

# 2SP0320T2Cx-17

## Preliminary Data Sheet

Compact, high-performance, plug-and-play dual-channel IGBT driver based on SCALE™-2 technology for individual and parallel-connected modules in 2-level, 3-level and multilevel converter topologies

### Abstract

The SCALE™-2 plug-and-play driver 2SP0320T2Cx-17 is a compact dual-channel intelligent gate driver designed for 1700V IGBT modules from Danfoss, Fuji or Infineon. The driver features an electrical interface with a built-in DC/DC power supply.

**The turn-on and turn-off gate resistors of both channels are not assembled in order to provide maximum flexibility. They must be assembled by the user before start of operation.** Please refer to the paragraph on "Gate Resistor Assembly" for the recommended gate resistors.

For drivers adapted to other types of high-power and high-voltage IGBT modules, refer to

[www.IGBT-Driver.com/go/plug-and-play](http://www.IGBT-Driver.com/go/plug-and-play)

### Features

- ✓ Plug-and-play solution
- ✓ Allows parallel connection of IGBT modules
- ✓ For 2-level, 3-level and multilevel topologies
- ✓ Shortens application development time
- ✓ Extremely reliable; long service life
- ✓ Built-in DC/DC power supply
- ✓ 20-pin flat cable interface
- ✓ Duty cycle 0... 100%
- ✓ Active clamping of  $V_{ce}$  at turn-off
- ✓ IGBT short-circuit protection
- ✓ Monitoring of supply voltage
- ✓ Safe isolation to EN 50178
- ✓ UL compliant
- ✓ Suitable for 1700V IGBT modules
- ✓ Gate resistors not assembled

### Applications

- ✓ Wind-power converters
- ✓ Industrial drives
- ✓ UPS
- ✓ Power-factor correctors
- ✓ Traction
- ✓ Railroad power supplies
- ✓ Welding
- ✓ SMPS
- ✓ Radiology and laser technology
- ✓ Research
- ✓ and many others

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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 common data that apply to the whole series, please refer to "Description & Application Manual for 2SP0320T SCALE-2 IGBT Drivers" on [www.IGBT-Driver.com/go/2SP0320](http://www.IGBT-Driver.com/go/2SP0320).

The gate resistors on this gate driver are not assembled in order to provide maximum flexibility. For the gate resistors required for specific IGBT modules, refer to the paragraph on "Gate Resistor Assembly". Use of gate resistors other than those specified may result in failure.

### Mechanical Dimensions

Dimensions: See the relevant "Description and Application Manual"

Mounting principle: Connected to IGBT module with screws

### 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 (Note 1)	0	16	V
Logic input and output voltages	To GND	-0.5	VCC+0.5	V
SO <sub>x</sub> current	Fault condition, total current		20	mA
Gate peak current $I_{out}$	Note 2	-20	+20	A
Average supply current $I_{DC}$	Note 16		600	mA
Output power per gate	Ambient temperature <70°C (Note 3)		3	W
	Ambient temperature 85°C (Note 3)		2	W
Turn-on gate resistance	Note 17	0.3		Ω
Turn-off gate resistance	Note 17	1		Ω
Switching frequency F	Note 23		n.d.	kHz
Test voltage (50Hz/1min.)	Primary to secondary (Note 19)		5000	$V_{AC(eff)}$
	Secondary to secondary (Note 19)		4000	$V_{AC(eff)}$
DC-link voltage	Note 4		1200	V
dV/dt	Rate of change of input to output voltage (Note 20)		50	kV/μs
Operating voltage	Primary/secondary, secondary/secondary		1700	$V_{peak}$

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Parameter	Remarks	Min	Max	Unit
Operating temperature		-40	+85	°C
Storage temperature		-40	+90	°C

### Recommended Operating Conditions

Power Supply	Remarks	Min	Typ	Max	Unit
Supply voltage $V_{DC}$	To GND (Note 1)	14.5	15	15.5	V
Supply voltage $V_{CC}$	To GND (Note 1)	14.5	15	15.5	V
Resistance from TB to GND	Blocking time $\neq$ 0, ext. value	128		$\infty$	k $\Omega$

### Electrical Characteristics

Power Supply	Remarks	Min	Typ	Max	Unit
Supply current $I_{DC}$	Without load		37		mA
Efficiency $\eta$	Internal DC/DC converter		85		%
Supply current $I_{CC}$	Without load		19		mA
Coupling capacitance $C_{io}$	Primary side to secondary side, total, per channel		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 5)	11.3	12.0	12.7	V
Monitoring hysteresis	Primary side, set/clear fault	0.35			V
Supply threshold $V_{isox}-V_{eex}$	Secondary side, clear fault	12.1	12.6	13.1	V
	Secondary side, set fault (Note 21)	11.5	12.0	12.5	V
Monitoring hysteresis	Secondary side, set/clear fault	0.35			V
Supply threshold $V_{eex}-V_{COMx}$	Secondary side, clear fault	5	5.15	5.3	V
	Secondary side, set fault (Note 21)	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	$V(INx) = 15V$ (Note 6)	4.3	4.5	4.6	k $\Omega$
Turn-on threshold	$V(INx)$ (Note 7)		10.5		V
Turn-off threshold	$V(INx)$ (Note 7)		5		V
SOx pull-up resistor to VCC	On board		10		k $\Omega$
SOx output voltage	Fault condition, $I(SOx) < 6.5mA$			0.7	V

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Short-circuit Protection	Remarks	Min	Typ	Max	Unit
Vce-monitoring threshold	Between auxiliary terminals		10.2		V
Response time	DC-link voltage > 550V (Note 8)		6.9		µs
Delay to IGBT turn-off	After the response time (Note 9)		1.4		µs
Blocking time	After fault (Note 10)		90		ms
Timing Characteristics	Remarks	Min	Typ	Max	Unit
Turn-on delay $t_{d(on)}$	Note 11		95		ns
Turn-off delay $t_{d(off)}$	Note 11		75		ns
Jitter of turn-on delay	Note 12		±2		ns
Jitter of turn-off delay	Note 12		±2		ns
Output rise time $t_{r(out)}$	$G_x$ to $E_x$ (Note 13)		7		ns
Output fall time $t_{f(out)}$	$G_x$ to $E_x$ (Note 13)		25		ns
Dead time between outputs	Half-bridge mode (Note 14)		3		µs
Jitter of dead time	Half-bridge mode		±100		ns
Transmission delay of fault state	Note 15		450		ns
Outputs	Remarks	Min	Typ	Max	Unit
Turn-on gate resistor $R_{g(on)}$	Note 17		not assembled		Ω
Turn-off gate resistor $R_{g(off)}$	Note 17		not assembled		Ω
Gate voltage at turn-on			15		V
Gate-voltage at turn-off	P = 0W		-10.4		V
	P = 0.3W		-10.2		V
	P = 2.1W		-9.7		V
	P = 3W		-9.6		V
Gate resistance to COMx			4.7		kΩ
dV/dt Feedback	Remarks	Implementation			
dV/dt feedback	Note 18		No		
Electrical Isolation	Remarks	Min	Typ	Max	Unit
Test voltage (50Hz/1s)	Primary to secondary side (Note 19)	5000	5050	5100	$V_{eff}$
	Secondary to secondary side (Note 19)	4000	4050	4100	$V_{eff}$
Partial discharge extinction volt.	Primary to secondary side (Note 22)	1768			$V_{peak}$
	Secondary to secondary side (Note 22)	1700			$V_{peak}$
Creepage distance	Primary to secondary side	20			mm
	Secondary to secondary side	17			mm

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

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### Footnotes to the Key Data

- 1) Both supply voltages  $V_{DC}$  and  $V_{CC}$  should be applied in parallel.
- 2) The gate current is limited by the gate resistors located on the driver.
- 3) If the specified value is exceeded, this indicates a driver overload. It should be noted that the driver is not protected against overload. From 70°C to 85°C, the maximum permissible output power can be linearly interpolated from the given data.
- 4) This limit is due to active clamping. Refer to "Description & Application Manual for 2SP0320T SCALE-2 IGBT Drivers".
- 5) Undervoltage monitoring of the primary-side supply voltage (VCC to GND). If the voltage drops below this limit, a fault is transmitted to the corresponding output(s) and the IGBTs are switched off.
- 6) The input impedance can be modified (customer-specific solution).
- 7) Turn-on and turn-off threshold values can be modified (customer-specific solution).
- 8) The resulting pulse width of the direct output of the gate drive unit for short-circuit type I (excluding the delay of the gate resistors) is the sum of response time plus delay to IGBT turn-off.
- 9) The turn-off event of the IGBT is delayed by the specified time after the response time.
- 10) Factory set value. The blocking time can be reduced with an external resistor. Refer to "Description & Application Manual for 2SP0320T SCALE-2 IGBT Drivers".
- 11) Measured from the transition of the turn-on or turn-off command at the driver input to direct output of the gate drive unit (excluding the delay of the gate resistors).
- 12) 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 8ns.
- 13) Refers to the direct output of the gate drive unit (excluding the delay of the gate resistors).
- 14) Note that the dead time may vary from sample to sample. A tolerance of approximately  $\pm 20\%$  may be expected. If higher timing precisions are required, CONCEPT recommends using direct mode and generating the dead time externally.
- 15) Transmission delay of the fault state from the secondary side to the primary status outputs.
- 16) If the specified value is exceeded, this indicates a driver overload. It should be noted that the driver is not protected against overload.
- 17) The gate resistors are not assembled on this IGBT gate driver. They must be assembled by the user according to the paragraph on "Gate Resistor Assembly".
- 18) A  $dV/dt$  feedback can optionally be implemented in order to reduce the rate of rise of the collector emitter voltage of the IGBTs at turn-off (customer-specific solution).
- 19) 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.
- 20) This specification guarantees that the drive information will be transferred reliably even at a high DC-link voltage and with ultra-fast switching operations.
- 21) Undervoltage monitoring of the secondary-side supply voltage (Visox to Veex and Veex 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 output.
- 22) 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.
- 23) The maximum switching frequency is not defined, as it depends on the IGBT module used. Please consult the corresponding driver data sheet for more information.

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### Gate Resistor Assembly

The turn-on and turn-off gate resistors of 2SP0320T2Cx drivers are adapted to their respective IGBT modules. Recommended gate resistors are: PR02 / 2W / 5% from Vishay.

The following versions exist:

1700V IGBT Type	R120/R121/ R220/R221	R122/R123 / R222/R223	Resulting R <sub>g,on</sub>	Resulting R <sub>g,off</sub>
FF450R17IE4	5.6Ω	10Ω	2.8Ω	5Ω
2MBI650VXA-170E-50	3.6Ω	6.8Ω	1.8Ω	3.4Ω
FF650R17IE4	3.6Ω	6.8Ω	1.8Ω	3.4Ω
FF650R17IE4D_B2	2Ω	6.8Ω	1Ω	3.4Ω
2MBI1000VXB-170E-50	3.6Ω	5.1Ω	1.8Ω	2.55Ω
DP1000B1700T103715	2.2Ω	5.6Ω	1.1Ω	2.8Ω
FF1000R17IE4	2.4Ω	6.8Ω	1.2Ω	3.4Ω
FF1000R17IE4D_B2	0.68Ω	4.7Ω	0.34Ω	2.35Ω
2MBI1400VXB-170E-50	1Ω	1.8Ω	0.5Ω	0.9Ω
2MBI1400VXB-170P-50	1Ω	2Ω	0.5Ω	1.0Ω
FF1400R17IP4	1Ω	3.3Ω	0.5Ω	1.65Ω

For the component position, refer to Fig. 1.

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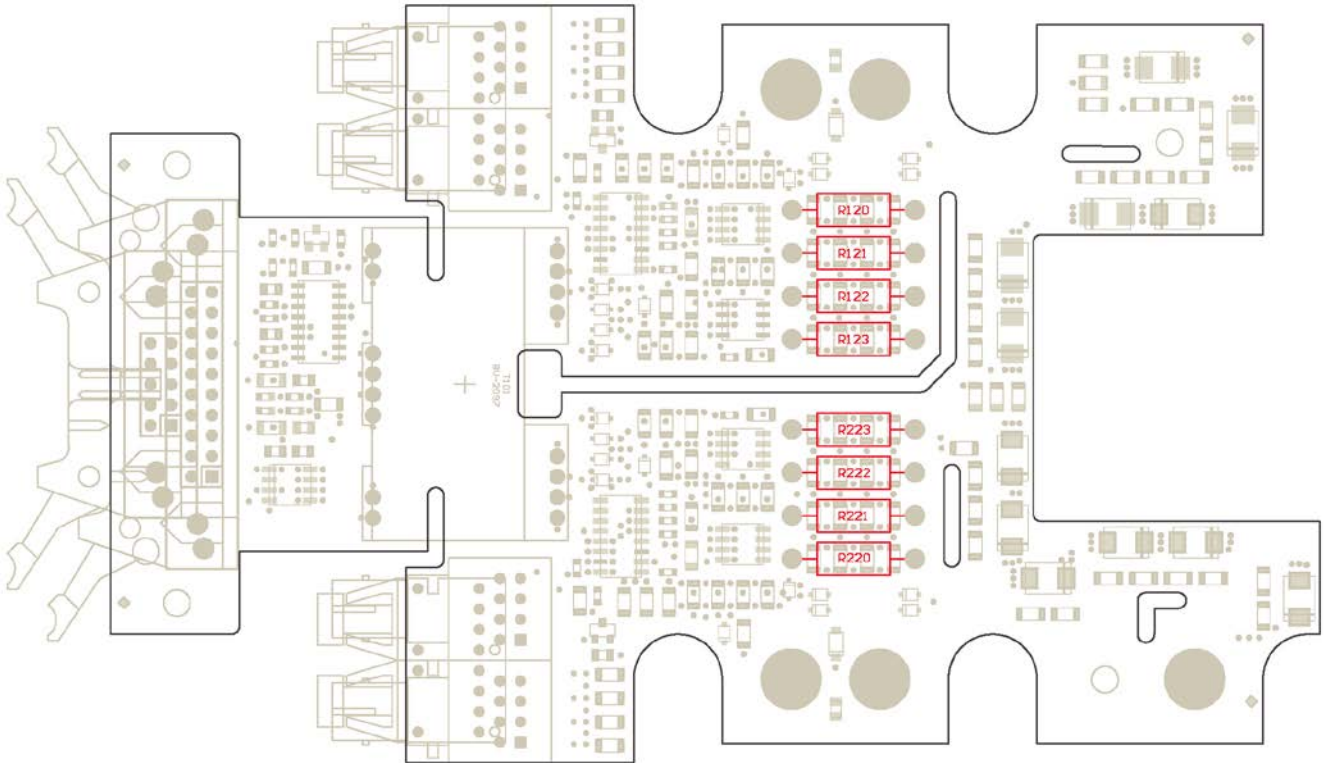
**Assembly Drawing**

Fig. 1: Assembly drawing of 2SP0320 with highlighted gate resistors

Note that the wires of the gate resistors should not project more than 1.6mm after soldering (excess length at bottom side). Furthermore, a minimum distance of 1mm must be maintained between the gate resistor body and the PCB.

**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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