# 2SC0435T2C0-17 Preliminary Datasheet

## Dual-Channel Low-Cost SCALE™-2 IGBT and MOSFET Driver Core


## Abstract

The low-cost SCALE™-2 dual-driver core 2SC0435T2C0-17 combines unrivalled compactness with broad applicability. The driver is designed for universal applications requiring high reliability. The 2SC0435T2C0-17 drives all usual high-power IGBT modules up to 1700V. The embedded paralleling capability allows easy inverter design covering higher power ratings. Multi-level topologies are also supported.

The 2SC0435T2C0-17 is the most compact driver core in its power range with a footprint of only 57.2 x 51.6mm and an insertion height of max. 20mm. It allows even the most restricted insertion spaces to be efficiently used. Compared with conventional drivers, the highly integrated SCALE-2 chipset allows about 85% of components to be dispensed with. This advantage is impressively reflected in increased reliability at simultaneously minimized cost.

The 2SC0435T2C0-17 combines a complete two-channel driver core with all components required for driving, such as an isolated DC/DC converter, short-circuit protection, advanced active clamping as well as supply voltage monitoring. Each of the two output channels is electrically isolated from the primary side and the other secondary channel.

An output current of 35A and 4W drive power is available per channel, making the 2SC0435T2C0-17 an ideal driver platform for universal usage in medium and high-power applications. The driver provides a gate voltage swing of +15V/-10V. The turn-on voltage is regulated to maintain a stable 15V regardless of the output power level.

Its outstanding EMC allows safe and reliable operation in even hard industrial applications.


## Product Highlights

- ✓ Ultra-compact dual-channel driver
- ✓ Highly integrated SCALE-2 chipset
- ✓ Gate current ±35A, 4W output power per channel
- ✓ +15V/-10V gate driving
- ✓ Blocking voltages up to 1700V
- ✓ Safe isolation to EN 50178
- ✓ Short delay and low jitter
- ✓ Interface for 3.3V ... 15V logic level
- ✓ Dedicated IGBT and MOSFET mode
- ✓ UL recognition E321757 for UL508C (NMMS2/8)
- ✓ UL recognition E346491 for UL60950-1 (NWGQ2/8)

## Applications

- ✓ General purpose drives
- ✓ Uninterruptible power supplies (UPS)
- ✓ Solar and wind power converters
- ✓ Auxiliary converters for traction
- ✓ Electro/hybrid drive vehicles
- ✓ Driving parallel-connected IGBTs
- ✓ Medical (MRT, CT, X-Ray)
- ✓ Laser technology

Preliminary Data Sheet

## Safety Notice!

The data contained in this 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 60747-1, Chapter IX or European standard EN 100015 (i.e. the workplace, tools, etc. must comply with these standards). Otherwise, this product may be damaged.

## Important Product Documentation

This data sheet contains only product-specific data. For a detailed description, must-read application notes and important information that apply to this product, please refer to "2SC0435T Description & Application Manual" on www.power.com/igbt-driver/go/2SC0435T

## Absolute Maximum Ratings

| Parameter | Remarks | Min | Max | Unit |
|---|---|---|---|---|
| Supply voltage $V_{DC}$ | VDC to GND | 0 | 16 | V |
| Supply voltage $V_{CC}$ | VCC to GND | 0 | 16 | V |
| Logic input and output voltages | Primary side, to GND | -0.5 | VCC+0.5 | V |
| SOx current | Failure condition, total current | | 20 | mA |
| Gate peak current $I_{out}$ | Note 1 | -35 | +35 | A |
| External gate resistance | Turn-on and turn-off | 0.5 | | Ω |
| Average supply current $I_{DC}$ | Notes 2, 3 | | 1050 | mA |
| Output power | Ambient temperature <70°C (Notes 4, 5) | | 6 | W |
| | Ambient temperature 85°C (Note 4) | | 4 | W |
| Switching frequency f | | | 100 | kHz |
| Test voltage (50Hz/1min.) | Primary to secondary (Note 15) | | 5000 | $V_{AC(eff)}$ |
| | Secondary to secondary (Note 15) | | 4000 | $V_{AC(eff)}$ |
| \|dV/dt\| | Rate of change of input to output voltage (Note 11) | | 75 | kV/µs |
| Operating voltage | Primary/secondary, secondary/secondary | | 1700 | $V_{peak}$ |
| Operating temperature | Note 5 | -40 | +85 | °C |
| Storage temperature | | -40 | +90 | °C |

## Recommended Operating Conditions

| Power Supply | Remarks | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply voltage $V_{DC}$ | VDC to GND, IGBT mode | 14.5 | 15 | 15.5 | V |
| Supply voltage $V_{CC}$ | VCC to GND | 14.5 | 15 | 15.5 | V |

## Electrical Characteristics (IGBT mode)

All data refer to +25°C and $V_{CC}$ = $V_{DC}$ = 15V unless otherwise specified.

| **Power supply** | **Remarks** | **Min** | **Typ** | **Max** | **Unit** |
|---|---|---|---|---|---|
| Supply current $I_{DC}$ | Without load | | 32 | | mA |
| Supply current $I_{CC}$ | f = 0Hz | | 22 | | mA |
| Supply current $I_{CC}$ | f = 100kHz | | 32 | | mA |
| Coupling capacitance $C_{io}$ | Primary to output, total | | 20 | | pF |
| **Power Supply Monitoring** | **Remarks** | **Min** | **Typ** | **Max** | **Unit** |
| Supply threshold $V_{CC}$ | Primary side, clear fault | 11.9 | 12.6 | 13.3 | V |
| | Primary side, set fault (Note 12) | 11.3 | 12.0 | 12.7 | V |
| Monitoring hysteresis | Primary side, set/clear fault | 0.35 | | | V |
| Supply threshold $V_{ISOx}$-$V_{Ex}$ | Secondary side, clear fault | 12.1 | 12.6 | 13.1 | V |
| | Secondary side, set fault (Note 13) | 11.5 | 12.0 | 12.5 | V |
| Monitoring hysteresis | Secondary side, set/clear fault | 0.35 | | | V |
| Supply threshold $V_{Ex}$-$V_{COMx}$ | Secondary side, clear fault | 5 | 5.15 | 5.3 | V |
| | Secondary side, set fault (Note 13) | 4.7 | 4.85 | 5 | V |
| Monitoring hysteresis | Secondary side, set/clear fault | 0.15 | | | V |
| **Logic Inputs and Outputs** | **Remarks** | **Min** | **Typ** | **Max** | **Unit** |
| Input bias current | V(INx) > 3V | | 190 | | µA |
| Turn-on threshold | V(INx) | | 2.6 | | V |
| Turn-off threshold | V(INx) | | 1.3 | | V |
| SOx output voltage | Failure condition, I(SOx)<20mA | | | 0.7 | V |
| **Short-Circuit Protection** | **Remarks** | **Min** | **Typ** | **Max** | **Unit** |
| Current through pin REFx | R(REFx, VEx)<70kΩ | | 150 | | µA |
| Minimum response time | Note 9 | | 1.2 | | µs |
| Minimum blocking time | Note 10 | | 9 | | µs |
| **Timing Characteristics** | **Remarks** | **Min** | **Typ** | **Max** | **Unit** |
| Turn-on delay $t_{d(on)}$ | Note 6 | | 85 | | ns |
| Turn-off delay $t_{d(off)}$ | Note 6 | | 70 | | ns |
| Jitter of turn-on delay | Note 17 | | ±3 | | ns |
| Jitter of turn-off delay | Note 17 | | ±3 | | ns |
| Output rise time $t_{r(out)}$ | Note 7 | | 20 | | ns |
| Output fall time $t_{f(out)}$ | Note 7 | | 20 | | ns |
| Transmission delay of fault state | Note 14 | | 400 | | ns |

| Electrical Isolation | Remarks | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Test voltage (50Hz/1s) | Primary to secondary side (Note 15) | 5000 | 5050 | 5100 | $V_{eff}$ |
| | Secondary to secondary side (Note 15) | 4000 | 4050 | 4100 | $V_{eff}$ |
| Partial discharge extinction volt. | Primary to secondary side (Note 16) | 1768 | | | $V_{peak}$ |
| | Secondary to secondary side (Note 16) | 1700 | | | $V_{peak}$ |
| Creepage distance | Primary to secondary side | 15.7 | | | mm |
| | Secondary to secondary side | 12 | | | mm |
| Clearance distance | Primary to secondary side | 15.7 | | | mm |
| | Secondary to secondary side | 7.3 | | | mm |

| Output | Remarks | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Blocking capacitance | VISOx to VEx (Note 8) | | 9.4 | | µF |
| | VEx to COMx (Note 8) | | 9.4 | | µF |

**Output voltage swing**

The output voltage swing consists of two distinct segments. First, there is the turn-on voltage $V_{GHx}$ between pins GHx and VEx. $V_{GHx}$ is regulated and maintained at a constant level for all output power values and frequencies.
The second segment of the output voltage swing is the turn-off voltage $V_{GLx}$. $V_{GLx}$ is measured between pins GLx and VEx. It is a negative voltage. It changes with the output power to accommodate the inevitable voltage drop across the internal DC/DC converter.

| Output Voltage | Remarks | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Turn-on voltage, $V_{GHx}$ | Any load condition | | 15.0 | | V |
| Turn-off voltage, $V_{GLx}$ | No load | | -10.1 | | V |
| Turn-off voltage, $V_{GLx}$ | 1W output power | | -9.8 | | V |
| Turn-off voltage, $V_{GLx}$ | 4W output power | | -9.5 | | V |
| Turn-off voltage, $V_{GLx}$ | 6W output power | | -9.3 | | V |

**Footnotes to the Key Data**

1) The maximum peak gate current refers to the highest current level occurring during the product lifetime. It is an absolute value and does also apply for short pulses.
2) The average supply input current is limited for thermal reasons. Higher values than specified by the absolute maximum rating are permissible (e.g. during power supply start up) if the average remains below the given value, provided the average is taken over a time period which is shorter than the thermal time constants of the driver in the application.
3) There is no means of actively controlling or limiting the input current in the driver. In the case of start-up with very high blocking capacitor values, or in case of short circuit at the output, the supply input current has to be limited externally.
4) The maximum output power must not be exceeded at any time during operation. The absolute maximum rating must also be observed for time periods shorter than the thermal time constants of the driver in the application.

5) An extended output power range is specified in the output power section for maximum ambient temperatures of 70°C. In that case, the absolute maximum rating for the operating temperature changes to (–40°C - 70°C) and the absolute maximum output power rating changes to 6W.
6) The delay time is measured between 50% of the input signal and 10% voltage swing of the corresponding output. The delay time is independent of the output loading.
7) Output rise and fall times are measured between 10% and 90% of the nominal output swing with an output load of 4.7Ω and 270nF. The values are given for the driver side of the gate resistors. The time constant of the output load in conjunction with the present gate resistors leads to an additional delay at the load side of the gate resistors.
8) External blocking capacitors are to be placed between VISOx and VEx as well as VEx and COMx for gate charges exceeding 3µC. Ceramic capacitors are recommended. A minimum external blocking capacitance of 3µF is recommended for every 1µC of gate charge beyond 3µC. Insufficient external blocking can lead to reduced driver efficiency and thus to thermal overload.
9) The minimum response time given is valid for the circuit given in the description and application manual (Fig. 7) with the values of table 1 ($C_{ax}$=0pF, $R_{thx}$=43kΩ).
10) The blocking time sets a minimum time span between the end of any fault state and the start of normal operation (remove fault from pin SOx). The value of the blocking time can be adjusted at pin TB. The specified blocking time is valid if TB is connected to GND.
11) This specification guarantees that the drive information will be transferred reliably even at a high DC-link voltage and with ultra-fast switching operations.
12) Undervoltage monitoring of the primary-side supply voltage (VCC to GND). If the voltage drops below this limit, a fault is transmitted to both SOx outputs and the power semiconductors are switched off.
13) Undervoltage monitoring of the secondary-side supply voltage (VISOx to VEx and VEx to COMx which correspond with the approximate turn-on and turn-off gate-emitter voltages). If the corresponding voltage drops below this limit, the IGBT is switched off and a fault is transmitted to the corresponding SOx output.
14) Transmission delay of fault state from the secondary side to the corresponding primary status output.
15) HiPot testing (= dielectric testing) must generally be restricted to suitable components. This gate driver is suited for HiPot testing. Nevertheless, it is strongly recommended to limit the testing time to 1s slots as stipulated by EN 50178. Excessive HiPot testing at voltages much higher than 1200$V_{AC(eff)}$ may lead to insulation degradation. No degradation has been observed over 1min. testing at 5000$V_{AC(eff)}$. Every production sample shipped to customers has undergone 100% testing at the given value for 1s.
16) Partial discharge measurement is performed in accordance with IEC 60270 and isolation coordination specified in EN 50178. The partial discharge extinction voltage between primary and either secondary side is coordinated for safe isolation to EN 50178.
17) Jitter measurements are performed with input signals INx switching between 0V and 5V referred to GND, with a corresponding rise time and fall time of 15ns.

## Legal Disclaimer

The statements, technical information and recommendations contained herein are believed to be accurate as of the date hereof. All parameters, numbers, values and other technical data included in the technical information were calculated and determined to our best knowledge in accordance with the relevant technical norms (if any). They may base on assumptions or operational conditions that do not necessarily apply in general. We exclude any representation or warranty, express or implied, in relation to the accuracy or completeness of the statements, technical information and recommendations contained herein. No responsibility is accepted for the accuracy or sufficiency of any of the statements, technical information, recommendations or opinions communicated and any liability for any direct, indirect or consequential loss or damage suffered by any person arising therefrom is expressly disclaimed.

## Ordering Information

The general terms and conditions of delivery of Power Integrations Switzerland GmbH apply.

| Type Designation | Description |
|---|---|
| 2SC0435T2C0-17 | Dual-channel SCALE-2 driver core (connector pin length of 5.84mm instead of 2.54mm for 2SC0435T2A0-17) |

Product home page: www.power.com/igbt-driver/go/2SC0435T

Refer to www.power.com/igbt-driver/go/nomenclature for information on driver nomenclature

## Information about Other Products

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

Please click: www.power.com

## Manufacturer

Power Integrations Switzerland GmbH
Johann-Renfer-Strasse 15
2504 Biel-Bienne, Switzerland

Phone +41 32 344 47 47
Fax +41 32 344 47 40
Email igbt-driver.sales@power.com
Website www.power.com/igbt-driver

© 2009…2015 Power Integrations Switzerland GmbH. All rights reserved.
We reserve the right to make any technical modifications without prior notice. Version 2.1 from 2015-02-24

## Power Integrations Worldwide High Power Customer Support Locations

**World Headquarters**
5245 Hellyer Avenue
San Jose, CA 95138 | USA
Main +1 408 414 9200
Customer Service:
Phone +1 408 414 9665
Fax +1 408 414 9765
Email usasales@power.com

**Switzerland (Biel)**
Johann-Renfer-Strasse 15
2504 Biel-Bienne | Switzerland
Phone +41 32 344 47 47
Fax +41 32 344 47 40
Email igbt-driver.sales@power.com

**Germany (Ense)**
HellwegForum 1
59469 Ense | Germany
Phone +49 2938 643 9990
Email igbt-driver.sales@power.com

**Germany (Munich)**
Lindwurmstrasse 114
80337 Munich | Germany
Phone +49 895 527 39110
Fax +49 895 527 39200
Email eurosales@power.com

**China (Shanghai)**
Rm 2410, Charity Plaza, No. 88
North Caoxi Road
Shanghai, PRC 200030
Phone +86 21 6354 6323
Fax +86 21 6354 6325
Email chinasales@power.com

**China (Shenzhen)**
17/F, Hivac Building, No 2,
Keji South 8th Road,
Nanshan District
Shenzhen | China, 518057
Phone +86 755 8672 8725
Fax +86 755 8672 8690
Hotline +86 400 0755 669
Email chinasales@power.com

**Italy (Milano)**
Via Milanese 20, 3rd. Fl.
20099 Sesto San Giovanni | Italy
Phone +39 024 550 8701
Fax +39 028 928 6009
Email eurosales@power.com

**UK (Herts)**
First Floor, Unit 15, Meadway Court,
Rutherford Close, Stevenage,
Herts SG1 2EF | United Kingdom
Phone +44 1252 730 141
Fax +44 1252 727 689
Email eurosales@power.com

**India (Bangalore)**
#1, 14th Main Road
Vasanthanagar
Bangalore 560052 | India
Phone +91 80 4113 8020
Fax +91 80 4113 8023
Email indiasales@power.com

**Japan (Kanagawa)**
Kosei Dai-3 Bldg., 2-12-11, Shin-
Yokohama, Kohoku-ku, Yokohama-shi,
Kanagawa 222-0033 | Japan
Phone +81 45 471 1021
Fax +81 45 471 3717
Email japansales@power.com

**Korea (Seoul)**
RM 602, 6FL
Korea City Air Terminal B/D, 159-6
Samsung-Dong, Kangnam-Gu
Seoul 135-728 | Korea
Phone +82 2 2016 6610
Fax +82 2 2016 6630
Email koreasales@power.com

**Taiwan (Taipei)**
5F, No. 318, Nei Hu Rd., Sec. 1
Nei Hu Dist.
Taipei 11493 | Taiwan R.O.C.
Phone +886 2 2659 4570
Fax +886 2 2659 4550
Email taiwansales@power.com