

MBS400 Series

400 W AC-DC Power Supplies

Sealed IP67

Medical

The MBS400 Series of AC-DC power supplies provides up to 400 W of regulated output power through wide input voltage range 90 – 264 VAC in single outputs of 12, 24, 36 or 48 VDC.

The MBS400 Series comes in a 83.0 x 212.0 x 42.0 mm form factor, offering 12 and 5 VSB standby outputs and a full set of protection features. Available control signals include Power Good (Power_OK), remote On/off (PS_ON) and remote sense (+RS).

The sealed and full potted package allows an IP67 ingress protection index and can be installed in contact with thermo-conductive part of the system to transfer heat by conduction.

The MBS400 Series complies with the latest international safety standards for medical equipment, offering 2x MoPP protection grade and displays the CE-Mark for the European Low Voltage Directive (LVD).

Key Features & Benefits

- Universal input voltage range (90 – 264 V_{AC})
- Input surge current limiting
- 400 W rated power (440 W peak up to 10 s)
- High efficiency up to 94%
- Low stand-by consumption (<0.5 W)
- 12, 24, 36 and 48 V standard output voltages
- Active PFC, EN61000-3-2 compliant (Class C, >25% load).
- Low earth / touch leakage current
- Over temperature protection, OV, OC and SC protections
- Stand by +5 V, 2 A and auxiliary / fan 12 V_{DC}, 1 A outputs.
- Remote On / Off signal
- Power good and remote sense signals
- Sealed, potted package IP67 rated, fits 1U applications
- Medical safety approval to IEC 60601-1 3rd edition, 2x MoPP rated and BF appliances compatible.
- EN 60601-1-2 4th ed. for immunity compliance
- RoHS 3 compliant (Directive 2015/863/EU)
- Medical version compatible with 4000 m altitude operation
- Optional heatsink accessory available (HSKIT-400-XBS)

Applications

- Computed tomography imaging
- Dialysis and ultrasound equipment
- Operating room equipment
- Laboratory and clean room equipment
- Ventilators



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1. MODEL SELECTION

| MODEL NUMBER | PACKAGE & COOLING | INPUT VOLTAGE RANGE [VAC] | NOM. OUTPUT VOLTAGE [VDC] | MAX. OUTPUT POWER [W] | MAX. OUTPUT CURRENT [A] | DIMENSIONS |
|---------------|---|---------------------------|---------------------------|-----------------------|-------------------------|---|
| MBS400-1012 | Sealed Chassis Convection / Conduction | 90 - 264 | 12 | 400 | 33.3 | Dimensions without heatsink: 83.0 x 212.0 x 42.0 mm 3.27 x 8.34 x 1.65 in |
| MBS400-1024 | Sealed Chassis Convection / Conduction | 90 - 264 | 24 | 400 | 16.7 | |
| MBS400-1036 | Sealed Chassis Convection / Conduction | 90 - 264 | 36 | 400 | 11.1 | Dimensions with heatsink: 83.0 x 212.0 x 70.1 mm 3.27 x 8.34 x 2.76 in |
| MBS400-1048 | Sealed Chassis Convection / Conduction | 90 - 264 | 48 | 400 | 8.3 | |
| HSKIT-400-XBS | - Heatsink accessory (optional) Mounting kit includes 4x screws, M4x10, and the thermally conductive graphite sheet | | | | | |

2. INPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT | |
|---|---|----------------------|----------|------------|------------------|---|
| AC Input Voltage | PS starts and operates at 90 V _{AC} at all load conditions | 90 | 100-240 | 264 | V _{RMS} | |
| DC Input Voltage | | 170 | - | 270 | V _{DC} | |
| Input Frequency | | 47 | 50/60 | 440 | Hz | |
| Input Current | RMS at 180 V _{AC} , maximum load, 50 / 60 Hz RMS at 90 V _{AC} , maximum load, 50 / 60 Hz | - | - | 2.5 5.0 | A | |
| Inrush Current | 265 V _{AC} , 25 °C ambient, cold start. | | | 20 | A | |
| Fusing | 2x Time Lag 6.3 A, 250 V on both L and N | - | - | 6.3 | A | |
| Efficiency | At 115 V _{AC} | 20% rated load | 90 | - | - | % |
| | | 100 % load | 92 | - | - | |
| | At 230 V _{AC} | 20% full load | 90 | - | - | |
| | | 50 – 100 % full load | 94 | - | - | |
| Input Power Consumption | Power on, 115-230 V _{RMS} , no load Stand by, 115-230 V _{RMS} , no load | - | 1 0.4 | 1.5 0.5 | W | |
| Power Factor | At full rated load, 115 VAC, 60 Hz and 230 VAC, 50 Hz input voltages | 0.95 | - | - | - | |
| Harmonic Current Fluctuations and Flicker | Complies with EN-61000-3-2 Class C at 230 VAC 50 Hz, load >50 W. Complies with EN-61000-3-3 at nominal voltages and full load. | | | | | |
| Leakage Current | Normal conditions, 240 V _{RMS} , 60 Hz. | | | 300 | µA | |

3. OUTPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT | |
|---|--|--|------|------------|------------------|-----|
| V1 Output Voltage | ±0.5% set point accuracy on all outputs | - | 12 | - | V | |
| | | - | 24 | - | | |
| | | - | 36 | - | | |
| | | - | 48 | - | | |
| V1 Output Power Rating | All models, convection cooling | - | - | 350 | W | |
| | All models, conduction cooling / heat sink | - | - | 400 | | |
| | All models, peak power (≤ 10 s) | - | - | 440 | | |
| V1 Output Current | * Conduction (with heatsink) | V1: 12 V _{DC} | - | 33.3 | A | |
| | | V1: 24 V _{DC} | - | 16.7 | | |
| | | V1: 36 V _{DC} | - | 11.1 | | |
| | ** Convection (without heatsink) | V1: 48 V _{DC} | - | 8.3 | A | |
| | | V1: 12 V _{DC} | - | 29.2 | | |
| | | V1: 24 V _{DC} | - | 14.6 | | |
| | | V1: 36 V _{DC} | - | 9.7 | | |
| | | V1: 48 V _{DC} | - | 7.3 | | |
| V1 Voltage Adjustment Range | | ±5 | - | - | %V1 | |
| V1 Load-Line-Cross Regulation | V _{AC} : 90 – 264 V _{RMS} | V1 Load: 0 – 33.3 A (12 V) 0 – 16.7 A (24 V) 0 – 11.1 A (36 V) 0 – 8.3 A (48 V) | - | - | ±2 | %V1 |
| | | V2 Load: 0 – 1 A 5V _{SB} Load: 0 – 2 A | | | | |
| V1 Line Regulation | V _{AC} : 90 – 264 V _{RMS} | - | - | ±0.1 | %V1 | |
| Transient Response (Voltage Deviation) V1, 5V _{SB} | 25% load changes at 1 A/μs | | | | | |
| | 12 V at 2200 μF Load / I _{OUT} > 0.5 A | | | | | |
| | 24 V at 1000 μF Load / I _{OUT} > 0.5 A | | | | | |
| | 36 V at 820 μF Load / I _{OUT} > 0.5 A | | | | | |
| | 48 V at 560 μF Load / I _{OUT} > 0.5 A | | | | | |
| | 5V _{SB} at 560 μF Load / I _{OUT} > 0.1 A | | | | | |
| V1 Ripple & Noise | All models, Peak-to-peak, 20 MHz BW. 100 nF ceramic and 10μF tantalum to the load. | - | - | 1 | %V1 | |
| Start-up Rise Time | 90<V _{IN} <264, any load conditions. | 5 | - | 85 | ms | |
| Start-up Delay | V1 in regulation after PS_ON is asserted | | | 200 | ms | |
| | V1 in regulation after AC is applied 5V _{SB} in regulation after AC is applied | | | 750 500 | | |
| Turn-on Overshoot | At 500 mA output current, V1 in regulation within 50 ms. | | 10 | | %V1 | |
| | | | 10 | | %V2 | |
| | | | 10 | | %V _{SB} | |
| Hold-up Time | At nominal V _{IN} , 400 W, for all outputs | - | 16 | - | ms | |
| | At nominal V _{IN} , 365 W, for all outputs | - | 20 | - | | |
| | At nominal V _{IN} , 200 W, for all outputs | - | 35 | - | | |
| Minimum Load *** | All models; V1, V2 and 5V _{SB} | 0 | - | - | A | |
| Maximum Load Capacitance | At nominal V _{IN} , 25 °C ambient | 12 V | - | - | 33000 | μF |
| | | 24 V | - | - | 16000 | |
| | | 36 V | - | - | 10000 | |
| | | 48 V | - | - | 7000 | |
| Temperature Drift | | -1.2 | - | +1.2 | mV/°C | |
| V2 Output Voltage | All versions. | | | | | |
| | Load on V2: from 5 to 1000 mA Load on V1: from 0.1 to 16.7 A | 11.25 | 12.5 | 13.75 | V | |
| V2 Output Current | All models, convection/forced air cooling | - | - | 1 | A | |
| V2 Ripple | Peak-to-Peak measured at 20 MHz Bandwidth. | | | 240 | mV | |
| 5V _{SB} Output Voltage | All models (3% set point accuracy) | - | 5 | - | V | |
| 5V _{SB} Output Current | All models, convection cooling | - | - | 1.5 | A | |
| | All models, conduction cooling / heat sink | - | - | 2 | | |

| | | | | | | |
|---|---|--|---|---|----|-------------------|
| 5V _{SB} Load-Line-Cross Regulation | V _{AC} : 90 – 264 V _{RMS} | V1 Load: 0 – 33.3 A (12 V) 0 – 16.7 A (24 V) 0 – 11.1 A (36 V) 0 – 8.3 A (48 V) | - | - | ±5 | %5V _{SB} |
| 5V _{SB} Ripple | Peak-to-Peak measured at 20 MHz Bandwidth. | V2 Load: 0 – 1 A 5V _{SB} Load: 0 – 2 A | | | 50 | mV |

- * The combined output power of V1, V2 and 5V_{SB} for all models, when conduction cooled or convection cooled with heat sink mounted, must not exceed 400 W up to 50 °C, and 300 W at 70 °C ambient temperature.
- ** The combined output power of V1, V2 and 5 V_{SB} for all models, when convection cooled and V_{IN} ≥ 180 V_{RMS}, must not exceed 350 W up to 50 °C, and 240 W at 70 °C ambient temperature. See de-rating curves below.
- *** When the load on the main output is less than 100 mA, V2 output voltage might regulate below its minimum value. Contact Bel for details.

3.1 OUTPUT POWER DE-RATING CURVES

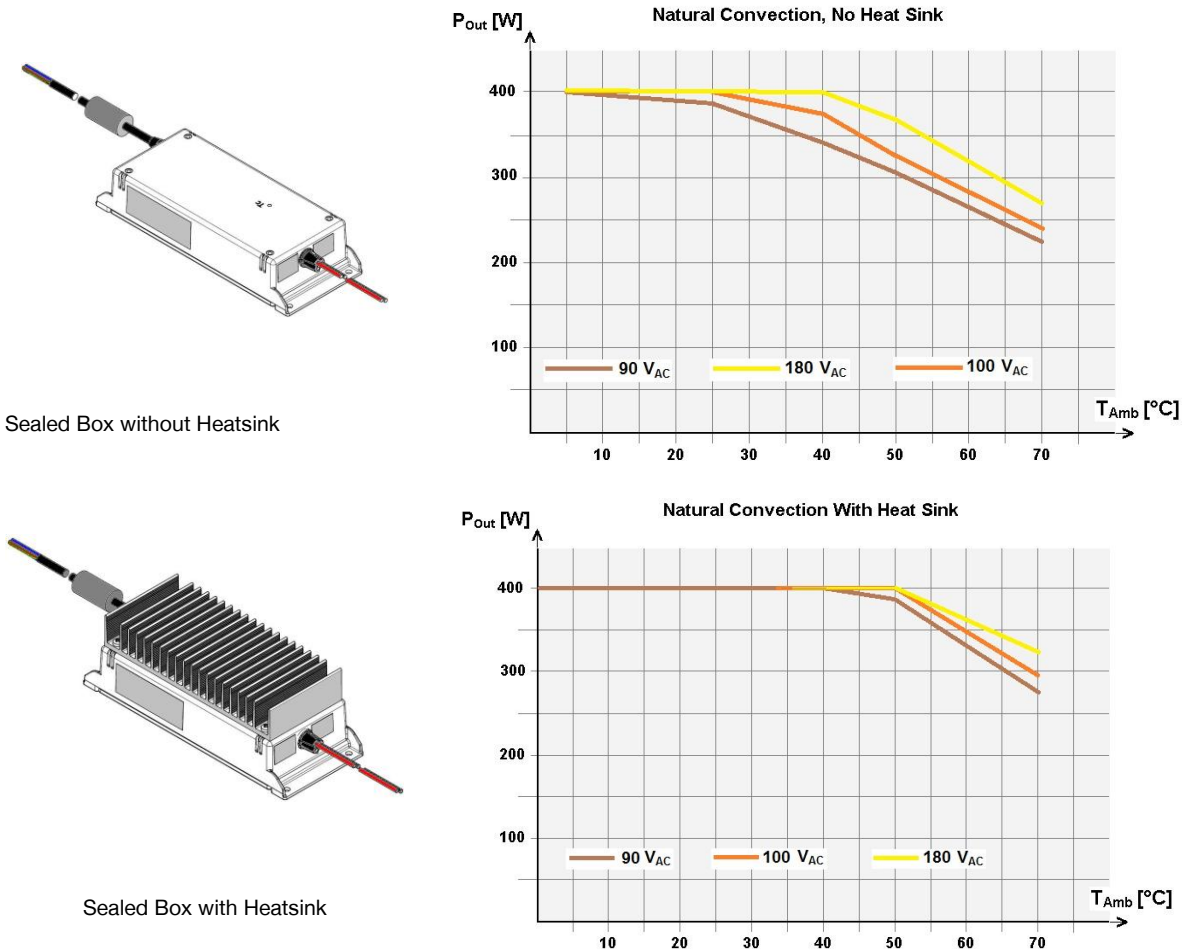
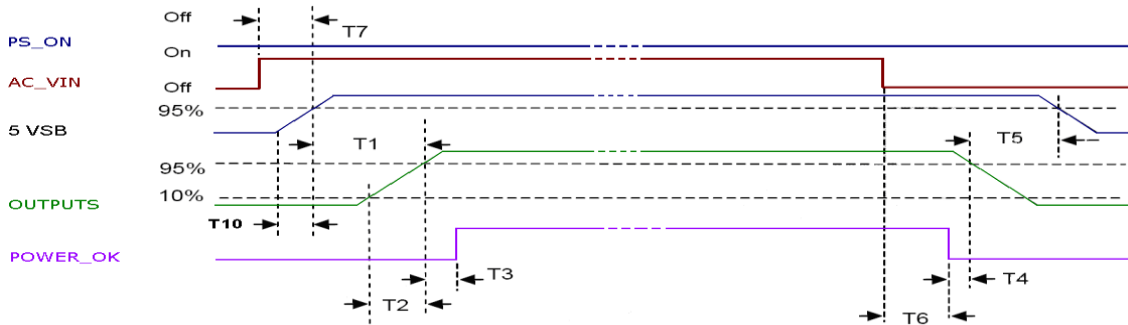


Figure 2. Power Derating Curves

4. SIGNALS, CONTROLS & TIMING SPECIFICATIONS

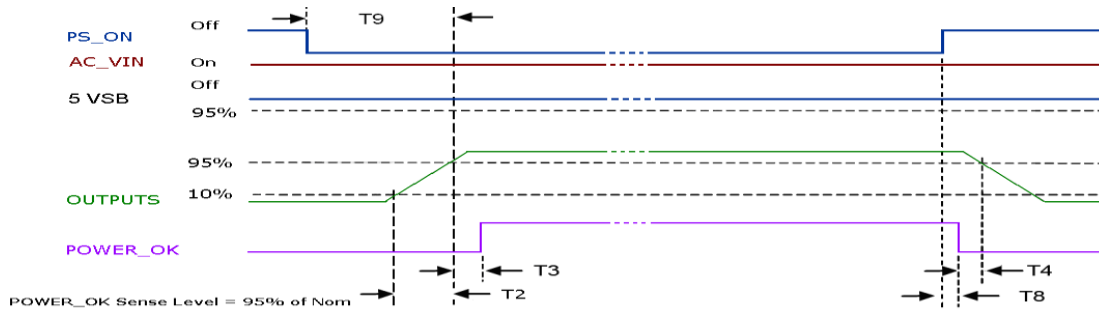
Base signals and controls are accessible from signal connector P204.

| SIGNAL | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|-------------------------------|---|------|-----|-----|------|
| PS_ON | Active low, +5 V TTL signal compatible. Input low voltage | 0 | - | 2.0 | V |
| | Input high voltage ($I_{IN} = 200 \mu A$) | 3.0 | - | - | V |
| | V1 and V2 disabled when PS_ON is open | | | | |
| | 5V _{SB} not affected by PS_ON | | | | |
| | V1 and V2 enabled with PS_ON connected to RTN | | | | |
| P_OK | +5 V TTL compatible | | | | |
| | Logic level low (<10 mA sinking) | - | - | 0.7 | V |
| | Logic level high (100 μA sourcing) | 2.4 | - | 5 | V |
| | Low to high time after V1 in regulation | 0.05 | - | 0.1 | s |
| | Power down warning time | 1 | - | - | ms |
| 5V_{SB} output | Active and in regulation after a $90 < V_{AC} < 264$ is applied | - | - | 200 | ms |
| | 5V _{SB} not affected by PS_ON | | | | |



Above waveforms are expected with AC Input ON/OFF:

| | |
|--|---|
| Standby on - Main outputs on | $50 \text{ ms} \leq T1 \leq 250 \text{ ms}$ |
| Main output Rise Time | $5 \text{ ms} \leq T2 \leq 110 \text{ ms}$ |
| 5 V _{SB} rise time | $4 \text{ ms} \leq T10 \leq 20 \text{ ms}$ |
| Main outputs On - P_OK delay | $25 \text{ ms} \leq T3 \leq 100 \text{ ms}$ |
| Power down warning ¹ | $T4 \geq 1 \text{ ms}$ |
| Main Output off - Standby off ² | $T5 \geq 1.2 \text{ s}$ |
| Hold-up time (AC off - P_OK low) | $T6 \geq 15 \text{ ms (115/ 230 VAC)}$ |
| AC_ON - Standby turn on time | $T7 \leq 500 \text{ ms}$ |



Above waveforms are expected with PS_ON Signal ON/OFF state change:

| | |
|----------------------------------|---|
| Main Output Rise Time | $5\text{ ms} \leq T2 \leq 110\text{ ms}$ |
| Main Outputs on – P_OK delay | $25\text{ ms} \leq T3 \leq 100\text{ ms}$ |
| Power down warning ¹ | $1\text{ ms} \leq T4 \leq 5\text{ ms}$ |
| PS_ON - Main Output (off) Timing | $T8 \leq 1\text{ ms}$ |
| PS_ON - Main Output (on) Timing | $T9 \leq 200\text{ ms}$ |

¹ T4 parameter measurement setup will assume at least 10% of the maximum load on each output.

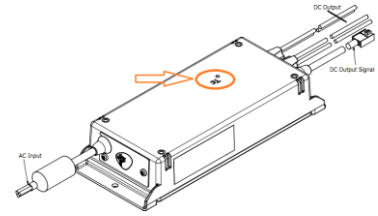
² T5 parameter measurement setup will assume 50% of the maximum load on 5V_{SB}.

5. PROTECTION SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--------------------------------------|---|------|-----|-----|------------------------------------|
| Input Under Voltage | Auto-recovering, hiccup mode. | 60 | 75 | - | V _{AC} |
| Input Fuse | 2x Time Lag 6.3 A, 250 V on L and N | - | - | 6.3 | A |
| Over Current | At nominal input voltages. V1: Hiccup mode, auto-recovering. V2: PTC limiting, auto-recovering. 5V _{SB} : Hiccup mode, auto-recovering. | 110 | - | 155 | %I _{1MAX} |
| Short Circuit | At nominal input voltages. V1: Hiccup mode, auto-recovering. V2: PTC limiting, auto-recovering. 5V _{SB} : Hiccup mode, auto-recovering. | - | - | - | |
| Over Voltage | 12 V 24 V 48 V 5 V _{SB} Shut down, latch-off. | 110 | - | 136 | %V _{NOM} |
| Over Temperature (on primary stage) | Shut down, latch off. | - | - | - | |
| Over Temperature (on secondary side) | Hiccup mode, auto-recovering. | - | - | - | |
| Isolation Primary to Secondary | Reinforced (2x MoPP) | 5660 | - | - | V _{DC} V _{AC} |
| Isolation Input to Earth | Basic (1x MoPP) | 1500 | - | - | V _{AC} |
| Isolation V1 to V2 | Functional | 100 | - | - | V _{DC} |
| Isolation Output to Earth | Basic (1x MoPP) | 1500 | - | - | V _{AC} |

6. ENVIRONMENTAL SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|-----------------------------|--|--------|-----|----------|--------|
| Operating Temperature Range | PS starts up at -30 °C See graphs above for output power de-rating against T _{Amb} and V _{In} . | -20 | - | 70 | °C |
| Storage Temperature Range | | -40 | - | 85 | °C |
| Humidity | RH, Non-condensing Operating Non-operating | - | - | 90 95 | % % |
| Operating Altitude | | - | - | 4000 | 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, 120 V _{AC} , 50 °C ambient 70% Duty cycle, Telcordia Issue 1 | 400000 | - | - | Hours |
| Cooling | Convection with or without heat sink and conduction providing an adequate thermal path between the unit and the external environment. Case hot spot temperature, T _c , should not exceed 90 °C in any working condition. | | | | |
| Useful Life | Low line range, 200 W, 40 °C ambient, natural convection. | - | 4 | - | Years |



7. ELECTROMAGNETIC COMPATIBILITY (EMC) – EMISSIONS

| PARAMETER | DESCRIPTION / CONDITION | STANDARD | PERFORMANCE CLASS |
|--------------------------------------|--|--|-------------------|
| Conducted | 115 V _{RMS} , 230 V _{RMS} . Maximum load. 4 dB minimum margin | EN 55011 (ISM) EN 60601-1-2 (Medical) | B |
| Radiated | At 10 m distance | EN 55011 (ISM) EN 60601-1-2 (Medical) | B |
| Line Voltage Fluctuation and Flicker | At 20%, 50% and 100% maximum load. Nominal input voltages. | EN 61000-3-3 | |
| Harmonic Current Emission | Nominal input voltages. Output load > 50 W. | EN 61000-3-2 | C |

8. ELECTROMAGNETIC COMPATIBILITY (EMC) – IMMUNITY

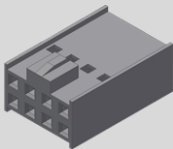
| PARAMETER | DESCRIPTION / CONDITION | STANDARD | TEST LEVEL | CRITERIA |
|-------------------------|--|---------------------------------------|------------|----------|
| | Reference standard for the medical version | EN 60601-1-2, 4 th edition | | |
| ESD | 15 kV air discharge, 8 kV contact, at any point of the system. | EN 61000-4-2 | 4 | A |
| Radiated Field | 3 V/m, 80-1000 MHz, 1 KHz/2 Hz 80% AM. Dwell time is 3 sec for 2 Hz modulation Dwell time is 1 sec for 1KHz modulation | 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 | ± 2kV line to line; ± 4 KV line to earth; on AC power port; ±0.5 kV for outdoor cables | EN 61000-4-5 | 3 | A B |
| Conducted RF Immunity | 3 V _{RMS} , 0,15-80 MHz, 1 KHz/2 Hz 80% AM | EN 61000-4-6 | 3 | A |
| Dips and Interruptions | Dip to 30% for 5 cycle (10 ms) | EN61000-4-11 | | A |
| | Dip to 40% for 5 cycles (100 ms) | EN61000-4-11 | | B |
| | Dip to 70% for 25 cycles (500 ms) | EN61000-4-11 | | B |
| | Drop-out to 5% for 10 ms | EN61000-4-11 | | B |
| | Interruptions > 95% for 5 s | EN61000-4-11 | | B |

9. SAFETY AGENCIES APPROVALS

| CERTIFICATION BODY | SAFETY STANDARDS | CATEGORY |
|-------------------------------|---|----------|
| CSA/UL | CSA C22.2 No.601.1, ANSI/AAMI ES60601-1 3rd edition | Medical |
| IEC IECEE CB Certification | IEC/EN 60601-1 3rd edition | Medical |
| CE | Low Voltage Directive (LDV) 2007/47/EC MDD | Medical |

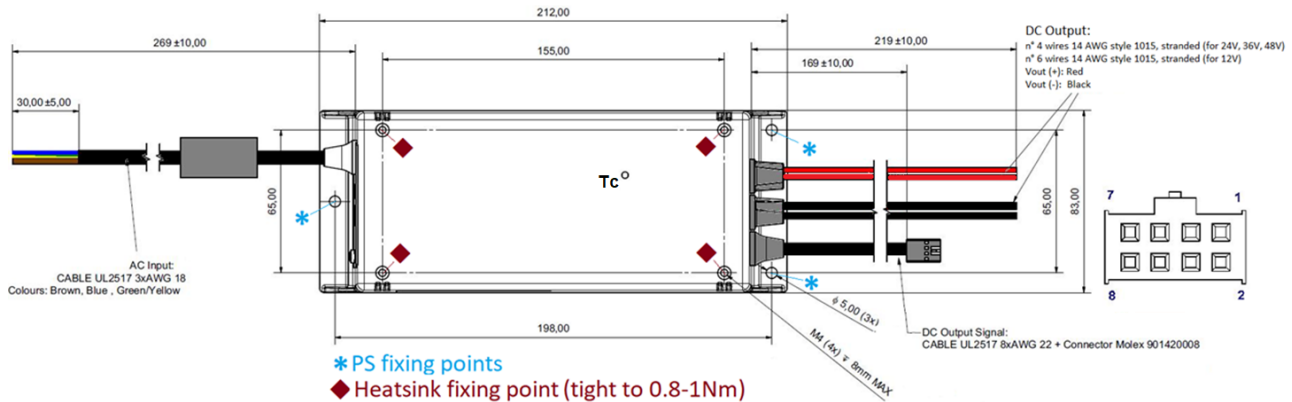
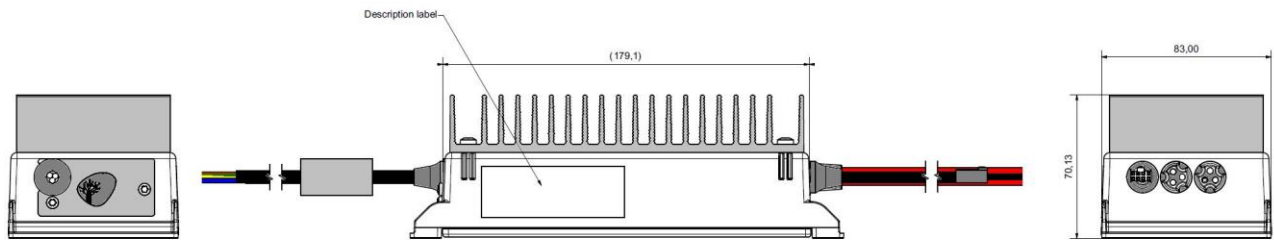
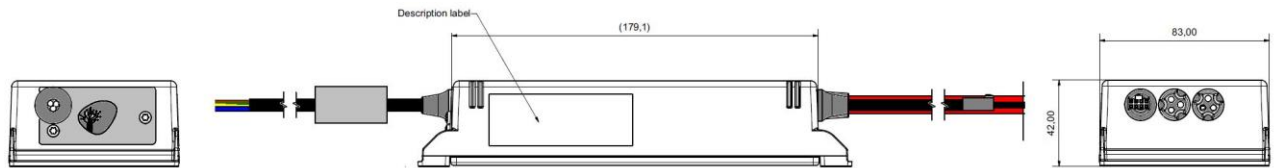
10. CONNECTIONS AND PIN DESCRIPTION

| CONNECTIONS | WIRES GAUGE AND LENGTH | ASSIGNMENT | COLOUR/PIN |
|---|--|---|--------------|
| AC Input | 3x 18 AWG, black external insulation, 300 V, 105°C, UL2517 cord, 310 ± 10 mm extension from grommet. | Live (L) | Brown |
| | | Neutral (N) | Blue |
| | | Protective Earth (PE) | Green Yellow |
| DC Output | 12 V version: 6 x 14 AWG, Style 1015, 600 V, 105°C, 260±10 mm 24, 48 V versions: 4x 14 AWG, Style 1015, 600 V, 105°C, 260±10 mm | 3x (2x) +V1 Output (+V1) | Red |
| | | 3x (2x) V1 Return (RTN) | Black |
| Auxiliary Voltages Control Signals | Wires: 8x 22 AWG, black external insulation, 300 V, 105°C, UL2517 cord, 220 ± 10 mm extension from grommet to connector. Housed by Connector: Molex 90142-0008 Terminals: Molex 90119-0109 (Tin plating) Mates with Molex 90130-1106 or equivalent. Terminals: Tin plating termination | +5 V Stand-by Output (+5V _{SB}) | Red / 1 |
| | | Output Power Good (P_OK) | Green / 2 |
| | | - Fan Voltage (-V2) | Brown / 3 |
| | | Remote On/Off (PS_ON) | Grey / 4 |
| | | + Terminal Remote Sense (+RS) | Yellow / 5 |
| | | Stand-by/Signals Return (RTN) | Blue / 6 |
| | | + Fan Voltage (+V2) | White / 7 |
| | | Stand-by/Signals Return (RTN) | Black / 8 |



11. MECHANICAL SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION |
|--------------------|---|
| Weight | 1300 g (2.87 lb) – without heatsink |
| | 1665 g (3.67 lb) – with heatsink |
| Overall Dimensions | 83.0 x 212.0 x 42.0 mm (3.27 x 8.34 x 1.65 in) - without heatsink |
| | 83.0 x 212.0 x 70.1 mm (3.27 x 8.34 x 2.76 in) - with heatsink |



For more information on these products consult: tech.support@psbel.com

NUCLEAR AND MEDICAL APPLICATIONS - Products are not designed or intended for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems.

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.



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