# Instruction Manual

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BRNS-7

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1 Connection for Standard Use

In order to use power supply, it is necessary to wire as shown in Fig 1.1.

- Short the following pins to turn on the power supply.
  - Reference 3.3 “Remote Sensing”
- Connect resistance to set the output voltage between TRM and GND
  - Reference 3.4 “Adjustment output voltage”
- Between input and output is not isolated.
- The BRNS series handle only the DC input. Avoid applying AC input directly. It will damaged the power supply.

![Diagram of Connection for Standard Use](image)

Table 1.1 External parts

<table>
<thead>
<tr>
<th>No.</th>
<th>parts</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F1: Fuse</td>
<td>2.1 (1) External fuse</td>
</tr>
<tr>
<td>2</td>
<td>Ci: External output capacitor</td>
<td>2.1 (2) External input capacitor</td>
</tr>
<tr>
<td>3</td>
<td>RTRM: Resistance for adjustment output voltage</td>
<td>3.4 Adjustable voltage range</td>
</tr>
</tbody>
</table>

Fig.1.1 Connection for standard use

2 Wiring Input / Output Pin

2.1 Wiring input pin

(1) External fuse
- Fuse is not built-in on input side. In order to protect the unit, install the normal-blow type fuse on input side.
- When the input voltage from a front end unit is supplied to multiple units, install the normal-blow type fuse in each unit.
- When the fuse is open, power good signal is not outputed.

Table 2.1 Recommended fuse

<table>
<thead>
<tr>
<th>Model</th>
<th>BRNS6</th>
<th>BRNS12</th>
<th>BRNS20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
<td>15A</td>
<td>20A</td>
<td>40A</td>
</tr>
</tbody>
</table>

(2) External capacitor on the input side
- Install an external capacitor Cin, between +VIN and GND input pins for low line-noise and for stable operation of the power supply.

Table 2.2 Recommended external input capacitor (Ceramic)

<table>
<thead>
<tr>
<th>Model</th>
<th>BRNS6</th>
<th>BRNS12</th>
<th>BRNS20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cin</td>
<td>22μF×2</td>
<td>22μF×2</td>
<td>22μF×3</td>
</tr>
</tbody>
</table>

- Cin is within 5mm for pins. Make sure that ripple current of Cin is less than its rating.
- When an impedance and inductance level of the input line become higher, the input voltage may become unstable. In that case, the input voltage becomes stable by increasing Cin.

(3) Recommendation for noise-filter
- Install an external input filter as shown in Fig.2.1 in order to reduce conducted noise. Cin is shown in Table 2.2

![Diagram of Recommended External Input Filter](image)

(4) Reverse input voltage protection
- Avoid the reverse polarity input voltage. It will damage the power supply.
- It is possible to protect the unit from the reverse input voltage by installing an external diode as shown in Fig 2.2

![Diagram of Reverse Input Voltage Protection](image)

2.2 Wiring output pin

- When the BRNS series supplies the pulse current for the pulse load, please install a capacitor Co between +VOUT and GND pins.
### Table 2.3 Recommended capacitor and max Co

<table>
<thead>
<tr>
<th>No.</th>
<th>Model</th>
<th>Recommended</th>
<th>Max Co</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BRNS6</td>
<td>47μF×1+100μF×1</td>
<td>1,000μF</td>
</tr>
<tr>
<td>2</td>
<td>BRNS12</td>
<td>47μF×1+100μF×1</td>
<td>1,000μF</td>
</tr>
<tr>
<td>3</td>
<td>BRNS20</td>
<td>100μF×2</td>
<td>1,000μF</td>
</tr>
</tbody>
</table>

The output ripple voltage may grow big by resonance with Co and ESL of the wiring. If resonance frequency and switching frequency are close.

Ripple and Ripple Noise are measured, as shown in the Fig.2.4. Cin is shown in Table2.2, Co1 and Co2 is shown in Table 2.4.

![Fig.2.4 Measuring method of Ripple and Ripple Noise](image1)

### Table 2.4 Co1 and Co2 which is used in measuring

<table>
<thead>
<tr>
<th>No.</th>
<th>Model</th>
<th>Vo</th>
<th>Co1</th>
<th>Co2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>BRNS6</td>
<td>0.6-3.3V</td>
<td>47μF×1</td>
<td>100μF×1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3.3-5.5V</td>
<td>22μF×1</td>
<td>22μF×1</td>
</tr>
<tr>
<td>3</td>
<td>BRNS12</td>
<td>0.6-3.3V</td>
<td>47μF×1</td>
<td>100μF×1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>3.3-5.5V</td>
<td>22μF×1</td>
<td>22μF×2</td>
</tr>
<tr>
<td>5</td>
<td>BRNS20</td>
<td>0.6-3.3V</td>
<td>100μF×1</td>
<td>100μF×1</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>3.3-5.5V</td>
<td>22μF×2</td>
<td>22μF×2</td>
</tr>
</tbody>
</table>

### 3 Function

#### 3.1 Overcurrent protection
- Over Current Protection (OCP) is built-in and works over 105% of the rated current or higher. However, use in an overcurrent situation must be avoided whenever possible.
- The output voltage of the power module will recover automatically when the fault causing overcurrent is corrected.
- When the output voltage drops after OCP works, the power module enters a "hiccup mode" where it repeatedly turns on and off at a certain frequency.

#### 3.2 Remote ON/OFF
- The remote ON/OFF function is incorporated in the circuit and operated with RC and -Vin. If positive logic control is required, order the power supply with "-R" option.

![Fig.3.1 RC connection example](image2)

<table>
<thead>
<tr>
<th>Standard</th>
<th>Negative</th>
<th>Between RC and GND</th>
<th>Output voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L level (-0.2-0.8V) or short or open</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td></td>
<td>H level (3.0-VIN)</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>Optional</td>
<td>Positive</td>
<td>L level (-0.2-0.3V) or short</td>
<td>OFF</td>
</tr>
<tr>
<td>-R</td>
<td></td>
<td>H level (3.0-VIN) or open</td>
<td>ON</td>
</tr>
</tbody>
</table>

- When remote on/off function is not used, please open RC or connected to the GND terminal.

![Fig.3.2 Connection when the remote sensing is in use](image3)

#### 3.3 Remote sensing

1. When the remote sensing function is not in use

![Fig.3.2 Connection when the remote sensing is in use](image4)
When the remote sensing function is not in use, it is necessary to confirm that pins are shorted between +S & +VOUT and between -S & GND.

Wire between +S & +VOUT and between -S & GND as short as possible.
Loop wiring should be avoided.
This power supply might become unstable by the noise coming from poor wiring.

(2) When the remote sensing function is in use

Twisted-pair wire or shield wire should be used for sensing wire.
Thick wire should be used for wiring between the power supply and a load.
Line drop should be less than 0.5V.
Voltage between +VOUT and GND should remain within the output voltage adjustment range.
If the sensing patterns are short, heavy-current is drawn and the pattern may be damaged.
The pattern disconnection can be prevented by installing the protection parts as close as possible to a load.

3.4 Adjustable voltage range

Output voltage is adjustable by the external resistor.
The temperature coefficient could become worse, depending on the type of a resistor.
Resistor · · · Metal film type, coefficient of less than ±100ppm/°C
When TRM is opened, output voltage is 0.6V.
R_TRM is calculated in the following expressions.

\[
R_{TRM} = \frac{12}{V_{out} - 0.6} [k\Omega]
\]

<table>
<thead>
<tr>
<th>No.</th>
<th>+VOUT</th>
<th>R_TRM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>OPEN</td>
</tr>
<tr>
<td>2</td>
<td>1.2</td>
<td>20.00kΩ</td>
</tr>
<tr>
<td>3</td>
<td>1.8</td>
<td>10.00kΩ</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
<td>6.32kΩ</td>
</tr>
<tr>
<td>5</td>
<td>3.3</td>
<td>4.44kΩ</td>
</tr>
<tr>
<td>6</td>
<td>5.0</td>
<td>2.73kΩ</td>
</tr>
</tbody>
</table>

When start of DC INPUT is slow, BRNS may start on the outside of the operating area. By the circuit of the Fig.3.6, you can raise the start-up voltage.

3.5 Softstart / Start-up sequence

The adjustment of the rise time is possible by connecting C_SEQ.

\[
C_{SEQ}[nF] = 6 \times T_{rise}[ms] - 15
\]

C_SEQ should be less than 1μsec.
At the time of start, the output voltage follows the SEQ voltage. Output voltage and SEQ voltage are expressed in the following calculation.
With the voltage to input into SEQ pin, you can control a start sequence of plural BRNS.

(1) The same time

\[ V_{OUT} = V_{SEQ} \times \left( \frac{20k \Omega}{R_{TRM}} + 1 \right) \]

* \( V_{SEQ} < 0.6V \)

(2) The same voltage

(3) The time lag

3.6 Power good

- By using PGOOD, it is possible to monitor power supply whether normal operation or abnormal operation.
- PGOOD terminal inside is comprised of an open drain.
- Sink current of PGOOD is 50μA min.

3.7 Sequence

- Fig.4.9 is a sequence chart of each function of BRNS.

3.8 Frequency synchronization

- BRNS can operate at the switching frequency that synchronized to frequency of square wave input into SYNC pin.
- There is a delay of 300nsec.
- Fig.3.10 is example of frequency synchronization. And recommended wave form of SYNC pin is shown in Fig.3.11.
- If this function is unnecessary, please make PGOOD pin open or short to GND.
- Please wire the input pin of both power supplies which is synchronizing to the same pattern and voltage.
4 Series and Parallel Operation

4.1 Series operation

Series operation is not possible.

4.2 Parallel operation

Parallel operation is not possible.
Redundancy operation is available by wiring as shown below.

Even a slight difference in output voltage can affect the balance between the values of \( I_1 \) and \( I_2 \). Please make sure that the value of \( I_3 \) does not exceed the rated current of the power supply.

\[ I_3 \leq \text{the rated current value} \]

5 Cleaning

When cleaning is necessary, clean under the following conditions.

- **Method**: Varnishing, ultrasonic wave and vapor
- **Cleaning agents**: IPA (Solvent type)
- **Total time**: 2 minutes or less

Do not apply pressure to the lead and name plate with a brush or scratch it during the cleaning.
After cleaning, dry them enough.

---

Table 3.3 Specification of SYNC pin voltage

<table>
<thead>
<tr>
<th>No.</th>
<th>VIN</th>
<th>VSYNC Lo level</th>
<th>VSYNC Hi level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>( \leq 5.5V )</td>
<td>-0.2V</td>
<td>0.3V</td>
</tr>
<tr>
<td>2</td>
<td>( &gt;5.5V )</td>
<td>2.0V</td>
<td>4.5V</td>
</tr>
</tbody>
</table>

As shown in Fig.3.12, frequency synchronization is possible without using an outside clock.

The maximum synchronization number is 5.

After the power supply which output CLK started, please start the synchronizing power supplies. And when stop power supplies, you should stop the powersupply which output CLK at first.

The max voltage of CLK pin is DC input voltage.

Please connect ZD\_CLK when the voltage more than 5.5V is input into SYNK pin.(refer to Table.3.3)

It is not possible to shorten rise time when not using this function.
6 Storage method

- To stock unpacked products in your inventory, it is recommended to keep them under controlled condition, 5-30°C, 60%RH and use them within a year.
- 24-hour baking is recommended at 125°C, if unpacked products were kept under uncontrolled condition, which is 30°C, 60%RH or higher.

Original reels are not heat-resistant. Please move them to heat-resistant trays in preparation to bake.

To check moisture condition in the pack. Silica gel packet has some moisture condition indicator particles.

Indicated blue means good. Pink means alarm to bake it.

- The reels will be deformed and the power supply might be damaged, if the vacuum pressure is too much to reseal.

7 Safety Considerations

- To apply for safety standard approval using this power supply, the following conditions must be met.
- This unit must be used as a component of the end-use equipment.
- The equipment must contain basic insulation between input and output. If double or reinforced insulation is required, it has to be provided by the end-use equipment in accordance with the final build-in condition.
- Safety approved fuse must be externally installed on input side.

8 Temperature Measurement Location

- Make sure the temperatures measurement locations shown from Fig.8.1 and Fig.8.2 below are on or under the derating curve in “Derating”.

- Ambient temperature must be kept at 85°C or under.

Temperature measurement location

Fig.8.1 Temperature measurement location (BRNS6/12)

Temperature measurement location

Fig.8.2 Temperature measurement location (BRNS20)
9 Package Information

Please refer to a Fig.9.1 to Fig.9.3 for Package form (Reel).

The packed number is 200.

Fig.9.1 Taping dimensions of BRNS6/12

Fig.9.2 Taping dimensions of BRNS20

![Diagram of BRNS6/12](image1)

![Diagram of BRNS20](image2)

Fig.9.3 Reel dimensions of BRNS

<table>
<thead>
<tr>
<th>Model</th>
<th>Tape width [mm]</th>
<th>W1 [mm]</th>
<th>W2 [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRNS6</td>
<td>24</td>
<td>25.5±1.0</td>
<td>29.5±1.0</td>
</tr>
<tr>
<td>BRNS12</td>
<td>24</td>
<td>25.5±1.0</td>
<td>29.5±1.0</td>
</tr>
<tr>
<td>BRNS20</td>
<td>32</td>
<td>33.5±1.0</td>
<td>37.5±1.0</td>
</tr>
</tbody>
</table>

Please refer to specifications for the details of package information.