DANGER

All connections are NOT hot plug capable. Please turn off power before removing or plugging in ANY plug!!!

PSPU

Documentation A.1

IB Ostendorff

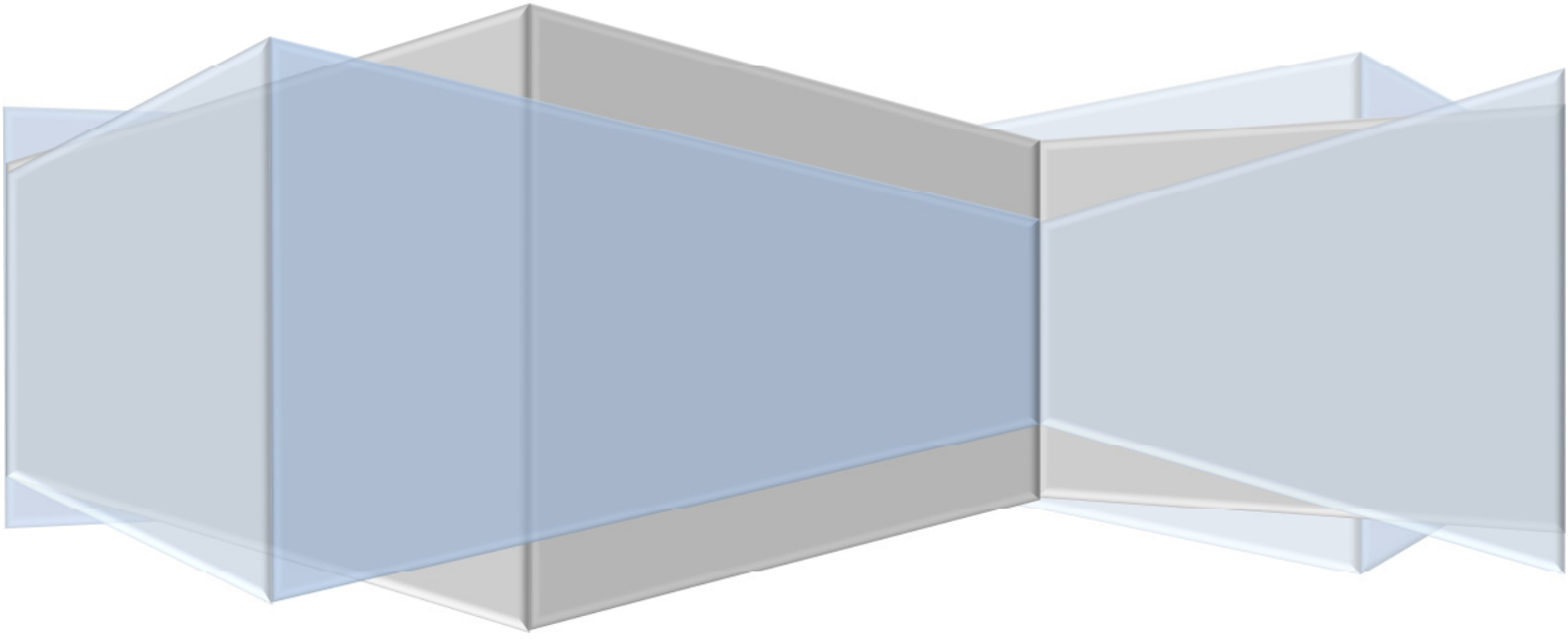

Table of content

1. Overview 1
   1.1. How to read 1
   1.2. BBU 1
   1.3. PSPU 1
   1.4. PSXU 3
2. Operation 4
   2.1. Operation of BBU 4
      2.1.1. LEDs 4
      2.1.2. DIP 5
      2.1.3. User Button 5
      2.1.4. Reset 5
   2.2. Operation of PSXU 6
3. Connections 7
   3.1. *GOLDI* bus connector 7
   3.2. Secondary power connector 7
   3.3. USB 8
   3.4. Expansion port 8
   3.5. PSXU connectors 10
4. Electro mechanical model connection 11
   4.1. Elevator (type A – 3 floors) 12
   4.2. Elevator (type C – 4 floors) 12
   4.3. Production Cell 12
   4.4. 3-axis portal 12
   4.5. Storage warehouse 14
5. Revisions 15

List of figures

Figure 1: PSPU v1_01 2
Figure 2: PSXU v1_01 top side 3
Figure 3: PSXU v1_01 bottom side 3
Figure 4: *GOLDi* connector 7
Figure 5: Power connector 7
Figure 6: Adapter polarity 8
Figure 7: Mini USB connector 8
Figure 8: BCU expansion ports 9
Figure 9: PSXU connectors 10

List of tables

Table 1: Function of BBU LEDs 4
Table 2: Function of BBU DIP switches 5
Table 3: Expansion ports 8
Table 4: 3-axis portal PSXU configuration (sorted) 13
Table 5: 3-axis portal PSXU configuration (as top view) 14

Abbreviations

BBU..... Base Board Unit

GOLDI ..... Grid of Online Lab Devices Ilmenau

JTAG ..... Joint Test Action Group

PSPU ..... Physical System Protection Unit

PSXU..... Physical System eXpansion Unit

BCU..... Bus Control Unit

Explanations

Symbols mark especially important information.

DANGER

Please read these sections with extreme attention, to avoid any danger for human beings and the machine.

ATTENTION

Read these sections carefully to avoid problems while using the device.

INFORMATION

Read this section for additional information and hints.

1. Overview

This documentation describes the PSPU.

PSPU stands for “Physical System Protection Unit” and protects the electro-mechanical model within the *Grid of Online Lab Devices Ilmenau (GOLDi)* against misuse and damage. It consists of the following parts:

- Base Board Unit (BBU) with a CAN Bus Interface (CBI),
- as well as two Physical System eXpansion Units (PSXU).

All boards are designed for academic and research use as part of the *GOLDi* infrastructure and NOT for any industrial usage.

For feedback, as well as ideas and comments please send an email to goldi@ib-ostendorff.de.

1.1. How to read

This document is for administrators only. Administrators should be familiar with the complete document. Users may read it as well to get a better understanding of the architecture of the lab, but it is not necessary when working with the lab.

1.2. BBU

The BBU is used to interface the PSXUs to the *GOLDi* infrastructure. It connects the plugged in eXpansion boards, PSXUs in this case, via CAN to *GOLDi*. The PSXUs has to be plugged in the top and bottom eXpansion ports of the BBU. See Figure 1 for details.

1.3. PSPU

The PSPU consists of a series of circuit boards. For PSPU_v1_01 this includes a BBU_v1_11, a CBI_v1_01 and two PSXU_v1_01. You can see a complete assembly in Figure 1.

Figure 1: PSPU v1_01

1.4. PSXU

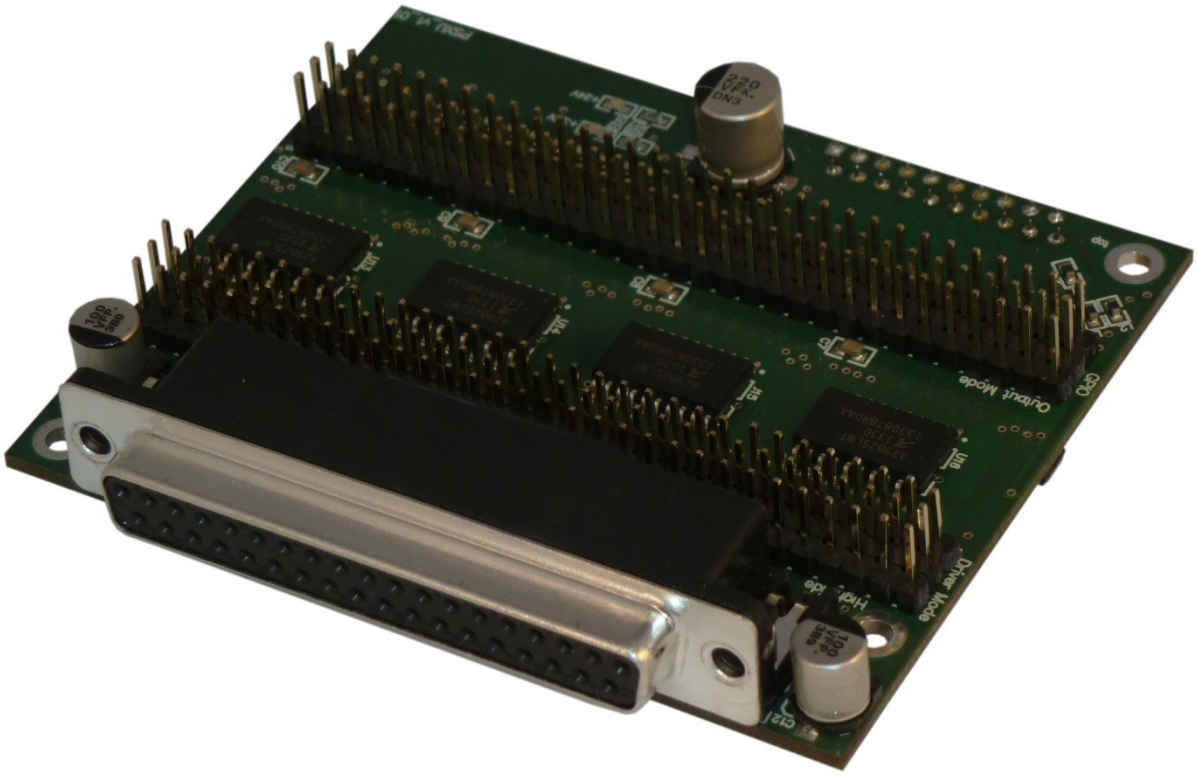

Figure 2: PSXU v1_01 top side

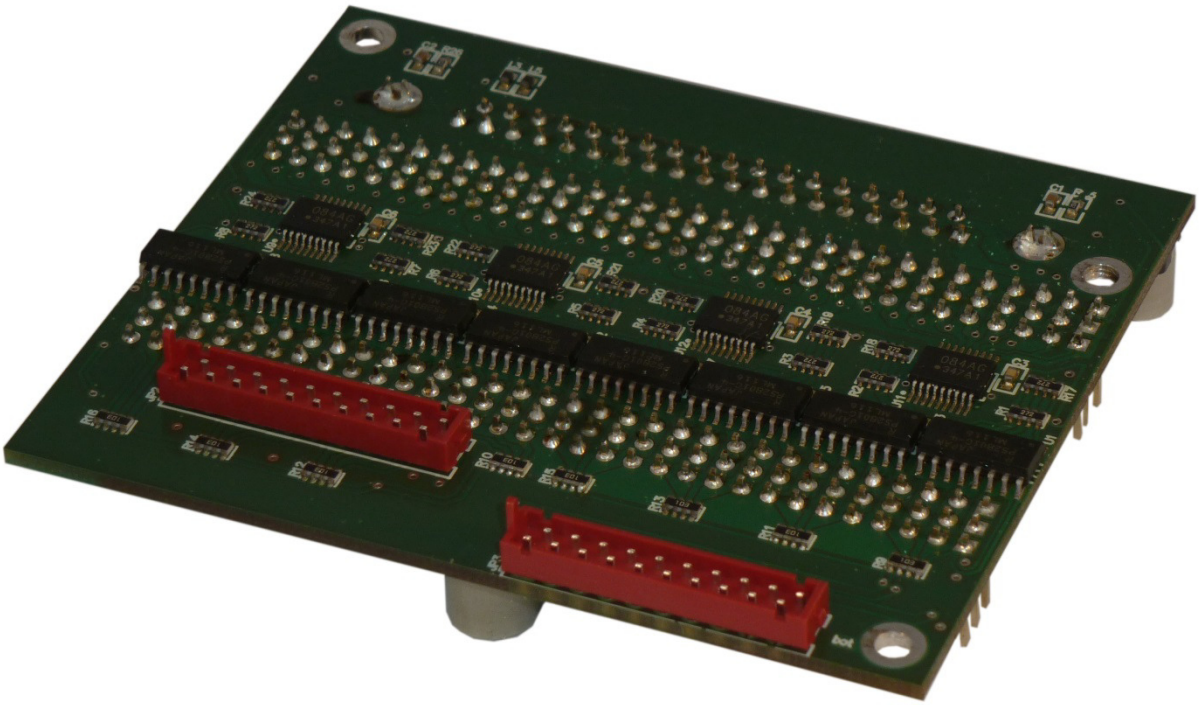

Figure 3: PSXU v1_01 bottom side

2. Operation

The functions described in this section only relate to the version 1.01 of the PSPU.

Please make sure to use the correct firmware for the PSPU.

The newest firmware can be found at www.ib-ostendorff.de/GOLDI_firmware or at www.tu-ilmenau.de/GOLDI.

The PSPU supplies the following functions relevant for the users. Some functions are only accessible for administrators on-site.

2.1. Operation of BBU

The BBU supplies the following functions relevant for the user.

2.1.1. LEDs

The four yellow LEDs on the front side of the BBU have the following functions:

LED	mode	
1	off	no connection to *GOLDi*
	flashing	firmware running
2	off	MCXU is powered off
	on	MCXU is powered on
3		*GOLDi* bus data traffic
4		*GOLDi* bus control message traffic

Table 1: Function of BBU LEDs

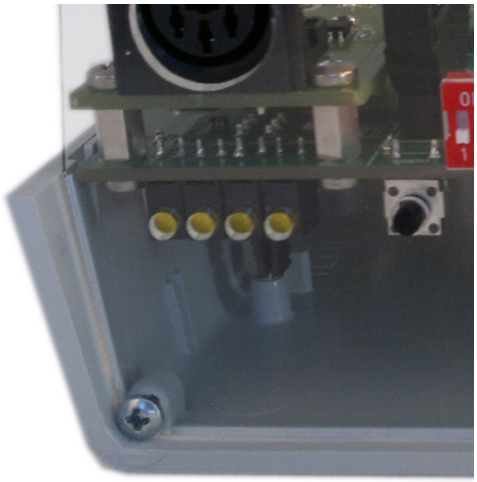

Figure 1: BBU LEDs

The LEDs 1..4 are numbered from left to right.

2.1.2. DIP

The four DIP switches on the front side of the BBU have the following functions:

DIP	mode	
1..4	0000	normal running mode
1..4	1111	firmware update mode
1..4	else	no function defined yet

Table 2: Function of BBU DIP switches

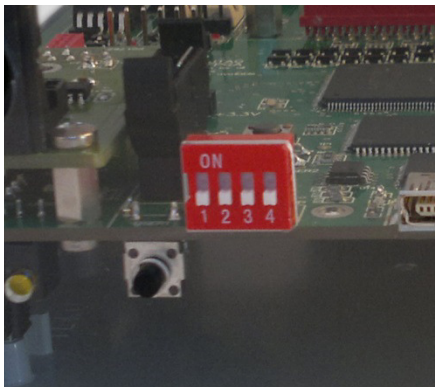

Figure 2: BBU DIP and user button

2.1.3. User Button

The user button currently has no functionality. For the location see Figure 2.

2.1.4. Reset

The reset button resets the complete PSPU. Press at least 1 second to reset device. It takes at least 3 seconds after releasing the button, until PSPU has been completely reset and is in a safe state again.

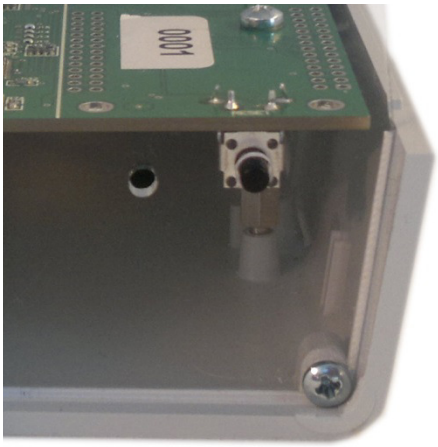

Figure 3: Reset button and power LED (not fitted on this board)

2.2. Operation of PSXU

The PSXU boards can be configured to be input or output. When configured as output, the active driving direction (high / low) can also be configured. The configuration is done via jumpers. The used settings depend on the electro mechanical model connected and is explained in section 4.

3. Connections

3.1. *GOLDI* bus connector

The *GOLDi* connector is a 6-pin DIN connector that interfaces the PSPU to the *GOLDi* infrastructure.

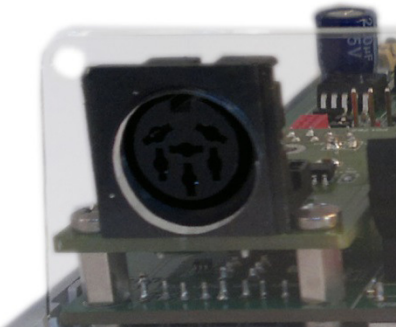

Figure 4: *GOLDi* connector

3.2. Secondary power connector

Generally the PSPU is powered via the *GOLDi* connector. In special cases, where the electro mechanical model connected to the PSXU boards needs more power than the BCU can supply over the *GOLDi* bus, a separate power supply can be connected to the PSPU.

In these cases use a 24V supply with at least 2A. The PSPU is fused at 2A to reduce the risk of damage. If the PSPU is self-powered, it CANNOT be switched on and off by the BCU anymore. This does not count for the electro mechanical model connected, which can still be controlled by the PSPU.

Figure 5: Power connector

Figure 6: Adapter polarity

3.3. USB

The BBU has a mini USB connector for firmware updates. A FTDI 2232HL is used to enable the reprogramming of the BBU.

The mini USB connector can be found in the top left corner of the board next to the DIP switch and the reset connector.

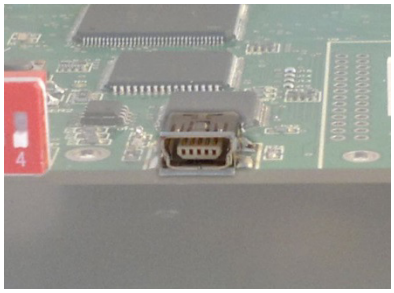

Figure 7: Mini USB connector

Only use the BBU programming tool supplied for any reprogramming to avoid damage to the hardware.

3.4. Expansion port

The BBU supplies one expansion connectors.

JP24 has the following pin out:

Connection	Pin number	Pin number	Connection
+5V (max. 1A)	1	2	GND
i2c SDA (@5V)	3	4	i2c SCL (@5V)
GND	5	6	GND
-5V (max 50mA)	7	8	i2c A IRQ
+24V (max. 1A)	9	10	+24V(max. 1A)

Table 3: Expansion port

Figure 8: BCU expansion ports

3.5. PSXU connectors

Each PSXU board contains one 37-pin connector to connect electro mechanical physical systems. These boards supply +24V to the connected electro mechanical physical systems as well as 32 I/Os. Each of these I/Os can be configured via Jumpers to be either input or output. Please refer to section 4 for more details about the configuration.

Figure 9: PSXU connectors

4. Electro mechanical model connection

The PSPU needs to be adapted to each electro mechanical model connected.

If you use a different electro mechanical model that is not mentioned in this document, please contact goldi@ib-ostendorff.de for support if needed.

DANGER

A wrong setting of the input / output direction or driving direction (high / low) may damage the PSPU and / or the electro mechanical model.

Be sure you know what you are doing!!!

The BBU can be fitted with two boards. The top PSXU board has the number 1, the bottom board the number 2. Most models will use two boards. One of them will be completely configured as input and the other one as output.

Please make sure to use the correct firmware for the PSPU. Each electro mechanical model requires a certain firmware.

The newest firmware can be found at www.ib-ostendorff.de/GOLDI_firmware or at www.tu-ilmenau.de/GOLDI.

4.1. Elevator (type A – 3 floors)

The top PSXU board should be completely configured as input.

The bottom PSXU board should be completely configured as output with the driving direction active high.

4.2. Elevator (type C – 4 floors)

The top PSXU board should be completely configured as input.

The bottom PSXU board should be completely configured as output with the driving direction active high.

4.3. Production Cell

The top PSXU board should be completely configured as input.

The bottom PSXU board should be completely configured as output with the driving direction active high.

4.4. 3-axis portal

The 3-axis portal only uses the top PSXU board. This has to be configured to be input and output. Use the following configuration. Table 5 shows how to place the jumpers (X means to place a jumper at this location), when the 37-pin header is pointing upwards.

number from left[1]	GPIO number	direction (jumper for JP4/JP5/JP6)	driver (jumper for JP7/JP8/JP9)	37-pin connect. number	function
1	GPIO_0	input (JP4/JP5)	none	1	X-axis at pos. X-
2	GPIO_1	output (JP5/JP6)	high (JP8/JP9)	20	X-axis to X-
3	GPIO_2	input (JP4/JP5)	none	2	X-axis at pos. X+
4	GPIO_3	output (JP5/JP6)	high (JP8/JP9)	21	X-axis to X+
5	GPIO_4	input (JP4/JP5)	none	3	X-axis ref. pos.
6	GPIO_5	output (JP5/JP6)	high (JP8/JP9)	22	Y-axis to Y-
7	GPIO_6	input (JP4/JP5)	none	4	X-axis channel A
8	GPIO_7	output (JP5/JP6)	high (JP8/JP9)	23	Y-axis to Y+
9	GPIO_8	input (JP4/JP5)	none	5	X-axis channel B
10	GPIO_9	output (JP5/JP6)	high (JP8/JP9)	24	Z-axis to Z+
11	GPIO_10	input (JP4/JP5)	none	6	X-axis channel Z
12	GPIO_11	output (JP5/JP6)	high (JP8/JP9)	25	Z-axis to Z-
13	GPIO_12	input (JP4/JP5)	none	7	X-axis at pos. Y-
14	GPIO_13	output (JP5/JP6)	high (JP8/JP9)	26	Z-axis to Z+
15	GPIO_14	input (JP4/JP5)	none	8	X-axis at pos. Y+
16	GPIO_15	none	none	27	reserved / spare
17	GPIO_16	input (JP4/JP5)	none	9	Y-axis ref. pos.
18	GPIO_17	none	none	28	reserved / spare
19	GPIO_18	input (JP4/JP5)	none	10	Y-axis channel A
20	GPIO_19	none	none	29	reserved / spare
21	GPIO_20	input (JP4/JP5)	none	11	Y-axis channel B
22	GPIO_21	none	none	30	reserved / spare
23	GPIO_22	input (JP4/JP5)	none	12	Y-axis channel Z
24	GPIO_23	none	none	31	reserved / spare
25	GPIO_24	input (JP4/JP5)	none	13	Z-axis at pos. Z+
26	GPIO_25	none	none	32	reserved / spare
27	GPIO_26	input (JP4/JP5)	none	14	Z-axis at pos. Z-
28	GPIO_27	none	none	33	reserved / spare
29	GPIO_28	input (JP4/JP5)	none	15	proximity switch
30	GPIO_29	output (JP5/JP6)	low (JP7/JP8)	34	reserved / spare
31	GPIO_30	none	none	16	reserved / spare
32	GPIO_31	output (JP5/JP6)	high (JP8/JP9)	35	reserved / spare

Table 4: 3-axis portal PSXU configuration (sorted)

[1] Number counted, when starting from the left side of the PCB and the 37-pin connector is pointing up. ATTENTION: Number starts counting at 1. GPIO counting starts at 0. DON'T mix up these two counting schemes.

37-pin connector

GPIO	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
JP8/JP9		X		X		X		X		X		X		X																		X
JP7/JP8																														X		
JP5/JP6		X		X		X		X		X		X		X																X		X
JP4/JP5	X		X		X		X		X		X		X		X		X		X		X		X		X		X					

Rest of the BBU

Table 5: 3-axis portal PSXU configuration (as top view)

Counting in Table 5 is a GPIO-based counting and therefore starts to count at 0.

4.5. Storage warehouse

The top PSXU board should be completely configured as input.

The bottom PSXU board should be completely configured as output with the driving direction active high.

5. Revisions

A.0	15.07.2014	First version of documentation.
A.1	23.01.2015	Minor corrections. Added pictures and more model descriptions.