1SP0340x2x0-45
Preliminary Data Sheet

Compact, high-performance, plug-and-play single-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 1SP0340x2x0-45 is a compact single-channel intelligent gate driver designed for 4500V 130x140mm and 190x140mm IGBT modules. The master driver 1SP0340V2M0-45 features a fiber-optic interface. It can be used as stand-alone driver or in conjunction with up to three 1SP0340D2S0-45 slaves to drive up to four parallel-connected IGBT modules.

The DC/DC power supply must be purchased as a separate unit (one per master driver).

The turn-on and turn-off gate resistors as well as the auxiliary gate capacitor 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 values.

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

www.power.com/igbt-driver/go/Plug-and-Play

Features

- ✓ Plug-and-play solution
- ✓ Allows parallel connection of IGBT modules
- ✓ For 2-level, 3-level and multilevel topologies
- ✓ Fiber-optic links (master)
- ✓ Built-in interface to 1SP0340D2S0 (slave)
- ✓ Duty cycle 0...100%
- ✓ Dynamic Advanced Active Clamping DA^{2}C
- ✓ Dynamic IGBT short-circuit protection
- ✓ Monitoring of supply voltage
- ✓ Monitoring of gate voltage
- ✓ Extremely reliable; long service life
- ✓ Shortens application development time
- ✓ Suitable for 4500V 130x140mm and 190x140mm IGBT modules
- ✓ Lead-free

Applications

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

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 the "Description & Application Manual for 1SP0340 SCALE-2 IGBT Drivers" on www.power.com/igbt-driver/go/1SP0340.

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

Mechanical Dimensions

Dimensions: Refer to the relevant "Description and Application Manual"

Mounting principle: Connected to IGBT module with screws

Fiber-Optic Interfaces (1SP0340V2M0)

Interface	Remarks	Part type #
Drive signal input	Fiber-optic receiver (Notes 1, 2)	HFBR-2522ETZ
Status output	Fiber-optic transmitter (Notes 1, 3)	HFBR-1522ETZ

Electrical Connectors

Interface	Remarks	Part type #
Power supply connector X1	On-board connector (Note 4)	214012
Bus connectors X2 and X3	On-board connectors (Note 5)	214013

Absolute Maximum Ratings

Parameter	Remarks	Min	Max	Unit
Supply voltage V_{DC}	VDC to COM	0	30	V
Average supply current I_{DC}	1SP0340V2M0 only (Note 6)		180	mA
Average supply current I_{DC}	1SP0340V2M0 with three 1SP0340D2S0 (Note 6)		620	mA
Gate output power	Ta ≤ 70°C		2.8	W
	Ta ≤ 85°C		2.1	W
Switching frequency f	Ta ≤ 70°C (Note 26)		n.d.	kHz
	Ta ≤ 85°C (Note 26)		n.d.	kHz
Gate peak current I_{out}	Note 7	-35	+35	A
DC-link voltage	Switching operation (Note 8)		3000	V
	Off state (Note 9)		3550	V
Operating voltage	Collector-emitter voltage		4500	V_{peak}
Emitter-emitter voltage	Between parallel connected drivers (Note 10)		200	V_{peak}
|dV/dt|	Between parallel connected drivers (Note 11)		50	kV/µs
Interface current	X2 and X3, total RMS value (Note 12)		4	A_{rms}
	X2 and X3, total peak value (Note 12)		20	A_{peak}
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 COM	23.5	25	26.5	V

Electrical Characteristics

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

Power Supply	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Supply current I_{DC}	Without load, only 1SP0340V2M0		47		mA
	Without load, per additional 1SP0340D2S0		20		mA
Power Supply Monitoring	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Supply threshold V_{iso}-V_{ee}	Clear fault	11.6	12.6	13.6	V
	Set fault (Note 13)	11.0	12.0	13.0	V
Monitoring hysteresis	Set/clear fault	0.35			V
Supply threshold V_{ee}-V_{COM}	Clear fault		5.15		V
	Set fault (Note 13)		4.85		V
Monitoring hysteresis	Set/clear fault		0.3		V
Bus to 1SP0340D2S0	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Supply voltage			VDC		
Turn-off command	To COM		0		V
Turn-on command	To COM		15		V
Gate Monitoring	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Turn-on threshold $V_{GE,on,min}$	G_{mean} to E, set fault (Note 14)		12.9		V
Turn-off threshold $V_{GE,off,max}$	G_{mean} to E, set fault (Note 14)		-7.6		V
Filter delay	Turn-on (Note 14)		32		µs
	Turn-off (Note 14)		47		µs
Short-circuit Protection	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Static V_{CE}-monitoring threshold	Between auxiliary terminals (Note 15)		170		V
Response time	DC-link voltage = 3000V (Note 16)		6.5		µs
	DC-link voltage = 2000V (Note 16)		6.5		µs
	DC-link voltage = 1500V (Note 16)		6.5		µs
	DC-link voltage = 1000V (Note 16)		9.7		µs
Delay to IGBT turn-off t_{CSHD}	After the response time (Note 17)		0.3		µs
Timing Characteristics	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Turn-on delay $t_{d(on)}$	Note 18		170		ns
Turn-off delay $t_{d(off)}$	Note 18		160		ns
Output rise time $t_{r(out)}$	G to E (Note 19)		10		ns
Output fall time $t_{f(out)}$	G to E (Note 19)		25		ns

Timing Characteristics	Remarks	Min	Typ	Max	Unit
Transmission delay of fault state	Note 20		90		ns
Delay to clear fault state $t_{(block)}$	After IGBT short circuit (Note 21)		9		µs
	After gate-monitoring fault (Notes 21, 25)		1		µs
Acknowledge delay time $t_{d(ack)}$	Note 22		230		ns
Acknowledge pulse width $t_{(ack)}$	On host side	400	700	1050	ns

Gate Output	Remarks	Min	Typ	Max	Unit
Turn-on gate resistor $R_{g(on)}$	Note 23		not assembled		Ω
Turn-off gate resistor $R_{g(off)}$	Note 23		not assembled		Ω
Auxiliary gate capacitor C_{ge}	Note 23		not assembled		nF
Gate voltage at turn-on	Note 24		15		V
Gate-voltage at turn-off	Note 24		-10		V

Footnotes to the Key Data

1) The transceivers required on the host controller side are not supplied with the gate driver. It is recommended to use the same types as used in the gate driver. For product information refer to www.power.com/igbt-driver/go/fiberoptics.
2) The recommended transmitter current at the host controller is 20mA. A higher current may increase jitter or delay at turn-off.
3) The typical transmitter current at the gate driver is 20mA. In case of supply undervoltage, the minimum transmitter current at the gate driver is 14mA: this is suitable for adequate plastic optical fibers with a length up to 10 meters.
4) This refers to the manufacturer ordering number, see www.power.com/igbt-driver/go/ext_erni. The customer-side connector as well as cables with different lengths can be supplied by Power Integrations. Refer to the "Description & Application Manual for 1SP0340 SCALE-2 IGBT Drivers" for more information.
5) This refers to the manufacturer ordering number, see www.power.com/igbt-driver/go/ext_erni. These connectors are to be used to connect 1SP0340V2M0 (master) or 1SP0340D2S0 (slave) to 1SP0340D2S0 (slave) if parallel connection of IGBT modules is required. Cables with different lengths can be supplied by Power Integrations. Refer to the "Description & Application Manual for 1SP0340 SCALE-2 IGBT Drivers" for more information.
6) If the specified value is exceeded, this indicates a driver overload. It should be noted that the driver is not protected against overload.
7) The gate current is limited by the gate resistors located on the driver and the load.
8) This limit is due to active clamping under switching conditions. Refer to the "Description & Application Manual for 1SP0340 SCALE-2 IGBT Drivers".
9) Due to the Dynamic Active Advanced Clamping Function (DA^2C) implemented on the driver, the DC-link voltage can be increased in the off-state condition (e.g. after emergency shut-down). This value is only valid when the IGBTs are in the off state (not switching). The time during which the voltage can be applied should be limited to short periods (< 60 seconds). Refer to the "Description & Application Manual for 1SP0340 SCALE-2 IGBT Drivers".
10) The maximum dynamic voltage between auxiliary emitters of parallel-connected drivers due to asymmetrical operation at turn-on and turn-off must be limited to the given value.
11) Maximum allowed rate of change between auxiliary emitter voltages of parallel connected drivers.
12) Dynamic voltages between auxiliary emitters of parallel connected drivers at turn-on and turn-off lead to equalizing currents over the X2 or X3 bus. The peak and RMS values of the resulting current must be limited to the given value.
13) Undervoltage monitoring of the secondary-side supply voltage (Viso to Vee and Vee to COM which correspond with the approximate turn-on and turn-off gate-emitter voltages). If the corresponding

voltage drops below this limit on 1SP0340V2M0 (masters), all paralleled IGBTs (master and slaves) are switched off and a fault is transmitted to the status output. If the corresponding voltage drops below this limit on 1SP0340D2S0 (slaves), the corresponding IGBT is switched off. If the IGBT was turned on, a fault will be generated by the gate-monitoring function on the master which will turn off all paralleled IGBT after the corresponding delay.

14) The average value $V_{GE,mean}$ of all gate voltages (master and all slaves) is filtered and compared to the given values at turn-on and turn-off. If the specified values are exceeded ($V_{GE,mean}<V_{GE,on,min}$ at turn-on resp. $V_{GE,mean}>V_{GE,off,max}$ at turn-off) after the given filter delay, the driver turns off all parallel-connected IGBTs and a fault is transmitted to the status output.
15) A dynamic V_{CE} protection is implemented on the driver. The maximum allowed V_{CE} voltage at turn-on is dynamically adjusted in order to better fit to the IGBT characteristics at turn-on. At the end of the turn-on process the given static value applies.
16) 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 the response time plus the delay to IGBT turn-off.
17) The turn-off event of the IGBT is delayed by the specified time after the response time.
18) Including the delay of the external fiber-optic links (cable length: 1m). Measured from the transition of the turn-on or turn-off command at the optical transmitter on the host controller side to the direct output of the gate drive unit (excluding the delay of the gate resistors).
19) Output rise and fall times are measured between 10% and 90% of the nominal output swing. The values are given for the driver side of the gate resistors with 2Ω/1uF load. The time constant of the output load in conjunction with the present gate resistors leads to an additional delay at their load side.
20) Delay of external fiber-optic links. Measured from the driver secondary side (ASIC output) to the optical receiver on the host controller with a 1m cable.
21) Measured on the host side. The fault status on the secondary side is automatically reset after the specified time.
22) Including the delay of the external fiber-optic links (cable length: 1m). Measured from the transition of the turn-on or turn-off command at the optical transmitter on the host controller side to the transition of the acknowledge signal at the optical receiver on the host controller side.
23) The gate resistors and the auxiliary gate capacitor are not assembled on this IGBT gate driver. They must be assembled by the user according to the paragraph on "Gate Resistor Assembly".
24) The driver supply voltage VDC is split into two distinct voltages on the driver. The first one is the turn-on voltage which is regulated at about 15V. The difference between VDC and the turn-on voltage is the turn-off voltage which is not regulated and mainly dependent on the driver input voltage VDC.
25) The given value applies if the driver goes from the "off state" to the "on state" and the gate-emitter voltage of one or more parallel connected drivers does not turn on. If the driver goes from the "on state" to the "off state" and the gate-emitter voltage of one or more parallel connected drivers does not turn off, the fault status is applied as long as the gate monitoring fault is present.
26) 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.

Gate Resistor and Auxiliary Gate Capacitor Assembly

The turn-on and turn-off gate resistors as well as the auxiliary gate capacitor of 1SP0340x2x0 drivers are adapted to their respective IGBT modules.

Recommended gate resistors (R168, R169, R178 and R179): PR02 / 2W / 5% from Vishay
Recommended auxiliary gate capacitor (C105): 1206 / X7R / 25V / 5%

The following versions exist:

4500V IGBT Type	R178/ R179	R168/ R169	Resulting Rg,on	Resulting Rg,off	C105
CM1200HC-90RA	5.6Ω	68Ω	2.8Ω	34Ω	not assembled
FZ1200R45HL3	2.7Ω	12Ω	1.35Ω	6Ω	not assembled
MBN900D45A	4.7Ω	5.6Ω	2.35Ω	2.8Ω	not assembled
MG900GXH1US53	8.2Ω	11Ω	4.1Ω	5.5Ω	not assembled

For the component position, refer to Figs. 1 and 2.

Assembly Drawing

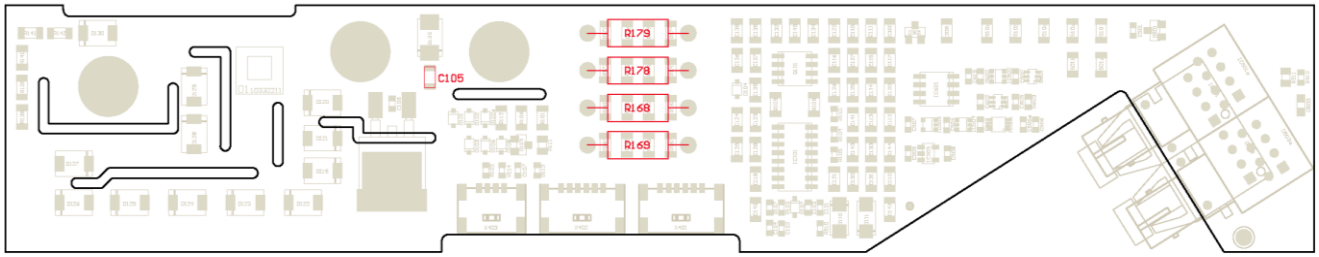


Fig. 1: Assembly drawing of 1SP0340V2M0 with highlighted gate resistors and gate capacitor

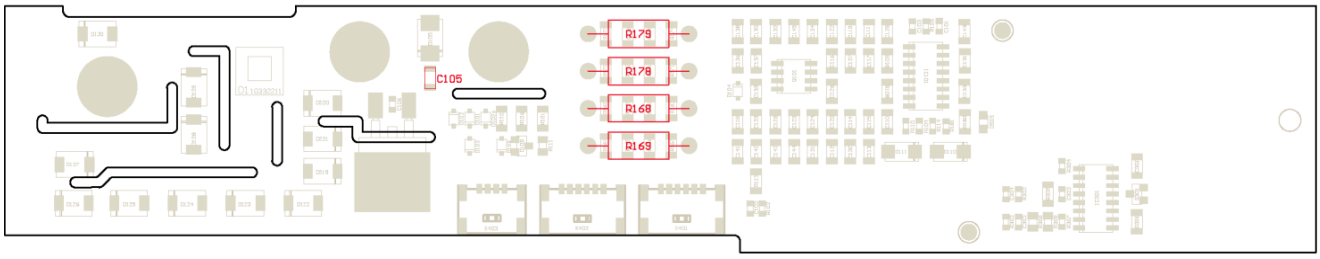


Fig. 2: Assembly drawing of 1SP0340D2S0 with highlighted gate resistors and gate capacitor

Note that the wires of the gate resistors should not project more than 1mm 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

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Ordering Information

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

Interface	Power Integrations Driver Type #	Related IGBT
Master, Fiber-Optic Interface	1SP0340V2M0-45	4500V IGBT modules
Slave, Electrical Interface	1SP0340D2S0-45	4500V IGBT modules

Product home page: www.power.com/igbt-driver/go/1SP0340

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 onto: www.power.com/igbt-driver

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