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Safety must always be thought of first when working on a vehicle. The potential risks should be considered and suitable precautions taken.

It is important that personnel working on the vehicles are familiar with operating instructions and workshop procedures. The following points are general guidelines only and are not intended to be all-inclusive.

1. Never work under a vehicle supported solely by jacks. Always use chassis stands and make sure that they are resting on a firm flat surface.

2. Particular care should be taken on vehicles with air suspension, as the chassis is liable to settle as the bag pressure decreases.

3. Never work under an unsupported body. Always fit a suitable stay/stays between the body and chassis in addition to using the normal locking devices.

4. Always fully tilt the cab and never work under a partially tilted cab.

5. Always use wheel locks to prevent the vehicle-rolling if the brakes have to be released.

6. The vehicle should always be left out of gear.

7. It is advisable to always disconnect the vehicle batteries as this acts as a precaution against inadvertent starting and reduces the risk of electrical fires. It also prevents accidental flattening of the batteries. Above all, do not jeopardize your own safety or the operational safety of the vehicle. Any additional holes required to mount equipment on the chassis frame must be drilled in accordance with the individual manufacturers instructions.
SYSTEM OVERVIEW

The basic function of the SYSTEM 2000 Top Speed limiter is to limit the maximum speed of a vehicle to a pre-set level and to control the speed of the vehicle at the maximum speed, whilst the throttle pedal is fully depressed, without noticeable variation in the speed. The Electronic Control Unit (ECU), mounted in the cab (as shown below) is connected to the tachograph, electronic speedometer or to a pulse emitter (gearbox sensor) of which there are various types. The speed parameters are set inside the ECU upon installation.

When the vehicle has reached its maximum pre-set speed, the ECU sends a signal to the Pressure Proportional valve (PPY). Upon receipt of the signal from the ECU, the PPY opens, allowing air to flow to the Throttle control cylinder mounted in the throttle linkage. The Throttle control cylinder either pushes or pulls, which lengthens or shortens the throttle linkage, depending upon the vehicle, thus controlling the speed.

COMPONENT LAYOUT

[Diagram showing various components such as Tachograph/speedometer, Pressure Proportional Valve (PPV), Accelerator linkage, Throttle Control Cylinder, Electronic Control Unit (ECU), Battery supply 12/24V, Airline filter (if fitted), Auxiliary air supply 8-10 bar]
SYSTEM OPERATION

The operation is part electronic and part pneumatic. A pneumatic Throttle Control Cylinder is fitted into the rod connecting the accelerator pedal to the fuel pump. This Throttle Control Cylinder can be extended by the Electronic Control Unit, which has the effect of reducing the throttle and hence the power available to the engine.

A signal is picked up from the tachograph or pulse emitter, which gives a frequency proportional to the road speed. This signal is fed to the Electronic Control Unit (ECU), which measures this frequency and converts it to a voltage, which is directly proportional to the road speed. This voltage is compared with a reference voltage within the ECU which has been pre-set to represent the maximum road speed of the vehicle. This process will decide whether the vehicle is traveling above or below the desired maximum road speed. Initially the speed will be below the maximum speed hence no action is required to reduce the vehicle speed. As the speed approaches the maximum, the ECU sends a signal to a Pressure Proportional valve (PPV), which regulates the compressed air pressure supply into a pressure, which is directly proportional to the voltage supplied from the ECU. Thus, if the voltage output from the ECU is low, then the pressure output from the PPV will be low.

This pressure increases until there is sufficient to overcome the internal spring pressure in the Throttle Control Cylinder and any external forces acting on the cylinder, at which point the cylinder begins to extend causing the throttle to be reduced. When the speed is at the maximum, the cylinder is at a point of equilibrium just sufficient to maintain a constant speed. If the speed increases (e.g. on a downhill) then the pressure to the cylinder is increased automatically to operate the cylinder and maintain the maximum speed. Conversely, if the speed falls, the pressure is reduced to retract the cylinder and again maintain the pre-set speed.

This action starts approximately 2kph below the desired maximum speed so that the correct position is attained by the time the maximum speed is achieved. This action reduces the chances of exceeding the maximum pre-set speed to virtually zero.

If the vehicle’s measured speed is less than 10kph and control signals are sent to the PPV, the system regards this as a fault and will blow the fuse in the ECU, resulting in the vehicle returning to the manufacturers specifications.
THROTTLE CONTROL CYLINDER OPERATION

The Romatic Speed limiter is basically designed to limit a vehicle’s speed to that set at the time it was calibrated. It operates on a combined electronic/pneumatic principle.

This is how it works:

A pneumatic Throttle Control Cylinder is fitted to the lever between the throttle pedal and the fuel pump. This cylinder is controlled by the Electronic Control Unit (ECU), which reduces the supply of diesel fuel. This reduces the engine speed.

The engine is idling. Lever 1 is in position A (resting position).

The throttle is depressed. Lever 1 turns and moves to position B, and the engine produce more power. The vehicle has not yet reached its maximum speed, however. The cylinder is still in the resting position.

The throttle pedal is now pressed right down and the maximum speed has been reached. The cylinder now adjusts between positions A and C, turning lever 1. This increases or reduces the engine power to keep the vehicle running at the set maximum speed.
With the driver's cab in its normal position, check that the throttle pedal and the throttle lever on the diesel pump reach their maximum travel at the same time. To do this, depress the throttle pedal fully and see if the diesel pump lever is wide open and at the limits of its travel. If it is not, adjust the fuel pump lever/cable or throttle pedal stop. If you cannot adjust the fuel pump lever/cable, you will have to fit a suitable stop under the throttle pedal. Check there is no excess play in the fuel pump lever or cable.

Tilt the driver's cab. Check whether the fuel pump lever has a push rod or pull rod and matches the cylinder supplied. If the fuel pump rod PUSHES when opening the throttle, you will need a pull cylinder. If it PULLS, you will need a push cylinder. A push cylinder can be used in most cases. Check that the cylinder stroke is sufficient to control the fuel pump lever movement. This can be done by measuring the stroke of the diesel pump lever movement and comparing it with the cylinder stroke (50 mm). Look at where the cylinder is to be installed to ensure there is sufficient room.

If the fuel pump rod PULLS when opening the throttle, you will need a PUSH cylinder.

If the fuel pump rod PUSHES when opening the throttle, you will need a PULL cylinder.
INSTALLING A PUSH OR PULL THROTTLE CONTROL CYLINDER INTO THE THROTTLE ROD

Remove the throttle rod from the vehicle, place it on the bench and measure the overall length. Assemble the hexagon brass adapter onto the throttle control cylinder and lay it alongside the throttle rod. Decide where to cut the rod, allowing adequate length for threading. The standard cylinder threads are M8 x 1.25

Once you have cut the throttle rod, use a M8 x 1.25 die nut to cut the threads into the rod you are utilizing. If available, it is possible to replace the throttle rod with M8 threaded rod to save installation time. Also, if the ball joints are of a similar thread, the piston can be screwed directly into one, thus eliminating the hexagon adapter. Once you have threaded the throttle rod, re-assemble it with the cylinder ensuring it is exactly the same length as the original rod, i.e. refer to measurements taken in paragraph one.

If the throttle linkage is less than 8mm in diameter, adapters can be supplied. If the throttle rod is a hollow tube, then it is necessary to insert a stud with an 8mm thread into the end of the tube and weld it into place. Pipe work from the PYY is 8mm O/D, and there are two types of fittings for connecting this into the cylinder:

a) Straight Connector.
b) Elbow Connector.

Decide which connector is suitable; this will depend upon access and the direction in which the tubing is to be run into the cylinder.

Note:
It is essential that only P.T.F.E. or THREAD TAPE is used to seal the threads against air leaks. SEALANTS CANNOT BE USED.
INSTALLING A PUSH THROTTLE CONTROL CYLINDER INTO THE THROTTLE CABLE

Remove the cable from bracket A

Drill out existing hole in bracket 'A' to 19mm.

Fit cylinder as shown.

Re-fit throttle cable to cylinder using bracket 'B' and 'C'.

It may be necessary to raise or lower bracket 'A' in order to keep the cable in line, thus preventing cable wear.

Note: It is necessary to have 50mm of slack in the outer cable to allow the piston full movement to completely collapse the throttle. Once the installation is complete, depress the accelerator pedal onto its stop. This will move the fuel pump lever onto its stop (giving full throttle). With the accelerator cable under load, operate the Throttle Control Cylinder (by operating the TCU). As the Throttle Control Cylinder piston moves towards the pump lever (drawing with it the cable) the fuel pump lever will be drawn back by the lever's return spring. Bracket C is used only as a support for the outer cable to slide through.
INSTALLING THE PRESSURE PROPORTIONAL VALVE (PPV)

Install the valve in a protected position. It must not be mounted on the engine block or in areas of excessive heat. On the side of the valve is a temperature indicator. This indicator changes colour at 60°C. If this colour change occurs all warranty for the PPV is void. The valve is mounted by bolting through the two 6mm holes in the valve body.

Air can now be supplied to the valve. This must be taken from the vehicle’s auxiliary supply, which is taken from circuit 2.4 of the four circuit protection valve. If you have any doubts as to where you take this supply from, we recommend that you contact the respective vehicle manufacturer. If you encounter a problem locating circuit 2.4 it is possible to take your supply from another source but firstly you must fit a pressure protection valve to ensure that the circuit you have taken from is safe.

Once you have located the position to take your air supply from it is necessary to check that you have the correct compression fitting. Romatic supply a variety of air line fittings and tees which are all cross-drilled. It is necessary for these connections to be cross-drilled to allow for adequate sealing of the system to prevent tampering. Before connecting into the air supply, drain the air reservoir.

If, when cutting into the vehicle’s air supply you find oil or sediment present or if the vehicle is not fitted with an air drier, we recommend that an alternative filtration system is used. This filter (Part Number: 060-042) can either replace or be fitted in addition to the existing in-line filter.
The pipe work supplied with the kit is 8mm O/D. This pipe work is run from the auxiliary manifold/pipe to the PPV ensuring that it does not run over any hot or moving parts and sharp edges. Use the rubber grommets to pass the pipe work through the chassis and secure with cable ties.

The 8mm pipe is connected into the PPV with the compression fittings supplied. These include a Pipe Nut, an Olive, and a Pipe Insert.

We recommend that the fittings are compressed on a Romatic Make-Up Tool to ensure a good connection.

The air supply to the PPV connects to the valve through the in-line filter screwed into Port 1 of the valve.

The PPV can now be connected to the cylinder. This, again, is run in 8mm tubing. When running tubing towards the valve, once again ensure that the tubing does not run over any hot or moving parts and retain with cable ties. Connect the pipe into the cylinder utilizing either the elbow or straight connector, depending upon access to the cylinder.

**TESTING THE SYSTEM**

Let the vehicle's air system come up to pressure.

Remove the connector block from the PPV. Pass one end of the twin core supplied through the shroud and connect into Terminals 1 and 2 of the connector block.

Re-connect the connector block/shroud back onto the PPV. Run the other end of the twin core to a +24V Supply.
The PPV should now open letting air through the cylinder and should push the cylinder's piston out. With the throttle pedal fully depressed, check that the cylinder cuts the fuel supply off completely and that the fuel pump lever is fully back onto its stop.

If the system is working correctly, screw the connector block onto the PPV, ensuring that gland nut (the access point for the wiring) faces downward to prevent water ingress. Also tighten the gland nut to increase the water and dust resistance of the valve.

Run the twin core up into the driving compartment.

Tilt the driver's cab back into its normal position and look for a location to fit the ECU. Try to find a position that is not easily visible, e.g. behind the dashboard or under the driver's seal.
The ECU controls the vehicle’s speed via a pressure proportional valve. The ECU begins to monitor as soon as the vehicle’s ignition is switched on. The ECU monitors the vehicle’s road speed constantly and operates the PPV when the maximum speed is reached. The ECU has a frequency.

**THE PRINTED CIRCUIT BOARD (PCB)**

The printed circuit board (PCB) is housed in a molded block, high impact A.B.S. box. The wiring enters the box through three gland nuts located in its side. The PCB is fastened to the under of the lid and is accessed by removing the four screws in its corners of the box. When you have access to the printed circuit board it should look similar to the diagram.
UNDERSTANDING THE ECU

VR 1 - SET SPEED POTENTIOMETER
This potentiometer calibrates the speed at which the speed limiter is set. By turning the potentiometer’s screw anti-clockwise you can lower the speed of the vehicle or by turning it clockwise you can increase the vehicle speed until your desired speed is reached.

VR2 - BAND
This potentiometer controls the reaction speed of the system. With the potentiometer screw turned fully anti-clockwise (as pre-set by the manufacturer), the system works to its optimum performance. However, there are occasions when the system reacts too quickly for the fuel pump or accelerator linkage, which could produce a surge. When this occurs, adjustment to VR2 is necessary. As you turn this screw clockwise it slows down the operating speed of the cylinder, which in turn dampens out the surge. VR2 also needs adjustment when a lightweight cylinder is used. The lightweight cylinder has weaker internal spring pressures in comparison to the standard cylinder therefore it will react faster to changes in air pressure. To compensate for this we turn the VR2 screw clockwise ten full turns.
In total, VR2 has 20 full turns from one end of the potentiometer to the other. However, we would not recommend adjusting it more than 16 turns.

THE GREEN LAMP OR LED (LIGHT EmitTING DIODE)
The Green LED illuminates when power is being fed to the ECU. If it does not illuminate it means that there is no power or the fuse in the ECU has blown.

THE RED LAMP OR LED
The Red LED illuminates when power is supplied to the PPV. It will begin to illuminate when a small voltage is supplied and will become brighter as the voltage increases.

FUSE
The ECU has a 1 amp protection fuse. Never try to use a fuse of higher amperage as this could damage the printed circuit board.

JP1 (JUMPER1)
This jumper allows you to calibrate the speed limiter through a wide variation of speed pulses. At the side of JP1 it is printed ‘High’ and ‘Low’. When the jumper is across the ‘Low’ pins the frequency within which the speed limiter will operate is 33Hz minimum to 350 Hz maximum. If you find the frequency you require to be much higher it is necessary to lift the jumper and place it over the ‘High’ pins. This will automatically give a maximum frequency range of 1000 Hz.
TEST SOCKET
This socket is the female connection for the Test and Calibration Unit (TCU). The TCU plugs into this connector and allows you to test the speed limiter. It also gives you a digital readout of the incoming frequency from the vehicle tachograph/sensor.

ELECTRICAL CONNECTOR BLOCK
On a standard top speed limiter printed circuit board there is a facility to run B wires into the board. These wires are screwed into an 8 pin connector block.

WIRING THE ECU TO AN ELECTRONIC TACHOGRAPH OR SPEEDO
BATTERY NEGATIVE (BATT–VE)
Always connect this to a negative battery terminal or earth point. Never connect it anywhere else, as contact resistance in the vehicle may cause voltage differences. This may result in erratic operation of the speed limiter or prevent it from working.

BATTERY POSITIVE (BATT + VE)
Connect this to a positive 12V or 24V after the ignition key switch. Note: We recommend that the ignition and negative be taken from the relative terminals on the tachograph head (where available. This keeps all installations uniform and the tachograph would monitor if the fuse were removed.

SOLENOID POSITIVE (+VE) - PPV
This connection supplies a constant 12V or 24V supply down to the PPV. The PPV is not polarity conscious, i.e. it does not matter which way the wires from Sol +Ve or Sol -Ve connect into terminals 1 and 2 of the PPV.

SOLENOID NEGATIVE (-VE) - PPV
This connection supplies a varying voltage down to the PPV. The lower the voltage the greater the voltage difference between Sol +Ve and therefore the greater the air pressure output from the PPV.

TRANSUDER SIGNAL (SIG)
This connection supplies the ECU with the road speed signal from the tachograph. This is normally called the C3/B7 Connection or Square Wave (\[\square\square\]).

Note: All Tachograph Connections can be found on page 21.
WIRING THE ECU TO A GEARBOX SENSOR OR TRANSDUCER

If the vehicle has a mechanical Speedo head it is connected to the gearbox via a Speedo cable. As there is no electronic Speedo pulse involved we have to install a mechanical gearbox sensor. This is normally filled onto the output drive of the gearbox, however, in a small number of cases it can be connected to the rear of the Speedo head. To install the sensor, simply remove the Speedo cable, screw the sensor onto the drive, and then replace the Speedo cable.

The sensor wiring is then run into the driving compartment where it is wired into the ECU. The wiring colour code could vary. However, on the outside of the packaging there is a label indicating where each colored wire is to be connected.

If a problem is encountered, i.e., the sensor does not seem to be working, put a multimeter (set to Volts D.C.) across the transducer negative and transducer signal. Slowly rotate the sensors drive pin and you should see a voltage variation from 0 - 4 Volts. This should occur 4 times for each complete revolution of the drive pin.

When installing a gearbox sensor it is necessary to follow the following procedure:

- Ensure that the face of the gearbox fittings is clean and free from damage and that the threads are clean.
- Insert the pin of the sensor unit into the gearbox fitting.
- Push the sensor unit tightly against the gearbox and twist the sensor unit to ensure that it is positioned squarely against the gearbox.
- As you tighten the retaining nut, keep the sensor tightly against the gearbox.
**BATTERY NEGATIVE (BATT –VE)**
Always connect this to a negative battery terminal or earth point. Never connect it anywhere else as contact resistance in the vehicle may cause voltage differences. This may result in erratic operation of the speed limiter or prevent it from working.

**BATTERY POSITIVE (BATT +VE)**
Connect this to a positive 12V or 24V after the ignition key switch. Note: We recommend that the ignition and negative are taken from the relative terminals on the tachograph/Speedo head. This keeps all installations uniform and the tachograph would monitor if the fuse were removed.

**SOLENOID POSITIVE (+VE) - PPV**
This connection supplies a constant 12V or 24V supply down to the PPV. The PPV is not polarity conscious, i.e. it does not matter which way the wires from the Sol +Ve or Sol-Ve connect into terminals 1 and 2 of the PPV.

**SOLENOID NEGATIVE (-VE) - PPV**
This connection supplies a varying voltage down to the PPV. The lower the voltage the greater the voltage difference between Sol +Ve and therefore the greater the air pressure output from the PPV.

**TRANSUCER POSITIVE (+VE)**
This supplies the gearbox sensor with a low voltage supply.

**TRANSUCER SIGNAL (SIG)**
This supplies the ECU with a road speed signal or pulse (similar to the pulse from the tachograph). TRANSUCER NEGATIVE (-VE) this supplies the gearbox sensor with a negative supply.

**TRANSUCER SCREEN (SCN)**
This outer screen protects the signal and power leads against interference and connects only to the ECU.
SYSTEM 2000 WIRING DIAGRAM

Speed signal from an electronic tachograph

Speed signal from a mechanical gearbox sensor
### TACHOGRAPH SPEED LIMITER CONNECTIONS

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
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<tr>
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<td>C3</td>
<td>A6</td>
<td>A4</td>
</tr>
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<td>C3</td>
<td>A6</td>
<td>A4</td>
</tr>
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<td>B7-D3</td>
<td>A6</td>
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<tr>
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<td>D3/SPEED</td>
<td>C6</td>
<td>C4</td>
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<tr>
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<td>8300</td>
<td>B7-D3</td>
<td>A6</td>
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<tr>
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<td>B7-D3</td>
<td>A6</td>
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<td>C3</td>
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<tr>
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<td>A4</td>
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</table>

### EXTRA TACHO PICK-UP TO AID FITMENT

**VOLVO**
You will find a yellow wire with a plastic female connected in the nearside fuse compartment (it is sometimes tagged with C3 or B7). Remove the bullet terminal and use a tamper-proof connection.

**MERCEDES**
S.K. Cab - This is a green/red wire going into a 6-way connection block, at the rear of the 1 Module, within the fuse box. Connect your signal wire into 3, 4, 5 or 6.

**SCANIA**
There is a short blue wire connected to the tacho signal connection. Remove the Lucar terminal and use a tamper-proof connection.

**DAF 95/S/A**
Underneath the nearside fuse compartment there is a blue wire numbered 3500A connected. Remove this wire and connect into Transducer Signal.

**STRATO**
Inside the control fuse compartment there is a blue and white striped wire, numbered 725. This can be connected into Transducer Signal.

**DAF**
Inside the control fuse compartment there is a blue and white striped wire, numbered 725. This can be connected into Transducer Signal.

**MAN**
On the rear of the vehicle's fuse board is a white wire numbered 605. The connection into the fuse board is Section 79, terminal 6.

In some cases, the strength of the speed signal from the tacho may be weakened by connecting a speed limiter and/or other equipment. If this is the case, it may be necessary to install a signal booster. This can be supplied by Autokontrol.
The TCU was designed to aid in the installation of the speed limiter. The facilities it offers the installer are:

- It enables the speed limiter to be set up without driving the vehicle at the required speed.
- It allows for checking the existing speed settings and the Recalibration of new speeds, whilst the vehicle is stationary.
- It gives you a digital readout of the tachograph signal whilst the vehicle is moving.
UNDERSTANDING THE TCU POWER LAMP OR LED

POWER LAMP OR LED
This illuminates when the TCU is connected into the ECU and the vehicle's ignition is on.

DISPLAY
Use this to read off the frequency (pulses per second) and road speed (if calibrated).

OPERATING LED
This illuminates when the ECU begins to supply power to the PPV

INTERNAL (INT.) AND EXTERNAL (EXT.) SWITCH
This is used to select between an internal signals, i.e. a signal produced by the TCU, and external signal that is supplied to the ECU via the tachograph or mechanical sensor.

CALIBRATION CONTROL
This is used to calibrate the TCU to the incoming speed signal from the tachograph or mechanical sensor. When calibrated, the TCU (switched to speed) will give a digital readout in KPH or MPH.

ADJUST KNOB
This knob controls the signal produced internally by the TCU. Turn the knob clockwise and the digital display increases, turn it anticlockwise and the display decreases.

FREQUENCY (FREQ.) AND SPEED SWITCH
This is used to select internal or external signal readouts in frequency (pulses per second) or road speed.

DIN PLUG
This plug connects the TCU into the ECU's test socket.
CALIBRATING THE SPEED LIMITER

THE K FACTOR
The K Factor is the number of pulses per kilometer received by the tachograph from its sender on the gearbox. This figure is normally written on the inside of the tacho head when the tacho is calibrated and it is possible to use this figure with the following formula to calculate the frequency (pulses per second) produced at the maximum speed you wish to set the limiter to.

\[
\text{FREQUENCY} = \frac{K \times \text{SPEED LIMIT (IN KPH)}}{3600}
\]

THE W FACTOR
The W Factor is inter-connected with the K Factor. The W Factor gives you the number of revolutions that the gearbox sensor drive completes per kilometer. This figure is also found inside the tacho head. Most tachographs use an 8 pulse sensor, so in this particular case the K Factor would be \( W \times 8 \). However, some earlier tachographs used 2 or 4 pulse sensors, therefore, it is necessary to know how many pulses the sensor gives per revolution to work out on accurate frequency. To calculate the frequency at a particular speed using W with an 8 pulse sensor, use the following formula:

\[
\text{FREQUENCY} = \frac{W \times 8 \times \text{SPEED LIMIT (IN KPH)}}{3600}
\]

CALIBRATING THE ECU
There are a number of ways to calibrate the ECU. These depend upon the equipment available and/or any relevant speed pulse information known, i.e., K or W FACTORS.

CALIBRATION WHILST DRIVING THE VEHICLE
In its simplest form, the ECU can be calibrated by driving the vehicle at the required maximum road speed. If you cannot reach this speed, turn the VR 1 potentiometer (set speed) clockwise until the limiting speed is reached. If the speed of the vehicle exceeds the limiting speed, turn VR 1 anti-clockwise until you arrive at your desired speed.

When you have calibrated the speed, the operation of the speed limiter should be smooth. If it is erratic (surging), it is necessary to adjust VR2 clockwise until you have eradicated the surge.

Note: When adjustment to VR2 is made, it may slightly alter the calibrated road speed. If this occurs, fine-tuning of VR1 will be necessary.
CALIBRATING THE ECU USING THE K FACTOR

Initially we need to calibrate the TCU, this is undertaken as follows:
1. Insert the DIN plug into the test socket of the ECU.
2. Switch the ignition on, this will power the TCU and ECU.
3. Read the K Factor from the tacho head.
4. Calculate (using the K Factor formula) what the frequency should be at the speed you wish to limit the vehicle to.
5. Set your T.C.U to INT. and FREQ.
6. Turn the adjust knob until the value calculated in 4 is displayed.
7. Switch from FREQ. to SPEED.
8. Turn the CAL Screw until the limiting speed (used in 4) is displayed.
9. The TCU is now calibrated.

Once the TCU is calibrated, it is possible to calibrate the ECU.

1. Leave the T.C.U switched to INT. and SPEED with your limiting speed displayed.
2. The operating LED will be either on or off.
3. Start up the engine.
4. Operate the throttle and bring the engine up to maximum revs.
5. If maximum revs can be achieved, turn VR1 anti-clockwise until approximately half revs are achieved.
6. If you cannot achieve half revs, then turn VR1 clockwise until half revs are achieved.
7. Now, providing all the information is accurate, the speed limiter should be calibrated.

ROAD TESTING

We recommend finishing with a road test to ensure correct operation of the speed limiter. Switch the TCU from INT. to EXT. but leave the other switched onto speed.

Begin to drive the vehicle and check that the TCU display reads the same as the tacho.

As you approach the limiting speed the operating LED will begin to illuminate.

Note: The LED begins to light at 1/2v which is not enough voltage to affect the cylinder. As you get closer to the maximum speed the voltage increases and eventually the limiter should operate.

If the calibrated speed is different to the tachograph reading, fine-tuning of VR 1 may be necessary.

If the vehicle surges at this speed, adjust VR2 clockwise until the vehicle runs smoothly.
Before disconnecting the TCU, switch the right hand switch onto FREQ. and make a note of the number at the limiting speed.

Note both the speed and the frequency readings on a label and stick it on the ECU, this will help with testing or re-calibration later. Close and seal the ECU.

**CHECKING THE ECU**

Read off the set speed limit and freq. from the label either in the cab or on the ECU

Turn the ignition on.

Switch your TCU to INT. and FREQ.

Start the engine and bring it up to maximum revs.

Turn the adjust knob until you read the frequency indicated on the label, and the revs should drop to approximately 1/2 revs. This shows the limiter is still set correctly.

**RE-SETTING THE ECU WITH THE TCU**

1. Plug the TCU into the ECU’s test socket.
2. Read off the set speed and frequency from the label in the cab or on the ECU.
3. Turn the ignition on.
4. Switch the TCU to INT and FREQ.
5. Dial up the frequency with the adjust knob (as read in 2) onto the display.
6. Switch from FREQ. to SPEED on the TCU.
7. Adjust the CAL. screw on the TCU until the display reads the same as the speed that was read previously from the label in the cab or on the ECU.
8. The TCU is now calibrated to the tachograph.
9. Start the engine with the TCU switched to INT. and SPEED, dial up the speed that you read from the label in the cab or on the ECU operate the throttle fully and make a note of the revs achieved.
10. Turn the adjust knob, until your new speed is displayed.
11. Once again, operate the throttle fully and adjust VR 1 until you achieve the same revs as previously noted in step 9.
12. The ECU is now re-calibrated.
It is necessary to seal all parts of the speed limiter to prevent sabotage. How resistant the system is to sabotage, depends on how well it is sealed.

**GENERAL GUIDELINES**

When using sealing wire, try to avoid tight bends in the wire. This could lead to the wire breaking if subjected to excessive vibration.

If you are bridging large distances with the sealing wire, twist it to give extra strength.

Run the sealing wire as straight as possible over the units to be sealed.

Use sealing paint where it is impossible to use sealing wire.

**SEALING THE PPV**

Run the sealing wire through the pipe connections and the screw that retains the electrical plug.

**SEALING THE AIRLINE CONNECTION**
SEALING THE THROTTLE CONTROL CYLINDER AND THROTTLE LINKAGE

As shown in the diagram below, the pipe connections are wired. Cover all the lock nuts and ball joints with sealing paint to prevent unauthorized adjustment to the linkage.
Check the system mechanically and electronically to see that it is working. This can be done using the test and calibration unit.

We would recommend that the filter element in the Pressure Proportional Valve is cleaned or replaced every 2 years. If you decide to clean the filter, we recommend you use solvent cleaner which will evaporate after cleaning.

If you find that the vehicle’s air quality is extremely poor, we recommend that the existing in-line filter is replaced with an alternative filter to give the P.P.V. extra protection. The part number of this filter is 060-042.
IS THERE POWER TO THE SYSTEM?
The green indicator LED on the speed limiter control unit shows if
the power is on. Alternatively, use a test lamp or multimeter across
the positive (+) and negative (-) terminals on the control unit. The
control unit needs at least 12v before the system will work.

HAS THE FUSE BLOWN?
You can check this by using a multimeter. The indicator LED should
not be on either. If the fuse has blown, check the leads for short
circuits before replacing it.

IS THE CONTROL UNIT GETTING A SIGNAL FROM THE
TACHOGRAPH?
You will need a test and calibration unit (TCU). Set the display
switch to FREQ. and signal switch to EXT. Connect the TCU to the
control unit. Now take the vehicle far a test drive. The frequency
reading should increase in line with the vehicle speed. If no signal
is received, check the signal lead from the tachograph for
damage. Check that the signal lead is also connected properly.

IS THE PRESSURE PROPORTIONAL VALVE (PPV) WORKING?
First, check that the PPV is taking power from the control unit.
Connect the TCU to the unit and set the switches to INT. and
FREQ.. Turn the control knob until the OPERATING LED comes on.
Connect a multimeter across the PPV connections and check if
there is any voltage. If the unit shows a voltage across the positive
and negative terminals, but there is no power in the PPV itself,
replace the two wires.

IS AIR GETTING TO THE PPV?
Undo the air inlet on the Filter side of the PPV and check if there is
air in the pipe. If you have a pressure gauge, check that the air to
the PPV is at the right pressure. Check the filter to see if it is
blocked.

IS THE PPV WORKING?
Once you have completed all the tests above, you need to start
the PPV working. You can do this by turning the control knob on
the TCU until the OPERATING LED comes on. Whilst turning the
control knob slowly, the cylinder should work smoothly until the
cylinder rod has extended by 50mm. If air is getting to the PPV but
the cylinder is not moving, replace the PPV If the operation of the
PPV is erratic try adjusting VR2. This will normally dampen out any
surging effect encountered on road test. If adjustment to VR2 does
d not cure your problem, we recommend replacement of the PPV
We also recommend replacing the PPV if the cylinder moves
jerkily.

If the P.P.V. is working erratically it is normally caused by
contamination (oil residue or sediment) in the vehicle’s air supply
entering the valve. Before replacing the valve with a replacement
item we would recommend that an alternative filter be used to
prevent a re-occurrence of the problem. The port number of this
filter is 060-042.
If the PPV is working properly, but the cylinder is not moving, check for leaks at the valve outlet and cylinder inlet. Check the cylinder itself for leaks as well. If there are no leaks, see if the cylinder is faulty. If it is, replace it.

In a small number of cases we have found that a fuel pump surge can create problems with the speed limiter. Usually, adding a fuel pump return spring directly onto the pump lever cures this. If there is already a return spring connected, it may need a stronger version. If the red operating LED on the ECU lights up and remains lit when the ignition is switched on (with the vehicle stationary and the TCU disconnected) it indicates that there is a breakdown between the ECU and the PPV. This could be due to a broken wire or the electrical connection to the PPV being disconnected.

SURGING/VARIATIONS IN ROADSPeed
The Pressure Proportional Valve is an extremely accurate device for controlling air pressure. Relatively small changes in voltage can cause the output pressure to the cylinder to vary, thus ensuring the accuracy of the speed limiter.

However, occasionally inherent vehicle electrical problems can adversely affect the speed limiter, which could cause it to operate erratically. These problems could be:

- **BAD EARTHS**
  Always ensure that the ECU Negative Connection is to a clean permanent negative/earth terminal, as contact resistance from poor earth would cause voltage differences.

- **POOR BATTERIES**
  If the vehicle's batteries are in poor condition the amount of power available to run all of its electrical circuits is limited. Due to this fact the limiter could fluctuate or alter speed if extra electrical circuits are switched on when the vehicle is moving, i.e. Windscreen wipers, cigarette lighter, etc.

- **POWER SUPPLY**
  Always ensure that the +24V power supply is clean to prevent any excessive current drain, which, in turn, would affect the limiter.

- **SOLENOID WIRING**
  Ensure that there are no joints or connections in the solenoid wiring. These connections could corrode or allow water ingress, which would adversely affect the speed limiter.

- **TACHOGRAPH**
  Tachographs can sometimes cause the limiter to fluctuate or malfunction. Signals into or out of the tacho could surge or at times disappear. This can normally be seen.
The purpose of this unit is to monitor the correct operation of a speed limiter and provide a visual indication if the system has been tampered with or has failed to function correctly.

POSSIBLE CAUSES OF ABUSE

The types of interference encountered to overcome the operation of a speed limiter are listed below and connection of the monitor unit should be capable of detecting any of them:

- Removal of the power supply
- Disconnection of the gearbox sensor
- Removal of the tacho signal
- Tampering with any of the mechanical parts of the speed limiter
- Driving in excess of the maximum set speed of the vehicle

OPERATION

The unit is designed to connect to the Romatic speed limiter electronic control unit. Under normal operation, a master indicator and two LEDs on the monitor unit will be lit at all times when the ignition of the vehicle is switched on. The master indicator may be mounted in a prominent position on the vehicle such as in the front windscreen whereas the monitor unit can be mounted in the cab where the two LEDs may be inspected to diagnose the cause of any malfunction.

The power supply and speed signal are taken from inside the speed limiter ECU. These connections are then monitored. Another protection system within the monitoring unit consists of an anti-tamper loop (similar to domestic security systems). This loop may be run through any part of the speed limiter, such as pneumatic connections or gearbox sensor. If any of these connections are tampered with then the loop will be broken and the monitoring unit will detect it.
When the unit is installed and power applied for the first time, the LEDs on the monitor unit will be 'off' and the remote indicator (MASTER) will also be 'off'. A reset button is provided within the unit which, when pressed will light the two LEDs and the master indicator (provided the ignition is 'on'). The application of the ignition is only to switch on the lights to conserve power when the vehicle is stationary. The two LEDs are used to indicate the type of fault:

- One LED indicates that the vehicle has gone over speed by more than 10% of maximum set speed for a period greater than 20 seconds. The LED will go out if this condition occurs.
- The second LED monitors the anti-tamper loop. If this loop is broken then this LED will go out.

If both LEDs are extinguished then this would indicate both of the above faults OR that the power supply to the speed limiter has been disconnected.

If either of the LEDs go out then the master indicator will also go out. The only method of resetting the system after a failure is to press the reset button within the monitor unit.

**CALIBRATION OF OVERSPEED LIGHT**

The internal red LED, which is controlled by potentiometer, VR1 is normally set by the calibrator to illuminate approximately 10kph above the maximum set speed of the vehicle, i.e. if the illuminator is set to 100kph the monitor LED 1 is set to 110 kph. When the LED illuminates for more than 20 seconds it will automatically put out the Over speed light indicating a fault or tamper condition.

<table>
<thead>
<tr>
<th>Master Indicator</th>
<th>Over speed Indicator</th>
<th>Tamper Indicator</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>1. All in order.</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>2. Mechanical tampering. Vehicle reached 10% Over speed.</td>
</tr>
<tr>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>3. Wiring or mechanical Tampering detected.</td>
</tr>
<tr>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>4. Power disconnected or conditions 2 and 3 detected.</td>
</tr>
</tbody>
</table>
SPEED LIMITER MONITORING UNIT
WIRING DIAGRAM
TOP SPEED LIMITER PLUS LOWER HOLD SPEED FACILITY
This option gives the driver the facility to select a lower limiting speed than the pre-set maximum. This can be of advantage especially in built up areas where speed traps and cameras are now common.

The mechanical installation, i.e. beneath the cob, is exactly the same as that carried out for Top Speed limiters. The difference lies with the electronic control unit, which incorporates a 3-position speed selection switch.

UNDERSTANDING THE E.C.U.

VR1 SET SPEED POTENTIOMETER
Please refer to Page 16

VR2 BAND
Please refer to Page 16

VR101 OFFSET
This potentiometer calibrates the lower speed setting. This is normally factory set but may require fine-tuning on the road.

GREEN LED
Please refer to Page 16

YELLOW LED
This LED indicates that the lower speed option has been selected.

RED LED
Please refer to Page 16

FUSE
Please refer to Page 16

JP1 (JUMPER 1)
Please refer to Page 16
**CON1 (4 PIN CONNECTOR)**
This connector block links the speed hold switch to the ECU. The switch only requires three wires which connect into Normally Open (INO”), Normally Closed ("NC"), and Common ("C"). The fourth connection LED - K can be linked to an indicator lamp fixed to the dashboard to show the lower speed option has been selected.

**WIRING THE E.C.U.**

**BAT -VE**
Please refer to Page 17

**BAT + VE**
Please refer to Page 17

**SOL + VE**
Please refer to Page 17

**SOL -VE**
Please refer to Page 17

**TRANS SIG**
Please refer to Page 17

**HOLD SPEED SWITCH**
The hold speed switch is fitted into the dashboard by drilling a 12mm hole, in a suitable location within easy reach of the driver. It is fitted with Terminal A 1 uppermost (see diagram). A small label is supplied with the switch with ‘Normal’, ‘Resume’, and ‘Set Acc’ printed onto it. Ensure that ‘Normal’ (Top Speed limit) is uppermost alongside A1.

As mentioned earlier, the speed hold switch has three positions, which line up with ‘Normal’, ‘Resume’, and ‘Set Acc’.

1. **NORMAL** - With the switch in the ‘Normal’ position the limiter operates at the pre-set maximum (top speed).
2. **RESUME** - With the switch in the ‘Resume’ position the limiter will return you to the prior lower speed selection.
3. **SET ACC** - When you pull the switch into the ‘Set! Acc’ position and release, the ECU memorizes the current speed and holds the limiter at this speed until the switch is altered or the ignition is switched off.

![Diagram of CON1 connector]
CALIBRATION OF THE E.C.U.
Calibration of the top speed is undertaken in exactly the same manner as covered previously on Pages 24 and 25.
In order to check and calibrate the lower speed hold you would proceed as follows:
Drive the vehicle at a speed lower than the set maximum (speed).
Note this speed and pull down the speed hold switch to the 'Set/Acc' position and then release. This lower speed should now be memorized and the vehicle's momentum should be maintained at this lower speed with the throttle pedal fully open. If the vehicle's speed is slightly higher than that selected, turn potentiometer VR 101 anti-clockwise. If the speed is lower, turn VR101 clockwise.
To accelerate away from this selected speed flick the speed hold switch back up to 'Normal' and the vehicle can return to its pre-set maximum. If you return the switch to the 'Resume' position, the vehicle will decelerate until the previous selected speed is reached and maintained.
In order to alter the selected lower speed, accelerate or decelerate until the new speed required has been reached, pull down the switch to 'Set/Acc', and release. The new speed is now memorized.

DUAL SPEED FACILITY
This option was developed for vehicles that have the top speed limiter fitted as standard but there is also a requirement for a second lower fixed speed, e.g. grizzlies, road sweepers, etc. To select this lower speed option we require a 12V or 24V power supply from the PTO Therefore, when the PTO is operated the ECU automatically switches to operate at the lower speed. To calibrate the ECU to two separate speeds there are two potentiometers, which work independently of each other. The two speeds can be calibrated as detailed in the top speed limiter manual.

UNDERSTANDING THE ECU
The main PCB is wired as covered on pages 15-20. The following items are located on the smaller PCB:

STD POTENTIOMETER
This potentiometer replaces VR 1 on the standard top speed limiter p.c.b by turning it clockwise you can increase the vehicle speed and by turning it anti-clockwise you decrease the vehicle speed.

PTO POTENTIOMETER
This potentiometer controls the lower speed option and works in the same way as the STD Potentiometer.
S.W. 1
This switch needs to be set for the incoming power supply from the PTO. It needs to be in the 'UP' position for 24V and 'DOWN' position for 12V.

PTO INPUT
This is where the 12V or 24V supply from the PTO is connected. It is not necessary to supply the smaller p.c.b. With a negative as this is fed from the main PCB.

POWER TAKE OFF/ REV CONTROL
This system was introduced as an add-on part to the standard kit. It was developed mainly for petro-chemical vehicles where constant rev control is an advantage when the tanker is being off-loaded. Another advantage is that it also prevents the driver from over-revving the engine, which can have a damaging effect on the pumping equipment.

INSTALLATION
Normally this would be incorporated in with the Road Speed Limiter. However, it can be used as a separate unit using a standard Top Speed Limiter kit.

Firstly, you install the equipment as a standard speed limiter.

If a hand throttle is fitted, it needs to be connected to the pedal side of the cylinder and not the fuel pump lever. This prevents the cylinder fighting against the hand throttle when trying to control revs.

If the vehicle has a rod throttle arrangement, i.e. Scania or ERF, an external throttle stop is required. This is fitted on the pedal side of the cylinder. To position this, look for an appropriate position to install a bracket, which stops the linkage at full throttle. This allows the cylinder to push off this stop, gaining maximum control.

For cable throttles no stop is required as the cylinder is always fixed at one end.
The rev signal is taken from either the 'W' post on the alternator or the rev signal generator on the engine. This is connected into the Rev Sig connection on the PCB.

The PTO select on the PCB is connected to a live supply when the PTO is in operation. If the vehicle is a petro-chemical rig, then the PTO is air operated and therefore has no warning light. In this case, to provide a live supply to PTO select, a pressure switch is connected into the air pipe, which goes from the PTO switch in the cab to the PTO Pump. A live supply is connected to one connection on the pressure switch, the other connects to PTO select on the PCB. Therefore, as soon as the PTO is operated, the pressure switch opens and allows power to go the PCB. The rev control works independent of the top speed limiter. To set the appropriate revs you need to run the engine, operate the PTO and open the throttle fully. You may now have some control or the throttle may have collapsed. To set to the desired revs you have to adjust the screw VR3 - CAL PTO. Any surge can be eliminated by adjusting the other screw VR4 GAIN PTO.

When the PTO is to be operated it is essential that the throttle is opened fully. Initially, the revs overshoot but then should settle in the desired position.

Note:
Ensure, when you are setting the revs, that the clutch is depressed to prevent damaging the PTO Pump. Also ensure that the fuel pump you are controlling is proportional, i.e. RQV. If it is RQ, then rev control may not be possible.

**SYSTEM 2000 UTILISING A SHUTTLE VALVE**

This option was originally introduced to reduce the overall cost of the speed limiter kit and to also save on installation time. It can only be used where the truck manufacturer has already inserted a pneumatic cylinder into the throttle linkage. This cylinder also has to close the throttle back to tick over. These cylinders are normally used for engine stops or used in conjunction with Exhaust Brakes, ABS, or ASR.

**UNDERSTANDING THE SHUTTLE VALVE**

The Shuttle Valve is a self-piloted 3-way, 2-position valve. There are two inlets (normally numbered 1 A and 1 B) and one Port (No. 2). Port 2 is always connected to the cylinder. The two inlets allow for two independent air supplies from different sources to be fed into the cylinder. This is accomplished by a ball, which alternately blocks 1A or 1B whilst Port 2 remains ‘open’. The exhaust always runs over the same path as the lost given signal.
INSTALLATION INSTRUCTIONS
Find a position in the pipe which feeds the cylinder which is easily accessible and into which we can introduce the Shuttle Valve. Before you cut this pipe ensure that you have the correct pipe fittings to complete the job. Once you have cut the pipe, connect the section of pipe which is continuing onto the cylinder into Port 2. The other section of pipe is connected into 1 A. The pipe which comes from the Pressure Proportional Valve (and normally connects into the Romatic cylinder) connect into 1 B. The rest of the installation is covered in the Top Speed Limiter Manual.

UTILISING A SHUTTLE VALVE SCHEMATIC

[Diagram showing the connections and labels as described in the text]
PRESSURE PROPORTIONAL VALVE (PPV)

Part Number: 060-020
Valve Function: 3 ports normally closed electrically actuated valve, which enables the outlet pressure to be varied proportionately to the quantity of applied electrical current.

Operating Media: lubricated, non-lubricated or dry compressed air and non-toxic gases filtered to sub-micron.

Operating Pressure: Inlet Pressure = 0 to 10Bar
Outlet Pressure = 1 to 8 Bar
-20c to + 60c

Voltages: Available Voltage - 24v DC
Limiting Current: 0.68 amps
Power Consumption: 11.4 walls
Coil Resistance: 26 ohms
Insulation: F (+155c)
Protection: IP65 to DIN 40050

WORKING CONDITIONS
The PPV takes its power from the ECU. Current consumption is 0.68A when on. The valve controls the working output pressure at variable levels. The working pressure depends on the power supplied from the ECU. The valve cuts in as soon as the ECU supplies power, and stays on until the vehicle’s speed has fallen below the permitted maximum and there is no power coming from the ECU. Maximum input pressure is 10 bar and output pressure is 1 bar min. and 8 bar max. Maximum consumption in active use is 11.4 walls.

MINIATURE IN-LINE FILTER
Port Number: 060-036
Filter Function: To provide optimum performance in minimum space. A filter element that removes particles above 40 microns.
Particle Removal: 40 Um
### ELECTRONIC CONTROL UNIT (ECU)

<table>
<thead>
<tr>
<th>Part Number:</th>
<th>E215</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECU Function:</td>
<td>The Electronic Control Unit has been specially designed for controlling the top speed on commercial and public service vehicles.</td>
</tr>
</tbody>
</table>

| Input Voltage (Min.): | 12v DC |
| Input Voltage (Max): | 28v DC |
| Input Frequency (Min.): | 30Hz |
| Input Frequency (Max): | 1000Hz |
| Operating Temperature: | -20c to +60c |
| Power Consumption: | 2.8W (at 28v) (without operating The solenoid) |
| Max Output Current: | 1 amp |
| Top Speed limiter: | Box Dimension |
| Length: | 120mm |
| Width: | 100mm |
| Depth: | 46mm |
| Protection Glass: | IP55 (This is dependant upon mounting). |

### WORKING CONDITIONS

The ECU requires a power supply of not less than 12 volts and not more than 28 volts. Power consumption is 1 A when on. The ECU has a wide ‘climatological’ working range of between approximately -20 and +60 Celsius. The system is also designed to withstand very high levels of humidity.

### THROTTLE CONTROL CYLINDER

| Port Number: | Various |
| Cylinder Function: | Single acting, non-cushioned. |
| Operating Medium: | Compressed air, filtered and lubricated. |
| Operating Pressure: | 1 to 10 Bar |
| Operating Temperature: | -20c to +80c |

### WORKING CONDITIONS

The Throttle Control Cylinder is an unbuffered single-action cylinder of 50mm stroke. Maximum working pressure is 10 bars. The operating temperature range is between approximately -20 and +80 Celsius.
**DESCRIPTION** | **PART NUMBER** | **PARTS LIST**
--- | --- | ---

**COMPLETE ASSEMBLIES**

**ELECTRONIC CONTROL UNITS**
- TS ELECTRONIC CONTROL UNIT | E215
- TS ELECTRONIC CONTROL UNIT WITH DUAL SPEED FACILITY | E203
- TSL ELECTRONIC CONTROL UNIT WITH PTO CONTROL | E199
- TSL ELECTRONIC CONTROL UNIT WITH LOWER ‘HOLD’ SPEED FACILITY | E217
- TSL ELECTRONIC CONTROL UNIT WITH LOWER ‘HOLD’ SPEED FACILITY PLUS PTO CONTROL | E198

**VALVES, FILTERS, AND SWITCHES**
- IN LINE FILTER | 060-036
- FILTER /SEPARATOR | 060-042
- PRESSURE PROPORTIONAL VALVE (PPV) ASSEMBLY | 060-020
- PPV PLUS AIR LINE FILTER – ASSEMBLY | 060-022
- SHUTTLE VALVE | 060-28
- LOWER SPEED HOLD SWITCH | E166
- LOWER SPEED HOLD SWITCH (ECONOMY) | E409
- MICRO SWITCH | ES135
- PRESSURE SWITCH ASSEMBLY (PTO) | 160-01-003

**CYLINDERS**
- 50MM STANDARD – PUSH | 001-79
- 50MM HEAVY DUTY - PUSH | 001-72
- 50MM LIGHTWEIGHT - PUSH | 001-05
- 50MM LIGHTWEIGHT – PULL | 001-06
- 50MM HEAVY DUTY – PULL | 001-86

**ACCESSORIES AND FITTINGS**

**PIPE FITTINGS**
- 8MM INSERT | 080-05-002
- 8MM OLIVE | 080-06-002
- 8MM NUT (CROSS DRILLED) | 080-07-010
- 1/8 BSP TO 5/16 PIPE ELBOW | 080-03-011
- 1/8 BSP TO 1/4 BSP UNION (CROSS DRILLED) | 004-003
- 1/4 X 1/4 BSP UNION (CROSS DRILLED) | 004-004
- 1/4” BSP NUT (CROSS DRILLED) | 004-005
- 1/2” X 24 T.P.I. NUT (CROSS DRILLED) | 004-006
### SENSORS
- GEARBOX SENSOR (MECHANICAL) 003-01
- GEARBOX SENSOR (ELECTRO-MECHANICAL) 003-05
- LUCAS SENSOR ELECTRONIC TACHO E150
- V-ROOT SENSOR ELECTRONIC TACHO E151
- LUCAS TACHO ENDS (CLAW TYPE) E152
- LUCAS TACHO HEAD PLUG E233
- V-ROOT TACHO PLUG EH110CN

### BRACKETRY FITTINGS
- M8 BALL JOINT BODY 005-61
- M6 BALL JOINT BODY 005-63
- M8 BALL JOINT 005-128
- M6 BALL JOINT 005-41
- M8 X M6 MALE ADAPTOR 005-67
- M8 X M6 FEMALE ADAPTOR 005-68
- 8MM FEMALE TO 6t-AM MALE ADAPTOR 005-85
- 8MM ROD X 1 OCM LONG THREADED 005-64
- 6MM ROD X 10CM LONG THREADED 005-65
- 8MM ROD X 20CM LONG THREADED 005-134
- 6MM ROD X 20CM LONG THREADED 005-135
- M.S. STUD ZINC PLATED (LARGE) 005-004
- M.S. STUD ZINC PLATED (SMALL) 005-003
- 6MM NUT 170-062
- M8 HALF LOCK NUT 170-067
- 18MM BRASS LOCK NUT 001-77
- 5/16 UNF FULL LOCK NUT 005-005
- 3/8 BSP BRASS LOCK NUT 01-040-05
- M8 SPRING WASHER 170-059
- M18 SHAKE PROOF WASHER 001-81
- 11MM FIBRE WASHER 005-006
- 8MM FIBRE WASHER 005-007
- 3/8 BSP BRASS BUSH 005-002
- SMALL SWIVEL ASSEMBLY 005-143
- LARGE SWIVEL ASSEMBLY 005-142
- FLAT BAR 25MM X 3MM X 200MM 200-019
- BOWDEN CABLE/ADAPTOR 8MM THREADS 001-87
- SOLDERLESS NIPPLE 180-029
- ROTARY CABLE CLAMP 180-064
- VARIOUS BRACKETRY FITTINGS E236