Application Note: Powering Inverters from a DC Supply

Please refer also to the Inverter Instruction Manual

AN091802-1 Rev A

Hitachi America, Ltd.
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Powering Inverters from DC

It is possible to power inverters from a DC Power source, or to connect the DC Bus of multiple inverters together to achieve energy savings, since inverters in power driving mode can use power from those that are in regeneration mode.

[1] Connection method

There are several ways for DC bus connection of the inverters. (Examples of 3-phase 200V or 400V class inverter.)

Case 1: Connected in parallel to a common DC bus

- DC power supply

Case 2: Connected in parallel to an AC-fed inverter

- AC power supply

Case 3: AC & DC Connected together

- AC power supply

Case 4: DC supply connection methods

- Connecting to + and - terminal
- Connecting to AC inputs and - terminal

Advantage and disadvantages of Case 4 connection method.

<table>
<thead>
<tr>
<th>Item</th>
<th>Contents</th>
<th>Advantage</th>
<th>Disadvantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connecting to + &amp; - terminal</td>
<td>No concern for the rectifier bridge diodes.</td>
<td>There will be no inrush current limiting.</td>
</tr>
<tr>
<td>2</td>
<td>Connecting to AC inputs and - terminal</td>
<td>Integrated inrush current limiting circuit is used.</td>
<td>Rectifier bridge diodes of the main inverter may need to be up-sized.</td>
</tr>
</tbody>
</table>
[2] DC voltage to be supplied

<table>
<thead>
<tr>
<th>Model</th>
<th>Class</th>
<th>UV</th>
<th>BRD ON</th>
<th>OV (regen)</th>
<th>OV source</th>
</tr>
</thead>
<tbody>
<tr>
<td>SJ200</td>
<td>200V</td>
<td>UV: 172.5+/-10Vdc&lt;br&gt;UV Retry: 192.5+/-10Vdc</td>
<td>Adjustable by [b096]&lt;br&gt;330~395Vdc</td>
<td>405+/-10Vdc</td>
<td>380Vdc+/-10Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>UV: 345+/-20Vdc&lt;br&gt;UV Retry: 385+/-20Vdc</td>
<td>Adjustable by [b096]&lt;br&gt;660~790Vdc</td>
<td>800+/-20Vdc</td>
<td>750Vdc+/-20Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td>L200</td>
<td>200V</td>
<td>same SJ200</td>
<td>(No BRD)</td>
<td>same SJ200</td>
<td>same SJ200</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>same SJ200</td>
<td>(No BRD)</td>
<td>same SJ200</td>
<td>same SJ200</td>
</tr>
<tr>
<td>X200</td>
<td>200V</td>
<td>UV: 175+/-10Vdc&lt;br&gt;UV Retry: 195+/-10Vdc</td>
<td>(No BRD)</td>
<td>400+/-10Vdc</td>
<td>390+/-10Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>UV: 345+/-20Vdc&lt;br&gt;UV Retry: 390+/-20Vdc</td>
<td>(No BRD)</td>
<td>800+/-20Vdc</td>
<td>780+/-20Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td>WJ200</td>
<td>200V</td>
<td>UV: 172.5+/-10Vdc&lt;br&gt;UV Retry: 195+/-10Vdc</td>
<td>Adjustable by [b096]&lt;br&gt;330~380Vdc</td>
<td>400+/-10Vdc</td>
<td>390+/-10Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>UV: 345+/-20Vdc&lt;br&gt;UV Retry: 390+/-20Vdc</td>
<td>Adjustable by [b096]&lt;br&gt;660~760Vdc</td>
<td>800+/-20Vdc</td>
<td>780+/-20Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td>SJ700</td>
<td>200V</td>
<td>UV: 175+/-10Vdc&lt;br&gt;UV Retry: 195+/-10Vdc</td>
<td>Adjustable by [b096]&lt;br&gt;330~380Vdc</td>
<td>400+/-10Vdc</td>
<td>390+/-10Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>UV: 345+/-20Vdc&lt;br&gt;UV Retry: 390+/-20Vdc</td>
<td>Adjustable by [b096]&lt;br&gt;660~760Vdc</td>
<td>800+/-20Vdc</td>
<td>780+/-20Vdc&lt;br&gt;Holds 100s</td>
</tr>
<tr>
<td>L700</td>
<td>200V</td>
<td>Same as SJ700</td>
<td>Same as SJ700</td>
<td>Same as SJ700</td>
<td>Same as SJ700</td>
</tr>
<tr>
<td></td>
<td>400V</td>
<td>Same as SJ700</td>
<td>Same as SJ700</td>
<td>Same as SJ700</td>
<td>Same as SJ700</td>
</tr>
</tbody>
</table>

[3] Cautions

Case 1 : Connected parallel to a common DC net

- Take preventive measures to limit inrush current at power ON, since the integrated inrush current limiting circuit is not used.
  - Otherwise there will be an unexpected UV at net side or damage to the inverter caused by ΔV=di/dt.
- Use DC chokes for each inverter to avoid interaction due to surge and/or harmonics.
  - Otherwise there may be an unexpected failure of the inverter or other attached equipment.
- Take preventive measures to ensure sufficient time between UV level and dead voltage of the DC/DC converter (*1) at power OFF. This is to allow ample time for EEPROM to store the existing data at power OFF. (Δt ; see below)
  - Otherwise there is a possibility of an EEPROM error at the next power ON.

Main power (AC)
For Cases 2 & 3

OFF

DC bus voltage
For Cases 1~3

UV level

Threshold voltage of DC-DC converter
(This value depends on the inverter model.
But in general it is around 100Vdc)

DC-DC conv.
(internal 5V)

EEPROM store period

Around 0.5~1s or more

(*1) The required time depends on the parameters which have changed before power OFF.
Case 2: DC Bus connected n parallel to a single AC-fed inverter

Pay attention to the selection of the main inverter (#1) because all the input current flows through the rectifier bridge of this inverter. (*2)

Need sufficient time for EEPROM to store the data. (Refer to Case 1)

Use DC choke. (Refer to Case 1)

Selection of the main inverter kW

(*2) Capacity of the main inverter
Rated current of the main inverter should be higher than;
- Total rated current of the inverters
- Possible highest total motor current

Example of 4 inverters in parallel
- \(i_{M1(max)} = i_{M2(max)} = i_{M3(max)} = i_{M4(max)} = 9.5 \text{ Arms}\)

In this case, the total motor current under the possible worst case is higher than that of the inverters.

\[
\text{Total inverter rated current} = i_1 + i_2 + i_3 + i_4 = 9.0 \times 4 = 36 \text{ Arms}
\]

\[
\text{Total motor current under possible worst case} = i_{M1(max)} + i_{M2(max)} + i_{M3(max)} + i_{M4(max)} = 38 \text{ Arms}
\]

Main inverter must therefore be SJ700-185HFxF2 (38A) or larger. SJ700-220HFxF2 is suggested to provide additional safety margin.