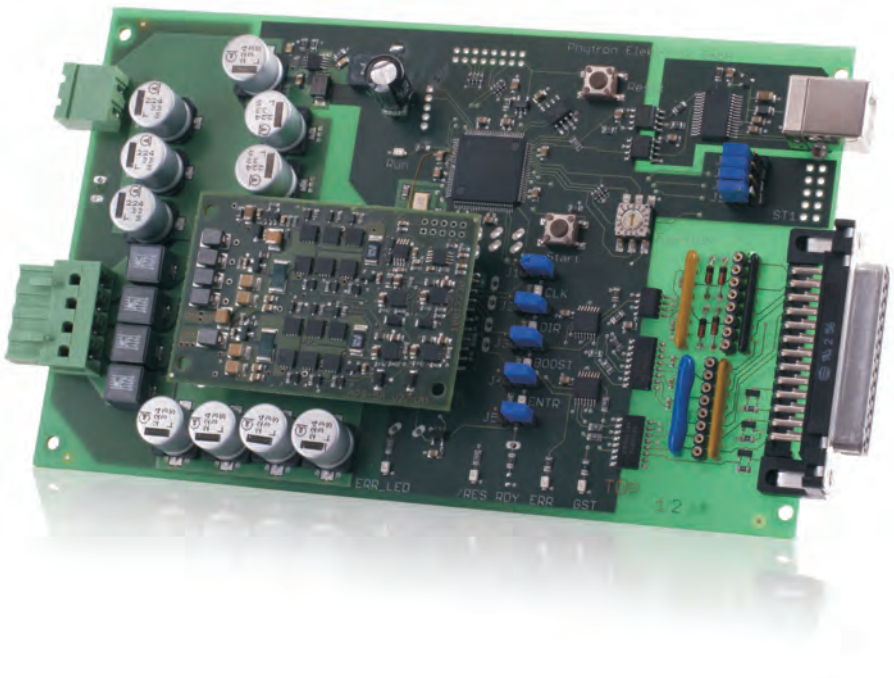
EVA-APS

phytron

Evaluation Board for the APS Stepper Motor Power Stage



Manual 2118-A002 EN

customized solutions in motion

EVA-APS

Evaluation Board for the

APS Stepper Motor Power Stage

TRANSLATION OF THE GERMAN ORIGINAL MANUAL

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In this manual you will find the descriptions of the features and specifications of the evaluation board: EVA-APS

This manual is also a supplementary to the "*APS Module High Performance Stepper Motor Power Stage"* manual.

Every possible care has been taken to ensure the accuracy of this technical manual. All information contained in this manual is correct to the best of our knowledge and belief but cannot be guaranteed. Furthermore we reserve the right to make improvements and enhancements to the manual and / or the devices described herein without prior notification.

We appreciate suggestions and criticisms for further improvement.

Email address: doku@phytron.de

Questions about the use of the product described in the manual that you cannot find answered here, please contact your representative of Phytron (http://www.phytron.de/) in your local agencies.

1 Information

This manual:

Read this manual very carefully before mounting, installing and operating the device and if necessary further manuals related to this product.

- Please pay special attention to instructions that are marked as follows:

 **DANGER – Serious injury!**	*Indicates a high risk of serious injury or death!*
 **DANGER – Serious injury from electric shock!**	*Indicates a high risk of serious injury or death from electric shock!*
 **WARNING – Serious injury possible!**	*Indicates a possible risk of serious injury or death!*
 **WARNING – Serious injury from electric shock!**	*Indicates a possible risk of serious injury or death from electric shock!*
 **CAUTION – Possible injury!**	*Indicates a possible risk of personal injury.*
 **CAUTION – Possible damage!**	*Indicates a possible risk of damage to equipment.*
 **CAUTION – Possible damage due to ESD!**	*Refers to a possible risk of equipment damage from electrostatic discharge.*
 **“Any heading”**	*Refers to an important paragraph in the manual.*

Observe the following safety instructions!

Qualified personnel

WARNING – Serious injury possible!

Serious personal injury or serious damage to the machine and drives could be caused by insufficiently trained personnel!

Without proper training and qualifications damage to devices and injury might result!

- Design, installation and operation of systems may only be performed by qualified and trained personnel.
- These persons should be able to recognize and handle risks emerging from electrical, mechanical or electronic system parts.
- The qualified personnel must know the content of this manual and be able to understand all documents belonging to the product. Safety instructions are to be provided.
- The trained personnel must know all valid standards, regulations and rules for the prevention of accidents, which are necessary for working with the product.

Safety Instructions

Further manual

This manual is a supporting manual for the following manual:

"APS Module High Performance Stepper Motor Power Stage"

- First read the basic manual and then the EVA-APS manual.

Intended use:

The APS module is designed for operating in a drive system.

- An installation is allowed only if the requirements of the EC Machinery and EMC Directives are conformed with.

Part of a machine:

This product is used as a part of a complete system, therefore risk evaluations concerning the specific application must be made before using the product.

- Safety measures have to be taken according to the results and be verified.
- Personnel safety must be ensured by the concept of this overall system (e.g. machine concept).

WARNING – Serious injury from electric shock!

If the APS module is not operated with SELV/PELV voltages, the risk of dangerous voltages may be on the device. Touching these components carrying high voltages can cause serious injury or death from electric shock:

- Always observe the safety concept SELV / PELV to ensure safe insulation and separation of low voltage supplies from the mains.

WARNING – Serious injury from electric shock!

During electrical installation cables, connectors, etc. can be live.

- Before starting wiring, make sure that none of the power supplies are connected to the primary side of the mains supply. Isolate the power supplies from the mains or remove the appropriate fuses.
- The APS module must be plugged into the EVA-APS board before installation.
- Do not plug or unplug the modules while powered.
- Do not plug or unplug the connectors while powered.
- If the equipment was energised, wait 3 minutes after power off to allow the capacitors to discharge and ensure that there are no residual charges on cables, connectors and boards

2 Contents

3 Module Overview – EVA-APS

EVA-APS is an evaluation board or carrier module for the application development of the high performance APS stepper motor power stage (5 A_{PEAK} at 24 - 70 V_{DC}).

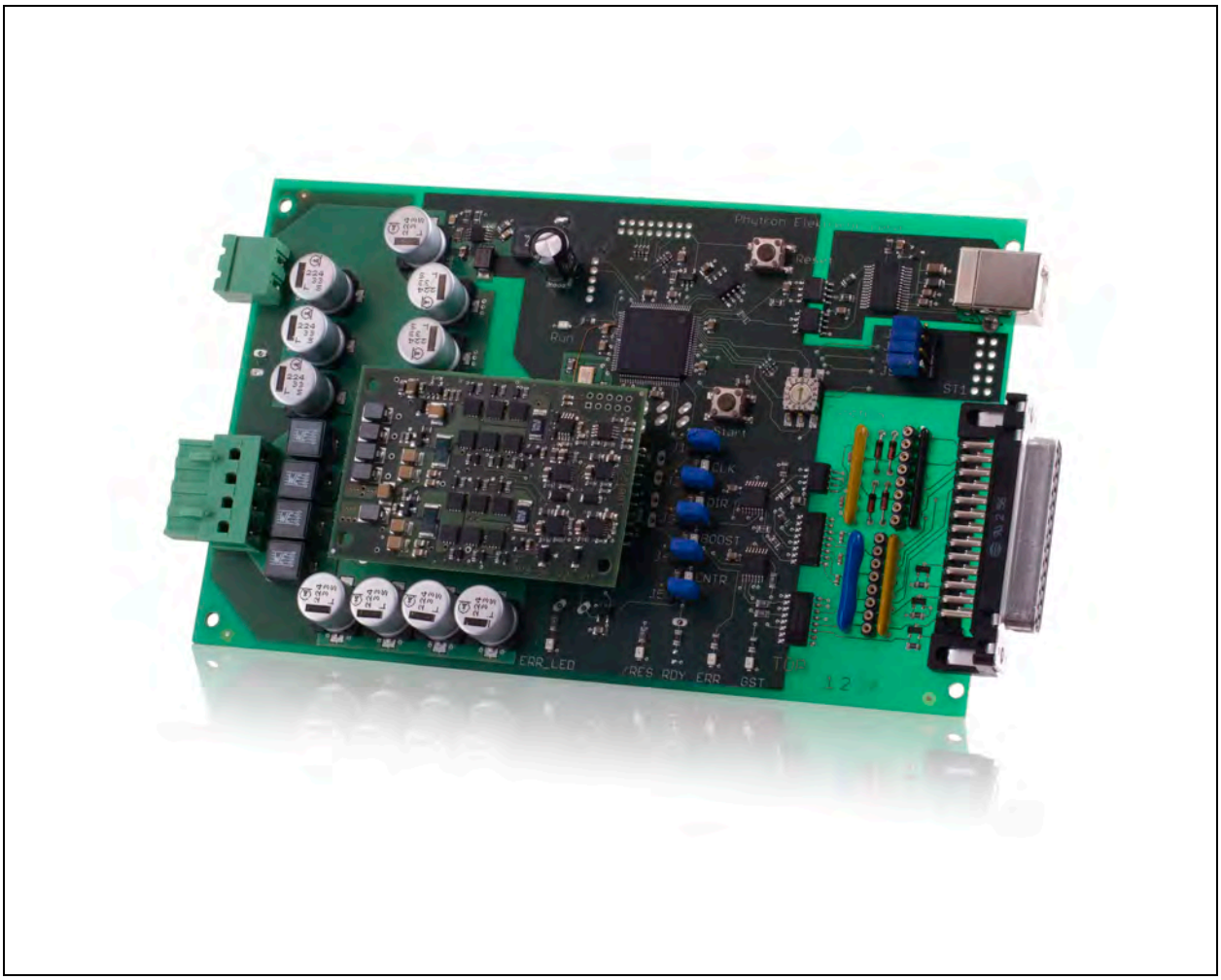


Fig. 1: EVA-APS carrier module with plugged APS module plugged in

- All the features of a full stepper motor power stage are available.
- Power stage module for 2-phase stepper motors up to 5 A_{PEAK} at 24 to 70 V_{DC}
- Online parameterising and diagnostics via USB interface
- Control via Pulse/Direction
- Supply of the input signals defined by jumpers
- Compact PCB in Europe size 100 x 160 mm
- ServiceBus-Comm™ software

Connections

- Power supply
- Motor connection
- USB connection (ServiceBus)
- Pulse/Direction
- SPI interface ST1 (customised)
- PCB connectors for APS power stage:
  2 mm grid; 0.5 mm pin (Fischer Elektronik company)
  Pins: 2x10 and 2x12
- 2 Program pushbuttons
- 1 Rotary switch (Function)
- 9 Jumpers

Scope of delivery

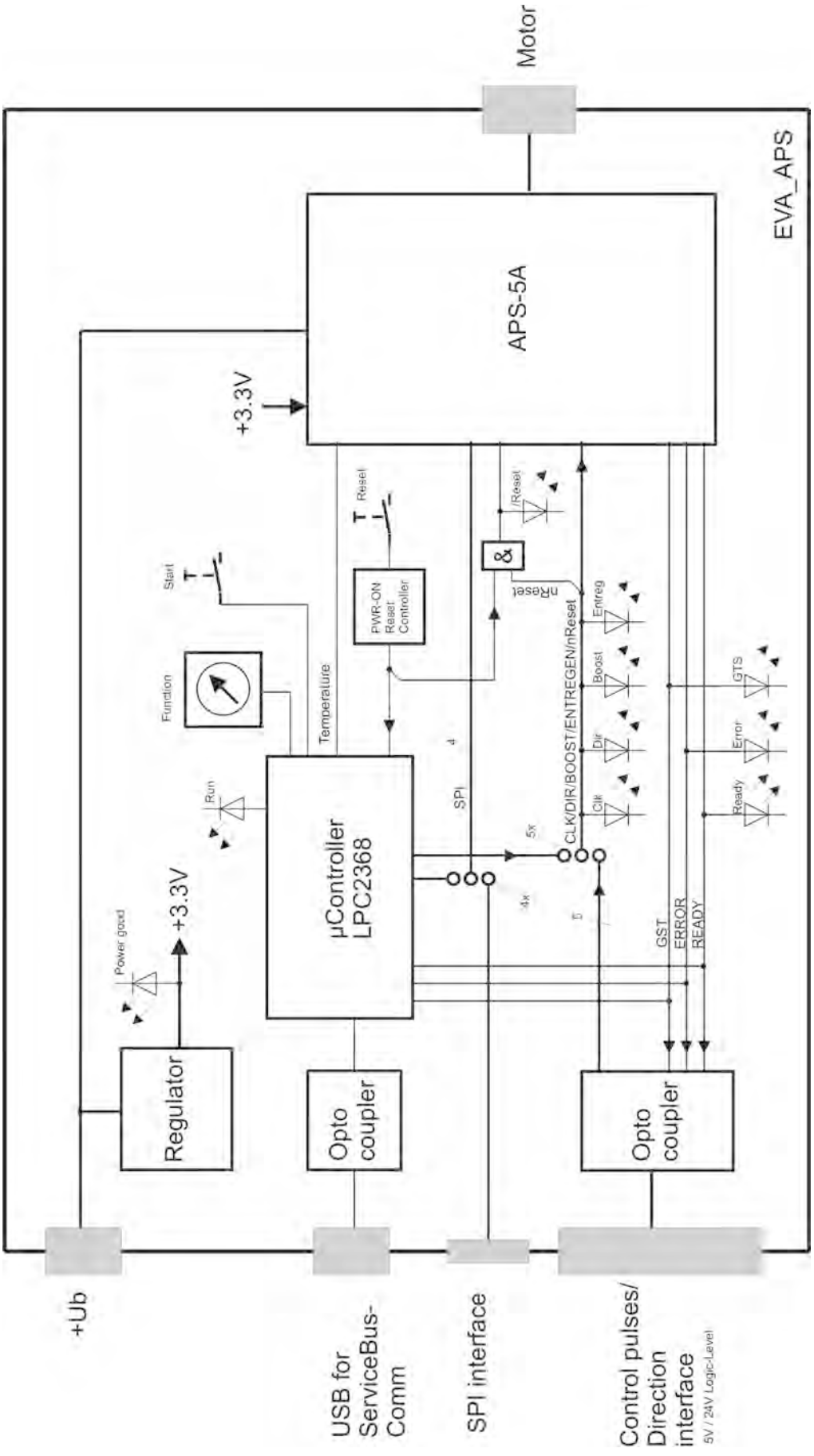
Includes:

- Phytron CD with the ServiceBus-Comm™ software and manual
- EVA–APS manual
- ServiceBus-Comm™ manual

WARNING – Damage by wrong motor current setting!

The power stage is set on delivery to a defined current value. Please check the adjusted current for the stepper motor before installation (see the motor data).

4 Block Scheme



5 Technical Data

5.1 Mechanical Data

Dimensions	100 x 160 mm
Weight	with APS: 225 g without APS: 210 g
Mounting	----

5.2 Transport and Storage

Permissible transport and storage conditions:

Transport and storage temperature:	-40 to +70 °C
Relative humidity	max. 95 % , no condensation and ice permissible
Package:	Always in ESD packing

CAUTION – Possible damage by ESD!

The module consists of sensitive electronic components that can be destroyed by electrostatic discharge voltages.

- Always store and transport single modules in ESD protective packaging.
- Always handle the components in compliance with the ESD protection measures.
- No liability is accepted for any consequences resulting from improper handling or non-ESD-friendly packaging.

CAUTION – Possible damage by collisions!

The APS module consists of sensitive electronic and mechanical components.

- Avoid collisions to the module.

5.3 Features

Performance Characteristics			
Supply voltage	24…70 V_{DC} Nominal voltage: 70 V_{DC}		
Nominal power of the motor voltage supply	100 W		
Stepper motor	for bipolar control of 2 phase stepper motor with 4, (6) or 8 leads		
Phase current	0.1 to 3.5 $A_{r.m.s}$ (0.1 to 5 $A_{PEAK,}$) short-circuit-proof, overload-proof		
Maximum step frequency	500,000 steps/sec.		
Inputs	Control pulses, Direction, Boost, Deactivation, Reset The inputs are electrical isolated by optocoupler. Input level 5 V or 24 V (dependent on the resistance)		
	Signal level	5 V	24 V
	High	3 – 5.5 V	20 – 30 V
	Low	< 0.4 V	< 3 V
	Required driver current	10 mA max. (at 3 V)	10 mA max. (at 20 V)
		30 mA max. (at 5.5V)	20 mA max. (at 30 V)
Outputs	Power stage is ready, Error		
2 Program pushbuttons	START: for motor running RESET: Reset of the settings		
1 Rotary switch (Function)	Setting of the operating mode		

Interfaces	
Motor voltage supply	24 V_{DC} to 70 V_{DC} input range for the supply of the power output and to generate internal logic voltages
USB	USB interface for parameterising of the APS power stage
Analogue outputs (Motor)	A, B, C, D for a 2 phase stepper motor
SPI Interface (ST1)	10 pole (2x5), pads for mounting a customised connector
Pulse/Direction interface	25-pole SUB-D connector female, opto-decoupled
PCB connectors 2x14 and 2x12 pin	2 mm grid; 0.5 mm pin Pins: 2x10 and 2x12 for APS power stage connection
9 Jumpers	For input signal specification

6 Installation

6.1 Mechanical Installation

The SPS is delivered as a single module board.

Unpack the module carefully in ESD protected area only.

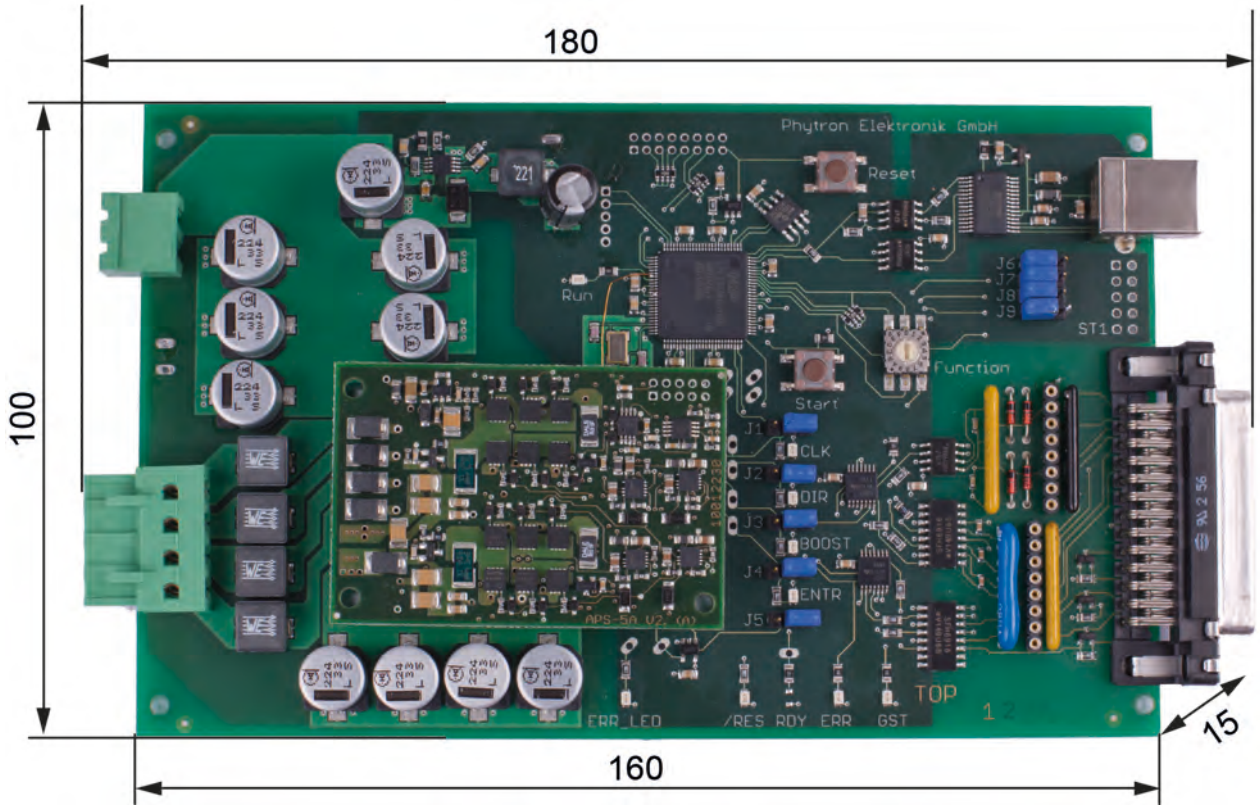


Fig. 2: Dimensions in mm

CAUTION – Possible damage by ESD!

The module consists of sensitive electronic components that can be destroyed by electrostatic discharge voltages.

- Always store and transport single modules in ESD protective packaging.
- Always handle the components in compliance with the ESD protection measures.
- No liability is accepted for any consequences resulting from improper handling or non-ESD-friendly packaging.

CAUTION – Possible damage!

The module is designed for a maximum supply voltage of 70 V_{DC}. If it is supplied with >70 V_{DC} the card might be damaged.

- Make sure that a power supply is used with less than 70 V_{DC} to avoid damage.

Before integrating or changing the APS module always make sure that the EVA-APS is shut down and the power supply is disconnected.

WARNING – Serious injury from electric shock!

During electrical installation cables, connectors, etc. can be live.

- Before starting wiring, make sure that none of the power supplies are connected to the primary side of the mains supply. Isolate the power supplies from the mains or remove the appropriate fuses.
- Do not plug or unplug the modules while powered.
- Do not plug or unplug the connectors while powered.
- If the equipment was energised, wait 3 minutes after power off to allow the capacitors to discharge and ensure that there are no residual charges on cables, connectors and boards.

Now you can start with the electrical installation.

6.2 Electrical Installation

Ensure sufficient bending radius of the cables during installation. Do not lay the cables in tension or bend them.

If all the connections are made, the last step is to plug in the power supply to the mains.

6.2.1 Connectors - Overview

Connector	Number of pins	Connector on the module	Mating connector
PCB connector BU1	2x12	2 mm grid (e.g. SLY8 SMD062-24-S)	e.g. BLY8 SMD-…
PCB connector BU2	2x10	2 mm grid (e.g. SLY8 SMD062-20-S)	e.g. BLY8 SMD-…
Supply	1x2	MSTBA2,5/2G	FMC1,5/2-ST-3,5
Motor	1x4	IC 2,5/4-G-5,08	IC 2,5/4-ST-5,08
USB	1x4	Female connector type B DIN IEC 61076-3-108	Connector type B DIN IEC 61076-3-108
D-SUB	25	D-SUB female connector	D-SUB connector
Pads ST1	2x5	customised	customised

6.2.2 Connector Assignment

The following is the assignment of the PCB connectors:

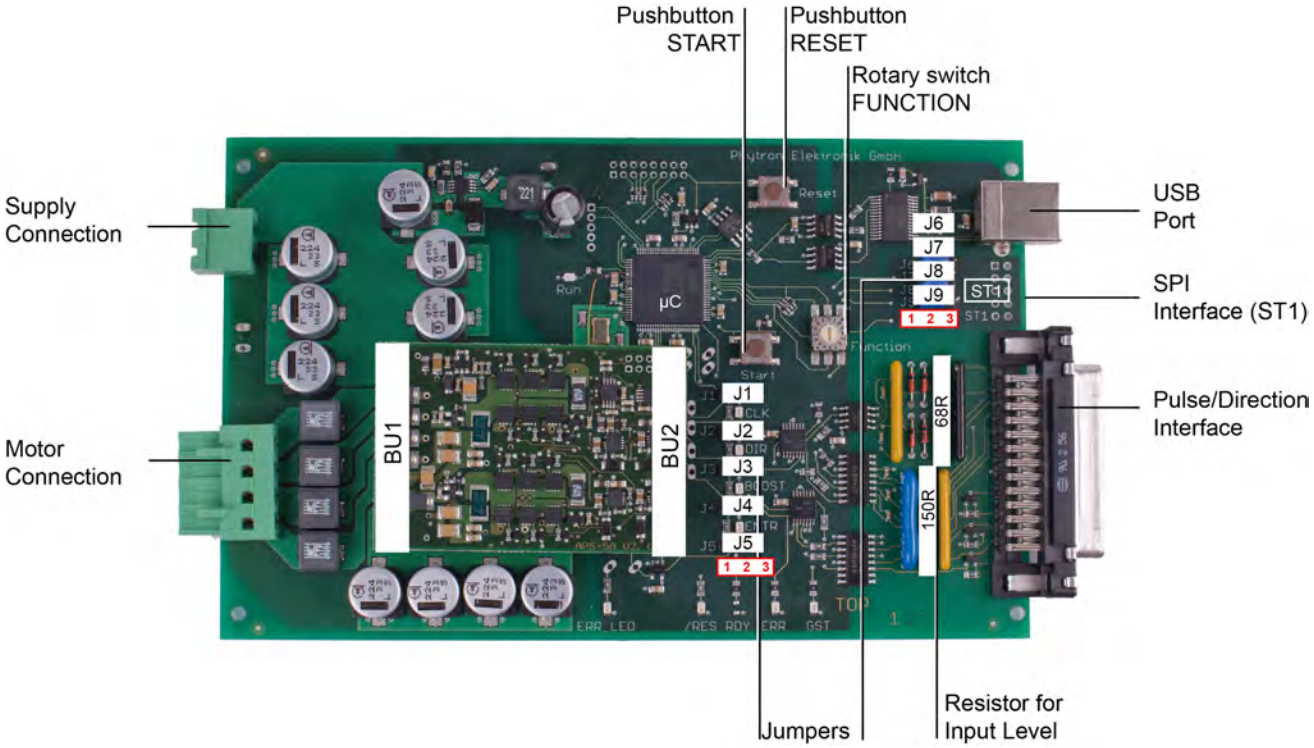


Fig. 3: Connection

6.2.3 APS Power Stage Module

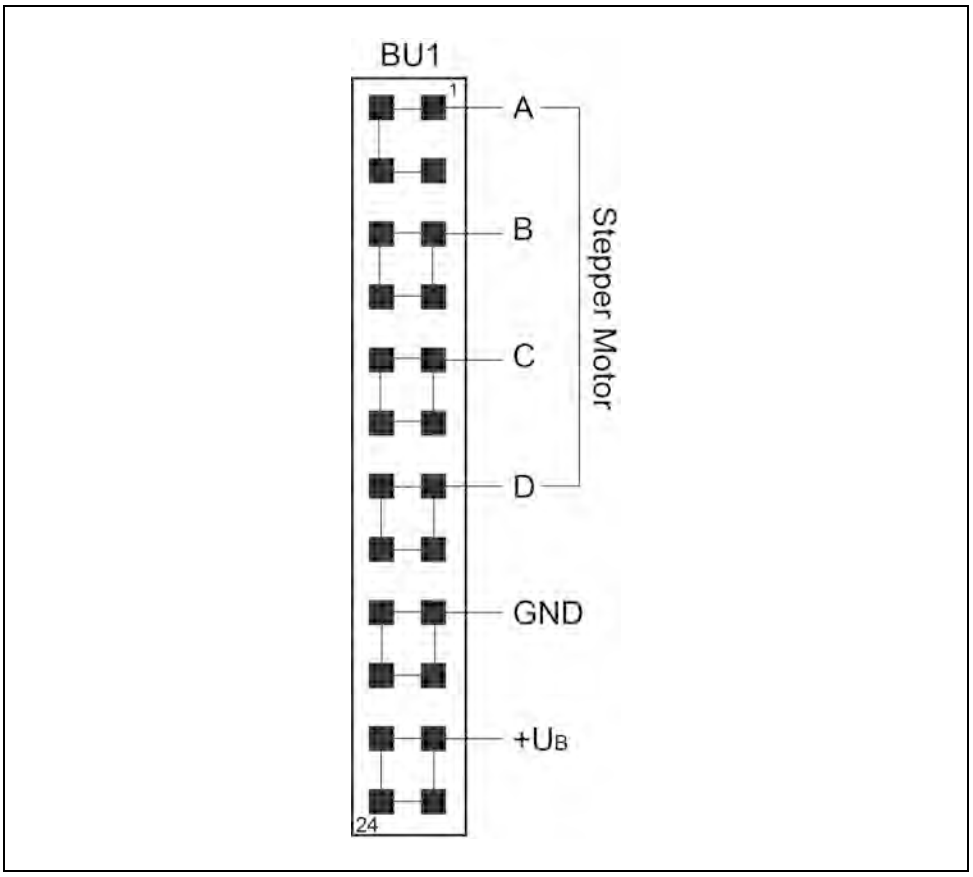


Fig. 4: Pin assignment "BU1"

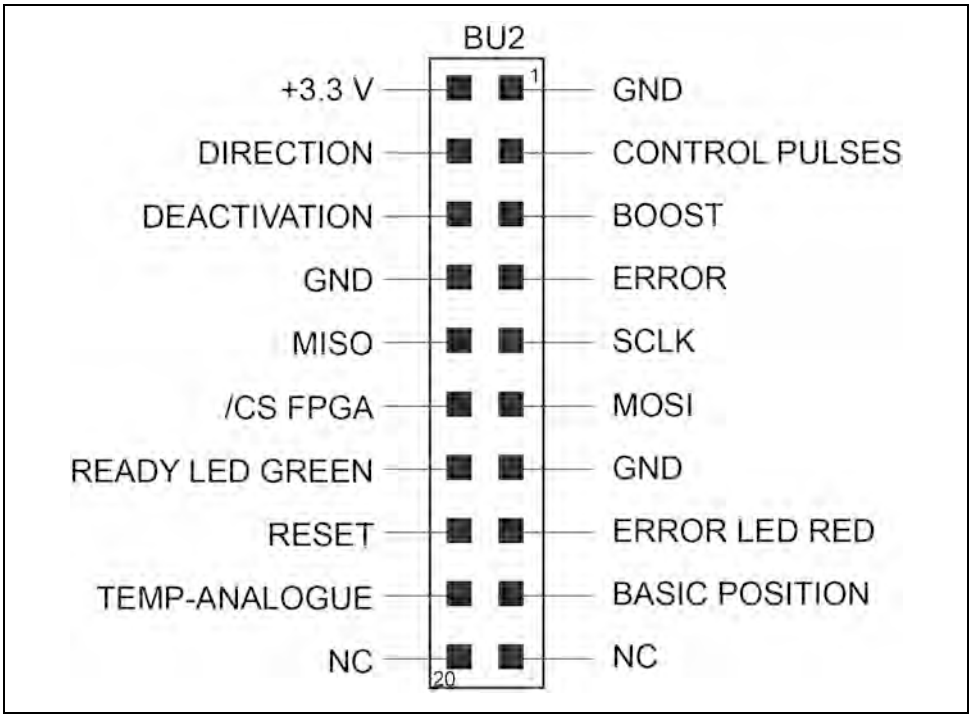


Fig. 5: Pin assignment "BU2"

6.2.4 Power Supply

Permissible supply voltage range: 24 to 70 V_{DC}

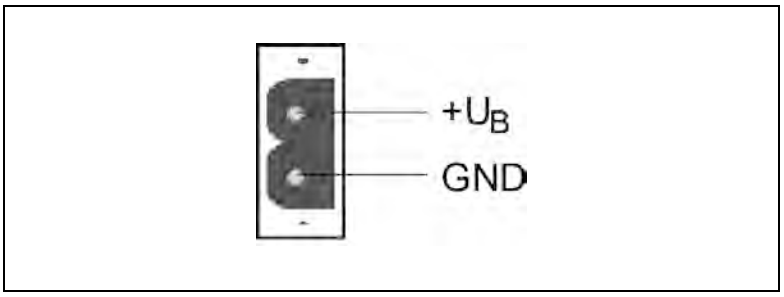


Fig. 6: Type MSTBA2,5/2G

6.2.5 Motor

In the following chapter the connection of a 2 phase stepper motor with 4, (6), or 8 lead wiring is described.
Stepper motors with 0.1 to 5.0 A_{PEAK} can be controlled at maximum 70 V_{DC} by the APS with the EVA-APS.

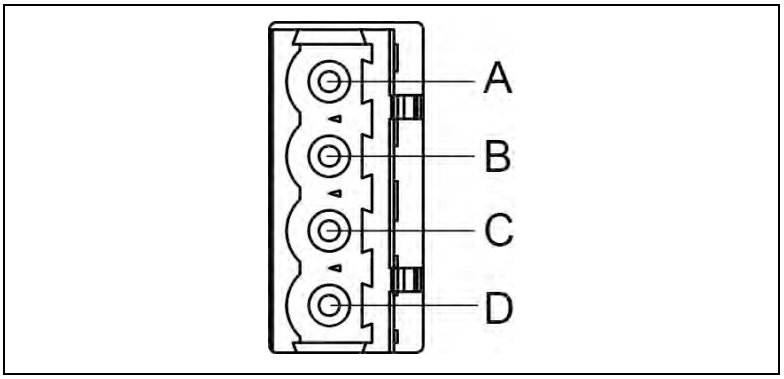


Fig. 7: Type MSTBA2,5/2G

Wiring Schemes

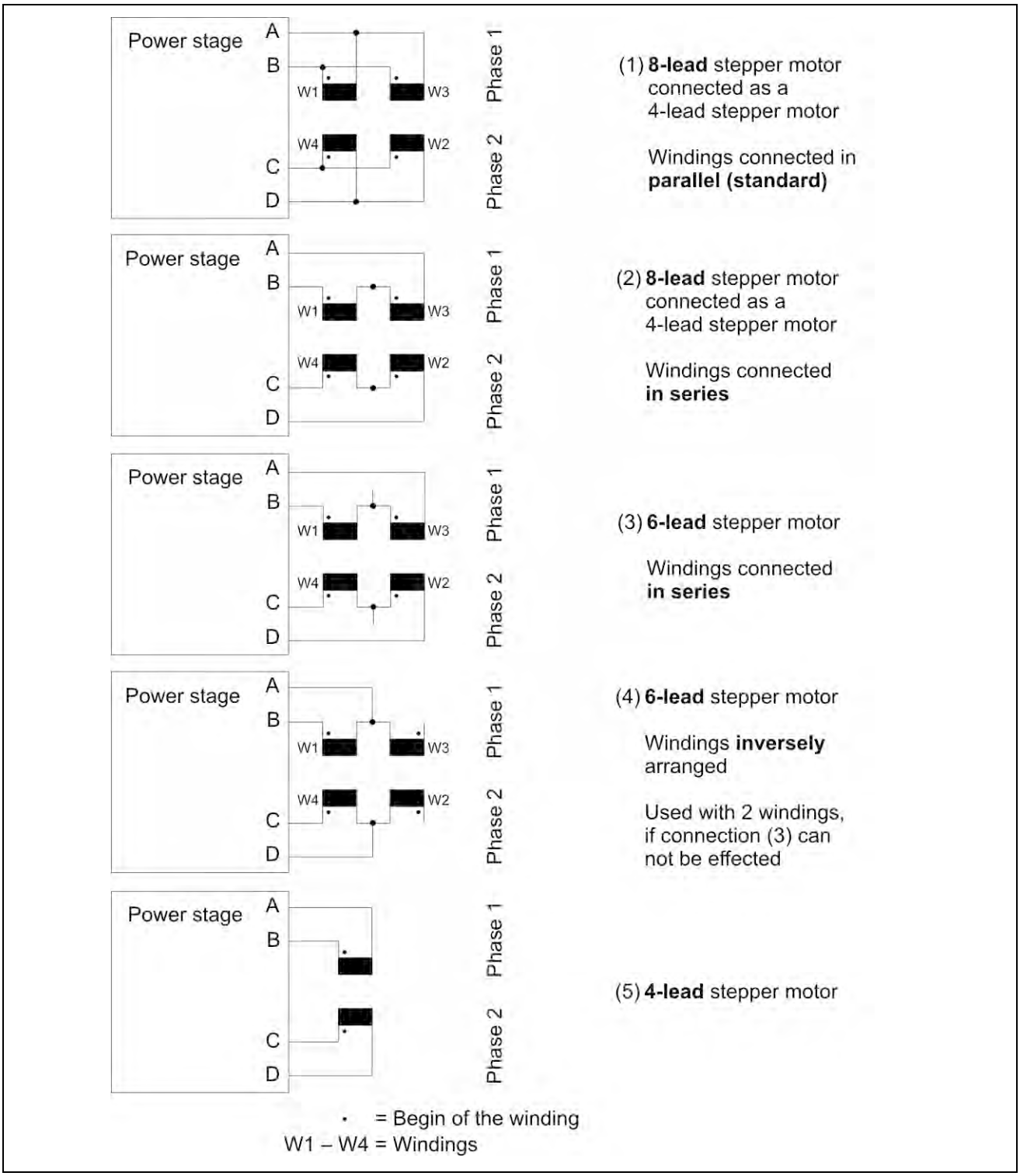


Fig. 8: Connection diagrams for 4,(6) and 8 lead stepper motors

Stepper motors with 8 leads can be connected with the windings wired in parallel (1) or series (2).

For 6 lead stepper motors, wiring scheme (3) with series windings is recommended.

If wiring scheme (3) cannot be used because of the motor construction, the motor may be operated with only two of the four windings energized according to wiring scheme (5).

CAUTION – Possible damage!

Destruction of the power stage by connecting a 5 phase stepper motor.

- Do not connect any 5 phase stepper motors to avoid damage.

Motor time constant τ:

$\tau = \frac{L}{R}$ applies to the electrical motor time constant τ.

The total inductance L_{total} is equal to the winding inductance in a parallel circuit, because of interlinked inductances.
L_{total}= 4 x L applies to a series circuit.

The result is an equal motor time constant τ for a serial and a parallel circuit:

Circuit	**series**	**parallel**
Resistance R_{total}	**2 x R**	$\frac{R}{2}$
Inductance L_{total}	**4 x L**	**L**
Motor time constant τ	$\tau_{series} = \frac{4 \times L}{2 \times R} = \frac{2 \times L}{R}$	$\tau_{parallel} = \frac{L}{R/2} = \frac{2 \times L}{R}$

6.2.6 USB Interface

The evaluation board is connected to the PC by a USB cable type A-B. The USB port of the PC (type A) is directly connected to the USB connector (type B).

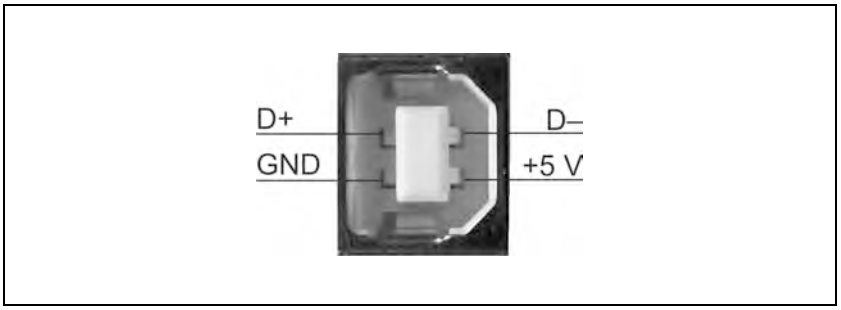


Fig. 9: USB port type B (DIN IEC 61076-3-108)

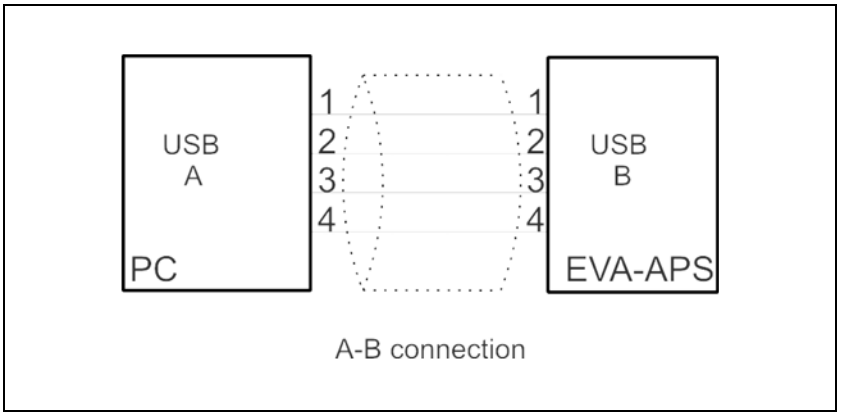


Fig. 10: Wiring scheme PC <-->EVA-APS by cable A-B

When the EVA-APS is connected to the PC by USB interface, USB drivers have to be installed on the PC.

USB Driver Installation (Windows)

- The user needs administrator rights for the installation.
- Use a USB cable with a maximum length of 2 m.
- If you want to test several identical USB devices, we recommend to use the same port on the PC. This avoids changing COM port addresses.

- Insert phytron's CD and open the folder **USB Driver** in Windows Explorer Select the .exe program which goes with your system software and start it by double clicking. The following window is shown on the desktop after a successful installation:

- Connect the EVA-APS directly or via USB converter to the USB port of your PC by USB cable.
- For checking the correct USB driver installation, continue as follows (i.e. Windows XP):

  Start the device manager by clicking **Start→Settings→System control** and double-click on **System**. Then select the **Device manager** tab. The USB components can be found in **Computer→ Ports** and in **Universal Serial Bus Controller**. Here the new USB component is shown: **USB Serial Port (Com X)**
- You'll find information about the driver installation for the chip FT232R and more drivers for Linux and MAC on http://www.ftdichip.com

6.2.7 Pulse/Direction Interface

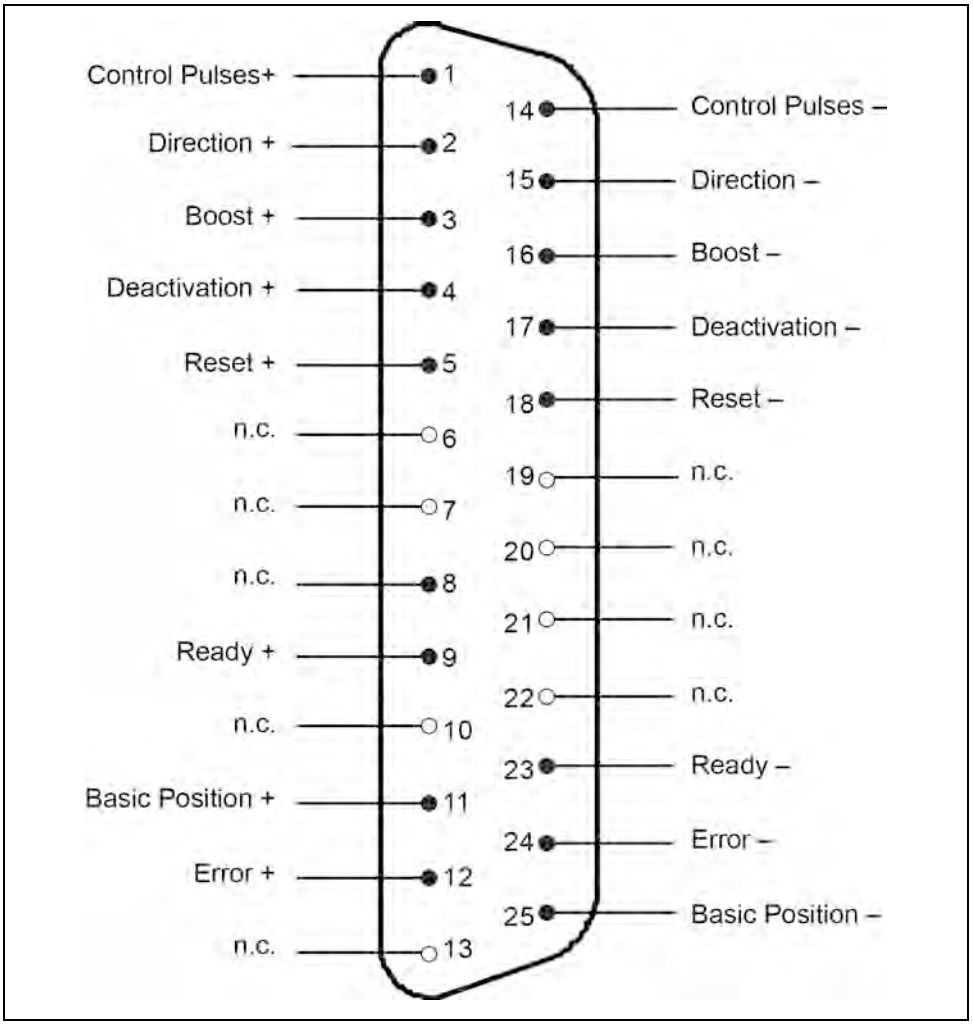


Fig. 11: 25-pole DSUB connector

6.2.8 SPI Interface (customised) ST1

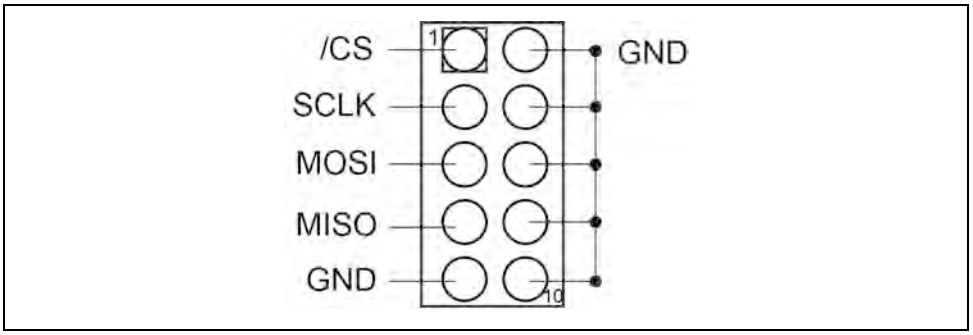


Fig. 12: ST1 2x5 pole pads

6.2.9 Rotary Switch

This switch is used to set the operating mode:

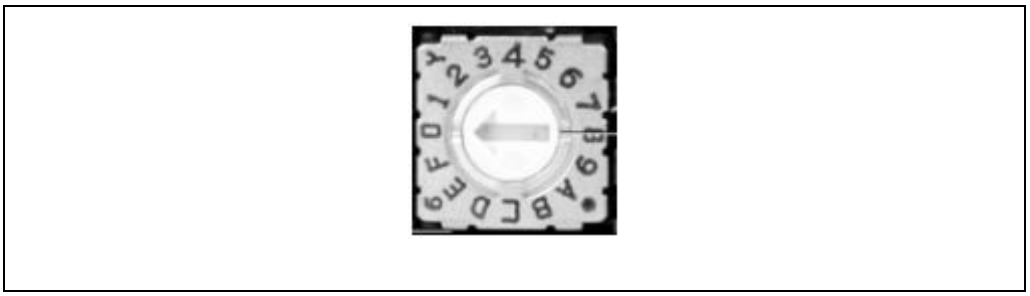
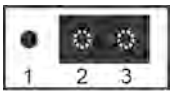
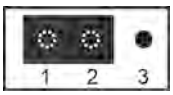
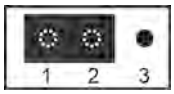
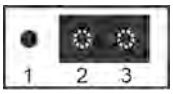


Fig. 13: Hex switch: 0...F

Position	Operating mode	Meaning
0	ServiceBus Mode	Parameterising via ServiceBus mode
1	RUN Mode	Parameterising via ServiceBus not possible. As long as the rotary switch is at position 1, the motor runs when the pushbutton is pressed.
2…9 A…F	Not available	

6.2.10 Definition of the Jumpers

Factory setting	
Jumper	**Position**
J1 to J5	
J6 to J9	

Jumper	**Definition**	**Position**	
			
J1	Control Pulses	Signal via µController; RUN mode Rotary switch position “1”	Signal via Pulse/Direction Interface; ServiceBus Rotary switch position “0”
J2	Direction		
J3	Boost		
J4	Deactivation		
J5	Reset		
J6/J7/J8/J9	APS01-SPI Interface	Connected to µC (Operating mode:0/1)	Connected to ST1 (for SPI connection external)

6.2.11 Input Wiring

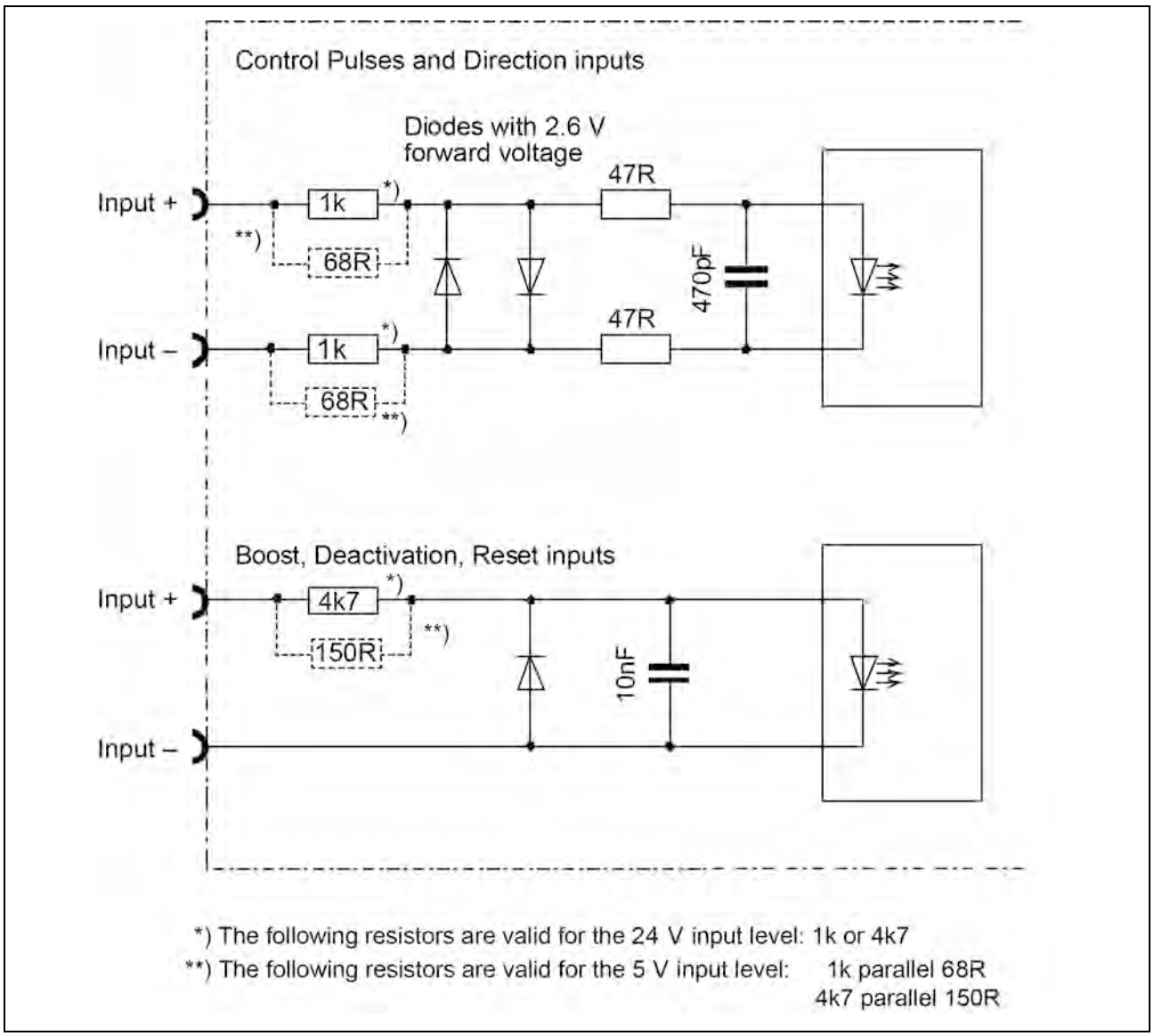


Fig. 14: Input wiring diagram

6.2.12 Output Wiring

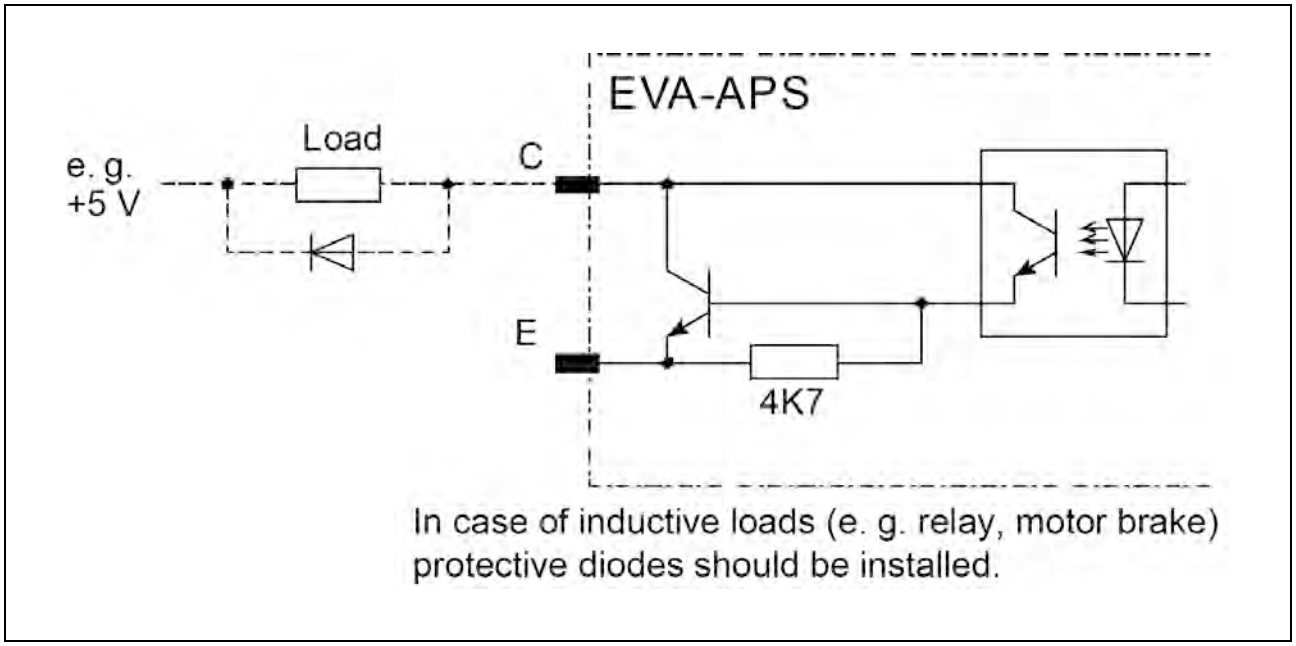


Fig. 15: Output wiring

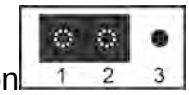
7 Operating Modes

7.1 ServiceBus (Rotary Switch Position “0”)

The ServiceBus mode allows the configuration and setting of the APS power stage from the PC with the ServiceBus-Comm™ for Windows® software.

Here, you can program e.g. the step resolution (up to 1/512 step), the current delay time and the phase current (in 10mA steps).

The setting of the operating parameters is unconditionally, i.e. no reset is required to save the set values.

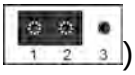
Remark: The jumpers J6 to J9 have to be placed on position 

for the “Z” command (Self test), to run the control pulses from the µC to the APS power stage.

7.2 RUN Mode (Rotary Switch Position “1”)

In the mode **no** parameterising of the APS power stage is possible via ServiceBus.

The motor is running as long as the pushbutton START is pressed.

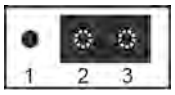
Jumper Power stage Control Pulses (J1): Connection µC – APS01 (Position: 

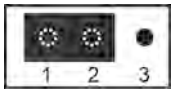
)

8 Commissioning

8.1 For the ServiceBus Mode (Rotary Switch Position “0“)

Please follow the described order when you put into service the evaluation board:

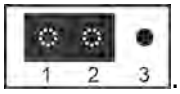
1. Plug the APS power stage into the socket connectors BU1 and BU2.
2. Set the **rotary switch** on position “0”.
3. Plug additional resistors for the “5 V” **input level** (see chap.6.2.10).
4. Put the jumpers J1 to J5 onto the following position: 

5. Plug the jumpers J6 to J9 onto the following position: 

6. Connect the PC via **USB** cable.
7. Connect the **motor** to the 4-pole connector and the signal connector to the **Pulse/Direction interface**.
8. Connect the input signals to the Control pulse and direction inputs (25-pole).
9. Connect the **supply voltage** of the board and **power on**.
10. Parameterise the APS power stage via ServiceBus-Comm™.

8.2 For the RUN Mode (Rotary Switch Position “1”)

Please follow the described order when you put into service the evaluation board:

1. Plug the APS power stage onto the socket connectors BU1 and BU2.
2. Set the **rotary switch** on position “1”.
3. Plug additional resistors for the “5 V” **input level**.
4. Put the jumper J1 onto the following position 
.
5. Connect the **motor** to the 4-pole connector and the signal connector to the **Pulse/Direction interface**.
6. Connect the input signals to the Control pulse and direction inputs (25-pole).
7. Connect the **supply voltage** of the board and **power on**.

CAUTION – Possible damage!

Some modules are set to a default value on delivery. So e.g., the motor current must be set to the corresponding value (see the motor data from the motor manufacturer). Connected components like motors can be damaged by incorrectly set values.

- Please check if the parameters are correct before starting.

9 Instruction Set ServiceBus

The EVA-APS module doesn't support the complete instruction set of the ServiceBus.

CMD	min	max	Scaling	Unit	Description
A	0	350	1/100	A	Boost current (resolution 10mA)
B					Version string: "EVA_APS Vx.xx"
BF					Version string FPGA: "APS5"
C					Reset power stage
D					Power stage temperature in 1/10 °C
F					Power stage status
G	0	1			Pref. direction
L	0	1			Logic level of all inputs
LA					Logic level: Deactivation input
LB					Logic level: Boost input
LD					Logic level: Direction
LR					Logic level: Reset input
LT					Logic level: Control pulses input
M	0	13			Step resolution (1 -1/512)
OE	0	1			Logic level Error output
OG	0	1			Logic level Basic position output
PE	0	3			Chopper frequency
PH	225	225000	1	Hz	Overdrive upper switching frequency
PO	0	1			Overdrive on/off
Q					Error status
R	0	350	1/100	A	Run current (resolution 10mA)
S	0	350	1/100	A	Stop current (resolution 10mA)
T	0	150	2	ms	Current delay time
Z					Self test: a motor direction (J1: CLK from µC)

10 Service

In case of a service contract, please proceed as follows:

First try to identify the technical problem. Feel free to ask our support team for help. We are pleased to assist you.

Removal of a module:

- Switch off the supply voltage
- Disconnect the supply voltage
- Carefully pull the APS module from the carrier board.
- To send a module to phytron use ESD packaging only.

11 Warranty, Disclaimer and Registered Trademarks

11.1 Disclaimer

Phytron GmbH has verified the contents of the manual to match with the hardware and software. However, errors and omissions are exempt and Phytron GmbH assumes no responsibility for complete compliance. The information contained in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

11.2 Warranty

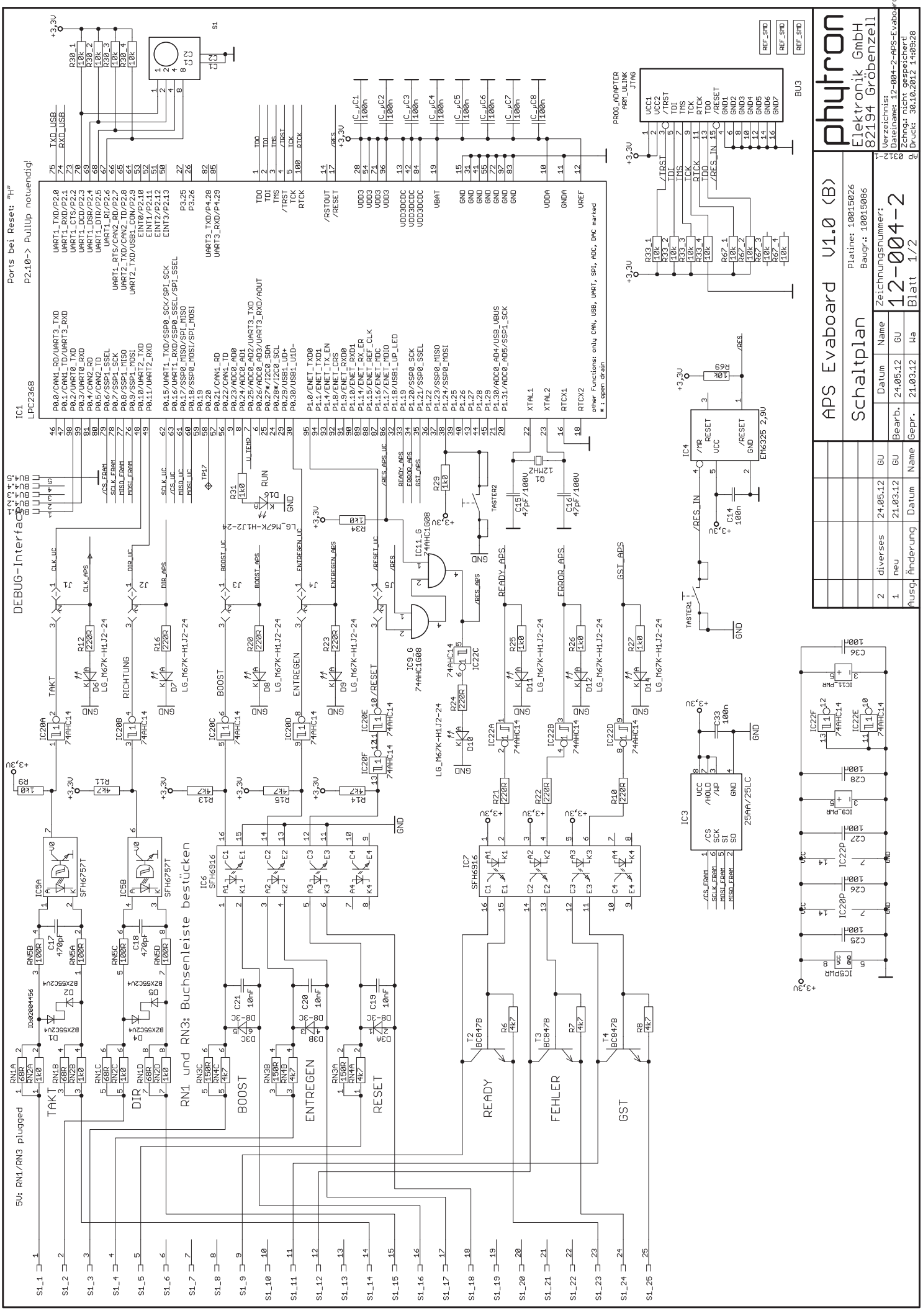
The APS modules are subject to **legal warranty**. Phytron will repair or exchange devices which show a failure due to defects in material or caused by the production process. This warranty does not include damage caused by the customer, for example, not intended use, unauthorised modifications, incorrect handling or wiring.

11.3 Registered Trademarks

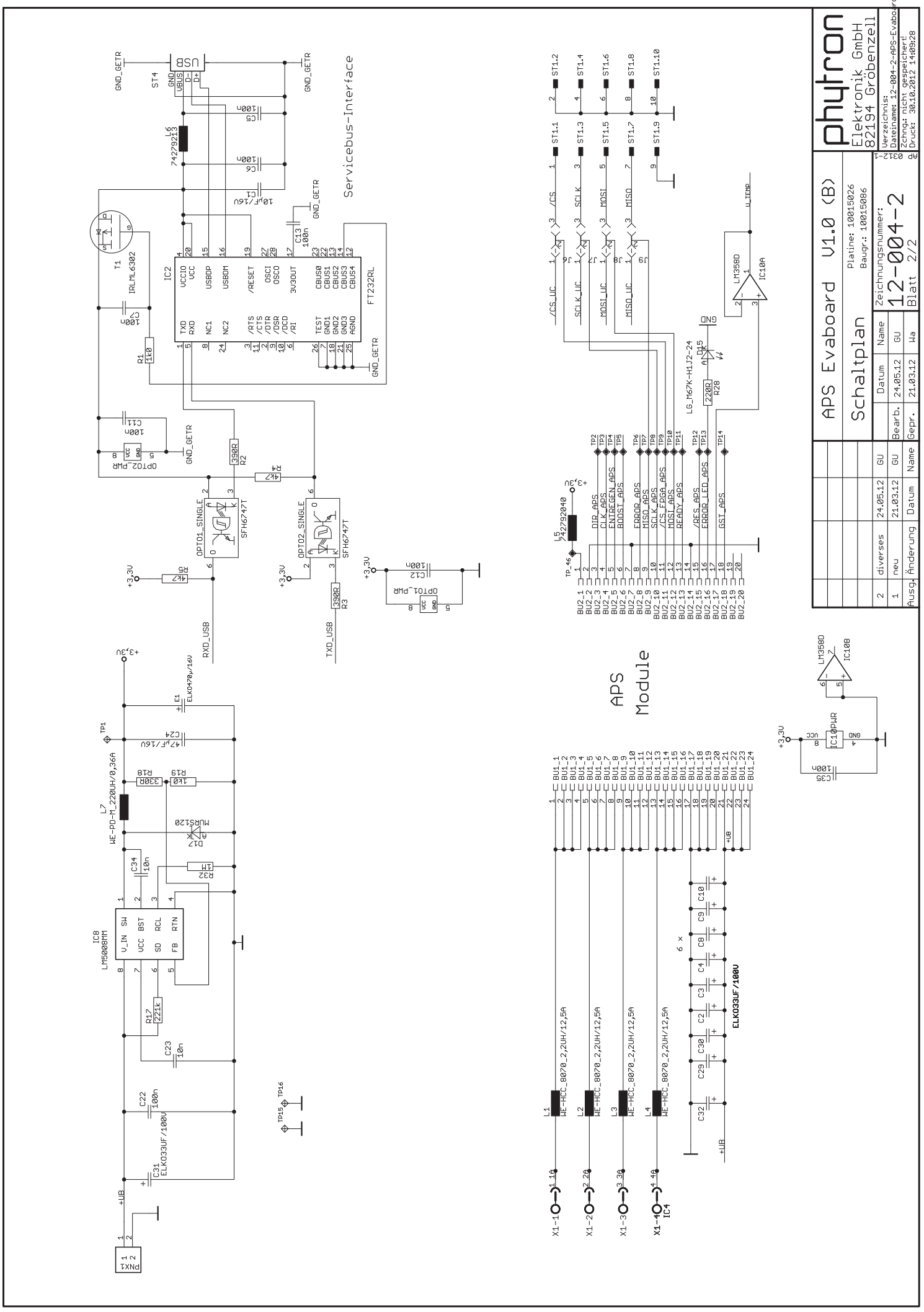
In this manual several trademarks are used which are no longer explicitly marked as trademarks within the text. The lack of these signs may not be used to draw the conclusion that these products are free of rights of third parties. Some product names used herein are for instance.

- ServiceBus-Comm™ is a trademark of the Phytron GmbH.
- Microsoft is a registered trade mark and WINDOWS is a trade mark of the Microsoft Corporation in the USA and other countries.

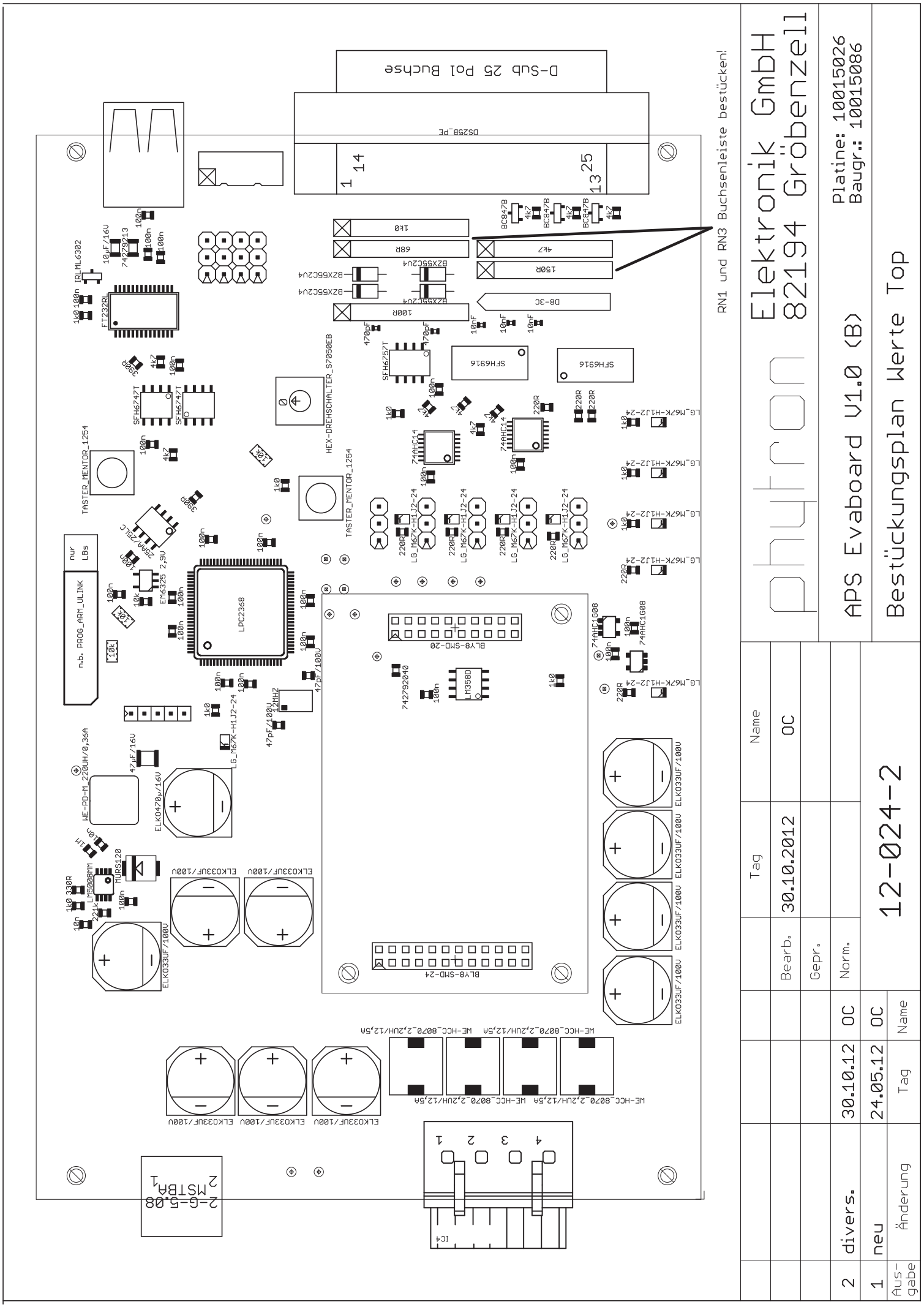
12 Circuit diagram part 1



12 Circuit diagram part2



13 Assembly diagram



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