638 Series

anything Possible.™

SSD DRIVES

Digital Servo Drive

Product Manual

07-02-12-02-E-V0406.doc

Additional Supporting Documentation

UL: CD 	**EASYRIDER® Windows - Software**
UL: 07-02-09-02 	**HIPERFACE® Feedback System**
UL: 07-05-02-03 	**Product Manual - Bus Interface SUCOnet K**
UL: 07-05-03-02 	**Product Manual Bus Interface CAN**
UL: 07-05-04-02 	**Product Manual - Bus Interface Profi Bus DP**
UL: 07-05-05-02 	**Product Manual - Bus Interface Interbus S**
UL: 07-05-07-02 	**Product Manual - I/O Interface**
UL: 07-05-08-02 	**Product Manual - Bus Interface DeviceNet**
UL 07-09-04-02 	**Product Manual - Suppression Aids EH**
UL: 10-06-03 	**Product Manual – Serial Tranfer Protocol EASY-Serial**

UL: 10-06-05 	**Product Manual - BIAS® Commands**
UL: 12-01 	**Product Manual - Plugs**
UL: 12-02 	**Product Manual - Cables**
UL: 12-03 	**Product Manual - Ballast Resistors**

Made in Germany, 2006

Thank you for your confidence in choosing our products.
These operating instructions are intended to provide an overview of the technical data and features of our products.

Please read the operating instructions completely before operating the product.

Should you have any questions, please contact your nearest service representative.

Improper application of this product in combination with dangerous high voltage can lead to serious injury or death.

Damage can also occur to motors or other products. Therefore, we request that you strictly observe our safety and installation instructions.

Safety Precautions

We assume that as an expert, you are familiar with and will observe all of the relevant safety regulations, especially in accordance with VDE 0100, VDE 0113, VDE 0160, EN 50178, the accident prevention regulations of the employer's liability insurance company and the DIN regulations.

Additionally, it is imperative that all relevant European Union Safety Directives be observed.

Depending on the type and location of the installation, additional regulations, e.g. UL, DIN, must also be fully observed.

If our products are operated in connection with components from other manufacturers, their operating instructions are also subject to be strictly observed.

Attention !

Digital servo drives, corresponding to EN 50178/VDE 0160, are electronic power components utilized for the regulation of the flow of energy in high-voltage
electrical power installations. They are exclusively designed, configured and approved to supply our servo motors. Handling, installation, operation, and maintenance are only permitted under the conditions of and in keeping with the effective and/or legal regulations, regulation publications and this technical document.

The operator must make sure that these regulations are strictly followed.

The Concept of Galvanic Separation and Insulation:

Galvanic separation and insulation corresponding to EN 50178/VDE 0160, provides for additional insulation protection.

In addition, all digital signal inputs and outputs are provided with a galvanic separation utilizing either a relay or an optical coupler. In this way, an increased level of protection against potential interference and a limitation of potential damage due to incorrect connections are provided.

The voltage level must not exceed the designated low safety voltage of 60V DC or 25V AC, respectively, in accordance with EN 50178/VDE 0160. The operator must make sure that these regulations are strictly followed.

Danger !

High Voltage!
Danger of Electrocution!
Life Threatening Danger!

Certain parts of the servo drive are supplied with dangerous electrical current. Physical contact with these components can cause death, life threatening injuries and/or serious damage to equipment and property.

Caution !

Due to safety considerations and product guarantees, the operator is prohibited from opening the servo drive case. Service, maintenance and repair of our products should only be carried out by specified representatives of the company. Expert configuration and professional installation, as described by this document, are the best way to insure problem-free operation of our servo drives!

Please Observe !

Pay Special Attention to the Following:

Permissible Protection Class: Protective Grounding - operation is only permitted when the protective conductor is connected according to regulations.
Operation of the servo drive when employing a residual current operated protective device as the sole protection against indirect touching, is not permissible.

The servo drive may only be used in conjunction with machines or electrical systems when placed in control cabinets which comply with EEC- Directive98/37EEC (Machine Directive) and EEC Directive 89/336/EEC (EMC – Directive).

Work on or with the servo drive may only be carried out with insulated tools.
Installation work may only be done in a de-energized state. When working on the drive, one should not only block the active input, but also separate the drive completely from the main power connection.

CAUTION - Risk of Electrical Shock:

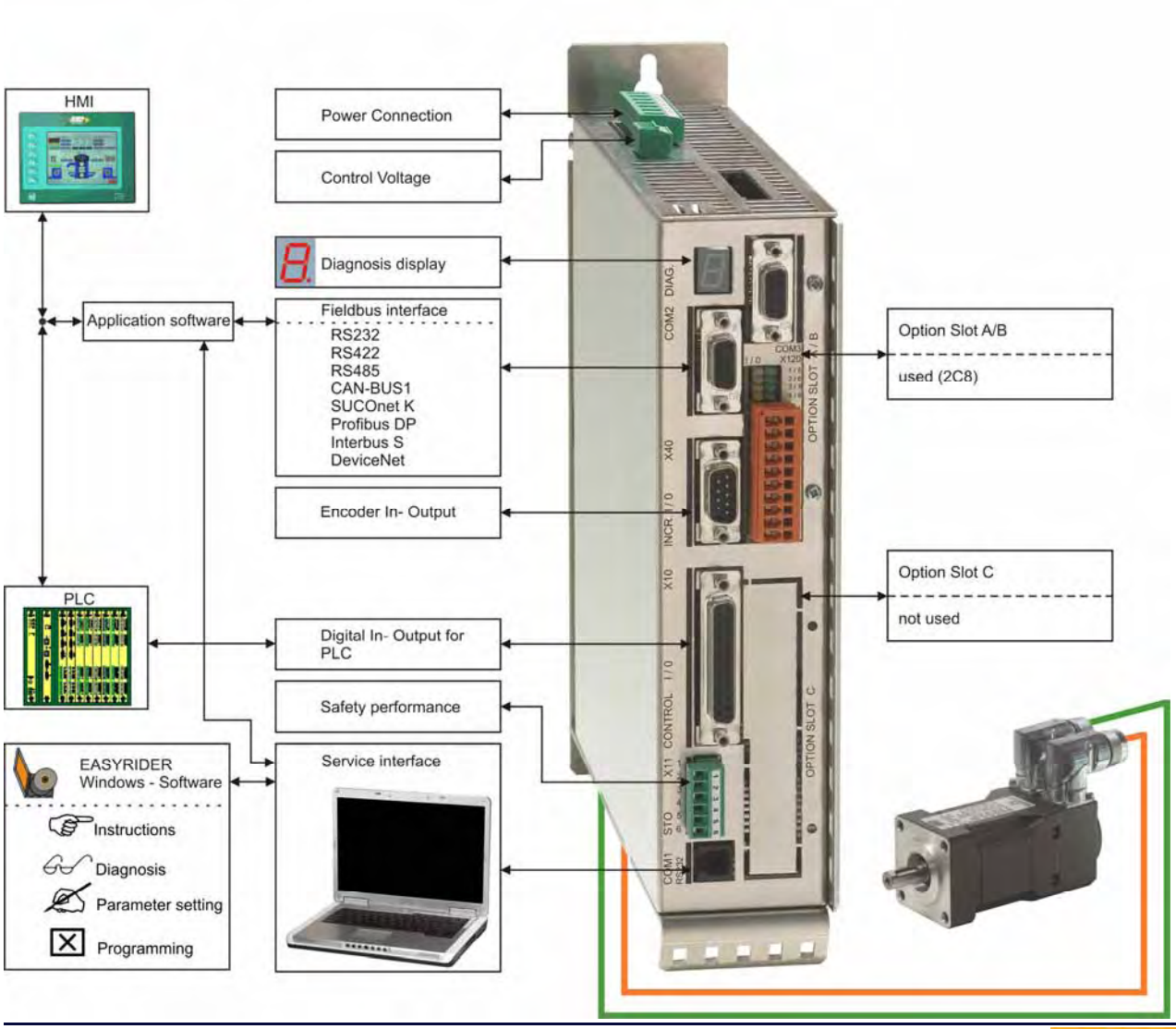
Wait 3 minutes after switching the component off to allow the capacitors to discharge.
Screws sealed with varnish fulfill an important protection function and may not be tampered with or removed.
It is prohibited to penetrate the inside of the unit with objects of any kind.
Protect the unit from falling parts, pieces of wire, metal parts, etc., during installation or other work in the control cabinet. Metal parts can lead to a short-circuit in the servo drive.
Before putting the unit back into operation, remove any additional covers so that the unit does not overheat. When conducting measurements on the servo drive it is imperative to pay attention to the electrical isolation.

Stop !

We are not liable for damage which may occur when the product instructions and/or the applicable regulations are not explicitly observed!

1.1 System Description

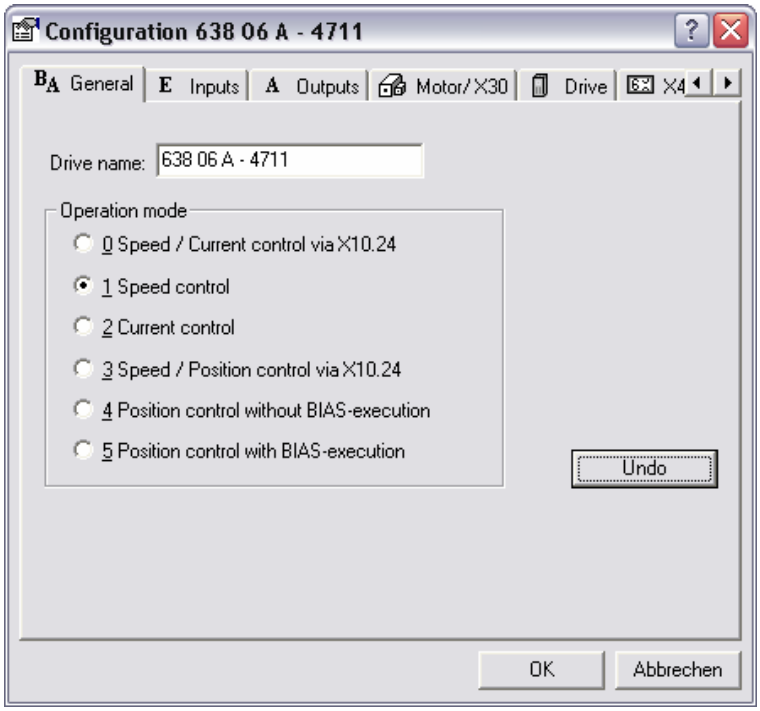
- **Special Features of the 638 Servo Drive**
  - The digital 638 servo drive provides for the electrical connection, rotational speed and position control of the **AC servo motor**.
  - All of the functions and system controls are digitally regulated, employing a **sampling rate of 105µs**.
  - The 638 servo drive supports the safety function "**Safe Torque Off**", STO, providing for a definitive system shut-down, for protection against an unanticipated start-up, in accordance with the requirements as stated in EN954-1, Category 3 and EN1037.
  - The feedback generated from the braking energy is dissipated through the employment of internal ballast resistance and when required through the employment of additional external ballast resistance.
  - The AC supply voltage can be directly connected or it can be connected through a transformer, as required.
  - The servo drive additionally requires a **24 V DC control supply voltage connection**.
  - The **built-in internal EMC filter** corresponds to the requirements regarding susceptibility to interference for industrial systems as described in EN50081-1.
  - By employing various option modules, through **2 additional plug-in receptacles**, it is possible to increase the potential connections to the **field bus system** and/or the input/output terminals.
  - Various motor feedback loop systems can be supported by employing the flexible **feedback module X300**.
  - Through the employment of additional 638 drives it is optionally possible to couple the DC link.
  - **Minimal Housing Dimension** is provided through the intelligent compact design of the unit.
- **Overview of Standard Digital Communication**



- **Determining Criteria for the Utilization of the 638 Drive**

  Decisions relating to the appropriate selection of the motor type, feedback system and drive type, as well as the system layout and option modules required, are dependant upon the specific application and the anticipated operating mode of the system.
  There are 6 operating modes to choose from:

  - **0** Seed / Current control switchable via Input X10.24
  - **1** Speed control
  - **2** Current control
  - **3** Speed / Position control switchable via Input X10.24
  - **4** Position control without BIAS – execution
  - **5** Position control with BIAS - execution



- **Operation Configuration**

  There are opportunities ranging from simple current and speed control to programmable position control processes (PLC), supported by the 1500 BIAS command blocks.
  "BIAS" User shell for intelligent drive controls:

  See Chapters: "■ Operation Modes" and "■ Software"

1.2 Model Code

											Special
Marking	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**h1**	**i**	**g**
Type:	**638**	X	XX	-X	**-F**	-X	**-STO**	-XXX	-XXX	-XXX	-XXX

Marking	Description			
a	**638**	=	6th. Generation Digital Servo Drive	
b			Size:	
	A	=	Size A	
c			Rated Current:	
	01	=	1 amps	
	02	=	2 amps	
	04	=	4 amps	
	06	=	6 amps	
d			Intermediate Voltage:	
	-3	=	325V DC (230V AC)	
e	**-F**	**=**	With Integrated Filter	= Standard
	-0	=	Without Filter	
f	-0	=	Without EMC - Clip	= Standard
g			**Safety Performance**:	
	-STO	**=**	**Safe Torque Off**	**= Standard**
h			Additional option-module RP -XXX on the drive for communication via **COM2**	
	-000	=	No Option	
	-232	=	RS 232 interface	≅ slot A (A, B)
	-422	=	RS 422 interface	≅ slot A (B)
	-485	=	RS 485 interface	≅ slot A (B)
	-CAN	=	CAN – Bus	≅ slot A (B)
	-2CA	=	2 x CAN (without I/O's)	≅ slot B (A) / [C*]
	-2C8	=	2 x CAN + 4 outputs and 4 inputs	≅ slot B (A) / [C*]
	-DEV	=	CAN - Bus / DeviceNet	≅ slot B (A)
	-SUC	=	SUCOnet K	≅ slot B (A)
	-PDP	=	Profibus DP	≅ slot B (A)
	-IBS	=	Interbus S	≅ slot B (A)
	-EA5	=	I/O - Interface (5 inputs, 2 outputs)	≅ slot B (A)
	-PC8	=	Profibus DP + CAN2 + 4 outputs and 4 inputs + RS 485	≅ slot B (A)
h1			Additional Options Module on the drive via **X200**	
	-000	=	No Option	
	-EAE	=	I/O - Interface (14 inputs, 10 outputs)	≅ slot C
i			X300 – Functions Module	
	-RD2	=	Standard X30 **R**esolver – Mo**d**ule **2nd** Version	≅ slot D
	-HF2	=	**H**IPER**F**ACE – Module **2nd** Version	≅ slot D
	-SC2	=	**S**ine / **C**osine - Module **2nd** Version	≅ slot D
g			Enter only when used	
	-Sxx	=	Special Resistance Setting	
	-BSx	=	Moisture/Condensation Protection	

*Only CAN2 can be employed when utilizing the option module located at slot [C], (internal BUS / COM3 B).

- **Combination Possibilities for the Various Communication / I/O - Modules**

Slot ⇨	A				B								C		
Option Module ⇨	232	422	485	CAN	2CA	2C8	DEV	SUC	PDP	IBS	EA5	PC8	EAE	*2CA	*2C8
Model Code ⇩															
638xxx-x-F-x-STO-**232**-**000**-xxx	●	-	-	-	-	-	-	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**232**-**EAE**-xxx	●	-	-	-	-	-	-	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**232**-**2CA**-xxx	●	-	-	-	-	-	-	-	-	-	-	-	-	●	-
638xxx-x-F-x-STO-**232**-**2C8**-xxx	●	-	-	-	-	-	-	-	-	-	-	-	-	-	●
638xxx-x-F-x-STO-**422**-**000**-xxx	-	●	-	-	-	-	-	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**422**-**EAE**-xxx	-	●	-	-	-	-	-	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**422**-**2CA**-xxx	-	●	-	-	-	-	-	-	-	-	-	-	-	●	-
638xxx-x-F-x-STO-**422**-**2C8**-xxx	-	●	-	-	-	-	-	-	-	-	-	-	-	-	●
638xxx-x-F-x-STO-**485**-**000**-xxx	-	-	●	-	-	-	-	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**485**-**EAE**-xxx	-	-	●	-	-	-	-	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**485**-**2CA**-xxx	-	-	●	-	-	-	-	-	-	-	-	-	-	●	-
638xxx-x-F-x-STO-**485**-**2C8**-xxx	-	-	●	-	-	-	-	-	-	-	-	-	-	-	●
638xxx-x-F-x-STO-**CAN**-**000**-xxx	-	-	-	●	-	-	-	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**CAN**-**EAE**-xxx	-	-	-	●	-	-	-	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**2CA**-**000**-xxx	-	-	-	-	●	-	-	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**2CA**-**EAE**-xxx	-	-	-	-	●	-	-	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**2C8**-**000**-xxx	-	-	-	-	-	●	-	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**2C8**-**EAE**-xxx	-	-	-	-	-	●	-	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**DEV**-**000**-xxx	-	-	-	-	-	-	●	-	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**DEV**-**EAE**-xxx	-	-	-	-	-	-	●	-	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**SUC**-**000**-xxx	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**SUC**-**EAE**-xxx	-	-	-	-	-	-	-	●	-	-	-	-	●	-	-
638xxx-x-F-x-STO-**SUC**-**SBT**-xxx	-	-	-	-	-	-	-	●	-	-	-	-	-	-	-
638xxx-x-F-x-STO-**PDP**-**000**-xxx	-	-	-	-	-	-	-	-	●	-	-	-	-	-	-
638xxx-x-F-x-STO-**PDP**-**EAE**-xxx	-	-	-	-	-	-	-	-	●	-	-	-	●	-	-
638xxx-x-F-x-STO-**PDP**-**2CA**-xxx	-	-	-	-	-	-	-	-	●	-	-	-	-	●	-
638xxx-x-F-x-STO-**PDP**-**2C8**-xxx	-	-	-	-	-	-	-	-	●	-	-	-	-	-	●
638xxx-x-F-x-STO-**IBS**-**000**-xxx	-	-	-	-	-	-	-	-	-	●	-	-	-	-	-
638xxx-x-F-x-STO-**IBS**-**EAE**-xxx	-	-	-	-	-	-	-	-	-	●	-	-	●	-	-
638xxx-x-F-x-STO-**EA5**-**000**-xxx	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-
638xxx-x-F-x-STO-**EA5**-**EAE**-xxx	-	-	-	-	-	-	-	-	-	-	●	-	-	-	-
638xxx-x-F-x-STO-**PC8**-**000**-xxx	-	-	-	-	-	-	-	-	-	-	-	●	-	-	-
638xxx-x-F-x-STO-**PC8**-**EAE**-xxx	-	-	-	-	-	-	-	-	-	-	-	●	●	-	-
638xxx-x-F-x-STO-**000**-**EAE**-xxx	-	-	-	-	-	-	-	-	-	-	-	-	●	-	-

-000 = No Option ● Possible Combination

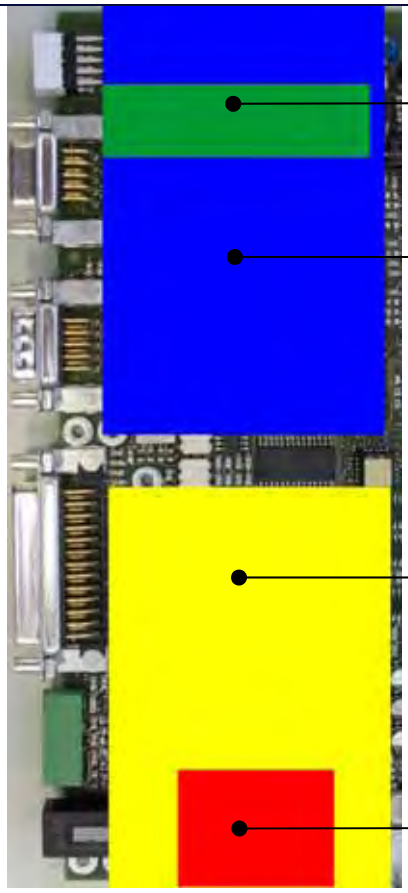
* Only CAN2 can be employed when utilizing the option module located at slot [C], (internal BUS / COM3 B)

Example:

638A04-3-F-0-STO-**232**-**EAE**-RD2

638	= 6th. Generation Digital Servo Drive	
A	= Size A	
04	= 4 Amps	
-3	= 325V DC (230V AC)	
-F	= With Integrated Filter	
-0	= Without EMC - Clip	
-STO	= Safe Torque Off	
-232	= RS 232 Interface	≙ on slot A
-EAE	= I/O Interface 14/10	≙ on slot C
-RD2	= Standard X30 Resolver	≙ on slot D (Motor - Feedback system)

- **Module Slots Layout**



Module Slots:

A
-232
-422
-485
-CAN

B
-2CA
-2C8
-DEV
-SUC
-PDP
-IBS
-EA5
-PC8

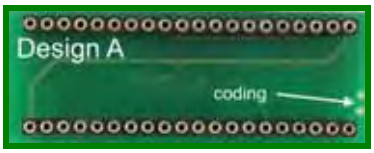
C
-EAE
*-2CA
*-2C8
*-PC8

Motor - Feedback System:

D
-RD2: Standard Resolver
-HF2: Option HIPERFACE®
-SC2: Option Sine / Cosine

- **Module Design**

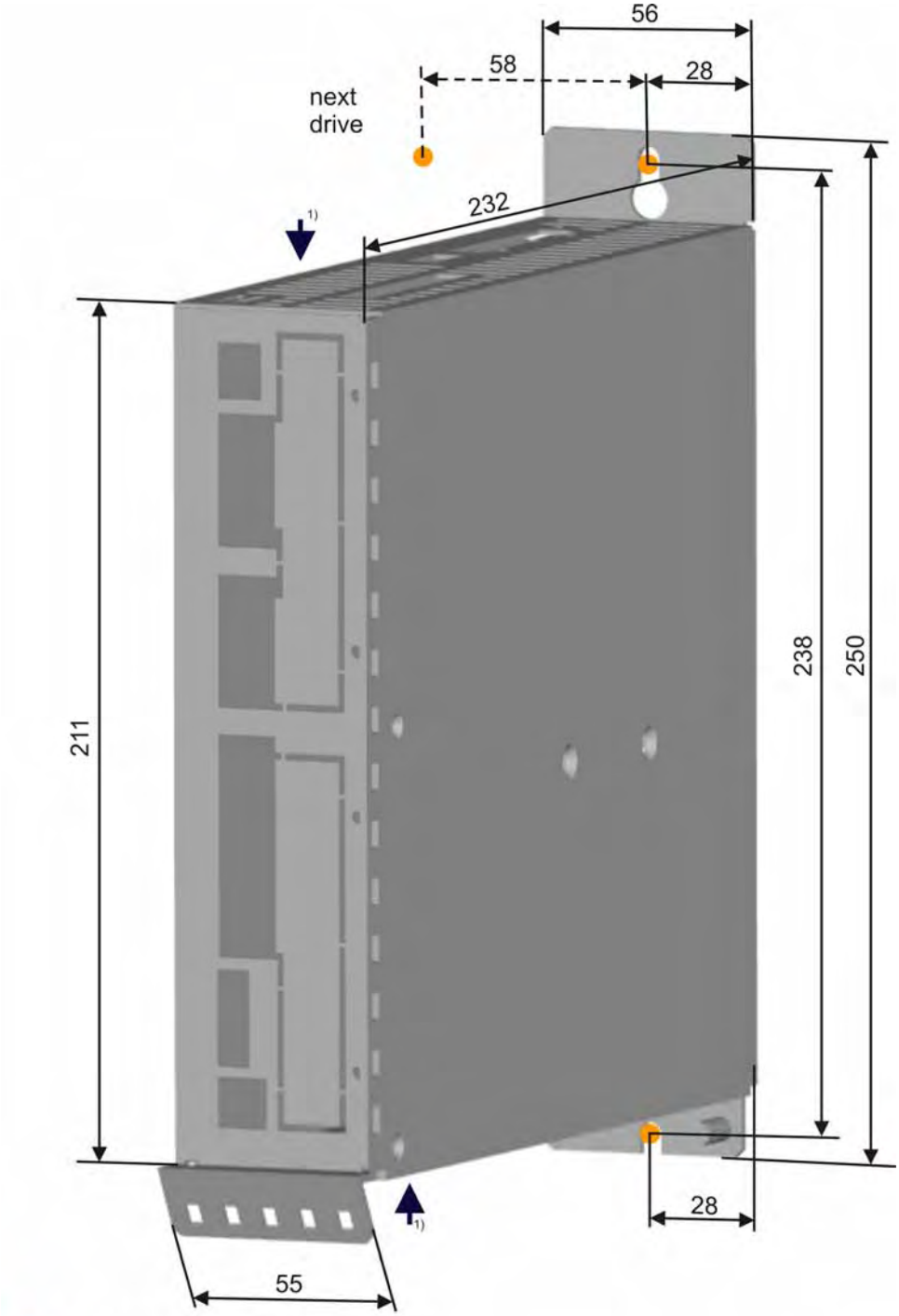
Design A



Design B

Design C

1.3 Dimensions

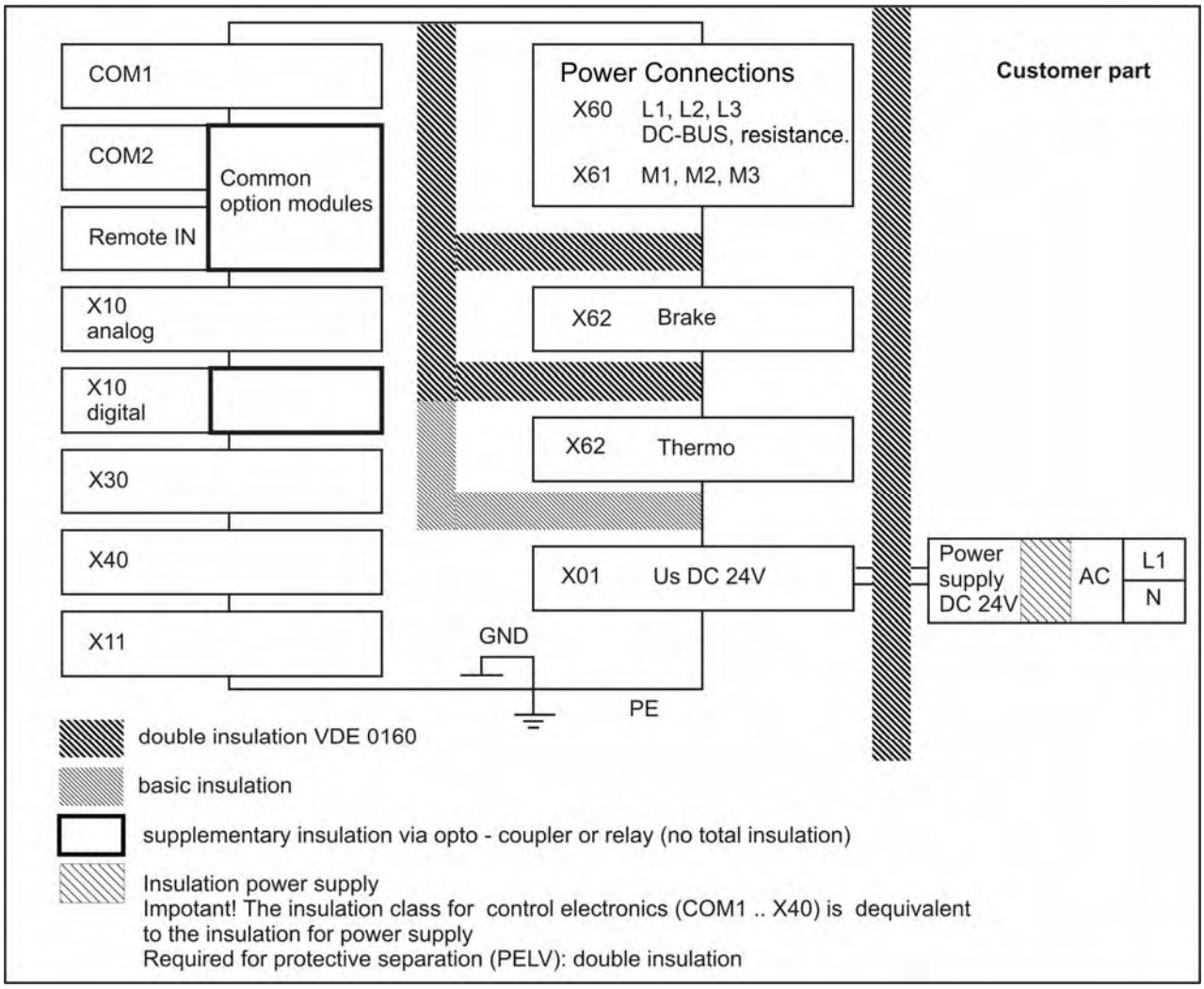


Important:

- Please note that on the front side of the unit, approximately 70 mm of additional space is required for the signal mating plugs!
- When installing multiple servo drives, there is no available space on the side.
- The unit should only be mounted vertically as shown.

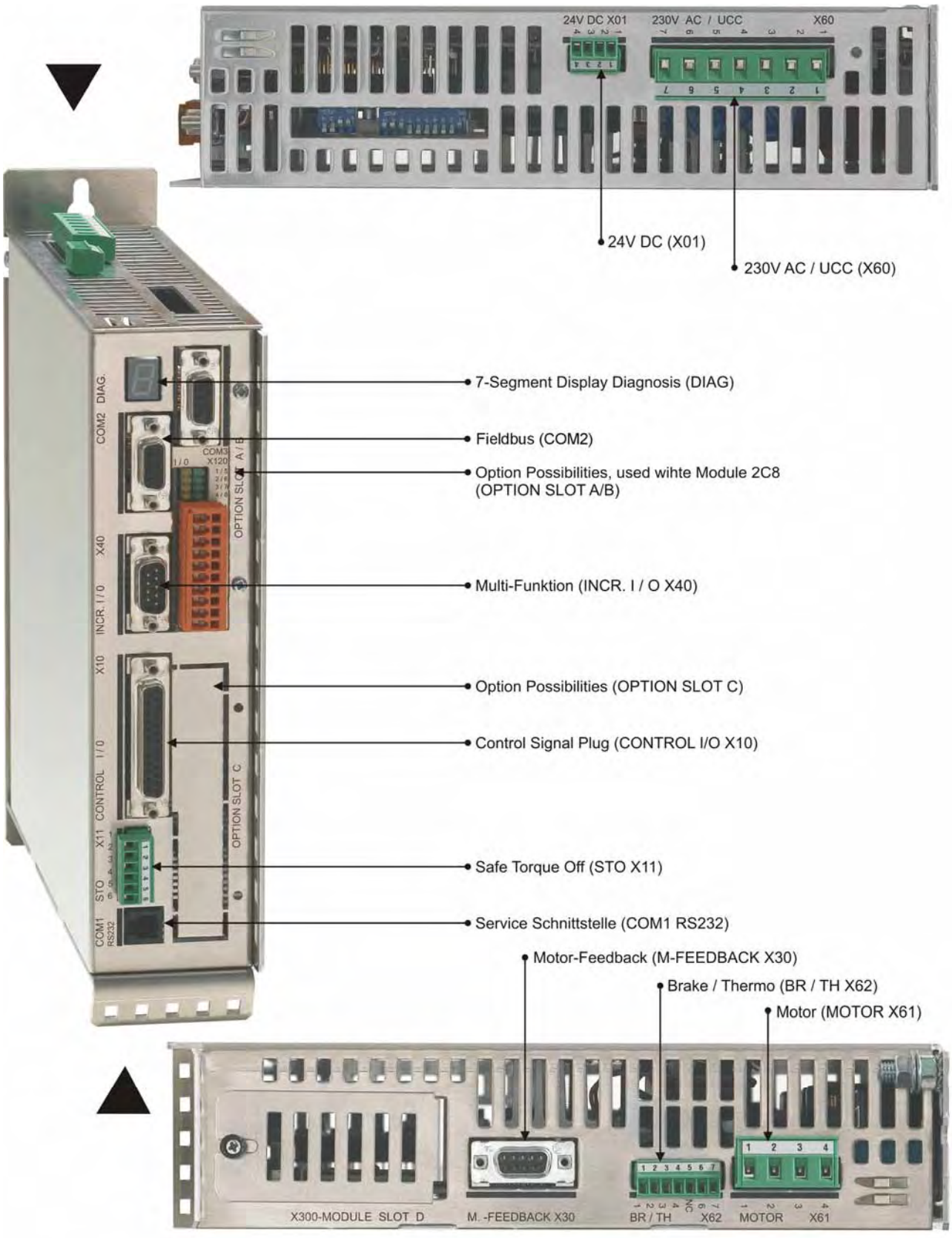
2.1 Insulation Concept

The insulation of the 638 units is achieved in various insulation classes or groups.



2.1 Overview of Compact Unit Connections

- **638A01.. to 638A06..**



2.4 Assignments Power Connections

- **Power, Ballast, DC Bus - Connection X60**

Plug - X60		
PIN	**Designation**	**Function**
1	0VP	0 Volt DC Bus
2	RB1/+UCC	External – Ballast Resistor / + DC - Bus
3	RB2	External – Ballast Resistor
4	L1	Power Connection 1, 230V AC
5	L2	Power Connection 2, 230V AC
6	L3 / N	Power Connection 3, 230V AC / Ground
7	PE	Protective Ground

- **24V - Control Supply Voltage X01**

Plug - X01		
PIN	**Designation**	**Function**
1	+24V	Supply Us (Input)
2	+24V	Supply Us (Output with PIN 1 jumpered)
3	0V	Reference Potential 0V
4	0V	Reference Potential 0V

- **Motor - Connection X61**

Plug - X61		
PIN	**Designation**	**Function**
1	M1 / U	Motor Supply
2	M2 / V	Motor Supply
3	M3 / W	Motor Supply
4	PE	Protective Ground

- **Brake / Thermo - Connection X62**

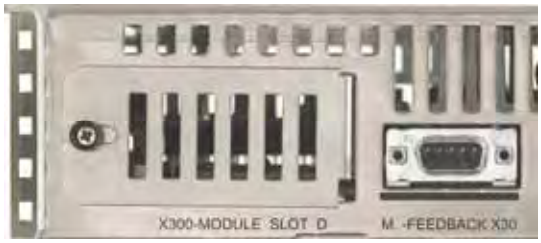
Plug - X62		
PIN	**Designation**	**Function**
1	+24V	Input; Supply Voltage Mechanical Brake
2	0V	Input; Refer. Potential Supply Voltage Mechanical Brake
3	BR+	Control Mechanical Brake +
4	BR-	Control Mechanical Brake -
5	-	Free
6	TH+	Thermo PTC / NTC
7	TH-	Thermo PTC / NTC

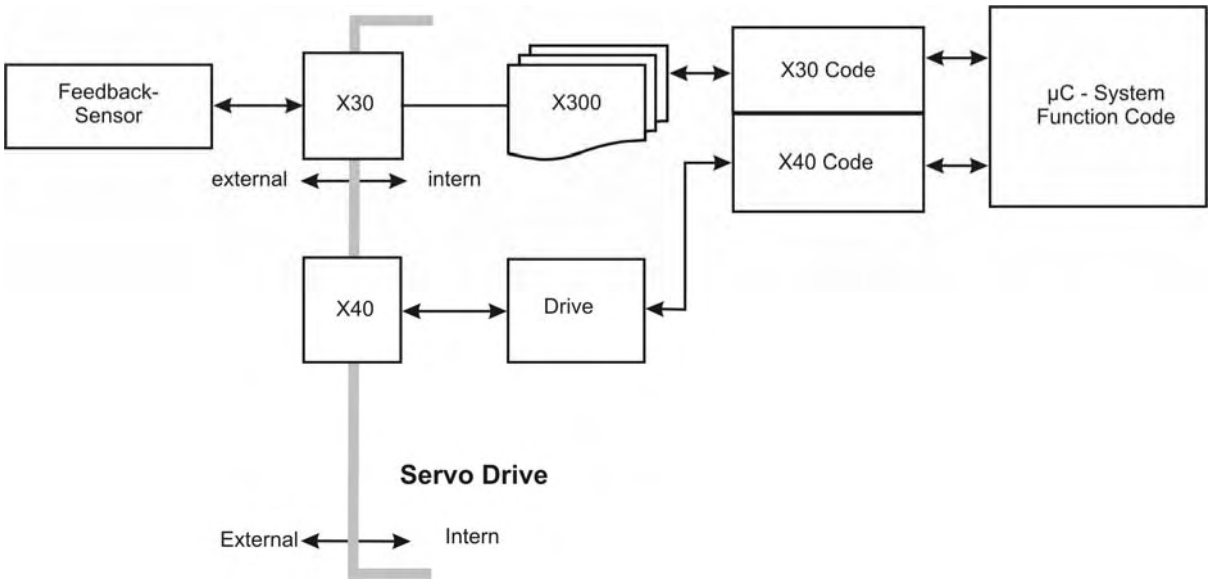
2.4 Feedback Sensor X30

The feedback system creates a digital value from the feedback position sensor.
From this value the following is derived: ➢ Commutation according to the pole division ➢ Actual rotational speed value ➢ Position value for the position controller

● Functions - Module X300

The X30 connection is directly connected to the Functions - Module X300.The mode of operation of the feedback system is specified by this plug-in module.
(**see:** **● Layout Module Slots**)
The 638 – Drive system therefore offers a built-in flexibility and provides for the possibility of future modification.





Model Type X300	Description	
X300_RD2	Resolver	Standard
X300_HF2	HIPERFACE®	Option
X300_SC2	Sine/Cosine	Option
Additional types available upon request.		

Plug and Play

The 638 Servo Drive is able to identify the type of X300 Module employed.
The EASYRIDER® Windows – Software loads the correct function code.
You follow the instructions in the EASYRIDER® Windows – Software

For function module RD2 the function code is already pre-set (factory default).

Note

When employing the Functions Module X300_HF2 (HIPERFACE®),
please pay attention to documentation 07-02-09-02-E-Vxx

- **Feedback Connection X30 (SUB D 09 Socket)**

Pinning for the Motor - Feedback - Socket X30 when employed with:

Resolver Module X300_RD2 (Standard Module)

Module: X300_RD2	
PIN X30	**Function**
1	shield
2	PTC optional
3	cos +
4	sin +
5	carrier +
6	PTC optional
7	cos -
8	sin -
9	carrier -

HIPERFACE® - Module X300_HF2

Module: X300_HF2	
PIN X30	**Function**
1	GND
2	10 VDC
3	cos +
4	sin +
5	data -
6	-
7	ref cos
8	ref sin
9	data +

Sine / Cosine - Module X300_SC2

Module: X300_SC2	
PIN X30	**Function**
1	GND
2	5,5 V
3	cos +
4	sin +
5	zero pulse -
6	-
7	ref cos
8	ref sin
9	zero pulse +

2.5 Service-Interface COM1 (RS232)

Functions:

- Supports all diagnostic and parameter configuration activities
- PC connection utilizing our communications cable KnPC/D
- Communication utilizing our operational program software (EASYRIDER® Windows - Software)

Com 1 RS232	PIN	Function Drive Side	PIN	RS232 on PC
4-Pin Modular Plug 				
RXD	**1**	Receive Serial Data	**3**	TXD
TXD	**2**	Send Serial Data	**2**	RXD
	3	Do Not Connect		
GND	**4**	Ground	**5**	GND

Model Type	Length	Description
Kn PC 630-03.0	3 m	PC-Side Sub D 09-Plug
Kn PC 630-05.0	5 m	Drive-Side 4-Pin RJ 10-Plug

Note:
The service interface port is not galvanically separated and should therefore not be used as the operations interface port (fixed wiring)!
The network connection with the PC must be located near the Drive in order to receive the reference potentials of the units together.

2.6 Safe Torque Off

- **Safe Torque Off X11**

Plug - X11		
PIN	**Description**	**Function**
1	STO1 #	Channel 1 (ACTIVE_STO1)
2	STO1 #	Channel 1 (ACTIVE_STO1) Parallel to PIN 1
3	0V / PE	Reference Potential 0V
4	STO2 #	Channel 2 (ACTIVE_STO2)
5	-	Ready potential-free contact assembly
6	-	Ready potential-free contact assembly

Further description of this function can be found in Chapter **"Safe Torque Off"** (**STO)**

- **Connection WITHOUT the utilization of the Safe Torque Off, (STO), function**

Input ACTIVE (24V) →
0VSPS →

PIN	Description
1	STO1 #
2	STO1 #
3	0V / PE
4	STO2 #
5	-
6	-

The control supply voltage must be definitively separated, in accordance to regulation EN 1578

2.7 Signal Connection

- **Control Signal Plug X10 (SUB D25 Socket)**

Inputs / Outputs

Control Signal Plug X10			
PIN X10	**Function**	**Type**	**Description**
1	Shielding Connection		Screen
2	Configurable (Operating Mode)	OPTO	Input
3	Stabilized Auxiliary Supply Voltage -12VDC; max. 80 mA		Output Auxiliary Supply Voltage
4	Configurable (Operating Mode)	OPTO	Input
5	Reference Point to X10.18		Input Analog 0...+/-10V / Ri = 10 kOhm
6	Configurable	-	Output Analog
7	Through JP100 (soldered jumper) assignable as a free and loopable potential for the READY Contacts		Optional
8	ON: Drive trouble free OFF: Drive problem or power supply interruption	Relays	Output Constant: Ready
9	Reference Point for Digital Input		Reference Point for Digital Inputs
10	Ground for Analog Signal		Ground
11	Configurable (Operating Mode)	OPTO	Input
12	Configurable (Operating Mode)	OPTO	Output
13	Configurable (Operating Mode)	OPTO	Output
14	Configurable (Operating Mode)	OPTO	Input
15	Configurable (Operating Mode)	OPTO	Input
16	Stabilized Auxiliary Supply Voltage +12V DC; max 80 mA		Output Auxiliary Supply Voltage
17	Configurable	-	Output Analog
18	Rotational Speed Setpoint; Scaleable differential with respect to X10.5		Input Analog 0...+/-10V / Ri = 10 kOhm
19	Specifications for the Power Limits - can be activated and are scaleable (0..+10V for 0.. I_{max})		Input Analog 0..+10V Ri = 10 kOhm
20	Configurable (Operating Mode)	OPTO	Output
21	Nominal: 24VDC		Supply for Outputs
22	Configurable (Safety Functions)	OPTO	Input
23	-	-	-
24	Configurable (Operating Mode)	OPTO	Input
25	Configurable (Operating Mode)	OPTO	Input

Data for the digital in and outputs: See Chapter. "■ General Technical Data"

2.8 Multi-Function X40

Description of the X40:

Via a programmable I/O processor, the X40 connection can be configured differently.
EASYRIDER® Windows - Software
Standard functions:

- Incremental output
- Incremental input
- Stepper motor - pulse inputs
- SSI interface

The unobstructed configurability provides ideal conditions for synchronous applications.

General Data	X40
Plug Type:	SUB D 09 male plug
Maximum Input or Output Frequency:	200 kHz
Maximum Cable Length - connected to galvanically insulated terminals (Encoder, controls) Maximum Cable Length - connected to ground related terminals (other drives, controls) Maximum Number of Signal Inputs - to one as incremental output configured device	25 m; For extended distances please contact our engineer 2 m; Pay attention to provide for good common grounding ! 8
Output Signals:	Driver Model MAX483 or compatible, RS422
Differential Logic Level:	L ≤ 0,5V H ≥ 2,5V
Nominal Range:	0,0 ... 5,0V 150mA max.
Input Signals:	Receiver Model MAX483 or compatible, RS422
Differential Input Level:	Diff min = 0,2V
Nominal Signal Difference:	1,0V
Current Consumption:	1...4 mA (depending on the frequency)

Notice:
Master / Slave Operation
1 Master, Maximum 8 Slaves
Condition: Devices must be located directly side by side!

- **Incremental - Output**

EASYRIDER® Windows - **X40 Connection: Mode = Incremental Output**
Incremental encoder simulation for processing in positioning modules
Standard: 1024 increments
Pulse Duty Cycle
Additional selectable pulse settings:4096, 2048, 512, 256, 128, 64

Inc. I/O X40		
PIN X40	**Function**	**Designation**
1	Channel B	B
2	Channel B - Inverted	/B
3	Shield Connector	Shield
4	Channel A	A
5	Channel A - Inverted	/A
6	Reference *	GND
7	Channel Z - Inverted Zero Impulse	/Z
8	Channel Z, zero impulse	Z
9	Supply Voltage Output Max. 150 mA	+ 5 VDC

Design Rule:
The input frequency range of the connected control must equal at least the value of the pulse output frequency on the X40.

n = max. speed (rpm)
x = increments e.g. 1024
f = output frequency at X40.1,2,4,5

Formula: $f = \frac{1{,}2 * (n * x)}{60} = [Hz]$

Example: n = 4000 1/min

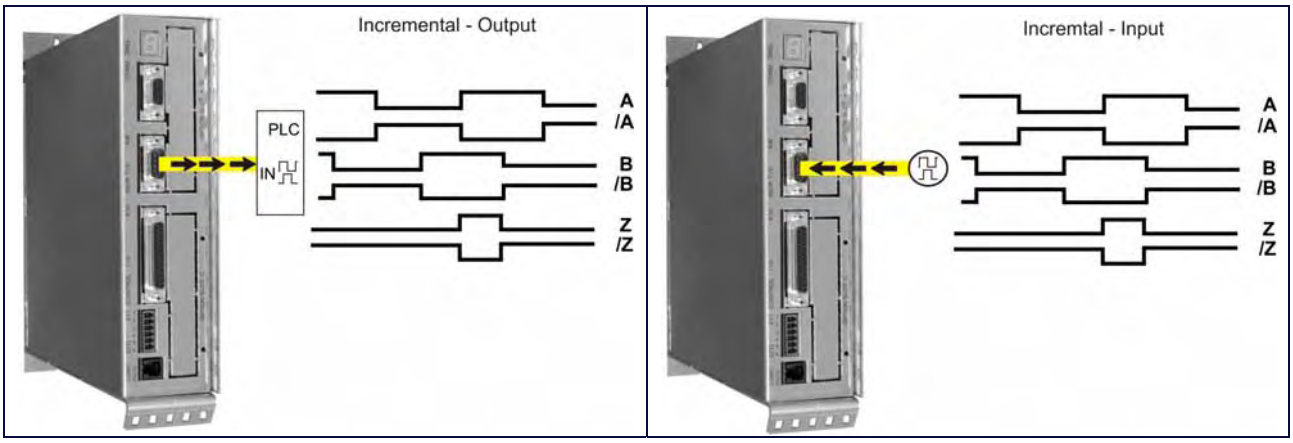
$$f = \frac{1{,}2 * (4000 * 1024)}{60} = 81920\ Hz$$

- **Incremental - Input**

EASYRIDER® Windows - Software **X40 Connection: Mode = Incremental Input**

Parameter range of the input signals: 10...1000000 increments

Figure:



Note:
The operation of incremental encoders via long cables may cause a voltage drop of the encoder power supply. We recommend the use of a separate voltage supply if necessary.

- **Stepper Motor <u>Input</u>**

  Two different modes are available

  EASYRIDER® Windows - Software **X40 Connection: Mode = Stepper Motor (Pulse+Direction)**

  EASYRIDER® Windows - Software **X40 Connection: Mode = Stepper Motor (2*Pulse)**

INCR. I/O X40			
PIN X40	**Function Mode: Pulse+Direction**	**Mode: 2*Pulse**	**Designation**
1	Output: Drive Active - Inverted		/READY
2	Output: Drive Active		READY
3	Shield Connector		Shield
4	Pulse Inverted	Pulse - Inverted	-
5	Pulse	Pulse -	-
6	Reference Potential (generally to connect)		GND
7	Direction Inverted	Pulse + Inverted	-
8	Direction	Pulse +	-
9	Supply Voltage Output Max. 150 mA		+5 VDC

Figure: Pulse+Direction

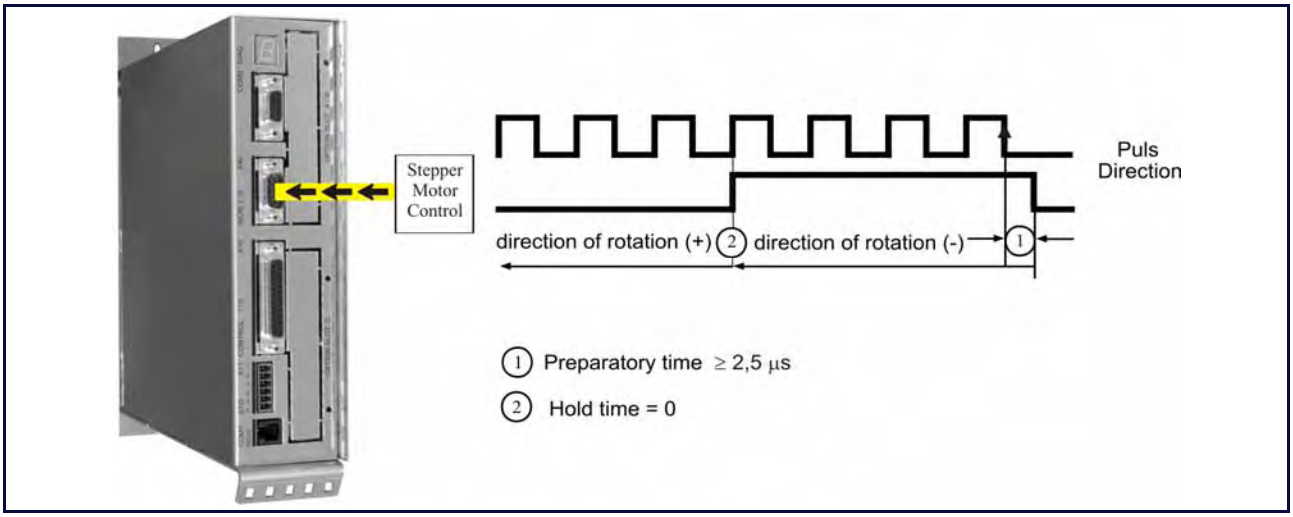
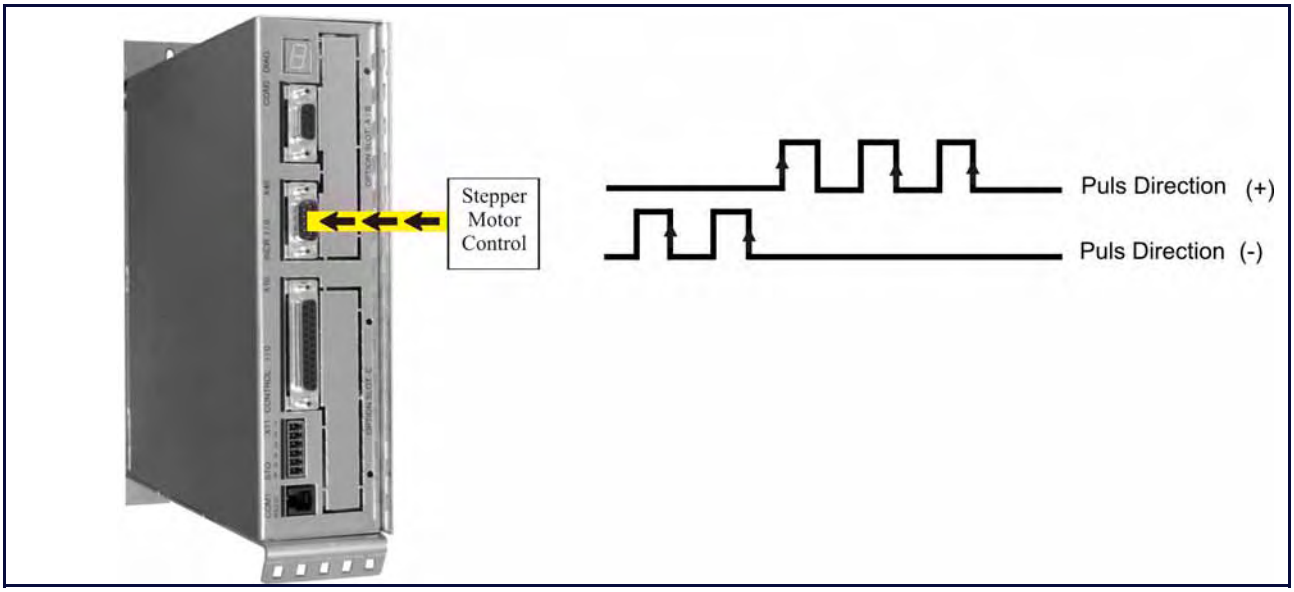


Figure: 2*Pulse



- **SSI-Encoder Interface**

  EASYRIDER® Windows - Software **X40 Connection: Mode = SSI _14** bit Singleturn

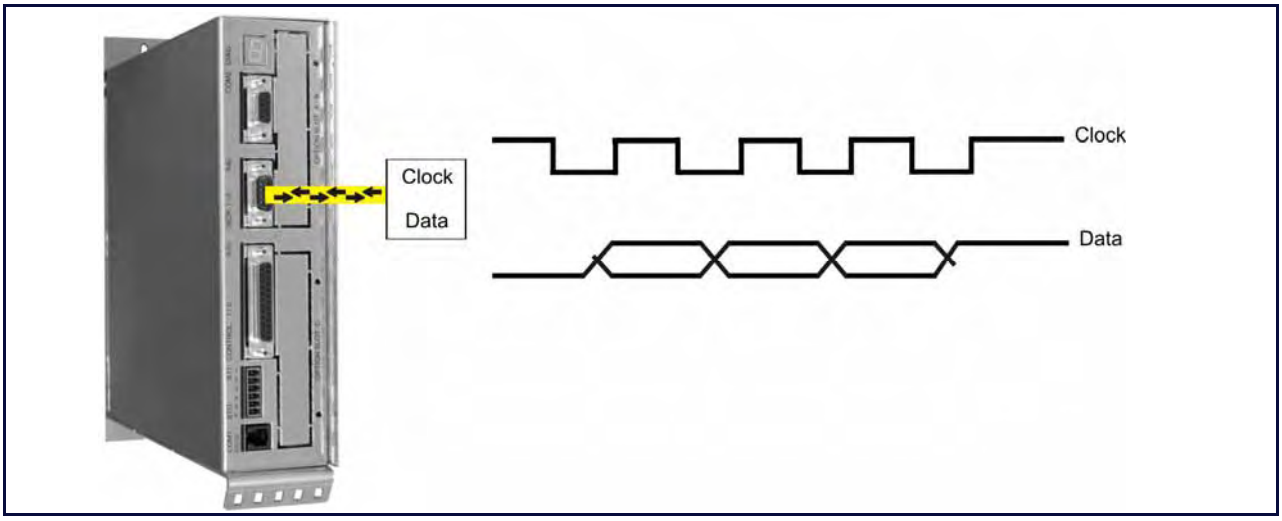
  EASYRIDER® Windows - Software **X40 Connection: Mode = SSI_25** bit Multiturn
  (**13** bit Single- / **12** bit Multiturn)

  EASYRIDER® Windows - Software **X40 Connection: Mode = SSI_26** bit Multiturn
  (**14** bit Single- / **12** bit Multiturn)

Incr. I/O X40		
PIN X40	**Function**	**Designation**
1	Serial Data from SSI Encoder, GRAY Code up to 26 Bit - Inverted	/DATA
2	Serial Data from SSI Encoder, GRAY Code up to 26 Bit	DATA
3	Shield Connector	Shield
4	Clock Output - Inverted Standard Frequenzy: 179 kHz	/TAKT
5	Clock Output Standard Frequenzy: 179 kHz	TAKT
6	Reference Potential	GND
7	Do Not Connect	
8	Do Not Connect	
9	Supply Voltage Output Max. 150 mA **If other data required:** a) Use of X300 Module b) External Supply	+5 VDC

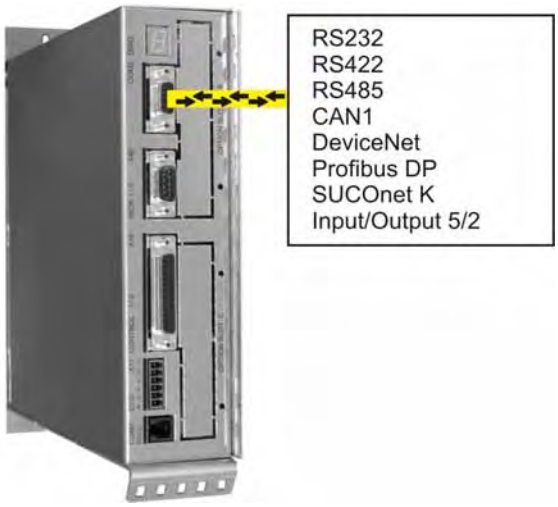
TAKT and /TAKT twisted pairs
DATA and /DATA twisted pairs
Cable Shielded - shielding grounded at both ends,
Max. Cable Length: 200m

Note:
For further information about SSI (Synchronous Serial Interface),
please refer to the documentation of the appropriate suppliers.
(e.g.: Comp. Sick or Hengstler)



2.9 Fieldbus Interface COM2

Additional functions can be realized through the optional employment of the **Options Modules**



- **Pinning for RS232**

Module: RP 232	
PIN	**Function**
1	-
2	RXD
3	TXD
4	-
5	GND / 485-GND
6	-
7	-
8	-
9	-

- **Pinning for RS422/485**

Module: RP 422 oder RP 485	
PIN	**Function**
1	-
2	-
3	-
4	Data In
5	GND
6	Data In - Inverted
7	Data Out - Inverted
8	Data Out
9	-

Options module **RP 422**, without galvanic separation
Options module **RP 485**, with galvanic separation
Parallel wiring for up to 16 units. (Full - Duplex, 4-Wire)

- **Pinning for CAN or DeviceNet**

Module: RP CAN (CAN BUS1) or RP DEV		
PIN	**Function**	**Designation**
1	-	-
2	CAN_L Bus Line (dominant low)	CAN_L
3	Ground	CAN-GND
4	-	-
5	-	-
6	Optional Ground	CAN-GND
7	CAN_H Bus Line (dominant high)	CAN_H
8	-	-
9	-	-

with galvanic separation

- **Pinning for Profibus DP**

Module: RP DP		
PIN	**Function**	**Designation**
1	-	-
2	-	-
3	Line B	B
4	Request to Send	RTS
5	Ground	PDP-GND
6	Potential +5V	+5V
7	-	-
8	Line A	A
9	-	-

with galvanic separation

- **Pinning for SUCOnet K**

Module: RP SUC		
PIN	**Function**	**Designation**
1	-	-
2	-	-
3	Data Line +	TA/RA
4	-	-
5	Signal Ground	SGND
6	-	-
7	Data Line -	TB/RB
8	-	-
9	-	-

with galvanic separation

- **Pinning for I/O-Interface (Digital In and Outputs)**

Module: RP EA5			
PIN	**Function**	**Designation**	**Status**
1	BIAS Input 101	Standard	Input
2	BIAS Input 102	Standard	Input
3	BIAS Input 107	Standard	Input
4	BIAS Input 108	Standard	Input
5	0VSPS	Ground reference 0VSPS	B
6	BIAS Input 106	Standard	Input
7	BIAS Output 109	Standard	Output
8	BIAS Output 110	Standard	A
9	+24VSPS	Ext. +24V feed-in	UB

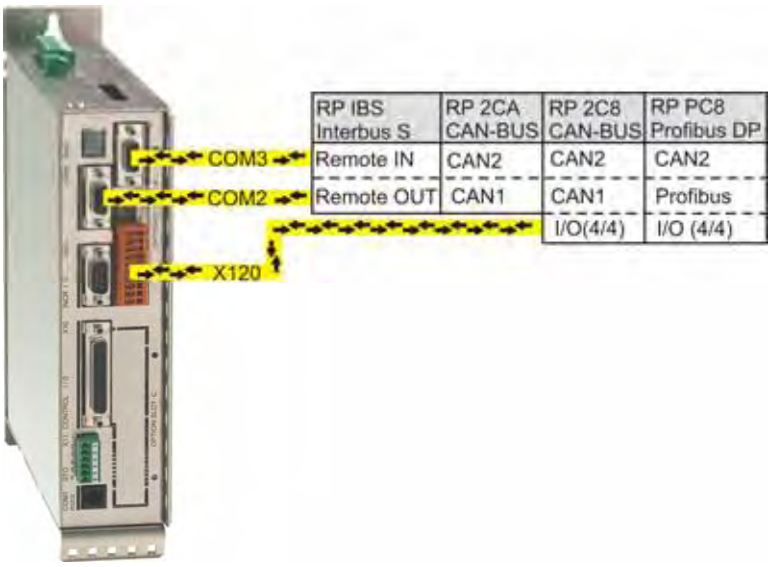
with galvanic separation

Notice !

The inputs with the internal numbers 107 and 108 must be connected to pin numbers 3 and 4.

The outputs with the internal numbers 109 and 110 must be connected to pin numbers 7 and 8.

2.10 Fieldbus Interface COM2 in Combination with COM3 (OPTION SLOT A/B)



- **Pinning for Interbus S (RP IBS)**

Remote OUT - Outgoing Interface (SUB D09 Socket)

Module: RP IBS		
PIN	**Function**	**Designation**
1	Data Line OUT Forward (error voltage A)	DO2
2	Data Line IN Backward (error voltage A)	DI2
3	Reference Potential	IBS-GND
4	-	-
5	VCCI	+5V
6	Data Line OUT Forward (error voltage B)	/DO2
7	Data Line IN Backward (error voltage B)	/DI2
8	-	-
9	Reporting Input *	RBST

* for additional Interbus S - Interfaces

Remote IN - Incoming Interface (SUB D09 Plug)

Module: RP IBS		
PIN	**Function**	**Designation**
1	Data Line IN Forward (error voltage A)	DO1
2	Data Line OUT Backward (error voltage A)	DI1
3	Reference Potential	IBS-GND
4	-	-
5	-	-
6	Data Line IN Forward (error voltage B)	/DO1
7	Data Line OUT Backward (error voltage B)	/DI1
8	-	-
9	-	-

with galvanic isolation

- **Pinning CAN-BUS1 and CAN-BUS2 (RP 2CA)**

Module: RP 2CA		
PIN	**Function**	**Designation**
1	-	-
2	CAN_L Bus Line (dominant low)	CAN_L
3	Ground	CAN-GND
4	-	-
5	-	-
6	Optional Ground	CAN-GND
7	CAN_H Bus Line (dominant high)	CAN_H
8	-	-
9	-	-

CAN1

CAN2

with galvanic isolation

- **Pinning CAN-BUS1 and CAN-BUS2 with I/O's (RP 2C8)**

Module: RP 2C8				
PIN	**Function**		**Designation**	
1	-		-	
2	CAN_L Bus Line (dominant low)		CAN_L	
3	Ground		GND	
4	-		-	
5	-		-	
6	Optional Ground		GND	
7	CAN_H Bus Line (dominant high)		CAN_H	
8	-		-	
9	-		-	
X120	**0**	**1**		**Status**
1	BIAS	Reset Drive Fault	Input 121	Input
2	BIAS	Limit Switch +	Input 122	Input
3	BIAS	Limit Switch -	Input 123	Input
4	BIAS	Reference Switch	Input 124	Input
5	BIAS	Cam 1	Output 125	Output
6	BIAS	Cam 2	Output 126	Output
7	BIAS	Cam 3	Output 127	Output
8	BIAS	Cam 4	Output 128	Output
9	Ext. +24 V Supply		+24 V SPS	Ub
10	Ground Reference 0 V		0 V SPS	B

CAN1

CAN2

I/O's

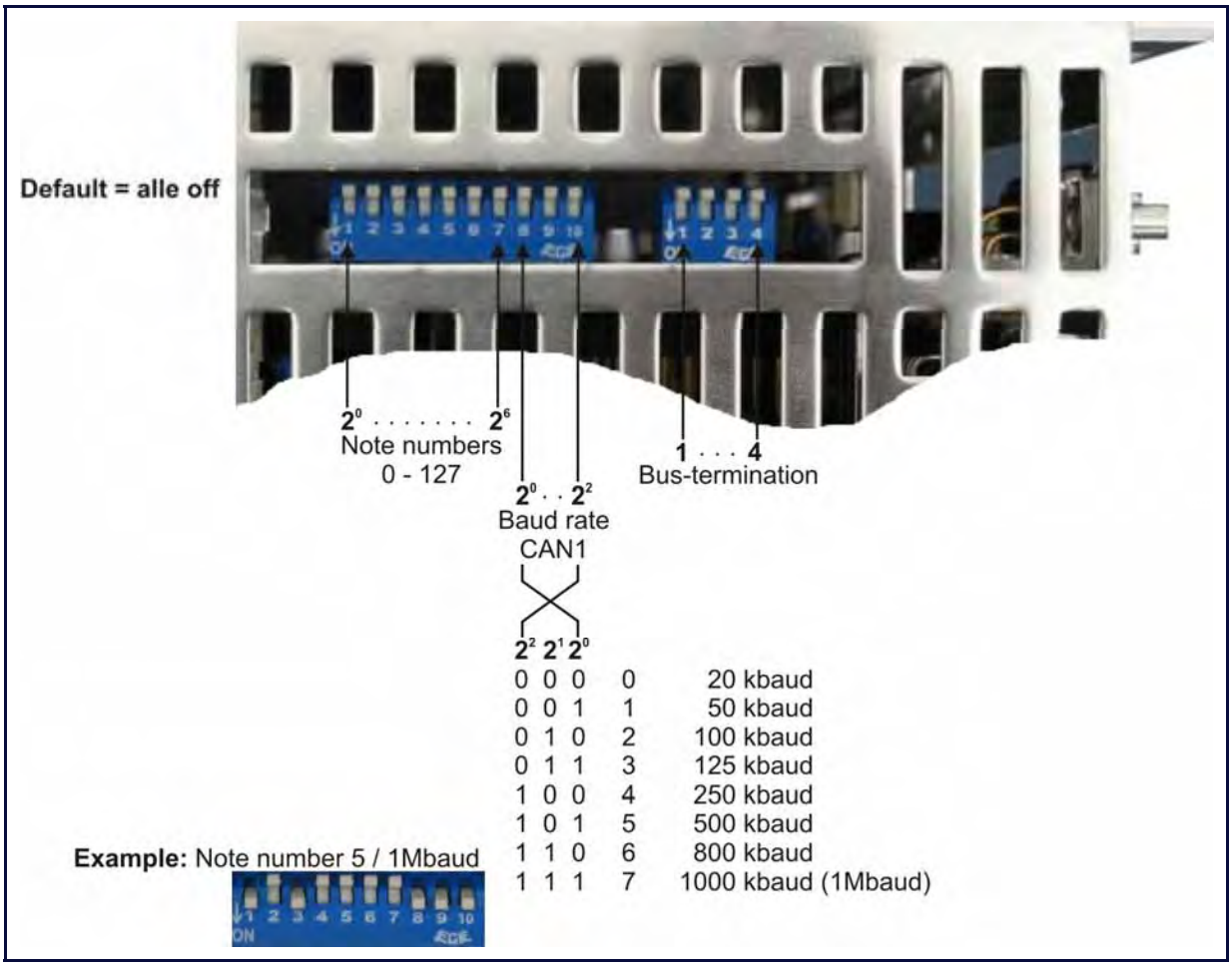
The signal status of the I/O's is shown with a 2mm LED

LED on I/O = high / LED off I/O = low.

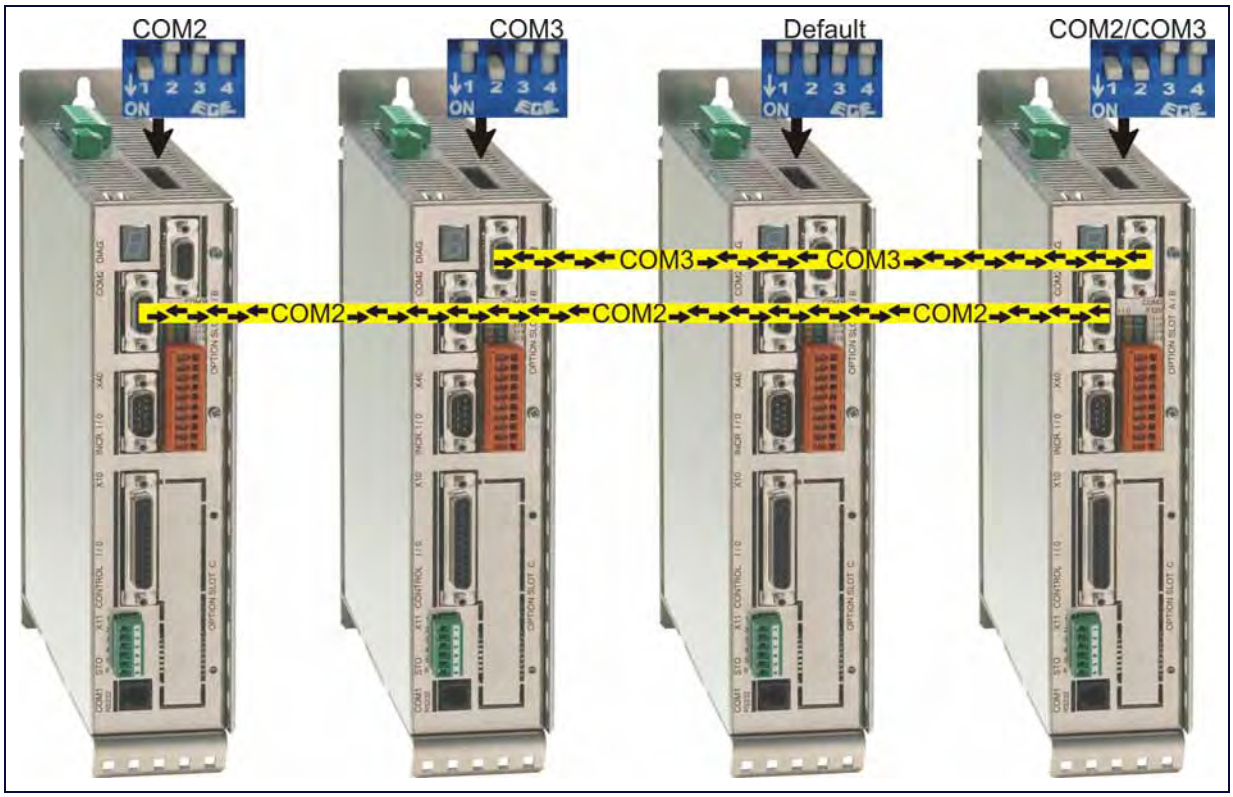
(min./max. cable cross-section: 0,08mm² / 1,5mm²)

– DIP Switch Position for Option Module RP 2CA and RP 2C8

DIP – Switch Position **CAN**



DIP – Switch Position **BUS – Termination**



- **Pinning Profibus DP and CAN-BUS2 with E/A's (RP PC8)**

Module: RP PC8				
PIN	**Function**		**Designation**	
1	-		-	
2	-		-	
3	Line B		B	
4	Request to Send		RTS	
5	Ground		PDP-GND	
6	Potential +5V		+5V	
7	-		-	
8	Line A		A	
9	-		-	

Profibus DP

	CAN2	**RS485**
1	-	Data-IN inv.
2	CAN_L Bus Line (dominant low)	-
3	Ground	485-/CAN-GND
4	-	DATA-IN
5	-	GND (optional)
6	Ground	485-/CAN-GND
7	CAN_H Bus Line (dominant high)	-
8	-	Data-OUT
9	-	Data-OUT inv.

CAN -BUS2 / RS485

X120	**0**	**1**		**Status**
1	BIAS	Reset Drive Fault	Input 121	Input
2	BIAS	Limit Switch +	Input 122	Input
3	BIAS	Limit Switch -	Input 123	Input
4	BIAS	Reference Switch	Input 124	Input
5	BIAS	Cam 1	Output 125	Output
6	BIAS	Cam 2	Output 126	Output
7	BIAS	Cam 3	Output 127	Output
8	BIAS	Cam 4	Output 128	Output
9	Ext. +24 V Supply		+24 V SPS	Ub
10	Ground Reference 0V		0 V SPS	B

I/O's

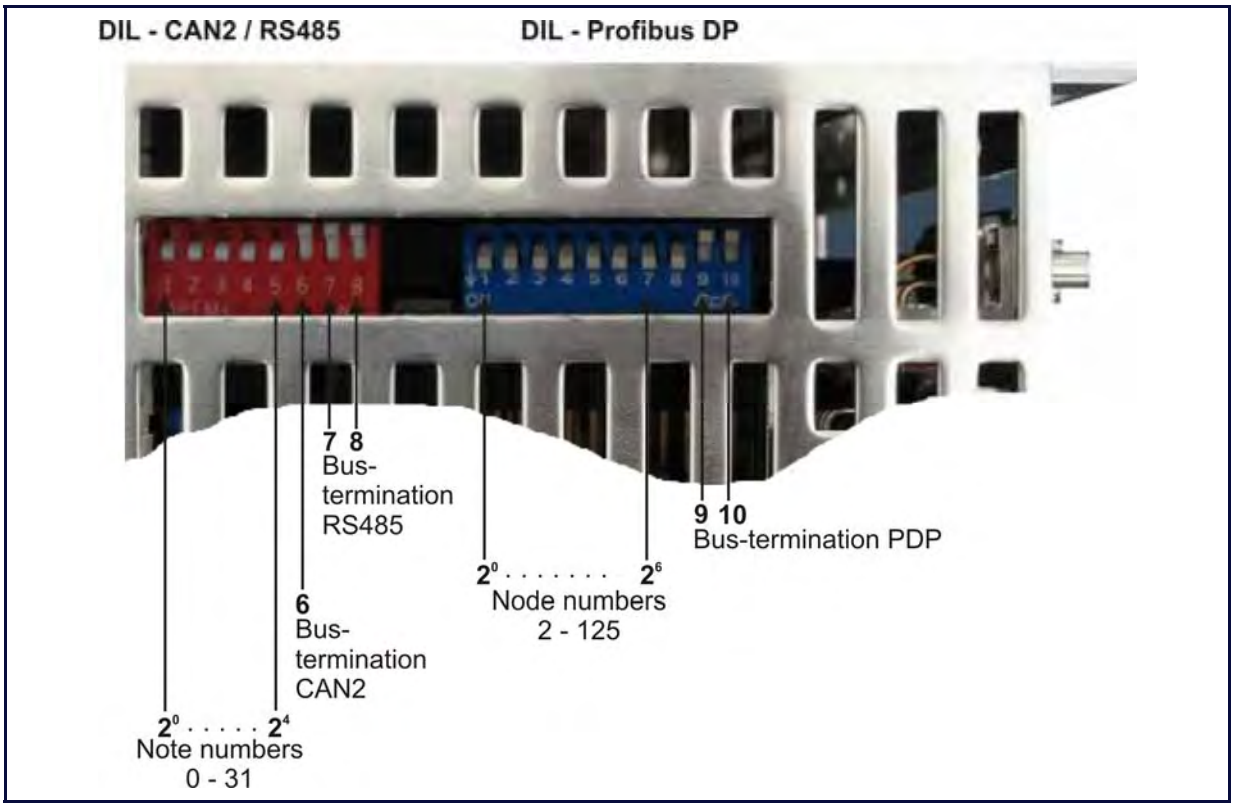
The signal status of the I/O's is shown with a 2mm LED

LED on I/O = high / LED off I/O = low.

(min./max. cable cross-section: 0,08mm² / 1,5mm²)

− DIP Switch Position for Option Module RP PC8

DIP – Switch Position **CAN2 / RS485 and Profibus DP**



Further information for the Profibus DP: See Documentation 07-05-04-02-E-Vxxxx.

3.1 Operating Mode General

The preselection of the device functions are carried out by choosing the operating modes 0...5 according to the following table, **see:** ■ **Operating modes and pin functions**, (EASYRIDER® Windows - Software).

Each operating mode allows for the assignment of different in and output functions (F0..F6).

Operating Mode	Reference Source	Hints for Selecting the Operating Mode
0 **1** **2**	Analog (X10.5/18)	Switching the operating modes 1 and 2 through input X10.24 Speed control analog Torque controller analog
3	Analog (X10.5/18) / Digital	Simple applications with the requirement of switching between position and speed control position controller (input X10.24). Handling like operating mode 4
4	Digital or Analog in acc. to parameter setttings	General position controlled systems - Up to 10 positions can be stored under identifier-numbers and activated as shown.
5	**Digital or Analog in acc. to programming or via digital communication (e.g. fieldbus)**	**Simple to complex systems using BIAS instructions** - **(up to 1500 command blocks)** **PLC Functions**

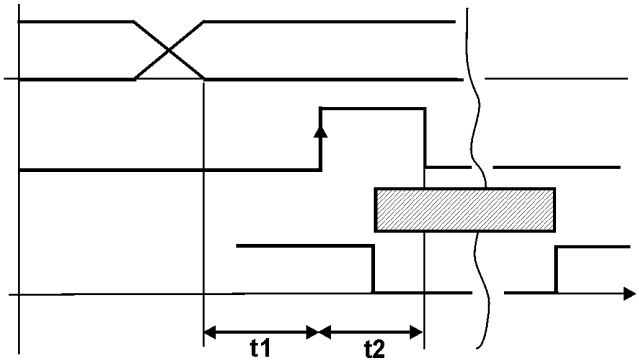
pos. selection (Nr. 0...9) function F2 data 2^0...2^4

input start function F2 X10.2

axis move to selected position-number

output position reached function F0 X10.12

t1= 2ms minimum t2= 2ms minimum



3.2 Operating Modes and Pin Functions

Available Contact Numbers	Operating Modes					
	0 Torque / Speed-Control	**1** Speed Control	**2** Torque Control	**3** Position / Speed Control	**4** Position Control	**5** **Position Control + BIAS Functions**
Input X10.14	F0, F1	F0, F1	F0, F1	F0, F1, F2, F3	F0, F1, F2, F3,F6	**F0, F1, F2,F6**
Input X10.15	F0, F1	F0, F1	F0, F1	F0, F1, F2, F3	F0, F1, F2, F3,F6	**F0, F1, F2,F6**
Input X10.4	---	---	---	---	F2,F6	**F0, F2, F3,F6**
Input X10.25	---	---	---	---	F2,F6	**F0, F2, F3,F6**
Input X10.11	F1	F1	F1	F1	F1,F2,F6	**F0, F1, F2, F3,F6**
Input X10.24	F0 L = torque- H = speed control	---	---	F0 L = torque- H = speed control	F1, F2,F6	**F1, F2, F3,F6**
Input X10.2	---	---	---	---	F0	**F2, F3**
Output X10.12	F0, F2, F5	F0, F2, F5	F0, F2, F5	F0, F1,F3, F5	F0, F1,F3, F5	**F0, F1, F2, F3, F4, F5**
Output X10.13	F0, F2, F5	F0, F2, F5	F0, F2, F5	F0, F1,F3, F5	F0, F1,F3, F5	**F0, F1, F2, F3, F4, F5**
Output X10.20	F0, F2, F5	F0, F2, F5	F0, F2, F5	F0, F1,F3, F5	F0, F1,F3, F5	**F0, F1, F2, F3, F4, F5**
Output X62.3 X62.4	F0, F2, F5	F0, F2, F5	F0, F2, F5	F0, F1,F3, F5	F0, F1,F3, F5	**F0, F1, F2, F3, F4, F5**

3.3 Configurable Pin Functions (Operating Mode Dependent)

Input Nr.	Input Functions (Operating Mode Dependent)						
	Function F0	**Function F1**	**Function F2**	**Function F3**	**Function F4**	**Function F5**	**Function F6**[2]
Input X10.14	☒	3) limit switch +	1) set selection data 2^0	move manually +	☒	☒	CAN Node no. 2^0
Input X10.15	☒	3) limit switch -	1) set selection data 2^a	move manually -	☒	☒	CAN Node no. 2^a
Input X10.4	latch input 1 ⌒	extended latch	1) set selection data 2^b	☒	☒	☒	CAN Node no. 2^b
Input X10.25	latch input 2 ⌒	☒	1) set selection data 2^c	☒	☒	☒	CAN Node no. 2^c
Input X10.11	start (slope 0->1) for BIAS - move commands	3) regulator trouble reset	1) set selection data 2^d	☒	☒	☒	CAN Node no. 2^d
Input X10.24	operating mode selection (0) – 1or 2 (3) – 1or 4	3) reference sensor	1) set selection data 2^{max}	☒	☒	☒	CAN Node no. 2^{max}
Input X10.2	start (slope 0-->1) with position set selection in position control (4)	☒	strobe (slope 0-->1) for BIAS-set selection	☒	☒	☒	☒
Output X10.12	position reached	reference output	☒	tracking window exceded	synchron-format trigger	no drive trouble	-
Output X10.13	temperature monitoring	reference output	☒	tracking window exceded	start offset trigger	no regulator trouble	-
Output X10.20	warning	reference output	☒	tracking window exceded	☒	no drive trouble	-
Output X62.3 X62.4	active ok (motor brake)	reference output	☒	tracking window exceded	☒	no drive trouble	-

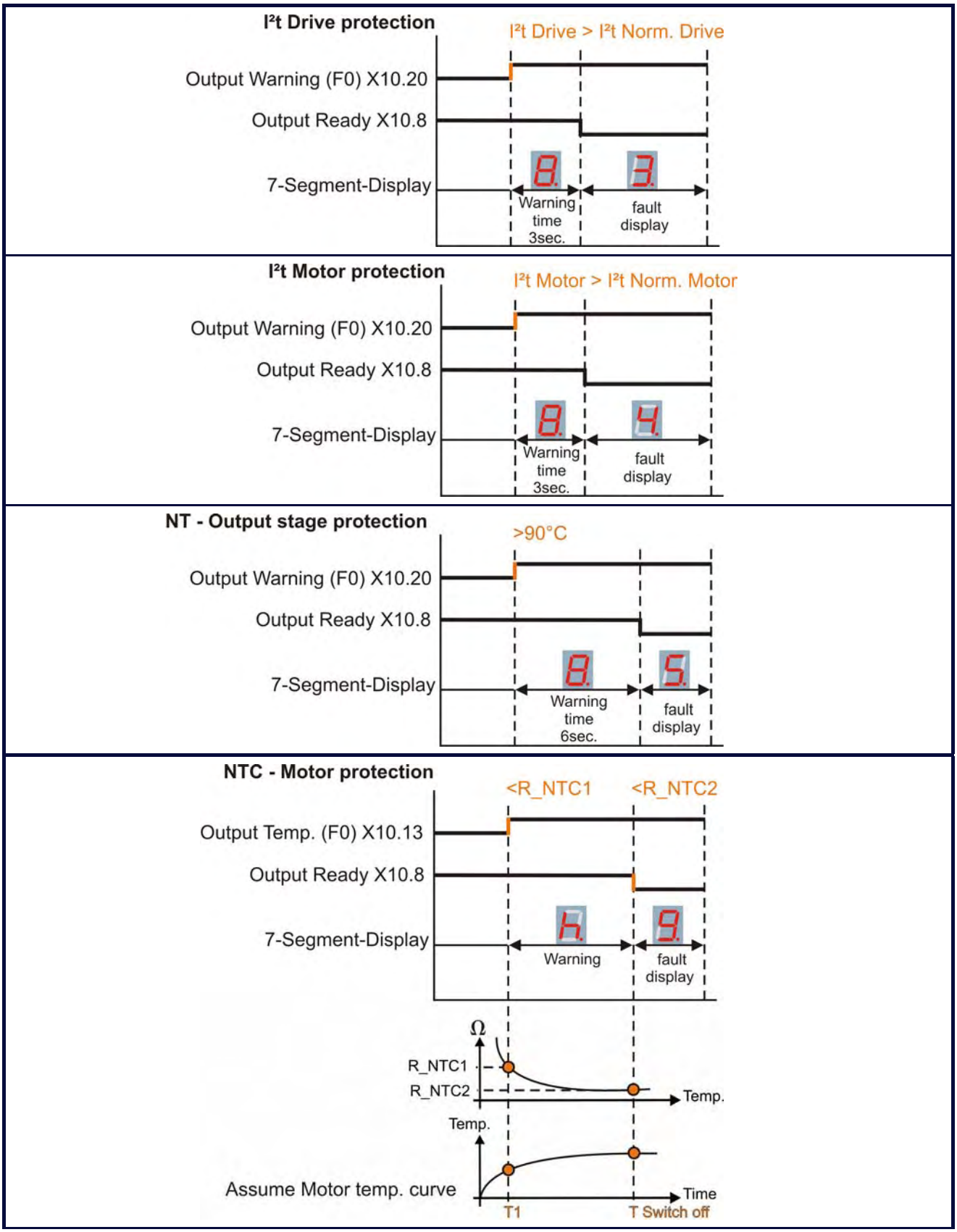
☒ BIAS function is freely programmable in operating mode 5. - No function in operating modes 0 to 4.

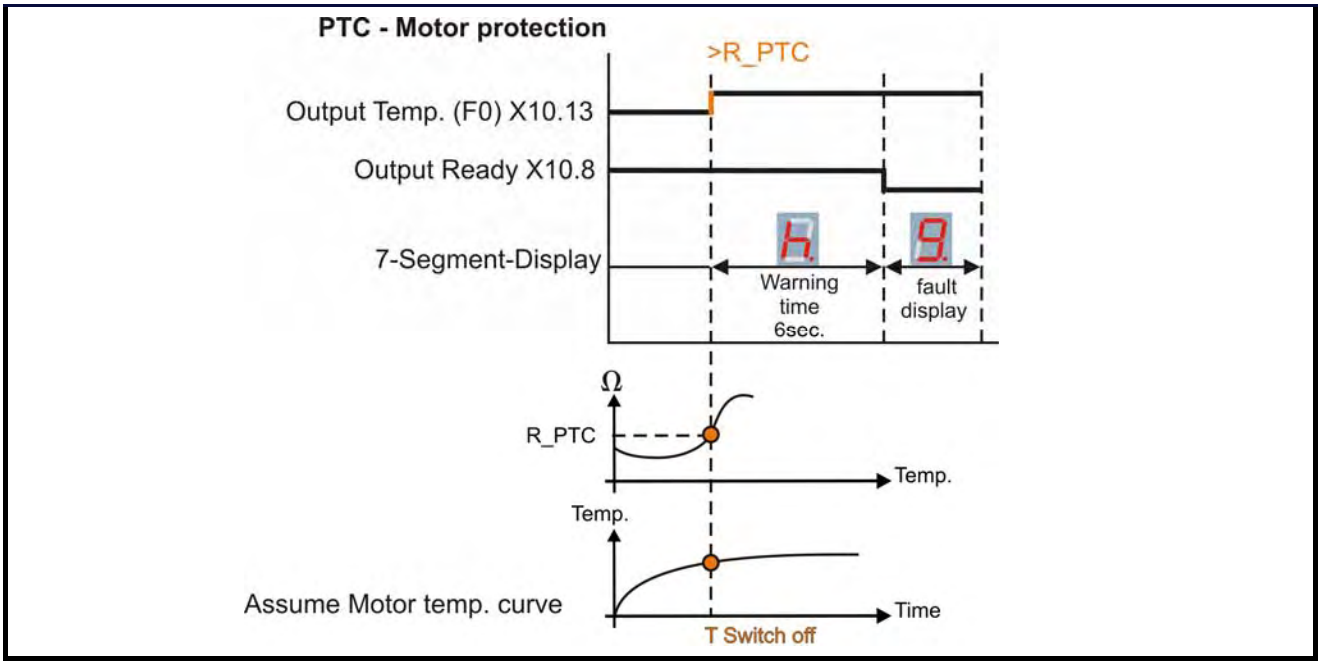
⌒ Fast input for optimal timing.

1) With every row (from the top to the bottom) in which the function F2 is assigned to an input, the binary value (2^n) increases by 1. (See example)
   Operating mode 4: Only numbers 0 - 9 are allowed to be set!
2) Only possible with module RP-CAN.
3) If the Option RP 2C8 / PC8 (**See:** Fieldbus - interface - COM2-COM3) is inserted, the contact functions as described for the X10-plug are not valid. The inputs are freely programmable utilizing the BIAS program.

3.4 Functions Diagrams with Protection Mode “Switch Off”

In accordance with EASYRIDER® Windows – Software **“**Commissioning / Motor / **Motor/30”**




PTC - Motor protection
>R_PTC
Output Temp. (F0) X10.13
Output Ready X10.8
7-Segment-Display
Warning time 6sec.
fault display
Ω
R_PTC
Temp.
Temp.
Assume Motor temp. curve
Time
T Switch off

4.1 Mounting

In order to guarantee the best possible air circulation for the cooling unit, the servo drive should only be installed in a vertical position. The vertical installation above other systems or heat producing units can cause overheating.

4.2 Control Cabinet Mounting

Installation should be carried out only in a control cabinet in which the inside is free from dust, corrosive fumes, gases and liquids.

Make absolutely sure that the condensing of evaporating liquids including atmospheric moisture is avoided. Should the digital servo drive be installed in a place where condensation is likely, a suitable anti-condensation heater must be installed. The heater must be SWITCHED OFF during normal operation.

Automatic switch off is recommended

The servo drives should not be installed in areas which have been classified as dangerous, unless they have been installed in an approved enclosure and in accordance with applicable regulations. In such an application double check all aspects of the installation.

Please pay attention during installation of the unit to provide for adequate space and ventilation!
(See: "■ **Dimensions**")

General Rule:
It is better to place heat-producing devices low in an enclosure to support internal convection and to spread out the heat. If placing such devices up high is unavoidable, enlarging the upper dimensions at the expense of height or the installation of fans should be considered.

4.3 Cooling and Ventilation

The digital servo drives are inherently designed to protect against damage which may be caused due to overheating. A temperature sensor is mounted on the heat sink. When the temperature reaches a level above >95°C, the unit will be automatically shut-down. This setting can not be altered.

The cooling of the power module will be assisted as much as possible with an internal fan. Depending upon the temperature the fan unit will operate at one of two levels, in order to limit unnecessary wear and potential pollution.

Make sure a cabinet of proper size is selected for adequate air circulation.

If the device is placed and operated in a non-ventilated environment, the case volume of the specified control cabinet must be calculated in accordance with the following table!

Unit	Volume / Cabinet
638A01.. bis 638A06..	0,12 m³

For more specific information, please refer to the information provided by the manufacturer of the cabinet.

5.1 Installation General

- **Safety**

The voltages carried by power supply cables, motor cables, connectors, and certain parts of the drive can cause serious electric shock and even death

- **Danger of Electric Shock**

Caution !

Risk of electrical shock, wait 3 minutes after switching off, for discharging of the capacitors.

Disconnect the drive unit from the mains before working on it. A period of **three** minutes **must** pass after switching off so that the internal capacitors can discharge completely. Until the discharge time is over, there can be dangerous voltage stored in the module !
Persons, who monitor or carry out electrical installation and maintenance must be adequately qualified and schooled in these activities.

- **Dangerous Areas**

The use of variable speed drives of all kinds can invalidate the certification for dangerous areas (apparatus group and/or temperature class) of explosion-protected motors. Inspection and certification for the
complete installation of servo motors and electronic components **must** be obtained.

- **Grounding - Safety Grounding**

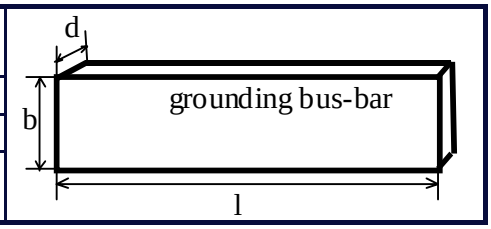
The grounding impedance must meet the requirements of local industrial safety regulations and should be inspected and checked at appropriate and regular intervals

Ground Connections

It is recommended to attach a ground bus, made of high conductivity copper, as near as possible to the servo-rack or regulator modules in order to minimize the length of the cable run connections.
The recommended dimensions are:

Thickness: d = 5 to 6 mm

Length (m)	Width (mm)
< 0,5	20
0,5 < 1,0	40
1,0 < 1,5	50



Due to increased discharge currents > DC 10mA resp. > AC 3,5mA the grounding connection of the drive has to be connected to the ground using a copper-cable with a minimum dimension of 10mm² !

- **Short-Circuit Capacity and Discharge Currents**

Due to the working principles of servo drives, there may discharge currents to the ground exceeding DC 10mA resp. AC 3,5mA.
Suitable for use in a system capable of delivering not more than 5000 RMS symmetrical amperes 505V maximum. (Note according to UL508C)

5.2 Fuses, contactors, filters

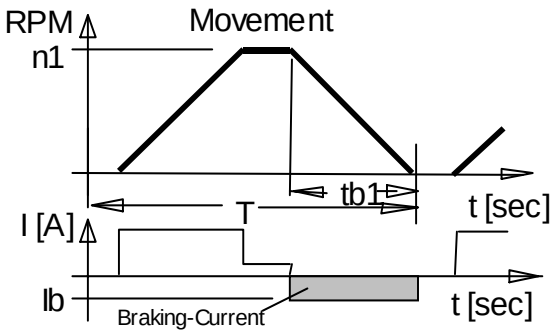
Servo Drive			638A01..	638A02..	638A04..	638A06..
Fuse, Contactor						
FI – Switch			Not recommended. (Requires a trip point threshold of 300mA; no protection). Suggestion: Reduce the current leakage by opening jumper JP600 and employing external filters			
Power Supply Input		[A]	3	5,5	9,6	11
Line Fuse	1)	Type	T10A	T10A	T10A	T20A
Protective Circuit Breaker	2)	Type	PK2MO-16	PK2MO-16	PK2MO-16	PK2MO-16
Line Contactor	2)	Type	DIL 06 M	DIL 06 M	DIL 06 M	DIL 06 M
EN 61800-3 First Environment Category C1 max. motor cable length 20m	3)	-	Internal filter	Internal filter	Internal filter	Internal filter
EN 61800-3 First Environment Category C2 max. motor cable length 40m						
Reduced Current Leakage Operation, single phase incoming power line JP 600 opened. EN 61800-3 First Environment Category C1	4)	Type Cable Length	external filter LNF E 1*230/012 at 100 m	external filter LNF E 1*230/012 at 100 m	external filter LNF E 1*230/012 at 100 m	external filter LNF E 1*230/012 at 100 m

1) Recommended to meet UL Regulations: Fa.Bussmann Type FRS-R, 600V,
   Only employ UL approved fuse holders !
2) Recommended for example : Klöckner Moeller
3) When employing an output-side ferrite ring core Type FR3.V2
4) It is necessary to employ a motor reactor, with a motor cable length > 50m.

5.3 Ballast Resistance

- **Selection of the Ballast Resistance**

When employing a breaking mechanism with an operating motor driven system, the contained energy flows back into the drive.
The capacitors within the motor can absorb a small portion of the excess energy. The rest of the energy must
be dissipated through a resistor in heat. The activation of the ballast resistance occurs, depending upon the voltage threshold.
The resistance load is electronically simulated and monitored by our software
(EASYRIDER® Windows - Software). Peak power (Pmax) and continuous power output (Pd) must be configured so that the specific requirements of the application are fulfilled.
The general rule for resistance measurements is as follows: Pmax / Pd <= 59.



Definition of Data	*Values for Example*
Speed at Brake-Start	n1 = 3000 RPM
Braking Time	tb1 = 0,1 sec.
Cycle-Time	T = 2,0 sec.
Total Inertia	J = 0,0005 kgm²
Braking-Current	Ib = 3,2 A
Motor-Resistance	Rph = 3,6 Ohm
Cable-Resistance	RL = 0,3 Ohm

Selection	
Step 1 **Evaluation of the Brake Capacity** (Approximation without capacitor load, friction and drive power loss)	Example
Power of Motion: **Pkin** = 0,0055 * J * n1² / tb1 [W]	Pkin = 0,0055 * 0,0005 * 3000²/0,1 Pkin = 247 W
Motor Power Loss: **Pvmot** = Ib² * (Rph + RL) [W]	Pvmot = 3,2² * (3,6 + 0,3) Pvmot = 40 W
Continuous Power: **Pd = 0,9 * (Pkin-Pvmot) * tb1 / T [W]**	Pd = 0,9 * (247 - 40) * 0,1 / 2 Pd = 9,3 W
Peak Power: **Pmax = (1,8 * Pkin) - Pvmot [W]**	Pmax = (1,8 * 247) - 40 Pmax = 405 W

Measurements Used:

J	Total Inertia [kgm²]
n1	RPM at Start of Braking [RPM]
tb1	Braking Time [Sec]
T	Cycle Time [Sec]
Ib	Motor Braking Current [A]
Rph	Motor Resistance (terminal/ terminal) [Ω]
RL	Cable Resistance of the Power Cable [Ω]

Step 2 Is internal and/or external ballast resistance required ?	Example-Drive Type: **638**
Is the internal ballast resistance sufficient or is no internal resistance available? Should no resistance be available then appropriately sized external ballast resistance can be employed to meet system requirements according to the table (See below), External and internal resistance can be employed in a parallel configuration. In this case the internal and external capacities can be added together.	Overall Rating: Internal Resistance: Continuous Power Pd = 20W Peak Power Pmax = 0,83kW Requirement: Pd = 9,3W Pmax = 405W **Result: The internal configuration is sufficient**
Selection Resistor **GVAD 210x20 – 033 R1500**	

- **Configuration of the Ballast Resistance**

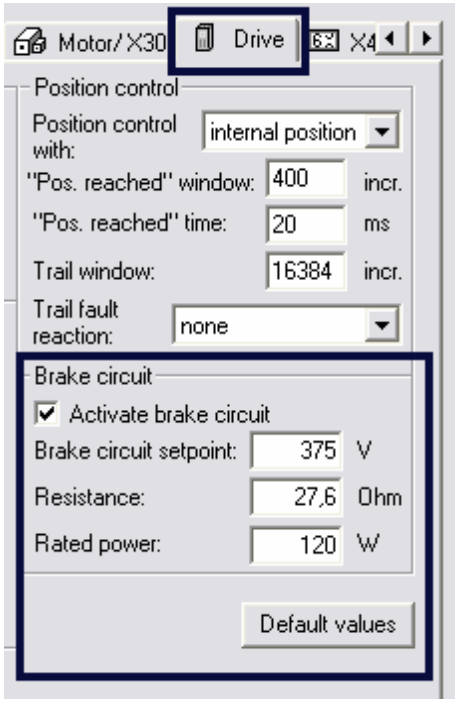
Ballast Circuit Configurations

1. Activate Electronic Ballast:
The electronic ballast will be activated. “Activate Ballast = Y“ (Default - setting)
2. Switching Threshold:
The switching threshold is to be selected.
“Ucc Ballast On = 375V“ for a 230V AC incoming power supply (Default - setting)
3. Resistance Value:
The total resistance value is determined by the selection of both the internal and external resistance values which are combined to provide the overall parallel resistance.
4. Rated Power:
The ballast performance rating is determined by the sum of the selected internal and external resistance capacity values.

The somewhat similar ratio of Pd – continuous power rating to Pmax – peak power rating is a prerequisite for the correct monitoring of the ballast resistance employed in a parallel configuration. This is guaranteed with the standard design configurations.

Example for 638A:

EASYRIDER



Determination of the resistance values through the employment of both internal and external resistors.

Internal “Ballast Resistance = 170 Ohm“
External “Ballast Resistance = 33 Ohm“

$$\text{Formula}: \frac{1}{\text{Rges.}} = \frac{1}{\text{R int.}} + \frac{1}{\text{Rext.}}$$

$$\frac{1}{\text{Rges.}} = \frac{1}{170\Omega} + \frac{1}{33\Omega} \Rightarrow \text{Rges.} = 27{,}6\Omega$$

Selected Resistance Value = **27,6 Ohm**

Determination of the ballast rating through the employment of both the internal and external ballast ratings

Internal “Ballast Rating = 20 Watt“
External “Ballast Rating = 100 Watt“

$$\text{Formel}: \text{Pges.} = \text{Pint.} + \text{Pext.}$$

$$\text{Pges.} = 20\text{W} + 100\text{W} \Rightarrow \text{Pges.} = 120\text{W}$$

Selected Power Rating = **120 Watt**

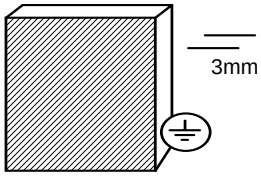
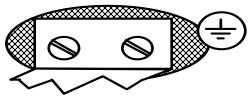
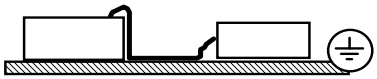
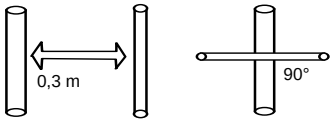
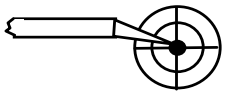
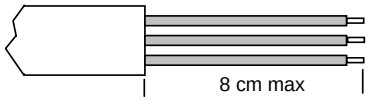
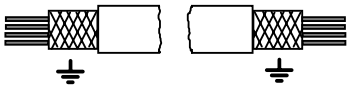
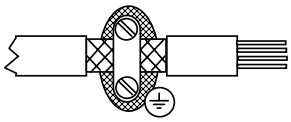
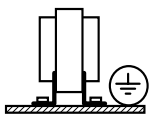
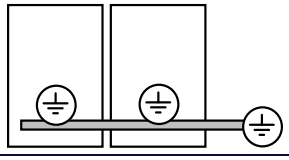
CAUTION!

Installation of External Ballast Resistors
Ballast resistors create heat !
The ballast resistance must therefore be installed in a manner which provides safeguards against the potential danger of inadvertent touching or the danger of fire, during both normal operations and under fault conditions.

6.1 Electromagnetic Compatibility (EMC)

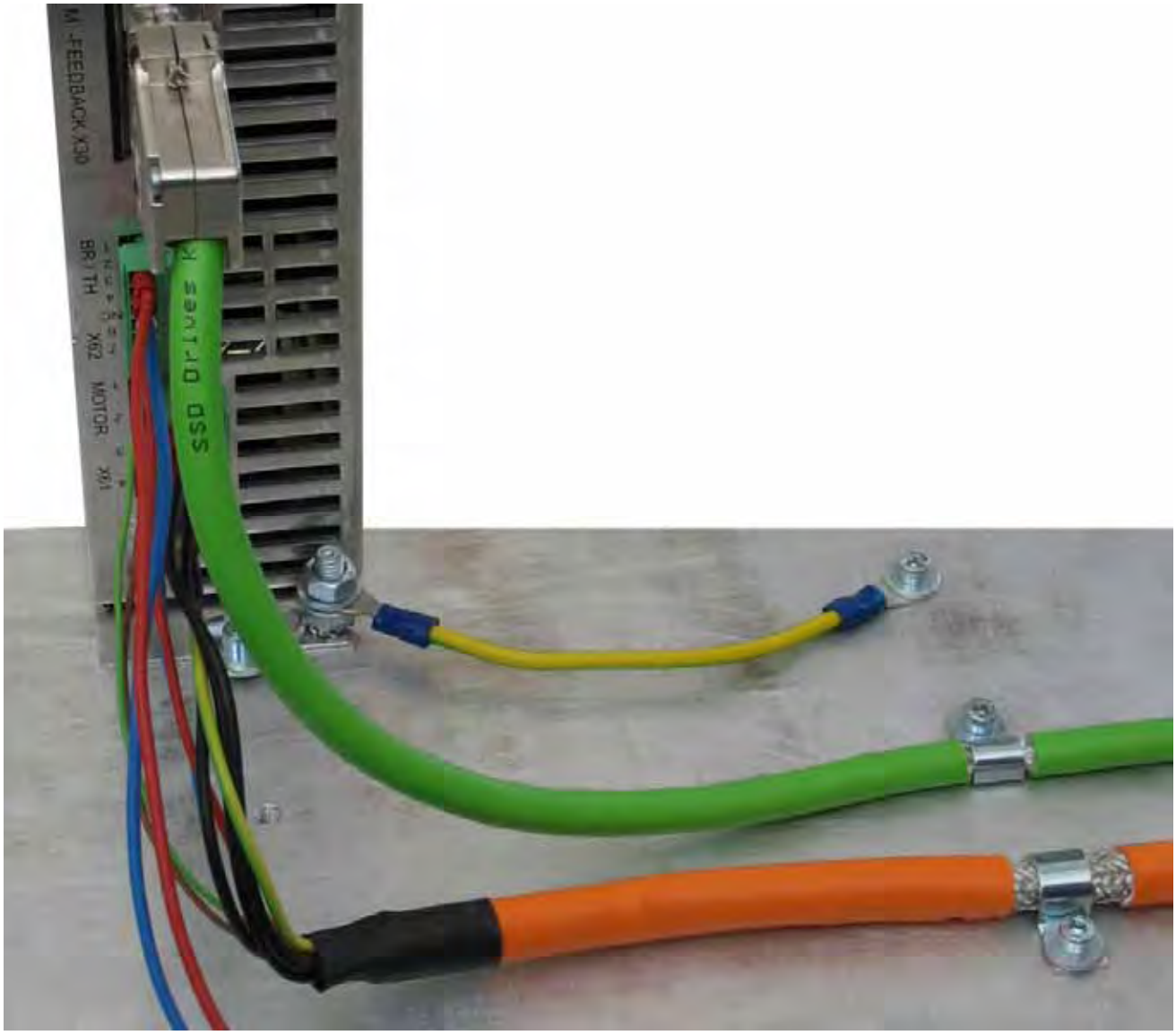
Conformity, in accordance with the EEC Directive 89/336/EEC has been evaluated using a reference-system, consisting of a compact type drive and a line-filter on mounting-plate, connected to an AC-synchronous motor.
The motor cable is mainly responsible for EMC emissions. The motor cable must be installed therefore employing exceptional care.
The layout of grounding is very important. Grounding has to be low-impedance for high frequencies.
That means, all ground connecting parts have to be connected over a large surface contact area.
The measurements provided are valid only with the use of our cables, suppression aids and line filters and by application of the following wiring instructions:

- **Hints for Mounting**

A	All components are mounted inside of a steel control cubicle on a mounting plate (min. thickness 3mm). Recommended: Galvanized	
B	The connection between the drive housing, the filter housing and the mounting plate must be bare metal and not reduced by varnish. All screws must be properly tightened !	
C	Use only our filters and cables for motor and resolver connections.	
D	Place all wires and cables as close as possible to grounded metal parts.	
E	Separate power and control cables. Minimum distance: 0,3m Cross Points: 90°	
F	Avoid cable loops. The run between the line-filter and drive has to be as close and short as possible (drilled).	
G	Maintain the shielding as close as possible to the cable-end (max distance 8 cm).	
H	Connect shielded connections according to general view of connections: See chapter 2.1. Ground shielding on both sides, with the shortest possible cable run. For long cables: Connect additional shielded areas along the way.	
I	Connect the shielded area to well grounded points.	
K	Connect unused wires in cables to the ground.	
L	Install control cables close to grounded metal parts or shielding when leaving the control cubicle	
M	Pay close attention to the grounding of control-transformer (DC 24V). Use a transformer with a metal socket and pay attention to provide for good conductive contact on mounting plate.	
N	Pay close attention to the overall grounding of the complete system. Interconnect several mounting plates using copper rails or copper band. Pay attention to the ground connection between the control cabinet and the equipment !	

- **Example for Mounting**

Motor Wiring:



7.1 Compliance with Regulations, Limitations and Basic Conditions

Insulation Requirement		
Insulation Class	EN 50 178	I
Protection against Electrical Shock		
Overvoltage Category	IEC 60364-4-443:1999	II
Pollution Degree	EN 61800-2, 4.1.2.1	2

Environmental Conditions		
General Environmental	EN 61800-2	
Ambient Temperature Rating:		
Operations	IEC 60721-3-3	0 bis +40 °C, 3K3
Storage	IEC 60721-3-3	-25 bis +55 °C, 1K4
Transport	IEC 60721-3-2	-25 bis +70 °C, 2K3
Allowable Humidity:		
Operations	IEC 60721-3-3	<= 85%, 3K3
Storage	IEC 60721-3-3	<= 95%, 1K4
Transport	IEC 60721-3-2	<= 95% bei +40 °C, 2K3
Protection	EN 60529	IP20
Altitude	Under <= 1000m above sea level with 100% power rating Over >1000m .. <= 2000m above sea level, decrease the power rating by 1% per 100m	
Method of Cooling		Forced ventilation (internal fan)

EMC - Requirement		
RFI-Emission	EN 61 800-3 First Environment	Cat. C1 max. motor cable length 20m Cat. C2 max. motor cable length 40m
Noise Immunity	EN 61800-3 (include EN 50081-2 and EN 50082-2)	Limits for industrial environments

EC - Guidelines	
EC Low-Voltage Guidlines 73/23/EWG and RL 93/68/EWG	EN 50 178, Electronic equipment for use in power installations EN 60 204-1, Electrical equipment to apply in part.
EG-EMC directive 89/336/EWG	EN 61 800-3, EMC Adjustable speed electrical power drive systems EN 50 081-2 ... 50 082-2, EN 61 000-4-2 ...61 000-4-5

UL Approved		
UL - List	UL 508 C	
UL Style-No.	E....	

8.1 Jumpers

All jumpers are set to a standard preset !

JP100, Bridged Pad		JP 100
2 and 3 (standard)	READY contact with reference to common output supply voltage on X10.21	1 3 2
1 and 3	READY contact can be freely wired	

JP101, Bridged Pad		JP 101
2 and 3 (standard)	Analog input X10.19 without internal pull-up.	2 3 1
1 and 3	Analog input X10.19 with internal pull-up to +12 V	

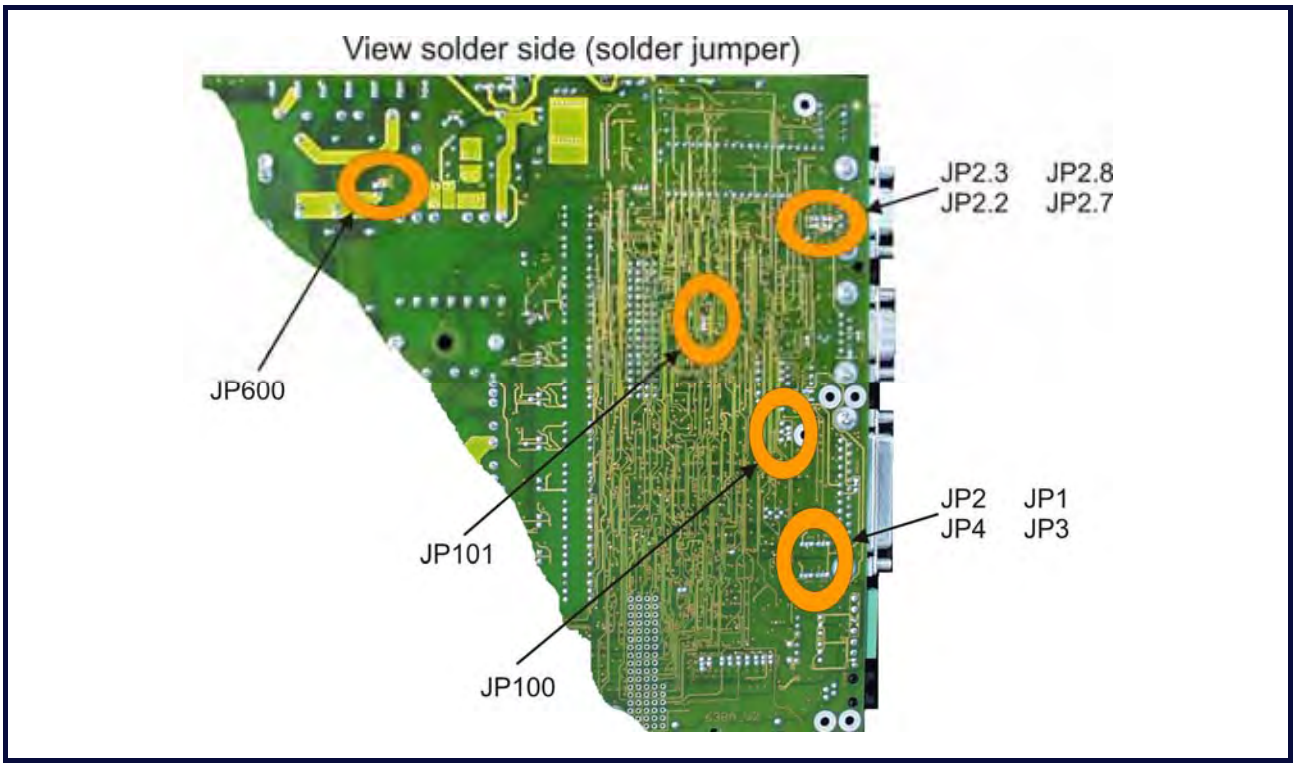
JP1, JP2, Bridged Pad	**Adjust identically !**
2 and 3 (standard)	X10.15 = high active
1 and 3	X10.15 = low active

JP3, JP4, Bridged Pad	**Adjust identically !**
2 and 3 (standard)	X10.14 = high active
1 and 3	X10.14 = low active

JP2.8, JP2.3, JP2.7, JP2.2	
Open	Default, **RP** -CAN, -DEV, -PDP, -2CA, -2C8 , PC8
Close	**RP** -232, -422, -485, -IBS, -EA5, -SUC

JP600	
Open	Default
Close	Minimal current leakage with external filter operation

- **Power Board Layout Plan**



9.1 Commissioning Preparation

Caution !

Improper installation conditions and/or wiring can cause uncontrolled movement and operation of the equipment.

Please carefully observe all safety instructions and regulations for the protection of both the equipment and personnel!

- It is recommended that one utilize the **EASYRIDER®** Windows - Software Program for the initial set-up of the equipment. This program communicates through the serial interface of the computer to the attached drive.
  Information concerning the operation of the EASYRIDER® software is discussed in this chapter.
  We suggest that the software be first run in the "Simulation" mode in order for the user to become familiar with and comfortable the system.
  The EASYRIDER® Windows - Software also provides for additional interactive "Help" functions.

- Due to security concerns some of the Menus are password protected.
  The set up and start up of the equipment must be carried out by qualified personnel only.

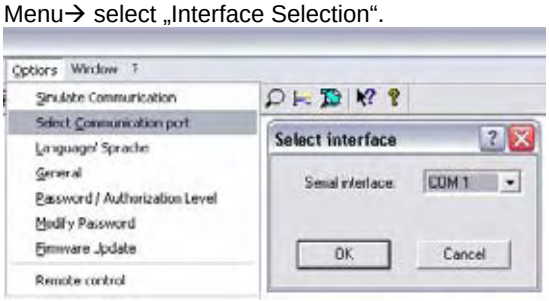
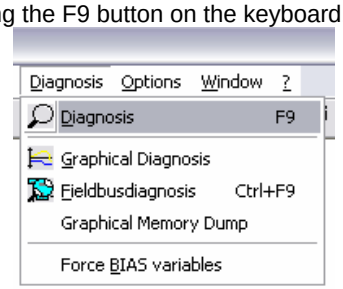
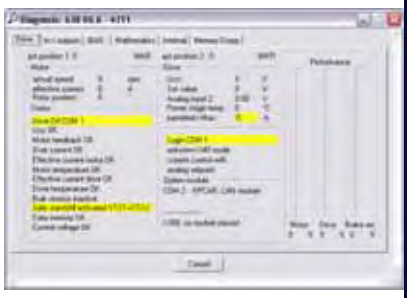
- The installation must be performed taking into consideration all of the specific safety regulations and security related functions, concerning the equipment.
  Double check all safety and security related items, including the limit switch.

- The conformity of the motor feedback system and the X300 feedback module built-in to the drive must be checked by examining the name plates on the equipment.

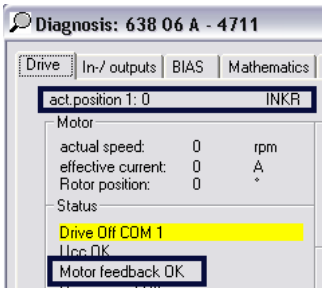
- For the initial equipment start up involving critical applications, we recommend that a test be run without the mechanical connection being made. If problems do arise then they can be solved without risk of damage to any other attached equipment.

- An experienced installer does have the possibility of tailoring the installation to meet the specific application requirements, provided that he/she assumes all of the responsibility for any alterations or deviations from the prescribed installation instructions.

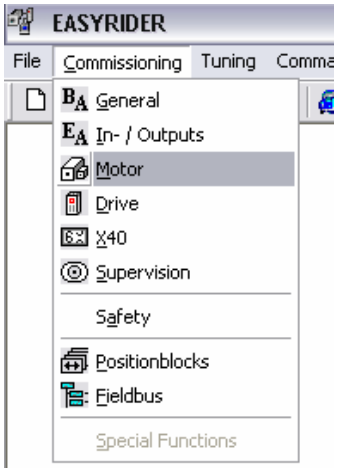
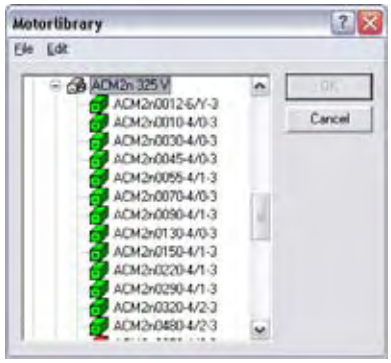
9.1 Step ①: Wiring and Communications Test

1	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
1.1	**Before Starting the Equipment!** Check the wiring; in particular: supply voltage, incoming powerline, motor wiring, motor polarity, feedback system, (Resolver; HIPERFACE® etc.), polarity Sine / Cosine etc.	-	638 Connector Assignment Electrical Installation Wiring Instructions Model Code
1.2	First uncouple the motor shaft, before addressing critical mechanical problems.	Limitation of potential danger	
1.3	Connection of the Diagnostic Interface Link for the Drive - COM1 RS232 Connection to the PC and start EASYRIDER Windows Software. 	EASYRIDER for Windows Software Start side: 	EASYRIDER Software Cable Interface USB RS232 Adapter
1.4	Settings for the Connected COM Ports With the PC in Options Menu→ select „Interface Selection“. 	The selected COM Port is shown on the lower right hand corner of the window of the EASYRIDER for Windows Software 	The available connections to the PC are shown in the Device Manager under System Control 
1.5	Supply Voltage US = 24V DC through X01-Connection to the system. 	7 Segment Display: 	Pin Assignments for the Power Supply Connection X01 7 Segment Display Symbol:
1.6	Check the communications connections and functions by utilizing the Diagnosis window or by employing the F9 button on the keyboard. 	EASYRIDER Diagnosis Window: 	It is always the last window where settings have been made which will be opened!
	On to Step ② ▼	👍 ☺ ☑	▲

9.3 Step ②. :Feedback Test and Motor Selection

2	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
2.1.1	**Prerequisite:** **Step ①** The feedback sensor is connected to the 638 Drive through the X30 connection port 		638 X30 Connector Assignment
2.1.2	Make the X30 connection to the drive only when the power supply is disconnected!	Eliminate the risk of a short circuit!	
2.1.3	Check the counter function by looking at the Actual Position Locator – Display 1 under the Drive Diagnosis window of the EASYRIDER Software and the movement of the motor shaft. ↻↺. - with linear motors the movement of the rotor.		When employing a motor with a brake, make certain that the brake is opened

- **Step 2.2 Motor Selection**

2	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
2.2.1	**Prerequisite:** **Step ①** The motor cable is connected to the 638 Drive through the X61 connection port 	-	638 X61 Connector Assignment
2.2.2	In the EASYRIDER configuration menu for „Motor“, select Motor Library and then scroll down to the appropriate motor utilizing the motor type information as listed on the name plate.  	When employing motors from other manufacturers it is possible to input and store the specific motor characteristics in the Customer Motor Library.
2.2.3	In the EASYRIDER configuration menu for „Motor“, send the selected motor information on to the drive and save the selection.	-	

- **Step 2.3 Motor with Resolver Feedback**

2	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
2.3	With standard motors, equipped with Resolver Feedback, when the unit is properly wired and the proper motor is selected, no additional action is required. For every360° motor shaft turn a position value of 2^{16} = 65536 pulses is sensed.		
	On to Step ③ ▼	👍 ☺ ☑	▲

- **Step 2.4 Motor with HIPERFACE Feedback**

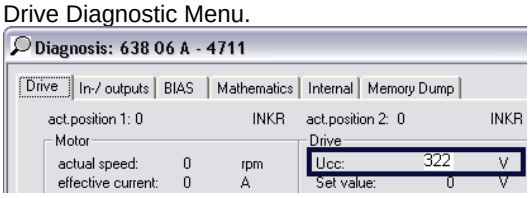
2	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
2.4	The characteristics of the HIPERFACE – Feedback System, as the absolute measuring device (multi-turn provider), allows for 2 additional parameter settings. 1. Selection of the position location, per rotation 16 or 20 bit. 2. Selection of the absolute position value according to the connection between the motor and the mechanical component. **Note:** It is necessary to initially provide the angular commutation parameter value as the absolute value for the HIPERFACE provider, when employing a motor from another manufacturer with HIPERFACE- Feedback		
	On to Step ③ ▼	👍 ☺ ☑	▲

- **Step 2.5 Motor with SIN-COS Feedback Linear Motor**

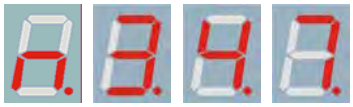
2	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
2.5	Additional settings are required with the employment of this variation, which are described in the following section: **Step 4.2. Optimization Linear Motors** .		
	On to Step ③ ▼	👍 ☺ ☑	▲

9.4 Step ③: Power Up and Drive Activation

- **Step 3.1 Power Up**

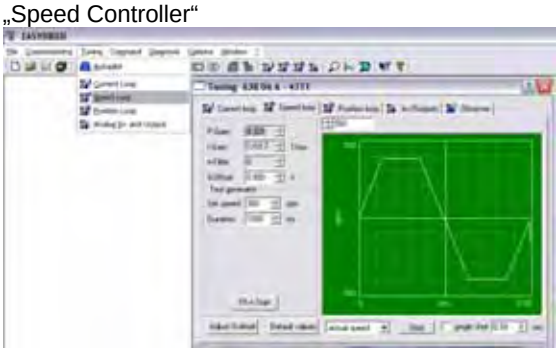
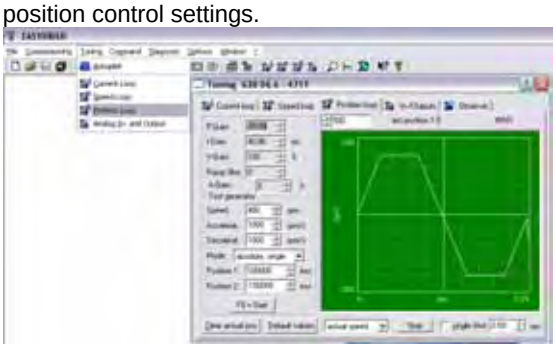
3	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
3.1.1	**Prerequisite:** **Step ①+②** The power supply is connected to the X60 connection of the 638 Drive. 	-	X60 Connector Assignment
3.1.2	Establish the X60 connection, when lacking, only when the drive system is not connected to the power supply!	In order to eliminate the risk of a short circuit!	
3.1.3	Terminals 1 and 4 on the X11 STO connection should be set at 0 V. 	The drive remains in a non-activated condition even after the power is connected.	X11 Connector Assignment **STO** = **S**afe **T**orque **O**ff
3.1.4	Turn on the power and check the voltage in the Drive Diagnostic Menu. 	The drive will show a DC link voltage Ucc of approx. 325 V DC with an incoming supply of 230 V AC, in a non-activated condition.	7 Segment Display: 

- **Step 3.2 Drive Activation**

3	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
3.2.1	It is necessary to make additional settings as described in Step 4.2 Optimization Linear Motor, when employing a motor with a Sin/Cos Feedback system.	In the event that the Feedback System = Sin/Cos On to Step 4.2	
3.2.2	Terminals 1 and 4 on the X11 STO connection should be set at 24 V.  	Driver – power stage is activated and the 7 segment display shows:  The drive is now set in the operations mode (Delivery condition; Speed control set to the analog setpoint)	X11 Connector Assignment The motor shaft can be set to turn slower through the 0-V offset setting of the analog setpoint input.
	In the event that no fault condition arises **On to Step ④** ▼	👍 ☺ ☑	
	Further function test from the STO – terminal, as per statement in chapter **Safe Torque Off**.		
Other-wise 3.2.3	With unanticipated operation or overheating of the motor, turn off the drive and attempt to locate the cause of the problem. Identify and rectify the fault condition.		Diagnosis and Troubleshooting
	and perform **Step ③** again ▲	☹	▲

9.5 Step ④: Control Loop Optimization

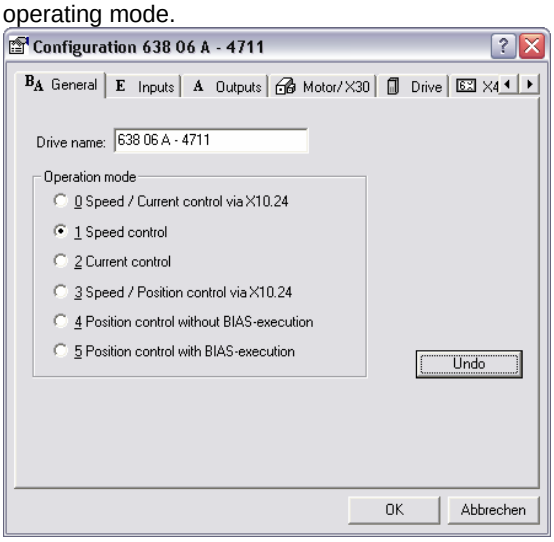
- **Step 4.1 Control Loop Optimization with Rotary Motors**

4	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
4.1.1	**Prerequisite:** **Step ①+②+③**	👍 ☺ ☑	
4.1.2	In the EASYRIDER Commissioning Menu select „Speed Controller“  and with F8=Start the Test Generator.	Check the speed and power variation characteristics utilizing an oscilloscope and through the adjustment of the P and I sections set the parameters for the control rigidity.	
4.1.3	Attach the mechanical component with the motor shaft.		
4.1.4	Perform step **4.1.2** again	Pay attention with linear motion! The speed generator is controlled by time and recognizes no parameters unless the limit switch is configured!	
4.1.5	Within the EASYRIDER Commissioning Menu select „Position Control“, when employing the position control settings.  Set the position and speed, with F8=Start the Test Generator.	Check the speed, power variation and control deviation characteristics utilizing an oscilloscope and through the adjustment of the P, I and V sections set the parameters for the power control rigidity.	
	On to Step ⑤ ▼	👍 ☺ ☑	▲

- **Step 4.2 Control Loop Optimization with Linear Motors**

Step	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
4.2.1	Prerequisite: Step ①+②+③	👍 ☺ ☑	
	Under Construction!!!		
	On to Step ⑤ ▼	👍 ☺ ☑	▲

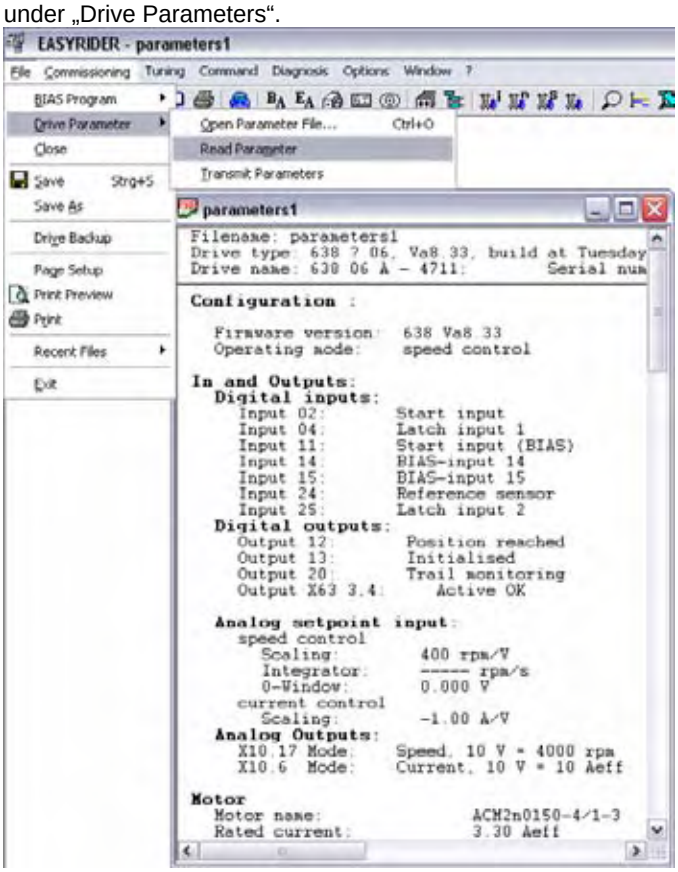
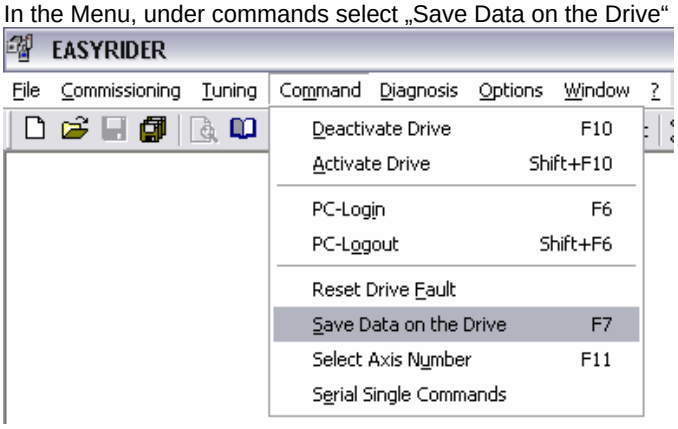
9.6 Step ⑤: Operation Mode Selection

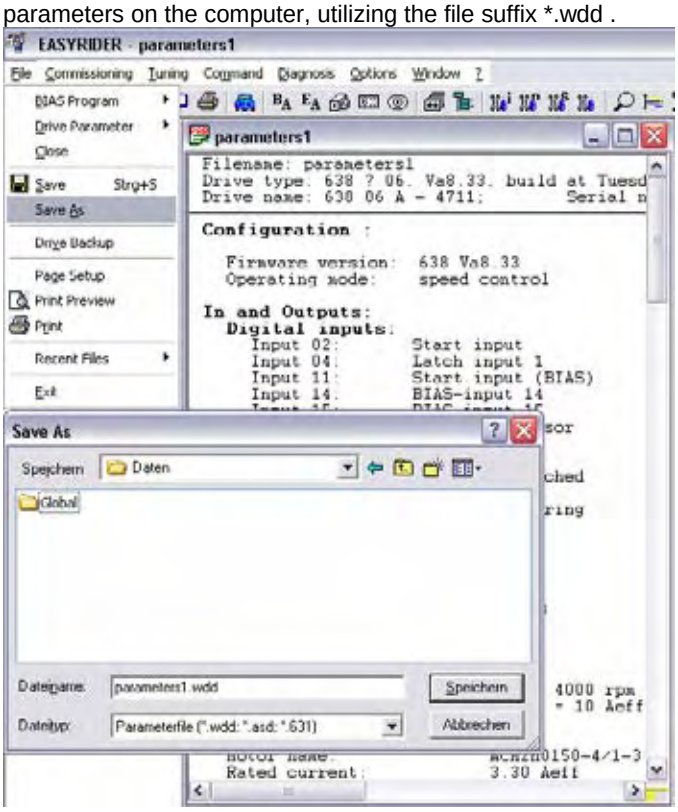
5	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
5.1	**Prerequisite:** **Step ①+②+③+④**	👍 ☺ ☑	
5.2	In the EASYRIDER configuration menu, select „General“ and then select the appropriate operating mode. 	With the selection of the operating mode, one must also select additional settings. For example: * On/Off Configuration * Analog Setpoint Selection and Integrator * Position Blocks * BIAS Program * Fieldbus Interface	Additional information and assistance is available through the utilization of the online help for EASYRIDER Software.
	On to Step ⑥ ▼	👍 ☺ ☑	▲

9.7 Step ⑥: Fieldbus Interface

6 	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
6.1	**Prerequisite:** **Step ①+②+③**	👍 ☺ ☑	
6.2 	The overall system commissioning and the communications test of the fieldbus interface are dependent upon the interface configuration of the drive. If there is not an options board connected then there are no more additional settings required, and one can move on to Step 7.		
6.3. 	In the configurations menu, under „Fieldbus“ additional settings may be required, depending upon the connection interface for the fieldbus board.	Additional information concerning start up procedure for the fieldbus interface connection can be found in the handbook about the Options Board.	
	On to Step ⑦ ▼	👍 ☺ ☑	

9.8 Step ⑦: Data Save

7	Action, Function	Anticipated Result	Remark, Cause of Fault Condition
7.1	**Prerequisite:** **Step ①+②+③+④+⑤+⑥**	👍 ☺ ☑	
7.2	Read the parameters shown in the EASYRIDER Data Menu under „Drive Parameters“. 		
7.2	In the Menu, under commands select „Save Data on the Drive“ 		

7.3	In the Menu under Data, select „Save As“ , to save the drive parameters on the computer, utilizing the file suffix *.wdd .  		
	First system start up procedure **<u>Steps</u> ①+②+③+④+⑤+⑥+⑦** **successfully accomplished.**	👍 ☺ ☑	

10.1 General Introduction

The following documentation is meant to provide the basic information concerning our drive controller and an understanding about the advanced, safety oriented machine construction. References to standards or other regulations are made in a general overview manner. The specific standards or regulations for your installation will vary depending upon the equipment employed and the specifics of your application.

For more information we suggest referring to specific technical literature, for example: BIA-Report 6/97 and BIA-Report 5/2003 (Information of the German Professional Trade Association).

These reports can be downloaded from: http://www.hvbg.de/d/bia/pub/rep/index.html

- **Important Technical Terms and Explanations**

Term	Explanation
Safety Category 3 according to EN 954-1	**Definition according to the Norm:** Circuit with built-in protective functions for individual fault conditions. Some, but not all faults will be recognized. The frequent occurrence of fault conditions can lead to a loss of the safety functions. The remainder of the risk must be understood and accepted. The determination for the application of the appropriate safety category requirements, (risk analysis), lies with the installer and operator of the equipment. You can reference the method described in EN954-1:1996, Appendix B, as an example.
‚Safe Stop' or alternatively: **‚Safe Torque Off'** or abbreviated as: **STO**	With the activation of "Safe Torque Off", the energy supply to the drive is definitively interrupted, according to the requirements of EN1037, section 4.1. The drive unit is not allowed to rotate and will therefore not be able to generate any dangerous rotational movements, (See EN 1037, section 5.3.1.3). The stopping position must not be monitored. Should there be the potential of an outside energy source affecting the drive and STO function, for example the dropping of a hanging load, then additional action needs to be taken to guarantee that no additional movement takes place, (i.e. installation of a mechanical brake). The following measures are appropriate for incorporation with "Safe Torque Off": - Protection between power connection and the drive system (Line Fault Protection) - Protection between the power unit and the motor (Motor Protection) - Protected lock of the control of the solid state power component (Start-up Lockout)
Start-Up Lockout	Protected lock of the control of the solid state power component. With help of this function one can establish the activation of the "Safe Torque Off".

- **Stop Category according to EN 60204-1 (Chapter. 9.2.2)**

Stop Category	Requirement	System Reaction	Note
0	Shutdown by immediate shut-off of power supply to the machines' driving components	Uncontrolled Shutdown	Uncontrolled shutdown is the stopping of the machines' movement by eliminating the power supply to the power components of the machine. Available brakes and/or other mechanical braking systems should be employed.
1	Shutdown, by a means which maintains the power supply connection to the machine drive component, to bring movement to a standstill. The power connection will be broken only after standstill has been achieved.	Controlled Shutdown	Controlled shutdown is the stopping of the machines' movement by for example, the setback of the electronic command signals to zero as soon as the stop signal is recognized by the controller, while the power supply to the machine drive components remains intact until a standstill condition is achieved.
2	Shutdown, by a means which maintains the power supply connection to the machine drive component.	Controlled Shutdown	This category will not be covered in the functions description of the manual.

- **Applications in Accordance with the Regulations**

The 638A Drive supports the safety function “Safe Torque Off”, in the sense of providing a definitive stopping of the equipment, with protection against unanticipated start-up, in accordance with regulations EN954-1, Category 3 and EN 1037.

The shut-off of the motor torque must be controlled through the machine controller. However, it does not provide for any verification of cessation of movement which may have been produced from some external source. One must pay specific attention to the vertical axes, without a mechanical self-inhibitor or balanced weight.

According to Machine Regulations 89/392/EWG, i.e. EN 292; EN 954 und EN 1050, when considering the safety and risk analysis, the machine constructor is responsible to make certain that the overall safety system for the whole machine takes all of the integrated components into consideration. Note that the electrical drives must also be included in this consideration.

One must pay attention to and follow the instructions completely as stated in the validation report, with regard to the initial start-up, service intervals, troubleshooting and repair of the equipment. The STO conformance protocol outlines a suggestion for the documentation of the relevant safety parameters in the validation report.

- **Trained Personnel**

Planning, installation and initial system commissioning require a detailed understanding of this information.
Protective safety standards and risk mitigation issues which are connected to the specifics of the installation must be recognized and taken into consideration, as well as appropriate actions to be taken in the event of an emergency.

- **Benefits with the Employment of the Safe Torque Off Function**

Safety Category 3 according to EN 954-1:

Performance Feature Requirement	Application of the Safe Torque Off Function	Conventional Solution : Utilization of External Switching Components
Reduced Switching Effort	Simple circuitry, certified application examples The grouping of multiple drives together on a main contactor is possible.	Two safety-oriented performance protections in series connections required.
Application in Production Processes **High Switching Frequency, High Reliability, Less Wear**	Extremely high switching frequency through the use of almost wear-free technology (Low voltage relays and an electronic switch). The condition “Safe Torque Off” is achieved through the use of a wear-free electronic switches (IGBT’S).	This performance feature is not achievable through the employment of conventional technology.
Application in Production Processes **Faster Reaction Time, Faster Re-Start**	The drive remains power and control related in a connected condition. No significant wait time with re-start.	With the utilization of power contactors on the incoming power line, a long wait time is required for the energy discharge from the DC link. With the use of two motor side power contactors, it is possible to increase the reaction time, however one must recognize the potential disadvantages:: a) Make certain that switching occurs only in a power free condition, (DC Power! Prevent arcing). b) Increased cost for EMC conforming cabling.
Emergency Stop Function	According to the German Edition of the Standards: Permissible without mechanical power switch element activation 1)	Shutdown employing a mechanical switching element is required.

1) According to the forward of the German edition of the standards EN 60204-1/11.98, electronic equipment for use with the emergency stop mechanism is acceptable, as long as the requirements in the safety categories, like those required in EN954-1, are completely observed.

- **Safety Instructions and Limitations**

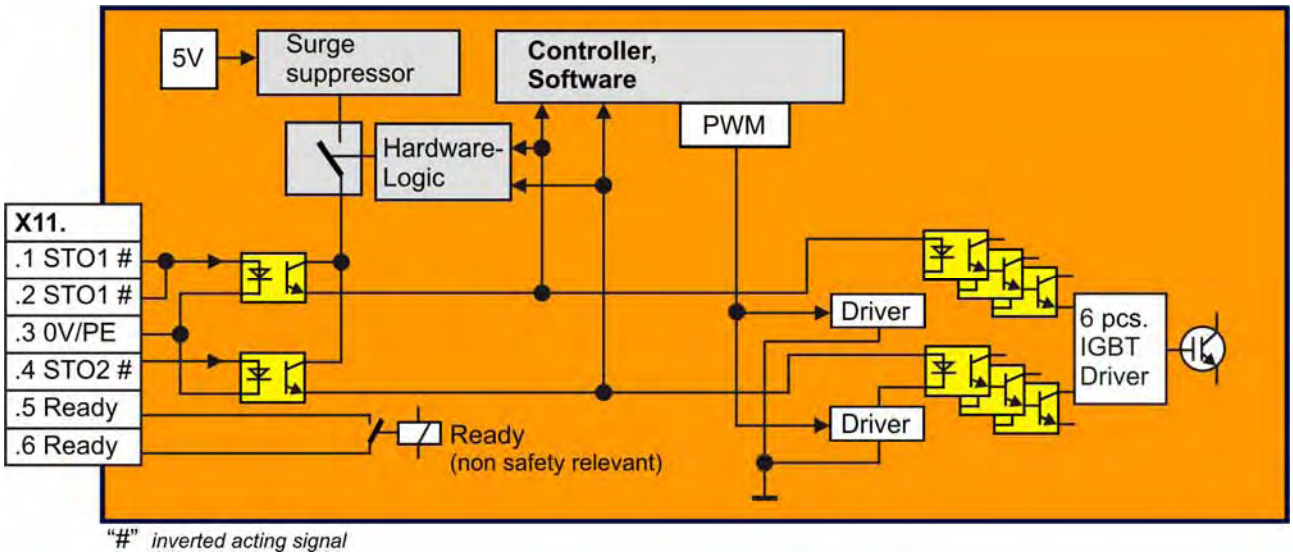
	**No Galvanic Separation of the Outputs** The galavanic separation does not occur through the starting lockout function. This therefore does not in any way provide protection against an “electrical spike”. For operation interruptions, maintenance, service and cleaning of the equipment, the entire system must be definitively and galvanically separated from the power supply at the main switch box and confirmation should be made that the system can not restart (See EN 60204-1;5.3). The described set-up is not applicable with residual risks associated with applications which go beyond conditions and requirements described in EN 954-1 Category 3.
	**Potential Sudden Jerking or Movement under Fault Condition** In the event that two fault conditions appear at the same time in the power unit, it is possible that unit may exhibit a sudden jerking or movement within a small angle of rotation. This is dependent upon the number of pole pairs of the motor. (Rotary Type:2-pole = 180°, 4-pole = 90°, 6-pole = 60°, 8-pole = 45°; Linear Motors: 180° electric).
	**Malfunction during the Active Braking Phase with Stop Category 1; EN 60204-1** (controlled stop with reliable monitored time delay) If a fault in the drive system occurs during the active braking phase, the axel can coast to a stop, uncontrolled or in the worst case continue to operate until the expiration of the predetermined shut-off time.
	**Hanging Loads or Influencing External Forces** In the event of a power failure the hanging loads can possibly fall in an uncontrolled manner endangering people or equipment. The operation of hanging axes therefore requires special attention relating to risk analysis and mitigation with hanging loads.
	**Not for Use in Drive Applications in Field Weakening Operation Ranges!** With motors which are employed in field weakening operation ranges, it is important to note that the operation of the STO function can be adversely affected, specifically involving an uncontrolled increase in rotational speed, life threatening over voltage and explosion of the drive unit!
	**Minimal request of safety function** The safety function STO must activate for at least weekly.
	**Acknowledgement** The configurable acknowledgement is only permissible with category B.

10.2 Safe Torque Off Function, (STO)

General
The electricity flow to the motor windings is controlled through a solid state power component bridge (6-times IGBT). A microprocessor switch with PWM logic switches the IGTB's rotating field orientation. Optical couplings are employed between the control logic and the power unit to provide for electrical isolation.

The X11 Connector Plug (STO) is located on the front of the drive unit. This connector plug is controlled utilizing two optical couplings which communicate over **two channels** through terminals **STO1#** and **STO2#,** and which in a controlled condition supplies the PWM optical coupler with control
of the solid state power component.
A test takes place to determine the condition of the input channels. Within the given window of time the condition of both channels must be identical. In the event that a fault condition exists, (different signals from STO1# and STO2#), then the coupling power supply is shut-off and a signal is sent to the 7 segment display.
The re-activation of the power supply to the coupling is then only possible by performing a hardware reset, by turning the equipment off and then back on again.
In addition to the description of the hardware based shut-off through the two channel communication, the internal unit processor provides for a software based shutdown of the PWM circuit.
The PWM circuit can be set for time delayed activation, after the recognition of the activation of both STO inputs, through the programming of the safety parameters for the **active time delay.**

- **Block Circuit Diagram**



"#" *inverted acting signal*

- **Status Diagram and Function of Terminals STO1# und STO2#**

- With hardware monitoring of the contact difference between STO1# und STO2# (Tolerance - ca. 20 Sec.)
- Active Time Delay t_{va} > 0
- No additional special functions

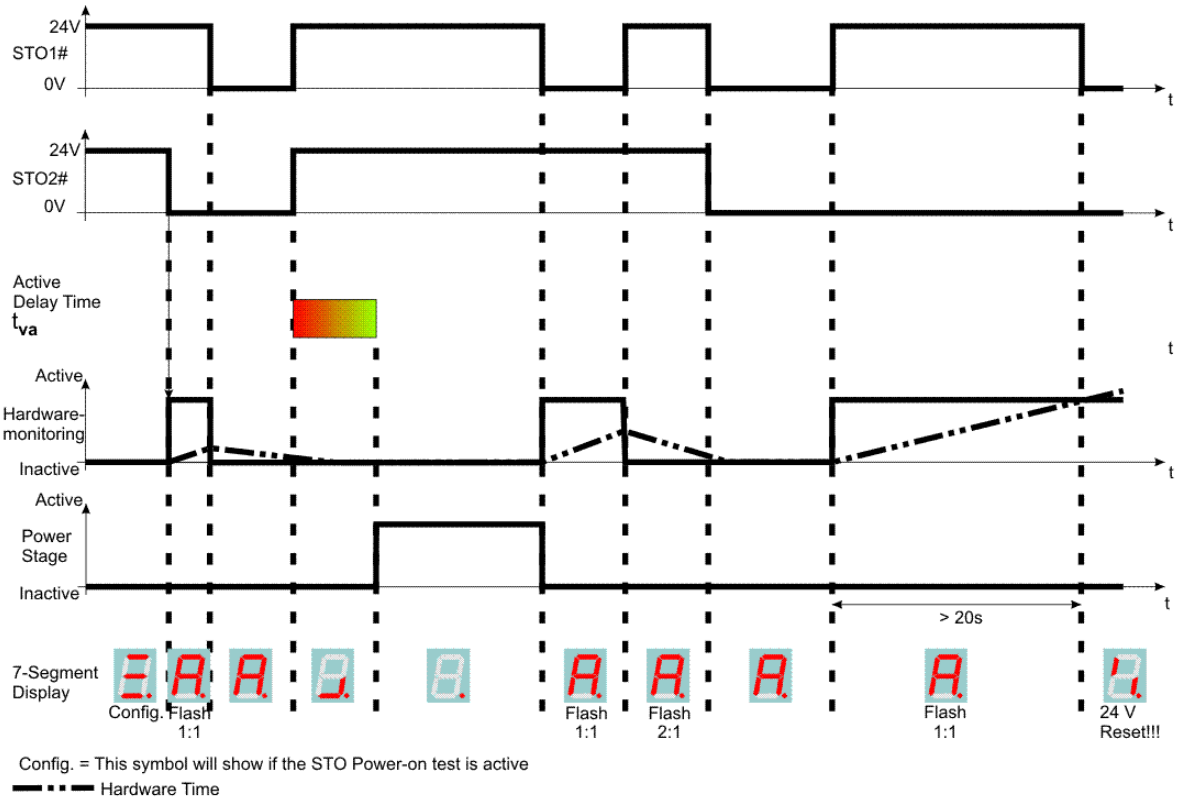


Diagram: Flow chart of the switching status from STO1# and STO2#

Note for Standard Operation:

- The STO inputs should always be operated simultaneously.
- If the safety parameter **Active Time Delay** is $\mathbf{t_{va}}$ = 0 s, then both STO inputs will be turned on immediately after recognition.

10.3 Configuration and Parameter Settings

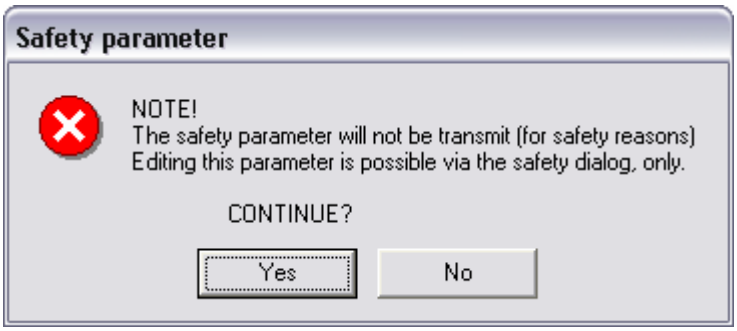
- **General Instructions for Parameter Settings**

The safe torque off, '**STO',** basic function is a built-in, hardware oriented safety function which is **not configurable**.

Depending upon the specific application however, it is possible to alter specific settings on the drive side which can increase the operational safety factor.
The configuration and programming of the safety parameters can be accomplished utilizing the Diagnosis and Parameter Setting screen in EASYRIDER for Windows.

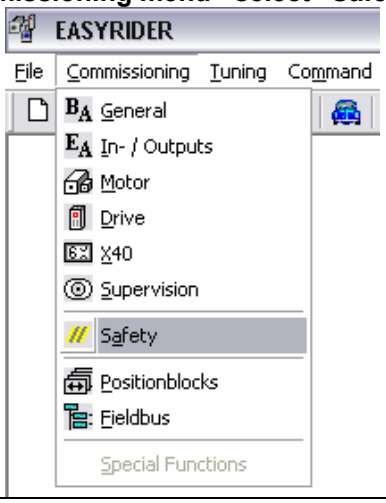
This configuration process has been designed to assist the user in making the proper parameter settings, in an attempt to eliminate the potential for systematic programming errors and/or improper parameter settings.

Required Actions for the Configuration of Relevant Safety Parameters	
	• Special password protected access is required to reach the relevant safety parameter setting screens. • The transmission of the data through the PC interface follows a specially designed protected procedure, including: CRC check, drive specific password and a double confirmation and acknowledgement process for the parameter values entered. • After the confirmation and acknowledgement of the entered data, the parameter values are saved in the drive and protected even in the event of a power loss. • The parameter values are stored twice within the drive, and provide for automatic periodic verification of the memory cell accordance. • Any other means of accessing the safety and security related data, as described here, is not permitted. • The creation of a parameter protocol, which can be stored as a document with appropriate name and date information.

	The relevant safety, secondary function parameters – Acknowledgement and Active Time Delay, can only be set within the Configuration Safety dialog box. The data **can not** be saved under Parameter Data utilizing the suffix *.WDD. 

- **EASYRIDER Safety Parameter Data Entry Dialog Boxes**

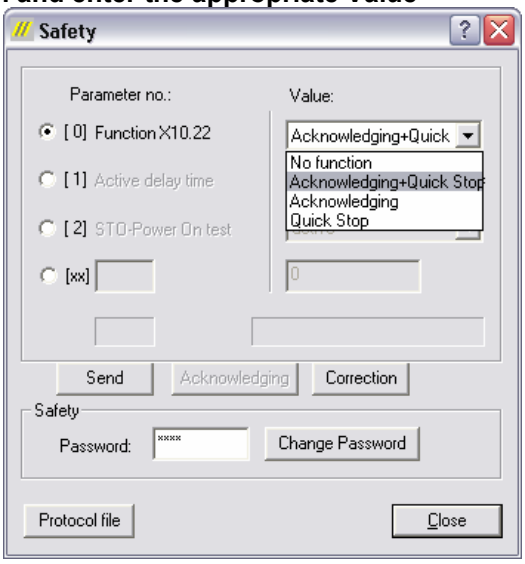
1. Commissioning menu - select "Safety" :



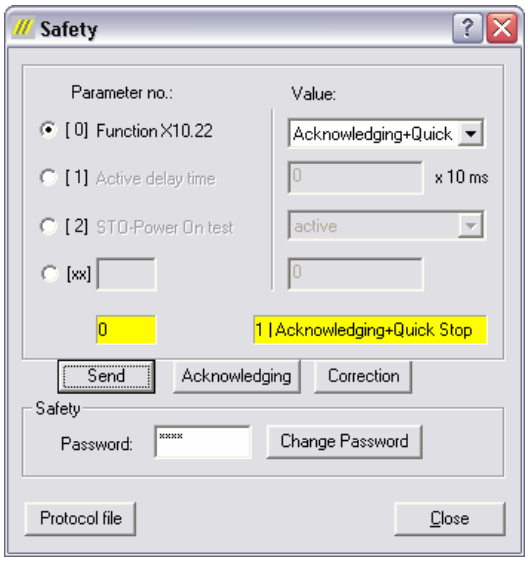
2. Access password - enter "BGSM"

and verify with "OK"

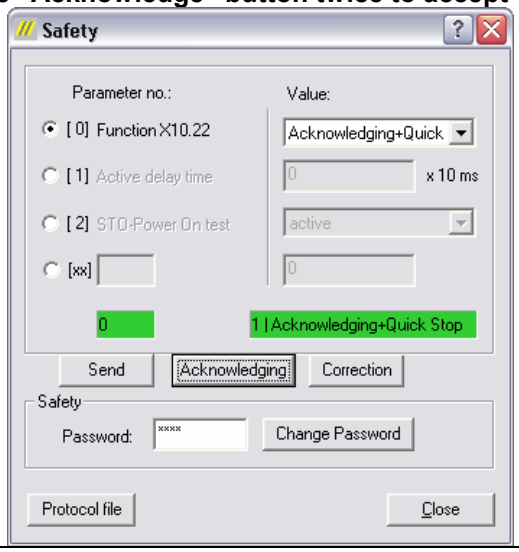
3. Enter Safety Password, select Parameter Nr. and enter the appropriate Value



4. Send the Parameter - press "Send"one time



4. When the yellow display is correct - press the "Acknowledge" button twice to accept



5. When the parameter display is green, it confirms that the value is correct, has been stored and power loss protected in the drive unit!

Once all of the relevant safety data parameters have been entered, then it is possible to call up the protocol form of the actual safety parameter settings by pressing the "Protocol file" button.
(ACROBAT Reader is required!)

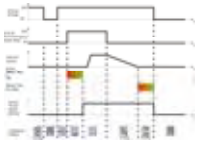
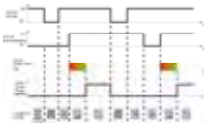
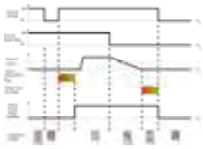
Note:

A copy of the Safety-Parameter-Protocol Form is available in the appendix of the Servo Drive Handbook and can be used for verification purposes.

- **Safety Parameter List**

The following safety functions are presently able to be configured:

- **Parameter 0: Function Input X10.22**
- **Parameter 1: Active-Time Delay**
- **Parameter 2: STO-Power-On-Test**

Parameter 0	Value Range	Explanation	Note	Flow Chart
Function X10.22	**Without Function**	No safety relevance. Function X10.22 is freely programmable (BIAS) Initial Factory Settings (default values)		
	Acknowledgement + Emergency Stop	STO-function activation through additional low→high edge of the X10.22 input acknowledgement and Emergency Stop before the STO shutdown through additional high→low edge of the X10.22 input.	See below	
	Acknowledgement	STO-function activation through additional low→high edge of the X10.22 input acknowledgement.	After the recognition of the edge – the active time delay will be started!	
	Emergency Stop	Before the STO shutdown through additional high→low edge of the X10.22 input.	After the recognition of the edge, when the rotational speed =0 then the emergency stop ramp will be executed and when the rotational speed =0, the time delay for the brake will be started!	

Parameter 1	Value Range	Explanation
Active-Time Delay (in 10 ms increments)	0 Initial Factory Settings (Default Value) 0- 500 (*10 ms)	Time delay for the activation of the final stage after acknowledgement (24 V) of both STO inputs, for example of the acknowledgement inputs (in the event that they have been configured). Note: If the STO inputs, for example, the acknowledgement inputs are removed (0V) before the expiration of the active time delay, then the time will be reset and only reactivated with a new edge (24 V).

Parameter 2	Value Range	Explanation
STO-Power-On-Test	activate (0),(default) deactivate (1)	The STO-Power-on-Test does not allow by deactivated STO (STO1# and STO2# High) to activate the drive. The 7-Segment-Display shows E. The drive will able to activate after the safety function STO was activated A and is deactivate. The safety function could activated by a safety gate or an emergency stop It is possible to use a PLC to automate this test.

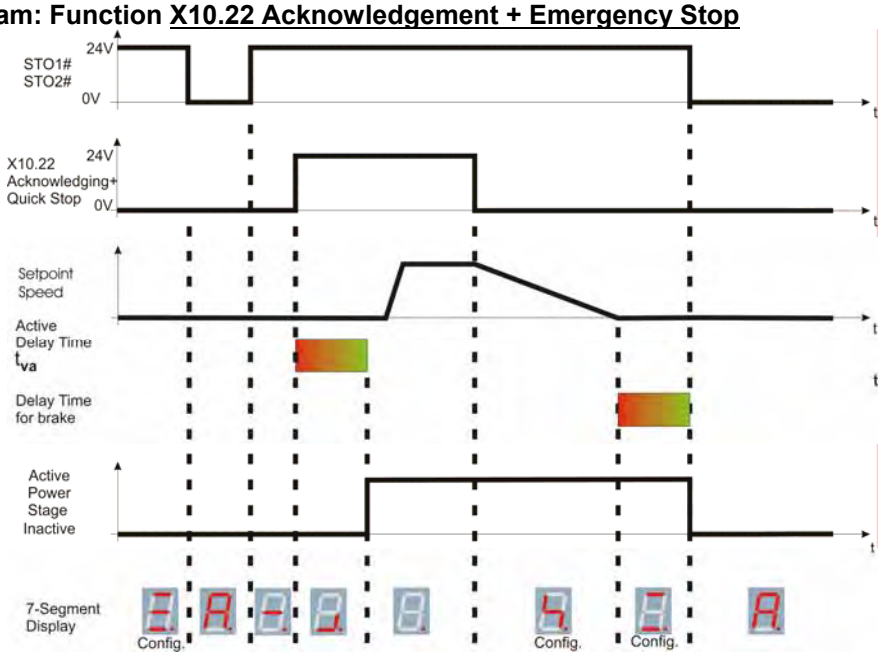
- **Safety Password**

The safety password must be entered in the appropriate field, every time that the Safety Parameter Configuration screen is selected.
The password is always comprised of 4 letters.
The difference between large and small case letters is recognized.

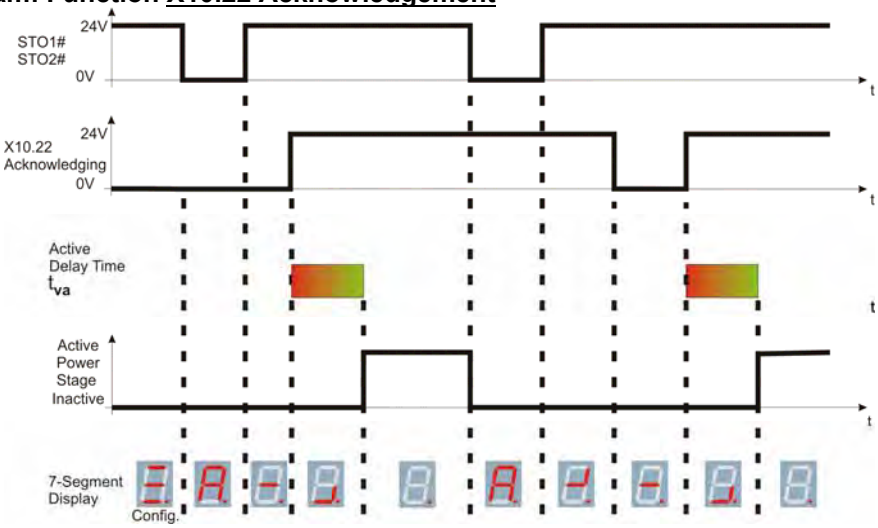
The drive side initial factory setting of the password is "**SAFE**".

The responsibility to set the new safety password lies with the operator of the equipment.
The new safety password should only be shared with authorized personnel,
for example: anyone who works on the STO, and/or has responsibilities in the areas of equipment operating guidelines or equipment safety and security.

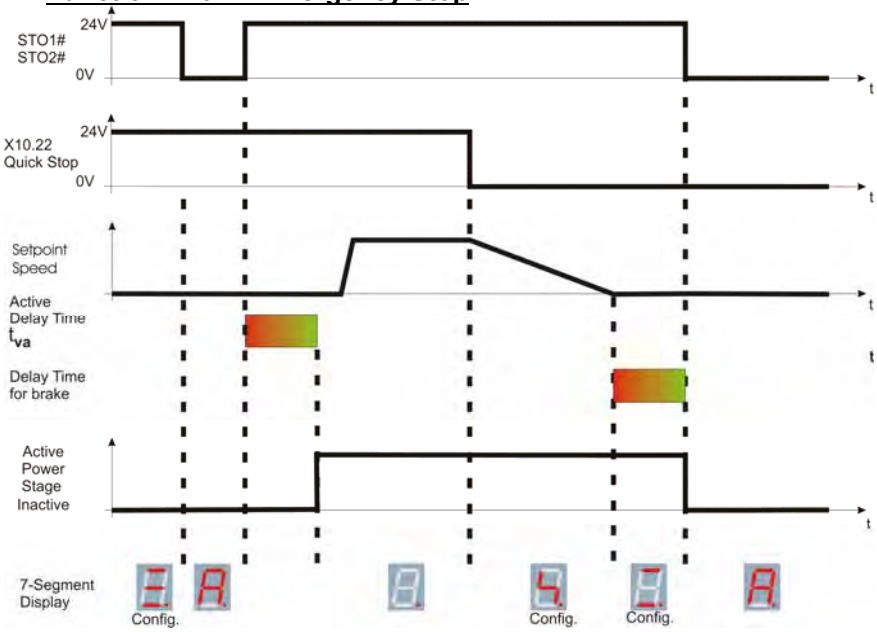
Flow Chart Diagram: Function X10.22 Acknowledgement + Emergency Stop



Flow Chart Diagram: Function X10.22 Acknowledgement



Flow Chart Diagram: Function X10.22 Emergency Stop

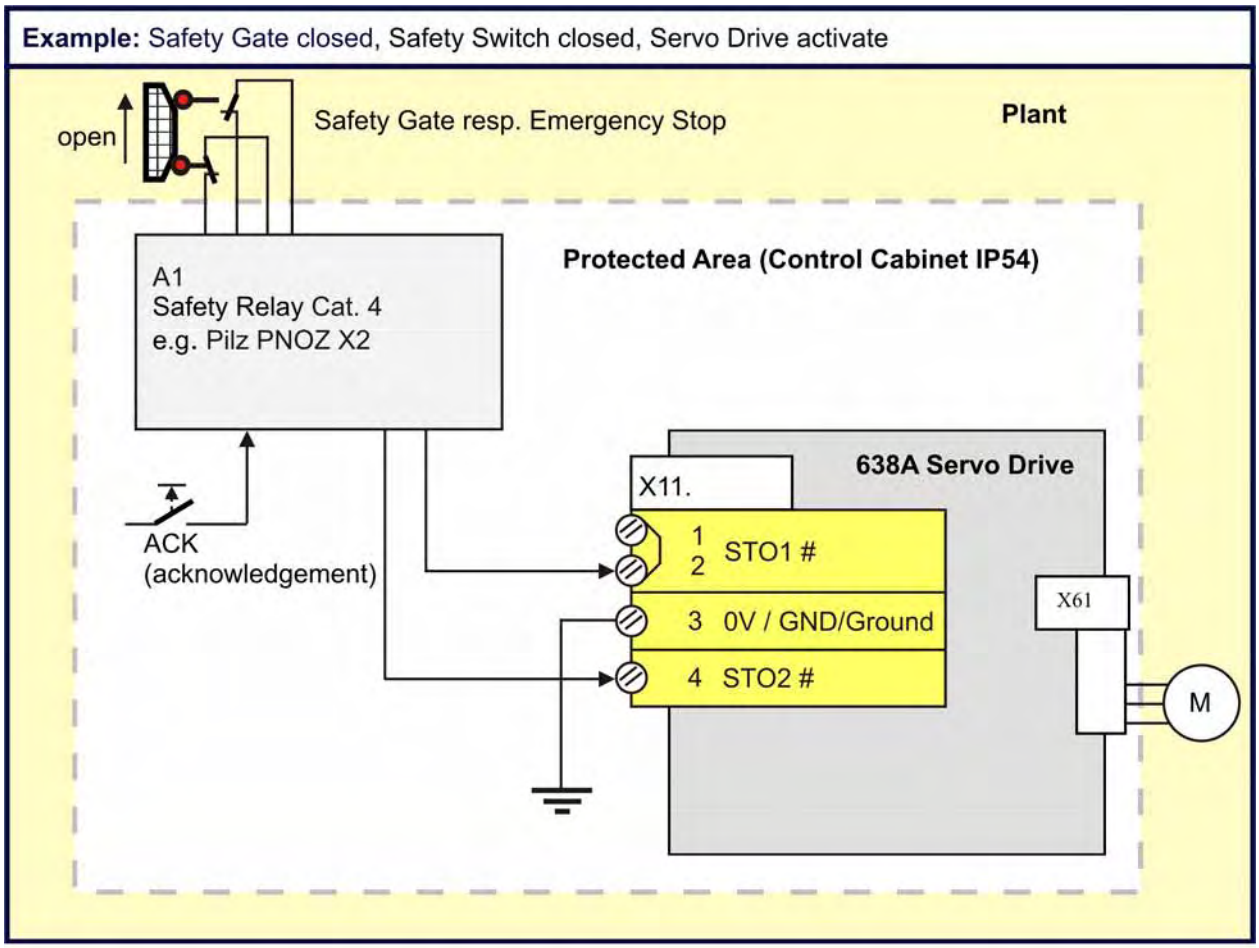


10.4 Application Example of STO (Safe Torque Off)

Example	Function
Application Example 1	Safety door monitoring or emergency shut-down with protection monitoring switch
Application Example 2	Safety door monitoring or emergency shut-down with protection monitoring switch and time delay
Application Example 3	Safety door monitoring or emergency shut-down WITHOUT protection monitoring switch
Application Example 4	Safety door monitoring or emergency shut-down with protection monitoring switch and time delay of several drives

- **Application Example 1**

Function/Action	Response	Protection Level EN 954-1	ISO 13849-1	Stop Cat. According to EN60204
Safety door monitoring or emergency shut-down with protection monitoring switch	The ‚STO' is tripped when the safety door is opened or emergency shut-down switch is activated.	Cat. 4	PL e	0

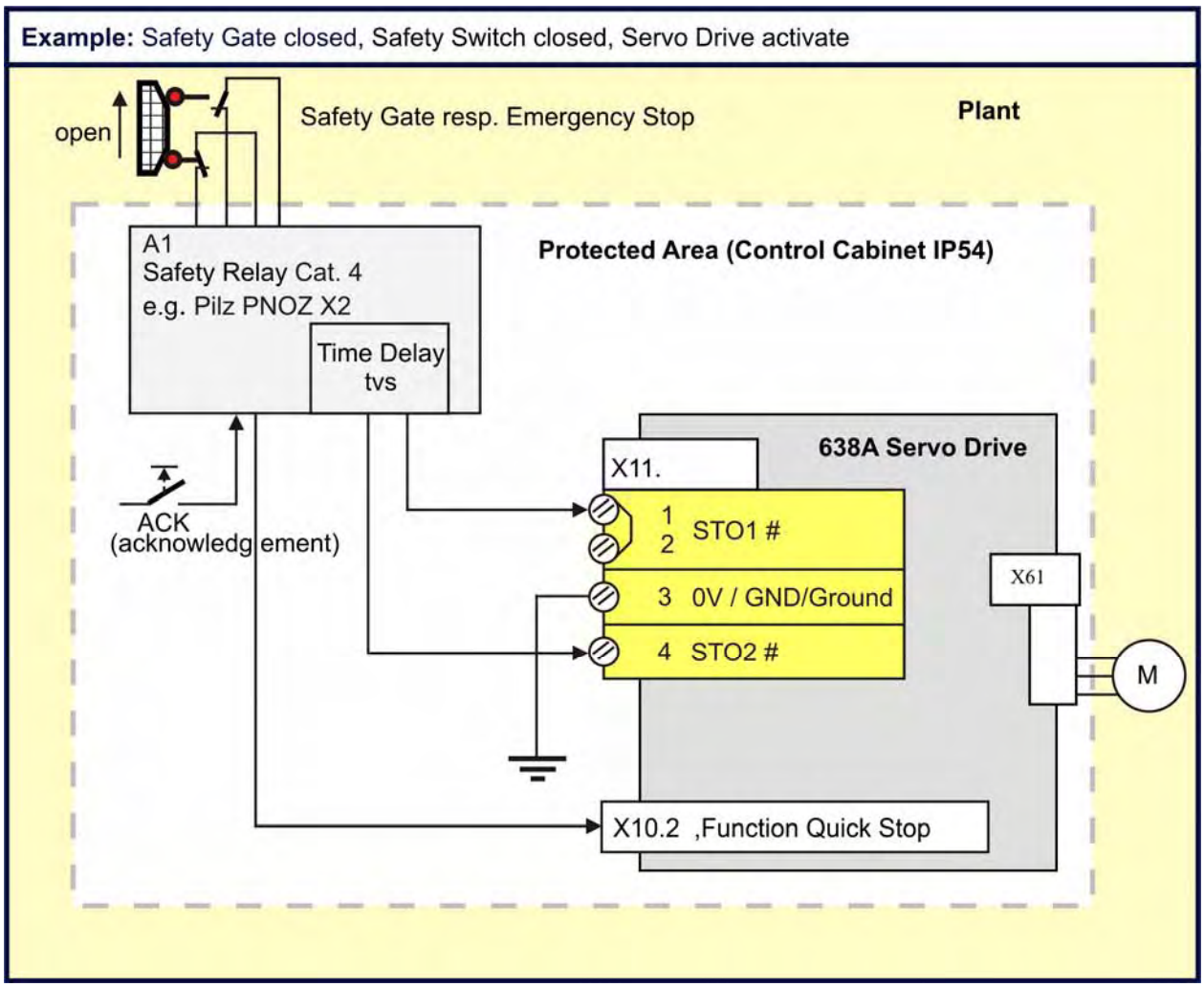


Important
The category 4 and PL e protection level can only be achieved with an active STO-Power-On-Test.

Note
The acknowledgement is only necessary, when after the cancellation of the STO function by the automatic start-up, a potential danger for the people in the area or the equipment exists.

● Application Example 2

Function/Action	Response/Reaction	Protection Level EN 954-1	ISO 13849-1	Stop Cat. According to EN60204
Safety door monitoring or emergency shut-down with protection monitoring switch and time delay	Active braking occurs when the safety door is opened, the emergency shut-down switch is activated or tripping of the ‚STO' occurs due to time delay.	Cat. 4	PL e	1



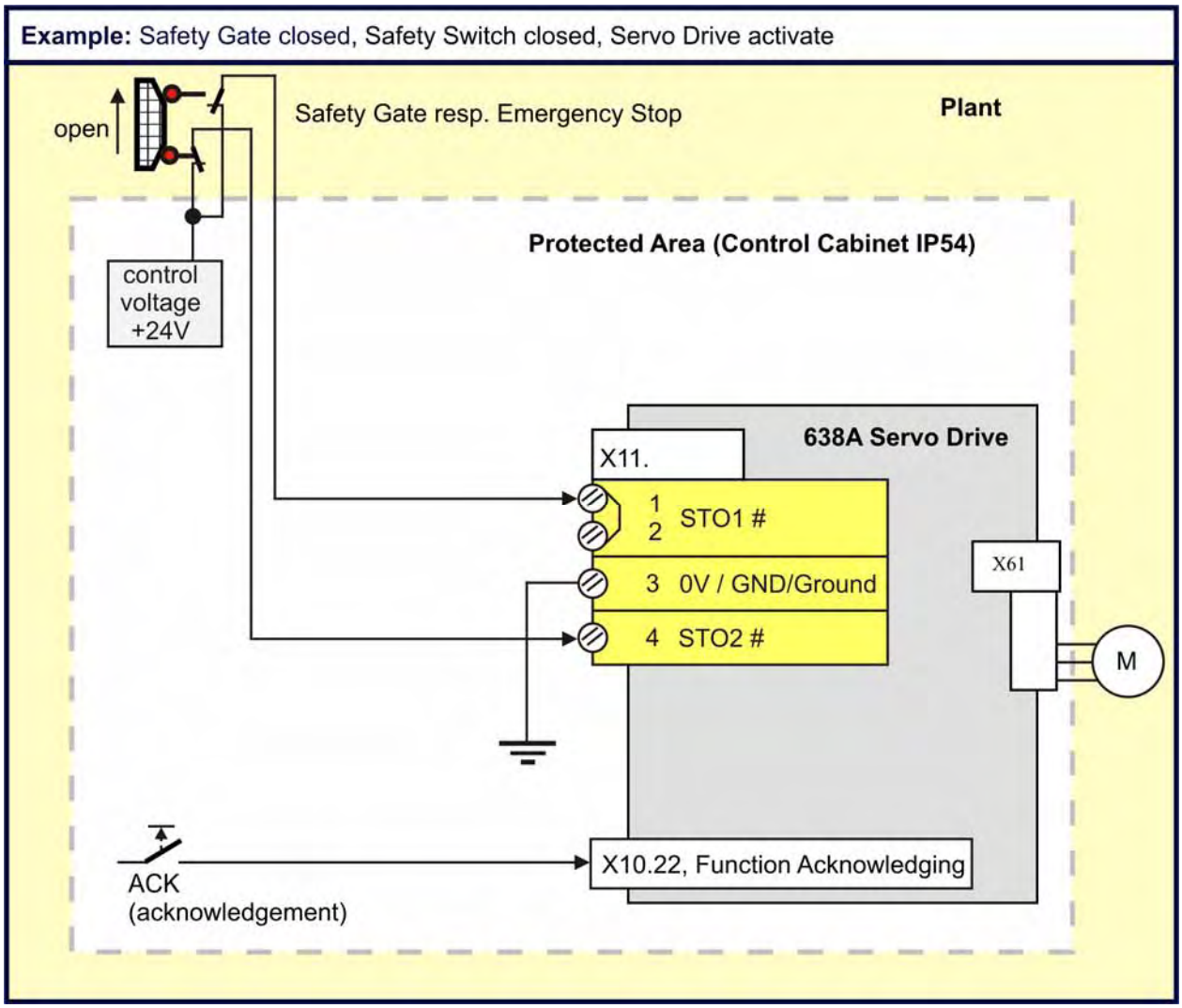
Important
The category 4 and PL e protection level can only be achieved with an active STO-Power-On-Test.

Explanation
The protection switch unit A1 must be set up with a fail-safe time delay as determined and required by the specific category relating to the application environment.
The 638A Servo Drive must be properly configured for the operating environment
(See: Chapter ■ Configuration and Parameter Settings).

Note
The acknowledgement is only necessary, when after the cancellation of the STO function by the automatic start-up, a potential danger for the people in the area or the equipment exists.

Application Example 3

Function/Action	Response/Reaction	Protection Level EN 954-1	ISO 13849-1	Stop Cat. According to EN60204
Safety door monitoring or emergency shut-down WITHOUT protection monitoring switch	The ‚STO' is tripped when the safety door is opened or emergency shut-down switch is activated.	Cat. 3	PL d	0



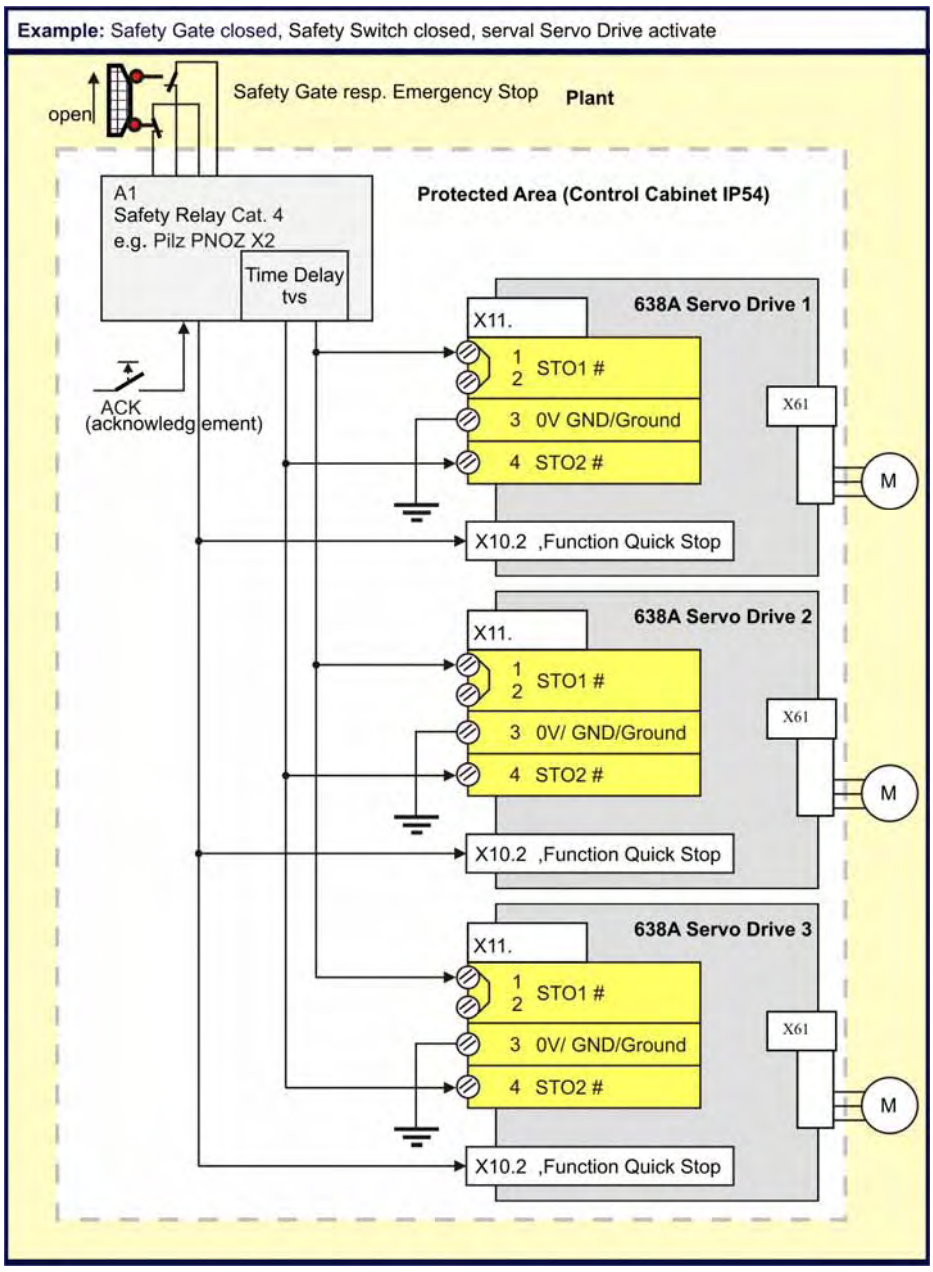
Explanation
The signals for STO1# and STO2# are delivered utilizing two separate channels. The wiring layout plan must allow for the physical separation of the wiring channels or incorporate adequate insulation protection and separation.

Note
The acknowledgement is only permissible with category B.
The acknowledgement is **not** permissible for use if the dangerous area is accessible. In this case, employment of an external acknowledgement unit is necessary.

The acknowledgement is only necessary, when after the cancellation of the STO function by the automatic start-up, a potential danger for the people in the area or the equipment exists.

● Application Example 4

Function/Action	Response/Reaction	Protection Level EN 954-1	ISO 13849-1	Stop Cat. According to EN60204
Safety door monitoring or emergency shut-down with protection monitoring switch and time delay of several drives	Active braking occurs when the safety door is opened, the emergency shut-down switch is activated or tripping of the ‚STO' occurs due to time delay.	Cat. 4	PL e	1



Important
The category 4 and PL e protection level can only be achieved with an active STO-Power-On-Test.

Explanation
The protection switch unit A1 must be set up with a fail-safe time delay as determined and required by the specific category relating to the application environment.
The 638A Servo Drive must be properly configured for the operating environment
(See: Chapter ■ Configuration and Parameter Settings).
Only 16 drives could plug together in a group.

Note
The acknowledgement is only necessary, when after the cancellation of the STO function by the automatic start-up, a potential danger for the people in the area or the equipment exists.

10.4 STO Function Test

The STO function must be tested when:

- The system is set-up for the first time. See: Commissioning
- Any component of the system is replaced.
- Any activity involving the wiring takes place.
- After all modifications to the drive system. (For example: parameter modifications, software updates, etc.)
- Established maintenance schedules dictate or after the machine has been inactive for a long period of time.

The STO functions test must be carried out by qualified personnel, with consideration for the required safety provisions.
Depending upon the system configuration and application, additional or other tests may be required.

Test Steps:

STO Test Step 1
STO Test Step 2
STO Test Step 3
STO Test Step 4
STO Test Step 5

STO-TEST Step	1	Action / Function	Anticipated Result	Remark, Cause of Fault Condition
STO-TEST 1.1	**Prerequisite:** **1.1.1 Safety Parameter:** **STO "Power On" Test is Active** **1.1.2 Supply Voltage US = 0 V (off)**			
STO-TEST 1.2	24V DC Voltage to Terminal X11.1 and Terminal X11.4			If the safety parameter, "Start-up Test" – is deactivated, then the drive will be activated immediately after the switch is turned on!  Test steps 2-4 can then be performed anyway.
STO-TEST 1.3	Supply Voltage US = 24 V to the System			

STO-TEST Step	2	Action / Function		Anticipated Result	Remark, Cause of Fault Condition
STO-TEST 2.1	**Terminal X11.1 Test:** Switch off 24 V DC Voltage at terminal X11.1			flash 	
STO-TEST 2.2	Wait approx. 20 seconds	Check 7-Segment-Display		flash 	
STO-TEST 2.3	After approx. 20 seconds	Check 7-Segment-Display		Software-STO control mechanism successful 	
STO-TEST 2.4	Switch on 24 V DC Voltage at Terminal X11.1			Hardware- STO control mechanism successful 	

STO-TEST Step	3	Action / Function		Anticipated Result	Remark, Cause of Fault Condition
STO-TEST 3.1	**Terminal X11.4 Test:** Rebuild STO Test Step 1		Switch the 24V Supply Voltage Off→On		
STO-TEST 3.2	Switch off 24 V DC Voltage at Terminal X11.4			 flash	
STO-TEST 3.3	Wait approx. 20 seconds		Check 7-Segment-Display	 flash	
STO-TEST 3.4	After approx. 20 seconds		Check 7-Segment-Display	Software-STO control mechanism successful 	
STO-TEST 3.5	Switch on 24 V DC Voltage at Terminal X11.4			Hardware- STO control mechanism successful 	

STO-TEST Step	4	Action / Function		Anticipated Result	Remark, Cause of Fault Condition
STO-TEST 4.1	**Terminal X11.1 and Terminal X11.4 Test:** Rebuild STO Test Step 1		Switch the 24V Supply Voltage Off→On		
STO-TEST 4.2	Switch Off 24 V DC Voltage at Terminal X11.1 and Terminal X11.4				
STO-TEST 4.3	Wait approx. 20 seconds		Check 7-Segment-Display		
STO-TEST 4.4	After approx. 20 seconds Switch on 24 V DC Voltage at Terminal X11.1 and Terminal X11.4			If the drive has no fault and no other switch off condition is set - then the drive is activated. 	

STO-TEST Step	5	Action / Function
STO-TEST 5		Once all of the relevant safety test steps have been accomplished, the actions taken must be documented. The protocol form can be found in the Appendix ■ STO - Safety - Parameter - Report - Proposal.

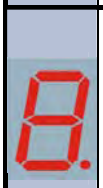
10.6 Signal Inputs Technical Data - Terminal Connection X11

General	The technical data provided in the section General Technical Data is valid, with the exception of the data listed below.
Nominal Voltage from the Inputs	24 V DC
Required Insulation from the Control Voltage 24V	protective extra-low voltage (PELV)
STO – Control Voltage Protection	1A
Number of Inputs Signal Inputs via Opto-Coupler	2 L = 0...7 V DC or open H = 15...30 V DC I_{in} at 24VDC: 8 mA
STO1#	L = STO activate H = STO deactivate
STO2#	L = STO activate H = STO deactivate
Break Time at Unequal Input Conditions	approx. 20 seconds

11.1 7-Segment-Display

Many sources of faults can be narrowed down with the diagnosis display.

Display (Code)	Explanation / Comment	Output Ready	Output Warning[2)]	Servo drive 631	635/637	637+	637f/638
 00h	no display any control voltage? external fuses ok?	off	off	☑	☑	☑	☑
 03h	system ready for operate drive ready, not active	on	off	☑	☑	☑	☑
 01h	drive ready for operate! DC link voltage within the limits, power stage active, fault-free			☑	☑	☑	☑
 12h	internal STOP with serial deactivating activate drive via serial interface	off	off	☑	☑	☑	☑
 82h	regulator of serial interface (bus interface) deactivated ! only if bus interface is integrated	off	off	☑	☑	☑	☑
 90h	deactivated with delay time for the brake deactivated via input. deactivated via serial command.	 on off	 off off	☑	☑	☑	☑
 92h	Active input is activated with switching on 24 V control voltage switch enable X10.**xx** switch on 0 V and after that 24 V	off	off	☑ X10.**7**	☑ X10.**22**	☑ X10.**22**	☑ X10.**22**
 46h	Under voltage of control voltage Power supply switched on? Power supply o.k ? internal fuse o.k.? control voltage < 17 V	off	off	☐	☑	☑	☑
 60h	Under voltage in DC-bus < Ua low threshold check power supply (power supply unit, wiring, fuse), check under voltage parameter	off	off	☑	☑	☑	☑
 DAh	feedback system error (e.g. resolver) wiring to encoder system ok? encoder system supply ok?	off	off	☑	☑	☑	☑
 F2h	I^2t- overload of the drive does the control loop oscillate? P-amplification too high mechanics stiff? requirements too high? is warning /8/ evaluated?	1)	1)	☑	☑	☑	☑
 66H	overload of the motor I^2t does the control loop oscillate? P-amplification too high mechanics stiff? requirements too high? is warning /8/ evaluated?	1)	1)	☑	☑	☑	☑

Display (Code)		Explanation / Comment	Output: Ready	Output: Warning[2)]	Servo drive: 631	635/637	637+	637f/638
	B6h	over temperature of the output stage (> 90°C) adequate cooling of the regulator? ambient temperature too high?	1)	1)	☑	☑	☑	☑
	3Eh	over voltage on DC bus ballast module ok? adequate ballast module?	1)	1)	☑	☑	☑	☑
	E0h	chassis shorting and short circuit due to hardware motor cabling ok? digital-loops setup ok? short circuit to chassis in the motor? braking resistor: ohm- value too low? try to start fresh! send in for repair	off	off	☑	☑	☑	☑
	FEH	WARNING! Overload of the regulator I²t or motor I²t or temp.- output stage too high. If no reaction within approx. 3sec.it switches off with signals /3/, /4/ or /5/. Signal /8/ clears when there is no more danger or it is switched off mechanics stiff? defective bearings; cold grease? reduce requirements and creep to next possible STOP	on	1)	☑	☑	☑	☑
	F6h	over temperature motor(NTC/PTC) check overload of the motor / cooling etc.	off		☑	☑	☑	☑
	2Eh	motor temperature too high check overload of the motor / cooling etc.	on	1)	☑	☑	☑	☑
	80h	ballast active Brake energy is removed			☑	☑	☑	☑
	38h	warning I²t ballast too high ballast resistance usage >90%			☑	☑	☑	☑
	7Ch	switch off ballast ballast resistance overloaded	on	1)	☑	☑	☑	☑
	6Ch	X 300 – Module not inserted or wrong inserted or defect X 300 testing	off	off	☐	☐	☑	☑
	6Eh	X 300 – setting wrong X 30 / X40 Counter-Configuration test in the EASYRIDER® Windows – Software			☐	☐	☑	☑
	1Ch	tracking window exceeded 3) only in operation mode position control, will be deleted with the next run-command			☑	☑	☑	☑

Display		Explanation	Output		Servo drive			
	(Code)	Comment	Ready	Warning[2)]	631	635/637	637+	637f/638
	1Eh	tracking error with switch off only in operation mode "position control"			☑	☑	☑	☑
	20h	limit switch + 3) limit switch + X10.**xx** on 0 Volt, from Firmware 6.16			☑ X10.**8**	☑ X10.**14**	☑ X10.**14**	☑ X10.**14**
	08h	limit switch - 3) limit switch-X10.**xx** on 0 Volt, from Firmware 6.16 3)			☑ X10.**9**	☑ X10.**15**	☑ X10.**15**	☑ X10.**15**
	9Eh	limit switch + / limit switch - both limit switch X10.**xx** on 0 Volt, from Firmware 6.16			☑ X10.**8** X10.**9**	☑ X10.**14** X10.**15**	☑ X10.**14** X10.**15**	☑ X10.**14** X10.**15**
	76h	memory-checksum-error try new start, store the value again	off	off	☑	☑	☑	☑
	62h	DC Bus Unterspannung < 100 V -			☑	☐	☐	☐
	4Eh	1: internal software error, Watchdog 2: blinking: BIAS software error 1: Firmware version check 2: Bias program error fix			☑ ☐	☑ ☐	☑ ☐	☑ ☑
	EEh	starting lockout RP SBT with 637f starting lockout STO1 and STO2 with 638 Terminal X290. 3/4 check with 637f TerminalX11. 1/4 check with 638			☐	☐	☐	☑
	24h	STO1 und STO2 Signale Difference>20 Seconds Switch Off /On Control Voltage			☐	☐	☐	☑ 638 only
	26h	X10.22 Quickstop Ramp active			☐	☐	☐	☑ 638 only
	42h	X10.22 low high slope missing			☐	☐	☐	☑ 638 only
	2Ah	Max. speed overload check speed limits resp. setpoint speed			☐	☐	☐	☑
	4Ah	CAN - Open 402 Sync Message error in Interpolated positioning mode -			☑ 6.19c	☐	☐	☑ 8.19d

Display (Code)		Explanation / Comment	Output Ready	Output Warning[2)]	Servo drive 631	635/637	637+	637f/638
	9Ch	SSI – Encoder Error -			☐	☐	☐	☑ 8.21
	9Ch	CAN-BUS Error Flashing display Noise on bus or lane missing!			☐	☐	☐	☑ 8.33
	CEh	Profibus-Modul Error			☐	☐	☐	☑ 8.31
	30h	638 Active Delay time runs			☐	☐	☐	☑ 638 only
	8Eh	638 SAFETY- Parameter Ram Error			☐	☐	☐	☑ 638 only

1) Reaction to these errors **chapter:** "■ **Function diagrams from inputs and outputs**"

2) With configuration corresponding **chapter :** "■ **Operating modes and pin functions**"

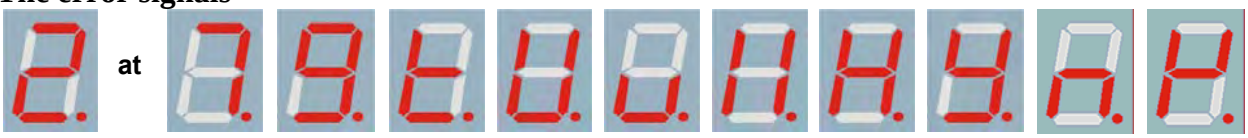
3) Operating mode "Position Control" only

The error signals are shown as long as there is control voltage (Us), also when the power (DC-Bus) is switched off for safety reasons.

11.2 Reset of a Drive Trouble

A general precondition for correct execution of the Reset is the elimination of the error cause.

The error signals



blinking (BIAS)

of the drive can be reset via:

1. **Control voltage OFF/ON**,
2. **the serial command "Drive Reset" 0x02**
   The host login must be occurred.
   The drive must be deactivated via the serial command "deactivate Drive" 0x00.
3. **the fieldbus-command " Drive Reset" 0x16 (22 decimal)**
   The host login must be occurred via the BUS command 0x01.The drive must be deactivated via the BUS command "deactivate Drive" 0x14.
   The fieldbus command "Drive Reset" with constant repetition of the fieldbus command 0x16 will be works-off only once.
   For further processing, it is necessary, meanwhile to send another control word (e.g. 0 status order).
4. **a 0 – 1 flank on input X10.11**
   Precondition:
   - The input X10.11 is with function 1"Reset drive fault" configured (EASYRIDER® Windows – Software)
   - There is no host login.
   - The input Active,(X10.22) is inactive (0V)
   - The signal must be present min. 250 ms

Notice !!

After remove of the tracking error deactivation  the warning message  (tracking error) is active up to the next move command.

The **error signal**  (releasing before ready) can be reset by deactivation the drive.

11.3 Trouble-Shooting

The following list refers to faults which can occur during operation.

Display: 

Error	Explanation and remedy	
no motor run despite current flow	motor mechanically blocked? motor brake released?	1)
motor runs unevenly	check setpoint wiring check grounding and shielding too high P-amplification in the speed controller reduce value (with EASYRIDER® setting/speed control) too small I-time in the speed controller? reduce value (with EASYRIDER® setting/speed control)	
no reaction of setpoint progression, despite torque in standstill	Limit switch functions effective (BIAS)	
no current flow; no torque despite activating the regulator correctly	motor cables interrupted? Is input "I extern" (X10.19) activated (config. menu) and not notched up? limit switch - input activated and not notched up?	
Interference symptoms with power frequency	Ground loops in setpoint or actual value wiring? Shieldings laid on both sides? Signal cables near high voltage cables?	
Motor takes up preferred positions after activation	Position encoder or motor cables with reversed poles? Resolver or Feedback- encoder incorrectly adjusted? Number of motor poles wrong matching? (config. menu)	1)
Motor runs up immediately after activation although there is no setpoint	Motor cables or feedback- cables reversed? Encoder incorrectly adjusted? (e.g. Resolver)	1)
Motor reaches in idling cycle very different speed when running to the right or to the left	Feedback-Encoder incorrectly adjusted (e.g. Resolver)	

1) Display  or  mostly short after activating; before warning 

12.1 General Technical Data

- **General Data**

Type of Protection - for Mounting in a Cabinet	IP20
Pollution Degree - for Mounting in a Cubicle	VDE / UL: 2
Vibration Test in Accordance with DIN IEC68-2-6 Test FC Condition for Testing Frequency Range Amplitude Acceleration Test Time per Axis Frequency Sweep Speed	 10...57Hz 57...150Hz 0,075 mm 1g 10 sweep cycle 1 octave/min

- **Power Circuit**

Galvanic Separation from the Control Circuit	in acc. with EN 50178 / UL 508C
Specifications in accordance with	EN 50178 / UL 508C and cUL
Short Circuit and to Frame Test for	min. 2000 releases
Overvoltage Monitoring	max. 400V DC ±5V DC
Undervoltage Monitoring	min. 15V DC; configurable
Overheating Switch Off at	95 ° C +/- 5%
Clock Frequency	9,5 kHz
Frequency of Current Ripple	19 kHz

- **Control Circuit**

Galvanic Separation from the Power Circuit	in acc. with EN 50178 / UL 508
Further Information:	See: "■ **Insulation Concept"**

- **Signal Inputs and Outputs - Connection X10**

Additional Galvanic Separation from Power and Control Circuit		
Nominal Voltage of the In and Outputs	24 V DC	
Number of Outputs Signal Outputs via OPTO Coupler	5 Umax = 45V DC; I = 0..60 mA; short circuit proof, resistive load	
Signal Outputs via RELAY	Umax = 45V DC; I = 1uA...1,2A	
Contact Protection with Inductive Load	internal varistor	
Number of Inputs Signal Outputs via OPTO Coupler	8 L = 0...7 V DC or open H = 15...30 V DC Iin 24VDC: 8 mA	
Shortest Time for a Signal to All Inputs - to Accept the Signal in an Application:	> 1 ms	
Damping of the Transfer from Low to High (0-->24V):	fast input: 20µs (X10.4, X10.25)	default input: 200µs
Interrupt Response Time for Fast Input	10µs (X10.4, X10.25)	
Damping of the Transfer from High to Low (24-->0V)	fast input: 250µs (X10.4, X10.25)	default input: 1000µs

- **Signal Inputs and Outputs - Connection X120B resp. 120C**

<table>
<tr><td>Additional Galvanic Separation from Power and Control Circuit</td><td></td></tr>
<tr><td>Nominal Voltage of the In and Outputs</td><td>24 V DC +20% / -10%</td></tr>
<tr><td>Number of Outputs
Signal Outputs via OPTO Coupler</td><td>4
resistive load Imax. = 2A
inductive load max. 1Henry
<table>
<tr><th>Iout.</th><th>Inductance</th><th>Max. Switching Frequency</th></tr>
<tr><td>1A</td><td>1H</td><td>1Hz</td></tr>
<tr><td>1A</td><td>0,1H</td><td>10Hz</td></tr>
<tr><td>0,33A</td><td>1H</td><td>10Hz</td></tr>
<tr><td>0,2A</td><td>0,5H</td><td>50Hz</td></tr>
</table>
short-circuit current limited by (5A)
over-heating protection,
active overvoltage clamping (50V);
keyed</td></tr>
<tr><td>Number of Inputs
Signal Outputs via OPTO Coupler</td><td>4
L = 0...7 V DC or open
H = 15...30 V DC
Iin at 24VDC: 8 mA</td></tr>
<tr><td>Shortest Time for a Signal to All Inputs to Accept the Signal in an Application:</td><td>> 1 ms</td></tr>
<tr><td>Damping of the Transfer from Low to High (0-->24V):</td><td>default input:
200µs</td></tr>
<tr><td>Damping of the Transfer from High to Low (24-->0V)</td><td>default input:
1000µs</td></tr>
</table>

- **Digital Control**

Current Control	
Loop-Cycle-Time	105 µs
Settings	according to factory specifications or motor data
Current Limits - Adjustment by:	speed control -menu
	Analog Input 0..10V = 0..100%; can be standardized, 10Bit

Speed Control	
Loop-Cycle-Time	105 µs
Settings	speed control menu
Differential Setpoint Input Analog	Usoll = 10 V, can be normed; Ri = 10k
Resolution (including sign)	14 bit
Digital Setpoint Input	via interfaces

Position Control	
Loop-Cycle-Time	105 µs

● Digital Communication

RS232 - Service Interface	COM1 19200 baud, 8 data bits, 1 start bit, 1 stop bit, parity: even
Optional RS232 / RS422 / RS 485 on SUB D – Socket	COM2
CAN1, Profibus DP, SUCOnet K on SUB D – Socket Interbus S on SUB D – Socket (OUT)	
Interbus S (Remote IN) CAN2	additional on SUB D – socket

● Resolver Evaluation / Transmitter Principles

General:
The specified data refers to the combination of the standard resolver interface with Function Module - X300_RD2; operated with the SSD Drives Resolver R 21-T05, R15-T05

Carrier Frequency	ft = 4,75 kHz
Ripple of the Actual Speed Value Signal	2% [1)]
Max. Position Resolution for One Revolution	65536 / 16 bit
Absolute Position Accuracy	+/- 0,7 ° [1)]
Relative Position Accuracy	+/- 0,08 ° [1)]

[1)] Data was checked – actual data results: Quality improved

● Controller System

System Start-Up Time after Switching On the Control Voltage	max. 6 seconds
Data Memory / Organization	Flash Eprom 256 KB RAM 64 KB; EEPROM 96 kByte

● Thermal Data

Operating Temperature Range	EN 50178 / UL 508, class 3K3
Storage Temperature Range	-25°...+55° C
Air Pressure	86 kPa - 106 kPa
Humidity	5% - 85%, 40°C
Operating Temp	0...40°C
Reduced Operation Derating of the Output Current	>40°...< 50°C 2% /°C
Altitude h	h ≤ 1000m
Reduced Operation Derating of the Output Current	h > 1000...≤ 4000m 1% / 100m

● Mechanical Data

Dimensions	see "■ Dimensions"
Weight	1,6 kg

12.2 Technical Unit Data

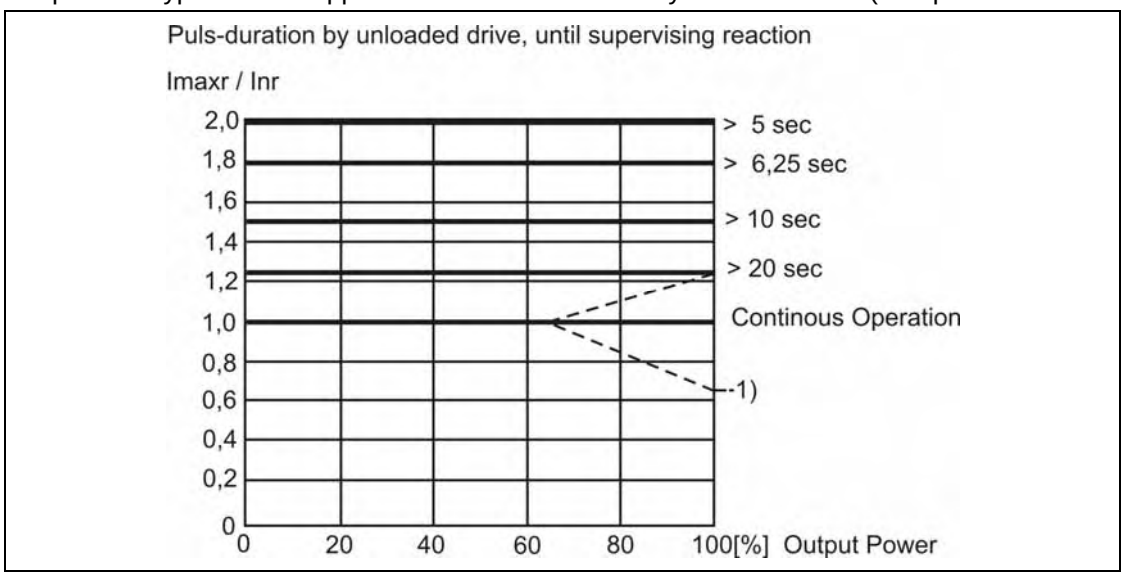
Servo Drive				638A01..	638A02..	638A04..	638A06..
Input							
Supply Voltage		min.	[V]	14			
50..60 Hz		Un	[V]	230			
		max.	tolerance	+10%			
Phases	1)			1 or 3			
Supply System				"■ Fuse, Contactors, Filter"			
Inrush Current Limitation		type		Softstart : capacitor - pre-charging over 390Ω			
Control Voltage	2)	Us	[V]	21,5 ... 24 … 29			
Control Current Incl. Fan Permanent: Inrush peak:		Is DC	 [A] [A/ms]	 nominal 0,4 maximum 0,8 nominal 3 maximum 6/0,8; 2,5/25			
Output							
Sine Voltage with Un		Unr	[Veff]	220			
Derating of Unr				Depending on load or with 1-phase supply			
Rated Current Efficiency		Inr	[A]	1	2	4	6
Max. Current Efficiency Time for Imax	1)	Imaxr min.	[A] Sec	2 5	4 5	8 5	12 5
Min. Motor Inductance (terminal / terminal)		Lph/ph	[mH]	10	6	3	2
Brake Circuit							
Operating Point DC		Ub	[V]	375			
Max. Power		Pbmax	[kW]	5,5			
Rated Power		Pbnenn	[W]	600			
Internal Brake Resistor		Rbint Pd Pmax	[Ω] [W] [W]	170 20 830			
Min. Ext. Brake Resistor	2)	Rbextmin	[Ω]	33 (use only our approved types)			
General							
Power Loss Fan Electronics		max.	[W]	17			
Fan Control			[V]	2-stage control			
Power Loss Rating Class per A		nominal	[W/A]	7 (4,75kHz) / 9 (9,5kHz			

1) Reference "● Output Power"

2) Recommended: Transformer power supply

- **Output Power**

In the event of continuous operation in the full-load range, the limits as shown in the following diagram need
to be respected. Typical servo applications are not affected by this restriction. (S3 operation: Start/Stop).

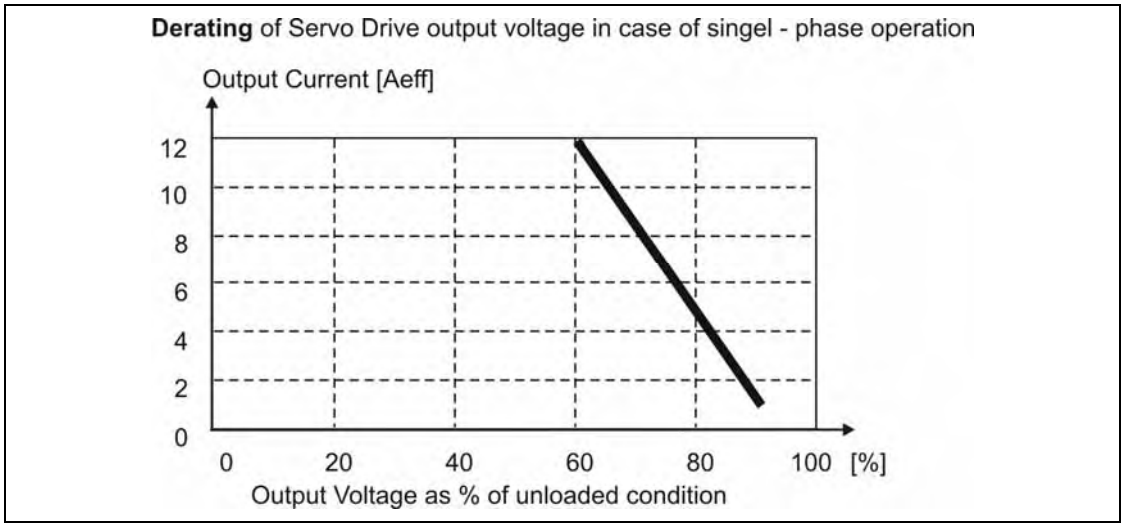


1) **At servo drive 638A/06.. :**
Load limitations decreased to 66% with 1-phase incoming supply and continuous operation and speed. (S1)

- **Single and Three-Phase Supply**

Due to the line-ripple of the DC-Bus, the rate of usable output voltage is reduced as follows.
This reduction affects the maximum attainable speed of the applied motor.

Three-phase supply: The unloaded output voltage will be reduced to approx. 90%, maximally 85 %
Single-phase supply: 50 – 60Hz: see following Diagram:



Hint for Parameterization:
To avoid the unexpected tripping of the under voltage threshold, the parameter setting should be left on the default values (EASYRIDER® Windows – Software).
Required motor-terminal-voltage for specified speed.

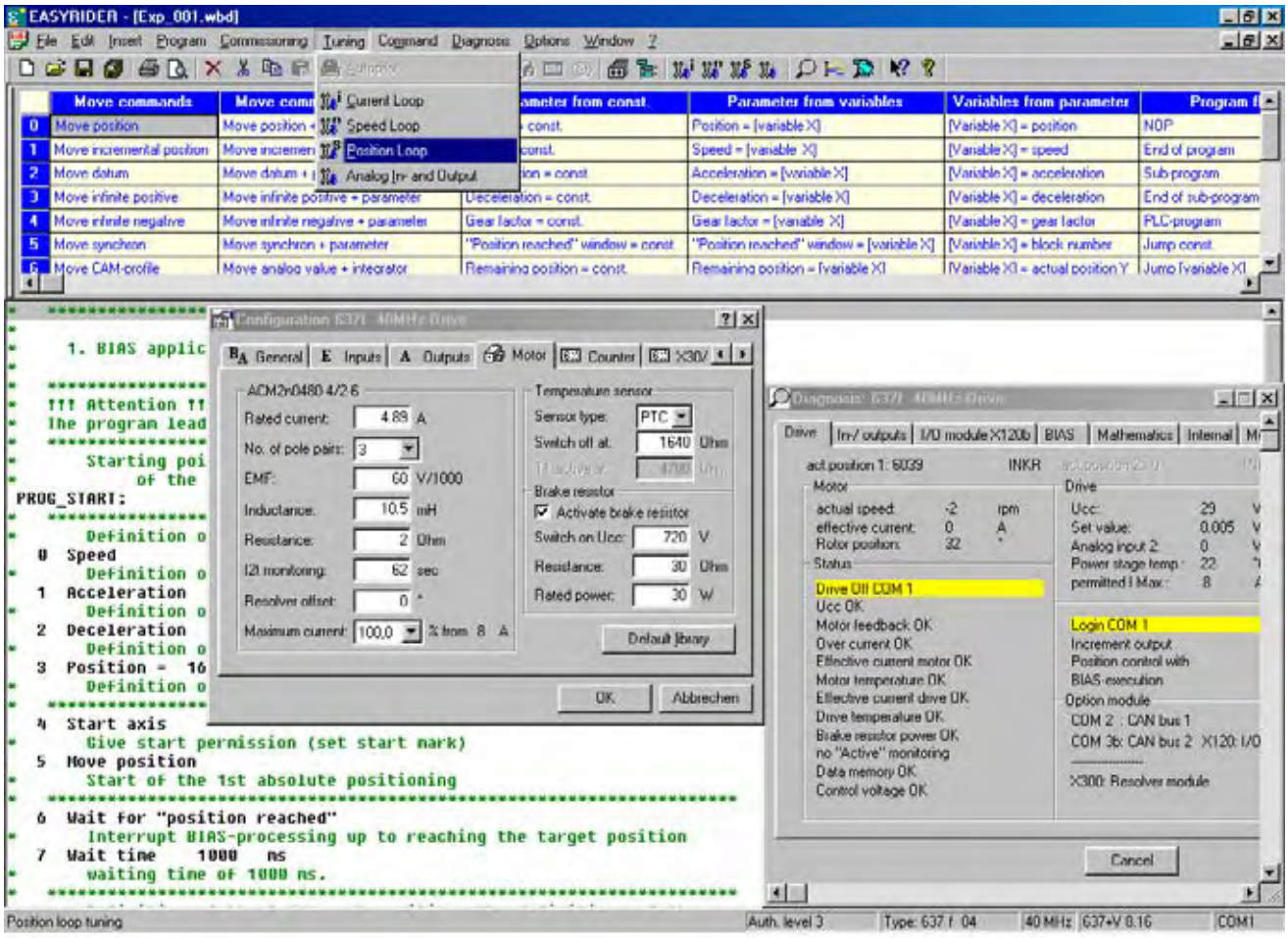
Approximation: (up to 3000RPM)

Ukl = 1,2 * (EMF * n / 1000) + I * (Rph + RL) [V]

Ukl	Required Motor Voltage [V_{RMS}]
EMF	Back-EMF of Motor [V_{RMS}] / 1000 RPM
Rph	Resistance of Motor (between terminals) [Ω]
RL	Line Resistance of Motor cable [Ω]
I	Motor Current [A_{RMS}]

13.1 EASYRIDER® Windows - Software

EASYRIDER® Windows software is a useful and convenient tool to use to control all drive functions. Detailed online help information and instructions are available.



EASYRIDER® Instructions: (extract)

- Auto pilot function as an interactive tutorial
- System identification
- BIAS instruction-set editor
- Oszilloscope function
- Start-up and commissioning tools
- Setting of parameters and setting of configurations
- Servo diagnostics, interface diagnostics and fieldbus diagnostics
- Motor library
- Save system data in file and load system data from file
- Send system data to servo drive and save system data in servo drive
- Load system data from servo drive

Important:
Edited data in EASYRIDER® is transmitted to the RAM of the servo drive and becomes **active only after** executing the **SEND** command. **Only the instruction** "**SAVE in EEPROM",** writes data into a non volatile memory. Data is stored there in the event of power failure.

13.2 Introduction

The selection of the Operating Mode 5 with the Drives 630 Serie activates the complete functionality of all control loops and the BIAS-program processing.
The EASYRIDER Software is the programming tool to create, load and save the BIAS Programs.

The programming language “BIAS“

Bedienersprache für **i**ntelligente **A**ntriebs – **S**teuerungen

was developed to allow the programming of complex and yet clear programs.
Therefore the BIAS commands were divided according to their function into the 12 following command groups:

0. Move command
1. Move command + parameters
2. Parameter commands
3. ”Parameter from variables” - commands
4. ”Parameter into variables” – commands
5. Control commands
6. Flag commands
7. In-/ output commands
8. Variable commands
9. Mathematics commands 1
10. Mathematics commands 2
11. Floating point commands

BIAS – Command overview

With these commands you will be able to program the required machine process in chains of steps
The size of a program is limited to a maximum of 1500 BIAS commands
The design of the programs occurs with EASYRIDER software at the PC and can be transmitted into the servo drive via serial communication.
If you create the BIAS program with the **EASYRIDER** shell, jump labels, comments and a unit for the position presettings are provided.
A further possibility is programming or transmitting and controlling the BIAS program via a field bus respectively. The necessary command coding is listed in the command instruction.

During the calculation of a BIAS-program is is possible to start parallel a PLC SPS-Task and/or a Mathematics-Task.

The PLC-Task is calculated parallel to the BIAS-Task and has a subset of the commands.

Save Table
The command is allowed in the PLC-Task only

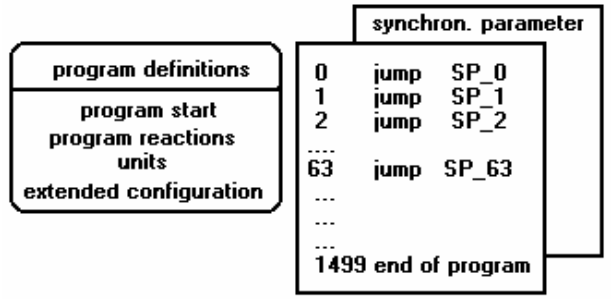
The Mathematik-Task is calculated in the interruptfree processing time of the drive and has also subset of the commands.

Profile value = [Variable X]
THe command is allowed in the Math only.

• Program layout

A BIAS program consists of 3 basic memory areas.

1. **The program definition**:
   contains all definitions for starting and processing a BIAS program, the entries for defining a unit for position presetting and the necessary configurations of the inputs and outputs.
2. **The command memory**:
   contains up to 1500 BIAS commands.
3. **The synchronous parameters**:
   contain the definitions for the 16 synchronous profile blocks and the 2048 supporting points.



The basic memory areas are part of the BIAS program.
In the EASYRIDER for Windows Software the extension is *.WBD.

• Execute a BIAS program

The BIAS processing is started in operating mode 5 ”position control with BIAS processing” after activating the output stage of the regulator.
The first BIAS block to be executed is determined in the BIAS program definition (Parameter ”program start”).
After that, the regulator processes one BIAS command sequentially every trajectory cycle.
If the BIAS processing encounters a move command, it can be started with the Low-High slope of the start input.

Serie	Input	Configuration
635/ 637/637+/637f/638:	X10.11	”Start input BIAS” (Function 0)
631:	X10.9	“Start input ” (Function 3)

Alternatively, move commands are started when the start identifier is set before the move command, via the BIAS command **”Start axis”**.
The following blocks will be processed after a successful start.
If the command, ”**Wait for “position reached”**” follows a move command, block processing will only be continued after the target position is reached.

Drive type:	Trajectory cycle:
631/635/637	1,899ms
637+/637f/638	0,844ms

- **Execute a PLC program**

A cyclic PLC program for supervisory monitoring tasks can be started parallel to the sequential processing of a BIAS program
The PLC program is started by processing the BIAS command, "**PLC program**".
After the PLC program is activated the programmed PLC commands are processed as of the specified block number.
The command "**end of program, mode = 0**" within a PLC program causes a jump back to the start of the PLC program.
The regulator processes one PLC command sequentially every trajectory cycle.
The reaction of the PLC program to the deactivation of the output stage can be adjusted in the BIAS program definition (parameter "program reaction PLC program"). Thus it is possible to allow the PLC program to continue to process also during the deactivation of the regulator. Is in this mode the first command of the BIAS execution the command "PLC program" the PLC task starts automatically independently of the state (deactive/active) of the drive.
In the plc-loop not all of the BIAS commands are allowed.
In the 3 command overview the allowed commands are listed.
The check of allowed commands is done by the drive during run time!

Drive type	Trajectory cycle
631/635/637	1,899ms
637+/637f/638	0,844ms

- **Execute a Mathematics program**

A 3 task as math program for supervisory calculation can be started parallel to the sequential processing of a
BIAS program and/or PLC program.
The mathematics-program is started by processing the BIAS command, **"Mathematics program**".
After the mathematics program is activated the programmed mathematics commands are processed as of the specified block number.
The command "**end of program, mode =0**" within a mathematic - program causes a jump back to the start of the mathematics program.
The command "**end of program, mode =3**" cancels the mathematics program.
The reaction of the mathematics program to the deactivation of the output stage can be adjusted in the BIAS program definition (parameter "program reaction mathematics program"). Thus it is possible to allow the mathematics program to continue to process also during the deactivation of the regulator.
In this mode the command „Mathematic program" is executed at the first or second line (if the PLC program is on line 1)of the BIAS progam or at line 0 , if the drive is not enabled.
The calculation of the mathematics commands is done in the interruptfree calculation time of the drive. In a standard application approx. 10 commands are processed every 2ms

13.2 BIAS - Commands

Position = const.	[Variable X] = position	BIAS-execution pointer	[Variable X] =flag Y	Profile value = [variable X]	Save table	PLC-program
This command is only permitted in the BIAS- task	This command is only permitted in the BIAS, PLC and MATH-Task	This command is only permitted in the PLC and MATH-Task	This command is only permitted in the BIAS and PLC -Task	This command is only permitted in the MATH-Task	This command is only permitted in the MATH-Task	This command is only permitted in the BIAS and MATH-Task

	0	1	2	3	4	5	6	7	8	9	A	B
0	Move position	Move position + parameter	Position = const.	Position = [variable X]	[Variable X] = position	NOP	Flag X = const.	If input X ? const.	[Variable X] = const.	Mathematic program	Table [[variable X]] = const.	[D Variable X] = [D Variable Y]+ [D Variable Z]
1	Move incremental position	Move incremental position + parameter	Speed = const.	Speed = [variable X]	[Variable X] = speed	End of program	If flag X ? const.	If output X ? const.	If [variable X] ? const.	Profile initialization = const.	Table [[variable X]] = [Y Variable Z]	[D Variable X] = [D Variable Y] - [D Variable Z]
2	Move datum	Move datum + parameter	Acceleration = const.	Acceleration = [Variable X]	[Variable X] = acceleration	Sub- program	Flag X = flag Y	Output X = const.	[Variable X] = [variable Y] + const.	Profile cycle length = [variable X]	[X Variable Y]= Table [[variable Z]]	[D Variable X] = [D Variable Y] * [D Variable Z]
3	Move infinite positive	Move infinite positive + parameter	Deceleration = const.	Deceleration = [variable X]	[Variable X] = deceleration	End of Sub-program	Flag X = input Y	Output X = flag Y	[Variable X] = [variable Y] – const.	[Variable X] = profile value	[W Variable X] = [Y Variable Z]	[D Variable X] = [D Variable Y] / [D Variable Z]
4	Move infinite negative	Move infinite negative + parameter	Gear factor = const.	Gear factor = [Variable X]	[Variable X] = gear factor	PLC-program	Flag X = output Y	_____	[Variable X] = [variable Y] * const.	Profile value = [variable X]	[X Variable Y] = const.	If [D Variable X] ? [D Variable Y]
5	Move synchron	Move synchron + parameter	"Position reached" window = const.	"Position reached" window =[variable X]	[Variable X] = block number	Jump const.	Flag X = flag Y & flag Z	_____	[Variable X] = [variable Y] / const.	_____	[Variable [X]] = const.	[D Variable X] = SIN {[D Variable Y]}
6	Move CAM profile	Move analogue value + integrator	Remaining position = const.	Remaining position = [variable X]	[Variable X] = actual position Y	Jump [variable X]	Flag X = flag Y | flag Z	_____	[Variable X] = flag Y	_____	[Variable [X]] = [variable Y]	[D Variable X] = COS {[D Variable Y]}
7	Synchronous settings 1	Move speed + integrator	Ramp filter = const., [variable X]	Maximal current = [variable X]	[Variable X] = analogue input Y	BIAS-Execution pointer = const.	Flag X = flag Y ^ flag Z	_____	[Variable X] = [variable Y].bit Z number	Save table	[Variable [X]] = [variable Y]	[D Variable X] = SQRT {[D Variable Y]}
8	Synchronous settings 2	Move speed + variable	Actual position X = const.	Actual position X = [variable Y]	[Variable X] = latch position Y	Wait for "position reached"	Flag X = ! flag Y	IBT- mask number = const.	[Variable X] = [variable Y]	_____	[Variable X] = [variable Y] ? [variable Z]	_____
9	Move PID; speed	_____	If actual position X ? const.	Analogue output X = [variable Y]	[Variable X] = actual speed Y	Wait time = const.	Flag X = status Y	IBT- notification number = const.	If [variable X] ? [variable Y]	_____	[Variable X] = [variable Y] ? const.	_____
A	Move PID; torque	Cycle length = const.	If actual position X ? [variable Y]	PID scaling	[Variable X] = latch status Y	Wait time = [variable X]	If status X ? const.	CAN Command = [variable X]	[Variable X]= [variable Y] + [variable Z]	_____	_____	_____
B	Set point [axis no.] = const.	Cycle length = [variable X]	Sensor window = const.	Sensor window = [variable X]	[Variable X] = position Y; axis no.	BIAS-execution pointer = [variable X]	Mode X = const.	IBT- data transfer	[Variable X]= [variable Y] - [variable Z]	_____	_____	_____
C	Set point [axis no.] = [variable X]	Load parameter set X = [variable[Y]]	Sensor position = const.	Sensor position = [variable X]	[Variable X] = value Y	Jump [var.[X]]; length = const.; from	Flag X = [variable Y]	CAN2 Command = [variable X]	[Variable X]= [variable Y] * [variable Z]	_____	_____	_____
D	Move relative	_____	Sensor adjustment 1 = const.	Sensor adjustment 1 = [variable X]	[Variable X] = axis status, axis no. Y	Execute X commands	[Variable X]. bit[Y] = const.	_____	[Variable X]= [variable Y] / [variable Z]	_____	_____	_____
E	Start axis	_____	Sensor adjustment 2 = const.	Sensor adjustment 2 = [variable X]	_____	_____	If [var. X]. bit Y == const. then jump	_____	[Teachvariable X] = [variable Y]	_____	_____	_____
F	Stop axis	Stop axis + parameter	Update parameter	PID parameter	_____	Virtual program	Axis state, axis no. X, bit Y = const., [flag Z]	_____	[Variable X] = [teachvariable Y]	_____	_____	_____

Command group "Move commands"
Command group "Parameter commands"
Command group "Variable commands"
Command group "Flag commands"
Command group "Conditional jump commands"
Command group "Program control commands"
Command group "Mathematic commands"
Command group "Output commands"
Command group "CAN- Commands"
Command group "637f commands"

14.1 DC Link Parallel Connection

- **General**

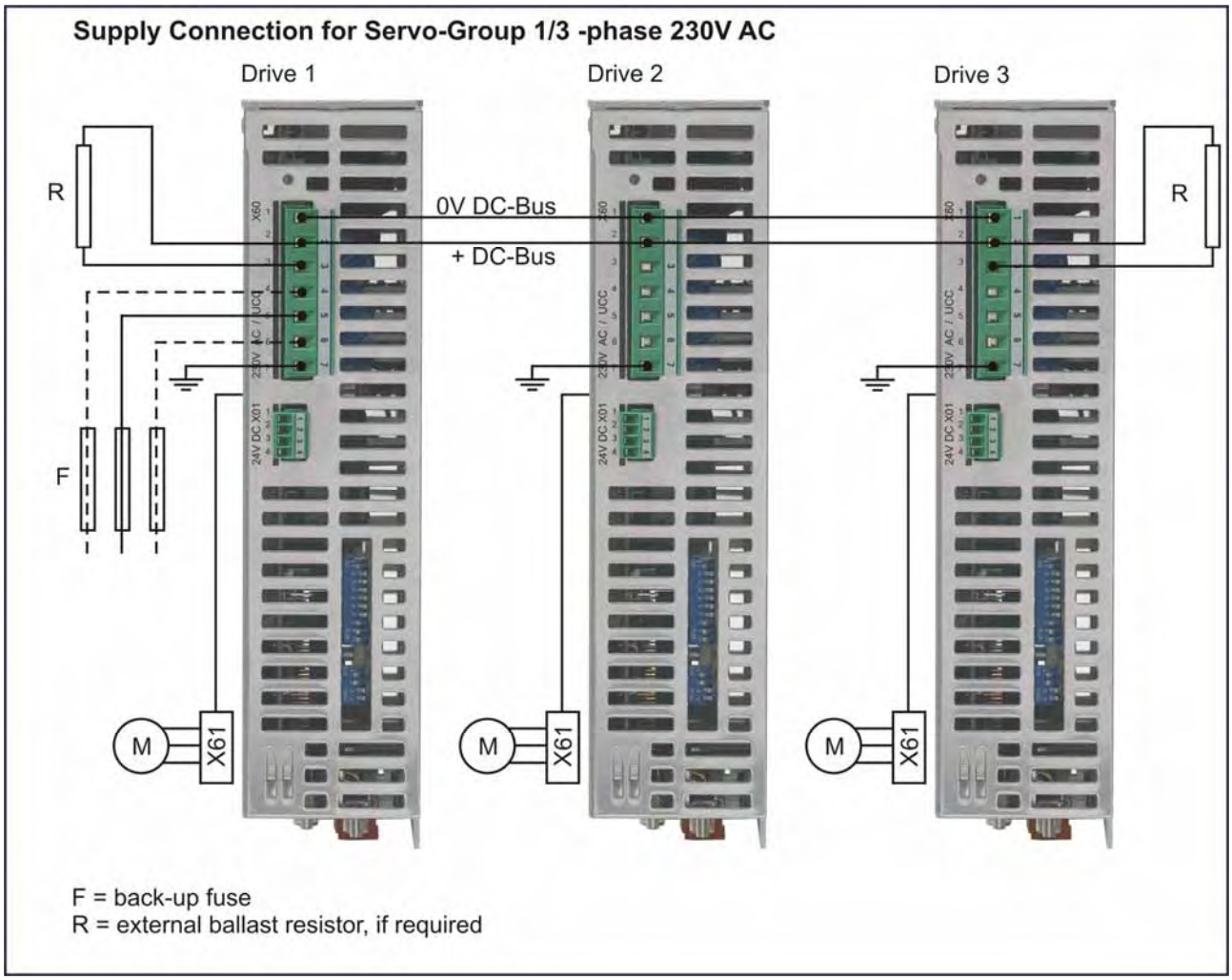
With the operation of a group of drives it is possible to couple the DC link circuit of the 638A Drives.

Advantages:

- Positive energy balancing - utilization of braking energy, with energy equalization achieved through the DC link
- Smaller load on the ballast resistors
- Increased DC link capacity through smaller residual rippling, specifically with single phase applications
- Increase of the internal ballast peak performance
- Increase of the internal ballast continuous power rating
- Internal unit balancing resistance provides for a uniform rectifier load sharing with a parallel incoming power supply

- **Variation 1; Servo Drives Connected to an Incoming Power Supply**

Block Diagram 1

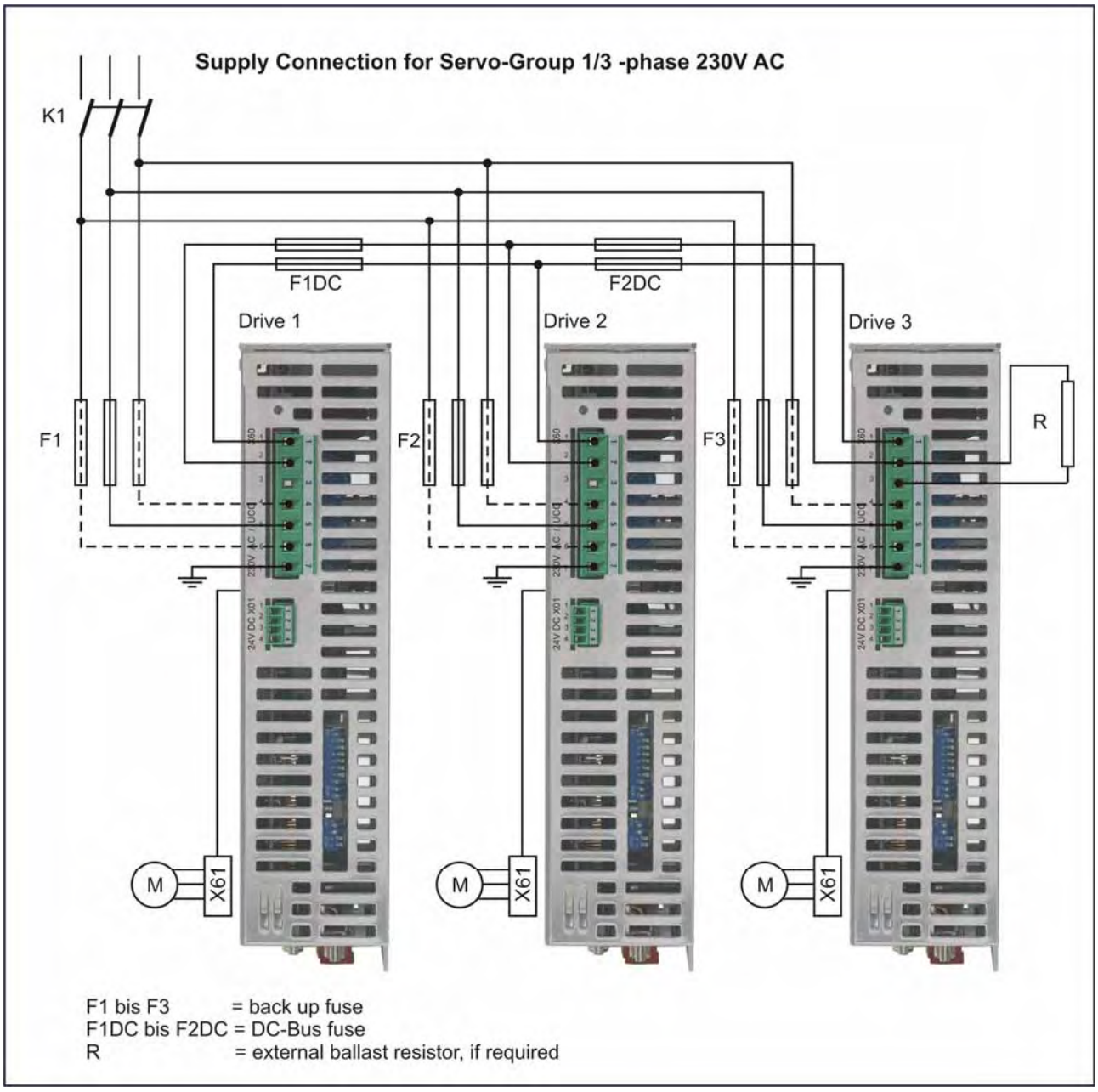


The sum of all of the rated currents is a maximum of **6 amps**.
A maximum of **6** - 638 Series Servo Drives can be connected in parallel.

Attention

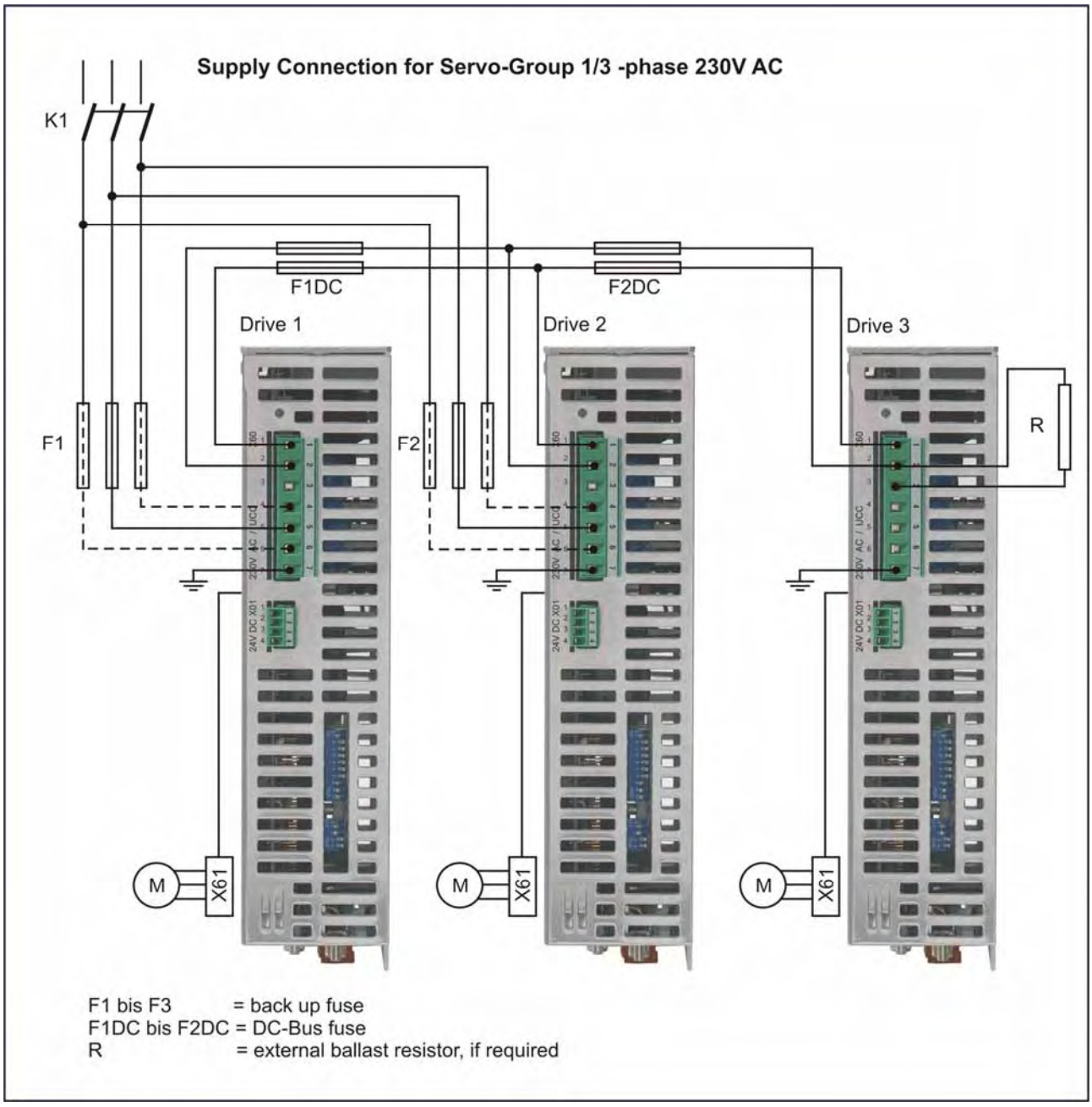
- **Variation 2; Servo Drives Connected to Multiple Incoming AC Power Supplies**

Block Diagram 2



- **Variation 3; Combination of Variations 1 and 2**

Block Diagram 3



● Installation Instructions and Warnings

Nr.	Installation Instructions
1	With a common DC link bus, one should employ the 638A Series of Servo Drives exclusively.
2	Drives which are located immediately next to each other, within the same control cabinet, should be carefully arranged with the DC links being made employing a short wire connection.
3	Multiple unit groups must be separated utilizing a DC fuse as shown. Recommended Fuse Type:

	**Note:** Units should be turned on together as shown. (Contactor K1) Switching delays can endanger the function of the rectifier and the “soft-power-up-circuitry“, (wear effect).

	**Note:** The failure of individual AC fuses can go unnoticed as the power continues to be delivered through the DC-bus of the units connected in parallel. Regular checks of the fuses are therefore strongly recommended.

	**Note:** Careful planning and wiring are imperative! A short-circuit on DC bus link connections can cause serious damage to the rectifiers and drives.

● Layout of the Ballast Capacity

Energy, which is produced by the electrical brake motor, will be fed into the DC link and then through the DC link coupling to serve other motors within the sequence. Only a portion of the energy which is produced in this manner leads to an increase in the DC link voltage and will then, at a specified voltage threshold, be converted to heat and released through the units’ internal or external ballast. Therefore, an energy exchange occurs between the units, creating a positive energy balancing and overall work load balance of the ballast switches. A significant reduction factor in the load can be anticipated, depending upon the specifics of the installation.

Layout Step by Step (without reduction factors)	Remarks
➢ Addition of all internal unit ballast continuous ratings ➢ Addition of all internal unit ballast peak performance ratings ➢ For information concerning the required data and design layout of the ballast resistance: See Chapter - **“● Layout of the Ballast Resistance“** ➢ Arrange the external ballast resistance with regard for the braking power occurrence, if possible.	The load on the internal ballast will be evenly divided between all of the units connected in parallel.

15.1 STO - Safety - Parameter - Report - Proposal

1 General Information

Checked according to STO inspection instruction: _____
Project / Machine: _____
Drive name: _____
Inspector name: _____

2 Safety - Parameter Configuration

Parameter-No.	Parameter description	Parameter value	
0	**Function X10.22**	no Function	
		Acknowledgement + Quick Stop	
		Acknowledgement	
		Quick Stop	
1	**Active-deceleration time**	x 10ms	
2	**STO-Power On test**	deactivate	
		activate	

3 STO Function test according to manual;

(638 Product Manual 07-02-12-02-E, Chapter STO)

Step 1 checked	
Step 2 checked	
Step 3 checked	
Step 4 checked	

4 Acknowledgement according as configuration;

successful checked	
not used	

5 Quick Stop according as configuration;

successful checked	
not used	

Quick stop integrator (Commissioning; Supervision)	rpm/s

Acceptance test date:_____

_____
Signature inspector

In-service inspection date:_____

_____
Signature inspector

Date:_____

_____
Signature inspector

Version	Modification	Chapter	Date	Name	Comment
V0106	preliminary version	-	07.04.2006	N. Dreilich	
V0206	preliminary version	-	-	-	
V0306	final version	-	21.08.2006	N. Dreilich	
V0406	STO - expansion		28.09.2006	N. Dreilich	New Photos

SSD Drives Germany

SSD Drives GMBH
Head Office Heppenheim

Von-Humboldt-Straße 10 • 64646 Heppenheim
Tel: +49 6252 7982-00 • Fax: +49 6252 7982-05
www.ssddrives.com • ssd@ssddrives.de

SSD Drives GMBH
Plant Servosystems

Im Sand 14• 76669 Bad Schönborn
Tel: +49 7253 9404-0 • Fax: +49 7253 9404-99
www.ssddrives.com • ssd@ssddrives.de

SSD Drives Global

UNITED KINGDOM
SSD Drives Ltd
New Courtwick Lane
Littlehampton
West Sussex BN17 7RZ
Tel: +44 (0)1903 737000
Fax: +44 (0)1903 737100

CANADA
SSD Drives Inc.
4391 Harvester Road, Unit #1
Burlington
Ontario L7L 4X1
Tel: +1 (905) 333 7787
Fax: +1 (905) 632 0107

CHINA
SSD Drives Ltd
Room 1603, Hua Teng Edifice
302# Jin Song San Qu
Chaoyang District,
Beijing 100021
P.R. China

DENEMARK
SSD Drives AB
Enghavevej 11
7100 Vejle
Tel: +45 (0)70 201311
Fax: +45 (0)70 201312

FRANCE
SSD Drives SAS
15 Avenue de Norvège
Villebon sur Yvette
91953 Courtaboeuf Cedex - Paris
Tel: +33 (0)1 69 18 51 51
Fax: +33 (0)1 69 18 51 59

GERMANY
SSD Drives GmbH
Von-Humboldt-Straße 10
64646 Heppenheim
Tel: +49 (6252) 7982-00
Fax: +49 (6252) 7982-05

ITALY
SSD Drives SpA
Via Gran Sasso 3
20030 Lentate Sul Seveso - MI
Tel: +39 (0362) 557308
Fax: +39 (0362) 557312

SCHWEDEN
SSD Drives AB
Montörgatan 7
30260 Halmstad
Tel: +46 (0)35-17 73 00
Fax: +46 (0)35-10 84 07

U.S.A.
SSD Drives Inc.
9225 Forsyth Park Drive
Charlotte
North Carolina 28273
Tel: +1 (704) 588 3246
Fax: +1 (704) 588 3249

SSD Drives Partner

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