2SP0325x2Ax-CM2500DY-24S
Preliminary Data Sheet

Compact, high-performance, plug-and-play dual-channel IGBT driver based on SCALE™-2 technology for Mitsubishi's New Mega Power Dual IGBT modules.

Abstract

The SCALE™-2 plug-and-play driver 2SP0325x2Ax-CM2500DY-24S is a compact dual-channel intelligent gate driver designed for Mitsubishi's New Mega Power Dual (New MPD) IGBT modules CM2500DY-24S 300G and CM2500DY-24S 302G. The driver features an electrical interface (2SP0325T) or a fiber-optic interface (2SP0325V) with a built-in DC/DC power supply.

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

www.IGBT-Driver.com/go/plug-and-play

Features

- ✓ Plug-and-play solution
- ✓ For 2-level, 3-level and multilevel topologies
- ✓ Built-in DC/DC power supply
- ✓ 20-pin flat cable interface (2SP0325T)
- ✓ Fiber-optic links (2SP0325V)
- ✓ Duty cycle 0... 100%
- ✓ Dynamic Advanced Active Clamping DA^{2}C
- ✓ IGBT short-circuit protection
- ✓ Monitoring of supply voltage
- ✓ Safe isolation to EN 50178
- ✓ UL compliant
- ✓ Lead free
- ✓ Extremely reliable; long service life
- ✓ Shortens application development time
- ✓ Suitable for CM2500DY-24S 300G and CM2500DY-24S 302G

Applications

- ✓ Wind power converters
- ✓ AC motor control
- ✓ Power supply
- ✓ Medium voltage drives
- ✓ 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 2SP0325T SCALE-2 IGBT Drivers” (electrical interface) or “Description & Application Manual for 2SP0325V SCALE-2 IGBT Drivers” (fiber-optic interface) on www.IGBT-Driver.com/go/2SP0325.

When applying SCALE-2 plug-and-play drivers, please note that these drivers are specifically adapted to a particular type of IGBT module. Therefore, the type designation of SCALE-2 plug-and-play drivers also includes the type designation of the corresponding IGBT module. These drivers are not valid for IGBT modules other than those specified. Incorrect use may result in failure.

Mechanical Dimensions

Dimensions: See the relevant “Description and Application Manual”

Mounting principle: Connected to IGBT module with screws

Fiber-Optic Interfaces

Interface	Remarks	Part type #
Drive signal input	2SP0325V, fiber-optic receiver (Notes 21, 22)	HFBR-2522ETZ
Status output	2SP0325V, fiber-optic transmitter (Notes 21, 23)	HFBR-1522ETZ

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Absolute Maximum Ratings

Parameter	Remarks	Min	Max	Unit
Supply voltage V_{DC}	VDC to GND (Note 1)	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_x current	Fault condition, total current		20	mA
Gate peak current I_{out}	Note 2	-25	+25	A
Average supply current I_{DC}	2SP0325T (Note 24)		430	mA
Average supply current I_{DC}	2SP0325V (Note 24)		550	mA
Output power per gate	Note 3		2	W
Switching frequency F			5	kHz
Test voltage (50Hz/1min.)	Primary to secondary (Note 19)		3800	$V_{AC(eff)}$
	Secondary to secondary (Note 19)		3800	$V_{AC(eff)}$
DC-link voltage	Switching operation (Note 4)		800	V
	Off state (Note 29)		990	V
|dv/dt|	Rate of change of input to output voltage (Note 20)		50	kV/µs
Operating voltage	Primary/secondary, secondary/secondary		1200	V_{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 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	2SP0325T, blocking time≠0, ext. value	128		∞	kΩ

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Electrical Characteristics

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}	2SP0325T, without load		32		mA
	2SP0325V, without load		145		mA
Efficiency η	Internal DC/DC converter		85		%
Supply current I_{CC}	Without load		23		mA
Coupling capacitance C_{io}	Primary side to secondary side, total, per channel				
	2SP0325T		22		pF
	2SP0325V		12		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 26)	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 26)	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	2SP0325T, V(INx) = 15V (Note 6)	4.7	4.8	4.9	kΩ
Turn-on threshold	2SP0325T, V(INx) (Note 7)		8.8		V
Turn-off threshold	2SP0325T, V(INx) (Note 7)		4.5		V
SOx output voltage	Fault condition, I(SOx)<8mA			0.7	V
Short-circuit Protection	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
V_{CE}-monitoring threshold	Between auxiliary terminals		10.2		V
Response time	Half-bridge short circuit,				
	DC-link voltage > 600V (Note 8)		7.2		µs
Delay in IGBT turn-off T_{cshd}	After the response time (Note 9)		0.1		µs
Blocking time	2SP0325T, after fault (Note 10)		90		ms

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Timing Characteristics	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Turn-on delay $T_{d(on)}$	2SP0325T (Note 11)		80		ns
Turn-off delay $T_{d(off)}$	2SP0325T (Note 11)		65		ns
Jitter of turn-on delay	2SP0325T (Note 28)		±2		ns
Jitter of turn-off delay	2SP0325T (Note 28)		±2		ns
Turn-on delay $T_{d(on)}$	2SP0325V (Note 12)		120		ns
Turn-off delay $T_{d(off)}$	2SP0325V (Note 12)		100		ns
Output rise time $T_{r(out)}$	G_x to E_x (Note 13)		25		ns
Output fall time $T_{f(out)}$	G_x to E_x (Note 13)		17		ns
Dead time between outputs	2SP0325T, half-bridge mode (Note 30)		3		µs
Jitter of dead time	2SP0325T, half-bridge mode		±100		ns
Transmission delay of fault state	2SP0325T (Note 14)		450		ns
Transmission delay of fault state	2SP0325V (Note 25)		90		ns
Delay to clear fault state	2SP0325V (Note 15)		8		µs
Acknowledge delay time $T_{d(ack)}$	2SP0325V (Note 16)		200		ns
Acknowledge pulse width $T_{(ack,on)}$	2SP0325V (at turn-on, on host side)	400	600	1050	ns
Acknowledge pulse width $T_{(ack,off)}$	2SP0325V (at turn-off, on host side)	400	750	1150	ns

Outputs	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Turn-on gate resistor $R_{g(on)}$	Note 17		0.5		Ω
Turn-off gate resistor $R_{g(off)}$	Note 17		2		Ω
Gate voltage at turn-on			15		V
Gate-voltage at turn-off	2SP0325T/2SP0325V				
	F = 0kHz		-10.2/-9.9		V
	F = 5kHz		-9.7/-9.3		V
Gate resistance to COMx			4.7		kΩ

dv/dt Feedback	**Remarks**	**Implementation**
dv/dt feedback	Note 18	Yes

Electrical Isolation	**Remarks**	**Min**	**Typ**	**Max**	**Unit**
Test voltage (50Hz/1s)	Primary to secondary side (Note 19)	3800	3850	3900	V_{eff}
	Secondary to secondary side (Note 19)	3800	3850	3900	V_{eff}
Partial discharge extinction volt.	Primary to secondary side (Note 27)	1220			V_{peak}
	Secondary to secondary side (Note 27)	1200			V_{peak}
Creepage distance	Primary to secondary side	12.5			mm
	Secondary to secondary side	6.5			mm
Clearance distance	Primary to secondary side	12.5			mm
	Secondary to secondary side	6.5			mm

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 and the internal gate resistance of the IGBT module.
3) If the specified value is exceeded, this indicates a driver overload. It should be noted that the driver is not protected against overload.
4) This limit is due to active clamping. Refer to “Description & Application Manual for 2SP0325T SCALE-2 IGBT Drivers” (electrical interface) or “Description & Application Manual for 2SP0325V SCALE-2 IGBT Drivers” (fiber-optic interface).
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) (2SP0325T and 2SP0325V) and the IGBTs are switched off (only 2SP0325T).
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 pulse width resulting from the direct output of the gate drive unit for half-bridge short circuits (excluding the delay of the gate resistors) is the sum of the response time plus the delay to IGBT turn-off. The short-circuit time may vary depending on the exact short-circuit conditions. Note that Mitsubishi’s short-circuit SOA CMH-10030 does not allow short-circuit inductances smaller than 10uH for external short circuits with CM2500DY-24S 300G, and that Mitsubishi’s short-circuit SOA CMH-10031 does not allow short-circuit inductances smaller than 5uH for external short circuits with CM2500DY-24S 302G.
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 2SP0325T 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) Including the delay of the external fiber-optic links. 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).
13) Output rise and fall times are measured between 10% and 90% of the nominal output swing with an output load of 1Ω (rise time)/2Ω (fall time) and 660nF. The values are given for the driver side of the gate resistors.
14) Transmission delay of the fault state from the secondary side to the primary status outputs.
15) Measured on the host side. The fault status on the secondary side is automatically reset after the specified time.
16) Including the delay of the external fiber-optic links. 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.
17) The gate resistors can be leaded or surface mounted. CONCEPT reserves the right to determine which type will be used. Typically, higher quantities will be produced with SMD resistors and small quantities with leaded resistors.
18) With “Yes”, a dv/dt feedback reduces the rate of rise of the collector-emitter voltage of the IGBTs at turn-off. For more information, refer to the “Description & Application Manual for 2SP0325T SCALE-2 IGBT Drivers” (electrical interface), or the “Description & Application Manual for 2SP0325V SCALE-2 IGBT Drivers” (fiber-optic interface). With “No”, no dv/dt feedback is implemented.
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 $850V_{AC(eff)}$ may lead to insulation degradation. No degradation has been observed over 1min. testing at $3800V_{AC(eff)}$. Every production sample shipped to customers has undergone 100% testing at the given value or higher ($<5100V_{eff}$) 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) 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.IGBT-Driver.com/go/fiberoptics
22) The recommended transmitter current at the host controller is 20mA. A higher current may increase jitter or delay at turn-off.
23) The typical transmitter current at the gate driver is 18mA. In case of supply undervoltage, the minimum transmitter current at the gate driver is 12mA: this is suitable for adequate plastic optical fibers with a length of more than 10 meters.
24) If the specified value is exceeded, this indicates a driver overload. It should be noted that the driver is not protected against overload.
25) Delay of external fiber-optic links. Measured from the driver secondary side (ASIC output) to the optical receiver on the host controller.
26) 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.
27) 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.
28) 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.
29) 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 “Description & Application Manual for 2SP0325T SCALE-2 IGBT Drivers” (electrical interface) or “Description & Application Manual for 2SP0325V SCALE-2 IGBT Drivers” (fiber-optic interface).
30) Note that the dead time may vary from sample to sample. A tolerance of approximately ±20% may be expected. If higher timing precisions are required, CONCEPT recommends using direct mode and generating the dead time externally.

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 GmbH apply.

Interface	CONCEPT Driver Type #	Related IGBT
Electrical Interface	2SP0325T2A1-CM2500DY-24S	CM2500DY-24S
Fiber-Optic Interface [1)]	2SP0325V2A1-CM2500DY-24S	CM2500DY-24S

1) Fiber-optic interface with versatile link (HFBR-2522ETZ and HFBR-1522ETZ)
See “Description & Application Manual for 2SP0325V SCALE-2 IGBT Drivers”

Product home page: www.IGBT-Driver.com/go/2SP0325

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

Information about Other Products

For other drivers, evaluation systems product documentation and application support

Please click: www.IGBT-Driver.com

Manufacturer

CT-Concept Technologie GmbH
A Power Integrations Company
Johann-Renfer-Strasse 15
2504 Biel-Bienne
Switzerland

Phone +41 - 32 - 344 47 47
Fax +41 - 32 - 344 47 40

E-mail Info@IGBT-Driver.com
Internet www.IGBT-Driver.com

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