2SC0635T2A1-45 Preliminary Datasheet

Dual-Channel Cost-Effective SCALE™-2 IGBT Driver Core for 4500V IGBTs

Abstract

The SCALE™-2 dual-driver core 2SC0635T2A1-45 combines unrivalled compactness with broad applicability. The driver is designed for universal applications requiring high reliability. The 2SC0635T2A1-45 drives all usual high-power IGBT modules up to 4500V. Its embedded paralleling capability allows easy inverter design covering higher power ratings. Multi-level topologies involving 1700V or 3300V IGBTs with higher isolation requirements can also be easily supported by 2SC0635T2A1-45.

The 2SC0635T2A1-45 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 from the other secondary channel.

An output current of 35A and 6W drive power is available per channel, making the 2SC0635T2A1-45 an ideal driver platform for universal use 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 even in hard industrial applications.

Product Highlights

- ✓ Ultra-compact dual-channel driver
- ✓ Highly integrated SCALE-2 chipset
- ✓ Gate current ±35A, 6W output power per channel
- ✓ 15V/-10V gate driving
- ✓ Blocking voltages up to 4500V
- ✓ Basic isolation to IEC 61800-5-1 and IEC 60664-1
- ✓ Short delay and low jitter
- ✓ 15V logic level interface
- ✓ UL compliant
- ✓ Lead free

Applications

- ✓ Traction
- ✓ Railroad power supplies
- ✓ Light rail vehicles
- ✓ HVDC
- ✓ Flexible AC transmission systems (FACTS)
- ✓ Medium-voltage converters
- ✓ Wind-power converters
- ✓ Industrial drives
- ✓ Medical applications

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 "2SC0635T Description & Application Manual" on www.power.com/igbt-driver/go/2SC0635T.

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		1450	mA
Output power	Ambient temperature 0°C…70°C (Notes 4, 5)		9	W
	Ambient temperature -40°C…85°C (Note 4)		6	W
Switching frequency f			100	kHz
Test voltage (50Hz/1min.)	Primary to secondary (Note 14)		10.2	kV_{eff}
	Secondary to secondary (Note 14)		10.2	kV_{eff}
|dV/dt|	Rate of change of input to output voltage		35	kV/µs
Operating voltage	Primary/secondary, secondary/secondary		4500	V_{peak}
Operating temperature	Notes 5, 17	-40	+85	°C
Storage temperature		-55	+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		70		mA
Supply current I_{CC}	f = 0Hz		25		mA
Supply current I_{CC}	f = 100kHz		34		mA
Coupling capacitance C_{io}	Primary to output, total		19		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 11)	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 12)	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 12)	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 impedance	V(INx) = 15V	4.7	4.8	4.9	kΩ
Turn-on threshold	V(INx)		8.8		V
Turn-off threshold	V(INx)		4.5		V
SOx pull-up resistor to VCC	On board		10		kΩ
SOx output voltage	Failure condition, I(SOx)<6.5mA			0.7	V
Short-Circuit Protection	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
V_{CE}-monitoring threshold	Factory set value (Note 18)		9.3		V
Minimum response time	Note 9		5.1		µs
Blocking time	After fault. Factory set value (Note 10)		130		ms
Minimum blocking time	Note 10		9		µs

Short-Circuit Protection	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Delay in IGBT turn-off	Factory-set value (Note 19)		0.2		µs

Timing Characteristics	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Turn-on delay $t_{d(on)}$	Note 6		80		ns
Turn-off delay $t_{d(off)}$	Note 6		65		ns
Jitter of turn-on delay	Note 16		±2		ns
Jitter of turn-off delay	Note 16		±2		ns
Output rise time $t_{r(out)}$	Note 7		20		ns
Output fall time $t_{f(out)}$	Note 7		25		ns
Transmission delay of fault state	Note 13		450		ns

Electrical Isolation	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Test voltage (50Hz/1s)	Primary to secondary side (Note 14)	10.2	10.3	10.4	kV_{eff}
	Secondary to secondary side (Note 14)	10.2	10.3	10.4	kV_{eff}
Partial discharge extinction volt.	Primary to secondary side (Note 15)	5400			V_{peak}
	Secondary to secondary side (Note 15)	5400			V_{peak}
Creepage distance					
On the PCB	Primary to secondary side	34			mm
(Material group IIIa)	Secondary to secondary side	34			mm
On the transformer	Primary to secondary side	29			mm
(Material group I)	Secondary to secondary side	25			mm
Clearance distance	Primary to secondary side	25			mm
	Secondary to secondary side	18			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		-10.8		V
Turn-off voltage, V_{GLx}	6W output power		-8.5		V
Turn-off voltage, V_{GLx}	9W output power		-8.2		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 ambient temperatures limited from 0°C to 70°C.
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 on 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 should be placed between the VISOx and VEx as well as the VEx and COMx terminals. Refer to "2SC0635T Description & Application Manual" (paragraph "DC/DC output (VISOx), emitter (VEx) and COMx terminals)" for recommendations. Ceramic capacitors are recommended.
9) The minimum response time is valid for the circuit given in the description and application manual (Fig. 7) with the values of table 1.
10) The blocking time sets a minimum time span between the end of any secondary-side 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.
11) 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.
12) Undervoltage monitoring of the secondary-side supply voltage (VISOx to VEx and VEx to COMx, which correspond to the approximate turn-on and turn-off gate-emitter voltages). If the corresponding voltage drops below this limit, a fault is transmitted to the corresponding SOx output and the IGBT is switched off after the corresponding delays. Refer to "2SC0635T Description & Application Manual" for more details.
13) Transmission delay of fault state from the secondary side to the corresponding primary-side status output.
14) 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. Excessive HiPot testing at voltages much higher than $3182V_{AC(eff)}$ may lead to insulation degradation. No degradation has been observed over 1min. testing at $10.2kV_{AC(eff)}$. Every production sample shipped to customers has undergone 100% testing at the given value for 1s.

15) Partial discharge measurement is performed in accordance with IEC 60270 and isolation coordination specified in IEC 60664-1. The partial discharge extinction voltage between primary and either secondary side is coordinated for basic isolation to IEC 60664-1.
16) Jitter measurements are performed with input signals INx switching between 0V and 15V referred to GND, with a corresponding rise time and fall time of 6ns.
17) The minimum operating temperature is limited to -40°C for the first series. This will be extended to -55°C upon completion of the ongoing qualification program.
18) The V_{CE}–monitoring threshold value can be reduced with an external resistor. Refer to "2SC0635T Description & Application Manual".
19) The turn-off event of the IGBT after a secondary-side fault (IGBT short circuit or undervoltage monitoring) can be additionally delayed with an external capacitor. Refer to "2SC0635T Description & Application Manual".

RoHS Statement

On the basis of Annexes II and III of European Directive 2011/65/EC of 08 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS), we hereby state that the products described in this datasheet do not contain lead (Pb), mercury (Hg), hexavalent chromium (Cr VI), cadmium (Cd), polibrometo of biphenyl (PBB) or polibrometo diphenyl ether (PBDE) in concentrations exceeding the restrictions set forth in Annex II of 2011/65/EC with due consideration of the applicable exemptions as listed in Annex III of 2011/65/EC.

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
2SC0635T2A1-45	Dual-channel 4.5kV SCALE-2 driver core (Increased EMI capability)

Product home page: www.power.com/igbt-driver/go/2SC0635T

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

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