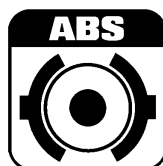


# WABCO



## Operating Instructions

for the WABCO Diagnostic Controller  
with Program Card ABS/ATC SAE  
446 300 730 0







# **Operating Instructions**

for WABCO Diagnostic Controller  
446 300 320 0  
with  
Program Card ABS/ATC SAE  
446 300 730 0



**Edition: October 1997**



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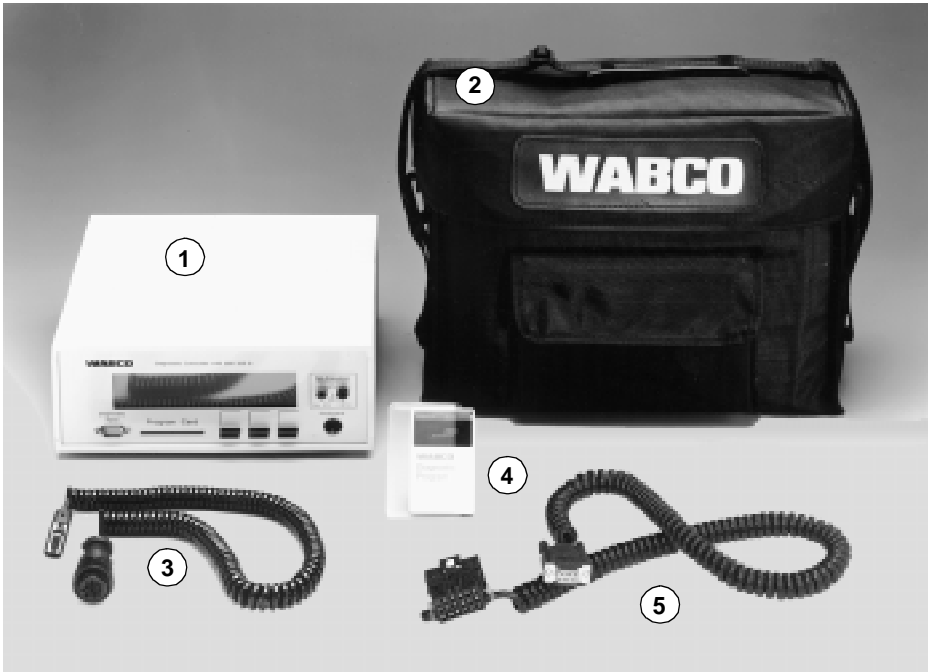
## LIST OF ABBREVIATIONS USED:

ABS	Anti-Lock Braking System
ASR	Anti-Spin Regulation (Drive-Slip Control)
ECU	Electronic Control Unit
L1/L2	Wheels on steered axle (diagonals 1/2)
A1/A2	Wheels on driven axle (diagonals 1/2)
Z1/Z2	Wheels on third axle (diagonals 1/2)
MRV	Modulator valve (ASR)
Diff. valves	Differential brake valve (ASR)
IV	Inlet valve which when energized prevents further pressure increase at the wheel brake
OV	Outlet valve which when energized allows pressure at the wheel brake to be released
PIN	Individual connector in the ECU plug
MOT-valve	Engine valve with on/off control for ASR (also known as black / white valve)
PROP-valve	Engine valve with proportional control for ASR operation
>	greater than
<	less than
$\Omega$	ohm
k $\Omega$	kilo ohm

The following abbreviations are protected trade names of engine control systems from certain manufacturers:

EMR	Electronic motor regulation (ASR engine control)
ESW	Electronic set-point emitter (ASR engine control)
PRIO	Priority signal emitter (ASR engine control)
PWMR	Pulse-width modulated acknowledgement signal (ASR engine control)
PWMV	Pulse-width modulated adjustment signal (ASR engine control)
EMS	Electronic engine control (ASR engine control)
EDC	Electronic Diesel Control

## 1. DIAGNOSTIC CONTROLLER SET 446 300 331 0



### Contents of Diagnostic Controller Set:

- |                          |               |
|--------------------------|---------------|
| 1. Diagnostic Controller | 446 300 320 0 |
| 2. Carrying Case         | 446 300 022 2 |

### Additional Test Equipment

- |                          |               |
|--------------------------|---------------|
| 3. Connector Cable (SAE) | 894 604 350 2 |
| 4. Program Card          | 446 300 730 0 |
| 5. Inter-Adapter         | 446 300 405 0 |

## 2. WHICH SYSTEMS CAN BE TESTED?

This program card can be used to test certain ABS/ATC systems which are identified by the part number of the ABS/ATC control unit.

### ABS/ATC SAE

system/plug	4-channel	6-channel
program card	446 300 730 0 	446 300 730 0 
inter-adapter  application: if no diagnostic plug (to SAE J 1587) on vehicle	446 300 405 0 	446 300 405 0 
ECUs which can be tested*	446 004 401 0 446 004 405 0	446 003 401 0 446 003 402 0 446 003 405 0 446 003 406 0

- \* no support for settings  
As per June '97. Additional ECUs may be suitable for testing.  
The program card won't realize any test if it cannot identify the ECU.

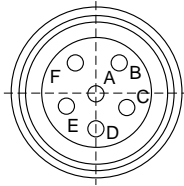
### 3. CONNECTION OF THE DIAGNOSTIC CONTROLLER

#### 3.1a. Diagnostic socket to SAE J 1587 available on vehicle

The allocation of PINs in the diagnostic socket must correspond to the SAE J 1587 standard as shown below. Connect Diagnosstic Cable to diagnostic socket on vehicle.

Allocation of diagnostic socket:

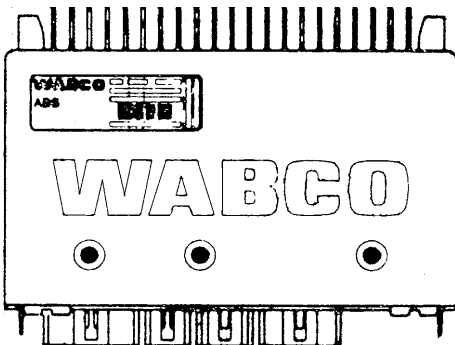
- PIN diagnostic line A
- PIN diagnostic line B
- PIN C battery positive
- PIN E battery negative



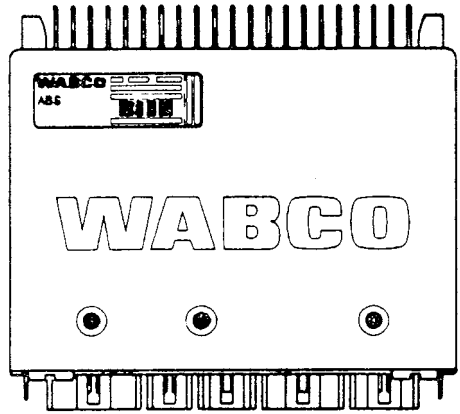
#### 3.1b No diagnostic socket to SAE J 1587 available

If there is no ISO diagnostic socket on the vehicle, an inter-adapter (accessories) can be fitted between the ECU and the vehicle harness connector (see diagram).

4-Channel



6-Channel



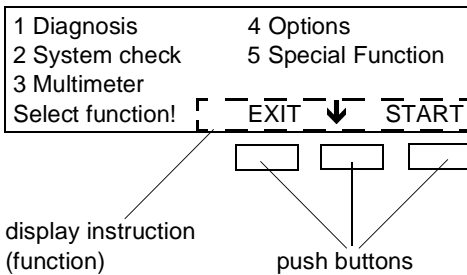
**3.2.** Connect the 9-pin plug of the connector cable (or the inter-adapter) to the Diagnostic Controller, thus establishing both the diagnostic connection and the voltage supply. Switch on ignition. The display will show black bars until a program card is inserted.

**3.3.** Insert program card, pushing it fully home (contact side first, black surface facing upwards). The display will now show which card has been inserted



#### 4. OPERATION OF THE DIAGNOSTIC CONTROLLER

The Controller is operated by means of three push-buttons on its front panel. Their allocation is shown via the instructions appearing on the display directly above the respective push-button.



Push-button	Function
-------------	----------

START:	Initiate program.
--------	-------------------

RETURN:	The display will return to the last main menu.
---------	--

(ARROW):	Select an item from the main menu.
----------	------------------------------------

↓	Scroll forward one item at the time by pressing the push-button. The item selected will blink.
---	--

CONTINUE:	The item selected is activated or released.
-----------	---

## 5. PROGRAM STRUCTURE ABS/ATC SAE

- 1 Diagnosis
  - 1 Error memory
  - 2 Component actuate
    - 1 ABS warning lamp
    - 2 ASR lamp ( except Basic-Version )
    - 3 Endurance brake
    - 4 Differential valve ( except Basic-Version )
    - 5 ASR engine control ( except Basic-Version ) see remark 1
    - 6 Modulator valves
  - 3 Measured values
    - 1 Voltages
    - 2 Wheel speeds
    - 3 Switch positions
  - 4 ECU parameters
    - 1 Display System
    - 2 Reset components
    - 3 Dump parameters
- 2 System check
- 3 Multimeter
  - 1 Direct voltage (DC)
  - 2 Alternating voltage (AC)
  - 3 Resistance
- 4 Options
  - 1 Online help
  - 2 Versions
- 5 Special function ( PIN input )

**Remark 1 : Automatic periphery detection**

## 6. DIAGNOSIS

1 Diagnosis	4 Options
2 System check	5 Special Functions
3 Multimeter	
Select function!	EXIT ↓ START

When selecting the diagnostic function, communication with the ABS control is established.

A	ECU type	: ABS/ATC D
WABCO	Part No.	: 446 004 401 0
S	Prod. date	: week / year
	Software No.	:83CONTINUE

The WABCO data of the ABS ECU is displayed.

After that the following displays will be shown :

1. The serial-number of the connected ECU
2. The connected system e.g. 4S/4M and additional components
3. Additional displays will show the installed switches e.g. :

PIN 6/18: ASR-traction-switch  
 PIN 5/18: ABS-off-road-push-button  
 PIN 4/18: ASR-off switch

1 Error memory	3 Measured values
2 Component actuate	4 ECU parameters
Select function!	EXIT ↓ START

In the diagnostic mode, the following functions are available for selection:

- 1.1 Error memory
- 1.2 Component actuate
- 1.3 Measured values
- 1.4 ECU parameters

### 6.1 Error memory

If the ABS control unit has recognized a fault in the system (safety lamp on), this function helps to locate the fault (example see Page 14). Depending on the type of ABS-system used and the type of error encountered, the following advice will appear on the display.

- 1. SID : A detected fault does identify which component of the system failed, e.g. wheel speed sensor front left.
- 2. FMI : Fault description :
  - e.g. - short circuit
  - air gap
  - wheel-end runout
  - frequency of the fault.

**Note:** The failure can only be acknowledged by the ECU **once** after ignition on.

- display „actual“ indicates that the error existed when the diagnostic mode was selected. This is followed by more detailed information about the error. If there is no information about a present error on the display, this means that the fault did **not** exist when the diagnostic mode was selected, i.e. it cannot be located by means of electrical measurement.
- After correction of faults the error memory of the ECU will be cleared.

- The fault location routine can be left only when all faults have been corrected.

## 6.1.1 Component Actuate

With „Component Actuate“ certain components of the ABS system can be actuated and tested. For this the respective components must be fitted.

### 6.1.1.1 ASR lamp

The ASR lamp can be switched on or off by push-button.

### 6.1.1.2 Warning lamp

The ABS warning lamp can be switched on or off by push-button.

### 6.1.1.3 Endurance brake

The endurance brake can be disabled using the push-button.

### 6.1.1.4 Differential valve

The differential brake valve of the ASR system can be actuated individually by push-button. By pressing the respective button, the valve will be actuated by a pulse program similar to the pulse-program of the modulator-valves.

### 6.1.1.5 ASR engine control

Depending on the equipment of the vehicle this function will give the possibility to actuate either the electronic engine control, the CAN or the pneumatic ASR engine control.

### 6.1.1.5.1 Electronic engine interfaces:

The connected interface will be automatically detected.

**Test:** Start engine, increase engine speed and hold constant. Reduce speed via push-button „ON“. After releasing the button, engine speed is returned to its original level.

### 6.1.1.6 ABS modulator valves

#### 6.1.1.6.1 Pulse program

Both function and allocation of the ABS modulator valves can be individually checked by means of a pulse program. For pressures see diagram on page 18.

### 6.1.2 Measured values

This part of the program is used to display values and switch positions.

#### 6.1.2.1 Voltages

The actual voltages measured by the ECU are displayed.

#### 6.1.2.2 Wheel speeds

The speeds of the ABS-controlled wheels are displayed. As soon as the wheel speed is more than 0.8 mph, it will appear on the display.

Further displays :

- $U_{\min}$  and  $U_{\max}$  of the sensor amplitude
- $U_{\min}/U_{\max}$  as proportion value

This value can be used to detect a wheelend runoff.

When the wheel is stationary, the display will show < 0.8 mph.

**Note:**

The ASR-controlled wheels must not turn at speeds higher than approx. 2.2 mph since this would cause the ASR function to initiate.

**6.1.2.3 Switch positions**

The positions of the different switch-inputs will be displayed.

**6.1.3 ECU parameters**

The following system-specific ECU data is displayed:

1. Display system
2. Reset components
3. Dump parameters (print)

**6.2. SYSTEM CHECK**

System check permits a complete ABS test including print-out of a test log (e.g. after first installation or after extensive repairs).

System check is divided into 2 sections:

- functional test
- print results

**Important notes:**

Once a test section has been initiated, it has to be processed step by step. It is neither possible to return to individual steps nor to leave them out.

If the supply voltage to the Diagnostic Controller is interrupted, all data measured and stored for the print log up to that point of time is destroyed. Thus it is important that the supply to the Diagnostic Controller is not interrupted if a print log is required.

**Functional Test**

This test is carried out with the ECU connected. The Controller instructs the ECU to follow certain control instructions. The tester is confronted with individual yes/no inquiries.

**Procedure:**

- actuate warning lamp  
ASR lamp  
endurance brake  
switches
- pulse programme  
modulators: for pulse program  
see page 17.
- actuate  
diff. valves of ASR-controlled  
driving wheels for pulse  
program see page 18.
- actuate  
pneumatic engine control  
(PROP- or MOT-valve) or  
alternatively electronic interface

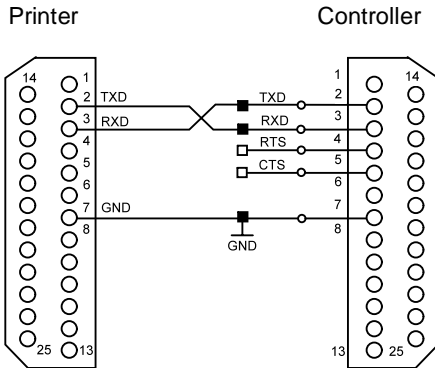
## Print System Check

At the end of the test the results can be printed.

As mentioned above, the Controller has to be permanently connected to the voltage supply. Any interruption will destroy all data stored.

Connection with the printer is established via the 25-pin socket on the rear and a serial printer cable. The cable must have a DB 25-plug (not socket !) at both ends.

The program works with EPSON FX-compatible printers with a serial interface (RS 232). The transmission parameters of the printer must be set to the configuration shown below:



Speed:	1200 baud
Data bits:	8
Stop bit:	1
Parity bit:	no
Protocol:	X ON / X OFF

## 6.3. MULTIMETER

The integrated multimeter function permits electric measurements on the vehicle. Only the desired measuring function (direct voltage, alternating voltage or resistance) needs to be selected. The measuring range is automatically set by the unit.

### Application:

Direct voltage: supply voltage on vehicle  
 Alternating voltage: sensor voltage  
 Resistance: valves, relays, sensors, wiring

### NOTE:

The measuring instrument is designed only for measurements within the vehicle-specific-range (low voltage). It must not be used beyond the above-mentioned measuring range.

Range	Display resolution	Accuracy of measuring range. Final value at 20°C	
DC-voltage			
2.0 volt	0.1 volt	± 0.2 %	± 0.0 volt
20.0 volt	0.1 volt	± 0.2 %	± 0.1 volt
50.0 volt	0.1volt	± 0.2 %	± 0.1 volt
AV-Voltage			
2.0 volt	0.01 volt	± 0.6 %	± 0.02 volt
35.0 volt	0.1 volt	± 0.6 %	± 0.4 volt
Resistance			
20.0 Ω	0.1 Ω	± 0.3 %	± 0.1 Ω
200.0 Ω	0.1 Ω	± 0.2 %	± 0.1 Ω
2.0 kΩ	1.0 Ω	± 0.2 %	± 1.0 Ω
20.0 kΩ	10.0 Ω	± 0.1 %	± 10.0 Ω
95.0 kΩ	100.0 Ω	± 0.2 %	± 100.0 Ω

## 6.4. OPTIONS

### 6.4.1 Online Help

This function enables the user to obtain additional information on the program. When the function is switched on, more de-tailed information will appear at suitable places. .

### 6.4.3 Versions

This function will show the initial values of the test facilities:

- Controller hardware
- Controller operating system with date of manufacturing
- Multimeter
- Program card with software manufacturing date and check sum.

## 6.5. SPECIAL FUNCTIONS

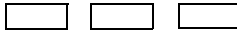
A PIN-code (Personal Identification Number) can be inserted to acquire the right to change parameters.

The authorization to change any of the parameters of the ECU requires a special WABCO-training.

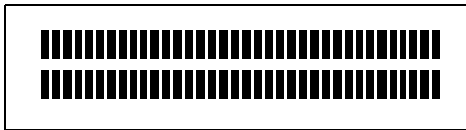
## 7. FUNCTIONAL FAULT IN DIAGNOSTIC SYSTEM



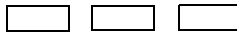
no display



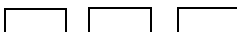
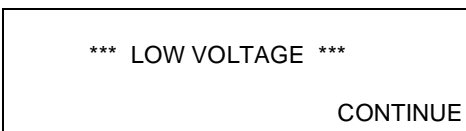
Cause	Remedy
<ul style="list-style-type: none"> <li>- no voltage supply</li> <li>- undervoltage (less than about 7 volts)</li> </ul>	<p>ISO diagnostic plug:</p> <ul style="list-style-type: none"> <li>- Check plug allocation</li> <li>- Voltage between PIN1 and PIN2 = supply voltage on vehicle</li> </ul>



black „bars“



Cause	Remedy
<ul style="list-style-type: none"> <li>- program card not inserted</li> </ul>	<ul style="list-style-type: none"> <li>- Insert program card, push it fully home</li> </ul>



Cause	Remedy
<ul style="list-style-type: none"> <li>- insufficient supply voltage (only during diagnosis)</li> </ul>	<ul style="list-style-type: none"> <li>- Check condition of battery and ensure sufficient supply</li> </ul>



\*\*\* Initialization error \*\*\*  
 Switch ignition on!  
 Check diagnostic connection!  
 CONTINUE

Cause	Remedy
<ul style="list-style-type: none"> <li>- Insufficient supply voltage (&lt; 11 volts)</li> <li>- No supply voltage (ignition off)</li> <li>- no ECU or wrong ECU connected</li> <li>- Diagnostic lines switched or disconnected</li> </ul>	<ul style="list-style-type: none"> <li>- Ensure supply</li> <li>- Switch on ignition</li> <li>- Check ECU and connection</li> <li>- Check lines and connections for function and proper allocation</li> </ul>

\*\*\* Wrong key word \*\*\*  
 Diagnosis impossible!  
 CONTINUE

Cause	Remedy
<ul style="list-style-type: none"> <li>- Wrong ECU connected</li> <li>- Wrong „WABCO Data“ in ECU or defective ECU</li> </ul>	<ul style="list-style-type: none"> <li>- Check ECU part number</li> <li>- Change ECU and check ECU part number</li> </ul>

Defective Program Card !  
 CONTINUE

Cause	Remedy
<ul style="list-style-type: none"> <li>- Defective program card</li> <li>- Wrong program card</li> </ul>	<ul style="list-style-type: none"> <li>- Change program card</li> </ul>

\*\*\* COMMUNICATION  
BREAKDOWN \*\*\*  
Restart diagnostic procedure!  
CONTINUE

Cause

– Data transmission discontinued during diagnostic Line or voltage disconnection during diagnosis

Remedy

– Check all connections  
ISO socket on vehicle  
– switch on ignition

\*\*\* Unknown control unit \*\*\*  
Diagnosis not possible  
with this program card!  
CONTINUE

Cause

– ECU cannot be tested with this program card

Remedy

– Use right program card

\*\*\* Error during self-test \*\*\*  
EEPROM of Diagnostic Controller faulty  
CONTINUE

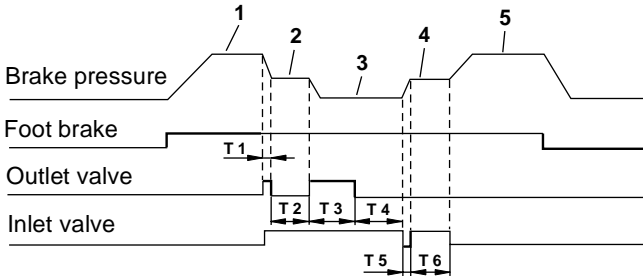
Cause

– EEPROM (Diagnostic Controller's) non-volatile memory of DC defective

Remedy

– Repair Diagnostic Controller

## 8. PULSE PROGRAM SEQUENCE: MODULATOR VALVES



### Test procedure:

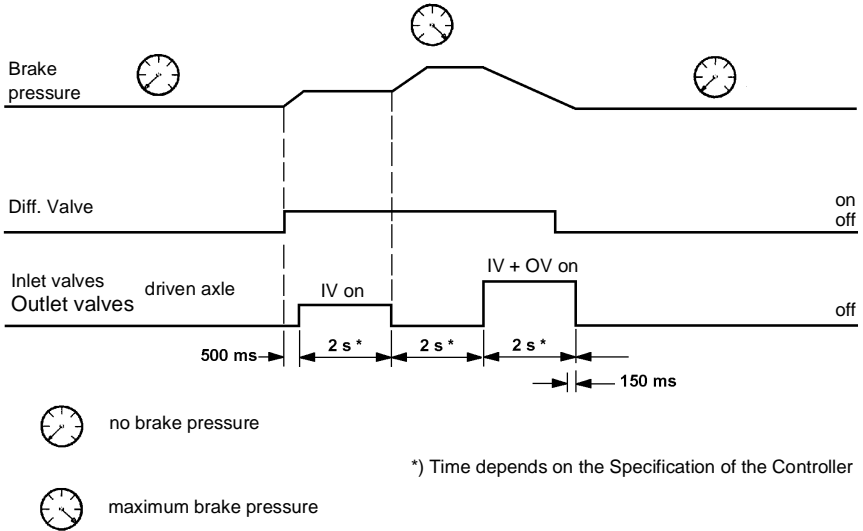
- Connect pressure gauge to brake chambers or
- Use brake test bench with independent wheel facility
- Actuate and hold brake !
- Start pulse program and observe pressure readings !

**Gauge** (according to above-mentioned pulse program sequence):

1. maximum brake pressure \*)  
Pressure holding phase
2. Pressure reduction  
Pressure holding phase
3. Pressure reduction to 0 bar  
Pressure holding phase
4. Pressure increase  
Pressure holding phase
5. Pressure increase to brake pressure \*)

\*) Can vary from axle to axle ( e.g. due to load sensing ). The initial brake pressure will fall during the test (air consumption).

## 9. PULSE PROGRAM SEQUENCE: DIFFERENTIAL VALVES



### Test procedure:

- Connect pressure gauge to brake chambers
- Start pulse program and observe pressure readings !

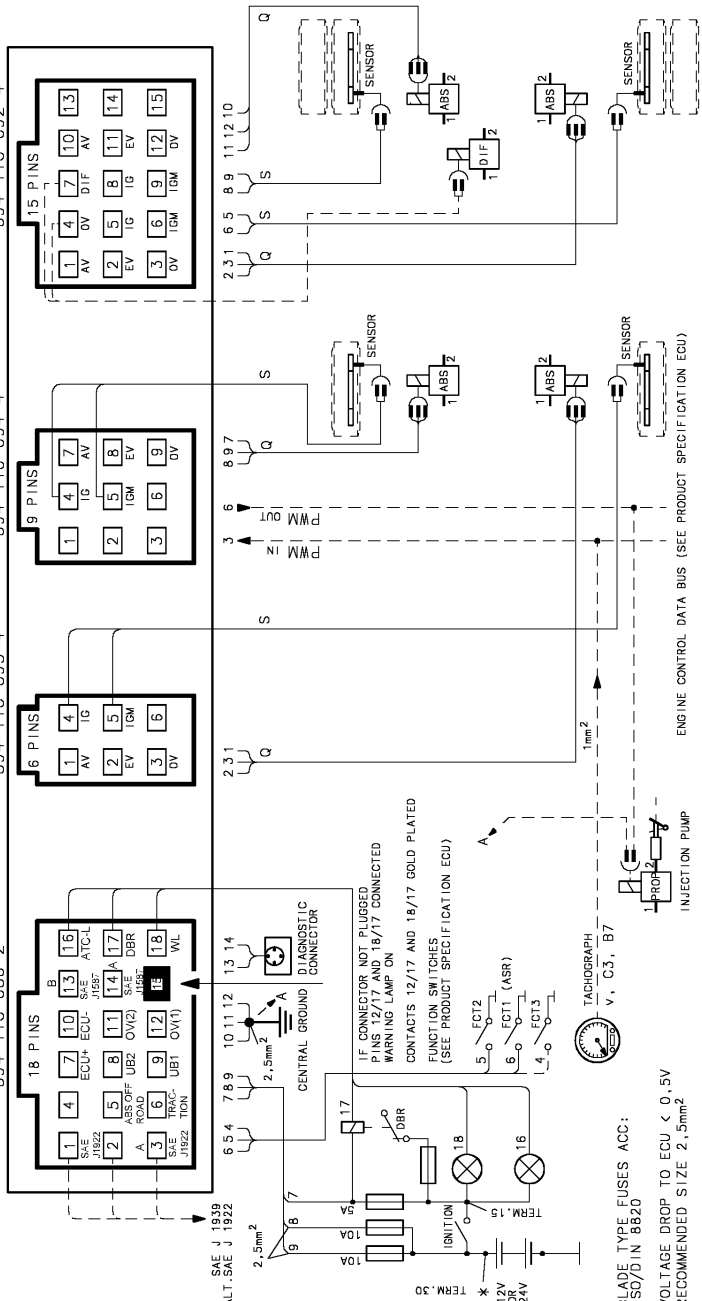
VIEW INTO ECU-CONNECTOR PINS

894\_110\_088\_2

894\_110\_095\_4

894\_110\_094\_4

894\_110\_092\_4



SAE J 1939

ALT. SAE J 1922

2,5mm<sup>2</sup>

2,5mm<sup>2</sup>

2,5mm<sup>2</sup>

2,5mm<sup>2</sup>

2,5mm<sup>2</sup>

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2,5mm<sup>2</sup>

2,5mm<sup>2</sup>

IF CONNECTOR NOT PLUGGED  
PINS 12/17 AND 18/17 CONNECTED  
WARNING LAMP ON

FUNCTION SWITCHES  
(SEE PRODUCT SPECIFICATION ECU)

CONTACTS 12/17 AND 18/17 GOLD PLATED

INJECTION PUMP

TACHOGRAPH

V, C3, B7

1mm<sup>2</sup>

ENGINE CONTROL DATA BUS (SEE PRODUCT SPECIFICATION ECU)

IG, IGM: SENSOR INPUTS

EV: INLET VALVE

DBR: OIL PRESSURE

DBR: OIL LAMP BRAKE (E.G. RETARDER)

BLADE TYPE FUSES ACC:  
ISO/DIN 8820

VOLTAGE DROP TO ECU < 0,5V  
RECOMMENDED SIZE 2,5mm<sup>2</sup>

CABLE SIZE:

WIRE RESISTANCE  
12V: 0,2 OHM / 24V: 0,28 OHM  
{12V: 4,4 OHM PER MODULATOR}  
{24V: 3A PER MODULATOR}

TWISTED SENSOR CABLES:

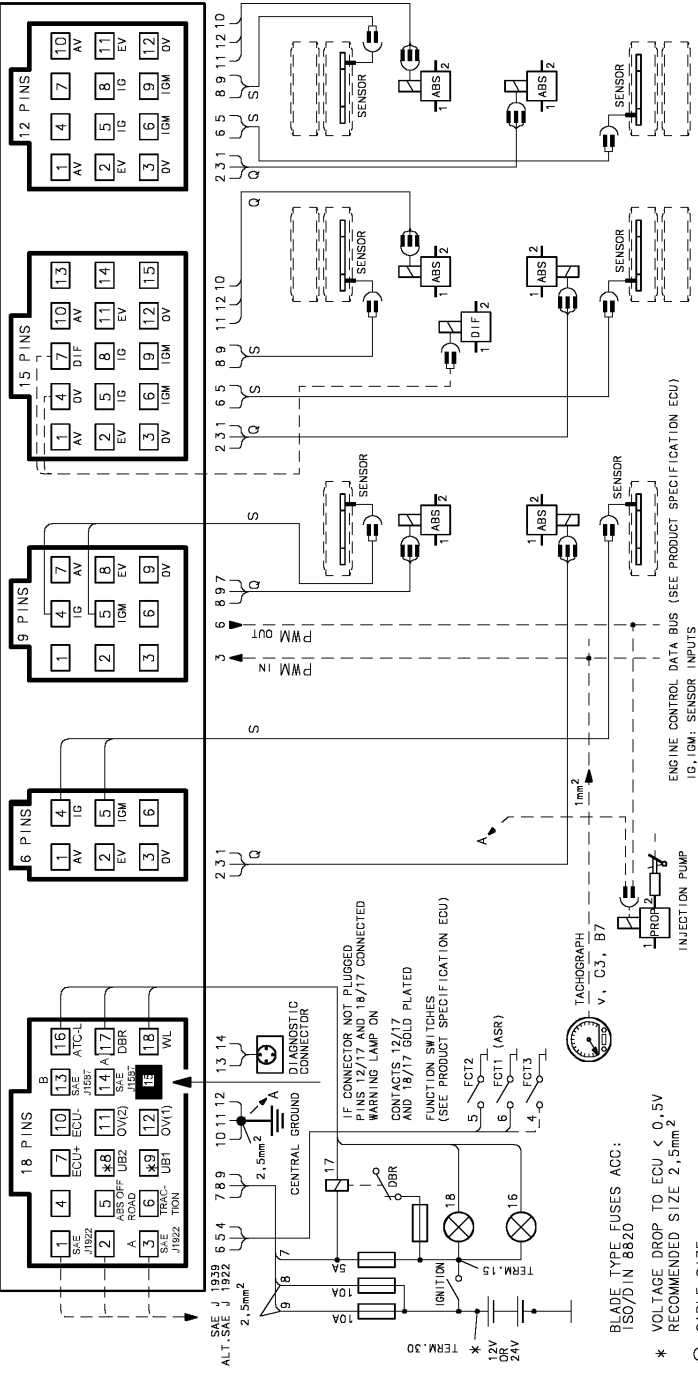
MIN. 1 TURN / 50mm  
SIZE > 0,5mm<sup>2</sup>

NON-MARKED WIRE GAUGE  
0,75 TO 1,5mm<sup>2</sup>

DASHED LINES: OPTION

CONNECTOR	INLET		OUTLET		COMMON
	BN	BL	GN	YE	
6	2	1	3		
9	8	7	9		
15	2	1	3		
	11	10	12		

ECU: 446 004 ... 0  
ABS/ASR D-VERSION 4S/4M



ENGINE CONTROL DATA BUS (SEE PRODUCT SPECIFICATION ECU)  
 IG, IGM: SENSOR INPUTS  
 EV: INLET VALVE  
 AV: OUTLET VALVE  
 DBR: AUXILIARY BRAKE (E.G. RETARDER)

CONNECTOR	INLET	OUTLET	COMMON
6	2	1	3
9	8	7	9
15	11	10	12
12	2	1	3
	10	12	

**BLADE TYPE FUSES ACC:**  
 ISO/DIN 8820

\* VOLTAGE DROP TO ECU < 0,5V  
 RECOMMENDED SIZE 2,5mm<sup>2</sup>

**Q CABLE SIZE:**

WIRE RESISTANCE MAY NOT EXCEED:  
 12V: 0,2 OHM / 24V: 0,28 OHM  
 (12V: 4, 4A PER MODULATOR)  
 (24V: 3A PER MODULATOR)

**S TWISTED SENSOR CABLES:**

MIN. 1 TURN / 50mm  
 SIZE > 0,5mm<sup>2</sup>  
 NON-MARKED WIRE GAUGE  
 0,75 TO 1,5mm<sup>2</sup>  
 DASHED LINES: OPTION

ECU: 446 003 ... 0  
 ABS/ASR D-VERSION 6S/6M

**WABCO**

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