

TCP3500/4000 Series

3-phase 3500/4000 W AC-DC Industrial PSU

The TCP3500/4000 Series is a universal 3-phase AC-DC converter with adjustable DC output and universal 3-phase AC input. Conduction cooling (no fan) makes this power supply series suitable for a wide variety of Industrial Applications that can utilize conduction or liquid cooling, negating the use of fans.

Emphasis is given on reliability and long life. Parallel operation is possible up to 16 units (57.6 kW).

The PSU includes DSP which enables monitoring of electrical parameters (including input voltage of all 3 phases) and controlling the PSU from system controller.

An RS485 bus is used for command, monitoring and diagnostic information that can be supplied to a system controller.

Key Features & Benefits

- World-Wide 3-phase Input Voltage Range (nom. 115 - 277 V / 200 - 480 V)
- Power Factor > 0.94
- High Power Density 16 W/in³
- 94% Typical Efficiency
- Parallel Operation up to 16 Units (up to 57.6 kW)
- Cold-Plate Cooling System
- 0 to 50°C of Cold-Plate Surface, 0 to 70°C of Ambient Air Temperature
- Possibility to Install 4 Units in 2U 19" Rack
- Advanced Performance for Fast Dynamic and Pulsed Load up to 100 kHz (Optional)
- RS485 Interfaces
- Wide Adjustable Output Voltage Range
- Fast Output Voltage Set Response (5 ms)
- Active Current Sharing
- SEMI F47 Compliant



1. MODEL SELECTION

| MODEL | INPUT VOLTAGE RANGE | NOMINAL OUTPUT VOLTAGE | OUTPUT VOLTAGE RANGE | MAX OUTPUT CURRENT | MAX OUTPUT POWER | AVAILABILITY |
|---------------------------|--------------------------|------------------------|-------------------------|-----------------------------------|------------------|-----------------|
| TCP3500-1024G | 180 – 528 Vrms, 50/60 Hz | 28 V | Adjustable 10 – 32 VDC | 125 ADC | 3500 W | Mass production |
| TCP3500-H048G | 180 – 528 Vrms, 50/60 Hz | 48 V | Adjustable 10 – 50 VDC | 73 ADC or pulse ¹ | 3500 W | Mass production |
| TCP3500-1048G | 180 – 528 Vrms, 50/60 Hz | 48 V | Adjustable 10 – 50 VDC | 73 ADC | 3500 W | Mass production |
| TCP4000-H090 ² | 180 – 528 Vrms, 50/60 Hz | 90 V | Adjustable 30 – 100 VDC | 45 ADC or 39 A pulse ¹ | 3500 / 4000 W | Mass production |

¹ PSU model with pulse load operation capability 0 – 100 kHz, 0 – 100% Duty, 0 A/lout_max.

² Output Power 4000W at Input Voltage range 340 – 528 Vrms (L-L)

2. INPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--------------------|--------------------------------------|-----------------------|-------|-----------------------|------|
| Input Voltage | 3-phase (L-N / L-L), 3 wires + PE | 115 - 277 / 200 - 480 | | 104 - 305 / 180 - 528 | V |
| | Permitted variation (L-N / L-L) | | | | V |
| Input Frequency | Permitted variation | 47 | 50/60 | 63 | Hz |
| Input Current | per Line at 3 x 180 V (line to line) | | | 14 | Arms |
| Input Current THDi | Typical | | 30 | | % |
| Power Factor | Load above 40% | 94 | | | |
| Fuse | 3 x 20 A, Fast acting | | | | |

3. OUTPUT SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|--------------------------|---|-------|-----|-----|------|
| Output Voltage | Adjustable or fixed (see Model Selection table) | | | | |
| Output Power Rating | | 3500 | | | W |
| Output Current | Fixed or Adjustable (60 – 100%) | | | | |
| Efficiency | Input Voltage 400 Vrms (L-L) and load above 40% | 94 | | | % |
| Voltage Setting Accuracy | | ± 0.5 | | | % |
| Line Regulation | $Io = 0.5 * Io_{nom}$ | ±0.5 | | | % |
| Load Regulation | | ±0.3 | | | % |
| Thermal Drift | | ±0.02 | | | %/°C |
| Transient Response | load variation 10-100% and back: | ±5 | | | % |
| | Recovery time: | | 2 | | ms |
| | load variation 50-100% and back: | ±3 | | | % |
| Ripple | Recovery time: | | 0.4 | | ms |
| | Vout_nom (BW 20 MHz) | | 1.5 | | % |
| | | | 2 | | s |
| Rise Time | | | 250 | | ms |

4. PROTECTION SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|----------------------------------|--|-----------|-----|-----------|------|
| Over Temperature Protection | Cooling Plate surface (PSU bottom side) | 55 | | | °C |
| Input Under Voltage Protection | 3-phase (L-N / L-L) | | | 104 / 180 | V |
| Input Over Voltage Protection | 3-phase (L-N / L-L) | 305 / 528 | | | V |
| Reversed Sense Output Protection | Latch type | | | | |
| Output Under Voltage Protection | Latch type – Fixed SW, based on Minimal Output Voltage | 50 | 85 | | % |
| | Latch type – Fixed HW, based on Nominal Output Voltage | 115 | 125 | | % |
| Output Over Voltage Protection | Resettable – Floating SW, based on Output Voltage Set Point (configurable) | +4 | +6 | | V |
| Output Over Current | PSU starts operating as a current source, based on Maximal Output Current | 104 | 112 | | % |
| | Latch type – Fixed SW, based on Maximal Measured Output Current | 114 | 122 | | % |
| Short Circuit Protection | Fast Acting Fuse for min. 120% of Rated Output Current | | | | |
| Alarms | Input under and over voltage Output under and over voltage Output overload Over temperature | | | | |

5. SAFETY, REGULATORY AND EMC SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | SPECIFICATION | |
|--|--|--|-------------|
| Insulation (Factory tested) | Input to output: Input to chassis: Output to chassis: Signals to chassis: | 2122 VDC 2122 VDC 500 VDC 500 VDC | |
| Safety Standards | UL/CSA60950-1 2 nd , EN60950-1 2 nd and IEC60950-1 2 nd UL/CSA62368-1, IEC 62368-1 | | |
| <i>Emission Requirements</i> | | | |
| Radiated Emission | EN55011 | Class A | |
| Conducted Emissions | EN55011 | Class A | |
| <i>Immunity Requirements</i> | | | |
| Electrostatic Discharge (ESD) | EN IEC 61204-3 | ±8 kV contact, ±15 kV air | Criterion A |
| Radiated Electromagnetic Field | EN IEC 61204-3 | | Criterion A |
| Electrical Fast Transients (EFT)/Burst | EN IEC 61204-3 | | Criterion A |
| Surge Immunity | EN IEC 61204-3 | | Criterion A |
| RF Conducted Immunity | EN IEC 61204-3 | | Criterion A |
| Useful Life Assessment | >5 years life at ambient temperature of +70°C and case temperature 55°C >10 years of predicted electrolytic capacitor life at 55°C of case temperature and 100% load. | | |
| Voltage Sag | SEMI F47 (Nominal output voltage and current (up to max. 3.5 kW), input voltage 200/208 VAC L-L and 400/480 VAC L-L) | | Criterion A |

6. ENVIRONMENTAL SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|-----------------------|--|-----|-----|------------|------|
| Humidity | Operating range according IEC 60068-2-78 | 10 | | 90 | RH |
| Operating Temperature | Cold-plate cooling: of base plate (T_c - ref. point) of ambient air temperature | 0 | 0 | +55 +70 | °C |
| Storage Temperature | | -40 | | +85 | °C |

7. MONITORING AND CONTROL

7.1 GUI (GRAPHIC USER INTERFACE) AND RS485 COMMUNICATION PROTOCOL

Bel Power Solutions provides a Windows® XP/Vista/Win7 compatible **Graphical User Interface SW** for TCP/TXP3500/4000 PSU's program, control and monitor via Serial Communication Interface – RS485.

The SW GUI can be downloaded from: belfuse.com/power-solutions.

For detailed information please see Communication Manual (BCA.00140) or contact Bel Power Solutions sales representative.

7.2 LED SIGNALING

| LED NAME | COLOR | STATUS | OPERATING CONDITIONS |
|----------|--------|----------------|--|
| AC-OK | Green | ON | AC Input Voltage is within operation range |
| DC-OK | Green | ON | Output is Enabled and Operational |
| OT/FAIL | Orange | ON Blinking | Over Temperature conditions inside the unit or FAIL appeared (e.g. Overload) FW upgrade via RS485-1 |

8. CONNECTORS

| PARAMETER | DESCRIPTION / CONDITION |
|-------------------------|---|
| Input Connector | 4-pin, Pitch 7.62 mm (Weidmüller 1081850000, see Figure 1) |
| Output Connector | Bus bars, screw size M4, see Fig.1 |
| Signal Input Connector | 15-pin D-SUB Male (Würth Elektronik, 61801529221, see Figure 1) |
| Signal Output Connector | 15-pin D-SUB Female (Würth Elektronik, 61801529321, see Figure 1) |

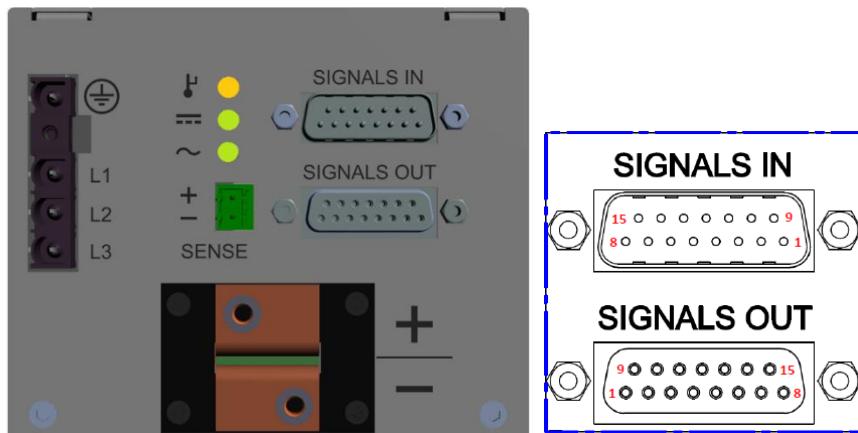


Figure 1a. Rear View of TCP3500-1048G – Detail of Signal Connectors Pin Position

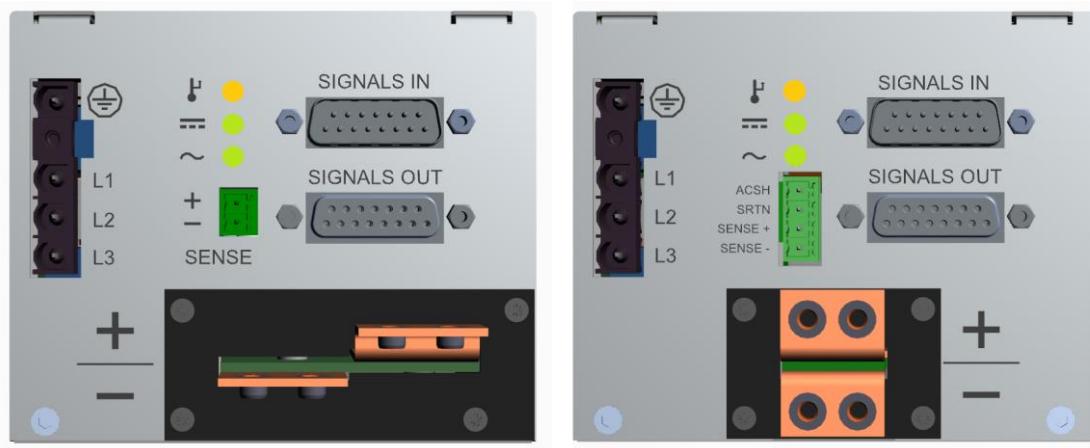


Figure 1b. Rear View of TCP3500-1024G (left) and TCP4000-H090 (right) - Connectors Position

8.1 INPUT POWER CONNECTOR: PINOUT

| SIGNAL NAME | PIN # | TYPE | RECOMMENDED WIRES | V MAX I MAX |
|-------------|-------|----------------------|--------------------------|--------------------------------------|
| Earth | | Earth / Chassis | Min. 2.5 mm ² | |
| AC Line 1 | L1 | Input Power AC Fused | Min. 2.5 mm ² | |
| AC Line 2 | L2 | Input Power AC Fused | Min. 2.5 mm ² | 528 Vrms (L-L) 16 Arms (per line) |
| AC Line 3 | L3 | Input Power AC Fused | Min. 2.5 mm ² | |

Connector type: Weidmüller 1081850000
 Mating part: Weidmüller 1173520000

8.2 POWER OUTPUTS CONNECTOR: +/- BUSBARS

| SIGNAL NAME | PIN # | TYPE | SIGNAL REFERENCE | LOW LEVEL HIGH LEVEL | V MAX I MAX |
|-------------|-------|-----------------|------------------|-------------------------|---------------------------|
| Vout+ | + | Output Power DC | Vout- | | see Model Selection table |
| Vout- | - | Output Power DC | - | | see Model Selection table |

Connector type: Busbar see Figure 1
 Mating part: Ring terminal for M4 screw, with appropriate cross section for wire.

8.3 SIGNAL INPUT CONNECTOR: PINOUT

| SIGNAL NAME | PIN # | TYPE | SIGNAL REFERENCE | LOW LEVEL HIGH LEVEL | V MAX I MAX |
|-------------------|-----------------|---|------------------|--|----------------------|
| RS485-1A | 1 | RS485 Half Duplex, Differential pair 1 | RS485-1B | +/-60 mA @ 60 Ω, 0 pF ² | -7 to 12 VDC 8 mA |
| RS485-2A | 2 | RS485 Half Duplex, Differential pair 2 | RS485-2B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| ADDR-INIT IN | 3 | The unit's address change required | SRTN | <0.4 VDC >2.5 VDC | 3.6 VDC 0.2 mA |
| IN OK | 4 | AC Power Fail Warning - open collector, external pull-up needed to max. 7 V | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| OUT OK | 5 | Output Voltage Fault - open collector, external pull-up needed to max. 7 V | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| INHIBIT | 6 | Output Inhibit - Open circuit or "High" to SRTN shuts OFF Vout | SRTN | <0.4 VDC >2.5 VDC | 3.6 VDC 0.2 mA |
| ENABLE | 7 | Power Supply Enable pin - for unit enable short this pin to SRTN | SRTN | <0.4 VDC >2.5 VDC | 3.6 VDC 0.2 mA |
| SRTN ¹ | 8 | Signal Return | - | - | - |
| RS485-1B | 9 | RS485 Half Duplex, Differential pair 1 | RS485-1B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| RS485-2B | 10 | RS485 Half Duplex, Differential pair 2 | RS485-2B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| Not Connected | 11 | - | - | - | - |
| OT/FAIL | 12 | Over Temperature /PSU Fail, open collector, external pull-up needed to max. 7 VDC | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| PS-PRESENT | 13 | Power Supply Seated – signal internally connected through 10 Ohm resistor to SRTN | SRTN | - | 1 VDC 100 mA |
| ACSH | 14 ³ | Active Current Share | SRTN | 0.2 VDC 5.0 VDC | 7 VDC 0.7 mA |
| Margin | 15 | Optional – analog signal for Output Voltage adjustment – Not connected | - | - | - |

Connector type: Würth Elektronik, 61801529221

Mating part: Würth Elektronik, 61801529321

¹ SRTN and Vout- are connected together inside the power supply (not valid for TCP4000-H090). The power supplies with maximal output voltage >60V have all signals on 15-pin DSUB connector galvanically isolated from main output (including SENSE +/- and ACSH).

² 120Ω resistors connection required between RS485-xA and RS485-xB on both sides externally.

³ The pin 14 on TCP4000-H090 is not internally connected to ACSH signal (see capture 8.6).

8.4 SIGNAL OUTPUT CONNECTOR: PINOUT

| SIGNAL NAME | PIN # | TYPE | SIGNAL REFERENCE | LOW LEVEL HIGH LEVEL | V MAX I MAX |
|-------------------|-----------------|---|------------------|--|----------------------|
| RS485-1A | 1 | RS485 Half Duplex, Differential pair 1 | RS485-1B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| RS485-2A | 2 | RS485 Half Duplex, Differential pair 2 | RS485-2B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| ADDR-INIT OUT | 3 | The unit's address change accepted | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| IN OK | 4 | AC Power Fail Warning - open collector, external pull-up needed to max. 7 V | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| OUT OK | 5 | Output Voltage Fault - open collector, external pull-up needed to max. 7 V | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| INHIBIT | 6 | Output Inhibit - Open circuit or "High" to SRTN shuts OFF Vout | SRTN | <0.4 VDC >2.5 VDC | 3.6 VDC 0.2 mA |
| ENABLE | 7 | Power Supply Enable pin – for unit enable short this pin to SRTN | SRTN | <0.4 VDC >2.5 VDC | 3.6 VDC 0.2 mA |
| SRTN ¹ | 8 | Signal Return | - | - | - |
| RS485-1B | 9 | RS485 Half Duplex, Differential pair 1 | RS485-1B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| RS485-2B | 10 | RS485 Half Duplex, Differential pair 2 | RS485-2B | +/-60 mA @ 60 Ω, 50 pF ² | -7 to 12 VDC 8 mA |
| Not Connected | 11 | - | - | - | - |
| OT/FAIL | 12 | Over Temperature /PSU Fail, open collector, external pull-up needed to max.7 VDC | SRTN | <0.4 VDC Pull up | 7 VDC 20 mA |
| PS-PRESENT OUT | 13 | Power Supply Seated – last unit in string will pull down this signal (external short to SRTN) and informs Master Controller that all units in string are seated and connected | SRTN | <0.4 VDC >2.5 VDC | 3.6 VDC 0.2 mA |
| ACSH | 14 ³ | Active Current Share | SRTN | 0.2 VDC 5.0 VDC | 7 VDC 0.7 mA |
| Margin | 15 | Optional – analog signal for Output Voltage adjustment - Not Connected | SRTN | - | - |

Connector type: Würth Elektronik, 61801529321

Mating part: Würth Elektronik, 61801529221

8.5 SIGNAL OUTPUT CONNECTOR: PINOUT

| SIGNAL NAME | PIN # | TYPE | SIGNAL REFERENCE | LOW LEVEL HIGH LEVEL | V MAX I MAX |
|-------------|-------|--|------------------|-------------------------|----------------|
| SENSE+ | 1 | Sense line for Vout+ – voltage drop compensation for positive pole | Vout+ | - | - |
| SENSE- | 2 | Sense line for Vout- – voltage drop compensation for negative pole | Vout- | - | - |

Connector type: Phoenix Contact, MC 1.5/2-G-3.81

Mating part: Phoenix Contact, MC 1.5/2-ST-3.81

8.6 SIGNAL OUTPUT CONNECTOR TCP4000-H090: PINOUT

| SIGNAL NAME | PIN # | TYPE | SIGNAL REFERENCE | LOW LEVEL HIGH LEVEL | V MAX I MAX |
|-------------|-------|--|------------------|-------------------------|----------------|
| ACSH | 1 | Active Current Share | SRTN | - | - |
| SRTN | 2 | Signal Return | - | - | - |
| SENSE+ | 3 | Sense line for Vout+ – voltage drop compensation for positive pole | Vout+ | - | - |
| SENSE- | 4 | Sense line for Vout- – voltage drop compensation for negative pole | Vout- | - | - |

Connector type: Phoenix Contact, MC 1.5/4-G-3.81

Mating part: Phoenix Contact, MC 1.5/4-ST-3.81

9. MECHANICAL SPECIFICATIONS

| PARAMETER | DESCRIPTION / CONDITION | MIN | NOM | MAX | UNIT |
|------------------------|---|-----|----------------------------------|-----|----------|
| Dimensions (W x D x H) | See Figure 2 | | 400 x 103 x 85 15.7 x 4 x 3.3 | | mm in |
| Weight | Single PSU | | 6.5 | | kg |
| Cooling | Liquid cooled cold-plate, power dissipation ~300 W/PSU Recommended water flow rate: 2 – 4 liters/min. (depends on the cooling plate design) | | | | |
| Insulation | Input to Output: 3.0 Input to Chassis: 1.5 | | | | kVAC |
| Enclosure | IP20 | | | | |

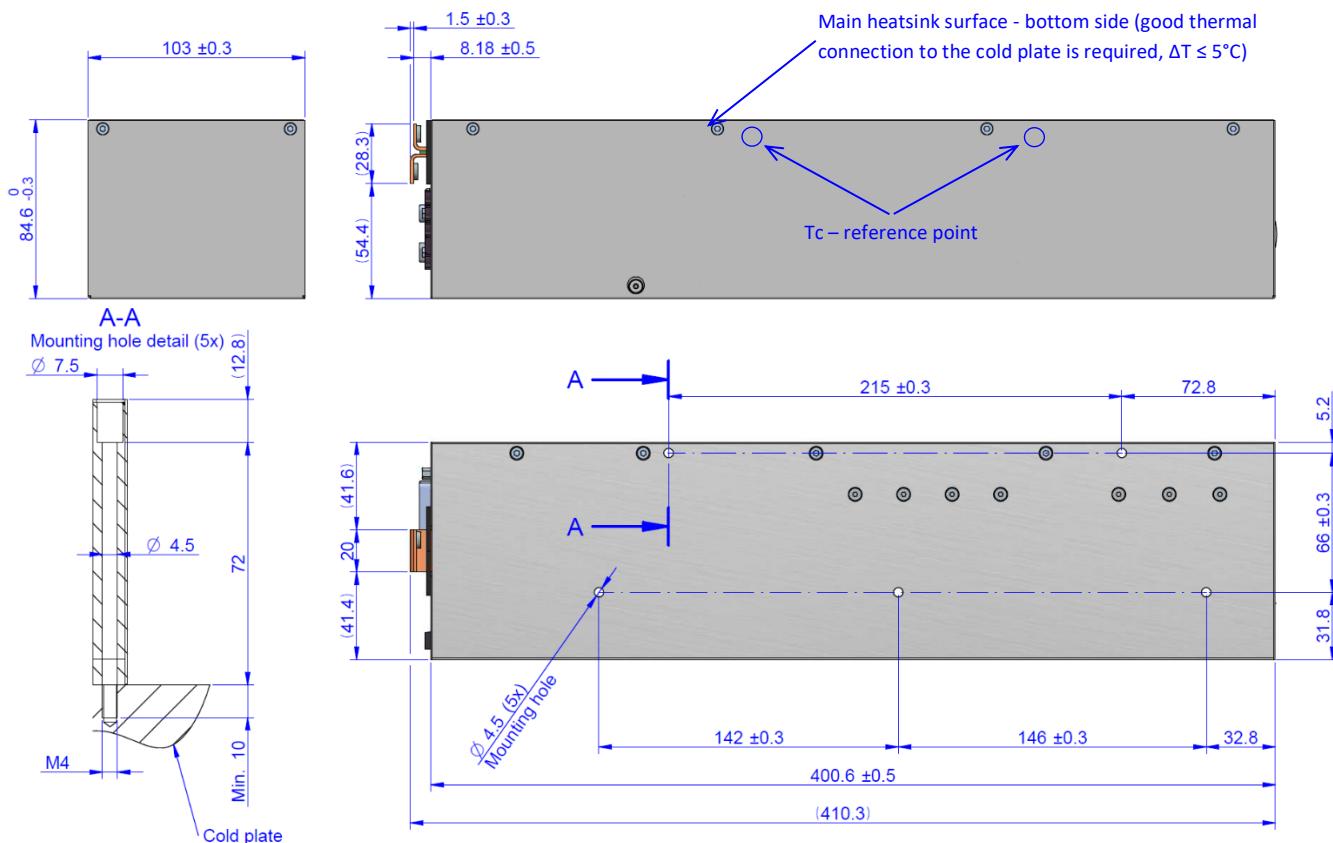
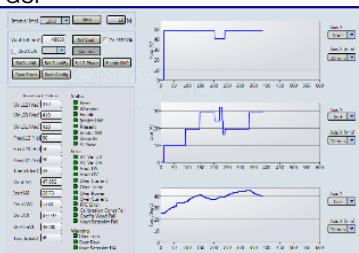


Figure 2. Mechanical Dimensions

10. ACCESSORIES

| ITEM | DESCRIPTION | ORDERING PART NUMBER | SOURCE |
|-------------------------|---|---|---|
| SW GUI |  | Bel Power Solutions Graphical User Interface Windows XP/Vista/7 compatible GUI to program, control and monitor TCP3500 PSU (and other Serial Communication units) | N/A belfuse.com/power-solutions |
| Mounting Screws | M4 x 80mm, Hex socket | XFM.00183.0 | BOSSARD: 3186737 |
| AC Input connector |  | 4-pin Straight Cable Receptacle (Female) | ZES.00962 Weidmüller: 1173520000 |
| Signal Connector |  | 2-pin Straight Cable Receptacle, pitch 3.81 mm (SENSE+/-) ^ 4-pin Straight Cable Receptacle, pitch 3.81 mm (SENSE+/- and ACSH) | 1-111890-G PHOENIXCONTACT: 1803578 1-114261-G PHOENIXCONTACT: 1803594 |
| Adapter USB to RS485 |  | USB 2.0 compatible adapter to dual RS485 with jumpers for signals: ENABLE, INHIBIT and ADDR-INIT_IN | VKA.00489.0 Bel Power Solutions |
| Signal End Board |  | PCB (ZGN.00383) with 15-pin DSUB connector and 6 jumpers: two for setting-up of 120Ω resistors for RS485-1 and -2, and signals ADDR-INIT_OUT, ENABLE, INHIBIT, PS PRESENT OUT | VKA.00488.0 Bel Power Solutions |
| Signal Connection Board |  | PCB (ZGN.00382) with two 15-pin DSUB connectors. This PCB makes practical and space saving solution for parallel signals connection. | VKA.00487.0 Bel Power Solutions |

² For TCP4000-H090 onlyFor 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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