

# MANUAL

Battery- Motor-Controller  
BAMO A1, A2-x-10 - 40  
for DC-Motors

BAMO A1, A2 10-40A



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G m b H

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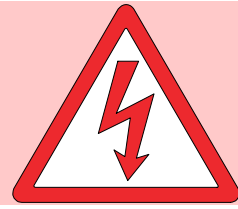
Version  
0310-1

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# 1 Basic-Information

Electronic equipment is not fault proof. This fact should be borne in mind for all possible operating conditions.

## **ATTENTION - Direct voltage 160V DC**



Before installation or commissioning begins, this manual must be thoroughly read and understood by the technical staff involved.

If any uncertainty arises, the manufacturer or dealer should be contacted.

The device BAMO- series is power electric parts used for regulating energy flow.

Protection rating IP00.

Connections only to a battery or galvanic isolated direct voltage. (See page 8)

### **Standards and guidelines**

The device and its associated components can only be installed and switched on where the local regulations and technical standards have been strictly adhered to:

EU Guidelines	89/392/EWG, 84/528/EWG, 86/663/EWG, 72/23/EWG EN60204, EN50178, EN60439-1, EN60146, EN61800-3
IEC/UL	IEC364, IEC 664, UL508C, UL840
VDE Regulations	VDE100, VDE110, VDE160
TÜV Regulations	
Trade body guidelines	VGB4

### **The user must ensure that in the event of:**

- device failure
  - incorrect operation
  - loss of regulation or control
- the axis will be safely de-activated.

It must also be ensured that the machine or equipment are fitted with device independent monitoring and safety features.

### **Setting adjustments**

- should only be carried out by suitably trained personnel
- should only be carried out in accordance with health and safety guidelines

### **Assembly**

- should only be carried out when all voltages have been removed.

### **QS**

Test results are archived with the device serial number by the manufacturer.

### **CE**

The device adheres to the following: Guideline EU 89/336/EWG. EMC standards EN61000-2 and EN61000-4.

## General Information

The battery motor controller BAMO-Ax-xx forms together with the low voltage DC-motor a propulsion unit distinguished by its high control range.

With a DC-motor the current is proportional to the torque and the voltage is proportional to the speed.

Current and voltage are measured precisely.

The analogue circuits of the servo drive are simply constructed.

The speed actual value is generated from armature voltage or from the DC-tachogenerator.

The speed and the current controller are designed as P-I-controller.

In version BAMO-A2 (4Q) the brake energy is refeeded to the battery.

## Application

for all kinds of machines or vehicles up to 6 kW battery feeded drive power especially for

- a great controller range
- a high efficiency
- small motor dimensions
- a even and smooth travel

for speed or torque regulation or

combined speed-torque regulation with or without superposed position controller.

## For use in

battery powered vehicles like cleaning machines, el. boats, fork-lift trucks, transport systems, Solar- or wind powered installations, and many other battery powered machines and installations

## Construction:

Cubicle-mount unit in IP23 according to the VDE- DIN- and EU- regulations. Standard analogue regulation electronics.

Power electronics with IGBT-power semiconductors, generous dimensioning.

## Characteristics:

- \* Battery supply or galvanic isolated direct voltage (Page 8)
- \* Differential comm. value inputs
- \* Speed and torque regulation
- \* Static and dynamic current limit
- \* Current comm. value output
- \* Enable logic, quick stop
- \* Temperature control for motor and device

# 1 Basic-Information

## Technical Data

### Power connection

Type BAMO A1, A2	10 - 40	10 - 40
Battery voltage	12, 36V	48 to 160V
direkt current bus mains (galvanicisolated)	12, 36V	48 to 160V
	Page 8	
Output voltage $0.8 \times U_B$	max. 30 V	max. 150V
Auxiliary voltage	24V= $\pm 10\%$ , max. 0.5A, Waviness <20% GND = $-U_B$	

### Spezifikationen

Device BAMO A1, A2-x-		10	25	40
Output current steady max.	A=	10	25	40
peak max. (5s)	A=	20	50	80
el. power max.	W	1500	3750	6000
fuses quick	AF		40	80
cooling	60%ED	convect	convect	head sink
cooling	100%ED	convect	head sink	head sink
Dimensions	BxHxT	see Page 6,7		
Weight	Kg	0.50	1.6	1.6
Weight with cooler	Kg	/	2.2	2.2

### Common specifications

protection standard	IP 00
device layout	VDE 0100 group C VDE 0160
humidity stress	class F accordig to DIN 40040
set up hight	< 1000m over NN
operating range	0 ... 45°C
extended operating range	up to 60°C red. 2%/°C
bearing range	-30°C up to + 80°C
speed controller	
control accuracy	no act.value error $\pm 0,5\%$
control range	1: 1000
temeperature observation	80°C

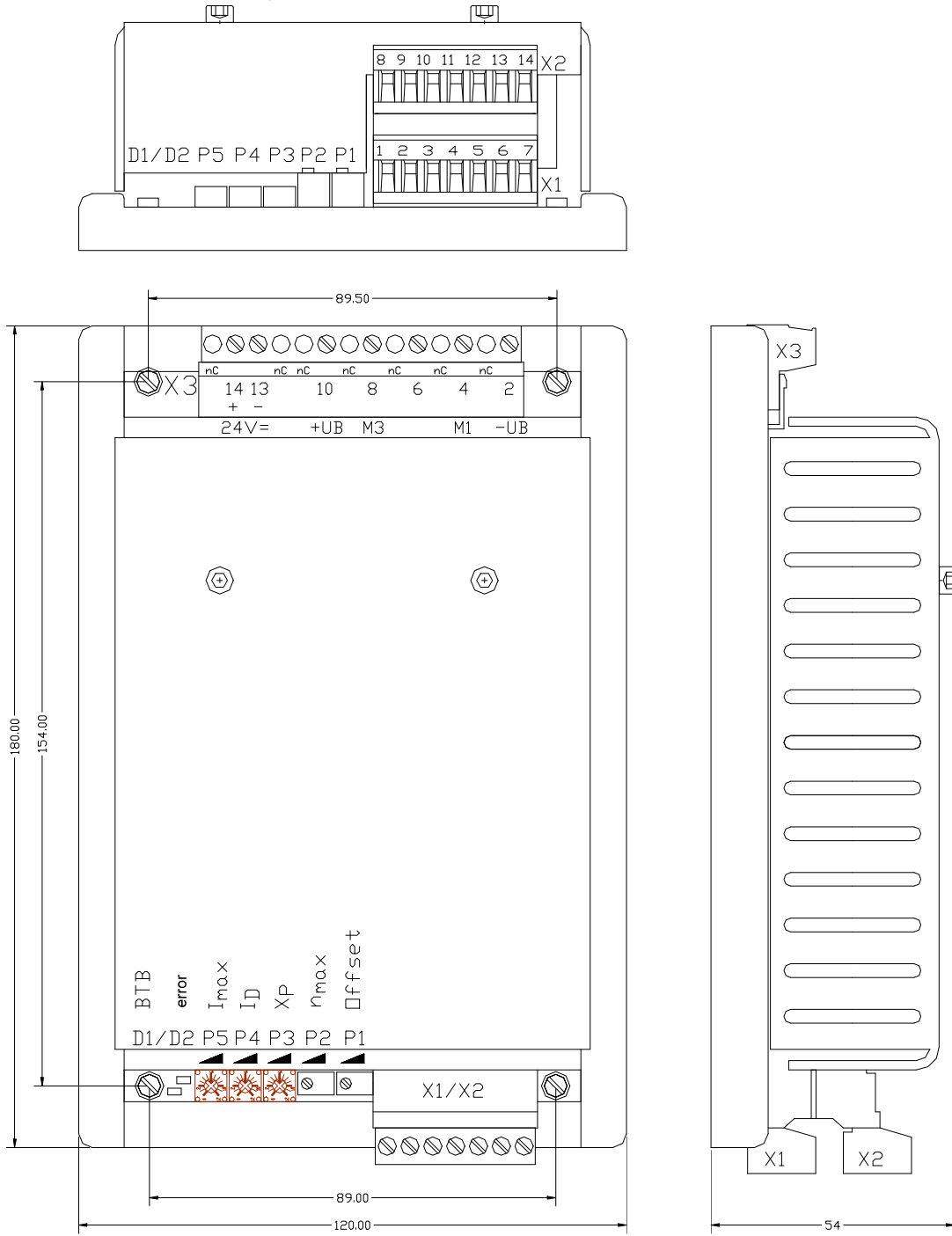
### Versions

BAMO A1-xx	1 Quadrant- controller	propeling in rotation direction
BAMO A2-xx	4 Quadrant- controller	propeling and breaking in both rotation directions,energy rear feed (see connect. advice page 8)

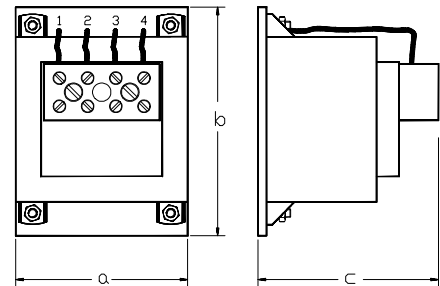
# Battery-Motor-Controller BAMO A1, A2-xx

Dimensions

## Dimensions BAMO A1, A2-x-10

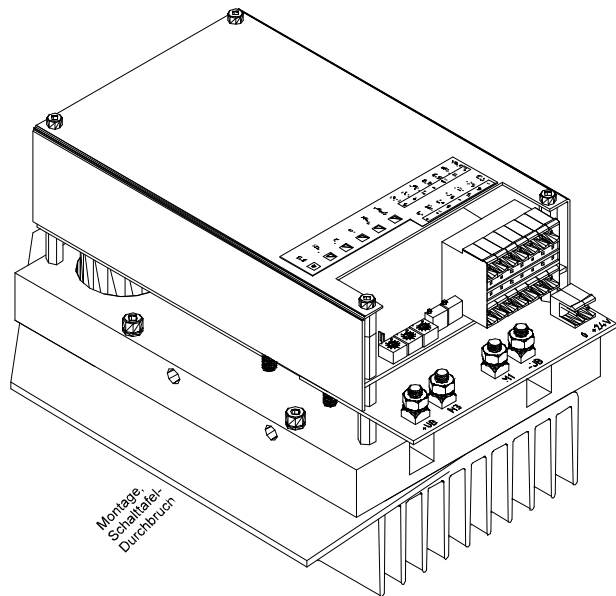
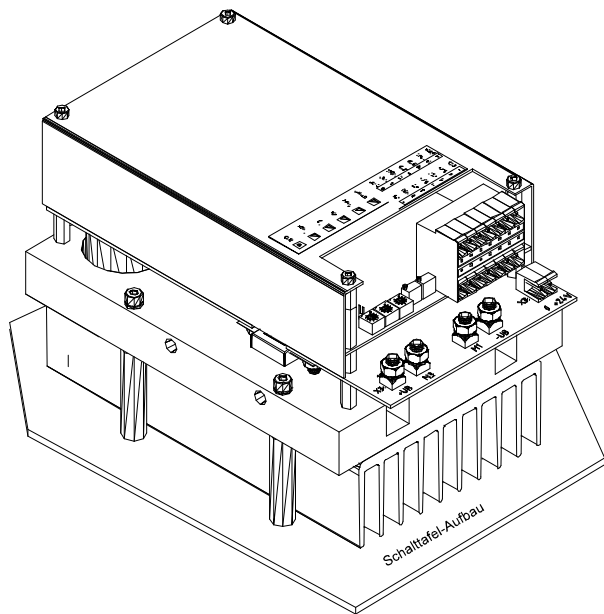
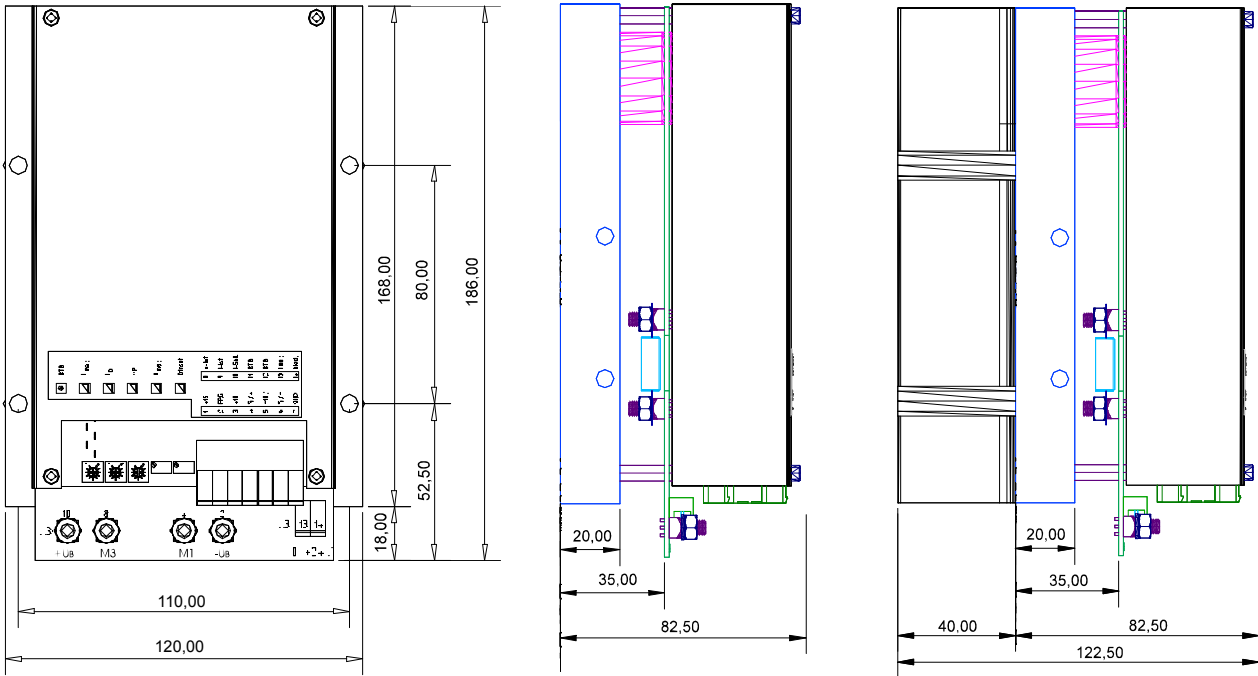


Choke Type	Current A	Induct. mH	Dimensions a / b / c mm	Weight kg
2M7-12	12	1.5	80x 105x 86	1.4
2EI105-20	20	1	90x92x115	3.1
2EI135-40	40	0.7	115x120x145	7



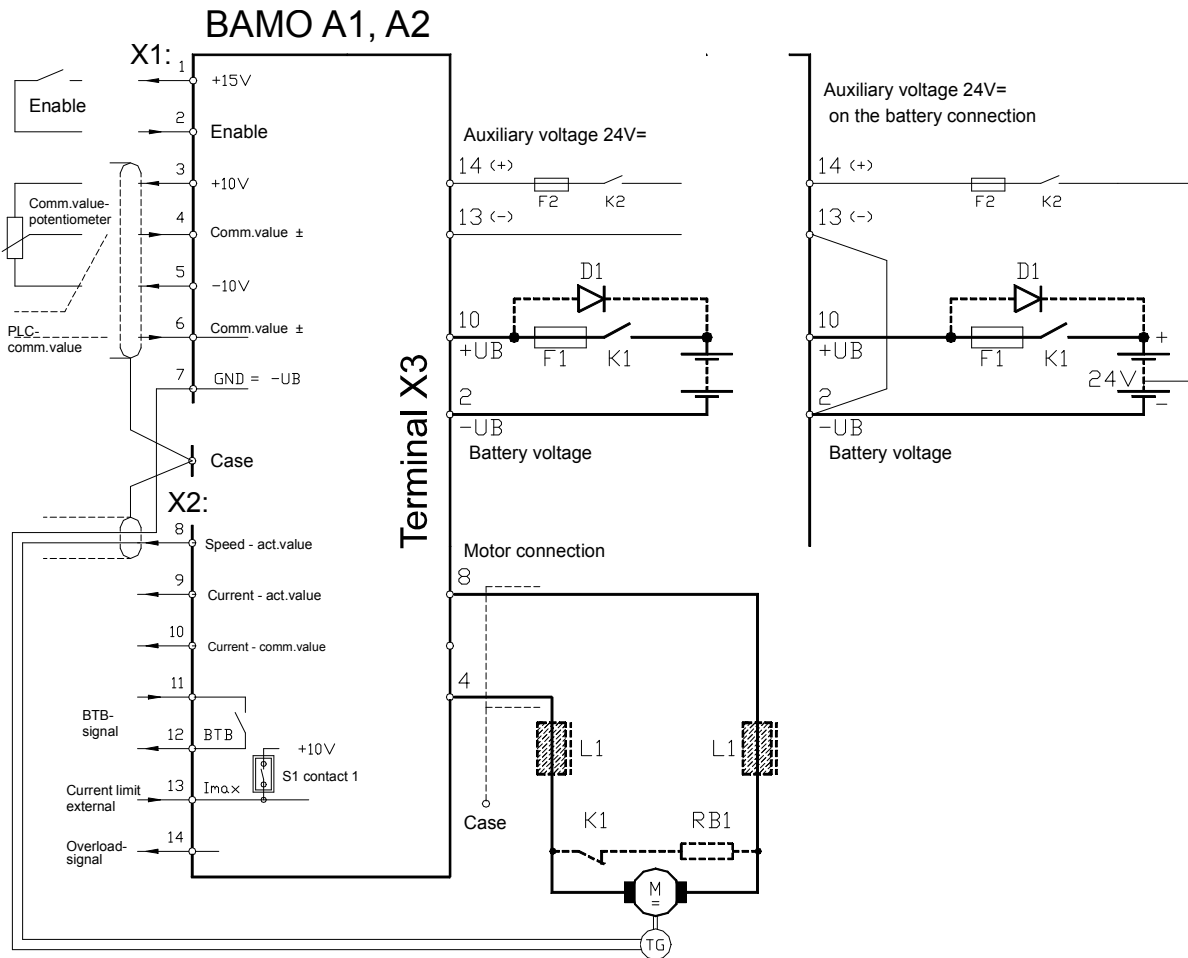
# 2 Mechanical Installation

## Dimensions BAMO A1, A2-x-25, 40



**Bolts : 10x40mm**

# Battery-Motor-Controller BAMO A1, A2-xx



**Notice:**

**Power connection X3:2 (-UB) , X3:10 (+UB)**

Connection polarity >>> no protection against mixing up the contacts  
when the connection is wrong the output stage can be destroyed!

The power connection must not be devided during braking! If nessesary built in reverse-current-protection-diode D1. On-stage current = device peek current

**Connection to Direct voltage bus or Power supply unit**

Make sure that the overvoltage in the buffer circuit is limited to 20% during braking. Small ResisTor of the source or ballast circuit.

If the ResisTor of the motor is very small the fast rising of the buffer voltage circuit can damage the semi-conductors. In normal case the device is switched to error by the overvoltage observation.

**Auxiliary voltage connection X3:13, X3:14**

Safe against mixing up the contacts. The connection can be switched seperated from the power connection.

Notice the tolerance and the residual ripple of the voltage.

**Motor connection X3:4 (M1),X3:8 (M3)**

The motor connections can be exchanged.In case of EMC-problems use chokes and shielded line.

Brakong resistor RB1 and DC-contactor K1 as resistor brake with type A1 or as battery failure brake with type A2

**Control connections see special advices.**

# 3 Electrical Installation

**Caution:**

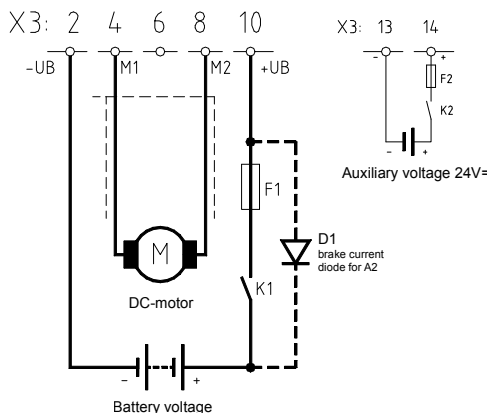
The connection advices concerning the individual attachment of the connections to the plug numbers or terminals are binding.  
 All further advices to this are not binding.  
 The input and output lines can be altered or completed in consideration of the electrical regulations.

**Notice:**

- connection and operation advices
- local technical regulations
- EU-machine regulation 89/392/EWG, 84/528/EWG, 86/663/EWG
- VDE and TÜV regulation
- CE-advice, EMC



**Connection**



**Caution:**

**Risk off distruction by overvoltage in buffer circuit**

Using BAMO-A2-36 the batterie voltage ( $U_{B+}$  X3:10,  $U_{B-}$  X3:2) must be applicated to the device 10s before switching on and 10s after switching off enable to limitate a possible occuring brake voltage by the batterie everse current protection diode D1 against uncontrolled disconnecting the batterie voltage while braking.

If using a DC-Bus notice advices on page 10.

**Connection lines**

dimensioning	at A	10	25	40
Battery connection	mm <sup>2</sup>	2.5	4	6
Motor connection	mm <sup>2</sup>	2.5	4	6
Power fuse F1	A	16	35	50

Auxiliary voltage line	mm <sup>2</sup>	0.5
Line fuse F2	AF	1

**Caution :** Battery lines < 2m  
 with longer lines = use a one step strengther cross section!  
 with batterie lines >5m install booster capacitors

**The connecting advices are for general information and without obligation**

**Notice:**

- Connecting- and operating instructions
- Local regulations
- EU-machine regulation
- VDE and TÜV regulation



pin-No. terminal block

X1: 1 up to X1:7 and X2 : 8 up to X2 : 14

**Signal lines**

Shielded and seperated from power lines.  
comm. values paired twisted and shielded.

**Logical connections**

Relay with gold contacts or reed relays. Contact current 6mA.

**Enable -internal logical voltage**

- internal logical voltage X1:1 +15V/10mA
- contact chain between X1:1 and X1:2

**Enable -external logical voltage**

- enable voltage +10 ... +30V X1:2
- GND X1:7

**Switch on enable**

- comm. value and speed controller are enabled immediately.

**Switch off enable**

- Command value and speed controller quick stop
- comm. value >>> is switched internally immediately to 0
- after 2 seconds >>> speed controller is locked.

**Caution:**

Make sure that the battery voltage is connected to the device at least for 10 seconds after switching off the enable.

**Auxiliary voltage connection**

- Direct voltage 24V= ±10%
- Power requirements 0.5A, with cooling 0.8A

# 3 Electrical Installation

## Comm. value-speed

voltage source for comm. values  $\pm 10V$ , 10mA

+10V	X1:3
-10V	X1:5
GND	X1:7

## comm. value input

- comm. value input maximum  $\pm 10V$
- differential input
- input resistor 50 k $\Omega$
- relay contacts: gold- or reed contacts



## Caution

comm. value lines paired twisted and shielded. Screen connection one-sided.

## Connection :

### comm. value voltage with internal supply

command value	X1:4 (signal)
	X1:7 (GND)
bridge	X1:6 — X1:7

### External comm. value voltage PLC/CNC

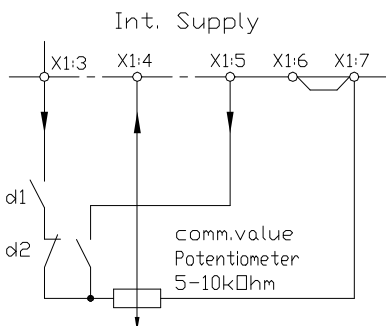
command value	X1:4 (signal)
	X1:6 (GND)

### External command value current PLC/CNC

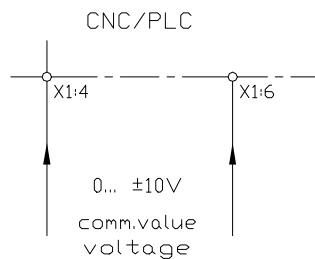
**Resistor** for command value current 0 ...  $\pm 20mA$  >>> R-comm.v. = 500 $\Omega$

command value current	X1:4 (signal)
	X1:6 (GND)

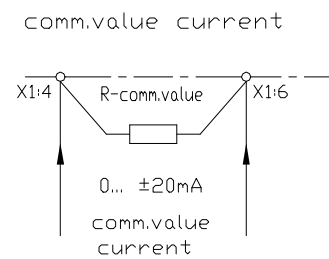
### int. supply



### CNC/PLC



### comm. value current



With A1(1Q) only positive command value

leave out d2 and connection X1:5 is not coated

## Caution:

do not use a command value current between 4 and 20mA



## External current limitation

voltage source for external current limit

+10V/10mA	X1:13
GND	X1:7

## Current limit- input

maximum input voltage +10V

input resistor 10 kΩ

internal attenuation with potentiometer  $I_{max}$

relay contacts: gold- or reed contacts

switch S1, contact 2 = OFF

## Connection

current limit	X2:13	(signal)
	X1:7	(GND)

## RANGE

0 ... + 5V

>>> 0 up to 100% device rated current

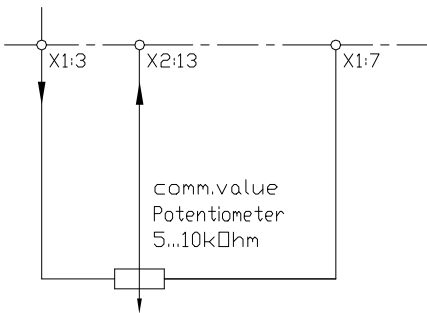
0 ... +10V

>>> 0 up to 200% device rated current

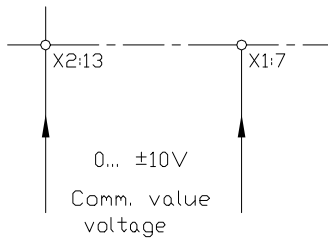
internal over current control

>>> max. 5 s.

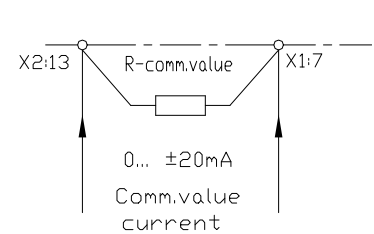
### Int.supply



### CNC/PLC



### comm. value current



## Caution:

in case of internal current limit adjustment

switch S1 >>> contact 2 = ON  
(see page 15)



### 3 Electrical Installation

#### Ready for operation signal BTB

##### Relay RL1

signal contact X2:11 - X2:12  
 contact values max. 48V; 0,5A

The ready for operation signal (BTB) shows the CNC/PLC that the drive is ready for operation.  
 Switch BTB- signals of several axes in one row.

delay after switching on mains >>> max. 1sec.

Function	Indication	BTB-Relais
ready for operation	LED green bright	contact closed
not ready f. operation	LED glims green	contact open
error	LED red bright	contact open

BTB turns off with		error
overtemperature		not stored
overvoltage		stored
short-circuit, line-to-earth-fault		stored
voltage error		not stored

**Caution:**

Use BTB-contact always with CNC/PLC - control or with emergency-stop circuit !  
 Self-starting possible!  
 fault memory  
 -is not effective with all faults !



Signal blocked		
current demand	normal	overload
output X2:14	>+12V	<+2V
Analogue measuring outputs		
Function	motor current indication	speed- indication
connection	X2:9 - X1:7	X2:8 - X1:7
measuring value	5.0V = peak current 2.5V = rated curret	
measuring speed		± tacho voltage before divider
output Resistor	1 kΩ	4.7 kΩ

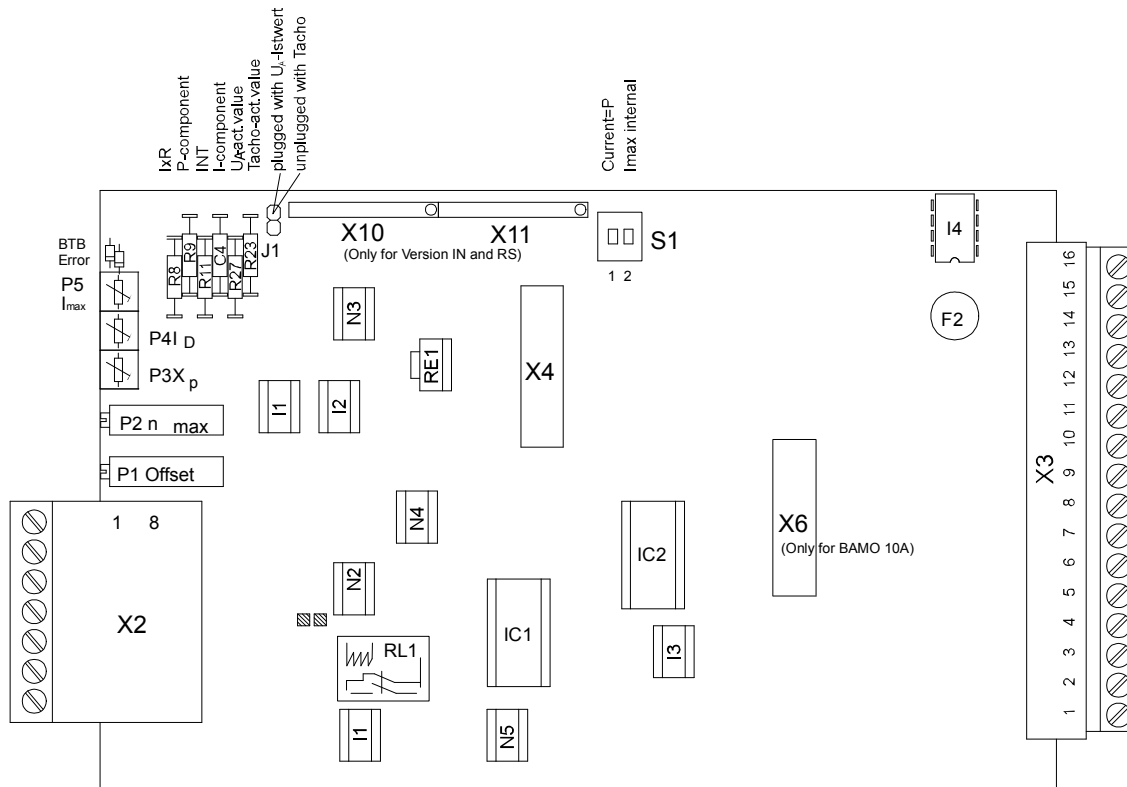
# Battery-Motor-Controller BAMO A1, A2-xx

Plug-Clamp-No.

<b>Control Connections</b>		
<b>Function</b>		<b>Clamp-number</b>
Voltage +15 V/10mA	(for enable)	X1:1
Enable +10 to up +30V	Enable - input	X1:2
Comm.value supply +	Voltage +10V/10mA	X1:3
Command value +	Comm.value - input +	X1:4
Command value supply -	Voltage -10V/10mA	X1:5
Command value -	Command value output	X1:6
GND		X1:7
Speed actual value	Tacho connection	X2:8
Current actual value	measuring output	X2:9
Current command value	measuring output	X2:10
BTB contact	ready for operation	X2:11
BTB contact	ready for operation	X2:12
Current limit external	current limit output	X2:13
Blocked	output	X2:14
<b>Power Connections</b>		
<b>Function</b>		<b>Clamp-number</b>
Battery -	- U <sub>B</sub>	X3:2
Motor 1	M1	X3:4
Motor 2	M2	X3:8
Battery +	+ U <sub>B</sub>	X3:10
<b>Auxiliary voltage</b>		<b>Clamp-number</b>
GND -24V		X3:13
+ 24V		X3:14

# 4 Device Overview

## Component overview



### Indications

D1 green BTB  
D2 red fault

### Poti

P5 I<sub>max</sub>  
P4 I<sub>D</sub>  
P3 X<sub>p</sub>  
P2 n<sub>max</sub>  
P1 Offset

### Jumper/Switch

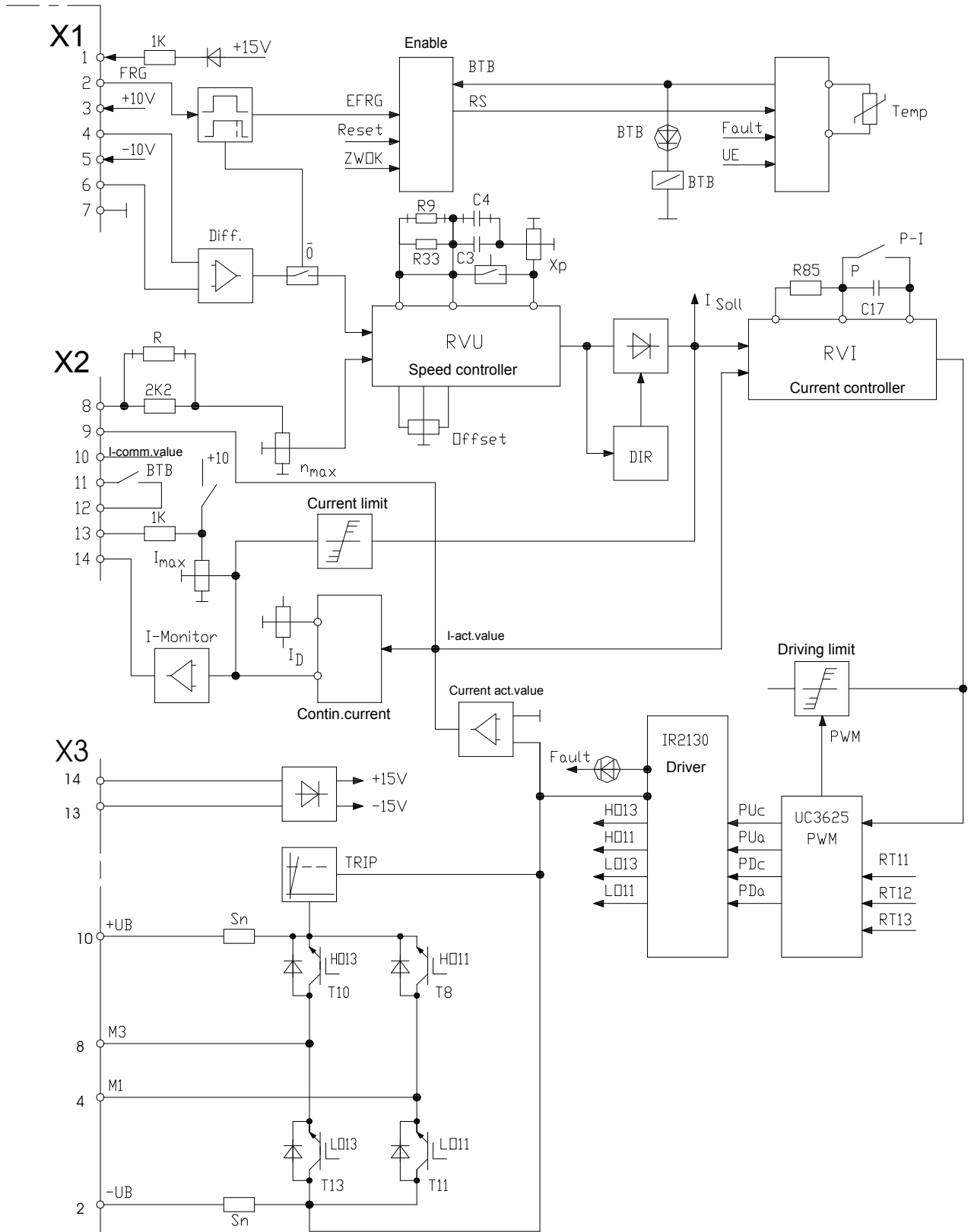
J1 armature voltage control  
S1 cont.1 current controller  
S2 cont.2 current limit internal

### Clamps

X1:1 +15V  
X1:2 enable  
X1:3 +10V  
X1:4 com.value+ (-)  
X1:5 -10V  
X1:6 com.value - (+)  
X1:7 GND  
  
X2:8 n-act.value  
X2:9 I-act.value  
X2:10 I-com.value  
X2:11-12 BTB-contact  
X2:13 ext.current limit  
X2:14 blocked

# Battery-Motor-Controller BAMO A1, A2-xx

Circuit diagram



## 4 Device Overview

Function	Poti	Switch	Jumper	Component
Act.value balance DC-Tacho	P2 (n <sub>max</sub> )		J1 offen	R23
Act.value balance armature voltage control	P2 (n <sub>max</sub> )		J1 gesteckt	R27
IxR - compensation				R8
Current limit internal	P5 (I <sub>max</sub> )	S1-2 ON		
Current limit external	P5 (I <sub>max</sub> )	S1-2 OFF		
Continuous current	P4 (ID)			
Amplification P-component	P3 (XP)			R9
Amplification I-component				C4
Integrator				R11
Zero balance	P1 (Offset)			

### Switch S1

Function	contact	ON	OFF	
Current limit	2	internal	external	
Current amplification	1	P	PI	

### LED- indication

Function	colour	Indication	LED No.	
BTB	green	bright	D1	
Temperatur error	green	low	D1	
error	red	bright	D2	

### Signal outputs

Function	description	Clamp- number
Speed	n-actual value	X2:8
Current	I-actual value	X2:9
Current com.value	I-command value	X2:10
blocked	>10V/6mA	X2:14
BTB - contact	BTB/error	X2:11 , X2:12

## Adjustment

- only by qualified personnel
- adhered to safety regulations
- notice adjusting sequence



Presettings	Adjust with
Actual value	Tacho coarse adjustment R23
Internal/external current limit	Switch S1, contact 2
Current regulator P- PI	Switch S1, contact 1

Optimization	Adjust with
Act.value adjustment	$n_{max}$ adjustment
Current controller	Switch S1, contact 1 (default setup = ON)
Current limit	$I_{max}$ , $I_D$ -adjustment
Speed controller	$X_P$ -adjustment, variable components
Zero point	Offset adjustment
Path-/position controller	in CNC\SP

## Caution:

control systems have to be optimized from inside to outside.

Sequence :

**Current controller** determined by the load circuit time constants  
(motor circuit inductance and motor circuit Resistor)  
optimized in factory, changing P/PI-amplification with S1

**Speed controller** determined by the drive (inertial moment, frictional moment)  
optimize to dynamic of the drive

**Position controller** optimize in the control (CNC\PLC)

Measuring values		
Measuring value	max. value	Measuring point
Nominal value	$\pm 10V$	X1:4
Speed act.value before divider	$\pm 150V$	X2:8
Current act.value unipolar	+ 5V	X2:9
Current com.value unipolar	- 10V	X2:10

# 5 Adjustment

Command value		
Function	max. value	connection
input signal	±10V	
input GND	X1:4	X1:6

Differential input >>> signal- and GND-connection exchangeable  
 External Supply >>> Bridge X1:6 and X1:7, GND connected to X1:7

### Command value as current signal

command value from external current source 0 bis ± 20mA  
 external burden resistor for command value 0 bis max. ±10V

Command value resistor  $R_{Soll}[\Omega] = \text{command value voltage} / \text{command value current}$  (max. 500Ω)

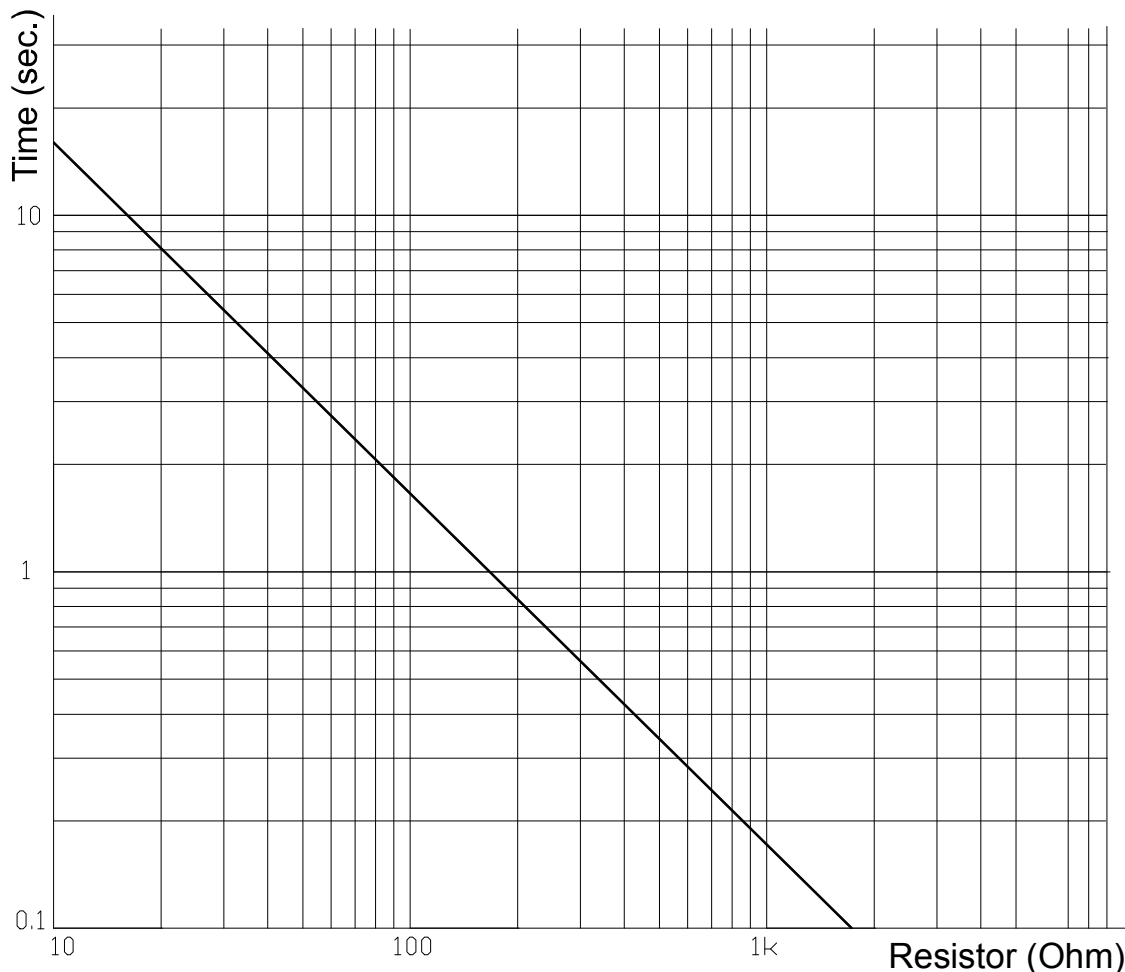


### Caution:

do not use command value current between 4 and 20mA  
 With A1x only positive command value

### Command value - Integrator

Linear - Integrator  
 Time adjustment with resistor R11



## Speed- Actual Value

BAMO - A1x (1Q) DC- or AC-tachogenerator with rectifer  
BAMO - A2x (4Q) only DC-tachogenerator

### Tacho-Connection

Jumper J1 = no plugged  
Input X1:7 = tacho (GND )  
Input X2: 8 = tacho ( Signal)  
PE-Bolt = shielding

com. value input X1: 4 positive >>> tacho input X2: 8 positive

### Tacho Voltage

at maximum speed  
limit >>> minimum 5V=, maximum 160V=

### Coarse adjustment

with resistor R23

Tacho-voltage-range				
without R23		>>>	15V	= up to 160V=
with R23	1k $\Omega$	>>>	5V	= up to 55V=

### Armature voltage regulation with IxR -compensation

internal feed back  
Coarse adjustment  
Voltage range resistor R27  
IxR compensation  
Motor resistor resistor R8

### Speed - fine adjustment

with potentiometer  $n_{max}$  (P2)

Command value from potentiometer:  
with 1V com. value adjust to 10% of max. speed  
with 10V com. value fine adjust to 100% (max. speed)

Command value from CNC\PLC:  
with 0.8V command value adjust to 10% of maximum speed

### Changing direction of rotation

change motor- **and** tacho-connection  
with armature voltage regulation change only motor-connection.

# 5 Adjustment

## Current limitation

peak current	range 0 up to 200% com. current reset time max. 5 sec.	poti I <sub>max</sub> (P5)
steady current	range 5 up to 100% com. current	poti I <sub>D</sub> (P4)

### Internally resetting current limits

Current limit	Function	Limit
overload	time	continuous current
signal to X2:14	blocked	

Peak current internal current limit (default setup)			
adjustment		switch	poti
I <sub>max</sub>		S1, contact 2=ON	I <sub>max1</sub> (P5)
External current limit			
adjustment	input	switch	poti
I <sub>max</sub>	X2:13 0 ... +10V	S1, contact 2=OFF	I <sub>max1</sub> (P5)
The external current limit can internally be reduced with I <sub>max</sub> - potentiometer.			
Constant current			
adjust motor protection for both torque directions on motor com. current with potentiometer I <sub>D</sub> (P4)			

## Measure adjustment values

- do not connect motor
- predetermine com. value and enable >>> switch off/on

Measuring value current com.value X2:10 (5V= rated current)		
com. value	measuring value I <sub>max</sub> (ca.2sec.)	measuring value I <sub>D</sub>
+5V	0 up to max.10V	0.25 up to max. 5V
- 5V	0 up to max.10V	0.25 up to max. 5V
Measuring value current actual value X2:9		
Current actual values	measuring value I <sub>max</sub> (ca.2sec.)	measuring value I <sub>D</sub>
±	0 upto+5V	0.12 up to+2.5V

### Caution:

- for exact torque control:
- PI-current control switching necessary
    - manufacturers adjustment is P-control
    - change from P- to PI-control in current controller
    - switch S1, contact 1 = OFF

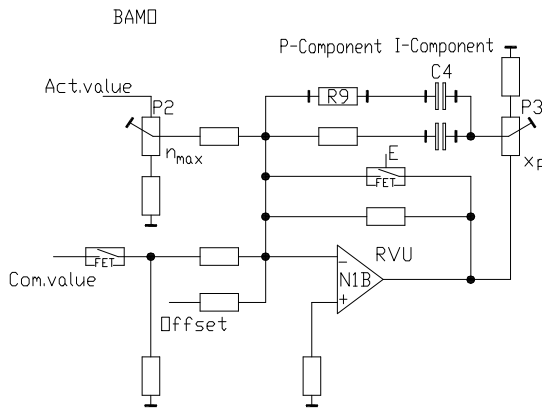


## Speed Controller Switching

- variable components R9, C4
- amplification potentiometer P3 (X<sub>P</sub>)
- in case of changing devices >>> take over adjustment values.

### Basic setup (values of soldered components)

- P- component = 390kOhm      decrease with R9 (470Ohm up to 220kOhm)
- I - component = 22nF      increase with C4 (0.1μF up to 1μF)
- amplification potentiometer X<sub>P</sub> to 50%



- optimal for most drives.

## Adjustment without measuring instruments

connect motor,

- com. value = 0
- X<sub>P</sub> = 50%
- R,C = basical values

enable drive,

- turn potentiometer X<sub>P</sub> clockwise until drive swings
- turn potentiometer X<sub>P</sub> anticlockwise until the swinging is dying-out,
- turn X<sub>P</sub>-potentiometer further 2 positions anticlockwise.

Drive behaviour:	
amplification too low	amplification too high
long oscillations 1... 0.1Hz	short oscillations 30 ... 200Hz
long overshoots	vibrates during acceleration
overruns target position	vibrates during braking and in position

### Caution:

- in case of operating with CNC\PLC
- in case of maximum speed
- adjust com. value speed with Poti n<sub>max</sub> from 8 up to 9V





## Basic setup

### Check connections before getting started

Connection	Voltage	Clamps
Battery connection	max.36V oder max.160V	X3: 2, X3:10
Auxiliary voltage	24V= ± 10%	X3:13, X3:14
Motor connection	max. 30V oder max. 150V	X3: 4, X3:8
Notice connection advice		

### Basic connections-power supply

Battery	2x power supply connection, Polarity please note!	
Motor	2x Motor connection	

### Basic connection-control connections

Auxiliary voltage	24V= ± 10%	X3:13, X3:14
BTB	Contact between	X2:11, X2:12
enable	Contact between	X1: 1, X1: 2
com. value ( PLC)	Differential input ± 10V	X1: 4, X1: 6

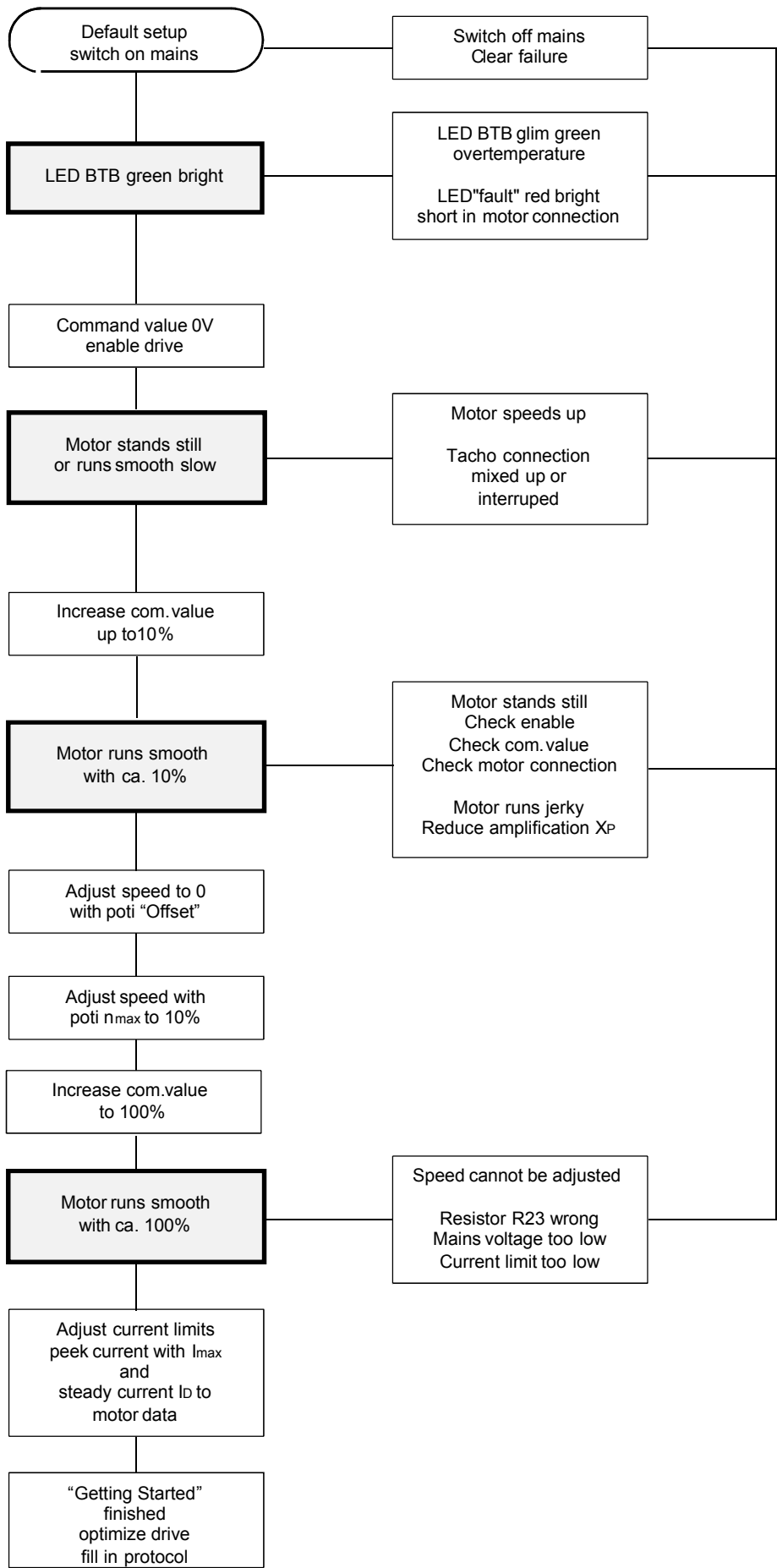
com. value with internal poti-supply		bridge X1:6-X1:7
A1 (1Quadr.)	Positiv 10V	X1:3 (GND X1:7)
A2 (4Quadr.)	Positiv 10V	X1:3
	Negativ 10V	X1:5
com. value	± 10V	X1:4

Actual value - tachometer	± 160V	X2:8 (GND X1:7)
Armature voltage regulation no actual value connection. Jumper J1 unplugged!		

### Default setup for first getting started

Function	Potentiometer		adjustment
peak current	I <sub>max</sub>		20%
steady current	I <sub>D</sub>		100%
amplification	X <sub>P</sub>		10%
speed	n <sub>max</sub>		0%
Zero point	Offset		50%
	Switch / contact		
Current controller PI	S1	K1	ON
Current limit internal	S1	K2	ON

# 6 Adjustment



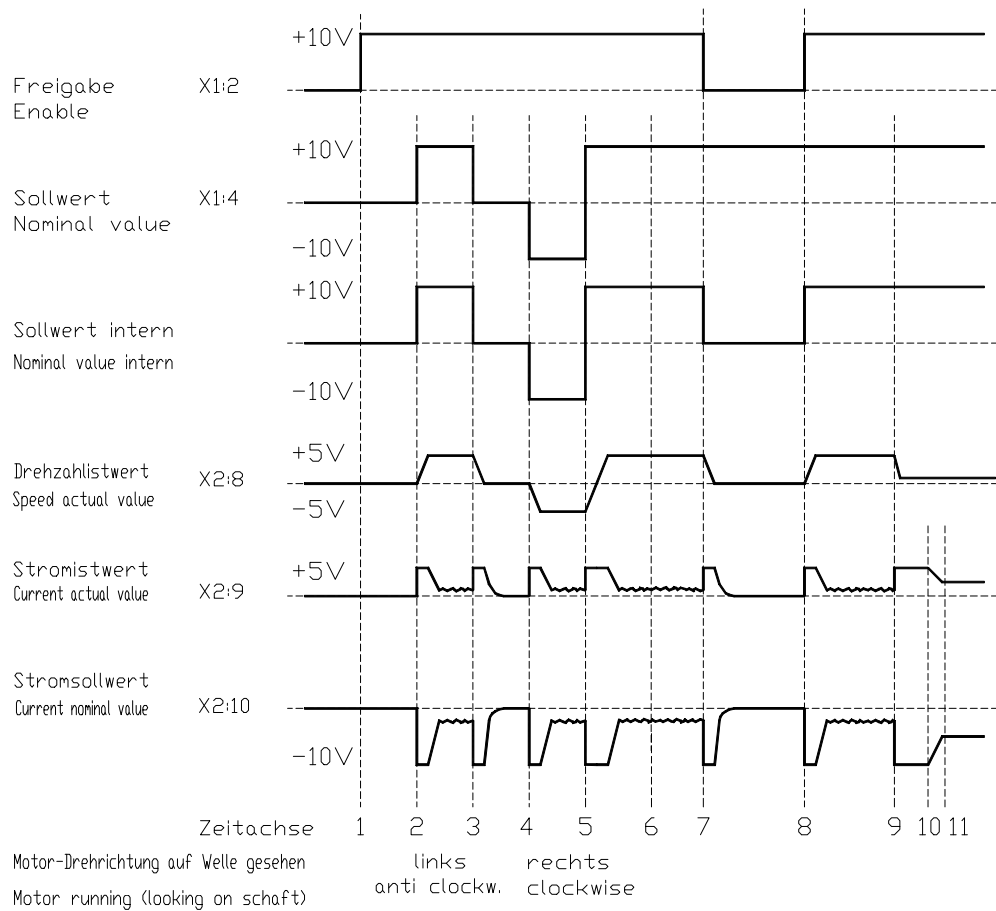
# Battery-Motor-Controller BAMO A1, A2-xx

## Faults

Faults	
Fault	Causes
LED bright red	Overtemperature Short in motor connection Output stage fault Overvoltage
Motor stands still no torque	Enable missed Current limit $I_{max}$ anti-clockwise stop Motor connection interrupted
Motor speeds up	Tachometer polarity wrong Tachometer connection interrupted
Motor runs jerky	Amplification $X_P$ too high. com. value faults
Drive switches to fault LED red bright	Overtemperature, phase- or earth-short. BTB-fault Ocoarse adjustment with resistor output stage fault
Speed can't be adjusted with poti $n_{max}$	Jumper J1 wrong R23 wrong command value wrong

# 7 Fault Finding

## Signalplan Signal scheme



Time axis		
1	Enable on	Motor stands still with torque
2	Command value positive	Motor accelerates
3	Command value 0V	Motor decelerates
4	Command value negative	Motor accelerates
5	Command value positive	Motor decelerates and accelerates
6	Speed constant	Motor runs with load current
7	Enable off	Motor decelerates, device is locked after 5s.
8	Enable on	Motor accelerates
9	Overload	Speed brakes down, current increases to maximum peek current
10	Overload >3s	Current is reduced to steady current
11	Steady current limit	

# Battery-Motor-Controller BAMO A1, A2-xx

<b>Commissioning protocol</b>					
Customer		Machinen-No.			
Device		Series-No.			
<b>Connection</b>					
Battery voltage [V=]		Auxiliary voltage [V=]			
fuse [A]		Fuse [A]			
<b>Input</b>					
enable	contact	PLC/CNC	voltage [V=]		
com. value	Poti	PLC/CNC	voltage [V=]		
Current com. value	Poti ext.	PLC/CNC	voltage [V=]		
<b>Actual value adjustment</b>					
Tacho	V=/1000UPM		R23 [kΩ]		
Armature voltage	V=/1000UPM		R27 [kΩ]		
IxR-comp.			R8 [kΩ]		
<b>Adjutment current controller</b>					
Switch	S1-cont.1 ON = P		S1-cont.1 OFF = PI		
Switch	S1-cont.2 ON = internal		S1-cont.2 OFF = current limit external		
<b>Adjustment speed controller</b>					
P-component	R9[kΩ]		I-component	C4 [nF]	
<b>Potentiometer - positions</b>					
peek current	I <sub>max</sub> P5	position			
Steady current	I <sub>D</sub> P4	position			
amplification	X <sub>P</sub> P3	position			
speed	n <sub>max</sub> P2	position			
Zero point	Offset P1	position			
<b>Measuring values</b>					
Motor voltage	max. [V=]				
Tachovoltage	max. [V=]				
Motor current	peek [A=]		steady [A=]		
<b>Motor data</b>					
Producer		Type			
Series-No.		Motor voltage		Motor current	
Tacho voltage		Brake		fan	

## 8 Guarantee

**UNITEK** products have a warranty against defects in material and workmanship for a period of one year from the date of shipment. All values from the pre- and final quality control checks are archived with the devices' serial numbers. UNITEK does not guarantee the suitability of the device for any specific application.

During the warranty period, UNITEK will, at its option, either repair or replace products that prove to be defective, this includes guaranteed functional attributes. UNITEK specifically disclaims the implied warranties or merchantability and fitness for a particular purpose. For warranty service or repair, this product must be returned to a service facility designated by UNITEK.

For products returned to UNITEK for warranty service, the Buyer shall prepay shipping charges to UNITEK and UNITEK shall pay shipping charges to return the product to the Buyer.

However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to UNITEK from another country.

The foregoing warranty shall not apply to defects resulting from:

- \* improper or inadequate repairs effected by the Buyer or a third party,
- \* non-observance of the manual which is included in the all consignments,
- \* non-observance of the electrical standards and regulations
- \* improper maintenance
- \* acts of nature

All further claims on transformation, diminution and replacement of any kind of damage, especially damage, which does not affect the UNITEK device, cannot be considered. Follow-on damage within the machine or system, which may arise due to malfunction or defect in the device cannot be claimed. This limitation does not affect the product liability laws as applied in the place of manufacture (i. e. Germany).

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