SmartPower

# DD7A202-300N

## 1. Product Overview

The **DD7A202-300N** DC-DC converter modules use patended circuit topology with PFM control, advanced power processing, control and packaging technologies to provide high efficiency, high power density and low noise. The modules have input over-voltage and under-voltage protection, output over-voltage and over-current protection, output short-circuit protection and over-temperature protection.

The efficiency is up to 91% and power density is 100W/in$^2$ High-frequency ZCS/ZVS switching provides high power density with low noise and high efficiency.


Note: Product images may not highlight current product markings

## 2. Applications:

Aerospace, aviation, ships, weapons and industrial control systems.

## 3. Main parameters and technical specifications:

1. DC input range: 180-375 V
2. Input surge voltage: 400V/100 ms
3. Power: up to 250 W
4. Efficiency: up to 91%
5. Operating Temperature: 100°C
6. Isolation voltage: 3000 VAC
7. Isolated output
8. Parallelable, with N+m tolerance
9. Patented circuit topology with PFM control
10. Low-noise ZCS/ZVS architecture

**Table 1. Technical Specifications (Tc=25°C)**

| Parameter | Index | Unit | Notes |
|---|---|---|---|
| Output voltage precision | ±1 | %$V_{out}$ (rated) | Normal input voltage, full load, 25 °C |
| Line regulation | ±0.2 | %$V_{out}$ (rated) | Minimum input voltage to maximum input voltage, full load |
| Load regulation | ±0.2 | %$V_{out}$ (rated) | No-load to full load, normal input voltage |
| Temperature regulation | 0,02 | %/°C | -55 … 100 °C |
| Power-sharing accuracy | ±5 | % | 30% - 100% of full load |
| Efficiency | 91 | % | Normal input voltage, full load, 25 °C |
| Programming range | 75 - 110 | %/°C | Without dummy load |
| PC bias voltage | 5.75 | V | Typical |
| PR drive capability | ≥6 | | PR pins are connected directly |
| SC bandgap voltage | 1.23 | V | In to Out |
| Temperature limiting | 105 | °C | Typical (baseplate) |
| Operating temperature | -55 - 100 | °C | Baseplate |
| Storage temperature | -65 - 125 | °C | |
| Package | 57.9×55.9×12.7 | mm | Half Brick |
| Weight | 94 - 98 | g | Typical |
| Note: The value of load regulation is a typical one. | | | |

### 3.1 Electrical characteristics

Unless otherwise specified, electrical characteristics apply over the full operating range of input voltage, output load (resistive) and baseplate temperature. All temperatures refer to the operating temperature at the center of tha baseplate.

**Table 2. Module Input/Output Specifications**

| **Input parameters** | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Operating input voltage | 180 | 300 | 375 | $V_{DC}$ | |
| Input surge withstand | | | 400 | $V_{DC}$ | <100 ms |
| Undervoltage turn-on | | 171.2 | 178.2 | $V_{DC}$ | |
| Undervoltage turn-off | 147.4 | 155.2 | | $V_{DC}$ | Exceeding the rated voltage may cause damage |
| Overvoltage turn-off/on | 378 | | 420 | $V_{DC}$ | |
| Disabled input current | | | 1.2 | mA | PC pin low |
| **Output parameters** | Min | Typ. | Max | Unit | Notes |
| Output voltage set point | | | ±1 | % | Of nominal output voltage.Nominal input, full load, 25°C |
| Line regulation | | ±0.15 | ±0.2 | % | |
| Temperature regulation | | ±0.01 | ±0.02 | %/°C | |
| Power sharing accuracy | | ±2 | ±5 | % | |
| Programming range | 75 | | 110 | % | Of nominal output voltage. For trimming below 90% of nominal, a minimum load of 10% of maximum rated power may be required |

**Table 3. Absolute maximum rating**

| Parameter | | Rating | Unit | Notes |
|---|---|---|---|---|
| +IN to -IN voltage | | -0.5…+420 | $V_{DC}$ | |
| PC to -IN voltage | | -0.5…+7.0 | $V_{DC}$ | |
| PR to -IN voltage | | -0.5…+7.0 | $V_{DC}$ | |
| SC to -OUT voltage | | -0.5…+1.5 | $V_{DC}$ | |
| Pin soldering temperature | | 260 | °C | <5s wave soldering |
| | | 390 | °C | <7s hand soldering |
| Mounting torque | | 0.57 | Nm | Each mounting slot |
| +OUT to -OUT | 3.3V | -0.5…+4.7 | $V_{DC}$ | External applied voltage |
| | 5V | -0.5…+7.0 | $V_{DC}$ | External applied voltage |
| | 8V | -0.5…+10.9 | $V_{DC}$ | External applied voltage |
| | 12V | -0.5…+16.1 | $V_{DC}$ | External applied voltage |
| | 15V | -0.5…+20.0 | $V_{DC}$ | External applied voltage |
| | 24V | -0.5…+31.7 | $V_{DC}$ | External applied voltage |
| | 28V | -0.5…+36.9 | $V_{DC}$ | External applied voltage |
| | 36V | -0.5…+47.1 | $V_{DC}$ | External applied voltage |
| | 48V | -0.5…+62.9 | $V_{DC}$ | External applied voltage |

*Notes: If the coversation module is used in an application enviroment with continuous dinamic load, please contact us for important information

**Table 4. Thermal resistance and capacity**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Baseplate to radiator, plane coated with thermal coductive silicone grease | | 0.16 | | °C/W |
| Baseplate to radiator, thermal pad (P/N 20265) | | 0.14 | | °C/W |
| Baseplate to ambient | | 8 | | °C/W |
| Baseplate to ambient (1000LFM) | | 1.9 | | °C/W |
| Thermal capacity | | 83 | | Ws/°C |

**Table 5. Control Specifications**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| **Primary Side (PC = Primary Control; PR = Parallel)** | | | | | |
| PC operating voltage | 5.5 | 5.8 | 6.0 | $V_{DC}$ | PC current = 1.0 mA |
| PC operating current | 2.5 | 3.8 | 4.5 | mA | PC voltage = 5.5 V |
| PC disable voltage | 2.3 | 2.6 | 2.9 | $V_{DC}$ | Switch must be able to sink ≥ 4mA (Fig.2) |
| PC enable delay time | | 4 | 7 | ms | |
| PC alarm voltage | | | 0.5 | $V_{AVG}$ | UV, OV, OT module fault (Fig.3 and 5) |
| PC resistance | 0.9 | 1.0 | 1.1 | MΩ | |
| PR emitter amplitude | 5.0 | 5.6 | 6.0 | V | PR load >30Ω, <30 pF |
| PR emitter current | 150 | | | mA | |
| PR receiver impedance | 375 | 500 | 625 | Ω | 25℃ |
| PR receiver threshold | 2.4 | 2.5 | 2.6 | V | Minimum pulse width: 20ns |
| PR drive capability | 6 | | | modules | Without PR buffer amplifier |
| **Secondary Side (SC = Secondary Control)** | | | | | |
| SC bandgap voltage | 1.21 | 1.23 | 1.25 | $V_{DC}$ | Referenced to -S |
| SC resistance | 990 | 1000 | 1010 | Ω | |
| SC capacitance | | 0.01 | | µF | |
| SC module alarm | | | 0.5 | $V_{DC}$ | Referenced to -S (Fig.7) |

**Specific Operating Specifications**

**DD7A152-300N3R3(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 84.5 | 85 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 180 | 200 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 4.14 | 4.2 | 4.46 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 3.5 | 6.9 | W | No load |
| Load regulation | | ±0.1 | ±0.2 | % | Nominal input |
| Load current | 0 | | 45.45 | A | |
| Current limit | 46.4 | 52.4 | 63.7 | A | Output voltage 95% of nominal |
| Short circuit current | 31.8 | 52.4 | 63.7 | A | Output voltage <250mV |

**DD7A202-300N5(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 88 | 89 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 80 | 130 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 6.03 | 6.16 | 6.47 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 5.1 | 5.6 | W | No load |
| Load regulation | | ±0.1 | ±0.2 | % | Nominal input |
| Load current | 0 | | 40 | A | |
| Current limit | 40.8 | 47 | 52 | A | Output voltage 95% of nominal |
| Short circuit current | 28 | 46.5 | 52 | A | Output voltage <250mV |

**DD7A202-300N8(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 90 | 91 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 100 | 150 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 9.36 | 9.82 | 10.1 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 5.1 | 8.3 | W | No load |
| Load regulation | | ±0.1 | ±0.2 | % | Nominal input |
| Load current | 0 | | 25 | A | |
| Current limit | 25.5 | 27.2 | 33.8 | A | Output voltage 95% of nominal |
| Short circuit current | 17.5 | 27.8 | 33.8 | A | Output voltage <250mV |

**DD7A252-300N12(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 90 | 91 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 150 | 200 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 13.7 | 14.5 | 14.9 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 5.5 | 6 | W | No load |
| Load regulation | | ±0.1 | ±0.2 | % | Nominal input |
| Load current | 0 | | 20.83 | A | |
| Current limit | 21.3 | 23.4 | 28.1 | A | Output voltage 95% of nominal |
| Short circuit current | 14.6 | 23.8 | 28.1 | A | Output voltage <250mV |

**DD7A252-300N15(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 91 | 91.8 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 170 | 200 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 17.1 | 17.6 | 18.5 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 6.6 | 8.3 | W | No load |
| Load regulation | | ±0.15 | ±0.2 | % | Nominal input |
| Load current | 0 | | 16.67 | A | |
| Current limit | 17 | 19.9 | 21.8 | A | Output voltage 95% of nominal |
| Short circuit current | 11.6 | 20 | 21.8 | A | Output voltage <250mV |

**DD7A252-300N24(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 90 | 91.5 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 150 | 200 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 27.1 | 28.4 | 29.1 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 4.9 | 8.3 | W | No load |
| Load regulation | | ±0.15 | ±0.2 | % | Nominal input |
| Load current | 0 | | 10.42 | A | |
| Current limit | 10.7 | 11.7 | 13.7 | A | Output voltage 95% of nominal |
| Short circuit current | 7.35 | 12.2 | 21.8 | A | Output voltage <250mV |

**DD7A252-300N28(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 90 | 91.5 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 150 | 200 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 31.5 | 32.5 | 33.9 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 3.9 | 8.3 | W | No load |
| Load regulation | | ±0.15 | ±0.2 | % | Nominal input |
| Load current | 0 | | 8.93 | A | |
| Current limit | 9.1 | 10.1 | 11.7 | A | Output voltage 95% of nominal |
| Short circuit current | 6.25 | 10.2 | 11.7 | A | Output voltage <250mV |

**DD7A252-300N36(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 90 | 90.5 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 300 | 350 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 40.4 | 41.6 | 43.4 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 5.1 | 8.3 | W | No load |
| Load regulation | | ±0.15 | ±0.2 | % | Nominal input |
| Load current | 0 | | 6.94 | A | |
| Current limit | 7.07 | 7.81 | 9.37 | A | Output voltage 95% of nominal |
| Short circuit current | 4.85 | 8.05 | 9.37 | A | Output voltage <250mV |

**DD7A252-300N48(H,M)-HB**

| Parameter | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|
| Efficiency | 90 | 90.5 | | % | Nominal input, full load, 25℃ |
| Ripple and noise | | 360 | 400 | mV | P-P, nominal input, full load, 20MHz bandwidth |
| Output OVP set point | 53.7 | 54.8 | 57.7 | V | 25℃, recycle input voltage to restart |
| Dissipation, standby | | 6.2 | 8.3 | W | No load |
| Load regulation | | ±0.15 | ±0.2 | % | Nominal input |
| Load current | 0 | | 5.21 | A | |
| Current limit | 5.31 | 5.82 | 6.78 | A | Output voltage 95% of nominal |
| Short circuit current | 3.65 | 5.82 | 7 | A | Output voltage <250mV |

### 3.2 Basic Module Operation

The permition load current must never be exceeded during normal, abnormal or test conditions. Converters subject to dynamic loading exceeding 25%of rated current must be reviewed by us to ensure that the converter will operate properly.
Under dynamic-load, light-load, or no-load conditions, the converter may emit audible noise.
For applications than may draw more than the rated current, a fast-acting electronic circuit breaker must be utilized to protect the converter. Under no circumstance should the rated current be exeeded. Utilizing or testing of current limit or short circuit current will damage the converter. Ensure that the total output capacitance connected to the converter does not exceed the limits "Maximum Output Capacitance" as previously stated.

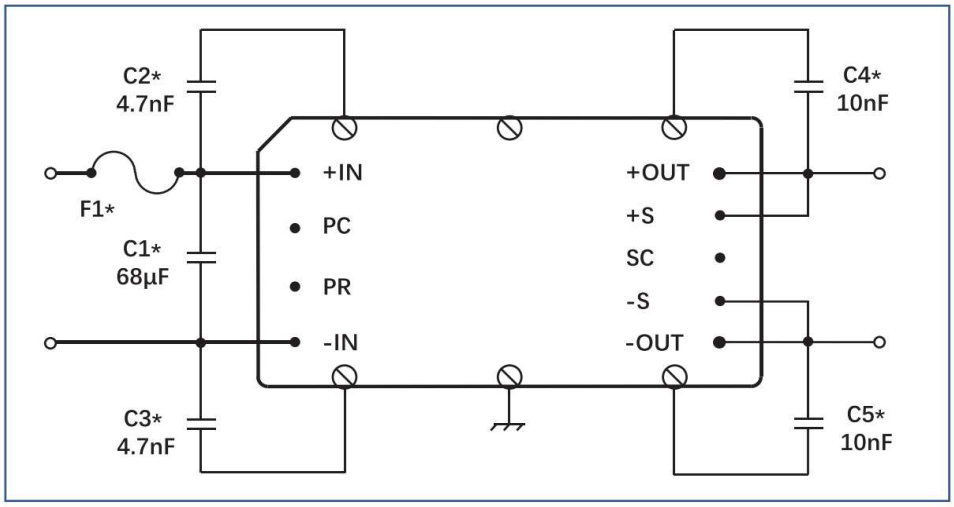



Fig.1 Basic module operation requires fusing, grounding, bypassing capacitors.

*Notes: The leads at both ends of C1-C5 connection should be as short as possible, and the capacitance in thr figure is for reference only.

### 3.3 Primary Control - PC Pin

**Module Enable/Disable**

The module may be disabled by pulling PC to 2.3V with respect to the -Input. This may be done with an open collector transistor, relay or optocoupler. Converts may be disabled with a single transistor or relay either directly or via "OR'ing" diodes for two or more convertres. Refer to Fig.2

**Primary Auxiliary Supply**

The PC Pin can provide a current no less than 2.5 mA. In the example shown in Fig.4, PC powers a module enabled LED.

**Module Alarm**

The module complete circuit which monitors input voltage, operating temperature and internal operating parameters. In the event that any of these parameters are outside of their allowable operating range, the module will shut down and PC/SC will go low. Once the abnormal contact occurs, the PC/SC will reset and the module will start working again (except for output overvoltage), refer to Fig.3 and Fig.5.

PC can provide on/off indication function. For isolated on/off indication, refer to Fig.6
SC can be monitored as an alarm signal, as shown in Fig.7

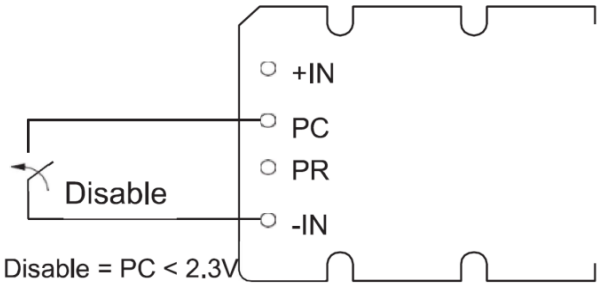



Fig.2 Module enable/disable

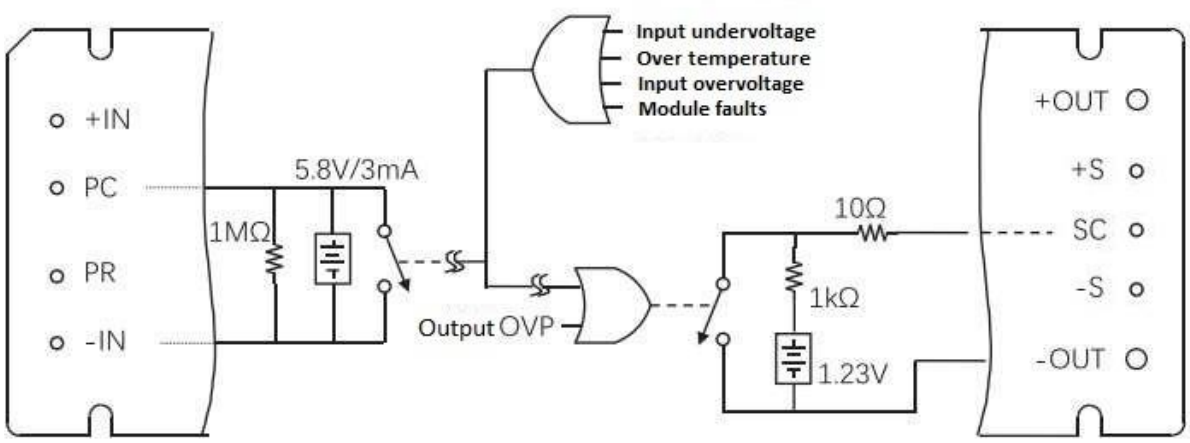



Fig.3 PC/SC module alarm logic

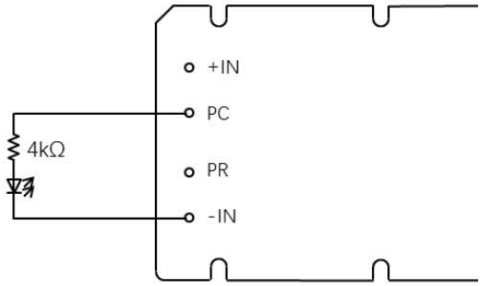



Fig.4 LED on-state indicator

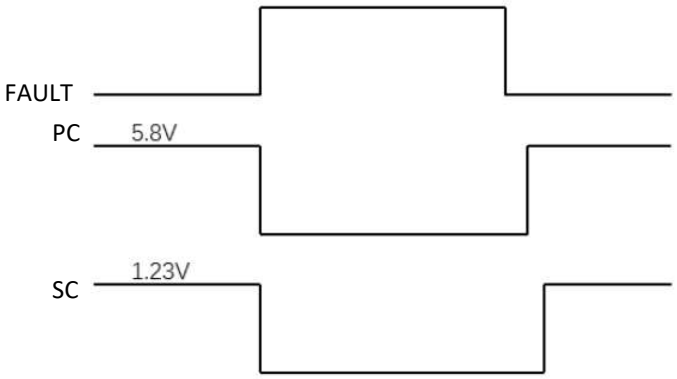



Fig.5 PC/SC module alarm timing

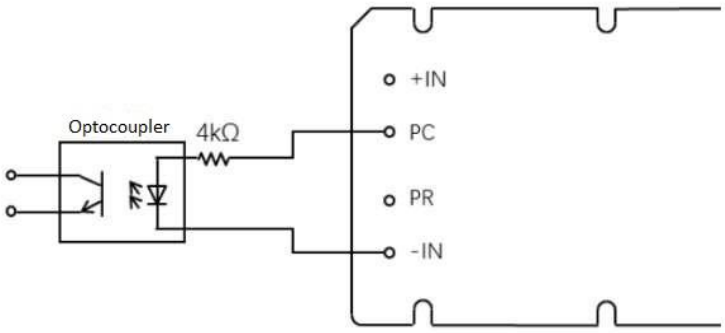



Fig.6 Isolated on-state indicator

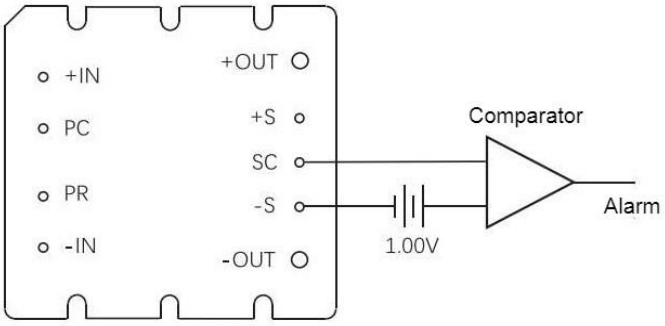
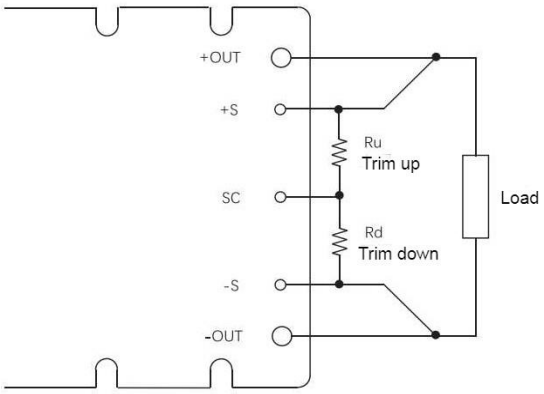



Fig.7 Alarm signal monitoring

## 3.4 Secondary Control - SC Pin

**Output Voltage Programming**

The output voltage of the converter can be adjusted or programmed via fixed resistors, potentiometers or voltage DACs. Refer to Fig.8




$$Ru(\Omega) = \frac{1000\times(Vout-1.23)\times Vnom}{1.23\times(Vout-Vnom)} - 1000$$

$$Rd(\Omega) = \frac{1000\times Vout}{Vnom-Vout}$$

Fig.8 Output voltage trim-down and trim-up circuit

**Trim down**

1. This converter is not a constant-power device, it has a constant current limit. Hence, avaible output power is reduced by the same percentage that output voltage is trimmed down. Do not exceed maximum rated outout current.

2. The trim-down resistor must be connected between the SC and -S pins. Do not use the SC pin directly deside a capacitor.

**Trim up**

1. The converter is rated for a maximum delivered power. To ensure that maximum rated power is not exceeded, reduce maximum output current by the same percentage increase in output voltage.

2. The trim-up resistor must be connected between the SC and +S pins. Do not use the SC pin directly beside a capacitor.

3. Do not trim the converter above maximum trim range (typically +10%) or the output over voltage protection circuit may be activated.

*Notes: The regulating resistance can be calculated according to the formula in Fig.8. If you have any questions, please contact us.

## 3.5 Parallel Bus - PR Pin

**Parallel Operation**

The PR pin supports paralleling for increased power with N+1 (N+M) redundancy. Modules of the same input voltage, output voltage, and power level will current share if all PR pins are suitably interfaced.

Compatible interface architectures include the following:

All PR pins are connected, and the impedance of PR and -IN of each module shall be as small as possible. The loop between PR and-N of each module shall be as small as possible. Refer to Fig.9.

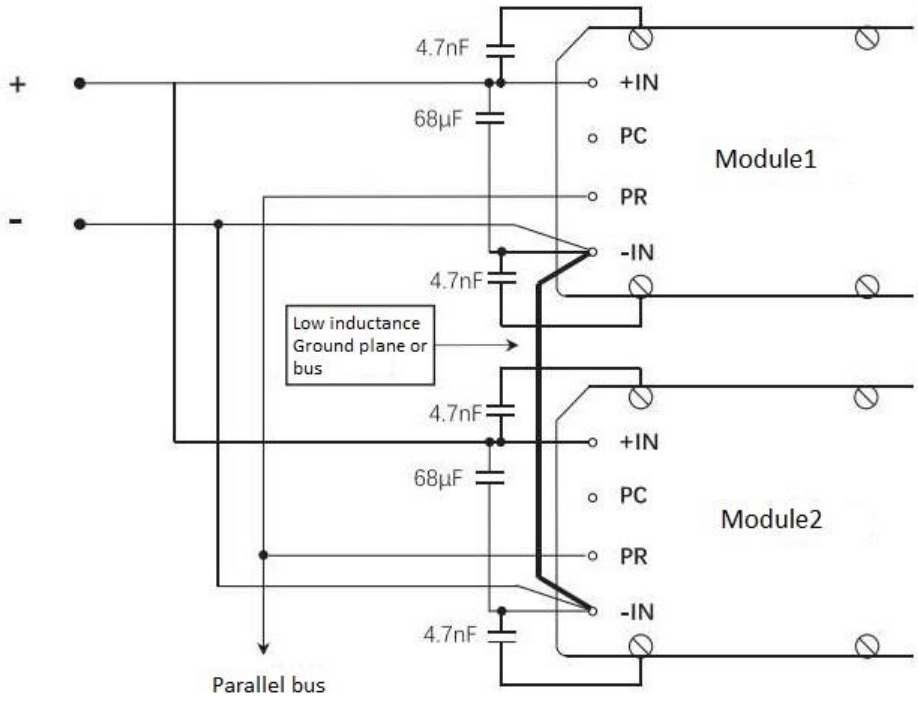



Fig.9 AC-coupled single-wire interface

## 4. Mechanical drawings and Pin designations (top view, Unit: mm)

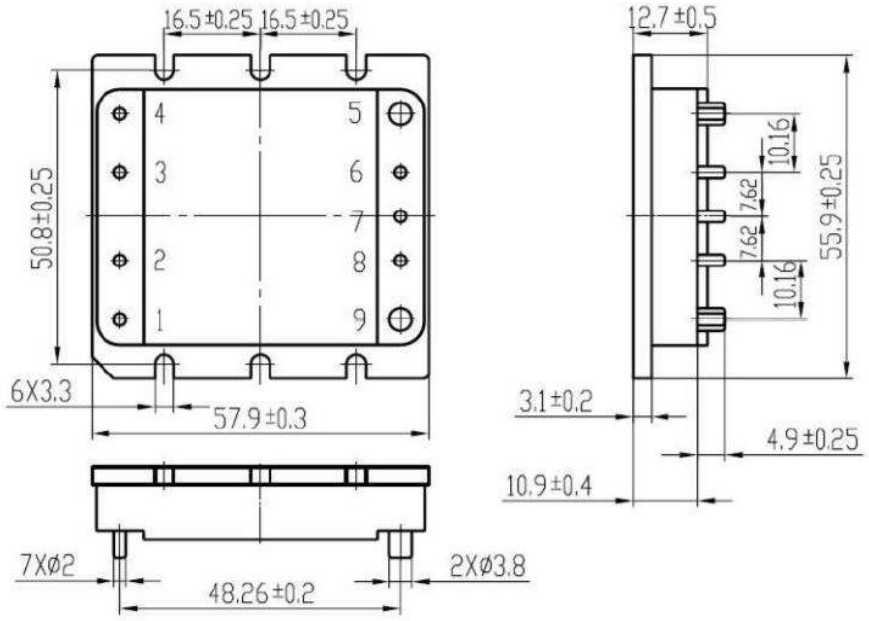



Fig.10 Mechanical drawings

**Table 6. Pin designations**

| Pin number | Label | Function | Pin number | Label | Function |
|---|---|---|---|---|---|
| 1 | +IN | Positive input | 5 | -OUT | Negative output |
| 2 | PC | Primary control | 6 | -Sense | -S |
| 3 | PR | Parallel | 7 | SC | Secondary contro |
| 4 | -IN | Negative input | 8 | +Sense | +S |
| | | | 9 | +OUT | Positive output |

## 5. PCB assembly parameters

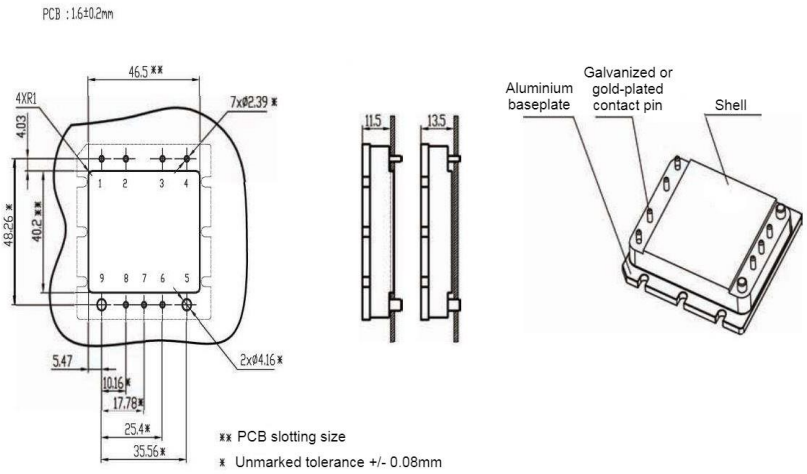



Fig.11 PCB mechanical drawings

## 6. Product series

**Table 7. Orderable part numbers**

| Part number | Output Voltage, V | Output Power, W | Output Current, A |
|---|---|---|---|
| DD7A152-300N3R3-M-HB | 3,3 | 150 | 45.45 |
| DD7A202-300N5-M-HB | 5 | 200 | 40 |
| DD7A202-300N8-M-HB | 8 | 200 | 25 |
| DD7A252-300N12-M-HB | 12 | 250 | 20.83 |
| DD7A252-300N15-M-HB | 15 | 250 | 16.67 |
| DD7A252-300N24-M-HB | 24 | 250 | 10.42 |
| DD7A252-300N28-M-HB | 28 | 250 | 8.93 |
| DD7A252-300N36-M-HB | 36 | 250 | 6.94 |
| DD7A252-300N48-M-HB | 48 | 250 | 5.21 |

*Notes:

1. Three temperature grades are available: T, H, M.
2. Output power value is customized.

### Product temperature grade

**Table 8. Temperature grades**

| Grade | Working temperature | Storage temperature |
|---|---|---|
| T | -40 … +100 °C | -40 … +100 °C |
| H | -40 … +100 °C | -40 … +125 °C |
| M | -55 … +100 °C | -55 … +125 °C |

## 7. Order guide

**Table 9. Part number guide**

| Company name | Type | Series name | Power, W | Input voltage,V | Outputs number | Output voltage, V | Temp grade, °C | Packaging options |
|---|---|---|---|---|---|---|---|---|
| D | D | 7A | 252 | 300 | N | 24 | M | HB |
| SmartPower | D: DC/DC | 250W DC/DC single output | 152=150W<br>202=200W<br>252=250W | 180-375 | single output | 3,3<br>5<br>12<br>15<br>24<br>28<br>36<br>48 | -55 … +100 | half-brick flanged |