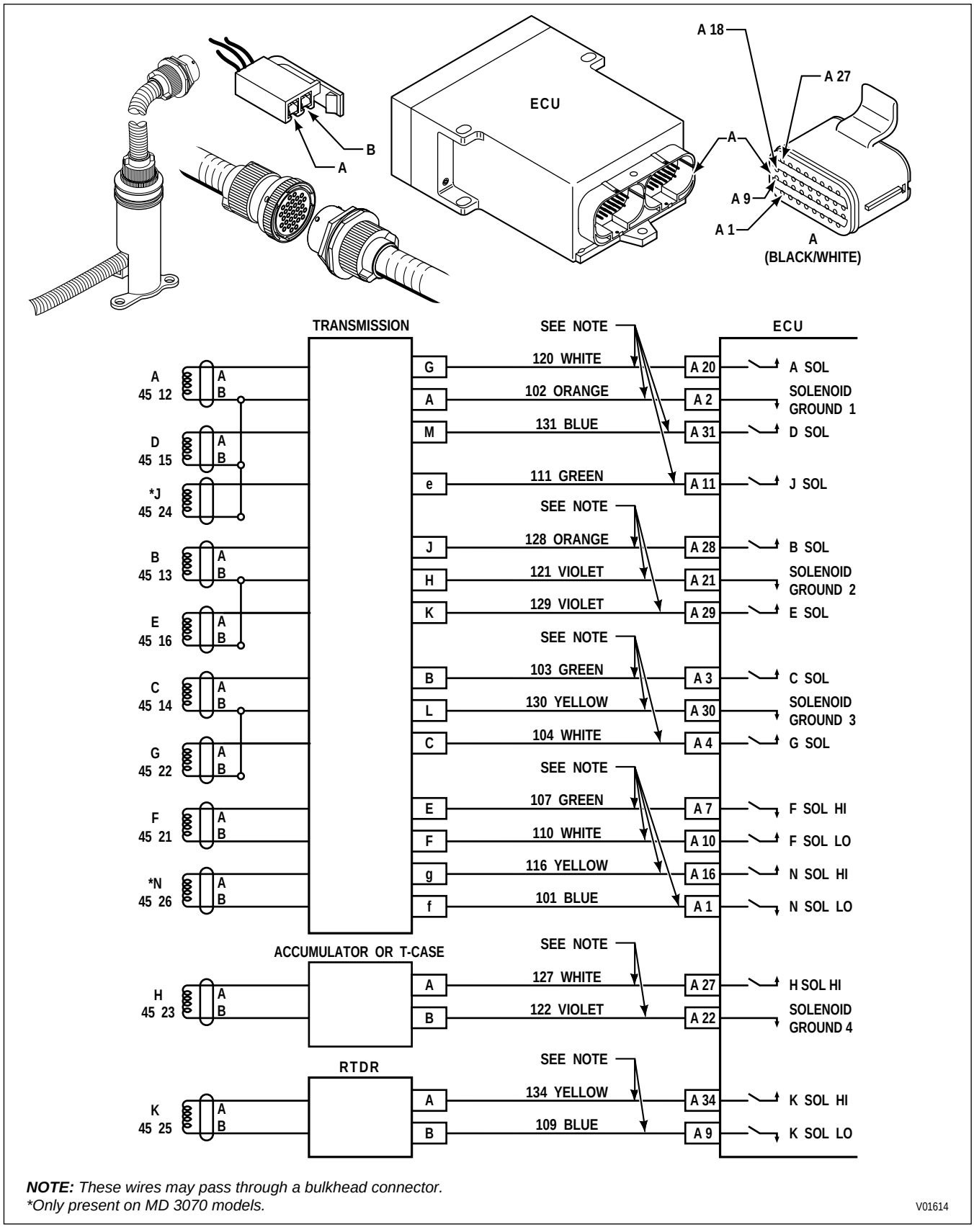


Figure 6–33. Code 45 Schematic Drawing (Units Produced 9/94–12/97)

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT

(Figures 6–32, 6–33)

Main code 45 indicates the ECU has detected either an open circuit condition in a solenoid coil or the wiring to that solenoid. The **DO NOT SHIFT** response is activated when this code is detected and all solenoids are turned off.

NOTE: For subcodes 12, 13, 14, 15, 16, 22 — neutral start is inoperable. For subcodes 21, 23, 24, 25, and 26 the DO NOT SHIFT light is not illuminated.

NOTE: If solenoid resistance is about 1–2 Ohms, a short-to-ground code may not be set but could cause a burned-out solenoid driver in the ECU. Replace the solenoid when this occurs (see appropriate transmission Service Manual for replacement procedure). If the solenoid driver is burned out, 69 XX codes will be set. See the troubleshooting procedure for 69 XX codes.

Main Code	Subcode	Meaning
45	12	Open Circuit A Solenoid Circuit
45	13	Open Circuit B Solenoid Circuit
45	14	Open Circuit C Solenoid Circuit
45	15	Open Circuit D Solenoid Circuit
45	16	Open Circuit E Solenoid Circuit
45	21	Open Circuit F Solenoid Circuit
45	22	Open Circuit G Solenoid Circuit
45	23	Open Circuit H Solenoid Circuit
45	24	Open Circuit J Solenoid Circuit
45	25	Open Circuit K Solenoid Circuit
45	26	Open Circuit N Solenoid Circuit

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

NOTE: The retarder accumulator solenoid (“H”) has a 30 Ohm coil. Since “H” solenoid is not mounted in the sump, no relationship between temperature and resistance is required.

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT

(Figures 6–32, 6–33)

PROBING THE CONNECTOR

When testing the control system from the feedthrough connector with the internal harness connected, contact with the following pairs of terminals will result in resistance measurements of two solenoids through a shared ground. The resistance should be twice that of a single solenoid. Refer to Figure 6–34 for solenoid resistance values versus temperature.

Terminals	Solenoids Which Share Ground
A1, D1	A, D
B1, E1	B, E
C1, F1	C, G

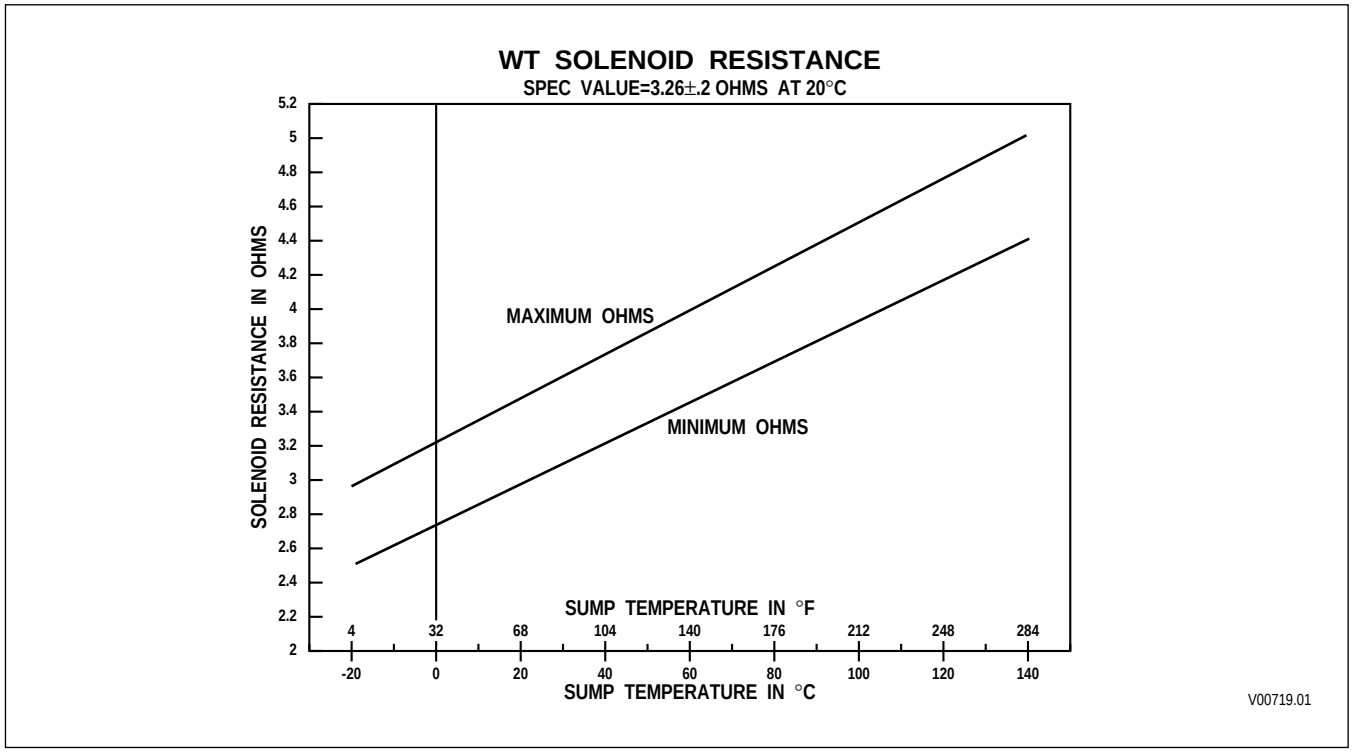


Figure 6–34. Solenoid Resistance vs. Temperature

CODE 45 XX — OPEN CONDITION IN SOLENOID CIRCUIT

(Figures 6–32, 6–33)

Troubleshooting:

1. Check the transmission connector and make sure it is tightly connected. If the connector is properly connected, disconnect the harness at the transmission and check the terminals in the external harness and feedthrough connectors. Clean or replace as necessary (Appendix E).
2. If the connector is connected, clean, and not damaged, check the solenoid circuit in the transmission for opens. Refer to the system schematic and/or chart to identify wires in the internal harness which are connected. If the open circuit is found, drain the fluid, remove the control module (see the transmission Service Manual), and isolate the open. The fault will be in the feedthrough connector, internal harness, or the solenoid itself (see Figure 6–1 for solenoid locations).
3. If the open is not found at the transmission connector, disconnect the connectors at the ECU and inspect the terminals in the connectors and the ECU for damage or contamination. Clean or replace as necessary. If the terminals are satisfactory, check the wires of the solenoid circuit in the external harness for continuity. If the open is found in one of the wires, isolate and repair it or use a spare wire in the external harness. See Appendix D for location of spare wires and Appendix E for information on connector/wire repair.
4. If the open is not found in either the transmission or the harness, the condition must be intermittent.
5. Drain the fluid, remove the control module, and replace the solenoid and internal harness (refer to the transmission Service Manual).
6. If the condition recurs, use spare wire(s) for the solenoid circuit indicated by the diagnostic code. See Appendix D for location of spare wires and Appendix E for information on connector assembly/disassembly.
7. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 51 XX — OFFGOING RATIO TEST DURING SHIFT (TIE-UP TEST)

Main code 51 indicates a failed offgoing ratio test. An offgoing ratio test occurs during a shift and uses turbine and output speed sensor readings to calculate the ratio between them. The calculated speed sensor ratio is then compared to the programmed speed sensor ratio of the commanded range. After a shift is commanded, the ECU, after a period of time, expects the old ratio to be gone. If the ratio does not change properly, the ECU assumes the offgoing clutch did not release. The shift is retried if conditions still exist to schedule the shift. If the second shift is not successfully completed, Code 51 XX is set and the ECU returns the transmission to the previous range. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: This test is not performed below a calibrated transmission output speed of 200 rpm.

Main Code	Subcode	Meaning
51	01	Low–1 upshift
51	10	1–Low downshift
51	12	1–2 upshift
51	21	2–1 downshift
51	23	2–3 upshift
51	24	2–4 upshift
51	35	3–5 upshift
51	42	4–2 downshift
51	43	4–3 downshift
51	45	4–5 upshift
51	46	4–6 upshift
51	53	5–3 downshift
51	64	6–4 downshift
51	65	6–5 downshift
51	XY	X to Y shift

Active Indicator Clearing Procedure:

- Power down
- Manual — except subcodes 35, 42, 43, 45, 53

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

CODE 51 XX — OFFGOING RATIO TEST DURING SHIFT (TIE-UP TEST)

Troubleshooting:

1. Incorrect fluid level can cause 51 Series codes. Allow the vehicle to idle for 3–4 minutes and check the transmission fluid level. If level is not correct, add or drain fluid to correct level.
2. If the fluid level is correct, connect a pressure gauge into the pressure tap for the offgoing clutch indicated by the code (refer to solenoid and clutch chart, Appendix C). Make the shift indicated by the code or use the Pro-Link® diagnostic tool clutch test mode to put the transmission in the offgoing and oncoming ranges (refer to Appendix B for clutch pressure check information).
3. If the offgoing clutch stays pressurized, drain the fluid, remove the control module, disassemble the control module and clean it, inspecting for damaged valve body gaskets and stuck or sticky valves. Inspect the transmission for signs of clutch damage indicating the need to remove and overhaul the transmission (refer to the transmission Service Manual).
4. If the problem has not been isolated, replace the solenoid for the offgoing clutch (refer to the transmission Service Manual).
5. If after replacing the solenoid the problem persists, install another ECU. If this corrects the problem, temporarily reinstall the old ECU to verify the repair.
6. If this does not correct the problem, reinstall the original ECU and check for mechanical problems. The clutch may be mechanically held (coned, burned and welded, etc.). It may be necessary to remove the transmission and repair or rebuild as required (see the transmission Service Manual).

CODE 52 XX — OFFGOING C3 PRESSURE SWITCH TEST DURING SHIFT

Main code 52 indicates a failed C3 pressure test. When a shift is commanded and C3 is the offgoing clutch, the ECU expects the C3 pressure switch to open within a period of time after the shift is commanded. If the ECU does not see the switch open, it assumes C3 has not released. If conditions for a shift exist, the shift is retried. If the C3 pressure switch still remains closed, the code is logged and the **DO NOT SHIFT** response is commanded. If the code is set during a direction change, neutral with no clutches is commanded, otherwise the transmission is commanded to the previous range. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: C3 tests are turned off below a calibrated temperature of –32ºC (–25°F).

Main Code	Subcode	Meaning
52	01	L–1 upshift
52	08	L–N1 shift
52	32	3–2 downshift
52	34	3–4 upshift
52	54	5–4 downshift
52	56	5–6 upshift
52	71	R–1 shift
52	72	R–2 shift
52	78	R–N1 shift
52	79	R–2 shift (R to NNC to 2)
52	99	N3–N2 shift
52	XY	X to Y shift

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

CODE 52 XX — OFFGOING C3 PRESSURE SWITCH TEST DURING SHIFT

Troubleshooting:

1. Use the Pro-Link® diagnostic tool to check the state of the C3 pressure switch.

NOTE: ***Energizing the solenoids and listening for ball/plunger movement is sometimes useful in troubleshooting.***

2. Check the C3 pressure switch wiring for a short-to-power or a switch stuck closed (refer to Code 32 XX). If a short is found, isolate and repair; or replace the switch if it is stuck closed.

3. If a fault is not found with the C3 pressure switch or circuitry, connect a pressure gauge to the C3 pressure tap.

4. Drive the vehicle to make the shift indicated by the code or use the DDR clutch test mode. Compare actual C3 pressure value with the table of specifications in Appendix B.

5. If C3 is being held on hydraulically (C3 remains pressurized), drain the fluid, remove the control module, disassemble and clean the control module, checking for damaged valve body gaskets or stuck and sticky valves (see the transmission Service Manual).

6. If the problem recurs, use spare wire(s) for the C3 pressure switch in the external harness. See Appendix D for location of spare wires and Appendix E for connector service information.

7. If the problem again recurs, replace the C solenoid (refer to the transmission Service Manual).

8. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 53 XX — OFFGOING SPEED TEST (DURING SHIFT)

Main code 53 indicates a failed offgoing speed test. The speed test during a shift is designed to ensure neutral is attained during shifts to neutral. This test compares engine speed to turbine speed. If neutral is selected and turbine speed is found to be much lower than engine speed, the ECU sees this as neutral not being attained. The transmission is commanded to Neutral with No Clutches and Code 53 XX is set. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to.

NOTE: ***This test is not performed if neutral output is below 200 rpm or when temperatures are below a calibrated 0°C (32°F).***

Main Code	Subcode	Meaning
53	08	L–N1 shift
53	09	Low–NNC shift
53	18	1–N1 shift
53	28	2–N1 shift
53	29	2–N2 shift
53	38	3–N1 shift
53	39	3–N3 shift
53	48	4–N1 shift
53	49	4–N3 shift
53	58	5–N1 shift
53	59	5–N3 shift
53	68	6–N1 shift
53	69	6–N4 shift
53	78	R–N1 shift
53	99	N3–N2 or N2–N3 shift
53	XY	X to Y shift

Active Indicator Clearing Procedure:

- Power down
- Manual — subcodes 78 and 99 only

NOTE: ***Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.***

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

NOTE: ***Energizing the solenoids and listening for ball/plunger movement is sometimes useful in troubleshooting.***

CODE 53 XX — OFFGOING SPEED TEST (DURING SHIFT)

Troubleshooting:

1. Be sure the transmission is warm and the fluid level is correct. Correct transmission fluid level as necessary.
2. Using the DDR, check the engine and turbine speed sensor signals under steady conditions. If a tachometer is available, compare the tachometer reading with the engine rpm reading on the diagnostic tool. Check signals in neutral, at idle, high idle and maximum no load rpms. If a signal is erratic, check sensor wiring for opens, shorts, and shorts-to-ground (refer to Code 22 XX). Check all connections for dirt and corrosion. If wiring problems are found, repair or replace as necessary. See Appendix E for connector service information.
3. If fluid and wiring are satisfactory, install a pressure gauge in the pressure tap for the offgoing clutch. Make the shift indicated by the code using the clutch test mode of the Pro-Link® diagnostic tool. If the pressure gauge shows clutch pressure (above 55 kPa or 8 psi) remains in the offgoing clutch, drain the fluid and remove the control module (see the transmission Service Manual). Disassemble and clean the control module and check for damaged valve body gaskets and stuck or sticky valves, particularly latch valves and solenoid second-stage valves.
4. If excessive clutch pressure is not remaining in the offgoing clutch, replace the engine speed sensor and the turbine speed sensor (refer to the transmission Service Manual).
5. If the control module is removed to replace the turbine speed sensor (MD, B 300, B 400), clean the control module and inspect for stuck or sticky valves (particularly the latch valves and solenoid G second stage valve). Check the rotating clutch drum to which the turbine speed sensor is directed for damage, contamination, or signs of contact between the drum and the sensor.
6. If the problem recurs, replace the solenoid(s) for the offgoing clutch(es) (refer to the transmission Service Manual).
7. If the problem again recurs, the offgoing clutch must be held on mechanically (coned, burned, etc.). Remove the transmission and repair or rebuild as necessary (see the transmission Service Manual).
8. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 54 XX — ONCOMING RATIO TEST (AFTER SHIFT)

Main code 54 indicates a failed oncoming ratio test. The ratio test after a shift is failed when the ECU has commanded the end of a shift and has not seen the transmission shift into the target range (comparing turbine and output speeds). Erratic readings from speed sensors are a likely cause of an oncoming ratio test failure. If conditions for a shift still exist, the shift will be retried one more time. If the ratio test is still not met, a code is logged and the **DO NOT SHIFT** response is commanded. If the code is set during a direction change, Neutral with No Clutches is commanded, otherwise the transmission is commanded to the previous range. **Main code 54 can also be caused by the EEPROM being calibrated for a close ratio transmission and installed in a wide ratio transmission, or vice versa.** Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to (there have been occurrences of Code 54 87, N1–R, for example).

NOTE: This test is not performed below a calibrated transmission output speed of 200 rpm.

Main Code	Subcode	Meaning
54	01	L–1 upshift
54	07	L–R shift
54	10	1–L downshift
54	12	1–2 upshift — incorrect calibration, wide ratio vs. close ratio
54	17	1–R shift
54	21	2–1 downshift
54	23	2–3 upshift
54	24	2–4 upshift
54	27	2–R shift
54	32	3–2 downshift
54	34	3–4 upshift
54	35	3–5 upshift
54	42	4–2 downshift
54	43	4–3 downshift
54	45	4–5 upshift
54	46	4–6 upshift
54	53	5–3 downshift
54	54	5–4 downshift
54	56	5–6 upshift
54	64	6–4 downshift
54	65	6–5 downshift
54	70	R–L shift
54	71	R–1 shift
54	72	R–2 shift
54	81	N1–1 shift
54	82	N1–2 shift
54	83	N1–3 shift
54	85	N1–5 shift
54	86	N1–6 shift
54	92	N2–2 shift
54	93	N3–3 shift
54	95	N3–5 shift
54	96	N4–6 shift
54	97	NVL–Reverse shift
54	XY	X to Y shift

CODE 54 XX — ONCOMING RATIO TEST (AFTER SHIFT)

Active Indicator Clearing Procedure:

- Power down
- Manual

NOTE: Before troubleshooting, read Pages 6–17 and 6–18 of Section 6–5. Also, check battery and ECU input voltages.

NOTE: Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.

NOTE: Energizing the solenoids and listening for ball/plunger movement is sometimes useful in troubleshooting.

Troubleshooting:

1. After the transmission is at operating temperature, allow the vehicle to idle on level ground for 3–4 minutes. Check transmission fluid level. If improper fluid level is found, correct as necessary. Improper fluid level could be the cause of the code (not enough or too much fluid may produce inadequate clutch pressure).
2. Connect a pressure gauge and check main pressure. If pressure is not adequate, the pump is possibly worn. See Appendix B for main pressure specifications.
3. If the fluid level is correct, check the turbine and output speed sensors for accurate, steady signals (not noisy) using the diagnostic tool (check with vehicle stopped and in range to confirm a zero speed reading from the turbine and output speed sensors). Check the wiring for opens and shorts (refer to Code 22 XX) and the sensor coils for proper resistance. If problems are found, repair or replace as necessary. Remove the speed sensor and check for a loose tone wheel.
4. If sensor and wiring resistance is acceptable, connect a pressure gauge(s) to the pressure tap for the oncoming clutches indicated by the code (refer to solenoid and clutch chart in Appendix C). Make the shift indicated by the code by operating the vehicle or by using the diagnostic tool's clutch test mode.
5. If the clutch pressure does not show on the gauge(s), the control module is probably not commanding the clutch on. Drain the fluid and remove the control module (see the transmission Service Manual). Disassemble and clean the control module, inspect for stuck or sticking valves.
6. Internal leakage is indicated by the clutch pressure gauge showing that pressure is being sent to the clutch but the clutch fails to hold. The fault may be: missing or damaged face seals, burnt clutch, leaking piston sealrings, or damaged control module gaskets. Drain the fluid, remove the control module (refer to the transmission Service Manual), and inspect the face seals and control module gaskets. If the seals and gaskets are satisfactory, replace the solenoid(s) indicated by the code. If replacing the solenoid does not eliminate the code, remove the transmission and repair as necessary.
7. If clutch pressures are correct and the clutch appears to be holding, replace the output and turbine speed sensors (refer to the transmission Service Manual for the proper procedure).
8. If the problem recurs, use the diagnostic tool to check the speed sensor signals for erratic readings. Possible causes of erratic speed readings are: loose sensors, intermittent contact in the wiring, vehicle-induced vibrations, or speed sensor wiring that is not a twisted-pair. If necessary, use a twisted-pair for a new speed sensor circuit — Service Harness Twisted Shielded Pair P/N 29522703 is available for this purpose.
9. If the condition persists, replace the ECU. If replacing the ECU corrects the problem, reinstall the original (bad) ECU to confirm that the problem is in the ECU. If the original ECU now works, inspect the ECU connectors for any corrosion or damage which may cause an intermittent condition. If the original problem recurs, reinstall the replacement ECU.

CODE 55 XX — ONCOMING C3 PRESSURE SWITCH (AFTER SHIFT)

Main code 55 indicates the C3 clutch is the oncoming clutch in a shift and the C3 pressure switch did not close at the end of the shift. When this code is set, the **DO NOT SHIFT** response and **N**eutral with **No C**lutches is commanded. On the N1 to R shift the transmission is commanded to the previous range. Additional codes could be logged for other shifts where "X" indicates the range from and "Y" indicates the range to. **Main code 55 can also be caused by the EEPROM being calibrated for a close ratio transmission and installed in a wide ratio transmission, or vice versa.**

Main Code	Subcode	Meaning
55	07	Oncoming C3PS (after shift), L–R shift
55	17	Oncoming C3PS (after shift), 1–R shift
55	27	Oncoming C3PS (after shift), 2–R shift
55	87	Oncoming C3PS (after shift), N1–R shift
55	97	Oncoming C3PS (after shift), N1–L to R shift
55	XY	Oncoming C3PS (after shift), X to Y shift

NOTE: ***When sump temperature is below 10˚C (50˚F), and transmission fluid is C4 (not DEXRON), follow this procedure when making directional change shifts:***

- ***To shift from forward to reverse; select N (Neutral) and then R (Reverse).***
- ***Failure to follow this procedure may cause illumination of the CHECK TRANS light and then transmission operation will be restricted to N (Neutral).***

Active Indicator Clearing Procedure:

- Power down
- Manual — subcode 87 only

NOTE: ***Intermittent connections or lack of battery-direct power and ground connections may cause this and other codes.***

NOTE: ***Check battery and ECU input voltages before troubleshooting.***

NOTE: ***Energizing the solenoids and listening for ball/plunger movement is sometimes useful in troubleshooting.***

Troubleshooting:

NOTE: ***Do not bring the transmission to operating temperature if the problem occurs at sump temperatures below that level. Do troubleshooting at the temperature level where the problem occurs.***

1. After the transmission is at operating temperature, allow vehicle engine to idle on level ground for 3–4 minutes. Check transmission fluid level. If improper fluid level is found, correct as necessary. Improper fluid level could be the cause of the code (not enough or too much fluid may produce inadequate clutch pressure).
2. Connect a pressure gauge and check main pressure. If pressure is not adequate, the pump is possibly worn. See Appendix B for main pressure specifications.