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Approved by:	JL E-KAZ

This document is valid for the following part numbers:

- L5060801 SKiFace Temp
- L5060802 SKiFace UZK
- L5068704 SKiiP4 SKiFace Adapt Temp V1.3

with date code(JJWW) ≥ 1303.

Technical Explanation SKiFace Adapter Board

Please note:
Unless otherwise specified, all values in this technical explanation are typical values. Typical values are the average values expected in large quantities and are provided for information purposes only. These values can and do vary in different applications. All operating parameters should be validated by user's technical experts for each application.
The document remains effective until replaced by subsequent revision of this document.

Table of content:

1 Related documents

- Data sheets SKiiP®4 SKiFace Adapter board Temp or UZK
- Technical Explanation SKiiP®3, Rev. 03.
- Technical Explanation SKiiP®4, Rev. 07.
- Data sheets SKiiP®4

2 Application and handling instructions

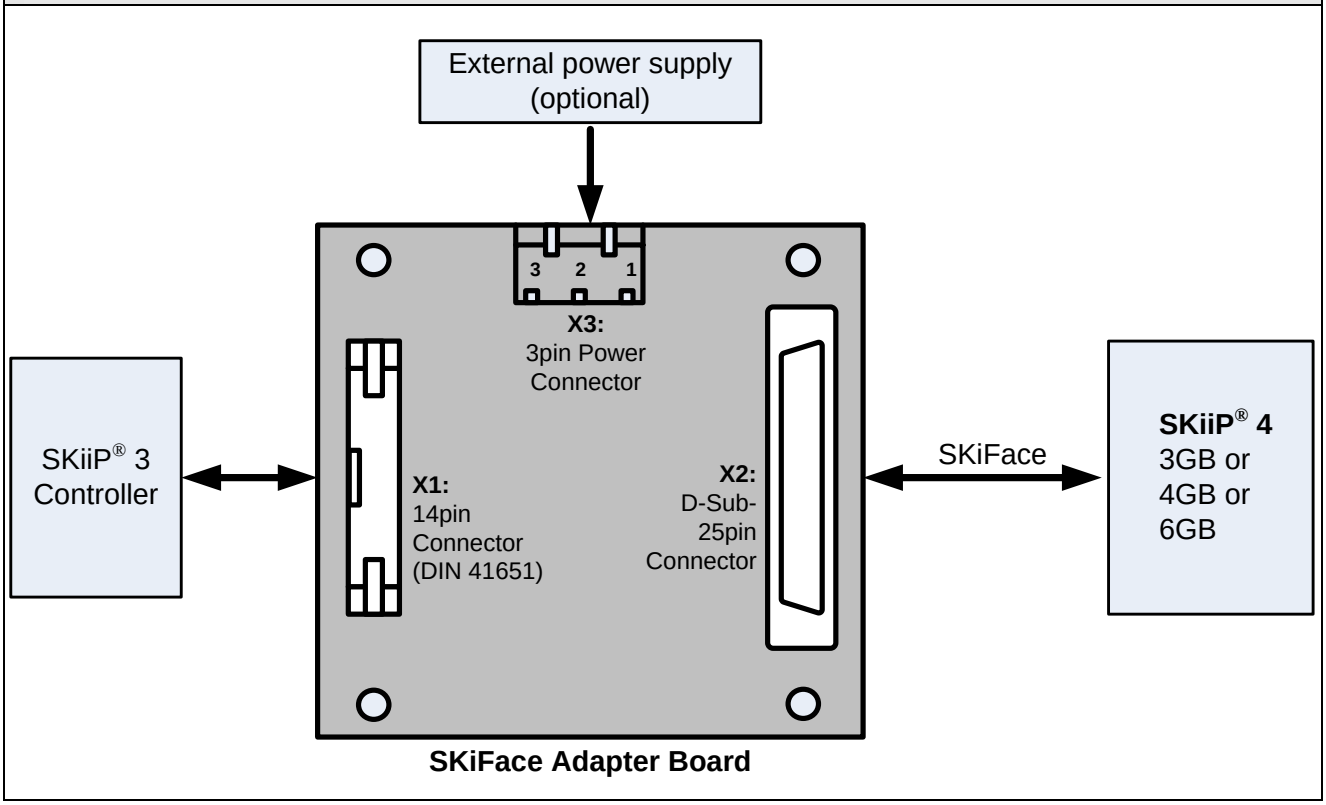
- Please provide static discharge protection during handling. As long as the board is not completely assembled, the input terminals have to be short-circuited. Persons working with devices have to wear a grounded bracelet. Any synthetic floor coverings must not be statically chargeable. Even during transportation the input terminals have to be short-circuited using, for example, conductive rubber. Worktables have to be grounded.
- The inputs of the are sensitive to overvoltage. Voltages higher than V_S +0,3V or below -18V may destroy these inputs. Therefore, control signal overvoltages exceeding the above values have to be avoided.

3 General description

3.1 Overview

Since SKiiP®3 and SKiiP®4 interfaces have different configuration it is not possible to run a SKiiP®4 system with a SKiiP®3 infrastructure. The SKiFace Adapter Board allows to adapt the SKiiP®3 system controller signals to SKiFace interface of SKiiP®4 system. The adaption of SKiiP®4 to a SKiiP®3 controller interface should only be done to test the compatibility SKiiP®4 in a SKiiP®3 design. In the final solution the controller should be equipped with a SKiiP®4 interface to have the features of the SKiFace as diagnostic channel (CANbus), bidirectional HALT-signal and shielded D-Sub cable.

Figure 1: SKiFace Adapter Board application with connected SKiiP®4



There are following variants of SKiFace Adapter Board:

- Board setup with analogue signal output for SKiiP®4 DCB temperature measurement
- Board setup with analogue signal output for DC-Link voltage measurement.

The SKiFace Adapter Board:

- should be located between the controller unit and the SKiiP®4 system.
- should be located possibly close to the controller unit.
- has pollution degree class 2 and IP00.

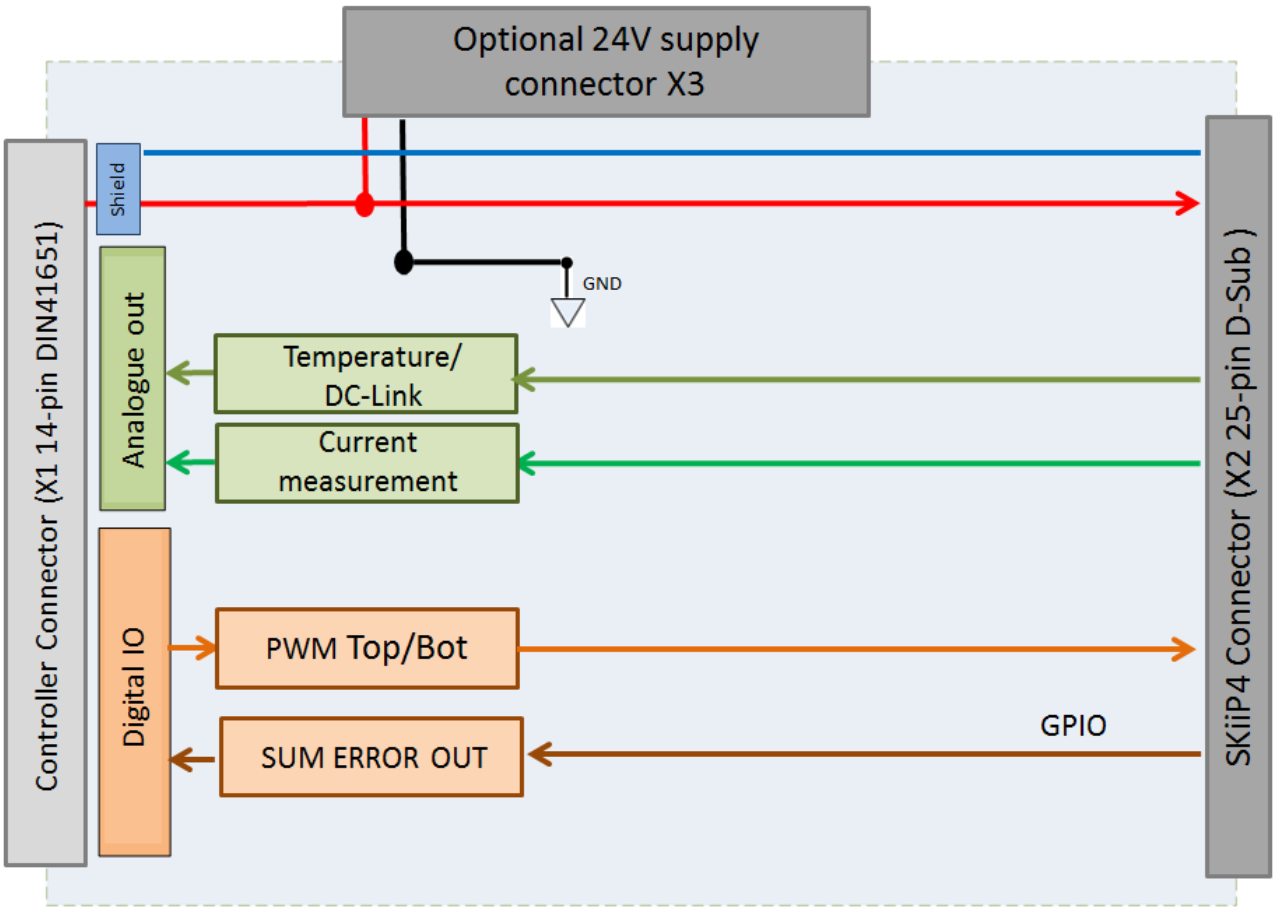
3.2 Type designation

There are two types of SKiFace Adapter Board. Their designations are:

- SKiFace Temp, that means, it has analogue signal output for SKiiP®4 DCB temperature measurement
- SKiFace UZK, that means, it has analogue signal output for DC-Link voltage measurement

4 Block diagram

Figure 2: Block diagram of main functions of SKiFace Adapter Board



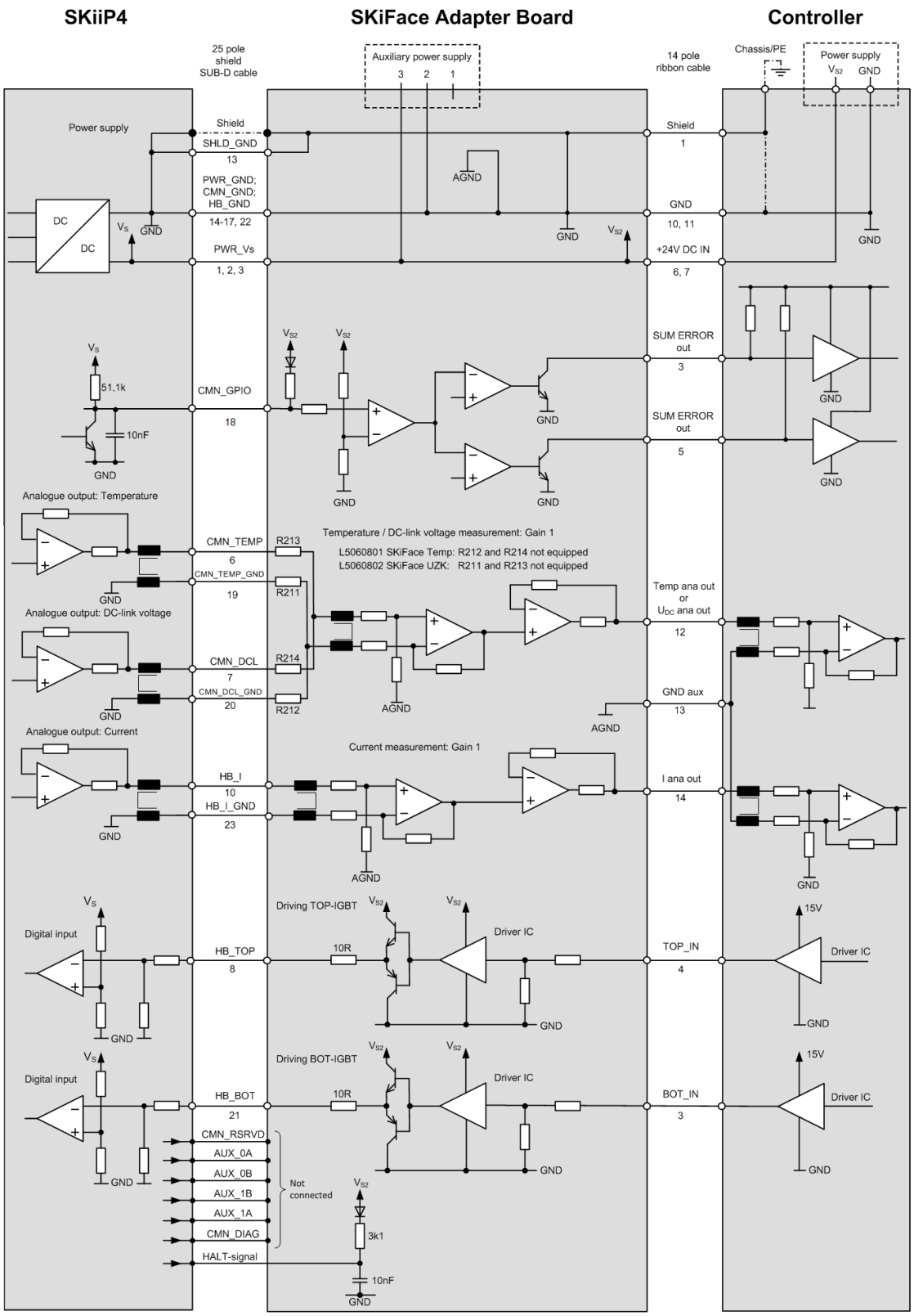
The main functions of the Adapter Board are shown in the Figure 2. They are:

- 24V routing from customer connector X1 to SKiiP®4 D-Sub connector X2
- Optional supplying 24V to SKiiP®4 D-Sub connector X2 from external power connector X3 in case of current consumption greater than 1,8A. Please refer to the Chapter 8 for more detailed information.
- Providing the SKiiP®4 DCB temperature or DC-Link voltage value (depending on the board setup) of connected SKiiP®4 system to the customer connector X1
- Providing the measured current value of connected SKiiP®4 system to the customer connector X1
- Conversion of TOP/BOT switching signals from SKiiP®3-Standard (customer connector X1) to SKiiP®4-Standard (SKiiP®4 connector X2)
- Conversion the GPIO error signal from the connected SKiiP®4 system to the error signal (SUM_ERROR_OUT) of the SKiiP®3 customer connector (Digital Out / connector X1)

Please note:The 15V power supply output for external devices is not available on the customer connector X1

The equivalent circuit diagram of SKiiP®3/SKiiP®4 interface is shown in the Figure 3.

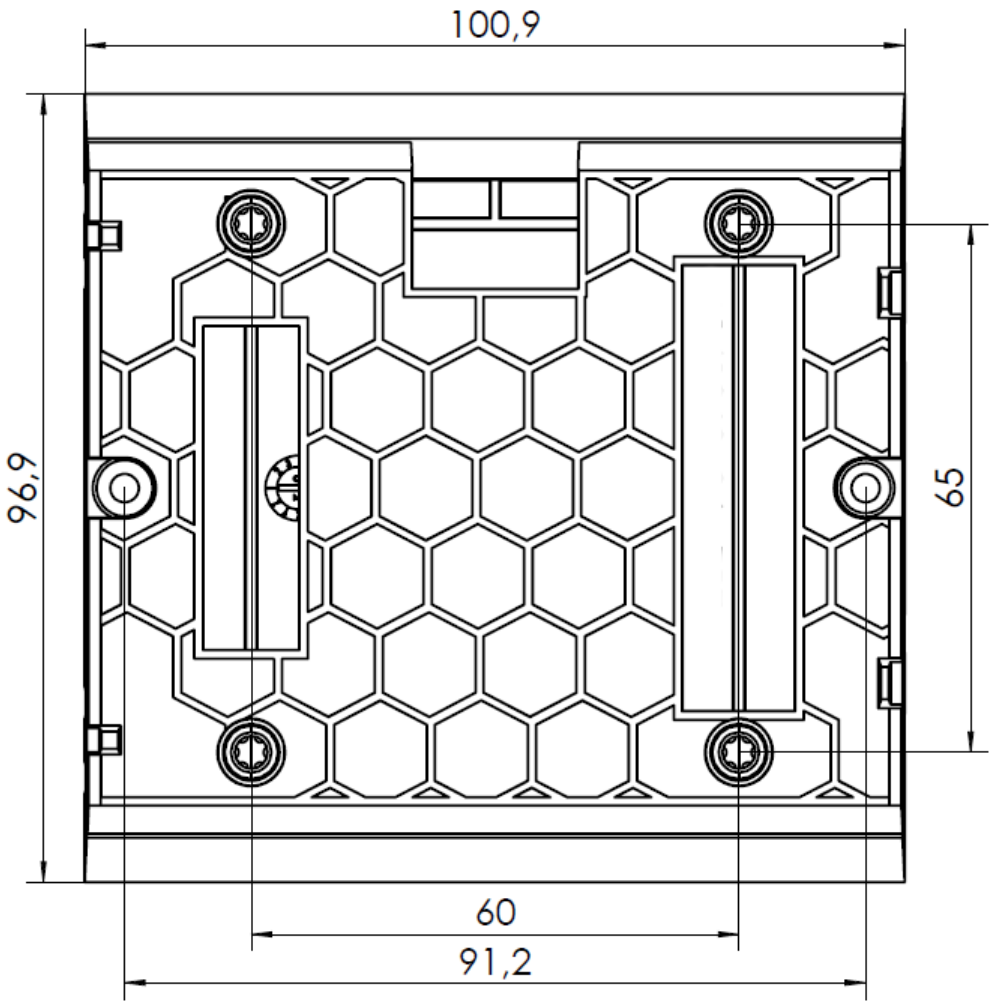
Figure 3: Equivalent circuit diagramm of SKiiP®3/SKiiP®4 interface



5 Dimensions

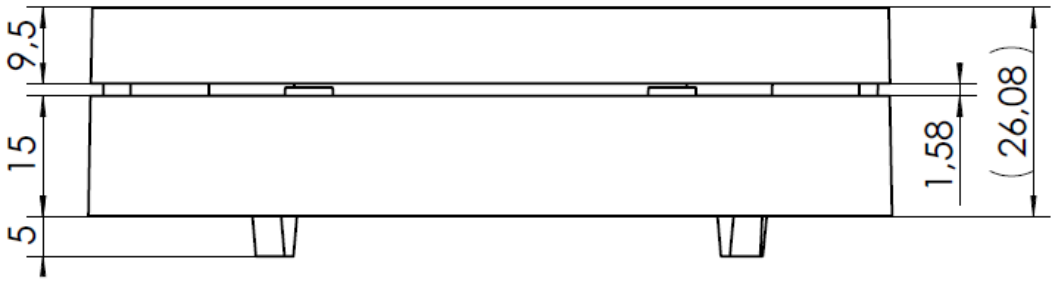
SKiFace Adapter Board should be placed as near as possible to the controller. The mechanical dimensions of SKiFace Adapter Board (Top view) are shown in the Figure 4.

Figure 4: Mechanical dimensions of SKiFace Adapter Board (Top view)



The mechanical dimensions of SKiFace Adapter Board (Side view) are shown in the Figure 5.

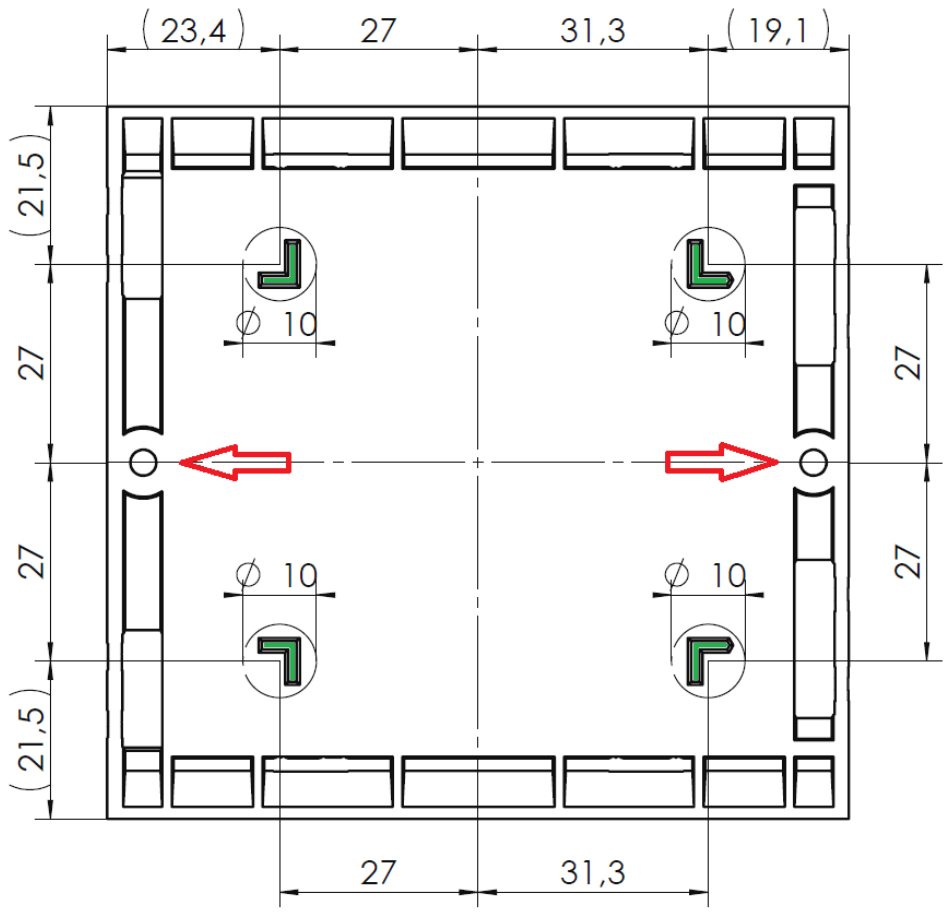
Figure 5: Mechanical dimensions of SKiFace Adapter Board (Side view)



6 Mounting instruction

The mounting should be realised with two screws M3 (min 8,8mm screw thread). The drill-holes are shown in Figure 6 marked by red arrows. The recommended torque is between 0,7 und 1,5 Nm depending on which counter piece it will be mounted on.
For easier mounting process the leading pins are available on the bottom side of SKiFace plastic case. They are marked with green colour in the Figure 6.

Figure 6: Mechanical dimensions of SKiFace Adapter Board (Bottom view)

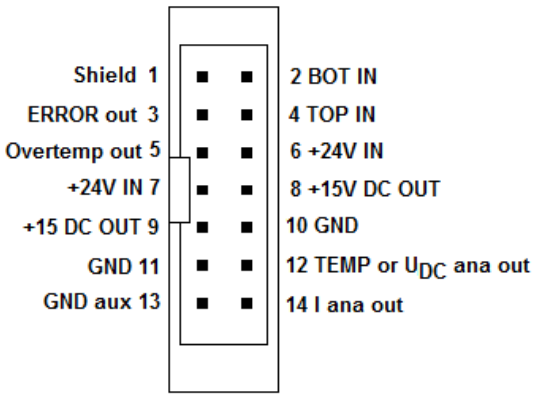


7 Pin Description

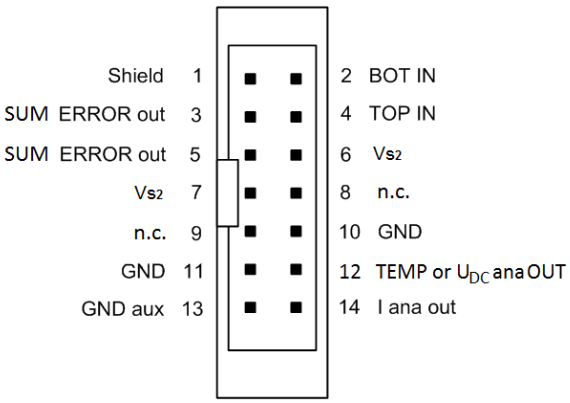
7.1 Pin assignment of controller connector X1

The controller connector X1 is a standard SKiiP®3 connector with some changes (please see pin out below).

Figure 7: SKiiP®3 controller connector 14 pin, male, vertical, top view.



standard SKiiP®3 connector



changed SKiiP®3 connector for SKiFace

Table 1: Pin description of SKiiP®3 controller connector X1

PIN	Signal	Function	Specification
1	Shield		Please refer to chapter 13
2	BOT IN	Switching signal input for low side IGBT	• Positive 15V CMOS Logik • 10kOhm resistance Please refer to chapter 9.1
3	SUM_ERROR_OUT	Error signal	• Open Collector • LOW = NO ERROR • Max. 30V/15mA Please refer to 0
5	SUM_ERROR_OUT		
4	TOP IN	Switching signal input for high side IGBT	• Positive 15VCMOS Logik • 10kOhm resistance Please refer to 9.1
6	V_{S2}	Power Supply	+24V ±20% Please refer to chapter 8
7			
8/9	n. c.		
10	GND	Power ground	Please refer to chapter 0
11			
12	TEMP or U_{DC} ana OUT	Analogue signal that corresponds to the SKiiP4 measured DCB temperature or the measured DC-link voltage (depends on the version of the SKiFace Adapter Board)	0…+10 V / 5 mA (max.) Please refer to chapter 0 or 10.3
13	GND aux	Reference for analogue output signals	Please refer to chapter 0
14	I ana out	Analogue signal that corresponds to the measured AC-current	-10…+10 V / 5 mA (max.) Please refer to chapter 10.1

7.2 Pin assignment of SKiiP®4 connector X2

The SKiFace Adapter Board is equipped with the SEMIKRON "SKiFace Standard" interface which has a 25-pin D-Sub connector. Please refer to SKiiP®4 Technical Explanation Rev.3 Chapter "Gate driver interface SkiFace" for further information and pin out of connector X2.

8 External Power Supply

The external power supply connector X3 should be used in following cases:

- The required current consumption of the SKiiP®4-System (please refer to the corresponding SKiiP®4 data sheet, p.2, for the current consumption formula) can not be supplied by SKiiP®3 controller.
- The voltage drop along the cable used between SKiiP®3 controller and X2 becomes significantly high because of high supply current, small cable wire diameter and length of cable.

Please note: If using external power supply connector X3, the 24V power supply available on the controller side must be disconnected. Please refer to Figure 2: Block diagram of main functions of SKiFace Adapter Board for more information.

The pin assignment of external power supply connector X3 is shown in the Table 2.

Table 2: External power supply connector X3 pin assignment

Pin	Signal name	Function
1		n.c.
2	GND	Ground
3	+24V	Supply voltage input for SKiiP®4

The comparison between power supply characteristics of SKiiP®3, SKiiP®4 and SKiFace Adapter Board are summarized in Table 3.

Table 3: Power supply characteristics for SKiiP®4, SKiiP®3, SKiFace Adapter Board

Signal	SKiiP®4	SKiiP®3	SKiface Adapter Board
Signal name	PWR_VS	+24V DC IN	V_{S2}
Signal range	24V±20% 19,2V…28,8V	13V…30V	24V ±20% 19,2V…28,8V
Supply current	Please refer to SKiiP®4 data sheet	Please refer to SKiiP®3 data sheet	Please refer to SKiFace Adapter Board data sheet

For further information about an appropriate external power supply for a SKiiP®4 system please refer to the Technical Explanation SKiiP®4, chapter "External power supply".

Please note: Power supply cable should be twisted or shielded to enhance the EMC robustness.

9 Digital Input/Output Signals

9.1 PWM Top/Bottom Signals

The input signals for the TOP and BOT switch have a digital positive/ active high logic (input HIGH = IGBT on; input LOW = IGBT off) characteristic. For SKiiP®4 all threshold levels of digital signals are related to supply voltage V_{s2}, whereas they are fixed values for SKiiP®3 (please refer to Table 4).

Table 4: Digital signal characteristics TOP/BOT Input

	SKiiP®4	SKiiP®3
Signal name	HB_TOP HB_BOT	TOP IN BOT IN
Input threshold voltage (High)	$0,7*V_{s2}$	12,3V
Input threshold voltage (Low)	$0,3*V_{s2}$	4,6V

Because of these differences the conversion of the TOP/BOT switching signals from SKiiP®3-Standard into SKiiP®4-Standard is needed.

Please note: A non-connected input will be considered as LOW signal.

9.2 GPIO Signal

The GPIO-Signal from SKiiP®4 driver is available as SUM_ERROR_OUT (open collector) on pin 3 and 5 of connector X1. The SKiiP®4 GPIO signal corresponds to the SKiiP®3 Error signal with the following exception:

- No independent signals for overtemperature and error.

10 Analogue Output Signals

SKiiP®3 has in comparison to SKiiP®4 only two analogue outputs. One is for current measurement and the other can be chosen between DC-link voltage or temperature measurement (UZK- or Temp-option). Therefore different adaprer board are available to provide the DCB temperature measurement or the DC-link voltage measurement. The aplification factor of the analogue signal is 1[1)] in exception of board L5068704 which has current amplification of 1,333[1)].

Table 5: Analogue amplification factor. Signal X1 (14-pol) to signal X2 (D-SUB)

	Pin X1 14-pol	Pin X2 D-SUB	L5060801 SKiFace Temp	L5060802 SKiFace UZK	L5068704 SKiiP4 SKiFace Adapt Temp V1.3
DCB temperature measurement	12	6	1[1)]	Not available	1[1)]
DC-link voltage measurement	12	7	Not available	1[1)]	Not available
Output current measurement	14	10	1[1)]	1[1)]	1,333[1)]

Please note: SKiiP®4 driver has different scaling on the analogue signals than the SKiiP®3 driver.

10.1 Measurement of output current

Signal characteristics of analogue current measurement per SKiiP®4 half bridge are shown in the Table 6. Please refer to the Technical Explanation SKiiP®4, chapter “Introduction” for half bridge definition and to chapter “AC-Current sensor” for transfer characteristic.

Table 6: Signal characteristics of analogue current signal per SKiiP®4- half bridge

	SKiiP®4	SKiiP®3
Signal name	HB_I	I ana out
Signal range	+/-10V	+/-10V
Trip level @ +/-10V	+/-900A	+/-625A for GB-type SKiiP®3 or +/-625A and +/-750A for GD-type SKiiP®3
Small signal bandwidth	50kHz[2)]	50kHz

[1)] Deviations of analogue output signal caused by temperature drift are limited to ±1% (relating to 10V) due to components characteristics.
[2)] Please refer to Technical Explanation SKiiP®4 for further explanations

10.2 Measurement of DCB temperature

Signal characteristics of SKiiP®4 DCB temperature measurement are shown in the Table 7. For transfer characteristic and further information about measurement and sensor position please refer to the Technical Explanation SKiiP®4, Rev.3 Chapter 5.3.8.2 “Integrated DCB-temperature sensor”.

Table 7: Signal characteristics of SKiiP®4 DCB temperature measurement		
	SKiiP®4	SKiiP®3
Signal name	CMN_TEMP	TEMP
Signal range	0V…10V	1V…10V
Trip level	135°C (typ.)[2] @ +8,75V	115°C (typ.)[2] @ +10V
Small signal bandwidth	5Hz[1]	5Hz

10.3 Measurement of DC-link voltage

Signal characteristics of DC-Link voltage measurement are schown in the Table 8. For transfer characteristic please refer to the Technical Explanation SKiiP®4, chapter 5.3.8.3 “DC-Link voltage sensing”.

Table 8: Signal characteristics of DC-link voltage measurement		
	SKiiP®4	SKiiP®3
Signal name	CMN_DCL	U_{DC} ana out
Signal range	0V…10V	0V…10V
Trip level for 1200V Systems	980V @ 9,8V	900V @ +9V
Trip level for 1700V Systems	1340V @ 10V	1200V @ +9,3V
Small signal bandwidth	2kHz[1]	320Hz

[1] Please refer to Technical Explanation SKiiP®4 for further explanations
[2] SKiiP®3 and SKiiP®4 have different temperature measurement points. The temperature sensor inside the SKiiP®4 is located closer to the chips and has therefore a smaller thermal resistance from junction to reference compared to SKiiP®3.

11 Timing

Please refer to [2] for definitions.

Table 9: Timing		
Signal	**SKiiP®4**	**SKiiP®3**
t_{TD} (top/bottom switch interlock time)	3µs	3µs
t_{SIS} (short pulse suppression time)	600ns	625…750ns
t_{POR} (Power-On-Reset completed)	3,5s	150ms
t_{pRESET} (error memory reset time)	1,3..2,9s	12,2µs

12 Ground connection

No adjusting of ground connection hardware is necessary.

Table 10: Ground connections of SKiiP®4 and SKiiP®3

Signal	SKiiP®4	SKiiP®3
Power ground and digital grounds	PWR_GND CMN_GND HB_GND SHLD_GND	GND
Analogue grounds	CMN_TEMP_GND CMN_DCL_GND HB_I_GND	GND aux

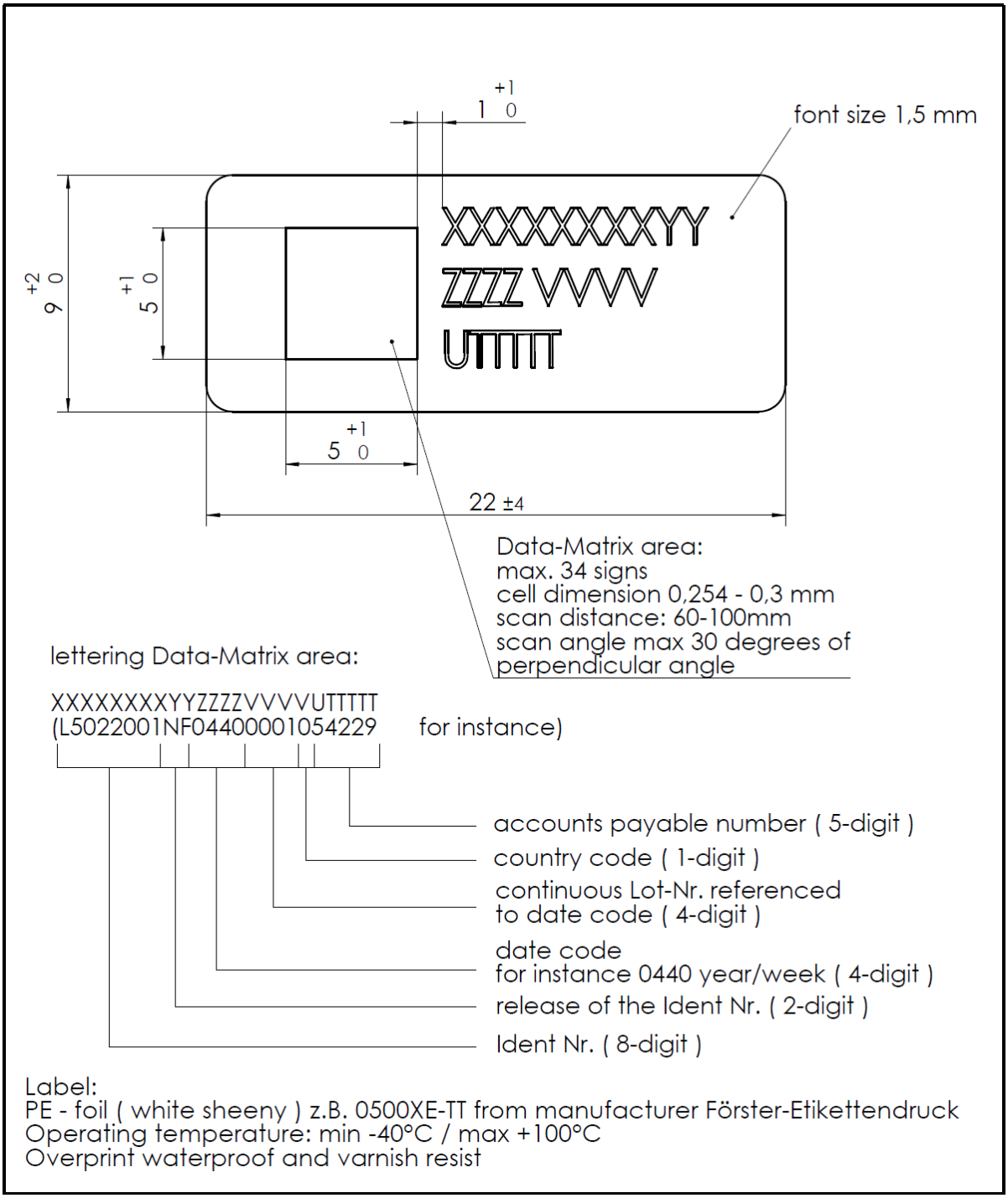
The availability of several power and digital ground connections makes it possible to use additional components in the ground connection on controller side for higher noise immunity like common mode chokes if it is needed. Please refer to the Figure 3 for visualization.

13 Shielding Concept

The shield of the D-Sub interface is connected on the SKiFace Adapter Board to PWR_GND. There is no connection on SKiiP®4 driver board to heat sink or other protective earth connections. The connection to chassis can be done on the controller board.

14 Logistics

Figure 8: Part Marking Information



15 Provisions and handling after use

Components which are obsolete or defective must be disposed according to local regulations

List of figures:

List of tables:

References

[1] www.SEMIKRON.com
[2] A. Wintrich, U. Nicolai, W. Tursky, T. Reimann, “Application Manual Power Semiconductors”, ISLE Verlag 2011, ISBN 978-3-938843-666

HISTORY

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