Fuji IGBT Modules for Welding machine

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## Topology in Welding machine

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<th>Topology (example)</th>
<th>Feature</th>
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</table>
| **Hard switching type** | • Duty control method  
• IGBT: small turn on and large turn off loss  
• FWD: small reverse recovery loss |
| ![Hard switching type](image1) |
| **Soft switching type (ZVS)** | • IGBT: zero voltage switching at turn on, and hard switching at turn off.  
• FWD: small reverse recovery loss |
| ![Soft switching type (ZVS)](image2) |
| **Soft switching Type (ZVZCS)** | • IGBT: zero voltage zero current switching at turn on, and hard switching at turn off.  
• FWD: small reverse recovery loss |
| ![Soft switching Type (ZVZCS)](image3) |
Topoogy in Welding machine

■ Topology (Hard switching type)

![Diagram of IGBT and FWD components]

- **Chopper Module:**
  - IGBT1 FWD1
  - IGBT2 FWD2
  - IGBT4 FWD4

- **H bridge (2in1):**
  - 1MBI200HH-120L-50
  - 1MBI300HH-120L-50
  - 1MBI400HH-120L-50

■ Feature:

- Duty control method
- IGBT: small turn on and large turn off loss (high speed IGBT is necessary.)
- FWD: small reverse recovery loss (high speed diode in 2in1 module is not necessary.)

![Waveform diagram showing IGBT and FWD operation]

- Generation of large switching loss

- FWD current is small and it is only leakage inductance energy.
Topology in Welding machine

■ Topology (Soft switching type)

- Chopper Module:
  - 1MBI200HH-120L-50
  - 1MBI300HH-120L-50
  - 1MBI400HH-120L-50

- H bridge (2in1)
  - 2MBI100HB-120-50
  - 2MBI200HH-120-50
  - 2MBI300HH-120-50

■ Feature:
- IGBT: zero voltage switching at turn on, and hard switching at turn off. (high speed IGBT is necessary.)
- FWD: small reverse recovery loss (high speed diode in 2in1 module is not necessary.)
Fuji IGBT module for Welding machine

<table>
<thead>
<tr>
<th>Welding output</th>
<th>IGBT P/N (2in1 module)</th>
<th>IGBT P/N (chopper module)</th>
</tr>
</thead>
<tbody>
<tr>
<td>125A</td>
<td>2MBI100HB-120-50</td>
<td>1MBI200HH-120L-50</td>
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<tr>
<td>160A</td>
<td>2MBI100HB-120-50</td>
<td>1MBI200HH-120L-50</td>
</tr>
<tr>
<td>250A</td>
<td>2MBI100HB-120-50</td>
<td>1MBI200HH-120L-50</td>
</tr>
<tr>
<td>315A</td>
<td>2MBI100HB-120-50</td>
<td>1MBI200HH-120L-50</td>
</tr>
<tr>
<td>400A</td>
<td>2MBI150HH-120-50</td>
<td>1MBI200HH-120L-50</td>
</tr>
<tr>
<td>500A</td>
<td>2MBI150HH-120-50</td>
<td>1MBI200HH-120L-50</td>
</tr>
<tr>
<td>630A</td>
<td>2MBI200HH-120-50</td>
<td>1MBI200HH-120L-50</td>
</tr>
</tbody>
</table>

- 2MBI100HB-120-50
- 2MBI150HH-120-50
- 1MBI200HH-120L-50
- 1MBI300HH-120L-50
- 1MBI400HH-120L-50
Fuji IGBT module for Welding machine

- **High performance for high carrier frequency application**
  - Optimized design for $fc = 20 \sim 50\text{kHz}$
    - Lower switching loss, lower surge voltage
  - Low thermal impedance package
    - New Si$_3$N$_4$-DCB substrate, RoHS package

- **2in1 module and Chopper module lineup**
  - **2in1 module:** 1200V / 100A ~ 200A
  - **Chopper module:** 1200V / 200A ~ 400A with NTC

Carrier frequency: $fc$
Fuji IGBT module for Welding machine

1/2 half-bridge - 2in1 module  ※only for soft turn on
High-speed IGBT + Standard, small FWD
2MBI100HB-120-50  (1200V/100A  Pkg: M233)
2MBI150HH-120-50  (1200V/150A  Pkg: M249)
2MBI200HH-120-50  (1200V/200A  Pkg: M249)

PFC – Chopper module + NTC
High-speed IGBT + High speed diode + NTC
1MBI200HH-120L-50  (1200V/200A  Pkg: M249)
1MBI300HH-120L-50  (1200V/300A  Pkg: M249)
1MBI400HH-120L-50  (1200V/400A  Pkg: M249)

RoHS, SiN-DBC
Small stray inductance is necessary to reduce surge voltage. Laminated bus bar or snubber capacitor are effective.

Large inductance → Large surge voltage
Small inductance → Small surge voltage

Recommended line inductance: $L_s < 20 \text{nH}$

Inductance of copper wire: $1 \text{cm} = 1 \text{nH}$
To realize $L_s = 20\,\text{nH}$, connect module and dc bus by short wire and attach snubber capacitor on the module.
## Fuji solution in GDU

<table>
<thead>
<tr>
<th>IC rating</th>
<th>IGBT P/N (example)</th>
<th>Driver type (example)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100A</td>
<td>2MBI100HB-120-50</td>
<td>2SP0115T2Ax</td>
</tr>
<tr>
<td>150A</td>
<td>2MBI150HH-120-50</td>
<td>2SP0115T2Ax</td>
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<tr>
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<td>2SP0115T2Ax</td>
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<tr>
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<td>1MBI300HH-120-50</td>
<td>2SP0115T2Ax</td>
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<tr>
<td>400A</td>
<td>1MBI400HH-120-50</td>
<td>2SP0115T2Ax</td>
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</tbody>
</table>

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<th>IC rating</th>
<th>IGBT P/N (example)</th>
<th>Driver type (example)</th>
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</thead>
<tbody>
<tr>
<td>100A</td>
<td>2MBI100HB-120-50</td>
<td>VLA546**</td>
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<tr>
<td>150A</td>
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<td>VLA546**</td>
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<td>VLA546**</td>
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<tr>
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<td>VLA546**</td>
</tr>
<tr>
<td>300A</td>
<td>1MBI300HH-120-50</td>
<td>VLA546**</td>
</tr>
<tr>
<td>400A</td>
<td>1MBI400HH-120-50</td>
<td>VLA500K</td>
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