

**Technical Explanation**  
**SKiM93 Adapter**  
**Board** L5063901

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Prepared by:	A.Schiller
Approved by:	N.Hofstötter

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**Attention:**

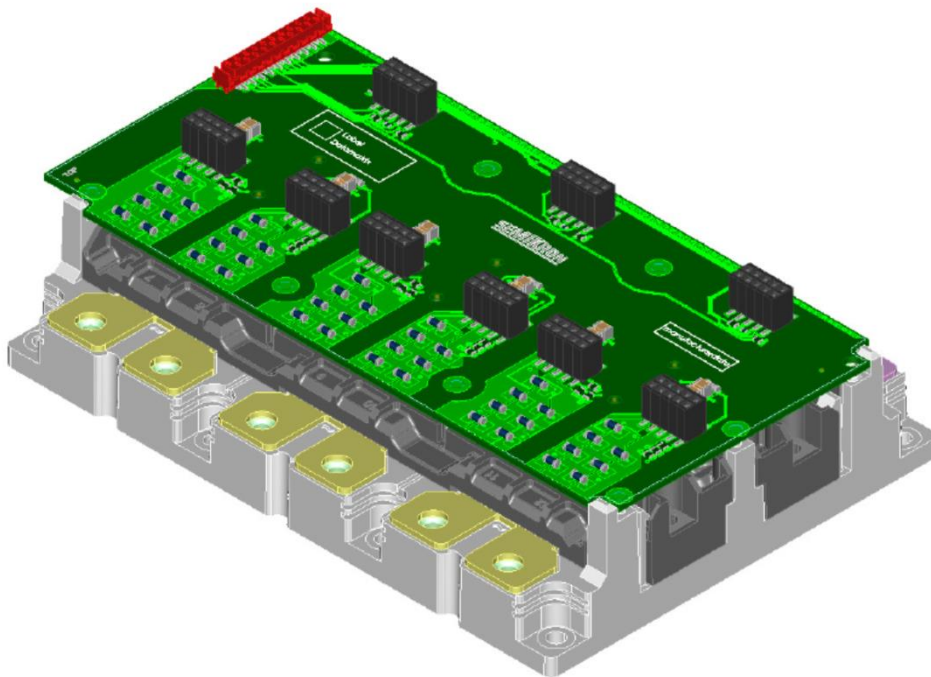
**The adapter boards are not tested for function but for correct component population. All electrical values are determined by the driver core SKYPER® 42 LJ R. Please refer to the technical explanation and data sheet of SKYPER® 42 LJ R for further details.**

## 1. Introduction

The Board SKiM<sup>®</sup>93 GD SKYPER<sup>®</sup> 42 LJ is an adaptor board for the SEMIKRON IGBT module SKiM<sup>®</sup> 93 (spring contact). The board is developed for the use with SKYPER<sup>®</sup> 42 LJ R. The board can be customized allowing adaptation and optimization to the used IGBT module.

The switching characteristic of the IGBT can be influenced through user settings, e.g. changing turn-on and turn-off speed by variation of  $R_{G(on)}$  and  $R_{G(off)}$ . Furthermore, it is possible to adjust the monitoring level and blanking time for the DSCP (see Technical Explanations SKYPER<sup>®</sup> 42 LJ R).

**Figure 1: Board SKiM<sup>®</sup>93 GD SKYPER<sup>®</sup> 42 LJ R**



The driver has the following features:

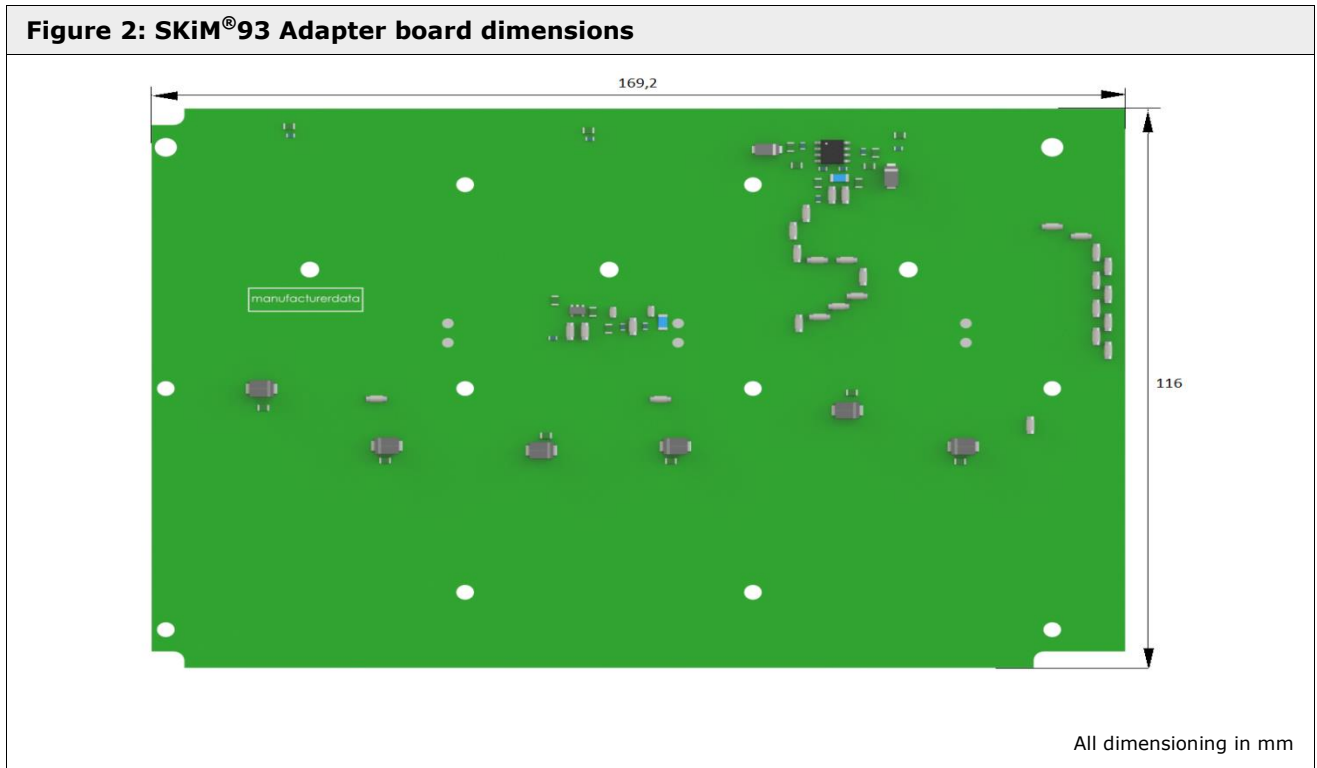
- Complete six channel driver for SKiM<sup>®</sup>93 up to 1200V DC link voltage
- DC Link measurement
- Adjustable temperature protection
- Differential DC link output
- $V_{CEsat}$ -monitoring with DSCP

**Please note:**

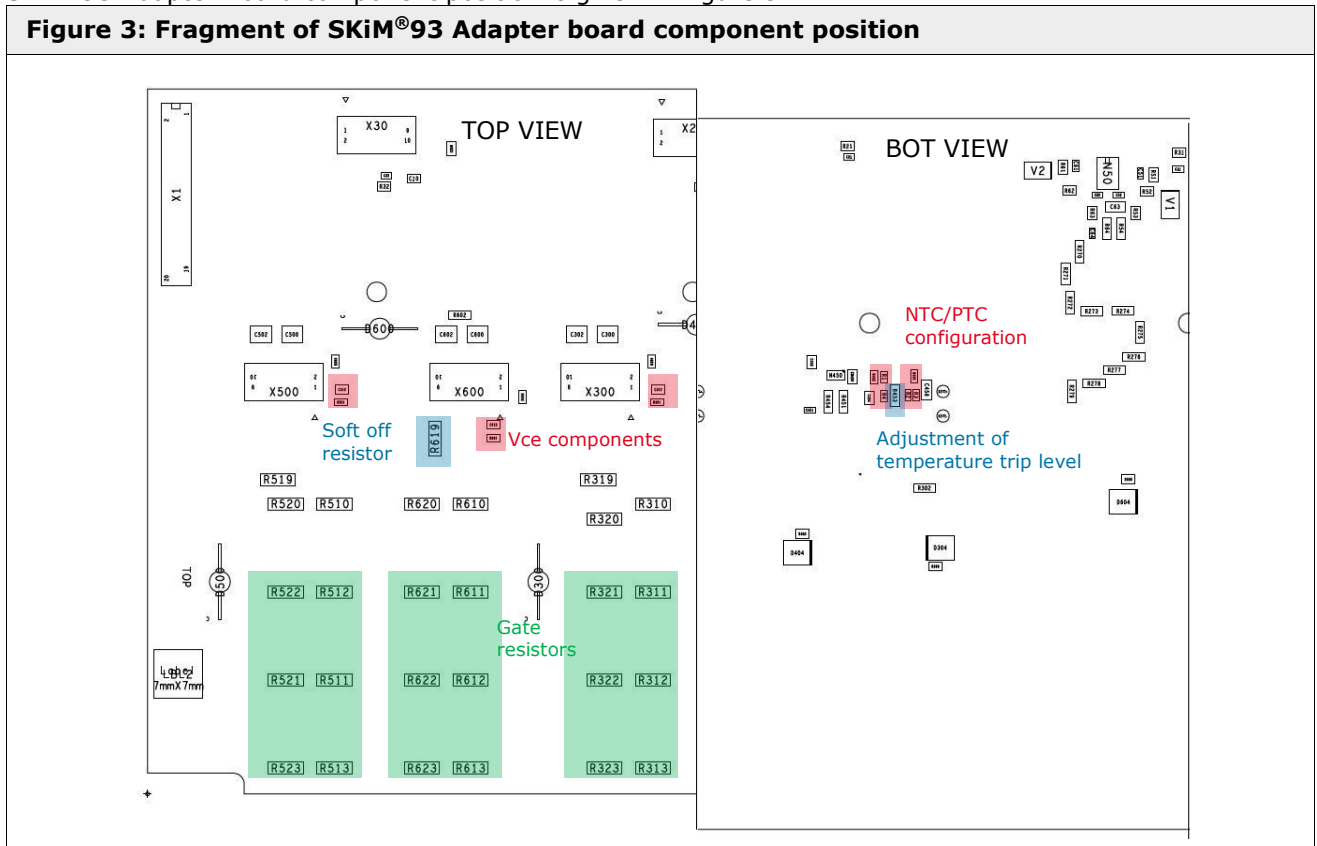
This Technical Explanation is based on the Technical Explanations for SKYPER<sup>®</sup> 42 LJ R. Please read the Technical Explanations SKYPER<sup>®</sup> 42 LJ R before using this Adaptor Board.

## 2. Board dimensions

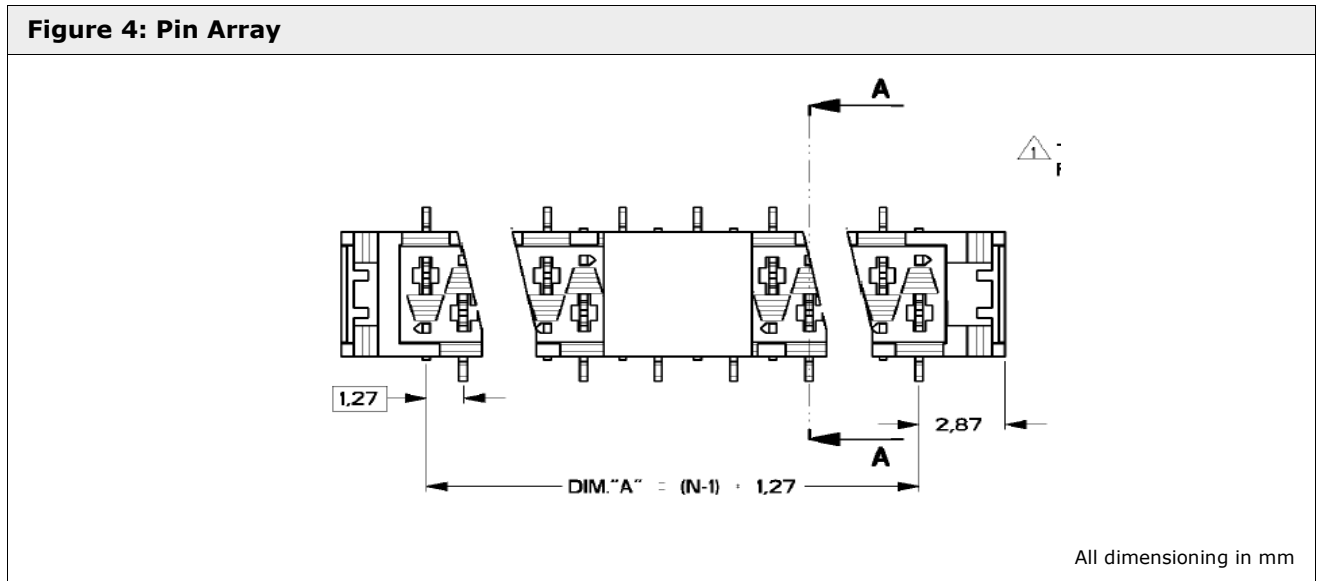
SKiM<sup>®</sup>93 Adapter board dimensions are given in the Figure 2.



SKiM<sup>®</sup>93 Adapter Board component position is given in Figure 3.



### 3. Driver interface



Connector details:

- Connector: Micromatch (female)
- Manufacturer: Tyco
- Order number: 2-338069-0 or 9-338069-0
- Specification: 20p with locking
- 3D model: <http://www.te.com/catalog/pn/en/2-338069-0?RQPN=2-338069-0>

**Table 1: Pin configuration**

Pin	Signals	Description	I/O	Specification
P:01	IF_PWR_VP	External power supply	I	Please refer to SKYPER® 42LJ document
P:02	IF_PWR_VP	External power supply	I	Please refer to SKYPER® 42LJ document
P:03	IF_CMN_DCLINK_P	Differential DC Link output, positive output	O	Nominal Voltage Range 0 ... +10V (Max 15V) Max Output Current 5mA
P:04	IF_CMN_DCLINK_N	Differential DC Link output, negative output	O	
P:05	IF_CMN_RSRVD	Reserved	-	To be connected with ground
P:06	IF_CMN_RSRVD	Reserved	-	To be connected with ground
P:07	IF_CMN_GND	Ground	GND	To be connected with ground
P:08	IF_CMN_HB1_TOP	Gate driver signal TOP, Phase U	I	Please refer to SKYPER® 42LJ R document
P:09	IF_CMN_HB1_BOT	Gate driver signal BOT, Phase U	I	Please refer to SKYPER® 42LJ R document

Pin	Signals	Description	I/O	Specification
P:10	IF_CMN_HB2_TOP	Gate driver signal TOP, Phase V	I	Please refer to SKYPER® 42LJ R document
P:11	IF_CMN_HB2_BOT	Gate driver signal BOT, Phase V	I	Please refer to SKYPER® 42LJ R document
P:12	IF_CMN_HB3_TOP	Gate driver signal TOP, Phase W	I	Please refer to SKYPER® 42LJ R document
P:13	IF_CMN_HB3_BOT	Gate driver signal BOT, Phase W	I	Please refer to SKYPER® 42LJ R document
P:14	IF_CMN_GND	Ground	GND	To be connected with ground
P:15	IF_CMN_ERR	ERROR output	O	External pull up necessary
P:16	IF_CMN_RSRVD	Reserved	-	To be connected with ground
P:17	IF_CMN_RSRVD	Reserved	-	To be connected with ground
P:18	IF_CMN_RSRVD	Reserved	-	To be connected with ground
P:19	IF_CMN_GND	Ground	GND	To be connected with ground
P:20	IF_CMN_GND	Ground	GND	To be connected with ground

#### 4. Adaptation of Gate Resistors

Settings for Gate Resistors are given in the Table 2 below.

Table 2: Adapter board configuration for $R_{Gon}$ & $R_{Goff}$			
Designation	Shape	Setting	
R110 – R113 (parallel connected)	MELF	$R_{G(on)}$ , Factory setting: not equipped	TOP 1
R120 – R123 (parallel connected)	MELF	$R_{G(off)}$ , Factory setting: not equipped	TOP 1
R210 – R213 (parallel connected)	MELF	$R_{G(on)}$ , Factory setting: not equipped	BOT 1
R220 – R223 (parallel connected)	MELF	$R_{G(off)}$ , Factory setting: not equipped	BOT 1
R310 – R3123 (parallel connected)	MELF	$R_{G(on)}$ , Factory setting: not equipped	TOP 2
R320 – R323 (parallel connected)	MELF	$R_{G(off)}$ , Factory setting: not equipped	TOP 2
R410 – R413 (parallel connected)	MELF	$R_{G(on)}$ , Factory setting: not equipped	BOT 2
R420 – R423 (parallel connected)	MELF	$R_{G(off)}$ , Factory setting: not equipped	BOT 2
R510 – R513 (parallel connected)	MELF	$R_{G(on)}$ , Factory setting: not equipped	TOP 3
R520 – R523 (parallel connected)	MELF	$R_{G(off)}$ , Factory setting: not equipped	TOP 3

R610 – R613 (parallel connected)	MELF	$R_{G(on)}$ , Factory setting: not equipped	BOT 3
R620 – R623 (parallel connected)	MELF	$R_{G(off)}$ , Factory setting: not equipped	BOT 3

## 5. Protection features

### 5.1 Over temperature protection

The external error input SEC\_TOP\_ERR\_IN on the secondary side (high potential) of the driver core SKYPER® 42 LJ R is used for an over temperature protection circuit to place the gate driver into halt mode, if the temperature trip level is exceeded.

#### Sensor type of the SKiM®93 module

According to the request from several automotive customers for Fail-safe operation (Functional Safety) a version of SKiM®93 module with PTC temperature sensor is created. The version of the temperature sensor embedded into the module is given in the corresponding module data sheet.

The module version with NTC sensor will be discontinued in 2019, so starting from date code 1901 (see Chapter 7 Marking) the factory default setting for the Adapter Board will be defined for module with PTC temperature sensor, see Table 3: Adapter board configuration for PTC and NTC temperature sensor versions Table 3.

#### Setting Over Temperature Protection

- Define an over temperature trip level according to the application.
- Calculate the nominal ohmic resistance value of the temperature sensor at the defined trip level (see Technical Explanations SKiM®63/93 on product overview page at <http://www.semikron.com>).
- The trip level on the adapter board is set with R453 by using the calculated resistance value.
- The exact components' position and value for PTC and NTC temperature sensor versions are given in the Figure 5 and Table 3

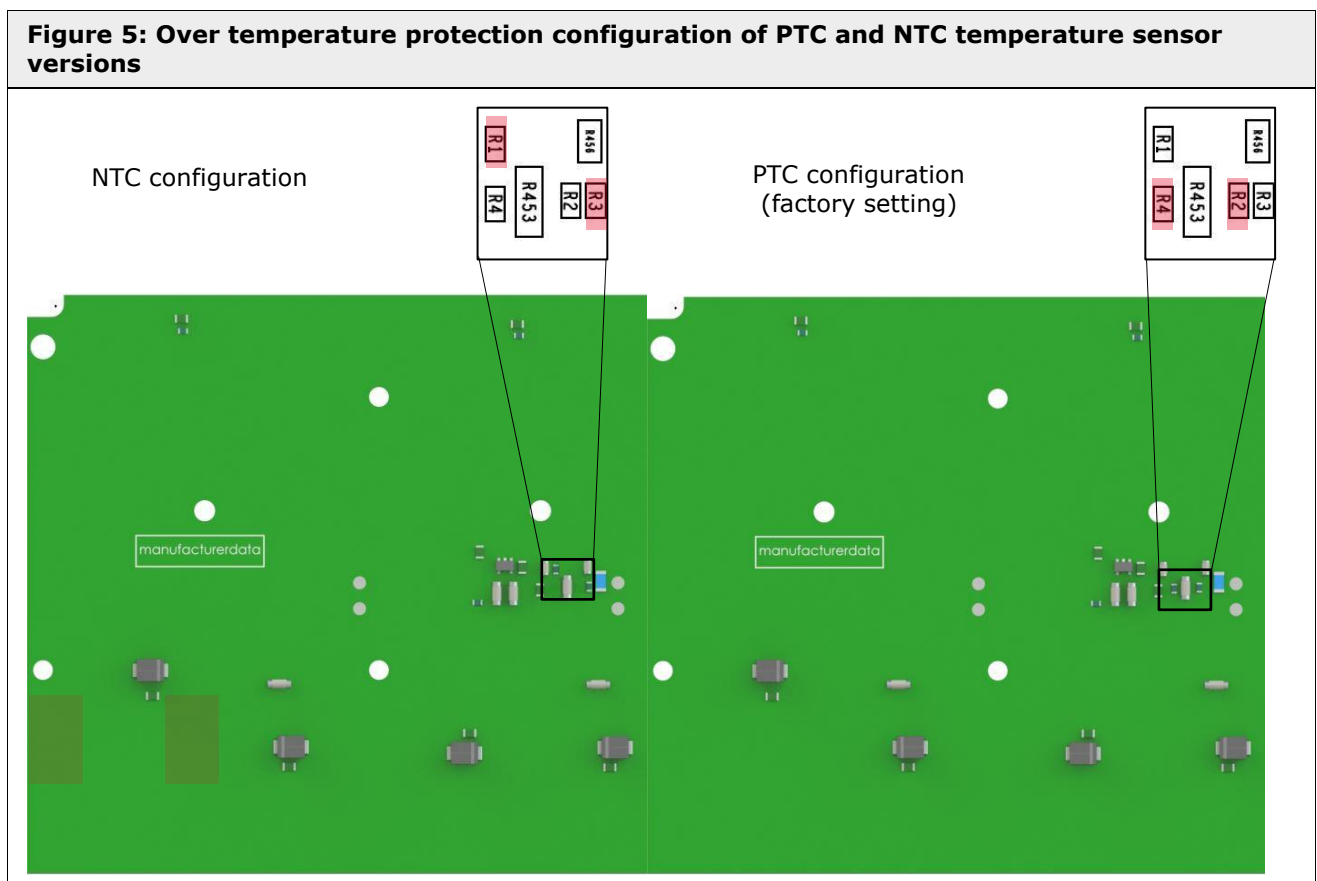


Table 3: Adapter board configuration for PTC and NTC temperature sensor versions			
PTC Version (factory settings)		NTC Version (rework needed)	
R1	DNI	R1	0R 0603
R2	0R 0603	R2	DNI
R3	DNI	R3	0R 0603
R4	0R 0603	R4	DNI
R453	1,69kΩ MINI-Melf 1%	R453	332Ω MINI-Melf 1%

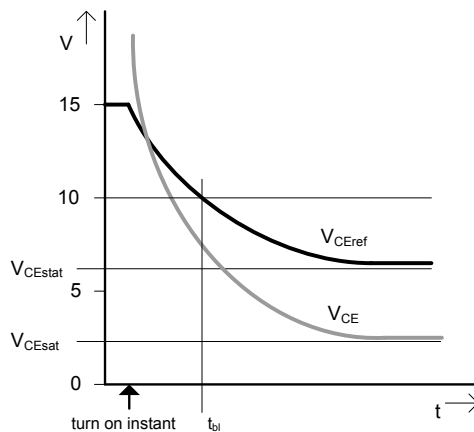
**Please note:**

Factory setting for R453 is a recommended value for  $T_{Trip} = 115^{\circ}\text{C}$ , it can be changed depending on application. If no resistor is used, a failure signal is generated

**5.2 Dynamic short circuit protection by  $V_{CEsat}$  monitoring ( DSCP )**

The DSCP monitors the collector-emitter voltage  $V_{CE}$  of the IGBT during its on-state. The reference voltage  $V_{CEref}$  has to be adapted dynamically to the IGBT's switching behaviour. During the turn-on process of the IGBT a higher  $V_{CE}$  value is effective than in steady on-state.  $V_{CEstat}$  is the steady-state value of  $V_{CEref}$  and has to be adjusted to the required value depending on maximum  $V_{CEsat}$  for each IGBT by an external resistor  $R_{Conf}$ . It may not exceed 10V. During the IGBT's turn-on process the  $V_{CE}$  value is higher than the recommended 10V, therefore the  $V_{CE}$ -monitoring has to blank out the IGBT turn-on process. The time constant  $t_{bl}$  for this delay could be adjusted by an external capacitor  $C_{Conf}$ .

**Figure 6: Reference Voltage ( $V_{CEref}$ ) Characteristic**



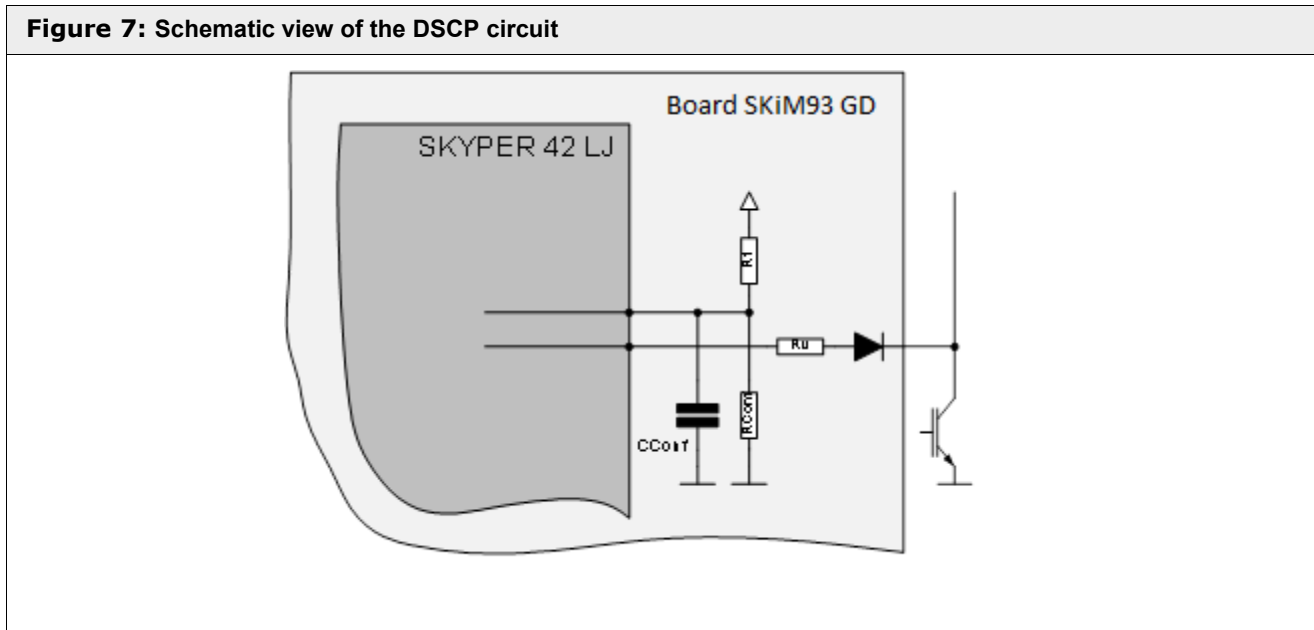
After  $t_{bl}$  has passed, the  $V_{CE}$  monitoring will be triggered as soon as  $V_{CE} > V_{CEref}$  and will turn off the IGBT.

**Settings Dynamic Short Circuit Protection**

Table 4: Adapter board configuration for $R_{Conf}$ & $C_{Conf}$		
Designation	Shape	Setting
R101	0805 (SMD)	$R_{Conf}$ , Factory setting: not equipped TOP1
C112	0603 (SMD)	$C_{Conf}$ , Factory setting: not equipped TOP1
R201	0805 (SMD)	$R_{Conf}$ , Factory setting: not equipped BOT1
C212	0603 (SMD)	$C_{Conf}$ , Factory setting: not equipped BOT1
R301	0805 (SMD)	$R_{Conf}$ , Factory setting: not equipped TOP2

C312	0603 (SMD)	C <sub>Conf</sub> , Factory setting: not equipped	TOP2
R401	0805 (SMD)	R <sub>Conf</sub> , Factory setting: not equipped	BOT2
C412	0603 (SMD)	C <sub>Conf</sub> , Factory setting: not equipped	BOT2
R501	0805 (SMD)	R <sub>Conf</sub> , Factory setting: not equipped	TOP3
C512	0603 (SMD)	C <sub>Conf</sub> , Factory setting: not equipped	TOP3
R601	0805 (SMD)	R <sub>Conf</sub> , Factory setting: not equipped	BOT3
C612	0603 (SMD)	C <sub>Conf</sub> , Factory setting: not equipped	BOT3

**Figure 7: Schematic view of the DSCP circuit**



**Example of  $t_{bl}$  and  $V_{CEref}$  calculation:**

$$R_1 = 30.1k\Omega$$

$$R_{Vce} = 551\Omega$$

$$U_{vce}(R_{conf}, R_1, R_{Vce}) = 15V \times \frac{R_{Conf}}{R_{conf} + R_1} - R_v \times 1mA$$

$$t_{bl}(R_{conf}, R_1, C_{conf}) = 60 * 10^{-9}s + \left( \frac{R_1 \times R_{Conf}}{R_{conf} + R_1} \right) \times C_{conf} \times \ln(3)$$

Please consider that the voltage drop of the high voltage diode is not considered in the formula.

**Recommendation:**

$$C_{CONF} < 1nF$$

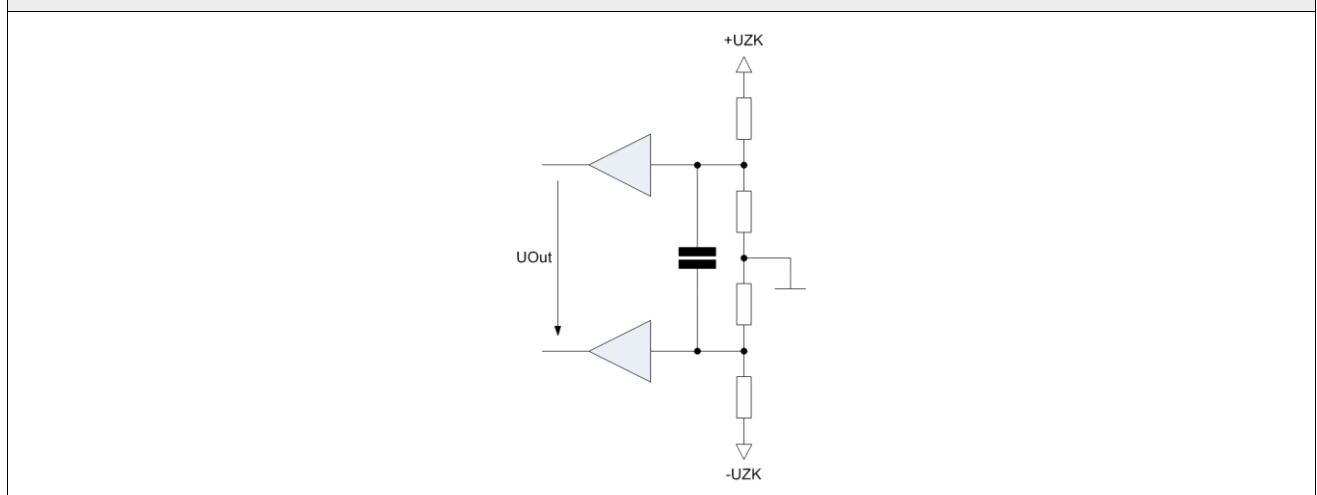
$$R_1 + R_{CONF} > 10 k\Omega$$

### 5.3 Over voltage protection

The adapter board provides differential output signal for the measurement of the DC link voltage for better EMC performance, at the pins P:03/P:04. Normalization of the actual DC-link-voltage signal and input impedances of the measurement circuit is shown in the table below.

Table 5: DC-Link voltage measurement signal	
Signal Characteristics	Value
Maximum measurable DC-link-voltage	1200V
Turns ratio of the analog signal	3mV/V <sub>DC</sub>
Accuracy of analog signal @ 600V	±2.5% @ T <sub>a</sub> =25°C
Bandwith	2 kHz
DC Offset	0.1V

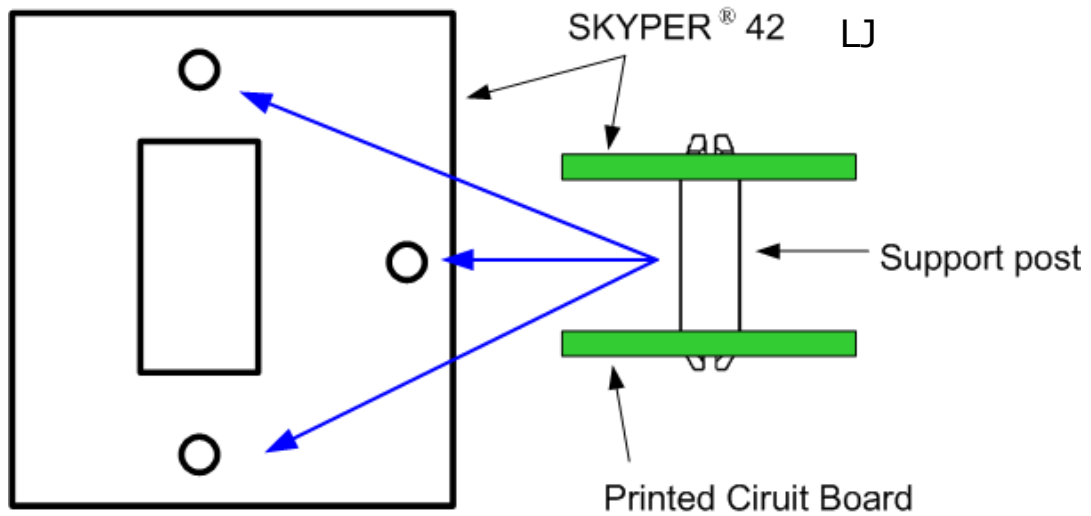
Figure 8: Schematic view of the DC-Link Measurement Circuit



### 6. Mounting hints

1. Soldering of components (e.g. R<sub>G(on)</sub>, R<sub>G(off)</sub>, etc.) on adaptor board.
2. Mounting the adapter board onto the module.
3. Insert driver cores into the box connectors on adaptor board.
4. The connection between driver core and adaptor board should be mechanical reinforced by using support posts, see **Fehler! Verweisquelle konnte nicht gefunden werden..** The posts have to be spaced between driver core and adaptor board. Product information of suitable support posts and distributor contact information is available at e.g. <http://www.richco-inc.com>.

**Figure 9: Driver Core Mounting**



**Adapter Board Mounting:**

**Adapter Board Mounting**

**Important:** Please use the mounting instruction of the SKiM<sup>®</sup> modules for choosing the right screws. The diameter of the screw heads must not be bigger than 5.5mm to keep the insulation performance.

**7. Marking**

**Figure 10: Label**

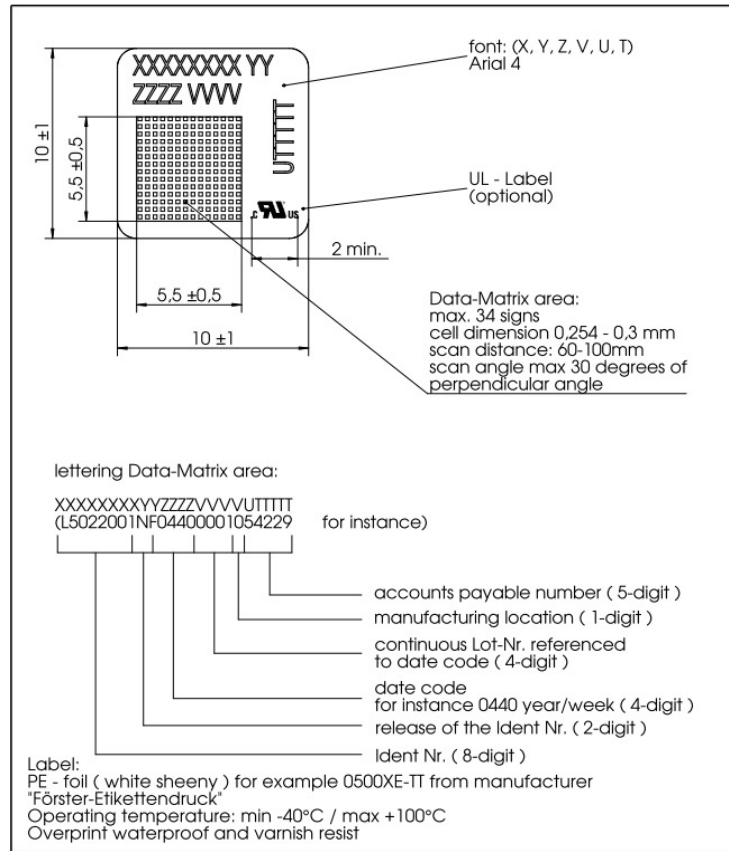


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## References

- [1] [www.SEMIKRON.com](http://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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SEMIKRON INTERNATIONAL GmbH  
P.O. Box 820251 • 90253 Nuremberg • Germany  
Tel: +49 911-65 59-234 • Fax: +49 911-65 59-262  
sales.skd@semikron.com • www.semikron.com