



POE INPUT

UNLOCKING THE BENEFITS OF POE INPUTS
FOR HIGH-PERFORMANCE AUDIO AMPLIFIERS

Abstract

System integrators often face the challenge of installing audio systems in venues without access to AC power, which can lead to delays and increased installation costs. To date, Power over Ethernet (PoE) infrastructures are increasingly being deployed in fixed installations, especially for AV systems. However, only a few power amplifiers on the market use PoE input to address the lack of AC mains. These products typically only allow basic diagnostics of the amplifier logic boards. To address this, Powersoft has developed a new technology that allows high-power and high-performance amplifiers, such as Powersoft's Unica series, to be powered via PoE. Considering that IT infrastructure is often already in place when system integrators install the AV system, having the ability to configure the amplifiers and test the loudspeakers is the solution to the lack of AC mains. Additionally, PoE technology offers several advantages, such as reduced installation time and cost, improved reliability, and ease of use for a wide range of applications, including uninterrupted system monitoring and PoE backup power. In this paper, we present the benefits of using PoE-powered Unica series amplifiers in fixed installations, while also providing an overview of PoE technology and highlighting how it can make the lives of integrators easier during multiple stages of their projects.



Table of Contents

Introduction	3
Power over Ethernet Explained.....	3
PoE Equipment	3
PoE Standards, Types and Classes	4
Interoperability	5
Power Availability and Wirings	5
Unica PoE Features.....	7
Application	8
Scenarios.....	8
System Setup and Test Without Mains	8
Uninterrupted System Monitoring.....	9
PoE Backup Power	9
Limitations of PoE Input on Unica Series Amplifiers	10
Excluded Applications	10
Conclusion.....	11
Appendix – PoE Switches and Injectors	12
PoE++ Operation	12
PoE+ Operation	13
Bibliography.....	14



INTRODUCTION

Power over Ethernet (PoE) technology has revolutionised the way we power devices and configure systems. It is now being applied to high-performance audio power amplifiers, such as the Unica series amplifiers from Powersoft, which feature a dedicated PoE input on the rear panel. In summary, this paper introduces how PoE-powered amplifiers can be utilised in fixed installations to simplify the life of system integrators during commissioning, monitoring the health and performance of amplifiers and loudspeakers during normal operation, and providing backup power in case of AC mains outages.

POWER OVER ETHERNET EXPLAINED

Power over Ethernet (PoE) is a method to transmits both power and Ethernet data over the same physical cable, eliminating the need for a separate power source, thus making installation more efficient and cost-effective. Developed as a series of proprietary technologies, PoE is now a global standard maintained by the IEEE 802.3 working group. It is a subset of the generic "Power over Data Lines" technology. Before diving into the details of Powersoft implementation and PoE features of Unica series amplifiers, this paragraph provides an introduction to the basics of PoE technology.

POE EQUIPMENT

Power over Ethernet (PoE) equipment is designed to either provide power and data, or receive both power and data over the same Ethernet cable. There are two main types of PoE devices: "transmitters" and "receivers". These devices come in various shapes and sizes, each with its own capabilities and purpose. For example, PoE-enabled switches can be used to power IP-enabled devices such as webcams, VoIP phones, and access points. PoE-enabled cameras, on the other hand, can be used to provide high-quality video surveillance and can be connected to a network without the need for an additional power source. The two main types of PoE equipment are described below.

- **PSE - Power Supply Equipment**

Power Supply Equipment (PSE) is a classification of Ethernet devices that combine power and Ethernet connectivity, such as injectors, routers and switches, where some or all of the ports support Power over Ethernet (PoE) in addition to Ethernet connectivity.



- **PD - Powered Device**

A Powered Device (PD) is any ethernet device that can be powered by Power over Ethernet (PoE). As the use of PoE increases, so does the range of equipment it supports, from phones and communication devices to video and audio equipment such as PoE-powered loudspeakers and amplifiers.

POE STANDARDS, TYPES AND CLASSES

Power over Ethernet (PoE) technology has evolved over the years. The IEEE working group has defined three standards that govern PoE devices: 802.3af (2003), 802.3at (2009), and 802.3bt (2018).

- **802.3af (PoE)**

The IEEE 802.3af standard for Power-over-Ethernet (PoE) devices, introduced in 2003, enabled the rapid growth of Internet-of-Things (IoT) devices by providing power to them over two of the four wire pairs in an Ethernet cable, with a power capacity of up to 15.4W.

- **802.3at (PoE+)**

The PoE+ standard was introduced in 2004 as an extension of the 802.3af protocol. This upgrade was designed to improve the power availability of the 802.3af, allowing it to be used to power videophones, dual-band wireless access points, and other devices. This was accomplished by allowing the PSE to provide up to 30W of power, with a minimum of 25.5W delivered to the PD.

- **802.3bt (PoE++)**

The need for higher wattage delivery over Ethernet cables has increased since the introduction of PoE+ in 2004, leading to the development of proprietary technologies. In 2018, the IEEE released the 802.3bt (PoE++) standard, consisting of four new classes. Depending on the class of the Power Source Equipment (PSE) device, PoE++ can deliver a minimum of 45W to a maximum of 90W per port.



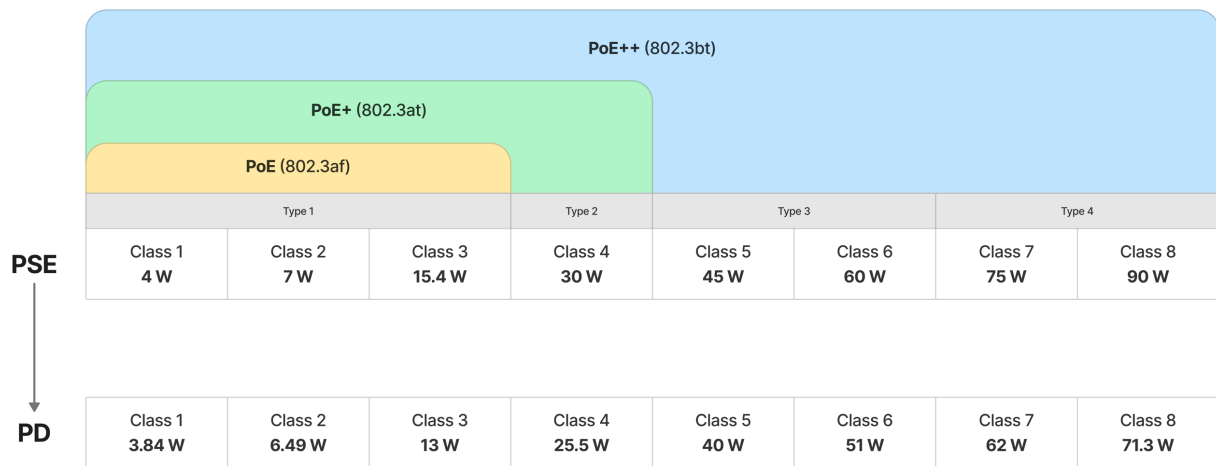


Figure 1 - PoE Types and Classes

INTEROPERABILITY

The various PoE standards, including 802.3at (PoE+) and 802.3bt (PoE++), ensure backward compatibility, meaning that a higher-powered PoE source can provide power to a device that requires less. This also applies to 802.3bt PoE++ sources, where compatibility is ensured for both PoE and PoE+ devices. The interoperability between the three standards is facilitated by a detection mechanism which is initiated when the PoE source is connected to a receiver device. This detection procedure consists of three steps: first, the Power Source Equipment (PSE) announces its capability to provide PoE; second, the Powered Device (PD) requests the amount of power it needs; and finally, the PSE delivers the requested power or less. The detection process typically takes a few seconds, and ensures that power is only delivered to a device when it is requested, and only up to the maximum power that the PoE source is capable of providing.

POWER AVAILABILITY AND WIRINGS

When designing a network infrastructure that utilizes PoE-powered devices, it is essential to choose the appropriate switch or injector, as well as the right cable gauge according to the expected cable length. This ensures that the power that the Power Source Equipment (PSE) can transfer to the Powered Device (PD) is not affected by the wires connecting the PoE source to the receiving device. Ethernet cables with a small wire gauge and up to 100m in length may introduce resistivity losses. Therefore, the IEEE working group specifies the minimum power available to a PD (or the maximum wire losses allowed) per class. For example, PoE+ compliant switches (802.3at) can deliver up to 31W per port, while the minimum guaranteed power for a receiving



device is 25W, allowing for a maximum of 6W dissipation due to wire losses. For short runs, any compatible ethernet patch cable can be used, especially when employing Class 4 (30W) equipment. However, when higher power or longer cable runs are required, greater attention should be paid to the selection of the ethernet cable. In general, it is recommended to use lower-gauge cables rated 75°C or higher for runs with tens of wires, in order to reduce losses and avoid overheating. For audio professionals, this means that when designing a network infrastructure based on PoE-powered devices, an appropriate switch or injector must be chosen and the right wire gauge should be selected according to the expected cable length. Doing so will ensure that the power delivered by the PoE source is not affected by the wires connecting it to the receiving device, thus avoiding resistivity losses.

The table below highlight the minimum wire gauge suggested to minimise losses according to the power required and cable length:

Class \ Cable length	25mt (82ft)	50mt (164ft)	75mt (246ft)	100mt (328ft)
802.3at- Class 4 (30W)	AWG26	AWG24	AWG24	AWG24
802.3bt- Class 6 (60W)	AWG24	AWG24	AWG22	AWG22
802.3bt- Class 8 (90W)	AWG24	AWG22	AWG22	AWG22

It is important to note that PoE-capable switches may not be able to provide the maximum power to every port at the same time. This concept is similar to Powersoft's Power Sharing technology, which is used to define the maximum channel capacity in relation to the total power rating of an amplifier. The same concept can be applied to PoE switches when determining the power available to each ethernet port in relation to the switch total PoE budget. For example, in a four-port PoE++ switch with a 200W PoE budget, the maximum power of 90W can be supplied to two ports. However, the overall capacity of the switch is limited to 200W, meaning the remaining 20W must be divided among the remaining two ports.



UNICA POE FEATURES

The Unica series amplifiers from Powersoft feature a dedicated Power over Ethernet (PoE) input on the rear panel, allowing for different applications depending on the amount of PoE power delivered to the amplifier. Class 4 or higher Power Supply Equipment (PSE) can be connected to support both PoE+ and PoE++, and the available functionality of the amplifier varies according to the available power:

- **PoE+**

When Unica is powered via PoE+, then it is possible to control and configure the amplifier via the Ethernet network, including Dante routing and settings, but the amplifier channels are turned off and it is not possible to drive loudspeakers.

- **PoE++**

When the PSE is PoE++ and the amplifier is powered with at least 71.3W, then it is possible to control and configure the amplifier as when powered via PoE+, while also monitoring the loudspeaker status via the onboard pilot tone generator and load monitor.

The table below highlights the available functionalities in detail:

Scenario	Available functionalities	PoE (902.3af)	PoE+ (902.3at)	PoE++ (902.3bt, Class 5-7)	PoE++ (902.3bt, Class 8)
PoE backup power	- Network Connectivity - Dante/AES67 Connectivity - DSP Configuration	NO	YES	YES	YES
PoE-only System Setup and Test / Monitoring	- Network Connectivity - Dante/AES67 Connectivity - DSP Configuration - Power Output Diagnostics - Loudspeaker Diagnostics	NO	NO	NO	YES (*)

(*) Up to 8W total output power is available when powered through PoE++ (Class 8, 90W PSE).



APPLICATION

The Power-over-Ethernet (PoE) input of the Unica amplifier series enables a variety of applications, from using PoE for CPU power backup to testing and monitoring the status of the amplifier and connected loudspeakers without the need for mains power. The versatility of Unica amplifiers when powered via PoE, and the range of different requirements and use cases achievable with PoE technology applied to professional high-performance amplifiers, such as Powersoft's Unica series amplifiers, are highlighted in the following scenarios.

SCENARIOS

SYSTEM SETUP AND TEST WITHOUT MAINS

Often, system integrators find themselves installing loudspeakers and amplifiers during the commissioning of a project, even if the mains distribution system is not yet in place or fully operational. This can be due to a variety of factors, such as poor project management or supply-chain issues. Without mains power available, system integrators can face multiple challenges when installing an audio system. Installing amplifiers and loudspeakers without power requires multiple trips to the site for testing and configuring the system, leading to costly delays. To prevent these issues, having a Power-over-Ethernet (PoE) infrastructure in place can provide multiple benefits. The PoE infrastructure can provide the amplifiers with enough power for configuring, testing and monitoring the amplifiers and the loudspeakers, even if mains are not yet in place. It is in fact true that the cost of deploying a PoE infrastructure is trending down, while more and more AV devices are designed for running over PoE instead of mains power. Additionally, the requirements for having a backup source of power for shorter wake-up times in case of power outages are rising, making PoE delivered to the amplifiers an ideal part of the network infrastructure. For integrators, having amplifiers with PoE input, such as the Unica series amplifiers, can be especially beneficial. When powered via PoE++ (Class 8, 90W), the Unica amplifiers offer a range of diagnostic tools that can be used to test and configure the audio system even if mains are not present during the commissioning. These tools include the pilot tone load monitor functionality (useful for testing lines of 100V or 70V loudspeakers), the Unica onboard pink noise generation, and the newly designed load impedance measurement feature, useful for measuring the complex impedance curve of both low and high impedance loudspeakers. This allows the integrator to spot major installation or loudspeaker product inconsistencies, and can save both time and money by preventing costly delays, and frustration. In this scenario of installing an audio system before the mains distribution is in place, integrators would install all the components, including amplifiers, loudspeakers, and wiring, as usual. When connecting the



network cables, the amplifiers would turn on, giving immediate access to their parameters via a laptop connected to the same network. This allows configuring the audio distribution system, speaker presets, matrix settings, input source selection, and loudspeaker testing via the onboard pink noise generator, pilot tone load-monitor tool, as well as the load impedance measurement tool. Additionally, it is possible to get and complete logic and output power diagnostics of the amplifier to spot critical hardware faults immediately, thanks to the auto-diagnostic feature within the amplifier themselves, extending from the main CPU and amplifier logic to the power output circuitry.

UNINTERRUPTED SYSTEM MONITORING

The PoE input on Unica amplifiers offers a revolutionary solution for fixed install audio systems with uninterrupted monitoring requirements. This unique capability allows for maximum efficiency, reliability, and cost savings, while still meeting the need for continuous system monitoring. The PoE input allows integrators to install Unica amplifiers without the need for a mains power supply or in case of a sudden mains loss, optimising power consumption and running costs, while increasing the life expectancy of the amplifiers and the overall system reliability. The Unica amplifiers can also be easily integrated into existing infrastructures, making it a great choice for upgrading existing fixed install audio systems that require continuous monitoring, by installing a PoE networking infrastructure (note that uninterrupted amplifier and loudspeaker monitoring are available from Unica series amplifiers powered via PoE++ sources in Class8, 90W). With the PoE input on Unica amplifiers, integrators can save money, time, and energy while fulfilling uninterrupted monitoring requirements, without sacrificing system performance or audio quality.

POE BACKUP POWER

The PoE input of Unica amplifier series provides an additional layer of protection in the event of sudden mains power failure. This is particularly beneficial for critical applications such as live performances, as it ensures that the amplification core processing will remain operational even when the mains power is lost. In fact, while the typical amplifier's start-up time without backup power is around 10 seconds (or even worse in case Dante/AES67 inputs are used), the PoE input on Unica series amplifiers ensure that operation is resumed as soon as 0.5sec after mains power is reapplied. This allows for greater flexibility and efficiency in fulfilling typical wake-up time requirements in fixed install systems in case of power outages, as the PoE-power-backup functionality of Unica series amplifiers only requires PoE sources in Class 4 (25.5W PoE+ or above). In conclusion, the PoE input on Unica amplifiers provides a reliable solution for all application scenarios where uninterrupted operation or short wake-up time in case of mains loss is essential.



LIMITATIONS OF POE INPUT ON UNICA SERIES AMPLIFIERS

The Power over Ethernet (PoE) input on Unica series amplifiers is a powerful and versatile feature, allowing for maximum system reliability, efficiency, and cost savings in a variety of applications. However, there are certain limitations to consider when using Unica amplifiers in PoE network infrastructures. For example, the PoE input of Unica amplifiers is only suitable for powering the amplifier's onboard CPU, logic board, networking, and loudspeaker diagnostic tools. It is not suitable for powering the amplifier channels to play audio inputs. This is mainly due to the limitations of PoE technology itself, as the maximum power available to a receiver is 90W in the case of PoE++, thus resulting in very limited current left to power the amplifier outputs on top of the quiescent current required to power the amplifier CPU and logic circuitry. Additionally, the PoE input of Unica amplifiers requires a minimum of 25.5W to operate, meaning that the PoE switch or injector powering the amplifier must be PoE+ or above (Type 2, 3, or 4). Lastly, Unica amplifiers do not support LLDP protocol for PoE power negotiation, which may result in non-optimised usage of PoE sources (i.e. network switches) in very specific cases.

EXCLUDED APPLICATIONS

Overall, the PoE input of Unica amplifiers offers a reliable and efficient solution for all applications where uninterrupted operation or short wake-up time in case of mains loss is essential. However, it is important to keep in mind the limitations of the PoE input when designing a fixed install system.

The following applications cannot be addressed by PoE-powered Unica amplifiers:

- Playing the amplifier analog or digital inputs when mains are not present, but PoE++ is.
- Using Unica as a PoE source (PD).
- Compatibility with some older PoE source devices may not be guaranteed, as there may be mismatches in their implementations of the PoE standard power negotiation protocol.



CONCLUSION

In summary, the PoE input on Unica amplifiers provides a range of advantages for a variety of applications, from CPU power backup to testing and monitoring of amplifiers and loudspeakers without the need for mains power. PoE technology applied to professional high-performance audio amplifiers offers a cost-effective solution that eliminates the need for expensive backup-power supply systems or additional hardware and wiring, providing superior system reliability, efficiency and cost savings. Unica amplifiers can be powered from PoE+ (30W) all the way up to 90W via PoE++, and feature load monitoring, pilot tone generator, and complex load-impedance measurement, allowing for testing and configuration of the audio system without mains power during commissioning. Furthermore, the PoE input provides an extra layer of safety in the case of a power failure, providing enough energy to keep the amplifier's onboard CPU, processing, networking, and digital audio distribution system running, and allowing the amplifier to resume playback as soon as power is restored.



APPENDIX – POE SWITCHES AND INJECTORS

The market offers a vast range of PoE switches and injectors, for convenience the table below highlights a list of PoE switches and injectors that have been tested and proven to be compatible with Unica series amplifiers. This list is by no means exhaustive, but it is means as a starting point for those looking for a reliable and suitable PoE switch or injector to use with Unica series amplifier.

POE++ OPERATION

For PoE++ operation of Unica series amplifiers, the following devices can be used:

Brand	Series	Model	Product Type	PoE std.	# PoE Ports	PoE budget	Notes
Netgear	AV line	GSM4212UX	Switch	PoE++ (90W)	8	720W	Up to 8 Unica amplifiers in PoE++ mode
Netgear	AV line	GSM4230UP	Switch	PoE++ (90W)	24	1440W	Up to 16 Unica amplifiers in PoE++ mode (*)
Netgear	AV line	GSM4248UX	Switch	PoE++ (90W)	40	2880W	Up to 32 Unica amplifiers in PoE++ mode (*)
Luminex	GigaCore	30i	Switch	PoE++ (90W)	24	1000W	Up to 11 Unica amplifiers in PoE++ mode (*)
Phihong	-	POE90U-1BT6	Injector	PoE++ (90W)	1	90W	

(*) Total PoE budget do not allow connecting all ports to Unica amplifier for PoE++ operation.



POE+ OPERATION

For PoE+ operation of Unica series amplifiers, the following devices can be used:

Brand	Series	Model	Product Type	PoE std.	# PoE Ports	PoE budget	Notes
Netgear	AV line	GSM4210PX	Switch	PoE+ (30W)	8	220W	Up to 7 Unica amplifiers in PoE+ mode (*)
Netgear	AV line	GSM4212PX	Switch	PoE+ (30W)	8	240W	Up to 8 Unica amplifiers in PoE+ mode
Netgear	AV line	GSM4230PX	Switch	PoE+ (30W)	24	480W	Up to 16 Unica amplifiers in PoE+ mode (*)
Netgear	AV line	GSM4248PX	Switch	PoE+ (30W)	40	960W	Up to 32 Unica amplifiers in PoE+ mode (*)
Luminex	GigaCore	30i	Switch	PoE++	24	1000W	Up to 24 Unica amplifiers in PoE+ mode (*)

(*) Total PoE budget do not allow connecting all ports to Unica amplifier for PoE++ operation.



BIBLIOGRAPHY

1. IEEE Std 802.3bt-2018
2. Analog Devices LT4293 Poe controller datasheet
3. CISCO installation guide appendix *“Analysis of Cabling Requirements for IEEE 802.3bt Type 4 Device”*
4. Ethernet Alliance *“Overview of 802.3bt - Power over Ethernet standard”*



Document Title: POE INPUT- UNLOCKING THE BENEFITS OF POE INPUTS FOR HIGH-PERFORMANCE
AUDIO AMPLIFIERS

Reference: DO000310.00 REV.00

Powersoft S.p.A

Via E. Conti, 5- Scandicci (Fi) 50018- Italy

TELEPHONE: +39 055 7350230

Commercial Enquires: <https://www.powersoft.com/en/about/contacts/>

Application & Technical Support: <https://www.powersoft.com/en/about/contacts/>

Service & Maintenance: service@powersoft.it

www.powersoft.com

