

2SC0435T2Ex-17 Preliminary Datasheet

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

Abstract

The low-cost SCALE-2 dual-driver core 2SC0435T2Ex-17 (RoHS version of 2SC0435T2Cx-17) combines unrivalled compactness with broad applicability. The driver is designed for universal applications requiring high reliability. The 2SC0435T2Ex-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 2SC0435T2Ex-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 2SC0435T2Ex-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 2SC0435T2Ex-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 $\pm 35A$, 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)
- ✓ RoHS compliant

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

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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.igbt-driver.com/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/ μ s |
| 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 |

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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 | $R(REFx, VEx) < 70k\Omega$ | | 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 |

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| 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.

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- 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. 6) with the values of table 1 ($C_{ax}=0\text{pF}$, $R_{thx}=43\text{k}\Omega$).
- 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 1200V_{AC(eff)} may lead to insulation degradation. No degradation has been observed over 1min. testing at 5000V_{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

This data sheet specifies devices but cannot promise to deliver any specific characteristics. No warranty or guarantee is given – either expressly or implicitly – regarding delivery, performance or suitability.

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Ordering Information

The general terms and conditions of delivery of CT-Concept Technologie AG apply.

| Type Designation | Description |
|------------------|---|
| 2SC0435T2E0-17 | Dual-channel SCALE-2 driver core (RoHS version of 2SC0435T2C0-17, connector pin length of 5.84mm) |

Product home page: www.IGBT-Driver.com/go/2SC0435T

Refer to www.IGBT-Driver.com/go/nomenclature for information on driver nomenclature

Information about Other Products

For other drivers, product documentation, and application support

Please click: www.IGBT-Driver.com

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