3 Digital Inputs & Outputs

3.1 In Brief

Drive systems typically require inputs and outputs – “Home Switch”, Positive/Negative Limit Switches” and “Brake Output” with sufficient current, just to mention a few.

The inputs and outputs can easily be configured using the «Configuration Wizard» and may be changed online via EtherCAT.

3.1.1 Objective

The present Application Note explains the functionality of digital inputs and outputs and features “in practice examples” suitable for daily use.

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3.1.2 Scope

Hardware	Order #	Firmware Version	Reference
EPOS3 EtherCAT		2200h	Firmware Specification
EPOS3 70/10 EtherCAT	411146	2200h or higher	Cable Starting Set Hardware Reference

Table 3-7 Digital Inputs & Outputs – covered Hardware and required Documents

3.1.3 Tools

Tools	Description
Crimper	Molex hand crimper (63819-0000)
	Molex hand crimper (63819-0900)
Software	«EPOS Studio» Version 2.00 or higher

Table 3-8 Digital Inputs & Outputs – recommended Tools

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3.2 Functionality

3.2.1 Digital Inputs

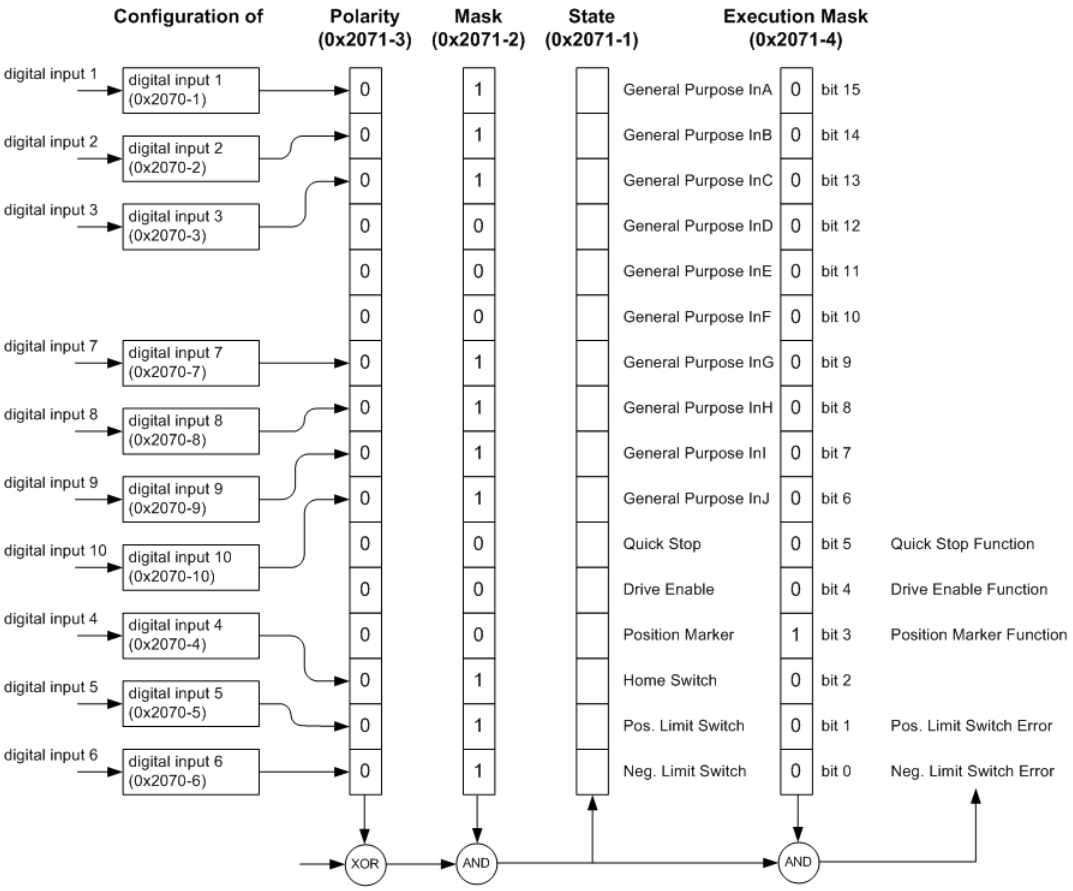

Figure 3-14 Digital Input Functionality – EPOS3 70/10 EtherCAT Overview (default Configuration)

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Configuration Parameter

Name	Index	Sub-index	Description
Configuration of Digital Input 1 (➔Table 3-11)	0x2070	0x01	Defines functionality assigned to DigIN1.
Configuration of Digital Input 2 (➔Table 3-11)	0x2070	0x02	Defines functionality assigned to DigIN2.
Configuration of Digital Input 3 (➔Table 3-11)	0x2070	0x03	Defines functionality assigned to DigIN3.
Configuration of Digital Input 4 (➔Table 3-11)	0x2070	0x04	Defines functionality assigned to DigIN4.
Configuration of Digital Input 5 (➔Table 3-11)	0x2070	0x05	Defines functionality assigned to DigIN5.
Configuration of Digital Input 6 (➔Table 3-11)	0x2070	0x06	Defines functionality assigned to DigIN6.
Configuration of Digital Input 7 (➔Table 3-11)	0x2070	0x07	Defines functionality assigned to DigIN7.
Configuration of Digital Input 8 (➔Table 3-11)	0x2070	0x08	Defines functionality assigned to DigIN8.
Configuration of Digital Input 9 (➔Table 3-11)	0x2070	0x09	Defines functionality assigned to DigIN9.
Configuration of Digital Input 10 (➔Table 3-11)	0x2070	0x0A	Defines functionality assigned to DigIN10.
Digital Input Functionalities Mask (➔Table 3-12)	0x2071	0x02	Displayed state of Digital Input Functionalities may be filtered.
Digital Input Functionalities Polarity (➔Table 3-13)	0x2071	0x03	Polarity of Digital Input Functionalities.
Digital Input Functionalities Execution Mask (➔Table 3-12)	0x2071	0x04	Execution of Digital Input Functionalities can be inhibited.

Table 3-9 Digital Input – Configuration Parameter

Input Parameter

Name	Index	Sub-index	Description
Digital Input Functionalities State (➔Table 3-12)	0x2071	0x01	Display state of Digital Input Functionalities.

Table 3-10 Digital Input – Input Parameter

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Input Configuration Values

Parameter “Configuration of Digital Input” defines bit position in “Digital Input Functionalities State”.

Value	Functionality	Description
15	General Purpose A	State can be read.
14	General Purpose B	State can be read.
13	General Purpose C	State can be read.
12	General Purpose D	State can be read.
11	General Purpose E	State can be read.
10	General Purpose F	State can be read.
9	General Purpose G	State can be read.
8	General Purpose H	State can be read.
7	General Purpose I	State can be read.
6	General Purpose J	State can be read.
5	Quick Stop	Set Quick Stop profile.
4	Device Enable	Enables/disables device.
3	Position Marker	Samples current position.
2	Home Switch	Used in some homing modes.
1	Positive Limit Switch	Generates limit error / used in some homing modes.
0	Negative Limit Switch	Generates limit error / used in some homing modes.

Table 3-11 Digital Input – Input Configuration Values

Parameter Description

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
General Purpose A	General Purpose B	General Purpose C	General Purpose D	General Purpose E	General Purpose F	General Purpose G	General Purpose H

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
General Purpose I	General Purpose J	Quick Stop	Device Enable	Position Marker	Home Switch	Pos. Limit Switch	Neg. Limit Switch

Table 3-12 Digital Input – Execution Mask Parameter

Polarity Values

Bit	0	1
associated pin	high active	low active

Table 3-13 Digital Input – Polarity Values

Note

- *“Digital Input Functionalities State” will only be displayed, if “Digital Input Functionalities Mask” is set to “Enable”.*
- *“Digital Input Functionalities State” enables/disables the specific function.*

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3.2.2 Digital Outputs

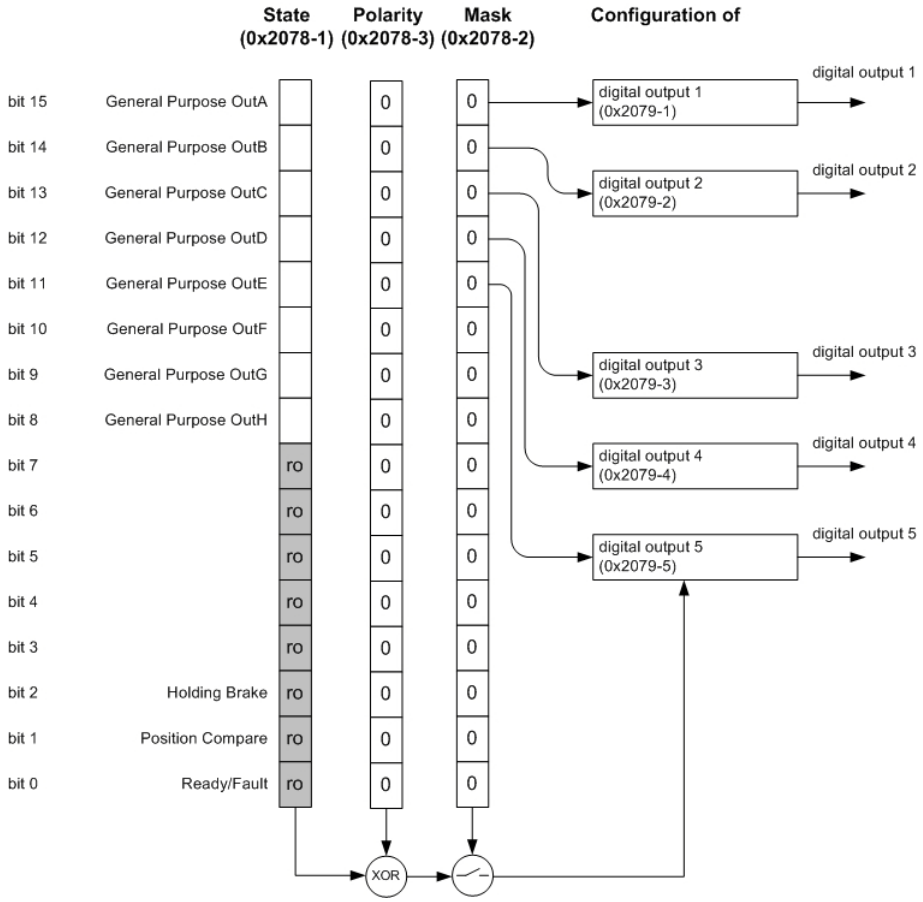

Figure 3-15 Digital Output Functionality – EPOS3 70/10 EtherCAT Overview (default Configuration

Configuration Parameter

Name	Index	Sub-index	Description
Configuration of Digital Output 1 (➔Table 3-15)	0x2079	0x01	Defines functionality assigned to DigOUT1.
Configuration of Digital Output 2 (➔Table 3-15)	0x2079	0x02	Defines functionality assigned to DigOUT2.
Configuration of Digital Output 3 (➔Table 3-15)	0x2079	0x03	Defines functionality assigned to DigOUT3.
Configuration of Digital Output 4 (➔Table 3-15)	0x2079	0x04	Defines functionality assigned to DigOUT4.
Configuration of Digital Output 5 (➔Table 3-15)	0x2079	0x05	Defines functionality assigned to DigOUT5.
Digital Output Functionalities State (➔Table 3-16)	0x2078	0x01	State of digital outputs may be set.
Digital Output Functionalities Mask (➔Table 3-16)	0x2078	0x02	Digital outputs may be filtered.
Digital Input Functionalities Polarity (➔Table 3-17)	0x2078	0x03	Change of polarity of digital output.

Table 3-14 Digital Output – Configuration Parameter

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Output Configuration Values

Parameter “Configuration of Digital Output” defines bit position in “Digital Output Functionalities State”.

Value	Functionality	Description
15	General Purpose A	State can be read.
14	General Purpose B	State can be read.
13	General Purpose C	State can be read.
12	General Purpose D	State can be read.
11	General Purpose E	State can be read.
10…8	not used	–
7…3	reserved	–
2	Holding Brake	Active output = activated brake Inactive output = deactivated brake
1	Position compare	Trigger output of Position Compare.
0	Ready / Fault	Active on Device Ready / Inactive on Fault

Table 3-15 Digital Output – Output Configuration Values

Parameter Description

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10…3	Bit 2	Bit 2	Bit 0
General Purpose A	General Purpose B	General Purpose C	General Purpose D	General Purpose E	not used / reserved	Holding Brake	Position Compare	Ready / Fault

Table 3-16 Digital Output – Execution Mask Parameter

Polarity Values

Bit	0	1
associated pin	not inverted 1 → high 0 → low	inverted 0 → high 1 → low

Table 3-17 Digital Output – Polarity Values

Note
A change in “Digital Output Functionalities State” is only of effect, if “Digital Output Functionalities Mask” is set to “Enable”.

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3.3 Connection

3.3.1 EPOS3 70/10 EtherCAT

Signal Cable 16core (275932) – Connector J6

Figure 3-16 Signal Cable 16core

Technical Data	
Cable cross-section	16 x 0.14 mm²
Length	3 m
Head A	Molex Micro-Fit 3.0 16 poles (430-25-1600) Molex Micro-Fit 3.0 female crimp terminals (43030-xxxx)
Head B	Cable end sleeves 0.14 mm2

Table 3-18 Signal Cable 16core – Technical Data

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Wire	Head A Pin	Head B Pin	Twisted Pair	Signal	Description
white	1		–	IN_COM2	Common signal 2 for DigIN4…6
brown	2		–	IN_COM1	Common signal 1 for DigIN1…3
green	3		–	DigIN6	Digital Input 6 “Negative Limit Switch”
yellow	4		–	DigIN5	Digital Input 5 “Positive Limit Switch”
grey	5		–	DigIN4	Digital Input 4 “Home Switch”
pink	6		–	DigIN3	Digital Input 3 “General Purpose”
blue	7		–	DigIN2	Digital Input 2 “General Purpose”
red	8		–	DigIN1	Digital Input 1 “General Purpose”
black	9		–	+V Opto IN	External supply input voltage for Digital Outputs (+12…24 VDC)
violet	10		–	DigOUT4	Digital Output 4 “Brake / General Purpose”
grey/ pink	11		–	DigOUT3	Digital Output 3 “Brake / General Purpose”
red/blue	12		–	DigOUT2	Digital Output 2 “General Purpose”
white/ green	13		–	DigOUT1	Digital Output 1 “General Purpose”
brown/ green	14		–	DigOUT_Gnd	Digital OUT ground reference to “+V Opto IN”
white/ yellow	15		–	DigIN11	Digital Input 11 “Power Stage Enable”
yellow/ brown	16		–	IN_COM3	Common signal 3 for DigIN11

Table 3-19 Signal Cable 16core – Pin Assignment EPOS3 70/10 EtherCAT

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Signal Cable 6x2core (300586) – Connector J5

Figure 3-17 Signal Cable 6x2core

Technical Data	
Cable cross-section	6 x 2 x 0.14 mm²
Length	3.00 m
Head A	Molex Micro-Fit 3.0 12 poles (430-25-1200) Molex Micro-Fit 3.0 female crimp terminals (43030-xxxx)
Head B	Cable end sleeves 0.14 mm2

Table 3-20 Signal Cable 6x2core – Technical Data

Wire	Head A Pin	Head B Pin	Twisted Pair	Signal	Description
white	1		1	DigIN10/	Digital Input 10 “High Speed Command” complement
brown	2			DigIN10	Digital Input 10 “High Speed Command”
green	3		2	DigIN9/	Digital Input 9 “High Speed Command” complement
yellow	4			DigIN9	Digital Input 9 “High Speed Command”
grey	5		3	DigIN7/	Digital Input 7 “High Speed Command” complement
pink	6			DigIN7	Digital Input 7 “High Speed Command”
blue	7		4	DigIN8/	Digital Input 8 “High Speed Command” complement
red	8			DigIN8	Digital Input 8 “High Speed Command”
black	9		5	$+V_{AUX}$	Auxiliary output voltage +5 VDC / 150 mA
violet	10			D_GND	Digital signal ground
grey/ pink	11		6	DigOUT5/	Digital Output 5 “High Speed Command” complement
red/blue	12			DigOUT5	Digital Output 5 “High Speed Command”

Table 3-21 Signal Cable 6x2core – Pin Assignment EPOS3 70/10 EtherCAT

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3.4 Configuration

Configuration is handled by a dynamic wizard assisting you in selecting desired functions and assigning them to inputs and outputs of you choice.

Note
The following explanations show you how to initiate the Configuration Wizard. Its further coarse will then depend on the functions and options you will actually chose. The stated figures are thereby meant as examples.

3.4.1 Step A: Open I/O Configuration Wizard

1) Complete standard system configuration (Startup Wizard) in «EPOS Studio».
2) Doubleclick ¤I/O Configuration Wizard¤ to commence configuration.

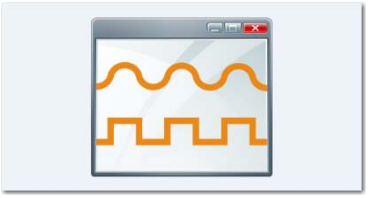

Figure 3-18 Open I/O Configuration Wizard

3) A screen will appear showing the number of I/Os available for configuration.
4) Click ¤Next¤ to continue.

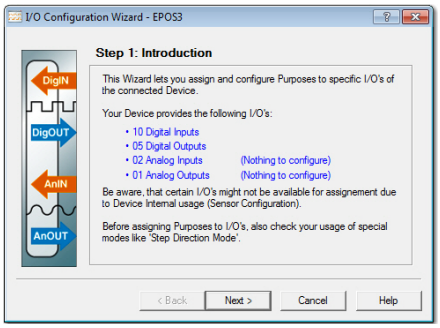

Figure 3-19 Configuration Wizard – Introduction

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3.4.2 Step B: Configure Digital Inputs

1) Select predefined functions you wish to use by ticking respective check boxes. An available digital input will automatically be assigned to your selection.
2) If you wish to assign a particular digital input to a given function, select desired input from the ¤Dropdown menu¤ in column “Input”.
3) Click ¤Next¤ to continue.

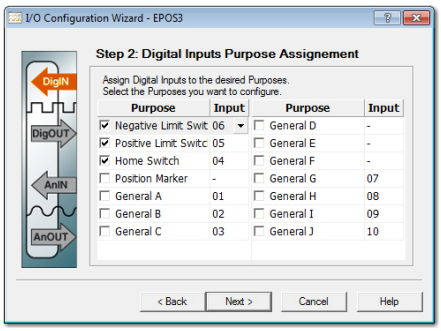

Figure 3-20 Configuration Wizard – Configure Digital Inputs

4) Define mask, type of switch (NPN or PNP) and switch output state.
5) Set limit switch error.
6) Click ¤Next¤ to continue.
7) Repeat for every earlier selected digital input.

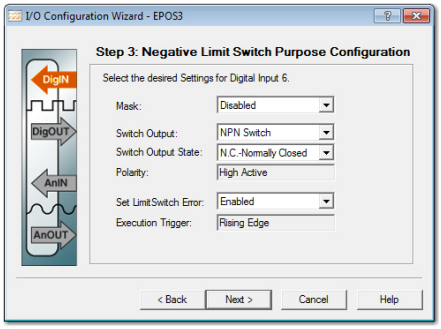

Figure 3-21 Configuration Wizard – Configure Digital Input Functionality

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3.4.3 Step C: Configure Digital Outputs

1) Select predefined functions you wish to use by ticking respective check boxes. An available digital output will automatically be assigned to your selection.
2) If you wish to assign a particular digital output to a given function, select desired input from the ¤Dropdown menu¤ in column “Output”.
3) Click ¤Next¤ to continue.

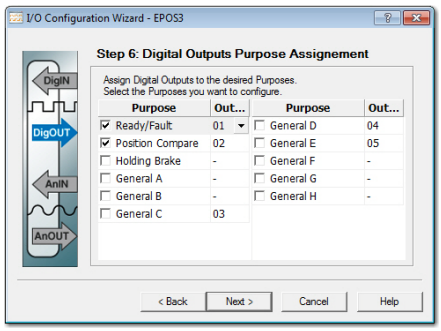

Figure 3-22 Configuration Wizard – Configure Digital Outputs

3.4.4 Step D: Save Configuration

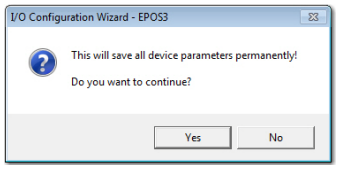

Figure 3-23 Safe Configuration

Note
You may check the status and alter the configuration at any time using the «I/O Monitor».

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3.5 Wiring Examples

3.5.1 EPOS3 70/10 EtherCAT

3.5.1.1 Proximity Switches

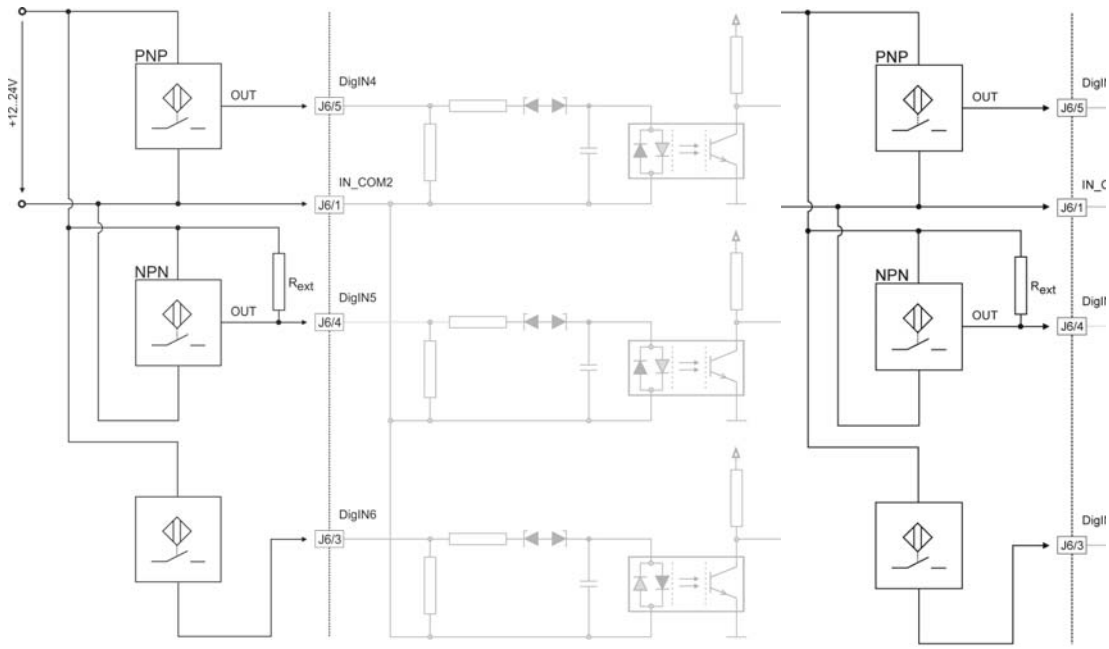

Figure 3-24 EPOS3 70/10 EtherCAT – DigIN4…6 / PNP/NPN Proximity Switches

Best Practice

- *We recommend the use of 3-wire PNP proximity switches.*
- *The use of 3-wire NPN proximity switches requires an additional external pull-up resistor:*
  – R_{ext} (12 V) = 560 Ω (300 mW)
  – R_{ext} (24 V) = 3 kΩ (200 mW)
- *The use of 2-wire proximity switches is possible.*

3.5.1.2 Permanent Magnet Brake

EPOS3 70/10 EtherCAT output 4 permits direct activation of loads with very high current demand (such as motor brakes and warning lights, etc.).

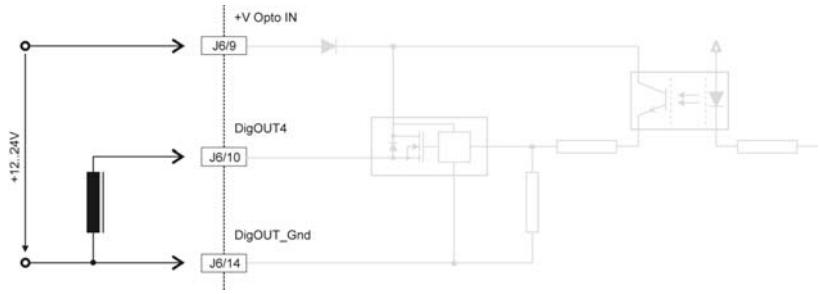

Figure 3-25 EPOS3 70/10 EtherCAT – DigOUT4 / permanent Magnet Brake

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