# Technical Explanation SKHI 22A/B and 21A

| | |
|---|---|
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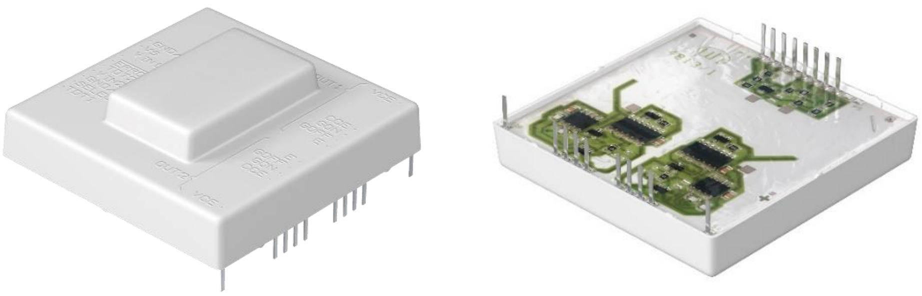
## 1. Introduction

Designed as form-, fit- and function-compatible replacement to their predecessors, the hybrid dual IGBT drivers SKHI 22A/B R and the MOSFET-compatible driver SKHI 21A R are suitable for all available low and medium power range IGBT and MOSFETs. The same as its predecessor, the SKHI 22 B R offer two additional pins signal pins on the primary side with which further functions may be utilized.

With the main idea to secure long-term availability and deliverability, these new SKHI 21/22 R drivers use up-to date components. Both SKHI 21 and SKHI 22 are designed with standardized isolation voltage (isolation testing voltage 4000 VAC, 2sec.), an increase for SKHI 21A type compared to its predecessor.

**Figure 1: SKHI 22B R**



Note: General product display

| New Version | Predecessor |
|---|---|
| L5071603 – SKHI 21A R | L5012520 – SKHI 21 A R |
| L5071601 – SKHI 22A R | L5012522 – SKHI 22A H4 R |
| L5071602 – SKHI 22B R | L5012524 – SKHI 22B H4 R |

### 1.1 General description

The new driver generation SKHI 22A/B and SKHI 21A is a hybrid component that can be mounted directly on the PCB. All functions necessary for driving, voltage supply, error monitoring and potential separation are integrated in the driver. In order to adapt the driver to the used power module, only very few additional wiring may be necessary.

The forward voltage of the IGBT is measured by an integrated short-circuit protection, which will turn off the module when a certain level is exceeded.

In case of short-circuit or too low supply voltage, the integrated error memory is set and an error signal is generated.

The driver is connected to a controlled +15V supply voltage. The input signal level is 0/15V for the SKHI 22A/21A and 0/5V for the SKHI 22B. In the following explanations, the whole driver family will be designated as SKHI 22B R. If a special type is referred to, the concerned driver version will explicitly be mentioned.

**KEY FEATURES**

- Two output channels
- 0.88W output power (0.6W for SKHI 21A) and 20A peak output current per channel
- Up to 1200V DC-Link voltage
- Fully isolated secondary side power supply
- Selectable interlock settings
- Power supply monitoring
- Short pulse suppression (SPS)
- Undervoltage protection (UVP)

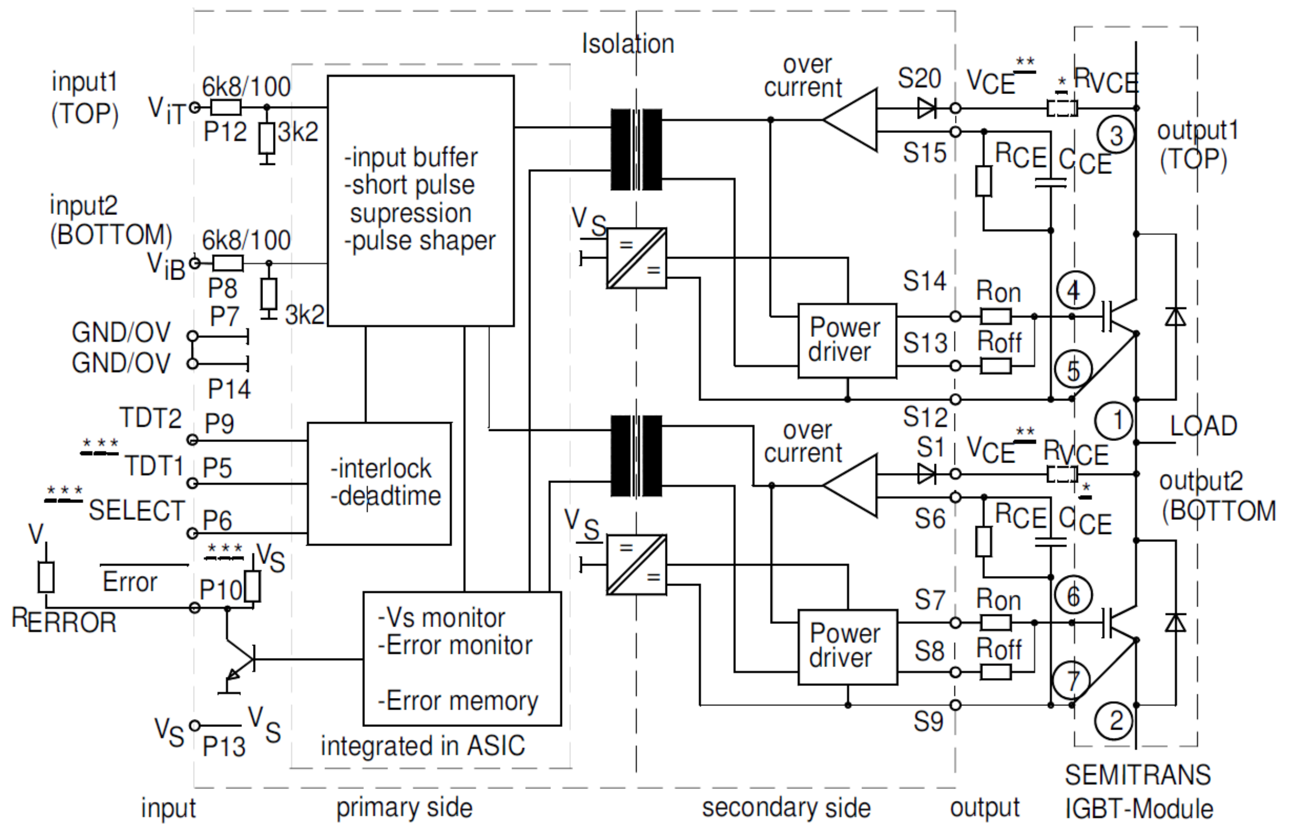
The following descriptions apply to the use of the hybrid driver for IGBTs as well as for power MOSFETs. For the sake of brevity, only IGBTs are referred to in the following. The terms "collector" and "emitter" refer to IGBTs, while "drain" and "source" are used instead for the MOSFETs.

## 2. Block Diagram and Application Example

### 2.1 Block diagram

The block diagram in the Figure 2 below shows the inputs of the driver (primary side) on the left side and the outputs (secondary side) on the right. It also shows the required external components for adjustment and adaptation to the power module.

**Figure 2: SKHI 22B R | Block diagram**




| | |
|---|---|
| * | When SKHI22B is driving 1700V IGBTs, a 1kΩ / 0,4W $R_{VCE}$-resistor must be connected in series to the $V_{CE}$ input. |
| ** | The $V_{CE}$-terminal is to be connected to the IGBT collector C. If the $V_{CE}$-monitoring is not used, connect S1 to S9 or S20 to S12 respectively. |
| *** | Terminals P5 and P6 are not existing for SKHI22A/21A; internal pull-up resistor exists in SKHI22A/21A only. |
| ① to ⑦ | Connections to SEMITRANS GB-module |

The transformer set consists of two pulse transformers and one power transformer. The pulse transformers work bi-directionally for switching signals of the IGBT and the error feedback between primary and secondary side. The other transformer serves as part of the DC/DC-converter between primary and secondary side. All transformers also provide the potential separation with an insulation voltage up to $4000V_{AC}$ for all type.

## 2.2 Application example

### 2.2.1 Primary Side

**Table 1: SKHI 22B R| External components primary side**

| Component | Function | Note |
|---|---|---|
| $R_{ERROR}$ | Pull-up resistance at Error Output P10<br>$\frac{U_{Pull-Up}}{R_{ERROR}} < 15mA$ (1)<br>Max. 30V/15mA | $1k\Omega < R_{ERROR'} < 10k\Omega$<br>See 5.4 |

### 2.2.2 Secondary side

**Table 2: SKHI 22B R | External components secondary side**

| Component | Function | Note |
|---|---|---|
| $R_{CE}$ | Steady-state reference voltage for $V_{CE}$-monitoring<br>$V_{CEstat,1200V}[V] = \frac{9 \cdot R_{CE}[k\Omega]-25}{R_{CE}[k\Omega]+10}$ (2)<br>with $R_{VCE}$ = 1kΩ (1700V IGBT):<br>$V_{CEstat,1700V}[V] = \frac{9 \cdot R_{CE}[k\Omega]-56}{R_{CE}[k\Omega]+10}$ (3) | $10k\Omega < R_{CE} < 100k\Omega$<br>See 5.5 |
| $C_{CE}$ | Blanking time for the $V_{CE}$-monitoring<br>$t_{blank}[\mu s] = \frac{R_{CE}[k\Omega] \cdot (C_{CE}[pF]+70) \cdot ln(0.0465 \cdot R_{CE}[k\Omega]+1.5)}{(100 \cdot R_{CE}[k\Omega]+1000)} + 0.3$ (4) | $C_{CE} < 1nF$<br>$2\mu s < t_{blank} < 10\mu s$<br>See 5.5 |
| $R_{VCE}$ | Collector series resistance for 1700V IGBT-operation | 1kΩ/0.4W<br>See 5.5.2 |
| $R_{G(on)}$ | Turn-on speed of the IGBT | $R_{G(on)}>3\Omega$ |
| $R_{G(off)}$ | Turn-off speed of the IGBT | $R_{G(off)} >3\Omega$ |

**NOTE:**
The calculated blanking time in the equation (4) doesn't indicate the gate-on time. Therefore, additional 0.25µs should be added.

Higher resistance $R_{G(on)}$reduces freewheeling diode peak recovery current, increases IGBT turn-on time. Higher resistance $R_{G(off)}$ reduces turn-off peak voltage, increases turn-off time and turn-off power dissipation

### 2.2.3 IGBT switching speed adjustment

The IGBT switching speed may be adjusted by the resistors $R_{G(on)}$ and $R_{G(off)}$. By increasing $R_{G(on)}$ the turn-on speed will decrease. The reverse peak current of the freewheeling diode will diminish. SEMIKRON recommends to adjust $R_{G(on)}$ to a level that will keep the turn-on delay time $t_{d(on)}$) of the IGBT <1µs.

By increasing $R_{G(off)}$ the turn-off speed of the IGBT will decrease. The inductive peak overvoltage during turn-off will diminish. The minimum gate resistor value for $R_{G(off)}$ and $R_{G(on)}$ is 3Ω.

### 2.2.4 Further application notes

The CMOS-inputs of the hybrid driver are extremely sensitive to overvoltage. Voltages higher than $V_S$ +0.3V or below −0.3V may destroy these inputs. Therefore, control signal overvoltages exceeding the above values have to be avoided.

Please provide for static discharge protection during handling. As long as the hybrid driver is not completely assembled, the input terminals have to be short-circuited.

Persons working with CMOS-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 same safety requirements apply to MOSFET- and IGBT-modules!

The connecting leads between hybrid driver and the power module should be as short as possible; the driver leads should be twisted.

Any parasitic inductances within the DC-link have to be minimized. Overvoltages may be absorbed by C- or RCD-snubbers between the main terminals for PLUS and MINUS of the power module.

When first operating a newly developed circuit, SEMIKRON recommends to apply low collector voltage and load current in the beginning and to increase these values gradually, observing the turn-off behavior of the free-wheeling diode and the turn-off voltage spikes generated across the IGBT. An oscillographic control will be necessary. In addition to that, the case temperature of the module has to be monitored. When the circuit works correctly under rated operation conditions, short-circuit testing may be done, starting again with low collector voltage.

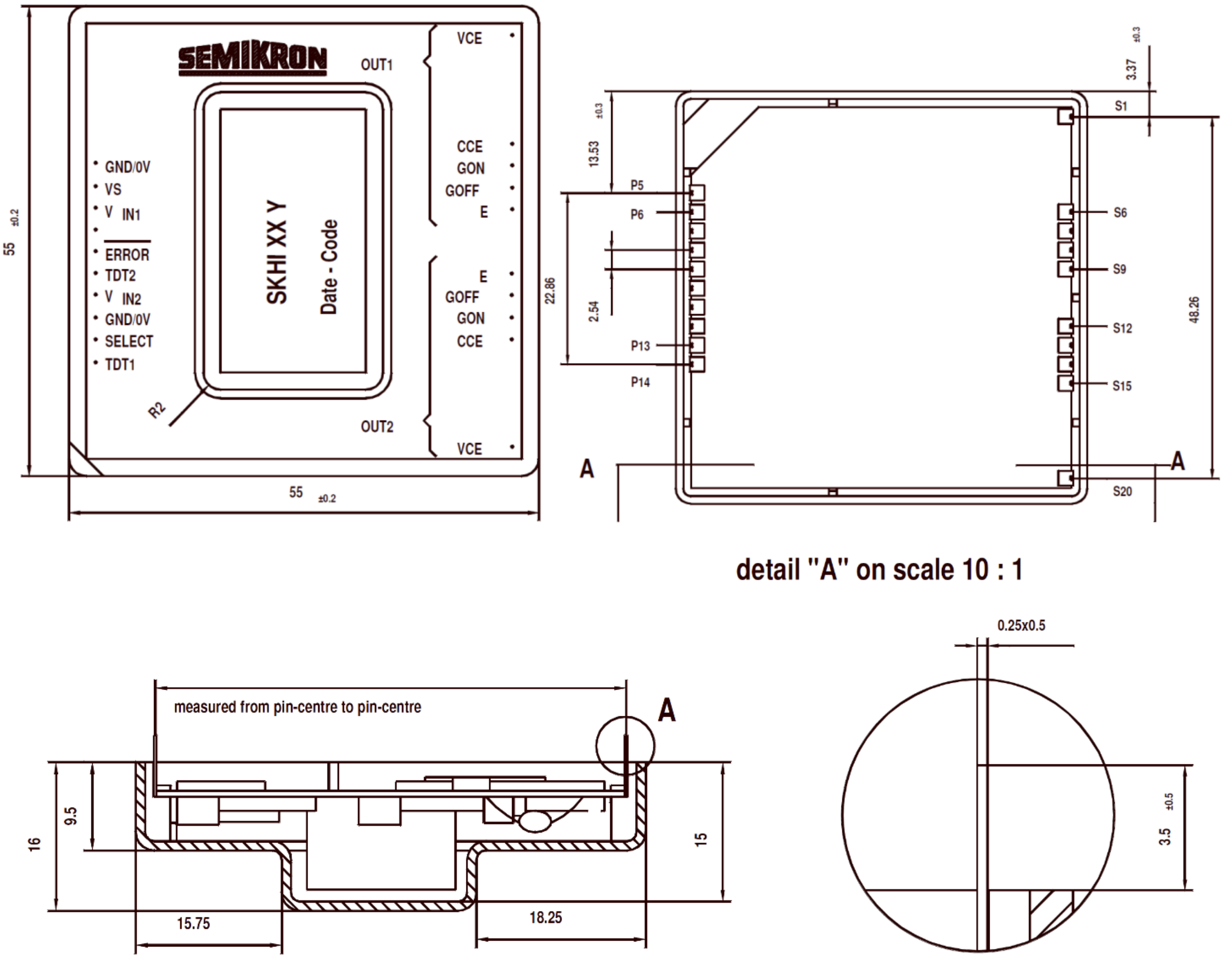
It is important to feed any errors back to the control circuit and to switch off the device immediately in such events. Repeated turn-on of the IGBT into a short circuit with a high frequency may destroy the device.

SEMIKRON recommends to start-up operation using the values recommended by SEMIKRON and to optimize the values gradually according to the IGBT switching behavior and overvoltage peaks within the specific circuitry.

# 3. Dimensions and mechanical precautions

## 3.1 Dimensions

**Figure 3: SKHI 22B R | Dimension drawing and pin array**




STEP file on request.

Dimension drawing and PIN array (P5 and P6 are not existing for SKHI22A/21A)

### 3.2 Solder connection and mechanical fixing on PCB

| Soldering hints |
|---|
| • The temperature of the solder must not exceed 265°C<br>• solder time must not exceed 4 seconds<br>• The ambient temperature must not exceed the specified maximum storage temperature of the driver<br>• The driver is not suited for hot air reflow or infrared reflow soldering processes |

In applications with mechanical vibrations, it is recommended to use special glue around the case edge (forms a concave mould) – after soldering and testing. The use of cable tie for fixing the driver is inadvisable. The housing may not be pressed on the PCB. When the SKHI 22B R is soldered on a PCB, the PCB should not be bend to prevent crack on the internal ceramic. The driver is not suitable for big PCBs.

Example of special glue:

**Table 3: SKHI 22B R | Glue recommendation**

| Manufacturer | Type |
|---|---|
| PACTAN | 5011 |
| WACKER | A33 (ivory) |
| WACKER | N199 (transparent) |

In an application with big PCB (e.g. approximately L x B x H = 97,0 x 67,5 x 1,5 mm), the PCB must be supported and reinforced in the area of the driver. If a PCB is directly plugged to IGBT modules, the PCB has to be fixed to the heat sink by thread bolts.

### 3.3 Storage instructions

In order to protect the SKHI 22B R from possible damages during storage, the following hints help to maintain the quality of the SKHI 22B R.SKHI 22B R

- Store driver only in original packaging.
- Avoid contamination of driver's surface during storage, handling and processing.
- Please use the driver within one year after driver manufacturing date. The manufacturing date is marked on the driver. Usage of the driver beyond this shelf life could compromise product long-term reliability.
- Further storage conditions are indicated in the data sheet

# 4. Interface Description

## 4.1 Pin assignment

### 4.1.1 Pin assignment | Primary side

| Table 4: SKHI 22B R \| Pin assignment – Primary side | | | |
|---|---|---|---|
| **Pin** | **Signal** | **Function** | **Specification** |
| P14 | GND/0 V | Related earth connection for input signals | To be connected to ground |
| P13 | $V_S$ | +15V ± 4% voltage supply | See 4.2 |
| P12 | $V_{IN1}$ | Switching signal input 1 (TOP switch) | Positive 5V logic for SKHI 22B (Positive 15V logic for SKHI 22A /21A)<br>See 4.3 |
| P11 | Free | Not wired | |
| P10 | /ERROR | Error output | LOW=error; open collector output; max 30V / 15mA<br>(for SKHI22A /21A, internal 10kΩ pull-up resistor versus $V_S$)<br>See 5.4 |
| P9 | TDT2 | Signal input for digital adjustment of interlocking time | SKHI22B: to be switched by bridge to GND (see Table 7)<br>SKHI22A /21A: to be switched by bridge to $V_S$<br>See 5.1 |
| P8 | $V_{IN2}$ | Switching signal input 2 (BOTTOM switch) | Positive 5V logic for SKHI 22B (Positive 15V logic for SKHI 22A /21A) |
| P7 | GND/0 V | Related earth connection for input signals | |
| P6 | SELECT | Signal input for neutralizing locking function | To be switched by bridge to GND<br>See 5.1 |
| P5 | TDT1 | Signal input for digital adjustment of locking time | To be switched by bridge to GND<br>See 5.1 |

**ATTENTION:**

Inputs P6 and P5 are not existing for SKHI 22A/ 21A. The contactor tracks of the digital input signals P5/ P6/ P9 must not be longer than 20 mm to avoid interferences, if no bridges are connected.

### 4.1.2 Pin assignment | Secondary side

| Table 5: SKHI 22B R \| Pin assignment – Secondary side | | | |
|---|---|---|---|
| **Pin** | **Signal** | **Function** | **Specification** |
| S20 | $V_{CE1}$ | Collector output IGBT 1 (TOP switch) | |
| S15 | $C_{CE1}$ | Reference voltage adjustment with $R_{CE}$ and $C_{CE}$ | See 5.5 |
| S14 | $G_{ON1}$ | Gate 1 $R_{G(on)}$ output | See 4.5 |
| S13 | $G_{OFF1}$ | Gate 1 $R_{G(off)}$ output | See 4.5 |
| S12 | E1 | Emitter output IGBT 1 (TOP switch) | |
| S1 | $V_{CE2}$ | Collector output IGBT 2 (BOTTOM switch) | |

| | | | |
|---|---|---|---|
| S6 | $C_{CE2}$ | Reference voltage adjustment with $R_{CE}$ and $C_{CE}$ | See 5.5 |
| S7 | $G_{ON2}$ | Gate 2 $R_{G(on)}$ output | See 4.5 |
| S8 | $G_{OFF2}$ | Gate 2 $R_{G(off)}$ output | See 4.5 |
| S9 | E2 | Emitter output IGBT 2 (BOTTOM switch) | |

### 4.2 Power supply | Primary side

For operation, the SKHI 22B R driver must be connected to a controlled +15V±4% supply voltage. Should the supply voltage fall below 13V, the error output P10 is activated as described in 5.3.

### 4.3 Gate drive signals | Primary side

The CMOS compatible input-Schmitt-trigger of the SKHI 22B R have a positive logic, which means a HIGH signal at the input of the driver turns on the corresponding output of the driver. A LOW signal at the input leads to a switch-off command at the corresponding output. The input signal level is 0/5V for the SKHI 22B R and 0/15V for the SKHI 22A/21A.

Short pulses as well as voltage peaks, e.g. caused by interference, are suppressed by the driver and will not be transmitted to the outputs. Further information on short pulse suppression can be found in chapter 5.2.

**Table 6: SKHI 21/22| Gate drive signals**

| Parameter | Min | Typ | Max |
|---|---|---|---|
| **SKHI 22B R** | | | |
| Threshold high | 3.9V | | |
| Threshold low | | | 1.5V |
| **SKHI 22A/21A** | | | |
| Threshold high | 12.5V | | |
| Threshold low | | | 4.5V |

### 4.4 Error output | Primary side

The error output signalizes any detected error event at the ERROR pin P10 by pulling it to low-level. The error output is an open collector output and requires an external pull-up resistor $R_{ERROR}$. The recommended value of the pull-up resistor is stated in 2.2.1 using equation (1). As long as the driver has not been reset, the error output remains at low-level.

For further explanation, please refer to 5.4

### 4.5 Gate resistors | Secondary side

The output transistors of the power drivers are MOSFETs. The sources of the MOSFETs are separately connected to external terminals in order to provide setting of the turn-on and turn-off speed by the external resistors $R_{G(on)}$ and $R_{G(off)}$. Do not connect the terminals S7 with S8 and S13 with S14. The IGBT is turned on by the driver at +15V by $R_{G(on)}$ and turned off at -7V by $R_{G(off)}$. $R_{G(on)}$ and $R_{G(off)}$ may not be chosen below 3Ω. In order to ensure locking of the IGBT even when the driver supply voltage is turned off, a 22kΩ-resistor versus the emitter output (E) has been integrated at output $G_{OFF}$.

## 5. Protection features

### 5.1 Dead time and Interlock

If one IGBT is turned on, the other IGBT of a half-bridge cannot be switched. Additionally, a digitally adjustable interlocking time is generated by the driver (see Table 7), which has to be longer than the turn-off delay time of the IGBT. This is to avoid that one IGBT is turned on before the other one is not completely discharged. This protection-function may be canceled by switching the select input P6 (see Table 7). Table 7 documents possible interlock-times. "High" value can be achieved with no connection and connection to 5V as well.

**Table 7: SKHI 22B R | Selection of interlock times**

| P6;<br>SELECT | P5;<br>TDT1 | P9;<br>TDT2 | Interlock time<br>$t_{TD}$/µs |
|---|---|---|---|
| Open / 5V | GND | GND | 1.25 |
| Open / 5V | GND | Open / 5V | 2.25 |
| Open / 5V | Open / 5V | GND | 3.25 |
| Open / 5V | Open / 5V | Open / 5V | 4.25 |
| GND | X | X | No interlock |

Table 7 shows the possible interlocking times between output1 and output2. Interlocking times are adjusted by connecting the terminals TDT1 (P5), TDT2 (P9) and SELECT (P6) either to GND (P7 and P14) according to the required function or by leaving them open.

A typical interlocking time value is 3.25µs (P9 = GND; P5 and P6 open). For SKHI 22A/21A the terminals TDT1 (P5) and SELECT (P6) are not existing. The interlocking time has been set to 3.25µs and can only be increased to 4.25µs by connecting TDT2 (P9) to $V_S$ (P13).

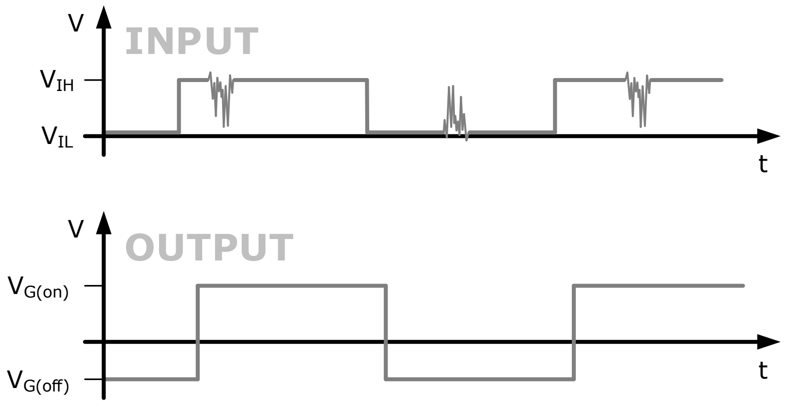
**ATTENTION:**

If the terminals TDT1 (P5), TDT2 (P9) and SELECT (P6) are not connected, any connected track on PCB must not be longer than 20mm in order to avoid interferences.

### 5.2 Short pulse suppression (SPS)

The integrated short pulse suppression avoids very short switching pulses at the power semiconductor caused by high-frequency interference pulses at the driver input signals. Switching pulses shorter than 500ns are suppressed and not transmitted to the IGBT.

**Figure 4: SKHI 22B R | Short Pules Suppression**




### 5.3 Power supply ($V_S$) monitoring

A controlled 15V supply voltage is applied to the driver. If it falls below 13V, an error is detected and the error output signal switches to low level.

### 5.4 Error monitoring and error memory

The error memory is set in case of under-voltage or short-circuit of the IGBTs. In case of short-circuit, an error signal is transmitted from the secondary side via the pulse transformers to the error memory. The error memory will lock all switching pulses to the IGBTs and trigger the error output (P10) of the driver. The error output consists of an open collector transistor, which pulls the signal to GND in case of error. SEMIKRON recommends the user to install a pull-up resistor directly on the error evaluation board and thus to adapt the error level to the desired signal voltage. The open collector transistor may be connected to max. 30V/15mA. If several SKHI 22B are used in one device, the error terminals may also be paralleled.

**ATTENTION:** Only the SKHI 22A/21A is equipped with an internal pull-up resistor of 10kΩ versus $V_S$. The SKHI 22B does not contain an internal pull-up resistor. The error memory is only be reset, if no error is pending and both cycle signal inputs are set to low for >9µs at the same time.

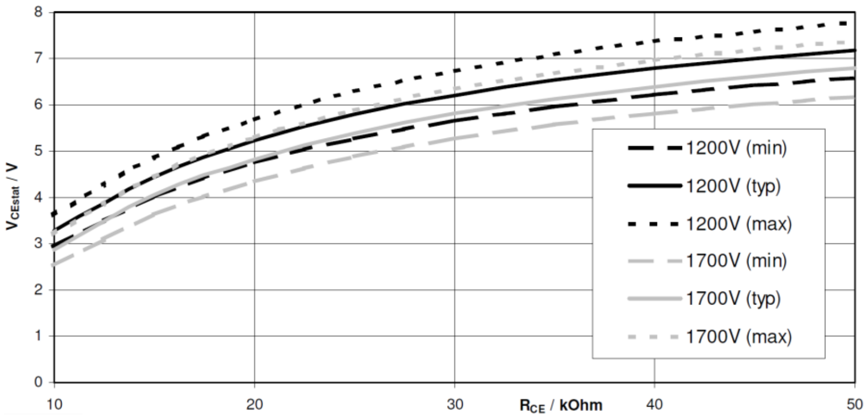
### 5.5 $V_{CE}$-monitoring

The $V_{CE}$-monitoring controls the collector-emitter voltage $V_{CE}$ of the IGBT during its on-state. $V_{CE}$ is internally limited to 10V. If the reference voltage $V_{CEref}$ is exceeded, the IGBT will be switched off and an error is indicated. The reference voltage $V_{CEref}$ may dynamically be adapted to the IGBTs switching behaviour. Immediately after turn-on of the IGBT, a higher value is effective than in the steady state. This value will be reset, when the IGBT is turned off. $V_{CEstat}$ is the steady-state value of $V_{CEref}$ and is adjusted to the required maximum value for each IGBT by an external resistor $R_{CE}$ to be connected between the terminals $C_{CE}$ (S6/S15) and E (S9/S12). It may not exceed 10V. The time constant for the delay of $V_{CEref}$ may be increased by an external capacitor $C_{CE}$, which is connected in parallel to $R_{CE}$. It controls the blanking time $t_{blank}$ which passes after turn-on of the IGBT before the $V_{CE}$-monitoring is activated. This makes possible any adaptation to the switching behavior of any of the IGBTs. After $t_{blank}$ has passed, an error will be triggered as soon as $V_{CE} > V_{CEref}$ and the IGBT will be turned off.

#### 5.5.1 $V_{CE}$-monitoring adjustment

As shown in Figure 2, external components are required for adjustment and adaptation to the power module. The external components $R_{CE}$ and $C_{CE}$ are used to set the steady-state threshold and dynamics of the short-circuit monitoring. $R_{CE}$ and $C_{CE}$ are connected in parallel to the terminals $C_{CE}$ (S15/ S6) and E (S12/ S9).

**Figure 5: SKHI 22B R | $V_{CEstat}$ in dependence of $R_{CE}$ (Tamb = 25°C)**




Dimensioning of $R_{CE}$ and $C_{CE}$ can be done in three steps:

1. Calculate the maximum forward voltage from the datasheet of the used IGBT and determine $V_{CEstat}$
2. Calculate approximate value of $R_{CE}$ according to equations (2) or (3) from $V_{CEstat}$ or determine $R_{CE}$ by using Figure 5.
3. Determine $t_{blank}$ and calculate $C_{CE}$ according to equation (4).

Example:

| | |
|---|---|
| for 1200 V IGBT: | $V_{CEstat}$ = 4.92V; $t_{blank}$ = 4.9µs |
| | $R_{CE}$ = 18.2kΩ, $C_{CE}$ = 820pF |
| for 1700 V IGBT: | $V_{CEstat}$ = 5.83V; $t_{blank}$ = 5.18µs |
| | $R_{CE}$ = 36kΩ, $C_{CE}$ = 470pF |

### 5.5.2 Adaptation to 1700 V IGBT

When using 1700V IGBTs it is necessary to connect a 1kΩ/0.4W adaptation resistor between the $V_{CE}$-terminal (S20/ S1) and the respective collector.

## 6. Electrical Characteristic

The drivers are designed for application with half-bridges and single modules with a maximum gate charge $Q_{GE}$<4µC (see Figure 6). The charge necessary to switch the IGBT is mainly depending on the IGBT's chip size, the DC-link voltage and the gate voltage. This correlation is also shown in the corresponding module datasheet curves.

However, it should be considered that the SKHI 22B is turned on at +15V and turned off at -7V. Therefore, the gate voltage will change by 22V during every switching procedure.

Unfortunately, most datasheets do not indicate negative gate voltages. In order to determine the required charge, the lower leg of the charge curve should be prolonged to negative range for determination of approximate charge per switch.

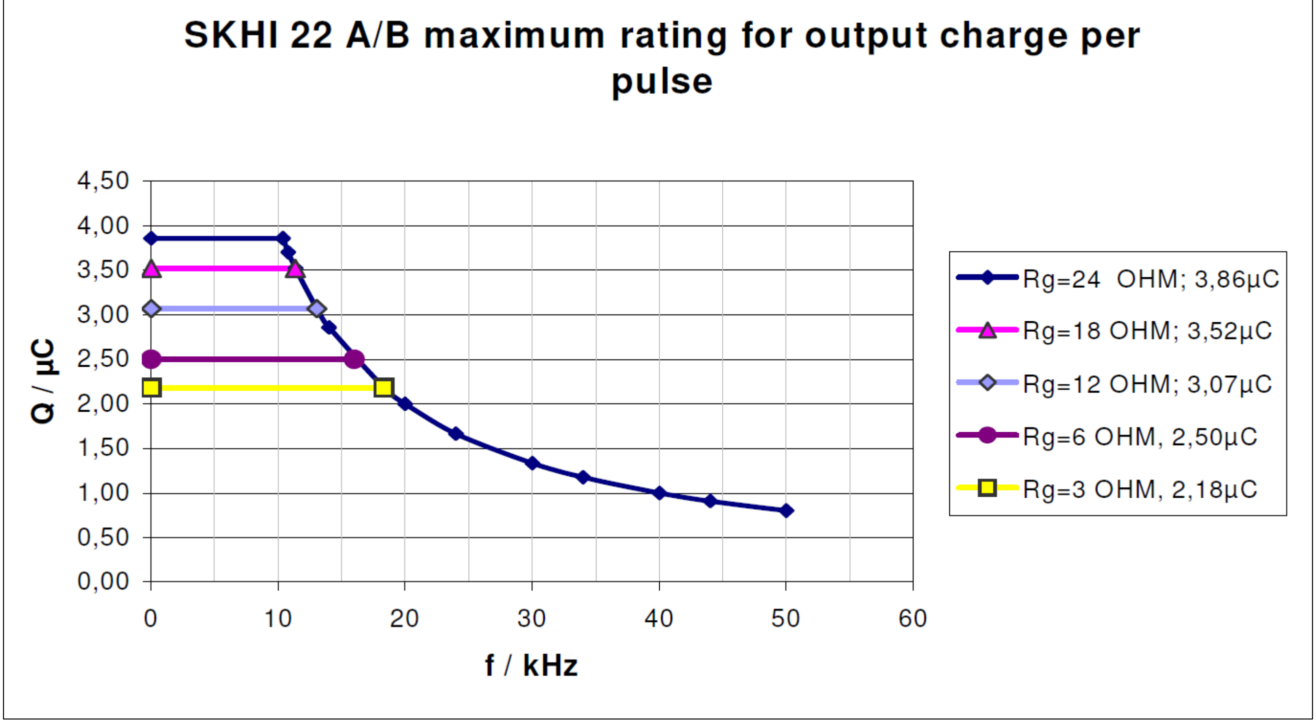
The average output current of the driver is determined by the switching frequency and the gate charge. For the SKHI 22B the maximum average output current is $I_{outAVmax}$<±40 mA.

The maximum switching frequency $f_{MAX}$ may be calculated with the following formula and should not exceed 50kHz:

$$f_{MAX}(kHz) = \frac{4 \cdot 10^4}{Q_{GE}(nC)}$$

Figure 6 shows the maximum rating for the output charge per pulse for different gate resistors.

**Figure 6: SKHI 22B R | Maximum rating for output charge per pulse**



## 7. Environmental conditions

| Table 8: SKHI 22B R \| Approval tests | | |
|---|---|---|
| **Function and characteristics** | **Rating** | **Norm / Standard** |
| Static characteristics (IBN) | 15V, 50kHz/22nF, 18kHz/100nF | SEMIKRON |
| Characteristics and signals<br>Emergency stop (step test) | -40°C … +105°C | SEMIKRON |
| **Isolation** | **Rating** | **Norm / Standard** |
| Pollution degree | PD II | IEC 50178 |
| Maximum altitude | 2000m above sea level | IEC 50178 |
| Overvoltage category | III | IEC 50178 |
| Impulse withstand voltage test | ±10kV | EN 61800-5-1:2008 |
| Isolation test | $4000V_{AC}$, 1s | EN 61800-5-1:2008 |
| Partial discharge and insulation test | 1.86 kV minimum inception voltage<br>1.49 kV minimum extinction voltage | EN 61800-5 :2007 |
| Creepage/clearance distance, primary/secondary side | ≥5.5mm | |
| Creepage/clearance distance, secondary/secondary side | ≥2mm | |
| **Environmental conditions** | **Rating** | **Norm / Standard** |
| Operating temperature | -40… +85°C | |
| Storage temperature | -40… +85°C | |
| | | RoHS/REACH |
| **Mechanic** | **Rating** | **Norm / Standard** |
| Vibration | Sine 5g, 20Hz-500Hz, 3 axis | EN 60068-2-6 |
| Shock | Half sine 29g (6 Shocks pro axis, 6 axis) | EN 60068-2-27 |
| **Climate and pollutant resistance** | **Rating** | **Norm / Standard** |
| High temperature storage | 105°C storage, 1000h | EN 60068-2-2 |
| Storage in humid heat | 85°C, 85% humidity, 330h | EN 60068-2-67 |
| Temperature Shock Test (TST) in storage | -40°C…125°C, 30 min, 300 cycles | EN 60068-2-14 |
| Climate class | 3K3 | IEC 60721-3-3 |

| Life Time | Rating | Norm / Standard |
|---|---|---|
| Operation under climatic change test | -15°C…85°C, 10%...85% humidity, 4x2h, 10 cycles.<br>Operation 22kHz, 82nF gate load | EN 60068-2-38 Z/AD |
| Temperature Shock Test (TST) under operation | -40°…95°C, 30min, 300 cycles<br>Operation 22kHz, 82nF gate load | EN 60068-2-14:2010 |
| High temperature continuous operation | +65°C, 360h<br>+95°C, 1000h<br>Operation 22kHz, 82nF gate load | EN 60068-2-2 |
| Thermography | | SEMIKRON |
| **EMC** | **Rating** | **Norm / Standard** |
| Burst Immunity | ≥ 2kV for signal lines<br>≥ 4kV for load lines | IEC 61000-4-4:2012 |
| BCI Immunity | Noise level 30V<br>150kHz to 400MHz | IEC 61800-3:2017 |

## 8. Change history

| Revision | Date | Changes |
|---|---|---|
| 00 | 2021-11-03 | Adapted from SKHI 21/22 H4 R Technical Explanation with updated information |
| | | |
| | | |

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