Air supply,
EP Brakes, Control system
&
Air suspension

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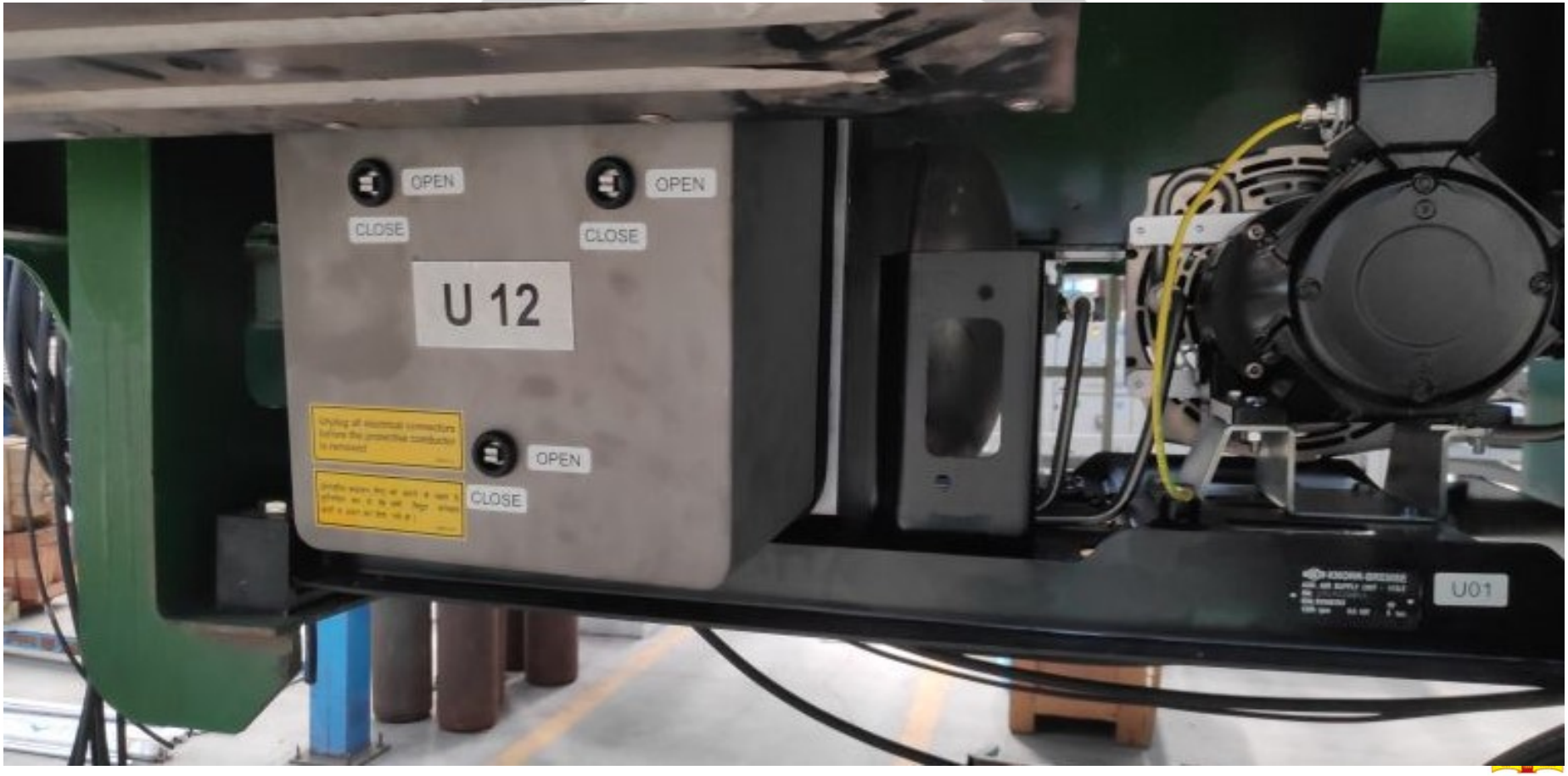
System overview

- Auxiliary Air Supply for Pantograph Equipment
- Air Supply Equipment
- Brake Control Equipment
- Mechanical Brake Actuating Components - Driver's Brake Control Equipment
- Brake application equipment
- Wheel-Slide Protection Equipment
- Air Suspension Equipment

Aux Air supply for Pantograph Equipment

- Battery powered
- Fitted on driving end - TC



Auxiliary air supply system

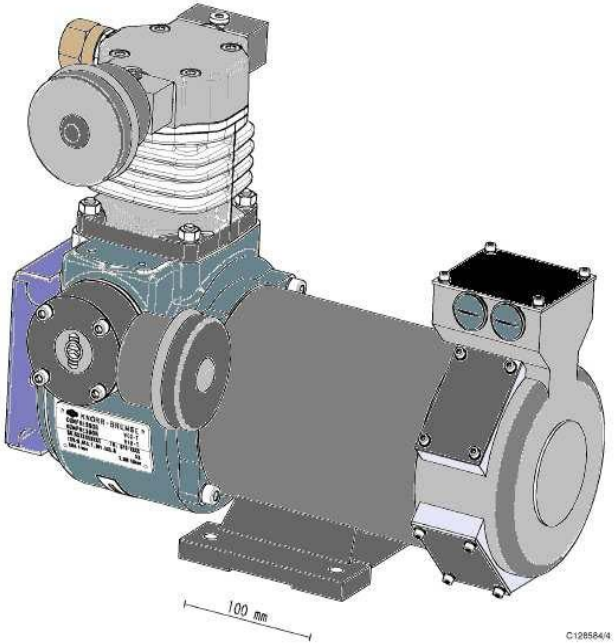
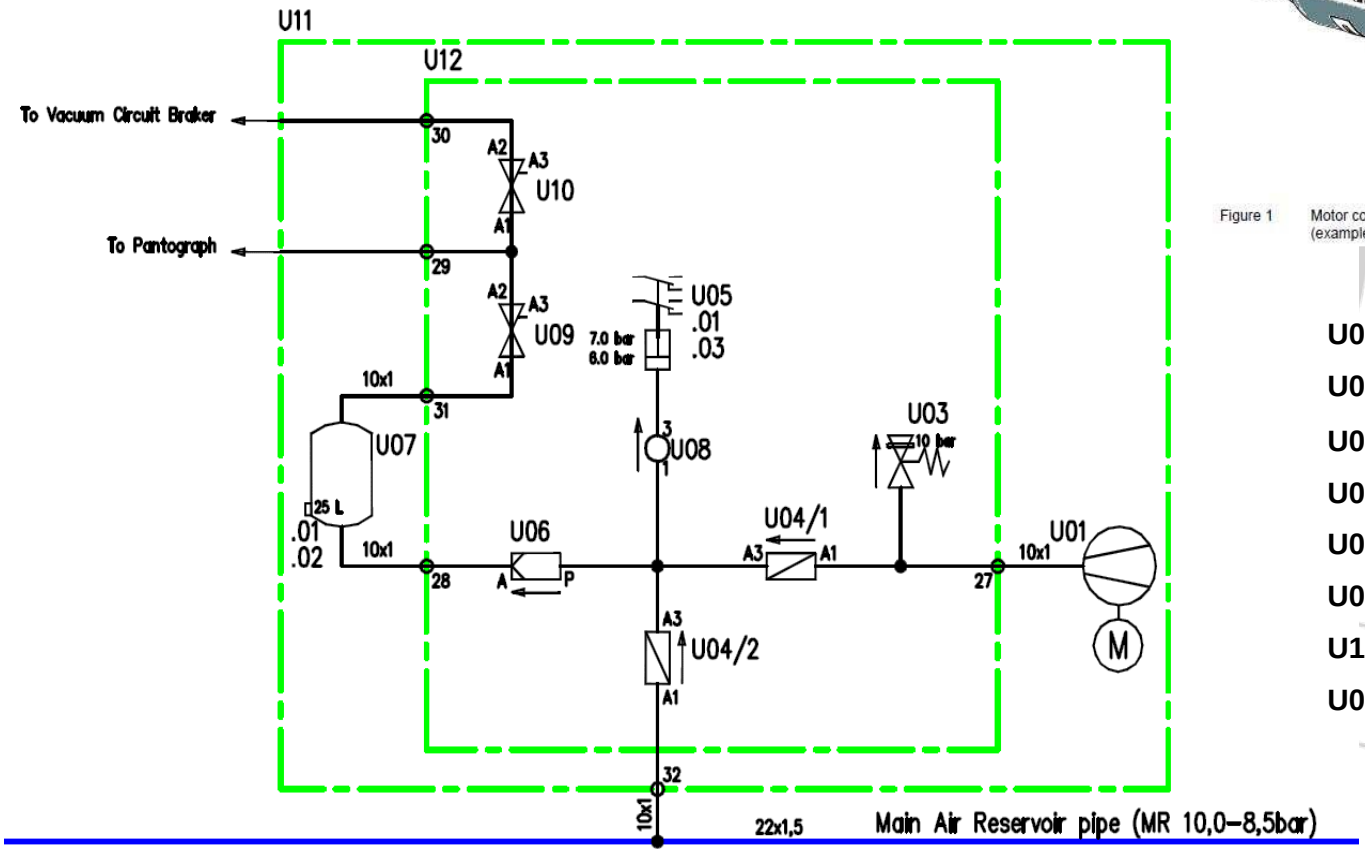


Figure 1 Motor compressor set V10-T
(example showing the compressor in a vertical attitude)



U01 – compressor set V10-T

U03 – safety valve 10,0 bar

U04 – check valve

U05 – pressure governor 7,0 – 6,0 bar

U06 – pipeline filter

U07 – air reservoir

U10 – ball cock

U09 – ball cock

Auxiliary compressor V10-T [U01]

- Auxiliary Compressor V10-T supply air to auxiliary equipment as long as electric supply is available from the battery only. Therefore, a typical application is the supply of air to the pantograph raising installation.
- The auxiliary compressor V10-T is a compact Oil Free 1-cylinder piston compressor, directly attached to a permanent magnet DC-motor, developed especially for this application.

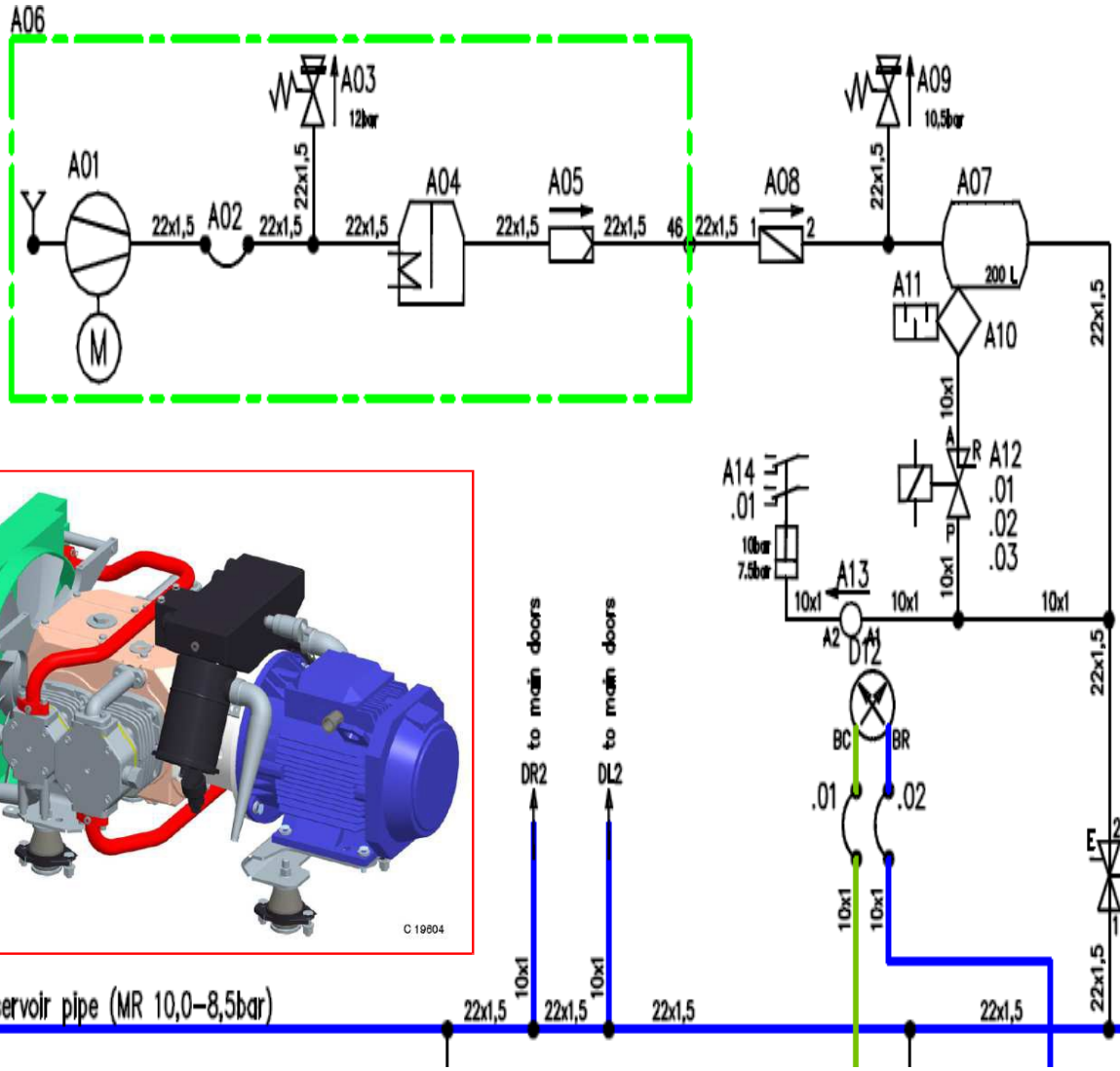
Technical data

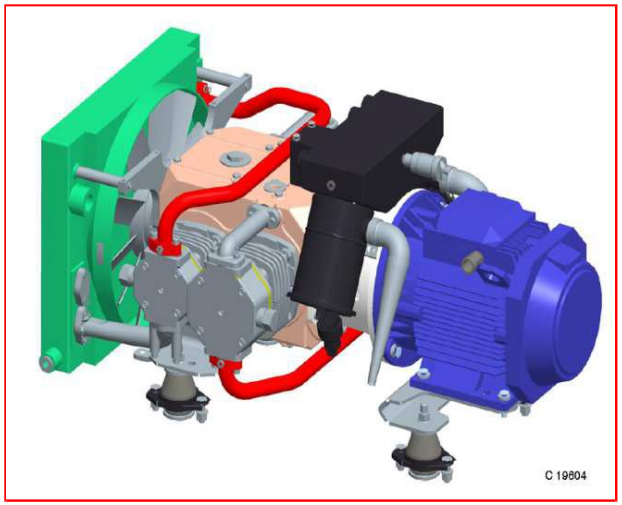
Intake air stream	70 LPM
Max end pressure	8 bar
Working temp range	- 40 to + 50 deg. C
Lubricating oil	NA
Power supply	110 V DC
Electric Power	790 W
Filling time (25 L Reservoir)	140 sec.

Air supply equipment

- DTC & NDTC
- 3 Phase 415 Aux power

Air Supply System





A01 – air supply unit

A02- Hose pipe

A03 – safety valve 12 bar

A04 – air dryer unit

A09 – safety valve 10,5 bar

A05 – micromesh oil filter OEF1

A07 – air reservoir

A13 – test fitting

A14 – pressure governor 10.0 – 7.5 bar

A14 – drain cock

A11 – silencer

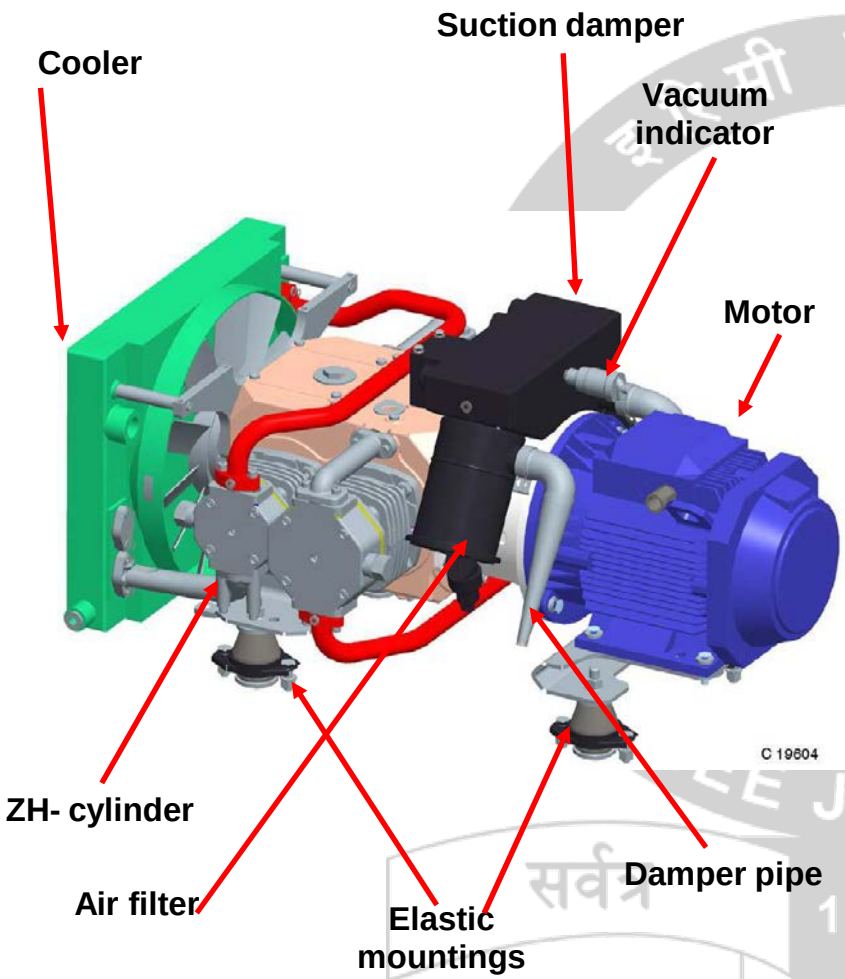
A12 – magnet valve

A15 – ball cock

A10 – Auto Drain Valve

Air compressor

Piston compressor VV120 - T



Air delivery	ca. 845 l/min ± 6%
Rotation speed	1455 rpm
Service temp. range	- 10°C - +50 °C
Working pressure	10 bar two- stage
Compression	3
Cylinder	
Frequency	50 Hz
Cooling air flow rate	0,64 m^3/s
Weight	200 kg ± 3%

Technical details

- **Two-stage 3-cylinder compressor with frameless suspended mounting**
  - Optimal cooling of all cylinders
  - Compact construction
- **Self-supporting, flange-mounting construction**
  - No extra frame necessary
  - Slight weight
  - Minimal installing dimension
  - Modular architecture
- **Low vibration level and low noise emission**
- **Oil-free compressed air**
  - No oil contamination of the compressor
- **Spring wire shock absorbers for bearing the compressor**
  - All-metal construction
  - Durable and maintenance- free
- **Coupling between motor and compressor is of great torsional rigidity**
  - Maintenance-free
  - Self-centring flange construction dispenses of lining up the motor and compressor

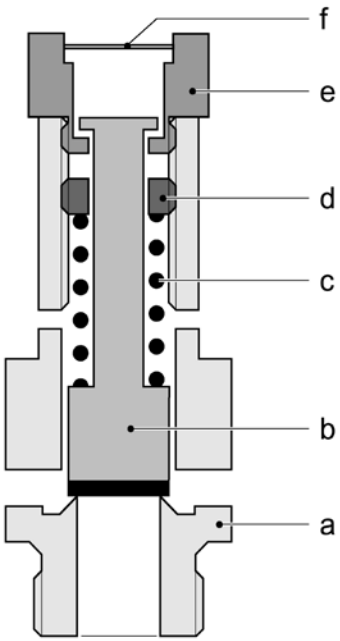
Piston Compressor Maintenance Tasks

Interval*	Maintenance activity	See
Every 1,000 compressor operating hours [oh] or after 12 months at the latest	Sight-check the resilient mounting.** Exchange the spring wire shock absorbers in case any of the wire strands are fractured. Exchange rubber shock absorbers in case of cracking or embrittlement.	Section 6.1.1
	If present, exchange the filter element of the dry-type air filter[1)] If present, remove and clean the swirl ring of the dry-type air filter. If present, inspect the hose section(s) between the air filter and crankcase.	Section 6.2.1
	Clean the coolers and cylinder cooling ribs.	Section 6.2.2
	Check the water separator for dirt deposits. Check the diaphragm and valve head of the drain valve in the water separator for cracking, embrittlement and peeling or lifting. Check the compression spring of the drain valve for corrosion.	Section 6.2.3
Every 3,000 oh or after 2 years at the latest	Replacing the wearing parts of the drain valve according to the servicing kit.	Section 6.2.4
After 3,000 operating hours or after 2 years ± 3 months at the latest	■ Conduct a spot-check of the piston ring of the HP stage once as a precautionary measure.*** [2)] ■ **VV270-T**: Conduct an additional spot-check of the piston rings of the LP stage once as a precautionary measure.*** [2)]	I-LG00.23
Every 12,000 operating hours or after 8 years at the latest	Overhauling the electric motor.	Section 6.4
Every 12,000 oh, after 8 years at the latest or as instructed by the operator on the basis of service conditions	General overhaul of the whole motor compressor set.**	Section 6.4

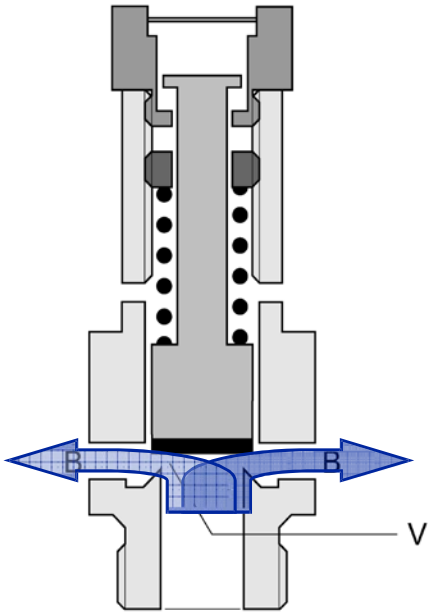
Safety valve SV10

Function testing with hand discharge screw is required at least once every 6 month at not less than 75% of the working pressure !

Closed



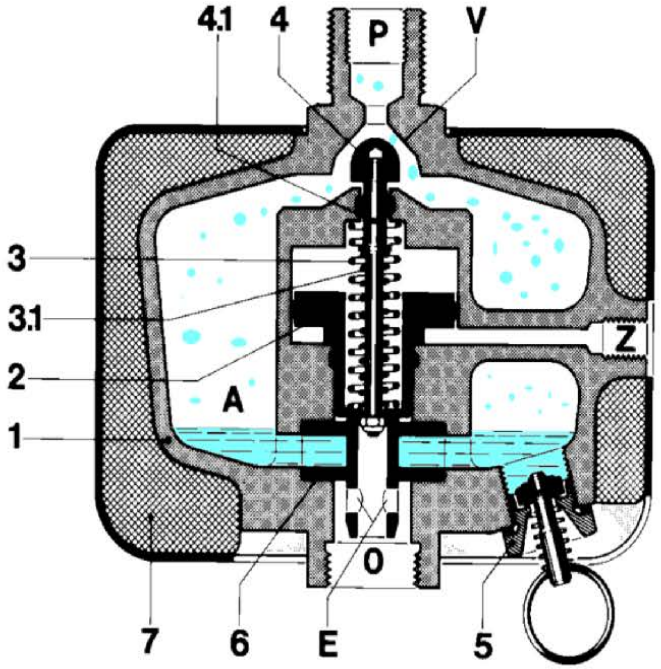
open

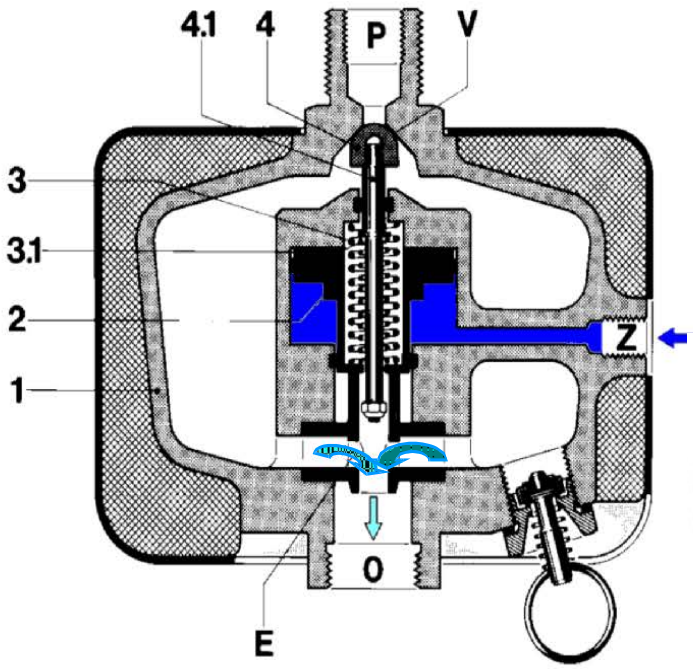


1. Function testing serves to check the valve movement, and to remove any dirt lodged in the valve seat
2. Unscrew the hand discharge screw far enough to open the valve and discharge air at the exhaust ports. Close the hand discharge screw again after venting the valve.

a	Body	d	Adjustment screw	B	Exhaust port
b	Valve rod	e	Hand disch. screw	V	Valve seat
c	Compression spring	f	Lead seal		

Drain valve EW6





1 Body
2 Piston
3 Spring
3.1 Spring
4 Valve
1. Valve stem
5 Manual drain valve
6 Sealing ring
7 Heat insulation

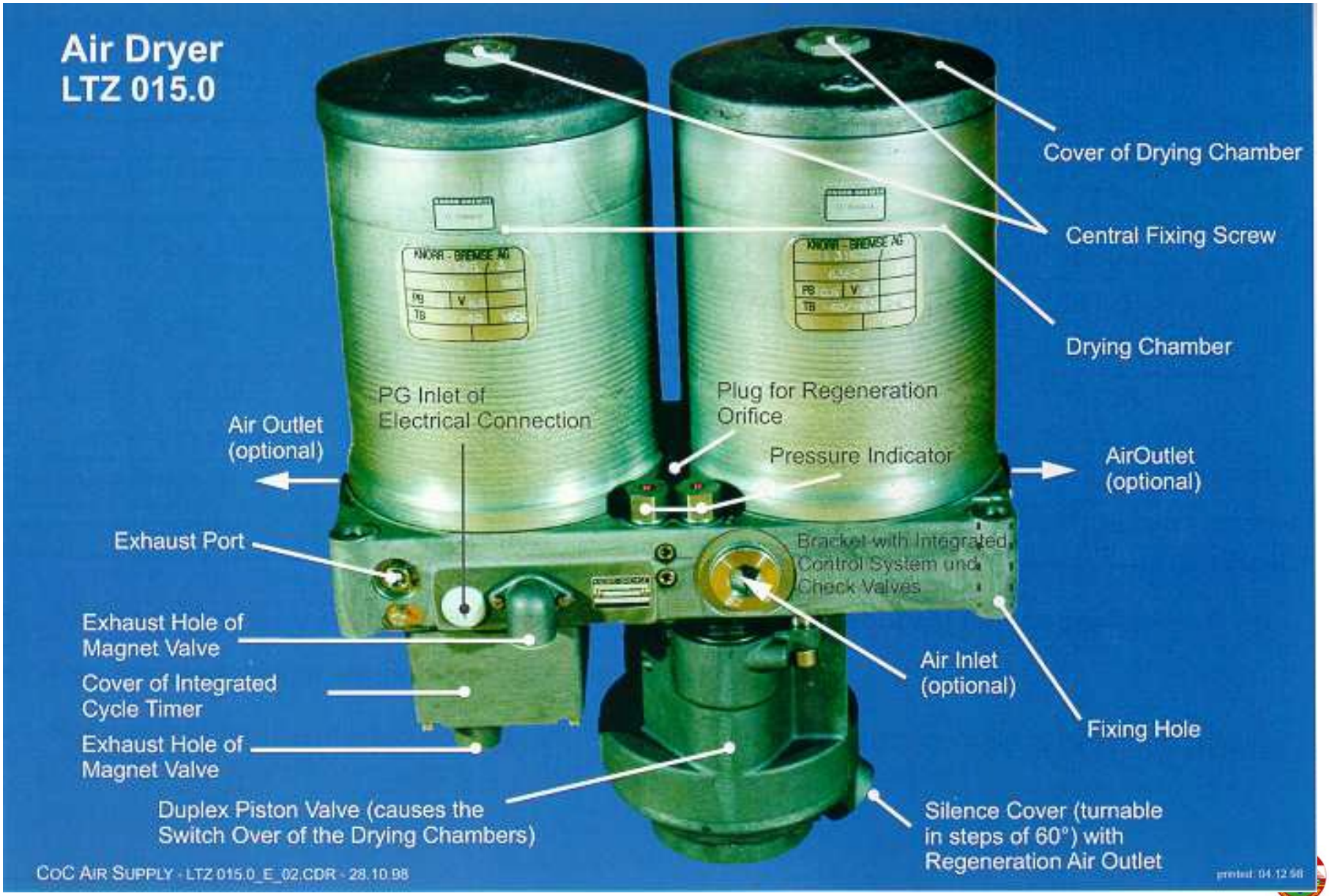
V Conical valve seat
E Drain bore
O Exhaust port
P Inlet port

Maintenance Tasks
Drain valve EW6

Activity	Interval
Inspection, function test (correct drainage)	1. According to vehicle operator's project-specific experience
	2. In accordance with project-specific maintenance schedule, if any*
	3. Every day in winter.

* If a project-specific maintenance schedule is drawn up, it must be worked out jointly by the customer and KNORR-BREMSE.

Air Dryer Unit



Air dryer unit LTZ015.1 Technical features

- Adsorption dryer of the dual – chamber type
- drying and regeneration run in parallel
- integrated oil separator
- pneumatic- controlled drain valve with silencer

❑ permissible working pressure	10.5 bar
❑ ambient temperature range	0°C to + 50°C
❑ air inlet temperature	max. + 60°C
❑ relative humidity on air outlet	< 35%
❑ Cycle time (complete cycle)	4 minutes
❑ weight	35 kg
❑ Desiccant charge per tower	4.36 kg
❑ 2 Pressure Switches for Air dryer Diagnostic	Info to TCMS

Maintenance information

No special maintenance is required, only regular functional checks

- once a year:
  - Function testing with a pressure dew point meter **
- Every 2000 oh or after 2 years
  - Check the power socket and the pressure switch for tightness **
  - Function testing of the pressure switch; must be exchanged after working 10^6 cycles **
- Check the function of the cycle timer:
  - every 4 minutes air must blow out of the pre-control magnet valve
- Check the function of the piston valve:
  - every 2 minutes air and condensate must blow out of the air outlet at the piston valve, the red indicators must change their position

- **** activity is recommended**

Brake control equipment

The brake system includes:

- Piston type Oil-free air compressor and air dryer unit.
- An electro-pneumatic, microprocessor controlled direct service brake
- An automatic indirect brake which is applied for redundancy reasons for an emergency brake application and in the event of failure of the direct service brake
- Towing mode operation based on brake pipe (indirect brake).
- Wheel mounted brake discs with compact brake caliper units RZS
- Designated quantities of the compact brake caliper units have a spring operated parking brake portion integrated.

Brake Control Unit EP-BGE [B03,B04]

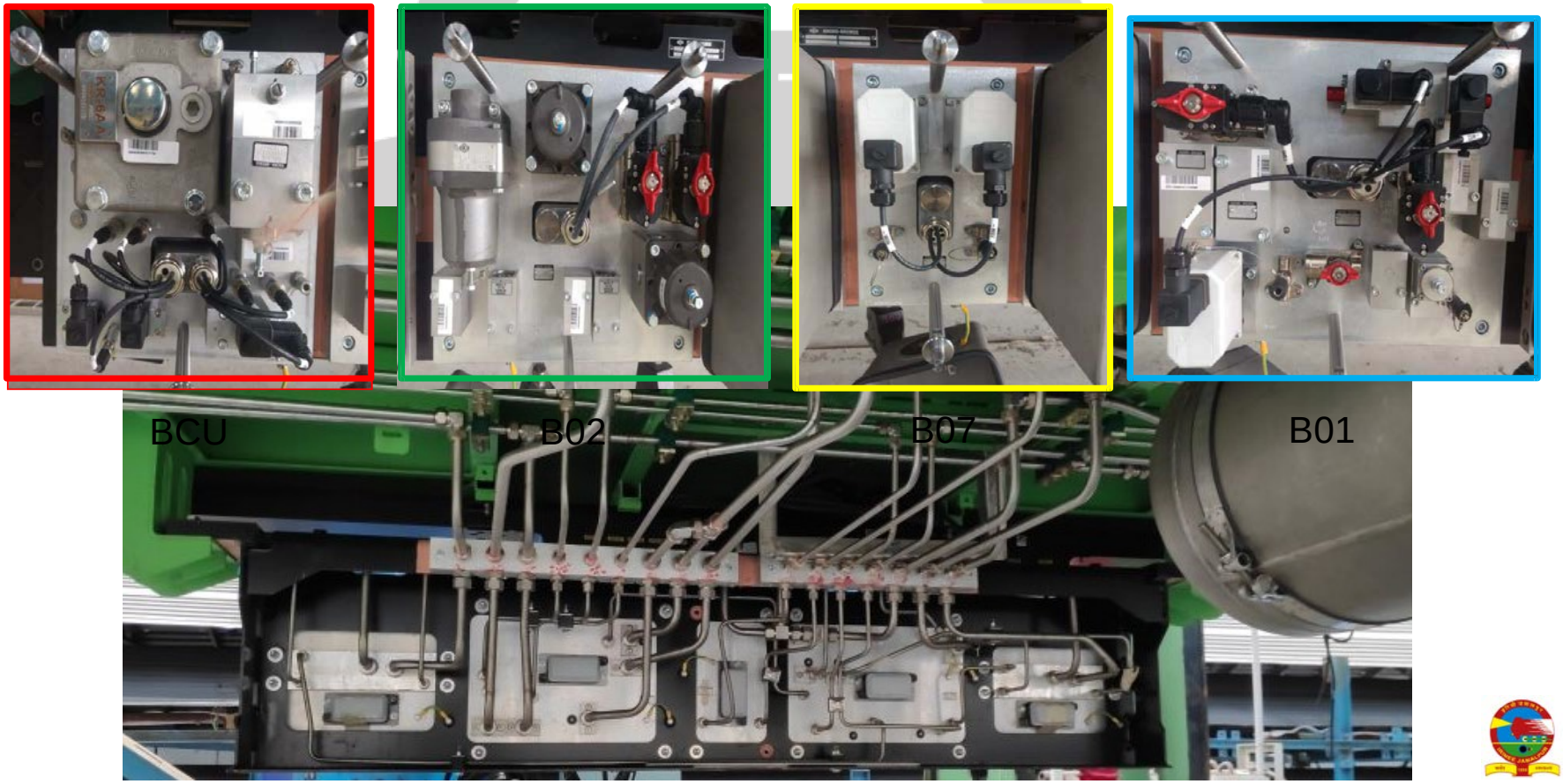
The main functions offered by the EP-BGE panel are:

- Service brake
- Emergency brake via magnet valve
- Brake pressure limitation based on train load
- Redundant Emergency brake pressure generation via service brake circuit

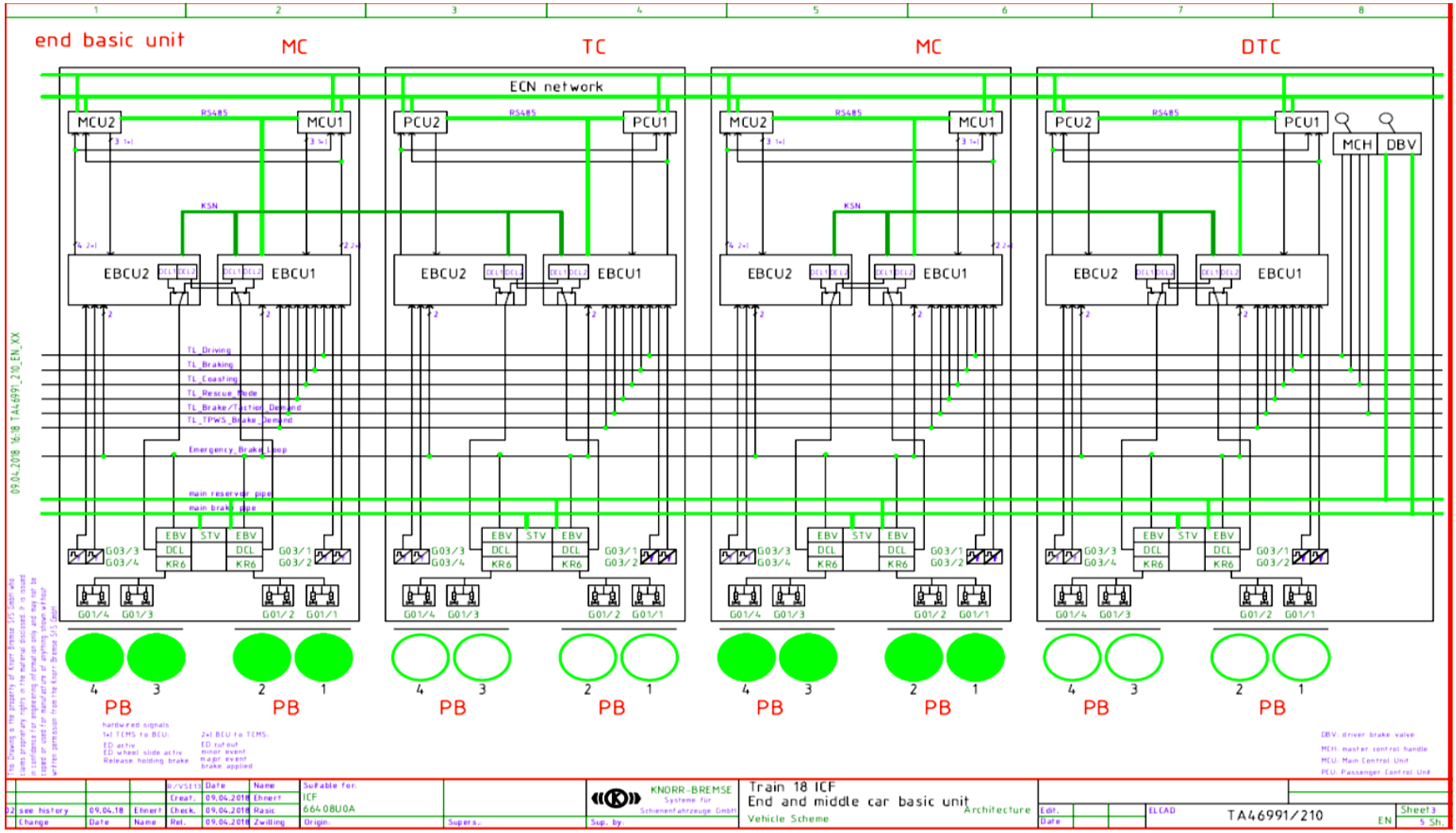
Components:

- Digital control loop
- Emergency brake valve
- Relay valve KR6
- Pressure limiting valve
- Pressure sensors
- Double check valve


BCU
B02
B07
B01
BCU


BCU
B02
B07
B01

System architecture



System overview

Technical Data

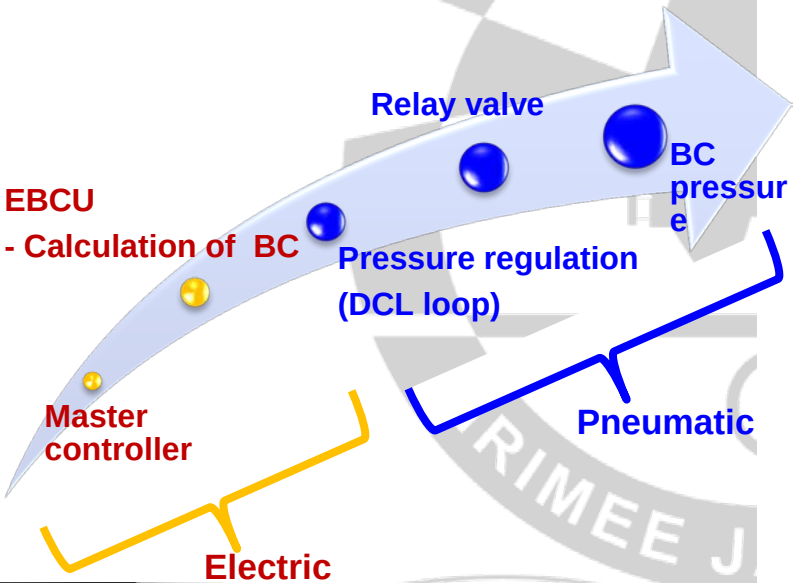
- The Electro-dynamic brake in motor cars is the main brake system, it will be generally used in preference to the EP- brake

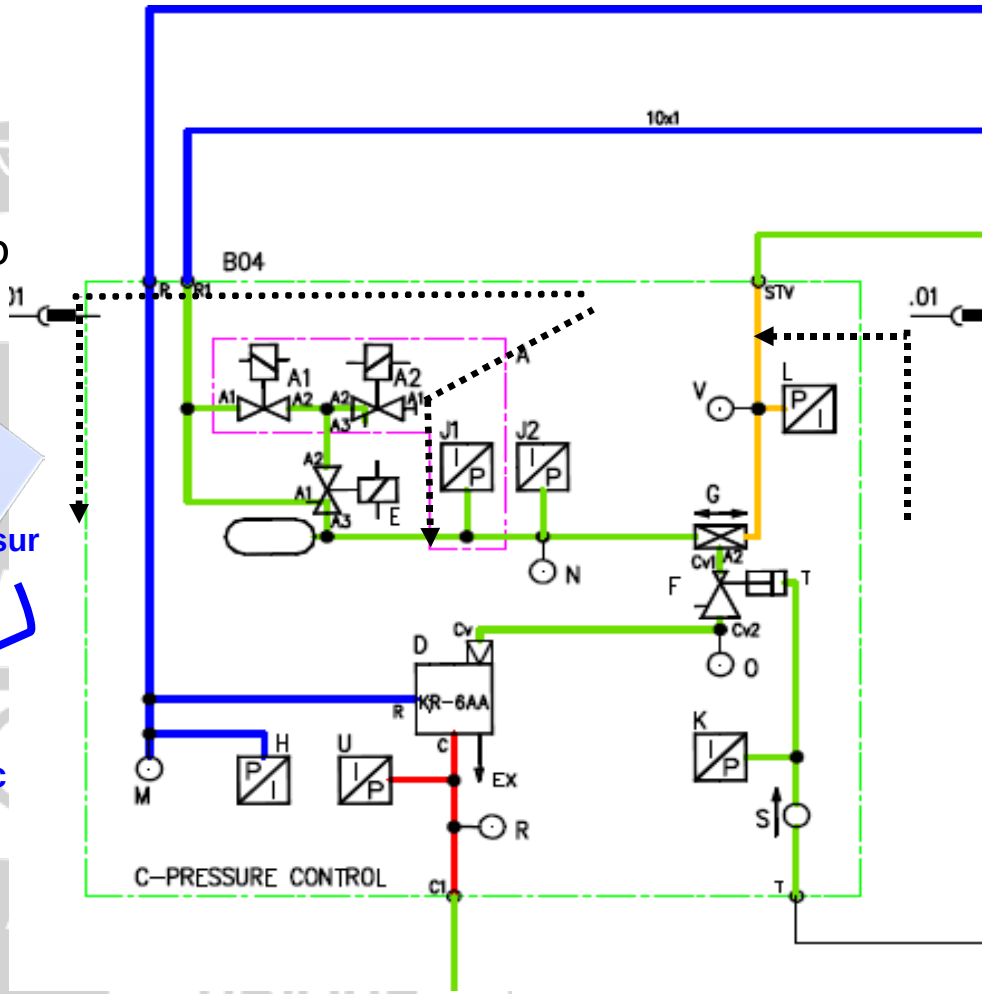
Friction brake system performs the basic functions:

- Service Brake
- Service Brake with (at times also partial) ED-Brake failure
- Emergency Brake
- Emergency Brake (released by driver's emergency push button)
- Parking Brake
- Stopping Brake
- Holding Brake

Brake Modes I Service brake

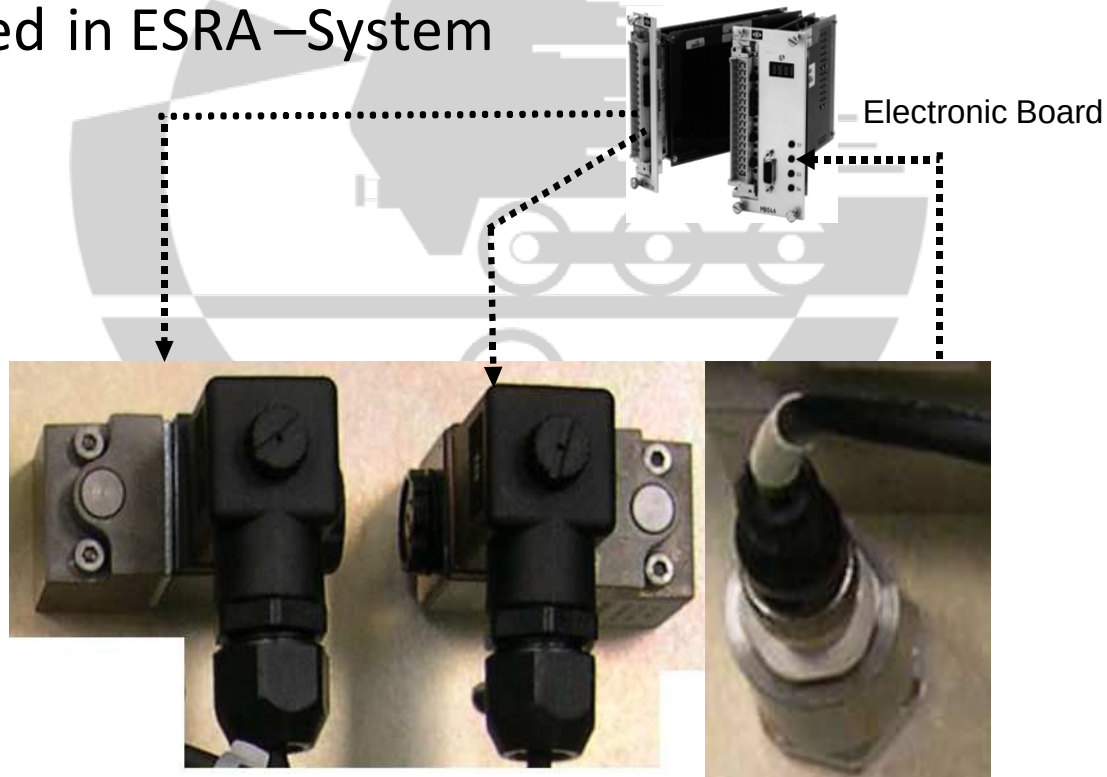
- Service brake is load corrected and wheel slide controlled
- The BCU converts the electric friction brake demand signal from the BECU into a proportional pre- control pressure.



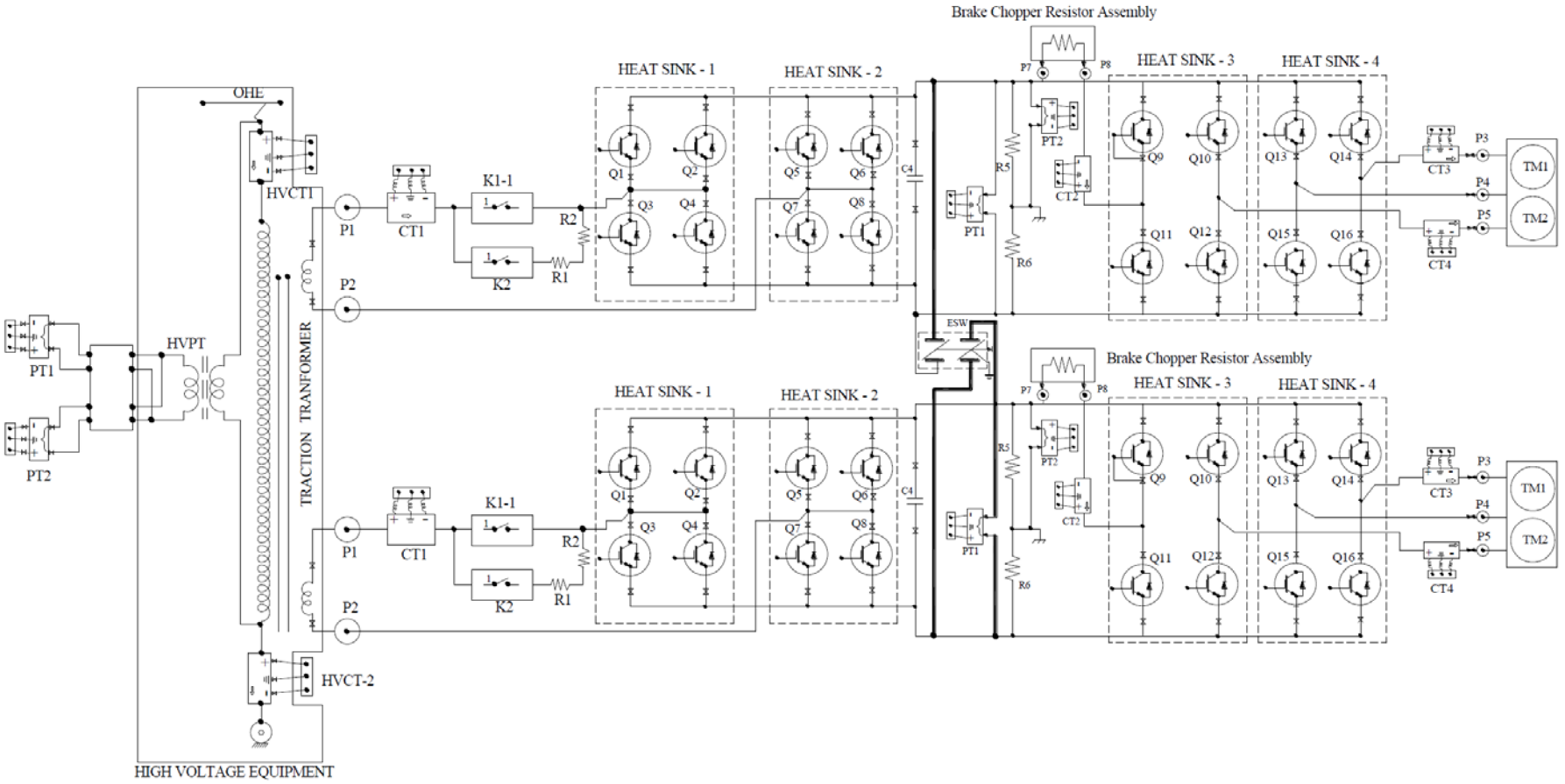


Digital Control Loop [B03a]

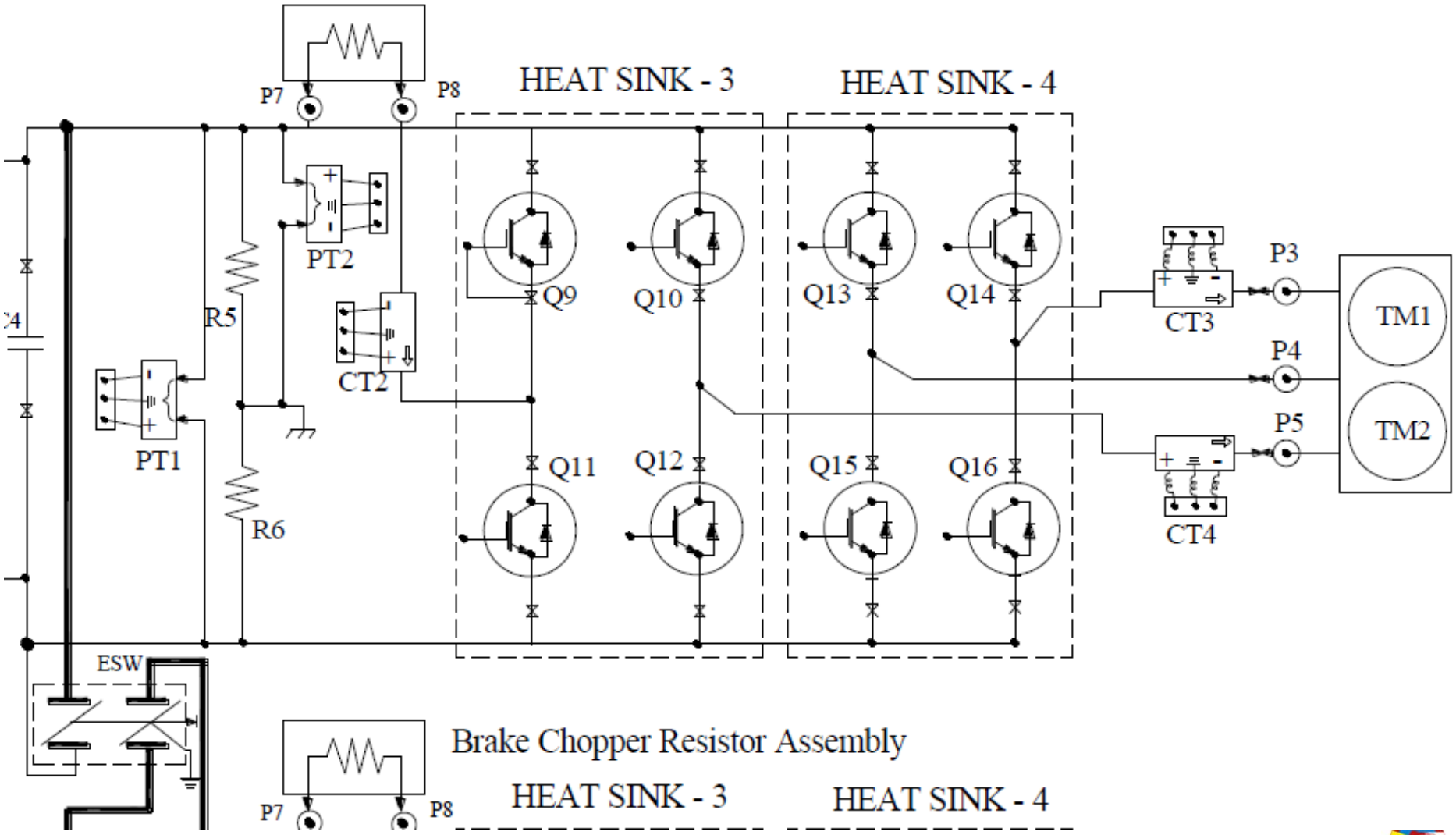
- Digital Control Loop (DCL) is used to adjust the pilot pressure (Cv) in EP Control.
- It is consist of EP- component (2 pre-control valves: venting/charging and pressure sensor) and electronic control part included in ESRA –System



Propulsion circuit



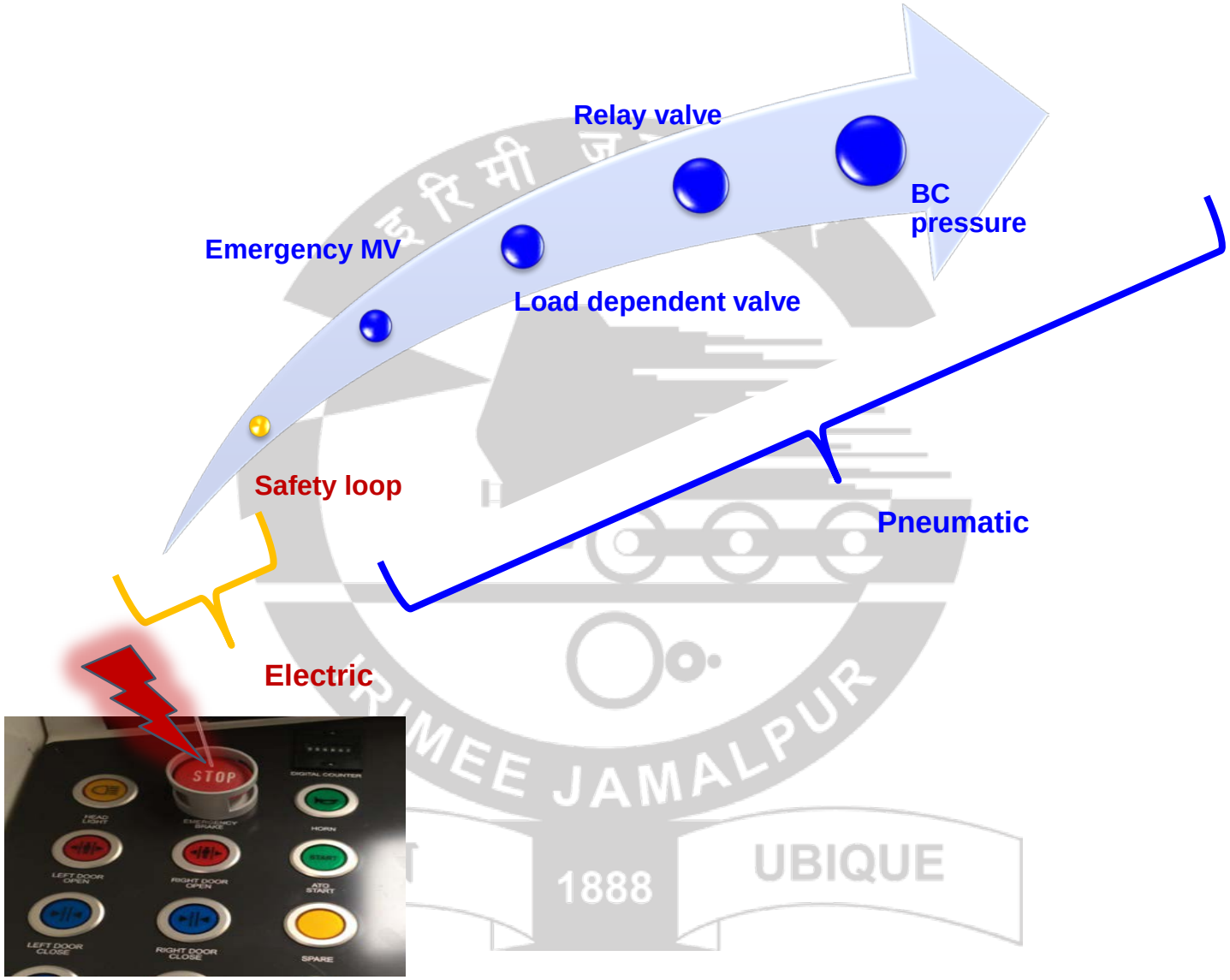
Brake chopper resister



Brake Modes II Emergency brake

- Equipped with an emergency brake loop wire
- Initiated with the master controller on driver's desk
- If the emergency brake loop is opened, the emergency brake valves will be de-energized and make the emergency brake pressure work
- Redundancy realized for the emergency brake pressure generation via the digital control valve (DCL) since the BECU receives emergency brake command from emergency loop as well
- Is load corrected via the load dependent pressure limiting valve in the BCU

Brake Modes II Emergency Brake



Brake Modes III Towing brake

- Control of the brake with only pneumatic connection to MR- and BP- pipe
- In case of venting of brake pipe pressure the pneumatic brake will be applied by the distributer valve
- The distributer valve STV200 will generate a brake cylinder pre-control pressure on an indirect logic (5.0 bar BP-pressure = 0 bar brake cylinder, 3.8 bar = max. brake cylinder pressure)
- The emergency brake loop wire is to be energized
- The brake pipe is controlled by the active drivers cab only

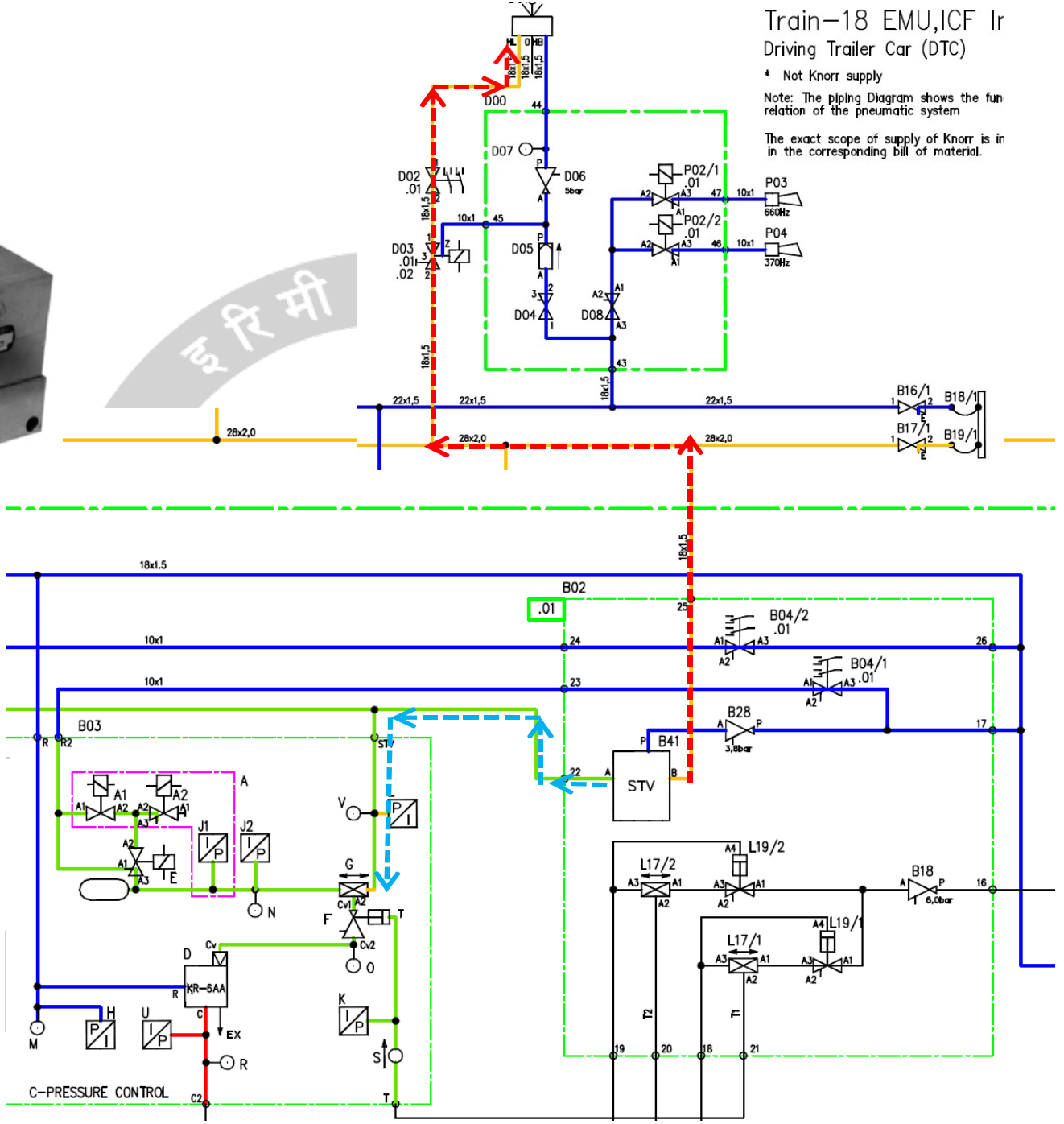
Train–18 EMU,ICF Ir

Driving Trailer Car (DTC)

* Not Knorr supply

Note: The piping Diagram shows the fun
relation of the pneumatic system

The exact scope of supply of Knorr is in
in the corresponding bill of material.



Brake Modes IV Parking brake control (Panel B01)

A parking brake application is a brake application for stopping a stationary train from rolling under set conditions for as long as required until the brake is released.

- The parking brake is release, when the spring actuators are vented.
- Controlled by the impulse magnet valve, which needs a short train line impulse from the driver
- The parking brake applies or releases
- It can be also manually operated
- Always applied in the event of loss of MR- pipe pressure

Parking Brake control

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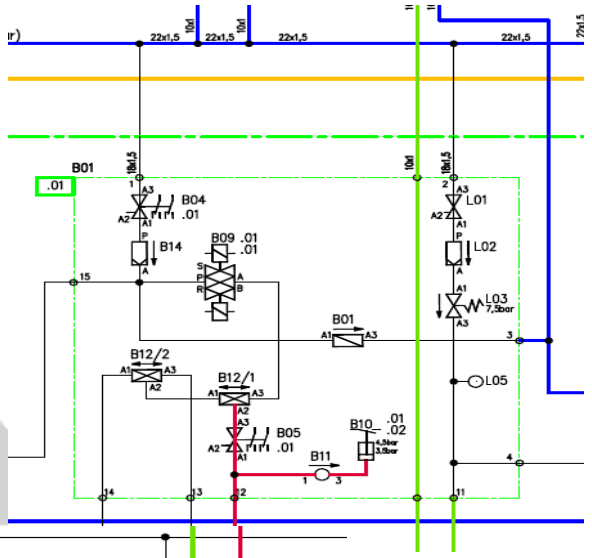
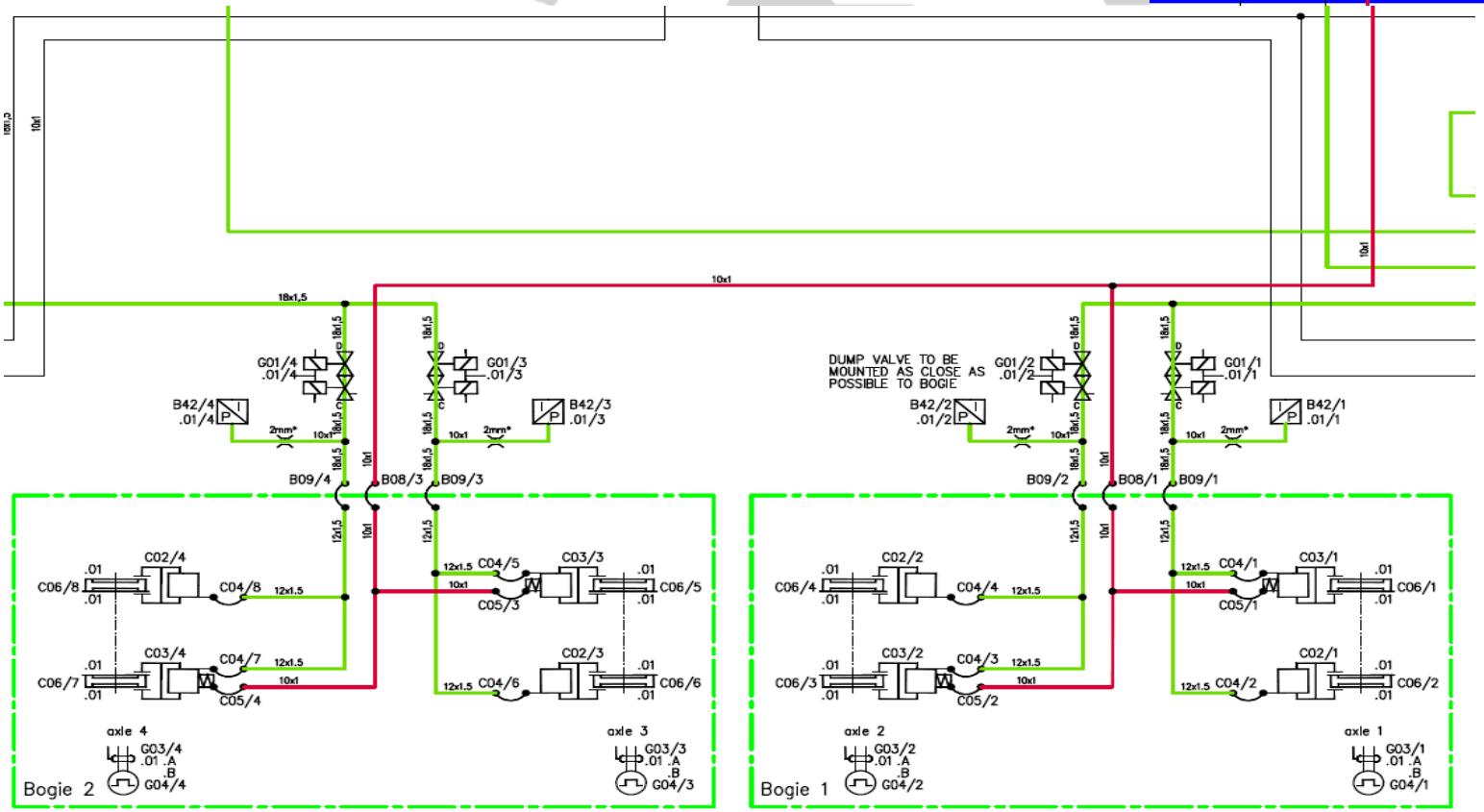
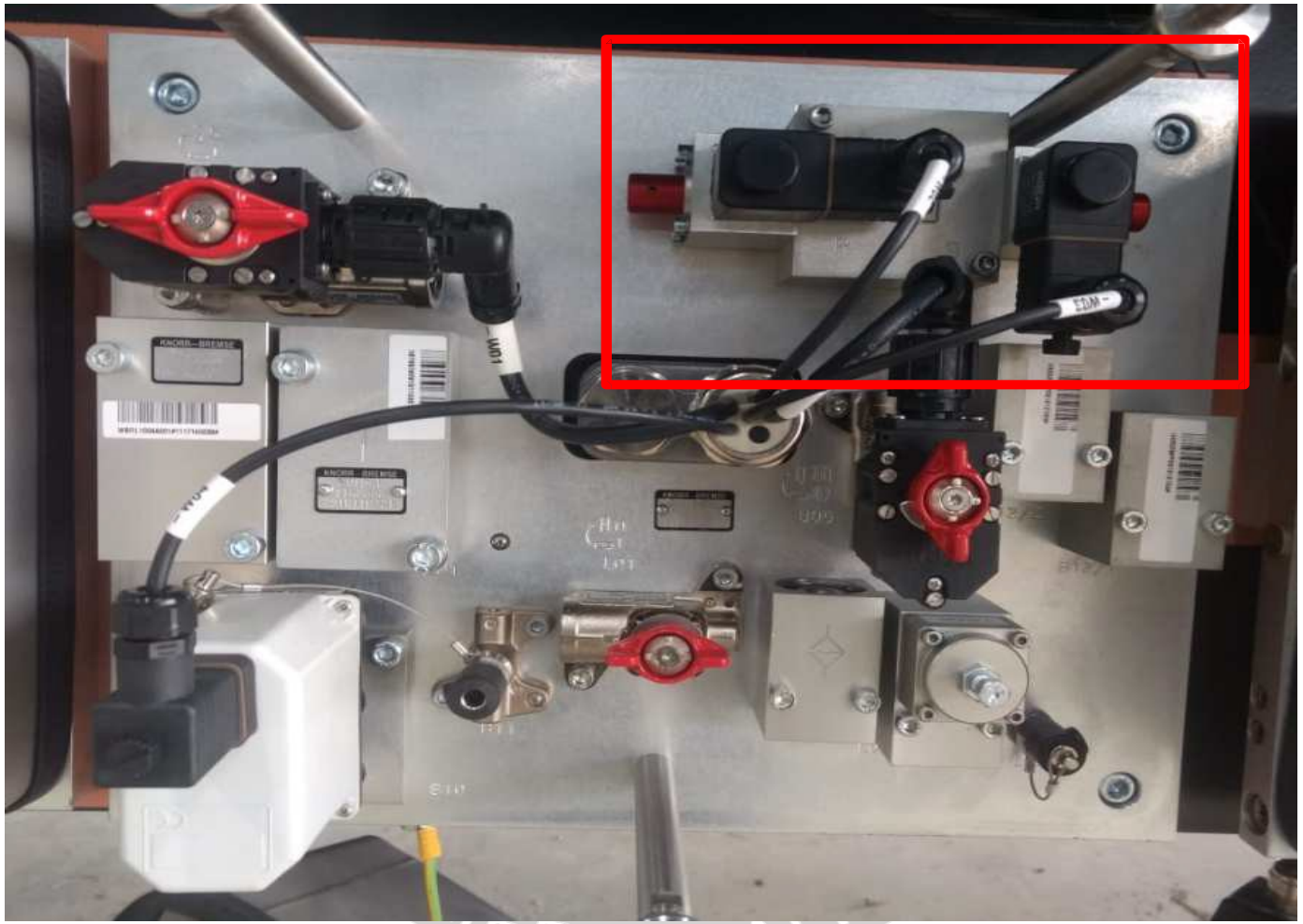
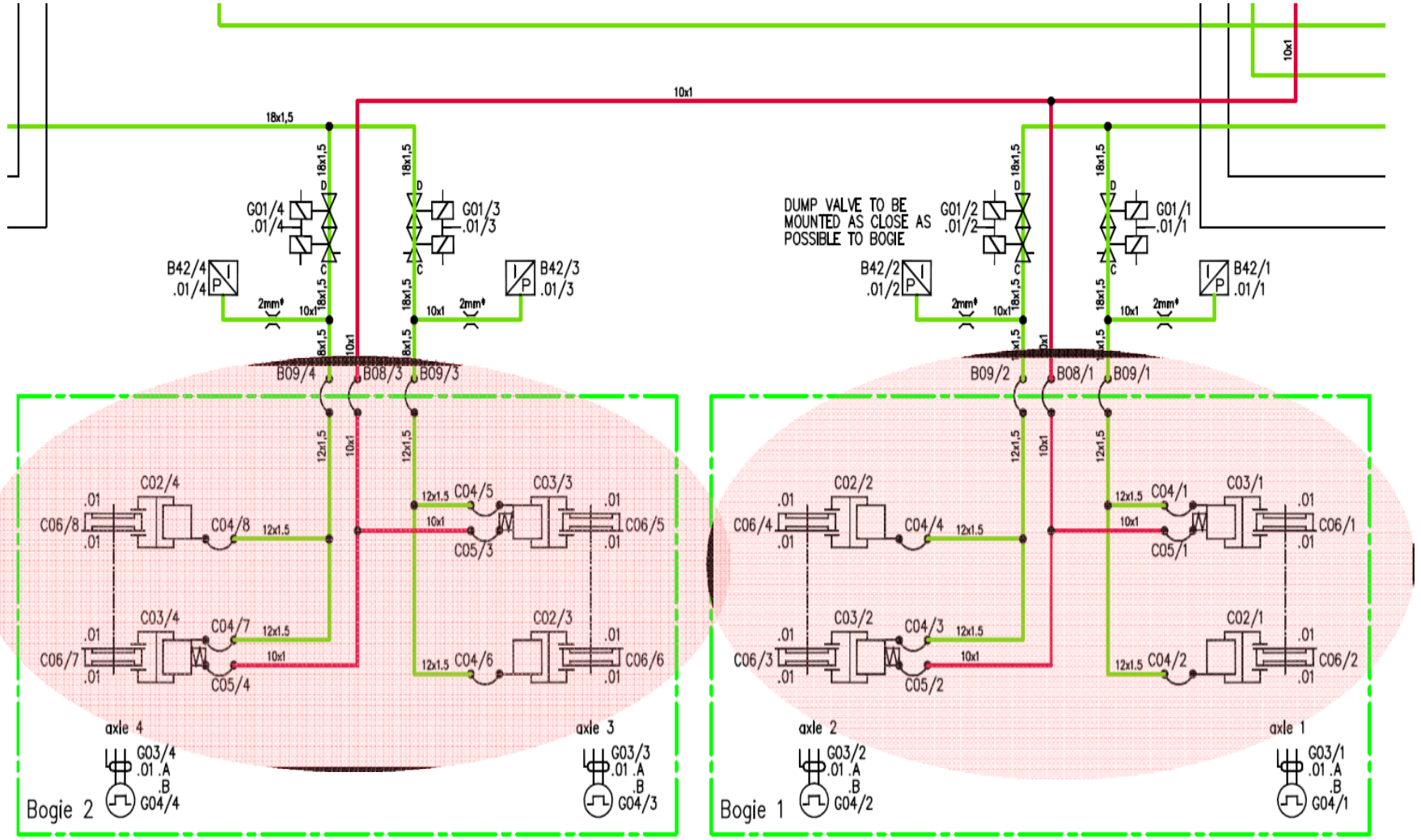






Brake mechanics



C02 – brake calliper unit RZS with spring actuator

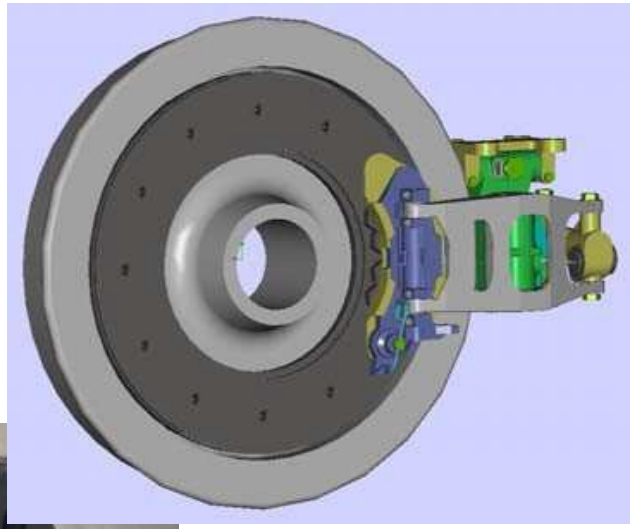
C03 – brake calliper unit RZS without spring actuator

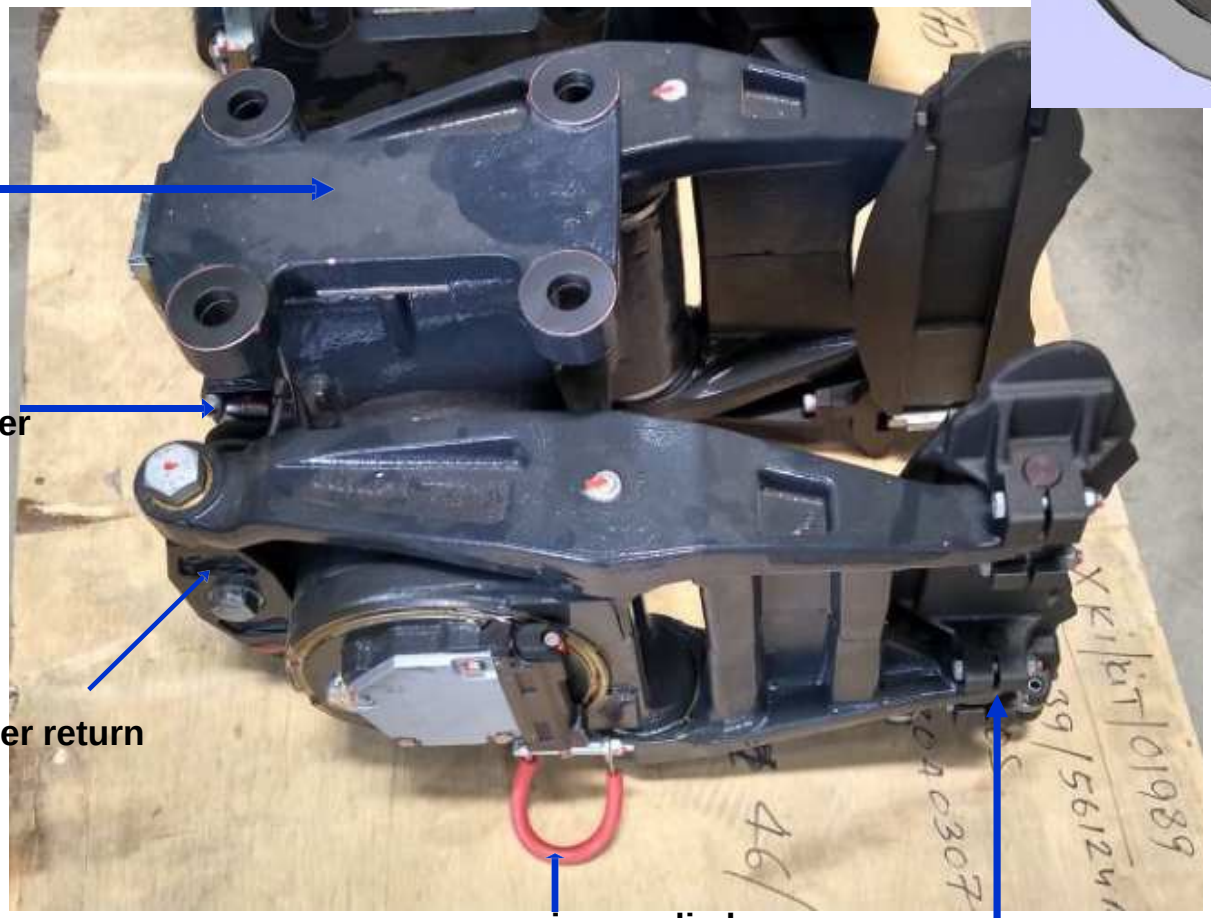
C04, C05 – hose pipe

C06 – brake disc

Abridgement of TA46991/11A

Brake calliper unit RZS….





Bracket

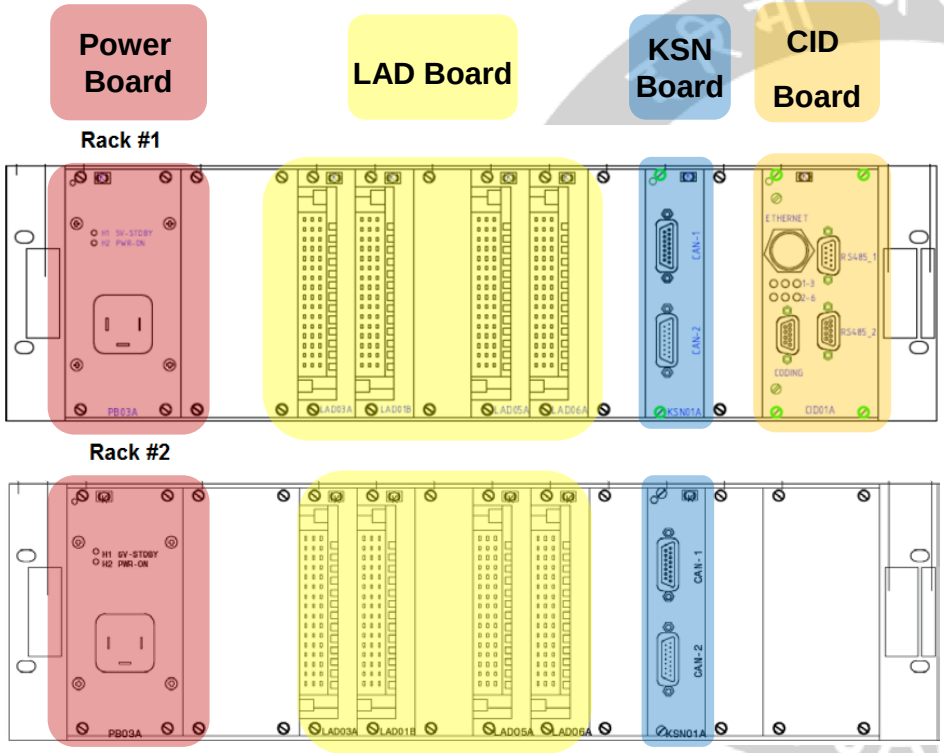
Slack adjuster

slack adjuster return screw

spring applied brake cylinder

Brake lever

Electronic Brake Control



Configuration of BECU

- One Power Board per rack
- One LAD05A per each rack
  - WSP Control Board
- One LAD06A per each rack
  - Pressure Regulator Board.
- One LAD01B per each rack
  - Digital I/O Board.
- One KSN per each rack
  - Knorr Safety Network
- One CID per each rack #1
  - BUS communication
    (RS485)

Hardware

Power – Board (PB03A)

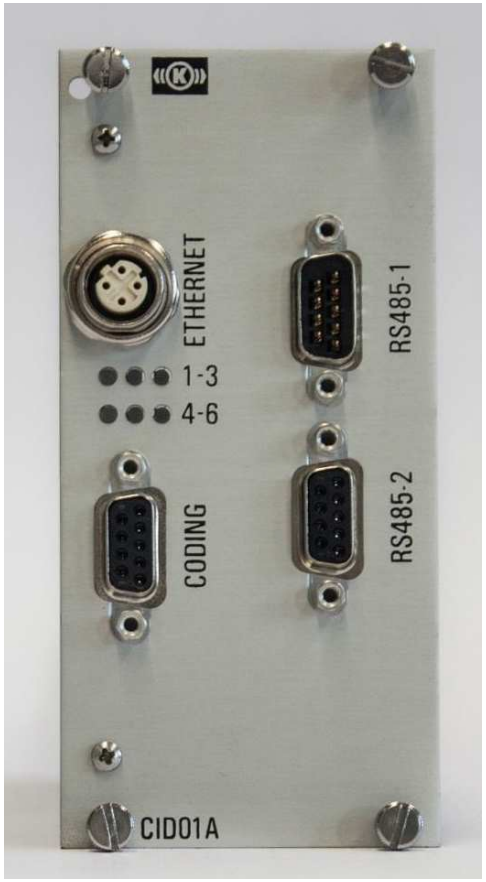
- The Power Board (PB) creates all necessary voltages for the electronics of the ESRA – Evolution system and for the connected sensors and actuators.
- The vehicle Battery voltage is converted into the ESRA Evolution system voltages.
- Depending upon the power consumption of one Rack a second PP can be plugged in a 19” Housing.

Hardware

Central Intelligence Device (CID01A)

- The CID is the central intelligence board, which contains the project specific SW and controls the Knorr Safety Network (dual CAN-Bus / Level 1 Bus) with connected LADs.
- Primary Secondary switch over for redundant brake control function
- Dual RS485 interface for connection to the TCMS.
- In case of standalone CID (without KSN) a coding device is connected to the CODING interface.

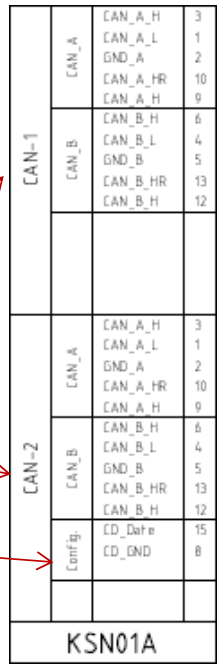
Ethernet	TX+	1
	RX+	2
	TX-	3
	RX-	4
CODING	n.c.	1
	n.c.	2
	n.c.	3
	n.c.	4
	GND	5
	n.c.	6
	n.c.	7
	n.c.	8
	DATA	9
RS485_1	Line_A-Ch_A	1
	Line_B-Ch_A	2
	Sig.0V	3
	Line_A-Ch_B	4
	Line_B-Ch_B	5
	Term_A-Ch_A	6
	Term_B-Ch_A	7
	Term_A-Ch_B	8
	Term_B-Ch_B	9
RS485_2	Line_A-Ch_A	1
	Line_B-Ch_A	2
	Sig.0V	3
	Line_A-Ch_B	4
	Line_B-Ch_B	5
	Term_A-Ch_A	6
	Term_B-Ch_A	7
	Term_A-Ch_B	8
	Term_B-Ch_B	9
CID01A		

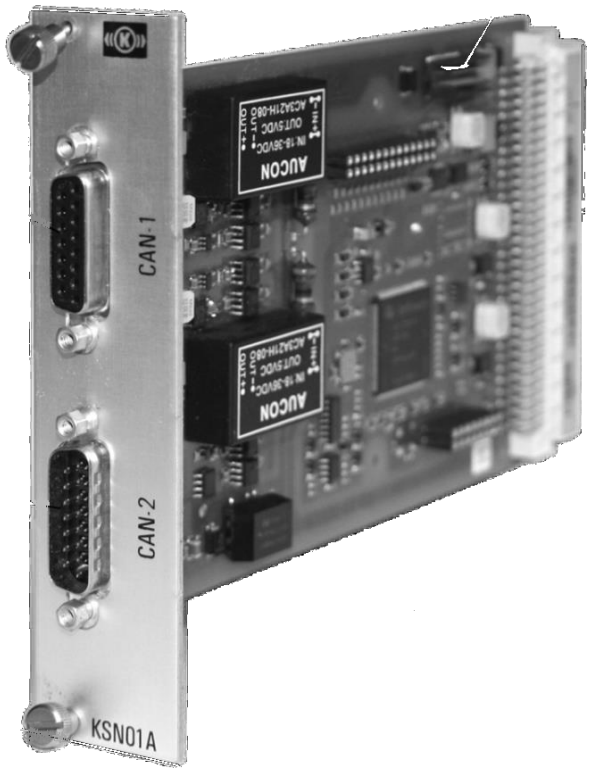


Hardware

Knorr Safety Network board (KSN01A)

- The KSN01A board is a communication gateway in the ESRA-Evolution system.
- The CAN gateway between KSN and Rack internal CAN Bus is the main role of the board.
- Redundant dual KSN Bus interface connection
- Coding Device connection on CAN-2 interface

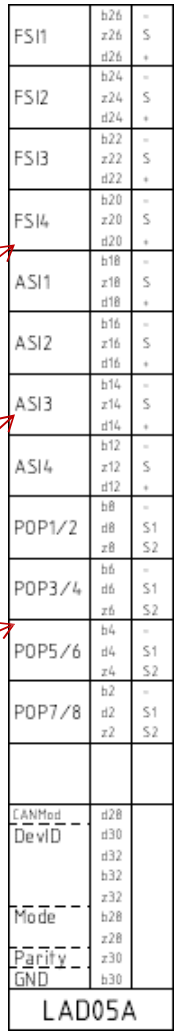




Hardware

Pressure Control board (LAD06A)

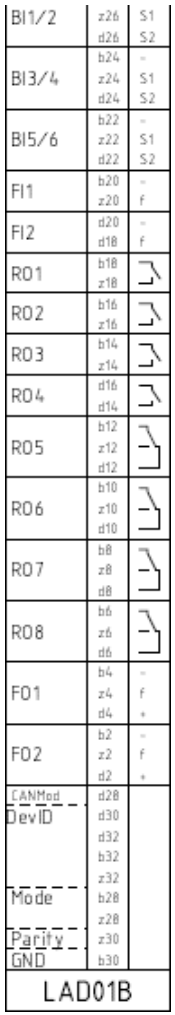
- Local Application Device works as slave board in KSN for pressure control .
- Contains two independent standard application modules for digital control loop (DCL),
- 4 speed sensor inputs
- 4 analog sensor inputs (pressure sensor)
- Up to 2 pneumatic brake control units (BCU) can be connected to the POPs

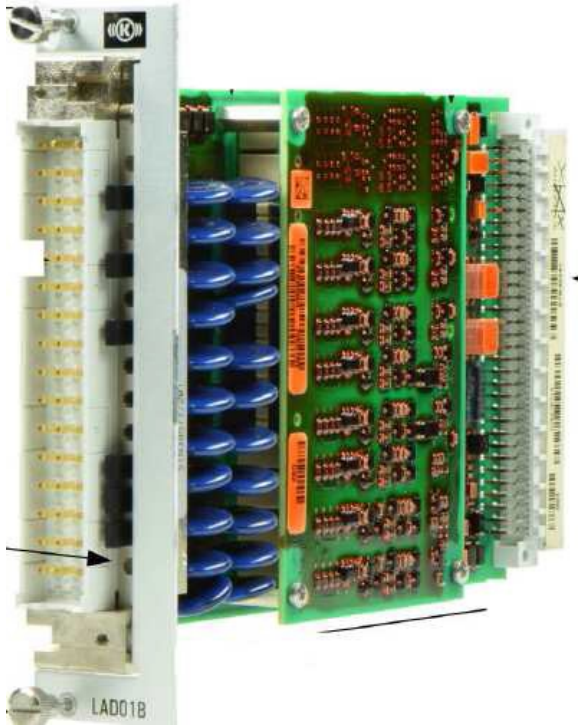


Hardware

Digital I/O Board (LAD01B)

- Local Application Device works as slave board in KSN for digital input and outputs.
- Contains standard application for reading signals and output signals
- 6 binary inputs + 2 frequency inputs
- 8 relay outputs + 2 frquency outputs

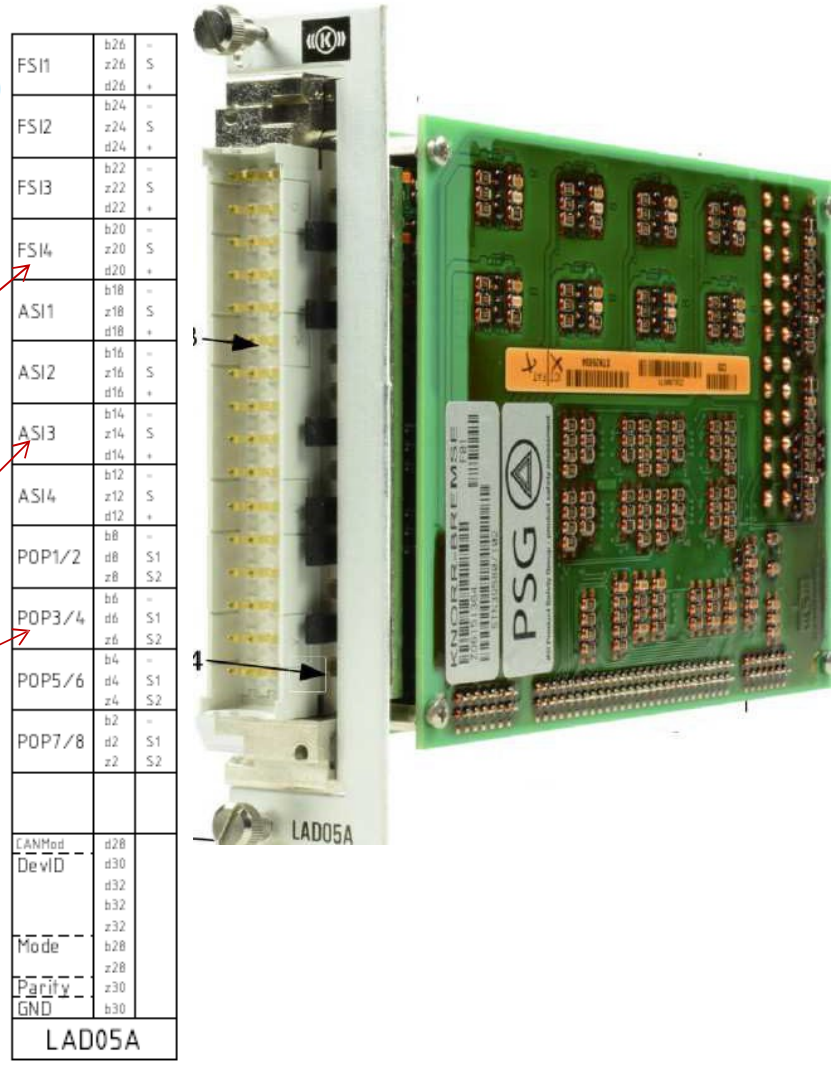




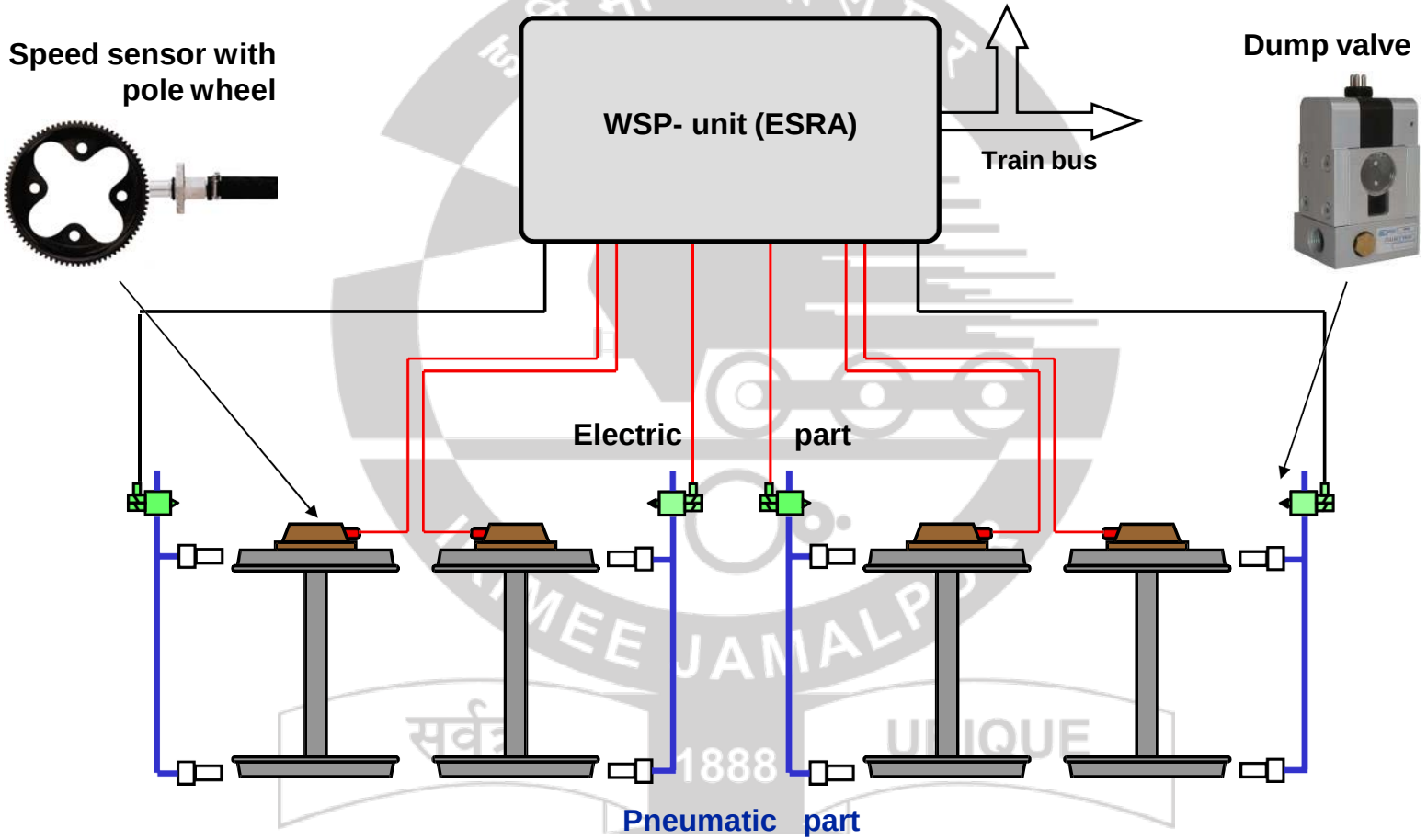
Hardware

Wheel Slide Protection (WSP) board (LAD05A)

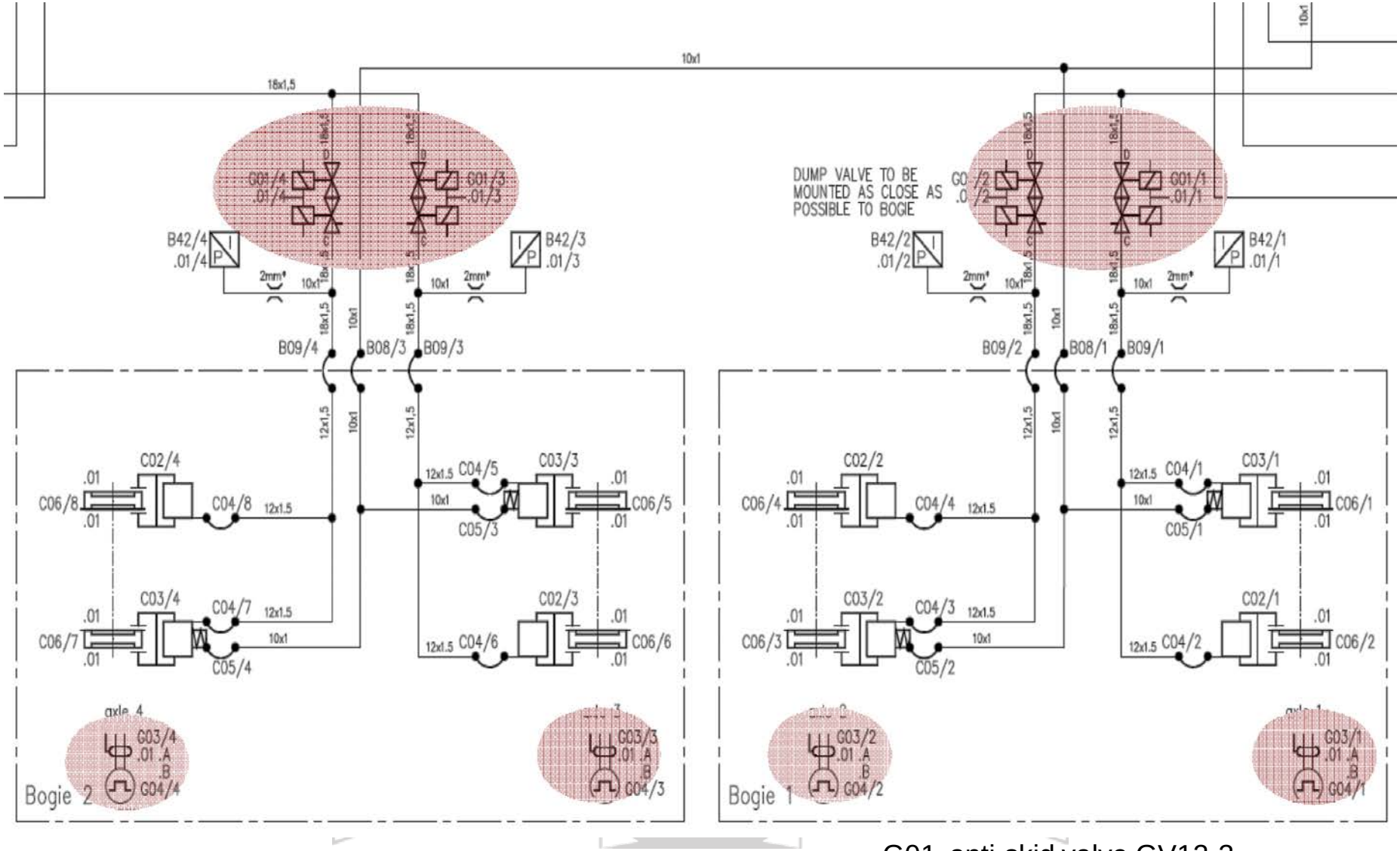
- Local Application Device works as slave board in KSN for WSP .
- Contains standard application for wheels slide protection, WSP monitoring and detection of non rotating axels (DNRA)
- 4 speed sensor inputs
- 4 analog sensor inputs (pressure sensor)
- Up to 4 dump valves can be connected to the POPs



Wheel- slide- protection- system

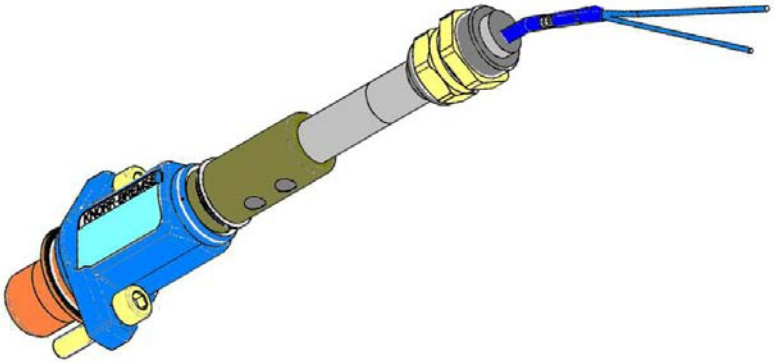


Wheel slide protection scheme

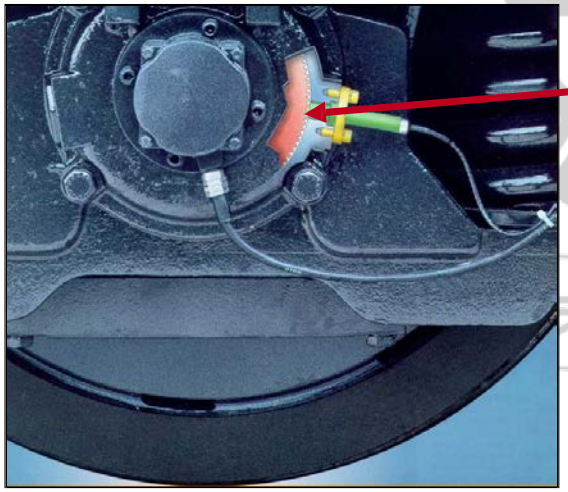


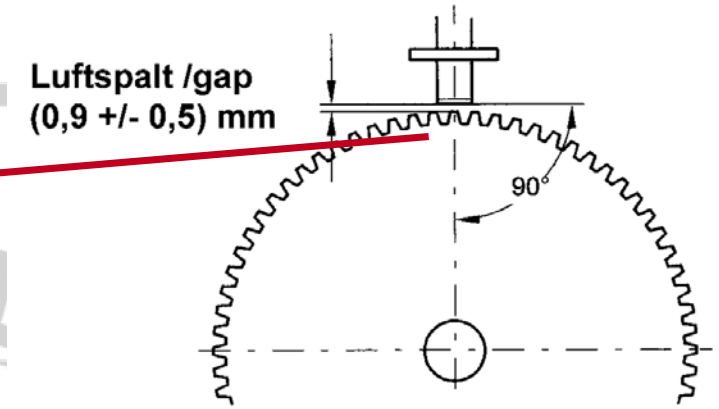
G01 anti-skid valve GV12-3
G03 speed sensor FS01B
G04 pole wheel

Speed sensors- FS01-B [G03]

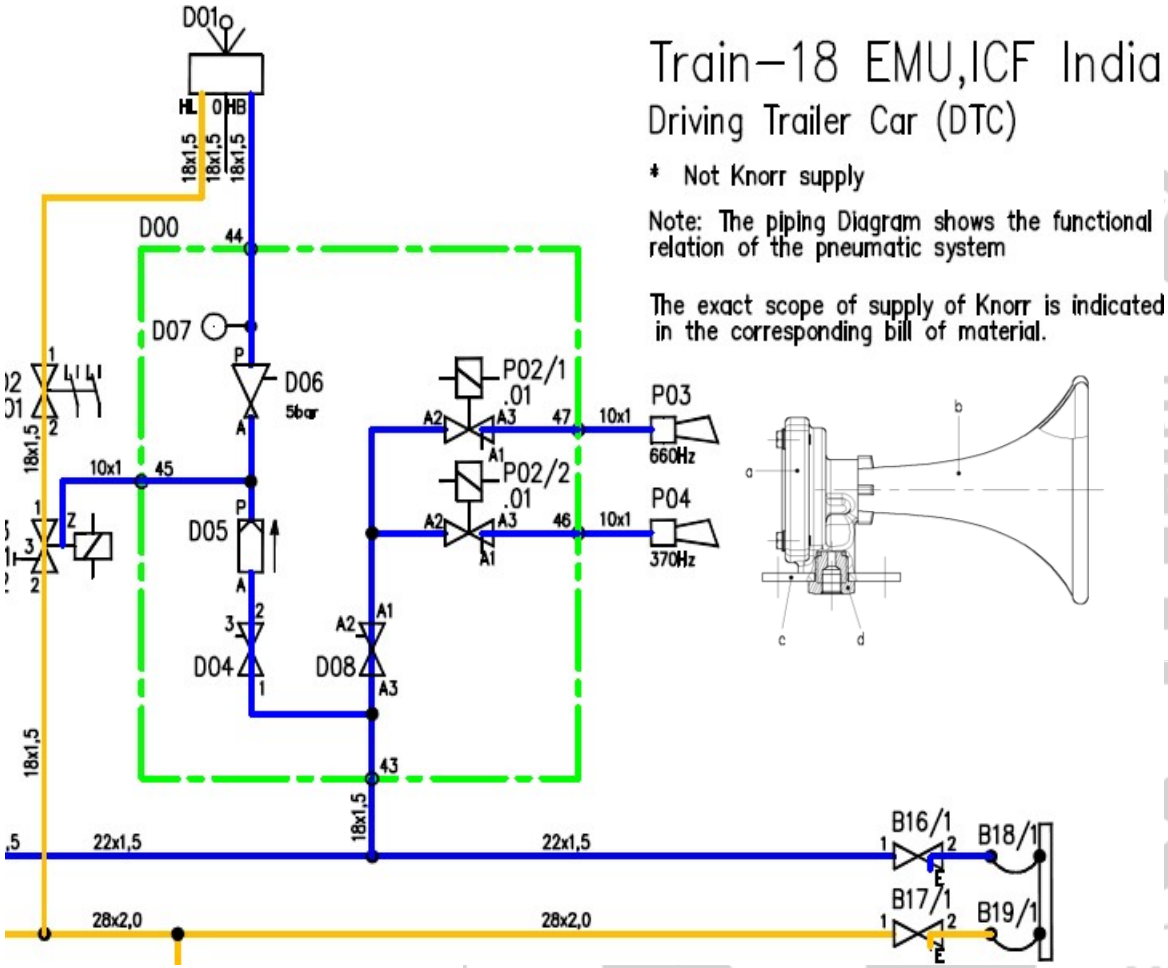


The speed sensor is a special Hall sensor, which senses the changing of magnetic flux between the teeth and gaps of a ferromagnetic pole wheel. The sensors translates the signals by switching the output current.





Horn



D08 ball cock
P02 magnet valve
P03 horn
P04 horn

The horn is only existing in DTC- car!

The signaling equipment consists of two electric horns (P03) and (P04).

The compressed air supply is controlled by the upstream magnet valve P02.

The compressed air causes the diaphragm to vibrate and the resulting sound signal is amplified by the horn.

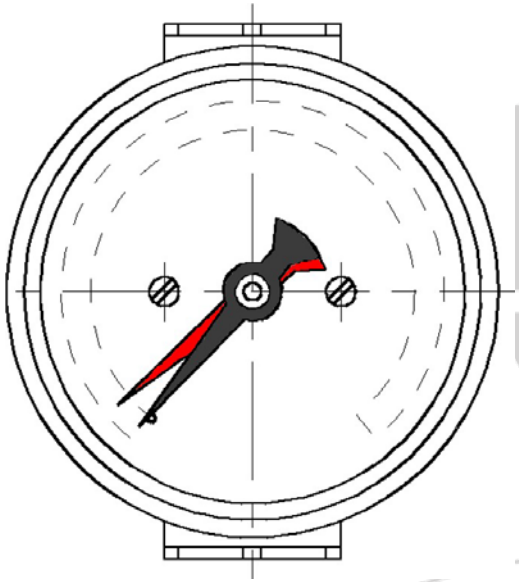
Warning !

Not suitable use may cause hearing damage !
The sound intensity level in front of the horn is approx. 104 dB (A) at a distance of 7 m.

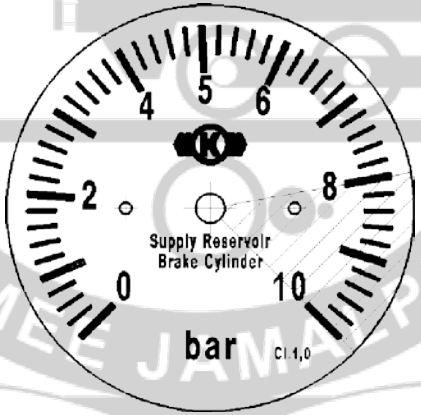
Tone frequency : 660 Hz [P03]
370 Hz [P04]

Double pressure gauge with lighting [D11, D12]

The double pressure gauge serve specially to measure two air pressures simultaneously. The unit has only one scale for two measuring instruments.



D12 – Supply reservoir pressure and Brake cylinder pressure



D11 – Brake pipe pressure and MRE-pressure