

MOP06 MOP06W SERIES

DC-DC CONVERTER
2:1 & 4:1 WIDE INPUT RANGE
UP TO 6 WATTS



FEATURES

- REINFORCED INSULATION FOR 300VAC WORKING VOLTAGE
- CLEARANCE AND CREEPAGE DISTANCE :6.6mm/2MOOP
- 3000VAC INPUT TO OUTPUT 2MOOP ISOLATION
- BUILT-IN EMI CLASS A FILTER
- LOW LEAKAGE CURRENT UNDER 2 μ A
- ANSI/AAMI ES60601-1, EN60601-1, IEC60601-1 3rd EDITION, UL60950-1, EN60950-1, & IEC60950-1 SAFETY APPROVALS
- CE MARKED
- COMPLIANT TO RoHS II & REACH

APPLICATIONS

MEDICAL EQUIPMENT
TELECOM/DATACOM
INDUSTRY CONTROL SYSTEM
MEASUREMENT EQUIPMENT
SEMICONDUCTOR EQUIPMENT
PV POWER SYSTEM
IGBT GATE DRIVER

| 3000VAC ISOLATION | UVP | OCP | SCP | OVP | LOW STANDBY POWER |
|-------------------|-----|-----|-----|-----|-------------------|
|-------------------|-----|-----|-----|-----|-------------------|

TECHNICAL SPECIFICATION

All specifications are typical at nominal input, full load and 25°C otherwise noted

| Model Number | Input Range | Output Voltage | Output Current @ Full Load | Input Current @ No Load | Efficiency | Maximum Capacitor Load |
|-----------------|-------------|----------------|----------------------------|-------------------------|------------|------------------------|
| | VDC | VDC | mA | mA | % | μ F |
| MOP06-05S3P3A/B | 4.5 ~9 | 3.3 | 1800 | 10 | 81.5 | 2100 |
| MOP06-05S05A/B | 4.5 ~9 | 5 | 1200 | 10 | 86 | 1500 |
| MOP06-05S12A/B | 4.5 ~9 | 12 | 500 | 15 | 86 | 260 |
| MOP06-05S15A/B | 4.5 ~9 | 15 | 400 | 15 | 87.5 | 210 |
| MOP06-05S24A/B | 4.5 ~9 | 24 | 250 | 20 | 87 | 75 |
| MOP06-05D05A/B | 4.5 ~9 | \pm 5 | \pm 600 | 25 | 84 | \pm 860 |
| MOP06-05D12A/B | 4.5 ~9 | \pm 12 | \pm 250 | 25 | 86.5 | \pm 150 |
| MOP06-05D15A/B | 4.5 ~9 | \pm 15 | \pm 200 | 25 | 87.5 | \pm 110 |
| MOP06-12S3P3A/B | 9 ~ 18 | 3.3 | 1800 | 10 | 83.5 | 2100 |
| MOP06-12S05A/B | 9 ~ 18 | 5 | 1200 | 10 | 86 | 1500 |
| MOP06-12S12A/B | 9 ~ 18 | 12 | 500 | 10 | 89 | 260 |
| MOP06-12S15A/B | 9 ~ 18 | 15 | 400 | 10 | 88.5 | 210 |
| MOP06-12S24A/B | 9 ~ 18 | 24 | 250 | 10 | 88.5 | 75 |
| MOP06-12D05A/B | 9 ~ 18 | \pm 5 | \pm 600 | 10 | 85 | \pm 860 |
| MOP06-12D12A/B | 9 ~ 18 | \pm 12 | \pm 250 | 10 | 89 | \pm 150 |
| MOP06-12D15A/B | 9 ~ 18 | \pm 15 | \pm 200 | 10 | 88 | \pm 110 |
| MOP06-24S3P3A/B | 18 ~ 36 | 3.3 | 1800 | 6 | 83 | 2100 |
| MOP06-24S05A/B | 18 ~ 36 | 5 | 1200 | 6 | 86.0 | 1500 |
| MOP06-24S12A/B | 18 ~ 36 | 12 | 500 | 6 | 89 | 260 |
| MOP06-24S15A/B | 18 ~ 36 | 15 | 400 | 6 | 89 | 210 |
| MOP06-24S24A/B | 18 ~ 36 | 24 | 250 | 6 | 88.5 | 75 |
| MOP06-24D05A/B | 18 ~ 36 | \pm 5 | \pm 600 | 6 | 85 | \pm 860 |
| MOP06-24D12A/B | 18 ~ 36 | \pm 12 | \pm 250 | 6 | 88.5 | \pm 150 |
| MOP06-24D15A/B | 18 ~ 36 | \pm 15 | \pm 200 | 6 | 88.5 | \pm 110 |
| MOP06-48S3P3A/B | 36 ~ 75 | 3.3 | 1800 | 4 | 82.5 | 2100 |
| MOP06-48S05A/B | 36 ~ 75 | 5 | 1200 | 4 | 86.5 | 1500 |
| MOP06-48S12A/B | 36 ~ 75 | 12 | 500 | 4 | 88 | 260 |
| MOP06-48S15A/B | 36 ~ 75 | 15 | 400 | 4 | 88.5 | 210 |
| MOP06-48S24A/B | 36 ~ 75 | 24 | 250 | 4 | 88 | 75 |
| MOP06-48D05A/B | 36 ~ 75 | \pm 5 | \pm 600 | 4 | 85 | \pm 860 |
| MOP06-48D12A/B | 36 ~ 75 | \pm 12 | \pm 250 | 4 | 88 | \pm 150 |
| MOP06-48D15A/B | 36 ~ 75 | \pm 15 | \pm 200 | 4 | 87 | \pm 110 |

| Model Number | Input Range | Output Voltage | Output Current @ Full Load | Input Current @ No Load | Efficiency | Maximum Capacitor Load |
|------------------|-------------|----------------|----------------------------|-------------------------|------------|------------------------|
| | VDC | VDC | mA | mA | % | μF |
| MOP06-24S3P3WA/B | 9 ~ 36 | 3.3 | 1800 | 6 | 83 | 2100 |
| MOP06-24S05WA/B | 9 ~ 36 | 5 | 1200 | 6 | 86.0 | 1500 |
| MOP06-24S12WA/B | 9 ~ 36 | 12 | 500 | 6 | 89 | 260 |
| MOP06-24S15WA/B | 9 ~ 36 | 15 | 400 | 6 | 89 | 210 |
| MOP06-24S24WA/B | 9 ~ 36 | 24 | 250 | 6 | 88.5 | 75 |
| MOP06-24D05WA/B | 9 ~ 36 | ±5 | ±600 | 6 | 85 | ± 860 |
| MOP06-24D12WA/B | 9 ~ 36 | ±12 | ±250 | 6 | 88.5 | ± 150 |
| MOP06-24D15WA/B | 9 ~ 36 | ±15 | ±200 | 6 | 88.5 | ± 110 |
| MOP06-48S3P3WA/B | 18 ~ 75 | 3.3 | 1800 | 4 | 82.5 | 2100 |
| MOP06-48S05WA/B | 18 ~ 75 | 5 | 1200 | 4 | 86.5 | 1500 |
| MOP06-48S12WA/B | 18 ~ 75 | 12 | 500 | 4 | 88 | 260 |
| MOP06-48S15WA/B | 18 ~ 75 | 15 | 400 | 4 | 88.5 | 210 |
| MOP06-48S24WA/B | 18 ~ 75 | 24 | 250 | 4 | 88 | 75 |
| MOP06-48D05WA/B | 18 ~ 75 | ±5 | ±600 | 4 | 85 | ± 860 |
| MOP06-48D12WA/B | 18 ~ 75 | ±12 | ±250 | 4 | 88 | ± 150 |
| MOP06-48D15WA/B | 18 ~ 75 | ±15 | ±200 | 4 | 87 | ± 110 |

PART NUMBER STRUCTURE

| MOP06 | - | 48 | S | 05 | A | - | P | T |
|-------------|---|---|--------------------------|---|------------------|----------------------------------|---|--|
| Series name | | Input Voltage (VDC) | Output Quantity | Output Voltage (VDC) | Input Range | Pin Connection Option | Remote On/Off Option | Trim Option |
| | | 05: 4.5~9 12: 9~18 24: 18~36 48: 36~75 | S: Single D: Dual | 3P3: 3.3 05: 5 12: 12 15: 15 24: 24 05: ±5 12: ±12 15: ±15 | □: 2:1 W: 4:1 | A: A type(Standard) B: B type | □: No On/Off control P: Remote On/Off (Only for B type Pin connection) | □: No Trim T: Trim (Only for B type Pin connection) |

| MOP06 | - | 48 | S | 05 | W | A | - | P | T |
|-------------|---|-----------------------|--------------------------|---|------------------|----------------------------------|---|--|---|
| Series name | | Input Voltage (VDC) | Output Quantity | Output Voltage (VDC) | Input Range | Pin Connection Option | Remote On/Off Option | Trim Option | |
| | | 24: 9~36 48: 18~75 | S: Single D: Dual | 3P3: 3.3 05: 5 12: 12 15: 15 24: 24 05: ±5 12: ±12 15: ±15 | □: 2:1 W: 4:1 | A: A type(Standard) B: B type | □: No On/Off control P: Remote On/Off (Only for B type Pin connection) | □: No Trim T: Trim (Only for B type Pin connection) | |

INPUT SPECIFICATIONS

| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
|--|-------------------------|---------------------------|------------|------|-----------------------------------|------|
| Operating input voltage range | 2:1 | 5Vin(nom) | 4.5 | 5 | 9 | VDC |
| | | 12Vin(nom) | 9 | 12 | 18 | |
| | (W) 4:1 | 24Vin(nom) | 18 | 24 | 36 | VDC |
| | | 48Vin(nom) | 36 | 48 | 75 | |
| Start-up voltage | 2:1 | 5Vin(nom) | | | 4.5 | VDC |
| | | 12Vin(nom) | | | 9 | |
| | (W) 4:1 | 24Vin(nom) | | | 18 | VDC |
| | | 48Vin(nom) | | | 36 | |
| Shutdown voltage | 2:1 | 5Vin(nom) | | 4 | | VDC |
| | | 12Vin(nom) | | 8 | | |
| | (W) 4:1 | 24Vin(nom) | | 16 | | VDC |
| | | 48Vin(nom) | | 33 | | |
| Start up time | Constant resistive load | Power up | | 30 | | ms |
| | | Remote ON/OFF | | 30 | | |
| Input surge voltage | 3 second, max. | 2:1 | 5Vin(nom) | | 16 | VDC |
| | | | 12Vin(nom) | | 25 | |
| | 3 second, max. | (W) 4:1 | 24Vin(nom) | | 50 | VDC |
| | | | 48Vin(nom) | | 100 | |
| Input filter | | | | | Pi type | |
| Remote ON/OFF (Only for B-type Pin connection option) | Referenced to - Vin pin | | | | OPEN or 0 ~ 1.2VDC 2.2 ~ 12VDC | |
| | | DC-DC ON DC-DC OFF | | | | |
| | | Input current of Ctrl pin | -0.5 | | 1 | mA |
| | | Remote off input current | | 2.5 | | mA |

OUTPUT SPECIFICATIONS

| Parameter | Conditions | | Min. | Typ. | Max. | Unit |
|--|---|--------------------------|-------|------|-------|--------------------------------|
| Voltage accuracy | | | -1.0 | | +1.0 | % |
| Line regulation | Low Line to High Line at Full Load | Single | -0.2 | | +0.2 | % |
| | | Dual | -0.5 | | +0.5 | |
| Load regulation | No Load to Full Load | Single | -0.2 | | +0.2 | % |
| | | Dual | -1.0 | | +1.0 | |
| Cross regulation | Asymmetrical load 25%/100% FL | Dual | -5.0 | | +5.0 | % |
| Voltage adjustability (Only for B-type Pin connection option) | Single output | 3.3Vout, 5Vout, 12Vout | -10 | | +10 | % |
| | | 15Vout, 24Vout | -10 | | +20 | |
| | Dual output | ±5Vout, ±12Vout, ±15Vout | -10 | | +10 | % |
| Ripple and noise | Measured by 20MHz bandwidth With a 10µF/25V X7R MLCC | 3.3Vout, 5Vout | | 30 | | mVp-p |
| | | 12Vout, 15Vout | | 40 | | |
| | | 24Vout | | 50 | | |
| Temperature coefficient | | | -0.02 | | +0.02 | %/°C |
| Transient response recovery time | 25% load step change | | | 250 | | µs |
| Over voltage protection | Single | 3.3Vout | 3.7 | | 5 | VDC |
| | | 5Vout | 5.6 | | 7.0 | |
| | | 12Vout | 13.5 | | 16 | |
| | Dual | 15Vout | 18.3 | | 22.0 | VDC |
| | | 24Vout | 29.1 | | 34.5 | |
| | | 5Vout | 5.6 | | 7.0 | |
| | 12Vout | 13.5 | | 18.2 | VDC | |
| | 15Vout | 17.0 | | 22.0 | VDC | |
| Over load protection | % of Iout rated; Hiccup mode | | | 150 | | % |
| Short circuit protection | | | | | | Continuous, automatic recovery |

GENERAL SPECIFICATIONS

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-----------------------|-----------------------------|------|------|------|--|
| Isolation voltage | 1 minute Input to Output | 3000 | | | VAC |
| Isolation capacitance | | | 12 | 17 | pF |
| Leakage current | 240VAC,60Hz | | | 2 | μA |
| Switching frequency | | 225 | 250 | 275 | kHz |
| Clearance/Creepage | | 6.6 | | | mm |
| Safety approvals | | | | | ANSI/AAMI ES60601-1 EN60601-1 IEC60601-1 UL60950-1 EN60950-1 IEC60950-1 |
| Case material | | | | | Non-conductive black plastic |
| Base material | | | | | Non-conductive black plastic |
| Potting material | | | | | Silicone (UL94 V-0) |
| Weight | | | | | 14g (0.48oz) |
| MTBF | MIL-HDBK-217F, Full load | | | | 4.718 x 10 ⁶ hrs |

ENVIRONMENTAL SPECIFICATIONS

| Parameter | Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|----------------------------|------|------|------|--------------|
| Operating ambient temperature | Without derating | -40 | | +88 | °C |
| | With derating | +88 | | +105 | °C |
| Storage temperature range | | -55 | | +125 | °C |
| Thermal impedance | Natural convection (20LFM) | | 18 | | °C/W |
| Thermal shock | | | | | MIL-STD-810F |
| Vibration | | | | | MIL-STD-810F |
| Relative humidity | | | | | 5% to 95% RH |

EMC SPECIFICATIONS

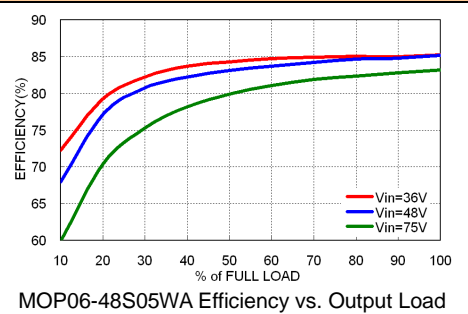
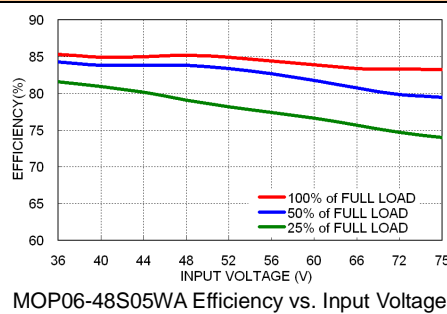
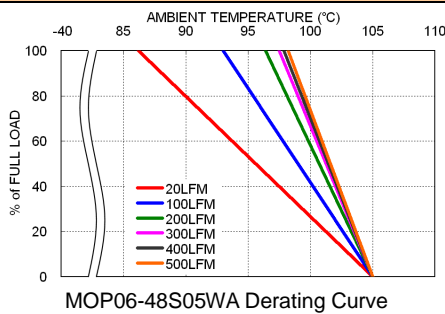
| Parameter | Conditions | Level |
|--------------------------------|-------------------------------------|------------------|
| EMI (1) | EN55011,EN55022 and FCC Part 18 | Class A, Class B |
| ESD | Air ± 8kV | Perf. Criteria A |
| | Contact ± 6kV | |
| Radiated immunity | 10 V/m | Perf. Criteria A |
| Fast transient (2) | ± 2kV | Perf. Criteria A |
| Surge (2) | ± 2kV | Perf. Criteria A |
| Conducted immunity | 10 Vr.m.s | Perf. Criteria A |
| Power frequency magnetic field | 100A/m continuous; 1000A/m 1 second | Perf. Criteria A |

Note:

- The MOP06 (W) series can meet EMI Class A with no external filter. And Class B only with external components. For further information, please contact with P-DUKE.
- An external input filter capacitor is required if the module has to meet EN61000-4-4, EN61000-4-5. The MOP06-05□□□□□ recommended an aluminum electrolytic capacitor (Nippon Chemi-con KY series, 1000μF/25V). And a reverse diode (Vishay V10P45) to connect in parallel. The MOP06-12&24□□□□□□ recommended an aluminum electrolytic capacitor (Nippon Chemi-con KY series, 470μF/50V). The MOP06-48□□□□□□ recommended an aluminum electrolytic capacitor (Nippon Chemi-con KY series, 330μF/100V).

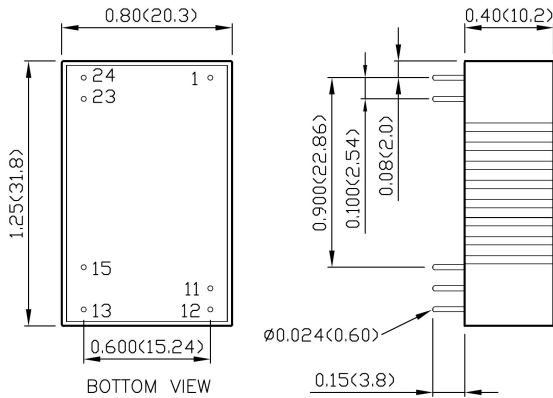
CAUTION: This power module is not internally fused. An input line fuse must always be used.

CHARACTERISTIC CURVE



MECHANICAL DRAWING

A TYPE

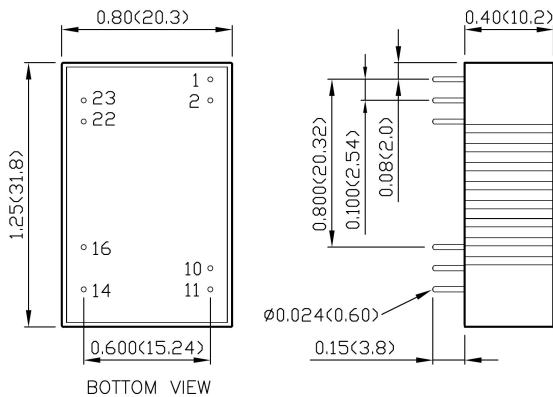


1. All dimensions in Inch (mm)
2. Tolerance: X.XX±0.02 (X.X±0.5)
X.XXX±0.01 (X.XX±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.004 (0.1)

PIN CONNECTION

| PIN | SINGLE | DUAL |
|-----|--------|--------|
| 1 | + Vin | + Vin |
| 11 | No pin | Common |
| 12 | -Vout | No pin |
| 13 | +Vout | -Vout |
| 15 | No pin | +Vout |
| 23 | - Vin | - Vin |
| 24 | - Vin | - Vin |

B TYPE



1. All dimensions in Inch (mm)
2. Tolerance: X.XX±0.02 (X.X±0.5)
X.XXX±0.01 (X.XX±0.25)
3. Pin pitch tolerance ±0.01 (0.25)
4. Pin dimension tolerance ±0.004 (0.1)

PIN CONNECTION

| PIN | SINGLE | DUAL |
|-----|--------------------------|-------------------------|
| 1 | CtrlL (Option) / No pin* | Ctrl (Option) / No pin* |
| 2 | - Vin | - Vin |
| 10 | Trim (Option) / No pin* | Trim (Option) / No pin* |
| 11 | No pin / NC ** | -Vout |
| 14 | +Vout | +Vout |
| 16 | -Vout | Common |
| 22 | +Vin | +Vin |
| 23 | +Vin | +Vin |

* If don't choose Ctrl or Trim option, there is no pin on the corresponding pin number.

** Pin 11 is "No pin" for

MOP06-□□S□□□**B-I**
MOP06-□□S□□□**B-PI**

Pin 11 is "NC" for

MOP06-□□S□□□**B**
MOP06-□□S□□□**B-P**

EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below. () for dual output trim.

