Application SCALE-2 Gate Driver

Basic Boards for 2SC0435T and 2SC0108T

CT-Concept Technologie AG

CONCEPT

Targets of the Basic Boards for 2SC0435T and 2SC0108T

- Support of our customers when using 2SC0108T and 2SC0435T

- Schematics and Layout available on www.IGBT-Driver.com

- User can reuse the schematics and merge it in it own circuit

- User can buy the basic board as a complete solution by CONCEPT sales partner

- User can produce the basic board on its own

- → "Plug-and-play" drivers for 34mm (2SC0108T) and 62mm (2SC0435T) IGBT modules

- → "Plug-and-play" drivers for 600V, 1200V and 1700V IGBTs

- Use of CONCEPT DIC-20 standard interface

➜ Schematics / Gerber files will be available soon

➜ Samples and high volume will also be provided to our customers soon

Agenda

2BB0435T2A0-XX Basic Boards for 2SC0435T

- Layout
- Schematics Overview
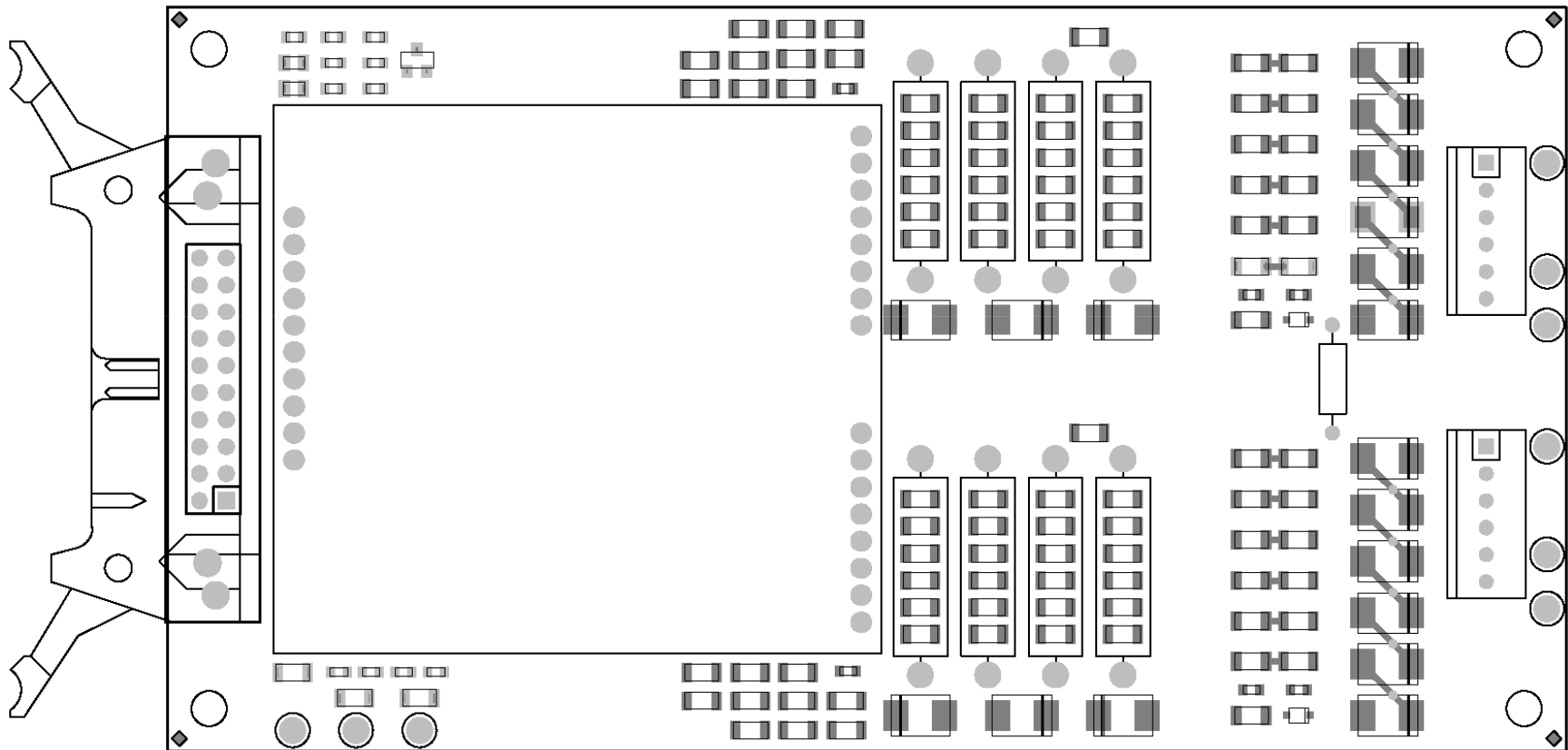- Detailed Functionality
- Layout
- Direct Paralleling

2BB0108T2A0-XX Basic Boards for 2SC0108T and General Information

- Layout
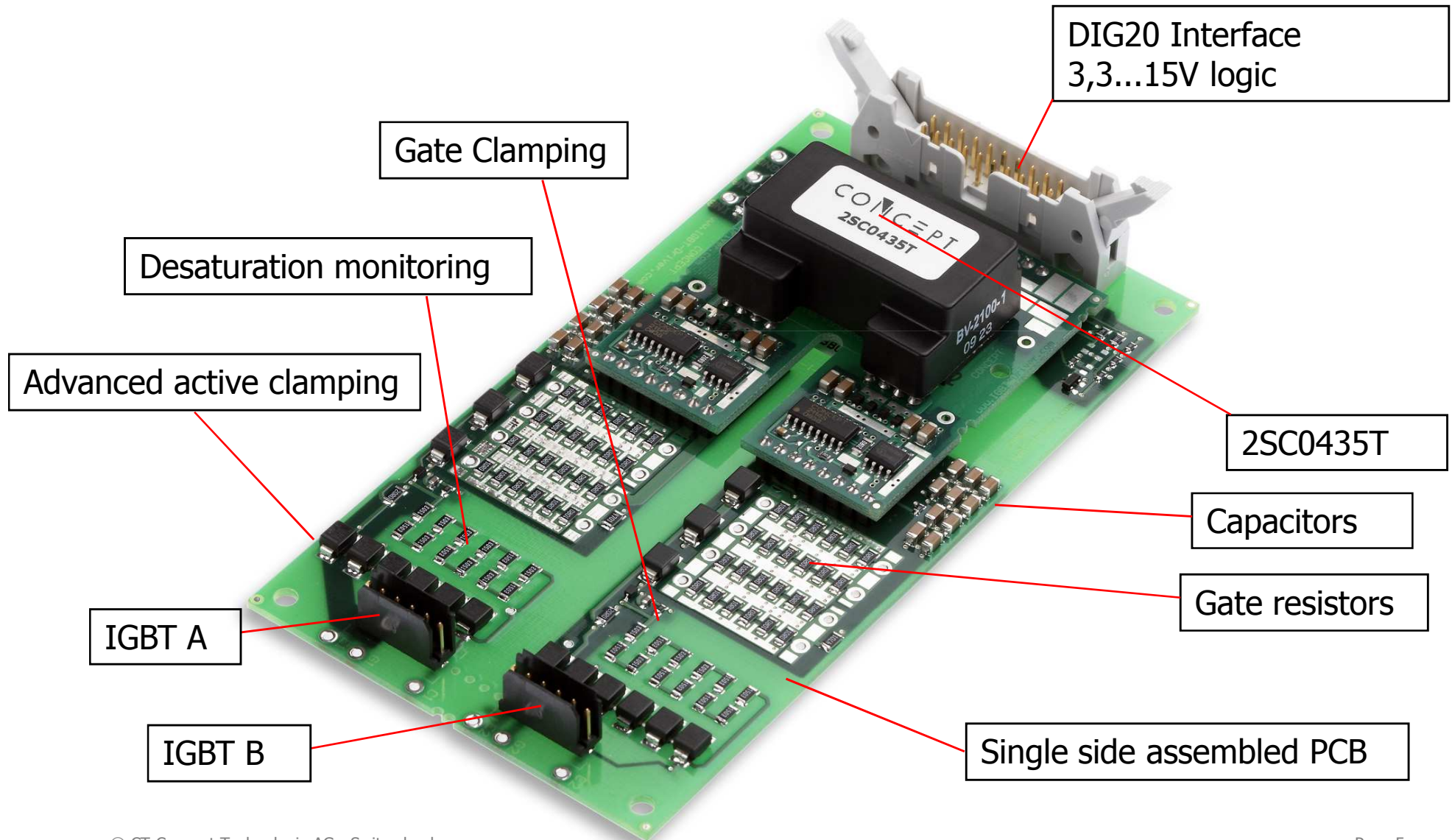- Schematics Overview
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General Information

- Don'ts from our Experience

Basic Board Layout 2BB0435T2A0-XX for 2SC0435T

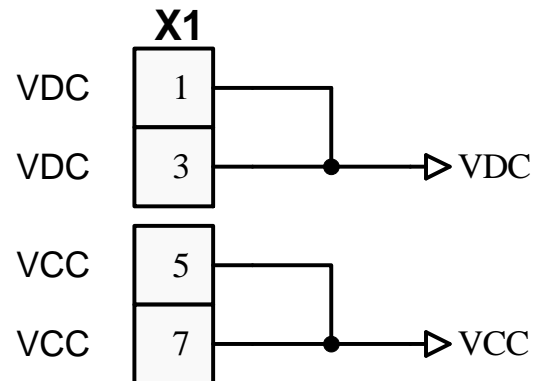# Overview of Basic Board based 2BB0435T2A0-XX for 2SC0435T

DIG20 Interface
3,3...15V logic

Gate Clamping

Desaturation monitoring

Advanced active clamping

2SC0435T

Capacitors

Gate resistors

IGBT A

IGBT B

Single side assembled PCB

Primary Side Connector – Standard DIC20 Electrical Interface

Pin	Des.	Function
1,3	VDC	+15V for DC/DC converter
5,7	VCC	+15V for primary side electronics
9	SO2	Status output channel 2
11	INB	Signal input B
13	SO1	Status output channel 1
15	INA	Signal input A
17	MOD	Mode selection (direct/half-bridge)
19	TB	Blocking time
2,4,6,8,10, 12,14,16,18,20	GND	Ground

Primary Side Connector – Supply Voltage VDC and VCC

- Supply voltage of primary side electronics and DC/DC converter are available as separate pins for testing purposes

- Only one +15V supply voltage is required

- The driver limits the inrush current at startup, no external current limitation of the voltage source for VDC is needed.
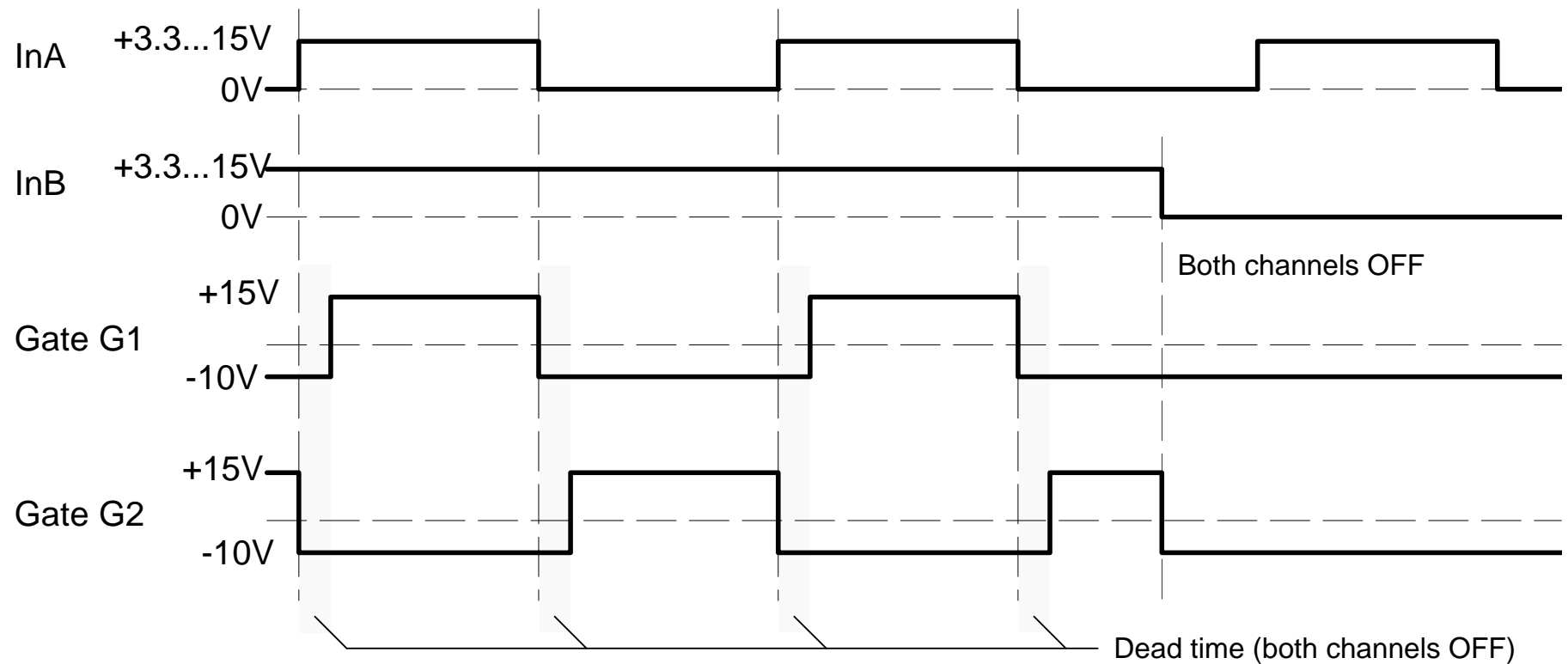
X1

VDC	1	
VDC	3	▷ VDC
VCC	5	
VCC	7	▷ VCC

Primary Side Connector – MOD Pin

- Allows to select direct mode or half-bridge mode

- Direct mode: MOD not connected (open) or connected to VCC
  INA drives channel 1, INB drives channel 2

- Half-bridge mode: MOD connected to GND
  See exact functionality on next page
  Dead time predefined with R303=150k → 3us
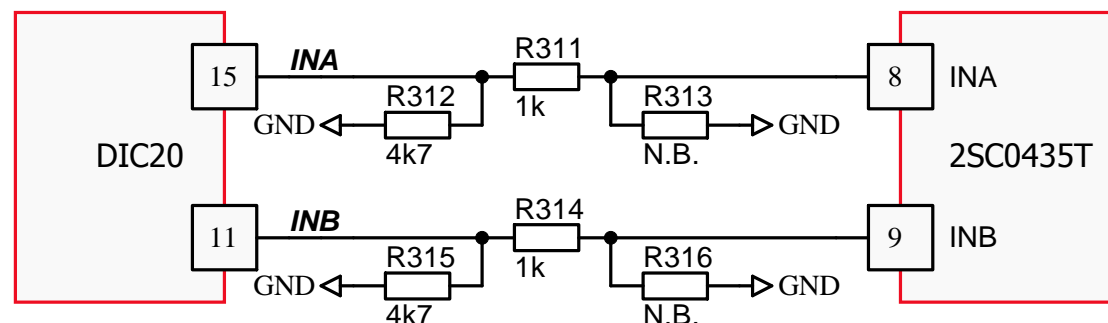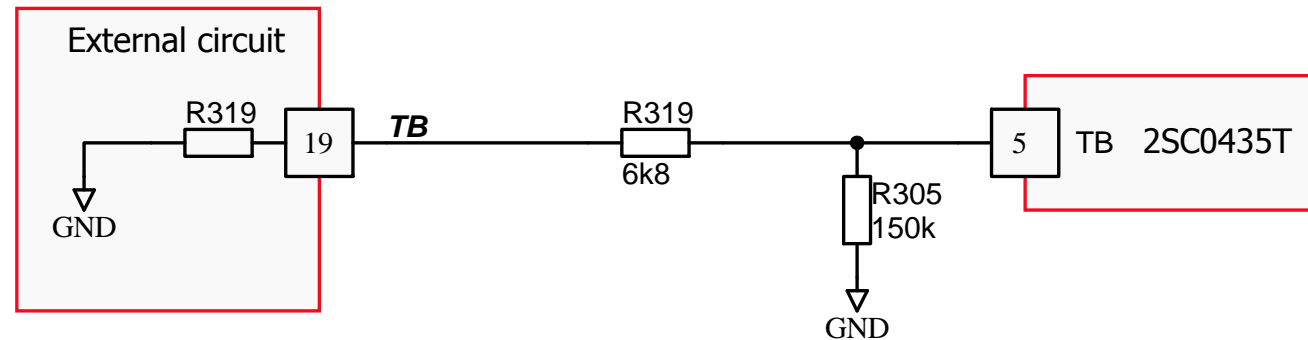 Selectable dead time range: 0.6us – 4.1us

Primary Side Connector – MOD Pin

Both channels OFF

Dead time (both channels OFF)

Primary Side Connector – Input Signals INA and INB

- INA and INB are drive inputs (Functionality: see MOD pin)

- Input hysteresis: 2.6V (turn-on), 1.3V (turn-off)

- Input hysteresis can be increased thanks to R313 and R316

- Accepted logic level: 3.3V - 15V

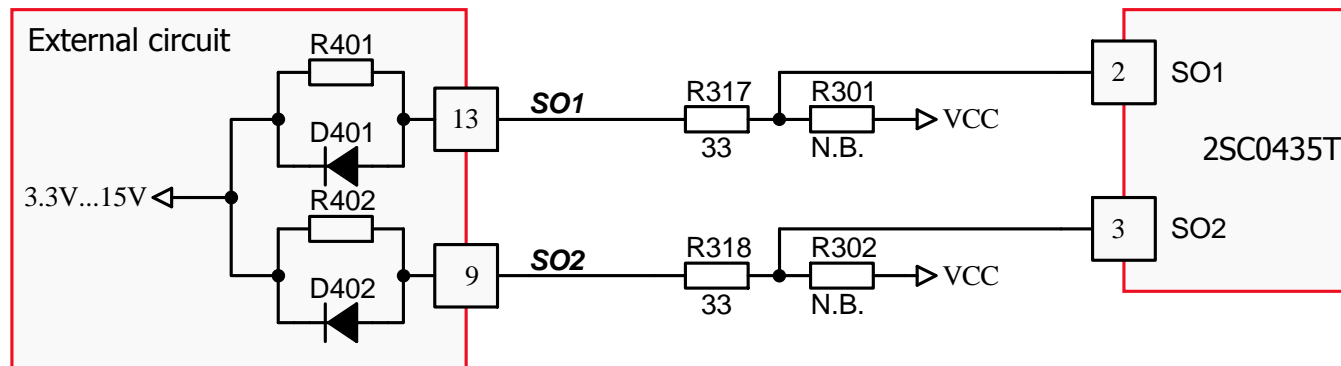- Caution: high slew rates (>0.25V/ns) are required in order to get small jitter values (~ 2-3ns)

Primary Side Connector – Blocking Time

▪ Blocking time:
- Corresponding channel is blocked (IGBT is turned off)
- Corresponding status output (SOx) is connected to GND

▪ Predefined blocking time: 90ms, adjustable to 9us or 20ms-90ms with an external resistor (R319)

Primary Side Connector – Status Outputs SO1 and SO2

- No fault: SOx are at ~4V without external pull-up or VCC with pull-up resistors

- Fault on SOx:
  - Primary supply undervoltage: SO1 and SO2 are connected to GND
  - Secondary supply undervoltage or IGBT short-circuit: SO1 and SO2 are connected to GND during the blocking time

- Max. SOx current: 20mA

- Internal (R301/R302) or external (R401/R402) pull-up resistors can be used

Secondary Side Interface – Gate Outputs GLx and GHx

- Use of separated turn-on and turn-off resistors (no additional diode is required)

- Separated turn-on and turn-off gate resistors are required!

- Additional capacitors are used on the driver secondary side

- Recommended capacitors and capacitance:
  - Ceramic capacitors (> 25V)
  - 3uF capacitance per 1uC gate charge between VISOx-VEx and VEx-COMx

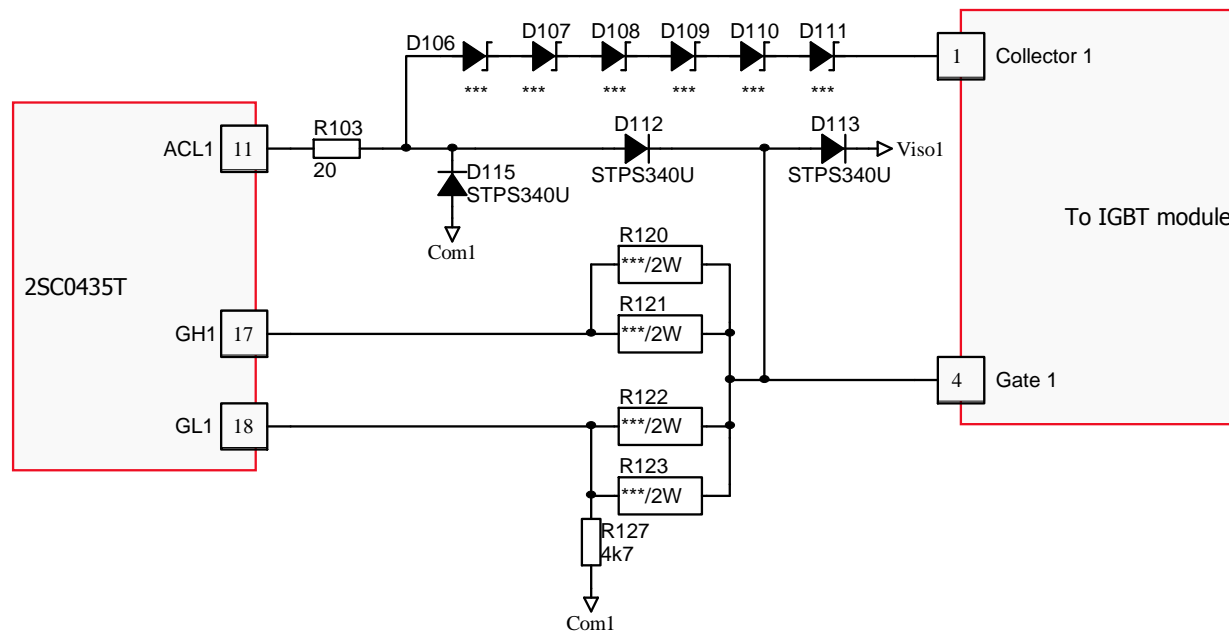- No static load must be applied between VISOx-VEx or VEx-COMx

Secondary Side Interface – Desaturation Protection

- Detection level pre-programmed at 10.2V with Rx01=68k

- Response time pre-programmed with capacitor Cx12

- Diode Cx05 must be low-leakage diodes (e.g. BAS416). Schottky diodes must be explicitly avoided

Secondary Side Interface – Advanced Active Clamping

- ▪ Overvoltage protection at turn-off

- ▪ Collector feedback to the gate (basic AC) and to the driver (advanced AC)
  - More efficient collector-emitter voltage reduction
  - Less losses through the clamping devices (transient voltage suppressors)

Parallel Connection of SCALE-2 Basic Boards

- SCALE-2 technology provide direct paralleling function.

- The basic board with its own IGBT module can be directly parallel connected (direct paralleling)

- Advantages are galvanic insulated gate loops.

- Consult application note AN-0904 for more information

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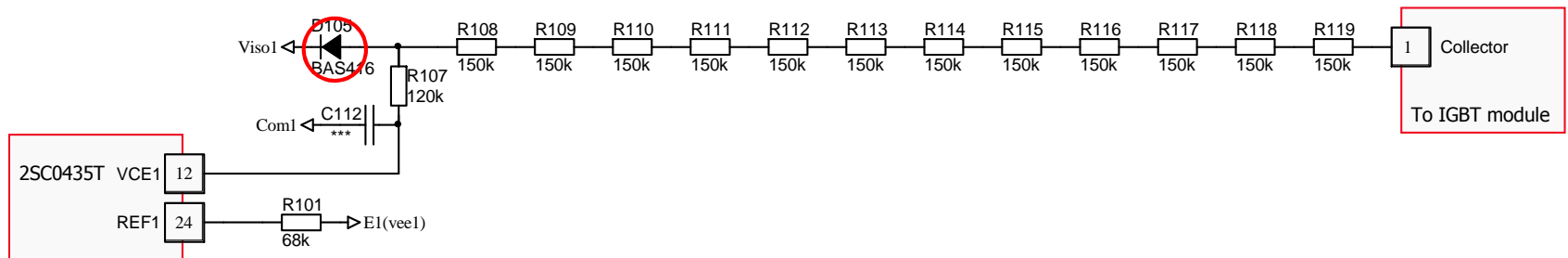- Layout
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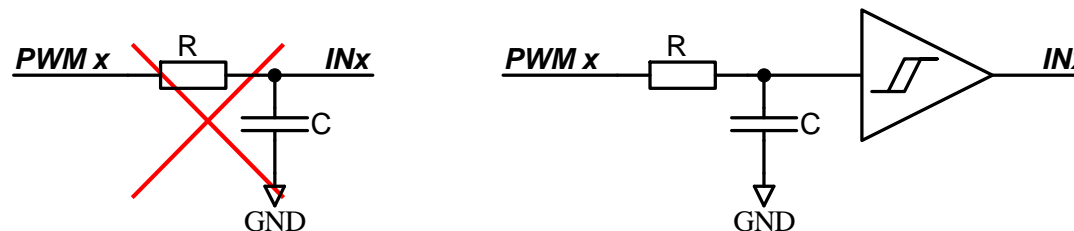- Direct Paralelling

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Overview of Basic Board 2BB0108T2A0-XX for 2SC0108T

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Gate Clamping

IGBT A

Desaturation monitoring

2SC0108T

Gate resistors

IGBT B

Active clamping

Single side assembled PCB

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Summary of Don'ts using 2SC0108T and 2SC0435T

- Don't replace low-leakage diodes (where specified) with Schottky diodes!!

- Don't Filter the input signals INA and INB (high increase of jitter)
  → If short-pulse suppression is required, the input signals to INA and INB can be filtered. A Schmitt-Trigger buffer must however be placed between filter and INA/INB!

■ Don't short-circuit GLx and GHx and use one common gate resistor

■ Don't place static loads between VISOx-VEx or VEx-COMx, but between VISOx-COMx

■ Don't set low reference voltages for desaturation protection (recommendation)
→ Desaturation monitoring is intended for short-circuit, not for accurate overcurrent protection

Many Thanks!