The Absolute Beginners Guide to the Range Rover P38 Electronic Air Suspension

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INTRODUCTION

This is for owners of the Range Rover P38, it is written for those with possibly limited technical experience but reasonably competent at DIY tasks.

The electronically controlled air suspension (EAS) system provides a smoother ride, and allows the selection of different ride heights, either manually or automatically. By controlling the volume of air in each of the air springs, the system changes and then maintains the ride height regardless of load.

Experts, technical purists, and those with an obsessive fixation with spring coils. may stop reading at this point.

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IMPORTANT SAFETY NOTE:

When working beneath the vehicle, and especially on issues connected to the EAS, support the body chassis either from the ground, or between axles and chassis with axle stands or wood blocks. Whilst leaving the doors or tailgate open ‘disables’ EAS activity this is not infallible. Air leaks or dislodged pipes may allow the vehicle to drop unexpectedly.

Throughout this document, the terms of ‘Driver’ or ‘Passenger’ side are avoided. Instead the terms of left and right as relating to standing at the rear of the vehicle facing towards the front of the vehicle are used. This is to assist the many owners of Left Hand Drive models.

Much thanks to Paul38A of Australian Land Rover forum

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May 2017

THE PARTS THAT MAKE IT ALL WORK

ELECTRONIC CONTROL UNIT (ECU)

The ECU, located under the left front seat, sends and receives information and commands to the suspension system through a large 35-pin connector. This also contains the data wire to retrieve/delete fault messages, program various elements, and view real time data using diagnostic equipment (Test Book for dealers, and third party equipment by others). The ECU is very reliable due to input and output overload protection. Whilst it is not 'waterproof', it is 'water resistant'.

Body Electrical Control Module (BECM)

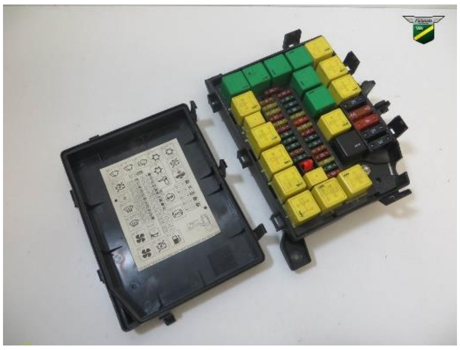
The BECM is the vehicle primary 'Brain', located under right front seat, it provides, amongst much other controls, basic inputs to the various Electronic Control Units (ECU's), receives fault messages and controls the dashboard message centre. If it fails, frankly, you are screwed.

RELAYS AND FUSES

A Fuse is a metal connector in a circuit, usually contained in a coloured plastic cover. They are designed to 'break' when the electric current is too high, and protect the electrical circuit. The rate in Amps at which they 'break' is printed on the plastic cover. It is never a good idea to use a fuse with the wrong rating, or even a bent paper clip.

A Relay is an electrical mechanical switch. A small amount of electrical power operates an internal switch to enable a much higher power circuit. E.g. a low power circuit from the ignition key/switch, via one or more relays can switch a much larger power circuit such as the starter motor. This is an image of the special suspension system Relay and Timer unit located under left plastic base panel of left front seat.

FUSE BOX



The suspension system uses three fuses and one relay located in the engine compartment fuse box. Fuse #24 (5A) for Key On, Delay Timer. Fuse #29 (10A) Powers ECU (also via Delay Relay Timer and Valve Driver Pack; Fuse #35 (10A) Ride Height and Inhibit switches; #40 (40A), for Air Compressor, Diaphragm Valve via a four-pin (yellow) relay #20. These are located in the Engine Bay Fuse Box. With the P38, whenever things stop working for no apparent reason (a common situation), this is the first place to check.

CONTROL SWITCHES

The height control rocker switch is located in the upper centre console and is used to show current system status and make manual height changes. The switch contains indicator lamps to identify current or selected ride height. The lamp will flash on selecting a change until the new height is achieved. All lights flashing indicates a soft (non-critical) fault, after 3 minutes they will remain on and steady. A hard (more serious) fault is additionally indicated by a “SLOW MAX SPEED 30 MPH” on the dashboard indicator panel. The non-technical term for this situation is “the Bloody Christmas Tree”.

Next to the height selector switch is the inhibit switch. This prevents the vehicle from changing height between standard and low settings. As this stops something from happening automatically, quite a few owners think it is broken as when pressed, nothing changes. If the lamp comes on – it is working. Often used when towing a caravan or trailer.

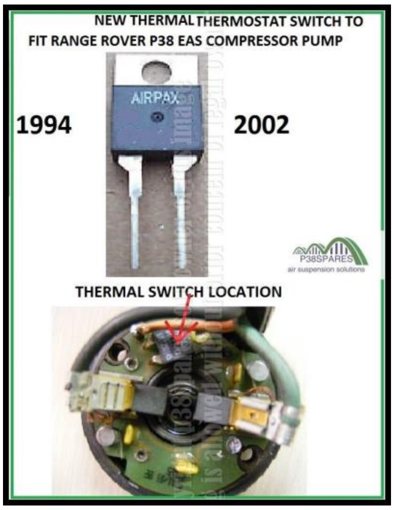
HEIGHT SENSORS

The height sensors are chassis/Axle mounted units that are connected via hinged link rods. There are four of them, one for each wheel. They are interchangeable from left to right, but not front to rear. Each sensor send information to report through a connection block the current height level to the ECU. This information is converted by the ECU to a digital format in a range between 0 and 255 ‘bits’. Whilst this is not directly related to any measured height individually by wheel or as a system, for a very rough guide 1 ‘bit’ equals 1.5mm.

AIR COMPRESSOR

The electric air compressor does what it says on the tin – it takes air and compresses it. The unit has an internal thermal switch which protects the motor from overheating by telling the ECU to stop its power if its temperature exceeds 120ºC. The ECU can also stop the compressor when the system pressure is above approx. 145 psi, or in the event of various faults. The compressor, valve block, valve driver, and air dryer are located in the engine bay above left wheel area. An air inlet filter is located on the front end of the compressor unit. The compressor is powered directly from a fuse box relay via a connector point. They can fail or become less efficient over time. Only very wealthy owners replace them. Everyone else just services or repairs them.

THERMAL SWITCH



The thermal switch is located within the compressor motor housing, on the circuit board attached to the motor end cap. If the internal temperature exceeds 120ºC it opens, breaks the circuit to the ECU. This then stops the motor in the compressor. When it cools to below 90ºC it closes, and the compressor power is restored.

AIR DRYER

The air dryer is fixed to the engine air filter case at the left front of the engine bay. Vertically fitted cylinder thus taking advantage of gravity, to drain moisture during the exhaust process. It is connected to the valve block by two 8mm Diameter air pipes. Compressed air passes through the valve block, into the bottom of the Dryer. The Dryer case contains moisture absorbing material so returns ‘dry’ air out of the top and back to the valve block and onwards to the storage cylinder. A diaphragm valve inside the valve block directs exhausting air through the dryer in the opposite direction, removing accumulated moisture from the dryer and thereby ‘regenerating the absorbent material. Simple but clever.

RESERVOIR

A compressed air storage tank is mounted to the chassis on the right side and approximately beneath the front right door. A single nylon airline serves as both inlet and outlet. It has a drain facility to remove any condensed water that may gather over time.

PRESSURE SWITCH

The pressure switch is located on the underside and front of the metal valve block (it is a small green cylinder with two red wires leading to the Driver Pack Unit). The pressure switch contacts should be open at pressures below 120 psi. The pressure switch contacts should be closed at a pressure of 150. Psi. This switch tells the system when to start or stop the compressor.

VALVE BLOCK

The valve block controls the flow of air in the system, in response to decisions made by the ECU. This is done through the use of external valves, and internal non-return valves, all are fitted on or within the metal valve block. Seven valves are used, one for each corner (wheel), and one each for inlet and exhaust. One diaphragm valve is used to control the direction of airflow in the dryer and is energized by the compressor relay. An air release valve (small brass cylinder fitted on the underside of the metal valve block, behind the pressure sensor) this will immediately release all air in the valve block if pressure exceeds 180 psi.

VALVES

The valves are essentially in two parts. There is an outer case that contains an electromagnet, connected to the Driver Pack by two black wires. Inside this is the actual valve unit, which is a spring-loaded metal ‘plunger’ that covers or uncovers holes in the metal valve block. Silicon rubber ‘O-rings of various sizes are used to ensure an air tight seal. An electric current generates a magnetic field, and this raises the internal plunger against a spring, thus opening the air holes in the block. They rarely fail, but when they do it is usually as a result of the Driver Pack having a severe mental breakdown which in turn damages the actuator head.

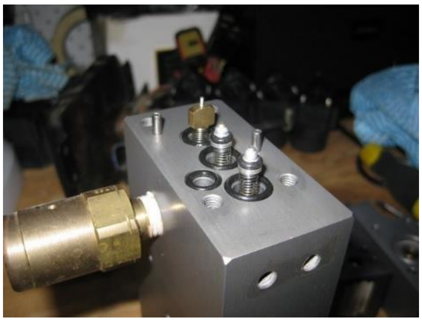
DIAPHRAGM VALVE DISC

Because air entering and leaving the system share many of the same routes (but not at the same time), this must be controlled. The Diaphragm Valve and its disc does this. The disc sits inside the valve block, held down with a small spring. It is a common reason for system failures, but simple to replace. This disc separates and directs air coming in from the compressor and air leaving through the exhaust. Its failure may often cause compressor air to get immediately dumped out through the exhaust bypassing the entire system – not ideal.

O RINGS

These are silicon rubber rings, in various sizes and thicknesses. They act as air tight seals between components. Whilst they have a long life, and rarely produce problems, the two O rings that are located within each of the air ports that the air lines fit into, are prone to damage and distortion. The very small rings that fit on the ends of the non-return valves MUST be the Black Neoprene variety.

NON-RETURN VALVES



These internal valves in the valve block stop air flowing backwards, hence their name of Non-Return Valves. Note which way up they go, and the rubber O rings (seals). Also note the brass cylinder in the image. That is the emergency air pressure relief valve.

VALVE DRIVER PACK

The Valve Driver Pack is a slim black rectangular case bolted to the metal valve block. This contains the electronics to operate the valves as the ECU commands via its connector. It is a sealed unit. In simple terms, it either works or it does not. I know of no successful repairs to this component. It must be noted that a major failure of this driver pack, may also damage one or more of the actual valve units. It is not uncommon to replace the driver pack unit and continue to have valve issues.

SILENCER

A silencer (small cylinder with screw thread and gauze cover), is screwed into the side of the valve block to quieten exhausting air. This operates the same as an engine silencer. It does not stop exhausting air, only reduces the sound – which can be frighteningly sudden, loud and repetitive without this fitted.

AIR SPRINGS

The air springs are mounted in the same position as conventional coil springs would be if you did not own a genuine Range Rover. The air spring unit consists of a top plate, a rubber 'bag', and a lower piston. Front and rear air springs are not interchangeable. In simple terms, they are very strong balloons. As air is pumped in, they inflate, and raise the vehicle. How much air, and at what pressure, is variable and depends entirely on the height requested, and actual weight each is supporting at any moment.

NYLON AIR HARNESS

All components are connected by nylon air lines to maximize corrosion resistance and temperature related fatigue failures. 6mm air pipes go to each air spring, and to/from the air tank plus the short blue pipe from compressor to metal air block. A 4mm vent line exits the diaphragm solenoid. Two 8mm Air lines connect the Air Dryer to the valve block. They are all repairable/replaceable.

HOW IT ALL WORKS

The system, receives a permanent power supply at all times through fuse #24 (5A) and #29 (10A). This supply runs to a dedicated EAS timer relay beneath left front seat

The system is a largely 'sealed' unit from pump, through to valves and on to air springs. There is only one air inlet and one air outlet [other than an emergency over-pressure relief valve].

The default (switched off) state of the system is all valves closed, pump not operating, all air contained.

When any door or tailgate is opened, the system becomes active. When the starter key is turned to Position 2, it carries out a self-check. The dashboard lamps on height selector and inhibit switches come on and remain steady. If they are on and flashing then it is reporting a fault.

When starting the vehicle, AND engine speed is greater than 500 rpm, AND Pressure Switch is open, the air inlet valve and diaphragm valve are activated, the compressor starts, the four air spring valves open, and the vehicle will rise to its standard level. All system lamps go out, except the lamp indicating the current height selected. If the Access lamp is also on and flashing, then this indicates a door/tailgate is not fully shut, if so the vehicle will not rise.

If the air storage tank is up to pressure, the compressor may run for only a few seconds, and the vehicle will rise using air stored in the tank.

The Control Unit, height Sensors and seven valves work together to manage system heights and air storage. the electric air compressor, air dryer, and a compressed air storage bottle are used continually to manage the air used in the system.

The four height sensors monitor the difference in height between the body of the vehicle and the wheels - one for each wheel. Information is received from each sensor by the electronic control unit (ECU) and is used to maintain, add or release air in each air spring by a series of valves.

When lowering the vehicle, the outlet and diaphragm valve, and air spring valves activate, and air is expelled through the air dryer and the exhaust silencer.

When driving over 30 mph the system continually adjusts the air in and out of the Air Springs to keep the selected heights, and the vehicle level. Driving round a sweeping bend and the vehicle will start to lean over. The system recognises the reduction in sensor height on one side, and pumps it up. Back on a straight road, it will let air out of that side to again level the vehicle.

The P38 has a relatively high centre of gravity. That means it can be less stable at high speeds. To counter this, the system automatically lowers the vehicle when driven over 50 mph.

When the height request switch is operated, the system will open the relevant air valves, and either inlet or exhaust vale depending if you are changing to a higher or lower height. The ride height lamp will flash during this process until the selected height is reached.

When switching off after use, with doors and tailgate closed, the EAS relay timer will check the system periodically to keep the vehicle level. If parked on uneven ground it will lower to the height of the lowest corner. faults, most notably worn height sensors, that prevent the system from 'sleeping', can also be a cause for battery drain.

Bonnet state (Open or Closed) has no effect on the air suspension system.

SYSTEM FAULT DIAGNOSIS/REPAIR

DIAGNOSTIC TOOLS

Correctly diagnosing issues and faults is frankly either difficult or often impossible without these basic tools.

An electrical Multimeter; Air Suspension Diagnostic hardware/software; a Pressure Gauge. A spray bottle containing a 50:50 washing liquid and water mix for spraying over airline components and watching for bubbles indicating leaks; and a length of 6mm air line with auto push fit/release connectors.

Diagnostic equipment such as EASunlock, Nanocom, Hawkeye etc. are essential. For most diagnostic tests and indeed maintenance/repair, the Air Springs and Air Storage Tank must be safely depressurised. All the standard diagnostic tools can achieve this. However, diagnostics results and fault codes must be treated with caution. The diagnostic signal cable stops at the ECU, and does not monitor any engine bay located items. The ECU can only ‘guess’ what a fault is, depending on what it notes is happening.

If a vehicle is down on one corner it knows this only from the height sensor, but can report incorrect signal, stuck air valve, etc. If the vehicle fails to rise, it can report Low Air Supply, Inlet valve Stuck etc. These may be true, but in these cases, air leaks are more likely the true culprit.

The most common cause of problems and faults are air leaks. Of these, leaks at the points where the air-lines enter the valve block, worn/damaged air springs, and at the collection point of pipes where they descend from the engine bay are the most common.

For electrical connections, refer to the connection diagrams below.

AIR LEAKS

These are the most common cause for many issues. Leaks will make the compressor operate longer than necessary, overheat, and wear out the piston seal; cause the vehicle to drop overnight at one or more corners; prevent the system from ‘sleeping’ when parked, this in turn contributes to battery drain; indeed, the entire system can be constantly working to counteract the effects of air loss.

Locating air leaks is, with the correct tools, quite simple. This is where an in-line Pressure Gauge becomes invaluable. The following test sequence should be followed, in order, to ensure nothing is missed. The line numbers refer to the numbers embossed on the side of the large black valve block holder/container.

(1) install the Gauge into Line 6, this runs to air storage tank. Leave door/tailgate open. Start Vehicle. The gauge will register the pressure in only that part of the system, which is essentially air inlet/outlet to the storage tank. The vehicle should not rise. You are looking for pressure to climb to about 145 psi, and the compressor to then stop. This test also confirms the operation of the Compressor, Pressure Switch, Inlet, and Diaphragm Valves. Note the exact pressure reading when pump stops. Close the valve on the gauge. Stop the engine. Wait for 15 minutes, and check that the pressure reading has not decreased.

   a. If it is decreasing, then there is a leak on that line, after the gauge, or at the air tank. Spray with soapy water and check for air bubbles.
   b. If it takes longer than 15 minutes to reach 145 psi the compressor needs servicing.
   c. If the compressor stops before 140 psi or after 155 psi, the Pressure switch is faulty.

(2) If no leaks detected at (1) above, open the gauge valve. Wait for the reading to settle. Note reading, and wait 15 minutes. It should not decrease.

   a. If it decreases there is a problem with the air line from the gauge as it enters the valve block. This is most likely to be the connection points of the air line, or the diaphragm disc. Spay with soapy water.

(3) Repeat (1) above on each of the Air Spring lines (1 to 4), in turn, but for these the doors/tailgate must be closed (leave window open). Wait until the car settles at standard height. Then open door/tailgate. The pressures recorded may differ, as front/rear air springs are different, and each spring is supporting a slightly different weight. Again, note the reading, close the gauge valve, stop engine, and wait for 15 minutes.

   a. If pressure decreases, there is a leak on that line or at/with the air spring.

(4) Repeat (2) above on each air spring line, and ensure the door/tailgate is open. This prevents the vehicle from self-adjusting.

   a. A reduction in pressure indicates a leak where line enters valve block, or a leak at the relevant valve – most likely related to the rubber O rings.

Leaking air lines should be replaced as an entire length; that stated, it is perfectly acceptable to use standard 6mm line connectors, possibly with a short length of replacement air line after cutting the damaged section out. The airlines can be bent to shape by inserting some electrical cable to prevent ‘creasing’, bend to shape, place in hot water, followed by cold, and removing the electric cable. It is essential that where the repaired lines enter the valve block, they do so straight, and at 90 degrees to the block. It is best to slightly trim to a cone shape the ends with a pencil sharpener by 1mm. This makes it easier to push completely home past the two internal O rings within the block.

THE SYSTEM IS NOT WORKING AT ALL

Check that battery shows a voltage higher than 11 volts. Turn the ignition on to Position 2, but do not start the engine. The suspension switch lamps and inhibit switch should illuminate if the system has power. If not, check fuses 24, 35 and 44 in the engine compartment fuse box are not broken.

VEHICLE RISES BUT LEANS TO ONE SIDE

Test for air leaks – see above.

Swap top two 6mm air lines (#1 Red and #4 Green) from Valve block with the two lower lines (#2 Blue and #3 Black). If lean remains on same side, problem is with leaning side air lines, air springs or height sensors. If leaning side changes, problem is with valves or Valve Driver pack.

Height Sensors. Inspect the sensors for mechanical damage and range with diagnostic equipment.

Valve actuators. Swap over (top black cover connected to driver pack unit by a pair of black wires – not the internal valves) in effect copying the same procedure used above for the airlines retaining existing connections. If side that leans changes, then an actuator or the drive pack is faulty.

THE VEHICLE IS SLOW TO LOWER

Inspect the exhaust filter for restriction. There is either a restriction in a hose or the exhaust valve or more likely the diaphragm disc is stuck during the exhaust period. Listen for valve clicking

HEIGHT SENSORS

The four height sensors are interchangeable left and right but not front to rear. They are simple sensors where a voltage is input and as the internal contact moves. The activity is sent to the ECU. NEVER connect a 12v supply to these sensors.

The ECU is programmed and programable to register what this signal means in relation to a specified height. Settings or activity outside of this range will produce a system fault and Diagnostic 'Signal Out of Range' message.

Over time, the internal parts of the sensor are liable to wear. This can result in unusual signals being sent to the ECU, causing sensor related soft faults. Diagnostic may show 'Signal Incorrect'.

You can swap the sensor units over from left side to right or vice versa. This reverses the effective location of the most used portion of the internal mechanism, and places a fresh or rarely used section under the sensor arm.

If the fault then transfers left to right, then the sensor is broke. It is not repairable. If the fault remains on the original side, then the problem is in the cable or ECU (extremely rare).

DROPPING TO BUMP STOPS OVERNIGHT – SLOW TO RISE IN MORNING

Pull the delay relay timer and see if it drops overnight. If it stays up, then the self-levelling putting it on the bump stops. If it still drops, then it is leaks.

Taking longer to come up means there is an empty tank, sometimes the result of self-levelling all the way down, or leaks.

On exiting and locking the vehicle the valves tick a little bit to compensate for weight (the driver's side will sit a little higher without weight. It should only be a few seconds' worth. If it goes for a while, it's hunting. There may be a bad sensor, or just out of calibration. If there is a leak ('s) in air springs or lines, that corner will drop, and the downward spiral begins.

VEHICLE JUMPS TO WADE HEIGHT

Check white plug behind Left Front foot well L/H panel for corrosion dampness. This is the connector from height selector switch to ECU. Also remove delay relay and inspect for dry solder joints.

DIAPHRAGM VALVE

Remove valve block. Remove alloy block blue pipe goes into. Four Allen bolts. Don't lose spring. Flick out old diaphragm fit new. Bolt back up not forgetting spring. Refit valve block.

THE COMPRESSOR

- I give this item a section to itself. First because this is the most important part of any system working by compressed air. Secondly, because most P38 owners are willing to beg, borrow, steal, or self-fabricate parts to keep their vehicles going; but, when it comes to the Air Suspension compressor playing up, they are prone to pay a hundred pounds or more for a risky second-hand unit, or get a second mortgage, to buy a pristine new one. I understand the equation of time and money – but these are not cheap items. I have simply lost count of the number of forum posts that state "I had xxx problem, purchased a replacement compressor and it died; did not solve the issue; had the same problem; ended up fixing my original pump".

-This is only a pump, powered by a standard Lucas type 12v electric motor. There is nothing inside that cannot be serviced, repaired or replaced, simply and cheaply. It is designed to produce high pressure air, at a range of altitudes, and do this relatively quickly, and most important, silently.

THE COMPRESSOR DOES NOT RUN AND APPEARS 'DEAD"

All of the following must be true for the compressor to run:

The engine speed must rise to more than 500 rpm and then cannot drop below 150 rpm.

The pressure switch must be open. Check continuity or open between pins 7 and 9 on Connector C192

The thermal switch must be off (closed, grounded). Check continuity between Pin 3 And 2 in connector C151

The thermal switch must be working (not damaged)

The exhaust valve must be closed, with no height changes taking place.

The compressor relay must be closed and the 30-amp fuse must be intact.

There must be 12v power at compressor connector

THE COMPRESSOR DOES NOT RUN/RUNS ERRATICALLY AND THERE IS LOW NOISE/VIBRATION

The seal on the compressor piston, or the piston itself has come detached and is jamming the system. The piston assembly requires servicing or repair.

The carbon brushes for the motor are worn and need replacing

The piston counterweight grub screw is loose

The electric motor itself needs servicing/replacing

COMPRESSOR RUNS, THEN STOPS AFTER A FEW SECONDS

The Valve Block and air tank are at correct operating pressure of 145 psi. as sensed by the Pressure Switch.

The Pressure switch is faulty. Check continuity or open circuit between pins 7 and 9 on Connector C192

The compressor is overheating. At 120ºC the thermal switch will tell the ECU to shut the compressor down for a three-minute cool-down period. After three minutes, the ECU will re-energize the circuit. This will continue in three minute periods until the temperature in the motor housing falls below 90ºC. Once the cool-down is successful, the compressor will again operate.

THE COMPRESSOR CYCLES ON AND OFF FREQUENTLY

Air Leaks

Faulty Relay in Engine Compartment Fuse Box

Poor Pressure switch connection or bad switch

Faulty Thermal switch

SYSTEM DOES NOT BUILD PRESSURE FAST ENOUGH

With compressor running, remove air inlet filter and place finger over inlet hole. You should feel suction. If not, service compressor.

Remove Blue outlet pipe from base of compressor. With compressor running you place finger over outlet port. You should feel air that is difficult or impossible to stop. If not, service compressor.

Remove exhaust silencer, and with system running place finger over exhaust port. You should not feel any air against your finger. If there is, it indicates a problem with the diaphragm valve or solenoid. Replace Diaphragm valve disc.

Air leaks. See above.

In normal operation, the compressor will run to achieve 145 psi in the air tank and valve block system. It will then stop running. From an empty tank this should not take longer than 15 minutes with door/tailgate open. With doors closed, from empty, to achieving standard ride height should take no longer than 6 minutes.

Adjusting the ride height will only use air from the reservoir, until the system pressure falls below 85 psi, at which point the compressor will again start. Note that reducing ride height expels air from the system to atmosphere NOT BACK TO AIR TANK.

THE COMPRESSOR TURNS OFF AND WILL NOT RUN FOR SEVERAL MINUTES

The compressor has probably overheated. If the thermal trip (120ºC) occurs, there will be a three-minute cool down period during which compressor operation will not occur. Note that the compressor motor housing is a metal unventilated cylinder, lined on the interior with a permanent magnet. This design does not readily assist with rapid dissipating of heat from operation.

THE COMPRESSOR IS NOISY

Place a gloved hand on compressor housing and press down. If noise reduces, then replace the rubber compressor mounts.

Service compressor ensuring piston and counterweight are correctly secured.

RUNNING COMPRESSOR OFF VEHICLE

Connect 12-volt Positive lead to GREEN wire. Negative lead to BLACK wire. Compressor should run. Under NO circumstances connect 12 volts Positive to Orange wire or allow it to contact it's terminal whilst compressor is running, thermal switch will be destroyed.

TESTING THERMAL SWITCH

Remove compressor plug from socket. Test continuity between Orange wire and Black wire. If continuity, switch is ok. If none switch is faulty. OR if you (ridiculous thought for a P38 owner) don't own a test meter. Leave plug connected and strip a small amount of insulation on Orange wire. Connect a wire to this and run it to ground. If compressor then runs, thermal switch has failed. Replacement is AIRPAX 67L 120.

COMPRESSOR MOTOR FAILURE/REPAIR

The 12v Lucas type electric motor that operates the compressor is quite reliable, but it can fail with age or constant overheating. The most common failure elements are the Internal thermal switch, and the carbon connecting brushes.

The Thermal switch is a replaceable item, and diagnosing this is listed elsewhere in this document.

If the motor is running, but is extremely quiet and vibration free, then it is likely the pump crank has come loose from motor rod. Remove front plate (with air filter) by removing the three hex screws. Visually check if motor is running, but pump assembly not turning correctly. At side of pump housing is a hex screw grommet. Remove this. Line up counterweight with grommet hole and using an allen key tighten internal screw against motor shaft.

DISMANTLING

Disconnect and remove the compressor pump. Remove the rear pump support plate (two hex screws); Remove the rear motor housing (two long cross head bolts). Carefully pull the end housing from the body whist guiding the rubber grommet for the power cables out of its groove, be careful not to damage the thin circular washer on the end housing.

Retain the interior insulating sleeve found inside the top of the main motor housing cylinder. This removed housing contains the sprung carbon brushes that power the motor, and the circuit board that also holds the thermal switch to which the thin orange electrical cable is connected.

REPLACING THERMAL SWITCH

Carefully drill out the three small rivets that hold the switch plate and circuit board to the motor end cap. De solder the connecting points on both ‘legs’ of the switch and remove. Replace and solder new switch into place. The support plate and board can be held back in place with small self-tapping screws or by a small drop of two-part epoxy resin over the plate/board and into the previously drilled out rivet holes.

REPLACING CARBON BRUSHES

Replacement carbon brushes with integrated power wire can be obtained from most electrical service centres. They are similar to those found in heavy duty power drills.

These are rectangular format 7.5mm wide, 6.3mm high and 15mm long with integrated electrical cable 20mm long. They must be the hard carbon variety.

It is important to shape the ends to match that of the brass motor head. The simplest method is to wrap a strip of fine carbon grit paper around the head and manually rotate the new installed brushes until their shape matches.

TESTING MOTOR COMMUTATOR PLATES AND COILS

At the top end of the motor unit are 10 copper ‘plates’ that the carbon brushes touch when assembled. These are connected to the motor wiring coils. With a standard multimeter, ensure connectivity between adjacent plates. Half of these plates (5 in number) will show adjacent connectivity, but not with the other half.

If any plate shows no connectivity with any neighbouring plate – the wiring loom is damaged. It can be repaired by a specialist or any garage that repairs starter motors or alternators, but otherwise be regarded as ‘dead’. The motor is a common product and will cost no more than 30 pounds to replace with new.

RE_ASSEMBLING MOTOR HOUSING END CAP

The carbon brushes must be pushed back into their housing and the springs placed beneath them to hold in place. The insulating sleeve replaced in the top of the main body – lining up with the cable slot.

The Rubber cable protector pushed into its slot on the outer case. The end cap (with thin circular washer) gently placed over the motor end and slowly pushed almost into place against the motor housing body.

Before the carbon bush springs are hidden from view, release them to hold the bushes into place against the motor end [this may take a few attempts]. Install the Cross-Head Bolts, and end support plate with hex bolts. Re-connect and test.

EAS HIGHT SETTING USING CALIBRATION BLOCKS

Above - Genuine Land Rover LRT 60-003 height calibration blocks. Cost c. 180 UK pounds.

Below – Home Made calibration blocks. Cost c. 2 UK Pounds.

High

Standard

Low

POSITIONING OF THE CALIBRATION BLOCKS AND CALIBRATION:

First, we need to obtain the calibration blocks (4 for each height) for the different height settings. I used a very simple method of making my own blocks. From a DIY store I bought a 2m length of round hard wood with a 30mm diameter and I cut 16 lengths from this.

These 16 pieces need to be cut to the following different lengths: It would be a good idea to write on each calibration block the correct height of each single piece, and if it is front or rear.

HIGH SETTING:

n° 2 blocks 145mm rear setting

n° 2 blocks 140mm front setting

STANDARD SETTING:

n° 2 blocks 105mm rear setting

n° 2 blocks 100mm front setting

LOW SETTING:

n° 2 blocks 80mm rear setting

n° 2 blocks 75mm front setting

ACCESS SETTING:

n° 2 blocks 40mm rear setting

n° 2 blocks 35 mm front setting

Using diagnostics set the vehicle to EXTENDED height. Position the HIGH length calibration blocks inside the bump stop rubbers on the chassis. The longer blocks go to the rear. This does not give an offset ride height, as the rear chassis bar is set 5mm higher than the front chassis bar.

See photo 4 (front) 5 (rear)

Foto 4

Foto 5

Once the calibration blocks have been positioned under the chassis on the axles, slowly lower the vehicle onto the blocks. CHECK THAT THE CALIBRATION BLOCKS ARE FIRMLY SECURED UNDER THE WEIGHT OF THE VEHICLE. CHECK BY USING A TOOL TO SEE IF THEY MOVE. **DO NOT PUT YOUR HAND UNDERNEATH THE BUMP STOP**

Now with use of the diagnostics read and note the data of the HIGH SETTING front and rear, left and right.

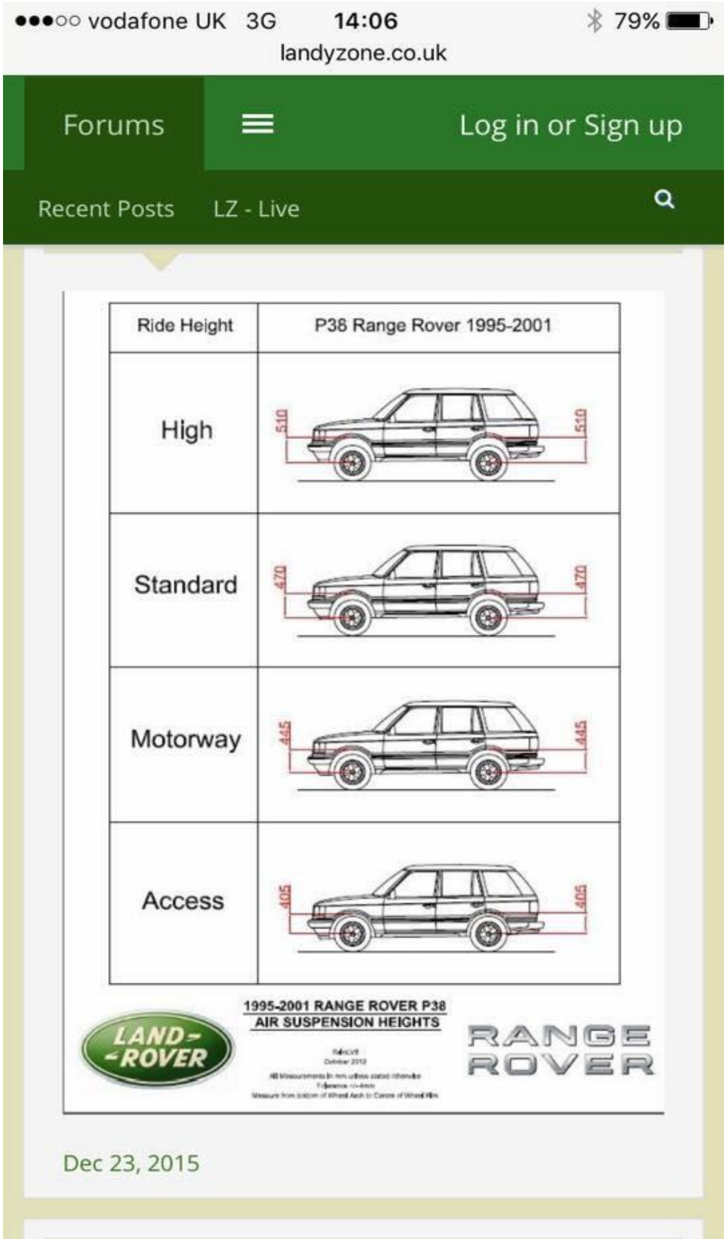
Raise the vehicle again and remove the HIGH Calibration blocks, and exchange them with the STANDARD calibration blocks. Lower the vehicle once again safely onto the blocks, and note the second set of readings.

Repeat this operation in the same way for all heights.

MEMORIZING HEIGHTS INTO THE SUSPENSION ECU

Once you have all the heights noted, you can proceed to writing them to the suspension ECU unit using the diagnostic equipment. Be sure to have removed the calibration blocks from under the vehicle.

Start the engine and confirm that once the vehicle has reached the selected height position it will no-longer make any adjustments. This means everything has been done correctly. All we need now is to go for a drive and see if all is working correctly. Below is the manufacturer physical height measurement chart.



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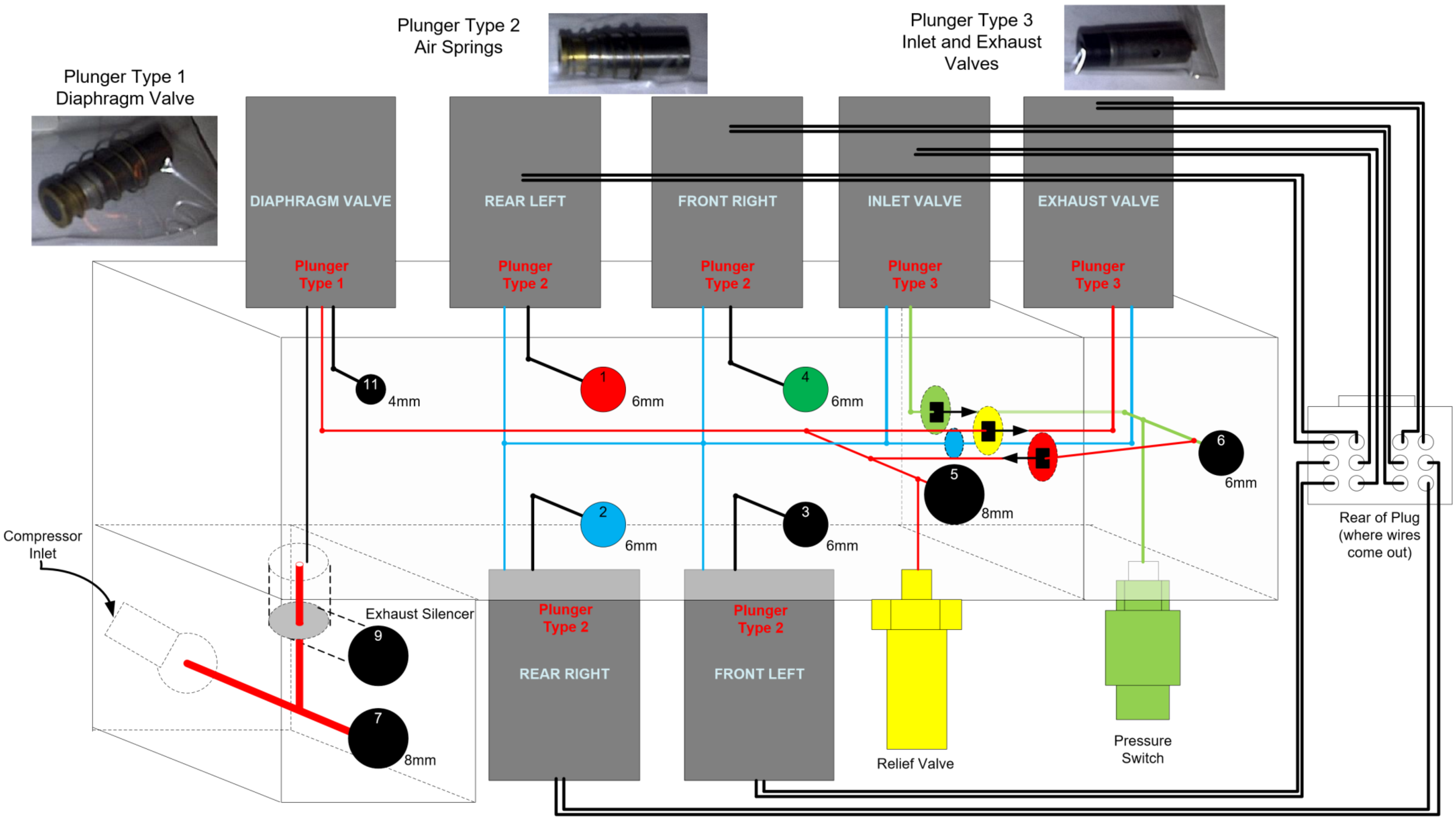
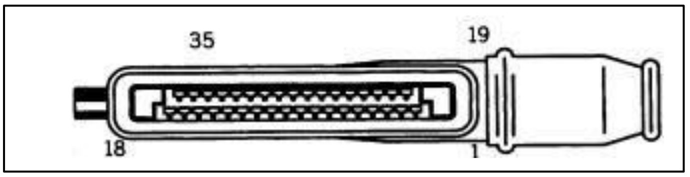


RANGE ROVER EAS CONNECTOR DETAILS



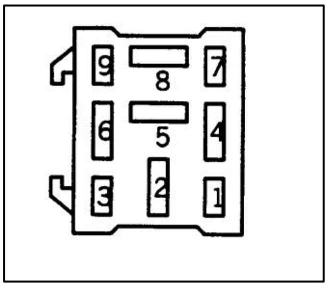
C117/C0867 ECU

No.	Colour	Description
1.	Slate/Green	Power from Delay relay
2.	Orange/Slate	Rear Left Height Sensor Source 5V
3.	Orange/Blue	Front Left Height Sensor Source 5V
4.	Orange/Pink	Rear Left Height Sensor Input Voltage
5.	Orange/Green	Front Left Height Sensor Input Voltage
6.	-	-
7.	Blue/Pink	Lamp Control and Message to BeCM
8.	Green	Compressor Relay Driver
9.	Green/Slate	Exhaust Valve, 12V to Open Valve
10.	Green/Black	Front Left Valve, 12V to Open
11.	Green/White	Rear Left Valve, 12V to Open Valve
12.	Slate	Engine Speed Input, from BeCM C114
13.	Slate/Blue	Pressure Switch Input, 12V when Switch Closed
14.	Black/Pink	Park/Hand Brake Input, From BeCM C112, Ground to enable Access Mode
15.	Yellow/Slate	Inhibit Switch Input, Ground when pressed
16.	Black/Purple	Thermal Switch Monitor, Open Circuit to Begin Cooling Cycle
17.	White/Pink	Serial Communications RECEIVE
18.	Black	Ground E154
19.	-	-
20.	Orange/Red	Rear Right Height Sensor Source 5V
21.	Orange/Pink	Front Right Height Sensor Source 5V
22.	Orange/Brown	Rear Right Height Sensor Input Voltage
23.	Orange/Yellow	Front Right Height Sensor Input Voltage
24.	Black/Pink	Height Sensor Ground
25.	Blue/White	Lamp Control and Message to BeCM
26.	Green/Orange	Inlet Valve, 12V to Open Valve

27.	Green/Pink	Front Right Valve, 12V to Open Valve
28.	Green/Yellow	Rear Right Valve, 12V to Open Valve
29.	-	-
30.	Yellow	Road Speed Input from BeCM C112, 12V square Wave
31.	Green/Purple	Brake Switch Input, 12V with Brakes Applied
32.	Yellow/Orange	Up Switch Input, Ground when Pressed
33.	Yellow/Brown	Down Switch Input, Ground when Pressed
34.	Purple/Slate	Door Input from BeCM C112, Ground with Door Open
35.	White/L. Green	Serial Communications TRANSMIT

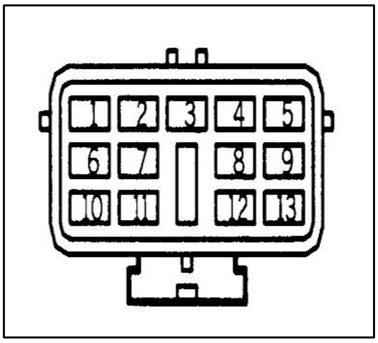
C118 Delay Relay Connector

No.	Colour	Description
1	-	-
2	Purple/Red	Battery Power from 10A F44
3	Slate/Red	Relay Interrupt from C231, Pull Low to Open Relay
4	White	Key ON Signal from 5A F24
5	Purple/Orange	Door Input to Wake Up if Key is Off
6	Black	Ground, E148
7	-	-
8	Slate/Green	Power to ECU, Valve Block, and Pressure Switch
9	-	-



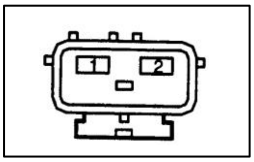
C139 Valve Block to Valve Driver Connector

No.	Colour	Description
14	White	Rear Left Valve Hit and Drop Control
15	Red/White	Rear Left Valve 12 Volt
16	-	-
17	Red/Orange	Exhaust Valve 12 Volt
18	Orange	Exhaust Valve Hit and Drop Control
19	Red/Brown	Front Left Valve 12 Volt
20	Red/Black	Inlet Valve 12 Volt
21	Pink	Front Right Valve Hit and Drop Control
22	Yellow	Rear Right Valve Hit and Drop Control
23	Brown	Front Left Valve Hit and Drop Control
24	Slate	Inlet Valve Hit and Drop Control
25	Red/Pink	Front Right Valve 12 Volt
26	Red/L Green	Rear Right Valve 12 Volt



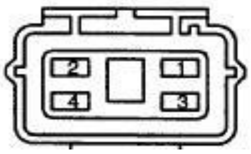
C142 Diaphragm Valve Connector

No.	Colour	Description
1.	Green	12V Power from Compressor Relay
2.	Black	Ground to C152, Pin 11



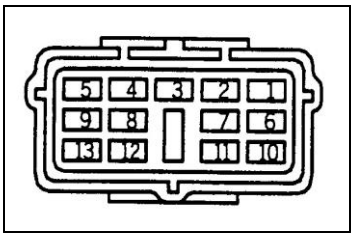
C151 Compressor Connector

No.	Colour	Description
1.	-	-
2.	Black/Purple	Thermal Switch Monitor, Open to Enter Cooling Period
3.	Black	Ground, E154
4.	Purple/Lt Green	Power Supply



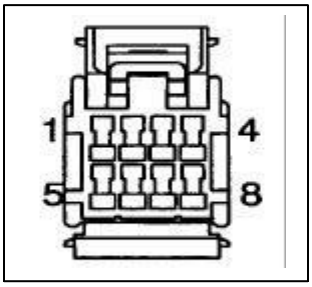
C152 Valve Block Connector from ECU

No.	Colour	Description
1.	Green/White	Rear Left Valve, 12V to Open Valve
2.	Green/Yellow	Rear Right Valve, 12V to Open Valve
3.	Green/Black	Front Left Valve, 12V to Open Valve
4.	Green/Pink	Front Right Valve, 12V to Open Valve
5.	Green/Orange	Inlet Valve, 12V to Open Valve
6.	Green/Slate	Exhaust Valve, 12V to Open Valve
7.	Slate/Green	Delay Relay to Pressure Switch 12V Power
8.	Purple/Lt Green	Diaphragm Valve, 12V to Open Valve
9.	Slate/Blue	Pressure Switch 12V Signal to ECU
10.	Black	Ground, E148
11.	Black	Ground, E148
12.	Slate/Green	12V Power from Delay Relay to Valve Driver
13.	Slate/Green	12V Power from Delay Relay to Valve Driver



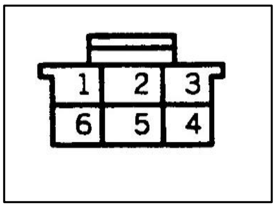
C213 Rocker Switch Connector

No.	Colour	Description
1.	Blue/White	Lamp control from BeCM C114, ECU Pin 25
2.	Red/White	Illumination
3.	White	Power from BeCM 10A F17
4.	Blue/Pink	Lamp Control from BeCM C114, ECU Pin 7
5.	Purple/Black	Wade Height Input to BeCM C114
6.	Yellow/Brown	Down Switch Input, Ground when Pressed
7.	Black	Ground E252
8.	Yellow/Orange	Up Switch Input, Ground When Pressed



C214 Inhibit Switch Connector

No.	Colour	Description
1.	Black	Ground E252
2.	Red/White	Illumination
3.	Yellow/Slate	Jumper to Same Connector, Pin 5
4.	Black	Ground E252
5.	Yellow/Slate	Inhibit Input, Ground to Inhibit
6.	White	Power from BeCM 10A F17



Typical Height Sensor-C108, C146, C147, C168

No.	Color	Description
1.	Refer to C117	Height Sensor Source, 5V from ECU
2.	Refer to C117	Height Sensor Wiper, Voltage is Height dependent
3.	Black/Pink	Height Sensor Ground