

ABS/ASR „D“- „Cab“ - Version Anti-Lock Braking System for Commercial Vehicles

 **1st Edition**

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WABCO

Vehicle Control Systems
An American Standard Company

2. System functions

2.1 Description of an ABS control cycle

In case of impending wheel lock, the brake pressure of the corresponding wheel will be decreased, held during expected or measured wheel re-acceleration and subsequently increased in steps after re-acceleration. The cycle is started again if the brake force is still too high for the actual friction level (adhesion).

Rear axle wheels are subject to individual control (IR), front axle wheels are subject to Modified Individual Regulation (MIR).

of the wheel. For this reason the 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 the wheel brake hysteresis has been overcome a continued reduction in pressure leads to a decrease in wheel deceleration.

At point 3 the wheel deceleration signal $-b$ drops below the threshold and the brake pressure is held at a constant level for a set time T_1 .

Normally, wheel acceleration will exceed the acceleration threshold $+b$ within this set time (point 4). As long as this threshold is exceeded, the brake pressure is kept constant. If (for example on a low-friction surface) the $+b$ signal is not generated within time T_1 , the brake pressure is further decreased by slip signal λ_1 . During this control phase the higher slip threshold λ_2 is not reached.

At point 5, the curve falls below the threshold $+b$. The wheel is now in the stable region of the μ - λ slip curve.

Brake pressure is now rapidly applied for time T_2 to overcome the brake hysteresis. The time T_2 is fixed for the first control cycle and then recalculated for each subsequent control cycle. After the initial rapid phase, brake pressure is then increased more gradually by "pulses", by alternating pressure hold and pressure increase.

The basic logic demonstrated in this example is not fixed at all; it adapts to the corresponding dynamic response of the wheel to varying coefficients of friction, i.e. it implements an adaptive type of system control.

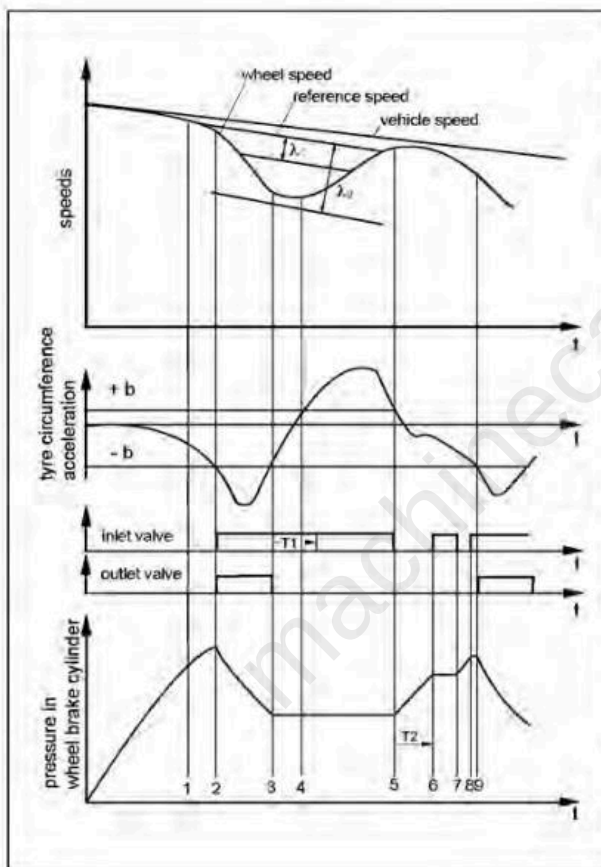


Fig. 1

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 does not achieve any further deceleration of the vehicle but merely deceleration

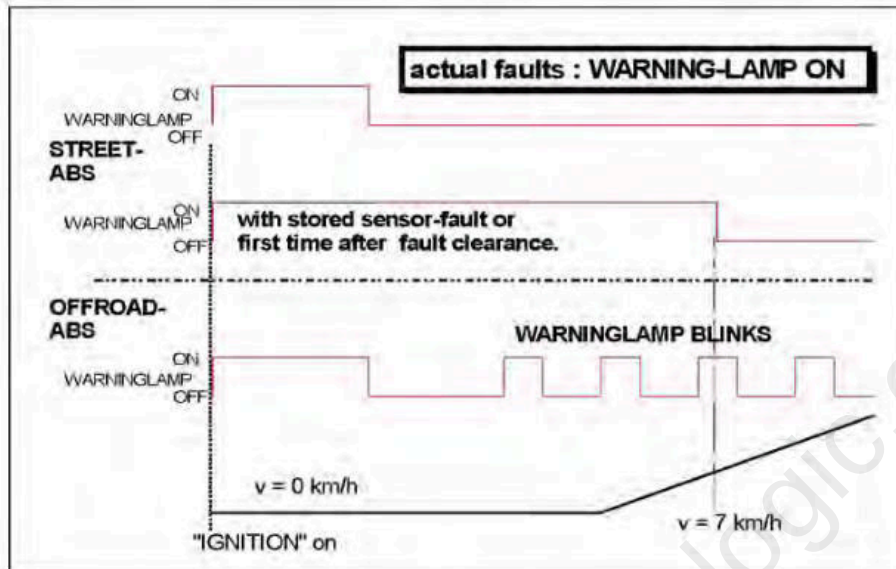
4.2.2 Function when ignition is switched on and vehicle is still stationary

In the normal mode (on-road ABS) the warning lamp goes off in keeping with ECE R 13 Supplement 07 while the vehicle is stationary. The warning lamp indicates defective sensors

detected when the ignition was first switched on.

It is possible that maintenance work (changing the lining) increases the clearance of the sensors because the workshop staff failed to re-adjust them (pushing sensors home).

In order to prevent that the vehicle is driven before this has been put right, WABCO recommends that the error memory of the ECU is deleted when maintenance work has been done. This puts the ECU into its workshop mode. To leave this mode, the speed signals received from all wheels have to be measured again. When this has been achieved successfully, the ECU will automatically return to the normal mode.



4.2.3 Sensor input ports

Different types of inductive sensors can be connected. In order to prevent any interference potential, the induced sinusoidal sensor voltage is filtered.

Different types of errors are detected to permit selective deactivation.

Types of errors: interrupt and short circuit to ground or plus and crossed or wrong connections are detected even before the vehicle has moved off and stored in the error memory. Dynamic sensor defects are detected by analysing the signalling frequency (implausible signals such as erratic changes).

To allow the ECU to detect any clearance or wheel wobble on the brake test bench, the ECU for the

D-version has been designed in such a way that the peak-peak voltage is measured and its highest and lowest readings stored in the RAM for at least one wheel revolution.

This is designed for the inspection after installation; the ECU should not be disconnected from the system for this purpose.

It is important to know that the filtered sensor voltages may result in different values being measured using an oscilloscope or a multimeter. In normal operation, measuring supports the safety functions and helps identify any errors in the installation, such as excessive clearances, wrong installation of a pole wheel, or a soiled pole wheel.

4.2.4 Grounding of output stage for modulators

Every solenoid is connected between a switching (+) transistor and one of the two (diagonal) disconnecting (ground) transistors.

This allows redundant interruption of the valve current, thereby ensuring that a single defect does not cause

ABS to be switched off. If there is a defect inside the ECU, the system is partially or fully shut down. The transistors are checked periodically. A distinction is made between parting of a cable and a defective output stage.

5.1 ASR components

In addition to the ABS system components: sensor, solenoid control valve, ECU, warning lamp, Fig. 5 shows the additional components for drive-slip control (ASR) integrated in ABS for commercial vehicles with air brakes.

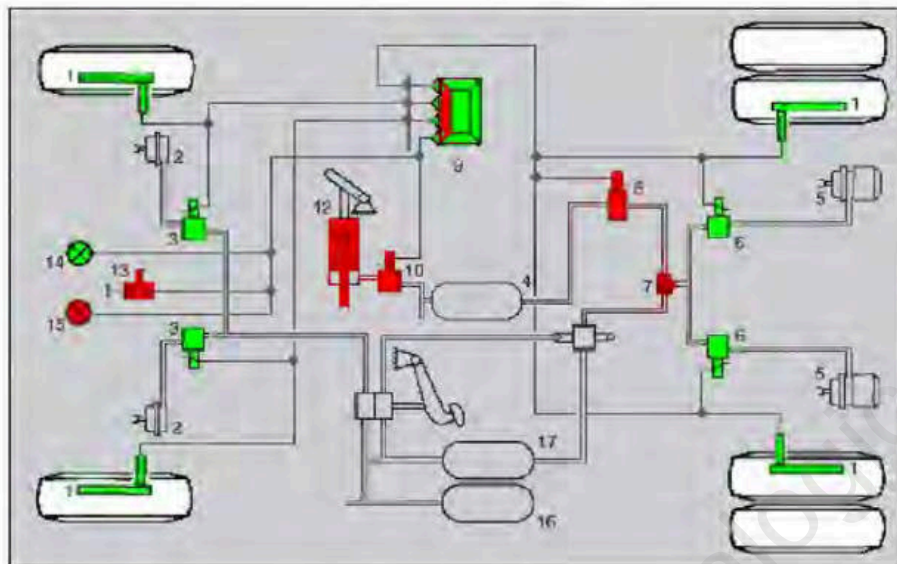


Fig. 5: 4-channel-ABS/ASR
2-axle commercial vehicle
with rear-wheel drive (4 x 2)

5.2 Data interfaces

The ABS D versions have different interfaces which are also used for the purpose of diagnostics. The following defined interfaces are being looked at in more detail:

- 1) SAE J 1922
- 2) SAE J 1939
- 3) SAE J 1587
- 4) ISO 9141 Mode 8 (JED 677)

– SAE J 1922

This standard defines a local network for heavy-duty commercial vehicles with a maximum of 4 electronic control units which exchange data on the network. The electronic control unit for engine control has to begin its transmission no later than 2 sec-

These are the ASR lamp which shows the driver that the ASR mode is active and thus indicates that the road surface is slippery, or that an ASR component may be defective; the differential brake valve (8) which, when required, actuates the foundation brake via a double check valve (7) for a wheel which may otherwise be spinning, the

- q engine control cylinder (12) and
- q the proportional valve (10)

which automatically control engine output to reduce engine power, irrespective of driver control.

These engine components are not required if the vehicle in question is equipped with an electronic engine control system which the ABS / ASR system ECU can communicate with via a specific interface.

onds after 'ignition on'. Otherwise the ABS control unit detects an error and the ASR control functions are inhibited. ASR engine control uses the 'torque limiting mode'. The engine's electronic control unit should follow the torque limiting requirements with a delay of no more than 150 milliseconds.

The transmission rate, hardware and protocol are defined in SAE J 1922 and SAE J 1708.

Electronic control units with this interface only exist together with the SAE J1587 interface used for diagnostics. This type of interface with 10 kBaud has been used for engines for years. SAE J1922 will be replaced by the SAE J1939 interface.

If the ABS control unit is being replaced on a vehicle that has no ASR, the following must be taken into account:

	Interface	Control / Function
ABS	without	
	DBR relay	sustained-action brake on/off
	SAE J1922 SAE J1587	– control retarder moment – status message (dashboard)
	SAE J1939 (CAN)	– control retarder moment – wheel speed message – status message (dashboard)
ABS+ASR (ATC)	DIF + SAE J1922	additional differential brake and engine control
	DIF + SAE J1939 (CAN)	see above

	spare part	on vehicle with		
desired system on vehicle	engine / retarder interface	DIFF brake	recognition	comments
ABS	interrupt	interrupt		¹⁾ permitted
ABS + SAE J1922	interrupt	interrupt	²⁾	¹⁾ accepted, ABS interface is stored once recognized
ABS + SAE J1939	interrupt	interrupt	²⁾	¹⁾ accepted, ABS interface is stored once recognized
ABS + DIF + SAE J1922	interrupt	connected	error ³⁾	
ABS + DIF + SAE J1939	interrupt	connected	error ³⁾	
ABS + DIF + SAE J1922	connected	interrupt		accepted (ABS + SAE J1922)
ABS + DIF + SAE J1939	connected	interrupt		accepted (ABS + SAE J1939)
DBR relay (retarder)	DBR load interrupt		⁴⁾	storage of load once recognized, irrespective of ASR

Please note:

1) filament test, ASR-L on for shorter than ABS: no ASR

2) parted cable recognition if interface / load was recognized previously.

3) ASR configuration.

4) sustained-action brake relay (DBR) cable break if relay was recognized previously.

After activating the system mode, ASR (ATC) is inhibited to prevent ASR (ATC) errors being detected on the roller dynamometer and to permit higher differences in the speeds of the driving and steering axles. If an ECU is used which provides for stimulation of the flash code via the warning lamp, the ASR (ATC) lamp comes on to show that ASR (ATC) has been inhibited.

> 0.5 sec [ASR(ATC) reduces the engine torque for 10 sec.].

2. A recognized ASR (ATC) or retarder system can be reset (reconfiguration) by pressing the push-button three times > 0.5 sec. (the absence of components is confirmed). Reconfiguration is confirmed by four brief flashing pulses.

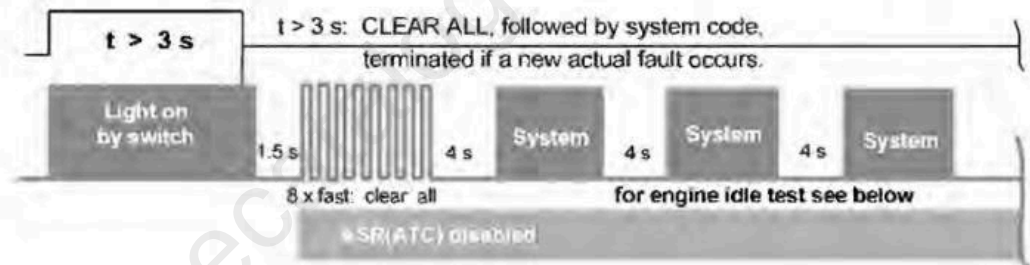
Two seconds after the system mode has been activated, other functions are possible:

No current error:

DELETION OF ALL ERRORS STORED

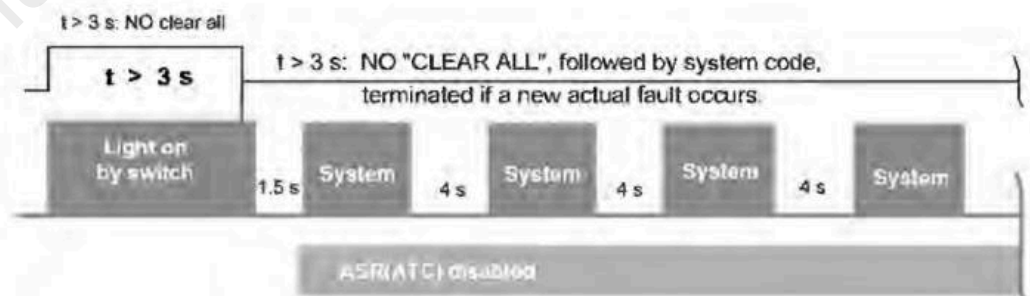
1. ASR (ATC) engine control can be tested by pressing the push-button twice for

Deletion is confirmed by 8 brief flashing pulses; this is followed by the system code being flashed out.



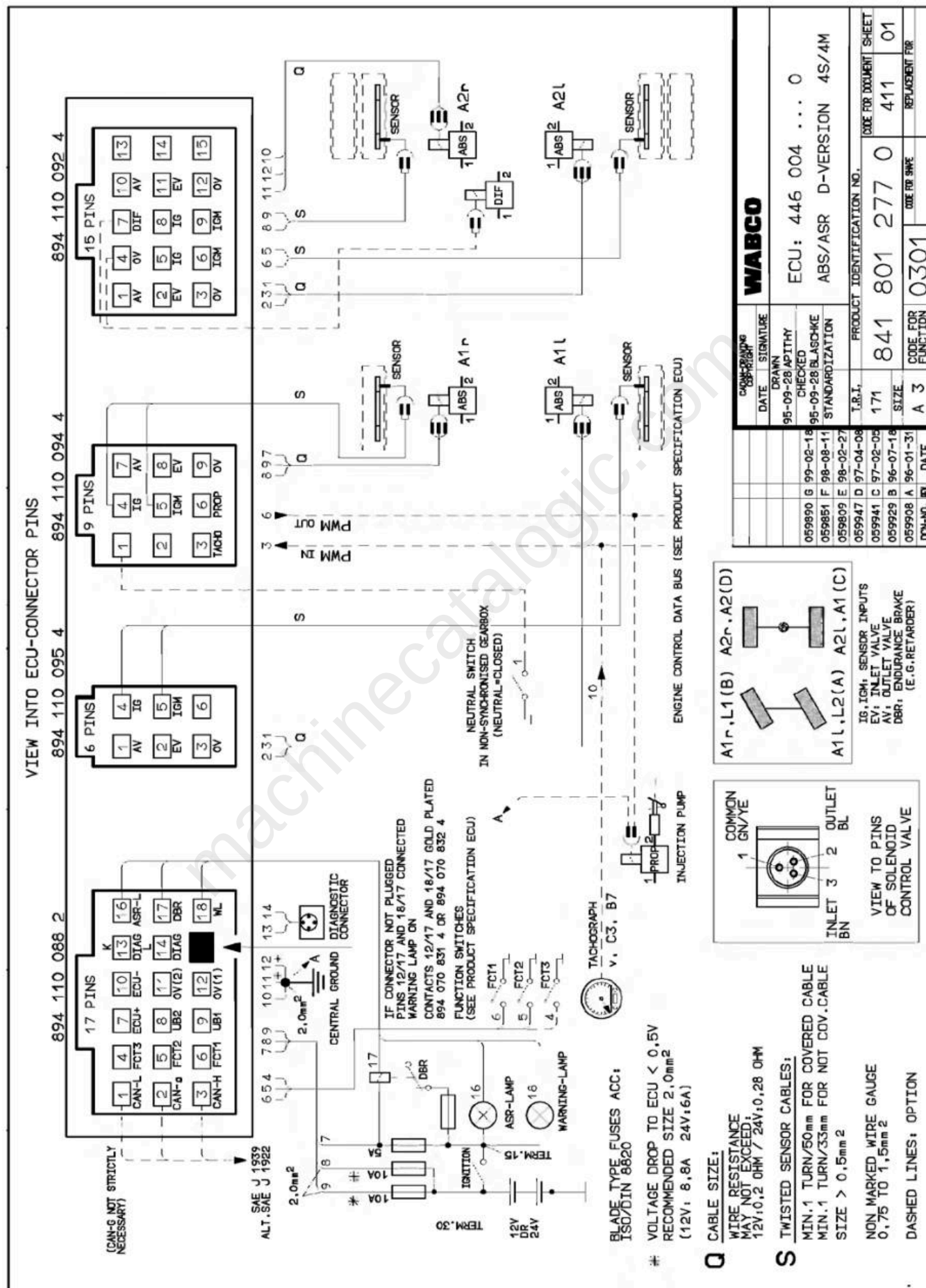
Current error:
like "no current error",

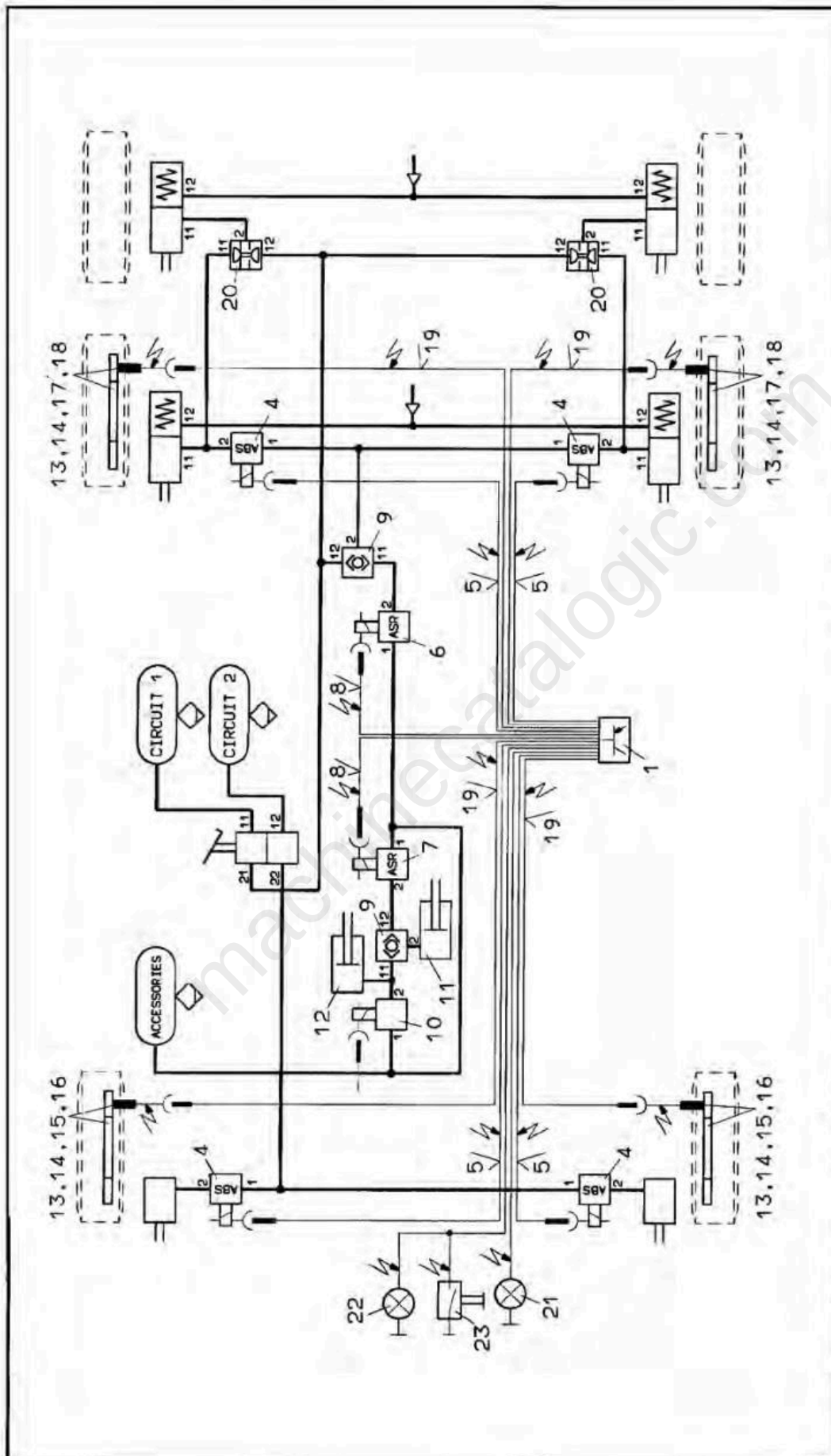
"DELETION OF ALL ERRORS STORED" is not possible.



Systems:

1 X 6S/6M (6x2 ASR)	6 X 4S/3M (VAR rear)
2 X 4S/4M	7 X 4S/2M (VAR both)
3 X 4S/3M (MAR/VAR front)	
4 X 6S/4M	
5 X 6S/6M (6x4 ASR)	



[illegible]

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