

MAIN FEATURES

- 90 – 264 V_{AC} Universal input voltage range
- 200 W rated power
- 2X4X1.48" foot print (> 16.9 W/in³)
- 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 (*)



FIVE YEAR WARRANTY



ENERGY EFFICIENT



MEDICAL



(*) 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	240 V _{AC} , 25 °C ambient, cold start. 12, 24, 48V, 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	-	-	-	-
	12V	-	92	-	%
	24V	-	93.5	-	%
	48V	-	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	Complies with EN-61000-3-2, Classes A, D				
Fluctuations and Flicker	Complies with EN-61000-3-3 at nominal voltages and full load.				
Earth Leakage Current	Normal conditions, 264 V _{AC} , 60 Hz.	-	-	300	μA
	Normal conditions, nominal input voltages and frequencies	-	260	-	μA
Touch Leakage Current “PC” variant	Normal conditions	-	75	100	μA

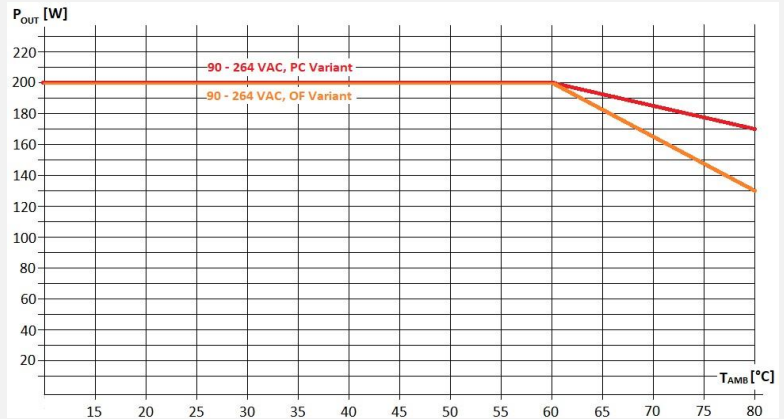
OUTPUT SPECIFICATIONS

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	12V, 10 CFM forced air cooling 24V, 10 CFM forced air cooling 48V, 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 12V at 2200 μF Load / I _{OUT} > 0.5 A 24 V at 1000 μF Load / I _{OUT} > 0.5 A 48V at 560 μF Load / I _{OUT} > 0.5 A	-	-	±5	%V1
V1 Ripple and Noise	12V 24V 48V 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 5V _{SB}	0	-	-	A
Maximum Load Capacitance	At nominal V _{IN} , 25 °C ambient, max load 12 V 24 V 48 V	-	-	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



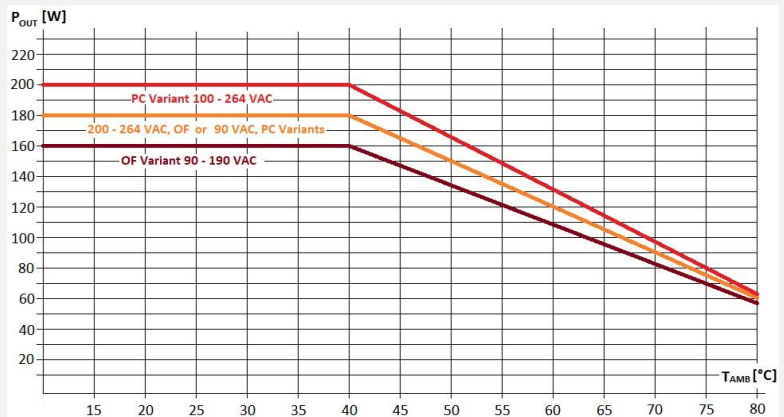
Natural Convection Cooling:

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	%I _{1MAX}
Short Circuit	At nominal input voltages. V1: Hiccup mode, auto-recovering. V2: PTC limiting, auto-recovering	-	-	-	
Over Voltage	12 V 24 V 48 V 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				
Vibration	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).				
	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	-	279000	-	Hours
Useful Life (*)	Low line range, 75% rated load, 40 °C ambient, natural convection.	-	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
ESD	Reference standard for the medical version 15 kV air discharge, 8 kV contact, at any point of the system.	EN 60601-1-2 4 th Ed. EN 61000-4-2	4	A
Radiated Field	10 V/m, 80-1000 MHz, 1 KHz, 80% AM. Close field proximity level	EN 61000-4-3	3	A
Electric Fast Transient	±2 kV on AC power port for 1 minute; ±1 kV on signal/control lines	EN 61000-4-4	3	A
Surge	± 1 kV line to line; ± 2 kV line to earth; on AC power port.	EN 61000-4-5	3	A B
Conducted RF Immunity	3 V _{RMS} , 0,15-80 MHz, 1 KHz, 80% AM 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 EN61000-4-11 EN61000-4-11 EN61000-4-11 EN61000-4-11		A B B B B

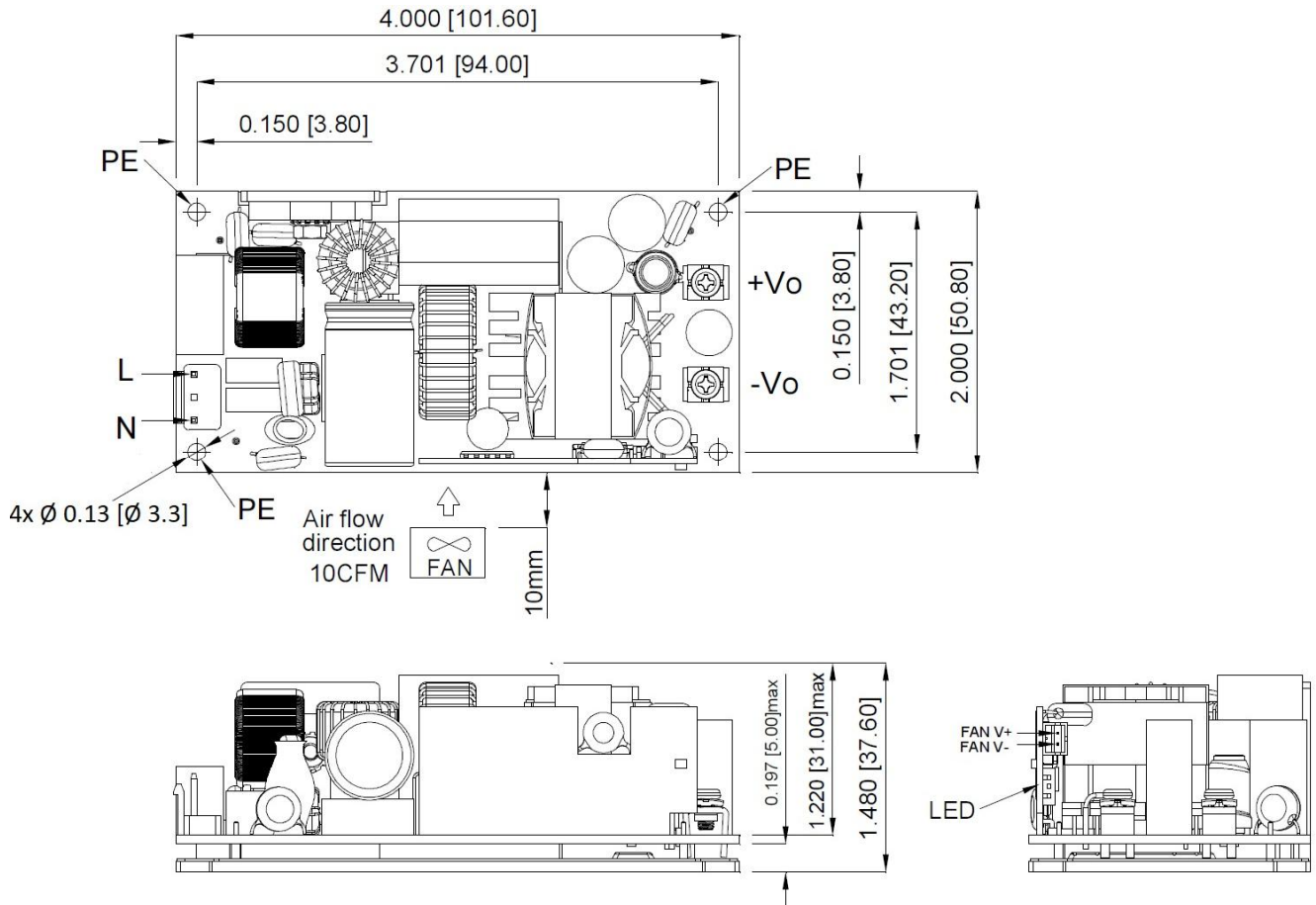
SAFETY AGENCIES APPROVALS

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

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: TAIWAN KING PIN TERMINAL PVHI series. Mate connector: JST Housing VHR series or equivalent.

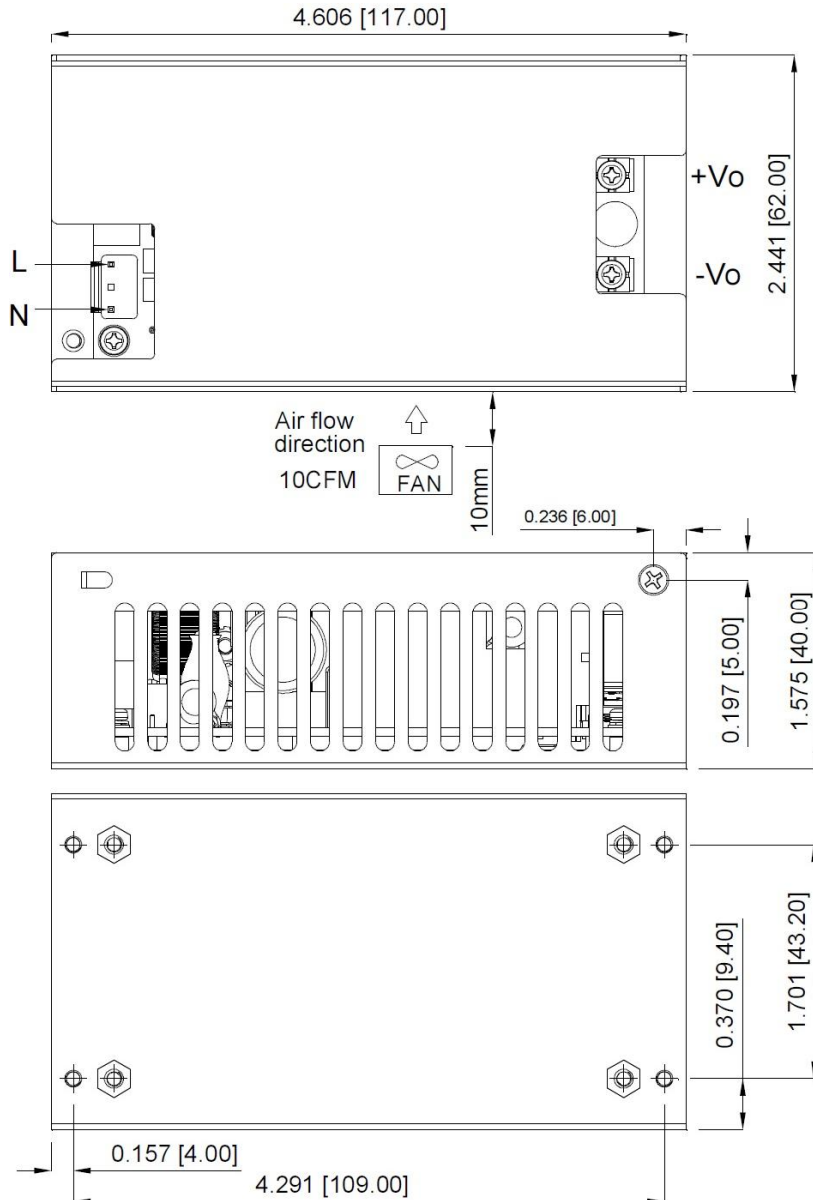
Fan output connector: TOWNES ENTERPRISE 2001BW series. Mate connector: JST Housing PHR-R5500 series and JST R5503-PT series crimp terminal or equivalent.

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) mm; (2.44 X 4.61 X 1.57) in

Weight: 314 g; 0.69 lb



Input connector: 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).

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REVISION HISTORY

Rev.	Date	Originator	Comments
00	November 8 th , 2017	M. Petritoli	First release
01	February 16 th , 2018	M. Petritoli	Note on additional input choke needed for Class B emissions when in Class II configuration
02	March 26 th , 2018	M. Petritoli	<ul style="list-style-type: none"> Added note to specifies cases where 5 years warranty terms do not apply Hold up time corrected (reduced to 10 ms typ.) to latest DVT result after changes to solve AC interruption issue Life time amended according to product qualification latest result.
03	May 7 th , 2018	M. Petritoli	<ul style="list-style-type: none"> Output derating curves updated
04	June 22 nd , 2018	M. Petritoli	<ul style="list-style-type: none"> 10 ms hold-up time regarded as a minimum value instead of typical Output voltage manual adjustment through potentiometer ($\pm 2\%$ of nominal value maximum) Touch current for the "PC" variant added
05	April 29 th , 2019	M. Petritoli	<ul style="list-style-type: none"> Operating temperature lower limit now -25 °C from original -20 °C
06	July 9 th , 2019	M. Petritoli	<ul style="list-style-type: none"> Rated power at forced air and natural convection cooling for both OF and PC packages specified over relevant input voltage ranges. Removed peak power reference from Main Feature Section.
07	July 16 th , 2019	M. Petritoli	<ul style="list-style-type: none"> L and N indication on both overall drawing amended
08	September 2 nd , 2019	M. Petritoli	<ul style="list-style-type: none"> Fuse current rating has been corrected from 2.5 to 5 A Compliance with the new RoHS 3 directive EU 2015/863