Gunson

FAULT CODE READER

FORD

PART NO G4160/4152

HANDBOOK

Fault Code Reader

FORD

Vehicles with EEC IV Electronic Control Unit (3 pin)
Plus early vehicles with 5pin diagnostic connector

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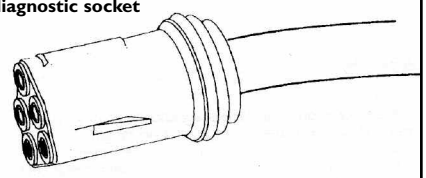
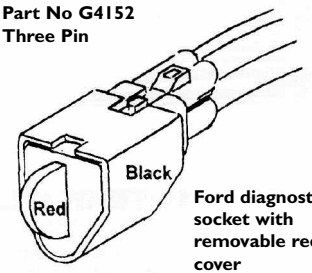
1. Application list

Part No	Type	Vehicle Application	Engine Type
G4160	Five Pin	Escort/Orion	1.6 CVH with KE Jetronic EFi with Catalyst 86-90
		Granada/Scorpio	2.0 OHC EFi (non catalyst) 2.4 V6 EFi (non catalyst) 2.8 V6 EFi 1986 2.9 V6 EFi (Non catalyst)
		Sierra/Saphire	2.0 OHC EFi (non catalyst) 2.8 V6 EFi 1986 2.9 V6 EFi(non catalyst)
		Escort/Orion/Mondeo Cosworth 2.0 with Weber Marelli Injection System	1.6/1.8/2.0 Zeta engine Up to 1995
G4152	3 Pin	Transit	2.9 V6 EFi(non catalyst)
		Fiesta, Escort, Orion Sierra, Sapphire, Granada, Scorpio	1.1/1.3 CVH CFi 1.3 HCS CFi 1.4 CVH CFi 1.6 CVH CFi &EFi 1.6 CVH EFi TURBO(not KE jetronic) 1.8 CVH CFi 2.0 OHC EFi Catalyst only 2.0 DOHC 2.4 V6 catalyst 2.9 V6 catalyst and V6 24v catalyst 1984/1986-95
		Escort/Orion/Mondeo	1.6/1.8/2.0 Zeta engine Upto 1995
		Vehicle Application Transit	2.0 OHC CFI 1986< 2.0 OHC EFi 1992< 2.9 V6 EFi 1992<

Part No G4160
Five Pin (early version)
Ford 5-way
diagnostic socket



Part No G4152
Three Pin



Ford diagnostic socket with removable red cover

2. SAFETY FIRST

General safety guidelines to follow when working on vehicles

- **Always operate the vehicle in a well ventilated area.**
- **Do not inhale exhaust gases - they are very poisonous.**
- **Always make sure the vehicle is in park (Automatic transmission) or neutral (manual transmission) and that the parking brake is firmly set. Block the drive wheels.**
- **Always keep yourself, tools and test equipment away from all moving or hot engine parts. Treat high tension ignition components with respect, remembering that electrical shocks can cause involuntary movement which may result in secondary injury.**
- **Wear approved eye protection.**
- **Never wear loose clothing that can catch in moving engine parts and always tie-up or cover long hair.**
- **Never lay tools on a vehicle battery. You may short the terminals together causing harm to yourself, the tools or the battery.**
- **When carrying out tests on a motor vehicle, remember NEVER run the engine with the car battery disconnected (either + or -) since the alternator would then run at a damaging over-voltage.**
- **Never smoke or have open flames near vehicle. Vapours from gasoline and charging battery are highly flammable and explosive. Always keep a suitable fire extinguisher handy.**
- **Never leave vehicle unattended while running tests.**
- **Keep children and animals out of the area.**
- **Always turn ignition key OFF when connecting or disconnecting electrical components, unless otherwise instructed.**
- **Always follow vehicle manufacturer's warnings, cautions and service procedures.**

CAUTION

Some vehicles are equipped with safety air bags. You must follow vehicle service manual cautions when working around the air bag components or wiring. If the cautions are not followed, the air bag may open up unexpectedly, resulting in personal injury. Note: The air bag may still open up several minutes after the ignition key is off (or even if the vehicle battery is disconnected) because of a special energy reserve module.

Precautions to be followed when using the Fault Code Reader

- **Before connecting the leads, ensure that the correct connector of the car has been identified.**

- **Using this product may cause vehicle systems to self test, items such as coolant fans to suddenly start with no warning, and engine speed to suddenly increase.**

- **Using this product can involve working on a car while the engine is running. This is a potential hazard and the user should take every precaution to avoid any possibility of damage or injury.**

3. HOW FAULT CODES MAKE IT EASY

Modern vehicles have electronic control units that are able to identify and remember faults which occur in the vehicle's equipment. This system was introduced on the higher specification electronic fuel injection vehicles around 1986 and was applied to other types of ECU a little later(ABS and Ignition) Its application is now virtually universal to all petrol engine vehicles. This is a great benefit to service and maintenance personnel as it can considerably simplify vehicle repair. The vehicle faults are stored in the vehicle's Electronic Control Unit (ECU) as "Fault Codes".

The system is so simple that retrieving vehicle fault codes does not require particular skill. However, in order to read these fault codes some equipment is necessary. (E.g. a Fault Code Reader), which is used to instruct the vehicle's ECU to download fault codes and/or present them to the user on a display. By far the most common system is to present the code as a "blink code". The Fault Code Reader will activate that part of the OBD programme which identifies the defective component and cause a code to be displayed, usually by a light on the Fault Code Reader or by an instrument panel "Check Engine" light. These provide a series of pulses to simply count a code number. Systems with an instrument panel "Check engine" light are able to illuminate this when the engine is running to warn of faults, other systems are more secretive and need to be interrogated.

The Fault Code Reader is an economical but very effective product. It is available for a wide range of vehicles and enables the user to instruct the vehicle to download stored fault codes. Having obtained the fault codes, the user then identifies the nature of faults by referring to a list of code numbers. Comprehensive lists of code numbers are included in this handbook.

NB Car manufacturers have in the past used a connector type unique to their own cars. Many manufacturers have used different types of connector at various times. Only recently have there been moves to standardise to a 16 pin socket.

Makes and models of car also vary in the degree of testing and fault diagnosis that is possible. In general, the ECU will identify faults that exist at the time of the test, but the ECU may also have a memory that remembers faults that have occurred in the recent past, and these can also be read out from memory using the Fault Code Reader. For instance, in some vehicles, the readout consists of the faults that are present at that time, followed after a "separator" code, by the codes that are held in memory from some previous time.

In most vehicles, tests are carried out with the engine off (but ignition on). Occasionally additional tests may be carried out with the engine running (this depends on the sophistication of the ECU and is not available on all makes of vehicle).

Having identified the fault codes, and eliminated the faults, the user may then wish to erase the faults from the ECU's memory. With some cars this is possible using a special sequence of operations, or a sequence of switch operations on the Fault Code Reader. With other vehicles this is not possible and it may be necessary to erase the memory by disconnecting the battery (-) connection (with engine not running), this has the disadvantage that codes for radio/ security system and also some ECU memory settings are temporarily lost. Fault codes generally disappear anyway after the fault has not been present for a certain number of engine start cycles, but deletion of the codes followed by a short drive has the advantage that it allows the operator to check if the fault has truly been rectified. This is confirmed if the code does not re-occur.

Before using this product (or indeed carrying out any vehicle maintenance), the user is recommended to read the precautions presented in later sections of this manual. In particular, note that during the use of this product the vehicle's On Board Diagnostic programme (OBD) takes control of the vehicle, and may activate various vehicle systems (such as turning on the cooling fan), this can constitute a safety hazard and the user should keep fingers clear during tests.

4. INTRODUCTION

This product is suitable for use only on Ford cards which have the EECIV Engine control unit (ECU). This ECU is very widely used on Ford vehicles. It was introduced in 1985, was universal on EFi engines from 1988/89 and became virtually universal on all petrol engined Ford cars from 1991/92. Ford EECIV is a generic system and there are several variants. Early EECIV used a 2 digit code system, and there are 2 different 2-digit code systems. Later EECIV used a 3 digit code and there is a variant of this Fault Code Reader with the correct socket to suit these vehicles. (Three way triangular socket with three contacts).

NB: After late 1995/early 1996 a 16 pin diagnostic socket may be fitted to some engine variants (EEC V ECU) and a blink code system is no longer used.

Full instructions to help you use the product and interpret the information are included and should be read carefully

Moving the Test Switch (labelled 0 and 1) from 0 to 1 starts a test or changes the way the vehicle's Electronic Control Unit (ECU) functions.

The LED code indicator. will transmit pulses which represent the fault codes.

5. HOW TO USE YOUR FAULT CODE READER

NUMBER / CODE IDENTIFICATION

Identifying fault codes is in fact very easy and simple, though it may seem complicated at a first reading, the user will soon get accustomed to the technique.

Basically, the ECU communicates with the "Code Reader" in a series of pulses, and the user simply counts these pulses to identify particular numbers. For example, the number 6 would be transmitted as 6 pulses in rapid succession. If we use the symbol ☼ to indicate a pulse, then the number 6 will be transmitted as:

☼ ☼ ☼ ☼ ☼ ☼ **= 6**

If the number is a 2 digit number, then each digit is transmitted separately. For

example, the number 25 would be represented as 2 pulses, followed by a brief pause, and then 5 more pulses.

2 5 = 25

In practice, the "Fault Code Reader" code will be output as a series of numbers one after the other, and the user has to recognise individual numbers, and recognise the gaps between numbers. This is made easy by the fact that the pause between two numbers is much greater than the pause between the individual digits of a number.

Similarly, there is an even greater pause between one series of code numbers (egg representing current faults), and another series of code numbers (e.g. representing faults stored in memory.

To make matters even easier, the ECU, in most instances, repeats a series of code numbers, so that the user has the opportunity to check the reading.

Each code has a particular meaning, which is identified by reference to the tables of Fault Codes which follow.

GENERAL NOTES

Before connecting "the Fault Code Reader" to the car, the user should ensure that the TEST SWITCH is set to "O" and the diagnostic socket has been correctly identified. Check that the car ignition is off, the car is out of gear, and that the handbrake is applied.

When a fault code appears, it does not necessarily mean that the component indicated is faulty. It could mean that the ECU has received a signal from the component or it's wiring, which is outside specification.
Therefore before tests are performed, (using the Test Procedure Notes later in this Manual), it is important
all of the connections and wiring associated with the indicated component are checked.

When multiple faults are indicated, it is possible that the fault on one component is causing incorrect readings from other components, but all the components will have to be checked to eliminate the true cause.

6. INSTRUCTIONS

Refer to the Tables in Section 5 to confirm whether the vehicle has a 2 or 3 digit code.

Initial Procedure

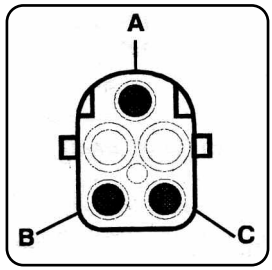
Before connecting the Fault Code Reader, carry out a basic inspection under the bonnet to ensure all leads and connectors are secure and that the breather system is operational.

Turn off the ignition

Disconnect any octane and idle adjust service wires if these have been connected to ground. This connector is usually coloured white and is illustrated in Fig 3. If this connector is connected to ground, then the test will proceed but Fault Code 53/54 may be recorded.

Ensure that the Fault Code Reader switch is in the O position. Connect the FCR to the diagnostic socket (usually found near the engine bulkhead or the battery)

FCR connection: **Brown to A**
Green/Yellow to B
Blue to C



A number of different test procedures are now possible:

IGNITION ON – ENGINE OFF TESTS

Turn the ignition but do not start the engine

Put the Test Switch into the I position. Wait for approximately 10 seconds and ignore any rapid pulses. (This is the on-board diagnostics (0BD) computer carrying out its initial tests). During this period the user may notice things happening under the control of the OBD system. Eg The coolant fan may momentarily start.

The OBD will then begin to output a sequence of codes which will be observed as a pulsing of the LED indicator on the FCR.

It will first transmit codes for faults that are currently present and after a short delay these codes will be repeated. A separator code may then be transmitted (the number 2) followed by the outputting of codes stored in

keep-alive memory (KAM).
These KAM codes will be repeated. Then there will be a further delay followed by the digit 1 – this signifies that this test is ended and that the OBD is now waiting for the start of the Wiggle Test

NB: The majority of vehicles using the Ford five way socket do not have KAM and Wiggle Test facilities. See the full application table in Section 5

WIGGLE TEST

Follow the test procedure as for Ignition On Engine Off. After the KAM codes are transmitted a single separator pulse will follow. This single digit indicated that the Engine Off test is complete and that the Wiggle Test is now activated.

The purpose of the Wiggle Test is to enable the testing of all connections and wiring to the main sensors (Eg air-flow meter, throttle position, air temperature, coolant temperature etc.) If a connector to a sensor is wiggled and a bad connection exists then the LED will pulse for as long as the connection remains bad.

Subsequent readout of th KAM codes will show which sensor had the connector fault.

NB: Setting the Test Switch to O during the Wiggle Test will erase fault codes stored in KAM

ENGINE RUNNING TEST

Ensure the engine is fully warmed up (and the air conditioning, if fitted, is switched off) and that the ignition is switched OFF. If the engine is not fully warmed up then when the test is started there will be a delay until the ECU detects that the engine has reached operating temperature.

Connect the FCR and set the Test switch to O

Switch on the ignition and start the engine. The engine should be started within 10 seconds after the ignition has been switched on otherwise the Engine Off tests will begin. (Some models require only a 3 second delay before Engine Off tests begin)

The vehicle's OBD procedure will now commence. Ignore any rapid pulses on the FCR as this is the OBD carrying out its initial tests. With some vehicles

Code 5 will be output to indicate that the engine running test has started. The engine speed will increase to about 2500rpm and after about 10 – 60 seconds the engine speed will return to normal.

The FCR will then transmit a single pulse (Code 1). This is the DYNAMIC RESPONSE signal and indicates that some action is required from the user. In this case, the required response is to depress the throttle fully and release.

The ECU will then transmit the Engine Running test codes and after a short delay these will be repeated. After a further delay six pulses may be transmitted (Code 6)

Therefore if there are no engine running faults the transmitted output codes will be as follows:

11 11 6

Code 6 indicates that the engine running tests are complete and the OBD is in SERVICE MODE where it will remain for about 2 minutes (See Service Mode). If Code 5 was transmitted earlier then Code 7 will be transmitted to indicate the end of Service Mode.

NB Single digit codes (Eg Codes 1 5 6 7) may be referred to in Ford documentation as Codes 10 50 60 70

SERVICE MODE

Service mode follows on from Engine On tests.

During Service Mode the idle speed and ignition are controlled by the ECU and it is during the Service Mode that the basic settings can be checked and reset by the user if required. Such adjustment cannot be made at other times as they would be overruled by the engine ECU. Refer to Section 5 for Service Mode data)

Service Mode is engaged for several minutes after Engine Running test (2-10minutes depending on the engine model)

The end of the Service Mode is signaled by a change, usually an increase in engine speed, and if adjustments have not been completed by that time then the engine-on tests should be repeated and the adjustment continued.

If Code 5 was transmitted at the start of the Engine Running Test, then the start of Service Mode will be indicated by Code 6 and the end of the Service

Mode by Code 7.

CONTINUOUS MODE

Ensure tat the engine is fully warmed up and that the air conditioning is off

Ensue that the FCR test switch is in the O position

Start the engine.
The ECU will transmit rapid pulses until the test switch is put into the I position
The ECU will now transmit any existing fault codes and repeat them continuously.
A suspicious connector can be manipulated and if a fault is present, the relevant fault code will be transmitted. If there is no fault, then the no-fault code (Code 11) will be output repeatedly.

ERASING FAULT CODES

Follow the test procedure for Ignition On Engine Off tests. The end of these tests is signified by a single digit code (1). At this point set the Test Switch to O.
The KAM codes will now be erased

7. Model Specific Data

Vehicle Model	Engine Type	Ignition ON	KAM	Engine Running	Cont Code	Service Ignition	Mode Idle	Power Bal	Code Type
Fiesta 1984-89	1.4 CVH CFi	X	X	X	X	12*			A 2 DIGIT
1Fiesta 1989-95	1.1/1.3 HCS CFi	X	X	X	X	10* (I)	1200 (i)		A 2 DIGIT
	1.4 CVH CFi	X	X	X	X	10* (I)	1200 (i)		A 2 DIGIT
	1.6 CVH EFi	X	X	X	X	10* (I)	750 (ii)		A 2 DIGIT
	1.6 CVH EFi Cat	X	X	X	X	10* (I)	750 (ii)		A 2 DIGIT
	1.6 CVH EFi Turbo	X	X	X	X	10* (I)	1200 (i)		A 2 DIGIT
	1.8 ZETA SEFi	X	X	X		10* (I)	1200 (i)		C 3 DIGIT
Escort/Orion 1986-1991	1.4 CVH CFi	X	X	X	X	12*			A 2 DIGIT
	1.6 CVH EFi DIS	X	X	X	X	10* (I)	1200 (i)		A 2 DIGIT
	1.6 CVH KE JETRONIC	X			X				C 2 DIGIT
	1.4 CVH CFi	X	X	X	X	10* (I)	750 (ii)		A 2 DIGIT
Escort/Orion 1991-1995	1.1/1.3 HCS CFi	X	X	X	X	10* (I)	1200 (i)		A 2 DIGIT
	1.4 CVH CFi	X	X	X	X	10* (I)	1200 (i)		A 2 DIGIT
	1.6 CVH EFi	X	X	X		10* (I)	1500 (I)		C 3 DIGIT
	1.6 CVH EFi Cat	X	X	X	X		875		A 2 DIGIT
Sierra/Sapphire	1.6 CVH EFi Turbo	X	X	X	X	10* (I)	1200 (I)		A 2 DIGIT
	1.8 ZETA SEFi	X	X	X	X	10* (I)	1200 (I)		B 2 DIGIT
	1.4 CVH CFi	X	X	X	X	8*	900		A 2 DIGIT
(Iv)	1.6 CVH EFi DIS	X		X	X	12/8*	1050 (iii)		A 2 DIGIT
	1.6 CVH KE JETRONIC	X	X	X	X		875		A 2 DIGIT
	1.4 CVH CFi	X	X	X	X		875		A 2 DIGIT
(Iv) 1986	1.1/1.3 HCS CFi	X		X	X	12/6*	625(ii)		A 2 DIGIT
	1.4 CVH CFi	X		X	X	15*	800/900 (ii)		A 2 DIGIT
Sierra	2.0 OHC 2.8 V6 NO CAT L JETRONIC	X		X	X				C 2 DIGIT
Sierra	1.6 CVH EFi Cat	X			X				C 2 DIGIT
Mondeo	1.6 CVH EFi Turbo	X	X	X		10* (I)	1500 (i)	X	C 3 DIGIT
Transit 1986	2.0 OHC CFi	X	X	X	X	10	1200 (i)		A 2 DIGIT
	2.9 V6 EFi	X		X	X	12/8*	800/900		A 2 DIGIT
Transit 1992	2.0 OHC EFi	X	X	X	X	18*	900 (i)		A 2 DIGIT
	2.9 V6 EFi	X	X	X	X	15*	700 (ii)		A 2 DIGIT
Granada/Scorpio 1985	2.0OHC EFI CAT	X	X	X	X	18*	900		A 2 DIGIT
(Iv)	2.0 OHC EFi	X		X	X	12/8*	1050 (ii)		A 2 DIGIT
	2.0 EFi DOHC	X	X	X	X		875		A 2 DIGIT
	2.0DOHC EFi CAT	X	X	X	X		875		A 2 DIGIT
	2.4 V6 EFi	X		X	X	12/8*	875		A 2 DIGIT
	2.4 V6 EFi CAT	X	X	X		15*	700(ii)		B 2 DIGIT
1986	2.8 V6 EFi	X		X	X	12/8*	625 (ii)		A 2 DIGIT
(Iv)	2.9 V6 EFi	X		X	X	12/8*	800/900		A 2 DIGIT
	2.9 V6 EFi CAT	X	X	X		15*	700 (II)		B 2 DIGIT
	2.9 24V V6 EFi CAT	X	X	X		15*	475 (ii)		C 3 DIGIT
	2.0 OHC 2.8 V6 NO CAT	X		X	X				C 2 DIGIT

Notes:

i Not adjustable
ii Disconnect plug from idle speed control
iii Disconnect plug from throttle position control
iv Export specification

The Escort/Orion 1.6 Turbo with KE Jetronic fuel injection has no self test capability

8. FAULT CODES

Table A – 2 digits

CODE	MEANING OF CODE	ACTION
1	Command Code	Wiggle test/open throttle momentarily
2	Separator Code	Codes stored in KAM will follow
5	Start of engine running test	
6	Start of service mode	
7	End of service mode	
11	No fault – system pass	
12	Vane air flow meter 1	Refer to TPN 1
13	Engine coolant temperature sensor (ECT)	Refer to TPN 2
14	Depending on fitted sensor: Air change temperature sensor (ACT or Vane air temperature sensor (VAT)	Refer to TPN 3
15	Throttle position sensor (TPS)	Refer to TPN 4 or 5
16	Vane air flow meter 2 (VAF-2)	Refer to TPN 1
17	Manifold absolute pressure sensor (MAP)	Refer to TPN 6
18	Battery voltage low (V Batt)	Check charging system and battery
19	Keep alive memory failure (KAM)	Check whether battery was disconnected. Check KAM/ROM fuse. If OK module is faulty
21	Irregular ignition signal	
22	Vane air flow meter (VAT-1) voltage too high	Refer to TPN 1
23	Engine coolant temperature sensor (ECT) voltage too high	Refer to TPN 2

CODE	MEANING OF CODE	ACTION
24	Depending on fitted sensor Air change temperature sensor (ACT or Vane air temperature sensor (VAT)	Refer to TPN 3
25	Separator Code	Refer to TPN 4 or 5
26	Start of engine running test	Refer to TPN 1
27	Manifold absolute pressure sensor (MAP) value too high	Refer to TPN 6
28	2.0 DOHC 16v only. HEGO sensor 1 (cylinders 1 & 4) mixture tool rich or sensor failed	Refer to TPN 9
29	2.0 DOHC 16v only: HEGO sensor 2 (cylinders 2/3) mixture too rich or sensor failted	Refer to TPN 9
31	RAM/ROM failure	Fit a new EEC IV module
32	Vane air flow meter 1 (vaf-1) voltage too low	Refer to TPN 1
33	Engine coolant temperature sensor (ECT) voltage too low	Refer to TPN 2
34	Depending on fitted sensor: Air change temperature (ACT) or Vane air temperature sensor (VAT)	Refer to TPN 3
35	Throttle position sensor (TPS) voltage too low	Refer to TPN 4 or 5
36	Vane air flow meter 2 9VAF-2) voltage too low	Refer to TPN 1
37	Manifold absolute pressure sensor (MAP) value too low	Refer to TPN 6
38	2.0 DOHC 16v only: HEGO sensor 1 (cylinders 1/4) mixture tool lean or sensor failed	Refer to TPN 9
39	2.0 DOHC 16v only: HEGO sensor (cylinders 2/3) mixture too lean or sensor failed	Refer to TPN 9
41	Vane air flow meter 1 – no change whist conducting self-test procedure	Repeat self test procedure
42	4VAF-2/MAP sensor, no change whilst conducting self test procedure	Repeat self test procedure
43	Throttle position sensor (TPS) no TPS change during throttle depression whilst conducting self test procedure	Repeat self test procedure
44	After Code 10 in self test procedure, throttle was opened too late or not at all	Repeat engine running self test procedure
45	Vehicle speed sensor (VSS)	
46	Idle speed control (ISC) valve, maximum engine speed not reached	Refer to TPN 10
47	Idle speed control (ISC) valve, maximum engine speed not reached or engine speed too low for testing HEGO sensor or EGR valve	Refer to TPN 10
48	CFi Engine: Idle tracking switch in throttle plate control motor (DC-ISC) EFi Engine: Idle speed control (ISC) VALVE	Refer to TPN 10
49	Exhaust gas recirculation (EGR) valve	Refer to TPN 10
51	Air conditioning (A/C) switched on	Switch off air conditioning, repeat engine running self-test procedure
52	Automatic transmission (A/T) in D Or vehicle rolling	Select position N/P repeat engine running test
53	Octane adjust 1 ground (FO1)	Disconnect service cable, repeat engine running self test procedure
54	Octane adjust 2 grounded (FO2)	Disconnect service cable, repeat engine running self test procedure
55	Idle adjust grounded (ISA)	Disconnect service cable, repeat engine running self test procedure
56	Knock sensor (KS)	

CODE	MEANING OF CODE	ACTION
57	Throttle operated too early whilst conducting self test procedure	Repeat engine running self test procedure
58	Phasing of PIP SPOUT signal(TFI module)	
59	CO% adjustment potentiometer (REMCO)	
61	Loss of power in cylinder 1	Check compression and spark plug
62	Loss of power in cylinder 2	Check compression and spark plug
63	Loss of power in cylinder 3	Check compression and spark plug
64	Loss of power in cylinder 4	Check compression and spark plug
65	Loss of power in cylinder 5 DOHC only: Brake On/Off (BOO) switch	Check compression and spark plug
66	Loss of power in cylinder 6 DOHC only: Kickdown switch (KDS)	Check compression and spark plug
67	Fuel rail temperature sensor (FTS)	Refer to TPN 8
68	Boost pressure control valve	Check/adjust turbocharge boost pressure
69	Boost pressure control valve	Check/adjust turbocharger
71	Vacuum controlled air valve (VAV) Pulse air solenoid (PUA)	
72	1.6EFi Turbo only: Wastegate control solenoid (WCS) EFi engine: Electronic vacuum regulator (EVR)	
73	Canister purge (CANP) solenoid	
74	Fuel pump (FP) DOHC only: Shift solenoid 3rd/4th gear	
75	Clutch converter lock up solenoid (CCO)	
76	Brake on/off switch (BOO)	
77	Kickdown activated	
78	Power steering pressure switch (PSPS) not activated during self-test procedure	Check whether PSPS fitted to vehicle. If so repeat self test procedure
81	Electronic vacuum regulator (EVS)	
82	Electronic pressure transducer (EPT) voltage below minimum	
83	Electronic pressure transducer (EPT) voltage too high	
84	Electronic pressure transducer (EPT) voltage too low	
85	HEGO sensors (multiplugs to HEGO sensors)	Interchange multiplugs between both HEGO sensors require interchangingrepeat engine running self-test procedure

Table B – 2 Digit

CODE	MEANING OF CODE	ACTION
1	Command code (dynamic test)	Momentarily, open throttle fully
2	Separator code (engine off test)	Code stored in the KAM will now follow
3	Module identification code for 6 cylinder engine	If code 3 does not appear during engine running self test procedure, check part number of module
5	Start of engine running test	
6	Start of service mode	
7	End of service mode	
11	System pass	
12	Idle speed control valve (ISC)	Refer to TPN 10
	Idle DC motor (1.8 CVH CFi)	
13	Idle speed control (ISC) valve	Refer to TPN 10
	Idle DC motor (1.8CVH CFi)	
14	Ignition signal (PIP)	
15	KAM/ROM failure	Check whether battery was disconnected. Check KAM/ROM fuse If OK module is faulty
16	Low idle speed during test	
17	Idle speed DC motor	
18	Spout signal fault	
19	Module power supply (IV PWR)	Check fuse in cable 1. If OK module faulty
20	4 cylinder identification code	
21	Engine coolant temperature sensor (ECT)	Refer to TPN 2
22	Manifold absolute pressure sensor (MAP)	Refer to TPN 6
23	Throttle position sensor (TPS)	Refer to TPN 5
24	Air change temperature sensor (ACT)	Refer to TPN 3
25	Knock sensor (KS)	
26	Idle speed DC motor	
27	Cruise control (CNTL) too slow	Check cruise control system
28	Crusie control (CNTL) too fast	Check cruise control system
29	Vehicle speed sensor (VSS)	
31	Electronic pressure transducer (EPT) voltage below minimum	
32	Electronic pressure transducer(EPT) outside specification	
33	Exhaust gas circulation (EGR) valve no exhaust gas recirculation	Refer to TPN 10
34	Electronic pressure transducer (EPT) outside specification	

CODE	MEANING OF CODE	ACTION
35	Electronic pressure transducer (EPT) voltage above maximum	
36	No increase in test speed (RPM)	Check fuel system, ignition system and /or vacuum system for induction leaks
37	No drop in self test speed (RPM) idle tracking switch is stuck closed(1.8CFi)	Check fuel systems and/or vacuum system of induction leaks
38	Idle tracking switch (ITS)	
39	Automatic transmission lock-up clutch solenoid (LUS)	
41	HEGO sensor 1(cylinder 1-3) mixture too lean	Refer to TPN 9
42	HEGO sensor 1 (cylinder 1-3) mixture too rich	´9
43	Idle speed DC motor	
44	TPS no change when idle speed DC motor extends	
45	Idle tracking switch (ITS)	
46	Thermactor – no air in self test	
47	Cruise control switch function	Check control system
48	Cruise control switch sticking	Check cruise control
49	Signal for cruise control (SIG)	Check cruise control
51	Engine coolant temperature (ECT) sensor – voltge too high	Refer to TPN 2
52	Power steering pressure switch (PSPS) not activated during self-test procedure	Is vehicle fitted with PSPS If so repeat self-test procedure
53	Throttle position sensor (TPS) voltage too high	Refer to TPN 4 or 5
54	Air change temperature (ACT) sensor – voltage too high	Refer to TPN 3
55	Key power circuit low	
56	VAF circuit above max voltage	Refer to TPN 1
57	Octane adjust grounded (FO)	Disconnect service cable, repeat engine running self test procedure
58	Service injection timing (crankshaft delay pin grounded) (CDS)	Disconnect service cable, repeat engine running self-test procedure
59	Idle adjust grounded (ISA)	Disconnect service cable, repeat engine running self test procedure
61	Engine coolant temperature sensor (ECT) voltage too low	Refer to TPN 2
62	Shift valve for 4th/3rd gear (3rd/2nd gear on US spec vehicles) closed	
63	Throttle position sensor (TPS) voltage too low	Refer to TPN 4 or 5
64	Air change temperature (ACT) voltage too low	Refer to TPN 3
65	Key power circuit low	66
66	VAF sensor input voltage low	Refer to TPN1
67	Air conditioning switch on or automotive transmission in D	Switch off air conditioning and select position N/P. Repeat engine self test procedure
68	Idle tracking switch (ITS)	

CODE	MEANING OF CODE	ACTION
71	Idle tracking switch (ITS)	
72	Manifold absolute pressure sensor (MAP)	Refer to TPN 6
73	Throttle position sensor (TPS) no TPS change during throttle depression whilst conducting self test procedure	Repeat self test procedure
74	Brake on/off switch (BOO) circuit broken	
75	Brake on/off switch (BOO) short in circuit	
76	Insufficient VAF change during dynamic response test	
77	Throttle not operated or operated too late	Repeat engine running self test procedure
81	Manifold absolute pressure (MAP) Sensor (Transit V6)	Refer to TPN 6
82	Secondary air solenoid (SAS)	Fault in pulse air system
83	Switch for heavy duty fan (HEDF)	Check circuit and switch
84	Electronic vacuum regulator (EVR) in exhaust gas recirculation (EGR) system	
85	Canister purge (CANP) solenoid	
87	Fuel pump (FP)	
88	Electronic cooling fan (EDF)	Check whether fitted to vehicle
89	Torque convertor lock-up clutch solenoid	
91	HEGO sensor 2 (cylinders 4-6) mixture too lean	Refer to TPN 9
92	HEGO sensor 2 (cylinders 4-6) mixture too rich	Refer to TPN 9
93	Idle speed DC motor	
95/96/98	Indication of malfunction (MIL) for MAP TPS ACT ECT sensors	Refer to TPN 6/4/5/3/2
99	Throttle position (TPS)	Refer to TPN 4 or 5

Tabel C 2 Digit – KE JETRONIC Escort 1.6 CVH

CODE	MEANING OF CODE	ACTION
1	Maximum ignition retardation reached	
2	Engine coolant temperature sensor (ECT)	Refer to TPN 2
3	Air change temperature sensor (ACT)	Refer to TPN 3
4	Knock sensor	
5	MAP sensor	Refer to TPN 6

Table C 2 Digit – L JETRONIC SIERRA/GRANADA 2.0 OHC/2.8 V6

CODE	MEANING OF CODE	ACTION
12	Vane air flow sensor	Refer to TPN 1
13	Engine coolant temperature sensor (ECT)	Refer to TPN 2
14	Vane air flow sensor	Refer to TPN 1
15	Throttle position sensor	Refer to TPN 4 or 5
22	Vane air flow sensor	Refer to TPN 1
31	Module fault	
32	Module fault	

Table C: 2 Digit – Weber/Marelli Escort RS or Sierra Cosworth 2.0 DOHC SEFi

CODE	MEANING OF CODE	ACTION
11	Engine speed/TDC sensor	
12	Phase sensor	
13	PIP/SPOUT signal	
21	Air change temperature sensor (short circuit)	Refer to TPN 3
22	Air change temperature sensor (open circuit)	Refer to TPN 3
23	Coolant temperature sensor (short circuit)	Refer to TPN 2
31	Coolant temperature sensor (open circuit) 4x4 only Oxygen sensor	Refer to TPN 2 Refer to TPN 9
32	MAP sensor (short circuit)	Refer to TPN 6
33	MAP sensor (open circuit) 4x4 only throttle position sensor	Refer to TPN 6 Refer to TPN 4 or 5
43	Module fault	
44	Module fault	

9. TEST PROCEDURE NOTES (TPN)

1. VANE AIR FLOW METER

This is positioned in the airstream and is opened by the flow of the air intake. The greater the airflow, the more the flap/plate opens. The flap/plate is connected to a potentiometer that will produce a voltage reading proportional to the position of the flap/plate.

To test a Vane Air Flow Meter, probe the airflow meter connector with a voltage meter until the sensor output is identified. The output will be a voltage of 0.5v to 4.5v, or 4.5v to 9v. The reading changes as the air flow is varied. The airflow can be varied by varying the engine speed.

Test the output of the airflow meter with the ignition on, at idle, at 1500 RPM, at 3000 RPM, and during a rapid acceleration, and compare to typical values given below:

Ignition on	**0.25v-0.5v**	**3.5v**
Idle	**0.5v-1.5v**	**4.5v-5.0v**
1500 RPM	**0.7v-2v**	**5.0v-5.5v**
3000 RPM	**1.1v-3v**	**6-7v**
Rapid Acceleration	**3v-4.5v**	**>8v**

Typical Air Flow sensor output

Most systems give an increase in voltage with air flow rate, but some systems give a fall in voltage.

Gradually increase engine speed from idle to 3000 RPM, observing the voltage change. If the voltage becomes 0v or 5v at any point, repeat the test. If the same result is obtained, the resistive track of the airflow meter is damaged. If the voltage stays at a value as the engine speed changes it indicates a sticking flap/plate.

A sensor simulator that can simulate a varying voltage, can be used to provide a voltage to the ECU to simulate the output of the airflow sensor and positively diagnose a faulty airflow meter.

2. COOLANT TEMPERATURE SENSOR:

This should be tested by an ohms meter when the engine is cold, and also when warm (with any connections to the sensor disconnected). The results

should be checked against manufacturer's specifications, or typical values as given overleaf:

Typical Coolant Temperature Sensor Resistance

Most systems		**Exception KE Jetronic, EEC1V.**	
Cold	**3-5 K Ω**	**50 K Ω**	**@ 15∞C**
Warm	**300-400 Ω**	**3.5 K Ω**	**@ 80∞C**

A sensor simulator that can simulate resistance can be used to simulate the resistance value of the sensor and positively identify a defective sensor.

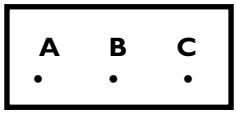
3 AIR TEMPERATURE SENSOR:
This may be tested by connecting an ohms meter across the sensor and checking against the typical values given below:

Typical Air Temperature Sensor Resistance

Most systems		**Exceptions***	
Cold	**5 K Ω**	**500 Ω**	**@ 0∞C**
Warm	**2.5 K Ω**	**200 Ω**	**@ 20∞C**

***Exceptions - KE,L,LE2 and LE3 Jetronic Lucas P Digital**
The sensor is intended for fine-tuning the petrol/air mixture. Therefore dynamic tests while observing the injection duration are inconclusive. The use of a Sensor Simulator to simulate extreme temperature variations is useful to show the injection duration can be affected by air temperature and therefore that the circuit is fully operational.

4.THROTTLE SWITCH:
This is a switch which connects two terminals at idle (or closed throttle), and connect two other terminals when the throttle is open.



At idle **A+B connected**

Open throttle B+C connected

Typical throttle position switch

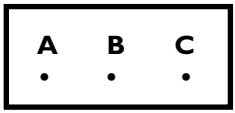
Therefore to test a throttle switch, connect an ohms meter across A + B. If the throttle is closed then there should be 0 ohms across A+B. With the throttle open, the reading should be open circuit or infinity. Connect the ohms meter across B + C. Vary the throttle positions and the opposite should be true.

Typical throttle switch resistance

Throttle closed	A to B = 0 Ω (closed circuit)
Throttle open	A to B = infinity (open circuit)
Throttle closed	B to C = infinity (open circuit)
Throttle open	B to C = 0 Ω (closed circuit)

5. THROTTLE POTENTIOMETER.

This is variable resistor with a reference voltage supplied to the resistor. As the throttle position changes the voltage on the output of the potentiometer varies. This voltage informs the ECU of the exact position of the throttle. In some cases the ECU measures the rate of change of throttle position, and so a "clean" potentiometer track can be very important.



A = Variable Voltage : 0.5 to 4.5v
B+C = Resistor - fixed : 3K Ω - 10K Ω

Typical throttle potentiometer

To test the throttle potentiometer disconnect the connector to the sensor and connect an ohms meter to terminals B and C. This is usually the fixed resistance of the potentiometer. A resistance of between 3k-10k should be observed. Re-connect the ohms meter to terminals A and B. A resistance of 0_-1k to 5k-10k should be observed between throttle closed and throttle open. From throttle closed, slowly open the throttle, observing the steady change in resistance. A rapid change in resistance or an open/ closed circuit reading indicates a faulty sensor.
To further test the sensor, reconnect the connector to the sensor and start the engine. Connect a voltage meter between terminal A and earth. Observe the voltage at idle. Slowly open the throttle observing the change in voltage. The

voltage is typically O.5v to 4.5v. A rapid change in the voltage, or a loss of the voltage, indicates a faulty sensor.
If the sensor is not producing a producing a voltage, or the tests are inconclusive, the use of a sensor simulator (to simulate the sensor output), should be used to provide a voltage to the ECU. If symptoms persist while using a Sensor Simulator, then the fault is not with the Throttle Position sensor. If the system works correctly while the sensor is being simulated (replaced) the sensor is positively identified as faulty.

6 MANIFOLD ABSOLUTE PRESSURE SENSOR:
This produces a voltage of 0.5 to 4.5v dependant upon the pressure/vacuum in the inlet manifold.
The connector usually has three terminals. Use a voltage meter to identify the 5 volt supply, the ground, and the output voltage of the sensor.
Test the response of the sensor output relative to engine speed as for (1). If there is little or no response, disconnect the vacuum pipe from the sensor and apply a vacuum directly to the sensor. If the voltage now varies, check the vacuum pipe for leaks or blockages. If the voltage does not vary with a direct vacuum, it is likely that the sensor is defective.
To positively identify the MAP sensor as faulty, use a Sensor Simulator to simulate the output of the sensor.

7. MASS AIR FLOW SENSOR:
This is a hot wire positioned in the air stream. The air flow through the air intake has a cooling effect on the hot wire, and the greater the flow, the greater the cooling effect. A control unit which regulates the temperature of the hot wire provides a voltage signal to the ECU relative to the air flow.

To test a mass air flow sensor, probe the airflow meter connector with a voltage meter until the sensor output is identified. The output will be a voltage of 0.5v to 4.5v, or 4.5v to 9v. This voltage changes as the air flow is varied. The airflow can be varied by varying the engine speed.
Test the output of the airflow meter with the ignition on, at idle, at 1500 RPM, at 3000 RPM and during a rapid acceleration and compare to the typical values below:

Ignition on	**0.25v-0.5v**
Idle	**0.5v-1.5v**
1500 RPM	**0.7v-2v**
3000 RPM	**1.1v-3v**
Rapid Acceleration	**3v-4.5v**

Typical Air Flow sensor output

Some systems produce a fall in the output voltage relative to an increase in air

flow. A sensor simulator can be used to provide a voltage to the ECU to simulate the output of the airflow sensor and positively diagnose a faulty airflow meter.

8.PETROL TEMPERATURE SENSOR:
This measures the fuel temperature in the fuel manifold/pipe. If the temperature exceeds 90∞C the ECU will enrich the mixture by increasing the injection duration, as fuel evaporation is likely above 90∞C.

9.LAMBDA OR OXYGEN SENSOR:
This sensor is positioned in the exhaust system. It provides a voltage signal to the ECU which is used to vary the injection duration to maintain an air/fuel ratio of 14 parts air to 1 part of fuel.
A Lambda sensor tester is required to test the operation of this sensor. On vehicles with a catalytic converter the Lambda sensor is essential as the sensor enables the ECU to maintain an oxygen content of about 2% in the exhaust. The catalytic converter requires the 2% of oxygen to perform its function.

10. VALVES:
The ECU uses valves in the fuel system to pass or restrict fuel or gases according to engine load conditions. Use the relay test to ensure that the ECU is actuating the valve. Valves are mechanical devices which can be sticking or jammed, therefore, removal and testing when removed from the vehicle may be required.

10. COMMON TERMS

Many abbreviated terms are peculiar to a particular manufacturer and are explained in the relevant text. Some more common or universal ones appear below.

COMPUTER SYSTEMS

ECU **ELECTRONIC CONTROL UNIT** **These units may control a separate function, for example fuel injection, ignition, ABS. Modern systems tend to be more multi- function as this saves cost, wiring complications and ensures greater resistance to interference and more control over emitted interference.**

OBD **ON BOARD DIAGNOSTICS** **The facility provided by modern ECU's to self diagnose and report faults in the ECU, sensors, wiring connections etc. Fault codes are used to differentiate faults.**

KAM **KEEP ALIVE MEMORY** **A system for maintaining a record of faults encountered to be accessed later. These may be intermittent or recorded only under particular conditions and therefore not accessible during no load testing.**

IGNITION

DIS **DISTRIBUTOR LESS IGNITION SYSTEM. These use one coil per cylinder or an arrangement which provides one coil per two cylinders and sparks every rotation of the engine instead of every two rotations (wasted spark). The net result is that H.T. voltages do not have to be mechanically distributed. Together with ignition advance "mapping" in the ECU this provides a high reliability and performance.**

EDIS **ELECTRONIC DISTRIBUTOR LESS IGNITION SYSTEM**

CID **CYLINDER IDENTIFICATION (SIGNAL) Determines which cylinder is not only receiving a spark but is also on the compression stroke.**

RON **Defines the OCTANE NUMBER of petrol. Multiple position plug/socket arrangements allow ignition requirements to be changed for different rated fuels. e.g. "octane multiplug"**

INJECTION/FUEL

LAMBDA SENSOR See EGO and HEGO sensors.

EGO EXHAUST GAS OXYGEN (SENSOR) Sensitive to low concentrations of oxygen in hot exhaust gas. Essential for accurate "feedback" control of injection.

HEGO HEATED EGO (SENSOR)

MAP MANIFOLD ABSOLUTE PRESSURE (SENSOR) Manifold pressure sensor measures differential pressure with vacuum sealed capsule (not atmospheric pressure).

MAF MANIFOLD AIR FLOW (SENSOR) "Vane" or "hot wire" flow sensor.

SENSORS GENERAL

PTC TEMPERATURE SENSOR of POSITIVE TEMPERATURE COEFFICIENT type. Low resistance when cold. NTC (NEGATIVE TEMPERATURE COEFFICIENT)is low resistance hot.

ATS, FTS, CTS, TTS TEMPERATURE SENSORS Air, Fuel, Coolant, Transmission.

11. WARRANTY

This warranty is in addition to the statutory rights of the purchaser.
The Tool Connection has made every effort to ensure that this product is of the highest quality and value to the customer. However, The Tool Connection can accept no responsibility for consequential damage howsoever caused arising from the use of this product.
All technical enquiries regarding this product should be made to:

The Tool Connection Technical Service Department: ++44 (0) 1926 818181

Please note that The Tool Connection cannot provide technical information or advice or service data on particular motor vehicles.
If this product should require service or repair, it should be returned to:

The Tool Connection Technical Service Department,
Kineton Road,
Southam,
Warwickshire,
CV47 0DR,
England.

Please give full details of faults requiring attention when sending goods for service or repair