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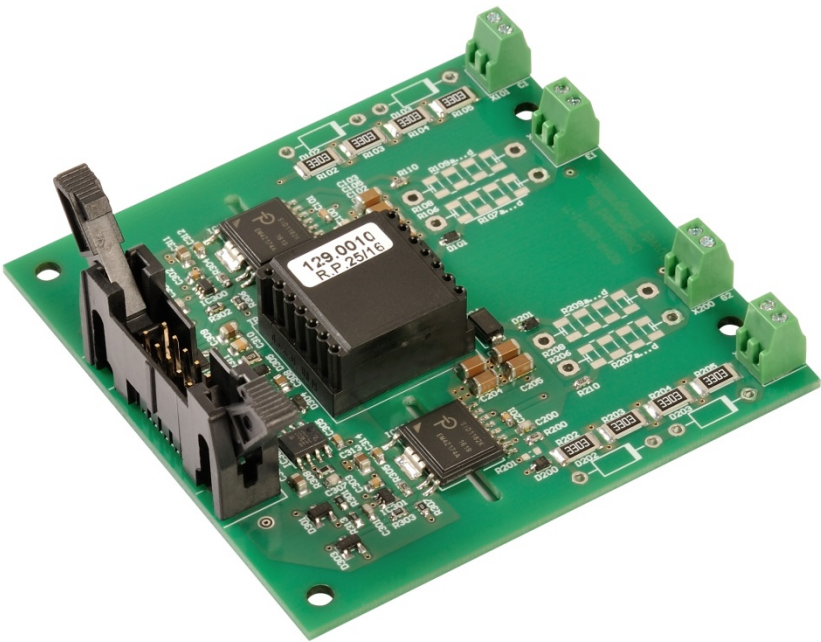
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General Purpose Base Board for SCALE™-iDriver SI D1182K

| | |
|-----------------------|---|
| Application | General purpose drives, UPS, solar power and others |
| Specification | Suitable for IGBT power modules in various housings Up to 800V DC-link voltage Electrical interfaces Interlock Short-circuit detection with Advanced Soft Shut Down |
| Author | High-Power Application Engineering Department |
| Document Number | RDHP-1608 |
| Revision ¹ | A.1 |



¹ The letter refers to the hardware revision. The number refers to the documentation revision.

Scope

This application proposal provides a circuit design for a general purpose base board for driving various IGBT power modules.

The main features of the design are:

- Suitable for IGBT power modules in various housings such as 17mm dual, 17mm six-pack, 62mm, PrimePACK™, etc. with a maximum blocking voltage of 1200V
- Short-circuit detection with Advanced Soft Shut Down (ASSD)
- Electrical command inputs and status outputs
- 0V/5V command input logic
- 0V/5V status output logic
- Minimum pulse suppression
- Interlock of command inputs
- 5V supply voltage
- Single PCB solution with soldered-in gate driver IC

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Application Conditions

The design is proposed for the following application conditions:

- General purpose applications and IGBT power modules
- Adaptations such as adjustment of gate resistors can easily be done
- Up to 8A peak gate current
- Up to 1W per channel

Design Description

In addition to the following design description, reference to the datasheet of the gate driver IC family is recommended.

Gate Resistors

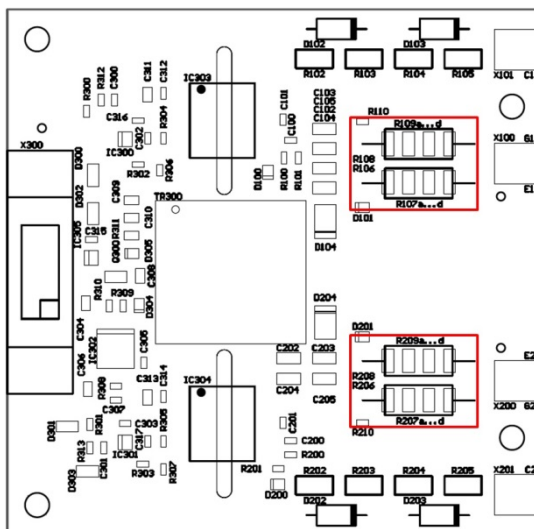
Gate resistor values are not explicitly given as they depend on the IGBT power module used and on the application. Gate resistors of either SMD (size 1206) or THT (size PR02) package can be selected.

Turn-on gate resistors:

| Channel | SMD Package | THT Package |
|---------|-----------------|-------------|
| 1 | R107a ... R107d | R106 |
| 2 | R207a ... R207d | R206 |

Turn-off gate resistors:

| Channel | SMD Package | THT Package |
|---------|-----------------|-------------|
| 1 | R109a ... R109d | R108 |
| 2 | R209a ... R209d | R208 |



The gate resistors must be determined and assembled by the user.

V_{CEsat} Monitoring

SID1182K gate driver ICs from Power Integrations provide sense inputs for monitoring IGBT short-circuit conditions.

This design offers a V_{CEsat} monitoring function using either a resistor network or high-voltage diodes based on the same layout (Power Integrations recommends using the resistor network implementation as the preferred solution). The assembly variants of either implementation are described in the following table:

| Implementation | C100, C200 | R100, R200 | R101, R201 | R102 ... R105, R202 ... R205 | D102, D103, D202, D203 | D100, D200 |
|---------------------|------------|------------|------------|------------------------------|------------------------|------------|
| Resistor network | 33pF | 120kΩ | n.a. | 330kΩ | n.a. | BAS416 |
| High-voltage diodes | 100pF | 330Ω | 47kΩ | n.a. | UF4007 | n.a. |



The driver ICs SID1182K of the SCALE-iDriver family feature an Advanced Soft Shut Down (ASSD) function, which reduces the turn-off di/dt to limit V_{CE} overvoltage spikes as soon as a short-circuit condition is detected. An excessive turn-off overvoltage is therefore avoided and the IGBT is turned off within its safe operating area.

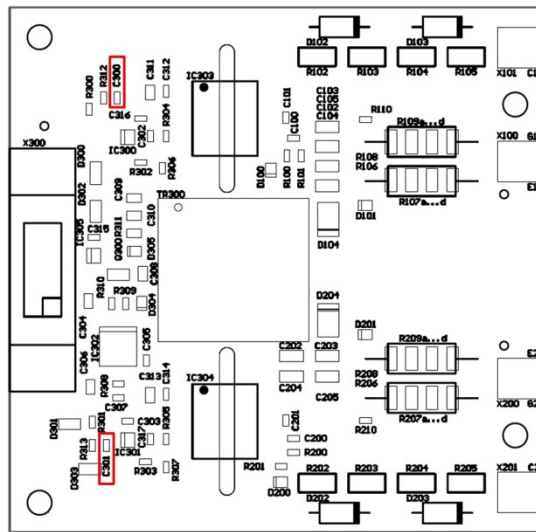
The ASSD function may also have performance limitations, such as at high DC-link voltages and/or high commutation loop stray inductances. If the application is operated at these boundary conditions, it is recommended to implement Basic Active Clamping.

For further details concerning the ASSD function refer to the datasheet of the gate driver IC SID1182K.

To prevent synchronous switching of the gate driver channels 1 and 2 an interlock circuitry is implemented.

This design possesses a minimum pulse suppression with a time constant τ of typically 99ns. If required the setting can be changed by adjusting C300 and C301. The time constant τ is given by the following equations:

$$\tau_2 = 99\Omega \cdot C301$$



Recommended values of C300 and C301 are in the range of 1nF ($\tau_x = 99\text{ns}$) to 3.3nF ($\tau_x = 327\text{ns}$), depending on actual application conditions.

Blocking Time

During the blocking time, which is set to typically 10 μs , the gate driver IC ignores incoming command signals. The blocking time starts once a fault was detected by the gate driver IC's secondary side (undervoltage lock-out or a short-circuit event) or when an undervoltage condition ends on the primary side.

For further details refer to the datasheet of the gate driver SID1182K.

Interfaces

Electrical Interfaces

| X300 | | |
|------|-------------|-------------------------------|
| Pin | Designation | Description |
| 1 | V5 | 5V supply (referenced to GND) |
| 3 | SO2 | Status output channel 2 |
| 5 | INB | Command input channel 2 |
| 7 | SO1 | Status output channel 1 |
| 9 | INA | Command input channel 1 |

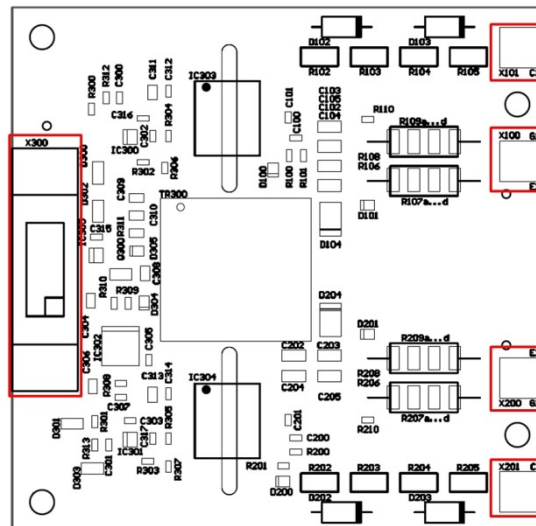
| X300 | | |
|------|-------------|-------------|
| Pin | Designation | Description |
| 2 | GND | Ground |
| 4 | GND | Ground |
| 6 | GND | Ground |
| 8 | GND | Ground |
| 10 | GND | Ground |

| X100 | | |
|------|-------------|-------------------|
| Pin | Designation | Description |
| 1 | E1 | Emitter channel 1 |
| 2 | G1 | Gate channel 1 |

| X101 | | |
|------|-------------|---------------------|
| Pin | Designation | Description |
| 1 | C1 | Collector channel 1 |
| 2 | C1 | Collector channel 1 |

| X200 | | |
|------|-------------|-------------------|
| Pin | Designation | Description |
| 1 | G2 | Gate channel 2 |
| 2 | E2 | Emitter channel 2 |

| X201 | | |
|------|-------------|---------------------|
| Pin | Designation | Description |
| 1 | C2 | Collector channel 2 |
| 2 | C2 | Collector channel 2 |



CAD Data

Layout Example

An example for a suitable layout is shown in the following picture. The recommended PCB thickness is 1.55mm.



Switching Characteristic

Turn-On/ Off

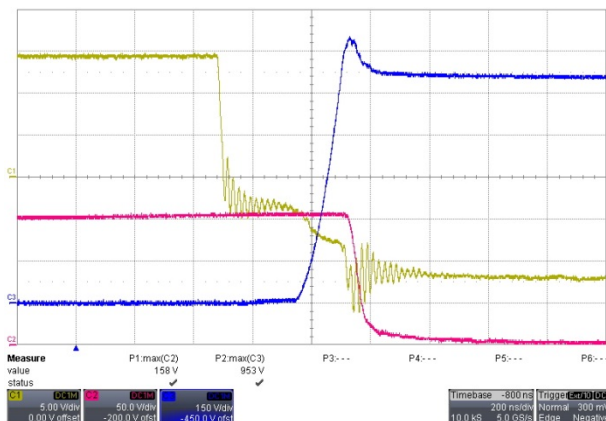
The measurement examples shown with the IGBT power module FF150R12YT3 from Infineon Technologies ($R_{Gon} = 2.4\Omega$ and $R_{Goff} = 2.4\Omega$) were carried out in a double-pulse test using a half-bridge topology setup at room temperature with an initial DC-link voltage of $800V_{DC}$. The adjusted load current is either $150A$ (I_{nom}) or $300A$ ($2 \times I_{nom}$).

Channel assignment:

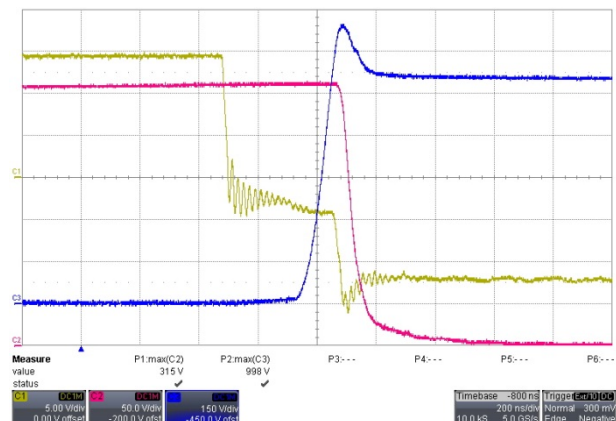
Channel C1: Gate-emitter voltage

Channel C2: Collector current [$1V \triangleq 1A$]

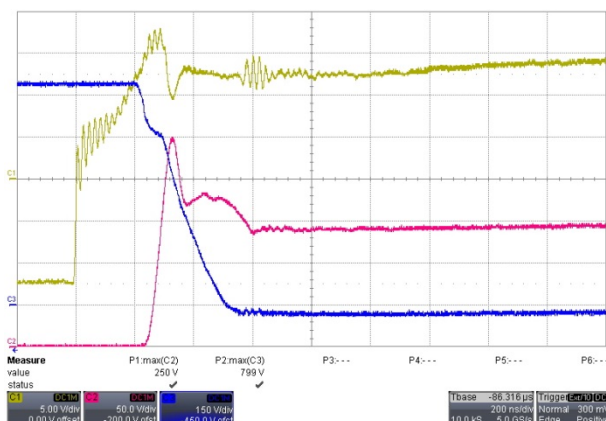
Channel C3: Collector-emitter voltage



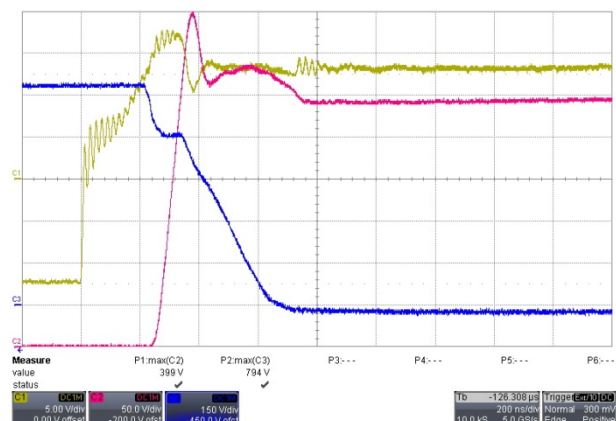
Turn-off bottom side (I_{nom})



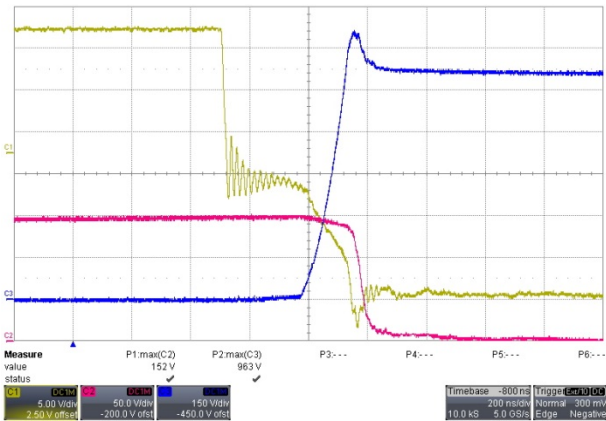
Turn-off bottom side ($2 \times I_{nom}$)



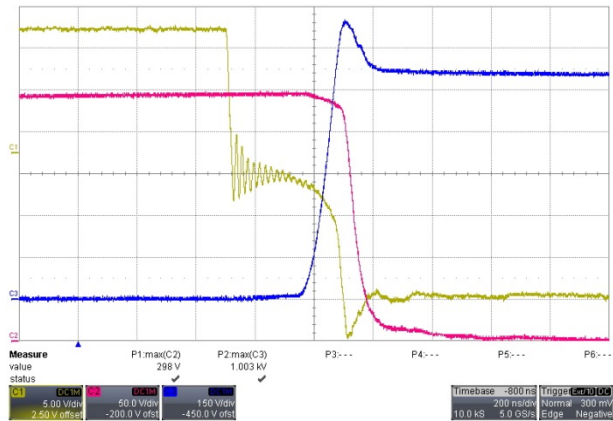
Turn-on bottom side (I_{nom})



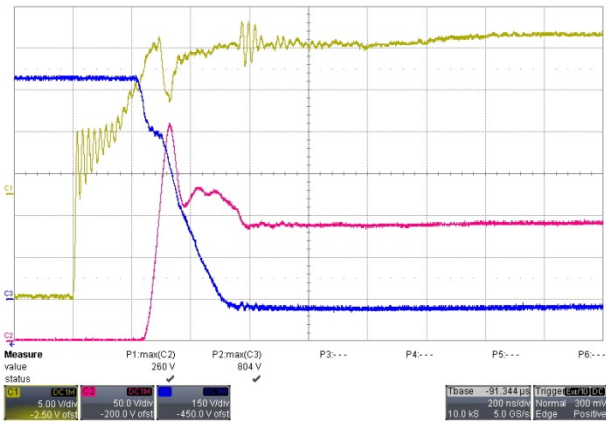
Turn-on bottom side ($2 \times I_{nom}$)



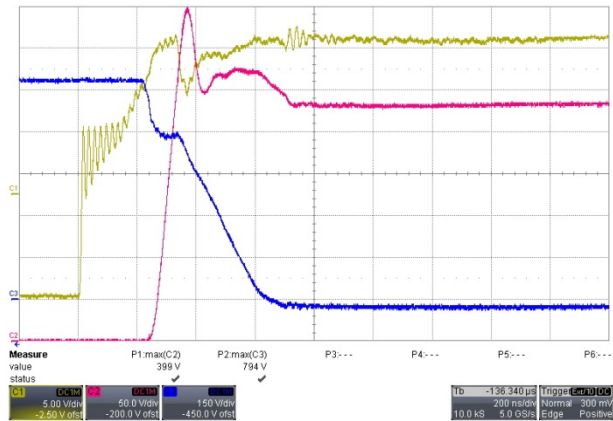
Turn-off top side (I_{nom})



Turn-off top side ($2x I_{nom}$)



Turn-on top side (I_{nom})



Turn-on top side ($2x I_{nom}$)

Short-Circuit

The measurement examples shown with the IGBT power module FF150R12YT3 from Infineon Technologies ($R_{Gon} = 2.4\Omega$ and $R_{Goff} = 2.4\Omega$) were carried out at room temperature with an initial DC-link voltage of $800V_{DC}$.

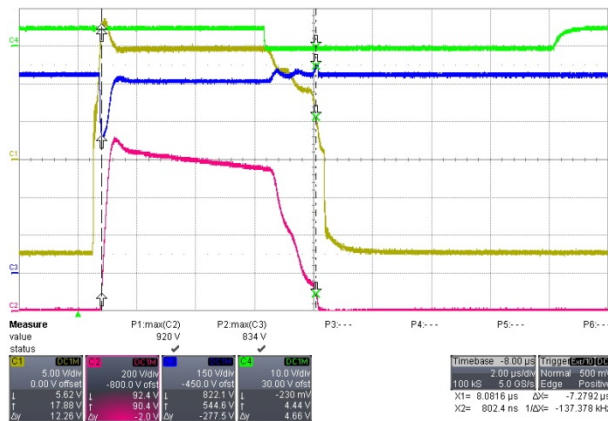
Channel assignment:

Channel C1: Gate-emitter voltage

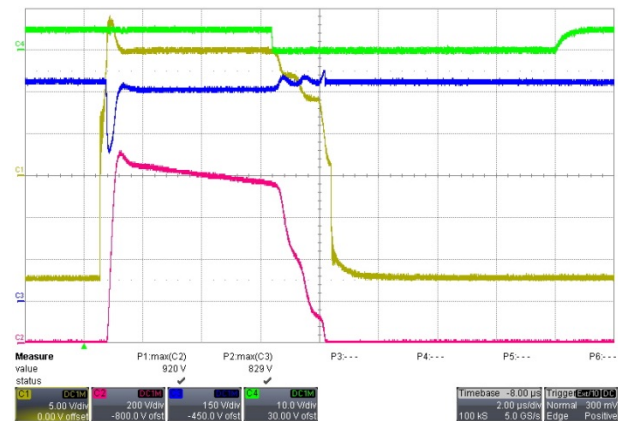
Channel C3: Collector-emitter voltage

Channel C2: Collector current ($1V \triangleq 1A$)

Channel C4: Status output



Bottom side



Top side

Handling

To avoid possible failures caused by ESD, a handling- and assembly-process with persistent ESD protection is necessary /2/.

References

/1/ SID11x2K SCALE-iDriver Family Data Sheet, Power Integrations

/2/ Application Note AN-0902, "Avoiding ESD with CONCEPT Drivers", Power Integrations

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