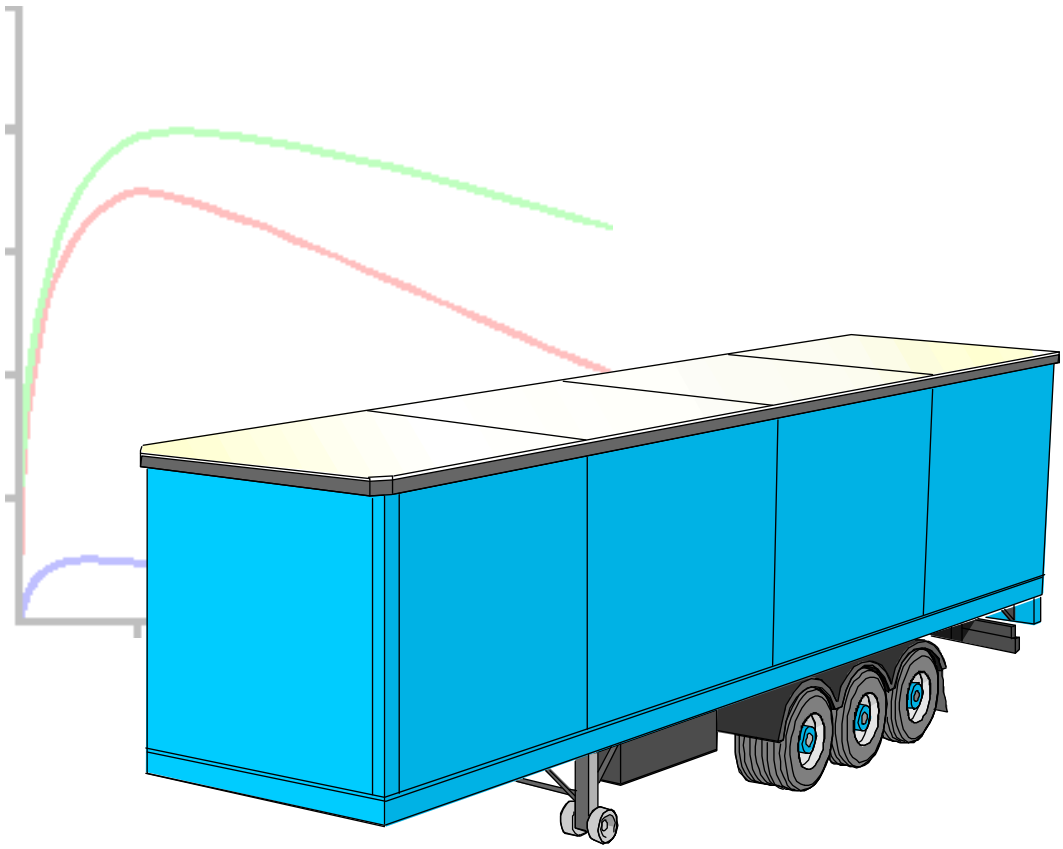
WABCO



TRAILER ABS

Date:

Name:

Company:

Training

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page

ABS Control Theory

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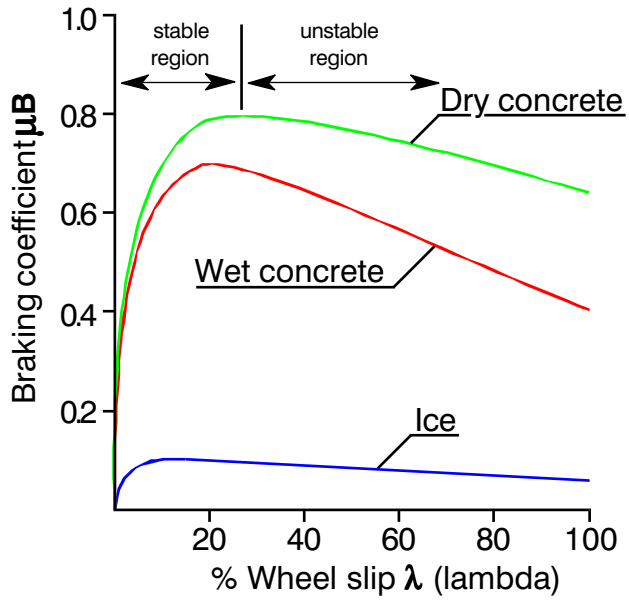

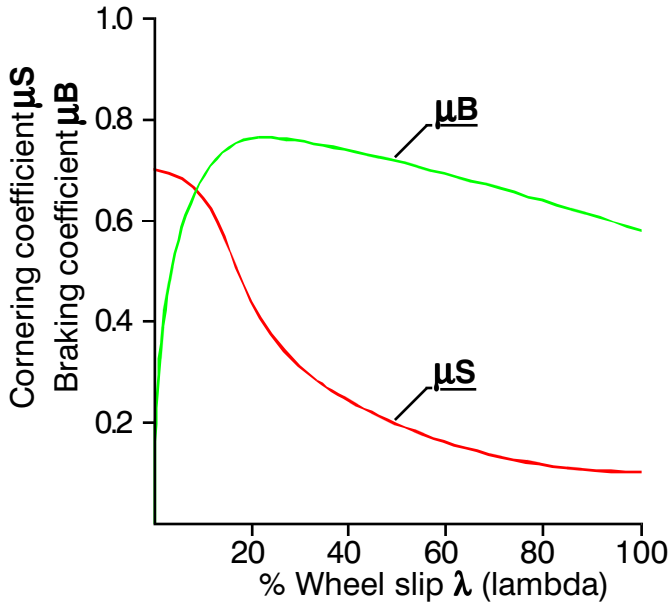

Typical Tyre/Road Surface Characteristics

notes:

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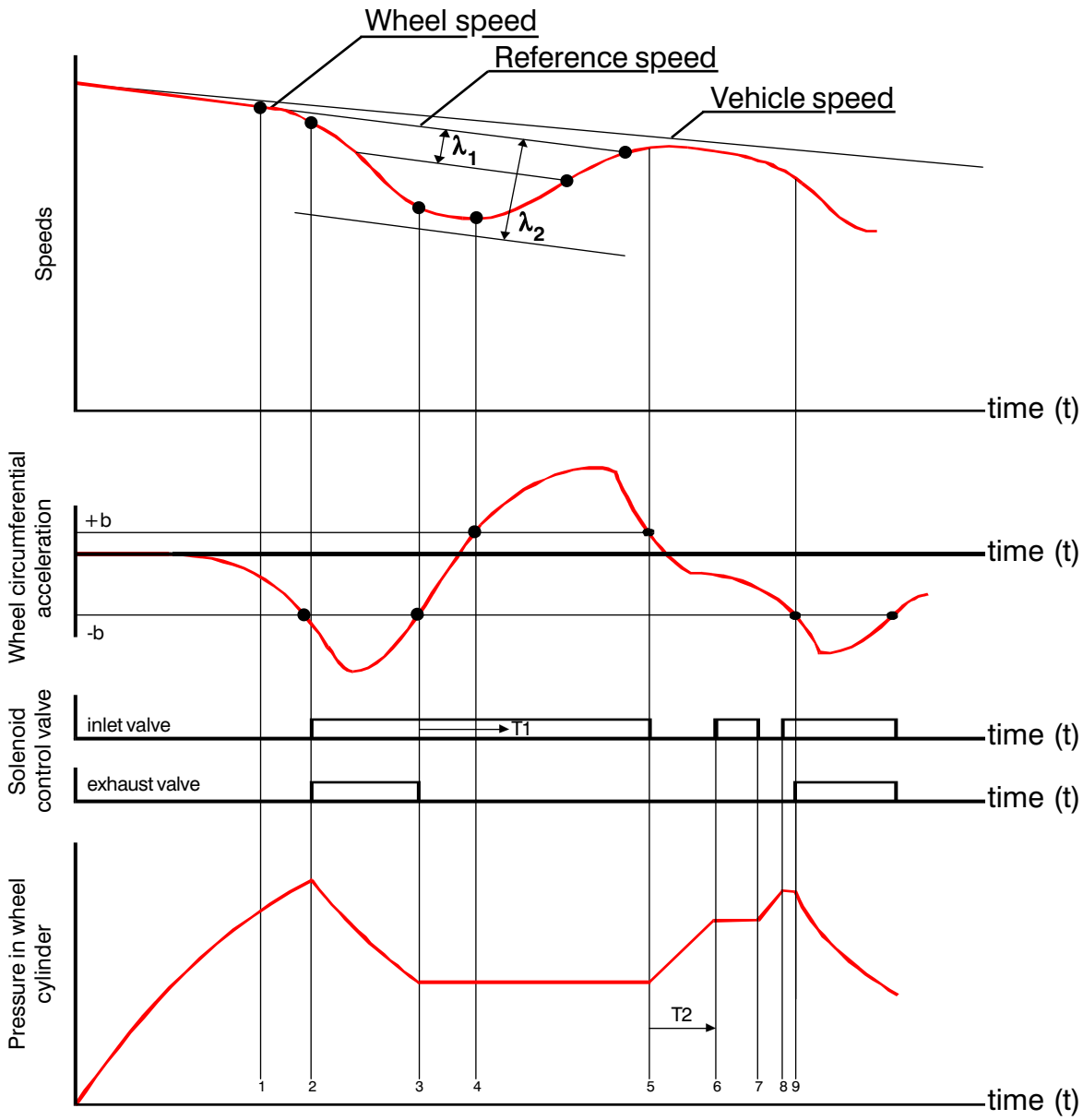

Typical ABS Control Cycle (ii)

notes:

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In the typical ABS control cycle the most important control variables are; wheel deceleration threshold -b, wheel acceleration threshold + b and slip thresholds Lambda 1 and Lambda 2.

When the brake pressure increases, the wheel is progressively decelerated. At point 1 wheel deceleration exceeds a value that cannot physically be reached by vehicle deceleration. The reference speed and the wheel speed, which up to this point had been the same, now diverge until at point 2 the wheel speed has achieved a high deceleration (exceeding the -b threshold) - typically 1.2g. A maximum value is derived from the reference speeds of the wheels of a control group and this is generally used as the mutual reference speed for the two wheels. Wheel slip is calculated from actual wheel speed (i.e. sensor output) and the corresponding reference speed which is electronically computed from all sensed wheels.

The deceleration threshold -b is exceeded at point 2. The wheel now moves into the unstable region of the μ-λ slip curve at which point the wheel has reached its maximum braking force and any further increase in braking torque increases only the rate at which the wheel decelerates. For this reason brake pressure is quickly reduced and so wheel deceleration decreases. The time taken for wheel deceleration is determined by the hysteresis of the wheel brake and by the characteristic of the μ-λ slip curve in the unstable region.

Only after wheel brake hysteresis has been overcome does a continued reduction in pressure lead to a decrease in wheel deceleration.

At point 3 the deceleration signal -b drops below the threshold and the brake pressure is held at a constant level for a set time T1. Normally, wheel acceleration will exceed the acceleration threshold + b within this set time (point 4). So long as this threshold is exceeded, brake pressure is kept constant. If (for example on a low friction surface) the + b signal is not generated within time T1, brake pressure is further decreased by slip signal Lambda 1. During this control phase the higher slip threshold Lambda 2 is not reached.

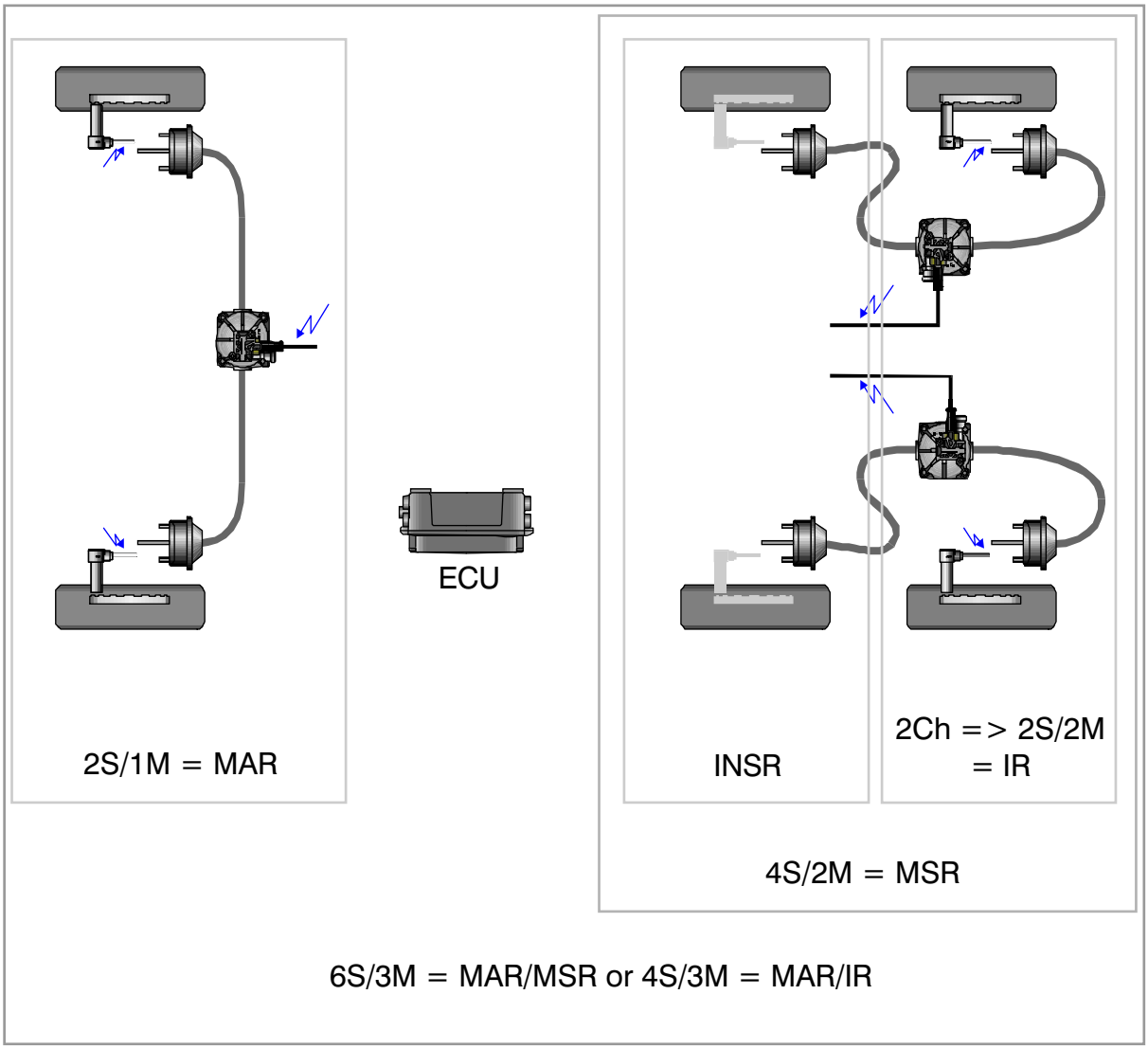
After falling below the threshold at point 5 the +b signal drops. The wheel is now in the stable region of *the* μ-λ slip curve and the μ-value utilised is somewhat below the maximum.

Brake pressure is now rapidly applied for time T2 to overcome brake hysteresis. This time T2 is fixed for the first control cycle and then calculated anew for each subsequent control phase. After the initial rapid phase, brake pressure is then increased more gradually by “pulses”, that is to say by alternating pressure hold and pressure increase.

The logic described here is not fixed but rather adaptable to the dynamic behaviour of the wheel for different coefficients of friction. The thresholds for wheel deceleration, acceleration or slip are likewise not constant, dependent upon several parameters, such as vehicle speed. The number of control cycles results from the dynamic behaviour of the total control loop of the ABS system – wheel brake, wheel and road surface. Here, adhesion is of paramount significance. 3 to 5 cycles per second are normal but significantly less on wet ice.

Typical ABS Control Cycle (i)

The Vario-C Concept



Modular System Concept VARIO-C

notes:

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With the increased use of self-steering axles on semi-trailers the following must be taken into account when installing WABCO Vario-C ABS.

1. When using 4S/3M or 6S/3M systems the steering axle MUST be controlled by the MAR (Modified Axle Regulation) circuit.
(i.e. Single modulator controlling both brake chambers on that axle) - see diagram 1

2. With 2S/2M and 4S/2M systems, where each side of the vehicle is controlled by a single modulator, the axle MUST be controlled using Select Low Regulation (SLR). This can be achieved by using a 'select low' double check valve*, which takes inputs from both modulators, the lowest being used to control both actuators on the steering axle. - see diagram 2

The purpose of the above is to prevent a steering torque being developed, on split coefficient surfaces, across the axle, due to different braking forces being generated by each wheel, which could cause vehicle instability under braking.

* Part No. 434 500 000 0

diagram 1 - 6S/3M & 4S/3M

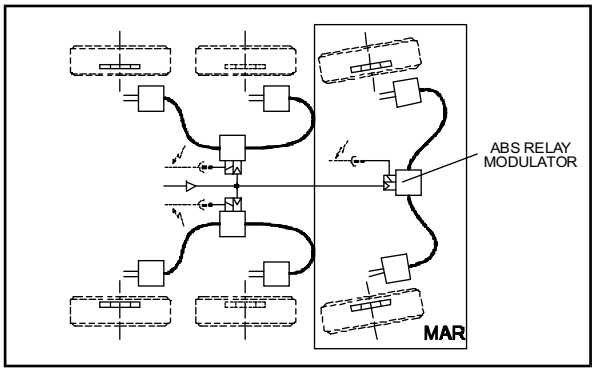
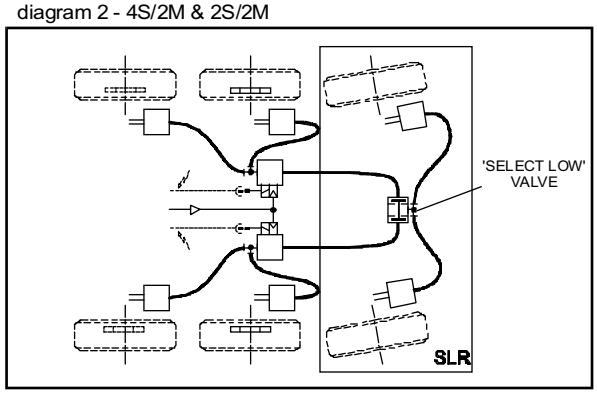


diagram 2 - 4S/2M & 2S/2M



Self-steering Axles and ABS

notes:

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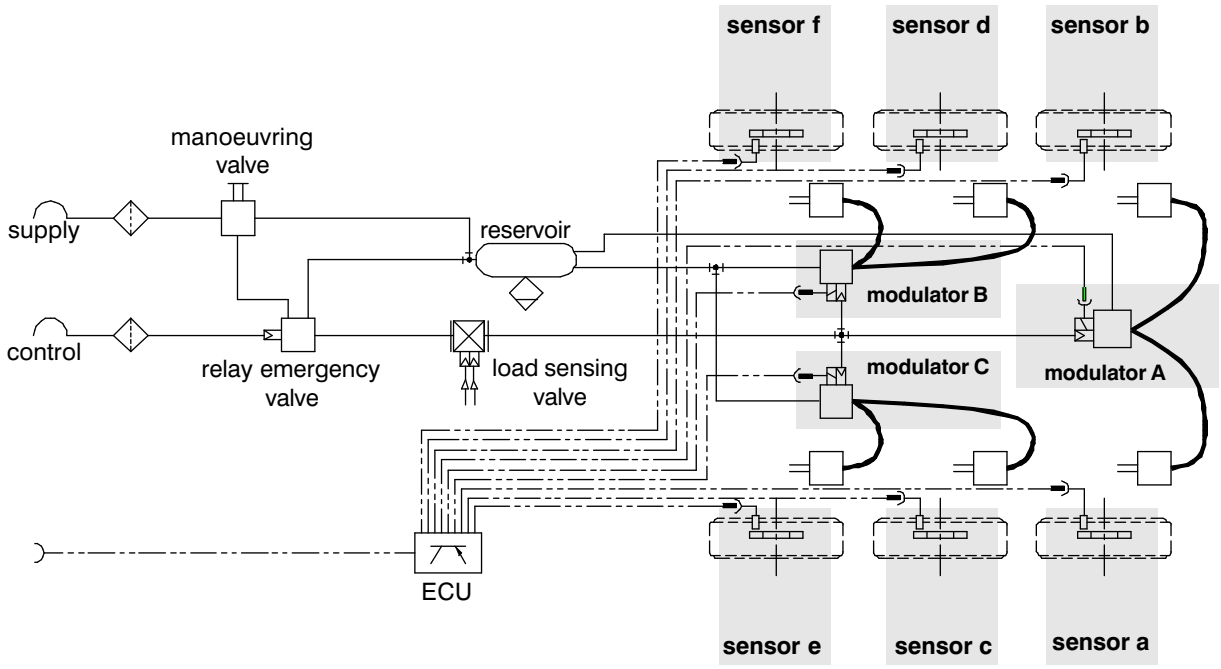


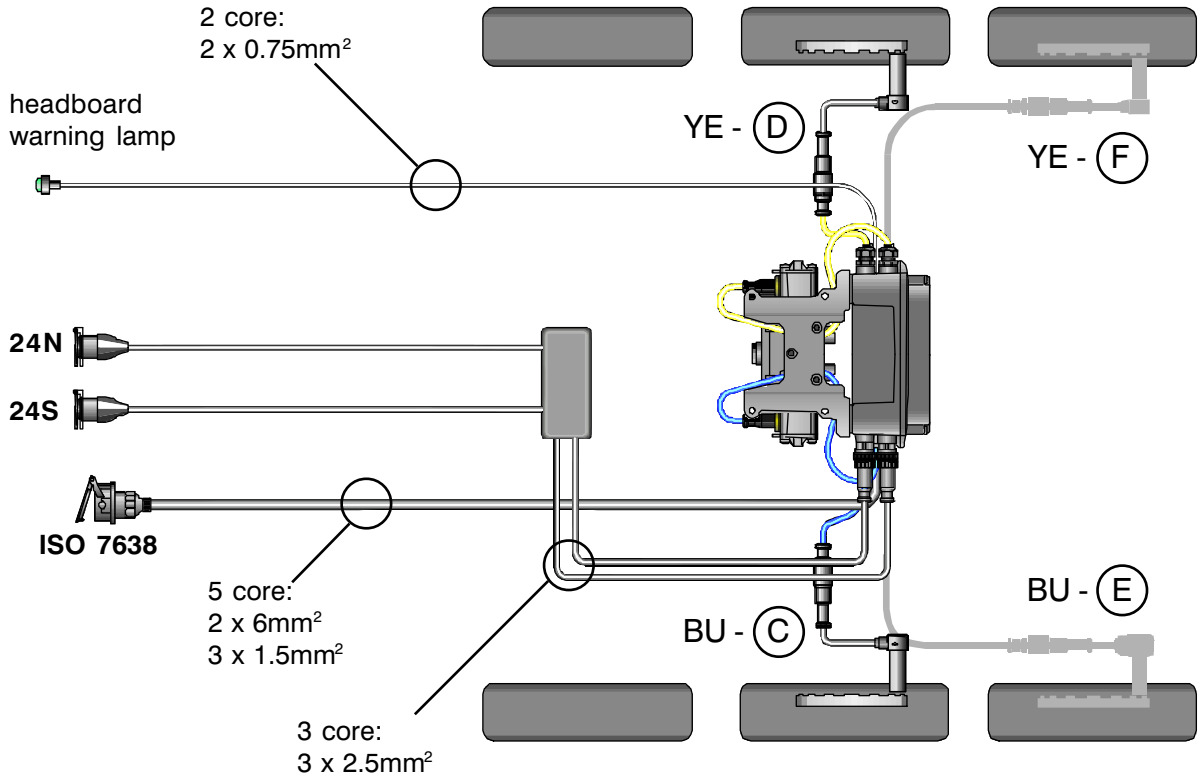
Modulator A and sensors	-	Red ECU baseplate
Modulator B and sensors	-	Yellow ECU baseplate
Modulator C and sensors	-	Blue ECU baseplate

Tri-Axle Semitrailer 6S/3M

notes:

WABCO

Component and Power Supply Wiring



Vario C Integral 4(2)S/2M

notes:

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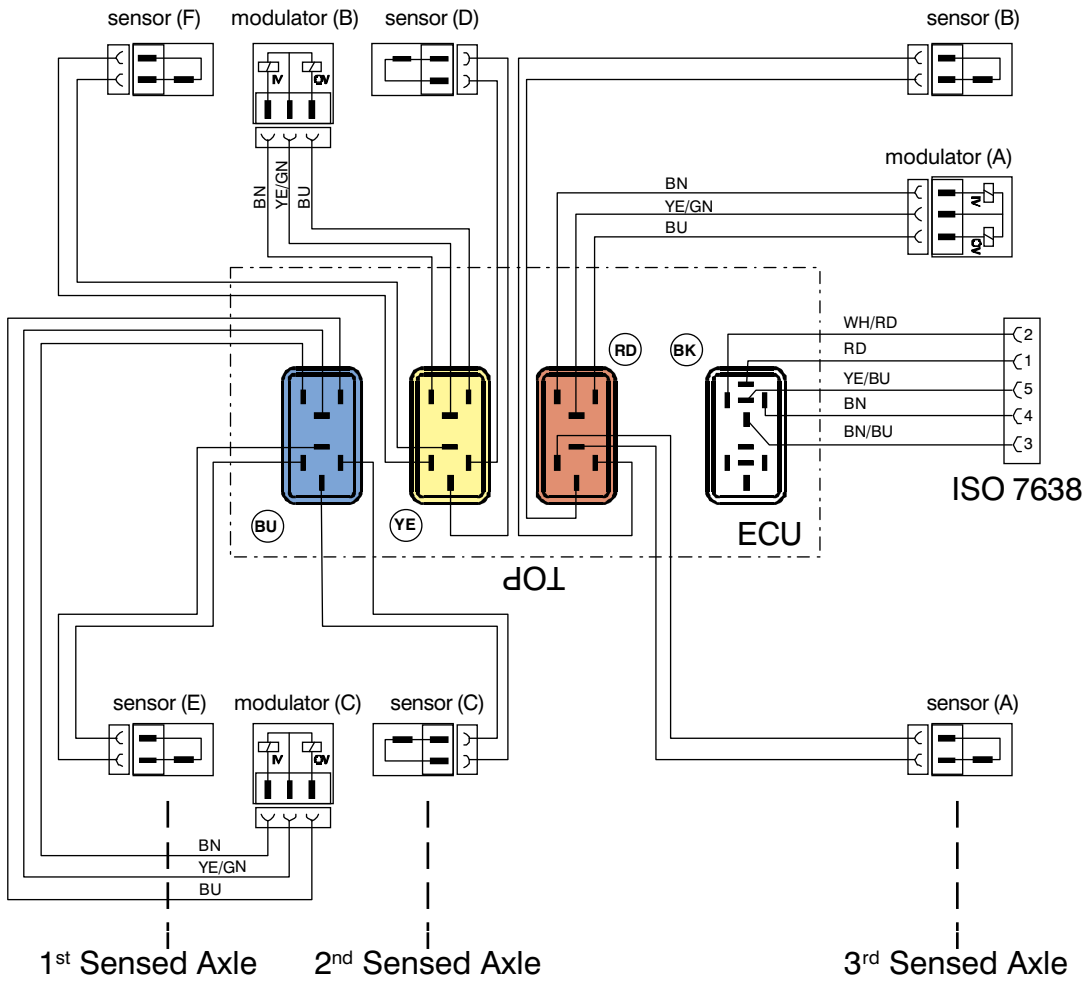

IV	-	Inlet Valve	BK	-	BLACK
OV	-	Outlet Valve	BN	-	BROWN
			RD	-	RED
Direction of Travel			YE	-	YELLOW
			GN	-	GREEN
			BU	-	BLUE
			WH	-	WHITE

6S/3M Wiring Diagram

notes:

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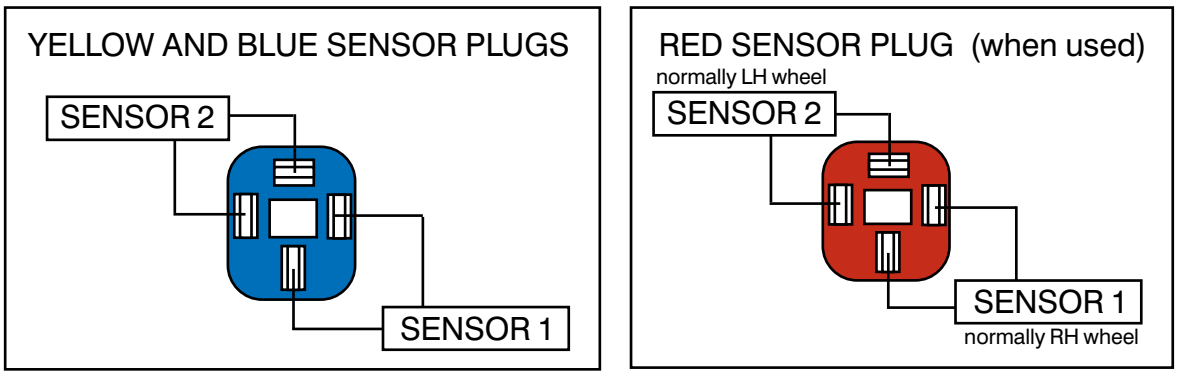
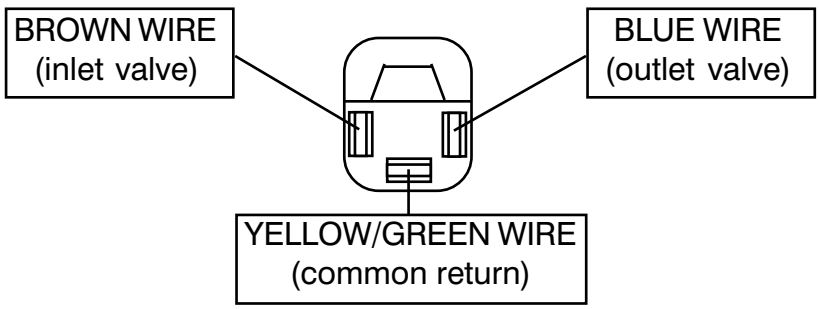
1) The blue channel is normally on the vehicle LH side
2) The yellow channel is normally on the vehicle RH side
3) If the red channel is used it will be controlling both brakes on one axle and not on one side of the vehicle, as with the yellow and blue channels.
4) Where the red channel is used both sensor inputs must be connected
5) If only one sensor per side is used to control the blue and yellow channels they must be connected to Sensor 1 of the respective sensor plug and not to sensor 2.

Sensor / relay modulator plug connections at the ECU are as below - viewed from the wire entry side.



NOTE: The brown/black sensor wires are not polarity conscious and can be inserted into the sockets either way round.

RELAY MODULATOR PLUGS - all channels



Sensors/Relay Modulators

notes:

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MODULATORS

A	RED BASE PLATE	-	BOTH ACTUATORS ON SINGLE AXLE
B	YELLOW BASE PLATE	-	ACTUATORS NORMALLY ON RH SIDE
C	BLUE BASEPLATE	-	ACTUATORS NORMALLY ON LH SIDE

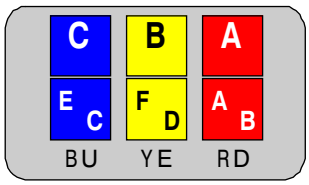
SENSORS

A	RED BASEPLATE	-	SENSOR 2 INPUT
B	RED BASEPLATE	-	SENSOR 1 INPUT
C	BLUE BASEPLATE	-	SENSOR 1 INPUT
D	YELLOW BASE PLATE	-	SENSOR 1 INPUT
E	BLUE BASEPLATE	-	SENSOR 2 INPUT
F	YELLOW BASEPLATE	-	SENSOR 2 INPUT

Sensor/Modulator, channel and Wheel Assignments

notes:

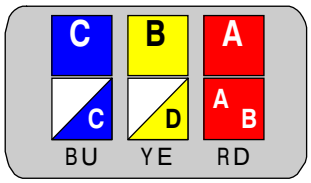
6S/3M



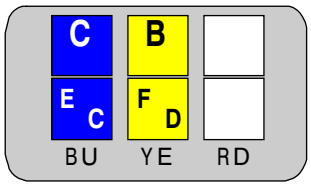
Modulators (3 pin)

Sensors (4 pin)

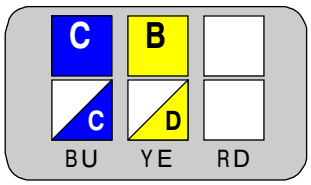
4S/3M



4S/2M



2S/2M



Sensor/Modulator inputs on ECU Baseplate

notes:

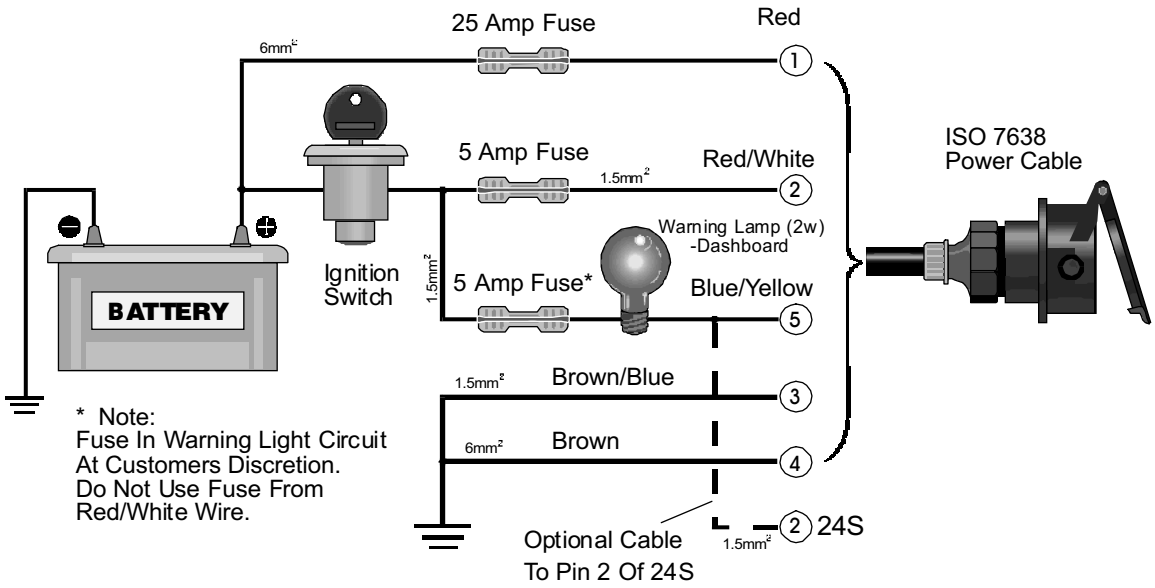
WABCO

For tractor units and drawbar trucks not fitted with an ABS power cable to ISO 7638, the following shows what is required and how it is installed.

ISO 7638 POWER CABLE (12 metre - 24volt)	**446 010 012 2**
PARKING SOCKET (tractors only)	**446 008 600 2**
DASHBOARD WARNING LAMP (red/amber - 2W typical)	**CUSTOMER SUPPLY**
FUSES	**CUSTOMER SUPPLY**

ISO 7638 CABLE	RED	BATTERY POSITIVE THROUGH 25 AMP FUSE
	RED/WHITE	IGNITION SWITCHED THROUGH 5 AMP FUSE
	BROWN	COMMON RETURN TO BATTERY NEGATIVE
	BROWN/BLUE	COMMON RETURN TO BATTERY NEGATIVE
	YELLOW/BLUE	DASHBOARD ABS WARNING LAMP

For vehicles with a supplementary power cable, the dashboard warning lamp can also be controlled via pin 2 of 24S, thereby removing the need to observe the headboard warning lamp when the ISO 7638 power cable is absent from the trailer



ISO 7638 Power Supply

notes:

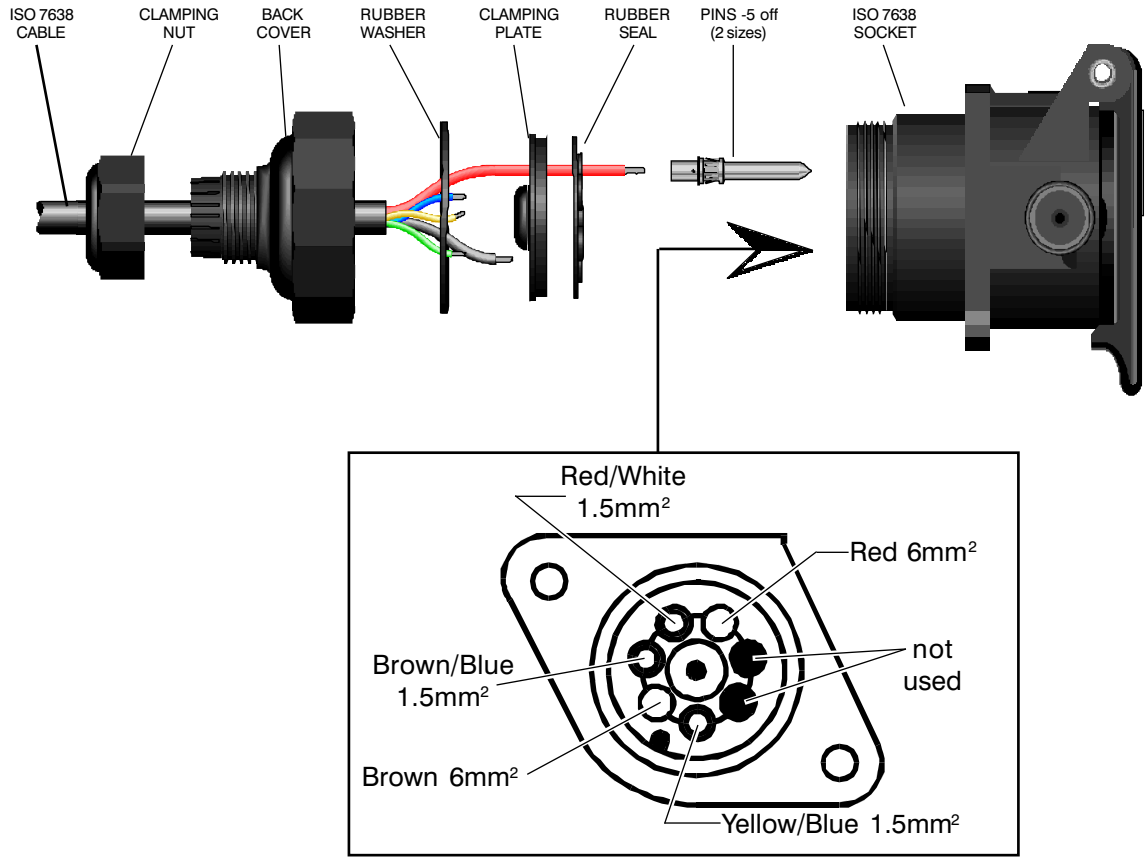
WABCO

For correct assembly, fit together as shown below.

1. Prepare cable / strip ends.
2. Feed through clamping nut ; back cover ; rubber washer ; clamping plate and rubber seal.
3. Insert wires into relevant pins.

note: 2 pin sizes for 2 wire sizes

4. Check full insertion through view hole and crimp the pin wall around bare wire.
5. Push barbed pins firmly into the iso connector as detailed below.



ISO 7638 - Assembly

notes:

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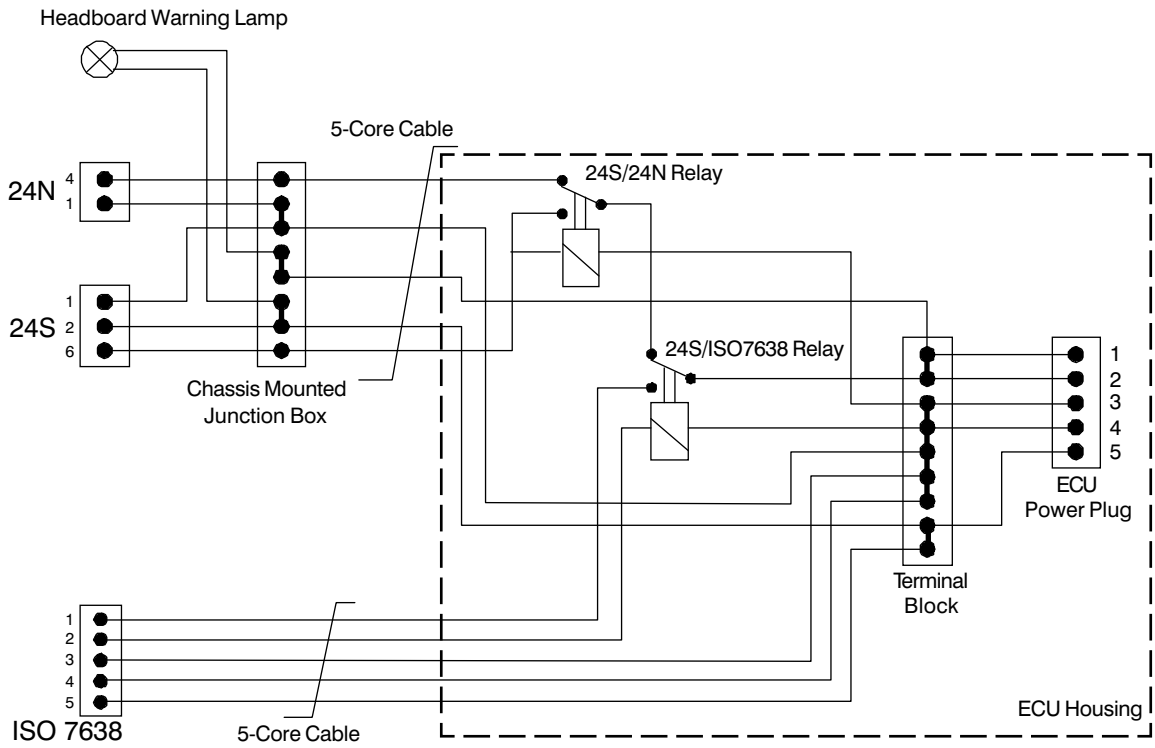


24N/24S/ISO7638 Power Supply

notes:

WABCO

The Boxer unit accepts all three forms of power supply:-
The ISO 7638 uses the standard five pin connector. The 24S and 24N both use the WABCO 3 core modulator cables (894 601 ... 2 series) which terminates at screwed connections on the side of the ECU housing. The colour for the wires is:-

	Brown	Positive Supply
	Yellow/green	Negative Return
*	Blue	Dashboard Warning Light

* For 24N, this wire is redundant in diag. 2 and should be cut back flush with the outer sheathing.

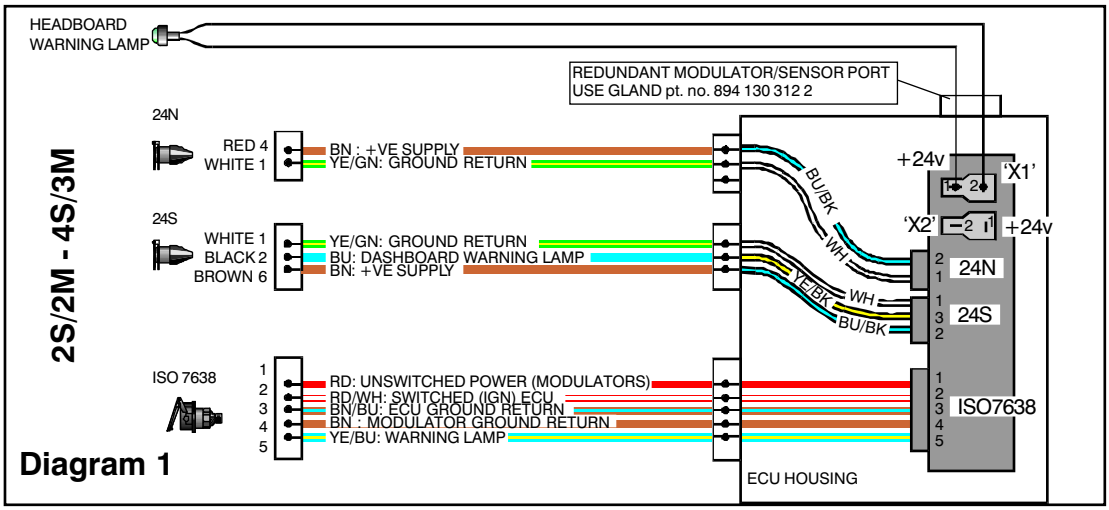


Diagram 1

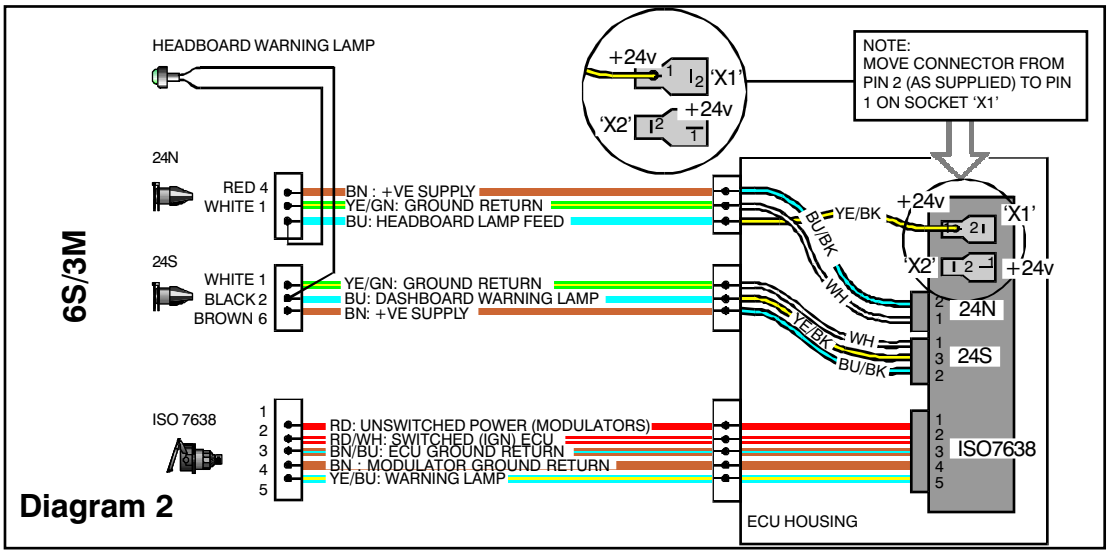


Diagram 2

Power Supply and Warning Lamp

notes:

THERE EXISTS THREE BASIC FORMS OF ABS POWER SUPPLY FOR TRAILERS. THEY ARE AS FOLLOWS;

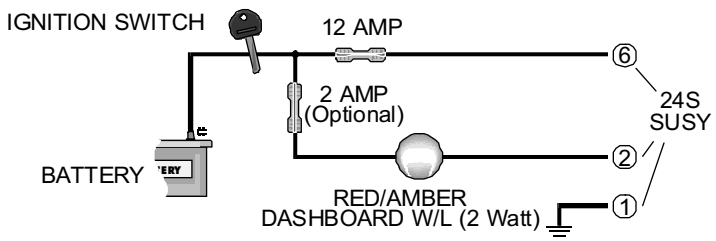
- **24S, A SECOND SOURCE OF CONSTANT POWER**
- **ISO 7638, A DEDICATED ABS POWER SUSY**
- **24N, A FEED FROM THE STOP LIGHT CIRCUIT**

TRAILERS SHOULD BE WIRED TO SELECT THE HIGHEST PRIORITY OF POWER AVAILABLE. THE 24N (STOP LIGHT CIRCUIT) SHOULD ONLY BE REGARDED AS AN EMERGENCY "GET YOU HOME" SETUP.

MOST VEHICLES DO NOT HAVE AN ISO 7638 POWER SUSY. THOSE FITTED WITH A 24S SUSY ARE USUALLY NOT CONNECTED AT THE RELEVANT PINS AND ARE THEREFORE ONLY USING THE STOP LIGHT 24N CIRCUIT TO POWER THE ABS.

THE DIAGRAM BELOW SHOWS HOW TO CONNECT THE 24S SUSY AND PROVIDE A DASHBOARD ABS WARNING LIGHT.

DO NOT FEED THE DASH BOARD WARNING LIGHT THROUGH THE 12 AMP FUSE POWERING PIN 6. USE AN ADDITIONAL 2 AMP FUSE IF REQUIRED.



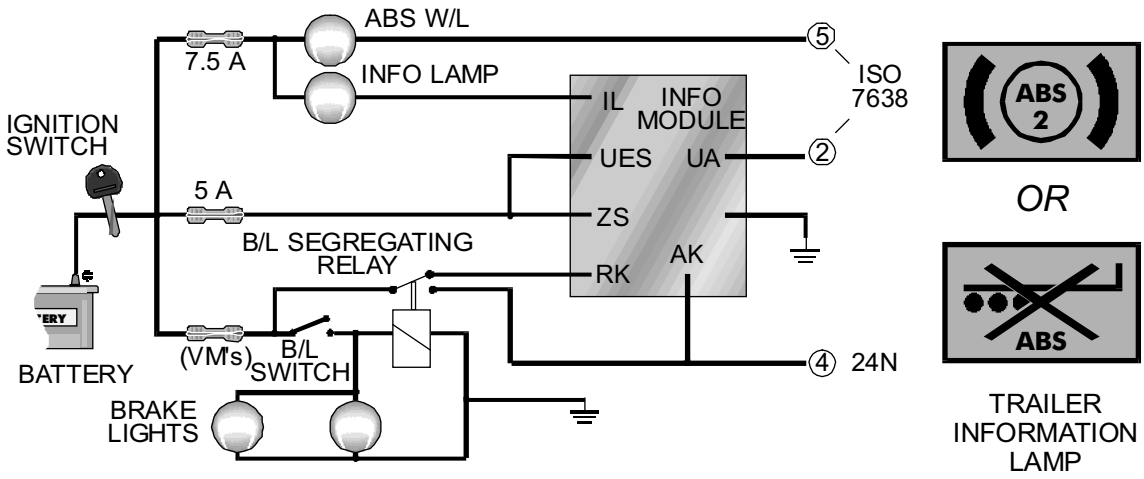
THIS WILL GIVE A CONSTANT POWER SUPPLY TO THE TRAILER PROVIDING THE TRAILER IS WIRED TO ACCEPT A 24S SUPPLY

24S Supplementary Power

notes:

WABCO

Information lamps are controlled by the information module and serve to inform the driver that his vehicle is coupled to a trailer without ABS. Unlike the ABS warning light, there are no legal requirements, fitment being at the discretion of the VM's (Vehicle Manufacturers).
The lights are usually orange or yellow and either resemble the tractor ABS warning light with a number or depict a trailer crossed out and the letters ABS underneath.
Detection of current to the trailer ABS is via pins UES and UA. Pins RK and AK together with the segregating relay, control a latching system and separate the motor vehicle brake lights from those on the trailer.



How it works:

The module first determines if the tractor has a trailer attached to it by reading the resistance in the indicator circuit via the 24N connector.
For an infinite resistance, it assumes no trailer is present and keeps the light OFF. If a resistance exists, the module would know that a trailer is coupled and look for a current drain to the trailer ECU on pin 2 of the ISO 7638 susy.
A drain on this pin indicates that the trailer is equipped with ABS; the information light will remain OFF. The light turns ON only if no drain is observed, indicating that ABS is not fitted.

ABS Information Lamp (i)

notes:

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24S / 24N Power Supply

Vehicles fitted with an information module may not recognise the presence of an ABS system when towing trailers which are powered by either the supplementary or the stoplight circuit. Operators wishing to dispense with the information lamp can adopt one of the following:-

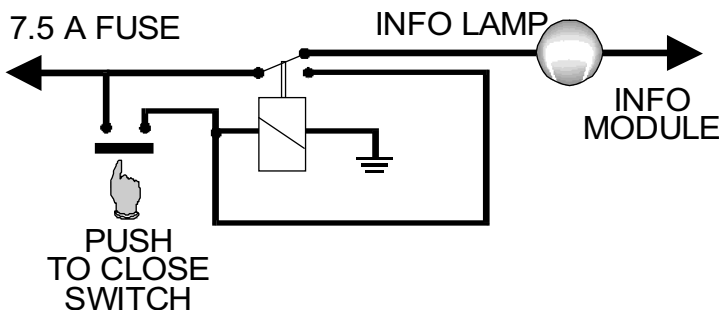
① Remove lamp and blank off aperture in dash panel.

or

② Discard information module. Identify terminals UES and UA on the base housing and bridge together using a suitable wire link.

or

③ Fit an additional relay and push button 'latch out' switch.



How it works

On picking up a trailer without ABS or one which is powered by an alternative supply (24S/24N), the light will illuminate. The adjacent button will latch the relay and turn the lamp off.
Once the ignition has been keyed off, the circuit will reset itself to normal operation.

ABS Information Lamp (ii)

notes:

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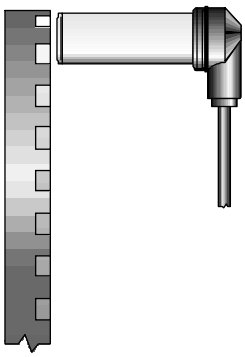
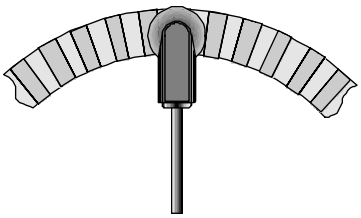
Sensor and Modulator Function

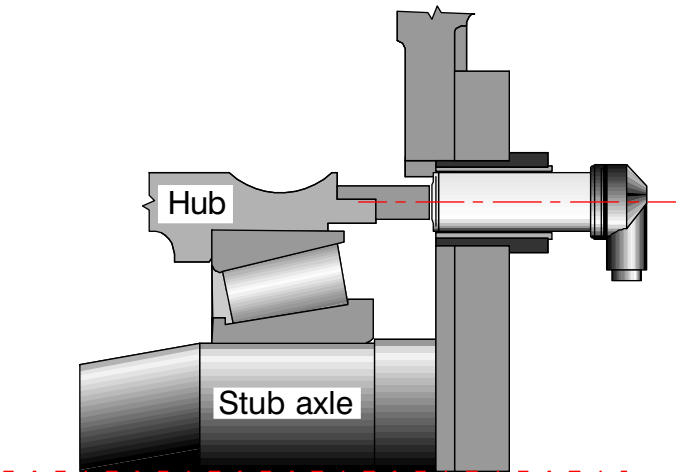
1 Pole wheels must run square to the axle.



2 Pole wheel teeth must be free from burrs or bruising - **NO DAMAGE ALLOWED**.

3 Sensors must be central over the pole wheel teeth.





Axle Installation

notes:

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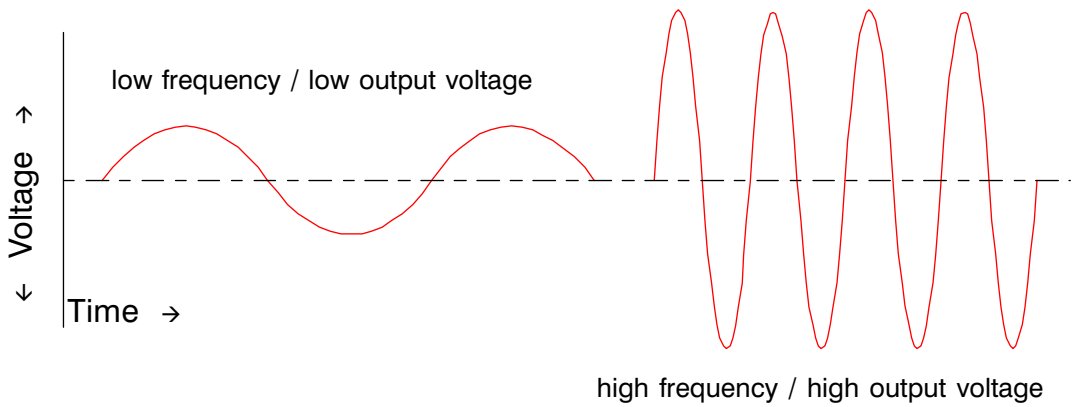

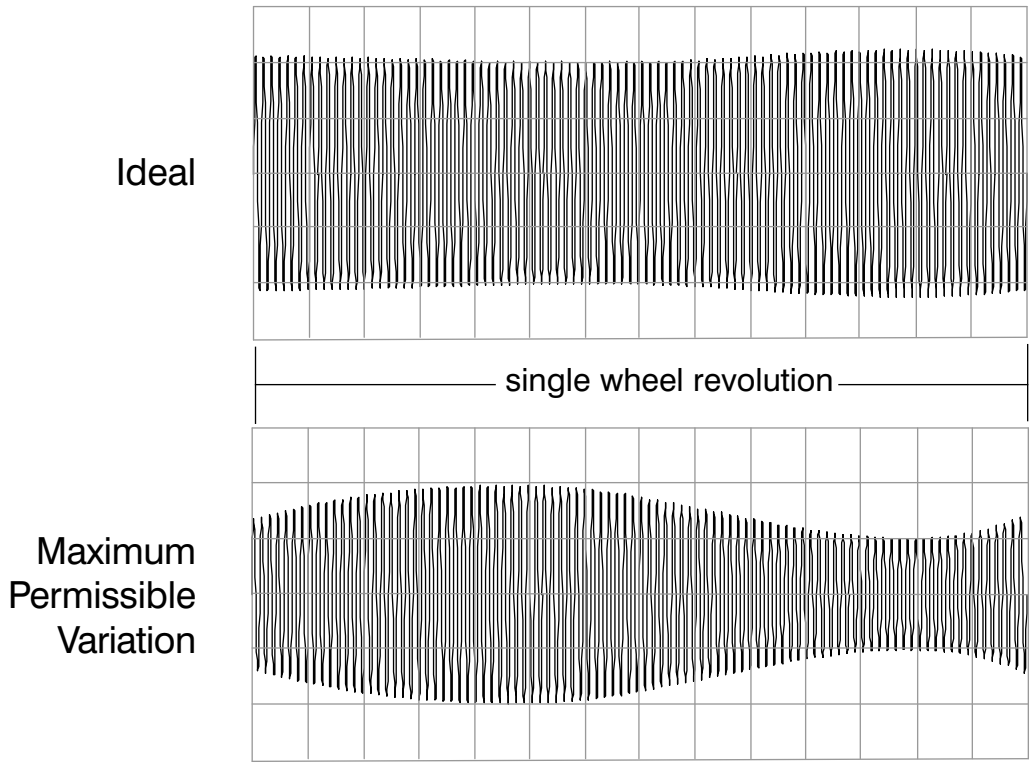

Sensor Output Voltage

notes:

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The output voltage from the sensor is AC. From this the electronic control unit (ECU) determined the individual wheel speed, which is proportional to the AC frequency. Moreover, the ECU continually assesses any rate of change in frequency which is a direct measure of the wheel's deceleration (or acceleration). Together with the speed information it establishes whether corrective action is required to prevent the onset of wheel locking.

To work effectively the output signals from the sensors must be readily understood by the ECU.

They must:

1) Give sufficient output voltage;
2) Have a reasonably steady output voltage at any given wheel speed;

and

3) The waveform should not deviate significantly from its sinusoidal pattern.

To these ends:

1a) The air gap between polewheel and sensor should be maintained at the absolute minimum - generally less than 0.5mm.

2a) Polewheel run-out and bearing clearances should be kept as small as possible - the combined effect on change in air gap not exceeding 0.2 mm.

3a) The polewheels should be free of any damage, the change in air-gap between adjacent teeth being no more than 0.04mm.

Providing the above criteria are satisfied:

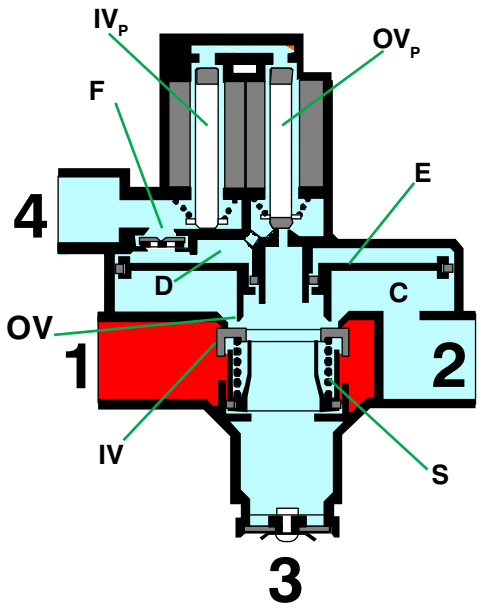
1b) The output voltage will exceed the minimum allowable figure of 0.1 v RMS. (this assumes that the wheel is turning at a constant speed of approx.0.5rev/sec.)

2b) The ratio of maximum to minimum output voltage when rotating at constant speed will not exceed 2.2 : 1 i.e. if the min value is 0.3v the max must not exceed 0.66v.

3b) The change in voltage amplitude between adjacent teeth will be inside specification. One deviation greater than 30% or two deviations greater that 20% is cause for rejection. (A diagnostic controller must be used as verification whenever polewheel damage is suspected).

Sensor Output Signal

notes:

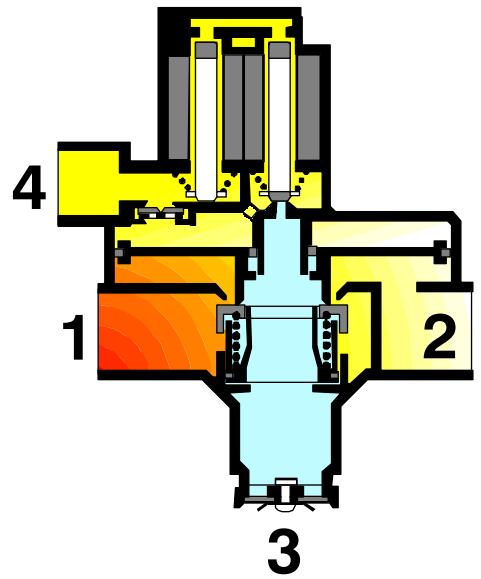


Valve Operation

Example 1:
Supply pressure at port 1 (e.g. 8 bar), no control pressure at port 4.
The spring (S) forces valve (V) against the outer (inlet) valve seat thus sealing off supply port 1 against piston chamber (C).

Example 2:
Supply pressure at port 1 (e.g. 8 bar), and control pressure at port 4 (e.g. 1 bar).
The control pressure at port 4 flows past the two solenoids (IV$_P$ [inlet] and OV$_P$ [outlet]) into the piston chamber (D) and forces piston (E) downwards thereby closing the outlet valve (inner seal) and opening the inlet valve (outer seal). This allows air to flow from port 1 to port 2 and into the brake chamber(s). The area of the piston is the same above and below, that means as soon as the pressure at port 2 equals that in chamber (D), the piston returns to a balanced position in which both the inlet and outlet valves are closed. If the control pressure is reduced, piston (E) is forced upwards the exhaust valve opens and excess pressure is vented through port 3 until a balanced condition is again reached.

If an ABS cycle is in operation and the ECU selects the '*pressure hold*' phase and the driver releases the brake at the same instant the pressure above the piston in chamber (D) is vented via port 4 through the non-return valve (F).



Pressure increase

Both solenoids non-energised - IV$_P$ open and OV$_P$ closed.
Control pressure present at port 4.
Exhaust valve closes, inlet valve opens.
Air flows from ports 1 to 2.

ABS Relay Valve Function (1)

notes:

The relay valve function is critical and dependent upon the preset characteristics of each individual solenoid. Consequently the unit is NON-SERVICEABLE in nature and should problems arise the entire assembly must be replaced.

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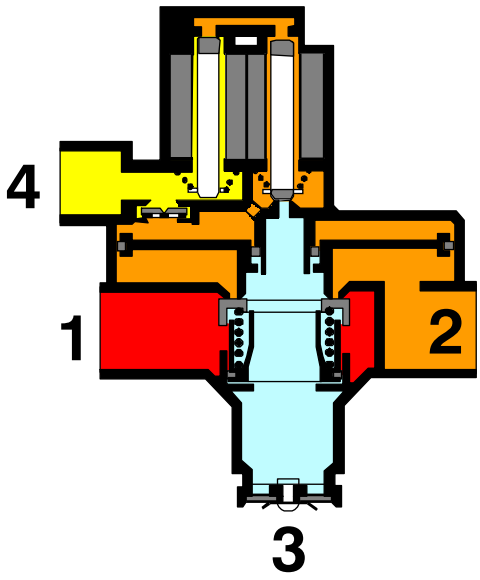
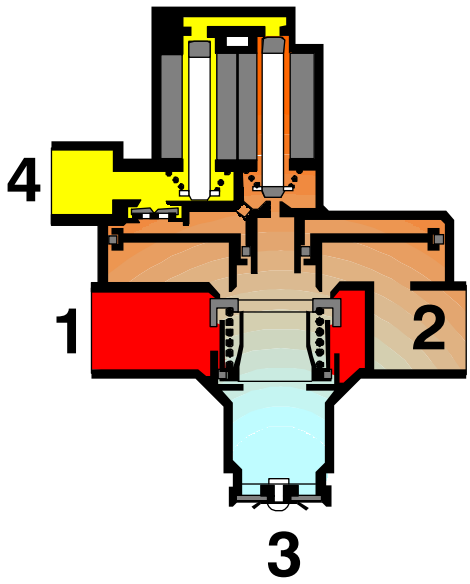


Pressure hold

Inlet valve solenoid IV_P is energized, its core is raised, therefore, despite the presence of control pressure at port 4, the flow of air from the control line to the upper chamber (D) is interrupted.
Pressure between upper and lower chambers equalizes.
Valve (IV) is forced upwards by the spring (S) sealing the chamber (C) from both supply and exhaust.
Air cannot, therefore, flow from ports 1 to 2 nor from 2 to atmosphere.



Pressure release

Outlet valve solenoid OV_P is energized.
Control pressure is prevented from entering upper chamber. The raised seal at the base of solenoid OVP vents the pressure in the upper chamber (D) through the central opening in the piston. Piston (E) moves upwards, valve IV is forced against the valve seat and air from the lower chamber, delivery port and the brake chamber(s) is vented to atmosphere.

ABS Relay Valve Function (2)

notes:

The relay valve function is critical and dependent upon the preset characteristics of each individual solenoid. Consequently the unit is NON-SERVICEABLE in nature and should problems arise the entire assembly must be replaced.

WABCO

Warning Lamp Function and Error Memory

The ABS Warning Lamp informs the driver that the ECU's internal safety controller has detected a fault and has either;

DISABLED THE DEFECTIVE SECTION.
or CLOSED DOWN THE APPROPRIATE DIAGONAL. (MOTOR VEHICLES ONLY)
or SWITCHED OFF THE ENTIRE ABS. (WORST CASE)

For both motor vehicles and trailers the warning lamp is fed directly between a live supply and the warning lamp terminal on the ECU. If a fault condition arises, the ECU grounds the connection, thereby completing the circuit and illuminating the warning lamp. When no fault condition exists, the ECU breaks the connection to ground and the lamp extinguishes

Motor Vehicles And Trailers With Permanent Power

On switching the ignition on, the warning lamp will illuminate. As a complete sensor check is unable to be made until the vehicle is in motion, the lamp will remain on. At ~7kph the warning lamp will extinguish and remain off for the duration of the journey, whether the vehicle is stationary or moving. If a fault is detected the warning lamp will illuminate and remain on. On stopping the vehicle, switching the ignition off and back on again, the safety circuit will reset itself. If the fault was intermittent and is no longer present, then on moving off the lamp will extinguish in the normal manner otherwise the light will remain on.

Trailers Powered From The Brake Light

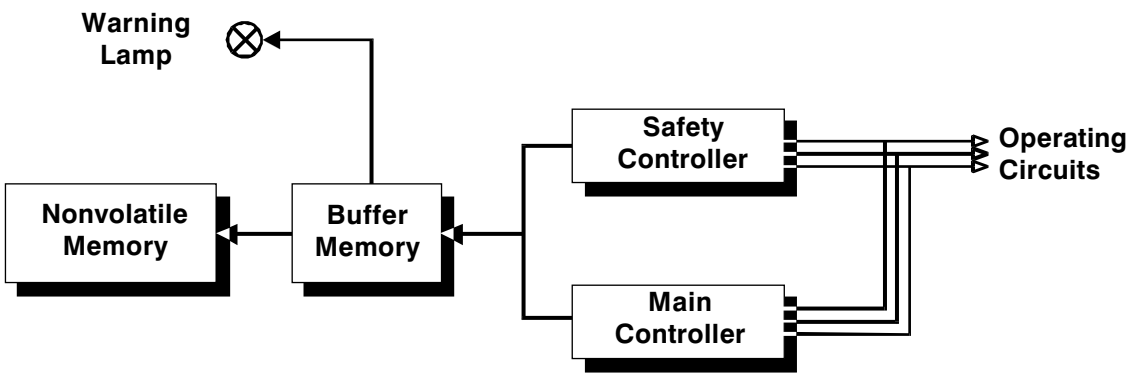
If the ECU is receiving power from the brake light circuit only, the driver will have to observe the action of the green head board warning light. Wheel speed signals can only be checked when the vehicle is in motion and during brake applications. Whenever the brake pedal is depressed at speeds less than ~7kph, the warning light will come on and remain on for that braking period. If the vehicle exceeds this speed, the warning light will briefly flash and remain off until the next brake application. Illumination of the warning light throughout braking at speeds above ~7kph, indicates a system fault has been detected.

Faults are stored in the ECU's nonvolatile memory for subsequent analysis in the workshop.

In the event of the ABS warning light illuminating during use, the vehicle should be driven with due care and attention directly to a workshop where a qualified person can diagnose and rectify the fault. As the ABS system operates independently from the conventional braking system, normal braking will still be possible.

ABS Warning Lamp

notes:



The ECU contains a main and safety controller which are constantly assessing whether the system is in good working order. In addition to checks within the ECU itself, the controllers are constantly checking the external wiring for short/open circuit connections and the plausibility of the wheel speed signals. These checks commence immediately the ignition is switched on. If no faults exist in the intermediate (or buffer) memory when moving off , providing satisfactory wheel speed signals are detected, the warning lamp will extinguish at about 7kph after which it should remain off whether moving or stationary.
The buffer memory controls the warning lamp and if a fault is subsequently detected it will immediately put the message into the buffer, disable the relevant section(s) of the ABS and illuminate the warning lamp. If the fault was of a temporary nature (e.g. poor electrical connection on a sensor cable) the action of switching off the power (ign. switch) will automatically transfer the fault from the buffer to nonvolatile memory. A temporary fault of this type will result in the buffer memory being clear when the ignition is next switch on, in which case the warning lamp will again extinguish on moving off. However if the fault is of a permanent nature (currently existing) it will be put into the buffer memory again and the warning lamp will fail to extinguish.

Vario-C
Fault Storage in Error Memory (i)

notes:

All faults, whether in the buffer or nonvolatile memory, are accessible by compact tester, diagnostic controller or flash code. Full instructions are provided on fault identification/clearance with both the compact tester and the diagnostic controller. The following give guidance on fault identification and clearance using flash code. Before describing the flash code itself the following should be noted.

1) No fault can be cleared down that currently exists. i.e. one which is in the buffer memory.

2) As a matter of priority, fault messages that are contained in the buffer are presented first. If the fault is current, i.e. cannot be moved across to nonvolatile memory by keying the ignition off and back on, it will be presented to you again and must be rectified before proceeding further.

3) Faults of a dynamic nature, i.e. those relating to the sensor signal (large air gap, excessive polewheel run-out) can always be cleared because, unlike a broken wire, the ECU is unable to assess whether the condition has been rectified until the vehicle is in motion.

4) The entire nonvolatile memory can be stacked with numerous faults but providing none are current when moving off the warning lamp will extinguish in the usual manner.

5) Despite however many times the same fault has been recorded a single clear ance action will clear all faults in that location.

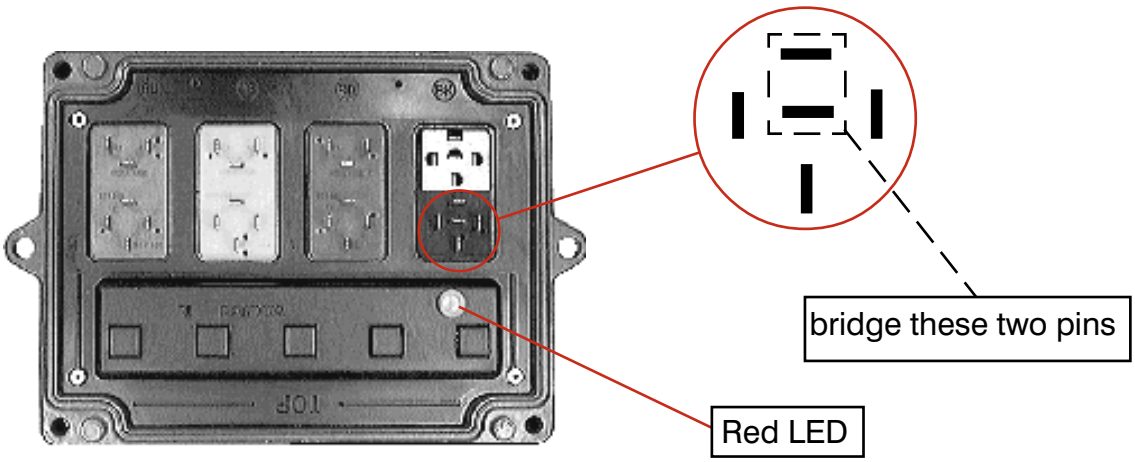
Vario-C
Fault Storage in Error Memory (ii)

notes:

Blinkcode Operation

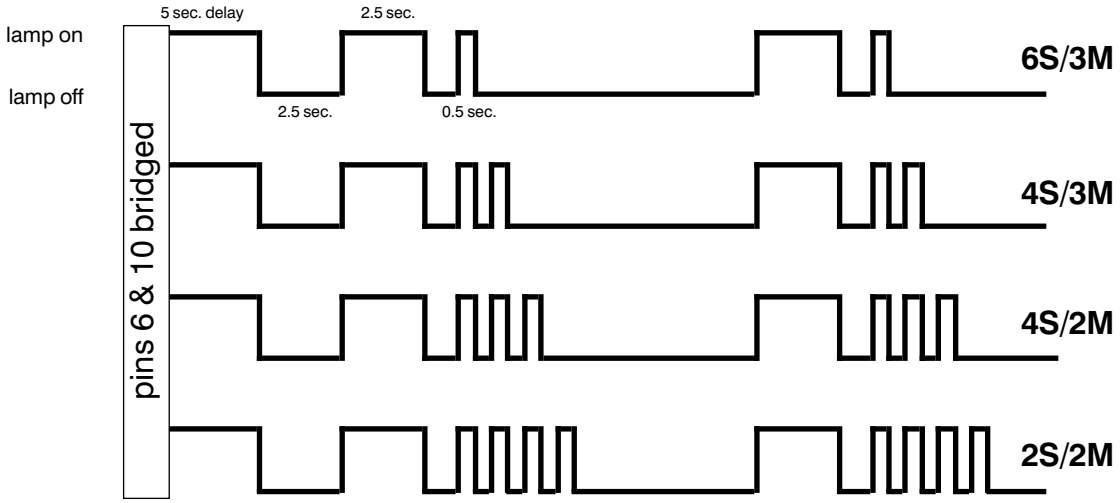
After removing the four M6 allen screws the ECU can be opened up and when hinged down will appear as below.

On applying power the headboard warning lamp (and, if applicable, dashboard warning lamp) will light up together with the red LED inside the ECU. In flash code mode all warning lamps should flash out together - verification that the warning lamp wiring is OK.
To activate the flash code it is necessary to bridge pins 6 and 10 on the diagnostic connector - see above, normally a pre-wired plug will be provided for this purpose in the housing. Providing the supply voltage is adequate (min. 23.5 volts) the LED will start to flash after approx. 5 seconds as shown below. The message will be repeated indefinitely until the bridge link is removed, in which case the lamp will continue to flash out to the end of the current sequence. It should be noted that, depending upon the point in the cycle when the bridge link is removed, the sequence may repeat itself once more before stopping at which point all warning lamps and red LED will remain lit.



Fault Identification by Flash Code (i)

notes:



The 2.5 sec. flash is the ECU's response to your request and the following number of 0.5sec. pulses indicates the type of system installed (see table #1).

Table #1

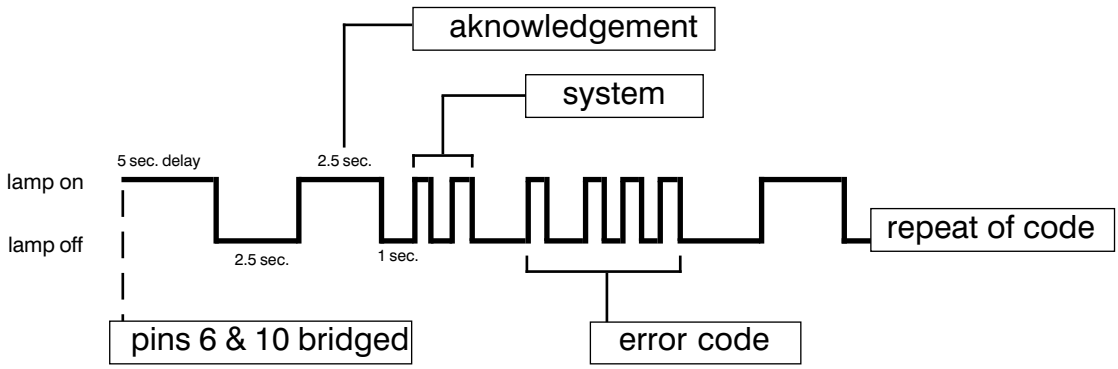
1 flash	6S/3M	(6 sensors / 3 modulators)
2 flashes	4S/3M	
3 flashes	4S/2M	
4 flashes	2S/2M	

If the memory is clear, no other groups of flashes will be presented and after removal of the bridging link the message will continue to the end of the sequence. If an error exists in the memory then a code usually made up of two groups of flashes will follow the system code.

Fault Identification by Flash Code (ii)

notes:

The following shows a typical complete message with system fault:- in this case system type 2 (2S/2M) followed by error code 1-3, air gap sensor B.



All fault codes are listed in the following table. Codes may appear which are not listed. If these can be satisfactorily cleared they should be ignored. If unlisted codes cannot be cleared or are frequently being recorded the fault probably lies within the ECU and contact should be made with WABCO Technical Services for further advice.

Fault Identification by Flash Code (iii)

notes:

WABCO

System Code see table #1	Error Code		Cause of Fault
*	0	0	System OK
*	1	1	Parameterize system ..... (re-initialise ECU - see separate sheet)
*	1	2	Sensor B ..... Sensor speed jump/ excessive polewheel run-out
*	1	3	Sensor B ..... Air gap
*	1	4	Sensor B ..... Break in wire, short circuit or excess ground leakage
*	1	5	Sensor D ..... Sensor speed jump/ excessive polewheel run-out
*	1	6	Sensor D ..... Air gap
*	1	7	Sensor D ..... Break in wire, short circuit or excess ground leakage
*	1	8	Sensor A ..... Sensor speed jump/ excessive polewheel run-out
*	1	9	Sensor A ..... Air gap
*	1	10	Sensor A ..... Break in wire, short circuit or excess ground leakage
*	1	11	Sensor C ..... Sensor speed jump/ excessive polewheel run-out
*	1	12	Sensor C ..... Air gap
*	1	13	Sensor C ..... Break in wire, short circuit or excess ground leakage
*	1	14	Sensor F ..... Sensor speed jump/ excessive polewheel run-out
*	1	15	Sensor F ..... Air gap
*	2	0	Sensor F ..... Break in wire, short circuit or excess ground leakage
*	2	1	Sensor E ..... Sensor speed jump/ excessive polewheel run-out
*	2	2	Sensor E ..... Air gap
*	2	3	Sensor E ..... Break in wire, short circuit or excess ground leakage
*	2	4	Modulator A ..... Inlet valve, break in wiring
*	2	5	Modulator A ..... Outlet valve, break in wiring
*	2	6	Modulator B ..... Inlet valve, break in wiring
*	2	7	Modulator B ..... Outlet valve, break in wiring
*	2	8	Modulator C ..... Inlet valve, break in wiring
*	2	9	Modulator C ..... Outlet valve, break in wiring
*	2	10	Modulator A ..... Inlet valve, short to earth/ground
*	2	11	Modulator A ..... Outlet valve, short to earth/ground
*	2	12	Modulator B ..... Inlet valve, short to earth/ground
*	2	13	Modulator B ..... Outlet valve, short to earth/ground
*	2	14	Modulator C ..... Inlet valve, short to earth/ground
*	2	15	Modulator C ..... Outlet valve, short to earth/ground
*	3	2	Contact 3 (supply plug) earth missing
*	3	3	Undervoltage
*	3	4	Break in wiring, contact 7 (e.g. retarder)
*	3	5	Short circuit, contact 7 (e.g. retarder)
*	3	6	Earth break, modulator A [red]
*	3	7	or ECU ◊
*	3	8	Earth break, modulator B [yellow]
*	3	9	or ECU ◊
*	3	10	Earth break, modulator C [blue]
*	3	11	or ECU ◊
*	3	13	Permanent power at contact 7 (e.g. retarder)
*	3	12	Overvoltage
*	4	6	Modulator A ..... inlet valve short circuit to positive
*	4	7	Modulator A ..... Outlet valve short circuit to positive
*	4	8	Modulator B ..... inlet valve short circuit to positive
*	4	9	Modulator B ..... Outlet valve short circuit to positive
*	4	10	Modulator C ..... inlet valve short circuit to positive
*	4	11	Modulator B ..... Outlet valve short circuit to positive
*	4	12	No operative modulator connected
*	4	13	No operative modulator connected
*	4	14	Short circuit to positive

◊ If this fault is indicated, the system configuration flashed out is meaningless. Before changing the ECU, re-check the earth lead (yellow/green) of each valve against outlet and inlet valves again.

ABS Vario-C Flash Code

WABCO

After all installation checks have been satisfactorily completed the ECU will need to be 'initialised'. This means that the ECU needs confirmation that the system to which it is currently connected is the one which it will relate all future faults to. It will not, for example, assume a satisfactory 4S/2M system when the original fitment was 6S/3M - the configuration changing in service by virtue of, say, the red sensor and modulator plugs becoming disconnected.

Initialisation is simply as follows:

1) Firstly connect all sensors and modulator plugs on the ECU base plate. The white/green power plug should be fitted last.
(Failure to observe this basic rule will, if voltage is present at the power plug, cause numerous faults to be stacked in the memory as the ECU sees all sensor and modulator wiring open circuit).

2) Apply power to the ECU via one of the relevant connections at the headboard.

3) Fit the diagnostic plug in the 'active' position (see flash code instruc tions).
After approximately 5 sec. the following codes will appear - see flash code listings for full interpretation of error codes.

1-1-1 ..... 6S/3M system
2-1-1 ..... 4S/3M system
3-1-1 ..... 4S/2M system
4-1-1 ..... 2S/2M system

The first digit represents the system type which the ECU sees as currently installed and the '-1-1' is the ECU's way of asking 'is this correct?'.

4) Remove the diagnostic plug and wait for the LED to stop flashing and give a continuous light. Do not switch the power off.

cont.....

Vario-C2 ECU Initialisation (i)

notes:

5) Wait 5 secs. and return the diagnostic plug to the “active” position. The flash code should then reveal 1-0-0 (6S/3M) etc. - initialisation complete and memory clear. If any faults have inadvertently been stored in the memory these will need to be cleared using the normal procedure (see flash code booklet) until the message 1-0-0: 2-0-0 etc. as applicable, is received.
If error messages have been stored in the memory before initialisation, after clearing each fault the ECU may ask for confirmation of the system type i.e. it will reveal error code ...-1-1 which must be answered before any other fault is revealed. To clear a fault message usually entails SWITCHING OFF the power at the end of the flash sequence whereas in confirming the system type it MUST remain on. Failure to observe these basic rules can result in lost time and frustration. The answer is simple - fully check-out the system first to ensure no faults exist before fitment of the ECU. Initialisation should then take less than 1 minute.

6) Return the diagnostic plug to the ‘inactive’ position.

Vario-C2 ECU Initialisation (ii)

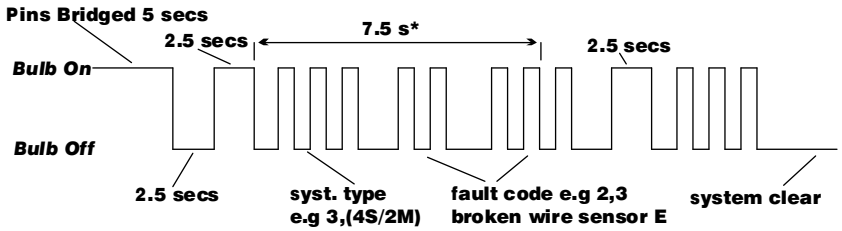
notes:

Vario C Trailer ABS 'Clear All Faults' Facility

All Vario C ECU's produced after week 26 of 1994 (2694) incorporate a clear all function. This makes fault clearance much simpler and is intended to be used when, for example the power has accidentally been applied to the ECU before all sensor/modulator connections have been made. To use the clear all function there must be no current faults i.e no faults in the buffer memory. Verify by checking that all wiring and connections are correctly made then temporarily remove then reconnect the power.

To Clear All Faults

Activate the flashcode (bridge pins 6 and 10 on the diagnostic plug). After about 5 seconds the warning lights and red ECU LED will start to flash - see flash code booklet for full diagnosis instructions. At the end of the 2.5 second 'bulb on' sequence in the following 7.5 seconds the diagnostic plug should be removed for greater than 1 second and then replaced. The first fault in the memory will then be presented after which the next sequence will give the 'all clear' as below.



*In this interval remove diagnostic plug (break connections 6 & 10) for greater than 1 second.

Note: If the system had not been initialised prior to the errors being inadvertently put into the memory although all faults will have been erased the initialisation code (1,1) will replace the all clear message. Initialisation must then be carried out using the appropriate procedure.
N.B do not forget to stow the diagnostic plug in its inactive position after carrying out this procedure.

Vario-C2 ECU “Clear All” Function

notes:

General Information

POLEWHEEL RUN-OUT ..... 0.2mm max.

SENSOR AIR GAP ..... 0.7mm max.

MIN. SENSOR OUTPUT VOLTAGE ..... 0.1 volt
(wheel turning at 0.5 rev/sec)

MAX/MIN SENSOR OUTPUT VOLTAGE ..... 2.2 : 1
(wheel turning at constant speed)

NOMINAL RESISTANCES

SENSORS

Cylindrical type ..... 1200 / 1360 ohm
Conical type ..... 1650 / 1850 ohm
Stepped type ..... 1100 / 1250 ohm
(all sensors are compatible)

Sensor ground leakage ..... 100 Kohm (min)

SOLENOID CONTROL VALVES

ABS Modulators ..... 15 ohm / coil (typical)

note: When measuring resistance due allowance should be made for the effects of temperature

Useful Data

notes:

- Sensor air gap too large
- Wheel bearing clearance excessive
- Unacceptable sensor ground leakage
  - Defective sensor or water in connectors
- Sensor wiring damaged in vicinity of hub
  - Rubbing on brake drum
    Unprotected and chafing where passing through hole in brake back plate
- blown fuses
  - Defective relays in power supply module
    - open circuit coil or high resistance contacts

Common Faults

notes:

Always re-grease friction bush and reset sensor whenever drums / hubs removed.

Don't damage the polewheel teeth.

Don't rock the wheels / hubs when refitting - can knock sensor back.

Ensure connector at back plate is fully home and secure.

Regularly check pipework / cabling for security.

Check that all modulators exercise at "switch-on" (pressurise brake lines first)

Always switch-off ignition before disconnecting sensor / modulator plugs or removing the ECU.

Remove the ECU from the vehicle before carrying out electric welding work.

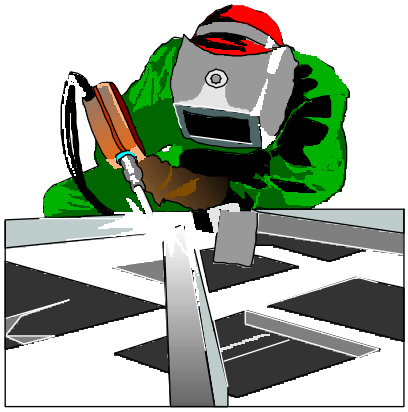
If the error memory reveals, for example, 'air gap wheel C' and the location of sensor C is uncertain, measure the sensor resistance at sensor 1 input - blue channel (wheel C) and unplug each wheel sensor at the extension cable near the brake back plate. The plug which, when disconnected, causes the meter to read open circuit has identified sensor C's location.

Helpful Hints

notes:

WABCO

The following applies to all WABCO ECU's and related system components. To avoid the possibility of damage to the ECU while welding, we recommend that the following precautions are adopted:



- DISCONNECT THE HARNESS OR POWER SUPPLY PLUG FROM THE ECU BEFORE UNDERTAKING ANY WELDING WORK ON THE VEHICLE.
- IN THE CASE OF TRAILER SYSTEMS IT IS ALSO RECOMMENDED THAT ALL MODULATOR AND SENSOR PLUGS ARE REMOVED AT THE ECU BASEPLATE.
- DO NOT USE ELECTRICALLY OPERATED COMPONENTS AS AN EARTH FOR WELDING.

ECU's and Welding

notes:

ABS Polewheels are precision made components which meet stringent design, manufacturing and quality control requirements. To avoid damage they must always be handled with care.

For the correct handling of polewheels the following instructions must be observed during storage, initial installation and in service

NEVER ...

Strike the polewheel.

Attempt to repair polewheels

Use the polewheel as a load bearing surface

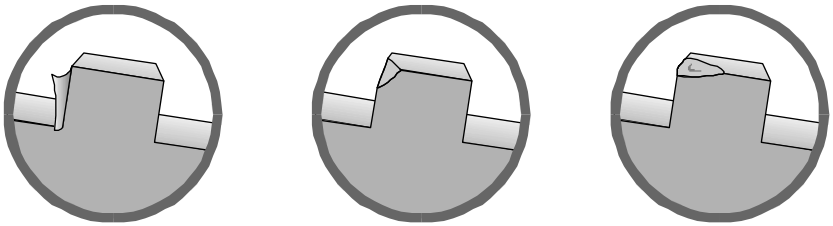
Stand the hubs with the polewheel face down

ALWAYS ...

Protect the polewheels from the possibility of damage.

Replace damaged polewheels

Inspect the polewheels carefully prior to assembly paying particular attention to tooth damage, for example;.



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Polewheel Handling

notes: