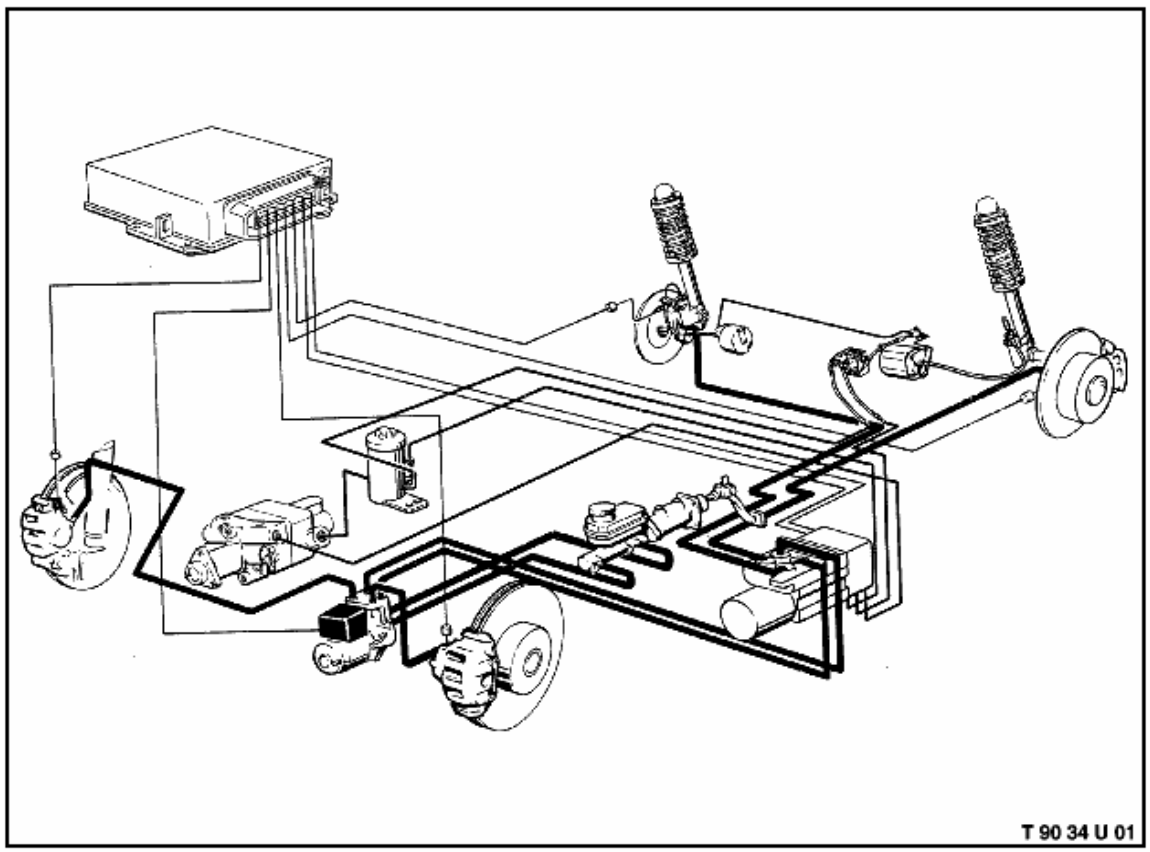

SUBJECT: Automatic Stability Control with Traction Control System (ASC+T)

MODEL: 750iL (to be phased into 850i)

When a vehicle is either accelerated or braked, a certain amount of wheel slip occurs. Wheel sli can be expressed as a percentage, representing the difference between road speed and the speed of a rotating wheel. For example, a vehicle cruising at a steady 50 MPH on a dry, level surface would have 0% wheel slip. A vehicle skidding on ice (road speed 50 MPH, wheel speed 0 MPH) would have 1 00% wheel slip.

Lateral locating forces (and therefore vehicle stability) decreases rapidly as wheel slip increases Because the ABS system limits wheel slip automatically during braking, vehicle stability is maintained, as lateral location forces remain high.



The same principle is applied to wheel slip when accelerating (wheel spin) by the ASC system. By controlling throttle opening and ignition timing, ASC reduces torque to the driven wheel if excessive wheel slip occurs during acceleration. More effective transmission of power to the road surface is achieved, and lateral locating forces remain high (resulting in greater vehicle stability).

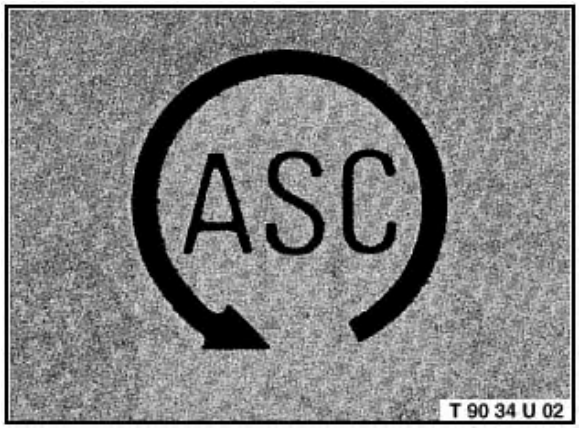
Because an automatic control system can react more quickly and precisely than the vehicle's driver, active safety is improved with these systems.

Automatic stability control with traction control (ASC+T) represents a further development of the ASC system. In addition to the throttle and timing controls of ASC, the ASC+T system adds the feature of braking control at the rear wheels, depending on degree of wheel slippage and road speed. In addition to the task of keeping wheel slippage (or spin) at acceptable levels, there is a equally important aspect of this function - by braking the spinning wheel and directing the torque to the wheel with better traction, the need for a limited-slip differential is eliminated.

Note: As the amount of spin required for optimum propulsion in deep snow, for instance, is very high, the system can be switched off for this operating range. The same applies if the car needs to be rocked free by rapidly changing between forward and reverse.

It should be remembered that even with ASC+T, the laws of physics cannot be defied. The consequences of insufficient traction and lateral locating forces (when these limits are exceeded) are factors for which only the driver is responsible.

The driver is informed of the status of the ASC+T system by an indicator lamp in the instrument cluster.



Whenever the ignition is switched ON, the ASC+T system is in operation. The indicator lamp goes off when the engine is started. As soon as the system is **activated**, for example, if the accelerator setting is excessive for the given road conditions, the ASC lamp in the instrument cluster flashes to alert the driver. If the ASC+T system fails or is switched off, the ASC lamp remains ON permanently.

Advantages of the ASC+T System

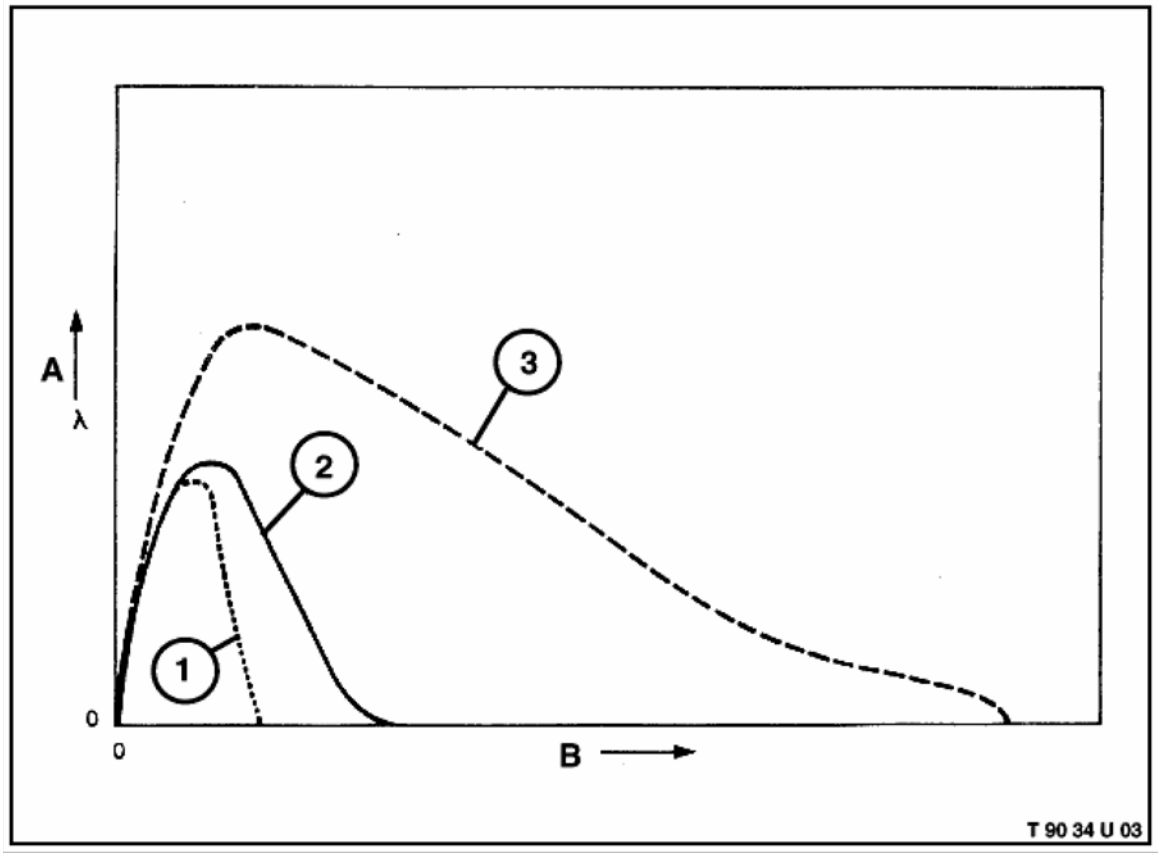
- Optimum traction at all speeds, as the system effectively transfers power from the driven wheels to the road surface, resulting in improved propulsion.
- Increased stability by retaining lateral locating forces, both when travelling straight ahead and cornering.
- Reduction of burden on the driver, by automatically intervening and controlling appropriate systems, and by informing the driver that the vehicle is approaching the limits of stability. All three of these advantages contribute to active safety.

Function

ASC+T controls wheel slip under acceleration (wheel spin) through four regulating functions:

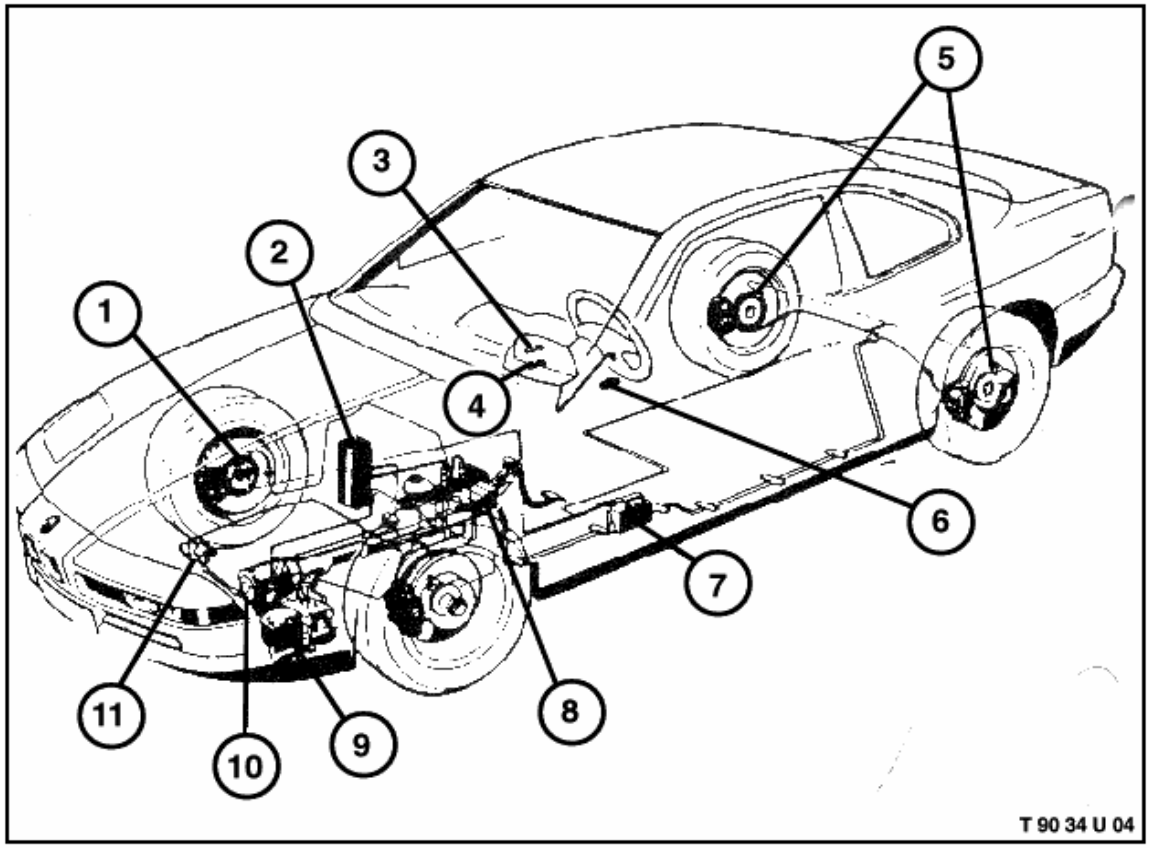
- Throttle valve regulation
- Ignition timing regulation
- Rear brake regulation
- EGS shift characteristic regulation

With the ASC+T, the braking effects provides a quicker, smoother reduction of driving torque than the engine regulating effect of the ASC system. The braking function is used for rapid control functions instead of the
ignition/injection "fade out".



A Wheelspin B Time
1 Anti-Slip Control by Throttle Valve
2 Anti-Slip Control by Throttle and Ignition Timing
3 Anti-Slip Control by Throttle Valve, Ignition Timing, and Rear Brake Regulation

Component Location

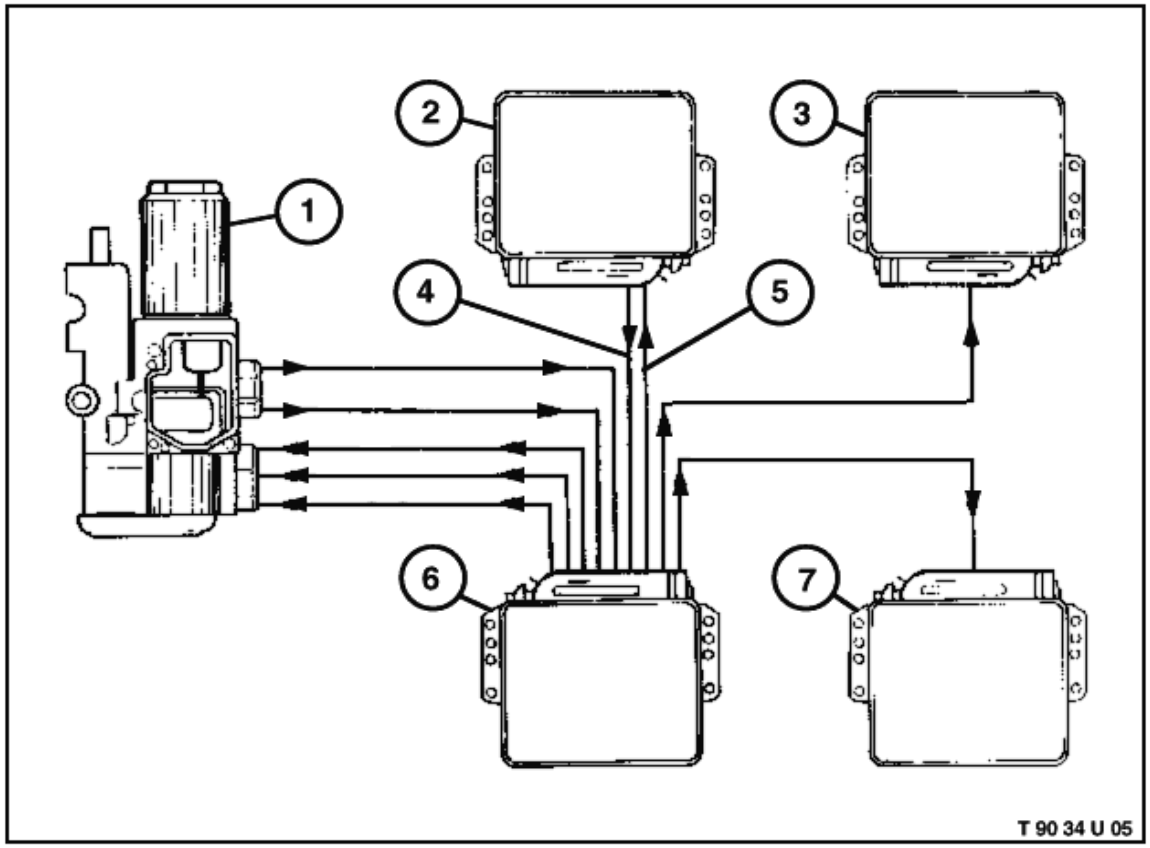


1	Front Speed Sensors	2	Fluid Resevoir
3	ASC Lamp	4	ABS Lamp
5	Rear Speed Sensors	6	ASC On/Off Switch
7	ABS/ASC Control Unit	8	ASC Hydraulic Unit
9	ABS Hydraulic Unit	10	Tandem Pump
11	Filter		

ASC+T Operation

The ASC+T system is integrated with the ABS system. The two systems share the same contro unit, and receive wheel speed information from the same wheel sensors. However, the two systems operate independently from each other, and each is capable of functioning in the event of the other's failure, provided no shared electrical component is involved. (Refer to the "Safety Logic" portion of this bulletin, and to the appropriate Diagnostic Manual and ETM).

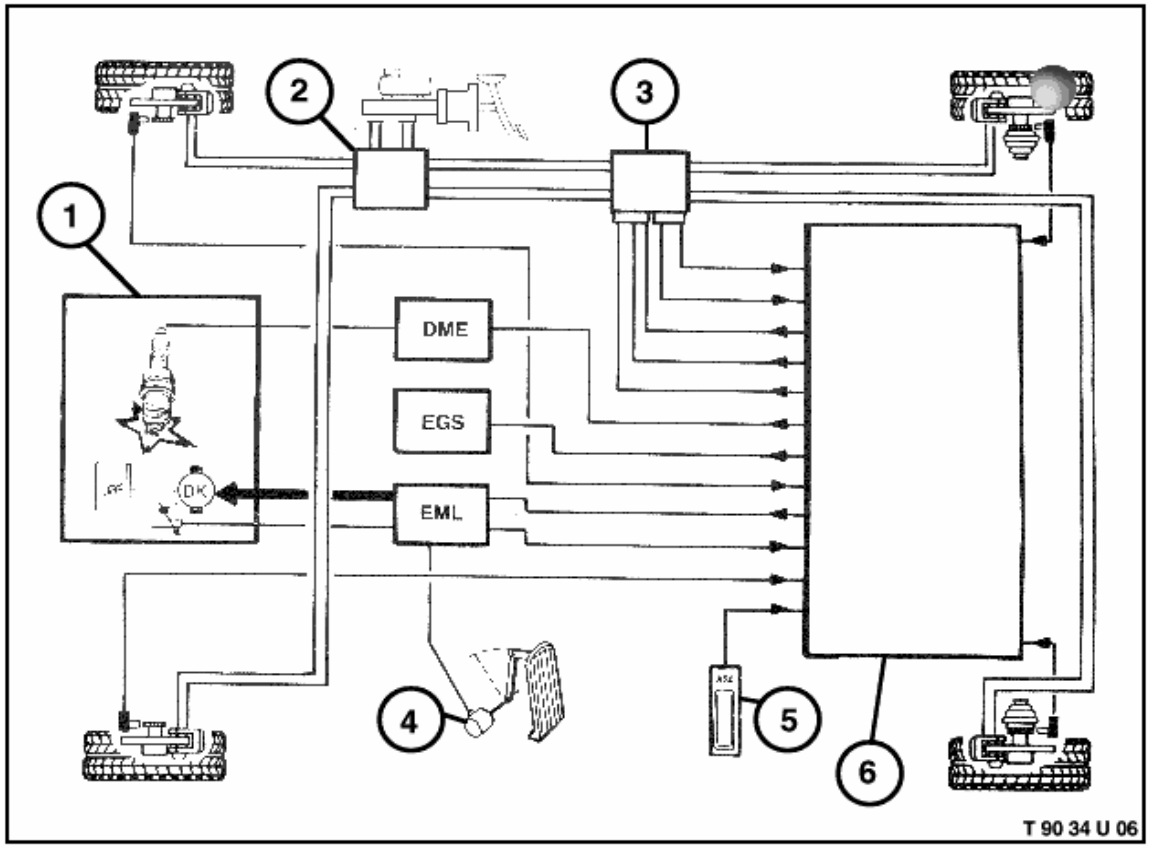
In order to obtain a highly effective and sensitive control system, it was necessary to coordinate the ASC+T system with the EML, DME, and EGS systems.



1 ASC+T Hydraulic Unit
2 EML
3 EGS
4 DKV (Throttle Close Signal from ASC+T)
5 DKR (Throttle Open Signal from Accelerator Pedal)
6 ASC+T
7 DME 1/2

ASC+T monitors wheel speed via the wheel sensors shared with the ABS system. When wheel spin is detected, the control circuits can intervene. If at least one wheel exhibits a speed difference of 1.8 MPH, the ASC+T system is activated (intervenes).

NOTE: For this reason, the condition of all four tires must always be uniform. Tire pressures must be as specified. Deviating pressures and tire diameters may activate the system unnecessarily. The system must be switched OFF if snow chains are fitted to the driven wheels, as the amount of spin required to obtain driving traction will exceed the ASC+T spin threshold. The same procedure must be followed if the vehicle is crossing a surface of loose gravel, dissimilar substances, etc.



1 M70 Engine
2 ABS Hydraulic Unit
3 ASC+T Hydraulic Unit
4 PWG Pot
5 ASC ON/OFF Switch

The ASC+T control unit receives throttle valve position information via an interface with the EML control unit. Communication between the EML control unit and the ASC+T control unit is in the form of pulse width modulated signals. The opening angle of the throttle valve can be modified by the EML control unit upon request from the ASC+T control unit. The ASC+T ignition adjustment function is carried out by the DME control unit, in response to digital signals issued by the ASC+T control unit. The DME control unit contains operation-related maps from which it selects precise data on ignition adjustment in response to these signals. The EGS control unit modifies gear shift points in response to a signal from the ASC+T control unit.

Select Low/Select High Traction Control

All control circuits of the ASC+T system operate according to the select low or select high principle, i.e., the degree of intervention depends on critical deviation in the event of wheel spin

The select low principle is applied if differences are detected between the left and right sides, or if both driven wheels exhibit spin and the vehicle speed is above 25 mph. In such cases, both rear wheels are braked together (only briefly) to allow the spinning wheels to regain traction.

Select low regulation is achieved in the following sequence:

1. Throttle valve opening angle regulation
2. Ignition timing regulation
3. Rear brake control

The select high principle is applied at road speeds below 25 mph, and if differences in spin are detected between the driven wheels. It provides individual brake application to either driven wheel, thus slowing the spinning wheel and transferring the torque to the wheel with greater traction. The select high function also raises the reference value range for wheel spin.

Select High Regulation is activated in the following sequence:

1. Rear brake control
2. Throttle valve opening angle regulation
3. Ignition timing regulation

Speed is calculated for each wheel and an average per axle is calculated. The speed of the non-driven front wheels serves as a reference speed. The critical reference value for control purposes is defined according to vehicle speed and vehicle acceleration.

EML Throttle Valve Control

When frictional surface conditions are poor, the ASC+T system can minimize wheel spin by signalling the EML control unit to reduce the throttle opening. When throttle valve control is activated, the throttle opening angle is reduced from the current setting to a calculated position. If wheel spin is still excessive, the opening angle is reduced in steps until a minimum spin value, dependent on road speed, is attained. As wheel spin is reduced to an acceptable level, the throttle opening angle is gradually adjusted to
the value specified by the driver. The ASC+T system rapidly calculates a sequence of reducing or increasing throttle opening angles as the wheel spin values vary.

Because of the slight dynamic delay effect of throttle valve control on drive torque, a combination with more rapid control circuits, ignition timing and braking function, was also adopted.

Ignition Function

By retarding the ignition timing, combustion peak pressure is modified and engine torque therefore reduced. Ignition timing is adjusted
from the current value on the engine map in a ramp pattern related to engine speed. Depending on the engine's operating mode, this intervention by ASC+T can reduce engine torque by up to 50%.

Braking Function

In some driving conditions, such as abrupt full throttle application or a sudden change in the road surface's coefficient of friction, throttle valve control responds too sluggishly. As an additional, more rapid method of reducing wheel spin, the driven wheels are therefore braked via the wheel brake with the aid of the ASC+T function.

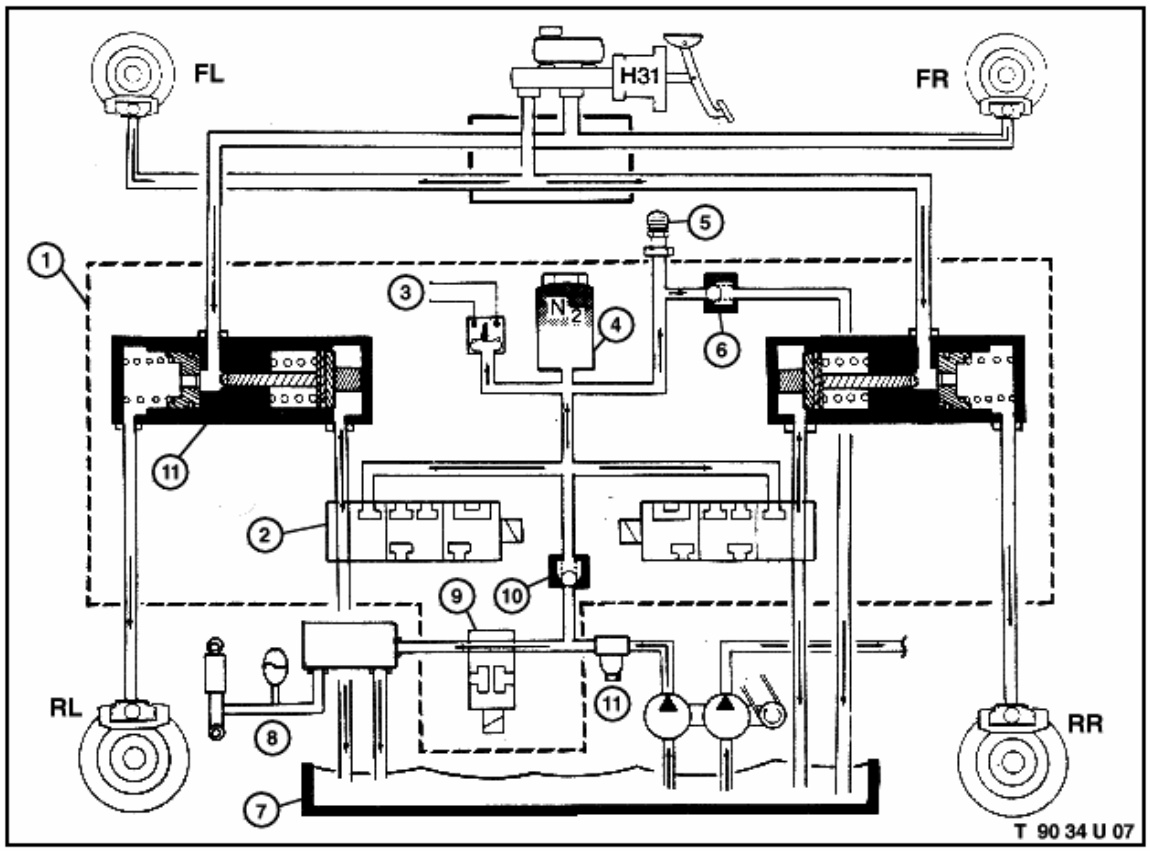
EGS Shift Characteristics Control

A signal path is maintained between the ASC+T and EGS control units. During ASC+T regulation, the signal from EGS is grounded. When this occurs, the gear change characteristics (in E and S modes) are modified to assist the ASC+T system in restoring suitable drive wheel traction (i.e., the EGS system shifts down later or shifts up earlier).

ASC+T Hydraulic Unit Operation

ASC+T is incorporated into the standard dual-diagonal circuit configuration of the familiar H31 power assist system.

The ABS system operates in standard fashion, but the rear wheel circuits **now** incorporate the ASC+T hydraulic unit.



1	ASC+T Hydraulic Unit	2	Solenoid Valve
3	Pressure Sensor	4	Accumulator
5	Bleeder Valve	6	Limiter
7	Fluid Reservoir	8	Ride Height Control
9	Charging Valve	10	Check Valve
11	Filter	12	Plunger Valve

There are two separate fluid circuits in the ASC+T system: Brake fluid and hydraulic control.

Brake Fluid Circuits

The ASC+T hydraulic unit is installed between the ABS hydraulic unit and the rear wheel calipers. Without ASC+T intervention, normal service braking takes place. During ASC+T intervention, brake pressures at the rear wheel calipers can be applied, maintained or released.

Hydraulic Control Circuit

The tandem belt-driven pump supplies oil under pressure from the fluid reservoir to the system pressure accumulator, by way of the charging valve. When ASC+T is active, one or both of the solenoid valves is energized, and accumulator pressure is used to modulate the respective plunger assemblies. As shown, the hydraulic pressure exerts a braking effect on the respective wheels.

An integrated pressure sensor detects minimum system pressure. Over pressure protection is provided by a mechanical pressure limiting valve in the pressure supply circuit

System Pressure Charging

Pressure is supplied by the tandem (forward section) to the accumulator. The ASC+T control unit regulates accumulator pressure by means of the charging valve, based on the signals provided by the pressure sensor. The ASC+T control unit de-energizes the charging valve (and stops the buildup of accumulator pressure) when a pressure of 150 + 15 BAR is reached.

As accumulator pressure is used in ASC+T regulation, a recharge point of 120 +15 BAR is reached, and the ASC+T control unit energizes the charging valve to restore pressure. Recharging takes approximately 3 seconds. The ASC+T system will "fault" if it cannot recharge in 15 seconds, or if the pressure sensor detects an accumulator pressure of less than 80 + 15 BAR.

Safety Logic

If a fault affecting the control function occurs, the ASC+T warning light immediately comes ON. If a fault occurs while ASC+T is active, ASC+T is switched off and the throttle valve opening angle is slowly adjusted to the specified pedal value
by EML in a ramp fashion.

The ASC+T system interfaces with the digital motor electronics and can be switched off by each of the control units if the inputs are wrong or implausible. All lines with a safety-relevant function are monitored for signal plausibility and potential. Interfaces and line errors are assessed as faults and the system is switched off.

An ASC+T intervention process is not necessarily interrupted in the event of a fault; it can continue until wheel spin is eliminated. If the ASC+T system fails, the vehicle can be driven as a conventional vehicle without ASC+T. The ABS, EML, and DME functions remain independently effective. Whether the ASC+T system is switched on or off, the entire safety circuit is active. The two microprocessors fitted are redundant and monitor each other. Self-test cycles also run continuously. Monitoring software defines interfaces and plausibility tests for identifying faults in sensors and actuating elements. If one of the processors identifies a fault, ASC+T is immediately switched off and the indicator lamp is activated immediately, but the ASC+T system continues the intervention process until its completion. If a fault is detected in an electrical component which is also utilized by ABS, the ABS system is also switched off.

The interface with EML was specially designed using digital pulse width modulated signal transmission (at 100 Hz frequency) for safety reasons. The ASC+T control unit continuously transmits the throttle valve control signal to the EML control unit, and checks whether any throttle valve opening adjustment signal is permitted
by safety thresholds defined by its programming.

For purposes of fault diagnosis, the fault memory can be read in the form of a flash code. Refer to the appropriate repair manual or electrical trouble-shooting manual for further details.

Care and Maintenance

ASC+T constitutes a highly effective safety system and as such needs very clean conditions and careful treatment during all repair and maintenance work. For this reason, all relevant instructions and notes should be observed for repairs and spare parts. No repairs or adjustments may be made to the hydraulic
assembly. The protective caps on the connections must remain fitted until shortly before installation, to avoid contamination. The connections are of varying sizes to prevent improper connections.

It is essential to observe storage instructions. Hydraulic assemblies which have been held in storage for more than five years must not be installed, and must be returned to the manufacturer. The system may only be filled with the approved oil grade for the appropriate circuit.

- Brake circuit: DOT 4 brake fluid
- Hydraulic control circuit: Pentosin CHF 7.1 mineral oil (viscosity range -40°C to + 100°C).

Any work, in particular filling and bleeding operations, must be performed in accordance with the repair manual.

In the mineral oil control circuit, there is one filter integrated into the fluid reservoir (screen), and one in the line to the hydraulic unit (fine mesh). The filter element to the hydraulic unit must be changed at every inspection 11.

For reasons of safety, the pressure (150 bar) in the accumulator must be bled off before any lines are opened. This is accomplished by a bleeder valve (see repair manual). For safety and technical reasons, the system cannot be retrofitted. The consequences of failure to comply with these instructions are the responsibility of the person concerned.