maxon motor

maxon motor control 4-Q-EC Servoamplifier DES 70/10

Order number 228597

Operating Instructions November 2005 Edition

The DES (**D**igital **E**C **S**ervoamplifier) is a very efficient digital servoamplifier with sinusoidal current commutation for perfectly controlling EC (**E**lectronic **C**ommutation) motors.
The EC motors must be equipped with Hall sensors and a digital encoder with line driver.
Control, monitoring and complete control algorithms are carried out in a very fast digital signal processor.
As with classic, conventional automatic controllers, easy trimming and adjustment of the servoamplifier is possible, with just a few potentiometers.
As an alternative, configuration is also possible using a PC (RS232 or CAN). This is particularly beneficial with series application, as all adjustments and parameters can be set quickly, numerically and easily reproduced.
The set value specification can be made conventionally with an analogue input (0 ... 5 V or ±10 V), RS232 or CAN bus interface.
The sinusoidal commutation causes minimal torque ripple and low motor noise.

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The latest edition of these operating instructions, additional documentation and software to the DES 70/10 may also be found on the Internet under www.maxonmotor.com category «Service», subdirectory «Downloads», Order number 228597.

This document is valid for the HardwareVersion 4102.

1 Safety Instructions

Skilled Personnel
Installation and starting of the equipment shall only be performed by experienced, skilled personnel.

Statutory Regulations
The user must ensure that the servoamplifier and the components belonging to it are assembled and connected according to local statutory regulations.

Load Disconnected
For primary operation the motor should be free running, i. e. with the load disconnected.

Additional Safety Equipment
An electronic apparatus is, in principle, not fail-safe. Machines and apparatus must therefore be fitted with independent monitoring and safety equipment. If the equipment breaks down, if it is operated incorrectly, if the control unit breaks down or if the cables break, etc., it must be ensured that the drive or the complete apparatus is kept in a safe operating mode.

Repairs
Repairs may be made by authorised personnel only or by the manufacturer. It is dangerous for the user to open the unit or make repairs to it.

Danger
Do ensure that during the installation of the DES 70/10 no apparatus is connected to the electrical supply. After switching on, do not touch any live parts!

Max. Supply Voltage
Make sure that the supply voltage is between 24 and 70 VDC. Voltages higher than 75 VDC or of wrong polarity will destroy the unit.

Short circuit and earth fault
The DES 70/10 amplifier is not protected against winding short circuits against ground safety earth and/or Gnd!

Electrostatic Sensitive Device (ESD)

2 Performance Data

2.1 Electrical Data

Supply voltage V_{CC} (Ripple < 5%)	24 - 70 VDC
Max. output voltage	0.9 · V_{CC}
Max. output current Imax	30 A
Continuous output current Icont	10 A
Switching frequency	50 kHz
Max. efficiency	92 %
Band width current controller	1 kHz
Max. speed (motor with 2 poles)	25 000 rpm
Minimum terminal inductance	400 µH

2.2 Inputs

"Set value"	configured by DIP switch **S9**:	-10 ... +10 V (R_i = 80 kΩ)
		0 ... +5 V (R_i = 50 kΩ)
"Enable"		+2.4 ... +50 VDC (Ri = 12 kΩ)
"Digital 1" (Switch "Monitor n" / "Monitor I")		+2.4 ... +50 VDC (Ri = 17 kΩ)
"Digital 2" (Switch speed-/ current controller)		+2.4 ... +50 VDC (Ri = 90 kΩ)
"STOP"		+2.4 ... +50 VDC (Ri = 17 kΩ)
Encoder signals		A, A\, B, B\, I, I\ ; max. 1 MHz
Hall sensor signals		Hall sensor 1, Hall sensor 2, Hall sensor 3
CAN ID (CAN identification)		configured by DIP switch **S1 ... 7**
		ID = 1 ... 127 (binary coded)

2.3 Outputs

Monitor	configurable by DIP Switch 10:	-10 ... +10 V (R_0 = 1 kΩ, f_g = 900 Hz)
		0 ... +5 V (R_0 = 1 kΩ, f_g = 900 Hz)
Status reading "Ready"		open collector: max. 30 VDC (I_L < 20 mA)

2.4 Voltage outputs

Encoder supply voltage	+5 VDC, max. 100 mA
Hall sensors supply voltage	+5 VDC, max. 50 mA
Auxiliary supply voltage	+5 VDC, max. 20 mA

2.5 Interfaces

RS232	RxD, TxD (max. 115 200 bit/s)
CAN	CAN_H, CAN_L (max.1 Mbit/s)

2.6 Trim potentiometers

n_{max}, Offset, $I_{max,}$ gain

2.7 LED indicator

Bi-colour LED	READY / ERROR
	green = READY, red = ERROR

2.8 Ambient temperature/ humidity range

Operating	-10 ... +45°C
Storage	-40 ... +85°C
non condensating	20 ... 80 %

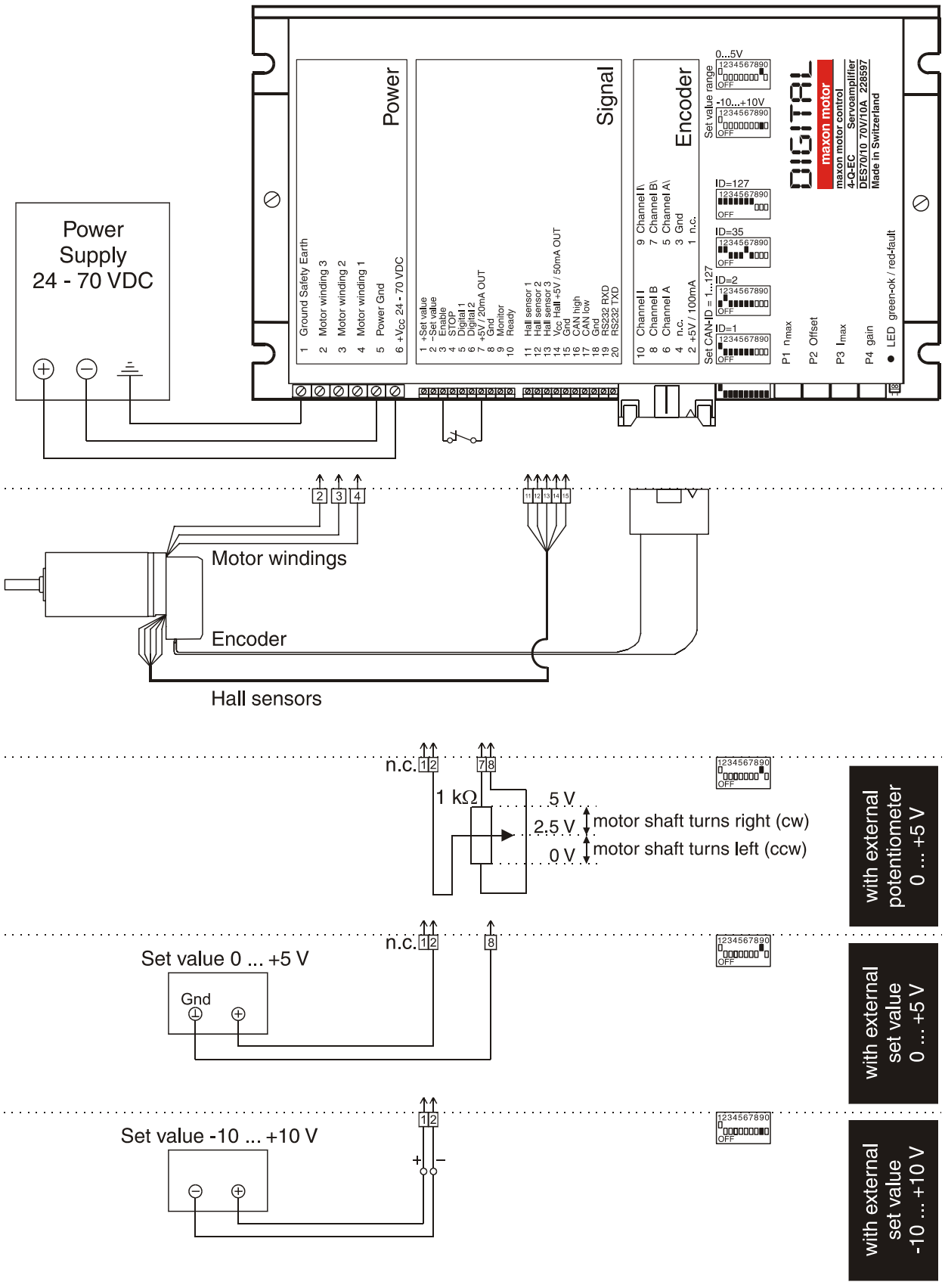
2.9 Mechanical data

Weight	approx. 400 g
Dimensions (L x W x H)	see dimension drawing, chapter 9
Mounting plate	for screws M4

2.10 Connections

PCB clamps		Power (6 poles), Signal (20 poles)
	Pitch	Power 5.08 mm, Signal 2.54 mm
	suitable for wire cross section	Power 0.14 ... 1.5 mm^2 (AWG 26-16)
		Signal 0.14 ... 0.5 mm^2 (AWG 26-20)
Encoder		Plug DIN41651 (10 poles)
		for flat band cable, pitch 1.27 mm, AWG28

3 Minimum External Wiring for Different Modes of Operation



4 Operating Instructions

4.1 Power supply layout

Any available power supply can be used, provided it meets the minimal requirements set out below.
During set up and adjustment phases, we recommend separating the motor mechanically from the machine to prevent damage due to uncontrolled motion.

Power supply requirements	
Output voltage	V_{CC} min. 24 VDC; V_{CC} max. 70 VDC
Ripple	< 5 %
Output current	depending on load, continuous max. 10 A acceleration, short-time max. 30 A

The required voltage can be calculated as follows:

Known values
- ⇨ Operating torque M_B [mNm]
- ⇨ Operating speed n_B [rpm]
- ⇨ Nominal motor voltage U_N [V]
- ⇨ Motor no-load speed at U_N, n_0 [rpm]
- ⇨ Speed/torque gradient of the motor $\Delta n/\Delta M$ [rpm / mNm]

Sought value
- ⇨ Supply voltage V_{CC} [V]

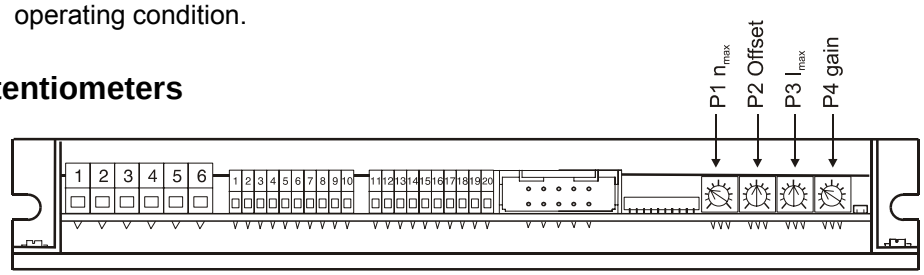
Solution

$$V_{CC} = \frac{U_N}{n_0} \cdot (n_B + \frac{\Delta n}{\Delta M} \cdot M_B) \cdot \frac{1}{0.9} + 2\,[V]$$

Choose a power supply capable of supplying this calculated voltage under load. The formula takes a max. PWM cycle of 90 % and a 2 volts max. voltage drop at DES 70/10 into account.

Consider:
The power supply must be able to buffer the back-fed energy from brake operation e. g. in a condenser. With electronically stabilized power supply units, care must be taken to ensure that the overcurrent protection responds in non-operating condition.

4.2 Function of the potentiometers



Potentiometer		Function	Turn to the left ↺	Turn to the right ↻
P1	n_{max}	max. speed at max. set value (e.g. external potentiometer fully clockwise; 5 V; 10 V)	slower min. 0 rpm	faster max. 25 000 rpm
P2	Offset	Adjustment: n = 0 rpm (set value e. g. ext. potentiom. in centre pos.)	motor turns CCW	motor turns CW
P3	I_{max}	current limit	lower ≈ 0A	higher ≈ 30A
	I_{cont}		lower ≈ 0A	higher ≈ 10A
P4	gain	amplification	lower	higher

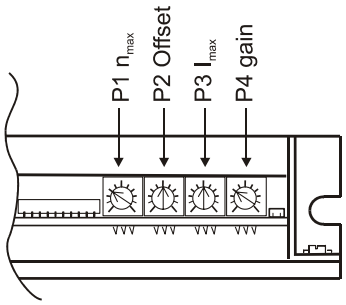
4.3 Adjustment of the potentiometer

4.3.1 Pre-adjustment

With the pre-adjustment, the potentiometers are set in a preferred position.

DES units in the original packing are preset.

Pre-adjustment potentiometers		
P1	n_{max}	30 % [1]
P2	Offset	50 %
P3	I_{max}	50 % [2]
P4	gain	30 %



1) 30 % are equivalent to n_{max} = approx 7500 rpm
2) 50 % are equivalent to I_{cont} = approx. 5 A, I_{max} = approx. 15 A

4.3.2 Adjustment

Digital speed control
(see also 5.1.6)

1. Give the max. set value (e.g. 10 V) and turn potentiometer **P1 n_{max}** until the required speed is achieved.
2. Set potentiometer **P3 I_{max}** at the required limiting value.
   Important: The limiting value I_{cont} (= $^1/_3$ I_{max}) should be below the max. continuous current as shown on the motor data sheet.
3. Increase potentiometer **P4 gain** slowly until amplification is set sufficiently high.
   Important: If the motor vibrates or becomes loud, the selected amplification is too high and the potentiometer P4 must be readjusted until the instability of the drive's closed loop ceases under all loads.
4. Adjust set value to zero, e.g. by short-circuiting the set value. Then, with the potentiometer **P2 Offset**, set the motor speed to zero.
   Note: Step 4 is not necessary with external set value potentiometer.

Digital current control
(see also 5.1.6)

1. Set potentiometer **P3 I_{max}** at the required limiting value.
   Important: The limiting value I_{cont} (= $^1/_3$ I_{max}) should be below the max. continuous current as shown on the motor data sheet.
2. Adjust set value to zero, e.g. by short-circuiting the set value. Then, with the potentiometer **P2 Offset**, set the motor speed to zero.

Note
Configured as a digital current controller, **P1 n_{max}** und **P4 gain** are not activated.

5 Functions

5.1 Inputs

5.1.1 "Set value"

Two different versions can be selected to give an analogue set value. Versions are selected by setting the DIP switch **S9** "Set value range".
The "Set value" input is protected against overvoltage.

Set value range -10 ... +10 V	Input voltage range	-10 ... +10 V
	Input circuit	differential
	Input resistance	80 kΩ
	Positive set value	(+Set Value) > (-Set Value)
	Negative set value	(+Set Value) < (-Set Value)
	DIP-Switch 9	OFF 

Set value range 0 ... +5 V is selected, if the set value is given from an external potentiometer.

Set value range 0 ... +5 V	Input voltage range	0 ... +5 V
	Input circuit	against Gnd
	Input resistance	50 kΩ
	Positive set value	(-Set Value) < 2.5 VDC
	Negative set value	(-Set Value) > 2.5 VDC
	DIP-Switch 8	ON 
	Required external potentiometer	1 kΩ

Note on set value range 0 ... +5 V:
If using a set value range 0 ... +5 V, do not connect "+Set Value" (Signal clamp pin 1).

5.1.2 "Enable"

If a voltage is given at "Enable", the servoamplifier switches the motor voltage to the winding connections. If the "Enable" input is not switched on (floating) or is connected to Gnd, the power stage will be high-impedance and therefore disabled.
The "Enable" input is protected against overvoltage.

	Input resistance	12 kΩ (+5 V) 7 kΩ (+24 V)
"Enable"	Minimum input voltage	+2.4 VDC
	Maximum input voltage	+50 VDC
	Switching time	nominal 3 ms (at 5 V)
"Disable"	Minimum input voltage	0 VDC
	Maximum input voltage	+0.8 VDC
	Switching time	nominal 4 ms (at 5 V)

5.1.3 "Hall sensor 1", "Hall sensor 2", "Hall sensor 3"

On one hand the Hall sensors detect the rotor position during start-up and on the other hand monitor the rotor position during operation.
The "Hall sensor" inputs are protected against overvoltage.

Voltage value "low"	max. 0.8 V
Voltage value "high"	min. 2.4 V
Internal pull-up resistance	2.7 kΩ against +5 VDC

Suitable for Hall effect sensors IC using Schmitt trigger with open collector output.

5.1.4 "STOP"

If a voltage is given at "STOP", the motor speed will be stopped with maximum deceleration (adjusted value at potentiometer P3 I_{max}) until motor shaft stands still.
If the "STOP" input is not switched off (floating) or is connected to Gnd, the motor speed is not affected.
The "STOP" input is protected against overvoltage.

	Input resistance	17 kΩ (+5 V) 12 kΩ (+24 V)
"STOP" disabled	Minimum input voltage	0 VDC
	Maximum input voltage	+0.8 VDC
"STOP" enabled	Minimum input voltage	+2.4 VDC
	Maximum input voltage	+50 VDC

5.1.5 Toggle monitor signal "Digital 1"

If the "Digital 1" input is not switched on (floating) or is connected to Gnd, the actual motor speed n is given at the "Monitor" output.
If a voltage is given at "Digital 1", the actual motor current I is given at the "Monitor" output.
The "Digital 1" input is protected against overvoltage.

	Input resistance	17 kΩ (+5 V) 12 kΩ (+24 V)
"Monitor n" enabled	Minimum input voltage	0 VDC
	Maximum input voltage	+0.8 VDC
"Monitor I" enabled	Minimum input voltage	+2.4 VDC
	Maximum input voltage	+50 VDC

5.1.6 Toggle controller mode (speed/current control) "Digital 2"

If the "Digital 2" input is not switched on (floating) or is connected to a voltage higher than 2.4 VDC, the servoamplifier is configured to speed controller mode.
If the "Digital 2" input is connected to Gnd, the servoamplifier is configured to current (torque) mode.
The "Digital 2" input is protected against overvoltage.

	Input resistance	92 kΩ (+5 V) 13 kΩ (+24 V)
	Internal pull-up resistance	22 kΩ against +5 VDC
Speed control enabled	Minimum input voltage	+2.4 VDC
	Maximum input voltage	+50 VDC
Current control enabled	Minimum input voltage	+0 VDC
	Maximum input voltage	+0.8 VDC

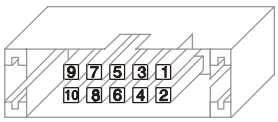
Note
If the controller mode has been changed, a disable-enable process (refer to 5.1.2, "Enable") must be carried out to activate the new mode.

5.1.7 Encoder

Encoder supply voltage	+5 VDC max. 100 mA
Maximum encoder frequency	1 MHz
Voltage value	TTL Low max. 0.8 V High min. 2.0 V
Internal Line Receiver	EIA standard RS-422

It is recommended to use an encoder with built-in line driver.

Male connector (front view)



Pin configuration at "Encoder" input:

1	n.c.	Not connected
2	+5 V	+5 VDC max. 100 mA
3	Gnd	Ground
4	n.c.	Not connected
5	A\	Inverted channel A
6	A	Channel A
7	B\	Inverted channel B
8	B	Channel B
9	I\	Inverted channel I
10	I	Channel I

This pin configuration is compatible with the flat cable plugs of the HEDL 55xx encoder (with line driver) and the MR encoders with line driver, type ML and L.

Note
The standard encoder adjustment (original packing) refers to a 500-counts per turn encoder. For other encoders, the adjustment must be modified with the software (GUI).

5.2 Outputs

5.2.1 Auxiliary voltage "V_{CC} Hall +5 V / 50 mA OUT"

An internal auxiliary voltage of +5 V is provided for powering the Hall sensors. The output is protected against overload.

Output voltage	+5 VDC
Maximum output current	50 mA

5.2.2 Auxiliary voltage "+5 V / 20 mA OUT"

An internal auxiliary voltage of +5 V is provided:
- Control of inputs: "Enable", "Digital 1" and "Digital 2"
- Supplying external potentiometer 1 kΩ

The output is protected against overload.

Output voltage	+5 VDC
Maximum output current	20 mA

5.2.3 "Monitor"

Speed monitor "Monitor n" "Digital 1" input 0 ... +0.8 VDC (or not connected)

The speed monitor is primarily intended for the qualitative estimation of the dynamics. The absolute speed is determined by the properties of the speed sensors and by the setting of the n_{max} potentiometer. The signal is proportional to the speed.

	DIP-Switch **S10** ↓ OFF	DIP-Switch **S10** ↑ ON
Output voltage range	0 ... +5 VDC	-10 ... +10 VDC
Ripple	max. 0.02 V	max. 0.08 V
Resolution	approx. 0.0125 V (400 Steps)	approx. 0.05 V (400 Steps)
Output resistance R_O	1 kΩ	1 kΩ
Cutoff frequency f_g	900 Hz	900 Hz
Example:		
$-n_{max}$ corresponding to	0 V	-10 V
0 rpm corresponding to	2.5 V	0 V
$+n_{max}$ corresponding to	5 V	+10 V

Current monitor "Monitor I" "Digital 1" input +2.4 ... +50 VDC

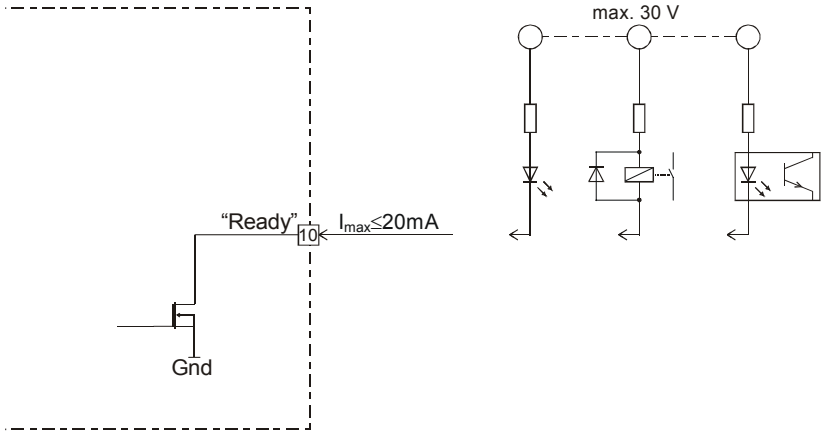
The servoamplifier makes a current actual value available for monitoring purposes. The signal is proportional to the mean value of the motor current.

	DIP switch **S10** ↓ OFF	DIP switch **S10** ↑ ON
Output voltage range	0 ... +5 VDC	-10 ... +10 VDC
Ripple	max. 0.02 V	max. 0.08 V
Resolution	approx. 0.0125 V (400 Steps)	approx. 0.0500 V (400 Steps)
Output resistance R_O	1 kΩ	1 kΩ
Cutoff frequency f_g	900 Hz	900 Hz
Gradient	≈ 12 A/V	≈ 3 A/V
Example:		
-30 A corresponding to	0 V	-10 V
0 A corresponding to	2.5 V	0 V
+30 A corresponding to	5 V	+10 V

The "Monitor" output is protected against overload.

5.2.4 Status reading “Ready”

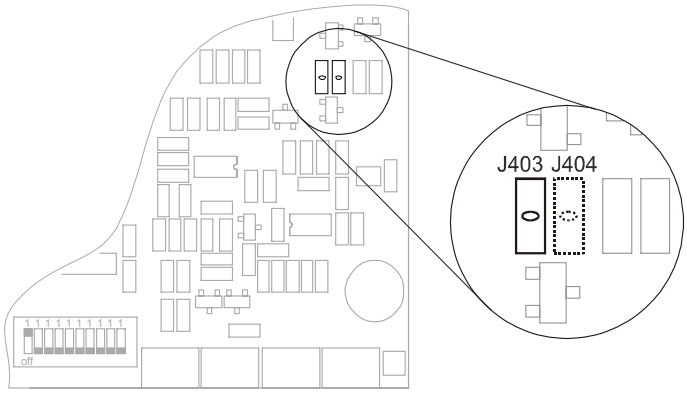
The “Ready” signal can be used to report operational readiness or a fault condition on a master control unit. The fault condition is stored. In order to reset the fault condition, the servoamplifier must be re-released (Enable). If the cause of the fault situation cannot be eliminated, the error will occur again immediately.



Additional external voltage is required:

Input voltage range	max. 30 VDC
Load current	< 20 mA

Caution:
The load current must be limited by an external barrier resistance up to 20 mA maximum!



Version 1:
Standard (pre-adjusted)

Error output	J403 short-circuited (0 Ω) J404 not mounted (open)

The open collector output is, in normal cases, i.e. no faults, switched to Gnd.
In case of a fault, the error output is not conducting (see also 6.2).

Version 2:
Special (customized)

Inverted error output	J403 not mounted (open) J404 short-circuited (0 Ω)

The open collector output is, in normal cases, i.e. no faults, not conducting (high resistance).
In case of a fault, the error output is switched to Gnd (see also 6.2).

5.3 Interfaces

5.3.1 Serial Interface “RS232 RxD”, “RS232 TxD”

Maximum input voltage	± 30 V
Maximum output voltage	± 30 V
Maximum bit rate	115 200 bit/s
Data line protection	ESD protected
internal RS232 driver/receiver	EIA RS232 standard
Baud rate (can be configured)	up to max. 115 200 bit/s

Note

- Please bear in mind your PC’s serial port maximal baud rate.
- The standard baud rate setting (original packing) is 38 600 bauds. If a different rate is required, the setting must be changed using the software (GUI).

Data bits	8
Parity	none
Stop bit	1
Protocol	none

Connection DES - PC

Servoamplifier DES 70/10	**PC Interface (RS232), DIN41652**
Signal clamp pin 18 Gnd	Pin 5 Gnd
Signal clamp pin 19 RS232 RxD	Pin 3 TxD
Signal clamp pin 20 RS232 TxD	Pin 2 RxD

5.3.2 CAN Interface “CAN high”, “CAN low”

Standard type	CAN high-speed ISO 11898 compatible
Maximum bit rate	1 Mbit/s
Max. number of CAN nodes (fan out)	127
Protocol	CAN 2.0B
CAN frame type	Standard (11 bit identifier)
Identifier setting	by DIP Switch or software using CAN or RS232 (only temporary setting with software)

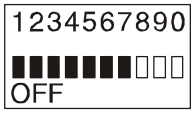
Connection DES - CAN bus line CiA DS-102

Servoamplifier DES 70/10	**CAN 9 pin D-Sub (DIN41652)**
Signal clamp pin 16 CAN high	Pin 7 CAN_H
Signal clamp pin 17 CAN low	Pin 2 CAN_L
Signal clamp pin 18 Gnd	Pin 3 CAN_GND

5.3.3 CAN ID (CAN Identification)

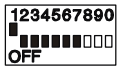
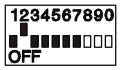
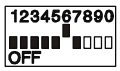
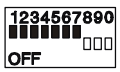
The CAN-ID (node address) is set at DIP switch **S1 ... 7**.
All addresses can be coded from 1 ... 127 using the binary code.

Switch	Binary code	Valence
1	2^0	1
2	2^1	2
3	2^2	4
4	2^3	8
5	2^4	16
6	2^5	32
7	2^6	64



If the valences of all switches set at ON are added together, this gives the set CAN-ID (node address).

Examples:
The following table can be used as a guide, but is not comprehensive.

	Switch	**1**	**2**	**3**	**4**	**5**	**6**	**7**	
	Valence	**1**	**2**	**4**	**8**	**16**	**32**	**64**	
CAN-ID	**Switch setting**								**Calculation**
1		**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
2		**0**	**1**	**0**	**0**	**0**	**0**	**0**	**2**
32		**0**	**0**	**0**	**0**	**0**	**1**	**0**	**32**
35		**1**	**1**	**0**	**0**	**0**	**1**	**0**	**1 + 2 + 32**
127		**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1 + 2 + 4 + 8 + 16 + 32 + 64**

Note
- CAN-ID = 0 is invalid and overwritten with CAN-ID = 1.
- DIP-Switches 8 to 10 have no impact on the CAN-ID.

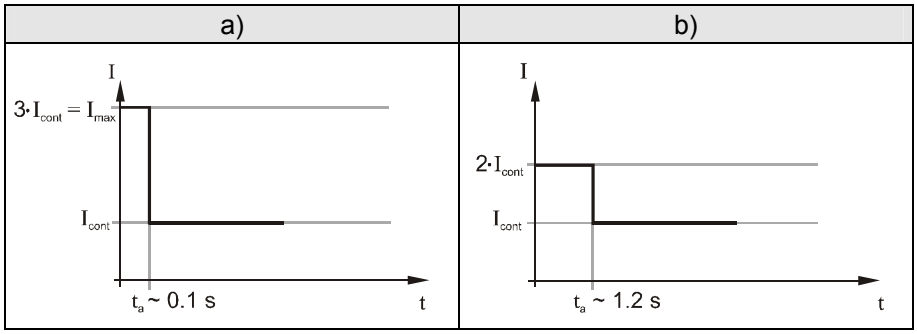
5.4 Current limit

Brushless maxon EC motors are particularly well suited for use in servodrives. Very fast acceleration times and thermal overload protection are required.
The digital servoamplifier DES 70/10 operates with I_{max}- and I_{cont} -current limitation, which satisfies both requirements.

Maximum output current I_{max}	< 30 A
Continuous output current I_{cont}	< 10 A
Ratio I_{max} : I_{cont}	3:1

The continuous output current Icont (0 ... 10 A), adjusted with the potentiometer, is available on an unlimited basis.
A higher current is also permitted for a short time (Imax = 3 • Icont), whereby the length of time is dependent on the previous history of the current path.

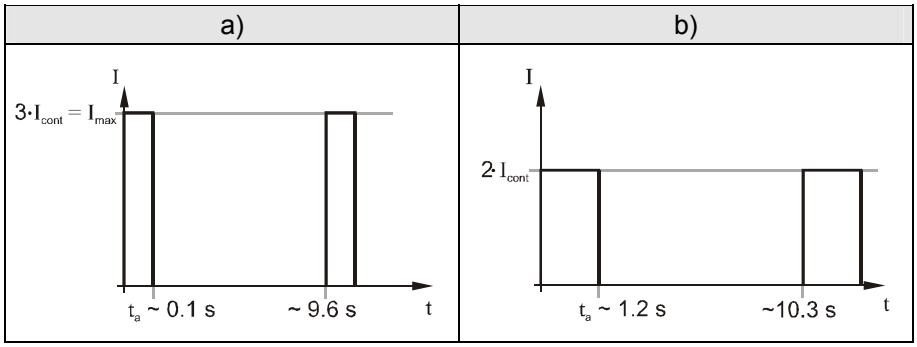
Example 1:



During the time t_a[1] a higher current is permitted for motor acceleration. The current is then limited to the continuous output current I_{cont}.

If the motor is operated long-term with the continuous output current I_{cont}, no higher current is permitted (thus t_a = 0 s).

Example 2: (cyclical mode)



In cyclical mode, the max. output current I_{max} is available after a break of approx. 10 s, provided that the current between the acceleration processes is zero, otherwise time t_a is reduced.

[1] The length of time depends on the current value and the motor's previous current load.

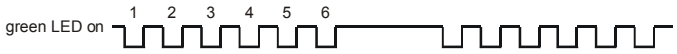
6 Error Messages

6.1 Faultless condition

The green LED shows the operating status (“Enable” or “Disable”) of DES.
DES in “Disable” status (DES ready): green LED flashes (flash frequency approx. 1 Hz), red LED does not shine.
DES in “Enable” status (power stage of DES is enabled): green LED shines continually, red LED does not shine.

6.2 Faulty condition

Error conditions are detected by DES.
The red LED shines continually in the event of error condition.
Depending on error, the green LED flashes at varying intervals.

Example: Error 5 

Number of flashing pulses of green LED	**possible errors**
1	*Error 0 => Hall sensor error* • Hall sensors incorrectly wired • Hall sensor supply voltage incorrectly wired • Damaged Hall sensor in the motor
2	*Error 1 => Index processing error* • Encoder without working index channel • System parameter “Encoder Resolution” set incorrectly • Input frequency of encoder signal too high
3	*Error 2 => Wrong setting of encoder resolution* • system parameter (“encoder resolution”) set incorrectly
4	*Error 3 => Hall sensor 3 not found* • Hall sensor 3 incorrectly wired • Damaged Hall sensor 3 in the motor • System parameter “Encoder Resolution” set too low
5	*Error 4 => Over current error* • Short circuit in the motor winding • Power supply cannot supply enough acceleration current • Gain regulation loop is too high; speed regulation gains must be reduced • System parameter ‘’Acceleration’’ too high • Damaged power stage
6	*Error 5 => Over voltage error* • power supply voltage too high • voltage in generation mode too high
7	*Error 6 => Over speed error* • Speed in current control mode too high (> 30 000 rpm)
8	*Error 7 => Supply voltage too low for operation* • supply voltage is too low for operation
9	*Error 8 => Angle detection error* • The difference of the angle between the encoder and Hall sensors is out of tolerance • interference on encoder and Hall sensor signals
12	*Error 11 => Overtemperature* • The temperature of the power stage is too high

7 EMC-compliant installation

Power supply (+V_{CC} - Power Gnd)

- No shielding normally required
- Star point-shaped wiring if several amplifiers are supplied by the same power supply

Motor cable (> 30 cm)

- Shielded cable highly recommended.
- Connect shielding on both sides:

  DES 70/10 side: Terminal 1 “Ground Safety Earth” and/or bottom of housing.

  Motor side: Motor housing or with motor housing mechanical design with low resistive connection.
- Use separate cable.

Hall sensor cable (> 30 cm)

- Shielded cable highly recommended.
- Connect shielding on both sides:

  DES 70/10 side: Terminal 1 “Ground Safety Earth” and/or bottom of housing.

  Motor side: Motor housing or with motor housing mechanical design with low resistive connection.
- Use separate cable.

Direct connection motor/Hall cable (≤ 30 cm) on DES 70/10

- Shield casing over motor/Hall connection cable (expecting EC 45/EC 60).
- Connect shielding on both sides.

or

- Lowest resistive connection of motor housing and “Ground Safety Earth” terminal 1 and/or bottom of DES 70/10 housing
- Cable design of motor/Hall connection cable as close as possible with aforementioned connection

Encoder cable

- Encoder with line driver recommended.
- Channel A, A\; channel B, B\; channel I, I\; twisted pair.
- No shielding normally required.
- Use separate cable.

RS-232

- Twisted pair shielded cable recommended.
- Use separate cable.

CAN

- See CiA DS-102 (twisted and / or shielded two-wire circuit closed with the circuit's impedance with common return circuit).
- Closure with impedance through external circuit.
- No galvanic separation on DES 70/10.

Analogue signals (Set value, Monitor)

- No shielding normally required.
- Use cable shielding with analogue signals with small signal level and electromagnetically harsh environment.
- Normally connect shielding on both sides. Place shielding on one side if there are 50/60 Hz interference problems.

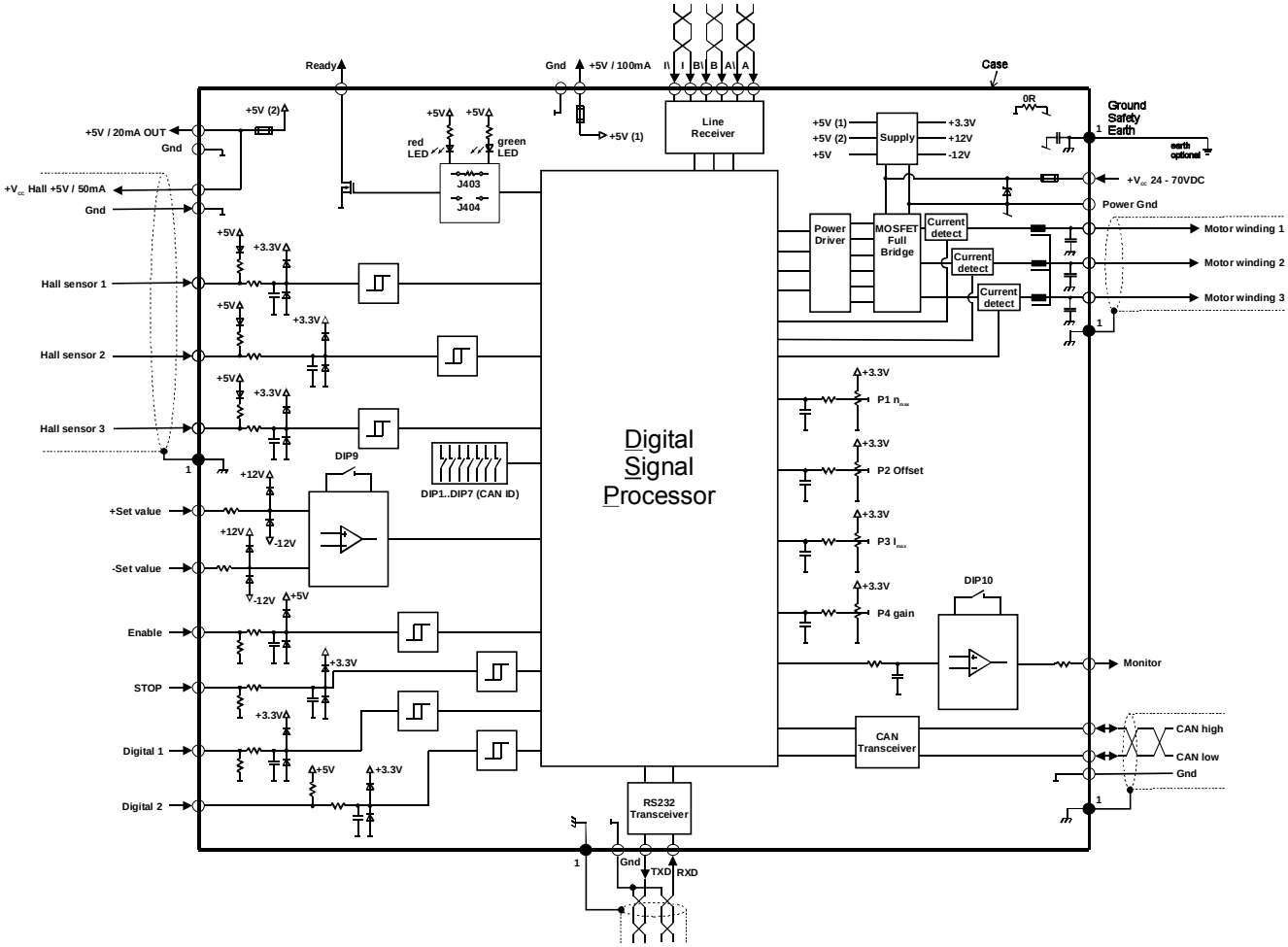
Digital signals (Enable, Stop, Digital 1, Digital 2, Ready)

- No shielding necessary.

See also block diagram in chapter 8.

In practical terms, only the complete equipment, comprising all individual components (motor, amplifier, power supply unit, EMC filter, cabling etc.) can undergo an EMC test to ensure interference-free CE-approved operation.

8 Block Diagram



9 Dimension Drawing

Dimensions in [mm]