

# Overcurrent protection for Power over Ethernet (PoE)

Transmitting both power and data over a single cable is an ingenious and simple idea – a “plug & play” solution. IEEE is working on a new standard called PoE++, which will define powering devices with up to 60 watts. As the amount of current increases, so does the danger of fire. Thus it is essential to protect electronics from overcurrents, and SCHURTER offers just the right fuses to provide this protection.

Data networks based on the Ethernet standard are in widespread use around the world. Just a few examples of devices tied into these networks include sensors, IP phones, card readers, remote-controlled webcams, point of sales (POS) terminals and small hubs and servers. Since the Ethernet standard was introduced, data rates have continually increased and today are reaching speeds up to 100 Gigabits per second. Twisted pair cables guarantee secure data transmission even over long distances. Ethernet cable is also increasingly being used to supply devices with power in addition to data over a single cable. This eliminates separate power cables and power supplies making devices standalone without the need for connection to the wall outlet or grid. There is also no need for a certified technician that might otherwise be required to install mains power. Ethernet power is less than 50V and lines can be up to 100 meters long. This makes it possible to install loads where power cables are not desirable or permitted. In addition, thanks to smart power management, this type of power transmission can save electricity by turning off devices that are in use.

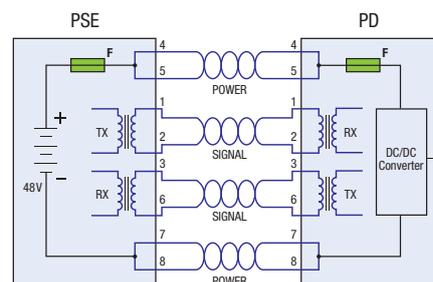


**IP phones – simple to connect and supply with power using Ethernet cable (Source: shutterstock)**

## Standard IEEE 802.3

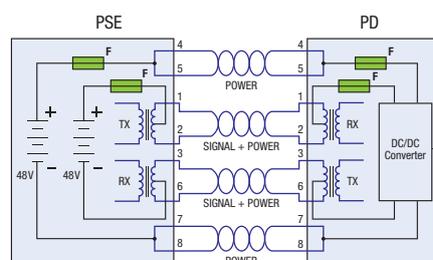
The standard for combining the transmission of data and power has been around since 2003. There are two different types of standards:

IEEE 802.3af-2003 limits the power consumption of a powered device (PD) to 12.95 W or 360 mA. Here the power sourcing equipment (PSE) must supply 15.4 W or 400 mA. The input voltage is at least 44 VDC and a maximum of 57 VDC (see Fig. 1).



**Fig. 1: Standard configuration of PoE and PoE+: two separate conductor pairs for power and signals. Chip fuses (F) protect the electronics simply and securely from overcurrents (Source: SCHURTER AG)**

With IEEE 802.3at-2009, a PSE can supply 30 W or 600 mA and a PD can consume up to 21.9 W of power. Here the power is fed over all four cable pairs. The input voltage is at least 50 VDC and a maximum of 57 VDC (see Fig. 2).



**Fig. 2: Maximum power with PoE++ is up to 90 W over four conductor pairs: 2x power + signal and 2x power (Source: SCHURTER AG)**

IEEE is working on a new standard called PoE++. It specifies power up to 60 W with expansion capability up to 90 W.

More power, however, also means higher risk due to the associated temperature rise. Suitable components must therefore be selected with great care.

## Overcurrent protection

The higher the current, the faster malfunctions can lead to fires. Suitable devices to protect against overcurrents must be installed in both PSEs and PDs (see Figs. 1 and 2).

The simplest, most cost-effective and reliable solution for protection against overcurrent is a chip fuse. Midget fuse is a known standard for UL & CSA size 10x38mm. This would not be the appropriate term to use to describe small. In addition, chip fuses take very little space. The USF 0603 chip fuse from SCHURTER is the ideal fuse for PoE applications. This thin-film USF 0603 fuse measures just 1.6 mm long, 0.8 mm wide and only 0.6 mm high. It offers overcurrent protection with super-quick-acting characteristics in a range of rated currents from 500 mA to 5 A. Rated voltage is between 32 and 63 VDC. It stands out due to a breaking capacity of 50 A at 32 V over the entire range of rated currents. Even today, such breaking capacity is unmatched in fuses of this size. Further, its voltage drop of a low 65 mV makes it unique. In addition, thanks to a design using planar technology, it has no impedance discontinuity and thereby guarantees better signal quality and higher data rates. The USF 0603 has a permissible ambient temperature of 90 °C and is approved to UL 248-1. Very legible lettering enables the visual identification of the rated current. It is supplied in packaging well suited for automated production according to EIA-RS481 and IEC 60286-3 with either 5000 or 15,000 units per roll.

Additional fuses suited for overcurrent protection in PoE applications on offer: the USFF 1206 and USF 1206 (see Table 1). All fuses mentioned are approved to CURus.



The tiny USF 1206 chip fuse protects electronic circuits simply and securely (Source: SCHURTER AG)



Headquarters Lucerne

Secondary Protection			
	<b>USF 0603</b>	<b>USF 1206</b>	<b>USFF 1206</b>
Rated Voltage	32 VAC 32-63 VDC	32-125 VAC 63-125 VDC	125 VAC 63 VDC
Rated current	0.5-5 A	0.375-4 A	0.05-0.25 A
Breaking Capacity	50 A	50-600 A	100 A
Characteristic	Super-Quick-Acting FF	Super-Quick-Acting FF	Super-Quick-Acting FF
Dimension [mm]	1.6x0.8	3.2x1.6	3.2x1.6
Approvals	CURus	CURus	CURus

**Table 1: Midget fuses are ideal for overcurrent protection. SCHURTER offers fuses suited for every PoE application**

**Close to the customer**

SCHURTER is your expert partner when it comes to circuit protection. SCHURTER supports its customers with extensive knowledge. And in cases where standard products are not exactly what you need, SCHURTER is happy to work out a customized solution.

**Company**

SCHURTER continues to be a progressive innovator and manufacturer of electronic and electrical components worldwide. Our products ensure safe and clean supply of power, while making equipment easy to use. We offer a broad range of standard products including circuit protection, connectors, EMC products, switches and input systems, as well as electronic manufacturing services. Moreover, SCHURTER is ready to work with our customers to meet their application specific requirements, not covered in our standard range. You can rely on SCHURTER's global network of companies and partners to guarantee a high level of local service and product delivery.

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# Increased safety and longer battery life for standalone devices

Precision and low power consumption: SMD fuses from SCHURTER

**The range of battery-powered devices extends from powerful hand tools for craftsmen, to sensors for room surveillance all the way through life-saving medical aids. The safety of such devices presents quite a challenge. To ensure the safe operation of standalone devices, SCHURTER offers two SMD fuses with low power dissipation and tight tolerances for tripping time.**

Many billions of lithium-ion batteries were manufactured in 2010. At the same time, the number of application areas for these products has also increased. These days, battery-powered devices can be found everywhere. And although these handy assistants are very useful, they also always present a source of danger. Any such device can catch fire, or an overcurrent condition can damage electronic circuits. In some cases, for example in medical technology, even a brief malfunction could place a patient's health at risk.



**Fig. 2: Insulin pump**

When it comes to safety technology, a short and precisely defined reaction time in the event of faults is important along with reliability across a wide temperature range. Both requirements have to be assured during the device's overall service life. Furthermore, the typical design parameters of standalone devices must be considered: The focus here is on low power consumption, small form factor and an attractive price/performance ratio. In addition, there are further desirable characteristics such as those relating to recycling.



**Fig. 1: Hearing aid**

## Safe overcurrent protection

Many types of damage can be avoided with effective overcurrent protection. In principle, a fuse is sufficient for this purpose. Although unimposing, a fuse must meet a wide range of challenging requirements, if it is to provide for the efficient and effective safe operation of insulin pumps, hearing aids or blood glucose meters.



**Fig. 3: Blood glucose meter**

In principle, overcurrent protection can also be implemented with an active protection circuitry. The SMD fuses from SCHURTER, however, can replace such an approach with distinct advantages.

## USF 0402 and USFF 1206 SMD fuses

A fuse is clearly more reliable compared to an active protection circuitry. In addition, it requires little space at low cost. In terms of power dissipation and tripping time, there is a clear difference among the various fuses available on the market. As for all these aspects, both the USF 0402 and USFF 1206 SMD fuses from SCHURTER feature values that make them a perfect solution for overcurrent protection for battery-driven devices.

Both fuses have been developed for the overcurrent protection of secondary circuits. The rated currents for the USF 0402 range from 375 mA to 5 A, while it has a rated voltage of 32 VDC up to 4 A and 24 VDC up to 5 A. The breaking capacity is specified at 35 A at rated voltage. The USFF 1206 was developed for smaller rated currents of from 50 to 250 mA; its rated voltage is 63 VDC and its breaking capacity is 100 A.



**Fig. 4: USF 0402 super-quick-acting SMD fuse, 1.05 x 0.55 mm, with rated currents from 375 mA to 5 A.**



**Fig. 5: USFF 1206 super-quick-acting SMD fuse, 3.2 x 1.6 mm, with rated currents from 50 mA to 250 mA.**

**Low power dissipation**

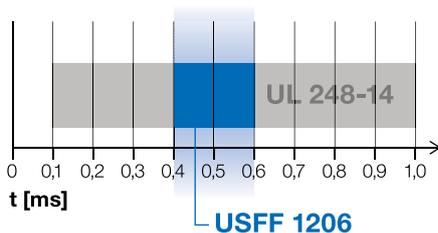
The first characteristic that differentiates these units from standard commercial products is their low power dissipation. For example, the 200 mA version of the USFF 1206 features a voltage drop of 87 mV at rated current. This value is much lower than for any comparable product in the market. As for the USF 0402, the voltage drop of the 1 A version is 65 mV at rated current. This is made possible by a unique design. The melting wire is wire-bonded and it is just a few micrometers thick. It is made of a special metal alloy. In the case of the USF 0402, the melting wire is encapsulated in a special epoxy resin; on the USFF 1206, which is somewhat larger, it is surrounded by air. Both technologies inhibit the dissipation of heat and thus drop power dissipation.

**Tight tolerance in tripping time**

The second differentiating characteristic is their tight tolerance in tripping time. For instance, the USFF 1206 is designed for a tripping time between 0.1 and 1 millisecond at tenfold rated current according to the component standard UL 248-14. But the tripping-time window of the USFF 1206 is considerably narrower: With a nominal tripping time of 0.5 milliseconds, for instance, the fuse trips within a tolerance band between 0.4 and 0.6 milliseconds.

The USF 0402 and USFF 1206 are currently the only fuses in this dimension that trip with such high precision.

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**Fig. 6: Precise tripping-time window at tenfold rated current**

**Fuses with clear advantages**

This precise tripping time increases safety for users, the environment and the device itself. Both SMD fuses make it possible to design standalone devices without active protection circuitry, which has a positive impact on the cost, size and battery lifetime of the corresponding device.

The low power dissipation and tight tolerance in tripping time are valid over the entire specified temperature range. In addition, the fuses feature a high service lifetime. In particular, they do not change their performance characteristics when handling pulsed loads such as in devices with electronically commutated motors.

**Continual advances in development**

In past years, SCHURTER has continually enhanced its know-how and applied it to both of these unique fuses. The company is delighted to be able to support its customers with this knowledge. Furthermore, custom-designed solutions are also possible such as versions of both fuses with current ratings outside the E Series.

You can find a detailed product overview of all SCHURTER SMD fuse products on our website: [www.schurter.com/pg01\\_2](http://www.schurter.com/pg01_2)

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**Technical data**

	USF 0402	USFF 1206
Rated voltage	24 - 32 VDC	125 VAC, 36 VDC
Rated current	0.375 - 5 A	0.050 - 0.250 A
Breaking capacity	35 A	100 A
Characteristic	Super-quick-acting FF	Super-quick-acting FF
Mounting	PCB, SMT	PCB, SMT
Dimensions (l x w x h) in mm	1.1 x 0.6 x 0.5	3.2 x 1.6 x 1.6
Approvals	UL 248 - 14	UL 248 - 14
Voltage drop at rated current	52 - 70 mV	75 - 95 mV 450 mV at 50 mA



**About SCHURTER**

SCHURTER is an internationally leading innovator and manufacturer of fuses, connectors, circuit breakers, input systems and EMC products as well as a PCB-assembly service provider for the electronics industry.

Among SCHURTER's customers are manufacturers of computers and peripheral equipment, appliances/instruments, telecommunication equipment, operator panels, medical technology, industry automations, renewable energy, aerospace, hobby, household and gardening equipment.

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