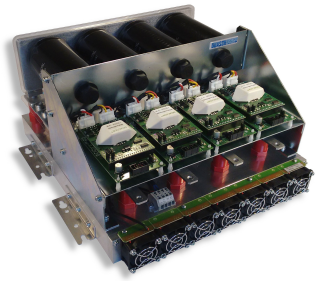
MTM-B8I0120F12IXIG

MT Series

PRELIMINARY TECHNICAL INFORMATION

HIGHLIGHTS

- B8I topology
- Very compact design
- IGBT drivers included
- DC-Link capacitor bank included
- Ready to use



non-contractual image

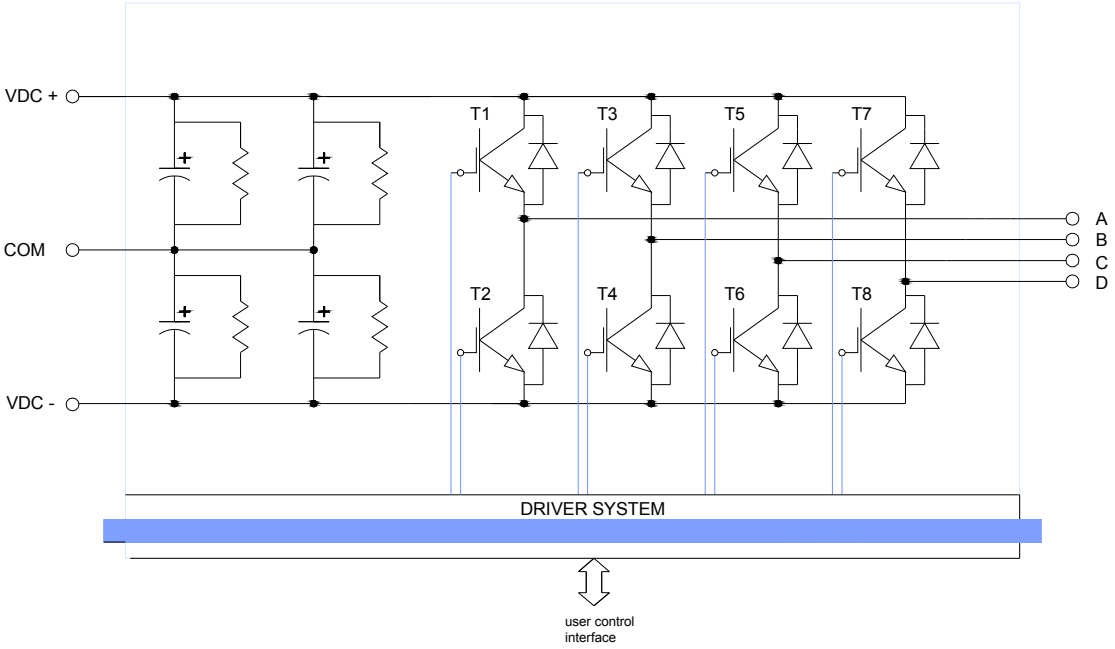
ABOUT MTM SERIES

RECTIFICADORES GUASCH S.A. offers a compact and ready-to-use B8I converter power stack for motor control, inverter applications or active filters. This power stack includes the IGBTs (1/2B2I modules) with a forced-air heatsink and optocoupled drivers. The customer can work in a short delivery time with a wide range of power assemblies in a very compact size.

The MTM series takes the medium range of power from our MT Series of IGBTs power stacks. MT series is suitable to realize converters, choppers, half, full or three phase bridge inverters for motor control, welding, renewable energies, UPS, etc.

BRIEFING

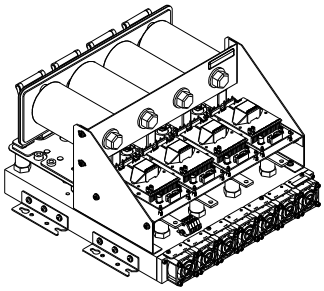
Topology	Capacitor bank + B8I	
Market	Industrial / Educational	
Cooling system	Extruded heatsink with axial fan array	
Driver system	SCiCoreDrive22	
Max Voltage applied to DClink		800 V
Output current per phase	f_{sw}=10 kHz, T_J<150ºC T_{env}=40ºC f_O=50 Hz, PF=0.85, m=1, V_{DCLINK} =600 V_{DC}	40 A



161116 Rev.:0

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POWER STACK GENERAL CHARACTERISTICS



MTM-B8I0120F12IXIG

Features
- 6th Gen. Trench V-IGBT
- Capacitor bank included
- Drivers included
- Forced air heatsink
- Ultra compact design

Typical applications
- Renewable energies
- AC inverter drives
- Traction
- Elevators
- Industrial drives
- UPS

ABSOLUTE MAXIMUM RATINGS

Symbol	Conditions	Min	Typ	Max	Units
System					
V_{DClink}	Operating DC link voltage			800	V_{DC}
$I_{U,V,W}$	*f_{SW}=10 kHz, T_J<150ºC, T_A=40ºC, fo=50 Hz, PF= 0.85, m=1, V_{DCLink}=600V*			40	A_{RMS}
T_{stg}		-40		50	ºC
T_{op}		-10		50	ºC
V_{ISOmod}	*50 Hz @1min*		4000		V_{AC}
IGBT					
V_{CES}	*T_J=25ºC*			1200	V
I_C	*T_C=25ºC, T_J=175ºC*			165	A
	T_C=80ºC, T_J=175ºC			127	A
T_J	junction temperature	-40		150	ºC
Diode					
V_{RRM}	*T_J=25ºC*			1200	V
I_F	*T_C=25ºC, T_J=175ºC*			130	A
	T_C=80ºC, T_J=175ºC			98	A
T_J	junction temperature	-40		150	ºC
Driver					
V_S	Pow er supply	13	15	17	V
V_{iH}	Input signal voltage (high)			5	V
V_{isolPS}	Isolation betw een secondaries			1000	V
V_{isolSS}	Isolation primary to secondary			3000	V
f_{sw}	Sw itching frequency		5	100	kHz
Capacitor bank					
C_N	Nominal capacity		2200		µF
C_{N_TOL}	Capacity tolerance		20		%
V_{DC_max}	Maximum voltage		800		V_{DC}
Heatsink					
V_S	Pow er supply voltage		12		V
R_{thHA}	Thermal resistance to ambient		0.10		K/W
T_{TH}	Thermal sw itch (NC) temperature		90		ºC

Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.

POWER MODULE CHARACTERISTICS

IGBT STATIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_{CES}	C-E Breakdown Voltage	T_j = 25 °C	1200	-	-	V
I_{CES}	C-E Cut-Off Current	$V_{CE} = V_{CES}$, V_{GE} = 0 V, T_j = 25 °C	3.81	5.08	150	µA
I_{GES}	G-E Leakage Current	$V_{GE} = V_{GES}$, V_{CE} = 0 V	2.17	8.75	200	nA
$V_{GE(th)}$	G-E Threshold Voltage	$V_{GE} = V_{CE}$, I_C = 4 mA	5.70	6.08	6.45	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 100 A, V_{GE} = 15 V, T_j = 25 °C	1.75	1.76	1.88	V
		I_C = 100 A, V_{GE} = 15 V, T_j = 150 °C	2.23	2.27	2.40	V

Table 1: IGBT part static characteristics.

IGBT DYNAMIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
C_{ies}	Input Capacitance	V_{CE} = 10 V, V_{GE} = 0 V f = 1 Mhz, T_j = 25°C	-	9.10	-	nF
C_{oes}	Output Capacitance		-	0.70	-	nF
C_{res}	Reverse Transfer Capacitance		-	0.80	-	nF
$t_{d(on)}$	Turn-On Delay Time	T_j = 150°C, R_G = 1.0 Ω	437	448	495	ns
t_r	Rise Time	V_{DC} = 600 V, I_C = 100 A	57.0	59.0	67.0	ns
$t_{d(off)}$	Turn-Off Delay Time	V_{GE} = ±15 V	558	569	630	ns
t_f	Fall Time	di/dt_{on} = 3230 A/µs	361	395	465	ns
E_{on}	Turn-On Switching Loss	di/dt_{off} = 1330 A/µs	9.99	10.8	14.0	mJ
E_{off}	Turn-Off Switching Loss	du/dtoff = 9350 V/µs	10.8	11.5	15.0	mJ
E_{ts}	Total Switching Loss		20.79	22.3	29.0	mJ
Q_g	Total Gate Charge	V_{GE} = -8 V...+15 V	-	1040	1117	nC
Q_{ge}	Gate-Emitter Charge		-	-	-	µC
Q_{gc}	Gate-Collector Charge		-	-	-	µC

Table 2: IGBT part dynamic characteristics.

DIODE ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
V_F	Diode Forward Voltage	I_F = 100 A V_{GE} = 0 V	T_j = 25 °C	1.76	1.79	1.92	V
			T_j = 150 °C	1.86	1.90	1.98	
I_{RRM}	Peak Reverse Recovery Current	V_{DC} = 600 V, I_C = 100 A	T_j = 150 °C	107	111	125	A
Q_{rr}	Diode Reverse Recovery Charge	V_{GE} = ±15 V	T_j = 150 °C	14.5	15.5	18.0	µC
E_{rr}	Diode Reverse Recovery Energy	di/dt_{off} = 3050 A/µs	T_j = 150 °C	5.38	6.04	8.00	mJ

Table 3: Diode part electrical specifications.

IGBT MODULE THERMAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$Rth_{(J-C)}$	Thermal Resistance (IGBT Part)	Junction-to-Case	-	0.197	0.270	°C/W
$Rth_{(J-C)D}$	Thermal Resistance (Diode Part)	Junction-to-Case	-	0.434	0.490	°C/W
$Rth_{(C-H)}$	Thermal Resistance	Case-to-Heatsink, per module	-	0.02	0.04	°C/W

Table 4: IGBT module thermal characteristics.

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COOLING SYSTEM CHARACTERISTICS

The cooling system is formed by a RG14092 extruded heatsink profile assembled with a standard forced air fan rack module SC-C300V40/12 from Semicode.

Description	Symbol	Notes / Test conditions	Min	Typ	Max	Units
Heatsink thermal resistance	$R_{th\ HA}$	**Note 1**		0.10		K/W
Profile length	L			300		mm
Profile section	S			5823		mm^2
Profile perimeter	P			2310		mm
Input supply voltage	$V_{IN\ DC}$		11.3	12	13.2	V_{DC}
Input supply current	$I_{IN\ DC}$			1106	1239	mA
Power consumption	P_N			13.27		W
Fan rated speed		±10%		8200		rpm
Air Flow		Free air		1.93		m^3/min
Static Air Pressure		Free air		88.8		Pa
Noise Level		per fan		37.5		dBA
Storage Temperature	T_{stg}	65% RH	-40		70	ºC
Operating Temperature	T_{op}	65% RH	-10		70	ºC
Failure Rate		40ºC / 65% RH		70000		h
Thermal switch temperature		NC (normally closed)	85.5	90	94.5	ºC
Thermal switch nominal voltage	$V_{N\ TH}$	50/60 Hz		250		V_{AC}
Thermal switch nominal current	$I_{N\ TH}$			10		A
Thermal switch threshold histeresis				30ºC ±10ºC		

Data at T_a = 25 °C, V_{IN} = 12 V_{DC} and rated values, unless otherwise indicated

Table 5: Cooling system technical specifications.

FAN RACK CONFORMALS		
Conformal coating		MIL-1-46058, Type UR
Security	TUV	EN60950-1, UL60950-1
Electromagnetic Compatibility	CE	EN 61000-6-1:2007, EN 61000-6-3:2007

Note 1:

The thermal resistance values showed are only standard values measured under the following conditions: using 4 modules of 31x91 mm layout footprint with a constant dissipated power equally distributed between modules. The test was perfomed on a power stack mounted on upright position with fan rack supplied at its nominal supply voltage.

This given data should be taken only as a reference and at any case should replace measurements under real field and on end application conditions.

Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.

CAPACITOR BANK CHARACTERISTICS

Description	Symbol	Notes / Test conditions	Min	Typ	Max	Units
Total bank nominal capacitance	C_{TOT}	±20%		2200		µF
Maximum voltage	V_{DC_MAX}				800	V
Surge voltage	V_S	per capacitor			440	V
Rated working voltage	V_{DC}			600		V
Equivalent series resistance	ESR	per capacitor, 100 Hz			69	mΩ
Impedance	Z_C	per capacitor, 100 Hz		0.725		mΩ
Ripple current	I_R	per capacitor, 100 Hz, T_A=85ºC			8.49	A
Leakage current	I_{LEAK}	per capacitor			2.64	mA
Mounting position		upright or horizontal				
C_N tolerance					20	%
Operating Temperature	T_{op}		-40		85	ºC
Useful life		T_A=55ºC, at rated I_R		40000		h

Data at T_a = 25 °C, V_{IN} = 600 V_{DC} and rated values, unless otherwise indicated

Table 6: Capacitor bank technical specifications.

Circuit diagram

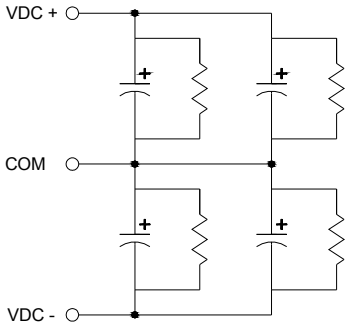


Figure 1: Capacitor bank circuit diagram.

Warning note:
When charged at nominal voltage and then disconnected from DC power source the capacitor bank will be naturally discharged after aproximately 10 min ($V_{C@10min}$ < 2% x V_{RATED}). If a shorter discharge time is needed an external discharge resistor must be used.

Ripple current

Data given for capacitors is regarding a withstand rms ripple current at 100 Hz and 85ºC. When the hotspot capacitor bank is operating at a temperature other than 85ºC, the permissible rms current given at 85ºC should be multiplied by the factors given below:

T_c	40ºC	45ºC	50ºC
Multiplying Factor	2.2	2.1	1.9

Table 7: Ripple current multiplying factor vs. hotspot temperature.

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Where capacitors are required to operate at frequencies other than 100 Hz, the multiplying factors given below may be used to determine the ripple current capacity at that frequency.

Frequency [Hz]	100	250	1k to 10k	>10k
Multiplying Factor	1.0	1.05	1.20	1.35

Table 8: Ripple current multiplying factor vs. frequency.

e.g.: For an application where the capacitor bank is operating at a 50ºC and ripple current frequency is about 5 kHz the total multiplying factor should be aproximately of 1.9 x 1.35 = 2.5. In that case the total ripple current withstand on DC-Link for the capacitor bank will be of 2 x 8.49 A x 2.5 = 42.45 A.

STACK MOUNTING CONSIDERATIONS

It is necessary a minimum distance of 100 mm with regard to the envelope. The free air circulation should be guaranteed avoiding external nearby heat sources from the assembly.

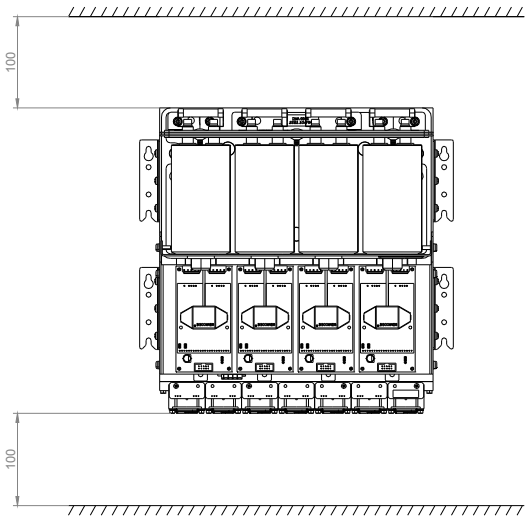


Table 9: Spacing example with regards the envelope.

The power stack must be mounted in upright or horizontal position and tightened to a plane surface using its mounting fasteners providing a correct heatsink fin air canalization and heatsink thermal performance in order to accomplish with rated values specified on this datashet, other mounting positions must be avoided.

For real applications it is important to consider a safety margin with regarding the working current, we recommend a margin of the 20%.
For critical cases (24 hours work, repetitive overloads, high ambient temperature...), margins of the 30% to 50% are used.

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DRIVERS SPECIFICATIONS AND CHARACTERISTICS

MTM-B8I power stacks uses as a driving circuitry the SCiCoreDrive22 2-channel IGBT driver from Semicode. This is a general purpose 2-channel driver designed to interface IGBTs up to 1200 V. It includes a V_{CE} monitoring for each IGBT which it protects the devices in case of failure by soft turning OFF the IGBT and providing to the user a galvanically isolated fault signal.

The input signaling are Schmidt-trigger, and admits logic levels of 0-5 V or 0-15 V, the MTM-B8I is configured by default with a 0-5 V input logic but the user can select the best suited configuration. Please see Table 13 and Figure 3 to change logic levels configuration.
The input signaling also includes a short pulse supressor to avoid undesired triggering glitches and parasites.

For more details and up to date information of the drivers please download the last released SCiCoreDrive22 datasheet here.

TECHNICAL DRIVER SYSTEM SPECIFICATIONS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_{CC}	Supply voltage		13	15	17	V
I_{CC}	Current consumption (full load)	Q_G=0.80 µC, f_{sw}=100 kHz (2 chan.)			480	mA
I_{STBY}	Stand by consumption (no load)			140		mA

Table 10: IGBT drivers power supply technical specifications.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_{IN_H}	IN signal high level	See LOGIC LEVELS			15	V
I_{CC}	IN signal low level		0			V
I_{STBY}	FAULT output current				8	mA

Table 11: IGBT drivers logic inputs and outputs characteristics.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d\ ON}$	High output propagation time				2.4	µs
$t_{d\ OFF}$	Low output propagation time				2.6	µs
$t_{d\ FAULT}$	Desat. Detection to FAULT output delay			1.8	5	µs
t_{blank}	Blanking time				2.8	µs
$t_{d\ DES(10)}$	Desat. Detection 10% turn off			0.3	0.5	µs
$t_{d\ DES(90)}$	Desat. Detection to 90% turn off 90%			2	3	µs
$t_{d\ RES_FAULT}$	Reset to fault		3	7	20	µs
PW_{RES_min}	Minimum pulse width for RESET		0.1			µs
f_{sw_max}	Max. Switching frequency				100	kHz
DC	Duty cycle for IN_x signals		0		100%	

Table 12: IGBT drivers timing characteristics.

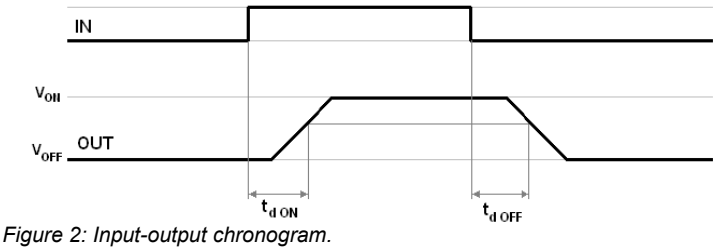


Figure 2: Input-output chronogram.

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APPLICATION NOTES REGARDING THE DRIVING SYSTEM

LOGIC LEVELS

The inputs of SCiCoreDrive22 (PWM_{TOP}_x, PWM_{BOT}_x and RESET_x) are TTL compatible see its pinout on Table 15. The FAULT_x outputs are open collector outputs, and require an external pull-up resistor.

LOGIC INPUTS/OUTPUTS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$V_{IN_H_RS}$	RST Input signal high level voltage	*RESET signal*	2		5	V
$V_{IN_L_RS}$	RST Input signal low level voltage	*(active when in low-state)*	0		0.8	V
$V_{IN5_H_IN}$	IN Input signal high level voltage	*IN_x signal*	3.7		5	V
$V_{IN5_L_IN}$	IN Input signal low level voltage	*(JP1 & JP2 plugged)*	0		1.3	V
$V_{IN15_H_IN}$	IN Input signal high level voltage	*IN_x signal*	11		15	V
$V_{IN15_L_IN}$	IN Input signal low level voltage	*(JP1 & JP2 unplugged)*	0		3.9	V

Table 13: IGBT drivers logic inputs/outputs configurations.

In addition, the inputs IN_x are schmitt-trigger and admits 2 different voltage levels depending on whether the JP1 & JP2 are plugged or not.

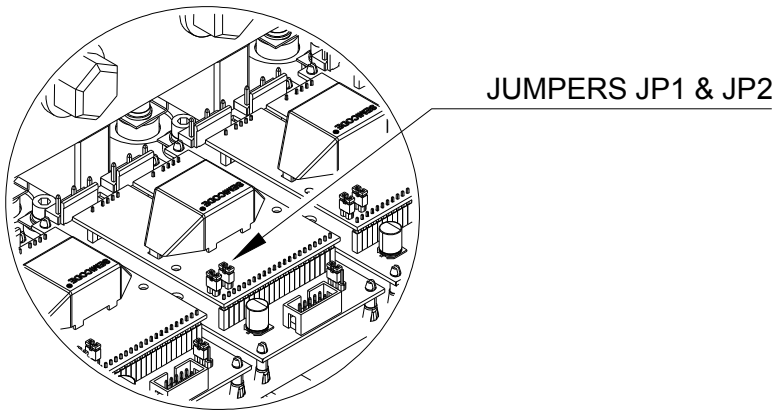


Figure 3: Position detail of voltage level input voltage on SCiCoreDrive22.

Warning note:
We recommend to use the 0-15V levels for a better noise immunity on harsh environments. It is not permitted to use different level configuration on each channel. Both channels must work as 0-15 V or 0-5 V. Using 0-15 V input signal when jumpers JP1 & JP2 are plugged can damage the driver. Using 0-5 V or 0-15 V on input signals when drivers are unpowered can also damage the equipment.

SHORT PULSE SUPPRESION (SPS)

Each Input signal (IN_x) of SCiCoreDrive22 includes a SPS to protect the driver and the IGBT from undesired short duration glitches. A pulse shorter than 1.4 µs will be eliminated with 100% probability. A pulse longer than 1.8 µs will pass the SPS without suffer any change. A pulse with a duration between 1.4 µs and 1.8 µs may pass or not.

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FAILURE MANAGEMENT

The power stage of a typical three phase inverter or full bridge is susceptible to several types of failures, most of which are potentially destructive to the power IGBT. Under any of these fault conditions, the current through the IGBT can increase rapidly, causing excessive power dissipation and heating. The IGBT become damaged when the current load approaches the saturation current of the device, and the collector to emitter voltage rises above the saturation voltage level. The drastically increased power dissipation overheats very quickly the power device and destroys it. To prevent damage to the drive, fault protection must be implemented to reduce or turn-off the over-currents during a fault condition. SCiCoreDrive22 provides fast local fault detection and shutdown.

The fault detection method is to monitor the saturation (collector) voltage of the IGBT and to trigger a local fault shutdown sequence if the collector voltage exceeds a predetermined threshold. A small gate discharge device slowly reduces the high short circuit IGBT current to prevent damaging voltage spikes. Before the dissipated energy can reach destructive levels, the IGBT is shut off. During the off state of the IGBT, the fault detect circuitry is simply disabled to prevent false 'fault' signals.

During normal operation, voltage at RON_x and ROFF_x is controlled by the signal IN_x, with the IGBT collector to emitter voltage being monitored through VDESAT. The FAULT output is high and the RESET input must be held high.

HALF BRIDGE MODE OF OPERATION

As each driver is interfacing a 2 IGBT forming a half bridge, the half bridge operation mode on SCiCoreDrive is set and is recommended not to change it.
In this mode the if both signals, IN1 and IN2, are high at the same time, the intern dead time generator of the driver resolves this conflictual situation by separating the signals in time and generating automatically a dead time. This way we can assure that the signals at the output of the driver don't provoke that both IGBTs are ON at the same time. See the chronogram of Figure 4.

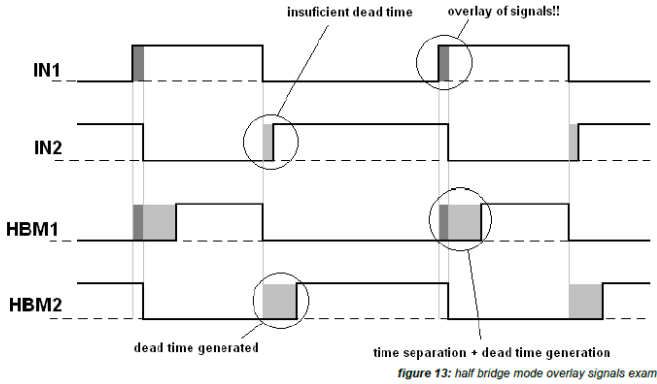


Figure 4: SCiCoreDrive22 signal operation chronogram.

USING EXTERNAL CAPACITORS TO INCREASE THE GENERATED DEAD TIME

The dead time generated by SCiCoreDrive22 drivers on the power stack is, by default, of 600 ns. This dead time can be increased by soldering capacitors to the pads CA1 & CA2 on the SCiCoreLink62 PCA. Please see Figure 5. Both external capacitors connected must be of the same value, otherwise the generated dead time between channels will be unbalanced.

To reach the soldering pads for dead time capacitors the SCiCoreDrive22 must be disassembled from its sockets pulling it out vertically with care to not bend or damage its pin arrays.

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See Table 14 with the relation between the value of the capacitors Cx and the dead time generated.

External capacitor	Dead time generated
47 pF	600 ns
100 pF	840 ns
150 pF	1100 ns
220 pF	1350 ns
330 pF	1700 ns
470 pF	2200 ns
680 pF	2900 ns
820 pF	4000 ns
1000 pF	4600 ns

Table 14: Dead time capacitors nominal values.

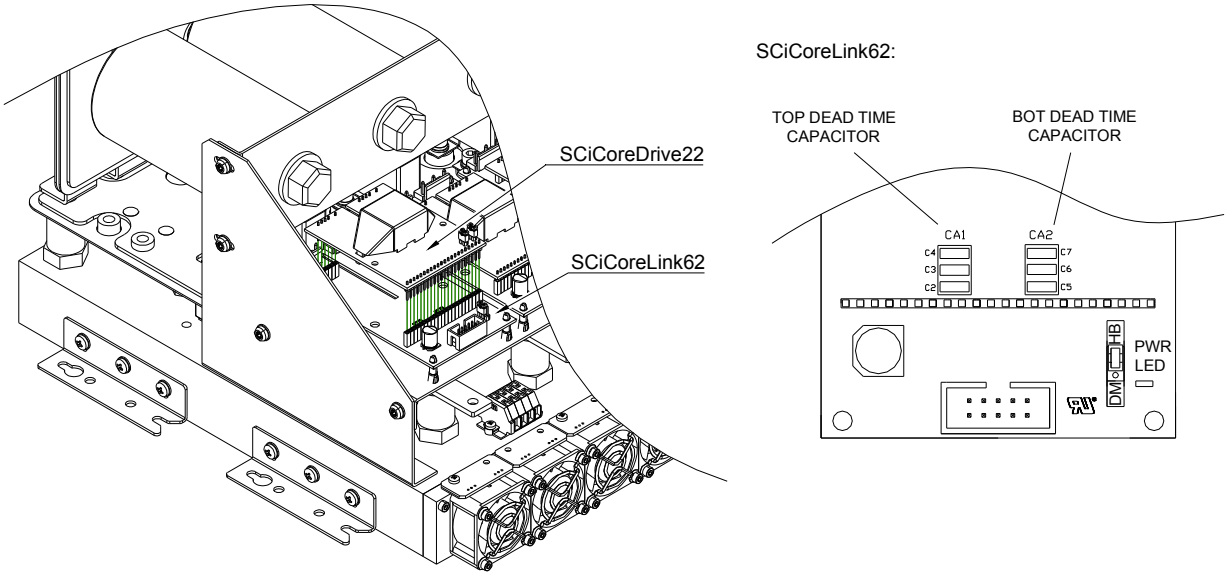


Figure 5: Position detail of dead time capacitors pads on SCiCoreLink62.

Warning note:
On those applications where one, or more, modules are not in use, e.g.: Three-phase inverter (B6I), the unused module's driver must be powered and stuck the both input switching signals to GND to ensure that any spureous signal or noise would not accidentally switch on the IGBT. Never leave any driver unconnected when operating with the power stack.

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POWER AND SIGNAL INTERFACES AND CONNECTIONS

DRIVERS I/O INTERFACE AND SUPPLY

Signal connections:

J1 to J4 CONTROL CONNECTORS are the main connectors for each half-bridge driver providing the control switching signals for each IGBT, reset signal, and output fault signals. It is also used to supply the drivers +15 V_{DC}. The position of this connectors on the power stack are depicted on Figure 6.

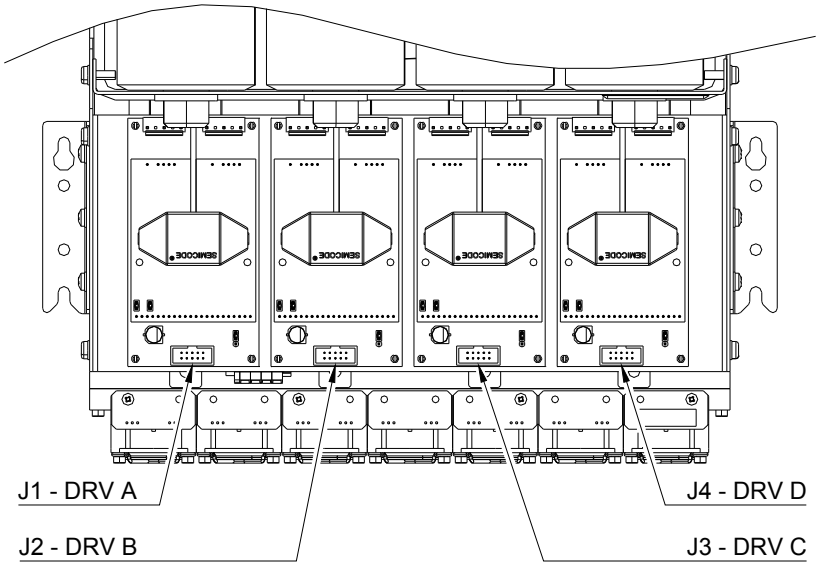


Figure 6: Position detail of control connectors.

CONNECTOR PINOUT

Pin	Designator	Description
1	PWM_{TOP}	Input logic signal for switching TOP IGBT
2	GND	Ground terminal for supply and logic signals
3	GND	Ground terminal for supply and logic signals
4	RESET	Reset input signal (low state)
5	GND	Ground terminal for supply and logic signals
6	VCC	+15 V_{DC} supply voltage
7	FAULT	Fault output signal
8	VCC	+15 V_{DC} supply voltage
9	VCC	+15 V_{DC} supply voltage
10	PWM_{BOT}	Input logic signal for switching BOT IGBT

Table 15: IGBT drivers pinout.

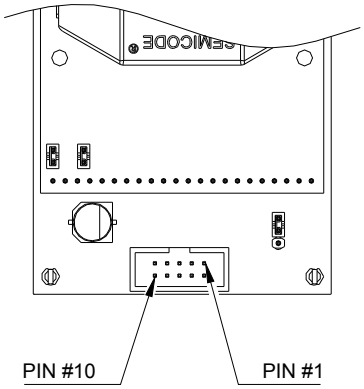


Figure 7: Connector numeration detail.

Connector type:
AMP-LATCH series, 5103308-1, TE Connectivity.

Recommeded matched connector socket for PCB-to-PCB connection:
AMPMODU series, 5-534206-5, TE Connectivity.

Recommended matched connector socket for PCB to flat cable connection:
AMP-LATCH series, 1658621-1, TE Connectivity.

Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.

POWER TERMINALS AND CONNECTIONS

AC POWER TERMINALS are the main power output terminals for the stack. Below on you can find the position of this terminals on the power stack.

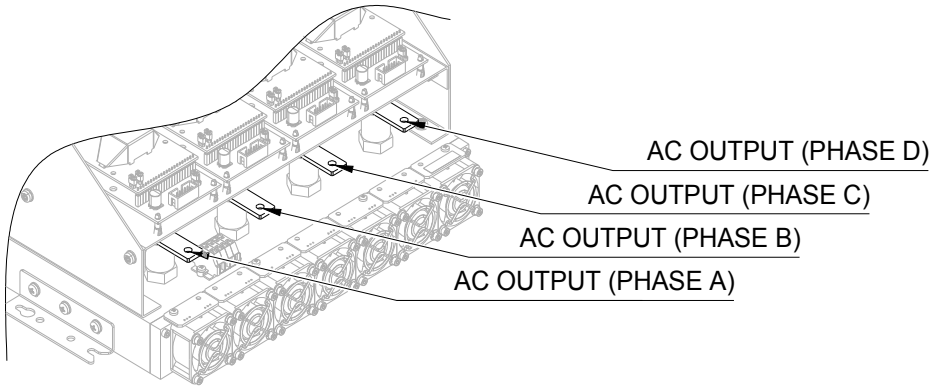


Figure 8: Output AC terminals position detail.

AC Output terminals mounting hole: Ø 5.5 mm, for M5 terminal thightening.

DC-LINK POWER TERMINALS are the electrical power connections for DC-Link. In the image below (Figure 9) is depicted the position and polarity for this terminals.

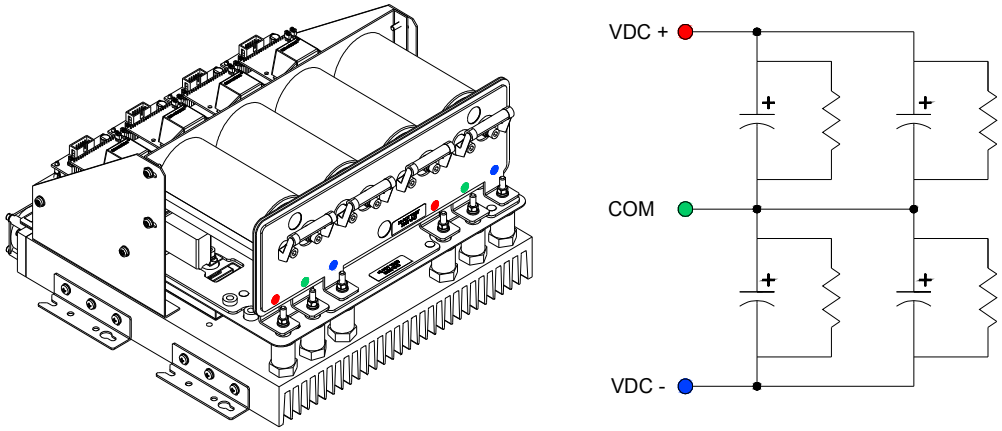


Figure 9: DC Input terminals position detail.

DC Input terminals threaded stud: M5x16 mm.

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FAN ARRAY SUPPLY AND THERMAL SWITCH SNAP-IN TERMINAL BLOCK

Pole	Designator	Description
1	-V	GND supply voltage
2	+V	+12 V_{DC} supply voltage
3	T1	Thermal switch 1
4	T2	Thermal switch 2

Table 16: Snap-in terminal block pinout.

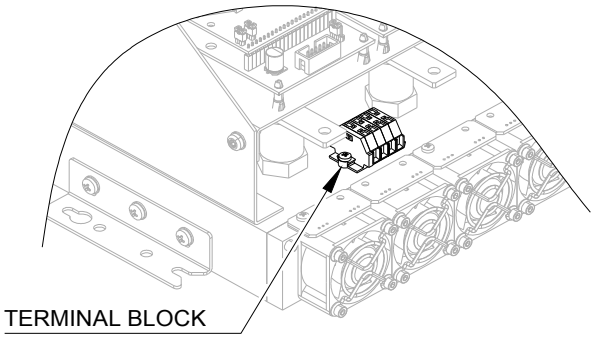


Figure 10: Snap-in terminal block position detail.

In order to work with the stack user must supply 12 V_{DC} on the snap-in terminal block to power on the fan array. The equipment should be operated with its fan rack powered on and user must ensure the correct supply of the fan array.

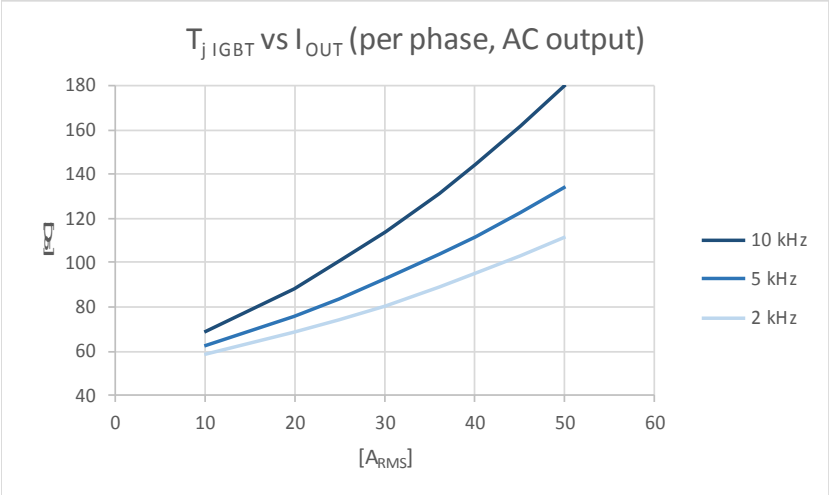
Please check the power requirements of the fan array and find all thermal switch characteristics stated on Table 5.

Note: *Thermal and power performance specifications in this datasheet are given under forced air operation, Rectificadores Guasch do not recommend to use it without power on the fan array or without it. In this case user must apply a current derating based on custom own power and thermal measurements.*

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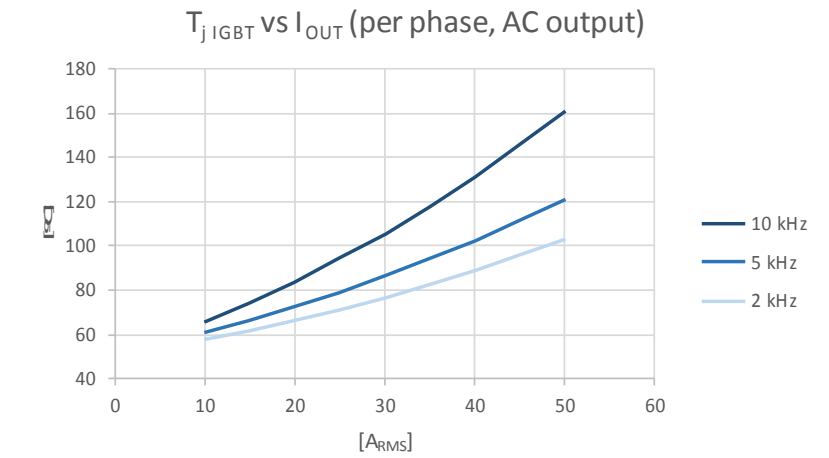
PERFORMANCE CURVES

Stack working as inverter. Each of four phases with the same current output as parameter.



Condition	Symbol	Value	Units
Ambient temperature	T_A	40	°C
DC-Link voltage	V_{DCLINK}	600	V
Modulation index	m	1	
Load power factor	PF	0.85	
Output frequency	f_{OUT}	50	Hz

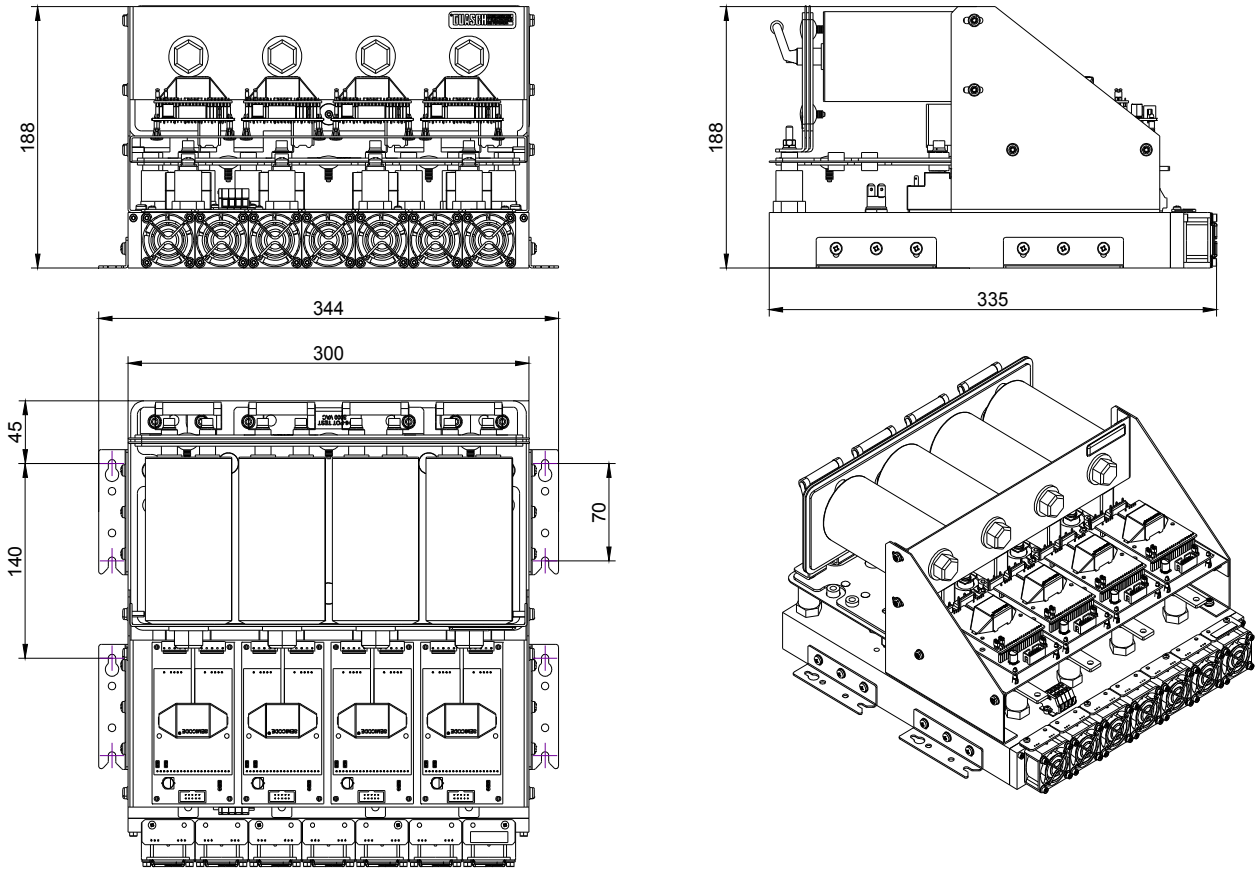
Stack working as a three-phase inverter, letting one of the IGBT modules phase unconnected and without switching.



Condition	Symbol	Value	Units
Ambient temperature	T_A	40	°C
DC-Link voltage	V_{DCLINK}	600	V
Modulation index	m	1	
Load power factor	PF	0.85	
Output frequency	f_{OUT}	50	Hz

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POWER STACK MECHANICAL DIMENSIONS



All dimensions in mm

Dimension	Typ	Units
Width	344	mm
Lenght	335	mm
Height	188	mm
Weight	10.8	kg

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