

# Secure 24 V DC even when a power supply unit fails

## Redundant power supply configuration for different power classes

Machines and plants in which critical states may occur when the 24 V DC supply is missing should be supplied by redundant switched power supply units, because even when power supply units - such as SITOP - are extremely reliable, a fault can never be ruled out completely. But why not simply switch the power supplies in parallel, and what does the solution with redundancy modules look like?

### Parallel switching is not sufficient

When a power supply unit fails, a unit switched in parallel directly at the 24 V DC output could take over the supply. However, the power supply unit fault could be on its secondary side and cause a short circuit on the 24 V side, for example due to a short circuit in the output capacitor. In this case, the intact power supply would also feed into the short-circuited electrical circuit and interrupt its own - and thus the entire - 24 V supply.

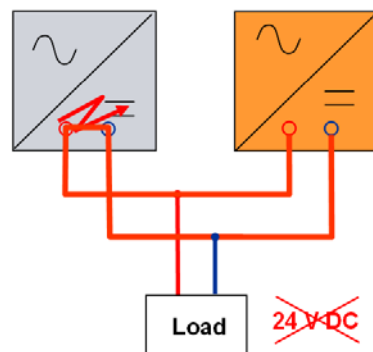


Figure 1:  
Parallel switching of power supplies without decoupling: the 24 V supply may fail in the event of a fault

### Why are power supply units decoupled for redundancy?

With the use of diodes for decoupling, the intact power supply unit is not affected by a short circuit of the faulty device and the continued supply of the loads is guaranteed. There are some power supply units with decoupling diodes already integrated in the output circuit. However, because the diode conductive-state voltage drops - proportional to the power - and there is a performance loss, the efficiency of the power supply unit is reduced.

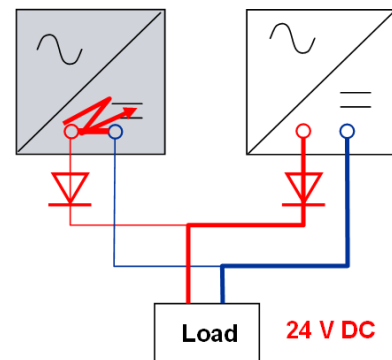


Figure 2:  
Parallel switching of power supplies with decoupling: the 24 volt supply is retained, even in the event of a short circuit in a power supply unit

# SITOP power supply

The performance loss due to integrated diodes is unnecessary for applications which do not require a redundant power supply configuration. This is another reason to recommend the use of redundancy modules in critical applications. SITOP redundancy modules also work with decoupling diodes. A signaling contact can be evaluated by the controller in order to inform the user of a power supply unit failure. The changeover contact is activated when one of the two power supplies fails. An LED changes from green to red for error detection on location. The switching threshold of this message (Infeed 1 and 2 o.k.) can be set from 20 to 25 V. This means that an output voltage drop of one of the two power supply units to or below the set value is signaled.

### Configuration of redundancy modules is based on power requirements

The SITOP PSE202U redundancy modules are available in the variants 24 V / 10 A and 24 V / 40 A, as well as the special variant 24 V / NEC class2 with output power limited to 100 VA (see page 3). The current value indicates the maximum aggregate current. This means that a 24 V / 10 A redundancy module is switched downstream from a power supply unit with up to 10 A or switches two power supplies with up to 5 A rated output current redundant. The configuration changes accordingly (figures 3 and 4).

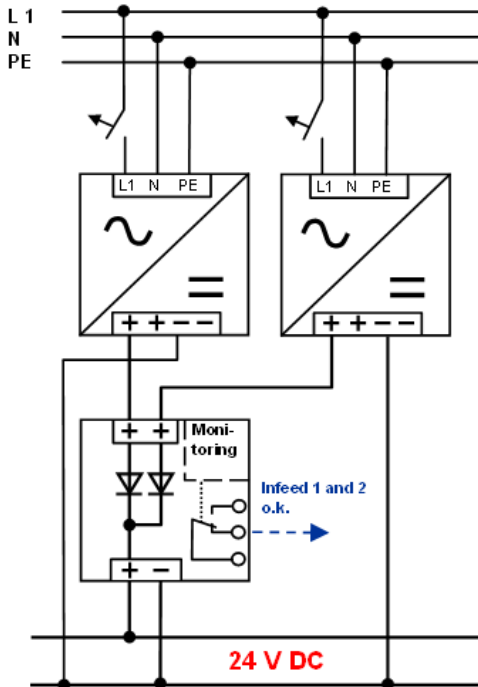


Figure 3: Configuration with one redundancy module for two power supplies: SITOP PSE202U 24 V / 10 A with two power supply units up to 5 A or 24 V / 40 A with two power supply units up to 20 A rated output current

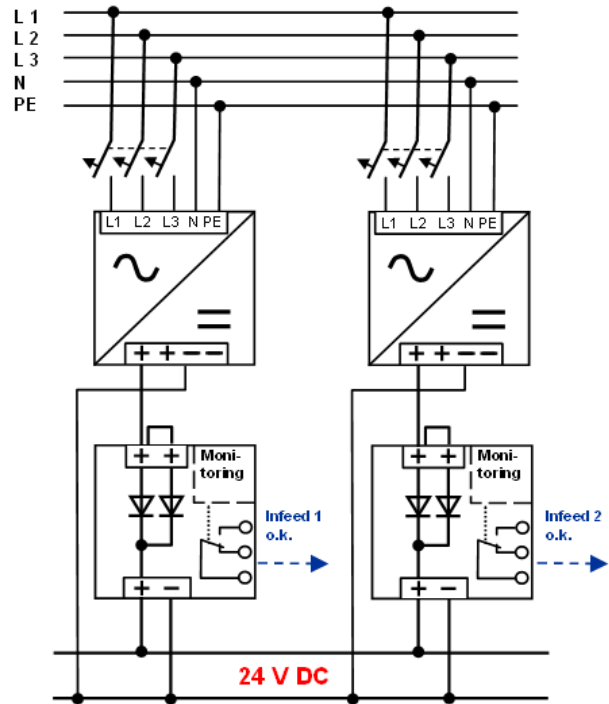


Figure 4: Configuration with one redundancy module for each power supply: SITOP PSE202U 24 V / 10 A with one power supply unit up to 10 A or PSE200U 24 V / 40 A with one power supply unit with a maximum of 40 A rated output current. Each of the two 24 V inputs on the redundancy modules is bridged

### 1 + 1 redundancy

In order to achieve 100% redundancy, so-called 1 + 1 redundancy, the load current must not exceed what can be supplied by one power supply alone. If one power supply fails, the entire load is supplied by the remaining second power supply.

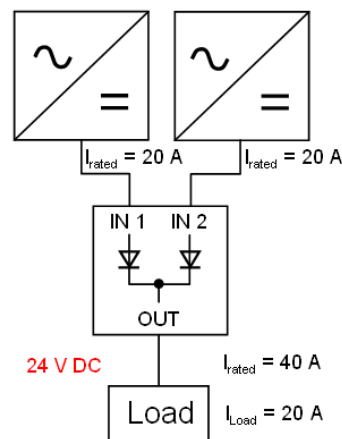


Figure 5: Configuration for 1 + 1 redundancy with two 24 V / 20 A power supplies of the same type for secure supply of a 20 A load

## Notes on redundant operation

Infeed via the primary side must also be redundant. This means that each power supply is supplied by a separate fuse/circuit breaker (fig. 3 and 4). A shared fuse would separate both power supplies from the mains immediately if a short circuit in a power supply unit occurred on the primary side.

When 1-phase power supply units are used, the infeed should take place via different phases when, for example, a three-phase network exists (fig. 6).

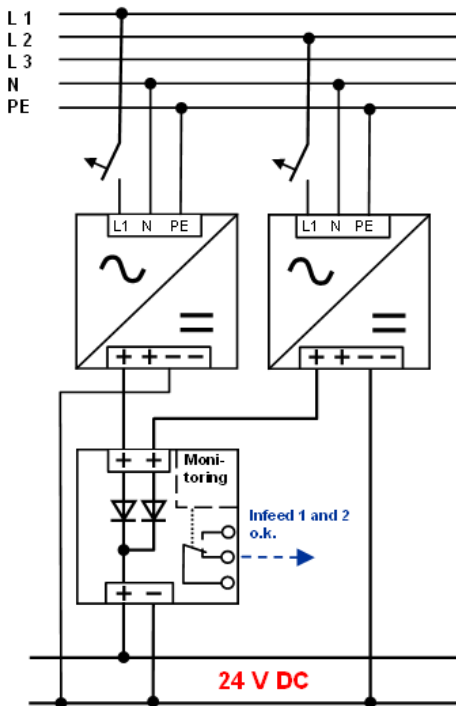


Figure 6:  
If a multi-phase network exists, single-phase power supplies should be supplied via different phases

Even load distribution should be aimed for in order to protect the power supply units. The following measures can help to achieve this:

- Using power supplies of the same type
- Same cable lengths and cross-sections (or the same impedance) between the power supplies and redundancy module
- Same settings for power supply output voltages. Difference between the power supplies must not exceed +/- 50 mV under no-load conditions before these are connected
- Simultaneous switch-on of the power supplies, e.g. using the main switch
- When the SITOP modular product range is used, the output characteristic can also be set to parallel operation. The "soft" characteristic ensures optimum load distribution

## N + 1 redundancy through performance increase

Using redundancy modules, power supplies can also be switched in parallel for a performance increase and redundancy is achieved at the same time (so-called N + 1 redundancy). If, for example, 60 A is required, four power supplies with 20 A rated output current can be switched in parallel using redundancy modules. In this way, three would remain active if one power supply failed and the required load current of 60 A would be ensured. 3 + 1 redundancy would exist in this specific case (three power supplies required, one power supply in reserve).

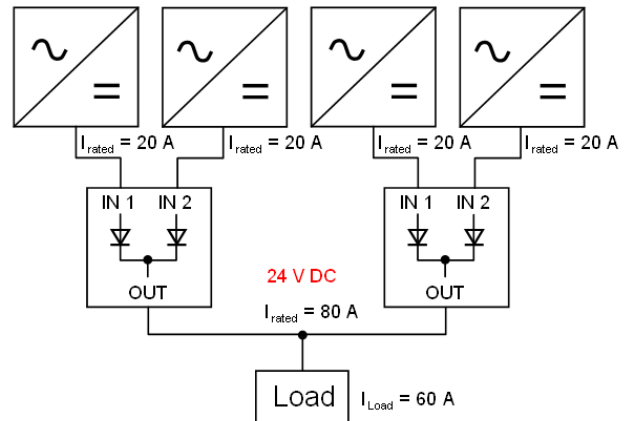


Figure 7:  
Possible configuration for N + 1 redundancy with four 24 V/20 A power supplies of the same type for secure supply of a 60 A load

## Redundant operation with power limitation to NEC class2

With SITOP PSE200U NEC class2 redundancy modules, two requirements can be met at the same time: firstly, the configuration of a redundant 24 V supply and, secondly, limitation of the output power to 100 VA, as required in the semiconductor and automotive industries, for example. The compact modules use the central 24 V supply (power supplies with certification according to UL60950-1 required) and distribute it across NEC class2 feeders.

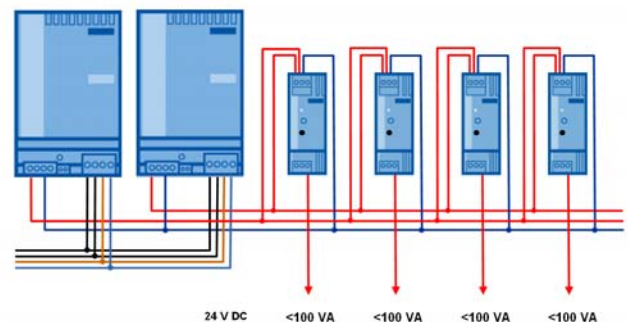


Figure 8:  
Redundant configuration with simultaneous power limitation of individual 24 V load circuits via compact SITOP PSE200U NEC class2 redundancy modules and two three-phase power supplies SITOP PSU300S 24 V/20 A

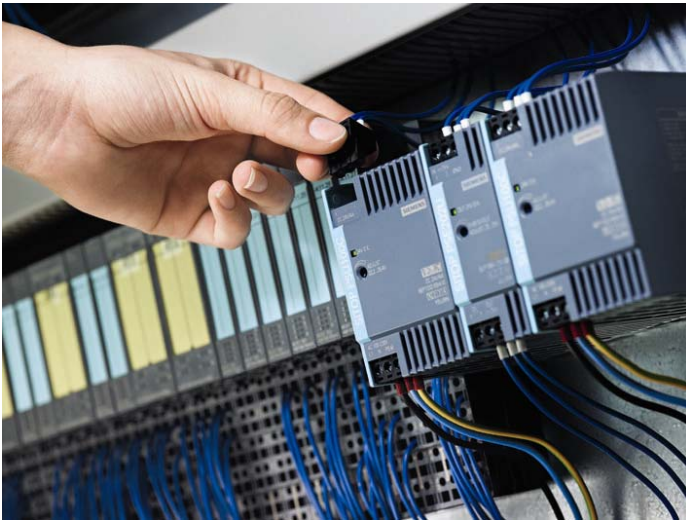




Figure 9:  
Compact solution for redundant operation with low outputs: two SITOP PSU100C 24 V/ 4 A (SITOP compact) power supplies and one SITOP PSE202U 24 V/ 10 A redundancy module

Technical data redundancy module SITOP PSE202U			
	24 V DC/ 10 A	24 V DC/ 40 A	24 V DC/ NEC class2
Order number	6EP1964-2BA00	6EP1961-3BA21	6EP1962-2BA00
Brief description of function	Decoupling of two 5 A power supplies or one 10 A power supply per redundancy module.	Decoupling of two 24 V/5 A to 20 A power supplies or one 24 V/40 A power supply per redundancy module.	Decoupling and limitation of the output to class 2 limit (100 V A) of 2 power supplies 5 to 40 A.
Input voltage – rated value	24 V DC	24 V DC	24 V DC
– range	19...29 V DC	24...28.8 V DC	19...29 V DC
Output voltage	U <sub>i</sub> - 0.5 V	U <sub>i</sub> - 0.5 V	U <sub>i</sub> - 0.5 V
Rated output current	10 A (maximum summation current)	40 A (maximum summation current)	3.5 A (max. 8 A summation current in fault case in accordance with NEC class 2)
Operation indicator	LED (green/ red) for „Input 1 and 2 o.k.“		LED (green/ red) for „Input 1 and 2 and output o.k.“
Signaling	Floating relais contacts (change-over contact) for „Infeed 1 and 2 o.k.“		Floating relais contacts (change-over contact) for „Infeed 1 and 2 o.k. and output o.k.“
Contact rating	6 A/ 42 V AC, 30 V DC	8 A/ 240 V AC, 24 V DC	6 A/ 42 V AC, 30 V DC
Settings	Switching threshold for "Infeed 1 and 2 o.k. adjustable between 20 to 25 V DC (+/- 0.5 V)		
Efficiency at rated values, approx.	97%	97%	95%
Degree of protection (EN 60529)	IP20	IP20	IP20
Ambient temperature range	-20...+70 °C	0...+60 °C	-20...+70 °C
Dimensions (W x H x D) in mm	30 x 80 x 100	70 x 125 x 125	30 x 80 x 100
Weight ca.	0.125 kg	0.5 kg	0.125 kg
Connections – +24 V and 0 V	0.5 ... 2.5 mm <sup>2</sup>	0.33 ... 10 mm <sup>2</sup>	0.5 ... 2.5 mm <sup>2</sup>
– Relais contact	0.5 ... 2.5 mm <sup>2</sup>	0.5 ... 2.5 mm <sup>2</sup>	0.5 ... 2.5 mm <sup>2</sup>
Certification	CE, cULus	CE, cULus, cCSAus class I Div 2, ATEX, GL, ABS	CE, cULus, NEC class 2