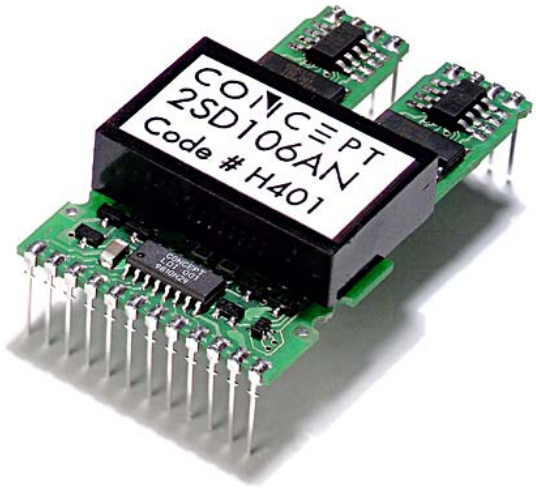
# 2SD106AI UL Dual SCALE Driver Core

## for IGBTs and Power MOSFETs

## Description




**The SCALE drivers from CONCEPT are based on a chip set that was developed specifically for the reliable driving and safe operation of IGBTs and power MOSFETs**.

The name “SCALE” is an acronym for the most outstanding properties of the SCALE series of drivers:

**SCALE** = **S**caleable, **C**ompact, **A**ll purpose, **L**ow cost and **E**asy to use.

The SCALE driver is a winning project of the competition organized by “Technology Center Switzerland 1998”. And ABB Switzerland AG honored the development of the SCALE driver by distinguishing it as the “best power electronics project in 1998”.

## Product Highlights

- ✓ Suitable for IGBTs and power MOSFETs
- ✓ Short circuit and overcurrent protection
- ✓ Extremely reliable, long service life
- ✓ High gate current of ±6A
- ✓ Electrical isolation of 4000$V_{AC}$
- ✓ Electrically isolated status acknowledgement
- ✓ Monitoring of power supply and self-monitoring
- ✓ Switching frequency DC to >100kHz
- ✓ Duty cycle: 0... 100%
- ✓ High dv/dt immunity, guaranteed >100,000V/µs
- ✓ Complete with DC/DC converter
- ✓ UL compliant

## Applications

- ✓ Inverters
- ✓ Motor drive technology
- ✓ Traction
- ✓ Railroad power supplies
- ✓ Converters
- ✓ Power engineering
- ✓ Switched-mode power supplies
- ✓ Radiology and laser technology
- ✓ DC/DC converter
- ✓ Research
- ✓ RF generators and converters

## Block Diagram

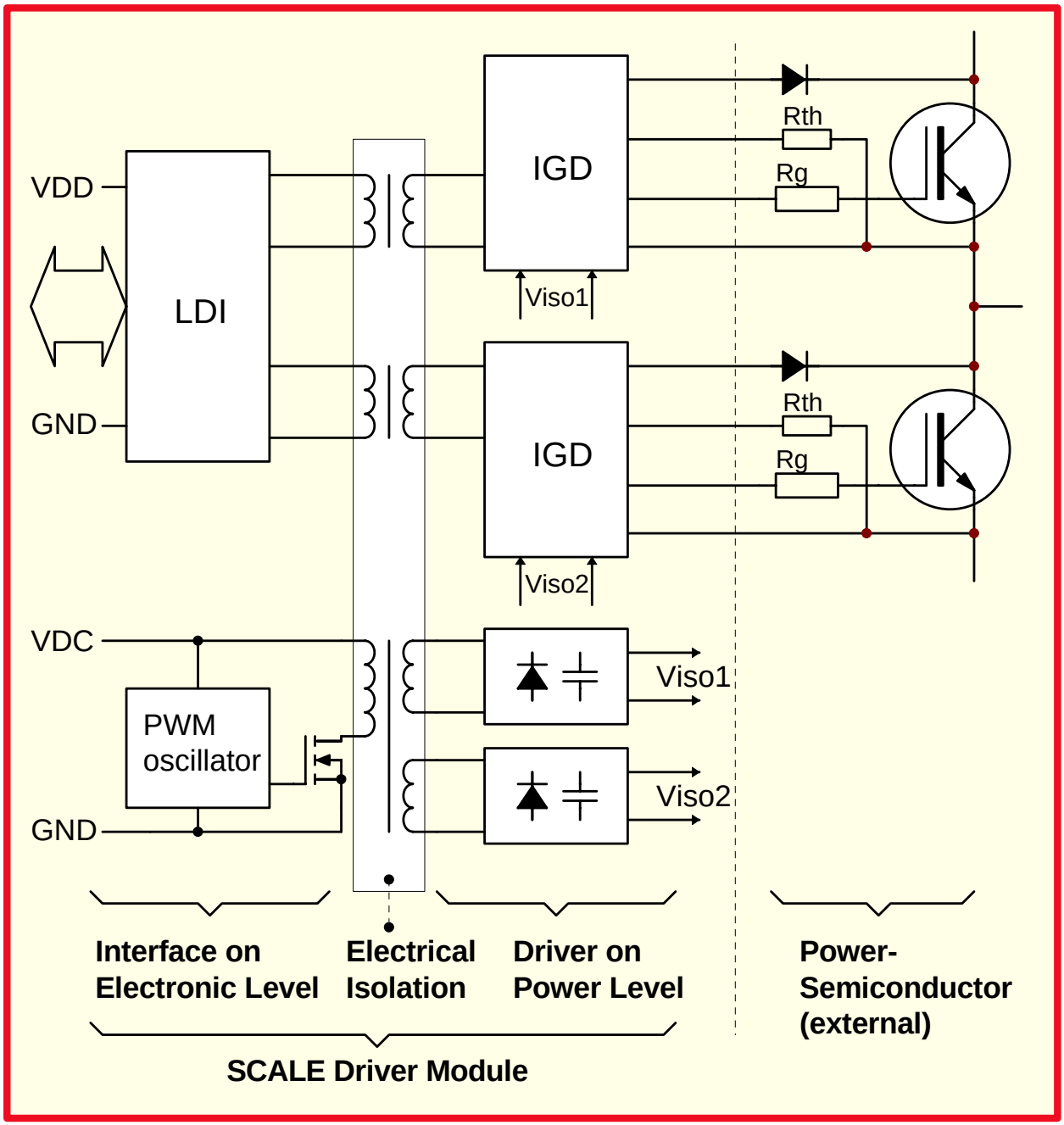



*Fig. 1 Block diagram of the 2SD106AI UL*

## Pin Designation

| Pin | Des. | Function | Pin | Des. | Function |
|---|---|---|---|---|---|
| 1 | VDD | +15V for electronic input side | 24 | | Free |
| 2 | GND | GND for electronic input side | 23 | C1 | Collector sense channel 1 |
| 3 | SO1 | Status output channel 1 | 22 | Rth1 | Reference resistor channel 1 |
| 4 | VL | Logic level/Reset | 21 | E1 | Emitter channel 1 |
| 5 | RC1 | RC network deadtime channel 1 | 20 | G1 | Gate channel 1 |
| 6 | InA | Input A | 19 | | Free |
| 7 | InB | Input B | 18 | | Free |
| 8 | RC2 | RC network deadtime channel 2 | 17 | C2 | Collector sense channel 2 |
| 9 | MOD | Mode input | 16 | Rth2 | Reference resistor channel 2 |
| 10 | SO2 | Status output channel 2 | 15 | E2 | Emitter channel 2 |
| 11 | GND(dc) | Ground of the DC/DC converter | 14 | G2 | Gate channel 2 |
| 12 | VDC | +15V for DC/DC converter | 13 | | Free |

**Legend:**

Pins with the designation “Free” are not physically present (drawn as “X” in Fig. 3 bottom).

## Mechanical Dimensions

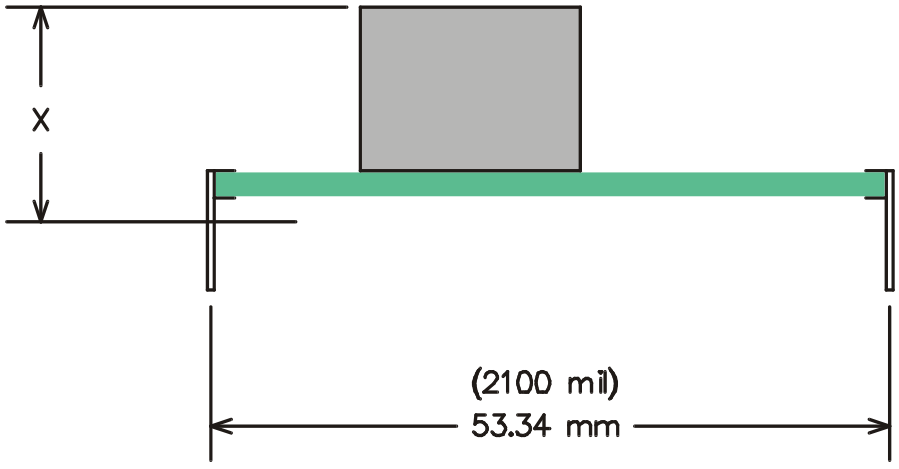



*Fig. 2 Side view 2SD106AI UL*

Height X: typ. 16mm

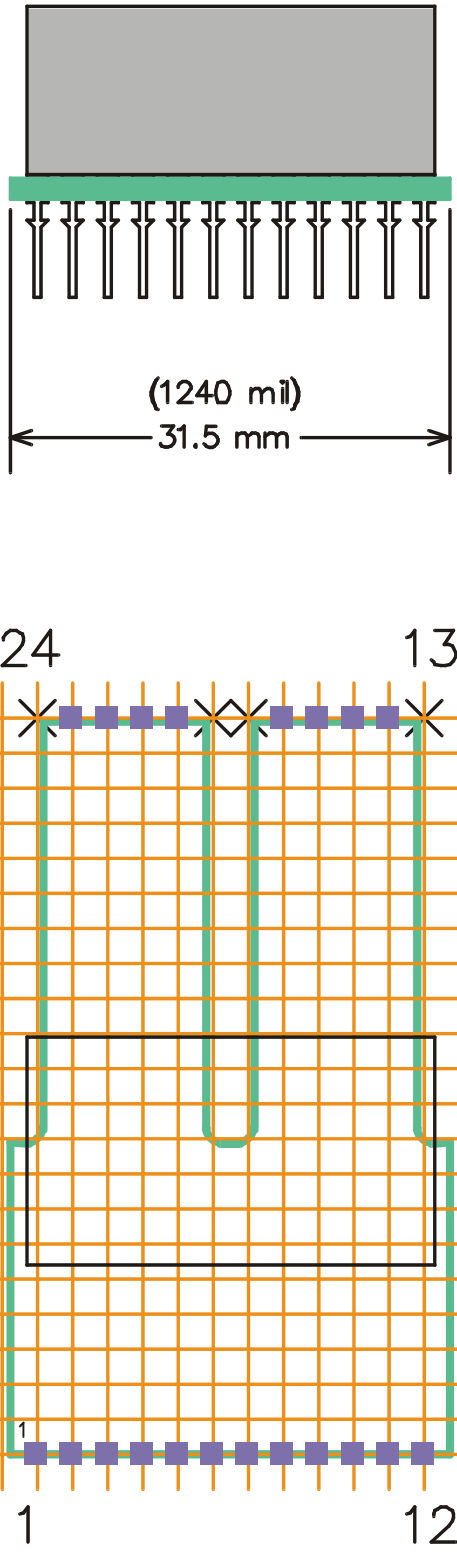



*Fig. 3 Front view (top) / Layout overview component side (bottom) 2SD106AI UL*

## Details of the circuit board layout

Grid of the aspect drawing on page 4 below: 2.54mm (100mil)

Recommended diameter of solder pad: Ø 1.6mm

Recommended diameter of drill holes: Ø 1.0mm

## Absolute Maximum Ratings

| Parameter | Test conditions | min | max | unit |
|---|---|---|---|---|
| Supply voltage ***VDC*** | | 0 | 16 | Vdc |
| Supply voltage ***VDD*** | | 0 | 16 | Vdc |
| Logic input voltage | to GND | 0 | ***VDD*** | Vdc |
| Gate peak current $I_{out}$ | Gx to Ex | -6 | +6 | A |
| Output power DC/DC converter | total for both channels | | 2 | W |
| Test voltage (50Hz/1min) | inputs to outputs | | 4000 | $V_{AC(eff)}$ |
| Operating voltage | continuous (see Note 8) | | 800 | Vdc |
| Operating temperature | (see Note 10) | -40 | +85 | °C |
| Storage temperature | | -40 | +90 | °C |

All data refer to +25°C and ***VDD*** = ***VDC*** = 15V unless otherwise specified

## Electrical Characteristics

| Power supply | Test conditions | min | typ | max | unit |
|---|---|---|---|---|---|
| Nominal supply voltage ***VDC*** | to GND (see Note 1) | | 15 | | Vdc |
| Supply current ***IDC*** | without load | | 23 | | mA |
| Max. supply current ***IDC*** | (see Note 2) | | | 153 | mA |
| Output power DC/DC converter | (see Note 3) | | | 2 | W |
| Efficiency η | internal DC/DC converter | | 85 | | % |
| Nominal supply voltage ***VDD*** | to GND | | 15 | | Vdc |
| Supply current ***IDD*** | without load | | 12 | | mA |
| Supply current ***IDD*** | at 25kHz switching frequency | | 15 | | mA |

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## Electrical Characteristics (Continuation)

| **Power supply monitoring** | **Test conditions** | **min** | **typ** | **max** | **unit** |
|---|---|---|---|---|---|
| Turn-on threshold $V_{th}$ | (see Note 4) | | 11.5 | | Vdc |
| Hysteresis on-/off | (see Note 4) | | 0.7 | | Vdc |
| **Logic inputs** | **Test conditions** | **min** | **typ** | **max** | **unit** |
| Input voltage | all inputs (see Note 5) | 0 | | ***VDD*** | Vdc |
| **Timing characteristics** | **Test conditions** | **min** | **typ** | **max** | **unit** |
| Delay time input to output | turn-on $t_{pd(on)}$ | | 300 | | ns |
| | turn-off $t_{pd(off)}$ | | 350 | | ns |
| Blocking time | after failure (see Note 12) | | 1 | | s |
| **Outputs** | **Test conditions** | **min** | **typ** | **max** | **unit** |
| Output current ***IG*** | Gx to Ex (see Note 6) | -6 | | +6 | A |
| Output rise time $t_{r(out)}$ | Gx to Ex (see Note 7) | | 100 | | ns |
| Output fall time $t_{f(out)}$ | Gx to Ex (see Note 7) | | 80 | | ns |
| Output current SOx | | 1.5 | | | mA |
| Output voltage rating SOx | SOx to GND | | | ***VDD*** | V |
| **Vce-Monitoring** | **Test conditions** | **min** | **typ** | **max** | **unit** |
| Inputs Cx | to Ex | 0 | | ***VDD*** | Vdc |
| **Electrical isolation** | **Test conditions** | **min** | **typ** | **max** | **unit** |
| Operating voltage | continuous (see Note 8) | | | 800 | Vdc |
| Test voltage | (50Hz/1min) (see Note 11) | | | 4000 | $V_{AC(eff)}$ |
| Partial discharge extinction volt. | IEC270 | | >1200 | | $V_{AC(pk)}$ |
| Creep path input-output | | | 12.7 | | mm |
| Creep path output-output | | | 12.7 | | mm |
| Maximum $\Delta V/\Delta t$ at $\Delta V$ =1000V | (see Note 9) | 100 | | | kV/µs |

All data refer to +25°C and ***VDD*** = ***VDC*** = 15V unless otherwise specified

## Operating Conditions

| Operating conditions | Test conditions | min | max | unit |
|---|---|---|---|---|
| Operating temperature | (see Note 10) | -40 | +85 | °C |
| Storage temperature | | -40 | +90 | °C |

### Footnotes to the key data

1) The drivers have a zener diode on each channel for over-voltage protection. When the feed voltage exceeds 16V, this protection can be subject to thermal overload.
2) If the specified power consumption is exceeded, this indicates an overload of the DC/DC converter. It should be noted that these DC/DC converters are not protected against overload.
3) This should be considered as a recommended value. Please consult the section: “Output power and self-heating”.
4) Under-voltage monitoring for protecting the power semiconductors. The voltage refers to the local supply voltage of each individual drive channel. However, this corresponds approximately to the voltage at VDC with respect to GND.
5) The input levels must never exceed the limits of the supply voltage (i.e. between GND and VDD), otherwise latch-up of the integrated circuits LDI 00I can occur. Particular care must be taken when driving via cables or longer leads.
6) The gate current must be limited to its maximum value by a gate resistor.
7) At a load of 39nF in series with 5.6 Ω (typical load of a 1200V/100A IGBT).
8) Maximum continuous or repeatedly-applied DC voltage between all inputs and all outputs. However, types that have been measured and selected for higher partial-discharge voltages (e.g. for 1700V IGBT modules) are also available.
9) This specification guarantees that the drive information will be transferred reliably even at a high DC-link voltage and fastest switching operations.
10) The application-specific self-heating of the drivers - specially at high load - must be taken into account.
11) The test voltage of 4000 Vac(rms)/50Hz may be applied only once during a minute. It should be noted that with this (strictly speaking obsolete) test method, some (minor) damage occurs to the isolation layers due to the partial discharge. Consequently, this test is not performed at CONCEPT as a series test. In the case of repeated isolation tests (e.g. module test, equipment test, system test) the subsequent tests should be performed with a lower test voltage: the test voltage is reduced by 400V for each additional test. The more modern if more elaborate partial-discharge measurement is better suited than such test methods as it is almost entirely non-destructive.
12) The typical blocking time after an error is 1 second. If required, versions with other blocking times may also be supplied.

# Application Hints

## IMPORTANT INFORMATION

**This data sheet contains only product-specific data. All data that apply to the whole type series of SCALE drivers is given in the document entitled: "Description and Application Manual for SCALE Drivers". In particular, this manual contains a detailed description of the concept of the SCALE drivers, a description of the function of all terminal pins as well as other important application hints.**

## Overview and application

The SCALE driver 2SD106AI UL is a two channel-driver for power MOSFETs and IGBTs.

Its compact mechanical dimensions and simple electrical interface make this driver suitable for almost all conceivable applications. When used as a half-bridge driver, the 2SD106AI UL can directly generate any dead times that may be required.

## Output power and self-heating

The specified output power of the driver totals 2W (1W per channel). This typically suffices to drive a 100A/1200V six-pack IGBT module with 25kHz. In the case of a drive power of 2W, the typical input power of the driver is about 2.33W; the losses due to the driver total about 0.33W. Because CONCEPT cannot predict how the drivers will be incorporated in the user's application, no binding recommended value for self-heating and thus for the maximum useful output power at high ambient temperatures can be made. It is consequently recommended to check the self-heating of the system, especially when it is used at higher temperatures.

For the calculation of the exact output power, reference should be made to Application Note AN-9701 "IGBT drivers correctly calculated" on www.igbt-driver.com/go/app-note.

## Collector sense and dimensioning of Rth

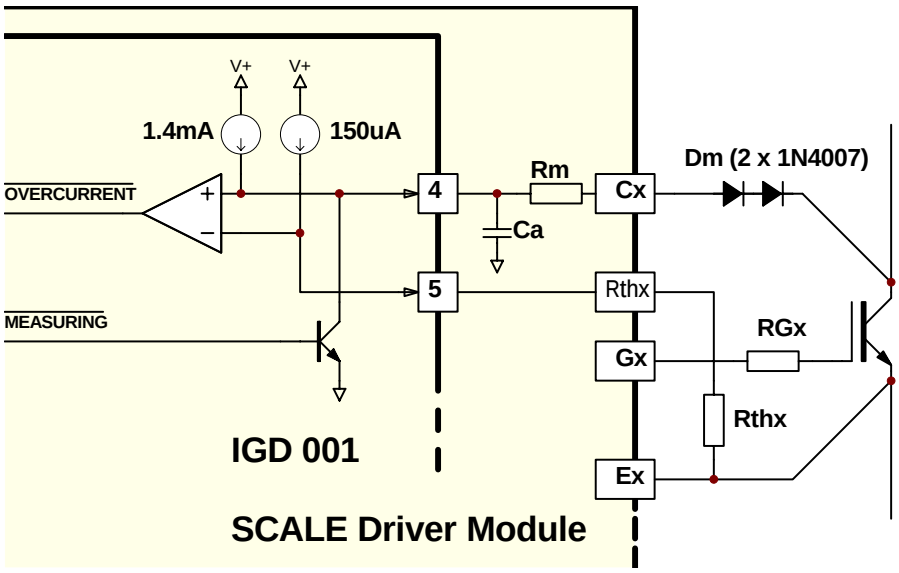



*Fig. 4 Collector-sense circuit principle*

The 2SD106AI UL dual driver has a collector-sense circuit to protect the power semiconductors. It is shown in Fig. 4

Its basic operating mode can be obtained from the brochure entitled: “Description and Application Manual for Scale Drivers”.

To correspond more effectively to the turn-on characteristic of the IGBTs, the SCALE drivers do not use a static reference voltage to compare the voltage at the collector. Instead, the reference is used as shown in Fig. 5.

| Value Rth | Reaction time | Vth1 | Vth2 | $V_{CE}$(off) |
|---|---|---|---|---|
| 22k | ≈ 4.9µs | ≈ 4.8V | ≈ 3.2V | 2.35V (1 Diode) |
| 27k | ≈ 5.7µs | ≈ 5.6V | ≈ 3.9V | 3.05V (1 Diode) |
| 33k | ≈ 6.8µs | ≈ 6.5V | ≈ 4.7V | 3.25V (2 Diodes) |
| 39k | ≈ 7.6µs | ≈ 7.3V | ≈ 5.6V | 4.15V (2 Diodes) |
| 47k | ≈ 9µs | ≈ 8.4V | ≈ 6.8V | 5.35V (2 Diodes) |

*Table 1 Reference resistor, reaction time and turn-off threshold*

### Notes on Table 1

The values for “Vth1” and “Vth2” are listed in **Table 1** as a function of the reference resistance Rth.

The value in the “Vth1” column corresponds to the voltage threshold after the response time has elapsed.

The value in the “Vth2” column corresponds to the voltage which is set up statically across the resistor Rth. This static value is typically reached after between 10 and 15µs.

The value in the "$V_{CE}$(off)" column corresponds to the collector-emitter voltage value at which the protection function is activated when the external circuit is used as shown in Fig. 4 with one or two Dm diodes of type 1N4007 connected in series.

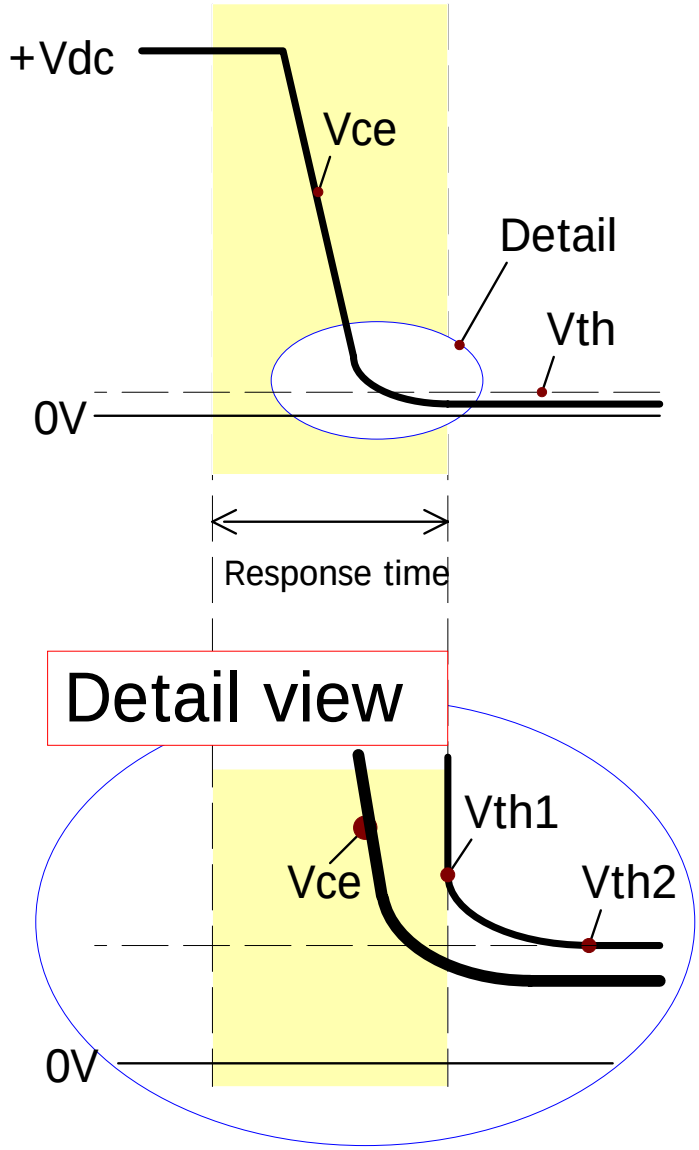



*Fig. 5 Collector-sense voltage curve*

## If you need any help, simply call our technical support

CONCEPT provides expert help with your questions and problems:

www.IGBT-Driver.com/go/support

## Quite special: customized SCALE drivers

If you need a power MOSFET or IGBT driver that is not included in the delivery range, don't hesitate to contact CONCEPT or your CONCEPT sales partner.

CONCEPT engineers have more than 20 years experience in the development and manufacture of intelligent drivers for power MOSFETs and IGBTs and have already implemented a large number of customized solutions.

## Important Notice

The data contained in this product data sheet is intended exclusively for technically trained staff. Handling all high-voltage equipment involves risk to life. Strict compliance with the respective safety regulations is mandatory!

Any handling of electronic devices is subject to the general specifications for protecting electrostatic-sensitive devices according to international standard IEC 747-1, Chapter IX or European standard EN 100015 (i.e. the workplace, tools, etc. must comply with these standards). Otherwise, this product may be damaged.

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2SD106AI UL Data Sheet

## Ordering Information

**UL Compliant Dual SCALE driver with ±6A gate current / ±15V gate voltage**

2SD106AI UL

## Information about Other Products

**For other drivers, product documentation, and application support**

Direct link: Please click: www.IGBT-Driver.com

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