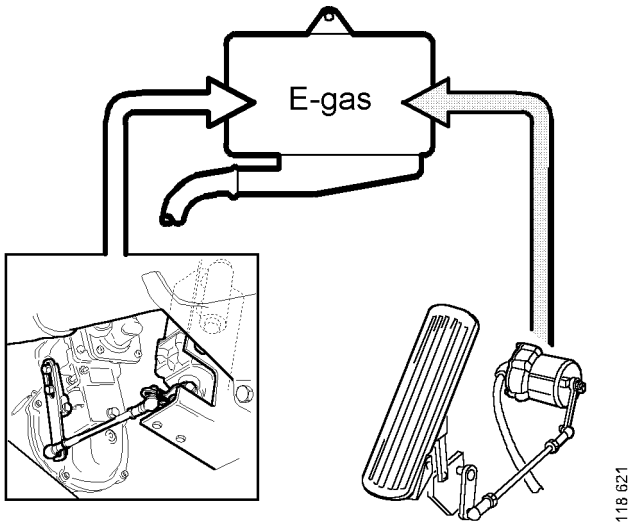
SCANIA

# 14:02-55

Issue 1 **en**

# Electric throttle

## Function description

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# Contents

# General

## Introduction

The electric throttle system may be regarded as an electronic link between the driver and the engine. The electric throttle system consists of an electronic control unit, an accelerator pedal sensor and a control motor. For reasons of comfort and safety, additional functions and components are connected to the control unit. The control unit then controls the control motor throttle actuation and other components depending on the input signals it receives.

The booklet describes the electric throttle system in buses with diesel or ethanol engines. At the back of the booklet is a description of the differences relating to buses and trucks with gas engines.

The electric throttle system has several advantages:

- Buses with transverse engines cannot stand sudden throttle actuation without the risk of natural oscillation of the engine suspension or the entire drive chain. Throttle actuation must always be gentle, regardless of how the driver treats the accelerator pedal.
- Buses must remain as roadworthy as possible, even if they develop a fault. The safety features include a warning system, using fault codes to indicate to workshop personnel which faults have occurred, and also notifying the driver by means of a warning lamp. The electric throttle system automatically compensates for wear provided that the basic mechanical settings are correct. Otherwise there would be a risk of the control motor exceeding its normal operating range. This may result in fault warnings and fault codes being sent to the driver and service personnel. These may also be due to electrical faults, e.g. corroded connectors or faulty earth.
- Several safety features are built into the electric throttle system. The electric throttle interacts electrically with the automatic gearbox and stop lamp (and on articulated buses also with the articulation control system). When the stop lamps are lit (i.e. when the bus brakes), the engine falls to idle speed, regardless of the accelerator pedal position.

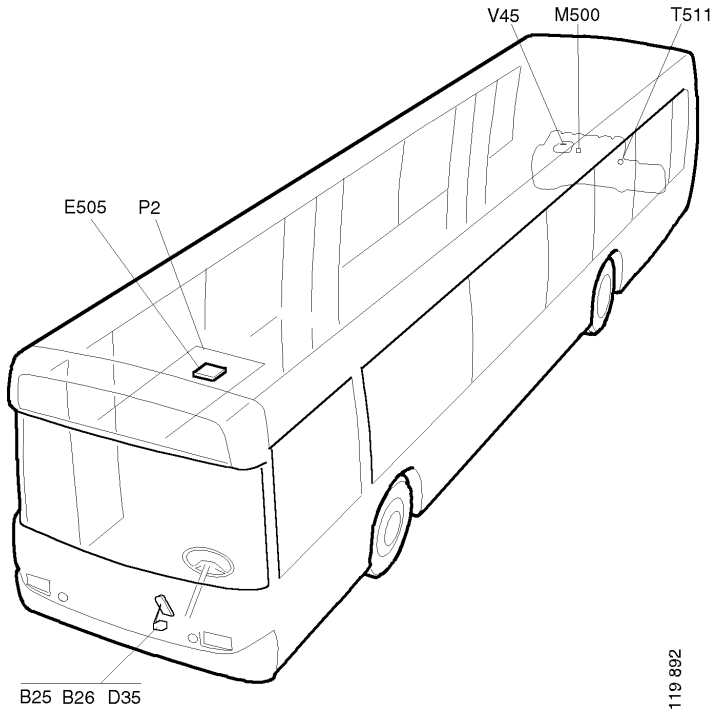
It is vitally important that the settings are correct. The work is not difficult, but must be carried out with care and in the correct order.

The settings procedure is described in the Work Description.

# Main components

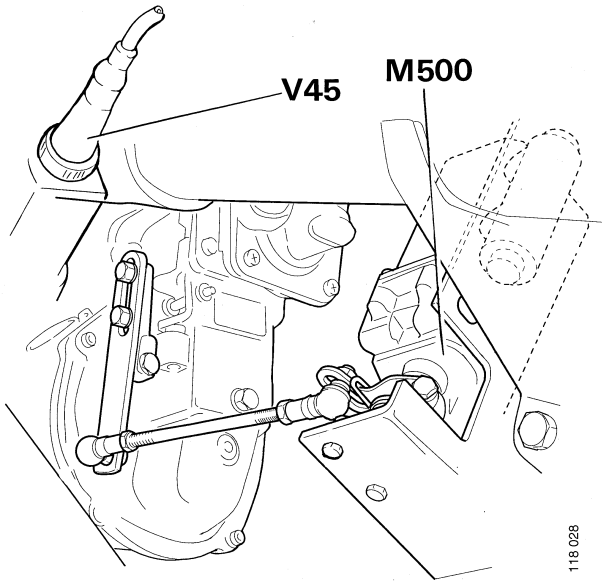
The following illustrations show the location of the main electric throttle system components in the CN94, i.e. busses with the Scania OmniCity body. In other vehicles, the component location may differ from that shown below. The front central electric unit on such vehicles may also look somewhat different, but the electric throttle system components are as shown.

## Component locations




*E505 = Electric throttle control unit*
*M500 = Control motor*
*P2 = Front central electric unit*
*T511 = Engine speed sensor*
*V45 = Fuel valve*
*B25 = Throttle actuation switch*
*B26 = Kick-down switch*
*D35 = Potentiometer*

Components relating to the injection pump




*Electric throttle system components relating to the engine injection pump.*

*M500 = Control motor*

*V45 = Fuel valve*

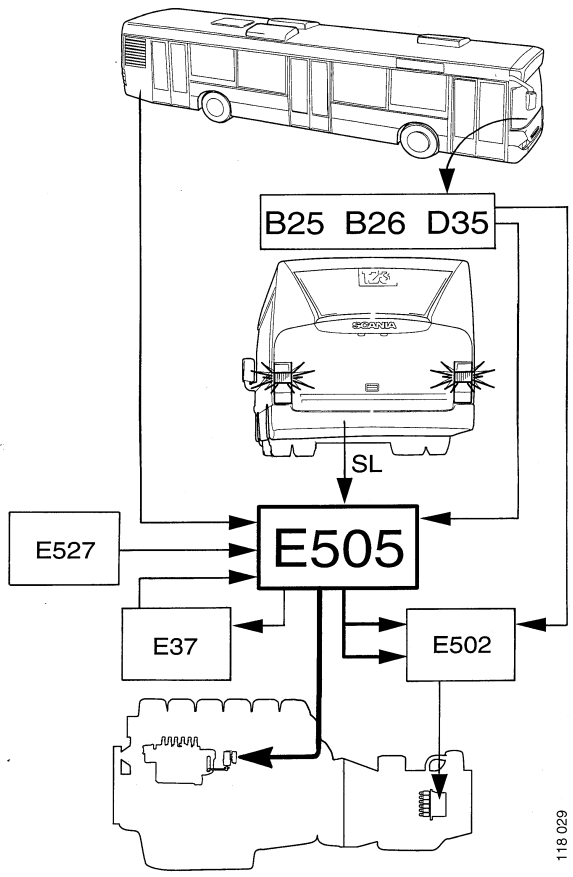
# Electric throttle overview

The illustration to the right shows how the electric throttle is connected to adjacent systems. Different faults may cause the systems to affect each other.

- A fault in the TC system generates a fault code in the electric throttle system, lighting the warning lamp.
- A fault in the articulation control system may affect the electric throttle, but not vice-versa.
- A fault in the stop light circuit may affect the electric throttle, but not vice-versa.
- A fault in the automatic gearbox or its control system may affect the electric throttle. At the same time, faults in the electric throttle may affect the function of the automatic gearbox.

Faults believed to be due to interaction between the systems can always be remedied by adjusting each system individually. The interaction between the systems should then be restored.

If this proves insufficient – but only if – then proper troubleshooting is justified.




*SL = Stop lamp control circuit*

*E37 = Control unit for ABS/TC (non-articulated buses)*

*E502 = Automatic gearbox control unit*

*E505 = Electric throttle control unit*

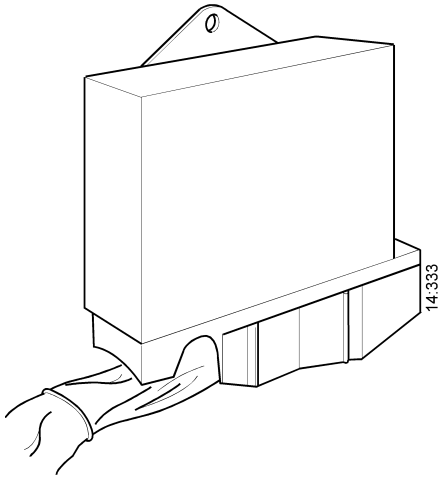
*E527 = Articulation control unit*

*B25 = Throttle actuation switch*

*B26 = Kick-down switch*

*D35 = Potentiometer*

# Control unit




## General

One of the main components in the electric throttle system is the control unit. The control unit is programmed using the Scania Programmer and can be adapted as follows:

- Engine type
- With / without TC (does not apply to articulated buses or trucks)
- Idle speed
- Maximum speed and Speed limit 2

Replacement control units must be programmed using the Scania Programmer (SP2). Only the basic programming has been carried out on delivery.

The control unit is supplied with power from pin 15 (starter key).

## Automatic gearbox

The electric throttle control unit sends a PWM signal on the throttle actuation to the automatic gearbox control unit. The PWM signal, which is sent unconverted, is used to control the automatic gearbox shift timing.

PWM = Pulse Width Modulation, meaning that the signal pulse width is proportional to the throttle actuation. An analogue value is transmitted by a digital signal.

## Idle speed control

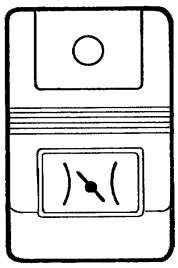
The electric throttle helps to keep the idle speed stable in the event of changes to the engine load, e.g. switching AC on or off.

# Raised idling speed (hand throttle)

Raised idling means that the idle speed can be increased to 1000 RPM, e.g. when warming up or filling the compressed-air system. When it is used, the warning lamp lights in the raised idling speed switch.

The drive mode selector must be in neutral position before raised idling speed is permitted. Engaging the switch for raised idling speed whilst driving has no effect. Only when the drive mode selector is in neutral position can raised idling speed be obtained. The switches for raised idling speed and neutral drive mode are connected in series.

The engine must be running for the control motor to move the injection pump arm to the raised idling speed position.

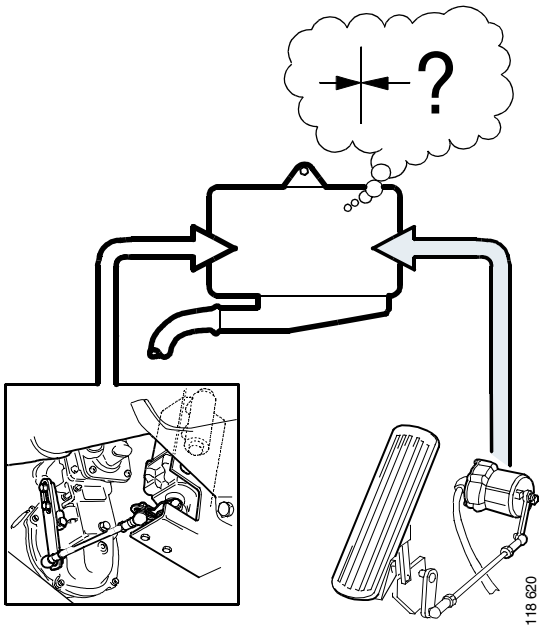


# Safety system

Several control features are built into the electric throttle system. For example, the throttle actuation from the accelerator pedal is continuously compared with the value from the positional potentiometer in the control motor.

These two readings should then indicate a value corresponding to that programmed[1] into the control unit, and agree with the status of the safety and throttle actuation switches. Otherwise, the safety system is activated by taking one or more of the following measures:

- The warning lamp is activated.
- Idle speed control is switched off.
- The throttle control reverts to idle speed.
- The engine speed is regulated using the fuel valve if the speed exceeds 1000 RPM. If this is the case, it will be adjusted to around 1000 RPM. The vehicle may only be driven a short distance, e.g. across a junction where the vehicle has stopped.



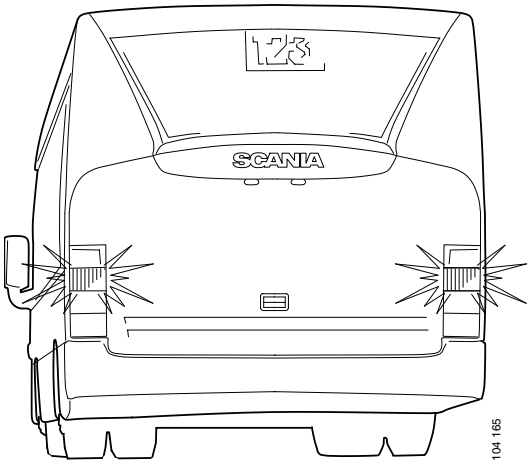

1. Values may vary significantly, e.g. with raised idling speed or idle speed control with a high load from the air conditioning or alternator. The values will also differ during the acceleration and deceleration curves.

# Brake circuit connection

The brake circuit connection is a connection from the stop lamp switch (for the service brake) and a pressure monitor (for the bus stop brake on a bus), which ensure that the control unit sets idle speed when the stop lamps are lit. The signal is passed to terminal 14 / Reduction 4 on the control unit.

Therefore, only idle speed can be obtained (in this case maximum 5% throttle actuation if the accelerator pedal is depressed) and the engine cannot be turned. See also the section 'Throttle reduction'.

This function is not engaged when the parking brake is applied. This allows the engine to be turned.



# Coachbuilder connection

Certain functions that can be used by the coachbuilder are pre-set at the factory. The cables are routed from the control unit to a connector (see the circuit diagram, group 16).

## Throttle actuation signal

Control unit pin 2 (Part load 3) is an output that earths when the accelerator pedal is depressed.

The output may be connected differently depending on the coachbuilder. On Scania bodies, it is connected to the node system (BNS). When the vehicle is stopped and the doors opened at a bus stop, the bus stop brake is applied. After closing the doors, this signal is used to release the brake as soon as the accelerator pedal is depressed. The connection is located in the front central electrical unit.

The output will earth (falling from +24 V to maximum +3 V) when the control motor is more than 2% actuated. The output may be loaded at maximum 0.8 A. The idle speed control does not activate the output.

## Speed limit 2

The electric throttle comprises two pre-programmed speed limits. Control unit pin 12 (Speed limit 2) is an input that activates Speed limit 2. Speed limit 2 is activated when +24 V is applied to the pin.

## Acceleration and deceleration curves

Buses with transverse engines cannot stand sudden throttle actuation or deactuation without the risk of natural oscillation of the engine suspension or the entire powertrain. Changes in throttle actuation must therefore be gentle. The electric throttle system acts as a link between the driver and the engine. Regardless of how fast the driver depresses or releases the accelerator pedal, the changes in throttle actuation or deactuation will be optimised.

The control unit achieves this by selecting different acceleration and deceleration curves according to the driving situation.

## 3-position throttle actuation adjustment

When certain types of errors occur, including faults in the accelerator pedal sensor potentiometer, the electric throttle system instead regulates the throttle actuation in three stages by means of the throttle actuation and kick-down switches. Then only idle speed, 50% or 100% actuation are available.

| **Pedal position** | **Throttle actuation switch** | **Kick-down switch** | **Actuation** |
|---|---|---|---|
| Released | Open | Open | Idle speed |
| Intermediate position | Closed | Open | 50% throttle actuation |
| Kick-down | Closed | Closed | 100% throttle actuation |

# Control unit terminals

The electric throttle control unit has a 55-pin connector. The table below explains the function of the pins.

| Pin no. / Name | Description | Function |
|---|---|---|
| 1 / Pin 31 | Pin 31 | Control unit earth. |
| 2 / Part load 3 | Partial throttle 3 | Output that will earth when accelerator is depressed. Over 2% actuation of the control motor will result in earthing. It may be loaded at maximum 0.8 A. |
| 3 / Actuator – | Control motor – | Voltage supply (–) for control motor. |
| 4 / Actuator + | Control motor + | Voltage supply (+) for the control motor. |
| 5 / Neutral | Neutral | +24 V input for neutral position on drive mode selector. |
| 6 / - | - | No function. |
| 7 / PWM actual throttle | PWM actual throttle actuation | Output for PWM signal on actual throttle actuation. Used by the automatic gearbox and TC. |
| 8 / Cruise control + | Cruise control + | Voltage supply (+) for cruise control switch. |

| Pin no. / Name | Description | Function |
|---|---|---|
| 9 / Cruise control ret. | Cruise control reduction | Input to reduce and lock cruise control speed. |
| 10 / Cruise control off | Cruise control off | Input to switch off cruise control and switch. |
| 11 / Speed | Speed | Input to indicate vehicle speed. Connected to vehicle speedometer / tachograph. |
| 12 / Speed limit 2 | Speed limit 2 | Input to activate Speed limit 2. |
| 13 / Flashing code | Flashing code | Input from diagnostics switch to activate flashing code. |
| 14 / Reduction 4 | Reduction 4 | Input to reduce maximum throttle actuation to pre-set value (5%). |
| 15 / - | - | No function. |
| 16 / - | - | No function. |
| 17 / Reduction 2 | Reduction 2 | Input to reduce maximum throttle actuation to pre-set value. |
| 18 / High idle 3 | High idle 3 | Input to increase idle speed to pre-set value. |

| Pin no. / Name | Description | Function |
|---|---|---|
| 19 / Motor on speed | Motor on speed | Input to activate motor on speed, adjusted using cruise control switch. |
| 20 / n | n | Input for engine speed from alternator or magnetic sensor. Scania control units are not programmed to use this input. |
| 21 / - | - | No function. |
| 22 / Safety switch actuator | Safety switch, control motor | Input from safety switch in control motor. |
| 23 / Pot–, actuator | Pot–, control motor | Voltage supply (–) for positional potentiometer in control motor. |
| 24 / Pot+, actuator | Pot+, control motor | Voltage supply (+) for positional potentiometer in control motor. |
| 25 / Kick down / Safety switch + | Kick-down / safety switch + | Voltage supply (+) for kick-down and throttle actuation switches in accelerator pedal sensor. |
| 26 / Pot–, sensor | Pot–, accelerator pedal sensor | Voltage supply (–) for positional potentiometer in accelerator pedal sensor. |
| 27 / Pot+, sensor | Pot+, accelerator pedal sensor | Voltage supply (+) for positional potentiometer in accelerator pedal sensor. |

| Pin no. / Name | Description | Function |
|---|---|---|
| 28 / Pin 15 | Pin 15 | Voltage supply (+24 V) for control unit from starter key, pin 15. |
| 29 / - | - | No function. |
| 30 / Status lamp | Warning lamp | Output (–) for warning lamp on instrument panel and in central electrical unit. |
| 31 / Safety system + | Safety system + | Output (+24 V) to activate fuel valve in safety system. |
| 32 / Kick down | Kick-down | Input for kick-down switch in accelerator pedal sensor. |
| 33 / High idle 2 | High idle 2 | Input to increase idle speed to pre-set value. |
| 34 / Part load 1 | Partial throttle 1 | Output to earth at a pre-set control motor position. May be loaded at maximum 10 mA. Decreases from +24 V to maximum +5.6 V. |
| 35 / PWM throttle reducing | PWM throttle reduction | Input for PWM signal to reduce control motor actuation. Used by TC. |
| 36 / Cruise control acc | Cruise control acceleration | Input to increase and lock cruise control speed. |

| Pin no. / Name | Description | Function |
|---|---|---|
| 37 / Cruise control resume | Cruise control resume | Input to resume latest used cruise control speed. |
| 38 / Cruise control off, brake | Cruise control off, brake | +24 V input to ensure engine speed regulation functions during normal operation. Cut-off voltage supply is interpreted by control unit as depressed brake pedal. |
| 39 / | - | No function. |
| 40 / | - | No function. |
| 41 / | Oscillator sensor + | Voltage supply (+) for engine speed sensor, compare terminal 20. Not used by Scania. |
| 42 / Ref. r/m | Ref RPM | Reference signal for control unit terminal 49 / RPM. |
| 43 / | - | No function. |
| 44 / Diagnosis | Diagnosis | Computer connection for programming control unit or for diagnosis program. |
| 45 / Reduction 3 | Reduction 3 | Input to reduce maximum throttle actuation to pre-set value. |
| 46 / Reduction 1 | Reduction 1 | Input to reduce maximum throttle actuation to pre-set value. |

| Pin no. / Name | Description | Function |
|---|---|---|
| 47 / Part load 2 | Partial throttle 2 | Output to earth at a pre-set control motor position. May be loaded at maximum 10 mA. Decreases from +24 V to maximum 5.6 V. |
| 48 / High idle 1 | High idle 1 | Input to increase idle speed to pre-set value. |
| 49 / r/m | RPM | Input for engine speed from inductive sensor. Scania control units are programmed to use this input. |
| 50 / Retarder | Retarder | Output to activate retarder when driving with cruise control. |
| 51 / Safety switch actuator + | Safety switch, control motor + | Voltage supply (+) for safety switch in control motor. |
| 52 / Pot signal actuator | Pot signal control motor | Input from positional potentiometer in control motor. |
| 53 / n-limit | n-limit | Input to activate pre-set maximum engine speed. |
| 54 / Safety switch sensor | Throttle actuation switch sensor | Input from throttle actuation switch in accelerator pedal sensor. |
| 55 / Pot signal sensor | Pot signal sensor | Input for signal from positional potentiometer in accelerator pedal sensor. |

# Control motor

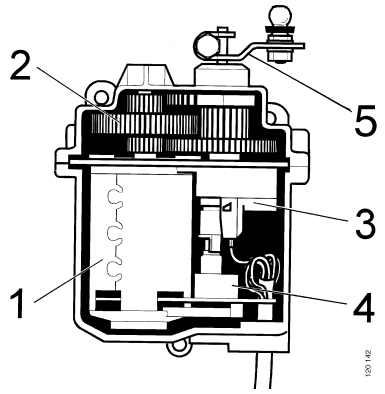
## General

The main components of the control motor are: electric motor, gearbox, arm, potentiometer and safety switch. The electric motor turns the arm via the gearbox. The arm and the injection pump are coupled together via a link. The output voltage from the potentiometer varies according to the position of the arm, and so informs the control unit of the arm position.

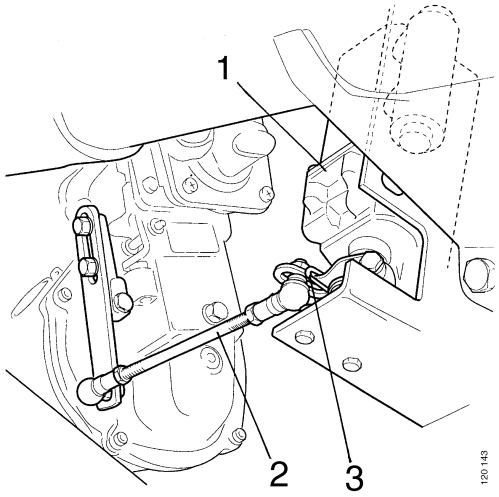
The safety switch opens when the control motor position increases from idle position. This allows determination of whether the control motor position (as well as the throttle actuation if the link is complete) is higher than idle speed, even if the potentiometer should stop functioning.

The control motor also comprises a return spring that returns the actuation arm to the idle speed stop bracket if the control motor loses power.

The control motor may not be opened. It cannot be repaired, but must be completely renewed.




*1 Electric motor*
*2 Gearbox*
*3 Safety switch*
*4 Potentiometer*
*5 Arm*




*1 The control motor is located by the injection pump, on diesel and ethanol engines.*
*2 Return spring*
*3 Link*

# Accelerator pedal sensor

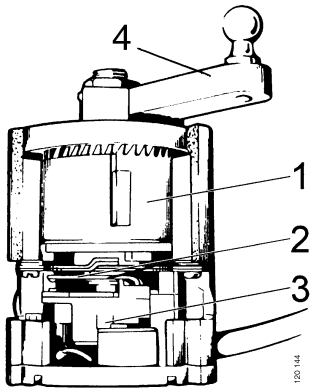
## General

The accelerator pedal sensor consists of a potentiometer connected to the accelerator pedal via a link. When the accelerator pedal is depressed, the movement is transferred (via the link and the accelerator pedal sensor arm) to the potentiometer, the resistance of which is controlled by the position of the accelerator pedal. The throttle regulation control unit reads the voltage from the potentiometer slip ring contact and so obtains information on the desired throttle actuation.

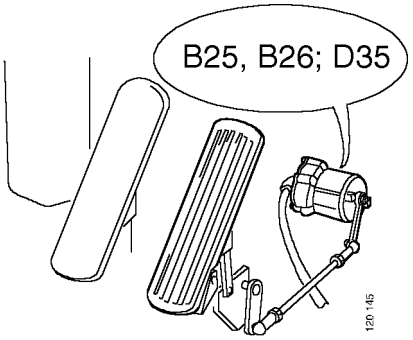
The main components of the accelerator pedal sensor are: return spring, potentiometer with throttle actuation switch and kick-down switch (behind the throttle actuation switch in the illustration).

The throttle actuation switch closes when the throttle actuation increases from idle.

The kick-down switch closes near full throttle position. The kick-down switch signal passes directly to the gearbox, but also to the electric throttle control unit.




*1 Return spring*
*2 Throttle actuation switch*
*3 Potentiometer*
*4 Arm*




*The accelerator pedal sensor is located under the driver floor*

*B25 = Throttle actuation switch*

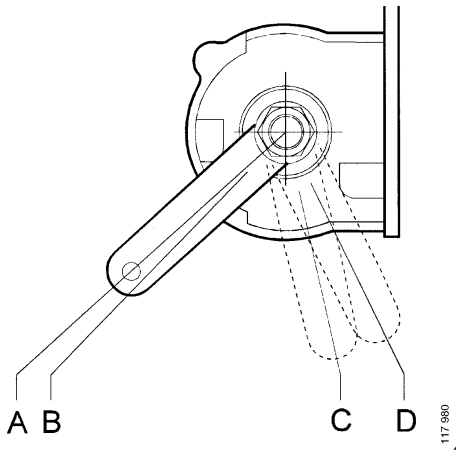
*B26 = Kick-down switch*

*D35 = Potentiometer*

The return spring returns the arm when the accelerator pedal is released and therefore also functions as a return spring for the accelerator pedal. The switch status and voltage from the potentiometer are compared by the control unit. This also allows fault indication.

The accelerator pedal sensor may not be opened. It cannot be repaired, but must be completely renewed.

The accelerator pedal sensor potentiometer and switch statuses are dependent on the arm position.




*A = Idle speed*

*B = 1-5°, closing angle for throttle actuation switch*

*C = 60-68°, closing angle for kick-down switch*

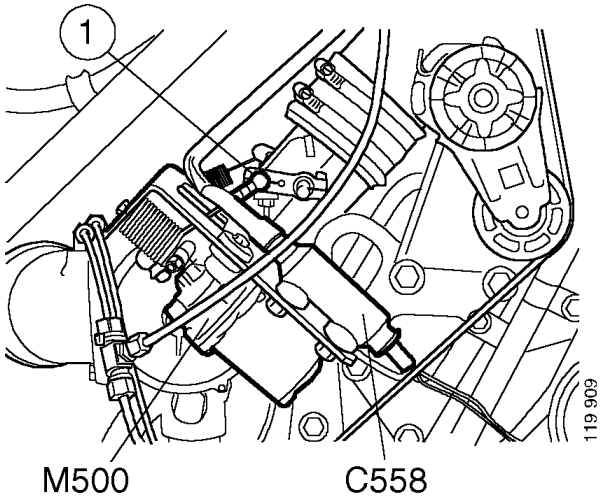
*D =Max. position*

# Buses with gas engines

## General

In this section the differences between buses with gas engines and buses with diesel / ethanol engines are described.

- The electric throttle control motor controls the throttle valve instead of the injection pump arm.
- There is a separate ignition control unit, but it is not connected to the electric throttle.
- The gas supply is automatically shut off at 2250 RPM and ignition is shut off at 2400 RPM.
- During a functional inspection of the safety system, the engine will run at approximately 2250 RPM.




*M500 = Control motor*
*C558 = Connector*
*① = Link*

# Safety features

During a functional inspection of the safety system, the engine will run at approximately 2250 RPM.

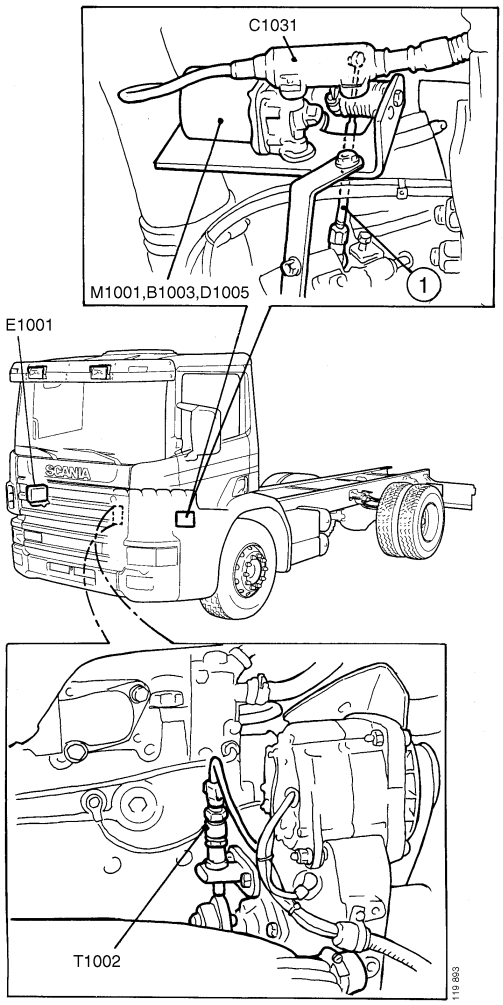
- The gas supply is automatically shut off at 2250 RPM and ignition is shut off at 2400 RPM. (In diesel and ethanol engines, the fuel valves are pulsed by the electric throttle to approximately 1000 RPM.)
- When the engine speed exceeds 2250 RPM, the electric throttle control unit applies +24 V to pin 31, which activates a relay (R1002) and shuts off the gas supply.

# Trucks with gas engines

## General

In this section the differences between trucks with gas engines and buses are described:

- The accelerator pedal sensor has separate connections for the potentiometer, kick-down switch and accelerator pedal sensor.
- The electric throttle control motor controls the throttle valve instead of the injection pump arm.
- There is a separate ignition control unit, but it is not connected to the electric throttle.
- The engine speed sensor reads off a rotating wheel mounted in the engine timing gears. The wheel is located where the injection pump is normally located.




*C1031 = Connector*
*M1001 = Control motor*
*B1003 = Safety switch*
*D1005 = Potentiometer*
*E1001 = Electric throttle control unit*
*T1002 = Sensor*
*① = Link*

# Safety features

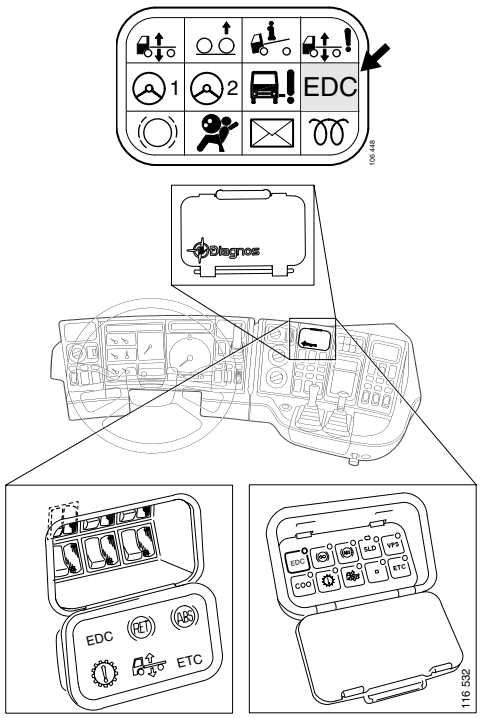
During a functional inspection of the safety system, the engine will run at approximately 2250 RPM.

- The gas supply is automatically shut off at 2250 RPM and ignition is shut off at 2400 RPM. (In diesel and ethanol engines, the fuel valves are pulsed by the electric throttle to approximately 1000 RPM.)
- When the engine speed exceeds 2250 RPM, the electric throttle control unit applies +24 V to pin 31, which activates a relay (R1002) and shuts off the gas supply.

# Warnings and fault codes

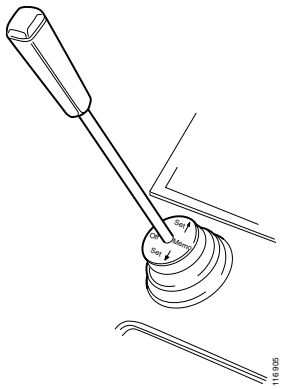
The EDC lamp is used as a warning lamp for the electric throttle system.

The EDC diagnostics button is used to obtain fault codes.



# Cruise control

In the driver area is a lever to regulate the cruise control settings. The lever is also used as a hand throttle to regulate the engine speed, e.g. during power take-off operation.



Control functions

| | |
|---|---|
| Set ↑ | Accelerate |
| Set ↓ | Decelerate |
| MEMO | Resume previous setting |
| OFF | Deactivation |

# Activating constant engine speed

Constant engine speed is activated via connector S1009/1. The connector is located under the switch panel by the steering wheel. Pin 2 (green cable) is the + supply and pin 6 (red cable) sends the signal to the electric throttle control unit.

Alternatives to obtain constant engine speed:

1 Connecting the connector to a switch in the instrument panel to manually activate constant engine speed.

2 Coupling together pins 2 and 6 with a relay controlled by signals from the desired location.

If an engine speed other than 1400 RPM is required, the cable to pin 18 on the electric throttle control unit must be moved to the relevant pins according to the table below.

| Pin | Engine speed |
|---|---|
| 33 | 1200 RPM |
| 48 | 1000 RPM |