ABOUT MTL SERIES

RECTIFICADORES GUASCH S.A. offers a compact and ready-to-use Converter-Brake-Inverter power stack for motor control or inverter applications. This power stack includes the IGBTs (CBI module) with a heatsink, the optocoupled drivers, output phase current sensors, DC-Link voltage sensors and module temperature. The customer can work in a short delivery time with a wide range of power assemblies in a compact size.

The MTL series takes the low 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.

HIGHLIGHTS
- CBI topology
- Compact design
- Current, voltage and temperature sensors
- IGBT drivers included
- Ready to use

BRIEFING

<table>
<thead>
<tr>
<th>Topology</th>
<th>B6U+ capacitor bank + brake + B6I (CBI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market</td>
<td>industrial</td>
</tr>
<tr>
<td>Cooling system</td>
<td>natural convection</td>
</tr>
<tr>
<td>Cooling system</td>
<td>SCiCoreDrive72</td>
</tr>
<tr>
<td>Parameters monitorized</td>
<td>DC-Link voltage, Output current (3 phase)</td>
</tr>
<tr>
<td></td>
<td>internal module NTC</td>
</tr>
<tr>
<td>Max Voltage applied to DClink</td>
<td>750 V</td>
</tr>
<tr>
<td>Output current per phase</td>
<td>$f_{sw}=10,\text{kHz}$, $T_J&lt;125^\circ\text{C}$, $T_{env}=40^\circ\text{C}$</td>
</tr>
<tr>
<td></td>
<td>$f_{O}=50,\text{Hz}$, $PF=0.85$, $m=1$, $V_{IN}=400,\text{V RMS}$</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Description</th>
<th>symbol</th>
<th>notes/test conditions</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input AC voltage</td>
<td>$V_{IN,RMS}$</td>
<td>network voltage (+15%)</td>
<td>400</td>
<td>460</td>
<td></td>
<td>V_RMS</td>
</tr>
<tr>
<td>Max DC voltage</td>
<td>$V_{DC,RMS}$</td>
<td></td>
<td>750</td>
<td></td>
<td></td>
<td>V_DC</td>
</tr>
<tr>
<td>Output current per phase</td>
<td>$I_{U,V,W}$</td>
<td>$f_{sw}=10$kHz, $T_J&lt;125$ºC $T_{env}&lt;40$ºC</td>
<td>13</td>
<td></td>
<td></td>
<td>A_RMS</td>
</tr>
<tr>
<td>IGBT maximum junction temperature</td>
<td>$T_{Jmax}$</td>
<td></td>
<td>150</td>
<td></td>
<td></td>
<td>ºC</td>
</tr>
<tr>
<td>IGBT temp. under switching conditions</td>
<td>$T_{J(sw)}$</td>
<td></td>
<td>-40</td>
<td>125</td>
<td></td>
<td>ºC</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>$T_{ST}$</td>
<td></td>
<td>-40</td>
<td>85</td>
<td></td>
<td>ºC</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>$T_{OP}$</td>
<td></td>
<td>-25</td>
<td>85</td>
<td></td>
<td>ºC</td>
</tr>
<tr>
<td>Power-to-control isolation voltage</td>
<td>$V_{IGBLC}$</td>
<td>50 Hz @1min/ note 1</td>
<td>3</td>
<td></td>
<td></td>
<td>kV_RMS</td>
</tr>
<tr>
<td>Module isolation voltage</td>
<td>$V_{ISOmod}$</td>
<td>50 Hz @1min/ note 2</td>
<td>2.5</td>
<td></td>
<td></td>
<td>kV</td>
</tr>
<tr>
<td>Weight (aprox)</td>
<td></td>
<td></td>
<td>5.8</td>
<td></td>
<td></td>
<td>kg</td>
</tr>
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</table>

RECTIFIER BRIDGE CHARACTERISTICS

<table>
<thead>
<tr>
<th>Description</th>
<th>symbol</th>
<th>notes/test conditions</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repetitive reverse voltage</td>
<td>$V_{RRM}$</td>
<td>$T_J=25$ºC</td>
<td>1600</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Average forward current</td>
<td>$I_{F,AV}$</td>
<td>$T_C=80$ºC</td>
<td>37</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Max DC output rectifier current</td>
<td>$I_{F,RMS}$</td>
<td>$T_C=80$ºC $T_J=150$ºC</td>
<td>105</td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Forward voltage</td>
<td>$V_F$</td>
<td>$I_F=50$A, $T_J=125$ºC</td>
<td>1.34</td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

CAPACITOR BANK CHARACTERISTICS

<table>
<thead>
<tr>
<th>Description</th>
<th>symbol</th>
<th>typ.</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single capacitor</td>
<td>$C$</td>
<td>Electrolytic type 1000 µF 250 V</td>
<td></td>
</tr>
<tr>
<td>Total equivalent capacitance</td>
<td>$C_{equiv}$</td>
<td>1000 µF</td>
<td></td>
</tr>
<tr>
<td>Capacitance Tolerance</td>
<td></td>
<td>±20%</td>
<td></td>
</tr>
<tr>
<td>max capacitor bank DC voltage</td>
<td>$V_{DC,HK}$</td>
<td>750 V</td>
<td></td>
</tr>
</tbody>
</table>

COOLING SYSTEM CHARACTERISTICS

<table>
<thead>
<tr>
<th>Description</th>
<th>symbol</th>
<th>notes/test conditions</th>
<th>Typical</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td>natural convection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan system supply voltage</td>
<td>$V_{FAN}$</td>
<td>N/A</td>
<td>$V_{DC}$</td>
<td></td>
</tr>
<tr>
<td>Fan system consumption</td>
<td>$I_{FAN}$</td>
<td>N/A</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

Note 1: This isolation voltage is referred to the minimum isolation voltage between any control/feedback signal (PWM, reset, fault, feedback sensor signals and supply) and any power voltage (AC/DC input, AC output).

Note 2: This is an inner property of the IGBT module. It refers to the isolation between the internal chip and the external case.

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BRAKE ARM CHARACTERISTICS

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Notes/Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake IGBT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-Emitter Voltage</td>
<td>VCES</td>
<td>TJ = 25 ºC</td>
<td>1200</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Collector current</td>
<td>ICM</td>
<td>TO = 80 ºC</td>
<td>12</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>VCEsat</td>
<td>IC = 9 A, TJ = 125 ºC</td>
<td>2.1</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brake Diode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetitive reverse voltage</td>
<td>VRRM</td>
<td>TJ = 25 ºC</td>
<td>1200</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average forward current</td>
<td>IFAV</td>
<td>TC = 80 ºC</td>
<td>8</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>VF</td>
<td>Ic = 5 A, TJ = 125 ºC</td>
<td>1.85</td>
<td>V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

INVERTER CHARACTERISTICS

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Notes/Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverter IGBT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-Emitter Voltage</td>
<td>VCES</td>
<td>TJ = 25 ºC</td>
<td>1200</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DC Collector current</td>
<td>ICM</td>
<td>TO = 80 ºC, TJ = 150 ºC</td>
<td>20</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collector-emitter saturation voltage</td>
<td>VCEsat</td>
<td>IC = 16 A, TJ = 125 ºC</td>
<td>2.1</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Wheeling Diode</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Repetitive reverse voltage</td>
<td>VRRM</td>
<td>TJ = 25 ºC</td>
<td>1200</td>
<td>V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average forward current</td>
<td>IFAV</td>
<td>TO = 80 ºC, TJ = 150 ºC</td>
<td>13</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forward voltage</td>
<td>VF</td>
<td>Ic = 13 A, TJ = 125 ºC</td>
<td>2.27</td>
<td>V</td>
<td></td>
<td></td>
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</tbody>
</table>

ENVIRONMENTAL SPECIFICATIONS

<table>
<thead>
<tr>
<th>Description</th>
<th>Protection grade (EN-60529 / CEI529 / UNE-20324)</th>
<th>Humidity max.</th>
<th>Pollution degree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IP-00</td>
<td>50% RH @ 35ºC</td>
<td>III</td>
</tr>
</tbody>
</table>

MOUNTING CONSIDERATIONS

It’s necessary a minimum distance of 100 mm with regard to the envelope. The free air circulation should be guaranteed. Avoiding the heat sources of nearby to assembly. In the 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...), margins of the 30% to 50% are used.
Drivers General Characteristics

MTL includes a 7-channel driver designed to control CBI topology with an internal isolated DC-DC converter per channel.
Includes a $V_{CE}$ monitoring of each IGBT, providing the necessary protection of this one in case of desat failure by soft turning-off the corresponding IGBT, and triggering an optically isolated feedback fault signal, it also provides an under voltage lock out protection to avoid trigger the IGBT with insufficient gate voltage. Each one of the 7 drivers are completely independent from the others.

### Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Symbol</th>
<th>Notes/Test Conditions</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic low input voltages (PWM &amp; reset)</td>
<td>$V_{IN,RESET}$</td>
<td></td>
<td>-0.5</td>
<td>0.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Logic high input voltages (PWM &amp; reset)</td>
<td>$V_{IN,RESET}$</td>
<td></td>
<td>2.0</td>
<td>5.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Logic high input voltages (relay)</td>
<td>$V_{RELAY}$</td>
<td></td>
<td>5</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Fault output current</td>
<td>$I_{FAULT}$</td>
<td></td>
<td>8</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Logic low input current (PWM &amp; reset)</td>
<td>$I_{IN,RESET}$</td>
<td></td>
<td>-0.5</td>
<td>-0.4</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Logic high input current (relay)</td>
<td>$I_{IN,RELAY}$</td>
<td>$V_{RELAY} = 5V$</td>
<td>20</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>High output propagation time</td>
<td>$t_{d ON}$</td>
<td></td>
<td>300</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Low output propagation time</td>
<td>$t_{d OFF}$</td>
<td></td>
<td>440</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Desat. detection to FAULT output delay</td>
<td>$t_{d FAULT}$</td>
<td>$C_G = 10,nF$</td>
<td>320</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Blanking time</td>
<td>$t_{blank}$</td>
<td>$R_G = 15,\Omega$</td>
<td>460</td>
<td></td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>Desat. detection to 90% $V_{OUT}$</td>
<td>$t_{d DES(90)}$</td>
<td></td>
<td>1.8</td>
<td>5</td>
<td>5</td>
<td>µs</td>
</tr>
<tr>
<td>Desat. detection to 10% $V_{OUT}$</td>
<td>$t_{d DES(10)}$</td>
<td></td>
<td>20</td>
<td>0.3</td>
<td>0.5</td>
<td>µs</td>
</tr>
<tr>
<td>Reset to fault</td>
<td>$t_{d RES,FAULT}$</td>
<td></td>
<td>3</td>
<td>7</td>
<td>3</td>
<td>µs</td>
</tr>
<tr>
<td>Minimum pulse width for RESET</td>
<td>$PW_{RES,min}$</td>
<td></td>
<td>0.1</td>
<td></td>
<td></td>
<td>µs</td>
</tr>
</tbody>
</table>

### Warning Note:

Driver system does not generate dead time between channels. The user must ensure a correct dead time generation (no less than 1 µs) with the control signals between the two IGBTs from each branch. If both IGBTs from a branch switch on at the same time the module can be damaged.
### SENSORS ELECTRICAL CHARACTERISTICS

<table>
<thead>
<tr>
<th>Description</th>
<th>symbol</th>
<th>notes/test conditions</th>
<th>min</th>
<th>typ.</th>
<th>max.</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>$V_{CC}$</td>
<td>±15</td>
<td>V</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback signal of output current</td>
<td>$V_{CUW}$</td>
<td>Accuracy=±0.65%</td>
<td>-7.5</td>
<td>7.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output current measurable range</td>
<td>@ $I_{max}$=20 A</td>
<td>-20</td>
<td>20</td>
<td>A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feedback signal of VDC-link voltage</td>
<td>$V_{U}$</td>
<td>Accuracy=±0.8%</td>
<td>0</td>
<td>7.5</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>DC-link voltage measurable range</td>
<td>@ $V_{DC}$=750V</td>
<td>0</td>
<td>750</td>
<td>$V_{DC}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NTC rated resistance</td>
<td>$R_{NTC}$</td>
<td>internal module</td>
<td>NTC</td>
<td>≤25ºC</td>
<td>5</td>
<td>kΩ</td>
</tr>
<tr>
<td>NTC B value</td>
<td>$B_{25/50}$</td>
<td>note 3</td>
<td>3375</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note 3:**

$$R_f = R_{25} \cdot e^{0.1 \left[ \frac{1}{T[K]} - \frac{1}{298.15K} \right]}$$

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EXTERNAL CONNECTIONS

Signal connections:

**J1 CONTROL CONNECTOR** (male DB-25) is the main connector for the control switching signals for each IGBT, reset signal, capacitor precharge relay signal, and output fault signals. Also can be used to supply the drivers $+12 \, V_{DC}$. Pinout of this connector below.

Please find the device designation correspondence with the general schematic on the first page of this datasheet.

### J1 - DB25 CONTROL CONNECTOR

<table>
<thead>
<tr>
<th>pin</th>
<th>designation</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FAULT T1</td>
<td>Fault open collector output signal from T1 channel</td>
</tr>
<tr>
<td>2</td>
<td>RESET</td>
<td>Input logic signal for reset the driver</td>
</tr>
<tr>
<td>3</td>
<td>PWM T1</td>
<td>Input logic signal for switching T1 IGBT</td>
</tr>
<tr>
<td>4</td>
<td>GND CTL</td>
<td>Ground terminal for supply and logic signals (note 4)</td>
</tr>
<tr>
<td>5</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>6</td>
<td>VIN</td>
<td>$+12 , V_{DC}$ from supply voltage</td>
</tr>
<tr>
<td>7</td>
<td>FAULT T7</td>
<td>Fault open collector output signal from T7 channel</td>
</tr>
<tr>
<td>8</td>
<td>GND CTL</td>
<td>Ground terminal for supply and logic signals</td>
</tr>
<tr>
<td>9</td>
<td>PWM T7</td>
<td>Input logic signal for switching T7 IGBT</td>
</tr>
<tr>
<td>10</td>
<td>FAULT T6</td>
<td>Fault open collector output signal from T6 channel</td>
</tr>
<tr>
<td>11</td>
<td>GND CTL</td>
<td>Ground terminal for supply and logic signals</td>
</tr>
<tr>
<td>12</td>
<td>PWM T6</td>
<td>Input logic signal for switching T6 IGBT</td>
</tr>
<tr>
<td>13</td>
<td>RELAY</td>
<td>Input logic signal for switching the DC-Link relay (note 5)</td>
</tr>
<tr>
<td>14</td>
<td>PWM T3</td>
<td>Input logic signal for switching T3 IGBT</td>
</tr>
<tr>
<td>15</td>
<td>VIN</td>
<td>$+12 , V_{DC}$ from supply voltage</td>
</tr>
<tr>
<td>16</td>
<td>FAULT T3</td>
<td>Fault open collector output signal from T3 channel</td>
</tr>
<tr>
<td>17</td>
<td>PWM T5</td>
<td>Input logic signal for switching T5 IGBT</td>
</tr>
<tr>
<td>18</td>
<td>GND CTL</td>
<td>Ground terminal for supply and logic signals</td>
</tr>
<tr>
<td>19</td>
<td>FAULT T5</td>
<td>Fault open collector output signal from T5 channel</td>
</tr>
<tr>
<td>20</td>
<td>PWM T2</td>
<td>Input logic signal for switching T2 IGBT</td>
</tr>
<tr>
<td>21</td>
<td>VIN</td>
<td>$+12 , V_{DC}$ from supply voltage</td>
</tr>
<tr>
<td>22</td>
<td>FAULT T2</td>
<td>Fault open collector output signal from T2 channel</td>
</tr>
<tr>
<td>23</td>
<td>PWM T4</td>
<td>Input logic signal for switching T4 IGBT</td>
</tr>
<tr>
<td>24</td>
<td>VIN</td>
<td>$+12 , V_{DC}$ from supply voltage</td>
</tr>
<tr>
<td>25</td>
<td>FAULT T4</td>
<td>Fault open collector output signal from T4 channel</td>
</tr>
</tbody>
</table>

**Note 4:** All ground terminals “GND  CTL” are internally interconnected.

**Note 5:** When powered, user must leave “RELAY” signal to 0 V (relay open) to precharge the capacitor bank. The user must ensure the capacitor bank is completely charged before switching on the relay (“RELAY” = 1). This can be accomplished sensing the voltage on DC-Link or waiting for about 2 seconds.
**J2 SENSORS CONNECTOR** (female DB-25) is the main connector for the sensor signals: current outputs, DC-Link voltage and temperature sensor from CBI module. Below you can find the pinout for this connector.

### J2 - DB25 SENSORS CONNECTOR

<table>
<thead>
<tr>
<th>pin</th>
<th>designation</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DCLINK U</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>2</td>
<td>DCLINK A</td>
<td>Output signal from DC-Link voltage sensor</td>
</tr>
<tr>
<td>3</td>
<td>OUT_I_U</td>
<td>Output signal from U line current sensor</td>
</tr>
<tr>
<td>4</td>
<td>OUT_I_V</td>
<td>Output signal from V line current sensor</td>
</tr>
<tr>
<td>5</td>
<td>OUT_I_W</td>
<td>Output signal from W line current sensor</td>
</tr>
<tr>
<td>6</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>7</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>8</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>9</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>10</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>11</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>12</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>13</td>
<td>NC</td>
<td>Leave this pin unconnected</td>
</tr>
<tr>
<td>14</td>
<td>VDD</td>
<td>15 VDC from supply voltage for sensors</td>
</tr>
<tr>
<td>15</td>
<td>VDD</td>
<td>15 VDC from supply voltage for sensors</td>
</tr>
<tr>
<td>16</td>
<td>VDD</td>
<td>15 VDC from supply voltage for sensors</td>
</tr>
<tr>
<td>17</td>
<td>GND SENS</td>
<td>Ground terminal for sensors supply and logic signals (note 6)</td>
</tr>
<tr>
<td>18</td>
<td>GND SENS</td>
<td>Ground terminal for sensors supply and logic signals</td>
</tr>
<tr>
<td>19</td>
<td>NTC1</td>
<td>NTC1 signal from CBI module</td>
</tr>
<tr>
<td>20</td>
<td>NTC2</td>
<td>NTC2 signal from CBI module</td>
</tr>
<tr>
<td>21</td>
<td>GND SENS</td>
<td>Ground terminal for sensors supply and logic signals</td>
</tr>
<tr>
<td>22</td>
<td>GND SENS</td>
<td>Ground terminal for sensors supply and logic signals</td>
</tr>
<tr>
<td>23</td>
<td>VEE</td>
<td>-15 VDC from supply voltage for sensors</td>
</tr>
<tr>
<td>24</td>
<td>VEE</td>
<td>-15 VDC from supply voltage for sensors</td>
</tr>
<tr>
<td>25</td>
<td>VEE</td>
<td>-15 VDC from supply voltage for sensors</td>
</tr>
</tbody>
</table>

Note 6: All ground terminals GND SENS are internally interconnected but isolated from GND_CTL.
Power connections:

J3 POWER TERMINALS is the main power connector for the stack. There are the connections for the AC power supply (R, S, T). The output terminals (U, V, W) for the load, Brake and VDCLINK+ to use a brake resistor, earth connection and, additionally, connections for VDCLINK- and VDCLINK+R (positive output of DCLINK at the rectifier bridge output). Below you can find the pinout.

### J3 - POWER TERMINALS

<table>
<thead>
<tr>
<th>terminal</th>
<th>designation</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EARTH</td>
<td>Earth connection</td>
</tr>
<tr>
<td>2</td>
<td>BRK</td>
<td>Brake output</td>
</tr>
<tr>
<td>3</td>
<td>NC</td>
<td>Leave this pole unconnected</td>
</tr>
<tr>
<td>4</td>
<td>VDCLINK +R</td>
<td>Positive power terminal from rectifier bridge</td>
</tr>
<tr>
<td>5</td>
<td>VDCLINK +I</td>
<td>Positive power terminal from inverter DC-Link</td>
</tr>
<tr>
<td>6</td>
<td>VDCLINK-</td>
<td>Negative power terminal from inverter DC-Link</td>
</tr>
<tr>
<td>7</td>
<td>R IN</td>
<td>R phase input</td>
</tr>
<tr>
<td>8</td>
<td>S IN</td>
<td>S phase input</td>
</tr>
<tr>
<td>9</td>
<td>T IN</td>
<td>T phase input</td>
</tr>
<tr>
<td>10</td>
<td>W OUT</td>
<td>W phase output</td>
</tr>
<tr>
<td>11</td>
<td>V OUT</td>
<td>V phase output</td>
</tr>
<tr>
<td>12</td>
<td>U OUT</td>
<td>U phase output</td>
</tr>
</tbody>
</table>

J4 DC POWER SUPPLY CONNECTOR is the auxiliary power connector for the stack. The system must be supplied with 12Vdc with this connector. It supplies the power for the drivers, the precharge relay and the fans (if the system has a air forced heatsink).

### J4 - DC POWER SUPPLY CONNECTOR

<table>
<thead>
<tr>
<th>terminal</th>
<th>designation</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VIN</td>
<td>12 Vdc supply voltage</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>GND supply voltage</td>
</tr>
</tbody>
</table>

J5 FAN POWER CONNECTOR is the power connector for the fan system. This connector sinks directly the power from J4 connector. (Not used on natural cooling versions)

### J5 - FAN POWER CONNECTOR

<table>
<thead>
<tr>
<th>terminal</th>
<th>designation</th>
<th>function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>GND supply voltage</td>
</tr>
<tr>
<td>2</td>
<td>VIN</td>
<td>+12 Vdc supply voltage</td>
</tr>
</tbody>
</table>

Reserves the right to change limits, test conditions and dimensions given in this data sheet at any time without previous notice.
In order to supply the power stack user must feed the drivers, capacitor bank precharge relay and fan system (if applicable) with 12 V\textsubscript{DC} from J3 or with the DB25 connector J2 (see: J2-DB25 CONTROL CONNECTOR pinout table).

Sensors must be supplied (±15 V\textsubscript{DC}) through J1 (see: J1-DB25 SENSORS CONNECTOR pinout table).

<table>
<thead>
<tr>
<th>Description</th>
<th>symbol</th>
<th>notes/test conditions</th>
<th>min.</th>
<th>typ.</th>
<th>max.</th>
<th>units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver voltage supply</td>
<td>( V_{\text{IN}} )</td>
<td></td>
<td>10.8</td>
<td>12</td>
<td>13.2</td>
<td>V</td>
</tr>
<tr>
<td>Driver power supply</td>
<td>( I_{\text{IN}} )</td>
<td></td>
<td>300</td>
<td></td>
<td>900</td>
<td>mA</td>
</tr>
<tr>
<td>Sensors voltage supply</td>
<td>( V_{\text{SENSE}} )</td>
<td></td>
<td></td>
<td>±15</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Sensors power supply</td>
<td>( I_{\text{SENSE}} )</td>
<td></td>
<td>50</td>
<td></td>
<td>250</td>
<td>mA</td>
</tr>
</tbody>
</table>
MECHANICAL DIMENSIONS (All dimensions in mm.)

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

T_{J,IGBT} vs I_{OUT} (per phase, AC output)

<table>
<thead>
<tr>
<th>Condition</th>
<th>symbol</th>
<th>value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>T_A</td>
<td>40</td>
<td>°C</td>
</tr>
<tr>
<td>Input voltage (each phase)</td>
<td>V_IN</td>
<td>400</td>
<td>V_{RMS}</td>
</tr>
<tr>
<td>Input frequency</td>
<td>f_{in}</td>
<td>50</td>
<td>Hz</td>
</tr>
<tr>
<td>DC link voltage</td>
<td>V_{DClink}</td>
<td>555</td>
<td>V_{DC}</td>
</tr>
<tr>
<td>Modulation index</td>
<td>m</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Load power factor</td>
<td>PF</td>
<td>0.85</td>
<td></td>
</tr>
<tr>
<td>Output frequency</td>
<td>f_{OUT}</td>
<td>50</td>
<td>Hz</td>
</tr>
</tbody>
</table>
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