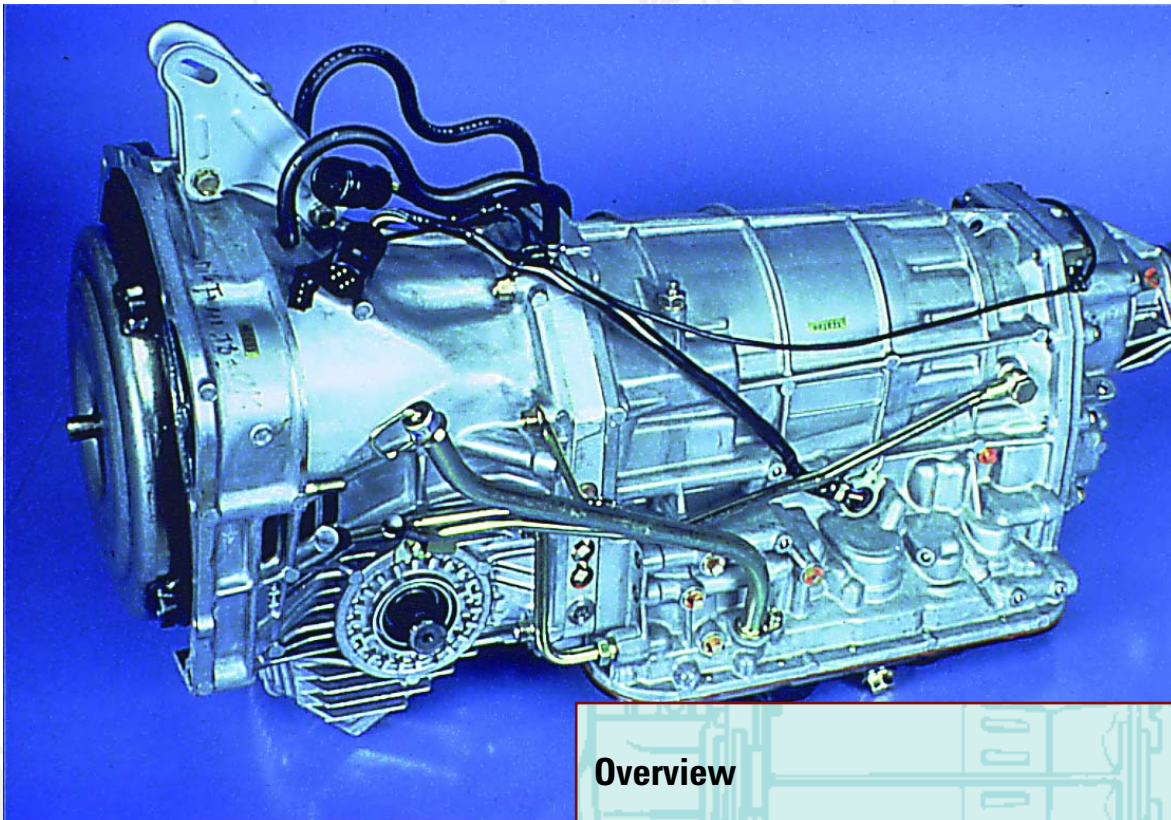


Subaru 4EAT Transmissions

Subaru 4EAT Transmissions



Overview

Features and Major Components

Power Flow

Final Drive FWD/AWD

Electronic Control System

Hydraulic Control System

Self Diagnostic System

Troubleshooting/Adjustments

The 4EAT Transmission is a 4 speed, microprocessor-controlled transmission that was first introduced in 1987.5 Subaru models. It is not a 3 speed transmission with overdrive. It features a lock-up torque converter which locks up in all forward gears except 1st. It has been offered in FWD or Full Time AWD configurations.

The 4EAT transmission has undergone continuous development and improvement since its introduction.

Overview

Several unique 4EAT features have been added, changed, or deleted from various Subaru models over the years. We'll provide you with a brief overview of these features here. For a more thorough description of specific 4EAT operating characteristics or features, refer to the applicable Subaru service manual for the year and model Subaru you are working on.

Some Subaru models were equipped with a 1-HOLD button. These include:

- 1987.5-91 XT and XT6 models
- 1988-89 "L" series
- 1990 Loyale

Manual 1st gear is activated when the 1-HOLD button is depressed and the shifter is in manually selected "2" to provide engine braking. The transmission will upshift through 2nd and 3rd if necessary, in order to prevent the engine from over-revving. The 1-HOLD indicator is displayed on the combination meter when the button is activated. When the computer overrides the 1-HOLD gear selection the display will change.

Some models have a POWER light located to the left of the tachometer (right on Legacy). It is activated momentarily whenever the vehicle is started. The POWER mode is selected by the computer based upon how quickly the gas pedal is depressed. This changes the performance characteristics of the transmission. i.e., it delays upshifts and may downshift if necessary. When selected, the computer turns the POWER light "ON."

An enhanced version of the original 4EAT was introduced with the 1990 model year Legacy. Although similar in design to the original 4EAT, the shift quadrant is different. The Legacy 4EAT has a seven position quadrant: P-R-N-D-3-2-1. The 1-HOLD button has been deleted and a manual button was added. Subaru vehicles equipped with the manual button included:

- 1990-94 Legacy
- 1993-94 Impreza
- 1992-97 SVX

When the selector is in 3rd range with the manual switch "ON," the transmission will start in 2nd gear and shift to 3rd. In 2nd range manual, the transmission starts and stays in 2nd gear, but will upshift to 3rd gear at 6500 RPM to prevent damage to the engine. In 1st range manual the transmission stays in 1st gear and also will upshift to second at 6500 RPM to prevent damage to the engine. Additionally, on AWD vehicles, the TCU applies a more aggressive AWD map when the selector is in the 1st position, manual switch "ON" or "OFF."

These changes result in improved driveability on low friction road surfaces.

The TCU monitors various engine and vehicle inputs, i.e., throttle position and vehicle speed, etc. It also controls the electronic shift solenoids in the transmission. Refer to the appropriate model year Subaru service manual, section 6-3, for the location of the TCU.



Shift Quadrant



Selector Lever



TCU



Shift Cable



MPT Assembly

Features and Major Components

The 4EAT features a double planetary gear set, a lock-up torque converter, and a variable displacement oil pump. The AWD system includes a Multi-Plate Transfer Clutch (MPT).

The electronic control system is designed to reduce shock during shifting, improve driving performance, and improve fuel economy. A self diagnostic system is incorporated in order to improve serviceability and reliability.

The shifter is quieter because of the compact push/pull cable design.

The electronically controlled Multi-Plate Transfer (MPT) System provides for controlled transfer clutch torque. It is designed to slip in order to eliminate torque bind on cornering.

This MPT System is equipped with a transfer hydraulic control system, including a duty solenoid and multi-plate clutch. This assembly is located in the transfer case on the rear of the transmission.

On later 4EAT models, the transfer apply piston has been modified and a transfer piston seal has been added to improve the torque split control. This prevents the MPT clutch from further applying during high speed driving.

The modified MPT clutch assembly cancels the centrifugal pressure build-up effect which occurs behind the clutch apply piston. It uses the lubricating pressure between the piston seal and the apply piston to ensure a positive release of the MPT clutch.



MPT Clutch

Lock-Up Torque Converter

The torque converter is designed to match a wide range of engines from large to small displacement. It is also designed to improve acceleration from a stop and reduce fuel consumption.

The torque converter has an electronically controlled, hydraulic lock-up clutch system that prevents slip loss during medium to high speed operation. This system replaces the previous centrifugal lock-up type clutch.

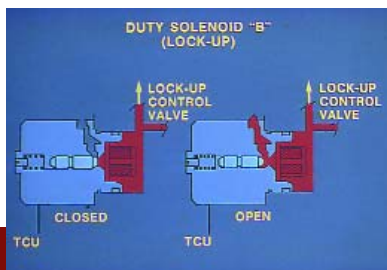
There is a friction surface on the back of the lock-up clutch (piston) which locks against the back of the impeller housing. Clutch engagement shock is minimized in part, because of the torsional clutch dampers and the wave spring/friction washer combination.

The lock-up operation is controlled by the TCU which then regulates Duty Solenoid "B" mounted on the lower valve body. This solenoid controls the lock-up valve located in the transmission upper valve body. Finally, the lock-up valve activates the lock-up clutch (piston) located in the torque converter.

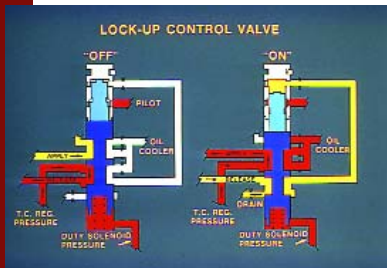
Operating Modes

The TCU regulates the cycle of Duty Solenoid "B." When the duty solenoid operates at five percent duty, i.e., substantially more "OFF" than "ON," pilot pressure is directed to the lock-up control valve.

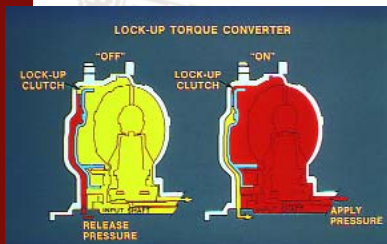
In this condition, the control valve is pushed UPWARD by the combined pilot pressure and spring force. This allows regulated hydraulic pressure to enter the lock-up release circuit.



Duty Solenoid "B"



Lock-up Valve



Torque Converter Cut-away



Torque Converter Components



Torque Converter



Lock-up Clutch



Piston and Cover

The release pressure then pushes the lock-up clutch (piston) rearward and the lock-up clutch is released from the impeller cover. On the other hand, oil drains through the apply circuit to the oil cooler in the radiator.

When Duty Solenoid "B" operates at 95 percent duty, i.e., substantially more "ON" than "OFF," it reduces pilot pressure to the control valve.

In this condition, the control valve is pushed **DOWNWARD** due to the reduced pilot pressure. As a result, regulated hydraulic pressure is directed to the lock-up apply circuit and the release circuit drains.

The apply pressure then pushes the lock-up clutch (piston) forward which engages the lock-up clutch with the impeller cover. When engaged, the transmission is coupled directly to the engine.

Oil Pump Assembly

A variable rate vane-type pump is used for optimum flow rate control with minimum energy loss. In addition to pressurizing the oil, the pump provides lubricating oil for the torque converter, the valves, the clutches, the brake and the band.

The pump consists of the following components:

- ① Rotor
- ② Vanes
- ③ Control Piston
- ④ Vane Rings
- ⑤ Cam Ring
- ⑥ Return Spring
- ⑦ Seal Ring
- ⑧ Oil Pump Cover

NOTE: THE ROTOR, VANES, CAM RING AND CONTROL PISTON ARE ALL SELECTIVE.

The pump rate is variable because of the cam ring eccentricity. The eccentricity is adjusted automatically corresponding to pressure from the regulating valve acting upon the control piston.

During low speed operation, filtered ATF is drawn into the pump suction port. The pump is driven directly at engine speed and the ATF is then compressed by the rotor vanes and discharged through the delivery port in the oil pump cover. The pressurized ATF then flows to the rest of the transmission case.

During high speed operation, as the engine speed increases, the delivery rate normally increases. However, feedback pressure generated from the regulator valve is applied to the control piston which pushes down the cam ring. This changes the relationship between the cam ring and the rotor. In this way, the pump delivery rate remains constant at a preset value.



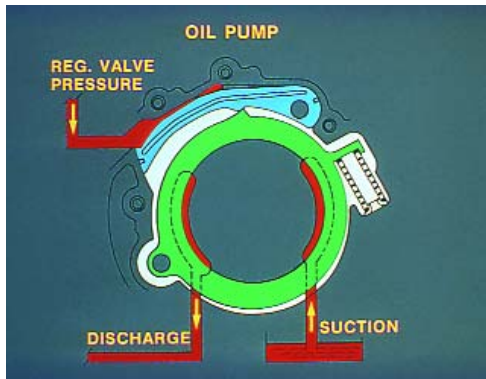
Oil Pump Assembly



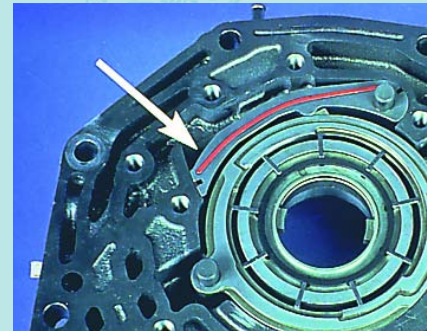
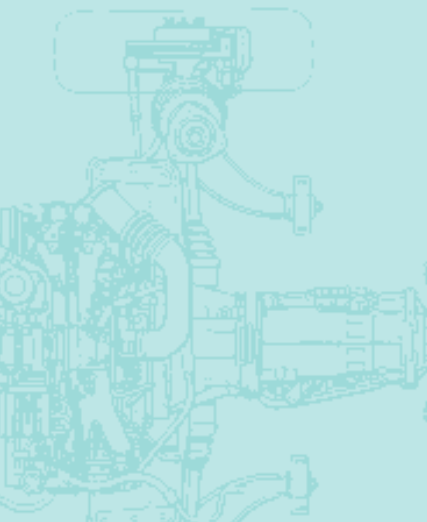
Oil Pump Components



Oil Pump Close-up



Oil Pump Low Speed



Oil Pump High Speed



Transaxle Gear Train

Transmission Gear Train

This compact unit features a double planetary gear set. It has a wide ratio between gears for improved fuel efficiency as well as high performance.

Gear Train Components

- ① Front sun gear
- ② Front planetary carrier
- ③ Rear sun gear
- ④ Rear planetary carrier (front internal gear)
- ⑤ Rear internal gear



Rear Sun/Rear Carrier



Rear Gear Set

Operating Principals: Rear Gear Set

The rear sun gear is always powered by the input shaft. The rear planetary carrier always transmits power to the output shaft.

The one way clutch (O.W.C.) 3-4 prevents the rear internal gear from turning counterclockwise. Its inner race is the rear internal gear and its outer race is the forward clutch hub. The overrunning clutch hub is also connected, by dogs, to the rear internal gear.

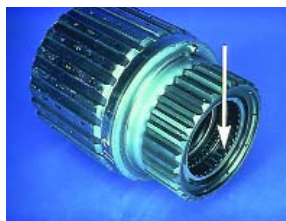
The overrunning clutch provides engine braking during deceleration except in D-1 and 3-1. The O.W.C. 3-4 is used in 1st, 2nd, and 3rd gears. The forward clutch is used in all forward gears. The rear internal gear is controlled by the forward clutch through the O.W.C. 3-4. Additionally, the rear internal gear is controlled by the overrunning clutch.

The forward clutch connects the rear internal gear to the front planetary carrier (splined to the forward clutch drum) through the O.W.C. 3-4. The overrunning clutch is also used to connect the rear internal gear to the forward clutch drum and the front planetary carrier. The O.W.C. 1-2 (Sprag) prevents the forward clutch drum from rotating counterclockwise. The Sprag is applied when the transmission is operating in D-1 or 3-1.

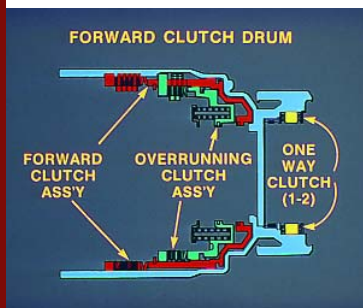
The Low /Reverse brake is splined to the case. It holds the forward clutch drum in order to keep it from turning when the transmission is in Reverse, 2-1, and 1-HOLD (if so equipped).



Overrunning Clutch Hub



One Way Clutch 1-2



Forward Clutch Drum



Low/Reverse Brake

Overrunning Clutch Hub Installed



One Way Clutch 3-4



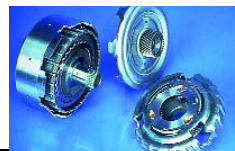
Rear Internal Gear



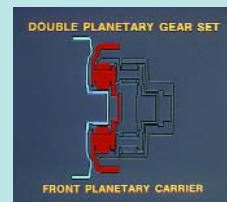
Reverse and High Clutches



Front Gear Set



Front Sun Gear



Front Planetary Carrier



Rear Sun Gear



Rear Planetary Carrier



Rear Internal Gear

Band Servo Operation

The band is applied in 2nd and 4th gears by a two stage servo which is controlled by accumulators.

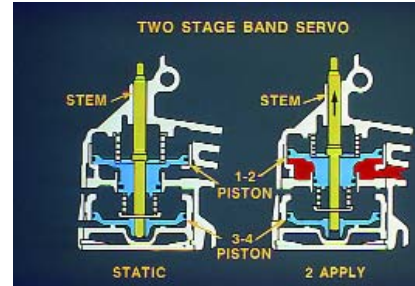
In order to obtain second gear the servo is in the 2-Apply mode. Hydraulic pressure from the 2A accumulator pushes the 1-2 piston UPWARD which tightens the band.

For third gear, the servo is in the 3-Release mode. In this case, hydraulic pressure from the 3R accumulator aided by the return spring pushes the 1-2 piston DOWNWARD in order to release the band.

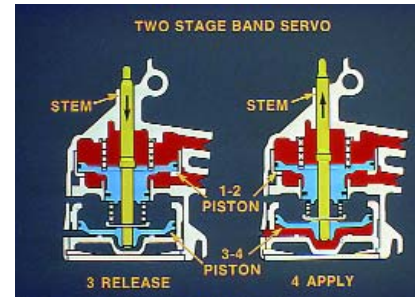
For fourth gear 4-Apply mode, hydraulic pressure from the 4A accumulator pushes the 3-4 piston UPWARD in order to apply the band.



Band and Servo



Servo Operation I (later 4EAT models)



Servo Operation II (later 4EAT models)

COMPONENT APPLICATION		REV. IC	B/S	HIGH	PAID. C	DWC	LOW/IC	FOR	DWC
PK	PK	PK	PK	PK	PK	PK	PK	PK	PK
1-2									
3-4									
4-5									
5-6									

Application Chart

Power Flow

D-1 or 3-1 Operating Mode

The input shaft powers the rear sun gear clockwise. When the Forward clutch is applied, the O.W.C. 3-4 outer race (forward clutch hub) is attached to the front carrier. With the O.W.C. 3-4 operating, the rear internal gear can only go clockwise. With the O.W.C. 1-2 operating, the forward clutch drum can only go clockwise. Output power is through the rear carrier and the output ratio is 2.785:1.

During coast mode, the O.W.C. 3-4 is released and there is no engine braking.

D-2, 3-2, Or 2-2 Operating Mode

Again, the input shaft powers the rear sun gear clockwise. When the forward clutch is applied, the O.W.C. 3-4 outer race (forward clutch hub) is attached to the front carrier. The band is also applied which holds the front sun gear stationary.

Output power is transmitted from the rear carrier (front internal gear) where the output ratio is 1.545:1.

During the coast mode, the O.W.C. 3-4 is released and there is no engine braking.

D-3, 3-3 Operating Mode

The input shaft powers the rear sun gear clockwise. When the forward clutch is applied, the O.W.C. 3-4 outer race (forward clutch hub) is attached to the front carrier. The high clutch is also applied and the front planetary carrier is therefore powered.

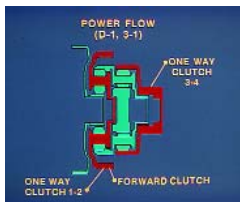
In this case the planetary gear set is locked up and the output ratio is 1:1.

During the coast mode, the O.W.C. 3-4 releases the rear internal gear and there is no engine braking.

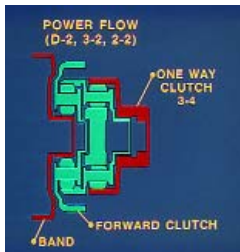
D-4 Operating Mode

The input shaft powers the rear sun gear clockwise. When the forward clutch is applied it doesn't affect the power flow. It free-wheels through the O.W.C. 3-4. When the high clutch is applied, the front planetary carrier is powered clockwise. Since the band is applied, the front sun gear is held stationary.

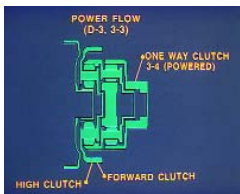
The output is clockwise through the front internal gear (rear planetary carrier) and the output ratio is 0.694:1. Engine braking occurs during the coast and deceleration modes. Neither O.W.C. is used.



Power Flow: D-1



Power Flow: D-2



Power Flow: D-3

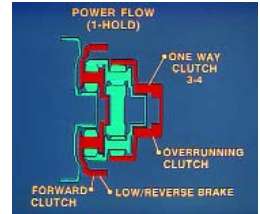


Power Flow: D-4

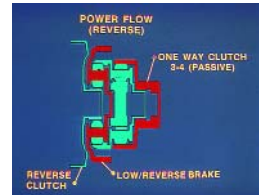
2-1 and 1-HOLD Operating Modes

The power flow is the same as in the other 1st gears except as follows. The rear internal gear is held by the overrunning clutch instead of by the O.W.C. 3-4. In addition, the forward clutch drum is held by the Low /Reverse brake instead of the O.W.C. 1-2.

Engine braking occurs during coast and deceleration due to conditions described above. The overrunning clutch is "ON" and the Low /Reverse brake is "ON."



Power Flow: 1-Hold



Power Flow: Reverse

Reverse Operating Mode

When the reverse clutch is applied the front sun gear is powered. The Low /Reverse brake is also applied, which holds the front planetary carrier stationary.

Output power is through the rear carrier at the ratio of 2.272:1.

Gear Train Components

- ① Front sun gear
- ② Front planetary carrier
- ③ Rear sun gear
- ④ Rear planetary carrier (front internal gear)
- ⑤ Rear internal gear

Final Drive FWD/AWD

Differential Overview

The hypoid gear set is mounted in the aluminum torque converter case. It is supported by taper roller bearings and features removable stub axle shafts. The pinion is mounted through the oil pump housing.

Oil Pump Housing Features

The housing is made of cast iron for greater rigidity. Double taper roller bearings are used to support the pinion. This allows for the thermal expansion of two dissimilar metals: aluminum and cast iron. These bearings also improve the durability and reliability of the unit. The pinion is preloaded by a locknut which allows for easy serviceability.

Pinion depth is set by shims which are located between the bearing flange and the oil pump housing.

A double-lip oil seal separates transmission fluid from the hypoid gear oil. This greatly improves the fluid system reliability.

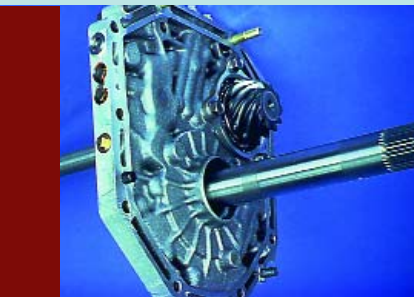
Differential Carrier Features

The ring gear is mounted on the right side of the carrier. This design adds to its compactness and makes it easier to service. The backlash is easily adjustable through the carrier bearing retainers. Final drive ratios have gone through several changes in the years since the 4EAT was originally introduced on 1987.5 models. For accurate final drive ratio information, refer to the applicable Subaru service manual.

Differential Carrier



Differential Housing



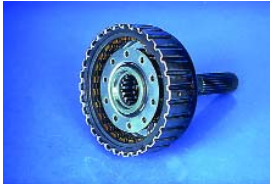
Oil Pump Housing



Oil Pump Cover Seals



MPT Assembly



MPT Clutch



MPT Clutch Hub



Reduction Shaft Seals



MPT Power Flow

Transfer Clutch Assembly (AWD)

The transfer unit consists of a hydraulic multiplate clutch and a hydraulic control system incorporating a duty solenoid. It is housed in the extension case at the rear of the transmission. A caged needle bearing supports the clutch on the reduction drive shaft and a ball bearing supports the clutch in the case.

Duty solenoid "C" regulates the MPT clutch. It is controlled by the TCU which determines the degree of AWD by altering the duty ratio. As the duty ratio increases, the amount of AWD decreases.

The clutch itself, features friction discs that are designed to slip. This eliminates torque binding during tight cornering. In order to get power to the front wheels, the reduction gear powers the reduction driven gear which is attached to the drive pinion shaft.

For the rear wheels, power goes from the reduction drive shaft to the MPT clutch hub which is welded to the drive gear. The power is transferred through the MPT clutch where it outputs to the rear drive shaft.

Reduction shaft seal rings direct fluid from the hollow shaft to the lubrication circuits inside the transmission.

Electronic Control System

Overview

The electronic control system consists of various inputs (sensors) and outputs (lights and solenoids) in addition to the Transmission Control Unit (TCU).

This is the next generation of Subaru automatic transmission. In addition to being smoother and quieter, it is designed to help maximize fuel economy while providing performance.

It monitors the engine and transmission performance conditions, the drivers demands and the vehicle speed.

Transmission Control Unit

The TCU is a highly sophisticated microprocessor with a self diagnostic long term memory. It also has a fail safe function which maintains driveability in case of a major electrical component failure.

In a transmission equipped for AWD the TCU utilizes a program which continually changes the degree of AWD based upon vehicle operating condition(s).

The TCU controls shifting and line pressure in addition to the lock-up torque converter and the MPT clutch.

TCU Inputs

- Throttle sensor /idle switch
- Vehicle speed sensor #1
- Vehicle speed sensor #2
- Tachometer signal
- Inhibitor switch
- Cruise control signal
- ATF temperature sensor
- Ignition/battery voltage
- 1-HOLD switch (if so equipped)
- Forced FWD

TCU Location

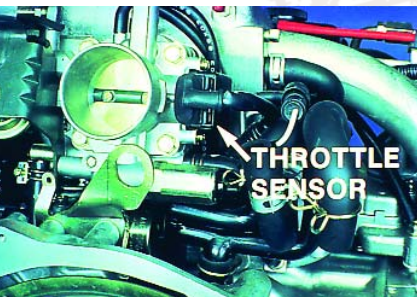


Legacy TCU Inputs

The Legacy fuel system ECM, beginning with model year 1990, sends new inputs to the TCU for line pressure control.

It networks the MPF1 ECU RPM and altitude compensation inputs. This provides additional line pressure control for high altitude compensation to reduce shift shock. ABS system inputs turn "OFF" the over-running clutch when ABS is active and fixes the duty ratio of the MPT clutch (mostly FWD).

- ECM RPM
- Altitude compensation
- ABS system



Throttle Sensor

Throttle Sensor

The throttle sensor/idle switch is basically electrical throttle pressure. The load signal effects: shifting, line pressure and lock-up. The closed throttle input effects the lock-up release mode as well as smooth downshifting into 2nd gear. It also causes a reduction in line pressure.

Vehicle Speed Sensor #1

Vehicle speed sensor #1 is mounted to the transmission and is basically electrical governor pressure. It is used to detect vehicle speed and it effects shift points, lock-up, and line pressure.

In FWD transmissions the speed sensor reads parking gear rotation at the front output shaft. In AWD transmissions it senses the transfer clutch drum rotation at the rear output shaft.



Speed Sensor #1

Vehicle Speed Sensor #2

Vehicle speed sensor #2 is built into the combination meter. In FWD units, it is used as a back-up for speed sensor #1. In AWD units, it is used as the front output shaft speed sensor.



Combination Meter

TCU

The TCU compares the speed signal from the front output shaft with the signal from the rear output shaft (sensor #1). The speed differential helps the TCU determine the degree of AWD (along with other inputs).

Tachometer

The tachometer signal effects the shift points at kickdown. The TCU uses the signal to prevent the engine from over-revving.

Inhibitor Switch

The inhibitor switch is located on the right side of the transmission. It is operated by the gear shift lever which controls the linkage that operates the manual valve. It signals the TCU of the selected gear range, which will then control the shift points and adjusts the line pressure accordingly.

NOTE: THE TCU WILL OVERRIDE THE INHIBITOR SWITCH, IF NECESSARY, IN ORDER TO PREVENT THE ENGINE FROM OVER-REVVING.



Inhibitor Switch

Cruise Control Signal

The cruise control signal tells the TCU of cruise control activation. This allows for a wider operating range in 4th gear unless a large speed differential exists from the set speed in which case the transmission may downshift. This improves fuel economy.

The ATF temperature sensor is located on the lower valve body next to duty solenoid "B."

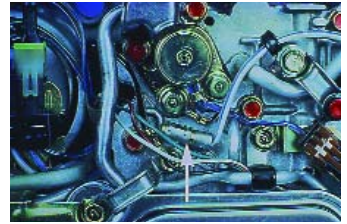
Cruise Control



When the ATF is cold, the TCU won't allow an upshift into 4th gear. The object is to warm the engine quickly for lower emissions. It is more sophisticated than the KDLH system and less objectionable for the consumer.

ATF Temperature Sensor

When the ATF is hot (AWD only), the TCU shifts the transmission as if in the POWER mode. This pushes the shift points higher which allows the engine to run faster. The oil pump then circulates ATF through the oil cooler more quickly so as not to overheat the engine coolant.



Temp Sensor

System Voltage

The TCU also monitors system voltage in order to correctly interpret the inputs and alter the control of the outputs. For example, the system is designed for 12 volt operation. When running, however, most vehicles have other than 12 volts available.

The 1-HOLD switch is located aft of the shift quadrant. When activated, it creates a forced 1st gear.

NOTE: THE TCU WILL SHIFT 2ND TO 3RD IF NECESSARY, IN ORDER TO PREVENT THE ENGINE FROM OVER-REVVING.



Shift Quadrant

Forced FWD Switch

The FWD switch changes the driving mode from AWD to FWD, and should be used for diagnostic purposes only. Do not drive the vehicle in this mode. The FWD switch is located on the left front shock tower. The Legacy FWD switch is located on the right strut tower. It is activated by inserting the spare fuse into the under-hood connector. The FWD light on the combination meter verifies that the vehicle is in FWD.



Forced FWD Switch

Maintenance Precautions

Before jacking up one or two wheels for maintenance with the engine running or before running the vehicle on a chassis dynamometer, the electronic AWD engagement system MUST be disengaged by installing the spare fuse (15A) of the fuse box into the FWD connector located under the hood. Failure to do so could result in movement of vehicle.

(Refer to owner's manual.)

TCU Outputs

There are two types of outputs; solenoid controls and light controls. The solenoids control shifting, line pressure, lock-up and AWD.

The light controls indicate operating conditions to the driver. They indicate the POWER mode, manually selected 1st or 2nd gear, or hot ATF (AWD only).

On the 1990 model year and later Legacy models the light controls indicate hot ATF (FWD and AWD), gears 3 - 2 - 1, MANUAL mode, and POWER mode.

Shift solenoids #1 and #2 are located on the upper valve body. The TCU induces "ON/OFF" conditions which regulate the shifting of the forward gears.

When a shift solenoid is "ON," it passes pilot pressure to shift valve "A" and/or shift valve "B." The valve(s) will then shift, feeding the appropriate controlling member circuits (high clutch, band, etc.).

NOTE: PILOT PRESSURE IS NOTHING MORE THAN A PRESSURE HELD AT A CONSTANT VALUE.



Power Lamp

When a shift solenoid is "OFF," the affected shift valve will move to its static position due to spring pressure. The appropriate controlling member circuit will then be fed (high clutch, band, etc.).



Shift Solenoids 1 and 2

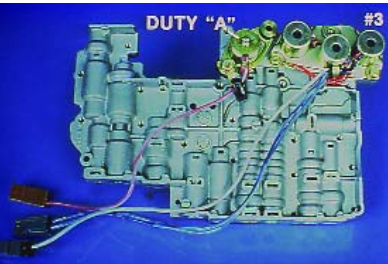
COMPONENT APPLICATION										
	REV./C	B/B	HIGH/C	FWD/C	D/W/C [3-1]	OVR/C [R/W/B]	Lo/1 [1-2]	Hi/2	Slid 1	Slid 2
P/N										
1st										
2nd										
3rd										
4th										

Solenoid Application Chart

Shift Modes

Shift Solenoid #3

Shift solenoid #3 is located on the upper valve body. It is used to control downshifts. It quickly releases the 3-Release pressure during low speed heavy load situations in order to provide smooth 3-2 downshifts. It operates the overrunning clutch in order to provide engine braking during deceleration. It is also used to cancel the overrunning clutch momentarily during light throttle 3-2 downshifts, or closed throttle 2-1 downshifts. This reduces the shift shock.



Shift Solenoid 3

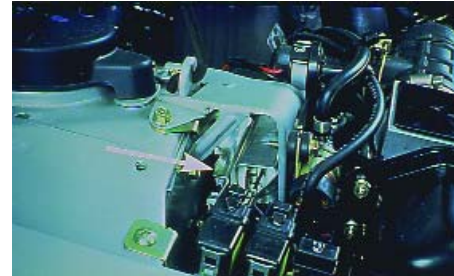
Duty Solenoid "A"

Duty Solenoid "A" is located on the upper valve body. It regulates line pressure at three levels:

- Basic: Altered with load, vehicle speed, and range signal.
- Shifting: Lowers line pressure in between shifts to minimize shift shock.
- Start up: With low ATF temperature or a low tach signal [cranking speed], it sets line pressure to a minimum.

Dropping Resistor

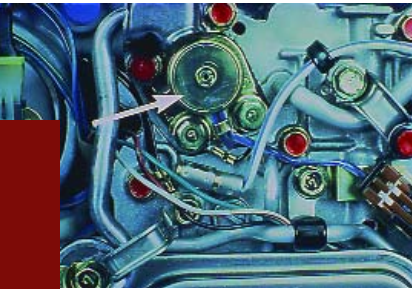
The dropping resistor is wired in parallel with duty solenoid "A," and is used to regulate line pressure. It is located on the right front shock tower behind the MPI fuel system dropping resistor. It takes over line pressure control during the "OFF" portion of the duty cycle for the duty solenoid. In other words, the duty solenoid is never fully "OFF."



Dropping Resistor

Duty Solenoid "B"

Duty Solenoid "B" is located on the lower valve body next to the ATF temperature sensor. It operates the lock-up clutch in 3 modes: "ON," "OFF," and a gradual "ON/OFF" control of the lock-up clutch during gear shifting in order to reduce shift shock.



Duty Solenoid "B"



Duty Solenoid "C"

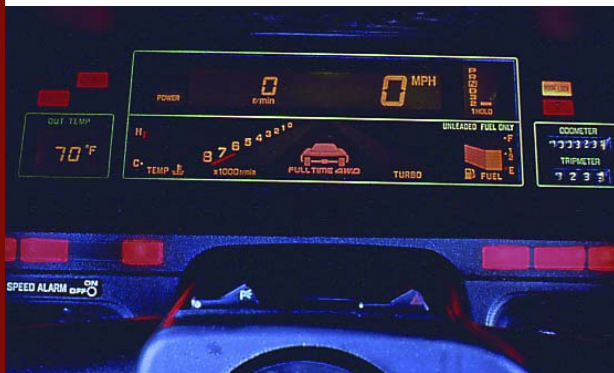
Duty Solenoid "C"

Duty Solenoid "C" is located in the extension housing. It is also controlled by the TCU. It varies the degree of AWD.

Power Indicator Light

The POWER Indicator Light is located in the combination meter. It is activated momentarily whenever the vehicle is started as part of the self check system. It turns "ON" when the TCU selects the POWER mode with the vehicle in the "D" range. It blinks a self diagnostic code whenever the TCU is programmed for self diagnosis.

Combination Meter



The TCU monitors the throttle angle opening speed, i.e., how quickly the gas pedal is depressed. When a predetermined rate is exceeded, the POWER mode is activated.

NOTE: THERE ARE A NUMBER OF PREDETERMINED RATES BASED ON THE VEHICLE SPEED VS. THROTTLE ANGLE RELATIONSHIP. THESE DETERMINE EASE OF ACCESS TO POWER MODE. AS A GENERAL RULE, IT IS EASIER TO ACTIVATE THE POWER MODE AT LOWER SPEEDS FROM A LIGHT THROTTLE THAN IT IS AT HIGHER SPEEDS FROM A LIGHT THROTTLE.

The POWER mode increases the upshift and downshift points. It is deactivated by the vehicle speed and the throttle angle, i.e., if the speed is equal to or greater than approximately 40 MPH with a light throttle, deactivation is immediate.

If the speed is less than approximately 40 MPH, a time lag of up to 3 seconds will occur before resuming the normal shift pattern.

2nd Gear Indicator

The 2nd Gear Indicator is located with the shift position indicators. It is controlled by the TCU. Other quadrant indicators are controlled by the inhibitor switch. The 2nd gear indicator is affected by the 1-HOLD switch input. The TCU grounds the 2nd gear indicator light with the 1-HOLD switch "OFF" and the shift lever in "2" (except Legacy).

1-HOLD Indicator Light (if so equipped)

The 1-HOLD indicator light ("L," Loyal and XT only) is located near the combination meter shift position indicator. It is activated by the TCU whenever the 1-HOLD button is depressed with the shift lever in "2." It changes the display and cancels the "2" indicator.

The vehicle stays in 1-HOLD unless the TCU determines a potential engine over-rev condition, at which point, the transmission will then upshift.

NOTE: WHEN 1-HOLD IS ACTIVATED, ALL OTHER SHIFTING INPUTS ARE IGNORED.

Beginning in the 1990 model year Legacy, the 1-HOLD button and light have been deleted and a MANUAL switch and light added. When the transmission is in 3rd range, MANUAL switch "ON," it locks out 1st gear and shifts 2-3. When in 2nd range MANUAL, the transmission locks out 1st gear and is held in 2nd gear (until 6500 RPM when it will upshift to prevent engine damage). When in 1st range MANUAL the transmission is locked in 1st gear (until 6500 RPM when it will upshift to prevent engine damage).

NOTE: TCU WILL ALWAYS OVERRIDE THE SELECTOR POSITION AT 6500 RPM.



Combination Meter Display

ATF Temperature Warning Lamp

An ATF Temperature Warning Lamp is provided for "L" Series and XT (AWD only) and for the Legacy (FWD and AWD). The lamp is located on the combination meter. It is activated by the TCU to indicate overheated ATF fluid. The TCU will shift the transmission as if in the POWER mode to help reduce the ATF temperature.

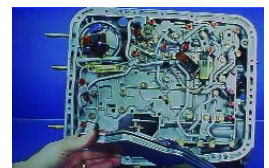
Hydraulic Control System

Valve Body

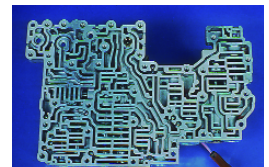
The valves and solenoids control the lubrication circuits, the lock-up torque converter, shifting, etc. The valve body is divided into two major sections: upper and lower.

The valve body works in conjunction with the TCU. It is designed to provide smooth shift control and component longevity. It also reduce unnecessary high pressure in certain instances. As an example, line pressure is lowered between shifts.

The valve body features shift step control. This means that gear members are momentarily applied between shifts it allows them to be brought up to speed which reduces shock.



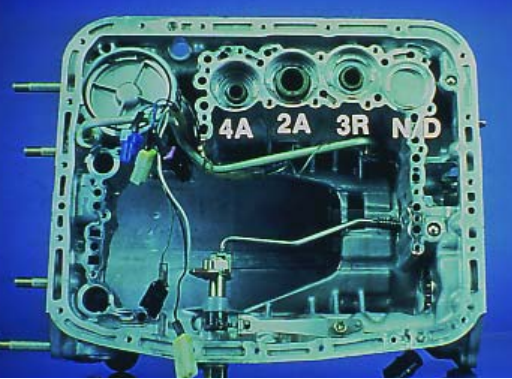
Valve Body



Upper Valve Body



Lower Valve Body



Accumulators

Accumulators

There are four accumulators mounted in the transmission case:

- 4-Apply (4A)
- 2-Apply (2A)
- 3-Release (3R)
- Neutral/Drive (ND)

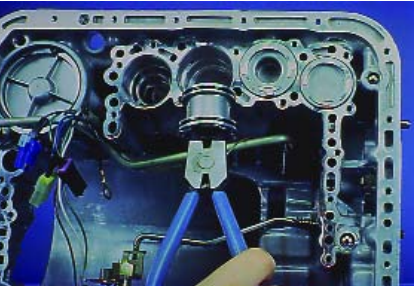
They are designed to lessen shift shock by absorbing the sudden pressure change generated when a circuit is activated. This ensures smooth component application. The accumulator resistance will vary in direct proportion to the line pressure.

Accumulators normally operate at a fixed rate in other automatic transmissions. Therefore, as the transmission pressures rise, the accumulator cannot further compensate due to the constant value of the spring. Pressure shocks are thus transferred to the components.

In the 4EAT Accumulators, however, the line pressure is applied to the back of the accumulator piston. Therefore, the resistance to pressure is proportionally increased hydraulically. This keeps the pressure shock under control, allowing smoother component application.

An additional accumulator is located in the lower section of the valve body, next to the manual valve. It absorbs line pressure pulses created by the sudden changes in line pressure.

NOTE: THE 4EAT IS A HIGHLY RELIABLE TRANSMISSION. SHOULD AN ELECTRICAL COMPONENT MALFUNCTION, HOWEVER, IT WILL ALWAYS FAIL SAFE FOR "LIMP HOME."



Accumulator Operation

Fail Safe Components And Failure Results

If a speed sensor fails, the remaining sensor signal will be used.

In case of throttle sensor failure, the idle contacts will signal the throttle opening. Line pressure will go to maximum at open throttle and it will go to minimum at closed throttle.

Although the inhibitor switch may fail, the manual valve will still be in the correct position for all selected ranges. In "P" and "N" however, it may effect start-up, therefore, there is a potential for a no-start condition. In Reverse, the TCU is passive. Therefore, an inhibitor switch failure has no effect. If multiple signals are seen in the forward ranges the inhibitor switch is ignored and there is no fourth gear.

If the 1-HOLD switch is defective, the system operates in the same manner as an inhibitor switch failure in the forward ranges.

If the MANUAL switch is defective (Legacy only), the transmission will shift normally in D position. It will operate the same as when there is an inhibitor switch failure when the transmission is in selector position 3 - 2 - 1 .

If shift solenoids #1 or #2 malfunction, the TCU deactivates the other. This results in either 3rd gear or Reverse (when selected).

If duty solenoid "A" fails, line pressure goes to maximum.

If duty solenoid "B" fails, the torque converter lock-up will not occur.

If shift solenoid #3 malfunctions, the overrunning clutch is always "ON" and there will be engine braking during deceleration.

If duty solenoid "C" should fail, the AWD control will be set to maximum and the rear wheels will always be powered.

Self Diagnostic System

The 4EAT self diagnostic system has three modes: a user mode and two dealer modes. In the first instance, the user is notified through the POWER light when a malfunction occurs. The failure is communicated after the next ignition "OFF/ON" cycle. For a more detailed description of the user mode, see the appropriate troubleshooting section of the service manual.

NOTE: THE SYSTEM WILL FAIL SAFE FOR "LIMP HOME." WHEN A COMPONENT FAILS, THE LIGHT WILL NOT ILLUMINATE UNTIL THE IGNITION IS SWITCHED "OFF" AND THEN SWITCHED TO "ON" AGAIN.

For specific information on the self diagnostic dealer modes, see the appropriate troubleshooting section of the service manual.

The Select Monitor requires the specific 4EAT cartridge to perform the analysis.

This form of analysis is the preferred troubleshooting/self-diagnostic method. The Select Monitor identifies current problems, past problems (through long-term memory), and indicates actual circuit and component performance.

It also allows data to be observed under actual driving conditions which is of great assistance in the diagnosis of intermittent problems.

The Select Monitor has four major modes:

1 Function modes (15)

These modes indicate sensor and component performance data and are displayed on the LED screen.

Example: Mode F 01 = F 01 12.6 volts (Battery voltage)

2 "A" modes (3)

These modes indicate the operation of 13 different switch inputs which are displayed by the red numbered LEDs.

- LED "ON" = switch "ON"
- LED "OFF" = switch "OFF"

Functions of the red LED's are identified by letter code on the upper screen.

3 "B" modes (2)

These two modes display the current TCU self-diagnostic codes and the past TCU self-diagnostic codes (long-term memory).

NOTE: WHEN USING SELECT MONITOR IN THE "B" MODES IT IS NOT NECESSARY TO PERFORM THE NORMAL SELF-DIAGNOSTIC ACCESS PROCEDURES.

4 "C" mode (1)

This clears the trouble codes that are stored in long-term memory.

NOTE: REFER TO THE APPROPRIATE SERVICE MANUAL, SECTION 3 - 2, AND REVIEW SELECT MONITOR USAGE AND TROUBLESHOOTING PROCEDURES.



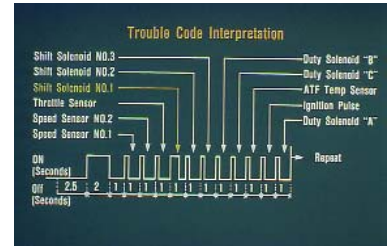
Shift Quadrant



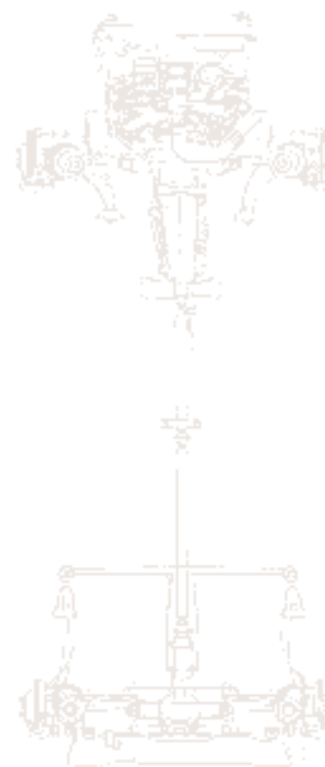
Combination Meter

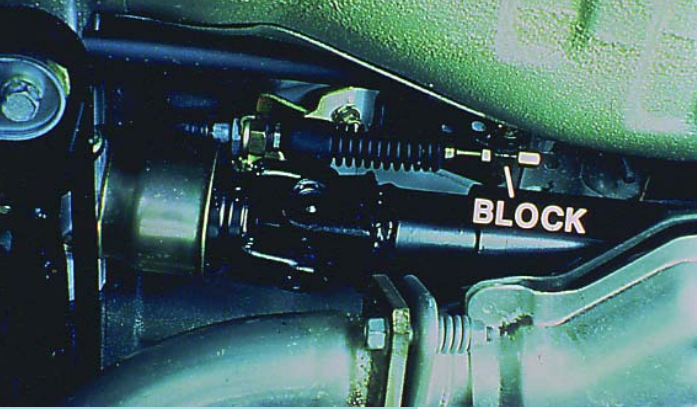


Select Monitor



Code Interpretation





Cable Adjustment



Inhibitor Switch/Cable



Inhibitor Switch/Adjustment

Troubleshooting/Adjustments

Preliminary Inspection

Check the following:

- ① Fluid level
- ② ATF leaks
- ③ Road Test:
 - Check proper shift points
 - Engine performance
- ④ Correctly adjusted throttle sensor
- ⑤ Gearshift cable adjustment
- ⑥ Correct stall test results
- ⑦ Inhibitor switch connections
- ⑧ Correct pressure test results

Gearshift Cable Adjustment

Place the transmission in neutral with the engine "OFF." Then loosen the locking nut and the adjusting nut. Push the shift lever arm rearward and tighten the adjusting nut until it contacts the connecting block. Finally, secure the cable with the locking nut and double check the operation.

After adjusting the gearshift cable, verify the correct inhibitor switch position. Remove the cable from the inhibitor switch in order to perform the adjustment. The switch must be in neutral.

Then insert the special tool #499267300 Stopper Pin through the 2 levers of the switch into the depression in the switch body. Next, loosen the 3 retaining bolts and rotate the inhibitor to adjust. Finally, reinstall the cable and reconfirm the cable adjustment.

Stall Test

The stall test checks the operating condition of the AT clutches, the torque converter, and the engine. Perform these checks in "D," "3," "2," and "Reverse."

Stall Test Results

Higher than normal RPM indicates one or more of the following:

- Slippage of the forward clutch
- O.W.C. not holding
- Low/Reverse brake slipping
- Overall low line pressure

Lower than normal RPM indicates one or more of the following:

- Incorrect throttle adjustment
- Poor engine operation
- Torque converter stator slippage

Time Lag Test

The time lag test checks the operation of the forward clutch, the reverse clutch, the low/Reverse brake, O.W.C. 3-4, and O.W.C. 1-2.

Perform this test at operating temperature. Idle the engine with the A/C "OFF." Confirm the proper idle speed in "N" and correct if necessary. Then shift into "D" and measure the time (seconds) to full engagement. It should take less than 1.2 seconds. Then shift into "R" and measure the time. It should take less than 1.5 seconds.

Time Lag Results:

If the time takes longer from "N" to "D" it may indicate one or more of the following:

- Low line pressure
- Worn forward clutch
- O.W.C. problem

If the time takes longer from "N" to "R," it may indicate one or more of the following :

- Low line pressure
- Worn reverse clutch
- Worn low/rev brake

Pressure Test

This is a preliminary test which should be conducted prior to any disassembly. Perform a pressure test when all the circuits show evidence of slippage or when the circuits show negative results from the time lag test. This test should also be performed if there is excessive shift shock, delayed shifting, or if the vehicle is immobile.

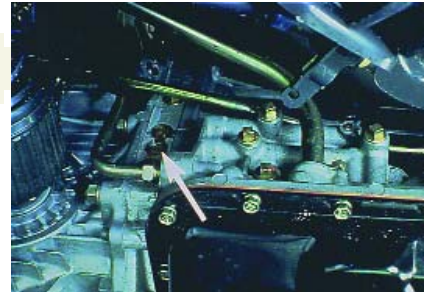
Perform this test by connecting the pressure gauge to the "oil pump outlet" test port in order to determine the overall line pressure. Should a particular component be suspected, perform pressure tests at its unique test port.

Refer to the Service Manual, Sec. 3-2 for other ports. Check for minimum and maximum values at each port.

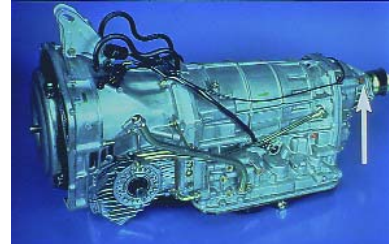
On Car Service/Adjustments

The following can be performed on the vehicle:

- Checking/changing fluids
- Band adjustment
- Valve body servicing
- Shift linkage adjustment/replacement
- Inhibitor switch adjustment/replacement
- Harness repair/replacement
- Transfer clutch assembly (servicing/replacement)
- Speed sensors replacement



Pressure Test Port



MPT Test Port

ON CAR SERVICE

- | | |
|--------------|--------------------|
| • Fluids | • Inhibitor Switch |
| • Band | • Wire Harness |
| • Valve Body | • MPT Assembly |
| • Linkage | • Speed Sensor |

