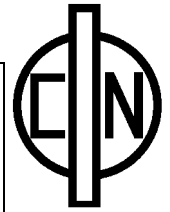


# 20W DC-DC Converter P20H-Series



PHI-CON

- Wide 4:1 input range
- Efficiency up to 90 %
- Adjustable output voltage
- Remote control on / off
- 1500 V<sub>DC</sub> isolation
- Continuous short circuit protection
- Over voltage protection
- Standard package 2" x 1" x 0.4"
- MTBF > 1 Mio. hours
- -40...+85 °C operating temperature range



## Model guide

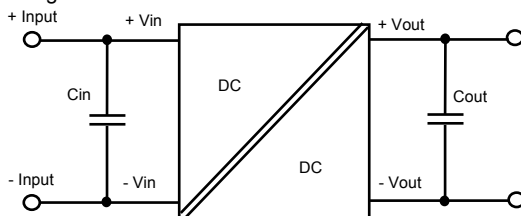
| Type          | Input nominal voltage<br><br>[V <sub>DC</sub> ] | Input current |           | Output voltage<br><br>[V <sub>DC</sub> ] | Output current |              | Efficiency<br>@ full load<br>typ.<br><br>[%] | Capacitive load<br>(see note 3)<br><br>[μF] max. |
|---------------|-------------------------------------------------|---------------|-----------|------------------------------------------|----------------|--------------|----------------------------------------------|--------------------------------------------------|
|               |                                                 | no load       | full load |                                          | minimum load   | maximum load |                                              |                                                  |
|               |                                                 | [mA]          | [mA]      |                                          | [mA]           | [A]          |                                              |                                                  |
| Single output |                                                 |               |           |                                          |                |              |                                              |                                                  |
| P20H243R3S    | 9...36                                          | 40            | 800       | 3.3                                      | 250            | 5000         | 86                                           | 18700                                            |
| P20H2405S     | 9...36                                          | 60            | 916       | 5                                        | 200            | 4000         | 90                                           | 9600                                             |
| P20H2409S     | 9...36                                          | 18            | 947       | 9                                        | 111            | 2222         | 88                                           | 4700                                             |
| P20H2412S     | 9...36                                          | 15            | 937       | 12                                       | 84             | 1667         | 89                                           | 1600                                             |
| P20H2415S     | 9...36                                          | 15            | 926       | 15                                       | 67             | 1333         | 90                                           | 1000                                             |
| P20H2424S     | 9...36                                          | 20            | 927       | 24                                       | 42             | 834          | 90                                           | 500                                              |
| P20H483R3S    | 18...75                                         | 35            | 400       | 3.3                                      | 250            | 5000         | 86                                           | 18700                                            |
| P20H4805S     | 18...75                                         | 35            | 463       | 5                                        | 200            | 4000         | 90                                           | 9600                                             |
| P20H4812S     | 18...75                                         | 10            | 468       | 12                                       | 84             | 1667         | 89                                           | 1600                                             |
| P20H4815S     | 18...75                                         | 10            | 463       | 15                                       | 67             | 1333         | 90                                           | 1000                                             |
| P20H4824S     | 18...75                                         | 10            | 463       | 24                                       | 42             | 834          | 90                                           | 500                                              |
| Dual output   |                                                 |               |           |                                          |                |              |                                              |                                                  |
| P20H2405D     | 9...36                                          | 20            | 969       | ±5                                       | ±100           | ±2000        | 86                                           | 2 x 4800                                         |
| P20H2412D     | 9...36                                          | 15            | 948       | ±12                                      | ±42            | ±834         | 88                                           | 2 x 800                                          |
| P20H2415D     | 9...36                                          | 15            | 947       | ±15                                      | ±33            | ±667         | 88                                           | 2 x 625                                          |
| P20H4805D     | 18...75                                         | 18            | 485       | ±5                                       | ±100           | ±2000        | 86                                           | 2 x 4800                                         |
| P20H4812D     | 18...75                                         | 14            | 474       | ±12                                      | ±42            | ±834         | 88                                           | 2 x 800                                          |
| P20H4815D     | 18...75                                         | 14            | 468       | ±15                                      | ±33            | ±667         | 89                                           | 2 x 625                                          |

With suffix "K" heatsink version

## 1) Recommended circuit

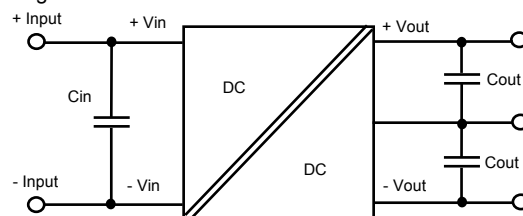
The P20H series is been tested according to the following recommended test circuit before leaving the factory (see Figures 1). If you want to further decrease the input / output ripple, you can increase a capacitance values properly or choose capacitors with low ESR, but the total capacitance of the filter capacitor must not exceed the maximum load capacitance value (see „Model guide“ table).

Figure 1a



| Recommended peripheral components to figure 1a |        |        |
|------------------------------------------------|--------|--------|
|                                                | Cin    | Cout   |
| P20Hxx3R3S                                     | 100 μF | 470 μF |
| P20Hxx05S                                      |        | 470 μF |
| P20Hxx09S                                      |        | 220 μF |
| P20Hxx12S                                      |        | 220 μF |
| P20Hxx15S                                      |        | 220 μF |
| P20Hxx24S                                      |        | 100 μF |

Figure 1b



| Recommended peripheral components to figure 1b |        |        |
|------------------------------------------------|--------|--------|
|                                                | Cin    | Cout   |
| P20Hxx05D                                      | 100 μF | 220 μF |
| P20Hxx12D                                      |        | 100 μF |
| P20Hxx15D                                      |        | 100 μF |



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# 20W DC-DC Converter P20H-Series

## Specifications

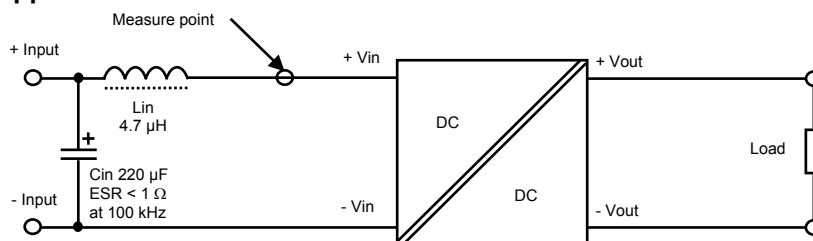
| Input                                            |            |                                                     |                           |
|--------------------------------------------------|------------|-----------------------------------------------------|---------------------------|
| Under voltage lockout                            | P20H48xxx  | on @ 9 V <sub>DC</sub>                              | off @ 7.5 V <sub>DC</sub> |
|                                                  | P20H24xxx  | on @ 17.8 V <sub>DC</sub>                           | off @ 16 V <sub>DC</sub>  |
| Filter                                           |            | π - type                                            |                           |
| Reflected ripple current *6                      |            | 30 mA <sub>p-p</sub> , typ.                         |                           |
| Remote control threshold                         | On state   | 2.5...12 V <sub>DC</sub> , or open input            |                           |
|                                                  | Off state  | 0...1.2 V <sub>DC</sub>                             |                           |
| Input idle current @ Off state                   |            | 1 mA, typ.                                          |                           |
| Isolation input - output:                        |            |                                                     |                           |
| Rated voltage (tested for 1 min.)                |            | 1500 V <sub>DC</sub>                                |                           |
| Resistance                                       |            | > 10 <sup>9</sup> Ω, measured @ 500 V <sub>DC</sub> |                           |
| Input / output capacitance                       | All others | 1000 pF, typ.                                       |                           |
|                                                  | P40Cxx24x  | 2000 pF, typ.                                       |                           |
| Output                                           |            |                                                     |                           |
| Voltage tolerance                                |            | ± 3 %, max.                                         |                           |
| Voltage load regulation                          |            | ± 1 % @ 5 %...100 % load                            |                           |
| Output voltage trim range                        |            | ± 10 %                                              |                           |
| Voltage cross balance (dual outputs)             |            | ±5 %, max. @ 10 % / 100 % load difference           |                           |
| Voltage regulation                               |            | ± 0.5 %, max @ full Vin range                       |                           |
| Temperature coefficient                          |            | ± 0.02 % / °C                                       |                           |
| Transient recovery time                          |            | <500 μs, @ 25 % load steps                          |                           |
| Transient response deviation                     |            | <5 %, @ 25 % load steps                             |                           |
| Short circuit protection                         |            | Continuous, hiccup                                  |                           |
| Short circuit restart                            |            | Automatic                                           |                           |
| Over load protection                             |            | 150 % of full load, typ.                            |                           |
| Rippel & noise, BW 20MHz                         |            | 100 mV <sub>p-p</sub> , max.                        |                           |
| Over voltage protection via integrated TVS-Diode |            | P20Hxx3R3x: 3.9 V <sub>DC</sub>                     |                           |
|                                                  |            | P20Hxx05x: 6.2 V <sub>DC</sub>                      |                           |
|                                                  |            | P20Hxx09x: 10.8 V <sub>DC</sub>                     |                           |
|                                                  |            | P20Hxx12x: 15 V <sub>DC</sub>                       |                           |
|                                                  |            | P20Hxx15x: 18 V <sub>DC</sub>                       |                           |
|                                                  |            | P20Hxx24x: 30 V <sub>DC</sub>                       |                           |

| General                                           |                  |                                |
|---------------------------------------------------|------------------|--------------------------------|
| Start up time                                     |                  | 10 ms, typ @ R-load            |
| Switching frequency                               |                  | 300...345 kHz, typ.            |
| Reliability calculated MTBF MIL-HDBK-217F @ 25 °C |                  | > 1 Mio. hours                 |
| EMC characteristics                               |                  |                                |
| Radiated emissions                                |                  | CISPR22 / EN55022 Class A      |
| Radiated emissions, with Fig. 2                   |                  | CISPR22 / EN55022 Class B      |
| Conducted emissions                               |                  | CISPR22 / EN55022 Class A      |
| Conducted emissions, with Fig. 2                  |                  | CISPR22 / EN55022 Class B      |
| ESD, with Fig. 2                                  |                  | EN61000-4-2 perf. crit. B      |
| RS                                                |                  | EN61000-4-3 perf. crit. A      |
| EFT, with Fig. 2                                  |                  | EN61000-4-4 perf. crit. B      |
| Surge, with Fig. 2                                |                  | EN61000-4-5 perf. crit. B      |
| CS                                                |                  | EN61000-4-6 perf. crit. A      |
| Environmental                                     |                  |                                |
| Operating ambient temperature                     |                  | -40 °C to +85 °C with derating |
| Case temperature                                  |                  | 105 °C, max.                   |
| Storage temperature                               |                  | -55 °C to +125 °C              |
| Over temp. protection                             |                  | t-case 110 °C, typ             |
| Storage humidity                                  |                  | 5...95 %, non condensing       |
| Cooling                                           |                  | Free air convection            |
| Physical                                          |                  |                                |
| Dimensions                                        | with heatsink    | 50.80 x 25.40 x 11.8 mm        |
|                                                   | without heatsink | 50.80 x 25.40 x 16.3 mm        |
| Weight                                            | with heatsink    | 28 g                           |
|                                                   | without heatsink | 36 g                           |
| Case material                                     |                  | Aluminium alloy                |
| Potting Material                                  |                  | Epoxy (UL94V-0 rated)          |
| Absolute max. ratings                             |                  |                                |
| Pin soldering temperature                         |                  | 300°C for 10 sec               |
| 1.5 mm distance from body                         |                  |                                |
| Max. input voltage < 1 sec                        | P20H24xxx        | -0.7...50 V <sub>DC</sub>      |
|                                                   | P20H48xxx        | -0.7...100 V <sub>DC</sub>     |

### Note:

- Min. load should not be less than 5 %, otherwise ripple maybe increased dramatically, If the product operates under min. load, it may not be guaranteed to meet all specifications listed. Operation under minimum load will not damage the converter.
- The recommended unbalanced load of dual output converter should be low than 5 %. If the load asymmetry greater than 5 %, it may not be guaranteed to meet all specifications listed. Please contact our technical support for more details.
- Maximum capacitive load is tested at input voltage range and full load.
- All specifications measured at Ta 25°C, humidity < 75 %, nominal input voltage and rated output load unless otherwise specified.
- In this datasheet, all test methods are based on our corporate standards.
- All characteristics are for listed models, and non standard models may perform differently. Please contact our technical support for more details.
- Please contact our technical support for any specific requirement.
- Specifications of this product are subject to changes without prior notice.
- It is not recommended to increase the output power capability by connecting two or more converters in parallel. The converters are not hot swappable

### Input reflected ripple measure circuit

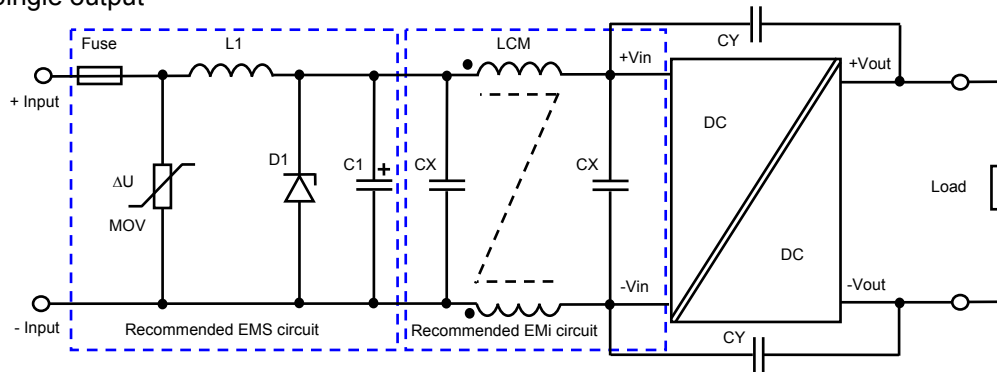


The input reflected ripple current is measured with inductor  $L_{in}$  and capacitor  $C_{in}$  to simulate source impedance.

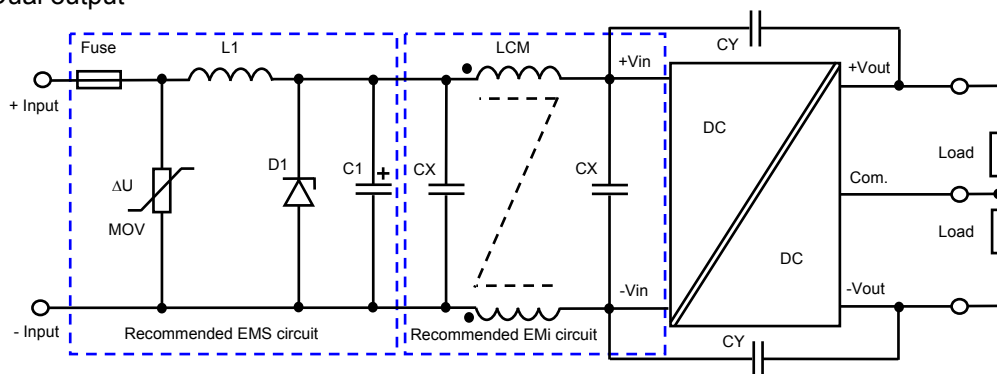
# 20W DC-DC Converter P20H-Series



**Figures 2, Recommended EMC circuit**  
Single output



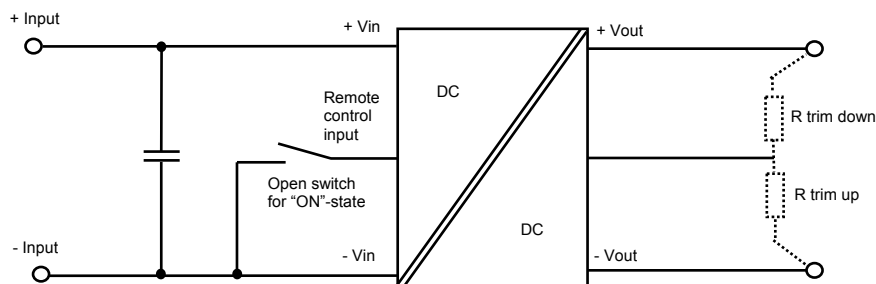
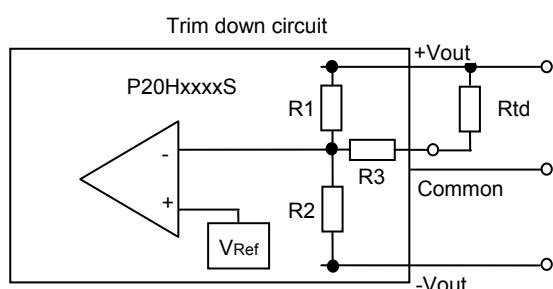
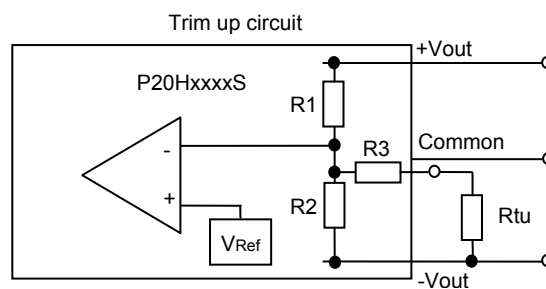
Dual output



| Recommended peripheral components to circuits in figures 2 |                   |             |            |            |                    |             |        |           |
|------------------------------------------------------------|-------------------|-------------|------------|------------|--------------------|-------------|--------|-----------|
|                                                            | Fuse<br>Slow blow | MOV<br>Type | L1         | D1<br>Type | C1                 | CX          | LCM    | CY        |
| P20H24xxS                                                  | 2.5 A             | 10D560K     | 56 $\mu$ H | SMCJ48A    | 120 $\mu$ F, 50 V  | 4.7 $\mu$ F | 2.2 mH | 1nF, 2 kV |
| P20H24xxD                                                  | 2.5 A             | 10D560K     | 56 $\mu$ H | SMCJ48A    | 120 $\mu$ F, 50 V  | 4.7 $\mu$ F | 2.2 mH | 1nF, 2 kV |
| P20H48xxS                                                  | 1.5 A             | 10D101K     | 56 $\mu$ H | SMCJ90A    | 120 $\mu$ F, 100 V | 2.2 $\mu$ F | 2.2 mH | 1nF, 2 kV |
| P20H48xxD                                                  | 1.5 A             | 10D101K     | 56 $\mu$ H | SMCJ90A    | 120 $\mu$ F, 100 V | 2.2 $\mu$ F | 2.2 mH | 1nF, 2 kV |

# 20W DC-DC Converter P20H-Series

Application note to remote control / trim function



## Calculation for trim down resistor (Rtd) or trim up resistor (Rtu)

| Model series                                                                   | R1 [kΩ] | R2 [kΩ] | R3 [kΩ] | V <sub>Ref</sub> [V] | Rtd min. [kΩ] | Rtu min. [kΩ] |
|--------------------------------------------------------------------------------|---------|---------|---------|----------------------|---------------|---------------|
| P20Hxx3R3S                                                                     | 4.801   | 2.864   | 15      | 1.24                 | 8.65          | 4.27          |
| P20Hxx05S                                                                      | 2.883   |         | 10      | 2.5                  | 1.16          | 4.9           |
| P20Hxx09S                                                                      | 7.5     |         | 15      |                      | 29.4          | 7             |
| P20Hxx12S                                                                      | 10.971  |         | 17.8    |                      | 53.5          | 6.6           |
| P20Hxx15S                                                                      | 14.497  |         | 17.8    |                      | 78.6          | 9.1           |
| P20Hxx24S                                                                      | 24.872  |         | 20      |                      | 162           | 8.37          |
| Maximum output voltage adjust range ± 10 % of Vout nominal, see min. Rtd / Rtu |         |         |         |                      |               |               |

### Trim down resistor formula

$$b = \frac{V_{out} - V_{ref}}{V_{ref}} \cdot R2$$

$$R_{td} = \frac{R1 \cdot b}{R1 - b} - R3$$

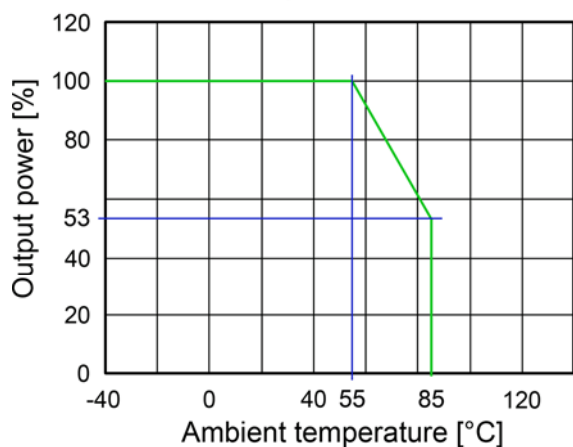
### Trim up resistor formula

$$a = \frac{V_{ref}}{V_{out} - V_{ref}} \cdot R1$$

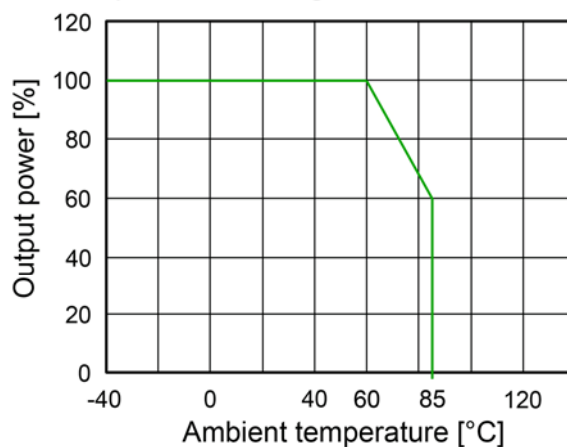
$$R_{tu} = \frac{R2 \cdot a}{R2 - a} - R3$$

# 20W DC-DC Converter P20H-Series

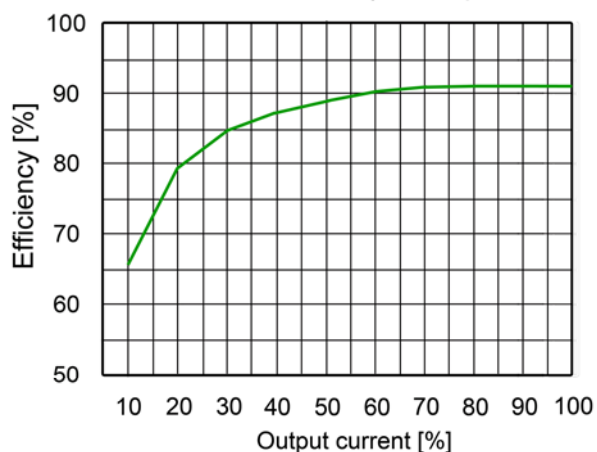
Temperature derating curve without heatsink



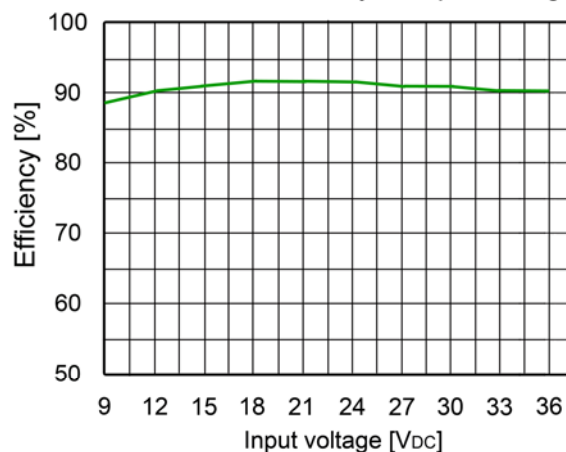
Temperature derating curve with heatsink



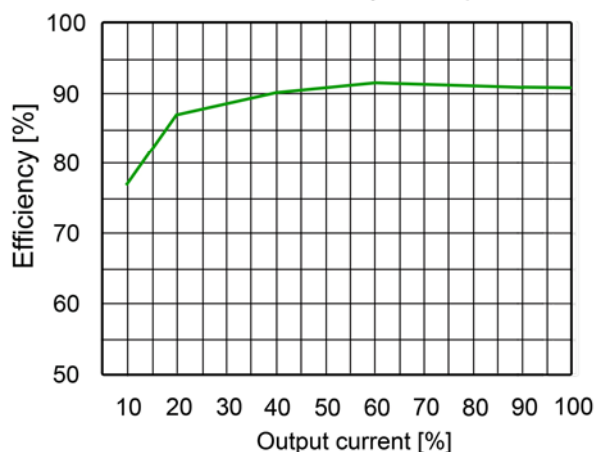
P20H2405S Efficiency vs output load



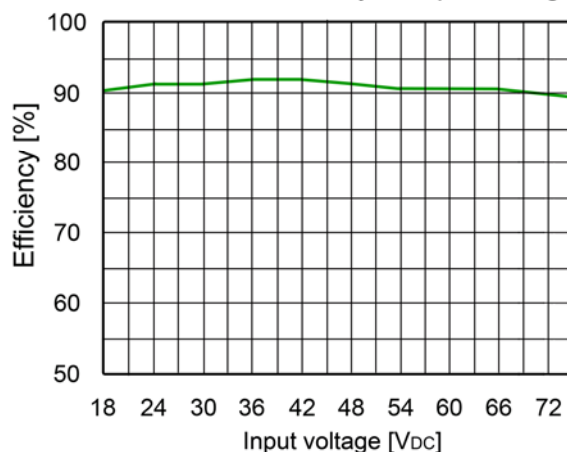
P20H2405S Efficiency vs input Voltage



P20H4815S Efficiency vs output load

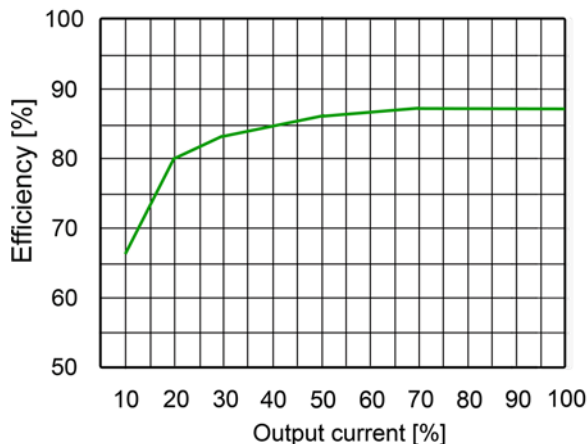


P20H4815S Efficiency vs input Voltage

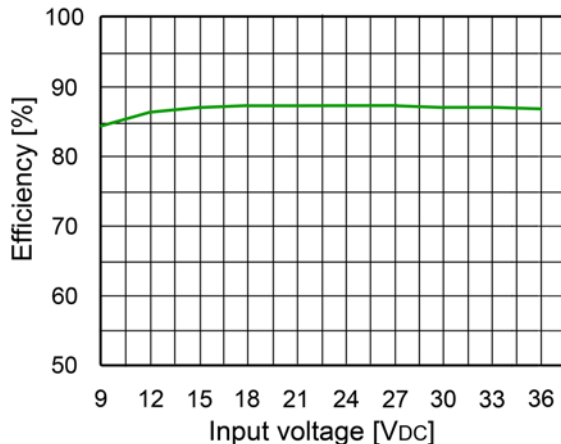


# 20W DC-DC Converter P20H-Series

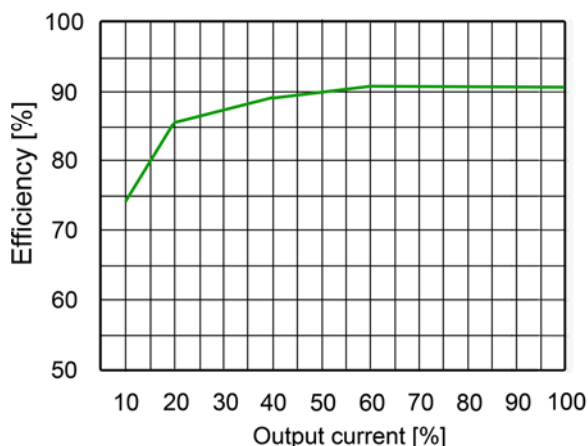
P20H2405D Efficiency vs output load



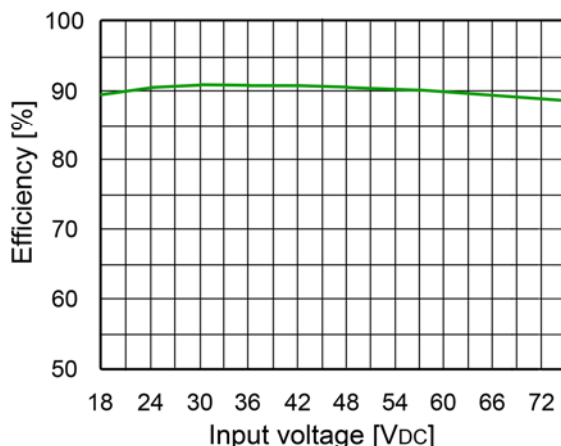
P20H2405D Efficiency vs input Voltage



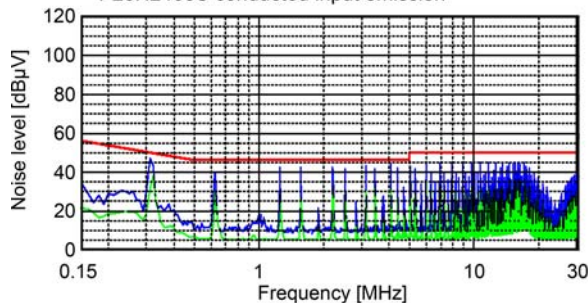
P20H4815D Efficiency vs output load



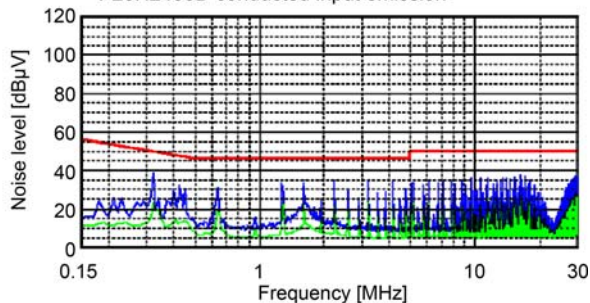
P20H4815D Efficiency vs input Voltage



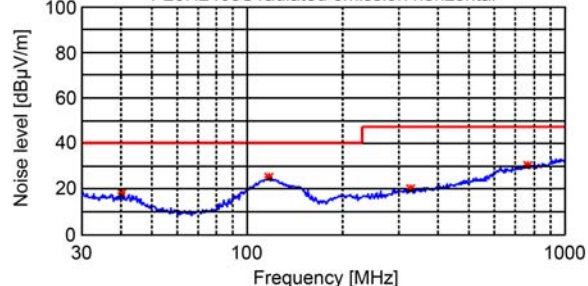
P20H2405S conducted input emission



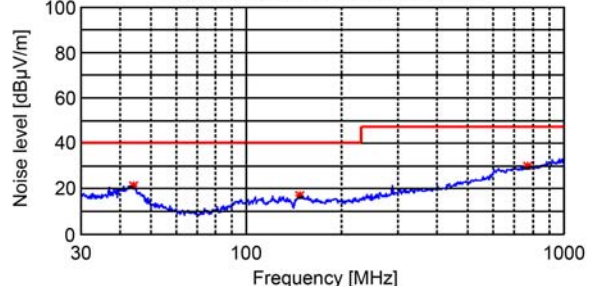
P20H2405D conducted input emission



P20H2405S radiated emission horizontal

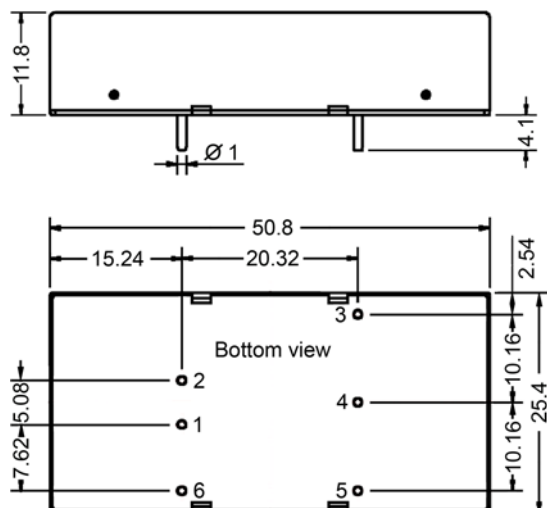


P20H2405S radiated emission vertical



# 20W DC-DC Converter P20H-Series

## Dimensions standard version



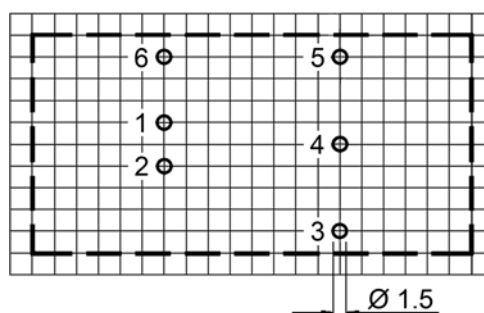
Unit: mm

Pin diameter tolerance: 0.1 mm

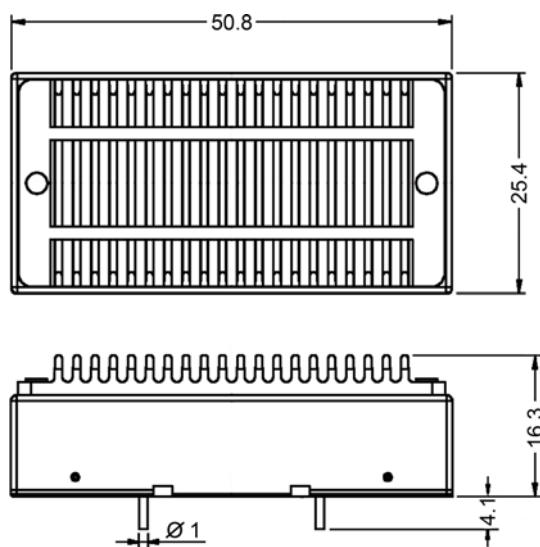
Pin height tolerance: 0.5 mm

General tolerances: 0.30 mm

| Pin configuration |          |          |
|-------------------|----------|----------|
| Pin               | Single   | Dual     |
| 1                 | - Vin    | - Vin    |
| 2                 | + Vin    | + Vin    |
| 3                 | + Vout   | + Vout   |
| 4                 | Trim     | Common   |
| 5                 | - Vout   | - Vout   |
| 6                 | Rem ctrl | Rem ctrl |



## Dimensions heatsink version



Unit: mm

Pin diameter tolerance: 0.1 mm

Pin height tolerance: 0.5 mm

General tolerances: 0.30 mm

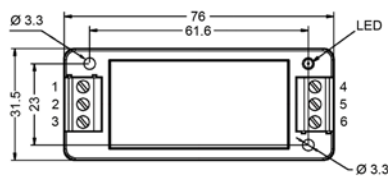
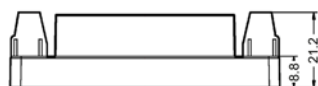




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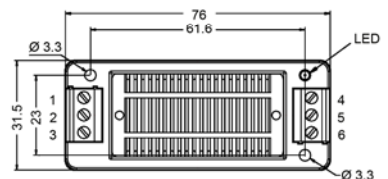
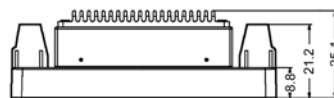
# 20W DC-DC Converter P20H-Series

Ordering designation P20HxxxxA2



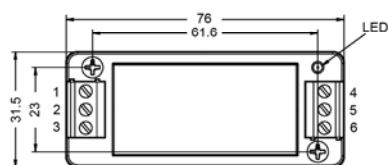
Dimensions in mm, general tolerances  $\pm 0.5$

Ordering designation P20HxxxxKA2



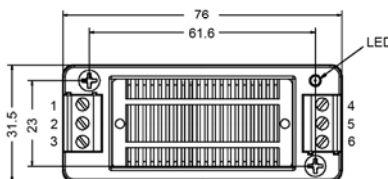
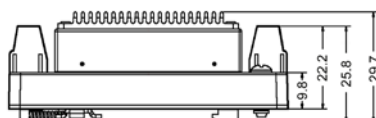
Dimensions in mm, general tolerances  $\pm 0.5$

Ordering designation P20HxxxxD



Dimensions in mm, general tolerances  $\pm 0.5$

Ordering designation P20HxxxxKD



Dimensions in mm, general tolerances  $\pm 0.5$

| Terminal assignment    |        |       |
|------------------------|--------|-------|
| Terminal               | Single | Dual  |
| 1                      | Ctrl.  | Ctrl. |
| 2                      | -Vin   | -Vin  |
| 3                      | +Vin   | +Vin  |
| 4                      | -Vout  | -Vout |
| 5                      | Trim   | Com.  |
| 6                      | +Vout  | +Vout |
| Wire range 24...12 AWG |        |       |

The DIN-Rail versions are TS35 compatible.

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