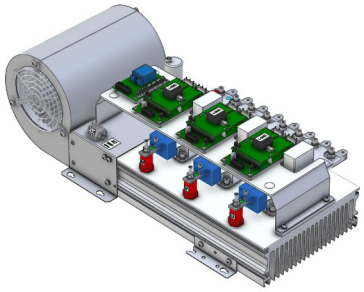
MTM-B6I0300F12INAA

IGBT POWER STACKS SERIES

PRELIMINARY TECHNICAL INFORMATION



Features

- Fast trench IGBT4
- B6I inverter topology
- Drivers included
- Current sensors included
- Voltage sensor included
- Forced air heatsink
- Compact design

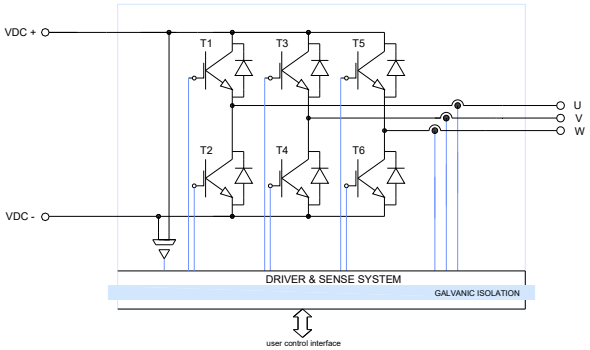
Typical applications

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

POWER STACK GENERAL CHARACTERISTICS

Symbol	Conditions	Min	Typ	Max	Units
System					
V_{DClink}	*Working as DC/AC converter inverter*			800	V_{DC}
I_{OUT}	*f_{SW}=5 kHz, T_A=35ºC, T_{vj}<125ºC, T_{HK}<90ºC* *f_{AC}=50 Hz, PF= 0.85, m=0.94, V_{DCLink}=600V*			253	A_{RMS}
T_{stg}		-40		70	ºC
T_{op}		-20	35	70	ºC
V_{ISOmod}	*50 Hz @1min*		4000		V_{AC}
IGBT					FF300R12KT4 (Infineon)
V_{CES}	*T_J=25ºC*			1200	V
I_C	*T_C=25ºC, T_{vjmax}=175ºC*			450	A
	T_C=100ºC, T_{vjmax}=175ºC			300	A
$T_{vj\,op}$	*under switching conditions*	-40		150	ºC
Diode					
V_{RRM}	*T_{vj}=25ºC*			1200	V
I_F				300	A
$T_{vj\,op}$	*under switching conditions*	-40		150	ºC
Driver					SCiCoreDrive22+SCiCoreLink62
V_S	Driver supply voltage		15	17	V
V_{iH}	Input signal voltage (high)			5/15	V
V_{isolSS}	Isolation between secondaries			1000	V
V_{isolPS}	Isolation primary to secondary			3000	V
f_{sw}	Switching frequency		5		kHz
Current sensors					HASS200-S (LEM)
I_{PN}	Nominal current		200		A
I_{PM}	Primary current measuring range	-600		600	A
G_{th}	Theoretical sensivity		3.125		mV/A
Sensor signaling					SCiSensor153
I_{OUT}	*Accuracy=±3%*	-600		600	A
U_{IOUT}	*@I_{meas}=200 A*	1.25		8.75	V
V_{DCLINK}	*Accuracy=±2,8%*	0		1000	V
$U_{VDCLINK}$	*@V_{DC}=600 V*	0		10	V
Heatsink					SV-C215A-RG14230/350
V_S	Radial fan supply voltage		230		V_{AC}
R_{thHA}	Thermal resistance to ambient		0.021		K/W
T_{TH}	Thermal switch temperature		NC 90 ±5		ºC

Topology



Rectificadores Guasch, S.A.U. 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_{vj} = 25 °C			1200	V
I_{CES}	C-E Cut-Off Current	$V_{CE} = V_{CES}$, V_{GE} = 0 V, T_{vj} = 25 °C			5	mA
I_{GES}	G-E Leakage Current	$V_{GE} = V_{GES}$, V_{CE} = 0 V			0.4	µA
$V_{GE(th)}$	G-E Threshold Voltage	$V_{GE} = V_{CE}$, I_C = 11.5 mA	5.2	5.8	6.4	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	I_C = 300 A, V_{GE} = 15 V, T_{vj} = 25 °C		1.75	2.15	V
		I_C = 300 A, V_{GE} = 15 V, T_{vj} = 125 °C		2.05		V

Table 1: IGBT part static characteristics FF300R12KT4.

IGBT DYNAMIC CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
C_{ies}	Input Capacitance	V_{CE} = 25 V, V_{GE} = 0 V, f = 1 MHz		19.0		nF
C_{oes}	Output Capacitance					nF
C_{res}	Reverse Transfer Capacitance			0.81		nF
$t_{d(on)}$	Turn-On Delay Time	Inductive load, T_{vj} = 125°C, R_G = 1.8 Ω, V_{CE} = 600 V, I_C = 300 A, V_{GE} = ±15 V		170		ns
t_r	Rise Time			45		ns
$t_{d(off)}$	Turn-Off Delay Time			52		ns
t_f	Fall Time			160		ns
E_{on}	Turn-On Switching Loss			25.0		mJ
E_{off}	Turn-Off Switching Loss			29.5		mJ
E_{ts}	Total Switching Loss			54.5		mJ
Q_g	Total Gate Charge	V_{GE} = -15 V...+15 V		2400		nC
Q_{ge}	Gate-Emitter Charge					µC
Q_{gc}	Gate-Collector Charge					µC

Table 2: IGBT part dynamic characteristics FF300R12KT4.

DIODE ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
V_F	Diode Forward Voltage	I_F = 300 A, V_{GE} = 0 V	T_{vj} = 25 °C		1.65	2.15	V
			T_{vj} = 125 °C		1.65		
I_{RRM}	Peak Reverse Recovery Current	V_{DC} = 600 V, I_C = 300 A, V_{GE} = 0 V, di/dt$_{off}$ = 600 A/µs	T_{vj} = 125 °C		380		A
Q_{rr}	Diode Reverse Recovery Charge		T_{vj} = 125 °C		48		µC
E_{rr}	Diode Reverse Recovery Energy		T_{vj} = 125 °C		23.5		mJ

Table 3: Diode part electrical specifications FF300R12KT4.

IGBT MODULE THERMAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$Rth_{(J-C)Q}$	Thermal Resistance (per IGBT)	Junction-to-Case			0.093	°C/W
$Rth_{(C-H)Q}$	Thermal Resistance (per IGBT)	Case-to-Heatsink		0.032		°C/W
$Rth_{(J-C)D}$	Thermal Resistance (per Diode)	Junction-to-Case			0.15	°C/W
$Rth_{(C-H)D}$	Thermal Resistance(per Diode)	Case-to-Heatsink		0.052		°C/W

Table 4: IGBT module thermal characteristics FF300R12KT4.

Note: *All above data extracted from Infineon's IGBT module data sheet, please refer to manufacturer's website for its last updated revision.*

COOLING SYSTEM CHARACTERISTICS

HEATSINK TECHNICAL SPECIFICATION

Symbol	Parameter	Notes / Test conditions	Min	Typ	Max	Units
$R_{th(HA)}$	Nominal thermal resistance			0.021		K/W
	Cooling type	*Forced air convection single axial fan*		SC-C215A (Semicode)		
$V_{IN\ AC}$	Input supply voltage			230		V_{AC}
$I_{IN\ AC}$	Input supply current	$V_{IN\ AC}$= 230 V_{AC}, f_{AC}= 50 Hz		740		mA
P_N	Power consumption			169		W
	Fan rated speed	±10%		1355		rpm
Q	Air Flow	Free air		680		m^3/h
P	Static Air Pressure				380	Pa
	Noise Level	ISO 3744		61		dBA
	Service life	@40ºC		--		h

Data at T_a = 25 °C, V_{IN} = 230 V_{AC}, 50 Hz and rated values, unless otherwise indicated

Table 5: Cooling system technical specifications.

FAN SUPPLY SNAP-IN TERMINAL BLOCK

Designator	Description
T	P.E.
L	Line connection
N	Neutral connection

Table 6: Snap-in terminal block pinout.

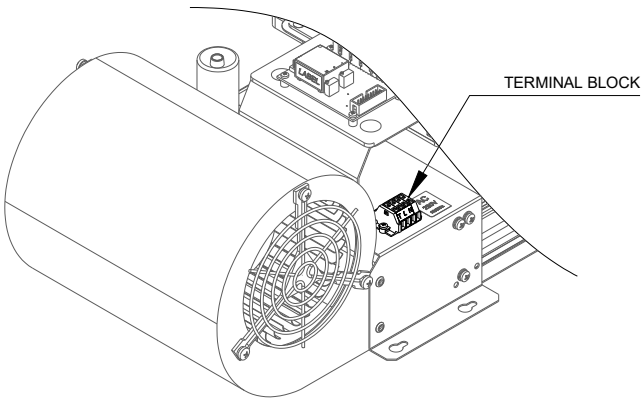


Figure 1: Snap-in radial fan terminal block position detail.

DRIVERS SPECIFICATIONS AND CHARACTERISTICS

The power stack 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 reference is configured by default with a 0-15 V input logic but the user can select the best suited configuration. Please see table 9 and figure 2 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 about the drivers please download the last released SCiCoreDrive22 datasheet here and its adaptation board SCiCoreLink62 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 7: 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 8: IGBT drivers logic inputs and outputs characteristics.

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 11. 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 (active when in low-state)*	2		5	V
$V_{IN_L_RS}$	RST Input signal low level voltage		0		0.8	V
$V_{IN5_H_IN}$	IN Input signal high level voltage	*IN_x signal (JP1 & JP2 plugged)*	3.7		5	V
$V_{IN5_L_IN}$	IN Input signal low level voltage		0		1.3	V
$V_{IN15_H_IN}$	IN Input signal high level voltage	*IN_x signal (JP1 & JP2 unplugged)*	11		15	V
$V_{IN15_L_IN}$	IN Input signal low level voltage		0		3.9	V

Table 9: 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.

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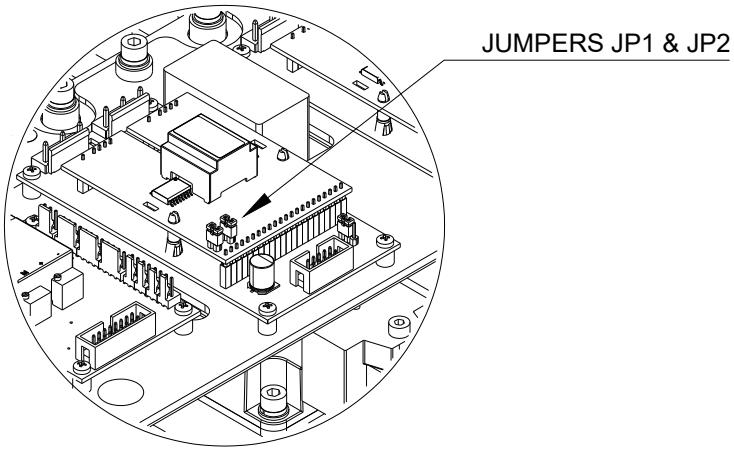


Figure 2: Position detail of voltage level input voltage on SCiCoreDrive22.

Warning note:
It is 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.

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 SCiCoreDrive22 is set and is recommended not to change it.
In this mode if both signals, IN1 and IN2, are high at the same time, the intern dead time generator of the driver resolves this conflicting 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 3. The dead time generated by SCiCoreDrive22 drivers on the power stack is, by default, of 4 µs.

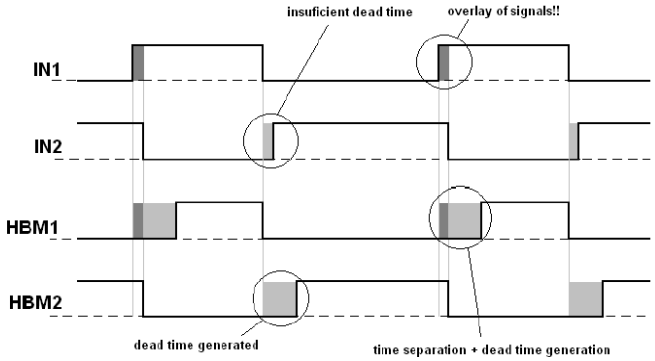


Figure 3: SCiCoreDrive22 signal operation chronogram.

CURRENT & VOLTAGE SENSOR CHARACTERISTICS

SENSOR BOARD ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
V_{CC}	Supply voltage		-	±15	-	V
I_{CC}	Supply current			±25	±100	mA
Current sensors						
V_{CX}	Feedback signal of output current	*relative error <3%*	1.25	-	8.75	V
V_{PM}	Current measurable range	*see HASS200-S datasheet*	-600	-	600	A
V_{ref0}	Voltage reference 0 Amp.			5		V
G_C	Overall sensor gain			6.25		mV/A
Voltage sensor						
V_U	Feedback signal of DC-Link voltage	*relative error <2.8%*	0	-	10	V
I_{PN}	Primary nominal rms current	*see LV 25-P/SP5 datasheet*		10	14	mA
V_{PM}	DC-Link measurable voltage range		0	-	1000	V
G_V	Overall sensor gain			10		mV/V
Temperature sensor						
V_T	Feedback signal of heatsink temp.	*relative error <2.5%*	0	-	12	V
I_{PN}	Heatsink temp. Measurable range		0		120	ºC

Table 10: SCiSensor153 technical specifications.

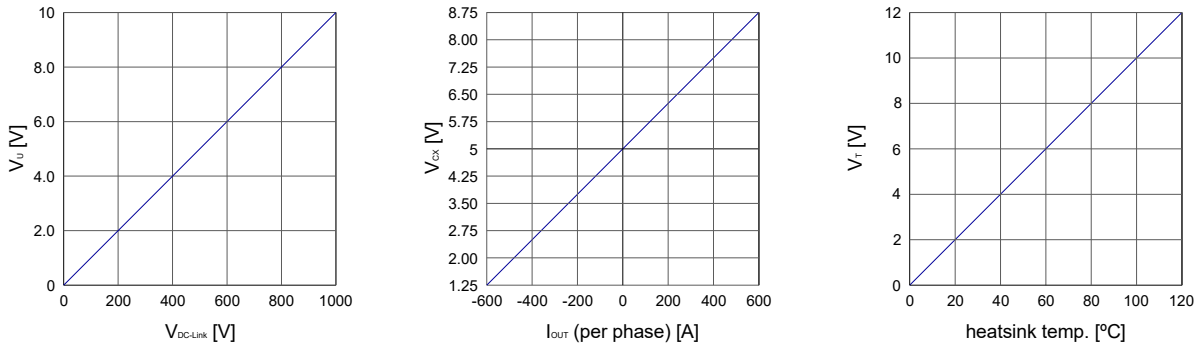


Figure 2: Default SCiSensor153 output I/U and temp. sensors span.

SIGNAL AND POWER INTERFACES

DRIVERS I/O INTERFACE AND SUPPLY

Signal connections:

J1 to J3 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 3.

J4 SENSOR CONNECTOR is the connector for SCiSensor153 sensor interface board for current and voltage signal sensors and its power supply ±15 V_{DC}. The position of this connectors on the power stack are depicted on figure 3.

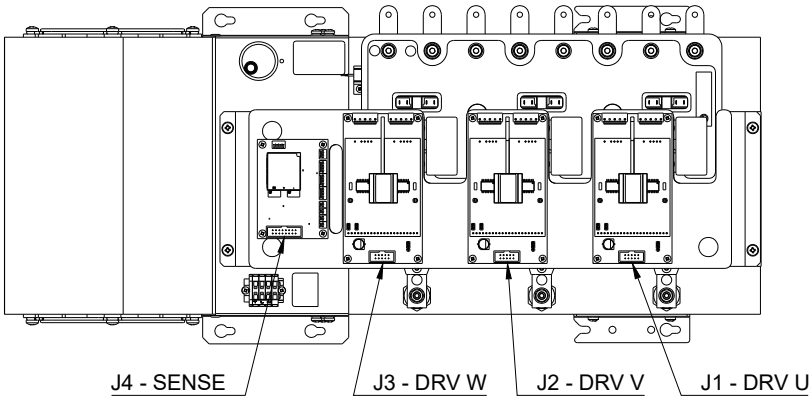


Figure 3: Position detail of signal & control connectors.

CONNECTORS PINOUT

J1...J3: DRIVERS - SCiCoreLink62

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 11: IGBT drivers pinout.

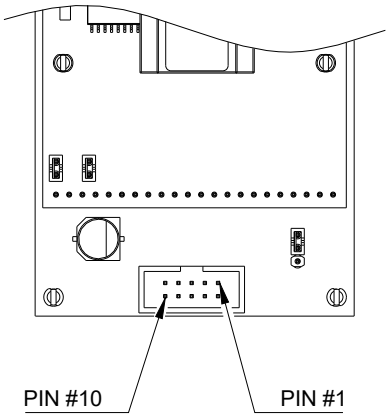


Figure 4: Connector numeration detail.

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

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

J4: SENSORS - SCiSensor153

pin	Designator	Function
1	V_{DD}	+15V_{DC} for supply voltage
2	NTC_{A1}	Not connected
3	NTC_{B2}	Not connected
4	NTC_{B1}	Not connected
5	NTC_{C1}	Not connected
6	NTC_{A2}	Not connected
7	NTC_{C2}	Not connected
8	TH2	Thermal switch terminal 2
9	V_T	Heatsink temperature
10	TH1	Thermal switch terminal 1
11	V_{C_V}	Output voltage signal phase V current
12	V_U	Output voltage signal for DC-Link voltage
13	V_{C_W}	Output voltage signal phase W current
14	V_{C_U}	Output voltage signal phase U current
15	V_{EE}	-15V_{DC} for supply voltage
16	GND	Ground terminal for supply and signals

Table 12: SCiSensor153 pinout.

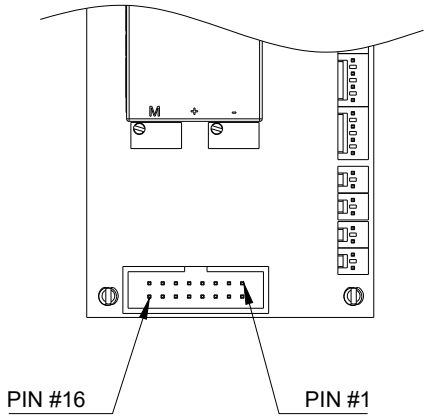
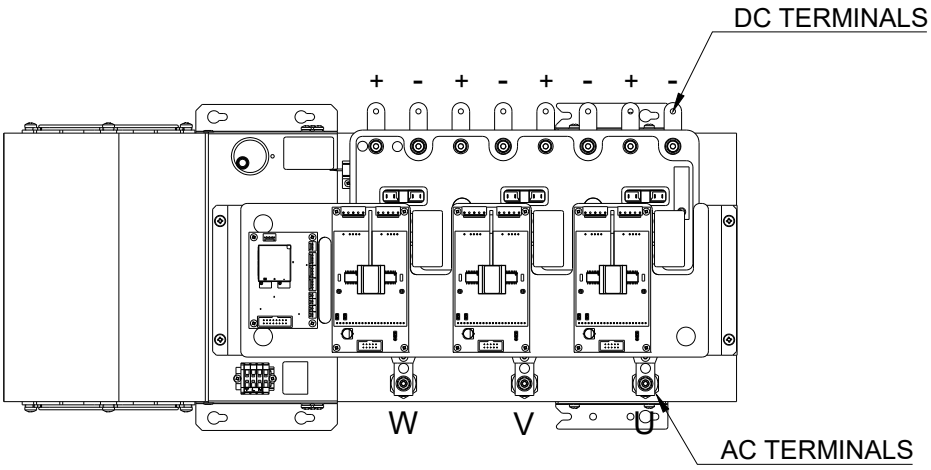


Figure 5: Connector numeration detail.

Connector type:
AMP-LATCH series, 5103309-3, TE Connectivity or equivalent alternative.

Recommended matched connector socket for PCB to flat cable connection:
AMP-LATCH series, 1658621-3, TE Connectivity.

POWER CONNECTION



TERMINAL CONNECTIONS

AC Output terminals: 3x threaded M6 studs. Thightening torque 6 Nm.

DC-Link terminals: 8x Ø6 mm on busbar. Stack includes adaptors M5 threaded. Thightening torque 4 Nm.

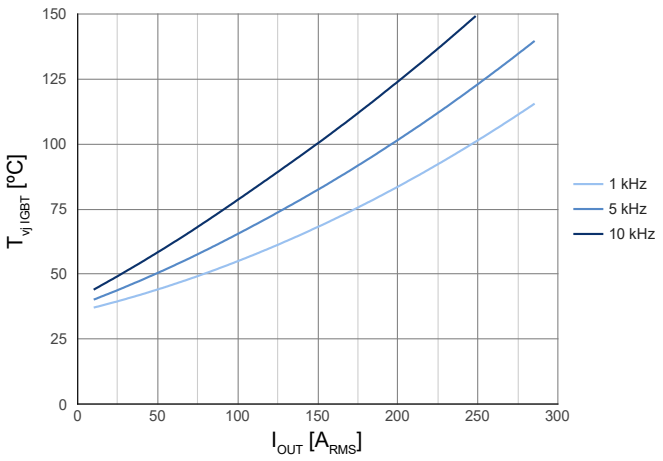
Directly compatible with MTM standard capacitor banks:

- MTM-DCL01260MKP1100 (1260 µF, 1100 V)
- MTM-DCL06200ELT1050 (6200 µF, 1050 V)
- MTM-DCL09400ELT0700 (9400 µF, 700V)

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PERFORMANCE CURVES

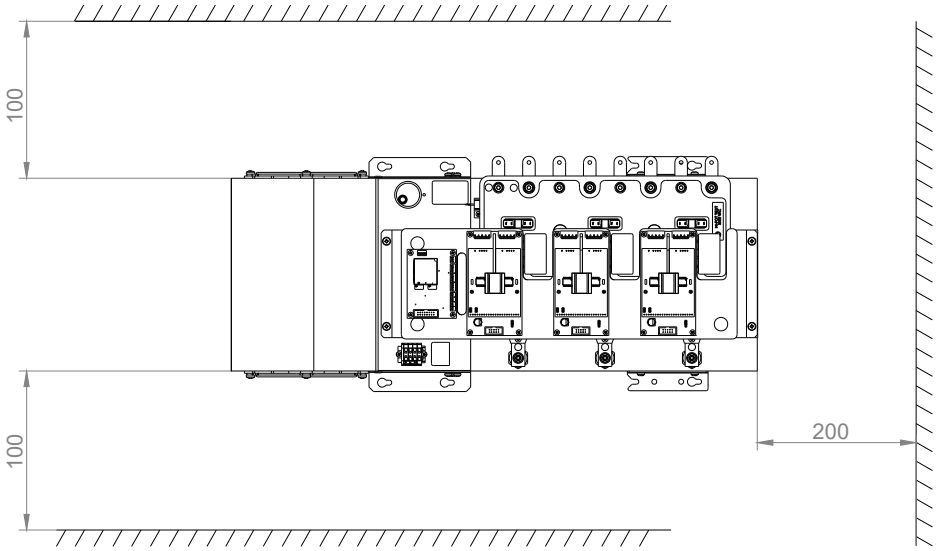
Module working as a three-phase inverter power stack.



Condition	Symbol	Value	Units
Ambient temperature	T_A	35	ºC
DC-Link voltage	V_{DCLINK}	600	V
Modulation index	m	1	
Load power factor	PF	0.85	
Output frequency	f_{OUT}	50	Hz

STACK MOUNTING CONSIDERATIONS

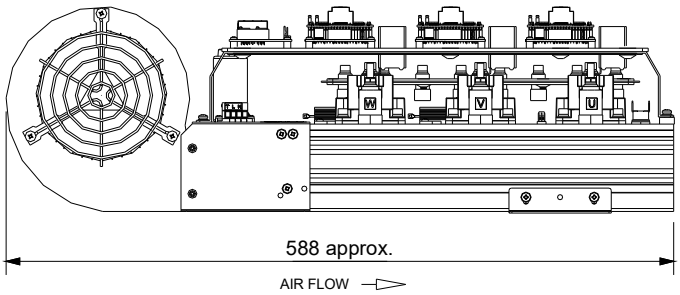
It is necessary a minimum distance of 100 to 200 mm with regard to the envelope. The free air circulation should be guaranteed avoiding external nearby heat sources from the assembly.

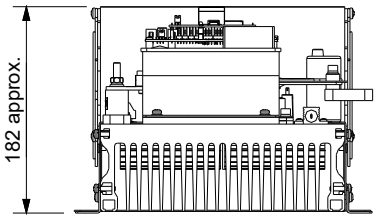


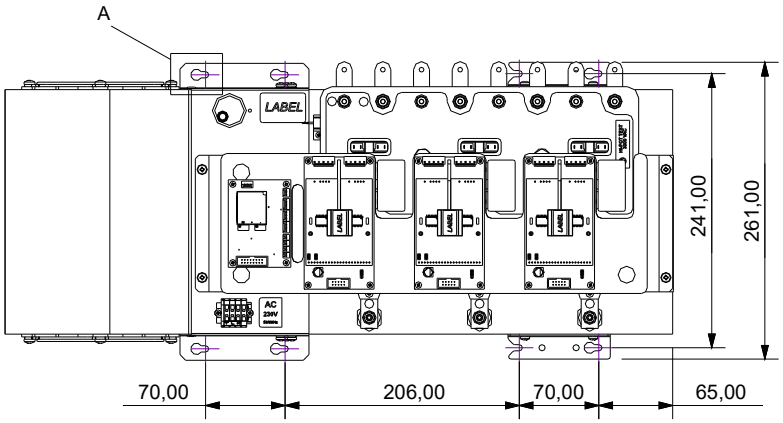
The power stack must be mounted in upright or horizontal position and tightened to a plane surface providing a correct heatsink fin air canalization and an optimal heatsink thermal performance, other mounting positions must be avoided.
When operating on final industrial application it is advisable to consider a safety margin with regards the maximum working current, we recommend a margin of the 20%.
For critical cases (24 hours work, repetitive overloads, high ambient temperature...), safety margins of 30% to 50% are used.

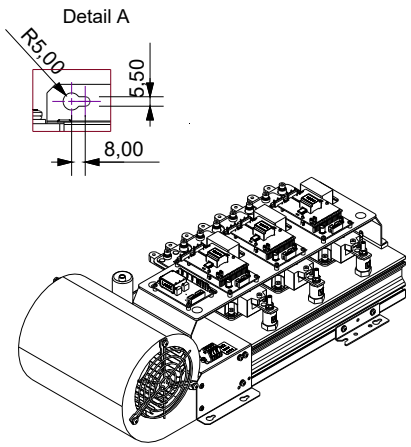
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MECHANICAL DIMENSIONS









Dimension	Typ	Units
Length	590	mm
Height	182	mm
Width	112	mm
Weight	15.5	kg

ANOTACIONES EN LA HOJA DE ESPECIFICACIONES:

RECTIFICADORES GUASCH, S.A.U. utiliza la siguiente anotación para identificar el estado del producto, en el lado izquierdo de la primera página:

Preliminary Technical Information: El producto se encuentra en proceso de diseño y desarrollo. La información presenta los datos del producto pero algunas características pueden cambiar.
Advance technical information: El producto se encuentra totalmente diseñado y las características se refieren a la fabricación en serie.
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