



Typical Features

- ◆ Wide input voltage range (1.7 : 1)
- ◆ Efficiency up to 94%
- ◆ Low no-load power consumption
- ◆ Operating temperature from -40°C to +100°C
- ◆ High isolation voltage 4242VDC (input-output) & 2100VDC (input-case)
- ◆ Input under voltage protection, output over voltage, short circuit, over current & over temp. protections
- ◆ Parallel operation with current sharing output
- ◆ Standard full brick size

ZAD2000-280S28 is a high-performance DC-DC modular converter with the rated input voltage 280VDC (full range from 250V to 425VDC), regulated single output 28V/2000W without minimum load limit. It has the advantage of high isolation voltage, Max operating temperature up to 100°C, with input under voltage protection, output over current, over voltage, over temperature and short circuit protections, input ON/OFF control, output voltage distal end compensation and output voltage Trim functions, etc.

Typical Product List

| Part No. | Input voltage range (VDC) | Output power (W) | Output voltage (VDC) | Output current (A) | Ripple & Noise (mVp-p) | Full load efficiency (%) Min/Typ. | Remarks |
|----------------|---------------------------|------------------|----------------------|--------------------|------------------------|-----------------------------------|---------|
| ZAD2000-280S28 | 250-425 | 2000 | 28 | 71.5 | 280 | 92/94 | |

Input Specifications

| Item | Operating conditions | Min. | Typ. | Max. | Unit |
|-----------------------------|--|------|------|------|------|
| Input current Max | Input voltage 250Vdc, full load output | -- | -- | 10 | A |
| Inrush voltage (1sec. max.) | The unit could be permanently damaged by the input over this voltage | -0.7 | -- | 450 | VDC |
| Start-up voltage | | -- | -- | 250 | |
| Under voltage protection | With half load test | -- | -- | 240 | |
| ON/OFF Control | Apply ≤1.2V or leave it open between ON/OFF+ & ON/OFF- to turn ON the converter Apply 3.5-12V between ON/OFF+ & ON/OFF- to turn OFF the converter | | | | |

Output Specifications

| Item | Operating conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|---|-------|------|-------|------|
| Output voltage | | 27.5 | 28.0 | 28.5 | V |
| Output voltage accuracy | Nominal input voltage, 0%-100% load | -- | ±0.5 | ±1 | % |
| Line regulation | Full load, input voltage from low to high | -- | ±0.1 | ±0.2 | |
| Load regulation | Nominal input voltage, 10%-100% load | -- | ±0.5 | ±1 | |
| Transient recovery time | 25% load step change (step rate 1A/50uS) | -- | 200 | 250 | uS |
| Transient response deviation | | -5 | -- | +5 | % |
| Temperature drift coefficient | Full load | -0.02 | -- | +0.02 | %/°C |

| | | | | | |
|--|--|--|-----|-----|-------|
| Ripple & Noise | 20M bandwidth, with external capacitor >1000uF | -- | 200 | 280 | mVp-p |
| Output voltage TRIM | | -10 | -- | +10 | % |
| Output voltage distal-end compensation (Sense) | | -- | -- | 3 | % |
| Over temperature protection | Maximum temperature of the metal base | 105 | 115 | 125 | °C |
| Over voltage protection | | 120 | -- | 130 | % |
| Over current protection | | 78 | -- | 85 | A |
| Short circuit protection | | Output constant current, self-recovery | | | |

General Specifications

| Item | Operating conditions | | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------|---------------------------------|------|------|------|---------|
| Isolation voltage | I/P-O/P | Test 1min, leakage current <3mA | 4242 | -- | -- | VDC |
| | I/P-Case | Test 1min, leakage current <3mA | 2100 | -- | -- | VDC |
| | O/P-Case | Test 1min, leakage current <3mA | 500 | -- | -- | VDC |
| Insulation resistance | I/P-O/P | @ 500VDC | 100 | -- | -- | MΩ |
| Switching frequency | | | -- | 170 | -- | KHz |
| MTBF | | | 150 | -- | -- | K hours |

Environmental characteristics

| Item | Operating conditions | | Min. | Typ. | Max. | Unit |
|---------------------------|---|--|--------------------------------------|------|------|------|
| Operating temperature | Refer to the temperature derating graph | | -40 | -- | +100 | °C |
| Storage humidity | No condensing | | 5 | -- | 95 | %RH |
| Storage temperature | | | -40 | -- | +125 | °C |
| Pin soldering temperature | 1.5mm from the case, soldering time <1.5S | | -- | -- | +350 | |
| Cooling requirement | | | EN60068-2-1 | | | |
| Dry heat requirement | | | EN60068-2-2 | | | |
| Damp heat requirement | | | EN60068-2-30 | | | |
| Shock and Vibration | | | IEC/EN 61373 C1/Body Mounted Class B | | | |

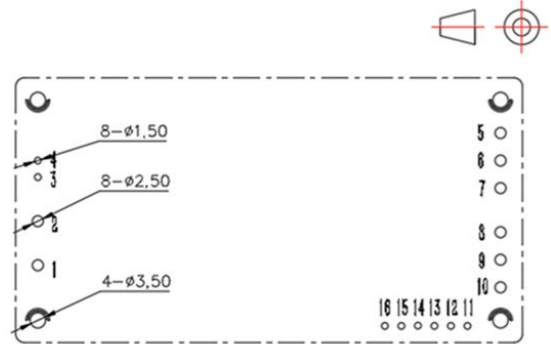
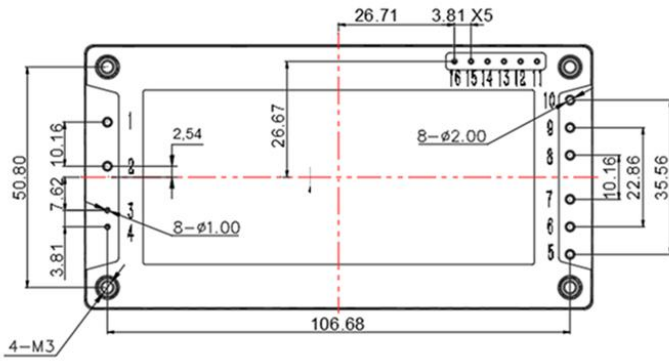
EMC Performances

| Item | | Standard | Performance/Class | |
|------|-------|-----------------------------------|--|------------------|
| EMI | CE | GB/T18655 EN55032 | Class A | |
| | RE | GB/T18655 EN55032 | Class A | |
| EMS | ESD | IEC/EN61000-4-2/GB/T 17626.2-2006 | Contact ±6KV/Air ±8KV | perf. Criteria A |
| | RS | IEC/EN61000-4-3/GB/T 17626.3-2006 | 10V/m | perf. Criteria A |
| | EFT | IEC/EN61000-4-4/GB/T 17626.4-2008 | ±2kV 5/50ns 5kHz | perf. Criteria A |
| | Surge | IEC/EN61000-4-5/GB/T 17626.5-2008 | Line to line ±1KV, line to ground ±2KV | perf. Criteria A |
| | CS | IEC/EN61000-4-6/GB/T 17626.6-2008 | 0.15MHz-80MHz 10 Vr.m.s | perf. Criteria A |

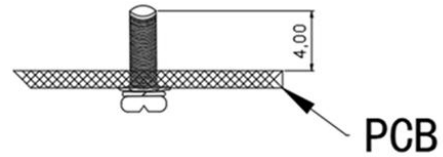
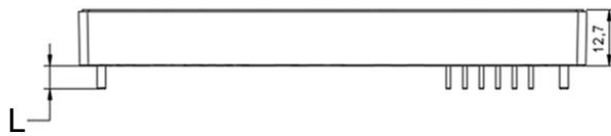
Physical Characteristics

| | |
|----------------|---|
| Case Materials | Metal base + plastic case in black, flame class UL94-V0 |
| Cooling Method | Conduction cooling or forced air cooling with fan |
| Unit Weight | Standard 250g |

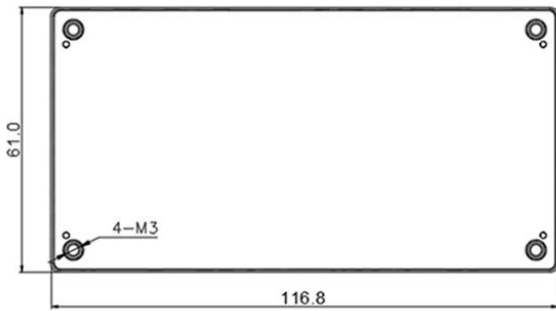
Mechanical Dimensions and Pin-out Function Description



Recommended PCB Holes



PCB



Standard
116.8x61.0x12.7mm

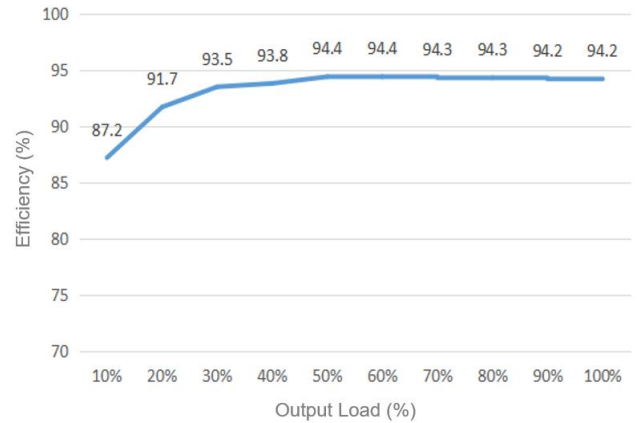
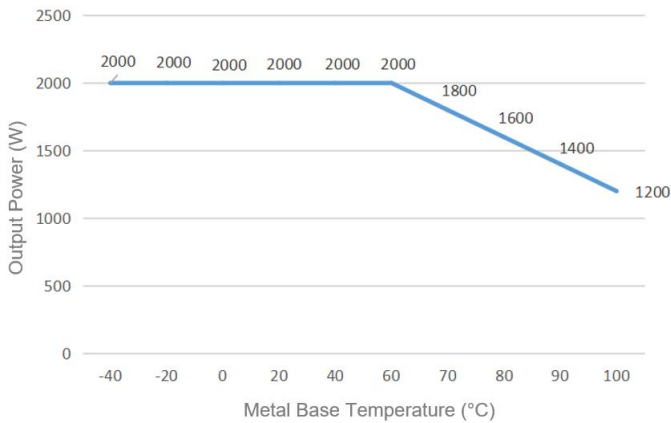
Note:
Unit: mm
Pin 1,2,5,6,7,8,9,10 diameter: 2.00
Pin 3,4,11,12,13,14,15,16 diameter: 1.00
General tolerance: X.X ±0.5; X.XX ±0.10
Screwing torque: 0.4 N.m Max

Pin Length L=5.3mm

| Pin No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|-------------|-----------|-----------|-----------------------------------|-----------------------------------|---------------------|-------------------|---------------|------------------|
| Function | Vin- | Vin+ | ON/OFF- | ON/OFF+ | Vout+ | Vout+ | Vout+ | Vout- |
| Description | Input V- | Input V+ | ON/OFF Control | ON/OFF Control | Output V+ | Output V+ | Output V+ | Output V- |
| Pin No. | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| Function | Vout- | Vout- | -Sense | +Sense | TRIM | PC | IOG | AUX |
| Description | Output V- | Output V- | Output distal end compensation S- | Output distal end compensation S+ | Output Voltage Trim | Current share bus | Output Status | Aux-power supply |

Note:
1. IOG is the output status signal, it is at low impedance while the converter is operating normally, it is at high impedance while the converter is operating under the abnormal condition, the maximum current 10mA.
2. AUX is the auxiliary power supply, the voltage is 14V at normal operation, the maximum overcurrent is 20mA.

Product Characteristics Graphs



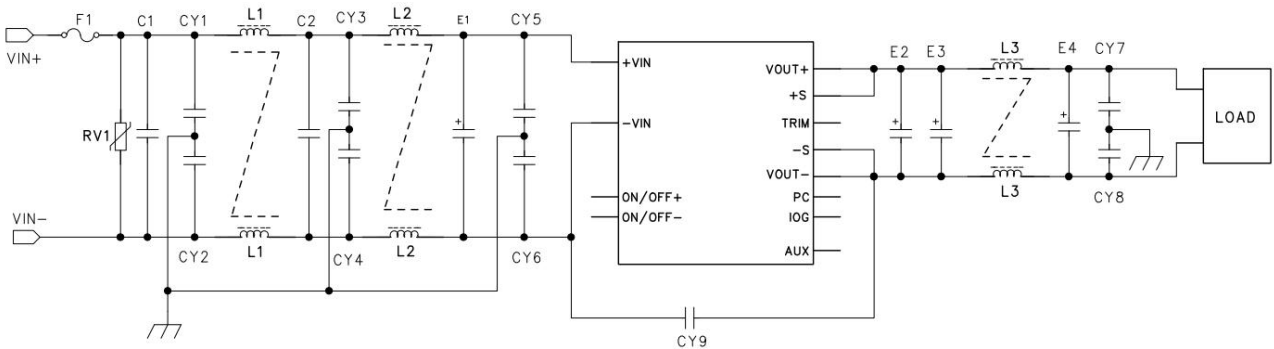
Note:

- The output power and the efficiency in the graphs are tested with the typical values.
- The data in the temperature derating graph is tested at Aipu laboratory test conditions. It is recommended to keep the temperature of the metal base not more than 60 °C when the converter operates at the rated load for the application.

Recommended circuits for application

1. Typical application circuit diagram

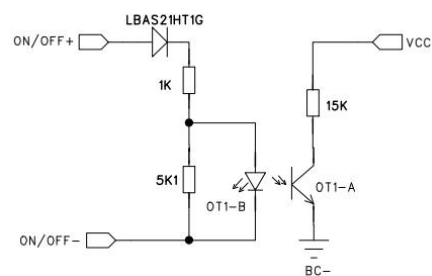
If this circuit diagram recommended below is not adopted, please use an electrolytic capacitor $\geq 100 \mu\text{F}$ at the input to suppress the possible surge voltage.



| | |
|------------------------------|--|
| F1 | T15A/250Vac, Time-delay fuse |
| RV1 | 14D 520V Varistor |
| C1, C2 | 105/630V Polyester Film Capacitor |
| CY1, CY2, CY3, CY4, CY5, CY6 | 102/250Vac Y2 capacitor |
| CY7, CY8 | 103/2KV Ceramic Capacitor |
| CY9 | 102/250Vac Y1 capacitor |
| E1 | 100 μF /450V Electrolytic Capacitor |
| E2, E3 | 2200 μF /35V Electrolytic Capacitor (More than one connected in parallel is acceptable) |
| L1, L2 | >5mH, temperature rise less than 25°@10A |
| L3 | >10uH, temperature rise less than 25°@72A |

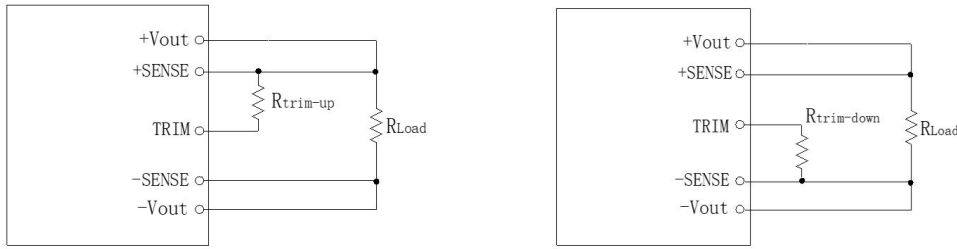
2. ON/OFF control circuit & application instruction

- ON/OFF control internal circuit diagram shown on the right
- Apply $\leq 1.2\text{V}$ or leave it open between ON/OFF+ & ON/OFF- to turn ON the converter
 - Apply 3.5-12V between ON/OFF+ & ON/OFF- to turn OFF the converter



3. Output voltage TRIM application

The Trim function adjusts the output voltage by an external Trim resistor.



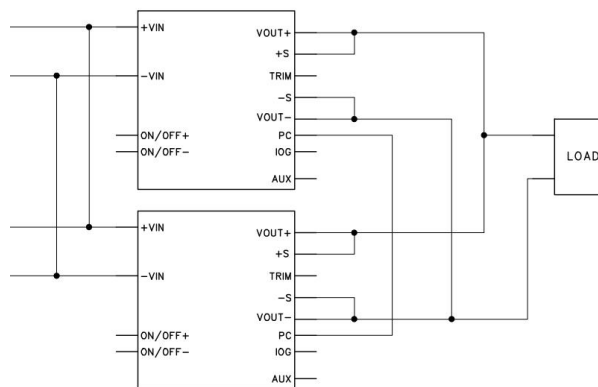
The output voltage can be adjusted between 90% to 100% of V_o by an external resistor used between the terminals of TRIM and V_o . The voltage can be increased by the resistor between TRIM and V_{o+} , and it can be decreased by the resistor between TRIM and V_{o-} . The resistor should be placed as closely as possible to the converter terminals. TRIM terminal should be No Connection when TRIM is not needed. The resistances of Trim-up and Trim-down calculating formulars are shown below.

$$R_{trim-up} = (5.1 * \Delta * V_o - 12.75) / (2.5 * \Delta - 2.5) - 10.2 \text{ (K}\Omega\text{)}$$

$$R_{trim-down} = (10.2 * \Delta - 5.1) / (1 - \Delta) \text{ (K}\Omega\text{)}$$

For example, $V_o = 28V$, we need increase it to be 30.8V, $\Delta = 30.8 / 28 = 1.1$, $R_{trim-up} = (5.1 * 1.1 * 28 - 12.75) / (2.5 * 1.1 - 2.5) - 10.2 = 567.12 \text{ K}\Omega$;
If we need decrease the voltage to be 25.2V, $\Delta = 25.2 / 28 = 0.9$, $R_{trim-down} = (10.2 * 0.9 - 5.1) / (1 - 0.9) = 40.8 \text{ K}\Omega$

4. Application for the converters parallel operation to increase the output power



Application circuit diagram for converters connected in parallel (≥2 converters)

Requirements:

- 1) Input connected in parallel
- 2) Current share bus PC terminals connected in parallel
- 3) Output connected in parallel
- 4) External application circuit refers to the single unit application

Others

1. The product warranty period is two years. The failed product can be repaired/replaced free of charge if it operates at normal condition. A paid service shall be also provided if the product fails after operating under wrong or unreasonable conditions.
2. Aipupower can provide customization design and filter modules for matching, please contact our technician for details.

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