

REDUNDANCY MODULE

- Cost Effective Solution to Build Redundant Systems
- Dual Input with Single Output
- Two Diodes (Common Cathode)
- DC12-48V (120Vdc) $\pm 25\%$ Wide-range Input
- Full Power Between -40°C and $+60^{\circ}\text{C}$
- Compact Design, Width only 45mm
- Quick-connect Spring-clamp Terminals
- Easy Wiring:
Distribution Terminal for Negative Pole Included
- 3 Year Warranty

GENERAL DESCRIPTION

The MLY02.100 is a simple is a redundancy module, which can be used to build 1+1 and N+1 redundant systems. It is equipped with two input channels, which can be connected to power supplies with up to 5A output current and one output, which can carry nominal currents up to 10A. The module is suitable for power supplies with constant current overload behavior as well as any kind of "Hiccup" overload behavior.

Unique quick-connect spring-clamp terminals allow a safe and fast installation and a large international approval package for a variety of applications makes this unit suitable for nearly every situation.

SHORT-FORM DATA

| | | |
|------------------------------|--|--|
| Input voltage | DC 12-48V $\pm 25\%$ DC 12-120V $\pm 25\%$ | w/o restrictions with restrictions |
| Input voltage range | 9-60Vdc 9-150Vdc | w/o restrictions with restrictions |
| Input current | 2x 0-5A 2x 0-8A | continuous for 5 seconds |
| Output current | 0-10A 10-16A <16A | continuous for 5 seconds at cont. overload/ short circuit |
| Input to output voltage drop | typ. 0.8V typ. 0.9V typ. 0.9V | input: 2x2.5A input: 1x5A input: 2x5A |
| Power losses | typ. 0W typ. 4.0W typ. 4.5W typ. 9.0W | at no load input: 2x2.5A input: 1x5A input: 2x5A |
| Temperature range | -40°C to $+70^{\circ}\text{C}$ | operational, |
| Derating | 0.25A/ $^{\circ}\text{C}$ | $+60$ to $+70^{\circ}\text{C}$ |
| Dimensions | 45x75x91mm | WxHxD |

ORDER NUMBERS

| | | |
|-------------------|------------------|--------------------------------|
| Redundancy Module | MLY02.100 | 12-48V (120V) Standard unit |
| Accessory | -- | |

MARKINGS





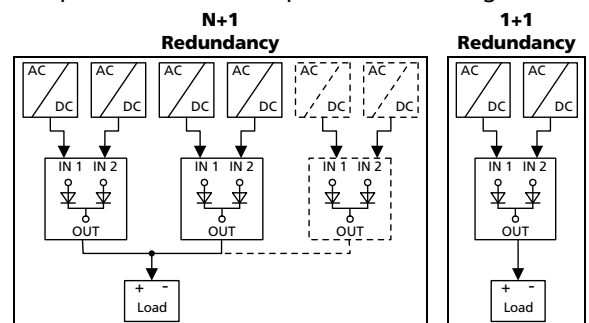
INDEX

| Page | Page |
|--|--|
| 1. Intended Use3 | 13. Approvals..... 12 |
| 2. Installation Requirements.....3 | 14. Physical Dimensions and Weight 13 |
| 3. Input and Output Characteristics4 | 15. Accessories 13 |
| 4. Power Losses.....5 | 16. Application Notes..... 14 |
| 5. Lifetime Expectancy and MTBF.....6 | 16.1. Recommendations for Redundancy..... 14 |
| 6. Terminals and Wiring.....7 | 16.2. Inductive and Capacitive Loads..... 14 |
| 7. Functional Diagram.....8 | 16.3. Example: 1+1 Redundancy 14 |
| 8. Front Side and User Elements.....8 | 16.4. Example: N+1 Redundancy..... 15 |
| 9. EMC.....9 | 16.5. Example: Battery Back-up 15 |
| 10. Environment..... 10 | 16.6. Mounting Orientations 16 |
| 11. Protection Features 11 | |
| 12. Safety Features 11 | |

The information presented in this document is believed to be accurate and reliable and may change without notice. No part of this document may be reproduced or utilized in any form without permission in writing from the publisher.

TERMINOLOGY AND ABBREVIATIONS

| | |
|--|---|
| PE and  symbol | PE is the abbreviation for Protective Earth and has the same meaning as the symbol  . |
| 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. |
| DC 24V | 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) |
| 24Vdc | A figure with the unit (Vdc) at the end is a momentary figure without any additional tolerances included. |
| may | A key word indicating flexibility of choice with no implied preference |
| shall | A key word indicating a mandatory requirement |
| should | A key word indicating flexibility of choice with a strongly preferred implementation |
| 1+1 Redundancy | Use of two identical power supplies in parallel to provide continued operation following most failures in a single power supply. The two power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements. E.g. two 2.5A power supplies are needed to achieve a 2.5A redundant system. |
| N+1 Redundancy | Use of three or more identical power supplies in parallel to provide continued operation following most failures in a single power supply. All power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements. E.g.: To achieve a 10A redundant system, five 2.5A power supplies are needed in a N+1 redundant system. |



1. INTENDED USE

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

This redundancy module can be used with any type of power supply as long as the maximum ratings are not exceeded. It is suitable for power supplies with constant current overload behavior as well as any kind of "Hiccup" overload behavior.

Do not use this redundancy module in equipment, where malfunction may cause severe personal injury or threaten human life.

This device is designed for use in hazardous, non-hazardous, ordinary or unclassified locations.

2. INSTALLATION REQUIREMENTS

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

This device does not contain serviceable parts.

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 input terminals are located on the top and the output terminals on the bottom of the unit. For other mounting orientations see de-rating requirements of chapter 16.6. 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 the 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 output current. Increase the side 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.

- 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 open, modify or repair the unit.
- Use caution to prevent any foreign objects from entering 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 surfaces may cause burns.

Notes for use in hazardous location areas:

The redundancy module is suitable for use in Class I Division 2 Groups A, B, C, D locations and for use in Group II Category 3 (Zone 2) environments and is evaluated according to EN 60079-0:2009 and EN 60079-15:2010.

WARNING EXPLOSION HAZARDS!

Substitution of components may impair suitability for this environment. Do not disconnect the unit unless power has been switched off or the area is known to be non-hazardous.

A suitable enclosure must be provided for the end product which has a minimum protection of IP54 and fulfils the requirements of the EN 60079-15:2010.

3. INPUT AND OUTPUT CHARACTERISTICS

| | | | |
|---------------------------------------|------|-----------------------|--|
| Number of inputs | - | 2 | |
| Number of outputs | - | 1 | |
| Input voltage | nom. | DC 12-48V $\pm 25\%$ | The input circuitry must meet the SELV requirements stipulated by IEC/EN/UL 60950-1. |
| Input voltage range | - | 9-60Vdc | |
| Input voltage with restrictions | nom. | DC 12-120V $\pm 25\%$ | See note 3 on bottom of the table |
| Input voltage range with restrictions | - | 9-150Vdc | Restrictions apply, see note 3 on bottom of the table. |
| Voltage drop, input to output | typ. | 0.8V | at 2x2.5A, see Fig. 3-2 |
| | typ. | 0.9V | at 1x5A, see Fig. 3-3 |
| | typ. | 0.9V | at 2x5A, see Fig. 3-2 |
| Input current | nom. | 2x 0-5A | continuous |
| | nom. | 1x 0-10A | continuous, see note 1 |
| | nom. | 2x 5-8A | for 5 seconds |
| Peak input current | max. | 125A | for maximal 10ms per input |
| Output current | nom. | 10A | continuous |
| | nom. | 10-16A | for 5 seconds |
| | max. | 16A | at continuous overload or short circuit, see note 2 |
| Reverse current | max. | 0.6mA | per input, -40°C to +60°C |
| Reverse voltage | max. | 200Vdc | voltage applied to the output, continuously allowed |

- Note 1: Each input can be loaded up to 10A. At currents above 10A, the other input should not be loaded. It is preferable to parallel the two inputs in order to minimize the power loss in such cases.
- Note 2: Ensure that the continuous output current does not exceed 16A. Check the short-circuit current of the power sources and if the power source can deliver more than 16A together, use an appropriate fuse on the output.
- Note 3: The redundancy module can be used with input voltages up to 150Vdc with the constraint, that it can be used only as a single input module at voltages above 60Vdc. Both inputs need to be connected together as shown in Fig. 3-1. Ensure proper means to protect against touching this voltage.

Fig. 3-1 Restrictions for utilizing voltages between 60 and 150Vdc (See also Note 3)

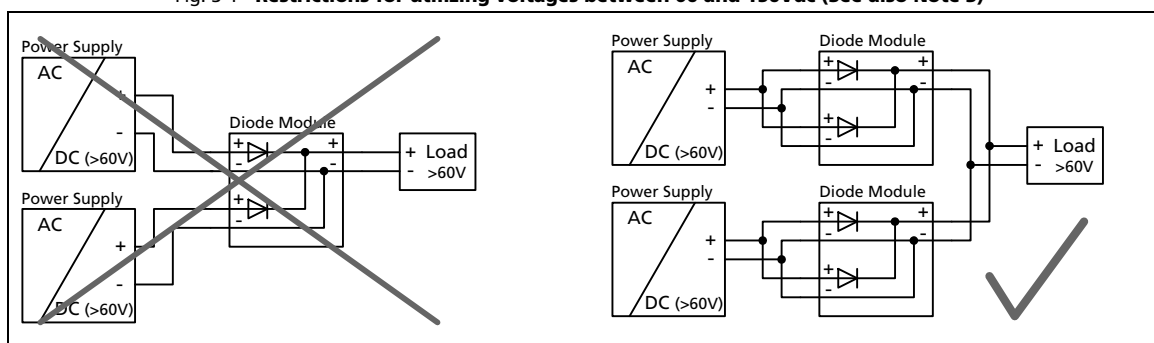


Fig. 3-2 **Input to output voltage drop when both inputs draw current**
(typical 1+1 redundant case, when the output voltages of the two units are equal or set into "parallel use" mode)

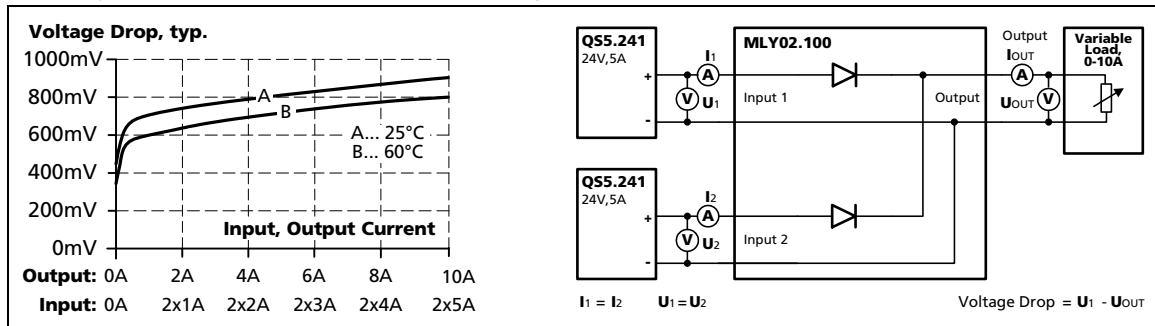
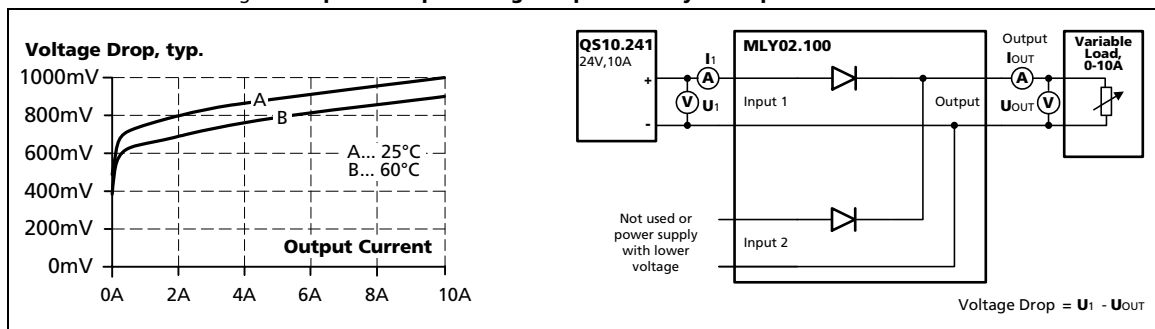


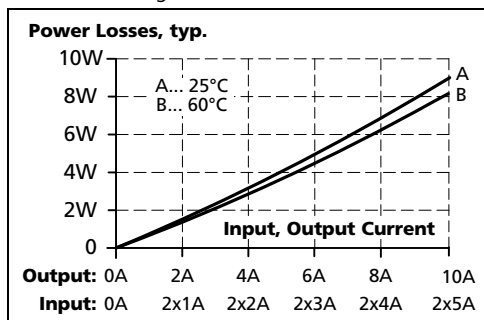
Fig. 3-3 **Input to output voltage drop when only one input draws current**



4. POWER LOSSES

| DC 24V | | | |
|----------------------|------|------|----------------------|
| Power losses | typ. | 4.0W | input: 2x2.5A |
| | typ. | 4.5W | input: 1x5A |
| | typ. | 9.0W | input: 2x5A |
| Standby power losses | typ. | 0W | at no output current |

Fig. 4-1 **Power losses**



5. LIFETIME EXPECTANCY AND MTBF

The redundancy module has two input channels which are completely independent from each other. Each control circuit, auxiliary voltage source, or other circuitry in the module are designed separately for each input. The dual input redundancy module can be considered as two single redundancy modules combined together in one housing. The only common point is the circuit trace that ties the two separate circuits together at the output.

The MTBF figures below are for the entire dual input module. If the MTBF number of only one path is needed, simply double the value from the table.

The redundancy module does not have electrolytic capacitors included. Therefore, the lifetime expectancy is extremely high.

| Input / output current conditions | | Input: 2x5A Output: 10A | |
|-----------------------------------|------|----------------------------|--------------------------------------|
| Lifetime expectancy *) | min. | 25 years | at 24V and 40°C |
| | min. | 25 years | at 24V and 25°C |
| MTBF **) SN 29500, IEC 61709 | | 84 868 000h | at 24V 40°C |
| | | 125 266 000h | at 24V 25°C |
| MTBF **) MIL HDBK 217F | | 71 454 000h | at 24V and 40°C (Ground Benign GB40) |
| | | 81 453 000h | at 24V and 25°C (Ground Benign GB25) |

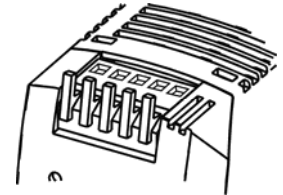
*) The **Lifetime expectancy** shown in the table indicates the minimum operating hours (service life).

) **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. The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

6. TERMINALS AND WIRING

Input and output

| | |
|-----------------------|---|
| Type | Bi-stable, quick-connect spring clamp terminals. IP20 Finger safe construction. Suitable for field- and factory installation. |
| Solid wire | 0.3-4mm ² |
| Stranded wire | 0.3-2.5mm ² |
| American Wire Gauge | 26-12 AWG |
| Max. wire diameter | 2.8mm (including ferrule) |
| Wire stripping length | 6mm / 0.25inch |
| Pull-out force | 10AWG:80N, 12AWG:60N, 14AWG:50N, 16AWG:40N (according to UL486E) |

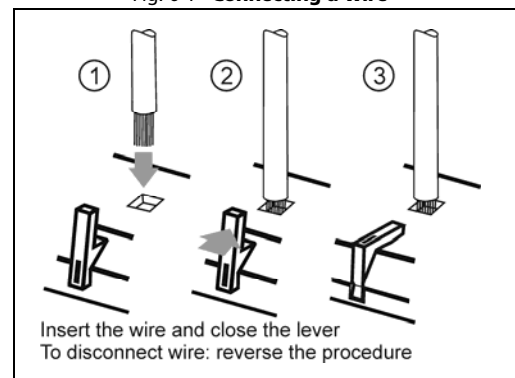


Terminals shipped in open position.

Instructions:

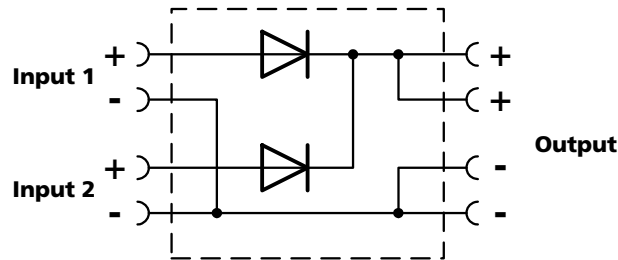
- Use appropriate copper cables that are designed for minimum operating temperatures of:
60°C for ambient up to 45°C and
75°C for ambient up to 60°C and
90°C for ambient up to 70°C minimum.
- Follow national installation codes and installation regulations!
- Ensure that all strands of a stranded wire enter the terminal connection!
- Ferrules are allowed, but not required.
- Do not connect or disconnect the wires from the terminals below -25°C (-13°F).

Fig. 6-1 Connecting a wire



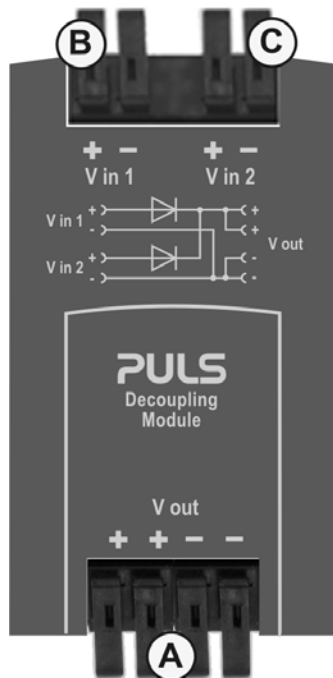
7. FUNCTIONAL DIAGRAM

Fig. 7-1 Functional diagram



8. FRONT SIDE AND USER ELEMENTS

Fig. 8-1 Front side



- A** Output terminals
- B** Input terminals for input 1
- C** Input terminals for input 2

9. EMC

The redundancy module is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions. A detailed EMC report is available on request.

| EMC Immunity | | According generic standards: EN 61000-6-1 and EN 61000-6-2 | | |
|-----------------------------------|--------------|--|-------|-------------|
| Electrostatic discharge | EN 61000-4-2 | Contact discharge | 8kV | Criterion A |
| | | Air discharge | 15kV | 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 | 2kV | Criterion A |
| | | Output lines | 2kV | Criterion A |
| Surge voltage on input lines | EN 61000-4-5 | + / - → DIN-Rail | 1kV | Criterion A |
| Surge voltage on output line | EN 61000-4-5 | + / - → DIN-Rail | 1kV | Criterion A |
| Conducted disturbance | EN 61000-4-6 | 0.15-80MHz | 10V | Criterion A |
| Power-frequency magnetic field *) | EN 61000-4-8 | 50Hz | 30A/m | Criterion A |

Criteria:

A: Redundancy module shows normal operation behavior within the defined limits.

Notes:

*) A test is not applicable according to EN 61000-6-2, since the device does not contain components susceptible to magnetic fields, e.g. hall elements, electrodynamic microphones, etc.

| EMC Emission | | According generic standards: EN 61000-6-3 and EN 61000-6-4 | |
|---------------------|------------------------------------|--|--|
| Conducted emission | IEC/CISPR 16-1-2, IEC/CISPR 16-2-1 | Class B, input lines *) | |
| | IEC/CISPR 16-1-2, IEC/CISPR 16-2-1 | Class B, output lines *) | |
| Radiated emission | EN 55011, EN 55022 | Class B | |

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.

*) Provided, that power sources connected on the inputs fulfill the class B requirements too.

10. ENVIRONMENT

| | | |
|----------------------------|--|---|
| Operational temperature *) | -40°C to +70°C (-40°F to 158°F) | Reduce output power above +60°C |
| Output de-rating | 0.25A/°C | 60-70°C (140°F to 158°F), see |
| Storage temperature | -40 to +85°C (-40°F to 185°F) | for storage and transportation |
| 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 ***) | 15g 6ms, 10g 11ms 3 bumps / direction 18 bumps in total | IEC 60068-2-27 |
| Altitude | 0 to 2000m (0 to 6 560ft) 2000 to 6000m (6 560 to 20 000ft) | without any restrictions reduce output power or ambient temperature, see Fig. 10-2 |
| Altitude de-rating | 0.7A/1000m or 5°C/1000m | > 2000m (6500ft), see Fig. 10-2 |
| Over-voltage category | not applicable | The concept of the overvoltage category is used for equipment energized directly from the low voltage mains (IEC 60664-1 §4.3.3.2.1). |
| Degree of pollution | 2 | IEC 62103, EN 50178, not conductive |
| LABS compatibility | The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops. | |

*) 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

***) Tested in combination with DIN-Rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard mounting orientation.

Fig. 10-1 Output current vs. ambient temp.

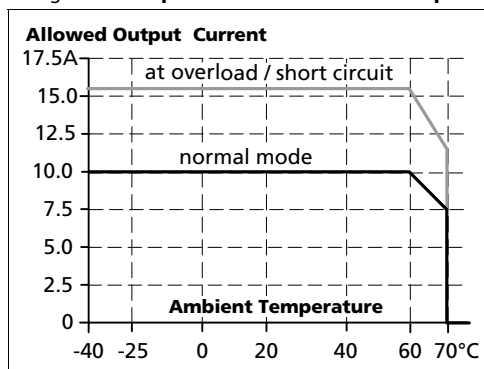
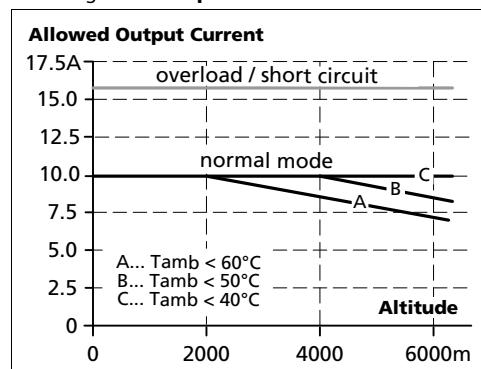


Fig. 10-2 Output current vs. altitude














11. PROTECTION FEATURES

| | | |
|-----------------------------------|--------------|--|
| Output over-current protection | not included | |
| Reverse input polarity protection | included | unit does not start when input voltage is reversed |
| Degree of protection | IP 20 | EN/IEC 60529 |
| Penetration protection | > 2.5mm | e.g. screws, small parts |
| Over-temperature protection | not included | |
| Input transient protection | not included | |
| Output transient protection | not included | |
| Internal input fuse | not included | |

12. SAFETY FEATURES

| | | |
|--------------------------------|--|---|
| Input / output separation | no galvanic separation | 200V epitaxial diode between input and output |
| Safety level of output voltage | The output voltage is regarded to be SELV (EN 60950-1) or PELV (EN 60204-1, EN 50178, IEC 60364-4-41) if the input voltage fulfills the requirements for a SELV source or PELV source. | |
| Class of protection | III | plastic housing, PE connection not required |

13. APPROVALS

| | | |
|--|--|---|
| EC Declaration of Conformity |  | The CE mark indicates conformance with the - EMC directive 2004/108/EC, - Low-voltage directive (LVD) 2006/95/EC and - RoHS directive 2011/65/EU. |
| EC Declaration of Conformity ATEX |  | The CE mark indicates conformance with the - ATEX directive 94/9/EC (Equipment and protection systems intended for use in potentially explosive atmospheres) |
| 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 |
| UL 60950-1 |  | Recognized for use as Information Technology Equipment, Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950); E-File: E137006 |
| CSA 22.2 No107.1-01 |  | CSA approval for Canada CAN/CSA C22.2 No 107-1; CAN/ CSA 60950-1-03; UL60950-1 |
| HazLoc (Class 1 Div 2) ANSI / ISA 12.12.01-2007 |  | LISTED for use in Hazardous Location Class I Div 2 T4 Groups A,B,C,D systems; U.S.A. (ANSI / ISA 12.12.01-2007) and Canada (C22.2 No. 213-M1987) |
| ATEX EN 60079-0, EN 60079-15 |  II 3G Ex nA IIC T4 Gc | Suitable for use in Category 3 Zone 2 locations. Number of ATEX certificate: EPS 11 ATEX 1 312 X The redundancy module must be built-in in an IP54 enclosure. |
| IECEX IEC 60079-0, IEC 60079-15 |  Ex nA IIC T4 Gc | Suitable for use in Category 3 Zone 2 locations. Number of IECEX certificate: IECEX EPS 12.0032X |
| Marine |  | GL (Germanischer Lloyd) classified and ABS (American Bureau for Shipping) PDA, Environmental category: C, EMC2, Marine and offshore applications |
| GOST R |  | Certificate of Conformity for Russia and other GUS countries |

14. PHYSICAL DIMENSIONS AND WEIGHT

| | |
|-------------------------|---|
| Weight | 140g / 0.31lb |
| 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 (91mm) to calculate the total required installation depth. |
| Installation clearances | See chapter 2 |

Fig. 14-1 Front view

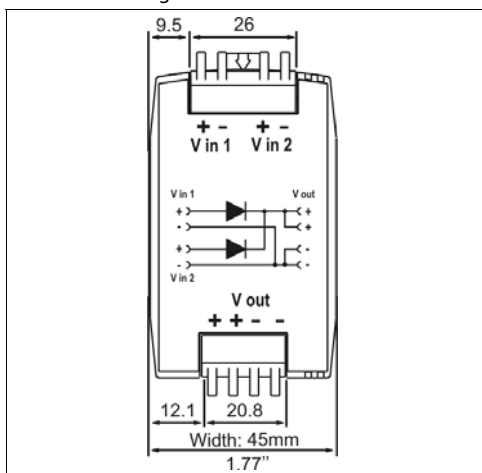
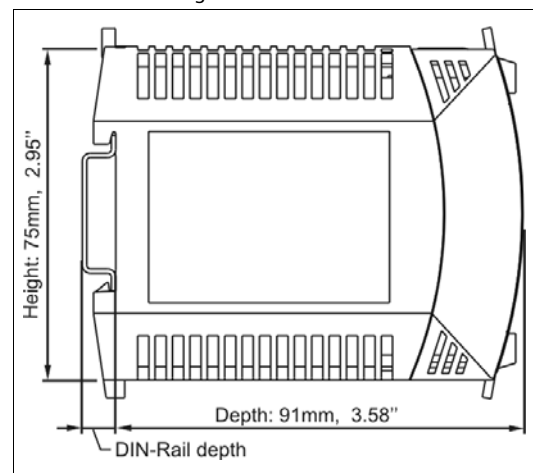


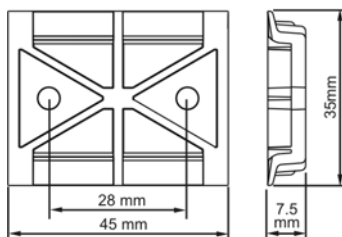
Fig. 14-2 Side view



15. ACCESSORIES

DIN-Rail bracket for wall or panel mount:

A suitable DIN-rail bracket is available on request.



The picture of the power supply is for representation only

16. APPLICATION NOTES

16.1. RECOMMENDATIONS FOR REDUNDANCY

Recommendations for the configuration of redundant power systems:

- Use separate input fuses for each power supply.
- Use three-phase power supplies to gain functional safety if one phase fails.
- When single-phase power supplies are utilized connect them to different phases or mains circuits if possible.
- Set the power supply in "Parallel-Use" mode if this feature is available
- It is desirable to set the output voltages of all power supplies to the same value.

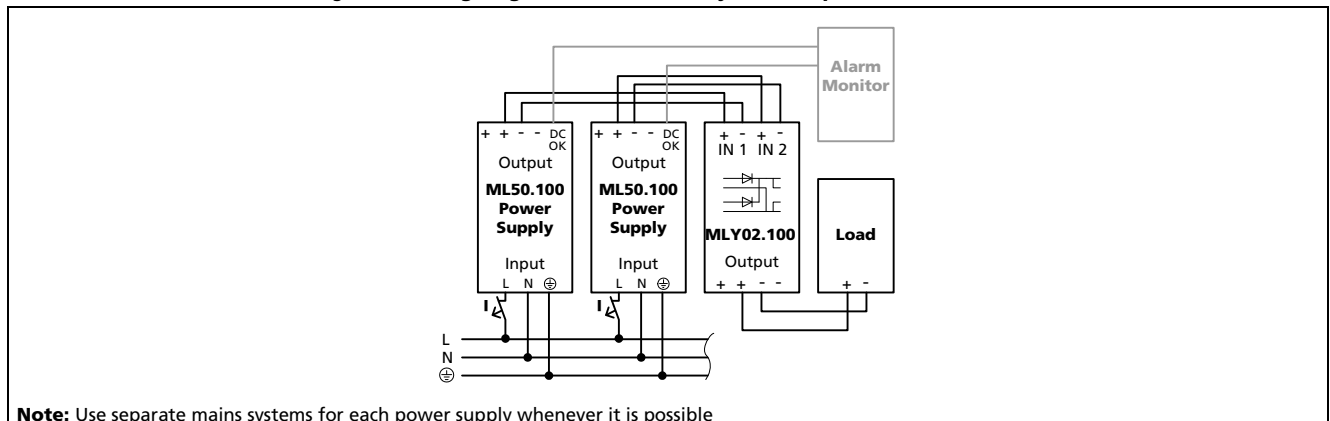
16.2. INDUCTIVE AND CAPACITIVE LOADS

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

16.3. EXAMPLE: 1+1 REDUNDANCY

1+1 Redundancy up to 2.1A requires two ML50.100 power supplies (each 2.1A output current) and one MLY02.100 redundancy module.

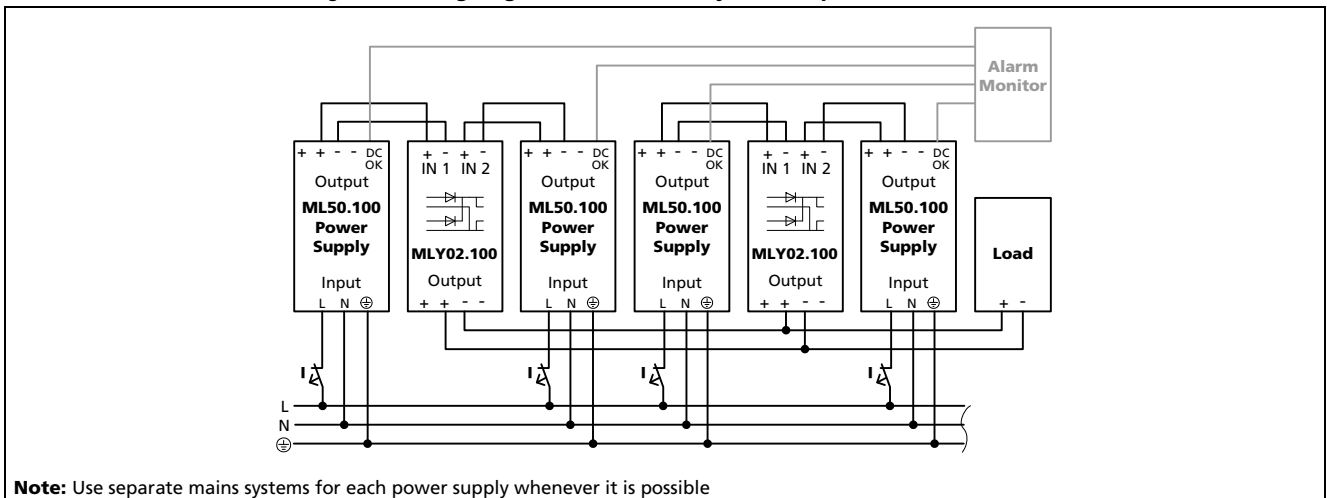
Fig. 16-1 **Wiring diagram, 1+1 Redundancy, 2.1A output current**



16.4. EXAMPLE: N+1 REDUNDANCY

N+1 Redundancy up to 6.3A requires four ML50.100 power supplies (each 2.1A output current) and two MLY02.100 redundancy modules.

Fig. 16-2 **Wiring diagram, N+1 Redundancy, 6.3A output current**



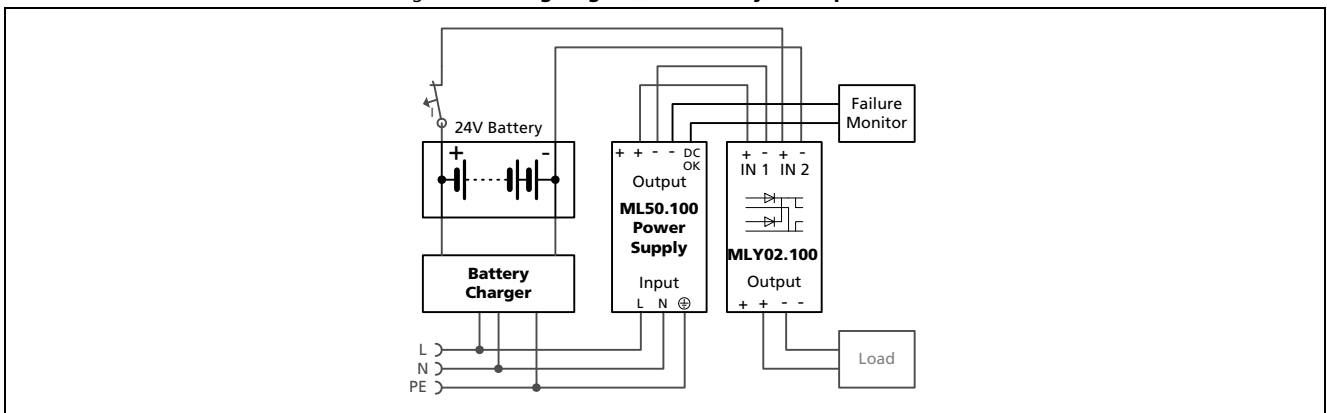
16.5. EXAMPLE: BATTERY BACK-UP

A battery back-up requires one power supply and one MLY02.100 redundancy module.

Please note:

Set output voltage of power supply to 26.5Vdc minimum to ensure, that the load current is delivered from the power supply and not from charger (battery). Use a fuse between battery and MLY02.100!

Fig. 16-3 **Wiring diagram, 10A Battery back-up**



16.6. 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 maximum allowed ambient temperature.

Fig. 16-4
Mounting Orientation A
(Standard orientation)

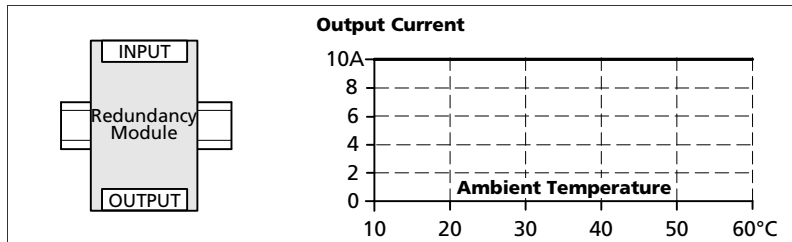


Fig. 16-5
Mounting Orientation B
(Upside down)

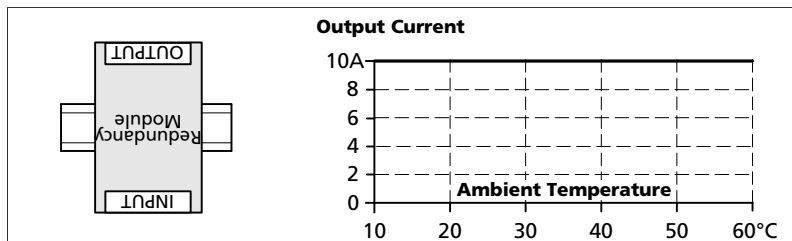


Fig. 16-6
Mounting Orientation C
(Table-top mounting)

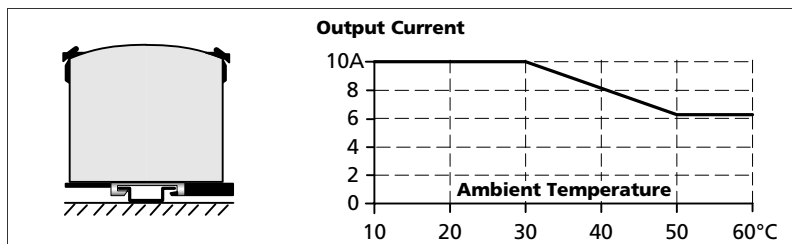


Fig. 16-7
Mounting Orientation D
(Horizontal cw)

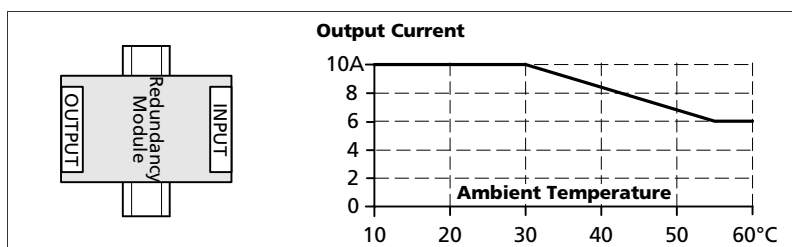


Fig. 16-8
Mounting Orientation E
(Horizontal ccw)

