MAIN FEATURES

- 90 – 264 V_{AC} Universal input voltage range
- 200 W rated power
- 2 x 4 x 1.48" foot print (> 16.9 W/in^3)
- High efficiency (up to 93.5%)
- No-load low power consumption (<0.3 W)
- 12, 24, and 48V_{DC} standard output variants
- Active PFC, EN61000-3-2 compliant
- Low earth leakage current (<300 µA)
- Over temperature protection, auto-recovery
- Output over voltage latch off protection
- Over load and short circuit hiccup protections
- 12 V Auxiliary, 0.5 A output
- Metallic protecting cage available option
- IEC safety installation Class I and Class II
- ANSI/AAMI ES60601-1 3rd ed. compliant
  IEC/EN 60601-1 3rd ed. compliant to 2XMoPP
- EN 60601-1-2 4th ed. for immunity compliance
- RoHS-3 compliant (EU directive 2015/863)
- 3000 m altitude operation
- 5 years warranty (*)

(*) Warranty period relevant the "-PC" variants when operated below 190 V_{AC}, at >75 % load natural convection, is Three (3) years

DESCRIPTION

The MDP200 series of medical grade power supplies is designed to provide 2xMoPP grade protection, small form factor, high power density in a free air-cooling environment.
Available in 12, 24 and 48 VDC outputs, this series of high-performance AC-DC power supplies provides up to 200 W of steady output power with moving air, or from 160 W upwards with convection cooling over the full 90 – 264 V_{AC} universal input voltage range, all in a compact 2.00 x 4.00 x 1.44" open frame form factor. It is also available in a 2.44" x 4.61" x 1.57" enclosed package which provides operator protection during system servicing and enhanced thermal performance.
The series carries a full set of electrical protections including fuse on each AC input lines and offers a 12 V, 0.5 A fan output.
Offering 93.5% efficiency and an extremely low 0.3 W power consumption at no-load, the MDP200 facilitates thermal management and equipment design, including compatibility with the latest environmental legislations.
The series comes configured in the IEC protective Class I or Class II variants as a standard.
The MDP200 series is approved to the 3rd edition of the ANSI/AAMI ES60601-1, IEC/EN 60601-1 standards for medical grade power supplies, including 2x MoPP means of patient protection and BF appliances compatibility. It also complies with the internationally recognized EMC standards EN 55011, EN 60601-1-2 Class B specifications for conducted noise emissions, and EN 60601-1-2 4th edition for immunity, making the series suitable for use in a wide range of medical equipment applications worldwide.

MARKET SEGMENTS AND APPLICATIONS

- Diagnostic equipment
- Imaging equipment
- Respiratory devices
- Therapy appliances
- Dental equipment
- Dermatology aesthetic medicine

MODEL CODING AND OUTPUT RATINGS

Model and Output Power	Output Nominal Voltage	Package Options
Medical 200W: **MDP200**	*12 V_{DC}:* **-US12**	*Open Frame:* **-OF**
	24 V_{DC}: **-US24**	
	48 V_{DC}: **-US48**	*Protective Cage:* **-PC**

MODEL CODING AND OUTPUT RATINGS

Model Number	Output Voltage V1 [V]	V1 Output Voltage Accuracy [%]	I1 Output Current Forced air [A]	I1 Output Current[1] Convection [A]	V1[2] Ripple [mV]	V1 Typical Efficiency [%]	Fan Voltage V2 [V]	I2[1] Output current forced air [A]	I2[1] Output current Convection [A]
MDP200-US12-OF	12	±2	16.67	15.00	150	92	12	0.5	0.3
MDP200-US24-OF	24	±2	8.33	7.50	240	93.5	12	0.5	0.3
MDP200-US48-OF	48	±2	4.17	3.75	480	93	12	0.5	0.3
MDP200-US12-PC	12	±2	16.67	16.67	150	92	12	0.5	0.3
MDP200-US24-PC	24	±2	8.33	8.33	240	93.5	12	0.5	0.3
MDP200-US48-PC	48	±2	4.17	4.17	480	93	12	0.5	0.3

[1] The combined output power of V1 and V2 for "-OF" and "-PC" packages, must not exceed 200 W when cooled by 10 CFM air flow, and 180 W when natural convection cooled, up to 40 °C. Above 40 °C output de-rating applies. See de-rating curves below.
In any case, the heat sink temperature should not exceed +110 °C at 50 °C ambient temperature.

[2] Peak-to-Peak measured at 20 MHz Bandwidth.

INPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
AC Input Voltage		90	100-240	264	V_{AC}
Input Frequency		47	50/60	63	Hz
Input Current	RMS at 100 V_{AC}, maximum load	-	-	2.5	A
Inrush Current (peak)	240 V_{AC}, 25 °C ambient, cold start 12, 24, 48 V_{DC}, variants	-	-	100	A
Fusing	Time Lag, 5 A, 250 V on both L and N	-	5	-	A
Efficiency	At 230 V_{AC}, 100 % rated load 12 V_{DC} 24 V_{DC} 48 V_{DC}	 - - -	 92 93.5 93	 - - -	%
No-load Power Consumption	At 115-230 V_{RMS}, no load	-	-	0.3	W
Power Factor	At full rated load, 115 V_{AC}, 60 Hz and 230 V_{AC}, 50 Hz input voltages	0.90	-	-	-
Harmonic Current Fluctuations and Flicker	Complies with EN-61000-3-2, Classes A, D Complies with EN-61000-3-3 at nominal voltages and full load.				
Earth Leakage Current	Normal conditions, 264 V_{AC}, 60 Hz Normal conditions, nominal input voltages and frequencies	- -	- 260	300 -	µA
Touch Leakage Current "PC" variant	Normal conditions	-	75	100	µA

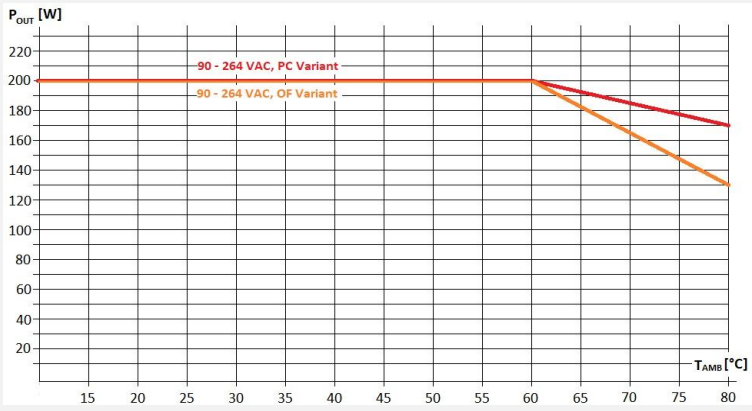
OUTPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nom.	Max.	Units
V1 Output Voltage	±2 % set point accuracy for all voltage variants At 60 % load, 25 °C ambient temperature Output voltage can be manually adjusted through potentiometer in a maximum ±2% of nominal value	- - -	12 24 48	- - -	V
V1 Rated Currents	12 V, 10 CFM forced air cooling 24 V, 10 CFM forced air cooling 48 V, 10 CFM forced air cooling See output power de-rating curves below	- - -	- - -	16.67 8.33 4.17	A
V2 Output Voltage	All models. ±10 % accuracy at 10-100 % full load	-	12	-	V
V2 Output Current (I2)	Convection / 10 CFM forced air cooling Natural convection cooling	- -	- -	0.5 0.3	A
V1 Load Regulation	V_{AC}: 90 – 264 V_{RMS} 20-100 % full load	-	-	±1	%V1
V1 Line Regulation	V_{AC}: 90 – 264 V_{RMS}	-	-	±0.5	%V1
Transient Response (V1 Voltage Deviation)	25 % load changes at 1 A/µs 12 V_{DC} at 2200 µF Load / I_{OUT}> 0.5 A 24 V_{DC} at 1000 µF Load / I_{OUT}> 0.5 A 48 V_{DC} at 560 µF Load / I_{OUT}> 0.5 A	-	-	±5	%V1
V1 Ripple and Noise	12 V_{DC} 24 V_{DC} 48 V_{DC} Peak-to-peak, 20 MHz BW. 100 nF ceramic and 47 µF aluminium electrolytic caps at the load	- - -	- - -	150 240 480	mV
Turn-on Overshoot		-	10	-	%V1
Hold-up Time	At nominal V_{IN}, full load, for all models	10	-	-	ms
Minimum Load	All models; V1, V2 and 5 V_{SB}	0	-	-	A
Maximum Load Capacitance	At nominal V_{IN}, 25 °C ambient, max load 12 V_{DC} 24 V_{DC} 48 V_{DC}	 - - -	 - - -	 16400 8570 1270	µF
Temperature Drift		-0.05	-	+0.05	%V1/°C

Output Power Ratings / De-ratings

10 CFM Forced Air Cooling:

200 W rated power for both “OF” and “PC” over the whole 90 – 264 V_{AC} input voltage range



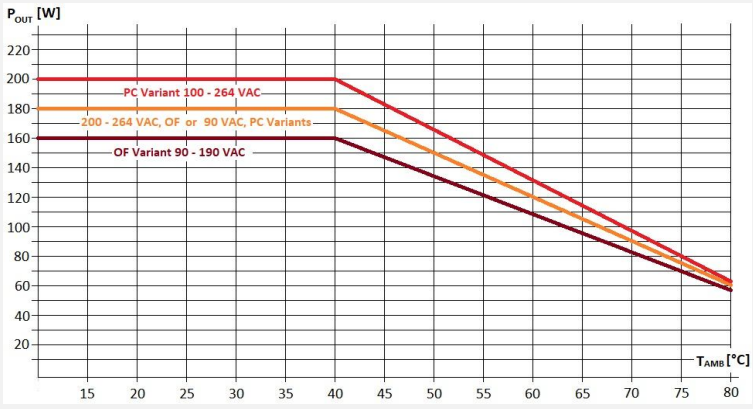
Natural Convection Cooling:

160 W rated power for “OF” over 90 – 190 V_{AC}

180 W rated power for “OF” over 200 – 264 V_{AC}

180 W rated power for “PC” over 90 – 264 V_{AC}

200 W rated power for “PC” over 100 – 264 V_{AC}



PROTECTION FEATURES

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
Input Fuse	Time Lag, 5 A, 250 V on L1 and L2	-	5	-	A
Over Current	At nominal input voltages V1: Hiccup mode, auto-recovering V2: PTC limiting, auto-recovering	130	150	180	%I1$_{MAX}$
Short Circuit	At nominal input voltages V1: Hiccup mode, auto-recovering V2: PTC limiting, auto-recovering	-	-	-	
Over Voltage	12 V_{DC} 24 V_{DC} 48 V_{DC} Unit shut down and latch off	- - -	16 31 56	- - -	V
Over Temperature	Hiccup mode, auto-recovering	-	-	-	
Isolation Primary-to- Secondary	Reinforced (2x MoPP)	4000	-	-	V_{AC}
Isolation Input-to-PE	Basic (1x MoPP)	1500			V_{AC}
Isolation V1-to-V2		100	-	-	V_{DC}
Isolation Output-to-PE	Basic (1X MoPP)	1500	-	-	V_{AC}

ENVIRONMENTAL SPECIFICATIONS

Specification	Test Conditions / Notes	Min	Nominal	Max	Units
Operating Temperature Range	See output power de-rating curves PS starts up at -25 °C	-25	-	70	°C
Storage Temperature Range		-40	-	85	°C
Humidity	RH, Non-condensing Operating Non-operating	-	-	93 95	% %
Operating Altitude		-	-	3000	m
Shock	**EN 60068-2-27** Operating: Half sine, 30 g, 18 ms, 3 axes, 6x each (3 positive and 3 negative) Non-Operating: Half sine, 50 g, 11 ms, 3 axes, 6x each (3 positive and 3 negative)				
Vibration	**EN 60068-2-64** Operating: Sine,10 – 500 Hz, 1 g, 3 axes, 1 oct/min., 60 min Random, 5 – 500 Hz, 0.02 g^2/Hz, 1 g_{RMS}, 3 axes, 30 min Non-Operating: 5 – 500 Hz, 2.46 g_{RMS} (0.0122 g^2/Hz), 3 axes, 30 min				
MTBF	Full Load, 115 V_{AC}, 25 °C ambient GB, MIL-HDBK-217F	-	279.000	-	Hours
Useful Life (*)	Low line range, 75% rated load, 40 °C ambient, natural convention	-	4	-	Years
Thermal Considerations	The output power de-rating curves are herein provided. These curves can be used as a guideline to assess the limit in performance of a power supply once installed in a system providing controlled air flow at a certain input voltage and ambient temperature				

(*) Calculated life time for the PC variants at natural convection, 115 V_{AC} input, 40 °C and 75% rated load is 3 years

ELECTROMAGNETIC COMPATIBILITY (EMC) – EMISSIONS

Phenomenon	Conditions / Notes	Standard	Equipment Performance Class
Conducted (*)	115 V_{RMS}, 230 V_{RMS}. Maximum load.	EN 60601-1-2 (Medical) EN 55011 (IMS)	B (*)
Radiated (*)		EN 60601-1-2 (Medical) EN 55011 (IMS)	B
Line Voltage Fluctuation and Flicker	At 20%, 50% and 100% maximum load. Nominal input voltages.	EN 61000-3-3	
Harmonic Current Emission	At nominal input voltages	EN 61000-3-2	A, D

(*) Need an external 1mH choke at input for Class II type to pass EN55011 and EN 60601.1-2 Class B when in Class II configuration

ELECTROMAGNETIC COMPATIBILITY EMC) – IMMUNITY

Phenomenon	Conditions / Notes	Standard	Test Level	Performance criteria
	Reference standard for the medical version	**EN 60601-1-2 4th Ed.**		
ESD	15 kV air discharge, 8 kV contact, at any point of the system.	EN 61000-4-2	4	A
Radiated, RF, EM field Immunity Test **Radiated, RF, EM Proximity Field Wireless Immunity Test**	10 V/m, 80-2700 MHz, 80% AM at 1KHz Close field proximity level	EN 61000-4-3	3	A
Electrical Fast Transient / Burst Immunity Test	±2 kV on AC power port, 100 kHz RPF, for 1 minute	EN 61000-4-4	3	A
Surge Immunity Test	± 1 kV line to line; ± 2 KV lines to earth; on AC power port.	EN 61000-4-5	3	A A
Immunity to Conducted Disturbances, Induced by RF Fields	3 V_{RMS}, 0,15-80 MHz, 80% AM at 1 KHz 6 V_{RMS}, ISM bands plus Amateurs bands	EN 61000-4-6	3 6	A
Dips and Interruptions	Dip to 30% for 0.5 cycle (10 ms) Dip to 40% for 5 cycles (100 ms) Dip to 70% for 25 cycles (500 ms) Drop-out to 5% for 10 ms Interrupts > 95% for 5 s	EN61000-4-11		A B B B B

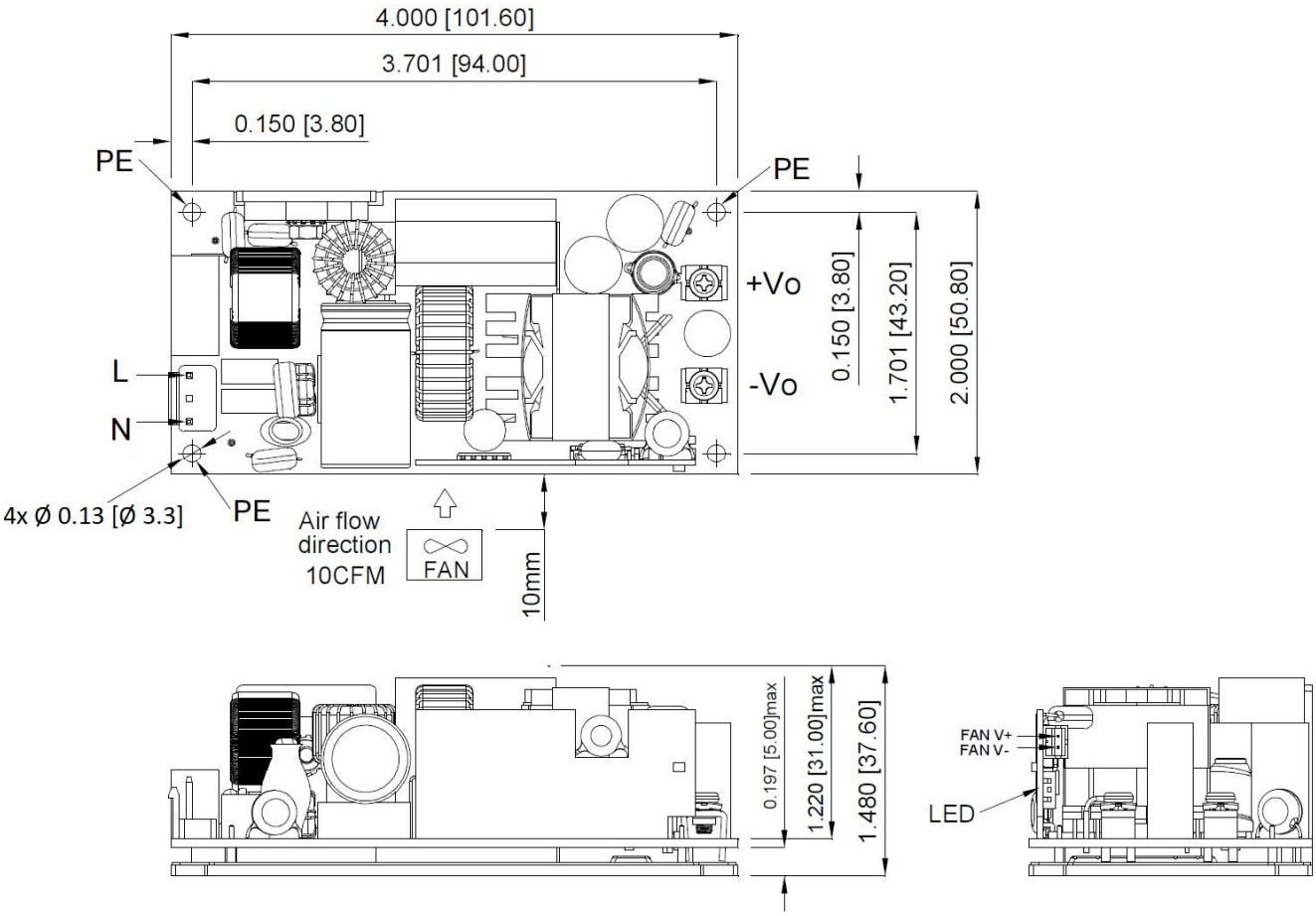
SAFETY AGENCIES APPROVALS

Certification Body	Safety Standards and file numbers	Category
CSA / UL	CSA C22.2 No.60601-1, ANSI/AAMI ES60601-1 3rd edition + A1	Medical
IEC IECEE CB Certification	IEC/EN 60601-1 3rd edition+A1	Medical
CE	Low Voltage Directive (LDV) 2007/47/EC MDD	Medical
	Directive EU 2015/863 (RoHS 3)	

OUTLINE DRAWING AND CONNECTIONS – OPEN FRAME (-OF)

Overall dimensions: 50.8 x 101.6 x 37.6 mm (2.00 x 4.00 x 1.48 in)

Weight: 253 g (0.56 lb)



Input connector (L, N): TAIWAN KING PIN TERMINAL PVHI series. Mate connector: JST Housing VHR series or equivalent.

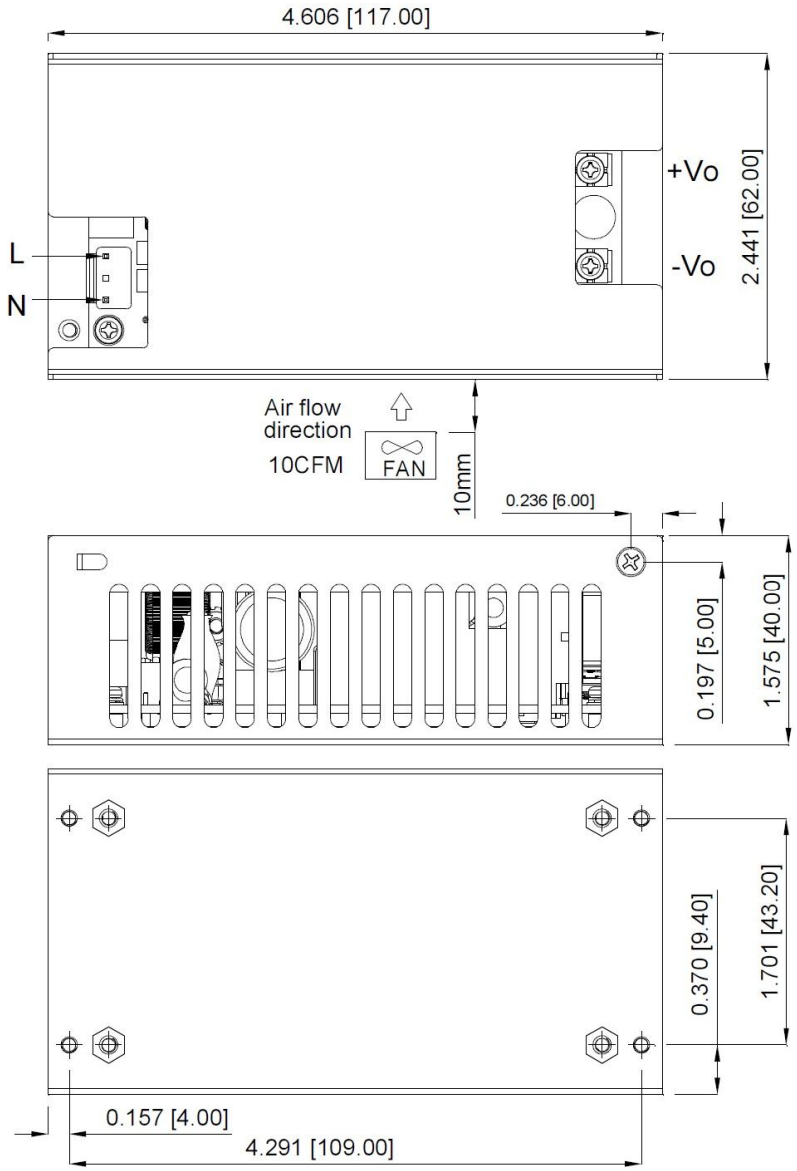
Fan output connector: TOWNES ENTERPRISE 2001BW series. Mate connector: JST Housing PHR-R5500 series and JST R5503-PT series crimp terminal or equivalent.

Output connectors (+Vo, -Vo): M3 screw block, mate with round terminal (outer diameter < 6.75 mm, inner diameter < 3.9 mm).

OUTLINE DRAWING AND CONNECTIONS – PROTECTIVE COVER (-PC)

Overall dimensions: 62.0 x 117.0 x 40.0 mm (2.44 x 4.61 x 1.57 in)

Weight: 314 g (0.69 lb)



Input connector (L, N): TAIWAN KING PIN TERMINAL PVHI series. Mate connector: JST Housing VHR series or equivalent.

Fan output connector: TOWNES ENTERPRISE 2001BW series. Mate connector: JST Housing PHR-R5500 series and JST R5503-PT series crimp terminal or equivalent.

Output connectors (+Vo, -Vo): M3 screw block, mate with round terminal (outer diameter < 6.75 mm, inner diameter < 3.9 mm).