

# TCP4000 Series

## 3-phase 4000 W AC-DC Industrial PSU

The TCP4000 series is a universal 3-phase AC-DC converter with adjustable DC output and universal 3-phase AC input. Conduction cooling (No Fans) 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). Passive or active current share system can be selected.

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/in<sup>3</sup>
- 94% Typical Efficiency
- Parallel Operation up to 16 Units (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 Interface
- Wide Adjustable Output Voltage Range
- Fast Output Voltage Set Response (5 ms)
- Active Current Sharing



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## 1. MODEL SELECTION

MODEL	INPUT VOLTAGE RANGE	NOMINAL OUTPUT VOLTAGE	OUTPUT VOLTAGE RANGE	MAX OUTPUT CURRENT	MAX OUTPUT POWER	AVAILABILITY
TCP4000-H090	180 – 528 Vrms, 50/60 Hz	90 V	Adjustable 30 – 100 VDC	45 ADC or 39 A pulse <sup>1</sup>	3500 / 4000 W	Engineering samples available

<sup>1</sup> PSU model with pulse load operation capability 0 – 100 kHz, 0 – 100% Duty, 0 A/Iout\_max.

## 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			V
	Permitted variation (L-N / L-L)	104 - 305 / 180 - 528			V
Input Frequency			50/60		Hz
	Permitted variation	47		63	Hz
Input Current	per Line at 3 x 180 V (line to line)			14	Arms
Fuse	3 x 20 A, Fast acting				

## 3. OUTPUT SPECIFICATIONS

PARAMETER	DESCRIPTION / CONDITION	MIN	NOM	MAX	UNIT
Output Voltage	Adjustable	30	90	100	V
Output Power Rating	Low Line		3500		W
	High Line		4000		
Output Current	Fixed or Adjustable (60 – 100%)	27		45	A
Efficiency	Typical, High Line and load above 60%		94		%
Voltage Setting Accuracy			± 0.5		%
Line Regulation	$I_o = 0.5 * I_{o\_nom}$		±0.5		%
Load Regulation			±0.3		%
Thermal Drift			±0.02		%/°C
Transient Response (At Vout_nom = 90 V)	load variation 10-100% and back:		±2		V
	Recovery time:			2	ms
Ripple	load variation 50-100% and back:		±1.5		V
	Recovery time:			0.4	ms
Ripple	Vout_nom (BW 20 MHz)			300	mV
Output Start Up				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 HW, based on Nominal Output Voltage	10		18	%
Output Over Voltage Protection	Latch type – Fixed HW, based on Nominal Output Voltage	115		125	%
	Resettable – Floating SW, based on Output Voltage Set Point (configurable)	+4		+6	V
Output Over Current	PSU starts operating as 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:	1.5 kVAC	
	Input to chassis:	1.5 kVAC	
	Output to chassis:	1.5 kVAC	
	Signals to chassis:	353 VAC	
Safety Standards	Latest edition of the following standards: CSA/UL62368-1, EN62368-1 and IEC62368-1		
<b>Emission Requirements</b>			
Radiated Emission	EN55011	Class A	
Conducted Emissions	EN55011	Class A	
<b>Immunity Requirements</b>			
Electrostatic Discharge	IEC 61000-4-2	Level 4: ±8 kV contact, ±15 kV air	Criterion B
Radiated Electromagnetic Field	IEC 61000-4-3	10 V/m	Criterion B
Electrical Fast Transient (EFT)/Burst	IEC 61000-4-4	Level 3: ±2/1 kV	Criterion B
Surge Immunity		Level 3: ±1 kV DM, ±2 kV CM	Criterion B
RF Conducted Immunity	Level 3: 10 V		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.		

#### 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	0		+55	°C
	of ambient air temperature	0		+70	°C
Storage Temperature		-40		+85	°C



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## 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](http://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)

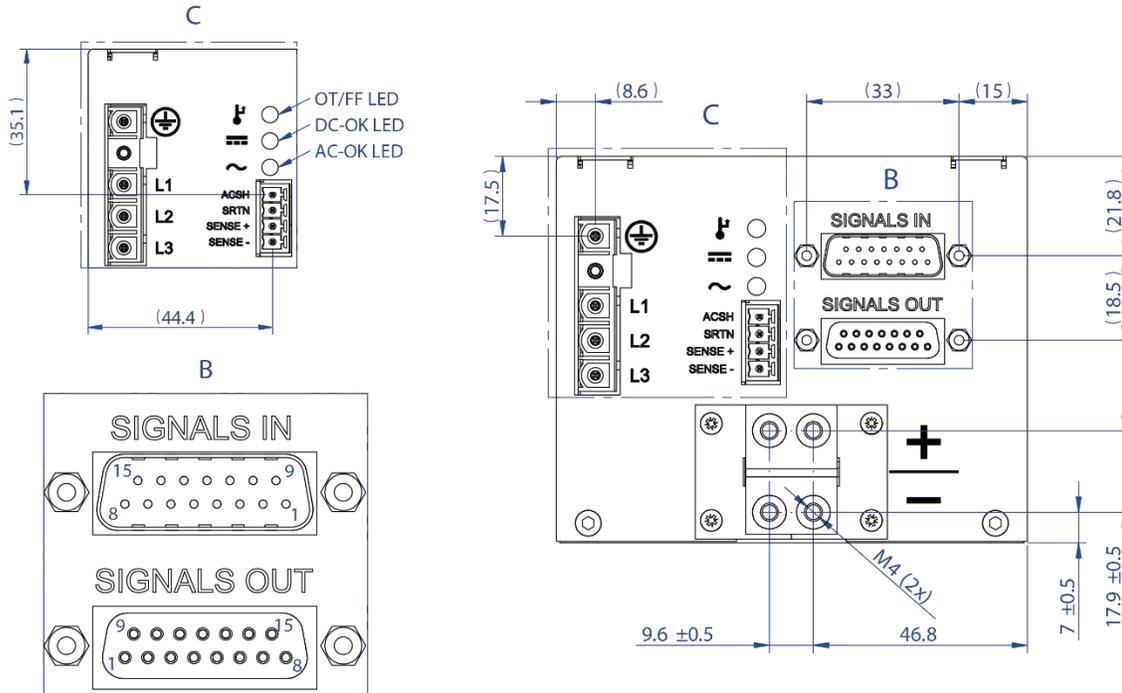


Figure 1. TCP4000- H090 - Connectors Position

### 8.1 INPUT POWER CONNECTOR: PINOUT

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

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-	-	100 VDC 8 mA
Vout-	-	Output Power DC	-	-	45 ADC

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

Connector type: Würth Elektronik, 61801529221  
Mating part: Würth Elektronik, 61801529321

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 <sup>2</sup>	-7 to 12 VDC 8 mA
RS485-2A	2	RS485 Half Duplex, Differential pair 2	RS485-2B	+/-60 mA @ 60 Ω, 50 pF <sup>2</sup>	-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 10 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 10 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 <sup>1</sup>	8	Internal Ground (Signal Return)	-	-	-
RS485-1B	9	RS485 Half Duplex, Differential pair 1	RS485-1B	+/-60 mA @ 60 Ω, 50 pF <sup>2</sup>	-7 to 12 VDC 8 mA
RS485-2B	10	RS485 Half Duplex, Differential pair 2	RS485-2B	+/-60 mA @ 60 Ω, 50 pF <sup>2</sup>	-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 10 mA
PS-PRESENT	13	Power Supply Seated – signal internally connected through 10 Ohm resistor to SRTN	SRTN	-	1 VDC 10 mA
ACSH	14	NC not connected	-	-	-
Margin	15	Optional – analog signal for Output Voltage adjustment – Not connected	-	-	-

<sup>1</sup> SRTN - Signal return on 15-pin D-SUB connector is galvanically isolated from Vout, SENSE +/- and ACSH.

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

## 8.4 SIGNAL OUTPUT CONNECTOR: PINOUT

Connector type: Würth Elektronik, 61801529321  
Mating part: Würth Elektronik, 61801529221

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 <sup>2</sup>	-7 to 12 VDC 8 mA
RS485-2A	2	RS485 Half Duplex, Differential pair 2	RS485-2B	+/-60 mA @ 60 Ω, 50 pF <sup>2</sup>	-7 to 12 VDC 8 mA
ADDR-INIT OUT	3	The unit's address change accepted	SRTN	<0.4 VDC Pull up	7 VDC 10 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 10 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 10 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 <sup>1</sup>	8	Internal Ground (Signal Return)	-	-	-
RS485-1B	9	RS485 Half Duplex, Differential pair 1	RS485-1B	+/-60 mA @ 60 Ω, 50 pF <sup>2</sup>	-7 to 12 VDC 8 mA
RS485-2B	10	RS485 Half Duplex, Differential pair 2	RS485-2B	+/-60 mA @ 60 Ω, 50 pF <sup>2</sup>	-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 10 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	NC not connected	-	-	-
Margin	15	Optional - analog signal for Output Voltage adjustment - Not Connected	SRTN	-	-

<sup>1</sup> SRTN - Signal return on 15-pin D-SUB connector is galvanically isolated from Vout, SENSE +/- and ACSH).

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

## 8.5 SIGNAL OUTPUT CONNECTOR TCP4000-H090: PINOUT

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

SIGNAL NAME	PIN #	TYPE	SIGNAL REFERENCE	LOW LEVEL HIGH LEVEL	V MAX I MAX
ACSH	1	Active Current Share	SRTN	-	-
SRTN <sup>1</sup>	2	Signal Return for Active Current Share	-	-	-
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-	-	-

<sup>1</sup> SRTN - Signal return on Active Current Share on 4-PIN connector (MC 1.5/ 4-G-3.81) is galvanically isolated from SRTN Signal (Internal Ground) on 15-pin D-SUB connector.

## 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: Input to Chassis:	3.0 1.5			kVAC
Enclosure	IP20				

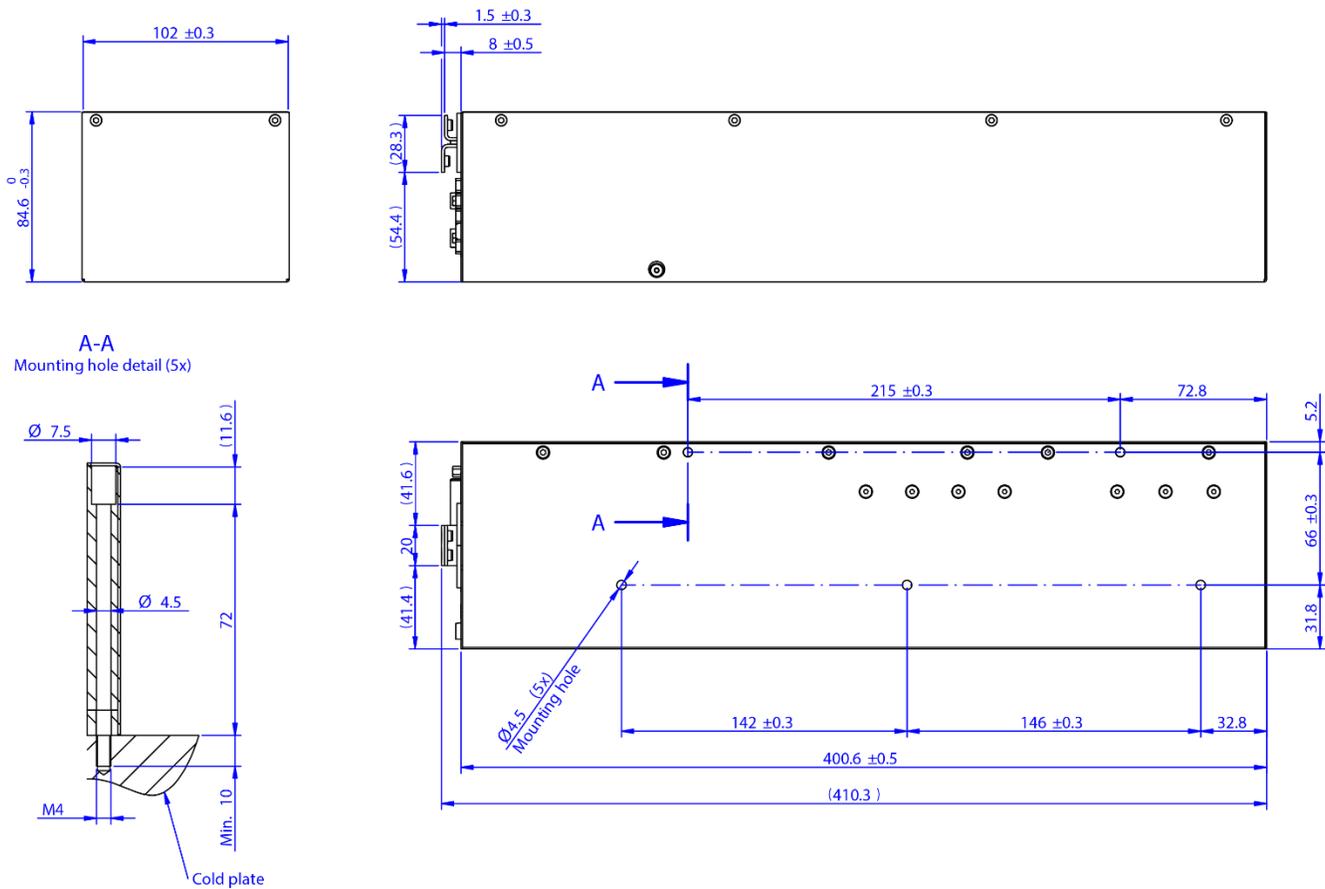
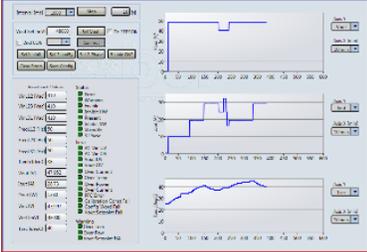


Figure 2. Mechanical Dimensions

## 10. ACCESSORIES

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

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