Technical Explanation SKiM93 Adapter Board *L5063901*

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Keyword: IGBT Driver, Adapter Board, SKiM®63, SKYPER® 42 LJ R

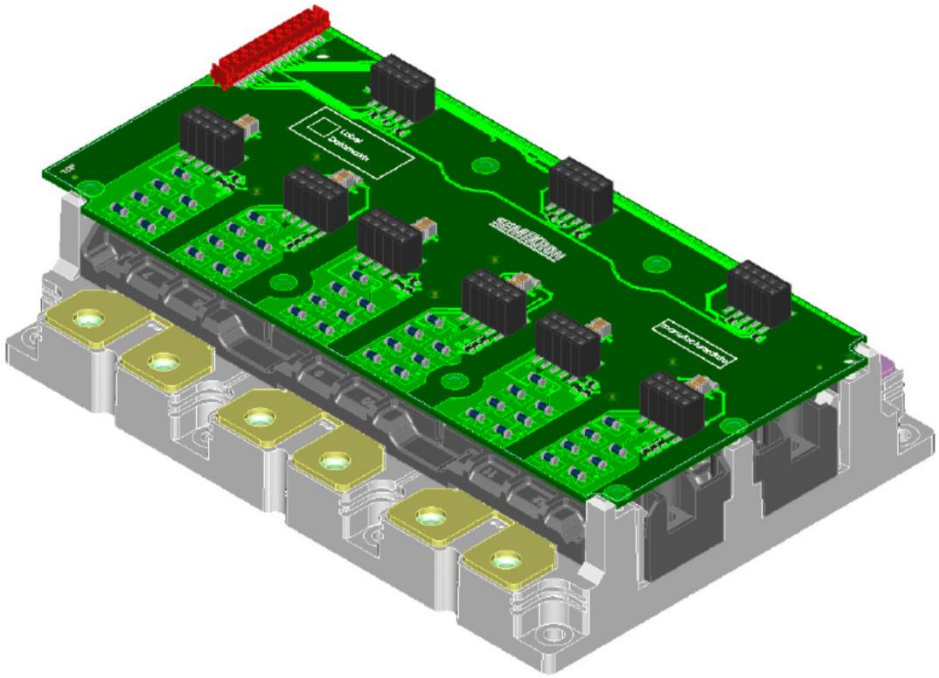
Attention:
The adapter boards are not tested for function but for correct component population. All electrical values are determined by the driver core SKYPER® 42 LJ R. Please refer to the technical explanation and data sheet of SKYPER® 42 LJ R for further details.

1. Introduction

The Board SKiM®93 GD SKYPER® 42 LJ is an adaptor board for the SEMIKRON IGBT module SKiM® 93 (spring contact). The board is developed for the use with SKYPER® 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® 42 LJ R).

Figure 1: Board SKiM®93 GD SKYPER® 42 LJ R



The driver has the following features:

- Complete six channel driver for SKiM®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® 42 LJ R. Please read the Technical Explanations SKYPER® 42 LJ R before using this Adaptor Board.

2. Board dimensions

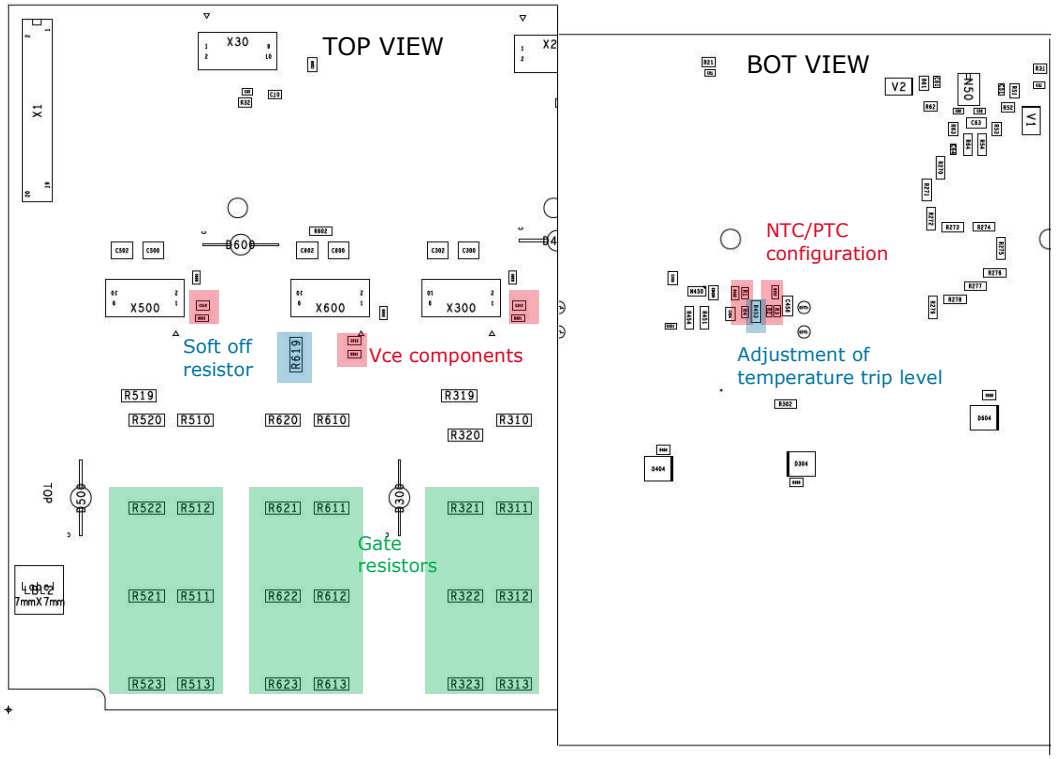
SKiM®93 Adapter board dimensions are given in the Figure 2.

Figure 2: SKiM®93 Adapter board dimensions

All dimensioning in mm

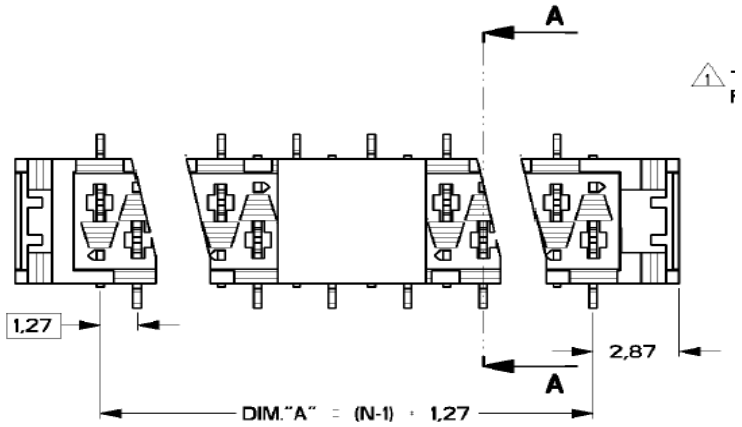
SKiM®93 Adapter Board component position is given in Figure 3.

Figure 3: Fragment of SKiM®93 Adapter board component position



3. Driver interface

Figure 4: Pin Array



All dimensioning in mm

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 versionsTable 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

Figure 5: Over temperature protection configuration of PTC and NTC temperature sensor versions

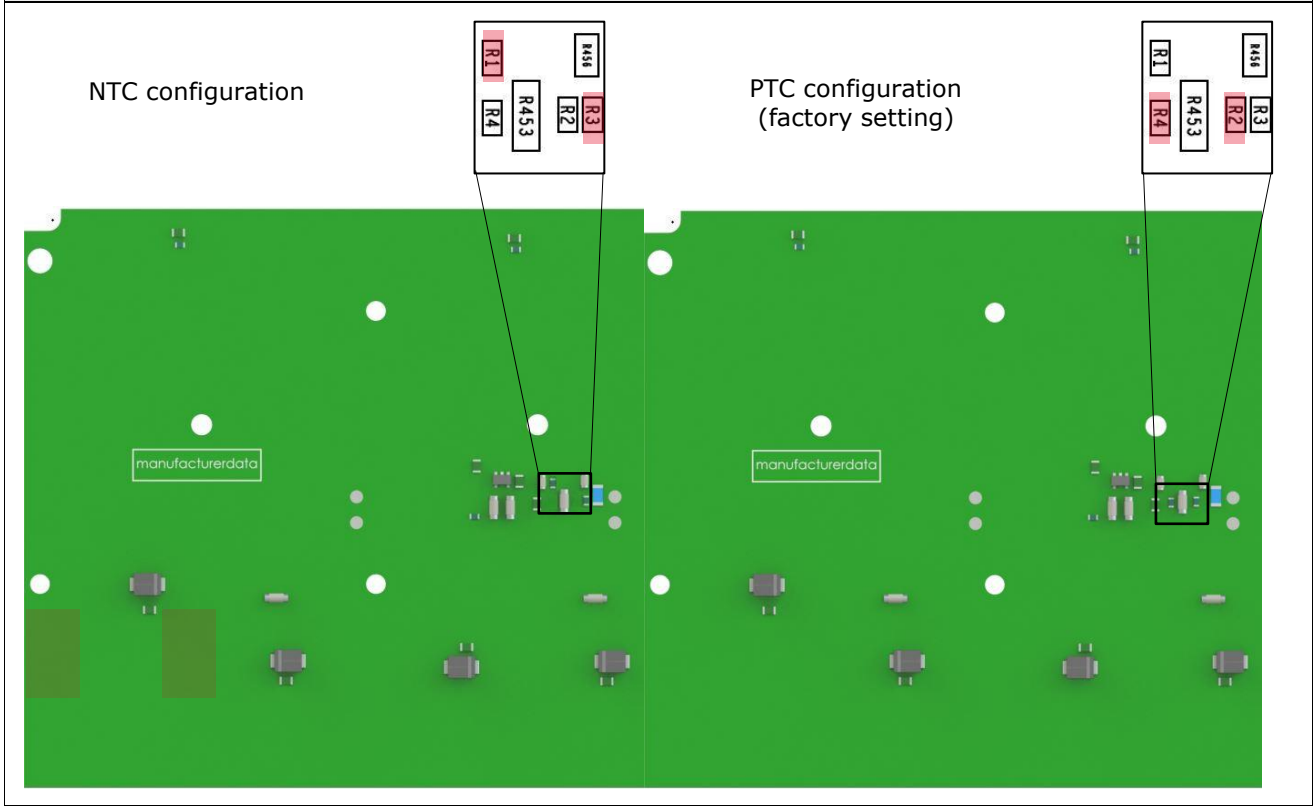


Table 3: Adapter board configuration for PTC and NTC temperature sensor versions			
PTC Version (factory settings)		**NTC Version (rework needed)**	
R1	DNI	R1	0R 0603
R2	0R 0603	R2	DNI
R3	DNI	R3	0R 0603
R4	0R 0603	R4	DNI
R453	1,69kΩ MINI-Melf 1%	R453	332Ω MINI-Melf 1%

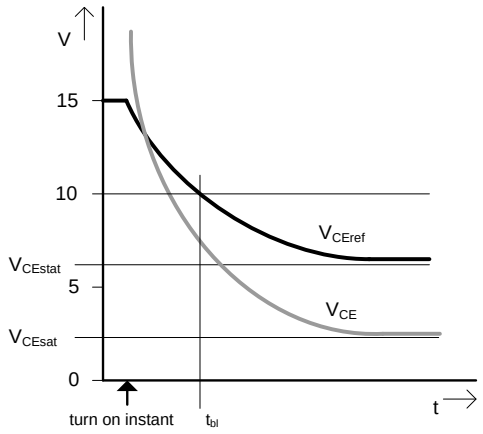
Please note:

Factory setting for R453 is a recommended value for T_{Trip} = 115°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



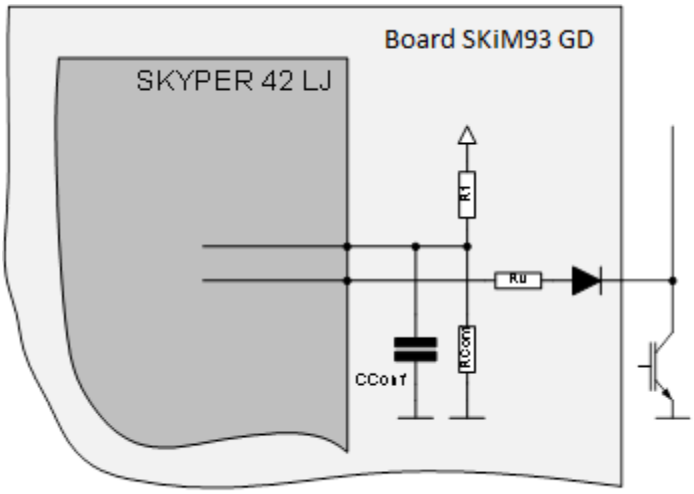
After t_{bl} has passed, the V_{CE} monitoring will be triggered as soon as $V_{CE} > V_{CEref}$ and will turn off the IGBT.

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_{Conf} , Factory setting: not equipped	TOP2
R401	0805 (SMD)	R_{Conf} , Factory setting: not equipped	BOT2
C412	0603 (SMD)	C_{Conf} , Factory setting: not equipped	BOT2
R501	0805 (SMD)	R_{Conf} , Factory setting: not equipped	TOP3
C512	0603 (SMD)	C_{Conf} , Factory setting: not equipped	TOP3
R601	0805 (SMD)	R_{Conf} , Factory setting: not equipped	BOT3
C612	0603 (SMD)	C_{Conf} , Factory setting: not equipped	BOT3

Figure 7: Schematic view of the DSCP circuit



Example of t_{bl} and V_{CEref} calculation:
R_1 = 30.1kΩ
R_{Vce}=551Ω

$$\mathrm{Uvce(Rconf, R1, RVce)} = 15\mathrm{V} \times \frac{\mathrm{RConf}}{\mathrm{Rconf} + \mathrm{R1}} - \mathrm{Rv} \times 1\mathrm{mA}$$

$$\mathrm{tbl(Rconf, R1, Cconfig)} = 60 * 10^{-9}\mathrm{s} + \left(\frac{\mathrm{R1} \times \mathrm{RConf}}{\mathrm{Rconf} + \mathrm{R1}}\right) \times \mathrm{Cconf} \times \ln(3)$$

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 kΩ

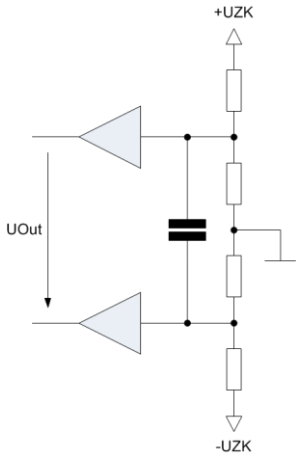
5.3 Over voltage protection

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_{DC}
Accuracy of analog signal @ 600V	±2.5% @ T_a=25°C
Bandwith	2 kHz
DC Offset	0.1V

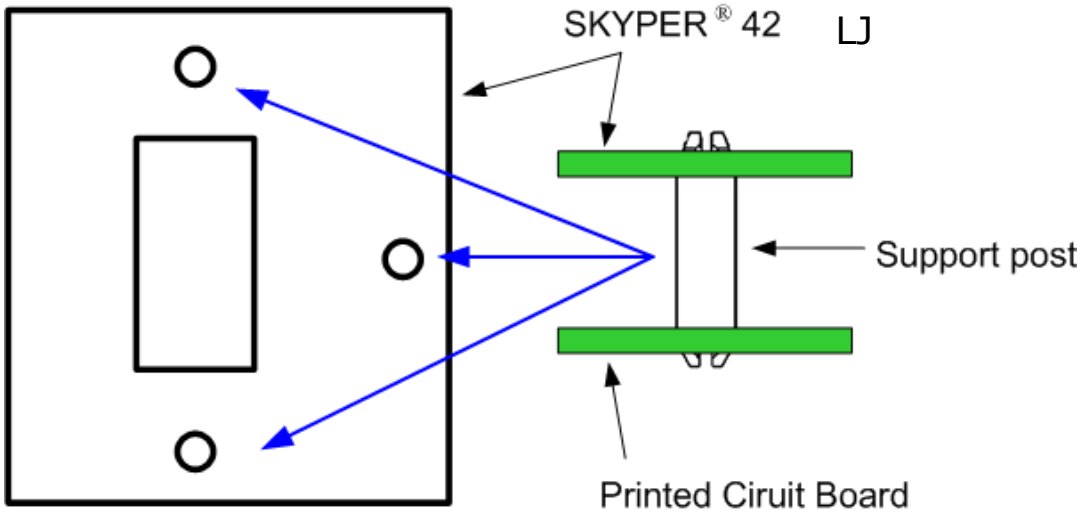
Figure 8: Schematic view of the DC-Link Measurement Circuit



6. Mounting hints

1. Soldering of components (e.g. $R_{G(on)}$, $R_{G(off)}$, 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

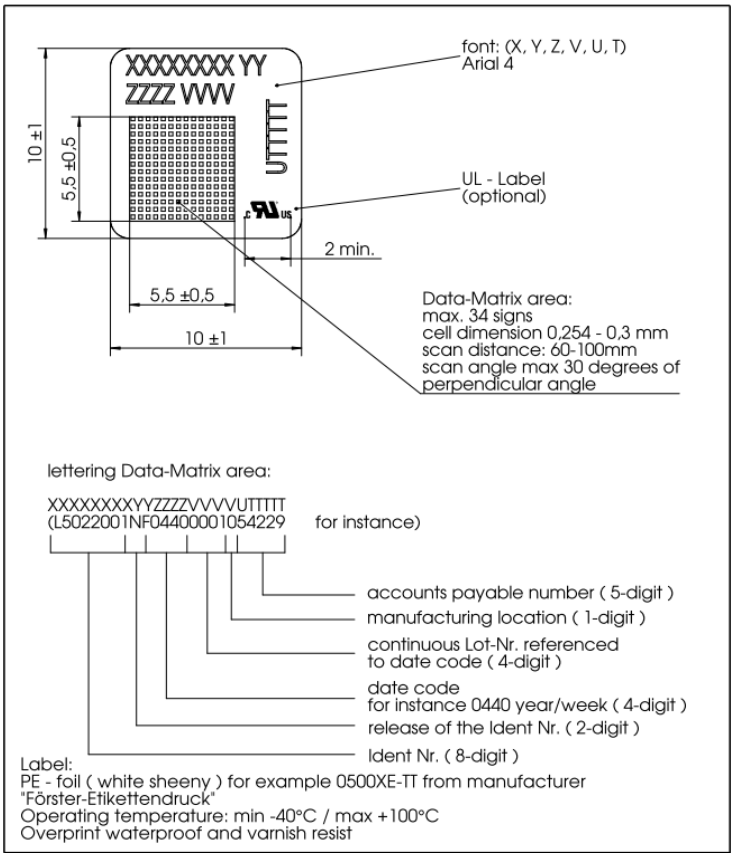


Adapter Board Mounting:

Adapter Board Mounting
Important: Please use the mounting instruction of the SKiM® 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



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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