

# Fault Diagnosis On Motronic M1.5 Engine Management System

## Introduction

From Model Year 1990, when catalytic converters were first fitted to the range, all Senator and Carlton GSi models incorporated the Bosch Motronic M1.5 engine management system. The engines in these models were coded as either C30NE; (The 3.0 Litre 12V engine.) C30SE; (The 3.0 Litre 24Valve engine.) or C26NE (The 2.6 Litre engine.), the 'C' indicating the fitment of 'Cats.'. From experience, the system is very reliable and problems encountered are usually caused by poor contact at the associated plug/socket combinations that link the various system sensors to the Electronic Control Unit (ECU). The electrical diagrams for these vehicles, issued by the manufacturers and others, are poorly presented and can easily cause confusion when attempting to trace a particular element of the engine management system. In consequence, fault finding on the engine electrics can be somewhat frustrating.

To improve this situation, Figure 1 on the following page, shows the complete engine management system in detail and includes all connectors and associated wiring, including all direct connections to the ECU.

Since the primary purpose of this article is to assist in the location of faults in the Engine Management System, the diagram as been kept as clear as possible, therefore, connections to other peripheral systems e.g. Cruise Control, Ride Height etc. are not shown.

This particularly applies to outputs from the Distance Sensor (P14) which, from Pin 2, supplies an output to many of these associated circuits. However, if the Mileometer is operating correctly, it can be safely assumed that P14 is also giving the correct output signal.

When a possible fault has been deduced by reference to Figure 1, then it can be confirmed by checking for satisfactory signal levels at the relevant pins of the ECU

Table 1, lists each pin of the ECU, in numerical order, and the expected 'Satisfactory Readings' under specified 'Engine/Ignition' conditions, when measured with respect to an associated 'Ground Reference Pin'.

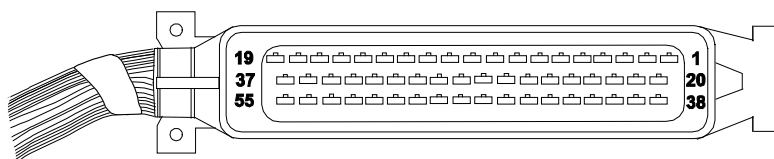
Details on how to access the 'Related Blink Codes', that are given in the last column of Table 1, is the concluding part of this article.

## Measurement of Signal Level On ECU Pins.

To gain access to the ECU, remove the plastic cover panel, located in the drivers foot well, at the outer side of the vehicle. Access to the relevant pins of the ECU for measurement is then achieved by releasing the screws securing the rear cover of the connecting plug then carefully removing it to expose the rear of the pins.

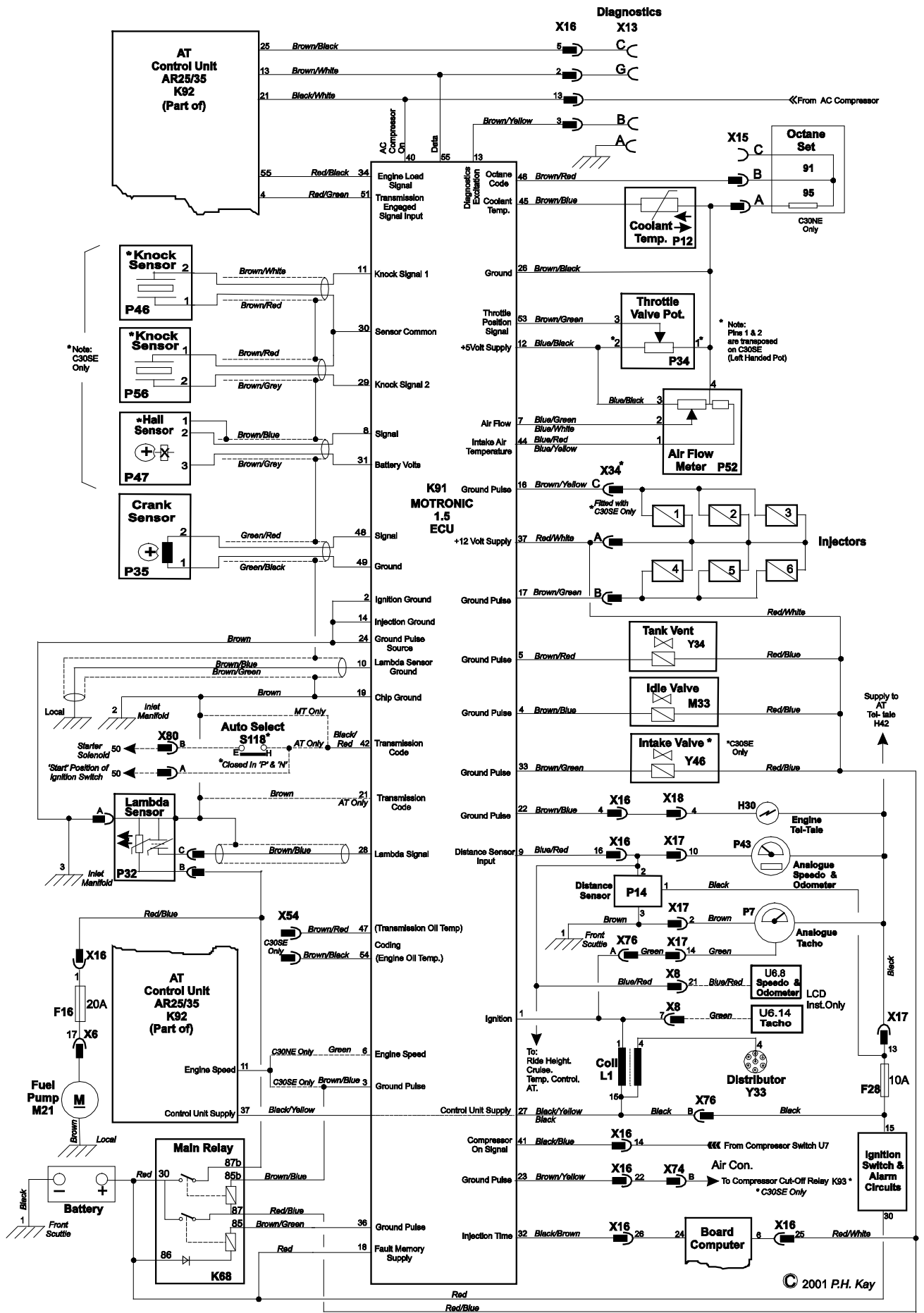
The following illustration shows the pin layout of this connector.

All measurements must be made using a digital multimeter or portable oscilloscope, as appropriate, pressing the instrument probes between the pin to be measured and the 'Associated Reference Pin', given along side it, in Table 1. CAUTION: Do not use a simple analogue multimeter as, in some circumstances, it would 'load' the ECU circuit under test, giving a false reading.



**Pin Layout of ECU Plug**

**Figure 1: Interconnection of Motronic M1.5 Engine Management System**



**Table 1: Check Details of ECU Signals**

Active ECU Pin and Signal Name	Associated Reference Pin	Engine / Ignition Conditions During Test	Satisfactory Readings	Related Blink Codes
1 IGNITION PULSE	2	Warm Idle. AT set to 'P' or 'N'.	<b>WARNING:EHT VOLTAGES.</b> Do not disconnect plug leads when Engine is Running. Ignition Pulse has 8 to 10 Degrees of preset Advance.	—
3 FUEL PUMP RELAY	24	Ignition ON	12V	53 & 54
		Idle	< 1.0V	
4 IDLE AIR CONTROL VALVE (IAC)	24	Warm Idle. AT to 'P' or 'N'.	Mark/Space ratio of pulses to be 32% to 60% to maintain correct idle speed (C30SE 570-730 rpm) (C30NE 670-830 rpm)	56 & 57
5 FUEL TANK VENT	24	Engine at Idle	12V	61 & 62
		Accelerate Briefly.	0V Pulses (1 to 99%)	
6 ENGINE SPEED SIGNAL				—
7 AIR FLOW SENSOR	26	Warm Idle.	0.5V to 1.5V	73 & 74
		Full Throttle	4.5V	
8 HALL SENSOR (C30SE Only)	9	Warm Idle.	Slow irregular change between 12V and 0V	93 & 94
9 DISTANCE SENSOR INPUT	19	Idle. Vehicle moved slowly forward then reverse.	Voltage changes slowly between 12V and 0V as vehicle moves.	—
11 KNOCK SENSOR 1 (C30SE Only)	30	Hot Idle then increase rpm to >2000 for 10secs.	Check Blink Codes 16 or 18 are not set.	16 & 18
12 5V SUPPLY	19	Ignition ON.	5V	
13 DIAGNOSTICS EXITATION	19	Ignition ON.	>11.5V (Battery Volts)	
		Pin 'B' of 'Diagnostics' socket (X13) connected to Pin 'A'.	0V	
16 INJECTION PULSES	14	Warm Idle.	12V to 0V Pulse	25&81
		MT	2.0ms To 2.8ms	
		AT	2.0ms To 3.0ms	
17 INJECTION PULSES	14	Warm Idle.	12V to 0V Pulse:-	25&81
		MT	2.0ms To 2.8 ms	
		AT	2.0ms To 3.0 ms	
18 FAULT MEMORY SUPPLY	19	Battery connected	Battery voltage (12V)	
20 EXHAUST CODING (Not utilised)	19	Ignition ON.	5V on European cars. 0V on USA cars. (Due to ground connection forcing 'Closed Loop' mode)	

**Table 1 (continued)**

Active ECU Pin and Signal Name	Associated Reference Pin	Engine / Ignition Conditions During Test	Satisfactory Readings	Related Blink Codes
21 TRANSMISSION CODING	19	Ignition <b>ON</b> .		—
		'AT'	0V	
		'MT'	5V	
23 AC CUT-OFF RELAY	24	Warm Idle.		87 & 88
		AC Switch set to <b>ON</b> .	12V	
		Increase engine speed to > 6000rpm.	0V	
28 LAMBDA (O <sup>2</sup> ) SENSOR	10	Warm Idle after 15 minutes fast drive.	Rapid change between 40mV and 1V at approx. 1Sec intervals.	38, 39 44, 45
29 KNOCK SENSOR 2 (C30SE Only)	30	Hot Idle then increase rpm to >2000 for 10secs.	Check that Blink Codes 17 or 18 are not set.	17 & 18
31 HALL SENSOR SUPPLY (C30SE Only)	19	Ignition <b>ON</b> .	12V	—
33 INTAKE VALVE (C30SE Only)	24	Remove Intake Cover AT select ' <b>P</b> ' or ' <b>N</b> '.		63
		Warm Idle.	12V Intake Flap Closed.	
		Accelerate briefly to >4000 rpm.	0V Intake Flap Opens.	
34 ENGINE LOAD SIGNAL (Output to AT)	19	Warm Idle.	1.8 to 2.5ms Pulses, Duration varied by position of Throttle Valve Potentiometer.	73 & 74 19 & 31
36 MAIN RELAY DRIVE PULSE	24	Ignition <b>ON</b> .	>11.5V (Battery Volts)	53 & 54
		Idle.	<1V	
37 BATTERY SUPPLY	19	Ignition <b>ON</b> .	>11.5V	48 & 49
		Warm Idle.	13V to 15.9V	
40 AC COMPRESSOR 'ON' SIGNAL	19	Warm Idle.		—
		AC Compressor <b>OFF</b> .	0V	
		AC Compressor <b>ON</b> .	12V	
41 AIR CONDITIONING 'ON' SIGNAL (AC Only)	19	Warm Idle. AC Switch U7 set to:-.		—
		<b>ON</b>	12V	
		<b>OFF</b>	0V	
42 PARK/NEUTRAL SWITCH (AT Only)	19	Ignition <b>ON</b> . AT Selector set to:-		—
		' <b>P</b> ' or ' <b>N</b> '	0V	
		' <b>1</b> ' ' <b>2</b> ' ' <b>3</b> ' or ' <b>R</b> '	12V	
44 INTAKE TEMPERATURE	26	Warm Idle. Intake Air Temperature:-		69 & 71
		10 degrees C.	3.9V	
		50 degrees C	2.3V	
45 COOLANT TEMPERATURE	26	Coolant Temperature:-		14 & 15
		20 degrees C	3.5V	
		80 degrees C.	1.4V	
		110 degrees C.	0.5V	

**Table 1 (continued)**

Active ECU Pin and Signal Name	Associated Reference Pin	Engine / Ignition Conditions During Test	Satisfactory Readings	Related Blink Codes
46 OCTANE SET PLUG (C30NE Only)	26	Ignition <b>OFF</b> . Octane Plug set to:-		—
		'91'	0 Ohm	
		'95'	220 Ohm	
47 TRANSMISSION OIL TEMPERATURE	19	Not used functionally but on C30SE engine is wired to separate plug (X54) in wiring loom.	If connected to pin 19 (Ground) then Engine Idle speed is increased above nominal.	—
48 CRANK SENSOR	49	Ignition <b>OFF</b> .	Measure clearance to crank Toothed Wheel 0.3mm to 1.3mm.	31 & 19
		Ignition <b>ON</b> . Engine stopped.	Check Fault code 31 is set.	
		Start engine then Idle.	12V ac (peak to peak)	
		Increase rpm to approximately 4000	Approximately 30V ac at 4000rpm. Check Fault Code 31 is cleared. If code is not cleared or engine will not start, then either Sensor or wiring is defective.	
51 TORQUE CONTROL (Transmission Engaged Signal) (AT only)	19	Normal Driving.	Signal to retard ignition and thus reduce torque during each change, thus giving smooth sequence.	75
53 THROTTLE POSITION SIGNAL (TPS)	26	Ignition <b>ON</b> .		21 & 22
		Throttle in Idle position. (at rest)	0.12V to 1.22V	
		Full Throttle position.	3.9V to 4.9V	
54 ENGINE OIL TEMPERATURE	19	Not used functionally but on C30SE wired to separate plug X54 in wiring loom.	If connected to pin 19 (Ground) then Fuel mixture is permanently enriched from nominal.	
55 DATA OUTPUT	19	Ignition <b>ON</b> .	>9V	

# Blink Codes Associated with Engine Management

## Introduction

The last column of Table 1 – ‘Check Details of ECU Signals’, shows the ‘Related Blink Codes’ that indicate a malfunction associated with each particular connecting pin on the Motronic 1.5 ECU. These Blink Codes can be accessed from the ECU very easily.

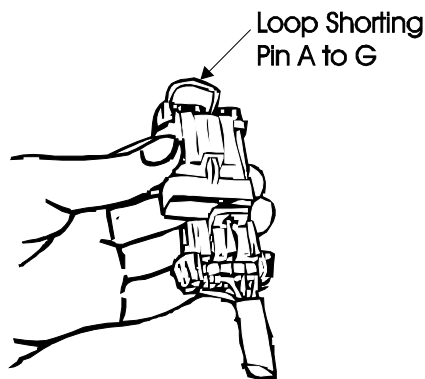
A previous article, by Ian Marsh, (in a leaflet issued with SSN number 31 ) listed the diagnostic codes applicable to all monitored systems in the Senator B and Carlton GSi and, to avoid having to refer to that article, Table 2, at the conclusion of this article, gives all the codes that are associated with the Engine Management System.

## Accessing The Blink Codes

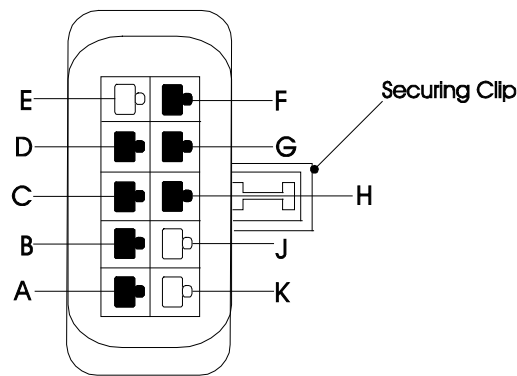
The ‘Blink Codes’ can be read by observing the engine management ‘warning’ light on the instrument panel (H30), after initiation of the diagnostics system. The 10 pin Assembly Line Diagnostics Link (ALDL) diagnostics socket (X13) is located under the bonnet, to the rear of either the left or right suspension turret mount, normally just below and behind it.

Irrespective of model, it would seem that it can be located on either side. In many cases it can, be positively recognised by having a shorting connector plug attached to it, which has a single loop of brown wire which leaves, then re-enters the cap, as shown in the following illustration. In some cases, however, a plain cover cap is fitted to this socket, which may have a shorting link inside or be left empty. The following illustration shows the physical appearance of the socket when a linked plug is fitted and, alongside it, the pin identification of the socket in all variants.

In this application, only pins A and B are relevant and it should be noted that they are both located on the opposite side to the cap securing clip.



Diagnostics Socket With Shorting Plug Removed



View On Socket which is attached to cable loom

To access the codes:-

1. With the Ignition set to OFF, remove and retain the shorting connector plug.
2. Prepare a 150mm length of fairly thick covered wire by removing 10mm of insulation from both its ends. Twist or tin the exposed wire ends to form a suitable contact probe for insertion into the exposed contacts of the ‘Diagnostics’ socket.
3. Using the prepared piece of wire, link Pin A to Pin B on the socket, ensuring a good contact.
4. Turn on the ignition (DO NOT START THE ENGINE).

## Understanding and Reading the Blink Codes

The codes are read by noting the sequence of flashes given by the Engine Management Lamp. When the ignition is first set to ON, after linking the relevant pins of the 'Diagnostics' plug, the lamp will be seen to flash.

Where ☼ equals one flash of the lamp, the sequence will be:-

☼ short pause ☼☼ then a long pause.

☼ short pause ☼☼ then a long pause.

☼ short pause ☼☼ then a long pause.

This sequence indicates code '12' which is the code for 'Start of Test'

All codes are repeated three times.

The next code is code '31' (No Crank Sensor Signal) which is always set when the ignition is set to ON with the engine stopped and, therefore, is always displayed at the start of each static test. It is cleared when the engine is started if the Crank Sensor circuit is functioning correctly.

☼☼☼ short pause ☼ then a long pause.

☼☼☼ short pause ☼ then a long pause.

☼☼☼ short pause ☼ then a long pause.

When all stored static fault codes have been displayed, in a manner identical to the two just described, the complete stored sequence is continuously repeated, until the ignition is set to off. Therefore, any fault codes that have been missed can be noted during the following sequences.

When all displayed codes have been noted with the engine stopped, then start the engine.

The original code '12' will still be present, but code '31' should have been cleared by pulses from the Crank Sensor.

Any additional codes now displayed will indicate a malfunction, as detailed in the following Table of Engine Management Fault Codes.

**Note:** The Code Descriptions only indicate a starting point for fault investigation, they are not always specific. For example; 'Voltage High', or 'Voltage Low' in the table can, respectively, indicate an open or short circuit in the associated wiring. It can also, however, indicate a defective sensor or circuitry within the ECU.

<b>Code</b>	<b>Code Description</b>	<b>Identification of Sensor</b>
13	Lambda (O <sup>2</sup> ) Sensor Open Circuit	P32
14	Coolant Temperature – Voltage Low	P12
15	Coolant Temperature – Voltage High	P12
16	Knock Sensor 1 - Signal Circuit Defective	P46 (C30SE Only)
17	Knock Sensor 2 - Signal Circuit Defective	P56 (C30SE Only)
18	ECU Knock Control Circuit Defective	K91
19	Intermittent loss of Crank Sensor Signal	P35
21	Throttle Valve Potentiometer – Volts High	P34
22	Throttle Valve Potentiometer – Volts Low	P34
23	ECU Knock Control Circuit Defective	K91
25	Injector Bank 1 – Volts High	All Injectors



<b>Table 2: (continued)</b>		
31	No Crank Sensor Signal	P35 (Engine running)
38	Lambda (O <sup>2</sup> ) Sensor – Volts Low	P32 (Weak mixture)
39	Lambda (O <sup>2</sup> ) Sensor – Volts High	P32 (Rich mixture)
44	Lambda (O <sup>2</sup> ) Sensor – Volts Low	P32
48	Alternator or Battery – Volts Low	Battery/Alternator
49	Alternator or Battery – Volts High	Battery/Alternator
52	Engine Tel-tale Check Lamp Volts Low	H30
53	Fuel Pump coil of Main Relay – Volts Low	K68 (85b)
54	Fuel Pump coil of Main Relay – Volts High	K68 (85b)
55	ECU General Failure	K91
56	Idle Air Control valve (IAC)– Volts High	M33
57	Idle Air Control valve (IAC)– Volts Low	M33
61	Fuel Tank Vent valve – Volts Low	Y34
62	Fuel Tank Vent valve – Volts High	Y34
63	Intake Flap Valve – Volts High	Y46
69	Intake Air Temperature – Volts Low	Part of P52
71	Intake Air Temperature – Volts High	Part of P52
73	Air Flow – Volts Low	Part of P52
74	Air Flow – Volts High	Part of P52
75	Torque Control – Volts Low	AT Vehicles only
81	Injector Bank 1 – Volts Low	All Injectors
87	AC Cut off Relay – Volts Low	K93 (C30SE Only)
88	AC Cut off Relay – Volts High	K93 (C30SE Only)
93	Hall Sensor – Volts Low	P47 (C30SE Only)
94	Hall Sensor – Volts High	P47 (C30SE Only)

WARNING: Whilst every effort has been made to ensure the accuracy of all data and information in this document. No responsibility can be accepted for any damage or injury resulting directly or indirectly from the use of this information.