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# EC7AW18 ECRT/EDRT Series
## Application Note V10

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1. Introduction

The EC7AW18 ECRT/EDRT series of chassis mountable DC-DC converters offers 10 watts of output power @ output voltages of 5, 12, 15, ±5, ±12, ±15VDC. It has a wide (16:1) input voltage range of 10 to 160VDC (72VDC nominal) and 3000VAC reinforced isolation.

High efficiency up to 87%, allowing case operating temperature range of –40°C to 100°C. Very low no load power consumption (6mA), an ideal solution for energy critical systems. LED indicator for power on.

Compliant with EN55032, EN55035, EN50155, EN45545, EN50121-3-2. The standard control functions include negative remote on/off logic.

Fully protected against input UVLO (under voltage lock out), input reverse polarity, output over-current, output over-voltage and continuous short circuit conditions.

EC7AW18 ECRT/EDRT series is designed primarily for common railway applications of 24V, 36V, 48V, 72V, 96V, 110V nominal voltage and also suitable for distributed power architectures, telecommunications, battery operated equipment and industrial applications.

2. Pin Function Description

<table>
<thead>
<tr>
<th>No</th>
<th>Label</th>
<th>Function</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+Vi</td>
<td>+V Input</td>
<td>Positive Supply Input</td>
<td>Section 7.1/7.2</td>
</tr>
<tr>
<td>2</td>
<td>-Vi</td>
<td>-V Input</td>
<td>Negative Supply Input</td>
<td>Section 7.1/7.2</td>
</tr>
<tr>
<td>3</td>
<td>Rem</td>
<td>Remote</td>
<td>External Remote On/Off Control</td>
<td>Section 6.4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Single Output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>NA</td>
</tr>
<tr>
<td>5</td>
<td>-Vo</td>
</tr>
<tr>
<td>6</td>
<td>+Vo</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dual Output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>-Vo</td>
</tr>
<tr>
<td>5</td>
<td>Com</td>
</tr>
<tr>
<td>6</td>
<td>+Vo</td>
</tr>
</tbody>
</table>

3. Terminal Block

<table>
<thead>
<tr>
<th>Terminal Type</th>
<th>Suitable Electric Wire (AWG)</th>
<th>Current Rating (max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DINKLE 0137-1103 or Equivalent</td>
<td>16-26</td>
<td>10A</td>
</tr>
</tbody>
</table>
4. Connection for Standard Use
The connection for standard use is shown below. An external output capacitors (C1) is recommended to reduce output ripple and noise, output capacitor recommended 1uF ceramic capacitor for all models.

5. Test Set-Up
The basic test set-up to measure parameters such as efficiency and load regulation is shown below. When testing the modules under any transient conditions please ensure that the transient response of the source is sufficient to power the equipment under test. We can calculate:

- Efficiency
- Load regulation and line regulation

The value of efficiency is defined as:

\[ \eta = \frac{V_o \times I_o}{V_{in} \times I_{in}} \times 100\% \]

Where:
- \(V_o\) is output voltage,
- \(I_o\) is output current,
- \(V_{in}\) is input voltage,
- \(I_{in}\) is input current.

The value of load regulation is defined as:

\[ \text{Load reg.} = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\% \]

Where:
- \(V_{FL}\) is the output voltage at full load.
- \(V_{NL}\) is the output voltage at no load.

The value of line regulation is defined as:

\[ \text{Line reg.} = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\% \]

Where:
- \(V_{HL}\) is the output voltage of maximum input voltage at full load.
- \(V_{LL}\) is the output voltage of minimum input voltage at full load.

6. Features and Functions

6.1 UVLO (Under Voltage Lock Out)
Input under voltage lock out is standard on the EC7AW18 ECRT/EDRT series unit. The unit will shut down when the input voltage drops below a threshold, and the unit will operate when the input voltage goes above the upper threshold.
6.2 Over Current/Short Circuit Protection
All models have internal over current and continuous short circuit protection. The unit operates normally once the fault condition is removed. At the point of current limit inception, the converter will go into hiccup mode protection.

6.3 Output Over Voltage Protection
The over-voltage protection consists of a zener diode to limiting the out voltage.

6.4 Remote On/Off
The EC7AW18 ECRT/EDRT series allows the user to switch the module on and off electronically with the remote On/Off feature. All models are available in “negative logic” versions. The converter turns off if the remote On/Off pin is high (>3.5Vdc to 12Vdc). Setting the pin low (0 to<1.2Vdc or open circuit) will turn the converter on. The signal level of the remote On/Off input is defined with respect to ground.

If not using the remote On/Off pin, leave the pin open (converter will be on).

<table>
<thead>
<tr>
<th>Logic State (CN1 Pin 3)</th>
<th>Negative Logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic Low – 0 to 1.2Vdc or Open circuit</td>
<td>Module on</td>
</tr>
<tr>
<td>Logic High – 3.5 to 12Vdc</td>
<td>Module off</td>
</tr>
</tbody>
</table>

The converter remote On/Off circuit built-in on input side. The ground pin of input side Remote On/Off circuit is – Vin pin. Inside connection sees below.

7. Input / Output Considerations

7.1 Hold Up Time
Hold up time is defined as the duration of time that DC/DC converter output will remain active following a loss of input power.

EC7AW18 ECRT/EDRT series internal with Hold up Bus Capacitor, Input voltage and output power will determine the output hold up time, refer to following figures.
7.2 Inrush Current Limiter
These modules have inrush current limiter inside, it could reduce the inrush current from the input line to the internal capacitor when the power on.

7.3 Output Ripple and Noise

Another method is shown in below, in case of coaxial-cable/BNC is not available. The noise pickup is eliminated by pressing scope probe ground ring directly against the -Vout terminal while the tip contacts the +Vout terminal. This makes the shortest possible connection across the output terminals.

7.4 Output Capacitance
The EC7AW18 ECRT/EDRT series converters provide unconditional stability with or without external capacitors. For good transient response, low ESR output capacitors should be located close to the point of load (<100mm). PCB design emphasizes low resistance and inductance tracks in consideration of high current applications. Output capacitors with their associated ESR values have an impact on loop stability and bandwidth. Cincon’s converters are designed to work with load capacitance to see technical specifications.
8. Series and Parallel Operation

8.1 Series Operation

Series operation is possible by connecting the outputs two or more units. Connection is shown in below. The output current in series connection should be lower than the lowest rate current in each power module.

**Note:**
Recommend Schottky diode (D1, D2) be connected across the output of each series connected converter, so that if one converter shuts down for any reason, then the output stage won’t be thermally overstressed. Without this external diode, the output stage of the shut-down converter could carry the load current provided by the other series converters, with its MOSFETs conducting through the body diodes. The MOSFETs could then be overstressed and fail. The external diode should be capable of handling the full load current for as long as the application is expected to run with any unit shut down. Series for ±output operation is possible by connecting the outputs two units, as shown in the schematic below.

8.2 Parallel Operation

The EC7AW18 ECRT/EDRT series parallel operation is **not** possible.
9. Thermal Design

9.1 Operating Temperature Range
The EC7AW18 ECRT/EDRT series converters can be operated within a wide case temperature range of -40°C to 100°C. Consideration must be given to the derating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from chassis mount models is influenced by usual factors, such as:

- Input voltage range
- Output load current
- Forced air or natural convection

9.2 Convection Requirements for Cooling
To predict the approximate cooling needed for the chassis mount module, refer to the power derating curves in datasheet. These derating curves are approximations of the ambient temperatures and airflows required to keep the power module temperature below its maximum rating. Once the module is assembled in the actual system, the module’s case plate temperature should be monitored to ensure it does not exceed 100°C, case plate temperature measuring point refer to below (thus verifying proper cooling).

9.3 Thermal Considerations
The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. The example is presented in datasheet. The power output of the module should not be allowed to exceed rated power \(V_{o,\text{set}} \times I_{o,\text{max}}\).

9.4 Power Derating
The operating case temperature range of EC7AW18 ECRT/EDRT series is -40°C to +100°C. When operating the EC7AW18 ECRT/EDRT series, proper derating or cooling is needed. The maximum case temperature under any operating condition should not exceed 100°C (refer to datasheet).
10. Safety & EMC

10.1 Input Fusing and Safety Considerations
The EC7AW18 ECRT/EDRT series converters have internal fuse. Achieve maximum safety and system protection, input line fuse specification is 2A time delay. Have a transient voltage suppressor diode (TVS) across the input terminal to protect the unit against surge or spike voltage and input reverse voltage (as shown).
10.2 EMC Considerations

EMI Test standard: EN55032 Class A, EN50121-3-2
Test Condition: Input Voltage: 110Vdc, Output Load: Full Load

Connection circuit for EN55032 & EN50121-3-2 EMI testing
Input Conducted Emission (EN55032):

**EC7AW18-72S05-ECRT**
- Line
- Neutral

**EC7AW18-72S12-ECRT**
- Line
- Neutral

**EC7AW18-72S15-ECRT**
- Line
- Neutral

**EC7AW18-72D05-ECRT**
- Line
- Neutral
EC7AW18-72D12-ECRT
Line
Neutral

EC7AW18-72D15-ECRT
Line
Neutral

Input Conducted Emission (EN50121-3-2):
EC7AW18-72S05-ECRT
Line
Neutral

EC7AW18-72S12-ECRT
Line
Neutral
Output Conducted Emission:

EC7AW18-72S05-ECRT
Positive

EC7AW18-72S12-ECRT
Positive

EC7AW18-72S15-ECRT
Positive

EC7AW18-72D05-ECRT
Positive

EC7AW18-72S05-ECRT
Negative

EC7AW18-72S12-ECRT
Negative

EC7AW18-72S15-ECRT
Negative

EC7AW18-72D05-ECRT
Negative
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EC7AW18-72D12-ECRT
Positive

EC7AW18-72D15-ECRT
Positive

EC7AW18-72D12-ECRT
Negative

EC7AW18-72D15-ECRT
Negative

Radiated Emission (EN55032):
EC7AW18-72S05-ECRT
Horizontal

EC7AW18-72S12-ECRT
Horizontal

EC7AW18-72S05-ECRT
Vertical

EC7AW18-72S12-ECRT
Vertical
EC7AW18-72S15-ECRT
Horizontal

Vertical

EC7AW18-72D05-ECRT
Horizontal

Vertical

EC7AW18-72D12-ECRT
Horizontal

Vertical

EC7AW18-72D15-ECRT
Horizontal

Vertical
Radiated Emission (EN50121-3-2):

EC7AW18-72S05-ECRT  
Horizontal  
Vertical

EC7AW18-72S12-ECRT  
Horizontal  
Vertical

EC7AW18-72S15-ECRT  
Horizontal  
Vertical

EC7AW18-72D05-ECRT  
Horizontal  
Vertical