RE 95273/2024-02-14
Replaces 2023-11-14

rexroth
A Bosch Company

BODAS Display DI5

- 5, 7 and 10.1 inch multitouch color displays with up to 1280 × 800 pixels
- iMX6 processors solo and dual with 800 MHz
- 4 GB flash memory and up to 1 GB RAM

Features

- Communication:
  - Up to 4 × CAN 2.0B
  - 2 × USB 2.0
  - RS232
  - Automotive Ethernet (T1)
  - 1 × acoustic speaker, 1 × audio-out
  - Real-time clock
  - Wake up signal
- Visualization
  - Adaptive brightness with light sensor
  - Anti-fogging display (optical bonding)
  - 1 × multicolor LED
- 12 V and 24 V supply
- Protection class IP 66
- Temperature: -30 ... +75 °C
- Freely programmable visual HMI
  - Composition of display content, operating element functions and behavior with CODESYS V3.5 development environment, C/C++ and Qt-Linux
- Flexible installation portrait or horizontal
- Integration into dashboard (mounting frame)
- CE conformity

Content

Type code

01	02	03	04
DI	**5**	–	–

Type

01	Display	**DI**

Version

02	Generation	**5**

Screen size

03	Screen size 5"	**5**
	Screen size 7“	**7**
	Screen size 10“	**10**

Version

04	Standard	**STD**
	CODESYS	**CODESYS**

Note:
The BODAS DI5 is not functional without prior programming. A project must be created with the CODESYS V3.x development environment (PC tool from 3S-Smart Software Solutions GmbH), Qt or C/C++ and transferred onto the DI5. A software package containing the DI5 development tools for both the Codesys and Qt environments is provided by Bosch Rexroth AG.

Designation	Material number
DI5-5 STD	R917014449
DI5-7 STD	R917014450
DI5-10 STD	R917014451
DI5-5 CODESYS	R917014459
DI5-7 CODESYS	R917014460
DI5-10 CODESYS	R917014461

Description

With the BODAS DI5 display family Bosch Rexroth is offering freely programmable high-resolution 5, 7 and 10.1 inch color multitouch displays with a powerful 800 MHz processor.
Depending on the programming, the displays enable, for example, process variables, static and dynamic graphic elements and the operation of machine functions to be displayed on one central unit.
The robust display DI5 has been developed specifically for use in mobile working machines and satisfies the relevant protection requirements regarding ambient temperatures, impermeability, shock and vibration and electromagnetic compatibility (EMC). It is intended for installation or assembly in the driver‘s cab and offers excellent readability, even in sunlight and harsh climatic conditions. The display brightness is adjustable. By programming, an ambient light sensor automatically adjusts the backlighting.
The front-glass of the display has an antifog-coating to avoid mist in case of rapidly changing temperatures.

The application-specific representation of screen pages, context menus, graphic elements and video signals is provided by the CODESYS or Qt programming environment. The integrated LEDs and the loudspeakers can be used as enhanced status indicators.

The BODAS display can be connected to a 12 V or 24 V on-board batterie-voltage. The internal real time clock is buffered against supply voltage interruption (2 weeks).

All displays are equipped with an automotive Ethernet interface.

The DI5 display can be flashed through three different methods:

- From a PC, using an Ethernet cable with a USB adapter, which plugs into the side USB port of the DI5. The Ethernet adapter is required to provide a network point, which is later configured in the PC settings (set IP and MAC address). Optionally, a second Ethernet-USB adapter can be added to use a USB port instead of the Ethernet port of the PC.
- From a PC, using an M-12 to Ethernet cable with a 100BASE-T1 media converter. The DI5 uses automotive Ethernet and therefore an adapter is required to connect it to the PC Ethernet port.

- Using a USB flash drive containing the pre-compiled software, which is plugged into the USB port of the DI5, which later needs to be started in service mode for starting the flashing process.

The video interface allows direct connection to up to two PAL or NTSC video sources (e.g., BODAS color video cameras by Bosch Rexroth). The video signals transmitted from the cameras can be displayed as superimposed images (picture in-picture) or as full-screen, depending on the user interface configuration.

Programming
The DI5 is freely programmable using C/C++, Qt-Linux or CODESYS V3.x development environment from the supplier 3S-Smart Software Solutions GmbH. This standard tool is extended by a product-specific Bosch Rexroth software-package. A design template, libraries, the license documentation and a demo project in which core functions have been applied to help you get started are included, as well as a specific online help. The DI5 Developer Guide RE95273-50 is available as a support for programming in C/C++.
DI5 Codesys training videos are available in the Bosch Rexroth Academy.

Each display page can be freely composed by the user on a PC in terms of the design, arrangement and number of elements. CODESYS Visualization allows the easy integration of predefined or freely designed items and bitmaps (such as customer logos, display instruments, charts, etc.) in display screens designed by the user.
The development environment from 3S and the additional DI5-specific software packages are available on request from Bosch Rexroth.

The dynamic input parameters, which are analog, digital or based on the (J1939 and proprietary) CAN protocol, such as speed values, temperature, settings, etc. can be assigned to the relevant elements by CODESYS development environment.
The designed surfaces are shown on the PC during the definition process, so that there is no need to download the configuration file to the display. The individual programming, configuration and menu navigation can be easily simulated and tested on the PC.

Typical applications include driving and operating state indicator, system parametrization and diagnosis.

Applications and installation variants
The BODAS display can be used as a dashboard display and/or user interface. Installation can be either integrated into the control panel or can be done as a stand-alone device within the drivers cab. A mounting frame is available for dashboard integration. A mounting flange for standalone installation is available on the back of the device. Mounting is done using defined screwing points and is compatible with the RAM Mount® system.

DI5 Toolbox
DI5 Toolbox enables the DI5 to be used as the gateway access to the BODAS RC/40 controllers to be used as a diagnostic and service interface for configuring and flashing software on the controllers or on the DI5 display itself. Parameters stored in the controllers can be read out, changed and written back via the CAN interface of the DI5. The visualisation of the active and stored J1939 DM1/DM2 errors of a BODAS RC/40 controller as well as the resetting of the errors are possible using the DI5 Toolbox via the DI5.

The DI5 Toolbox is part of the DI5 software package which is available in myRexroth.

For questions regarding access authorisation, contact Onboarding.BODAS@boschrexroth.de

Technical data

Type			DI5-5 STD	DI5-5 CODESYS	DI5-7 STD	DI5-7 CODESYS	DI5-10 STD	DI5-10 CODESYS
Housing			Aluminium die cast powder coated					
Mounting			Landscape or portrait Standalone In-dash					
Display								
	Type		TFT Color graphic LCD with LED backlight					
	Size		5”, 108 mm × 64.8 mm		7”, 152.4 mm × 91.44 mm		10.1”, 259 mm × 175 mm	
	Resolution		800 x 480 px (WQVGA), 15:9		800 x 480 px (WQVGA), 15:9		1280 x 800 px (WQVGA), 15:9	
	Colors		16.7 Mio					
	Brightness (typical)		800 cd/m²		800 cd/m²		1000 cd/m²	
	Contrast ratio (typical)		700:1		700:1		800:1	
Input devices								
	Touch		Capacitive touch					
	Indicators and sensors		Light sensor 1 multicolor LED					
Electronics								
	Processor platform	CPU	Freescale I.MX6®, 800 MHz		Freescale i.MX6®, 800 MHz Dual		Freescale i.MX6®, 800 MHz Dual	
		Mass storage (minus space for OS & application)	4 GB		4 GB		4 GB	
		RAM	512 MB		1 GB		1 GB	
		RTC	Buffered by gold cap Buffered for 2 weeks at tambien deviation max. 1 s/day					
	Speaker		Up to 90 dB @ 10 cm distance (max. @ ~8kHz)					
	Audio		1 x Audio output (left, right, GND) AC97 compatible Output power: approx. 50 mW					
	Silent wake input		Input which can be used for silent-wake-on of the DI5 to reduce visible boot-time active on positive edge					
	Power supply		System supplied through terminal 30 (battery +, see pinout) and 31 (battery –, see pinout) Terminal 15 (ignition) to be used to switch on/off					
		Operating voltage range	8 ... 36 V DC					
		Short circuit protection	Integrated					
		Over-voltage protection	Up to 48 V for max 5 min					
		Inverse polarity protection	Up to –48 V DC for max 5 min					
Connectors								
	Main		Typo-AMP 1437288-6		Typo-AMP 1437288-6		Typo-AMP 1437288-6	
	Mating connector (customer)		Typo-AMP 3-1437290-7		Typo-AMP 3-1437290-7		Typo-AMP 3-1437290-7	
	Mating crimp contact (customer)		Typo-AMP 3-1447221-4		Typo-AMP 3-1447221-4		Typo-AMP 3-1447221-4	
	Dummy Plug (customer)		Typo-AMP 4-1437284-3		–		Typo-AMP 4-1437284-3	
	Video connector		M12 round connector, female, 5-pole, B-coded acc. to EN 61076-2-101					
	Ethernet connector		M12 round connector, female, 4-pole, D-coded acc. to EN 61076-2-101					
Weight			660 g		775 g		1400 g	
Energy consumption			Current at		Current at		Current at	
		Power mode	12 V	24 V	12 V	24 V	12 V	24 V
		On	≤ 775 mA	≤ 380 mA	≤ 1200 mA	≤ 600 mA	≤ 1700 mA	≤ 850 mA
		Sleep	≤ 85 mA	≤ 50 mA	≤ 110 mA	≤ 60 mA	≤ 160 mA	≤ 85 mA
		Off	≤ 5 mA	≤ 4 mA	≤ 5 mA	≤ 4 mA	≤ 5 mA	≤ 4 mA

Type	**DI5-5 STD**	**DI5-5 CODESYS**	**DI5-7 STD**	**DI5-7 CODESYS**	**DI5-10 STD**	**DI5-10 CODESYS**
Interfaces						
CAN bus (according to ISO 11898)[1)]	2 × CAN-Interface		2 × CAN-Interface		4 × CAN-Interface	
CAN-specification	2.0 B active, up to 1 Mbit/s (default 250 kbit/s, possible 10 kbit/s, 20 kbit/s, 50 kbit/s, 83.3 kbit/s, 111.1 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s, 1 Mbit/s)					
RS232	1 × RS232-Interface					
Type	EIA232 (only RXD, TXD, GND)					
Speed	max. 115.200 kbps					
USB	Host 2.0					
Side connector	1 × Type A high speed guaranteed 900 mA @ 5V					
Back connector	1 × Type A high speed Guaranteed 900 mA @ 5V					
Ethernet interface	1 × Automotive Ethernet interface T1, TCP/IP					
Video interface (PAL and NTSC format/standard)	1 × analog video input, 1 Vss		1 × analog video input, 1 Vss		2 × analog video input, 1 Vss	
	Camera control output (open drain) for special functionality (mirror, shutter, heating etc.) Camera supply output guaranteed 300 mA @ 12 VDC					
Software						
Operating system	Linux Kernel 4.14.0 or higher		Linux Kernel 5.43.53 or higher		Linux Kernel 4.14.0 or higher	
Application programming	–	CODESYS 3.x	–	CODESYS 3.x	–	CODESYS 3.x
	Qt					
	C/C++					

Electrical		
Inverse polarity resistance	5 min @ −48 V (no defect)	
Over voltage resistance	5 min @ +48 V (no defect)	
Start behavior	Start over temperature Start at T_{Room}; decrease in 5° steps to T_{min}; go to T_{Room}; increase in 5° steps to T_{High}; Start DUT at each T; Successful start expected	
Short circuit strength	Connect each pin of main, video and Ethernet connector for 5 min to GND and for 5 min to 36 V; FS: C	
Superimposed alternating voltage	Triangle signal, frequency sweep: 50 Hz-25 kHz-50 Hz inside 60 s; FS: A	
Level	**12 V system**	**24 V system**
AC peak-to-peak UPP1	1 VAC	4 VAC
AC peak-to-peak UPP2	2 VAC	4 VAC
AC peak-to-peak UPP3	3 VAC	10 VAC
De-/increase supply voltage	Sweep voltage U_{Min}-0V-U_{Min} with 0.5 V/min; FS: D	
Drop in supply voltage	**12 V system**	**24 V system**
	U_{Start} = U_{min}; U_S = 4.5 V	U_{Start} = U_{min}; U_S = 9 V
	td = 100 ms; FS: B	td = 100 ms; FS: B
Battery less operation	U_1 = 10 V; U_2 = 18 V;	U_1 = 20 V; U_2 = 38 V;
	t = 5 min; FS: A	t = 5 min; FS: A

1) CAN-open and J1939 can be realized by additional software.

Mechanical			
Vibration, noise 32 h per axis; FS: A	**Frequency [Hz]**	**PSD [(m/s2)/Hz]**	
	10	20	
	20	36	
	30	36	
	141	1.64	
	200	1.93	
	300	1	
	2000	1	
Vibration, sinusoidal Resonance sweep 1 Octave/minute, 30 min per resonance	**Frequeny**	**Displacement**	**Acceleration**
	2 Hz	+/– 1 mm (2 mm PtP)	(0.016 g)
	10 Hz	–	2 g
	2000 Hz	–	2 g
Endurance test 0.5 Octave/minute, 8 h per resonance. FS: A	**Frequeny**	**Displacement**	**Acceleration**
	5 Hz	+/– 0.75 mm (1.5 mm PtP)	(0.075 g)
	57.5 Hz	–	–
	2000 Hz	–	5 g
Mechanical shock			
Part 1	300 m/s², 18 ms, 10 times per axis/direction; FS: A		
Part 2	500 m/s², 11 ms, 3 times per axis/direction; FS: A		
Part 3	500 m/s², 6 ms, 10 times per axis/direction; FS: A		
Part 4	400 m/s², 6 ms, 4000 times per axis/direction; FS: A		
Drop test	Drop the DUT on each side and each edge from a high of 1 m on a concrete floor. No damage or visible damage.		
Package			
Drop test	Drop the DUT inside the package on each side and each edge from a high of 1m on a concrete floor. No damage of the DUT No cracks to the package		

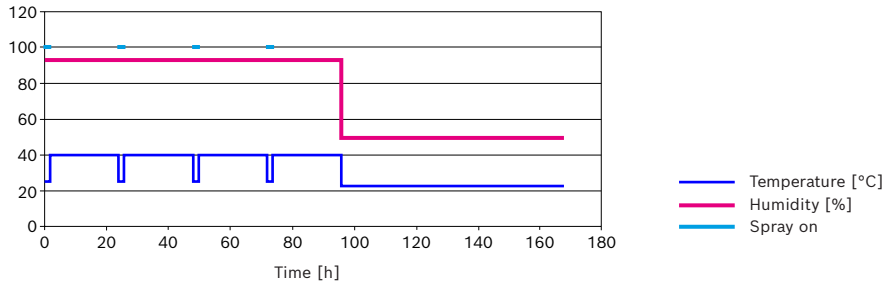
Testing and verification

CE Compliance		
EU Directive 2014/30/EU (EMC)		
according to	EN 13766-1[1)]	Earth-moving and building construction machinery – electromagnetic compatibility (EMC) of machines with internal electrical power supply - Part 1: General EMC requirements under typical electromagnetic environmental conditions
	EN 13309[2)]	Construction machinery – electromagnetic compatibility of machines with internal electrical power supply
	EN ISO 14982	Agricultural and forestry machinery – electromagnetic compatibility – test methods and acceptance criteria
	EN 12895	Materials handling equipment – electromagnetic compatibility
	EN 50498	Electromagnetic compatibility (EMC) Product family standard for aftermarket electronic equipment in vehicles
	EN 61000-6-2	Electromagnetic compatibility (EMC) Generic standards – immunity for industrial environment
	EN 61000-6-4	Electromagnetic compatibility (EMC) Generic standards – emission standard for industrial environment

EMC Emission radiated		
30 ... 75 MHz	62 ... 52**1** dB (µV/m) – QP – 120 kHz 52 ... 42**1** dB (µV/m) – AV – 120 kHz	
75 ... 400 MHz	52 ... 63**2** dB (µV/m) – QP – 120 kHz 42 ... 53**2** dB (µV/m) – AV – 120 kHz	
400 ... 1000 MHz	63 dB (µV/m) – QP – 120 kHz 53 dB (µV/m) – AV – 120 kHz	
1000 ... 2500 MHz	73 dB (µV/m) – P – 120 kHz 53 dB (µV/m) – AV – 120 kHz	
2500 ... 6000 MHz	80 dB (µV/m) – P – 1000 kHz 60 dB (µV/m) – AV – 1000 kHz	
EMC Immunity radiated	20 MHz to 800 MHz with amplitude modulation 800 MHz to 6 GHz with pulse modulation 30 V/m for the radiated field (absorber lined chamber) testing method (ISO 11452-2) in vertical and horizontal polarization	
OR/AND	60 mA for the bulk current injection (BCI) testing method (ISO 11452-4)	
EMC Emission conducted	**12 V system** (maximum values)	**24 V system** (maximum values)
Positive slow pulses	+37 V	+37 V
Negative slow pulses	–75 V	–150 V
Positive fast pulses	+75 V	+150 V
Negative fast pulses	–112 V	–150 V
Test pulse 1	U_s = 112 V; FS: C	U_s = 450 V; FS: C
Test pulse 2a	U_s = +55 V; FS: B	U_s = +55 V; FS: B
Test pulse 2b	U_s = +10 V; FS: C	U_s = +20 V; FS: C
Test pulse 3a	U_s = –165 V; FS: A	U_s = –220 V; FS: A
Test pulse 3b	U_s = +112 V; FS: A	U_s = +220 V; FS: A
Test pulse 4 (Starting profile)	U_{s6} = 6 V; U_s = 6.5 V FS: B	U_{s6} = 6 V; U_s = 10 V FS: B
Load dump	U_s = + 79 V; FS: C	U_s = +151 V; FS: C
Electrostatic discharge	+/– 8 kV contact discharge; FS: A +/– 15 kV air discharge; FS: A	
EMC Susceptibility conducted		
Frequency	150 kHz ... 80 MHz; U = 10 V; AM: 1 kHz, 80%; FS: A	
ISO 16750-2	Road vehicles – environmental conditions and tests for electrical and electronic equipment	
Burst	tr = 5 ns; td = 50 ns;	
Burst duration	15 ms	
Period	300 ms; t = 5 min; FS: B	
Power lines	US = +/– 2kV	
Signal lines	US = +/– 1kV	
Surge	tr = 1.2 us; td = 50 us	
Amount	5	
Wait time	60 s; FS: B	
Power lines	US = +/– 0.5 kV	
E1 – Type approval	EU Directive ECE R 10.4	
Protection level (IP Code)		
IP 66 according to ISO 20653	Road vehicles – degrees of protection (IP-Code) – protection of electrical equipment against foreign objects, water and access	
REACH according to regulation (EG) no. 1907/2006		
RoHS according to 2011/65/EU		
UKCA Certification		

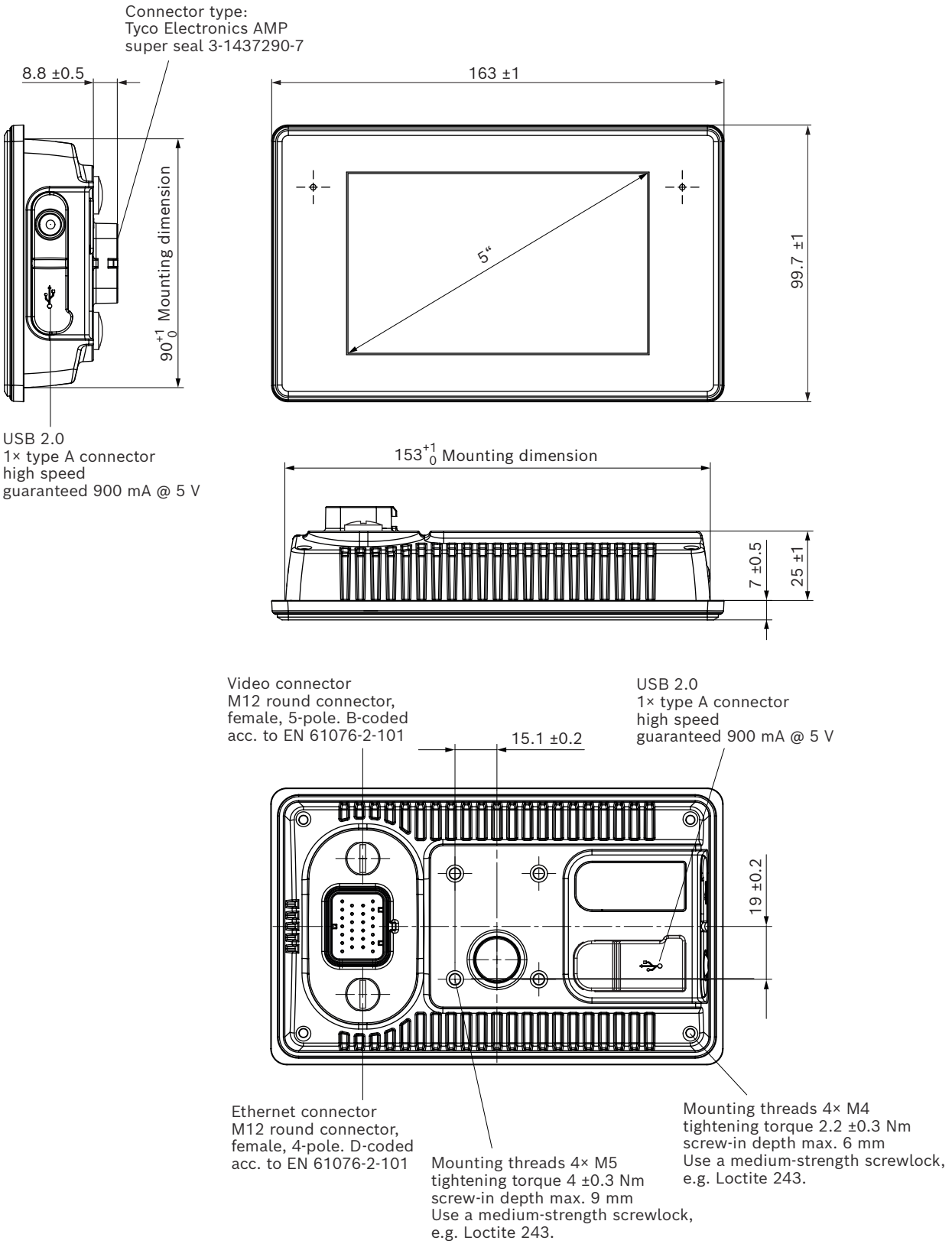
QP: Quasi-peak
AV: Average
P: Peak

1: Value decreases linearly with the logarithm of the frequency
2: Value increases linearly with the logarithm of the frequency
FS: Function Status

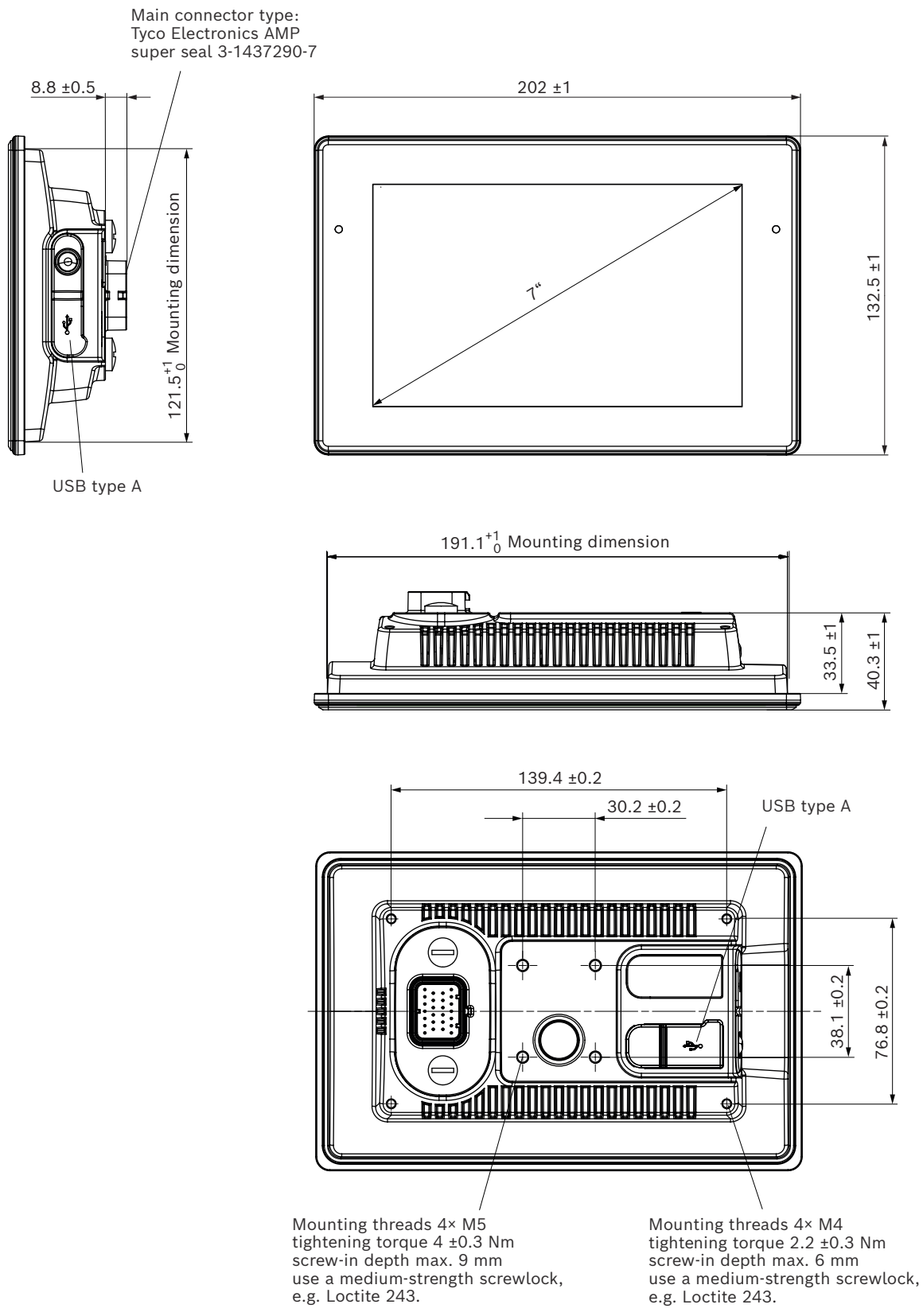
Climate	
Salt spray resistance	
Part 1	7 cycles at 24 h (8 h spraying; 16 h rest) salt concentration: 5%
Part 2	4 cycles at 168 h; 1 cycle: 
Chemical resistance	Apply once a day, for three days, the following chemicals with a brush over the exposed surface Inspect without rinsing immediately afterwards and after 100 h Alcohol, antifreeze liquid (ethyl glycol), diesel oil, domestic ammonia, gasoline, hydraulic oil 10W40, liquid lime, motor oil, NPK chemical fertilizers 20 10 20, windscreen cleaning mixture, ammonium nitrate and ammonium phosphate fertilizers, bovine effluent - (up to 5% propionic acid), diesel fuel, STOU (Super Tractor Universal Oil) lubricating oil
Damp heat steady	21days @+40 °C and 93% r.H.; FS: C
Damp heat cyclic	6 cycles (each 24 h); T_{Low} = +25 °C; T_{High} = +55 °C
Humidity	≧ 93% r.H.; FS: A
Temperature/humidity cyclic	10 cycles (each 24 h); T_{Low} = −10 °C; T_{High} = +65 °C
Humidity	80...96% r.H. or uncontrolled.; FS: A
Operating temperature	24 h @ −30 °C; FS: A 96 h @ +75 °C; FS: A Max. value with reduced backlight brightness
Storage temperature	24 h @ −40 °C; FS: C 48 h @ +85 °C; FS: C
Temperature cycling	30 cycles (each 8 h); T_{Low} = −30 °C; T_{High} = +75 °C; FS: A
Temperature shock	100 cycles (each 2 h); T_{Low} = −30 °C; T_{High} = +75 °C; T_{change}: <30 s; FS: C
UV resistance	
Overall time	1500 h
Cycle	8 h UV at +60 °C, 4 h 95% r.H. No material damage, no visible change

Dimensions

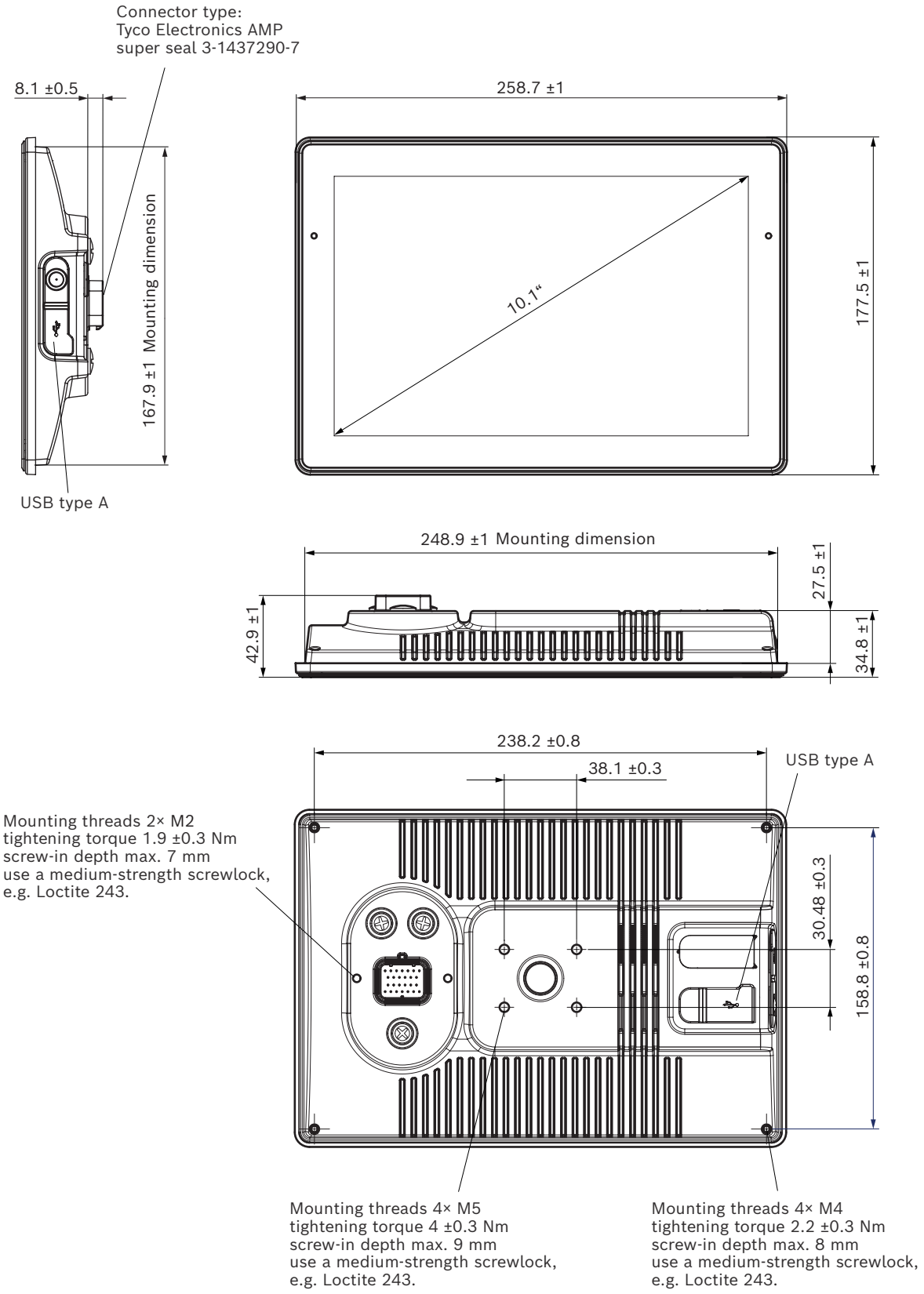
Display DI5-5



Display DI5-7



Display DI5-10



Connectors on the display

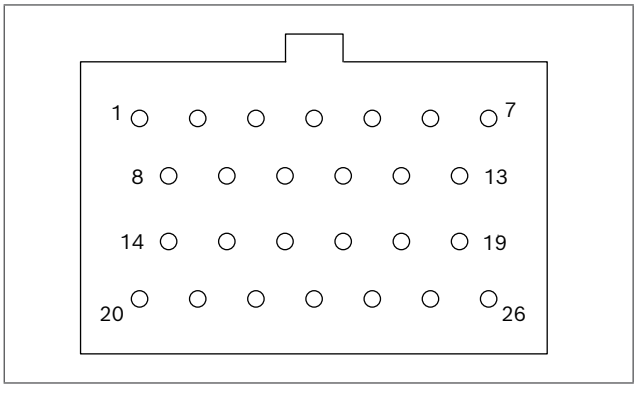
Main connector pinout DI5-5 and DI5-7

Pin	Assignment	Description
1	VCC	Supply voltage + (terminal 30)
2	Ignition input	Ignition input (terminal 15)
3	GND	Supply voltage – (terminal 31)
4	Wake	Wake input, “doorswitch”
5	Audio Out L	Audio line out, stereo
6	Audio Out R	Audio line out, stereo
7	Audio GND	Audio line out, ground
8	CAN1H	CAN 1 high
9	CAN1L	CAN 1 low
10	CAN2H	CAN 2 high
11	CAN2L	CAN 2 low
12	–	not connected
13	–	not connected
14	–	not connected
15	–	not connected
16	RS232 R×D	RS232 receive data
17	RS232 T×D	RS232 transmit data
18	RS232 GND	RS232 GND
19	–	not connected
20	–	not connected
21	–	not connected
22	–	not connected
23	SERV_EN	Service enable
24	–	not connected
25	–	not connected
26	–	not connected

Main connector pinout DI5-10

Pin	Assignment	Description
1	VCC	Supply voltage + (terminal 30)
2	Ignition input	Ignition input (terminal 15)
3	GND	Supply voltage – (terminal 31)
4	Wake	Wake input, “doorswitch”
5	Audio Out L	Audio line out, stereo
6	Audio Out R	Audio line out, stereo
7	Audio GND	Audio line out, ground
8	CAN1H	CAN 1 high
9	CAN1L	CAN 1 low
10	CAN2H	CAN 2 high
11	CAN2L	CAN 2 low
12	CAN3H	CAN 3 high
13	CAN3L	CAN 3 low
14	CAN4H	CAN 4 high
15	CAN4L	CAN 4 low
16	RS232 R×D	RS232 receive data
17	RS232 T×D	RS232 transmit data
18	RS232 GND	RS232 GND
19	–	not connected
20	–	not connected
21	–	not connected
22	–	not connected
23	SERV_EN	Service enable
24	–	not connected
25	–	not connected
26	–	not connected

▼ **View on rear side of the DI5**

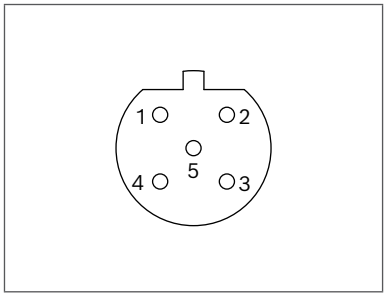


Video connector pinout

DI5-5, DI5-7 and DI5-10

Round connector, 5 pins, M12	
1	Video signal +
2	Switching output
3	Power 12 V
4	Power GND
5	Video signal GND

▼ **Video connector, M12, female, 5 pins, B-coded, View on rear side of the DI5**

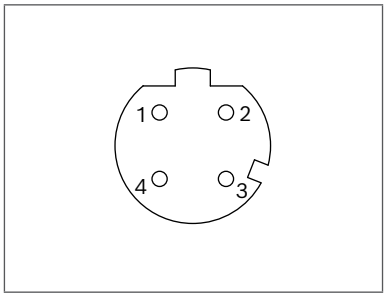


Ethernet connector pinout

DI5-5, DI5-7 and DI5-10

Automotive Ethernet Round connector, 4 pins, M12	
1	D+
2	n.c.
3	D−
4	n.c.

▼ **Video connector, M12, female, 4 pins, D-coded, View on rear side of the DI5**



Accessories

The following accessories are available at Bosch Rexroth:

Designation	Order number
BODAS camera Standard	R902109630
BODAS camera Professional	R902603837
Cable camera	R917010013
RAM-Mount DI5-5 & DI5-7 set	R917014782
RAM-Mount DI5-10 & DI4 set	R917010015
Mounting frame DI5-5	R917014775
Mounting frame DI5-7	R917014776
Connector set DI5	R917010017
Connector Cover DI5-5 & DI5-7	R917014778
Cable Ethernet DI5	R917010014
USB socket DI5	R917014954
Developer wiring harness DI5	R917014784

BODAS Color Video Camera CAM (R902109630 or R902603837)

Transmission of video signals, for example for workspace monitoring. BODAS cameras are available in the Standard or PRO versions. For additional details, see data sheet 95280.

Cable camera (R917010013)

Cable camera mating connector for connection to the wiring harness. The video cable consists of a M12 connector, male, 5-pin, B-coded according to EN61076-2-101 and shows on the opposite side of the cable tin-plated tails. The cable is shielded. Length: approx. 5 m

RAM Mount® DI5-5 and DI5-7 set (R917014782)

The set used for display installation the vehicle installation consists of 1x RAM®103U (RAM round base with AMPS hole pattern and 1.0” ball as well as double socket arm for 1.0” ball bases), one RAM-347U (RAM square plate with AMPS hole pattern and 1.0” ball) and the corresponding screws.

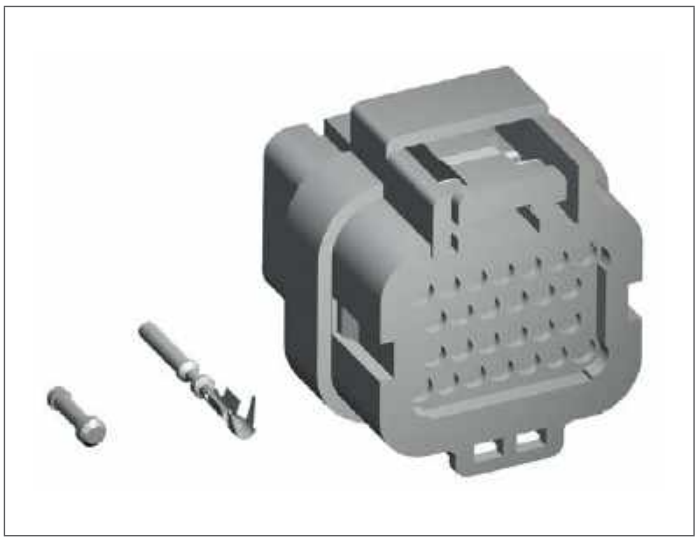
RAM Mount® DI5-10 and DI4 set (R917010015)

The set used for display installation the vehicle installation consists of 2x RAM®202U (RAM 2.5 inch round base with AMPS hole pattern and 1.5 inch ball), one RAM-201U (double socket arm for 1.5“ ball bases) and the corresponding screws.

Mounting frame
DI5-5 (R917014775) and DI5-7 (R917014776)

Installation instructions mounting frame DI5-5 see RE95273-60-B and Installation instructions mounting frame DI5-7 see RE95273-61-B.

Connector set DI5 (R917010017)



Main connector including 26-pin connector housing, contacts and sealing for the manual connector/cable assembly.

1) Suitable for development only – not for series installation

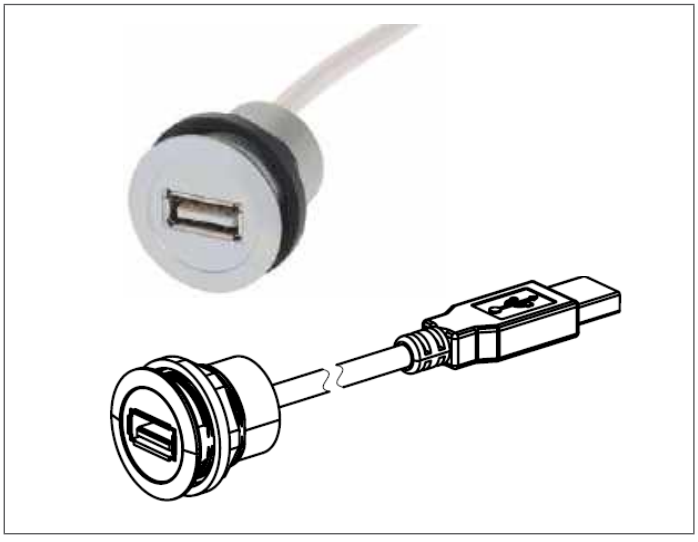
Connector Cover DI5-5 and DI5-7 (R917014778)

Connector Cover DI5-10 on request.

Cable Ethernet DI5 (R917010014)[1)]

The Ethernet cable consists on the one end of a RJ45 connector and on the other end of a M12 connector, male, 4-pin angular connector, D-coded according to EN61076-2-101. Length approx. 1 m.

USB socket DI5 (R917014954)



Port for access to the BODAS display and controller via USB

- ▶ USB 2.0 plug connector, approximately 1,5 m of cable
- ▶ Counter nut including seal.

Note on Software

Supplementary offer and sales conditions

Open source software

- The DI5 software contains open source software and third party software under royalty-free licenses (“OSS”). The OSS scope that is used or is available at the time of market launch is in listed in an OSS appendix. If changes occur to the OSS scope over the service life of the product, the OSS system will be updated accordingly. A complete list of all the OSS used, depending on the development and production of the offered DI5, is available on request and will be delivered with the product as part of the Rexroth software package.
- The OSS included in the DI5 is subject to OSS license agreements (“OSS licenses”). Under these OSS licenses, Bosch Rexroth is obliged to pass on the conditions of these to you. You must comply with these terms and conditions and with the relevant obligations, unless you use the OSS in any manner other than simply installing it and allowing it to run internally on your machines, for example continuing to dispose of the product, for example by distributing it, selling it or otherwise transferring it to third parties. Should you distribute a copy of the product to third parties, the conditions granted under the OSS licenses applying to distribution shall apply (in some cases, the OSS license grants a direct license from the author/licensor of the OSS to the third party). Where there are numerous OSS licenses, Bosch Rexroth can neither grant you rights for these nor obtain such rights on your behalf. The applicable OSS licenses are available at the web address of the respective OSS provider or from Bosch Rexroth on request.
- The DI5 software contains open source software licensed under the LGPL-2.1 and GPL-2-0 (see folder / licenses in DI5 software package or license module for QT or CODESYS in DI5)

  NO WARRANTY
  BECAUSE THE LIBRARY/PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY/PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY/PROGRAM „AS IS“ WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY/PROGRAM IS WITH YOU. SHOULD THE LIBRARY/PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.
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- The source code version of some open source software is available under the terms of Mozilla Public License 1.0 (see folder / licenses in DI5 software package or license module for QT or CODESYS in DI5). To obtain it see Written Offer.
- You must, either expressly or in an implied manner, accept the applicable OSS licenses and take responsibility for complying with the applicable OSS licenses. You must also agree that updates or new versions of the software of product may contain different or additional OSS or changes to the OSS licenses. Bosch Rexroth will inform you of this fact at the time of delivery of updates, as well as of any additional or modified OSS licenses.
- The OSS itself has no effect on the retail price of the DI5 and is therefore made available free of charge.
- The sale of the DI5, unless otherwise agreed, does not include service or support by Bosch Rexroth with regard to the fulfilment of your obligations arising from the OSS licenses. Any such service or support provided by Bosch Rexroth shall require a separate agreement in which these services or support are specified and reasonable remuneration is paid for this purpose.

Codesys Runtime-System

- By acquiring the product the user for indefinite period receives a single and non-transferable right to use the delivered Codesys Software.
- The conditions are defined with the “License Agreement for the Usage of the PLC Development System CODESYS” released by 3S-Smart Software Solutions GmbH, 87439 Kempten, Germany.

Cryptocraphic Software

- This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit. (http://www.openssl.org/)
- This product includes cryptographic software written by Eric Young (eay@cryptsoft.com)

Export Restrictions

- You acknowledge that Software is subject to export restrictions of various countries.
- In addition, you agree that you will comply with all applicable international and national laws that apply to the software, including all applicable laws and regulations with respect to export restrictions.

Written Offer

- This product contains software components licensed by the right holders as Free Software respectively Open Source Software under one or more of the licenses mentioned below and thus require their source code to be made available. The source code of these software components is not being delivered altogether with the product. Instead, for the licenses listed below, Bosch Rexroth offers to provide the source code on request. Please send your query to obtain the source code via email to open.source@boschrexroth.de or via mail to the following address:
  Bosch Rexroth AG, Open Source Office, Zum Eisengießer 1,97816 Lohr am Main, Germany
- For those software components that are licensed under the GNU General Public License version 2 and/or 3, respectively the GNU Library General Public License version 2, and/or GNU Lesser General Public License version 2.1 and/or 3.0, Affero General Public License version 1,2 and/or 3, the 7-Zip License or eCos License 2.0 the following applies:
  - Everyone has the right to receive the corresponding source code of these software components from us.
  - This offer is valid for a time period of up to three years after the last assignment of the object code by Bosch Rexroth; notwithstanding the foregoing, in case of a licensing under the GNU General Public License version 3, the Affero General Public License version 3 or the GNU Lesser General Public License version 3.0 the offer remains valid as long as Bosch Rexroth offers spare parts or support for the product.
  - The corresponding source code will include, to the extent required by the applicable license, all the source code needed to generate, install and (if it is an executable work) run the object code and to modify the work.
  - Bosch Rexroth reserves the right to charge for performing the distribution of the corresponding source code the incidental costs of creating the data carrier (CD-ROM, DVD or USB memory stick) plus postage.
  - Please state where the corresponding source code shall be sent to. Additional information to the product (e.g., product identification, serial number) would help us to identify the corresponding source code.
- For those software components or corresponding source code that are either licensed under Mozilla Public License (MPL) version 1.0, 1.1 or 2.0, the Common Development and Distribution License (CDDL) version 1.0, Nokia Open Source License (Nokia or NOKOS) Version 1.0a, Common Public Attribution License v.1.0 or fall under the exception of the Modified GPLv2 FreeRTOS License (Exception), the following applies:
  - If you have received such software components from Bosch Rexroth, Bosch Rexroth will provide to you upon request the corresponding source code of the software component licensed under the terms of the applicable above-mentioned license either, depending on the volume, via email or file hosting service.
  - If Bosch Rexroth has modified preexisting source code, the corresponding source code of this modification will be provided (licensed under the terms of the applicable above-mentioned license) for at least 12 months after the first time it was made available to a third party, however at least 6 months after a subsequent version of the modification has been made available to a third party.
  - Please provide information to the product with which you have received the software components (e.g., product identification, serial number) in order to help us to identify the corresponding source code.

Safety instructions

General instructions

- Do not open the housing to avoid danger to high voltage. Before touching the electric assemblies make sure that the electricity is switched off completely. If the front panel is broken the device needs to be taken out of service due to risk of injury. If perceivable damages on the device exist that can compromise the functionality, it must be taken out of service due to the danger of malfunctions. These particularly include damages to the LCD display, damages to the keyboard, damages that compromise the protection level and damages to the encoder knobs.
- The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- Work on the PC with CODESYS development environment measuring adapter in connection with a control unit or display in a machine or a vehicle may only be performed during commissioning of the machine were during service work. Appropriate safety measures must be provided against hazards caused by unexpected operational states.
- Changing parameters or loading (flash-programming) software onto the BODAS display DI5 may only be performed by trained and experienced specialists who are suitably familiarized with both the components used and the complete system.
- When performing flash-programming, the user is responsible for ensuring that the software to be flash-programmed is compatible with the BODAS display hardware for the vehicle in question.
- The unexpected reset of the device could be caused by a watchdog failure. This safety mechanism can be caused by overload, malfunction of the device or undervoltage of the supply.
  The root cause needs to be determined and remedied before the device/ system is used again.
- Permanent high CAN bus load has to be avoided for consistent and reliable operation. A validation of the bus load should be determined in the overall system structure by the OEM.
- Faulty programming of the BODAS display DI5 may lead to dangers in the running operation of the machine. It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Bosch Rexroth shall assume no liability for dangers of this kind.
- Opening, modifying or repairing the BODAS display DI5 are prohibited. Modifications or repairs to the wiring could lead to dangerous malfunctions. Repair work on the BODAS display DI5 mailing be carried out by Bosch Rexroth or by suitable contracting partners.
- Make sure that the BODAS display DI5 configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- Ensure that the product has been tested by sufficient validation within the overall system, taking into account all possible combined ambient conditions and considering both normal use and misuse.
- When using cameras in conjunction with the BODAS display DI5, please note that the picture display can cause distortion, depending on the curvature of the camera lens (fish-eye effect). There may be decelerations in image response times when the processor workload is high. Take adequate account of these boundary conditions when planning and operating your system.
- Interference to the video picture may occur when operating the DI5 with NTSC cameras in rooms with 50 Hz lighting. This is not a device fault.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- While commissioning the BODAS display DI5 respectively during use of the DI5 Toolbox, the machine may pose unforeseen hazards.
  During system commissioning or during use of the offered DI5 Toolbox functionality, you must ensure that the vehicle and the hydraulic system are in a safe condition. Use of the function for flashing DI5 or RC-controllers is only allowed during machine stand-still and maintenance activities.
- Make sure that nobody is in the machine‘s danger zone.
- No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- No compressed air must be blown into the openings of the device (explosion risk).
- The back and the front glass of the display in particular may become hot during operation. There is a risk of burns.

- Noise hazards may occur through the integrated loudspeakers or with using the audio out signal, particularly at a short distance from the speaker. The overall system must be designed and verified to ensure that no health hazard is possible, even at the maximum level.
- The brightness of the status LEDs and the display brightness, must be so selected that no hazardous glare occurs. This can be done via manual level setting or by using the ambient light sensor. A time-delayed adjustment of the lighting level must be ensured when the ambient light sensor is used.
- The device must be taken out of service immediately if a smoke/vapor emission fault is observed.

Mounting and Handling

- Do not use the cable as a handle to carry the device.
- Mounting in clean working environment only.
- Do not mount the device under the use of violence because it can cause damage.
- The device must be mounted by trained personnel only into especially designed and tested system.
- The device may not be opened or disassembled.
- The device is to be cleaned with a moist fuzz free cotton cloth. If necessary, a mild cleaning agent may be used. Do not use acid or abrasive cleaning agents.
- The device is to be stored in a cool and dry environment and to be protected against sunshine.
- If the environmental temperature is beneath 10 °C the reaction time of the display increases.

Notes on the installation point and position

- Do not install the BODAS display DI5 in the vicinity of parts that generate considerable heat (e.g. the exhaust). Increased temperatures have a negative effect on the service life of the product.
- To avoid the risk of strokes of lightning do not mount the BODAS Display DI5 at exposed positions on the machine.
- Cables out of specification or too long cables can lead to improper stress on connections which can lead to failures. Ensure that connectors are securely latched in place and that the wiring and connectors are protected against moisture and water. For outdoor applications the main mating connector needs to have sealing plugs in unused pin locations and rear boot to prevent water ingression.
- All connectors must be unplugged from the electronics during electrical welding and painting operations.
- Cables/wires must be sealed individually to prevent water from entering the device.
- Standing and permanently running water are not permitted anywhere near the front glass, the button bar or the pressure compensation element (DAE). Remind that the device cannot be controlled and read while it is in frozen condition and that it needs to be de-iced by self-heating before being used.
- The mounting frame of the display should be well secured against loosening or untightening.
- The mounting frame does not secure completely against water ingression.The recess and the material arround need to be sufficiently stiff against deflection and must not increase vibrations.
- Attention should be paid to ergonomics requirements when positioning the display and configuring the display contents. It must be ensured that it is possible work in a fatigue-free way at all times. Direct sunlight may decrease the readability of the display. We recommend that you use a location without direct sunlight and display content with a contrast level that is sufficiently high.
- Ensure that the screw connections are tightened to the specified tightening torque and are protected against unexpected loosening. Ensure that the DI5 cannot drop suddenly when the RAM-Mount® clamping screws are loosened. Appropriate measures for this must be taken.

Notes on transport and storage

- If it is dropped, the BODAS display DI5 may not be used any longer as invisible damage can have a negative impact on reliability or function.
- Impacts with hard objects on the case or integrated front glass could cause the case or glass to break. In such cases, the BODAS display DI5 must be replaced without delay.
- Contamination of the BODAS display DI5 should be eliminated immediately to ensure correct function.
- Do not expose to extremely acidic or alkaline substances. Avoid prolonged contact with oils and grease.
- Only use clean water and a damp cloth to clean the front glass.
- When cleaning the BODAS display DI5, do not use any coarse or abrasive cleaning utensils.
- A sudden large increase in air pressure may cause the front glass to brake or lead to leaks. Suddenly large decrease in air pressure may cause an explosion. Take appropriate measures in these cases, for example when the device is being transported by air.

Notes on wiring and circuitry

- The BODAS display DI5 and the cameras must be powered from the same network. Powering the camera from a port on the display is recommended.
- To improve the EMC relevant behavior especially regarding radiation, it can be necessary to energize all wires with ferrite rings.
- Wires to cameras are recommended to be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- Electric supply for BODAS display DI5 and cameras is to be considered from the same source. Most optimal the cameras are powered by the DI5.
- Cables to the electronics must not be routed close to other power-conducting wires in the machine or vehicle.
- The wiring harness should be fixated mechanically in the area in which the BODAS display DI5 is installed (spacing < 150 mm). The wiring harness must be secured so that in-phase excitation with the display occurs (e.g. at the display bolting point).
- If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- Lines are to be routed with sufficient distance from hot or moving vehicle parts.

Intended use

- Operation of the BODAS display DI5 must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences. The specified limits must not have a permanent effect.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- Any use of the BODAS display DI5 other than that described in the chapter “Intended use” is considered to be improper.
- The BODAS display DI5 is not suitable for use in functions relevant to safety.
- The BODAS display DI5 are not allowed for functions that are used to control a machine movement.
- Make sure that the display configuration does not lead to safety-critical display failures or display malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- Use in explosive areas is not permissible.
- Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Disposal

- Disposal of the display and packaging must be in accordance with the national environmental regulations of the country in which the display is used.

More detailed information

- Important information on programming the DI5 (software relevant) can be found in the help file (part of the Bosch Rexroth software download package for DI5) and in the corresponding “readme”.
- Pay regular visits to our home page for the latest product information and information about updates.

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RE 95256/2023-11-28
Replaces: 2023-02-16

Control panel
CP2

- Control panel for Electrohydraulic Hitch Control EHC
- CAN-version

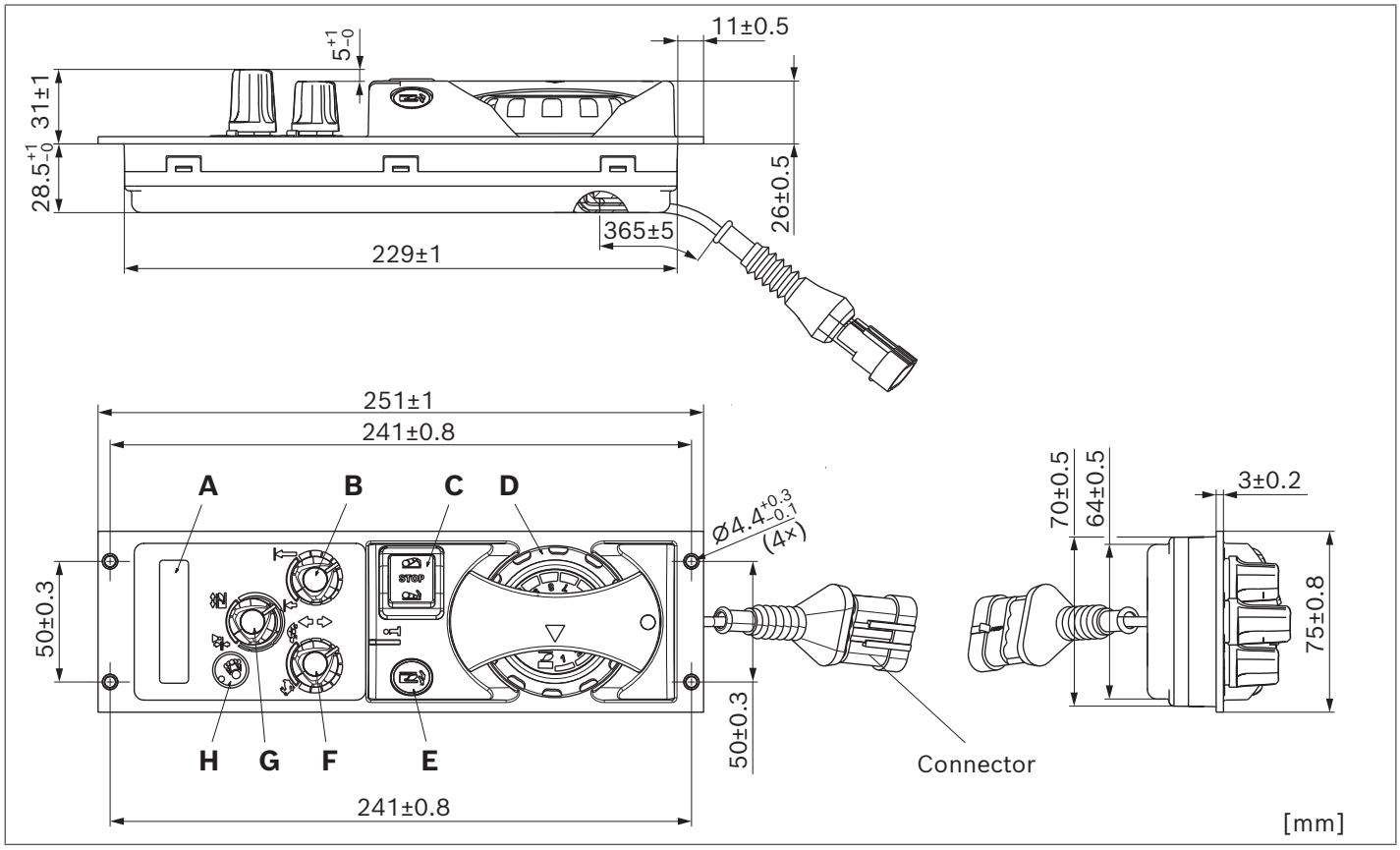
Technical data

Type	CP2
Ambient temperature range	–30 °C bis +85 °C
Supply voltage	12 V System according to ISO 16750-2 Code B
EMV	at 400 MHz to 1 GHz 200 V/m at 1 GHz to 4 GHz 100 V/m
Type of protection	IP6k7
Symbols	Illuminated
Electric connection	Tyco Superseal number 282106-1
CAN-load resistance (internal)	120 Ω
Weight	500 g
ROHS	EU-RoHS2-compliant
CE	ISO 14982:2009
Storage time	5 years at an average relative humidity of 60 % and a temperature between -10 °C and +30 °C. For short periods of time, a storage temperature of -20 °C to +40 °C is permissible for up to 100 hours.

Available variants

Type	Material number
CP2	R983077790

Dimensions

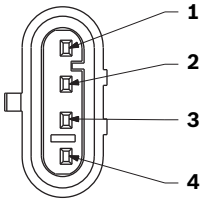


Control elements

	Description
A	LCD Display, 16×2 character
B	Height control knob
C	Transport/stop/control switch, on-off-on
D	Draft control knob
E	Fast sink switch, momentary
F	Speed control knob
G	Mix control knob
H	Damp control switch (transport mode)

Pin assignment

Pin	Functions
1	Supply
2	CAN Low
3	CAN High
4	Ground



Mating connector

(Material number R917011205)

Wiring harness connector, comprising:

Designation	Material number
Connector housing	282088-1
Contacts for 0.75 mm^2 to 1.5 mm^2	183025-1
Individual sealing for 0.75 mm^2 to 1.5 mm^2	281934-2
Protective cap	493581-1

Safety-related characteristics in accordance with ISO 25119

CP2 has following safety functions:

- Safety function 1 (SF1):
  correct recognition, processing of the standstill demand and sending the corresponding CAN messages without failure.
- Safety function 2 (SF2):
  correct recognition, processing of the direction demand and sending the corresponding CAN messages without failures.
- Safety function 3 (SF3):
  correct recognition, processing of the speed demand and sending the corresponding CAN messages without failure.

- The CP2 possesses a single channel architecture with external watchdog
- The CP2 fulfills the requirements of basic and well-tried safety principles
- The CP2 software fulfills the requirements of Software Requirement Level 1 (SRL 1)

$MTTF_D$ and Diagnostic Coverage (DC) of each safety function for different temperature profiles

			SF1		SF2		SF3	
Temperature Profile	**Operating time [%]**	**Temperature [°C]**	**$MTTF_D$ [years]**	**DC[1)] [%]**	**$MTTF_D$ [years]**	**DC[1)] [%]**	**$MTTF_D$ [years]**	**DC[1)] [%]**
Temperature Profile 1	5	10	746	14	810	16	1432	28
	10	30						
	50	40						
	30	50						
	5	60						
Temperature Profile 2	100	60	507	17	538	18	938	31
Temperature Profile 3	100	85	258	21	267	22	428	36

Failure detection possibilities

Diagnostic method	Failure reaction	Failure response time
Temporal monitoring of the program execution via external watchdog	µC reset, no sending of CAN messages	20 ms
Detection of open circuit, short circuit to GND, short circuit to power of the potentiometers and switches	No failure detection possible	–
Over-voltage detection of the power supply	µC reset, no sending of CAN messages	20 ms
Under-voltage detection of the power supply	µC reset, no sending of CAN messages	20 ms
µC internal failures detection	µC reset, no sending of CAN messages:	Instantaneous

1) It is assumed that the machine control unit will monitor the CAN messages and react to failure message and loss of CAN messages by bring the system into a safe state.

Safety instructions

General instructions

- The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- It is not permissible to open the control panel or to modify or repair the control panel. Modifications or repairs to the wiring could result in dangerous malfunctions. Repairs on the control panel may only be performed by Bosch Rexroth or by an authorized partner.
- System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- While commissioning and maintenance the control panel, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- Make sure that nobody is in the machine's danger zone.
- No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- Mobile phones or other wireless devices in the vicinity of the control unit can impair the function of the control unit. Connection to an external antenna will remedy the situation.

Notes on the installation location and position

- Do not install the control panel close to parts that generate considerable heat (e.g. exhaust).
- A sufficient distance to radio systems and mobile phones must be maintained to ensure proper functionality.
- All connectors must be unplugged from the electronics during electrical welding and painting operations.
- Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- If it is dropped, the control panel must not be used any longer as invisible damage could have a negative impact on reliability.
- When cleaning the control panel, do not use any coarse or abrasive cleaning utensils.

Notes on wiring and circuitry

- The control panel may only be wired when it is de-energized.
- Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- The wiring harness should be fixated mechanically in the area in which the control panel is installed (spacing <100 mm). The wiring harness should be fixated so that in-phase excitation with the control panel occurs (e.g. at the control panel mounting points).
- If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharpedged ducts without protection.
- Lines are to be routed with sufficient distance from hot or moving vehicle parts.

Intended use

- The control panel is only intended for use in tractors featuring hitch control with Rexroth controller and with EHC software installed.
- Operation of the control panel must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- Any use of the control panel other than that described in chapter "Intended use" is considered to be improper.
- The control panel is not suitable for use in safety-related functions.
- Use in explosive areas is not permissible.
- Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- The customer is responsible for performing a risk analysis of the machine and determining the possible machine safety functions.
- It is customer’s responsibility to evaluate the complete safety-related system and to determine the suitability of CP2 for any machine safety functions.
  - CP2 as a single component fulfills the requirements of ISO 25119:2018 AgPL a, restricted by the limited failure detection availabilities. However, if used as part of a Category 2 machine safety-related system, it can support a safety level up to AgPL c (e.g. a higher system level DC is reached via the rest of the safety-related system).
  - CP2 failure responses are listed in the table “failure detection possibilities”. It shall not be used if the failure responses including the failure response time is determined to be insufficient for the machine safety functions.
- The machine control system shall monitor the CAN messages and react to failure messages and loss of messages by bring the machine into a safe state.
- An efficient field observation process shall be established by the customer. Any field failures involving the CP2 should be immediately notified to Bosch Rexroth, even if it is not covered by warranty.

Disposal

- Disposal of the control panel and packaging must be in accordance with the national environmental regulations of the country in which the control panel is used.

Further information

- Further information about the control panel can be found at www.boschrexroth.com/mobile-electronics.

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Accumulator charging valve

Type LT 06

RE 66191
Edition: 08.2012
Replaces: 10.2011

- Component series 3X
- Maximum system pressure 200 bar
- Approx. 4 bar Δp with a flow of 70 l/min

Features

- Simple and quick installation
- Reduced piping effort
- Small installation dimensions
- Integration into existing hydraulic systems is possible
- Quickly ready-for-operation
- Flexible connection possibilities of accumulators
- Connection possibilities for downstream consumers

Contents

Ordering code

01	02		03	04		05		06	07		08	09	10
LT	**06**	**–**	**A**	**06**	**–**	**3X**	**/**			**/**	**02**	**M**	*****

01 to 04	This information is used only for internal purposes and is always identical.	

Component series

05	30 to 39 (unchanged installation and connection dimensions)	**3X**

Pressure stage of the accumulator circuit

06	100 bar	**100**
	150 bar	**150**
	185 bar	**185**
	200 bar	**200**

Accumulator charging flow

07	ca. 6 l/min	**B18**
	ca. 17 l/min (Standard)	**B40**

Line connections

08	Metric threads according to DIN 3852-1 (see table on page 6)	**02**

Seal material

09	NBR seals, suitable for mineral oil (HL, HLP) according to DIN 51524	**M**[1)]

10	Further details in clear text	

Preferred standard types

Pressure stage [bar]	**LT 06 B18** **Part no.**	**LT 06 B40** **Part no.**
100	R900549834	R900427588
150	R900455464	R900427591
200	R900586937	R900427595

1) Observe sealing compatibility of the hydraulic fluid used!

Technical data

(For applications outside these parameters, please consult us!)

General			
Weight		kg	Approx. 3
Installation position			Upright preferred, pressure adjustment element face upwards
Type of connection			Metric threats according to DIN 3852-1
Ambient temperature range	θ	°C	–25 to +80
Priming			Single coat RAL 5010

Hydraulic			
Maximum system pressure in the accumulator circuit		bar	200
Maximum inlet pressure at port	– P	bar	200
Maximum tank pressure at port	– T	bar	Zero pressure to tank
Maximum flow (at ca. 4 bar Δp)	– Accumulator charging flow P → S	l/min	ca. 17 (Standard = **B40**)
	– Pump flow P → N	l/min	70
Hydraulic fluid			Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568 as well as hydraulic fluids as specified in the data sheet 90221, on inquiry.
Hydraulic fluid temperature range	θ	°C	–20 to +80
Viscosity range	ν	mm²/s	2.8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

Function

Accumulator charging valves or pressure shut-off valves assume the function of keeping a pressure level in an accumulator circuit within certain limit values (cut-in pressure, cut-out pressure). The switching pressure differential is approx. 18 % of the cut-off pressure.

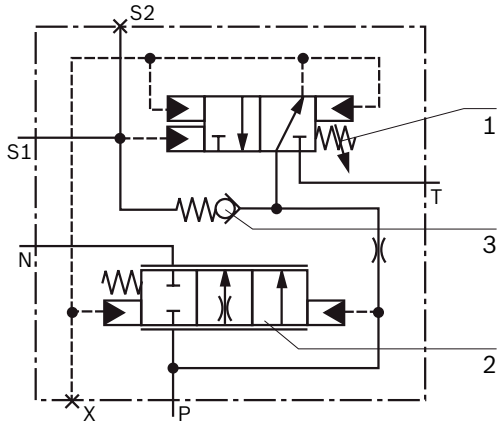
Caution!
If downstream consumers (**N**) generate a higher pressure than the cut-off pressure of the accumulator charging valve, the pressure of the accumulator circuit is raised to this level. The pressure of the downstream consumers (**N**) must be 30 % lower than the accumulator pressure (N < Accumulator pressure –30 %).

The valve basically consists of a pilot control with pressure adjustment element (**1**), pressure compensator (**2**) and check valve(**3**).

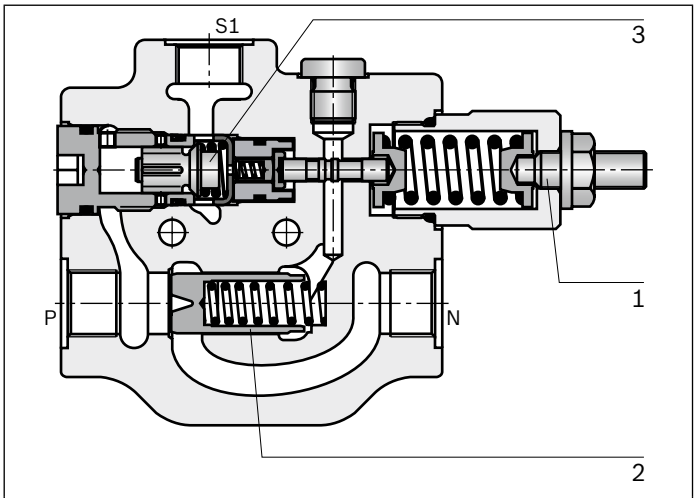
Changing the pump flow over from accumulator charging to neutral circulation
During the charging process, the pump feeds oil via the check valve (**3**) into the accumulator circuit. To this end, the pressure is directed via the pilot line and pilot control to the load signal side of the pressure compensator (**2**). This pressure compensator throttles the pump flow until the pressure that builds up in the accumulator circuit overcomes the spring force of the pressure adjustment element (**1**).
The pilot control element reconnects the load signal line of the pressure compensator (**2**) from **S1** to **T**. The pressure compensator (**2**) then re-directs the pump flow from **P** to **N** and the check valve (**3**) closes. The charging process is completed and the pump flow flows with a low Δp through the charging valve.

Changing the pump flow over from neutral circulation to accumulator charging
When the pressure in the accumulator circuit falls below the lower switching point (cut-in point), **P** is connected to the load signal chamber of the pressure compensator (**2**) and the pump flow is directed again into the accumulator circuit.

Symbol, cross-section



Legend	
P	Pump
T	Tank
S1	Accumulator circuit 1
S2	Accumulator circuit 2
X	Load Sensing (LS)
N	Downstream consumers



1 Pressure adjustment element (factory setting)
2 Pressure compensator
3 Check valve

General notes

Installation notes

- Observe the minimum distance of 30 cm to the valve while cleaning with a high-pressure cleaner.
- The cross-sections of hydraulic transmission elements (pipes, hoses) must be selected so that at low operating temperatures the pressure drop between hydraulic accumulator and brake cylinder remains low.
- Port **T** must be connected separately at zero pressure to tank.
- Ensure that the brake system is always vented.
- Protect the pressure compensator from falling down while removing the plug from port **P**.

Notes for the repair

- Damaged valves must be repaired, even if their function is not impaired.

Intended use

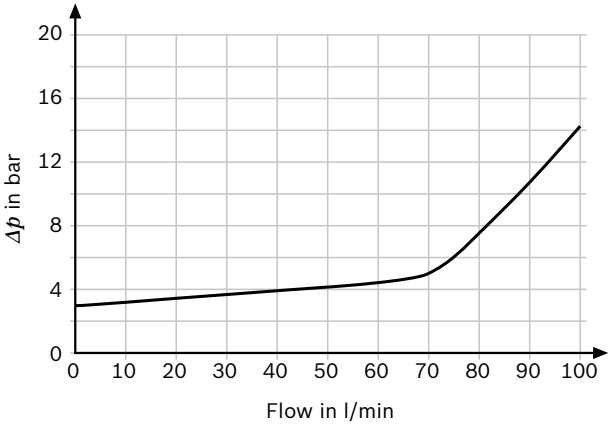
Accumulator charging valves LT 06 are hydraulic components and are therefore either covered by the cope of the completely or the partly completed machinery in the sense of the EC machinery directive 2006/42/EC. The component is exclusively intended to be assembled together with other components to form partly completed or complete machinery. The component may only be commissioned if it has been integrated in the machine for which it is designed.

You may use the product as follows:

- Accumulator charging valves LT 06 have been developed for the application in mobile working machinery.
- Comply with the technical data.
- The product is only intended for professional use and not for private use.

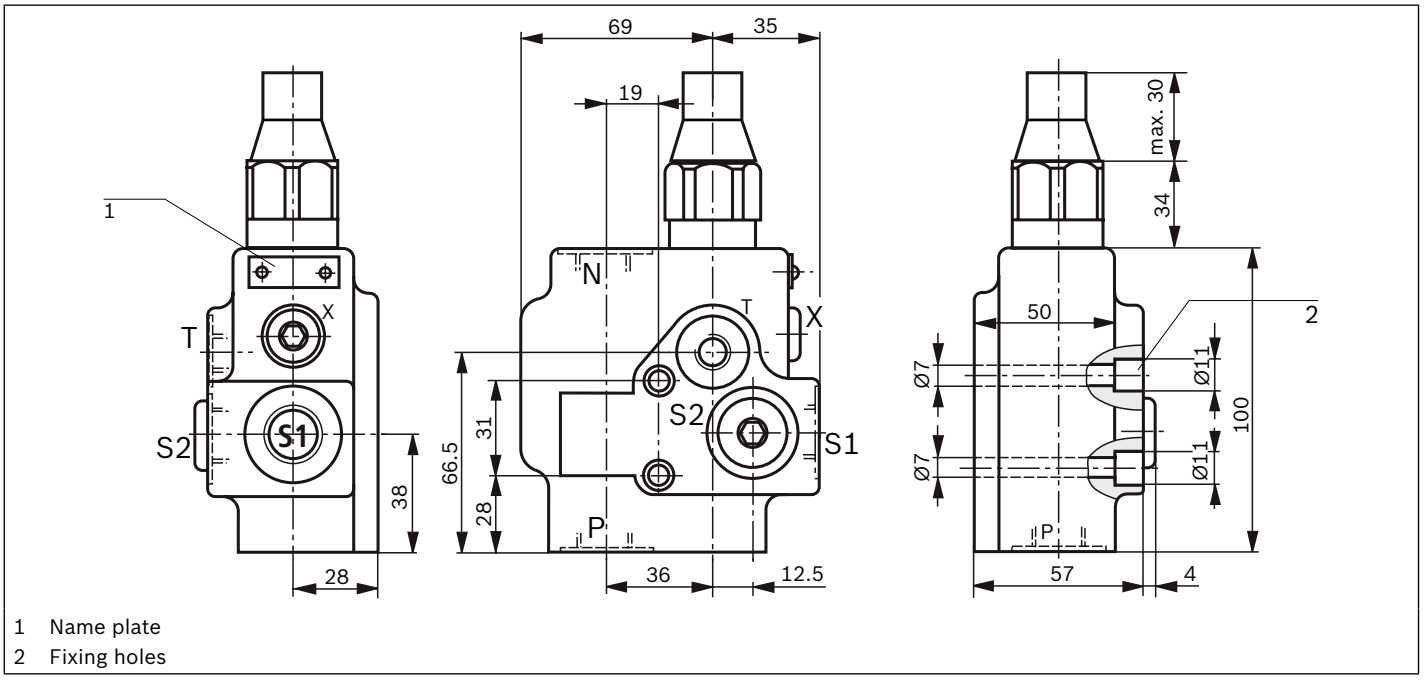
Characteristic curve

Pressure loss Δp from P → N



Dimensions

Dimensions in mm

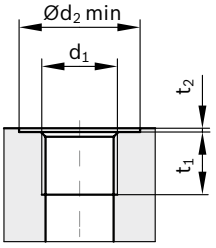


1 Name plate
2 Fixing holes

Ports according to DIN 3852-1

Port	d_1	Ød_2	t_1	t_2
P, N	M18 x 1.5	32	12	1
S1, S2	M18 x 1.5	32	12	1
T, X	M12 x 1.5	19	12	1

Ports **S2** and **X** plugged by default.



Spare parts

Spare part	Part no.
Protective cap (Color code orange) for pressure adjustment element	R900025379

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Dual-circuit power brake valve LT 08

RE 66148
Edition: 05.2015
Replaces: 07.2009

HAD 6881

- Series 2X
- Parking brake pressure 25, 40, 60, 80, 100 and 125 bar
- Maximum inlet pressure 200 bar
- For modular designs

Features

- A direct-operated pressure reducing valve in 3-way design with hand lever actuation
- For use in spring loaded brake systems
- Integrated maximum pressure limitation of the parking brake pressure
- Good fine control

Fields of application

- Construction machines
- Material handling vehicles
- Forestry and agricultural machinery
- Specialized vehicles

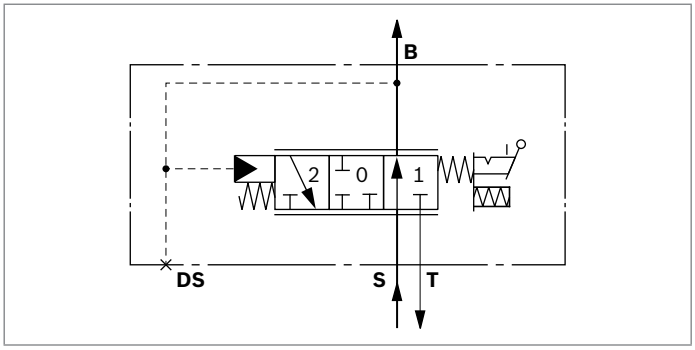
Contents

Function

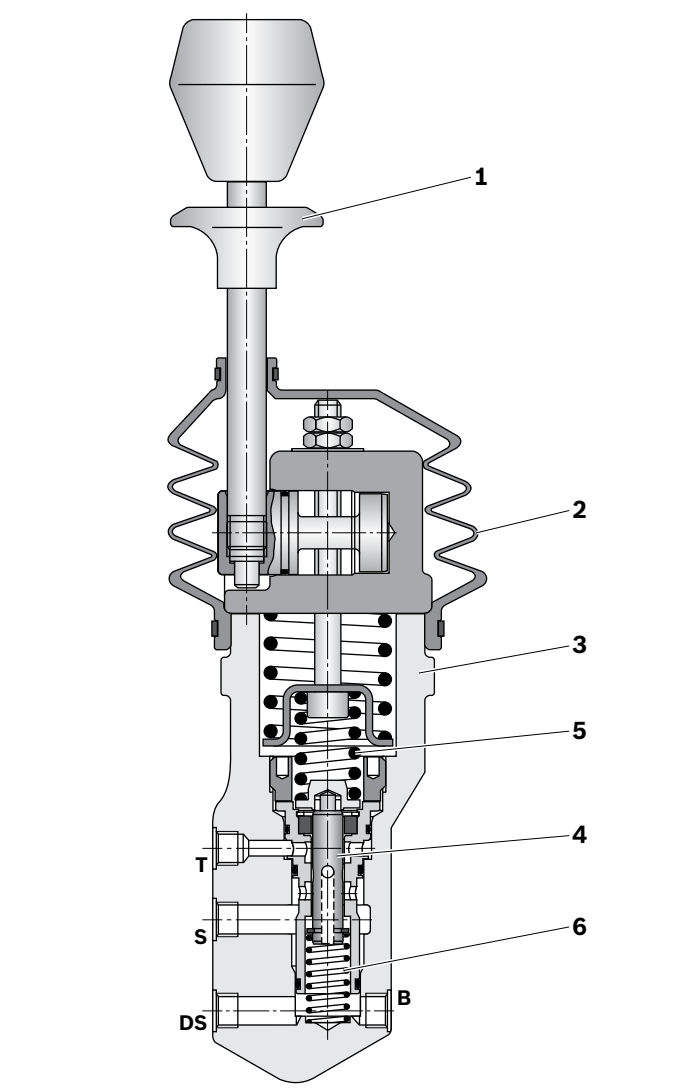
The hand brake valve LT 08 is a direct-operated pressure reducing valve in 3-way design. It is designed for use in spring loaded brake systems; other applications, however are also possible.
In position 1 (see dimensions) of the hand lever the flow from **S** to **B** is open. The spring loaded brake system is, therefore opened with the pressure applied in **B**. In this position the maximum defined pressure in **B** is limited according to type of the valve 25, 40, 60, 100 or 125 bar independent of the pressure at input **S**.
By moving the hand lever into the detent position 2, the pressure from **B** to **T** is decreased directly proportional to the travel of the lever and the operating speed. The pressure at port **B** can be finely controlled with hand lever. The spring loaded brake system is activated.
The hand lever is released by lightly lifting the release ring (**1**).

Ports	
S	Inlet
B	Parking brake
T	Tank
DS	Pressure switch (optional)

▼ **Symbol LT 08**



▼ **Cross section LT 08**



1 Release ring
2 Bellow
3 Housing
4 Control spool
5 Main regulator spring
6 Return spring

Technical data

General				
Weight			kg	3.2
Installation position				Preferably standing
Connection type				Metric threads according to DIN 3852-1
Ambient temperature range		θ	°C	–25 to +80
Priming				One-coat paint RAL 5010

Hydraulic				
Maximum parking brake pressure at port	B	p	bar	125
Maximum inlet pressure at port	S	p	bar	200
Maximum tank pressure at port	T	p	bar	0.5 (The tank pressure must not exceed the contact pressure of the brake. Tank pressure peaks due to flow operations are permitted.)
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, e.g. HEES (Synthetic ester) according to VDMA 24568 and hydraulic fluids as specified in data sheet 90221, on request
Hydraulic fluid temperature range		θ	°C	–20 to +80
Viscosity range		ν	mm²/s	2.8 to 380
Maximum admissible degree of contamination of the hydraulic fluid, Cleanliness level according to ISO 4406 (c)				Class 20/18/15, we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

Note
Please contact us if the unit is to be used outside the specified range of values.

Ordering code

01	02			03		04		05	06	11
LT 08	**MM**	**A**	**–**	**2X**	**/**		**/**	**02**	**M**	*****

Series

01	Hand brake valve LT 08	**LT 08**

Type of actuation

02	Mechanical with hand lever	**MM**

Series

03	20 to 29 (unchanged installation and connection dimensions)	**2X**

Parking brake pressure

04	25 bar	**025**
	40 bar	**040**
	60 bar	**060**
	80 bar	**080**
	100 bar	**100**
	125 bar	**125**

Line connections

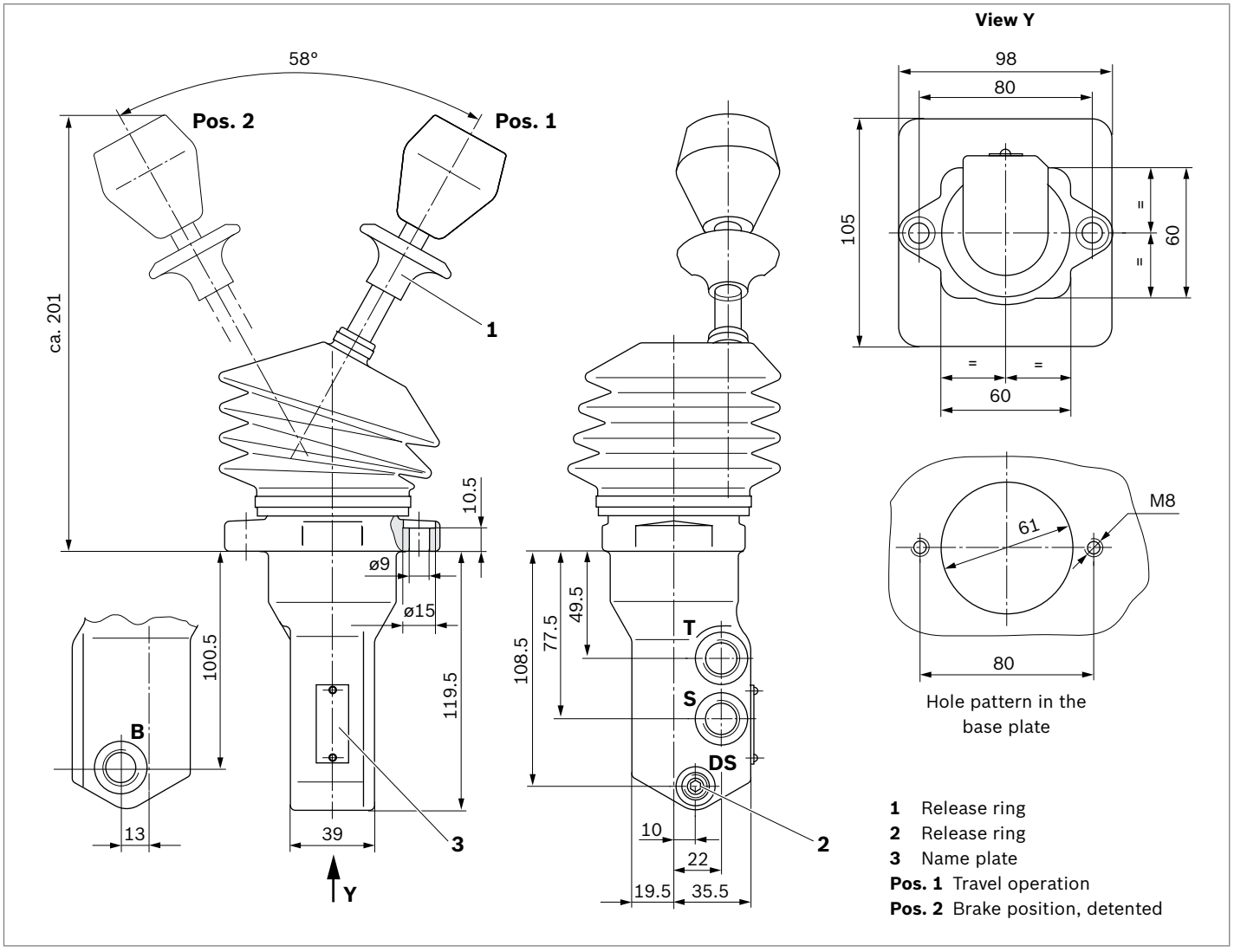
05	Metric threads according to DIN 3852-1 (see table on page 5)	**02**

Sealing material

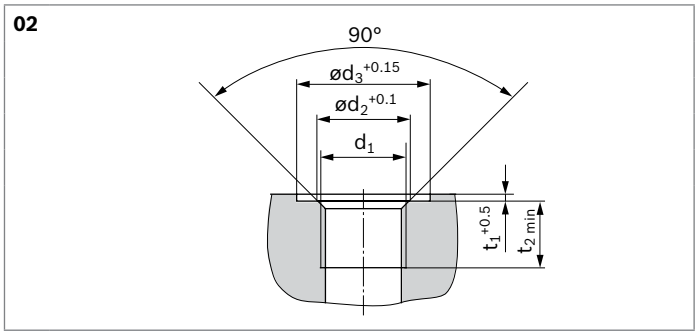
06	NBR (nitrile rubber)	**M**

07	Further specifications in plain text	*****

Dimensions



▼ **Metric threads according to DIN 3852-1**



Port	d_1	Ød_2	Ød_3	t_1	t_2
S	M16 × 1.5	16.4	24.3	1	12
B	M16 × 1.5	16.4	24.3	1	12
T	M16 × 1.5	16.4	24.3	1	12
DS	M12 × 1.5	12.4	18	1	12

Port **DS** is usually closed.

Related documents

The hand brake valves LT 08 are hydraulic components in the power brake systems of mobile machines.
Observe the instructions for the other system components.
Only commission the product if the following documentation is available to you and you have understood and observed it.

Title	Document number	Document type
Hydraulic power brake valves for mobile applications	66200-B	Instruction manual
System documentation from the machine manufacturer		Instruction manual

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RE 66143/2023-03-20
Replaces: 09.2013

rexroth
A Bosch Company

Single-circuit power brake valve LT05

HAD 6749

- Directly actuated pressure reducing valve in 3-way design with continuous mechanical actuation
- Series 3X
- Service brake pressure 25 to 160 bar
- Maximum inlet pressure 200 bar
- For modular design

Features

- Brake pressure, proportional to the actuation force
- Maximum pressure limitation of the brake circuit
- Ergonomic adjustment of the pedal's angle of attack possible
- All pedal versions are equipped with a slip resistant, removable pedal rubber pad
- Small installation dimensions

Fields of application

- Construction machinery
- Material handling vehicles
- Forestry and agricultural machinery
- Municipal vehicles
- Special vehicles

Contents

Type code

01	02		03		04	05		06	07	08	09	10	11	12
LT05		**–**	**3X**	**/**			**/**	**02**	**M**					

Series

01	Single-circuit power brake valve LT05	**LT05**

Type of actuation

02	Mechanical (up to 100 bar BBA)	**MKA**
	Mechanical, reduced actuating force (from 100 bar BBA)	**MRA**
	Mechanical, with sensor (up to 100 bar BBA)	**MKS**
	Mechanical, with sensor, reduced actuating force (from 100 bar BBA)	**MRS**

Series

03	30 to 39 (unchanged installation and connection dimensions)	**3X**

Characteristic curve

04	Linear	**L**
	Progressive	**P**

Nominal pressure (service brake pressure BBA)

05	25 to 160 bar, indicating 3 digits, e.g. 60 bar = **060**	**...**

Line connections (see page 8)

06	Metric ISO thread according to DIN 3852-1	**02**
	UNF thread according to ISO 11926-1	**19**
	Thread according to ISO 6149-1 (with O-ring sealing)	**50**

Sealing material

07	NBR (nitrile rubber)	**M**

Other (optional)

08	LT19 standard version	**12**
	LT19 special version with shortened pedal plate	**37**

Electric angle sensor (information only for MKS and MRS)

09	Sensor, left in direction of travel		**SL**
	Sensor, right in direction of travel		**SR**
	Sensor on both sides		**RL**
10	Supply voltage	Battery voltage	**1**
		5 VCC ±0.2 V	**2**
11	Actuating force at the pedal	Force feedback	**FB**

Other (optional)

12	Pin for double pedal connection	**DP**
	Detent hook	**DH**

1) Other pressure stages upon request

Functional description

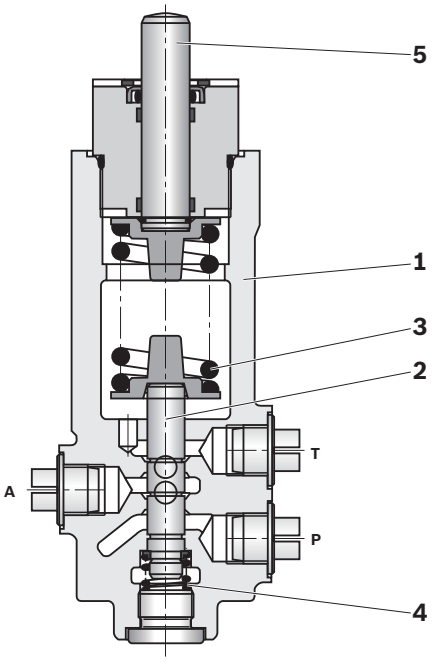
The single-circuit power brake valve LT05 is a directly actuated pressure reducing valve in 3-way design with continuous mechanical operation.
It comprises a maximum pressure limitation of the secondary circuit and a continuous dosing capability of the brake pressure, proportional to the travel of the actuation element (**5**) or to the pedal actuation angle. Here, the actuating force is also proportional to the path of actuation.
The single-circuit power brake valve mainly consists of housing (**1**) and control spool (**2**), main control spring (**3**), actuation element (**5**) and return spring (**4**). The valve is actuated via the actuation element (**5**). This presses the main control spring (**3**) against the control spool (**2**).
First, the control edges close at the channel **T**, then the control edges open from **P** to **A** and the pressure builds up in the brake circuit.
The pressure which now builds up in the brake line also acts simultaneously via the brake pressure feedback behind the control spool (**2**) of the main control spring (**3**) so that the brake pressure (secondary pressure) increases proportionally to the deflection of the actuation element (**5**).
When the deflection of the actuation element (**5**) is kept constant, the control spool (**2**) moves into the control position and keeps the brake pressure constant.
When the main control spring (**3**) is unloaded, the return spring (**4**) moves the control spool (**2**) back into the basic position. The control edges close from **P** to **A** and open from **A** to **T**. The secondary circuit (brake circuit) is thereby released.

Version with angle sensor

During the first degrees of actuation of the pedal, only the electrical signal of the angle sensor is output. Hereby, for example, the hydrostatic travel drive can be reversed (drive pump swivels back).
Upon further actuation of the pedal, the hydraulic brake pressure is built up. See characteristic curve on page 4

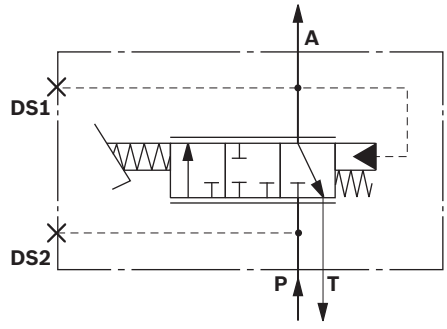
Notice
For version with angle sensor, cabin installation is mandatory for the sensor assembly.
For further information on the angle sensor, see data sheet 66238.

▼ **Section LT05**



1	Housing	**4**	Return spring
2	Control spool	**5**	Actuation element
3	Main control spring		

▼ **Symbol LT05**



Ports	
A	Service brake
P	Service brake supply
T	Tank
DS1	Pressure switch (braking light)
DS2	Pressure switch (accumulator pressure)

Technical data

General				
Weight	Without pedal		kg	2.7
	With standard pedal		kg	4.4
Installation position				Preferably vertical
Connection type				See page 8
Ambient temperature range		ϑ	°C	–25 ... +80
Priming				Single-layer coating RAL 5010

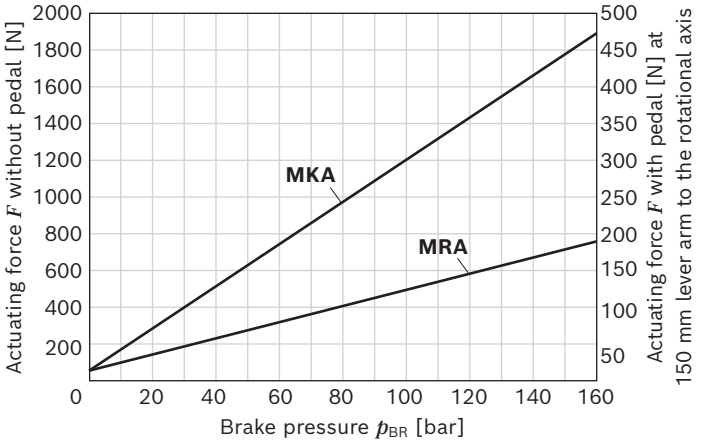
Hydraulic	Port			
Maximum nominal pressure	**A**	p_{BR}	bar	160
Maximum inlet pressure	**P**	p	bar	200
Maximum tank pressure	**T**	p	bar	0.5 (The tank pressure must not exceed the application pressure of the brake. Tank pressure peaks due to flow processes are admissible.)
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to ISO 15380, as well as hydraulic fluids as specified in data sheet 90221, upon request
Hydraulic fluid temperature range		ϑ	°C	–20 ... +80
Viscosity range		ν	mm²/s	2.8 ... 380
Maximum admissible degree of contamination of the hydraulic fluid Cleanliness level according to ISO 4406 (c)				Level 20/18/15, for this, we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

Notice

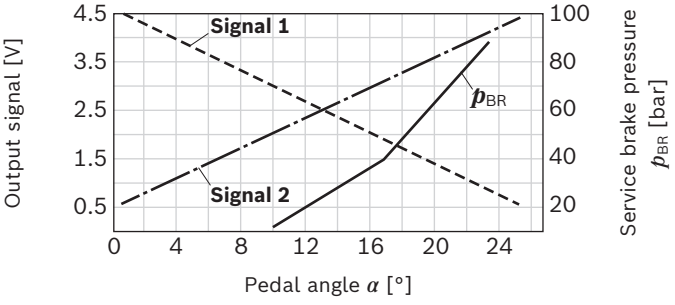
- For applications outside these parameters, please consult us!
- The electric data for the angle sensor can be found in the data sheet 66238.

Theoretical characteristic curves

▼ **Type of actuation: mechanical**

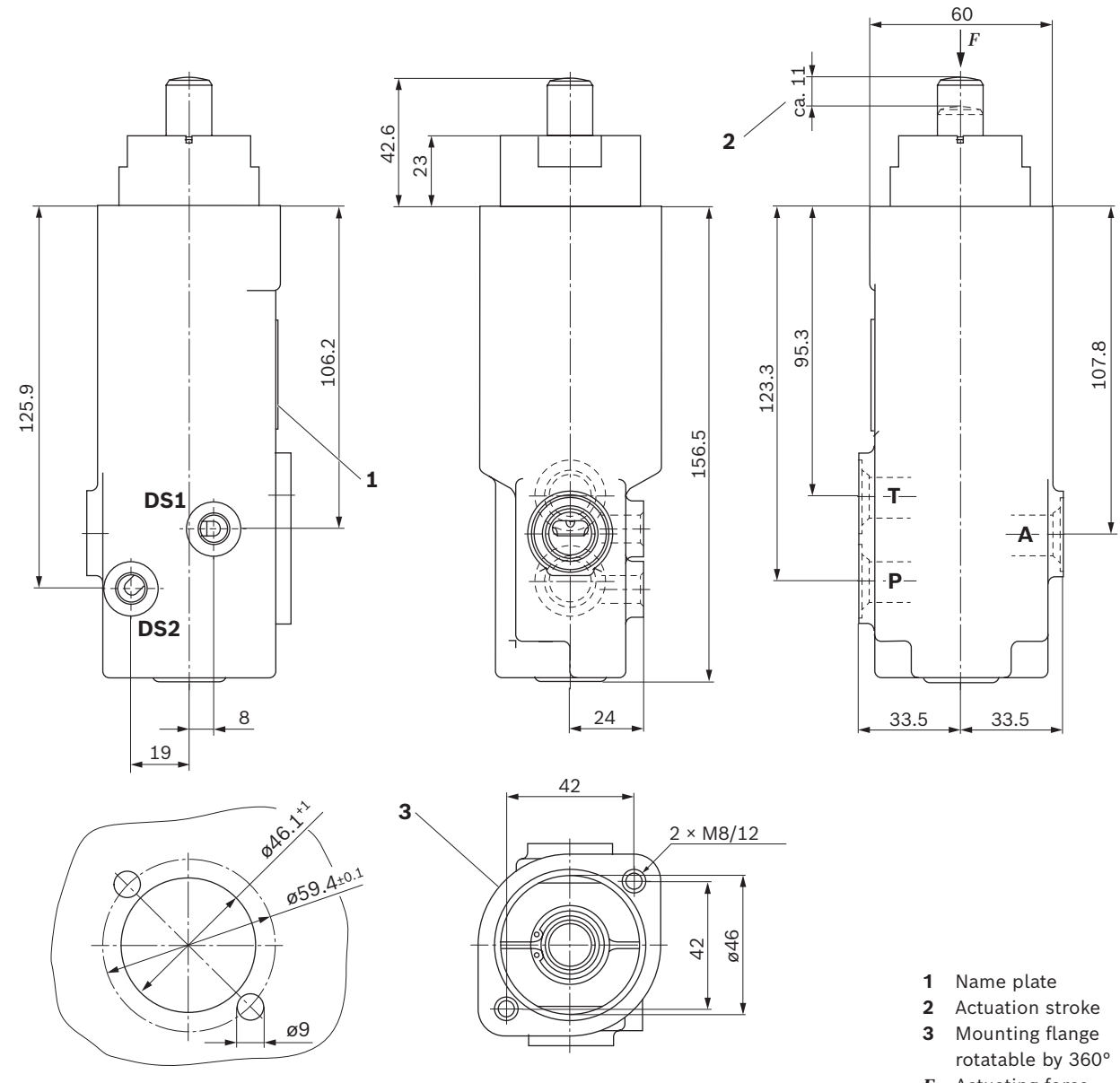


▼ **Brake pressure and angle sensor voltage signal**



Dimensions

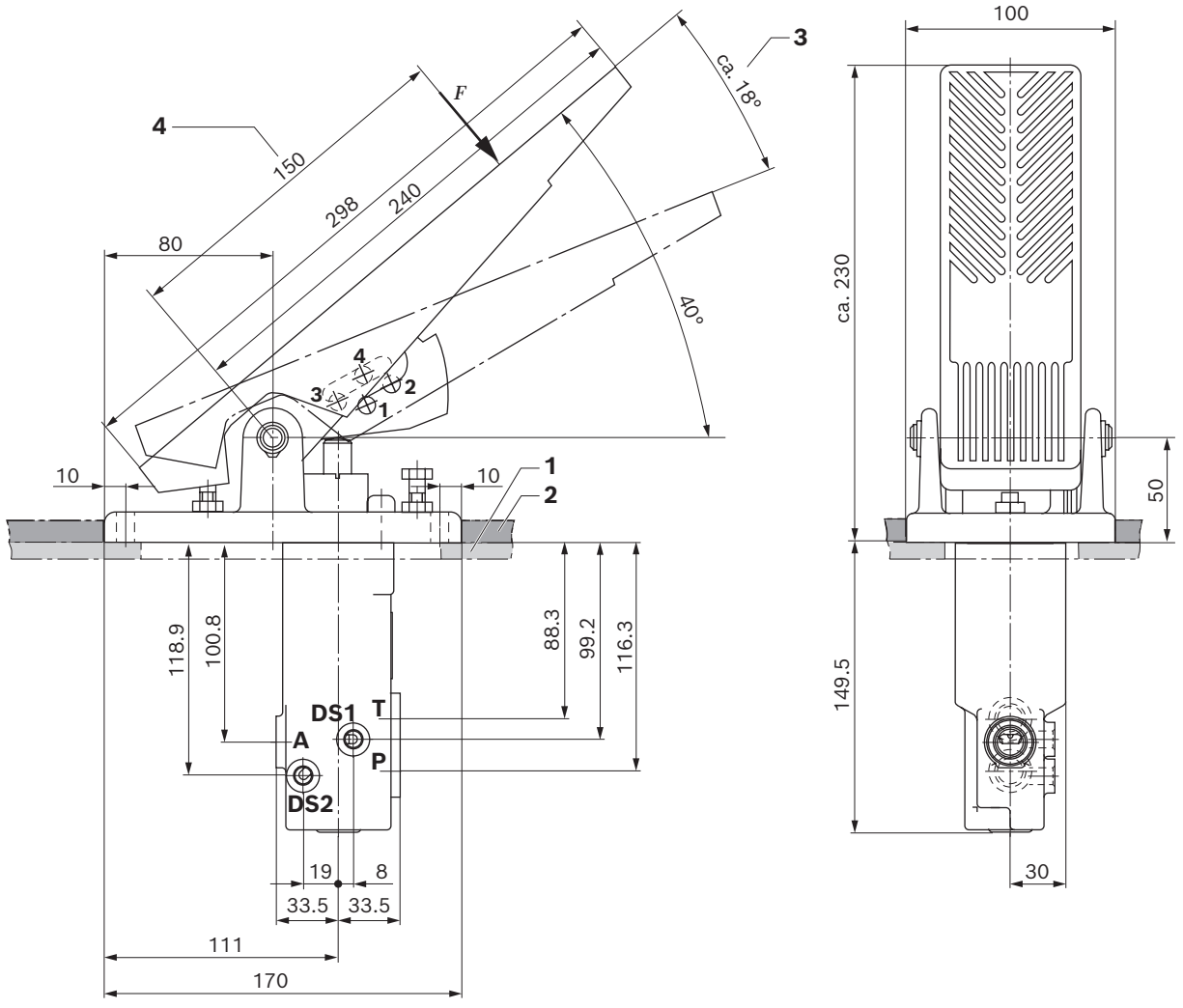
▼ **LT05 without pedal**

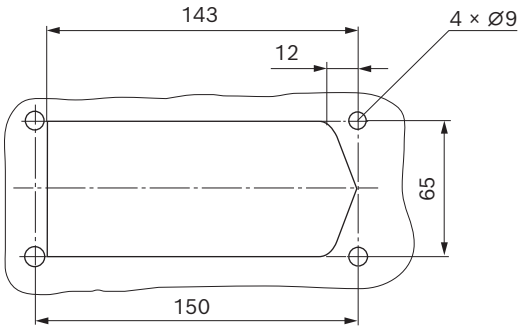


Proposal for hole pattern in the base plate

1 Name plate
2 Actuation stroke
3 Mounting flange rotatable by 360°
F Actuating force

▼ **LT05 with fitted standard pedal LT19**

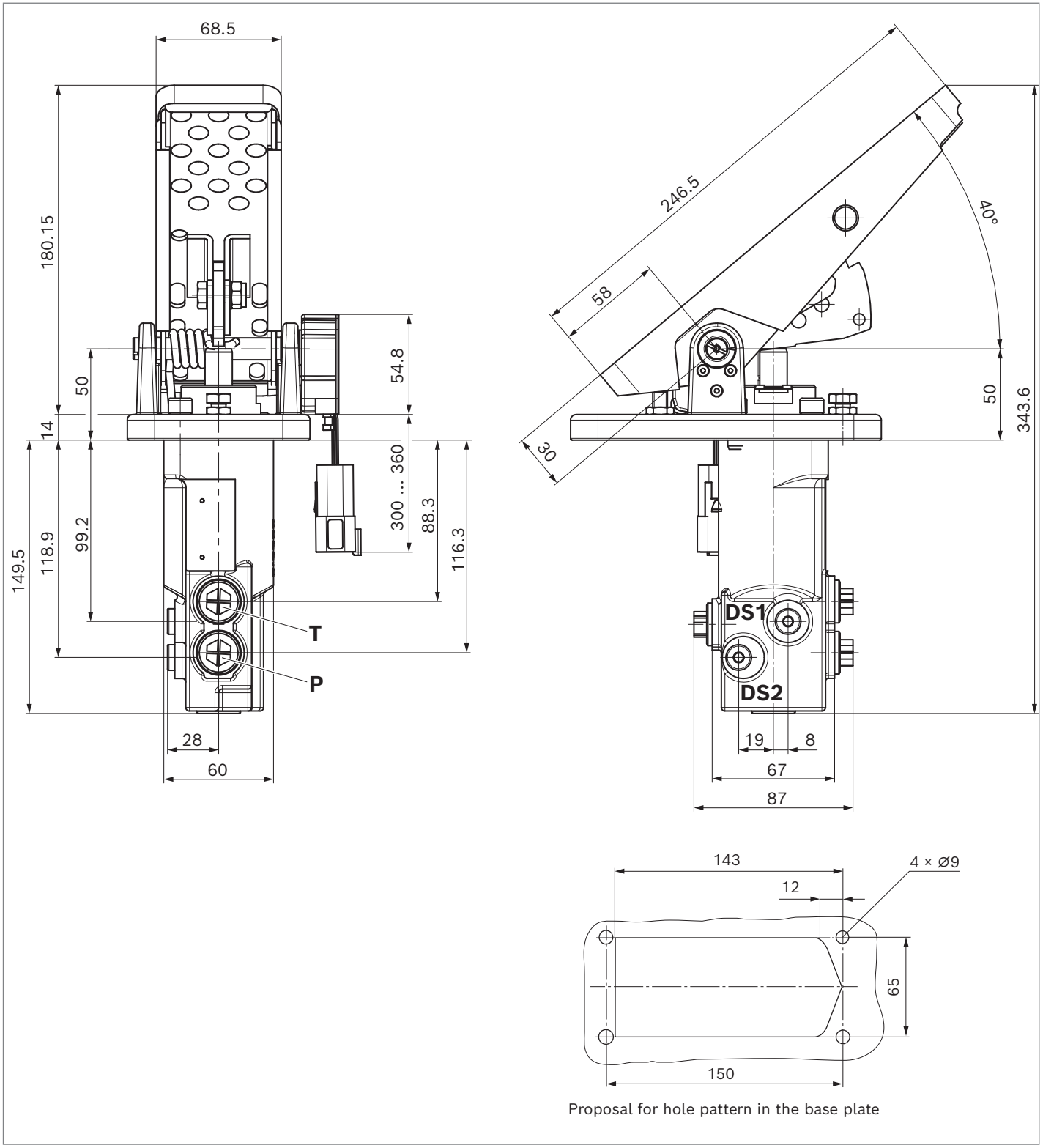




Proposal for hole pattern in the base plate

1 Base plate
2 Rubber mat
3 Actuation angle
4 Lever arm
F Actuating force

▼ **LT05 with fitted pedal LT19 with shortened pedal plate and angle sensor**

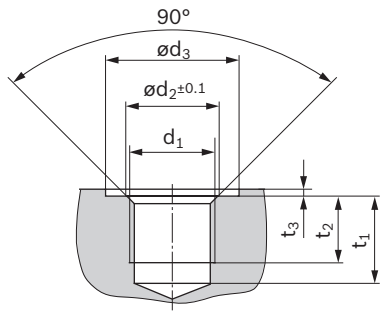


Proposal for hole pattern in the base plate

Line connections

▼ Metric thread according to DIN 3852-1

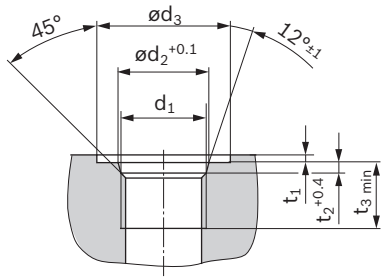
02



Port	d_1	Ød_2	Ød_3	t_1	t_2	t_3
P	M16 × 1.5	16.4	23	17.5	13	1
T	M16 × 1.5	16.4	23	17.5	13	1
A	M16 × 1.5	16.4	23	17.5	13	1
DS1	M10 × 1	10.4	16	15	9	–
DS2	M10 × 1	10.4	16	15	9	–

▼ UNF thread according to ISO 11926

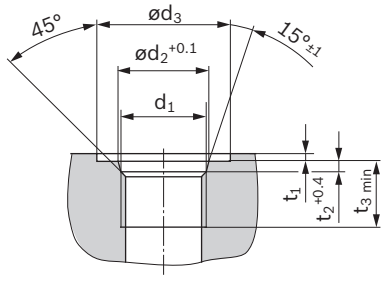
19



Port	d_1	Ød_2	Ød_3	t_1	t_2	t_3
P	9/16-18	15.6	25	1.5	2.5	13
T	9/16-18	15.6	25	1.5	2.5	13
A	9/16-18	15.6	25	1.5	2.5	13
DS1	7/16-20	12.4	21	1.5	2.4	11.5
DS2	7/16-20	12.4	21	1.5	2.4	11.5

▼ Thread according to ISO 6149-1

50



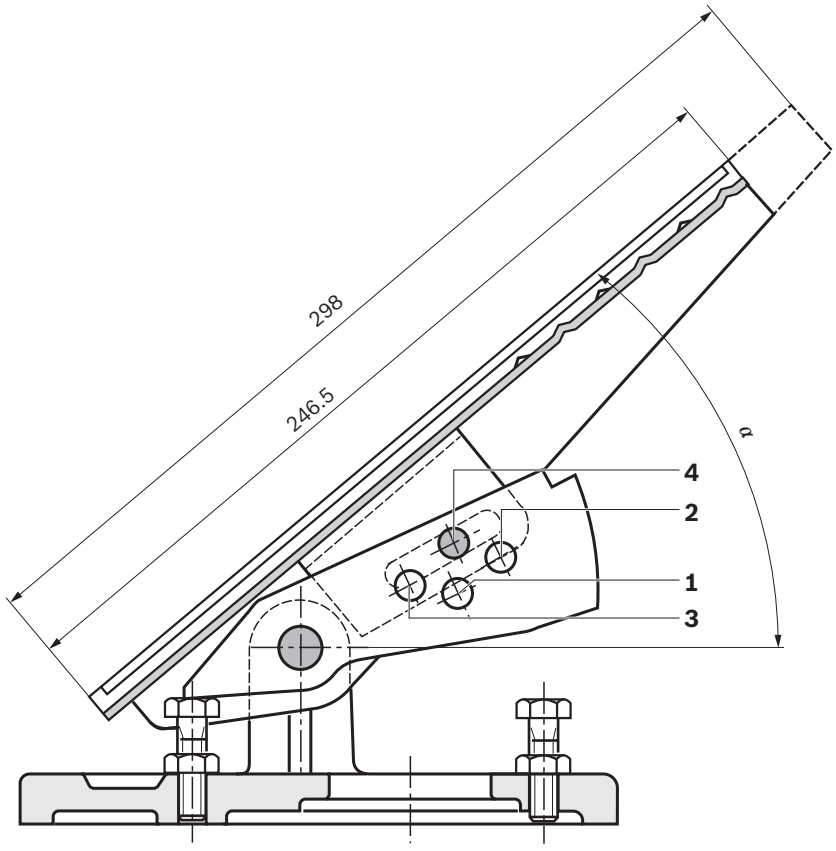
Port	d_1	Ød_2	Ød_3	t_1	t_2	t_3
P	M16 × 1.5	17.8	27	1.5	2.4	13
T	M16 × 1.5	17.8	27	1.5	2.4	13
A	M16 × 1.5	17.8	27	1.5	2.4	13
DS1	M10 × 1	–	20	1	–	8
DS2	M10 × 1	–	20	1	–	8

Notice
The **DS1** and **DS2** ports are closed by default.

Brake pedal variants

The power brake valve LT05 is optionally supplied with or without pedal. The pedals LT19 and LT20 are available (further variants available on request).

▼ **LT19 standard version / LT19 special version with shortened pedal plate**

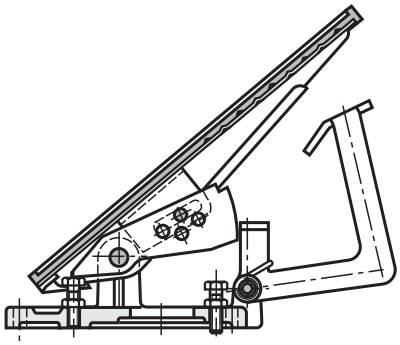


Pedal angle α adjustable in 5° steps:

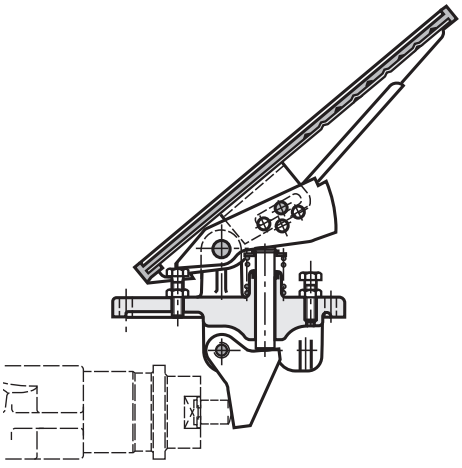
1 Hole 1 = 25°
2 Hole 2 = 30°
3 Hole 3 = 35°
4 Hole 4 = 40° (standard version)

Notice
All pedal variants are, by default, equipped with a slip-resistant, removable rubber pad.

▼ **LT19 with detent hook**



▼ **LT20 special version for horizontally installed brake valve**



Notice
The brake valve and brake pedal are delivered separately.
Order number LT20: R900517761

Related documents

Document type	Title	Document number
Instruction manual	Hydraulic power brake valves for mobile applications	66200-B
Data sheet	Brake pedal angle sensor	66238
	Reliability characteristics $MTTF_D$ for power brake valves	90291

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Single-circuit power brake valve with compact design
LT 12

RE 66218/12.2013
Replaces: 05.2012

LT 12 H

- Series 3X
- Service brake pressure 40, 60, 80, 100 and 125 bar

Features

- Single-circuit power brake valve, accumulator charging valve and shuttle valve in one housing
- Electric or mechanical parking brake valve (optional)
- Brake pressure proportional to actuating force and path
- Fast and simple assembly
- Minimized piping
- Little space required
- Integration into existing hydraulic systems possible
- Fast readiness for operation
- Sensitive dosing
- Minimum number of components
- Flexible installation

Fields of application

- Construction machines
- Conveyor vehicles
- Forestry and agricultural machinery
- Municipal vehicles
- Special vehicles

Contents

Functional description

The LT 12 is a single-circuit power brake valve in compact design combining all required functions in one valve.

Accumulator charging valve
The accumulator charging valve (**1**) primarily charges the accumulator. If the accumulator pressure falls below the switch-on pressure of the charging valve, the accumulators will be charged until the cut-off pressure is reached. The switching pressure differential is approx. 18 % of the cut-off pressure. The accumulators are charged with a charging flow of e.g. 17 l/min (version B40). If the pump delivers more than e.g. 17 l/min, the downstream actuator (**N**) will be supplied with the difference.

NOTICE
If downstream actuators (**N**) generate a pressure higher than the cut-off pressure of the accumulator charging valve, the accumulator circuit will be raised to this pressure level. The pressure of the downstream actuators (**N**) must be 30 % lower than the set accumulator pressure (N < accumulator pressure –30 %).

Accumulator circuit separation
The valve supplies the two brake circuits service brake system (BBA) and parking brake system (FBA). The accumulators S1 (BBA) and S2 (FBA) are separated by the inverted shuttle valve (2). If the BBA fails, the FBA still remains functional and can - with mechanical operation of the FBA - be used as "auxiliary brake".

Single-circuit braking valve
The single-circuit power brake valve LT 12 is a direct operated pressure reducing valve in 3-way version with stepless mechanical operation.
The LT 12 offers stepless dosing of the brake pressure in the BBA (**BR1**) proportional to the path of the actuation element and to the actuating force. The maximum BBA brake pressure must be set at the brake pedal (e.g. LT 20), see page 9.

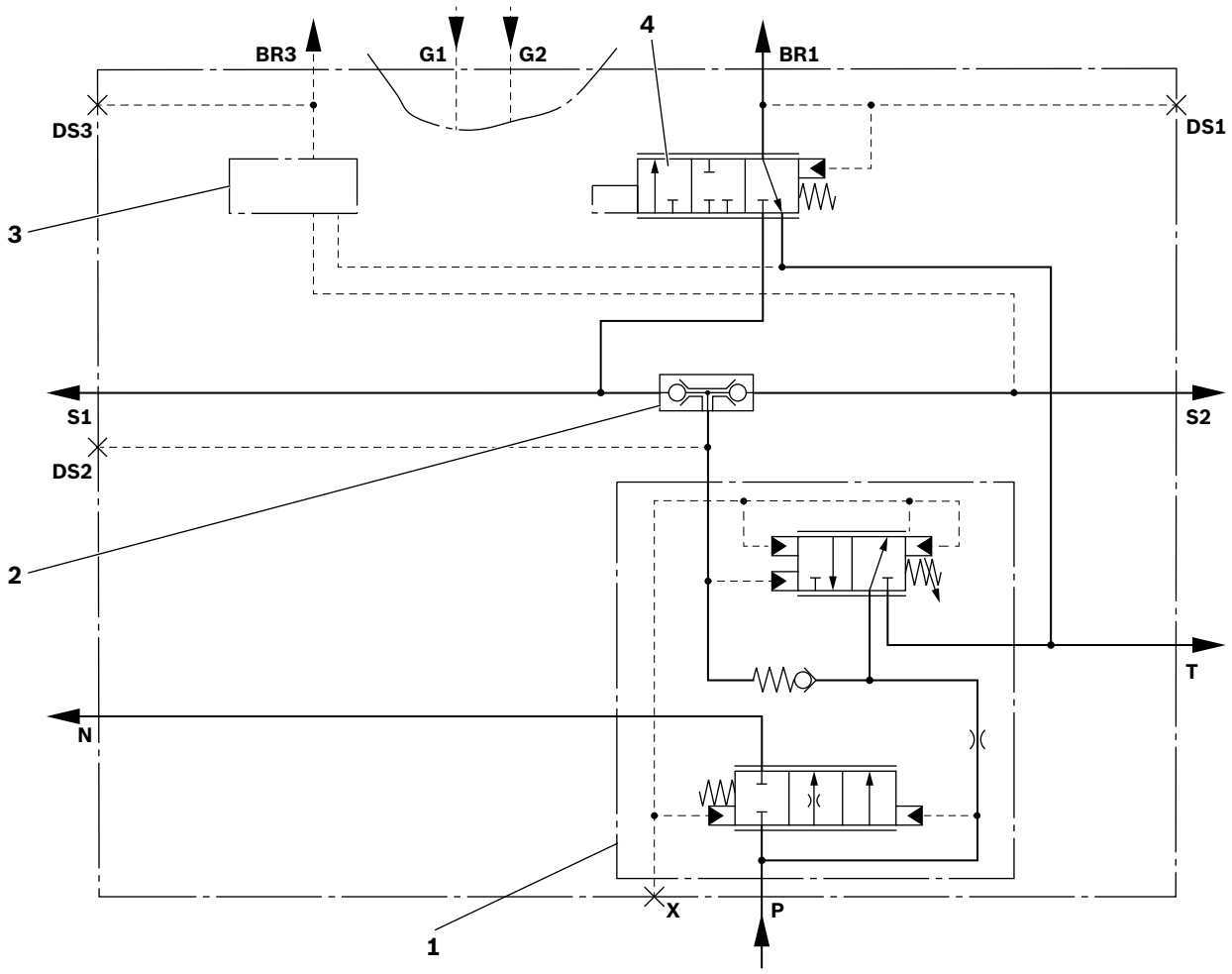
Mechanically operated service brake
For the mechanical operation of LT 12 M, an LT 20 foot pedal is most suitable. If the recommended overall set-up is observed, actuating force and path are adjusted to each other.

Hydraulically operated service brake
In case of hydraulic operation, the tandem master cylinder is operated by means of a suitable pedal. The hydraulic fluid supplied from the storage tank is piped to the LT 12 H pickup head proportional to the pedal path. Both, the tandem master cylinder and the LT 12 H pickup head have two separate chambers.
The pickup spools steer in line proportional to the supplied hydraulic fluid and charge the main brake spool via the brake pressure control springs.

Mechanically operated parking brake/auxiliary brake (3)
The parking brake valve is a direct operated 3-way pressure reducing valve. If the valve is operated, the pressure decreases proportional to the operation. The valve controls the pressure in a controllable manner. So the "auxiliary brake" function can also be satisfied.

Electrically switched parking brake (3)
The electrically switched parking brake valve (**3**) is a 3/2 directional valve. If the valve is switched with an electric signal, port **BR3** is connected to port **S2**. The applied accumulator pressure **S2** supplies the parking brake via **BR3**. If the electric signal is switched off or fails, the parking brake valve **BR3** is connected to **T** and the pressure pending in the parking brake can be reduced. The auxiliary brake function cannot be shown.

▼ **Symbol LT 12**



1 Accumulator charging valve
2 Shuttle valve
3 Parking brake (optional) (FBA)
4 Single-circuit braking valve (BBA)

Connections	
BR1	Service brake
BR3	Parking brake
DS1	Pressure switch, braking light
DS2	Pressure switch, accumulator pressure
DS3	Pressure switch, parking brake
S1	Service brake supply
S2	Parking brake supply
G	Hydraulic control of the service brake (alternative)
P	Pump
T	Tank
N	Return flow or downstream actuators
X	Load-sensing (LS)

Technical data

general				
Weight			kg	Approx. 10 (depending on the version)
Installation position				Preferably horizontal
Type of connection				Metric thread
Ambient temperature range		θ	°C	–25 to +80
Priming				Single-layer coating RAL 5010

hydraulic				
Maximum service brake pressure at port	BR1	p_{Br}	bar	125
Maximum parking brake pressure at port BR3	Version M	p	bar	120 (proportional)
	Version E	p	bar	Corresponds to the accumulator charging pressure/depending on the setting at the accumulator charging valve
Maximum inlet pressure at port	P	p	bar	210
Maximum accumulator pressure at port	S1, S2	p	bar	200
Maximum accumulator charging pressure	Cut-off pressure	p	bar	200
	Switch-on pressure	p	bar	Approx. 18 % below cut-off pressure
Maximum tank pressure at port	T	p	bar	0.5 (The tank pressure must not exceed the application pressure of the brake.)
Maximum pressure at port	N	p	bar	30 % less than the set accumulator pressure
Maximum encoder pressure with version H at port	G1, G2	p_G	bar	30
Maximum flow	P → S		l/min	Approx. 6 (B18) Approx. 17 (standard, B40)
	P → N		l/min	70
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568, as well as hydraulic fluids as specified in data sheet RE 90221, upon request
Hydraulic fluid temperature range		θ	°C	–20 to +80
Viscosity range		v	mm²/s	2.8 to 380
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)				Class 20/18/15, for this, we recommend using a filter with a minimum retention rate of $\beta_{10} \geq 75$

electric				
Voltage type				Direct voltage
Supply voltage			V	12; 24
Protection class according to VDE 0470-1 (DIN EN 60529), DIN 40050-9	Version K4			IP65 with mating connector mounted and locked[1)]
	Version C4			IP65 with mating connector mounted and locked[1)]
				IP69K with Rexroth mating connector (material number R901022127)[1)]
	Version K40			IP65K with mating connector mounted and locked[1)]

NOTICE
For applications outside these parameters, please consult us!

1) Mating connectors are not included in the scope of delivery and must be ordered separately, see data sheet 08006.

Ordering code

01	02	03		04	05	06	07	08	09	10	11		12	13	14	15
LT 12		**3X**	**/**									**/**		**M**		*****

Series

01	Single-circuit power brake valve with compact design LT 12	**LT 12**

Type of actuation (BBA)

02	Mechanical	**M**
	Hydraulic	**H**

Series

03	30 to 39 (unchanged installation and connection dimensions)	**3X**

Characteristic curve

04	Linear characteristic curve	**L**
	Progressive characteristic curve	**P**

Service brake pressure (BBA)

05	40 bar	**040**
	60 bar	**060**
	80 bar	**080**
	100 bar	**100**
	125 bar	**125**

Type of actuation parking brake system (FBA)

06	Without FBA	**–**
	Mechanically operated	**M**
	Electrically switched	**E**[1)]

Parking brake pressure (FBA)

07	[1)]	**XXX**
	Without FBA	**000**
	20 bar	**020**
	40 bar	**040**
	60 bar	**060**
	80 bar	**080**
	100 bar	**100**
	120 bar	**120**

Accumulator charging pressure

08	100 bar	**A**
	120 bar	**B**
	150 bar (standard)	**C**
	165 bar	**D**
	185 bar	**E**
	200 bar	**F**

1) With electrically switched FBA, the parking brake pressure of the FBA corresponds to the accumulator charging pressure. Observe the switching hysteresis!

Accumulator charging current

09	Approx. 17 l/min (standard)	**B40**
	Approx. 6 l/min	**B18**

Voltage at the switching solenoid

10	12 Volt	**AG12**
	24 Volt	**AG24**

Connector type (standard with manual override)[2)]

11	Cubic connector	**NK4**
	Deutsch plug	**NK40**
	Junior timer, 2-pole (AMP)	**NC4**

Line connections

12	Metric thread	**02**
	UNF thread	**19**

Seal material

13	NBR seals, suitable for mineral oil (HL, HLP) according to DIN 51524	**M**

Additional equipment

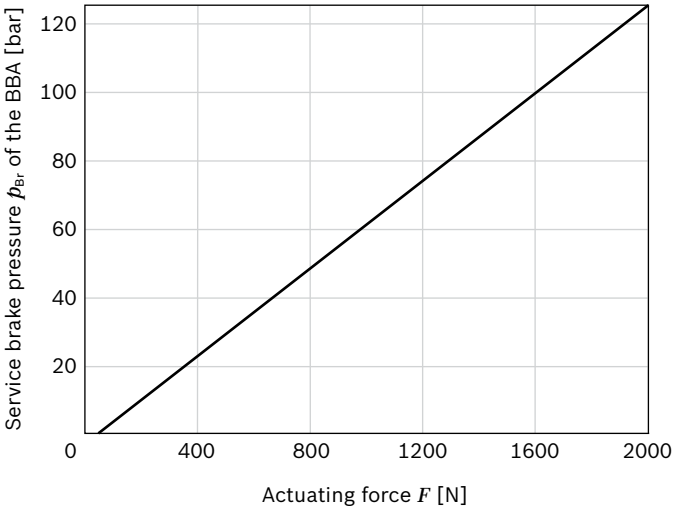
14	With actuation rod	**16**
	With actuation rod and pressure switch	**17**

15	Further details in the plain text	*

Characteristic curves

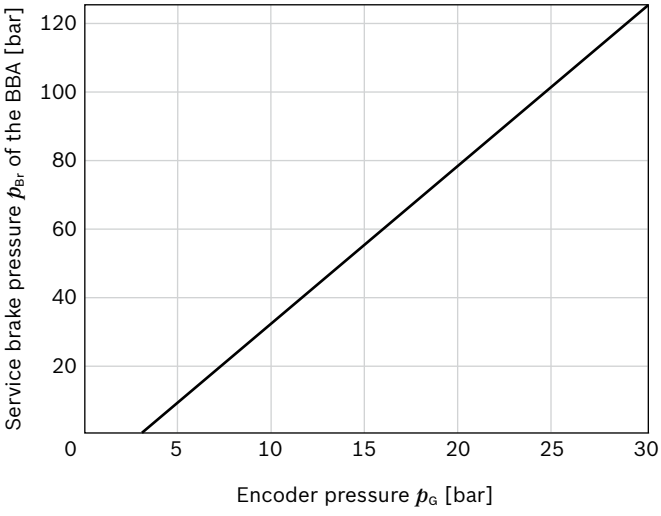
Version M

▼ **Service brake pressure dependent on the actuating force (directly operated, without pedal)**



Version H

▼ **Service brake pressure depending on the encoder pressure**



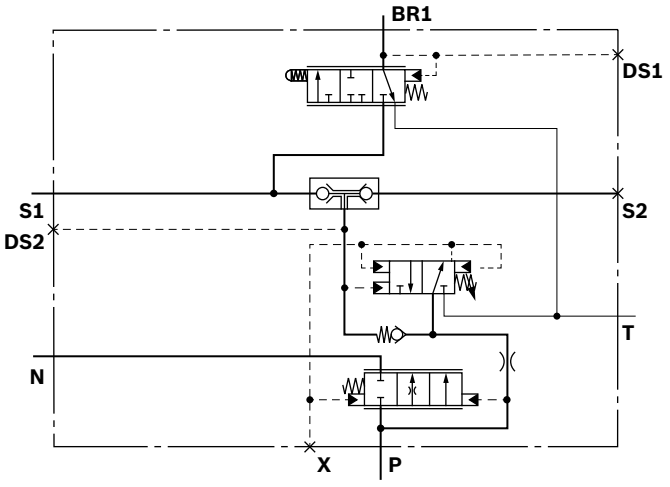
2) Mating connectors are not included in the scope of delivery and must be ordered separately, see data sheet 08006.

Symbols

Mechanical actuation BBA, without FBA

Ordering code:

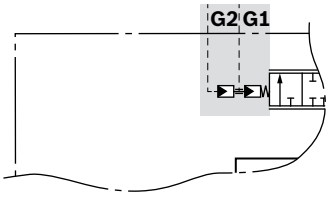
LT 12	M	3X	/	...	–	...



Hydraulic actuation BBA, without FBA

Ordering code:

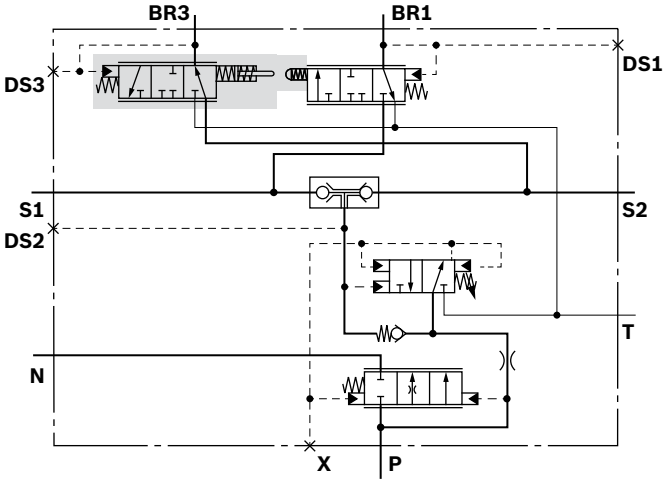
LT 12	H	3X	/	...	–	...



Mechanical actuation BBA, mechanical FBA

Ordering code:

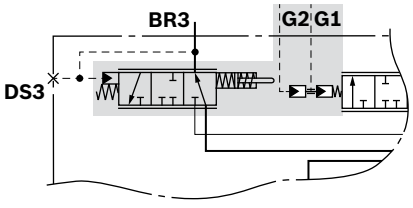
LT 12	M	3X	/	...	M	...



Hydraulic actuation BBA, mechanical FBA

Ordering code:

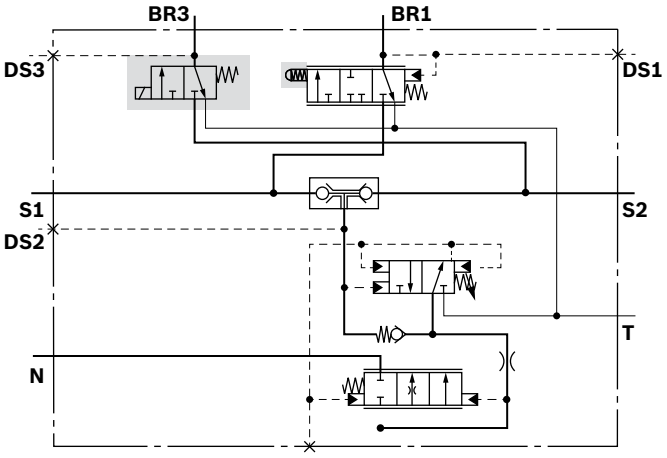
LT 12	H	3X	/	...	M	...



Mechanical actuation BBA, electric FBA

Ordering code:

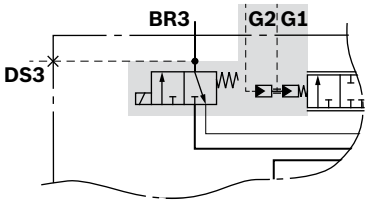
LT 12	M	3X	/	...	E	...



Hydraulic actuation BBA, electric FBA

Ordering code:

LT 12	H	3X	/	...	E	...



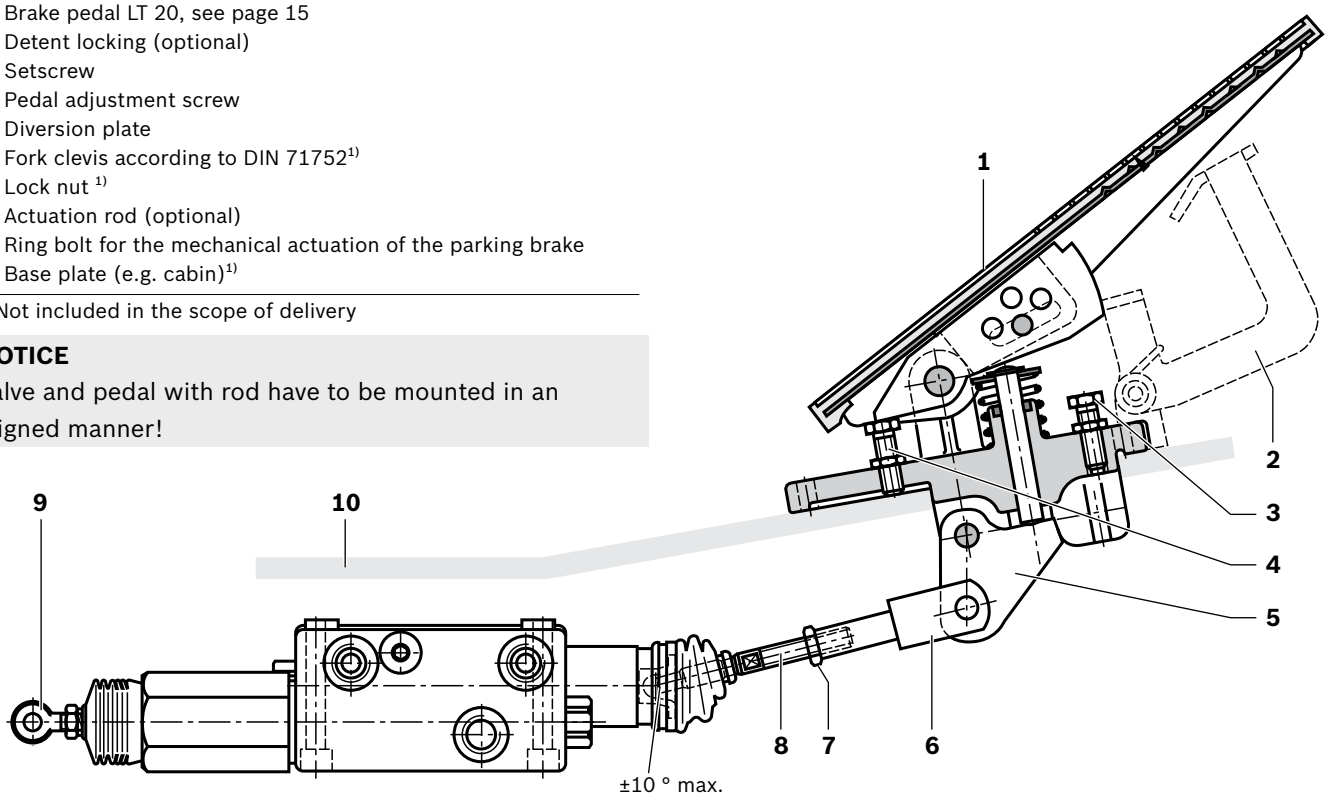
Overall set-up

LT 12 with mechanical actuation

1 Brake pedal LT 20, see page 15
2 Detent locking (optional)
3 Setscrew
4 Pedal adjustment screw
5 Diversion plate
6 Fork clevis according to DIN 71752[1)]
7 Lock nut [1)]
8 Actuation rod (optional)
9 Ring bolt for the mechanical actuation of the parking brake
10 Base plate (e.g. cabin)[1)]

1) Not included in the scope of delivery

NOTICE
Valve and pedal with rod have to be mounted in an aligned manner!



Assembly
Low-friction operation requires good orientation of the valve to the pedal. In the top view, valve axis, actuation rod (**8**) and pedal (**1**) must be aligned! In the side view, the actuation rod may press against the valve actuation with an incline of max. 10°. Incline and height of the pedal influence the actuation angle and the force.
If due to the space required, the control is designed with a longer actuation unit, it has to be resistant to buckling (see actuating force).

Setting the pedal
Lock nut (**7**) and fork clevis (**6**) are screwed onto the actuation rod (**8**); after assembly of the valve and the pedal, the fork clevis (**6**) will be connected at the diversion plate (**5**) with the axis bolt.

Pedal (1) not operated
The actuation rod (**8**) is adjusted until the play between ball head and valve actuation is reduced to the minimum.

NOTICE
The valve actuation must not be preloaded. The operation rod must allow for minimum movement. This setting is secured by means of the lock nut (**7**).

Pedal (1) operated
The maximum brake pressure is set by means of the setscrew (**3**) as required and secured by means of the lock nut. When the pedal is released, only the tank pressure may be available.

Option – Pedal with detent locking (2)
Lock nut (**7**) and fork clevis (**6**) are screwed onto the actuation rod (**8**), the fork clevis is connected at the diversion plate (**5**) with the axis bolt. Bring the pedal in the detented position. Set the actuation rod (**8**) so that the valve achieves the desired maximum pressure. Secure the pressure adjustment by locking the nut (**7**).

Releasing the detent locking
When the pedal (**1**) is not operated, rotate the pedal adjustment screw (**4**) until the smallest play possible is achieved.

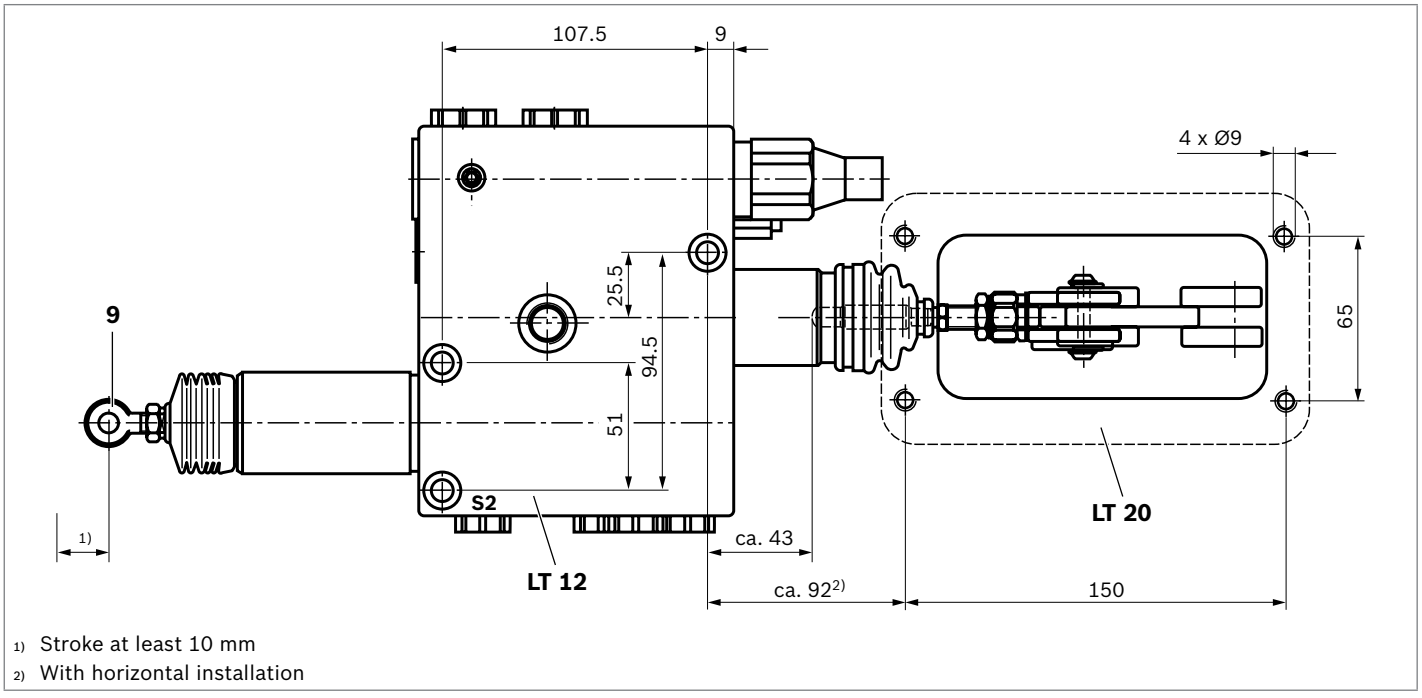
Parking brake version M

The parking brake has been set to the desired pressure at the factory. If the parking brake is not activated, the parking brake pressure corresponds to the pressure set at the factory. The bowden cable must be set so that in the non-operated state, no traction force acts on the ring bolt (**9**). With increasing operation (pulling) of the parking brake, the brake pressure decreases to the tank pressure. Then, the entire force of the spring-loaded accumulator cylinder acts on the wheel brake. To this end, the bowden cable must allow for a stroke of at least 10 mm. The holding force corresponds to the connection force and is max. 1100 N. The bowden cable is to be laid so that low-friction operation is possible.

Parking brake version E

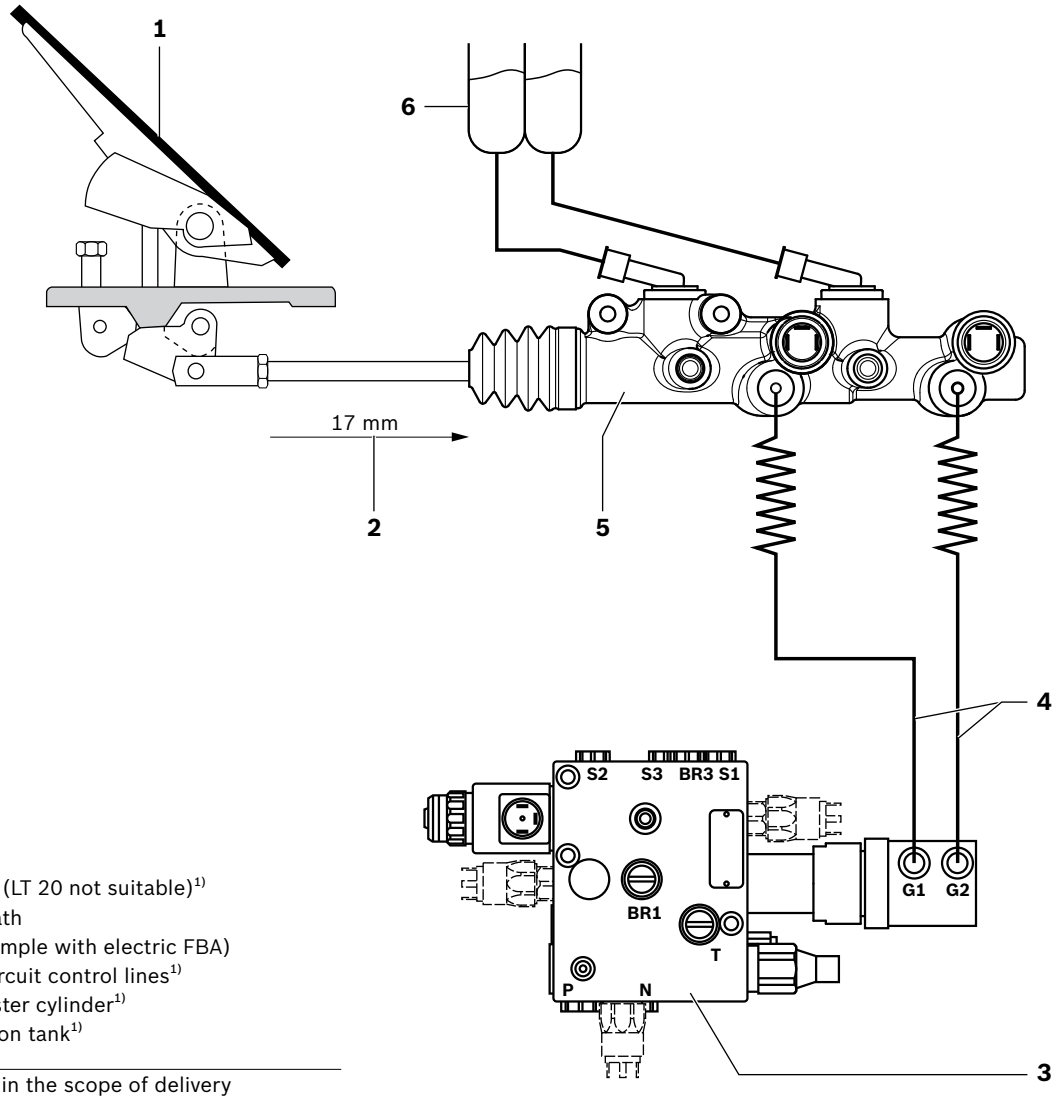
The electric FBA cannot be set.

With voltage applied to the solenoid (12 or 24 Volt), the accumulator pressure is switched to the parking brake. The minimum parking brake pressure corresponds to the switch-on pressure of the charging valve. If there is no voltage applied to the solenoid, the output pressure corresponds to the tank pressure.



1) Stroke at least 10 mm
2) With horizontal installation

LT 12 with hydraulic actuation



1 Brake pedal (LT 20 not suitable)[1)]
2 Actuating path
3 LT 12 H (example with electric FBA)
4 Flexible 2-circuit control lines[1)]
5 Tandem master cylinder[1)]
6 Compensation tank[1)]

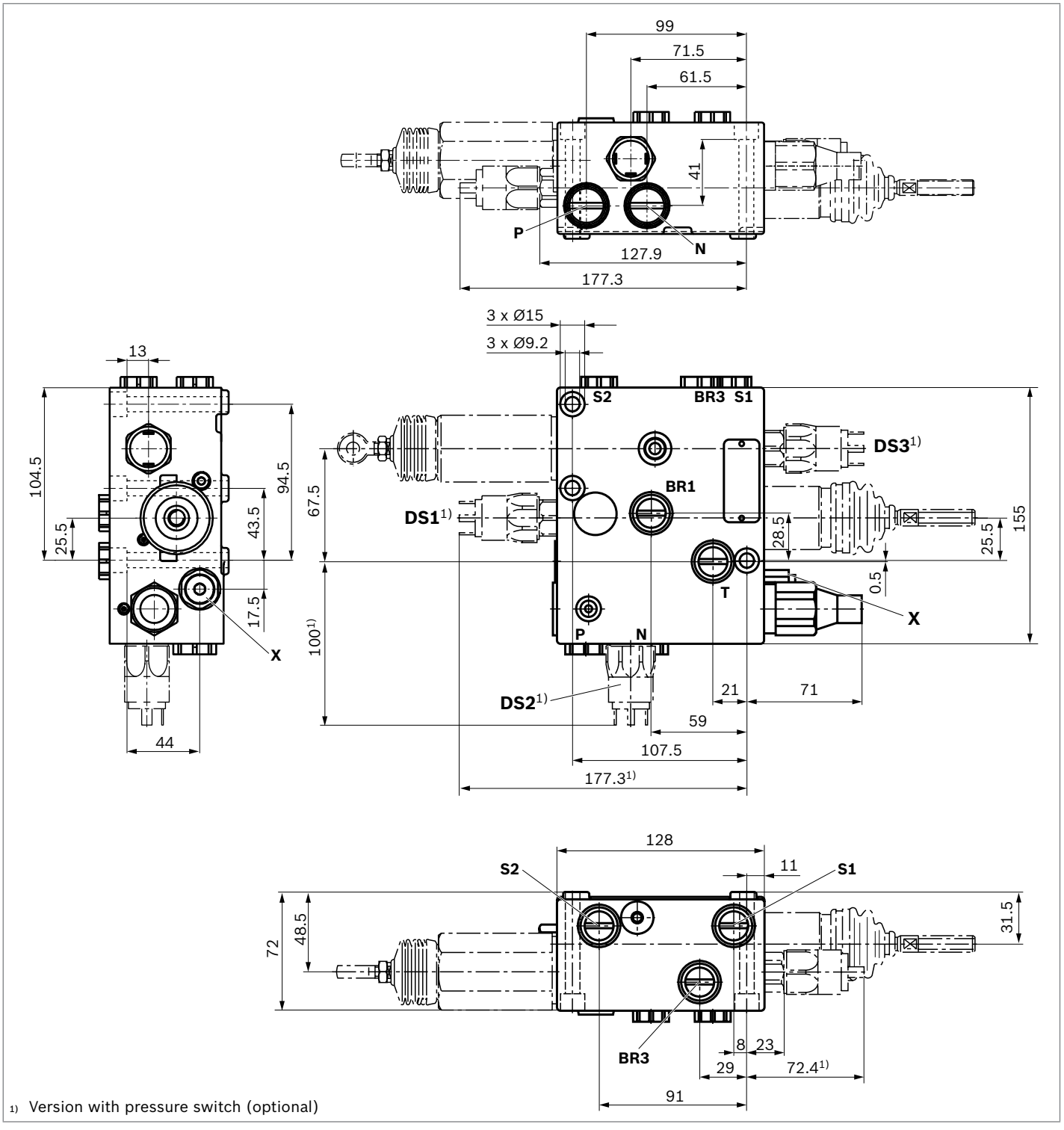
1) Not included in the scope of delivery

For the control, we recommend the tandem master cylinder MH17861.2.1 by FTE Automotive (Ebern). Stroke volume of encoder cylinder and displacement of the LT 12 H pickup head are adjusted to each other.

NOTICE
If one control line (**4**) fails, the tandem master cylinder requires twice the actuating path to achieve the brake pressure.

Dimensions

▼ **Basic valve LT 12**

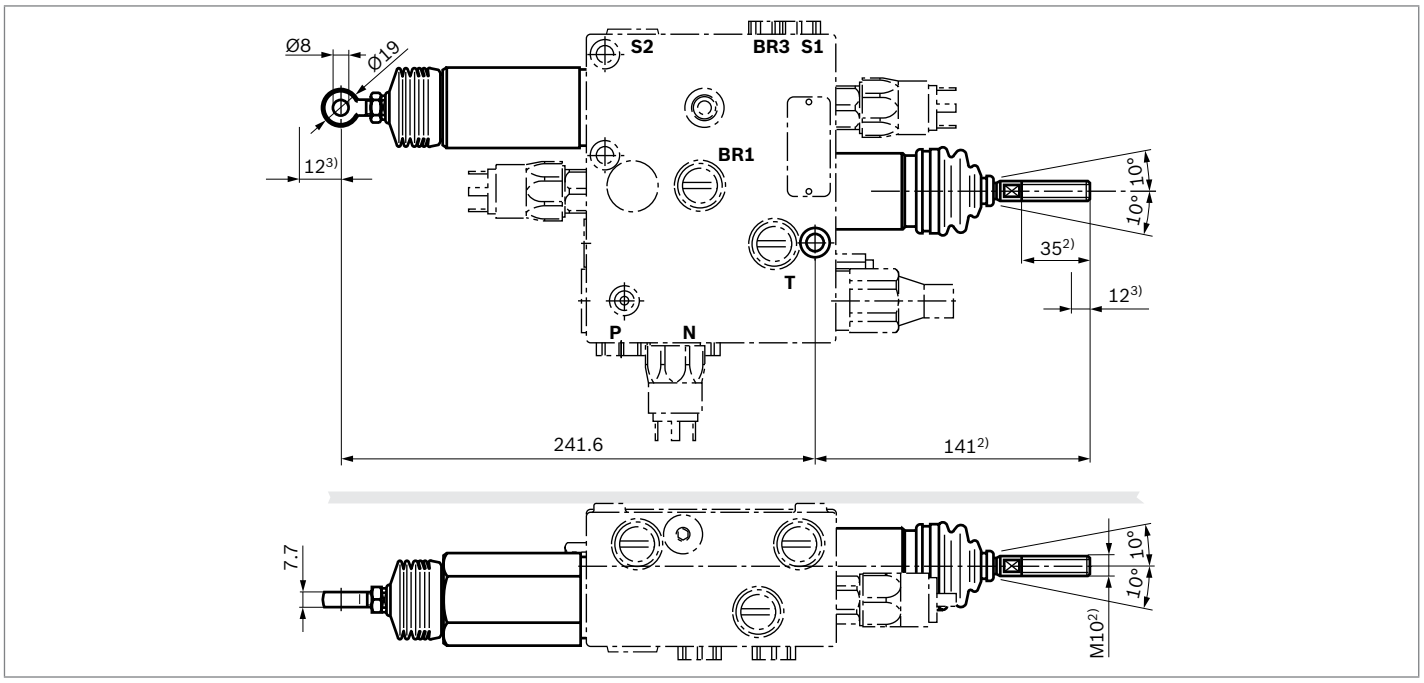


1) Version with pressure switch (optional)

▼ **Mechanical actuation BBA, mechanical FBA**

Version

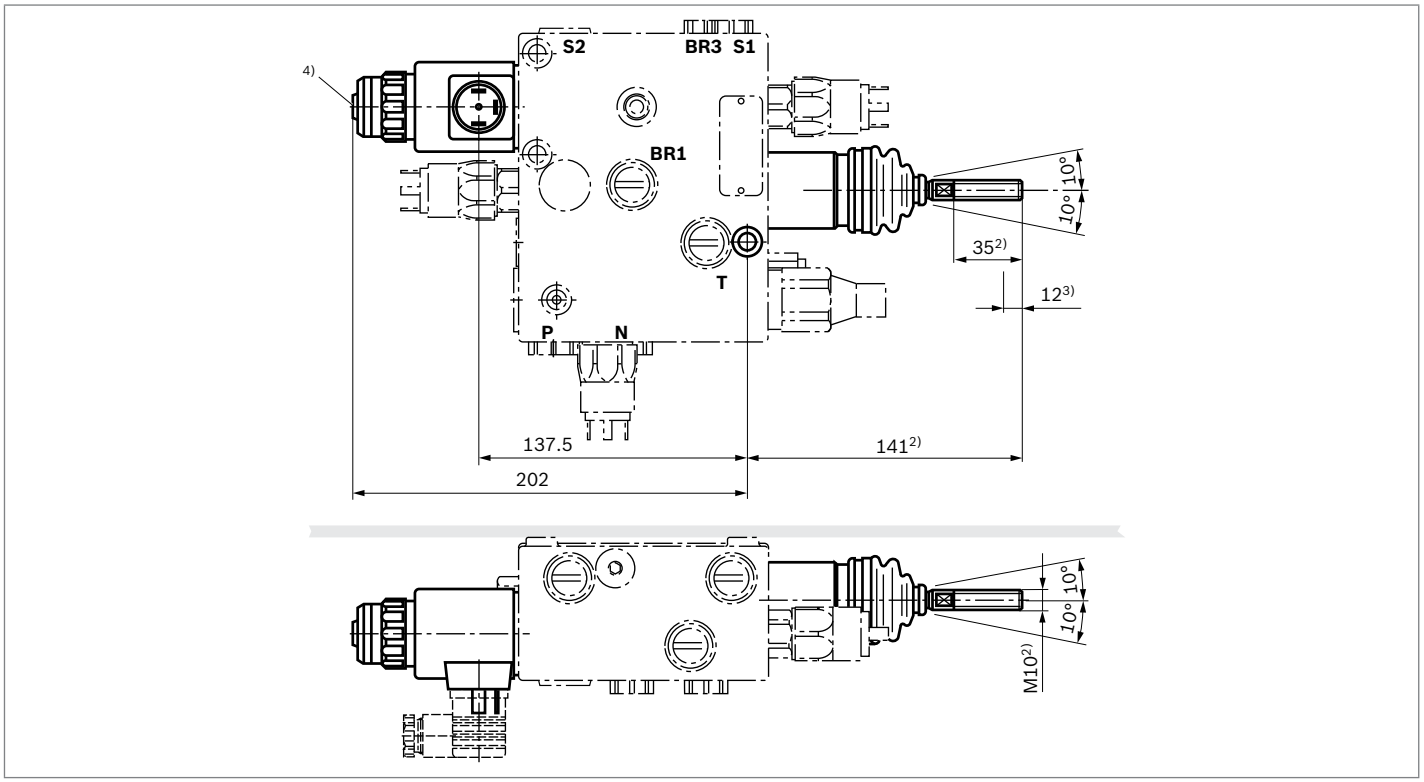
LT 12	M	3X	...	M	...



▼ **Mechanical actuation BBA, electric FBA**

Version

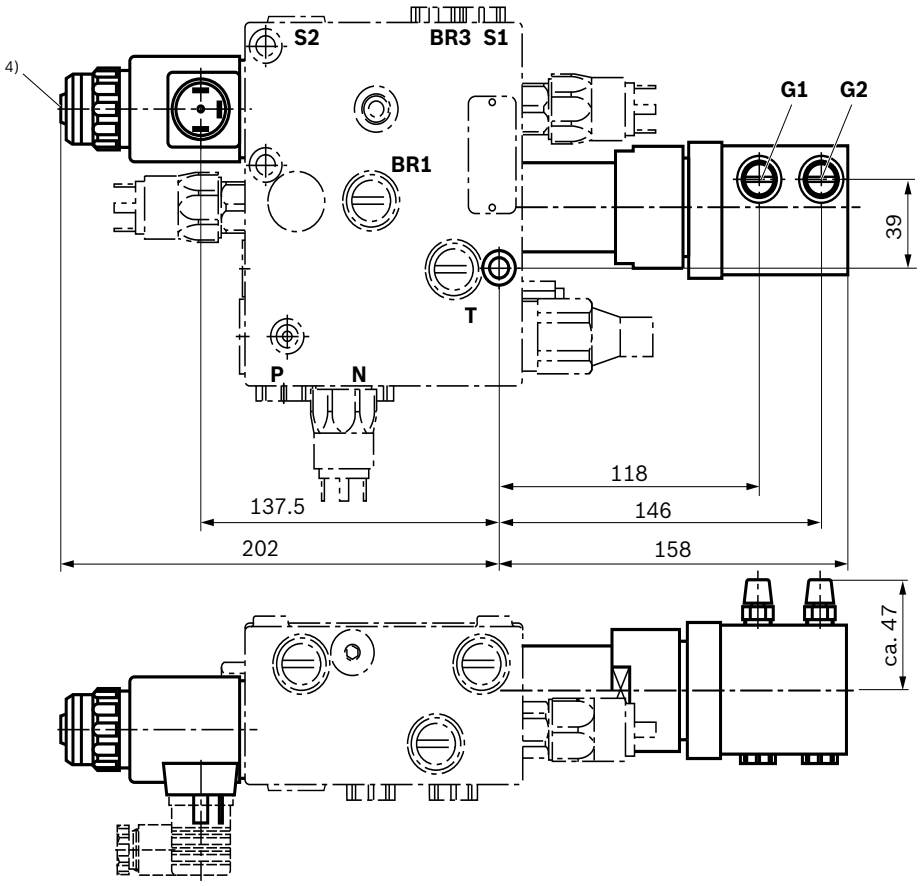
LT 12	M	3X	...	E	...



2) Version with actuation lever
3) Maximum stroke
4) Manual override

▼ **Hydraulic actuation BBA, electric FBA**

Version	LT 12	H	3X	...	E	...

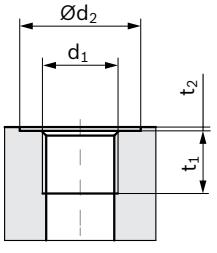


4) Manual override

Line connections

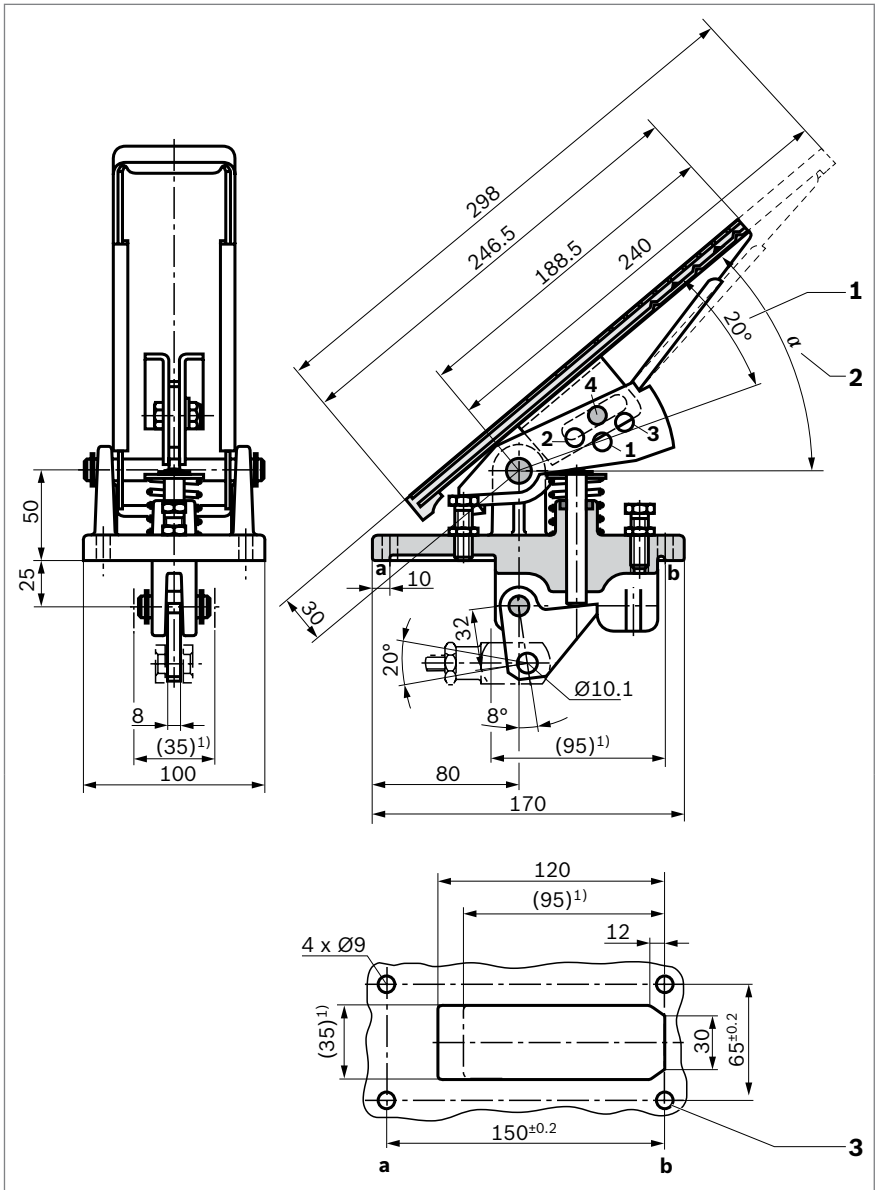
Thread design 02

Connection	d_1	Ød_2	t_1	t_2
BR1, BR3	M16 x 1.5	26	12	1
DS1, DS3	M12 x 1.5	18	12	0.5
DS2	M10 x 1	–	6	–
S1, S2	M16 x 1.5	26	12	1
G1, G2	M12 x 1.5	20	12	1
X	M12 x 1.5	18	12	1
P, N	M18 x 1.5	28	12	1.5
T	M16 x 1.5	26	12	1



Brake pedal variants

▼ **Standard version LT 20 (R900412420)/ version LT 20 with shortened pedal plate (R901056192)**



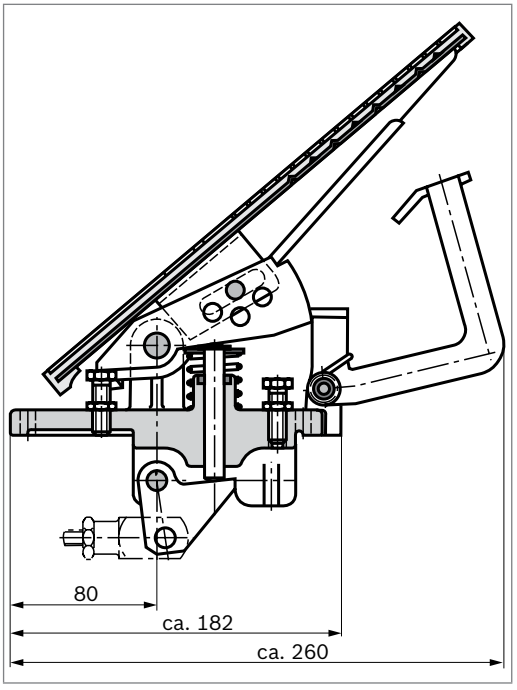
1 Actuation angle

2 **Pedal angle of attack α can be adjusted in 5° steps:**
Hole 1 = 25°
Hole 2 = 30°
Hole 3 = 35°
Hole 4 = 40° (standard version)

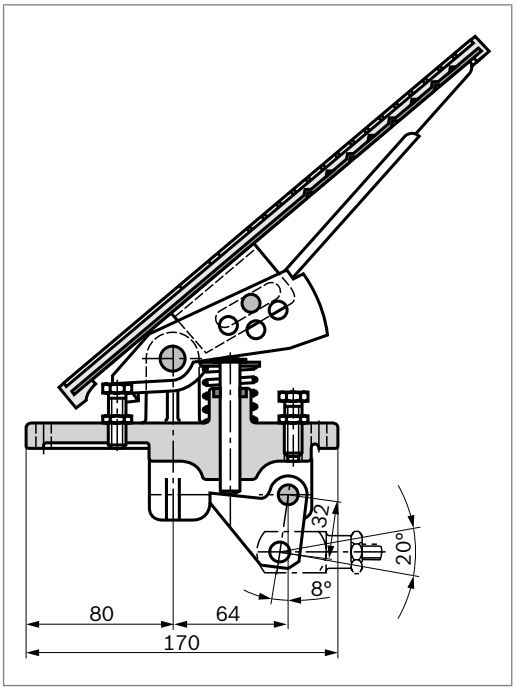
3 Assembly hole pattern in the base plate (proposal)

1) Minimum dimensions of the base plate for the pedal installation

▼ **Version LT 20 with locking hook (R900328536)**



▼ **Version LT 20 with actuation rod to the front (R900412421)**



NOTICE

All pedal variants are, by default, equipped with anti-slid pedal rubber that can be disassembled.

Accessories

Pressure switches

Connection	Function	Switching pressure	Order number
DS1	Braking light	5 bar	R901355130
DS2	Accumulator pressure	50 bar	R900015507
	Accumulator pressure	100 bar	R900014525
	Accumulator pressure	115 bar	R900026566
DS3	Parking brake	25 bar	R901355138

NOTICE
Bosch Rexroth uses pressure switches by SUCO / Bietigheim-Bissingen.

Brake pedals

Type	Description	Order number
LT 20 MKA-1X/000H/00-	Standard version	R900412420
LT 20 MKA-1X/000H/00-SO1	Version with locking hook	R900328536
LT 20 MKA-1X/000H/00-SO2	Version with actuation rod to the front	R900412421
LT 20 MKA-1X/000H/00-SO9	Version with shortened pedal plate	R901056192

Other components (recommendation, not sold by Bosch Rexroth)

Description	Type
Stepped tandem cylinder	**MH17861.2.1** by FTE Automotive, Ebern
Bowden cable (remote operation FBA)	MFB GmbH, Mühlheim a. d. Ruhr
Fork clevis	FBA axis connection, fork clevis according to DIN 71752 G8 x 16/32
	BBA axis connection, fork clevis according to DIN 71752 G10 x 20/40
Accumulator	**NOTICE:** Use ECO diaphragms for brake accumulators (for extended temperature range!)

Related documents

The power brake valves LT 12 are hydraulic components in power brake systems in mobile machines.

Also observe the instructions for the other system components. Do not commission the product until you are provided with the following documentation and have understood and observed it.

Title	Document number	Document type
Hydraulic power brake valves for mobile applications	66200-B	Operating instructions
System documentation from the machine manufacturer		Operating instructions

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Mobile Applications
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www.boschrexroth.com

RE 66146/2022-12-15
Replaces: 04.2017

rexroth
A Bosch Company

Dual-circuit power brake valve LT07

- Direct-operated pressure reducing valve in 3-wayversion with infinitely variable mechanical actuation
- Series 2X
- Service brake pressure 40 to 150 bar
- Maximum inlet pressure 250 bar
- For modular designs

Features

- Optimum piping possible through freely rotating mounting flange
- Brake pressure proportional to the actuating force
- Synchronization thanks to low hysteresis
- Maximum pressure limitation of the brake circuits
- All consumer ports on one side
- Optionally available with electric angle sensor
- Ergonomic adjustment of the pedal work angle possible
- All pedal models with detachable, slip resistant pedal rubber
- Compact mounting dimensions

Fields of application

- Construction machinery
- Material handling vehicles
- Forestry and agricultural machinery
- Special-purpose vehicles

Contents

Type code

01	02		03		04	05		06	07	08	09	10	11	12
LT07		**–**	**2X**	**/**			**/**	**02**	**M**					

Series

01	Dual-circuit power brake valve LT07	**LT07**

Type of actuation

02	Mechanical (up to 100 bar BBA)	**MKA**
	Mechanical, reduced actuating force (from 100 bar BBA)	**MRA**
	Combined mechanical/hydraulic, reduced actuating force (from 100 bar BBA)	**MHA**
	Mechanical, with sensor (up to 100 bar BBA)	**MKS**
	Mechanical, with sensor, reduced actuating force (from 100 bar BBA)	**MRS**

Series

03	20 to 29 (unchanged installation and connection dimensions)	**2X**

Characteristic curve

04	Linear	**L**
	Progressive	**P**

Nominal pressure (service brake pressure BBA)

05	40 to 150 bar, 3 digits, e.g., 60 bar = **060**	**...**

Line connections (see page 10)

06	ISO metric thread according to DIN 3852-1	**02**
	UNF thread according to ISO 11926-1	**19**
	Thread according to ISO 6149-1 (with O-ring seal)	**50**

Sealing material

07	NBR (nitrile rubber)	**M**

Pedal (optional)

08	LT19 standard version	**12**
	LT19 special version with shortened pedal plate	**37**

Electric angle sensor (only for MKS and MRS)

09	Sensor, in the direction of travel left		**SL**
	Sensor, in the direction of travel right		**SR**
	Sensor on both sides		**RL**
10	Supply voltage	Battery voltage	**1**
		5 VCC ±0.2 V	**2**
11	Actuating force on the pedal	Force feedback	**FB**

Other (optional)

12	Pin for double pedal link	**DP**
	Detent hook	**DH**

Functional description

The dual-circuit power brake valve LT07 is a direct-operated pressure reducing valve in 3-way design with continuous mechanical actuation.
It has a maximum pressure limitation of the secondary circuits and continuous dosing of the pressure in the secondary circuits (brake circuits) proportional to the path of the actuation element (**4**) or to the pedal actuation angle (**8**).
In case of failure of one brake circuit, the second brake circuit remains functional by means of mechanical contact of the two control spools (**2**). The actuating force of the pedal remains unchanged.
The dual-circuit power brake valve consists essentially of a housing (**1**) and control spool (**2**), the main regulator springs (**3**), actuation element (**4**) and the return springs (**5**) and (**6**). The valve is operated via the actuation element (**4**). This element presses both of the main regulator springs (**3**) against both control spools (**2**).
First, the control edges at channel **T** close, then the control edges of **SP** to **BR** open, creating pressure build-up in both brake circuits. The pressure then builds up in the brake lines, acting simultaneously on the brake pressure returns (**7**) located behind the control spools pushing against the main regulator springs (**3**), so that the brake pressure (secondary pressure) in both brake circuits rises in proportion to the deflection of the actuation element (**4**). In keeping the deflection of the actuation elements constant, the control spools (**2**) move into the control position and keep the pressure introduced in the channels **BR1** and **BR2** constant, whereby the pressure in **BR1** is only about 2 bar higher than in **BR2**.
The actuating force of the actuation element is proportional to its deflection.
If the main regulator springs (**3**) are released, the return springs move the control spools back into the starting position. The control edges close from **SP** to **BR** and open from **BR** to **T**. The secondary circuits (braking circuits) are thereby released.

Combined mechanical/hydraulic actuation
The brake valve can be controlled mechanically by a pedal and/or hydraulically via the **Pst** port.

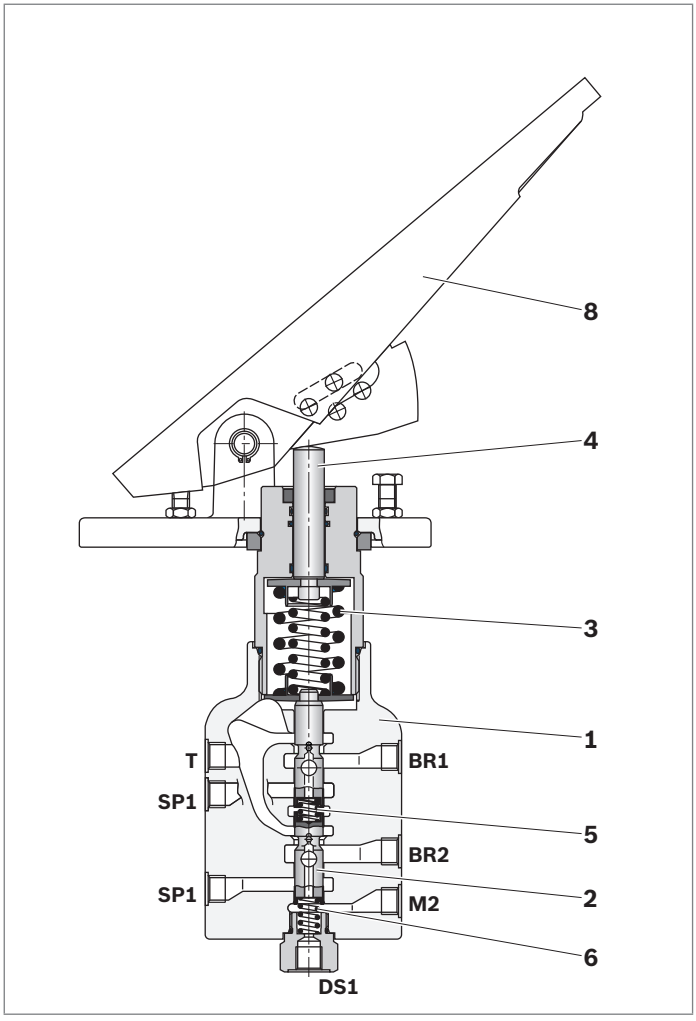
Version with angle sensor
During the first degrees of actuation of the pedal, only the electrical signal of the angle sensor is output. With this, for example, the hydrostatic travel drive can be taken back (drive pump swivels back).
Upon further actuation of the pedal, the hydraulic brake pressure is built up. See characteristic curve on page 6

Notice
The version with an angle sensor requires cabin installation for the sensor assembly.
For more information on the angle sensor, see data sheet 66238.

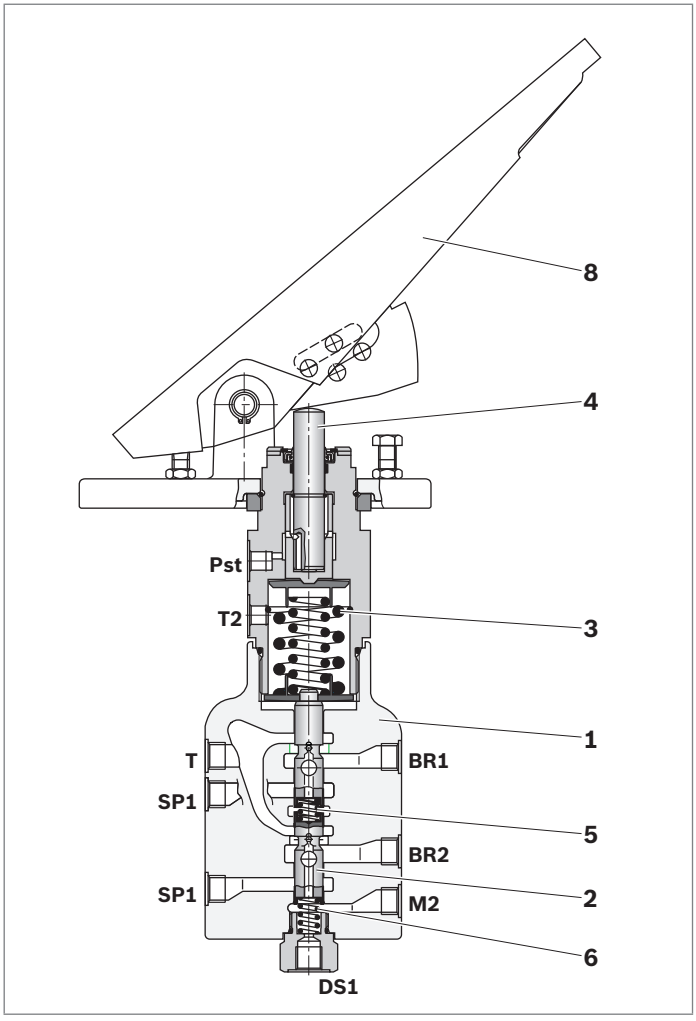
Ports	
SP1	Supply to service brake circuit 1
SP2	Supply to service brake circuit 2
T	Reservoir
BR1	Service brake circuit 1
BR2	Service brake circuit 2
M1	Brake pressure return (service brake circuit 1)[1)]
M2	Brake pressure return (service brake circuit 2)[1)]
DS1	Pressure switch (brake lights)
Pst	Pilot pressure

1) Pressure switch optional (brake lights)

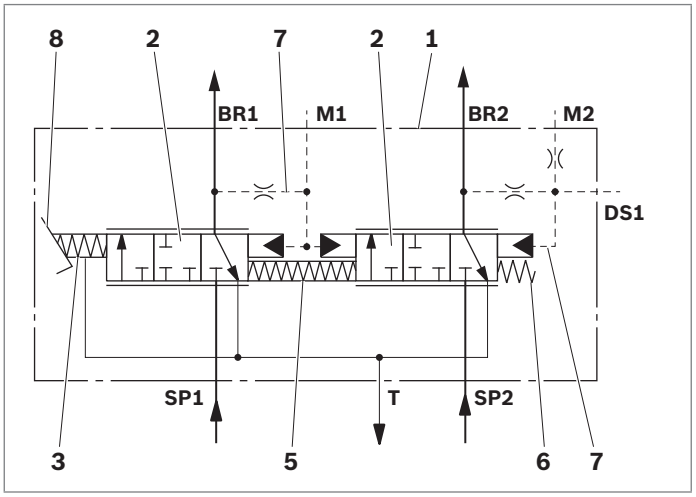
▼ **Section LT07 MKA**



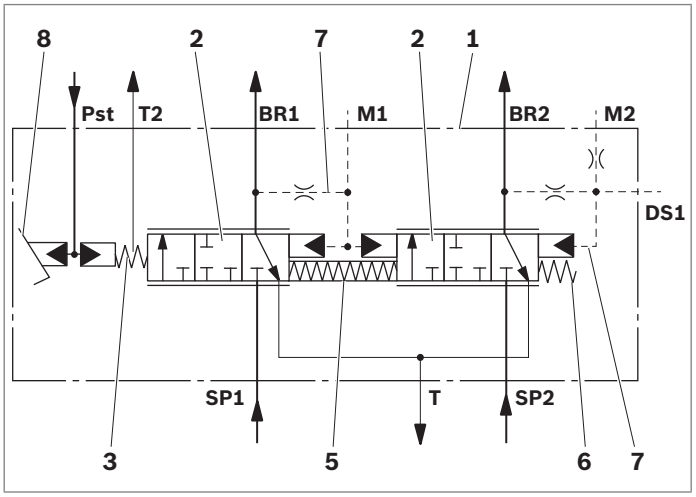
▼ **Section LT07 MHA**



▼ **Symbol LT07 MKA**



▼ **Symbol LT07 MHA**



1 Housing
2 Control spool
3 Main regulator springs
4 Actuation element
5 Return spring
6 Return spring
7 Brake pressure return
8 Standard brake pedal

Technical data

General				
Weight	Excluding pedal		kg	4.7
	With standard pedal		kg	6.4
Installation position				Preferably standing
Connection type				See page 10
Ambient temperature range		θ	°C	–25 ... +80
Standard paint				Single coat RAL 5010

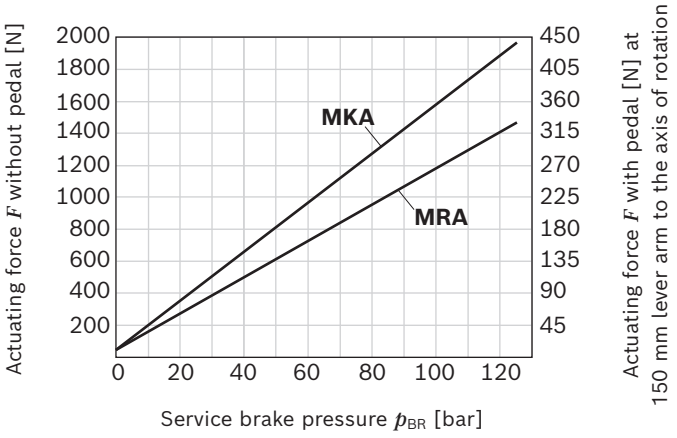
Hydraulic	**Port**			
Nominal pressure, maximum	**BR1**, **BR2**	p_{BR}	bar	40 ... 150
Maximum inlet pressure	**SP1**, **SP2**	p	bar	250
	Pst	p_{St}	bar	30
Maximum tank pressure	**T**	p	bar	0.5 (The tank pressure must not exceed the contact pressure of the brake. Tank pressure peaks due to flow operations are permitted.)
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, e.g., HEES (synthetic ester) according to ISO 15380 and hydraulic fluids as specified in data sheet 90221, on request
Hydraulic fluid temperature range		θ	°C	–20 ... +80
Viscosity range		ν	mm²/s	2.8 – 380
Maximum admissible degree of contamination of hydraulic fluid Cleanliness level according to ISO 4406 (c)				Level 20/18/15, we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

Notice

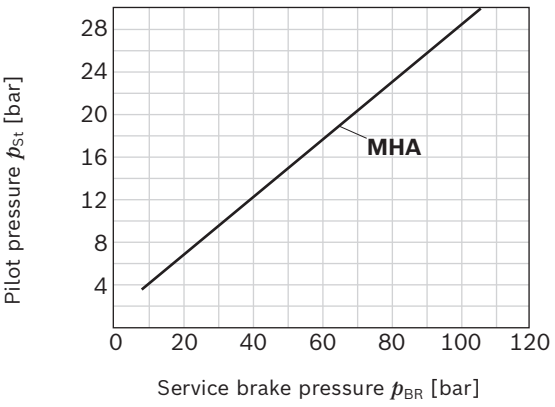
- For applications outside these values, please consult us!
- The electrical data for the angle sensor can be found in the data sheet 66238.

Theoretical characteristic curves

▼ **Type of actuation mechanical, linear characteristic curves**

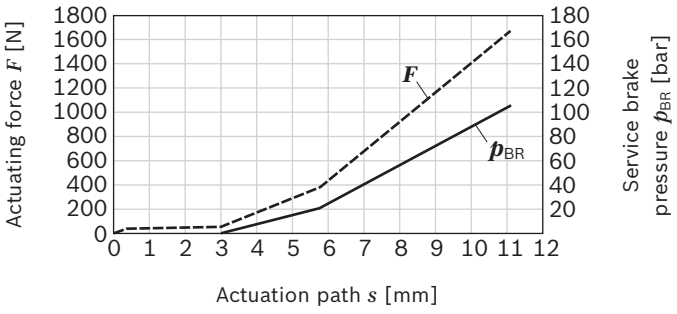


▼ **Type of actuation mechanical/hydraulic combined, linear characteristic curves**

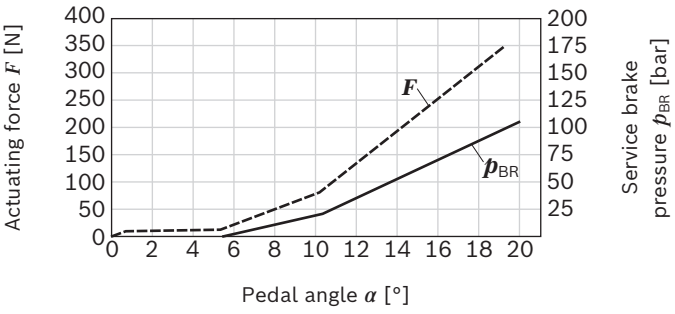


▼ **Type of actuation mechanical, progressive characteristic curves (example: Version MKA, 100 bar)**

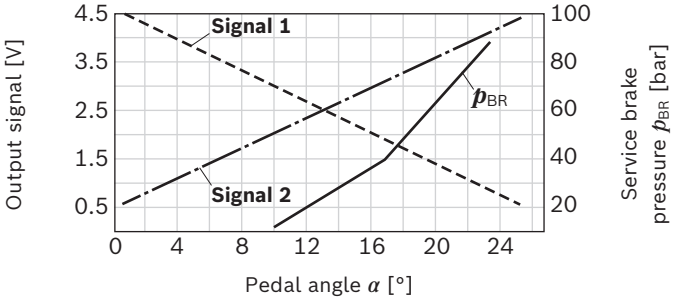
Excluding pedal



With pedal

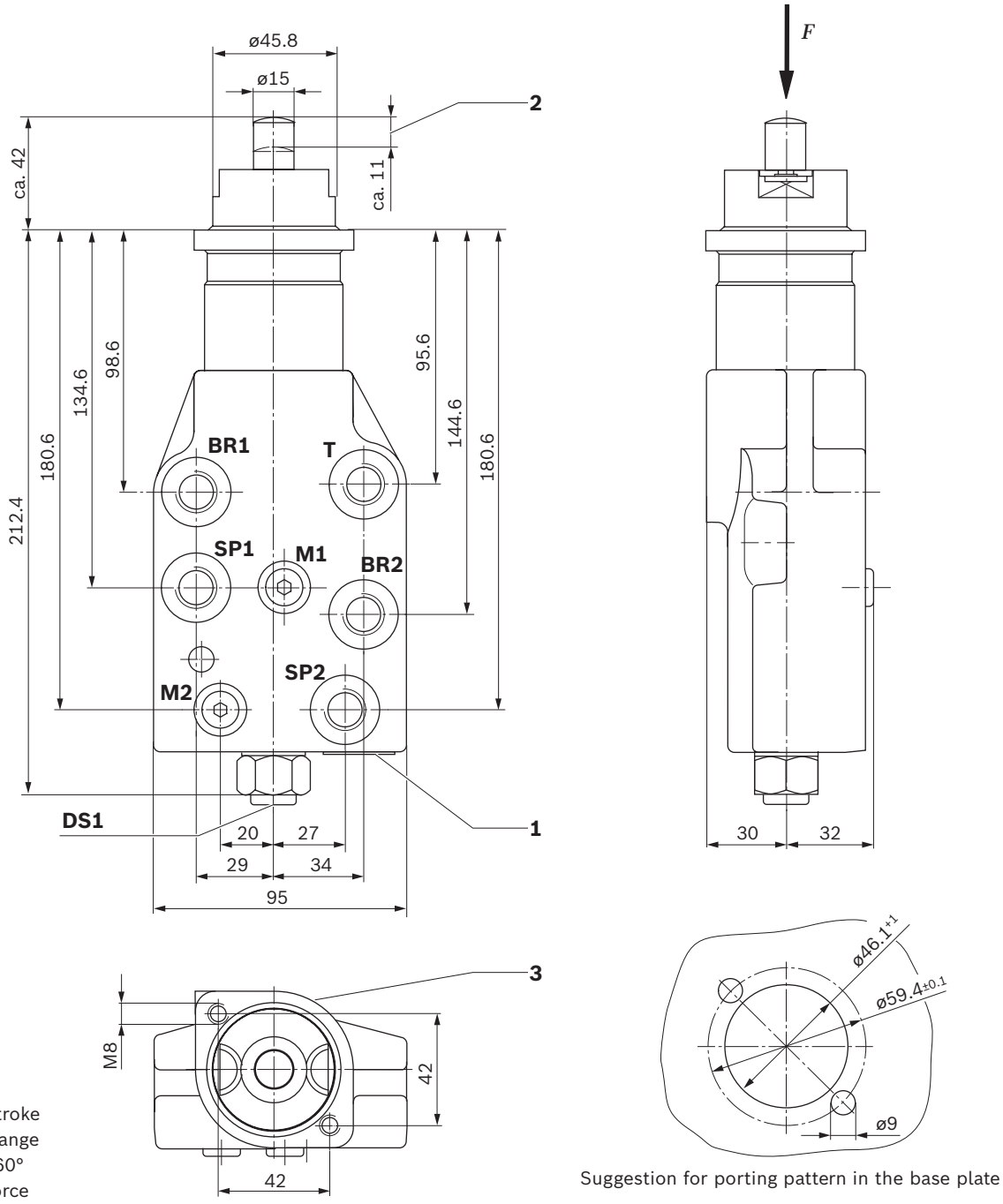


▼ **Brake pressure and angle sensor voltage signal, progressive characteristic curve (example)**



Dimensions

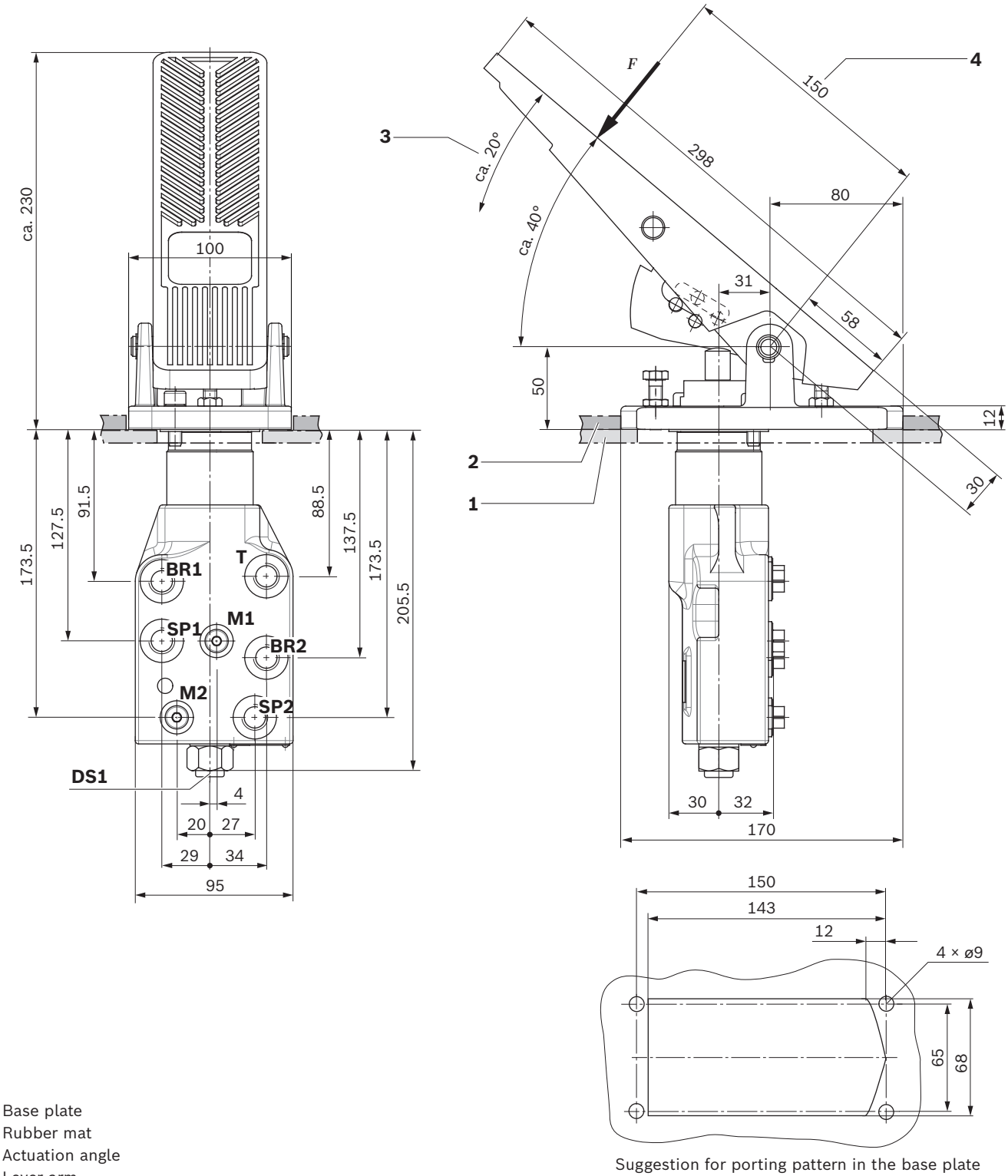
▼ **LT07 excluding pedal**



1 Name plate
2 Actuation stroke
3 Mounting flange rotatable 360°
F Actuating force

Suggestion for porting pattern in the base plate

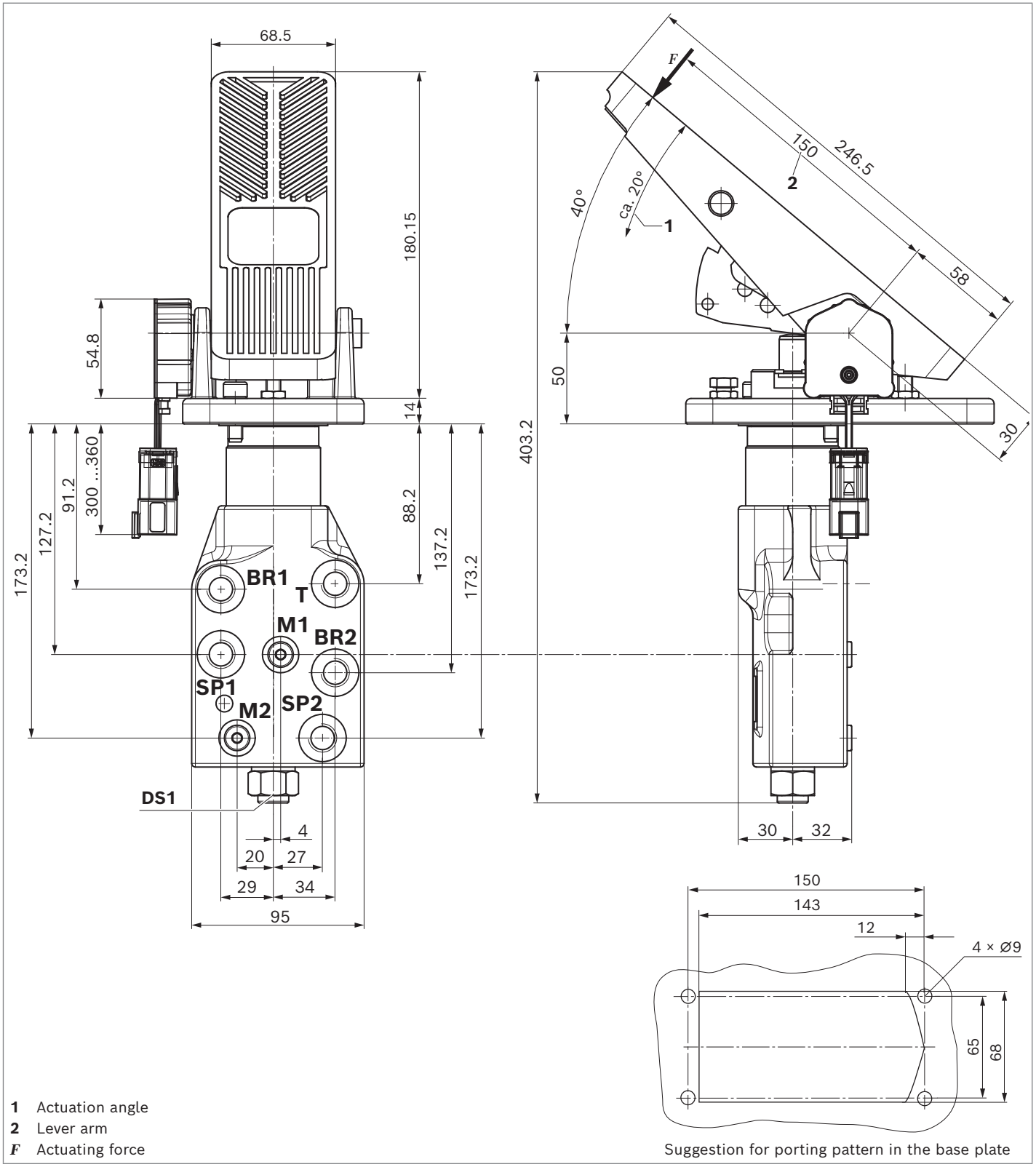
▼ **LT07 with mounted standard pedal LT19**



1 Base plate
2 Rubber mat
3 Actuation angle
4 Lever arm
F Actuating force

Suggestion for porting pattern in the base plate

▼ **LT07 with mounted pedal LT19 with shortened pedal plate and angle sensor**



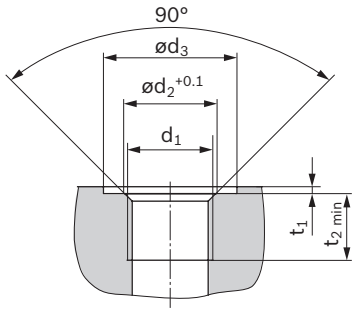
1 Actuation angle
2 Lever arm
F Actuating force

Suggestion for porting pattern in the base plate

Line connections

▼ Metric thread according to DIN 3852-1

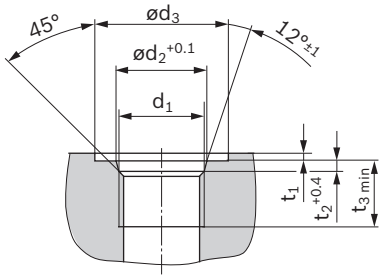
02



Port	d_1	Ød_2	Ød_3	t_1	t_2
BR1; BR2	M16 × 1.5	16.4	26	1.5	12
SP1; SP2	M16 × 1.5	16.4	26	1.5	12
T	M16 × 1.5	16.4	26	1.5	12
DS1	M12 × 1.5	–	20	0.9	11
M1	M10 × 1	–	20	1	8
M2	M10 × 1	–	20	1.5	8
Pst	M10 × 1	–	20	1	8
T2	M10 × 1	–	20	1	8

▼ UNF thread according to ISO 11926

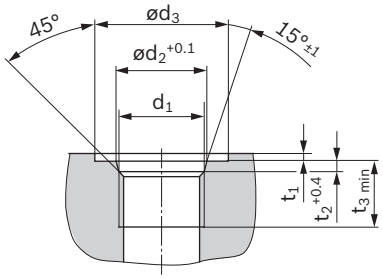
19



Port	d_1	Ød_2	Ød_3	t_1	t_2	t_3
BR1; BR2	9/16-18	15.6	25	1.5	2.5	13
SP1; SP2	9/16-18	15.6	25	1.5	2.5	13
T	9/16-18	15.6	25	1.5	2.5	13
DS1	7/16-20	12.4	21	0.9	2.4	12
M1, M2	7/16-20	12.4	21	1.5	2.4	11.5
Pst	M10 × 1	–	20	1	–	8
T2	M10 × 1	–	20	1	–	8

▼ Thread according to ISO 6149-1

50



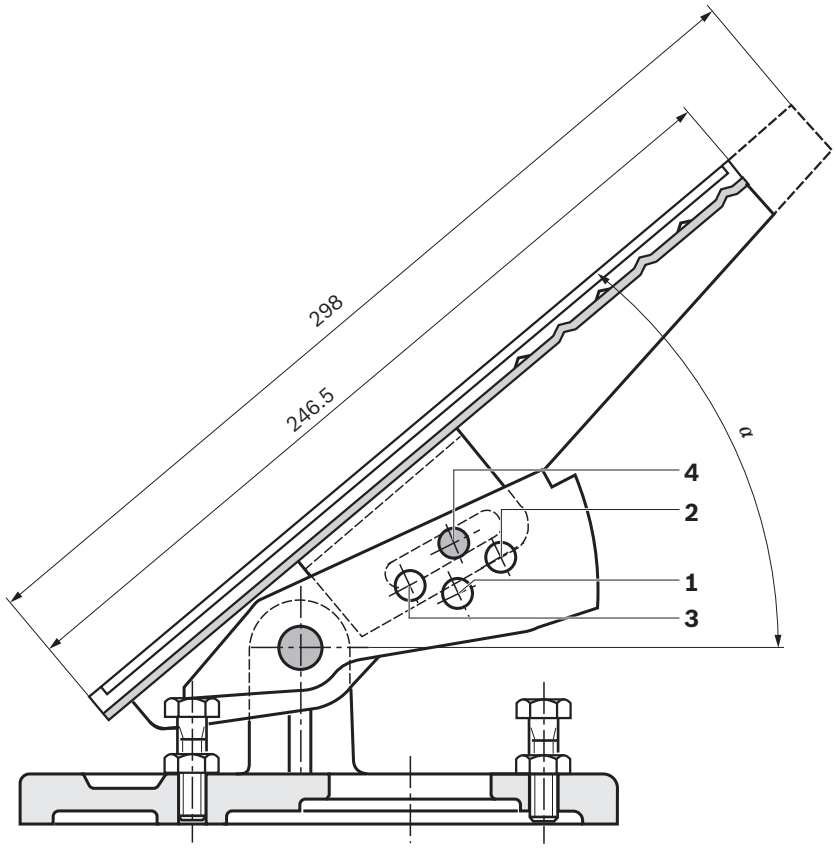
Port	d_1	Ød_2	Ød_3	t_1	t_2	t_3
BR1; BR2	M16 × 1.5	17.8	27	1.5	2.4	13
SP1; SP2	M16 × 1.5	17.8	27	1.5	2.4	13
T	M16 × 1.5	17.8	27	1.5	2.4	13
DS1	M12 × 1.5	12.4	20	0.9	–	11
M1, M2	M10 × 1	–	27	1.5	–	9
Pst	M10 × 1	–	20	1	–	8
T2	M10 × 1	–	20	1	–	8

Notice
Ports **DS1**, **M1** and **M2** are usually plugged.

Brake pedal models

The power brake valve LT07 is supplied with or without a pedal. The pedals LT19 and LT20 are available (further variants available on request).

▼ **LT19 standard version / LT19 special version LT19 with shortened pedal plate**

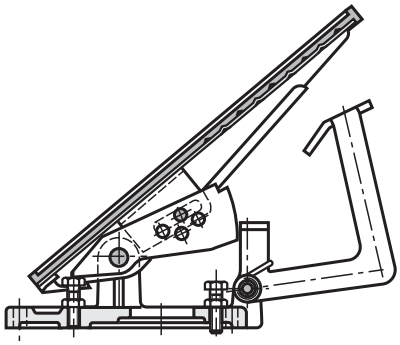


Pedal work angle α variable in steps of 5°:

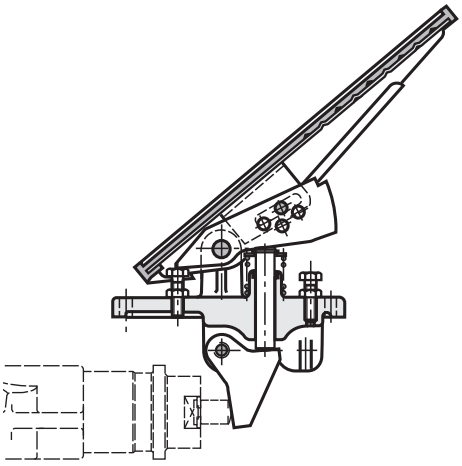
1 Hole 1 = 25°
2 Hole 2 = 30°
3 Hole 3 = 35°
4 Hole 4 = 40° (standard version)

Notice
All pedal models come equipped with a slip-resistant, removable rubber mat.

▼ **Version LT19 with detent hook**



▼ **LT20 special version for horizontally installed brake valve**



Notice
The brake valve and brake pedal are delivered separately.
Order number LT20: R900517761

Related documentation

Document type	Title	Document number
Instruction manual	Hydraulic power brake valves for mobile applications	66200-B
Data sheet	Brake pedal angle sensor	66238
	Reliability characteristics $MTTF_D$ for power brake valves	90291

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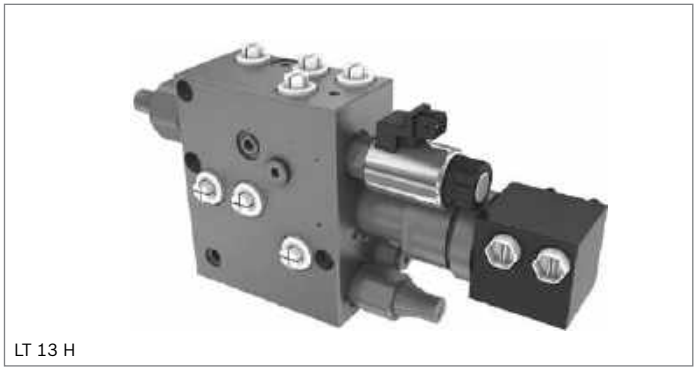
Dual-circuit power brake valve with compact design
LT 13

RE 66221
Edition: 05.2017
Replaces: 04.2014



LT 13 H

- Compact module with brake valve and accumulator charging valve, optionally with parking brake
- Nominal pressure 40, 60, 80, 100 and 125 bar
- Maximum parking brake pressure 210 bar
- Series 3X

Features

- Electric or mechanical parking brake valve (optional)
- Brake pressure proportional to actuating force and actuation path
- Quick and easy installation
- Minimized piping work
- Little space required
- Integration into existing hydraulic systems possible
- Fast operational readiness
- Sensitive metering
- Minimum number of components
- Flexible installation

Fields of application

- Construction machinery
- Material handling vehicles
- Forestry and agricultural machinery
- Municipal vehicles
- Specialized vehicles

Contents

Type code

01	02	03		04	05	06	07	08	09	10	11		12	13	14	15
LT 13		**3X**	**/**									**/**		**M**		*****

Series

01	Dual-circuit power brake valve with compact design LT 13	**LT 13**

Type of actuation service brake (BBA)

02	Mechanical	**M**
	Hydraulic, series connection	**H**
	Hydraulic, parallel connection	**P**
	Mechanical/hydraulic combined	**K**

Series

03	30 to 39 (unchanged installation and connection dimensions)	**3X**

Characteristic curve

04	Linear characteristic curve	**L**
	Progressive characteristic curve	**P**

Nominal pressure (service brake pressure BBA)

05	40 bar	**040**
	60 bar	**060**
	80 bar	**080**
	100 bar	**100**
	125 bar	**125**

Type of actuation parking brake (FBA)

06	Without FBA	**–**
	Mechanically operated	**M**
	Electrically switched[1)]	**E**
	Electrically switched, reduced	**R**
	Electrically switched with external pressure supply[2)]	**S**

Parking brake pressure (FBA)

07	[1); 2)]	**XXX**
	Without FBA	**000**
	20 bar	**020**
	40 bar	**040**
	60 bar	**060**
	80 bar	**080**
	100 bar	**100**
	120 bar	**120**

Accumulator charging pressure

08	100 bar	**A**
	120 bar	**B**
	150 bar (standard)	**C**
	165 bar	**D**
	185 bar	**E**
	200 bar	**F**

1) With the electrically switched FBA, the parking brake pressure of the FBA corresponds to the accumulator charging pressure. Observe the switching hysteresis!

2) With external FBA pressure supply, the parking brake pressure of the FBA corresponds to the supplied pressure.

01	02	03		04	05	06	07	08	09	10	11		12	13	14	15
LT 13		**3X**	**/**									**/**		**M**		*****

Accumulator charging flow

09	Approx. 17 l/min (standard)	**B40**
	Approx. 6 l/min	**B18**

Voltage at the switching solenoid

10	12 Volt	**AG12**
	24 Volt	**AG24**

Connector type (standard with manual override)[3)]

11	Cubic connector	**NK4**
	Deutsch connector	**NK40**
	Junior timer, 2-pin (AMP)	**NC4**

Line connections

12	ISO metric thread according to DIN 3852-1	**02**
	UNF thread according to ISO 11926-1	**19**

Sealing material

13	NBR (nitrile rubber)	**M**

Additional equipment

14	With pressure switch (not possible in conjunction with parking brake version **R**)	**14**
	With actuation rod	**16**
	With actuation rod and pressure switch (not possible in conjunction with parking brake version **R**)	**17**

15	Further specifications in plain text	*****

3) Plug-in connectors are not included in the scope of delivery and must be ordered separately, see data sheet 08006.

Functional description

The LT 13 is a dual-circuit power brake valve with compact design, which combines all the required functions in one valve.

Accumulator charging valve
The accumulator charging valve (**1**) primarily charges the accumulator. If the accumulator pressure falls below the switch-on pressure of the charging valve, the accumulators will be charged until the cut-off pressure is reached. The switching pressure differential is approx. 18% of the cut-off pressure. The accumulators are charged with a charging flow of e.g., 17 l/min (version B40). If the pump conveys more than e.g., 17 l/min, then the downstream consumer (**N**) is supplied with the difference.

Notice
If downstream consumers (**N**) generate a pressure higher than the cut-off pressure of the accumulator charging valve, then the accumulator circuit is raised to this pressure level. The pressure of the downstream consumers (**N**) must be 30% lower than the set accumulator charging pressure (N < accumulator charging pressure –30%).

Circuit separation
The valve supplies two separate brake circuits.
They are separated by means of an inverted shuttle valve (**2**).

Dual-circuit brake valve
The dual-circuit power brake valve LT 13 is a directly operated pressure reducing valve in a 3-way version with continuous mechanical actuation.
The LT 13 essentially consists of two 3-way pressure reducing valves arranged in tandem design. The pressure in both brake circuits increases proportional to the actuating force and actuation path. When the deflection is kept constant, the regulated pressure in the channels **BR1** and **BR2** is kept constant. The valve of the first brake circuit (**4.1**) is directly operated. The pressure of the second brake circuit (**4.2**) is controlled by the first brake valve. If the hydraulic supply of the first brake circuit fails, the second brake circuit will then be directly operated.

Mechanically operated service brake
For the mechanical actuation of the LT 13 M, an LT 20 foot pedal is suitable (for variants see page 18). When the recommended overall set-up is observed, the actuating force and actuation path are matched to one another.

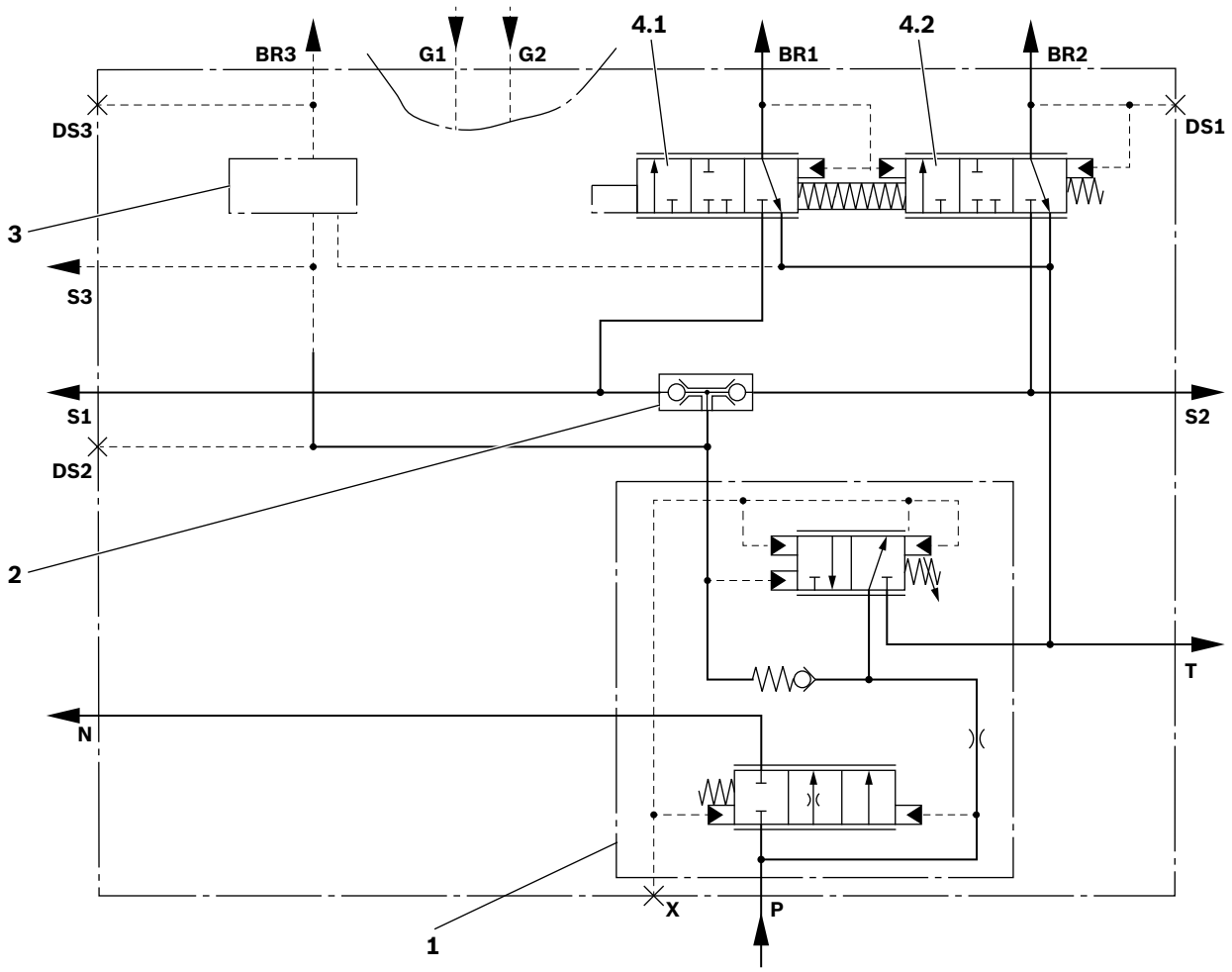
Hydraulically operated service brake
For hydraulic actuation, the tandem master cylinder is actuated using a suitable pedal. The hydraulic fluid supplied from the storage tank is piped to the LT 13 H pickup head proportional to the pedal path. Both the tandem master cylinder and the LT 13 H pickup head have two separate chambers.
Proportional to the supplied hydraulic fluid, the pickup spools move in line and charge the main brake spools via the brake pressure control springs.

Mechanically operated parking brake/auxiliary brake (3)
The parking brake valve is a directly operated 3-way pressure reducing valve. If the valve is actuated, the pressure then drops proportional to the actuation. The valve controls the pressure by means of metering. As a result, the “auxiliary brake” function can also be fulfilled.

Electrically switched parking brake (3)
The electrically switched parking brake valve (**3**) is a 3/2 directional valve. If the valve is switched with an electric signal, then port **BR3** is connected to port **S3**. The applied accumulator pressure **S3** supplies the parking brake via **BR3**. When the electric signal is switched off or fails, the parking brake valve **BR3** connects to **T** and the applied pressure in the parking brake can be reduced.
The auxiliary brake function cannot be realized.

Mechanical/hydraulic combined, actuated service brake
For the mechanical actuation of the LT 13 K, an LT 20 foot pedal is suitable (for variants see page 18). When the recommended overall set-up is observed, the actuating force and actuation path are matched to one another.
The LT 13 K can also be hydraulically controlled via port **G**. This control is either carried out via the internal parking brake valve (**3**) or via an external pressure supply (switchable or proportional).

▼ **Symbol LT 13**



1 Accumulator charging valve
2 Shuttle valve
3 Parking brake (optional) (FBA)
4 Dual-circuit brake valve (BBA)

Ports	
BR1	Service brake (1st brake circuit)
BR2	Service brake (2nd brake circuit)
BR3	Parking brake
DS1	Pressure switch brake lights
DS2	Pressure switch accumulator pressure
DS3	Pressure switch parking brake
S1	Supply to service brake (1st brake circuit)
S2	Supply to service brake circuit (2nd brake circuit)
S3	Supply to parking brake
G	Hydraulic control of the service brake (alternative)
P	Pump
T	Reservoir
N	Return flow or downstream consumers
X	Load sensing (LS)

Technical data

General				
Weight (approx.)			kg	11 (depends on the version)
Installation position				Preferably horizontal
Connection type				Metric thread
Ambient temperature range		θ	°C	–25 to +80
Standard paint				One-coat paint RAL 5010

Hydraulic		**Port**			
Nominal pressure		BR1, BR2	p_{Br}	bar	40 ... 125
Maximum inlet pressure		P	p	bar	210
Maximum pilot pressure	Version **H**	G1, G2	p_G	bar	40
	Version **P**	G1, G3	p_G	bar	180
	Version **K**	G	p_G	bar	180
Maximum reservoir pressure		T	p	bar	0.5 (the reservoir pressure must not exceed the application pressure of the brake.)
Maximum parking brake pressure	Version **M**	BR3	p	bar	120
	Version **E**	BR3	p	bar	Corresponds to the accumulator charging pressure
	Version **R**	BR3	p	bar	120
	Version **S**	BR3	p	bar	210 (≙ max. pressure S3 of the external pressure supply)
Maximum accumulator charging pressure	Cut-off pressure	S1, S2, S3	p	bar	210
	Switch-on pressure	S1, S2, S3	p	bar	Approx. 18% lower than the set accumulator charging pressure
Maximum consumer pressure		N	p	bar	30% lower than the set accumulator charging pressure
Maximum flow		P → S		l/min	approx. 6 (B18) approx. 17 (standard, B40)
		P → N		l/min	70
Hydraulic fluid					Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, e.g. HEES (Synthetic ester) according to ISO 15380 and hydraulic fluids as specified in data sheet 90221, on request
Hydraulic fluid temperature range			θ	°C	–20 to +80
Viscosity range			ν	mm²/s	2.8 to 380
Maximum admissible degree of contamination of the hydraulic fluid, cleanliness level as per ISO 4406 (c)					Class 20/18/15, we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

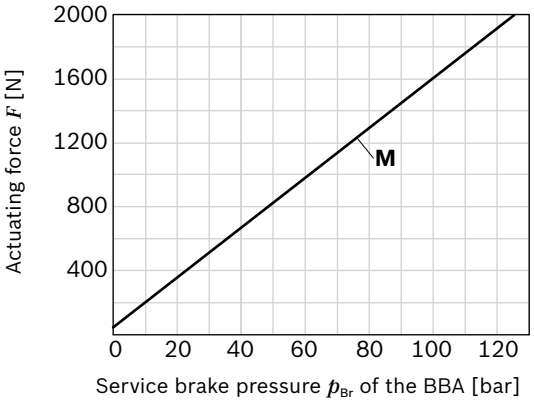
Electric				
Voltage type				DC voltage
Supply voltage			V	12; 24
Type of protection according to VDE 0470-1 (DIN EN 60529), DIN 40050-9	Version **K4**			IP65 with installed and locked plug-in connector[1)]
	Version **C4**			IP65 with installed and locked plug-in connector[1)]
				IP69K with Rexroth plug-in connector (material number R901022127)[1)]
	Version **K40**			IP65K with installed and locked plug-in connector[1)]

Notice
Please contact us if the unit is to be used outside the specified range of values.

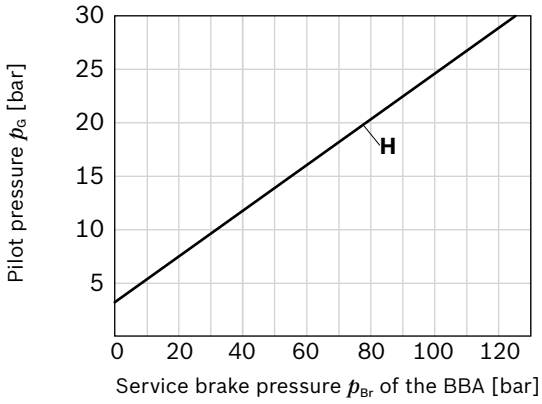
1) Plug-in connectors are not included in the scope of delivery and must be ordered separately, see data sheet 08006.

Characteristic curves

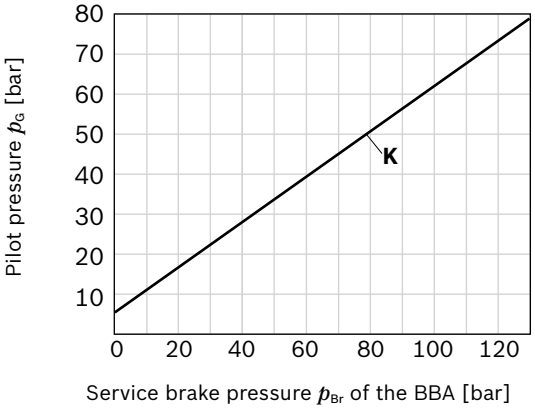
▼ **Type of actuation mechanical, linear characteristic curves (directly operated, without pedal)**



▼ **Type of actuation hydraulic, linear characteristic curves**

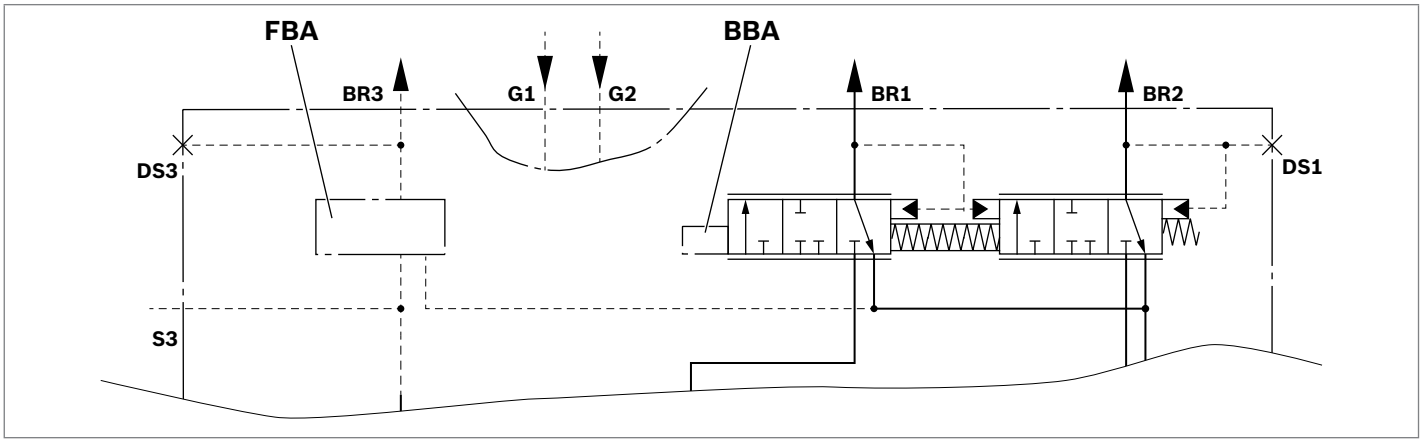


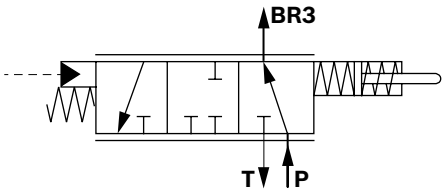
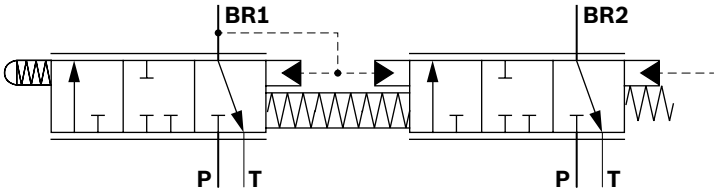
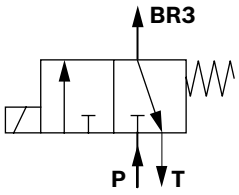
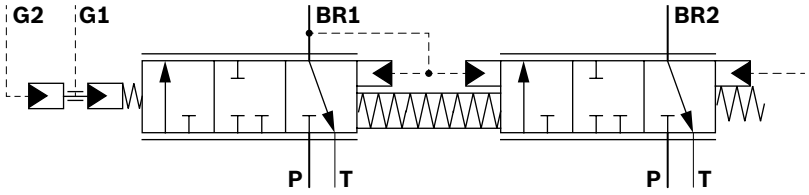
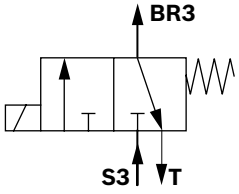
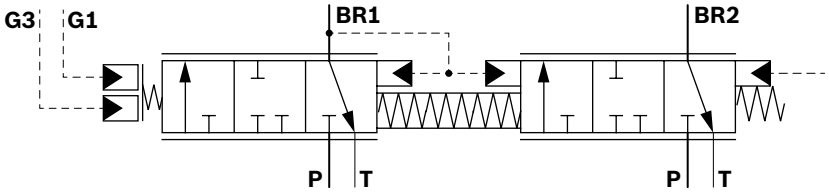
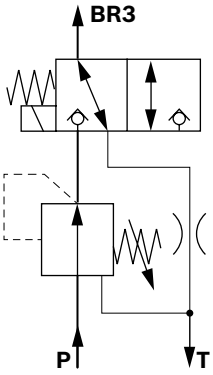
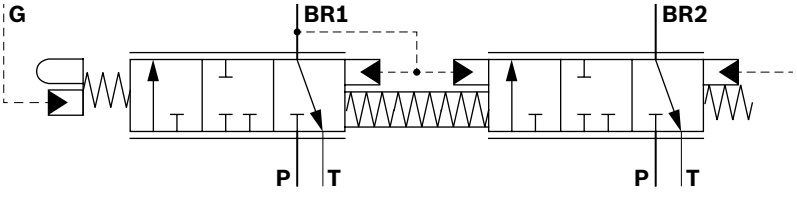
▼ **Type of actuation mechanical/hydraulic combined, linear characteristic curves**



Notice
The set service brake pressure cannot be exceeded with a higher pilot pressure.

Types of actuation



Parking brake (FBA)	Service brake (BBA)
M 	M 
E 	H[1] 
S 	P[1] 
R 	K[1] 

1) The connection to port **G** needs to be made by the customer. Bosch Rexroth recommends an upstream damping valve at port **G** for directly switched actuation.

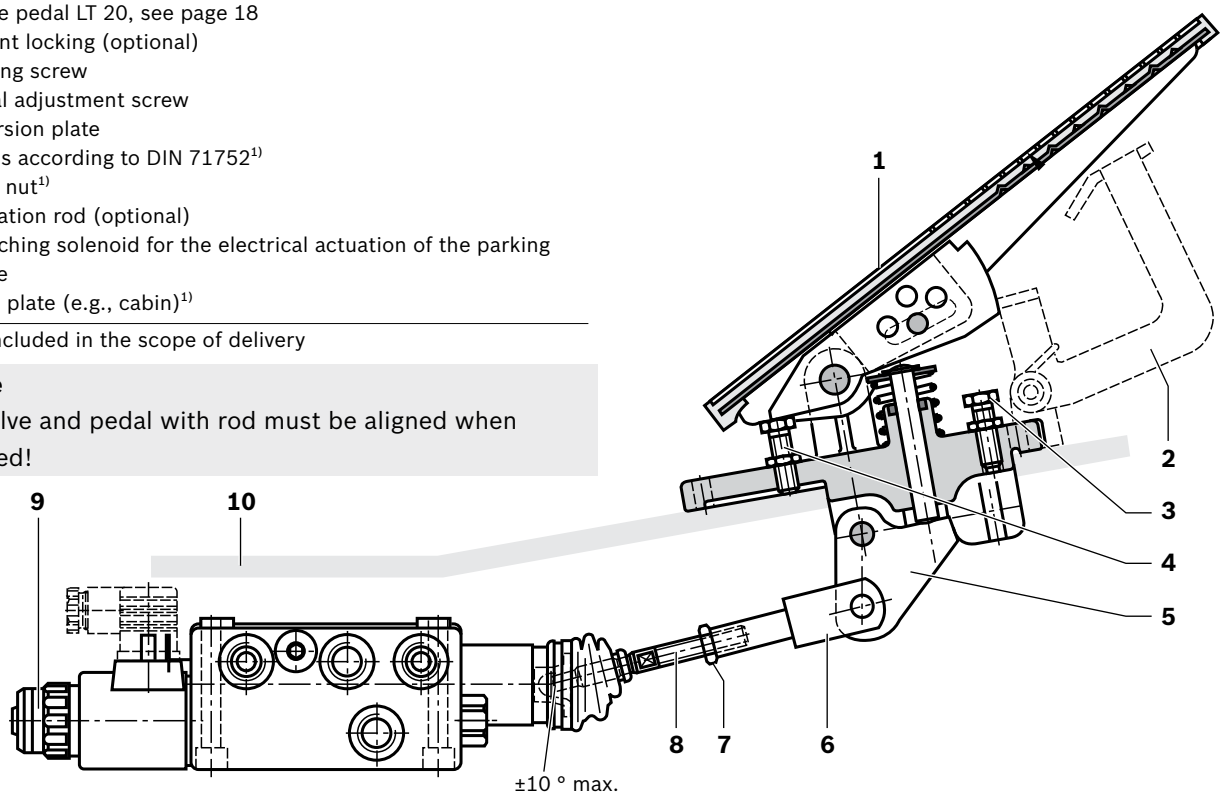
Overall set-up

LT 13 with mechanical actuation BBA

1 Brake pedal LT 20, see page 18
2 Detent locking (optional)
3 Setting screw
4 Pedal adjustment screw
5 Diversion plate
6 Clevis according to DIN 71752[1)]
7 Lock nut[1)]
8 Actuation rod (optional)
9 Switching solenoid for the electrical actuation of the parking brake
10 Base plate (e.g., cabin)[1)]

1) Not included in the scope of delivery

Notice
The valve and pedal with rod must be aligned when installed!



Installation
For low-friction actuation, it is important that the valve that is well aligned with the pedal. In the plan view, the valve axis, actuation rod (**8**) and pedal (**1**) must be aligned! In the side view, the actuation rod may press against the valve actuation at a maximum angle of 10°. The gradient and height of the pedal influence the actuation angle and the force.
If the required space necessitates a control with a longer actuation unit, it has to be resistant to buckling (see actuating force).

Setting the pedal
The lock nut (**7**) and clevis (**6**) are screwed onto the actuation rod (**8**), after installing the valve and the pedal, the clevis (**6**) is connected to the diversion plate (**5**) with the axle bolt.

Pedal (1) not actuated
The actuation rod (**8**) is adjusted until the play between the ball end and valve actuation is reduced to a minimum.

Notice
The valve actuation must not be preloaded. The actuation rod must be able to move very slightly back and forth. This setting is secured by means of the lock nut (**7**).

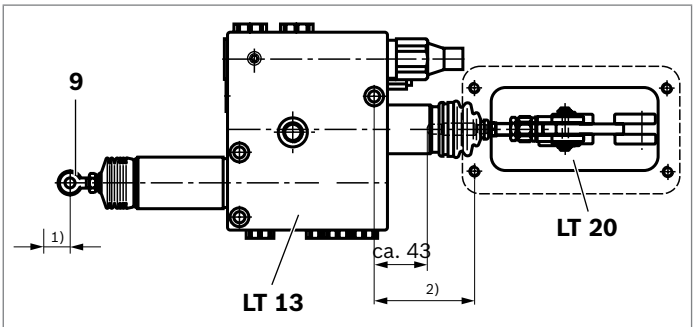
Pedal (1) actuated
The maximum brake pressure is set as required using the setting screw (**3**) and secured by means of the lock nut. When the pedal is released, only the reservoir pressure may be available.

Option – Pedal with detent locking (2)
The lock nut (**7**) and clevis (**6**) are screwed onto the actuation rod (**8**), the clevis is connected to the diversion plate (**5**) with the axle bolt. Bring the pedal in the detented position. Set the actuation rod (**8**) so that the valve achieves the desired maximum pressure. The pressure setting can be secured by locking the nut(**7**).

Releasing the detent locking
When the pedal (**1**) is not actuated, rotate the pedal adjustment screw (**4**) until the smallest possible play is achieved.

Parking brake version M

The parking brake is set to the desired pressure at the factory. If the parking brake is not activated, the parking brake pressure corresponds to the pressure set at the factory. The Bowden cable must be set so that no traction force acts on the eye bolt (**9**) in the non-actuated state. With increasing actuation (pulling) of the parking brake, the brake pressure decreases to the reservoir pressure. The entire force of the spring-loaded accumulator cylinder then acts on the wheel brake. To this end, the Bowden cable must allow for a stroke of at least 10 mm. The holding force corresponds to the connection force and is max. 1100 N. The Bowden cable should be laid in such a way that low-friction actuation is possible.



1) Stroke min. 10 mm
2) customer-specific

Parking brake version E

The electric FBA cannot be set.
When voltage is applied to the solenoid (12 or 24 Volt), the accumulator pressure is switched to the parking brake. The minimum parking brake pressure corresponds to the switch-on pressure of the charging valve. If no voltage is applied to the solenoid, the output pressure corresponds to the reservoir pressure.

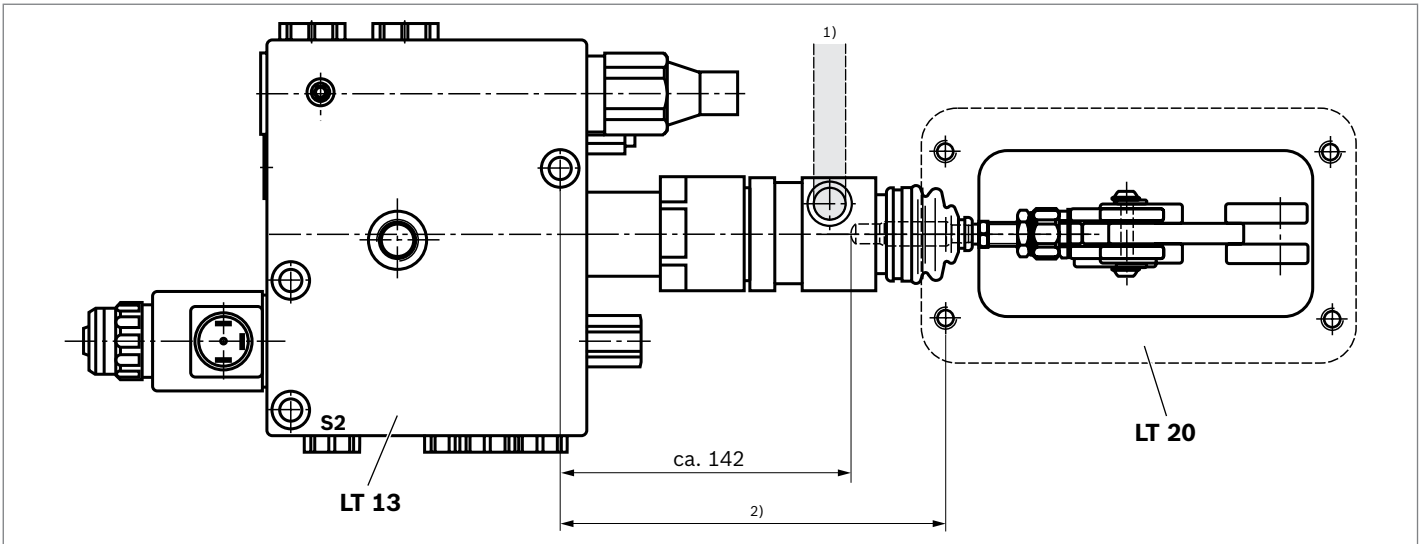
Parking brake version R

When voltage is applied to the solenoid (12 or 24 Volt), the set pressure is switched to the parking brake. If no voltage is applied to the solenoid, the output pressure corresponds to the reservoir pressure.

Parking brake version S

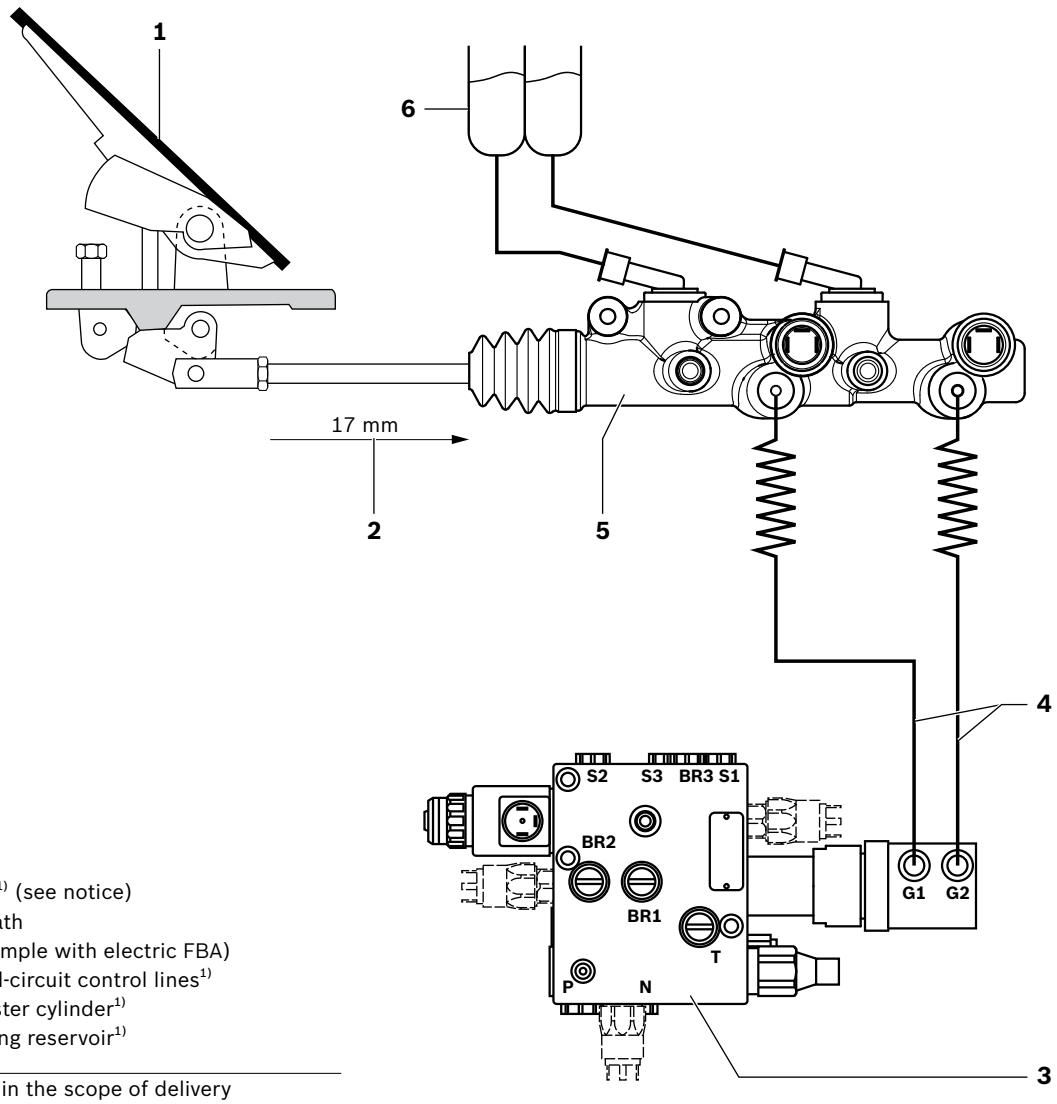
When voltage is applied to the solenoid (12 or 24 Volt), the external pressure supply connected to **S3** is connected to port **BR3** and switched to the parking brake. If no voltage is applied to the solenoid, the output pressure **BR3** corresponds to the reservoir pressure.

LT 13 With combined mechanical/hydraulic actuation BBA



1) Piping by customer
2) customer-specific

LT 13 with hydraulic actuation BBA



1 Brake pedal[1)] (see notice)
2 Actuation path
3 LT 13 H (example with electric FBA)
4 Flexible dual-circuit control lines[1)]
5 Tandem master cylinder[1)]
6 Compensating reservoir[1)]

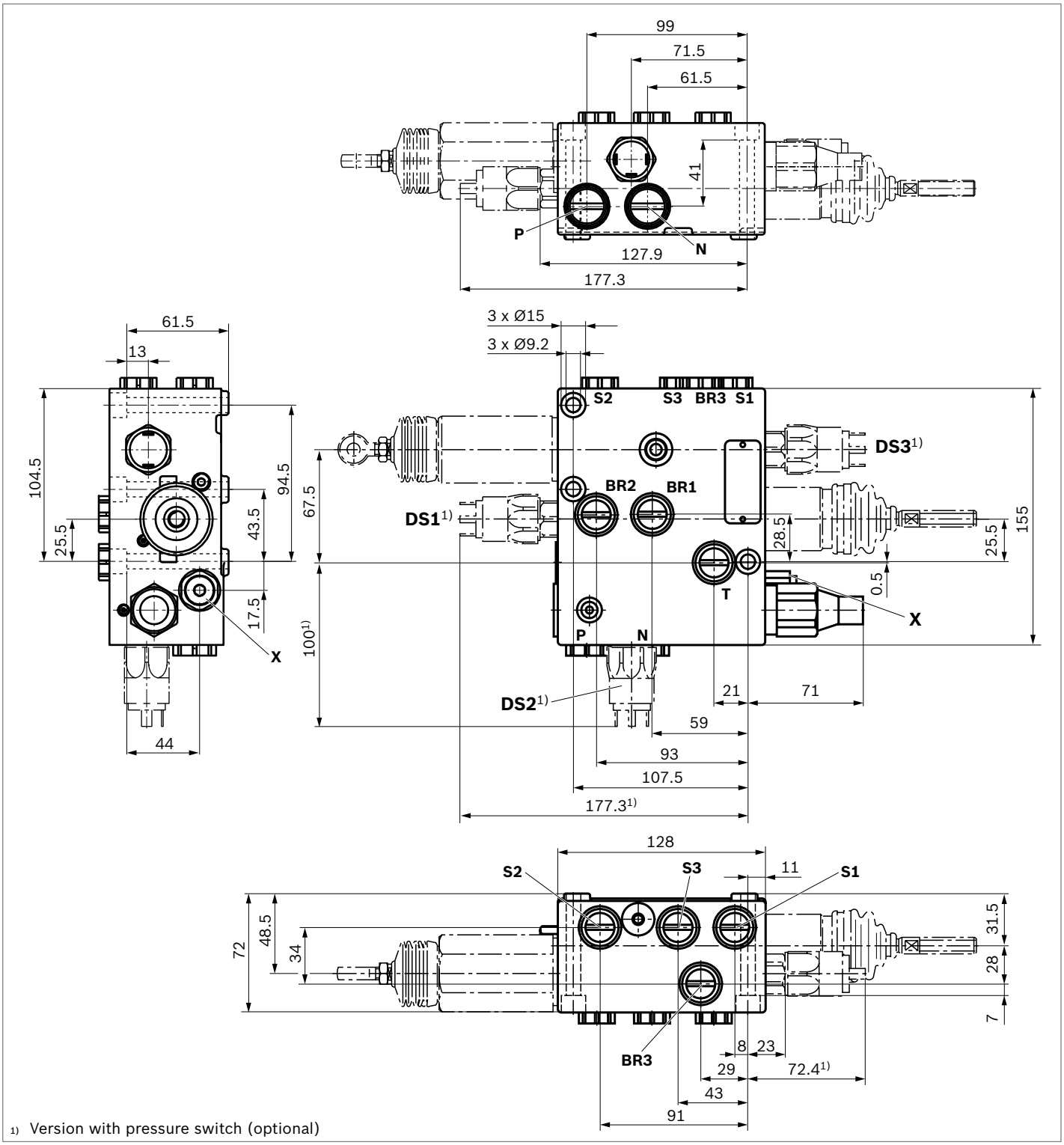
1) Not included in the scope of delivery

For the control, we recommend the tandem master cylinder MH17861.2.1 from FTE Automotive (Ebern/Germany). The stroke volume of the encoder cylinder and the displacement of the LT 13 H pickup head are matched to one another.

Notice
If one control line (**4**) fails, the tandem master cylinder requires twice the actuation path to achieve the brake pressure. Twice the actuation path cannot be achieved with the LT 20.

Dimensions

▼ **Basic valve LT 13**

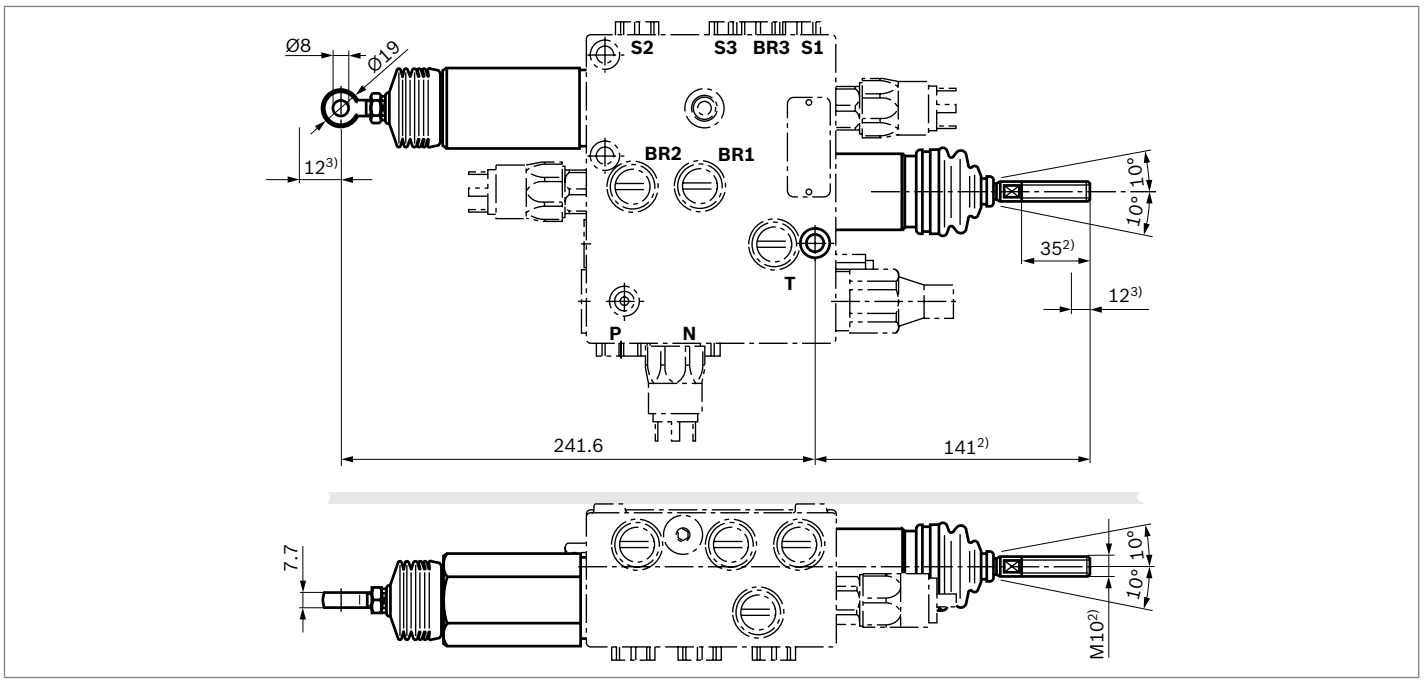


1) Version with pressure switch (optional)

▼ **Mechanical actuation BBA, mechanical FBA**

Version

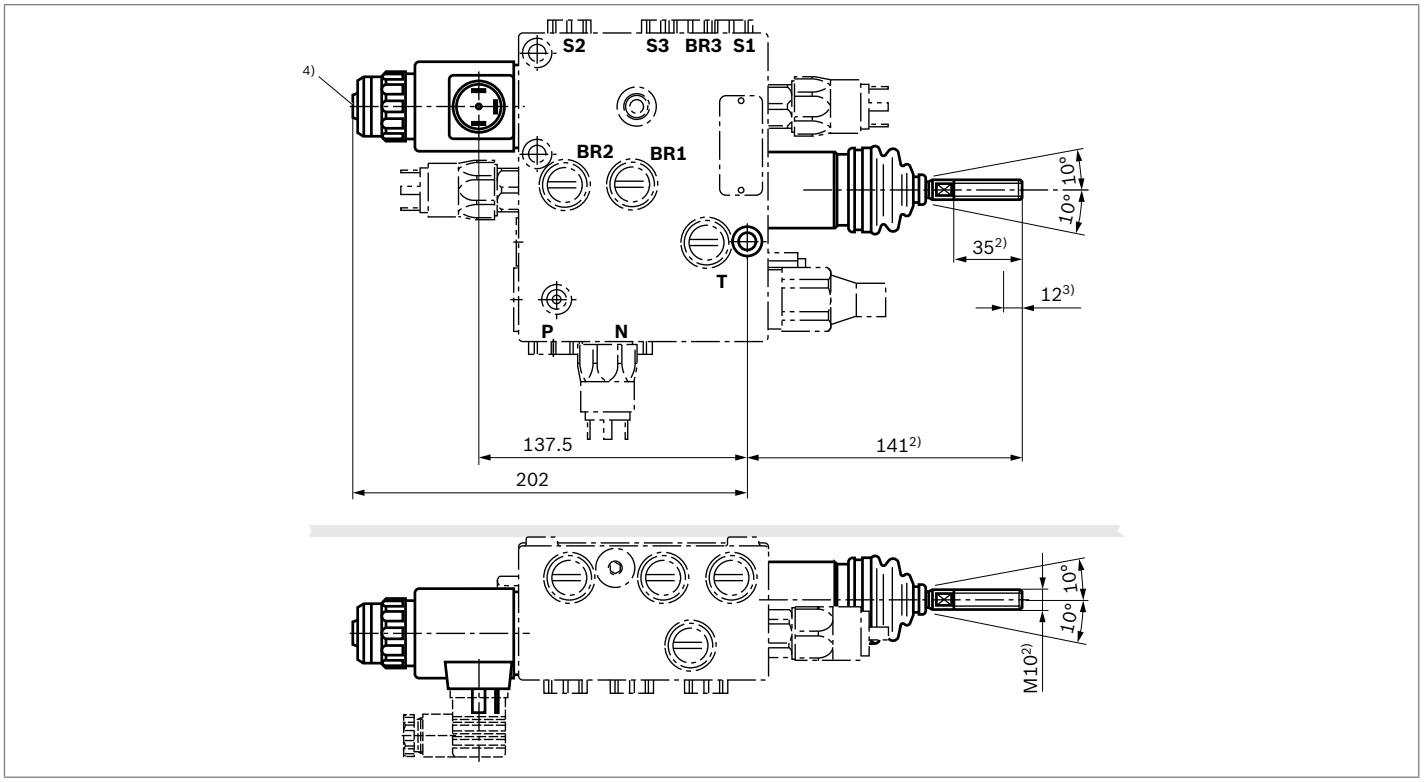
LT 13	M	3X	...	M	...



▼ **Mechanical actuation BBA, electric FBA**

Version

LT 13	M	3X	...	E	...
LT 13	M	3X	...	S	...

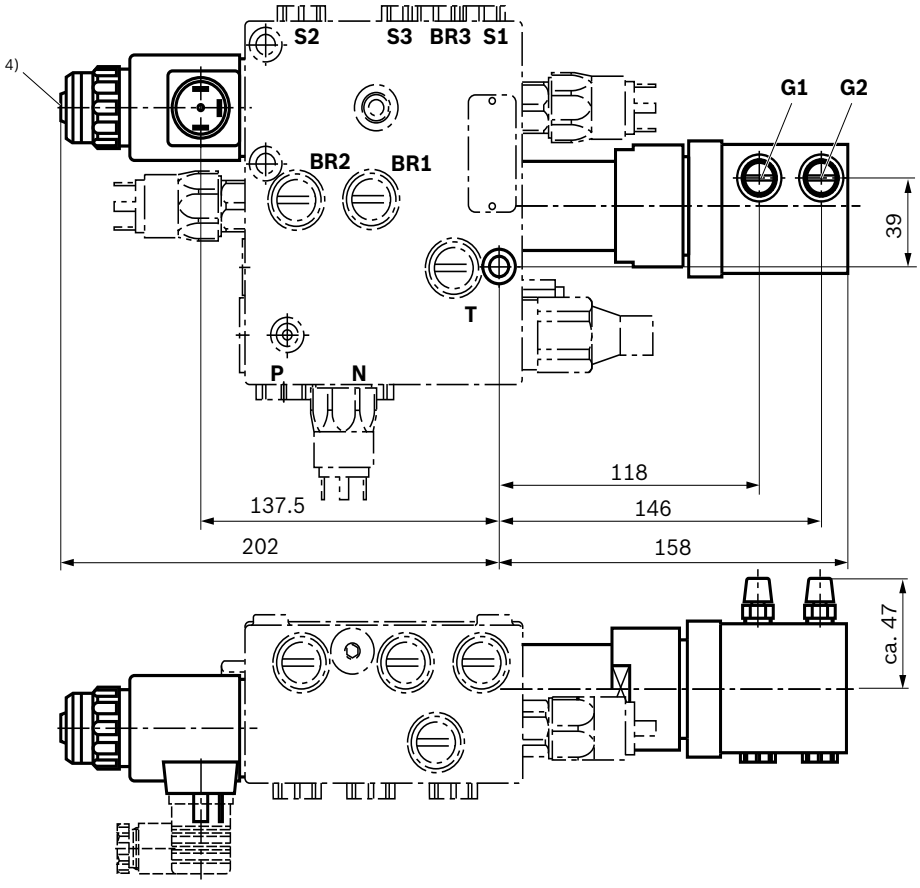


2) Version with actuation lever
3) Maximum stroke
4) Manual override device

▼ **Hydraulic actuation BBA (series connection), electric FBA**

Version

LT 13	H	3X	...	E	...
LT 13	H	3X	...	S	...

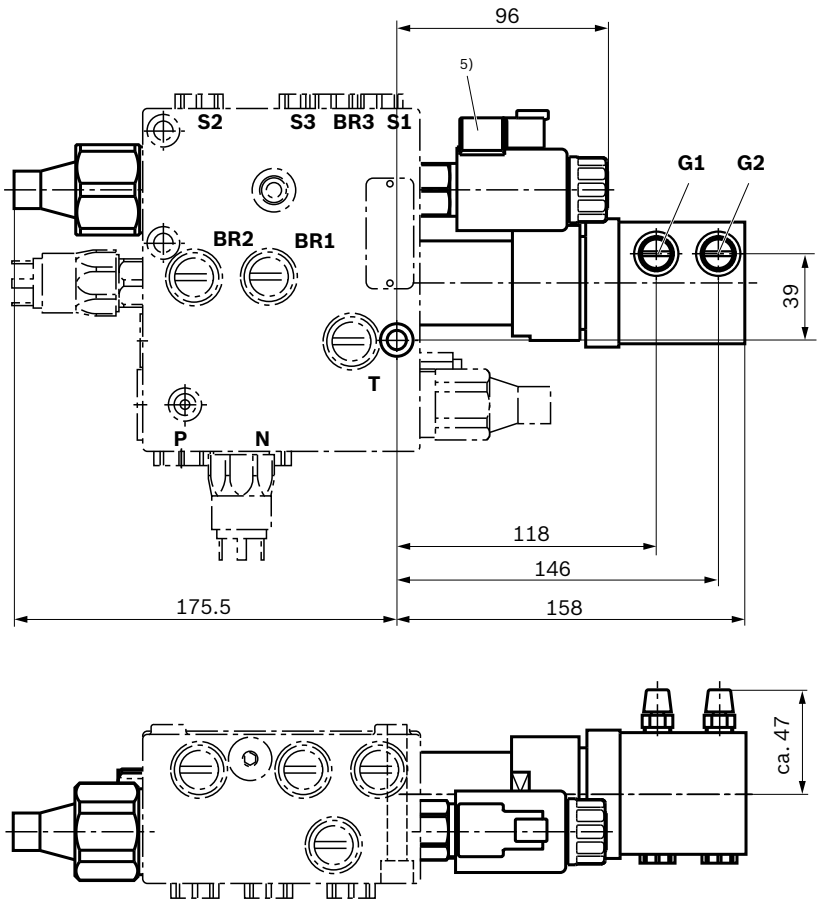


4) Manual override device

▼ **Hydraulic actuation BBA (series connection), electrically reduced FBA**

Version

LT 13	H	3X	...	R	...

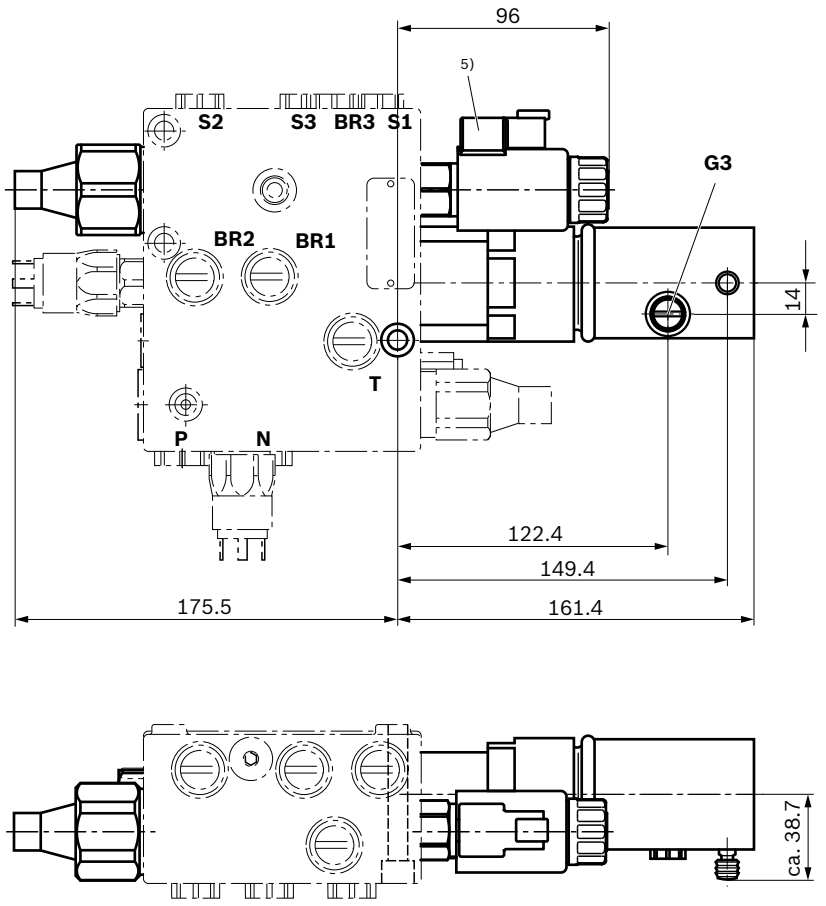


5) With connector type C4, K4 or K40, depending on the version

▼ **Hydraulic actuation BBA (parallel connection), electrically reduced FBA**

Version

LT 13	P	3X	...	R	...

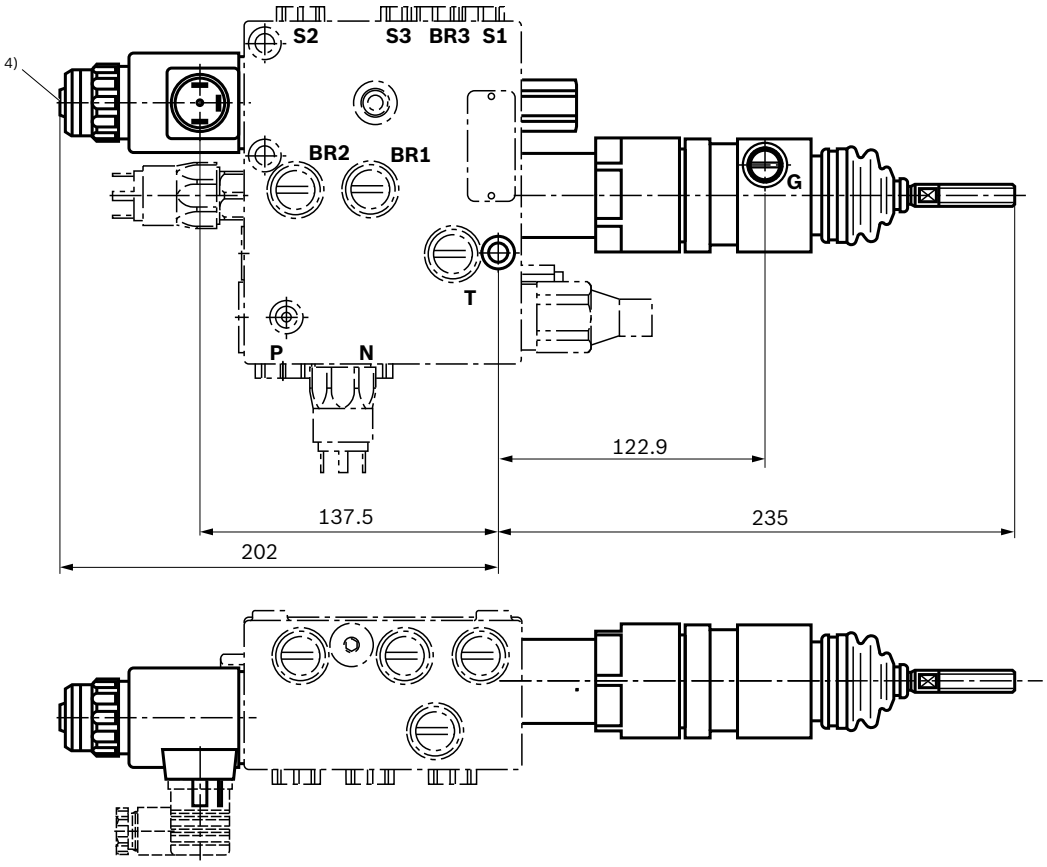


6) With connector type C4, K4 or K40, depending on the version

▼ **Mechanical/hydraulic combined actuation BBA, electric FBA**

Version

LT 13	K	3X	...	E	...

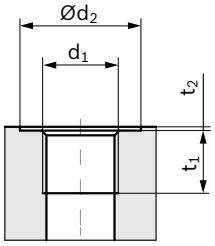


4) Manual override device

Line connections

Thread design 02

Port	d_1	Ød_2	t_1	t_2
BR1, BR2, BR3	M16 × 1.5	26	12	1
DS1, DS3	M12 × 1.5	18	12	0.5
DS2	M10 × 1	–	6	–
S1, S2, S3	M16 × 1.5	26	12	1
G, G1, G2	M12 × 1.5	20	12	1[1)]
G3	M12 × 1.5	20	12	2
X	M12 × 1.5	18	12	1
P, N	M18 × 1.5	28	12	1.5
T	M16 × 1.5	26	12	1



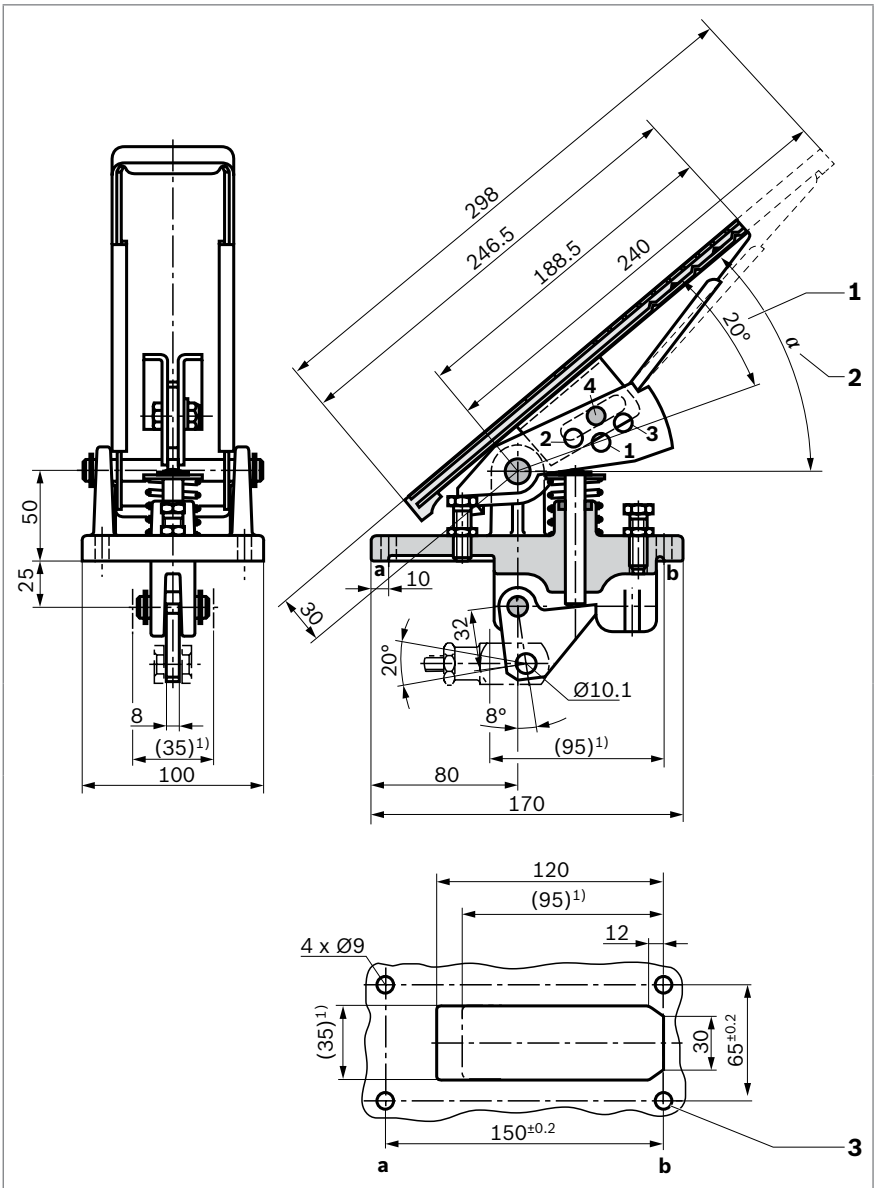
The surface is not machined at port **DS2** (no countersink). The seal of port **DS2** must therefore be made by means of a conical thread.

For the recommended pressure switch, see page 19.

1) Version LT 13 P: **G1** = 2.5

Brake pedal models

▼ **Standard version LT 20 (R900412420) / special version LT 20 with shortened pedal plate (R901056192)**



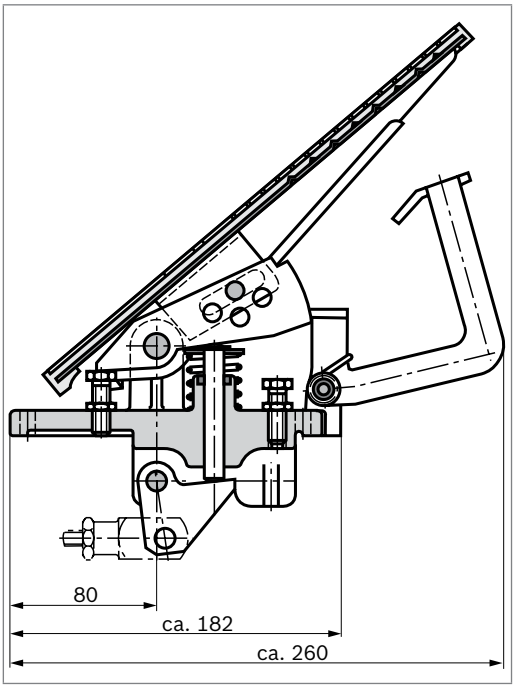
1 Actuation angle

2 **Pedal work angle *α* can be adjusted in 5° steps:**
Hole 1 = 25°
Hole 2 = 30°
Hole 3 = 35°
Hole 4 = 40° (standard version)

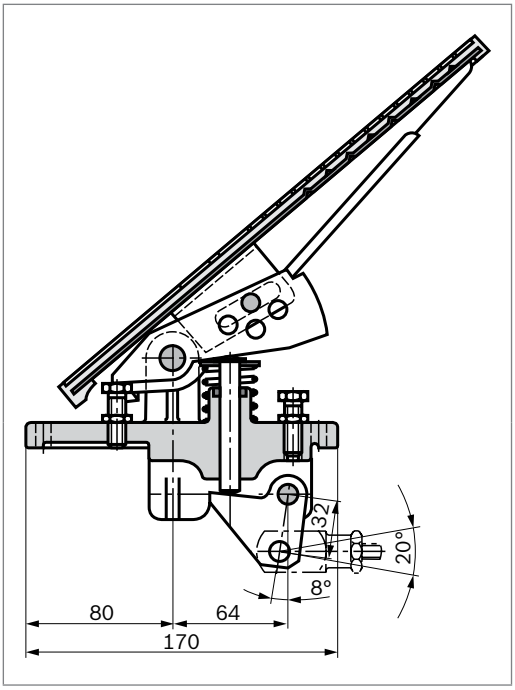
3 Suggestion for hole pattern in the base plate

1) Minimum dimensions of the base plate for installing the pedal

▼ **Special version LT 20 with locking hook (R900328536)**



▼ **Special version LT 20 with actuation rod to the front (R900412421)**



Notice
All pedal models come equipped with a slip-resistant, removable rubber mat.

Accessories

Brake pedals

Description	Order number
Standard version LT 20	R900412420
Special version LT 20 with locking hook	R900328536
Special version LT 20 with actuation rod to the front	R900412421
Special version LT 20 with shortened pedal plate	R901056192

Pressure switch

Port	Function	Switching pressure	Order number
DS1	Brake lights	5 bar	R901355130
DS2	Accumulator pressure	100 bar	R901453122
	Accumulator pressure	115 bar	R901468577
DS3	Parking brake	25 bar	R901355138

Other components (recommendation, not sold by Bosch Rexroth)

Description	Type
Stepped tandem cylinder	**MH17861.2.1** from FTE Automotive, Ebern/Germany
Bowden cable (remote actuation FBA)	MFB GmbH, Mühlheim a. d. Ruhr/Germany
Clevis	FBA axis connection, clevis according to DIN 71752 G8 × 16/32
	BBA axis connection, clevis according to DIN 71752 G10 × 20/40
Accumulator	**Notice:** Use ECO diaphragms for brake accumulators (for extended temperature range!)

Related documentation

Further information on installation, commissioning, and operation can be found in the instruction manual 66200-B: “Hydraulic power brake valves for mobile applications”.

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Dual-circuit power brake valve of compact design
LT 17

RE 66228
Edition: 01.2016
Replaces: 05.2014

HAD 7110

- Series 4X
- Service brake pressure 40 to 125 bar

Features

- Dual-circuit brake valve, accumulator charging valve and shuttle valve in one housing
- Simple and quick assembly (Plug-and-Play solution)
- Optional electrical on/off parking brake valve
- Connection facility for separate parking brake valve
- Integration into existing hydraulic systems is possible
- Integrated actuation pedal
- Direct connection of the pressure accumulator is possible (separate accumulator block is not required)
- Quickly ready for operation
- Sensitive metering
- Low in maintenance
- Integrated maximum pressure limitation of the brake circuit
- Brake pressure proportional to actuation force and travel
- Synchronisation through low hysteresis
- Ergonomic adaption of the pedal blade angle possible
- All pedal variations with slip resistant, removable rubber plates

Fields of application

- Construction equipment
- Material handling vehicles
- Forestry and agricultural machines
- Municipal vehicles
- Special vehicles

Contents

Functional description

The LT 17 is a dual-circuit brake valve in compact design with assembled foot pedal, which combines all necessary functions in one housing.

Accumulator charging valve
The accumulator charging valve (**1**) loads, as a priority, the accumulator. When the accumulator pressure falls below the switch-on pressure of the charging valve, the accumulators are loaded until the switch-off pressure is reached. The switching pressure differential is approx. 18 % of the cut-off pressure. The accumulators are loaded with a flow of e.g. 17 l/min (version B40). If the pump supplies more than e.g. 17 l/min, then the subsequent consumers (**N**) are supplied with the difference.

Note
If subsequent consumers (**N**) generate a higher pressure than the cut-off pressure of the accumulator charging valve, the pressure of the accumulator circuit is raised to this level!

Circuit separation
The valve supplies two separate braking circuits.
These are separated by an inverted shuttle valve (**2**).

Dual-circuit brake valve
The dual-circuit brake valve LT 17 is a directly operated pressure reducing valve in three-way design with stepless mechanical operation.
It has a maximum pressure relief of secondary circuits and infinitely adjustable pressure in the secondary circuits (brake circuits) which is in proportion to the actuation travel angle of the pedal.
The LT 17 basically consists of two tandem design 3-way pressure reducing valves, which were actuated via the assembled foot pedal (**5**). The pressure in both brake circuits rises proportional to the actuation force and the actuation travel angle of the pedal. With the deflection of the pedals kept constant, the defined pressure in channels **BR1** and **BR2** is kept constant. Thereby the pressure in **BR1** is only approx. 2 bar higher than in **BR2**. The valve of the 1st circuit (**4.1**) is directly operated. The pressure of the 2nd brake circuit (**4.2**) is controlled by the 1st brake valve.
If the hydraulic supply to the 1st brake circuit fails, then the 2nd brake circuit is directly actuated.
When the foot pedal is released, the two pressure reducing valves move back to the starting position. Thus the secondary circuits (**BR1** and **BR2**) are relieved.

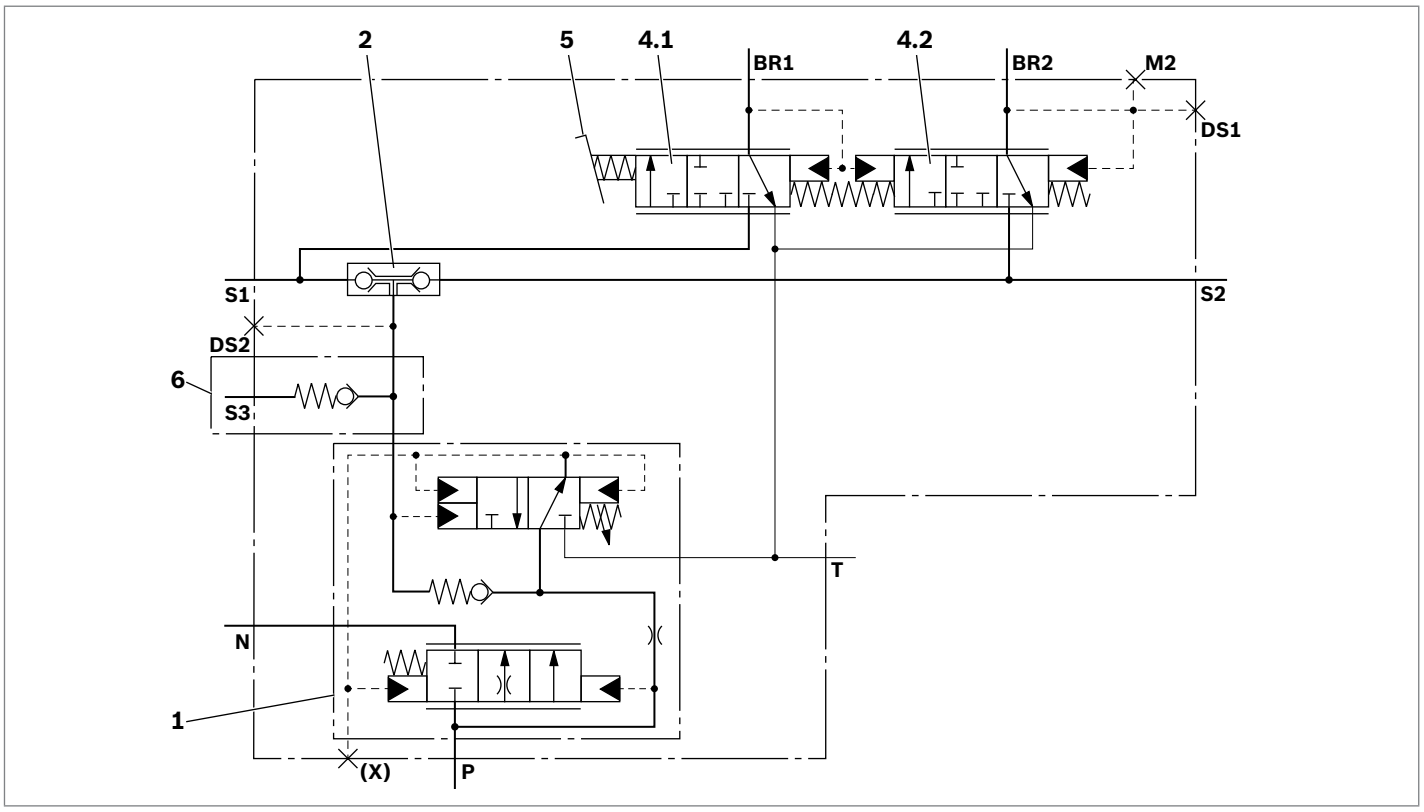
Version without parking brake valve
On accumulator port **S3** a separate hydraulic parking brake valve (e.g. LT 08) can be connected. For this, we recommend the optional version **R** (**6**) with check valve in **S3**.

Version with parking brake valve
The electrically switched parking brake (**3**) is a 3/2-way directional valve. When the valve is switched with an electrical signal, then the port **BR3** is connected with port **S3**. The present accumulator pressure **S3** supplies the parking brake via **BR3**. By switching off or failure of the electrical signal, the parking brake valve connects **BR3** with **T** and the applied pressure in the parking brake valve can be released. The auxiliary brake function cannot be performed.

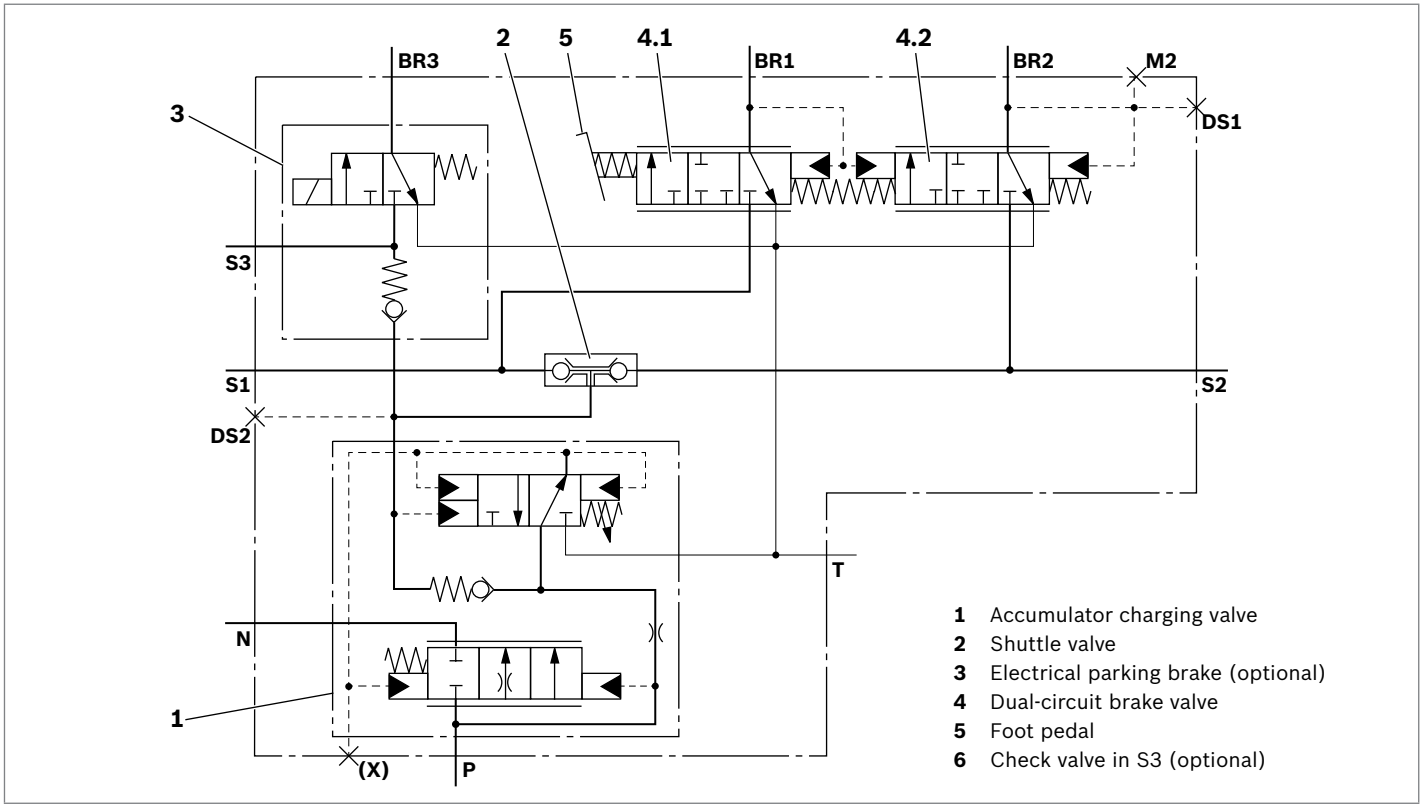
Ports	
BR1	Service brake (1st brake circuit)
BR2	Service brake (2nd brake circuit)
BR3	Parking brake
DS1	Pressure switch brake light
DS2	Pressure switch accumulator pressure
S1	Supply service brake (1st brake circuit)
S2	Supply service brake (2nd brake circuit)
S3	Supply parking brake
P	Pump
T	Tank
N	Subsequent consumers
M2	Pressure switch brake light (alternative to **DS1**)
X	Load-sensing (LS) (optional, version SO4*)

Symbols

▼ **Version without parking brake valve**



▼ **Version with parking brake valve**



Technical data

General				
Weight			kg	12
Installation position				Upright preferred
Type of connection				Metric threads
Ambient temperature range		θ	°C	–25 to +80
Priming				Priming RAL 5010

Hydraulic					
Maximum service brake pressure at port		BR1, BR2	p_{Br}	bar	125
Maximum parking brake pressure with version **E** at port		BR3	p	bar	210 (according to the set accumulator pressure)
Maximum inlet pressure	without FBA at port	P	p	bar	250
	with FBA at port	P	p	bar	210
Maximum tank pressure at port		T	p	bar	0.5 (Tank pressure must not exceed the pressure being applied by the brake.).)
Maximum accumulator pressure at port		S1, S2	p	bar	250
		S3	p	bar	210
Maximum pressure at port		N	p	bar	30 % less than the set accumulator pressure
Maximum accumulator charging pressure		Switch-off pressure	p	bar	210
		Switch-on pressure	p	bar	ca. 18 % below switch-off pressure
Maximum flow		P → S		l/min	ca. 4.5 (Standard, B18) ca. 17 (B40)
		P → N		l/min	70
Hydraulic fluid					Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, such as HEES (synthetic esters) according to VDMA 24568 as well as hydraulic fluids as specified in the data sheet 90221, on inquiry.
Hydraulic fluid temperature range			θ	°C	–20 to +80
Viscosity range			ν	mm²/s	2.8 to 380
Maximum permitted degree of contamination of the hydraulic fluid, cleanliness class according to ISO 4406 (c)					Class 20/18/15, for this we recommend a filter with a minimum retention rate of $\beta_{10} \geq 75$

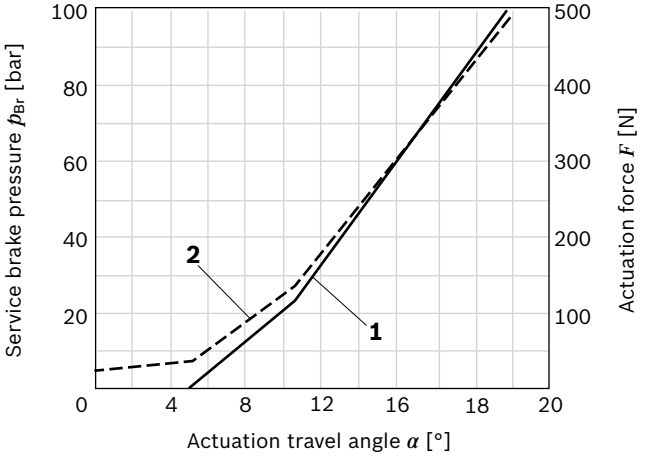
Electric (version **E** with parking brake valve)[1)]			
Power consumption at 20 °C		W	14.4
Duty cycle		%	100
Protection category according to DIN 40050			IP6K5

Note
For applications outside these parameters, please consult us.

1) Further details see data sheet 58007

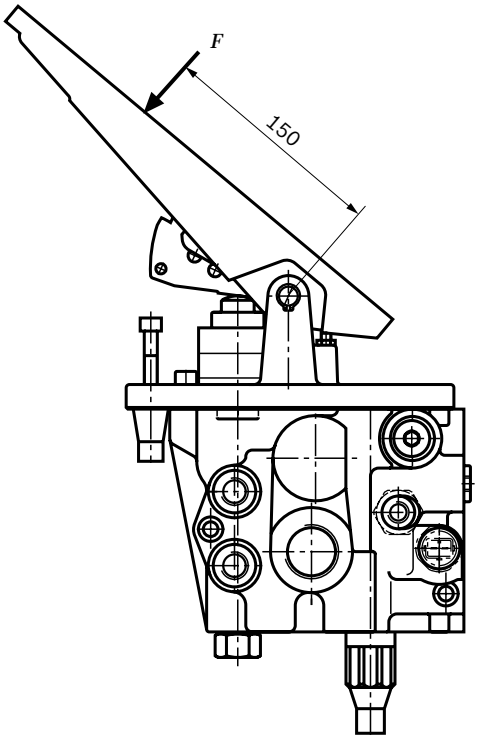
Characteristic curve

▼ **Service brake pressure and actuation force depending on the pedal angle, z. B. 100 bar (Standard)**



1 Service brake pressure
2 Actuation force

▼ **Actuation force F at pedal with lever of 150 mm**



Ordering code

01	02	03		04	05	06	07	08	09	10	11		12	13	14	15
LT 17	**M**	**4X**	**/**									**/**		**M**	**14**	*****

Model code

01	Dual-circuit power brake valve of compact design LT 17	**LT 17**

Type of actuation service brake (BBA)

02	Mechanical	**M**

Series

03	40 to 49 (unchanged installation and connection dimensions)	**4X**

Characteristic curve

04	Linear characteristic curve	**L**
	Progressive characteristic curve	**P**

Service brake pressure (BBA)

05	40 bar	**040**
	60 bar	**060**
	65 bar	**065**
	70 bar	**070**
	80 bar	**080**
	85 bar	**085**
	90 bar	**090**
	95 bar	**095**
	100 bar	**100**
	105 bar	**105**
	120 bar	**120**
	125 bar	**125**

Type of actuation parking brake (FBA)

06	Without FBA	**–**
	Electrically switched[1)]	**E**

Parking brake pressure (FBA)

07	[1)]	**XXX**
	Without FBA	**000**

Accumulator charging pressure

08	100 bar	**A**
	120 bar	**B**
	150 bar (Standard)	**C**
	160 bar	**D**
	185 bar	**E**
	200 bar	**F**
	210 bar	**G**

Accumulator charging flow

09	Approx. 4.5 l/min (standard)	**B18**
	Approx. 17 l/min	**B40**
	Approx. 4.5 l/min with check valve	**R18**
	Approx. 17 l/min with check valve	**R40**

1) With electrically switched FBA, the parking brake pressure of the FBA corresponds to the accumulator charging pressure. Observe the switching hysteresis!

Voltage at the switching solenoid

10	12 Volt	**AG12**
	24 Volt	**AG24**

Connector type (standard with manual override)[2)]

11	Cubic connector	**K4**
	Deutsch plug	**K40**
	Junior timer, 2-pole (AMP)	**C4**

Line connections

12	Metric threads	**02**
	Metric threads, reduced	**40**
	UNF threads	**19**

Seal material

13	NBR seals, suitable for mineral oil (HL, HLP) according to DIN 51524	**M**

Additional equipment

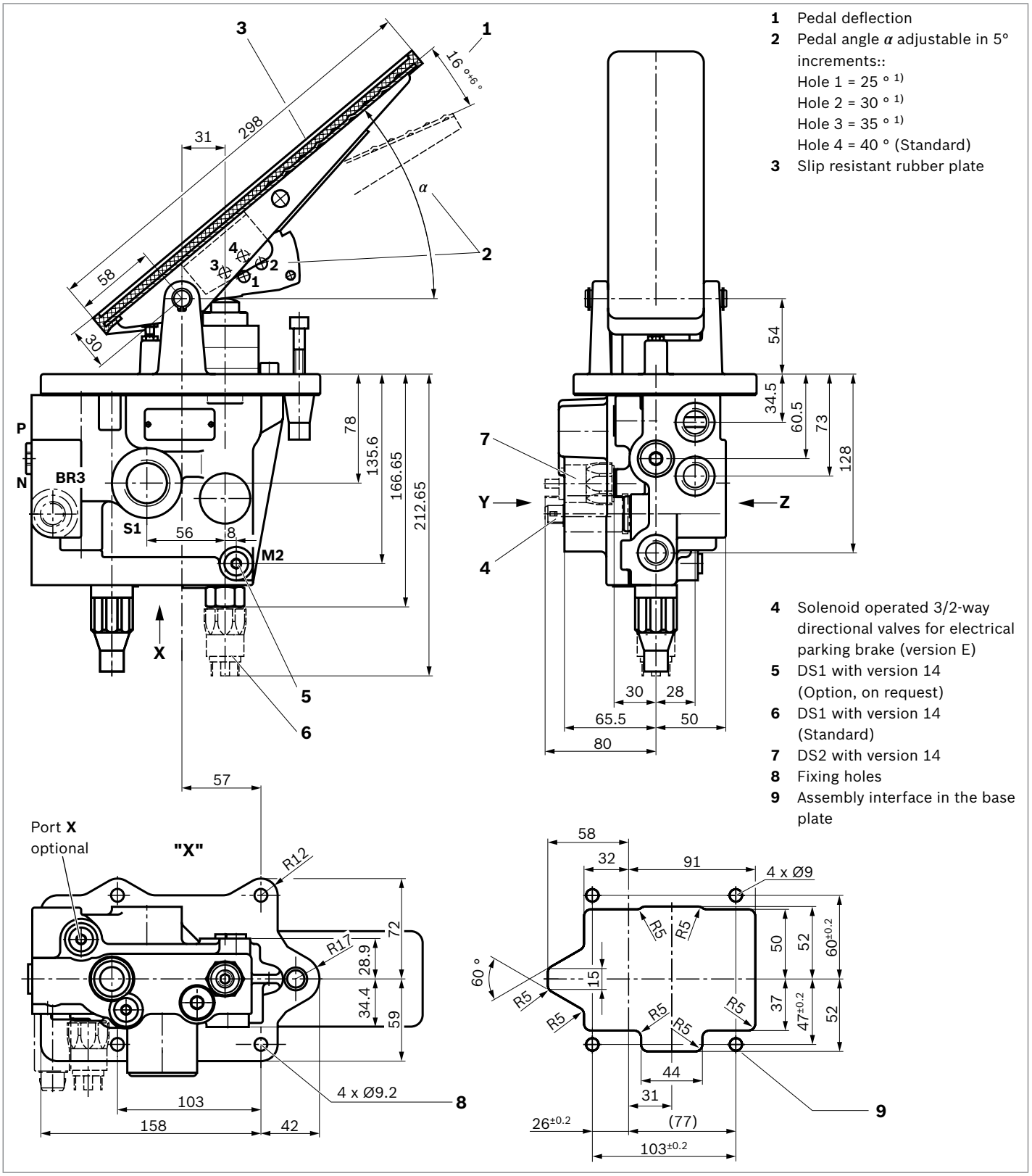
14	With pressure switch	**14**

15	Further details in clear text	*****

2) Mating connectors are not included in the scope of delivery and must be ordered separately, see data sheet 08006.

Dimensions

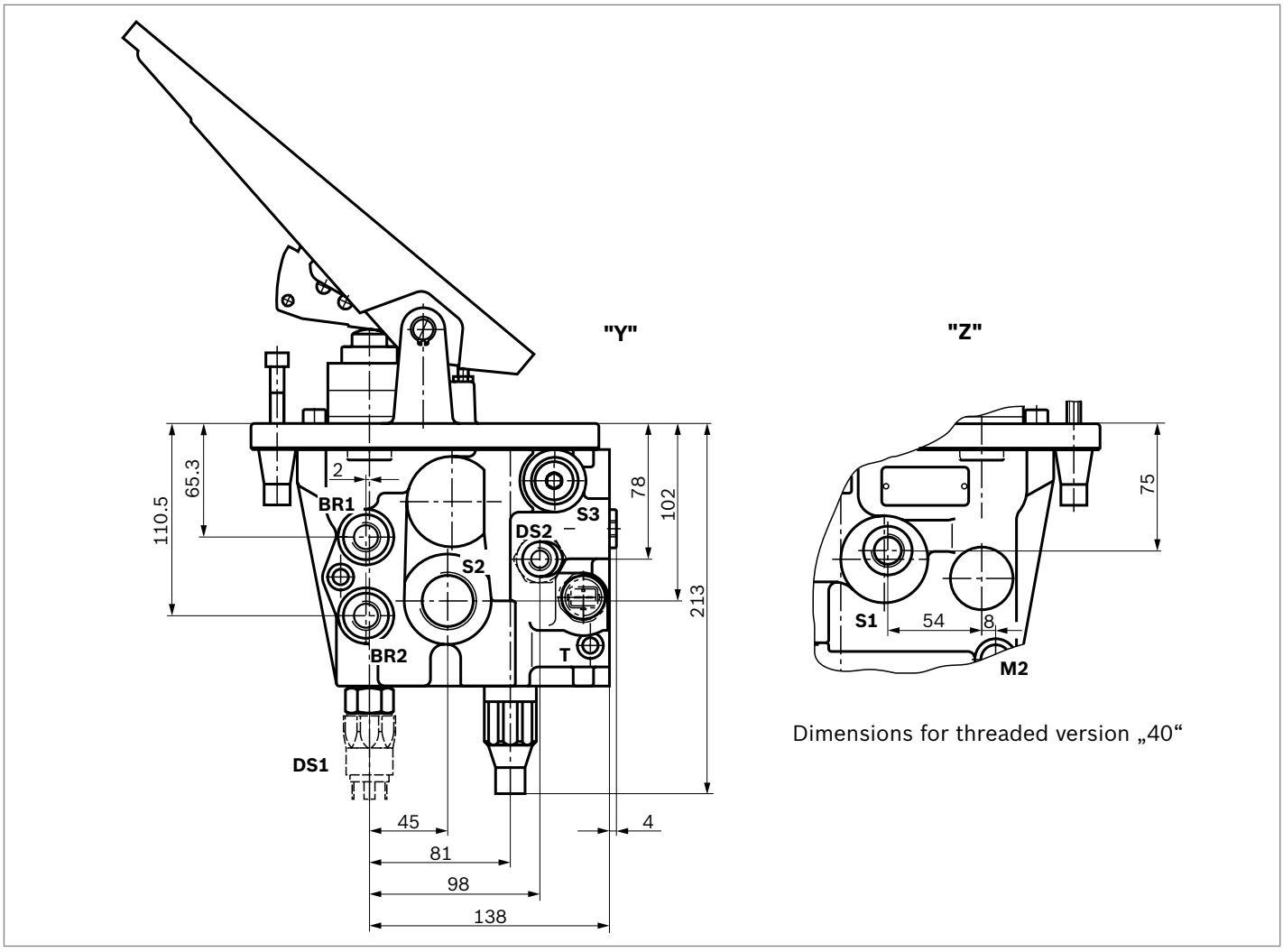
Standard version



Line connections see page 12

1) Possible as a special version

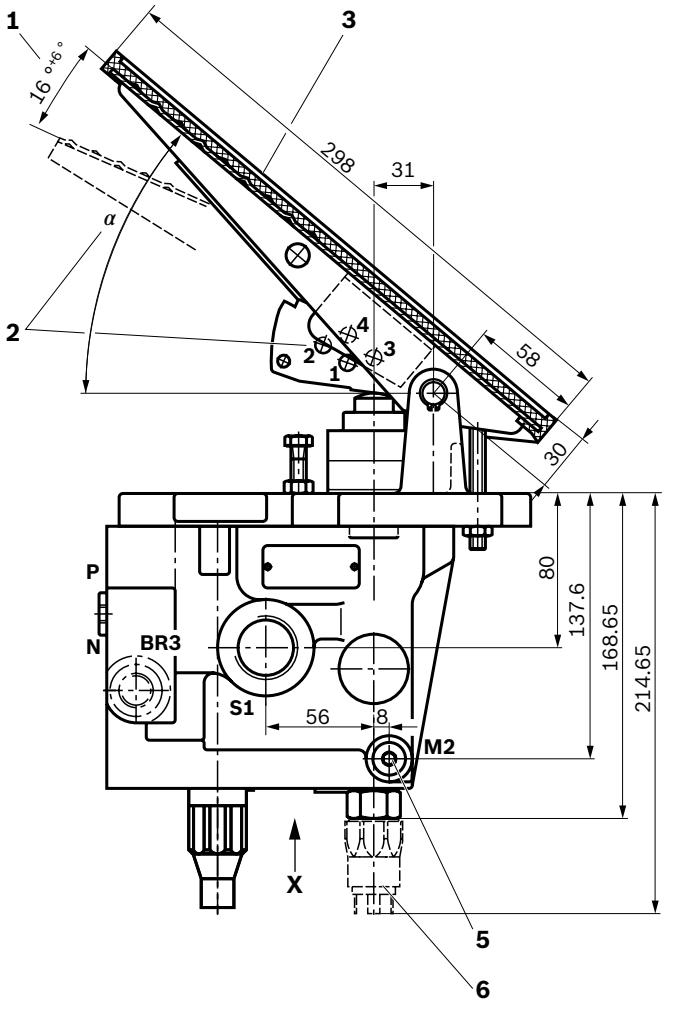
Standard version

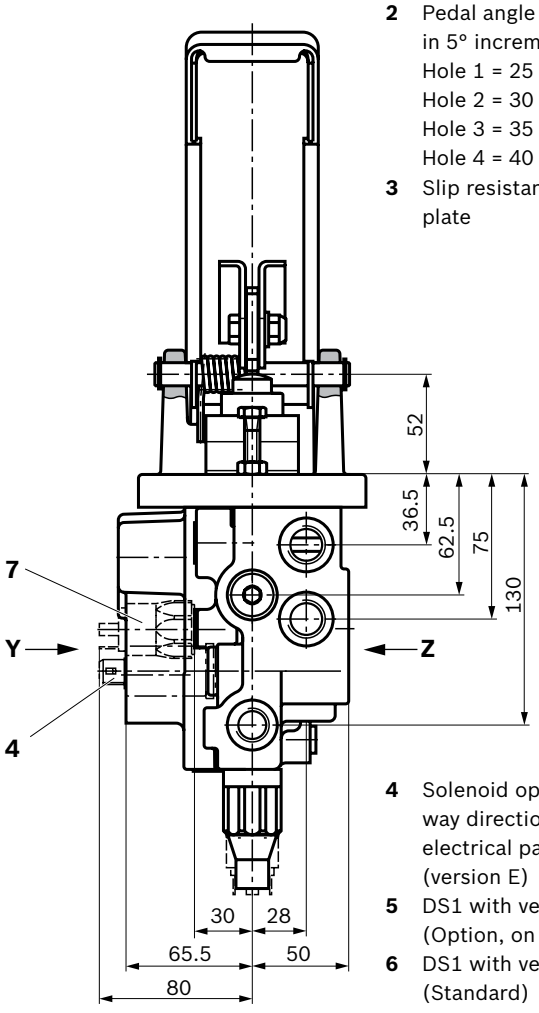


Dimensions for threaded version „40“

2-pole plug for solenoid:: AMP Junior Timer
Line connections see page 12

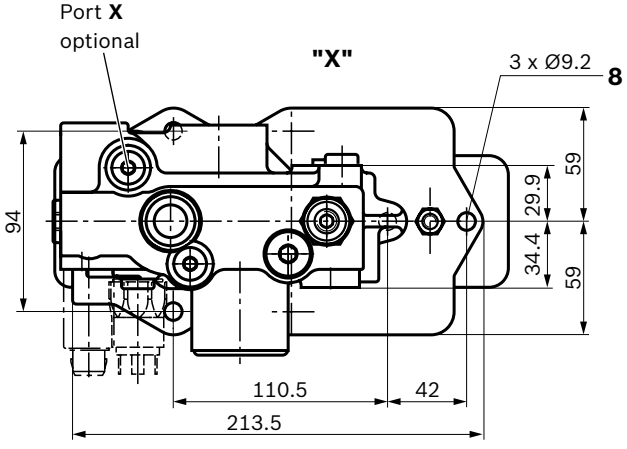
Version...SO6 – Replaces for series 3X

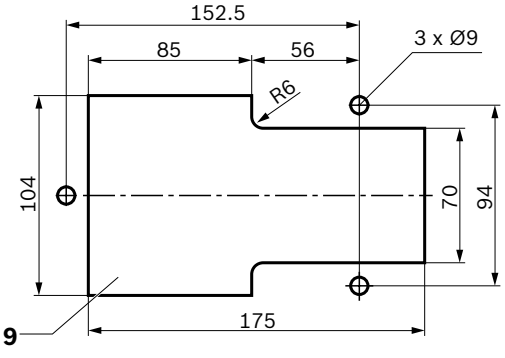




1 Pedal deflection
2 Pedal angle α adjustable in 5° increments::
Hole 1 = 25 ° 1)
Hole 2 = 30 ° 1)
Hole 3 = 35 ° 1)
Hole 4 = 40 ° (Standard)
3 Slip resistant rubber plate

4 Solenoid operated 3/2-way directional valves for electrical parking brake (version E)
5 DS1 with version 14 (Option, on request)
6 DS1 with version 14 (Standard)
7 DS2 with version 14
8 Fixing holes
9 Assembly interface in the base plate

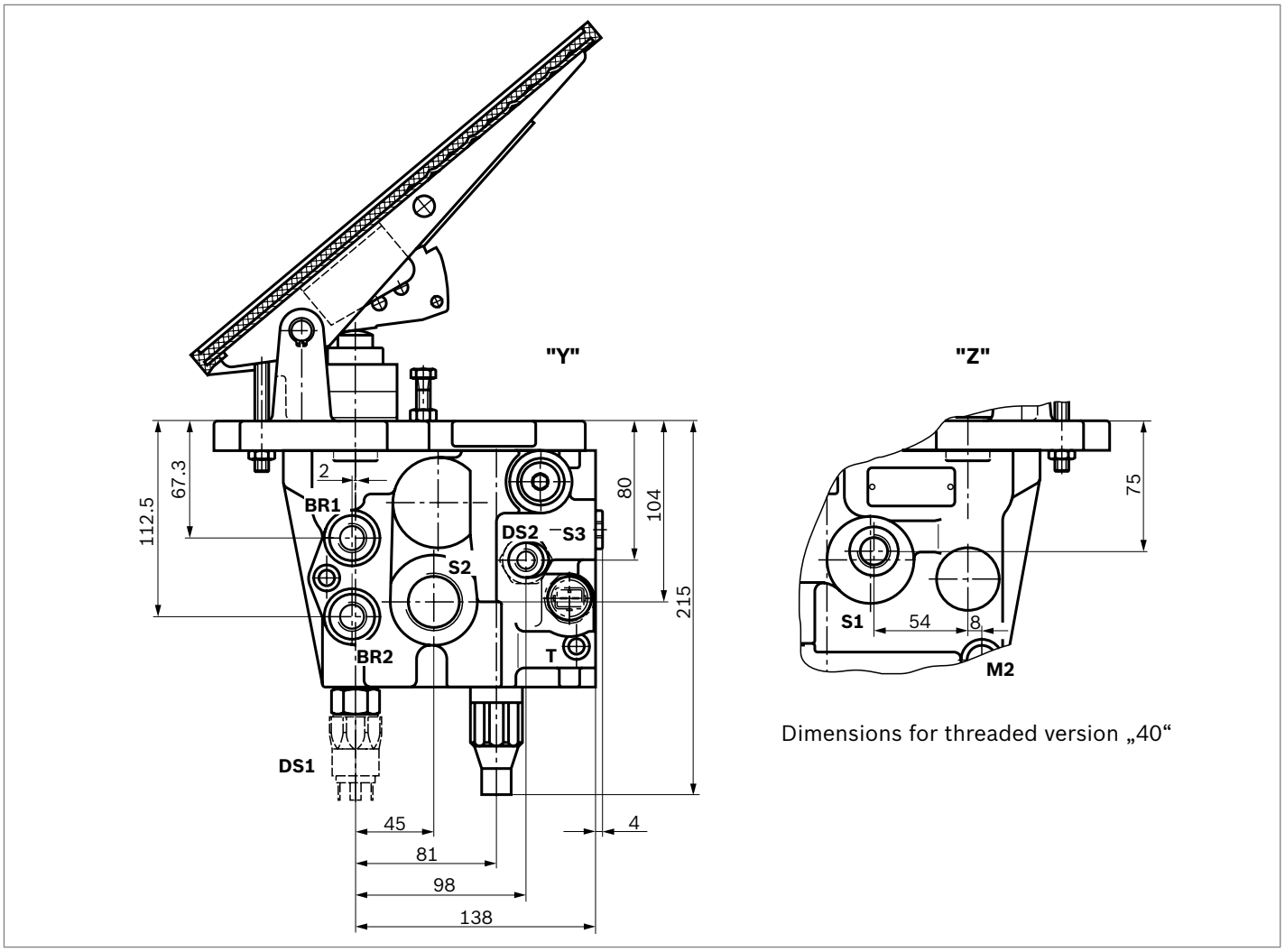




Line connections see page 12

1) Possible as a special version

Version ...SO6 – Replaces for series 3X



Dimensions for threaded version „40“

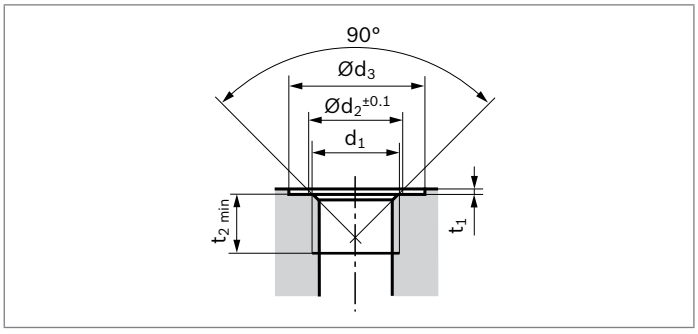
2-pole plug for solenoid: AMP Junior Timer
Line connections see page 12

Line connections

Thread type 02 (ports similar to DIN 3852-1)

Port	d_1	$Ød_2^{\pm 0.1}$	$Ød_3$	t_1	$t_{2\ min}$
BR1, BR2, BR3[1)]	M16 x 1.5	16.4	26	1.4	12
DS1	M12 x 1.5	12.4	20	0.9	11
DS2	M12 x 1.5	12.4	–	–	11
S1, S2	M33 x 1.5	33.5	–	–	20
S3	M16 x 1.5	16.4	26	1	12
M2	M12 x 1.5	12.4	–	–	11
P, N	M18 x 1.5	18.4	28	1.5	12
T	M16 x 1.5	16.4	26	1	12
X	M12 x 1.5	12.4	24	4	12

Port **M2** plugged by default.



Thread type 40 (ports similar to DIN 3852-1)

Port	d_1	$Ød_2^{\pm 0.1}$	$Ød_3$	t_1	$t_{2\ min}$
BR1, BR2, BR3[1)]	M16 x 1.5	16.4	26	1.4	12
DS1	M12 x 1.5	12.4	20	0.9	11
DS2	M12 x 1.5	12.4	–	–	11
S1, S2	M18 x 1.5	18.4	28	1.6	12
S3	M16 x 1.5	16.4	26	1	12
M2	M12 x 1.5	12.4	–	–	12
P, N	M18 x 1.5	18.4	28	1.5	11
T	M16 x 1.5	16.4	26	1	12
X	M12 x 1.5	12.4	24	4	12

Port **M2** plugged by default.

Accessory „14“

Pressure switch (optional accessories and spare parts)

Port	Function	Switch pressure	Material no.
DS1	Brake light	5 bar	R901355130
DS2	Accumulator pressure	100 bar	R901373063

Note
Bosch Rexroth uses pressure switches manufactured by SUCO / Bietigheim-Bissingen.

Related documents

Title	Document number	Document type
Hydraulic power brake valves for mobile applications	66200-B	Operating instructions
System documentation from the machine manufacturer		Operating instructions

Bosch Rexroth AG
Mobile Applications
Zum Eisengießer
97816 Lohr am Main, Germany
Phone +49 9352 18-0
info.ma@boschrexroth.de
www.boschrexroth.com

Relay valve
LT 09

RE 66153
Edition: 08.2016
Replaces: 01.2011

- Series 2X
- Maximum service brake pressure 200 bar
- Maximum control pressure 140 bar
- For modular designs

Features

- Direct operated pressure reducing valve in 3-way version with hydraulic actuation
- Brake pressure proportional to the control pressure
- Installation preferably directly at the axis to be decelerated

Fields of application

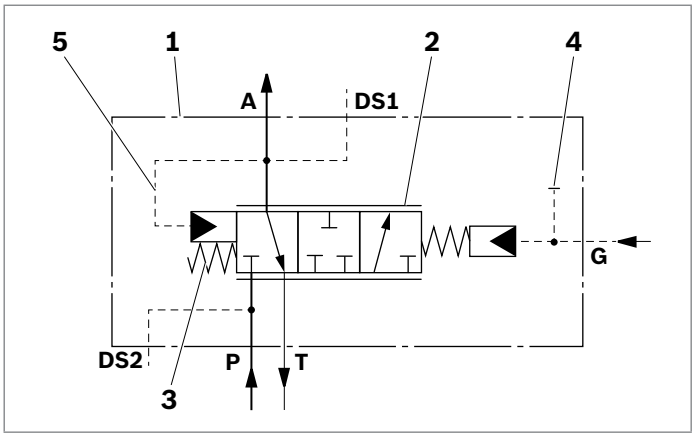
- For mobile machines with very long brake lines or very large brake cylinder volumes

Contents

Functional description

The hydraulic relay valve is a directly operated proportional pressure reducing valve of 3-way design with hydraulic pilot.
The relay valve consists mainly of the housing (**1**), control spool (**2**), return spring (**3**) and bleed screw (**4**). The valve is controlled via a hydraulic control pressure in port **G**. This control pressure directly effects the control spool (**2**). Firstly the control edge closes at port **T**, afterwards the flow from **P** to **A** is released.
The pressure which builds up in the brake line **A** simultaneously pushes via the pilot oil drilling (**5**) behind the control spool (**2**) against the control pressure so that the brake pressure rises in proportion to the control pressure. With the control pressure being held constant, the control spool (**2**) moves into the control position and holds the value set in channel **A** constant. When the control pressure decreases, the return spring closes via the control spool (**2**) from **P** to **A** and opens **A** to **T**, so that the braking circuit is unloaded.

▼ **Symbol LT 09**



1 Housing
2 Control spool
3 Return spring
4 Bleed screw
5 Pilot oil drilling

Ports	
P	Pump port
T	Tank port
A	Service brake
G	Pilot control port
DS1	Pressure switch (brake light)
DS2	Pressure switch (accumulator pressure)

Technical data

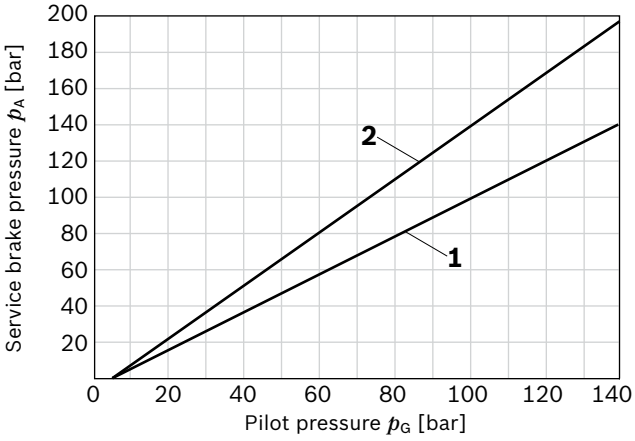
General				
Weight			kg	3
Installation position				Upright, bleed screw at the top (see page 6)
Connection type				See page 4
Ambient temperature range		θ	°C	–25 to +80
Priming				One-coat paint RAL 5010

Hydraulic				
Maximum service brake pressure at port	A	p_A	bar	200
Maximum inlet pressure at port	P	p	bar	250
Maximum pilot pressure at port	G	p_G	bar	140
Maximum tank pressure at port	T	p	bar	0.5 (The tank pressure must not exceed the contact pressure of the brake. Tank pressure peaks due to flow operations are permitted.)
Hydraulic fluid				Mineral oil (HL, HLP) according to DIN 51524, other hydraulic fluids, e.g. HEES (Synthetic ester) according to VDMA 24568 and hydraulic fluids as specified in data sheet 90221, on request
Hydraulic fluid temperature range		θ	°C	–20 to +80
Viscosity range		ν	mm²/s	2.8 to 380
Maximum admissible degree of contamination of the hydraulic fluid, Cleanliness level according to ISO 4406 (c)				Class 20/18/15, we recommend a filter with a minimum retention rate $\beta_{10} \geq 75$

Note
Please contact us if the unit is to be used outside the specified range of values.

Characteristic curve

▼ **Service brake pressure depending on the pilot pressure**



1 Ratio p_G: p_A = 1:1 (Standard)
2 Ratio p_G: p_A = 1:1.4

Note
Further ratios on request.

Ordering code

01	02		03		04		05	06		07	08
LT 09	**HA**	**–**	**2X**	**/**		**/**		**M**	**–**		*****

Series

01	Relay valve LT 09	**LT 09**

Type of actuation

02	Hydraulic	**HA**

Series

03	20 to 29 (unchanged installation and connection dimensions)	**2X**

Service brake pressure

04	Details given in bar, 3-digit (max. 200 bar) e.g. 150	**...**

Line connections (see page 4)

05	Metric thread according to DIN 3852-1	**02**
	Thread according to ISO 6149-1 (with O-ring seal)	**50**

Sealing material

06	NBR (nitrile rubber)	**M**

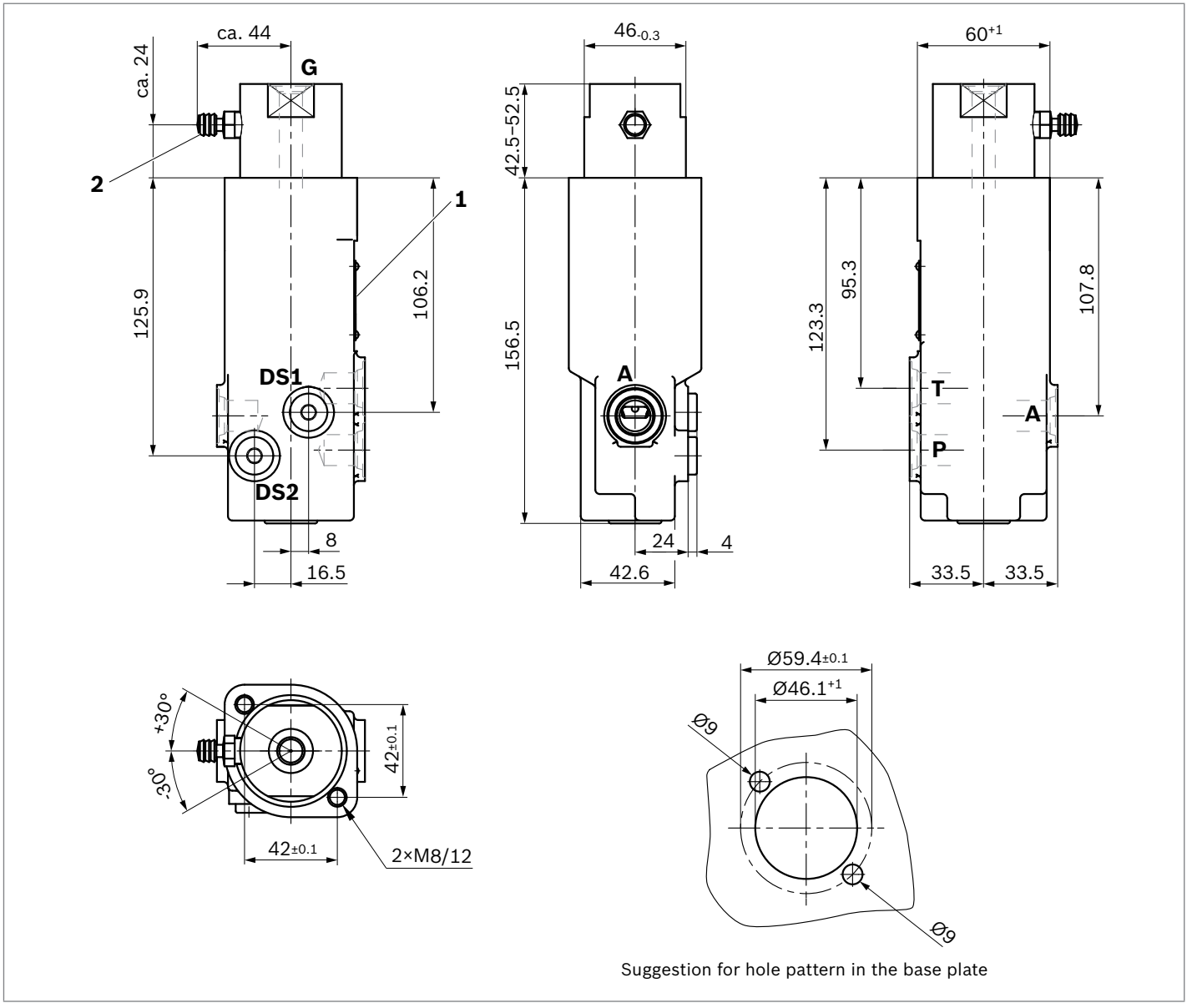
Ratio (further on request)

07	Pilot pressure p_G : Service brake pressure p_A	1:1 (Standard, no code)	
		1:1.4	**1/1.4**

08	Further specifications in plain text	*****

Dimensions

▼ **LT 09**



Suggestion for hole pattern in the base plate

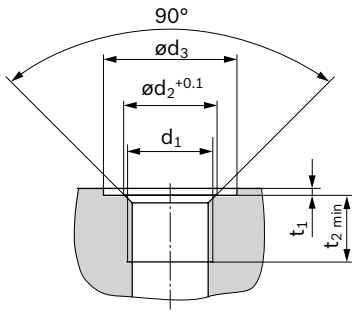
1 Name plate

2 Bleed screw, alignment varies within ±30° relatively to the housing; Tightening torque M_A = 15 Nm, SW12

Line connections

▼ **Metric thread according to DIN 3852-1**

02

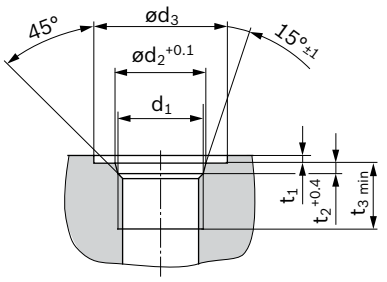


Port	d_1	Ød_2	Ød_3	t_1	t_2
P	M16 × 1.5	16.4	23	1	13
T	M16 × 1.5	16.4	23	1	13
A	M16 × 1.5	16.4	23	1	13
G	M12 × 1.5	12.4	20	1	12
DS1	M10 × 1	10.4	16	–	9
DS2	M10 × 1	–	16	–	9

Note
Ports **DS1**, **DS2** are usually closed.

▼ **Thread according to ISO 6149-1**

50



Port	d_1	Ød_2	Ød_3	t_1	t_2	t_3
P	M16 × 1.5	17.8	24	1.5	2.4	13
T	M16 × 1.5	17.8	24	1.5	2.4	13
A	M16 × 1.5	17.8	24	1.5	2.4	13
G	M12 × 1.5	13.8	19	1.5	2.4	11.5

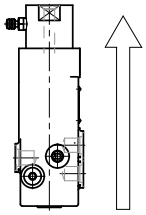
Project planning information

Installation notes

- Preferably the accumulators should be installed near the relay valve.
- The tank pressure must not exceed the brake application pressure.
- The tank must be mounted above the relay valve LT 09.

Installation position

Upright, bleed screw at the top.



Related documents

Further information on installation, commissioning, and operation can be found in the instruction manual 66200-B: “Hydraulic power brake valves for mobile applications”.

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