

Electronic joystick for mobile applications 4THE5 CAN version



- ▶ For the control of mobile machines
- ▶ Up to 2 proportional axes
- ▶ CAN, also exists in PWM or analog signal (see data sheet 29697)
- ▶ Ergonomics comparable with hydraulic joysticks
- ▶ Series 41

Features

- ▶ Reliable and robust mechanism similar to the one of the hydraulic joysticks
- ▶ Large selection of ergonomic grips with various E-contacts on/off rockers or proportional control
- ▶ Excellent protection of the electronic part
- ▶ Configurable electronics
- ▶ High reliability level compliant with application in safety-related parts of control systems up to PLC or d according to ISO 13849
- ▶ Two CAN outputs internally connected for “Daisy-Chain” function, for an easier integration in the CAN bus

Contents

Functional description	2
4THE5 features	3
Dimensions	3
Ordering details	4
Safety-relevant information according to ISO 13849	5
Technical data	6
Electrical functions	8
Bosch Rexroth standard protocol	11
CANopen protocol	12
SAE J1939 protocol	15
Enhanced J1939 protocol	18
Guidelines	20
Safety instructions	21
Related documentation	22

Functional description

Design

Joysticks of type 4THE5 CAN version are mainly composed of an operating element (1), a fixation plate (2) and a box (3) containing the contactless sensors and electronic cards.

General

4THE5 have similar mechanics and ergonomics to the hydraulic joysticks. This design provides a high robustness level to the 4THE5. The ergonomics of 4THE5 pushes the refinement to reproduce the sensations perceived by the operation of hydraulic joysticks.

The 4THE5 CAN version periodically generates a frame on CAN bus which allows the communication with other systems.

The 4THE5 architecture increases its reliability to match the requirements for integration in safety-related parts of control systems up to PLc or d.

The 4THE5 Joystick is made to be connected to a machine controller (ECU) which will be used as a power control and system logic.

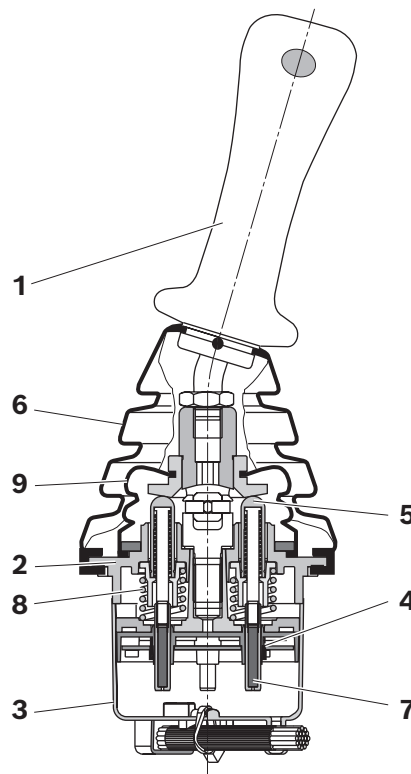
Function principle

When not actuated the operating element is held in neutral position by the return springs (8). With deflection of the control grip (1), the plunger (5) compresses the return spring (8). The magnet (7) mechanically linked to the plunger (5) moves upwards or downwards while following the control grip actuation direction. The command value generated by the sensor (4) is proportional to the deflection of the control grip.

A rubber boot (6) protects the mechanical components of the housing from external contamination. The internal mini boot (9) is an additional protective barrier for the cardan and plungers.

▼ 4THE5 sectional view

- 1 Control grip (operating element)
- 2 Fixation plate
- 3 Box
- 4 Sensor
- 5 Plunger
- 6 Rubber boot
- 7 Magnet
- 8 Return spring
- 9 Mini boot



4THE5 features

Special features

- ▶ Electromagnetic compatibility (EMC) according to EN ISO 13766-2:2018
- ▶ Life expectancy up to 5 million cycles

Supported by the electronic base:

- ▶ Up to 7 proportional axis
- ▶ Or up to 16 on/off or analog push buttons without redundancy
- ▶ Or up to 8 analog push buttons with redundancy
- ▶ Or up to 6 on/off or signal PWM outputs (LED driver)

Wiring

See page 7.

Outputs characteristic curves

See page 6.

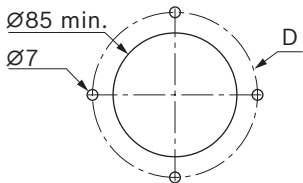
Installation guidelines

- ▶ Mounting flange area: flatness = 0.5 mm.
- ▶ Screw head dimensions = Ø10 mm.
- ▶ Tightening torque for the flange fixing screws = max. 10 Nm

Applications

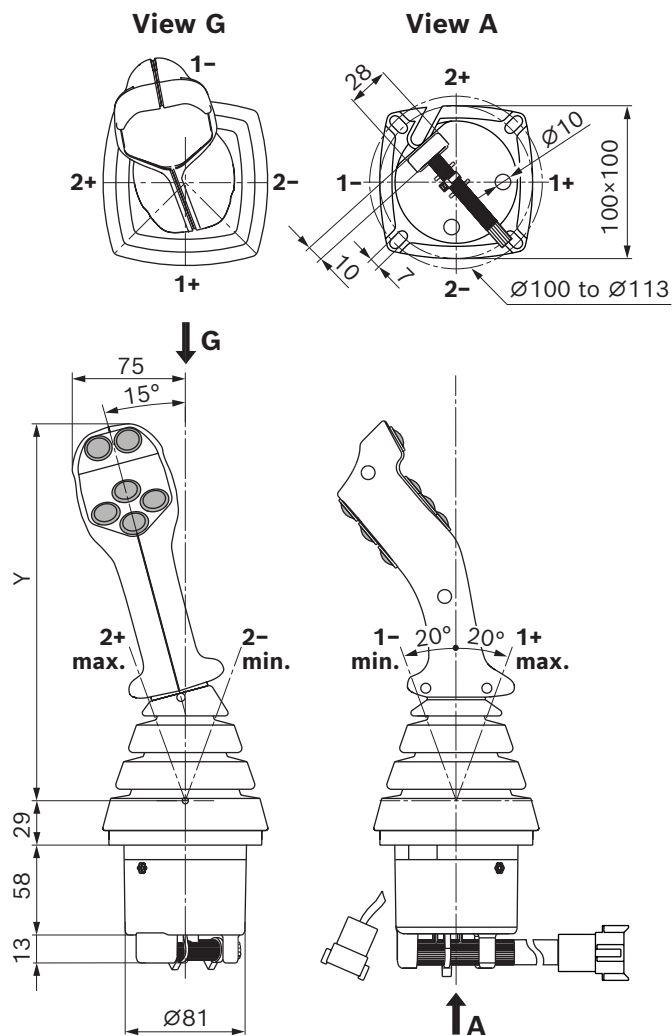
The joystick base enables to manage the control grip components by data-processing. This option allows a direct connection of the control grip to the base and a unique CAN interface with the machine.

Mounting pattern



- ▶ Nominal diameter / fixing via 4 screws
D = Ø100 to Ø113 mm

Dimensions



Vertical dimension Y by type of control grip

Type of control grip	With bent lever	With straight lever
EC2000	207	211.5
EC2000+	215.5	220.5
EC3000+	234	238
EC3500+	240	244
EC4000	250.5	257

Ordering details

01	02	03	04	05	06			07	08
4	THE		5		-	41	/		5

Number of axes

01	2 axes (joystick)	4
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Product

02	Electronic joystick	THE
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Type of output

03	CAN joystick for application in safety-related parts of control systems up to PLc	C
	CAN joystick for application in safety-related parts of control systems up to PLd	D

Product

04	THE5 joystick	5
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Type of control element

05	Control grip EC2000, see data sheet 64087	E
	Control grip EC4000, see data sheet 64091	H
	Control grip EC2000+, see data sheet 64088	I
	Control grip EC3000+, see data sheet 64089	K
	Control grip EC3500+, see data sheet 64090	M/N
	Without lever	Z
	Other control grip (no designation)	

Series

06	Series 41	41
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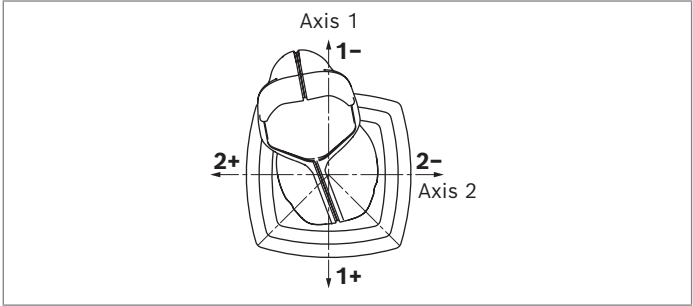
Control grip orientation / machine

07	Straight lever and control grip towards 1-	03
	Bent lever towards 2- and control grip towards 1- (left hand joystick)	43
	Bent lever towards 2+ and control grip towards 1- (right hand joystick)	23
	Without lever (no designation)	

Connectors

08	DEUTSCH DT connector, sealed plugs IP67 for the wiring of the control grip	5
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▼ Axes positions and control grip orientation

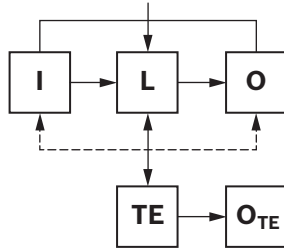


Safety-relevant information according to ISO 13849

4THED5

4THED5 with or without redundant rollers or push buttons (XS, ZL) managed by the electronic joystick.

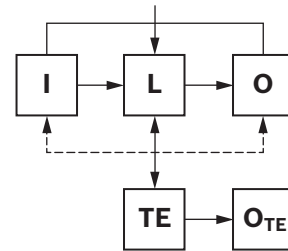
- Meets the architectural category 2 requirements of the standard ISO 13849 (test channel including redundant axis).
- Diagnostic Coverage (DC) = High



4THEC5

4THEC5 with or without non redundant rollers or push buttons managed by the electronic joystick.

- Meets the architectural category 2 requirements of the standard ISO 13849.
- Diagnostic Coverage (DC) = Medium



Notice

This product has been developed according to ISO 13849. However, it is not a safety component in the sense of the Machine Directive 2006/42/EC! For further information, see manual 29696-02-B: "Safety-relevant project planning instructions".

Technical data

General			
CE Mark		Compliance with EMC Directive 2014/30/EU. The harmonized norms EN 13309:2010, EN 12895:2015 and EN ISO 14982:2009 have been applied.	
		Compliance with RoHS2 directive 2011/65/EU on the restriction of the use of certain hazardous substances.	
Compliance with REACH Directive			
Mechanical characteristics			
Life time		5 millions actuation cycles	
Temperature range	Storage, ambient	°C	-40 ... +85
	Operation	°C	-20 ... +85
Resistance to vibrations and shocks	Vibration (ISO 16750-3 and IEC 60068-2-64)	Hz	20 ... 2000 (11.2 g RMS)
	Shocks (IEC 60068-2-27)	g	50 during 11 ms
Electronic protection level (IEC 60529)		IP 67	
Actuation torque		Nm	See curve
Maximum permissible actuation torque at the operating element with an exceptional, one-time loading		Nm	100
Actuation angle		°	±20 or 23
Weight (depends of equipment)		kg	1

Notice

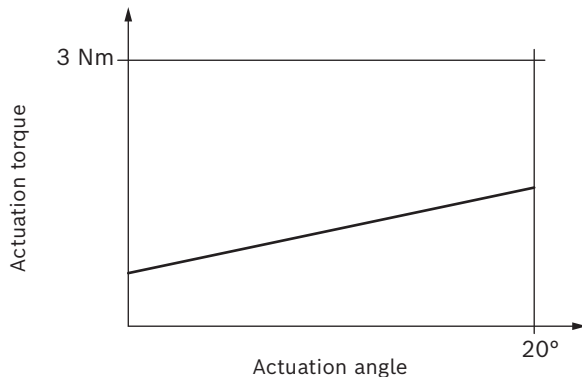
For applications outside these parameters, please consult us!

Variants of operation curves

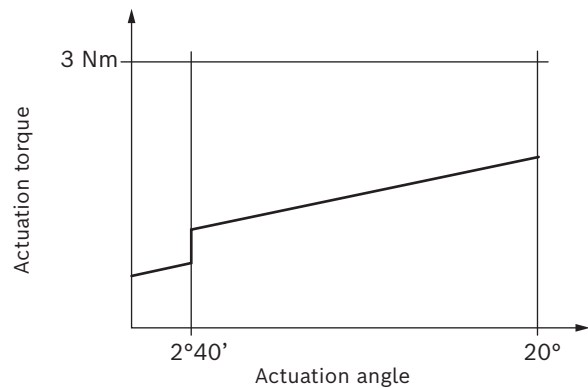
The design of the 4THE5 joysticks can reproduce similar sensations to the operators of hydraulic joysticks.

Echelons can be added to the standard operation curve for feeling the out of neutral or the activation of a specific functionality (float position...).

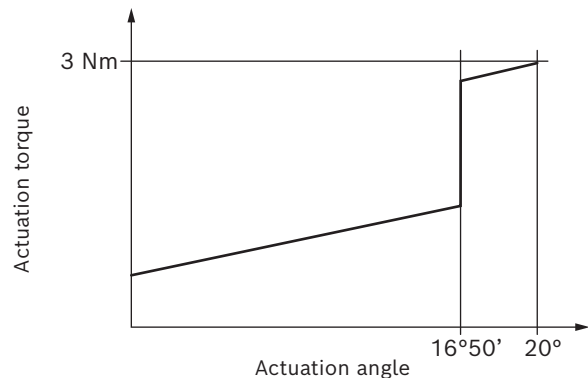
▼ Standard operation curve



▼ Operation curve with feeling of the out of neutral: PFI



▼ Operation curve with prefeeling of the activation of a specific functionality: PFD

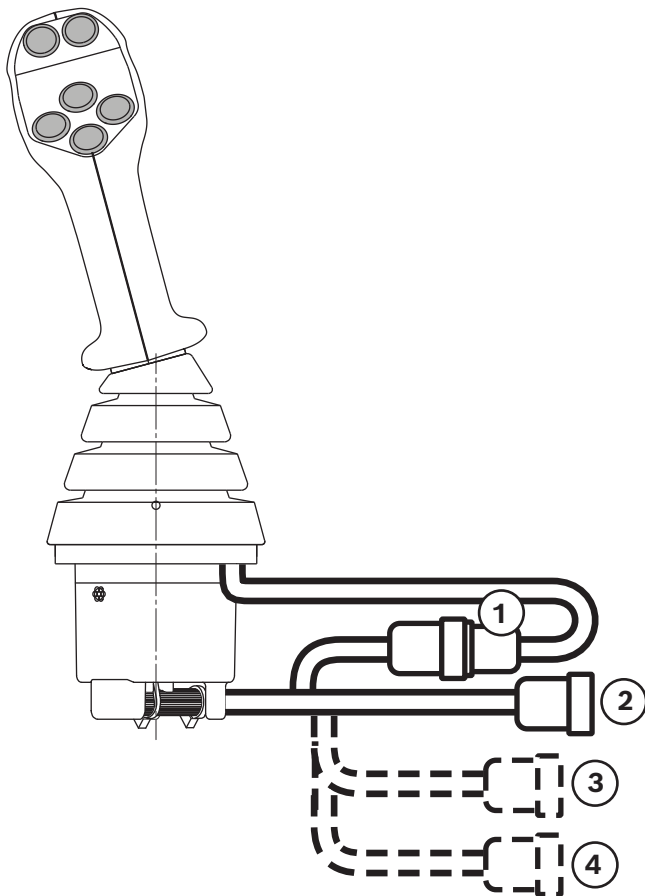


Electrical characteristics			
Power supply	V	7 to 36	
Maximum current consumption	mA	300 for 14 V without control grip	
Protections	Protection against reverse polarity	Yes on supply side	
	Protection against short circuit	Connections towards machine protected from 0 to 32 V	
Electromagnetic compatibility (EMC) according to EN ISO 13766-2:2018	Current injection (ISO 11452-4)	[50 kHz; 400 MHz]; [100 mA - 300 mA]	
	Radiated emission (CISPR 25 - 2016)	[150 KHz, 2.5 GHz]; Class 3	
	Radiated field (ISO 11452-2)	[200 MHz; 2.7 GHz]; -150 V/m	
	Direct electrostatic discharge (ISO 10605)	kV	±8
	Electrostatic discharge in the air (ISO 10605)	kV	±15

Notice

For applications outside these parameters, please consult us!

Electrical connection to the machine and connectors

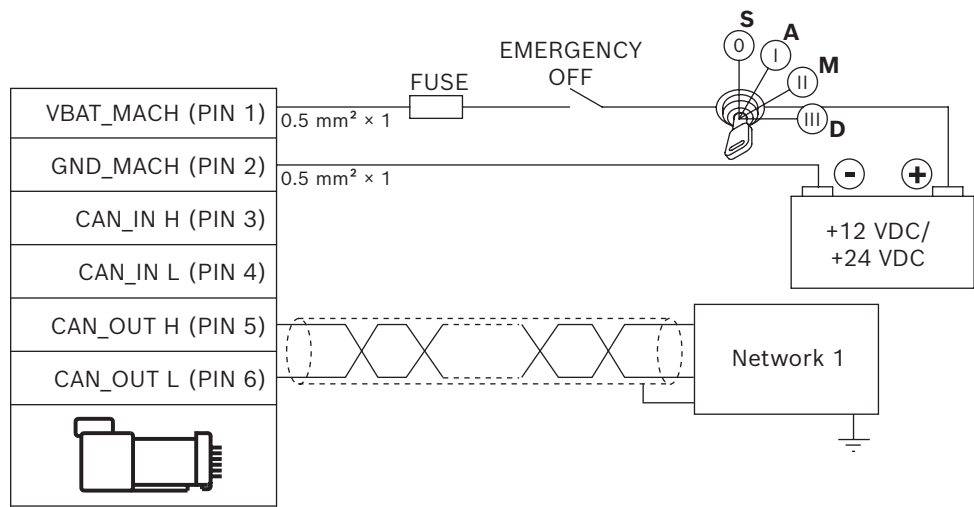


- 1 Control grip connector 12S
- 2 Supply and CAN connector 6P
- 3 Optional connector for analogical options 8S
 - Supply 5 V for auxiliary functions
 - Voltage input from potentiometer or push button
- 4 Optional connector for on/off options 8P
 - Inputs outputs at V bat.

Electrical functions

Electrical connection to a CAN network

(supply and CAN connector 6P, see page 7 item 2)



Characteristics of the 5 V power supply

The CAN electronic joystick delivers a stabilized 5 Volt on one output in order to supply external components.

Power supply 5 V	Identification	Characteristics			
		Voltage [V]	Current [mA]	Protection	Remarks
For control grip components	VCCEXT_5V	0 to 5	100	Short circuit: 0 V 5 V	
For sensors and main functions of the machine wiring	VCCAUX_36V	0 to 5	150	Short circuit: 0 V 36 V	

Characteristics of the analog external inputs

The CAN joysticks integrate 4 analog external inputs that may be used in different ways:

- ▶ Use in pairs to create a redundant analog input
- ▶ Use in single for non redundant analog input
- ▶ Use in single for on/off input

▼ Analogical inputs

Input	Identification	Characteristics				Remarks
		Voltage [V]	Current [mA]	Protection	Polarization mode	
EXT1	ADEXT1_DIP1_DI1_5V	0 to 5	1.7	Short circuit: 0 V 5 V	Internal pull-up 5 V: 3.16 kΩ	Dedicated for Bosch Rexroth rollers: XS, XM components or push-buttons: SL, ZL, ZS components
EXT2	ADEXT2_DIP2_DI2_5V					
EXT1R	ADEXT1R_DIP1R_DI7_5V					
EXT2R	ADEXT2R_DIP2R_DI8_5V					

Characteristics of the analog auxiliary inputs

The CAN joysticks integrate 6 analog auxiliary inputs that may be used in different ways:

- ▶ Use in pairs to create a redundant analog input
- ▶ Use in single for non redundant analog input
- ▶ Use in single for on/off input

▼ These inputs can be used to connect auxiliary proportional or on/off controls to the electronic joystick

AUX Input	Identification	Characteristics				Remarks
		Voltage [V]	Current [mA]	Protection	Polarization mode	
AUX1	ADAUX1_DIP3_DI3_32V	0 to 5	1.6	Short circuit: 0 V 36 V	Internal pull-up 5 V: 3.16 kΩ + diode	Dedicated for Bosch Rexroth rollers: XS, XM components or push-buttons: SL, ZL, ZS components
AUX2	ADAUX2_DIP4_DI4_32V					
AUX3	ADAUX3_DIP5_DI5_32V					
AUX1R	ADAUX1R_DIP3R_DI11_32V					
AUX2R	ADAUX2R_DIP4R_DI12_32V					
AUX3R	ADAUX3R_DIP5R_DI13_32V					

Characteristic of digital input processed in a proportional way

The CAN joysticks integrate 6 proportional digital inputs that may be used in different ways:

- Use in pairs to create a redundant proportional digital input
- Use in single for non redundant proportional digital input

▼ Digital inputs processed in a proportional way

Input	Identification	Characteristics				
		Voltage [V]	Current [mA]	Protection	Polarization mode	Remarks
DIP 6	AD_DIP 6 / DI6	0 to 5	1.1	Short circuit: 0 V 5 V	Internal pull-up 5 V: 3.16 kΩ Internal pull-down 4.75 kΩ	Dedicated for Bosch Rexroth push-buttons: SL, ZL, ZS components
DIP 7	AD_DIP 7 / DI7					
DIP 8	AD_DIP 8 / DI8					
DIP 6 R	AD_DIP 6R / DI14					
DIP 7 R	AD_DIP 7R / DI15					
DIP 8 R	AD_DIP 8R / DI16					

Characteristics of the digital outputs (on/off or PWM)

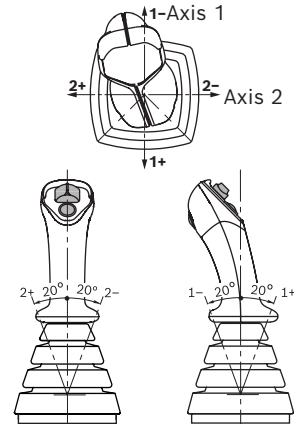
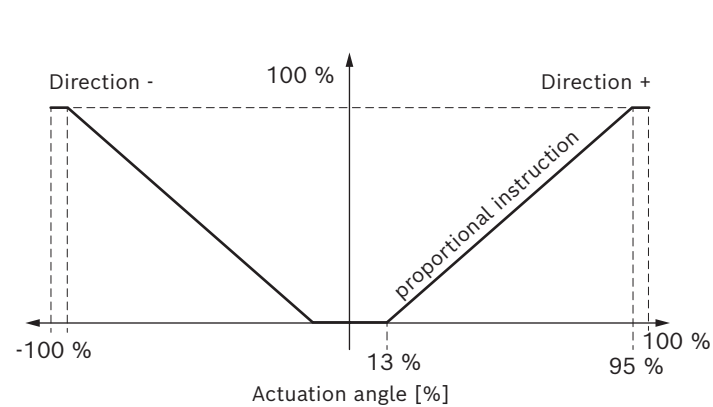
The CAN joysticks integrate 6 digital outputs. These voltage outputs can supply relays, lamps but also control the brightness of LED by PWM modulation of the

voltage signal (contact us for the configuration of the PWM signal).

▼ List of the digital outputs

Digital output	Identification	Characteristics				
		Voltage [V]	Current [mA]	Protection	Polarization mode	Remarks
DO1	DO1_36V	0 to 36	33 per output	Short circuit: 0 V 36 V	On/off output “pull up” at Vbat.	Short circuit protection is common for the six digital outputs. We recommend to use a freewheeling diode in parallel of the inductive load.
DO2	DO2_36V					
DO3	DO3_36V					
DO4	DO4_36V					
DO5	DO5_36V					
DO6	DO6_36V					

Example of output curve for CAN signal



Bosch Rexroth standard protocol

Predefined protocol with periodic transmission of frames.

The identifier of the frame is configurable.

Telegram 1									
ID:	Configurable on 11 bits								
Transmission rate:	Every 20 ms								
DLC:	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
Axis 1	0..255								Byte 1
Axis 2	0..255								Byte 2
Axis 3	0..255								Byte 3
Axis 4	0..255								Byte 4
Direction (Dir)	4-	4+	3-	3+	2-	2+	1-	1+	Byte 5
Digital input (DI)	DI8	DI7	DI6	DI5	DI4	DI3	DI2	DI1	Byte 6
Error (Err)	Error codes are available on request								Byte 7
Incremental counter (Inc)	Cyclic counter 0..255								Byte 8

Additional information

- Physical layer: Standard 2.0A
- Identifier 11 bits
- BUS speed: 250, 500, 1000 kBd (kBaud)
- The list of errors to be managed by machine controller is available on request.

CANopen protocol

CAN frame according to the protocol in the CAN electronic joysticks THEC5 or THED5.

Object dictionary

The CANopen protocol is based on the use of the object dictionary that contains a list of objects.

Network management

According to CiA301 standard, CANopen defines four operating status:

- ▶ Initialization: component initialization on the network
- ▶ Pre-operational: component configuration on the network.
- ▶ Operational: normal function of the component on the network
- ▶ Stop: Suspension of the frame transmissions to the network (to temporarily reduce the bus load).

The operating status are accessible via NMT frame (Network Management)

A special option offered to customers can boot directly into the operational status (without using NMT frame to move from the pre-operational to operational status).

TxPDO

The TxPDOs frames convey the status of internal axis information, rollers, rockers and push buttons. They may also contain frame counters, error codes and other objects of the dictionary.

The electronic joystick sends the TxPDO1 frames TxPDO2, TxPDO3 and TxPDO4 whose identifiers respect the DS300 standard.

The electronic joystick proposes following frames transmission modes:

- ▶ Synch 0: Transmission on reception of synchronization frames when internal status changes
- ▶ Synch X (1 – 10): Transmission after reception of X synchronization frames.
- ▶ Asynchronous:
 - Periodic transmission (configurable periodicity with a resolution of 10 ms and minimum 10 ms).
 - Periodic transmission (configurable periodicity) or on status change (but no faster than 10 ms).

The content of TxPDOs frames is fully configurable during production.

RxPDO

RxPDO frames are used for piloting On/Off outputs of the joystick, which goal could be to pilot relays, LED, etc. or PWM (e.g. back light on push button).

The electronic joystick receives the RxPDO1 frame which identifier comply with the CiA301 standard.

The use or not of this frame depends of the customer need.

EMCY

The EMCY frame (emergency) is emitted by the electronic joystick as soon as it detects a default.

EMCY identifier comply with the CiA301 standard.

The list of errors to be managed by machine controller is available on request.

CANopen protocol

General

Node ID	Configurable
NMT	Compliant with DS301 (Configurable initial state: Pre-operational or Operational)
Emergency frame (EMCY)	Compliant with DS301 (error codes are available on request)
Error Control Services	Configurable: Node guarding, heartbeat
Device profile	DS401 (Object dictionary and eds file available on request)

Frame1 TxPDO

COD ID	0x180 + node ID
Transmission rate:	Every XX ms; On Synch Y; Every XXX ms or on change (no faster than XX ms)
DLC	8 bytes

Mapping

bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
								Byte 1
								Byte 2
								Byte 3
								Byte 4
								Byte 5
								Byte 6
								Byte 7
								Byte 8

Area to be filled with
the items contained in the
object dictionary available
on request.
See section describing the
specifics of the CANopen
standard.

Frame 2 (TxPDO)								
COD ID	0x280 + node ID							
Transmission rate:	Every XX ms; On Synch Y; Every XXX ms or on change (no faster than XX ms)							
DLC	8 bytes							
Area to be filled with the items contained in the object dictionary available on request. See section describing the specifics of the CANopen standard.	Mapping							
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
								Byte 1
								Byte 2
								Byte 3
								Byte 4
								Byte 5
								Byte 6
								Byte 7
								Byte 8

Frame RxPDO1								
COD ID	0x200 + node ID							
Transmission rate:	Every XX ms; On Synch Y; Every XXX ms or on change (no faster than XX ms)							
DLC	8 bytes							
Area to be filled with the items contained in the object dictionary available on request. See section describing the specifics of the CANopen standard.	Mapping							
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
								Byte 1
								Byte 2
								Byte 3
								Byte 4
								Byte 5
								Byte 6
								Byte 7
								Byte 8

SAE J1939 protocol

Physical layer: Standard CAN 2.0B

Identifier 29 Bits

BUS speed: 250, 500, 1000 kBd (kBps)

Source Address

The source address is the identifier of the electronic joystick on the CAN J1939 network. It is configurable from 2-253 based on the needs expressed by the customer.

Address claiming process (SAE J1939-81 MAR 2017)

The electronic joystick can be configured in “master configurable mode”, or in “self configurable mode”.

- ▶ **Master configurable mode:**
In case of conflict and priority loss during the claiming process, the electronic joystick stops any frame transmission until the master node allocates a new address.
- ▶ **Self configurable mode:**
In case of conflict and priority loss during the claiming process, the electronic joystick automatically chooses a new address and starts again the claiming process.

CAN messages

- ▶ **BJM** (basic joystick message) and **EJM** (extended joystick message):
The electronic joystick manages BJM and EJM messages. The message transmission occurs when status changes or periodically each 100 ms. The periodicity in case of status change can be configured (10 ms or 20 ms).
The electronic joystick proposes two message contents. The first content complies with the SAE J1939-71 standard and the second is a customization integrating counters and redundancy checks.
- ▶ **DM1** (diagnostic message 1) according to SAE J1939-73 JAN 2019:
The DM1 message is an information issued by the electronic joystick when an internal fault is detected. It is reissued every second until the fault disappears. The DM1 message that contains the list of errors to be managed by machine controller is available on request.
- ▶ **DM13** (diagnostic message 13) according to SAE J1939-73 JAN 2019:
The DM13 message allows the control of the BUS load by validating or stopping the frame transmission on the CAN bus.

SAE J1939 protocol

General									
Source Adress (SA)	Configurable								
Name	NAME field as defined in SAE J1939-81 MAR 2017								
Address claiming process	[Self Configurable; Master configurable] compliant with SAE J1939-81 MAR 2017								
Telegram 1									
Type	Basic Joystick Message 1 (BJM1)								
Parameter group number (PGN)	0x00FDD6								
Transmission rate	Every 100 ms and on change but no faster than XX ms (XX = 20 ms or 10 ms)								
DLC	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
X Axis (2)			SPN2665		SPN2670		SPN2675		Byte 1
			SPN2660						Byte 2
Y Axis (1)			SPN2666		SPN2671		SPN2676		Byte 3
			SPN2661						Byte 4
Limit warning 1	SPN 2680		SPN 2681		Not used	Not used	Not used	Not used	Byte 5
Digital input (DI 1 - 4)	SPN 2685 (DI1)		SPN 2686 (DI2)		SPN 2687 (DI3)		SPN 2688 (DI4)		Byte 6
Digital input (DI 5 - 8)	SPN 2689 (DI5)		SPN 2690 (DI6)		SPN 2691 (DI7)		SPN 2692 (DI8)		Byte 7
Digital input (DI 9-12)	SPN 2693 (DI9)		SPN 2694 (DI10)		SPN 2695 (DI11)		SPN 2696 (DI12)		Byte 8

SPN = Suspected Parameter Number

Telegram 2									
Type	Extended Joystick Message 1 (EJM1)								
Parameter group number (PGN)	0x00FDD7								
Transmission rate	Every 100 ms and on change but no faster than XX ms (XX = 20 ms or 10 ms)								
DLC	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
Axis (3)			SPN2667		SPN2672		SPN2677		Byte 1
			SPN2662						Byte 2
Axis (4)			SPN 2668		SPN 2673		SPN 2678		Byte 3
			SPN 2663						Byte 4
Axis (5)			SPN 2669		SPN 2674		SPN 2679		Byte 5
			SPN 2664						Byte 6
Limit warning 2	SPN 2682		SPN 2683		SPN 2684		Not used		Byte 7
Not used	Not used		Not used		Not used		Not used		Byte 8

SPN = Suspected Parameter Number

Telegram 3

Type	Extended Joystick Message 2 (EJM2)								
Parameter group number (PGN)	0x00FDD9								
Transmission rate	Every 100 ms and on change but no faster than XX ms (XX = 20 ms or 10 ms)								
DLC	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
	Axis (6)		SPN2704		SPN2709		SPN2714		Byte 1
SPN2669						Byte 2			
Axis (7)			SPN 2705		SPN 2710		SPN 2715		Byte 3
			SPN 2700						Byte 4
Not used			SPN 2706		SPN 2711		SPN 2716		Byte 5
			SPN 2701						Byte 6
Limit warning 3	SPN 2719		SPN 2720		SPN 2721		Not used		Byte 7
Not used	Not used		Not used		Not used		Not used		Byte 8

SPN = Suspected Parameter Number

Enhanced J1939 protocol

General									
Source Address (SA)	Configurable								
Name	NAME field as defined in SAE J1939-81 MAR 2017								
Address claiming process	[Self Configurable; Master configurable] compliant with SAE J1939-81 MAR 2017								
Telegram 1									
Type	Basic Joystick Message 1 (BJM1)								
Parameter group number (PGN)	0x00FDD6								
Transmission rate	Every 100 ms and on change but no faster than XX ms (XX = 20 ms or 10 ms)								
DLC	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
X Axis (2)			SPN2665		SPN2670		SPN2675		Byte 1
			SPN2660						Byte 2
Y Axis (1)			SPN2666		SPN2671		SPN2676		Byte 3
			SPN2661						Byte 4
Limit warning 1	SPN 2680		SPN 2681		Not used	Not used	Not used	Not used	Byte 5
Digital input (DI 1 - 4)	SPN 2685 (DI1)		SPN 2686 (DI2)		SPN 2687 (DI3)		SPN 2688 (DI4)		Byte 6
Digital input (DI 5 - 8)	SPN 2689 (DI5)		SPN 2690 (DI6)		SPN 2691 (DI7)		SPN 2692 (DI8)		Byte 7
Counter and checksum	SPN 4207 (Checksum)				SPN 4206 (Counter)				Byte 8

SPN = Suspected Parameter Number

Telegram 2									
Type	Extended Joystick Message 1 (EJM1)								
Parameter group number (PGN)	0x00FDD7								
Transmission rate	Every 100 ms and on change but no faster than XX ms (XX = 20 ms or 10 ms)								
DLC	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
Axis (3)			SPN2667		SPN2672		SPN2677		Byte 1
			SPN2662						Byte 2
Axis (4)			SPN 2668		SPN 2673		SPN 2678		Byte 3
			SPN 2663						Byte 4
(FNR)	Reserved		Forward status		Rearward status		Neutral status		Byte 5
Digital input (DI 9 – 12)	SPN 2693 (DI9)		SPN 2694 (DI10)		SPN 2695 (DI11)		SPN 2696 (DI12)		Byte 6
Limit warning 2	SPN 2682		SPN 2683		Not used		Not used		Byte 7
Counter and checksum	SPN 4207 (Checksum)				SPN 4206 (Counter)				Byte 8

SPN = Suspected Parameter Number

Telegram 3									
Type	Extended Joystick Message 2 (EJM2)								
Parameter group number (PGN)	0x00FDD9								
Transmission rate	Every 100 ms and on change but no faster than XX ms (XX = 20 ms or 10 ms)								
DLC	8 bytes								
	Mapping								
	bit 8	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	
Axis (5)									Byte 1
									Byte 2
Axis (6)									Byte 3
									Byte 4
(FNR 2)	Reserved		Forward status		Rearward status		Neutral status		Byte 5
Digital input (DI 13 – 16)	SPN 2697 (DI13)		SPN 2698 (DI14)		SPN 2699 (DI15)		SPN 2670 (DI16)		Byte 6
Limit warning 3	SPN 2684		SPN 2685		Not used		Not used		Byte 7
Counter and checksum	SPN 4207 (Checksum)				SPN 4206 (Counter)				Byte 8

SPN = Suspected Parameter Number

Guidelines

Wiring recommendations

The wiring diagram on the machine is described on page 8. The fuse used on the power supply is

- ▶ 1 A / 0.4 A²s under 14 V
- ▶ 2 A / 1.4 A²s under 28 V

Recommendations for the definition of CAN frames

We recommend to incorporate an incremental frames counter into the set frames sent by the electronic joystick. When processing CAN messages, the machine controller must verify the correct increment of the counter of the joystick frame and implement a message detection that will stop the movements controlled by the joystick in case of no message detected.

Maintenance recommendations

Error code

If the electronic joystick is in default, an error code is emitted. The message containing the error code depends on the protocol used.

- ▶ In BRM Std: The error code is included in the 7th bytes of the frame 1.
- ▶ In CANopen: The error code is included in the 3rd and 4th bytes of the EMCY frame.
- ▶ In J1939: The error code is included in the 3rd and 4th bytes of the DM1 frame.

The description of the error codes is available on request.

Reset in case of error

The error codes are classified into 4 categories.

- ▶ Information Error Code
This type of defect does not influence the functioning it disappears when the fault is no longer present.
- ▶ Minor error code
This type of defect notify a malfunction of an electronic joystick functionality.
It issues a neutral position signal on the faulty axis regardless of its position. It indicates an inactive status of some component regardless of its status. The operation returns to normal as soon as the axis or component returns to neutral and the fault is no longer detected.
- ▶ A major error code
This type of defect notify a major malfunction of the electronic joystick.
It issues neutral position signals on all axes in default whatever their positions.
It indicates an inactive status of all connected components whatever their status. Resetting requires a reboot by resetting the power supply.
- ▶ Critical error code
Identical description to the “major error code” unless the fault remains present even after reset. To disable this type of defect, a specific CAN message must be sent to the electronic joystick.
Contact Bosch Rexroth for the reset procedure.

Safety instructions

General instructions

- ▶ Provide at the receiver (Machine Controller), a “time out” device compatible with the controlled functions.
- ▶ Signal cables and power cables must be rooted separately and away from each other.
- ▶ In case of electric welding operations on the machine, unplug the power supply battery as well as all plugs connecting the electronics.
- ▶ Ensure adequate distance between electronics and any radio installations in order to limit the magnetic field seen by the electronic joystick.
- ▶ Do not use electronic joysticks close to a magnetic field source of frequency lower than 50 Hz and amplitude greater than 0.6 mT.
- ▶ Do not direct the jet of a pressure washing unit directly at the unit.
- ▶ Equip other inductances of the machine with freewheel diodes to avoid the generation of parasites.
- ▶ If the product is dropped, it should be replaced as invisible damage could have negative impact on reability.
- ▶ Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the joystick.
- ▶ Incorrect parameter settings on the joystick may create potential hazards while the machine is in operation. 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 assumes no liability for dangers of this type.
- ▶ The component firmware/software must be installed and removed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ It is not permissible to open the joystick or to modify or repair the joystick. Modification or repairs to the wiring and the control grip could result in dangerous malfunctions. Repairs to the joystick may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ To switch off the system in emergencies, the stop switch (two-channel stop function) may be used. The switch must be in an easily accessible position for the operator. The system must be designed in such a way that safe braking is ensured when the outputs are switched off.
- ▶ When the electronics is not energized no pins must be connected to a voltage source.
- ▶ Make sure that the joystick’s integration 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.
- ▶ 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.
- ▶ Whilst commissioning and maintenance of the joystick, the machine may pose unforeseen hazards. Therefore the vehicle and the hydraulic system have to be in a safe condition during such operations.
- ▶ 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. (Example: Boot damage or badly positioned, visible damages on mechanical or electronic components.)

Intended use

- ▶ The joystick is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the joystick must generally occur within the operating ranges specified and approved in this data sheet, particularly with regard to voltage, current, 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 joystick other than that described in chapter “Intended use” is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Use in safety-related functions

- The customer is responsible for performing a risk analysis of the mobile working machine and for determining the possible safety-related functions.
- In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Disposal

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

Further information

- In addition, the application-specific documents (customer drawing, compliance matrix, etc.) are to be observed.

Related documentation

Document type	Title	Document number
Instruction manual	Electronic joystick 4THE5 series 41	29696-01-B
	Electronic joystick 4THE5 series 41 – safety-relevant project planning instructions	29696-02-B
Data sheet	Electronic joystick 4THE5 – Analog & PWM version	29697

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