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Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China





POWER SUPPLY

- 3AC 380-480V Wide-range Input
- 2 or 3-Phase Operation Possible
- Width only 62mm
- Efficiency up to 92.9%
- Excellent Partial Load Efficiency
- 20% Output Power Reserves
- Easy fuse tripping Due to High Overload Current
- Input -Transient Blanking Circuit Included
- Minimal Inrush Current Surge
- Three Input Fuses Included
- Current Sharing Feature for Parallel Use
- Full Power Between -25°C and +60°C
- 3 Year Warranty

GENERAL DESCRIPTION

The Dimension C-Series are cost optimized power supplies without compromising quality, reliability and performance. The C-Series is part of the DIMENSION power supply family. The most outstanding features of CT10.481 are the high efficiency, electronic inrush current limitation, active input transient filter and wide operational temperature range.

The C-Series includes all the essential basic functions. The devices have a power reserve of 20% included, which may even be used continuously at temperatures up to +45°C. Additionally, the CT10.481 can deliver 3 times the nominal output current for 10ms which helps to trip fuses on faulty output branches.

SHORT-FORM DATA

| | | |
|-------------------|----------------|-------------------|
| Output voltage | DC 48V | |
| Adjustment range | 48-56V | |
| Output current | 5 – 4.3A | ambient <60°C |
| | 6 – 5.2A | ambient <45°C |
| Output power | 240W | ambient <60°C |
| | 288W | ambient <45°C |
| Output ripple | < 100mVpp | 20Hz to 20MHz |
| Input voltage | AC 380-480V | -15%/+20% |
| Mains frequency | 50-60Hz | ±6% |
| AC Input current | 0.7 / 0.6A | at 3x400 / 480Vac |
| Power factor | 0.53 / 0.52 | at 3x400 / 480Vac |
| AC Inrush current | typ. 4A peak | |
| Efficiency | 92.8 / 92.9% | at 3x400 / 480Vac |
| Losses | 18.6 / 18.3W | at 3x400 / 480Vac |
| Temperature range | -25°C to +70°C | operational |
| Derating | 6W/°C | +60 to +70°C |
| Hold-up time | typ. 34 / 54ms | at 3x400 / 480Vac |
| Dimensions | 62x124x117mm | WxHxD |

ORDER NUMBERS

| | | |
|--------------|-----------------|----------------------|
| Power Supply | CT10.481 | 48-56V Standard unit |
| Accessory | ZM1.WALL | Wall mount bracket |
| | ZM13.SIDE | Side mount bracket |
| | YRM2.DIODE | Decoupling module |
| | UF20.481 | Buffer unit |

MARKINGS



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The information presented in this document is believed to be accurate and reliable and may change without notice.

TERMINOLOGY AND ABBREVIATIONS

| | |
|--|---|
| PE and \oplus symbol | PE is the abbreviation for Protective Earth and has the same meaning as the symbol \oplus . |
| Earth, Ground | This document uses the term "earth" which is the same as the U.S. term "ground". |
| T.b.d. | To be defined, value or description will follow later. |
| AC 400V | A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually $\pm 15\%$) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V) |
| 400Vac | A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included. |
| 50Hz vs. 60Hz | As long as not otherwise stated, AC 380V and AC 400V parameters are valid at 50Hz and AC 480V parameters are valid at 60Hz mains frequency. |

1. INTENDED USE

This device is designed for installation in an enclosure and is intended for the general use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this power supply in aircrafts, trains and nuclear equipment where malfunction may cause severe personal injury or threaten human life.

This device is designed for use in non-hazardous, ordinary or unclassified locations. Do not use in hazardous location areas.

2. INSTALLATION REQUIREMENTS

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse (if included) is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Mount the unit on a DIN-rail so that the output terminals are located on top and input terminal on the bottom. For other mounting orientations see de-rating requirements in this document.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 30%!

Keep the following installation clearances: 40mm on top, 20mm on the bottom, 5mm on the left and right sides are recommended when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. another power supply).

⚠ WARNING Risk of electrical shock, fire, personal injury or death.

- Do not use the power supply without proper grounding (Protective Earth). Use the terminal on the input block for earth connection and not one of the screws on the housing.
- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering into the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

3. AC-INPUT

| | | | |
|--------------------------------|------|---|--|
| AC input | nom. | 3AC 380-480V | TN, TT, IT-mains networks, grounding of one phase is allowed except for UL508 applications |
| AC input range | | 3x 323-576Vac 3x 576-700Vac 3x 200-323Vac | continuous operation for max. 1 second, occasional (not periodical) full power for 200ms, no damage between 0 and 200Vac |
| Allowed Voltage Phase to Earth | | 500Vac | IEC 62103 |
| Input frequency | nom. | 50–60Hz | ±6% |
| Turn-on voltage | typ. | 3x 260Vac | steady-state value, see Fig. 3-1 |
| Shut-down voltage | typ. | 3x 185Vac | steady-state value, see Fig. 3-1 |

| | | 3AC 400V | 3AC 480V | |
|-------------------|------|-----------------|-----------------|---|
| Input current | typ. | 0.7A | 0.6A | at 48V, 5A, symmetrical phase voltage, see Fig. 3-3 |
| Power factor *) | typ. | 0.53 | 0.52 | at 48V, 5A, see Fig. 3-4 |
| Start-up delay | typ. | 90ms | 90ms | see Fig. 3-2 |
| Rise time | typ. | 55ms | 55ms | 0mF, 48V, 5A, see Fig. 3-2 |
| | typ. | 140ms | 140ms | 5mF, 48V, 5A, see Fig. 3-2 |
| Turn-on overshoot | max. | 300mV | 300mV | see Fig. 3-2 |

*) The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.

Fig. 3-1 **Input voltage range**

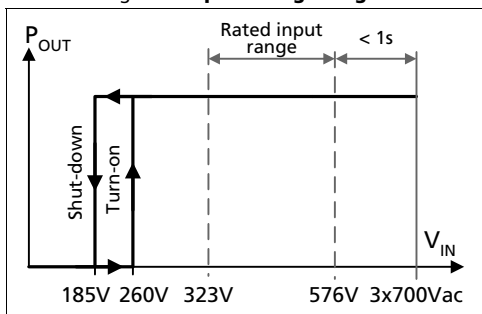


Fig. 3-2 **Turn-on behavior, definitions**

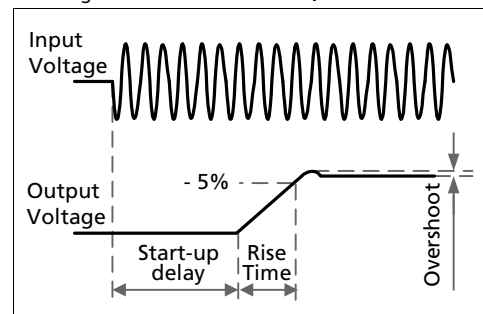


Fig. 3-3 **Input current vs. output load at 24V**

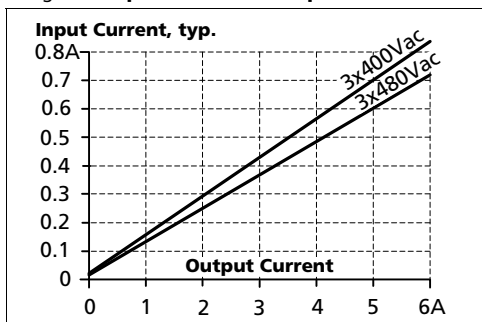
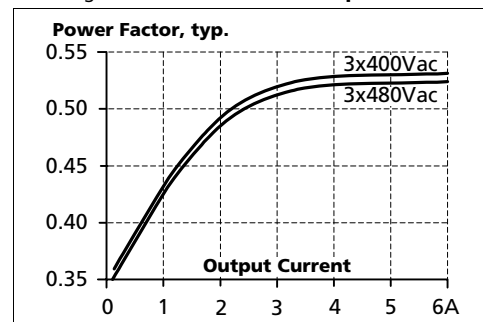


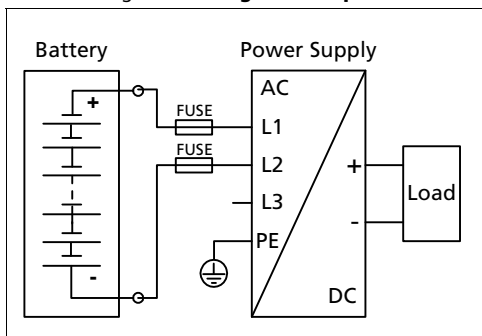
Fig. 3-4 **Power factor vs. output load**



4. DC-INPUT

| | | | |
|-------------------------------|------|----------------|-----------------------------|
| DC input | nom. | DC 600V | |
| DC input range | | 450-780Vdc | continuous operation |
| Allowed Voltage Line to Earth | max. | 820Vdc | IEC 62103 |
| DC input current | typ. | 0.58A / 0.34A | 450Vdc / 780Vdc, at 48V, 5A |
| Turn-on voltage | typ. | 370Vdc | steady state value |
| Shut-down voltage | typ. | 260Vdc | steady state value |

Fig. 4-1 **Wiring for DC Input**



Instructions for DC use:

- a) Use a battery or similar DC source.
For other sources contact PULS
- b) Connect +pole to L1 and –pole to L2.
- c) Terminal L3 remains unused, terminal screw of L3 must be securely tightened.
- d) Use appropriate external fuses in the + and – lines which are suitable for the DC-voltage.
- e) Connect the PE terminal to a earth wire or to the machine ground.
- f) DC-operation is not included in the UL approval.
Additional testing might be necessary.

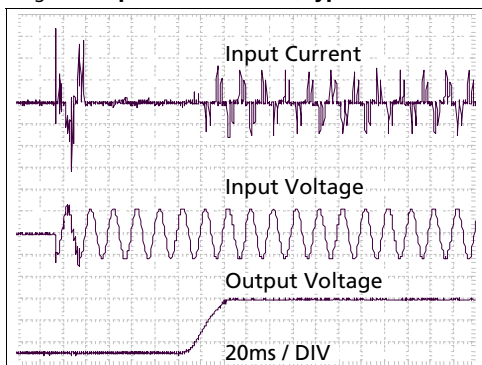
5. INPUT INRUSH CURRENT

An active inrush limitation circuit limits the input inrush current after turn-on of the input voltage and after short input voltage interruptions.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

| | | 3AC 400V | 3AC 480V | |
|----------------|------|---------------------|---------------------|----------------|
| Inrush current | max. | 10A _{peak} | 10A _{peak} | -25°C to +70°C |
| | typ. | 4A _{peak} | 4A _{peak} | -25°C to +70°C |
| Inrush energy | max. | 0.5A ² s | 0.5A ² s | -25°C to +70°C |

Fig. 5-1 **Input inrush current, typical behavior**



Input: 3x 400Vac
 Output: 48V, 5A
 Ambient: 25°C
 Upper curve: Input current 1A / DIV
 Middle curve: Input voltage 500V / DIV
 Lower curve: Output voltage 20V / DIV
 Time basis: 20ms / DIV

6. OUTPUT

| | | | |
|--------------------------|------|---------|--|
| Output voltage | nom. | 48V | |
| Adjustment range | min. | 48-56V | guaranteed |
| | max. | 60V | at clockwise end position of potentiometer |
| Factory setting | typ. | 48.0V | ±0.2%, at full load, cold unit, in "single use" mode |
| | typ. | 46.0V | ±0.2%, at full load, cold unit, in "parallel use" mode |
| | typ. | 48.0V | at no load, cold unit, in "parallel use" mode |
| Line regulation | max. | 10mV | 3x 323-576Vac |
| Load regulation | max. | 100mV | in "single use" mode: static value, 0A → 5A |
| | typ. | 2000mV | in "parallel use" mode: static value, 0A → 5A, see Fig. 6-2 |
| Ripple and noise voltage | max. | 50mVpp | 20Hz to 20MHz, 50Ohm |
| Output capacitance | typ. | 2 400µF | |
| Output current | nom. | 6A | at 48V, ambient < 45°C, see Fig. 6-1 |
| | nom. | 5A | at 48V, ambient < 60°C, see Fig. 6-1 |
| | nom. | 5.2A | at 56V, ambient < 45°C, see Fig. 6-1 |
| | nom. | 4.3A | at 56V, ambient < 60°C, see Fig. 6-1 |
| Output power | nom. | 288W | ambient < 45°C |
| | nom. | 240W | ambient < 60°C |
| Short-circuit current | min. | 9.5A | continuous, load impedance 200mOhm, see Fig. 6-1 |
| | max. | 11.5A | continuous, load impedance 200mOhm, see Fig. 6-1 |
| | min. | 14A | <20ms, load impedance 200mOhm, see Fig. 6-1 |
| | max. | 16A | <20ms, load impedance 200mOhm, see Fig. 6-1 discharge current of output capacitors not included |

Fig. 6-1 Output voltage vs. output current, typ.

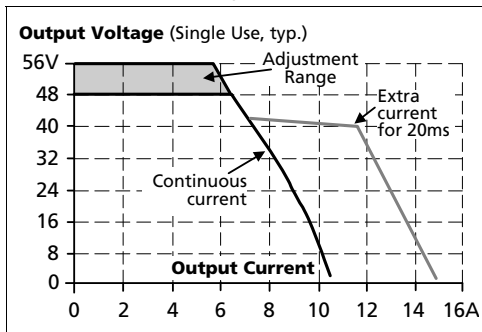
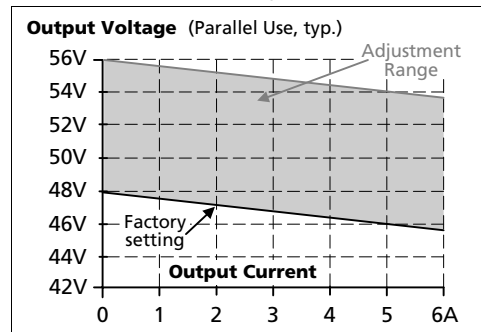


Fig. 6-2 Output voltage in "parallel use" mode, typ.



Peak current capability (up to several milliseconds)

The power supply can deliver a peak current which is higher than the specified short term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 23.1.

| | | | |
|---------------------------|------|-----------------|---------------------------------|
| Peak current voltage dips | typ. | from 48V to 34V | at 10A for 50ms, resistive load |
| | typ. | from 48V to 35V | at 25A for 2ms, resistive load |
| | typ. | from 48V to 28V | at 25A for 5ms, resistive load |

7. HOLD-UP TIME

| | | 3AC 400V | 3AC 480V | |
|--------------|------|-----------------|-----------------|----------------------------|
| Hold-up Time | typ. | 34ms | 54ms | at 48V, 5A, see Fig. 7-1 |
| | typ. | 68ms | 108ms | at 48V, 2.5A, see Fig. 7-1 |

Fig. 7-1 **Hold-up time vs. input voltage**

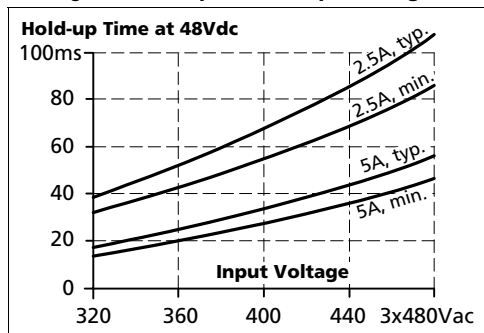
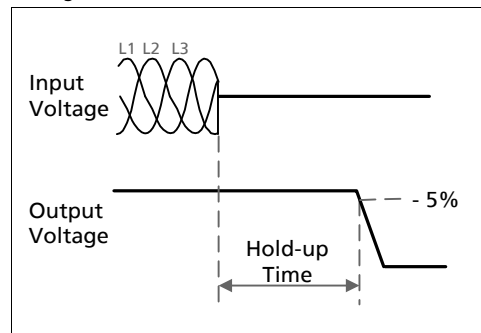


Fig. 7-2 **Shut-down behavior, definitions**



8. EFFICIENCY AND POWER LOSSES

| | | 3AC 400V | 3AC 480V | |
|-----------------------|------|-----------------|-----------------|--|
| Efficiency | typ. | 92.8% | 92.9% | at 48V, 5A, 3-phase operation |
| | typ. | 92.4% | 92.6% | at 48V, 5A, when using only two legs of a 3-phase system, see also chapter 23.6. |
| Average efficiency *) | typ. | 92.0% | 91.7% | 25% at 1.25A, 25% at 2.5A, 25% at 3.75A. 25% at 5A, 3-phase operation |
| Power losses | typ. | 2.3W | 2.6W | at 0A, 3-phase operation |
| | typ. | 18.6W | 18.3W | at 48V, 5A, 3-phase operation |
| | typ. | 23.5W | 22.8W | at 48V, 6A, 3-phase operation |

*) The average efficiency is an assumption for a typical application where the power supply is loaded with 25% of the nominal load for 25% of the time, 50% of the nominal load for another 25% of the time, 75% of the nominal load for another 25% of the time and with 100% of the nominal load for the rest of the time.

Fig. 8-1 **Efficiency vs. output current at 48V, typ., 3-phase operation**

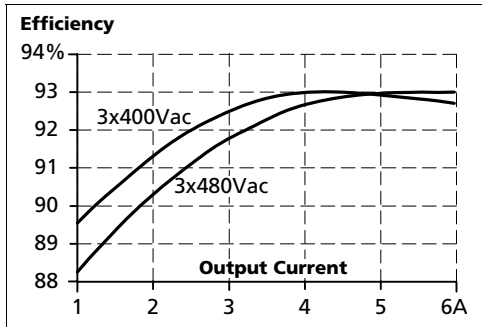


Fig. 8-2 **Losses vs. output current at 48V, typ., 3-phase operation**

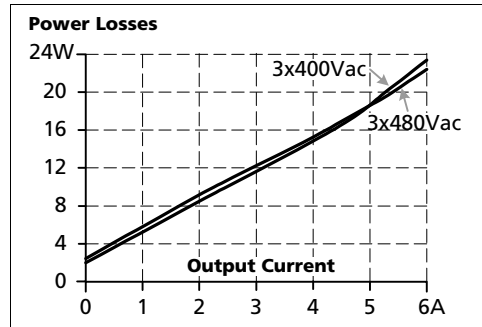


Fig. 8-3 **Efficiency vs. input voltage at 48V, 5A, typ., 3-phase operation**

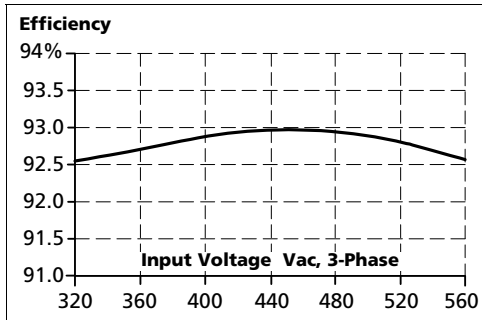
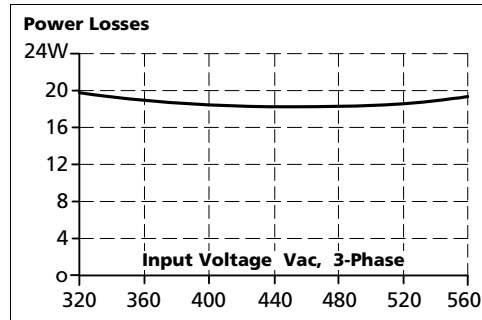
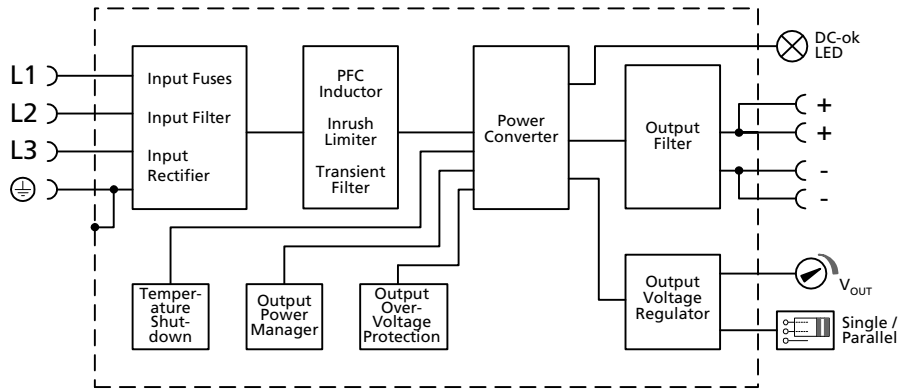


Fig. 8-4 **Losses vs. input voltage at 48V, 5A, typ., 3-phase operation**



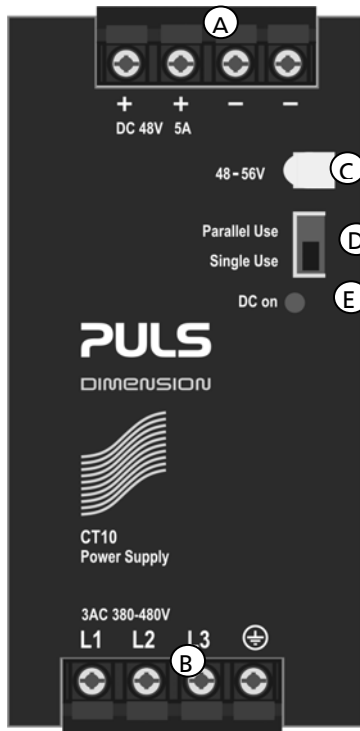
9. FUNCTIONAL DIAGRAM

Fig. 9-1 Functional diagram



10. FRONT SIDE AND USER ELEMENTS

Fig. 10-1 Front side



- A** Output Terminals
Screw terminals, dual terminals per pole
+ Positive output
- Negative (return) output
- B** Input Terminals
Screw terminals
L1, L2, L3 Phase input
⊕ PE (Protective Earth) input
- C** Output voltage potentiometer
Open the flap to set the output voltage. Factory set: 48.0V
- D** "Parallel Use" "Single Use" selector
Set jumper to "Parallel Use" when power supplies are connected in parallel to increase the output power. In order to achieve a sharing of the load current between the individual power supplies, the "parallel use" regulates the output voltage in such a manner that the voltage at no load is approx. 5% higher than at nominal load. See also Fig. 6-2. A missing jumper is equal to a "Single Use" mode. Factory setting is "Single Use" mode.
- E** DC-OK LED (green)
On when the voltage on the output terminals is > 36V

11. TERMINALS AND WIRING

| | Input | Output |
|-------------------------------|---------------------------------|---------------------------------|
| Type | screw terminals | screw terminals |
| Solid wire | 0.5-6mm ² | 0.5-6mm ² |
| Stranded wire | 0.5-4mm ² | 0.5-4mm ² |
| American Wire Gauge | 20-10 AWG | 20-10 AWG |
| Wire stripping length | 7mm / 0.275inch | 7mm / 0.275inch |
| Screwdriver | 3.5mm slotted or Pozidrive No 2 | 3.5mm slotted or Pozidrive No 2 |
| Recommended tightening torque | 0.8Nm, 7lb.in | 0.8Nm, 7lb.in |

Instructions:

- a) Use appropriate copper cables that are designed for an operating temperature of: 60°C for ambient up to 45°C and 75°C for ambient up to 60°C minimum.
- b) Follow national installation codes and installation regulations!
- c) Ensure that all strands of a stranded wire enter the terminal connection!
- d) Up to two stranded wires with the same cross section are permitted in one connection point (except PE wire).
- e) Do not use the unit without PE connection.
- f) Screws of unused terminal compartments should be securely tightened.
- g) Ferrules are allowed, but not required

12. RELIABILITY

| 3-Phase operation | 3AC 400V | 3AC 480V | |
|------------------------------|-----------------|-----------------|---|
| Lifetime expectancy *) | 122 000h | 126 000h | at 48V, 5A and 40°C |
| | 249 000h | 226 000h | at 48V, 2.5A and 40°C |
| | 78 000h | 88 000h | at 48V, 6A and 40°C |
| | 345 000h | 355 000h | at 48V, 5A and 25°C |
| MTBF **) SN 29500, IEC 61709 | 1 051 000h | 1 048 000h | at 48V, 5A and 40°C |
| | 1 805 000h | 1 799 000h | at 48V, 5A and 25°C |
| MTBF **) MIL HDBK 217F | 438 000h | 424 000h | at 48V, 5A and 40°C; Ground Benign GB40 |
| | 585 000h | 568 000h | at 48V, 5A and 25°C; Ground Benign GB25 |

| Operation on only 2 legs of the three phase system | 2AC 400V | 2AC 480V | |
|---|-----------------|-----------------|---|
| Lifetime expectancy *) | 114 000h | 120 000h | at 48V, 5A and 40°C |
| | 253 000h | 234 000h | at 48V, 2.5A and 40°C |
| | 76 000h | 81 000h | at 48V, 6A and 40°C |
| | 322 000h | 341 000h | at 48V, 5A and 25°C |
| MTBF **) SN 29500, IEC 61709 | 1 019 000h | 1 023 000h | at 48V, 5A and 40°C |
| | 1 765 000h | 1 771 000h | at 48V, 5A and 25°C |
| MTBF **) MIL HDBK 217F | 437 000h | 425 000h | at 48V, 5A and 40°C; Ground Benign GB40 |
| | 584 000h | 569 000h | at 48V, 5A and 25°C; Ground Benign GB25 |

*) The **Lifetime expectancy** shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitor's manufacturer specification. The prediction model allows only a calculation of up to 15 years from date of shipment.

) **MTBF stands for **Mean Time Between Failure**, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

13. EMC

The power supply is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions. The CE mark indicates conformance with EMC guideline 89/336/EC, 93/68/EC and 2004/108/EC and the low-voltage directive (LVD) 73/23/EC and 2006/95/EC. A detailed EMC report is available on request.

| EMC Immunity | Generic standards: EN 61000-6-1 and EN 61000-6-2 | | | |
|--|--|---|----------------------------------|--|
| Electrostatic discharge | EN 61000-4-2 | Contact discharge Air discharge | 8kV 15kV | Criterion A Criterion A |
| Electromagnetic RF field | EN 61000-4-3 | 80MHz-2.7GHz | 10V/m | Criterion A |
| Fast transients (Burst) | EN 61000-4-4 | Input lines Output lines | 4kV 2kV | Criterion A Criterion A |
| Surge voltage on input | EN 61000-4-5 | L1 → L2, L2 → L3, L1 → L3 | 2kV | Criterion A |
| Surge voltage on input | EN 61000-4-5 | L1 / L2 / L3 → PE | 4kV | Criterion A |
| Surge voltage on output | EN 61000-4-5 | + → - + / - → PE | 500V 500V | Criterion A Criterion A |
| Conducted disturbance | EN 61000-4-6 | 0.15-80MHz | 10V | Criterion A |
| Mains voltage dips (Dips on three phases) | EN 61000-4-11 | 0% of 380Vac 0% of 480Vac | 0Vac, 20ms 0Vac, 20ms | Criterion A Criterion A |
| Mains voltage dips (Dips on two phases) | EN 61000-4-11 | 40% of 380Vac 40% of 480Vac 70% of 380Vac 70% of 480Vac | 200ms 200ms 500ms 500ms | Criterion A Criterion A Criterion A Criterion A |
| Voltage interruptions | EN 61000-4-11 | | 0Vac, 5000ms | Criterion C |
| Voltage sags | SEMI F47 0706 | Dips on two phases according to section 7.2. of the SEMI F47 standard 80% of 380Vac 70% of 380Vac 50% of 380Vac | 1000ms 500ms 200ms | Criterion A Criterion A Criterion A |
| Powerful transients | VDE 0160 | over entire load range | 1550V, 1.3ms | Criterion A |

Criteria:

- A:** Power supply shows normal operation behavior within the defined limits.
- C:** Temporary loss of function is possible. Power supply may shut-down and restarts by itself. No damage or hazards for the power supply will occur.

| EMC Emission | Generic standards: EN 61000-6-3 and EN 61000-6-4 | |
|-------------------------------|---|----------------------|
| Conducted emission | EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22 | Class B, input lines |
| Radiated emission | EN 55011, EN 55022 | Class B |
| Harmonic input current | EN 61000-3-2 | fulfilled |
| Voltage fluctuations, flicker | EN 61000-3-3 | fulfilled |

This device complies with FCC Part 15 rules.

Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Switching frequency Variable between 50kHz and 140kHz depending on load and input voltage

14. ENVIRONMENT

| | | |
|----------------------------|---|---|
| Operational temperature *) | -25°C to +70°C (-13°F to 158°F) | reduce output power according Fig. 14-1 |
| Storage temperature | -40 to +85°C (-40°F to 185°F) | for storage and transportation |
| Output de-rating | 3.2W/°C 6W/°C | 45-60°C (113°F to 140°F) 60-70°C (140°F to 158°F) |
| Humidity **) | 5 to 95% r.H. | IEC 60068-2-30 |
| Vibration sinusoidal | 2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis | IEC 60068-2-6 |
| Shock | 30g 6ms, 20g 11ms 3 bumps / direction, 18 bumps in total | IEC 60068-2-27 |
| Altitude | 0 to 6000m (0 to 20 000ft) | reduce output power or ambient temperature above 2000m sea level. |
| Altitude de-rating | 15W/1000m or 5°C/1000m | above 2000m (6500ft), see Fig. 14-2 |
| Over-voltage category | III II | IEC 62103, EN 50178, altitudes up to 2000m altitudes from 2000m to 6000m |
| Degree of pollution | 2 | IEC 62103, EN 50178, not conductive |

*) Operational temperature is the same as the ambient temperature and is defined as the air temperature 2cm below the unit.

***) Do not energize while condensation is present

Fig. 14-1 Output current vs. ambient temp.

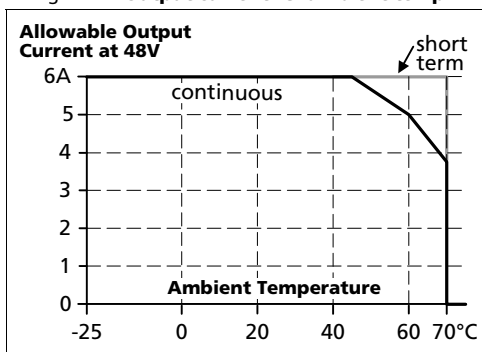
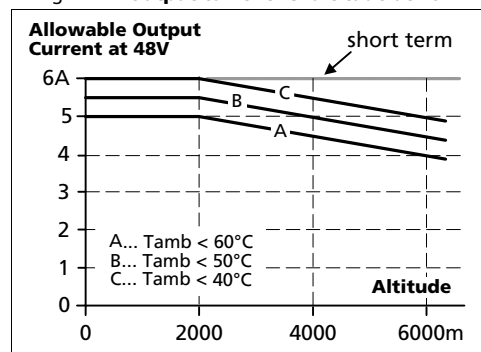


Fig. 14-2 Output current vs. altitude at 48V



15. PROTECTION FEATURES

| | | |
|--------------------------------|--|---|
| Output protection | Electronically protected against overload, no-load and short-circuits *) | |
| Output over-voltage protection | typ. 58.5Vdc max. 60Vdc | In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart. |
| Degree of protection | IP 20 | EN/IEC 60529 |
| Penetration protection | > 3.5mm | e.g. screws, small parts |
| Over-temperature protection | yes | output shut-down with automatic restart |
| Input transient protection | MOV (Metal Oxide Varistor) and active transient filter | |
| Internal input fuse | 3x T3.15A H.B.C. | not user replaceable |

*) In case of a protection event, audible noise may occur.

16. SAFETY FEATURES

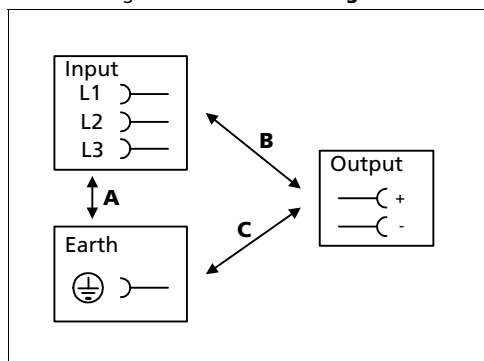
| | | |
|---------------------------------|--|--|
| Input / output separation *) | SELV PELV | IEC/EN 60950-1 IEC/EN 60204-1, EN 50178, IEC 62103, IEC 60364-4-41 |
| Class of protection | I | PE (Protective Earth) connection required |
| Isolation resistance | > 5M Ω | Input to output, 500Vdc |
| PE resistance | < 0.1 Ω | |
| Touch current (leakage current) | typ. 0.17mA typ. 0.24mA < 0.22mA < 0.31mA | 3x 400Vac, 50Hz, TN mains 3x 480Vac, 60Hz, TN mains 3x 440Vac, 50Hz, TN mains 3x 528Vac, 60Hz, TN mains |

*) Double or reinforced insulation

17. DIELECTRIC STRENGTH

The output voltage is floating and has no ohmic connection to the ground. Type and factory tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2s up and 2s down). Connect all phase-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.





Fig. 17-1 Dielectric strength



| | | A | B | C |
|-------------------------|-----|----------|----------|----------|
| Type test | 60s | 2500Vac | 3000Vac | 500Vac |
| Factory test | 5s | 2500Vac | 2500Vac | 500Vac |
| Field test | 5s | 2000Vac | 2000Vac | 500Vac |
| Cut-off current setting | | > 10mA | > 10mA | > 30mA |

To fulfill the PELV requirements according to EN60204-1 § 6.4.1, we recommend that either the + pole, the - pole or any other part of the output circuit shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

18. APPROVALS

| | | |
|----------------|---|---|
| IEC 60950-1 |  | CB Scheme, Information Technology Equipment |
| UL 508 |  | Listed for use as Industrial Control Equipment; U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01); E-File: E198865 Mains supply circuit: 3-wire + PE, star |
| UL 60950-1 |  | Recognized for use as Information Technology Equipment; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950); E-File: E137006, Level 5 |
| Marine pending |  | GL (Germanischer Lloyd) classified and ABS (American Bureau for Shipping) PDA Environmental category: C, EMC2 Marine and offshore applications |

19. FULFILLED STANDARDS

| | |
|---------------------|---|
| EN 61558-2-17 | Safety of Power Transformers |
| EN/IEC 60204-1 | Safety of Electrical Equipment of Machines |
| EN/IEC 61131-2 | Programmable Controllers |
| EN 50178, IEC 62103 | Electronic Equipment in Power Installations |

20. USED SUBSTANCES

The unit does not release any silicone and is suitable for the use in paint shops.

The unit conforms to the RoHS directive 2002/96/EC

Electrolytic capacitors included in this unit do not use electrolytes such as Quaternary Ammonium Salt Systems.

Plastic housings and other molded plastic materials are free of halogens, wires and cables are not PVC insulated.

The production material within our production does not include following toxic chemicals:

Polychlorized Biphenyl (PCB), Polychlorized Terphenyl (PCT), Pentachlorophenol (PCP), Polychlorinated naphthalene (PCN), Polybrom Biphenyl (PBB), Polybrom Biphenyl-oxyd (PBO), Polybrominated Diphenylether (PBDE), Polychlorinated Diphenylether (PCDE), Polydibromphenyl Oxyd (PBDO), Cadmium, Asbestos, Mercury, Silicia

21. PHYSICAL DIMENSIONS AND WEIGHT

| | |
|-------------------------|--|
| Weight | 750g / 1.65lb |
| DIN-Rail | Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN-rail height must be added to the unit depth (117mm) to calculate the total required installation depth. |
| Installation Clearances | See chapter 2 |

Fig. 21-1 **Front view**

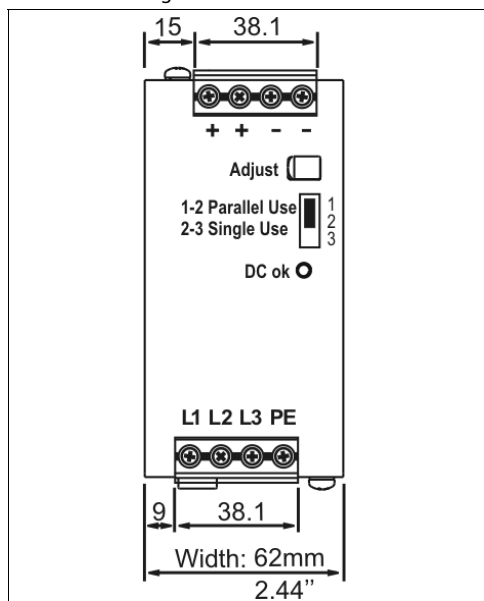
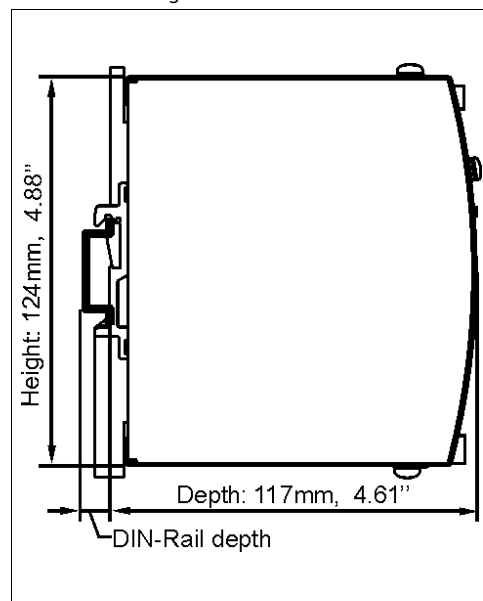


Fig. 21-2 **Side view**



22. ACCESSORIES

ZM1.WALL Wall mounting bracket

This bracket is used to mount specific Dimension units onto a flat surface without utilizing a DIN-Rail. The two aluminum brackets and the black plastic slider of the unit have to be removed, so that the two steel brackets can be mounted.

Fig. 22-1 ZM1.WALL Wall mounting bracket

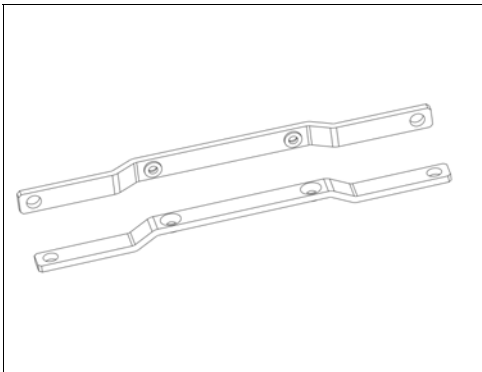
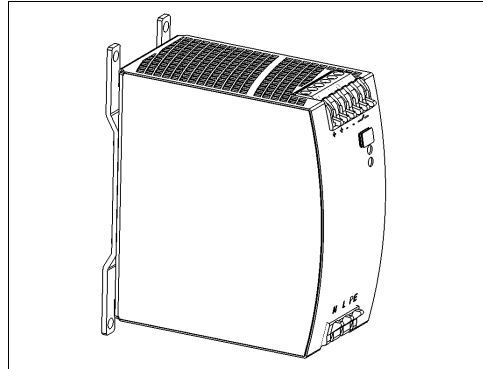


Fig. 22-2 Assembled wall mounting bracket *)

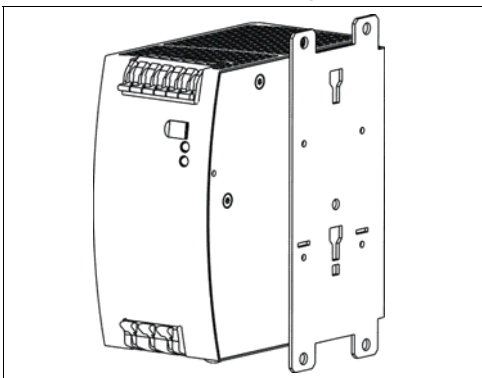


*) Picture of the power supply is for representation only

ZM13.SIDE Side mounting bracket

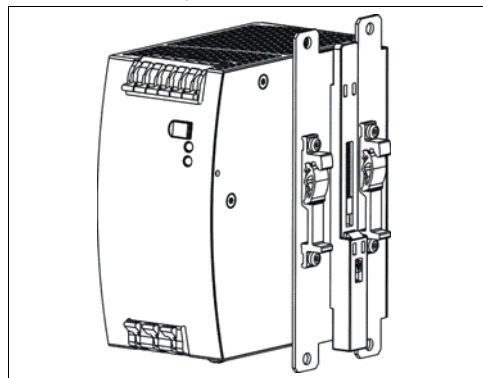
This bracket is used to mount Dimension units sideways with or without utilizing a DIN-Rail. The two aluminum brackets and the black plastic slider of the unit have to be detached, so that the steel brackets can be mounted. For sideways DIN-rail mounting, the removed aluminum brackets and the black plastic slider need to be mounted on the steel bracket.

Fig. 22-3
ZM13.SIDE Side mounting bracket *)



*) Picture of the power supply is for representation only

Fig. 22-4
Side mounting with DIN-rail brackets *)



23. APPLICATION NOTES

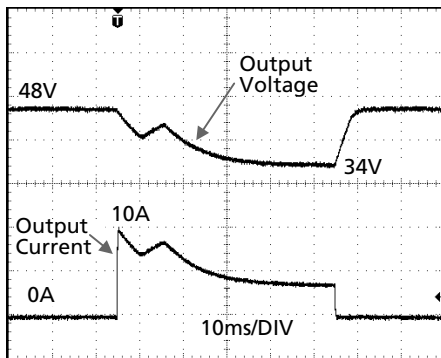
23.1. PEAK CURRENT CAPABILITY

Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady-state current and usually exceeds the nominal output current (including the PowerBoost) The same situation applies, when starting a capacitive load.

Branch circuits are often protected with circuit breakers or fuses. In case of a short or an overload in the branch circuit, the fuse needs a certain amount of over-current to trip or to blow. The peak current capability ensures the safe operation of subsequent circuit breakers.

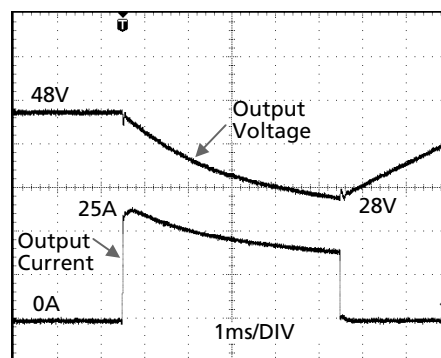
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 23-1 Peak load 10A for 50ms, typ.



Peak load 10A (resistive) for 50ms
Output voltage dips from 48V to 34V.

Fig. 23-2 Peak load 25A for 5ms, typ.



Peak load 25A (resistive) for 5ms
Output voltage dips from 48V to 28V.

23.2. BACK-FEEDING LOADS

Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).

This power supply is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter, whether the power supply is on or off.

The maximum allowed feed-back-voltage is 63Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 6.

23.3. CHARGING OF BATTERIES

The power supply can be used to charge lead-acid or maintenance free batteries. (4x 12V batteries in series)

Instructions for charging batteries:

- a) Set jumper on the front of the unit into "Parallel Use"
- b) Set output voltage (measured at no load and at the battery end of the cable) very precisely to the end-of-charge voltage.

| | | | | |
|-----------------------|-------|------|-------|-------|
| End-of-charge voltage | 55.6V | 55V | 54.3V | 53.6V |
| Battery temperature | 10°C | 20°C | 30°C | 40°C |

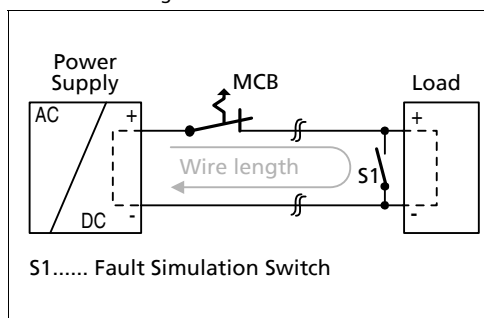
- c) Use a 10A circuit breaker (or blocking diode) between the power supply and the battery.
- d) Ensure that the output current of the power supply is below the allowed charging current of the battery.
- e) Use only matched batteries when putting 12V types in series.
- f) The return current to the power supply (battery discharge current) is typ. 4.4mA when the power supply is switched off (except in case a blocking diode is utilized).

23.4. OUTPUT CIRCUIT BREAKERS

Standard miniature circuit breakers (MCB's or UL1077 circuit breakers) are without doubt, one of the most efficient and economical ways to open circuits on faulty branches. Most of these breakers may also be used on 48V branches. MCB's are designed to protect wires and circuits. If the ampere value and the characteristics of the MCB are adapted to the wire size that is used, the wiring is considered as thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and under-voltage situations in adjacent 48V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10ms is necessary corresponding roughly to the ride-through time of PLC's. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B- and C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.

Fig. 23-3 Test circuit



Maximal wire length for a magnetic (fast) tripping *):

| | 0.75mm ² | 1.0mm ² | 1.5mm ² | 2.5mm ² |
|-------|---------------------|--------------------|--------------------|--------------------|
| C-2A | 52m | 70m | 94m | 148m |
| C-3A | 33m | 42m | 64m | 97m |
| C-4A | 19m | 23m | 33m | 48m |
| C-6A | 8m | 9m | 13m | 22m |
| C-8A | - | - | - | - |
| C-10A | - | - | - | - |
| B-6A | 18m | 22m | 33m | 46m |
| B-10A | 4m | 5m | 10m | 13m |

*) Don't forget to consider two times the distance to the load (or cable length) when calculating the total wire length (+ and - wire).

23.5. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 30A (U.S.A.) and 32A (IEC). An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 6A B- or 3A C-Characteristic breaker should be used

23.6. USING ONLY 2 LEGS OF A 3-PHASE SYSTEM

The power supply is allowed to run permanently on two legs of a 3-phase system, when the output power is reduced according to the curves below. A long-term exceeding of these limits will result in a thermal shut-down of the unit. No external protection device is required to protect against a phase-loss failure. EMC performance, hold-up time and losses differ from a three phase operation. Therefore, check suitability of your individual application. The screw of the terminal which remains unused must be securely tightened.

Using only two legs of a 3-phase system is not included in the UL approval. Therefore, additional testing might be necessary.

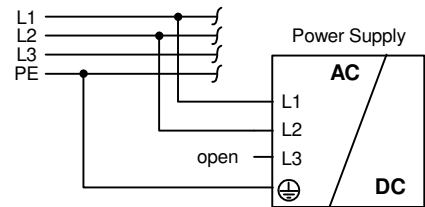


Fig. 23-4
Allowed output current for use on only two legs of a 3-phase system

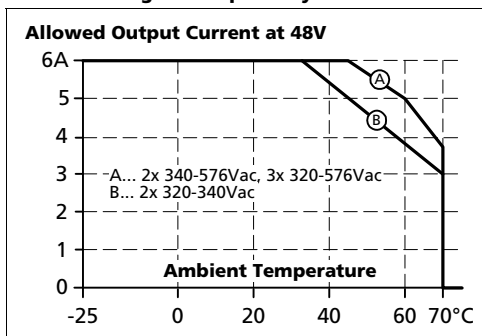


Fig. 23-5
Hold-up time for use on only two legs of a 3-phase system

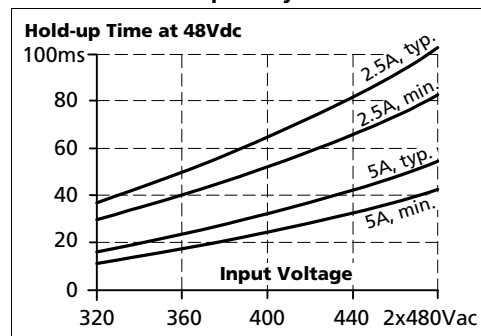


Fig. 23-6
Efficiency vs. output current at 24V for use on only two legs of a 3-phase system

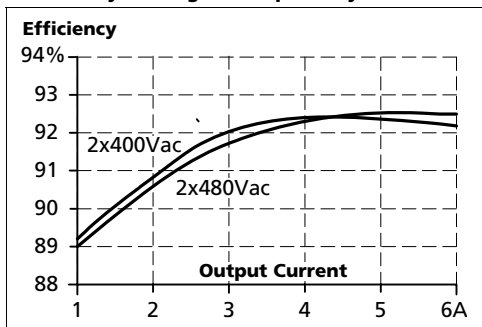
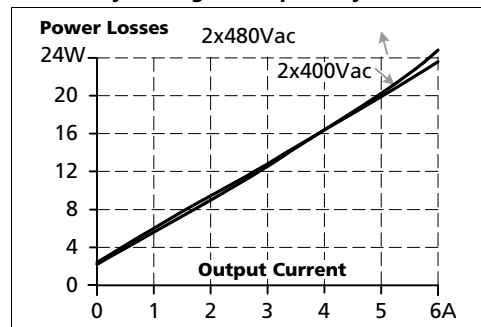


Fig. 23-7
Losses vs. output current at 24V for use on only two legs of a 3-phase system

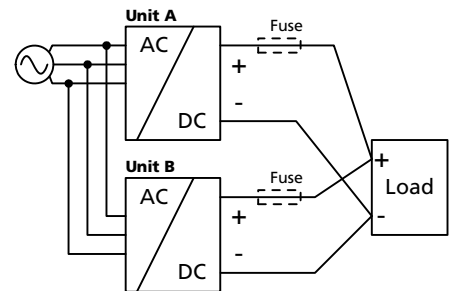


23.7. INDUCTIVE AND CAPACITIVE LOADS

The unit is designed to supply any kind of loads, including unlimited capacitive and inductive loads.

23.8. PARALLEL USE TO INCREASE OUTPUT POWER

CT10.481 power supplies can be paralleled to increase the output power. This power supply can also be paralleled with power supplies of the same type. The output voltage of all power supplies shall be adjusted to the same value ($\pm 100\text{mV}$) in "Single use" mode with the same load conditions on all units, or the units can be left with the factory settings. After the adjustments, the jumper on the front of the unit shall be moved from "Single use" to "Parallel use", in order to achieve load sharing. The "Parallel use" mode regulates the output voltage in such a manner that the voltage at no load is approx. 5% higher than at nominal load. See also chapter 6. If no jumper is plugged in, the unit is in "Single use". Factory setting is "Single use" mode. A fuse (or diode) on the output of each unit is only required if more than three units are connected in parallel. If a fuse (or circuit breaker) is used, choose one with approximately 150% of the rated output current of the power supply. Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in parallel in mounting orientations other than the standard mounting orientation (input terminals on the bottom and output terminals on top of the unit) or in any other condition where a derating of the output current is required (e.g. altitude, above 60°C, ...). Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.



23.9. PARALLEL USE FOR REDUNDANCY

Power supplies can be paralleled for redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one power supply unit fails. The simplest way is to put two power supplies in parallel. This is called a 1+1 redundancy. In case one power supply unit fails, the other one is automatically able to support the load current without any interruption. Redundant systems for a higher power demand are usually built in a N+1 method. E.g. five power supplies, each rated for 5A are paralleled to build a 20A redundant system. For N+1 redundancy the same restrictions apply as for increasing the output power, see also section 23.8.

Please note: This simple way to build a redundant system does not cover failures such as an internal short circuit in the secondary side of the power supply. In such a case, the defect unit becomes a load for the other power supplies and the output voltage can not be maintained any more. This can only be avoided by utilizing decoupling diodes which are included in the decoupling module YRM2.DIODE.

Recommendations for building redundant power systems:

- Use separate input fuses for each power supply.
- Set the power supply into "Parallel Use".
- Monitor the individual power supply units. A DC-ok lamp and a DC-ok contact is included in the redundancy module YRM2.DIODE. This feature reports a faulty unit.
- It is desirable to set the output voltages of all units to the same value ($\pm 100\text{mV}$) or leave it at the factory setting.

23.10. DAISY CHAINING OF OUTPUTS

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the average output current through one terminal pin does not exceed 25A. If the current is higher, use a separate distribution terminal block.

Fig. 23-8 Daisy chaining of outputs

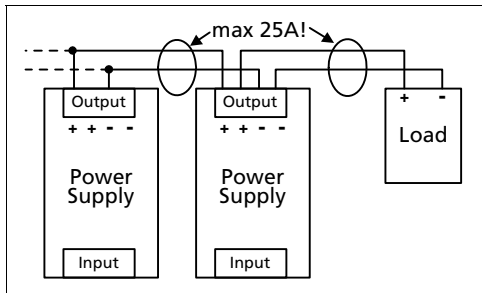
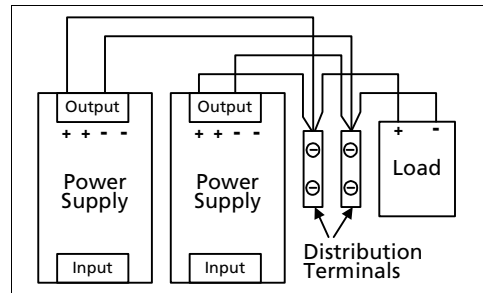
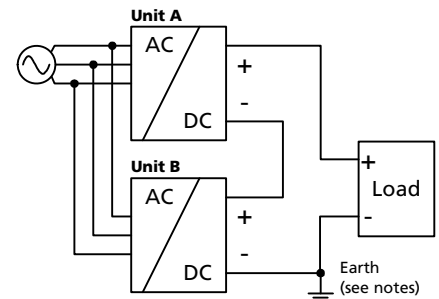


Fig. 23-9 Using distribution terminals



23.11. SERIES OPERATION

Power supplies of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc. Voltages with a potential above 60Vdc are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching. Earthing of the output is required when the sum of the output voltage is above 60Vdc. Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals. Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.



23.12. USE IN A TIGHTLY SEALED ENCLOSURE

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. In such situations, the inside temperature defines the ambient temperature for the power supply.

The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

The power supply is placed in the middle of the box, no other heat producing items are inside the box

| | |
|--------------------------------|---|
| Enclosure: | Rittal Typ IP66 Box PK 9519 100, plastic, 180x180x165mm |
| Load: | 48V, 4A; (=80%) load is placed outside the box |
| Input: | 3x 400Vac |
| Temperature inside enclosure: | 48.9°C (in the middle of the right side of the power supply with a distance of 2cm) |
| Temperature outside enclosure: | 24.7°C |
| Temperature rise: | 24.2K |

23.13. MOUNTING ORIENTATIONS

Mounting orientations other than input terminals on the bottom and output on the top require a reduction in continuous output power or a limitation in the max. allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different derating curves for continuous operation can be found below:

Curve A1 Recommended output current.

Curve A2 Max allowed output current (results in approximately half the lifetime expectancy of A1).

Fig. 23-10
Mounting Orientation A
(Standard orientation)

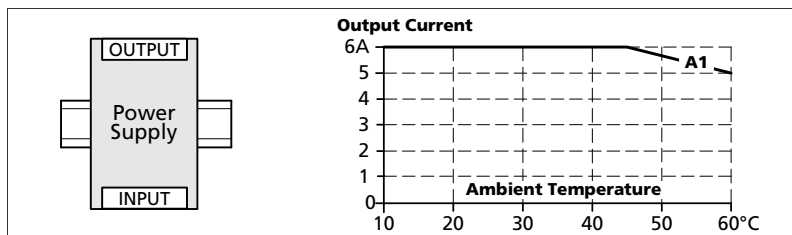


Fig. 23-11
Mounting Orientation B
(Upside down)

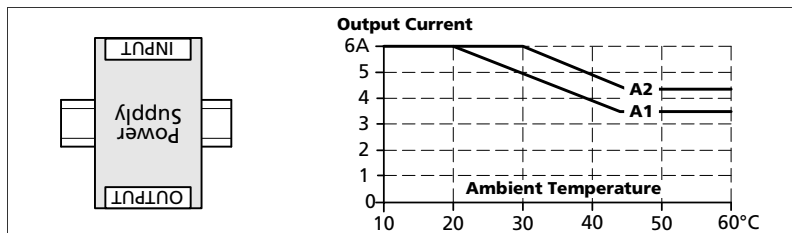


Fig. 23-12
Mounting Orientation C
(Table-top mounting)

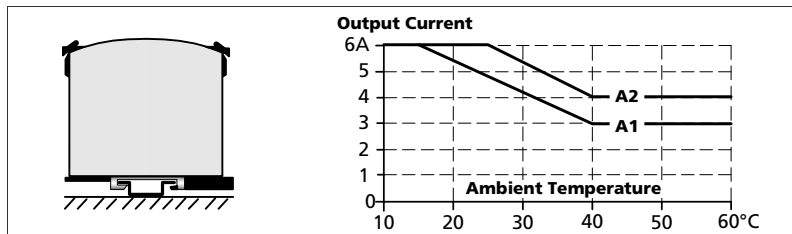


Fig. 23-13
Mounting Orientation D
(Horizontal cw)

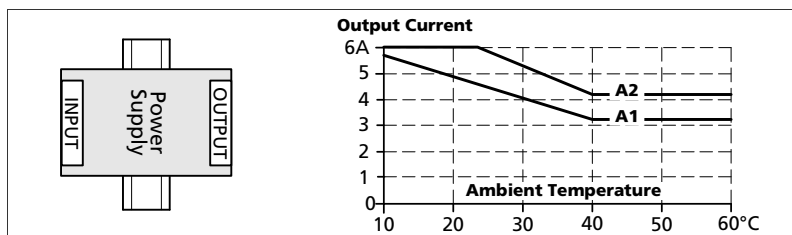


Fig. 23-14
Mounting Orientation E
(Horizontal ccw)

