2SC0535T2A1-33 and 2SC0535T2A1C-33 Datasheet

Dual-Channel SCALE™-2 IGBT Driver Core for 3300V IGBTs

Abstract

The SCALE™-2 dual-driver core 2SC0535T2A1-33 (Connector pin length of 5.84mm; lead free) / 2SC0535T2A1C-33 (Coated version using ELPEGUARD SL 1307 FLZ/2 from Lackwerke Peters) combines unrivalled compactness with broad applicability. The driver is designed for universal applications requiring high reliability. The 2SC0535T2A1(C)-33 drives all usual high-power IGBT modules up to 3300V. Its embedded paralleling capability allows easy inverter design covering higher power ratings. Multi-level topologies involving 1700V IGBTs with higher isolation requirements can also be easily supported by 2SC0535T2A1(C)-33.

The 2SC0535T2A1(C)-33 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 5W drive power is available per channel, making the 2SC0535T2A1(C)-33 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, 5W output power per channel
- ✓ 15V/-10V gate driving
- ✓ Blocking voltages up to 3300V
- ✓ Safe isolation to EN 50178 and EN 50124
- ✓ Short delay and low jitter
- ✓ Interface for 3.3V...15V logic level
- ✓ 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

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 "2SC0535T Description & Application Manual" on www.power.com/products/scale-2-driver-cores/2sc0535t.

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		1250	mA
Output power	Ambient temperature <70°C (Notes 4, 5)		7.5	W
	Ambient temperature <85°C (Note 4)		5	W
Switching frequency f			100	kHz
Test voltage (50Hz/1min.)	Primary to secondary (Note 14)		9100	$V_{AC(eff)}$
	Secondary to secondary (Note 14)		6000	$V_{AC(eff)}$
|dV/dt|	Rate of change of input to output voltage		50	kV/µs
Operating voltage	Primary/secondary, secondary/secondary		3300	V_{peak}
Operating temperature	Note 5	-55	85	°C
Storage temperature	Note 17	-55	50	°C
Surface temperature	Only for 2SC0535T2A1C-33 (Note 18)		125	°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 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		1.5		µs
Minimum blocking time	Note 10		9		µs

Timing Characteristics	Remarks	Min	Typ	Max	Unit
Turn-on delay $t_{d(on)}$	Note 6		75		ns
Turn-off delay $t_{d(off)}$	Note 6		75		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		400		ns

Electrical Isolation	Remarks	Min	Typ	Max	Unit
Test voltage (50Hz/1s)	Primary to secondary side (Note 14)	9100	9150	9200	V_{eff}
	Secondary to secondary side (Note 14)	6000	6050	6100	V_{eff}
Partial discharge extinction volt.	Primary to secondary side (Note 15)	4125			V_{peak}
	Secondary to secondary side (Note 15)	3300			V_{peak}
Creepage distance					
On the PCB	Primary to secondary side	44			mm
(Material group IIIa)	Secondary to secondary side	22			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	14			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}	5W output power		-9		V
Turn-off voltage, V_{GLx}	7.5W output power		-8.5		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 (-55°C - 70°C) and the absolute maximum output power rating changes to 7.5W.
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 "2SC0535T 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 with the values of the corresponding tables.
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. The specified blocking time is valid if TB is connected to GND.
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 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.
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 as stipulated by EN 50178. Excessive HiPot testing at voltages much higher than $2330V_{AC(eff)}$ may lead to insulation degradation. No degradation has been observed over 1min. testing at $9100V_{AC(eff)}$. The transformer of 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 EN 50178. The partial discharge extinction voltage between primary and either secondary side is coordinated for safe isolation to EN 50178.
16) 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.
17) The storage temperature inside the original package (1) or in case the coating material of coated products may touch external parts (2) must be limited to the given value. Otherwise, it is limited to 90°C.
18) The component surface temperature, which may strongly vary depending on the operating condition, must be limited to the given value for coated driver versions to ensure long-term reliability of the coating material.

RoHS Statement

We hereby confirm that the product supplied does not contain any of the restricted substances according Article 4 of the RoHS Directive 2011/65/EU in excess of the maximum concentration values tolerated by weight in any of their homogeneous materials.

Additionally, the product complies with RoHS Directive 2015/863/EU (known as RoHS 3) from 31 March 2015, which amends Annex II of Directive 2011/65/EU.

Legal Disclaimer

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Ordering Information

Our international terms and conditions of sale apply.

Type Designation	Description
2SC0535T2A1-33	Dual-channel 3.3kV SCALE-2 driver core (Connector pin length of 5.84mm, lead free)
2SC0535T2A1C-33	Dual-channel 3.3kV SCALE-2 driver core (Connector pin length of 5.84mm, lead free, conformal coating)

Product home page: www.power.com/products/scale-2-driver-cores/2sc0535t

Information about Other Products

For other drivers, product documentation, and application support

Please click: www.power.com/products/gate-drivers

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