



# *RANGE ROVER*

## *BODY ELECTRICAL CONTROL MODULE (BeCM)*

APPLICABILITY	RANGE ROVER
DATE OF REVISION	20 MARCH 1998



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## Description of Functionality

### **General**

The Body electrical Control Module (BeCM) controls, monitors and provides power supply to many of the vehicle's electrical systems. This document identifies which system the BeCM interfaces with and describes the functionality and operation of systems that are not covered within other documents. This document also provides a complete list of BeCM inputs and outputs. This document is not intended as a complete diagnostic guide. The ETM should be referred to where further details of the connector pinouts and wire colours are required. Testbook should be used for diagnosis of the observed failures. The diagram on page 8 identifies the systems that the BeCM interfaces with.

### **BeCM activation and Sleep modes**

The BeCM has two modes of operation, normal operation mode or "activation mode", and a low quiescent current state or "sleep mode". The sleep mode is required to enable the vehicle to be left for extended periods of time without the vehicle's battery being discharged.

Transitions between the two states are controlled by the status of the BeCM activation inputs (see activation input table).

Sleep mode will be entered when all timers have timed out (i.e. courtesy lights are off) and all activation inputs have been inactive for two minutes.

Activation mode will be entered when any of the activation inputs changes state. The quiescent current during sleep mode is approximately 30mA when the vehicle is unlocked and approximately 40mA when the vehicle alarm is armed.

If the BeCM is kept awake for more than two days without the vehicle being started, then this will cause the battery to discharge to a level where starting the engine may be difficult.

See sleep mode detection section for diagnosing BeCM sleep mode problems.

### **Load inhibition during cranking.**

In order to maximise battery voltage during cranking, the majority of BeCM outputs will be inhibited when the engine is being cranked (ignition turned to position III). The exceptions to this strategy are:

- Hazards/turn signals
- Side lamps
- Handbrake/Park signal to air suspension
- Door open to air suspension
- Alarm audio-visual functions.

### **Engine running detection**

The BeCM has two methods of detecting engine running, namely tacho pulse monitoring and alternator charge input status.

Tacho pulse detection is used for safety related functions (e.g. memory seat one-touch inhibition) and alternator charge status for electrical load control functions (e.g. heated mirrors).





### ***Horn***

The vehicle system has two horns, left and right, these are operated simultaneously when the horn switch is depressed, irrespective of the ignition position.

### ***Cigar Lighter.***

The vehicle has one cigar lighter in the front of the vehicle. The cigar lighter can be operated provided that the auxiliary feed has been switched on and the inertia switch is not tripped.

### ***Fuel Level to Engine Management System (GEMS).***

The fuel level to the EMS is simply a link from the fuel level input via a series resistor. This signal is used by the EMS for diagnostics.

### ***Auto Transmission Interlock (Shift Interlock).***

The gear select lever may only be moved out of the park position when the ignition is on and the brake pedal is depressed. The shift interlock solenoid will be energised continuously whilst the ignition is on and the gear selector lever is in a position other than park.

### ***Key inhibit solenoid.***

The key inhibit solenoid will be energised to prevent the removal of the key from the ignition switch at all times when the key is in the ignition unless the gear select lever is in the park position.

### ***Inertia Switch.***

Activation of the inertia switch will only be effective when the ignition is on and will have the following effects:

1. All doors including tailgate will be unlocked.
2. The hazard warning lamps will be activated.
3. The "Inertia switch"/"Refer handbook" message sequence will be activated on the instrument pack display.
4. All external bulb failure warning messages will be inhibited.
5. Auxiliary controlled outputs will be inhibited to prevent operation of HEVAC blowers.
6. The power supply to the fuel pump is inhibited. (Included for information only, the pump is not controlled by the BeCM).



### ***"Limp Home" modes.***

The BeCM has a limited ability for self diagnosis in the event of an internal failure. In the event of such a failure the BeCM may continue to function with a reduced level of functionality. The precise functionality available will be dependent upon the nature of the failure, however if one of the two main processors inside the BeCM stops working then the functionality will be as follows:

1. Side, tail and dipped beam lamps default to the on state.
2. Fully functional external turn signals and hazard lamps - excluding bulb failure warning and hazard tell tale lamp.
3. Front wiper slow - no automatic wiper arm park facility.
4. Front screen wash - No program wash/wipe facility.
5. Horn will operate when the horn switch is pressed.
6. Crank will operate normally.
7. Shift interlock solenoid activated with brake pedal.
8. Ignition and auxiliary feeds.
9. Stop lamps when brake pedal is depressed.
10. Fuel filler flap release.

All other outputs shall revert to the off state.

A failure of a BeCM is extremely unlikely to result in an engine misfire or the engine cutting out. The ignition signal from the ignition switch is fed through the BeCM and to the underbonnet fuse box then to the Engine ECU. The BeCM monitors the ignition switch signal but does not control it electronically. Even if the power supply (via the 3 maxi fuses) is lost with the engine running the engine will continue to run.

### ***Service Engine Reminder***

The "Service Engine" warning lamp will be illuminated as an emission maintenance reminder after the vehicle has covered 50,000 miles or 80,000km (dependent upon selected distance units) whenever the ignition is on. This lamp will have a 3 second bulb check initiated at ignition on. For 96½ MY (VIN: TA331365 ) onwards the mileage is changed to 82 500 miles or 132 000km.



***History of Software Changes within the BeCM***

<b>Part No</b>	<b>Micro/PAM</b>	<b>Date</b>	<b>Description</b>
AMR 4918	M23	10-94	Diagnostic mode 3 address, R/W and READY flags are swapped.
AMR 4918	M25	12-94	Cranking now only possible on automatic vehicles when park or neutral is selected.
AMR 5406	M27	2-95	Now permits air suspension fault mode messages ayed in kph.
AMR 5406	M30	3-95	Code replaced that was deleted from the service engine block code.
AMR 4916	P28	2-95	Passive immobilisation functionality. Pwake continuously monitored. Passive key coil switched off when vehicle is about to go to sleep. Auto-relock only triggered by an unlock when vehicle was in an armed state. Remote superlock state made accessible using double key superlock (Part of passive immobilisation functionality. Provision for mislocks using battery backed Klaxon. Number plate lamps now turned on with daylight running.
AMR 4916	P30		NAS functionality introduced, affecting operation of foglamps, mainbeam and main auxiliary driving lamps. Police functionality introduced. Alarm inhibited when unlock request is generated. Horn switch input inhibited to stop sounding during crank. S/W mechanism inserted to cancel any alarm audio-visuals when in a disarmed state and during disarming.
AMR 4916	M31	4-95	Sense of fog bulb failure toggled. Gearbox fail message re-displays on each occurrence. Mainbeam failure displayed on ignition off even if beams are not active. Mislock on lazy locking due to open window results in window open message. Traction failure beeps on first occurrence only. Service indicator software change.
AMR 4916	M32	4-95	Gearbox fault inhibited for 1 second on crank. TRACTION FAILURE results in LH turn signal tell-tale to illuminate. This has been rectified.





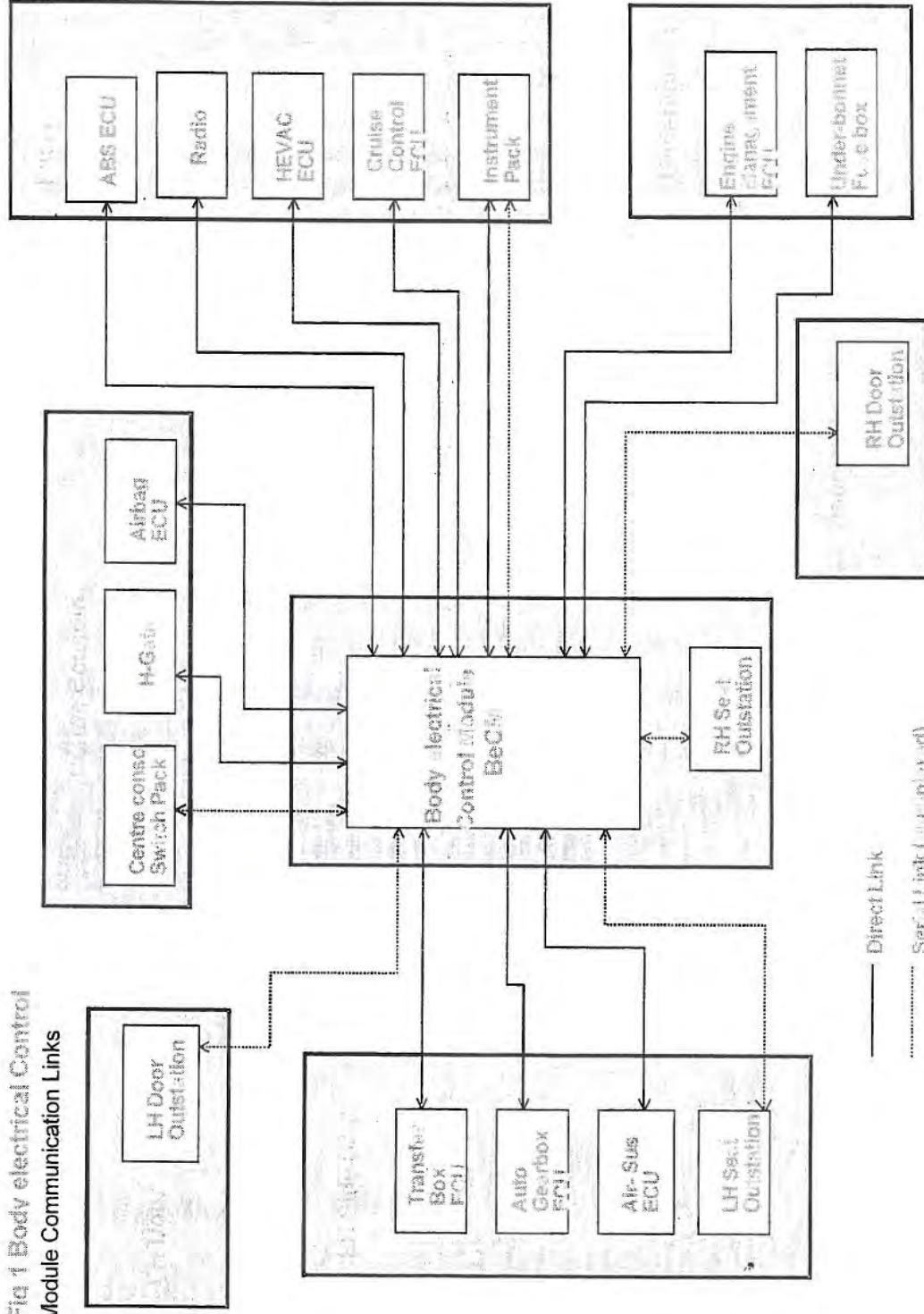
## BeCM System Information Document – Edition 2

<u>Part No</u>	<u>Micro/PAM</u>	<u>Date</u>	<u>Description</u>
AMR 4916	M33	4-95	Spurious triple audible warning on repeated cranking inhibited. Slow 55 kph audible warning now sounds on every occurrence.
AMR 4916	M34	9-95	Service indicator extended to 82,500 miles. Park lamp warning messages re-activated after driver's door has been closed following a "lights on" warning. Two timers added to overcome accidental driver lock-out due to dropping sill buttons.
AMR 5145	M35	4-96	Friendly synchronisation implemented. Sunroof anti-boom. Faster power-on-reset, 200mS.
AMR 5628	P31		Passive immobilisation - on re-mobilisation rear doors only unlock if vehicle was in an armed state.
AMR 5630	P32		Accidental sill lock prevented with software. Slam lock now prevented (i.e. function deleted, vehicle now unlocks).
AMR 5999	P34		Wiper s/w diagnostics problem solved. Sill drop timer now implemented by PAM to free up code space in micro. Slamlock to continue functioning in limp-home. Sleep mod. allowing sleep when ultrasonics active. Vital functions of moving vehicle enhanced to reduce recovery time. Diagnostics reset between mode changes and log out modified to support fast reset. A s/w crash forces micro to limp home and power on reset. Implementation of daylight running mod for NAS/Canada (turn off DRL in PARK). Modification of NAS key inhibit functionality to prevent "sticking" key. Removal of cancellation of auto-relock via a second remote unlock request.



## BeCM System Information Document – Edition 2

Fig 1 Body electrical Control  
Module Communication Links







## Description of System Operation

### ***BeCM sleep mode detection***

The BeCM will wake up or remain awake (vehicle quiescent current drain approx. 1A) if any of the activation input are active. When all timers have timed out and the activation inputs are not active (see activation input table), the BeCM quiescent current will drop to approx. 30mA after approximately 2 minutes.

There are two ways to check if the BeCM is asleep or not:

1. Follow the Quiescent current (I<sub>q</sub>) drain test (page 14) with an ammeter. If the vehicle passes, then the BeCM is allowed to go into sleep mode. If the vehicle does not pass the I<sub>q</sub> test then some vehicle component is keeping the BeCM awake with an activation input (see Table 1). This can be done by either an inductive ammeter or by putting an ammeter/voltmeter in series between the disconnected negative battery cable and the negative post on the battery.
2. If an ammeter is not available, then making sure that all doors are closed, wait until 2 minutes and see whether or not the interior lamps extinguish and if the Gearbox H-gate selector dot extinguishes. The selector dot will remain lit at a **low** intensity if the BeCM is kept awake or completely extinguish after two minutes if the BeCM does not receive any more activation inputs. This may be difficult to observe in highly lighted areas (i.e. you may need to cup your hands around the dot to determine whether or not the dot is still illuminated during lower I<sub>q</sub> drains).

**Number 1 is the preferred sleep mode detection procedure, use number 2 only as a last resort if any means of current monitoring can not be found.**

Table 1 shows the activation inputs.

The BeCM will recognise an input Low (GND) as anything < 3v and an input High as >5v.



## BeCM System Information Document – Edition 2

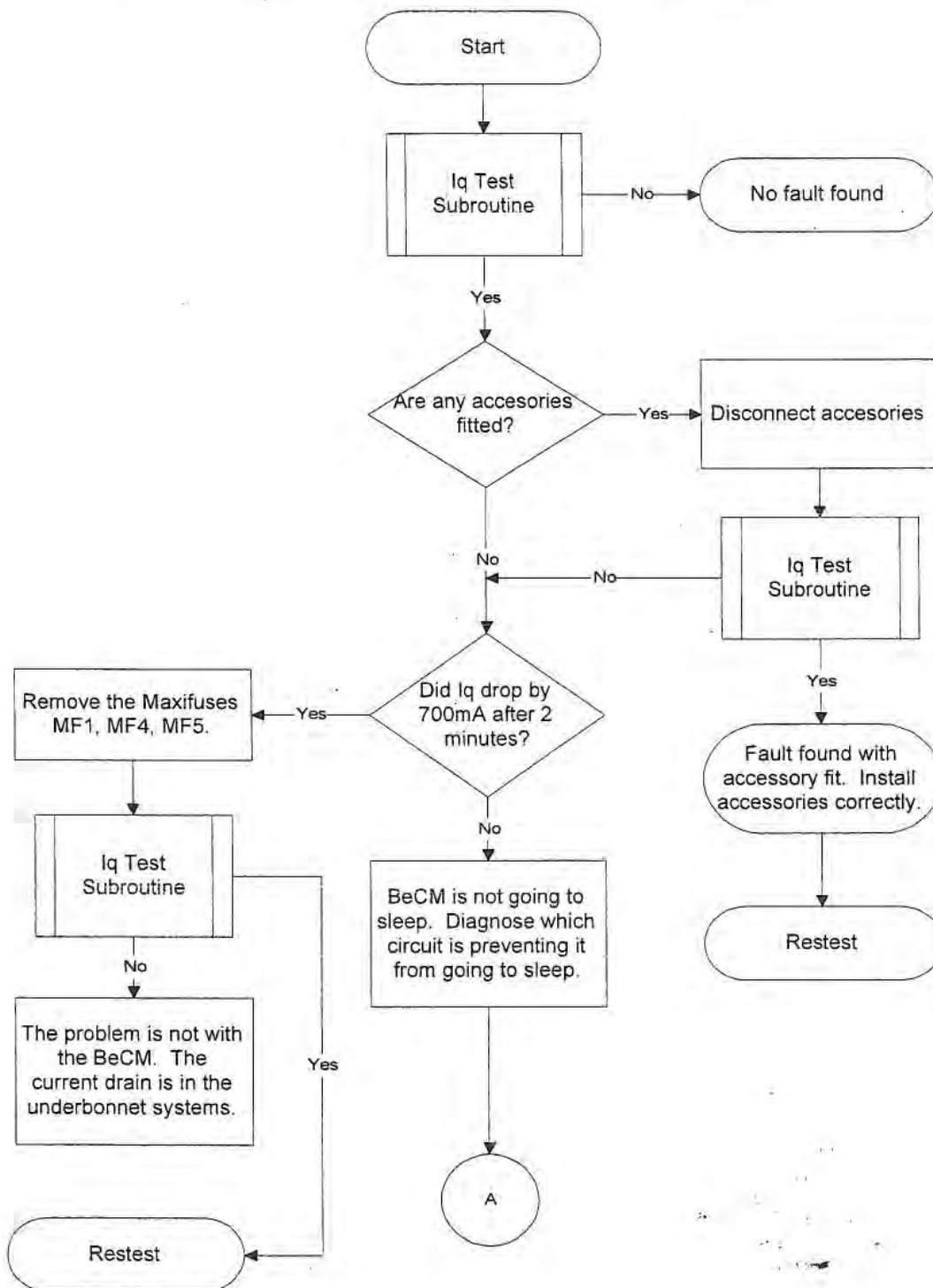
Table 1. ACTIVATION INPUTS TO THE BeCM.

Input ( BeCM )	Connector	Pin	Wire Col.	Signal
Bonnet Open Switch	C114 GREEN 20WAY	14	PW	When bonnet is open -- I/P to BeCM is GND (edge triggered)
Diagnostic line "K"	C255 WHITE 20WAY	8	KR	Input Short to ground will wake up BeCM
Hazard Switch	C255 WHITE 20WAY	13	PG	When hazards are on -- I/P to BeCM is GND
Diagnostic line "L"	C255 WHITE 20WAY	17	LGR	Input Short to ground will wake up BeCM
IGN position I	C256 WHITE 16WAY	13	WK	Ignition 1 on -- I/P to BeCM is GND
H/Lamp Flash Switch	C257 YELLOW 20WAY	8	US	Switch Closed -- I/P to BeCM is GND (non latching )
Sidelight Switch	C257 YELLOW 20WAY	9	OR	If sidelights are on -- I/P to BeCM is GND
Horn Switch	C257 YELLOW 20WAY	17	PB	If switch is closed -- I/P to BeCM is GND (non latching )
Fuel Flap Release Switch	C257 YELLOW 20WAY	18	LGS	If switch is closed -- I/P to BeCM is GND ( non latching )
IGN position II	C258 WHITE 10 WAY	8	W	IGN. 2 on -- I/P to BeCM is GND
Courtesy Lamp Switch	C326 BLUE 20WAY	2	BP	Switch Closed -- I/P to BeCM is GND ( non latching )
Tailgate Open Switch	C326 BLUE 20WAY	3	PY	When tailgate is open -- I/P to BeCM is GND (edge triggered)
Radio remote I/P	C326 BLUE 20WAY	6	OR	BeCM wakes up when 433MHz / 315MHz received *. * An intermittent contact does not activate BeCM
Rear L Door open Switch	C362 BLACK 16WAY	4	PW	If door is open -- I/P to BeCM is GND ( edge triggered )
Security - Ultrasonic I/P	C362 BLACK 16WAY	6	YK	If active -- I/P to BeCM is GND
Diagnostic line "K" (Gearbox ECU)	C626 BLACK 20WAY	12	K	Input Short to ground will wake up BeCM

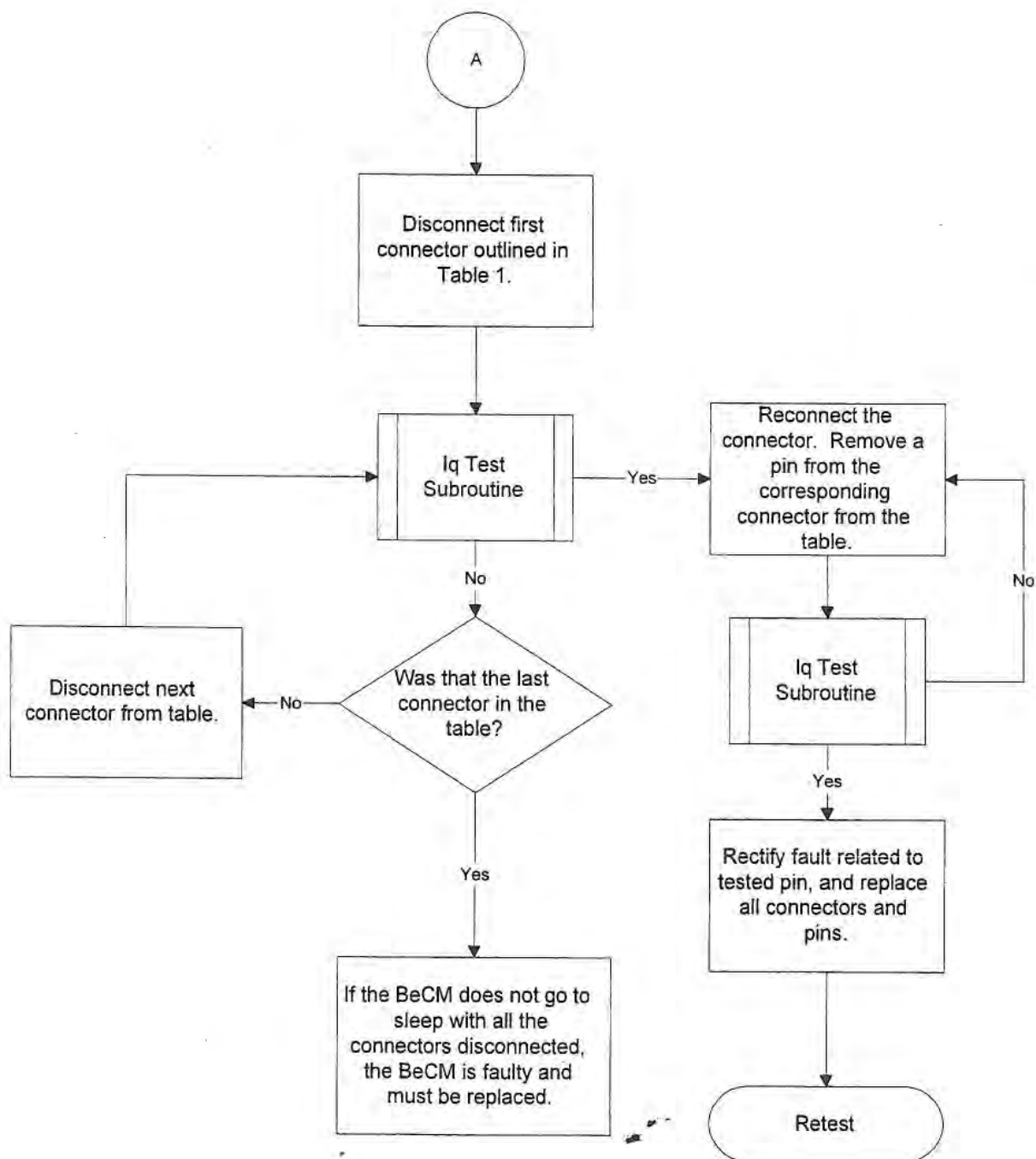
Input ( Door Outstation )	Connector	Pin	Wire Col.	Signal
FLH Door Open Switch	C758L 20WAY BLACK	7	PW	If door open -- I/P to Door Outstation is GND (edge triggered)
FLH CDL Switch	C758L 20WAY BLACK	5	WP	Switch Closed -- I/P to Door Outstation is GND (edge triggered)
FLH Key Switch	C758L 20WAY BLACK	6	UR	Switch Closed -- I/P to Door Outstation is GND (edge triggered)
FRH Door Open Switch	C758R 20WAY BLACK	7	PW	Door open -- I/P to Door Outstation is GND (edge triggered)
FRH CDL Switch	C758R 20WAY BLACK	5	WP	Switch Closed -- I/P to Door Outstation is GND (edge triggered)
FRH Key Switch	C758R 20WAY BLACK	6	UR	Switch Closed -- I/P to Door Outstation is GND (edge triggered)

Should a BeCM fail to go to sleep then the diagnostic flowchart on pages 11 -15 should be followed.

## Quiescent current drain (Iq) fault location flowchart

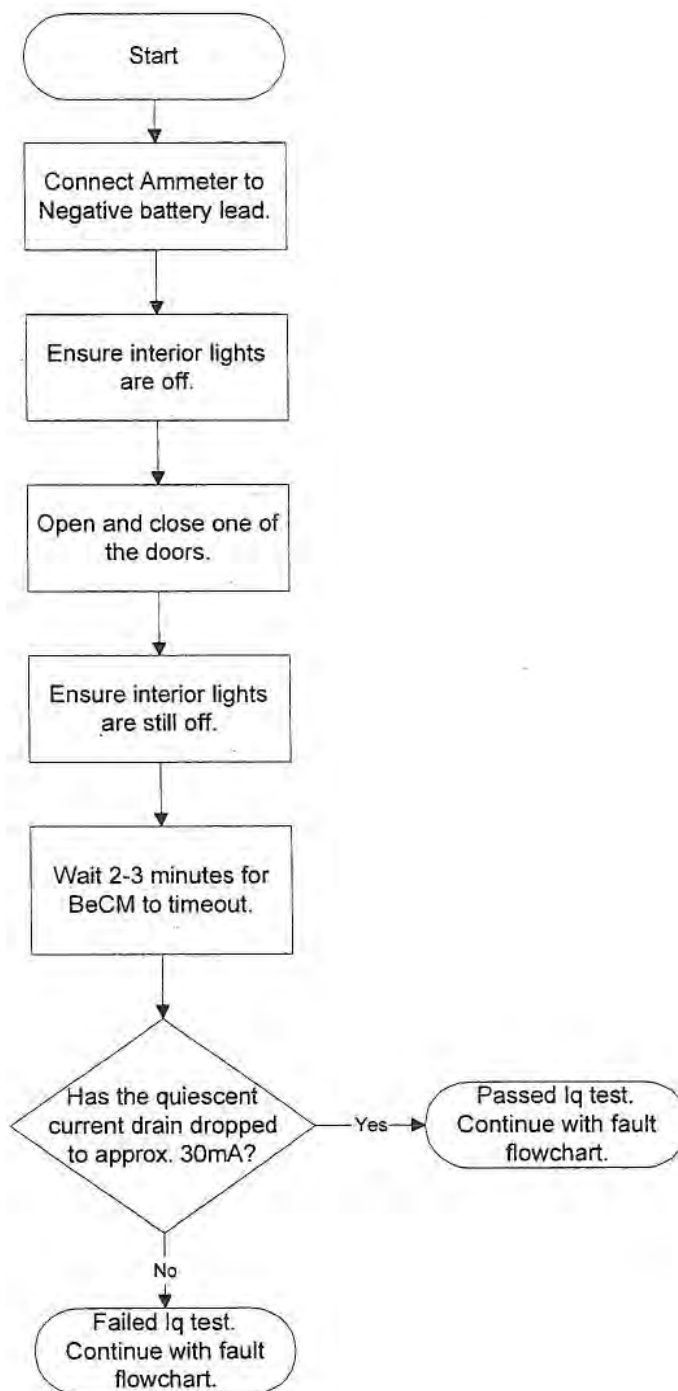


Quiescent current drain ( $I_q$ ) fault location flowchart, continued

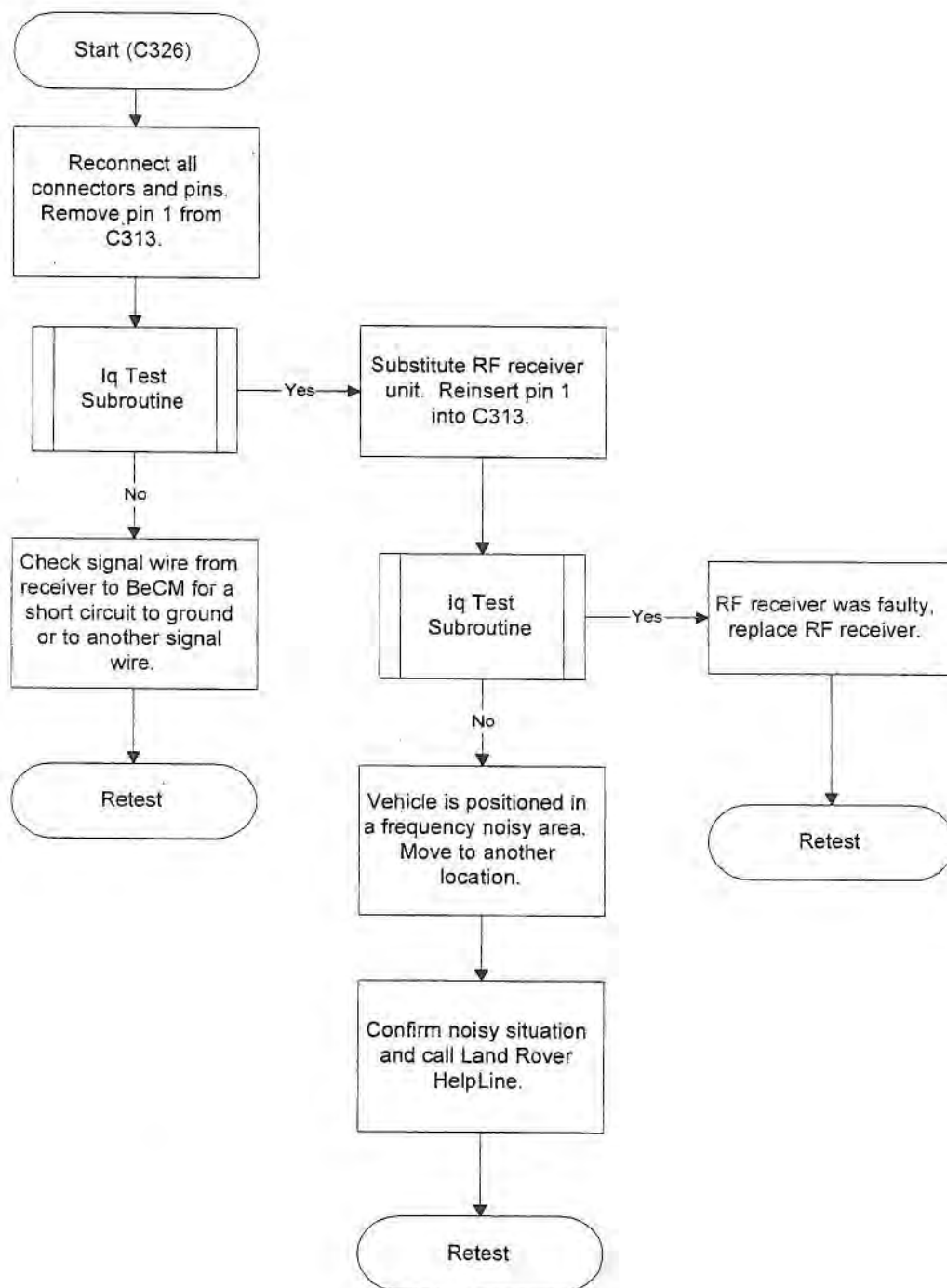




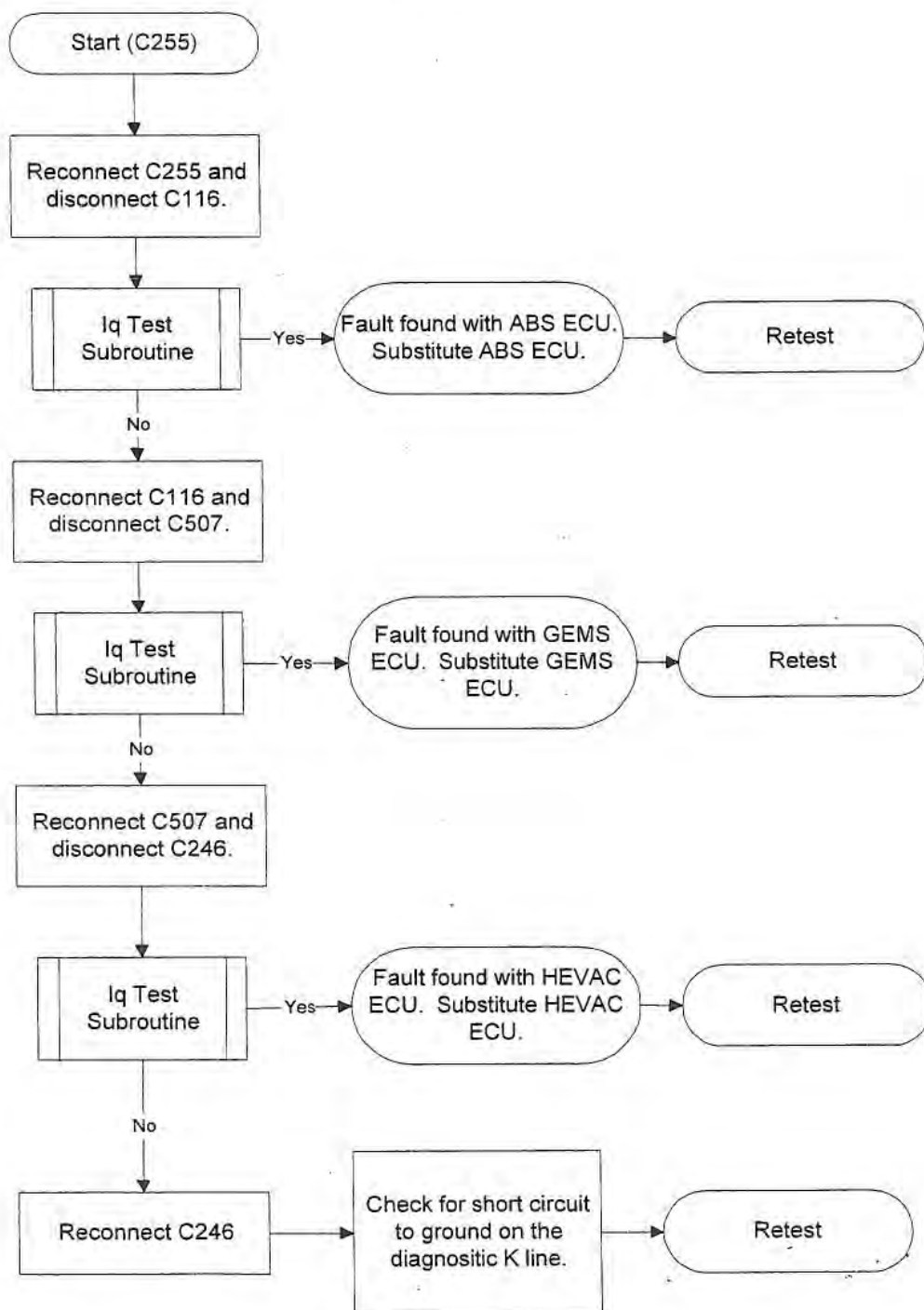
### Quiescent current drain (Iq) subroutine test



If pin 6 in C326 is found to be the cause for keeping the BeCM awake, follow the flowchart below.



If pin 8 in C255 is found to be the cause for keeping the BeCM awake, follow the flowchart below.





### ***Engine running signals***

The tacho signal is generated by the GEMs ECU, this signal is in the form of a pulse train. The engine rpm thresholds for tacho pulse monitoring will be:

Petrol          180rpm

### ***Horn Signals***

The vehicle horns are driven when the horn switch on the steering wheel is pressed. The BeCM sees the horn switch activated when the switch is grounded(0v). The BeCM will output a low (0v) signal to the coil of the horn relay (in the engine compartment fuse box), causing the relay to energise, closing the relay contacts allowing Vbat(12v) to pass through and activate the two horns simultaneously. When the switch is released the input will be high (Vbat), causing the output to be high(Vbat) which in turn de-energises the relay, causing the horns to stop sounding.

### ***Warning Messages***

There are a number of components which supply input signals to the BeCM, but are only used for warning messages on the instrument pack. The BeCM may only act as a direct link, passing the information from sensors to the instrument pack. The BeCM is responsible for generating the messages that are then sent to the instrument pack through the serial link for display. The messages are generated when the correct conditions are met.

### ***Flat Battery***

If a flat battery is found check for a battery drain of less than 30mA when the BeCM is asleep. If the BeCM is awake it will be approximately 0.8 Amps and the battery will last only 2 to 3 days with this amount of drain. Determine if the problem is underbonnet or BeCM related, by removing the 3 large 60 Amp MaxiFuses from the underbonnet fuse box. If the drain does not reduce to 30mA, then the problem is underbonnet. The alternator has been found to cause a drain of 4 to 10 Amps and the two fuse boxes have a combined drain of 1 Amp.





## BeCM and ECU interconnections

### *Power Distribution*

#### BeCM Multiplexed communications to other ECUs

The multiplexed communication is a method of electronic communication that enables the BeCM to 'talk' to several other Outstations by passing electrical instructions through the same wires (the serial link).

Each serial link comprises the following:

- Feed wire               Supplies battery voltage
- Earth wire             Provides vehicle earth
- Clock wire            Provides reference signal
- Signal wire           Carries instructions between electronic control units
- Direction wire       identifies the direction of instruction

The instructions are communicated through the serial link to the relevant outstations, which then processes the signal, to determine the meaning, before carrying out the instruction.

All the voltages relating to the serial link are either Ground(0v) for logic 0, or Vbat(12v) for logic 1.

The electronic instructions can not be seen using a multimeter.

Refer to Fig. 1 for serial link ECU connections.

#### Message generation

The audible sounder is operated by a moving coil transducer mounted in the instrument pack, controlled by the BeCM output. The tone outputs will be in the form of equally spaced pulses.

The tone of the 'beep' is determined by the frequency and volume is determined by the voltage of the pulse. Maximum volume is 7volts.

#### Odometer logging

The BeCM monitors the odometer value received from the instrument pack through the serial link. When the ignition is turned on, the BeCM stored value will be automatically be updated by the distance value held by the instrument pack. A distance unit is defined as either a mile or a kilometer, as applicable to the vehicle configuration. If the BeCM receives five consecutive numbers from the instrument pack that are less than the number already stored in the BeCM memory, then an odometer error condition will be displayed on the instrument pack. This will only occur if a BeCM with a higher stored odometer value has been put into a vehicle with a lower odometer value in the instrument pack, or an instrument pack with a lower odometer value is fitted (i.e. new instrument pack). The error message can be reset through the use of TestBook, by carrying out an odo update. (In TestBook: instrument pack\Toolbox\Odo Update).



**WARNING: IF AN ODO UPDATE IS CARRIED OUT THE ODOMETER WILL TAKE UP A HIGHER VALUE THAN IT CURRENTLY HAS, THEREFORE PLEASE MAKE SURE EVERYTHING IS CORRECT BEFORE CARRYING OUT AN ODO UPDATE.**

If the odometer value is greater than the value stored by the BeCM, then the BeCM will automatically update the stored value.

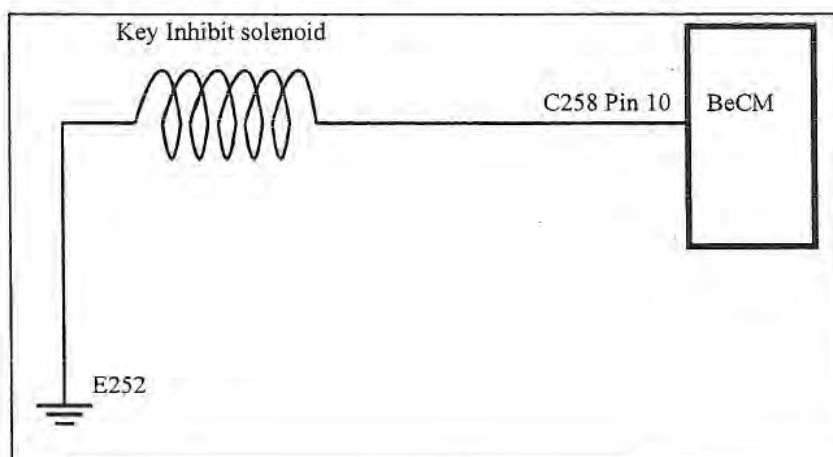
**WARNING: PLEASE NOTE THAT IF A BeCM WITH A LOWER STORED VALUE IS PUT INTO A VEHICLE WITH A HIGHER ODOMETER VALUE, THE BeCM WILL STORE THE CURRENT ODO VALUE. THEREFORE DO NOT EXCHANGE OR SUBSTITUTE BeCMs TO ELIMINATE FAULTS BETWEEN VEHICLES. IF A BeCM HAS TO BE SUBSTITUTED, THEN DISCONNECT ALL THE INSTRUMENT PACK CONNECTORS, BEFORE CONNECTING POWER TO THE VEHICLE.**

#### LRNA Technical Support

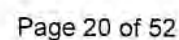
If a fault free BeCM is locked to a vehicle accidentally, LRNA has the ability to unlock the BeCM from that particular vehicle. LRNA can reset the new fault free BeCM and allow it to be installed into another vehicle as if it were directly from parts stock. It is important that if a BeCM is sent to LRNA to be unlocked that it be fault free. LRNA Service Department will unlock the BeCM and return it for a small fee. If this procedure is needed contact the Technical HelpLine at 1800-562-5824 and inform them of the situation.

### Key inhibit solenoid

When the gear selector lever is not in park or the ignition is not in the off position, the BeCM will output Vbat(12v) - Connector C258 Pin 10 - to energize the solenoid and prevent the key being removed from the ignition barrel. Once the ignition switch is turned to the off position and the gear lever is moved to the park position, the BeCM output will be GND(0v), the solenoid will be de-energized, allowing the key to be removed. Difficulties may be experienced if the driver attempts a rapid key removal, this is due to the solenoid not being able to respond quickly enough. To cure this, for 97MY onwards, the solenoid will energize when the gear lever is out of the park position (BeCM output = Vbat(12v)), and the BeCM output will be GND(0v) to de-energise the solenoid, when the gear lever is in the park position, regardless of the position of the ignition switch.



The starter solenoid is controlled by the BeCM through a starter relay in the engine compartment fuse box. Providing the vehicle is disarmed correctly (e.g. MIL/Check Engine lamp is on, when the ignition is on), gear lever in neutral or park, when the key is turned to ignition position 3, the BeCM input (C238 pin 2) will be grounded(0v). The BeCM will output a low(GND) signal to energise the starter relay. The relay contacts will supply the starter solenoid relay with Vbat(12v) through a 30A Maxifuse (MF 2). This in turn will close the starter solenoid relay contacts to allow a direct feed from the battery positive terminal to the starter motor. If the MIL/ Check Engine lamp does not come on the engine is immobilised.







## BeCM Replacement and Reprogramming using TestBook.

This is to be used as a guide when replacing a BeCM. It is a step by step guide of how the BeCM programming works. It should be used if the TestBook operator is unsure of how the procedure works.

It is assumed the new BeCM has just been fitted and is awaiting programming.

Please use the latest disk to program the BeCM.

1. Connect TestBook to vehicle.
2. Power up TestBook and await Welcome Screen.
3. Choose DIAGNOSTIC SYSTEM.
4. On the Next Screen Select Vehicle Type, Model Year etc. then CONTINUE
5. Now Enter the full VIN of the vehicle. Check it before pressing CONTINUE.  
( If an invalid VIN has been entered, re entering it will be necessary )
6. The next screen confirms the selections that have been made. If they are correct then CONTINUE.
7. Next, under SYSTEM SELECTION choose BeCM PROGRAM.

There may be THREE or FOUR choices and EXIT on the BeCM Reprogramming MENU, depending the disk being used.

8. Choose NEW BeCM.

Ensure that you are using the blue Diagnostic cable or the Switchable Diagnostic cable is in Position A then CONTINUE.

The next screen will ask whether the necessary vehicle information is available, this is VIN, Lockset Barcode, Build Date.

9. If all the information is available choose YES.

Here, the VIN that was entered earlier will be confirmed. If it is not correct, then press NO and retype the VIN. If it is correct then press YES.

10. The next screen will ask for the Lockset Barcode. It is necessary to type in all 14 characters of the Lockset Barcode. The Lockset Barcode must be the correct one for the HANDSETS. Then press CONTINUE.



11. Next, the Build Date will be asked for. It must be entered in this format: DD/MM/YY ( Day, Month and Year ) .

If it is in any other format, it is incorrect and will have to be re entered. Press CONTINUE.

The next selection of icons is the Market Selection. Here TestBook will determine whether the vehicle should have an EKA code or not. It will not actually program the market, that will be done later.

12. Choose the correct market for the vehicle.
13. The next screen is SELECT VEHICLE TYPE. Press the required tick boxes that conform to the vehicle specification. Press CONTINUE after the correct Vehicle type has been entered.
14. Finally, all the data that has been inputted will now be displayed. The operator of TestBook must ensure that all this information is correct at this point. If it is not correct, press NO and the diagnostic will return to the VIN check screen. The vehicle information will have to be re entered. If all of the information is correct press YES.

**WARNING : ENTERING INCORRECT INFORMATION WILL IMMOBILISE THE VEHICLE AND THE BeCM WILL HAVE TO BE REPLACED AGAIN. ENSURE THIS DOESN'T HAPPEN !**

15. The next screen is the last chance to change any vehicle information before it is locked into the BeCM. After this point the information can never be changed. If the information is definitely correct then press YES otherwise press NO.
16. The following screen is the MODEL YEAR selection. Look at the VIN and select the 10 character from the left. M, S, T or V. Conformation of the Market that was selected earlier will be given.
17. The following screen is CUSTOMER OPTIONS PROGRAMMING. Press CONTINUE to change customer options.  
  
Front fogs, Sunroof and Trip computer should be enabled.
18. Select the options that are required by pressing the check boxes. Press CONTINUE when the correct options have been programmed. Conformation of these options will be given followed by conformation that the options have been programmed into the BeCM.

THE BeCM IS NOW PROGRAMMED. IF NEW REMOTE HANDSETS HAVE BEEN SUPPLIED, THE LOCKSET BAR CODE WILL BE DIFFERENT TO THE PREVIOUS ONE AND IT WILL BE NECESSARY TO PUT GEMs INTO LEARN MODE ( THROUGH GEMs DIAGNOSTIC).

- RESYNCHRONISE THE HANDSETS AND CRANK THE VEHICLE.
- SET ALL THE WINDOWS AND SUNROOF.
- ENTER THE RADIO CODE





## BeCM Substitution Process

There is no customer or dealer accessible facility for altering the stored BeCM or instrument pack odometer value either within the vehicle or via TestBook. However if you need to substitute a BeCM into a vehicle for fault diagnosis then follow the procedure below to avoid locking the new BeCM with vehicle information.

1. Substitute the BeCM in the problem vehicle.
2. Connect all the wire connectors to the BeCM.
3. Remove driver's side access panel and Instrument pack surround as per Workshop Manual and disconnect the Instrument pack connector (C242 ). This will allow access to vehicle diagnosis without transferring odometer mileage information from the instrument pack to the BeCM.
4. Re-connect vehicle battery after ensuring instrument pack connector (C242) is disconnected
5. Start the BeCM replacement procedure through TestBook as if the BeCM was being replaced with a new unit.
6. Enter in all vehicle information (i.e. VIN, Lockset Barcode, Build Date, etc.)
7. When the confirmation step is reached, TestBook will ask to confirm the information and warn that if continued the displayed information will be locked into the BeCM. **At this time you must ABORT the installation process.**

The abortion of the new BeCM installation process will allow use of the vehicle without locking the BeCM to that particular vehicle.

**NOTE:** When reconnecting C242 support the instrument pack behind connector to ensure that the connection is complete and to avoid damage to the PC board in the instrument pack. C242 **MUST NOT** be inserted while the substitute BeCM is in place; only when the BeCM that will remain in the vehicle is in situ, can the connector be re-fitted.

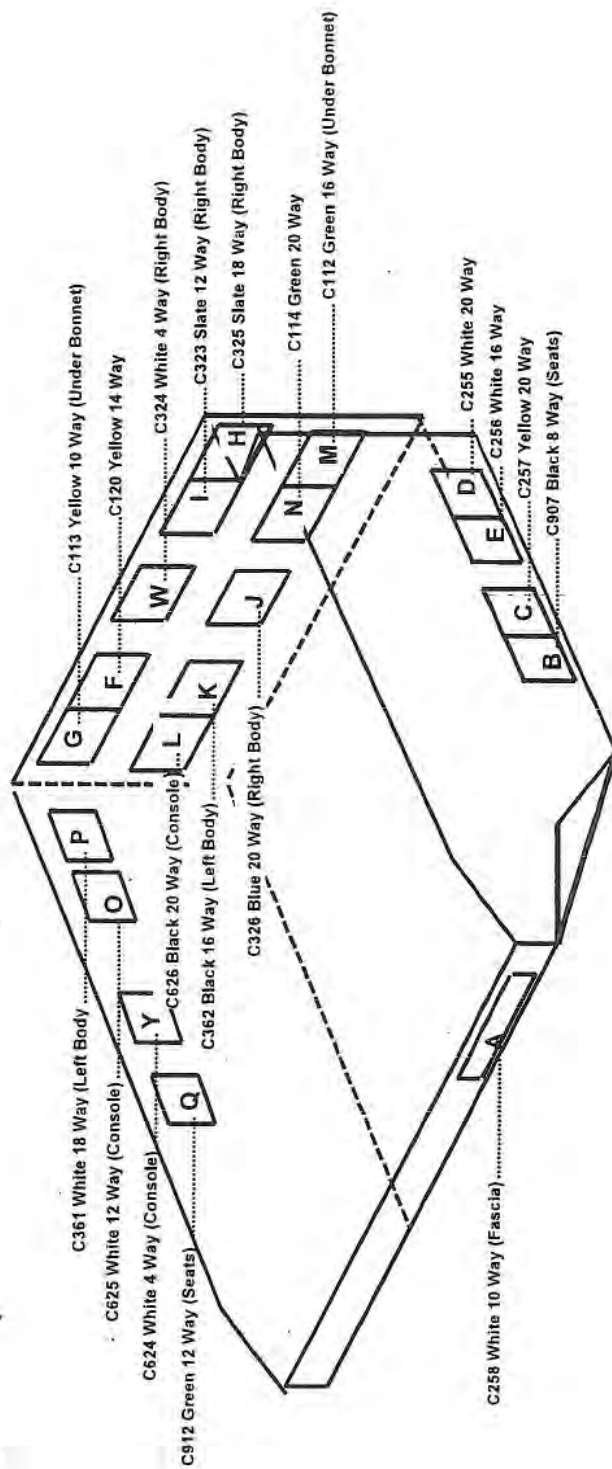
In completing this process, diagnosis is inhibited in the areas related to any Instrument pack functions (speedometer, tachometer, fuel gauge, etc.). **The vehicle will run but is not road worthy, DO NOT drive vehicle on public roads.** If required, only drive vehicle around dealership.

**If it is decided to replace the BeCM with the substituted unit the New BeCM installation process needs to be carried out again completely with out aborting. Failure to reprogram and lock the BeCM will compromise vehicle security.**



## BeCM System Information Document – Edition 2

### BeCM Connector Identification







## BeCM System Information Document – Edition 2

### Connector Pinouts

#### BeCM

Connector C112 16 WAY AMP 040 FEMALE PLUG ( GREEN )					Status	Comments
Cavity	Wire col.	I / O	Fuse No.	Function		
1						
2	BK	O		Park /handbrake on signal to air sus. ECU	GND when park or handbrake selected, otherwise battery. volts	
3	PO	O		Door / tailgate open signal to air sus. ECU	GND when door or tailgate open, otherwise battery. volts	
4	BP	I		Auto gearbox oil temp. input.	GND when temperature OK otherwise battery. volts	Responsible for "Gearbox Overheat" message
5	B	O		Security code to Engine control module.	Security code sent to ECM when ignition 2 selected & vehicle not immobilised.	A single burst of 5v pulses.
6						
7						
8	WLG	O		Tells u/bonnet fuse box, IGN. I selected	GND when ignition key in either position 1 (aux) or position 2, otherwise battery. volts	
9	S	I		Engine speed input from Engine control. mod.	Square wave input from ECM. 0v - 12v.	Typical average value is 6v when engine is running.
10	BS	I		ABS warning light & message input.	Modulated 0 to Battery. volts signal depending on message.	
11	BW	I		Brake pressure input from ABS pump	This input will be GND when ABS pump pressure is low, otherwise battery. volts	
12						
13	Y	O		Road speed output to air sus. & engine ECU's.	Square wave output, switching between GND & Vbatt. 8000 pulses per mile. Typically 5-6v.	Signal originates from ABS ECU and filtered by the BeCM. A signal can be seen with a good quality voltmeter. The meter will give an average value.
14	BY	I		Catalyst overheat (Japan).	GND when warning activated otherwise Vbatt.	
15						
16	GB	O		Fuel level signal to ECM.	GND when fuel level low, otherwise Vbatt.	Signal used by ECM.



## BeCM System Information Document – Edition 2

### Connector C113 10 WAY AMP 070 FEMALE PLUG (YELLOW)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	UB	O	F.E.T.	R.H. Main beam 1 output (twin element).	Vbatt. when main beam selected, otherwise ground.	
2	WR	O		Starter motor signal to U/Bonnet fuse box.	GND when starter motor request made, otherwise Vbatt.	
3	UO	O	F.E.T.	R.H. Dipped beam output.	Vbatt. when dipped beam selected, otherwise ground	
4	GW	O	F.E.T.	R.H. Front direction indicator lamp.	Pulse from 0v to Vbatt. when R.H. direction indicator selected, otherwise GND	RH turn signal will flash at twice normal rate if a bulb fails.
5	UP	O	F.E.T.	R.H. Main beam 2 output (inner lamp).	Vbatt. when main beam selected, otherwise ground.	
6	LGR	O		Headlamp wash wipe signal to U/B fuse box.	GND when headlamp wash/wipe request made, otherwise Vbatt.	Headlamp wash wipe is normally operated every other front screen wash cycle. There will be no headlamp wash wipe when the washer fluid level is low.
7	NLG	O		Front wipers fast output signal to U/B fuse box relay.	GND when front wiper fast speed request made, otherwise Vbatt.	
8	KLK	O		Front wipers slow output signal to U/B fuse box relay.	GND when front wiper slow speed request made, otherwise Vbatt.	Signal will remain on when fast speed is selected.
9	RW	O	F.E.T.	R.H. Front side light.	Vbatt. when side lights selected, otherwise ground.	
10	RY	O	F.E.T.	R.H. Front fog light.	Vbatt. when fog lights selected, otherwise ground.	Side or head lamps will need to be on for fog lights.



## BeCM System Information Document – Edition 2

Connector C114 20 WAY AMP 040 FEMALE PLUG ( GREEN )						
Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	YB	I		Low screen wash fluid signal input.	GND with low screen washer fluid level, otherwise Vbatt.	
2	WP	I		Inertia switch tripped signal input.	GND when inertia switch tripped otherwise Vbatt.	
3	NLG	I		Front wiper park switch	GND when wipers are parked, otherwise Vbatt.	
4						
5	BY	I		Petrol check engine warning lamp input.	GND when warning lamp activated. Otherwise Vbatt.	
5	WU	I		Diesel check engine warning lamp input.	GND when warning lamp activated. Otherwise Vbatt.	
6						
7	WN	I		Oil pressure switch input.	GND with low oil pressure, otherwise Vbatt.	
8	PB	I		Air sus. wade warning lamp input.	GND when vehicle in wade height or for bulb check.	This input activates warning lamp on Inst. pack
9	UK	I		Air sus. message input 1.	Air sus. message line control air sus. messages on instrument pack & Ride height status illumination	See table 2
10	GB	I		Fuel level sensor input	Variable voltage depending on volume of fuel. 0v - 5v.	
11	YG	I		Road speed from ABS ECU.	This is a 0 to V.Batt. square wave with 8000 pulses per mile.	Meter reading will be an average value
12	WK	I		Signal for traction control messages & ETC bulb.	0 to Vbatt Modulated signal depending upon message.	
13						
14	PW	I		Bonnet open switch input.	GND when bonnet open. Otherwise Vbatt.	May Keep the BeCM awake (see Table 1).
15	NY	I		Alternator charge input.	Vbatt. when charging, otherwise GND	
16	BP	I		Brake fluid level input.	Brake fluid level switch closed to ground via ABS pressure switch when level OK.	There is a 10 sec. anti slosh delay before low brake fluid message displayed.
17						
18	UW	I		Air sus. message input 2.	Air sus. message line control air sus. messages on instrument pack & Ride height status illumination	See table 2
19	G	I		Engine Coolant Temperature Input.	Variable voltage depending on coolant temperature.	
20	S	O		Engine speed out put to Air sus. ECU.	Square wave output 0v - 12v.	Typical value 6.6 volts.

**TABLE 2**

Air sus. messages		Input 1	Input 2
Slow: 20mph max./slow: 40kph max.		GND	GND
EAS Manual		GND	Vbatt
EAS Fault		Vbatt.	GND
Slow: 35mph max./Slow: 55kph max.		Vbatt.	Vbatt.

The Ride height status lamps are controlled via a serial link and correct signal functionality cannot be checked by measuring the voltage.





## BeCM System Information Document – Edition 2

### Connector C120 14 WAY AMP 070 FEMALE PLUG ( YELLOW )

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	GS	O	7	Air bag ignition feed. (Secondary feed)	Batt. volts with ignition on.	Failure will result in air bag fault message
2	PY	O		Alarm Klaxon.	Output 0 to Vbatt. pulse signal. Otherwise GND	
3	RY	O	F.E.T.	L.H. Front fog light.	Vbatt. when fog lights selected, otherwise ground.	Side or head lamps will need to be on for fog lights.
4	BLG	O		Rear Screen Wash pump motor.	Vbatt. when activated. Otherwise GND	
5	RB	O	F.E.T.	L.H. Front side light.	Vbatt. when side lights selected, otherwise ground.	
6	RG	O	F.E.T.	L.H. side repeater.	Pulse from 0v to Vbatt. when L.H.D.I. selected, otherwise ground.	Output will be GND if circuit is short/open circuited
7	PN	O		Horn output to fusebox relay.	GND when horn selected, otherwise Vbatt..	
8	UG	O	F.E.T.	L.H. Main beam 2 output (inner lamp).	Vbatt. when main beam selected, otherwise ground.	
9	W	O		Ignition signal to underbonnet fuse box.	GND when ignition switched on otherwise Vbatt..	
10	US	O	F.E.T.	L.H. Main beam 2 output (twin element).	Vbatt. when main beam selected, otherwise ground.	
11	UK	O	F.E.T.	L.H. Dipped beam output.	Vbatt. when dipped beam selected, otherwise ground	
12	GR	O	F.E.T.	L.H. Front direction indicator lamp.	Vbatt. (oscillating) when L.H. direction indicator selected, otherwise GND	Output will be GND if circuit is short/open circuited
13	LGB	O		Front Screen Wash pump motor.	Vbatt. when activated.	
14	WG	O	F.E.T.	RH. side repeater.	Pulse from 0v to Vbatt. when R.H.D.I. selected, otherwise ground.	Output will be GND if circuit is short/open circuited

Note: F.E.T is Field Effect Transistor, used to drive the outputs instead of the conventional relays.





## BeCM System Information Document – Edition 2

### Connector C255 20 WAY AMP 040 FEMALE PLUG ( WHITE )

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	RN	I		Rear fog light switch input.	GND when switch pressed, otherwise Vbatt.	This switch is non latching type.
2						
3	NW	I		Key in switch (Ignition key) input	GND when key in ignition barrel, otherwise Vbatt.	
4	YG	I		Clutch switch input (manual).	GND when pedal not depressed, otherwise Vbatt.	
5						
6	BR	I		R.H. Seat heater request input.	GND when switch pressed, otherwise Vbatt.	Signal comes from HEVAC ECU
7	GLG	O		Hazard switch telltale.	Vbatt. when hazards selected, otherwise GND	This switch is a latching type.
8	KR	I/O		Test book diagnostic line "K"	Normally Vbatt. unless data being transmitted.	When data transmitted voltage will change rapidly from GND to Vbatt.. Can be seen with meter.
9	NY	O		Alternator charging signal to HEVAC.	GND when alternator charging.	
10	Y	O		Road speed signal to HEVAC.	Square wave output, switching between GND & Vbatt. 8000 pulses per mile.	Typical value = 6-7v when vehicle is in motion.
11	WB	I		Rear screen heater request signal.	GND when heated rear screen selected, otherwise Vbatt.	Signal comes from HEVAC ECU.
12	R	O		Passive Immobilisation coil feed.	When key inserted into ignition & vehicle immobilisation. This line will pulse to Vbatt. to fire handset. Otherwise this output is at GND	This signal can be seen with a meter. Typically 1.6v to 12v Pulse.
13	PG	I		Hazard switch input.	GND when hazards selected otherwise at Vbatt.	Keeps BeCM awake (see Sleep Mode)
14	WY	I		Cruise enable switch.	GND when cruise switch selected otherwise at Vbatt.	
15	BP	I		L.H. Seat heater request input.	GND when switch pressed, otherwise Vbatt.	Signal comes from HEVAC ECU
16						
17	LGR	I/O		Test book diagnostic line "L"	Normally Vbatt. unless data being transmitted.	When data transmitted voltage will change rapidly from GND to Vbatt.. Can be seen with meter
18	OW	O		Cruise ECU, switch telltale & inverter power	Vbatt. when fascia cruise enable switch is selected, otherwise GND	
19						
20	Y	O		Road speed signal to Cruise ECU.	Square wave output, switching between GND & Vbatt. 8000 pulses per mile.	Typically 2.5v when vehicle is in motion.



## BeCM System Information Document – Edition 2

Connector C256 16 WAY AMP 040 FEMALE PLUG ( WHITE )					
Cavity	Wire col.	I/O	Fuse No.	Function	Status
1	OG	O		Instrument pack serial link - direction	Typical average value is 6volts
2	RG	O		Instrument pack serial link - clock	Typical average value is 6volts
3	LG	I/O		Instrument pack serial link - data (duplicate)	Typical average value is 6volts
4	RLG	I		Input from panel lamps dimmer switch	GND when dimmer switch moved to " increase" position.
5	BG	O		Instrument pack serial link - signal GND(dup.)	GND 0volts
6	RU	O		Fog lamp rear switch telltale illumination.	Vbatt. when rear fog lamps illuminated.
7	SR	O		Security LED.	Pulse signal when LED flashing. 0v - 12v
8	S	O		Tachometer signal to Instrument Pack.	Square wave signal. 0v - 12v.
9	OG	O		Instrument pack serial link-direction (duplicate)	Typical average value is 6volts
10	RG	O		Instrument pack serial link - clock (duplicate)	Typical average value is 6volts
11	LG	I/O		Instrument pack serial link - data.	Typical average value is 6volts
12	RB	I		Input from panel lamps dimmer switch	GND when dimmer switch moved to " decrease" position.
13	WK	I		Ignition I input from ignition barrel.	GND when ignition key in position I or II
14	BG	O		Instrument pack serial link - signal GND	GND at all times.
15	BK	O		Instrument pack audible warning.	Pulses of 0v - 7v. otherwise GND
16	Y	O		Speedometer signal to Instrument Pack.	Square wave output, switching between GND & Vbatt. 8000 pulses per mile.
					Comments
					This wire is a duplicate of pin 11
					Meter will only give average value
					Meter will only give average value
					May Keep BeCM awake (see Table 1)
					Voltage level determines the volume of sounder.
					Typically 2.5v when vehicle is in motion.

All instrument pack serial links are pulsed signals, hence, using a multimeter will only give an average value. Although the meter may display a value, this does not necessary mean the serial link is functioning correctly.



## BeCM System Information Document – Edition 2

**Connector C257 20 WAY AMP 040 FEMALE PLUG ( YELLOW )**

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	LGB	I		Rear screen wash switch.	GND when selected, otherwise Vbatt..	
2	GW	I		Right D.I. switch input.	GND when Right D.I. switch selected, otherwise Vbatt..	
3	U	I		Headlamp dip beam switch input.	GND when headlamp switch selected, otherwise Vbatt..	
4	LGO	I		Front screen wash switch.	GND when selected, otherwise Vbatt..	
5	RLG	I		Front wiper switch 2.	Input goes to GND when wiper switch moved to int. or slow position.	
6	WR	I		Ignition position 3 input.	GND when selected, otherwise Vbatt..	
7	GR	I		Left D.I. switch input.	GND when Left D.I. switch selected, otherwise Vbatt..	
8	US	I		Headlamp flash input	There is a momentary GND input when selected, then returns to Vbatt.	May Keep BeCM awake (see Table 1)
9	OR	I		Sidelight switch input.	GND when side lights switch selected, otherwise Vbatt.	May Keep BeCM awake (see Table 1)
10	YR	I		Front fog lamp switch telltale.	Vbatt. when front fog lamps activated, otherwise GND	
11	OP	I		Wiper intermittent delay potentiometer.	Resistance to GND typically 2k to 53 k ohms, depending on position selected.	If measuring resistance remove C257 from BeCM.
12	UW	I		Headlamp main beam switch.	There is a momentary GND input when selected, then returns to Vbatt.	
13	OB	I		Rear wiper switch.	GND when selected, otherwise Vbatt..	
14	RY	I		Front fog lamp switch input.	This signal is latched to GND when fog lamps selected, otherwise Vbatt..	
15	ULG	I		Front wiper switch 3.	Input goes to GND when wiper switch moved to fast or slow position.	
16	WG	I		Front wiper switch 1.	Input goes to GND when wiper switch moved to flick position, otherwise Vbatt.	
17	PB	I		Horn switch input.	GND when selected, otherwise Vbatt..	May Keep BeCM awake (see Table 1)
18	LGS	I		Fuel Flap release button input.	There is a momentary GND input when selected, then returns to Vbatt.	May Keep BeCM awake (see Table 1)
19				Spare		
20				Spare		





## BeCM System Information Document – Edition 2

**Connector C258 10 WAY AMP 070 FEMALE PLUG ( WHITE )**

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	ON	O		Cruise Pump Supply	Vbatt. supply to cruise pump. ( See Table 3 )	
2	RW	O		Clock/Facia SW/Heater/Inst. Illumination	Vbatt. when Sidelamp Switch Operated, otherwise GND	
3	PR	O		Front Footwell + IGN Key Illumination	Vbatt. any time when courtesy lights on, otherwise GND	
4	GP	I		Brake Switch	Vbatt. when Brake applied, otherwise GND	
5	R	O		Glovebox Lamp	Vbatt. when sidelamp switch operated, otherwise GND	May result in No. Plate failure if a fault occurs in the glove box lamp circuit.
6	WK	O	17	Radio / HEVAC Auxiliary.	Vbatt. when auxiliary supply is on ( Ignition 1 ).	
7	P	O	1	Clock / Radio / Inst. Pack battery feed	Permanent battery feed.	
8	W	I		Ignition 2 Switch	GND when Ignition 2 selected, Vbatt. otherwise.	
9	W	O		Brake Feed Switch/PAS/Air Sus. Switches & HEVAC Signal	Vbatt. when Ignition selected otherwise GND	
10	UK	O	13	Key Inhibit	Vbatt when Ignition 1 and transmission is not in Park - 97MY onwards - Transmission is not in park, regardless of Ignition switch	Solenoid energises if output is Vbat.

**TABLE 3**

Automatic Vehicle Cruise Available	Status
	IGN on, Cruise Enable Switch on, Transfer Box in High Mode, Gear = D321
	Pin 1 output = 12v





## BeCM System Information Document – Edition 2

### Connector C323 12 WAY AMP 070 FEMALE PLUG ( GREY )

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	WP	O	6	Rear View Mirror Dip - Ignition	Vbatt when Ignition on.	
2	PU	O	9	Right Front Door Outstation	Permanent Battery Feed	Including ICE amplifier
3	RB	O		Left Trailer Tail Lamp	Vbatt when Lamp On, otherwise GND	
4	P	O	15	Rear Right Ice Amp	Permanent Battery Feed	
5	SO	O	2	Rear Right Window Down	Vbatt when Motor being Driven, Otherwise GND	
6	RP	O		Rear Right Puddle / Marker Lamps	Vbatt when Lamps On, otherwise GND	
7	OB	O	14	Fuel Filler Flap Unlock	Relay Controlled Load Vbatt for 1sec when button pressed.	
8	YR	O		Rear Right Anti Trap Feed	Control Feed: Vbatt	
9	WR	O		Sun Roof Anti Trap Feed	Control Feed: Vbatt	
10	S	O	2	Rear Right Window Up	Vbatt when Motor being Driven, Otherwise GND	
11	RN	O		Rear Right Door Switch Illumination	Sidelamp Controlled Illumination: Variable pulse width 0v to Vbatt when Sidelamps selected.	Meter will display 12v.
12	PB	O	22	Right Front Door Outstation ( Window )	Permanent Battery Feed	

### Connector 324 4 WAY POWER CONNECTOR ( SUMITOMO ) ( CLEAR )

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	YO	O	13	Sunroof Backward	Vbatt when Sunroof back Switch Pressed. Otherwise GND	
2	PLG	O	12	Rear Screen Heater	Vbatt when Rear Screen Heater selected. Otherwise GND	
3	YK	O	13	Sunroof Forward	Vbatt when Sunroof forward switch Pressed. Otherwise GND	
4	G	O	6	Sun Visor Illumination - IGN	Vbatt when Ignition on.	



## BeCM System Information Document – Edition 2

Connector C325 18 WAY AMP 070 FEMALE PLUG ( GREY )					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		
1	RY	O		Rear Left Fog Lamp	Vbatt. when Rear Fog lamps selected	
2	GN	O		Left Reverse Lamp	Vbatt. when reverse selected	0.5 second delay for auto transmission vehicles
3	RY	O		Rear Right Fog Lamp and Trailer Fog Lamp	Vbatt. when Rear Fog lamps selected	Trailer Fog lamps also activates if fitted.
4	GW	O		Rear Right Directional Indicator	Pulsed square wave between 0v - 12v when RH turn signal is selected	Also true when the Hazard switch is selected
5	WO	O	8	Aerial Amplifier auxiliary	Battery feed when ignition I is on.	
6	OK	O		Rear Right Door Superlock	Vbatt. when driving motor.	Typically 800ms duration.
7	OB	O	15	Rear Wiper	Vbatt. when driving motor.	Typically 800ms duration.
8	O	O	14	Rear Right Door Lock	Vbatt. when driving motor.	Typically 800ms duration.
9	GN	O		Right Reverse Lamp	Vbatt when reverse selected.	0.5 second delay for auto transmission vehicles
10	RW	O		Right Tail Lamp + Right Trailer Tail Lamp	Vbatt. when sidelights / mainbeam selected otherwise GND	Also activates Trailer Tail lamps if fitted.
11	PR	O		Rear right + Front Courtesy Lamp + Loadspace	GND to illuminate the lamps.	Operated either manually or if any door or tailgate is opened. Lamps will fade out after 15 sec. if all doors & tailgate are closed
12	GP	O	17	RH Stop Lamp + Trailer Stop Lamp	Vbatt. when Brake applied	This output is driven by the brake switch
13	GV	O	17	High Mounted Stop Lamp	Vbatt. when Brake applied	This output is driven by the brake switch
14	GR	O		Left Trailer Directional Indicator	Pulse from 0v to Vbatt when L.H.D.I selected otherwise GND	
15	GY	O		Right Trailer Directional Indicator	Pulse from 0v to Vbatt when R.H.D.I selected otherwise GND	
16	RU	O		Number Plate Lamps	Vbatt when sidelights selected otherwise GND	Internally connected in BeCM to glove box lamp
17	P	O	15	Front + Right Courtesy Lamps, Tailgate CDL, Alarm RF + Loadspace Lamp Supply	Vbatt – Permanent feed for outputs	
18	K	O		Rear Right Door Unlock	Vbatt. when driving motor.	Typically 800ms duration.



## BeCM System Information Document – Edition 2

### Connector C326 20 WAY AMP 040 FEMALE PLUG ( BLUE )

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	OP	I		Rear Wiper Park	When Rear Wiper is Parked, Input is GND Otherwise Vbatt.	
2	BP	I		Courtesy Lamp Main Switch	Input is GND when operated. Otherwise Vbat.	May Keep BeCM awake (see Table 1)
3	PY	I		Tailgate Open Switch	Input is GND when Tailgate is Open.	May Keep BeCM awake (see Table 1)
4	RY	I		Sunroof Anti Trap 1	Pulse Signal when Motor operated.	0v to 12v Pulses
5	BG	I		Rear Right Anti Trap 1	Pulse Signal when Motor operated.	0v to 12v Pulses
6	OR	I		Radio Remote Input	When IP detected, approx. 10v , otherwise Approximately 2 volts	May Keep BeCM awake (see Table 1)
7	Y	I		Front Right Anti Trap 1	Pulse Signal when Motor operated.	0v to 12v Pulses
8	BO	I		Rear Right Window Down Switch	GND when switch is operated, Otherwise Vbatt..	
9	R	O		Right Front Door Serial Link Clock	Signal Logic : 0 = V(Low) = GND , 1 = V(High) = Vbatt	Meter will display average value
10	OG	O		Right Front Door Serial Link Direction	Signal Logic : 0 when transmitting, 1 when receiving.	Meter will display average value
11	YG	I		Sunroof Closed Input	Input is GND when Sunroof Closed, otherwise V. battery.	
12	PO	I		Right Front Door Analog Output	Voltage dependant on position of Mirror Potentiometers. 0v - 5v	
13	PW	I		Rear Right Door Open Switch	Input is GND when Door is Open, otherwise V. battery.	May Keep BeCM awake (see Table 1).
14	YP	I		Sunroof Anti Trap 2	Pulse Signal when Motor operated. ( Pulse lags Anti Trap 1 signal by 90° ).	0v - 12v Pulses
15	YB	I		Rear Right Anti Trap 2	Pulse Signal when Motor operated. ( Pulse lags Anti Trap 1 signal by 90° ).	0v - 12v Pulses
16	YU	I		Front Right Anti Trap 2	Pulse Signal when Motor operated. ( Pulse lags Anti Trap 1 signal by 90° ).	0v - 12v Pulses
17	BK	I		Rear Right Window UP Switch	GND when switch is operated, Otherwise Vbatt.	
18						
19	LG	O		Right Front Door Serial Link Data	Trans: 1=Vbatt, 0= GND	Meter will display average value
20	NU	O		Reverse Signal ( Rear View Mirror )	When reverse selected, output voltage = GND Otherwise 5volts	





## BeCM System Information Document – Edition 2

Connector C361 18 WAY AMP 070 FEMALE PLUG ( WHITE )					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		
1	WO	0	8	Telephone Auxiliary	Vbatt when Ignition 1 selected.	
2	S	0	12	Rear Left Window Up	Vbatt when Motor being Driven, Otherwise GND	
3	RP	0		Rear Left Puddle / Marker Lamps.	Vbatt when Lamps On, Otherwise GND	
4	KO	0	14	Trailer Battery Supply	Battery Supply for Trailer.	
5	GN	0		Trailer Reverse Lamp	Vbatt after 0.5 seconds when Reverse selected	
6	P	0	15	LH Rear C Lamp/LH Space Lamp & Sub Woofer Amp & LH Rear Ice Amp Batt Feed	Battery Supply to these areas.	
7	PU	0	22	Front Left Door Outstation ( Window )	Permanent Vbatt	
8	PB	0	9	Front Left Door Outstation	Permanent Vbatt	
9	PR	0		Rear Left Courtesy Lamp	GND when Courtesy Lamp is activated, otherwise Vbatt.	
10	SO	0	12	Rear Left Window Down	Vbatt when Motor being Driven, Otherwise GND	
11						
12	RB	0		Left Tail Lamp	Vbatt When Sidelight Selected	
13	K	0	14	Rear Left Door Unlock	Vbatt when latch motor being driven.	
14	GR	0		Rear Left turn signal	Pulse from 0v to Vbatt when L.H.D.I selected otherwise GND	
15	OK	0		Rear Left Door Superlock	Vbatt when Superlock Initiated.	CDL Motor also activated
16	RN	0		Rear Left Door Switch Illumination	Variable pulse width from 0v to Vbatt when Sidelamps/headlamps are selected. Otherwise GND	Meter will display 12v.
17	GP	0	17	Left Stop Lamp	Vbatt when Brake applied. Otherwise GND	
18	O	0	14	Rear Left Door Lock	Vbatt when latch motor being driven.	





## BeCM System Information Document – Edition 2

Connector C362 16 WAY AMP 040 FEMALE PLUG (BLACK)					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		
1	LG	O		Front Left Door Serial Link Data	Trans: 1= Vbatt, 0=GND	Typically 6v
2	YB	I		Rear Left Anti Trap 2	Pulse Signal when Motor operated. ( Pulse lags Anti Trap 1 signal by 90°).	0v - 12v Pulses
3	YU	I		Front Left Anti trap 2	Pulse Signal when Motor operated. ( Pulse lags Anti Trap 1 signal by 90°).	0v - 12v Pulses
4	PW	I		Rear Left Door Open Switch	Input is GND when Door Open	May Keep BeCM awake (see Table 1)
5	BG	I		Rear Left Anti Trap 1	Pulse Signal when Motor operated. 0v - 12v.	
6	YK	I		Security – Ultrasonic Input	Pulse Train when Ultrasonic Detects movement.	May Keep BeCM awake (see Table 1)
7	BO	I		Rear Left Window Down Switch	GND when switch is operated, Otherwise Vbatt.	
8	PO	I		Front Left Analog Output	Voltage dependant on position of Mirror Potentiometers 0v - 5v.	
9	OG	O		Front Left Door Serial Link Direction	Signal Logic : 0 when transmitting, 1 when receiving.	Typically 6v
10	R	O		Front Left Door Serial Link Clock	Signal Logic : 0 = V(Low) = GND , 1 = V(High) =Vbatt	Typically 6v
11	Y	I		Front Left Anti Trap 1	Pulse Signal when Motor operated 0v - 12v.	
12						
13						
14	BK	I		Rear Left Window Up Switch	GND when switch is operated, Otherwise Vbatt.	
15	RY	O		Security Ultrasonic feed	Control Feed: Vbatt when Ultrasonic activated	
16	YR	O		Rear Left Anti Trap Feed	Control Feed: Vbatt.	

Connector 624 4 WAY POWER CONNECTOR ( SUMITOMO ) ( CLEAR )					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		
1						
2						
3	P	O	4	Transfer Box Battery Feed	Vbatt always	
4						



## BeCM System Information Document – Edition 2

Connector C625 12 WAY AMP 070 FEMALE PLUG ( WHITE )					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		
1	WY	O	6	Transfer Box ECU - ignition feed	Vbatt. feed to Transfer Box ECU when ignition on	
2	W	O	6	H-Gate - Ignition feed	Vbatt. feed to H-Gate when ignition is on	
3	W	O	6	Auto Gearbox ECU - ignition feed	Vbatt. feed to Auto Gearbox ECU when ignition on	
4	GR	O	11	Transfer Box Neutral Tow Link	If fuse 11 is put in, GND	If fuse 11 is inserted, vehicle is in low mode, transfer box will remain in neutral.
5	G	O	8	Front Cigar Lighter - AUX	Vbatt. feed to Cigar Lighter when IGN 1 selected ( Auxiliary )	
6	PR	O	13	Shift Interlock Solenoid	Vbatt. when energised	Solenoid is energised when ignition is on and gear select is not in park.
7	PY	O	3	Auto Gearbox ECU battery feed	Permanent battery feed to Auto Gearbox ECU	
8	PU	O	1	Centre Console switch pack battery feed	Permanent battery feed to the centre console switch pack	
9						
10						
11	RU	O		Centre Console Illumination : Switches, Gear select, cigar lighter.	Variable pulse width from 0v to Vbatt. when sidelamps/headlamp selected	Meter will display 12v.
12	PW	O		Rear Footwell Lamps	Vbatt. with tailgate or any door opened for greater than 0.5 seconds	



## BeCM System Information Document – Edition 2

Connector C626 20 WAY AMP 040 FEMALE PLUG ( BLACK )					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		
1	LG	O		Gearbox ECU ISO9141 L Pin	Pulse Train ( Meter will display average value ) Typically value 6v	<b>Table 4</b>
2	OG	O		Centre Console Serial Link Direction	Signal Logic : 0 when transmitting, 1 when receiving. Typically 6v	MES Status Inputs
3	NY	I		Transfer Box -- H	If High Range Selected then voltage = < 1.5v. Otherwise 12v	MES 1 MES 2 MODE
4	NW	I		Transfer Box -- N	If Neutral Selected then voltage = < 1.5v. Otherwise 12v	1 1 Auto
5	YR	I		Manual/Economy/Sport Status 2 from gearbox ECU.	See Table 4	1 0 Sport
6	GB	I		Transfer Box Over Temp	Input is GND when Transfer Box is over temperature.	0 1 Manual
7	NR	I		Transfer Box -- L	If Low Range Selected then voltage = < 1.5v. Otherwise 12v	0 0 Gearbox Fault
8	UB	I		Gear Status X. From gearbox switches.	See Table 5	
9	UP	I		Gear Status Y. From gearbox switches.	See Table 5	
10	UN	I		Gear Status SI	Not Used	1 = switch S/C to GND 0v 0 = switch O/C Vbatt.
11	S	O		Engine Speed to Auto Gearbox	Pulse Train ( VLow = <1.5v , VHigh = > 6v ) Typically 6v	<b>Table 5</b>
12	K	O		Gearbox ECU 9141 K Pin	Pulse Train . Typically 5v	Gear Status Input
13	R	O		Centre Console Serial Link Clock	Signal Logic : 0 = V(Low) = GND , 1 = V(High) = Vbatt. Typically 6v	
14	LG	O		Centre Console Serial Link Data	Trans: 1= Vbatt, 0= GND Typically 6v	X Y Z
15						P 1 0 0
16	YG	I		Manual/Economy/Sport status 1. From gearbox ECU.	See Table 4	R 1 1 0
17	BK	I		Handbrake Switch	Input is GND when Handbrake applied	N 0 1 0
18	UG	I		Gear Status Z. From gearbox switches.	Auto - See Table 5. Manual - Neutral when GND	D 0 1 1
19	WB	I		Seat Belt Switch	Input is GND when Seatbelt latched	3 1 1 1
20	UN	O		Clutch Switch / Neutral Park to Transfer Box. Diesel EMS	GND when selected.	2 1 0 1
						Z 0 0 0 Fault Condition
						1 = switch S/C to GND 0 = O/C

Connector C907 8 WAY AMP 040 FEMALE PLUG ( BLUE )					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function		





## BeCM System Information Document – Edition 2

1	R	O		RH Seat Serial Link Clock	Signal Logic : 0 = V(Low) = GND , 1 = V(High) = Vbatt	Meter will display average value Typically 6v .
2	OW	O		LH Seat Serial Link Direction	Signal Logic : 0 when transmitting, 1 when receiving.	Meter will display average value Typically 6v .
3	LGW	O		LH Seat Serial Link Data	Trans: 1= Vbat, 0= GND	Meter will display average value Typically 6v .
4	PW	I		LH Seat Serial Link Analog Signal	Feedback Voltage increases when Front Cushion goes Down, Rear cushion goes down, Backrest goes up or Headrest goes up. 0v to 5v.	
5	O	O		RH Seat Serial Link Direction	Signal Logic : 0 when transmitting, 1 when receiving.	Meter will display average value Typically 6v .
6	LG	O		RH Seat Serial Link Data	Trans: 1= Vbatt, 0 = GND	Meter will display average value Typically 6v .
7	RW	O		LH Seat Serial Link Clock	Signal Logic : 0 = V(Low) = Vbatt , 1 = V(High) = GND	Meter will display average value Typically 6v .
8	P	I		RH Seat Serial Link Analog Signal	Feedback Voltage increases when Front Cushion goes Down, Rear Cushion goes down, Backrest goes up or Headrest goes up. 0v to 5v.	

### Connector C912 12 WAY AMP 040 FEMALE PLUG ( GREEN )

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	NU	O	2	RH Seat Heater	Output is Vbatt when RH Seat Heater selected. Otherwise GND	This is irrespective of Thermal Switch (located in seat)
2	NR	O	2	LH Seat Heater	Output is Vbatt when LH Seat Heater selected. Otherwise GND	This is irrespective of Thermal Switch (located in seat)
3	BY	O		Seat Enable 2	Output is Vbatt if Vehicle does not have Memory Seats. Otherwise GND	
4	BW	O		LH Seat Signal GND	GND always	
5	WLG	O	10	RH Seat Lumbar	Battery Feed to RH Seat Lumbar	
6	WU	O	20	LH Seat Lumbar	Battery Feed to LH Seat Lumbar	
7	WP	O	20	LH Seat Battery 2	Battery Feed to LH Seat ( Fuse Rated 30A )	
8	W	O	20	LH Seat Battery 1	Battery Feed to LH Seat ( Fuse Rated 30A )	
9	BY	O		Seat Enable 1	Output is Vbatt if Vehicle does not have Memory Seats. Otherwise GND	
10	BO	O		RH Seat signal GND	GND always	
11	WO	O	10	RH Seat Battery 1	Battery Feed to RH Seat ( Fuse Rated 30A )	
12	WR	O	10	RH Seat Battery 2	Battery Feed to RH Seat ( Fuse Rated 30A )	

Note: The harness connector views can be found in the ETM - section Z6.  
UNLESS STATED OTHERWISE, THE INPUT AND OUTPUT CAN BE MEASURED WITH A VOLTMETER.  
When measuring the pulse train outputs, the meter may not display the full voltage, but the average voltage.





## BeCM System Information Document – Edition 2

### Instrument Pack

Connector C242 20 WAY AMP 040 FEMALE PLUG (BLACK)					
Cavity	Wire col.	I/O	Fuse No.	Function	Status
1	SU	I		Trip computer switch	Switch grounded to zero volts when switch pressed, 5V otherwise.
2	RG	I		Serial Link - clock	Square wave signal. Typically 6V average.
3	OG	I		Serial Link - direction	Square wave signal. Typically 6V average.
4	P	I	1	Battery supply	V batt
5	LG	I/O		Serial Link - data	Square wave signal. Typically 6V average.
6	RW	I		Dimmer (Controls illumination levels of pack when lighting is on)	Square wave signal (pulse width modulated) Average value will vary depending on illumination level)
7	B	O		Power GND	GND 0 volts
8	BG	O		Serial Link GND	GND 0 volts
9	Y	I		Speedometer signal	Square wave signal 0 -12 volts
10	BK	I		Sounder (Driven from BeCM)	Pulses between 0 - 7 volts otherwise ground
11	SP	I		Overspeed warning switch	Switch grounded to zero volts when switch pressed, 5V otherwise.
12	RG	I		Serial Link - clock (dup)	Square wave signal. Typically 6V average.
13	OG	I		Serial Link - direction (dup)	Square wave signal. Typically 6V average.
14	P	I	1	Battery supply	V batt
15	LG	I/O		Serial Link - data (dup)	Square wave signal. Typically 6V average.
16	S	I		Tachometer signal	Square wave signal 0 - 12 volts
17	B	O		Power GND	GND 0 volts
18	BG	O		Serial Link - signal GND	GND 0 volts
19	GU	I		Fuel pulses signal	Square wave pulsed signal.
20	O	O		External LCD dimmer (supplies control of illumination to HEVAC display panel)	Square wave signal.

NOTE: Square wave signals cannot be measured directly with a voltmeter. The voltmeter will give an average value that may fluctuate depending on the meter used. This signifies the fact that there is not a short circuit to ground or V batt. In this case the part of the serial link tested is probably working, but there is still the possibility of a fault.



## BeCM System Information Document – Edition 2

### Center Console Outstation

#### Connector C614 8 WAY AMP 040 FEMALE PLUG (BLUE)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	PU	I	1	Battery supply	V batt, permanent battery feed	Mirrors, windows and sunroof will not work without battery feed.
2	LG	I/O		Serial link - data	Typically 6 volts, during transmitting = Vbatt, all other times = GND. (square wave)	Not active when BeCM goes to sleep.
3	OG	I		Serial link - direction	Typically 6 volts, during transmitting = GND, when receiving = Vbatt. (square wave)	Not active when BeCM goes to sleep.
4	R	I		Serial link - clock	Square wave, typically 6V.	Not active when BeCM goes to sleep.
5	RU	I		Illumination	Variable pulse width modulated from 0-Vbatt when sidelamps/headlamps are selected.	12 volts is displayed on the voltmeter
6	B	O		GND	GND 0 volts	
7						
8						

### Door Outstations

#### Connector C755 16 WAY AMP 070 FEMALE PLUG (BLACK)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	BO	O		Anti-trap GND	GND 0 volts	Provides the ground for the Hall Effect Sensors in the window motor for one-touch operation and anti-trap.
2	PR	O		Puddle / Marker Lamp Feed	12volts while courtesy lamps are on, otherwise floating voltage.	
3	PO	O		Analog	Varying voltage, dependant upon seat position. 0-5volts	
4	YR	O		Anti-trap Feed	V batt, permanent battery feed	Provides power for the Hall Effect Sensors in the window motor for one-touch operation and anti-trap.
5		O				
6	PU	O	22	Power Feed (Window, Locking)	V batt, permanent battery feed	Provides power for lock and window operation.
7	B	O		Power GND	GND 0 volts	
8	SG	O		Window Down	12volt output when window 'down' is selected, GND when window not operating or when window 'up' is selected.	
9	B	O		Power GND	GND 0 volts	
10	PB	O	9	Power Feed	V batt, permanent battery feed	Provides power for door locks and windows.
11	B	O		Puddle / Marker Lamp Ground	GND 0 volts	
12	P	O	9	Ice Power Amp Feed	V batt, permanent battery feed	Provides power for sound system door amplifier
13	LG	I/O		Serial Link - data	Typical average value is 6 volts	
14	R	I		Serial Link - clock	Typical average value is 6 volts	
15	OG	I		Serial Link - direction	Typical average value is 6 volts	
16	SW	O		Window Up	12volt output when window 'up' is selected, GND when window not operating or when window 'down' is selected.	



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### Connector C754 12 WAY AMP 040 FEMALE PLUG (BLACK)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	Y	O		Mirror left	12volt output when mirror 'left' is selected, GND when mirror not operating or when mirror 'right' is selected.	
2	R	O		Mirror right	12volt output when mirror 'right' is selected, GND when mirror not operating or when mirror 'left' is selected.	
3	G	O		Mirror heater	12volt output when engine is running or mirror is operated.	
4						
5	BR	O		Mirror potentiometer GND	GND 0 volts	
6	O	I		Mirror vertical position		
7	S	O		Mirror up	12volt output when mirror 'up' is selected, GND when mirror not operating or when mirror 'down' is selected.	
8	U	O		Mirror down	12volt output when mirror 'down' is selected, GND when mirror not operating or when mirror 'up' is selected.	
9						
10	W	O		Mirror potentiometer power feed	5volt feed for the mirror potentiometer.	
11	P	I		Mirror horizontal position	Varying voltage, depending upon mirror position.	
12	B	O		Heater GND	GND 0 volts	





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### Connector C750 20 WAY AMP 040 FEMALE PLUG (BLACK)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	OB	O		Door Lock	12volt output when 'lock' is operated, GND when lock not operating or when 'unlock' is operated.	
2	KB	O		Door Unlock	12volt output when 'unlock' is operated, GND when lock not operating or when 'lock' is operated.	
3						
4						
5	GR	I		CDL Switch	5volts when switch is open, GND when operated.	
6	UR	I		Key Switch	5volts when switch is open, GND when operated.	
7	PN	I		Door Open Switch	5volts when switch is open, GND when closed.	Only fitted to driver's side door.
8	OK	O		Door Superlock	12volts when latch is driven into superlock, otherwise floating voltage.	
9						
10						
11	B	O		Door Lock Switch GND	GND 0 volts	Ground for all switches in door latch.
12						
13						
14						
15						
16						
17						
18						
19						
20						





## BeCM System Information Document – Edition 2

### Seat Outstations

Connector C901(LH)/C902 (RH) 12 WAY AMP 070 FEMALE PLUG (SLATE)					
Cavity	Wire col.	I/O	Fuse No.	Function	Status
1	P	O		Analog	Varying voltage, dependant upon seat position. 0-5volts
2	R	I		Serial Link - clock	Square wave, typically 6V.
3	WO	I	Left 20, Right 10	Power Feed	Permanent 12 volt supply for seat motors.
4	WR	I	Left 20, Right 10	Power Feed	Permanent 12 volt supply for seat motors.
5	BO	O		Serial Link - signal GND	GND 0 volts
6	WLG	I	Left 20, Right 10	Lumbar Feed	Permanent 12 volt supply for seat lumbar pump.
7	O	I		Serial Link - direction	Square wave, typically 6V.
8					
9	B	O		GND	GND 0 volts
10	B	O		GND	GND 0 volts
11					
12	LG	I/O		Serial Link - data	Square wave, typically 6V.
					Comments
					Seat memory will not function without this output

Connector C977 8 WAY AMP 040 FEMALE PLUG (BLACK)					
Cavity	Wire col.	I/O	Fuse No.	Function	Status
1	KR	I		Memory switch 1	5volts when switch open, GND when switch is selected.
2	LG	I		Memory switch 2	5volts when switch open, GND when switch is selected.
3					
4	B	O		Memory switch GND	GND 0 volts
5	KY	I		Memory store switch	5volts when switch open, GND when switch is selected.
6					
7					
8					
					Comments
					Inability to store memory positions for seat.



## BeCM System Information Document – Edition 2

### Connector C962 12 WAY AMP 070 FEMALE PLUG (GREEN)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	UG	O		Headrest down	12volt output when headrest 'down' is selected, GND when motor not operating or when headrest 'up' is selected.	If seat is not operating in a certain direction, check to see if proper voltage/GND condition exists.
2	G	O		Headrest up	12volt output when headrest 'up' is selected, GND when motor not operating or when headrest 'down' is selected.	If seat is not operating in a certain direction, check to see if proper voltage/GND condition exists.
3	YR	I		Backrest raise/lower potentiometer	Varying voltage, depending upon position of backrest, 0-5volts	
4	UY	I		Headrest raise/lower potentiometer	Varying voltage, depending upon position of headrest, 0-5volts	
5	YB	O		Backrest down	12volt output when backrest 'down' is selected, GND when motor not operating or when headrest 'up' is selected.	If seat is not operating in a certain direction, check to see if proper voltage/GND condition exists.
6	Y	O		Backrest up	12volt output when headrest 'down' is selected, GND when motor not operating or when headrest 'up' is selected.	If seat is not operating in a certain direction, check to see if proper voltage/GND condition exists.
7	RS	O		Backrest/headrest raise/lower potentiometer feed	12volt feed for the backrest and headrest potentiometers.	
8	WLG	O	left 20, right 10	Lumbar feed	12volt feed for the lumbar pump motor.	Lumbar pump may not operate without this output.
9	N	O		Backrest/headrest raise/lower potentiometer GND	GND 0 volts	
10		O				
11	BS	O		Lumbar pump down	GND when lumbar 'down' is selected. Floating when not selected.	Lumbar pump may not deflate without this output.
12	PP	O		Lumbar pump up	GND when lumbar 'up' is selected. Floating when not selected.	Lumbar pump may not inflate without this output.



## BeCM System Information Document – Edition 2

Connector C999 (RH)/C998(LH) 18 WAY AMP 070 FEMALE PLUG (SLATE)					Status	Comments
Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	NY	O		Lumbar switch GND	GND 0 volts	
2	K	O		Backrest switch GND	GND 0 volts	
3	N			Spare pin		
4	GN			Spare pin		
5	GY/Y	I		Rear cushion raise switch	5volts when switch open, GND when switch is selected.	
6	PW/B	I		Rear cushion lower switch	5volts when switch open, GND when switch is selected.	
7	BY/US	I		Backrest raise switch	5volts when switch open, GND when switch is selected.	
8	S/G	I		Seat forward switch	5volts when switch open, GND when switch is selected.	
9	R	O		Cushion switch GND	GND 0 volts	No cushion operation without this ground.
10	P/UP	I		Lumbar pump up switch	Floating voltage when switch is open, GND when switch is selected.	
11						
12	UP/P	I		Lumbar pump down switch	Floating voltage when switch is open, GND when switch is selected.	
13	U/W	I		Headrest up switch	5volts when switch open, GND when switch is selected.	
14	W/U	I		Headrest down switch	5volts when switch open, GND when switch is selected.	
15	B/PW	I		Front cushion lower switch	5volts when switch open, GND when switch is selected.	
16	Y/GY	I		Front cushion raise switch	5volts when switch open, GND when switch is selected.	
17	O/Y/S	I		Backrest lower switch	5volts when switch open, GND when switch is selected.	
18	G/S	I		Seat back switch	5volts when switch open, GND when switch is selected.	





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### Connector C971 18 WAY AMP 070 FEMALE PLUG (WHITE)

Cavity	Wire col.	I/O	Fuse No.	Function	Status	Comments
1	WG	O		Front cushion up	12volts when switch is selected, otherwise GND with switch open.	
2	BG	O		Front cushion down	12volts when switch is selected, otherwise GND with switch open.	
3	UY	I		Front cushion raise/lower potentiometer	Varying voltage, dependant upon seat position. 0-5volts	
4	W	I		Forward/back potentiometer	Varying voltage, dependant upon seat position. 0-5volts	
5						
6	BY	O		Rear cushion down	12volts when switch is selected, otherwise GND with switch open.	
7						
8	WB	O		Seat forward motor	12volts when switch is selected, otherwise GND with switch open.	
9	U	O		Forward/back potentiometer GND	Permanent ground, 0 volts	
10	RB	O		Front cushion raise/lower potentiometer GND	Permanent ground, 0 volts	
11	RB	O		Rear cushion raise/lower potentiometer GND	Permanent ground, 0 volts	
12	UR	I		Rear cushion raise/lower potentiometer	Varying voltage, dependant upon seat position. 0-5volts	
13	RG	O		Forward/back potentiometer feed	12volt feed for the backrest and cushion forward/back potentiometers.	
14	RG	O		Front cushion raise/lower potentiometer feed	12volt feed for the backrest and front cushion raise/lower potentiometer.	
15	RG	O		Rear cushion raise/lower potentiometer feed	12volt feed for the backrest and rear cushion raise/lower potentiometer.	
16		O				
17	WY	O		Rear cushion up	12volts when switch is selected, otherwise GND with switch open.	
18	BW	O		Seat back motor	12volts when switch is selected, otherwise GND with switch open.	





### Appendix A

#### Glossary

BeCM	Body electrical Control Module. This unit controls, monitors and provides power supply to many other vehicle's electrical systems.
Sleep Mode	When all timers time out and activation inputs are inactive for two minutes. Current drain should be approx. 30mA.
Tacho pulse monitoring	Square wave pulses from the engine when it is running.
Key Inhibit solenoid	This solenoid is energised to prevent the gear lever being move out of the park position.
Inertia switch	A switch that is used to switch off the engine fuelling and unlock the doors should the vehicle be involved in an impact.
Limp Home Mode	This is when the BeCM has an internal failure and default to safety critical operations only.
Quiescent Drain	This is the current taken by the vehicle when all timers have timed out and activation inputs are inactive.
Level switched	The BeCM will recognise this activation input as a high or a low value.
Edge triggered	The BeCM will only recognise this input as an activation input when the input voltage is changing between high and low or visa versa.
Diagnostic 'K' & 'L' lines	These are communication lines used by the BeCM to 'talk' to Testbook.
Serial Link	<p>This is a method of electron communication that enables the BeCM to 'talk' to several other outstations using the same wires.</p> <p>Data - This line carries the information between the BeCM and the outstation. It is a bi-directional line and information can travel either way.</p> <p>Clock - This signal is controlled by the BeCM to ensure that both microchips between the BeCM and outstation are synchronized with each other.</p> <p>Direction - This signal is controlled by the BeCM to ensure both microchips, either in the BeCM or outstation, are not trying to communicate at the same time. This signal determines which component is sending data and which component is receiving the data.</p>
Odometer Logging	The BeCM and the Instrument pack both store the mileage the vehicle has done. The instrument pack updates the BeCM with the latest mileage.



## Appendix B

### Battery Feed 1

Wire colour - NLG

Supply fuse = Maxifuse 1

Feeds F1, F2, F3, F4 and FETs

Connector C171

Components supply by this battery feed	Fuse
Left tail lamp	
Rear left puddle lamp	
Rear left direction indicator	
Left seat heater	F2
Right heater	F2
Left sidelight	
Front left direction indicator	
Left direction indicator repeater	
Left dipped beam	
Front left fog lamp	
Left main beam 1	
Left main beam 2	
Left trailer tail lamp	
Left trailer direction indicator	
Rear left fog lamp	
Left reverse lamp	
Rear right window up	F2
Rear right window down	F2
Centre console battery	F1
Clock/Radio/Instrument pack	F1
Auto gearbox ECU	F3
Transfer box ECU	F4



## Battery Feed 2

Wire color - N

Supply fuse = Maxifuse 4

Feeds F6, F7, F12, F13, F14, F15, F17 and FETs

Connector C170

Components supply by this battery feed	Fuse
Rear left door lock	F14
Rear left door unlock	F14
Trailer reverse lamp	
Left rear courtesy lamp, sub-woofer amp & left rear ice amp	
Rear left window up	F12
Rear left window down	F12
Trailer battery	F14
Right sidelight	
Alarm Klaxon	
Front right direction indicator	
Right side direction indicator repeater	
Right dipped beam	
Front right fog lamp	
Right main beam 1	
Right main beam 2	
Air bag ignition feed	F7
Rear right puddle lamps	
Number plate lamps	
Glovebox lamps	
Right tail lamp & trailer tail lamp	
Rear right direction indicator	
Rear view mirror dip (IGN)	F6
Front & Right courtesy lamps, loadspace lamp, alarm RF & Tailgate CDL	F15
Rear right ice amp	F15
Rear right fog lamp	
Trailer fog lamp	
Right reverse lamp	
Sun-visor illumination	F6
Rear right door lock	F14
Rear right door unlock	F14
Rear wiper	F15
Sunroof back	F13
Sunroof forward	F13
Rear screen heater	F12
Fuel flap release	F14
Spare IGN	F6
Shift interlock solenoid	F13
Auto gearbox IGN	F6
Key inhibit solenoid	F13
Break switch feed	F17
HEVAC IGN feed & Air suspension ECU	F17
Transfer box ECU IGN	F6





### Battery Feed 3

Wire color - NK

Supply fuse = Maxifuse 5

Feeds F8, F9, F10, F20, F22 and FETs

Connector C169

Components supply by this battery feed	Fuse
Front left & right battery 1 (window & locking)	F22
Front left & right battery 2 (inc. LH & RH front ICE amp)	F9
Rear left door switch illumination	
Rear left door superlock	
Car phone Aux	F8
Left seat battery 1	F20
Left seat battery 2	F20
Right seat battery 1	F10
Right seat battery 2	F10
Left seat lumbar	F20
Right seat lumbar	F10
Front screen wash	
Aerial amplifier (Aux)	F8
Rear right door superlock	
Rear right door illumination	
Audible warning (instrument pack)	
Cruise Pump	
Spare (S1)	
Spare (S3)	
Spare (Y4)	F_SP2
Front cigar lighter	F8
Radio	F8
HEVAC	F8
Fascia controls/ Inst. pack/ radio/ HEVAC/ Clock	

Command Name	Code (hex)	Structure
Hardware Commands		
BACKGROUND	90	<div>CMND</div>
WRITE_BYTE	C0	<div>CMND</div> <div>ADDRESS</div>
WRITE_BD_BYTE	C4	
WRITE_WORD	C8	
WRITE_BD_WORD	CC	
READ_BYTE	E0	<div>CMND</div> <div>ADDRESS</div>
READ_BD_BYTE	E4	
READ_WORD	E8	
READ_BD_WORD	EC	
Firmware Commands		
WRITE_NEXT	42	<div>CMND</div> <div>DATA</div> <div>DL</div> <div>HOST TO TARGET</div>
WRITE_PC	43	
WRITE_D	44	
WRITE_X	45	
WRITE_Y	46	
WRITE_SP	47	
READ_NEXT	62	<div>CMND</div> <div>DLY</div> <div>DATA</div> <div>TARGET TO HOST</div>
READ_PC	63	
READ_D	64	
READ_X	65	
READ_Y	66	
READ_SP	67	
GO	08	<div>CMND</div>
TRACE1	10	
TAG_GO	18	

Hardware commands that access memory in the target need to impose delays in case the target MCU has to wait for a free bus cycle to actually perform the access. When a hardware command attempts to access a target system memory location, the logic waits for a CPU free cycle where the CPU is not using the buses. Usually there would be a free cycle within a few cycles, but an unusual sequence of code with a lot of changes in flow could keep the buses busy. If the BDM logic does not find a free cycle within 128 cycles, the CPU is momentarily frozen to allow the BDM logic to steal a cycle to complete the access. If the access is a word access through a narrow 8-bit external bus, or if the access is to an area controlled by a stretched chip select space, the BDM can hold the CPU off for enough bus-rate cycles to complete the access.

The READ\_NEXT and WRITE\_NEXT (word) firmware commands offer the fastest way to read or write a block of target memory. Since the MCU is in active background mode when these commands are executed, there is no need to delay waiting for free cycles (although a shorter delay of about 32 E cycles is needed to allow BDM firmware to complete the requested access). Also these commands only require the 8-bit serial command plus the 16-bit read or write data. The speed of the BDM serial interface controls the best-case speed of data transfer (about 50  $\mu$ s per

