ON-BOARD DIAGNOSTICS

W5A 580 Automatic Transmission

Vehicle Coverage:

XJ Series 4.0L S/C 2000 to 2002 model year
XKR 4.0L S/C 2000 to 2002 model year

1 Contents

2 Introduction

This document describes the on-board diagnostic monitoring strategy and malfunction criteria for the W5A 580 Transmission Systems.

2.1 OBD-II Systems

California OBD-II applies to all gasoline engine vehicles up to 14,000 lbs. Gross Vehicle Weight Rating (GVWR) starting in the 1996 MY and all diesel engine vehicles up to 14,000 lbs. GVWR starting in the 1997 MY.

"Green States" are states in the Northeast that chose to adopt California emission regulations, starting in the 1998 MY. At this time, Massachusetts, New York, Vermont and Maine are Green States. Green States receive California-certified vehicles for passenger cars and light trucks up to 6,000 lbs. GVWR.

The National LEV program (NLEV) requires compliance with California OBD-II, including 0.020" evaporative system monitoring requirements. The NLEV program apply to passenger cars and light trucks up to 6,000 lbs. GVWR nation-wide from 2001 MY through 2003 MY

Federal OBD applies to all gasoline engine vehicles up to 8,500 lbs. GVWR starting in the 1996 MY and all diesel engine vehicles up to 8,500 lbs. GVWR starting in the 1997 MY.

OBD-II system implementation and operation is described in the remainder of this document.

2.2 Introduction

This electronically controlled five-speed transmission system is unique to supercharged vehicles. The system is controlled by a transmission control module, which is located in the same housing as the engine control module.

The TCM processes input and output in both analogue and digital form, which may be summarized in four categories:

Inputs	Outputs
Gear selector position (Dual Linear Switch x 4 inputs)	Solenoid valve 1 <-> 2 and 3 <-> 4 shift
Fluid temperature	Solenoid 2 <-> 3 shift
Kickdown	Solenoid valve 3 <-> 4 shift
Speed sensor #1	Solenoid valve converter lock-up clutch
Speed sensor #2	Control valve - modulating pressure
Mode switch	Control valve - shift pressure
	Solenoid supply
	Speed sensor supply
	Speed and fluid temperature sensor ground

CAN Input Signals	CAN Output Signals
Traction status	Engine torque reduction request
ABS malfunction	MIL status (whether present DTC should operate MIL)
ABS status	Transmission input speed
Engine torque status	Transmission output speed
Throttle position	Converter slip
Accelerator pedal position	Kickdown status
Engine torque reduction confirmation	Gear position (actual)
Engine speed	Gear position (selected)
Cruise status	Gear selection fault
OBDII fault code clear request	Converter lock-up status
Throttle malfunction warning RED or AMBER	Current selected shift map
All road wheel speeds	Fluid temperature
Token for network status ECM	Transmission malfunction
Token for network status INST	Programmable CM status flag (state of current TCM program)
Token for network status ABS	Target for next gear position
Diagnostic data in from external device	Gear shift torque transfer progress at shift
	MIL status (response to activate the MIL relevant to a DTC)
	OBDII fault code clear acknowledgement
	Transmission DTCs (P codes)
	Token for network status TCM
	Diagnostic data out to external device
	Input is used by the TCM to control shift selection, energy and program management.

2.3 Emergency Running (electronic limp-home mode)

The TCM constantly monitors the transmission for faults. In the event of a problem the TCM will adopt the limp-home mode, in which the last gear shifted remains engaged, until **P** or **N** is selected. The modulating and shift pressures will increase to maximum and converter lock-up will be inhibited.

Following the selection of **P** or N, the only ratios available will be **2** (irrespective of forward ratio manual selection) and R.

With the vehicle at rest, the procedure to manually select is as follows:

1. Select P.
2. Switch OFF the ignition.
3. Wait 10 seconds.
4. Start the engine.
5. Select **R** (reverse will be selected).
6. Select **D (2** will be selected).

The limp-home mode will be retained until the fault is remedied or the fault code has been erased. Cycling the ignition OFF/ON may clear intermittent faults. In certain cases the component may need to be operated before the fault code is cleared e.g. a shift solenoid.

2.4 Emergency Running (mechanical/hydraulic limp-home mode)

Should slip be detected, due to a mechanical failure or loss of pressure, the transmission will either shift to, and hold **3** or shift to, and hold, the **last** gear which was known to be alright. This condition may be cleared by cycling the ignition OFF/ON following mechanical repair.

The operator will be made aware of certain faults by a warning message on the instrument cluster.

Data concerning OBDII related transmission failures is stored in the ECM for access via the J1962 socket.

2.5 Safety Functions

These functions are designed to safeguard against inappropriate actions by the operator as well as system malfunctions.

The electrical and diagnostic system has been designed such that system integrity is protected at all times, the safety concept being based on the following three points.

1. The hydraulic system has 'fail-safe' characteristics regarding its electrical operation, such that should the power supply be lost to the electro-hydraulic actuators the transmission will initiate a limp-home mode.
2. Recognition of critical shift operation by monitoring the last element in the signal path, i.e. the solenoid valve, and checking by means of redundant measured variables relative to engine, transmission and road speeds.
3. Each time the vehicle is started there is a check on the entire safety hardware and the associated program parts and signal paths. A malfunction in this part of the system, or triggering of the safety circuit, is communicated to the operator by a warning message on the instrument cluster.

2.6 Components and Functions

2.6.1 Torque converter

This assembly acts as a fluid coupling between the engine and transmission and provides multiplication of engine torque. It also allows speed and torque adaption when starting from rest.

It comprises of the housing, impeller, turbine, stator, freewheel and a lock up clutch assembly.
The lock-up clutch reduces converter slip and so, engine speed. Depending on engine speed and load, the clutch is engaged automatically, normally in 4th and 5th gears. The converter is fitted with a drain plug.

2.6.2 Transmission casing

The following components are housed within the casing;

- Stator, intermediate and output shafts.
- Three epicyclic gear trains.
- Six multi-disc clutch/brake packs.
- Two freewheels (One-way clutches).
- Hydraulic pump.
- Parking lock assembly.
- Electro-hydraulic control unit.
- Internal harness and 13 pin connector with bayonet lock.

2.6.3 Power flow through the transmission

From the **Torque converte**r, power is transferred to the **three epicyclic gear trai**ns, various elements of which can either be joined together or held still by either the **Freewheels** or the **Multi-disc Clutch/Brake assemblies** (controlled by the Electro-hydraulic control unit). This combination of elements results in five forward and two reverse gear ratios. The resulting rotational torque is taken from the transmission output shaft, to the final drive assembly via the driveshaft

2.6.4 Hydraulic pump.

This engine driven pump is located at the front of the transmission casing and provides pressure for the hydraulic functions. The pump supplies fluid under pressure to the torque converter, gear train, electro-hydraulic control unit and the lubrication circuit. It also draws fluid from the fluid pan below the transmission casing, through a filter.

2.6.5 Parking lock

This component prevents movement of the vehicle by engaging a fixed pawl with the parking lock gear located on the output shaft. The pawl is engaged by moving the gear selector lever to the park **(**P) position.

2.6.6 Electro-hydraulic control unit

This unit, mounted in the transmission lower case, converts signals, mechanical from the J-gate and electrical from the TCM, into hydraulic functions.
The following components are assembled to the unit:

- Selector valve.
- Shift plate.
- Control valve - modulating pressure.
- Control valve - shift pressure.
- Solenoid valve 1 <-> 2 and 4 <-> 5 shift.
- Solenoid valve 3 <-> 4 shift.
- Solenoid valve 2 <-> 3 shift.
- Solenoid valve - converter lock-up.
- Speed sensors (2).
- Temperature sensor.

2.6.7 Speed sensors

There are two speed sensors within the transmission assembly, which provide input to the TCM. These inputs, when used in conjunction with CAN data relative to engine speed (from ECM) and road speed (from ABS), are used to electronically control the transmission.

2.6.8 Temperature sensor

The output from this sensor allows the TCM to compensate for the affect of fluid temperature on shift time and quality

2.6.9 Shift Programs

Upon encountering the following conditions, the TCM will automatically use the Normal or Sports shift map to enhance the operation of the vehicle:

1. Traction: When traction intervention is active.
2. Hot mode: Extreme engine/transmission temperatures.
3. Gradient: Under specific speeds and loads.
4. Manual: Driver initiated override of the normal shift map when the LH side of the 'J gate' is used.

Traction

When traction or stability control (engine or brake system derived) is operational the TCM will implement the traction map to maximize control of wheel slip.

Gradient

The gradient function is intended to enhance vehicle drivability when climbing a gradient or towing. The TCM will implement the function when increased driving resistance is detected, and provides enhanced drivability, additional cooling and/or increased performance as appropriate.

2.7 Control Module Pin Numbering

The following table details the Pin numbering for the transmission control module.

Connector 1 – 18 Way Black

Pin	Circuit	Pin	Circuit	Pin	Circuit
001	)	007	)	026	Dual linear switch position W1
002	Kickdown Switch	008	)	027	Dual linear switch position W2
003	Mode Switch	009	)	028	Dual linear switch position W3
004	)	023	)	029	Ignition B+
005	)	024	)	030	Power ground
006	)	025	Dual linear switch position W0	031	)

Connector 2 – 14 Way Black

Pin	Circuit	Pin	Circuit	Pin	Circuit
012	N2 Speed Control	017	Torque Converter Solenoid	037	Pressure Regulator Shift Signal
013	Speed Sensor +ve	033	Speed Sensor & Interlock Ground	038	Solenoid & Pressure Regulator +ve
014	Solenoid 1 <-> 2 & 4 <-> 5	034	Temperature Sensor	040	CAN link -ve
015	Solenoid 3<-> 4	035	N3 Speed Signal	041	CAN link +ve
016	Solenoid 2 <-> 3	036	Pressure Regulator Modulating Signal		

3 On-Board Monitoring

When the ignition switch is set to position II (ignition ON) the TML comes on briefly and then goes off again.

When the TCM detects a fault, it stores the fault code and activates the transmission fault-warning lamp (TWL). For faults detected in less critical inputs/outputs, the TCM substitutes the faulty input/output with a default value and continues the normal mode of operation. This allows the vehicle to be driven normally, although gear change quality will be affected.

3.1 Control Module Malfunctions

Electronic Transmission Operation – Control Module Malfunctions								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
CAN Link	P1795	Incorrect network token received from other nodes.	Network token values are incorrect.	N/ A	None	None	30ms	2 Drive Cycles
	P1796	CAN IC internal diagnostics detects CAN Bus- Off.	No CAN bus activity.	30ms	None	None	250ms	2 Drive Cycles
	P1797	No network token received from ECM node.	No token received from ECM	200ms	None	None	850ms	2 Drive Cycles
System Voltage	P1793	Ignition supply out of allowable range.	Ignition supply checked.	7<::> 16v	Engine speed	>1600RPM	300ms	2 Drive Cycles
	P1789	Ignition supply too low to operate solenoids, but able to maintain the present solenoid state	Ignition supply checked.	7<::< 9.0v	Engine speed	>1600RPM	2.55s	2 Drive Cycles
TCM Internal	P1605	PROM fault, incorrect checksum.	Calculated checksum does not match stored checksum.	94.2s	None	None	2.56s	2 Drive Cycles
	P1603	EEPROM fault.	Write to EEPROM and read back value.		None	None	Immediate	Immediate
	P1608	Watchdog fault.	Internal TCM watchdog detects fault.		None	None	10ms	2 Drive Cycles

Electronic Transmission Operation – Control Module Malfunctions – Cont'd								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
	P1796	CAN info totally distorted message check	CAN info totally distorted	Token_ ECM<> C4	Ignition on		260ms	2 Drive Cycles
	P1797	CAN ECM info totally distorted message check	CAN ECM info totally distorted	Counter increase dependent upon engine speed and estimated engine torque	Ignition on		300ms	2 Drive Cycles
		CAN inconsistent ECM node token check	Inconsistent ECM node		TCC= slipping		300ms	2 Drive Cycles
	P1601	TCM internal check(EEPROM incorrect coding)	Internal control module computer error	Range check of EEPROM	Ignition on			2 Drive Cycles
		TCM internal check (clock)	Internal control module computer error	Counter increase on hardware clock fail	Ignition on		Counter >50	2 Drive Cycles
		TCM internal check (internal watchdog test)	Internal control module computer error	Watchdog timer to be reset within 132 ms	Ignition on		132ms	2 Drive Cycles
		TCM internal check (external watchdog test)	Internal control module computer error	Trigger set off by watchdog within 124 ms	Ignition on		124ms	2 Drive Cycles
		TCM internal check (RAM)	Internal control module computer error	Time measured with timer/ range check of bit pattern	Ignition on		Incorrect values	2 Drive Cycles
		TCM internal check (ROM)	Internal control module computer error	ROM check of calculated values	Ignition on		Incorrect value 3 times	2 Drive Cycles
		TCM internal check (EEPROM critical functions)	Internal control module computer error	Checksum of EEPROM block 8 incorrect	Ignition on			2 Drive Cycles
		TCM internal check (EEPROM non- critical functions)	Internal control module computer error	Checksum of EEPROM block 8 incorrect	Ignition on			2 Drive Cycles

3.2 Transmission Range/Position Switch

Electronic Transmission Operation – Transmission Range/Position Switch								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Transmission	P0705	Selector lever signals implausible	Transmission range circuit malfunction	Invalid 4 bit code	Ignition on		300ms	2 Drive Cycles

3.3 Input Speed Sensor Circuit

Electronic Transmission Operation – Input Speed Sensor Circuit								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Input Speed Sensor	P0715	Speed sensor n2 (check speed signal exists, not electrical)	Input/ turbine speed circuit malfunction	n2= 0	Engine speed> 450rpm Wheels > 250rpm		800ms	2 Drive Cycles
		Speed sensor n3 (check speed signal exists, not electrical)	Input/ turbine speed circuit malfunction	n3= 0	Gear = 3 or 4, n2> 150rpm		800ms	2 Drive Cycles
		Implausible speed n2 and or n3	Input/ turbine speed circuit malfunction	n2 - n3> 40rpm	n3> 800rpm, gear =2/ 3/ 4		300ms	2 Drive Cycles

3.4 Output Speed Sensor Circuit

Electronic Transmission Operation – Output Speed Sensor Circuit								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Output Speed Sensor	P1720	CAN : Wheel speed, rear right implausible	Loss of wheel speed information	Wheel speed = FFFF	4B0h is received		300ms	2 Drive Cycles
		CAN : Wheel speed, rear left implausible	Loss of wheel speed information	Wheel speed = FFFF	4B0h is received		300ms	2 Drive Cycles
		CAN inconsistent ABS node (Token check)	Loss of wheel speed information	Token_ ABS<> C4	Ignition on		300ms	2 Drive Cycles
		CAN ABS info distorted check of 0FA / 4B0 message	ABS CAN info distorted	Missing	Ignition on		300ms	2 Drive Cycles

3.5 Transmission Fluid Temperature Sensor

Electronic Transmission Operation –Transmission Fluid Temperature Sensor								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Oil Temperature Sensor	P0711	Oil temperature sensor value suddenly changes or	Oil temperature change between samples. (100 ms)	>5º C	Disable:	Engine idle speed diag	1.5s	No Mil
		Oil temperature does not rise correctly from cold	Oil temperature	<20º C	Engine running	>600rpm	180ms	No Mil
			d oil temperature	>10º C	Time Disable:	180ms Engine idle speed diag		
	P0712	Oil temperature input too low.	Input voltage to TCM	<0.294v	Disable:	Engine idle speed diag	1.5s	No Mil
	P0713	Oil temperature input too high.	Input voltage to TCM	<0.294v	Disable:	Engine idle speed diag	1.5s	No Mil

3.6 Torque Convertor Lock Up Solenoid

Electronic Transmission Operation – Torque Convertor Lock Up Solenoid								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
	P1744	TCC (measures slippage in TCC while in slipping mode)	Torque converter clutch heat control				Counter > 7	2 Drive Cycles
	P0740	PWM solenoid valve for TCC active	Torque converter clutch electrical	> 6.0 V	Ignition on, PWM> 94%		160ms	2 Drive Cycles
		TCC stuck on (Checks input speed against engine speed)	Torque converter clutch circuit malfunction	nmot- nt< 30rpm and estimated eng TQ >100 Nm	Gear = 1/ 2/ 3/ 4/ 5, TCC= Open		1000ms	2 Drive Cycles

3.7 Shift Solenoid "A"

Electronic Transmission Operation – Shift Solenoid "A"								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Shift Solenoid A	P0753	Electrical check of solenoid A	Condition active Condition inactive	> 4 V < 0.45 V	Ignition on Ignition on		160ms	2 Drive Cycles

3.8 Shift Solenoid "B"

Electronic Transmission Operation – Shift Solenoid "B"								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Shift Solenoid B	P0758	Electrical check of solenoid B	Condition active Condition inactive	> 4 V < 0.45 V	Ignition on Ignition on		160ms	2 Drive Cycles

3.9 Shift Solenoid "C"

Electronic Transmission Operation – Shift Solenoid "C"								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Shift Solenoid C	P0763	Electrical check of solenoid C	Condition active Condition inactive	> 4 V < 0.45 V	Ignition on Ignition on		160ms	2 Drive Cycles

3.10 Pressure Regulator

Electronic Transmission Operation – Pressure Regulator								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
Regulator solenoid	P1748	Regulator solenoid valve shift pressure	Electrical check of pressure control solenoid B	(Vset - Vmeas>+/ - 1.3V) (Iset- Imeas>+/ - 0.153A)	Ignition on		300ms	2 Drive Cycles
Regulator solenoid	P0748	Regulator solenoid valve modulator pressure	Electrical check of pressure control solenoid	(Vset - Vmeas>+/ - 1.3V) (Iset- Imeas>+/ - 0.153A)	Ignition on		300ms	2 Drive cycles
	P0702	Solenoid valve voltage supply out of tolerance	Trans control system electrical	Vbatt - Vout> 2V	Ignition on		100ms	2 Drive Cycles
		Speed sensor voltage supply out of tolerance	Trans control system electrical	Vreg< 4.8V or >7.8V	Ignition on			

3.11 Transmission System Mechanical

Electronic Transmission Operation – Transmission System Mechanical								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
	P0730	Over speed of n2 and or n3	Incorrect gear ratio	n2 or n3 > 7000rpm	No N2 or N3 fault code		80ms	2 Drive Cycles
		Over speed of engine	Incorrect gear ratio	Engine speed > 6500rpm	Engine on		80ms	2 Drive Cycles
		Engaged gear implausible	Incorrect gear ratio	Measured gear < Commanded gear 1.986< 1v< 2.386 and	Wheel speed > 400rpm Lever in D/ 4/ 3/ 2		40ms	2 Drive Cycles

Electronic Transmission Operation – Transmission System Mechanical								
Strategy	DTCs	Description	Malfunction Criteria	Value	Secondary parameter	Enable Conditions	Time Required	MIL
				N3= 0rpm (1st gear)				
		Engaged gear implausible or trans slipping	Incorrect gear ratio	1.986< 1v< 2.386 and n2-N3< 100rpm (2nd gear)				
				1.355< 1v< 1.455 (3rd gear)				
				0.970< 1v< 1.030 (4th gear)				
				0.476< 1v< 0.536 (5th gear)				
				1.726< 1v< 2.126 (reverse gear)				
				No messages	Wheel speed> 50rpm, Engine speed > 450rpm, N2> 150rpm			
				12C missing	Ignition on		1000ms	2 D/ C
Transmission	P0780	Gear identification repeatedly negative (calculated ratio vs actual ratio)	Shift malfunction	Counter increase dependent upon output speed and n2 / n3	Wheel speed> 50rpm, Output speed> 180rpm, N2> 150rpm		Counter> 11	2 D/ C