

SERIES: P78-2000-S | **DESCRIPTION:** NON-ISOLATED SWITCHING REGULATOR

FEATURES

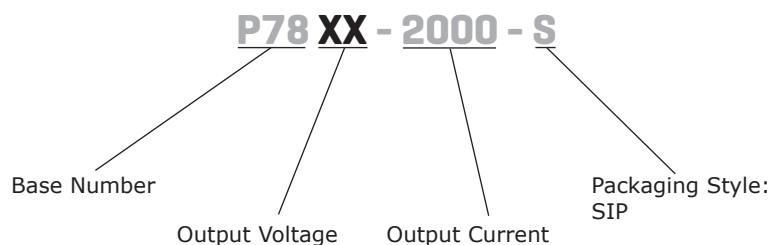
- 2 A of output current
- high efficiency up to 95%
- no-load input current as low as 0.1 mA
- wide temperature range: -40°C ~ +85°C
- output short circuit protection
- pin-out compatible with linear regulators
- designed to meet EN/BS EN 62368



| MODEL | input voltage | | output voltage (Vdc) | output current max (mA) | output power max (W) | ripple and noise ^{1,2} max (mVp-p) | efficiency typ (%) |
|--------------|---------------|----------------|-------------------------|-------------------------------|----------------------------|---|--------------------------|
| | typ (Vdc) | range (Vdc) | | | | | |
| P78X2-2000-S | 24 | 4.5~28 | 1.8 | 2000 | 3.6 | 75 | 83 |
| P7802-2000-S | 24 | 4.5~36 | 2.5 | 2000 | 5 | 75 | 89 |
| | 12 | 8~32 | -2.5 | 1000 | -2.5 | 150 | 84 |
| P7803-2000-S | 24 | 6~36 | 3.3 | 2000 | 6.6 | 75 | 89 |
| | 12 | 8~31 | -3.3 | 1000 | -3.3 | 150 | 83 |
| P7805-2000-S | 24 | 8~36 | 5 | 2000 | 10 | 75 | 92 |
| | 12 | 8~30 | -5 | 1000 | -5 | 150 | 84 |
| P7806-2000-S | 24 | 10~36 | 6.5 | 2000 | 13 | 75 | 92 |
| | 12 | 8~29 | -6.5 | 1000 | -6.5 | 150 | 85 |
| P7809-2000-S | 24 | 13~36 | 9 | 2000 | 18 | 75 | 95 |
| | 12 | 8~26 | -9 | 1000 | -9 | 150 | 84 |
| P7812-2000-S | 24 | 16~36 | 12 | 2000 | 24 | 75 | 96 |
| | 12 | 8~23 | -12 | 1000 | -12 | 150 | 85 |
| P7815-2000-S | 24 | 18~36 | 15 | 2000 | 30 | 75 | 96 |
| | 12 | 8~20 | -15 | 1000 | -15 | 150 | 85 |

Notes: 1. Ripple and noise are measured at 20 MHz BW, nominal input, full load by "parallel cable" method with 1 µF ceramic and 10 µF electrolytic capacitors on the output.
2. 20~100% load ripple & noise ≤ 100 mVp-p. 0~20% load ripple & noise ≤ 180 mVp-p

PART NUMBER KEY



INPUT

| parameter | conditions/description | min | typ | max | units |
|-------------------------|------------------------------|--|-----|------------|----------|
| operating input voltage | 1.8 Vdc output model | 4.5 | 24 | 28 | Vdc |
| | 2.5 Vdc output model | 4.5 | 24 | 36 | Vdc |
| | 3.3 Vdc output model | 6 | 24 | 36 | Vdc |
| | 5.0 Vdc output model | 8 | 24 | 36 | Vdc |
| | 6.5 Vdc output model | 10 | 24 | 36 | Vdc |
| | 9 Vdc output model | 13 | 24 | 36 | Vdc |
| | 12 Vdc output model | 16 | 24 | 36 | Vdc |
| no load input current | positive output, nominal Vin | 1.8 & 2.5 Vdc output all other outputs | | 0.2 0.1 | mA mA |
| | negative output, nominal Vin | -2.5, -3.3, -5, -6.5 Vdc output all other outputs | | 1 2 | mA mA |
| filter | capacitance filter | | | | |

OUTPUT

| parameter | conditions/description | min | typ | max | units |
|------------------------------|--|-----|-----------|------------|------------|
| capacitive load | 1.8 & 2.5 Vdc output models | | | 2000 | μF |
| | 3.3 Vdc output model | | | 1800 | μF |
| | 5 & 6.5 Vdc output models | | | 1000 | μF |
| | 9 Vdc output model | | | 680 | μF |
| | 12 & 15 Vdc output models | | | 470 | μF |
| line regulation | input voltage range, full load | | ±0.4 | ±0.8 | % |
| load regulation | from 10% to 100% load | | ±0.5 | ±1.5 | % |
| voltage accuracy | 100% load, input voltage range | | | | |
| | 1.8, 2.5, 3.3 Vdc output models all other models | | ±2 ±2 | ±4 ±3 | % % |
| switching frequency | 100% load, nominal input | | | | |
| | 5 Vdc output model | | | 200 | kHz |
| | 12 Vdc output model | | | 270 | kHz |
| | 15 Vdc output model all other models | | | 300 400 | kHz kHz |
| transient recovery time | 25% load step change | | 0.2 | 1 | mS |
| transient response deviation | 25% load step change | | | | |
| | 1.8 & 2.5 Vdc output models | | 80 | 150 | mV |
| | positive output: all other models negative output: all other models | | 50 100 | 150 150 | mV mV |
| temperature coefficient | -40°C ~ 85°C | | | ±0.03 | %/°C |

PROTECTIONS

| parameter | conditions/description | min | typ | max | units |
|--------------------------|--------------------------------|-----|-----|-----|-------|
| short circuit protection | continuous, automatic recovery | | | | |

SAFETY AND COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|---------------------|---|-----|-----|-----|-------|
| safeties approval | designed to meet 62368: EN, BS EN | | | | |
| conducted emissions | CISPR32/EN55032 class B (see fig. 4-② for recommended circuit) | | | | |
| radiated emissions | CISPR32/EN55032 class B (see fig. 4-② for recommended circuit) | | | | |
| ESD | IEC/EN 61000-4-2, contact ± 6kV, perf. Criteria B | | | | |
| radiated immunity | IEC/EN 61000-4-3, 10V/m, perf. Criteria A | | | | |
| EFT/burst | IEC/EN 61000-4-4, ± 1kV (see fig. 4-① for recommended circuit), perf. Criteria B | | | | |
| surge | IEC/EN 61000-4-5, line to line ± 1kV (see fig. 4-① for recommended circuit), perf. Criteria B | | | | |
| conducted immunity | IEC/EN 61000-4-6, 3 Vr.ms, perf. Criteria A | | | | |

SAFETY AND COMPLIANCE

| parameter | conditions/description | min | typ | max | units |
|-----------|-----------------------------|-------|-----|-----|---------|
| MTBF | as per MIL-HDBK-217F @ 25°C | 2,000 | | | K hours |
| RoHS | 2011/65/EU | | | | |

ENVIRONMENTAL

| parameter | conditions/description | min | typ | max | units |
|-----------------------|------------------------|-----|-----|-----|-------|
| operating temperature | see derating curve | -40 | | 85 | °C |
| storage temperature | | -55 | | 125 | °C |
| storage humidity | non-condensing | 5 | | 95 | % |

SOLDERABILITY

| parameter | conditions/description | min | typ | max | units |
|----------------|--------------------------------|-----|-----|-----|-------|
| hand soldering | 1.5mm from case for 10 seconds | | | 260 | °C |

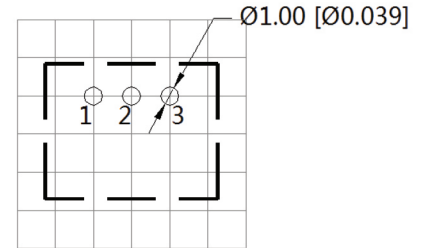
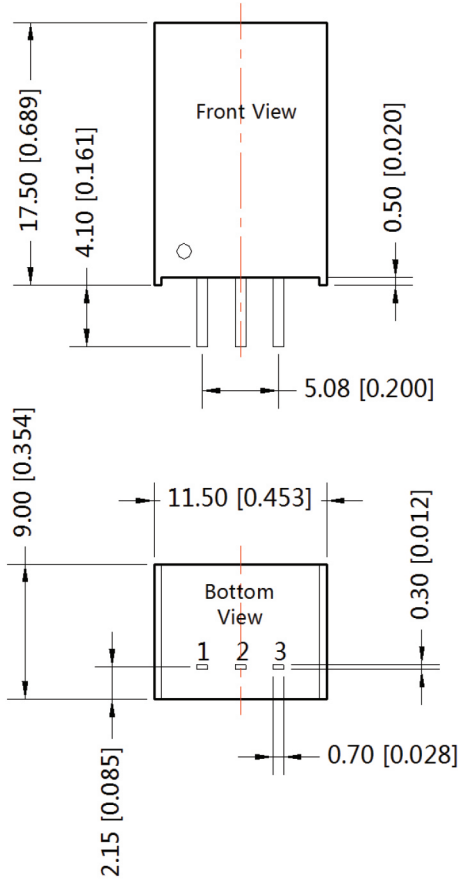
MECHANICAL

| parameter | conditions/description | min | typ | max | units |
|---------------|--|-----|-----|-----|-------|
| dimensions | 11.50 x 9.00 x 17.50 (0.457 x 0.297 x 0.400 inch) | | | | mm |
| case material | Black flame-retardant and heat-resistant plastic (UL94-V0) | | | | |
| weight | | | 3.8 | | g |

MECHANICAL DRAWING

units: mm [inches]
 tolerance: ± 0.25 [± 0.010]
 pin section tolerance: ± 0.10 [± 0.004]

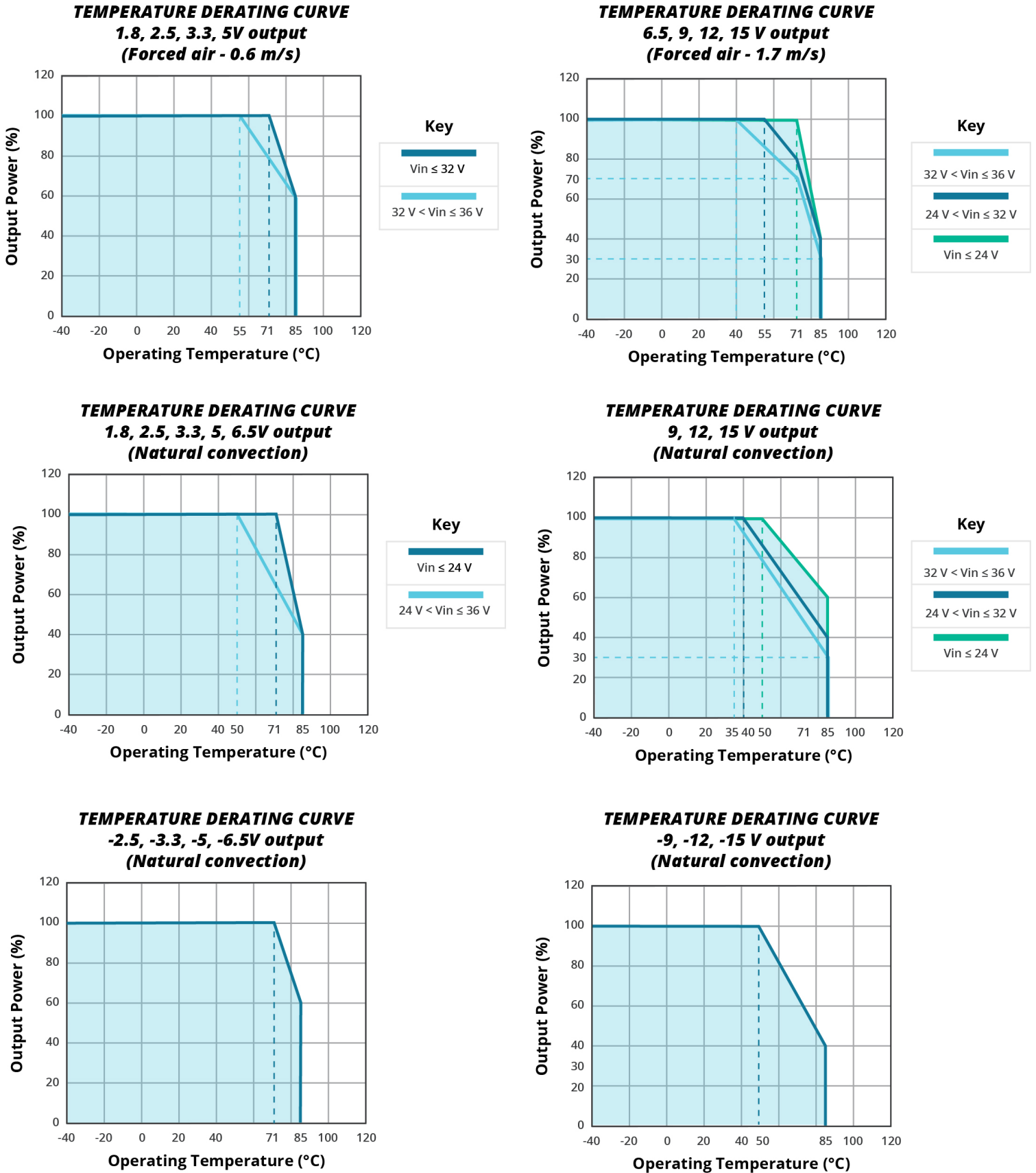
| PIN CONNECTIONS | | |
|-----------------|-------------------------------|-------------------------------|
| Pin | Function (positive output) | Function (negative output) |
| 1 | +Vin | +Vin |
| 2 | GND | -Vo |
| 3 | +Vo | GND |



Note : Grid 2.54*2.54mm

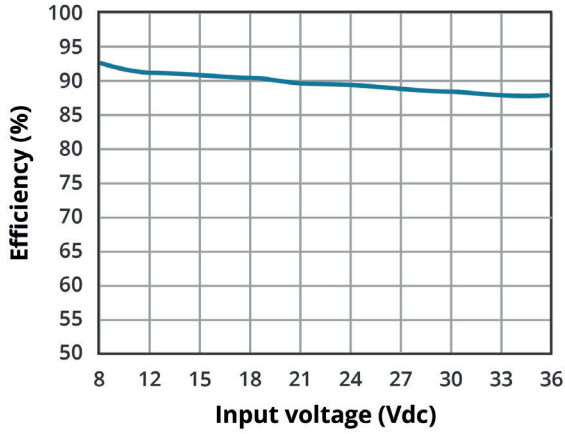
DERATING CURVES

Figure 1

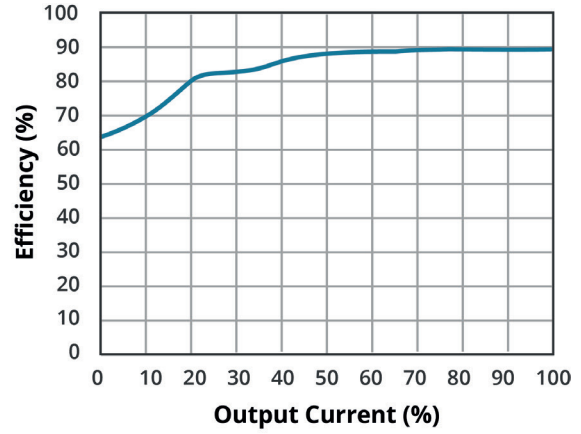


EFFICIENCY CURVES

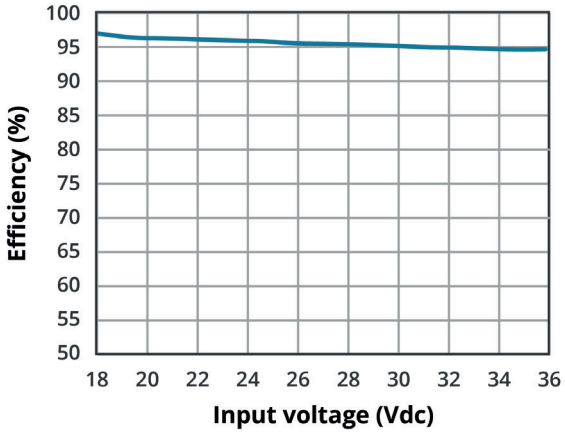
**EFFICIENCY VS INPUT LOAD
P7805-2000-S (full load)**



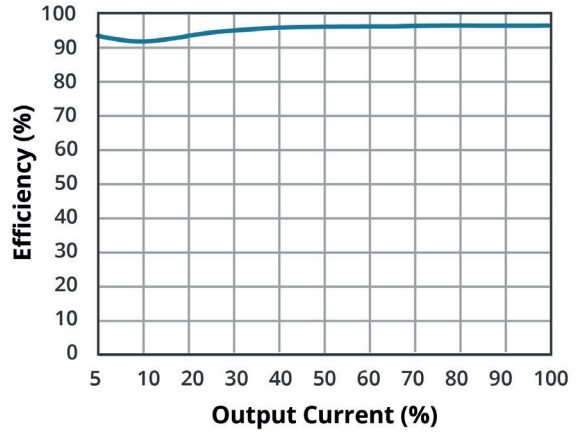
**EFFICIENCY VS OUTPUT LOAD
P7805-2000-S (Vin = 24 V)**



**EFFICIENCY VS INPUT LOAD
P7815-2000-S (full load)**

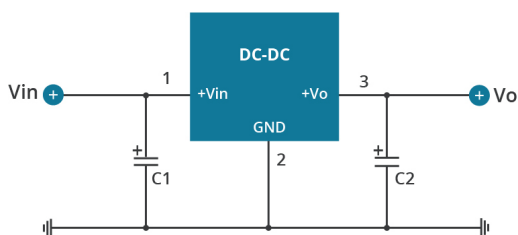


**EFFICIENCY VS OUTPUT LOAD
P7815-2000-S (Vin = 24 V)**

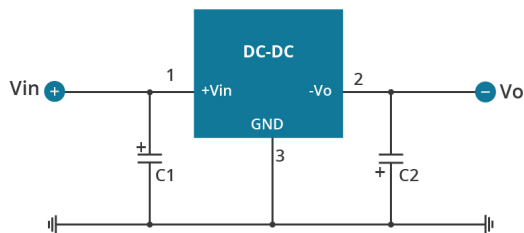


TYPICAL APPLICATION CIRCUIT

**Figure 2
positive output**



**Figure 2
negative output**



- Note:
1. C1 and C2 are required and should be connected close to the pin terminal of the module.
 2. The capacitance of C1 and C2 refer to Sheet 1.
 3. To reduce the output ripple further, C2 can be increased properly if required, tantalum capacitor and aluminum electrolytic capacitor of low ESR may also suffice.
 4. Cannot be used in parallel to enlarge the power for output and hot swap.

Table 1

| Part No. | C1 (ceramic capacitor) | C2 (ceramic capacitor) |
|--------------|---------------------------|---------------------------|
| P78X2-2000-S | 22 μ F/50V | 22 μ F/10V |
| P7802-2000-S | 22 μ F/50V | 22 μ F/10V |
| P7803-2000-S | 22 μ F/50V | 22 μ F/10V |
| P7805-2000-S | 22 μ F/50V | 22 μ F/10V |
| P7806-2000-S | 22 μ F/50V | 22 μ F/10V |
| P7809-2000-S | 22 μ F/50V | 22 μ F/16V |
| P7812-2000-S | 22 μ F/50V | 22 μ F/25V |
| P7815-2000-S | 22 μ F/50V | 22 μ F/25V |

EMC RECOMMENDED CIRCUIT

Figure 3

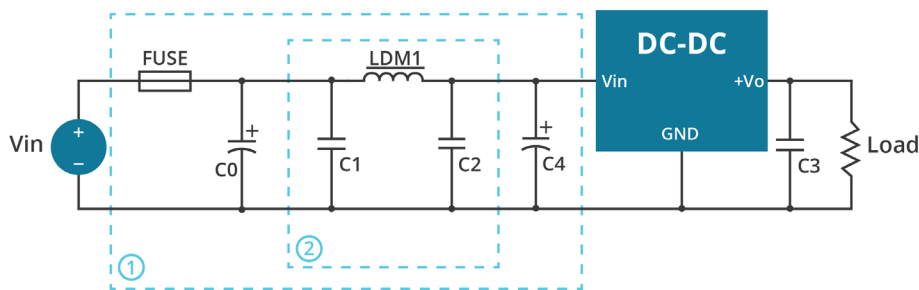


Table 2

| Recommended external circuit components | |
|---|---|
| FUSE | choose according to practical input current |
| C0 | 100 μ F /100V |
| LDM1 | 22 μ H |
| C4 | 680 μ F /50V |
| C1/C2 | 10 μ F /50V |
| C3 | 22 μ F/25V |

- Note: Part ① in the Fig. 4 is for EMS test, part ② is for EMI filtering; parts ① and ② can be added based on actual requirement.

REVISION HISTORY

| rev. | description | date |
|------|---|------------|
| 1.0 | initial release | 01/22/2020 |
| 1.01 | logo update | 02/21/2020 |
| 1.02 | derating curve, efficiency curves and circuit figures updated | 09/23/2021 |
| 1.03 | datasheet updated | 05/24/2022 |
| 1.04 | CE certification removed | 11/02/2022 |
| 1.05 | 1.8V, 2.5V & 6.5V input model added | 07/17/2023 |

The revision history provided is for informational purposes only and is believed to be accurate.



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