전자제어 샤시시스템 I
샤시시스템

http://www.ultimatemotorsports.com/images-new/02-Parts/chassis-800.jpg
샤시시스템 [2]

현가 시스템 (Suspension System)

제동 시스템 (Braking System)

조향 시스템 (Steering System)

http://files.solidworks.com/InternalMarketing/PressRoom/automotive/FIP%20Leiria_Suspension_Steering_Brake.jpg

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A **vehicle brake** is a brake used to slow down a vehicle by converting its kinetic energy into heat.

- Brake pedal
- Brake boost
- Master cylinder
- Apportioning valves
- Disk or Drum Brake

[http://discountemissions.com/start/services/brakes/]
Vacuum booster uses a stored vacuum to multiply braking force applied by the driver to the brake pedal, before applying the transferred force to the brake master cylinder.

In petrol engines, the manifold vacuum is utilized, whereas in diesel engines, a separate vacuum pump is used.

http://en.wikipedia.org/wiki/Vacuum_servos
제동시스템 [2][3]

http://auto.howstuffworks.com/auto-parts/brakes/brake-types/power-brake2.htm

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제동시스템 [2][3]

Beyond a slip ratio of 30%, braking efficiency is reduced, stopping distance is increased and directional control is lost.

제동시스템: ABS [2][3]

- A: 급제동, 유압상승, 횡속도감소, 슬립율 증가
- A→B: Control Unit 감압명령, 횡속도 조절을 위해 감속
- B→C: 입력유지, 횡속도 회복
- C→D: Lock됨에 따라 관련압력증가
- D→E: 제동력 조절을 위해 증가, 유저 명령을 반복

http://ns2.bit.ac.kr/~shs0308/chassis/ch7-7.files/frame.htm
제동시스템: ABS [2][3]

ABS System Diagram

ABS is combined with the conventional braking system and located between the master cylinder and the wheel cylinders.

Anti-lock braking system (ABS)

제동시스템: ABS [2][3]

Typical ABS Control System

The ECU monitors the four wheel sensors, processes the data and controls the actuator solenoids and pump motor through the ABS Relay.

Rotary vane pump. Note that modern pumps have an area contact between rotor and stator (and not a line contact).

1. pump housing
2. rotor
3. vanes
4. spring

http://en.wikipedia.org/wiki/Rotary_vane_pump
Hydraulic Motor, Pump

Learn hydraulic: external gear motor

http://www.youtube.com/watch?v=P_FjHC5ItnU
Hydraulic Motor, Pump

Learn hydraulic: axial piston motor
http://www.youtube.com/watch?v=PViwHoOY-J8
Hydraulic Motor, Pump

Harben Radial Piston Pump - How It Works
http://www.youtube.com/watch?v=piUoATHxLNw
Check Valve

A check valve, clack valve, non-return valve or one-way valve is a mechanical device, a valve, which normally allows fluid (liquid or gas) to flow through it in only one direction.

A ball check valve in the open position to allow forward flow and closed position to block reverse flow

Theory of check valve operation
http://www.youtube.com/watch?v=MEAlVFrX55Y
**Solenoid Valve**

A solenoid valve is an electromechanical device used for controlling liquid or gas flow.

The solenoid valve is **controlled by electrical current**, which is run through a coil.

When the coil is energized, a magnetic field is created, causing a plunger inside the coil to move. Depending on the design of the valve, the plunger will either open or close the valve.

When electrical current is removed from the coil, the valve will return to its de-energized state.
Solenoid Valve

What are the different parts of a solenoid valve?

The illustration below depicts the basic components of a solenoid valve. The valve shown in the picture is a normally-closed, direct-acting valve. This type of solenoid valve has the most simple and easy to understand principle of operation.

1. Valve Body
2. Inlet Port
3. Outlet Port
4. Coil / Solenoid
5. Coil Windings
6. Lead Wires
7. Plunger
8. Spring
9. Orifice

http://Solenoid-Valve-Info.com
Solenoid Valve

Direct-Acting Solenoid Valve Animation
http://www.youtube.com/watch?v=SwqM8zpmAD8
2-Position Solenoid Types

Controls pressure to four brake assemblies in three stages: pressure holding, increase and reduction.

제동시스템: ABS [2][3]

제동거리 단축

코너링 안정

Bosch ABS - The advantage
http://www.youtube.com/watch?v=ZSqGPvWroes

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제동시스템: ABS [2][3]

장애물 회피

Split-μ 대응

Bosch ABS - The advantage
http://www.youtube.com/watch?v=ZSqGPyWroes
Differential
A **differential** is a device, usually but not necessarily employing gears, capable of transmitting torque and rotation through three shafts, almost always used in one of two ways:
1) it receives one input and provides two outputs—this is found in most automobiles
2) it combines two inputs to create an output that is the sum, difference, or average, of the inputs.

In automobiles and other wheeled vehicles, the differential allows each of the driving roadwheels to rotate at different speeds, while for most vehicles supplying equal torque to each of them.

Input torque is applied to the ring gear (blue), which turns the entire carrier (blue). The carrier is connected to both the side gears (red and yellow) only through the planet gear (green) (visual appearances in the diagram notwithstanding). Torque is transmitted to the side gears through the planet gear. The planet gear revolves around the axis of the carrier, driving the side gears. If the resistance at both wheels is equal, the planet gear revolves without spinning about its own axis, and both wheels turn at the same rate.

If the left side gear (red) encounters resistance, the planet gear (green) spins as well as revolving, allowing the left side gear to slow down, with an equal speeding up of the right side gear (yellow).

Differential

Around The Corner (1937) How Differential Steering Works

http://www.youtube.com/watch?v=yYAw79386WI

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Traction control system (TCS), also known as Anti-Slip Regulation (ASR) to prevent loss of traction of the driven road wheels, and therefore maintain the control of the vehicle when excessive throttle is applied by the driver and the condition of the road surface (due to varying factors) is unable to cope with the torque applied.

- Engine 출력 줄이기
- Slipping wheel의 brake 잡기

When the traction control computer detects one or more drive wheels spinning significantly faster than another, it will use the HU (Hydraulic Unit) to apply brake friction to the wheels that are spinning too fast.

http://en.wikipedia.org/wiki/Traction_control_system
제동시스템: TCS [2][3]

http://ledhyun.tistory.com/3
제동시스템: TCS [2][3]

MGH-20 BTCS CURCUI'T DIAGRAM

HS (Hydraulic Shuttle) Valve
TC (Traction Control) Valve

http://training.hmc.co.kr/guid/pass/FC/ABSBTCS.ppt
• **Phase0 - Phase1**: When the wheel spin tendency is detected.

• **Phase1 - Phase2**: When the wheel spin tendency is reduced.

• **Phase2 - Phase3**: When the wheel deceleration is under the threshold and the wheel spin is reduced under a slip threshold.

• **Phase3 - Phase4**: When the wheel speed is within the slip threshold.

• **Phase4 - Phase5**: When the wheel acceleration is over the threshold and the wheel spin is over the slip threshold.

The procedure above is repeated to control the wheel and the slip threshold is modified according to the low-μ level to get maximum acceleration.
제동시스템: TCS [2][3]

- NORMAL MODE
- INCREASE MODE
- DUMP MODE
- HOLD MODE

http://training.hmc.co.kr/guid/pass/FC/ABSBTCS.ppt
제동시스템: TCS [2][3]

NORMAL MODE

http://training.hmc.co.kr/guid/pass/FC/ABSBTCS.ppt
제동시스템: TCS [2][3]

▶ PRESSURE INCREASE MODE

<table>
<thead>
<tr>
<th>SOLENOID VALVE</th>
<th>FRT</th>
<th>N.O</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N.C</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>RR</td>
<td>N.O</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N.C</td>
<td>OFF</td>
<td></td>
</tr>
</tbody>
</table>

| MOTOR          |     | ON   |     |
| TC VALVE       |     | ON   |     |

http://training.hmc.co.kr/guid/pass/FC/ABSBTCS.ppt

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제동시스템: TCS [2][3]

▶ PRESSURE DUMP MODE

| SOLENOID VALVE | FRT | N.O | ON  |
|                | N.C | ON  |
| RR             | N.O | ON  |
|                | N.C | OFF |

| MOTOR | ON |
| TC VALVE | ON |

http://training.hmc.co.kr/guid/pass/FC/ABSBTCS.ppt

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제동시스템: TCS [2][3]

PRESSURE HOLD MODE

http://training.hmc.co.kr/guid/pass/FC/ABSBTCS.ppt
MANDO TCS : Traction Control System
http://www.youtube.com/watch?v=nQcd5D4DIFI
Electronic stability control (ESC) is a computerized technology that improves safety of a vehicle's stability by detecting and minimizing skids. When ESC detects loss of steering control, it automatically applies the brakes to help "steer" the vehicle where the driver intends to go. Braking is automatically applied to wheels individually, such as the outer front wheel to counter oversteer or the inner rear wheel to counter understeer. Some ESC systems also reduce engine power until control is regained.

제동시스템: ESC [2][3]

ESC II – Functions and Components

- Hydraulic-electronic control unit with sensitive pressure control MK60E MK25E
- Actuation unit with vacuum booster
- Steering wheel angle sensor
- Wheel speed sensors
- Interface to drive-train management

Optional: variable dampers

Yaw rate sensor and lateral acceleration sensor (cluster)

Interface to active steering system


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제동시스템: ESC [2][3]


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제동시스템: ESC [2][3]

ESP - Electronic Stability Program
http://www.youtube.com/watch?v=L1qt84c2KN0
MANDO ESP: Electronic Stability Program

http://www.youtube.com/watch?v=2WTz2EiWdke
제동시스템: EHB

Electro Hydraulic Braking (EHB)

CV: cut valve
BV: balance valve
IV: inlet valve
OV: outlet valve
S/U: stroke sensor unit
P/U: pressure sensor unit


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Wedge
It functions by converting a force applied to its blunt end into forces perpendicular (normal) to its inclined surfaces. The mechanical advantage of a wedge is given by the ratio of the length of its slope to its width.

Cross-section of a splitting wedge with its length oriented vertically. A downward force produces forces perpendicular to its inclined surfaces.

http://en.wikipedia.org/wiki/Wedge_(mechanical_device)
Electronic Wedge Brake (EWB)

EWB Braking Technology
http://www.youtube.com/watch?v=6KMdT3iaFdQ
참고자료