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phytron

Evaluation Board for the APS Stepper Motor Power Stage

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APS-Arduino Shield

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: APS-Arduino Shield

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.eu/) 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 Overview

APS-Arduino Shield is an evaluation board for the application of the high performance APS stepper motor power stage (5 A_{PEAK} at 24 - 70 V_{DC}) in research, prototyping, model making and art installations.

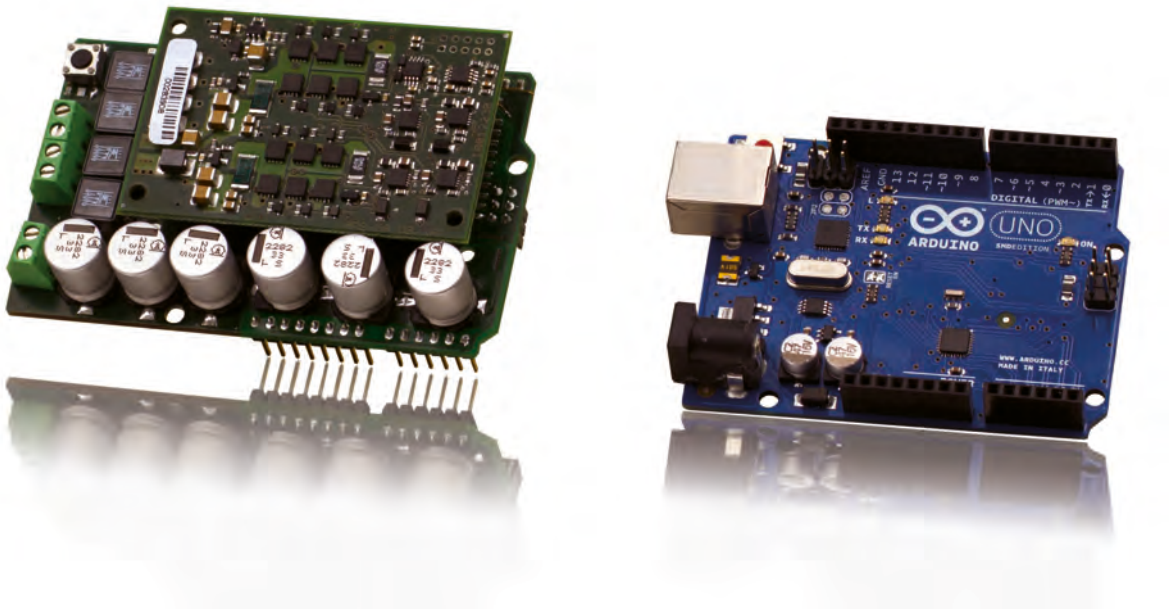

Fig.1 APS-Arduino shield module with APS power stage (left) and Arduino board (right)

- APS power stage parameters and diagnostics via Serial Peripheral Interface (SPI)
- Control pulses and direction signal comes from the digital pins of the Arduino
- Download a demo program and its description from the phytron website

Connections

– Power supply

– Motor connection

– PCB connectors (APS):
  2 mm grid; 0.5 mm pin (Fischer Elektronik company)
  Pins: 2x10 and 2x12

– Reset button

Manuals available

- Manual APS-Arduino shield (this manual)
- Manual APS

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

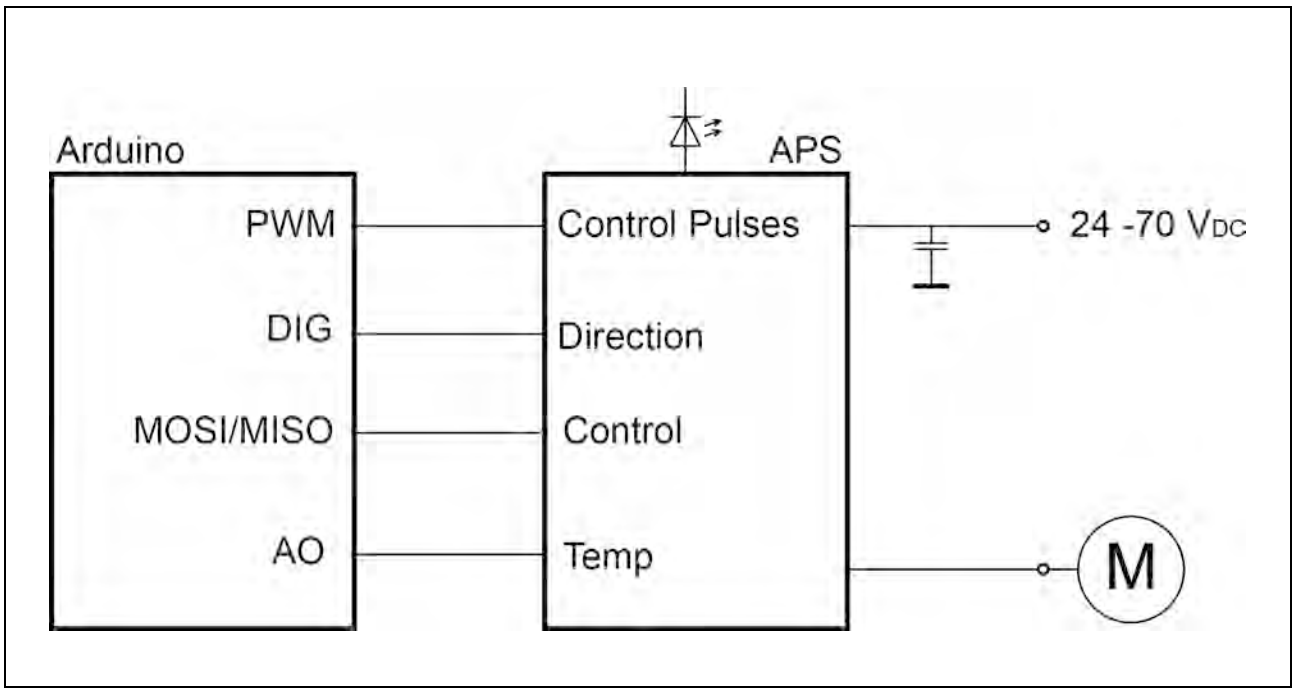

Fig.2 Block scheme

Power supply voltage:

The APS supply (24 – 70 V) is not connected to the Arduino supply.
APS Arduino Shield requires its own power supply to supply the APS power stage!

The Arduino is not supplied by the APS supply (24-70 V).There is no electrical isolation of the supplies.
Please note the Arduino manual for the power supply of the Arduino board!

5 Technical Data

5.1 Mechanical Data

Dimensions	53 x 84 mm
Weight	with APS: 57 g without APS: 41 g
Mounting	pluggable on Arduino board

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

Operation/Connection	
Motor voltage supply	24 V_{DC} to 70 V_{DC} input range of supply of the power stage
Analogue outputs (motor)	A, B, C, D for a 2 phase stepper motor connected as a 4-lead stepper motor 6- or 8-lead stepper motors should be connected as a 4-lead stepper motor.
SPI	For parameterising and diagnostics of the power stage
Control pulses/direction interface	Control pulses and direction signal from the digital pins of the Arduino
PCB connectors (APS)	2 mm grid; 0.5 mm pin Pins: 2x10 and 2x12
Pushbutton	Reset of the Arduino

6 Installation

6.1 Mechanical Installation

The APS is delivered as a single module board.

Unpack the module carefully in ESD protected area only.

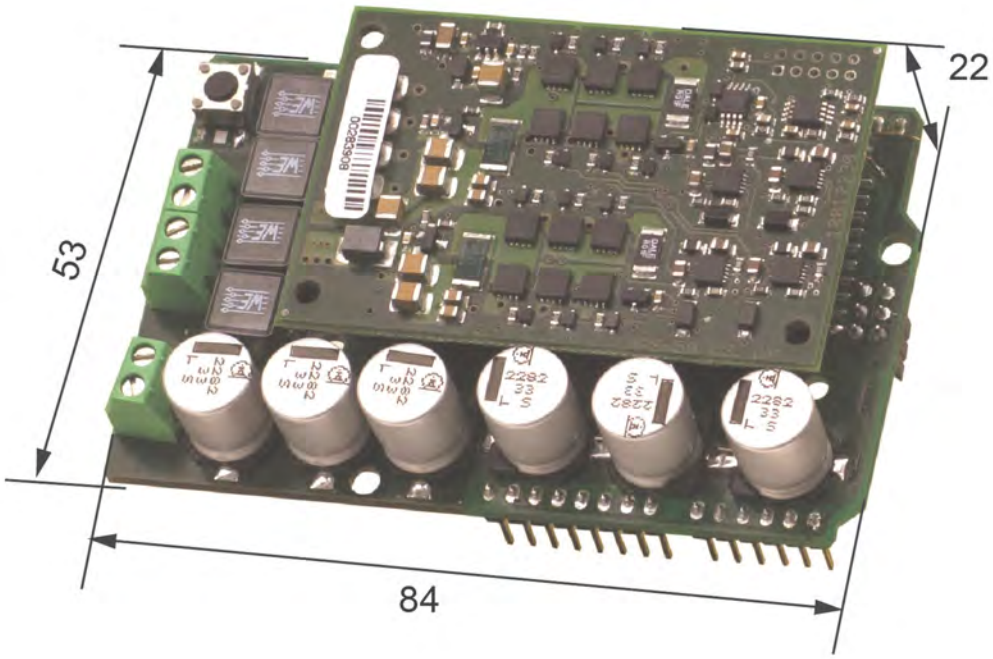

Fig.1 Dimension in mm

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 APS-Arduino shield 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	2x12	2 mm grid (e.g. SLY8 SMD062-24-S)	e.g. BLY8 SMD-…
PCB connector	2x10	2 mm grid (e.g. SLY8 SMD062-20-S)	e.g. BLY8 SMD-…
Supply	1x2	PCB terminal block Phoenix MKDS 1/2-3,81	–
Motor	2x2	PCB terminal block Phoenix MKDS 1/2-3,81	–

6.2.2 Connector Assignment

The following is the assignment of the PCB connectors:

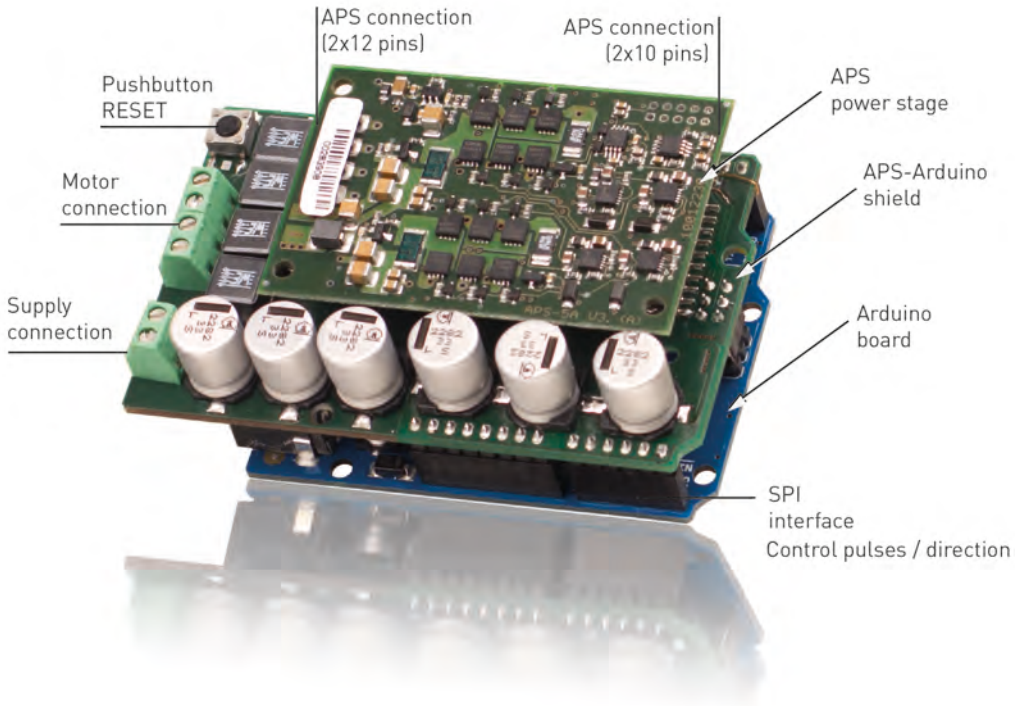

Fig.2 Connection

6.2.3 APS Power Stage Module

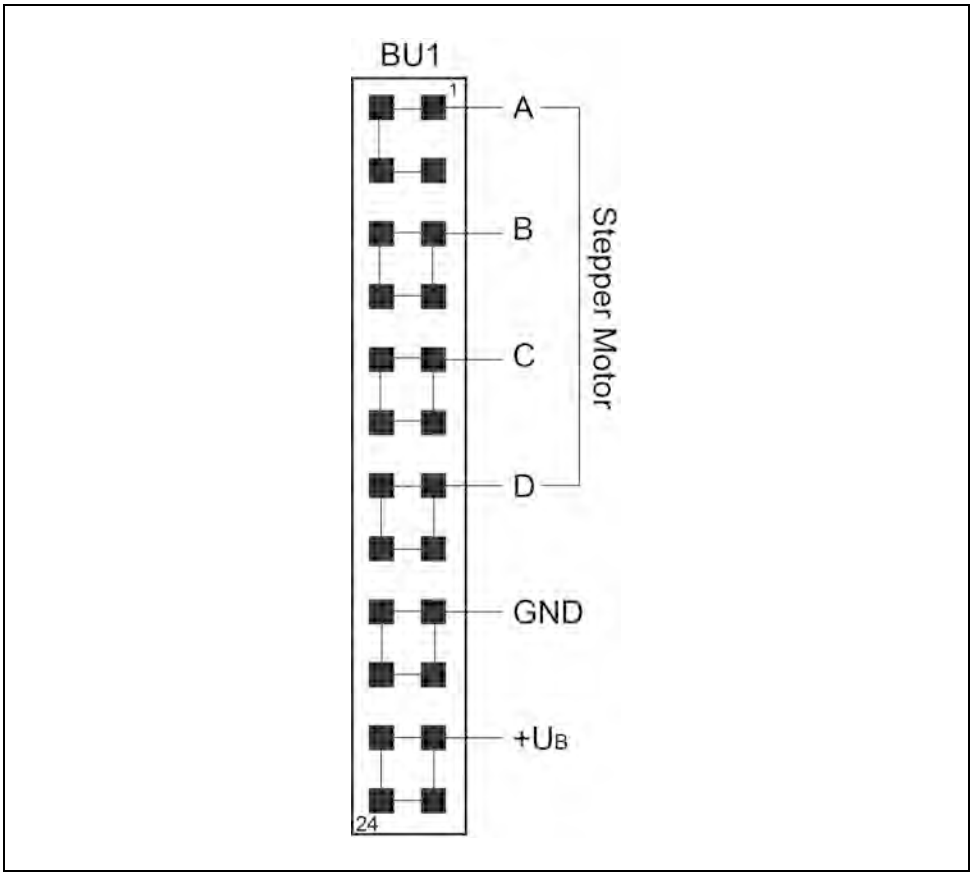

Fig.3 Pin assignment "BU1"

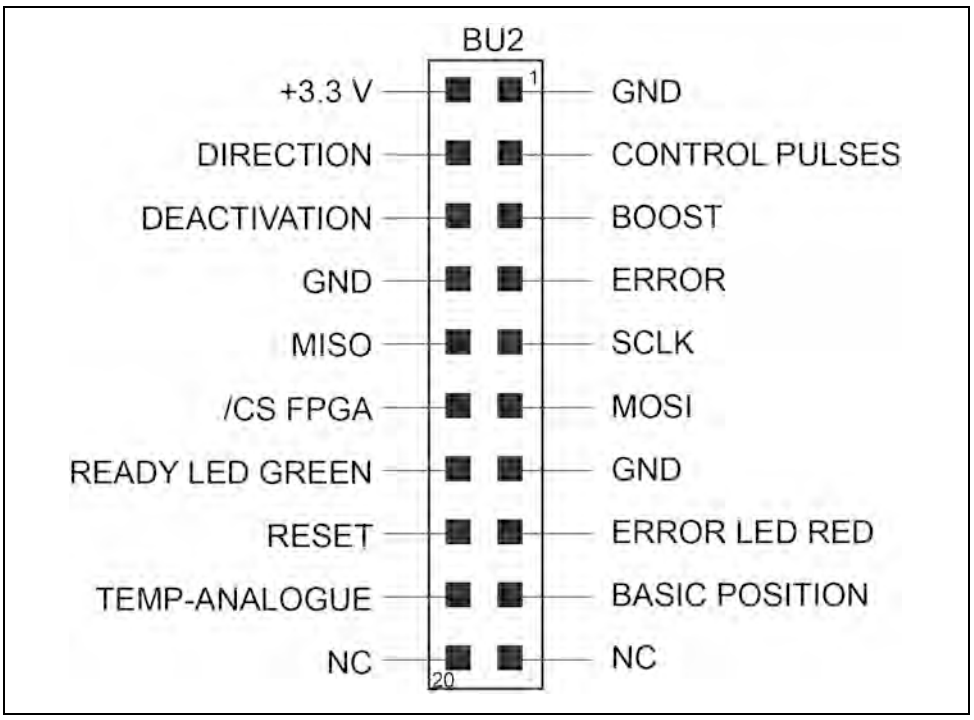

Fig.4 Pin assignment "BU2"

6.2.4 Connection – Power Supply and Motor

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

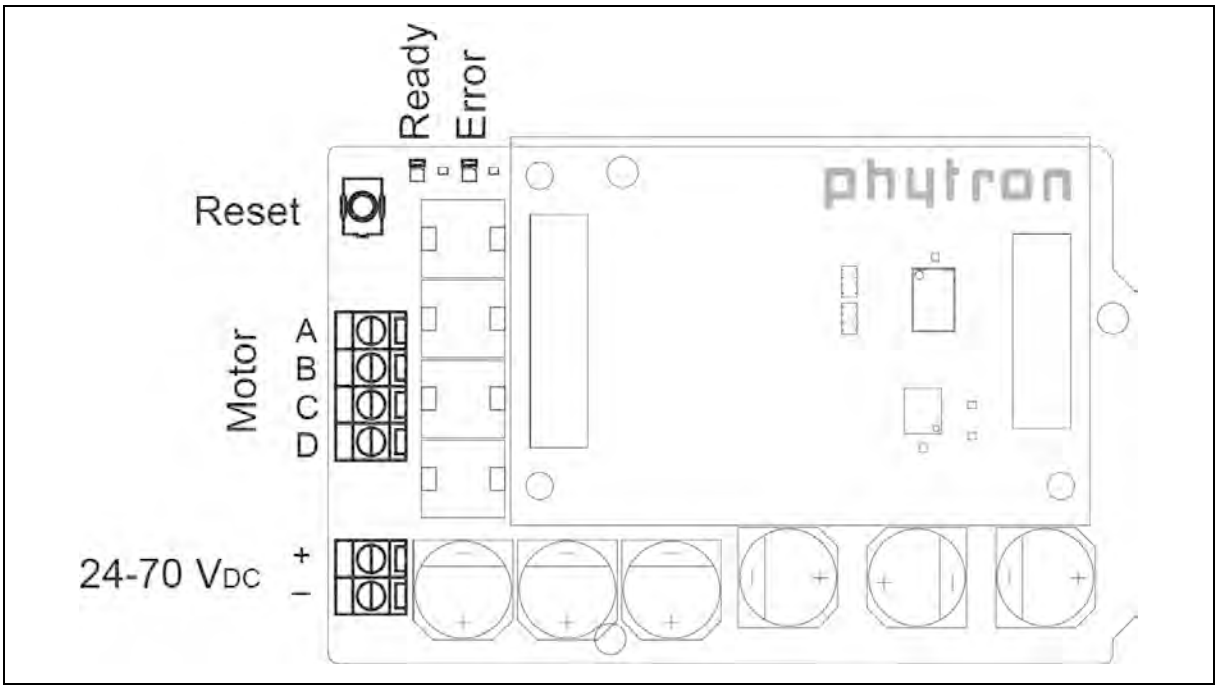

Fig.5 Power supply and motor connection

Wiring Schemes

Stepper motors with 0.1 to 5 A_{PEAK} phase current can be controlled at a maximum of 70 V_{DC} with the APS module Arduino shield.

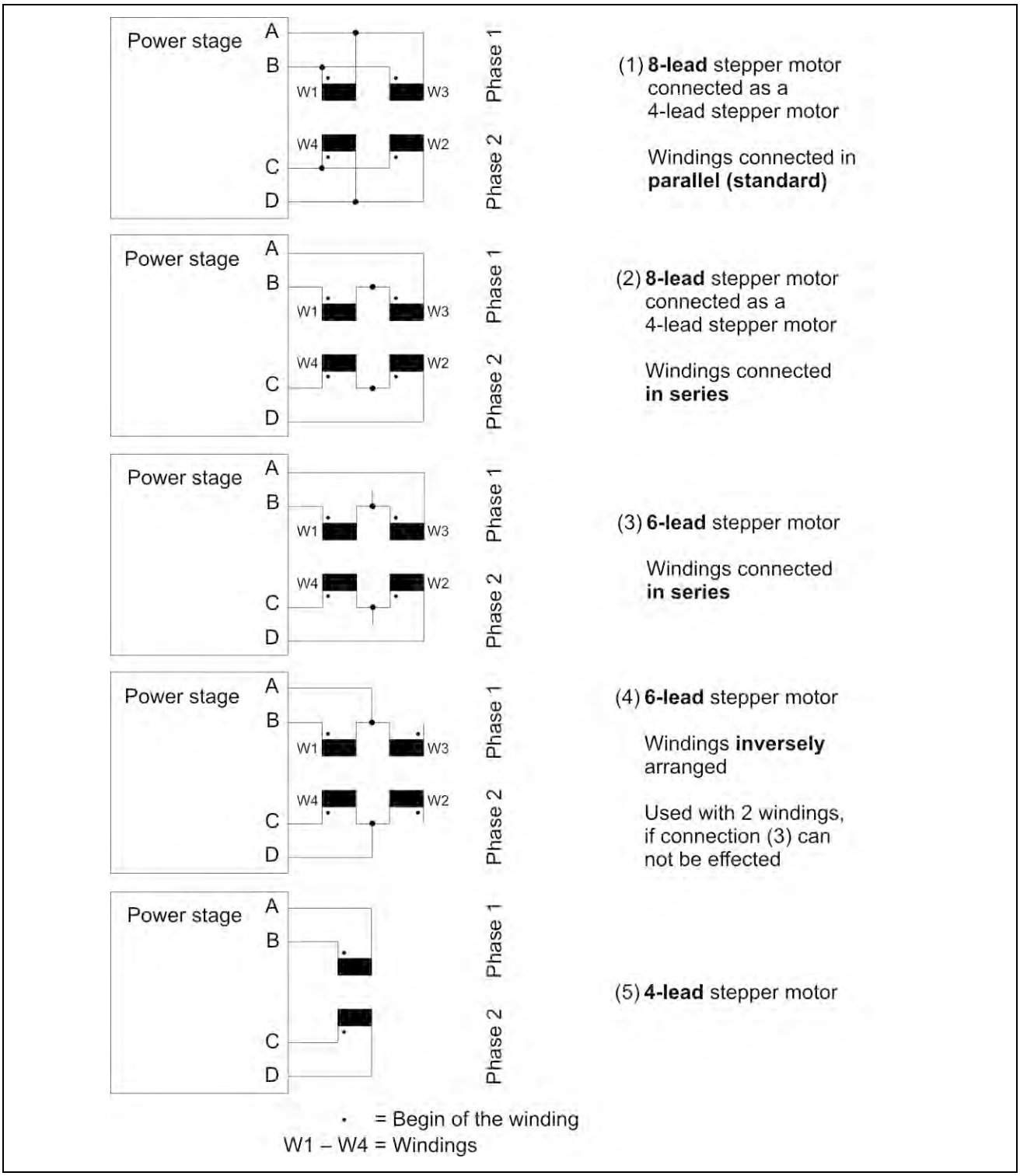

Fig.6 Connection diagrams for 4,(6) and 8 lead stepper motors

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	$\tau_{series} = \frac{4 \times L}{2 \times R} = \frac{2 \times L}{R}$	$\tau_{parallel} = \frac{L}{R/2} = \frac{2 \times L}{R}$

7 Commissioning

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

1. Plug the APS power stage onto the socket connectors of the APS-Arduino shield.
2. Plug the shield onto the Arduino board.
3. Screw the wire ends of the **motor cable** to the 4-pin socket.
4. Screw the wire ends of the **supply cable** to the 2-pin socket.
5. Connect the PC via **USB** cable.
6. Power **on**.
7. Parameterise the APS power stage via SPI Interface and Arduino software.

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.

8 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.

9 Warranty, Disclaimer and Registered Trademarks

9.1 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.

9.2 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.

9.3 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.

10 Circuit diagram

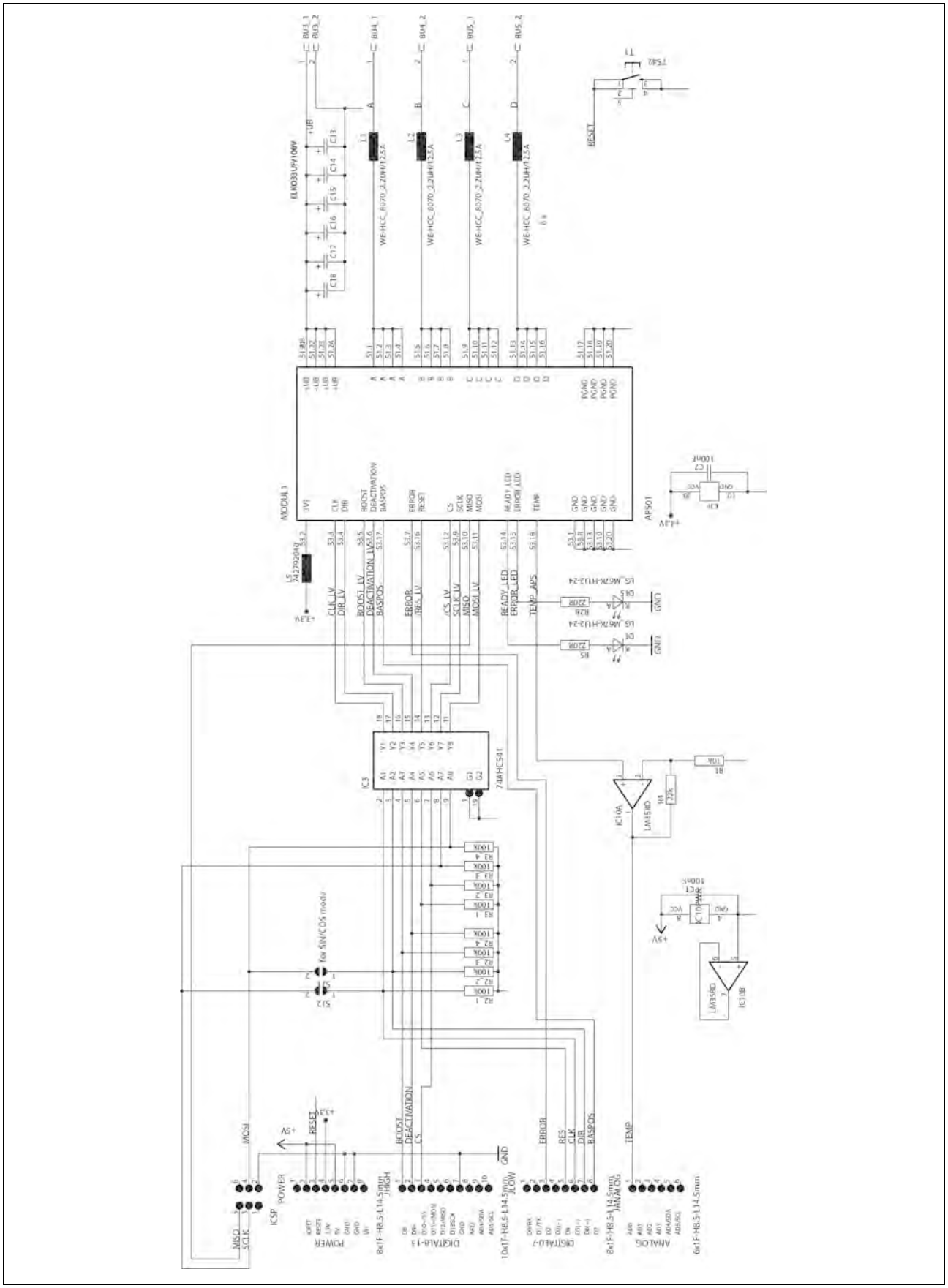

Fig.7 Circuit diagram of the APS-Arduino shield

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