

YR80.241

Mosfet Redundancy Module With a Voltage Drop of Only 50mV

Author: Michael Raspotnig

The break down of the 24V DC supply voltage can often mean significant safety risks or economical losses. The reliable and uninterrupted supply of all 24V loads is becoming increasingly important, especially as systems are becoming more intelligent with processes that are very sophisticated and efficient. This applies not only to industrial systems, but also to many other areas.

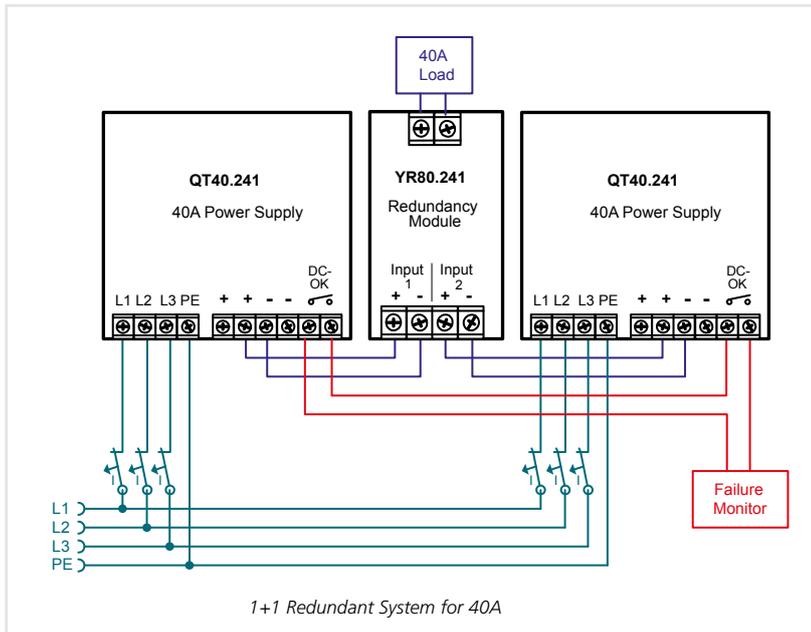
In telecom applications, process industry and power plant stations, redundant power supply systems are common practice now a days. In areas such as traffic control systems, tunnel monitoring and access control systems, redundancy is becoming more and more popular and important. PULS has developed two new redundancy modules in the higher power range for such applications. Together with standard 24V power supplies, redundant systems for high power applications can be built.

Thanks to the low-loss MOSFET technology, for the first time just one redundancy module is now required to build a 40A redundant system. It will be no longer necessary to have two separate modules for each power supply in this power range.



In the simplest scenario, redundancy means that two power supplies are connected in parallel and each is capable of handling the load by itself. This scheme is known as 1+1 redundancy.

For higher output currents, N+1 redundant systems are used. In the example of a 120A load current, four 40A devices are operated in redundant mode. If one device fails, the remaining three power supplies can continue to safely supply the 120A system with power.

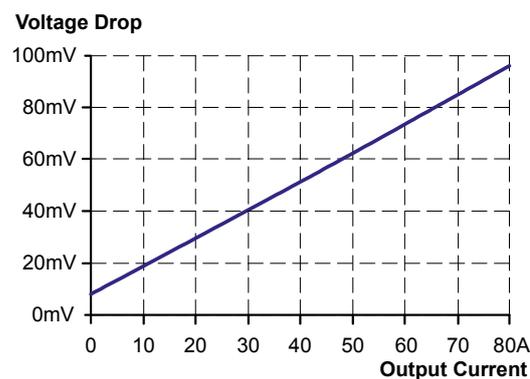


first time. At first glance, this doesn't appear to represent any significant breakthrough as "synchronous rectifiers" like this have been commonly used in practice for output stages of power supplies. With external redundancy modules, additional operating scenarios such as short-circuits, reversed polarity or back-feeding loads need to be considered too which is not at all simple to resolve. In the case of a short-circuit on the load or cabling, the power supply voltage fails and there is virtually no more useable voltage available on the redundancy module. However, the MOSFETs in the redundancy module must remain supplied to be able to allow the short-circuit current to flow with low power losses. If the supply to the MOSFETs fails, the total

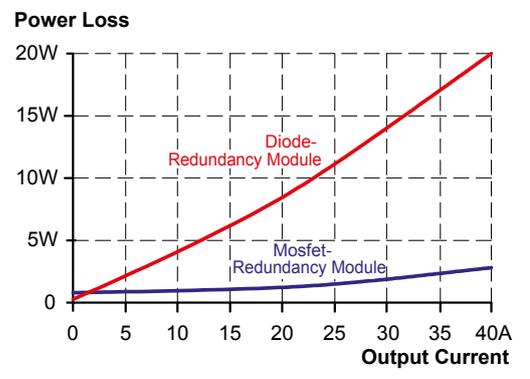
In basic terms, redundant power supply systems are individual power supply units connected in parallel. As standard power supplies do not normally have decoupling diodes on the output, these devices must be connected together with the use of redundancy modules. This means that the system also remains redundant even if a short-circuit or a defect occurs in a power supply output stage. Redundant systems require the functioning of each individual power supply to be monitored. This enables early fault detection and the initiation of maintenance routines. The DC-OK signal of the power supplies can be used for this purpose.

"Decoupling diode" with a voltage drop of only 50mV

Epitaxial or Schottky diodes in standard redundancy modules cause voltage drops of 500 to 800mV between the input and output. Depending on the load current, the power losses can be very high and may result in heat problems. In the new YR40.241 (40A) and YR80.241 (80A) redundancy modules, traditional diodes have been replaced by MOSFETs for the



YR80.241:
Typical voltage drop between the input and output



YR80.241:
Power losses of diode and MOSFET redundancy modules



80A MOSFET redundancy module without heat sink

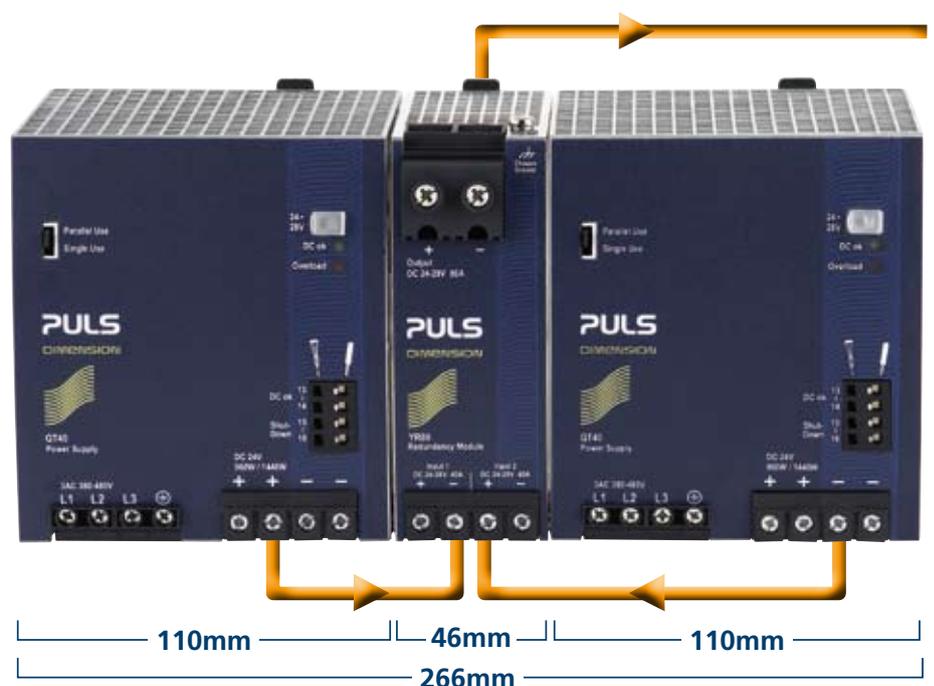
The YR80.241 redundancy module has two 40A inputs and one 80A output, and can be overloaded up to 160% for short periods. This allows 1+1 or N+1 redundant systems with power supplies up to 40A output current with only one redundancy module. Thanks to the low losses no heat sinks are required internally and the width of the unit can be kept as small as 46mm. The module is short-circuit proof, protected against reverse polarity and can be operated with full power between -40°C and +70°C. Even back-feeding loads such as braking motors are permitted up to a maximum voltage of 40Vdc. For global usage, a comprehensive international approval package is planned, including ATEX certification in addition to many other safety approvals. For smaller output currents, the YR40.241 redundancy module with a maximum output current of 40A and a width of just 36mm is available.

A strong team: QT40.241 and YR80.241

Until recently, a single 40A power supply required more space on the DIN-rail than a fully redundant system consisting of two 3-phase 40A power supplies (QT40.241) and one YR80.241 redundancy module. A width of 266mm is sufficient here. With 1-phase systems, QS40.241 power supplies can be used. This increases the total width to 296mm. The high partial load efficiency and the "Parallel Use" mode of these new 40A power supplies is especially advantageous. This mode ensures uniform power distribution of the load current to the individual power supplies which benefits the reliability and service life of the entire system. Integrated input fuses, active PFC, wide temperature range, large power and current reserves (60A for 4s) are just some of the many innovative new features in the new QT40 and QS40 power supplies. The integrated DC-OK signal monitors the power supply function and enables early fault detection and the initiation of maintenance routines.

current would otherwise flow through the MOSFET's "body diodes" and would cause around 15 times higher losses on the MOSFETs. To avoid this, a patented circuit is used to generate an adequate supply voltage from the minimal residual voltage. This is absolutely essential when the power supplies are turned on while a short-circuit exists or if the input voltage has been reverse-poled. The new circuit also allows such scenarios.

The benefits of the MOSFET redundancy module are clear. The low on-resistance of the MOSFETs causes a considerably lower voltage drop than when using diodes. At 40A output current, only 50mV difference is present between the input and output terminals with the YR80.241. With a traditional diode module at least a drop of 500mV will occur in that scenario. Accordingly, the losses in diodes are minimum 10x higher and require large heat sinks to be cooled. The MOSFET redundancy module YR80.241 produce only 2.7W losses at 40A output current. This includes not only the losses of the MOSFET but also the losses of the terminals, internal wiring and the required supply circuit. A heat sink is not required.



For the first time it is possible to build a 40A redundant system with only one redundancy module.

Recommendations for reliable redundancy operation:

- Use separate input fuses for each power supply.
If possible, connect the power supplies to different phases or mains circuits.
- Use three-phase power supplies to gain functional safety if one phase fails.
- Always use redundancy modules or decoupling diodes.
- All power supplies must be monitored individually. Faults need to be detected early and immediately corrected.
For this purpose, the DC-OK signals of the power supplies can be used.
- Set all output voltages as evenly as possible and set the device in "Parallel Use" mode if this feature is available.

The design of 20A redundant systems is realized in a similar way by using the YR40.241 redundancy module and 20A power supplies.

In addition to these two high-current redundancy modules, PULS offers also redundancy modules with diodes for small and moderate output currents. These modules are available with or without integrated monitoring function. The monitor recognizes an output voltage of the power supply which is below a fixed threshold value and opens a signal contact in such cases. This is an important feature when the power supply itself does not have a DC-OK signal included.

The large PULS product range of power supplies and redundancy modules allows to set-up a redundant power supply systems for virtually any application.

Complex customized solutions are in most cases not necessary and cost-effective, superior designed and comprehensively tested standard units can be used.



YR2.DIODE
for 20A
output current

YRM2.DIODE
for 20A
output current
with monitoring

YR40.241
for 40A
output current

YR80.241
for 80A
output current